CPSC 100

Computational Thinking

Data Visualization

Instructor: Firas Moosvi
Department of Computer Science
University of British Columbia

Course Admin

Course Admin

- All of the **resubmissions** to Milestone 2 have been graded!

- **Reminder:** Project Milestone 3 is due tonight at 6 PM (the regular grace period applies)

- Check Ed Discussion for the example I shared!

Here is an example:

- A group of four students (Nancy, Robin, and Vecna) are called **STRANGER_THINGS** and they want to aim for an A+ project
- **STRANGER_THINGS** chooses from one of the **5 broad themes**: "*Financial and Environmental impacts of Technology*"
- The group has a main **area of inquiry**: "*Electric cars and Self Driving Cars*" and each member has the following interests/angles/slants/directions:
    - **Vecna** wants to investigate how AI is affecting car manufacturing companies particularly from a financial and economic side. Vecna plans to explore this concept using the following course topics:
        - AI (1)
        - Ethics and Computer Science (2)
        - Social Implications and Computing (3)
        - Data Storage (4)
        - Data Security (5)
    - **Max** wants to explore the environmental and social/ethical impacts of electric vehicles. Vecna plans to explore this concept using the following course topics:
        - AI
        - Ethics and Computer Science
        - Social Implications and Computing
        - Data Privacy (6)
    - Nancy wants to explore the financial and environmental impacts of companies like Waymo using self-driving cars for ride-sharing. Vecna plans to explore this concept using the following course topics:
        - AI
        - Algorithms (7)
        - Data Representation (8)
        - Data Mining (9)
        - Data Security

Learning Goals (Part 1)

After this **today's lecture**, you should be able to:

- Define infographics and their role in conveying information effectively.
  - Understand the difference between infographic vs. visualization
- Recognize, define and apply high-level principles of infographic design
- Identify strengths and weaknesses in infographic designs based on high-level principles.

Learning Goals (Part 2)

After this **today's lecture**, you should be able to:

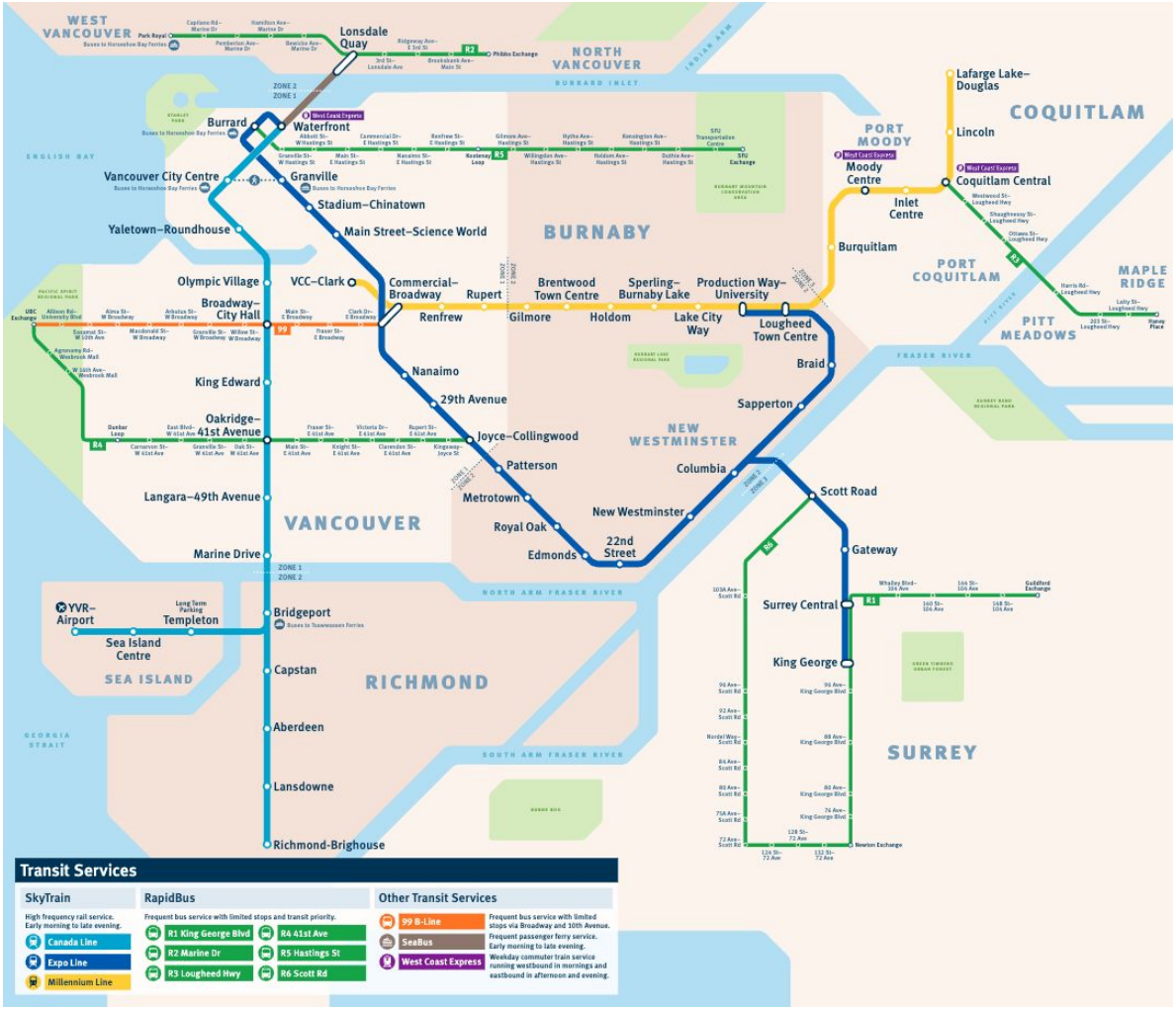
- Explain how different chart types are used to represent and compare data.
- Apply knowledge of data types (categorical, quantitative) to select suitable visualizations to convey information.
- Explain how different visualizations contribute to an effective data story.

After watching the **take-home video**, you should be able to:

- Differentiate between effective and ineffective use of **visualization channels** in data representation.

Infographics

Vancouver


WEST VANCOUVER
NORTH VANCOUVER
BURNABY
COQUITLAM
PORT MOODY
PORT COQUITLAM
MAPLE RIDGE
PITT MEADOWS
NEW WESTMINSTER
VANCOUVER
RICHMOND
SEA ISLAND
SURREY
Lonsdale Quay
Burrard
Waterfront
Vancouver City Centre
Granville
Stadium–Chinatown
Yaletown–Roundhouse
Main Street–Science World
Olympic Village
VCC–Clark
Commercial–Broadway
Rupert
Renfrew
Broadway–City Hall
Brentwood Town Centre
Gilmore
Holdom
Sperling–Burnaby Lake
Production Way–University
Lake City Way
Lougheed Town Centre
Burquitlam
Moody Centre
Inlet Centre
Coquitlam Central
Lafarge Lake–Douglas
Lincoln
King Edward
Oakridge–41st Avenue
Nanaimo
29th Avenue
Joyce–Collingwood
Patterson
Metrotown
Royal Oak
Edmonds
22nd Street
New Westminster
Columbia
Braid
Sapperton
Scott Road
Gateway
Surrey Central
King George
Langara–49th Avenue
Marine Drive
Bridgeport
YVR–Airport
Templeton
Sea Island Centre
Capstan
Aberdeen
Lansdowne
Richmond-Brighouse
Transit Services
SkyTrain
High frequency rail service. Early morning to late evening.
Canada Line
Expo Line
Millennium Line
RapidBus
Frequent bus service with limited stops and transit priority.
R1 King George Blvd
R2 Marine Dr
R3 Lougheed Hwy
R4 41st Ave
R5 Hastings St
R6 Scott Rd
Other Transit Services
99 B-Line
Frequent bus service with limited stops via Broadway and 10th Avenue.
SeaBus
Frequent passenger ferry service. Early morning to late evening.
West Coast Express
Weekday commuter train service running westbound in mornings and eastbound in afternoon and evening.

What are Infographics?

"Information graphics or infographics are **visual representations of data**, information, or knowledge intended to **present the idea quickly succinctly, and clearly."** (Wikipedia)

- Static representation that conveys a specific message
- Typically includes graphics and stats (but it doesn't have to)
- Images used do not necessarily have to encode data

Infographics vs. Visualization

- An infographic is a **static representation** that conveys a specific message. It typically includes graphics and stats but doesn't have to.

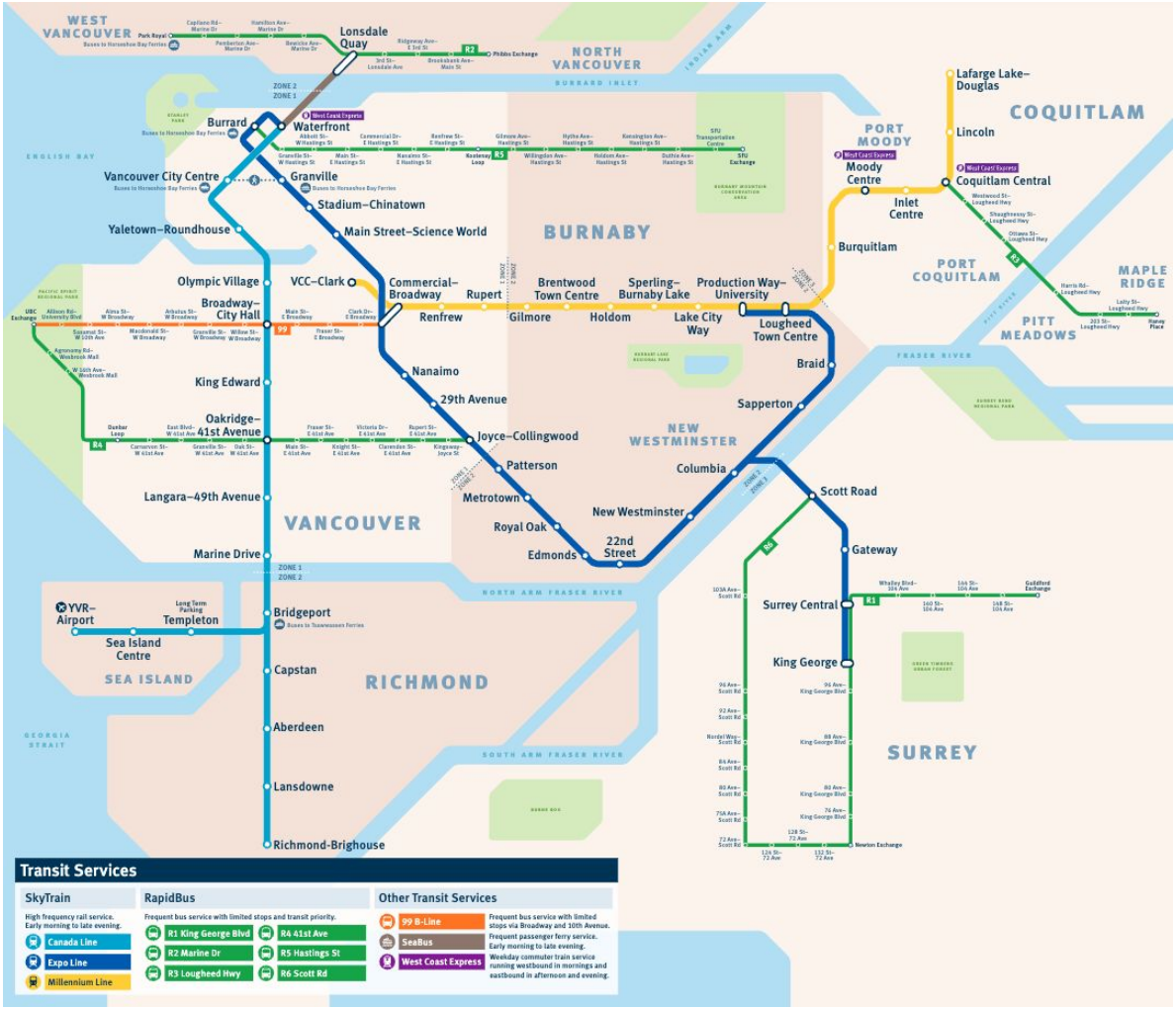
- Visualization can be an **interactive or static representation** that primarily uses visual marks to encode data.

Why Infographics?

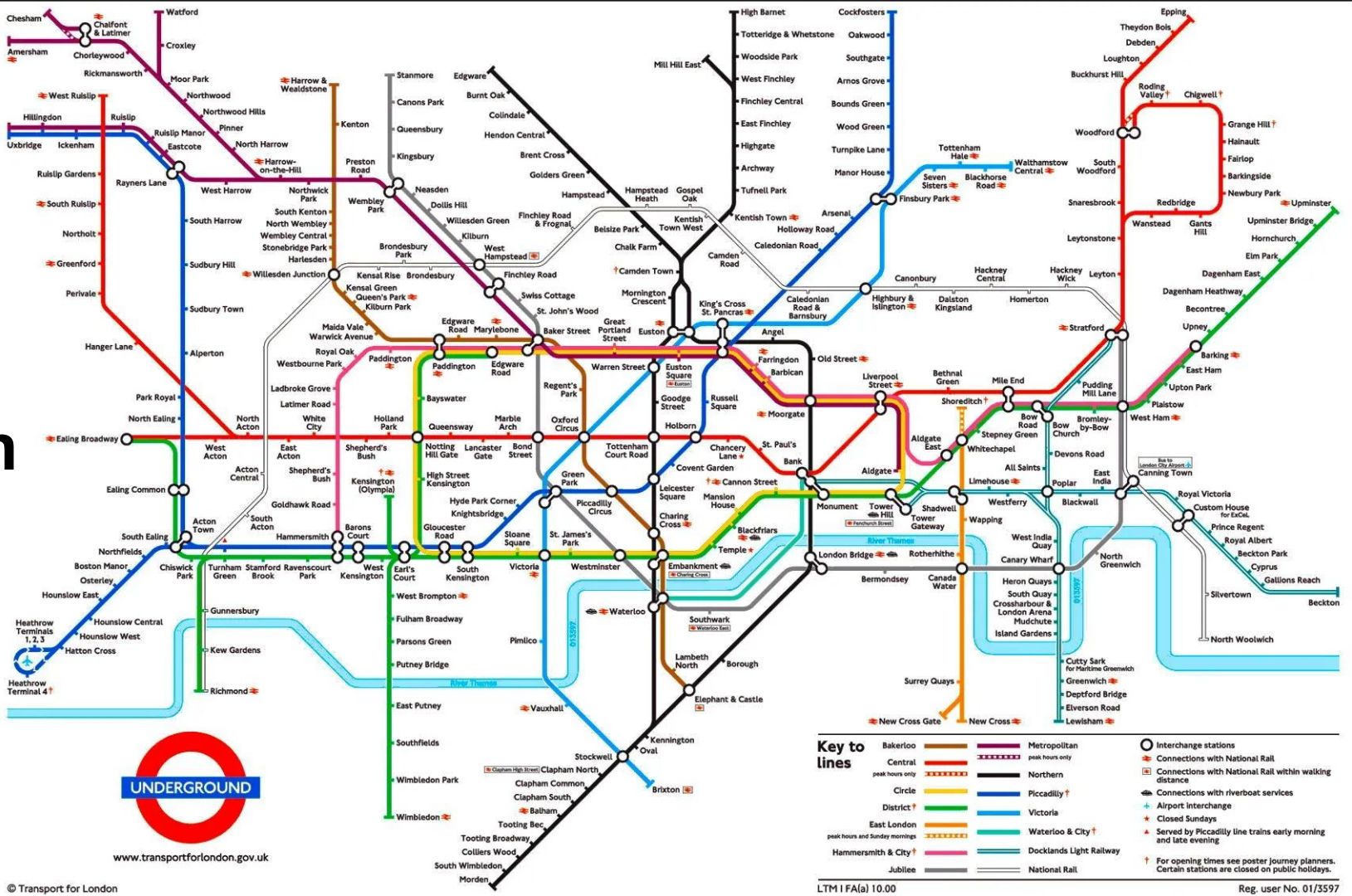
- Improve Comprehension and Retention
  - mix of text, visuals, and icons to break down complex ideas
- Enhance Engagement
  - attracts more attention than plain text
- Simplify Data and Statistics
  - make numbers more understandable*
    - * = simplification should not compromise the accuracy of the data
- Increase Information Accessibility
  - bridge language and literacy gaps by using icons, symbols, and structured layouts

