GDSC EPITA
Introduction to Deep Learning
Workshop

Philippe Bouchet
EPITA SANTE 2023

Presentation ~ 30 min
Workshop ~ 1h30

Summary

- Who am I?
- What is AI?
- Deep learning in the real world
- But how does it work?
- QnA

This is NOT an advanced deep learning course.

This is a workshop for budding AI and DL enthusiasts. No maths! ;)

Who am I?

- Philippe Bouchet
- EPITA Majeure SANTE 2023, Healthcare Major
- We specialize in:
  - AI and image processing for healthcare
  - Tech solutions for medical problems
    - Brain tumor detection
    - Segmentation of gray/white matter
  - Bridging the gap between developers and doctors

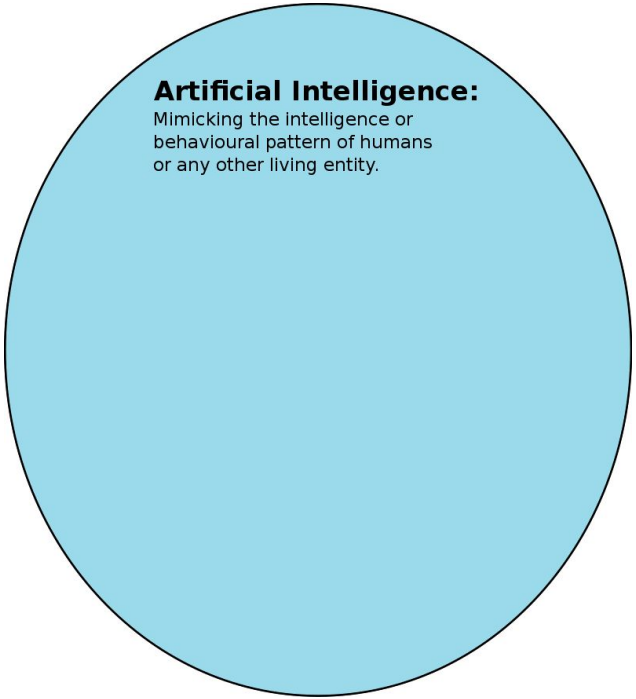
What is AI?

What is AI?

- What’s the difference between AI, ML and DL?

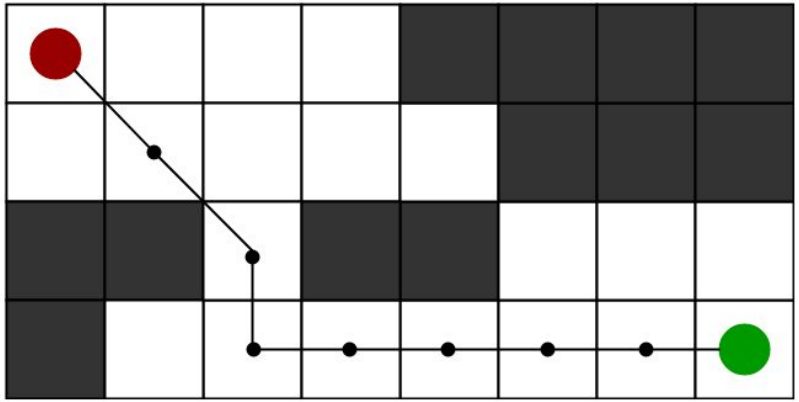
What is AI?

- Artificial Intelligence
  - NPCs in video games
  - Minimax algorithm
  - A* path search algorithm

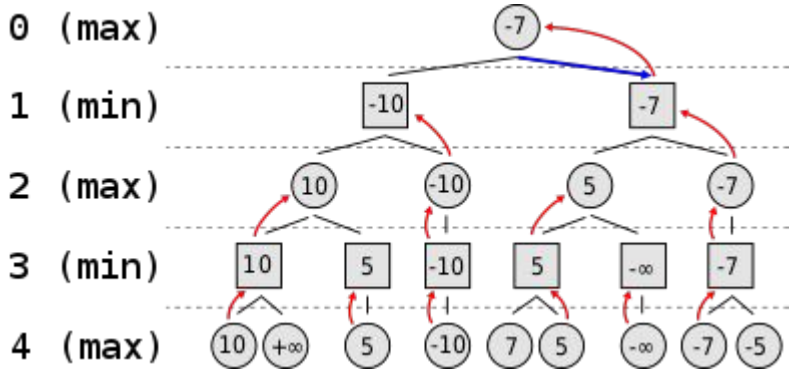


What is AI?

A* pathfinding algorithm

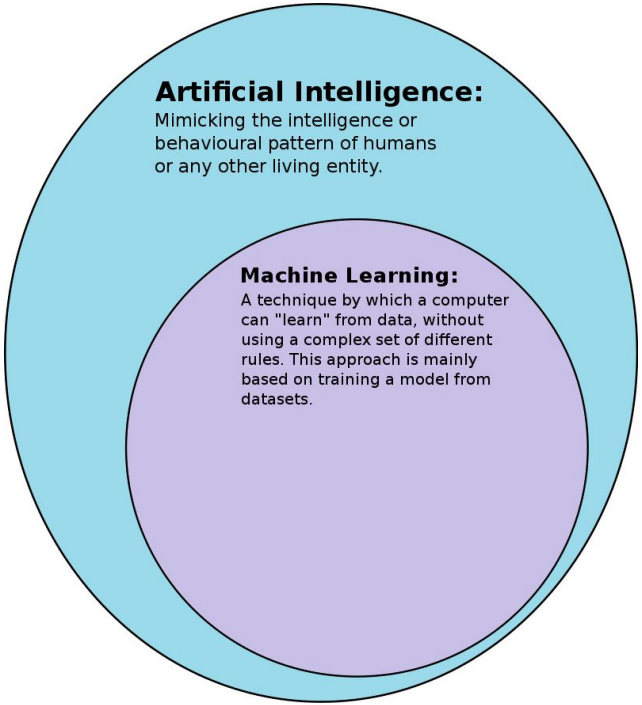


Minimax algorithm



What is AI?

- Artificial Intelligence
- Machine Learning
  - Using data to improve a statistical model’s accuracy
  - Supervised learning (labeled data)
  - Classification, regression



What is AI?

X	y
1	10
2	20
3	30

What is AI?

How do we **estimate** the value of the new data?

X	**y**
1	10
2	20
3	30
4	**?**

What is AI?

How do we **estimate** the value of the new data?

