Introduction to

IoT and AI

Where are we headed??

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Me?

Artificial Intelligence(AI)

- Machine Translation of languages
- Tutoring Systems for Language Learning

- But I rarely call a system “Intelligent.”

AI?

- Narrow sub-area performer vs. general intelligence.
- Machines are now good at specific tasks such as image recognition, diagnosis, playing chess, spam detection, information retrieval, data analysis.
- Machines are not yet good at general natural language understanding and other general cognitive tasks.
- What's hard for a human is often what's easy for a computer.
- What's easy for a human is often what's hard for a computer.

The 3rd Industrial Revolution

History:

- Darpanet
- Internet
- Smartphones

But now **the 4th Industrial Revolution**!!

thanks to Cloud Computing and IoT.

Simple IoT

Control devices from far away

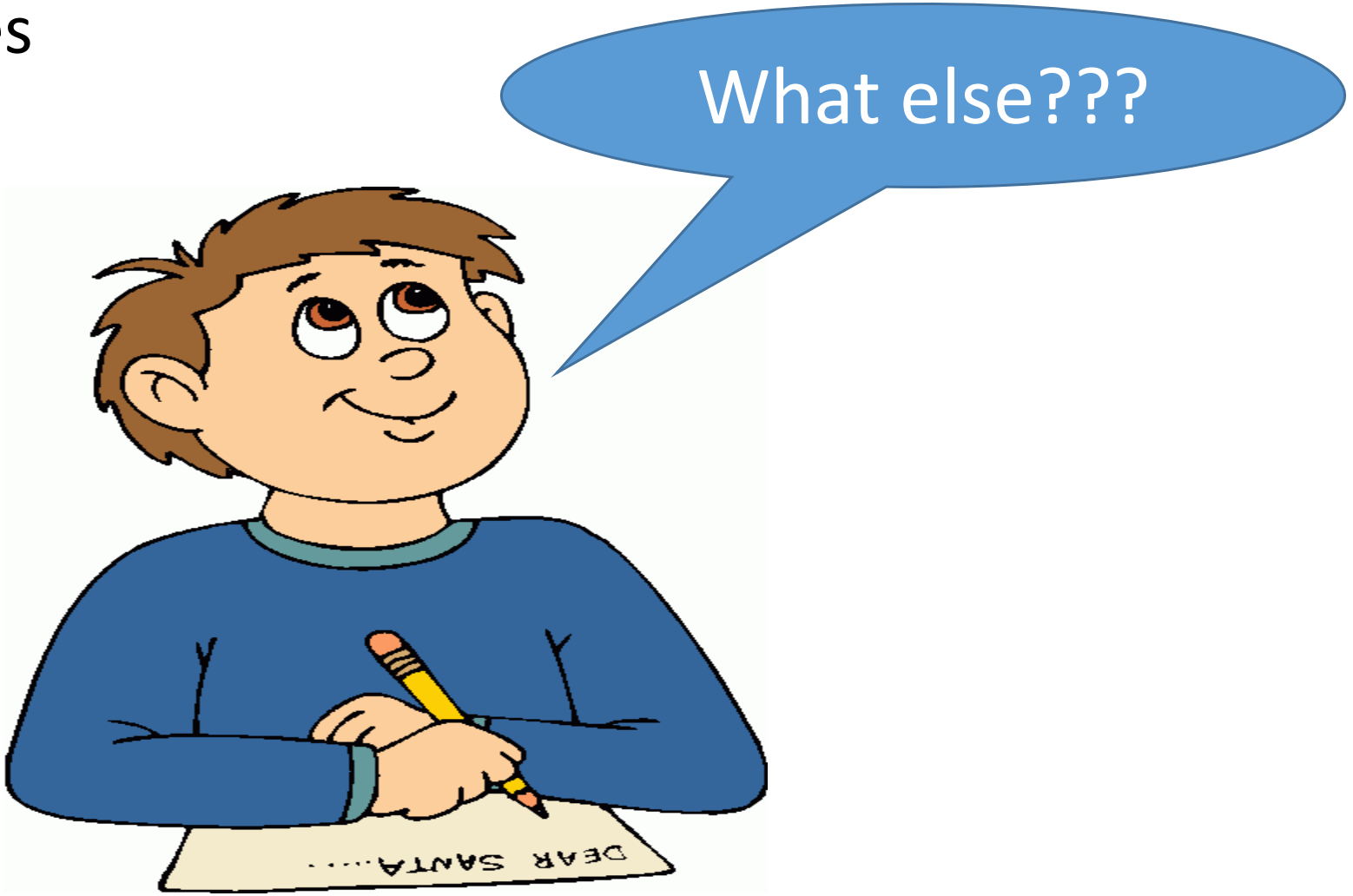
Simple IoT

Order items automatically

Also, allows us to collect data!!!!!!

Hey, let’s embed a lot of sensors in everything!

- In coffee machines
- In microwaves
- In fridges
- In washers
- In beds
- In cars
- In dog collars
- In chopsticks
- In belts

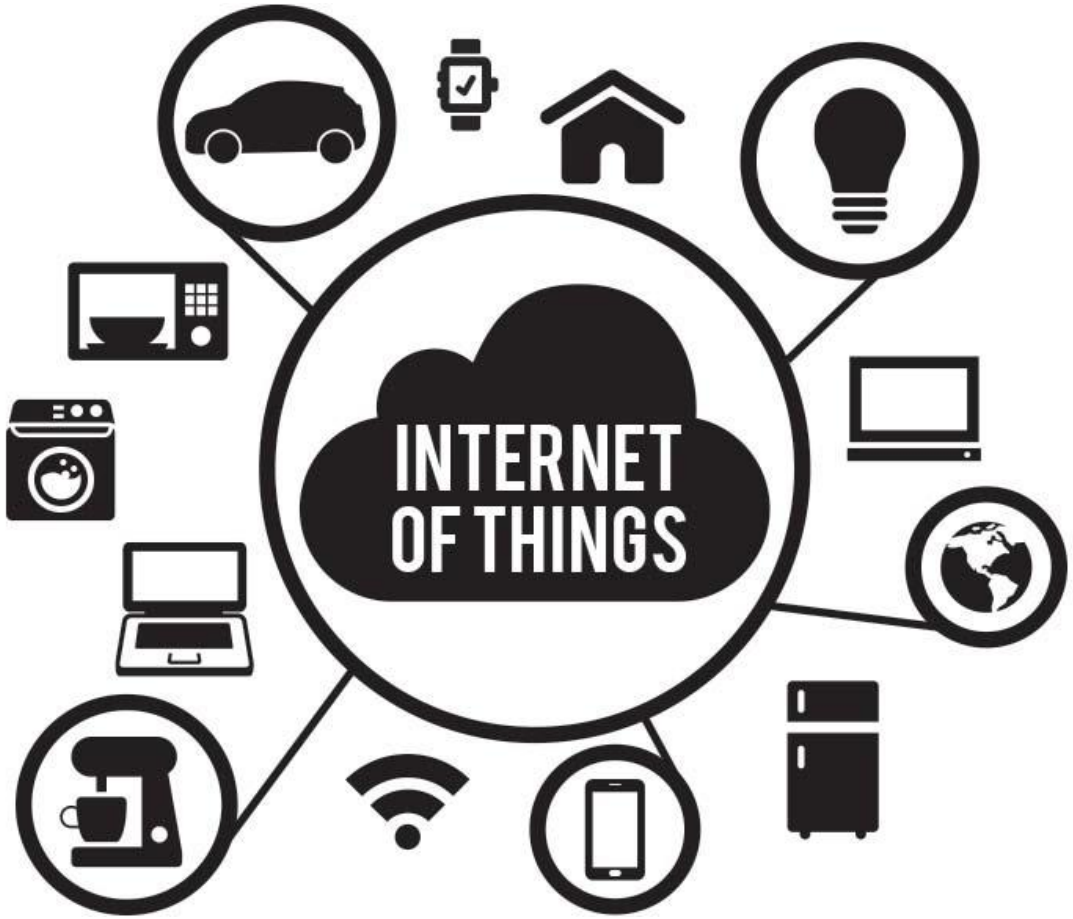


How Many Devices are Connected?

