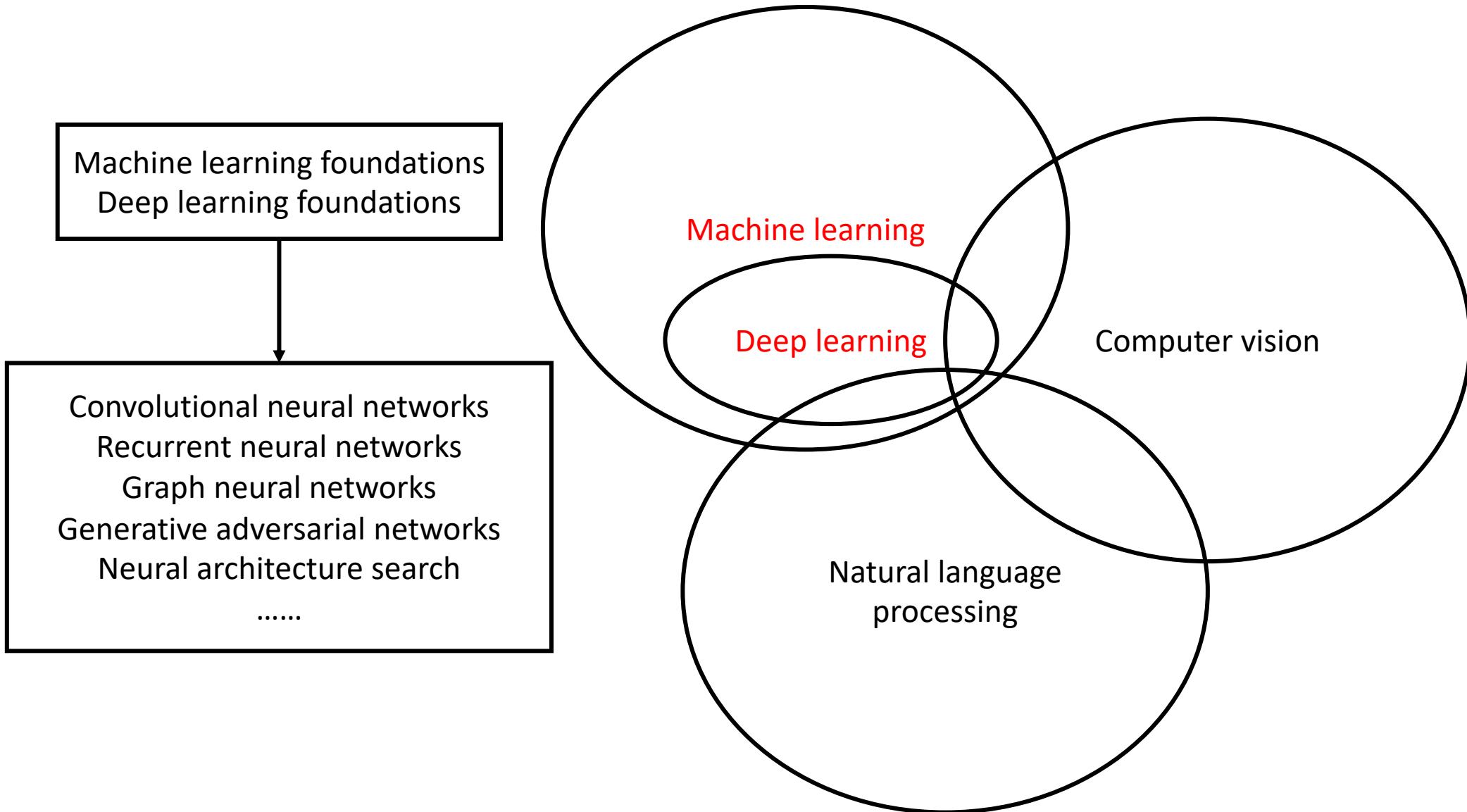


Basic Concepts of ML

CPT_S 434/534 Neural network design and application

Course overview



Deep learning? What is learning?



What is in this picture?

Deep learning? What is **learning**?



Past data

Learning system



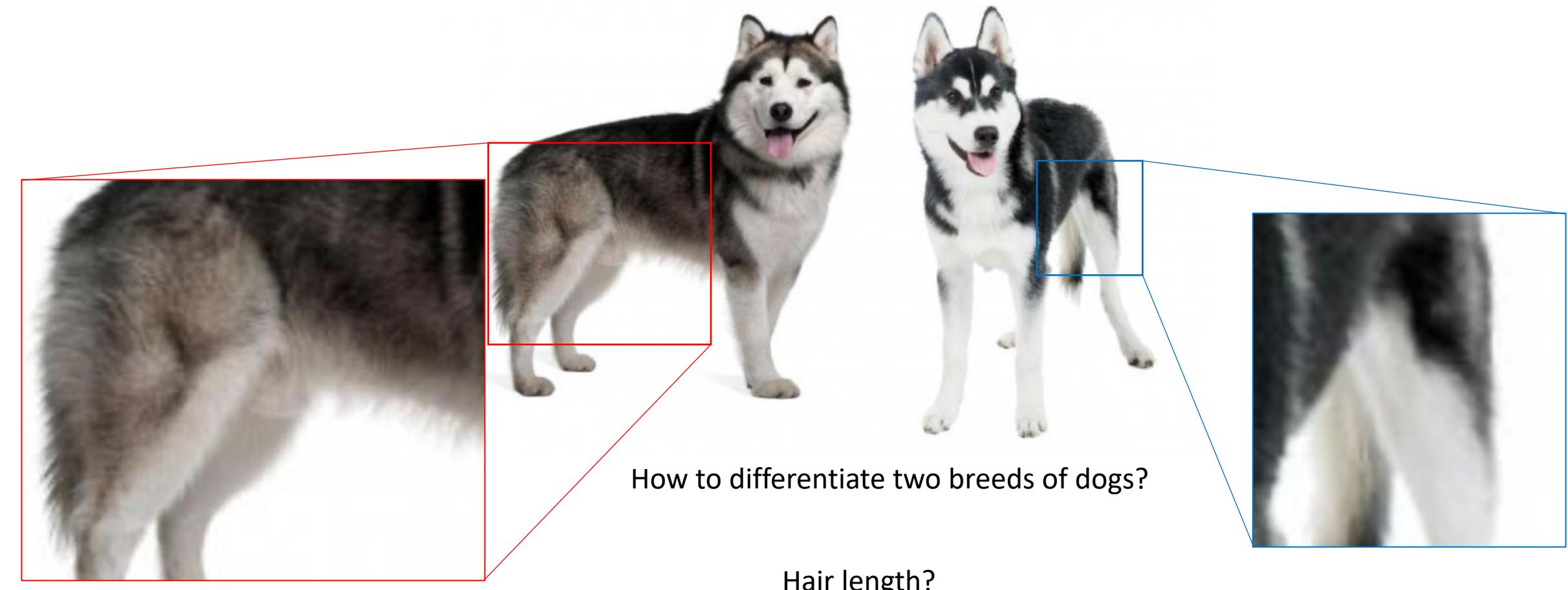
Future data

Husky vs Malamute

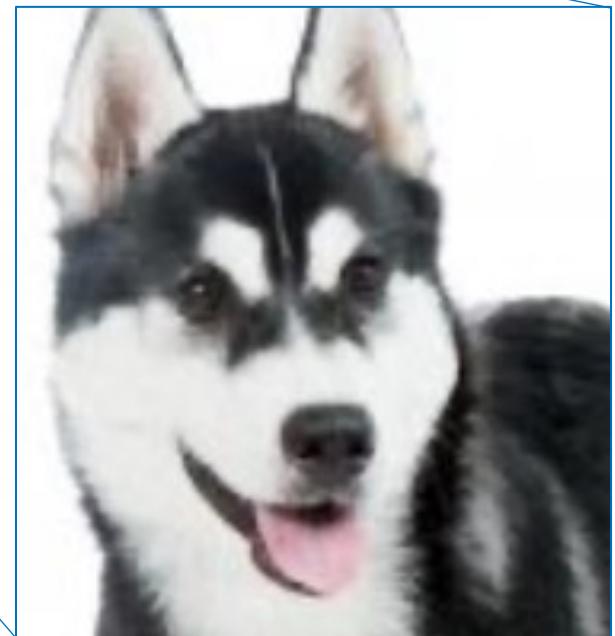
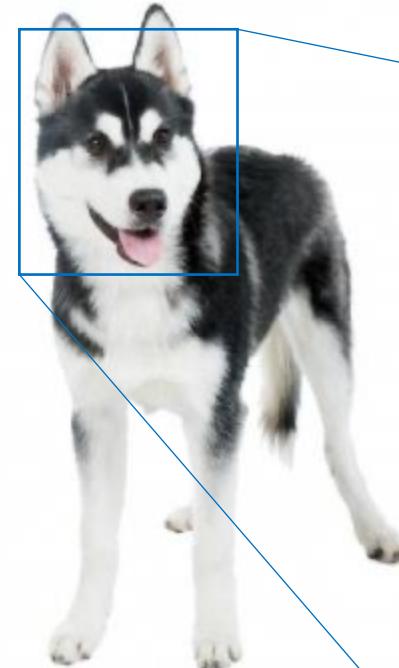
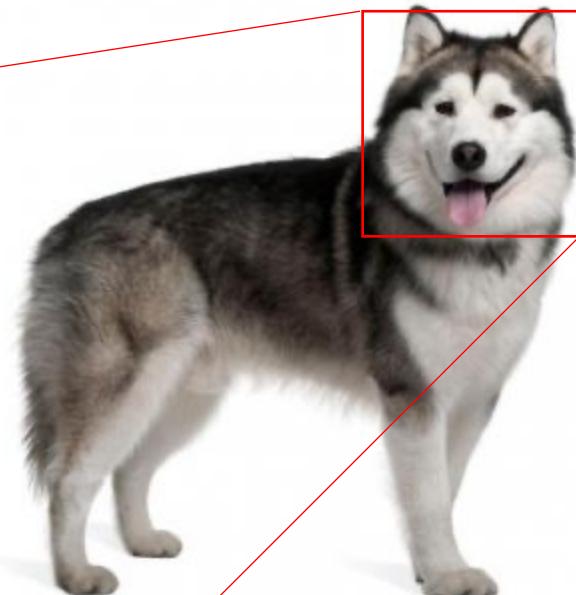
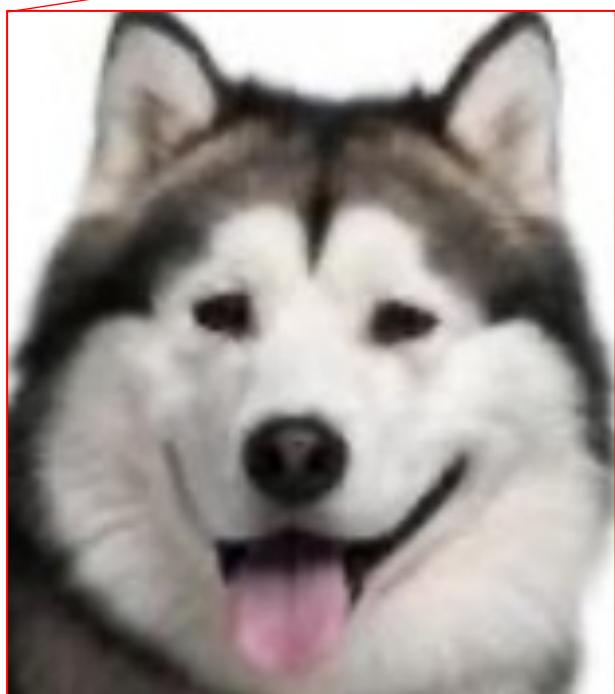


How to differentiate two breeds of dogs?

Husky vs Malamute



Husky vs Malamute



How to differentiate two breeds of dogs?

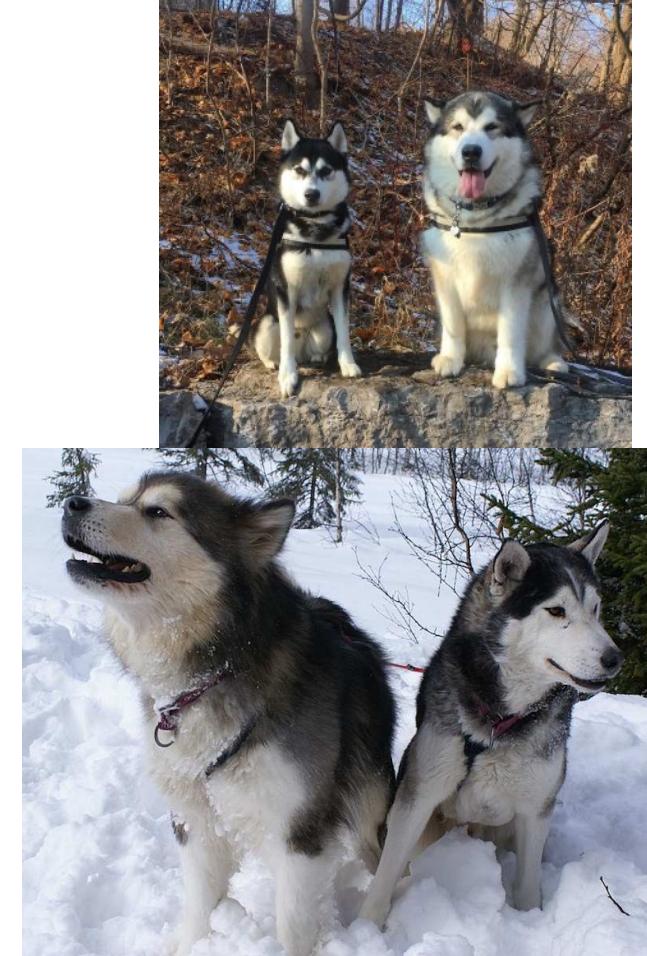
Face markings?

