Introduction to Machine learning

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Artificial Inteligence
& Computer Vision
Laboratory

Today

- Machine learning definition
- Taxonomy of machine learning

What is machine learning?

Definition of Machine Learning

- How can we solve a specific problem?
  - ➢ As computer scientists we write a program that encodes a set of rules that are useful to solve problem
  - ➢ In many cases is very difficult to specify those rules, e.g., given a picture determine whether there is a cat in the image

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- Learning systems are not directly(explicitly) programmed to solve a problem, instead develop own program based on:
  - Examples of how they should behave
  - From trial-and-error experience trying to solve the problem

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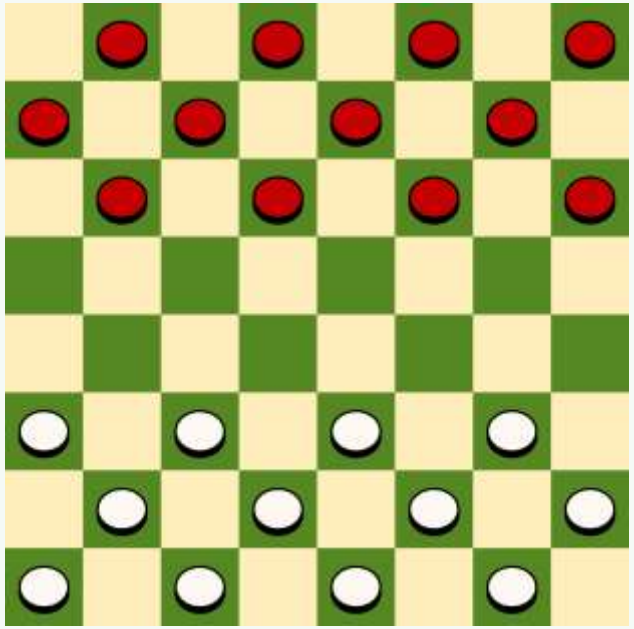
  - Examples of how they should behave
  - From trial-and-error experience trying to solve the problem
- Learning simply means incorporating information from the training examples into the system

Definition of Machine Learning

- Arthur Samuel (1959): Machine Learning is the field of study that gives the computer the ability to learn without being explicitly programmed.

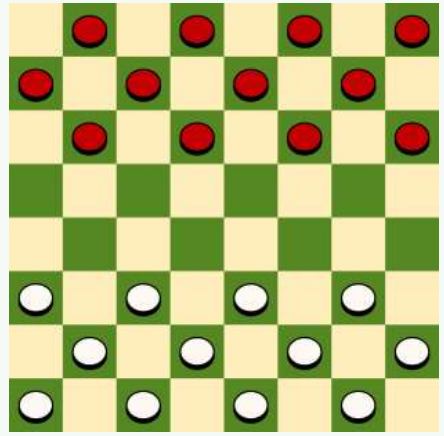


Definition of Machine Learning

- Tom Mitchell (1998): a computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E.

Experience (data): games played by the program (with itself)

Performance measure: winning rate



Tasks that requires ML

- What makes a 2?
- What distinguishes a 2 from a 7?

Tasks that requires ML

- How can we make a robot cook?

Learning algorithms are useful in many tasks

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- Machine learning grew out of work in AI
- New capability for computers
- Examples:
  - ➢Data mining
    Large datasets from growth of automation/web
    E.g., Web click data, medical records, biology, engineering
  - ➢Application can't program by hand
    E.g., Autonomous helicopter, handwriting recognition, most of Natural Language Processing (NLP), Computer Vision
  - ➢Self-customizing programs
    E.g., Amazon, Netflix product recommendations
  - ➢Understanding human learning (brain, real AI)

Taxonomy of Machine Learning
(A Simplistic View Based on Tasks)

