Machine Learning for Newbies

[NUS Orbital 2016] – Mission Control 4A/4B

What is Machine Learning?

Please select your answers :

A) Memorizing something

B) Learning facts through observation and exploration

C) Generalizing a concept from experience

What type of learning to apply…

Depends on what type of feedback is available:

- Supervised learning: correct answers for each example
- Unsupervised learning: correct answers not given
- Reinforcement learning: occasional rewards


ALPHAGO
01:58:30
LEE SEDOL
01:59:41
Mind
Match
AlphaGo
Lee Sedol

Induction

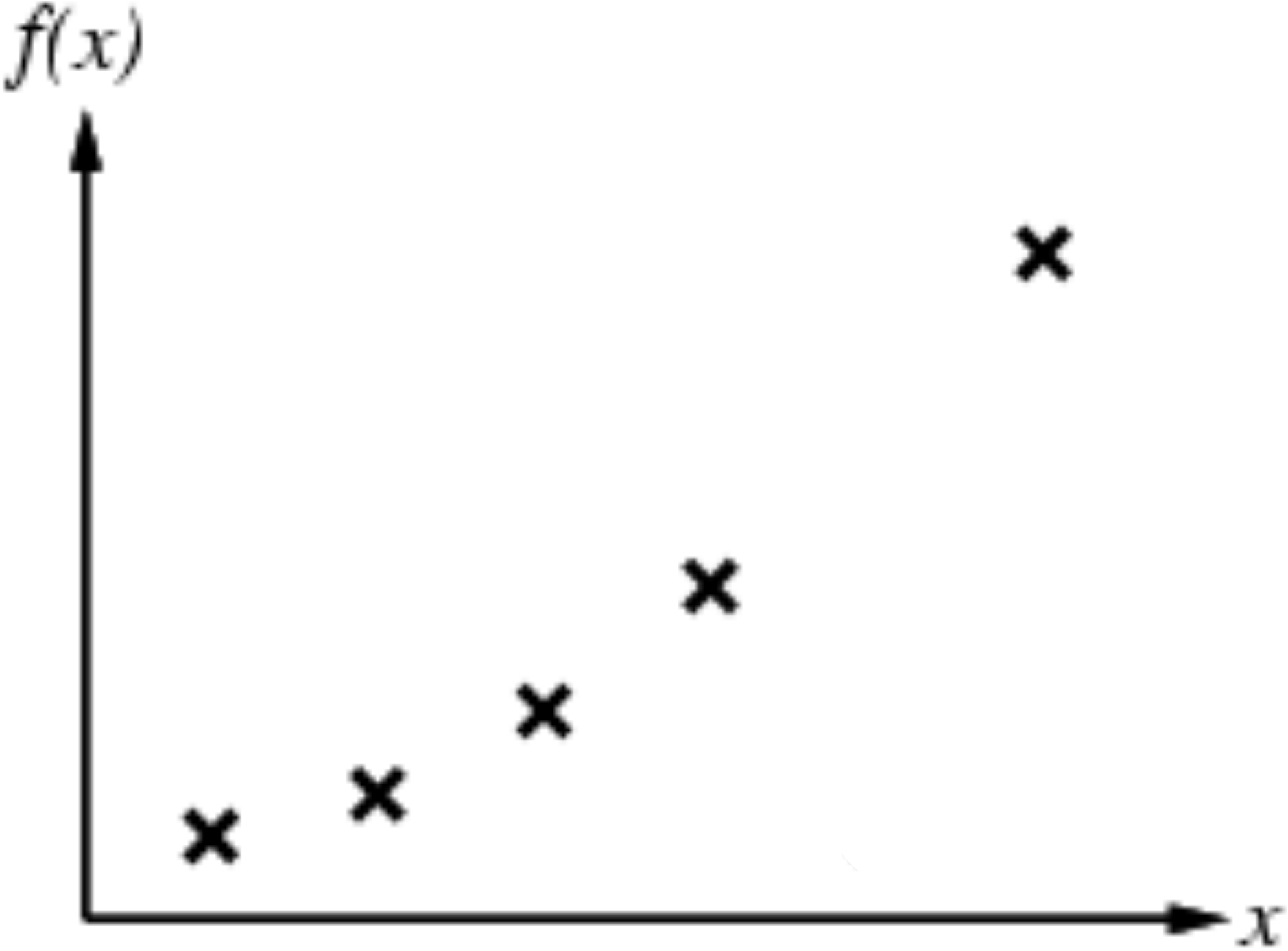
Making predictions about the future based on the past. But is induction sound? Why believe that the future will look similar to the past?

