

Artificial Intelligence — — Introduction



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Announcement of lab course

- Will start in the Third Week (实B201)
- Five or six experiments
- A final project
- All the subjects will be carefully redesign (different from last year's subjects)
- Strictly prohibited for plagiaristic activities (严禁抄袭)

Background

- **Camera:** Simulate part functions of eyes
 - images and videos -> electrical signal
 - Computer Graphics (CG), Computer Vision (CV), etc.
- **Microphone:** Simulate part functions of ear
 - audios -> electrical signal
 - Speech Recognition (SR), etc.
- **Computer:** Simulate small part functions of brain
 - computing brain; symbol -> pattern
 - Artificial Intelligence (AI), etc.
- ...
- The connection between digital devices and brain
 - Human-Computer Interaction (HCI)

Human-Computer Interaction

- Substitute some functions of human, make *human* better



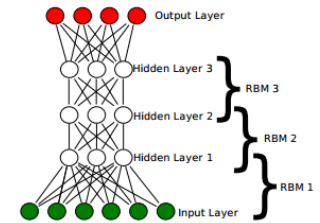
Artificial Intelligence

- Simulate more functions of brain, make *computer* better
 - chess brain, question answering brain, drive brain, etc.

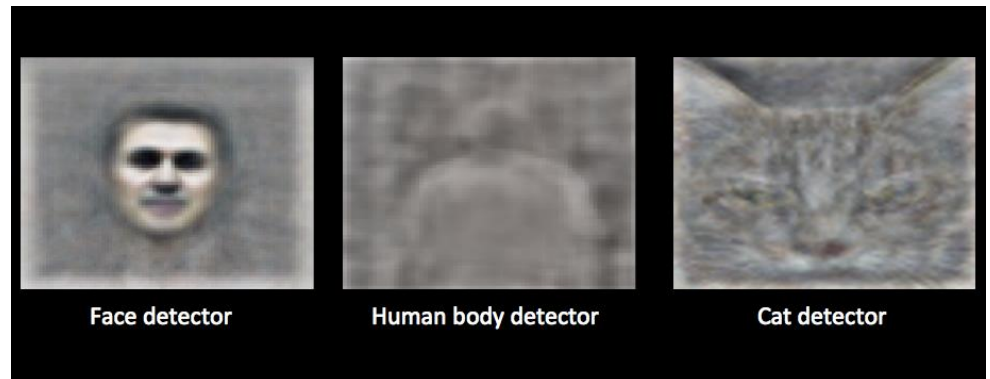


Artificial Intelligence

- Simulate more functions of brain, make *computer* better
 - chess brain, question answering brain, drive brain, etc.



- face detector
- human body detector
- cat detector
- ...



History of AI

- Turing Test, proposed by A.M. Turing in 1950
- Loebner Prize, pledged by Hugh Loebner in 1990
 - “Question Answering”/Chat robots
 - <http://www.loebner.net/Prizetf/loebner-prize.html>
 - 1991, Joseph Weintraub
 - If you say "I need my Mommy", ELIZA will say "Tell me why you need your Mommy?"
 - It employs AI sentence parsing and knowledgebase technology, plus a 70,000 word vocabulary.
 - ...

History of AI

- Logic, 1950s
 - “Knowledge” is transferred by experts/humans
 - *propositional* logic (命题逻辑), first-order *predicate* logic (谓词逻辑), *fuzzy* logic...

Logic

- “true” or “false”
- negation
- conjunction
- disjunction
- implication
- equivalence
- universal quantifier
- existential quantifier
- ...

```
~~~~~欢迎您!~~~~~
      游戏：五子棋
~~~~~

人人对弈1  人机对弈2
请您选择1  或者2:  2
您选择了人机对弈~~~~
黑方1  US  白方2
请您选择1  或者2:  2
您选择了2,对方先下~~

  1 2 3 4 5 6 7 8 9 A B C D E F
1 + + + + + + + + + + + + + +
2 + + + + + + + + + + + + + +
3 + + + + + + + + + + + + + +
4 + + + + + + + + + + + + + +
5 + + + + + + + + + + + + + +
6 + + + + + + + + + + + + + +
7 + + + + + + + + + + + + + +
8 + + + + + + + + + + + + + +
9 + + + + + + + + + + + + + +
A + + + + + + + + + + + + + +
B + + + + + + + + + + + + + +
C + + + + + + + + + + + + + +
D + + + + + + + + + + + + + +
E + + + + + + + + + + + + + +
F + + + + + + + + + + + + + +
该计算机下了, 请输入1
```

