Accenture / Fjord Dublin (via teleconference) 07 July 2020

# Systems Theory in Design Design Systems

Hugh Dubberly **Dubberly Design Office** 

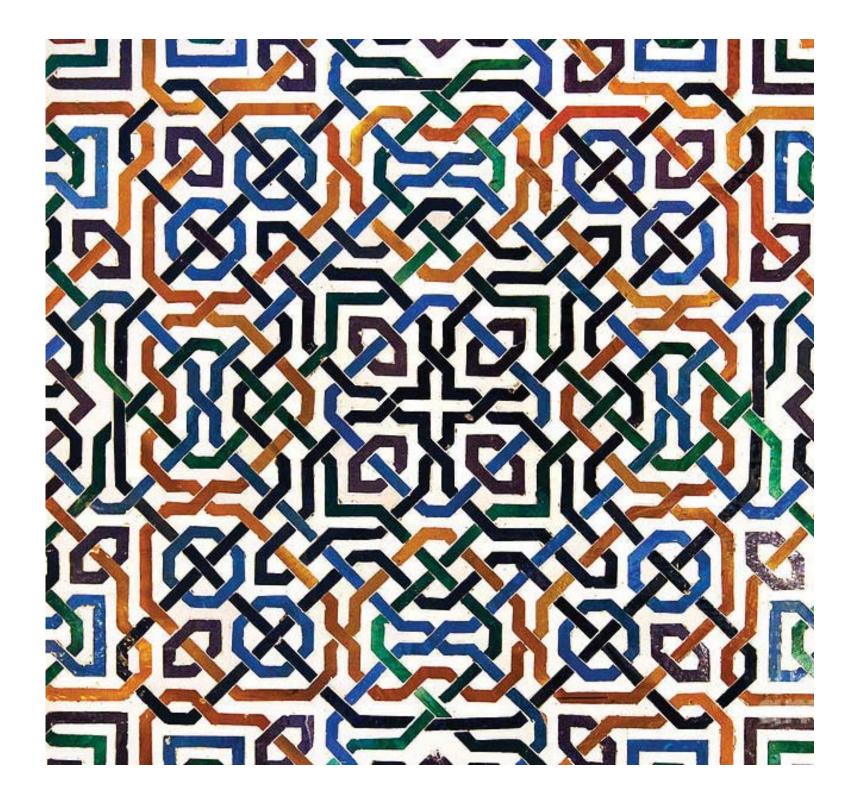
For hundreds of years, a few designers of each generation created "systems" to aid their work and to guide the work of others.

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#### The Alhambra

# Granada, ~1250

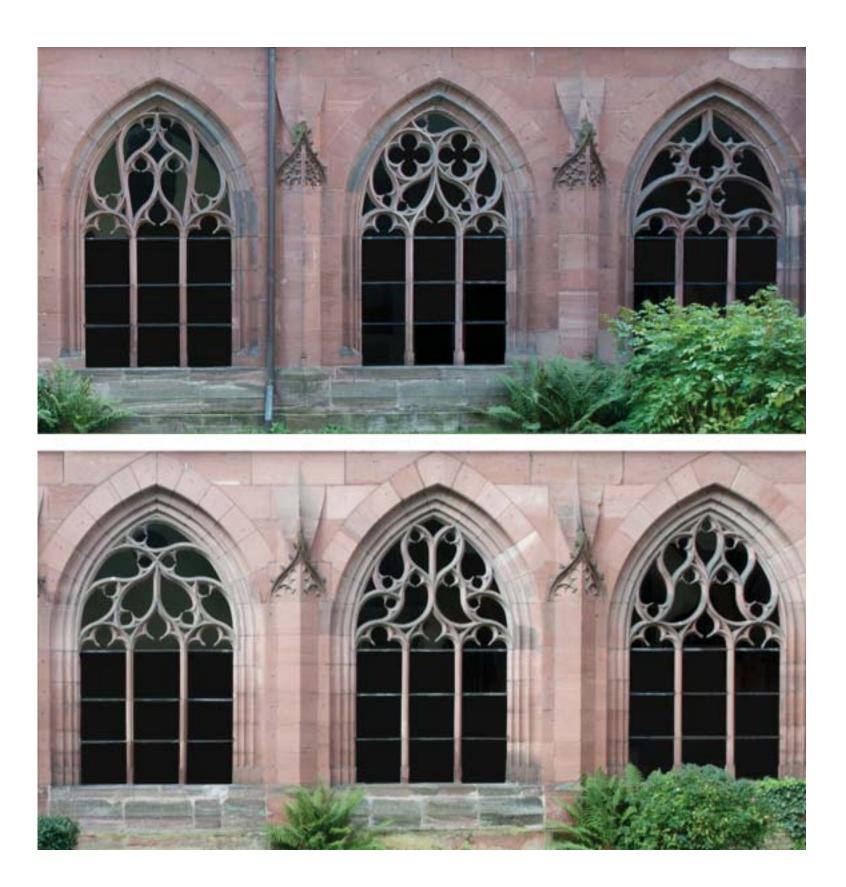
Islamic tile mosaics that form complex mathematical patterns symbolizing order and unity.



#### **Münster Cathedral Cloister**

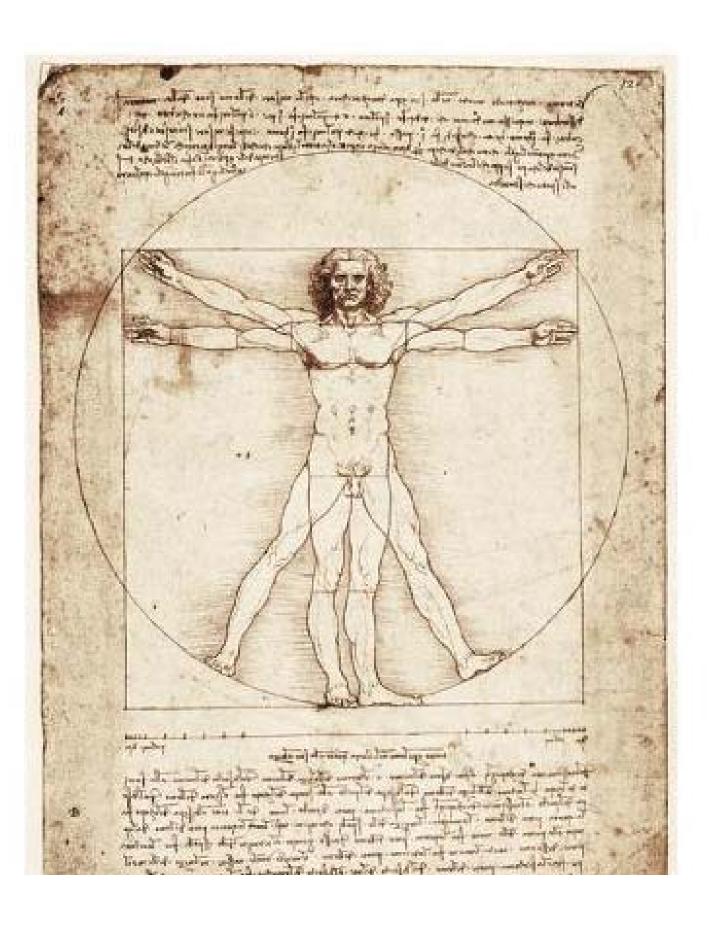
#### **Basel**, ~1421

16 different patterned designs within an arch which adheres to the same constraints and variables.



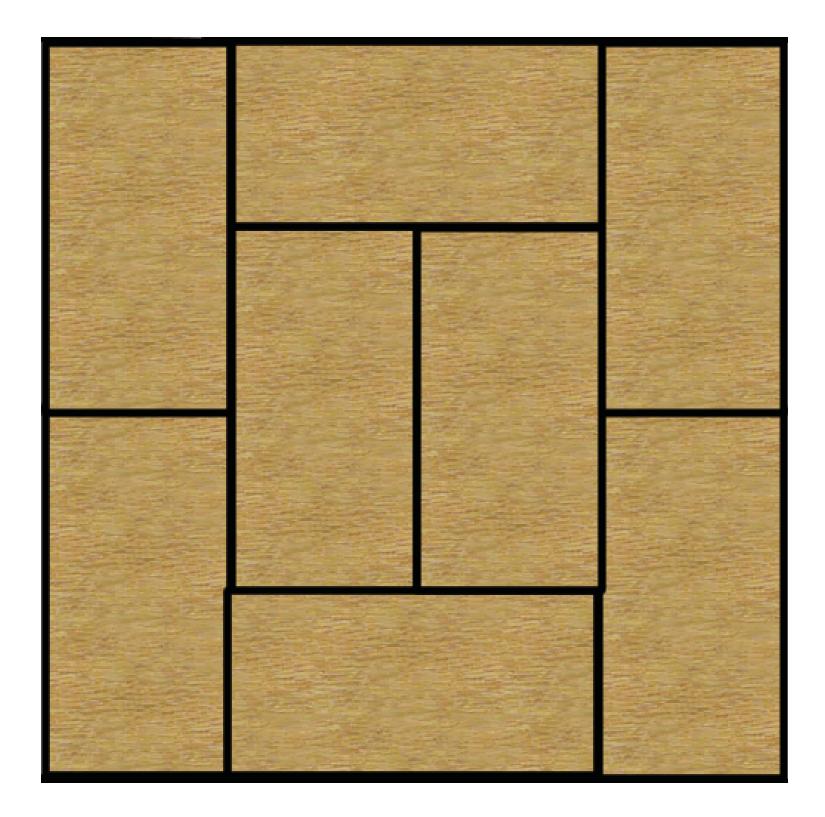
## **Vitruvian Man**

Leonardo da Vinci, 1490 A drawing depicting the correlations of the human body's proportions through application of mathematics and architecture.



#### **Tatami Mats**

Japan, ~1650 Flooring material in traditional Japanese-style rooms that are arranged following a set of rules.



## **Action Office**

Herman Miller, 1964 Product line of furniture components that could be combined and recombined over time according to demands.



### **Heller Dinnerware Set**

Massimo & Lella Vignelli, 1964 A stackable dinnerware set that can be stored as a compact group to maximize storage space and maintains a seamless design.



# **Oxo Good Grips**

## **Sam Farber, 1989** Introduced the concept of Universal Design to mass retail through the launch of kitchen tools.



# **IKEA Furniture Hacking**

#### 2006

An IKEA hack is any modification to an original IKEA product which can range from reassembly to repurposing items to create something new.

BEFORE







KALLAX Shelf unit, high gloss white









Size 30 3/8x30 3/8

IKEA



#### Definition

## A "Design System" is

- a collection of reusable components (elements)
- rules for their use (relationships)
- procedures for extending the system (modifying its purpose)

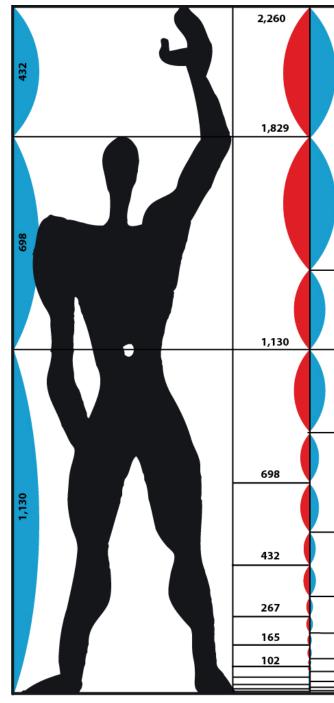
Design systems are also known as construction sets, frameworks, grids, libraries, modules, programmes, templates, toolkits

In the mid-twentieth century, design systems flourished amid the rise of modernism, which aspired to make design "rational".

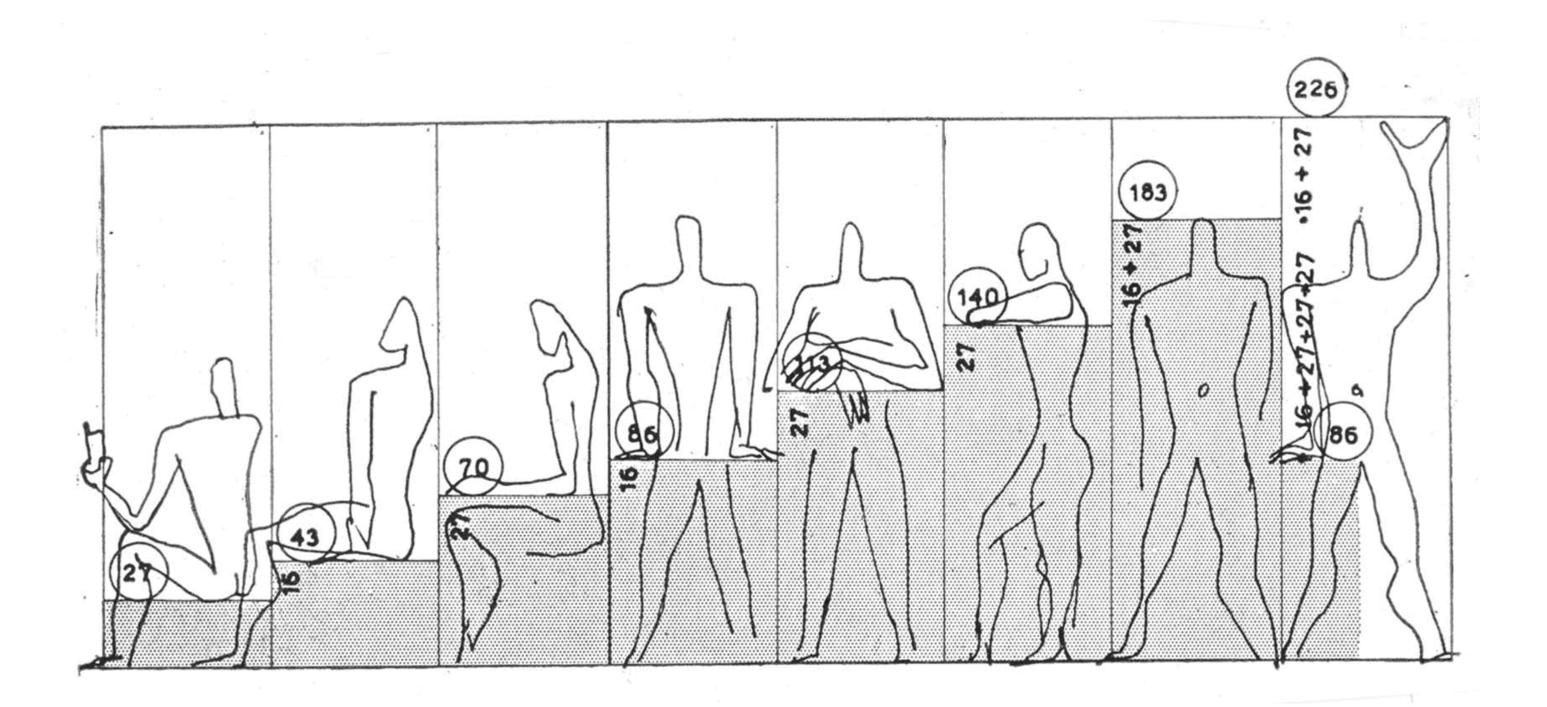
Four texts stand out as classics of design systems theory.

#### Le Modulor

## **Le Corbusier, 1950** System of proportions to combine human form, architecture and beauty.



1,397			
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### **Designing Programmes**

### Karl Gerstner, 1964

An early collection of examples of design systems, which he called "programmes".

Karl Gerstner: Designing

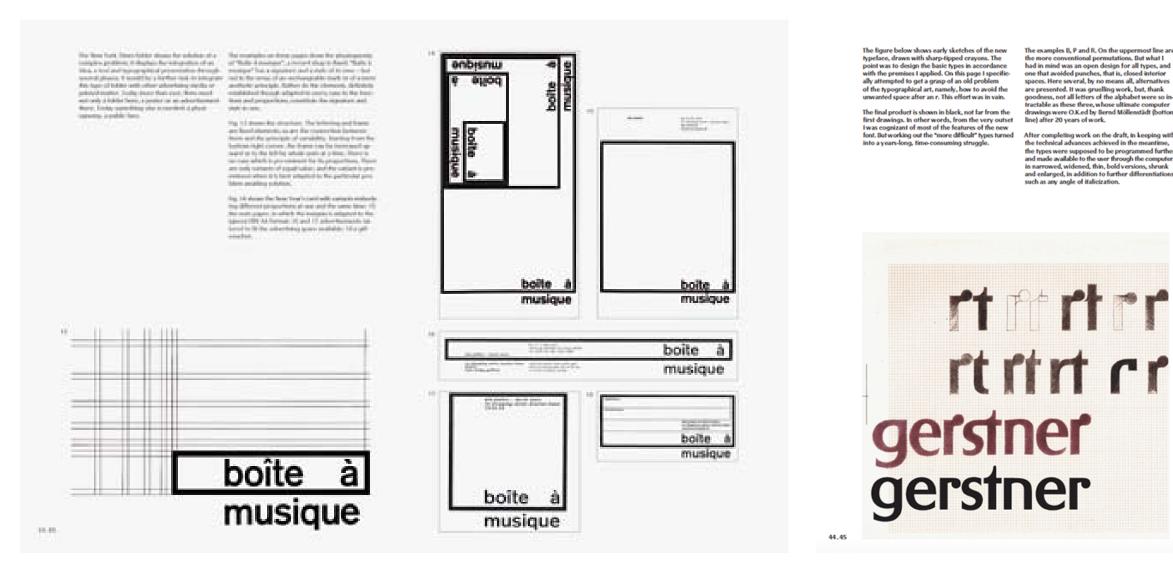
Programme as typeface Programme as picture Programme as method

# Programmes

Programme as morphology Programme as logic Programme as grid Programme as photography Programme as literature Programme as music

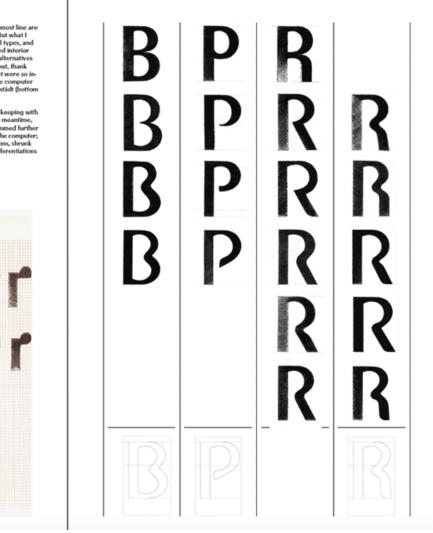
Programme as typography

Lars Müller Publishers



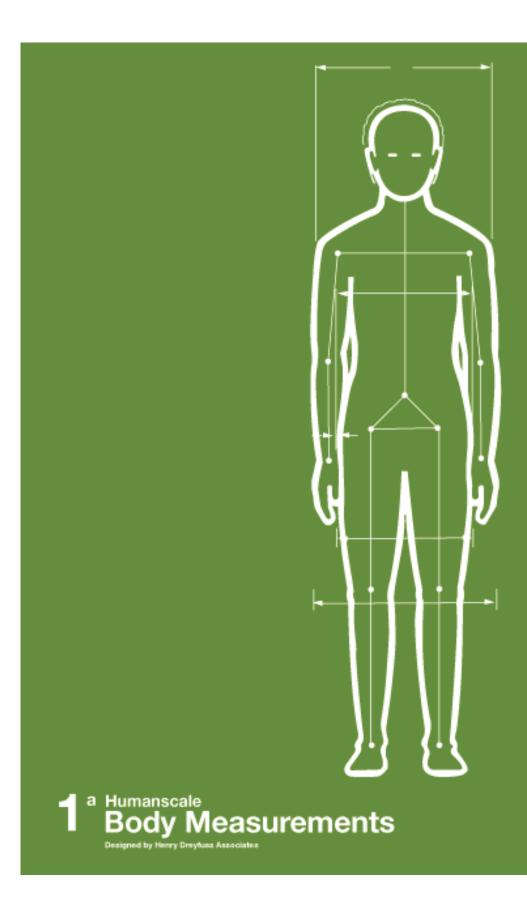
After completing work on the draft, in keeping with the technical advances achieved in the meantime, the types were supposed to be programmed further and made available to the user through the computer; in narrowed, widened, thin, bold versions, shrunk and enlarged, in addition to further differentiations such as any angle of italicization.

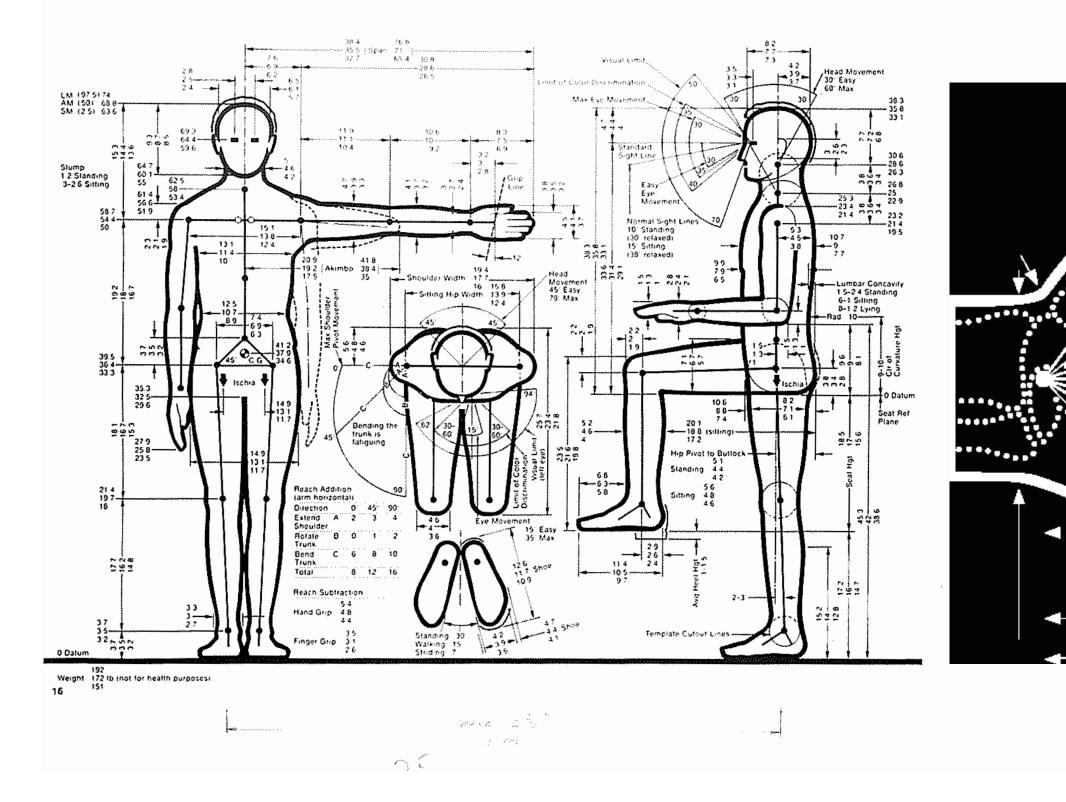
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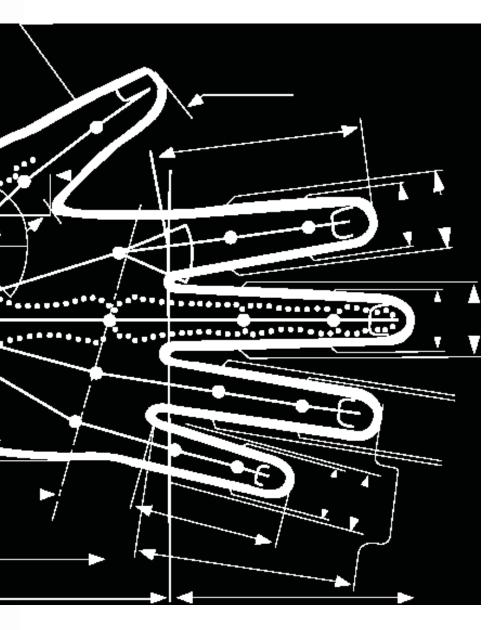


#### Humanscale

Henry Dreyfuss Associates, 1974 **Reference** guide for designing objects, interactions, and environments for humans. It incorporates the philosophy that all good design should be humancentered and reflect systematic thinking.







#### **Grid Systems**

Josef Müller-Brockmann, 1981 Visual communication manual that provides guidelines and rules for the function and use for grid systems.



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Margin proportions

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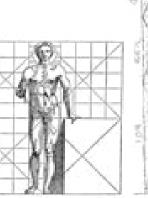
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# Toward a new "theory" of design systems

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# **Design system: theme + variation; coherence + flexibility**

By creating a design system a designer envisions more than one solution; A design system outlines a "solution space". They define a theme and how it may be varied.

Thus, design systems enable flexibility while ensuring the coherence of a set of finished artifacts.

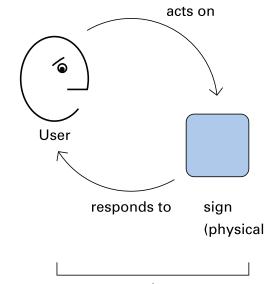
For audiences (so-called users), design systems promise, "These items are related. They come from the same source. They work together."

"If you've seen this system before, you pretty much know what to expect, even if this instance is new to you." For designers (and their clients), design systems are tools for ensuring consistent delivery across time, space, and channel.

Design systems are also tools for managing at scale helping ensure a shared vision while enlisting many collaborators.

# **Design systems create conditions** in which others can design.

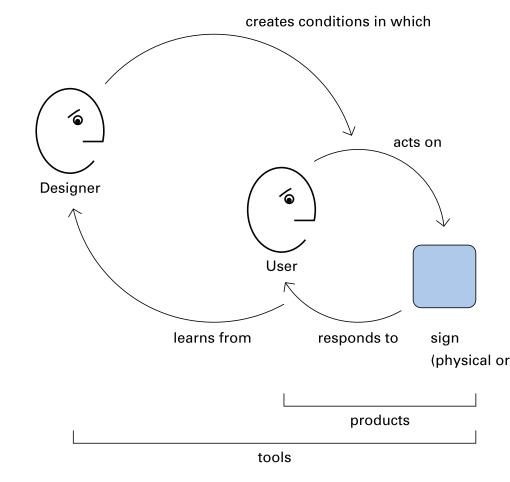
#### User interacting with artifact



products

(physical or virtual artifact)

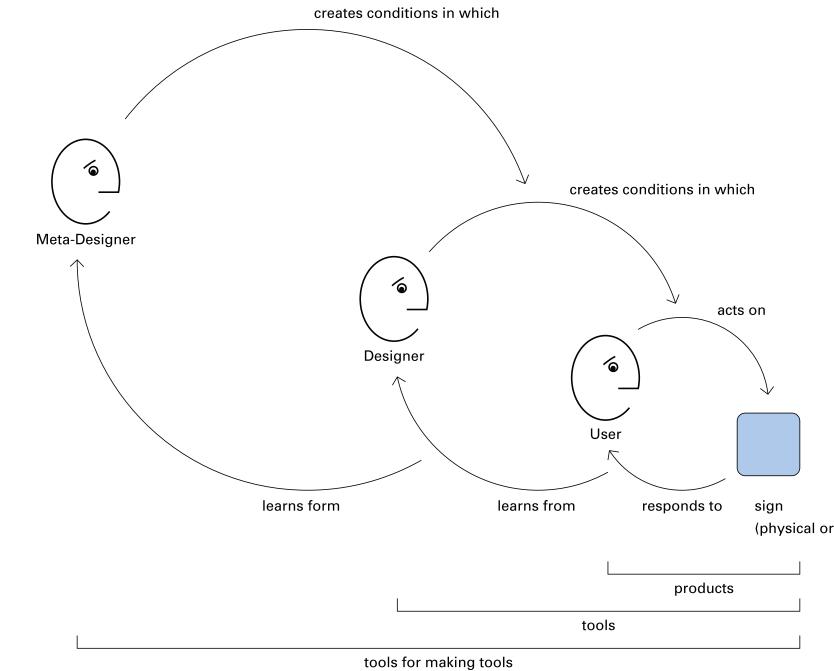
#### **Designer interacting with User interacting with artifact**



(physical or virtual artifact)

# Meta-Designer interacting with

#### **Designer interacting with User interacting with artifact**



(physical or virtual artifact)

#### Era analysis of design systems

	Star-driven 1900–1960	Consultant binders 1960–2010	Integra 2010–
Scale	Individual, maestro	Local team, centralized	Distrib
Participants	Hero only	Invite only	Everyo
Structure	Expert "professional"	Design "police"	Smart
Location	Memory, oral	Printed	On-line
Elements	Archive	Curated samples	In code design
Rules	Ad hoc	Written	Logic b
Change process	Ad hoc	Re-publish	Comm

#### rated systems

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# The third-era of design systems has begun to change design practice.

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#### With the rise of software, designers again focused on modular systems.

"Principles such as simplicity and modularity are the stuff of software engineering; ... It means that when you want to change the system, you can with luck in the future change only one part, which will only require you to understand (and test) that part. This will allow other people to independently change other parts at the same time."



— **Tim Berners-Lee**, "Principles of Design," 1993



# Reusable modular systems (and models that describe them) have become the new basic "unit of work" in design practice.

*Apple Human Interface Guidelines,* Bruce Tognazzini et al. 1978. *Making It Macintosh,* Lauralee Alben, Jim Faris, & Harry Saddler, 1993.

Yahoo! User Interface Library (YUI), Thomas Sha, 2006. JQuery UI, John Resig, 2007.

Bootstrap, CSS framework, Mark Otto & Jacob Thorton, 2011. *Atomic Design,* Brad Frost, 2013. React, JS library, Jordan Walke, 2013. Google Material Design System, Matias Duarte et al., 2014.

### These design systems have become an integral part of software development.

Cloud hosting, e.g., Amazon Web Services (AWS), 2006 (NB Bezos 2002 memo) Libraries, e.g., Ruby on Rails, 2004; Node.js, 2009 Version Control, e.g., GitHub, 2008 (NB Torvalds, 2005)

Package Managers, e.g., NPM, 2010 Containerization, e.g., Docker, 2013 Al platforms, e.g., Google, Microsoft, 2019

# With reusable modular systems, designing becomes "meta" our frame of designing shifts to stewardship and scaffolding.

First-order design

Correcting an error

=

=

Solving your problem

prescriptive (here's what to do)

presumptive (I / we know what you need)

Second-order design Learning what matters =

Creating conditions for systems to emerge, in which others can design [for] themselves

- generative (allowing the "seeing" [defining] of what we will do)
- generous (let us see what we decide we need)

# A partial history of design systems...

35

Design systems as way finding. as symbol systems. as identity. as type. as **typography**. as **building**. as art process. as artifact. as toys. as **games**. as graphical user interface (GUI). as genetic algorithms.

#### Design systems as **way finding**.

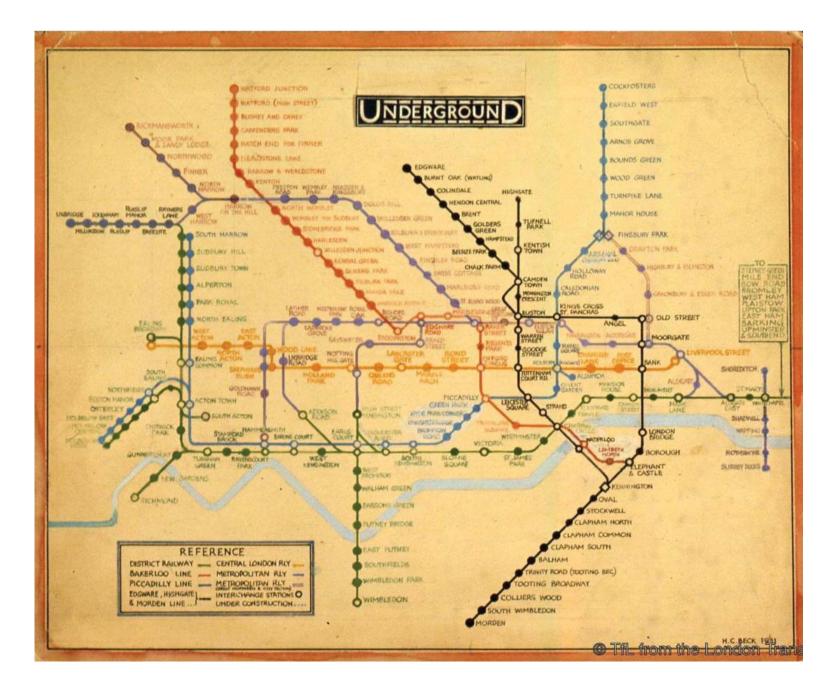
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37

#### London Underground Map

#### Harry Beck, 1931

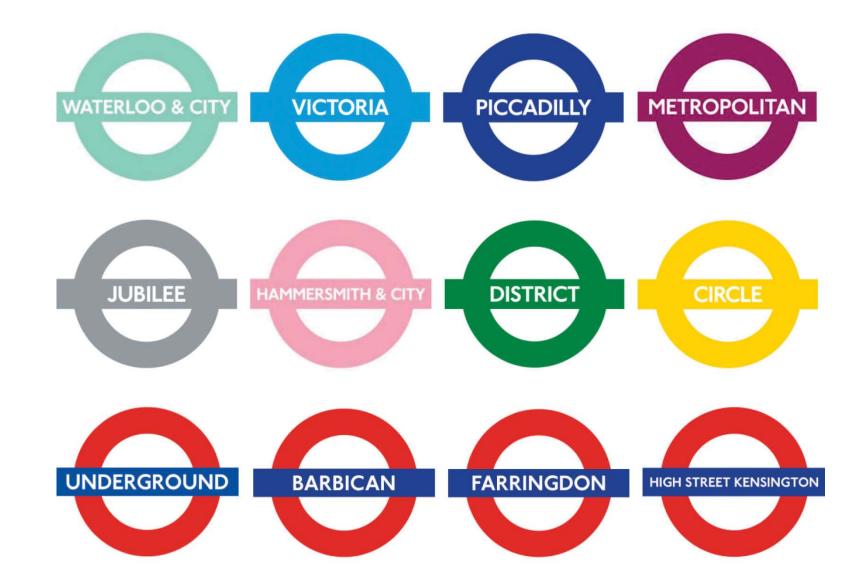
Diagrammatic map which includes topology that communicated the networking of the London Underground on a circuit system.



#### London Underground Signage System

### Edward Johnston, 1933

The famous roundel logo which was first introduced in 1908 by Frank Pick. This symbol has become an iconic symbol of the city and adapted by Transport for London.



#### **Plans Indicateurs Lumineux d'Itinéraries (PILI)**

#### Paris Metropolitan Railway Company, 1937

The luminous indicator plans for itineraries are analog computers programmed to show the fastest route to travel between subway stations.



#### Milan Metro Signage System

**Franco Albini & Bob Noorda, 1964** Efforts to display station information in the clearest way possible through color and typography while creating a uniform visual identity.



#### **New York Subway Signage System**

#### **Unimark International, 1966**

The New York City Transit Authority Graphics Standards, 1970 document that established the modern identity and system-wide design for the subway.





### **Schiphol Airport Signage**

**Benno Wissing, 1967** Wayfinding and signage design that served as the blueprint for many other international airports.



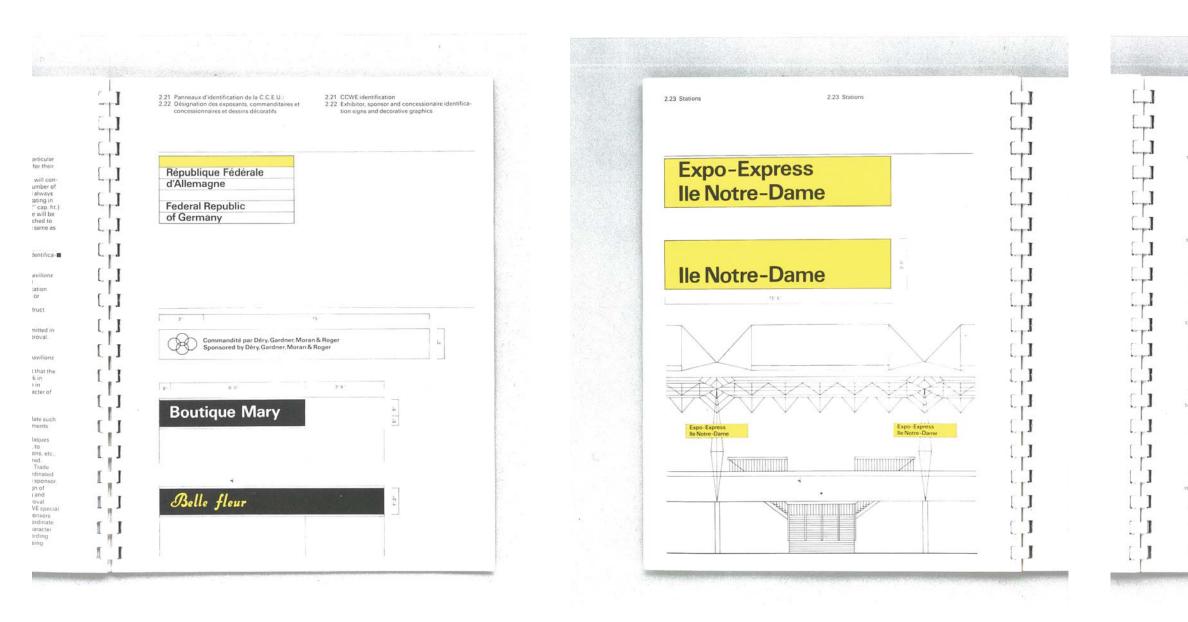
#### **Expo '67 Standard Sign Manual**

**Paul Arthur & Associates, 1965** A manual designed for the 1967 Universal and International Exhibition, also known as Expo '67 in Canada. It is considered to be the most successful World's Fair exhibition of the 20th century with around 50 million visitors.



### Normes de signalisation

# **Sign Manual**





#### A Sign Systems Manual

#### **Theo Crosby, Alan Fletcher & Colin Forbes, 1970**

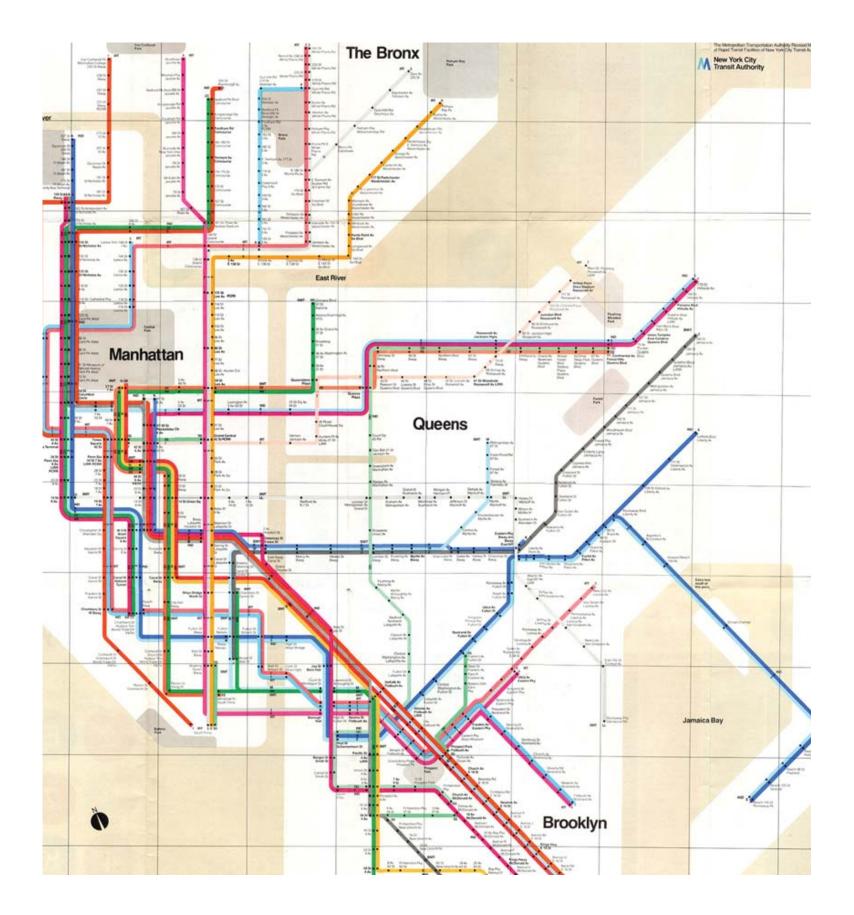
A book describing a basic system for designing and displaying signs through rules and methods.





#### **New York Subway System Map**

Massimo Vignelli, 1972 Simplifying information to effectively help users navigate a complicated infrastructure.



#### **New York Subway System Map**

#### John Tauranac & Michael Hertz, 1979

A replacement design for Vignelli's New York Subway map due to much controversy. This version included geographic and navigational clarity above ground.



#### Design systems as **symbol systems**.

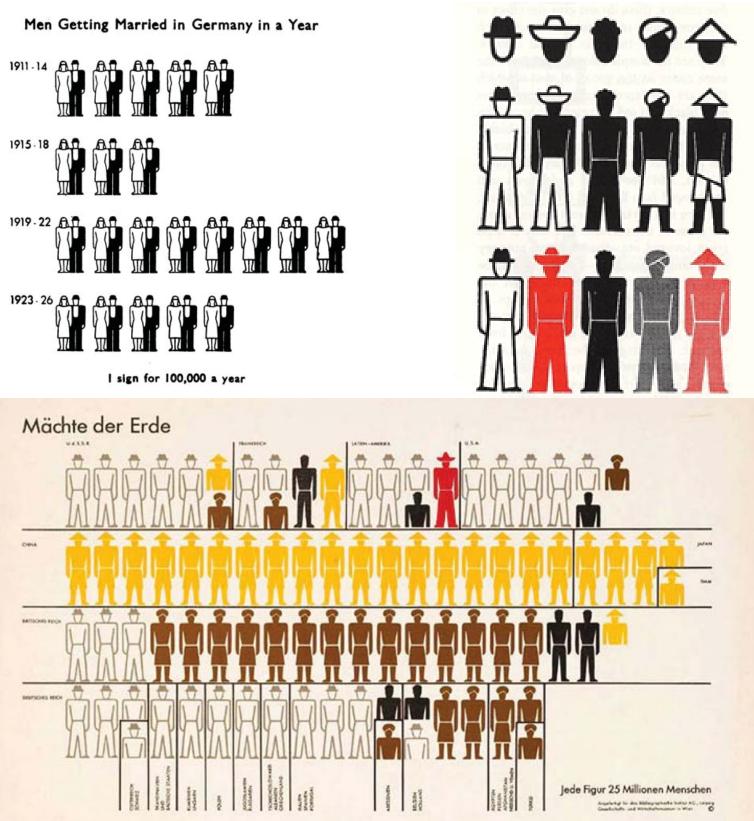
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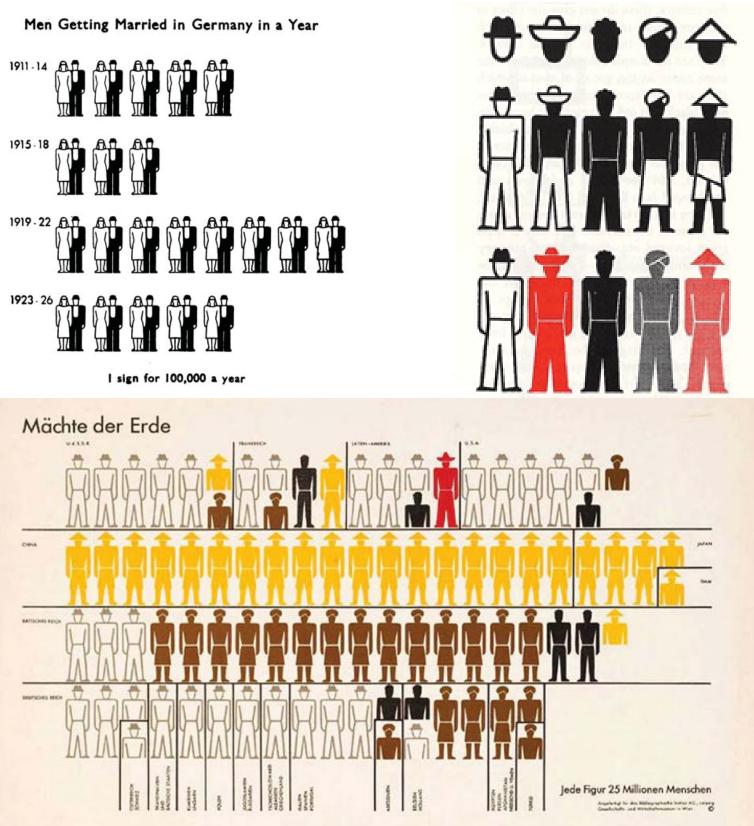
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#### Isotype

**Otto Neurath, 1920's** 1915.18

International System of **Typographic Picture Education** (ISOTYPE), is a visual program for displaying information and quantitative facts.

