

# Machine Learning

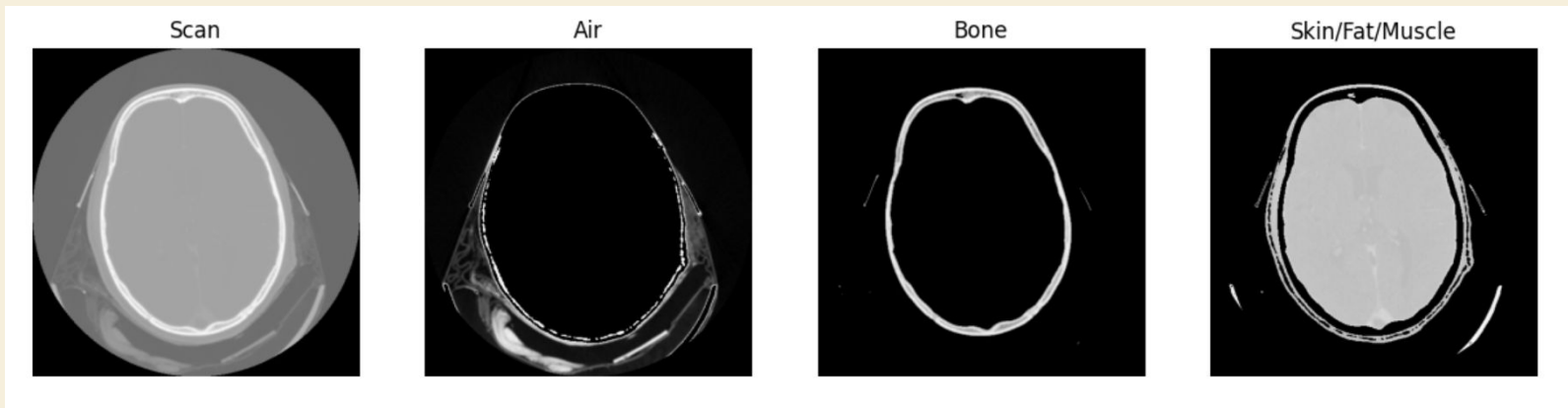
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# Machine Learning

- “Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy.”
- Supervised Learning:
  - ◆ Machine learning that makes use of labelled datasets. They’re used as a form of training for models, helping them learn to recognize desired patterns in the data at large, as well as to verify the model’s accuracy on hand-labelled data.
- Unsupervised Learning:
  - ◆ Machine learning that requires no human intermediate to help it learn patterns. As such, no labelled data is used in these forms of learning. The model learns directly from patterns inherent in the data.

# What're we trying to solve?

- Our ultimate goal is to be able to accurately label the different types of tissue/bone present within CT scans such that you'd be able to filter out a patient's scan based on those parameters.
- An example segmentation may look like the hand-segmentation done below. While this would primarily be achieved via supervised classification, we have also attempted unsupervised data clustering with mixed results.



# Tensorflow

- Free and open-source software library
- Stable APIs provided for Python and C++, although Python is more the standard
- Originally developed by researchers/engineers within Google's Machine Intelligence department
- Works in conjunction with Keras, another open-source library for artificial neural networks

<https://playground.tensorflow.org/>

# Tensorflow

→ Supervised - Algorithm 'learns' from previous examples of labelled data

- ◆ Classification
- ◆ Regression

→ Unsupervised - Algorithm finds patterns from the data given

- ◆ Clustering
- ◆ Association
- ◆ Dimensionality reduction



# Demo



<https://colab.research.google.com/drive/1fFIhITKrGk8woqaZUIFmvrkX-uSDCskB?usp=sharing>