Examples: Transit Maps

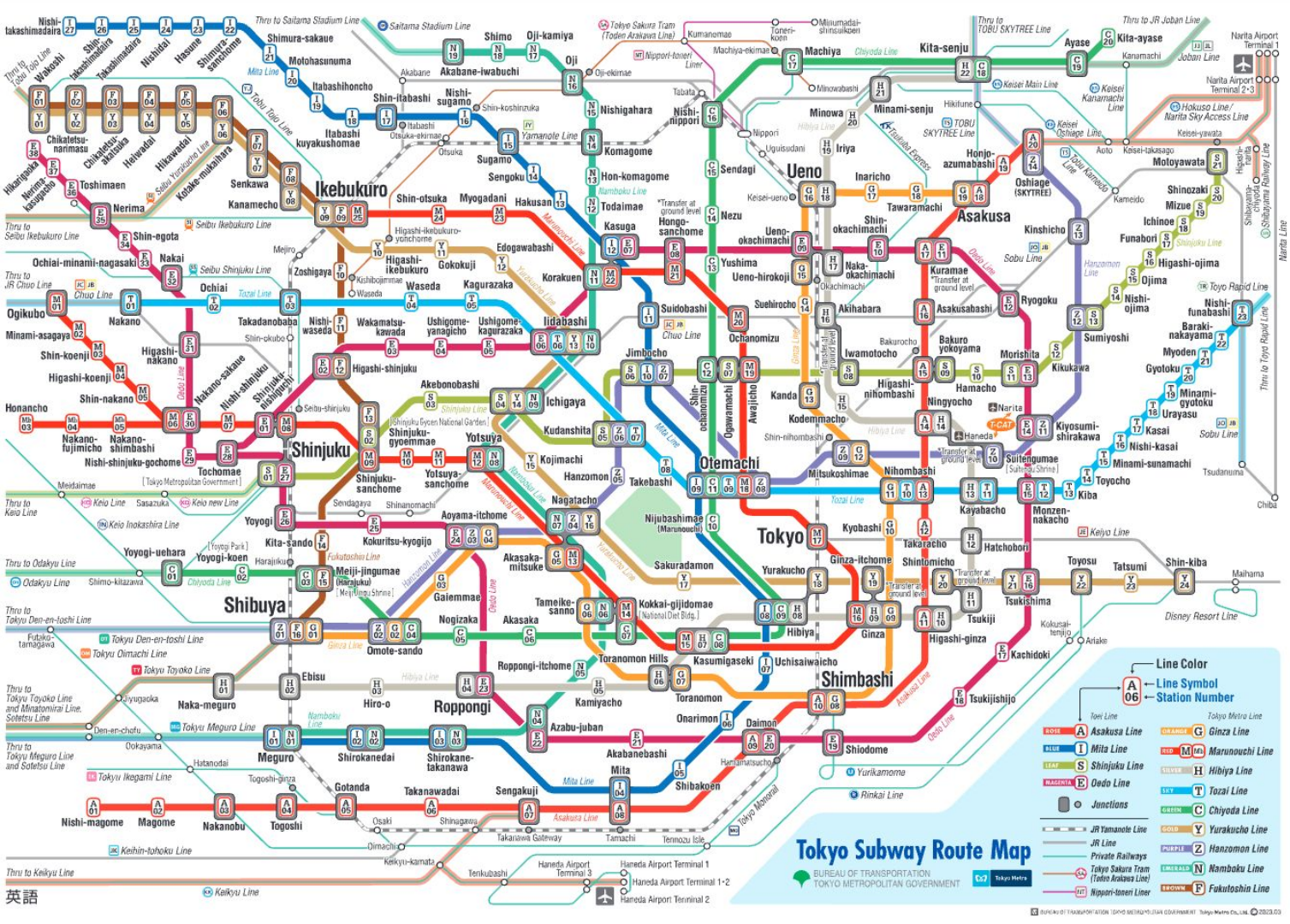
Vancouver


WEST VANCOUVER
NORTH VANCOUVER
BURNABY
COQUITLAM
PORT MOODY
PORT COQUITLAM
MAPLE RIDGE
PITT MEADOWS
NEW WESTMINSTER
VANCOUVER
RICHMOND
SEA ISLAND
SURREY
Lonsdale Quay
Burrard
Waterfront
Vancouver City Centre
Granville
Stadium–Chinatown
Yaletown–Roundhouse
Main Street–Science World
Olympic Village
VCC–Clark
Commercial–Broadway
Rupert
Renfrew
Broadway–City Hall
Brentwood Town Centre
Gilmore
Holdom
Sperling–Burnaby Lake
Production Way–University
Lake City Way
Lougheed Town Centre
Burquitlam
Moody Centre
Inlet Centre
Coquitlam Central
Lafarge Lake–Douglas
Lincoln
Braid
Sapperton
King Edward
Oakridge–41st Avenue
Nanaimo
29th Avenue
Joyce–Collingwood
Patterson
Metrotown
Royal Oak
Edmonds
22nd Street
New Westminster
Columbia
Scott Road
Gateway
Surrey Central
King George
Langara–49th Avenue
Marine Drive
Bridgeport
YVR–Airport
Templeton
Sea Island Centre
Capstan
Aberdeen
Lansdowne
Richmond-Brighouse
Transit Services
SkyTrain
High frequency rail service. Early morning to late evening.
Canada Line
Expo Line
Millennium Line
RapidBus
Frequent bus service with limited stops and transit priority.
R1 King George Blvd
R2 Marine Dr
R3 Lougheed Hwy
R4 41st Ave
R5 Hastings St
R6 Scott Rd
Other Transit Services
99 B-Line
Frequent bus service with limited stops via Broadway and 10th Avenue.
SeaBus
Frequent passenger ferry service. Early morning to late evening.
West Coast Express
Weekday commuter train service running westbound in mornings and eastbound in afternoon and evening.

London


UNDERGROUND
www.transportforlondon.gov.uk
© Transport for London
Key to lines
Bakerloo
Central
peak hours only
Circle
District†
East London
peak hours and Sunday mornings
Hammersmith & City†
Jubilee
Metropolitan
peak hours only
Northern
Piccadilly†
Victoria
Waterloo & City†
Docklands Light Railway
National Rail
Interchange stations
Connections with National Rail
Connections with National Rail within walking distance
Connections with riverboat services
Airport interchange
Closed Sundays
Served by Piccadilly line trains early morning and late evening
† For opening times see poster journey planners. Certain stations are closed on public holidays.
LTM I FA(a) 10.00
Reg. user No. 01/3597

Tokyo


Tokyo Subway Route Map
BUREAU OF TRANSPORTATION
TOKYO METROPOLITAN GOVERNMENT
Line Color
Line Symbol
Station Number
Toei Line
Tokyo Metro Line
Asakusa Line
Mita Line
Shinjuku Line
Oedo Line
Ginza Line
Marunouchi Line
Hibiya Line
Tozai Line
Chiyoda Line
Yurakucho Line
Hanzomon Line
Namboku Line
Fukutoshin Line
Junctions
JR Yamanote Line
JR Line
Private Railways
Tokyo Sakura Tram (Toden Arakawa Line)
Nippori-toneri Liner
Ikebukuro
Shinjuku
Shibuya
Ueno
Asakusa
Tokyo
Otemachi
Shimbashi
Roppongi
Ebisu
Meguro
Shirokanedai
Shirokane-takanawa
Gotanda
Takanawadai
Sengakuji
Mita
Shibakoen
Shiodome
Akabanebashi
Daimon
Onarimon
Toranomon
Toranomon Hills
Kasumigaseki
Uchisaiwaicho
Hibiya
Ginza
Tsukiji
Higashi-ginza
Kachidoki
Tsukijishijo
Akasaka
Akasaka-mitsuke
Nagatacho
Sakuradamon
Nijubashimae (Matsunouchi)
Kyobashi
Takaracho
Hatchobori
Ginza-itchome
Shintomicho
Tsukishima
Kokkai-gijidomae [National Diet Bldg.]
Kamiyacho
Azabu-juban
Roppongi-itchome
Omote-sando
Gaiemmae
Meiji-jingumae (Harajuku)
Aoyama-itchome
Kita-sando
Yoyogi
Yoyogi-uehara
Yoyogi-koen
Shibuya
Nogizaka
Tameike-sanno
Hanzomon
Kojimachi
Takebashi
Nihombashi
Mitsukoshimae
Kodemmacho
Kayabacho
Hamacho
Ningyocho
Suitengumae [Suitengu Shrine]
Monzen-nakacho
Kiba
Toyocho
Kikukawa
Morishita
Higashi-nihombashi
Shin-nihombashi
Bakuro-yokoyama
Bakuro-machi
Iwamotocho
Kanda
Ochanomizu
Awajicho
Ogawamachi
Shin-ochanomizu
Jimbocho
Suidobashi
Ichigaya
Kudanshita
Yotsuya
Shinjuku-gyoemmae
Shinjuku-sanchome
Yotsuya-sanchome
Akebonobashi
Shinjuku Gyoen National Garden
Higashi-shinjuku
Shinjuku-nishiguchi
Nishi-shinjuku
Nishi-shinjuku-gochome
Tochomae [Tokyo Metropolitan Government]
Nakano-shimbashi
Nakano-fujimicho
Honancho
Nakano-sakaue
Higashi-koenji
Shin-koenji
Minami-asagaya
Ogikubo
Nakano
Ochiai
Ochiai-minami-nagasaki
Nakai
Nerima
Shin-egota
Toshimaen
Hikarigaoka
Nerima-kasuyama
Chikatetsu-narimasu
Chikatetsu-akatsuka
Heiwadai
Hikawadai
Kotake-mukaihara
Senkawa
Kanamecho
Zoshigaya
Mejiro
Ikebukuro
Shin-otsuka
Myogadani
Hakusan
Higashi-ikebukuro
Higashi-ikebukuro-yonchome
Gokokuji
Edogawabashi
Kagurazaka
Waseda
Kishibojimmae
Todaimae
Hon-komagome
Komagome
Nishigahara
Sugamo
Shin-sugamo
Otsuka
Shin-koshinzuka
Yamanote Line
Oji
Oji-kamiya
Shimo
Akabane-iwabuchi
Akabane
Shin-itabashi
Itabashi
Itabashi-kuyakushomae
Motohasunuma
Shimura-sakaue
Shimura-sanchome
Takashimadaira
Shin-takashimadaira
Nishi-takashimadaira
Wakoshi
Hasuna
Nishidai
Mita Line
Tobu Tojo Line
Thru to Tobu Tojo Line
Thru to Saitama Stadium Line
Saitama Stadium Line
Tokyo Sakura Tram (Toden Arakawa Line)
Kumanomae
Toneri-koen
Nippori-toneri Liner
Machiya-ekimae
Machiya
Chiyoda Line
Kita-senju
Thru to TOBU SKYTREE Line
Minowabashi
Minowa
Hikifune
Nippori
Uguisudani
Iriya
Tsukuba Express
Keisei Main Line
TOBU SKYTREE Line
Keisei Oshiage Line
Aoto
Keisei-takasago
Keisei-yawata
Motoyawata
Oshiage (SKYTREE)
Honjo-azumabashi
Tawaramachi
Inaricho
Minami-senju
Ayase
Kanamachi
Keisei Kanamachi Line
Hokuso Line / Narita Sky Access Line
Joban Line
Thru to JR Joban Line
Narita Airport Terminal 1
Narita Airport Terminal 2·3
Shinozaki
Mizue
Ichinoe
Funabori
Kinshicho
Sobu Line
Hanzomon Line
Shinjuku Line
Higashi-ojima
Ojima
Nishi-ojima
Toyo Rapid Line
Nishi-funabashi
Baraki-nakayama
Myoden
Gyotoku
Minami-gyotoku
Urayasu
Kasai
Nishi-kasai
Minami-sunamachi
Tsudanuma
Sobu Line
Thru to Toyo Rapid Line
Hasuda Line
Shibayama-chiyoda
Shibayama Railway Line
Narita Line
Chiba
Sumiyoshi
Kiyosumi-shirakawa
Ryogoku
Asakusabashi
Kuramae
Ueno-hirokoji
Naka-okachimachi
Okachimachi
Ueno-okachimachi
Shin-okachimachi
Yushima
Nezu
Sendagi
Nishi-nippori
Sendai
Kasuga
Hongo-sanchome
Korakuen
Iidabashi
Ushigome-kagurazaka
Ushigome-yanagicho
Wakamatsu-kawada
Nishi-waseda
Takadanobaba
Shin-okubo
Seibu Ikebukuro Line
Seibu Shinjuku Line
Seibu Yurakucho Line
Tozai Line
Chuo Line
JR Chuo Line
Thru to Seibu Ikebukuro Line
Thru to Seibu Shinjuku Line
Thru to JR Chuo Line
Thru to Keio Line
Keio Line
Keio new Line
Keio Inokashira Line
Sasazuka
Meidaimae
Thru to Odakyu Line
Odakyu Line
Shimo-kitazawa
Chiyoda Line
Thru to Tokyu Den-en-toshi Line
Tokyu Den-en-toshi Line
Futako-tamagawa
Tokyu Oimachi Line
Tokyu Toyoko Line
Thru to Tokyu Toyoko Line and Minatomirai Line, Sotetsu Line
Jiyugaoka
Naka-meguro
Tokyu Meguro Line
Ookayama
Den-en-chofu
Thru to Tokyu Meguro Line and Sotetsu Line
Tokyu Ikegami Line
Hatanodai
Togoshi-ginza
Nishi-magome
Magome
Nakanobu
Togoshi
Osaki
Shinagawa
Takanawa Gateway
Tamachi
Tennozu Isle
Oimachi
Keihin-tohoku Line
Thru to Keikyu Line
Keikyu Line
Keikyu-kamata
Tenkubashi
Haneda Airport Terminal 3
Haneda Airport Terminal 1
Haneda Airport Terminal 1·2
Haneda Airport Terminal 2
Tokyo Monorail
Rinkai Line
Yurikamome
Hamamatsucho
Tsukiji
Ariake
Kokusai-tenjijo
Toyosu
Tatsumi
Shin-kiba
Disney Resort Line
Maihama
Keiyo Line
Kasai
Edogawa
Urayasu
Kasai Rinkai Park
Tokyo Metro
Toei
英語

Other Examples

UBC Library Snapshot

UBC Library advances research, learning and teaching excellence by connecting communities within and beyond UBC to the world's knowledge. The Library, a high-ranking member of the Association of Research Libraries (ARL), is the largest library in British Columbia and provides access to expanding digital resources and houses an on-site digitization centre. For more information, visit library.ubc.ca.

15 branches across 2 campuses

315 full-time staff
- 88 librarians
- 184 management & support staff
- 43 student employees

Rankings
- **14 out of 115** university libraries in the Association of Research Libraries (ARL)
- **2nd** among Canadian academic libraries (ARL)
- cIRcle, UBC's information repository, **ranks 2nd in Canada** and 44th globally among 1,650 repositories.

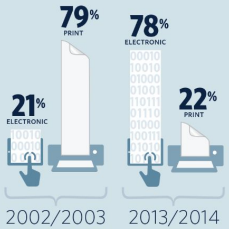
COLLECTIONS

- More than **7.4m** volumes
- More than **1.8m** e-books
- **330,000+** e-journals
- **500,000+** items in locally produced **digital collections**

More than
5 million e-book downloads
8 million e-journal downloads

LIBRARY RESOURCES

Expenditures shifting from **print** to **electronic**



on-campus **3.8M+** visits (JAN–DEC 2013)
library.ubc.ca **11.1M+**

UBC Library on SOCIAL MEDIA

Twitter **4,8K**
Facebook **9,9K** 16 accounts

Librarians provided 1,768 instructionals to more than **41,427 participants** and answered reference questions
- 54,648 in-person
- 10,756 online

UBC Library Snapshot

UBC Library advances research, learning and teaching excellence by connecting communities within and beyond UBC to the world's knowledge. The Library, a high-ranking member of the Association of Research Libraries (ARL), is the largest library in British Columbia and provides access to expanding digital resources and houses an on-site digitization centre. For more information, visit library.ubc.ca.

15 branches across 2 campuses

315 full-time staff
- 88 librarians
- 184 management & support staff
- 43 student employees

Rankings
- **14 out of 115** university libraries in the Association of Research Libraries (ARL)
- **2nd** among Canadian academic libraries (ARL)
- cIRcle, UBC's information repository, **ranks 2nd in Canada** and 44th globally among 1,650 repositories.

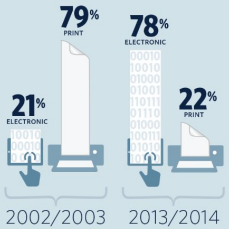
COLLECTIONS

- More than **7.4m** volumes
- More than **1.8m** e-books
- **330,000+** e-journals
- **500,000+** items in locally produced **digital collections**

More than
5 million e-book downloads
8 million e-journal downloads

LIBRARY RESOURCES

Expenditures shifting from **print** to **electronic**



on-campus 3.8M+ visits (JAN–DEC 2013)
library.ubc.ca 11.1M+

UBC Library on SOCIAL MEDIA

Twitter 4,8K
Facebook 9,9K
16 accounts

Librarians provided 1,768 instructionals to more than **41,427 participants** and answered reference questions
- 54,648 in-person
- 10,756 online

Company: Benevity

Principles for Infographics

Principles for Infographics

- **Simplicity**
- **Consistency**

- **Visibility**
- **Navigability** (structure)

- **Suitability**

Principles for Infographics

- **Simplicity** – minimal text, clear message, avoid clutter
- **Consistency**

- **Visibility**
- **Navigability** (structure)

- **Suitability**

Principles for Infographics

- **Simplicity** – minimal text, clear message, avoid clutter
- **Consistency** – layout and design elements should be consistent.
  - 2 to 3 font sizes, colour scheme
- **Visibility**
- **Navigability** (structure)

- **Suitability**

Principles for Infographics

- **Simplicity** – minimal text, clear message, avoid clutter
- **Consistency** – layout and design elements should be consistent.
  - 2 to 3 font sizes, colour scheme
- **Visibility** – appropriate font sizes, colors that contrast
- **Navigability** (structure)

- **Suitability**

Principles for Infographics

- **Simplicity** – minimal text, clear message, avoid clutter
- **Consistency** – layout and design elements should be consistent.
  - 2 to 3 font sizes, colour scheme
- **Visibility** – appropriate font sizes, colors that contrast
- **Navigability** (structure) – clear order to follow, use scale/proportion to emphasize key points/headings
- **Suitability**

Principles for Infographics

- **Simplicity** – minimal text, clear message, avoid clutter
- **Consistency** – layout and design elements should be consistent.
  - 2 to 3 font sizes, colour scheme
- **Visibility** – appropriate font sizes, colors that contrast
- **Navigability** (structure) – clear order to follow, use scale/proportion to emphasize key points/headings
- **Suitability** – right data for message, right graphic for the message, right metaphors for the audience