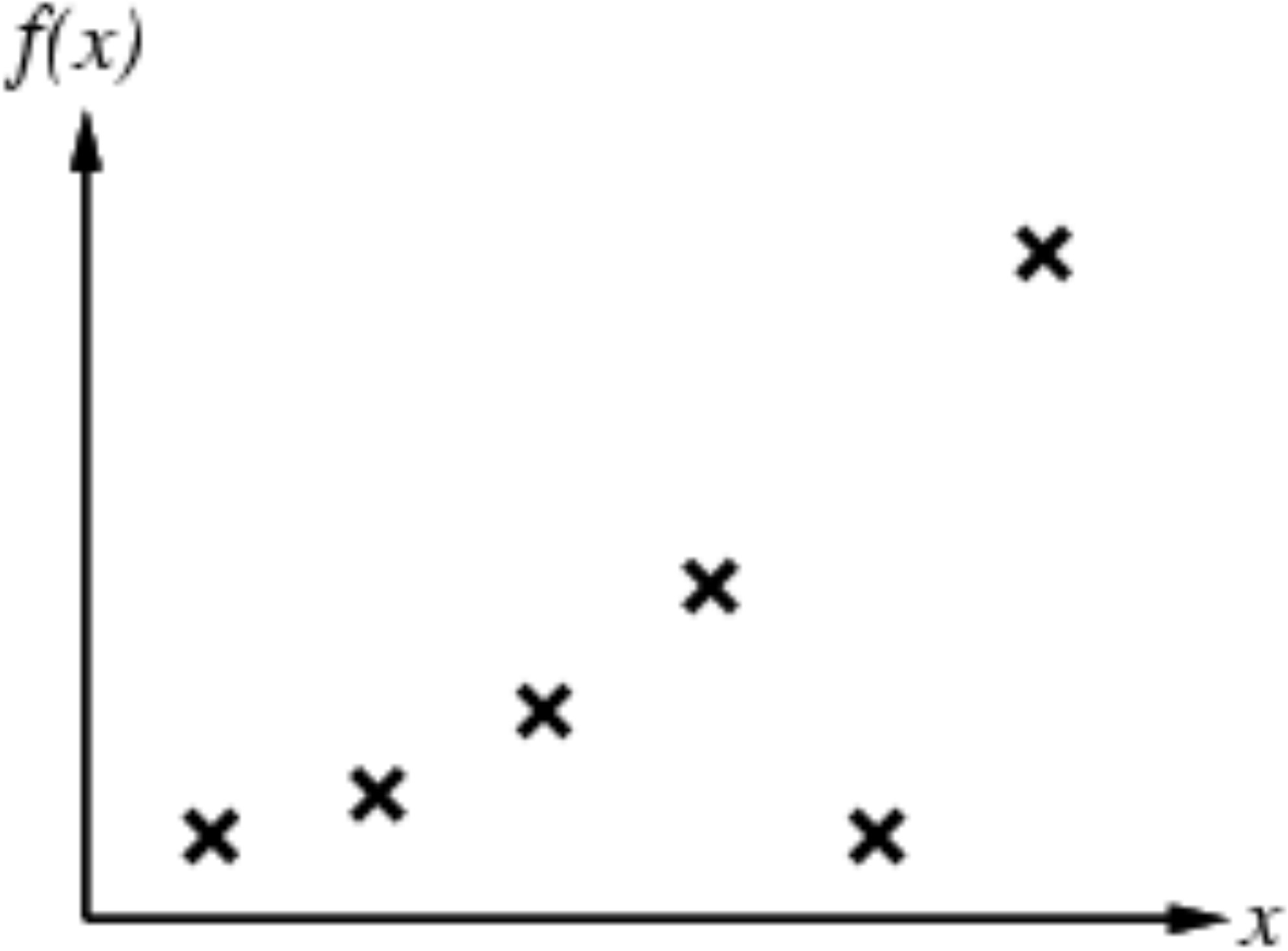
> If asked why we believe the sun will rise tomorrow, we shall naturally answer, "Because it has always risen every day." We have a firm belief that it will rise in the future, because it has risen in the past.
>
> – Bertrand Russell