# Basic Model

- Basic model
  - Created from a series of layers
- Layers/Nodes
  - Make up the 'network' part of neural networks
  - Composed of Input/Hidden/Output Layers
  - How many to use? How many nodes?
- Loss functions
  - Different measure by which to calculate 'loss'
- Epochs
  - Number of times it iterates over provided data sets
- Evaluate
  - Returns loss values and other metrics for model

```
[ ] ## Steps in Modelling
import tensorflow as tf

tf.random.set_seed(42)

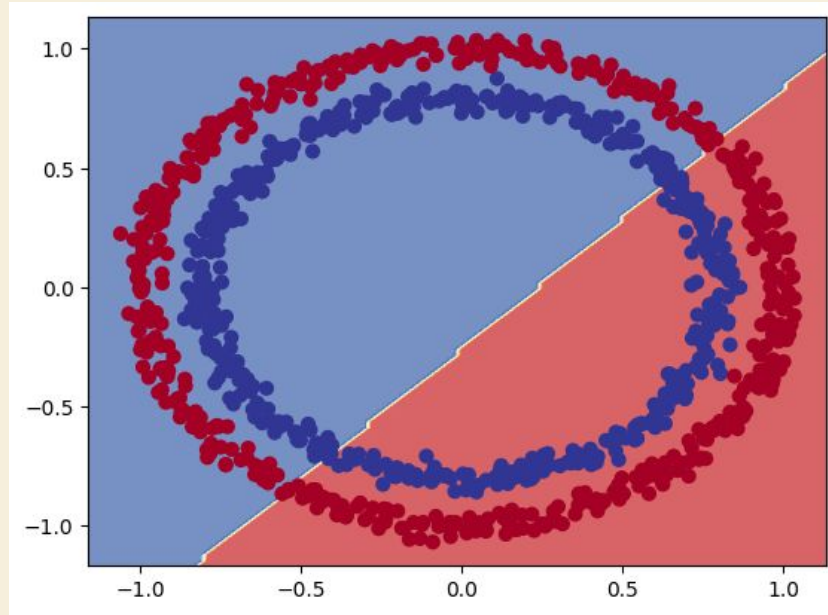
model_1 = tf.keras.Sequential([
    tf.keras.layers.Dense(1)
])

model_1.compile(loss=tf.keras.losses.BinaryCrossentropy(),
                optimizer=tf.keras.optimizers.SGD(),
                metrics=["accuracy"])

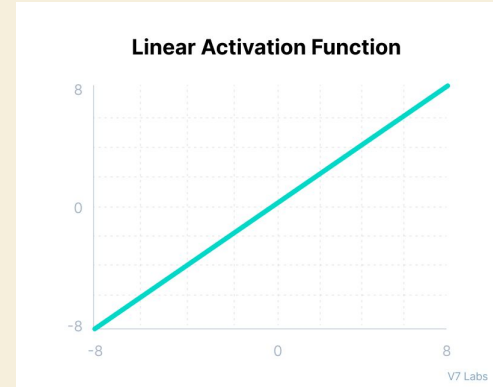
model_1.fit(X, y, epochs=5)

model_1.evaluate(X, y)
```

# Basic Model

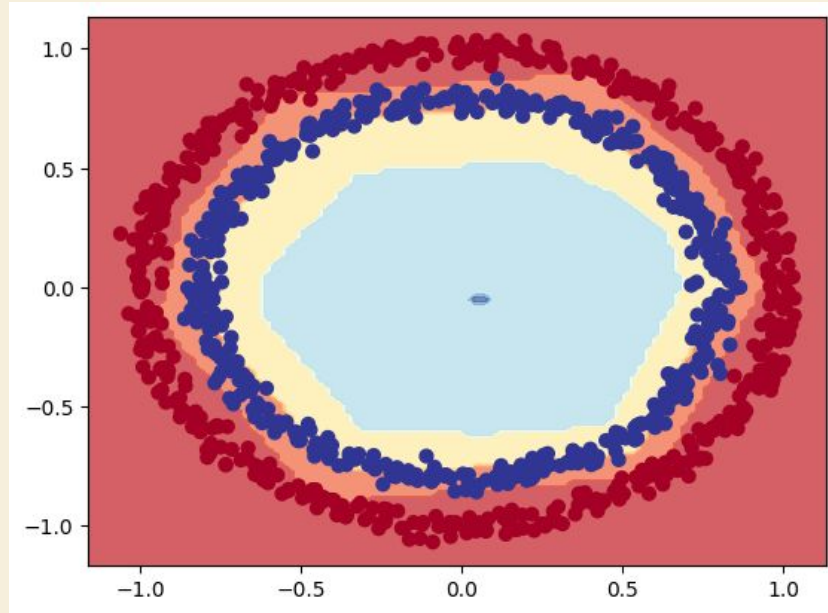


Activation: linear (non-function)