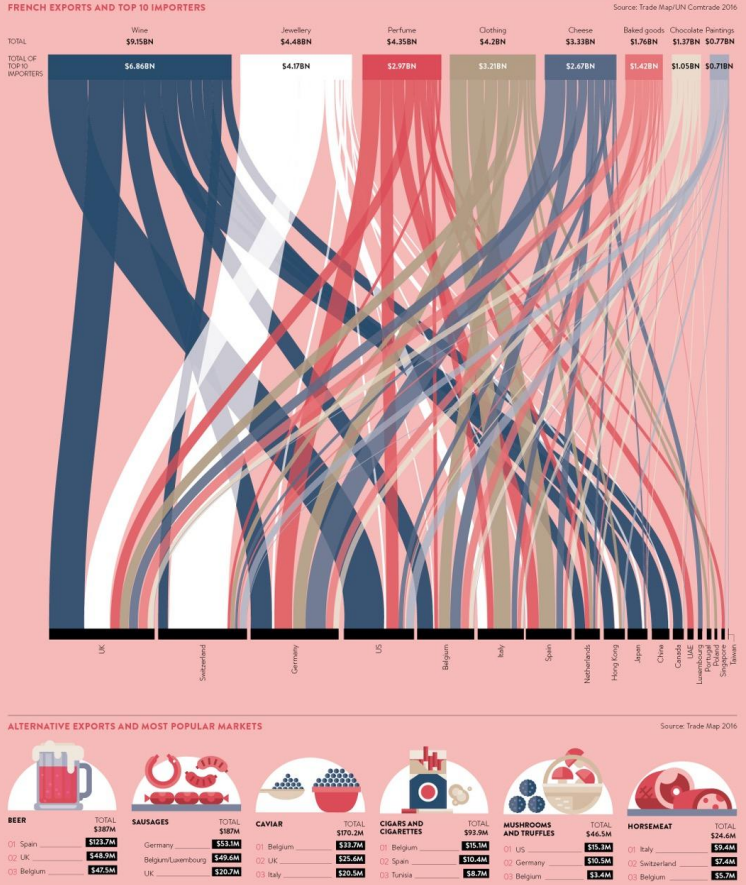
Principles for Infographics

- **Simplicity** – minimal text, clear message, avoid clutter
- **Consistency** – layout and design elements should be consistent.
  - 2 to 3 font sizes, colour scheme
- **Visibility** – appropriate font sizes, colors that contrast
- **Navigability** (structure) – clear order to follow, use scale/proportion to emphasize key points/headings
- **Suitability** – right data for message, right graphic for the message, right metaphors for the audience

Principles in Action

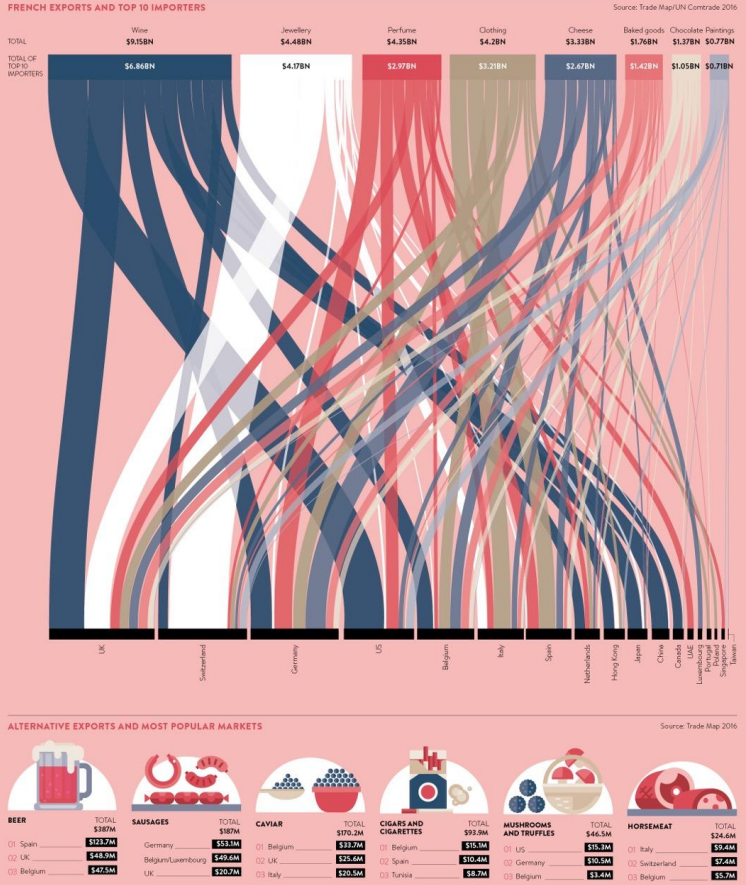
Made in France

France exported $572 billion of goods in 2015, making it the sixth largest exporter in the world. While aircraft, cars and medicines are the country's highest-valued goods, there are many other exports to varied markets



Made in France

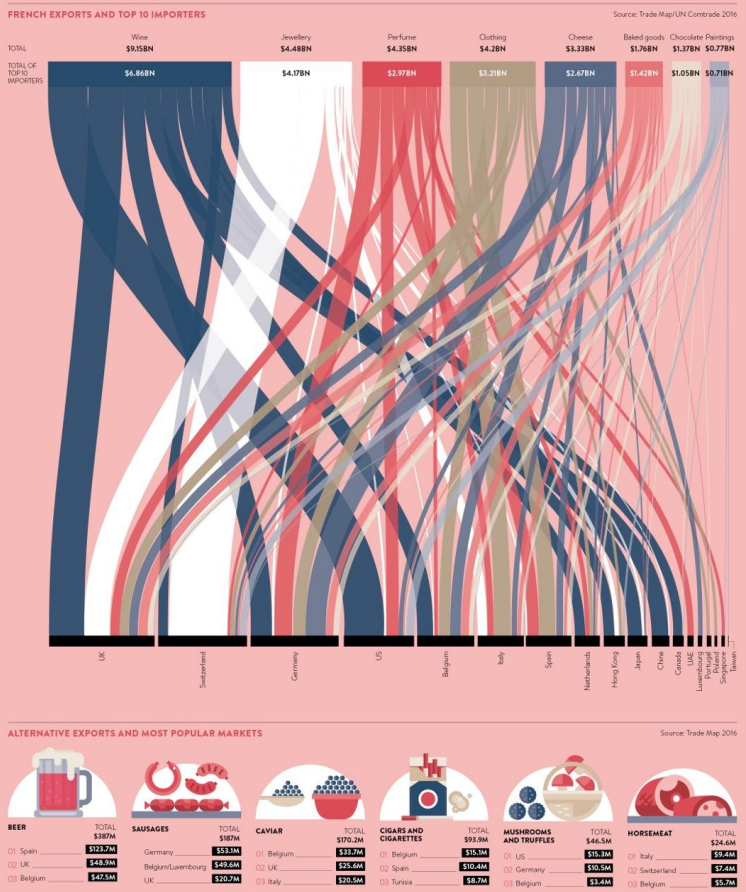
France exported $572 billion of goods in 2015, making it the sixth largest exporter in the world. While aircraft, cars and medicines are the country's highest-valued goods, there are many other exports to varied markets



FRENCH EXPORTS AND TOP 10 IMPORTERS
Source: Trade Map/UN Comtrade 2016
TOTAL
TOTAL OF TOP 10 IMPORTERS
Wine $9.15BN
Jewellery $4.48BN
Perfume $4.35BN
Clothing $4.2BN
Cheese $3.33BN
Baked goods $1.76BN
Chocolate $1.37BN
Paintings $0.77BN
$6.86BN
$4.17BN
$2.97BN
$3.21BN
$2.67BN
$1.42BN
$1.05BN
$0.71BN
UK
Switzerland
Germany
US
Belgium
Italy
Spain
Netherlands
Hong Kong
Japan
China
Canada
UAE
Luxembourg
Portugal
Poland
Singapore
Taiwan
ALTERNATIVE EXPORTS AND MOST POPULAR MARKETS
Source: Trade Map 2016
BEER TOTAL $387M
01 Spain $123.7M
02 UK $48.9M
03 Belgium $47.5M
SAUSAGES TOTAL $187M
Germany $53.1M
Belgium/Luxembourg $49.6M
UK $20.7M
CAVIAR TOTAL $170.2M
01 Belgium $33.7M
02 UK $25.6M
03 Italy $20.5M
CIGARS AND CIGARETTES TOTAL $93.9M
01 Belgium $15.1M
02 Spain $10.4M
03 Tunisia $8.7M
MUSHROOMS AND TRUFFLES TOTAL $46.5M
01 US $15.3M
02 Germany $10.5M
03 Belgium $3.4M
HORSEMEAT TOTAL $24.6M
01 Italy $9.4M
02 Switzerland $7.4M
03 Belgium $5.7M

Made in France

France exported $572 billion of goods in 2015, making it the sixth largest exporter in the world. While aircraft, cars and medicines are the country's highest-valued goods, there are many other exports to varied markets



✗ Simplicity

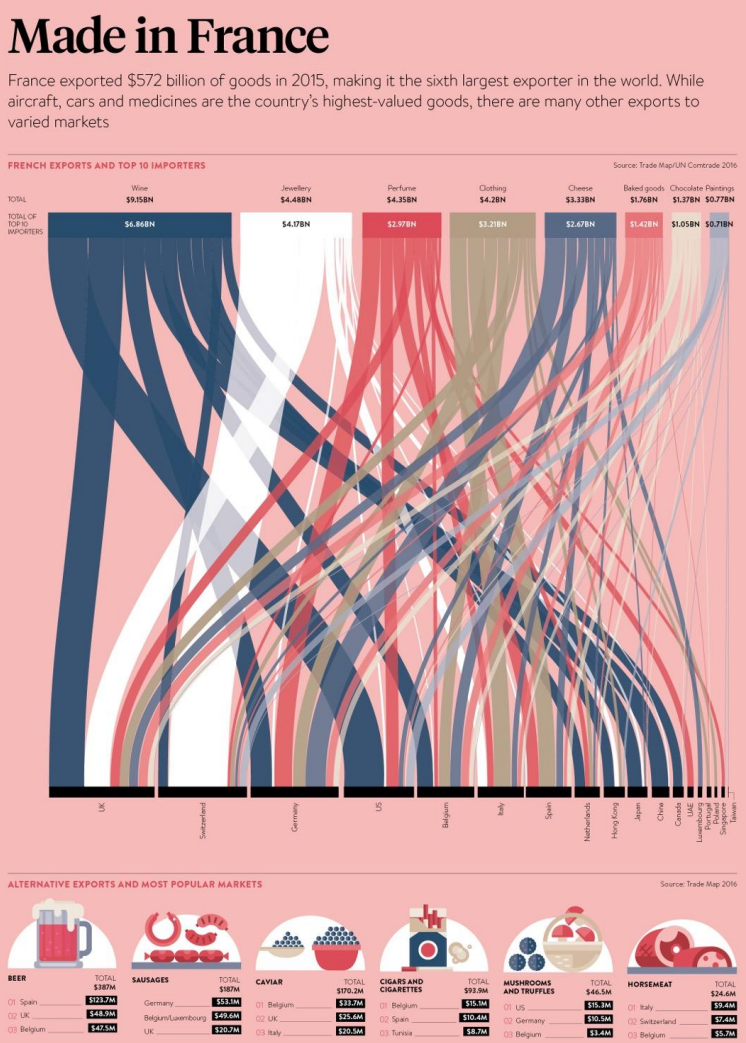
use of a sankey diagram does not help

✗ Visibility

text at the bottom is very hard to read

✗ Suitability

what is the focus of the infographic?



❌ Simplicity

use of a sankey diagram does not help

❌ Visibility

text at the bottom is very hard to read

❌ Suitability

what is the focus of the infographic?

✅ Navigability

top to bottom

✅ Consistency

colour theme

Infographics vs. Visualization

- An infographic is not a type of visualization, as it could just be made up of words and images. (e.g., 70% of children like chocolate ice cream with a picture of an ice cream cone).
- The images in an infographic do not necessarily have to encode data. So you can have infographic that has an emoji, an image of an animal, food, but not encode quantitative data with the images (e.g. no bar charts).

Activity

Activity

- On the next few slides are some examples of good (denoted by ✅) and bad (denoted by ❌) infographics.
- As part of this activity, try to make sense of the infographic, and determine which principle(s) the infographic violate or adhere to.
  - *Hint 1: some infographics may violate/adhere to more than 1 principle.*
  - *Hint 2: "good" infographics may also be violating some principles and vice-versa, a "bad" infographic may be adhere to some principles.*


CHEMICALS IN CIGARETTE SMOKE
(SELECTED FROM OVER 4,000 TOTAL)
ACETANISOLE
ACETIC ACID
ACETONE
ACETOPHENONE
ALFALFA EXTRACT
ALLYL HEXANOATE
ALLYL IONONE
ALMOND BITTER OIL
ALUMINUM
AMMONIA
AMMONIUM BICARBONATE
AMMONIUM SULFIDE
ARSENIC
BENZALDEHYDE GLYCERYL
BERYLLIUM (METAL)
BUTANOL
BUTANE
CAFFEINE
CALCIUM CARBONATE
CARBON DIOXIDE
CARBON MONOXIDE
CITRONELLA OIL
CHLOROFORM
COCONUT OIL
COFFEE
CUMINALDEHYDE
CYANIDE
CYSTEINE
DANDELION ROOT EXTRACT
DAVANA OIL
DDT/DIELDRIN
EUCALYPTOL
FARNESOL
FENCHONE
FENNEL SWEET OIL
FIG JUICE
FORMALDEHYDE
LACTIC ACID
MACE POWDER EXTRACT
MENTHOL
PATCHOULI OIL
RUM ETHER
SILICON
SKATOLE
SMOKE FLAVOR
SNAKEROOT OIL
SODIUM ACETATE
SOLANONE
TOBACCO EXTRACTS
UREA
NAIL POLISH REMOVER
BATHROOM CLEANER
RAT POISON
CAR EXHAUST FUMES
INSECTICIDE
URINE
SMOKY TRAILS
MAJOR SMUGGLING ROUTES
CANADA
Engages in tax-evasive border crossing return shipments with the USA.
USA
Major interstate smuggling to evade high taxes. Source of cigarettes smuggled to Latin America and Europe.
PANAMA
Transit hub between Europe and LatinAmerica.
COLOMBIA
Smuggling routes shared with Drug Cartels. Portal country into South America.
UNITED KINGDOM
Major destination for smuggled Asian and Russian cigarettes.
SPAIN
Destination country for US cigarettes, routed through Panama and the Netherlands
ARUBA
Tax haven and transit hub between Europe and Latin America.
CAMEROON
Portal country into Africa. Tobacco arrives from Europe and Latin America.
EGYPT
Transit hub between Asia and Europe.
THE NETHERLANDS
Transit hub between Latin America and Europe.
LATVIA & LITHUANIA
Transit hub between Russia and Europe.
TURKEY
Transit hub between Asia and Europe.
UNITED ARAB EMIRATES
Transit hub between China and Europe.
RUSSIA
Huge importer to Europe. Also a major player in the online cigarette market.
BANGLADESH
Portal country into India and the rest of Asia. Tobacco usually arrives from Poland, Albania and Egypt.
CHINA & HONG KONG
Besides supplying much of Southeast Asia, China is a main source of tobacco smuggled to Western Europe.
SSSMOKIN!
THE GLOBAL TOBACCO TRADE
1000 PACKS OF MARLBOROS
111 DAYS OF LIFE
WHERE DID ALL THE CIGARETTES GO?
In 2000, there was a disparity of 292 billion cigarettes between worldwide exports and imports. In other words, nearly 1/3 of the world's total cigarette production simply disappeared, at least on paper. The global tobacco black market is booming and big tobacco companies like Phillip Morris and British American Tobacco are leading the charge. Lured by untapped markets in developing nations like India, Colombia and Bangladesh, and desperate to avoid soaring import taxes in countries like America, big tobacco is fueling a big business, and all of it is off the books.
964 BILLION CIGARETTES EXPORTED
672 BILLION CIGARETTES IMPORTED
60% SHIP
30% TRUCK
3% YACHT
1% CAR
1% AIRPLANE
1% TRAIN
TOOLS OF THE TRADE
BASED ON SMUGGLERS CAUGHT IN 2000 IN THE EUROPEAN UNION
1 LEATHER JACKET
Buying 1000 packs of Marlboro cigarettes will give you enough "Marlboro Miles" to win a free leather jacket. If each smoked cigarette takes 8 minutes off your life, that jacket will cost you 111 days. Enjoy!
WHO SMOKES & HOW MUCH?
The World Health Organization estimates about 1.25 billion smokers in the world, roughly 1/3 of all people over the age of 15. With 1/5 of the world's population, China smokes 1/3 of its cigarettes. 61% of Chinese men are smokers, a world high.
CHINA 1643 BILLION
USA 451 BILLION
JAPAN 328 BILLION
RUSSIA 258 BILLION
INDONESIA 215 BILLION
CIGARETTES CONSUMED IN 1998
INA INTERNATIONAL NETWORKS ARCHIVE
MAP BY JONATHAN HARRIS OF FLAMING TOAST PRODUCTIONS
SOURCES - WORLD HEALTH ORGANIZATION - DR. JOEL DUNNINGTON, TOBACCO ALMANAC, 1993 - "ILLEGAL PATHWAY TO ILLEGAL PROFITS" BY THE CAMPAIGN FOR TOBACCO FREE KIDS - ACTION ON SMOKING AND HEALTH UK

THE THREE-TRILLION-DOLLAR WAR
ITS COST IN TEN STEPS

In 2003, Secretary of Defense Donald Rumsfeld estimated that a war with Iraq would cost $60 billion. Five years later, the cost of Iraq War operations is more than 10 times that figure. By the time the United States leaves Iraq, the estimated cost of war will be more than $3 trillion.

1 **OPERATIONAL COSTS**
The total operational cost to date is $600 billion. This includes costs for helicopters, tanks, fuel, combat pay, military training, military bases, and embassies.

2 **ADDITIONAL EXPENDITURES**
Add $110 billion for additional military expenditures indirectly attributed to the wars.

3 **INFLATION**
Correct for inflation over the past five years.

4 **OPERATIONAL AND PEACEKEEPING COSTS**
Add $520 billion for operational and peacekeeping costs before and after troop withdrawal.

5 **HEALTH CARE**
Add $590 billion for future health care for returning veterans.

6 **RESTORING THE MILITARY**
Add $280 billion to restore the military to its prewar strength.

7 **SOCIAL SECURITY**
Add $38 billion for Social Security to veterans who can no longer work.

8 **INTEREST**
Add $615 billion in interest, since the war is funded primarily from borrowed money.

9 **LOST ECONOMIC OUTPUT**
Add $370 billion for the loss of economic output from soldiers' deaths and disability.