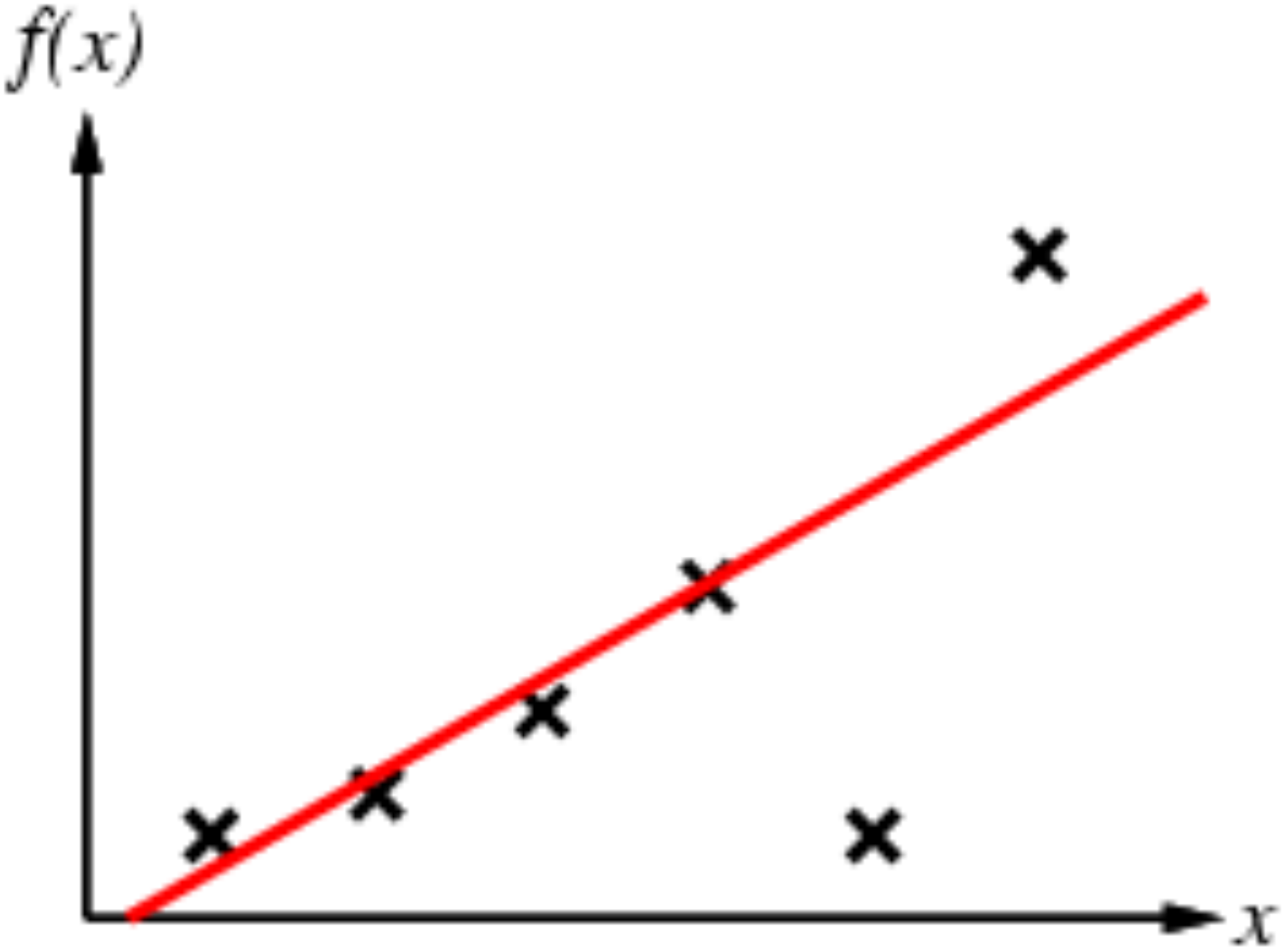
Inductive Learning

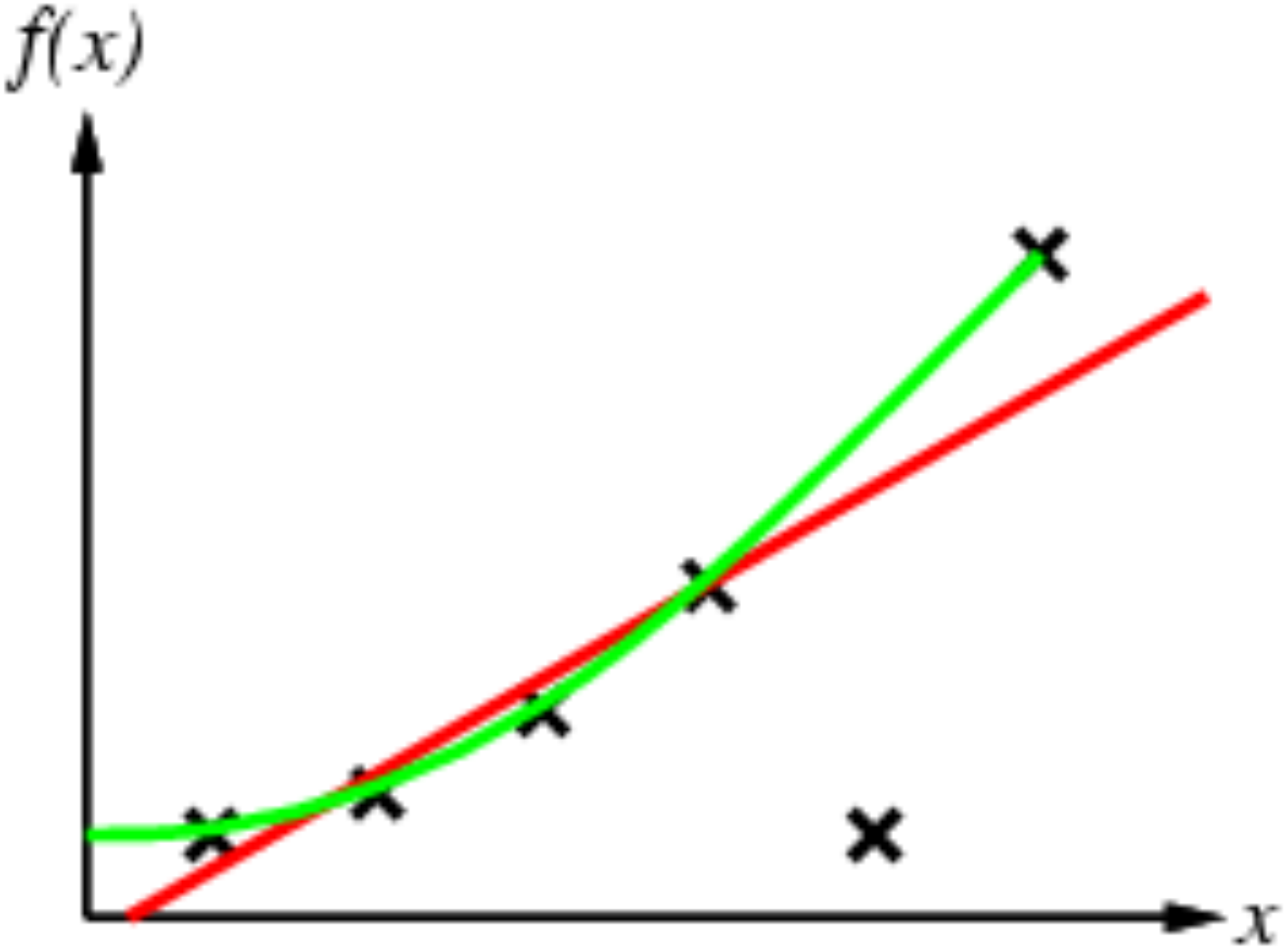
Learn a function from examples

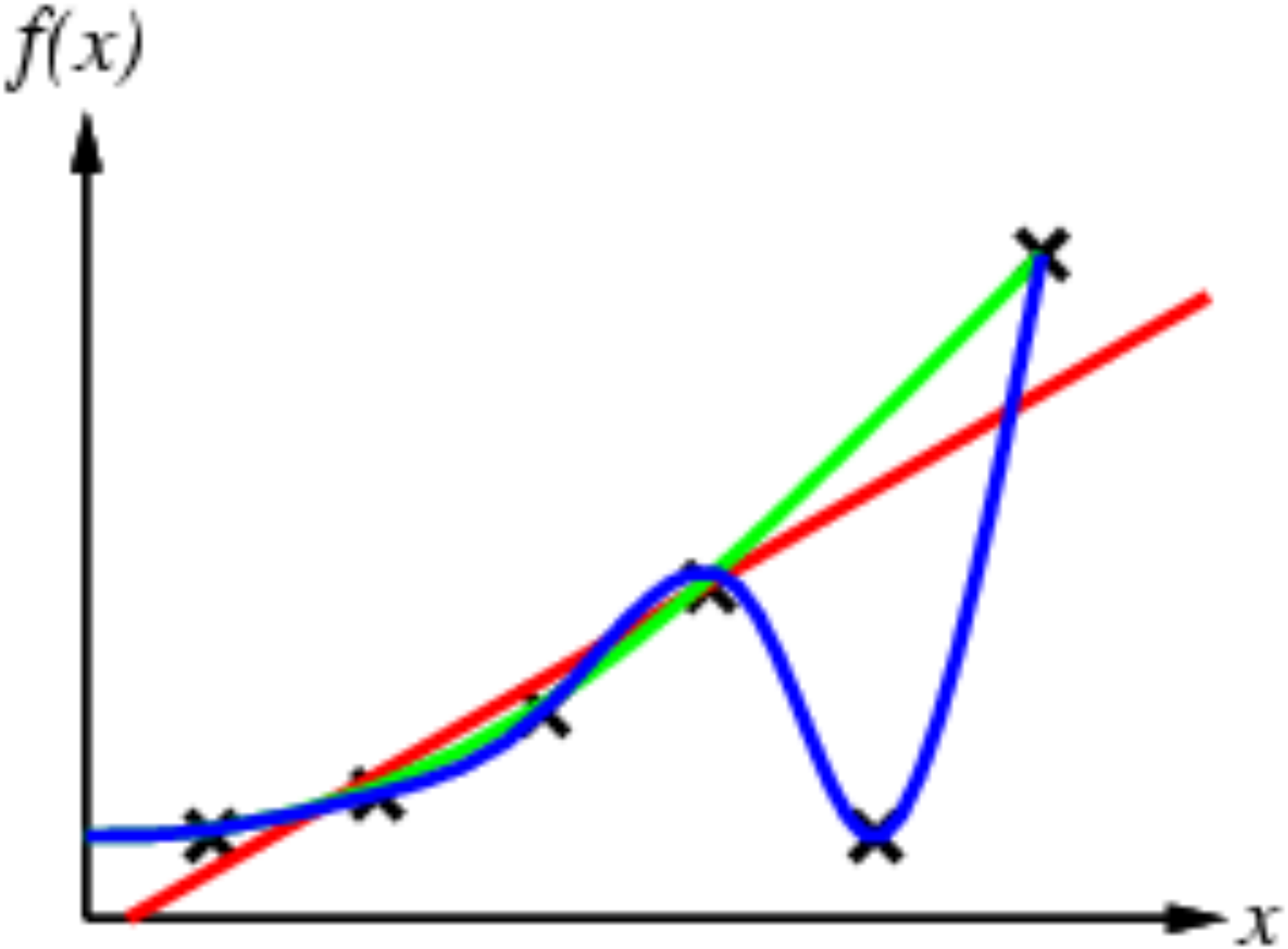
- `f` is the target function
- An example is a pair `<x, f(x)>`
- Problem: find a hypothesis h
  - such that h ≈ f, given a training set of examples