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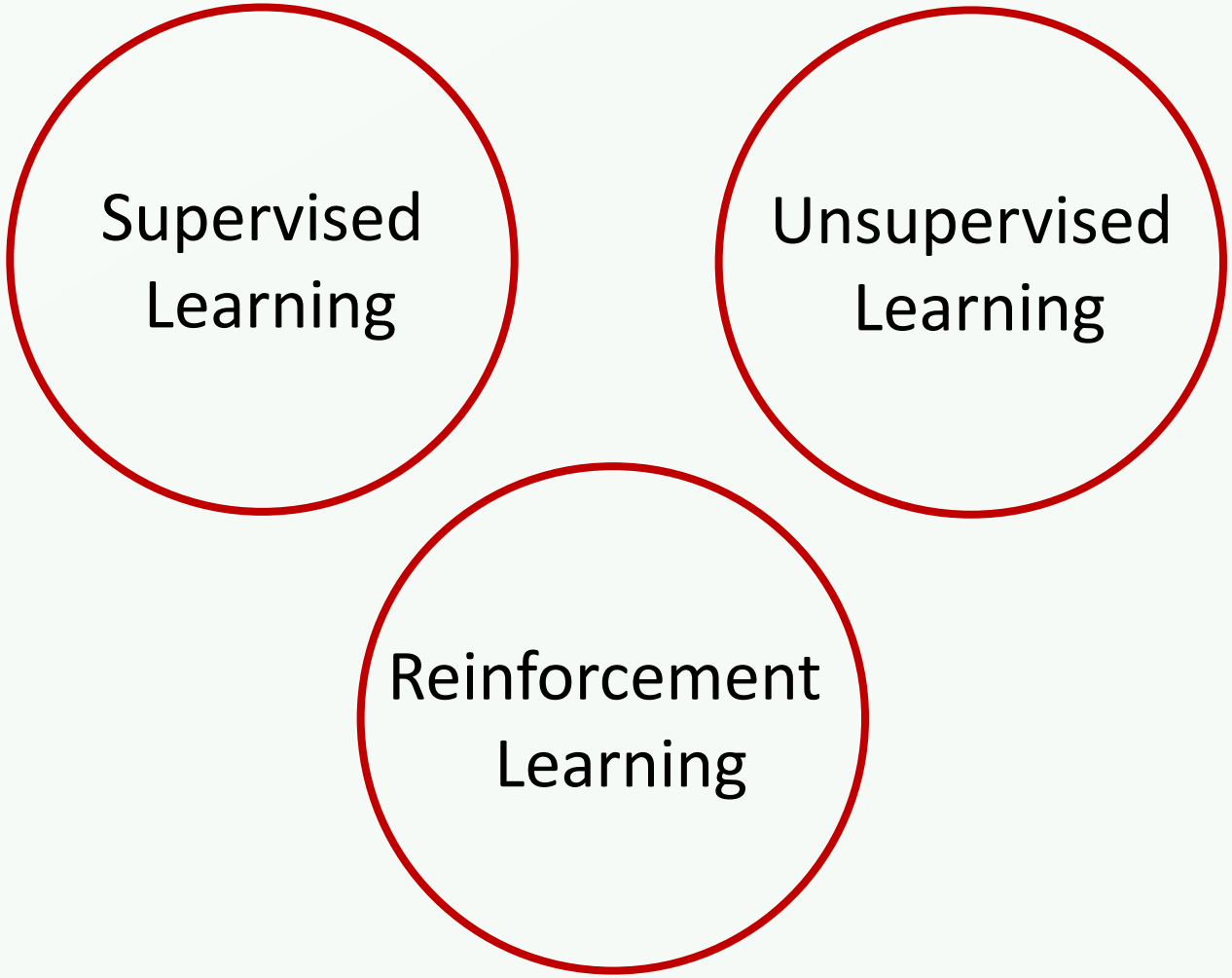
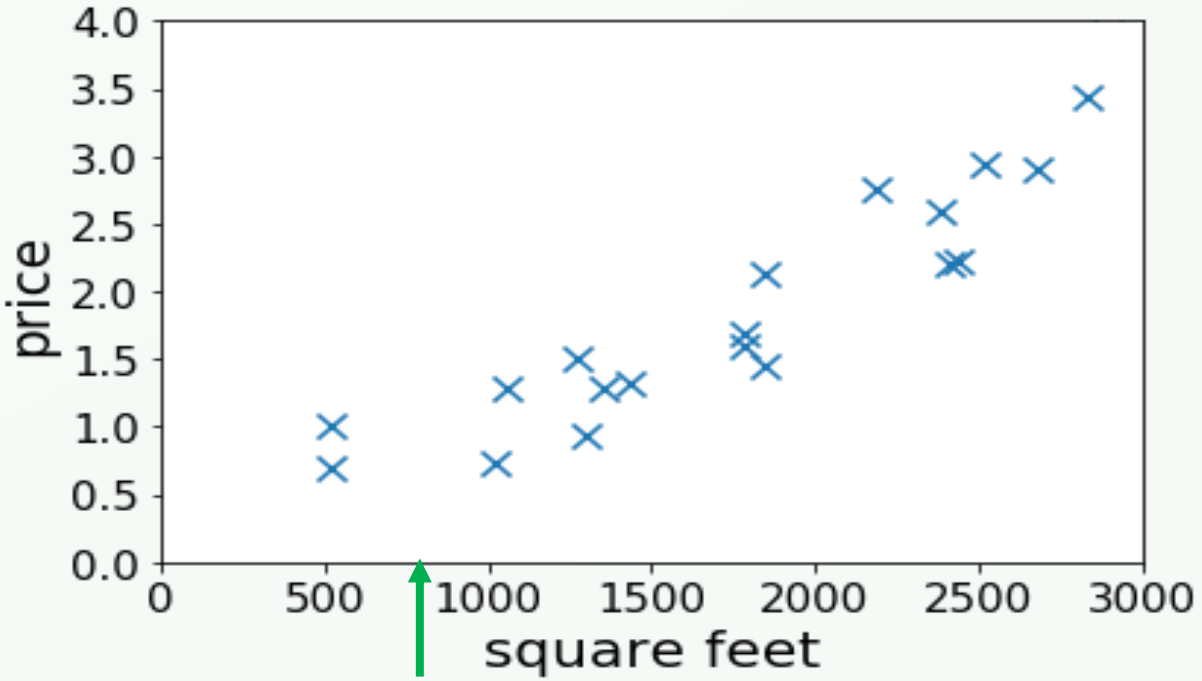