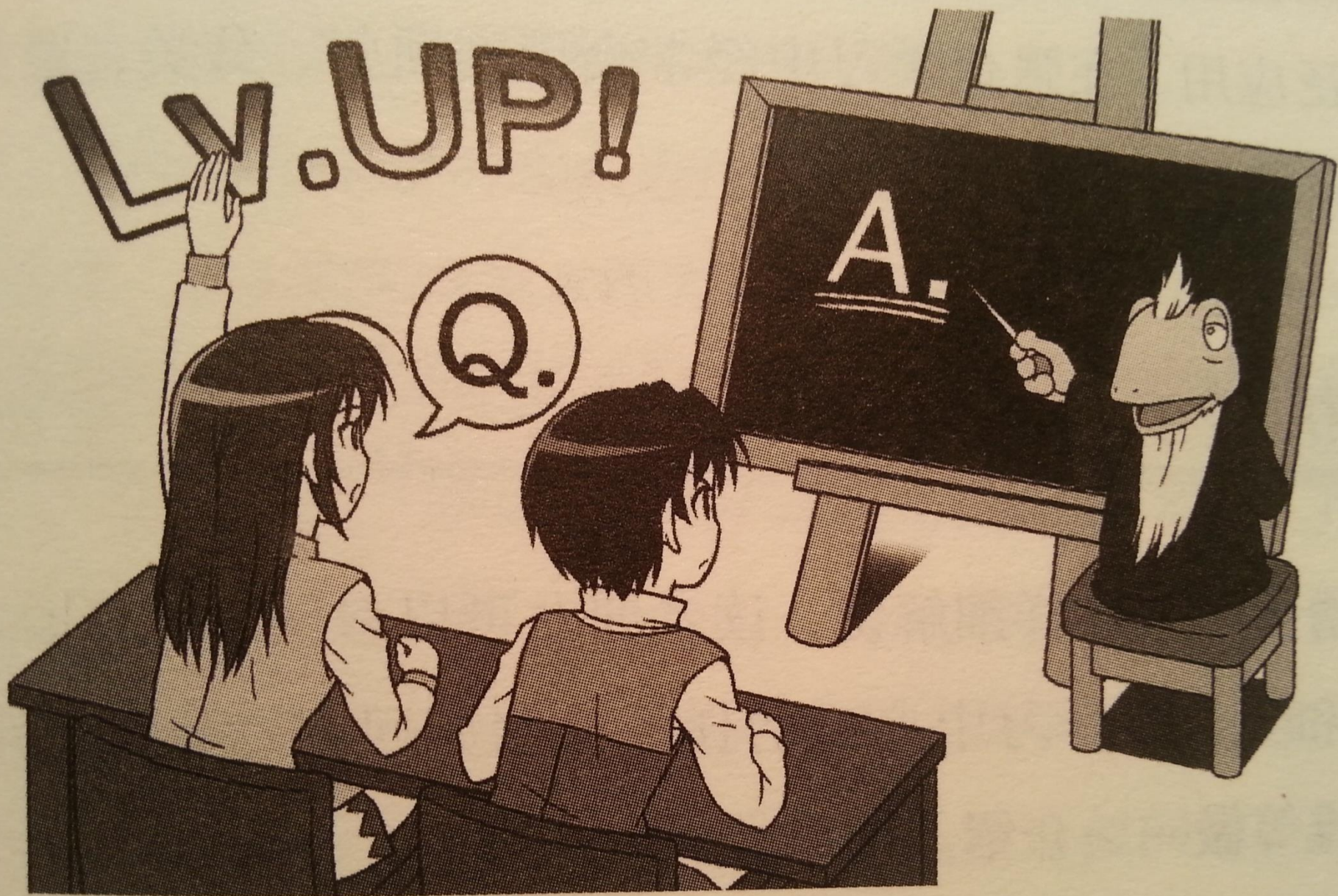
Logic

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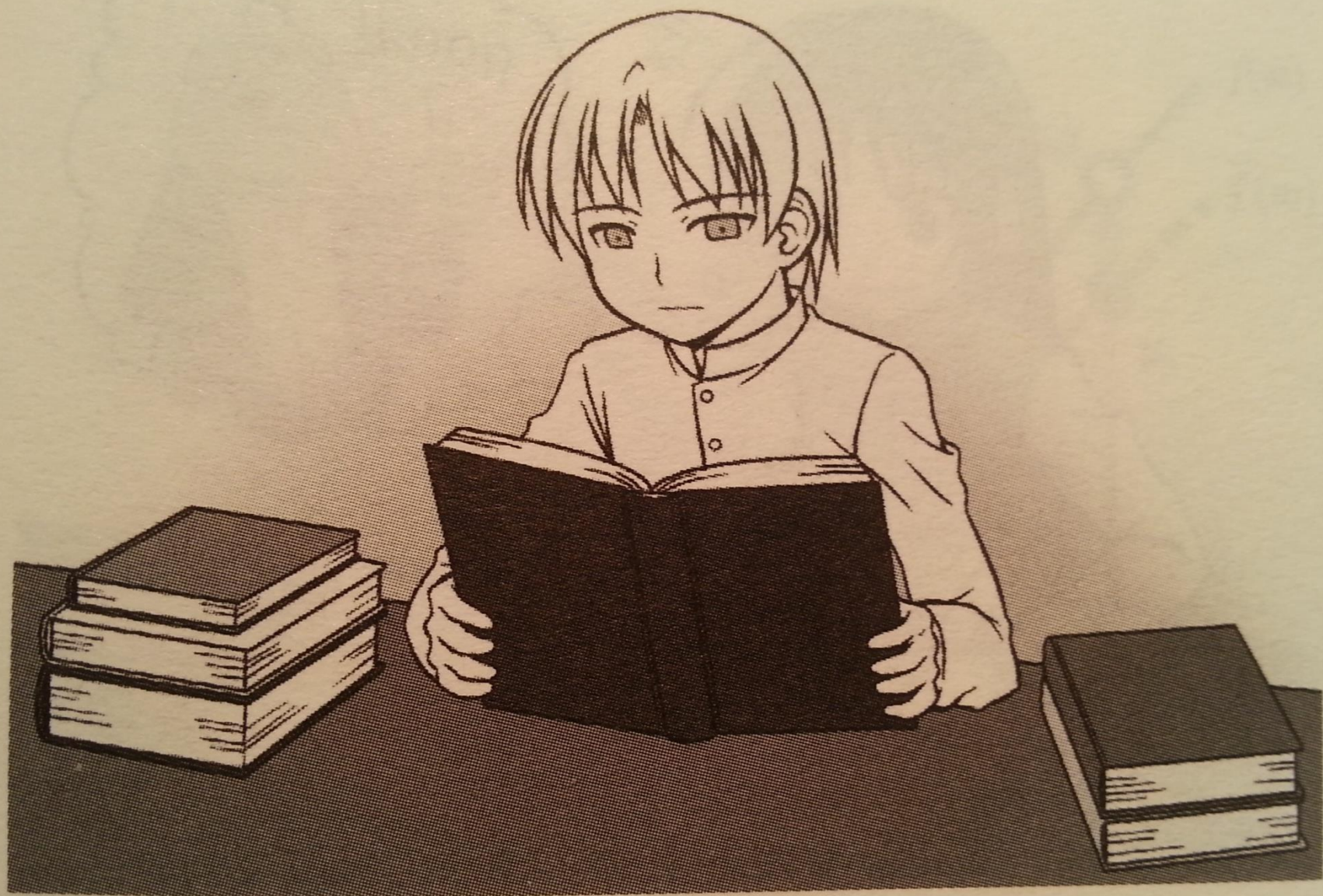
```
当前步数为: 40
  1 2 3 4 5 6 7 8 9 A B C D E F
1 + + + + + + + + + + + + + +
2 + + + + + + 0 0 + + + + + +
3 + + 0 0 0 0 0 0 + + + + + +
4 + + + 0 0 0 0 0 + + + + + +
5 + + + 0 0 0 0 0 + + + + + +
6 + + 0 0 0 0 0 0 + + + + + +
7 + 0 0 0 0 0 0 + + + + + +
8 + + + 0 + 0 + + + + + + +
9 + + + 0 + + + + + + + + +
A + + + + + + + + + + + + +
B + + + + + + + + + + + + +
C + + + + + + + + + + + + +
D + + + + + + + + + + + + +
E + + + + + + + + + + + + +
F + + + + + + + + + + + + +
