COSC 419 Topics in Computer Science

Artificial intelligence

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What is AI?

What is Artificial Intelligence

Artificial Intelligence (AI) is a branch of computer science that focuses on creating systems and machines capable of performing tasks that typically require human intelligence. These tasks include learning, reasoning, problem-solving, perception, language understanding, and decision-making. AI aims to mimic cognitive functions that humans associate with the human mind, such as learning from experience, recognizing patterns, and adapting to new information.

Key Components of AI

- Machine Learning (ML):
  - A subset of AI that enables machines to learn from data without being explicitly programmed.
  - Uses algorithms to identify patterns, make decisions, and improve over time with experience.
- Deep Learning:
  - A further subset of machine learning that uses neural networks with many layers (deep neural networks) to model complex patterns in data.
  - Especially effective for tasks like image and speech recognition.
- Natural Language Processing (NLP):
  - Involves the interaction between computers and human language.
  - Enables machines to understand, interpret, and generate human language, including speech and text

Other Fields of AI

- Computer Vision:
  - Enables machines to interpret and understand visual information from the world, such as images and videos.
  - Used in applications like facial recognition, object detection, and autonomous driving.
- Robotics:
  - Involves creating intelligent robots that can perform tasks autonomously or semi-autonomously.
  - Combines AI with physical components to interact with the physical world.
- Expert Systems:

  AI programs that mimic the decision-making ability of a human expert in specific domains.

  Used for tasks like medical diagnosis, financial forecasting, and troubleshooting.

What is an Artificial Intelligence Model?

An Artificial Intelligence (AI) model is a mathematical and computational framework that uses algorithms and data to perform tasks that typically require human intelligence.

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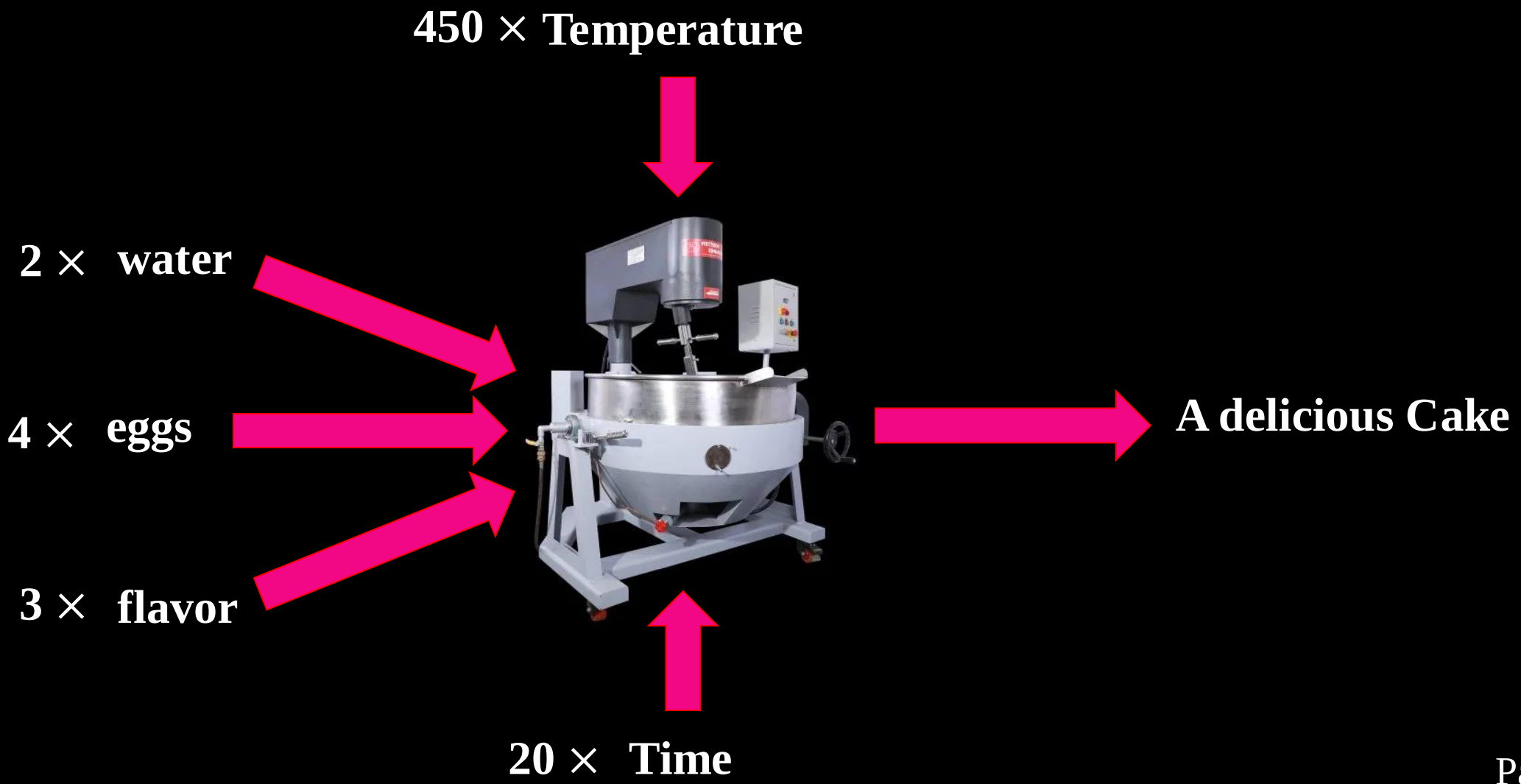