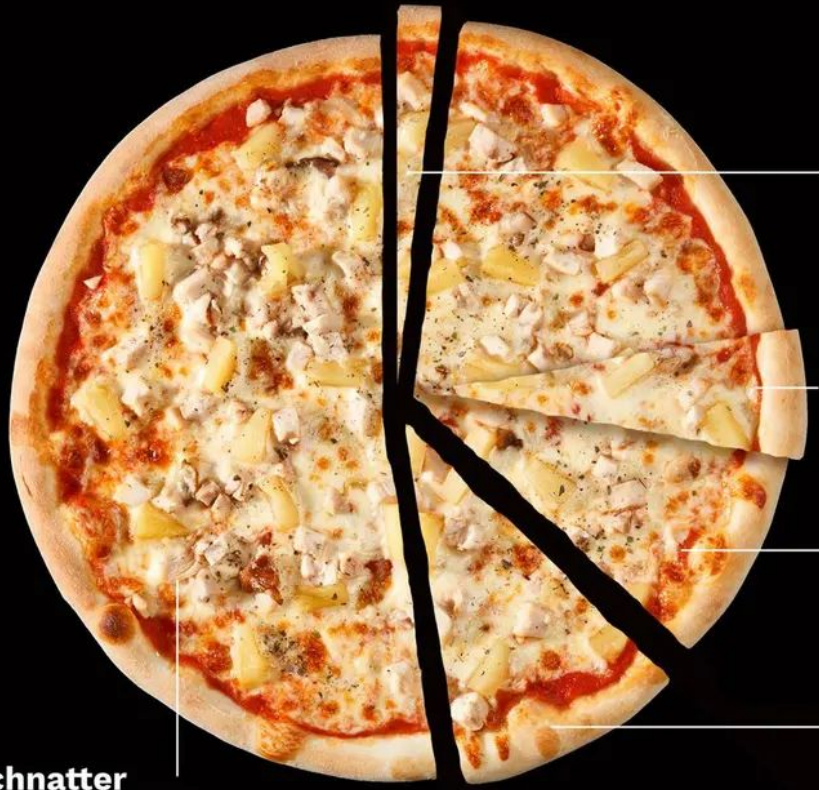
10 **MACROECONOMIC IMPACT**
Add $1.9 trillion for the macroeconomic impact of both the funds diverted from schools, roads, and research and the high cost of oil during much of the war.

GOOD Watch the $3 trillion war unfold in a video at www.good.is.

SOURCES The Three Trillion Dollar War by Joseph E. Stiglitz and Linda J. Bilmes; War at Any Price? The Total Economic Cost of the War Beyond the Federal Budget by the Joint Economic Committee Majority Staff

The Big Cheese

Papa John's founder John Schnatter has been the dominant presence at his company since its founding— even after turning over the CEO role to a rotating cast of executives



Steve Ritchie
January 2018 – Present

Jude Thompson
Co-CEO April 2010 – April 2011

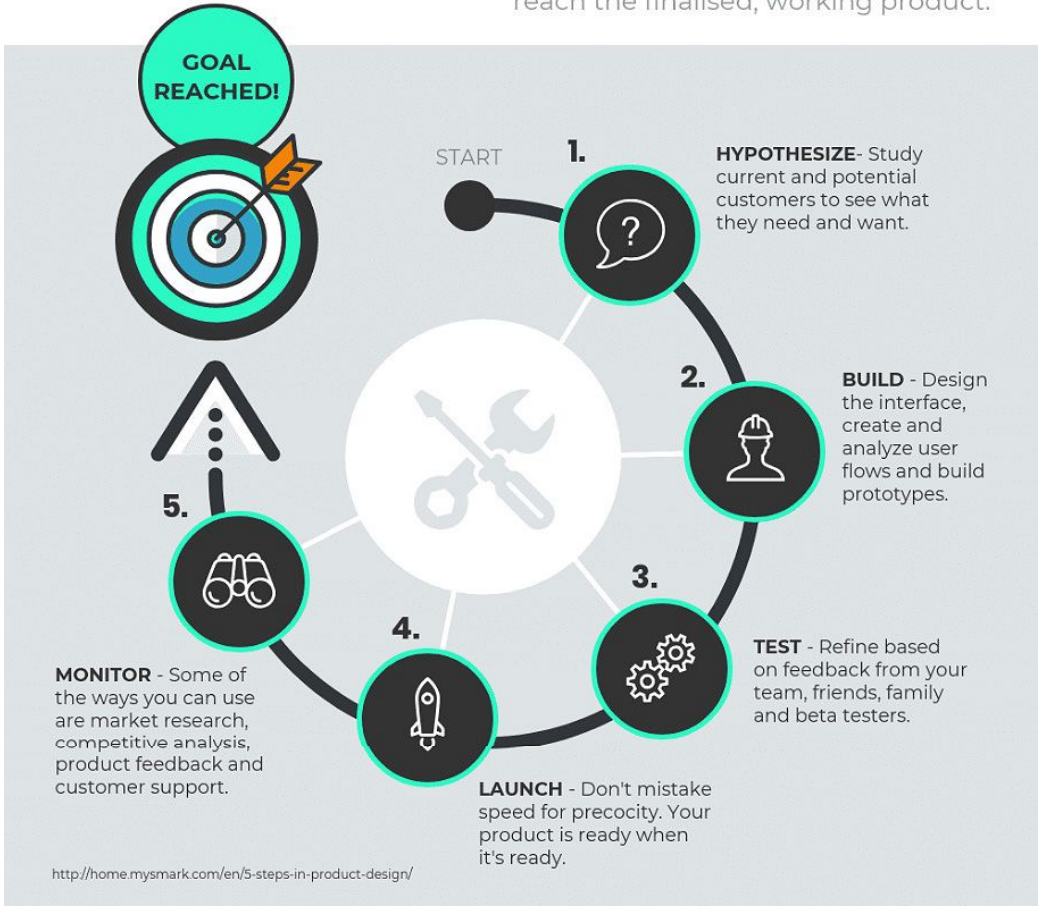
John Schnatter
December 2008 – December 2017

Nigel Travis
January 2005 – December 2008

John Schnatter
1990 – January 2005

STEPS IN PRODUCT DESIGN

Product design involves many steps in order to reach the finalised, working product.



5 Tips
To Keep Your Chin Up

1

Do something impulsive.

Do something impulsive that you haven't planned every day. It's better to have no plan so we can seize the opportunities that may arise.

2

Have rituals.

We are less who we are than what we do. Do 3 things that you love every day. As a result, feeling the gratitude will help you better sleep. Better sleep helps to be in a better mood. A better mood helps to make better decisions.

3

Exercise at least 10 minutes a day.

Exercising has an influence on your brain, on your mood, on your ability to reflect and on your health.

4

Take breaks.

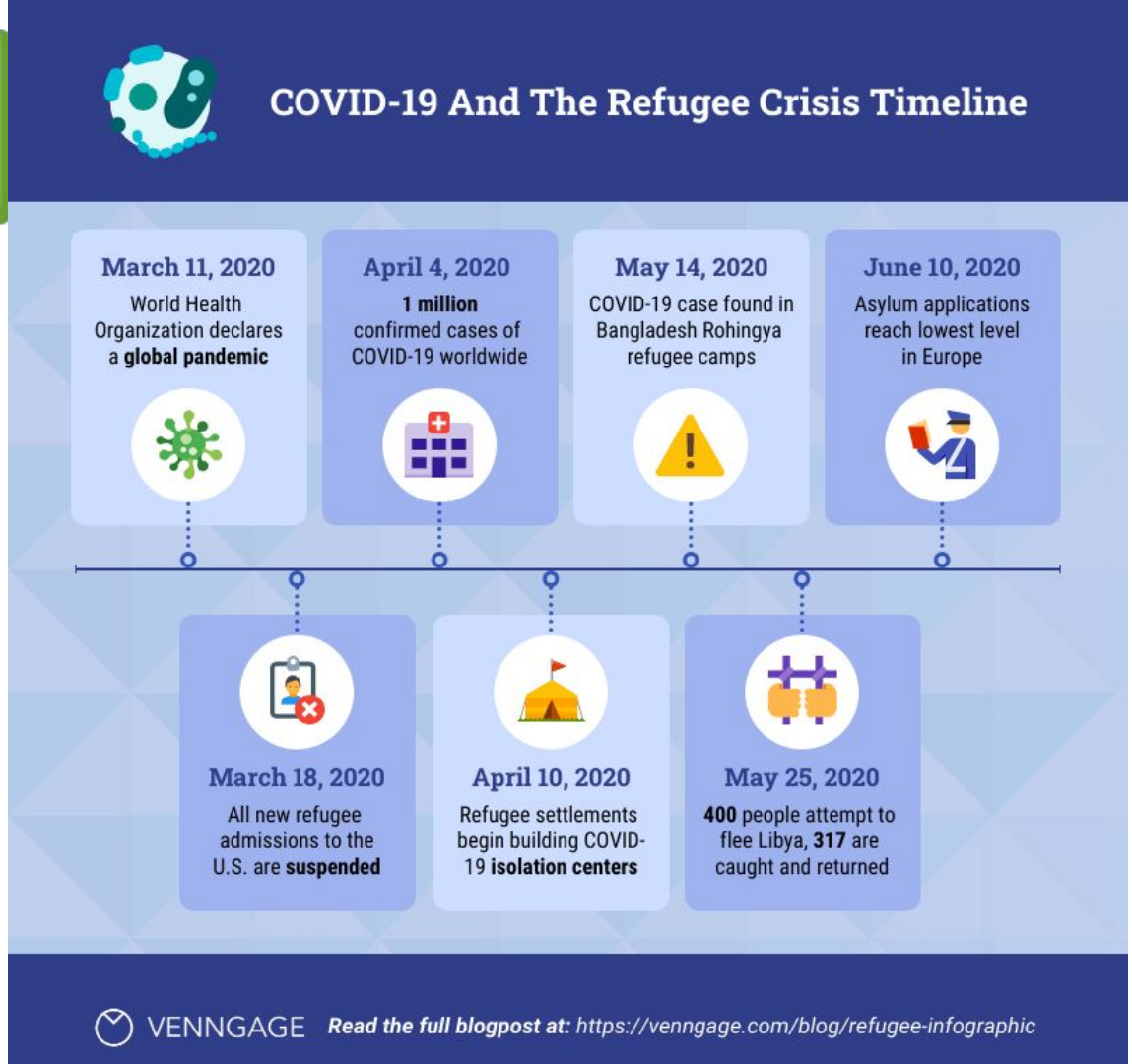
Prevent burnouts by stopping what you are doing and do something else. Create a different atmosphere, add some novelties in your daily routine.

5

Learn something new.

Learning helps to create new connections in your brain and to come up with new ideas and new opportunities.

Source


COVID-19 And The Refugee Crisis Timeline
March 11, 2020
World Health Organization declares a **global pandemic**
April 4, 2020
1 million confirmed cases of COVID-19 worldwide
May 14, 2020
COVID-19 case found in Bangladesh Rohingya refugee camps
June 10, 2020
Asylum applications reach lowest level in Europe
March 18, 2020
All new refugee admissions to the U.S. are **suspended**
April 10, 2020
Refugee settlements begin building COVID-19 **isolation centers**
May 25, 2020
400 people attempt to flee Libya, **317** are caught and returned
VENNGAGE
Read the full blogpost at: https://venngage.com/blog/refugee-infographic

Visualization Zoo

Visualization Zoo

- **Comparing Categories**
  - Bar Chart: Bar, Stacked Bar, Grouped Bar
  - Pie Chart
- **Discovering Temporal Trends**
  - Line, Multi-Line, Area Charts
- **Multiple Attributes**
  - Radar Chart, Bubble Charts, Parallel Coordinates
- **Visualizing Relationships and Hierarchy**
  - Tree Maps, Scatterplots, Tree Diagrams, Network Graph

Activity

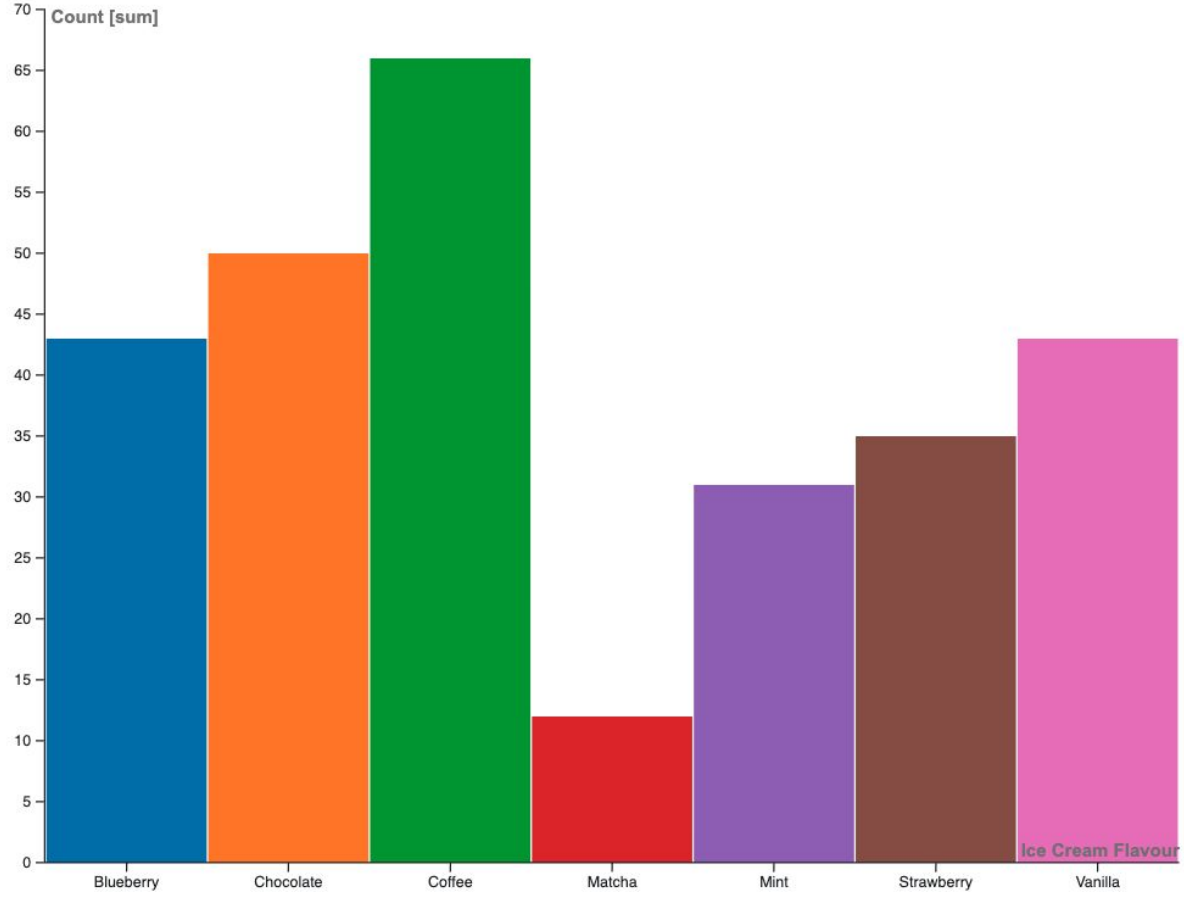
Recall

- Visualize the dataset below in at least 5 different ways.
- Sketch on paper/PrairieLearn OR use a tool

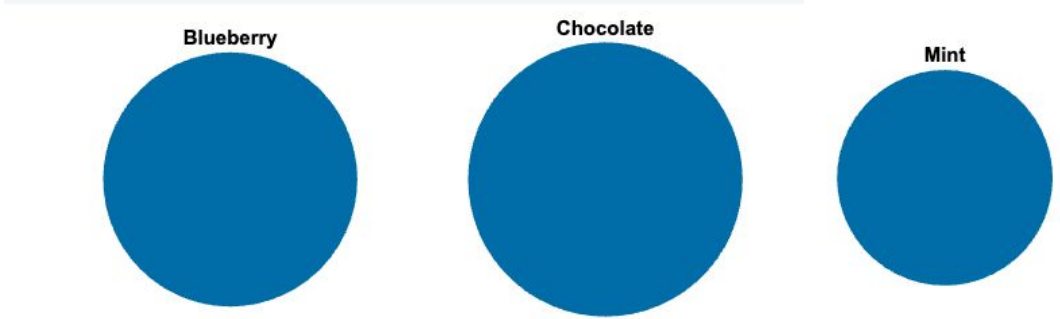
Ice Cream Flavour	Count
Chocolate	50
Vanilla	43
Mint	31
Strawberry	35
Matcha	12
Blueberry	43
Coffee	66

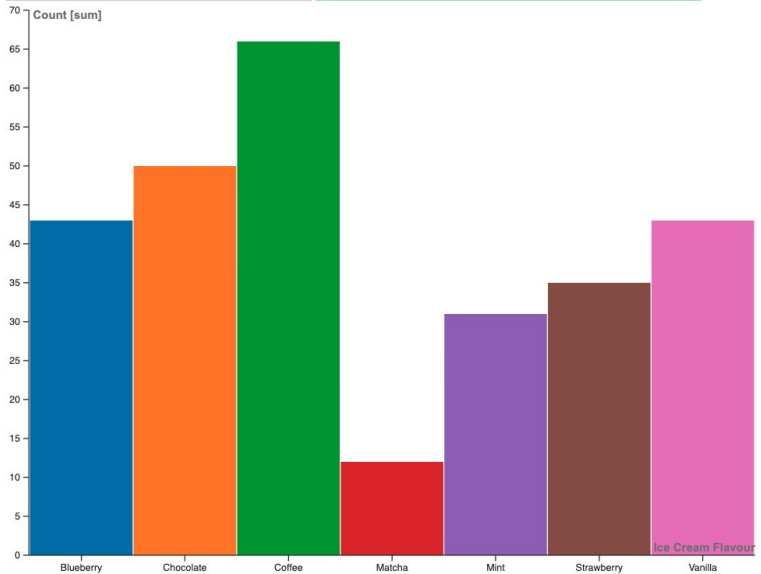

Chocolate
Strawberry
Matcha
Blueberry
Vanilla
Coffee
Mint

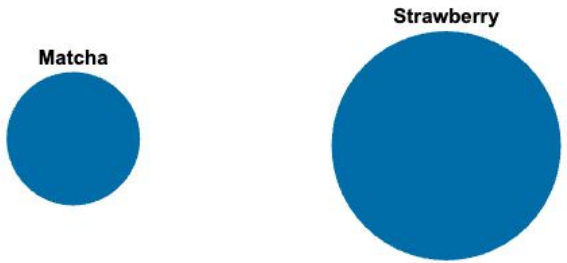

Chocolate
Strawberry
Matcha
Blueberry
Vanilla
Coffee
Mint

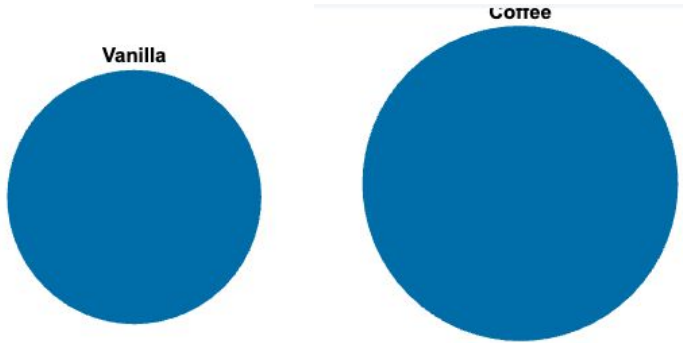

Count [sum]
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Blueberry
Chocolate
Coffee
Matcha
Mint
Strawberry
Vanilla
Ice Cream Flavour