您的输入是: 6 3
祝贺您!您赢了~
```

History of AI

- Logic, 1950s
 - “Knowledge” is transferred by experts/humans
 - *propositional* logic (命题逻辑), first-order *predicate* logic (谓词逻辑), *fuzzy* logic...
- Machine Learning, 1990~
 - “Knowledge” is learnt by computers primarily
 - *supervised* learning (监督学习): classification...
 - *unsupervised* learning (无监督学习): clustering, density estimation...
 - *reinforcement* learning (强化/增强学习)



监督学习



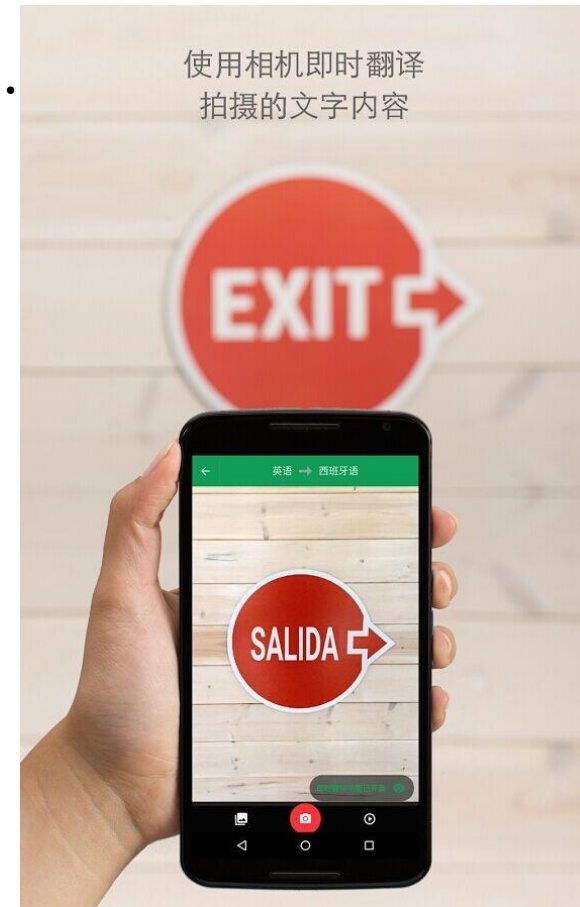
无监督学习



强化学习

What is Artificial Intelligence

- Compute something that shows **intelligent** behavior
 - Natural language processing, ...



