

DeepONet V/s ANN Model

DOUBLE INTEGRAL OPERATOR.

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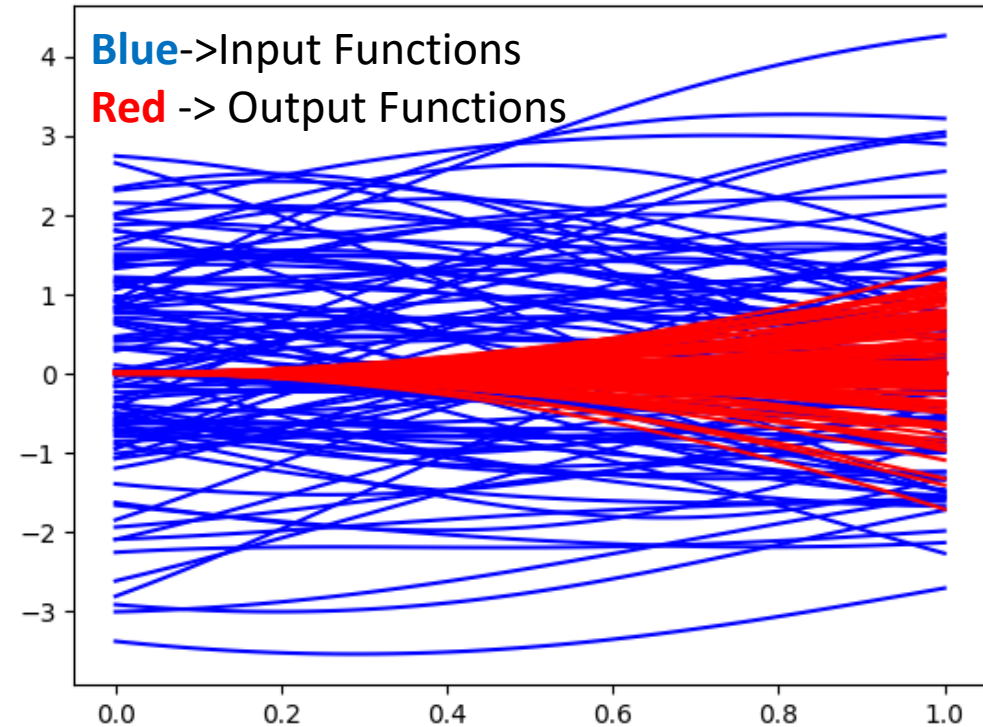
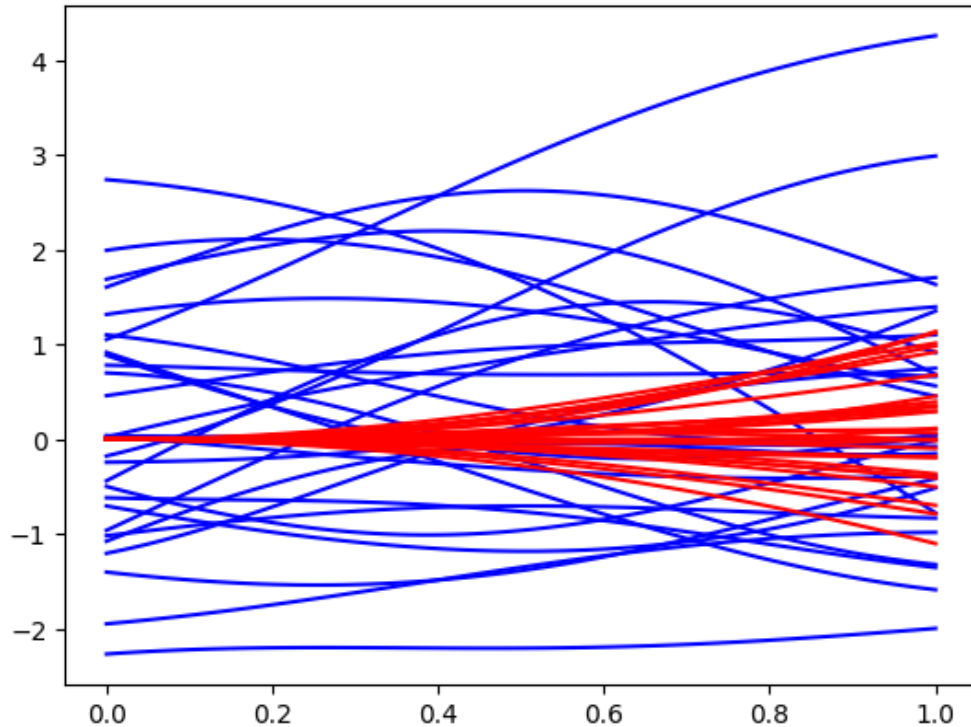
2021MEB1261

PROJECT UNDER- DR. MANISH AGARWAL

A solid orange horizontal bar spanning the width of the slide at the bottom.

Parameters

- We have trained the model on a dataset which we generate by using the **Gaussian Random field**.
- Vary the values of $x=(0,1)$ and discretized it at 100 random values using linspace.
- $m=100 \rightarrow$ sampling points for the function.
- $p=100 \rightarrow$ points where output measured
- We have $n=150$ i.e different functions on which we trained the model to show difference between DeepONet and ANN model.
- We trained the model on Double Integral Operator.

