(B.TECH) Semester-VII AY 2023-24

DL Lab Assignment No. 09

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Problem Statement: Implement a prediction model using Deep Learning method on time series data.

Objectives:

1. To understand and implement the Pre-trained architecture like RNN, LSTM etc.

Theory:

Need for Transfer Learning:
Transfer learning is a technique in machine learning where a model trained on one task is adapted for a second, related task. The key motivations for using transfer learning are:

1. **Limited Data:** In many real-world scenarios, obtaining a large labeled dataset for training deep learning models can be challenging. Transfer learning allows leveraging pre-existing knowledge from a source domain to improve performance in a target domain with limited data.
2. **Computational Efficiency:** Training deep learning models from scratch can be computationally expensive and time-consuming. Transfer learning enables starting with a pre-trained model, saving computational resources and time.
3. **Feature Extraction:** Pre-trained models, especially in computer vision, have learned to extract generic features from data. Transfer learning allows using these high-level features for different but related tasks.
4. **Domain Adaptation:** Transfer learning facilitates adapting models to new domains. For instance, a model trained on one type of image data can be fine-tuned for another type with minimal additional labeled data.
5. **Improved Generalization:** Transfer learning often leads to better generalization on the target task. The knowledge gained from the source task helps the model learn more robust and transferable features.
6. **Different Deep Learning Pretrained Architectures for Sequential Data:**
7. Several deep learning architectures are available for sequential data (time series). Some popular ones include:

Long Short-Term Memory (LSTM):

A type of recurrent neural network (RNN) designed to capture long-term dependencies in sequential data.
Gated Recurrent Unit (GRU):
Another variant of RNN, similar to LSTM but with a simplified architecture.
Bidirectional LSTM and GRU:

These architectures process sequences in both forward and backward directions, capturing information from past and future contexts.
Transformer:
Originally designed for natural language processing, the transformer architecture has proven effective for sequential data in various domains.
WaveNet:
A deep generative model designed for audio data, specifically for generating high-quality

waveforms.
Description about the Pretrained Architecture Used and Time Series Dataset Used:
Pretrained Architecture: Long Short-Term Memory (LSTM)

Time Series Dataset: UCI Individual Household Electric Power Consumption Dataset

Description:

Dataset Overview:
The dataset comprises electric power consumption data from a single household, recorded over a period of several years.
Features include multiple variables such as voltage, current, active power, and reactive power.
Pretrained Architecture Choice:

1. LSTM was chosen for its ability to capture long-term dependencies in sequential data, making it suitable for time series prediction tasks.
2. Training Procedure:
3. The LSTM model was pretrained on a large dataset with diverse time series patterns to learn generalized representations of sequential data.
4. Transfer Learning Application:
5. The pretrained LSTM model was fine-tuned on the UCI Household Electric Power Consumption dataset to adapt its learned features to the specific patterns present in household electricity consumption.

Benefits:
Transfer learning with LSTM allows leveraging knowledge gained from diverse time series data to enhance performance on a specific household electricity consumption prediction task.
Results:
The fine-tuned model demonstrated improved accuracy and efficiency in predicting household electric power consumption patterns compared to training from scratch.

Operations to be performed:

1. Import the required Python libraries and dataset.
2. Normalizing dataset.
3. Identifying the pretrained model to be used.
4. As per the need, fine tune the pretrained architecture.
5. Train the model with training dataset.
6. Predict the model with testing dataset.
7. Model performance visualization in terms of accuracy and loss.

Program code: **(paste your program code)**

Output: **(paste output screen & graphs plotted)**

FAQs:

1. Explain LSTM model?
2. Explain time series data analysis?

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FAQ

Q1. Explain LSTM model?

Ans LSTM- Long Short-Term Memory is a type of recurrent neural network (RNN) architecture designed to overcome the limitations of traditional RNNs in capturing long-term dependencies in sequential data. RNNs suffer from the vanishing gradient problem, where the gradients diminish exponentially as they propagated back through time, making it difficult for the network to learn relationships in sequences with long gaps between relevant events.