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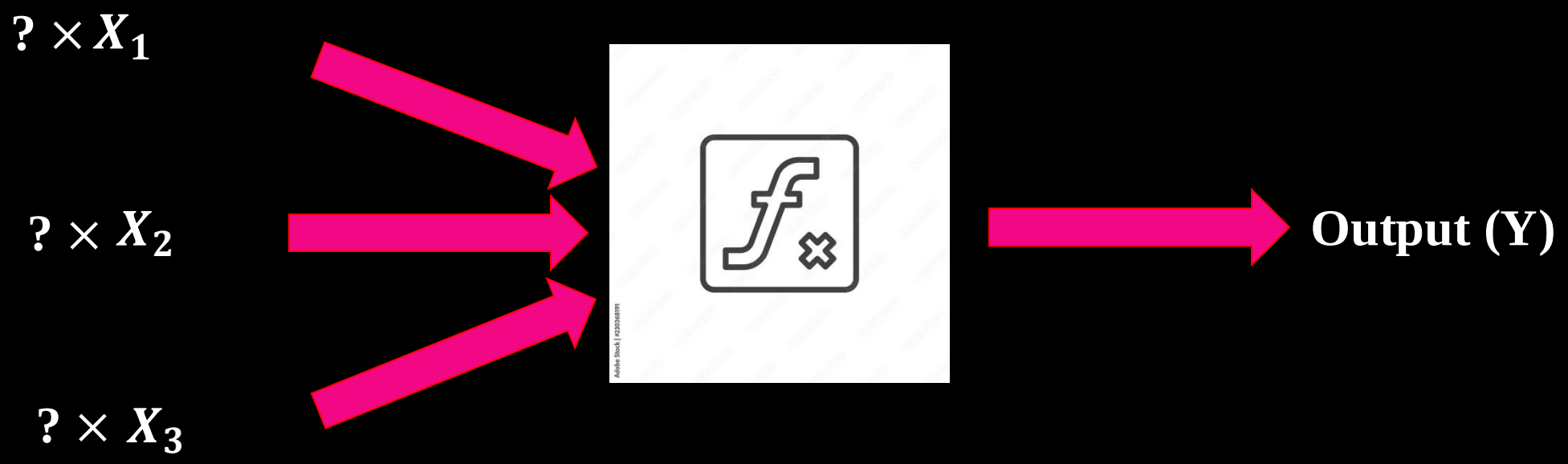
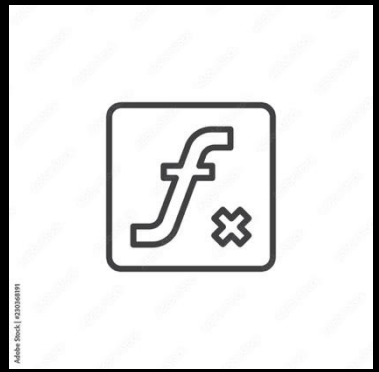
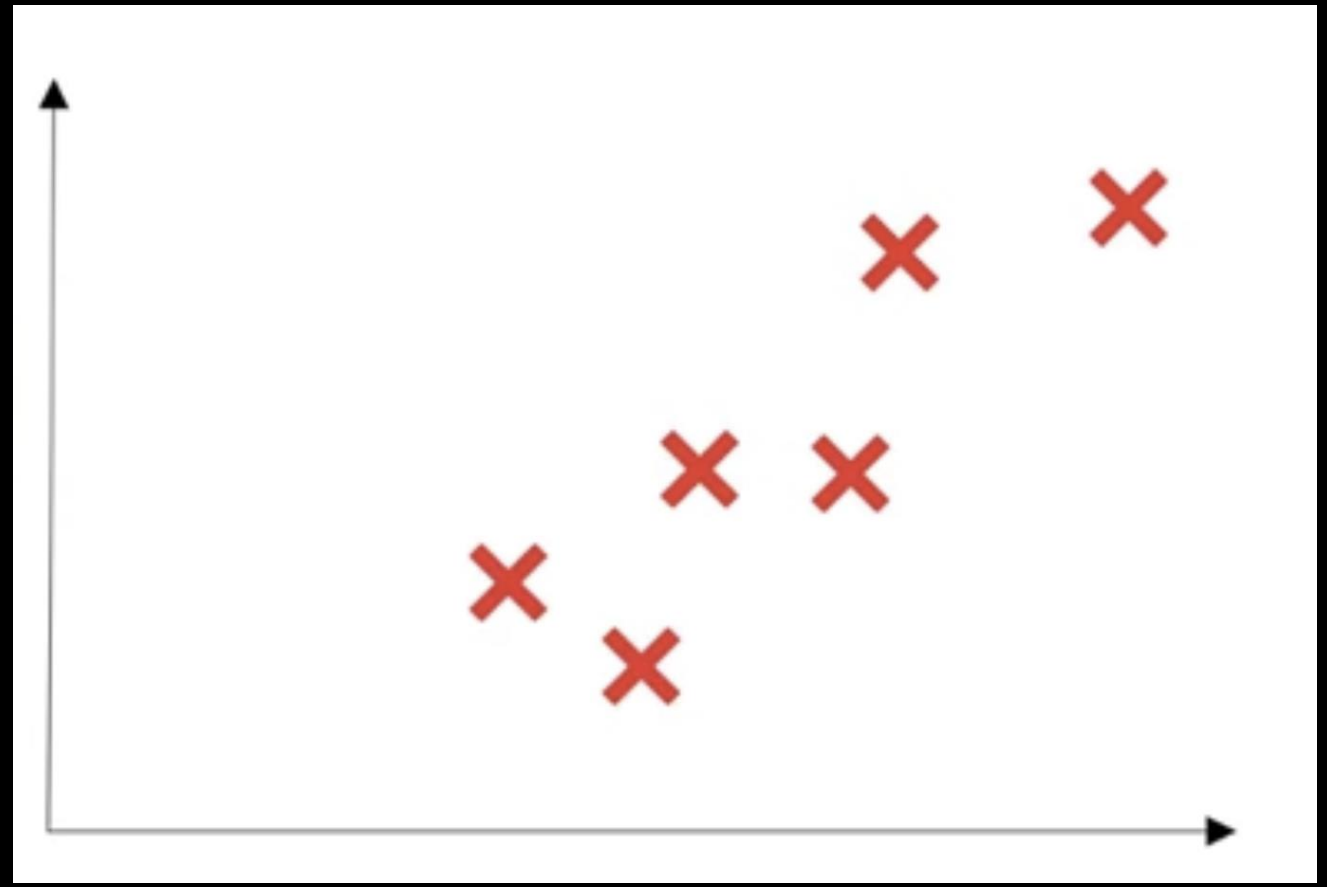


What is an Artificial Intelligence Model?

