Topic 1 - Introduction to Machine Learning and Neural Networks

Applications of Machine Learning

- Machine learning is a **branch of artificial intelligence** that in essence enables **machines to learn by example**.
- Related to field such as:
    - Computer vision
    - Signal processing
    - Data mining
- By using advances in machine learning, computer vision, and biometrics, **e-passport** gates **use face recognition systems** that identify passengers with a high probability
- Computer vision can also be used to **identify human body location**, posture, and even facial expressions.
- Machine learning can also be applied to **audio and text**, and intersecting with areas such as audio and natural language processing. For example, in **handwritten digit recognition**, **consumer oriented personal assistants** that can recognize speech.
- **Issue of privacy**, particularly with systems that capture personal data.
- Another machine learning application that we encountered in our daily lives as **recommendation algorithms**
- **Generative models** in machine learning are techniques that can **generate data**

Types of Machine Learning

- We use machine learning because we want to **learn from data** rather than hard coded solutions.
- There are two main types of machine learning problem, **supervised and unsupervised**.
- With **supervised** learning problems, the label, in this case y, **is associated with every sample x**
- In a **classification problem** we need produce **discrete output**
- If for example, we were interested in the price of a goat to the cost of it as it changes over time if you're buying and selling one at a market, then we have a **continuous output**. In such a case, we have a **regression problem**
- There's a third type of machine learning problem which falls into the category of **reinforcement learning**.
- In reinforcement learning, we're interested in predicting a sequence of actions that entail a specific reward

The Machine Learning Black Box

A typical machine learning pipeline for supervised learning:

- We want to approximate some mapping between x and y. That is, map the inputs to the outputs. An example of this process may be, given a set of images containing faces which we call x, and a set of output labels y which would be the identity of each of the people in the images.
- We can then learn a mapping that links the facial images to their identities. When a new data sample arrives, data that we haven't seen before is indicated by x followed by an asterix, which we call x star. We can use this mapping that we've learned on x and y, the experience in the system, to pervade a prediction which we call y star
- For example, imagine that we are given a new image of an unknown person that the system has not seen during training and we want to identify that person that appears in the image. That is, the system has been trained on lots of images of that person but this is a new one that it hasn't seen before and can't identify the person using this new image.
- If we have a look inside the black box, we find that even unsupervised learning systems, most of the time, **unsupervised learning methods are also used.** In many cases as a pre-processing stage.