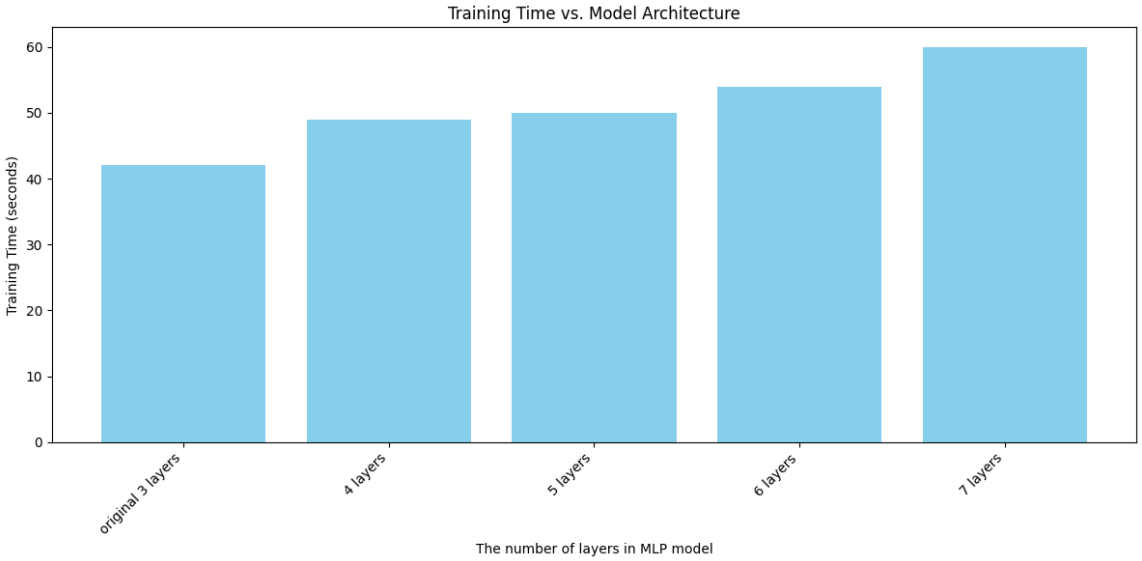
Singapore HDB Flat Resale Price Prediction

1. Total number of parameters in my initial model is **6,629.**
2. Number of layers used in my initial model is **3.** (2 hidden layers and 1 output layer)
3. Model Improvement Analysis:
    a) Training Time Analysis

    Deeper models require longer training times as they contain more parameters. The 3-layer model trains fastest, while the 7-layer model takes the most time due to its greater complexity.



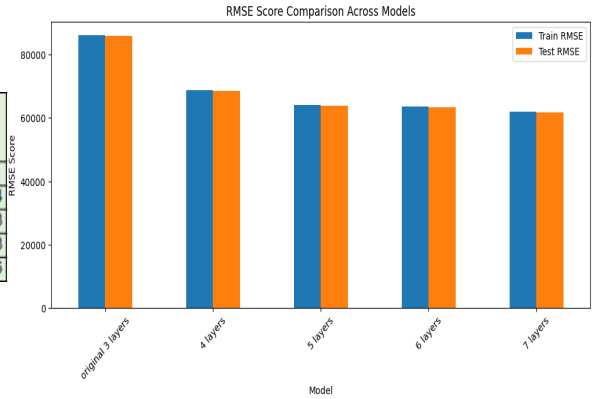
    b) Performance Changes:
        i. RMSE (Root Mean Square Error)
        ii. MAE (Mean Absolue Error)
        iii. MAPE (Mean Absolute Percentage Error)
        iv. R2 (R Squared) are used to compare the model performance.

    General understanding about those metrics

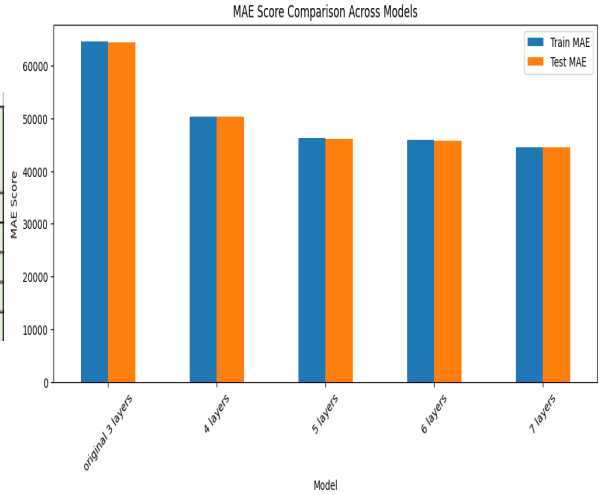
Metrics	Description	Interpretation
RMSE	Measures prediction error magnitude. i.e., how far the model prediction are from the actual value	Lower = better (0 = perfect prediction)
MAE	Calculates average absolute error.	Lower = better (less sensitive to outliers)
MAPE	Shows percentage error.	Lower = better (eg 7% = 7% average error)
R2	Explains variance in data.	Higher = better (1= perfect, 0 = no better than horizontal line, Negative value = worse than mean)

The below figures represent deeper layers model performance comparison in terms of RMSE, MAE, MAPE and R2.