Husky vs Malamute



How to differentiate two breeds of dogs?

Size?



Husky vs Malamute



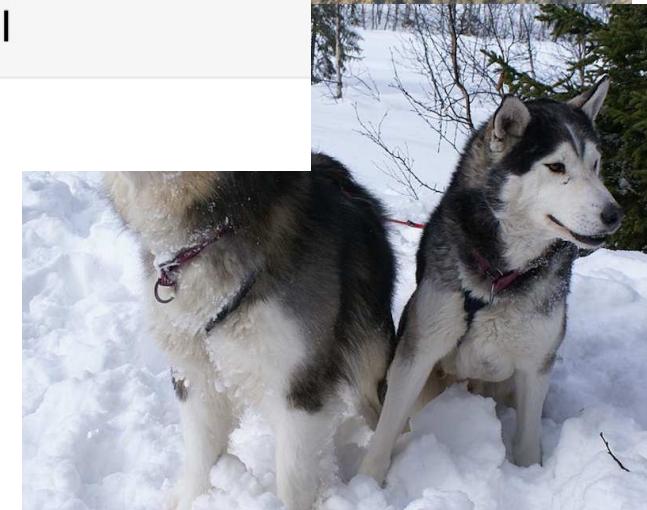
Alaskan Malamute vs Siberian Husky Comparison



	Alaskan Malamute	Siberian Husky
Size:	20-25 inches tall	20-22 inches tall
Weight:	85-100lbs	35-60lbs

How to differentiate two breeds of dogs?

Size?



Deep learning? What is **learning**?



Past data

Q: can we specify those key components?

Learning system

What is it?



Future data

Machine learning paradigm



Past data: **features**

Learning
model

Prediction on future data



Task: prediction/decision

(pre-defined setting)

Machine learning paradigm



Past data: **features**

Q: How to choose/generate useful features?

Learning
model

Prediction on future data



Task: prediction/decision

(pre-defined setting)

Machine learning paradigm



Past data: **features**

Q: How to choose/generate useful features?

Learning model

Q: How to determine this model?

Prediction on future data



Task: prediction/decision

(pre-defined setting)

Machine learning paradigm



Past data: **features**

Q: How to choose/generate useful features?



Learning model

Q: How to determine this model?

Prediction on future data



Task: prediction/decision

(pre-defined setting)

In practice:
We first inspect what **TASK** it is

Pre-defined problem settings (by label info)

- Supervised learning



Complete label information: supervised learning

Pre-defined problem settings (by label info)

- Non-supervised learning?



Labeled and unlabeled data: **semi-supervised** learning

Pre-defined problem settings (by label info)

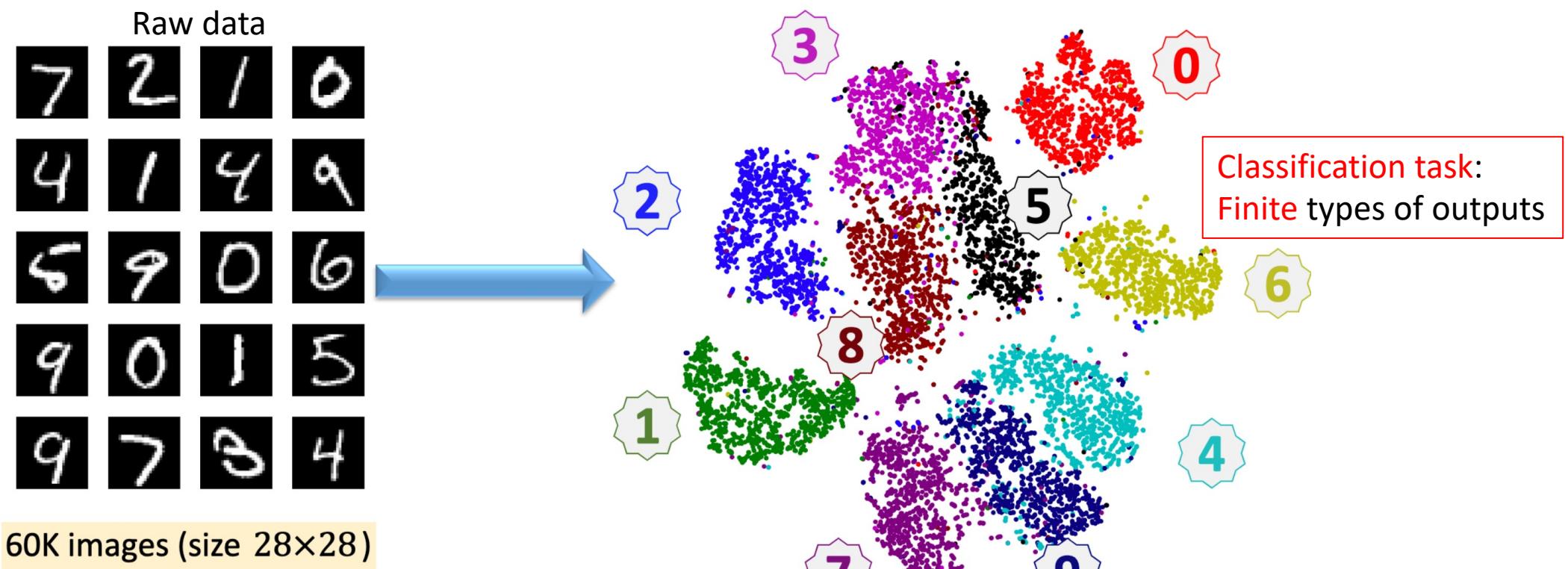
- Non-supervised learning?



Unlabeled data: unsupervised learning

Pre-defined problem settings (by task)

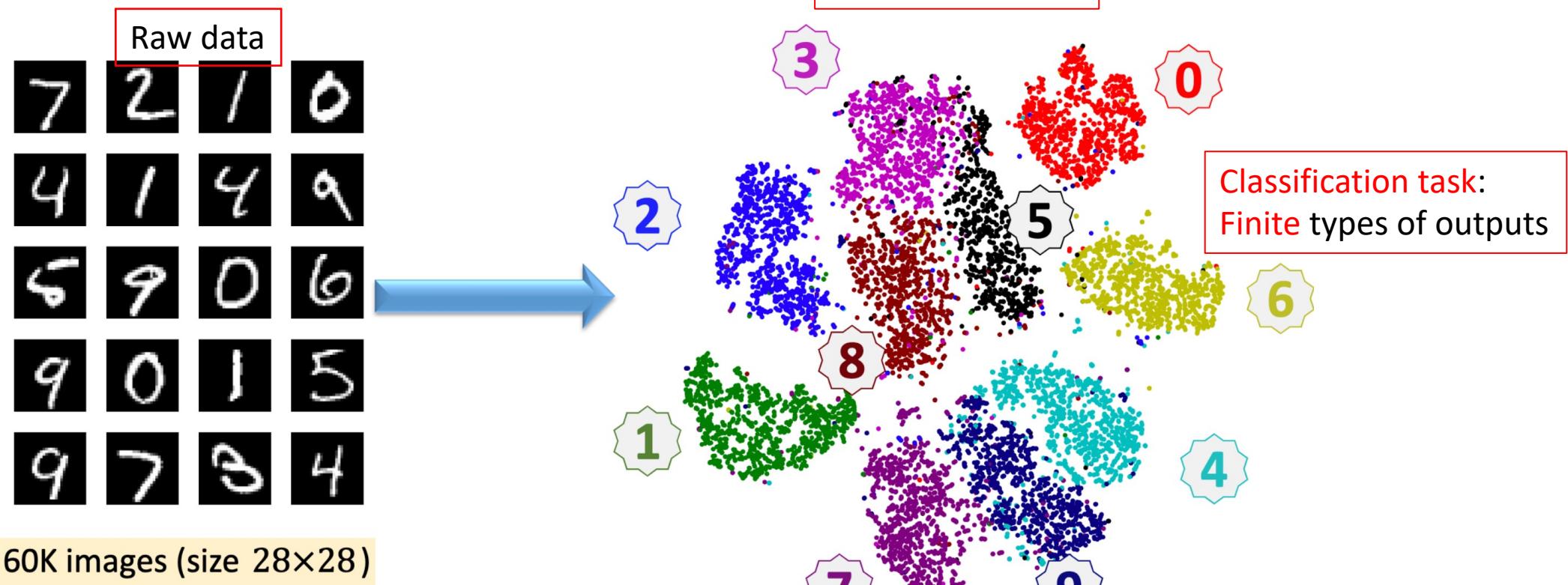
- **Unsupervised learning**



Autoencoder for hand-written digit data, retrieved from Shusen Wang's slides at
https://github.com/wangshusen/DeepLearning/blob/master/Slides/1_ML_Basics.pdf

Pre-defined problem settings (by task)

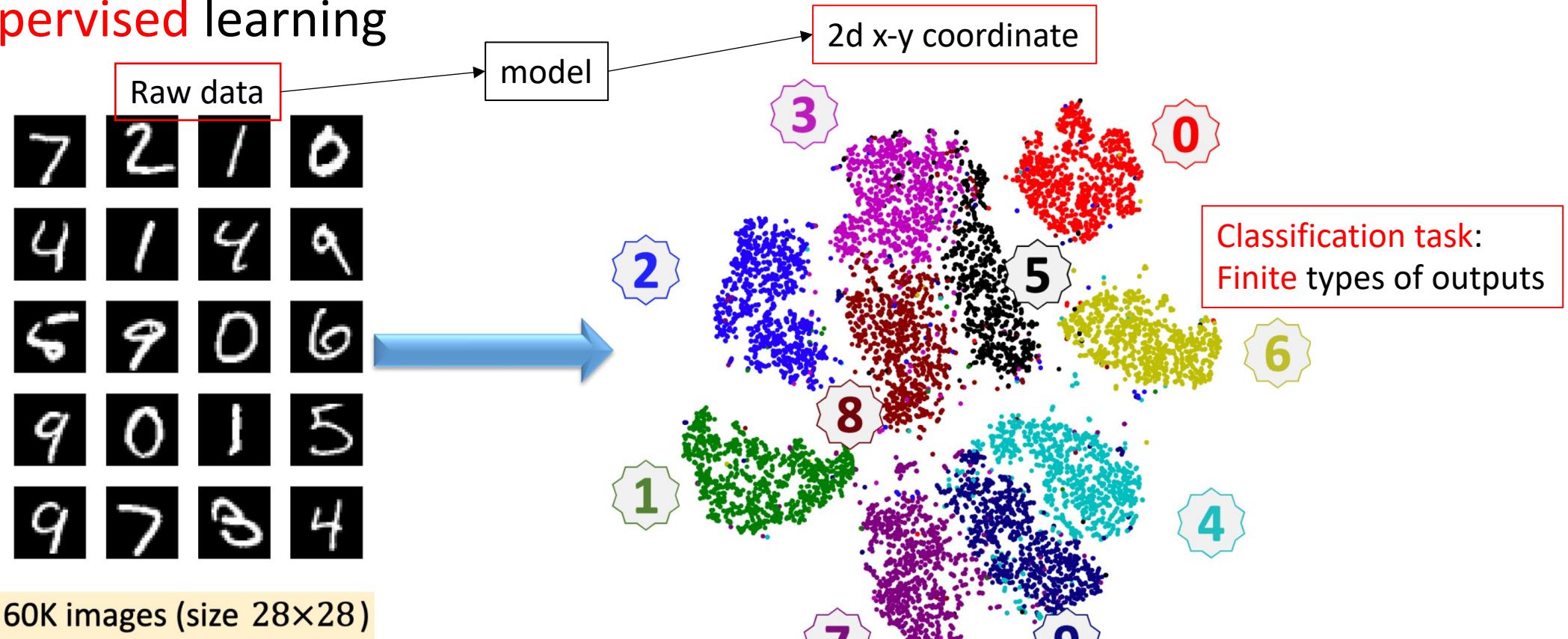
- Unsupervised learning



Autoencoder for hand-written digit data, retrieved from Shusen Wang's slides at
https://github.com/wangshusen/DeepLearning/blob/master/Slides/1_ML_Basics.pdf

