

---

# Introduction to Machine learning

---

Eun Yi Kim



Artificial Intelligence  
& Computer Vision  
Laboratory



# Today



- Machine learning definition
- Taxonomy of machine learning



# What is machine learning?



# Definition of Machine Learning



Artificial Intelligence  
& Computer Vision  
Laboratory

- 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



- 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., 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



Artificial Intelligence  
& Computer Vision  
Laboratory

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

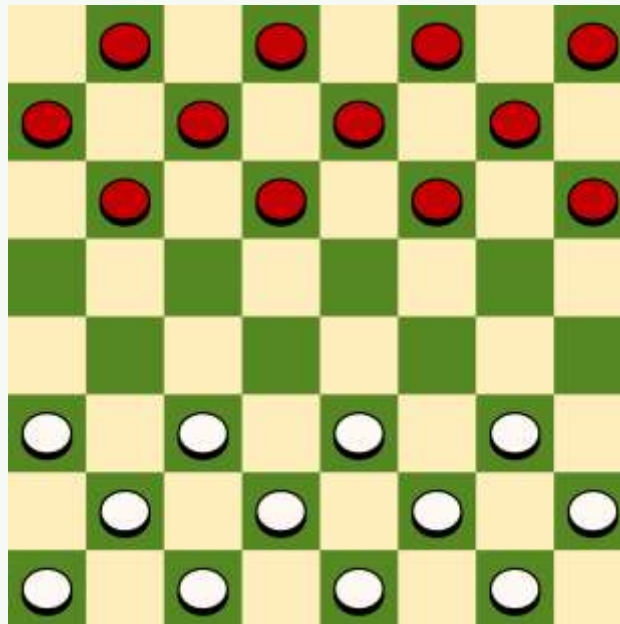
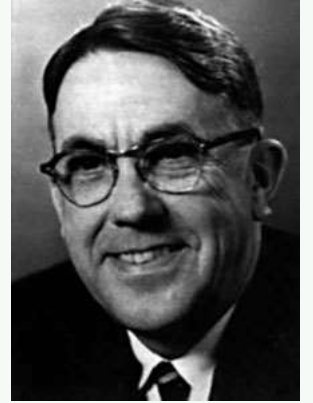


# Definition of Machine Learning



Artificial Intelligence  
& Computer Vision  
Laboratory

- 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



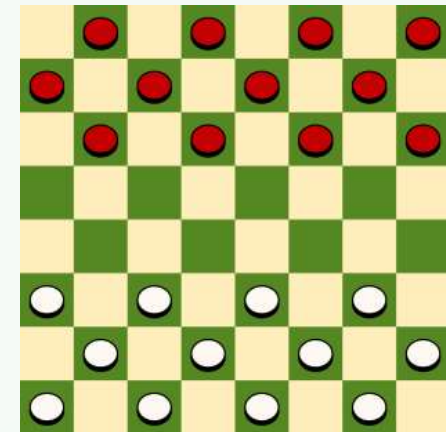
Artificial Intelligence  
& Computer Vision  
Laboratory

- 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)