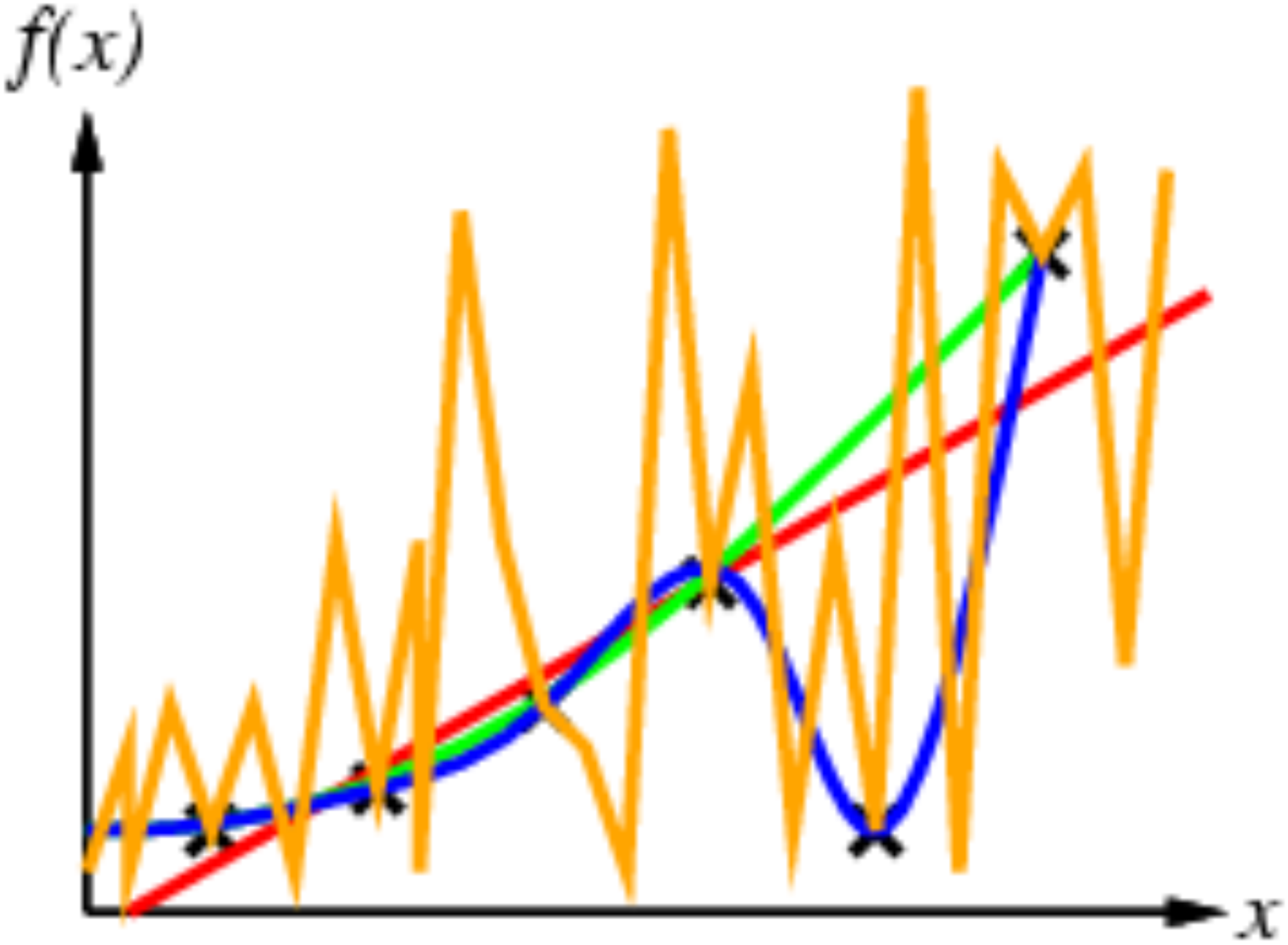

f(x)
x


f(x)
x


f(x)
x


f(x)
x


f(x)
x


f(x)
x

x is usually <X>

That is, instead of learning from a single variable, we learn a function that is dependent on many inputs, or a vector.