Pre-defined problem settings (by task)

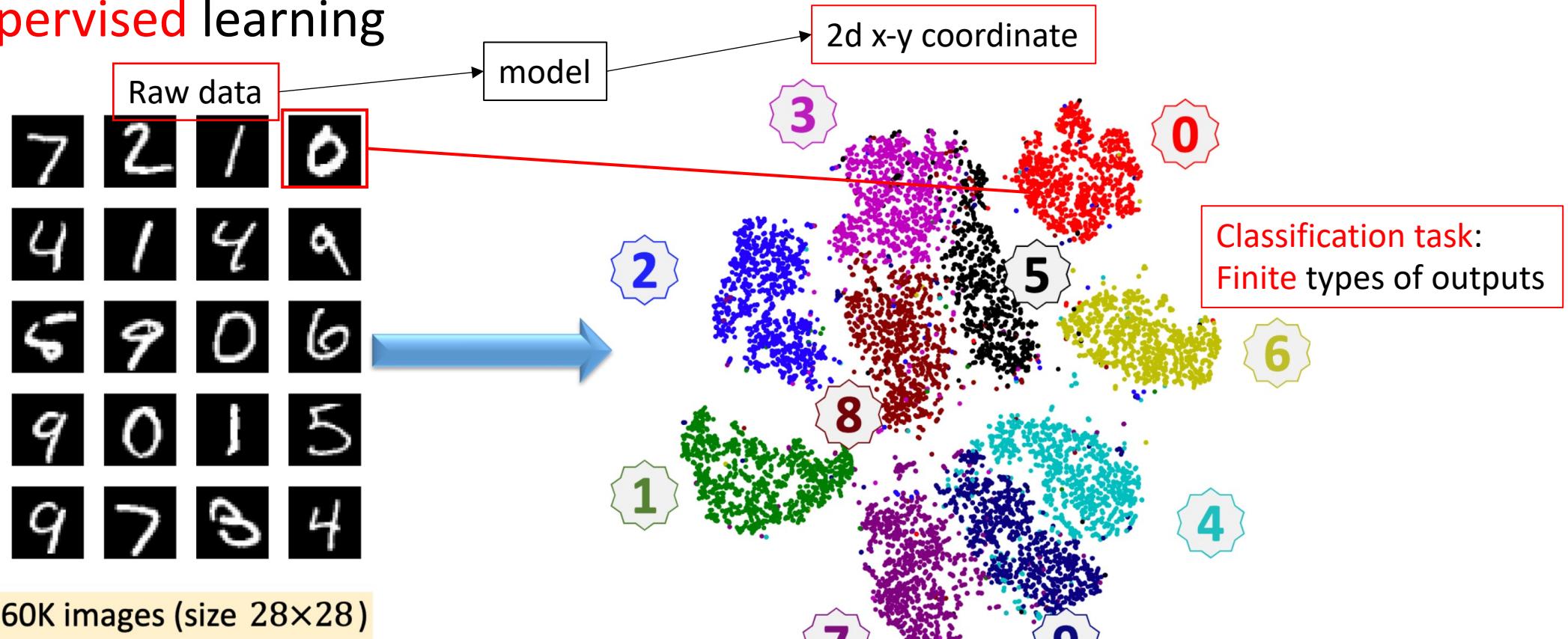
- **Unsupervised learning**



Autoencoder for hand-written digit data, retrieved from Shusen Wang's slides at
https://github.com/wangshusen/DeepLearning/blob/master/Slides/1_ML_Basics.pdf

Pre-defined problem settings (by task)

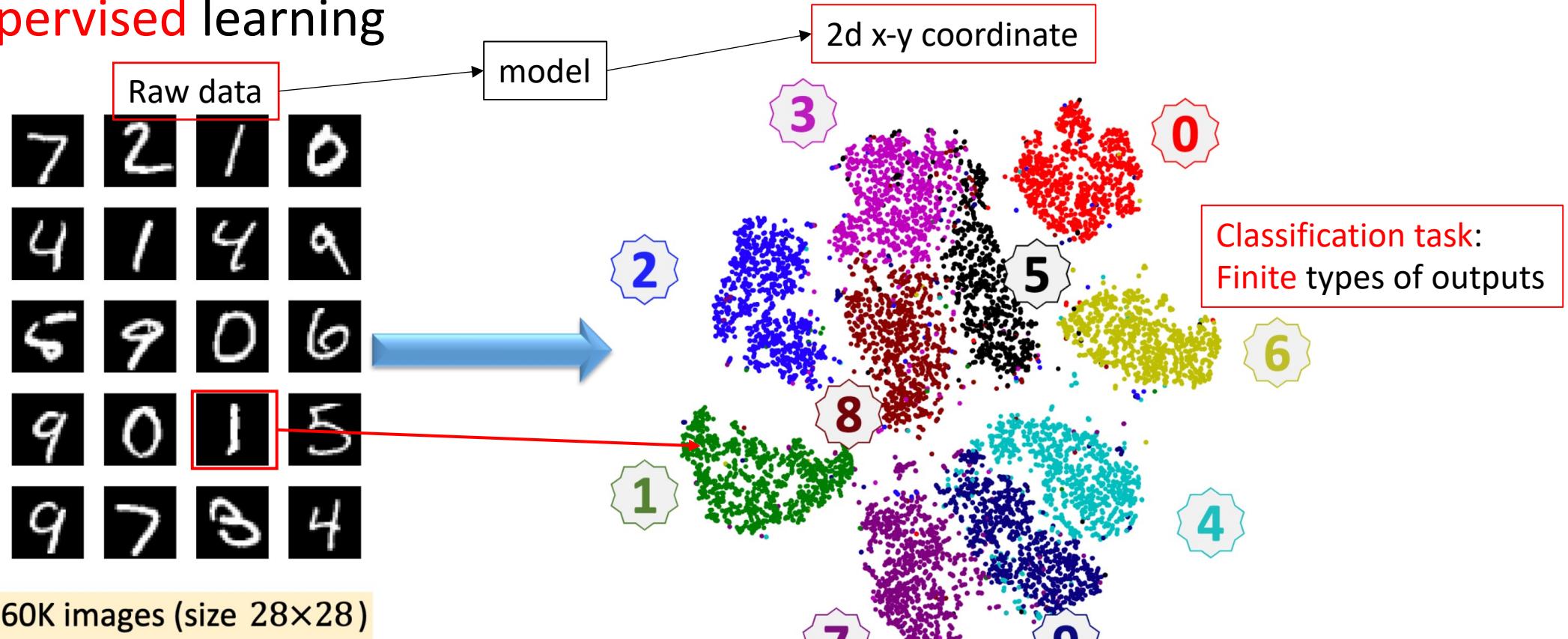
- **Unsupervised learning**



Autoencoder for hand-written digit data, retrieved from Shusen Wang's slides at
https://github.com/wangshusen/DeepLearning/blob/master/Slides/1_ML_Basics.pdf

Pre-defined problem settings (by task)

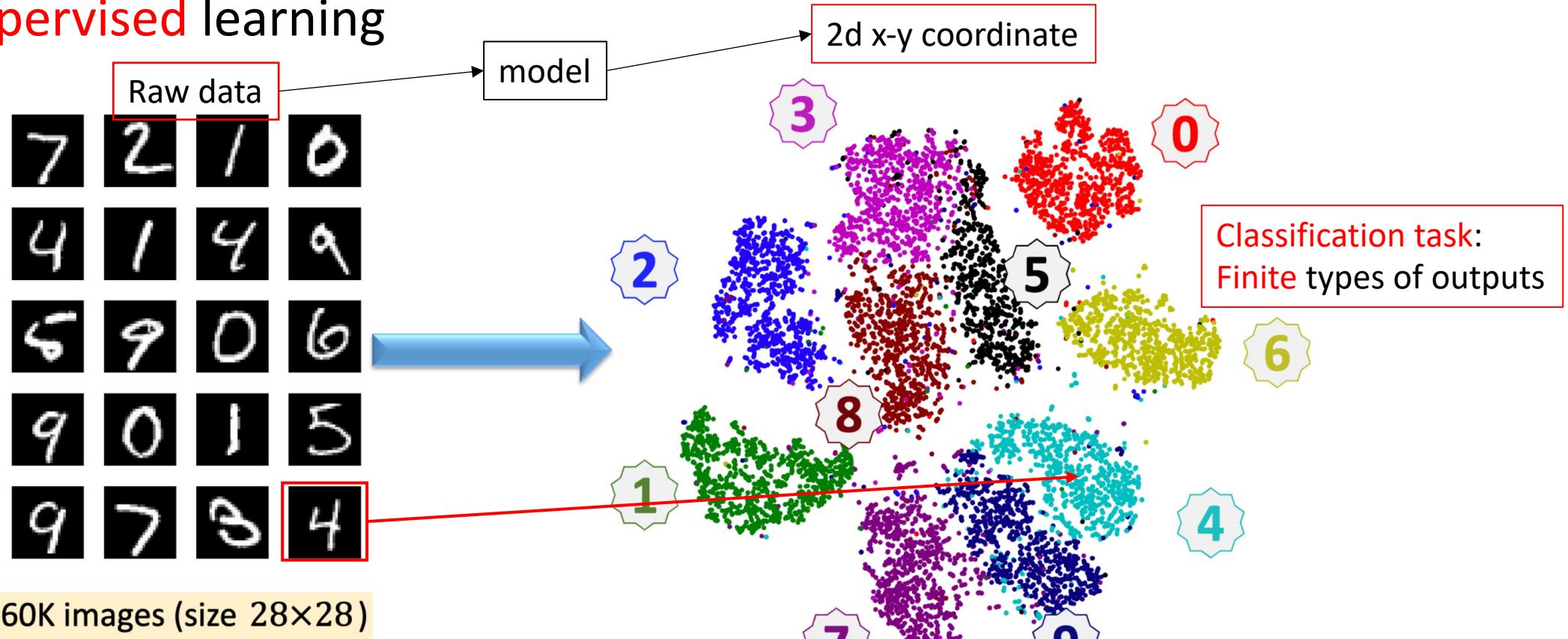
- **Unsupervised learning**



Autoencoder for hand-written digit data, retrieved from Shusen Wang's slides at
https://github.com/wangshusen/DeepLearning/blob/master/Slides/1_ML_Basics.pdf

Pre-defined problem settings (by task)

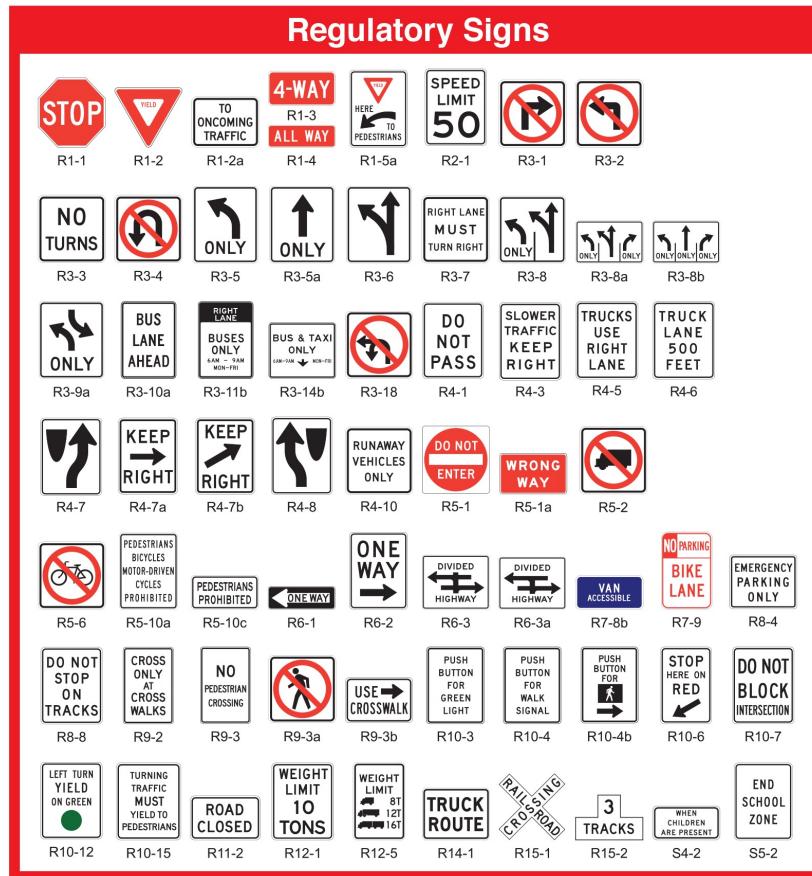
- **Unsupervised learning**



Autoencoder for hand-written digit data, retrieved from Shusen Wang's slides at
https://github.com/wangshusen/DeepLearning/blob/master/Slides/1_ML_Basics.pdf