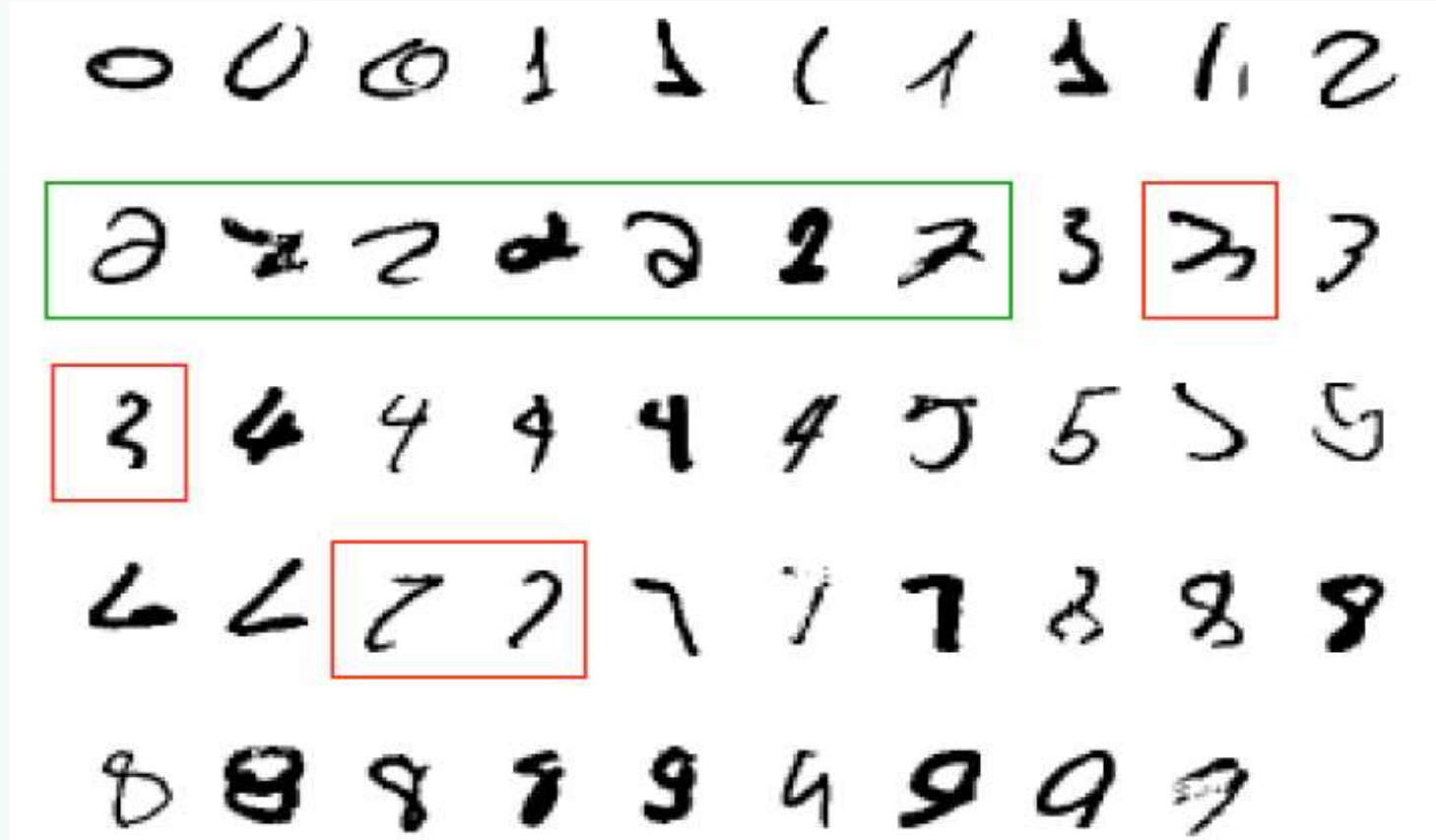
Performance measure: winning rate



# Tasks that requires ML



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



# Tasks that requires ML



Artificial Intelligence  
& Computer Vision  
Laboratory

- How can we make a robot cook?



# Learning algorithms are useful in many tasks



- 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)

