

Human-Computer Interaction

CPSC 481 - Winter 2019

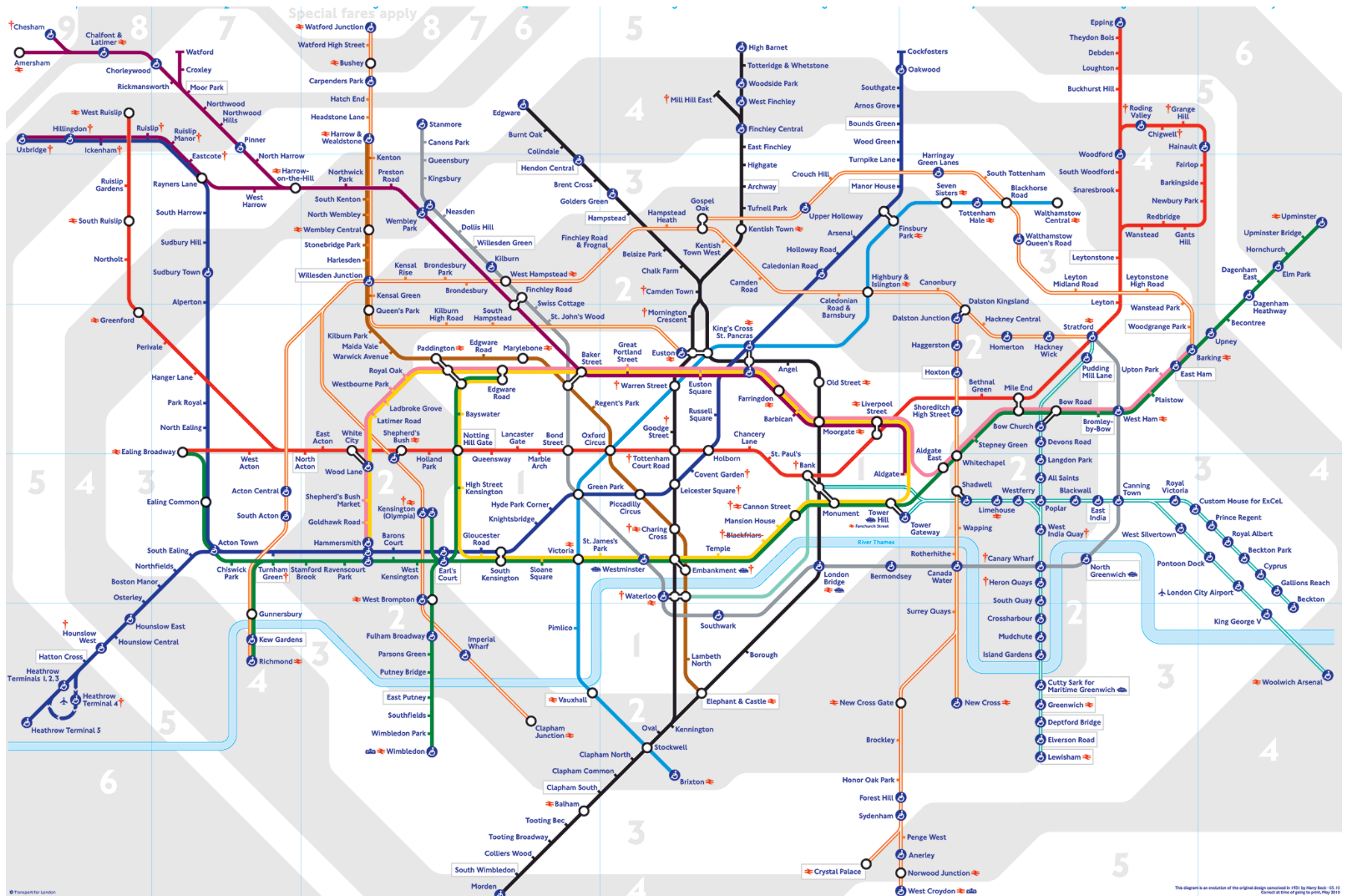
Information Representation

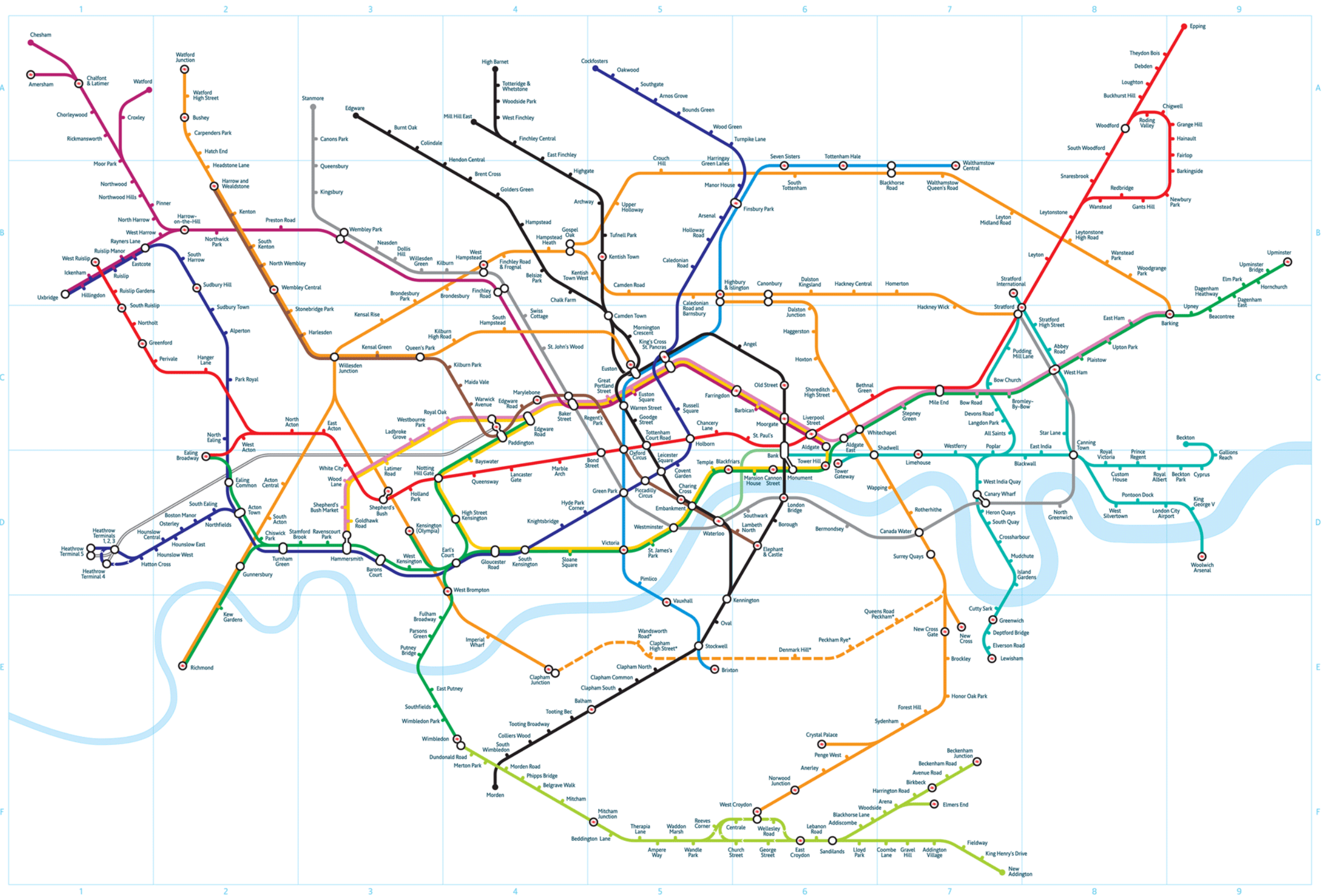
Adapted from Tony Tang

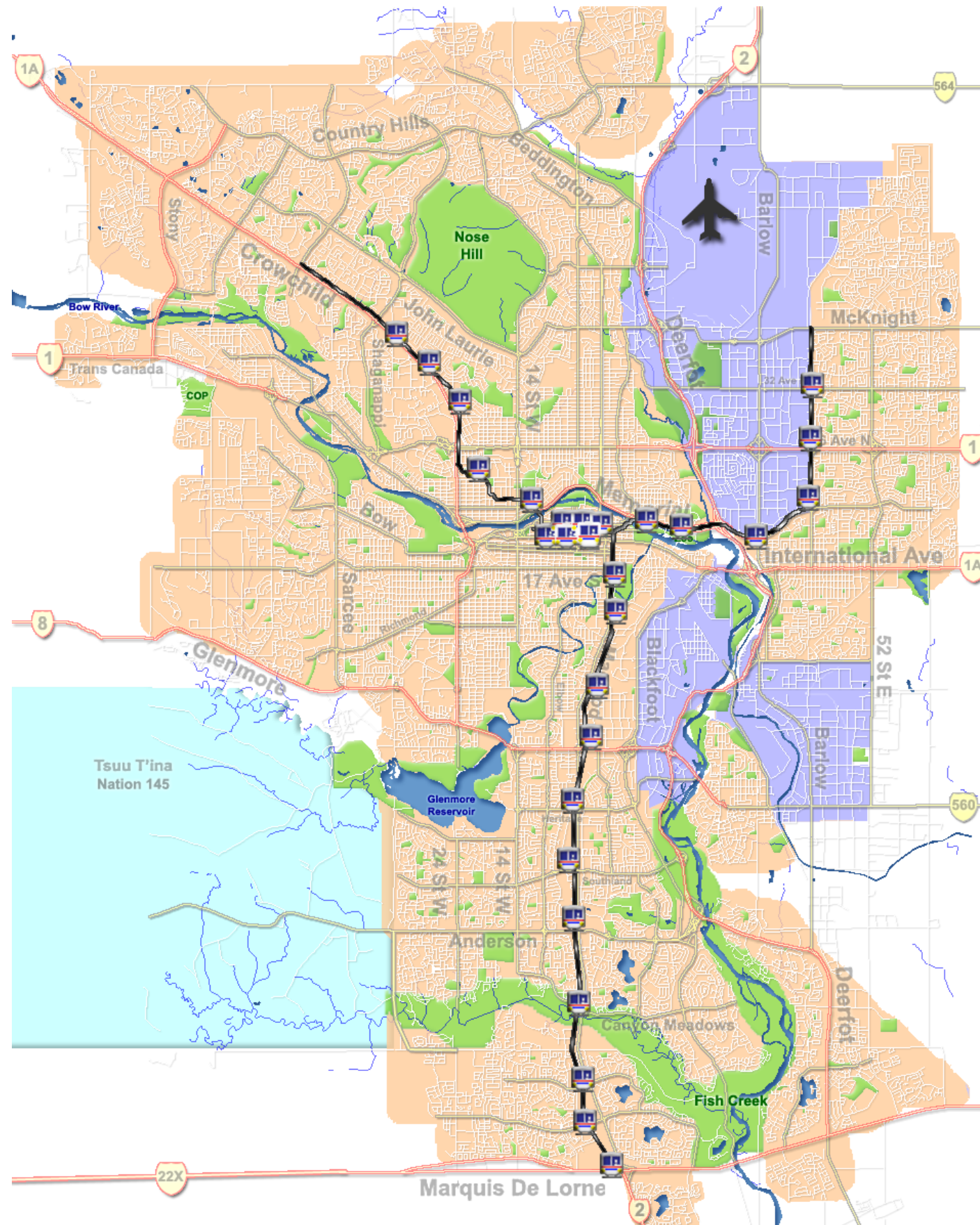
Learning objectives

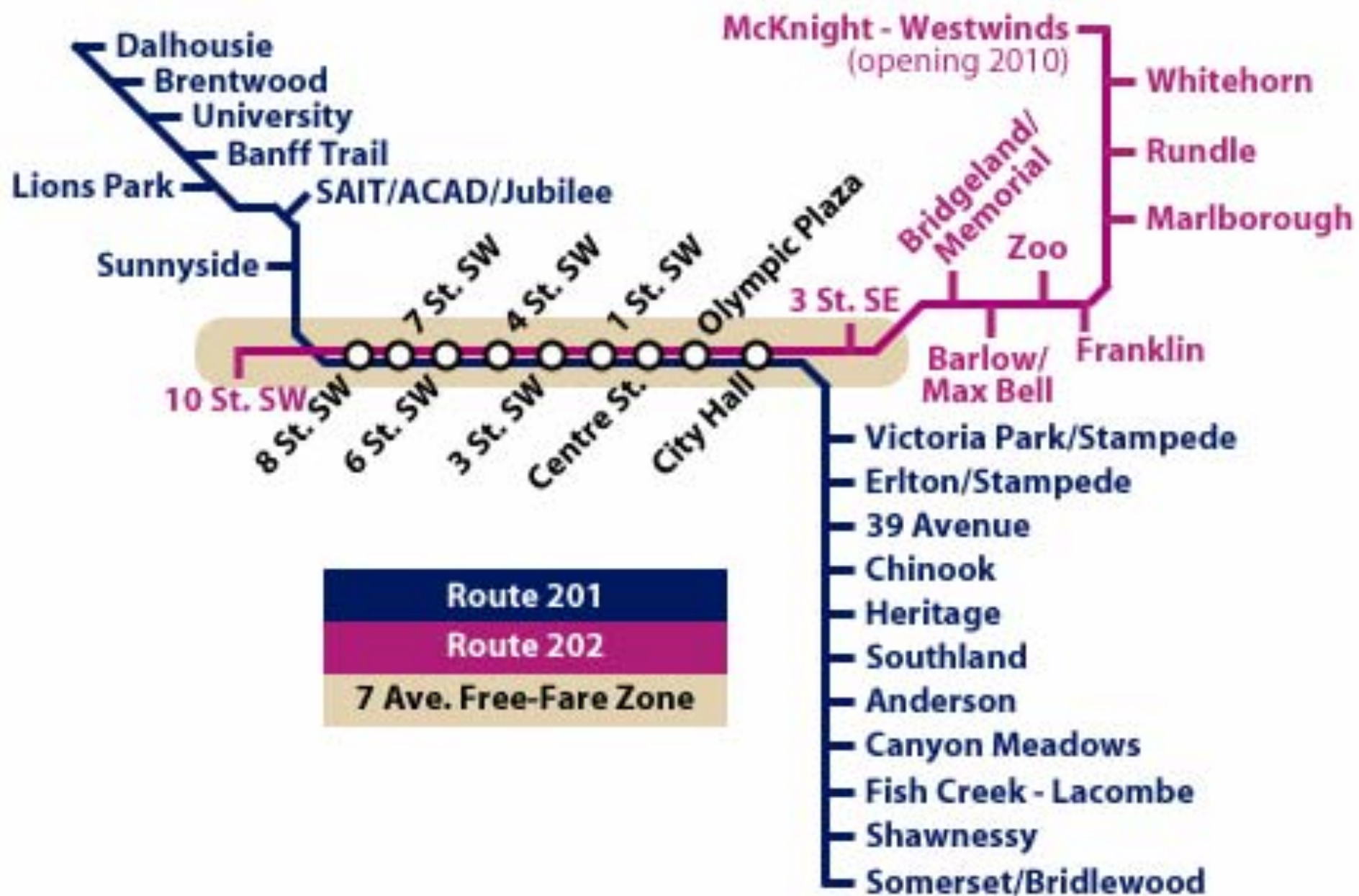
- By the end of this lecture, you should be able to:
 - Describe characteristics of good information representations
 - Discuss the relationship between information representation and problem solving
 - Identify factors that affect what a good representation is
 - Define “chart junk” (Edward Tufte) and understand his argument against it
 - Define “data density” and its relationship with “chart junk”











Punchline

- Good representations...
 - Show essential elements of the event/world
 - Leave out irrelevant elements
 - Appropriate for the person (interpretation, attention)
 - Appropriate for the task

How many buffalo?



