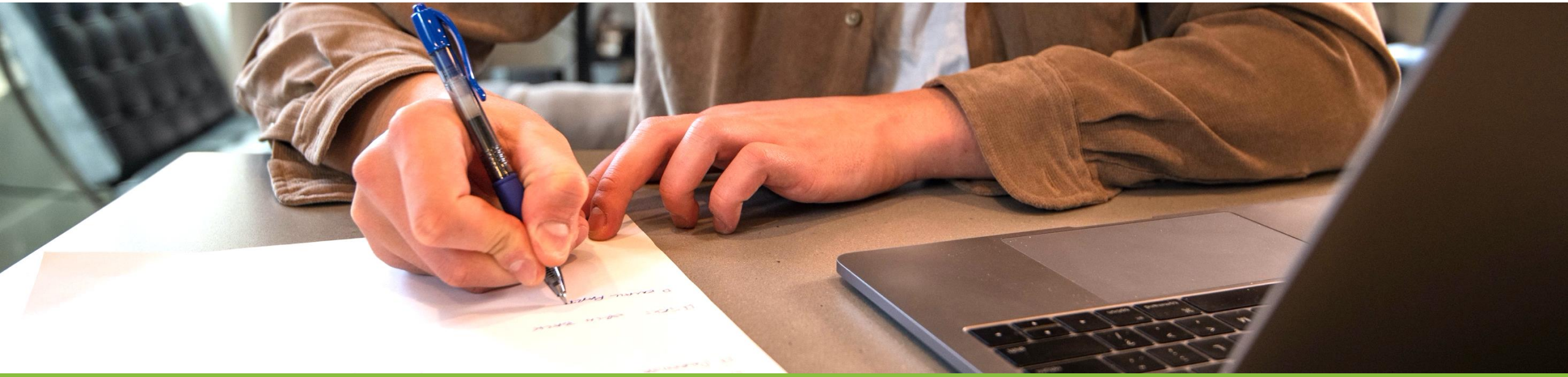

Introduction to Intelligent User Interfaces

Artificial Intelligence: An Overview for HCI

Image Source

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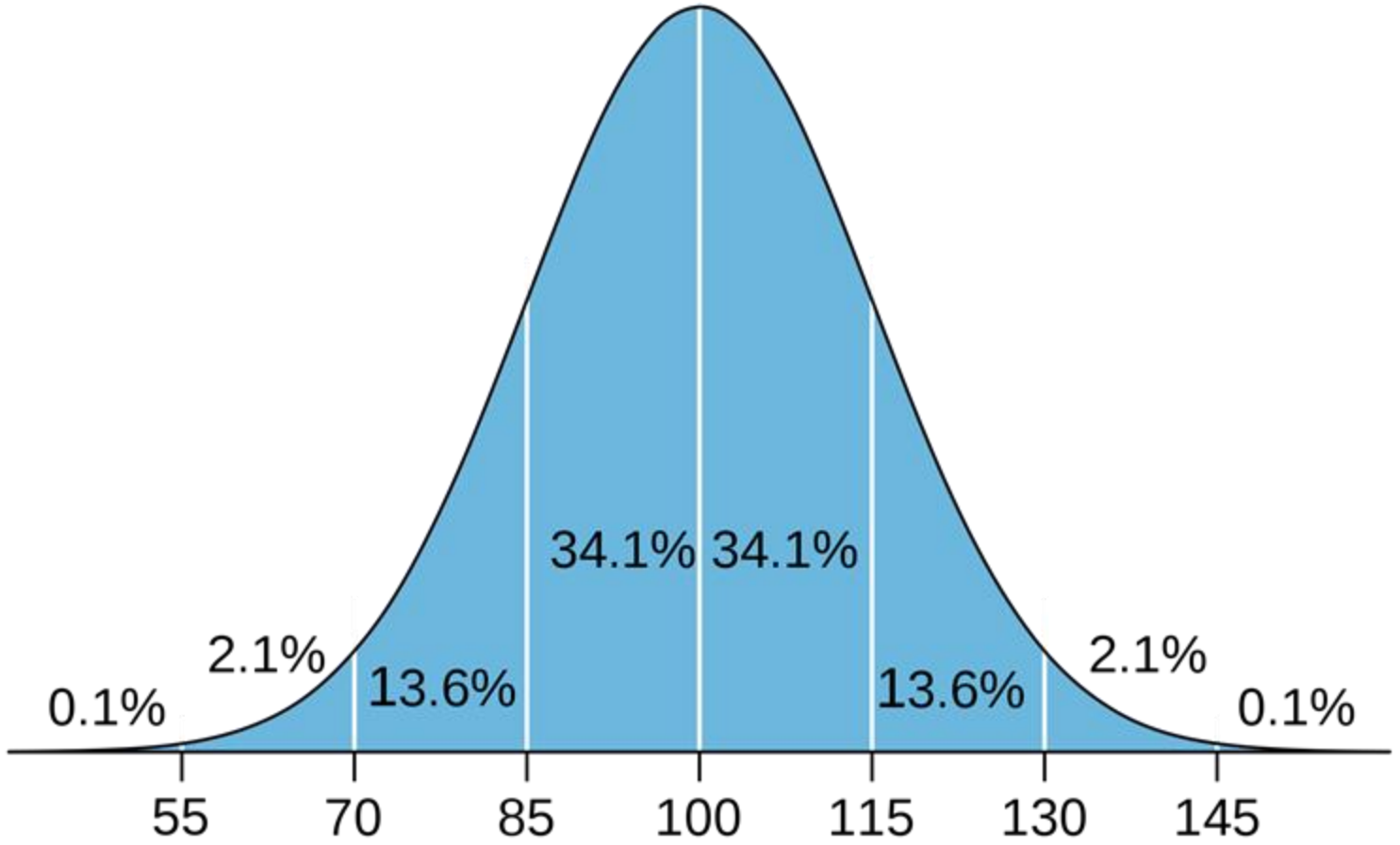
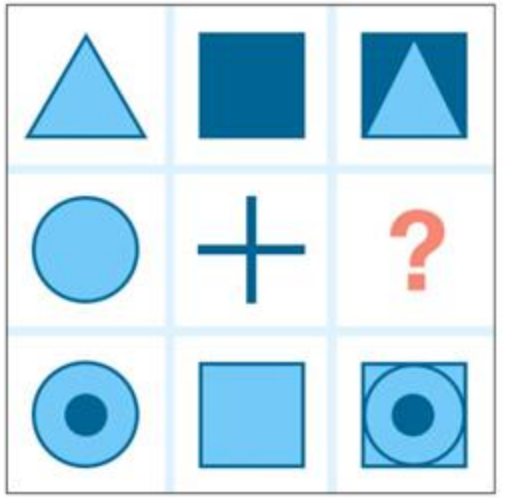
What is considered Artificial Intelligence?

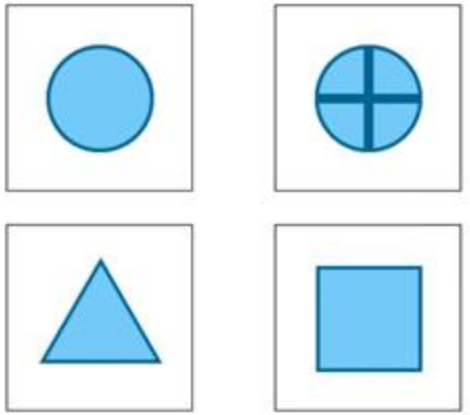
What is considered Artifical Intelligence?

What is Human Intelligence?





Which figure fits?



Artificial Intelligence?

- Artificial Narrow Intelligence (also Weak AI)
  - Solves very specific and well described problems in a specific domain
- Artificial General Intelligence (also Strong AI)
  - An artificial intelligence that has the ability to mimic human intelligence
  - Its behavior cannot be distinguished by observation from a human
- Artificial Super Intelligence
  - An artificial intelligence that surpasses human intelligence

http://www.geminoid.jp/en

AI Knowledge Map: how to classify AI technologies

A sketch of a new AI technology landscape by Francesco Corea

- **Technologies**
  - Logic-based
  - Knowledge-based
  - Probabilistic methods
  - Machine learning
  - Embodied intelligence
  - Search and optimization
- **Domains**
  - Reasoning
  - Knowledge
  - Planning
  - Communication
  - Perception

https://medium.com/@Francesco_AI/ai-knowledge-map-how-to-classify-ai-technologies-6c073b969020

AI Knowledge Map: how to classify AI technologies

A sketch of a new AI technology landscape by Francesco Corea

Technologies

- **Logic-based tools**: tools that are used for knowledge representation and problem-solving
- **Knowledge-based tools**: tools based on ontologies and huge databases of notions, information, and rules
- **Probabilistic methods**: tools that allow agents to act in incomplete information scenarios
- **Machine learning**: tools that allow computers to learn from data
- **Embodied intelligence**: engineering toolbox, which assumes that a body (or at least a partial set of functions such as movement, perception, interaction, and visualization) is required for higher intelligence
- **Search and optimization**: tools that allow intelligently searching through many possible solutions

https://medium.com/@Francesco_AI/ai-knowledge-map-how-to-classify-ai-technologies-6c073b969020

AI Knowledge Map: how to classify AI technologies

A sketch of a new AI technology landscape by Francesco Corea

Domains

- **Reasoning**: the capability to solve problems
- **Knowledge**: the ability to represent and understand the world
- **Planning**: the capability of setting and achieving goals
- **Communication**: the ability to understand language and communicate
- **Perception**: the ability to transform raw sensorial inputs (e.g., images, sounds, etc.) into usable information

https://medium.com/@Francesco_AI/ai-knowledge-map-how-to-classify-ai-technologies-6c073b969020

