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Machine Learning

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Lesson 2.1

Introduction of Supervised Learning

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- What is supervised learning
- Types of supervised learning
- When to use supervised learning

What is Supervised Learning

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- Supervised learning is the most mature, the most studied and the type of learning used by most machine learning algorithms.
- Learning with supervision is much easier than learning without supervision.
- Training data includes desired outputs.
- **Supervised learning** is also called inductive learning.

What is Supervised Learning

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- We are given input samples (x) and output samples f(x) and the problem is to estimate the function f.
- Specifically, the problem is to generalize from the samples and the mapping to be useful to estimate the output for new samples in the future.
- In practice it is almost always too hard to estimate the function, so we are looking for very good approximations of the function.

Example

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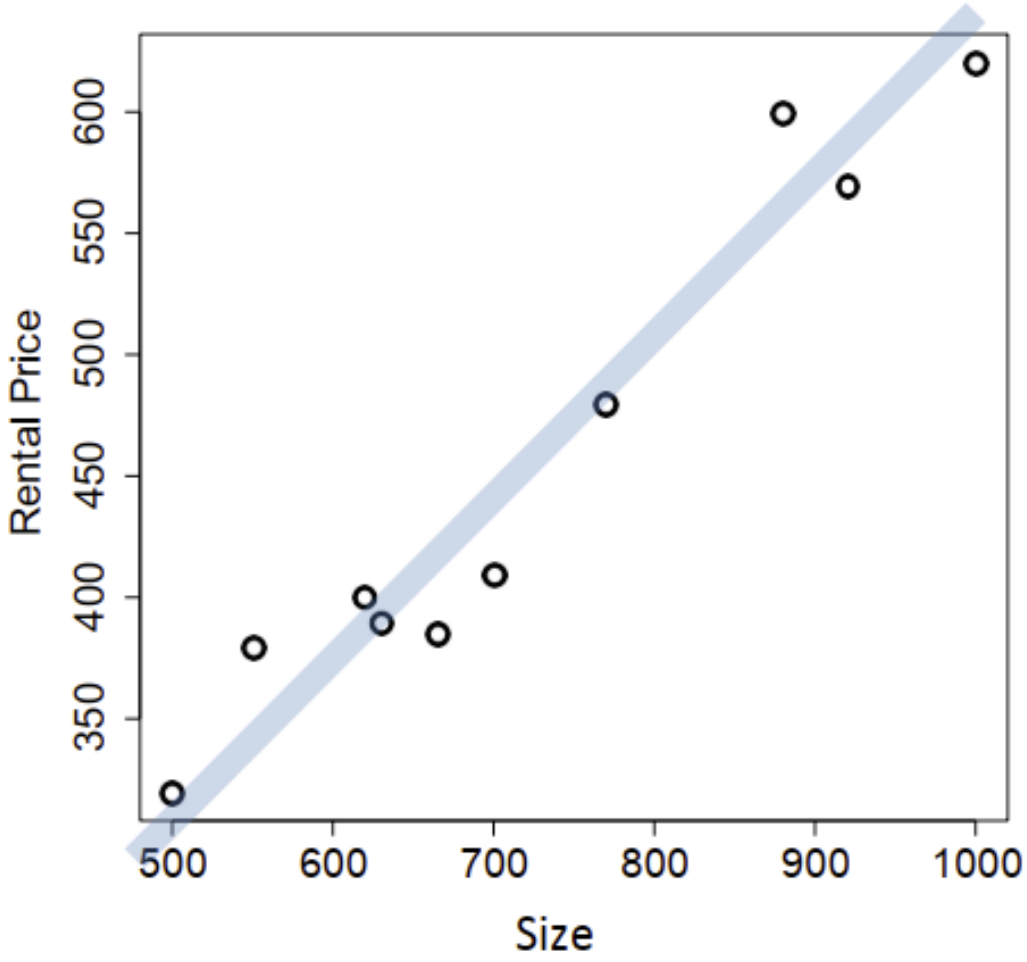
- What is x?
- What is y?
- What is f?



