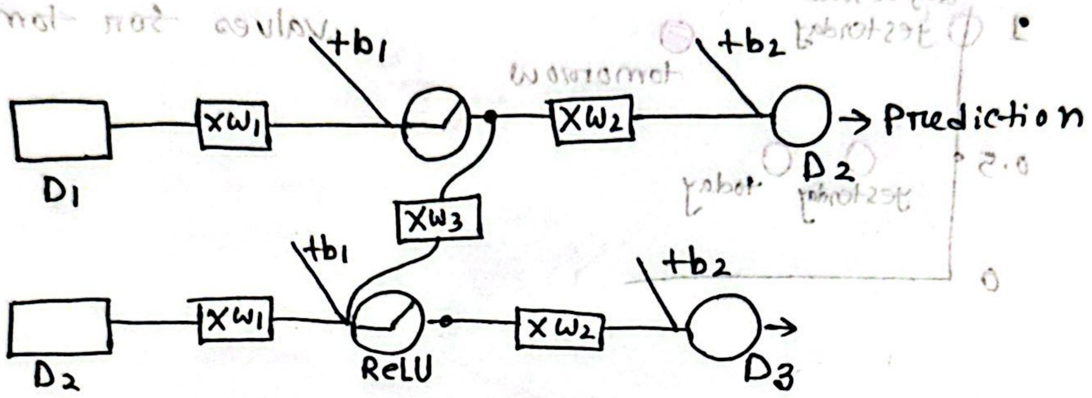
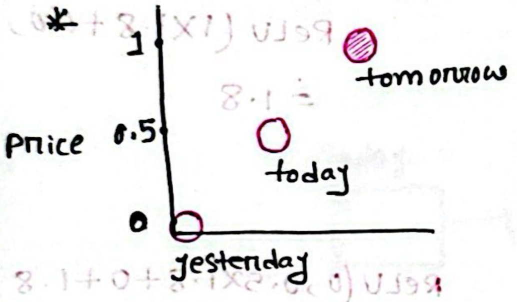
Azmari Sultana

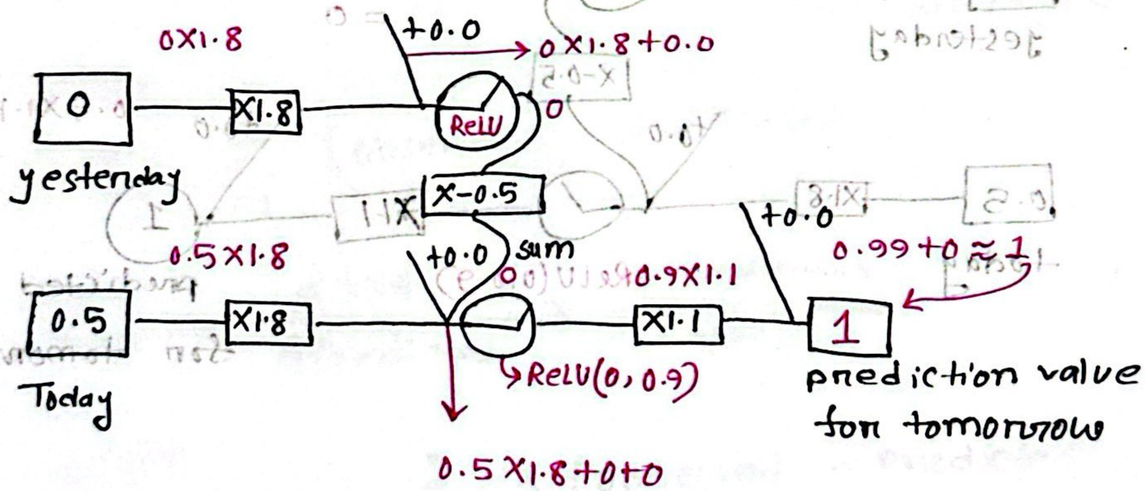
TOPIC NAME: Recurrent Neural Network **DAY:** **TIME:** **DATE:** / /

Steps of RNN (Forward Pass)





when we run yesterday and today's values ~~for~~ through RNN, we predict the correct values for tomorrow.