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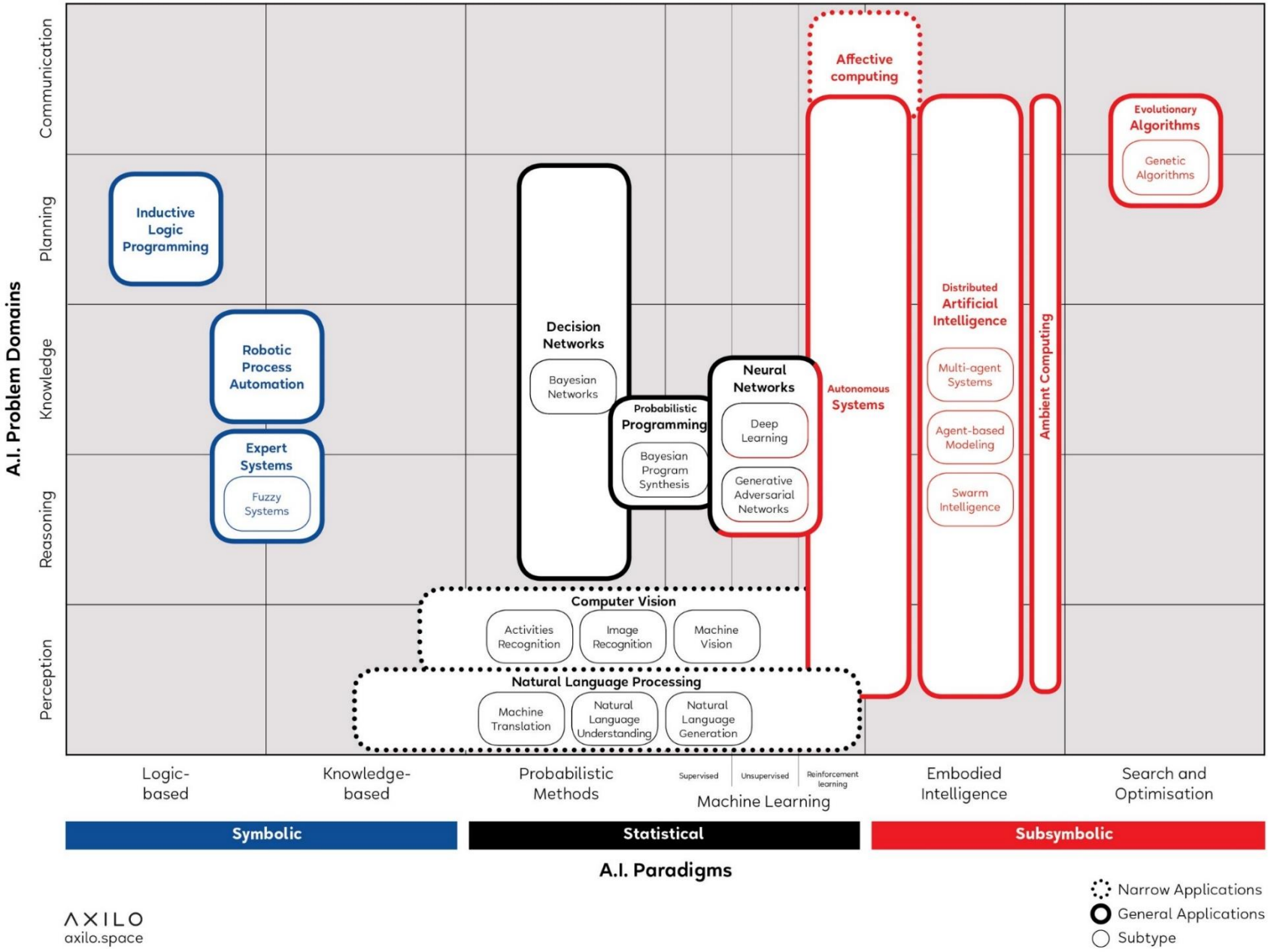
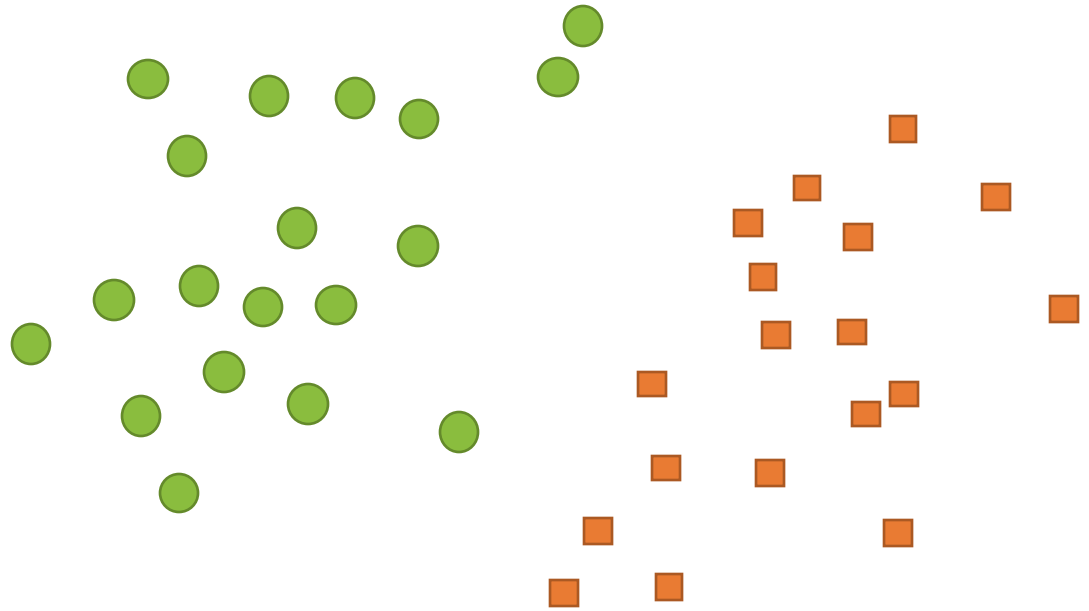


AI Knowledge Map: how to classify AI technologies. A sketch of a new AI technology landscape Francesco Corea

Classification

e.g. is an Email spam or not?



- These are your examples…
- How can we find a “line” that separates the two groups?

Classification

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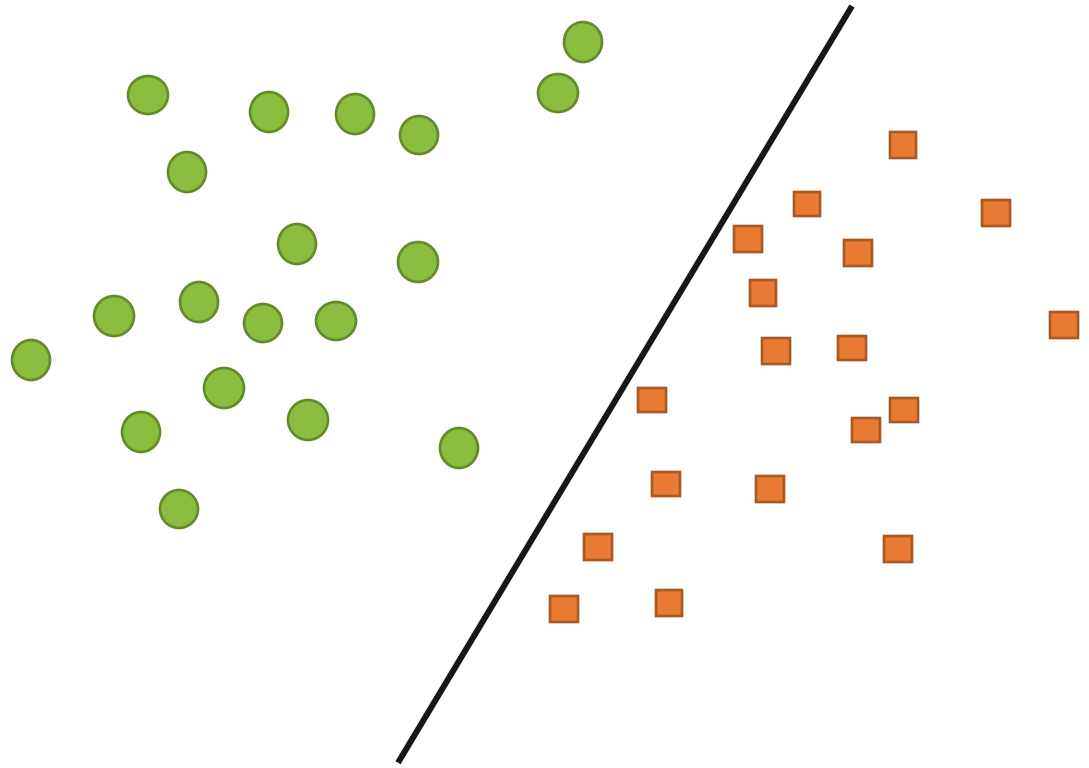

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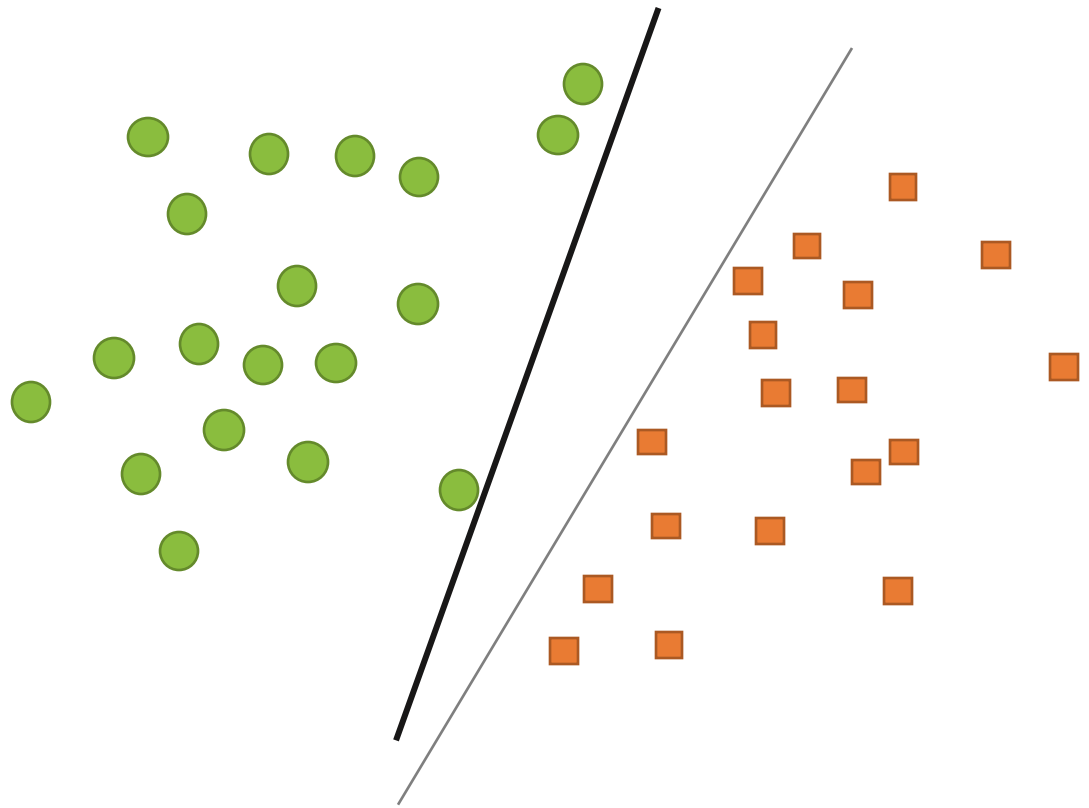