A scatter plot of the SIZE and RENTAL PRICE features from the office rentals dataset.

ID	SIZE	RENTAL PRICE
1	500	320
2	550	380
3	620	400
4	630	390
5	665	385
6	700	410
7	770	480
8	880	600
9	920	570
10	1,000	620

Supervised Learning: Types

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- **Classification**: when the function being learned is discrete.
- **Regression**: when the function being learned is continuous.
- **Probability Estimation**: when the output of the function is a probability

Supervised Learning: Regression

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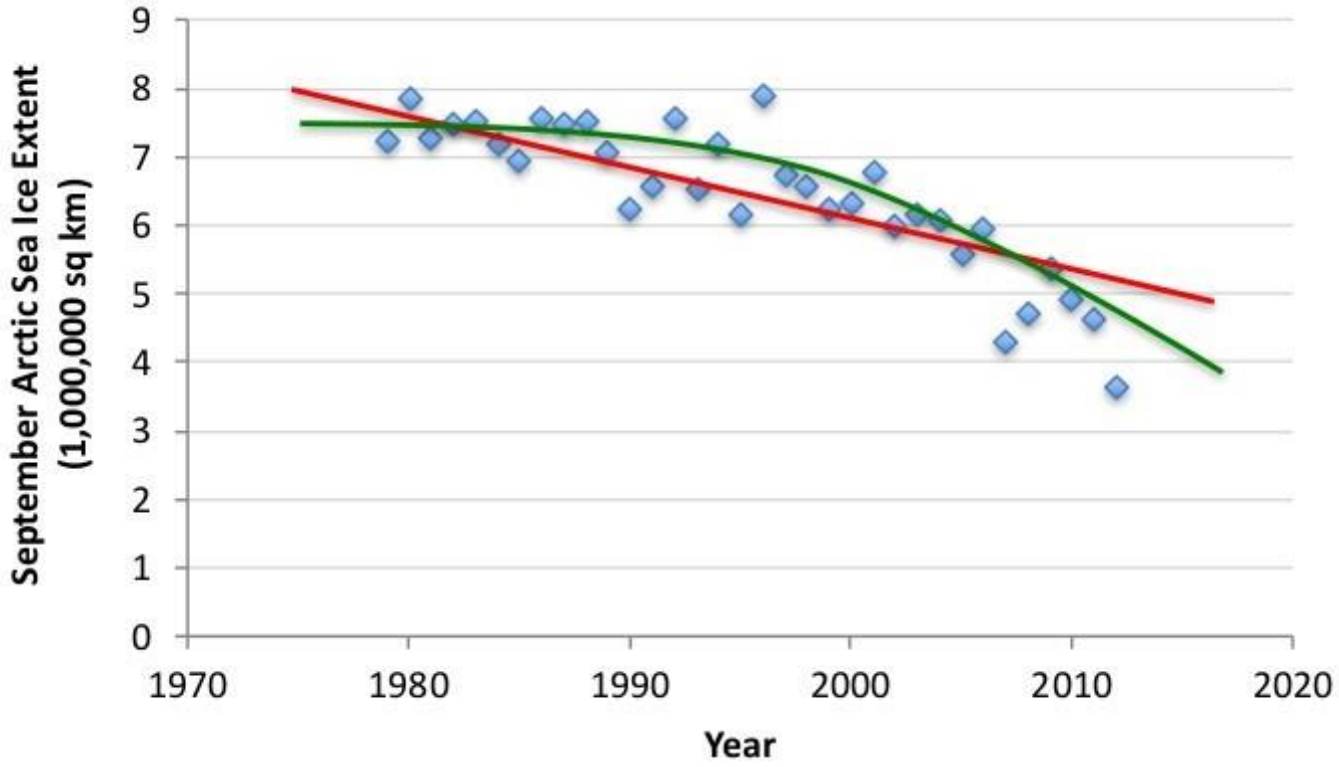
- Given $(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)$
- Learn a function $f(x)$ to predict y given x
  - y is real-valued == regression