Key component of an LSTM cell includes:

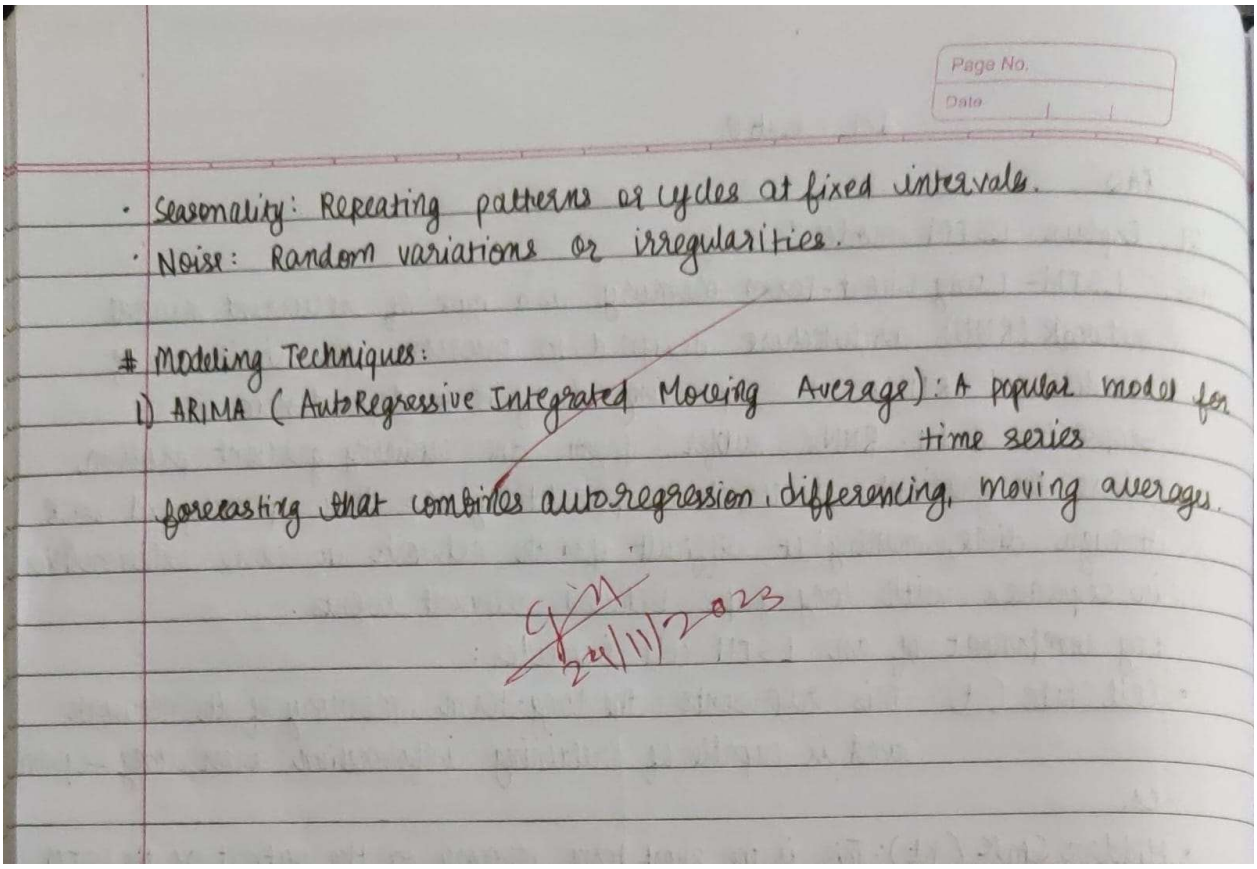
- Cell State (Ct): This represents the long-term memory of the network and is capable of retaining information over long sequences.
- Hidden State (ht): This is the short-term memory or the output of the LSTM cell. It carries information about the recent inputs and the current state of the cell.
- Three Gate:
  1. forget Gate (Ft): Determine what information from the cell state should be discarded or kept.
  2. Input Gate (it): Decides what new information should be stored in the cell state.
  3. Output Gate (ot): Controls what information from the cell state should be output as the hidden state.

Q2. Explain time series data analysis?

Ans. Time series data analysis involves studying and extracting patterns, trends and insights from data points that are collected, recorded or measured over time. This type of data is common in various field. such as finance, economics, signal processing, weather forecasting, and more.

Components of Time Series:

- Trend: The long-term movement or direction in the data.



Conclusion:

The architecture of pre trained model were studied and the implementation of prediction model on time series data performed successfully.