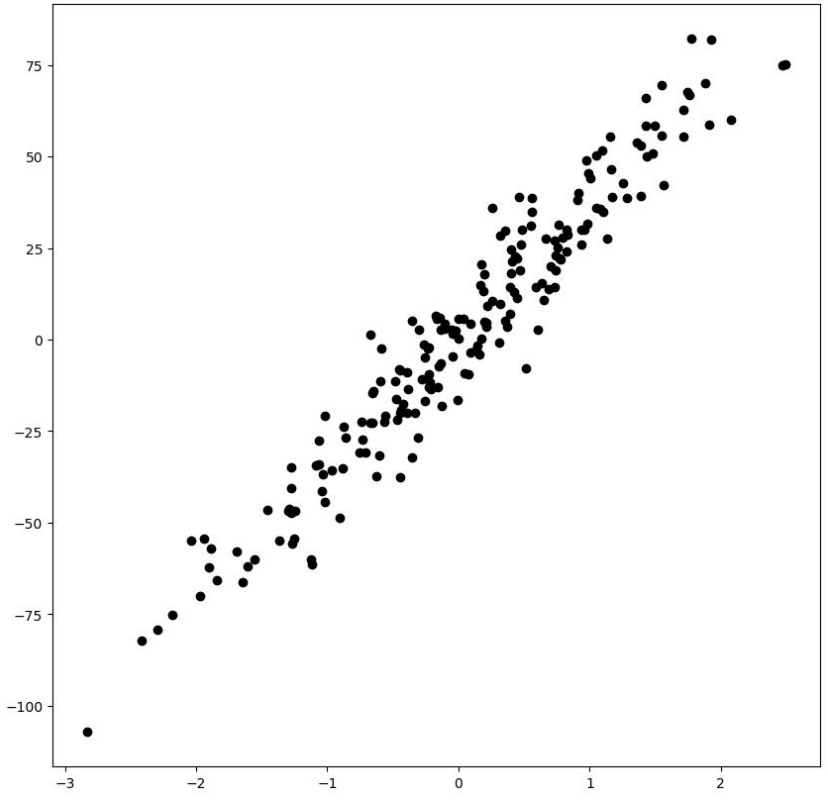
*f(x) = 10 * x*

X	**y**
1	10
2	20
3	30
4	**40**

What is AI?

Linear regression example

- `n_samples = 200`
- `n_features = 1`
- We have a dataset that maps X to y
- **Goal**: Function *f* that best fits the data
- f(x) = *a*x + *b*, what is *a* and what is *b*?

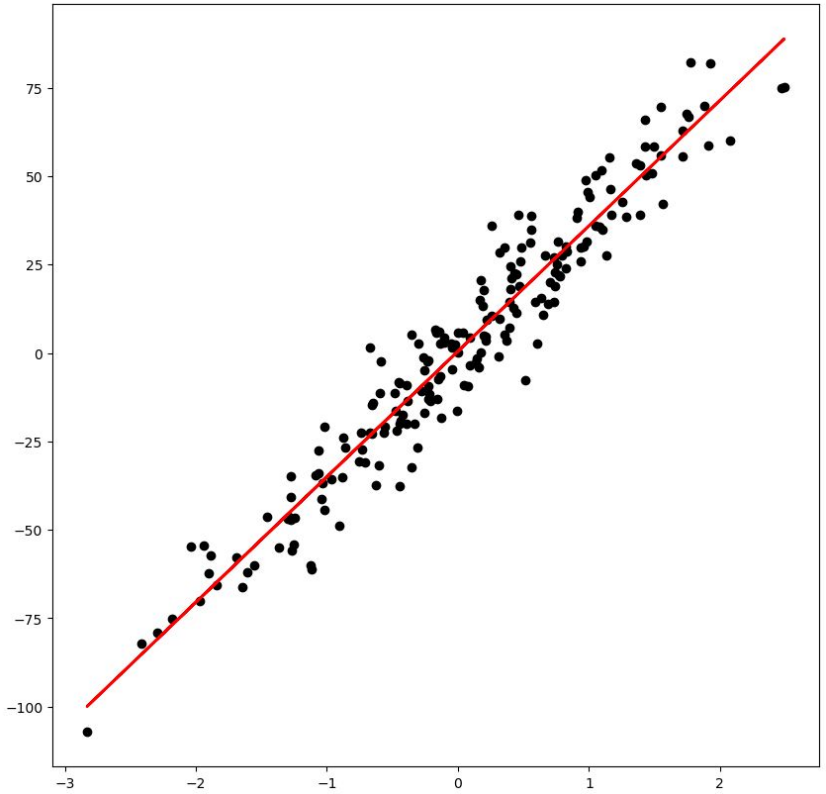


What is AI?

Linear regression example

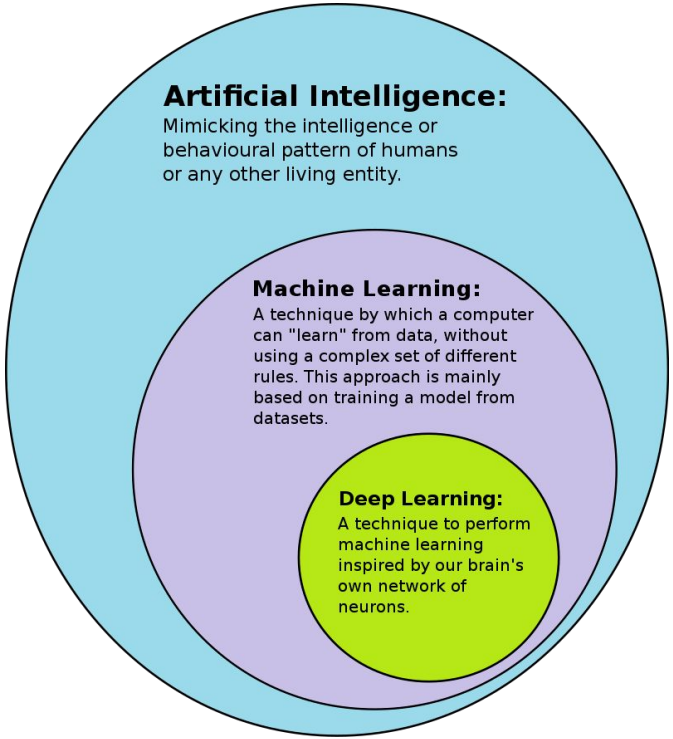
- `n_samples = 200`
- `n_features = 1`
- We have a dataset that maps x to y
- Function *f* that best fits the data?

f(x) = 35.59x + 2.227



What is AI?