What is Artificial Intelligence

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 - Natural language processing, ...

2015年6月18日下午，日本，Pepper和阿里巴巴集团零售事业群总裁张建锋互动：

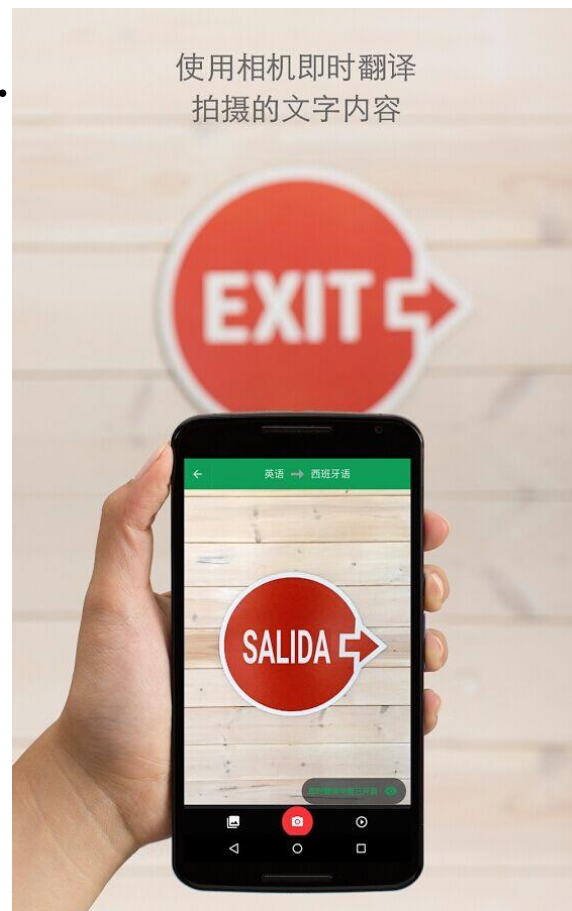
.....

Pepper: 快乐20，紧张60，生气0，悲伤0，
我的情感引擎显示，您好象有点紧张，是吗？

.....

Pepper: 快乐80，紧张20，生气0，悲伤0。
我的情感引擎显示你的心情似乎不错。你是
不是开始喜欢我了？

.....



What is Machine Learning

- Tom Mitchell (1997): A **computer program** (vs *human*) is said to **learn** from experience E (e.g., **labeled data**) with respect to some class of tasks T (e.g., **classification**) and performance measure P (e.g., **precision & recall**), if its performance at tasks in T , as measured by P , improves with experience E .

What is Pattern Recognition

- Christopher M. Bishop (2006): The automatic discovery of regularities in data through the use of computer algorithms (*e.g.*, Machine Learning) and with the use of these regularities to take actions such as classifying the data into different categories

What Kinds of Regularities?

- **Classification**

- A loan user: high or low risk? \leftrightarrow *banker*
- A person: health or sick? \leftrightarrow *doctor*
- An Iris flower: Setosa, Versicolour, or Virginica? \leftrightarrow *botanist* (植物学家)



Classification

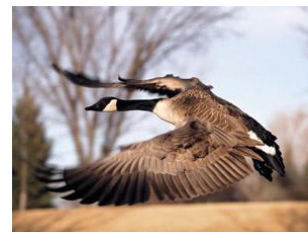
- Make the computer as intelligent as an expert
 - Classify a person as healthy or sick
 - Identify the author of a piece of art or a book
 - Identify the variety of an animal or a plant

Classification

- Make the computer as intelligent as an expert
 - Classify a person as healthy or sick
 - Identify the author of a piece of art or a book
 - Identify the variety of an animal or a plant
- Training data: examples of the input vectors along with their corresponding target vectors
 - Input vectors: height, weight, has a tail? (yes or no)
 - Target vectors: human or monkey

Classification

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 - Identify the author of a piece of art or a book
 - Identify the variety of an animal or a plant
- Training data: examples of the input vectors along with their corresponding target vectors
 - Input vectors: height, weight, has a tail? (yes or no)
 - Target vectors: human or monkey
 - Which attributes are good to classify a bird from others?



Classification

- Input vectors of birds:
 - can move? (yes or no)
 - can chirp? (yes or no)
 - have feather? (yes or no)
 - size (length, width, height)
 - reaction to sound? (yes or no)
 - ...