- 2012 8.7 billion
- 2016 22.9 billion
- 2017 28.4 billion
- 2020 50 billion prediction

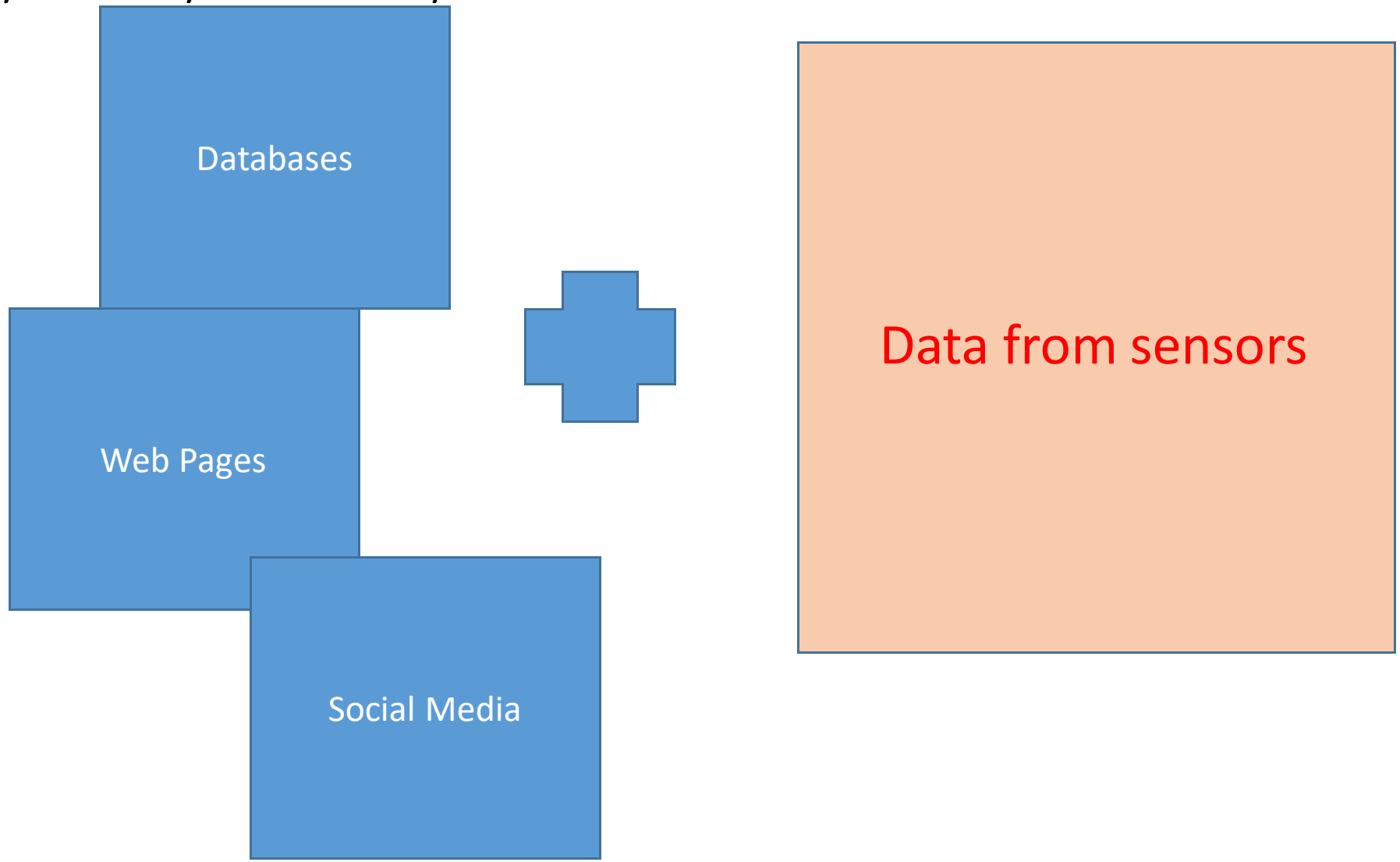
www.statista.com

Lots and Lots of Data is Collected



Big Data? Massive in terms of size and types

petabyets – exabytes – 35 zetabytes in 2020



Why Analyze Big Data?