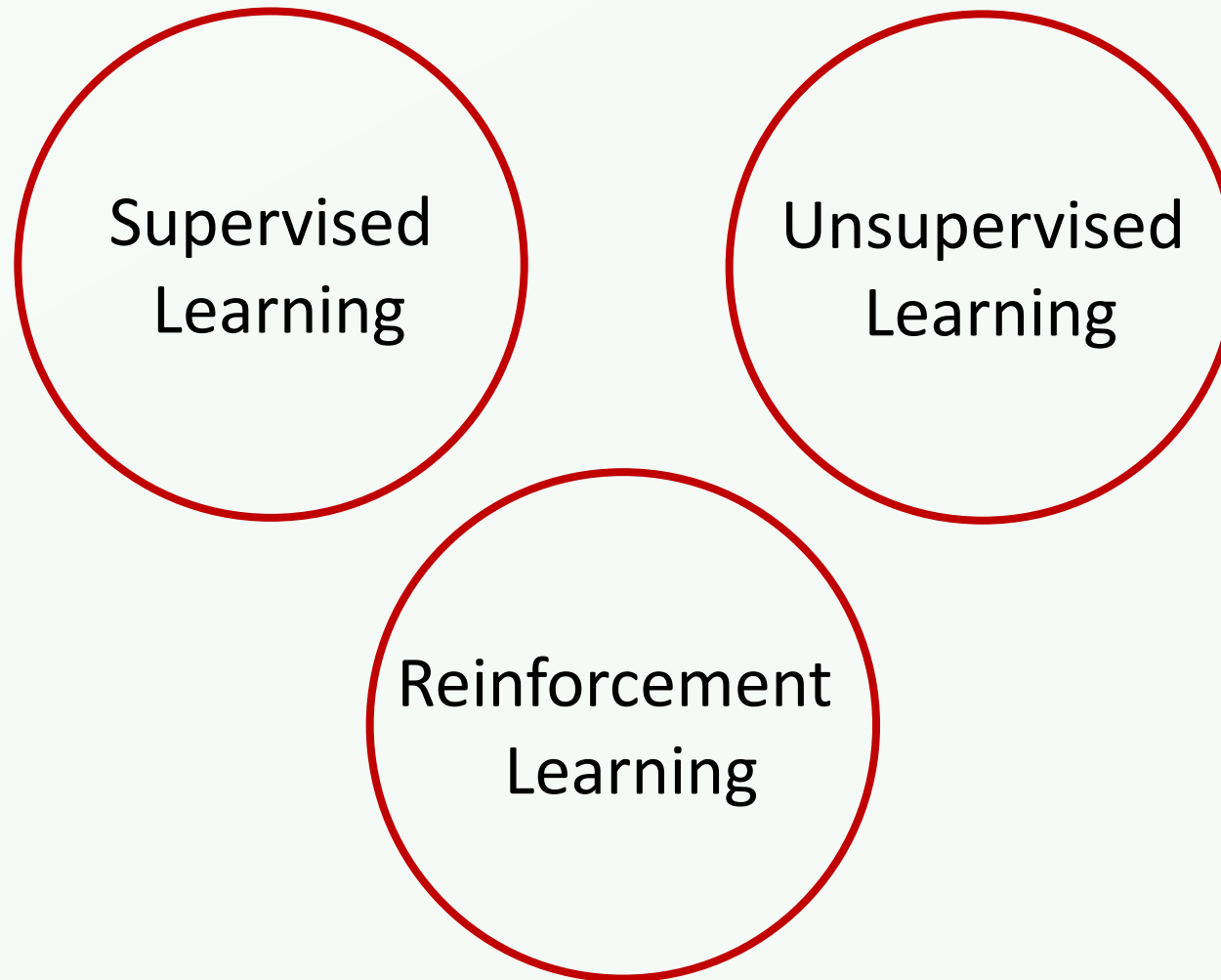


# Taxonomy of Machine Learning

(A Simplistic View Based on Tasks)



