National College of Ireland

Configuration Manual

MSc Research Project
Data Analytics

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MSc Project Submission Sheet

School of Computing

Student Name: ……. …Arun Reddy Thatipally ……

Student ID: ……23340215…… ….……

Programme: ……M.sc Data Analytics …… **Year:** …2025-26……..

Module: … MSc (Research) Practicum/Internship Part 2…….……

Lecturer: ……Bharath Agarwal…….……

Submission Due Date: ……11 Dec 2025…….……

Project Title: MAMBA-CROSS: Bidirectional State Space Models with Channel-Temporal Attention for Remaining Useful Life Prediction…… ……

Word Count: ……427…… **Page Count:** ……9……..……

I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.
ALL internet material must be referenced in the bibliography section. Students are required to use the Referencing Standard specified in the report template. To use other author's written or electronic work is illegal (plagiarism) and may result in disciplinary action.

Signature: ……Arun Reddy Thatipally ……

Date: ……11 Dec 2025……

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Configuration Manual

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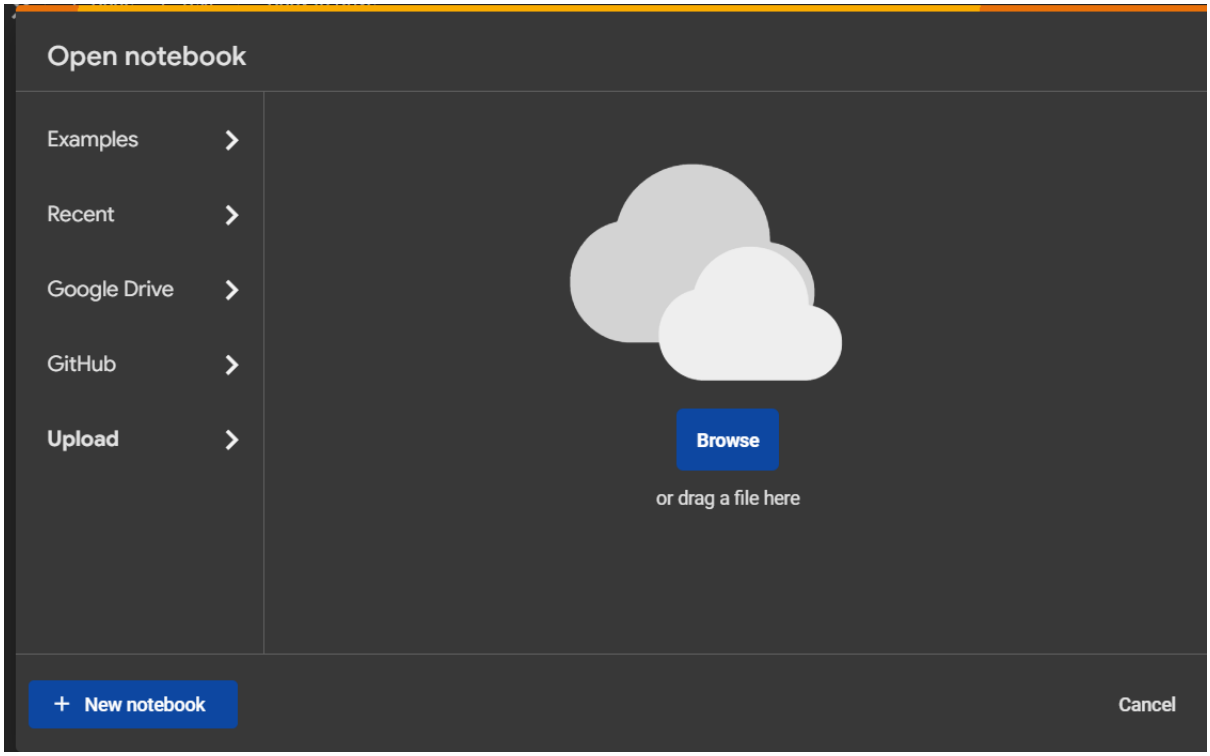
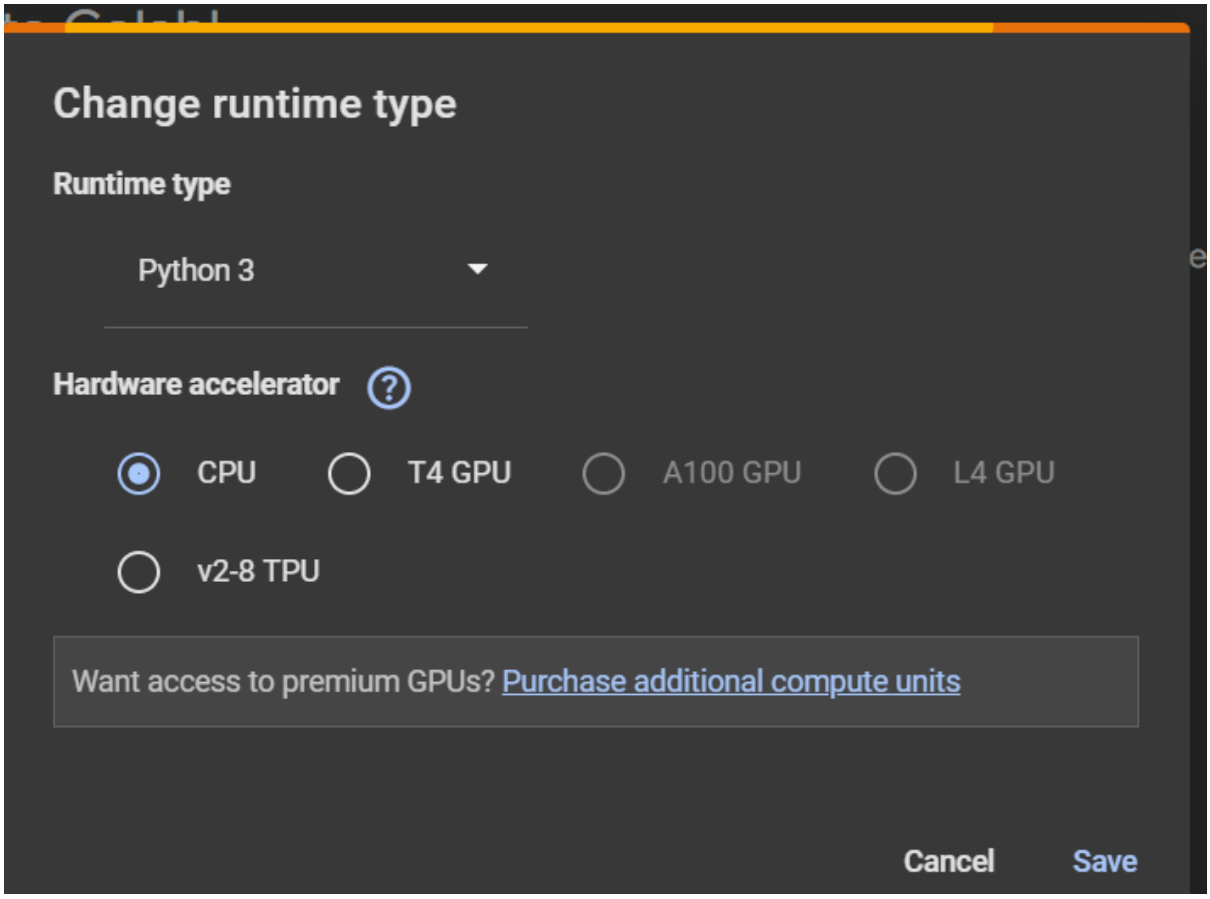
1 Integrating Google drive to google coloab

Step 1: Lauch the colab environment
Step 2: Navigate the google colab website using google
Step 3: Now upload the File

