Department of Computer Science and Engineering (Data Science)

Subject: Time Series Analysis

Jhanvi Parekh

60009210033

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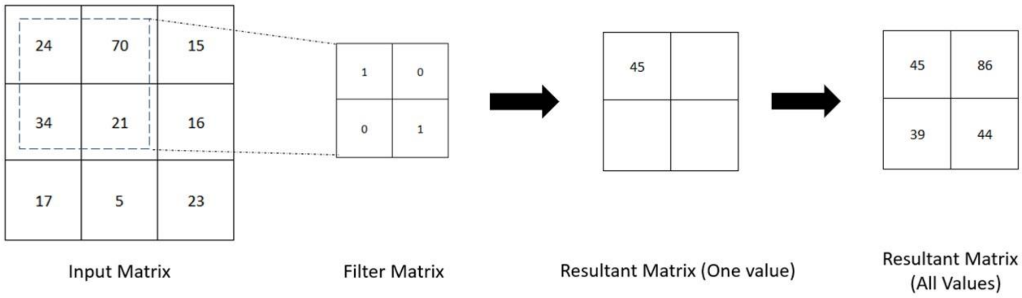
Experiment 8

(Convolution Neural Network Model)

Aim: Implement a convolution model on any sales/finance dataset.

Theory:

- Every image that is digitally available is actually a matrix of pixel values. Each pixel value can range from 0 to 255 depending on the intensity of the pixel. Each image also comprises channels depending on the color composition of the image.
- A grey image has one channel since each channel corresponds to the colors it contains.
- A color image has three channels comprising red, blue, and green colors.
- A convolutional neural network perceives each image as a matrix of pixel values in the dimension of image width, length, and the number of channels.
- The primary components of a Deep CNN model are as follows:
- Convolutional Layer
- Pooling Layer
- Fully Connected Layer **Convolutional Layer:**
- In the convolutional layer, the image input matrix is multiplied by a filter matrix to extract important features of the image.



Basic illustration of Convolution Operation on Input Image Matrix

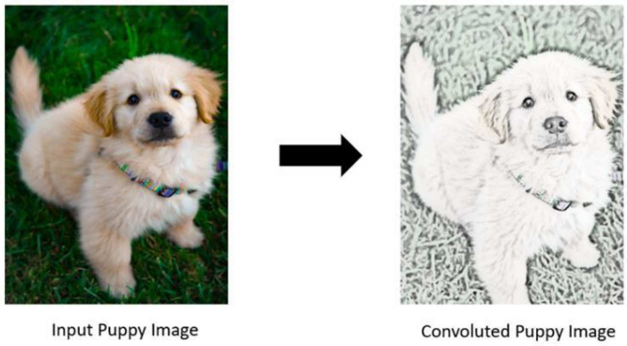


Illustration showing Convolution Layer extracting features from Input Image through filter matrix

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Pooling Layer:

- In the pooling layer, the resultant matrix is then multiplied to pooling matrix which extracts the maximum or average values from the small subsections.

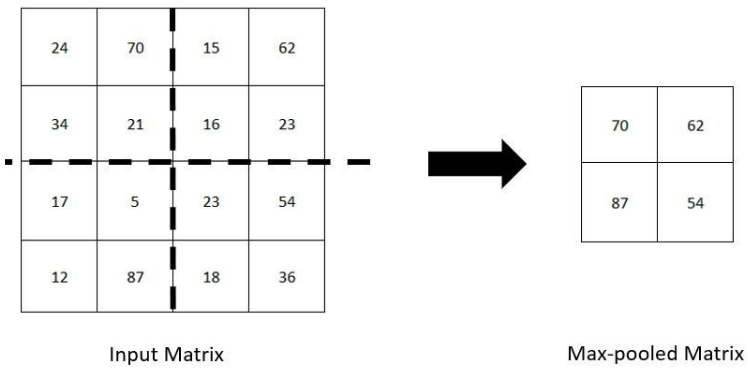
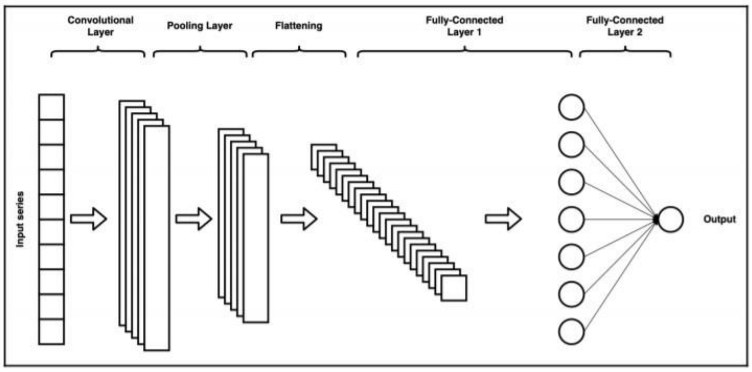


Illustration of maximum pooling operation in CNNs

Fully Connected Layer:

- The pooled matrix is then flattened and then fed to the fully connected layer which learns the images through its neural networks.

- In our time series stock price forecasting example, the 1D time series is converted to a 3D matrix using the methodology below and the neural network analogy remains the same.



Methodology for CNN model:

- Following the below-mentioned pathway for applying CNNs to a univariate 1D time series :
    1. Import Keras libraries and dependencies
    2. Define a function that extracts features and outputs from the sequence.
    3. Reshape the input X in a format that is acceptable to CNN models
    4. Design the CNN model architecture of convolutional layers(Conv-1D), pooling(max-pooling in our case), flattening layer, and the fully connected neural layers.
    5. Train the model and test it on our univariate sequence.

Lab Assignments to complete:

Perform the following tasks using the datasets mentioned. Download the datasets from the link given:

Link:
https://drive.google.com/drive/folders/1dbqJuZJULas76_Zzkqs-yRd2DbJReJup?usp=sharing

Dataset: Any sales/finance dataset.

1. Perform the following:
   Step 1: Import all the libraries from Keras for neural network architectures.
   Step 2: Define a function that extracts features (lagged values)
   Step 3: Initializing Sequence, steps, and reshaping the output to input it to our CNN model.

Step 4: Reshaping the X matrices.
Step 5: Define the CNN model.
Step 6: Implement CNN Model Fitting.
Step 7: Predict the future values.
Step 8: Plot the graph the predicted values.

LINK:
https://colab.research.google.com/drive/15l0kb2TaXWDpqkHqJoL6b8V7uu3L8LnU?usp=sharing