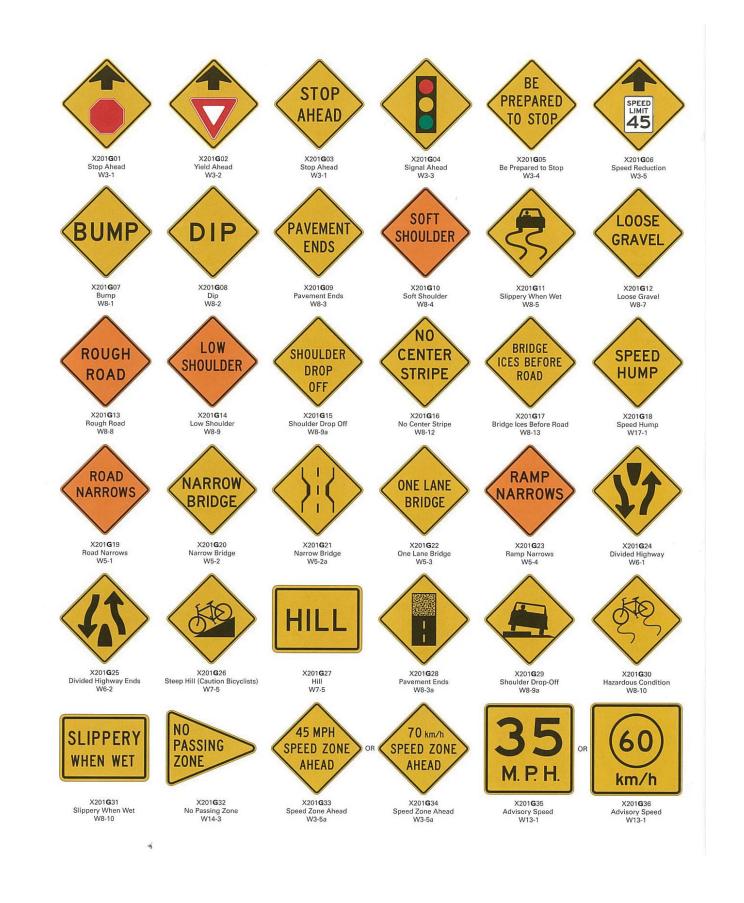




Manual on Uniform Traffic Control Devices for Streets and Highways

#### American Association of State Highway and Transportation Officials, 1935

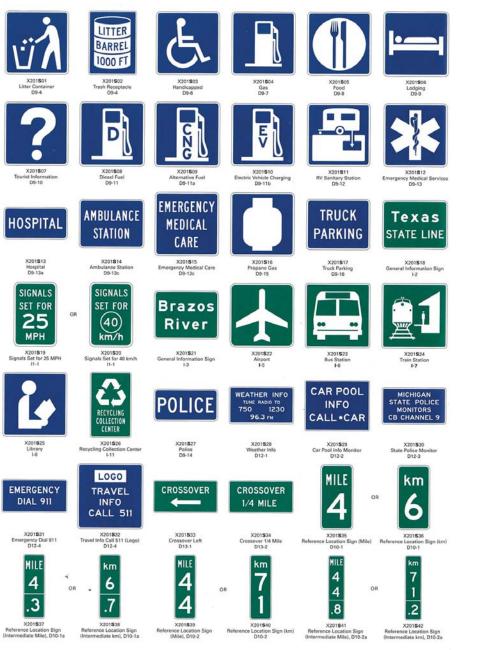
Specifies the standards by which traffic signs, road marking, and signals are designed, installed, and used in the United States by the Department of Transportation.



STOP	TO ONCOMING TRAFFIC	4-WAY	ALL WAY	SPEED LIMIT 10	
X201A01 X201A02 Stop Yield R1-1 R1-2	X201A03 To Oncoming Traffic R1-2a	X201 <b>A</b> 04 4 - Way R1-3	X201 <b>A</b> 05 All Way R1-4	X201A06 Speed Limit, 10 M.P.H. R2-1	
SPEED SPEED LIMIT LIMIT	SPEED	SPEED	SPEED	SPEED	
15 20	25	30	35	40	Į
X201A07 X201A08 Speed Limit, 15 M.P.H. Speed Limit, 20 M.P.H. R2-1 R2-1	X201A09 Speed Limit, 25 M.P.H. R2-1	X201A10 Speed Limit, 30 M.P.H. R2-1	X201A11 Speed Limit, 35 M.P.H. R2-1	X201A12 Speed Limit, 40 M.P.H. R2-1	
	NIGHT	NIGHT	SPEED	SPEED	
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X201A13 Truck Speed Limit, 40 M.P.H R 2-2 X201A14 Trucks Speed Limit, 60 km/h R2-2	X201A15 Night Speed Limit R2-3	X201A16 Night Speed Limit R2-3	X201A17 Speed Limit, 45 M.P.H. R2-1	X201A18 Speed Limit, 50 M.P.H. R2-1	
SPEED LIMIT SPEED LIMIT	SPEED	SPEED	REDUCED	SPEED	
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X201A19 X201A20 Speed Limit, 80 km/h Speed Limit, 55 M.P.H. R2-1 R2-1	X201A21 Speed Limit, 60 M.P.H. R2-1	X201A22 Speed Limit, 65 M.P.H. R2-1	X201A23 Reduced Speed Ahead R2-5a	X201A24 Speed Zone Ahead R2-5c	
MINIMUM SPEED MINIMUM		LIMIT (80)	FINES	TRAFFIC LAWS	
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X201A25 X201A26 Minimum Speed Minimum Speed 40 M.P.H, R2-4 60 km/h, R2-4	X201A27 Speed Limit 50 M.P.H. Min. 30 M.P.H., R2-4a	X201A28 Speed Limit 80 km/h Min. 30 km/h, R2-4a	X201A29 Fines Higher R2-6	X201 <b>A</b> 30 Traffic Laws Photo Enforced R10-18	1
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ENFORCED		TURNS			
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HILE 4 4 4 4 8 8 8 9 10 10 10 10 10 10	Reference Location Sign (tem, Dio.3	MILE 4 4 9 .9 X20103 Reference Location Sign (Intermediate Mile), D16-3	R 1 5 .5 X201704 Reference Location Sign (Intermediate wh), D10-3a	WEST 12 MILE 260 X201705 Enhanced Reference Location (Mile)	WEST <b>123</b> km 418 xzortro Enhanced Reference Location (km)
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Location (Intermediate Mile) NEXT EXIT 12 MILES NEXT EXIT 12 MILES X201T13	Columbia EXITS College St 1/2 Hanover St 2/4 High St 3	E11-1  GAS-EXIT 211  LODGING-EXIT 21  X201T15 Specific Services		E11-16 SAN FRANCISCO LOS ANGELES  X201T17 Destination Sign	E11-1e CHICAGO 38 + BOSTON 100 CLEVELAND 136 + X201T18 Destination Sign
Next Exit 12 Miles ST LOUIS 5 MEMPHIS 40 NEW ORLEANS 65 X201T19	Community Interchanges Identification (Example)	Example)	Ventral advices (Example)		DI-30 JUN
PARK & RIDE	PARK & RIDE	Diagrammatic Sign (Example) END CONSTRUCTION	Diagrammatic Sign (Example) ROAD WORK	Gore Sign	Parking Area D4-1
x201726 Park & Ride Next Right WEIGH STATION	Ato Tab Park Ride D4-2	REST AREA	x20128 End Road Work G20-2a	X201729 Directional Sign (Right) TOURIST ACTIVITIES STEWARD'S JET BOATS	x201T20 Directional Sign (Left) BLUE SPRINGS
X201T31 Weigh Station D8-3	X201T32 Trail 1.4	X201T33 Rost Area Gore	X201T34 Tourist Information Center (Supplemental)	X201T35 Tourist Oriented Directional (Example), E2-1A	X201T36 General Directional Guide (Example)

X201T37 loadside Table

X201T38 Parking Direction (Example)

NO CAMPFIR

X201T39 No Camplires Proh



X201T40 No Smoking Prohit

#### NSDAP

#### Organisationsbuch der NSDAP, 1938

The Party's handbook which detailed organizing principles and mechanics are showed for building the movement.

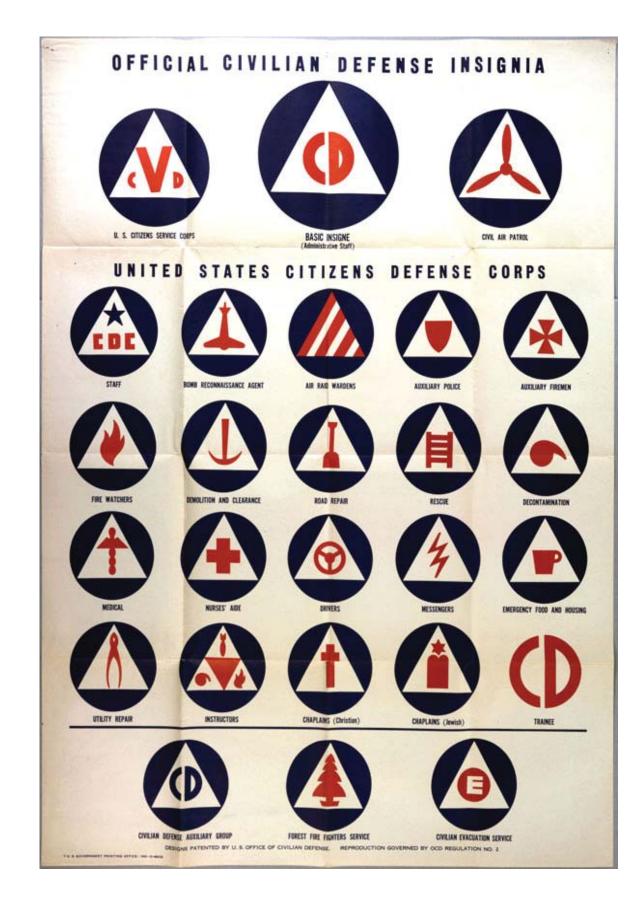


#### Organisationsbuch der NSDAP.

#### **Civil Defense Symbols**

#### **Charles Coiner, 1942**

A system of symbols that were use by the United States Citizens Defense Corps to illustrate jobs assigned to volunteers.



#### **Protocol on Road Signs and** Signals

#### **United Nations Conference on Road and Motor Transports**, 1949 The difficulty of a multiplicity of languages led to the development of a pictorial sign system for international highway signs.







X02A10 Left Lane Ends



X02A16



X02A22

M

X02428

X02A34

ailway, Level Cros

without Gates



X02A23

X02A11



X02A29



X02A35



Railway, Level Cros with Gates





**Right Lane End** 



Heavy Traffic sible Conges





X02A30



X02A36 Two Way Traffi



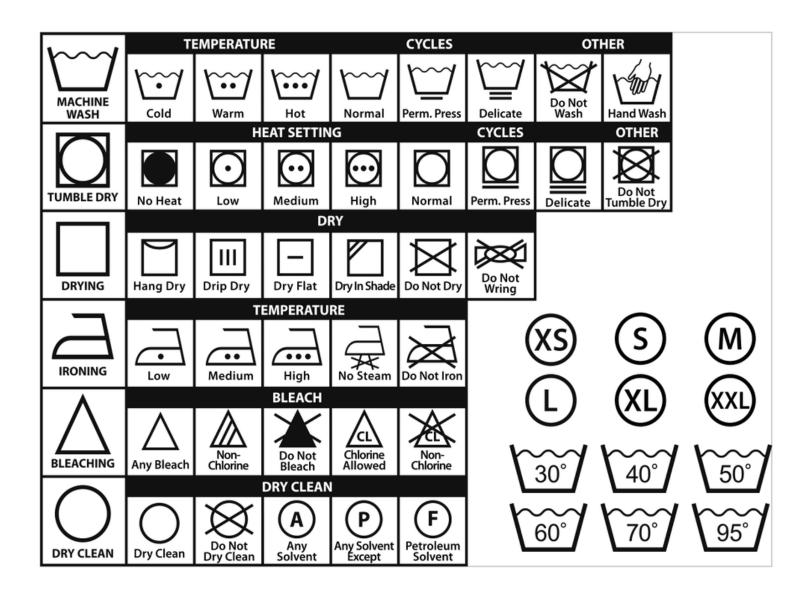
Railroad Crossin Single Track



#### **Fabric Care Symbols**

#### **GINETEX, 1963**

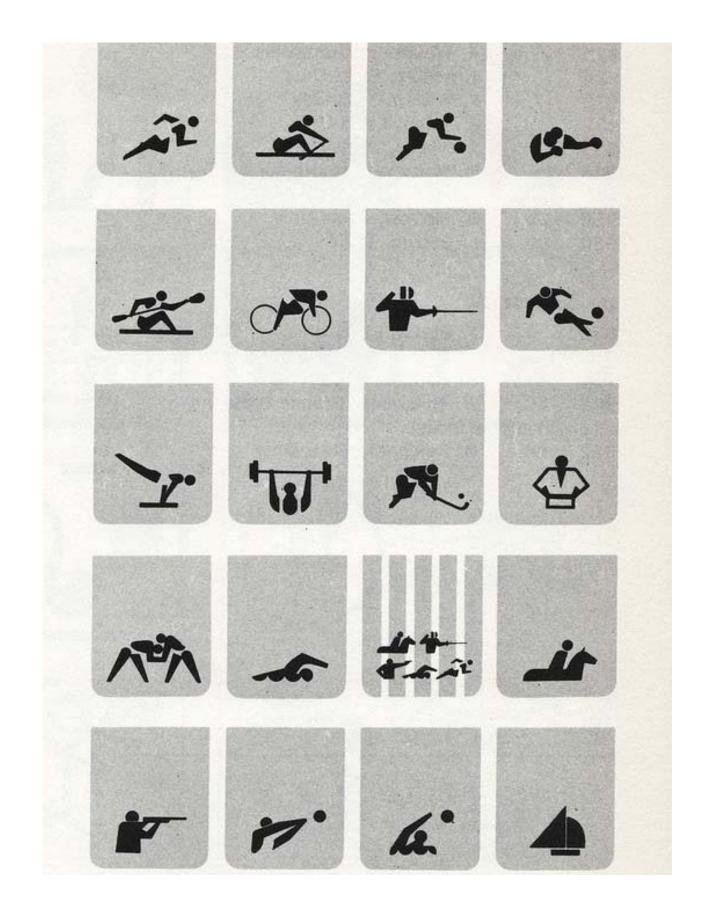
A system of symbols that were created to assist consumers on clothing care information. In 1972 the Federal Trade Commission enforced the Care Labeling Rule to attach instructions to garments.



#### **Tokyo Olympic Pictograms**

#### Yoshiro Yamashita & Masura Katzumie, 1964

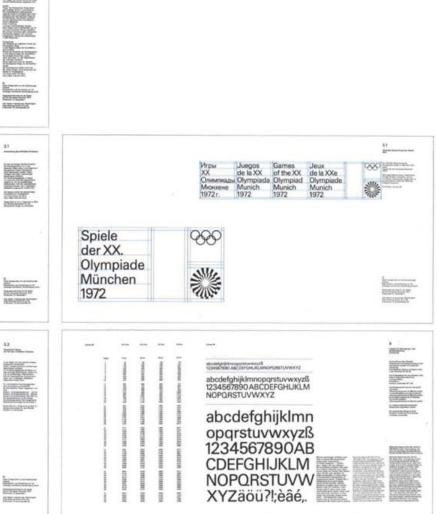
Pictograms were introduced to represent each sport to visually communicate to international groups of athletes and spectators.

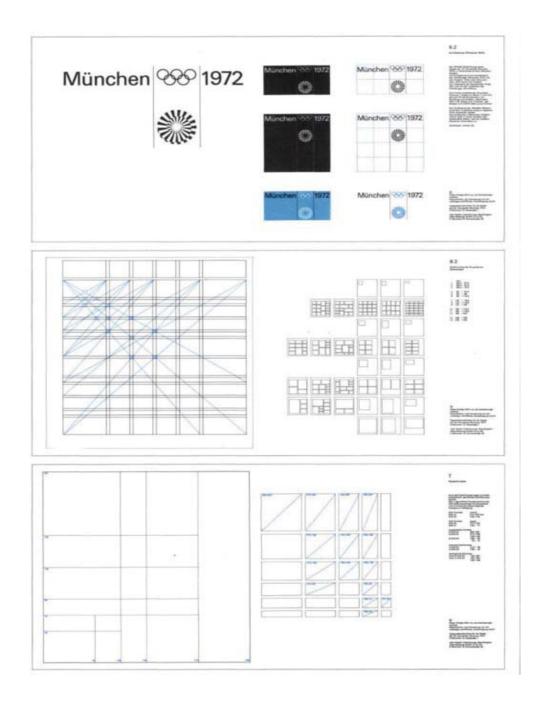


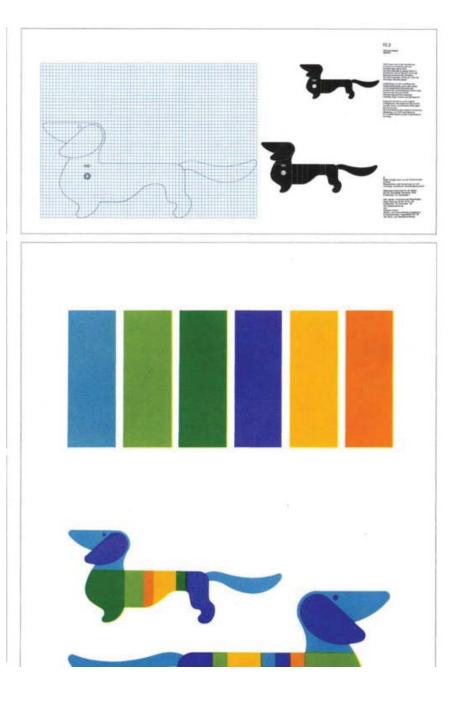
#### **Munich Olympics Design Manual**

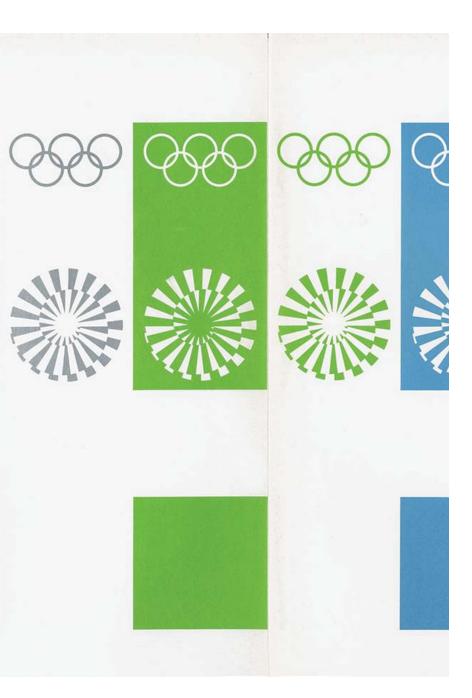
#### Otl Aicher, 1969

A collection of visual modules which express continuity and connectedness through the design system which was used for governing everything from signage to urban planning. <del>SS</del> And a second sec 









## Munich Olympics Identity & Signage System

### Otl Aicher, 1972

Standardizing forms through a system of graphic and geometric rules to create unity throughout the pictograms.



#### Olympiapark: Volleyballhalle Hockeyanlage

#### Boxhalle

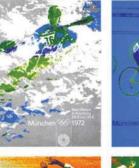
#### Olympiastadion

#### Sporthalle Schwimmhalle

#### Radstadion Geländelaufstrecke





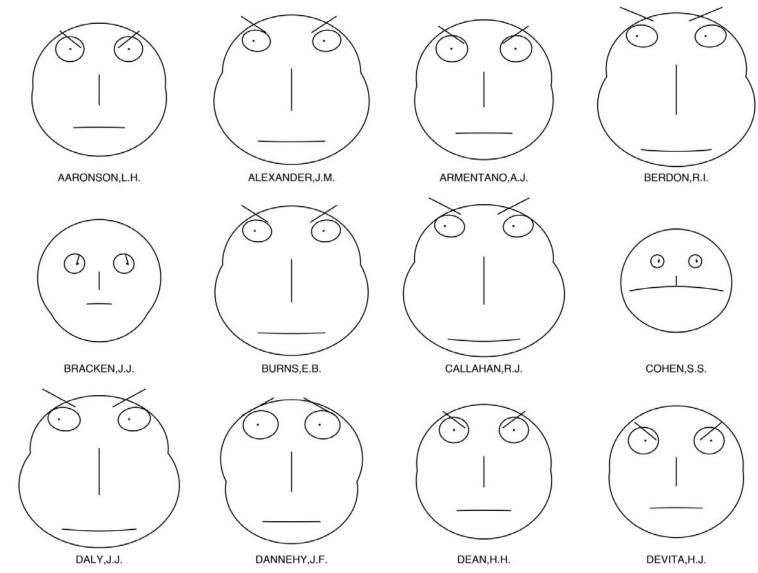




#### **Chernoff Faces**

#### Herman Chernoff, 1973

A display of multivariate data in human face shapes. Based on the dataset, the position of the human face parts are skewed in theory behind how humans can easily recognize subtle facial changes.



#### Symbol Signs

## The American Institute of Graphic Arts, 1974

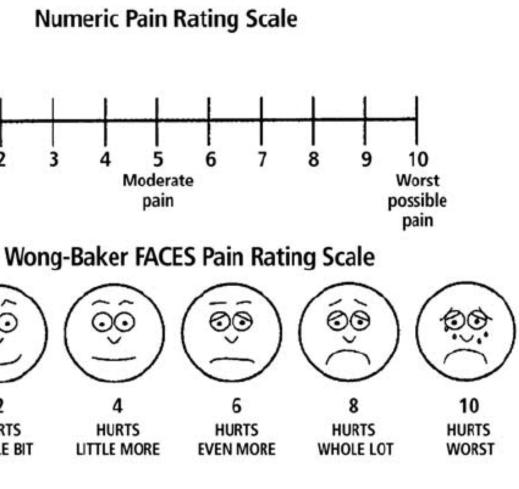
A visual recommendation for the system of passenger and pedestrian oriented symbols developed by AIGA.



## Wong-Baker FACES Pain Rating Scale

#### Donna Wong & Connie Baker, 1981

Originally developed for young children to communicate about their pain levels in order to be effectively treated and supported.

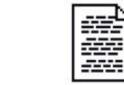


#### **Macintosh Icons**

#### **Susan Kare, 1984** Graphical user interface icons introduced in the original Macintosh operating system.



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#### **Emoticons**

#### Scott Fahlman, 1984

An emotional icon; emoticon. Punctuation marks, letters, and numbers used in to create pictorial icons that display emotions or sentiment.

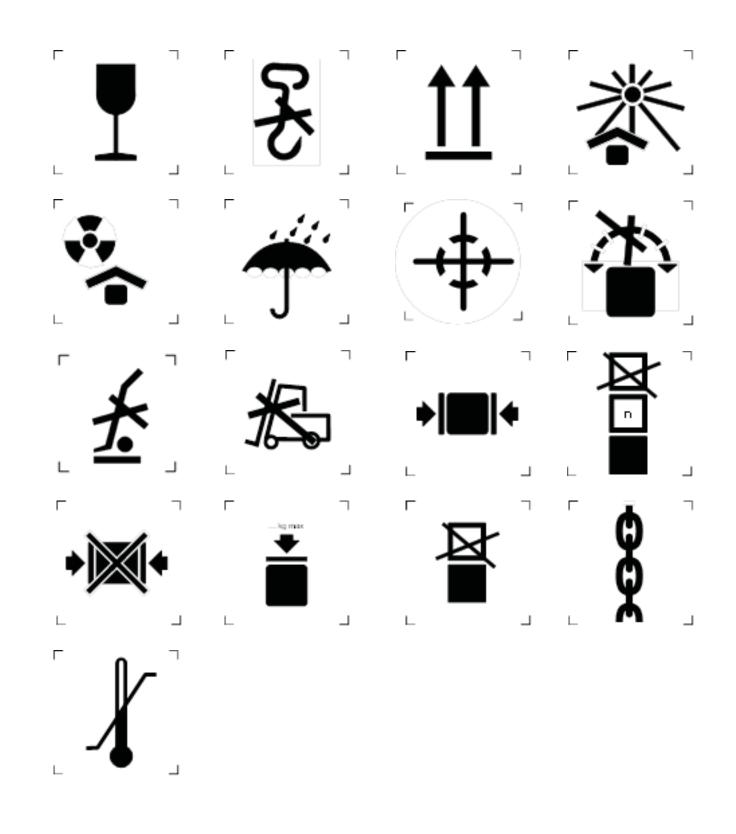
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- :-D :D =D
- :-P :P :-p :p =P
- :-(:(:[=(
- :-):):]=)

#### **Package Handling Marks**

## International Organization for Standardization, 1985

Universally recognized pictorial markings for handling of goods that convey the consignor's intention of instructions which are included in ISO 780.



#### Emojis

#### Shigetaka Kurita, 1999

In Japanese translating to picture character, emojis were introduced to tackle the problem of the SMS character limit. This system is a global language transforming how we communicate digitally.





#### Design systems as **identity** for **corporate identity systems**. for **dynamic identities**. for **packaging**.

#### **Corporate Identity Systems**

Dubberly Design Office · Systems Theory in Design-Design Systems · 07 July 2020

70

#### **AEG (Allgemeine Elektrizitäts Gesellschaft**)

#### Peter Behrens, 1907

Introduced modern corporate identity; unified logos, advertising material and company publications with a consistent and unified design concept.







#### Olivetti

#### **Camillo Olivetti, 1908**

Originally founded as a typewriter manufacturer, in 1938 son Adriano Olivetti took over and integrated a graphic design department into the corporate structure that focused on design over pure functionalism.

### olivetti

#### **NRA Blue Eagle**

**Charles Coiner, 1933** As part of a publicity campaign, the Blue Eagle became a recognized symbol in partner with the National Recovery Administration.

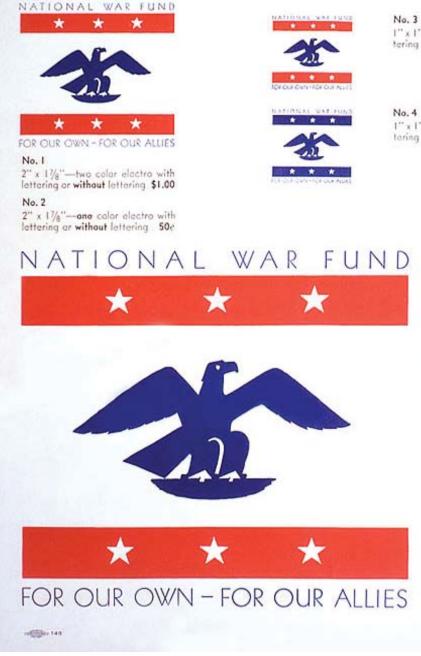


#### **National War Fund**

**Charles Coiner, 1943** Implementing the Blue Eagle symbol, Coiner designed this identity during World War II in support for the raising funds for war efforts.

The National War Fund symbol was widely used as the insignia for the 1943 campaigns for war relief agencies. More than 132,000,000 pieces of printed campaign literature were issued carrying the symbol alone or in combination with established local identification.

Its use is recommended as a means of more effectively tying in with the national effort. The symbol has been designed for use in national media, printed promotional material, for state war chests, and for local war chests.



#### NATIONAL WAR FUND SYMBOL CUTS

It may be used with or without the following lettering: "National War Fund" and "For Our Own-For Our Allies". It may be combined with local community chest or war fund symbols where this seems desirable.

Electrotypes of the symbol are available as shown herewith, Mats are also available, Reproductions in other sizes. may be made from glossy photographs,

Electrotypes, mats and photographs are available through your State director.

1" x 1"-two color electro with lettering or without lettering\_\$1.00



1" x 1"-one color electro with lettoring or without lettering \_\_ 50c



#### No. 5

34"x %"-two color electra. Available without lettering only 75¢

No. 6

'4"x%"—one color electro. Available without lettering only 50d

#### No. 7

5" x 45%" - two color electro with lettering or without letter-\$2.00 ing

#### No. 8

5" x 45/8" - one color electro with lettering or without letter-\$1.00

Please enter your order through your state director. Ask for NWF Symbol Cut No. [ ]. Be sure to specify whether with or without lettering on top and bottom of symbol,

NATIONAL WAR FUND 46 Cedar St., New York S, N. Y.

### **Connecticut General Life Insurance Company Identity**

#### Lester Beall, 1956

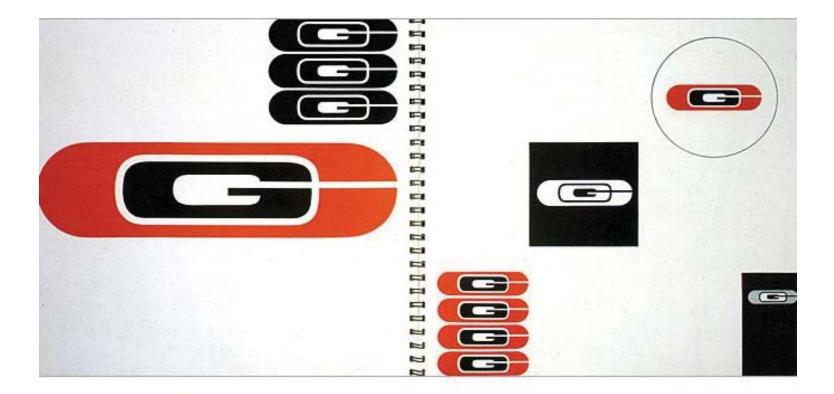
The stylized and elongated logo that were project the strength of the company.



### **Connecticut General Life Insurance Company Manual**

#### Lester Beall, 1960

Corporate identity style book that represents his creative approaches analytically.



### **Upjohn Company**

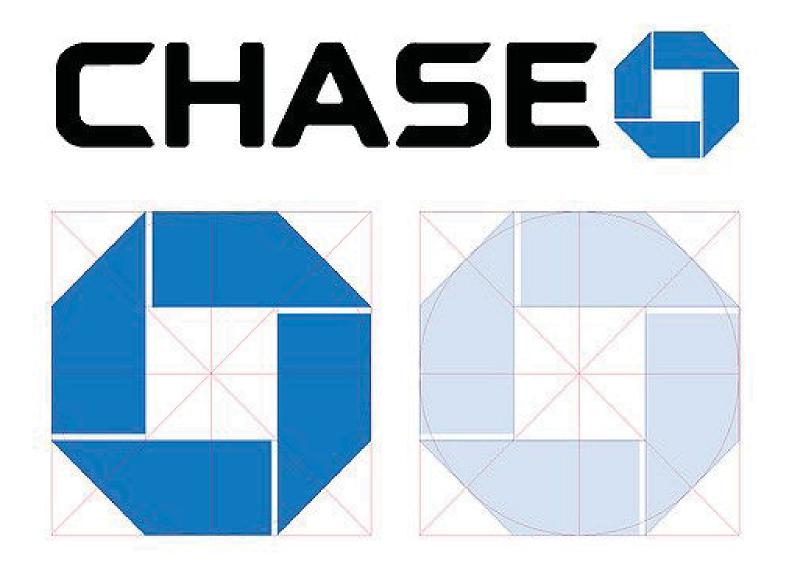
#### Will Burtin, 1959

Various loose mechanicals and paste-ups for the company's manuals and standards.



#### **Chase Manhattan Bank Identity**

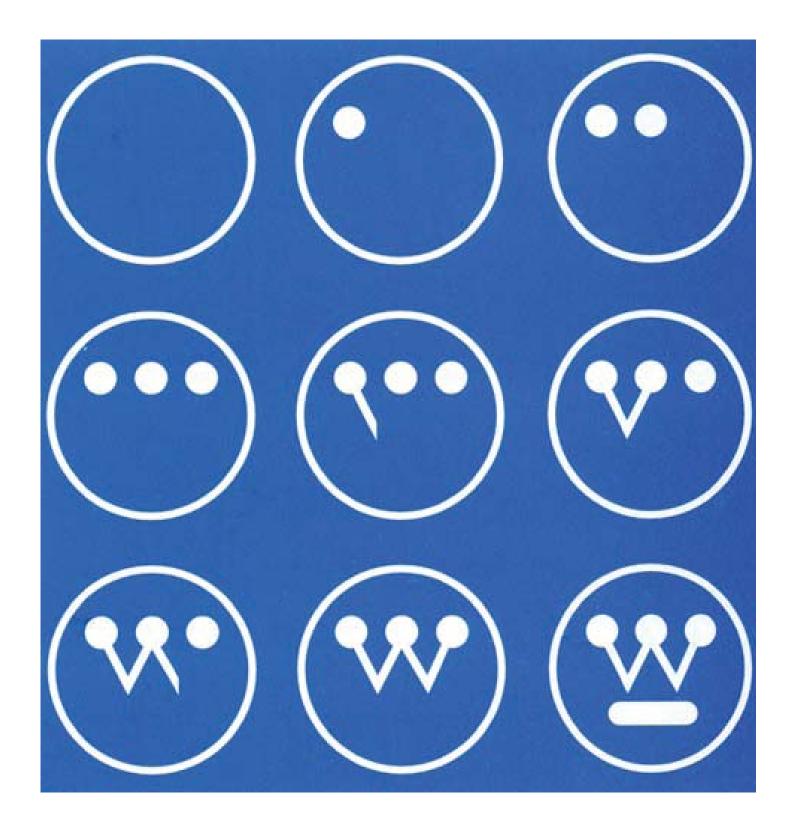
**Chermayeff & Geismar, 1960** Design should be able to be reproduced on and in various materials and scalable.



### Westinghouse Identity

#### Paul Rand, 1959

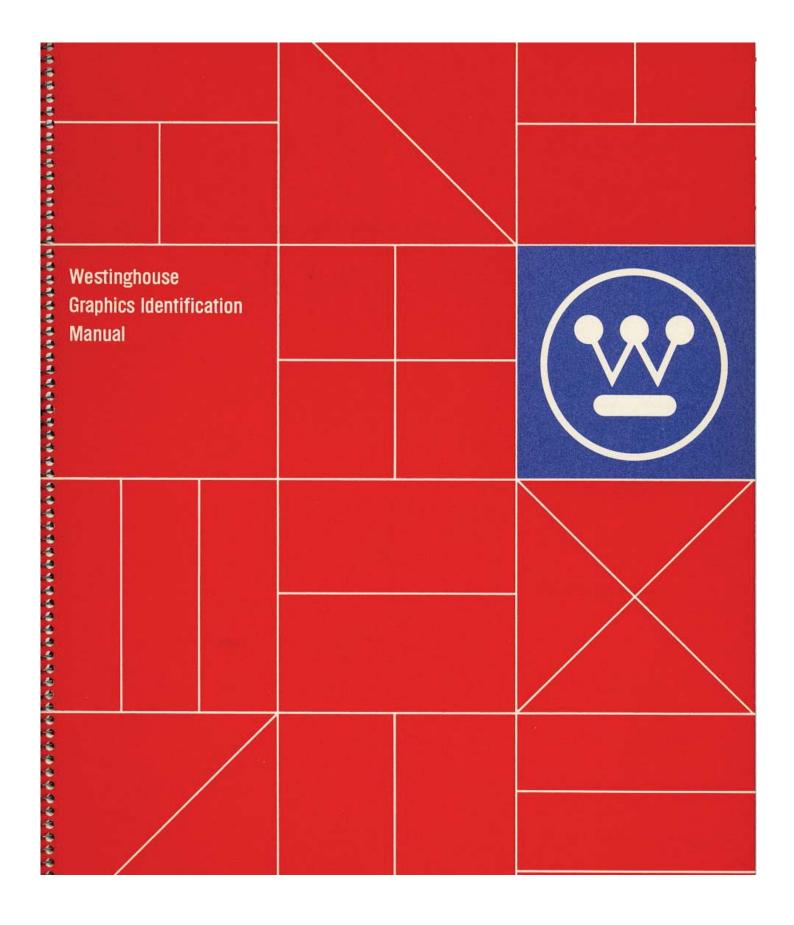
A design that suggested the interlinking points on a circuit board for the electric company.



### Westinghouse Graphics Identification Manual

### Paul Rand, 1961

To unify and improve the company's graphics, the manual proposed standards and showed how they should work.



#### Westinghouse Gothic Typeface

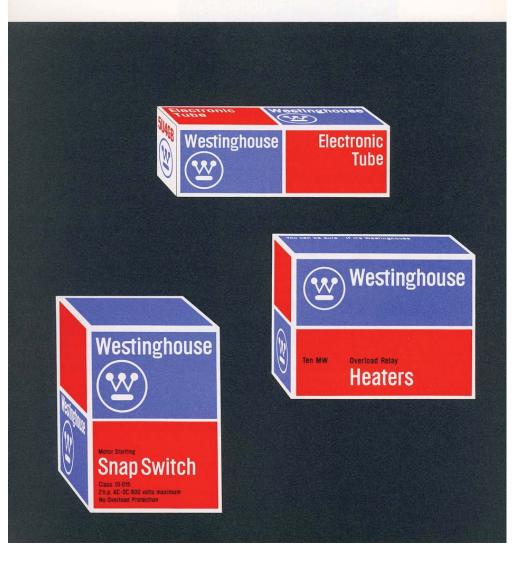
An exclusive typeface, designed especially for Westinghouse, is available. Some of its distinguishing features are:

- 1: Smaller capital letters, (in comparison to the lower case) than are found in other typefaces, as well as short ascenders and descenders.
- 2: The forms of the lower case  $f, g, r, t, \$, \phi$ .
- 3: The ligature "st." (Note: this "st" may not be used for any word but "Westinghouse.")
- 4: Short ascenders and descenders permit large size type in small areas.

Use of Westinghouse Gothic in advertising, TV, packaging, and other printed matter has demonstrated its practicability. It is one more factor which helps to distinguish Westinghouse graphics from hordes of other printed material. Primarily, the typeface should be used in display, rather than text matter.

Westinghouse Gothic comes in two weights: heavy and light. Type sizes range from 8 point to 72 point, and it may be obtained from Westinghouse Electric Corporation, Printing and Nameplate Department, Trafford, Pa., from your local supplier of Protype, or from Photo Lettering, 216 E.45 St., New York (MU 2-2346).





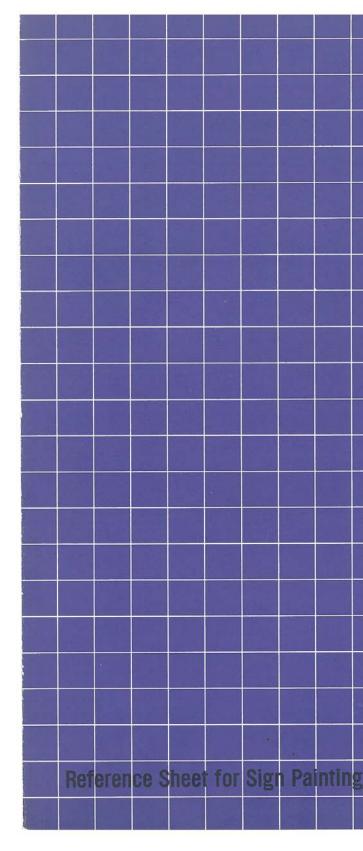
15

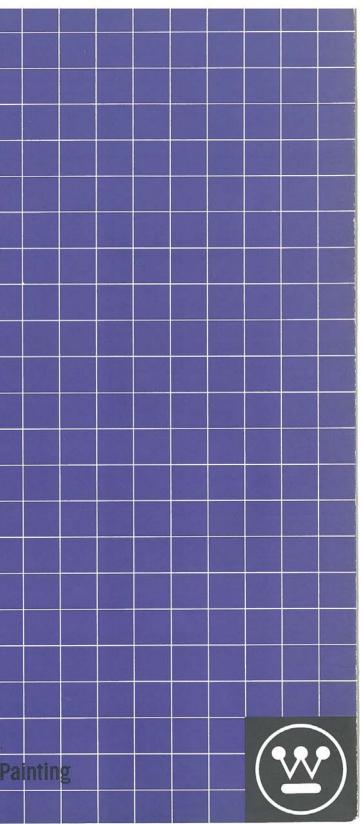


# Westinghouse Reference Sheet for Sign Painting

### **Paul Rand**

A manual showcasing how sign painting should be constructed and some the elements used.



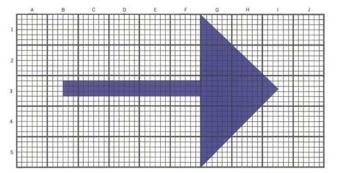


#### **Reference Sheet for Sign Painting**

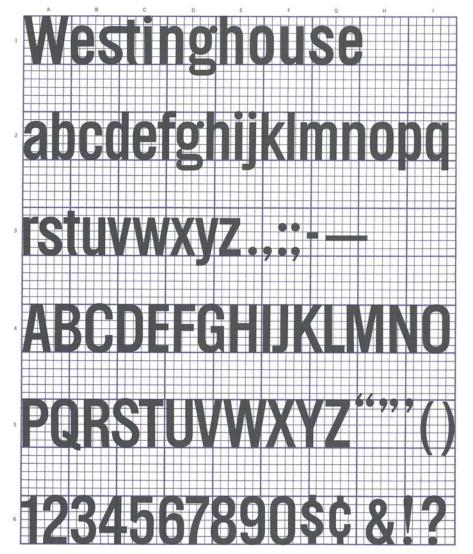
The Westinghouse Standard Sign Manual (B8716) available from Headquarters Identification Section, should be consulted before using this sheet.

Westinghouse Blue is the Corporate color. It should be used on signs as specified in the Standard Sign Manual.

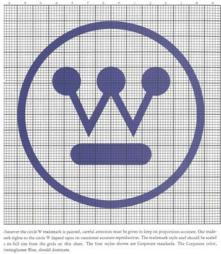
Before painting any sign, a small segment of the sign surface should be tested by applying the color, comparing it with the above panel, and adjusting the paint until the closest color match is obtained. It is important that the test be made on the actual sign surface to be used, because each surface has its own properties which influence how the paint will look when applied.



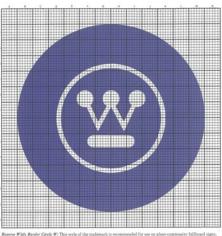
The Westinghouse Direction Arrow was specially designed for high legibility and distinctiveness. It should be used on painted signs whenever an arrow is required. It should be placed horizontally and vertically, right or left, up or down—never at an odd angle. Whenever possible, locate the arrow in the lower right hand corner of the sign as illustrated on Page 19 of the Standard Sign Manual. This location provides the best focal point for the arrow.



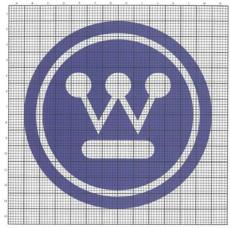
Westinghouse Logotype Trademark and Gothic Type Face: Lettering for all Westinghouse signs should be in the type face of the logotype, the way the trademark "Westinghouse" is printed. This special Gothic type face was developed for high legibility and distinctiveness. The logotype and individual letters of the alphabet can easily and accurately be reproduced by following the grid scale on this page.



a its full size from the grids on destinghouse Blue, should domin builties Circle W: The above style unded for task and tower identif and be seen for great distances.

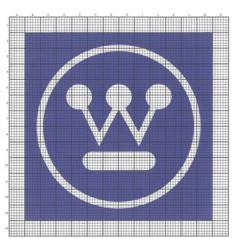


trademark is the simplest, most multy reproduced form. This is the form recomtion. When painted in Westinghouse Blue on a light colored tank, the trademark



everse Nerrew Border Circle W? For special use only . . . contact Headquarters Identification Section for suitability.

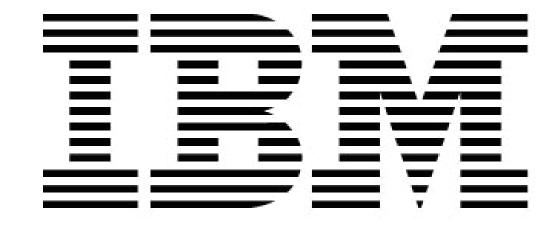
style of the trademark is recommended for use on plant-community billboard signs, and fire Meaned. Is features high healbilling due used descention conflictor



Reserve Square Grele W? For special use only . . . contact Handquarters Mentification Section for suitability

#### **IBM Identity**

**Paul Rand & Eliott Noyes, 1966** The company's famous stripes were introduced to indicate speed and vibrancy to the international expansion.



#### **IBM Graphic Standards Manual**

#### Paul Rand, 1969

The graphic manual that showcased the design system used to reimagine the company's identity and strategy.

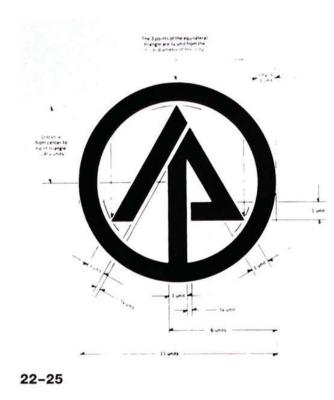


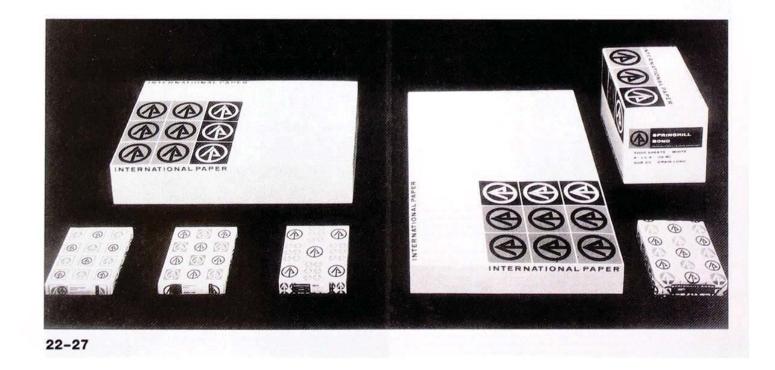


#### International Paper Company Identity

#### Lester Beall, 1960

Reshaped the entire company through a corporate identity program to be efficiently introduced and maintained.







22-26

#### **International Paper Company Corporate Identification**

#### Lester Beall, 1967

This style manual was among the first to showcase the detail of an integrated system in corporate design.