- Artificial Intelligence
- Machine Learning
- Deep Learning
  - *Deep* learning because we use *deep* neural networks
  - NLP
  - Image segmentation

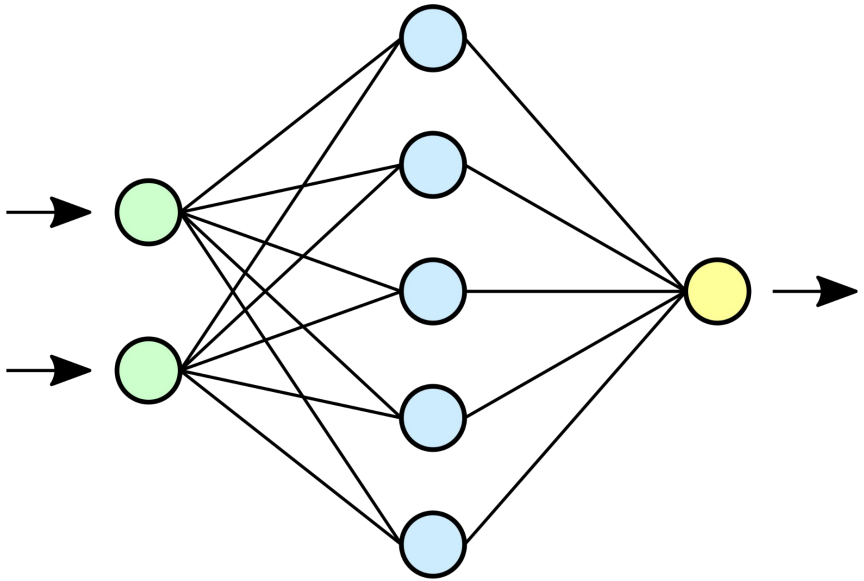


What is AI?

- What is a neural network?

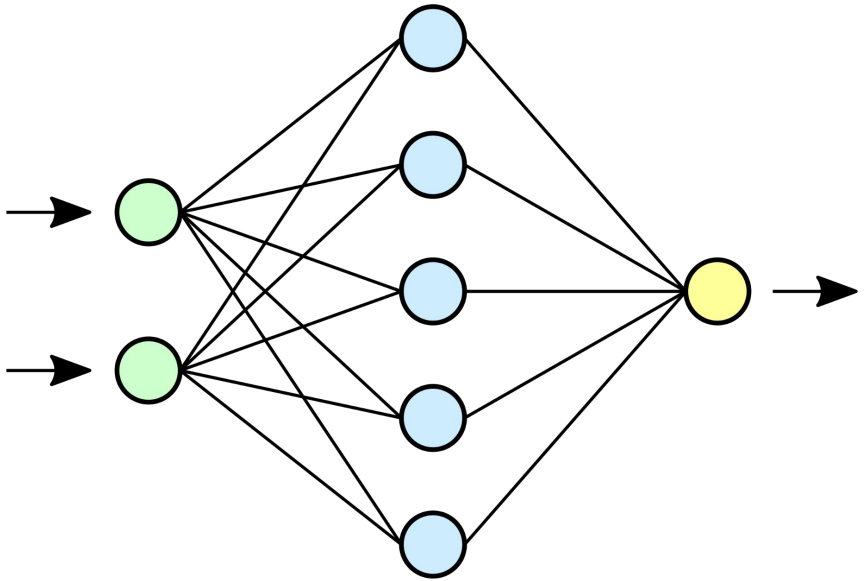
What is AI?

- What is a neural network?



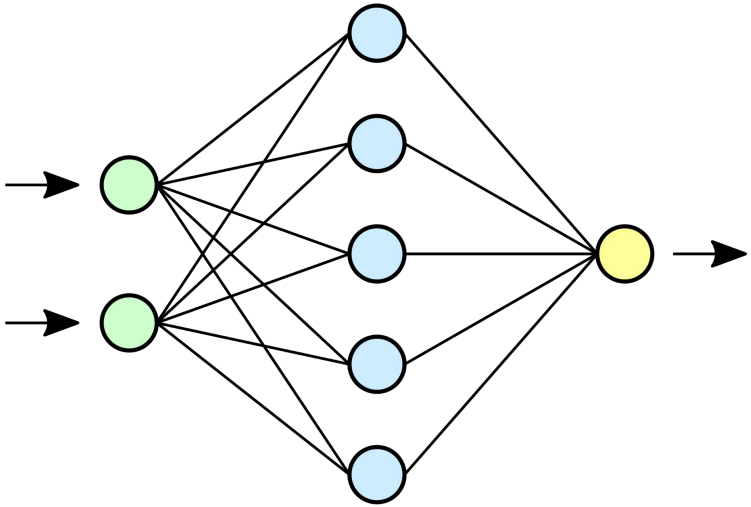
What is AI?

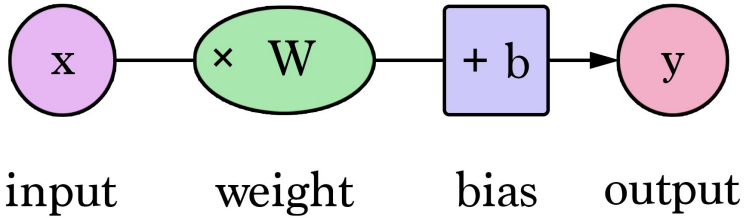
- What is a neural network?
  - Input layer
  - Hidden layer
  - Output layer



What is AI?

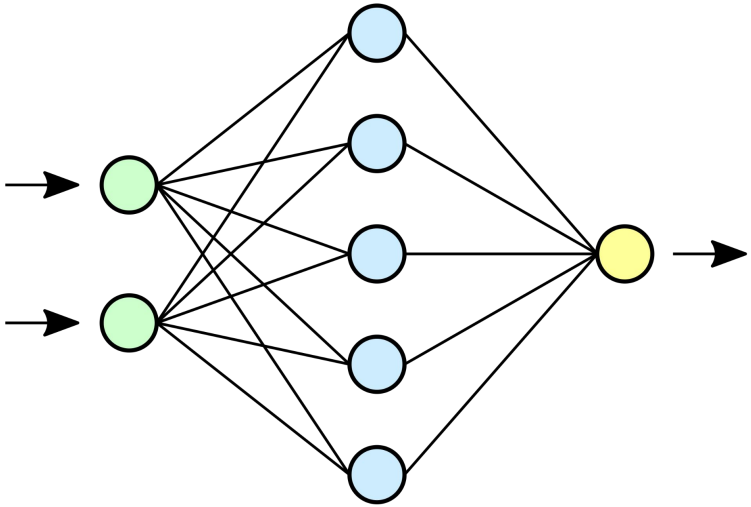
- What is a neural network?
  - Input layer
  - Hidden layer
  - Output layer
- Parameters
  - Weights
  - Biases
  - Linear operations

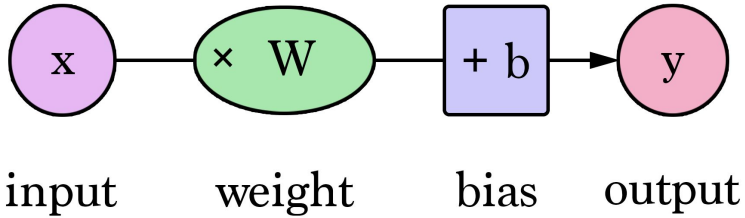




What is AI?