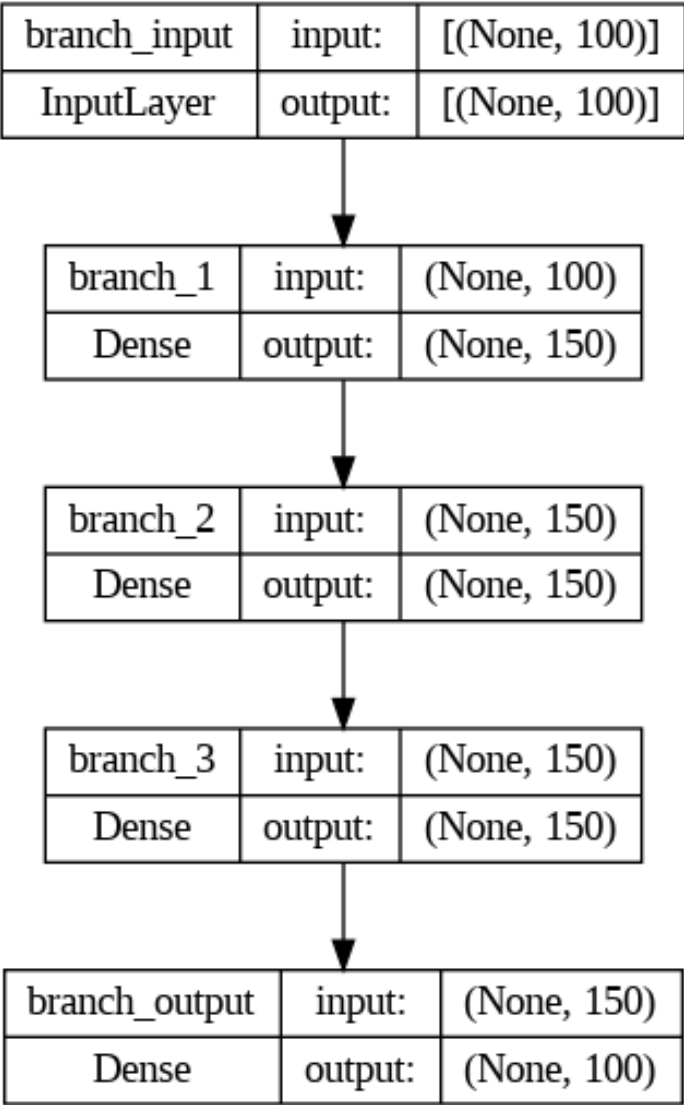
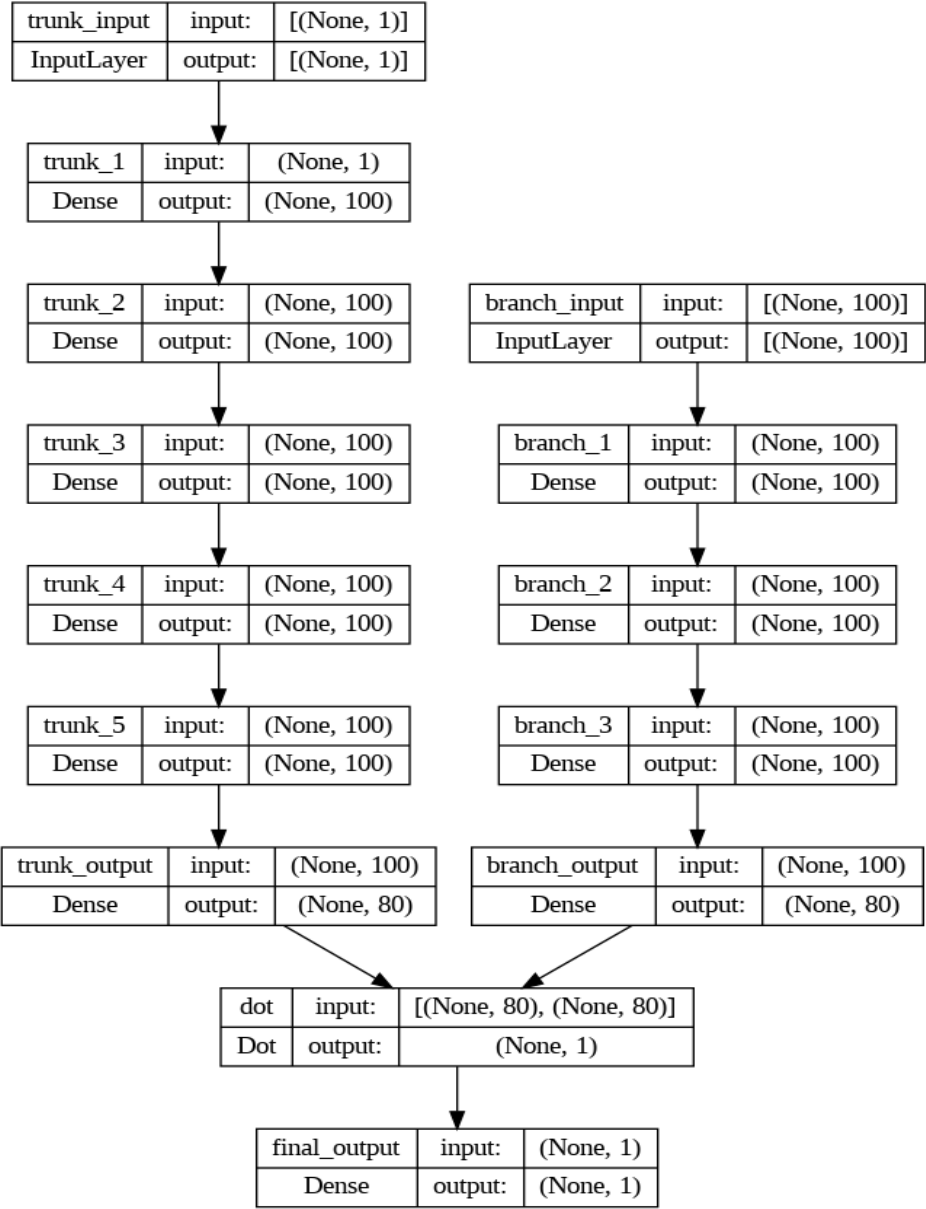


Graph depicts the different function and there output on which model is trained.

