



Concluding Topics

Chapter 4 – Hands on Data Analytics for Everyone

November 28, 2022

北京师范大学-香港浸会大学联合国际学院
United International College

Contents

- **How to Present your Data Analytics Project**
- A Common Mistake: Correlation and Causality
- Advanced Applications of Data Analytics
 - Autonomous Driving



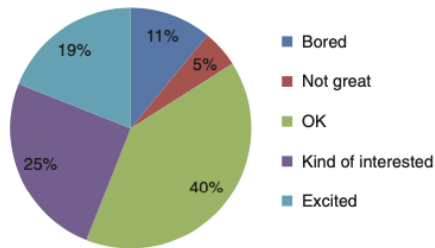
- A visualization graph is worth more than thousands of words
- Visualization graphs are used for describing data (exploratory) and communicating data (explanatory)
- How we communicate can change the results
- Give context: Start a presentation by telling a story!



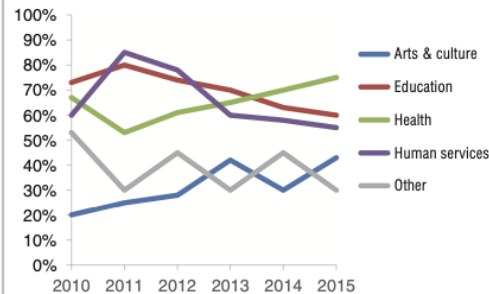
Data Visualization Examples



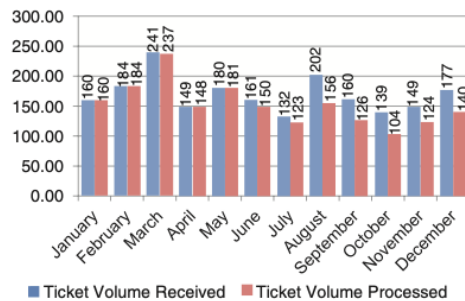
Survey Results



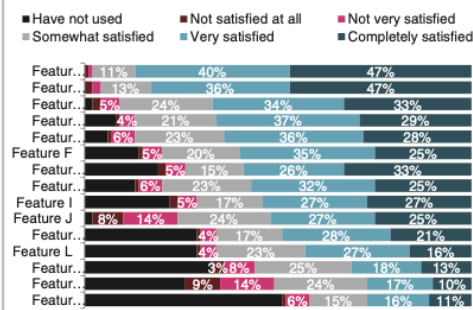
Non Profit Support



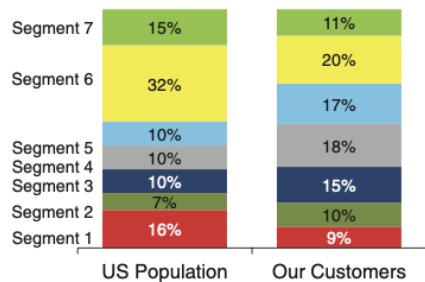
Ticket Trend



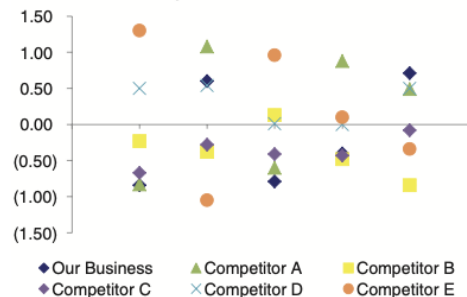
User Satisfaction



Our Customers



Weighted Performance Index



Examples of Ineffective Visualization

Source: Cole Nussbaumer Knaflic (2015), "Storytelling with Data", Wiley Eds.



Please approve the hire of 2 FTEs

to backfill those who quit in the past year

Ticket volume over time



Data source: XYZ Dashboard, as of 12/31/2014 | A detailed analysis on tickets processed per person and time to resolve issues was undertaken to inform this request and can be provided if needed.

Example of Effective Visualization

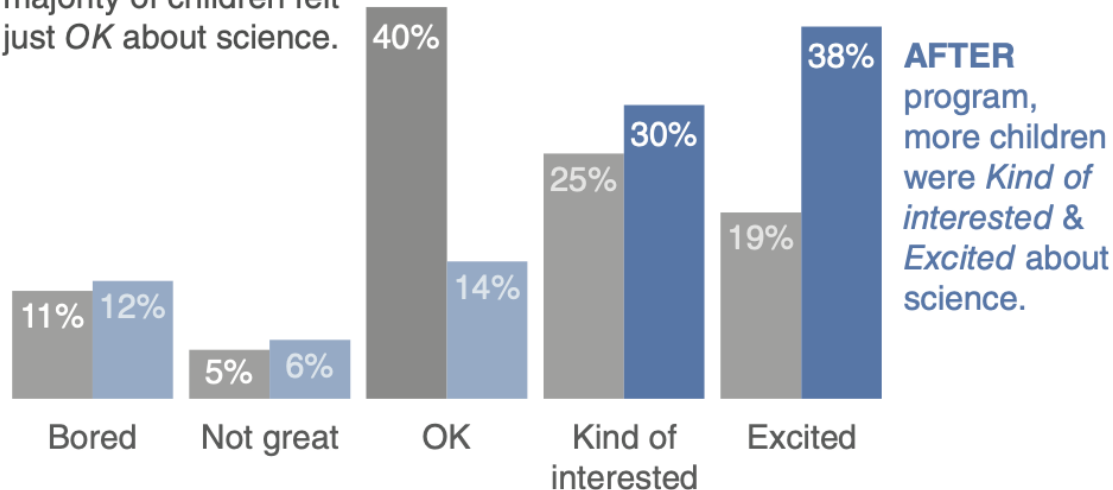
Source: Cole Nussbaumer Knaflic (2015), "Storytelling with Data", Wiley Eds.