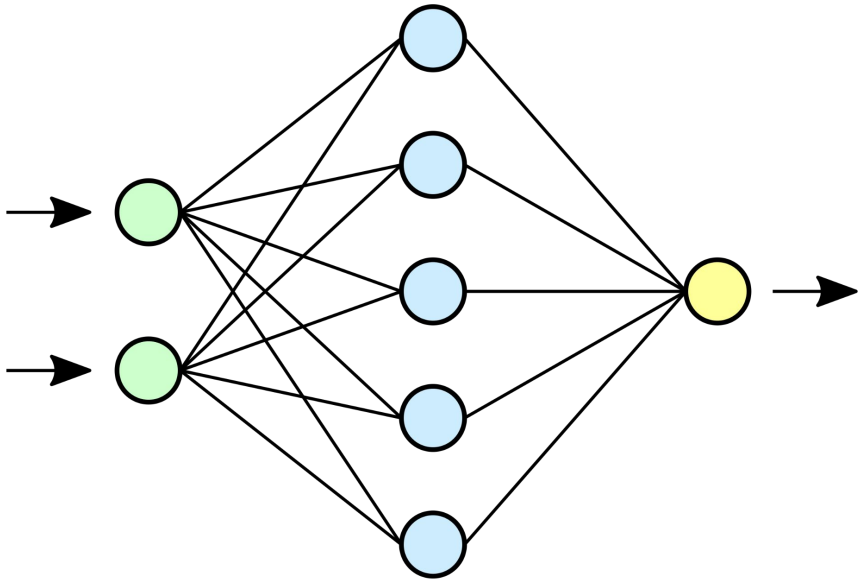
- What is a neural network?
  - Input layer
  - Hidden layer
  - Output layer
- Parameters
  - Weights
  - Biases
  - Linear operations
- Useful for simple tasks in ML
  - Classification
  - Regression





What is AI?

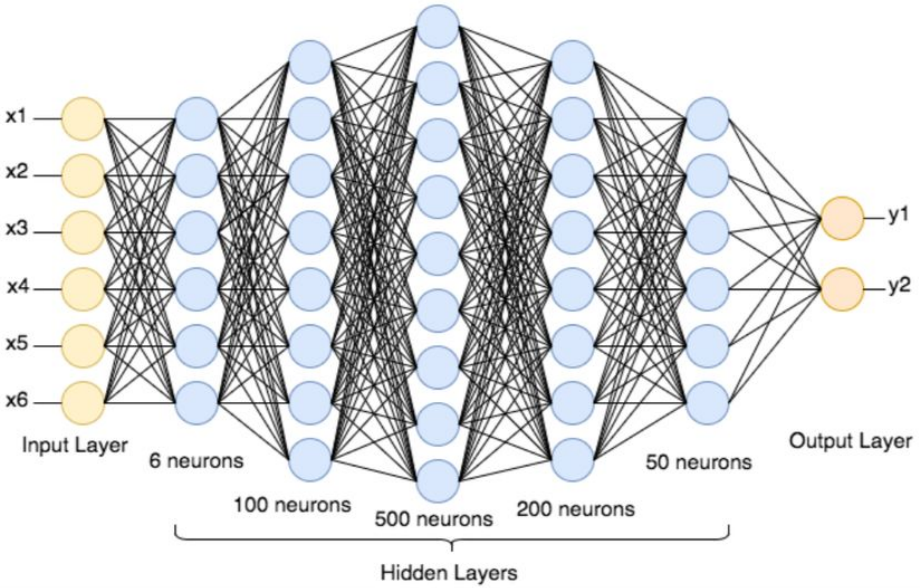
- Limitations
  - Only linear activations
  - 2 dimensions in this example
  - What about 784 dimension?



What is AI?

Add more hidden layers!

- Deep Neural Network
  - Non linear models
  - Time consuming computation
  - More capacity to learn