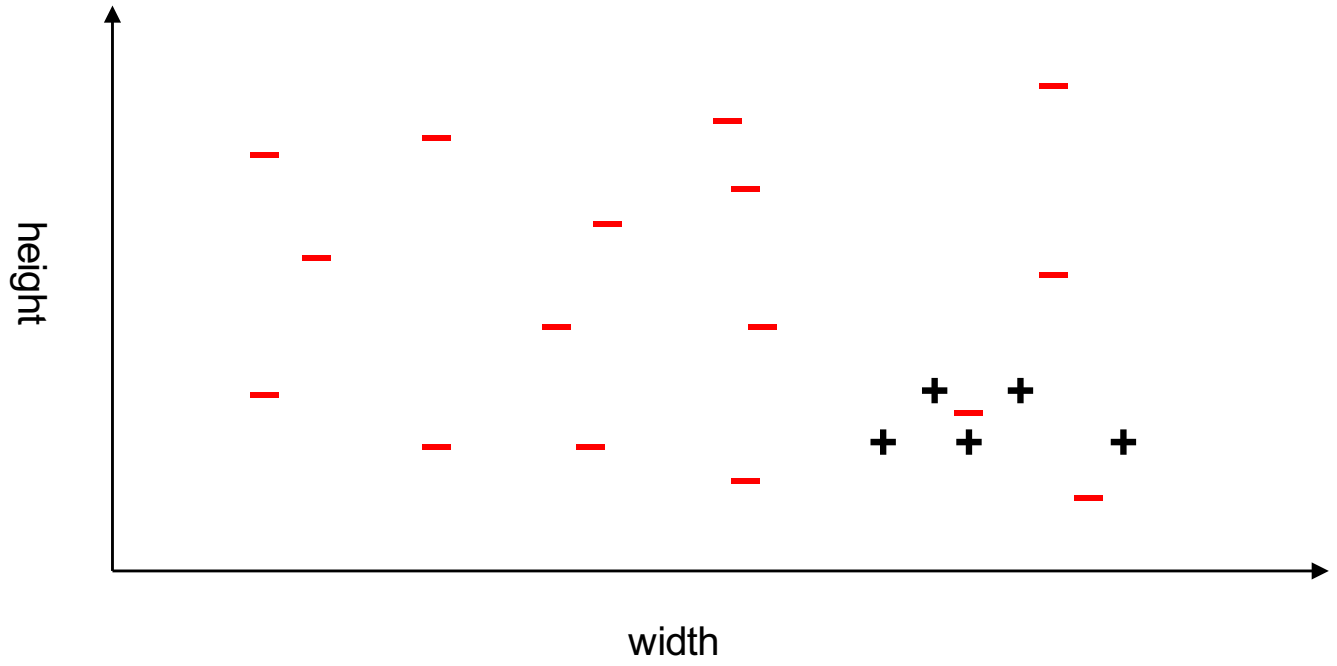
Multiple, numeric inputs

Text, treated as words, then mapped to numbers

An application: Ad blocking

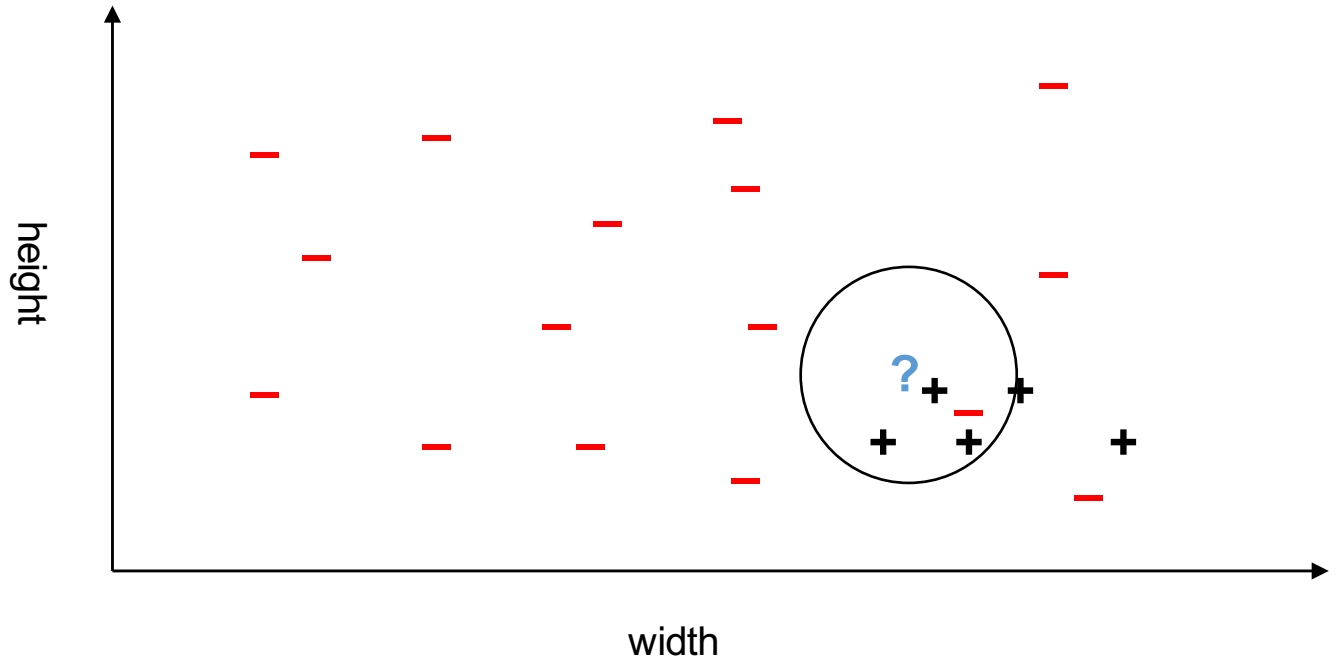
Learning Ad Blocking

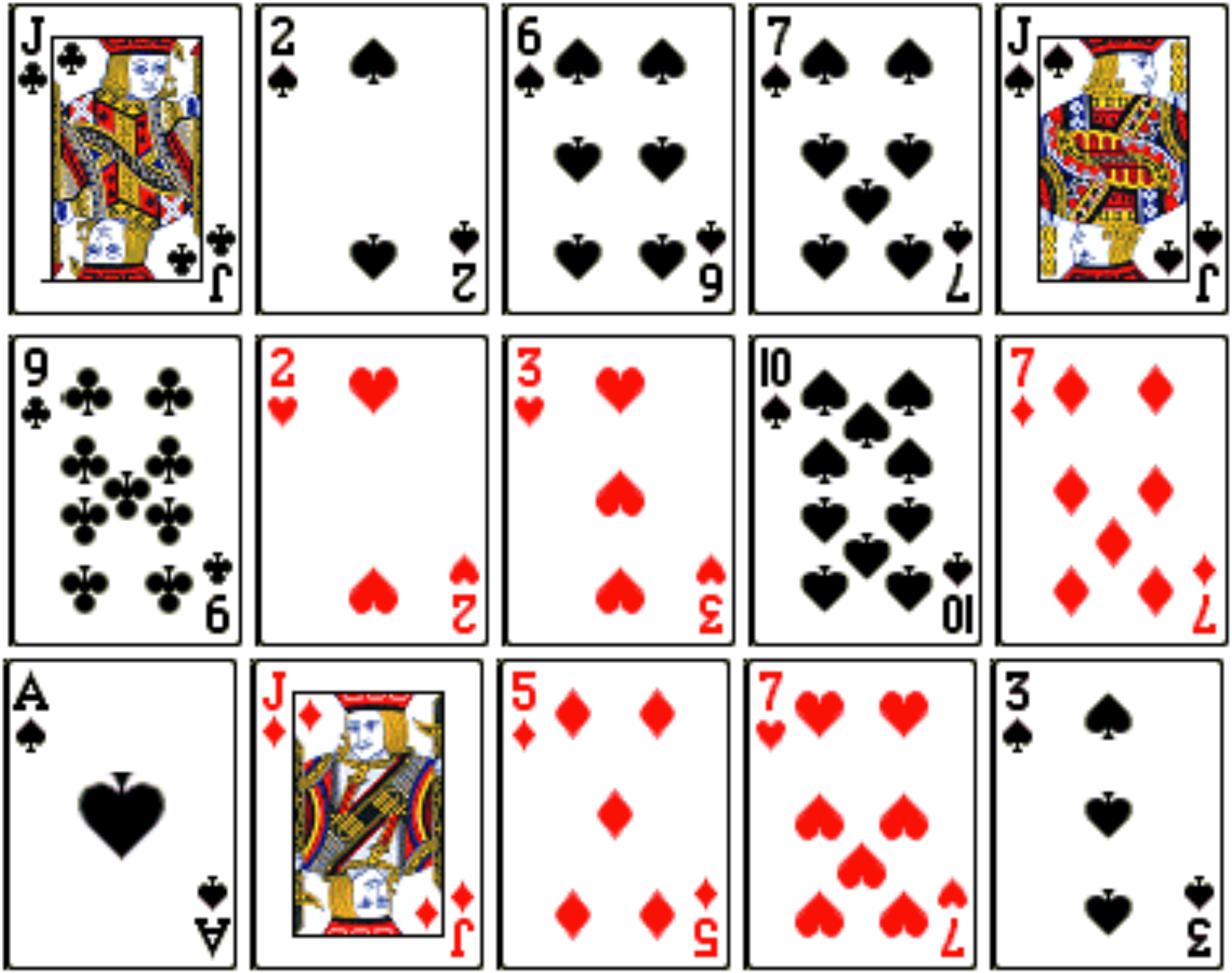
- Features <x>: Width and height of image