Supervised Learning

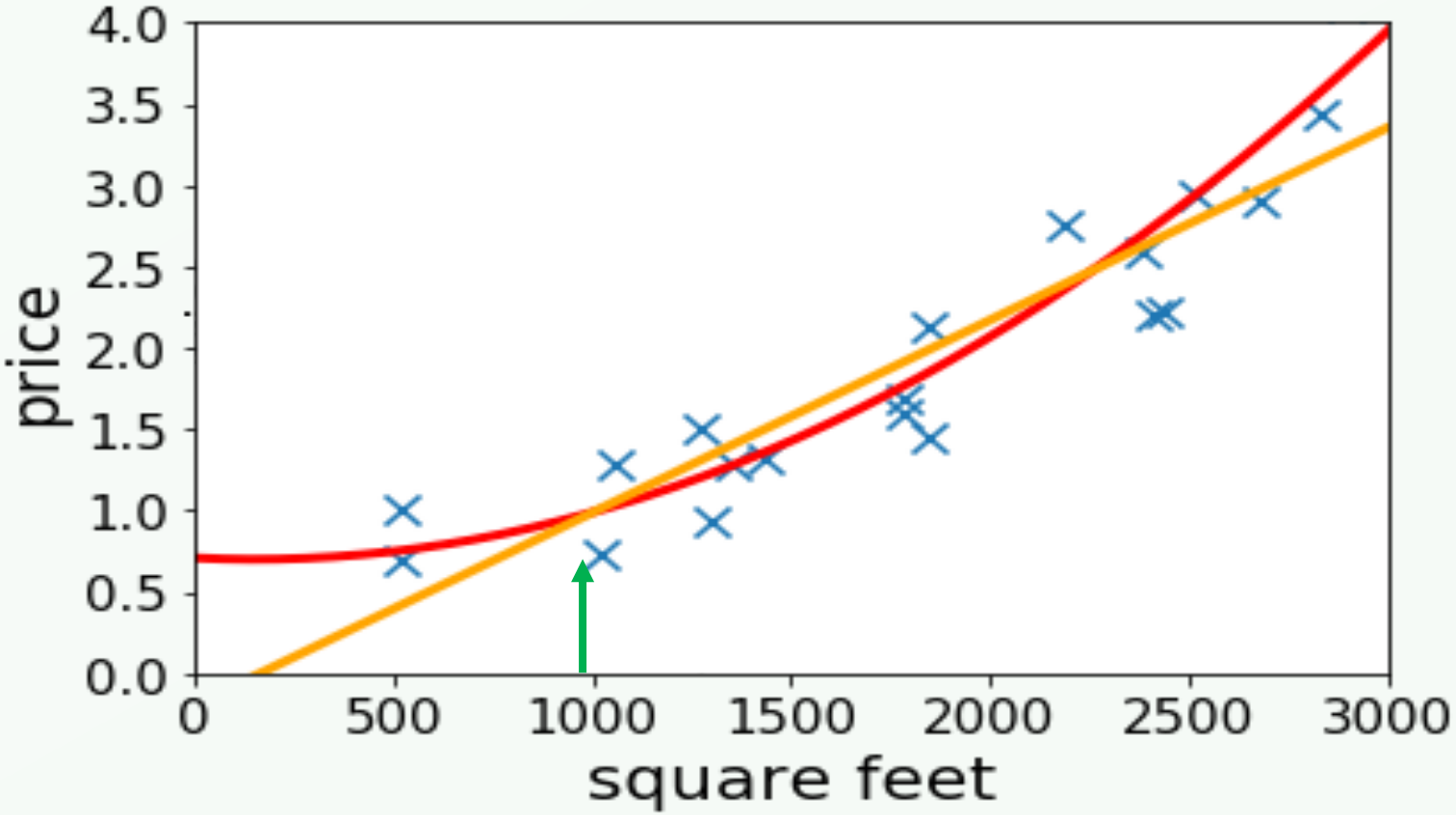
Housing Price Prediction



- Supervised Learning
  : “right answers” given
- Regression
  : Predict continuous valued output (price)

