
Introduction to Machine learning

Eun Yi Kim



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L a b o r a t o r y



Today



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- Machine learning definition
- Taxonomy of machine learning



What is machine learning?



Definition of Machine Learning



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- 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



Definition of Machine Learning



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 - In many cases is very difficult to specify those rules, e.g., handwritten characters
- 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



Definition of Machine Learning



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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
- Learning simply means incorporating information from the training examples into the system

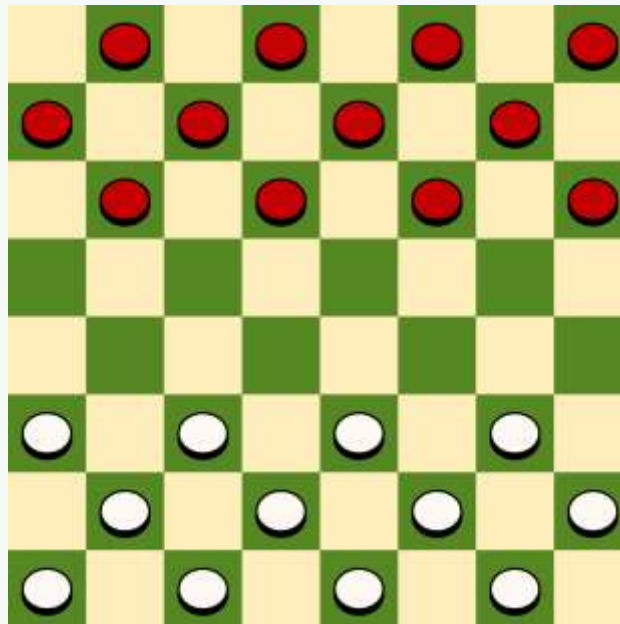
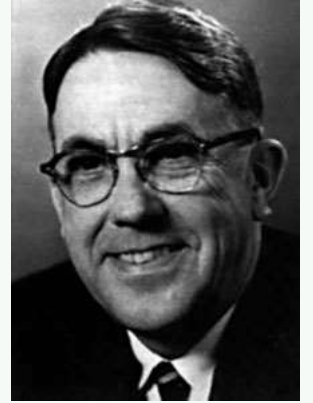


Definition of Machine Learning



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- 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



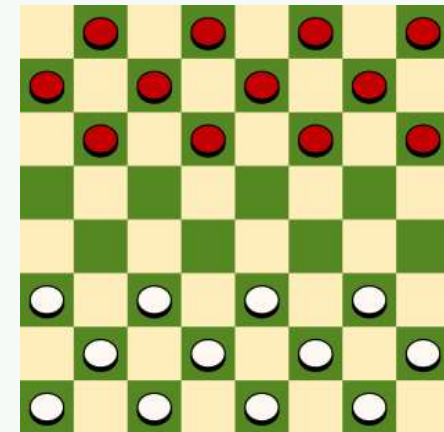
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- Tom Mitchell (1998): a computer program is said to learn from experience E with respect to some class of tasks T and performance measure P , if its performance at tasks in T , as measured by P , improves with experience E .