Find **unexpected correlations** among things (**new insights**):

- To help **identify** things
- To help **classify** things
- To help **predict**

Want to know:

What's related to a cancer?

Where and at what time will a burglary happen in the city tonight?

Who will get married before age 35?

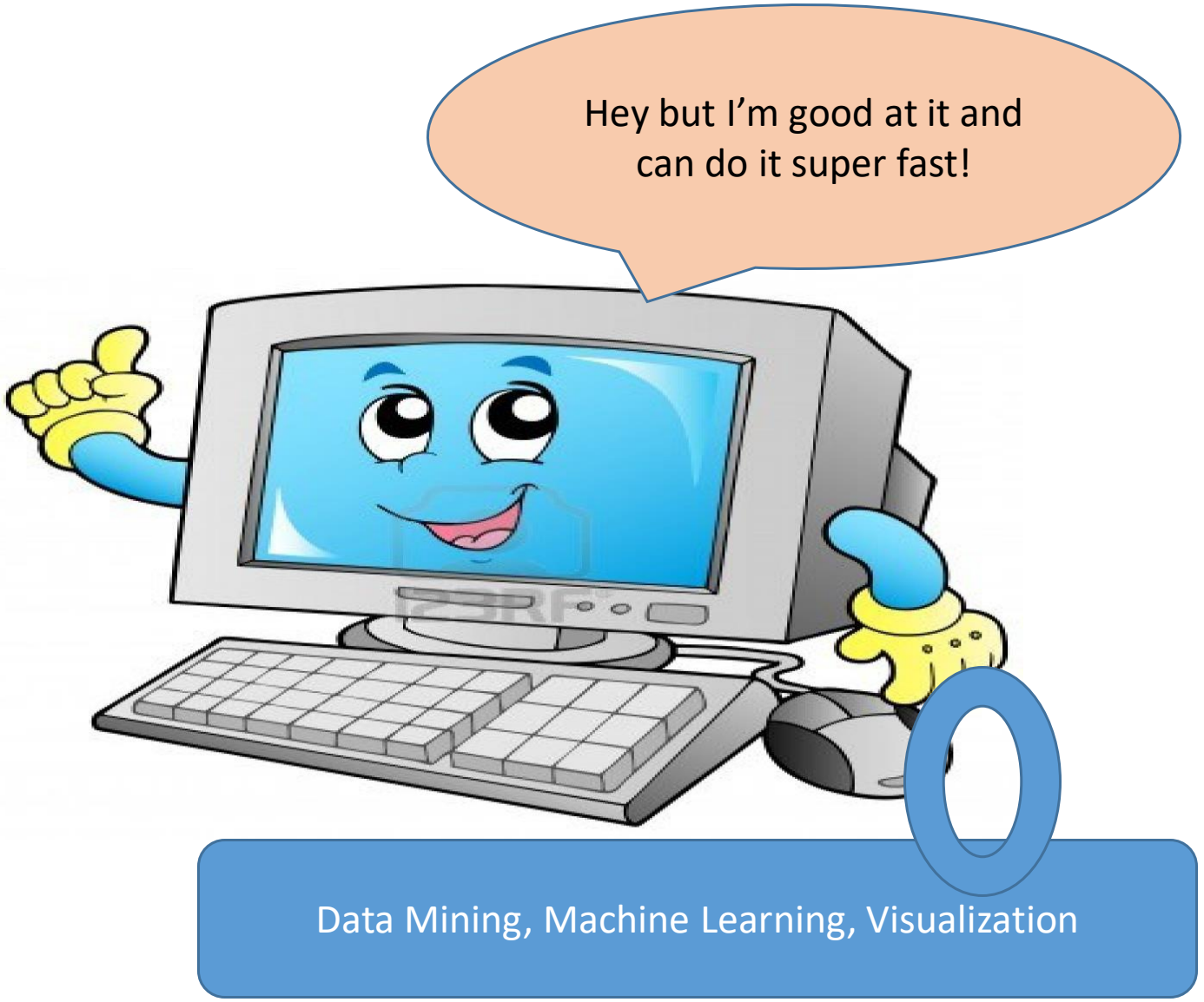
Where will we have a big earthquake next year?