Housing Price Prediction

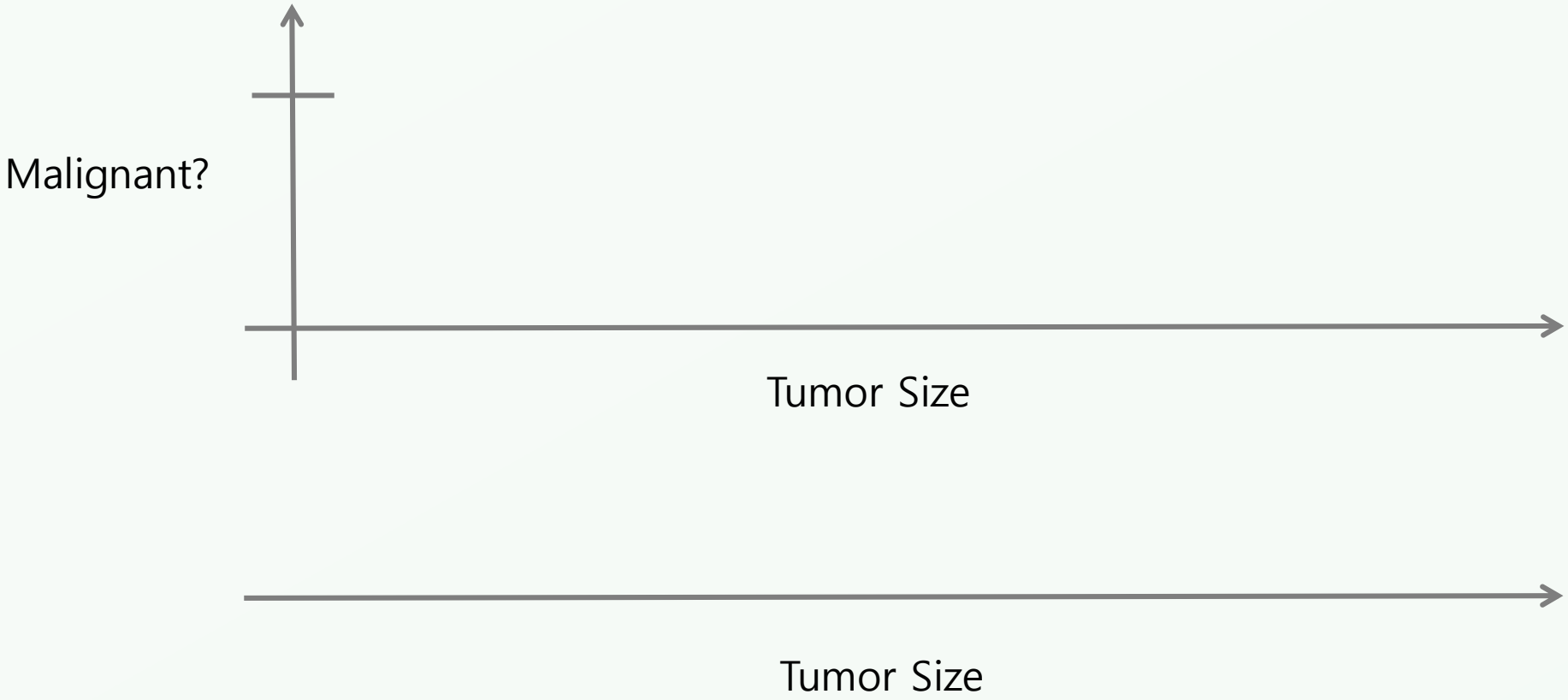
- Task: if a residence has x square feet, predict its price?



- Lecture 2&3: fitting linear/quadratic functions to the dataset

Breast cancer (malignant, benign)

- Classification: Discrete valued output (0 or 1)



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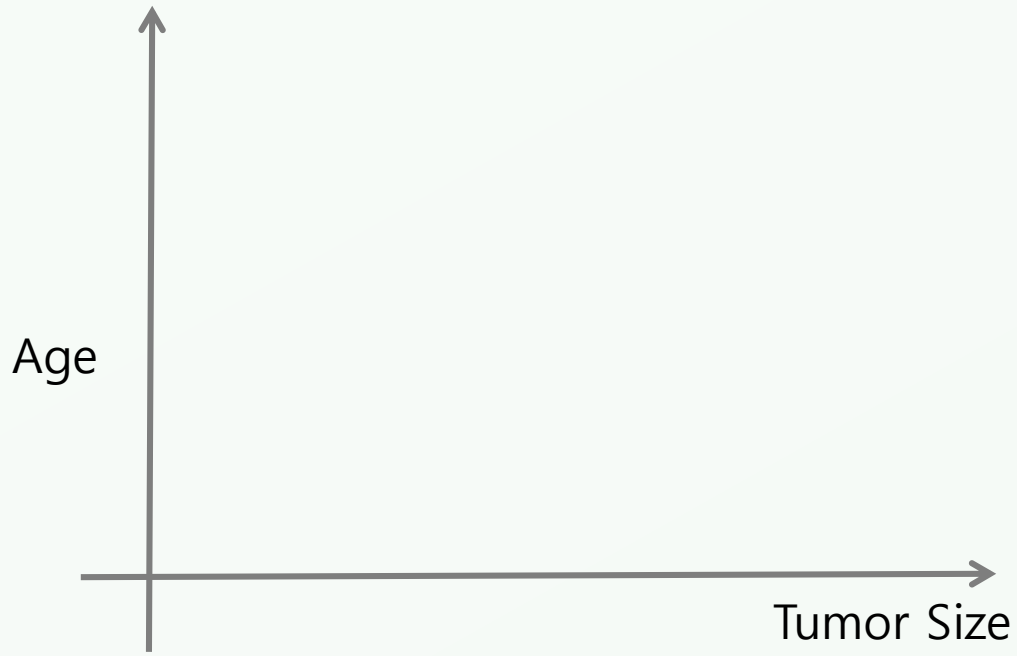