Classification

- Input vectors of birds:
 - can move? (yes or no)
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Classification

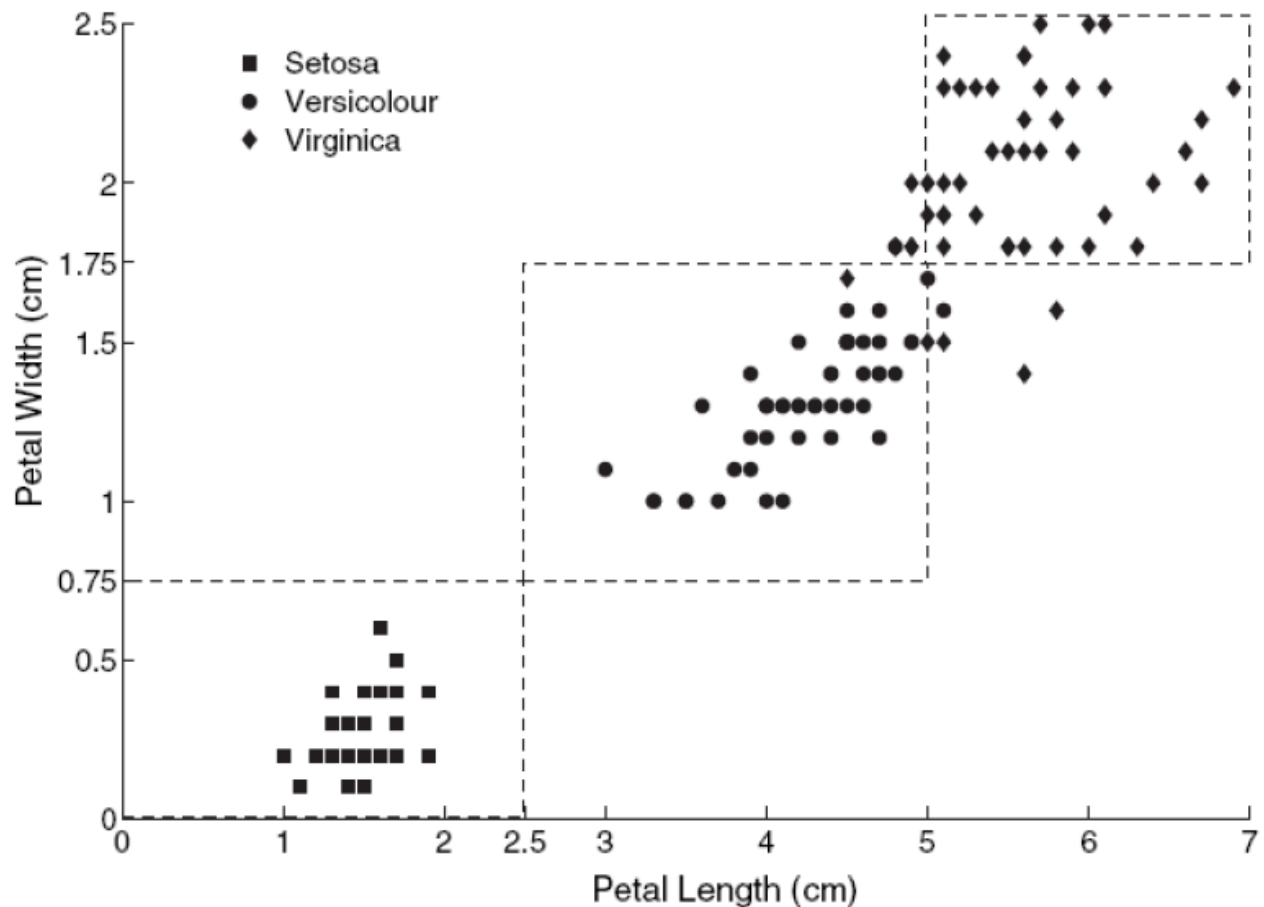
- Data set for Machine Learning
 - UCI Machine Learning Repository (<http://archive.ics.uci.edu/ml/datasets.html>)
- Iris data set
 - <http://archive.ics.uci.edu/ml/datasets/Iris>
 - Attributes provided by Fisher (experts)
 - sepal (萼) length (cm), sepal width (cm), petal (瓣) length (cm), petal width (cm), class

5.3,3.7,1.5,0.2,	Iris-setosa
5.0,3.3,1.4,0.2,	Iris-setosa
7.0,3.2,4.7,1.4,	Iris-versicolor
6.4,3.2,4.5,1.5,	Iris-versicolor
6.3,3.3,6.0,2.5,	Iris-virginica
5.8,2.7,5.1,1.9,	Iris-virginica

Classifier: Decision tree, SVM, Neural Network, ...