Chocolate
Strawberry
Matcha
Blueberry
Vanilla
Coffee
Mint

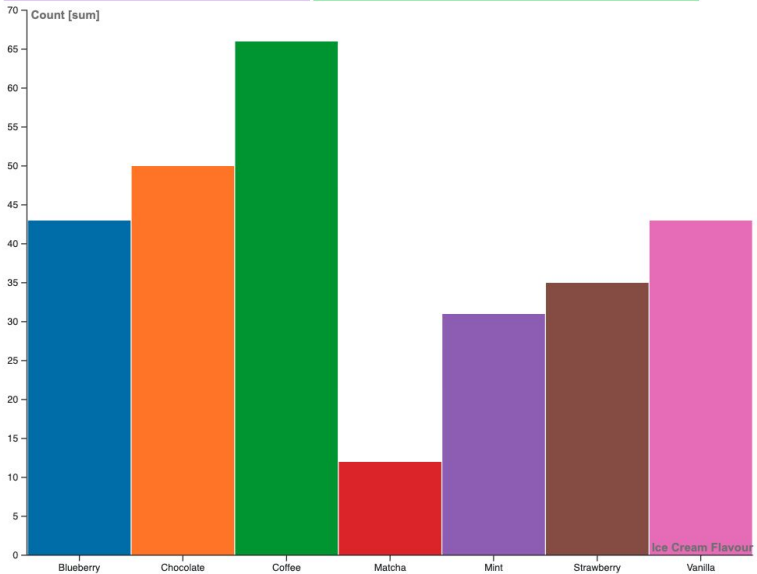

Blueberry
Chocolate
Mint

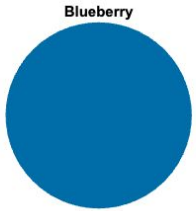

Count [sum]
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Blueberry
Chocolate
Coffee
Matcha
Mint
Strawberry
Vanilla
Ice Cream Flavour

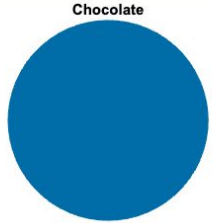

Matcha
Strawberry

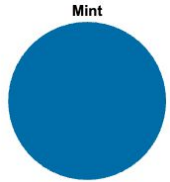

Vanilla
Coffee

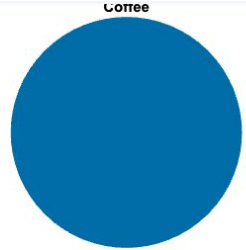

Chocolate
Strawberry
Matcha
Blueberry
Vanilla
Coffee
Mint


Count [sum]
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Blueberry
Chocolate
Coffee
Matcha
Mint
Strawberry
Vanilla
Ice Cream Flavour

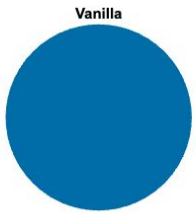

Blueberry

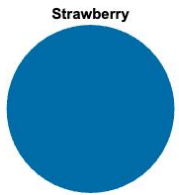

Chocolate


Mint


Coffee


Matcha


Vanilla


Strawberry

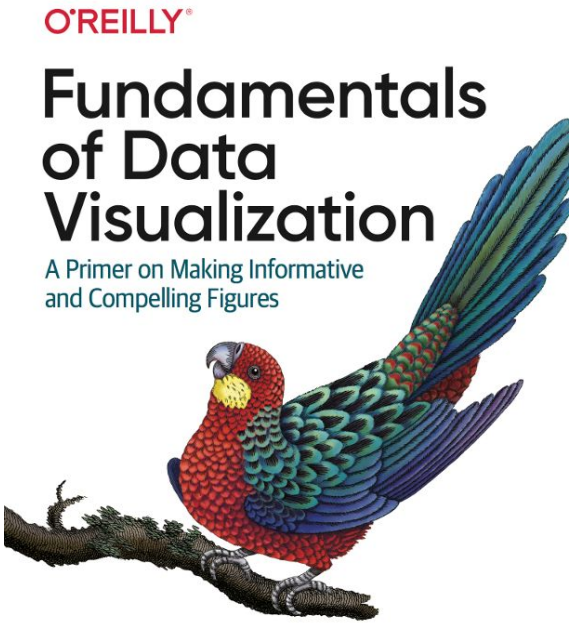

chocolate
coffee
matcha
vanilla
blueberry
strawberry
mint

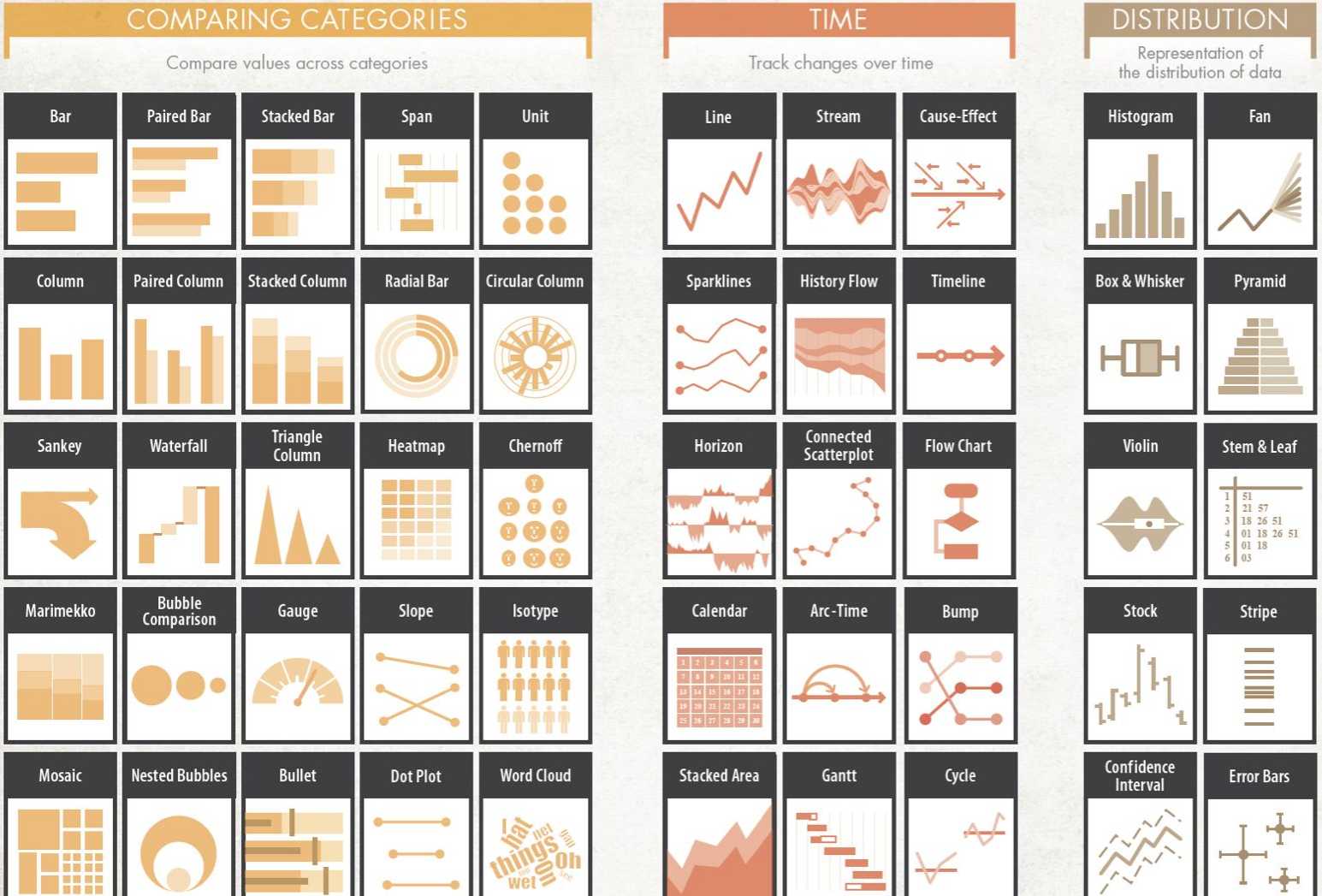
Principles of Effective Visualizations

Principle	Definition	Examples
• Proportional Ink	The amount of ink used to indicate a value should be proportional to the value itself.	Truncating the y-axis on a bar chart to exaggerate the difference between bars violates the principle of proportional ink.
• Data:ink ratio	Remove distracting visual elements to focus attention on the data	Lighten line weights, remove backgrounds, never use 3D or special effects, ~~remove~~ avoid unnecessary/redundant labels.
• Labels & legends	Use axes labels and titles to highlight/ communicate data	Never leave your data column names as axes labels! Generally good to add a title.
• Overplotting	With large datasets, points overlap, resulting in large clouds of data	To fix overplotting, could plot just a sample subset of the data, use alpha, and use smaller points. Or, jitter - but check if appropriate!
• Visualization choice	Must be informed by the **data** you have, the **research question** being asked and the **audience** that cares.	Pick the simplest plot that best shows most/all of the data needed to answer the research question. If you only have summary statistics, cannot show distributions. Tailor the visualization to your audience (within reason) but don't dumb it down.
• Colour & Accessibility	Colour can be used to encode information or for aesthetics/style/ design. However, colour can also be distracting if used inappropriately or poorly.	Choose a perceptually uniform colour palette; can be sequential or diverging for quantitative data. Opt for colour-blind friendly palettes. Categorical data can use qualitative colour schemes.

Welcome to the wonderful world of Data Visualization!

- Highly recommend this free online book as a reference!




COMPARING CATEGORIES
Compare values across categories
Bar
Paired Bar
Stacked Bar
Span
Unit
Column
Paired Column
Stacked Column
Radial Bar
Circular Column
Sankey
Waterfall
Triangle Column
Heatmap
Chernoff
Marimekko
Bubble Comparison
Gauge
Slope
Isotype
Mosaic
Nested Bubbles
Bullet
Dot Plot
Word Cloud
TIME
Track changes over time
Line
Stream
Cause-Effect
Sparklines
History Flow
Timeline
Horizon
Connected Scatterplot
Flow Chart
Calendar
Arc-Time
Bump
Stacked Area
Gantt
Cycle
DISTRIBUTION
Representation of the distribution of data
Histogram
Fan
Box & Whisker
Pyramid
Violin
Stem & Leaf
Stock
Stripe
Confidence Interval
Error Bars

GEOSPATIAL

Relates data to its geography

- Map
- Flow Map
- Icon Map
- Choropleth
- Map with Columns
- Isopleth
- Cartogram
- Map with Pie Charts
- Contour
- Non-Contiguous Cartogram
- Bubble Map
- Dorling Map
- Connection Map
- Point Map
- Subway Map

PART-TO-WHOLE

Relates the part of a variable to its total

- Pie
- Treemap
- Donut
- Square Cloud
- Arc
- Voronoi
- Nightingale
- Triangle Treemap
- Sunburst
- Waffle

RELATIONSHIP

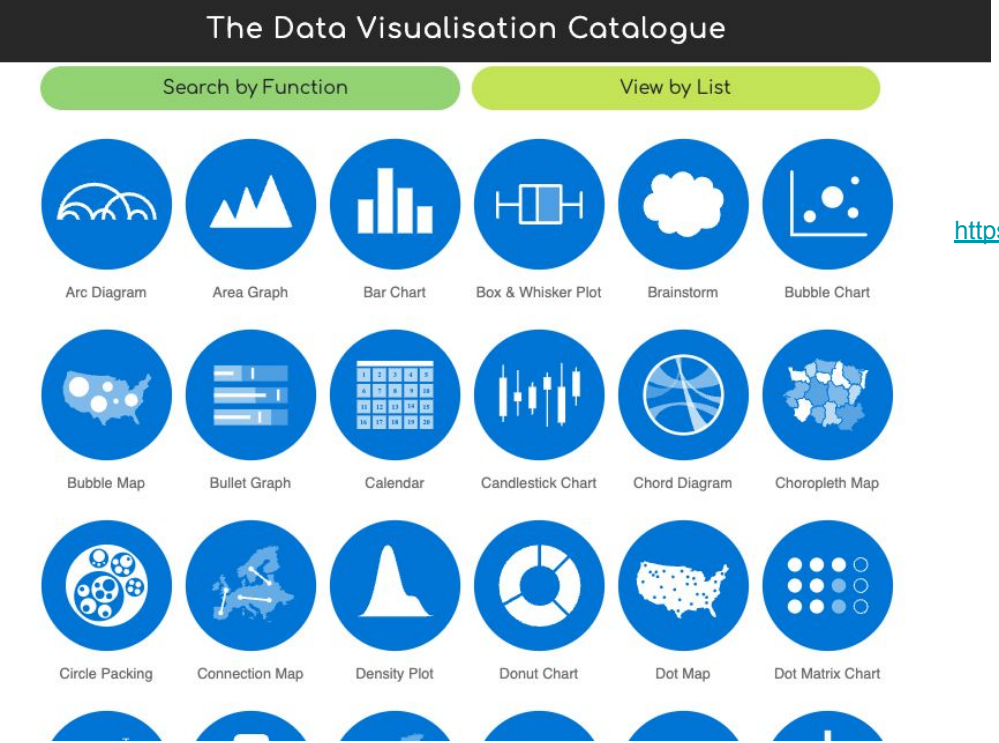
Illustrates correlations or relationships between variables

- Scatterplot
- Arc-Connection
- Dendrogram
- Word Tree
- Circle Packing
- Chord
- Tree
- Correlation Matrix
- Bubble
- Hive
- Double Tree
- Radar
- Parallel Coordinates
- Force-Directed
- Network
- Venn Diagram

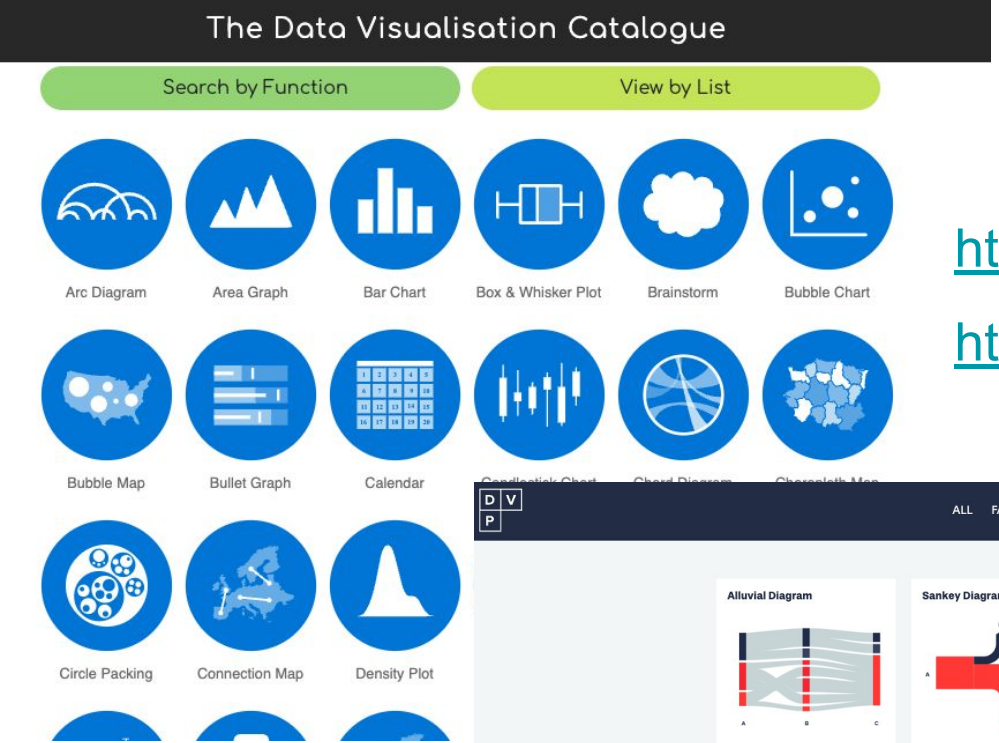
@jschwabish @SR_Visual_Info

Data Types

- **Categorical Data**
  - Represents distinct groups or labels (e.g., cities, ice cream flavors, departments)
  - Typically non-numeric, though can be encoded as such
- **Numerical (Quantitative) Data**
  - Measures quantities
  - Can be discrete (counts) or continuous (time, temperature)
- **Multivariate Data**
  - Contains more than two variables per observation