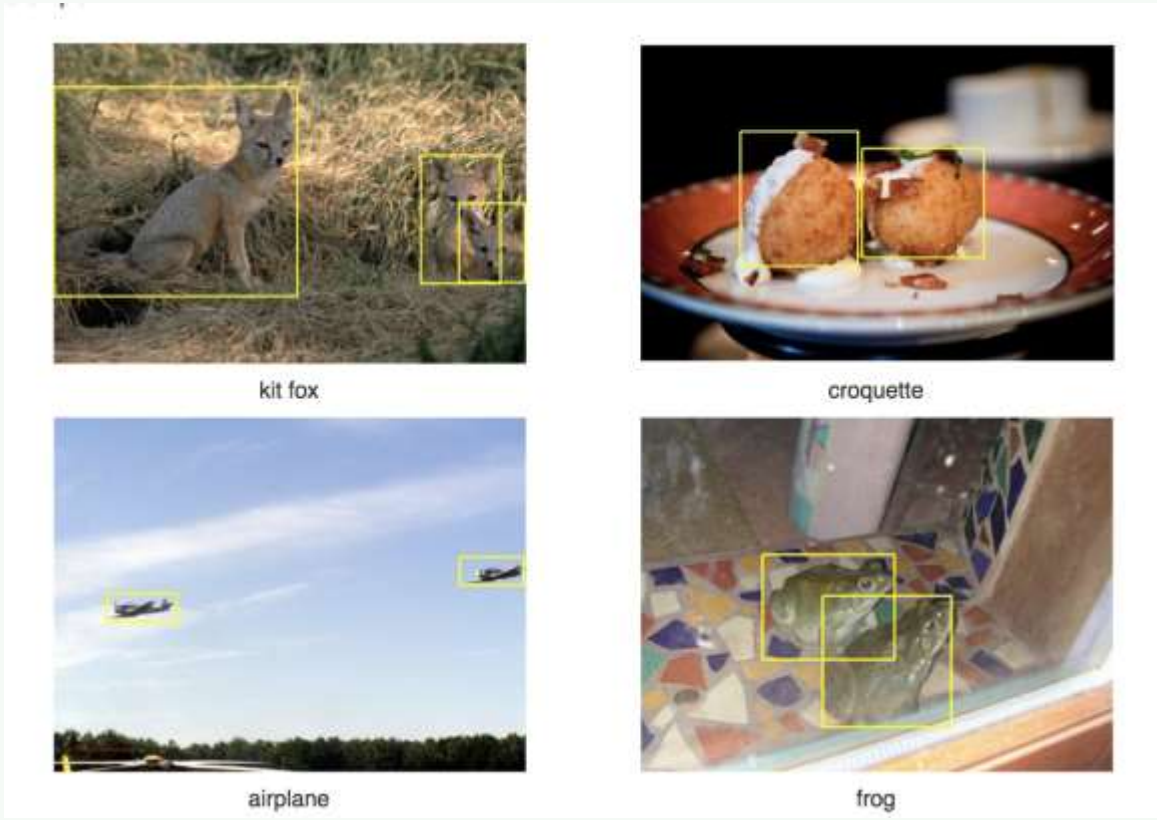
- More features
  - Clump Thickness
  - Uniformity of cell size
  - Uniformity of cell shape