Pre-defined problem settings (by task)

- Classification: traffic sign recognition



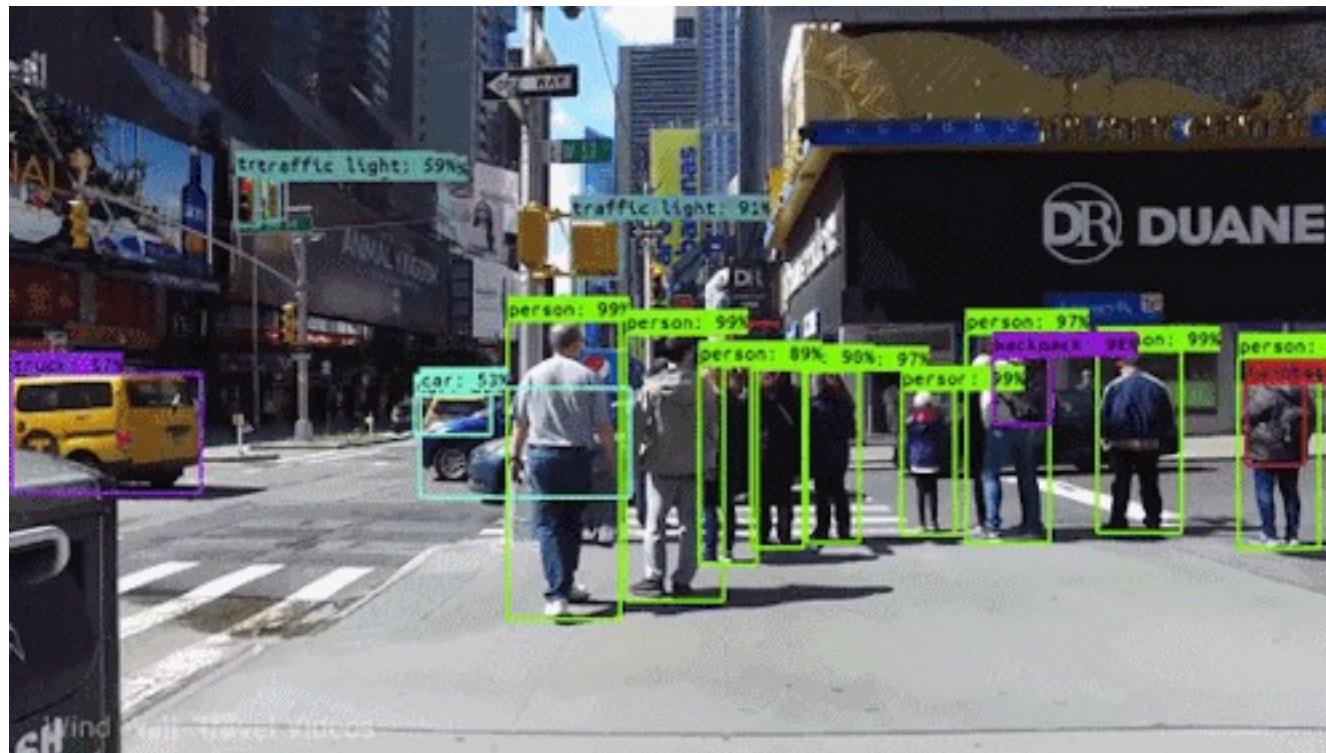
Learning model for traffic sign recognition



Q: How we can use recognition in practice?

Pre-defined problem settings (by task)

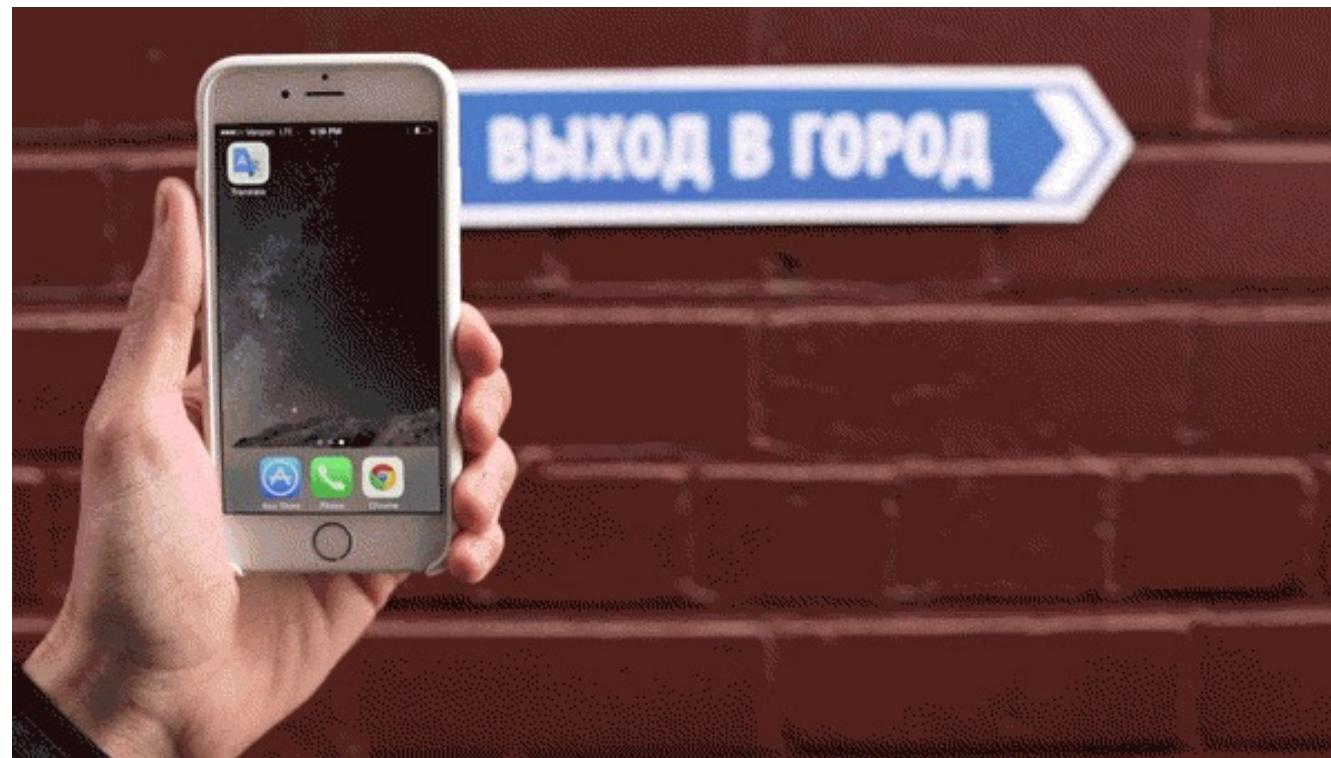
- **Classification:** traffic sign recognition



A use example: autonomous driving system

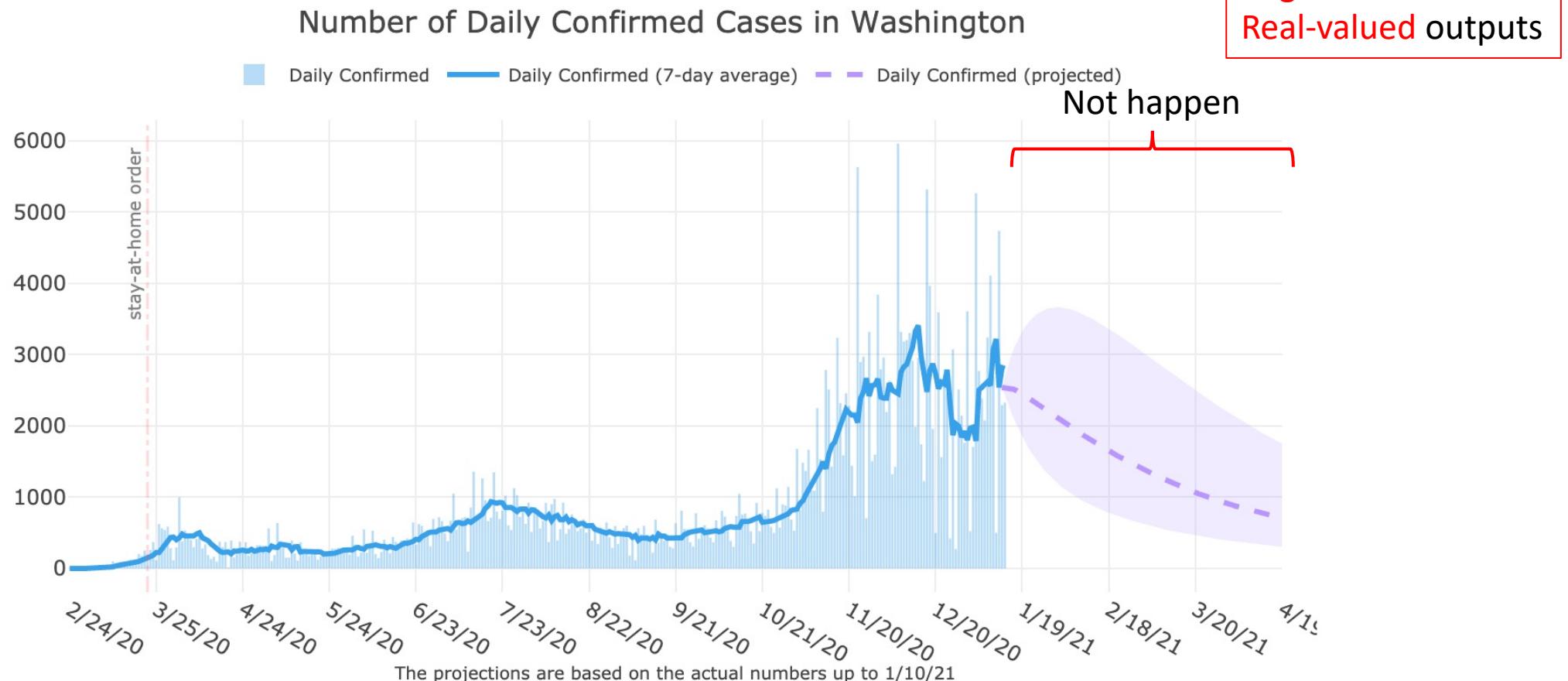
Pre-defined problem settings (by task)

- **Classification:** camera translate app



Pre-defined problem settings (by task)

- Prediction vs decision making

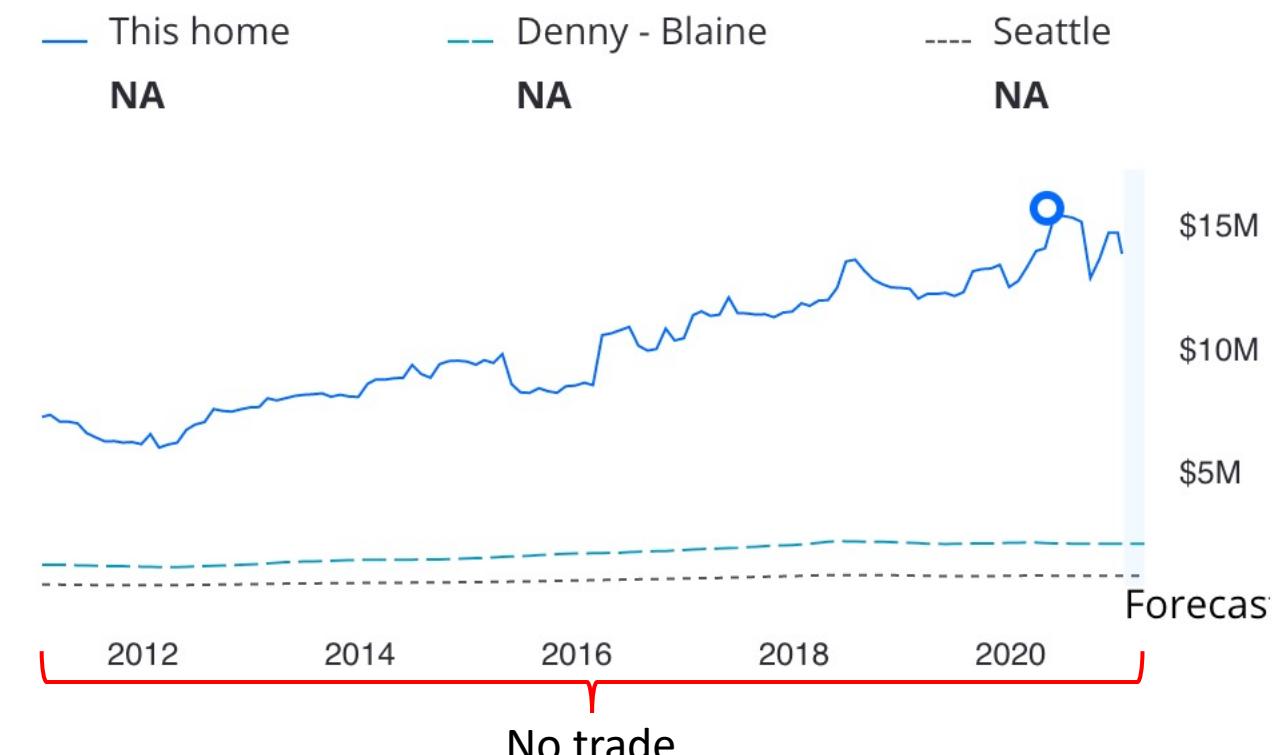


Pre-defined problem settings (by task)