1. Upload the ipynb or py file

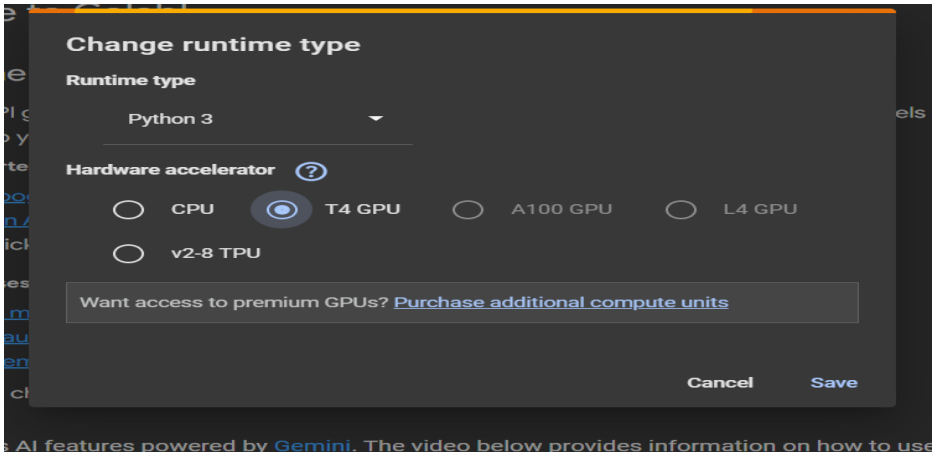
Step 4: From Runtime change the GPU acceleration
Step 5: Save the runtime for next use





2 Starting the session

Step 1: Now open the google and launch the google colab
Step 2:Login into the mail
Step 3:Open new /saved configuration file
Step 5 : Activate the GPU
Step 6 : Upload the Notebook



3 Loading of Data

Step 1:Set up the configuration

```python
CONFIG = {
    # Data
    'train_path': 'train.csv',
    'test_path': 'test.csv',

    # Preprocessing
    'window_sizes': [30, 50, 100],
    'stride': 1,
    'rul_cap': 125,
    'val_split': 0.2,
    'normalize': 'minmax',
    'remove_constant_sensors': True,

    # Architecture - Enhanced BiMamba
    'd_model': 64,
    'd_state': 64,
    'd_conv': 4,
    'expand': 2,
    'num_mamba_layers': 4,
    'num_heads': 4,
    'dropout': 0.2,
```

Step 2: Load the data and process

1. Change the path for the usage

```python
class ImprovedDataProcessor:
    def __init__(self, config, window_size=None):
        self.config = config
        self.window_size = window_size if window_size else config.get('window_size', 30)
        self.scaler = None
        self.feature_cols = None
        self.num_features = None

    def load_data(self):
        train_df = pd.read_csv(self.config['train_path'])
        test_df = pd.read_csv(self.config['test_path'])

        print(f"Raw train: {train_df.shape}, Raw test: {test_df.shape}")

        op_cols = [c for c in train_df.columns if c.startswith('op_setting')]
        sensor_cols = [c for c in train_df.columns if c.startswith('sensor_')]

        if self.config['remove_constant_sensors']:
            sensor_cols = [c for c in sensor_cols if c not in CONSTANT_SENSORS]

        self.feature_cols = op_cols + sensor_cols
        self.num_features = len(self.feature_cols)
        print(f"Features: {self.num_features} ({len(op_cols)} op_settings + {len(sensor_cols)} sensors)")

        rul_cap = self.config['rul_cap']
```

4 End Results

```
...
================================================================================
                        TABLE 1: Main Performance Metrics
================================================================================
```

	Model	RMSE	MAE	R2	Adj R2	NASA Score	Parameters
0	MAMBA-CROSS	16.17	9.93	0.6868	0.6867	10.61	588,804
1	LSTM	19.28	14.20	0.5546	0.5546	13.60	161,602
2	Transformer	19.36	13.12	0.5509	0.5508	25.95	174,466

```
================================================================================
                TABLE 2: Prediction Accuracy Within Thresholds
================================================================================
```

	Model	+-5 cyc (%)	+-10 cyc (%)	+-15 cyc (%)	+-20 cyc (%)	Early (%)	Late (%)
0	MAMBA-CROSS	53.56	67.15	76.22	82.63	29.02	70.98
1	LSTM	26.99	50.00	64.82	75.16	23.40	76.60
2	Transformer	40.19	56.05	67.39	77.05	26.56	73.44

```
================================================================================
                TABLE 3: Per-Dataset RMSE Comparison
================================================================================
```