https://datavizcatalogue.com/index.html

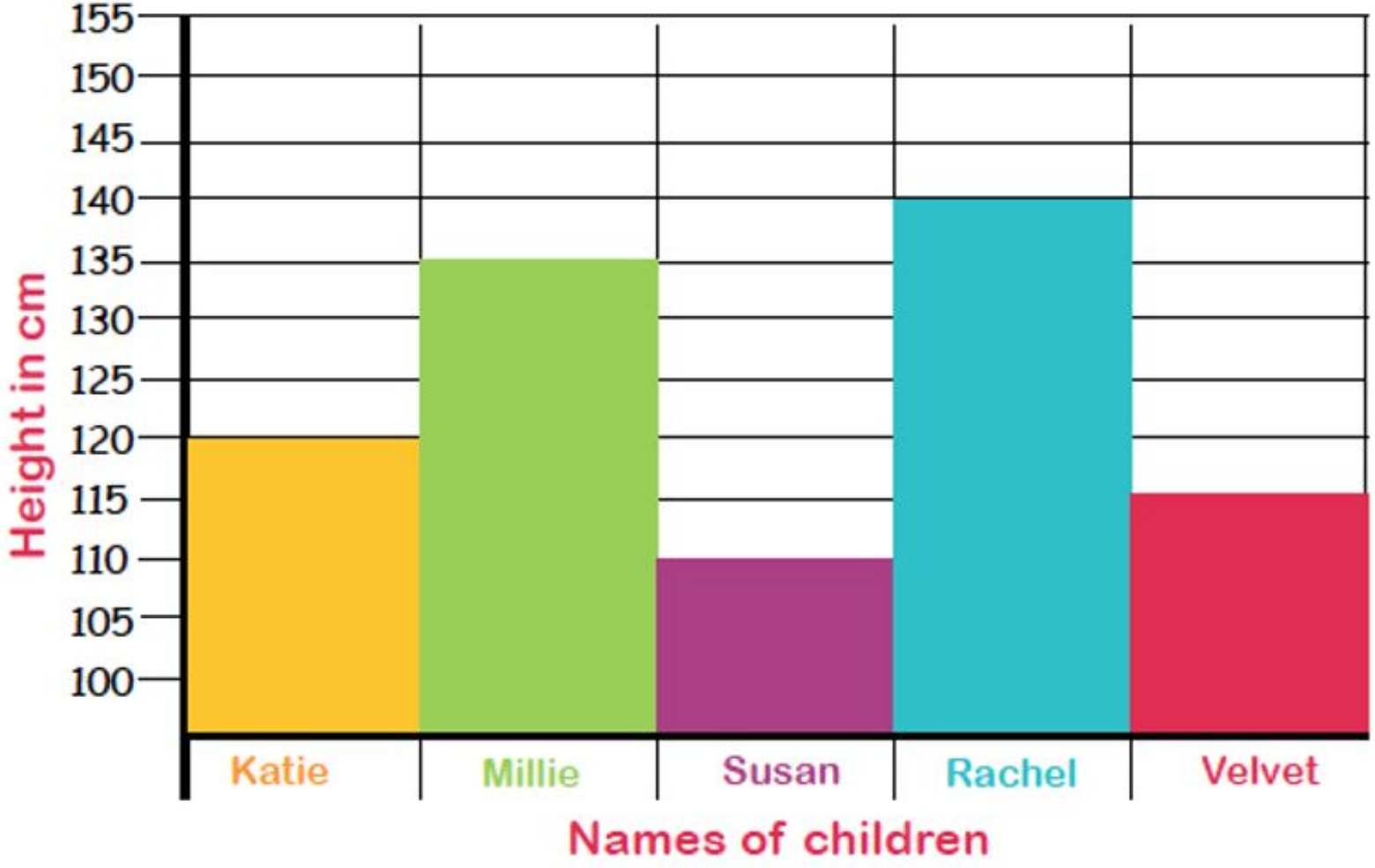


https://datavizcatalogue.com/index.html

https://datavizproject.com/#

Visualization Zoo

- **Comparing Categories**
  - **Bar Chart: Bar, Stacked Bar, Grouped Bar**
  - **Pie Chart**
- Discovering Temporal Trends
  - Line, Multi-Line, Area Charts
- Multiple Attributes
  - Radar Chart, Bubble Charts, Parallel Coordinates
- Visualizing Relationships and Hierarchy
  - Tree Maps, Scatterplots, Tree Diagrams, Network Graph

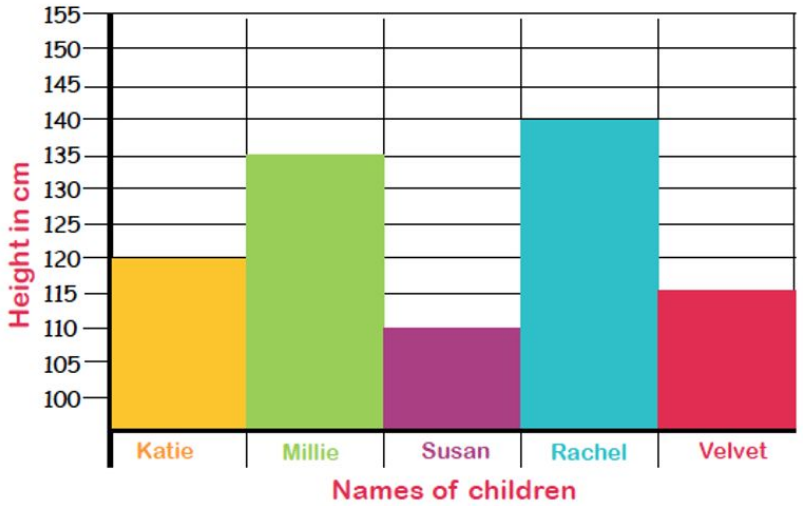

155
150
145
140
135
130
125
120
115
110
105
100
Height in cm
Katie
Millie
Susan
Rachel
Velvet
Names of children

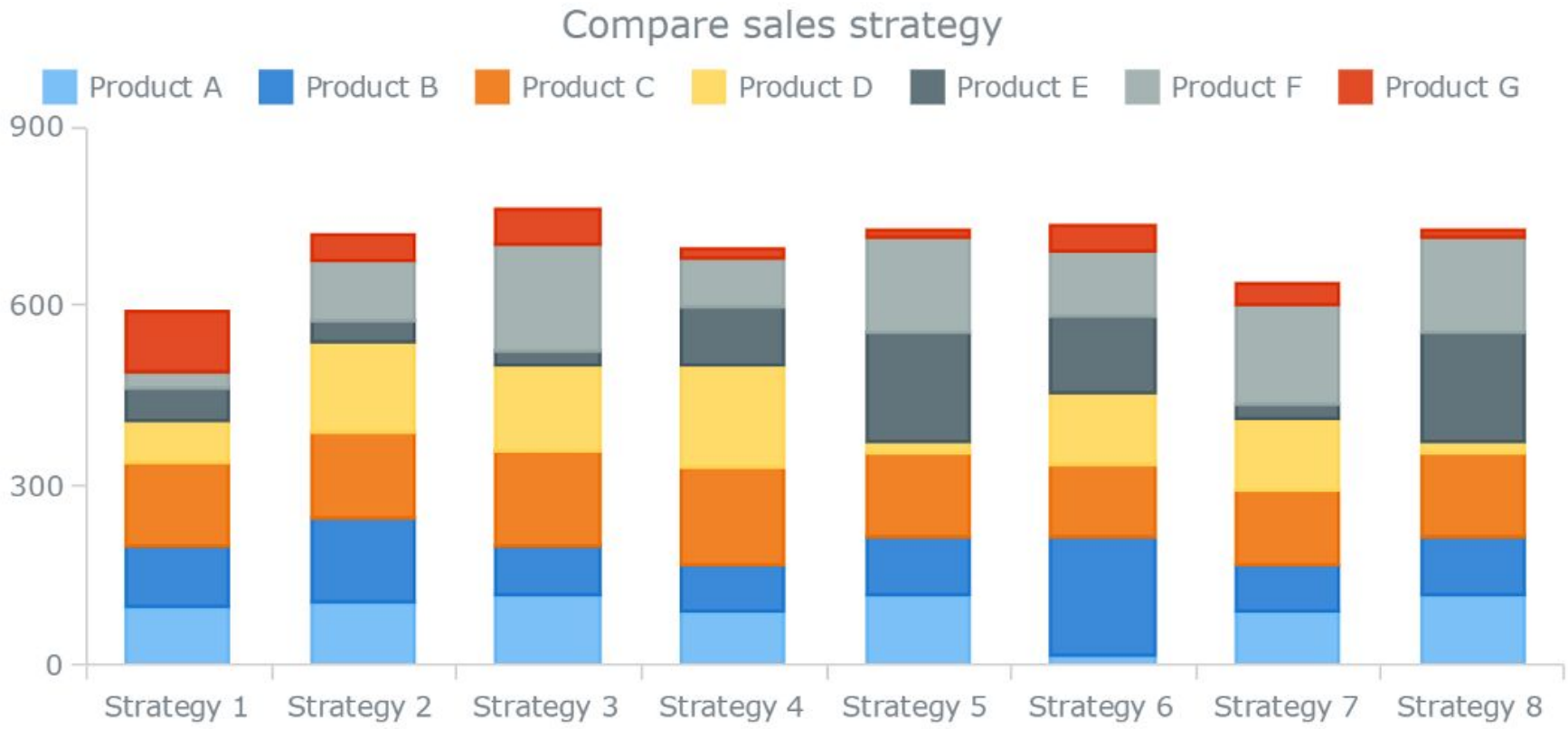
Bar Chart

- Use for comparing discrete categorical data (e.g., product sales, survey responses)
  - Answers the question of "how many?" in each category.
- it does not display **continuous developments** over an interval
- Easily readable and interpretable.

Data type:

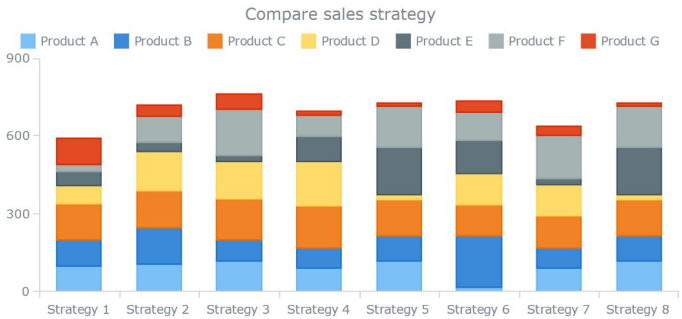
Categorical (x-axis) + Numeric (y-axis)




Compare sales strategy
Product A
Product B
Product C
Product D
Product E
Product F
Product G
900
600
300
0
Strategy 1
Strategy 2
Strategy 3
Strategy 4
Strategy 5
Strategy 6
Strategy 7
Strategy 8

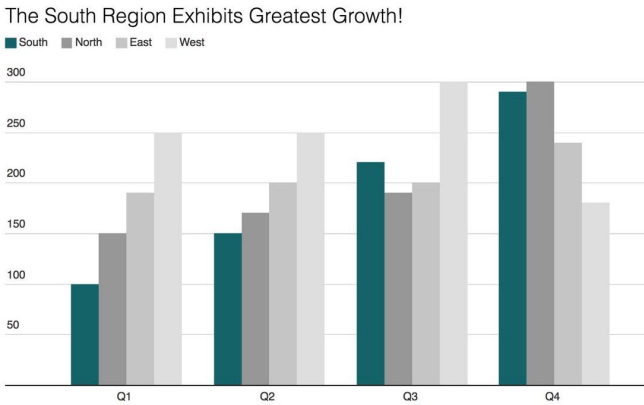
Stacked Bar Chart

- Good for proportions, parts to a whole, comparisons
  - Shows sub-category composition within each main category.
- **Limitation(s):**
  - Harder to read the more segments each bar has.
  - Comparing segments to each other is difficult, as they're not aligned on a common baseline.
- **Data type:**
  - Categorical with grouped sub-categories

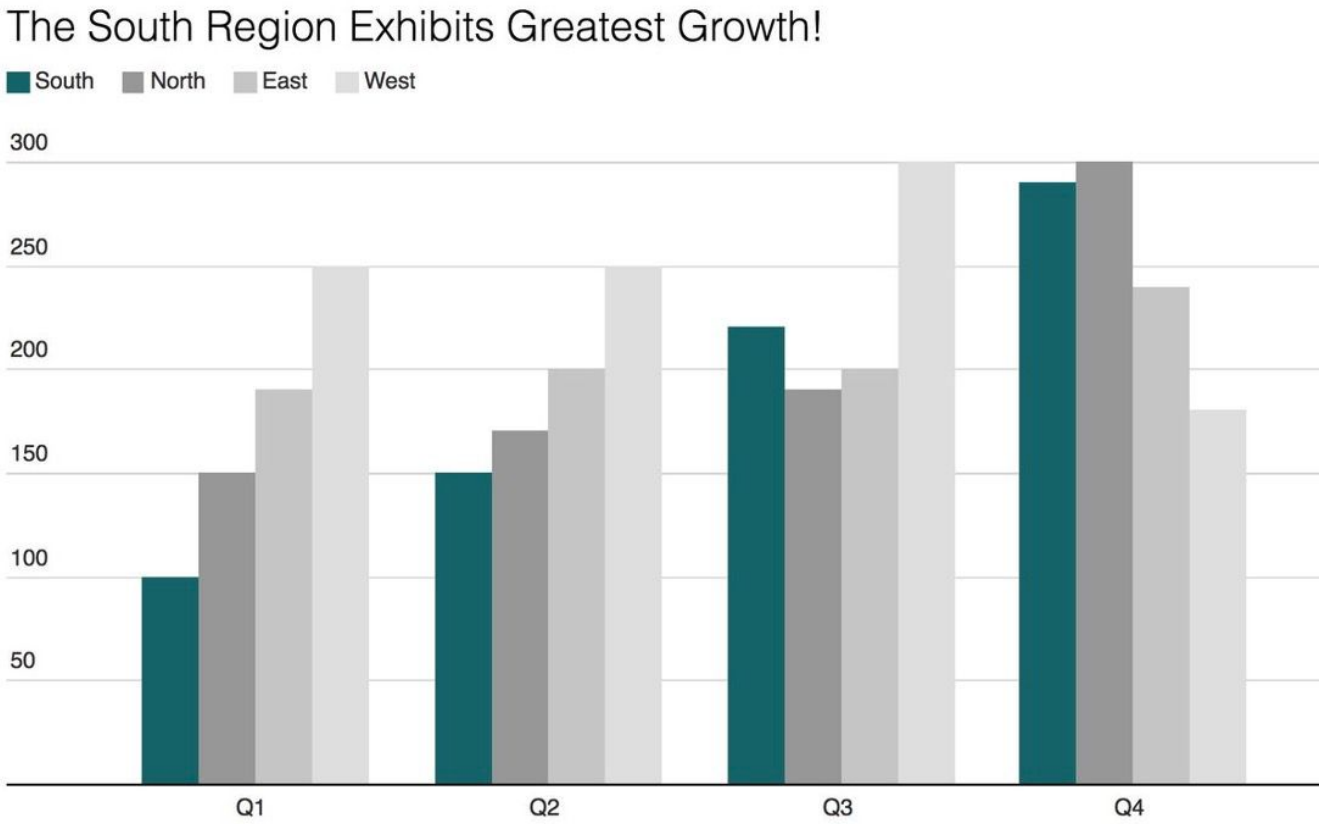


Multi-Set or Grouped Bar Chart

- Good for distribution, relationships and comparisons
  - Easier than stacked bar for subgroup comparison
- **Limitation(s):**
  - Becomes unreadable with too many groups
- **Data type:**
  - Categorical (grouping + sub-grouping)



Multi-Set or Grouped Bar Chart



Pie Chart

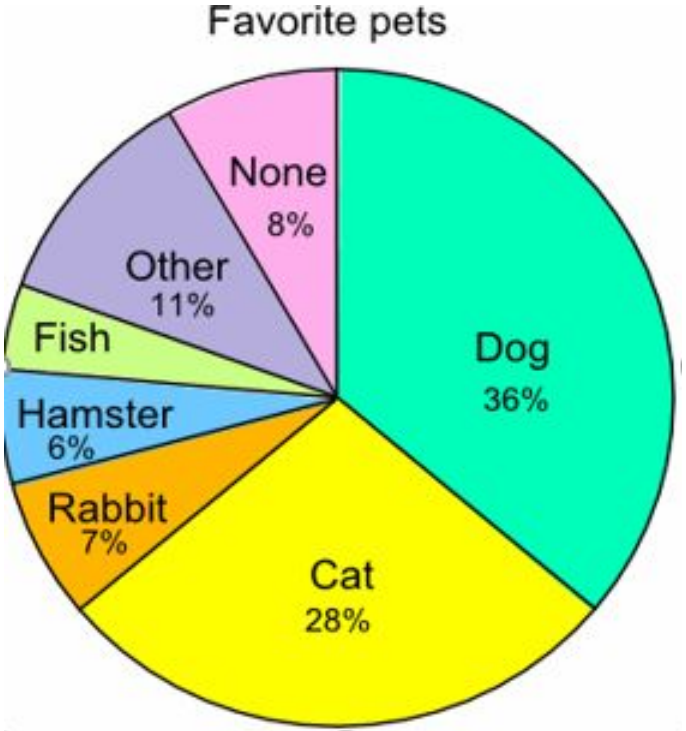
- Show part-to-whole relationships
  - Quick visual impression of proportions

Limitation(s):

- Poor for precise comparison
- Difficult to read with more than ~5 slices

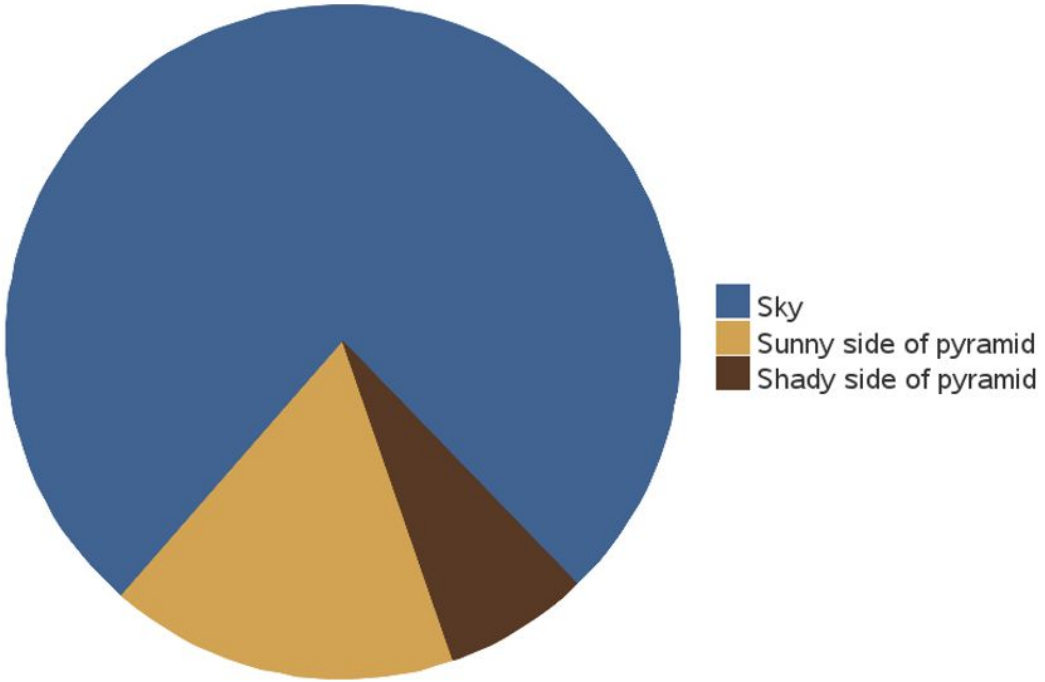
Data type:

- Categorical (each slice), numerical (size)



When is a good time to use a pie chart?