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

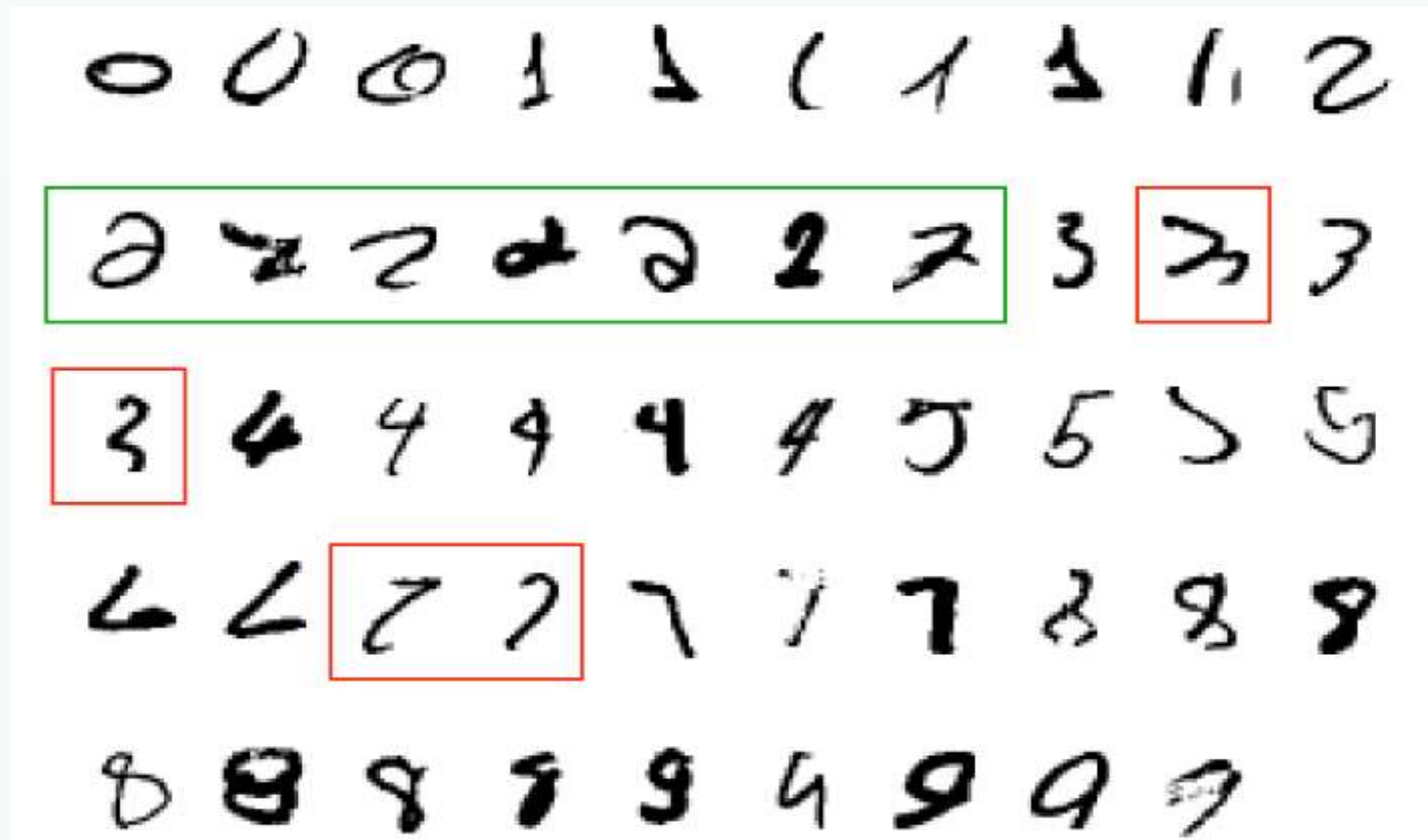
Performance measure: winning rate



Tasks that requires ML



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



Tasks that requires ML



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- 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)