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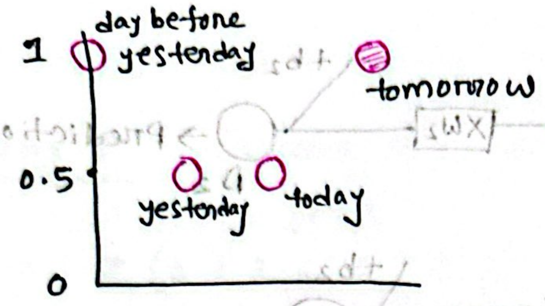
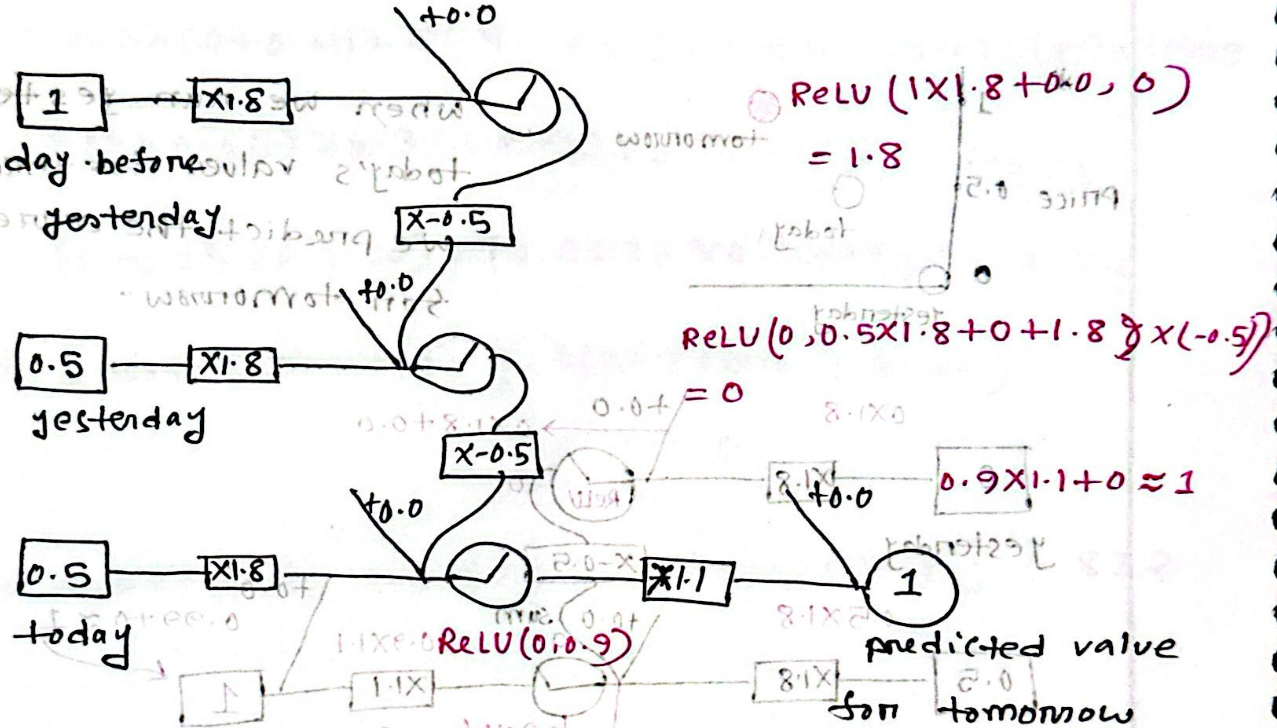
* we predict the correct values for tomorrow.