https://en.wikipedia.org/wiki/Universal_approximation_theorem

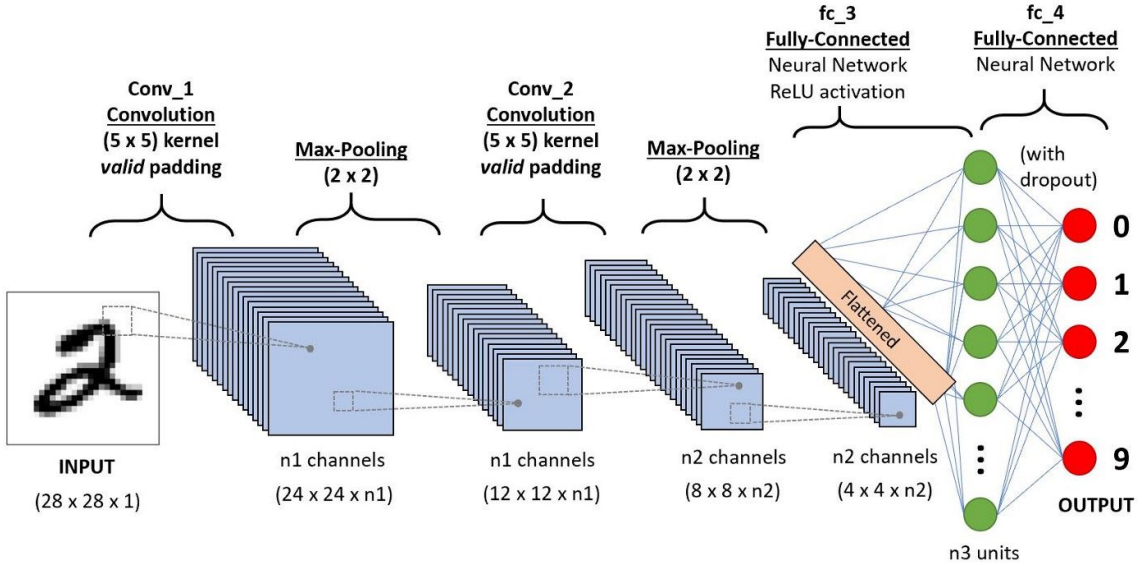
Deep learning in the real world

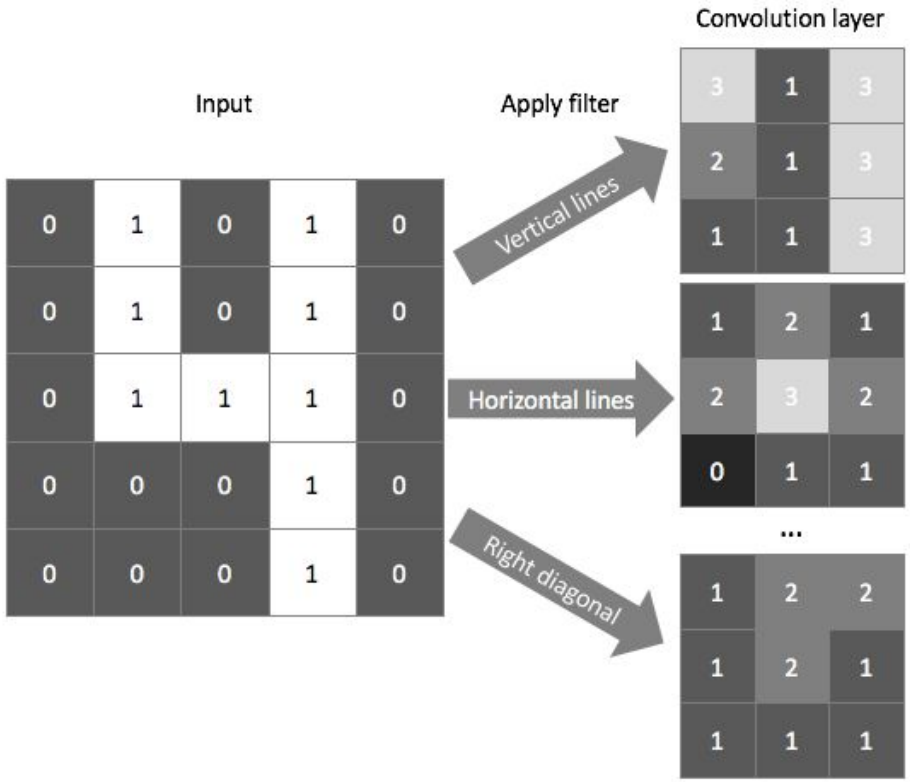
An example of a DNN (Deep Neural Network)

Deep learning in the real world

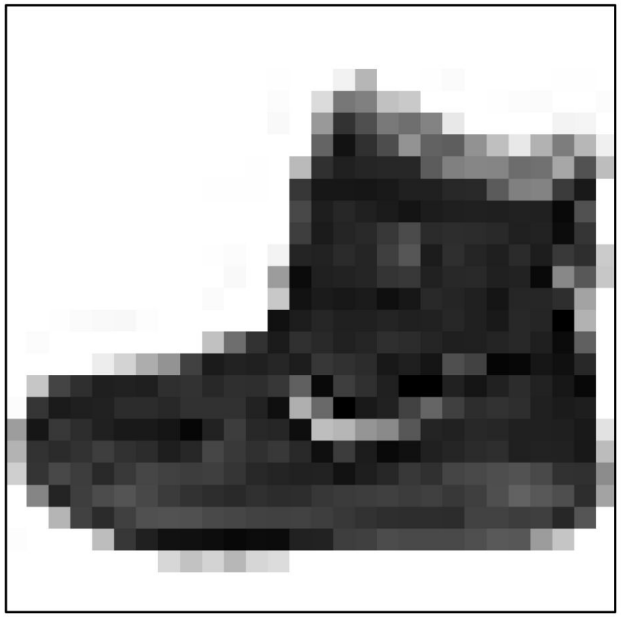
Convolutional Neural Networks

- Convolution kernel (5x5)
- Max-pool to reduce size
- Repeat
- Fully connected
- Prediction

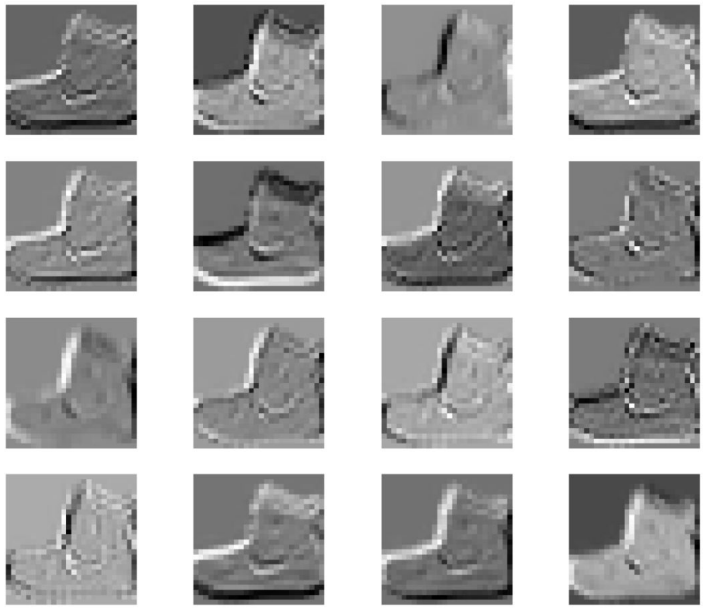



Input
Apply filter
Convolution layer
0 1 0 1 0
0 1 0 1 0
0 1 1 1 0
0 0 0 1 0
0 0 0 1 0
Vertical lines
Horizontal lines
Right diagonal
3 1 3
2 1 3
1 1 3
1 2 1
2 3 2
0 1 1
...
1 2 2
1 2 1
1 1 1