How many buffalo?



||||/ |||/ ||
Buffalo

How many buffalo?



||||| / ||||| / ||
Buffalo

||||| / ||||| / ||
Buffalo

How many buffalo?



|||||
Buffalo

|||||
Buffalo

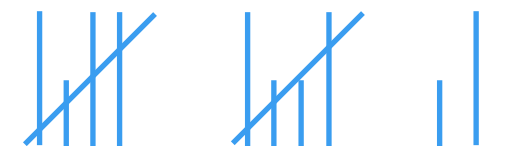
|||||
Adults

|||||
Calfs

How many buffalo?



Buffalo



Buffalo



Adults

8



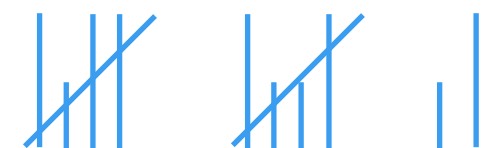
Calfs

4

How many buffalo?



Buffalo



Buffalo



Adults



Calfs



8

4



What is a representation?

- Representation
 - “Formal system or mapping by which information can be specified”

What is a representation?

- Representation
 - “Formal system or mapping by which information can be specified”
- Example
 - Decimal 34
 - Binary 100010
 - Roman XXXIV
- Representation choices tell us something specific about the information

Representations

- *Solving a problem simply means representing it so as to make the solution transparent (Simon, 1981)*
- Good representations
 - Allow people to find relevant information
 - Information may be present but hard to find
 - Allow people to compute desired conclusions
 - Computations may be difficult or “for free” depending on representations

Let's play a game... (1)

- Let's play a game: the game of "15". The "pieces" for the game are the nine digits: 1, 2, 3, 4, 5, 6, 7, 8, 9. Each player takes a digit in turn. Once a digit is taken, it cannot be used by other player. The first player to get three digits that sum to 15 wins.

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- Here is a sample game: Player A takes 8. Player B takes 2. Then A takes 4, and B takes 3. A takes 5.

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- Here is a sample game: Player A takes 8. Player B takes 2. Then A takes 4, and B takes 3. A takes 5.
- Question: Suppose you are now to step in and play for B. What move would you make?

Let's play a game... (2)

- Now let's play a different game, tic-tac-toe. Players alternately place a naught (the symbol O) or a cross (the symbol X) in one of nine spaces arranged in a rectangular array (as shown in the following illustration). Once a space has been taken, it cannot be changed by either player. The first player to get three symbols in a straight line wins. Suppose player A is X and B is O, and the game has reached the following state:

Let's play a game... (2)

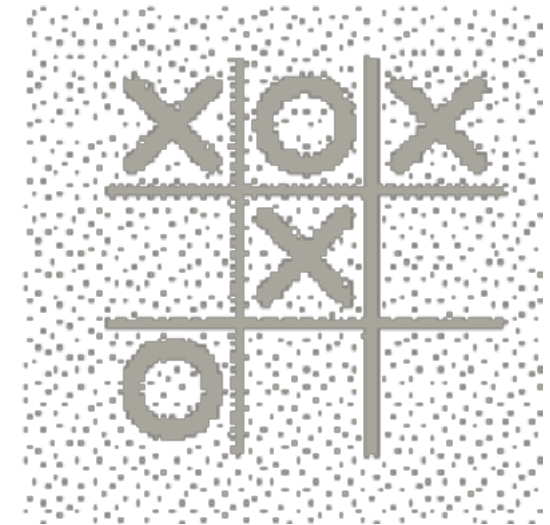
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Let's play a game... (3)



4	3	8
9	5	1
2	7	6



- Remember the moves in the game of 15? A had selected 8, 4, and 5; B had selected 2 and 3:

•

Let's play a game... (3)

4	3	8
9	5	1
2	7	6

- Remember the moves in the game of 15?
A had selected 8, 4, and 5; B had selected 2 and 3:

-

X	O	X
	X	
O		
4	3	8
	5	
2		

Let's play a game... (3)

4	3	8
9	5	1
2	7	6

- Remember the moves in the game of 15? A had selected 8, 4, and 5; B had selected 2 and 3:
- B better select 6 this time!

X	O	X
	X	
O		
4	3	8
	5	
2		

Which is the best flight option?

- Length
- Stop-overs
- Switches
- Different time zones
- ...

		depart	arrive
AC 117	Vancouver - Calgary	7:00	9:00
Cdn 321	Vancouver - Calgary	9:00	12:00
Cdn 355	Calgary - Montreal	13:30	19:30
AC 123	Calgary - Toronto	12:30	16:30
AC 123	Toronto - Montreal	16:45	17:30

*time zone: +1 van-cal, +2 cal-tor, mtl

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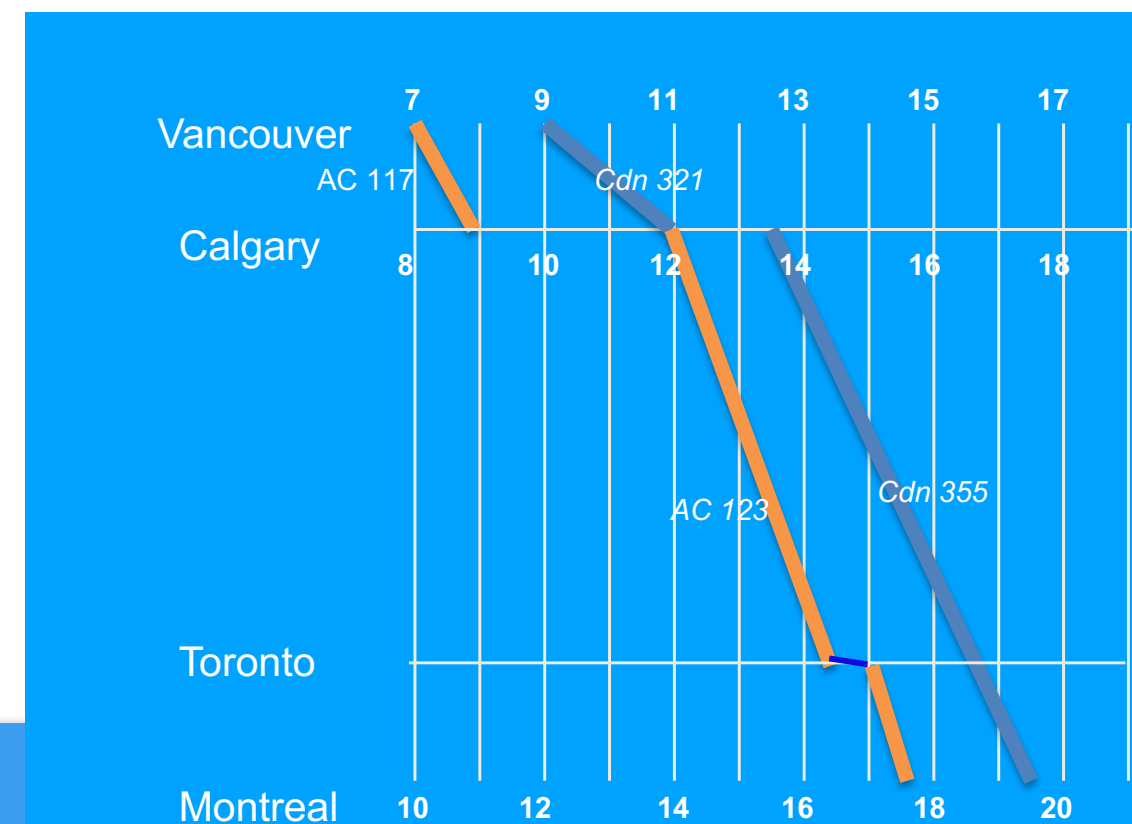
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When do I take my drugs?