Model Architecture

DeepONet

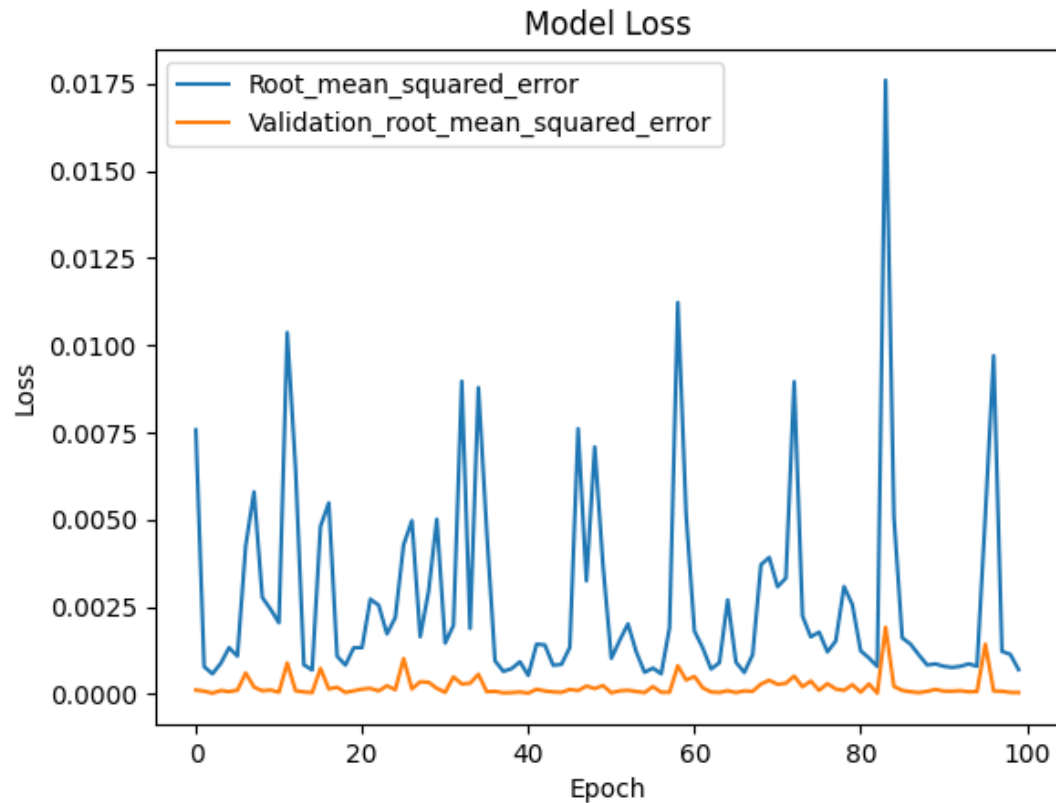
ANN



Root Mean Square Error

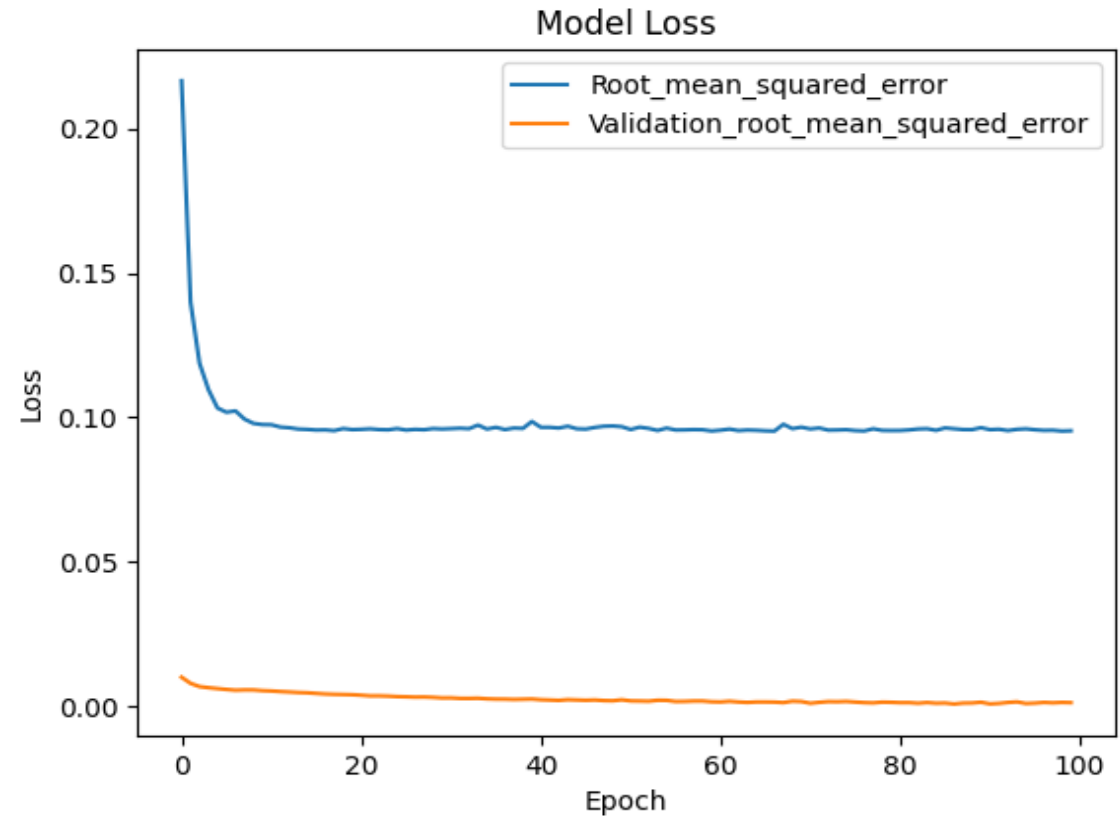
Epoch=100

DEEPONET MODEL



Loss: **4.9423e-07**
Root_mean_squared_error: **7.0302e-04**