Original Image

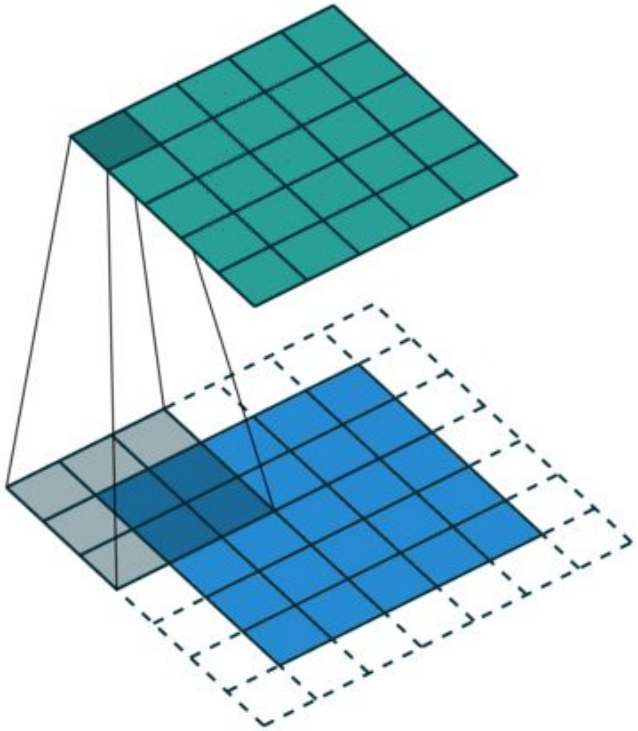


Example Feature Maps

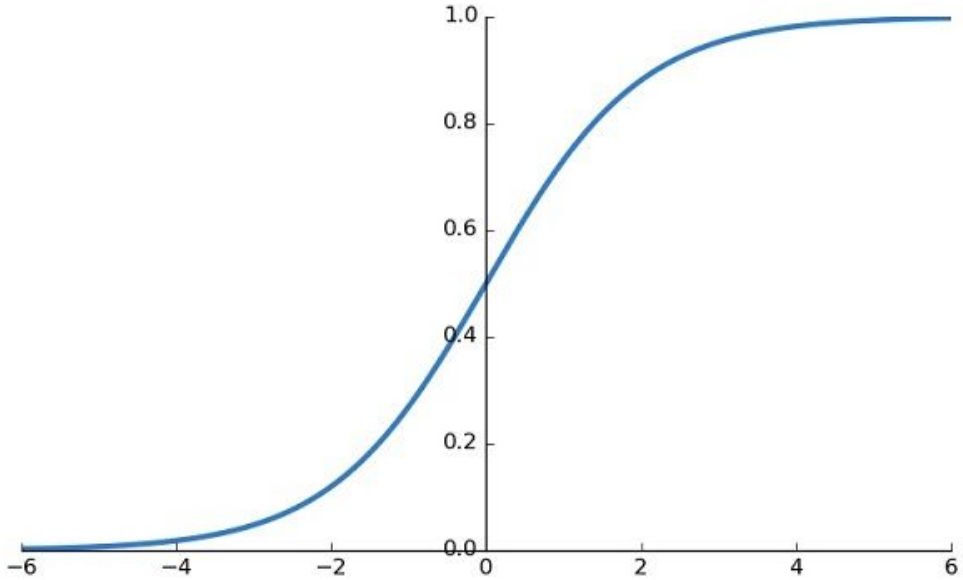


Deep learning in the real world

Convolution



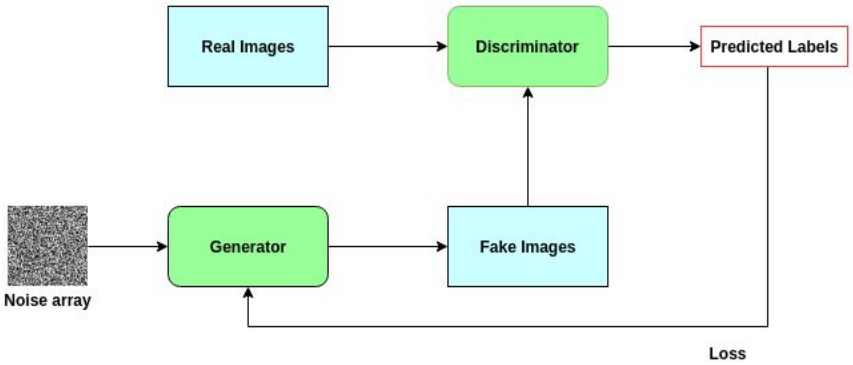
Softmax



Deep learning in the real world

- Generative Adversarial Network (GAN):
  - Ian J. Goodfellow et al. 2014
  - Generates fake images from noise
  - Discriminator guess if it's a real image or not
  - Generator is updated with **loss**

https://arxiv.org/pdf/1406.2661.pdf



Deep learning in the real world - *Some examples*

This person does not exist

https://thispersondoesnotexist.com/

Deep learning in the real world - *Some examples*

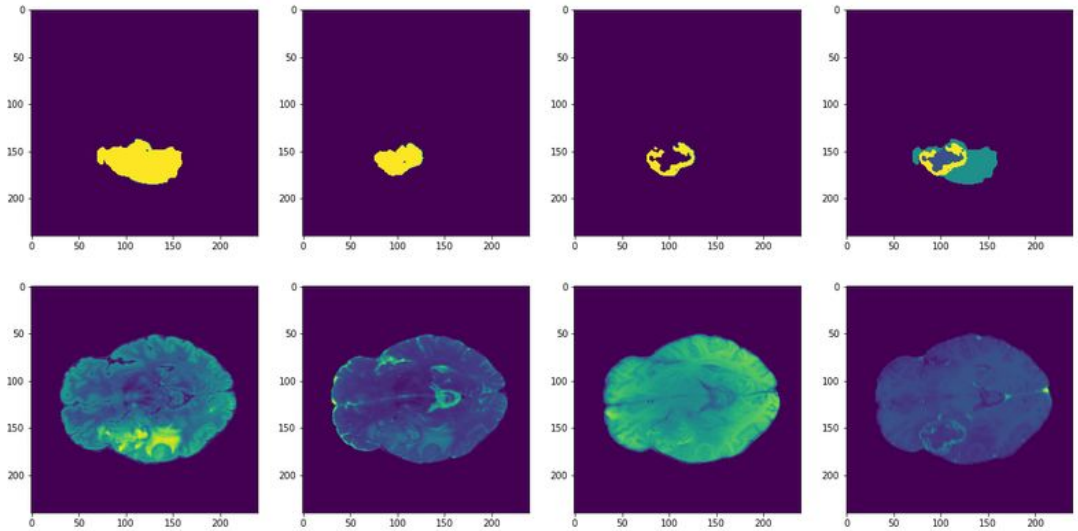
Image segmentation:

Facebook’s detectron

https://github.com/facebookresearch/Detectron

Deep learning in the real world - *Some examples*

Brain tumor segmentation



Deep learning in the real world

What are the frameworks to develop DNN models?