- Prediction vs decision making

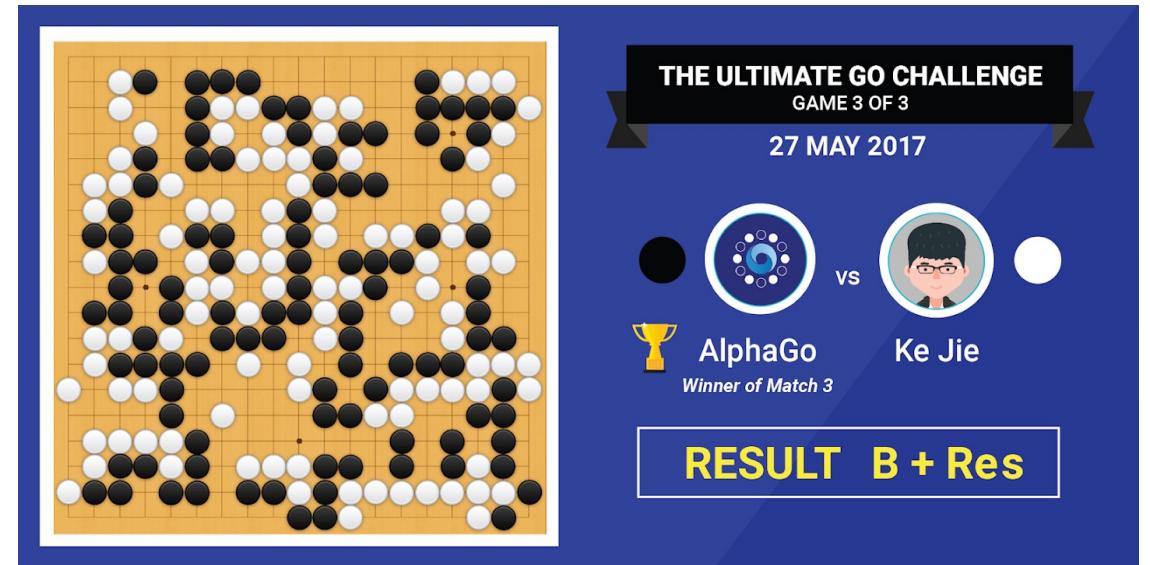
Zestimate history

Regression:
Real-valued outputs



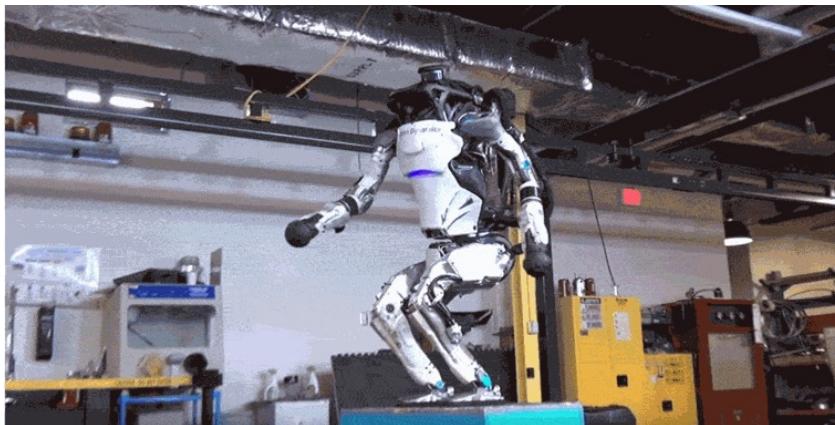
Pre-defined problem settings (by task)

- Prediction vs **decision making**



Pre-defined problem settings (by task)

- Prediction vs **decision making**



Machine learning paradigm



Past data: **features**

Q: How to choose/generate useful features?

Learning model

Q: How to determine this model?

Prediction on future data



Task: prediction/decision

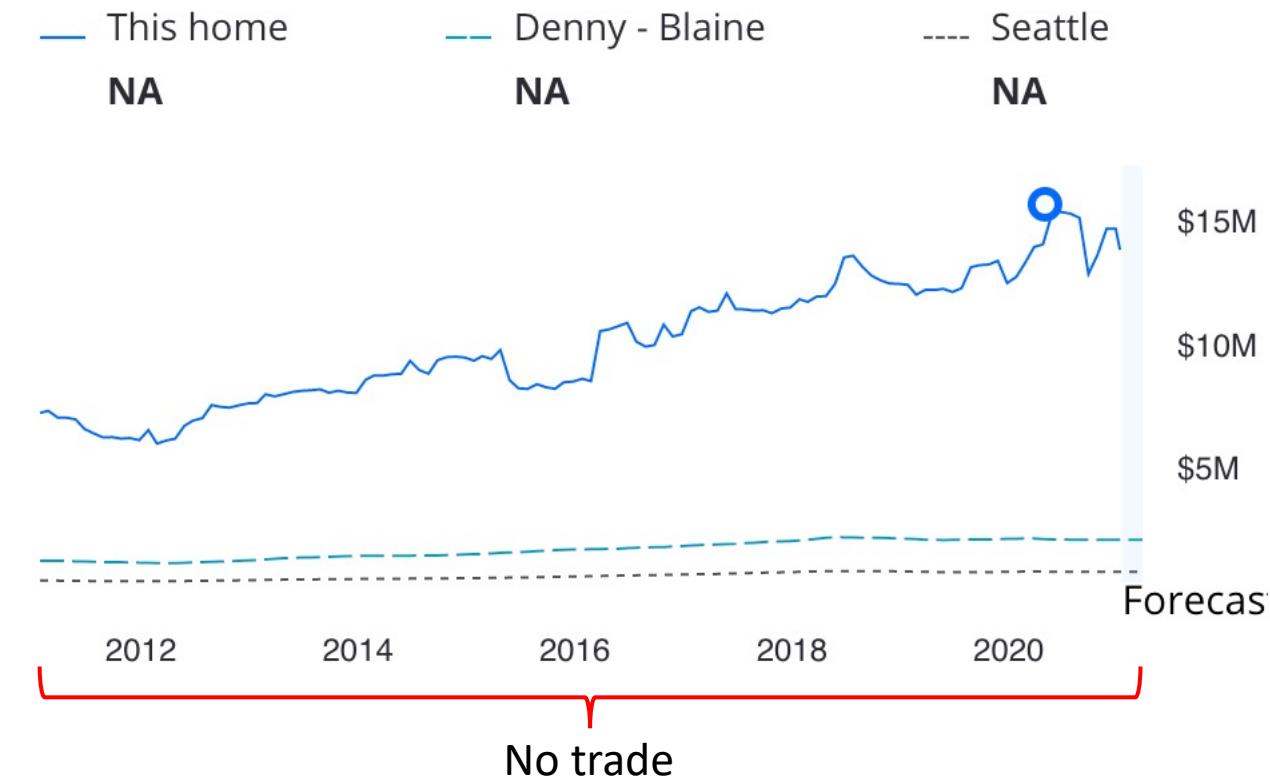
(pre-defined setting)

In practice:
We first inspect what TASK it is

Features

Q: What features can we use?

Zestimate history



Feature in house price prediction

- Home characteristics: lot size, location, #bedrooms
- Unique features: hardwood floors, granite countertops or a landscaped backyard
- On-market data: listing price, description, days on the market
- Off-market data: tax assessments, prior sales

Feature in house price prediction

Existing physical
properties

Land size (sqft)

#bedrooms

Zip code

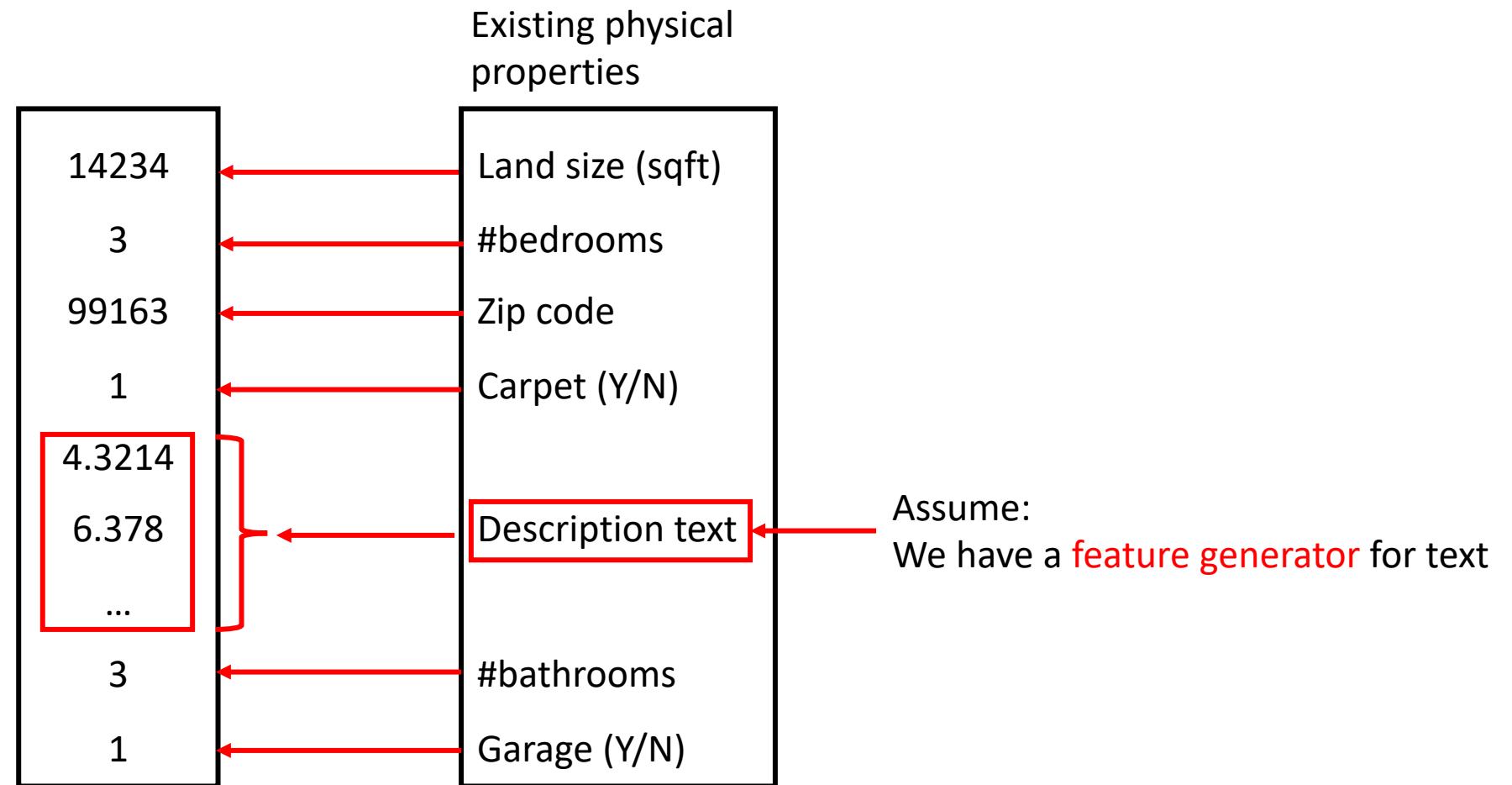
Carpet (Y/N)

