DeepONet V/s ANN Model

DOUBLE INTEGRAL OPERATOR.

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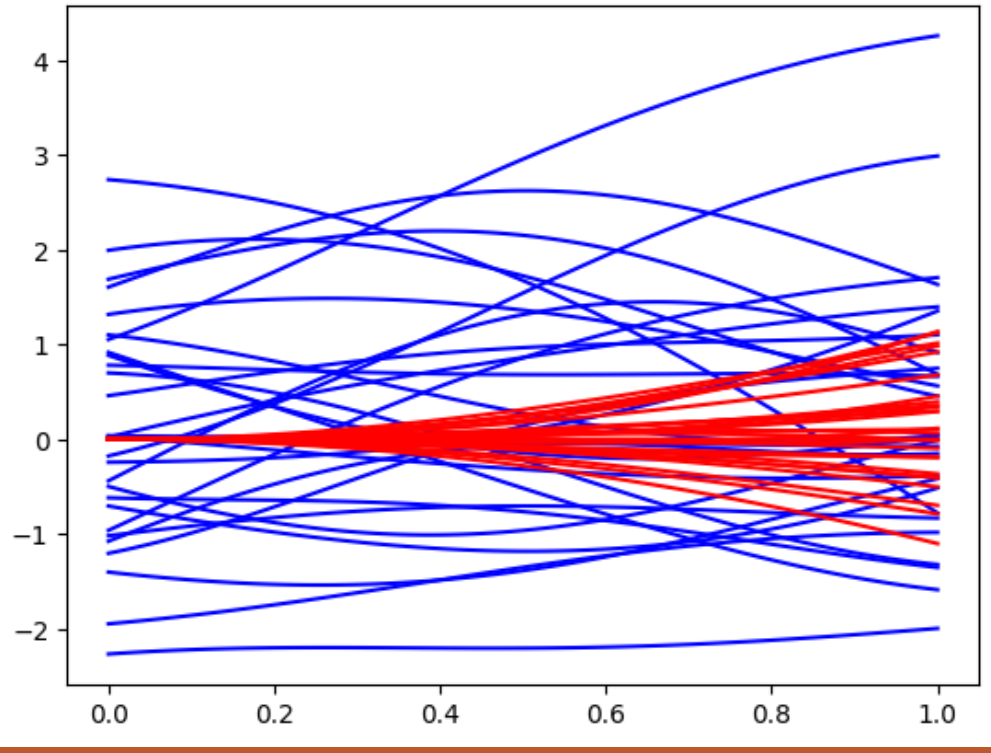
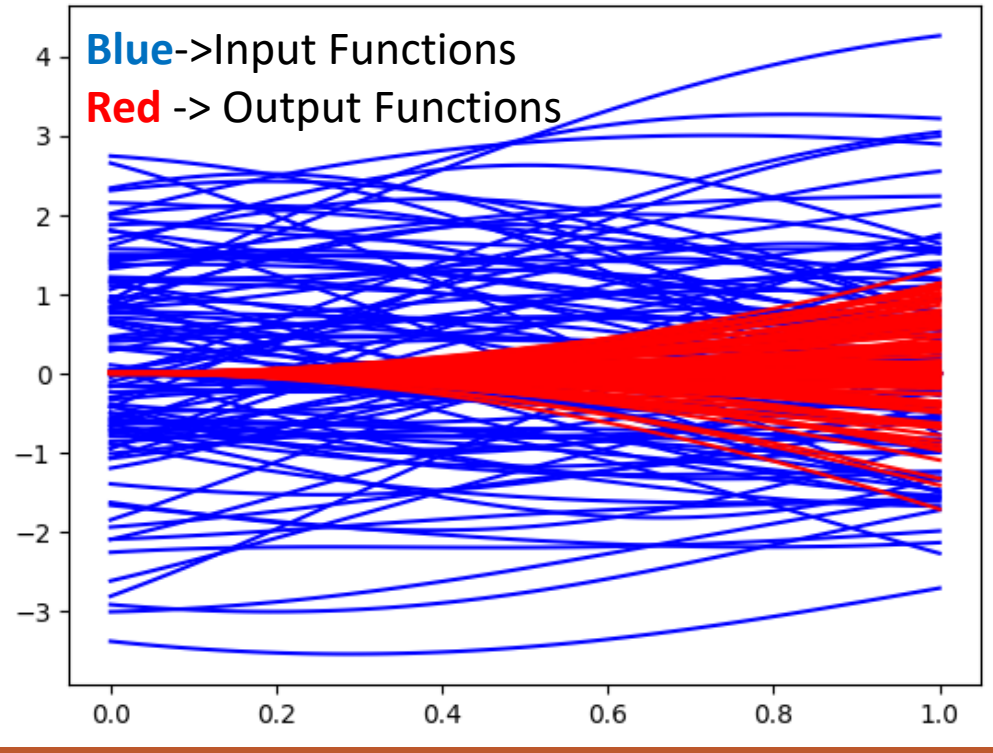
Parameters

- 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 -> sampling points for the function.
- p =100 -> 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.