Classification

- Plot using petal length and width



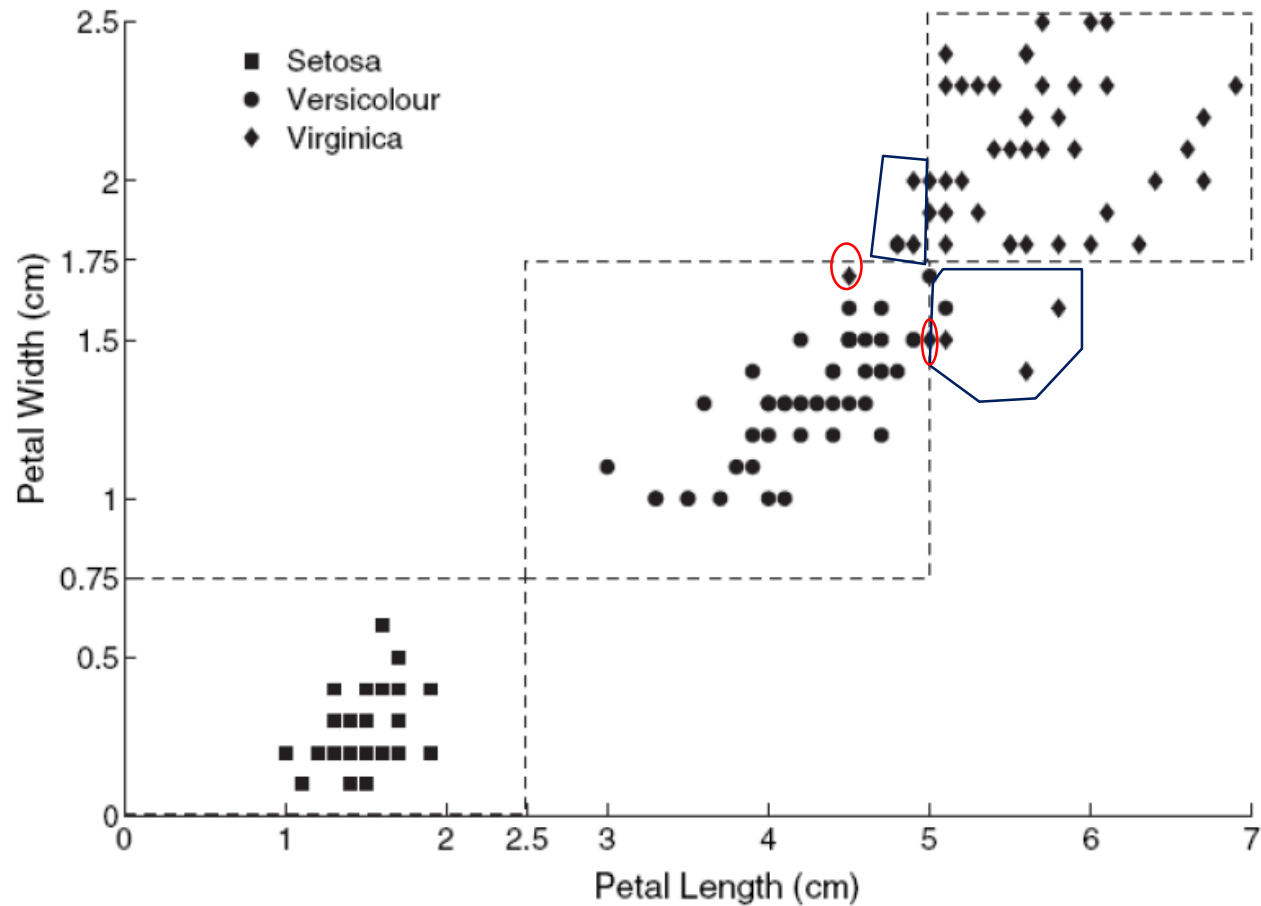
Classification

- Based on these categories with data, the following rules can be derived:
 - Petal width low and petal length low implies Setosa (山鸢尾).
 - Petal width medium and petal length medium implies Versicolour (变色鸢尾).
 - Petal width high and petal length high implies Virginica (维珍尼亚鸢尾).