- Regular Programming (Cooking Machine):
  - The machine will be provided with clear instructions. The coefficient of each feature is determined.
  - The machine executes the instructions and produces the output. It doesn't consider the quality of the output.
- Machine Learning Function
  - The machine learning function (algorithm) should find the coefficients of the input features
  - In some cases, the input features should also be explored by the machine.
  - The machine finds useful patterns inside the data.



What is a Neural Network



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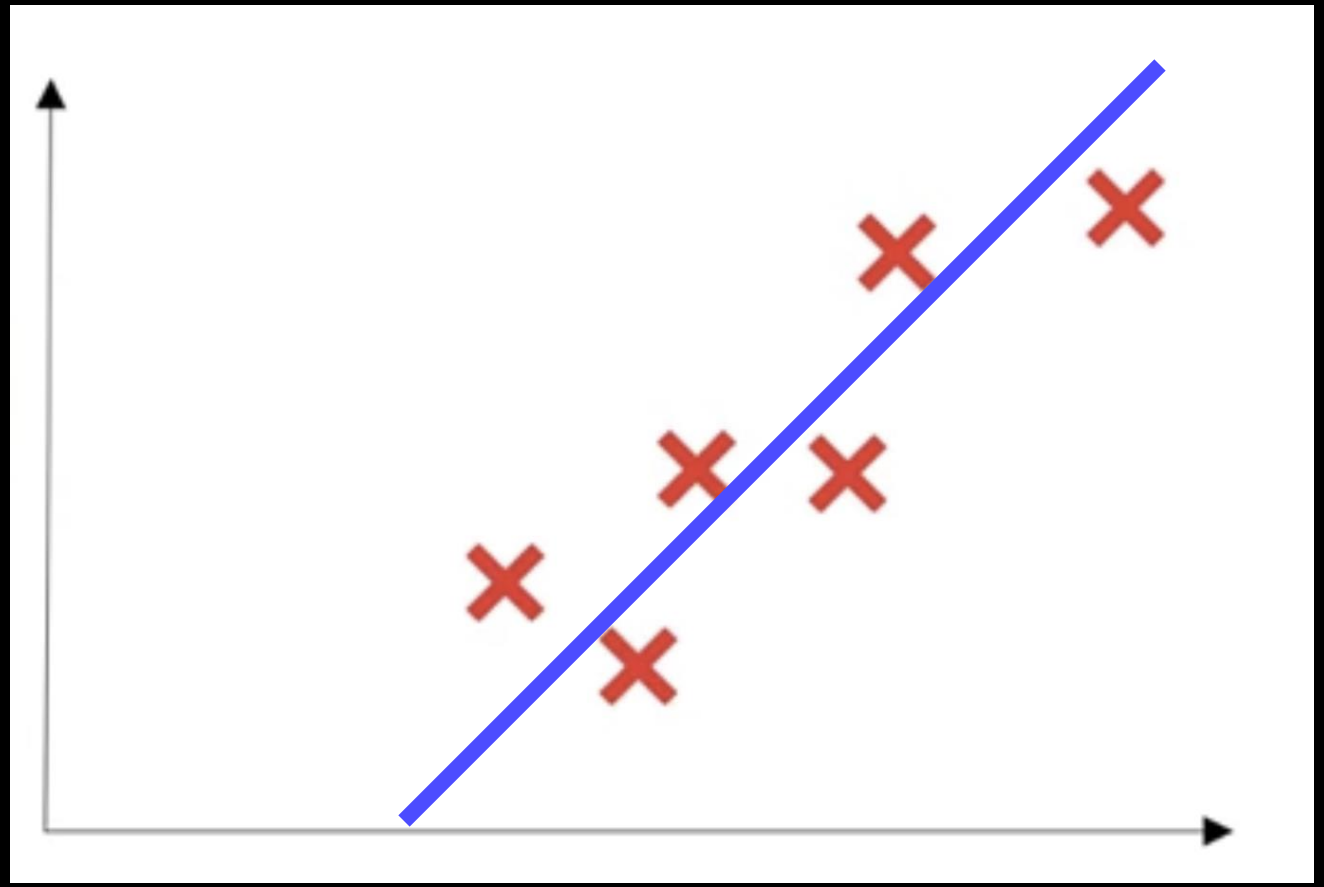