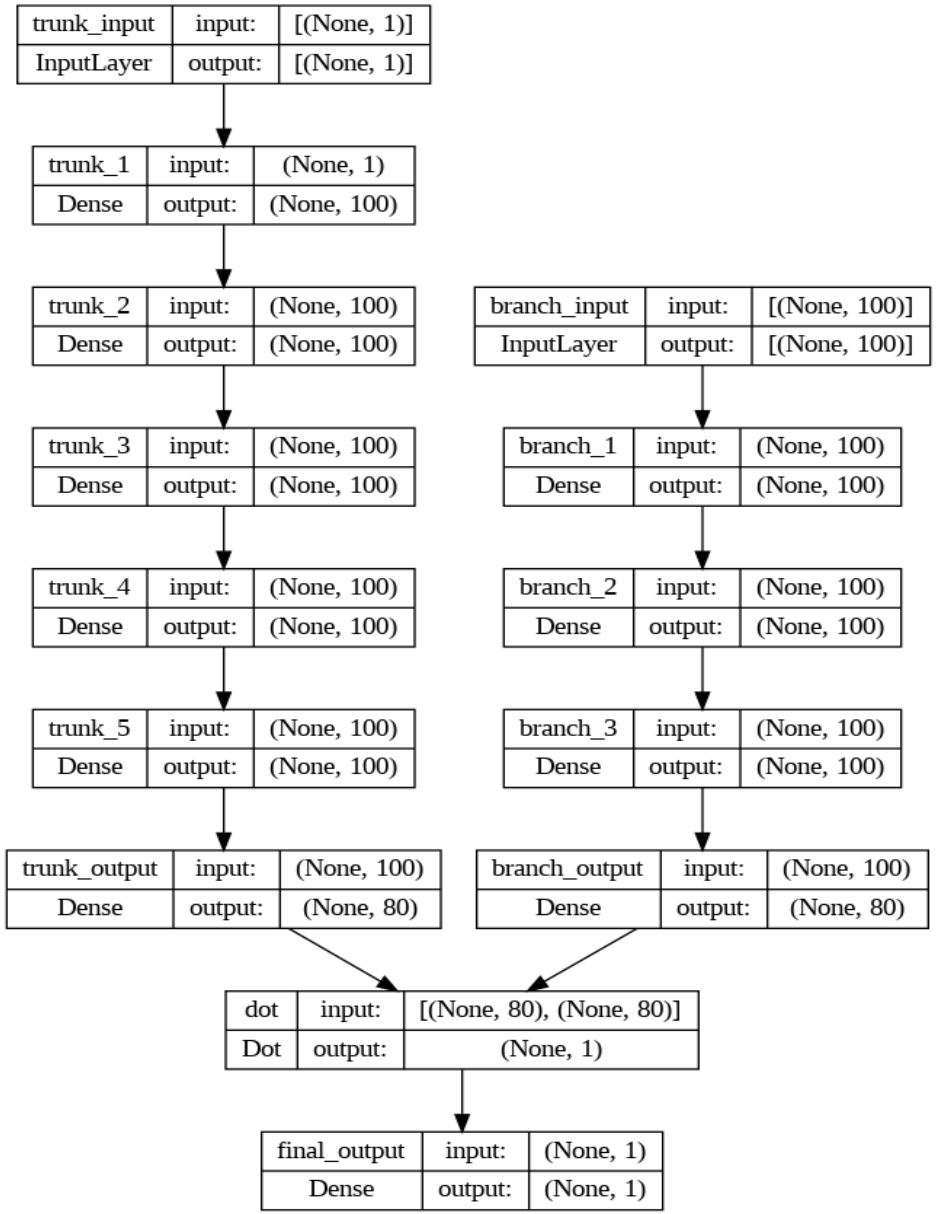




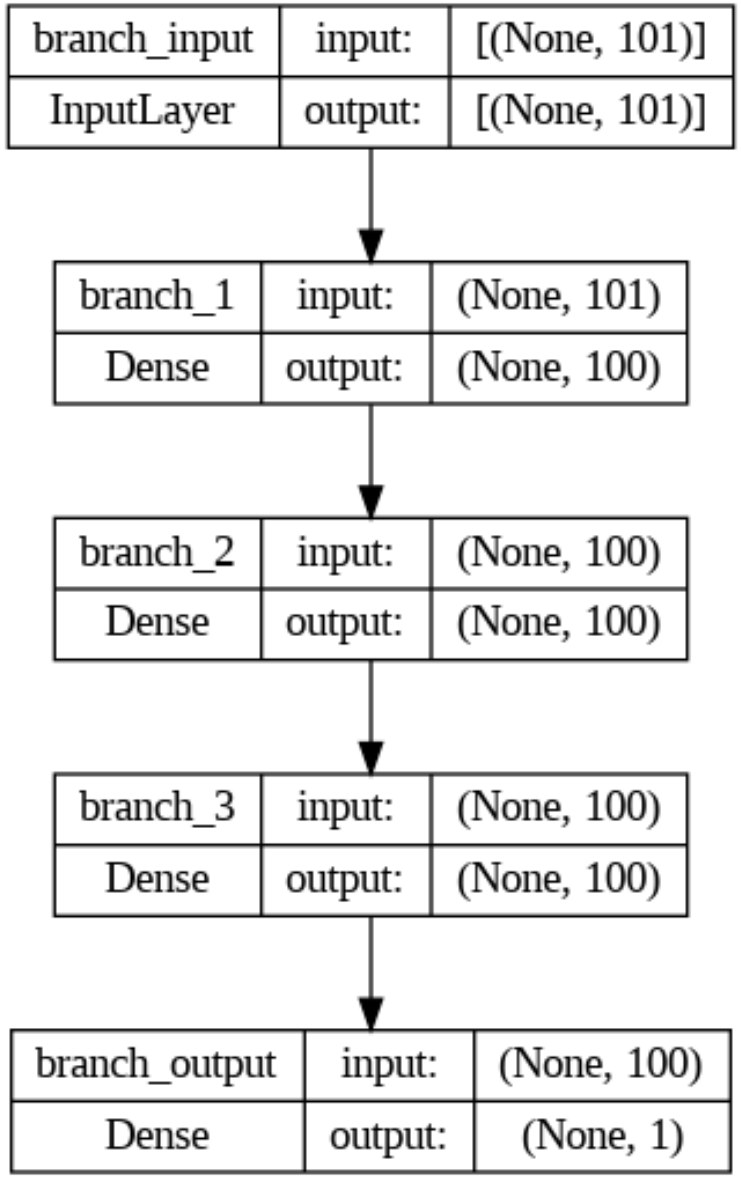
Graph depicts the different function and there output on which model is trained.

