1. Describe the difference between ARIMA/SARIMA models for forecasting compared to Neural Networks. (2) What other models can be used for forecasting? (2)

ARIMA/SARIMA models take into past values using a moving average. They also utilize regression. Neural Networks on the other hand use all the data in a window format during training to predict the next value. Other models that can be used for forecasting are HMM’s, Autoregressive (similar to Arima) and random walk models.

1. Describe the fundamental difference between discriminatory and generative AI models. (2)

Generative AI models look at the distribution and probabilities of the data and make inferences based on said data. Therefore it can create new data that fits within the learn distribution. Discriminative map an input to an output and has no knowledge of how the data is spread.

1. What is a Hidden Markov Model? Describe the fundamental idea, and why it can be classified as a generative model. (3)

HMM are based on Markov models where the states are Unknown. Generally used for time series or sequential data. The observed variable depend on the hidden Markov Process. One can only see the outcome of the states and not the states themselves. It also learns the transition probabilities between states. Because it learns these probabilities it is generative

1. What is the latent space in Autoencoders? (2) Compare the concept of the latent space with PCA. (2)

Latent space Autoencoders take in data and store it in a space requiring less storage than storing the original data. Autoencoders are Neural Networks that can then store and then retrieve the information from the latent space. The main difference between autoencoders and PCA is that PCA is a linear process that reduces dimensionality without reconstruction while latent spaces with Autoencoders allow for reconstruction (basically compressing then decompressing).

1. Describe the general approach to using Autoencoders for Anomaly Detection. (2)

Using Autoencoders for anomaly detection involves training a DNN on a set of data where the target and input data are the same. For images this can involve flatting the data to 1D and training.

1. What is a Variational Autoencoder? (1) Describe the difference to a classic Autoencoder in as much detail as you can. (4) What applications can it be used for? (2)

A VAE is an autoencoder that learns the distribution of the data. Whereas Auto encoders will store data in a latent space VAE’s have a probabilistic layer allowing them to be generative looking at both the mean and standard deviation of the data. Therefore, autoencoders are deterministic (data into that same data reconstructed out) whereas VAE maps inputs into a distribution and the output will represent a variation of the input. Applications for VAE most notably include image generation.

1. Bonus question (3): Describe (conceptually) the approach to constructing the Loss function for a VAE. Comment briefly on the components of the total loss.

The total loss is summed through the reconstruction error (negative log likelihood) which looks at how well the output adheres to the distribution as well as regulation which helps stop the model from overfitting.