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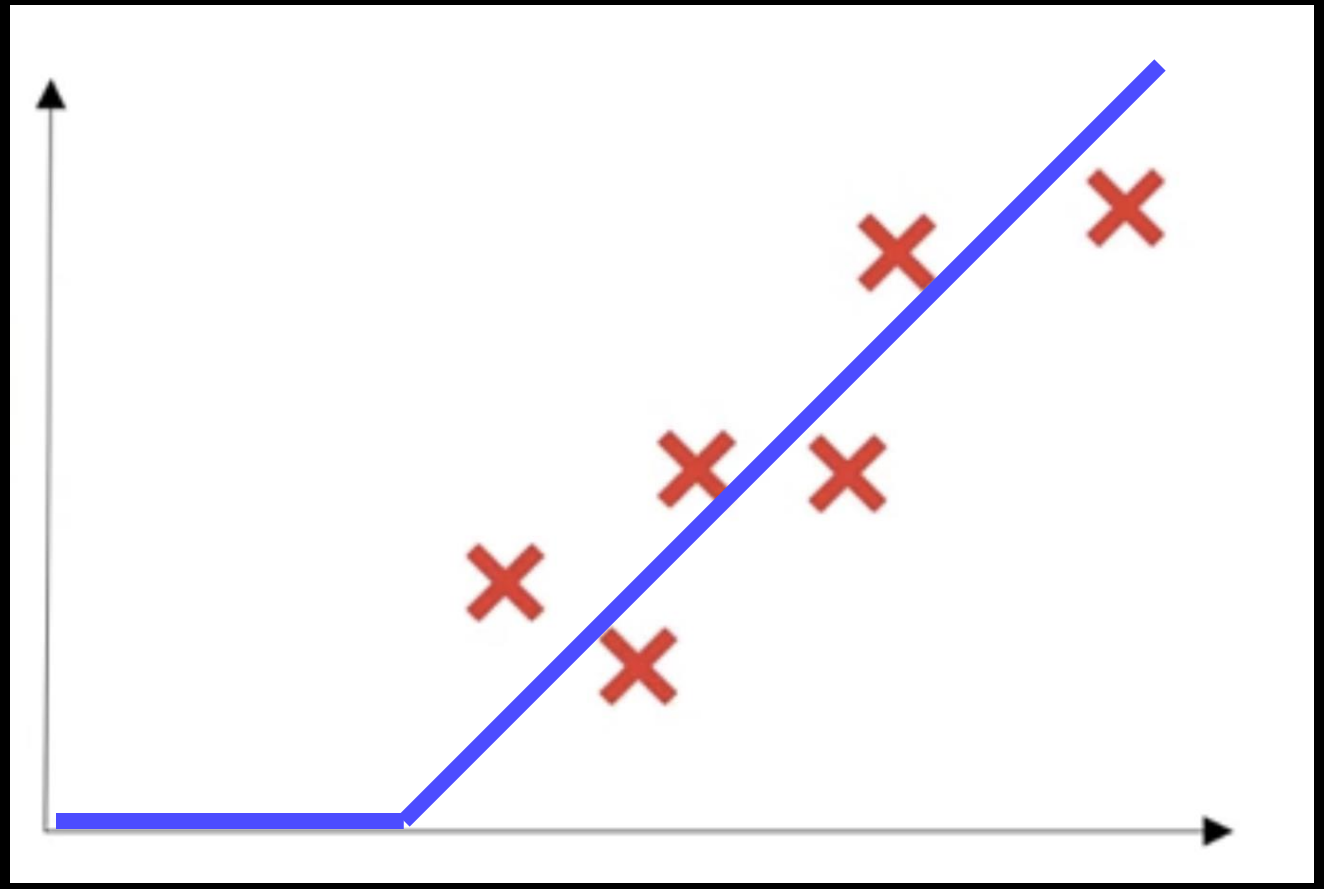
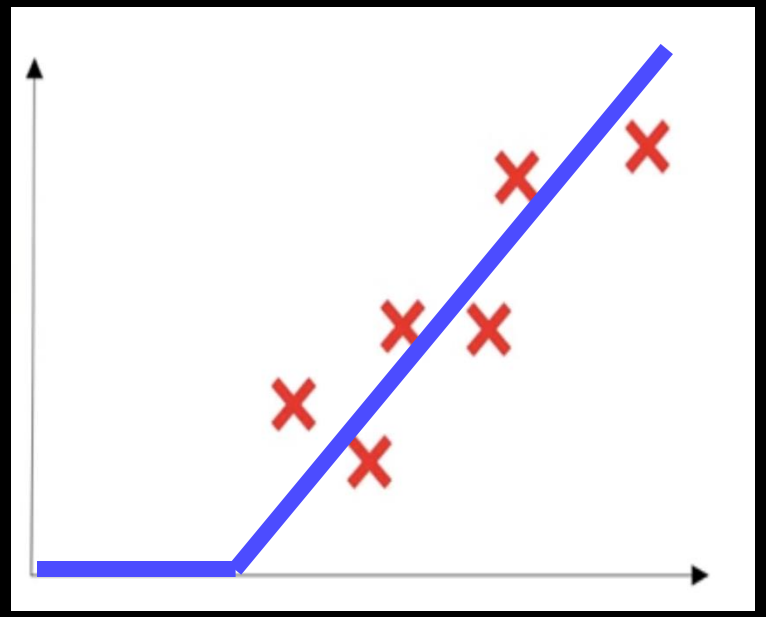
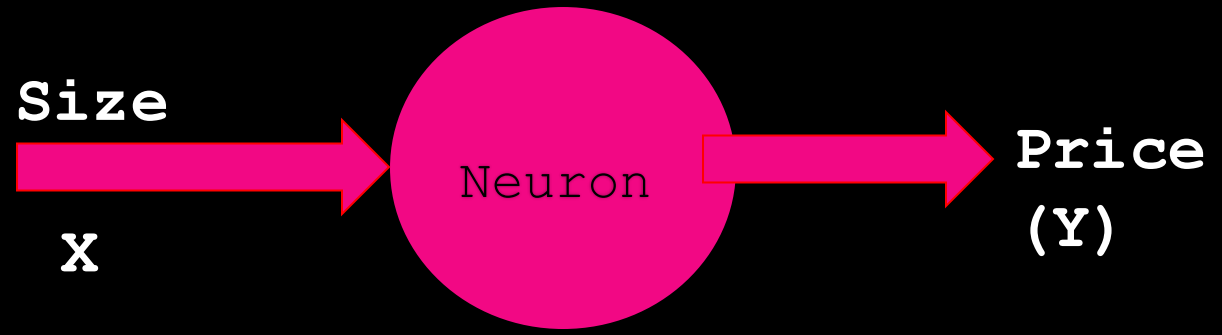
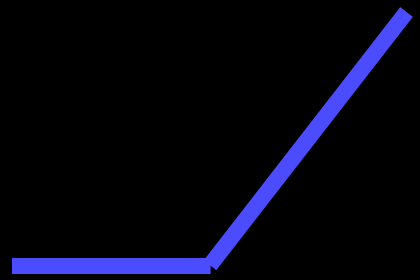


- We can consider this as a neural network
- Neural take size as input, computes linear function, ignores negative outputs and calculates the price