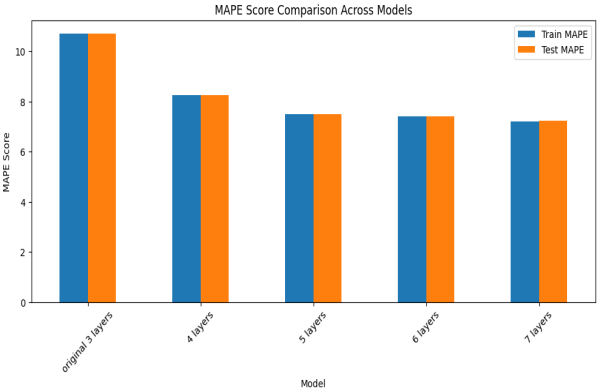
Model	Train RMSE	Test RMSE	Train RMSE improvement in percentage (%) from baseline original model	Test RMSE improvement in percentage(%) from baseline original model
original 3 layers	86143.01	85999.2		
4 layers	68737.03	68608.75	20.20591	20.22164
5 layers	64005.34	63810.09	25.69874	25.80153
6 layers	63511.2	63323.53	26.27237	26.3673
7 layers	62052.31	61844.95	27.96594	28.0866



Model	Train MAE	Test MAE	Train MAE improvement in percentage (%) from baseline original model	Test MAE improvement in percentage(%) from baseline original model
original 3 layers	64557.18	64390.54		
4 layers	50381.96	50337.73	21.95762	21.82434
5 layers	46280.87	46142.46	28.31027	28.33969
6 layers	45871.38	45776.97	28.94457	28.90731
7 layers	44568.14	44495.05	30.96331	30.89816



Model	Train MAPE	Test MAPE	Train MAPE improvement in percentage (%) from baseline original model	Test MAPE improvement in percentage(%) from baseline original model
original 3 layers	10.7	10.69		
4 layers	8.24	8.25	22.99065	22.82507
5 layers	7.49	7.48	30	30.02806
6 layers	7.42	7.41	30.65421	30.68288
7 layers	7.21	7.22	32.61682	32.46024



Model	Train R2	Test R2	Train R2 improvement in percentage (%) from baseline original model	Test R2 improvement in percentage(%) from baseline original model
original 3 layers	0.82	0.82		
4 layers	0.88	0.88	7.31707	7.31707
5 layers	0.9	0.9	9.7561	9.7561
6 layers	0.9	0.9	9.7561	9.7561
7 layers	0.91	0.91	10.97561	10.97561

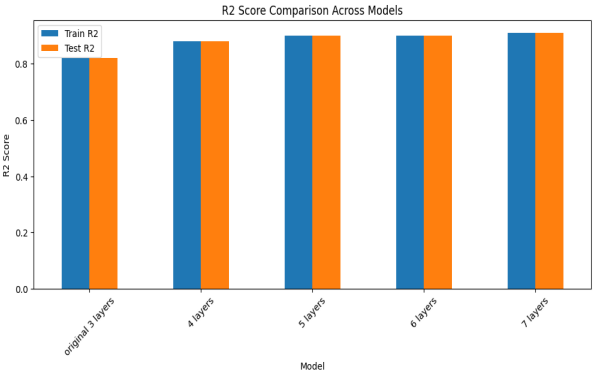


Figure Both training and test metrics comparison

Increasing neural network depth from 3 to 7 layers significantly improves model performance. The 7-layer architecture demonstrates better results, reducing test RMSE by 28% (85,999 → 61,845) and test MAE by 30.8%, while improving prediction accuracy (MAPE) by 32.4%. The R^2 score also increases by 10.9%, confirming better explanation of data patterns.

Deeper neural netowrk (with more layers) achieve better performance because they can learn more complex patterns in the data. For example, while 3 layer model might only identify baseic features, a higher layers combine those basic feature into higher-order patterns to understand the complex data.