Time Series Analysis (7th semester Btech(AI))

Assignment

Q.1. a) An input time series signal is reshaped into a matrix of size 28x28 along with a filter of size 3x3 with the stride of 2 Determine the size of the convoluted Matrix

b) Can you explain what the vanishing gradient problem is? How is it related to recurrent neural networks?

Q.2. Consider the following AR(1) Gaussian process for Indian stock returns:

kt+1 = ρ0 + ρ1 kt + Єt+1 Єt+1 IID N(0, σE2) we know that ρ0=1 , that E[Kt+1]=2, that Var[Kt+1] = 1/3, prove that ρ1=0.5 and σE2= ¼

Q.3. Consider the following AR(1) model with the disturbances having zero mean and unit variance yt = 0.2 + 0.4 yt-1 + ut

1. The (unconditional) mean of y will be given by
2. The (unconditional) variance of the AR(1) process

Q.4. A space agency wants to discriminate between Aliens (A) and Humans (H) based on the following characteristics: Blue ∈ {N, Y}, Height ∈ {S, T}, Legs ∈ {2, 3}, Smelly ∈ {N, Y }. Create and draw a decision tree using the ID3 algorithm. Our available training data is as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Species | Blue | Legs | Height | Smelly |
| A | N | 3 | S | Y |
| A | Y | 2 | T | N |
| A | Y | 3 | T | N |
| A | N | 2 | S | Y |
| A | Y | 3 | T | N |
| H | N | 2 | T | Y |
| H | N | 2 | S | N |
| H | N | 2 | T | N |
| H | Y | 2 | S | N |
| H | N | 2 | T | Y |

Q.5. The Demand and Forecast of an item for six months are given in the following table:

|  |  |  |
| --- | --- | --- |
| Period | Actual Demand | Forecast Demand |
| April | 225 | 240 |
| May | 220 | 200 |
| June | 285 | 270 |
| July | 290 | 300 |
| August | 250 | 230 |
| Sepember | 276 | 250 |

Calculate a) Mean Absolute Deviation (MAD)

b) Mean Absolute Percent Error (MAPE)

c) Mean squared error (MSE)

Q 6. Your friend is happy someday and angry on other days. You can only observe when he smiles, frowns, laughs, or yells but not his actual emotional state. Let us start on day 1 in the happy state. There can be only one state transition per day. It can be either to happy state or angry state. The HMM is shown below;

A diagram of a person's emotions

Description automatically generated

Assume that qt is the state on day t and ot is the observation on day t. Answer the following questions.

(a) What is *P(q2 = Happy)*?

(b) What is *P(o2 = frown)*?

(c) What is *P(q2 = Happy | o2 = frown)*?

(d) What is *P(o1 = frown o2 = frown o3 = frown o4 = frown o5 = frown, q1 = Happy q2 = Angry q3 = Angry q4 = Angry q5 = Angry)*ifπ*= [0.7, 0.3]*?