- 10 - 30% error rate in taking pills, same for pillbox organizers

Inderal - 1 tablet 3 times a day

Lanoxin. - 1 tablet every a.m.

Carafate - 1 tablet before meals and at bedtime

Zantac - 1 tablet every 12 hours (twice a day)

Quinag - 1 tablet 4 times a day

Couma - 1 tablet a day

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	Breakfast	Lunch	Dinner	Bedtime
Lanoxin	O			
Inderal	O	O	O	
Carafate	O	O	O	O
Quinag	O	O	O	O
Zantac		O		O
Couma				O

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Breakfast	Lunch	Dinner	Bedtime
Lanoxin			
Inderal	Inderal	Inderal	
Carafate	Carafate	Carafate	Carafate
Quinag	Quinag	Quinag	Quinag
	Zantac		Zantac
			Couma

	Breakfast	Lunch	Dinner	Bedtime
Lanoxin	O			
Inderal	O	O	O	
Carafate	O	O	O	O
Quinag	O	O	O	O
Zantac		O		O
Couma				O

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Breakfast	Lunch	Dinner	Bedtime
-----------	-------	--------	---------

Lanoxin			
---------	--	--	--

Inderal	Inderal	Inderal	
---------	---------	---------	--

Carafate	Carafate	Carafate	Carafate
----------	----------	----------	----------

Quinag	Quinag	Quinag	Quinag
--------	--------	--------	--------

	Zantac		Zantac
--	--------	--	--------

Couma

	Breakfast	Lunch	Dinner	Bedtime
--	-----------	-------	--------	---------

Lanoxin	O			
---------	---	--	--	--

Inderal	O	O	O	
---------	---	---	---	--

Carafate	O	O	O	O
----------	---	---	---	---

Quinag	O	O	O	O
--------	---	---	---	---

Zantac		O		O
--------	--	---	--	---

Couma				O
-------	--	--	--	---

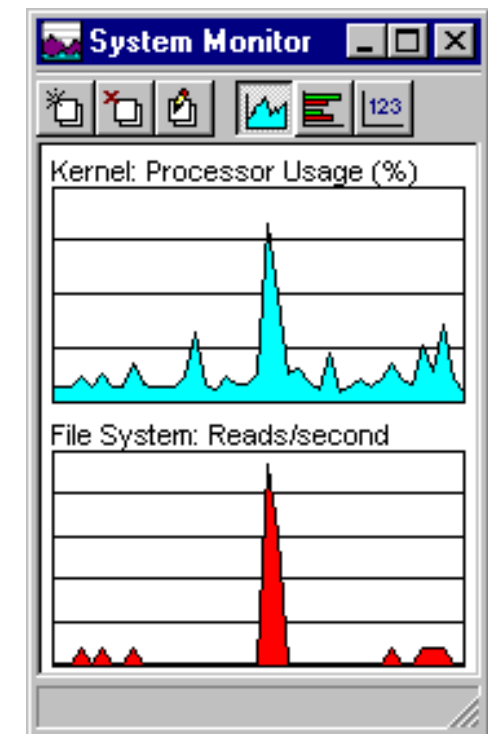
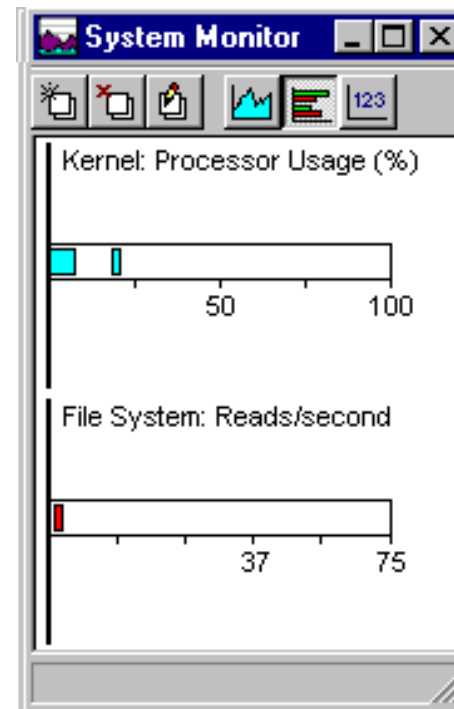
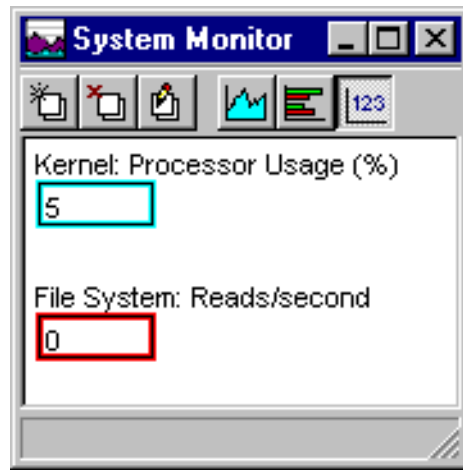
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Breakfast	Lunch	Dinner	Bedtime
Lanoxin			
Inderal	Inderal	Inderal	
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Quinag	Quinag	Quinag	Quinag
	Zantac		Zantac
			Couma

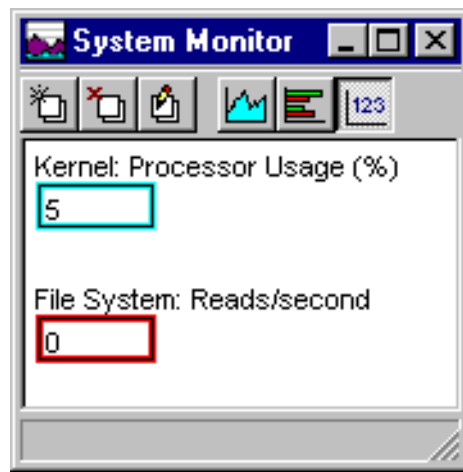
	Breakfast	Lunch	Dinner	Bedtime
Lanoxin	O			
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Carafate	O	O	O	O
Quinag	O	O	O	O
Zantac		O		O
Couma				O

Which representation is best?

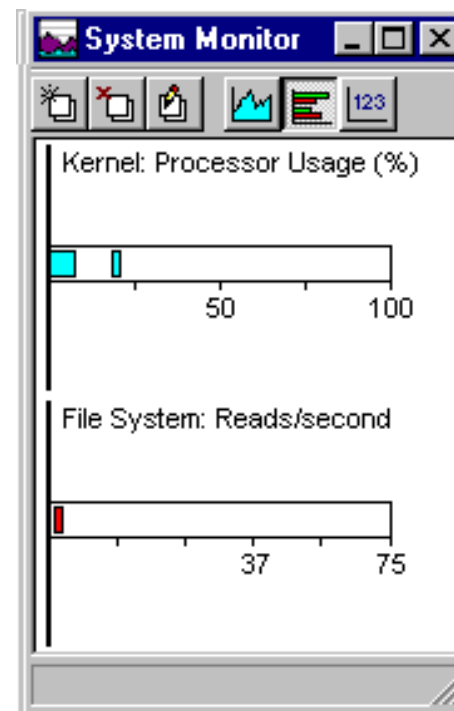


Which representation is best?

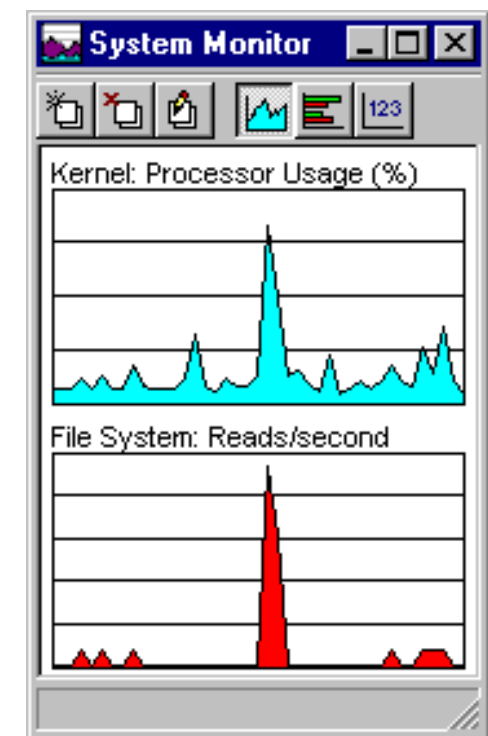
- It depends heavily on task



What is precise value?