Model Architecture

DeepONet



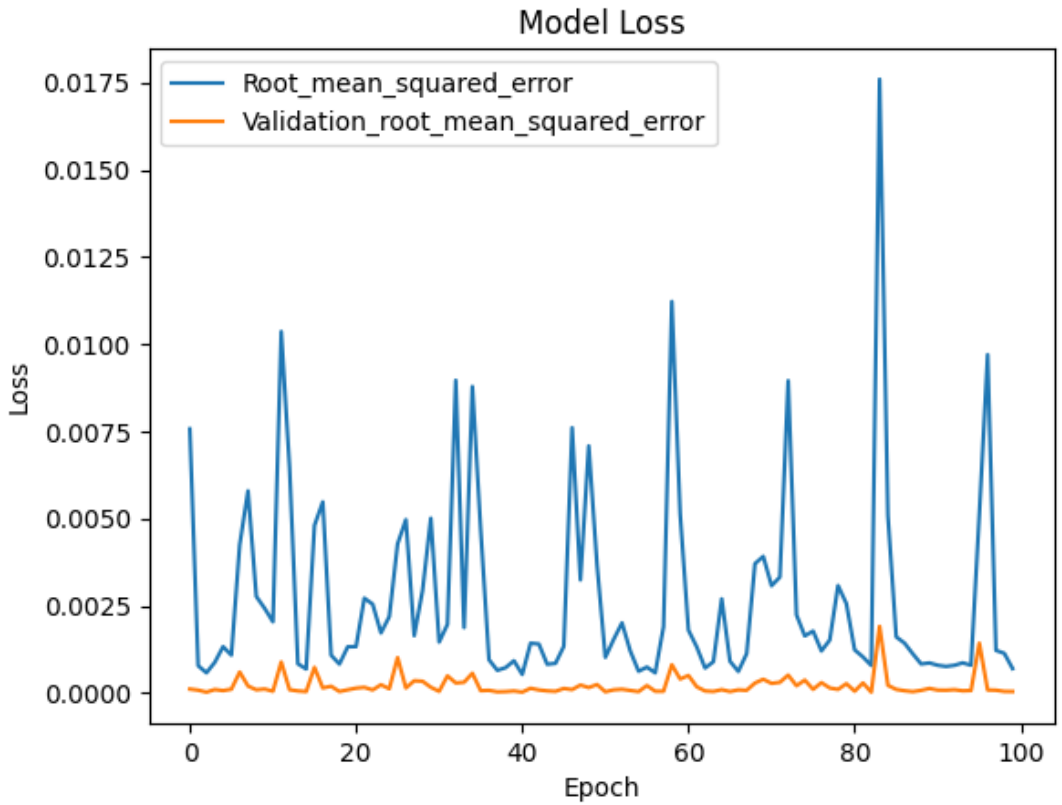
ANN



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**

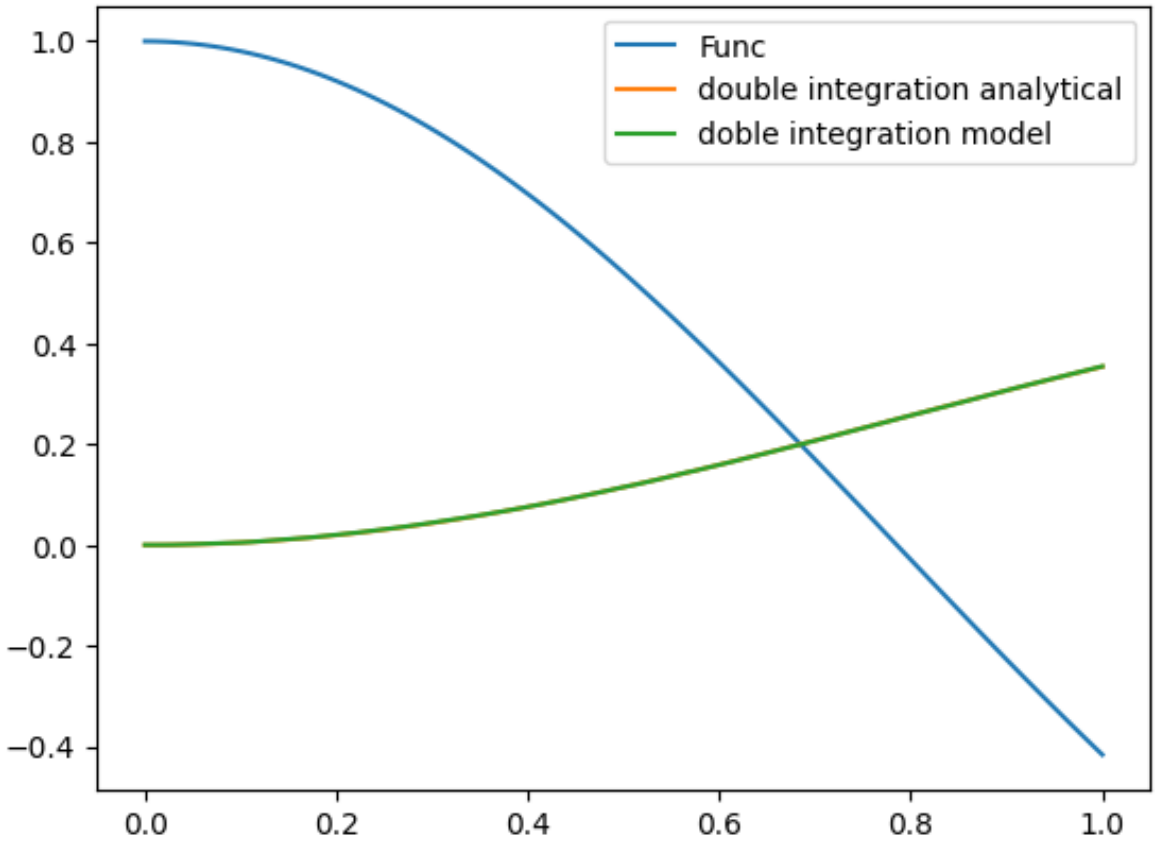
ANN MODEL

Loss: **2.4327e-04**
Root_mean_squared_error: **0.0156**
Val_loss: **2.4749e-06**
Val_root_mean_squared_error: **0.0016**