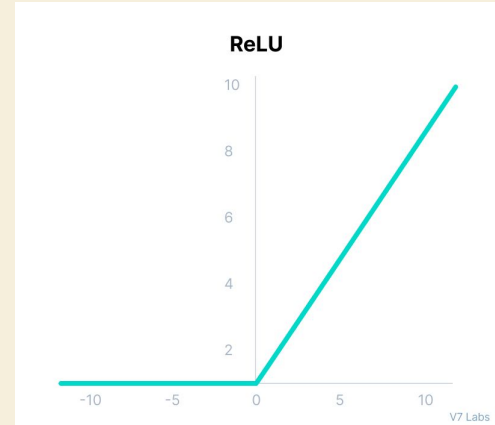




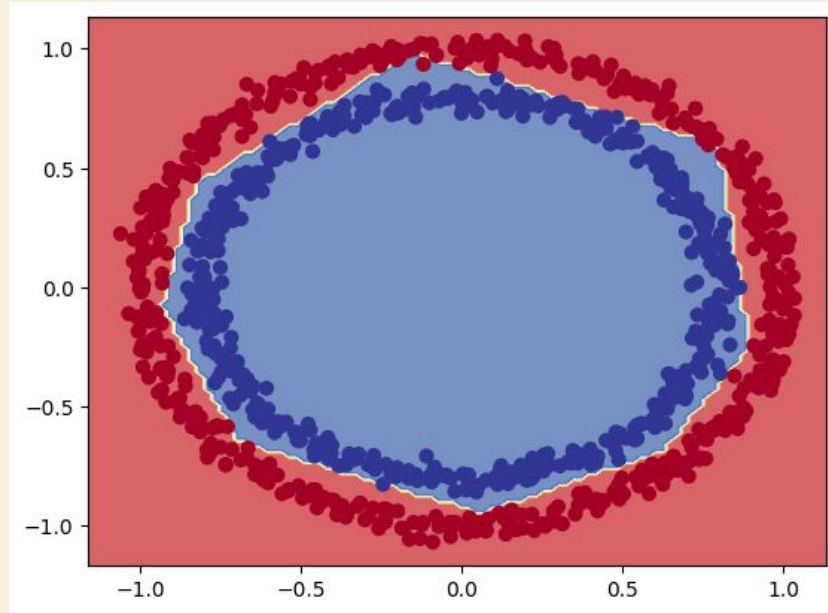
# Basic Model



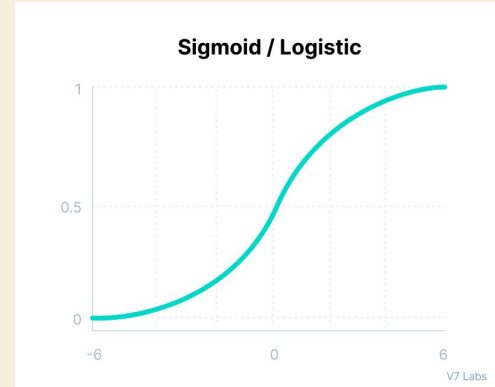
Activation: Linear (ReLU)