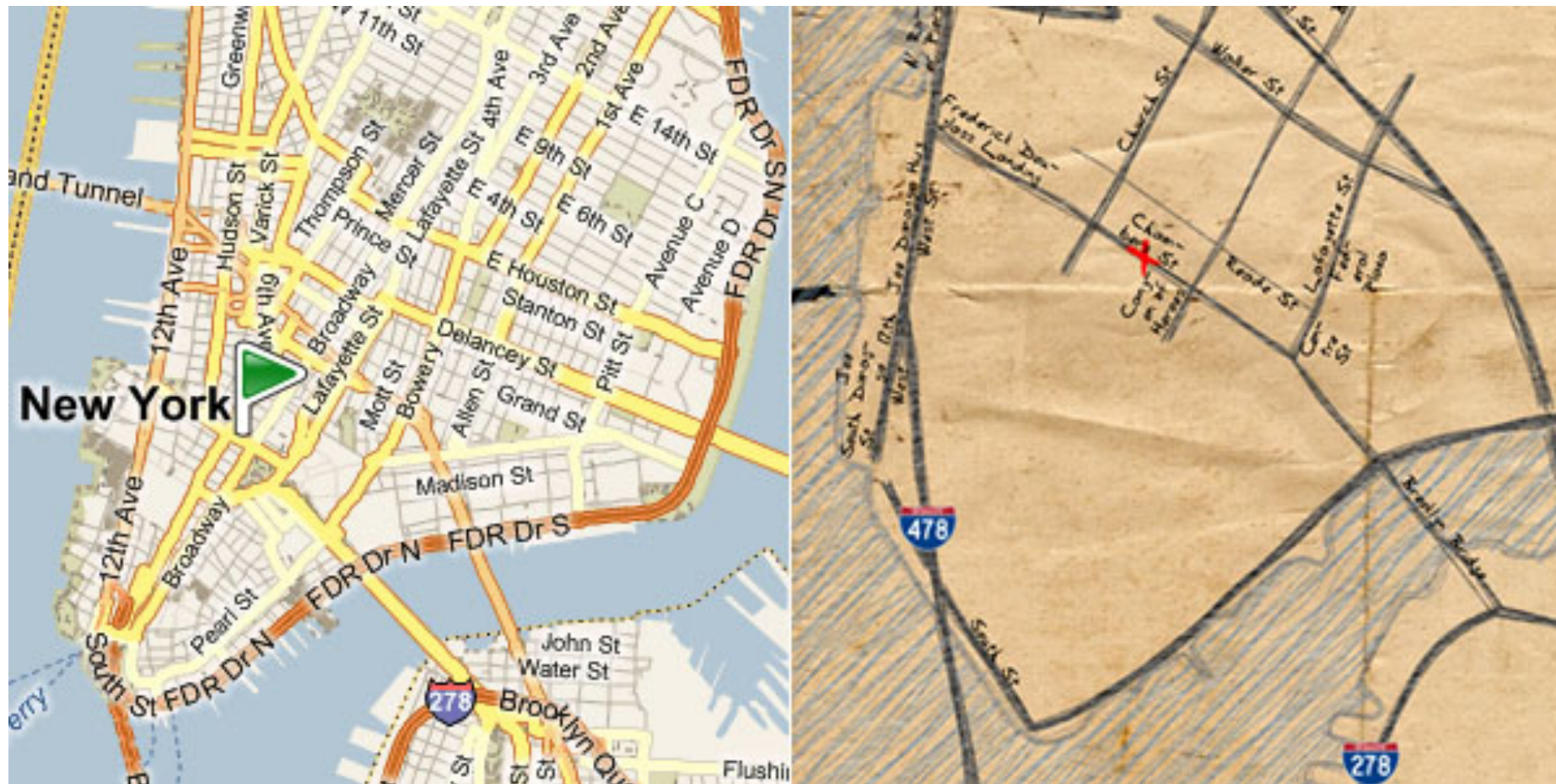


How does the performance now compared to its peak?



How does performance change over time?

Bing Maps: Napkin Sketches



Each of these is good for different kinds of things. The napkin sketch is useful when trying to get from one place to another, and knowing which roads are the relevant ones. The regular map view is useful if you get lost! Also useful for seeing other features of the map.

Which representation is best?



What station am I listening to? What is my ability to look at the display?

Which representation is best?

- Depends also on user...



What station am I listening to? What is my ability to look at the display?

Edward Tufte

- PowerPoint can do harm
 - changes the way we think
 - changes the way we do presentations
 - argues that it caused the 2003 NASA Columbia disaster
- Chart junk is confusing, overly prevalent and unnecessary
- Goal should be high data density

Chart Junk does Harm...

“...the interior decoration of graphics generates a lot of ink that does not tell the viewer anything new. The purpose of decoration varies – to make the graphic appear more scientific and precise, to enliven the display, to give the designer an opportunity to exercise artistic skills. Regardless of its cause, it is all non-data-ink or redundant data-ink, and it is often chartjunk...”

Tufte, The Visual Display of Quantitative Information.

Chart Junk: confusing and unnecessary visual elements

- Information display is not just pretty graphics
 - graphical re-design by amateurs on computers gives us
 - “fontitis,” “chart-junk,” etc.