#### **Dynamic Identities**

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88

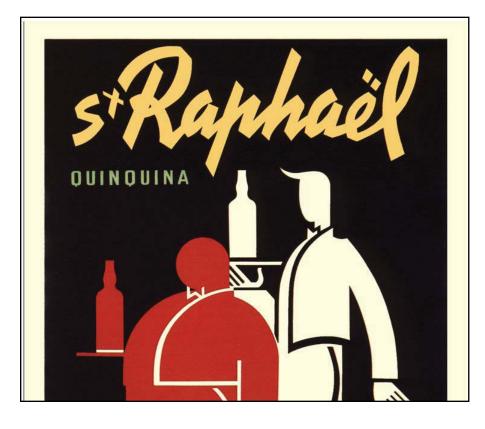
#### St-Raphaël

#### **Charles Loupot, 1957**

While redefining the brand, Loupot gave an infinite field of expression to their graphics. A modular system was used for producing all of the brand's visuals offering numerous combination sets.

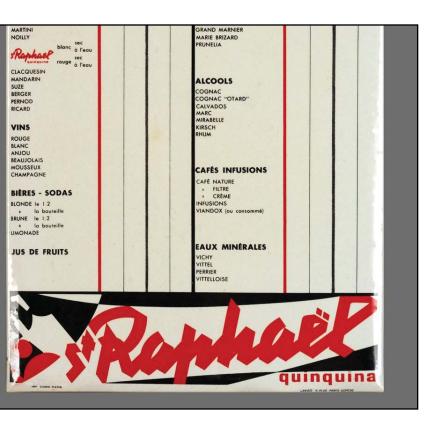


89



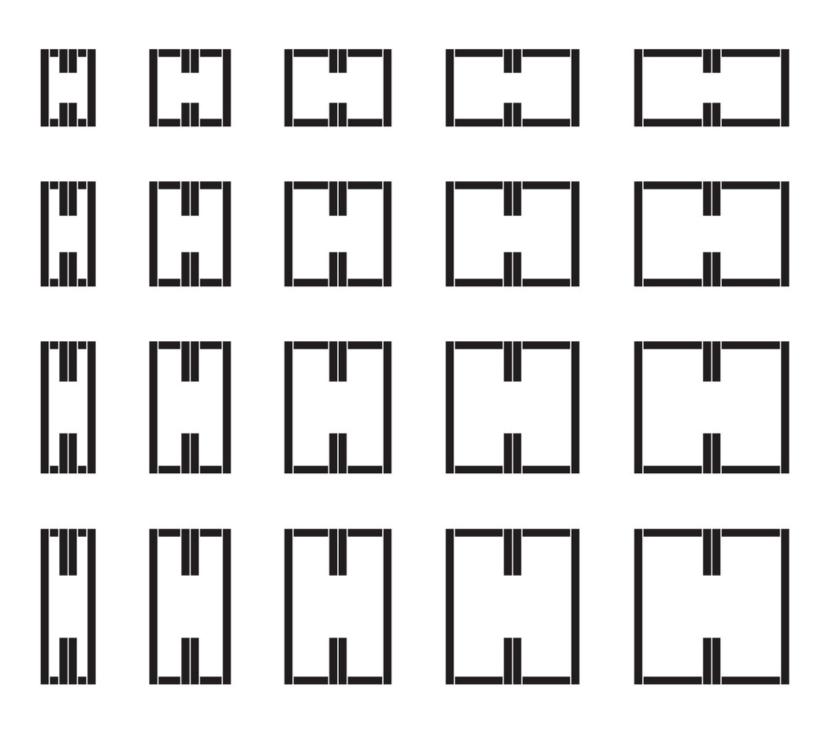






### Holzäpfel

Karl Gerstner, 1959 An office furniture trademark whose identity consist of parts which are components to printer's metal rules.



### MTV

#### Manhattan Design, 1980

One of the first dynamic identities which fixated the shapes and position of the logo but could be built with variations to express its youthful vibe.







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#### Tate Modern

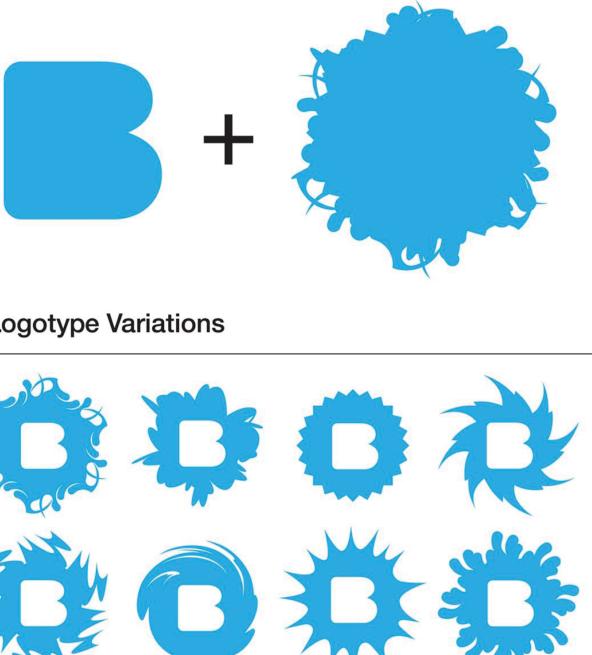
Marina Willer, 2000 The range of logos suggest the dynamic nature of Tate always changing and yet still recognizable.



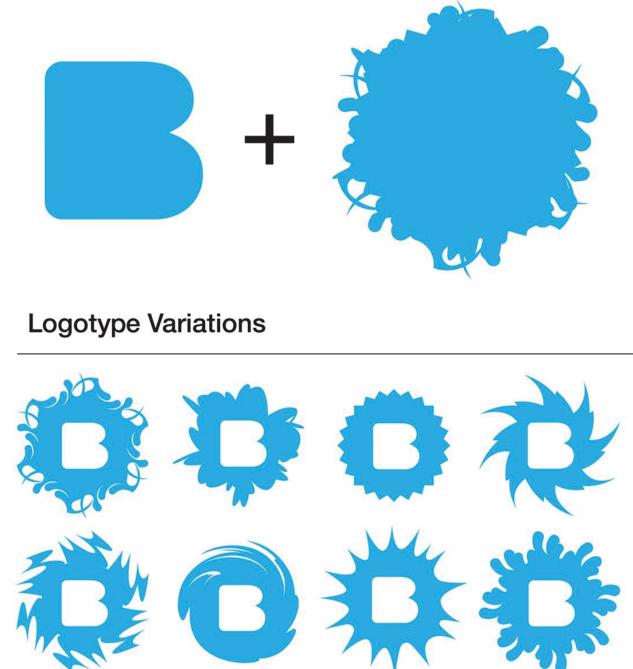
#### **Brooklyn Museum**

#### 2x4, 2004

A contemporary take on the classic museum seal with reimaging the Brooklyn Museum as an alternative museum; family rather than tourist-oriented. The dynamic logo indicates the wide range of the Museum's collection.



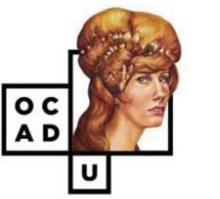
Logotype

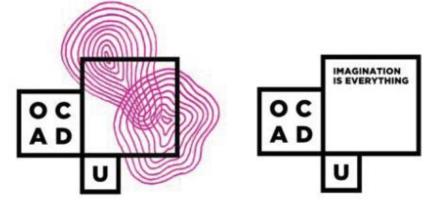


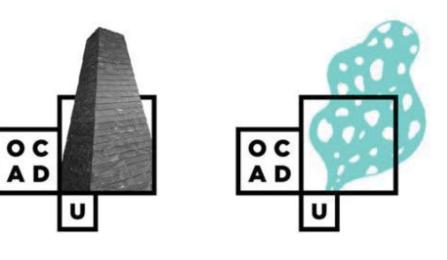
### **OCAD** University

### **Bruce Mau Design, 2011** Customized dynamic identity which allows students to insert their individual mark to add to the library collection.





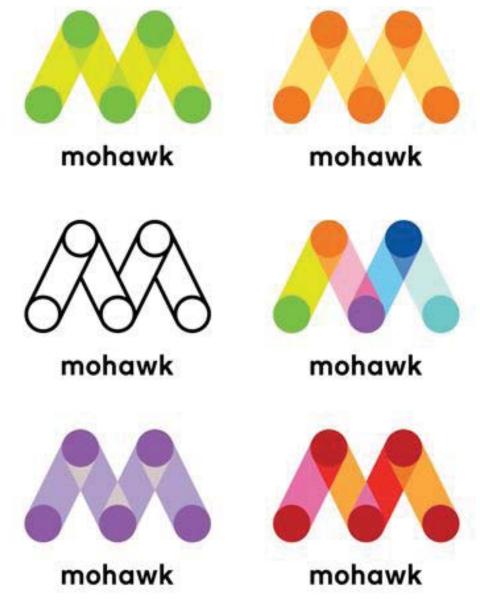


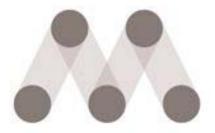


#### Mohawk

#### Pentagram, 2012

The monogram is the centerpiece of the dynamic system which is to evoke the papermaking and printing process which involve paper moving around cylinders.





mohawk



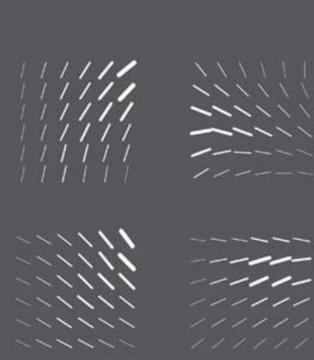
mohawk



#### **EMSCom at Università della** Svizzera Italiana

### **Moving Brands**, 2013

A dynamic reactive logo based on an organic grid of lines created using processing code.



~ **` ` ` ` `** ` ~ **` ` ` ` `** ~ / **/ / /** ~ **` ` ` ` ` `** ~ \ **\ \ \** \ \ < **< < < <** <

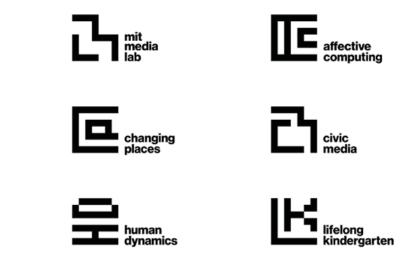
#### COMMUNICATION MANAGEMENT EXECUTIVE EDUCATION

11/1/1 ///// 11/111 11111-----111---111--111---

#### MIT Media Lab

#### Pentagram, 2014

An interrelated system of glyphs that celebrates the diversity of activities at the Lab.









































#### Packaging

99

### **Ciba-Geigy**

#### Max Schmid, 1948

Design of uniform packaging for pharmaceuticals to promote the company brand instead of the product brand.



Campbell's Soup Cans

#### Andy Warhol, 1962

A series of work produced through screen printing which mimicked the repetition and uniformity of advertising.



#### Teddymat

## Karl Gerstner, 1964

A full comprehensive system of laundry detergent packaging represented through a simple visual formula.



#### **Kellogg's Cereal Boxes**

**1987** 







### Kellogg's Cereal Boxes Redesign

#### Landor, 2019

The packaging redesigns were to reflect the naturalness of the food and heritage of the company's story.



#### **Clear RX**

Deborah Adler, 2005 Prescription drug packaging system which included color coded rubber rings and an easy to read label.







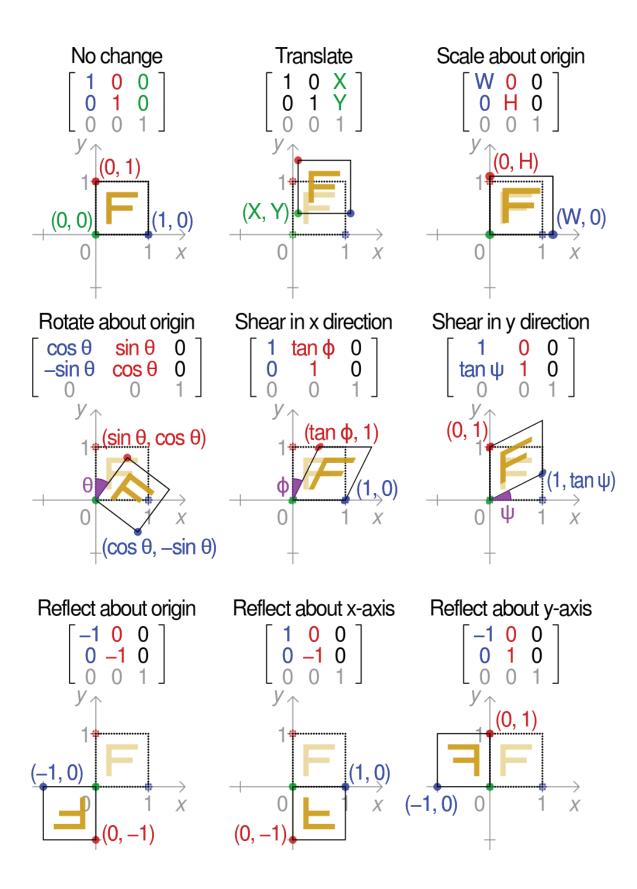
#### Design systems as **type** with **matrix transformations**. with **character set expansions**. with **programmatic descriptions**.

#### Matrix transformations

Dubberly Design Office  $\,\cdot\,$  Origins and development of design systems  $\,\cdot\,$  19 May 2020

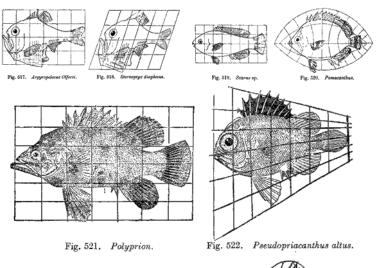
### **Transformation Matrix**

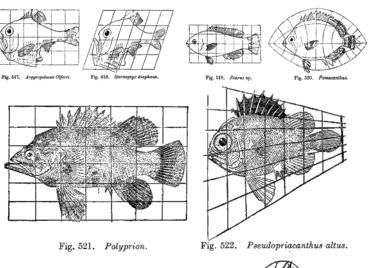
Allow linear transformations to be displayed in a consistent format appropriate for computation.



### **D'Arcy Wentworth Thompson**

**On Growth and Form, 1917** Uses mathematics in biology to show the theory of geometrical transformations within evolution.





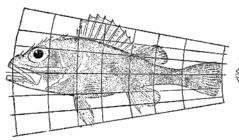
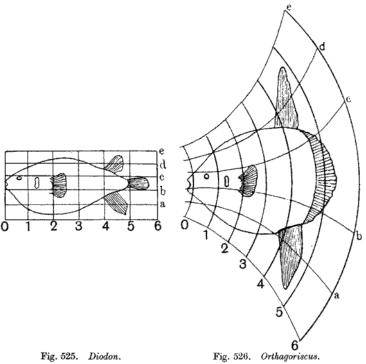


Fig. 523. Scorpaena sp.



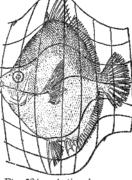


Fig. 524. Antigonia capros.

## **Majuscules and Minuscules**

**Poggio Bracciolini, 1400 A.D.** First pairing of majuscules and minuscules in the modern manner which evolved the Humanistic script. The pairing is also known as uppercase and lowercase characters.



Majuscules (uppercase)

dragenol eri duulit. Morte lubtractul spectaculo magil bominu firuphints glorie syphix ett tibur auduta- multo ante mortuus fabalba traductus fuerar. Conspecta tamen morseus fuerit qui publico funere ett elatus. bunc regem in truipho ductum polibus baud quag spernendus auctor tradit. Secutus scipionem truiphantem ett pilleo capiti imposito. Q. terentus culleo, omnig: deinde uita ut dignu erat libertans auctorem coluit. Africani cognomen militaris primis fauor an popularis auto celebrauerit. In sicuti sylle magniq: pompey patru memoria ceptum ab assentione familiaris sit pirum compertum babeo. Primis certe bic impator nomine uitte a se genti ett nobilitatus : exemplo deinde buis nequag iuctoria pires, insignes imagini titulos claraq: cognomina familie fecere.

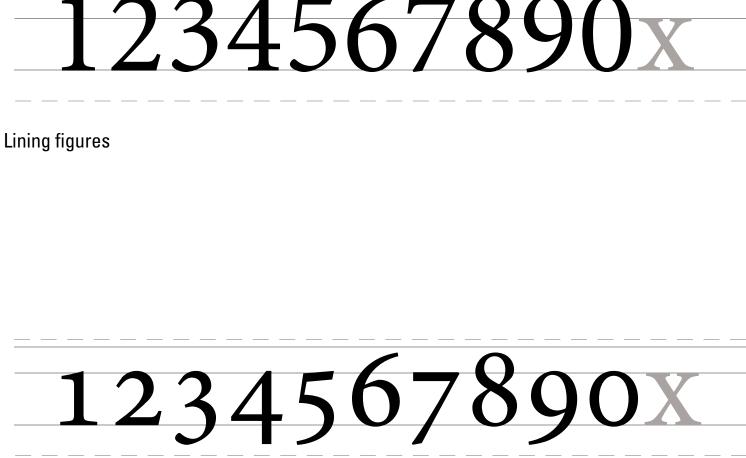
# abc

Minuscules (lowercase)

## **Old Style Figures**

### 12th century

Text figures that have varying heights and alignments based off of the lining figures. Old style figures are usually preferred in a running block of text to create a harmonized look. They were introduced into European typography in 1788.



Old style figures

### **Small Caps**

Glyphs that resemble majuscules or uppercase letters but have a reduced x-height to harmonize with minuscules or lowercase letters.



Lining figures

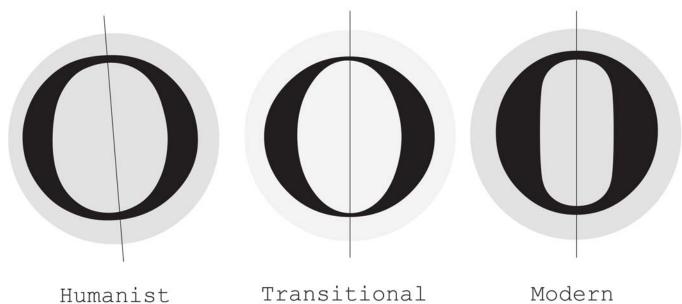
GOOD MORNING, EVERYONE. Today, the Senate is poised to pass tax cuts and unemployment insurance, putting the House of Representatives in the position to send me this critical economic package so I can sign it into law. I am absolutely convinced that this tax cut plan, while not perfect, will help grow our economy and create jobs in the private sector. It

# ABCX

Small caps

### **A Range of Stresses**

**Old Style Typefaces**, 15th century Bembo is an example of an Old Style typeface which emphasized stress and were based on pendrawn strokes.



## **Roman and "Flourish" Form**

### Humanist cursive handwriting, late 1400's Style of script base on Carolingian minuscule.



bone uoluntatis tue coronaste nos quiem eternam. AnDirige domine + deus meus in conspectu tuo uiam me Omine ne infurore tuo arouas me ne q in ira tua corripias me Mulerere mei domine quoniam infirmus sum sana 1 me domine: quoniam conturbata sunt omnia ossa mea L t'anima mea tur bata est ualde: led tu domine ulgq quo Conuertere domme et eripe ai mam meam : laluum me fac propter 4 misericordiam tuam Quoniam non est in morte qui memor sit turin ifer no autem quis confitebitur tibi boraui in gemitu meo lauabo per sin gulas noctes lectum meum lachry

### **Roman and Swash Characters**

### **16th century**

Embellishments that extend off the standard character that were inspired by the period of handwriting.



Roman

THE QUTCK JUMPS OVE DOG THE Q DOG



Swash

# THE QUTCK BROWN FOX

### JUMPS OVER THE LAZY

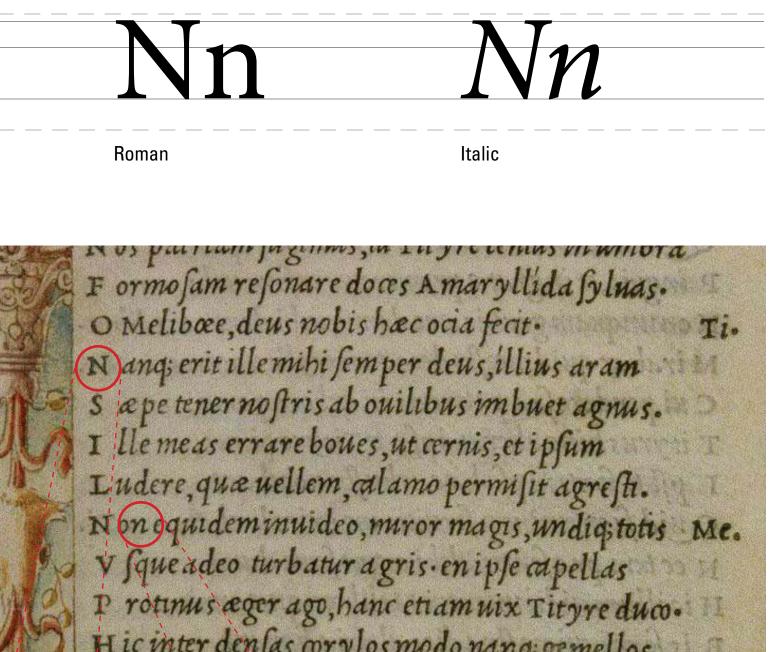
### THE QUICK BROWN

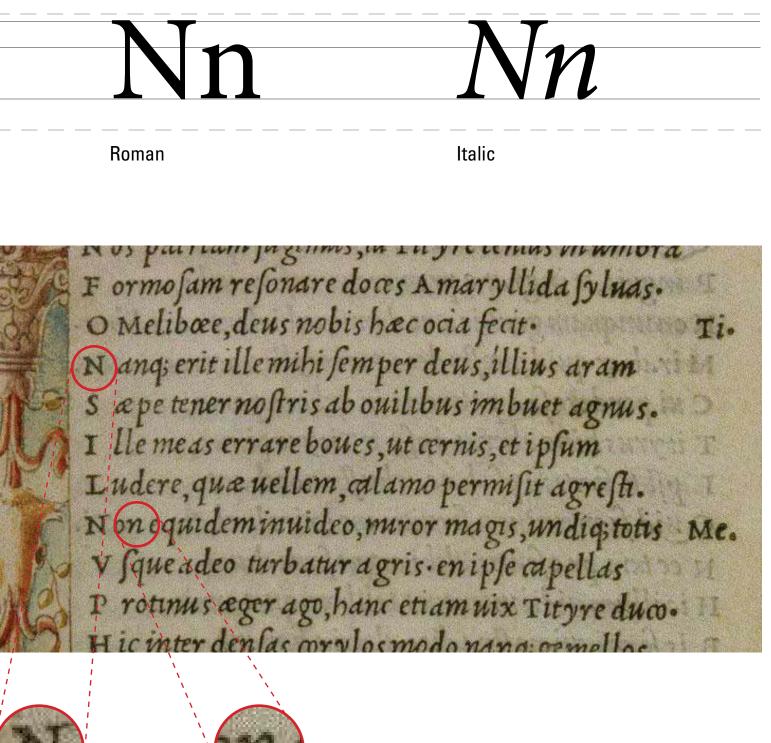
### FOX JUMPS OVER THE LAZY

### **Roman and Italic**

## Francesco Griffo & Aldus Manutius, 1501

This edition of the Aldine Virgil was designed in a smaller format and italic type allowed for more information to be printed while saving space.

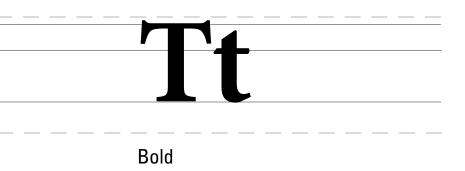




### **Roman and Bold**

**Clarendon, 1845** Robert Besley's Clarendon typeface is the first type designed as a related bold; made to harmonize and align with its roman type. Roman

**PIRACY** is the great sin of all manufacturing communities:—there is scarcely any Trade in which it prevails so generally as among **TYPE FOUNDERS**. Messrs. **BESLEY** & Co. originally introduced the Clarendon Character, which they registered under the Copyright of Designs' Act, but no sooner was the time of Copyright allowed by that Act expired, than the **Trade was inundated** with all sorts of **Piracies and Imitations**, some of them mere effigies of letters. Notwithstanding this, nearly all the respectable Printers in **Town and Country** who claim to have either taste or judgment, have adopted the original Founts, and treated the Imitations with the contempt they deserve.



### **Roman and Bold**

## Franklin Gothic, 1902

At American Type Founders (ATF), Morris Benton created large families of typeface designs to create consistency in different sizes and weights.

Bold	Franklin Gothic Wide	Franklin Gothic and Italic	Franklin Gothic Condensed	Franklin Gothic Extra Condensed	
Heavy IIIIIIIIIIIIII		News Gothic Bold	Alternate Gothic No. 3	Alternate Gothic No. 2	Alternate Gothic No. 1
Medium IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	Monotone Gothic	News Gothic	News Gothic Condensed		News Gothic Extra Condensed
Lightface	Extended	Normal Lightline Gothic	Condensed	Extra Condensed	Compress

### **Condensed, Regular & Extended**

### **Century, 1894**

Originally designed by Linn Boyd Benton, Century was expanded over years creating extensions of the typeface.

Century Expanded Century Expanded Italic **Century Bold Century Bold Italic Century Bold Condensed Century Bold Extended** Century Oldstyle Century Oldstyle Italic **Century Oldstyle Bold Century Oldstyle Bold Italic** 

### **Bold as a System**

### **Cheltenham**, **1902**

Designed by Morris Fuller Benton, Cheltenham and its Bold are wellbalanced with strong symmetry in various letters.

# **Cheltenham Bold** Cheltenham Bold Italic **Cheltenham Bold Condensed** Cheltenham Bold Condensed Italic

### **Cheltenham Bold Extra Condensed**

### **Font Families**

**Venus Font Family, 1907 Released by the Bauer Type** Foundry, this popular early twentieth century type series included condensed and extended weights.

**36 PL ABCDEFGHIJKLMNOPQRSTUVWXYZ** abcdefghijklmnopqrstuvwxyz **\$1234567890 &..,-;:?!''()** 

XYZ abcdefghijklmnopqrstuvwxyz \$1234567890 &...-::?!"()

**VENUS BOLD** FOUNDRY

### 42 pt ABCDEFGHIJKLMNOPQRSTUVW

ADCRAFT TYPOGRAPHERS, IN

### **Serif and San-serif**

Jan van Krimpen, 1935 The Romulus serial type family was the first to include both serif and san-serif.

ABCDEFGHIJKLMN O P Q R S T U V W X Y Z ROMULUS SEMI-BOLD ABCDEFGHIJKLMNOP QRSTUVWXYZ **ROMULUS SANS SERIF LIGHT** ABCDEFGHIJKLMNOP QRSTUVWXYZ

ROMULUS ROMAN

ROMULUS SANS SERIF

ABCDEFGHIJKLMNOP QRSTUVWXYZ

**ROMULUS SANS SERIF SEMI-BOLD** 

**ROMULUS GREEK AND ROMAN** ΤΥΦΧΨΩ

ΑΒΓΔΕΖΗΘΙΚΛΜΝΞΟΠΡ

### ABCDEFGHIJKLMNOP QRSTUVWXYZ

## **Optical Scaling**

Harry Carter, 1937 A design method where characters of the same typeface differ from each other in both size and shape for legibility.

- Hamburgefont
- Hamburgefonts
- Hamburgefonts
- Hamburgefonts
- Hamburgefonts

### Display

Headline



Hamburgefonts

Hamburgefon Hamburgefonts

tion

### Hamburgefonts Hamburgefonts Hamburgefonts

Hamburgefonts Hamburgefonts

124

### **Univers Font Family, 1957**

Designed by Adrian Frutiger as a full system of fonts with a wide range of weight and variations through a numbering system as opposed to names for the weight.



### **Univers Font Family, 1957**

# Univers 55

### Weight

30 = Thin

40 = Light

**50 = Roman** 

60 = Bold

70 = Black

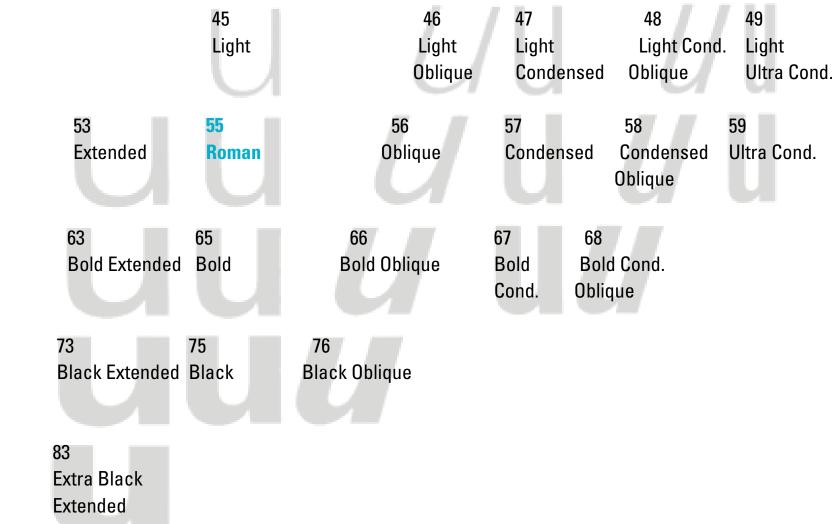
80 = Extra Black

Width & stress	
3 = Extended	

### 5 = Roman

- \* 6 = Oblique
- 7 = Condensed
- \* 8 = Oblique
- 9 = Ultra Condensed

\* even value = oblique



39 Thin Ultra Cond.

### **Encoding Systems**

Dubberly Design Office · Systems Theory in Design—Design Systems · 07 July 2020

127

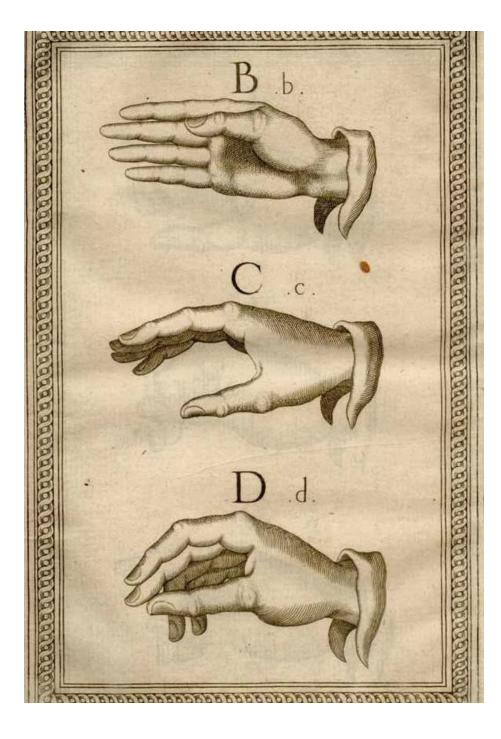
### **Encoding Systems**

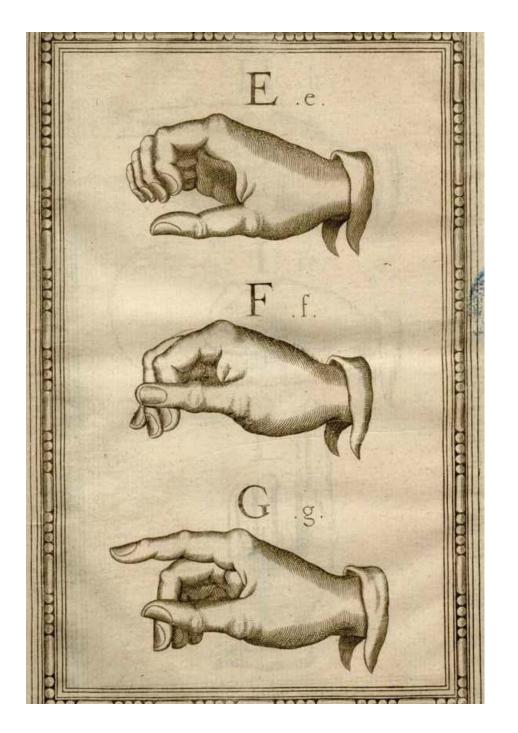
A rules system that pairs each character in a character set with a unique ID number or code to signal the application what glyph to display on screen.

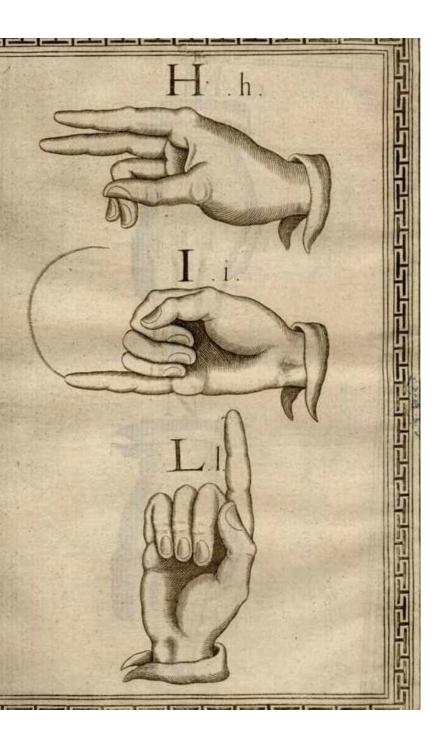
## Sign Language

Juan Pablo de Bonet, 1620 Spanish priest, Bonet, published a dictionary and book demonstrating a manual sign language alphabet system through handshapes for the deaf community.









### **Jacquard Loom Punchcards**

### Joseph Marie Charles "Jacquard", ~1804

A weaving loom that could base its pattern upon the punched wooden cards. The ability to store and repoduce complex operations was applicable in textile manufacturing.



## **Computer Punchcard**

### Semyon Korsakov, 1832

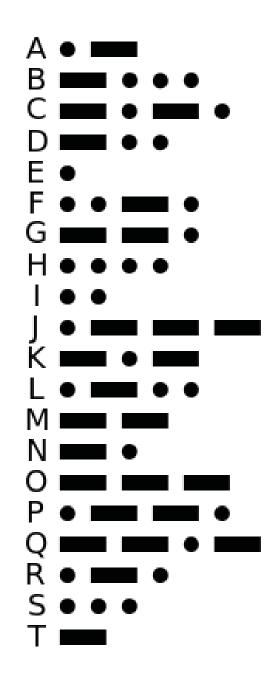
A piece of paper that can be used to represent digital data through the presence or absence of holes in defined positions. They were widely used in the data processing industry during the 20th century.

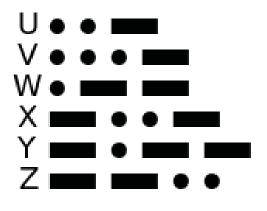
	1 11 11	
000000000000000000	000000000000000000000000000000000000000	000000000000000000000000000000000000000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	16 17 16 19 20 21 22 23 24 25 26 27 28 29 29 31 32 33 34 35 36 37 38 39 40 41 47 43 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 50 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 75 77 78 78 80 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
22 2222222222222	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
3333333333333333333	33 <b>8</b> 3 3 3 3 3 3 3 <b>3</b> 3 3 3 3 3 3 3 3 3 3	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
444444444444444444444444444444444444444	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	444444444444444444444444444444444444444
555555555555	55555 55 55 55 55 55 55 55 55 55 55 55	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
		666666666666666666666666666666666666666
		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
		888888888888888888888888888888888888888
9 5 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 1 IBM UNITED KINGD	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 4	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9

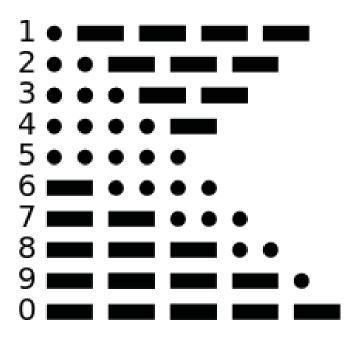
### Morse Code

### Samuel B. Morse, 1836

A system that transmits text as a series of on-off tones, lights, or clicks developed for sending text via telegraph.







### **Baudot Code**

Émile Baudot, 1874 A 5-bit binary coding system which was later known as the International Telegraph Alphabet No.1 (ITA1).

(No Model.)

No. 388,244,



11 Sheets-Sheet 6.

J. M. E. BAUDOT. PRINTING TELEGRAPH.

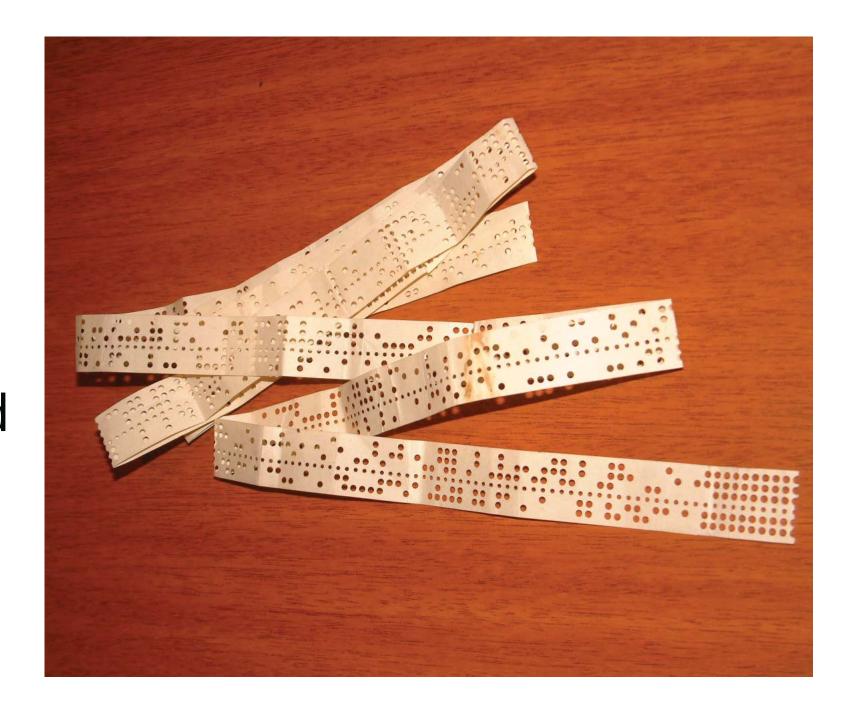
Patented Aug. 21, 1888.

Fig. 24.

	-	g	v	<i>x</i> .	
	- + + + + + + + + + + + + + + + + + + +	3 22 1 1 1 + + + + + + + + + + + + + + +	3 +++++++++++++++++++++++++++++++++++++	*   + + +   + + + + + + + + + + +                   + +	Note: The second se
ABCD FEFE HIJ KLMNOP QRSTUY WXYZESY	+	-	-	-	_
$\mathcal{B}$	-		+	+	
C	+	-	+	+	
IJ	+	+	+	+	
£		+			
E	+	+	1-	-	
4	-	+	+	+	-
æ .	1-	+	-	+	-
. <del>Т</del>	+	+	17	+	
л Л	1	+	+	-	-
1r	+		-	+	-
л т			-		
15	+	+	-	+	+
N		+		+	
ີດ່	-	1.	-	-+	+
p	-	+	1	-	-
0		+	+	+	
R		-	+	+	
ž	_		-	+	
$\tilde{\tau}$	1		II		1
$\hat{v}$	1		+		<b>T</b>
r	1	-	1	_	
Ŵ	-	1	I		I
x		4	_	_	I
Ŷ			+		
$\tilde{z}$	-	4	-	_	-
z		-			-
5/	<u> </u>	_	_	-+	+
~~		_	_	4	
	_	<u> </u>	_	-	+
	_	_			_
					_

## Murray Code

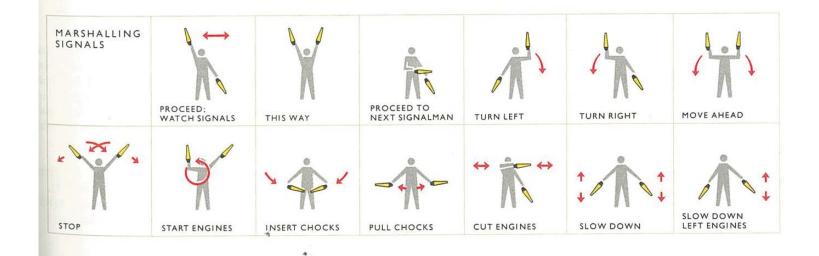
**Donald Murray, 1901** A modification of the Baudot code which was prompted by the development of a typewriter-like keyboard. This system introduced control characters and later would be known as the International Telegraphy Alphabet 2 (ITA2).



### **Aircraft Marshalling Signals**

## International Civil Aviation Organization, 1955

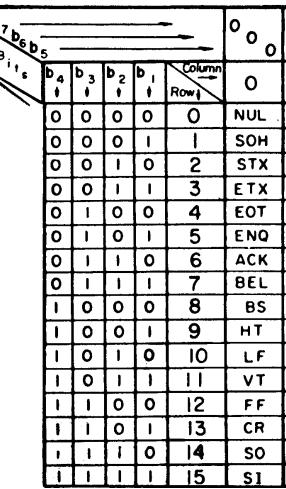
Specific movement system of signals that one must perform to direct the flight crew of an aircraft.



## ASCII

### **American Standards Association**, 1963

The American Standard Code for Information Interchange is a 7-bit character encoding system based on the order of the English alphabet.



°°,	0   0	0   	<sup>1</sup> 0 <sub>0</sub>	<sup>1</sup> 0	1 1 0	1 1
ł	2	3	4	5	6	7
DLE	SP	0	0	Р	Ň	р
DC1	!	1	A	Q	0	P
DC2	01	2	B	R	Þ	r
DC 3	#	3	C	S	С	5
DC4	\$	4	D	Т	d	t
NAK	%	5	E	U	e	U
SYN	8	6	F	V	f	V
ETB		7	G	¥	g	W
CAN	(	8	н	X	h	x
EM	)	9	1	Y	i	У
SUB	*	:	J	Z	j	Z
ESC	+	;	к	C	k j	(
FS	•	<	L	\ \	l	1
GS	-	ŧ	М	כ	m	}
RS	•	>	N	^	n	$\sim$
US	1	?	0		0	DEL

**USASCII** code chart

### **ISO/IEC 8859**

## **European Computer Manufacturer's Association, 1986** A universal standard for codepages and 8-bit character encodings. It later grew to 16 codepages covering all Latinbased scripts and more.

	-0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-A	-B	-C	-D	-E	-F
0-		0001	0002	0003	0004	0005	0006	0007	0008	0009	000A	000B	0000	000D	000E	000F
1-	0010	0011	0012	0013	0014	0015	0016	0017	0018	0019	001A	001B	001C	001D	001E	001F
2-	0020	0021	<b>11</b> 0022	<b>#</b> 0023	\$	% 0025	& 0026	<b>1</b> 0027	(	)	* 002A	+ 002B	<b>9</b> 002C	- 002D	• 002E	/ 002F
3-	0	1	2	3 0033	<b>4</b>	5 0035	6 0036	7 0037	8 0038	9 0039	003A	, 003B	< 003C	= 003D	> 003E	2003F
4-	0030	A 0041	<b>B</b> 0042	C 0043	D 0044	E 0045	<b>F</b> 0046	G	0038 H 0048	I 0049	<b>J</b> 004A	0048	L 004C	004D	N 004E	003F
5-	Р	<b>Q</b> 0051	R	S	Т	U	V	W	X	Y	Z	[	1	]	^	_
6-	0050	a	0052 b	0053 C	0054 <b>d</b>	0055 e	0056 f	0057 g	0058 h	0059 i	005A j	005B	005C	005D	005E	005F
7-	0060 P	0061 <b>Q</b>	0062	0063 S	0064	0065 U	0066 V	0067 W	0068 <b>X</b>	0069 <b>y</b>	006A Z	0068 {	0060	006D	006E	006F
8-	0070	0071	0072	0073	0074	0075	0076	0077	0078	0079	007A	007B	007C	007D	007E	007F
9-	0080	0081	0082	0083	0084	0085	0086	0087	0088	0089	008A	008B	008C	008D	008E	008F
A-	0090	0091	¢	£	0094 X	0095 ¥	0096	0097 §	••	0099	008A <u>a</u>	∞		009D	R	009F
В-	00A0 O	00A1	00A2 2	00A3 3	00A4	00A5 µ	00A6	00A7 •	۵۵۸۵ د	00A9 1	00AA <u>0</u>	00AB	00AC	00AD	00AE	00AF
- C-	À	оов1 Á	Â	OOB3	0084 Ä	Å	Æ	0087 Ç	оова È	оовэ É	OOBA Ê	оовв <b>Ё</b>	oobc Ì	oobd Í	oobe Î	оовғ <b>Ї</b>
D-	00C0 Đ	00C1 Ñ	00C2	00C3	Ô	00C5 Õ	Ö	300C7	ooca Ø	<sup>00C9</sup> Ù	00CA Ú	00CB	oocc Ü	oocd Ý	DOCE	DOCF
E-	òodo à	00D1	00D2	00D3 ã	00D4	oods å	00D6 æ	00D7	õoda è	00D9 é	00DA ê	оорв <b>ё</b>	oodd Ì	oodd Í	00DE	00DF
<b>C</b> -	00E0	00E1	00E2	00E3	00E4	00E5	00E6	00E7	00E8	00E9	00EA	00EB	00EC	00ED	00EE	00EF
F-	ð 00F0	$\mathbf{\tilde{n}}_{_{00F1}}$	<b>Ò</b> 00F2	Ó 00F3	<b>Ô</b> 00F4	Õ 00F5	Ö 00F6	00F7	Ø 00F8	ù 00F9	<b>Ú</b> 00FA	û 00FB	<b>ü</b> 00FC	ý <sub>oofd</sub>	<b>b</b> DOFE	ÿ

### Unicode

Joe Becker & Lee Collins, 1987 Character encoding standard that supports the unification of prior character sets as well as character for writing.