Pilot program was a success

How do you feel about science?

BEFORE program, the majority of children felt just *OK* about science.



AFTER program, more children were *Kind of interested & Excited* about science.

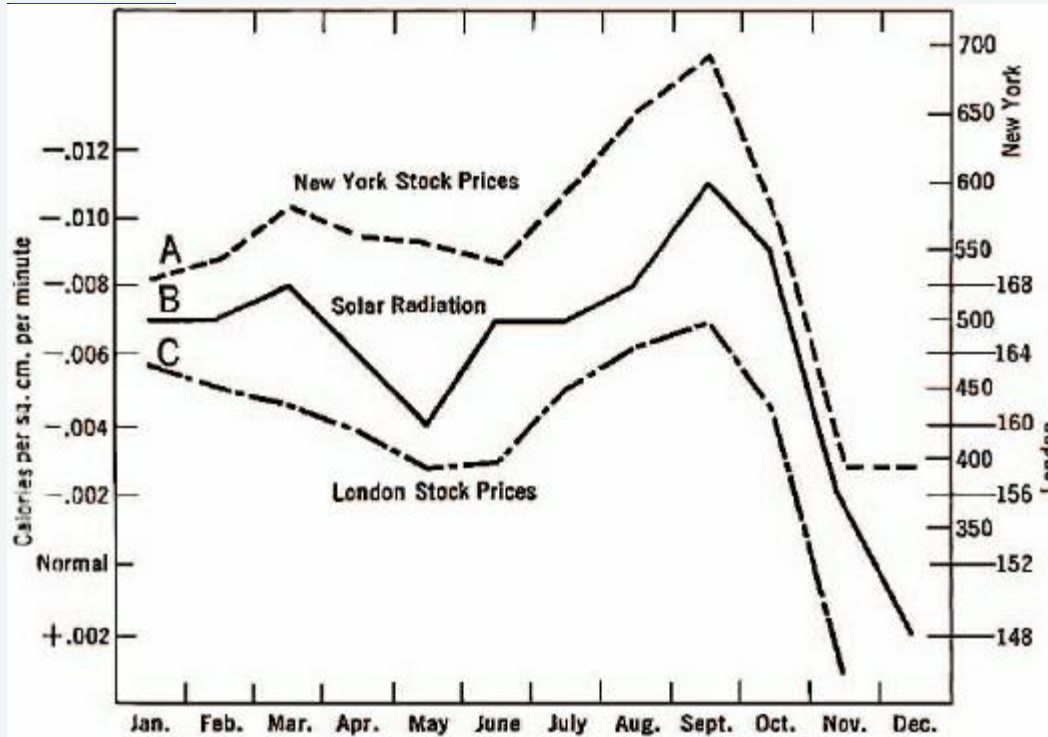
Based on survey of 100 students conducted before and after pilot program (100% response rate on both surveys).

Example of
Effective
visualization

Source: Cole Nussbaumer Knaflic (2015), "Storytelling with Data", Wiley Eds.



A Minimalist Example



Is anything wrong with this plot?

Contents

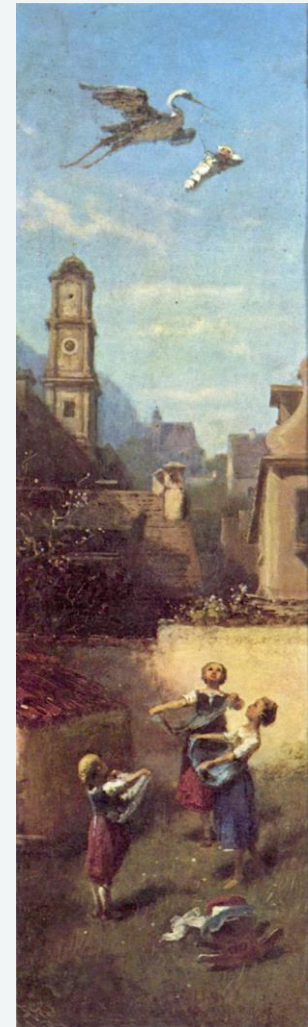
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A Stork