# Basic Model

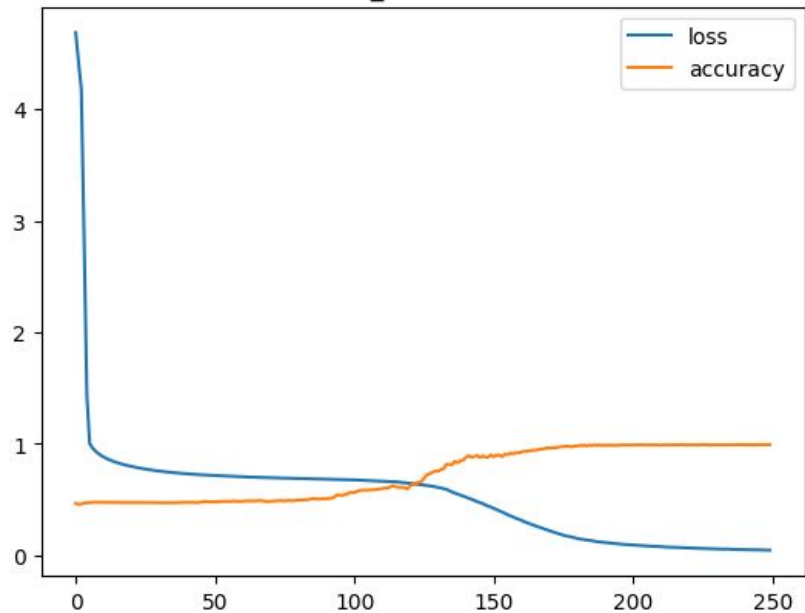


Activation: Sigmoid

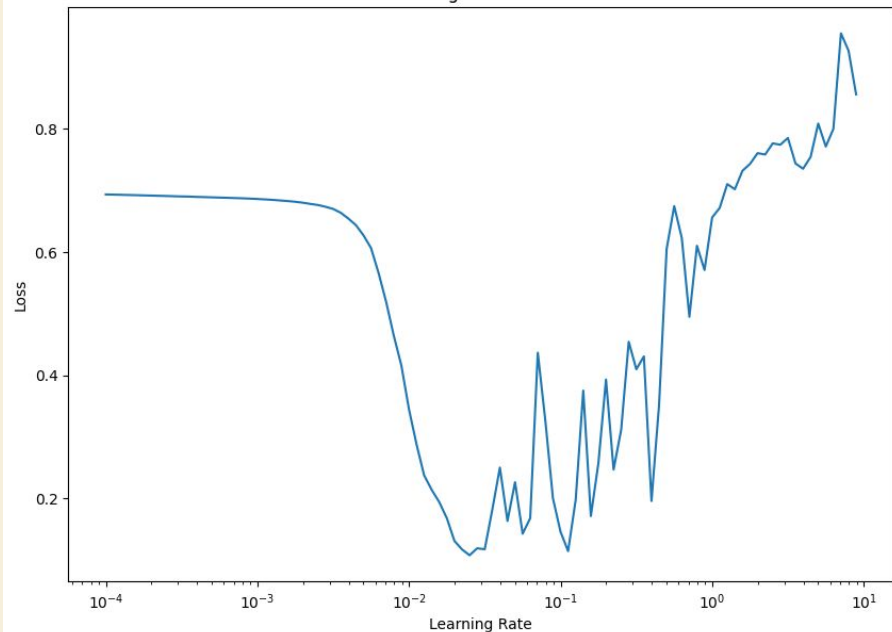


# Basic Model

Model\_6 loss curves



Learning Rate vs. Loss



# Our work

→ Supervised - Algorithm 'learns' from previous examples of labelled data

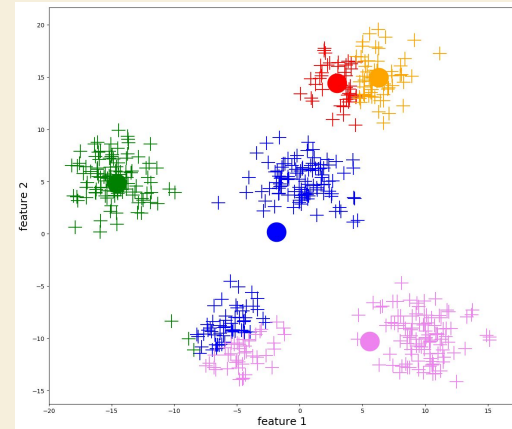
◆ Classification

- Previously: Using basic masking with ranges of values
- Now: Working with professionally labelled data