Val_loss: **2.0007e-09**
Val_root_mean_squared_error: **4.4729e-05**

ANN MODEL



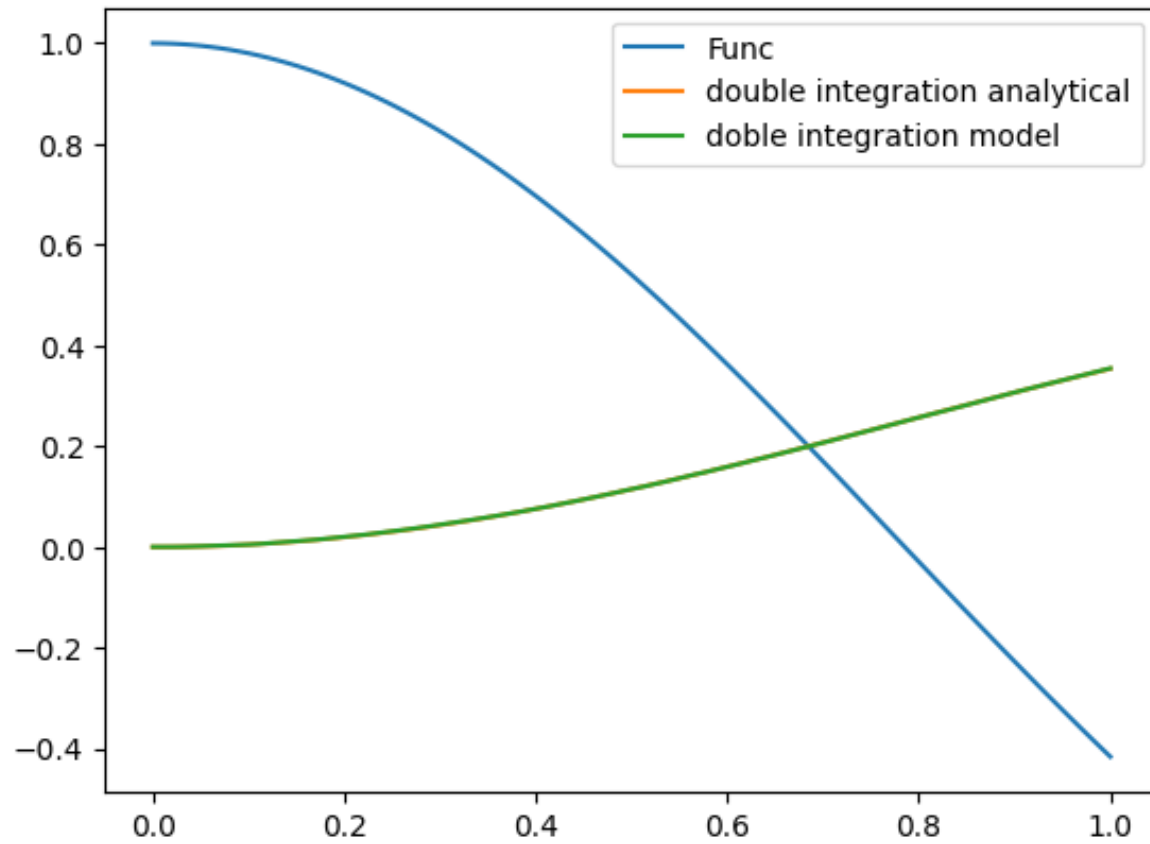
Loss: **0.0091**
Root_mean_squared_error: **0.0954**
Val_loss: **1.5277e-06**
Val_root_mean_squared_error: **0.0012**