Classification

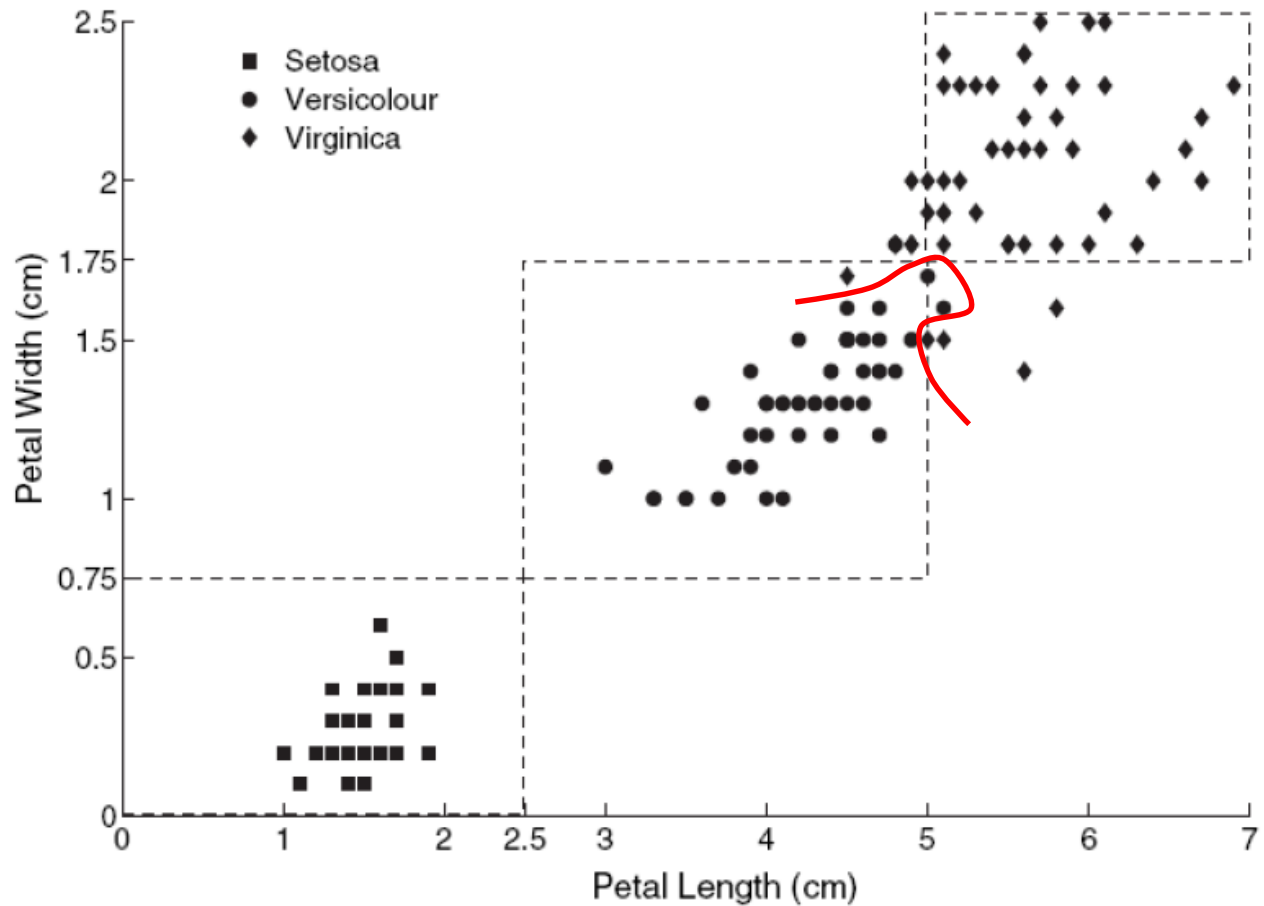
- These rules do not classify all the flowers correctly.
 - Flowers from the Setosa species are well separated from the other two species with respect to petal width and length.
 - However, the Versicolour and Virginica species overlap somewhat with respect to these two attributes.
- Solutions?

Classification



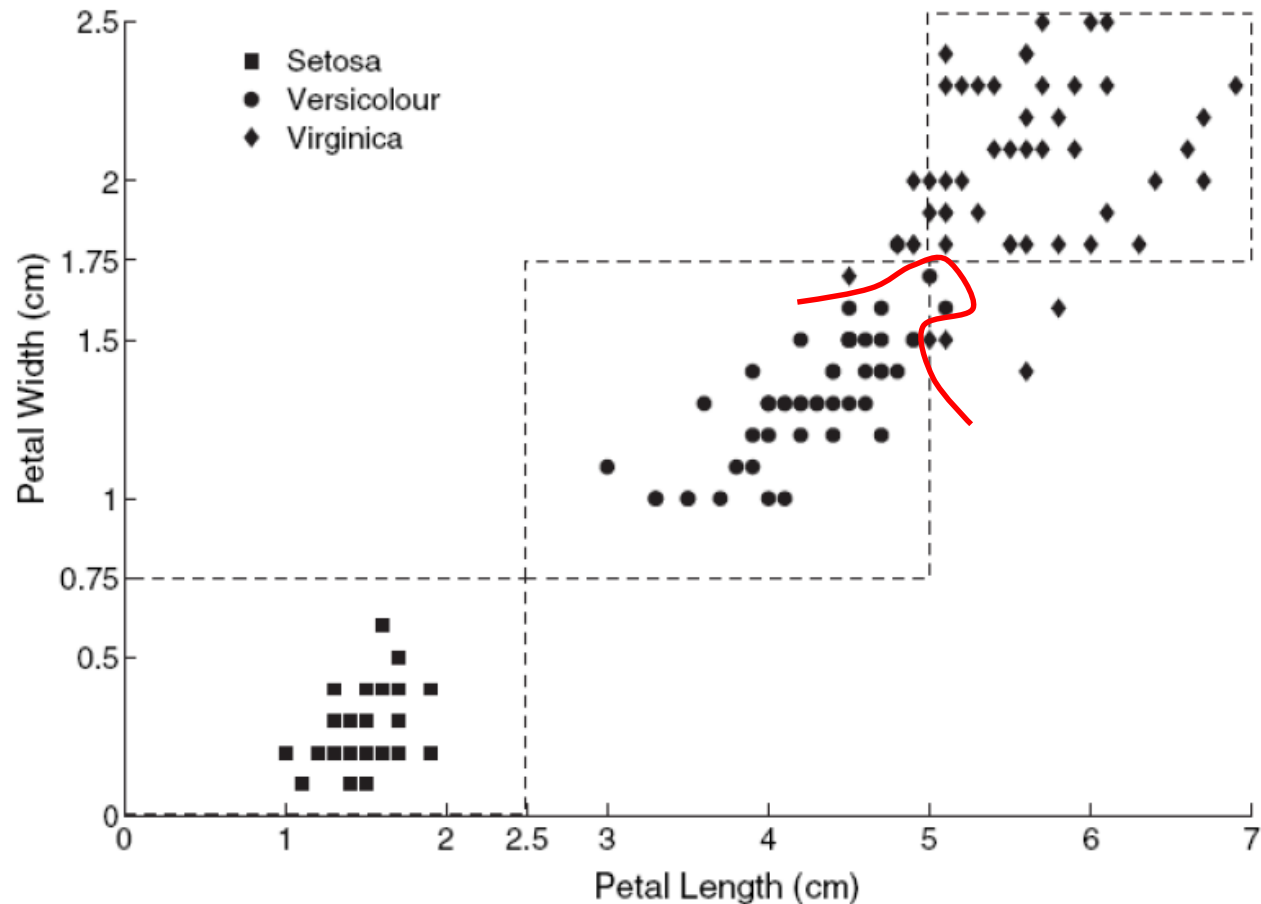
1. Records surrounded by red line: misclassified
2. Records surrounded by blue line: unclassified