- Binary Classification y: ad or not_ad?



(k) Nearest Neighbors

- Pick nearest neighbor, and associate the new example with its neighbors' class
- Generalized to *k* nearest neighbors

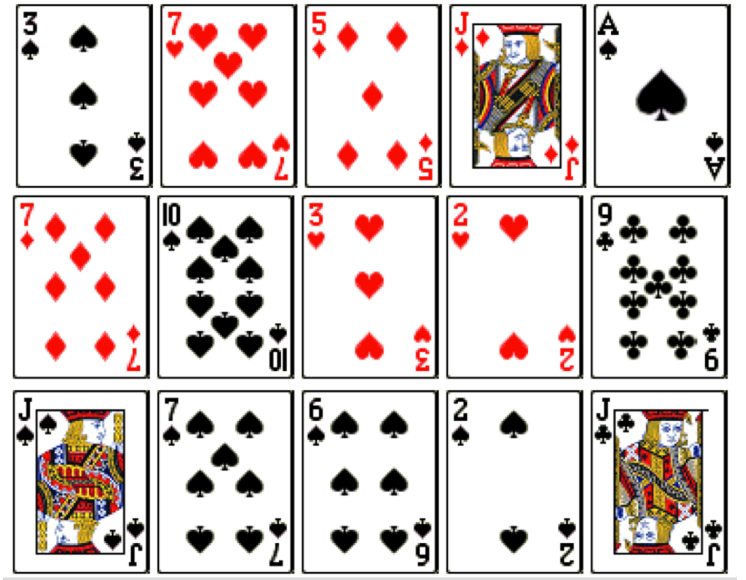




Twenty Questions

- Idea: pick a good attribute.