Supervised Learning in Computer Vision

- Image Classification
  - X = raw pixels of the image
  - Y = the main object

Supervised Learning in Computer Vision

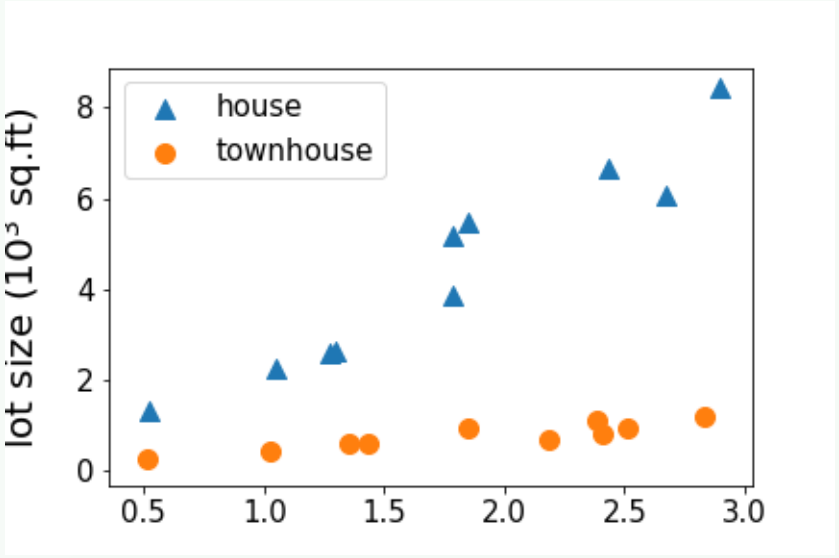
- Object localization and detection
  - X = raw pixels of the image
  - Y = the bounding boxes



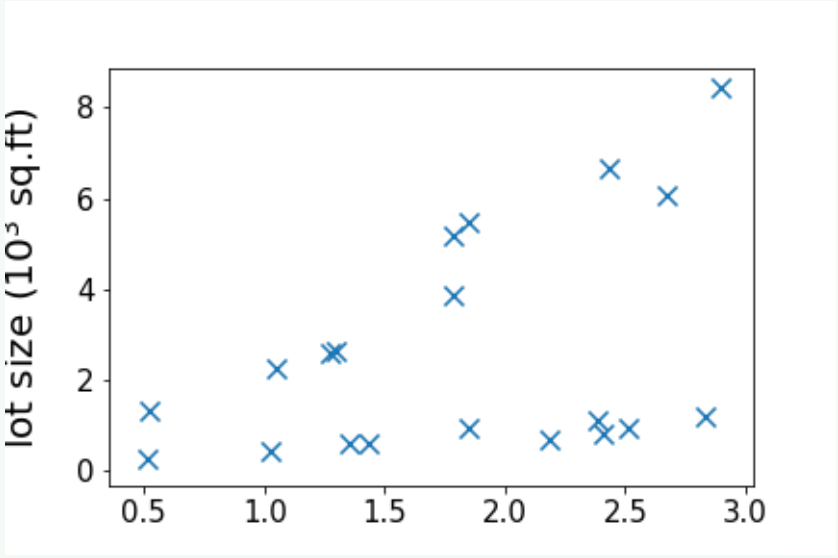
Unsupervised Learning

Unsupervised Learning

- Dataset contains no labels
- Goal (vaguely-posed): to find interesting structures in the data