00	01	02	03	04	05	06	07	08	09	0A	0В	0C	0D	0E	0F
10	11	12	13	14	15	<b>1</b> 6	17	18	19	1A	18	10	1D	16	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	зА	зв	зс	ЗD	ЗE	ЗF
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
60	61	62	63	64	65	66	67	68	69	6A	6B	бC	6D	6E	6F
70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F
80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
90	91	92	93	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F
Α0	Al	A2	AЗ	A4	A5	AS	A7	A8	A9	AA	А <mark>В</mark>	AC	AD	AE	AF
во	81	В2	вз	В4	в5	B6	B7	в8	В9	ВA	вв	вс	вD	BE	BF
C0	сı	C2	СЗ	C 4	С5	C6	с7	C8	C9	CA	СВ	cc	CD	CE	CF
DO	Dl	D2	DЗ	D 4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF
EO	El	E2	EЗ	E4	E5	E6	E7	E8	E9	ΕA	EВ	ЕC	ED	EE	EF
FO	Fl	F2	F3	F4	F5	F6	F7	F8	F9	FA	FB	FC	FD	FE	FF

Latin script Non-Latin European scripts African scripts Middle Eastern and Southwest Asian scripts South and Central Asian scripts Southeast Asian scripts East Asian scripts CJK characters Indonesian and Oceanic scripts American scripts Notational systems Symbols Private use UTF-16 surrogates Unallocated code points

As of Unicode 12.0

### **Character Set Expansions**

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140

### **Character Set Expansions**

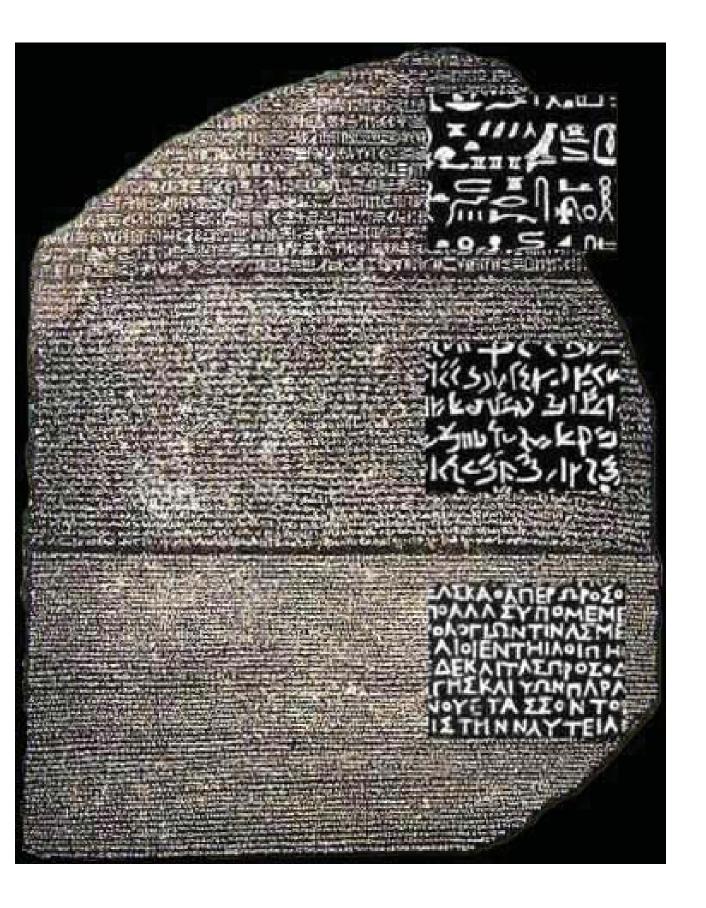
A group of letters, numbers, punctuation, ideograms, and other symbols that together compromise a 'font'.

·										
GRANDI	GRANDE POLICE									
de cene cinquante	milliers de lettres,									
POUR UN CAR	pour un Caractère Grec.									
Lettres fimples.	µ. Mu. 1500									
a Alpha. 3000	» Nu. 5000									
β Béta. 400	E Xi. 800									
6 400	o Omicron.3500									
y Gamma.1500	π Pi. 1000									
5 400	☞ 600									
Г · 200	p Ro. 1500									
o Della. 2000	P 500									
A 300	C Sigma. 300									
E Epfilon. 3800	J 1200									
(Zits. 700	51500									
2 300	T Tau. 2000									
n Éta. 3000	1 1000									
O Thésa. 700	u Upfilon. 3000									
9 800	<b><math>\phi</math></b> Phi. 600									
9 300	φ 400									
1 Iota. 3500	χ Chi. 1200									
x Kappa. 2000	<b>↓</b> <i>Pfi</i> . 800									
λ <i>Lamda</i> . 1600	ω Oméga. 2500									
N										

POURL	E GREC. 249
Capitales.	¥ Pfi. 120
A Alpha. 250	Ω Oméga. 200
B Βέια. 200 Γ Gamma. 200	Esprits & Accens.
Γ Gamma. 200 Δ Delta. 200	<sup>2</sup> Doux. 300
E Epfilon. 250	Doux. 300 Rude. 250
Z Zéla. 100	' Aigu. 300
H Éta. 250	Grave. 250
<i>⊙ Thita.</i> 160 I lota. 260	<sup>≠</sup> Doux aigu. 150 <sup>+</sup> Douxgrave. 100
K Kappa. 120	d Rude aigu. 80
A Landa. 200	* Rude grave. 70
M Mu. 200	Circonflexe. 200
N Nu. 200 Z Xi. 150	<sup>a</sup> Circ. doux. 50
Z. Xi. 150 O Omicron. 250	<sup>«</sup> Circ. rude. 50 " Tréma. 30
П Рі. 200	<sup>1</sup> Tréma aigu. 25
P Ro. 200	<sup>1</sup> Tréma grave. 20
Σ Sigma. 200 Τ Ταμ. 200	Lettres accentuées.
Τ Ταυ. 200 Υ Upfilon. 240	a.
Φ Phi. 120	a 500
X Chi. 200	å 400

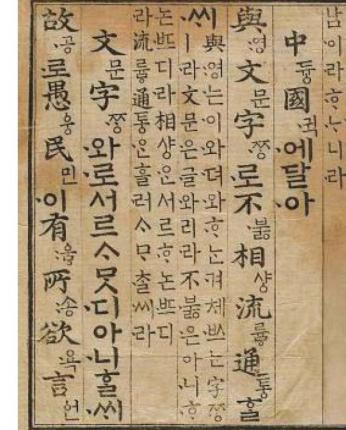
### **Similar Mixed Texts**

**Rosetta Stone**, **196 BC** The Stone is written in two languages; Egyptian and Greek and contains three writing systems; hieroglyphic, demotic, and Greek. This was intended so that all people could read and understand the content.



### **Chinese Characters**

*Hunminjeongeum*, 1446 A new alphabet created by King Sejong of Korea, known as hangul, that incorporated hanja characters within the new language.



E

### Latin and Greek

### Helvetica Greek, 1971 Designed as a phototype by Matthew Carter, Helvetica Greek marked the beginning of a period in type development for Greek letters.

Helvetica Greek (8 pt font) ΑΒΓΔΕΖΗΘΙΚΛΜΝΞ ΟΠΡΣΤΥΦΧΨΩ αβγδεζηθικλμνξοπρςσ τυφχψω 1234567890

Helvetica Greek Inclined (8 pt foni) ΑΒΓΔΕΖΗΘΙΚΛΜΝΞ ΟΠΡΣΤΥΦΧΨΩ αβγδεζηθικλμνξοπρςσ τυφχψω 1234567890

Helvetica Bold Greek (8 pt font)

### ΑΒΓΔΕΖΗΘΙΚΛΜΝΞ ΟΠΡΣΤΥΦΧΨΩ αβγδεζηθικλμνξοπρςσ τυφχψω 1234567890

Helvetica Bold Greek Inclined (8 pt font)

ΑΒΓΔΕΖΗΘΙΚΛΜΝΞ ΟΠΡΣΤΥΦΧΨΩ αβγδεζηθικλμνξοπρςσ τυφχψω 1234567890

Βάσιμοι πληροφορίαι και αύθεντικά δεδομένα ώς πρός την πρόοδον καί οίκονομικότητα της στοιχειοθετήσεως διά φωτογραφήσεως άποτελούν σπουδαιοτάτας προϋποθέσεις δι' έπενδύσεις μελλοντικού προσανατολισμού.

Βάσιμοι πληροφορίαι και αύθεντικά δεδομένα ώς πρός την πρόσδον καί οίκονομικότητα τής στοιχειοθετήσεως διά φωτογραφήσεως άποτελοῦν σπουδαιοτάτας προύποθέσεις δι' έπενδύσεις μελλοντικού προσανατολισμού.

Βάσιμοι πληροφορίαι και αύθεντικά δεδομένα ώς πρός τήν πρόοδον καί οίκονομικότητα τής στοιχειοθετήσεως -υοπο νῦολατοπό χωασήφεογοτωφ ἀιδ δαιοτάτας προϋποθέσεις δι' ἐπενδύσεις μελλοντικού προσανατολισμού.

Βάσιμοι πληροφορίαι και αύθεντικά δεδομένα ώς πρός την πρόοδον καί οίκονομικότητα τῆς στοιχειοθετήσεως διά φωτογραφήσεως άποτελοῦν σπουδαιοτάτας προϋποθέσεις δι' ἐπενδύσεις μελλοντικού προσανατολισμού.

#### Latin and Hebrew

**Oron, 1966 Designed by Asher Oron, this** typeface was the Hebrew companion to Univers.

#### אבגדהוזחטיכלמנסעפצקרשת רְםןרְץ abcdefghijklmnopqrstuvwxyz 4

#### **Pan-European Accent Sets**

#### **Times New Roman Basic Latin and Latin 1**

abcdefghijklmnopqrstuvwxyz

àáâãäåæçèéêëìíîiñ

ðòóôõöøùúûüýþÿ

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# ABCDEFGHIJKLMN **OPQRSTUVWXYZ** ÀÁÂÄÄÅÆÇÈÊËÌÍÎÏĐÑ ÒÓÔÕÖØÙÚÛÜÝÞß

#### **Japanese Characters**

The Japanese writing system consists of three separate alphabets, Kanji, Hiragana and Katakan. Kanji is used for regular Japanese words, Hiragana is to write foreign loan words and sounds, and Hiragan is used for grammatical purposes and simple words.



#### **Non-Latin Character Sets**

### Lucida Sans Unicode, 1993 Typeface which contained Latin, Cyrillic, Greek and Hebrew characters in hope to be used as a default core font for different operating systems and languages.

ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 1234567890 !@#%^&\*()\_+-=[]{};:'"\|/.,

# АБВГДЕЖЗИКЛМНОПРСТУФХЦЧШЩЬЫЪЭЮЯ абвгдежзиклмнопрстуфхцчшщьыъэюя

### **Bitmaps Paired with Outlines**

#### Lucida, 1984

**Designed by Charles Bigelow and** Kris Holmes, to show that original digital designs could be effective and successful.



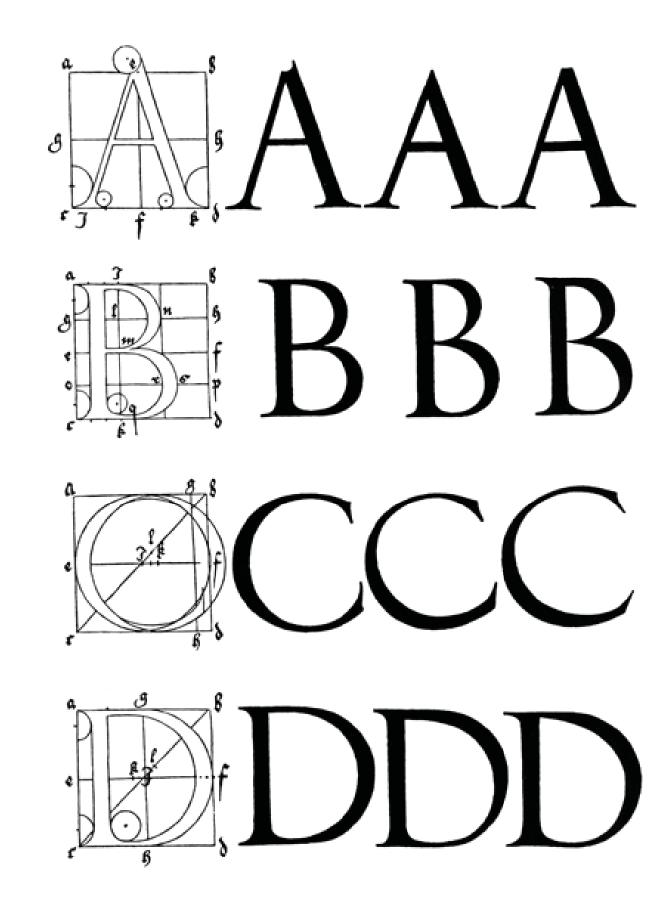
#### **Programmatic Descriptions**

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150

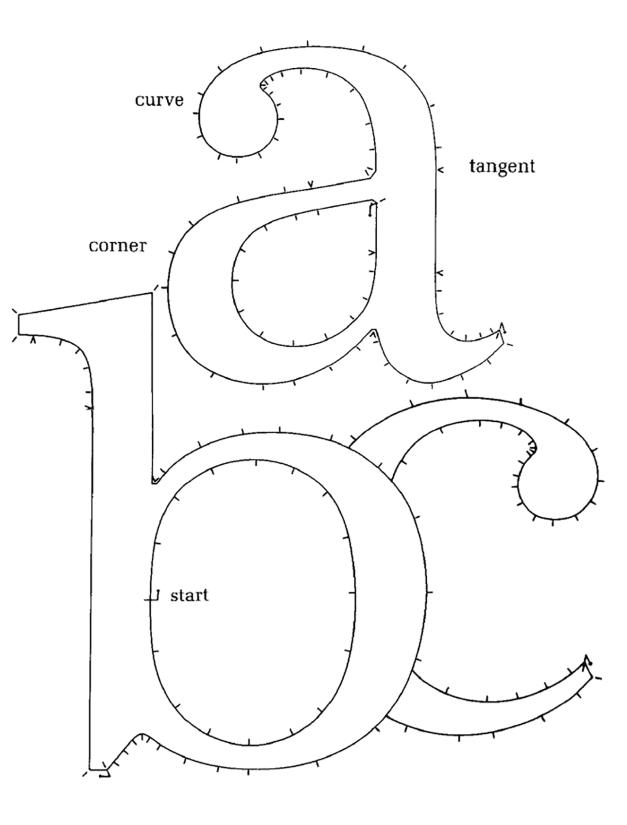
#### **Construction of Roman Letters**

Albrecht Dürer, 1525 His typographic guide, *Underweysung der Messung mit dem Zirckel und Richtscheyt*, detailed how his Roman typeface is based on mathematical principles.



#### Ikarus

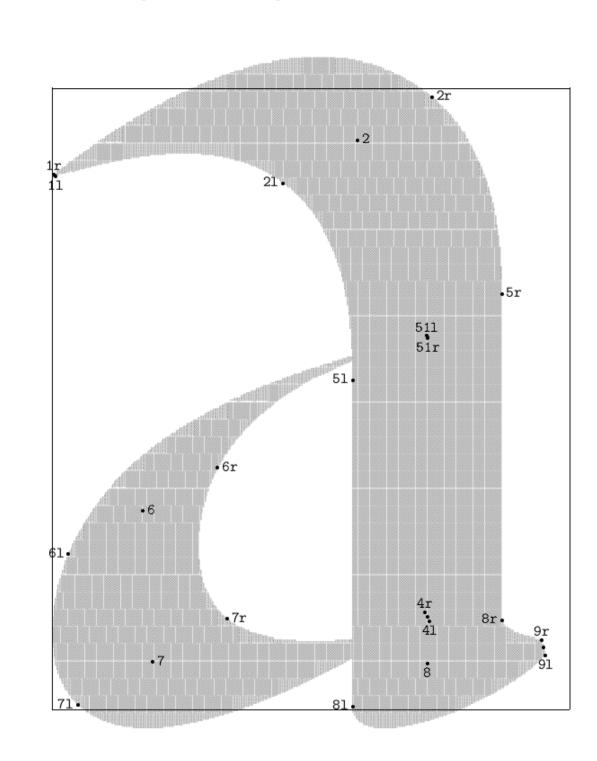
### **Peter Karow, 1975** Type design and production software used for converting existing typefaces and artwork into a digital.



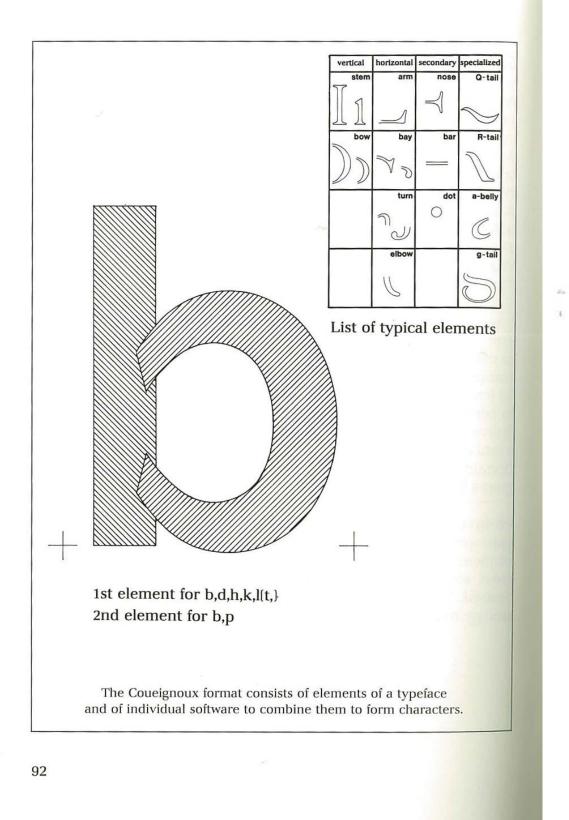
#### Metafont

**Donald Knuth, 1979** 

A programming language used to define vector fonts and created as a companion to the TeX typesetting system.



METAFONT output 2012.05.07:1838 Page 1 Character 97



# SSSSS

FIGURE 12. Different S's obtained by varying the slope in the middle. (This shows  $\frac{1}{2}$ ,  $\frac{2}{3}$ ,  $\frac{3}{4}$ , 1,  $\frac{4}{3}$ ,  $\frac{3}{2}$ , and 2 times the "correct" slope.)

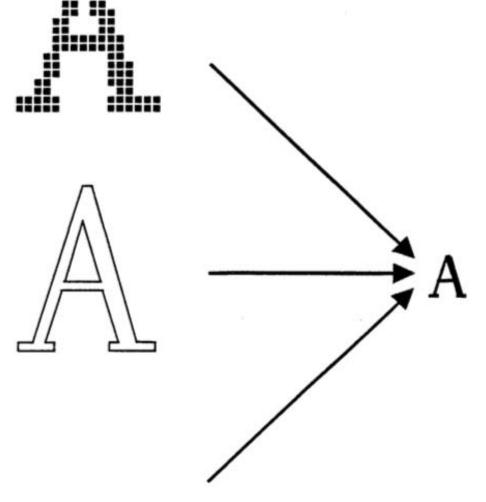


#### Interpress

### Xerox PARC, 1983 Xerox's commercial page description language which encoded printer output. Each character is defined in a character coordinate system.

pictorial

geometric



textual

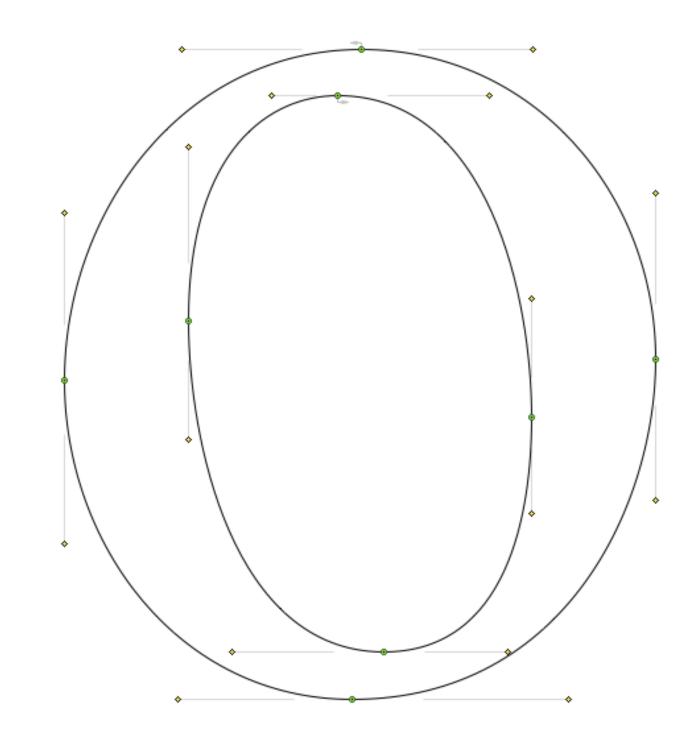
Figure 1.4. Three ways of printing the letter "A" on a page

'The 65th character in the font named Times Roman 10"

#### **PostScript**

#### Adobe, 1984

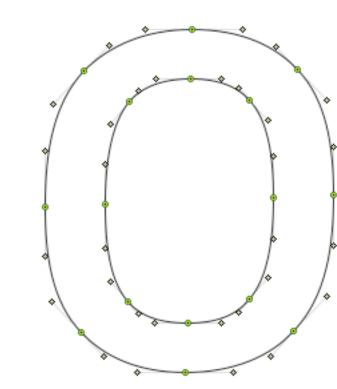
Type 1 PostScript included support for hinting to help low resolution rendering which used cubic Bézier curves to communicate complex graphic printing instructions to digital printers.

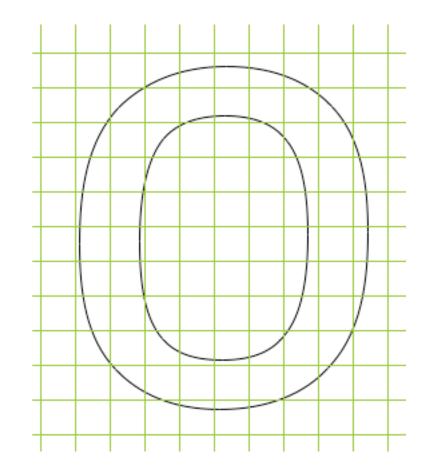


### TrueType

#### **Apple, 1991**

A competitor to PostScript, it offered type developers pixellevel control of how fonts were displayed at various sizes based on a robust hinting system from outlines.





#### **Adobe's Multiple Master Fonts**

#### Adobe, 1991

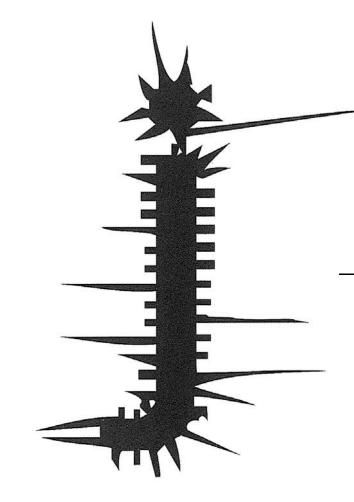
Fonts which contain two or more 'masters' and enable a user to interpolate between them along a continuous range of 'axes'.

Semi- extended	limit	limit	limit	limit	limit	limit	limit	limit	limit
extended	limit	limit	limit	limit	limit	limit	limit	limit	limit
	limit	limit	limit	limit	limit	limit	limit	limit	limit
Normal	limit	limit	limit	limit	limit	limit	limit	limit	limit
-	limit	limit	limit	limit	limit	limit	limit	limit	limit
	limit	limit	limit	limit	limit	limit	limit	limit	limit
Condensed	limit	limit	limit	limit	limit	limit	limit	limit	limit
l	Light		Regular		Semibold		Bold		Black
					Weight				

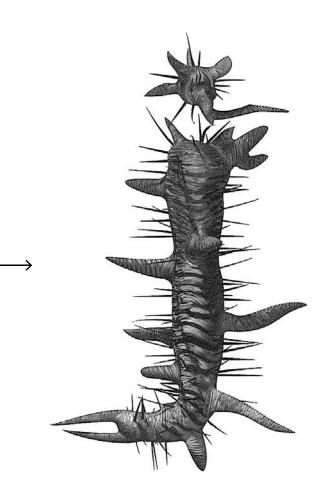
#### **Randomness Within Fonts**

#### Rhizome, 1996

A dimensional typography set designed by Guy Williams that interprets the silhouettes of font, *Jesus Loves You,* and creates it in to a botanical motif.

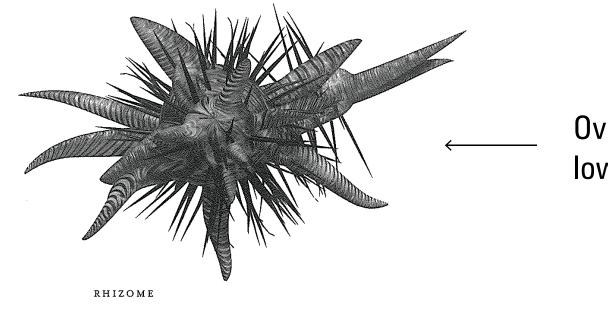


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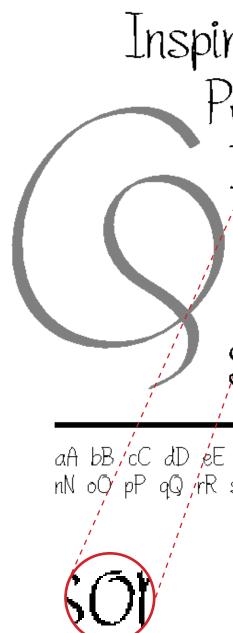


JESUS LOVES YOU Designed by Lucas de Groot in 1995, the font Jesus Loves You, and its companions, Jesus Loves Your Sister and Jesus Loves Your Brother exhibit an agitated crownof-thorns-like complexity.

## Overhead view of the lowercase letter j

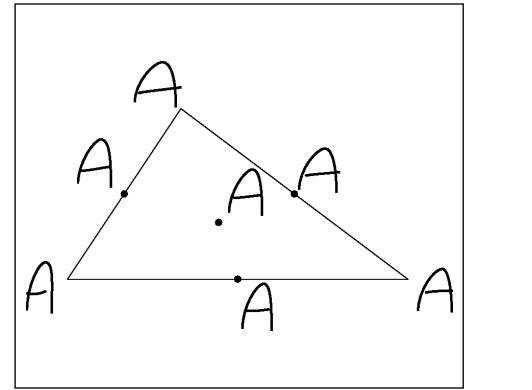
#### **Random dynamic fonts**

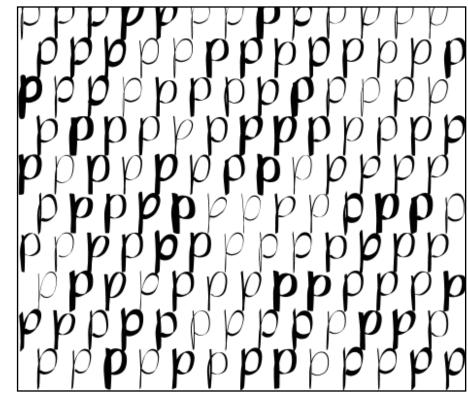
**Bernard Desruisseaux**, 1996 A thesis which set out to prove that one could build a font in which all glyphs were changed randomly, while controlling the randomness by parameters. Its six major axes create subtle changes in the glyphs.



Inspiring lypeface Personal Dynamic Feel aA bB, cC dD , eE fF gG bH iI jJ kK IL mM nN oQ pP qQ , rR sS, tT uV wW xX yY zZ

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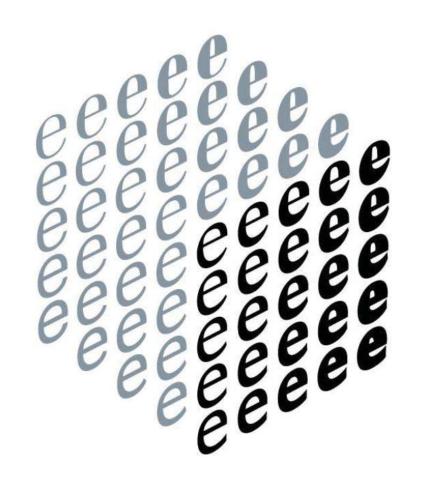


This is Bernard Desruisseaux's type 3 font. Enjoy. This is Bernard Desruisseaux's type 3 font. Enjoy. This is Bernard Desruisseaux's type 3 font. Enjoy. This is Bernard Desruisseaux's type 3 font. Enjoy.

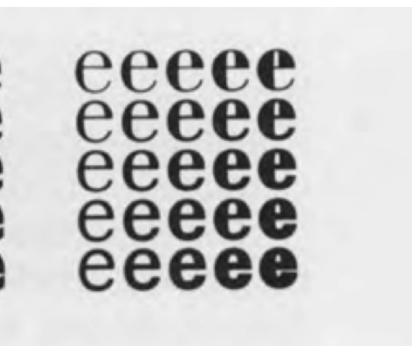
### The Gerrit Noordzij Cube

**Gerrit Noordzij, 1985** Introduced in his book, *The Stroke: Theory of Writing*, Noordzij created his cubic visualization of translation, expansion and contrast of letters in typography.



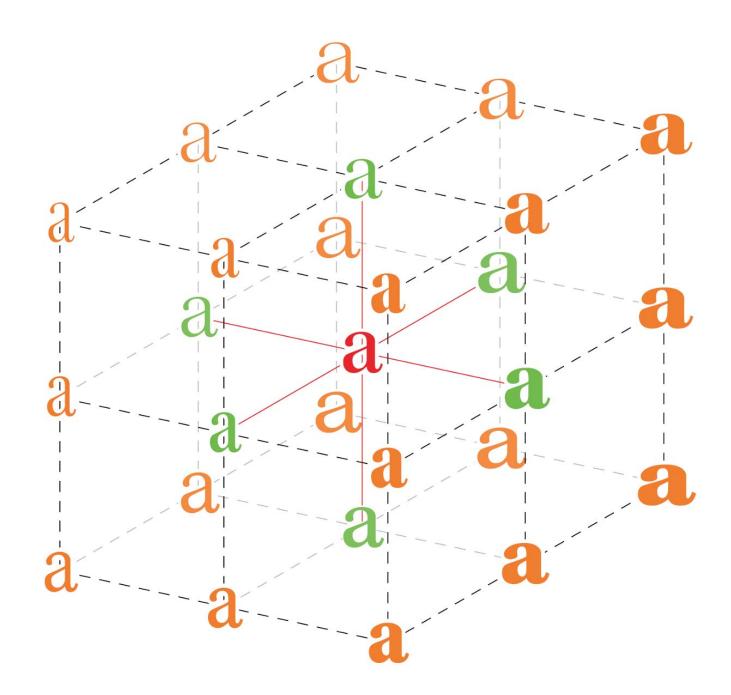


#### eeeee eeeee



#### **Variable Fonts**

**OpenType 1.8, 2016** An extension of OpenType, variable fonts are a single digital file that can produce a multitude of style variants. Developed by Google, Apple, Microsoft and Adobe, variable fonts offer flexibility and responsive typography.

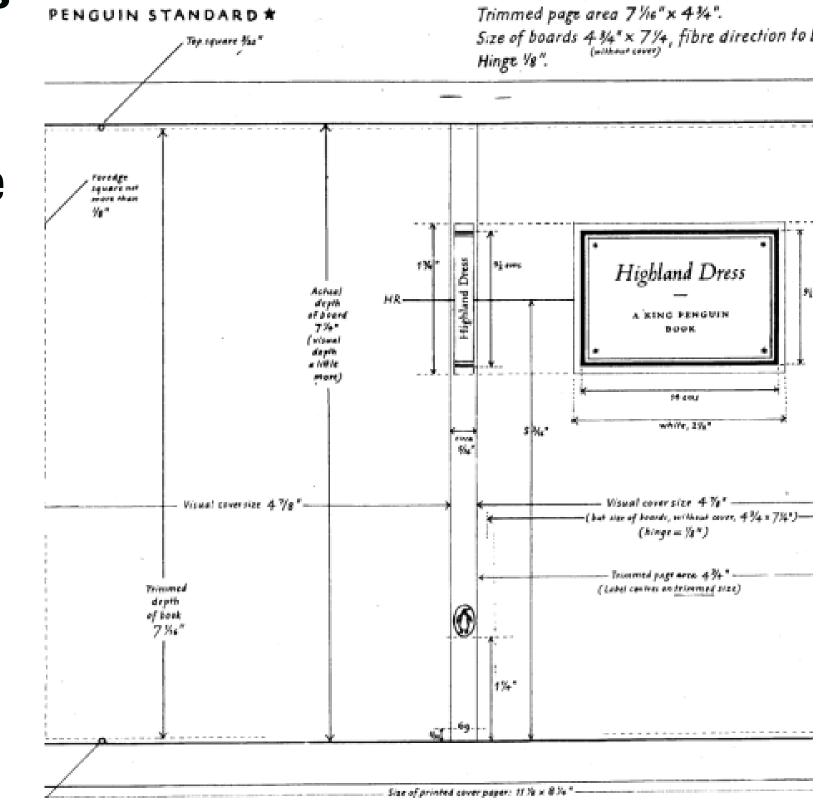


#### Design systems as **typography**.

166

### **Penguin Books Composition Rules**

**Jan Tschichold**, 1947 Guidelines used for composing the pages and typography which later influenced its graphic standards.



#### Smithsonian Magazine

**Bradbury Thompson**, 1969 Thompson created the layout for the magazine and his design remained for more than a quarter of a century.

#### April 1989

#### Smithsonian

Volume 20, Number 1

#### Table of Contents

- Cover: Detail from Benton's 1956 Old Kansas City (Trading at Westport Landing). One of a series of historical murals, it was made for the River Club, which stands where explorers Lewis and Clark once encamped (p. 82) From a private collection
- 12 Smithsonian horizons by Secretary Adams
- 16 Letters to the Editor Picture credit.
- 24 Around the Mall and beyond by Eric Dinerste 32 Phenomena, comment and notes by John P. Wiley jr.
- 40 Hong Kong lives lavishly-on borrowed time In the money-driven Crown Colony, hope balances fear as residents brace for the coming of Communist rule By Stanley Karnow
- nters of the brown bear kind 56 Close enco At Alaska's McNeil sanctuary, Larry Aumiller teaches bruins and humans to mind their manners and get along Article and photographs by Boyd Norton
- 66 Is there anything Gordon Parks can't do?
- 82 Thomas Hart Benton's appetite for America In the artist's realistic portravals of regional life, folks found something controversial By Verlyn Klinkenborg
- 102 John Dobson, the celestial Pied Piper Teaching people how to build their own cheap, simple big telescopes, he revolutionized amateur astronomy By Don Moser, photographs by Roger Ressmeyer

114 Since 1789 we've been 'calling in the marshals' As these versatile federal agents mark two centuries of law enforcement, they're still standing tall By Donald Dale Jackson

130 For Russian Orthodoxy, a hands-on revival Visiting the USSR, the author meets with artists who are restoring and re-creating icons, frescoes, churche By James H. Billington, photograp

147 Carry Nation did more than Just Sa More radical than chic, she smashed igars from men's mouths and foug By Robert Day

- 166 Book reviews 174 Additional reading
- 176 April events at the Smithsonian

182 Smithsonian tours, seminars and ex 184 'He welted the sphere a prodigious By Donald Dale Jackson

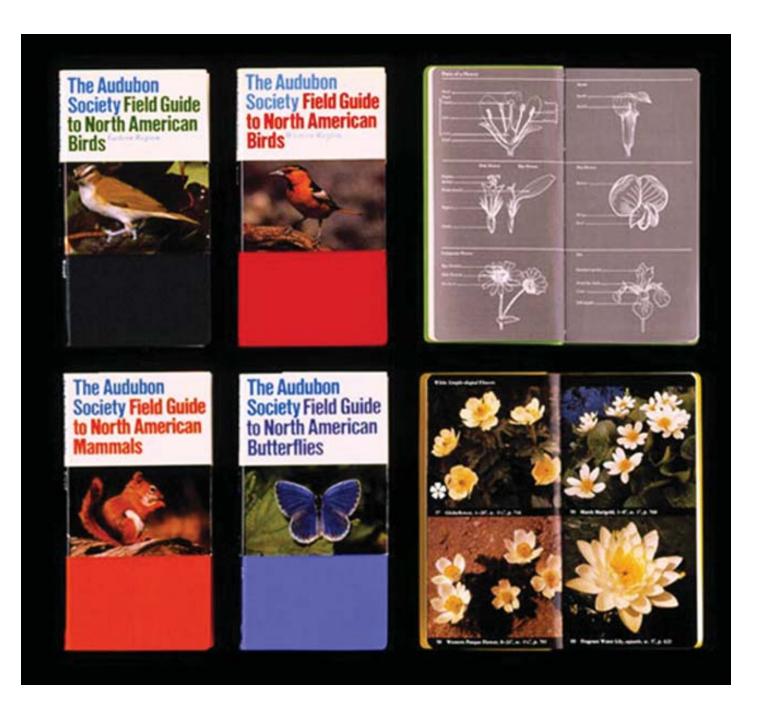
- Photographer, composer, writer of prose and poetry, film director, ballet creator . . . but wait, he's only 76 By Deedee Moore

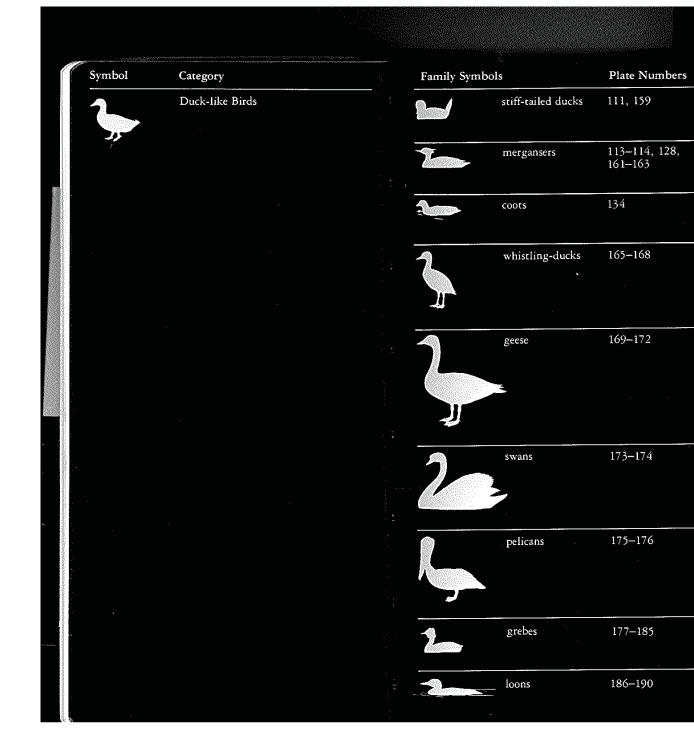


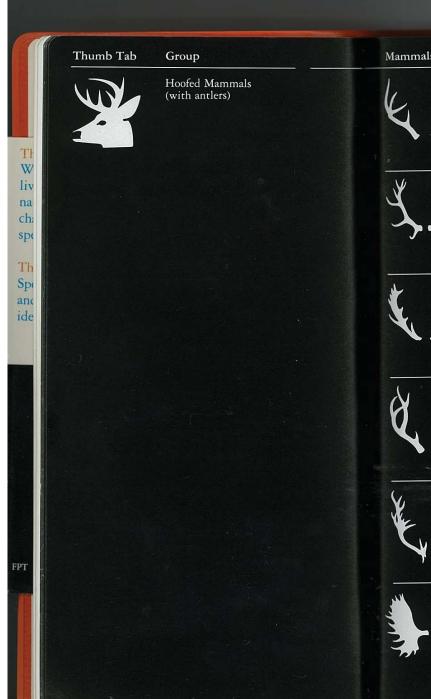


#### The Audubon Society Field Guides

Massimo Vignelli, 1977 A series of books which followed a design system to keep a uniform look.

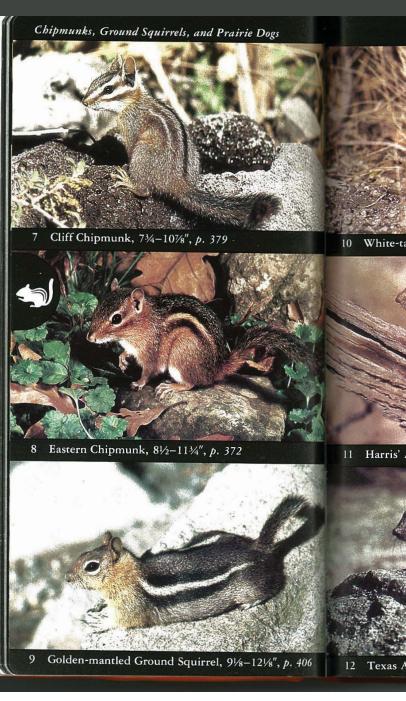






lls		Plate Numbers	
للخبر	white-tailed deer	285, 286	
Ł	elk	287	
J	fallow deer	288	
لللر	mule deer	289	
	caribou	290	
	moose	291	



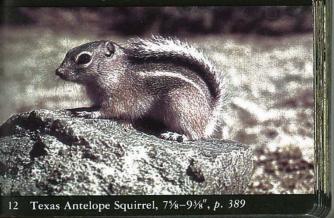




10 White-tailed Antelope Squirrel, 75/8-93/8", p. 389

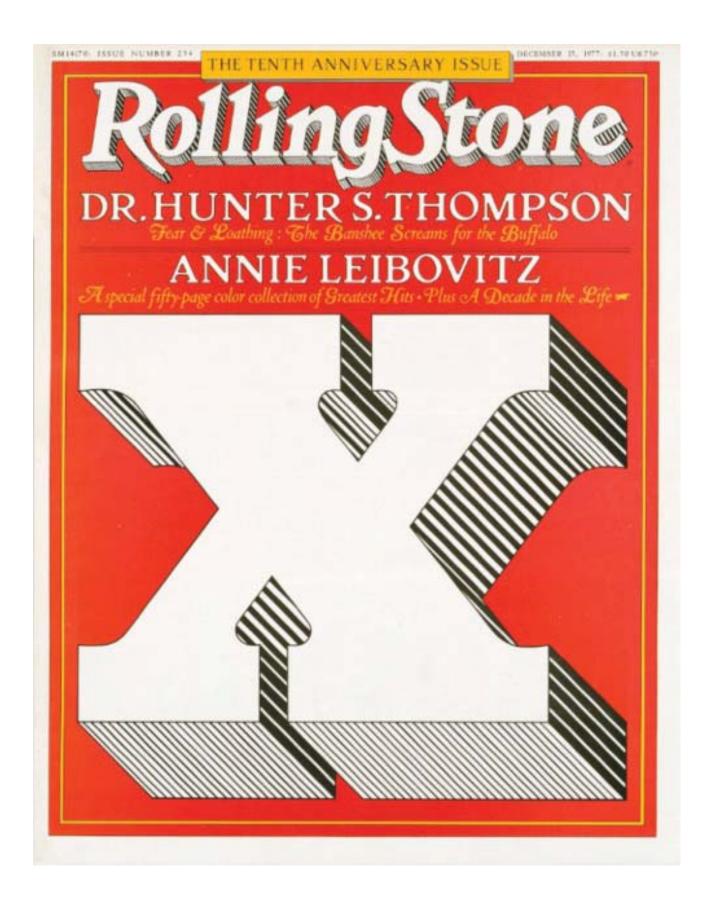


11 Harris' Antelope Squirrel, 8<sup>3</sup>/<sub>4</sub>-9<sup>3</sup>/<sub>4</sub>", p. 388

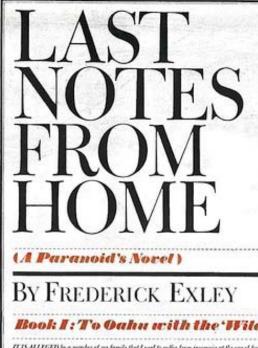


#### **Rolling Stone**

**Roger Black, 1970's** Established a typographical identity and established the magazine's look of taking the underground to mainstream media.







#### Book II: To Oahn with the Wild Geese'

I HAVE SEEN the hippoptaneous, both astrop and marke; and I can amore you that, marke or writep, he is the agricat of the works of Gol. But you react loar of my triangles. Thathermy scenars that he was equalwars and considers of the provided errot of usy My. Two descriptions of the pair that descriptions and are strained of the product and prime as to the mid-aoth Century America and prime as the mid-aoth Century America and prime as to the mid-aoth Century America and prime as the mid-aot see Bilemith, they left him in the very moment at which he was about to display himself -but spare my molesty. Law with for robing more or sorth, now that Madame Turanad, in whose Paulteren Lieped over for a place, is deed. — Turanan Basisceren Macsatar in Turanan Fromex Faris

T SEVEN IN THE MOBNING I GO TO OANU. What was going to be a few jolly days of imbibing and, bopefully, copulating with heartbreakingly beautiful Eur-anian girls (I was observed with Ioin fantasies of Tabitian anian girls (I was observed with Ioin fantasies of Tabitian amon girls (1 was observed with hoin fantancies of Tabitian nyruphets) has turned into a deathwarks. My older borcher fäll, with whom 1 was one day hoping to spend these larksome days, is dying of a particularly virulent form of cancer, one that begins in the caccum-a pusch of "blind gut" lying between the large and small intentions. Because the caccum opers onto so many of the virul ev-gans, and therefore moves into the lyingh glands with destined the caccum opers of the second second second second second particular the caccum opers onto so many of the virul ev-gans, and therefore moves into the lyingh glands with

the years being awarded the Silver Star, the I gion of Merit, the Beonre Star Medal, the Jo Services Commendation Medal, and two Pun Hearts. He rose steadily from the rank of priva and I used to chide him that he'd never know : pose until he got his brigadier's star. Althou in response that invariably grambled Shovit, never denied it.