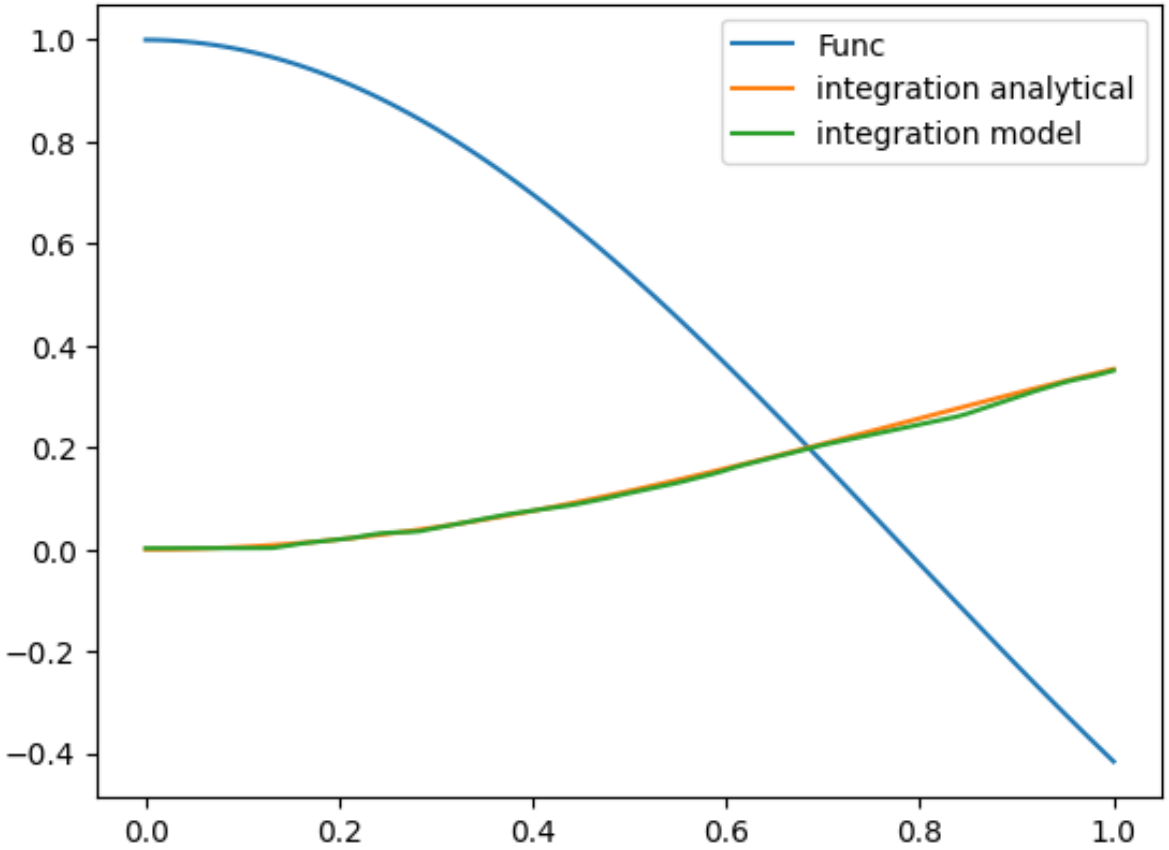
Testing Result

Input function= cos(2*x)
Output function= 0.5*sin(x)**2

DEEPONET MODEL



ANN MODEL

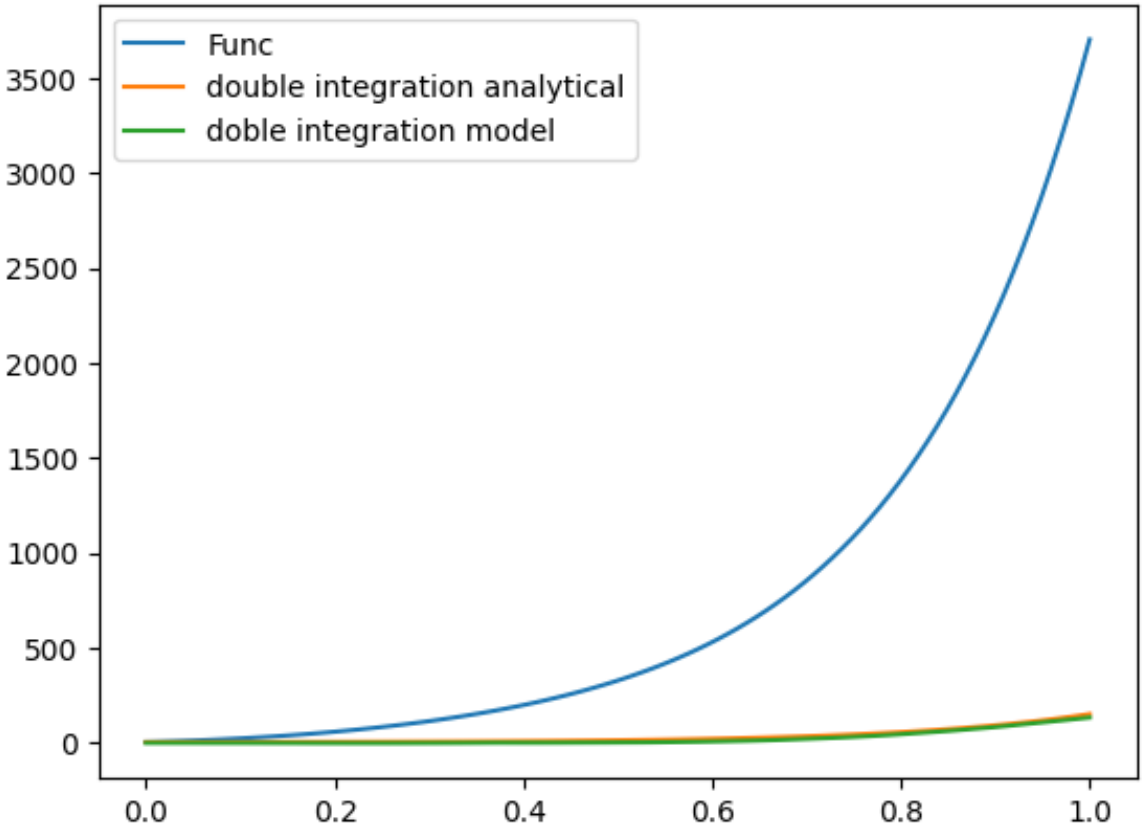