- The short answer is only in very rare occasions.
- Ideally in interactive situations or if you're looking to see if exactly two things are equal. E.g.



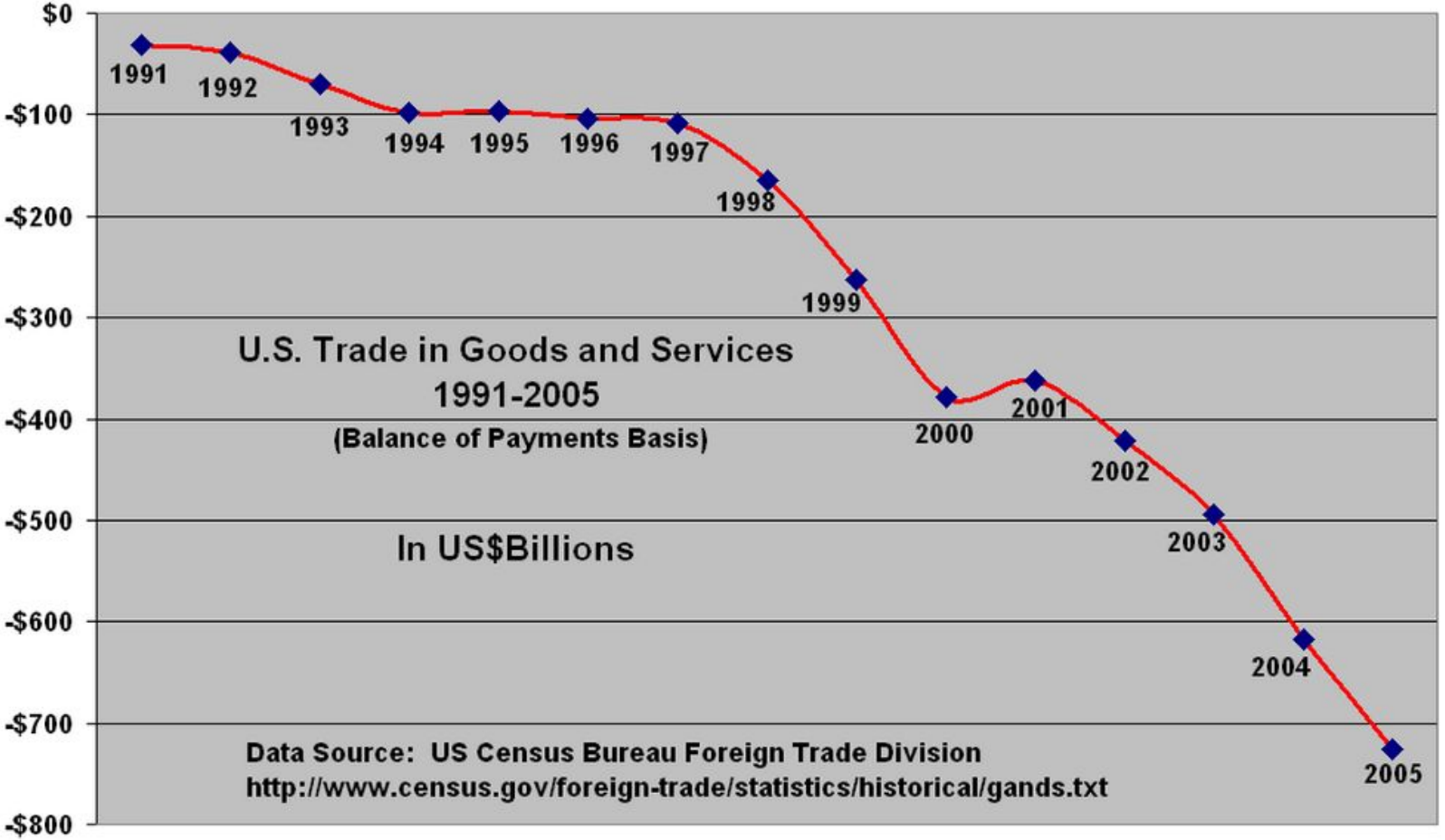
Visualization Zoo

- Comparing Categories
  - Bar Chart: Bar, Stacked Bar, Grouped Bar
  - Pie Chart
- **Discovering Temporal Trends**
  - **Line, Multi-Line, Area Charts**
- Multiple Attributes
  - Radar Chart, Bubble Charts, Parallel Coordinates
- Visualizing Relationships and Hierarchy
  - Tree Maps, Scatterplots, Tree Diagrams, Network Graph

Line Chart/Graph

- Show trends over continuous intervals (e.g., months, years)
  - Good for spotting increases/decreases over time

Limitation(s): Doesn’t work well for categorical or sparse time points

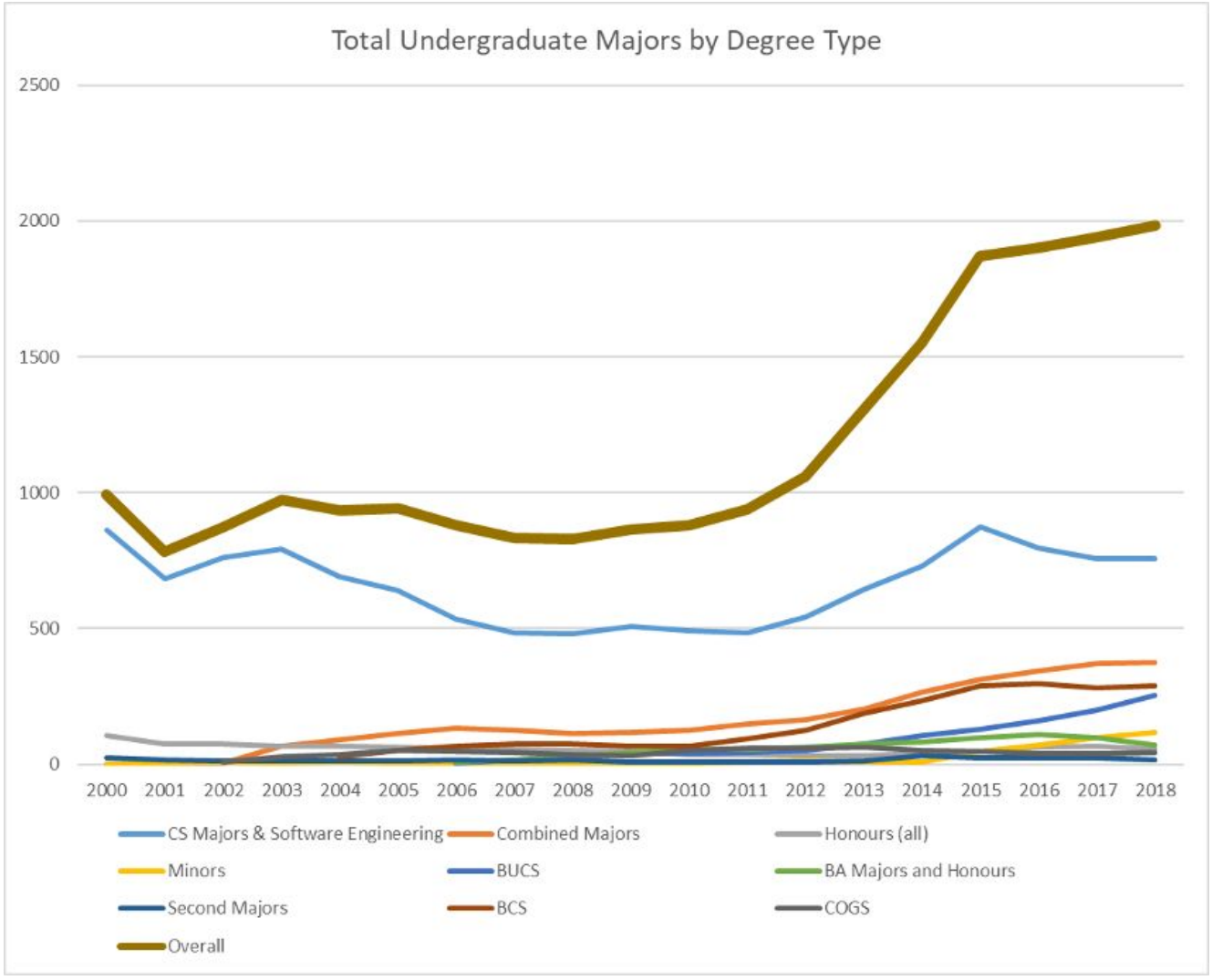

$0
-$100
-$200
-$300
-$400
-$500
-$600
-$700
-$800
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
U.S. Trade in Goods and Services
1991-2005
(Balance of Payments Basis)
In US$Billions
Data Source: US Census Bureau Foreign Trade Division
http://www.census.gov/foreign-trade/statistics/historical/gands.txt

Multi-Line Chart

- Compare multiple trends simultaneously
  - Highlights similarities or differences across groups

Limitation(s):

- Colour/label clutter with more than 4–5 lines


Total Undergraduate Majors by Degree Type
2500
2000
1500
1000
500
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
CS Majors & Software Engineering
Combined Majors
Honours (all)
Minors
BUCS
BA Majors and Honours
Second Majors
BCS
COGS
Overall

Area Chart

- Show cumulative change or volume over time
  - Visual emphasis on totals and growth

Limitation(s): Overlapping areas can obscure individual trends

- Can be misleading if baseline isn't zero

Data type:

- Time series, numeric

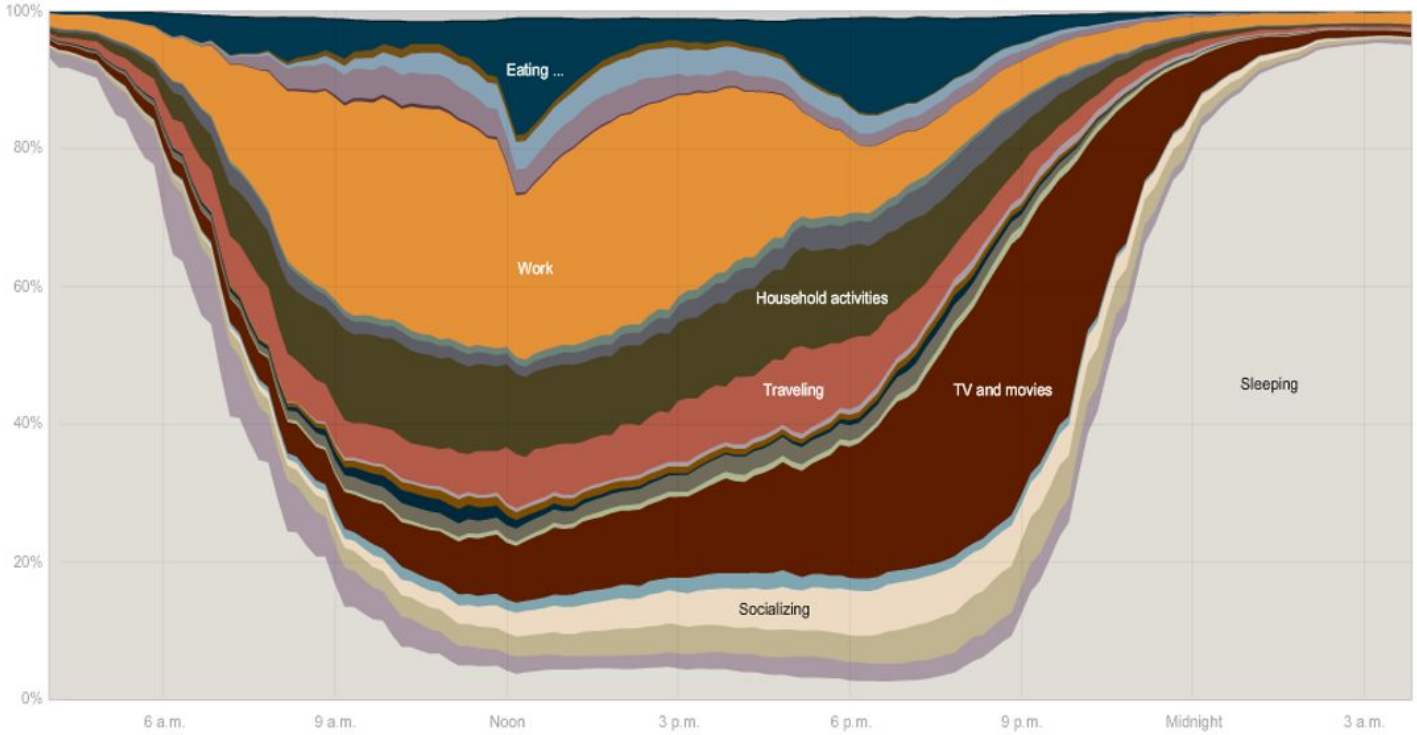
How Different Groups Spend Their Day

The American Time Use Survey asks thousands of American residents to recall every minute of a day. Here is how people over age 15 spent their time in 2008. Related article

Everyone

Sleeping, eating, working and watching television take up about two-thirds of the average day.

Everyone	Employed	White	Age 15-24	H.S. grads	No children
Men	Unemployed	Black	Age 25-64	Bachelor's	One child
Women	Not in lab...	Hispanic	Age 65+	Advanced	Two+ children



By SHAN CARTER, AMANDA COX, KEVIN QUEALY and AMY SCHOENFELD | Send Feedback

Visualization Zoo

- Comparing Categories
  - Bar Chart: Bar, Stacked Bar, Grouped Bar
  - Pie Chart
- Discovering Temporal Trends
  - Line, Multi-Line, Area Charts
- **Multiple Attributes**
  - **Radar Chart, Bubble Charts, Parallel Coordinates**
- Visualizing Relationships and Hierarchy
  - Tree Maps, Scatterplots, Tree Diagrams, Network Graph

Radar Chart (Spider Chart)

- Profile comparison across multiple attributes (e.g., performance metrics)
  - Great for showing shape or balance of characteristics

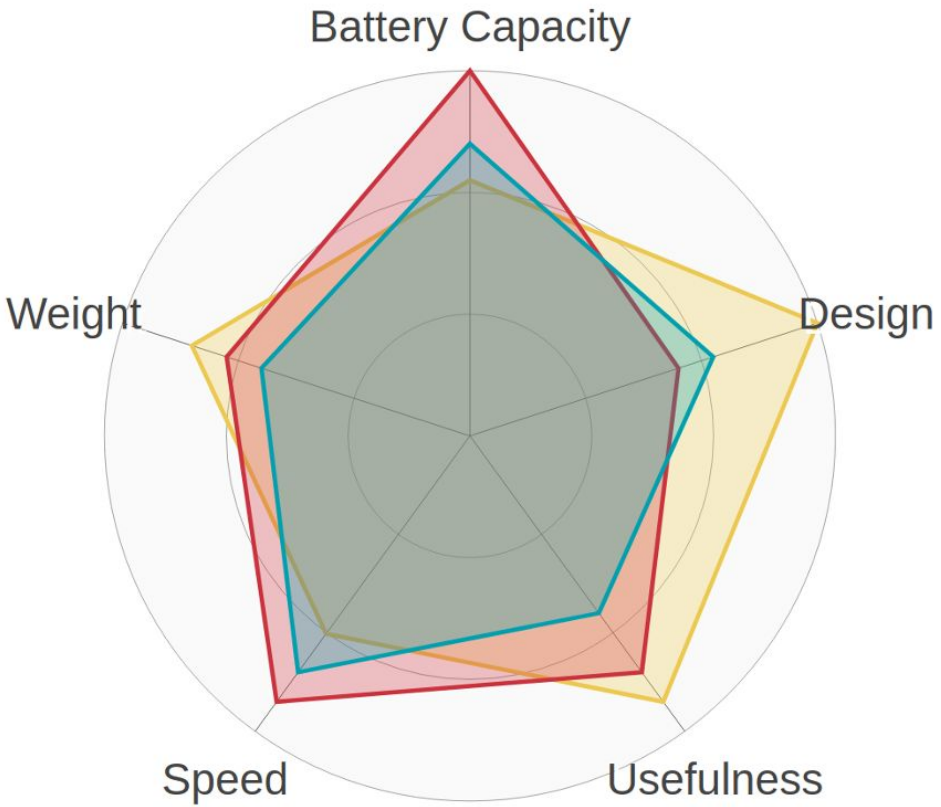
Limitation(s):

- Difficult to interpret beyond 5–7 axes
- Angles can distort perception

Data type:

- Multivariate (many numeric dimensions per category)

Radar Chart (Spider Chart)



Bubble Chart

- Show 3 variables in one chart (x, y, and bubble size)
  - Captures correlation and scale