Convinced at length, however, that the for work involved in promotion above the rank of f hird was more arduous and derious than he car to cope with, that as a high-school graduate co to cope with, that as a ingrisentiate practice practice of peting with his West Point-VMI-Citadel brethr be would, for brigadier, be "passed over one's reti-first time (if one is twice passed over one's reti-ment is, at least tacitly, demanded), he decid to take his retirement in Honolulu where he assigned to the 500th Intelligence Group, t army's top-secret intelligence unit for the ent Pacific.

His plans were to remain permanently Oahu with his arouy-brat wife, the daughter of a other colonel, and his sixteen-year-old son. T Brigadier owns a 100-thousand-dollar home Kailua, a Honolulu suburh on the norther shore of Oahu much favored by the military. nearly as I can determine, he was hiring out to real estate firm to supplement his ample colone pension. He would sell property part time, sit the edge of his kidney-shaped pool sumning his self, drink chilled Olympia (oh-lee) here from t can, and call back the days of sacrifice a daughter, of cannon and carnage, of madner cowardice and heroism. Although I ever-so-el gantly disapproved of it all-and The Brigad damn well knew it (a lot he gave a shit!) - ar there were times when I actually wondered he we could have issued from the same old lad loins within three years of one another, I yet hi hoped that on his retirement I might spend a ye with him at the patio of that blue pool and th Brigadier served in World War H. Korea as Vietnam, and I thought his tale might tell

Alas. The Brigadier and I shall never-at lea together-tell the story of his life.

The Brigadier was not sick. Rather, he was ver sick and did not know it. The physical examin tion for the retiring nilitary is very scrupulou Should a disease or injury incurred during one term of service be detected, it may mean the d ference between one's being retired at full or ha

gans, and therefore moves into the lyingh glands with alarming rapidity, the patient, mercifully, goes wildy, Although years ago I laid on him the cognomen of Brigadier, lift is only a full colonel. The frigadier is a joke we had. Just graduated from Watertown High School, he entered the military at 17 in February 1944; He served in three wars. He was much-decorated, over

One



COPURATE BY DRIDGHT'S, DURY,

#### Design systems as art process.

Dubberly Design Office · Systems Theory in Design-Design Systems · 07 July 2020

174

### **The Nuremberg Chronicle**

### Hartmann Schedel, 1493 One of the most densely illustrated and technically advanced incunables of early printing which contains 1809 images that were made from 645 different woodcut blocks. Certain woodcuts were reproduced more than once for the depiction of different people and cities.

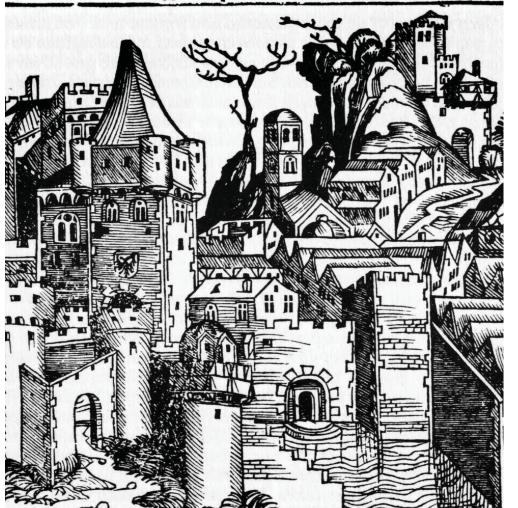














#### **Birds of America**

John James Audubon, 1827–1838 435 life-sized engravings of America's birds which details ornithological importance and history.





Drawn from Nature and Bablished, by John J. Audubon, F.R. S.E., F.L. S., M.W. S.

Nº Z

Engraved, Printed & Coloured by R. Havell & Son, London, 1828





Gellow Red-poll Marthers texense recessarian blietsmale 2. hlemmer gastrelenteken

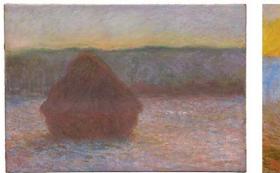
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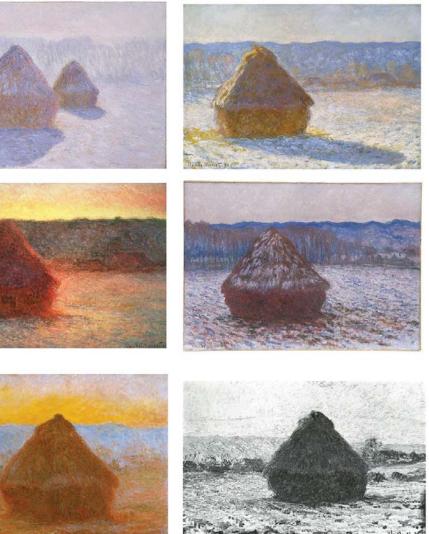


#### Haystacks

**Claude Monet, 1890–1891** A series of 25 impressionist paintings which repeated the same subject in different lighting and atmospheres during various times of day across many seasons.







#### **Rouen Cathedral**

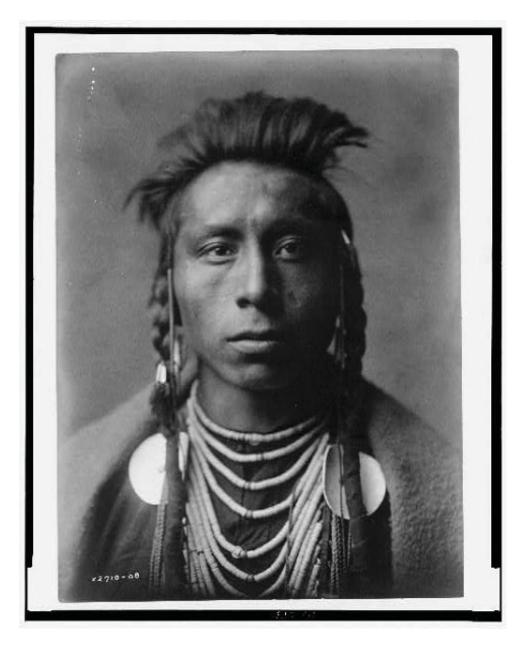
**Claude Monet, 1892–1894** A series of paintings that consisted of more than 30 canvases showcasing the facade of the Gothic Rouen Cathedral during different conditions of light and weather.

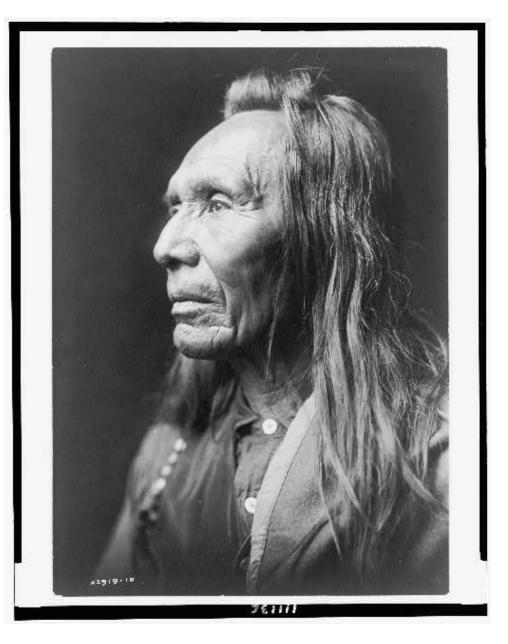


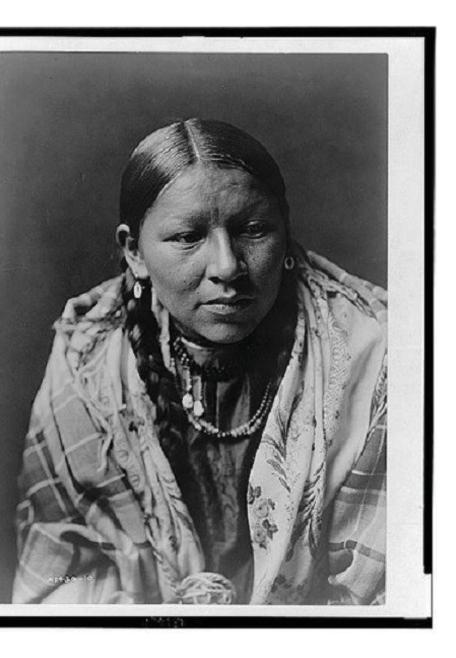
#### The North American Indian

**Edward S. Curtis, 1907–1930** A 20 volume set of portraits, photographs, and ethnographic descriptions of the Native American traditional life.





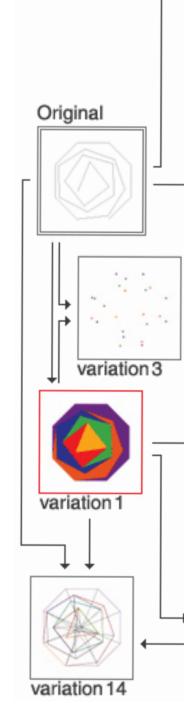


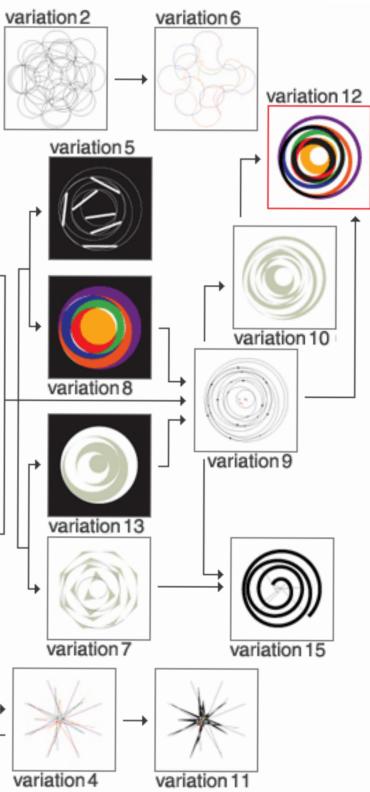


# *Quinze variations sur un même thème*

# Max Bill, 1935–1938

Fifteen variations on a single theme is based on one original drawing as the nucleus of idea and sets the modular rules.

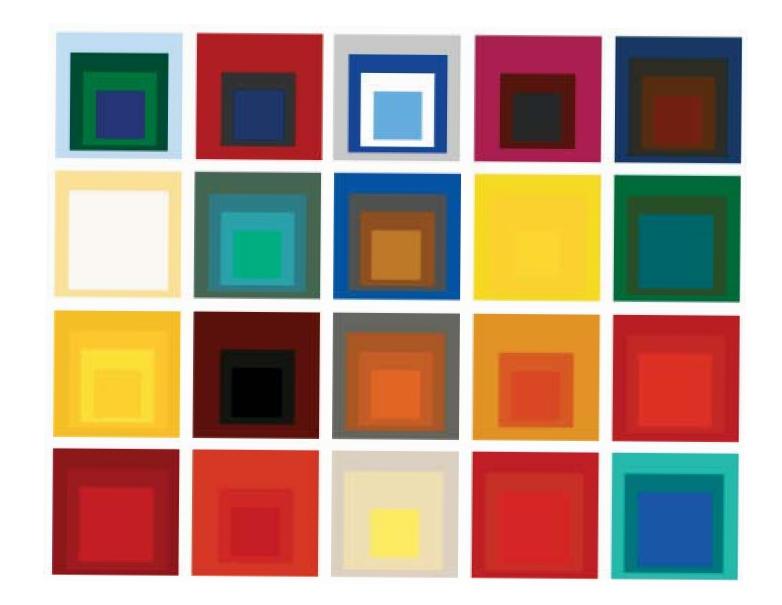




#### Homage to the Square

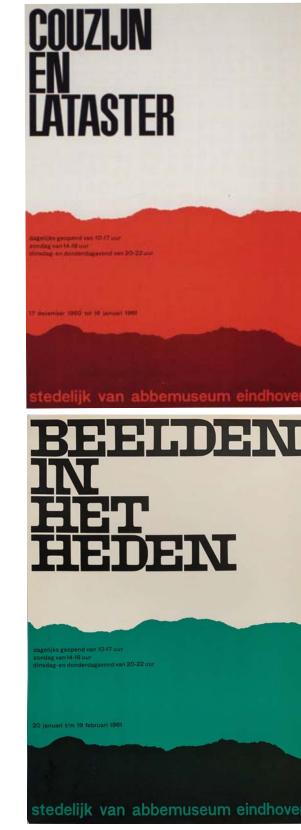
#### Josef Albers, 1950

A geometric abstraction series based on a mathematically determined format of several squares that are overlapping or nested within one another.



# **Stedelijk Museum Posters**

# Wim Crouwel, 1960 Silk-screened posters for group exhibitions at the modern and contemporary art museum of Stedelijk in Eindhoven, Netherlands.



#### hussem en bouthoorn

wart tot 17 april 196

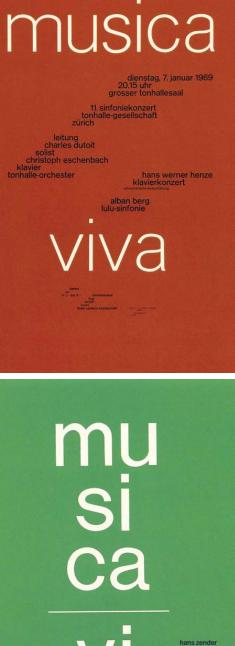
edelijk van abbemuseum eindhove



stedelijk van abbemuseum eindhover

### **Musica Viva**

**Josef Müller-Brockmann, 1969** A series of concert posters for the Zürich Tonhalle that represented the International Typographic Style.



lienstag 1. mai 1971 20.15 uhr prosser tonhallesaal iertes nusica viva-konzert ler ler en seelle-gesellschaft türich eitung nans zender solisten juo kontarsky

schachspiel orchestergru serocki -forte e piano klaviere und luigi dallapicc due pezzi per władimir voge hörformen II für grosses o uraufführung

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2015 art großer torhallesaal X) unforekonzert der torhalle-gesellsch zinchals enstes konzert im musice viva-zykket leitung solistien Maxier torhalte-orchieter vonlatien (is erschatter / vom Richerse

aylophon und kleines orchester sechs stücke für grosses orchester, op. 6



musica viva-konzert donnerstag, 8. januar 1970 20.15 uhr grosser tonhallessaal 12. sinfoniekonzert der tonhalle-gesellschaft zürich ung klaus hi toit list györgy l gel igor strawir rier llo- klaus hi

tür grosses orche 1966-67 ti -atmosphéresy konzert für klavier, blasins kontrabässe und p r -tenebraewiederholung

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#### Incomplete Open Cubes

# Sol LeWitt, 1974

An arithmetic concept that identifies all variations in which a cube can be incomplete. The titles explain where each piece falls in the schematic progression.



# **Cubic Limit I**

# Manfred Mohr, 1973–1976 A pioneer of digital art, his work consists of computer generated algorithmic geometry. He dubbed the phrase 'programmed expressionism' through his abstract computer drawings.



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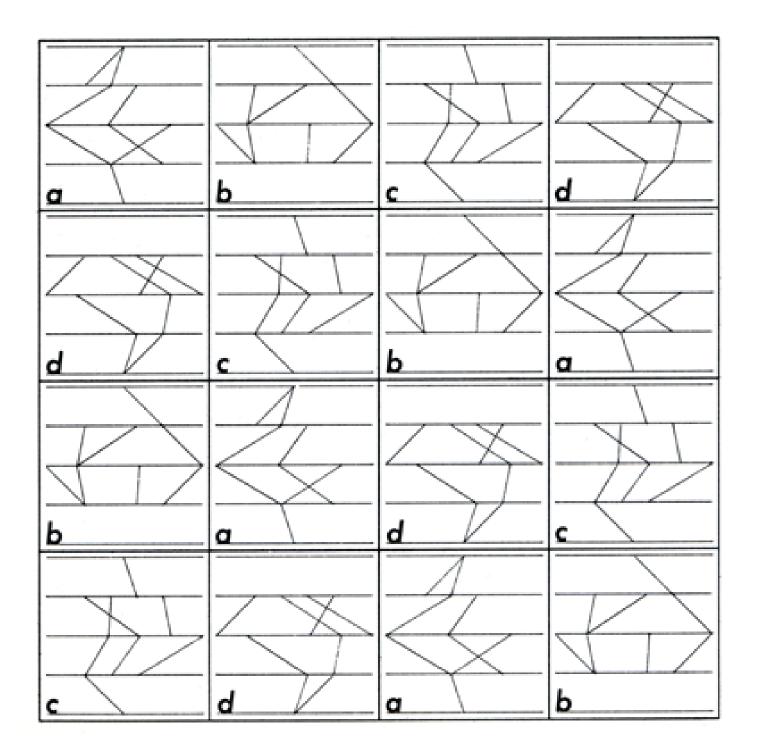
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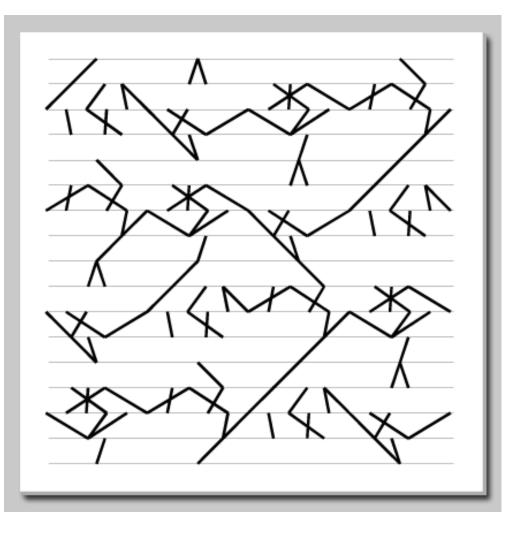
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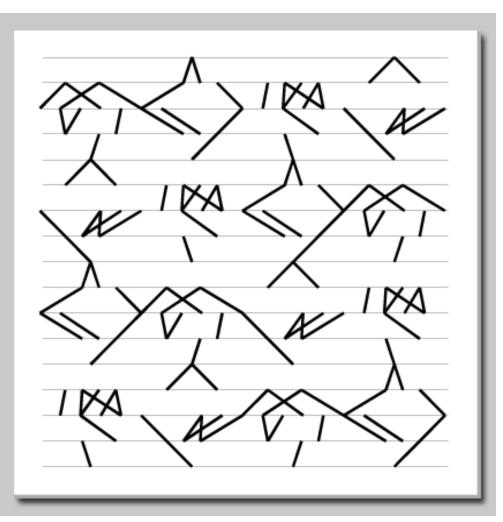
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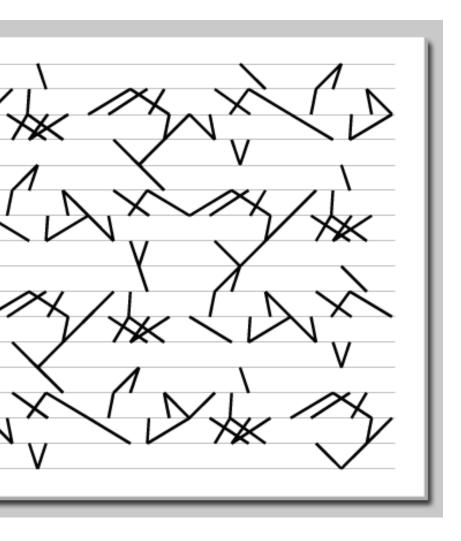
# **Dimensions** I

**Manfred Mohr, 1977–1979** Based on the graph of a 4-Dimensional hyper-cube as the basic generator of signs. It is a representation of showing relationships between points, lines, squares and cubes in this structure.





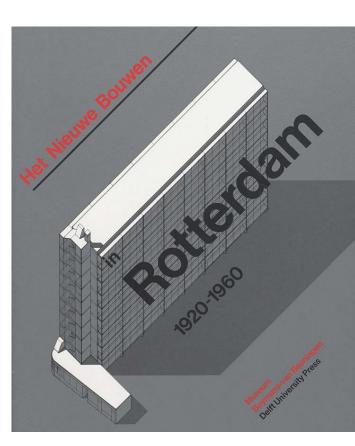


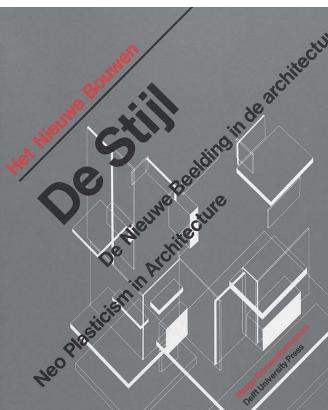


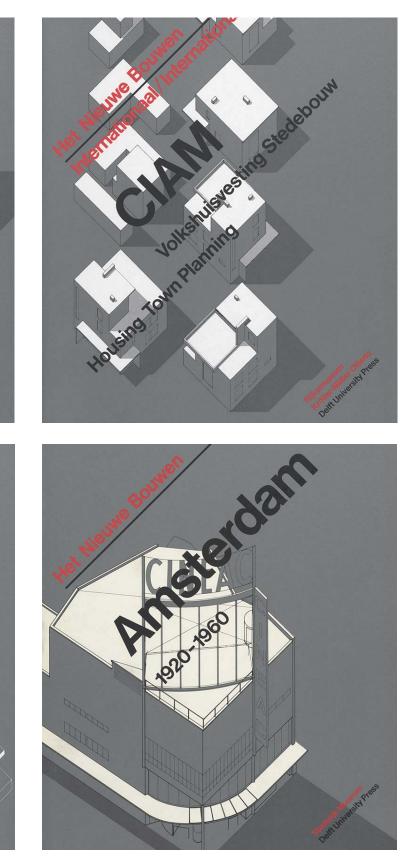
# Het nieuwe bouwen Series

### Wim Crouwel, 1982–1983

Crouwel's artwork was used for both posters and book covers to accompany a series of exhibitions on architecture across various museums.





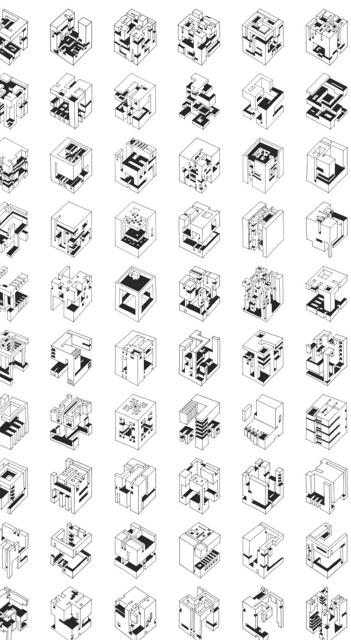


#### **100 Restless Cubes**

# Atelier Reza Aliabadi, 2012

A space-making exercise which consisted of drawing different isometric cubes with only the operation of subtraction to create a family of variations.

https://www.youtube.com/watch?v=GClrb7mCm54&feature=youtu.be https://www.behance.net/gallery/84546847/100-Restless-Cube

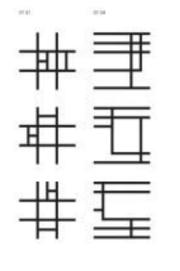


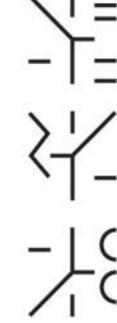
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# Phantasmagorias: Daydreaming with Lines

# Willi Kunz, 2017

A documentation of his creative thoughts, Kunz is inspired by alphanumeric characters, symbols and geometric elements. He produces three aesthetically connected line drawings defined by dimensions of a square.





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#### Design systems as artifact.

Dubberly Design Office · Systems Theory in Design-Design Systems · 07 July 2020

197

#### Design systems as **toys**.

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#### **Froebel Blocks**

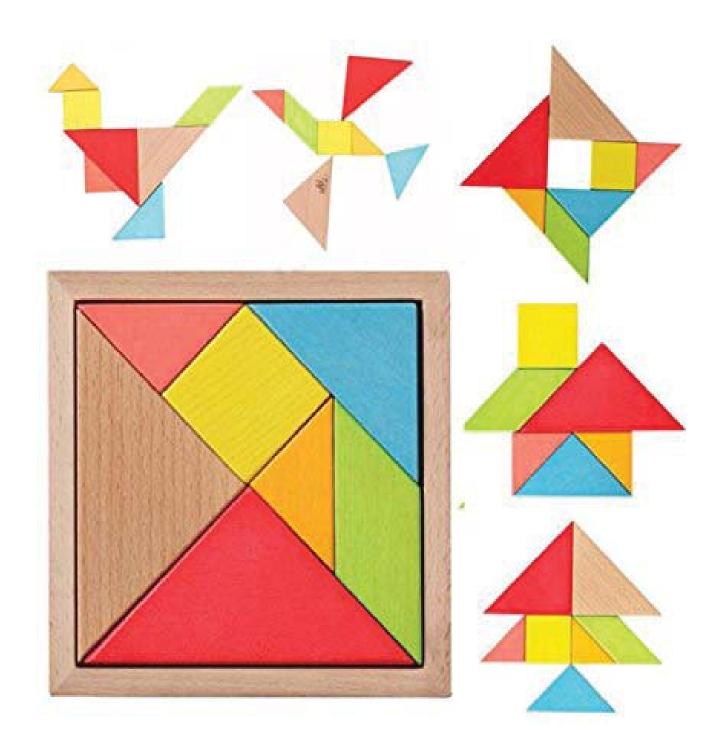
**Friedrich Fröebel, early 1800's** Educational toys that were created in a series system to expand child brain development and creativity.



# Tangram

# China, early 1800's

A dissection puzzle formed from seven polygons used to create specific shapes which was popularized in the early 19th century.



#### **Meccano Kit**

Frank Hornby, 1898 Construction set that explored the principles of mechanical engineering through interchanging components.



#### **Erector Set**

# Alfred Carlton Gilbert, 1913 Educational toy encouraging constructive instincts through both static and dynamic structures.



### **Tinker Toys**

### Charles H. Pajeau & Robert Petit, 1914

Set of rods and spools that exercised spatial intelligence based on the Pythagorean theorem.



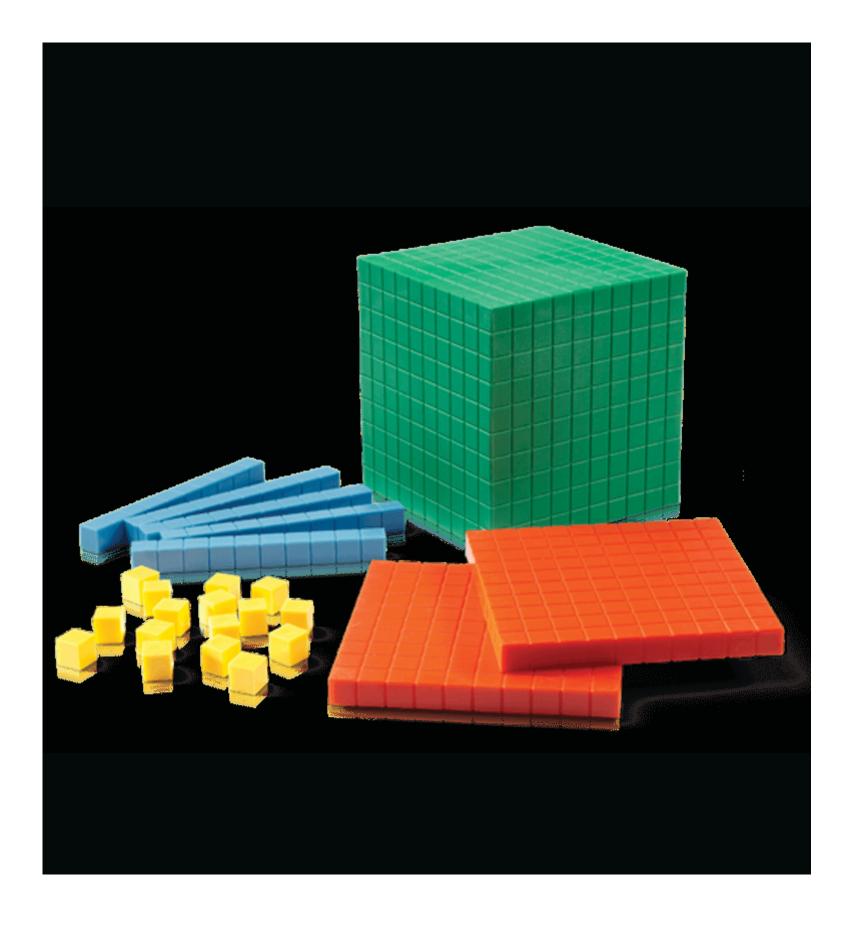
# Lincoln Logs

John Llyod Wright, 1916 A system of interlocking wooden beams that could construct different log buildings.



#### **Base 10 Blocks**

**Stern & Stern, 1948** Blocks that provide a spatial model of the base ten number system and can be used as a mathematical manipulative learning tool.



#### Legos

#### The Lego Group, 1949

Interlocking plastic bricks system that allows unlimited creativity and design combinations.



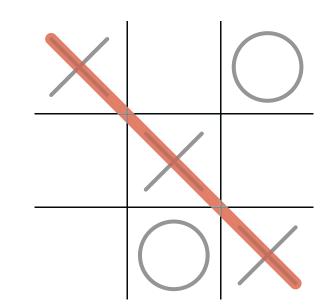
#### Design systems as games.

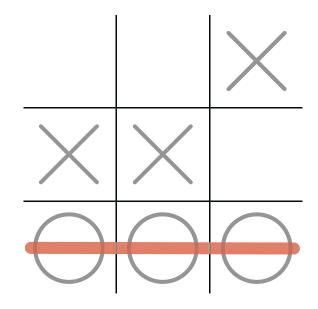
Dubberly Design Office · Systems Theory in Design-Design Systems · 07 July 2020

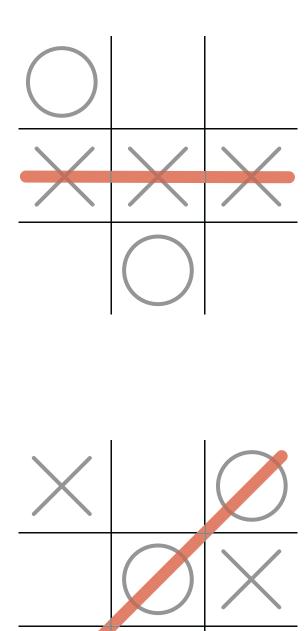
207

#### Tic-tac-toe

**Roman Empire, 1st century B.C.** Usually played as a paper and pencil game on a 3x3 grid, the objective of this game is to connect three of your symbols in a row before your opponent.







#### The tic-tac-toe solution space

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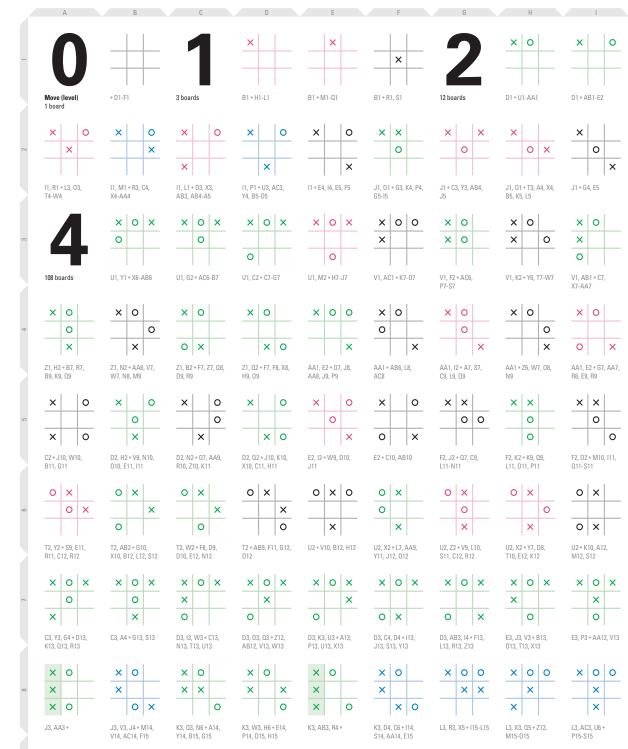
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The tic-tac-toe solution space









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F2, O2 • M10, I11, 011-S11



U2 º K10, A12,

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E3, P3 • AA12, V13

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L3, AC3, U6 •

P15-S15

M12, S12















K1. N1 • J3. L4. R4. G5, M5, N5





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G2, M2 • L9, M11,

o x

X O

U2 • B10, G12, P12

x o x

x o

E3, AA3, J4 • E13,

x o o

×

L3, E4, T4 •

×

M13. 013. Z13

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D1 • Y1, AA1,

J2-N2

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K1, Q1 • H3, N4,

Q4, H5, M5, O5

x o

V1, O2 • E7, C8-F8

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M11 N11 P11

X

V2 • AB7, S8, T12

x o o

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O X 0







B14-F14







X O



K L M N

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o x

E1 º AB1, B2,

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K1 • E3, Z3, AC4,

x o

o x

W1 • X6, K8, L8

x x o

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AB1, AC1 • AB9-C10

× ×

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J2, K2 • U7, AC8,

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V2, AC2 • T7, K8,

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N8, V11, V12

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F3, X3, N5 •

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D1 º C2, O2-Q2

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K1, S1 • N3, P3,

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T4, V4, P5, Q5

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E1 • V1, X1, J2, N2, V2-X2



K1, N1 • V3, B4, Z4, C5, K5, R5



W1, L2 ° X6, T7, M8-08



AB1, K2 • 09, R9, D10-F10

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J2, O2 • M7, K11, W/11\_V11



V2, AA2 • C8, P8, S10, K12, N12



× F3, AC3, P6 • F14-I14



N3, B4, M6 • Q15, T15, X15, Y15



0 V1, J2 • H7, AB7-B8









W1 ∆2 ∘ K7

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V2, AA2 • K7, Z10, X11. J12. U12



F3, R3, F6 •











P15, T15, U15

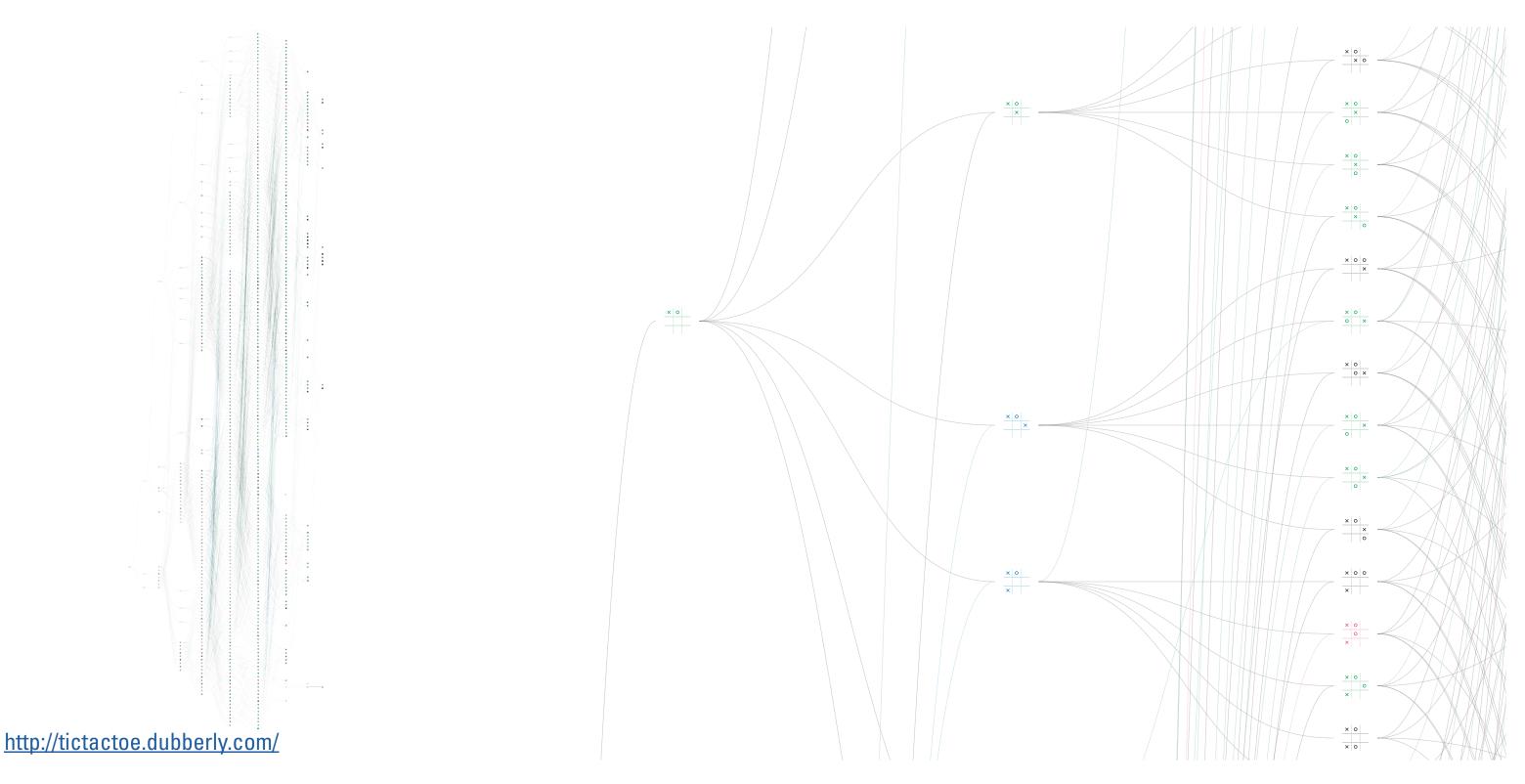








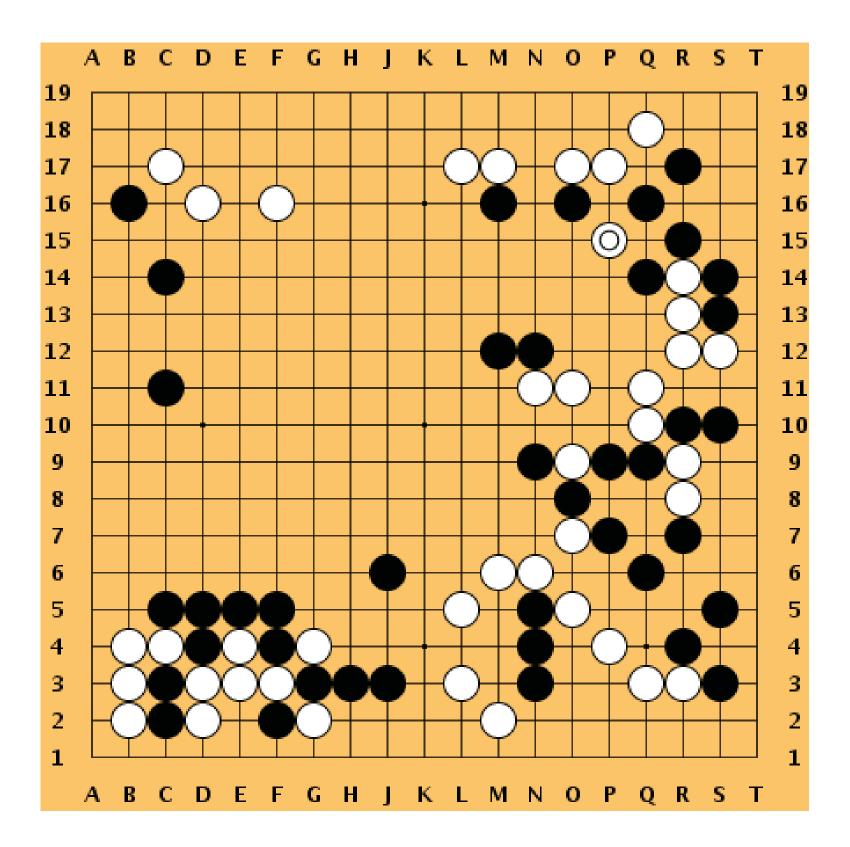
#### The tic-tac-toe solution space



# Go

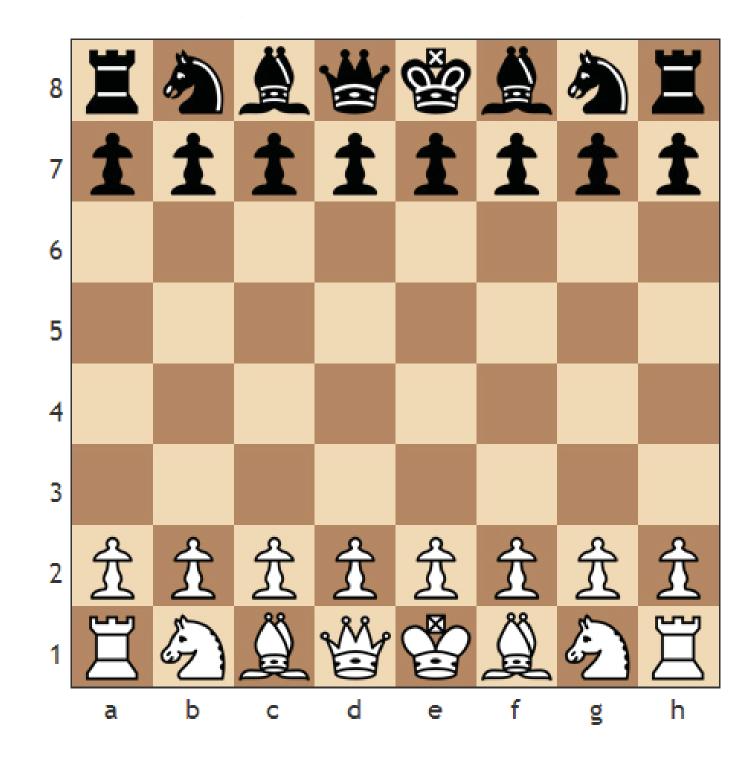
# China, 4th century B.C.

An abstract strategy board game that is played on a 19x19 grid with black and white pieces called stones. The objective of the game is to control more territory than your opponent by the end of the game.



#### Chess

Romantic Era, 1880's Derived from the Indian game, chaturanga, chess is a strategic board game played on an 8x8 grid. The primary objective of chess is to checkmate your opponent's King piece.

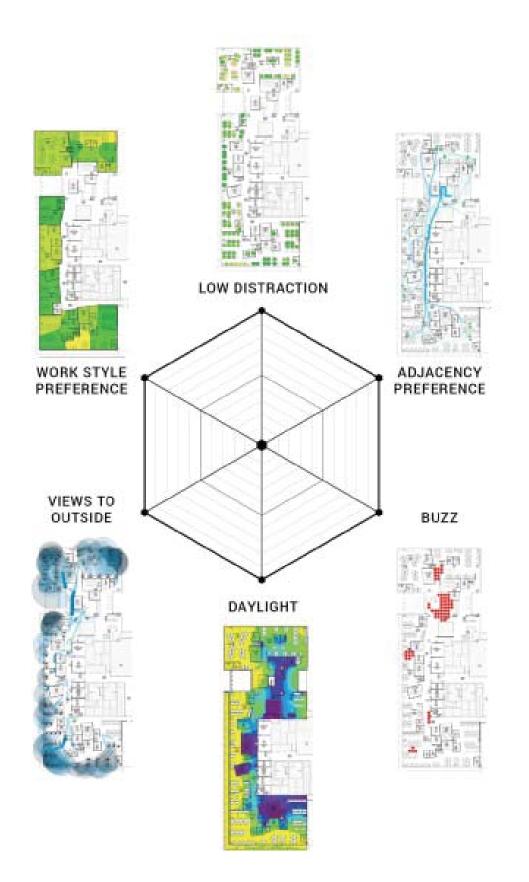


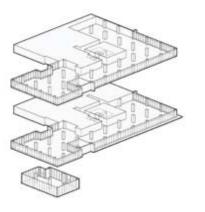
#### Design systems as **genetic algorithms** for **generative design systems**.

### Autodesk MaRS Office

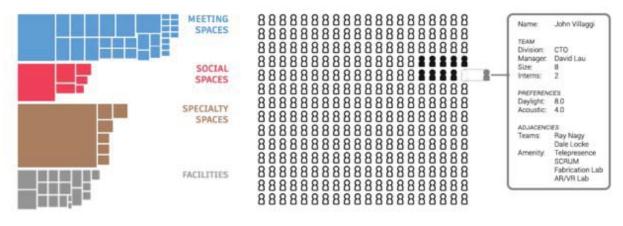
The Living & Autodesk, 2016 Founded by David Benjamin, The Living explored design methods and contextual projects using generative design. Design constraints and objectives were taken into consideration when determining goals for the office layout.



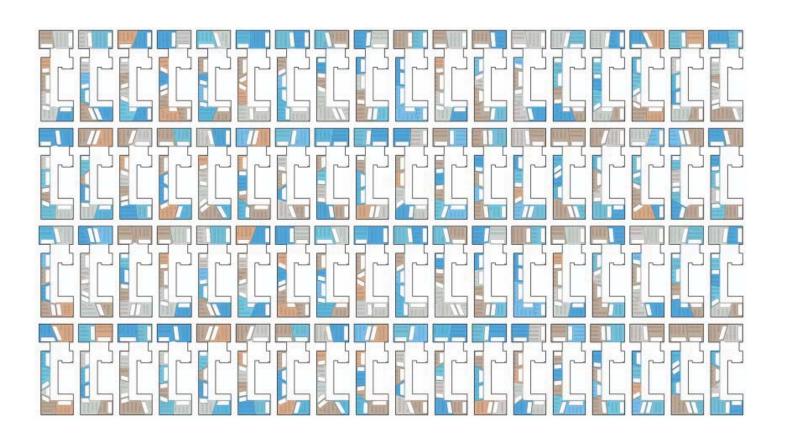




3 floors 48,000 square feet



11 meeting rooms6 multi-purpose rooms11 phone booths



#### 250+ people 25+ teams

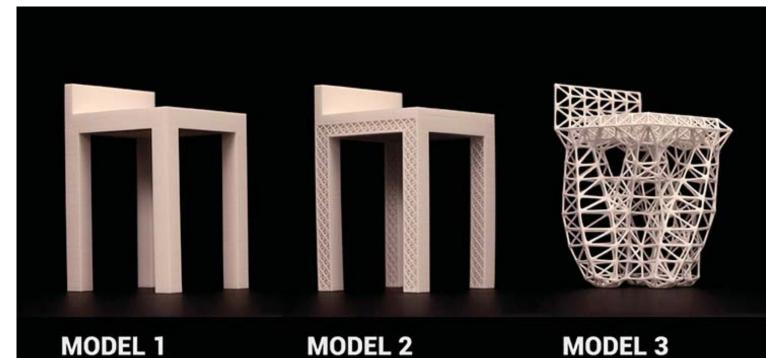
### **Project Dreamcatcher**

# Autodesk, 2018

A generative design algorithm which generates high-preforming design alternatives and all the possible permutations of a solution based on a designer's input.