When do pedestrians move this way? Other cars move this way?

What products to develop?

What is the person thinking of? (neuro-semantics with fMRI)

Humans are not good at analyzing massive amounts of data.



How??

Describe data by discovering new patterns:

- Collect probabilities
- Discover association rules (A implies B)
- Discover clusters (clusters of dots on a graph)

Predict/classify via Clusters:

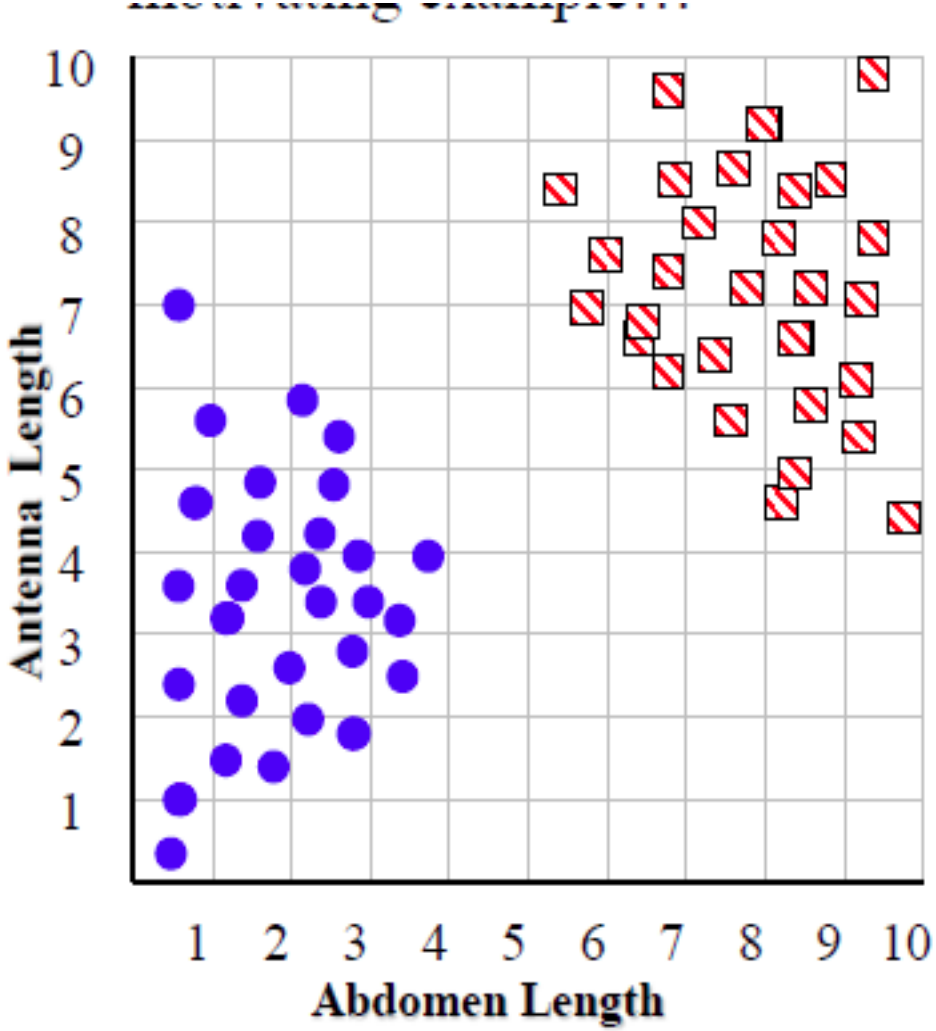
- K-nearest neighbors classifier → in this cluster or that cluster