Artificial Intelligence  
& Computer Vision  
Laboratory



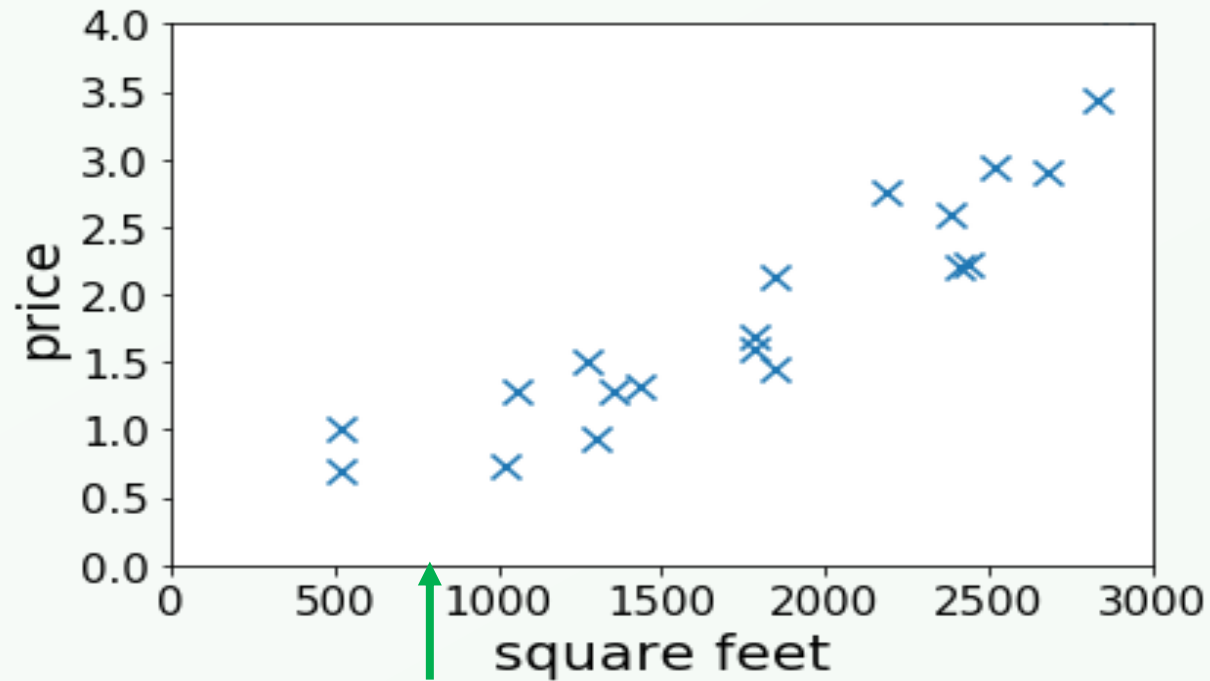
# Supervised Learning



# Housing Price Prediction



Artificial Intelligence  
& Computer Vision  
Laboratory



- Supervised Learning  
: “right answers” given

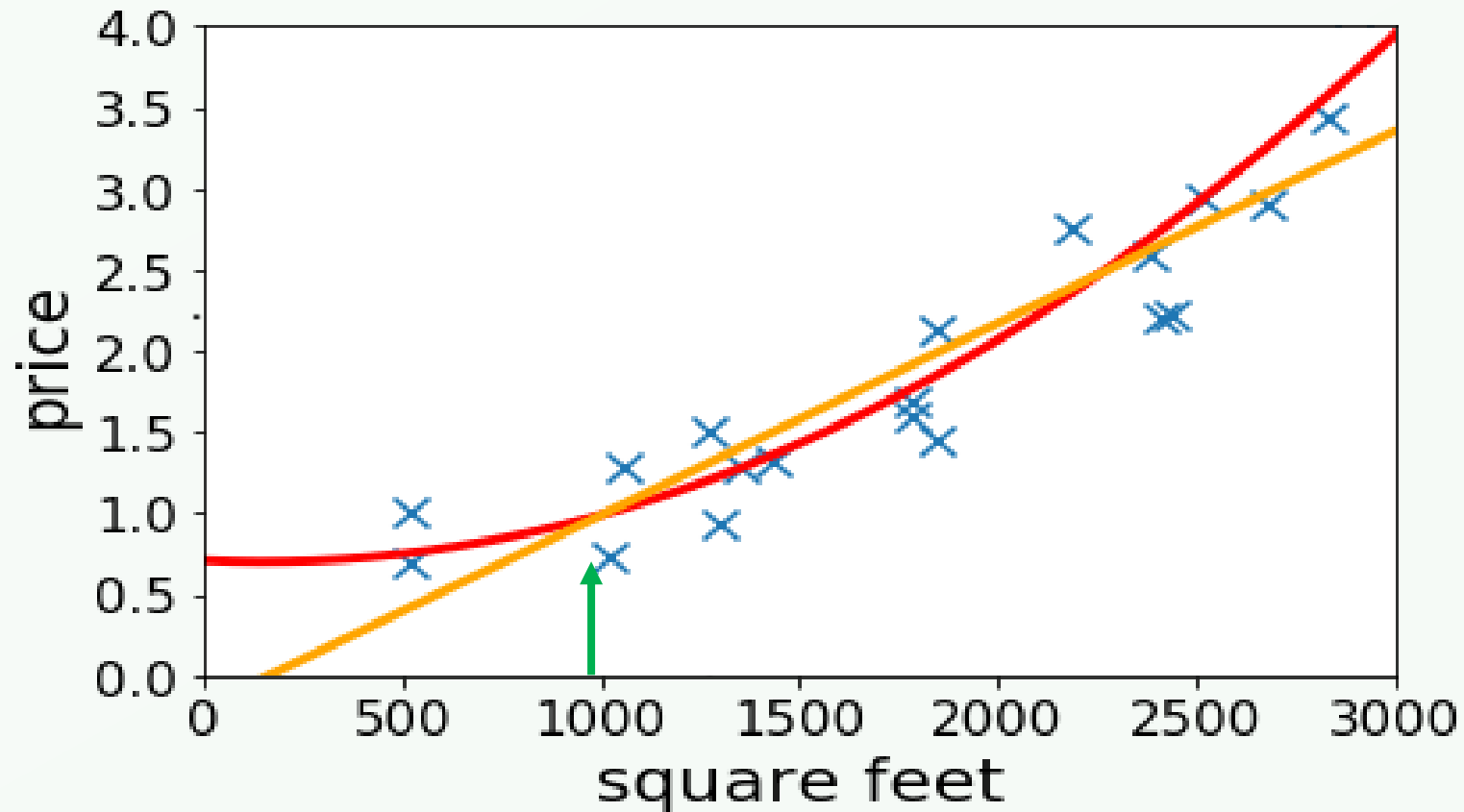
- Regression  
: Predict continuous valued output (price)