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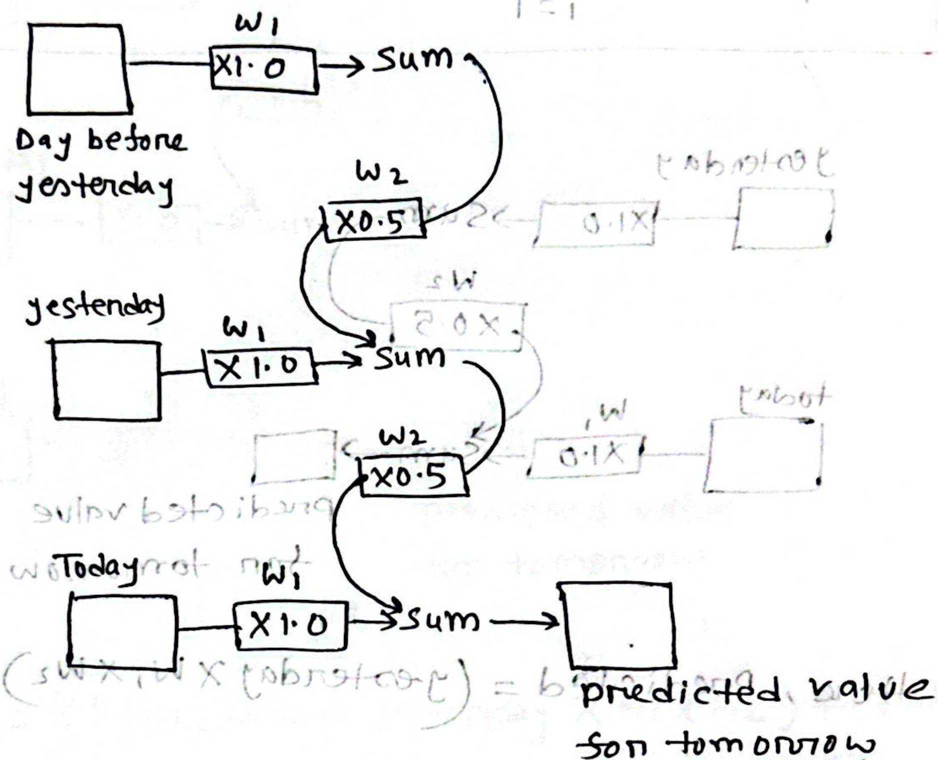
RNN Backpropagation



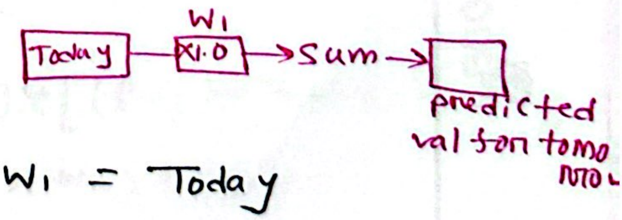
Analyse

$$SSR = \sum_{i=1}^{n} (observed_i - predicted_i)^2$$

$$\frac{dSSR}{dW_1} = \frac{dSSR}{dPredicted} \times \frac{dPredicted}{dW_1}$$

$$\frac{dSSR}{dPredicted} = \sum_{i=1}^{n} -2\,(observed_i - predicted_i)$$

$$Predicted = Today \times W_1$$



$$\frac{dPredicted}{dW_1} = \frac{d}{dW_1} Today \times W_1 = Today$$

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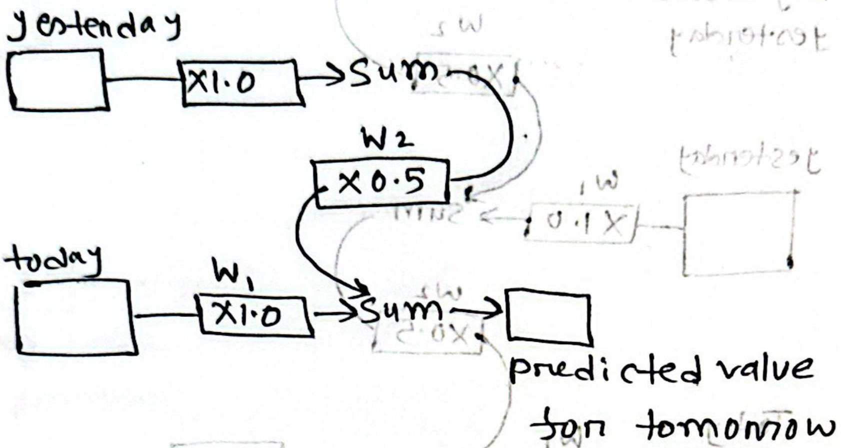
$$\boxed{\frac{dSSR}{dW_1} = \sum_{i=1}^{n} -2(\text{Observed}_i - \text{Predicted}_i) \times \text{Today}}$$