Epoch=100

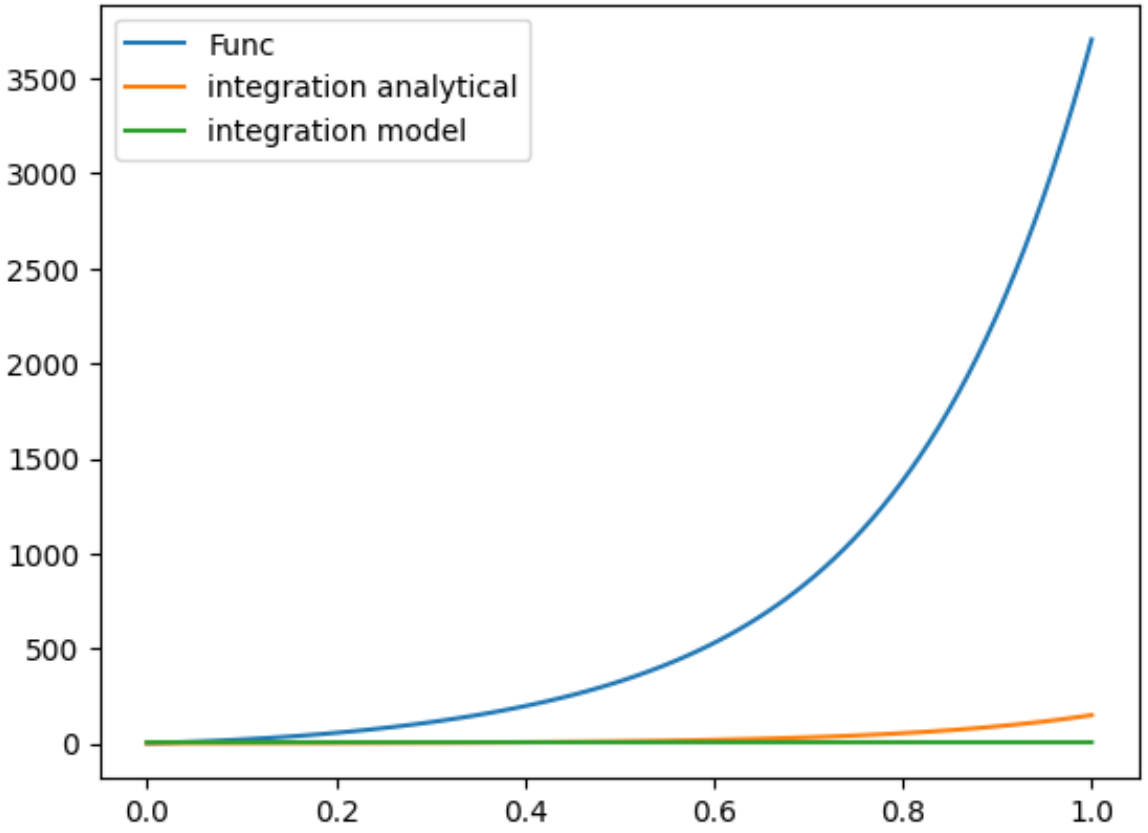
Testing Results

Input function= 25*exp(5*x) + 2 -25*cos(5*x)
Output function= exp(5*x)+ x**2 + cos(5*x)