  Good means it splits the training set into subsets that are (ideally) "all positive" or "all negative"



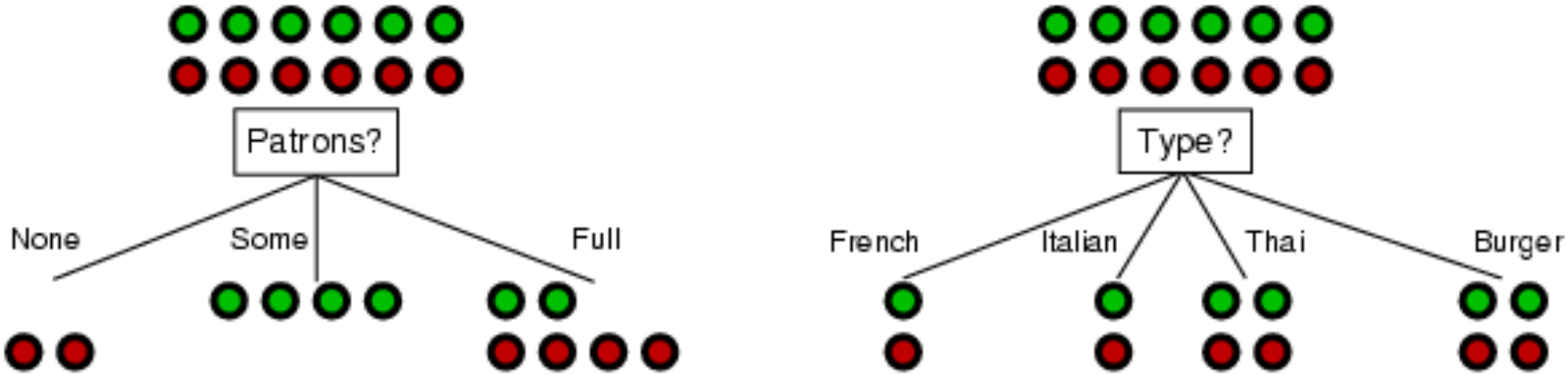
You try:

For the hidden function “Black Jacks”, which question (attribute) is better?

- Are the correct cards red?
- Are the correct cards in the first row?

Decision Trees

- This is the basis for Decision Trees: one of the easiest to explain algorithms for learning
- Split a dataset by a variable and factor the task into a set of smaller problems
- The smaller problems stop being problems when the class is pure. E.g., for a "eating out" problem:



y is often Y, too

That is, instead of a binary output, many tasks may be better cast as a multiclass classification problem.

Some classifiers do this by making *n* binary classifiers, and choosing the class that has the highest confidence:
{CS, IS, InfoSec, CompBio, CompEng, BZA}

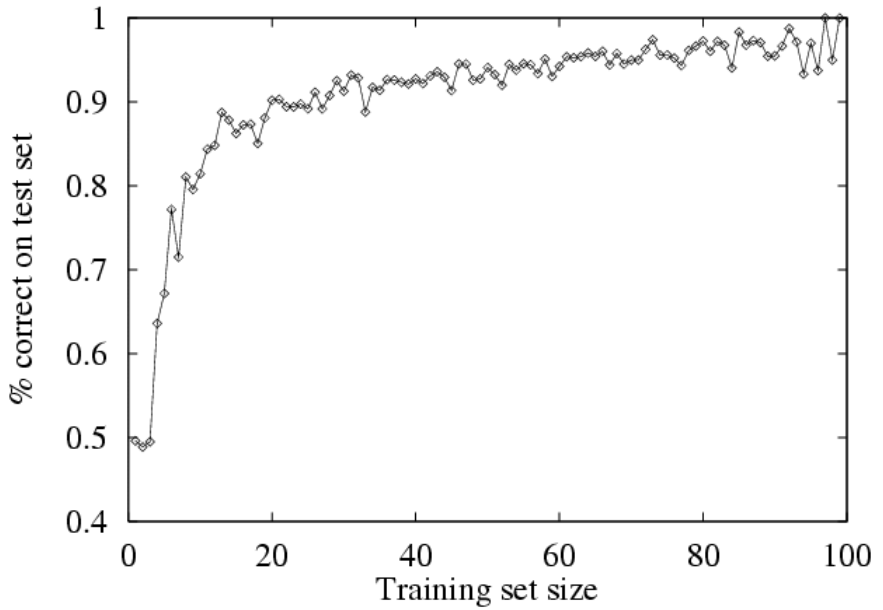
They can also be multi-label ("Select all that apply"):
{Monday, Tuesday, Wednesday, Thursday, Friday}

Performance measurement

How do we know that $h \approx f$?

Try h on a new **test set** of examples

Learning curve = % correct on test set as a function of training set size



Training and testing sets

Where does the test set come from?

1. Collect a large set of examples
2. Divide it into **training** and **testing data**
3. Train on training data, assess on testing
4. Repeat 1-3 for different splits of the set = *k* fold cross validation