What is a Neural Network

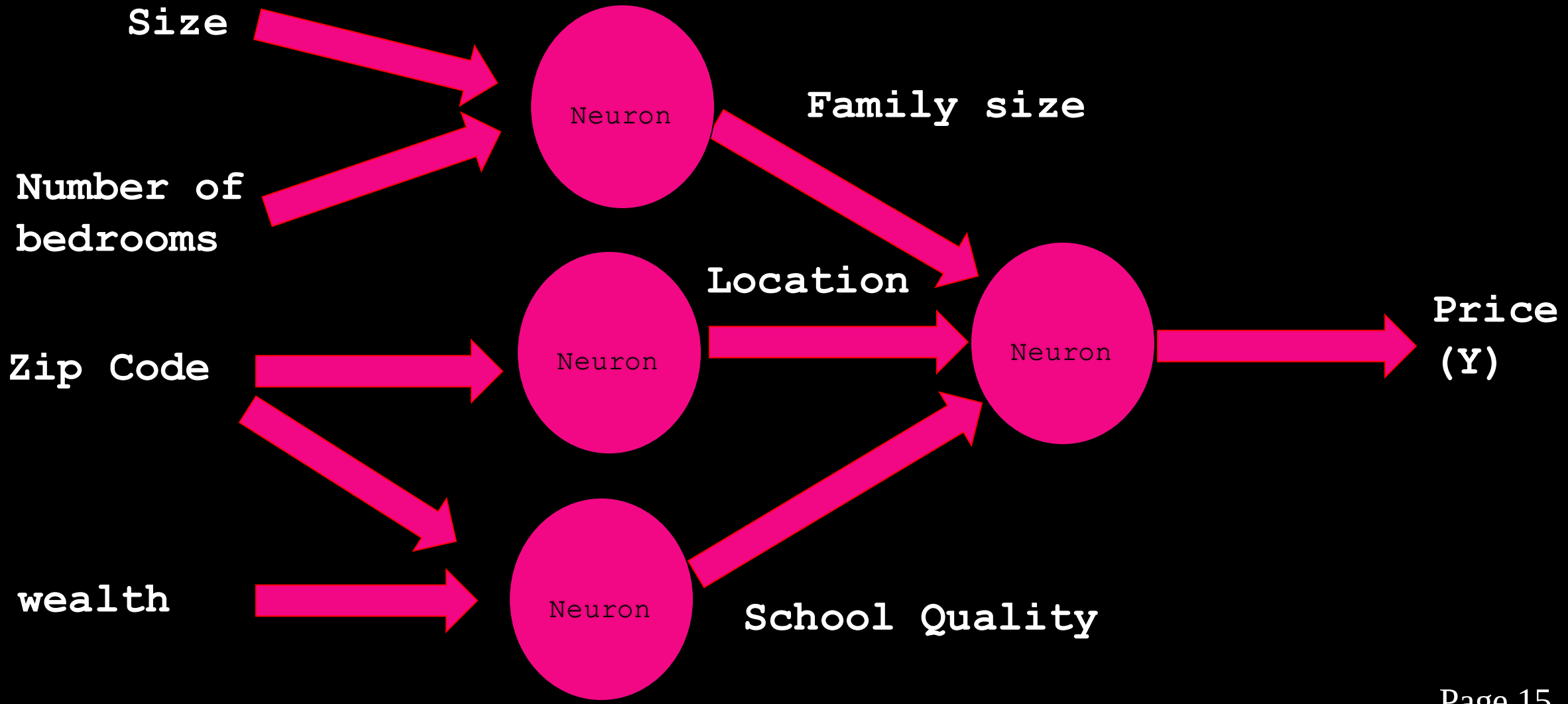






ReLu:
Rectified
Linear
Unit

What is a Neural Network (Housing price)



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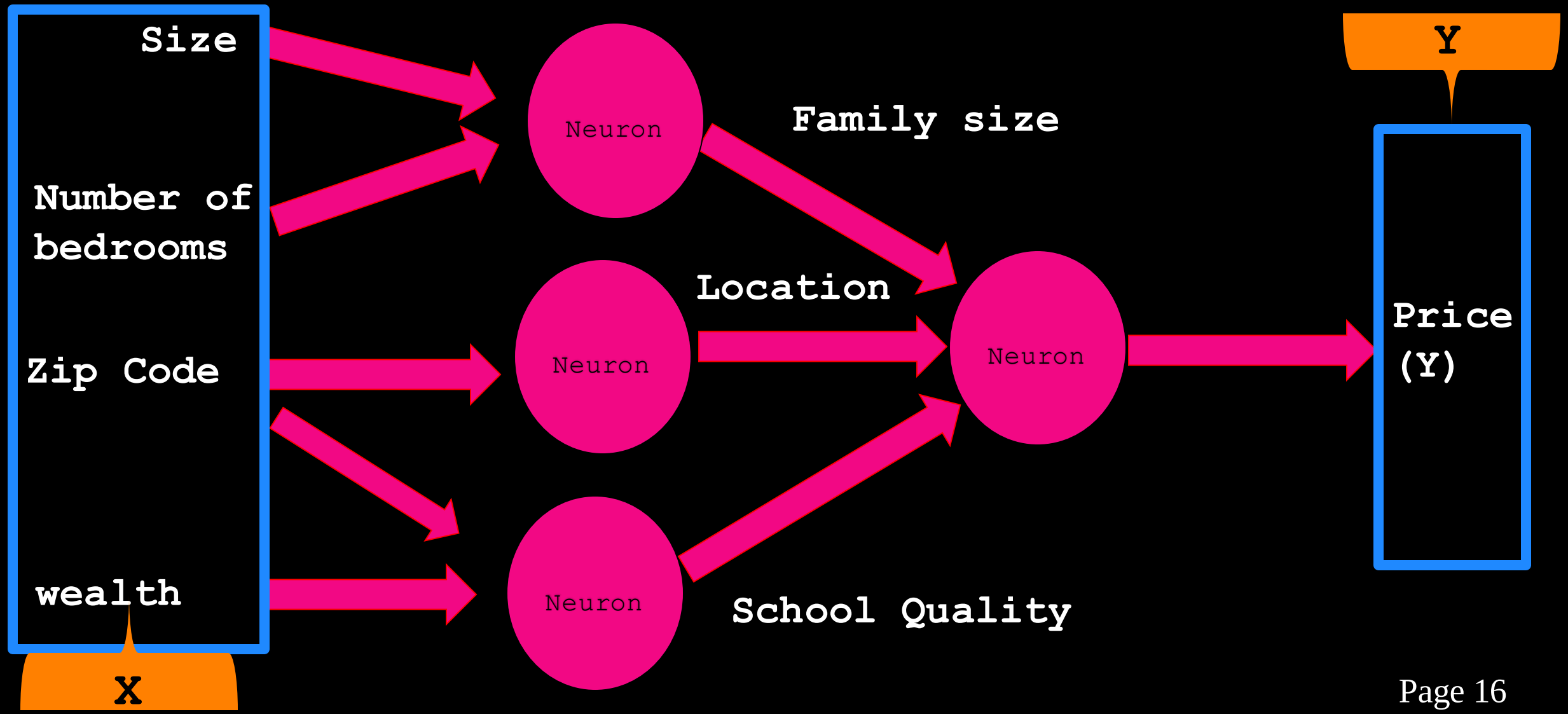