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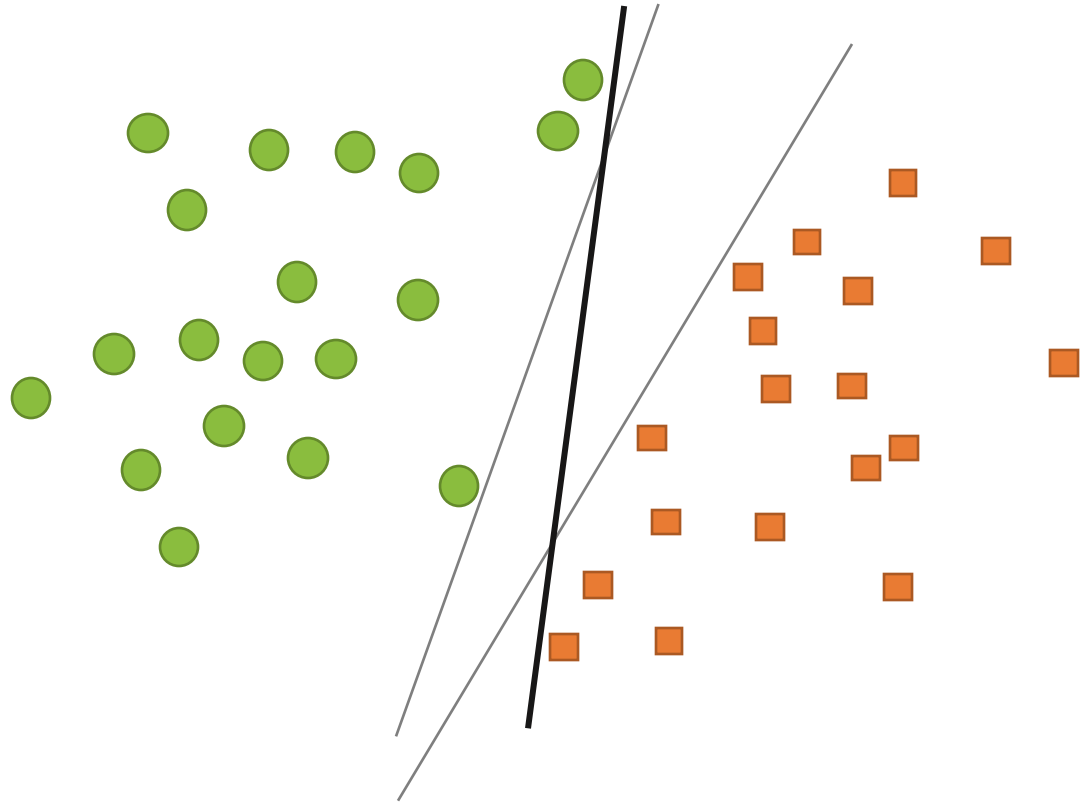

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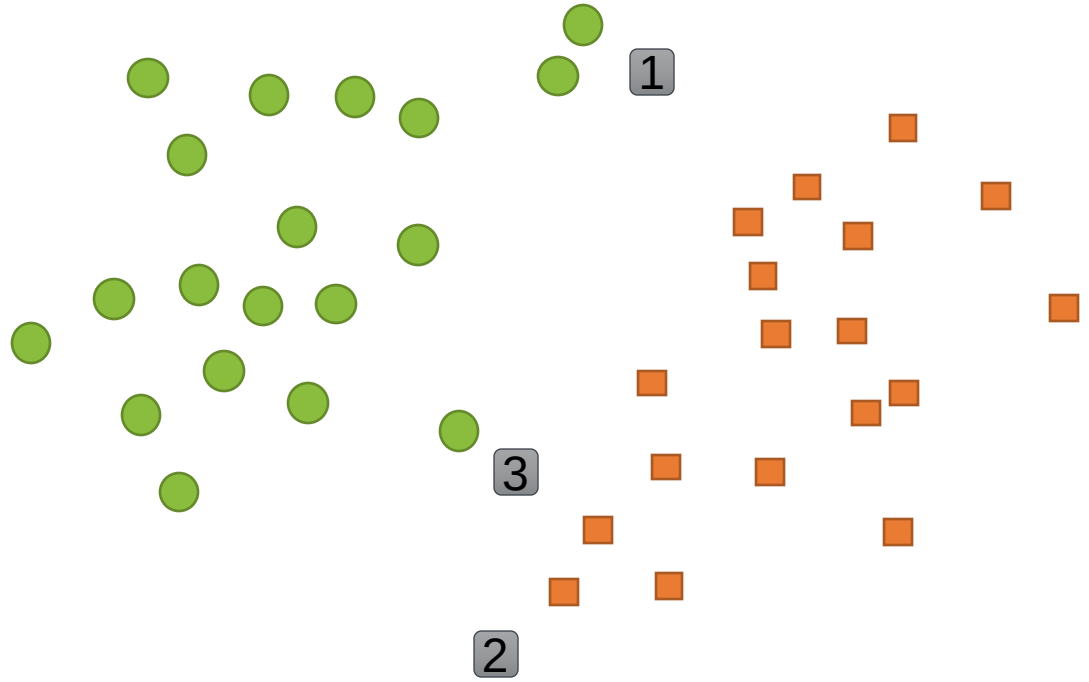
Classification

e.g. is an Email spam or not?

- How will you classify the new data points?



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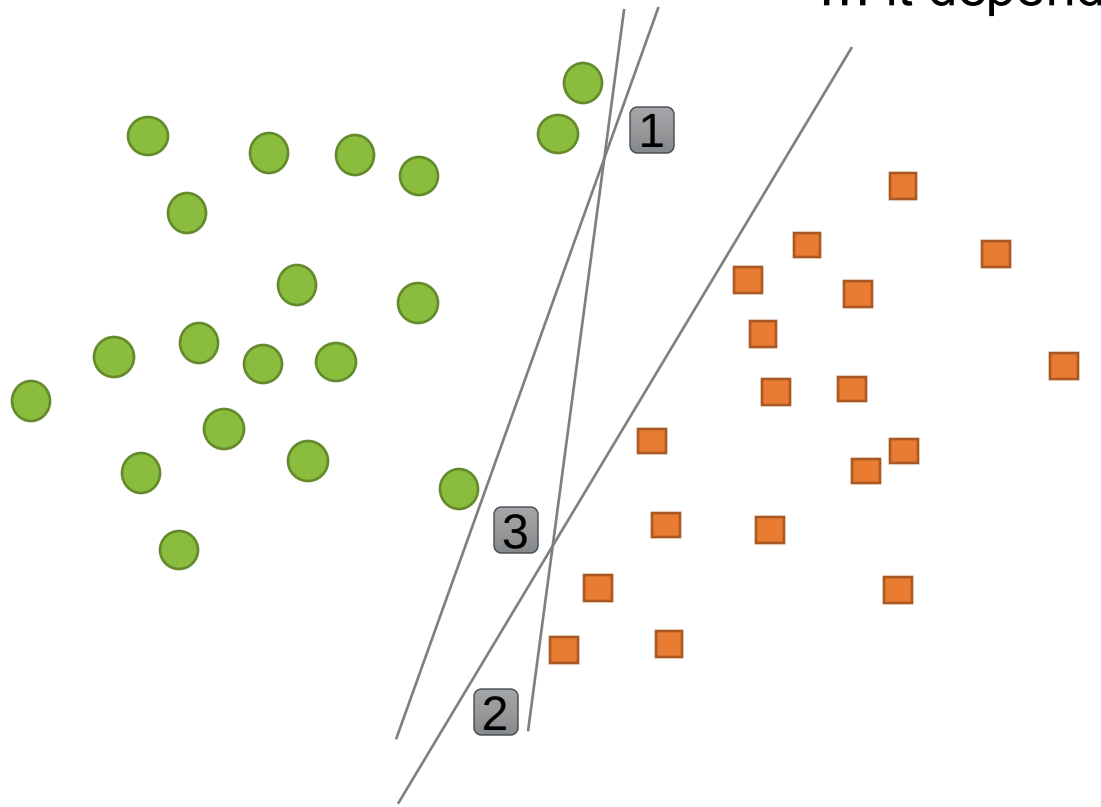
- How can we find a “line” that separates the two groups?

Classification

e.g. is an Email spam or not?

- How will you classify the new data points?

… it depends on your “line”



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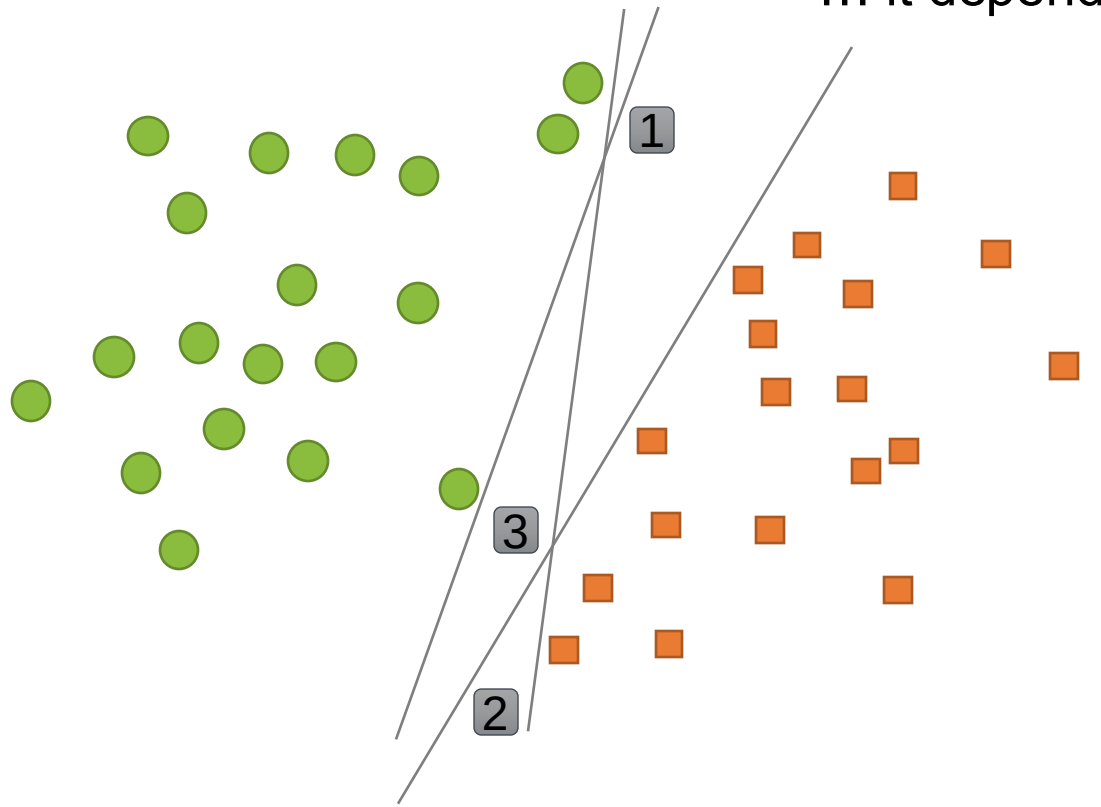
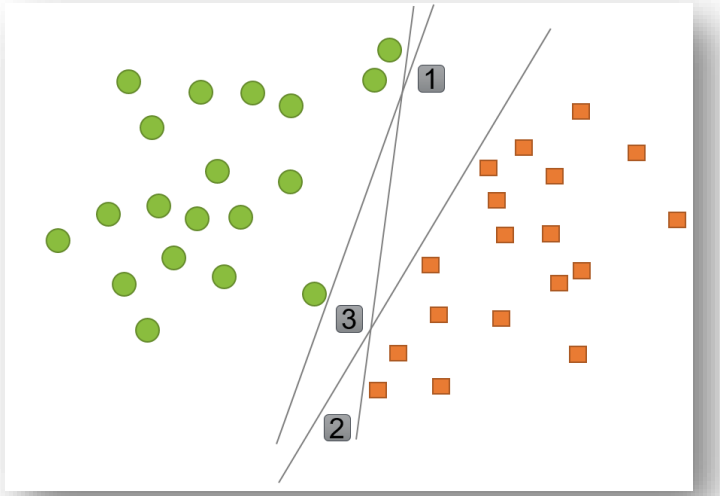


- These are your examples…
- How can we find a “line” that separates the two groups?