Description text

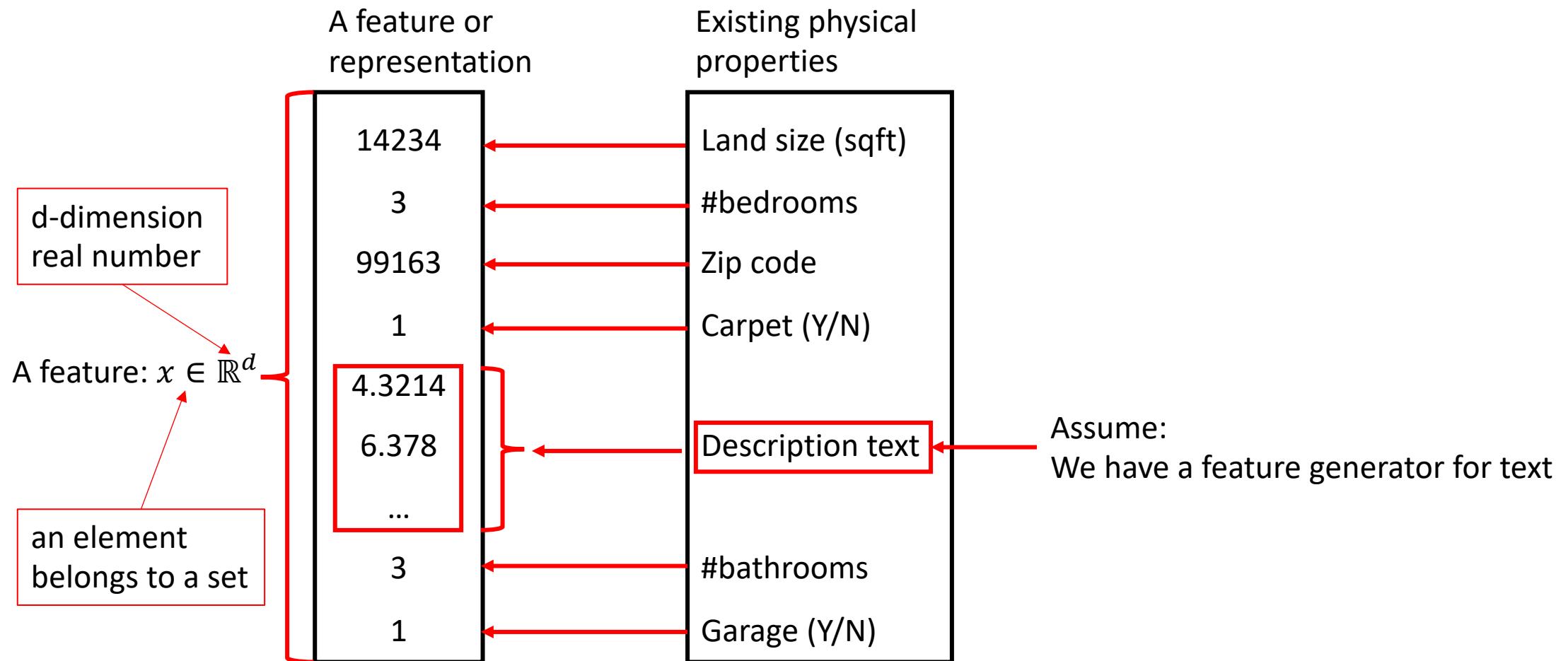
#bathrooms

Garage (Y/N)

Feature in house price prediction



Feature in house price prediction



Machine learning paradigm



Past data: **features**

Q: How to choose/generate useful features?

Learning model

Q: How to determine this model?

Choose a type of model
Determine its parameters

Prediction on future data



Task: prediction/decision

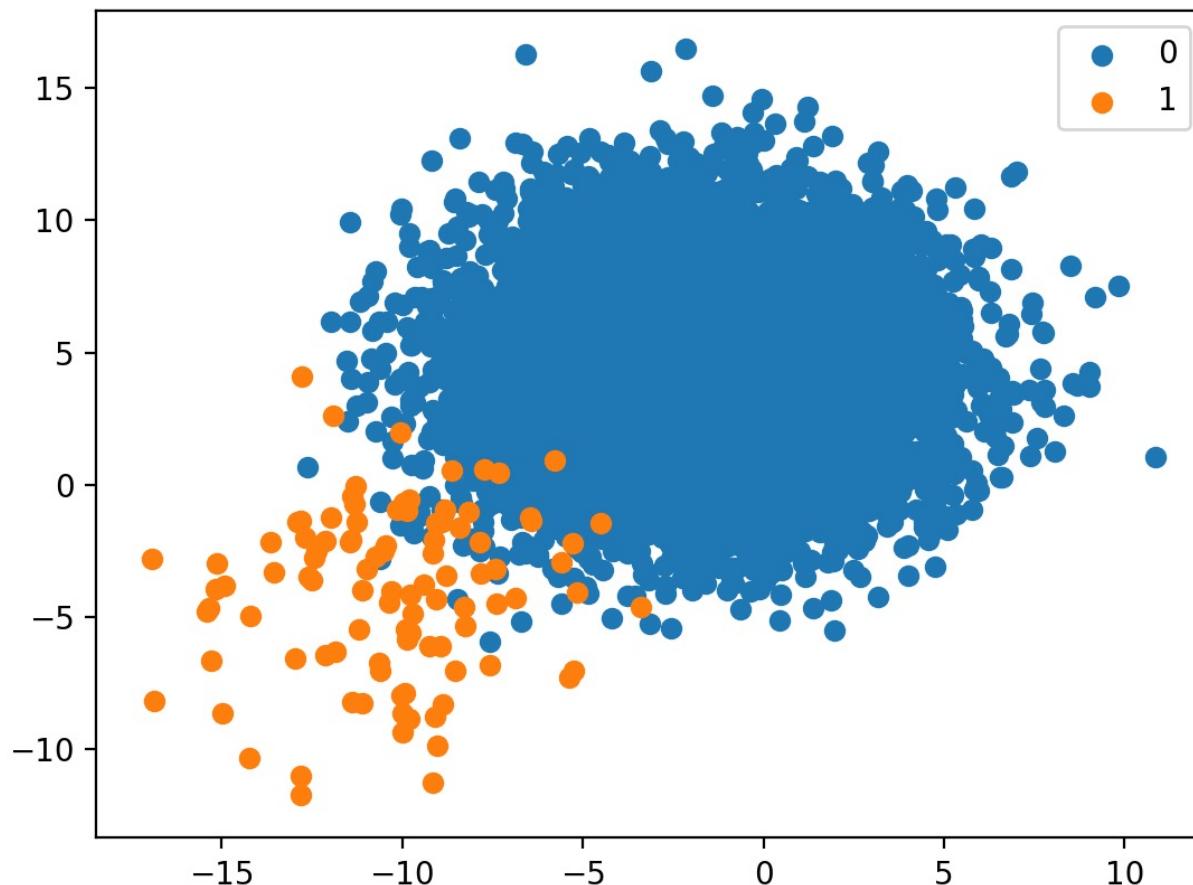
(pre-defined setting)

In practice:
We first inspect what **TASK** it is

Build a model

Try to separate two classes

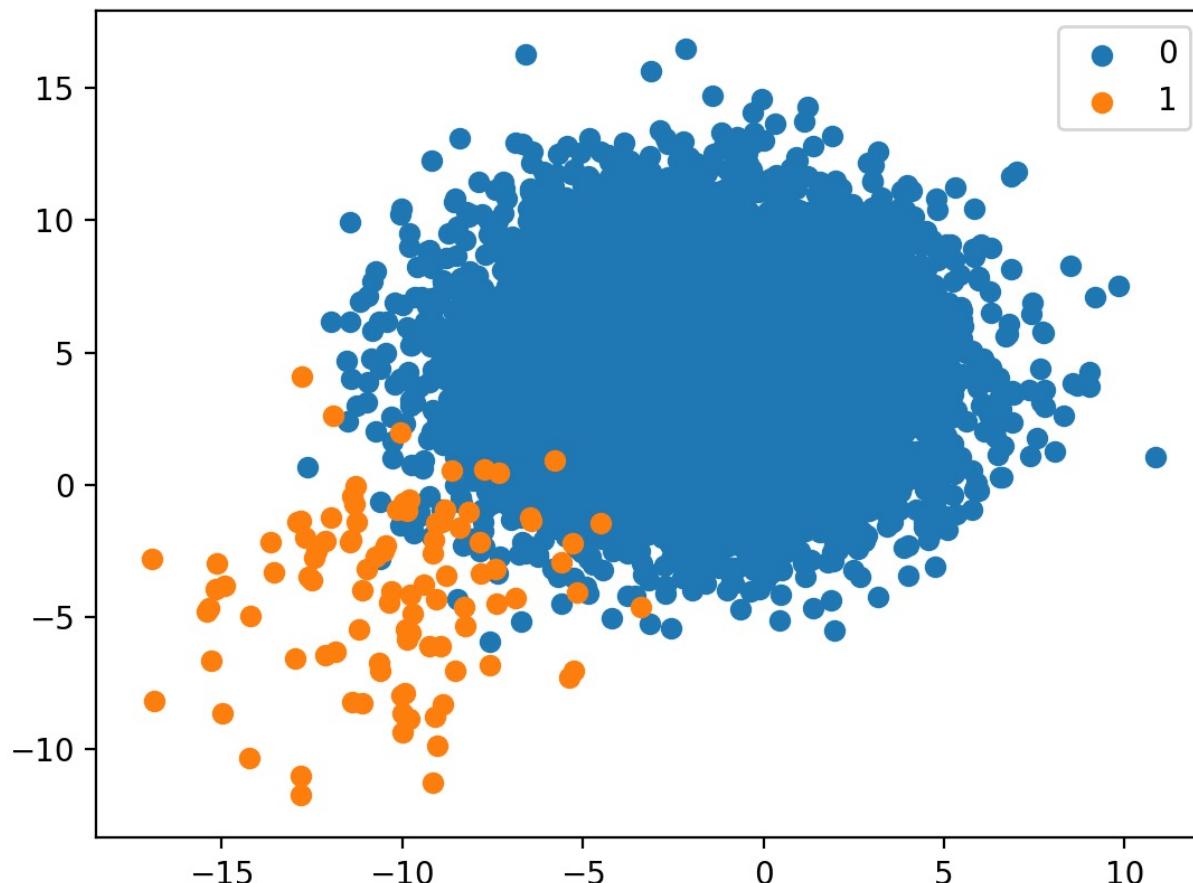
- What is a model



Build a model

- What is a model

Try to separate two classes
Q: how to separate them?

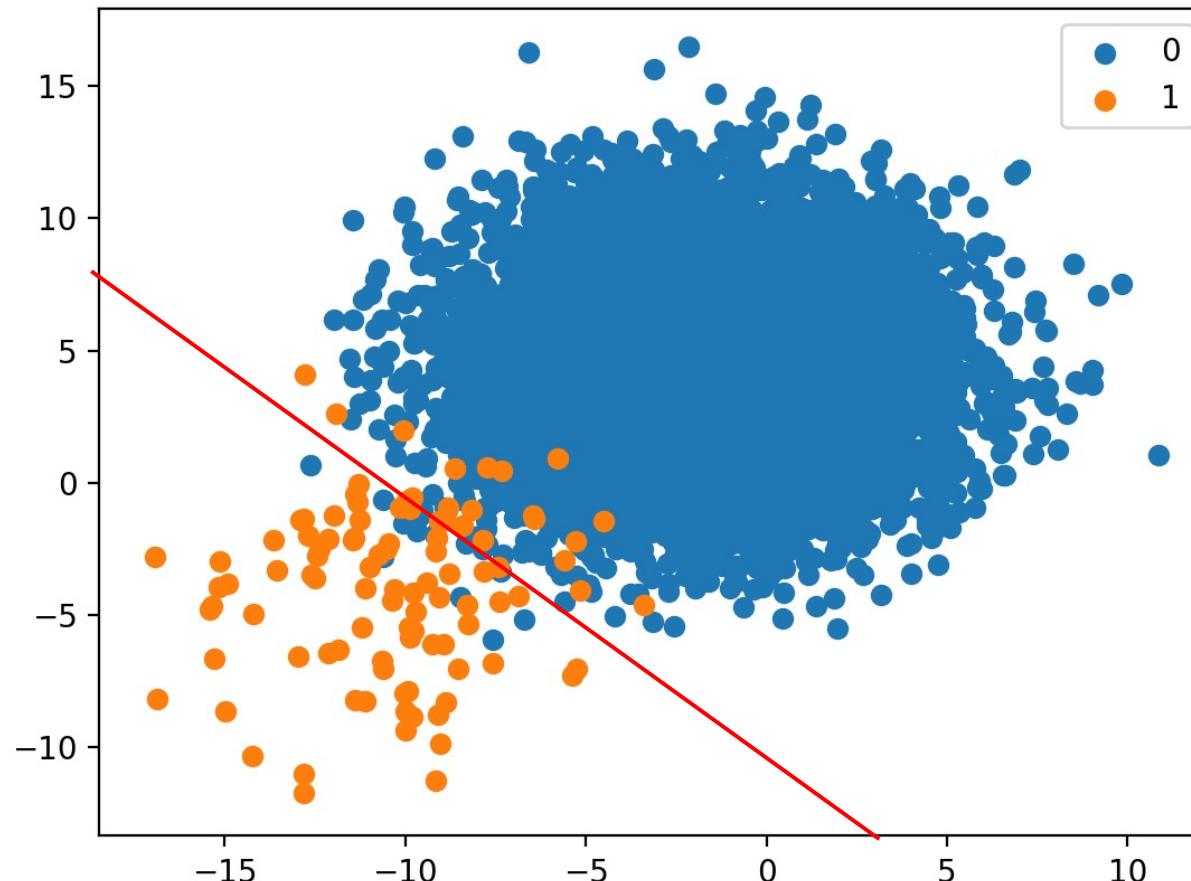


Build a model

- What is a model

A linear function

Try to separate two classes
Q: how to separate them?