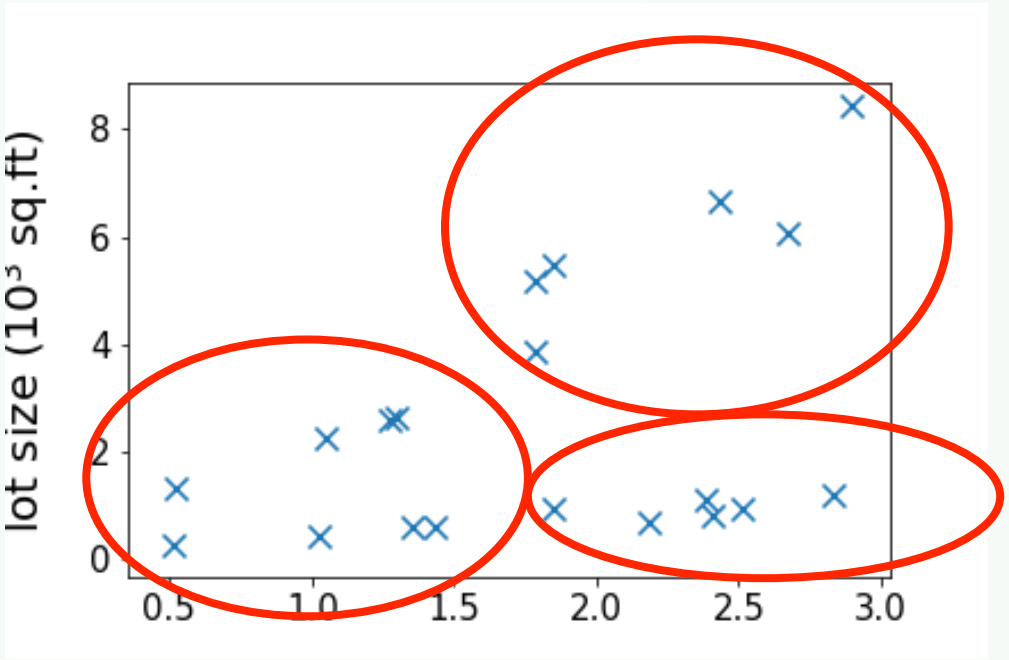
supervised

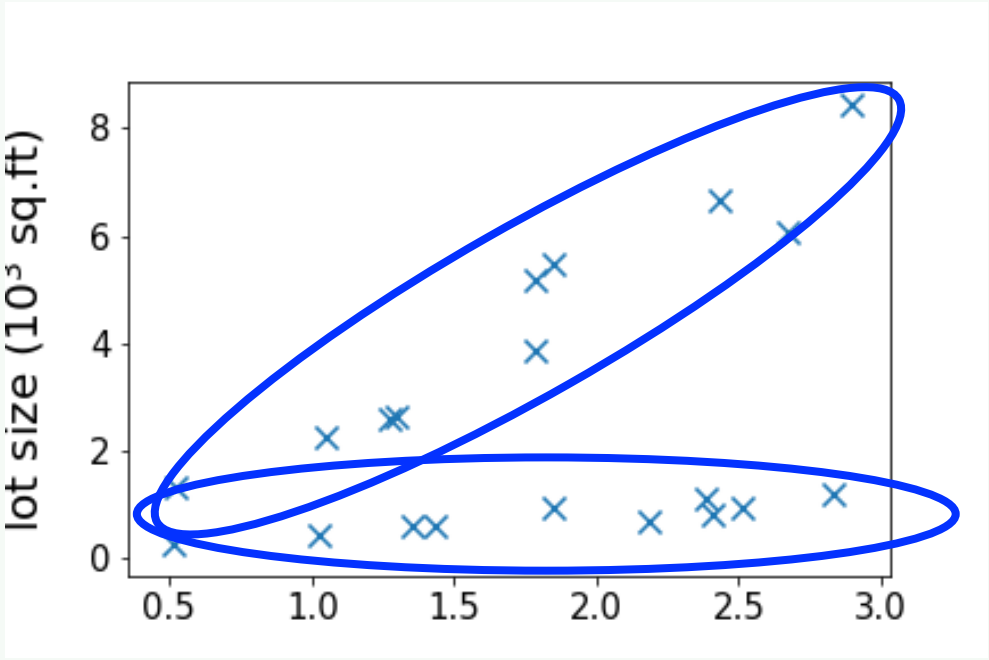


unsupervised

Unsupervised Learning

- Clustering

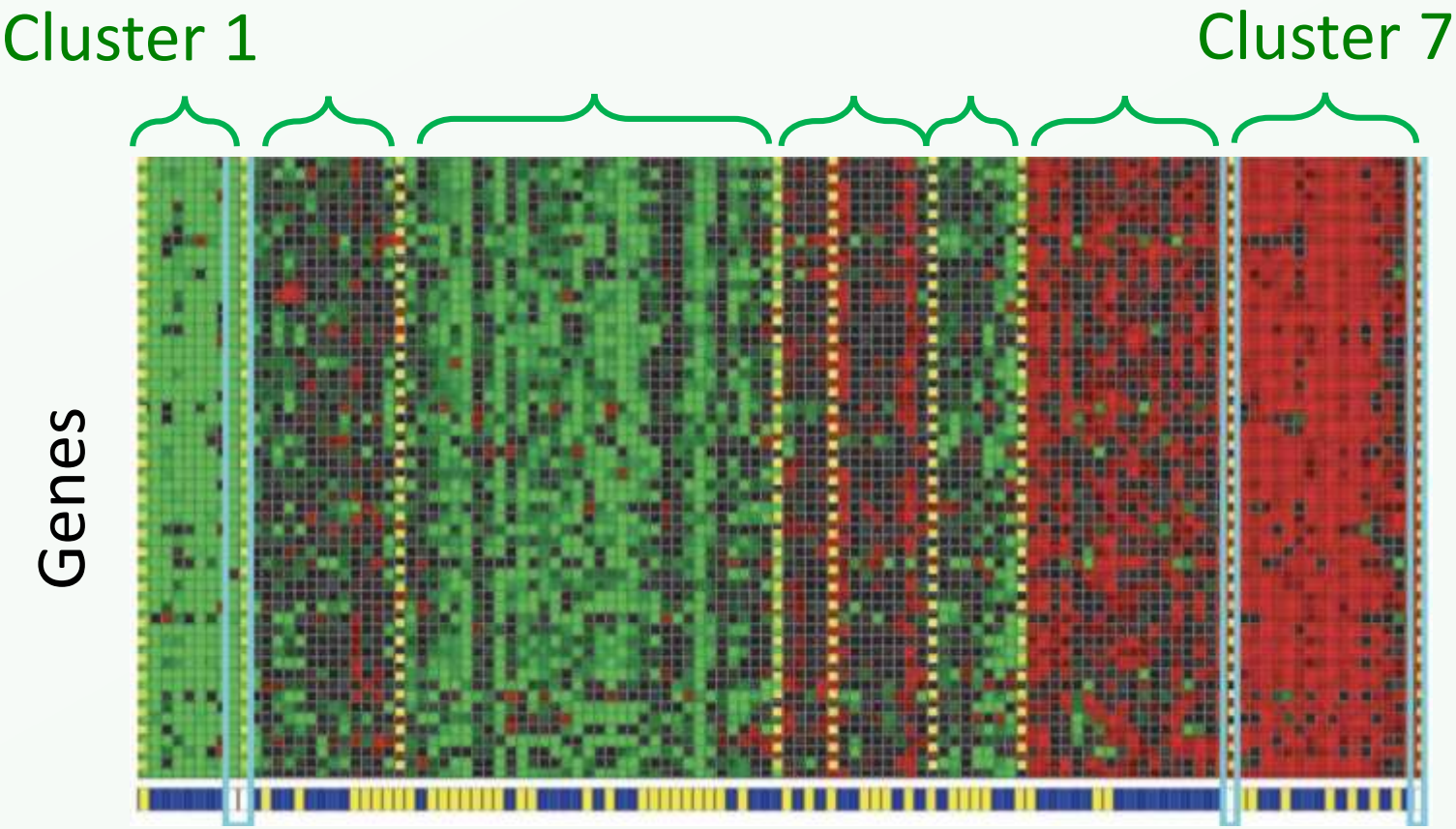




➢ Lecture 12&13: k-mean clustering, mixture of Gaussians

Unsupervised Learning

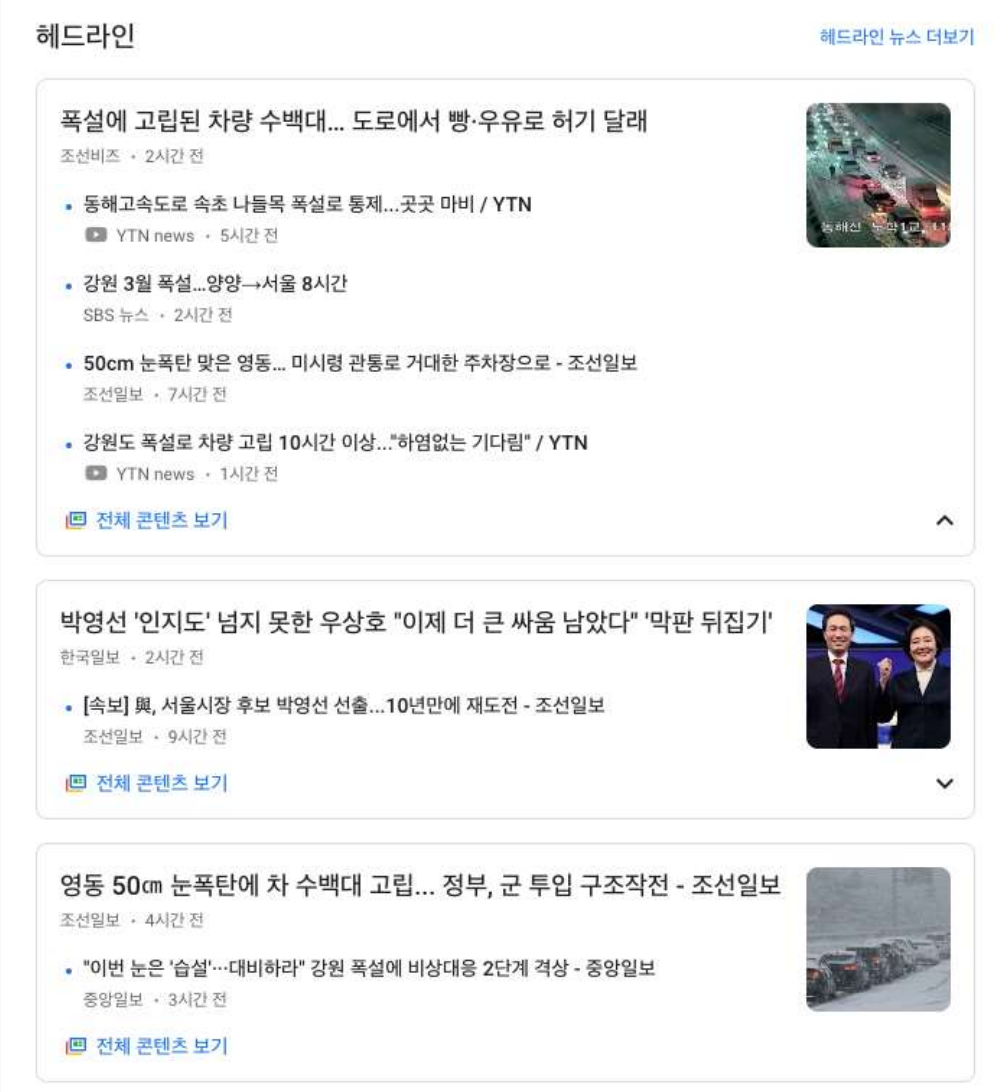
- Clustering genes



Identifying Regulatory Mechanisms using Individual Variation Reveals Key Role for Chromatin Modification. [Su-In Lee, Dana Pe'er, Aimee M. Dudley, George M. Church and Daphne Koller. '06]

Unsupervised Learning

- Clustering



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