DEEPONET MODEL



ANN MODEL

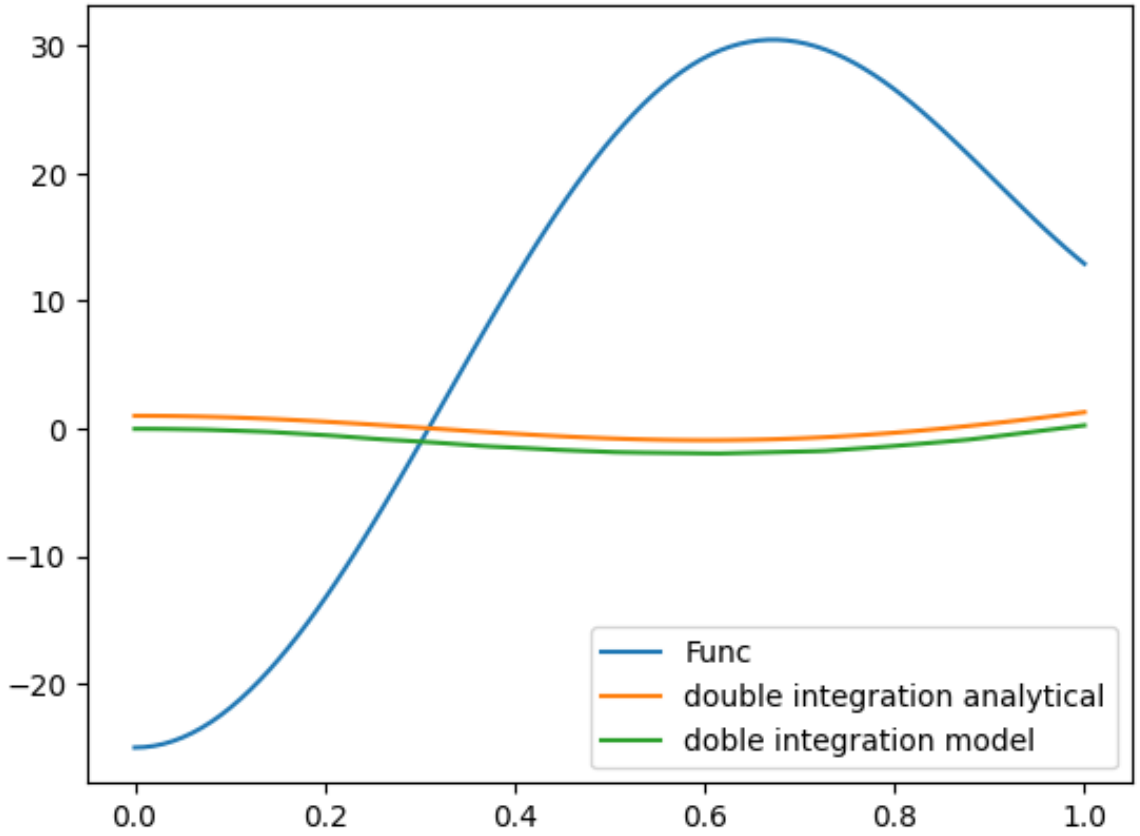


Epoch=100

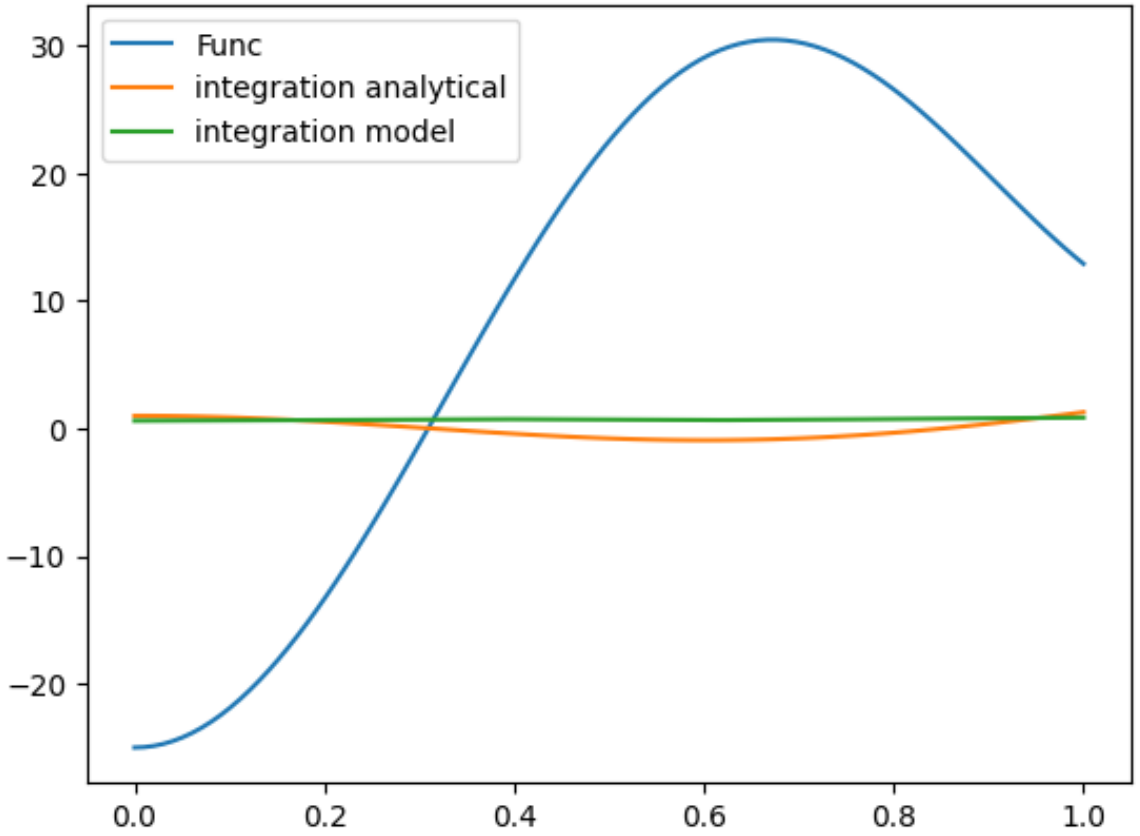
Testing Results

Input Function:20*x**3 -25*cos(5*x)
Output Function : x**5 + cos(5*x)