Supervised Learning: Classification

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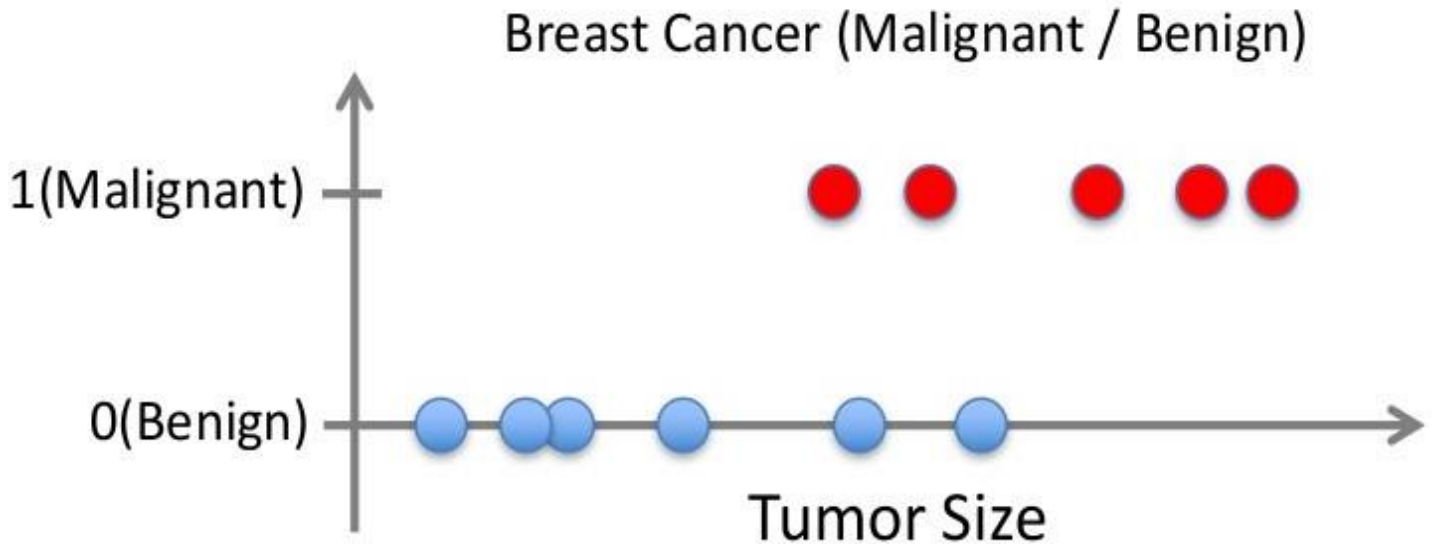
- Given $(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)$
- Learn a function $f(x)$ to predict y given x
  - y is categorical == classification



Examples of Supervised Learning

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- **Credit risk assessment**.
  - The x is the properties of the customer.
  - The f(x) is credit approved or not.

- **Disease diagnosis**.
  - The x are the properties of the patient.
  - The f(x) is the disease they suffer from.

Classification or regression?

Examples of Supervised Learning

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- **Face recognition**.
  - The x are bitmaps of people's faces.
  - The f(x) is to assign a name to the face.

- **Automatic steering**.
  - The x are bitmap images from a camera in front of the car.
  - The f(x) is the degree the steering wheel should be turned.

Classification or regression?

When to use Supervised Learning

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It is important when to use and when not to use supervised machine learning.

- **Problems where there is no human expert**. If people do not know the answer they cannot write a program to solve it. These are areas of true discovery.

- **Humans can perform the task but no one can describe how to do it**. There are problems where humans can do things that computer cannot do or do well. Examples include riding a bike or driving a car.

When to use Supervised Learning

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- **Problems where the desired function changes frequently**. Humans could describe it and they could write a program to do it, but the problem changes too often. It is not cost effective. Examples include the stock market.

- **Problems where each user needs a custom function**. It is not cost effective to write a custom program for each user. Example is recommendations of movies or books on Netflix or Amazon.