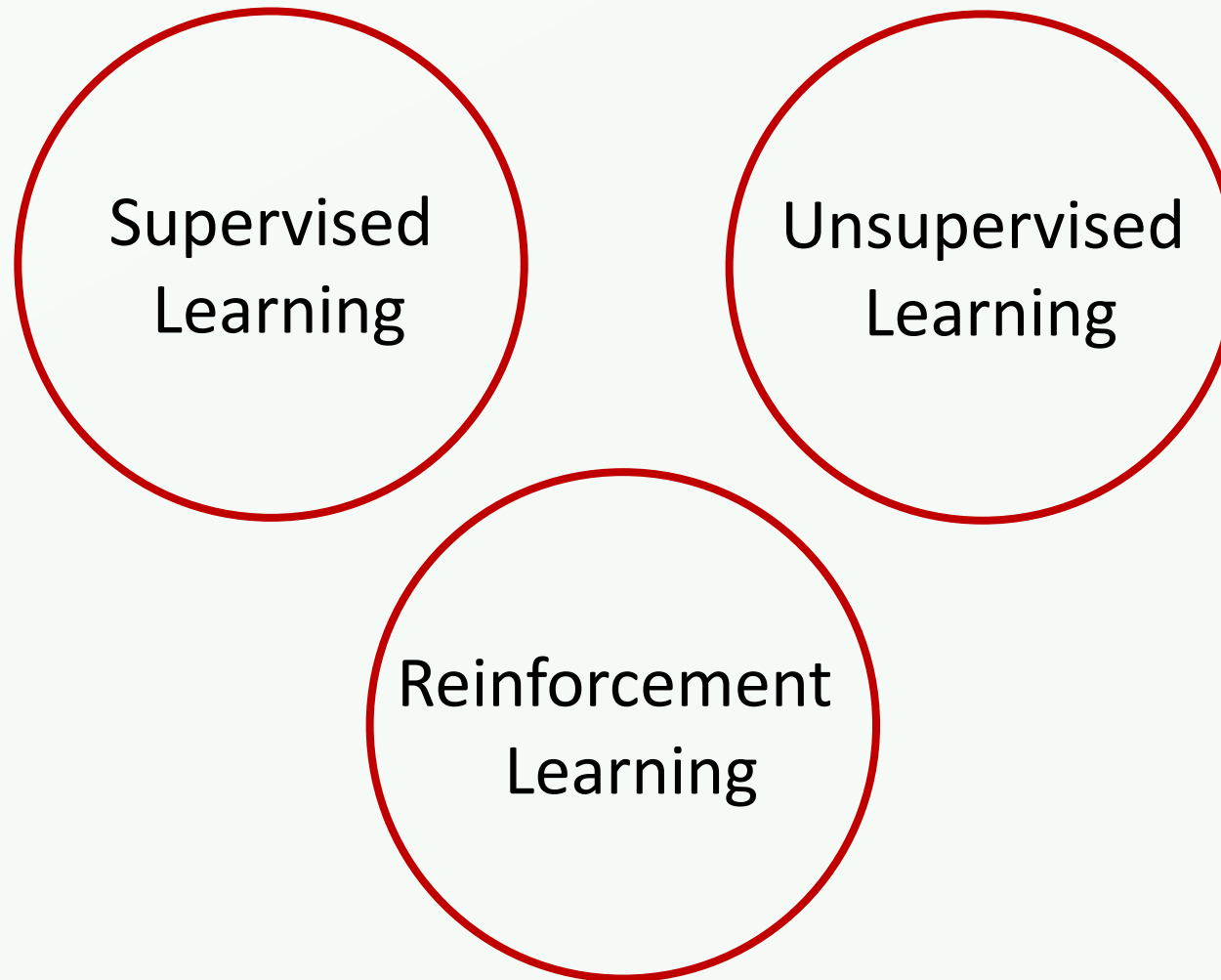


Taxonomy of Machine Learning

(A Simplistic View Based on Tasks)



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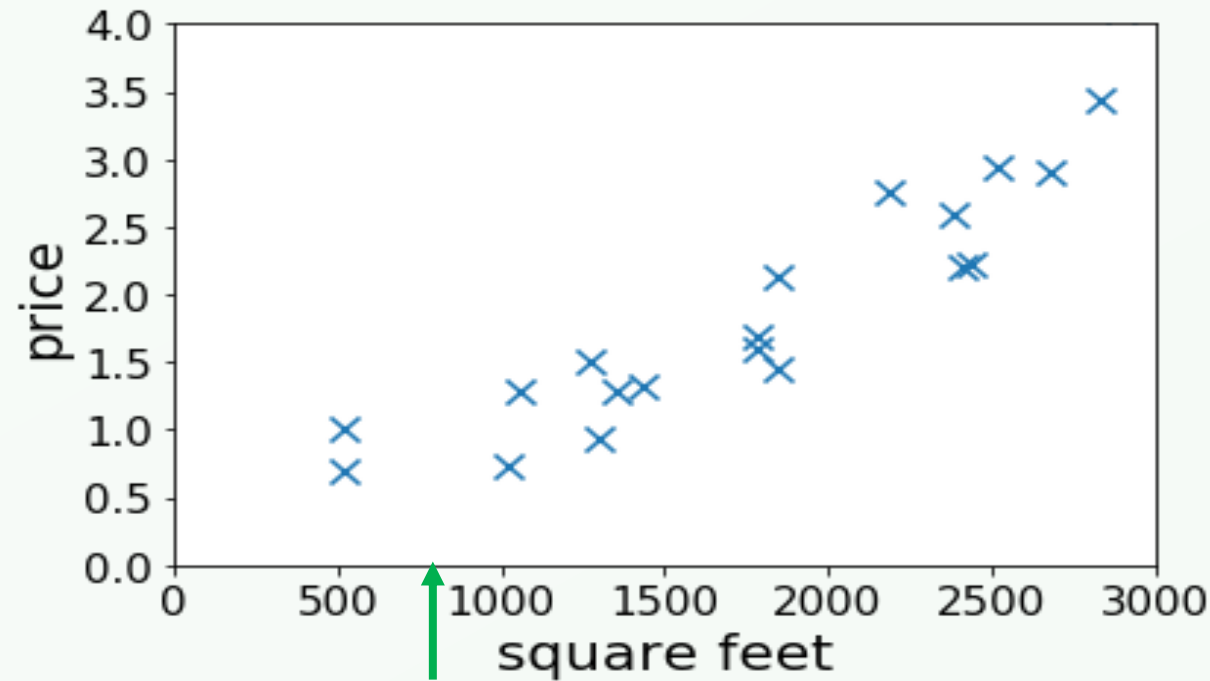
Supervised Learning



Housing Price Prediction



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- Supervised Learning
: “right answers” given