Deep learning in the real world

- Python
  - Tensorflow, simple API with Keras
  - PyTorch, a bit difficult to get into

TensorFlow

Deep learning in the real world

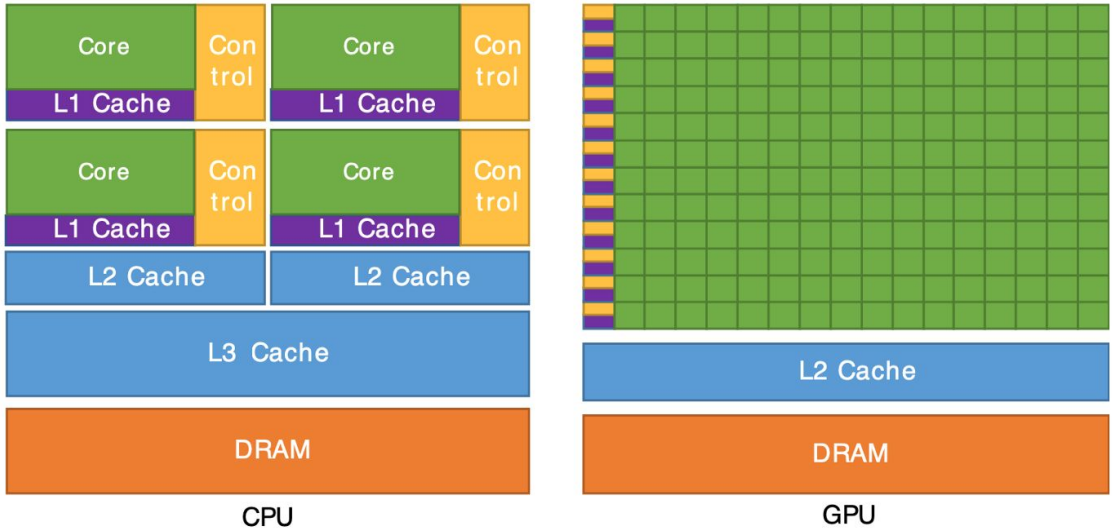
- Python
- C/C++/FORTRAN
  - Low-level GPU Optimizations with CUDA
  - Deep learning depends on GPUs

Deep learning in the real world

- But why GPUs?

Deep learning in the real world

- But why GPUs?
  - Many cores (ALUs)
  - Parallelizable code
  - Accelerate model training



Deep learning in the real world

- But what about in daily life?

Deep learning in the real world

- Deep learning is used everywhere!
  - To unlock your phone with face ID

Deep learning in the real world

- Deep learning is used everywhere!
  - To unlock your phone with face ID
  - When you use Google translate

Deep learning in the real world

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  - Virtual assistants (Alexa, Siri)

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Deep learning in the real world

- Deep learning is used everywhere!
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  - Snapchat filters

Deep learning in the real world

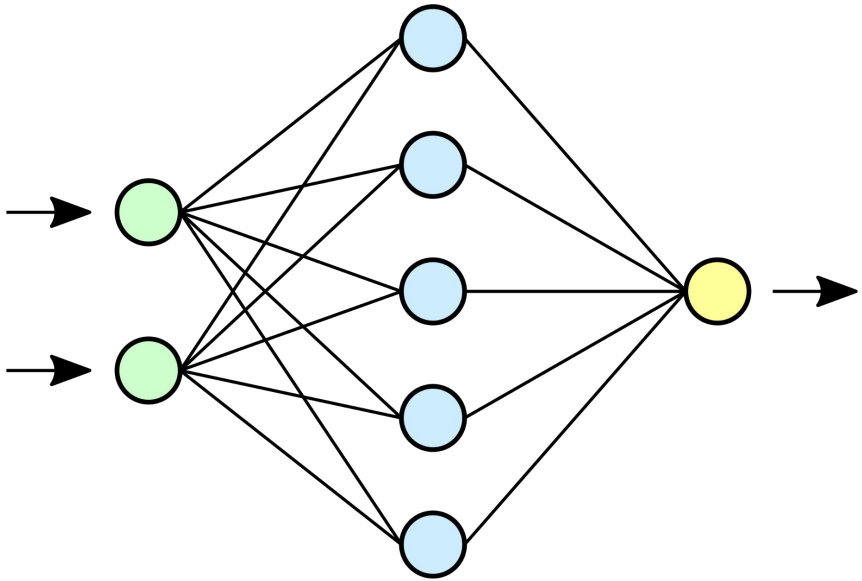
- Deep learning is used everywhere!
  - To unlock your phone with face ID
  - When you use Google translate
  - Virtual assistants (Alexa, Siri)
  - Colourisation of black and white images
  - Snapchat filters

…and the list goes on!

…But how does it work?

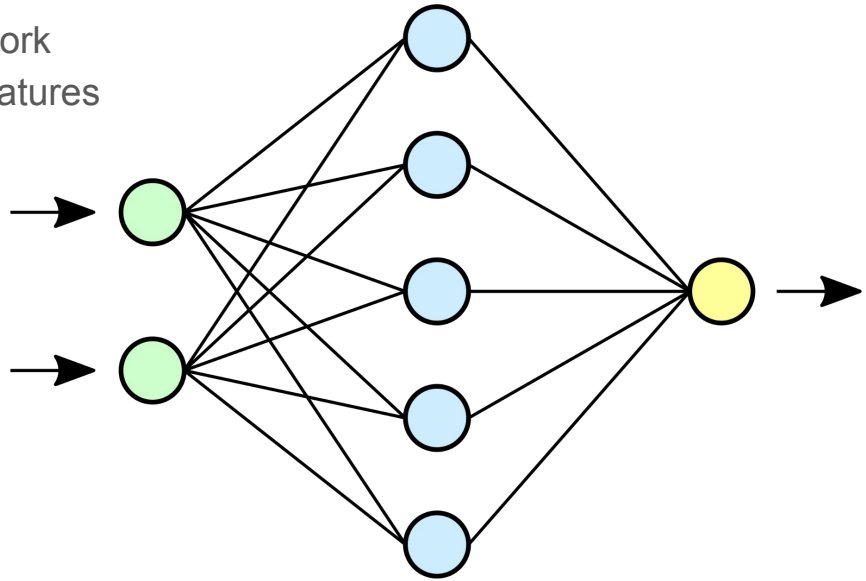
…But how does it work?