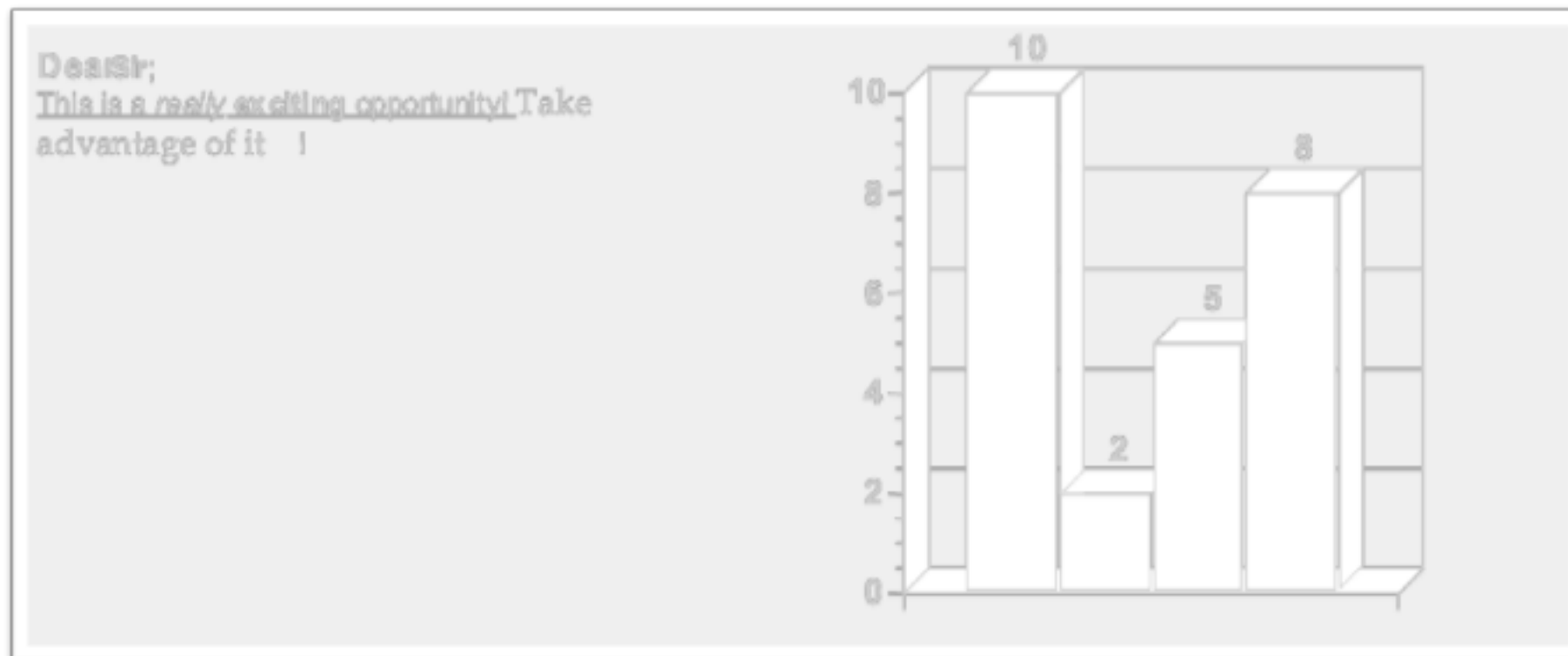


Chart Junk: Removing deception and simplification

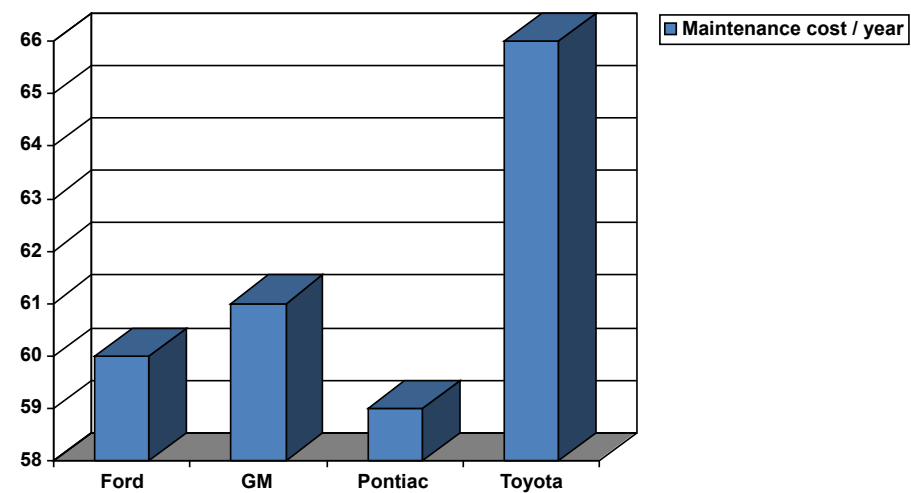


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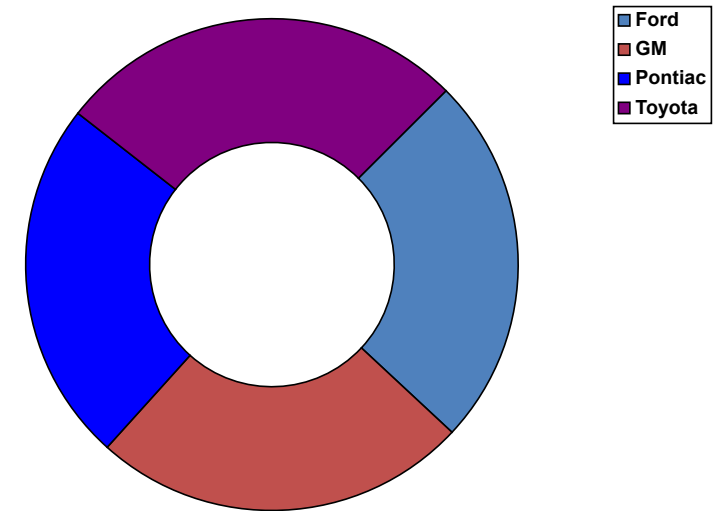
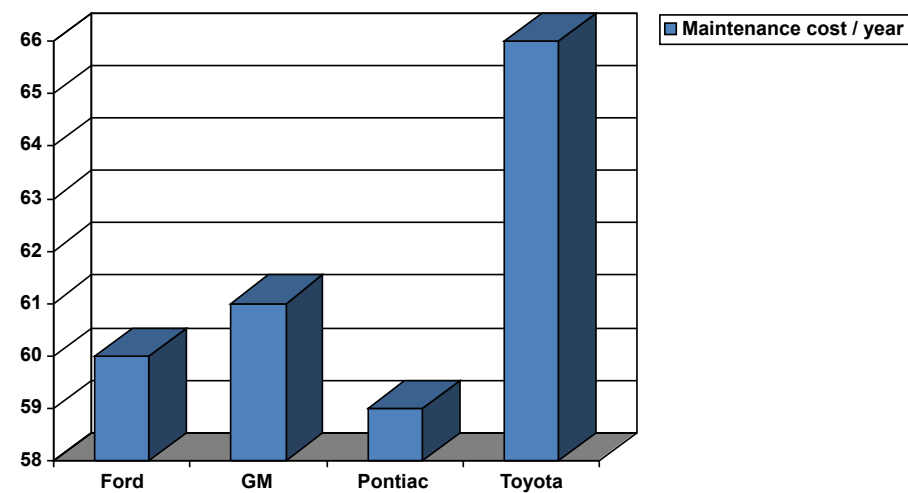