Classification

Example: Support Vector Machines (SVM)

- Determine whether a given data point belongs to a certain class or not
- Supervised method:
  - First training a classifier model on data points for which the class is known (e.g. a set of emails that are labeled as spam or not spam)
  - Then use the model to determine the class of new, unseen data-points
- Find the boundary line that separates two classes
- The boundary line should create a maximum separation between the classes



https://www2.deloitte.com/nl/nl/pages/data-analytics/articles/part-2-artificial-intelligence-techniques-explained.html#

Classification

Example: Support Vector Machines (SVM)

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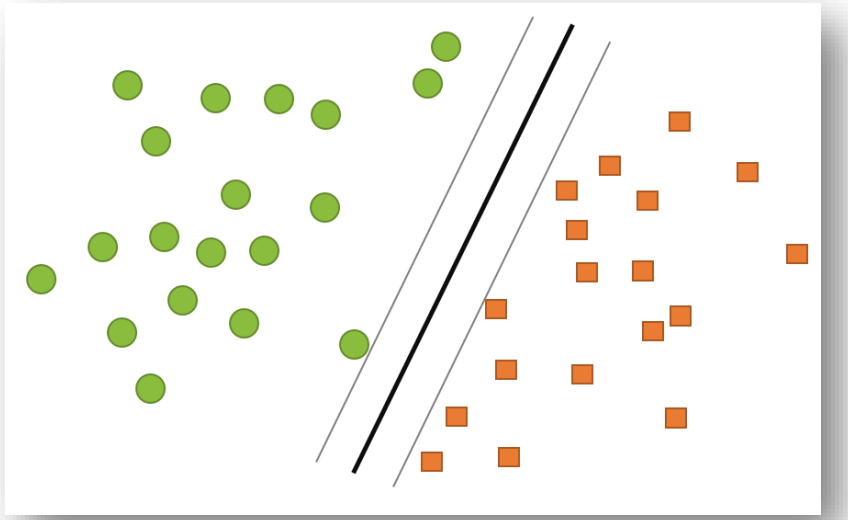
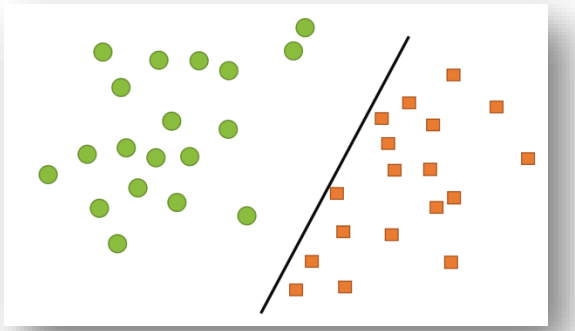
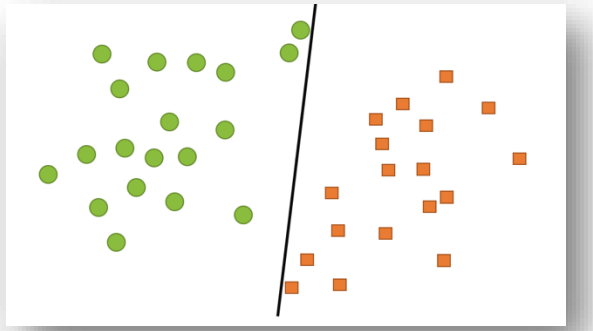
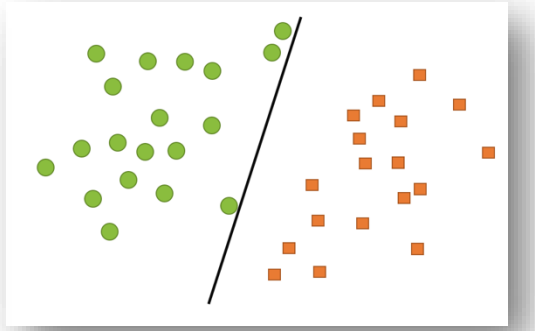




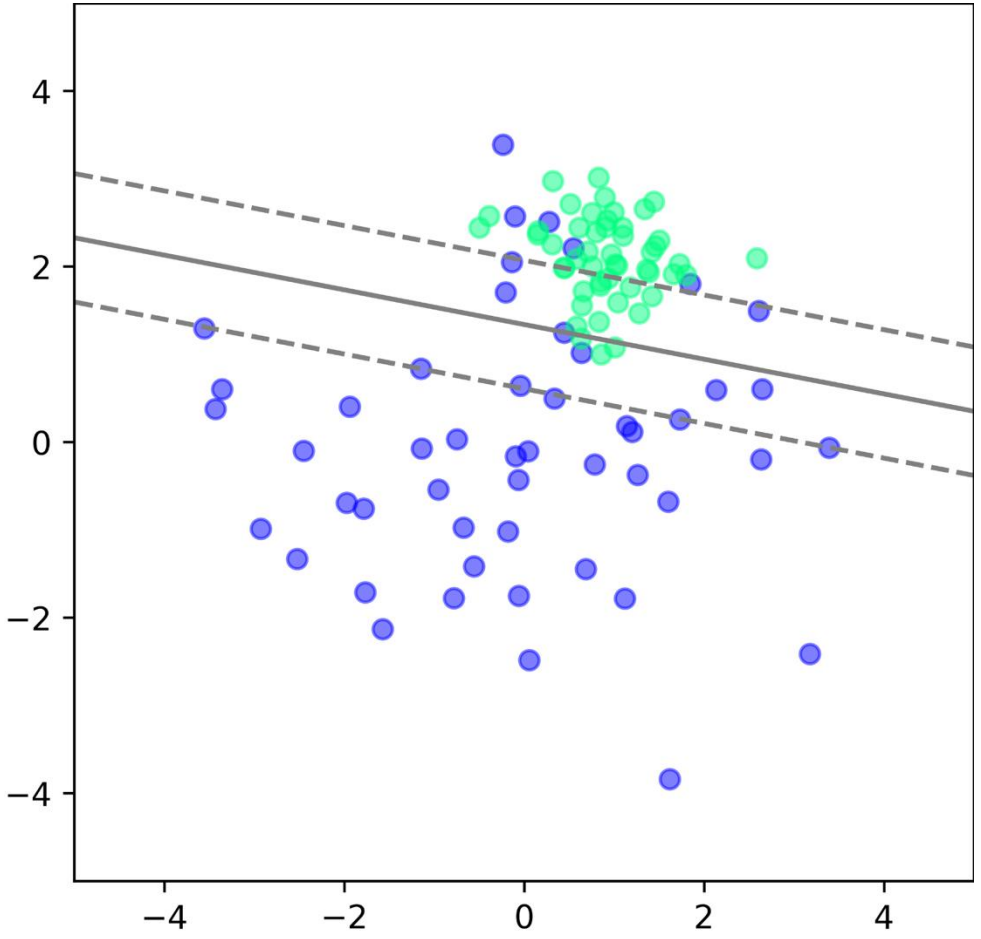




Live Coding Example 1

SVM in Python

- SVM with scikit-learn
  https://scikit-learn.org



Supervised Learning vs. Unsupervised Learning

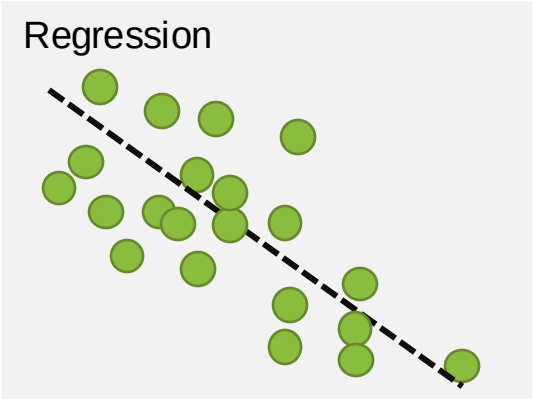
- Supervised Learning
  - We have a set of examples (data point) for which we know the ground truth (knowledge about the group the data point belongs to)
  - Typically a data set with labels exists (or is created)
  - During learning the algorithm look at the data AND the desired outcome and learns to associated them
  - Learning / preparation is done with a learning set
  - It is tested with a set that has not been used for learning
- Unsupervised learning
  - We may not know what class or group a data point belongs to
  - It may not be clear how many classes exist
  - The goal is to infer the natural structure present within a set of data points

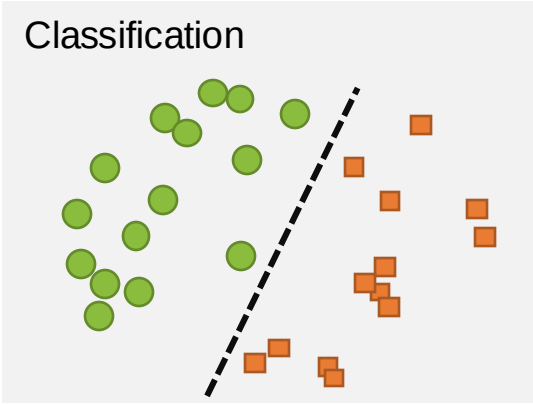
https://towardsdatascience.com/supervised-vs-unsupervised-learning-14f68e32ea8d

Supervised Learning

“Supervised learning is typically done in the context of classification, when we want to map input to output labels, or regression, when we want to map input to a continuous output. Common algorithms in supervised learning include logistic regression, naive bayes, support vector machines, artificial neural networks, and random forests. In both regression and classification, the goal is to find specific relationships or structure in the input data that allow us to effectively produce correct output data. Note that “correct” output is determined entirely from the training data, so while we do have a ground truth that our model will assume is true, it is not to say that data labels are always correct in real-world situations. Noisy, or incorrect, data labels will clearly reduce the effectiveness of your model.”