# Housing Price Prediction



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



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

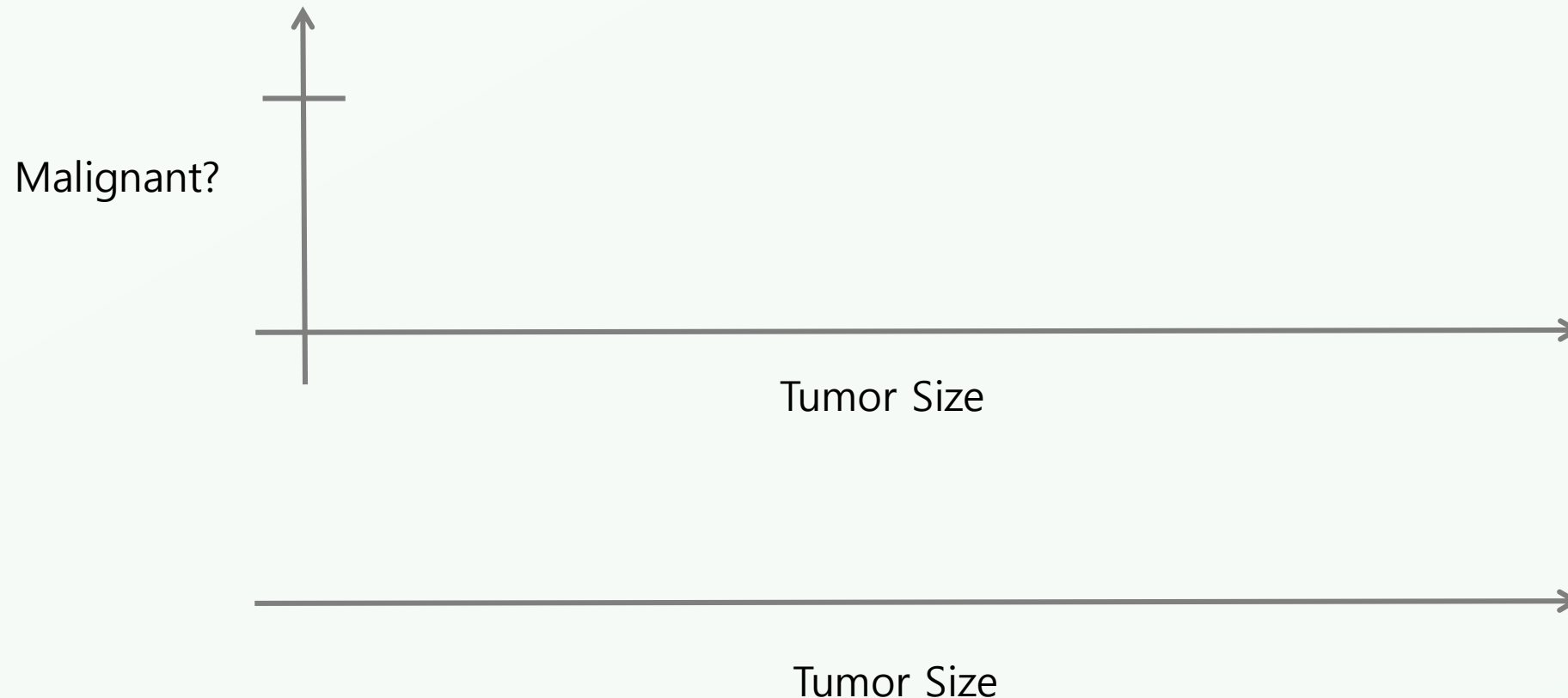


# Breast cancer (malignant, benign)



Artificial Intelligence  
& Computer Vision  
Laboratory

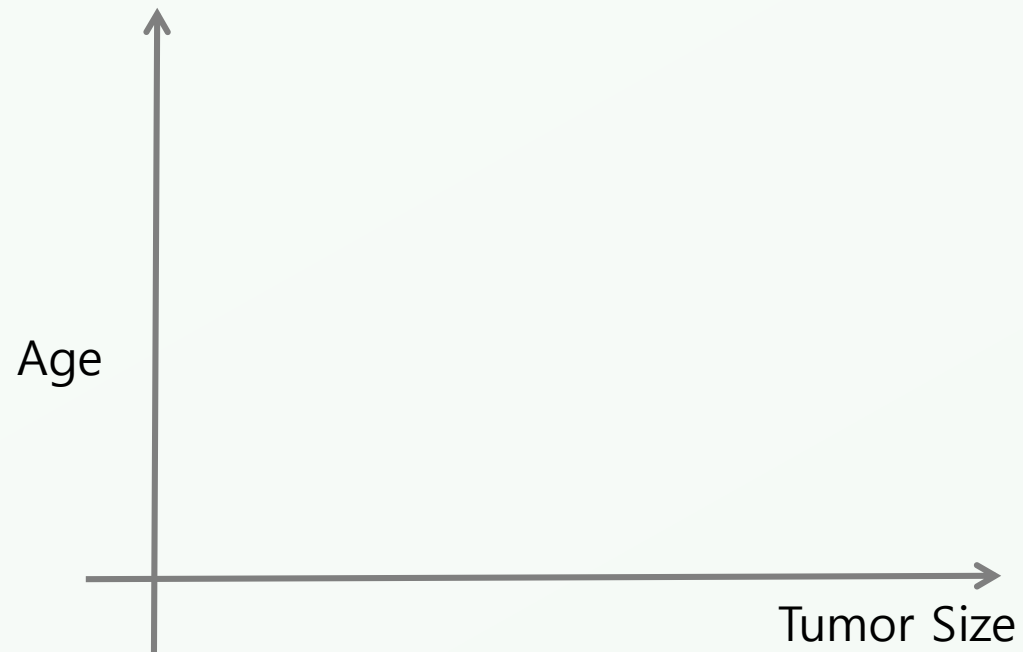
- Classification: Discrete valued output (0 or 1)