Testing Result

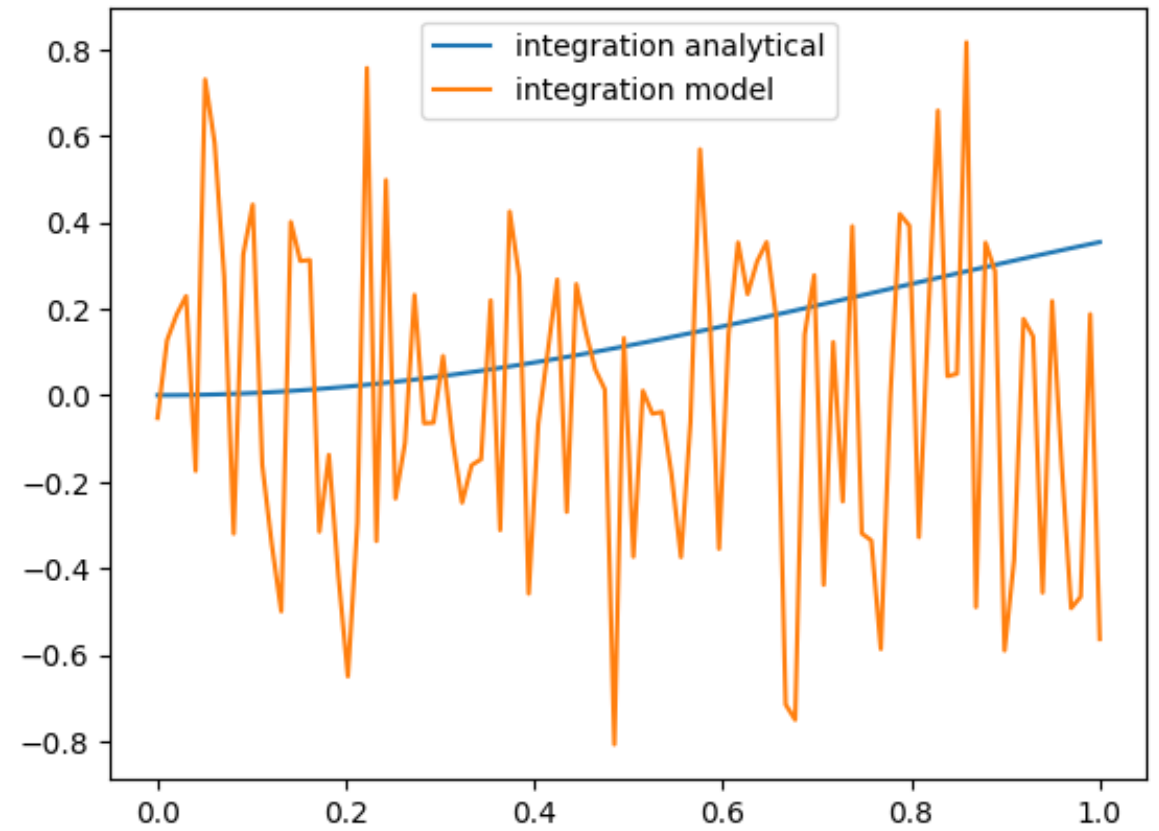
Input function= $\cos(2*x)$

Output function= $0.5*\sin(x)**2$

DEEPONET MODEL



ANN MODEL