Here, $\text{Predicted} = (\text{yesterday} \times W_1 \times W_2) + (\text{Today} \times W_1)$

$$\frac{d\text{Predicted}}{dW_1} = \frac{d}{dW_1}\left((\text{yesterday} \times W_1 \times W_2) + (\text{Today} \times W_1)\right)$$

$$= (\text{yesterday} \times W_2) + \text{Today}$$

$$\boxed{\frac{dSSR}{dW_1} = \sum_{i=1}^{n} -2(\text{observed} - \text{predicted}) \times [(\text{yesterday} \times W_2) + \text{Today}]}$$

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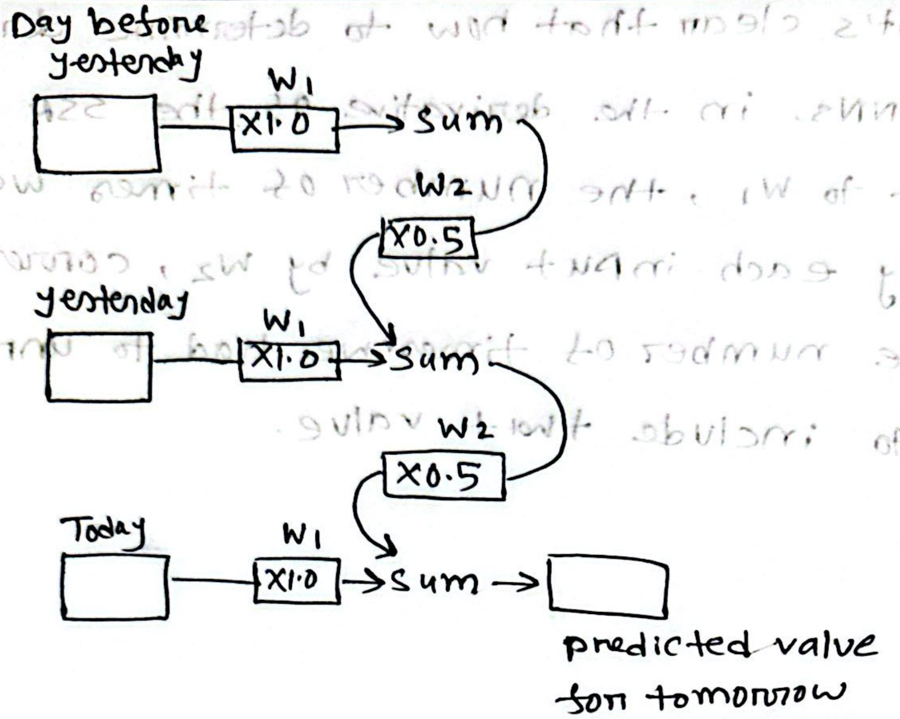

here,

$$\text{Predicted} = \{[(\text{Day before yesterday} \times W_1 \times W_2) + (\text{yesterday} \times W_1)] \times W_2\} + (\text{Today} \times W_1)$$

$$\frac{d\,\text{Predicted}}{dW_1} = \frac{d}{dW_1}\left[(\text{Day before yesterday} \times W_1 \times W_2^2) + (\text{yesterday} \times W_1 \times W_2) + (\text{Today} \times W_1)\right]$$

$$= (\text{Day before yesterday} \times W_2^2) + (\text{yesterday} \times W_2) + \text{Today}$$

$$\frac{d\,SSR}{dW_1} = \frac{d\,SSR}{d\,\text{Predicted}} \times \frac{d\,\text{Predicted}}{dW_1}$$

$$= \sum_{i=1}^{n} -2 \times (\text{Observed} - \text{Predicted}) \times \left[(\text{Day before yesterday} \times W_2^2) + (\text{yesterday} \times W_2) + \text{Today}\right]$$

Now, it's clear that how to determine derivatives for RNNs. in the derivative of the SSR with respect to W_1, the number of times we multiply each input value by W_2, corresponds to the number of times we had to unroll the RNN to include that value.