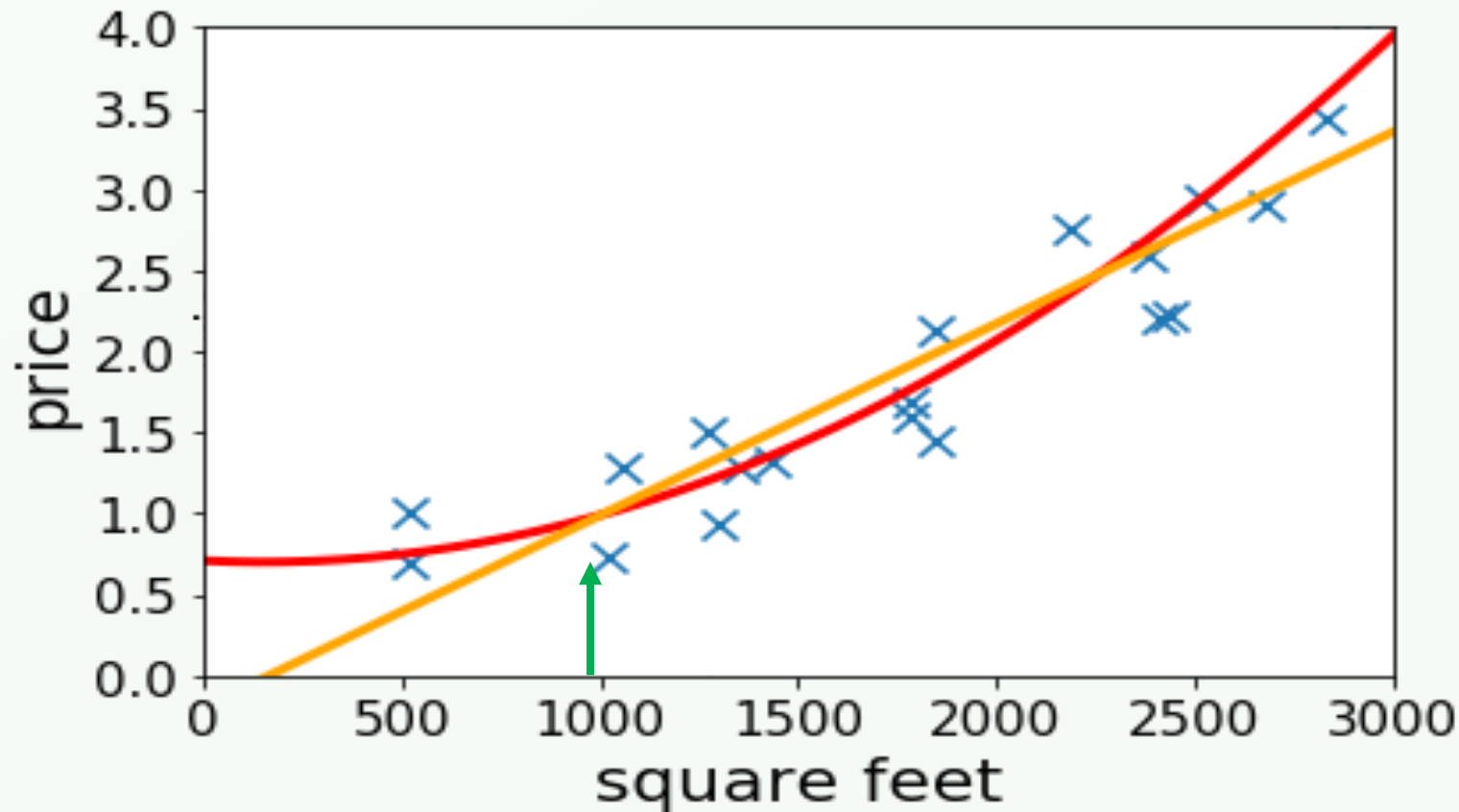
- Regression
: Predict continuous valued output (price)