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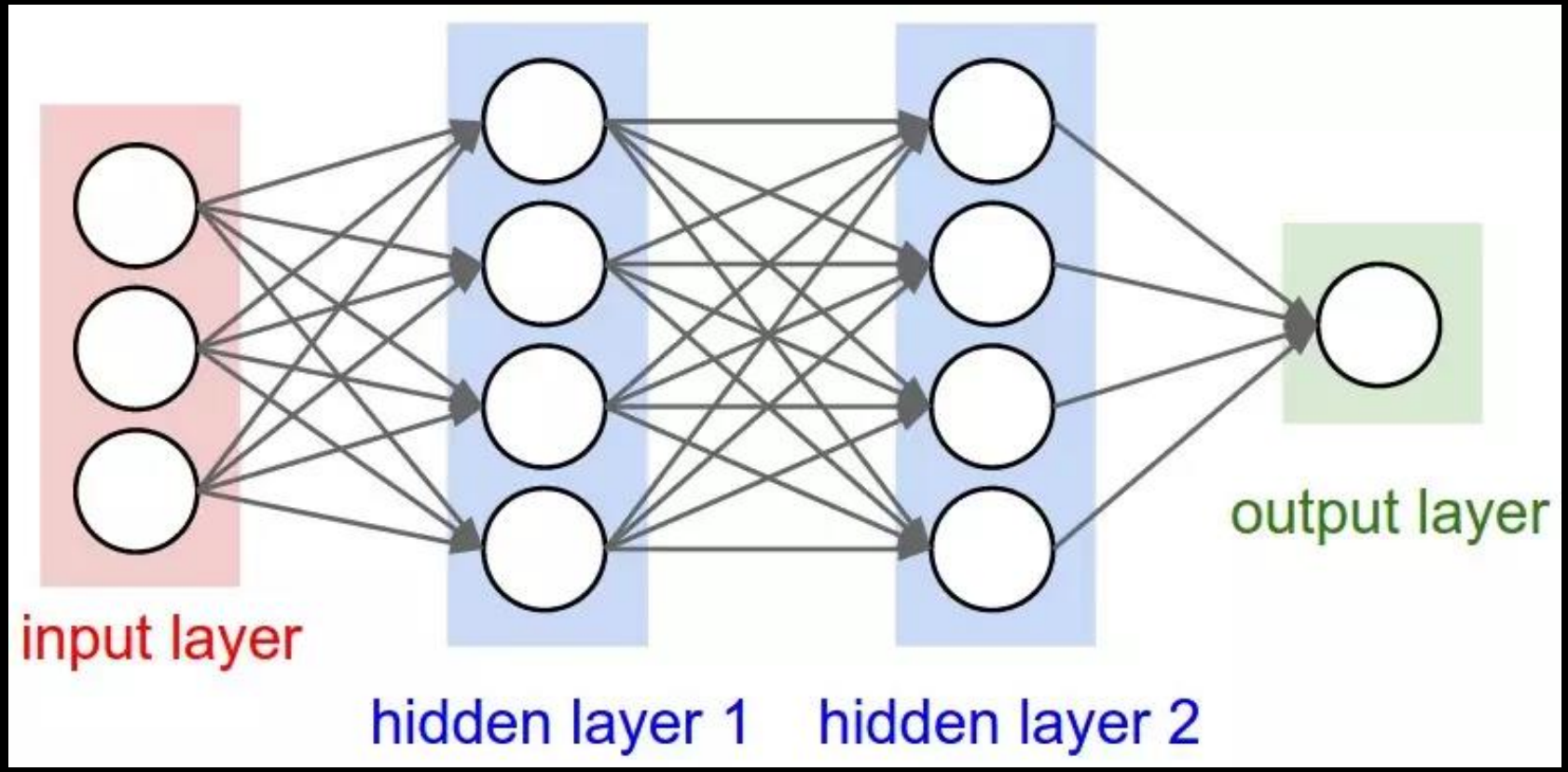
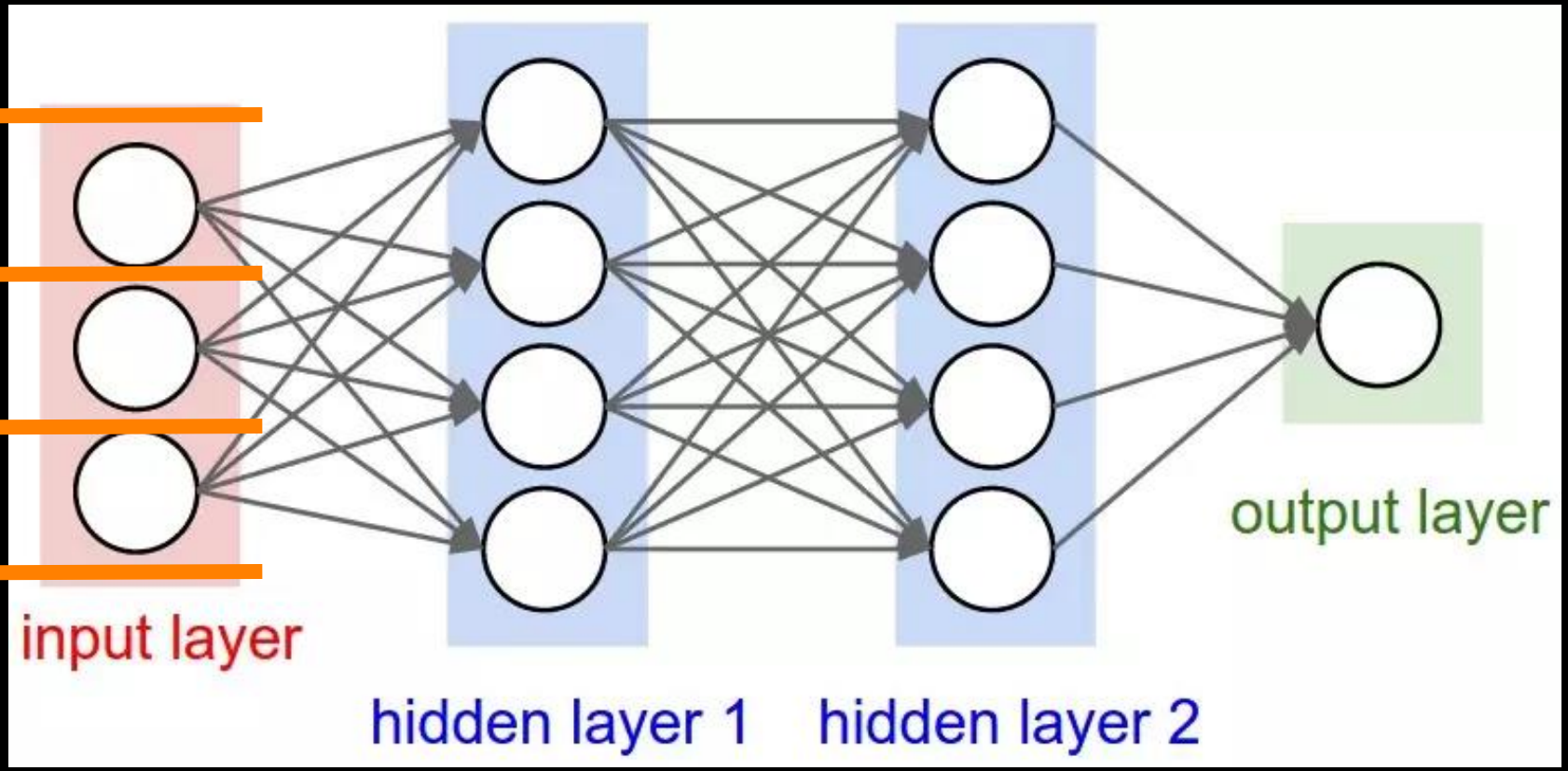