- Multilayer Perceptron (MLP)
  - Earliest neural network
  - Input layer
  - Hidden layer
  - Output layer



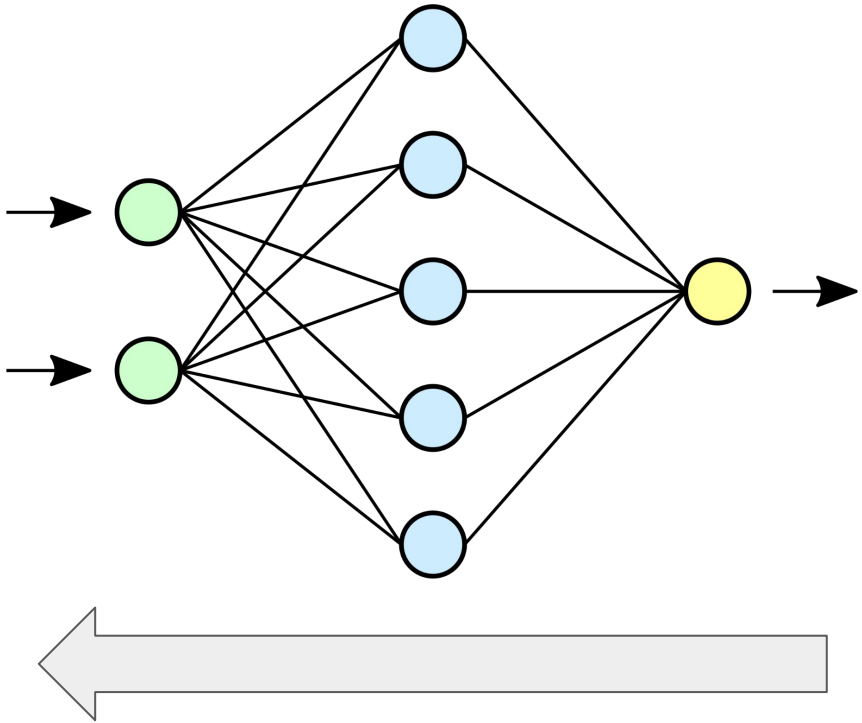
…But how does it work?

- Feed forward
  - Input is passed forward through the network
  - Weights and biases extract interesting features



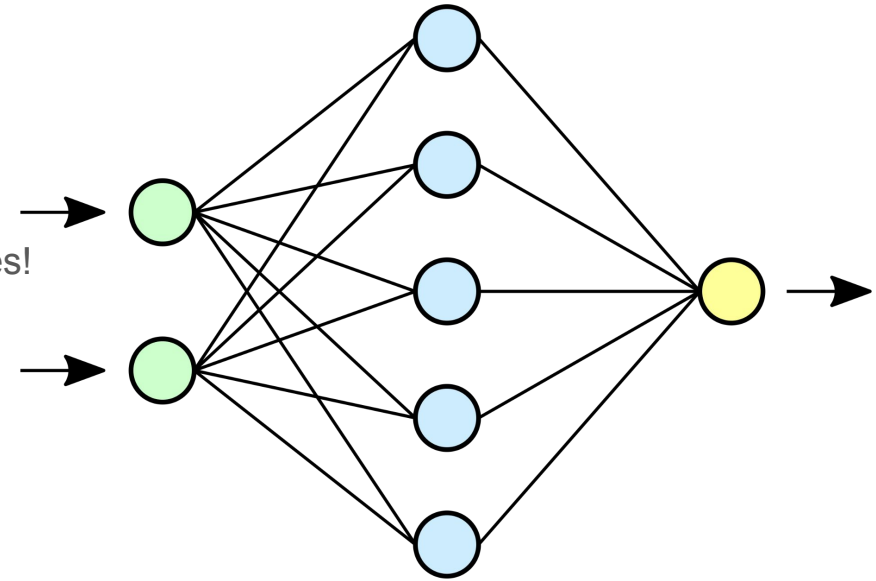
…But how does it work?

- Feed forward
- Back propagation
  - Backward pass through the network
  - Update weights and biases
  - Better correspond with desired output
  - *Gradient descent*



…But how does it work?

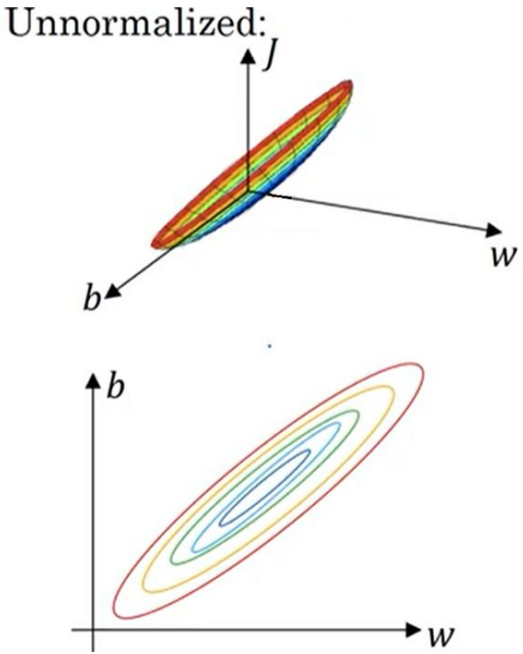
- Feed forward
- Back propagation
  - Backward pass through the network
  - Update weights and biases
  - Better correspond with desired output
  - *Gradient descent* with **normalized** values!

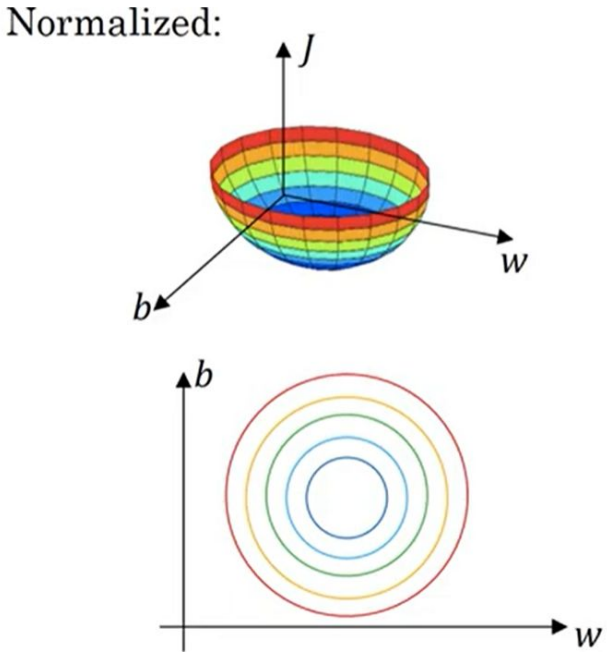


*This is a **VERY** simplified explanation!*

…But how does it work?

Normalize to find the focal minimum much faster.





…But how does it work?

- For this workshop
  - Using Jupyter notebooks
  - Using Tensorflow 2.0
  - Access to Google colab for GPUs

…But how does it work?

- For this workshop
  - Using Jupyter notebooks
  - Using Tensorflow 2.0
  - Access to Google colab for GPUs
- The task
  - Create your own custom Deep Learning model to classify images!

Thank you!

Any questions?