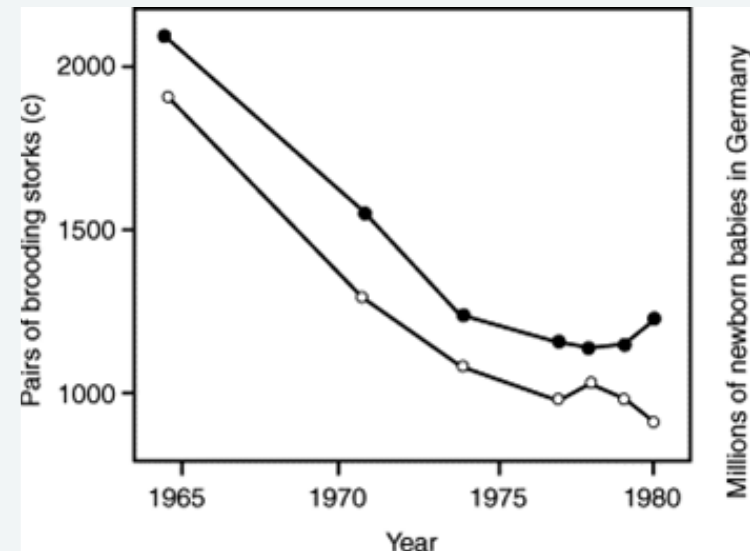
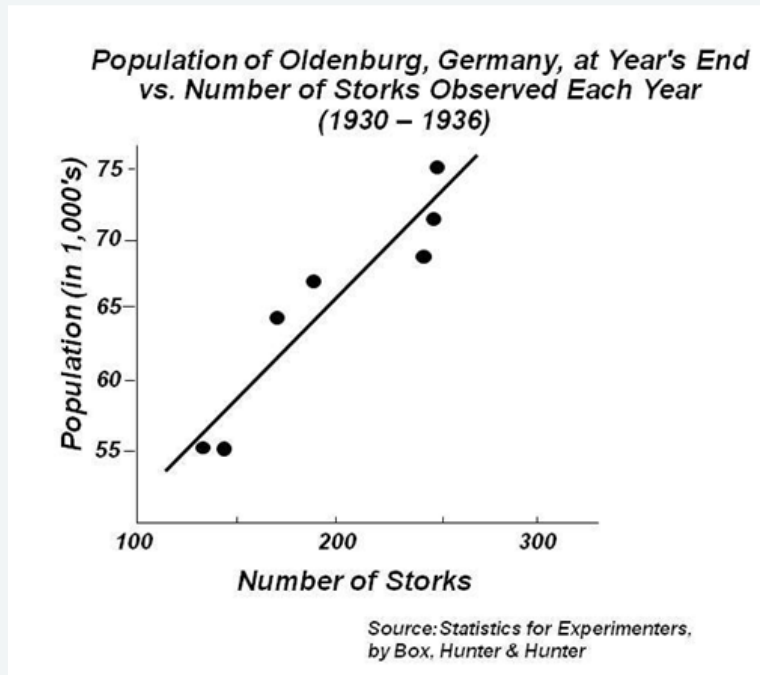
Hypothesis:
Storks bring babies



Der Klapperstorch (The Stork),
[Carl Spitzweg](#) (1808–1885)



German data for number of storks and population



Correlation is significant and positive!



Correlation \nRightarrow Causality



.. and what about Chocolate and Nobel prices?