**Uniform** lattice

10.3 kilograms ...... 4.1 kilograms ..... 2.9 kilograms

0.8 micrometers ..... 4.2 micrometers ..... 6.1 micrometers

Displacement:

Weight:

Smart design with ALM

Solid bars

Weight:

Traditional design

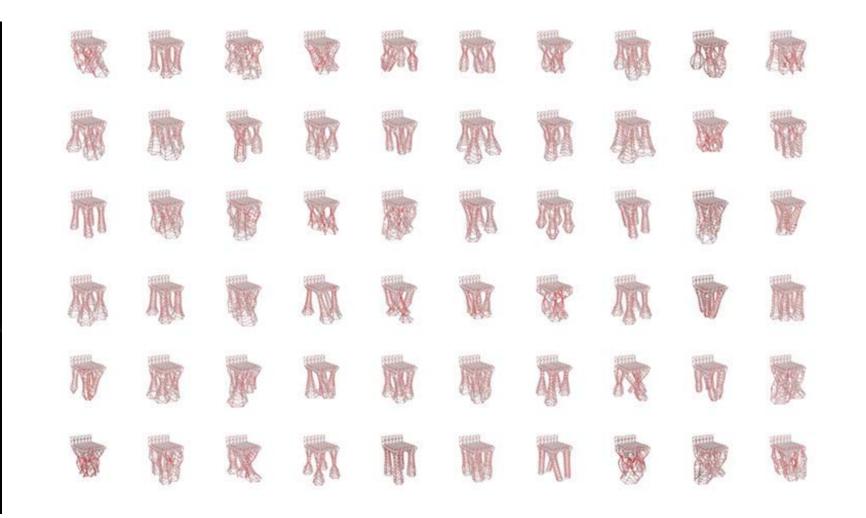
Displacement:

**Evolved lattice** 

Displacement:

Weight:

Evolutionary design with ALM



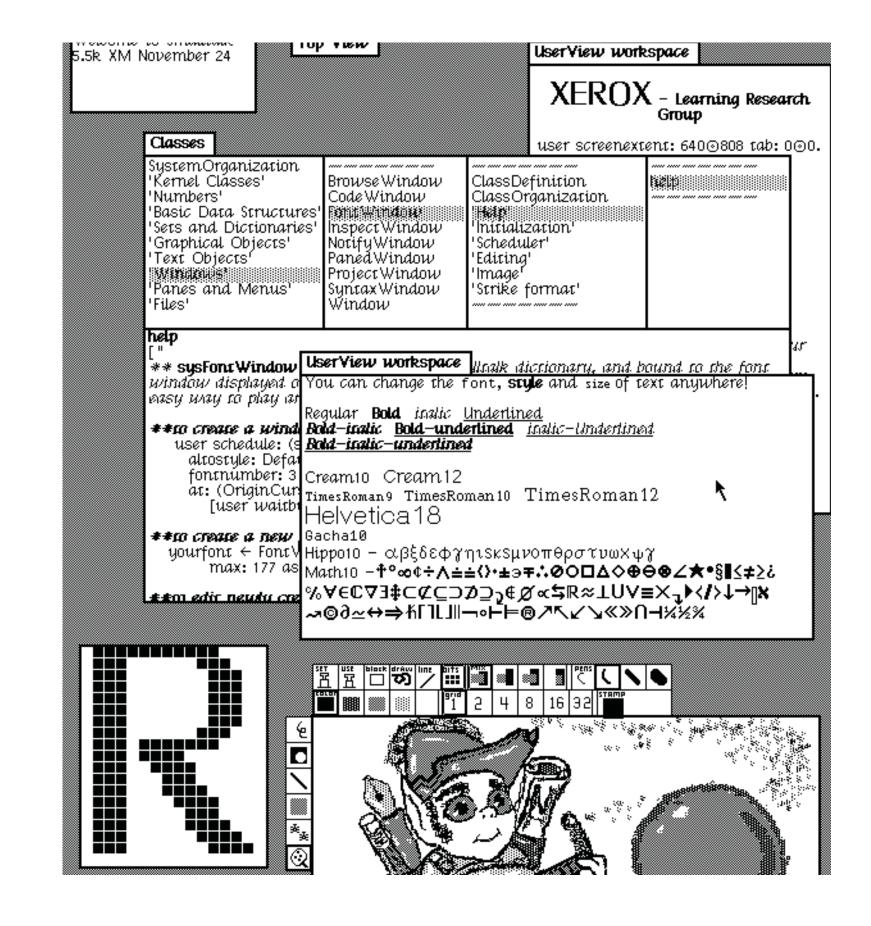
#### Design systems as graphical user interface (GUI).

218

## **Xerox Alto**

#### Xerox, 1973

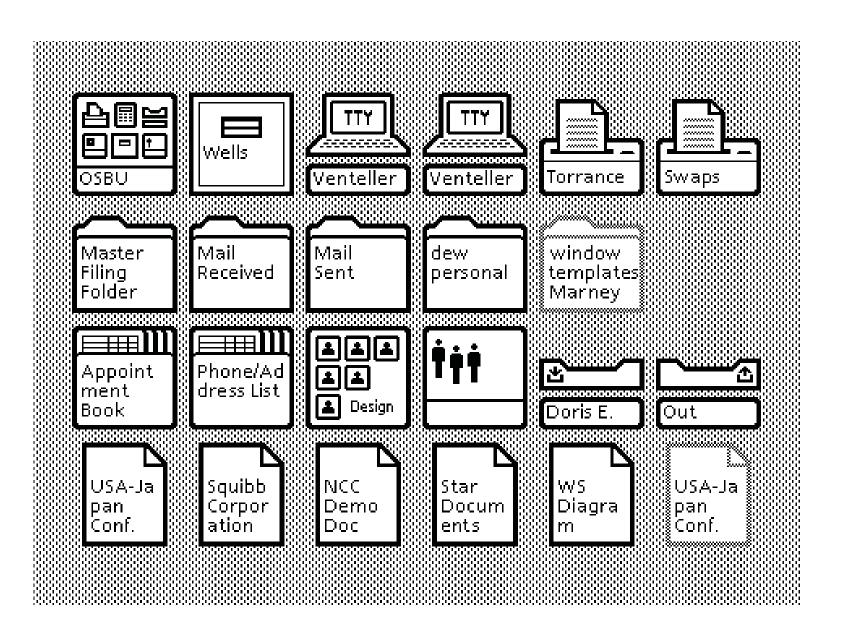
The first personal computer designed to support an operating system based on a mouse driven graphical user interface.



## Xerox Star (Xerox 8010 Information System)

## Xerox, 1981

The first commercial office automation system to incorporate the desktop metaphor and WYSIWYG technology.



## **Apple Mac Standards**

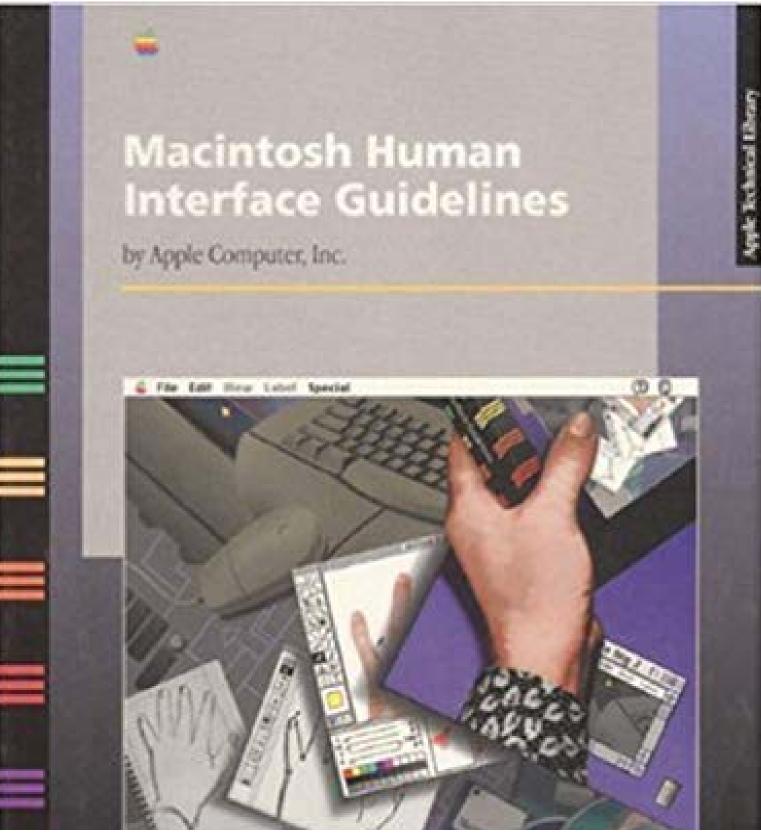
## **1984 Design System**

System Software with graphical user interface; consistent look and feel among applications.



## **Apple Mac Standards**

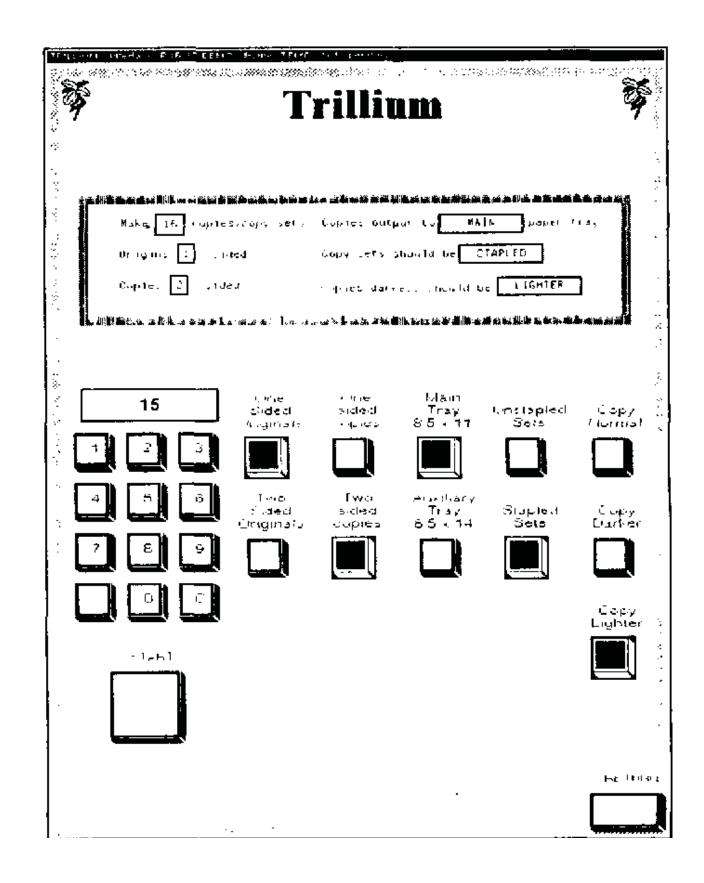
**1985 Standards for Developers** The Macintosh Human Interface Guidelines which was an essential resource for developing software for the Macintosh.





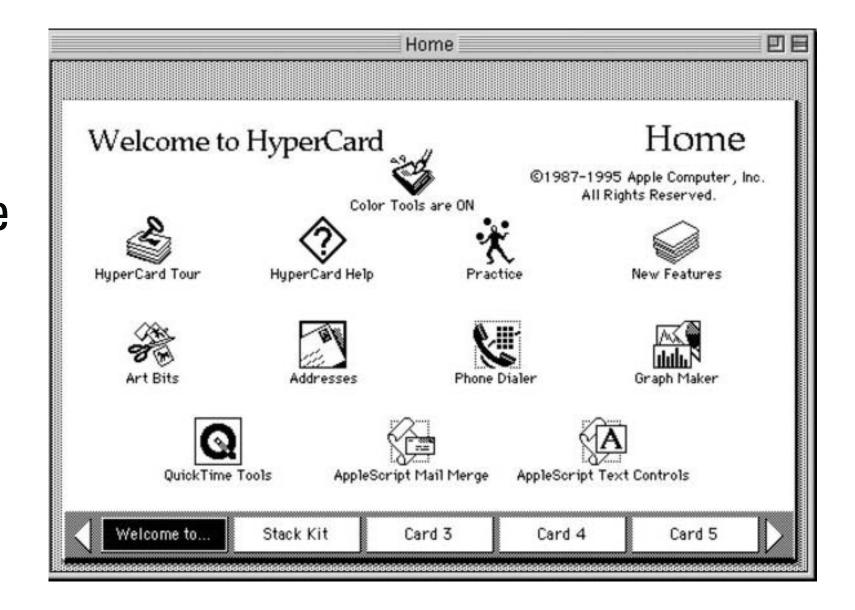
## **Xerox Trillium**

## **D. Austin Henderson Jr., 1986** A computer-based environment for simulating and experimenting with interfaces for simple machines.



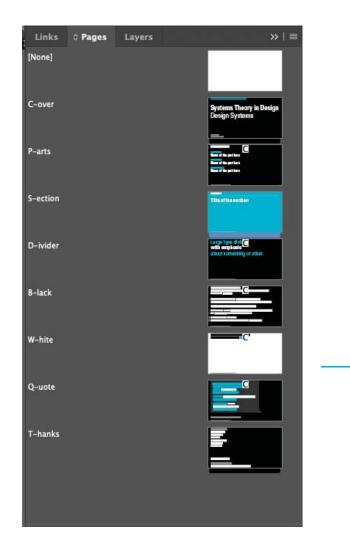
## **Apple Hypercard**

**Bill Atkinson, 1987** Software application and development kit that combines a flat-file database with a modifiable user interface.



#### Software applications contain

Master pages Page templates Symbols Libraries



Master Pages can be used to keep a consistent layout throughout the entire document.

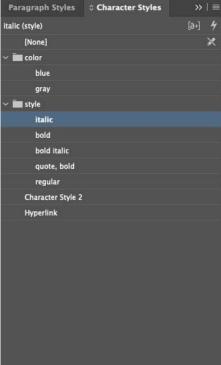
Headline of the slide goes here. Usually the headline is bold, but it could also be regular weight with bold for emphasis. Text and headline have an indent/left margin built-in so that when a list is needed, you don't have to move the text box. Half-spaces are used between body paragraphs. A list can use **dashes** (en dashes ... to change, alter the para style) The **color change** of the dashes is automatic 1 A list can also be **numbered** 2 The numbers, like the dashes, are added automatically

Page Templates allows for customization within each page and its unique content.

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Paragraph Styles and Character Styles allows for further customization within the pages while still keeping a uniformed feel.

**CSS (Cascading Style Sheets)** 

# **Proposed by Håkon Wium Lie, 1994**

Declarative programming language.



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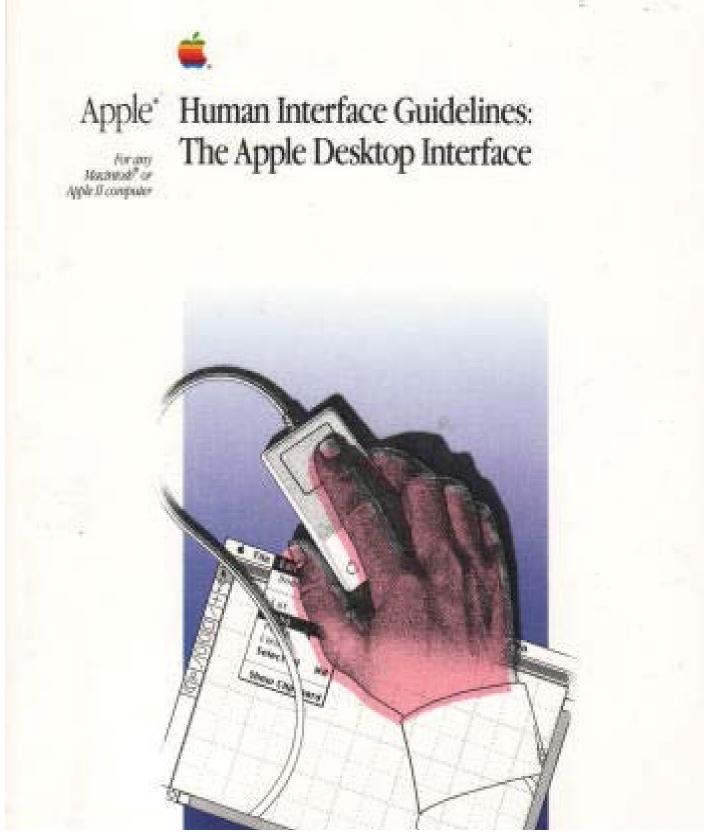
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auto: 2em 2em 4em; th: 8<del>00</del>px; ly: "Helvetica size: 16px ine-height: 1.5em; or: #545454 hackground-color: # hax-shadow: 0 0 2px r

## **Apple II Human Interface Guidelines**

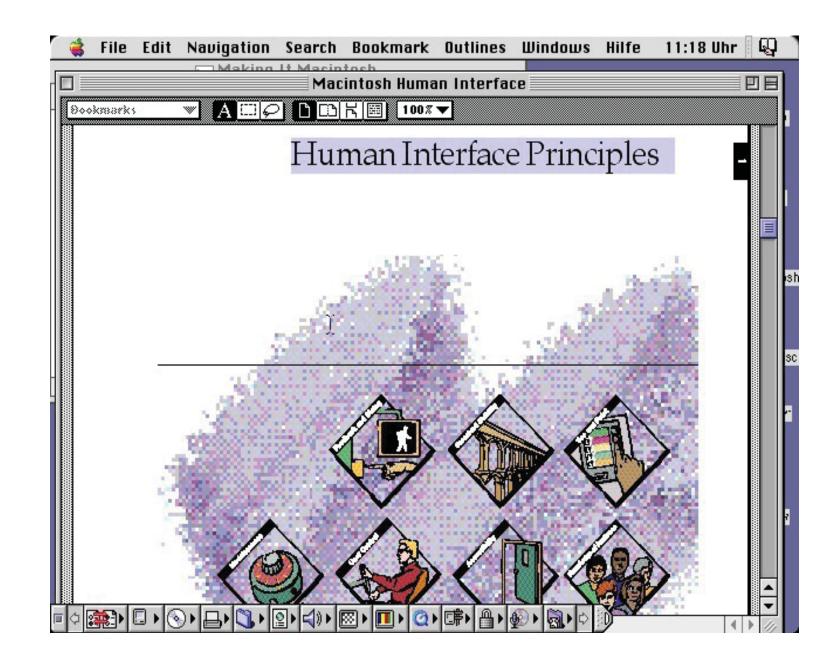
## Bruce Tognazzini et al., 1987

First document that outlined how Macintosh applications should work in consideration with HCI (human-computer interaction).



## Making It Macintosh

**Apple Computer Inc., 1993** Interactive guide that documented the Macintosh human-computer interface and showcased the applications consistent design principles.



## Yahoo! User Interface Library (YUI)

#### Thomas Sha, 2006

Open-source JavaScript and CSS library for building richly interactive web applications which were compatible across all browsers.



## jQuery

## John Resig, 2006

JavaScript Library that simplifies a variety of programming operations by inputting less code.



## jQuery UI

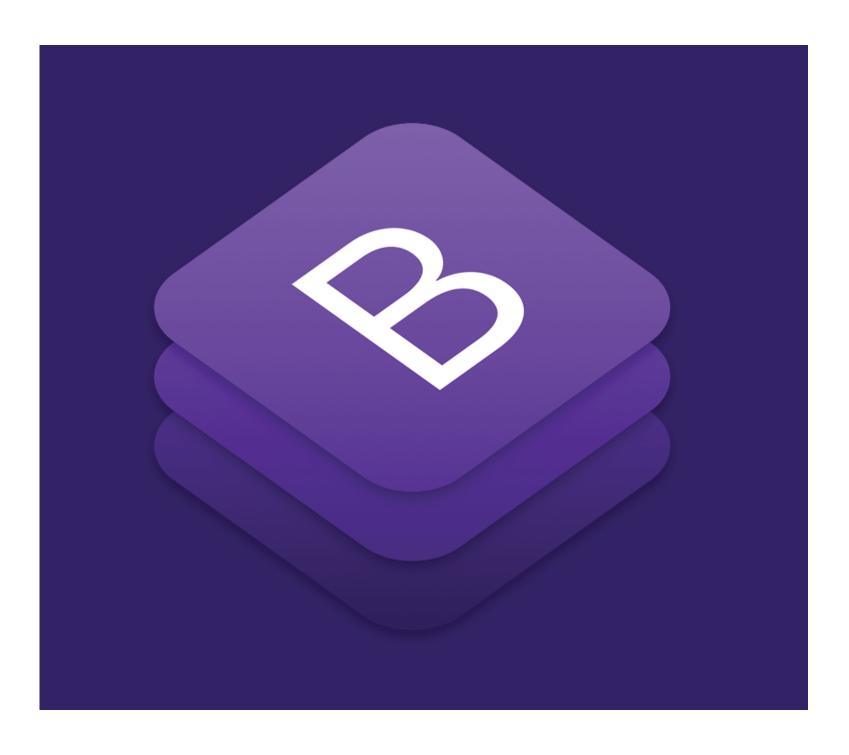
## Paul Bakaus, 2007

Curated set of user interface interactions, effects, widgets and themes built on top of the jQuery JavaScript Library.



#### Bootstrap

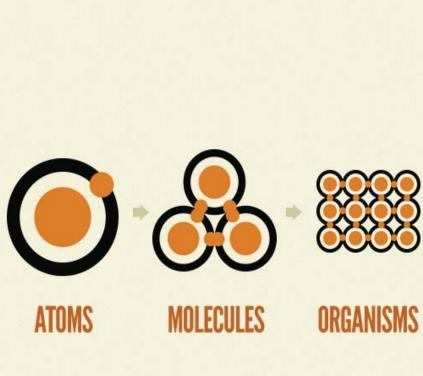
Mark Otto & Jacob Thorton, 2011 CSS framework for responsive mobile-first front-end web development which encourages consistency across internal tools.

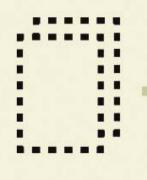


#### Atomic Design

## **Brad Frost**, 2013

A methodology for creating and maintaining robust interface design systems in a deliberate and hierarchal manner.





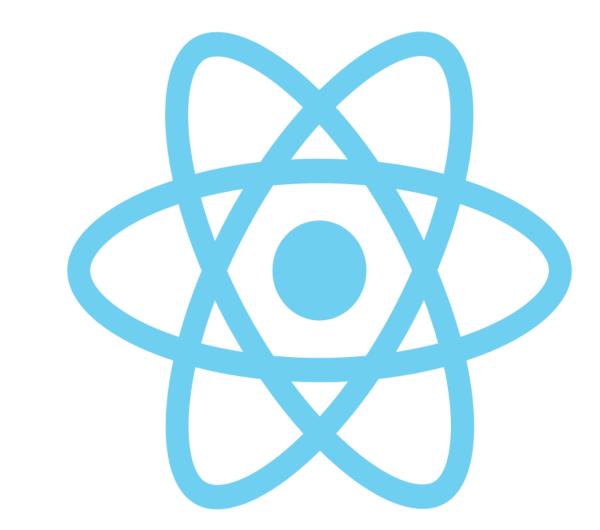
TEMPLATES



PAGES

#### React

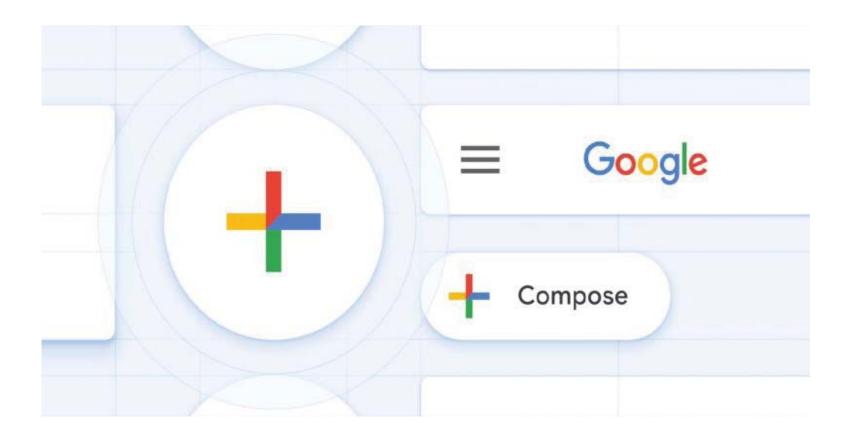
Jordan Walke, 2013 JavaScript Library for building user interfaces and allows creation of reusable UI components.



## **Material Design**

#### Released by Google, 2014

Design language which included a comprehensive set of guidelines and tools for developers to create a consistent interface hierarchy intended for the Android.



## **Cloud Hosting/Cloud Computing**

Resources for maintaining your website are spread across more than one web server and are rendered as per need basis.



## **Cloud Hosting/Cloud Computing**

## Amazon Web Services (AWS) 2006

On-demand cloud computing platform that provides IT infrastructure services and tools.



### •Bezos 2002 Mandate Human API (application programming interface) Manifesto

#### Libraries

Suite of data and programming code that is used to help both the programmer and programming language compiler develop software programs and applications.

## **Ruby on Rails**

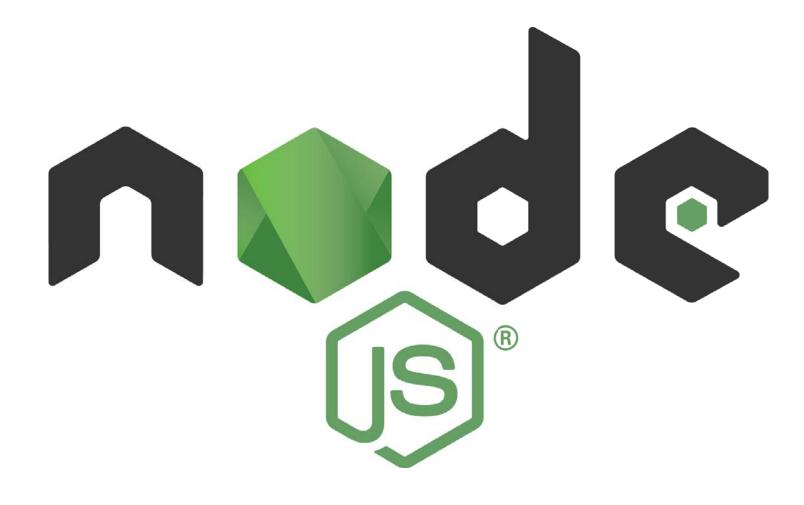
**David Heinemeier Hansson, 2004** MVC (model view controller) framework providing structures for a database, web service and web pages.



## Node.js

## Ryan Dahl, 2009

JavaScript run-time environment that executes JavaScript outside of a browser before the page is sent to the web browser.



#### **Version Control**

Software tools that manage revisions to source code over time.

## Git

#### Linus Torvalds, 2005

Distributed version-control system that can track changes in any set of files.





## GitHub

## Chris Wanstrath, P.J. Hyett, Tom Preston-Werner & Scott Chacon, 2008

Provides hosting for version control and SCM (source code management) functionally.

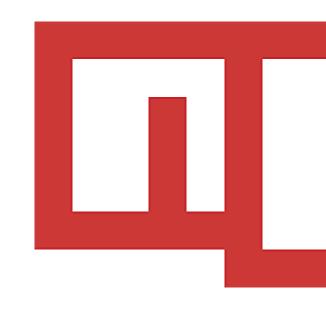


### Package Manager/Package Management System (PMS)

Program used to install, uninstall, and manages a computer's operating system and its module libraries.

#### **Node Package Manager (NPM)**

## **Issac Z. Schlueter, 2010** Software registry for JavaScript programming language.



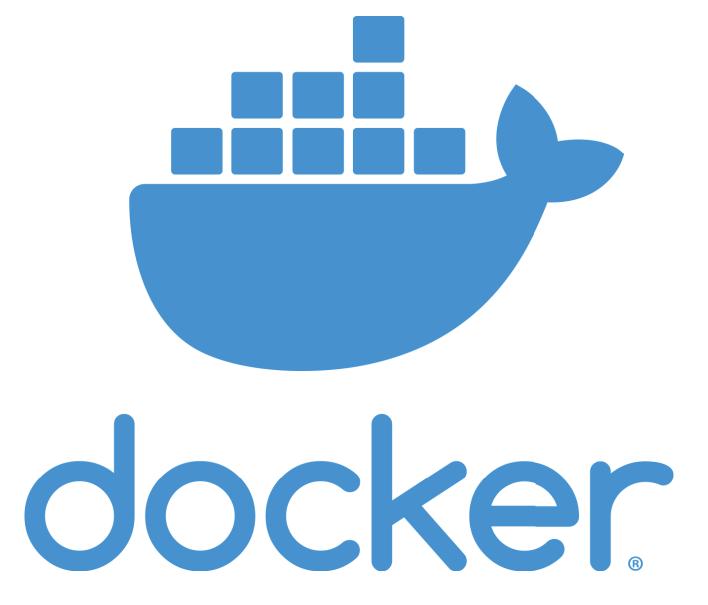


#### Containerization

OS (Operating system)-level virtualization method used to deploy and run distributed applications without launching an entire VM (virtual machine) for each app.

#### Docker

**Docker, Inc., 2013** Set of platform-as-a-service products that provides the ability to package and run an application in a container.



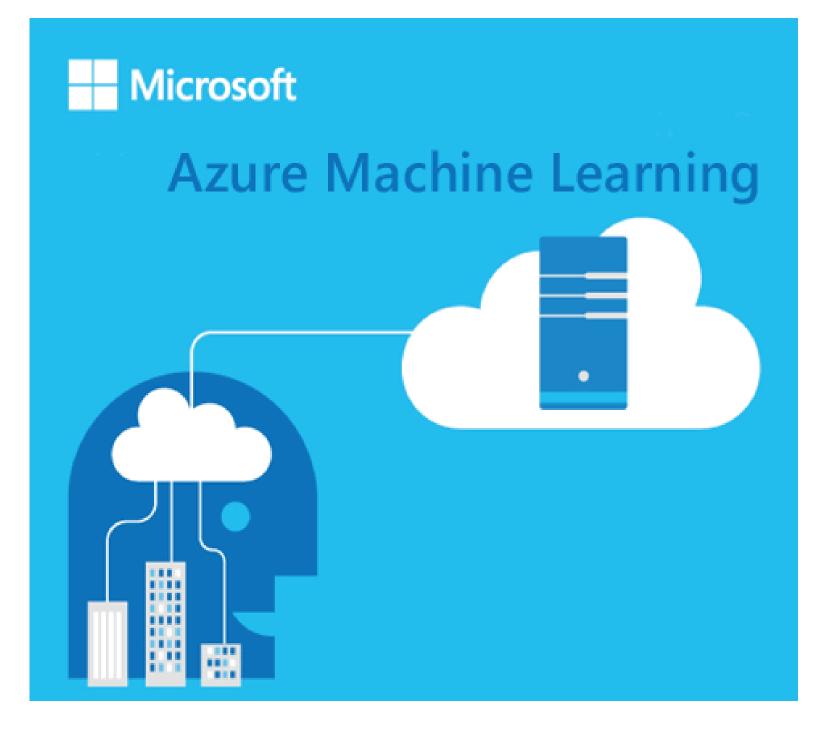
#### **AI Platforms**

Provide a tool kit which combines intelligent, decision-making algorithms with data to enable developers to create business solutions and applications.

## Microsoft Azure Machine Learning

## Mircosoft, 2015

Provide a tool kit which combines intelligent, decision-making algorithms with data to enable developers to create business solutions and applications.



## **Google Cloud Prediction API**

**Google**, 2010 Provides a **RESTful** (representational state transfer) to build machine learning models and analyzes data to add features to applications.

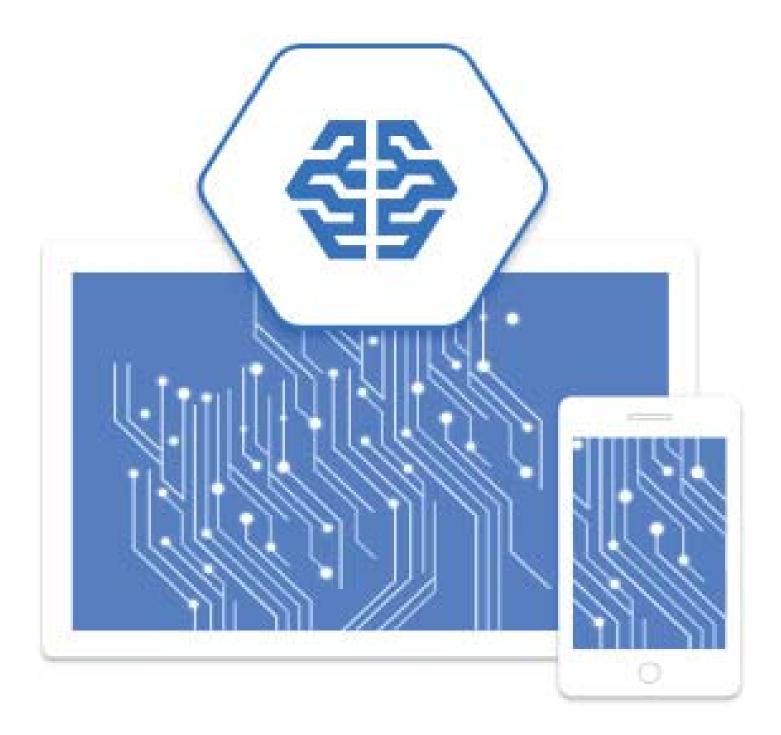


## Google Prediction API

## Google Cloud Machine Learning Engine

## **Google, 2016**

Managed service for training and building machine learning models based on mainstream frameworks.



#### **Appendix:**

Pioneering systems in design firms

#### Landor

Founded by Walter Landor, 1941 Pioneer in branding the use of consumer research for establishing a corporate identity.



# andor

# Lippincott

### Founded by Gordon Lippincott & Walter Margulies, 1943 Intersection of design and strategy. They helped create the field of corporate identity by combining product design and storytelling.

# LIPPINCOTT

#### **Chermayeff & Geismar**

### Ivan Chermayeff & Tom Geismar, 1957

Shaped how corporate identity systems influenced culture.



#### CHERMAYEFF&GEISMAR

#### **Total Design**

Wim Crouwel, Friso Kramer, **Benno Wissing, Paul Schwarz &** Dick Schwarz, 1963 Incorporated total design; a system of design used across all variations of media to unify and reassure corporate identity.



#### **Unimark International**

**Ralph Eckerstrom, Massimo** Vignelli, Bob Noorda, James Fogelman, Wally Gutches, Larry Klein & Jay Doblin, 1965 Embraced standardization and use of grid system for corporate communicates and a pioneer of the modernist philosophical direction.

# Unimark

#### Pentagram

**Founded by Alan Fletcher, Theo Crosby, Colin Forbes, Kenneth Grange & Mervyn Kurlansky, 1972** A Sign Systems Manual, 1970 Illustrates and describes a basic system for designing and displaying signs.

# Pentagram



#### Design systems in **language**. in **music**. in **food**.



### Limerick

## England, 18th century

A short humorous verse consisting of five lines with a rhyme scheme of AABBA. Edward Lear, a famous British poet and writer popularized the limerick form during the 19th century. What is a limerick, Mother?

Α

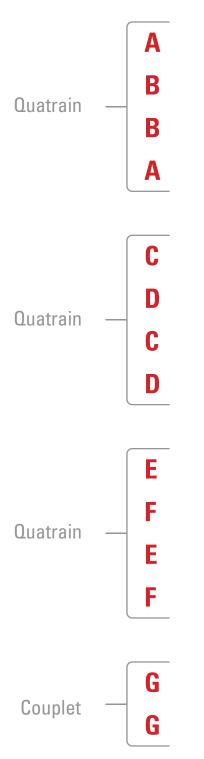
- A It's a form of verse, said Brother
- B In which lines one and two
- **B** *Rhyme with five when it's through*
- A And three and four rhyme with each other.

#### Sonnet

**Giacomo de Lentini, 13th century** A fourteen-line poem written in iambic pentameter relating to a specific rhyme scheme and structured thematic organization. Petrarchan/Italian sonnets and Shakespearean/English sonnets are the most popular forms of this type of poetry.



#### Shakespearean/English



## Haiku

#### Japan, 13th century

A short three-line poem composed of seventeen syllables that mainly focus on images from nature, simplicity, and direct expression. These Japanese poems are written in a 5/7/5 syllable pattern and were mastered by Matsuo Basho in the 17th century.

- 5 An old silent pond...
- 7
- 5
  - Matsuo Basho

A frog jumps into the pond,

Splash! Silence again.

### Jueju

#### China, 5th-6th century

A form of Chinese modern poetry that grew popular during the Tang Dynasty. These poems are limited to only four lines, also known as quatrains, and exactly twenty or twenty eight characters requiring authors to use symbolic language to a high degree.



### Wujue

# The five syllable form of a jueju poem.

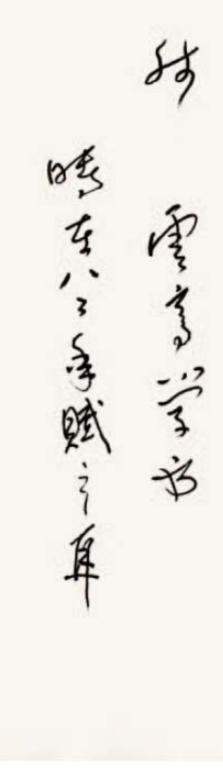
夜雪 已讶衾枕冷 复见窗户明 夜深知雪重 时闻折竹声

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Yè Xuě Yi yà qīn zhěn lěng Fù jiàn chuāng hu míng Yè shēn zhī xuě zhòng Shí wén zhé zhú shēng

#### Qijue

# The seven syllable form of a jueju poem.



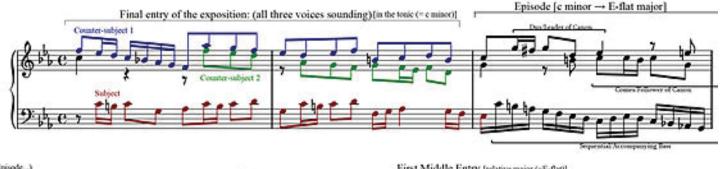
12

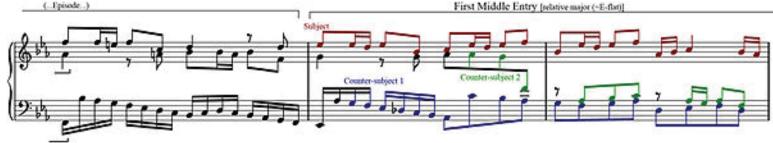
#### Music

## Fugue

## 13th century

A musical composition technique consisting of two or more contrapuntal voices interweaving. It gained popularity in the Baroque Period during 1600-1750.

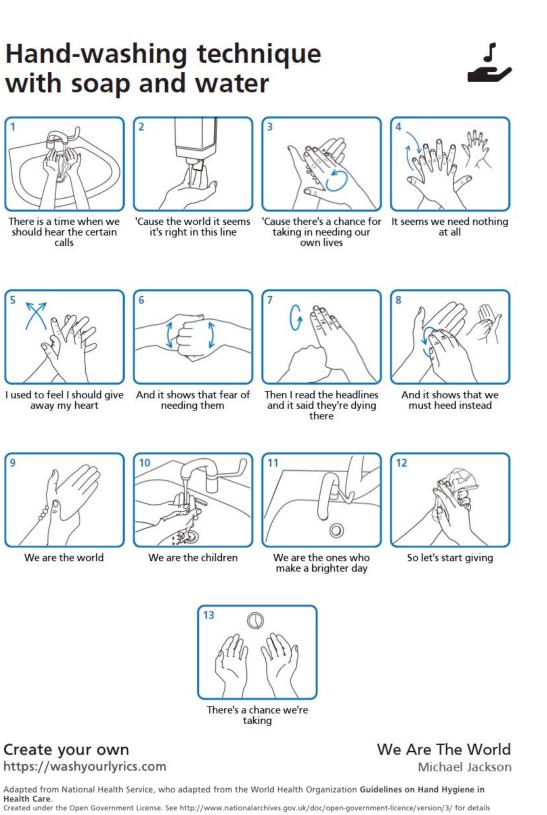




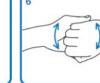
## **Wash Your Lyrics**

## **William**, **2020**

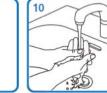
A generator tool used to create infographic posters on proper hand-washing instructions based on your favorite song lyrics. Enter in the song title and artist to automatically generate your custom poster.