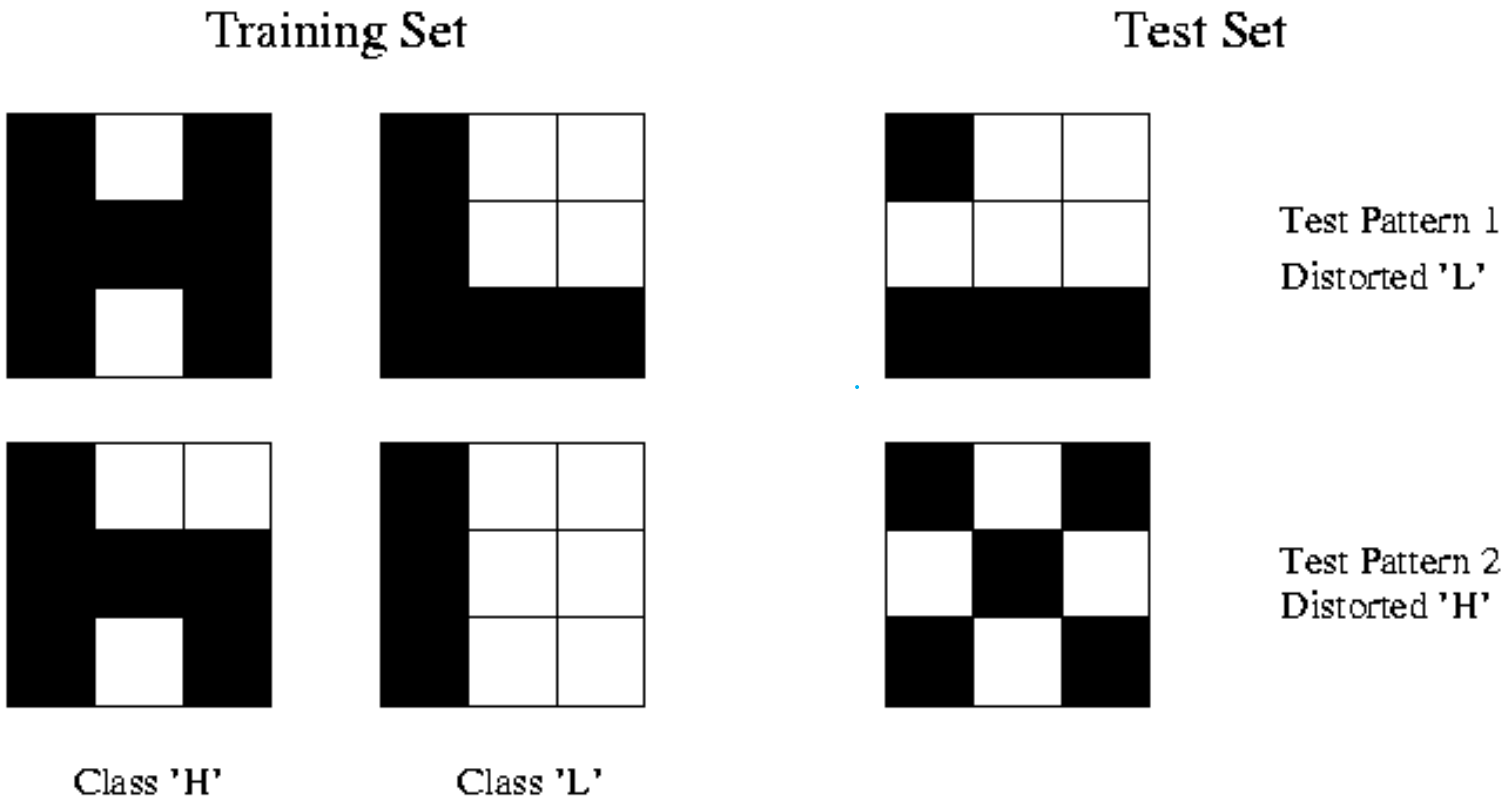
https://towardsdatascience.com/supervised-vs-unsupervised-learning-14f68e32ea8d





Live Coding Example 2

H or L



IUI - SVM - Example 1 | IUI - SVM - Example 2 | IUI - Clustering

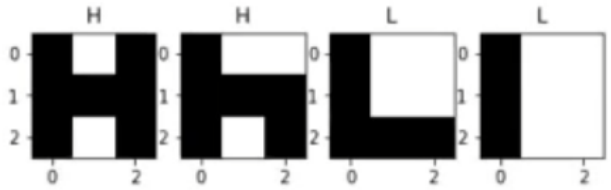
localhost:8888/notebooks/IUI%20-%20SVM%20-%20Example%202.ipynb#

jupyter IUI - SVM - Example 2 Last Checkpoint: 8 minutes ago (unsaved changes) Logout

File Edit View Insert Cell Kernel Widgets Help Trusted Python 3

Run Markdown

```
for i in range(4):
    ax[i].imshow(1-x[i].reshape((3,3)), cmap="gray")
    ax[i].set_title(value_map[y[i]])
```



Training ¶

In [3]:
```
classifier = sklearn.svm.SVC(gamma=0.001, kernel="linear")

classifier.fit(x, y)
```

Out[3]:
```
SVC(gamma=0.001, kernel='linear')
```

Testing

In [ ]:
```
x_test = np.array([[1,0,0,0,0,0,1,1,1], [1,0,1,0,1,0,1,0,1,]])
y_test = [1,0]

fig, ax = plt.subplots(1,2)
```

Unsupervised Learning

Exercise: make reasonable groups!

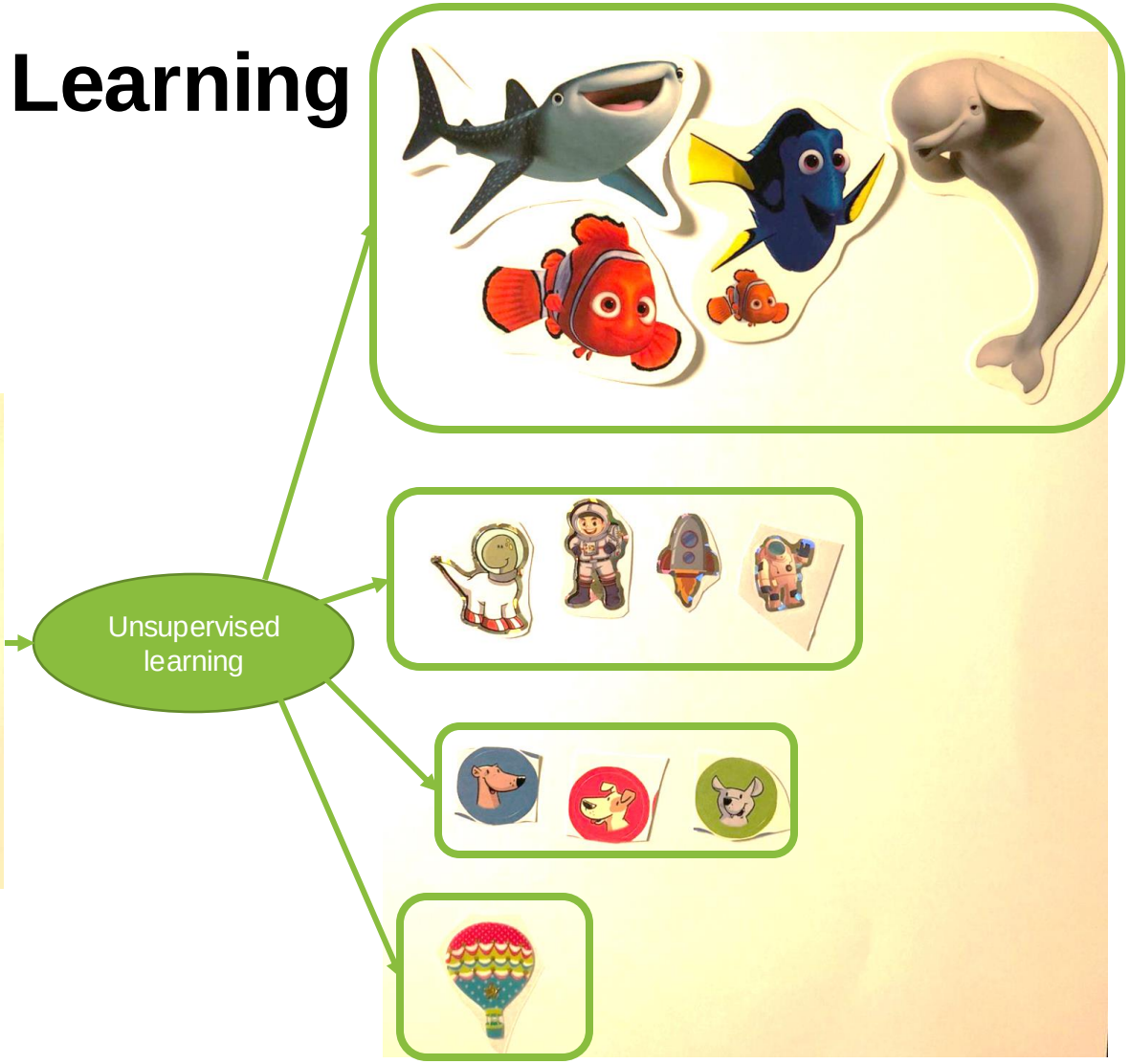
“The most common tasks within unsupervised learning are clustering, representation learning, and density estimation. In all of these cases, we wish to learn the inherent structure of our data without using explicitly-provided labels. Some common algorithms include k-means clustering, principal component analysis, and autoencoders. Since no labels are provided, there is no specific way to compare model performance in most unsupervised learning methods.

Two common use-cases for unsupervised learning are exploratory analysis and dimensionality reduction.”

https://towardsdatascience.com/supervised-vs-unsupervised-learning-14f68e32ea8d

Unsupervised Learning

Make reasonable groups!



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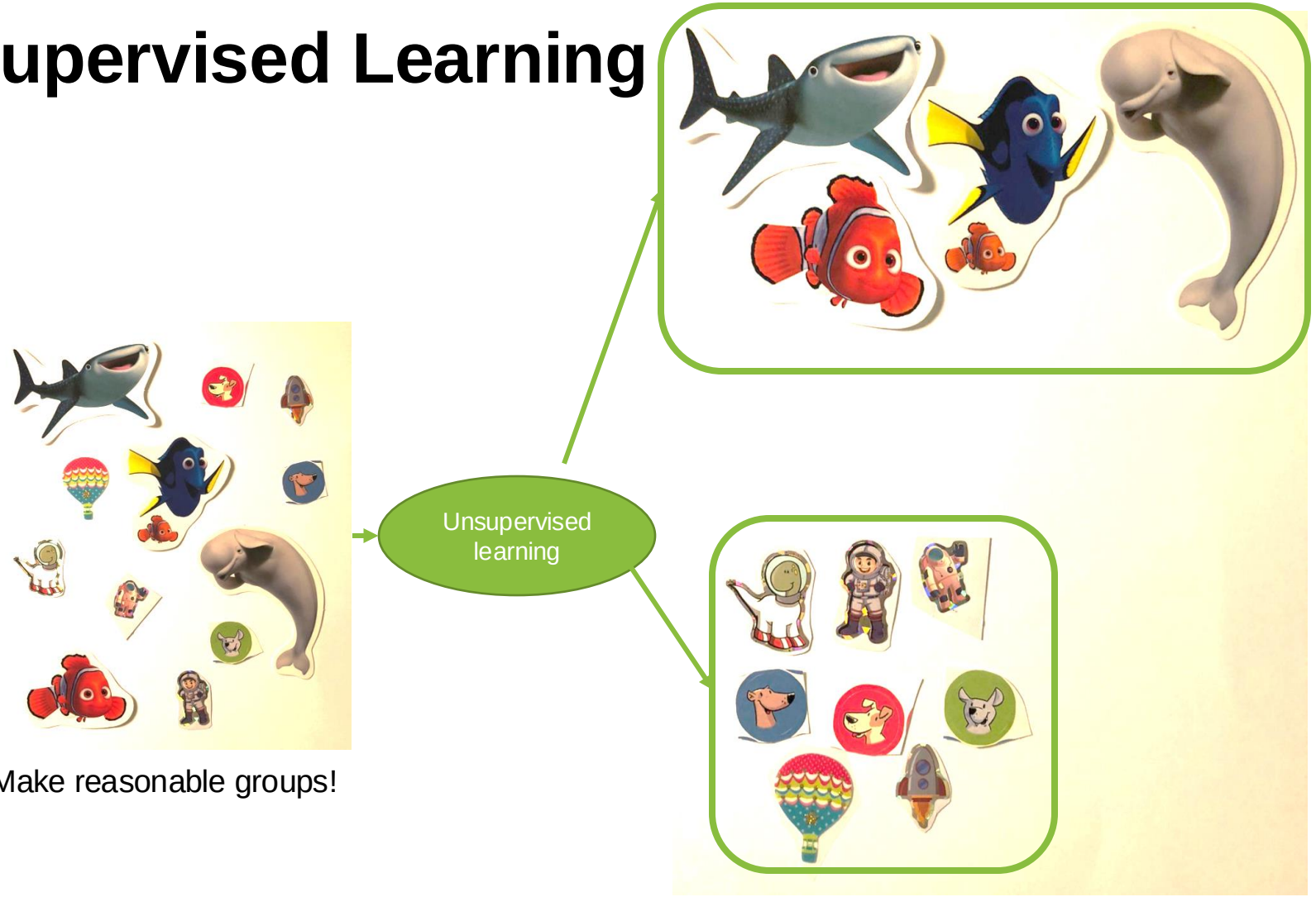
Unsupervised Learning