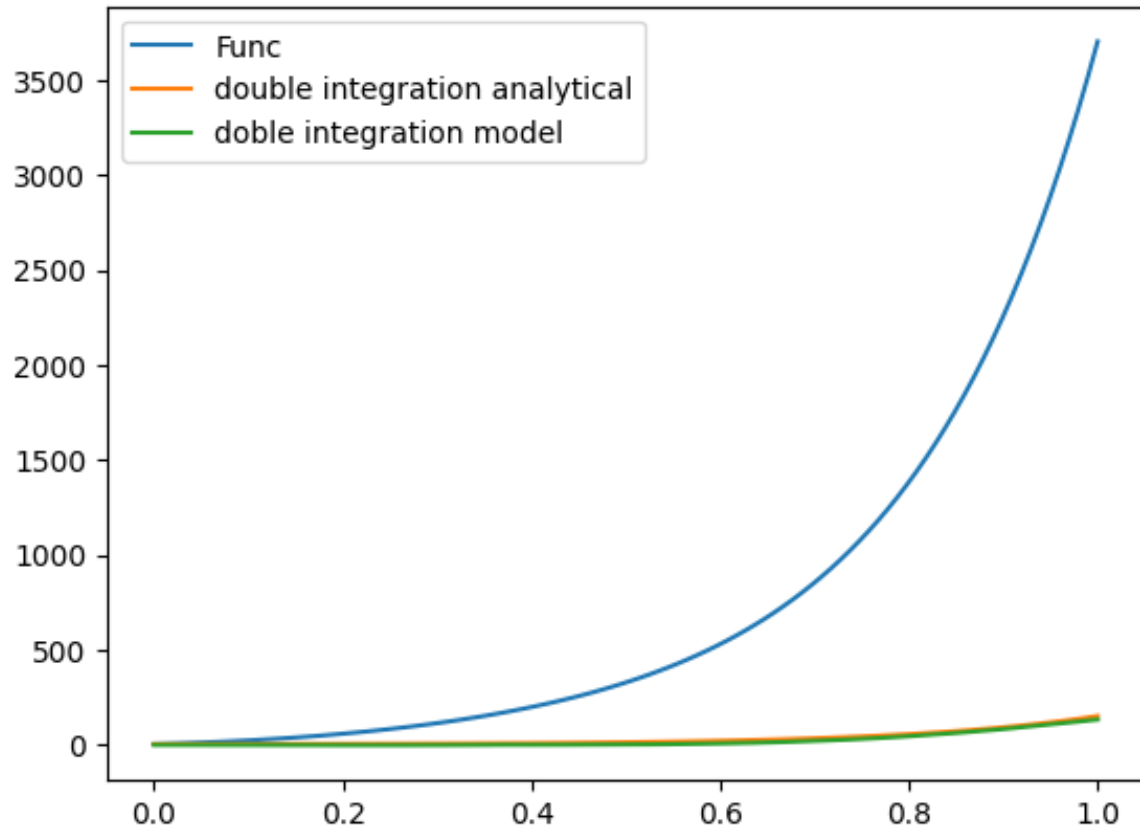
Epoch=100

Testing Results

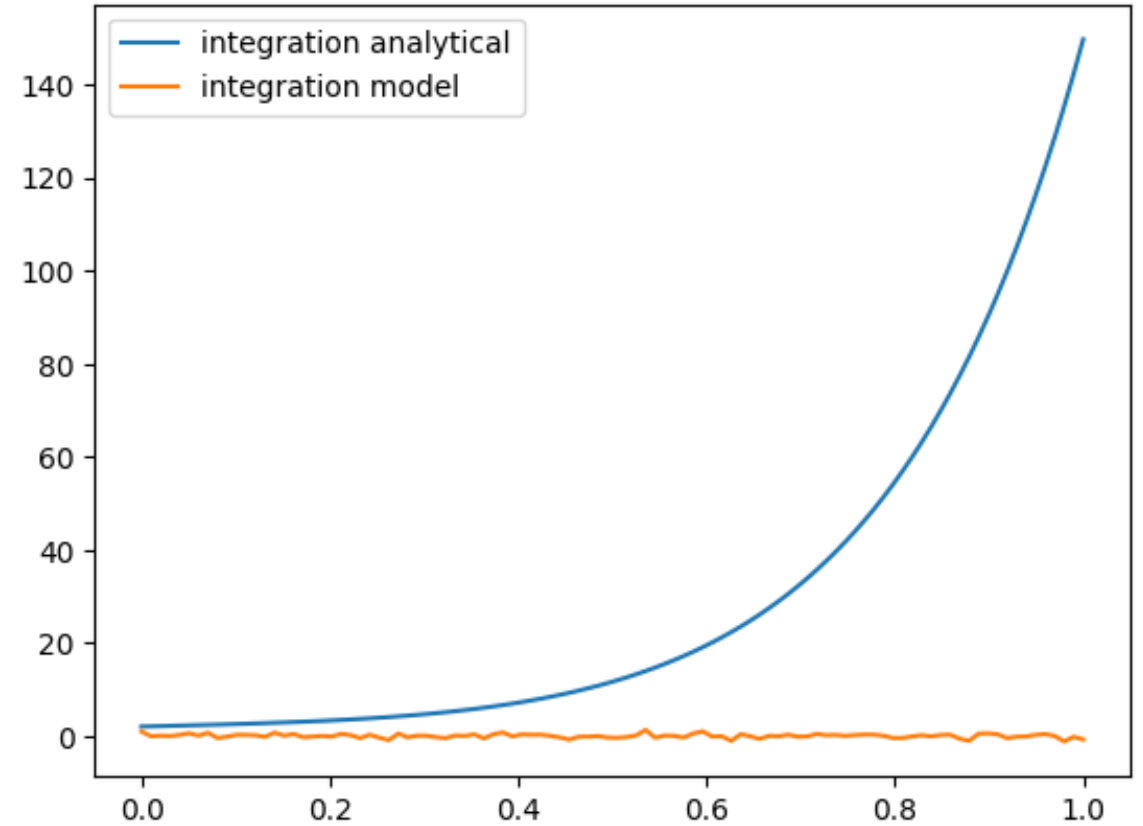
Input function= $25 \cdot \exp(5 \cdot x) + 2 - 25 \cdot \cos(5 \cdot x)$