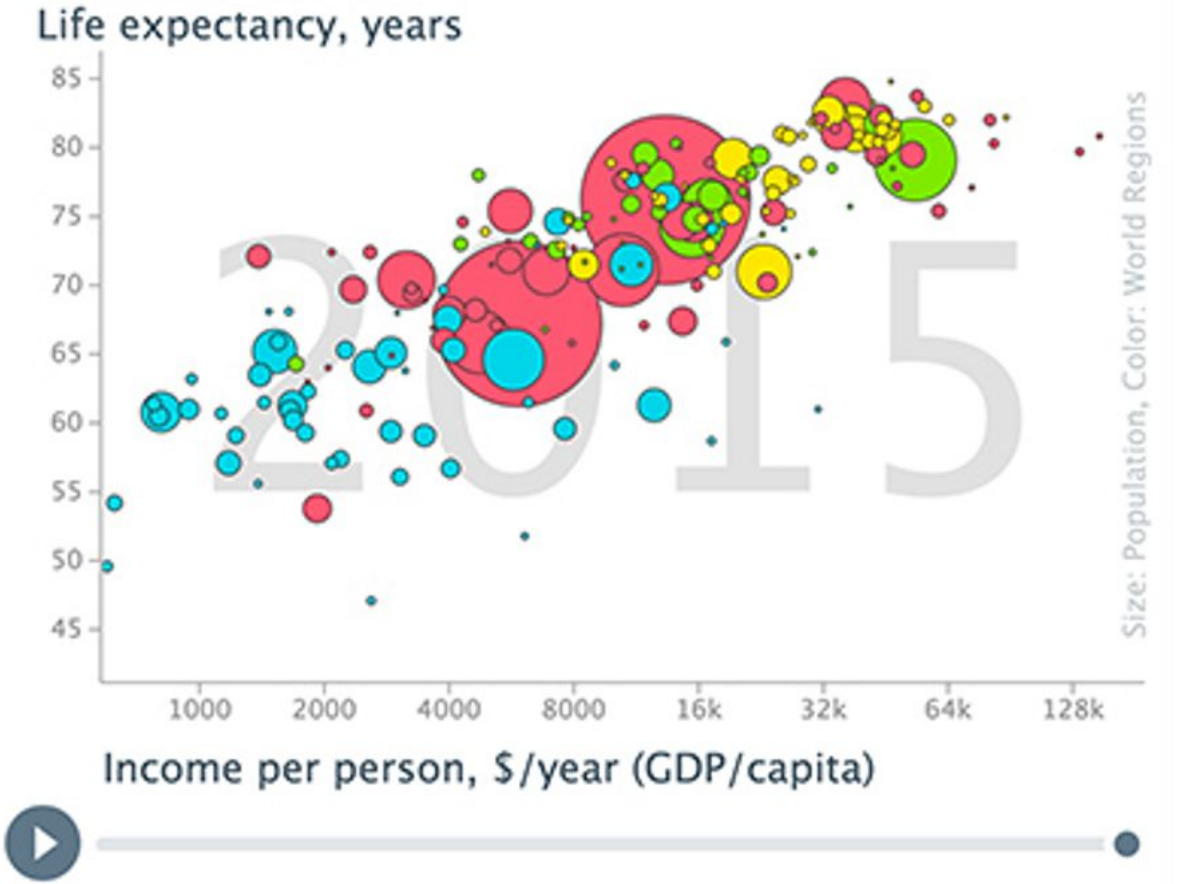
Limitation(s):

- Bubble size often misinterpreted (area vs. radius)
- Overlapping bubbles obscure meaning

Data type:

- Quantitative x, y, and magnitude

Bubble Chart



Parallel Coordinates

- Visualize high-dimensional numerical data
  - Detect patterns, clusters, and outliers

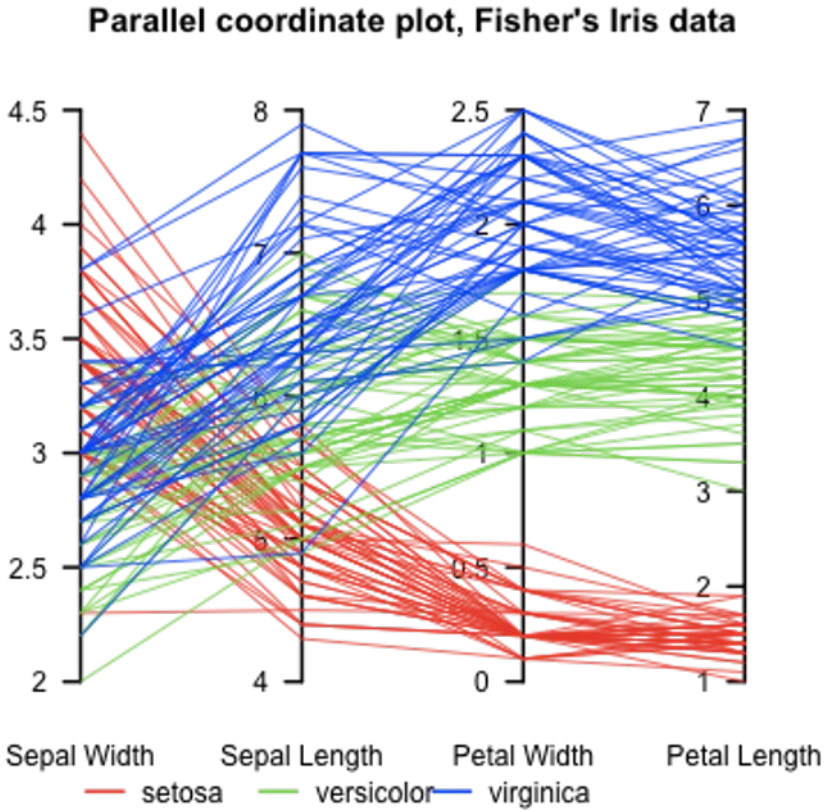
Limitation(s):

- Steep learning curve for novices
- Overplotting with many records

Data type:

- Multivariate numerical

Parallel Coordinates



Visualization Zoo

- Comparing Categories
  - Bar Chart: Bar, Stacked Bar, Grouped Bar
  - Pie Chart
- Discovering Temporal Trends
  - Line, Multi-Line, Area Charts
- Multiple Attributes
  - Radar Chart, Bubble Charts, Parallel Coordinates
- **Visualizing Relationships and Hierarchy**
  - **Tree Maps, Scatterplots, Tree Diagrams, Network Graph**

Tree Map

- Represent hierarchical parts-of-a-whole using nested rectangles
  - Space-efficient and good for proportional data

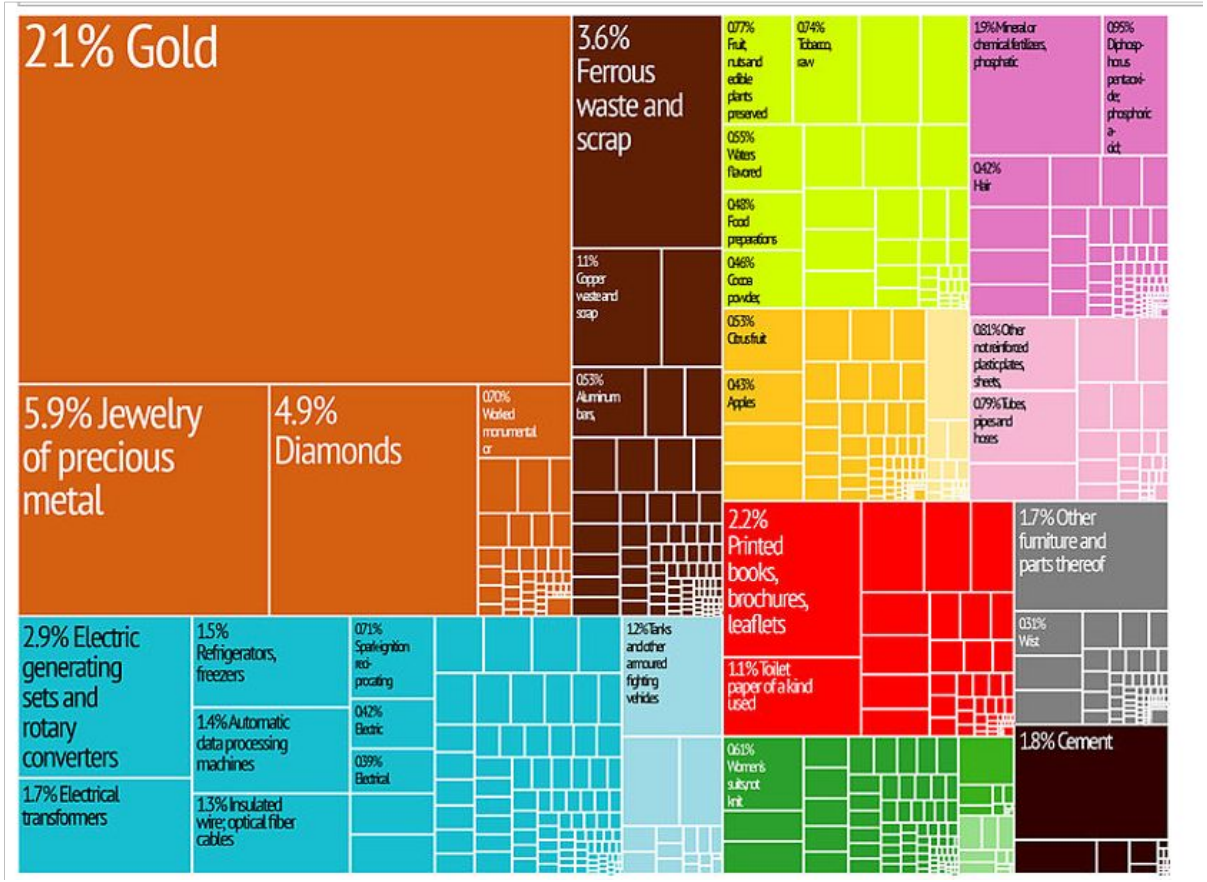
Limitation(s):

- Hard to compare small segments
- Poor for deep hierarchies

Data type:

- Hierarchical categorical + numerical

Tree Map


21% Gold
3.6% Ferrous waste and scrap
5.9% Jewelry of precious metal
4.9% Diamonds
2.9% Electric generating sets and rotary converters
1.5% Refrigerators, freezers
1.4% Automatic data processing machines
1.7% Electrical transformers
1.3% Insulated wire; optical fiber cables
1.2% Tanks and other armoured fighting vehicles
2.2% Printed books, brochures, leaflets
1.1% Toilet paper of a kind used
1.7% Other furniture and parts thereof
1.8% Cement
0.77% Fruit, nuts and edible plants preserved
0.74% Tobacco, raw
0.55% Waters flavored
0.48% Food preparations
0.46% Cocoa powder,
0.53% Citrus fruit
0.43% Apples
1.9% Mineral or chemical fertilizers, phosphatic
0.95% Diphosphorous pentaoxide; phosphoric acid
0.42% Hair
0.81% Other noteinforced plasticplates, sheets,
0.79% Tubes, pipes and hoses
1.1% Copper waste and scrap
0.53% Aluminum bars,
0.70% Worked monumental or
0.71% Spark-ignition reciprocating
0.42% Electric
0.39% Electrical
0.61% Women's suits;not knit
0.31% Wax

Scatterplot

- Show relationships between two quantitative variables
  - Reveals correlation, clusters, and outliers

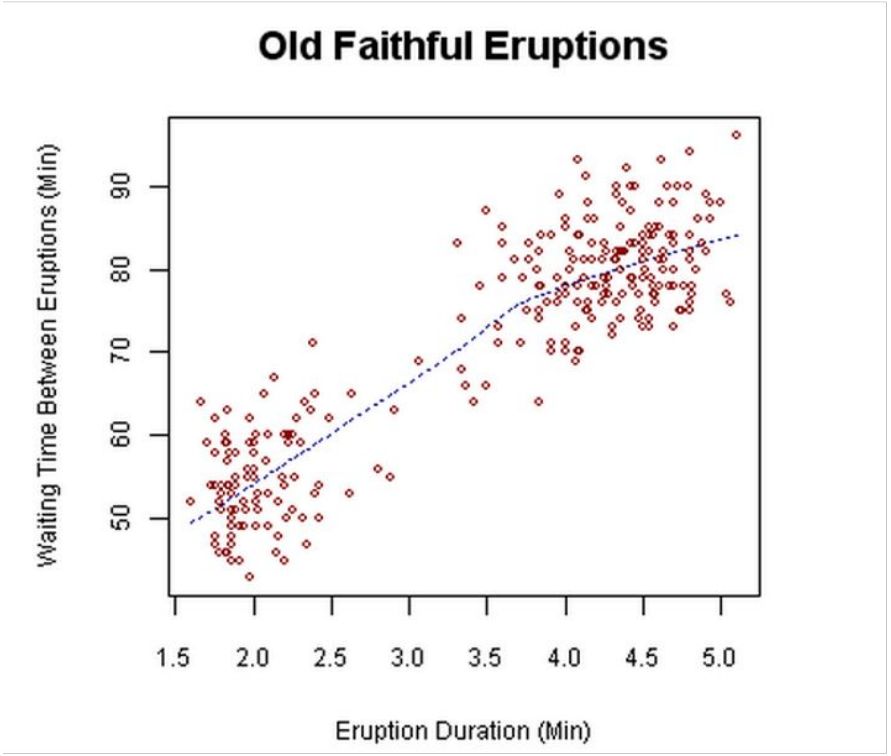
Limitation(s):

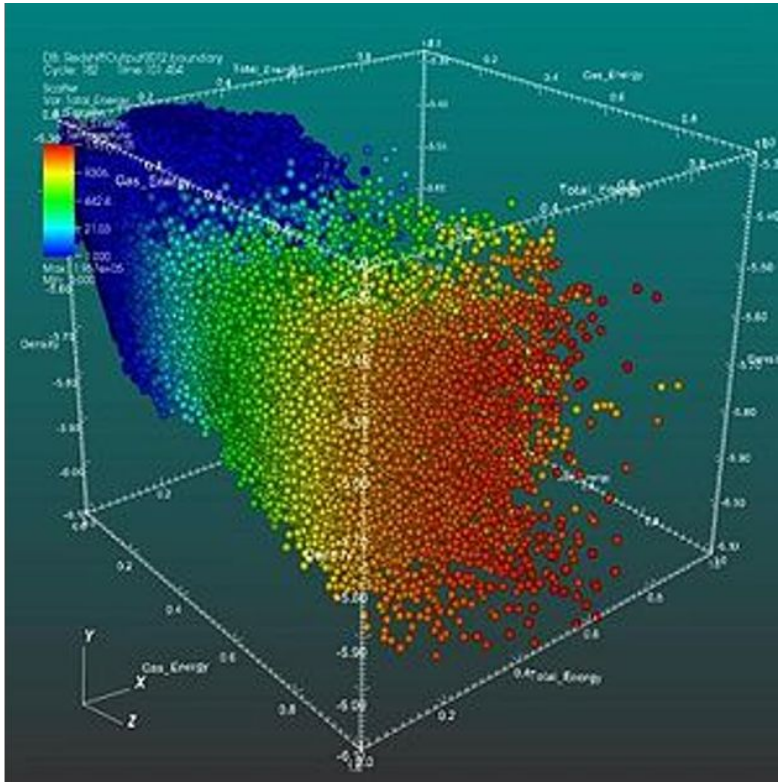
- Can’t handle more than 2–3 variables without color/size

Data type:

- Quantitative x and y

Scatterplot





Network Graph

- Display relationships between entities (e.g., social networks, citations)
  - Highlights central nodes, connectivity

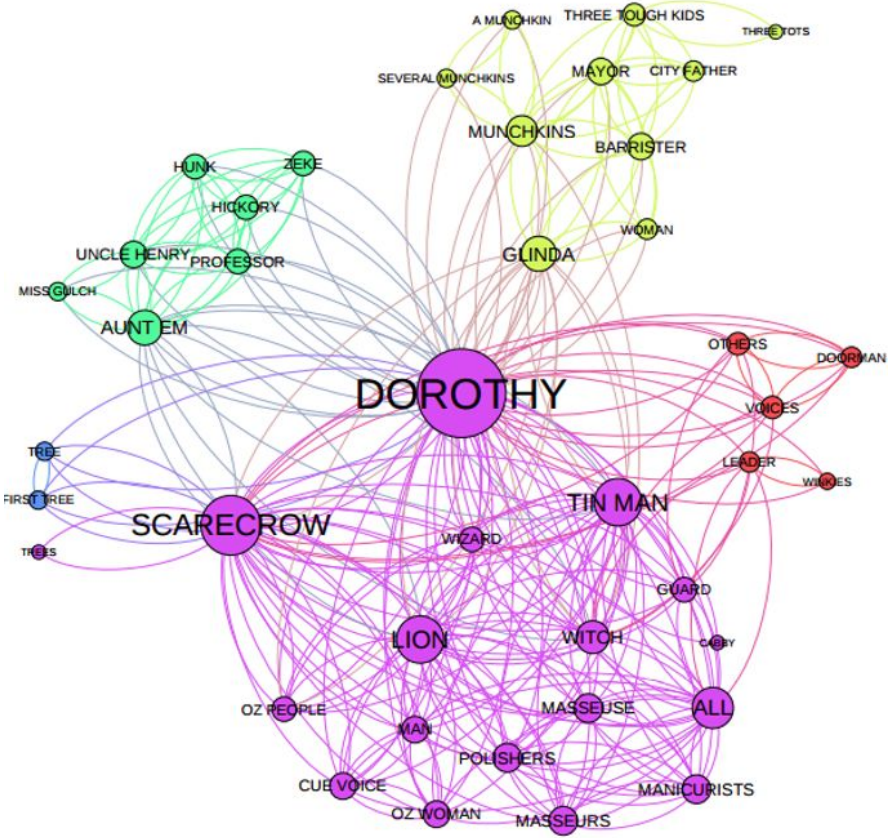
Limitation(s):

- Layout heavily affects readability
- Dense networks require interactivity

Data type:

- Nodes + edges (categorical and/or weighted)

Network Graph



Wrap up