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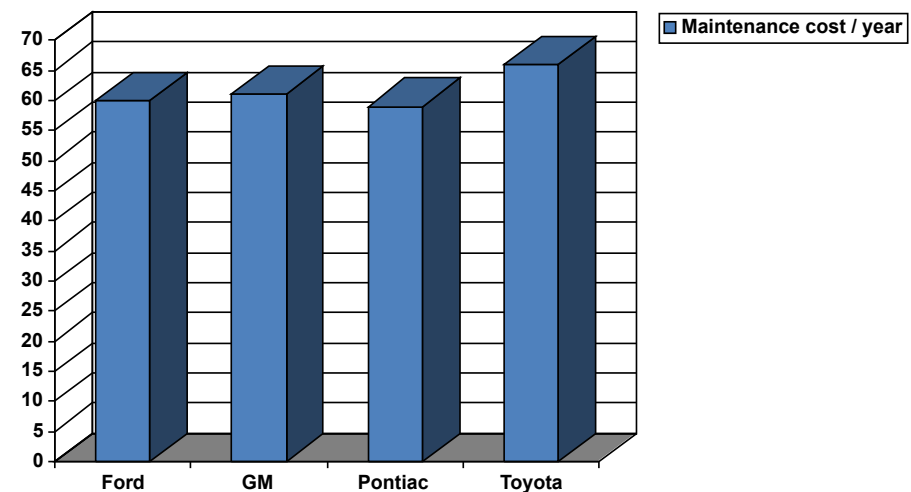
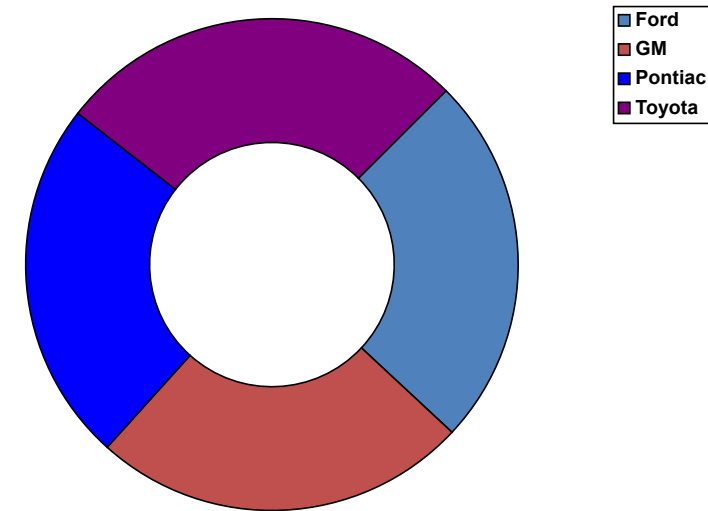
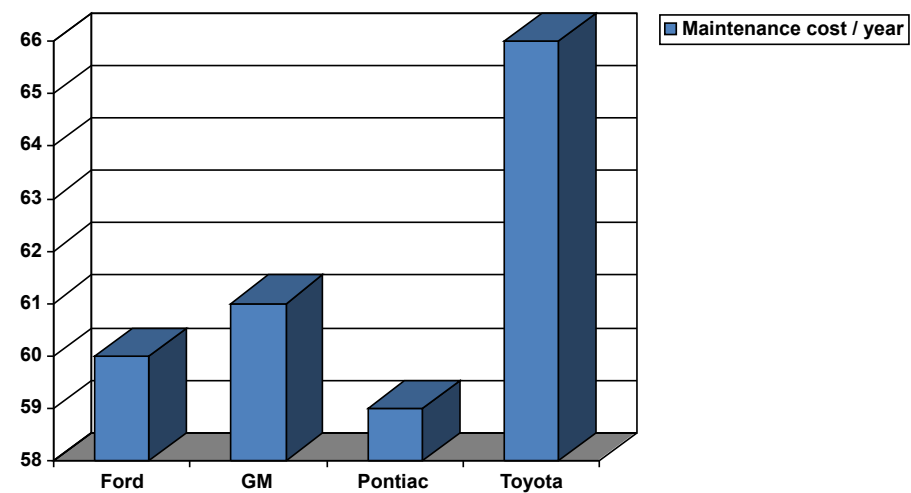
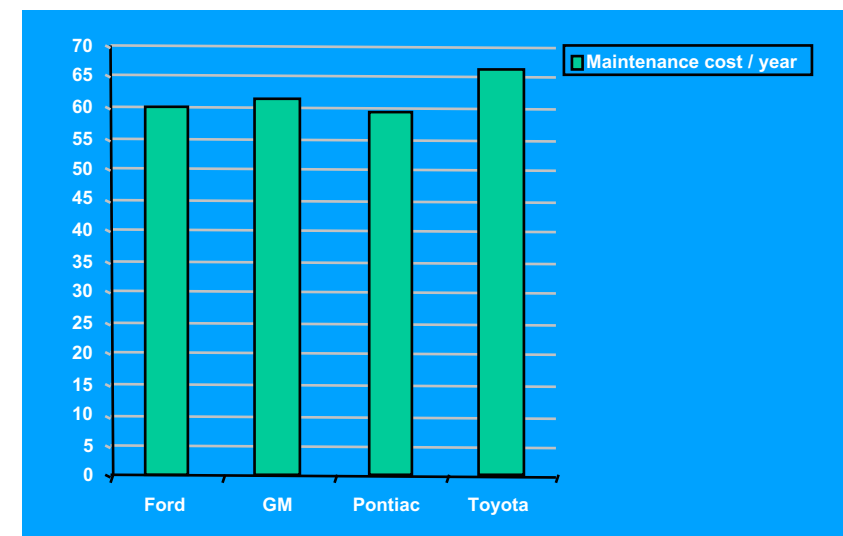
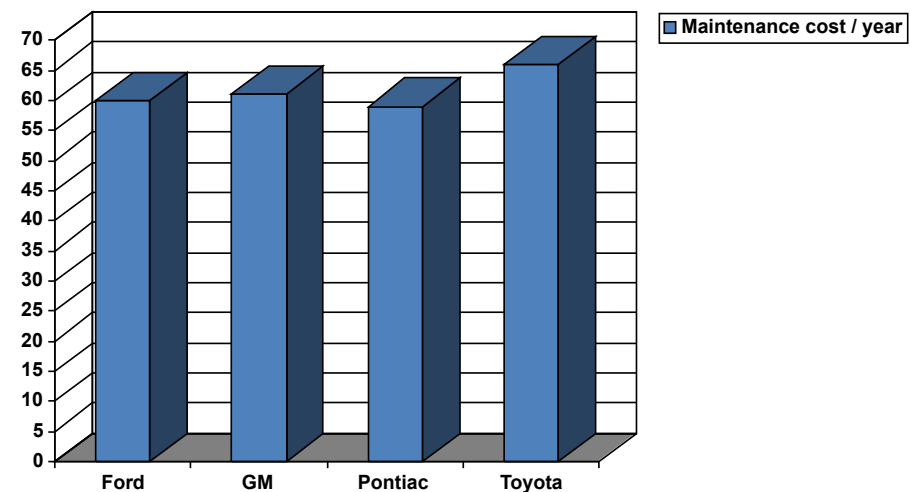
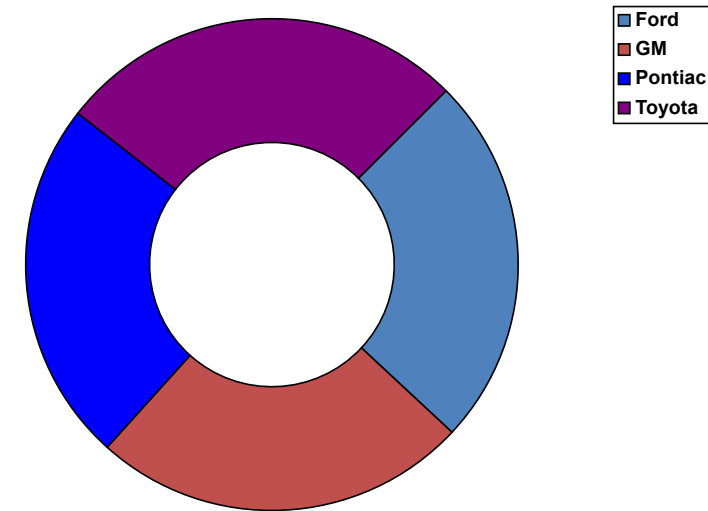
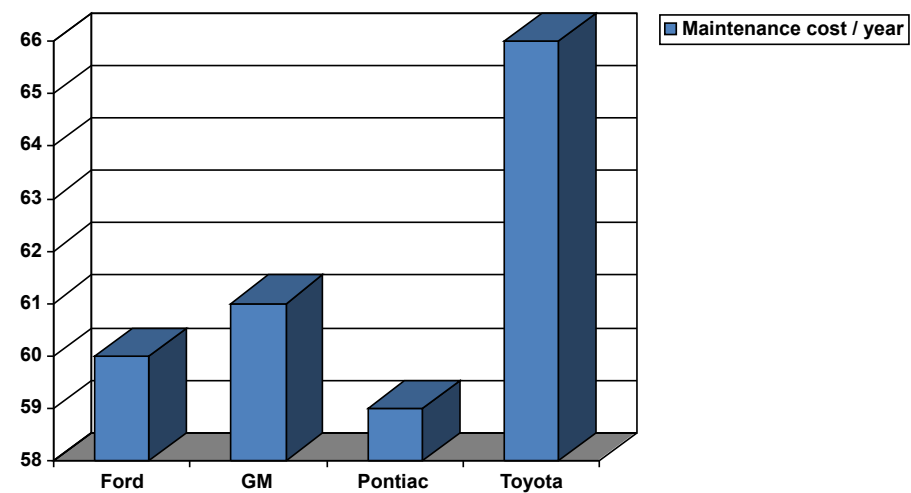