DEEPONET MODEL



ANN MODEL

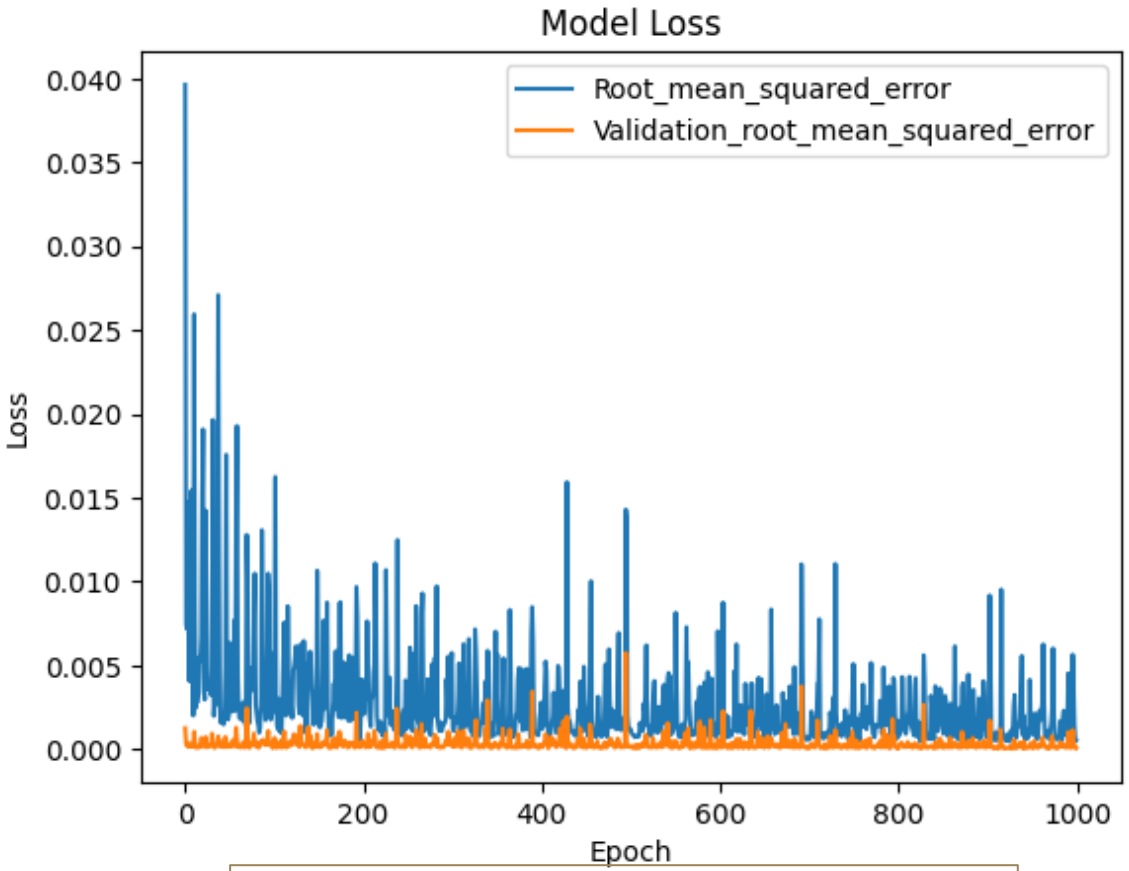


Epoch=100

Root Mean Square

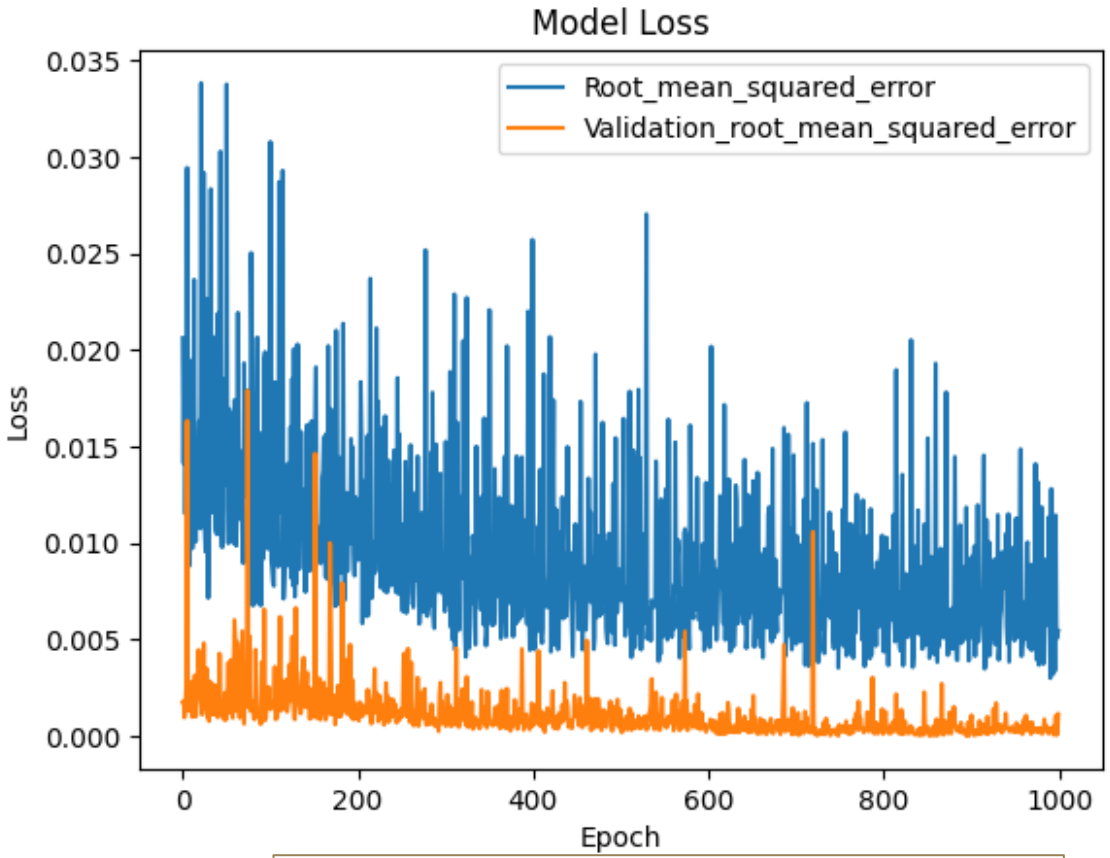
Epoch=1000

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

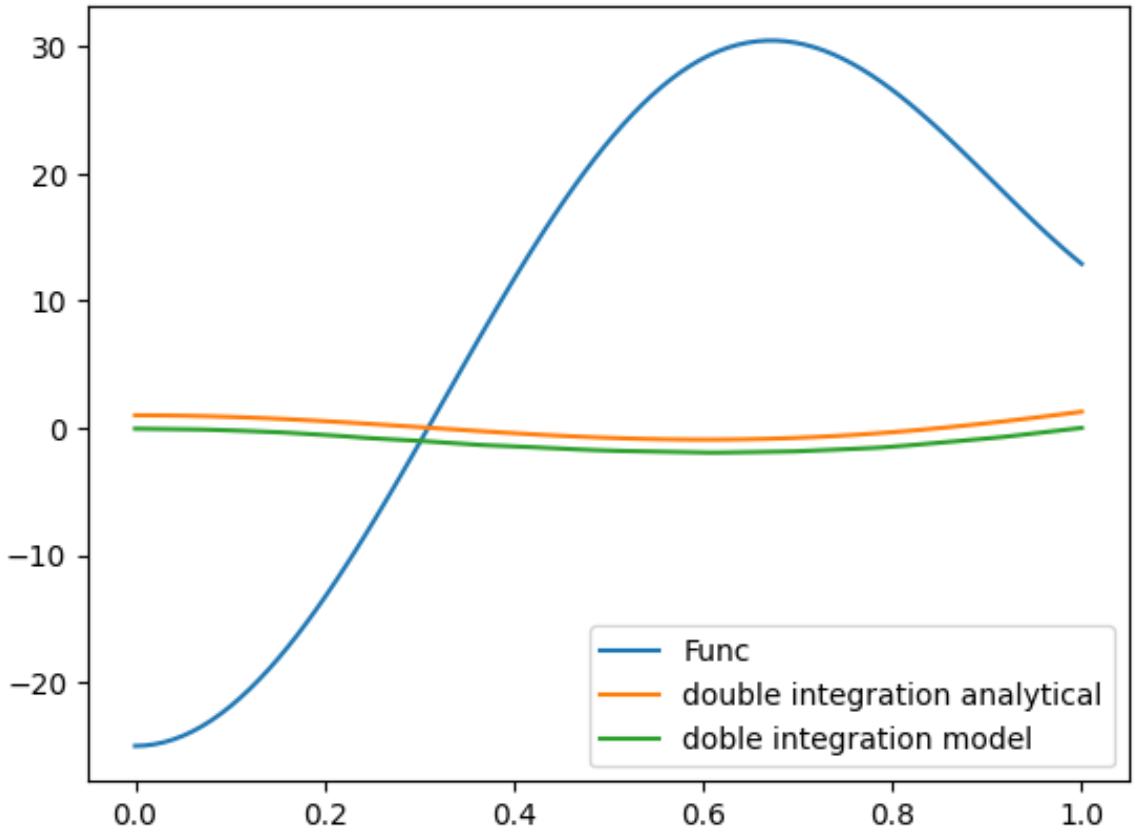


Loss**: 2.5193e-05**
Root_mean_squared_error**: 0.0050**
Val_loss**: 1.6382e-09**
Val_root_mean_squared_error**: 4.0475e-05**