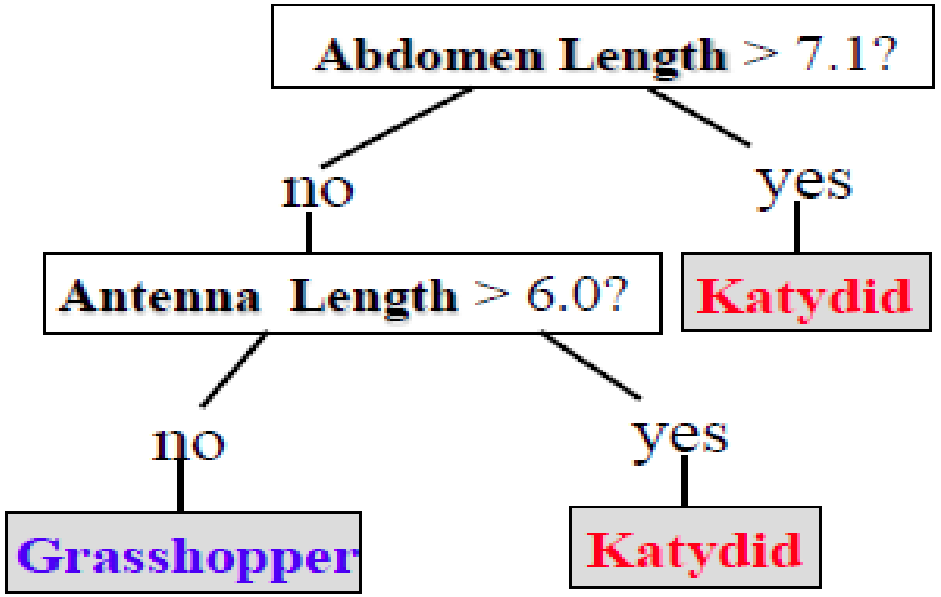
Predict/classify via Supervised Machine Learning:

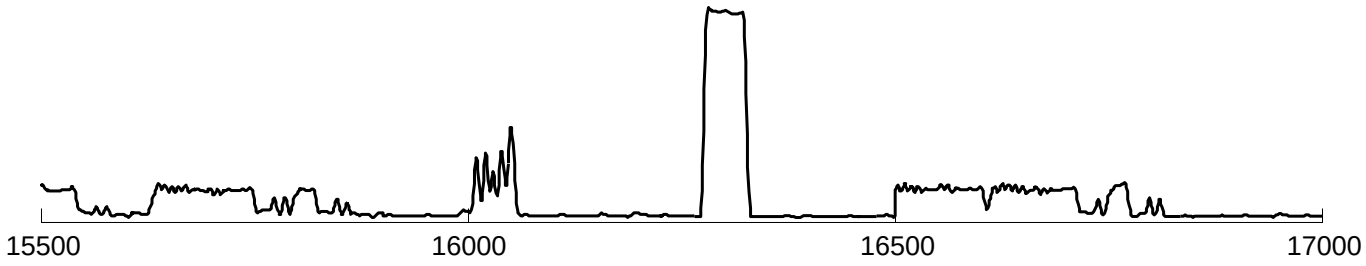
Learned from Data => Now predict the output for a new instance

- Neural networks found a weight vector for features →yes or no
- Found a decision tree based on features → yes or no
- SVM found a decision boundary → yes or no