What is a Neural Network (Housing price)

Size

Number of bedrooms

Zip Code



Different types of learning (Supervised learning)

Input (X)	Output (Y)	Application
Home features	Price	Real state
Persons features	gender	Statistical analysis
Ad, user info	Clicked on ad? (0/1)	Online advertisement
Code snippets	Perform the same functionality (0/1)	Code clone detection (code understanding)
Pixels of an image	Dog or Cat?	Image classification
English	French	Machine translation

Different types of learning (Supervised learning)

test.csv (474.04 kB)

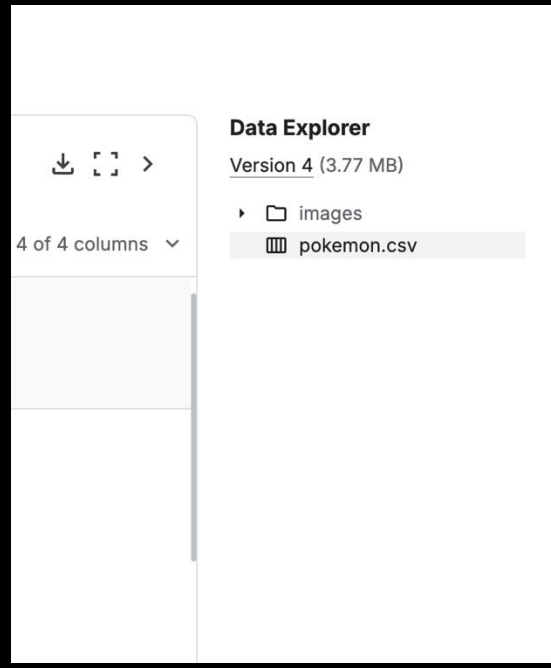
Detail | Compact | Column

textID		text		sentiment	
[null]	27%	[null]	27%	neutral	30%
f87dea47db	0%	Last session of th...	0%	[null]	27%
Other (3533)	73%	Other (3533)	73%	Other (2104)	44%
f87dea47db		Last session of the day http://twitpic.com/67ezh		neutral	
96d74cb729		Shanghai is also really exciting (precisely -- skyscrapers galore). Good tweeps in China: (SH) (B...		positive	
eee518ae67		Recession hit Veronique Branquinho, she has to quit her company, such a shame!		negative	

pokemon.csv (17.05 kB)

Detail | Compact | Column

Name Name of the Pokemon	Type1 primary type	Type2 secondary tpe
809 unique values	Water 14% Normal 13% Other (590) 73%	[null] 50% Flying 12% Other (310) 38%
bulbasaur	Grass	Poison
ivysaur	Grass	Poison
venusaur	Grass	Poison
charmander	Fire	
charmeleon	Fire	
charizard	Fire	Flying
squirtle	Water	
wartortle	Water	
blastoise	Water	