→ Unsupervised - Algorithm finds patterns from the data given

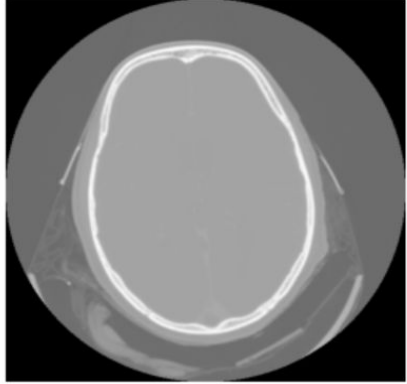
◆ Clustering

- Motivated by the fact large enough swaths of data will have inherent patterns

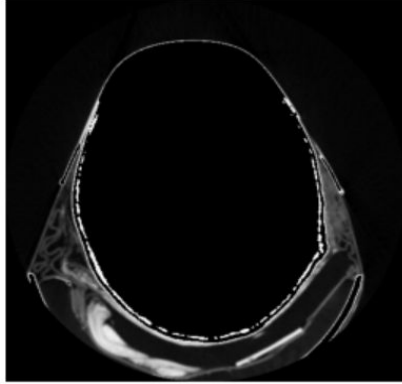


# Simple Masking

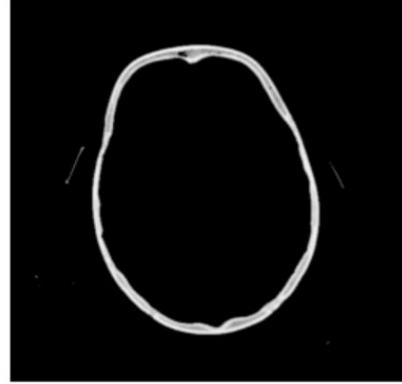
Scan



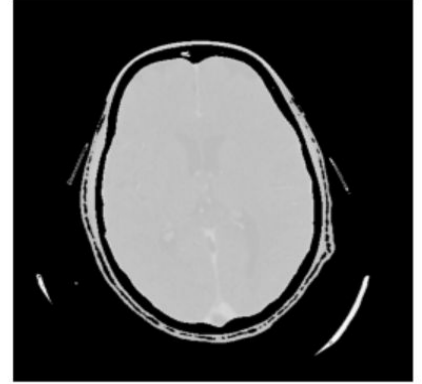
Air



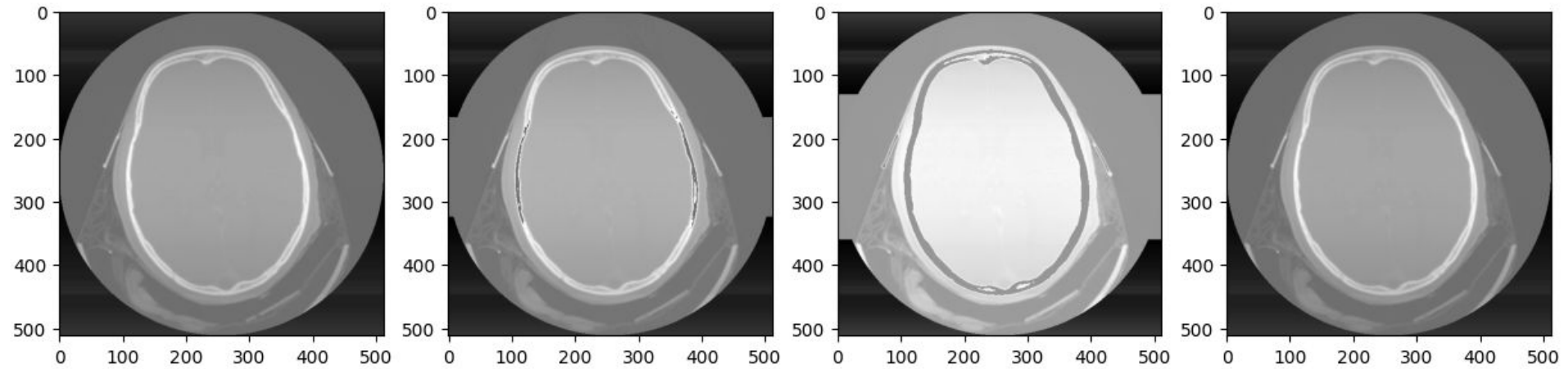
Bone



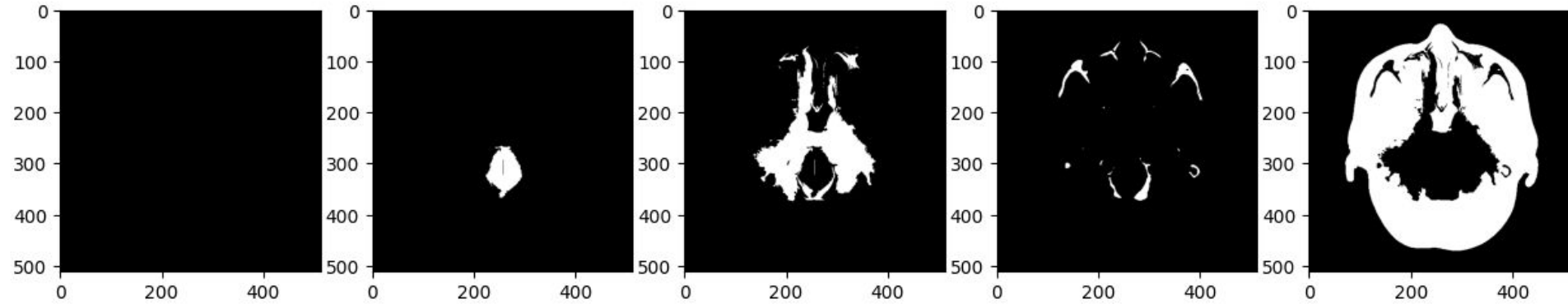
Skin/Fat/Muscle



# K-Means Clustering



# Correct Labelling



# Citations

- <https://www.ibm.com/cloud/blog/supervised-vs-unsupervised-learning>
- <https://www.ibm.com/topics/machine-learning>
- <https://builtin.com/data-science/unsupervised-learning-python>
- <https://machinelearningmastery.com/how-to-configure-the-number-of-layers-and-nodes-in-a-neural-network/>
- <https://www.v7labs.com/blog/neural-networks-activation-functions#:~:text=The%20linear%20activation%20of%20function%2C%20also,the%20value%20it%20was%20given>
- <https://machinelearningmastery.com/rectified-linear-activation-function-for-deep-learning-neural-networks/>