Make reasonable groups!

https://towardsdatascience.com/supervised-vs-unsupervised-learning-14f68e32ea8d

Unsupervised Learning

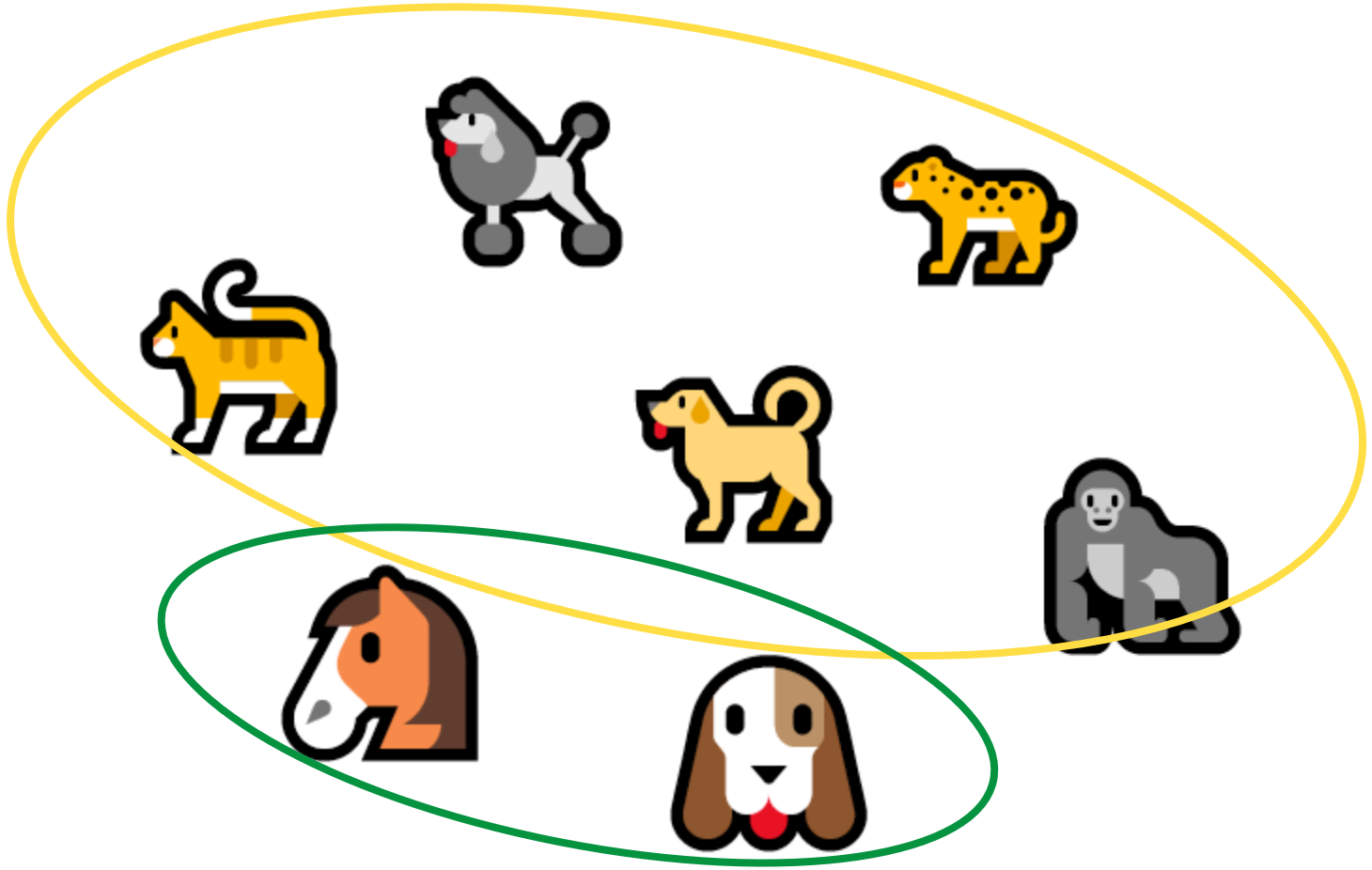
- Data

Not needed:

- Lables (Classes)
- Continues values

Unsupervised Learning

What can we learn just buy looking at the data?



Unsupervised Learning

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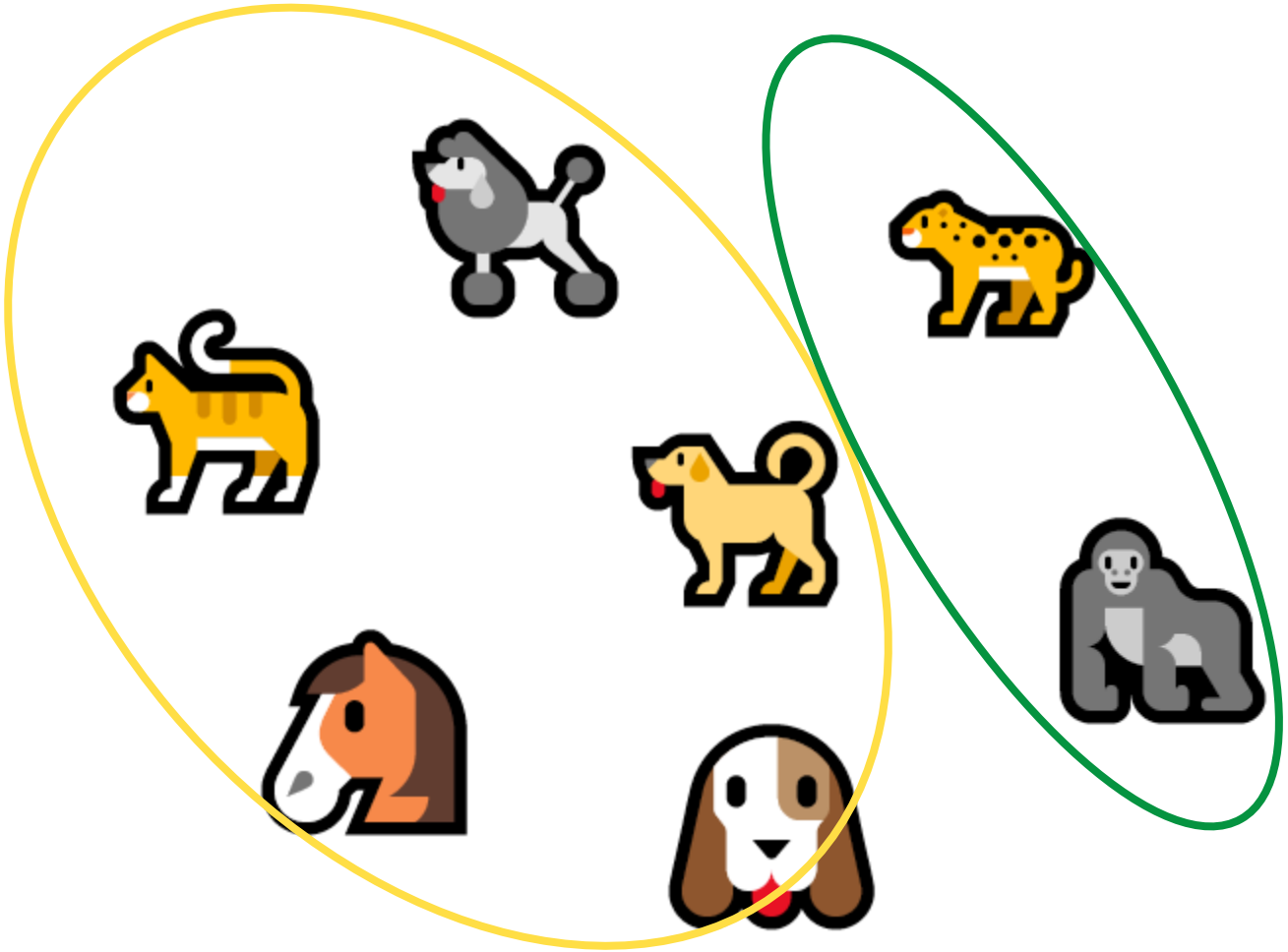


Learning Strategies

	Supervised Learning	Unsupervised Learning
Discrete	Classification or Categorization	Clustering
Continuous	Regression	Dimensionality reduction

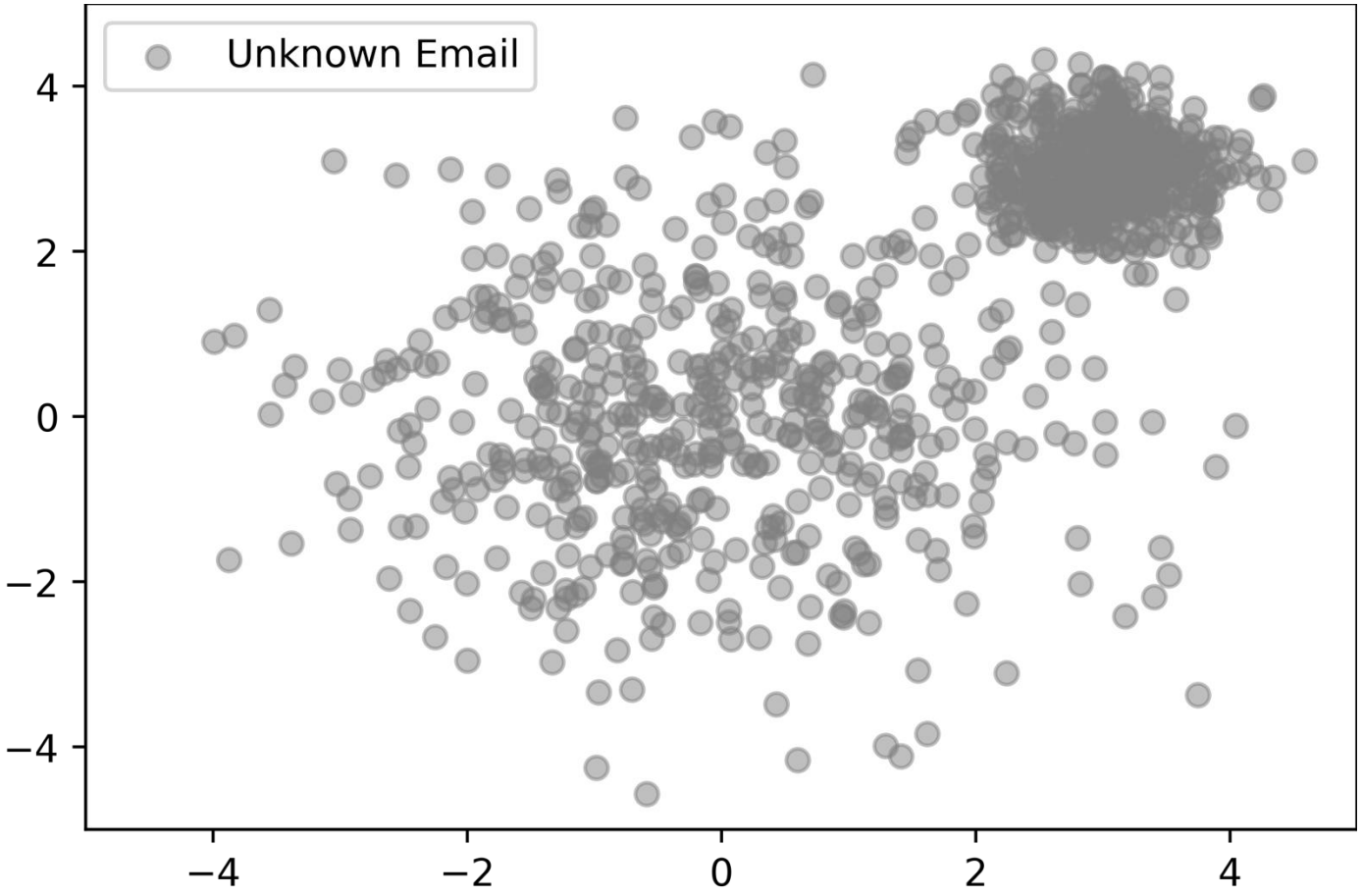
Unsupervised Learning Methods

- Hierarchical clustering
- **K-means clustering**
- **Principal Component Analysis (PCA)**
- Singular Value Decomposition
- Independent Component Analysis
- ….