Build a model

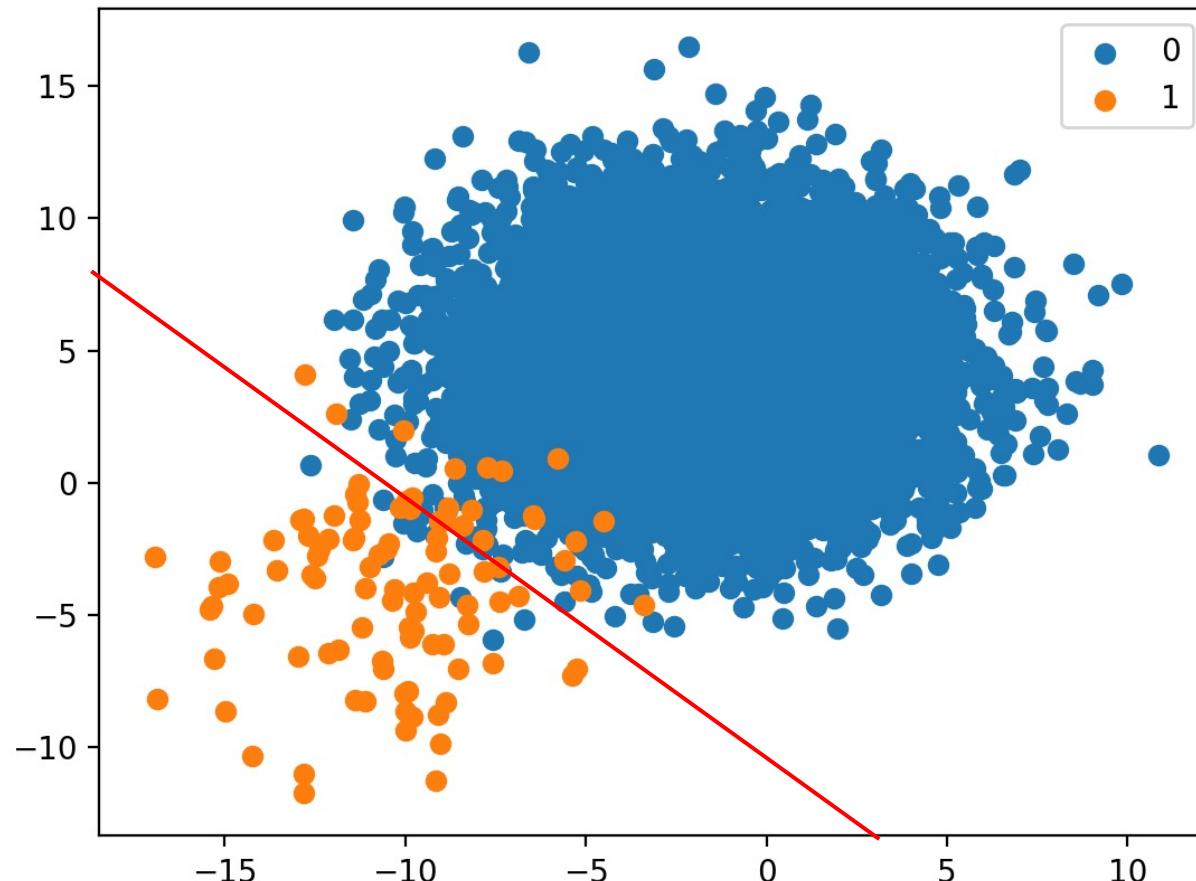
- What is a model

A hypothesis class

A linear function

$$y = ax + b$$

Try to separate two classes
Q: how to separate them?

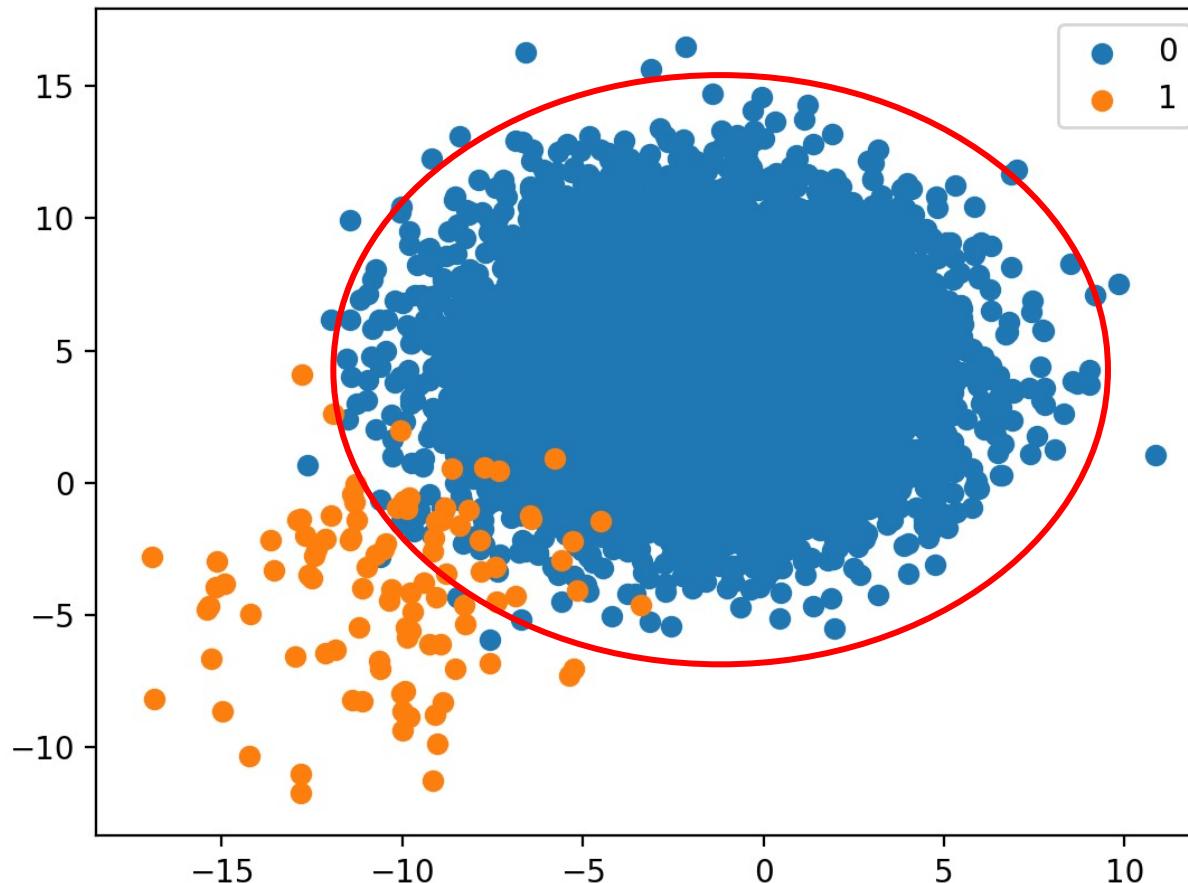


Build a model

- What is a model

An ellipse (nonlinear function)

Try to separate two classes
Q: how to separate them?

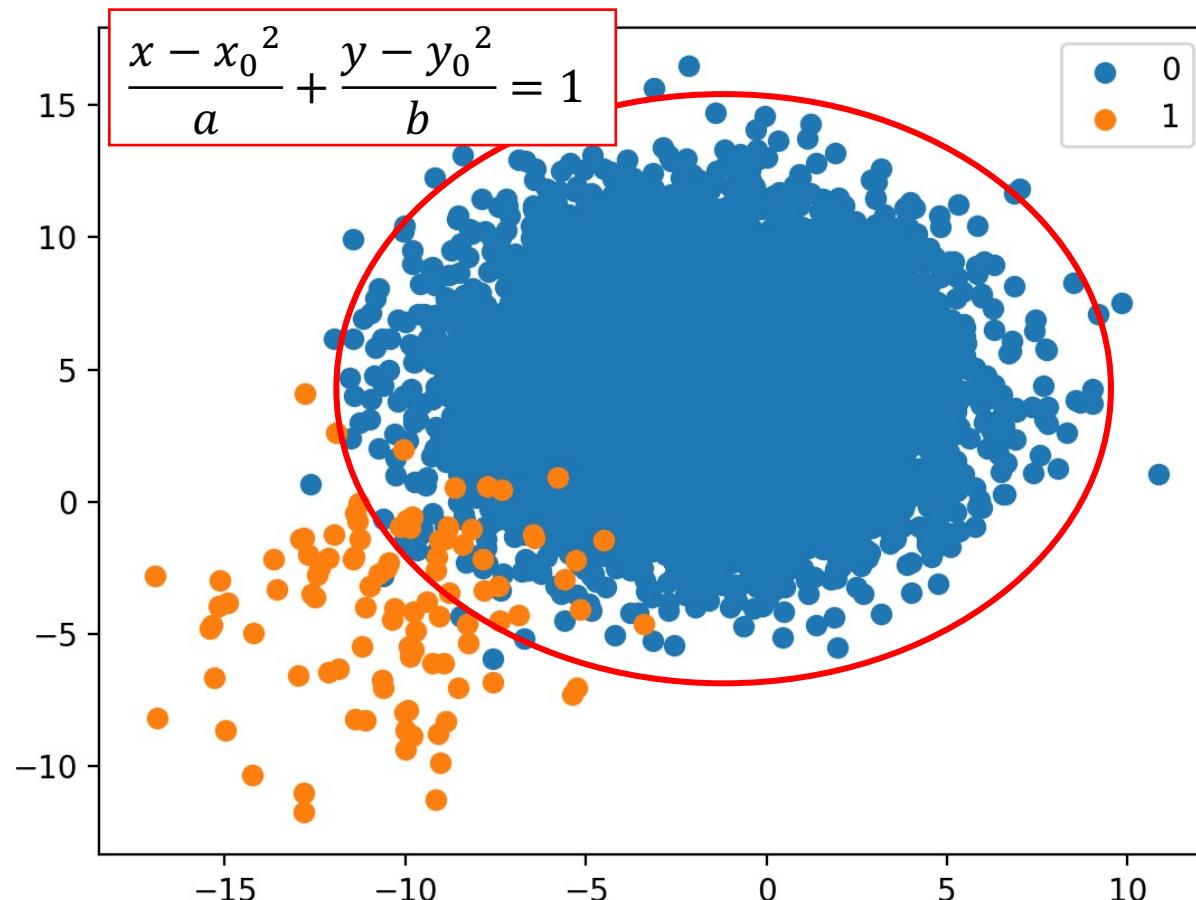


Build a model

- What is a model

An ellipse (nonlinear function)
Another hypothesis class

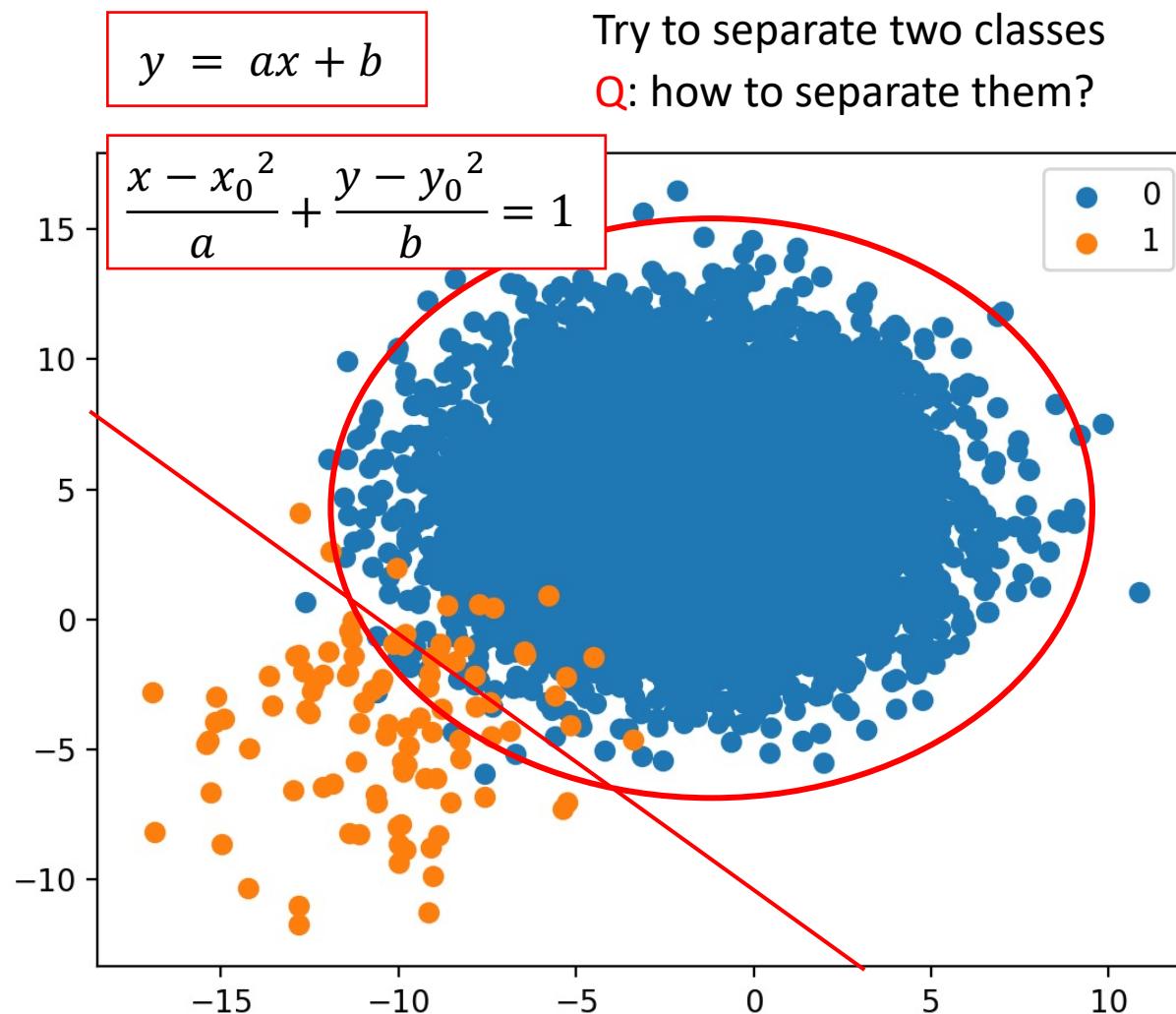
Try to separate two classes
Q: how to separate them?