Housing Price Prediction



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



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

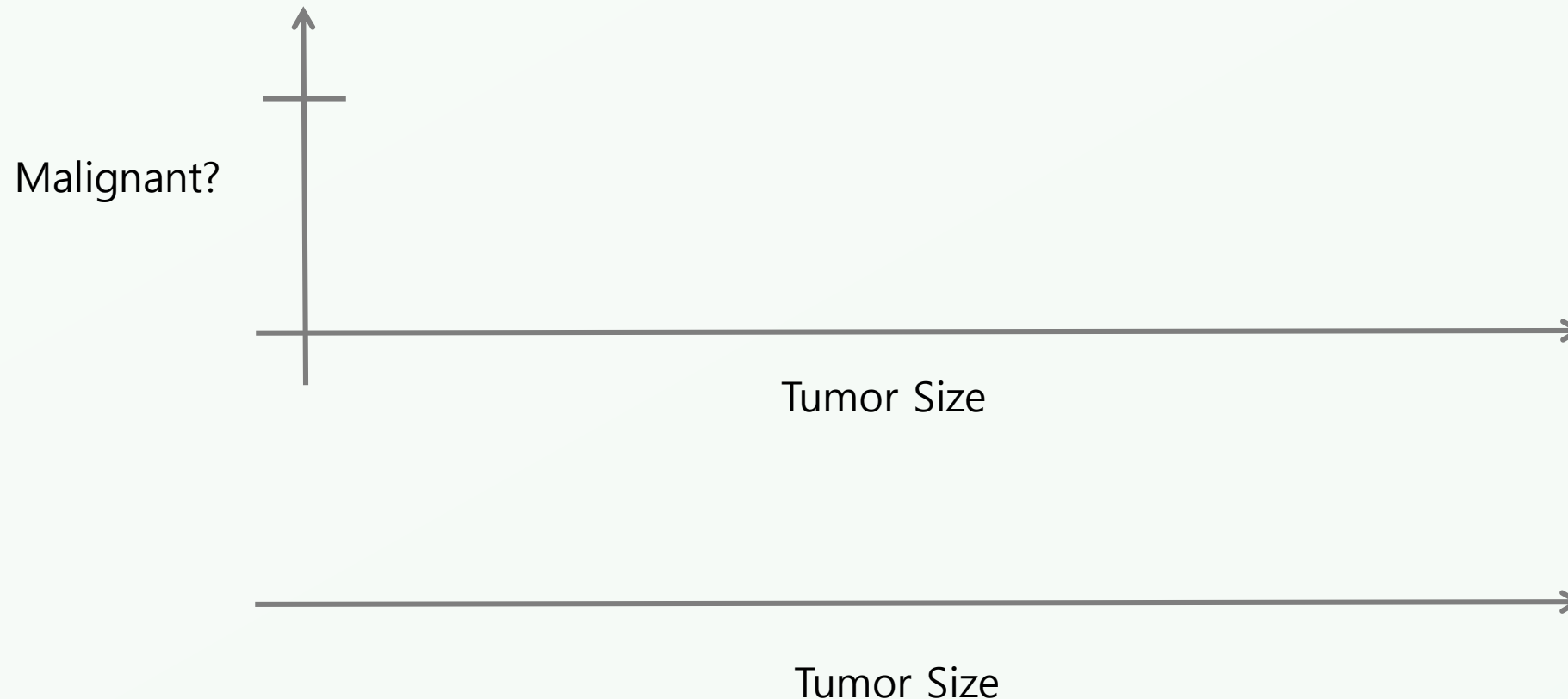


Breast cancer (malignant, benign)



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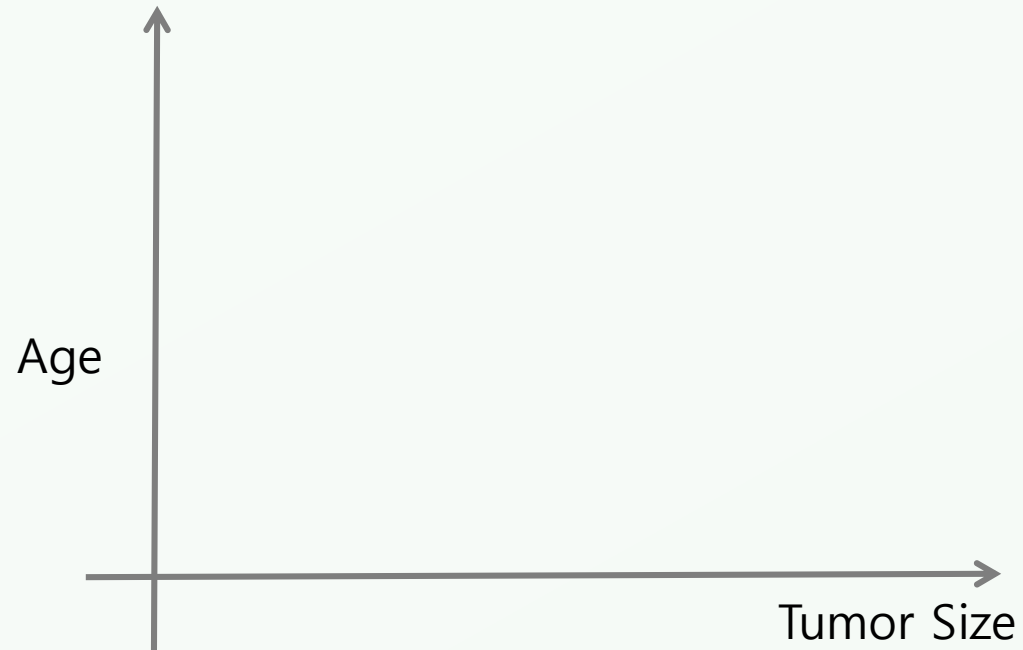
- Classification: Discrete valued output (0 or 1)