Clustering

Unsupervised Learning

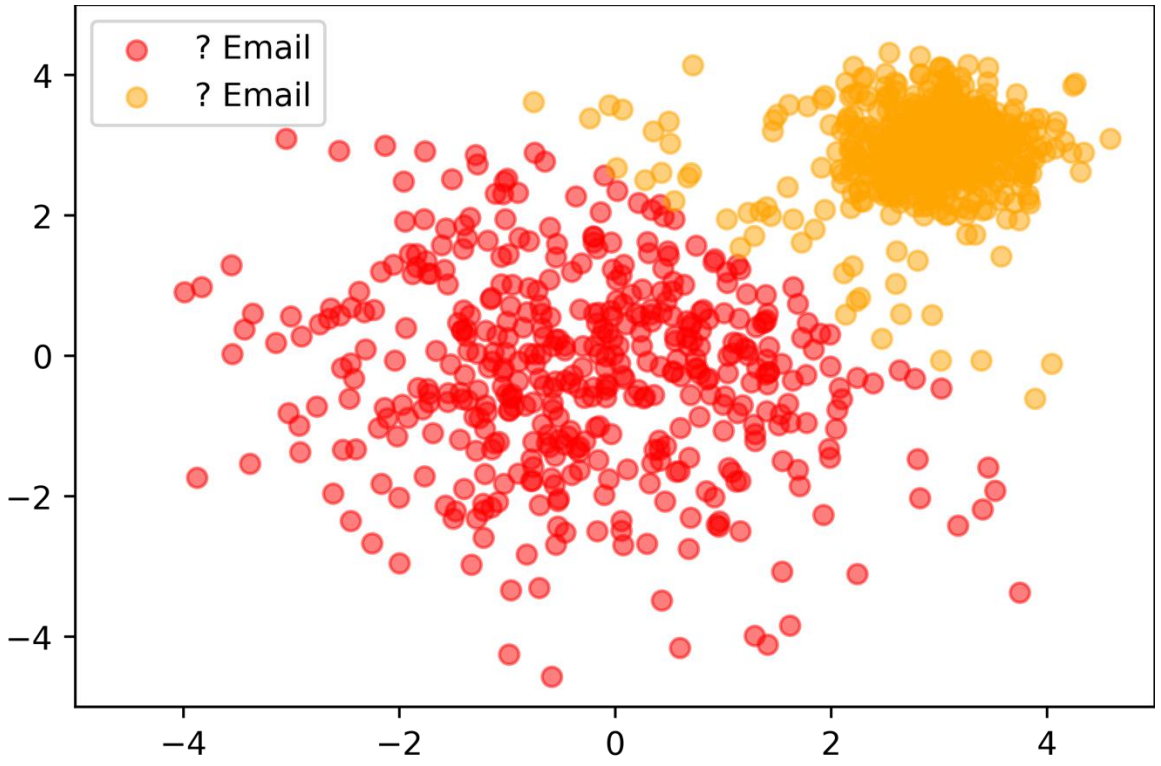
Unknown Data



Clustering

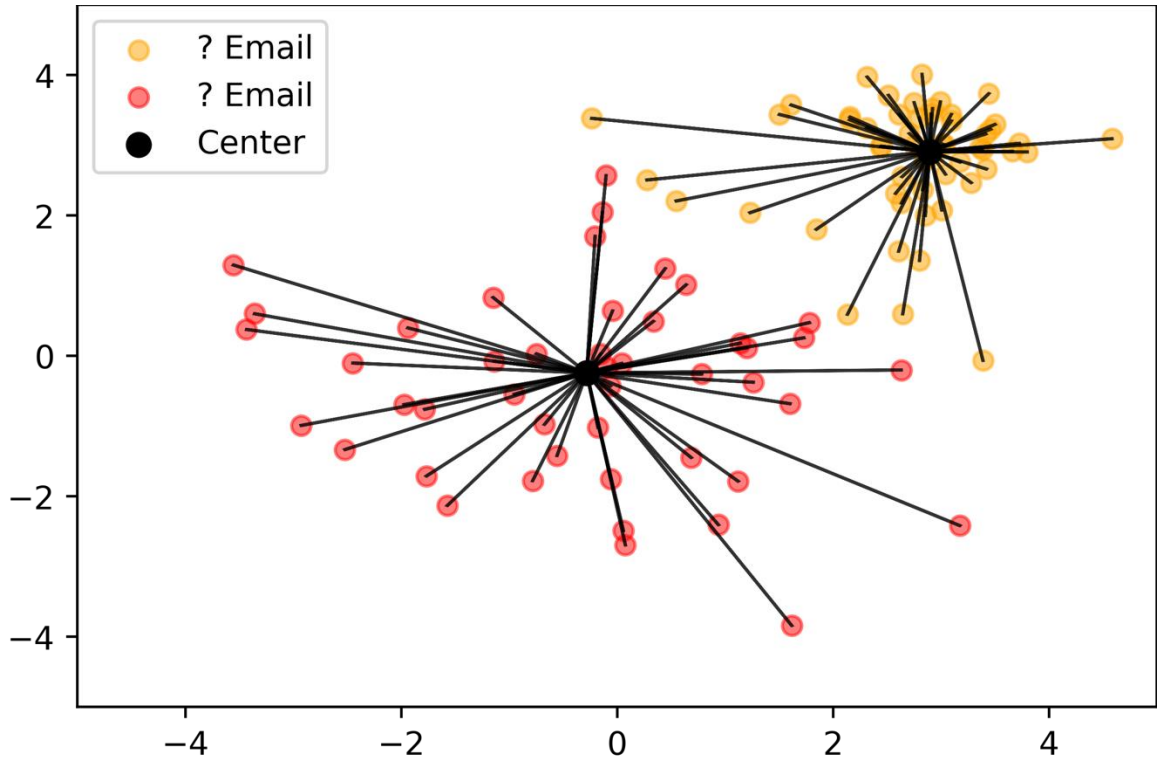
K-means clustering

- Uncovering “structure” in unlabeled data



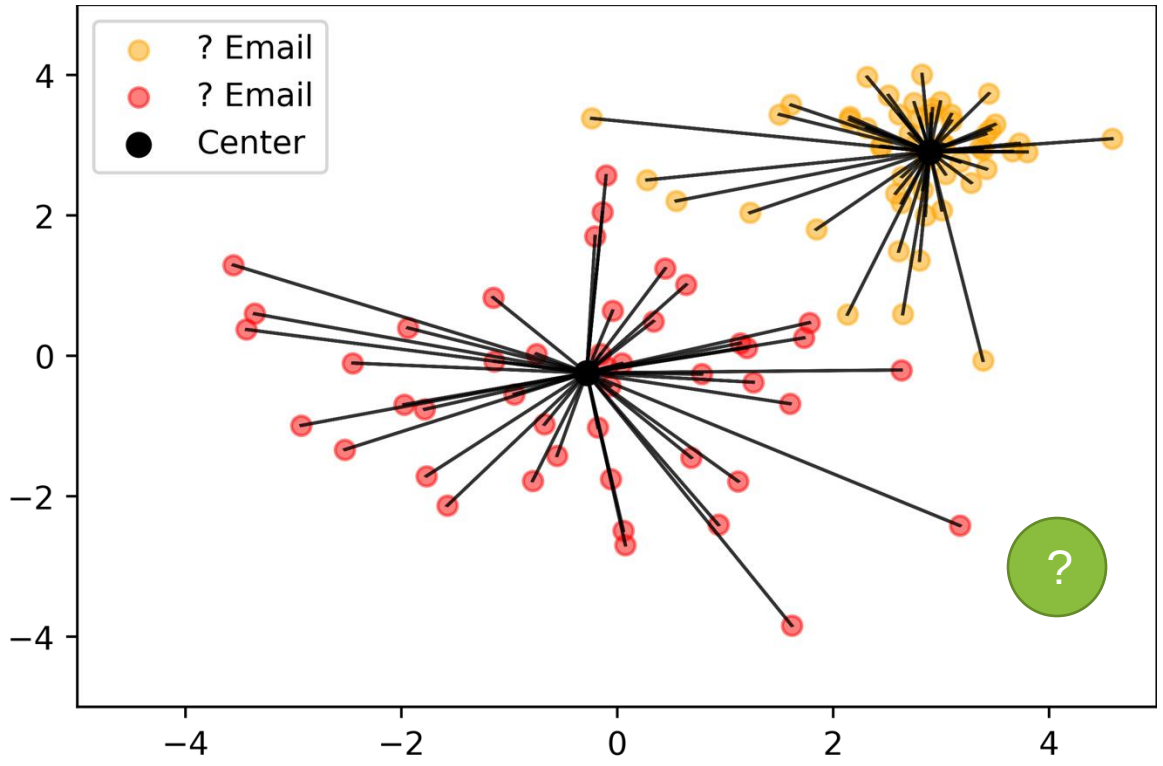
Clustering

K-means clustering



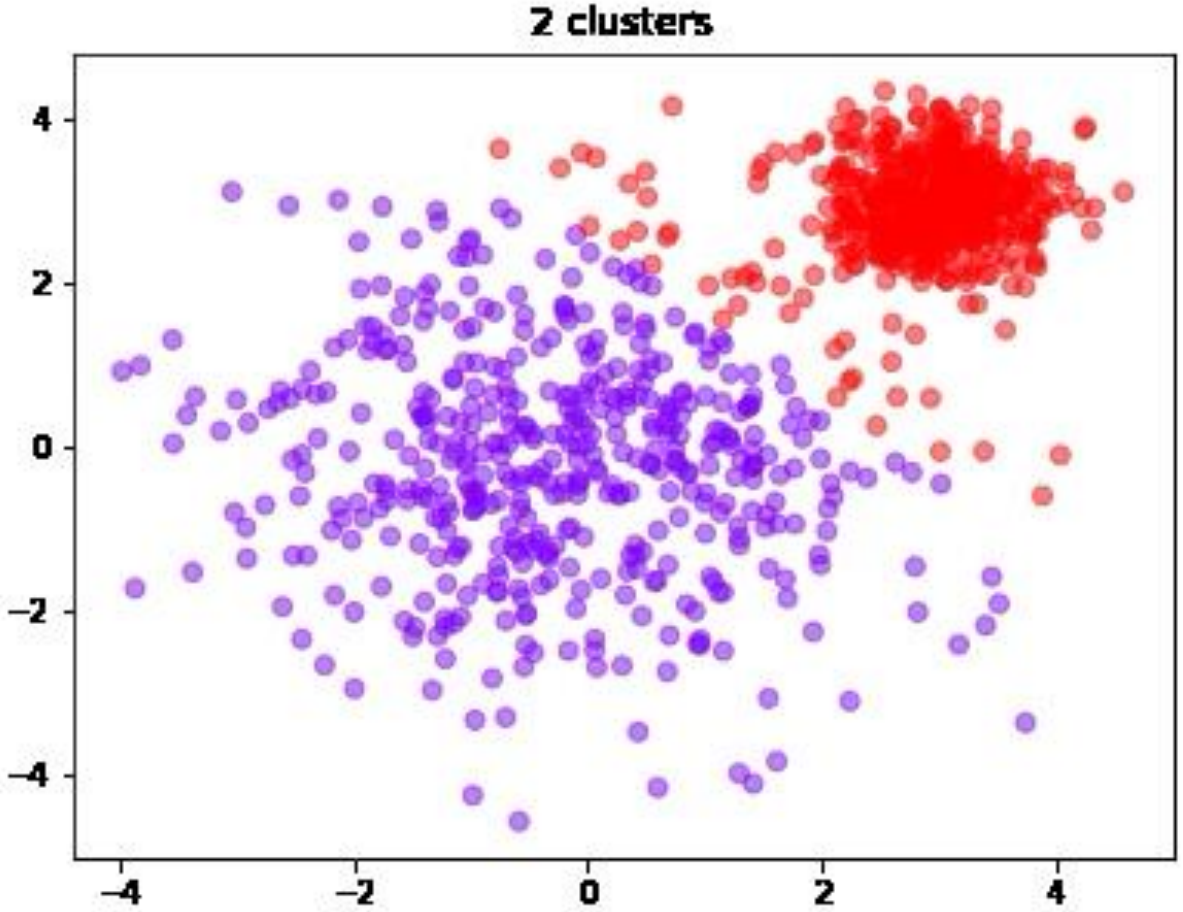
Clustering

K-means clustering



Clustering

Cluster Count?



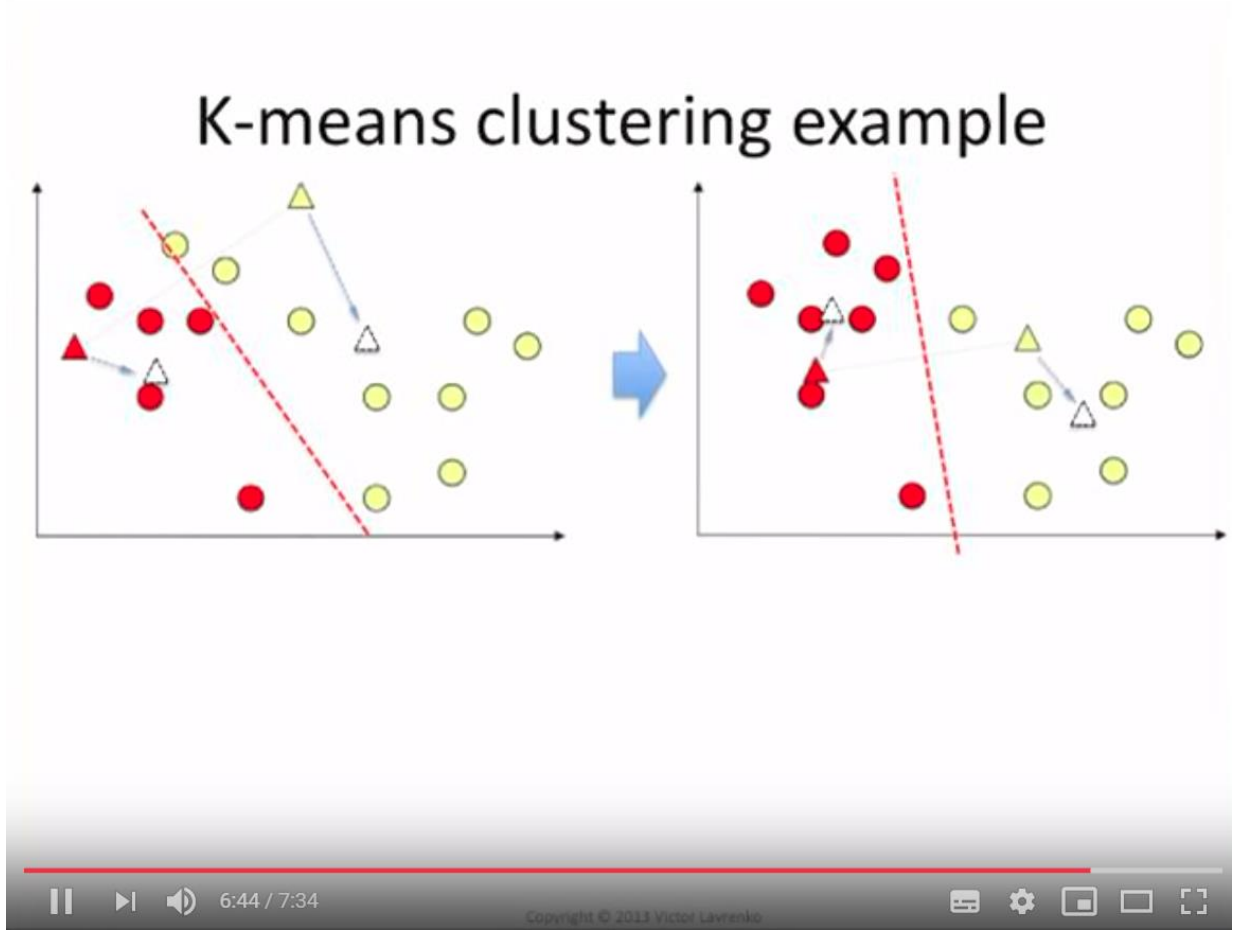
Supervised Learning vs. Unsupervised Learning

	Supervised Learning	Unsupervised Learning
Discrete	Classification or Categorization	Clustering
Continuous	Regression	Dimensionality reduction

https://towardsdatascience.com/supervised-vs-unsupervised-learning-14f68e32ea8d

Example: Clustering

https://www.youtube.com/watch?v=_aWzGGNrcic



Discussion: Usable Security

- Detecting “the wrong user” trying to log in?
- Detecting a denial of service vs. a user who forgot her password?