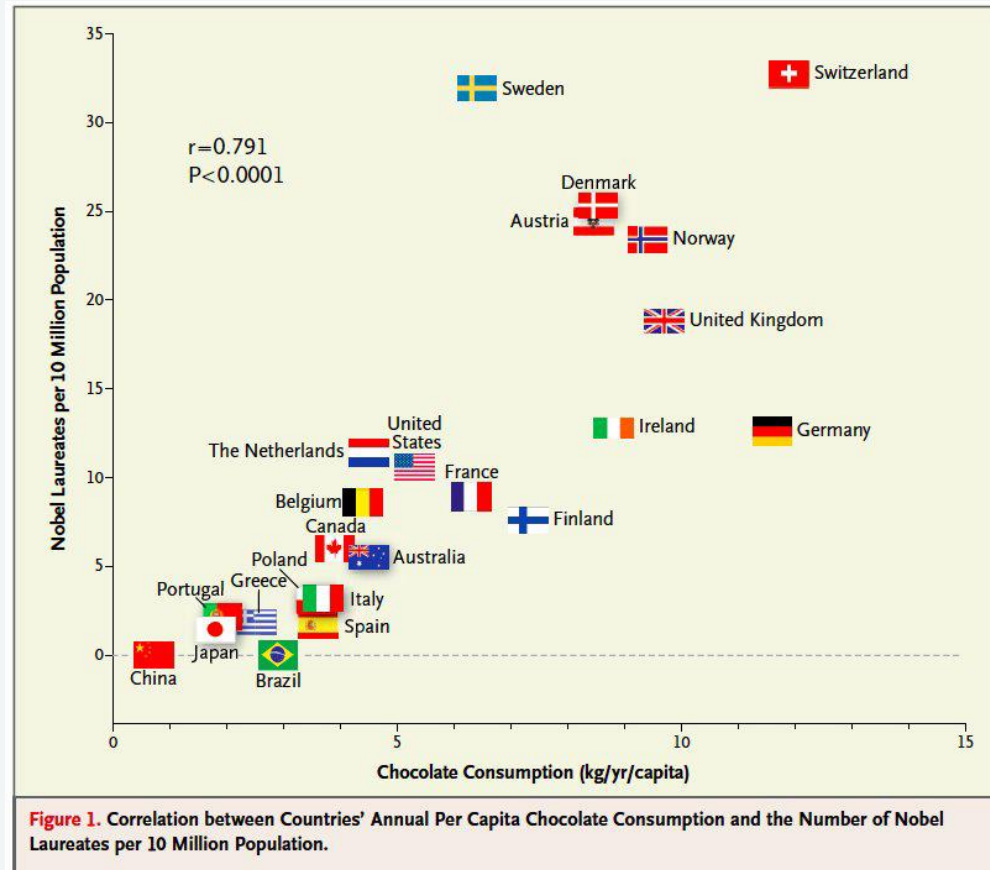


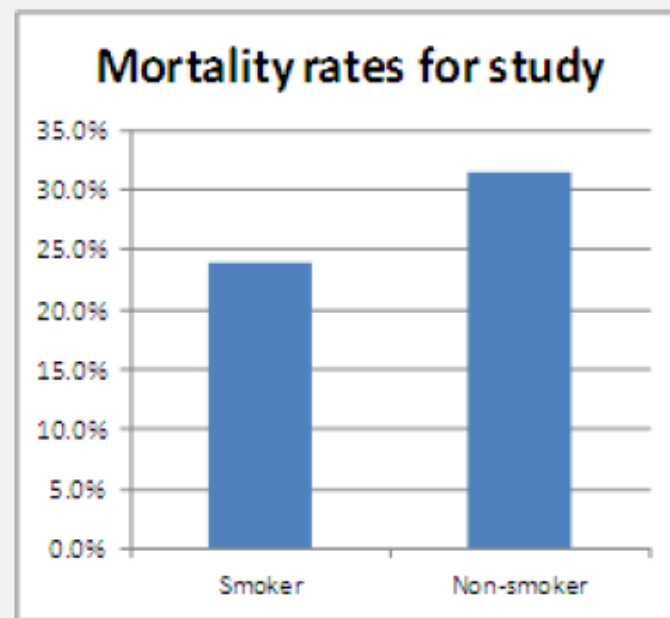
Image Credit: <http://www.nejm.org/doi/full/10.1056/NEJMon1211064>

Should I start smoking to live longer?

• Mortality Rate Study

	Died	Survived	Total	Rate
Smokers	139	443	582	23.9%
Non Smokers	230	502	732	31.4%
Total	369	945	1314	28.1%

Credit:
<http://www.significancemagazine.org/details/webexclusive/2671151/>

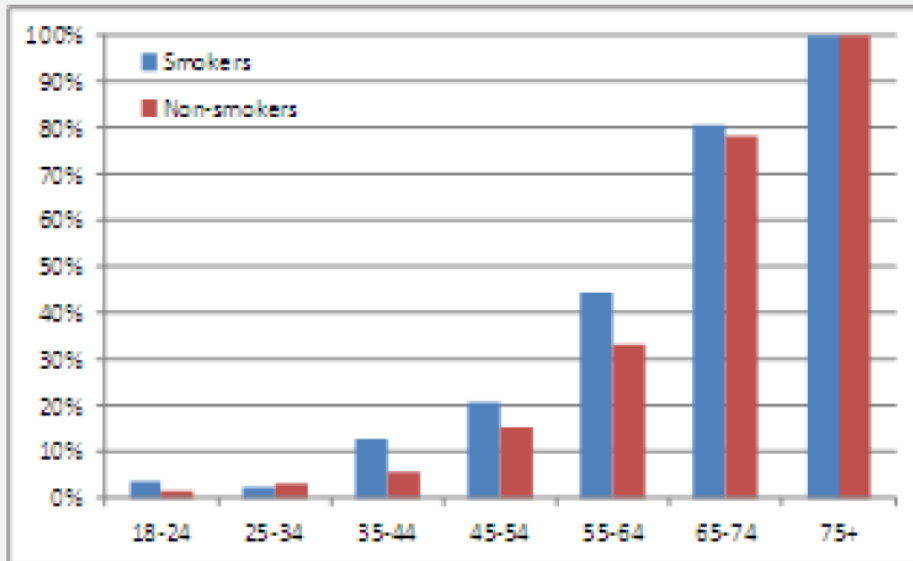




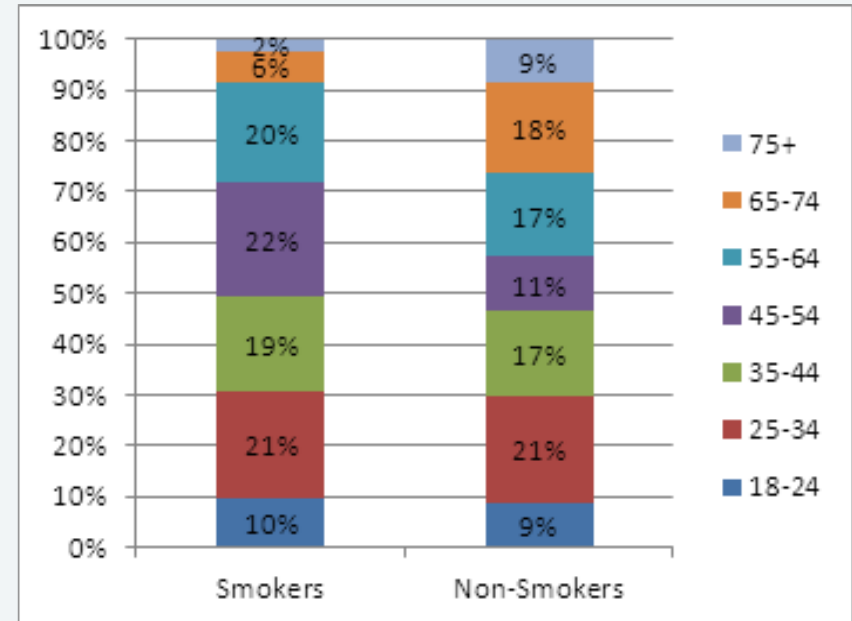
Simpson's Paradox: Smoking and Mortality



Mortality Rates by Age



Distribution of Age by Smoking Status



Credit:

<http://www.significancemagazine.org/details/webexclusive/2671151/Simpsons-Paradox-A-Cautionary-Tale-in-Advanced-Analytics.html>

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Simpson's Paradox: Population Weighting and Tax Rate



Adjusted gross income	Tax Rate		% of total income	
	1974	1978	1974	1987
Under \$5000	0.054	0.035	4.73	1.60
\$5000 - \$9999	0.093	0.072	16.63	9.89
\$10000 - \$14999	0.111	0.100	21.89	13.83
\$15000 - \$99999	0.160	0.159	53.40	69.62
\$100000 and more	0.384	0.383	3.34	5.06
Total	0.141	0.152	100	100

Table Credit: Counting for Something by William S. Peters

... does the overall tax rate go up, while all individual rates go down?