# Breast cancer (malignant, benign)



Artificial Intelligence  
& Computer Vision  
Laboratory



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



# Supervised Learning in Computer Vision



Artificial Intelligence  
& Computer Vision  
Laboratory

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

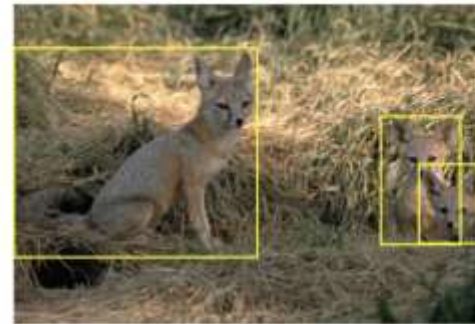


# Supervised Learning in Computer Vision

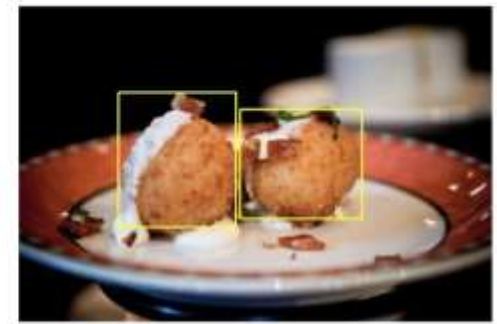