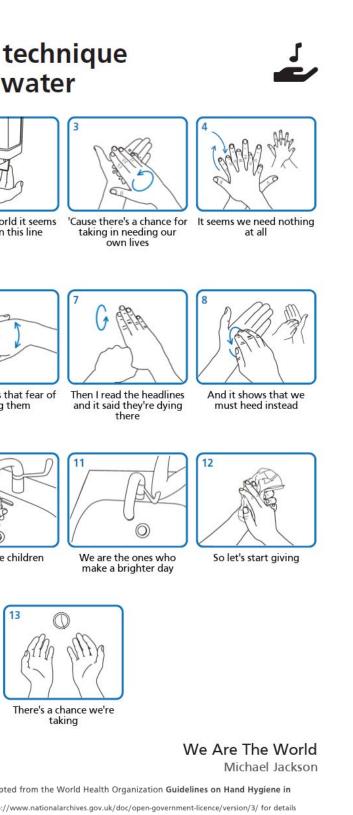












Create your own https://washyourlyrics.com

Health Care

#### Hand-washing technique with soap and water









Just a small-town girl

Livin' in a lonely world

She took the midnight train goin' anywhere

NE

 $\bigcirc$ 





Born and raised in South Detroit

He took the midnight train goin' anywhere



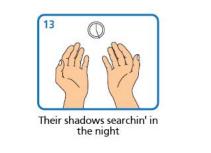


For a smile, they can share It goes on and on and on the night and on

Strangers waitin'



Up and down the boulevard



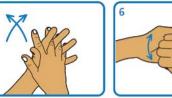
Create your own https://washyourlyrics.com Don't Stop Believin' Journey

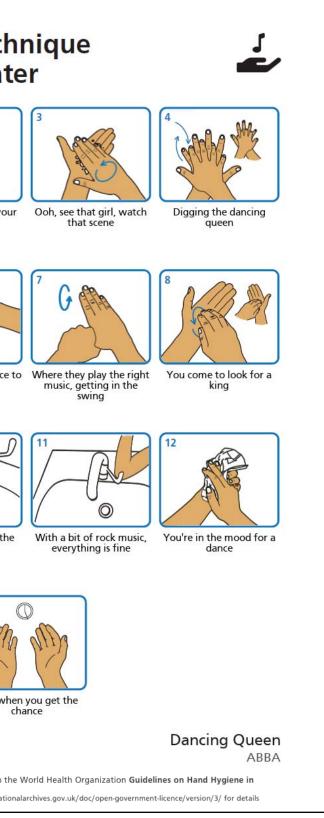
Adapted from National Health Service, who adapted from the World Health Organization Guidelines on Hand Hygiene in Health Care. Created under the Open Government License. See http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/ for details

#### Hand-washing technique with soap and water



jive



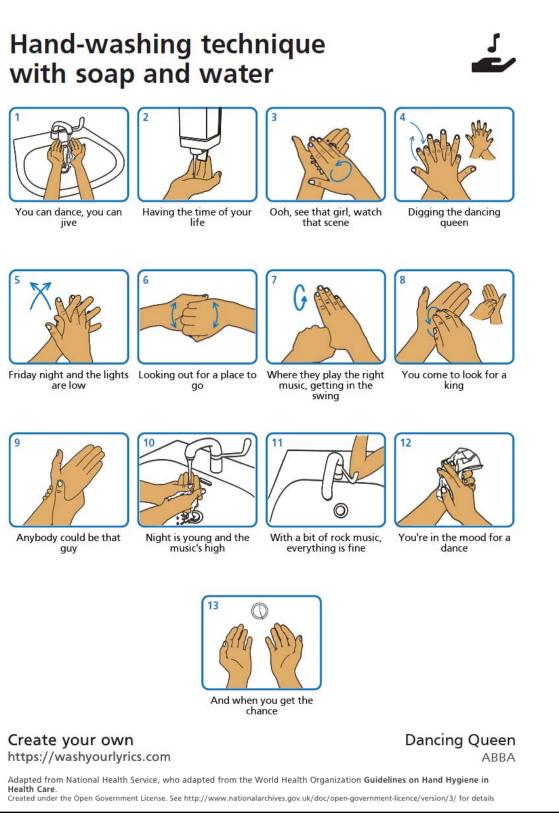




guy



Anybody could be that Night is young and the music's high



Create your own https://washyourlyrics.com

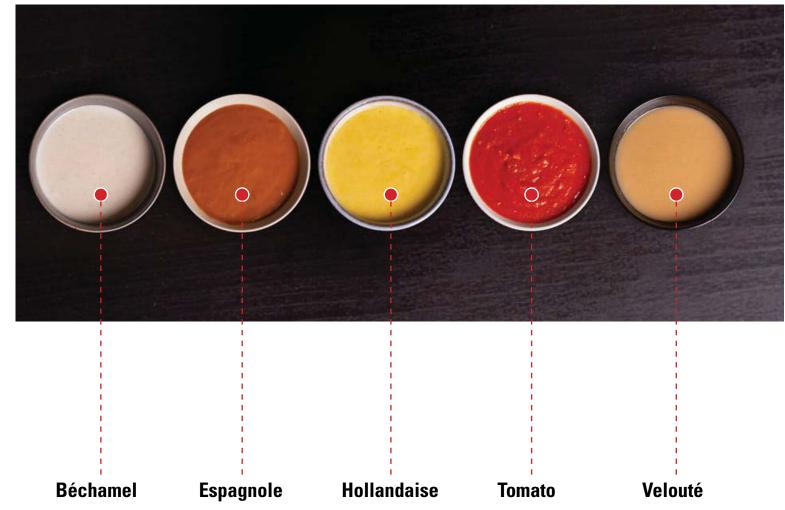
Adapted from National Health Service, who adapted from the World Health Organization Guidelines on Hand Hygiene in Health Care. Created under the Open Government License. See http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/ for details

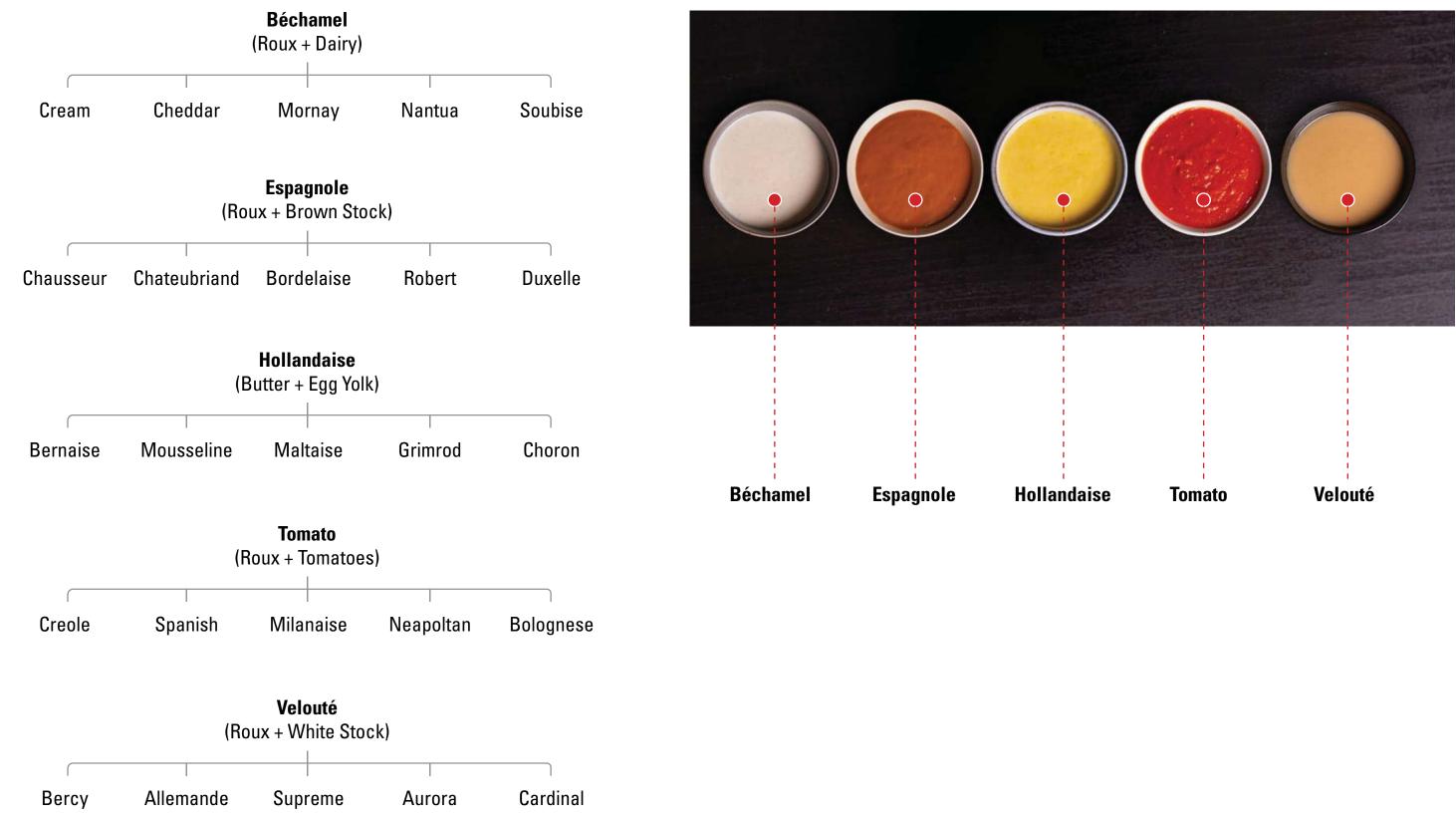
#### Cooking

#### **Mother Sauces**

# Marie-Antoine Carême, 19th century

Refers to any of the five basic sauces which are the starting points for making various secondary sauces known as small sauces.





Mac and Cheese

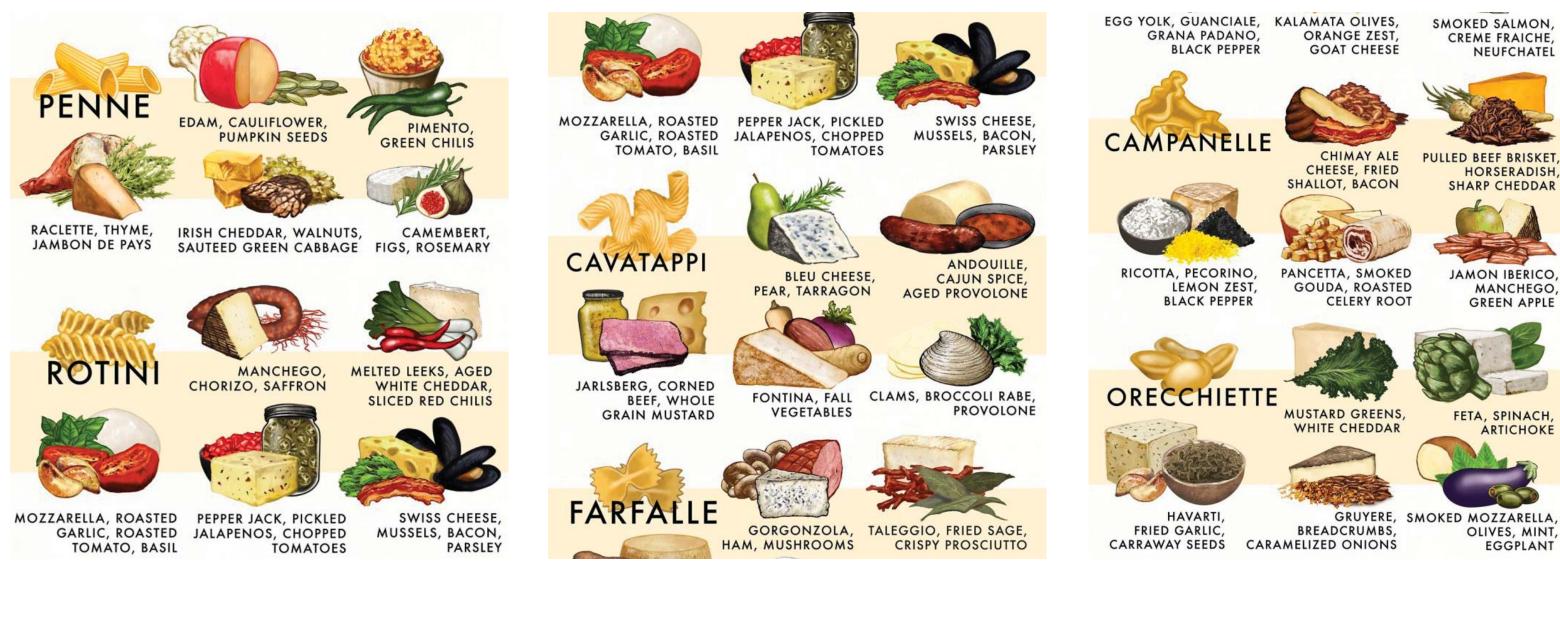
**Food Republic, 2014** An idea generator of different combinations you can do to make a mac and cheese dish.







CHEDDAR, TOMATO





#### CREME FRAICHE, NEUFCHATEL



HORSERADISH, SHARP CHEDDAR



JAMON IBERICO, MANCHEGO, GREEN APPLE

OLIVES, MINT, EGGPLANT

#### Wraps and Burritos

Wraps and burritos are made up of a sum of many simple parts that are put together in an assembly line order.



#### E.g., Chipotle assembly line



#### Ramen

Like many other Asian oriented soups, ramen has a basic set of components that can be mixed in different combinations to create a soup to fit a customers needs.

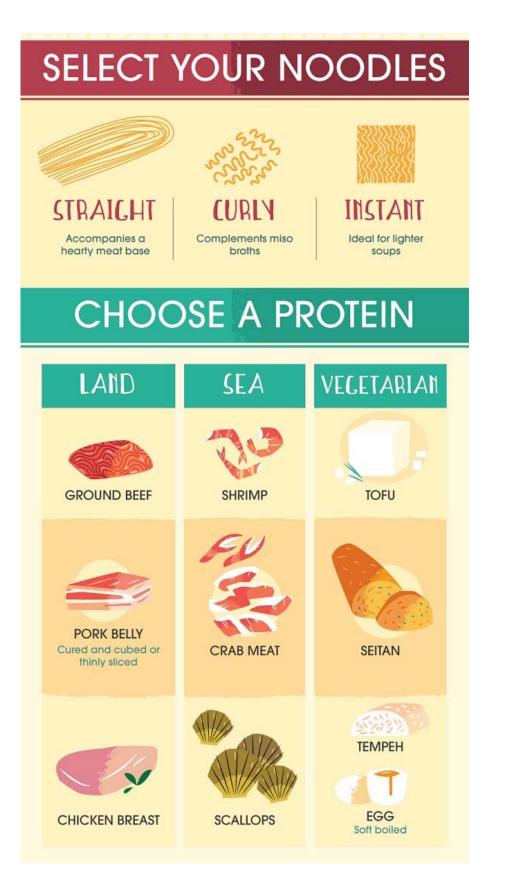
# **RAMEN STYLES**

Flavors SHIO TONKOTSU Sea Salt Pork Bone 00' **MISO** SHOYU Fermented Soybean Paste Soy Sauce









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#### ADD THE AROMATICS



#### SELECT AND PREPARE VEG

cabbage

bean sprouts

MISO

4

A nutty

fermented bean

paste soup

CHOOSE YOUR SOUP BASE



carrots

mushrooms

TONKOTSU

rich base of

boiled pork

bones













scallion







SHOYU

A light broth

made with soy

sauce







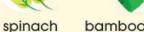
















































































SHIO

A salty, clear

broth











































#### **SEASONING OPTIONS**



TOGARASHI Japanese spice powder



SESAME SEEDS A great complement to miso broths



COLD BUTTER A thick-cut pat for richness



CHILI PASTE For heat



MAYU Slow-cooked sesame oil and garlic



CURRY POWDER To add body to broths



#### **Starbucks latte framework offers nearly 200 million variations.**

Cup type	To-go	For-here	Personal cup	
Drink type	Warm	lced		
Kind of espresso	Regular	Decaf	Half-caf	Теа
Amount of espresso	Single	Double	Triple	Quad
Drink size	Short	Tall	Grande	Venti
Milk type	Non-fat	2%	Whole	Soy
Syrup combinations	(Choose from about 15 flavors)			
Whipped cream	w/Whip	No whip	Light whip	
Temperature	Extra hot	Cooler	Specific degree	Standard (
Build order	Upside down	Right-side up	Macchiato	Otherwise
Long/Short pull	Long	Short	Normal	
Amount of foam	Dry	Wet	Normal	None
Amount of syrup	1 pump	2 pumps	3 pumps	4 pumps

Simple for beginners and rich for aficionados: How Starbucks' drink framework and ordering language engage customers at all levels

None

N shots

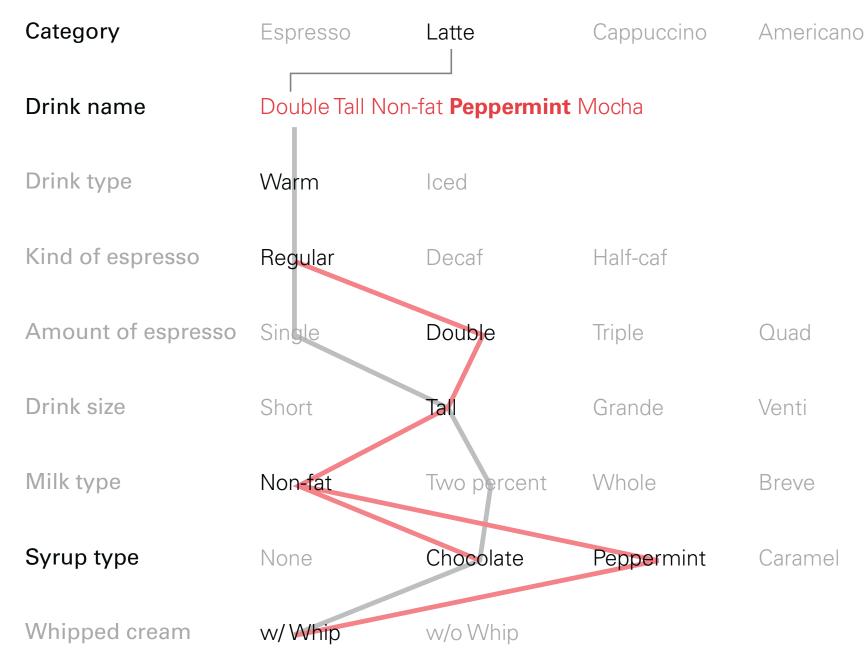
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#### N pumps

#### **Starbucks latte framework offers nearly 200 million variations.**



Simple for beginners and rich for aficionados: How Starbucks' drink framework and ordering language engage customers at all levels

N shots

Sov

Etc.

#### Starbucks even has training dice for new baristas.



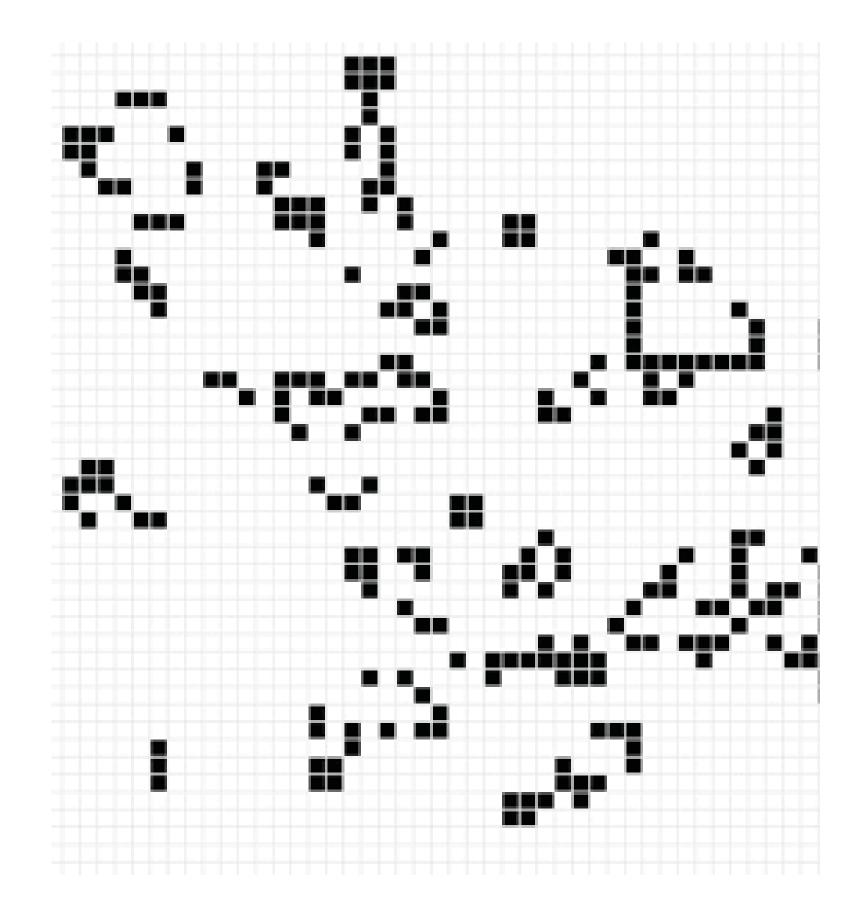
Simple for beginners and rich for aficionados: How Starbucks' drink framework and ordering language engage customers at all levels

#### **Computational Systems**

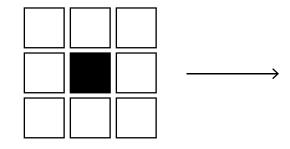
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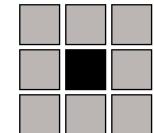
### The Game of Life

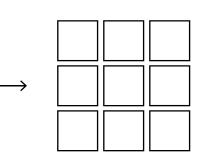
**John Conway, 1970** A 2D cellular automation zeroplayer game, meaning that its evolution is determined by the initial state requiring no input.

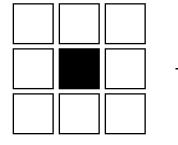


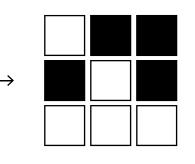
#### **Rules of The Game of Life**

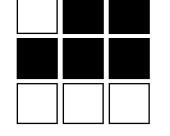


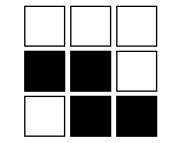


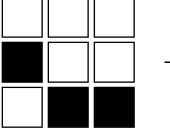


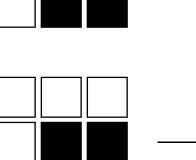












Each cell has 8 neighbors

1. Isolation—each live cell with one or fewer live neighbors will die in the next generation

2. Overcrowding—each live cell with four or more live neighbors will die in the next generation

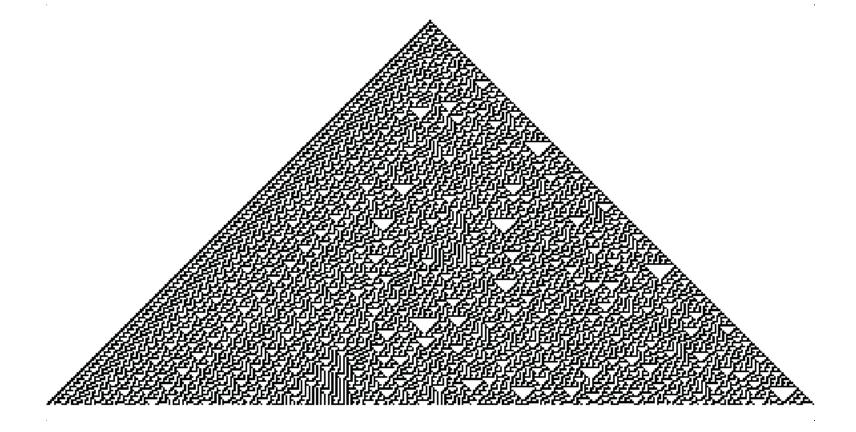
3. Births—each dead cell adjacent to exactly three live neighbors will become live in the next generation

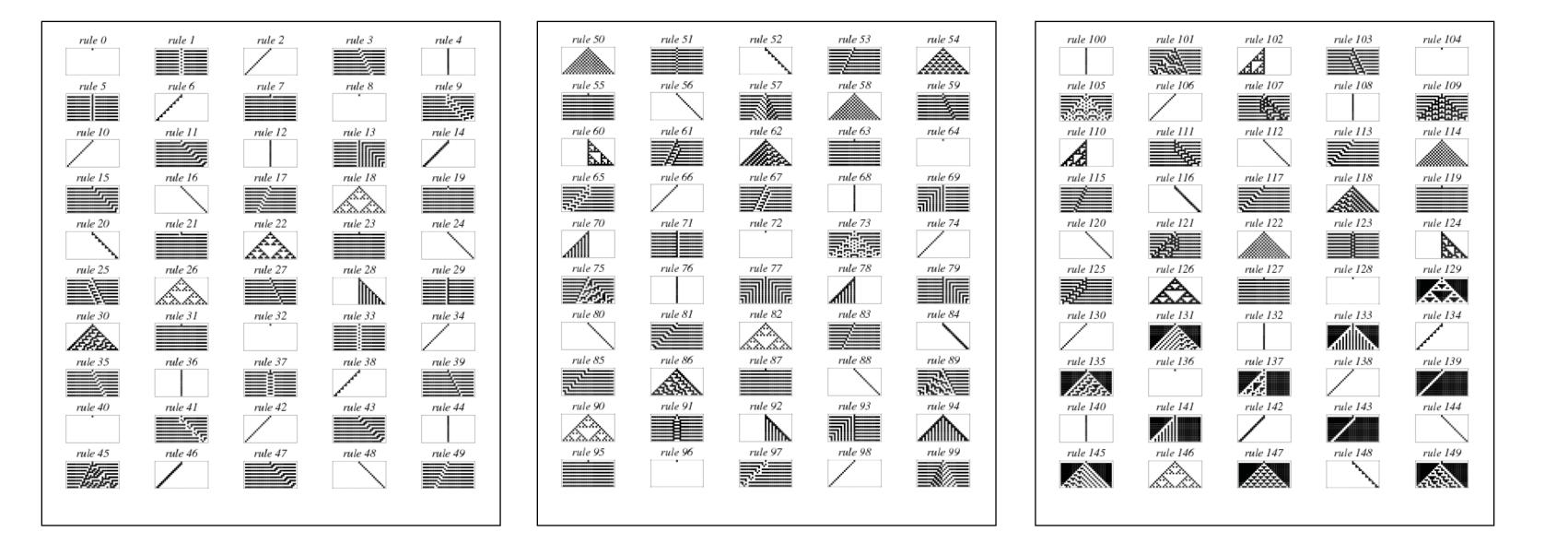
4. Survival—each live cell with either two or three live neighbors will remain alive for the next generation

#### **Cellular Automata**

### Stanislaw Ulam & John von Neumann, 1940's

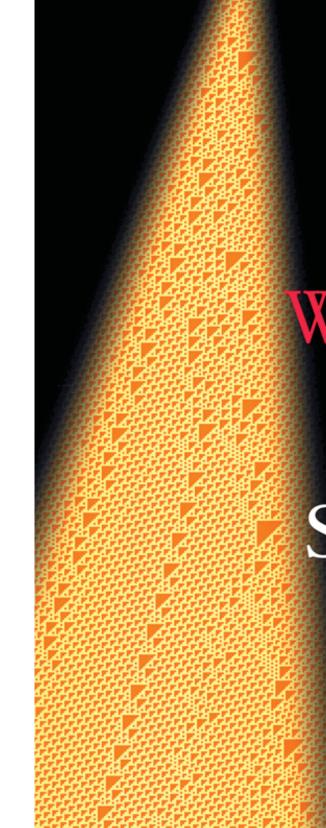
A discrete model which consists of a grid of cells where each has two possible states, 'on' and 'off'. It evolves through a number of time steps according to a set of rules based on neighboring cells.



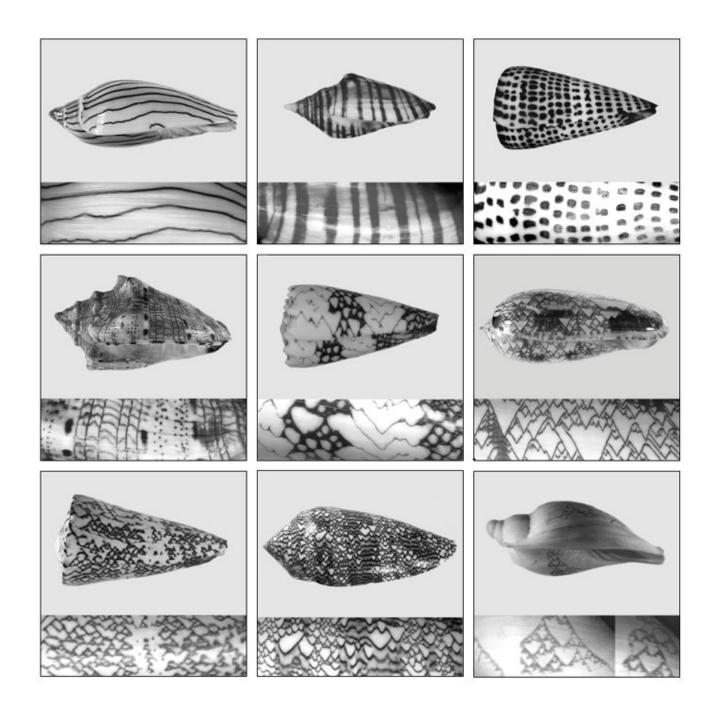


#### A New Kind of Science

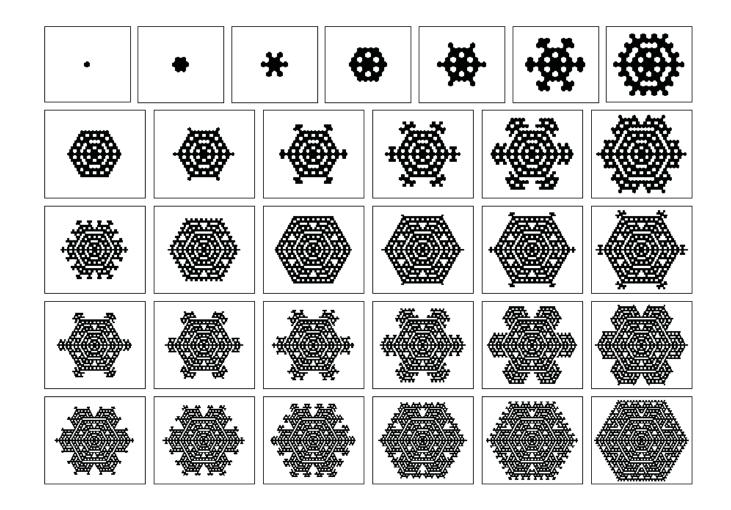
#### **Stephen Wolfram, 2002** A book that contains empirical and systematic studies of computational systems. Wolfram refers to these systems as simple programs and argues they are relevant to other fields of science.



## STEPHEN OLFRAM A NEW KIND OF SCIENCE



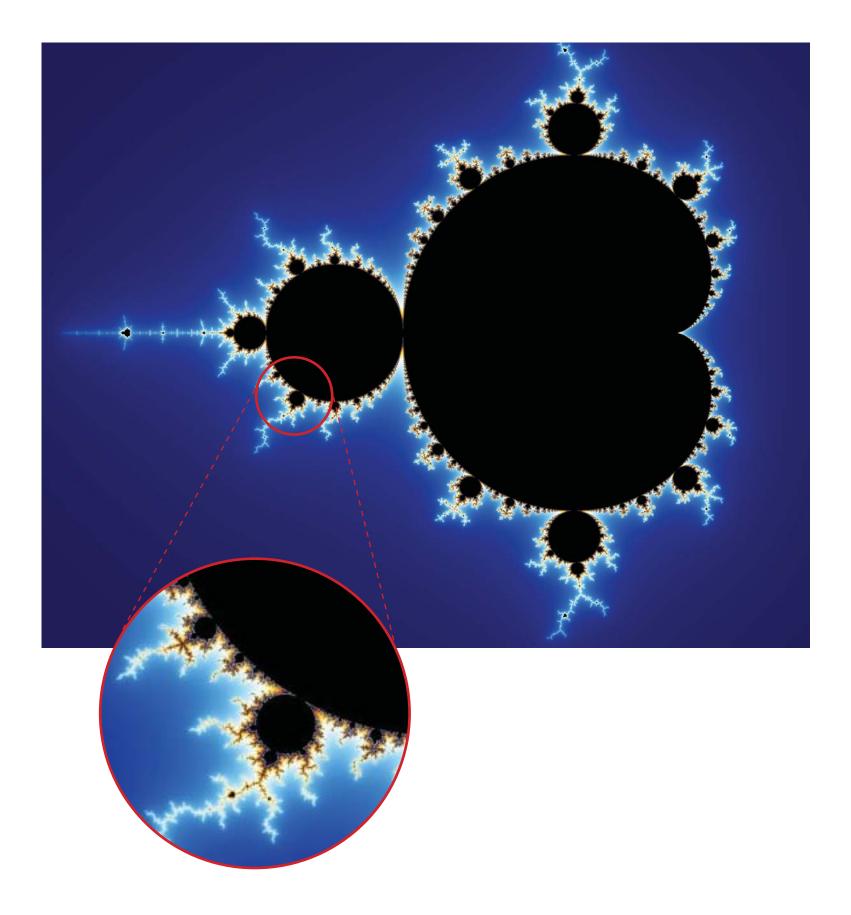
#### Pigmentation patterns on mollusc shells

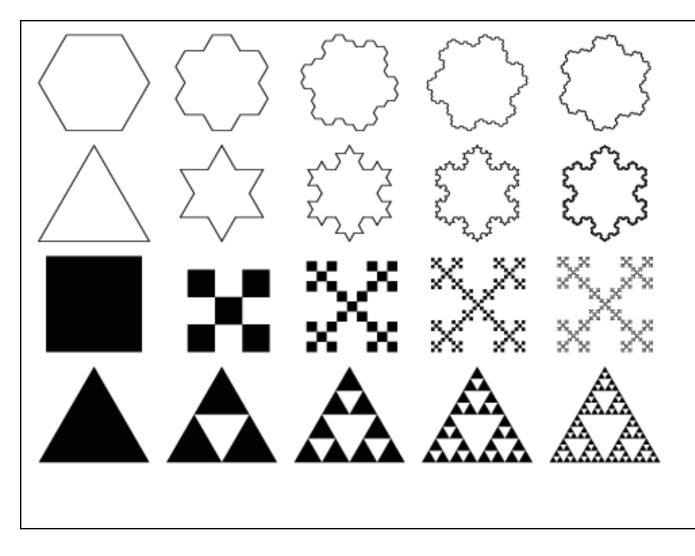


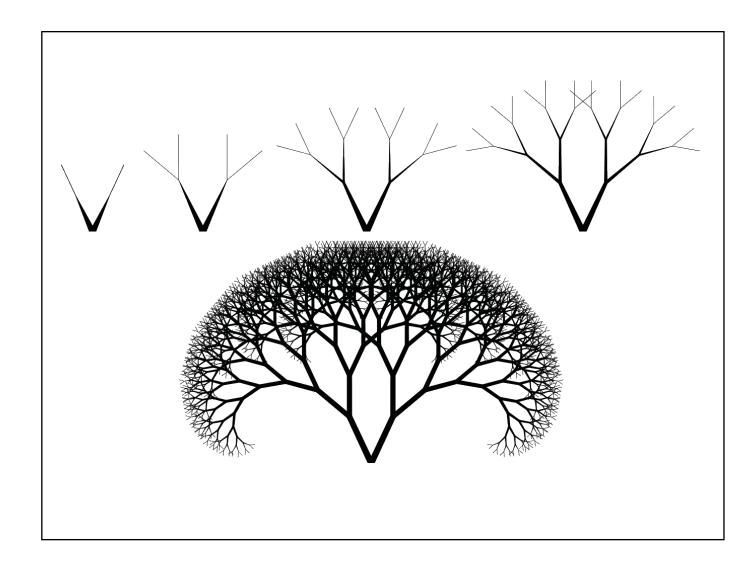
The evolution of a cellular automaton which occurs in snowflake formation

#### **Fractals**

Benoit Mandelbrot, 1975 Mathematician, Mandelbrot, coined the term "fractal" to describe repeating or self-similar mathematical patterns of scale. It is a set that is invariant under unlimited transformations.





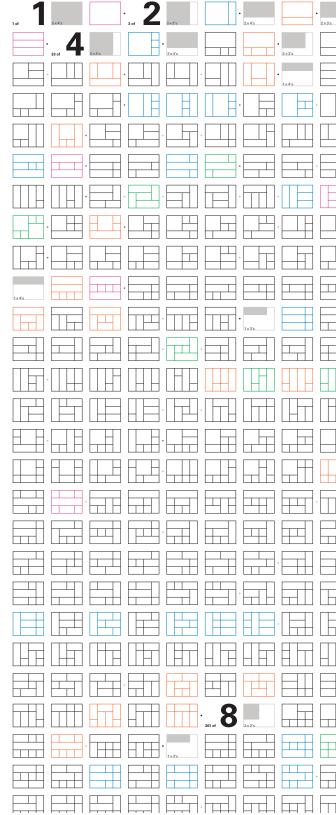


The Gosper Island, Koch Snowflake, Box Fractal and Sierpinski Triangle

An example of a fractal tree

#### **Permutations**

The various ways in which members from a set may be rearranged to form subsets with consideration of the order.



×25.	
x4's.	

#### **ISO Paper Sizes**

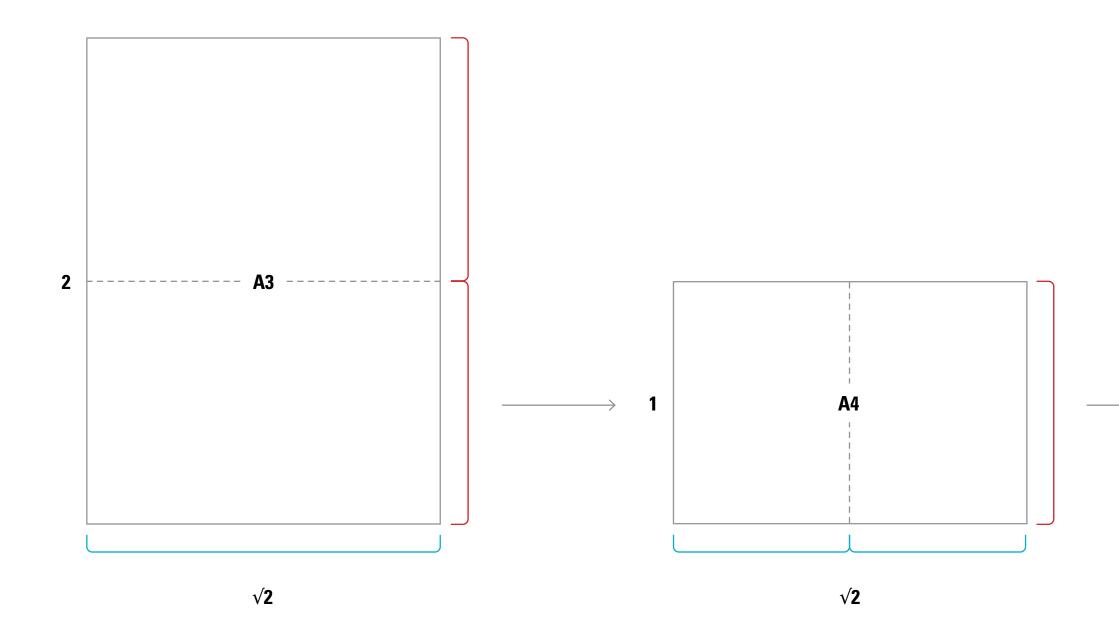
#### International Organization for Standardization, 1975 ISO 216 is based on the German DIN 476 for international paper sizing. ISO paper sizes are all based on the aspect ratio of $1:\sqrt{2}$ .

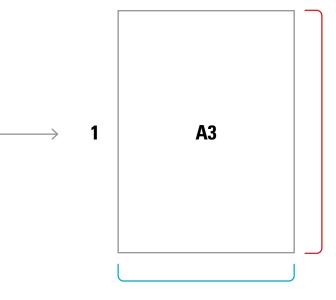
A1

A0

	A5	A6				
A3	43	A6				
AS	<b>A</b> 4					
A	2					

# An aspect ratio of 1: $\sqrt{2}$ , and the other sizes in the series are defined by folding the paper in half, parallel to its smaller side.

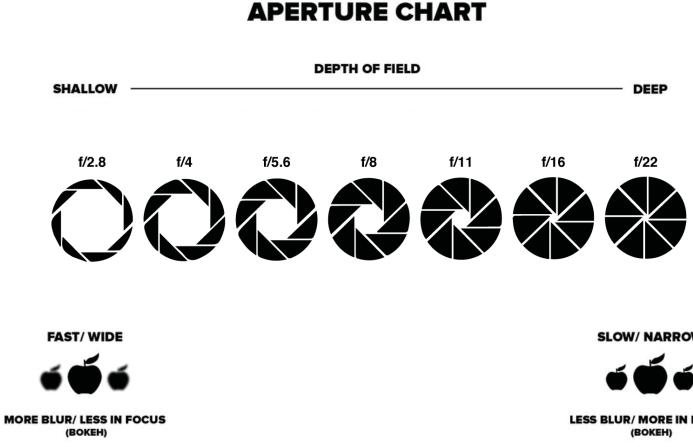






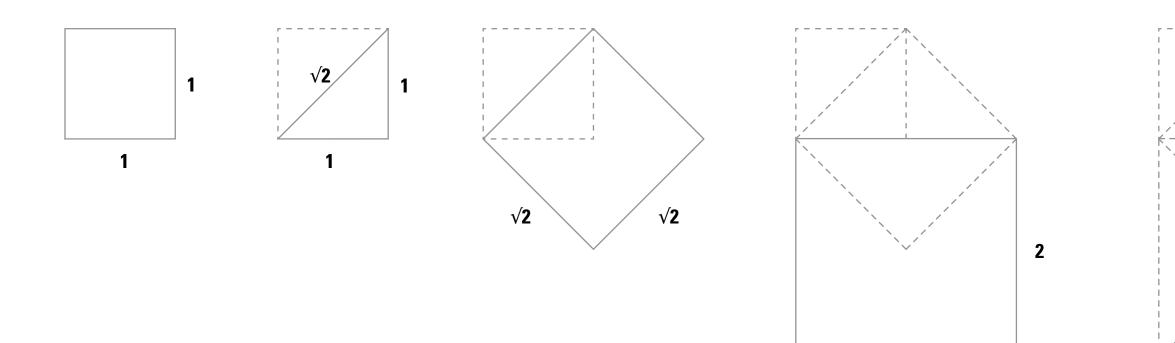
#### **F-stop System**

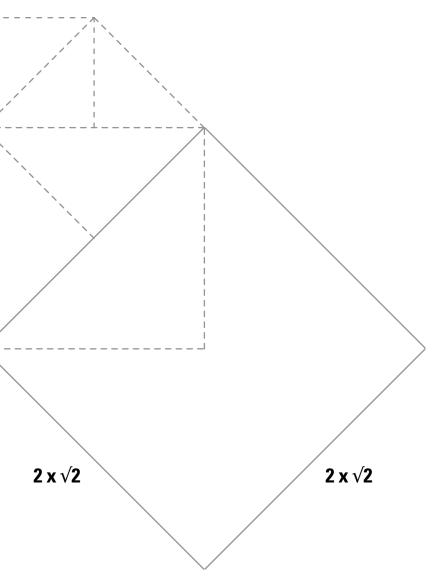
The f-stop is the ratio of the camera lens focal length to the diameter of the entrance pupil. The f-stop numbering is a system in relation to the lens aperture based on the square root of 2.



#### SLOW/ NARROW

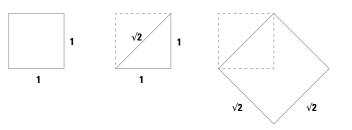
**LESS BLUR/ MORE IN FOCUS** 

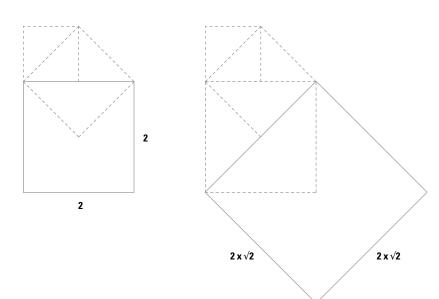




## f/2.8 f/4 f/5.6 f/8 f/11 f/16 f/22

 $2 \times \sqrt{2} = 2.8$ f/2.8  $2.8 \times \sqrt{2} = 4$ f/4  $4 \times \sqrt{2} = 5.6$ f/5.6  $5.6 \times \sqrt{2} = 8$ f/8  $8 \times \sqrt{2} = 11$ f/11  $11 \text{ x} \sqrt{2} = 16$ f/16  $16 \text{ x} \sqrt{2} = 22$ f/22



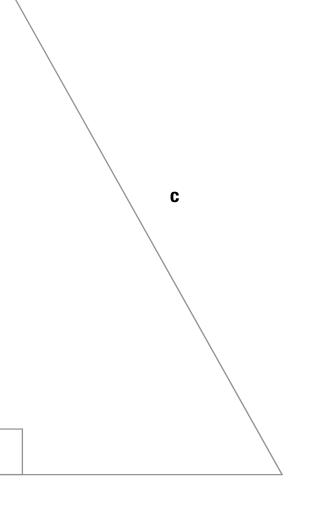


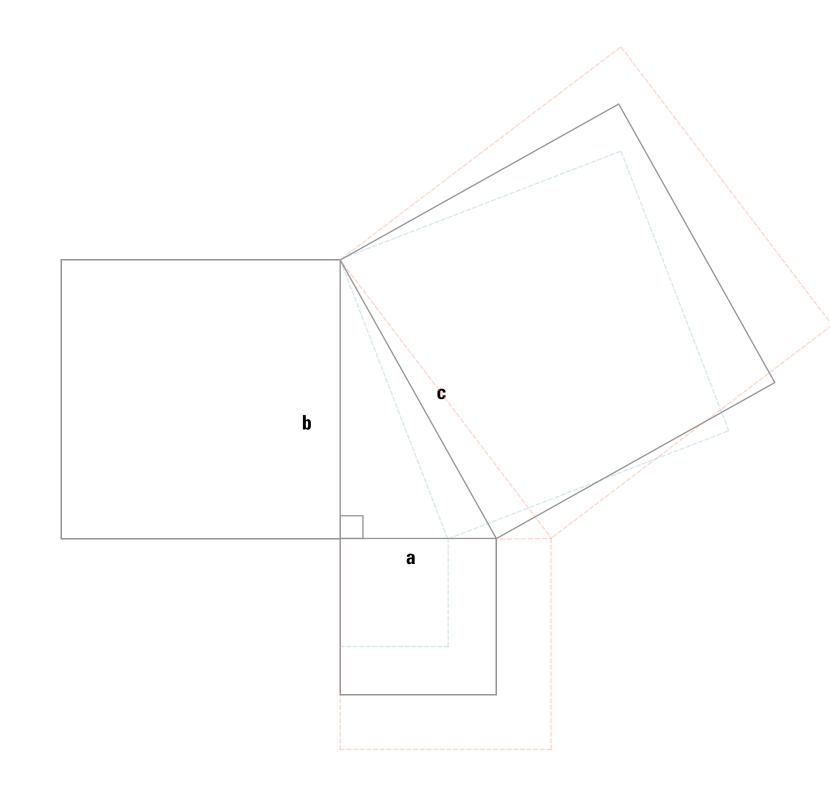
#### **Pythagorean Theorem Proof**

The Pythagorean Theorem states that in a right triangle, the square of side a plus the square of side b is equal to the square of side c, often referred to as the hypotenuse. The length of the hypotenuse is dependent on the length of the two sides of the triangle.