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 - **Autonomous Driving**



Three Philosophical Questions in Your Life



Where am I ?

Where shall I go ?

How do I get there ?



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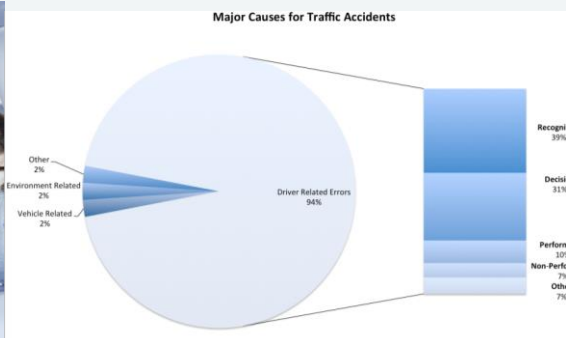


Why Do We Need Autonomous Driving

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The Great Learning Way



Free our hands



More safety



Save energy

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How Do We Make a Car Drive Itself?

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Perception

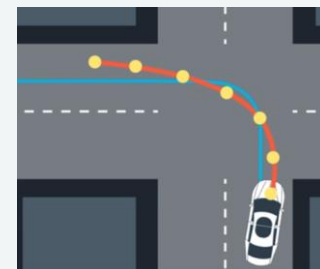
Planning

Control

1. Where am I?
2. What is around me?

1. Where should I go?
2. How to get there?

1. How to control the car to follow the path?

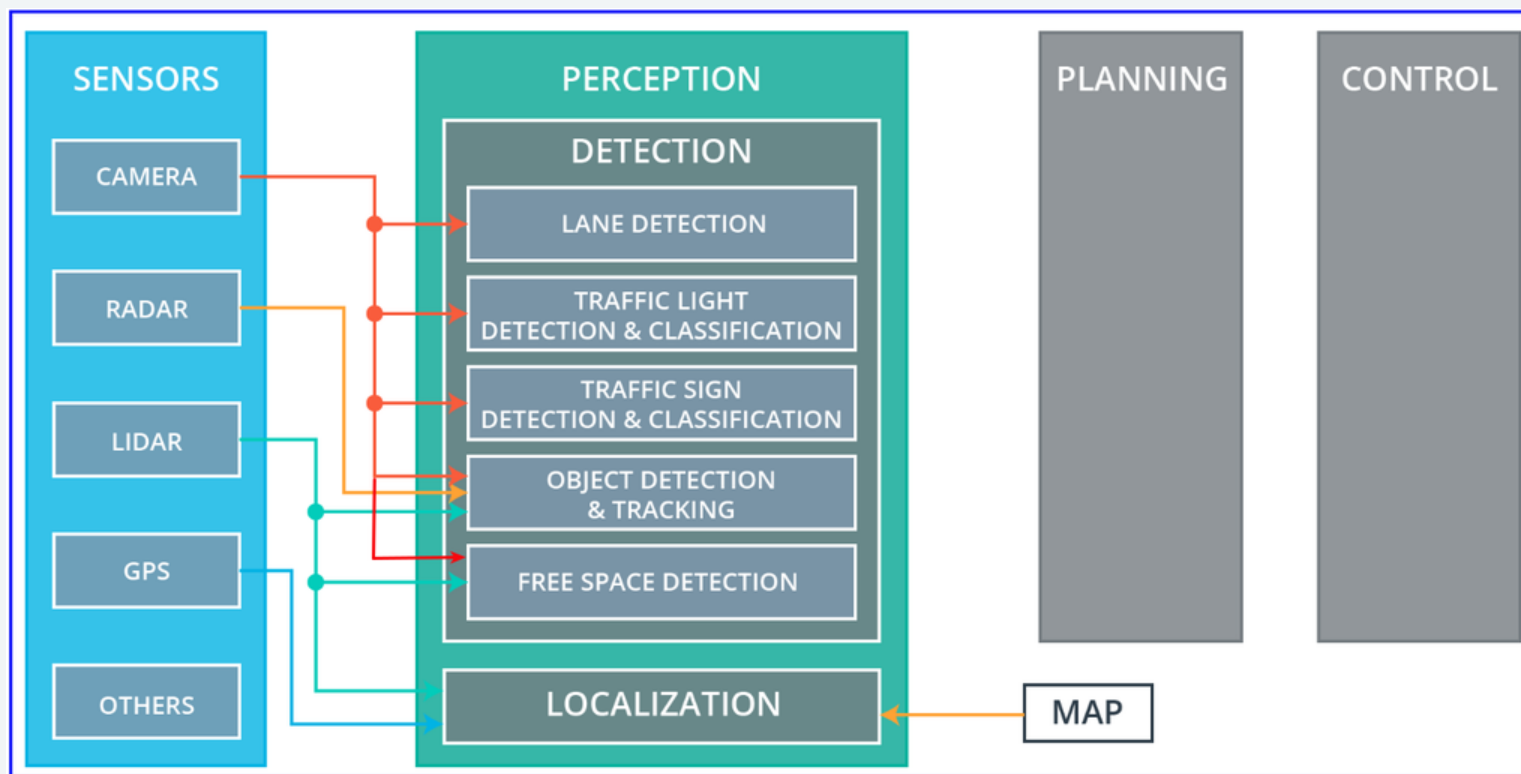


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Perception Objective



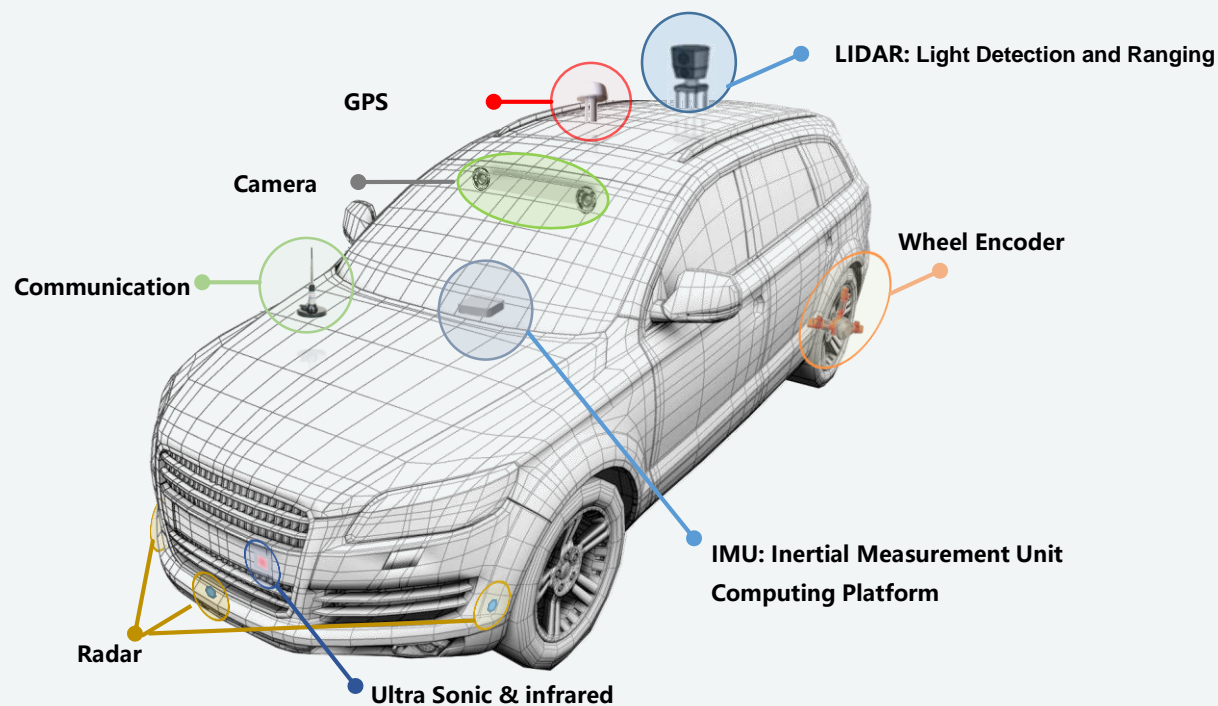
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Perception System

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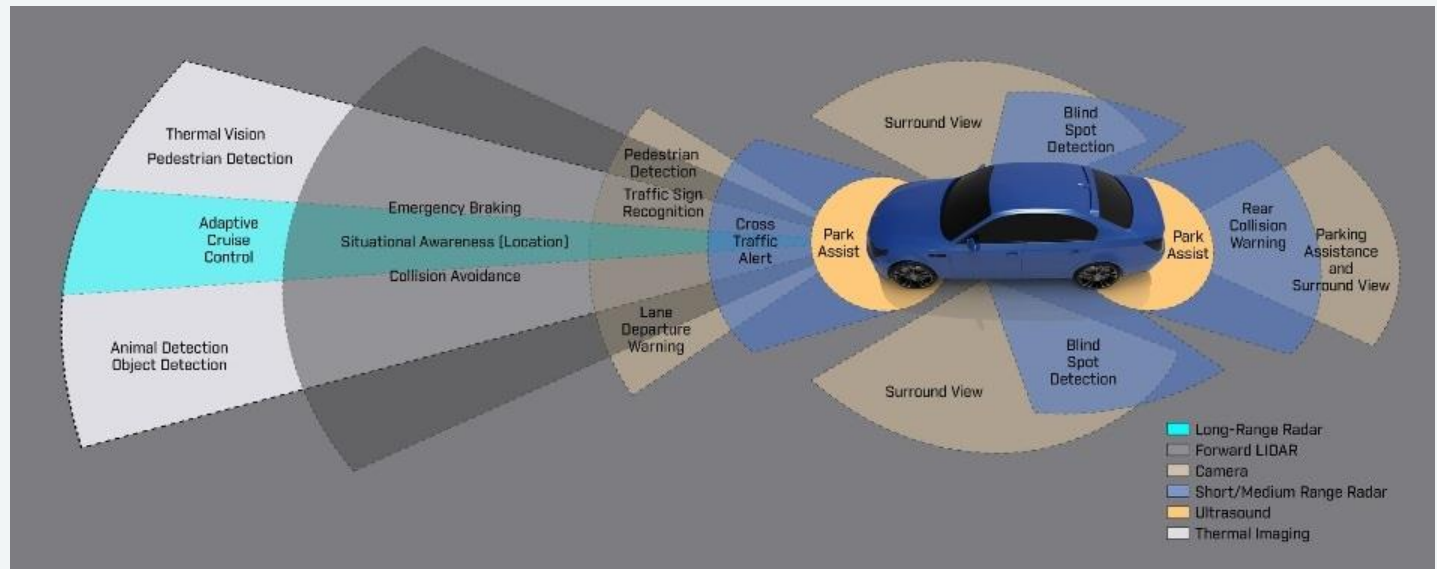