Build a model

- What is a model

A hypothesis class
A linear function
or
An ellipse (nonlinear function)
Another hypothesis class



Build a model

- What is a model

A hypothesis class

A linear function

or

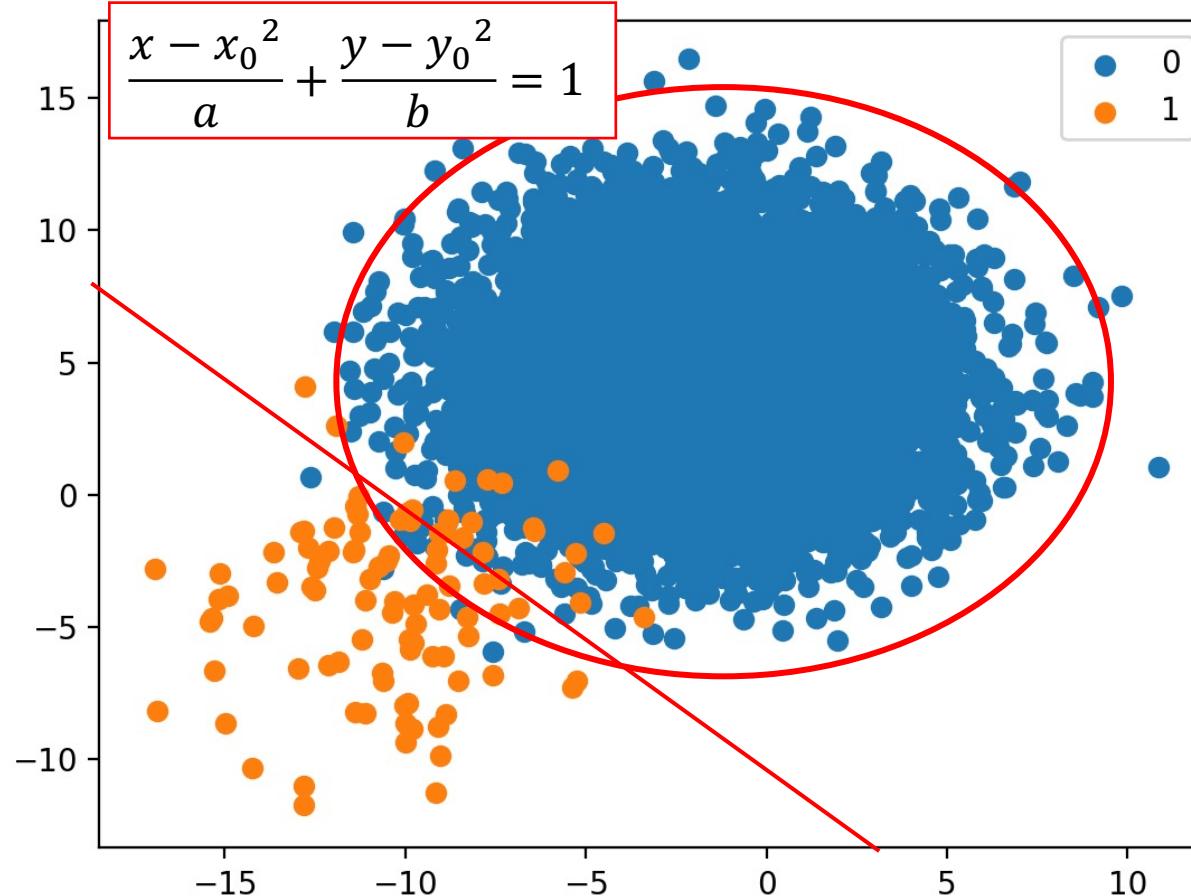
An ellipse (nonlinear function)

Another hypothesis class

Q: what is the feature used here?

$$y = ax + b$$

Try to separate two classes
Q: how to separate them?



Build a model

- What is a model

A hypothesis class

A linear function

or

An ellipse (nonlinear function)

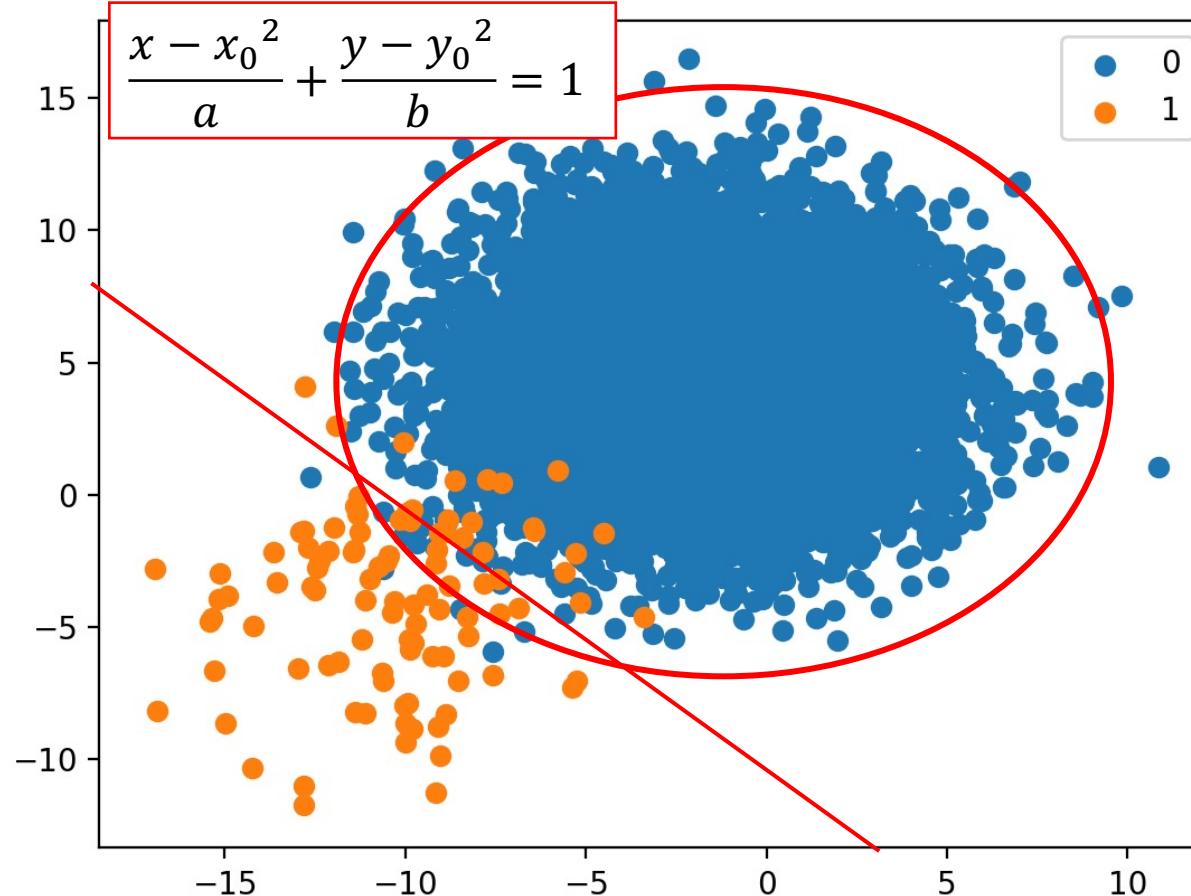
Another hypothesis class

Q: what is the feature used here?

A: x-y coordinates

$$y = ax + b$$

Try to separate two classes
Q: how to separate them?



Build a model

- What is a model

A hypothesis class

A linear function

or

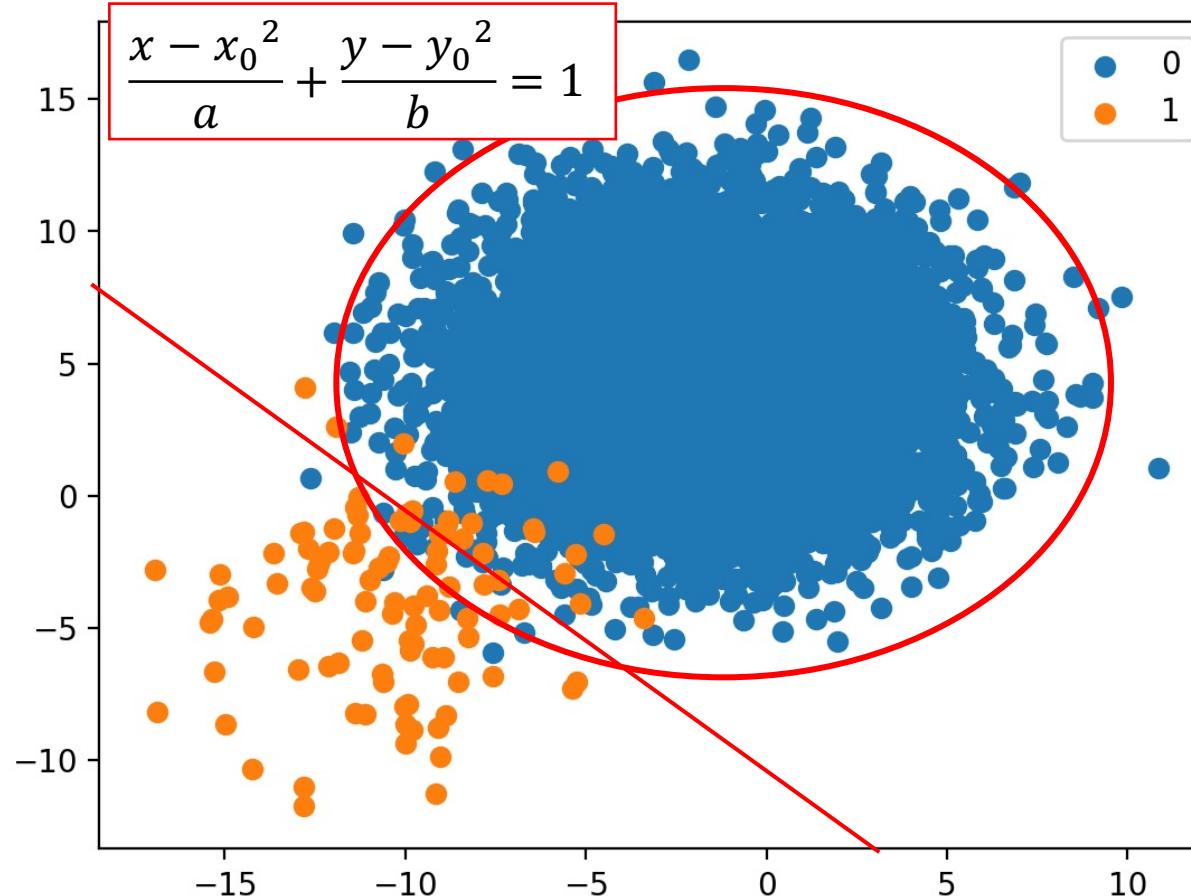
An ellipse (nonlinear function)

Another hypothesis class

Q: what are their parameters?

$$y = ax + b$$

Try to separate two classes
Q: how to separate them?



Build a model

- What is a model

A hypothesis class

A linear function

or

An ellipse (nonlinear function)

Another hypothesis class

Q: what are their parameters?

$$y = ax + b$$

Try to separate two classes
Q: how to separate them?