Breast cancer (malignant, benign)



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



Supervised Learning in Computer Vision



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

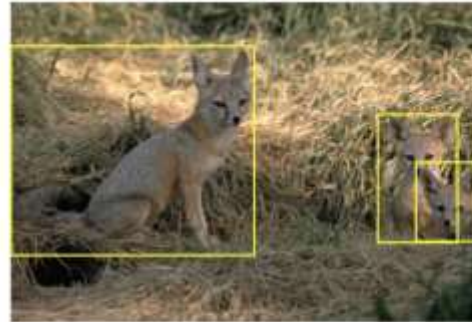


Supervised Learning in Computer Vision

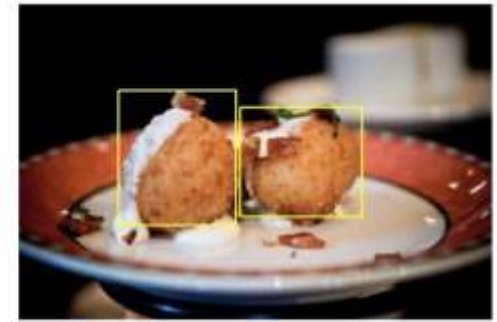


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- Object localization and detection
 - X = raw pixels of the image
 - Y = the bounding boxes



kit fox



croquette



airplane



frog



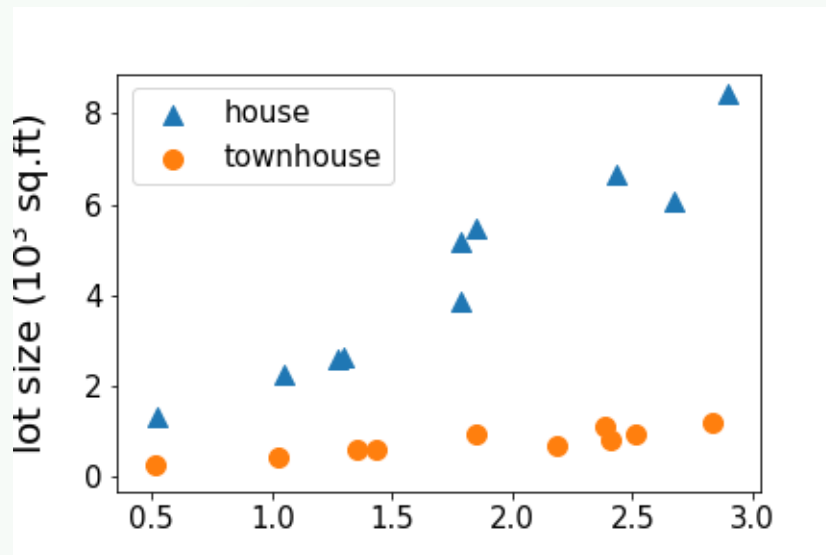
Unsupervised Learning



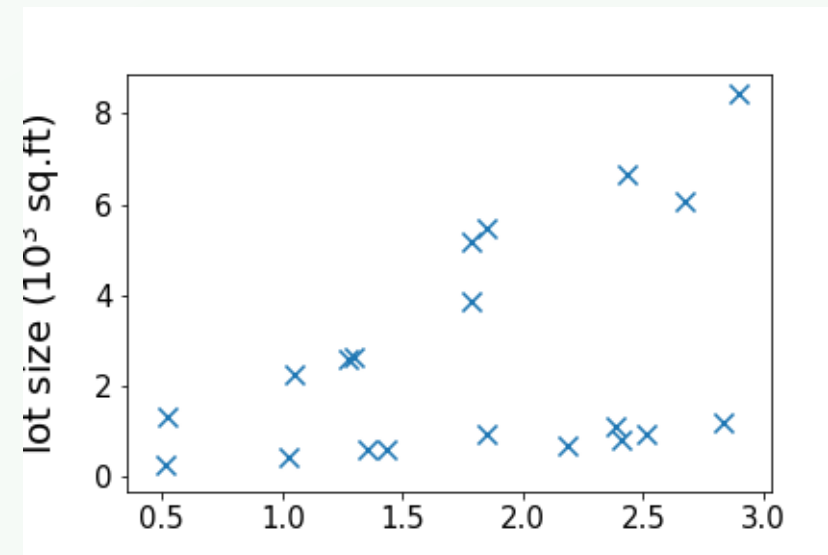
Unsupervised Learning



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



supervised



unsupervised

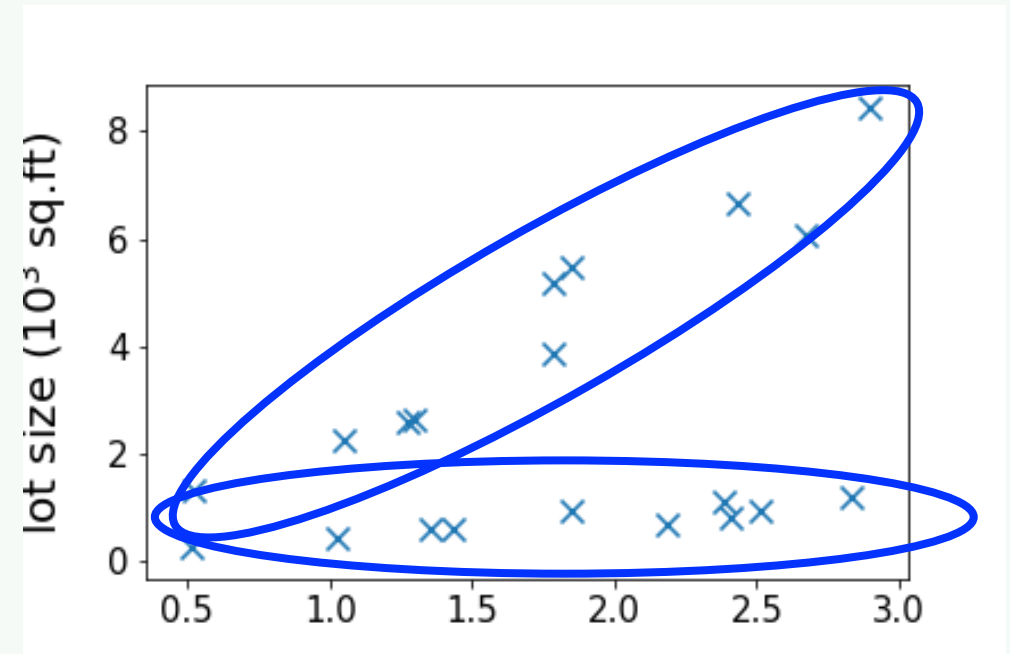
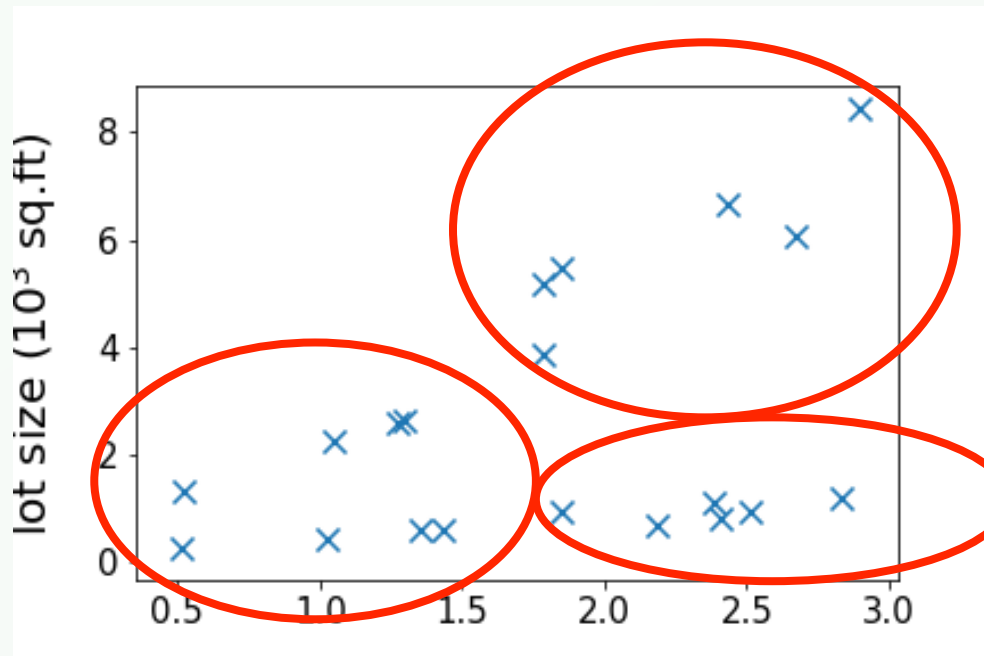