Perception: Why So Many Sensors



Different sensors have their own strength and weakness

- Sensors : Data Collection
- Perception: Data Processing, Information Extraction



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Computer Vision and Pattern Recognition

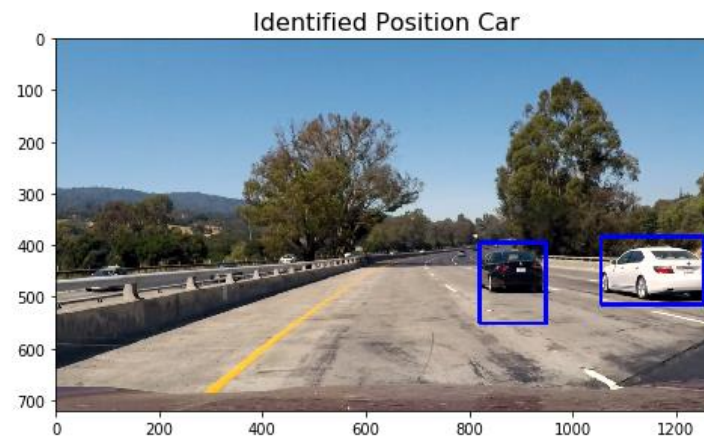
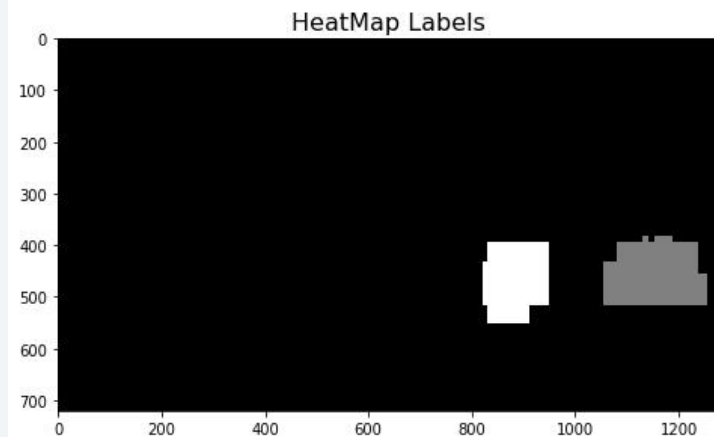
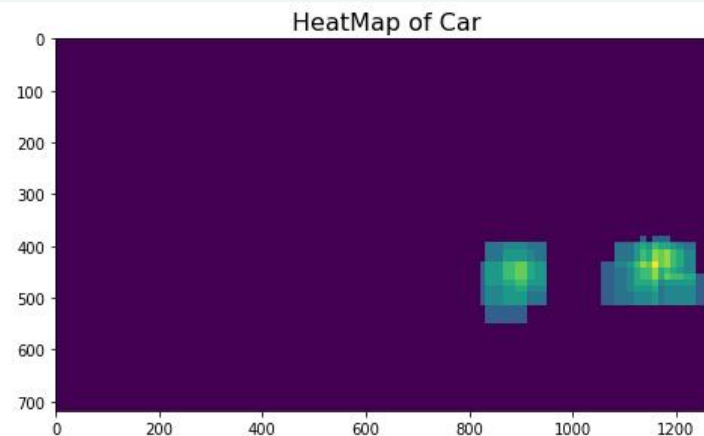
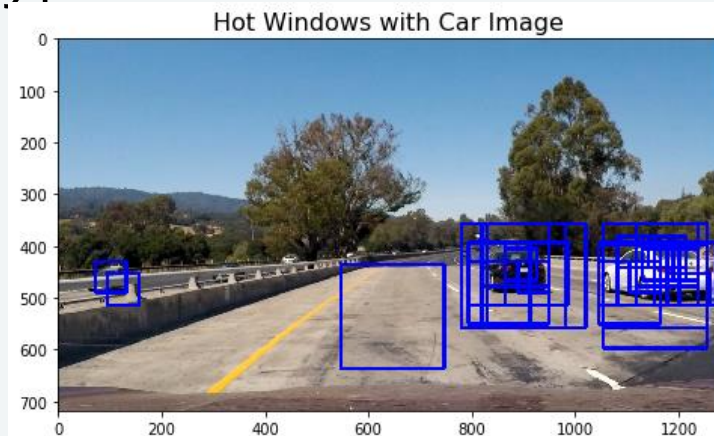
Basic problems: understanding and interpreting images

- What is this in the image ?
- Where are xxx's in the image?
- What are they doing in the image?