- How can you do use machine learning to do this?
- How to use a cluster algorithm?

	Supervised Learning	Unsupervised Learning
Discrete	Classification or Categorization	Clustering
Continuous	Regression	Dimensionality reduction

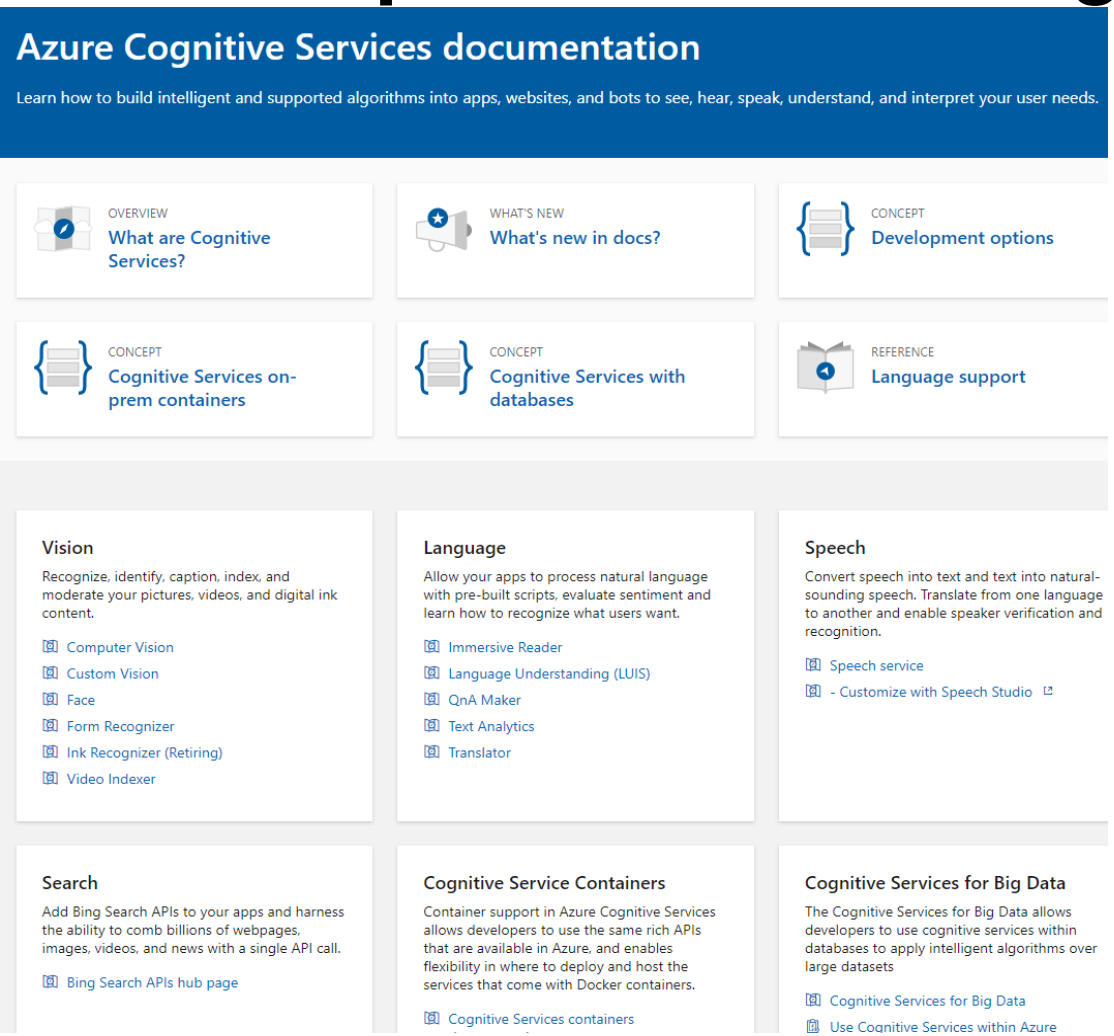
https://towardsdatascience.com/supervised-vs-unsupervised-learning-14f68e32ea8d

Implementing AI

- Libraries
- Frameworks
- Web Services

See Exercises and Tutorials…

Cloud Services
Example: Microsoft Cognitive Services



https://docs.microsoft.com/en-us/azure/cognitive-services/

Cloud Services from:

- IBM
- Google
- Amazon
- Microsoft
- … and many others

Why do people use them?

What is the risk?

Discussion

Pros and Cons of Online APIs for AI/Machine learning?

How to Install Python

- Python with pip https://www.python.org/downloads/
- Python in the web via Google Colab https://colab.research.google.com
- Python via Anaconda www.anaconda.com