Artificial Intelligence  
& Computer Vision  
Laboratory

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



kit fox



croquette



airplane



frog



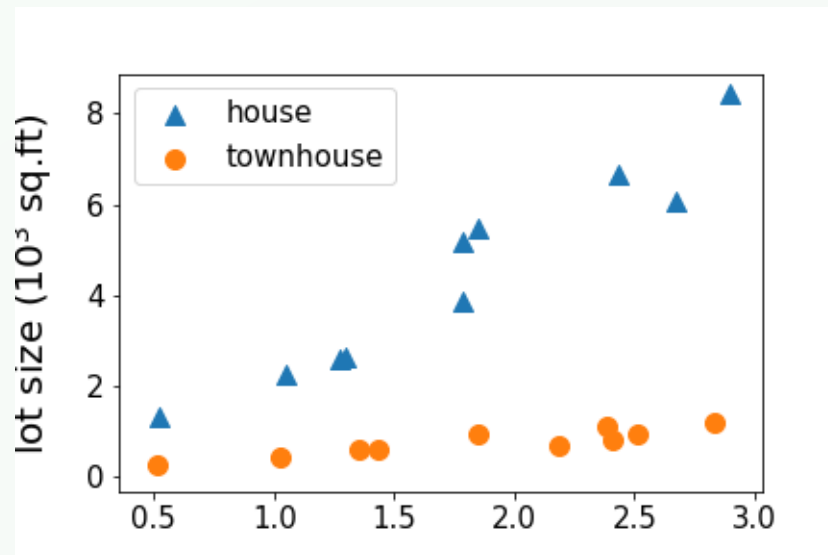
# Unsupervised Learning



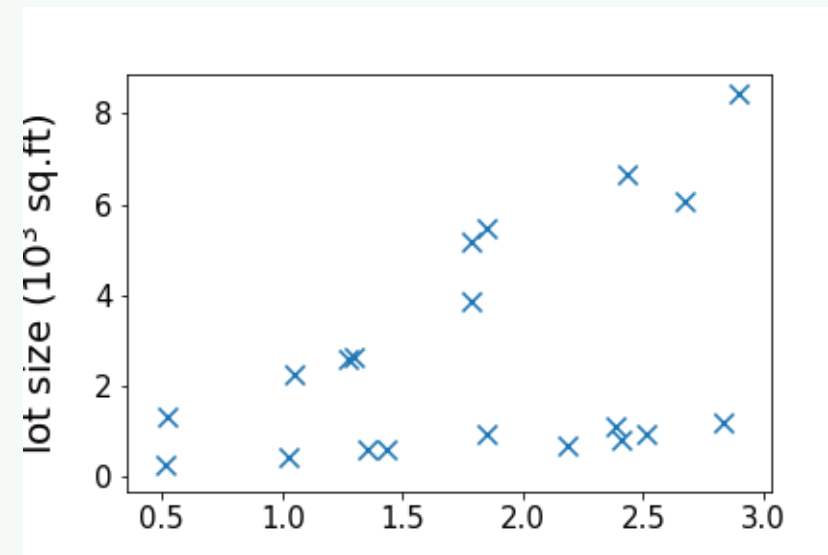
# Unsupervised Learning



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



supervised



unsupervised

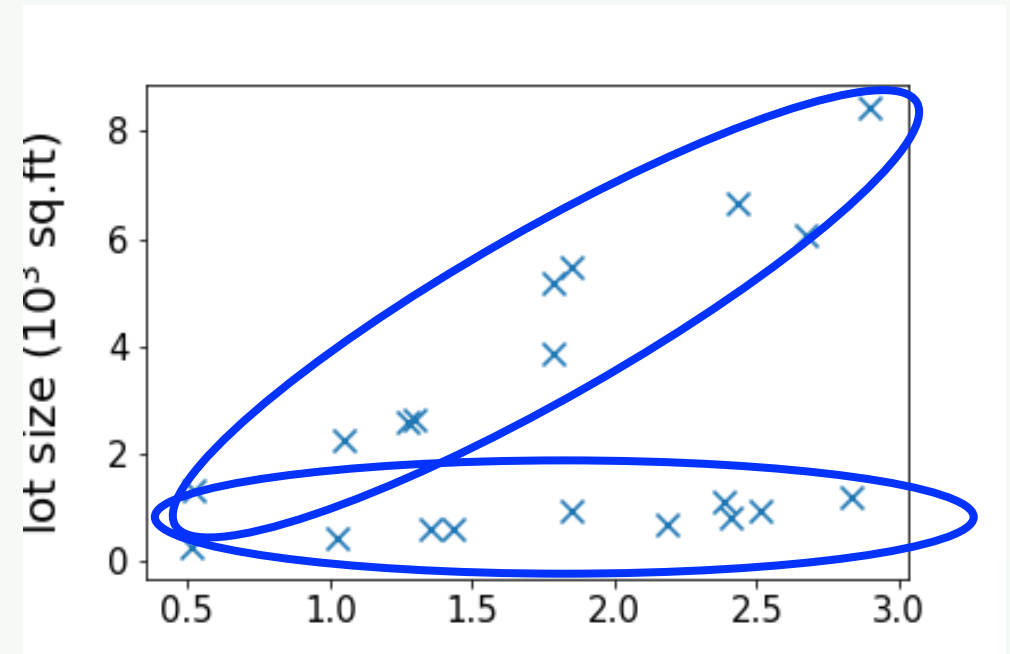
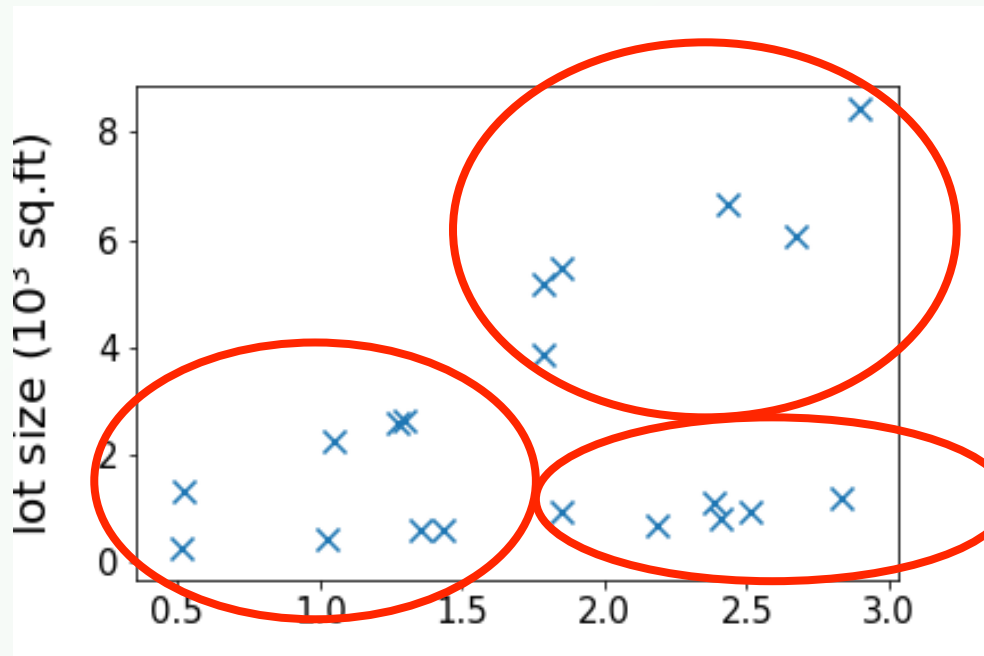