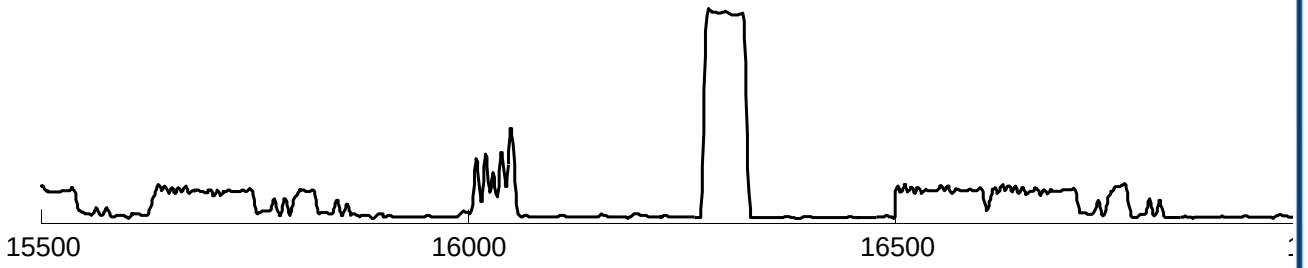
Example classification outputs

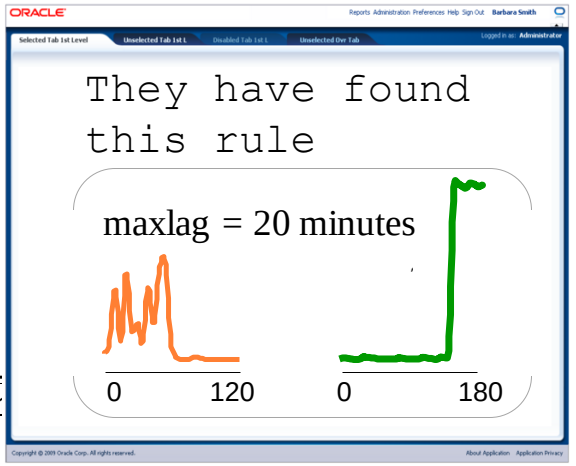






Here is an example of rule based prediction by Dr. Keogh and students @ UCR
Electrical power demand produces terabytes of time series data.
Can an algorithm look in this data and find predictive rules?





We did find this rule, read as: If you see this, within 20 min you will see that.

Result = Bi-Directional IoT

Automatically Warn, Adjust, Operate

+ M2M communication

➔**Cyber Physical Systems**

Bi-Directional IoT == Good??

- Prevent crimes (e.g. Santa Cruz) through predictions
- Prevent illnesses through classification
- Self-driving vehicles (10 million in 2020)
- Self-operating machines
- Warn you when you are not eating right
- Warn you when your dog is not healthy
- Remotely and automatically do all construction/agricultural work

Can you think of other benefits???

Problems?

- Need many more IT/CS people to work on this
  - 75000 shortage in Japan in 2030
  - Decreasing number of domestic CS researchers in the U.S.
- Security & Crimes – But use AI to prevent? 
- Lose jobs? (Two white house reports)
  - No drivers needed?
  - Do the things computers cannot do. (Change in Education)
- Privacy and who owns the data?
- New laws (e.g. self driving cars)
- SigAI (ACM) Seminar on concerns about “AI and Ethics”