Unsupervised Learning



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- Clustering



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

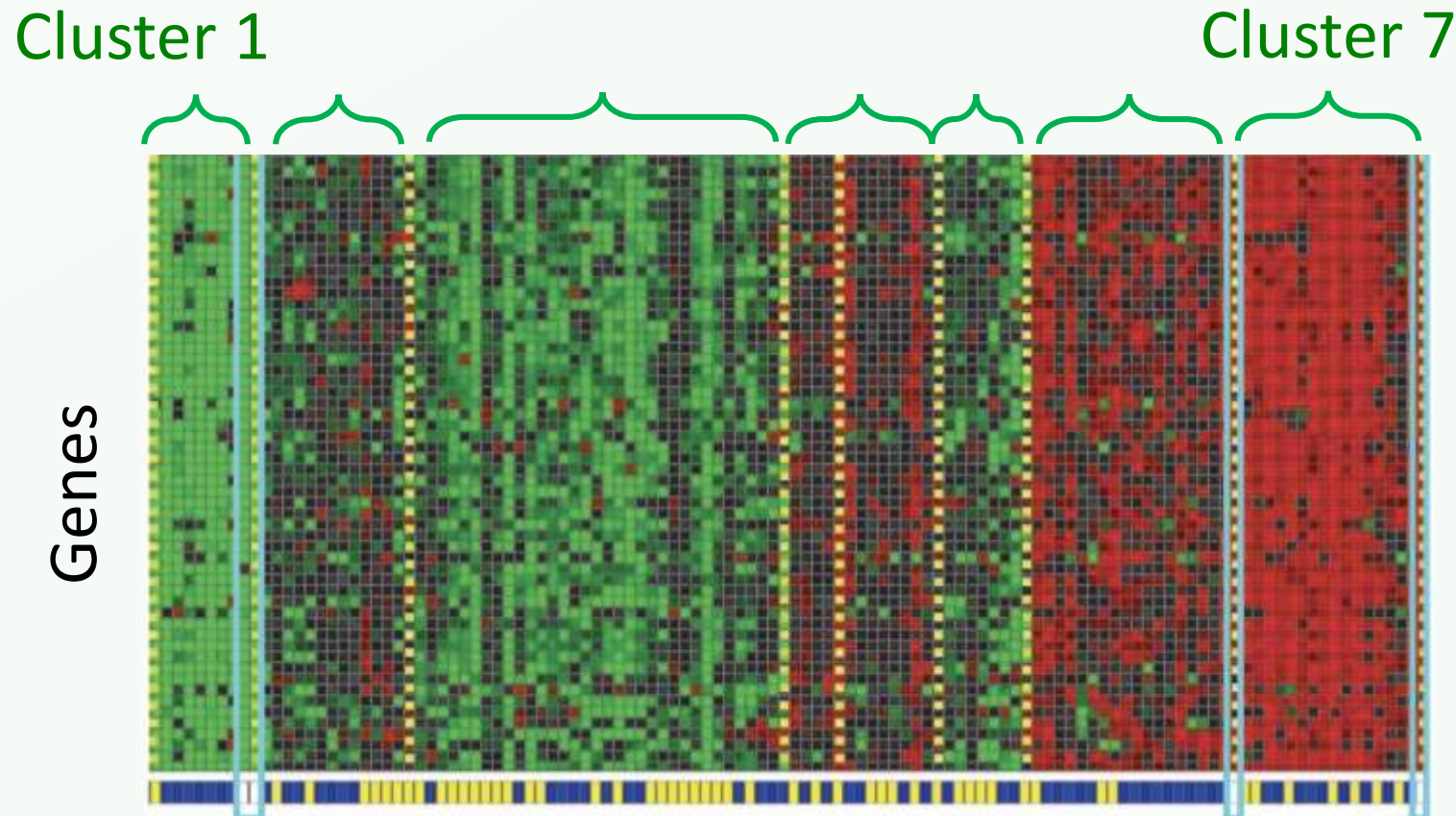


Unsupervised Learning



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- 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



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• Clustering

헤드라인

[헤드라인 뉴스 더보기](#)

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YTN news · 5시간 전
- 강원 3일 폭설...양양→서울 8시간
SBS 뉴스 · 2시간 전
- 50cm 눈폭탄 맞은 영동... 미시령 관통로 거대한 주차장으로 - 조선일보
조선일보 · 7시간 전
- 강원도 폭설로 차량 고립 10시간 이상..."하염없는 기다림" / YTN
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한국일보 · 2시간 전

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조선일보 · 4시간 전

- "이번 눈은 '습설'...대비하라" 강원 폭설에 비상대응 2단계 격상 - 중앙일보
중앙일보 · 3시간 전

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- Machine learning definition
- Taxonomy of machine learning