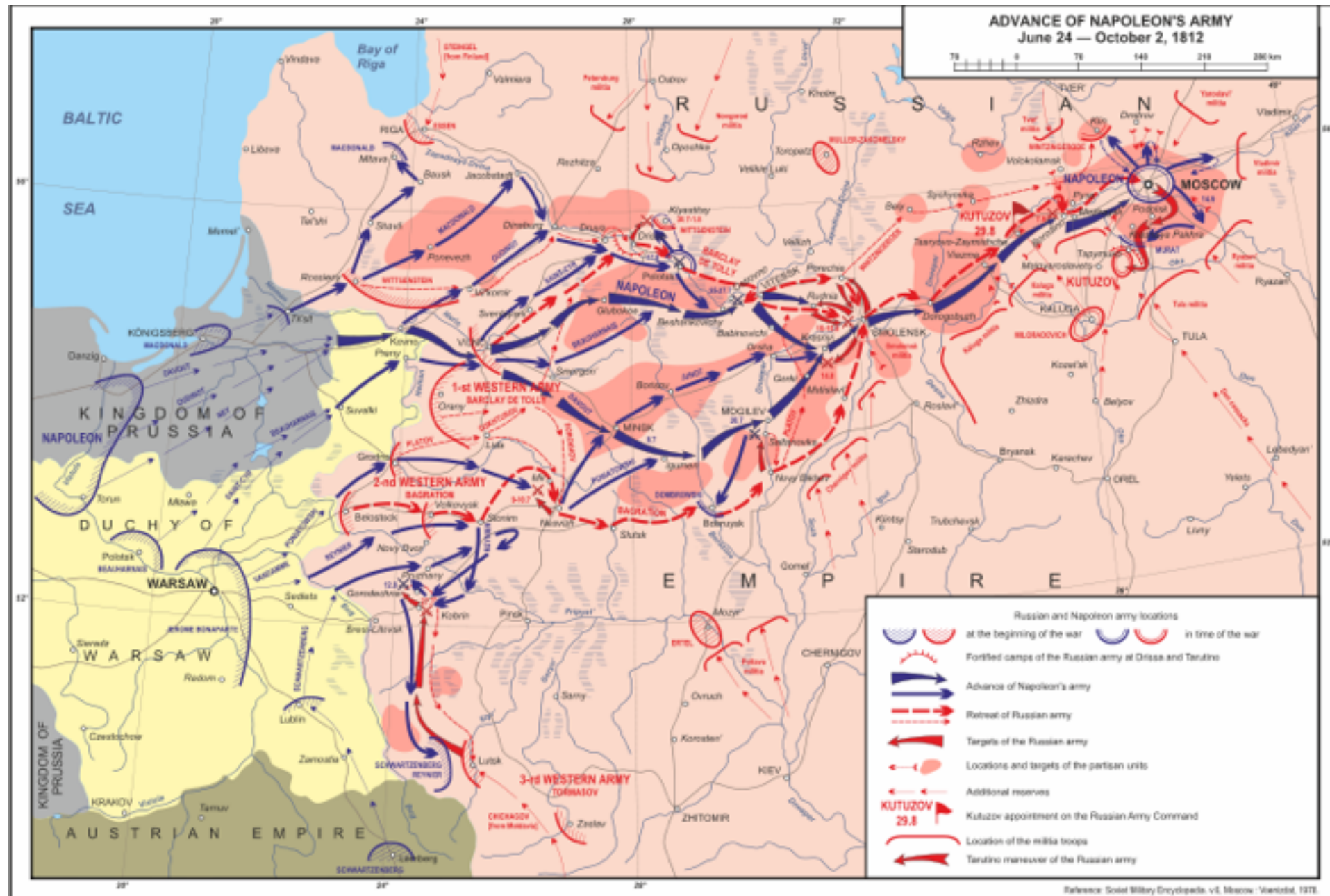
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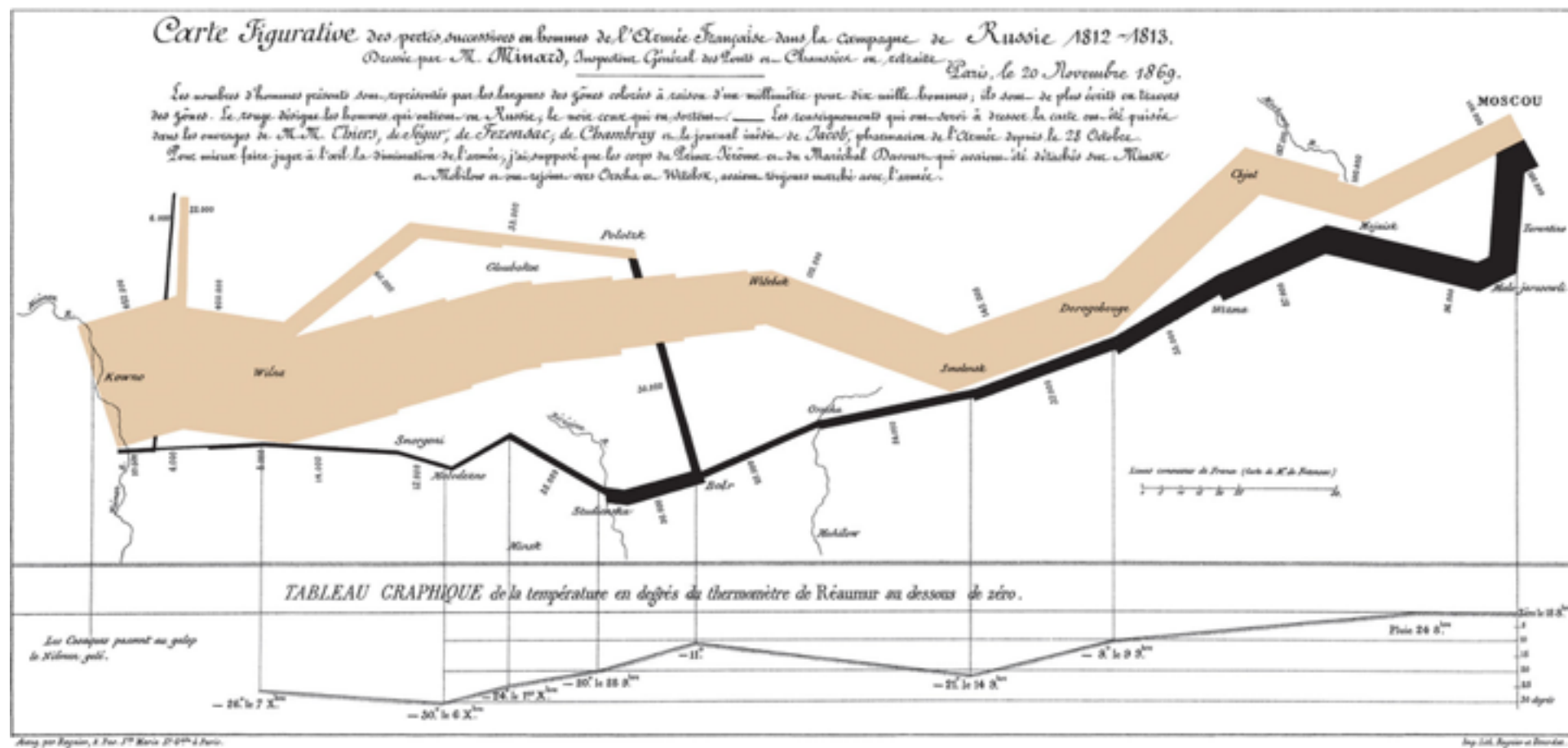
Data Density

- Graphics are at their best when they represent very dense and rich datasets. (*“Use only the ink you need to use”.*)
- Tufte defines data density as follows:
 - **Data density = (no. of entries in data matrix) / (area of graphic)**

Napoleon's march to Moscow



Napoleon's march to Moscow (Minard)



Learning objectives

- You should now be able to:
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 - Define “chart junk” (Edward Tufte) and understand his argument against it
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Acknowledgements

- Tony Tang
- Lora Oehlberg
- Ehud Sharlin
- Frank Maurer
- Saul Greenberg

Course information

- Website
 - GitHub Pages <https://silvadasilva.github.io/CPSC481-2019W/en/#!/index.md>
- Communications
 - Slack <https://cpsc481-2019w.slack.com/>
- Readings and Slides
 - Posted online at the main website