Output function= $\exp(5 \cdot x) + x^2 + \cos(5 \cdot x)$

DEEPONET MODEL



ANN MODEL

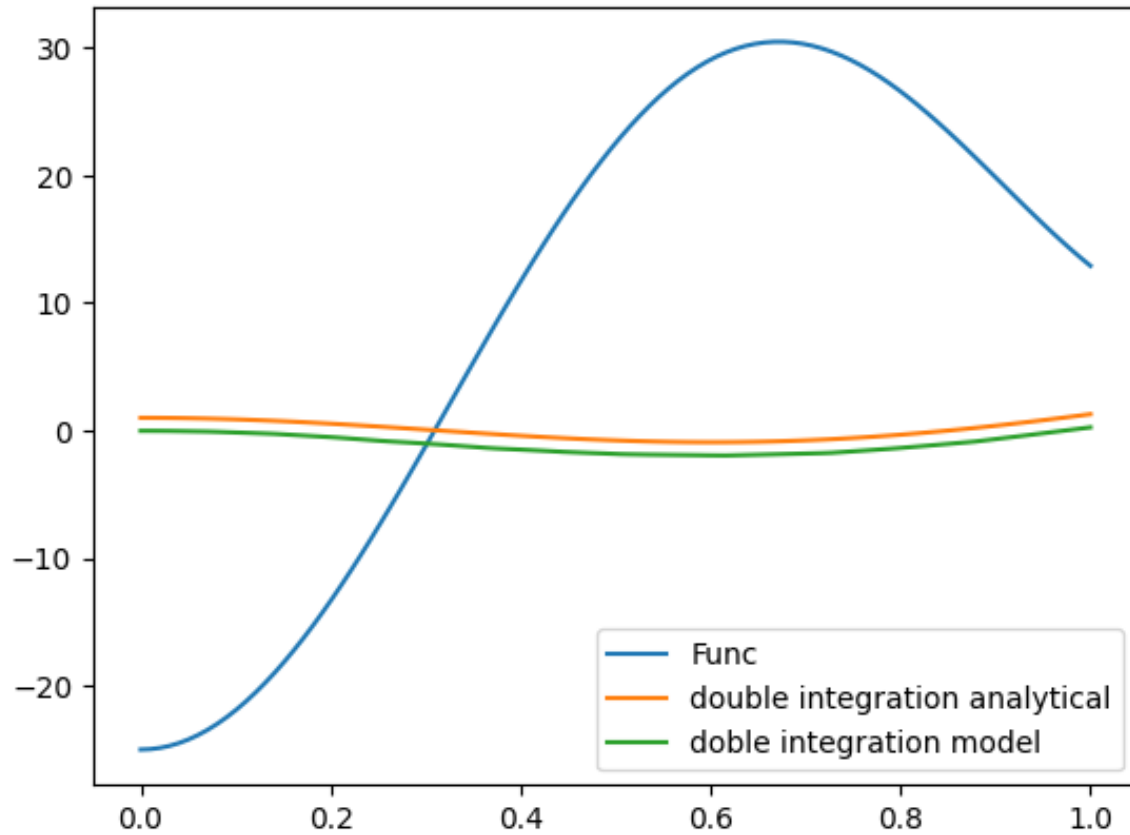


Epoch=100

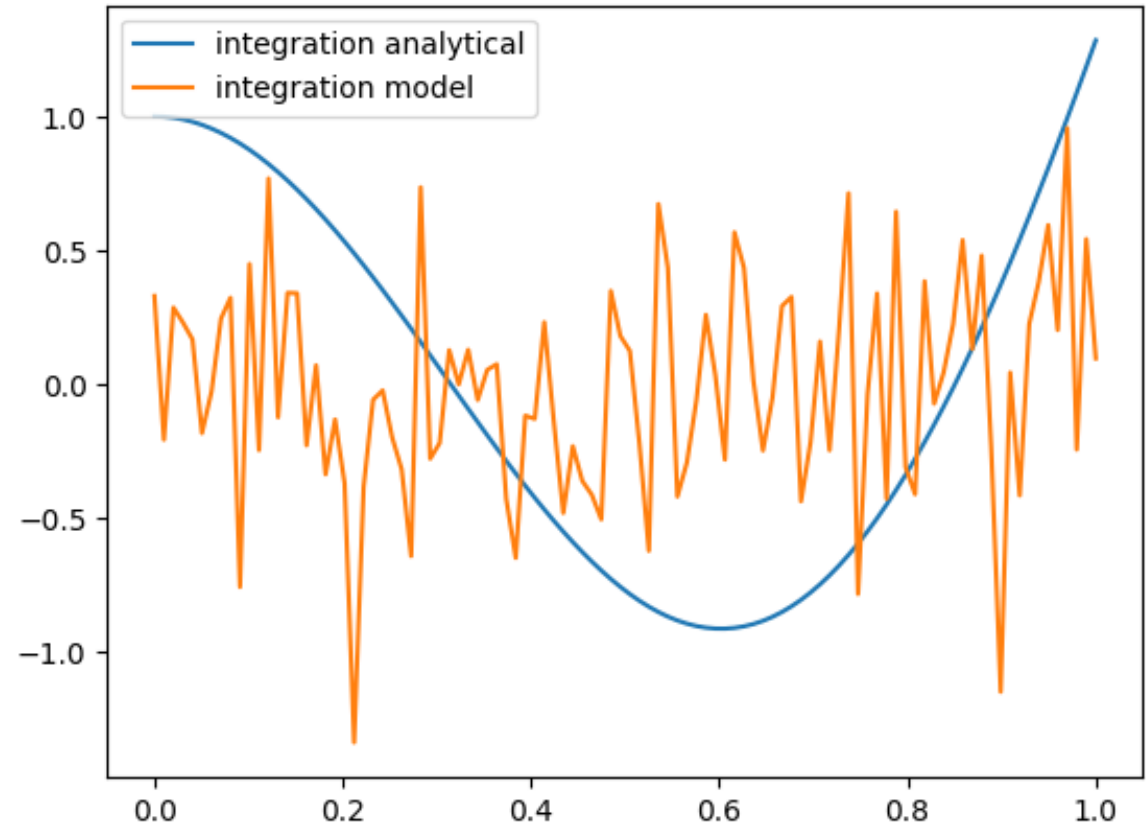
Testing Results

Input Function: $20x^3 - 25\cos(5x)$
Output Function : $x^5 + \cos(5x)$

DEEPONET MODEL



ANN MODEL

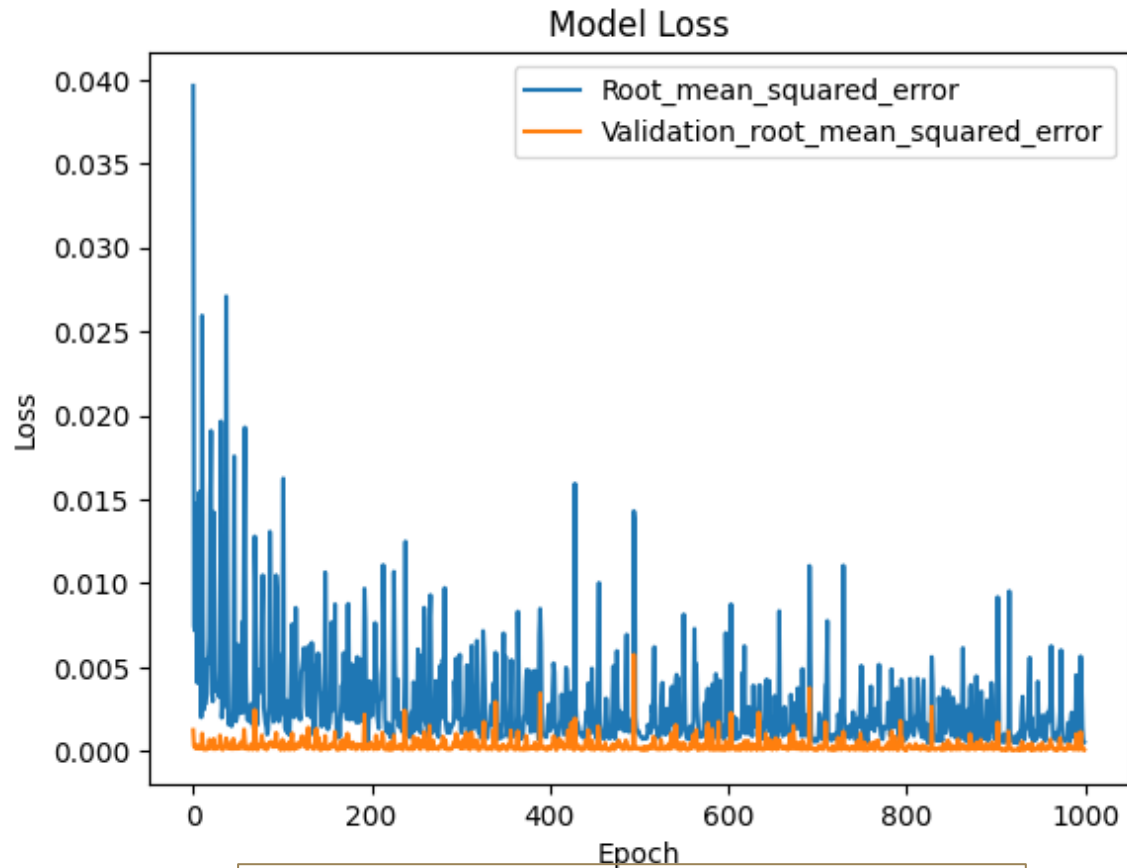


Epoch=100

Root Mean Square

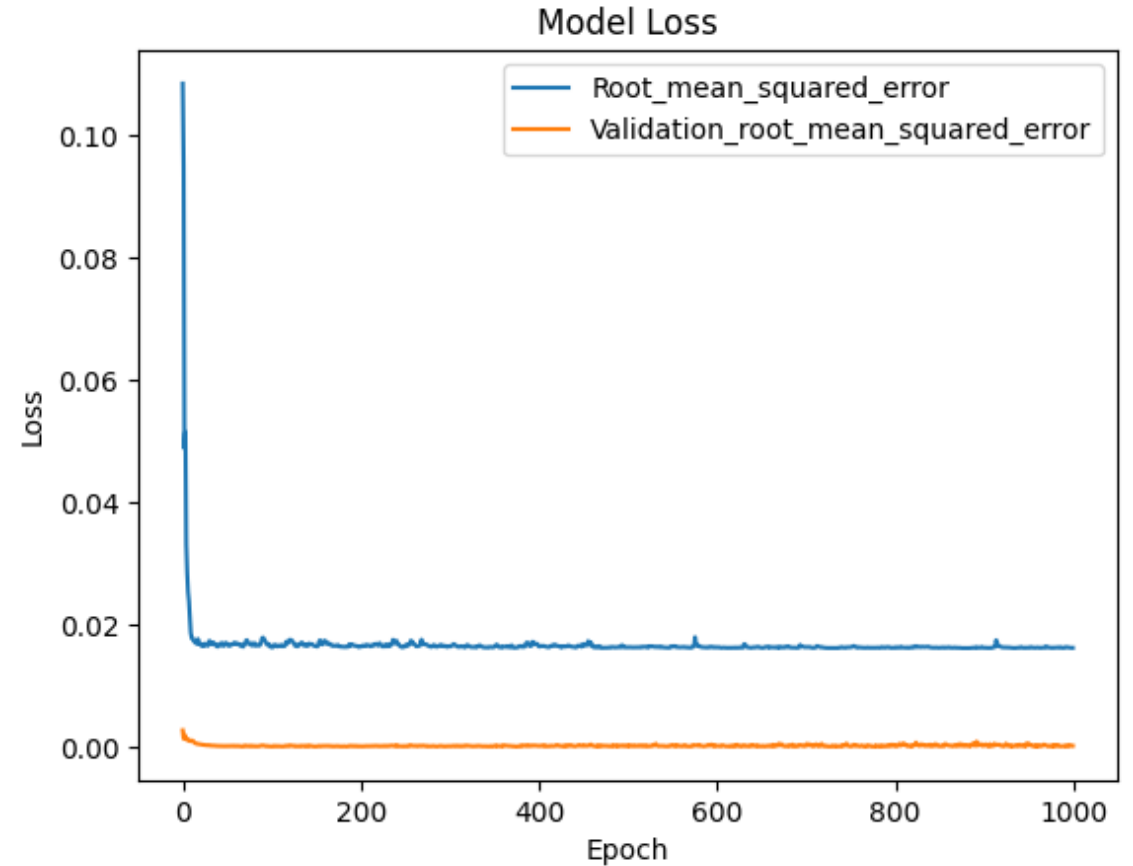
Epoch=1000

DEEPONET MODEL



Loss: **2.6970e-07**
Root_mean_squared_error: **5.1932e-04**
Val_loss: **3.3749e-09**
Val_root_mean_squared_error: **5.8094e-05**

ANN MODEL



Loss: **2.6238e-04**
Root_mean_squared_error: **0.0162**
Val_loss: **3.5855e-08**
Val_root_mean_squared_error: **1.8936e-04**

Conclusion

- For smaller number of epochs DeepONet model performs better.
- From MSE comparison we see that DeepONet model generalized well then Neural Network for epoch=100.
- DeepONet model performs far better for testing as you can see for three functions that we plotted above.