1 - Summary

This week, we explored deep learning, focusing on neural networks and how they can model complex, non-linear relationships. The lecture introduced the structure of feedforward neural networks and explained how they are trained using backpropagation and optimization techniques like stochastic gradient descent.

2 - Concepts

- **Neural networks**: A series of interconnected layers where each layer applies a linear transformation followed by a non-linear activation function to the input data.

- **Hidden layers**: Intermediate layers between the input and output that allow the network to learn complex features and interactions.

- **Activation functions**: Functions like ReLU (Rectified Linear Unit), sigmoid, or tanh that introduce non-linearity, enabling the network to model non-linear patterns.

- **Training neural networks**: Involves minimizing a loss function using optimization methods like gradient descent. The backpropagation algorithm computes the gradient of the loss function with respect to each weight efficiently.

- **Tuning parameters**: Includes the number of hidden layers, the number of units per layer, the choice of activation functions, learning rate, and batch size.

- **Advantages of deep learning**: Able to learn hierarchical representations and perform well on large, complex datasets like images or text.

3 - Uncertainties

I'm still unclear on how to choose the number of hidden layers and units. There doesn't seem to be a consistent rule beyond trial and error or cross-validation. It's also not obvious how to interpret the fitted model, which makes deep learning feel more like a black box compared to linear models. Lastly, while I understand the concept of backpropagation in theory, the mechanics of how gradients are actually computed across multiple layers still feel a bit abstract.