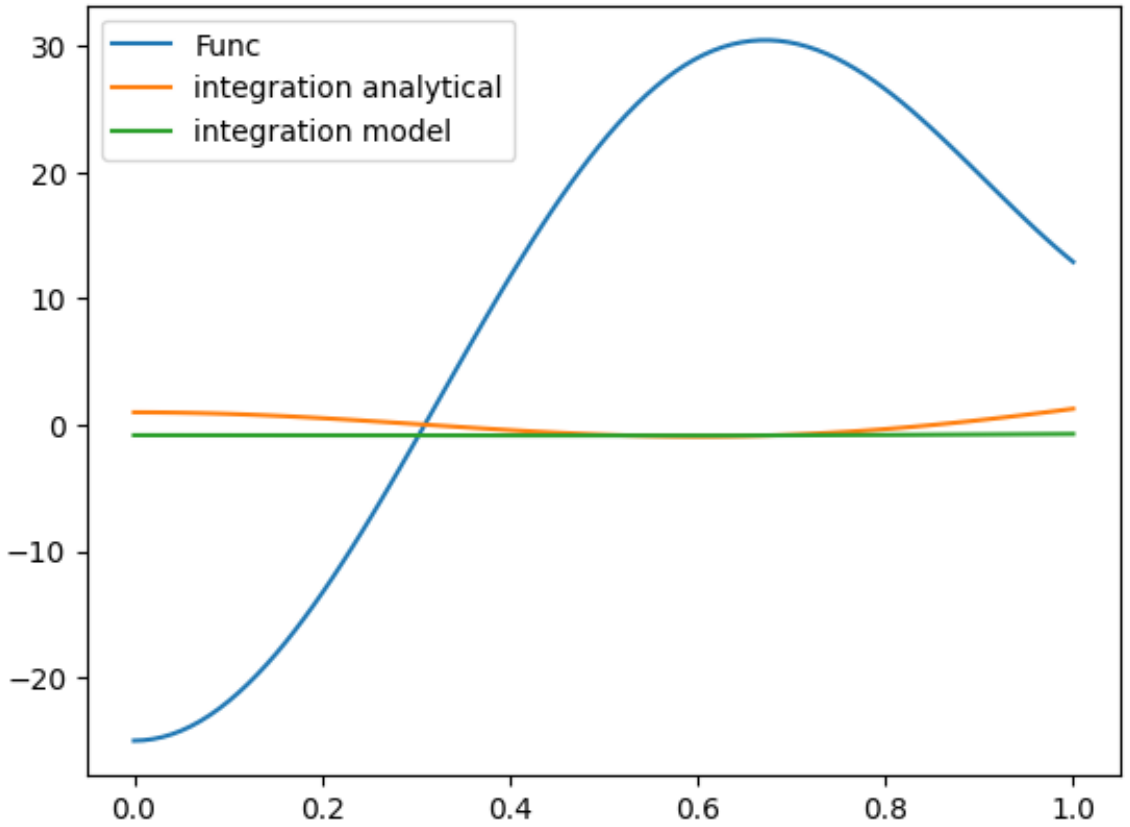
Testing Result

Input Function:20*x**3 -25*cos(5*x)
Output Function : x**5 + cos(5*x)

DEEPONET MODEL



ANN MODEL



Epoch=1000

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 better for testing as you can see for three functions that we plotted above.
- When we increase epoch to 1000, both model performs almost same and generalization for neural network improved too.