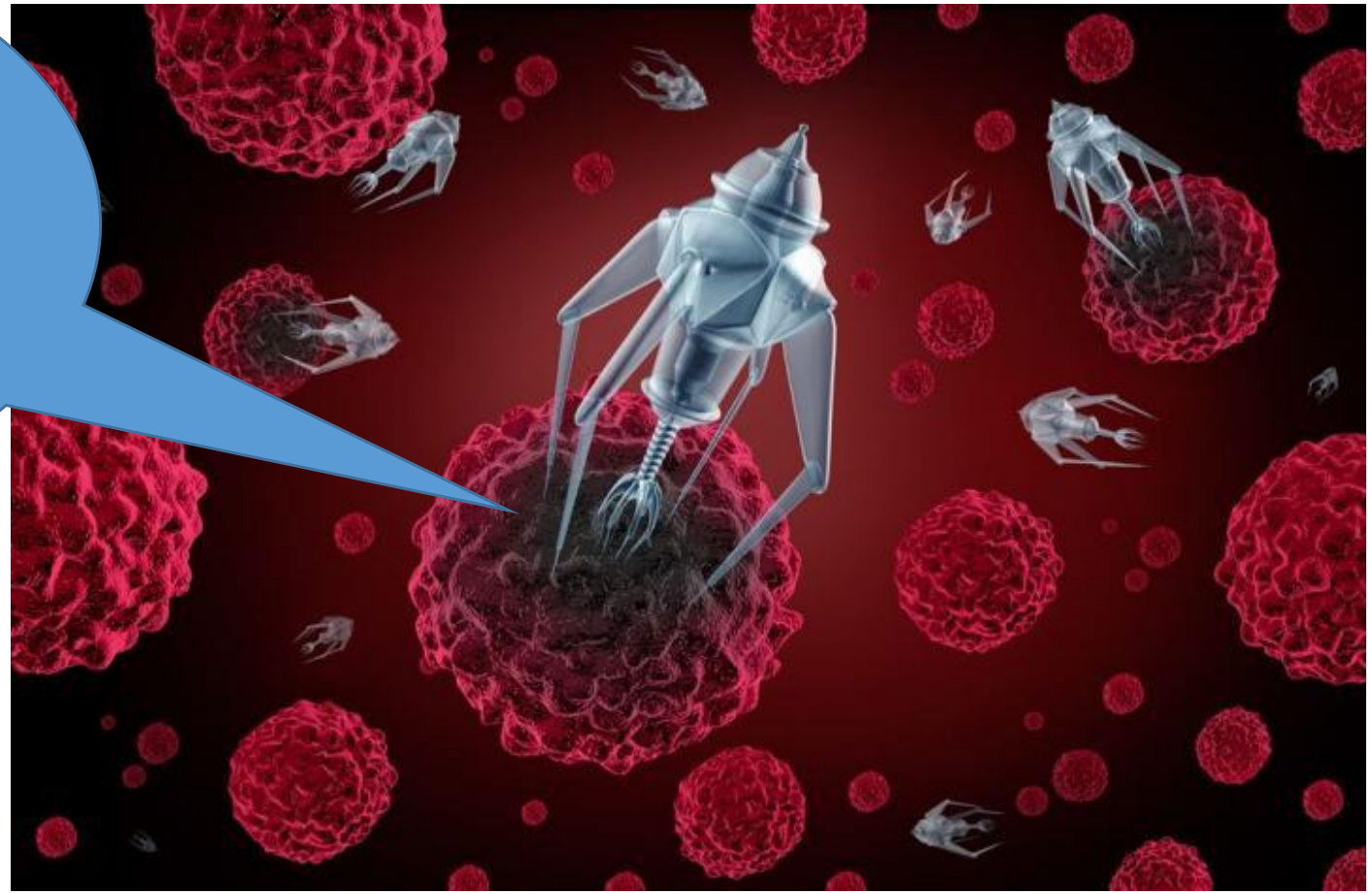
What am I interested in???

Decades from now…..

The future is exciting

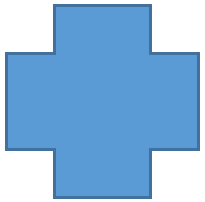
The Future of IoT + Big Data: Nanomachine/nanorobot doctors

We will find and kill all the bad things in your body.



Future of AI + Big Data:
Learn Everything + Tutor Everything

- Machines that learn **everything** by reading everything and use the knowledge to provide private tutoring on **everything**. [I would call this one “Intelligent”]
- Requires perfect **Natural Language Understanding.**
- **Recommend YouTube videos by Tom Mitchell of CMU on NELL.**



Example Dialog:

Mary comes home.

Mary: I don’t understand this homework problem. Help.

Robo: Ok, I see that this is an algebra problem. Have you tried factoring first?

Mary: I don’t know how to factor.

Robo: Ok, let me give you some examples to start with..

Robot gives examples.

Mary works on the problem.

Robo intervenes and gives more hints.

Machine Learning

Domain Knowledge

Pedagogical Knowledge

Dynamically creates interactions

Interface

Student Model Constantly Updated

Discussion:

1. Do you want a predictable world?
2. Do you want an automated world?
3. How do we prepare for the future??

Thank you!!