Classification



1. A new better classifier model

Classification



1. A new better classifier model
2. Add more attributes
(i.e., sepal length and width, and others if possible)

What Kinds of Regularities?

- **Regression**

- Highly related to statistics
- Many concerned quantitative variables:
 - A person's life expectancy
 - A journal article's citations
 - A city's air temperature next day
 - ...
- Mining the correlation between a series of independent variables (X) and dependent variables (Y)

Regression

- Which one of the following is false for building a regression model?

(X: independent variables; Y: dependent variables)

- 1. X is the working years of an employee, Y is the employee's salary
- 2. X is a child's height, Y is the height of the child's father or mother
- 3. X is the total production of a product, Y is the total consumption of the product
- 4. X is the total consumption of a product, Y is the total production of the product

Regression

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(X: independent variables; Y: dependent variables)

- 1. X is the working years of an employee, Y is the employee's salary
- 2. X is a child's height, Y is the height of the child's father or mother
- 3. X is the total production of a product, Y is the total consumption of the product (**iPhone**)
- 4. X is the total consumption of a product, Y is the total production of the product

What Kinds of Regularities?

- Association Rules
 - Detect sets of attributes or items that frequently co-occur in many records
 - On Thursday, during 4-11pm, customers often purchase diapers and beers together



Association Rules

- Where does the data come from?
 - supermarket transactions, customer complaint calls, discount coupons, etc.
- Cross-marketing analysis
 - purchase recommendation, cross selling
 - what are the subsequent purchases after buying a given product?
- Target-marketing
 - what types of users buy what products
- Catalog design

What Kinds of Regularities?

- **Clustering**

- seeks to find groups of closely related records (*e.g.*, users, articles, genes, planets)
- can be applied to
 - compress data
 - anomaly detection
 - reduce dimensions
 - group sets of related customers/products



Clustering

- Key steps
 - Feature extraction for each record
 - A user of Amazon
 - An article, *etc.*
 - Weighting for each feature
 - Linear
 - Nonlinear, *etc.*
 - Similarity measurement for *paired* records
 - Euclidean distance
 - Cosine similarity, *etc.*

Clustering

- How to decide these three articles as two groups/clusters?
 - 1: *I'm involved in the release of apple's iPhone 6.*
 - 2: *Apple's iPhone 6 released on Friday.*
 - 3: *I've eaten an apple this Friday.*

The screenshot shows the Clusty search engine interface. At the top, there's a navigation bar with links for 'web', 'news', 'blogs', 'wikipedia', 'jobs', and 'more'. The search bar contains 'iPhone 6' and a 'Search' button. Below the search bar, there are tabs for 'clouds', 'sources', 'sections', and 'time'. The 'clouds' tab is selected, showing a list of search results. The first result is 'All Results (307)' with a 'remix' button. Below this, there are several search results listed with their respective counts: 'Pre-orders (28)', 'Apple Pay (21)', 'Samsung (17)', 'China (20)', 'Stocks (17)', 'iPhone 6 launch (15)', 'IOS 8 (13)', and 'Buy The Iphone 6 (10)'. The main content area displays the top 307 results for the query 'iPhone 6'. The first result is 'Apple's latest iPhones: What's in the box?' from CNBC, dated 1 hour ago. The second result is 'Big Day for Apple's Plus-Sized Phones' from ABC News, dated 2 hours ago.

Clusty

web news blogs wikipedia jobs more »

iPhone 6 Search advanced preferences

Top News World U.S. Business Sports Health Tech Science

Top 307 results retrieved for the query iPhone 6 (details)

Search Results

Apple's latest iPhones: What's in the box? 1 hour ago - They are bigger, slimmer and have faster processors than the iPhones that came before them, but what's in Apple's new iPhone 6 and iPhone 6 Plus box? www.cnbc.com/id/102009946 - [cache] - CNBC

Big Day for Apple's Plus-Sized Phones 2 hours ago - September 19 has been circled on the calendar of Apple enthusiasts who woke up in the middle of the night last week to pre-order the new iPhone 6 and iPhone 6 Plus. Others have spent days camped outside Apple stores for a chance to be one of the first customers to purchase a new device when the... abcnews.go.com/Technology/buying-apple-iphone-iphone-today/story?id=25601151 - [cache] - ABC News