Supervised learning Dataset Examples

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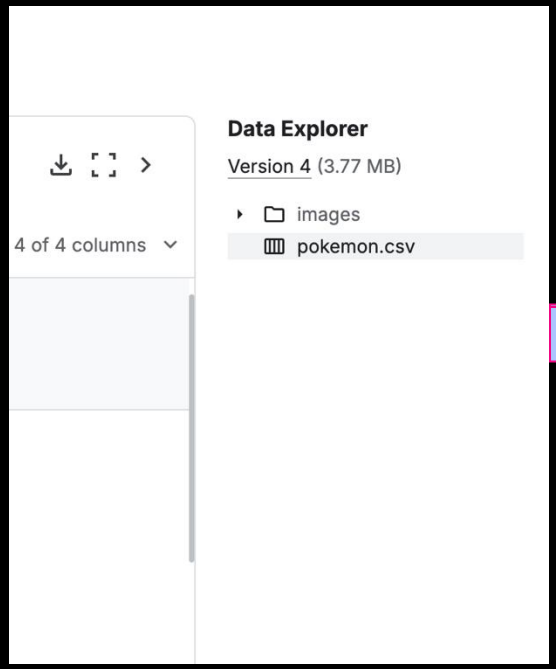

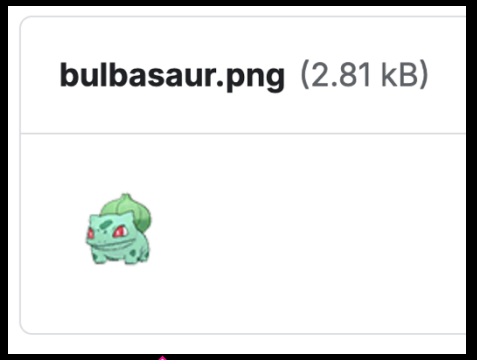

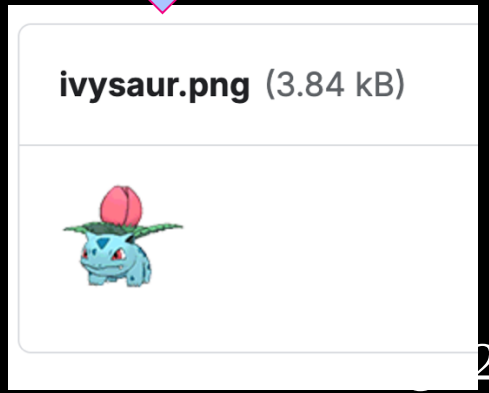

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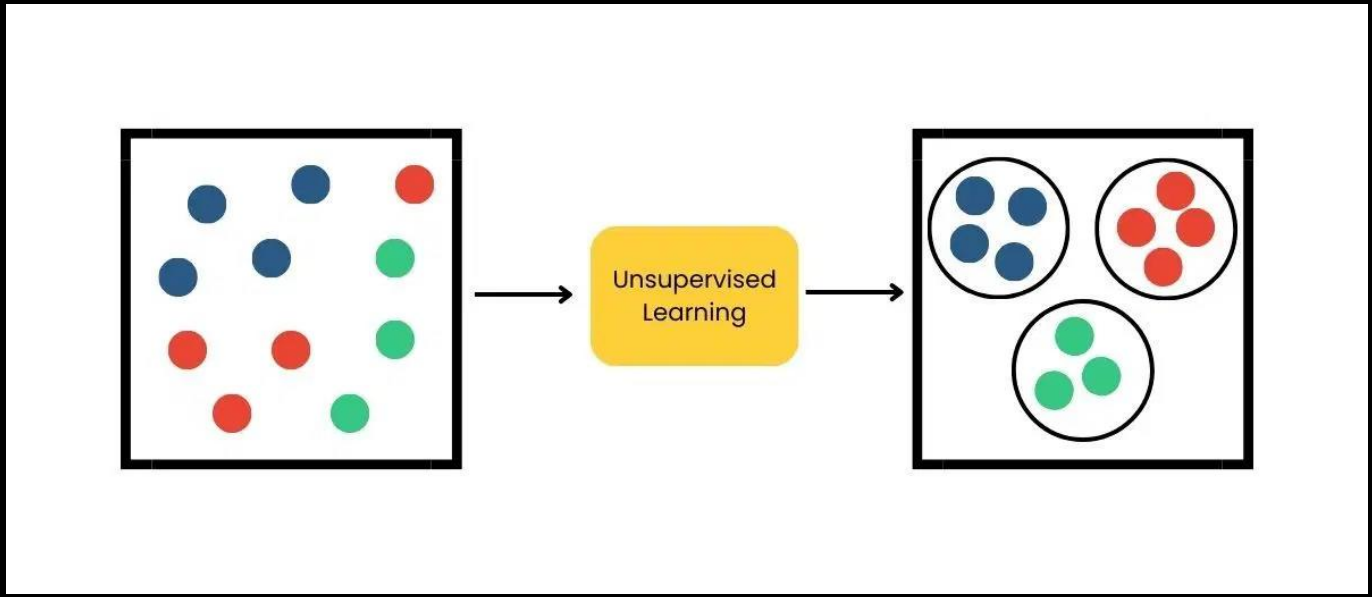
Different types of learning (Unsupervised learning)

- No Labeled Data:
  - The data provided to the model does not have labeled outputs or target values. The model has to figure out patterns and relationships from the input data alone.
- Discovering Patterns:
  - The model tries to learn the inherent structure of the data. This could involve grouping similar data points, reducing dimensionality, or identifying outliers.



How about Language models

- Pre-training is unsupervised
  - The initial phase of training LLMs involves unsupervised learning, where the model learns from vast amounts of text data without explicit labels. The model learns to predict the next word in a sentence (language modeling), fill in missing words (masked language modeling), or predict the next sentence, depending on the architecture.

- Fine-Tuning on the down stream task is supervised
  - After the initial unsupervised pre-training, LLMs often undergo supervised fine-tuning on specific tasks or datasets with labeled data. During this phase, the model is trained with explicit input-output pairs to learn specific tasks, such as answering questions, summarizing text, or following instructions.

How about Language models

Generation: This is a cat

This  **is**

How about Language models

Generation: This is a cat

This → **is**

This is → **a**

How about Language models

Generation: This is a cat

This → **is**

This is → **a**

This is a → **cat**

How about Language models

Generation: This is a cat

This → **is**

This is → **a**

This is a → **cat**

Output of the model: This is a cat