# Unsupervised Learning



Artificial Intelligence  
& Computer Vision  
Laboratory

- Clustering

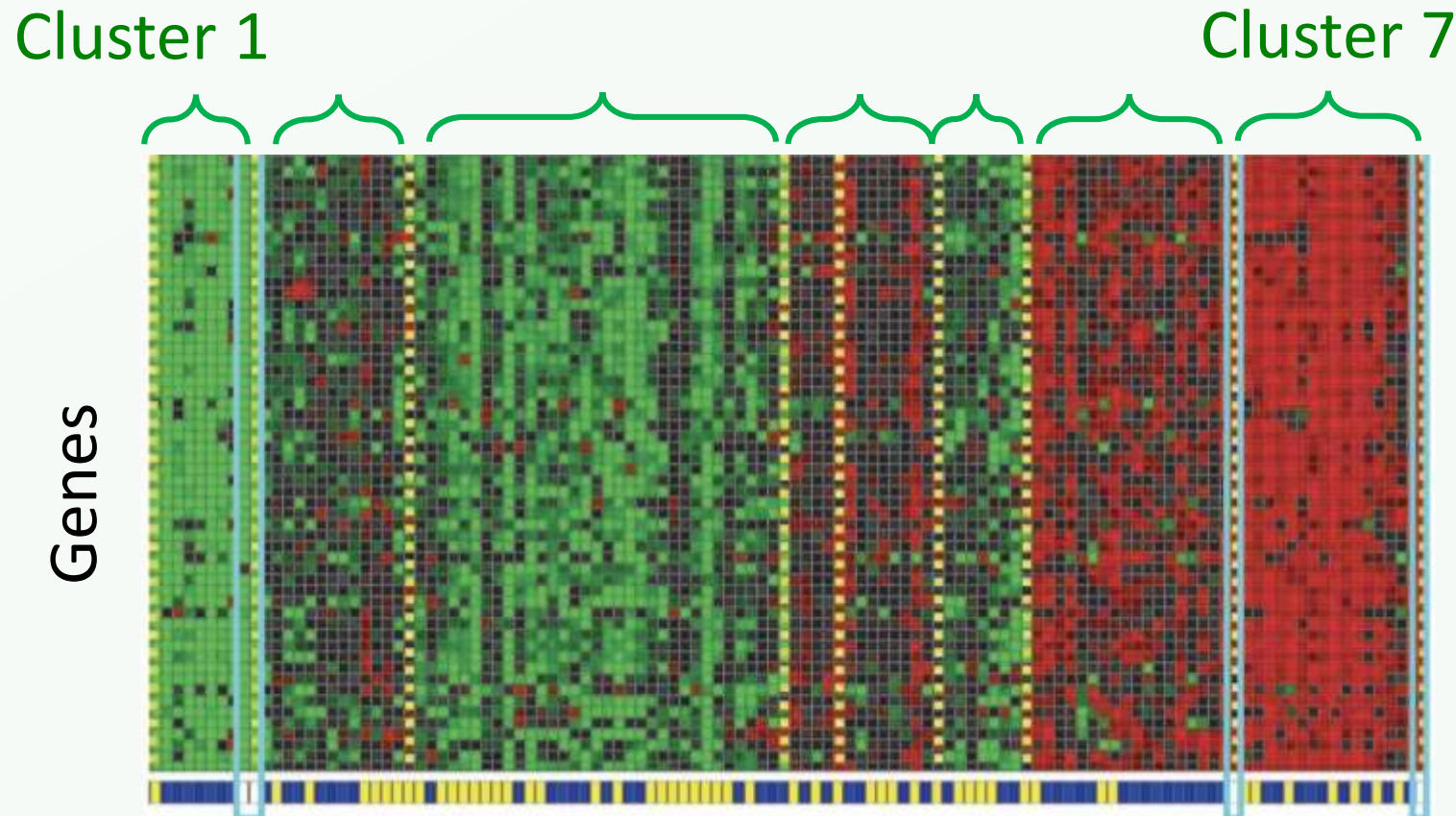


➤ Lecture 12&13: k-mean clustering, mixture of Gaussians





- 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



Artificial Intelligence  
& Computer Vision  
Laboratory

## • Clustering

### 헤드라인

[헤드라인 뉴스 더보기](#)

**폭설에 고립된 차량 수백대... 도로에서 빵·우유로 허기 달래**  
조선비즈 · 2시간 전

- 동해고속도로 속초 나들목 폭설로 통제...곳곳 마비 / YTN  
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  
YTN news · 1시간 전

[전체 콘텐츠 보기](#)

**박영선 '인지도' 넘지 못한 우상호 "이제 더 큰 싸움 남았다" '막판 뒤집기'**  
한국일보 · 2시간 전

- [속보] 與, 서울시장 후보 박영선 선출...10년만에 재도전 - 조선일보  
조선일보 · 9시간 전

[전체 콘텐츠 보기](#)

**영동 50cm 눈폭탄에 차 수백대 고립... 정부, 군 투입 구조작전 - 조선일보**  
조선일보 · 4시간 전

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

[전체 콘텐츠 보기](#)



# Today



Artificial Intelligence  
& Computer Vision  
Laboratory

- Machine learning definition
- Taxonomy of machine learning