Typical Problem: Vehicle Detection



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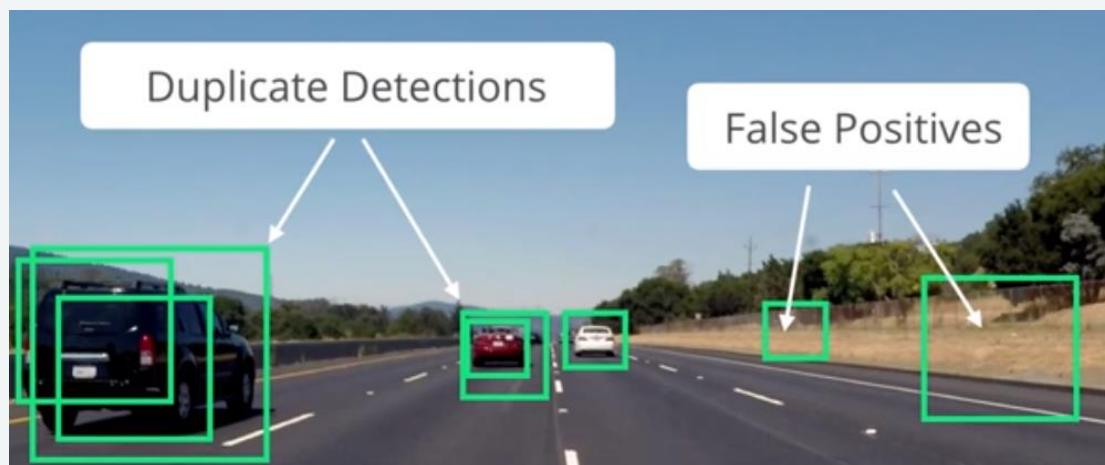
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Perception: Camera Data Processing



- Sliding window
- Duplication removal
- Handle false positives



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Perception: Camera



PERCEPTION
DETECTION
LANE DETECTION
TRAFFIC LIGHT DETECTION & CLASSIFICATION
TRAFFIC SIGN DETECTION & CLASSIFICATION
OBJECT DETECTION & TRACKING
FREE SPACE DETECTION



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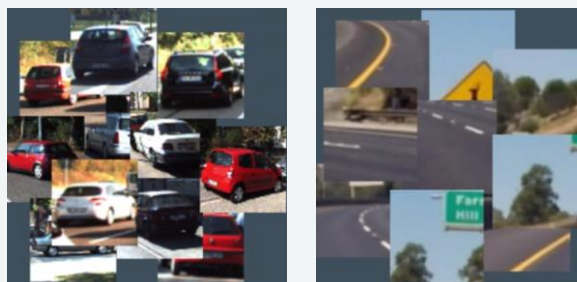
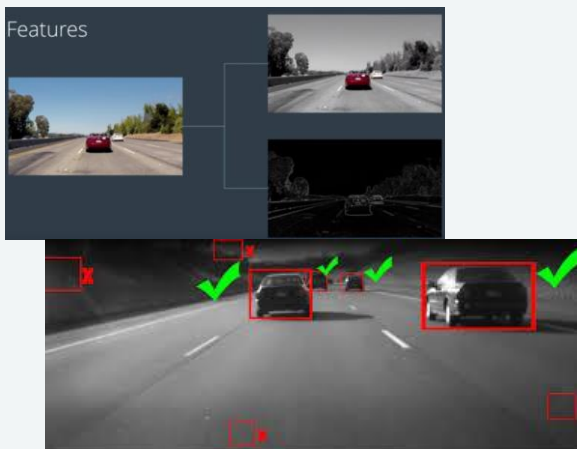


How to solve the problems?

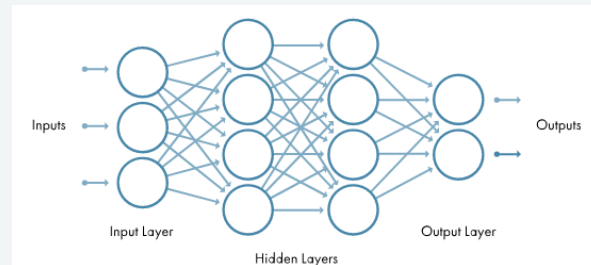
Manually feature
extraction and
matching
colors, edges, shapes

Manual Features
+ Machine
Learning

Deep Learning



Train a **classifier** using designed
features with **labeled data**



No feature extraction needed
Large data set required
Intensive computation

Algorithm Centric

Data Centric

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Perception: Example Current Capabilities



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Perception: State of the Art

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Scene understanding through deep learning



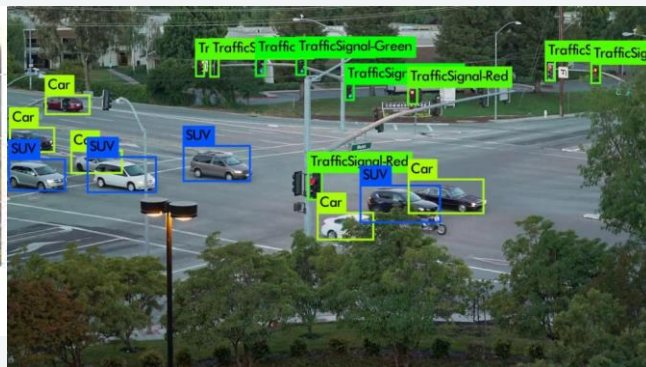
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Perception: Challenges

- The real world is far from perfect
- Robustness
 - Rain, snow, PM2.5, sunlight, perspective, darkness
- Computation power



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How Do We Do It in UIC



Self-driving enabled vehicle platforms for outdoor experiments



Low cost self-driving vehicle platforms for outdoor /indoor experiments



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