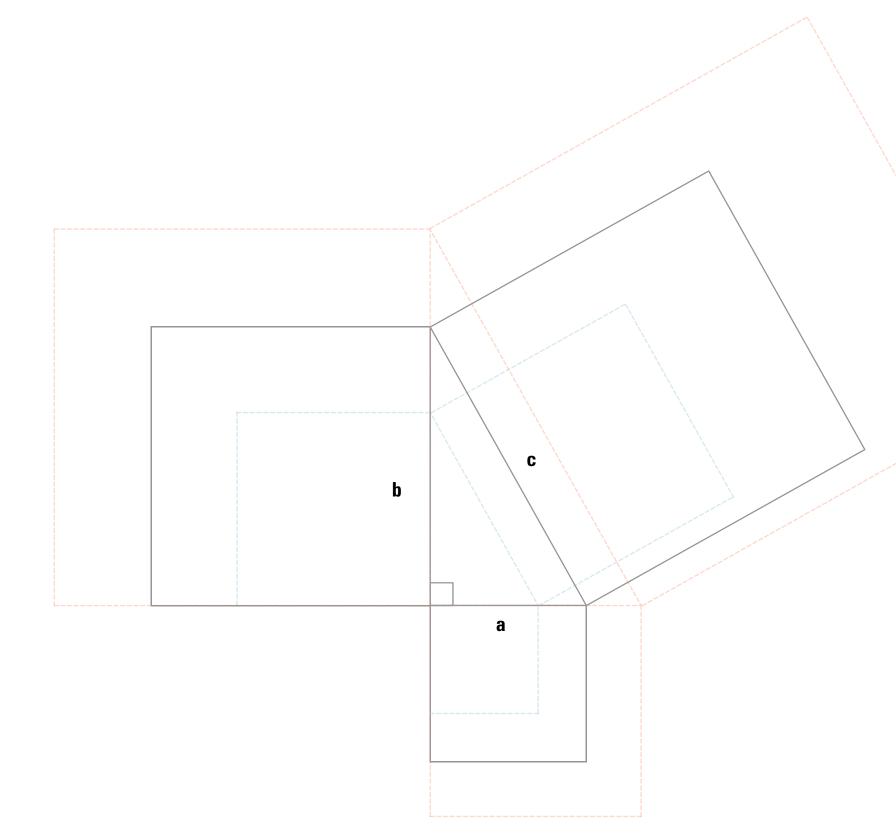
b

#### $a^2 + b^2 = c^2$



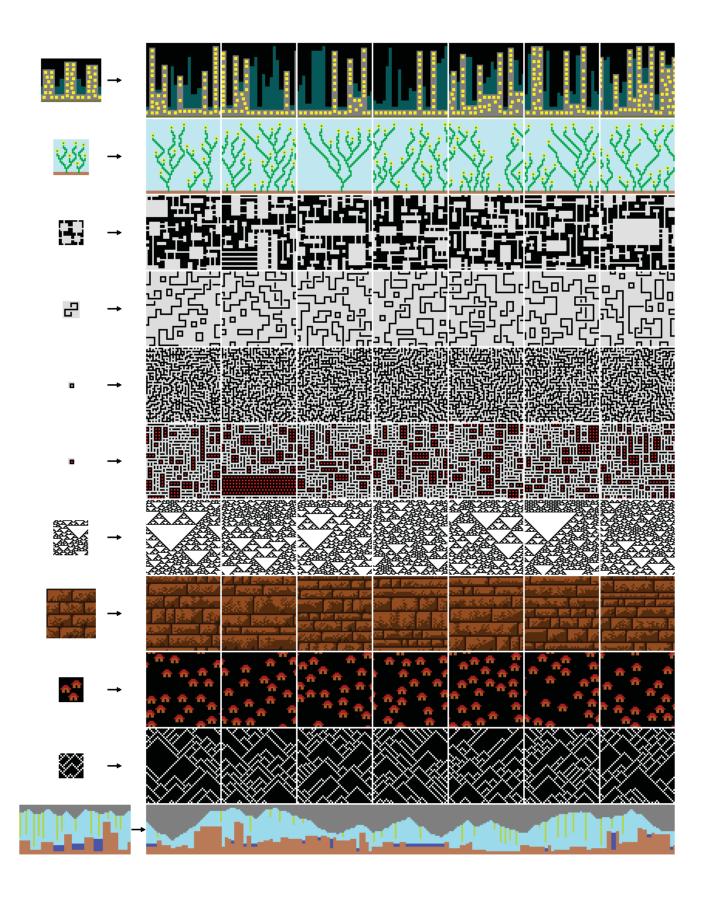


300

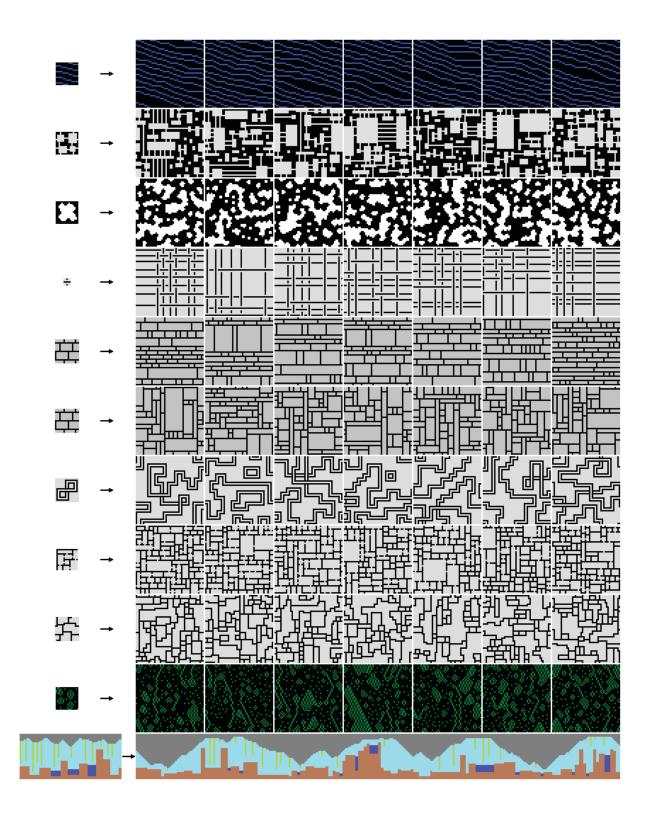


#### Wave Function Collapse

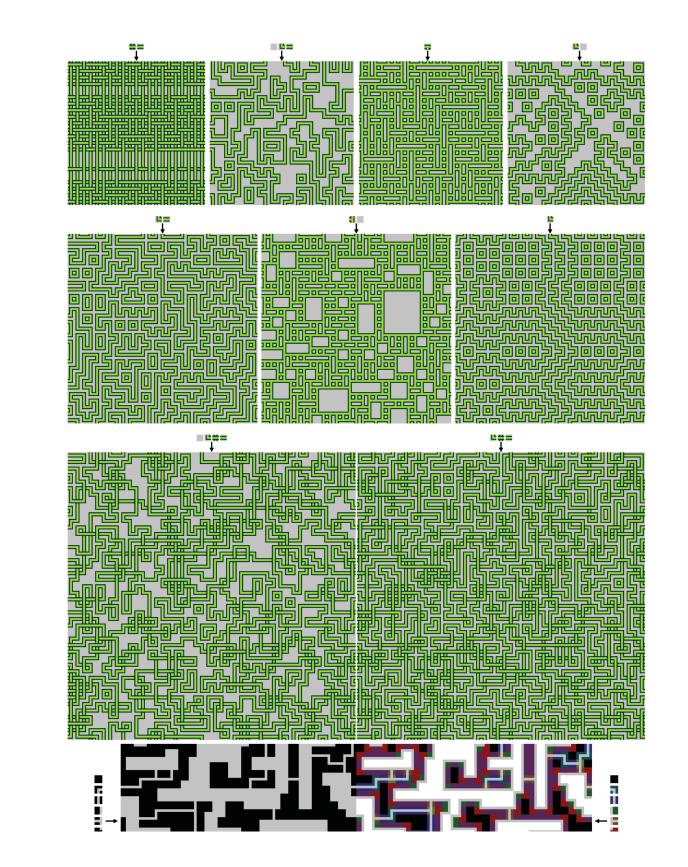
A program that generates bitmaps that are locally similar to the input bitmap.



302



https://github.com/mxgmn/WaveFunctionCollapse



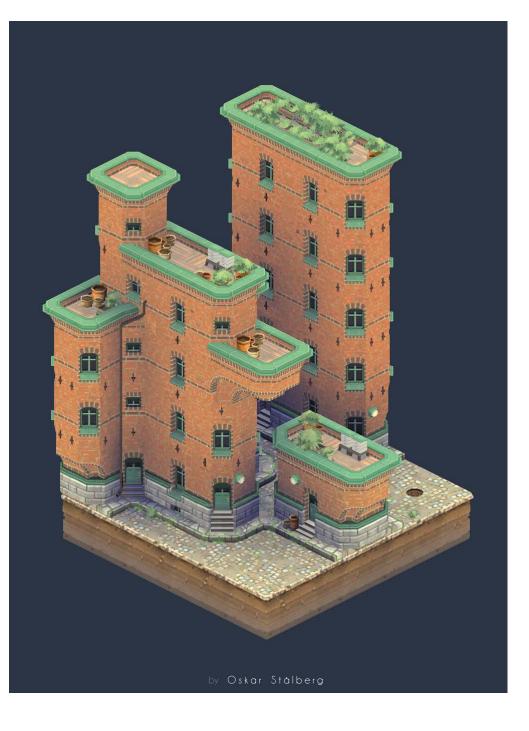
#### **Brick Block**

### **Oskar Stálberg**

# A browser-based procedural building generator.



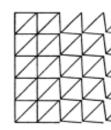


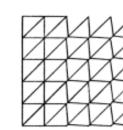


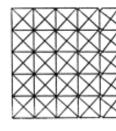


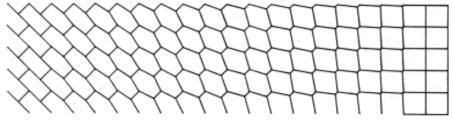
#### **Parquet Deformation**

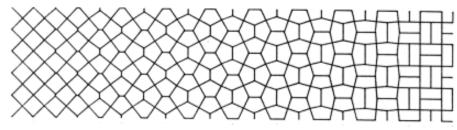
#### William Huff, 1960's A term to describe a regular pattern of tiles that transforms from left to right whilst maintaining the regularity of the tiling.

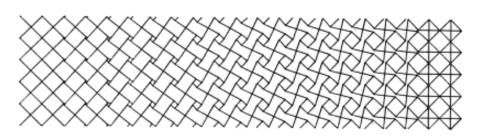




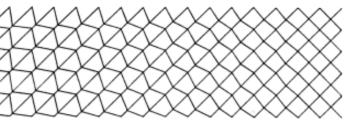


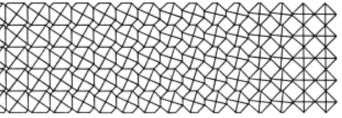


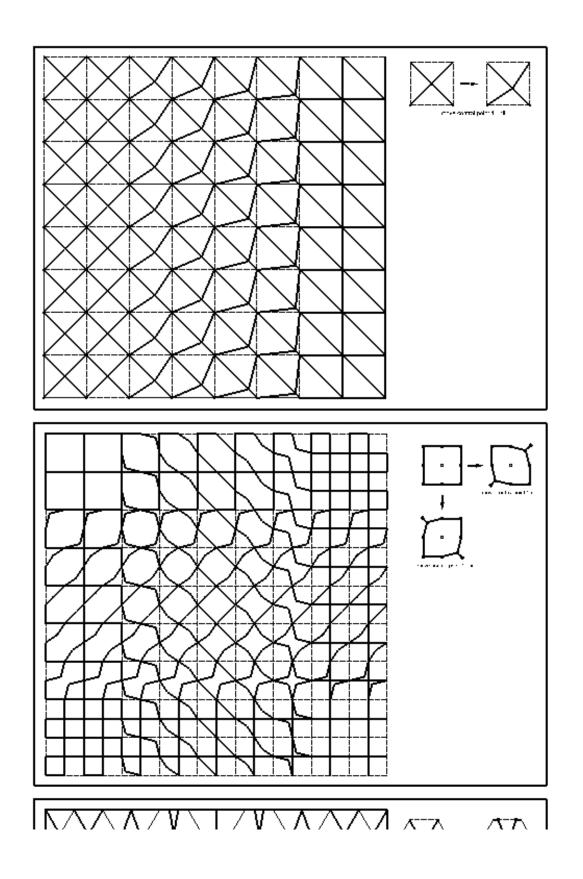


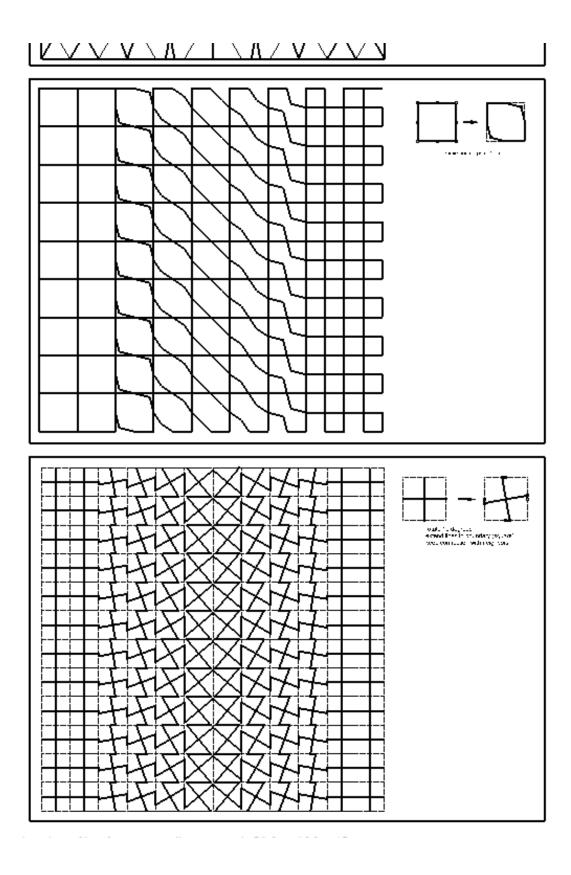






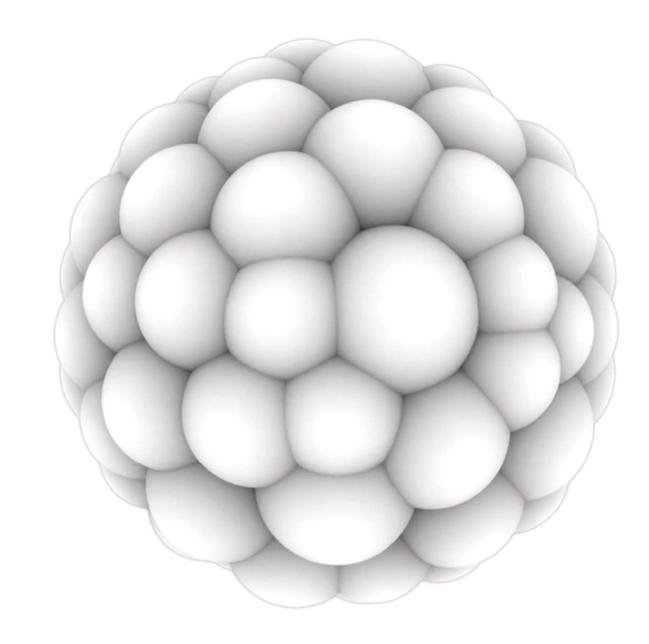


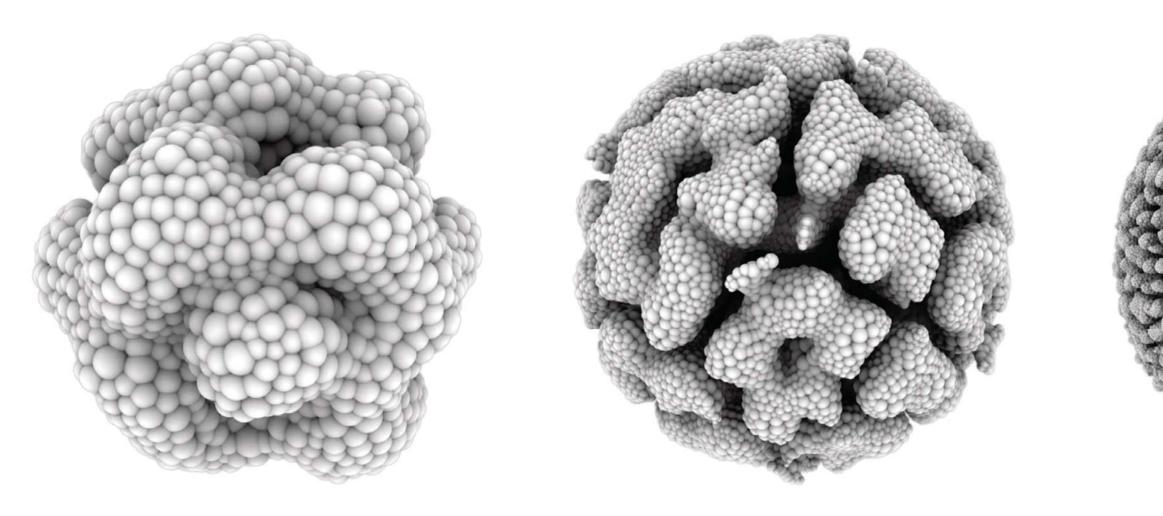


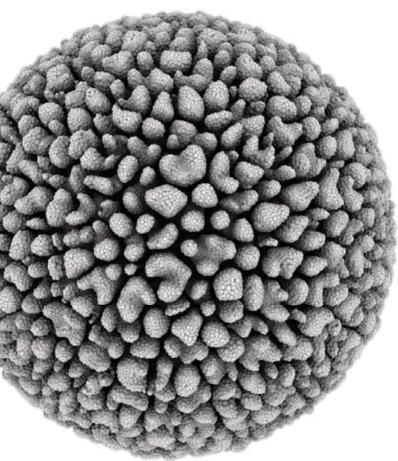


#### **Cellular Forms**

**Andy Lomas** Digitally generated structures using simulation of morphogenesis.





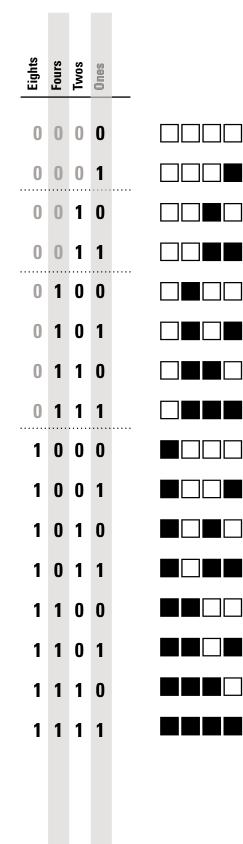


#### **Numbering Systems**

310

#### **Binary**

Expressed in the Base-2 numeral system which is comprised by 0's and 1's. This system is used by almost all modern computers and computer-based devices.



#### Base-3

Also known as the ternary number system, it shows all possible combinations of the elements.

	Nines	Threes	Ones			
	0	0	0			
	0	0	1			
	0	0	2			
•••••	0	1	0			
	0	1	1			
	0	1	2			
	0	2	0			
	0	2	1			
	0	2	2			
• • • • • • • •	1	0	0	•••••		
	1	0	1			
	1	0	2			
	1	1	0			
	1	1	1			
	1	1	2			
	1	2	0			
	1	2	1			
	1	2	2			
	2	0	0			
	2	0	1			
	2	0	2			
	2	1	0			
	2	1	1			
	2	1	2			
	2	2	0			
	2	2	1			
	2	2	2			

#### Base-10

Also known as the decimal system because a digit's value in a number is determined by its relationship to the decimal point. It is made up of 10 digits to possibily represent the 10 fingers on a human hand.

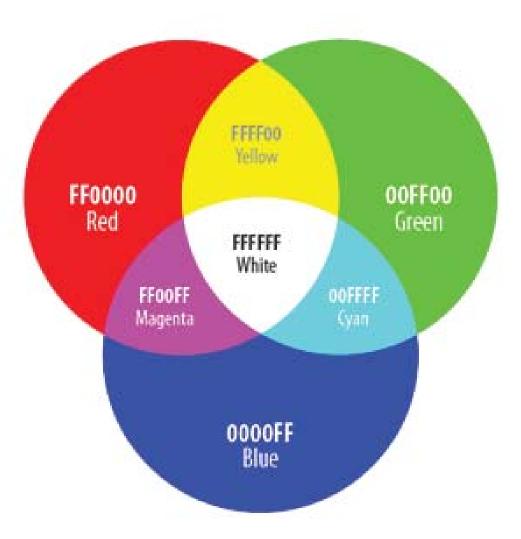
Thousands	Hundreds	Tens	Ones	
			0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
		1	9	
		1		
		1	1	
		1	2	
		1	3	
		1	4	
		1	5	
		1	6	
		1	7	
		1	8	
		1	9	

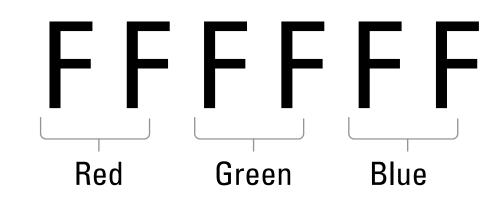
#### Hexadecimal

A Base-16 positional system made up of 16 distinct symbols; 0–9 to represent vales zero through nine and symbols A–F to represent values ten through fifteen

$16^5 = 1048576$	$16^4 = 65536$	$16^3 = 4096$	$16^2 = 256$	$16^{1} = 16$	$16^{\circ} = 0$	
0	0	0	0	0	0	
0	0	0	0	0	1	
0	0	0	0	0	2	
0	0	0	0	0	3	
0	0	0	0	0	4	
0	0	0	0	0	5	
0	0	0	0	0	6	
0	0	0	0	0	7	
0	0	0	0	0	8	
0	0	0	0	0	9	
0	0	0	0	0	A	•••
0	0	0	0	0	B	
0	0	0	0	0	C	
0	0	0	0	0	D	
0	0	0	0	0	Ε	
0	0	0	0	0	F	
0	0	0	0	1	0	•••
0	0	0	0	1	1	
0	0	0	0	1	F	
F	F	F	F	F	F	

. . . . . . .





#### **Unique Combinations**

1																										
	A	B	C	D	E	F	G	H	1	J	K	L	M	N	0	P	0	R	S	T	U	V	W	X	Y	Z
A	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	A0	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ
В	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	B0	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ
C D	CA	CB		CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN	C0	CP	CQ	CR	CS	CT	CU	CV	CW	CX	CY	CZ
E	DA EA	DB EB	DC EC	DD	DE	DF EF	DG EG	DH	DI	DJ EJ	DK EK	DL	DM	DN EN	DO EO	DP EP	DQ EQ	DR ER	DS	DT ET	DU EU	DV EV	DW	DX	DY EY	DZ
F	FA	FB	FC	ED FD	EE FE	FF	FG	FH	FI	FJ	EK FK	EL FL	EM FM	EN FN	FO	EP FP	FQ.	En FR	ES FS	FT	FU	EV	FW	EX FX	FY	EZ FZ
r G	GA	GB	GC	GD	GE	GF	GG	GH	GI	rj Gj	GK	GL	GM	GN	GO	GP	GQ	GR	GS	GT	GU	GV	GW	GX	GY	GZ
н	HA	НВ	нс	HD	HE	HF	HG	НН	н	HJ	нк	HL	HM	HN	но	HP	НΩ	HR	HS	нт	HU	HV	нw	нх	нү	HZ
	IA	IB	IC	ID	IE	IF	IG	ін		IJ	IK	IL	IM	IN	10	IP	10	IR	IS	ш	10	IV	IW	IX	IY	IZ
' J	JA	JB	JC	JD	JE	JF	JG	JH	JI	JJ	JK	JL	JM	JN	10 J0	יי JP	Jα	JR	JS	JT	JU	JV	JW	JX	JY	JZ
ĸ	КА	КВ	кс	KD	KE	KF	KG	КН	KI	KJ	КК	KL	км	KN	ко	KP	ка	KR	KS	кт	ки	ку	кw	кх	KY	KZ
Ľ	LA	LB	LC	LD	LE	LF	LG	LH	LI	LJ	LK	LL	LM	LN	LO	LP	LQ	LR	LS	LT	LU	LV	LW	LX	LY	LZ
м	MA	MB	MC	MD	ME	MF	MG	MH	MI	MJ	MK	ML	MM	MN	MO	MP	МΩ	MR	MS	MT	MU	MV	MW	МХ	MY	MZ
N	NA	NB	NC	ND	NE	NF	NG	NH	NI	NJ	NK	NL	NM	NN	NO	NP	ΝQ	NR	NS	NT	NU	NV	NW	NX	NY	NZ
0	0A	OB	00	OD	0E	OF	OG	OH	01	OJ	ОК	OL	0M	ON	00	OP	00	OR	OS	OT	OU	٥v	0W	OX	OY	0Z
Р	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL	PM	PN	PO	PP	PQ	PR	PS	PT	PU	PV	PW	РХ	РҮ	ΡZ
۵	۵A	۵B	۵۵	۵D	QE	۵F	۵G	۵H	۵١	۵J	۵ĸ	QL	۵M	۵N	۵۵	۵P	۵۵	۵R	۵۵	۵T	۵۷	۵۷	۵W	۵Χ	۵Y	۵Z
R	RA	RB	RC	RD	RE	RF	RG	RH	RI	RJ	RK	RL	RM	RN	RO	RP	RQ	RR	RS	RT	RU	RV	RW	RX	RY	RZ
S	SA	SB	SC	SD	SE	SF	SG	SH	SI	SJ	SK	SL	SM	SN	SO	SP	sa	SR	SS	ST	SU	SV	SW	SX	SY	SZ
т	TA	ТВ	TC	TD	TE	TF	TG	TH	TI	TJ	ТК	TL	тм	ΤN	TO	ТР	тα	TR	ΤS	TT	TU	τv	тw	тх	ТҮ	ΤZ
U	UA	UB	UC	UD	UE	UF	UG	UH	UI	UJ	UK	UL	UM	UN	UO	UP	υQ	UR	US	UT	UU	UV	UW	UX	UY	UZ
v	VA	VB	VC	VD	VE	VF	VG	VH	VI	VJ	VK	VL	VM	VN	VO	VP	٧Q	VR	VS	VT	VU	VV	vw	vx	VY	٧Z
w	WA	WB	WC	WD	WE	WF	WG	WH	WI	WJ	WK	WL	WM	WN	W0	WP	wa	WR	WS	WT	WU	wv	ww	WX	WY	WZ
x	XA	ХВ	XC	XD	XE	XF	XG	XH	XI	XJ	ХК	XL	ХМ	XN	XO	XP	xα	XR	XS	ХТ	XU	xv	xw	хх	ХҮ	XZ
Y	YA	YB	YC	YD	YE	YF	YG	YH	ΥI	YJ	YK	YL	YM	YN	YO	ΥP	ΥQ	YR	YS	ΥT	YU	Y٧	YW	ΥX	ΥY	ΥZ
z	ZA	ZB	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ	ZK	ZL	ZM	ZN	ZO	ZP	ZQ	ZR	ZS	ZT	ZU	ZV	ZW	ZX	ZY	ZZ

## (n<sup>2</sup>-n) 2

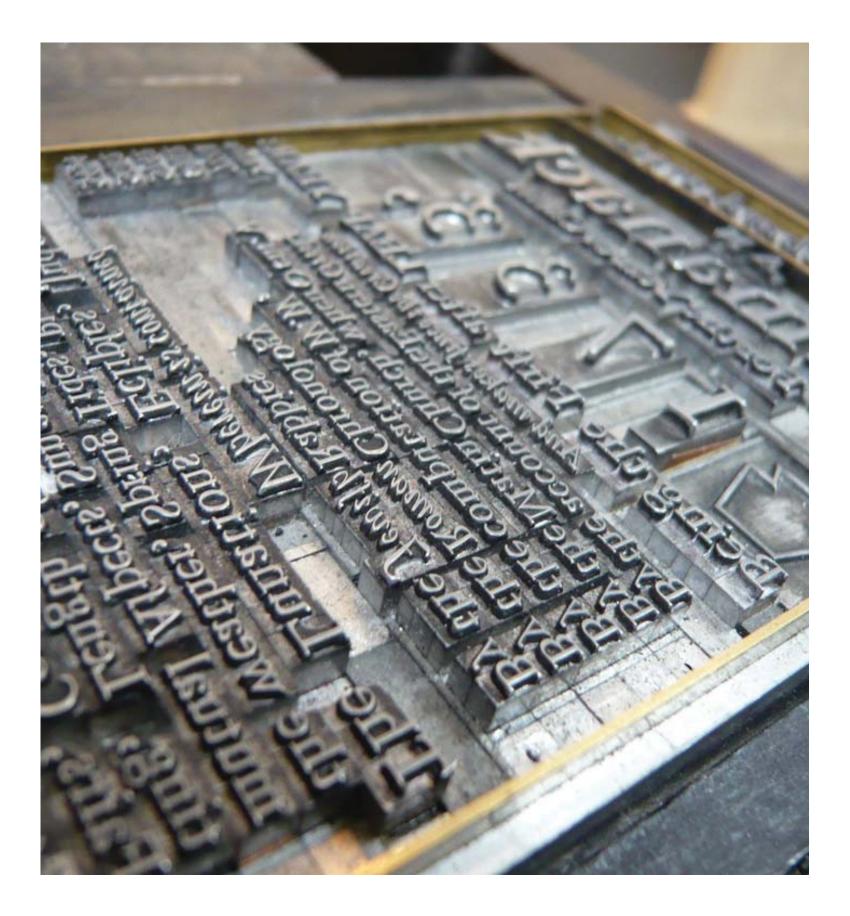
### Movable Type

**Bi Sheng, 990–1051 AD** Originating in China, the first movable type was constructed out of small clay blocks. The blocks are able to be rearranged to make the printing process more efficient and easier.



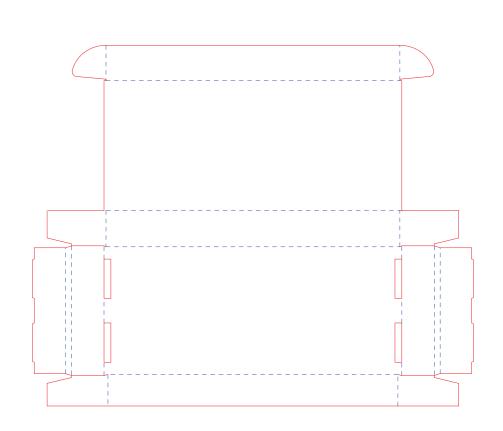


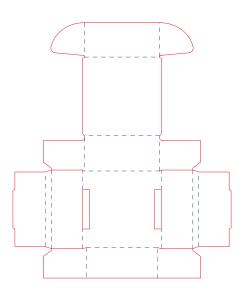
#### Johannes Gutenberg, 1450



#### **Dielines**

Usage of the same dieline for different sized boxes.



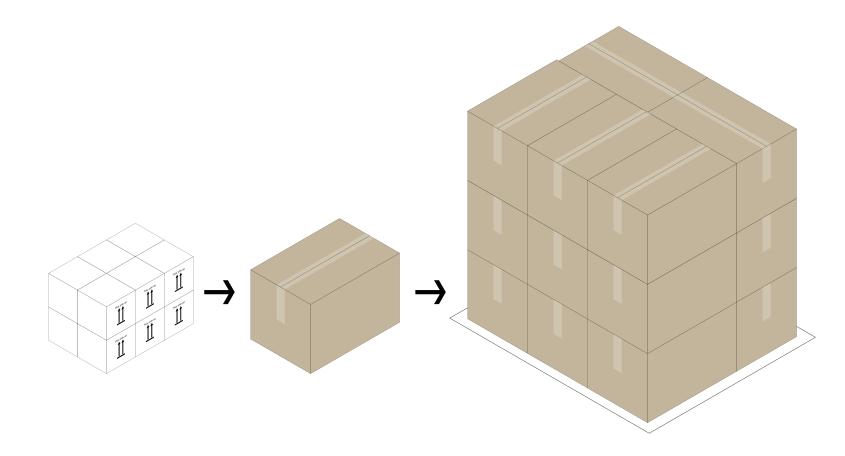


#### **Responsive Design**



#### **Palletization**

The process of placing and arranging goods or materials onto pallets for shipping and storage.





Once a pallet sized is determined, the boxes are configured in a specific layout that is both efficient and effective for the shipping process.

An example of filled pallets with stacked boxes inside warehouse shelving units.





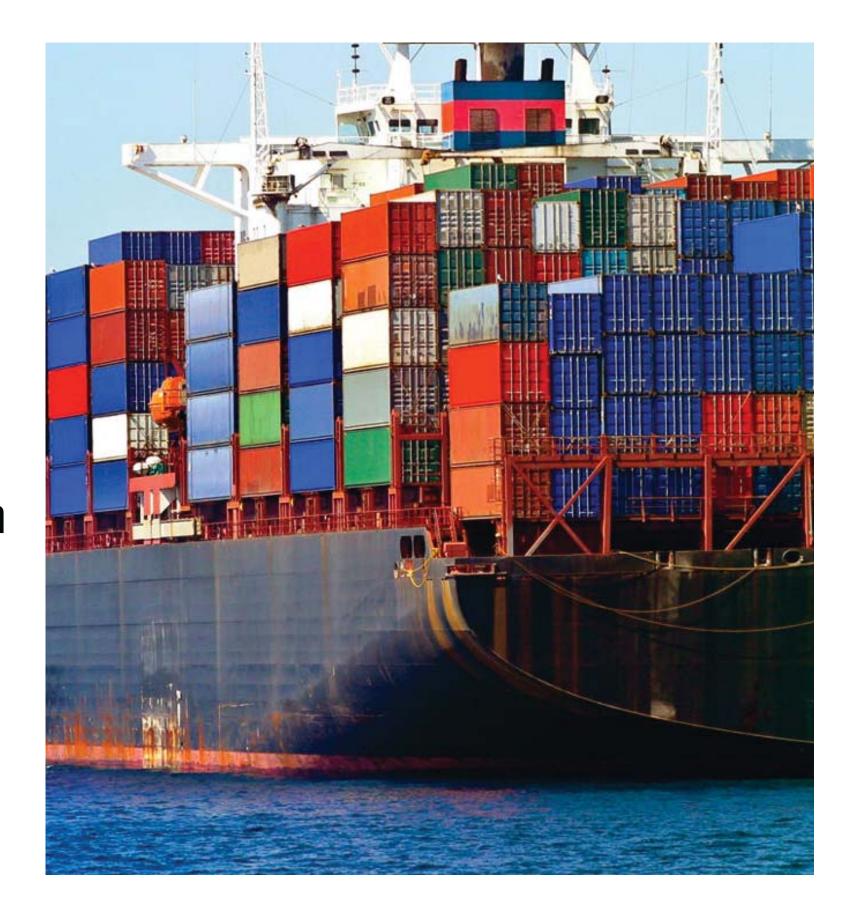
An example of a filled shipping container.

Intermodal transportation of containers.

#### Containerization

#### SeaLand, 1960

Originally founded by American trucking entrepreneur, Malcom McLean, revolutionized the shipping industry by packing goods through a system of uniform intermodal containers.

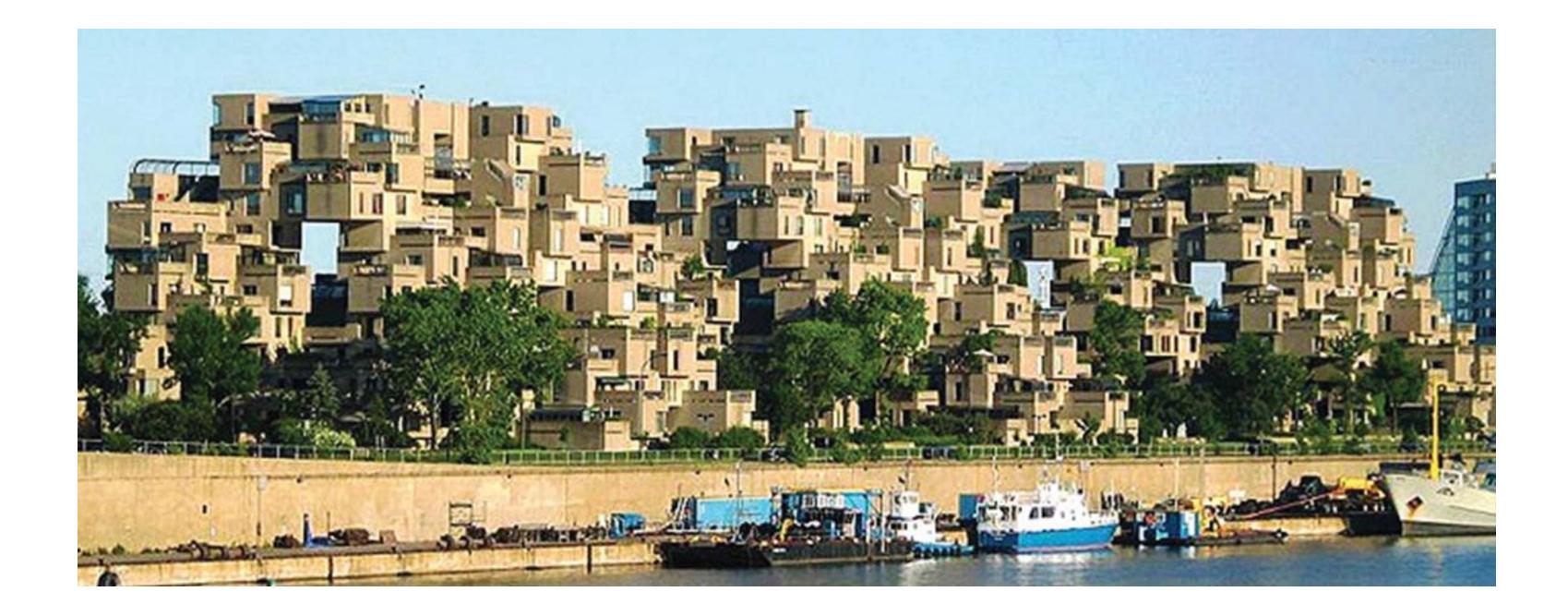


#### Habitat 67

#### Moshe Safdie, 1967

This minimalist housing complex is compromised of 354 identical concrete modules arranged in various combinations to create one of the most recognizable architectural landmarks in both Montreal and Canada.

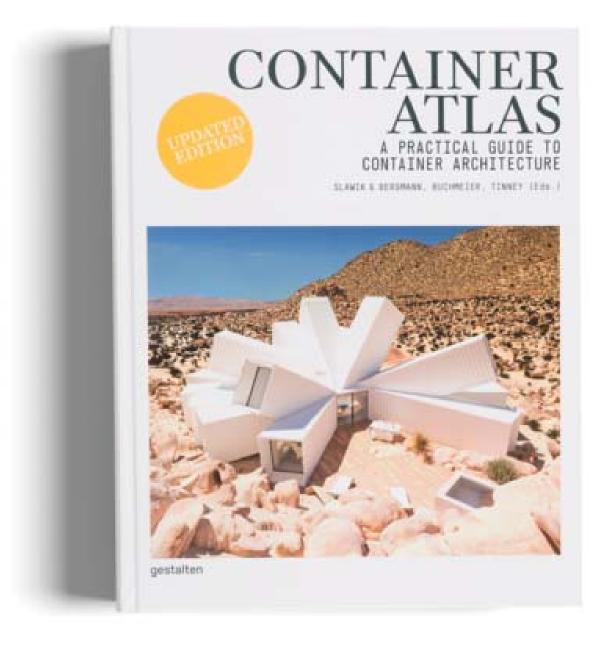




#### **Container Atlas: A Practical Guide to Container Architecture**

### Hans Slawik, 2010

Architect and professor Han Slawik, provides insight into container architecture and its evolution around the world. He reclaims and reuses modular shipping containers to create different structures.





Vener JOSHUA TREE RESIDENCE WHITAKER STUDIO





E1, 83 Internet remains strategy indicates providing and true the pertains will. 80, 94 Internet remains strategy to tune applicat the strategy. Delition or Indicate.



to catch the i private space rooms face a attion was de cuttance in i architects, w are open, you and hold out



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#### **Science Classification Systems**

Dubberly Design Office · Systems Theory in Design-Design Systems · 07 July 2020

329

#### **Periodic Table**

Dmitri Mendeleev, 1871 Russian chemist, Dmitri Mendeleev, arranged the elements based on atomic mass and arranged them in groups with similar properties.

Reihen	Grappo I. — R*0	Gruppo 11. R0	Gruppo III. R <sup>1</sup> 0 <sup>3</sup>	Gruppe IV. RH4 RO <sup>2</sup>	Groppe V. RH <sup>2</sup> R <sup>2</sup> 0 <sup>5</sup>	Grappo VI. RHª RO'	Gruppe VII. RH R*0'	Gruppo VIII. RO
1	II=1							
2	Li=7	Be=9,4	B==11	C=12	N=14	0=16	F=19	
\$	Na=23	Mg = 24	A1=27,8	Si=28	P=31	8=32	Cl== 35,5	
4	K=39	Ca= 40	-==44	Ti== 48	V==51	Cr= 52	Mn=55	Fo=56, Co=59, Ni=59, Cu=63.
5	(Cu=63)	Zn==65	-=68	-=72	As=75	So=78	Br== 80	
6	Rb == 86	Sr=87	?Yt=88	Zr= 90	Nb == 94	Mo=96	-==100	Ru=104, Rh=104, Pd=106, Ag=108.
7	(Ag≈108)	Cd=112	In==113	Sn==118	Sb==122	Te=125	J=127	
8	Cs== 133	Ba=187	?Di=138	?Co==140	-	-	-	
9	()	- 1	- 1	-	-	-	-	
10	-	-	?Er=178	?La=180	Ta=182	W=184	-	Os=195, Ir=197, Pt=198, Au=199.
11	(Au=199)	flg=200	Ti== 204	Pb=207	Bi==208	- 1	-	
12	-	-	-	Th=231	-	<b>U</b> ==240	-	

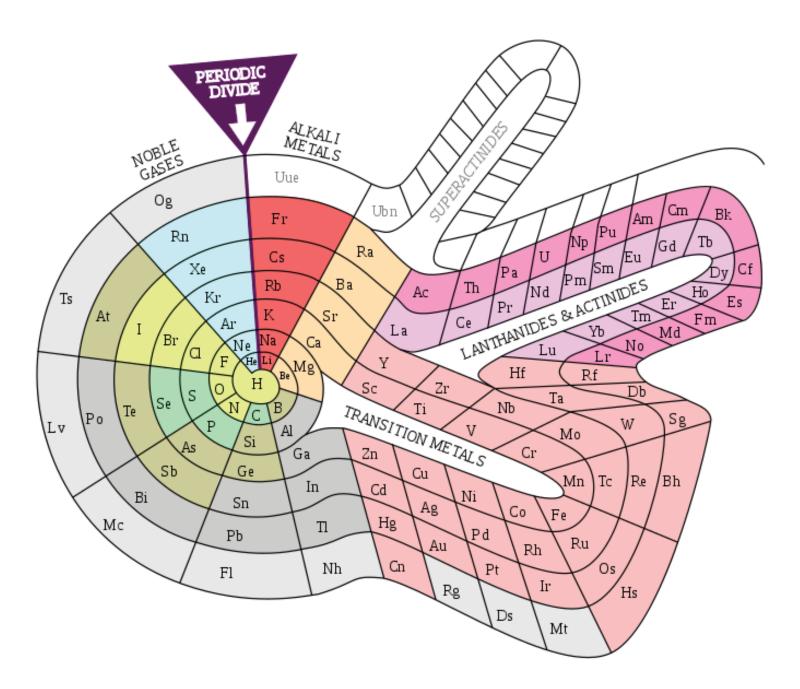
H = 18-11 C = 120 = 16Li = 7 Na = 23?Er=56 La=94

Zr = 90? = 180.Ti = 50Nb- 94 Ta-182. V == 51 Cr=52 Mo= 96 W=186. Mn=55 Rh=104,4 Pt=197,4 fe = 56Rn-104.4 Ir=198. NI-Co=59 PI=106.8 0-=199. Cu-63.4 Ag-108 Hg-200. Be = 94 Mg = 24 Zn = 652 Cd = 112 A1=27.1 ?=68 Ur=116 Au=197? Si = 28 ?= 70 Sn = 118P-31 As=75 Sb=122 Bi=210? S=32 Se=79,1 Te=128? F=19 Ci=35,6Br=80 1-127 K=39 Rb=85,4 Cs=133 TI=204. Ca=40 Sr=87. Ba=137 Pb=207. ?=45 Ct=92 ?Y1=60 Di=95 ?In - 75,6 Th = 118?

#### **Spiral Periodic Table**

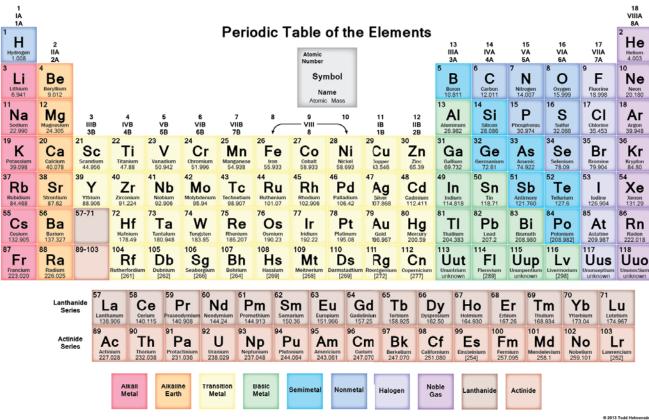
#### **Theodor Benfey, 1964**

A two-dimensional spiral that was a model of an extended periodic table.



#### **Modern Periodic Table**

An arrangement of chemical elements organized by their atomic numbers, electron configurations and recurring properties. The standard table consists of rows (periods) and columns (groups).



chemistry.about.com sciencenotes.org

#### **Binomial Naming**

#### Carl Linnaeus, 1735

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8	Canis. Meks	Diger andere eine bei gest. 6 uteren.	Casa Lapan Sprintil Vajva Tauta		Pelecanus. Cygnus. Anas.	byle, depentien , acto organizare, inderes bork industria. Byle, maine-corresan, Ayle, maine-depentien.	Giun Ellen Ander And Burnicle. Anne fein, Graudum, Baltina, Guardan, Francisco, Guargantick.	РАКАДОХА. Нтова сорон верша, рейли филон, сейк б. рин, к токата срадом, какта едена, кйетеат Нап- метр, блайная перена Кулан Арасаруаса 43. 50- ами Сал. п. В. зак. облоро. Екроп верша петь альны брена растика и байло. Какта бай от напал брена притика регибуска, байло. Какта бай от	NTIN NTIN	Zen, Cottus, Trigla.	Corpar competion. Space Stations. Methods bands alls. 6. Corps colorana , corpore Main. Agendus al pice. prd. Stational a set p.	Apri. Faler, Caller mar. Centralias, Scorpto mar. Centra, Gallo A. copt. Lyna, Genardia,		Attalabus. Cantharis. Carabus.	<ul> <li>das, familios, confronte anirale no- bernacios, preservaira, goscian.</li> <li>A Astronas forenças.</li> <li>Conse pietras, mengio melipar presis.</li> <li>Lipose fectula.</li> <li>Conse free glaza.</li> </ul>	Castaria da. Castaria da. Castaria famina. Castarilia surena.		Haliotia.	Tefensintini, paula, lenter coeses, potenin, al agalem Quela.	Auto terms.
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Special thanks to Chuck Bigelow Lou Danziger Paul Kahn Roger Remington Knut Synstad Jamie Ikeda

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