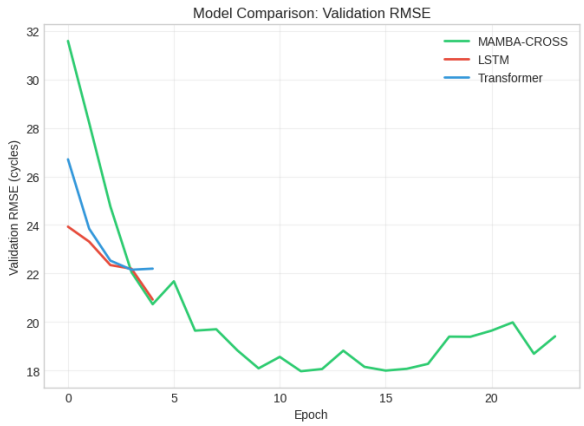
	Dataset	MAMBA-CROSS	LSTM	Transformer	Best
0	FD001	14.99	20.28	19.91	MAMBA
1	FD002	18.17	21.26	20.51	MAMBA
2	FD003	13.01	16.51	17.71	MAMBA
3	FD004	15.99	18.36	18.90	MAMBA
4	OVERALL	16.17	19.28	19.36	

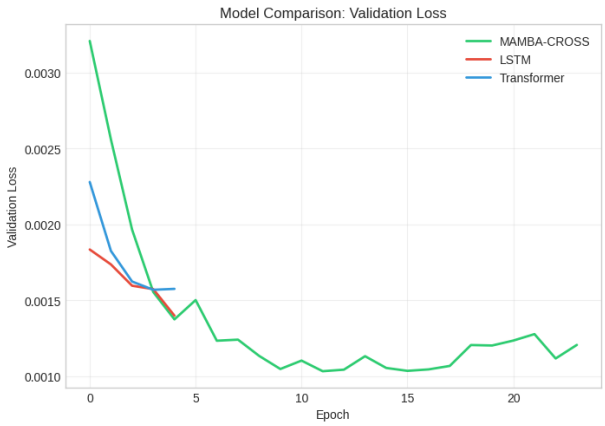
```
================================================================================
                TABLE 4: Per-Dataset R2 Score Comparison
================================================================================
```

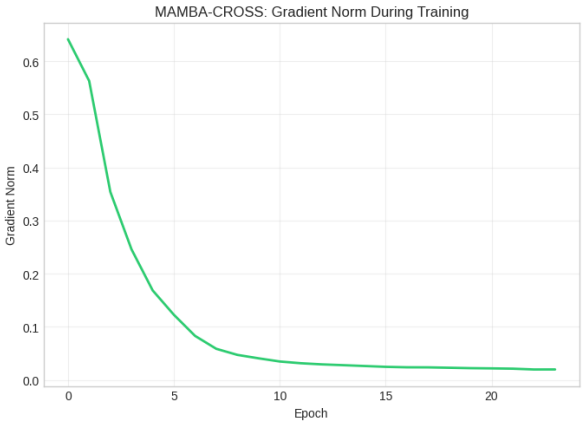
	Dataset	MAMBA-CROSS	LSTM	Transformer	Best
0	FD001	0.7456	0.5346	0.5512	MAMBA
1	FD002	0.6561	0.5295	0.5620	MAMBA
2	FD003	0.7604	0.6144	0.5562	MAMBA
3	FD004	0.6572	0.5480	0.5214	MAMBA
4	OVERALL	0.6868	0.5546	0.5509	

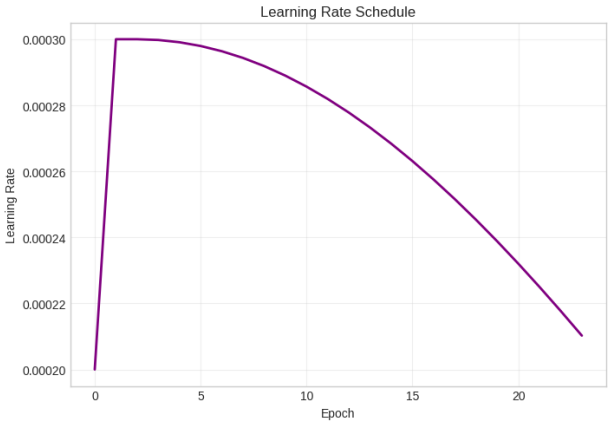
```
================================================================================================
                        TABLE 5: MAMBA-CROSS Detailed Per-Dataset Performance
================================================================================================
```

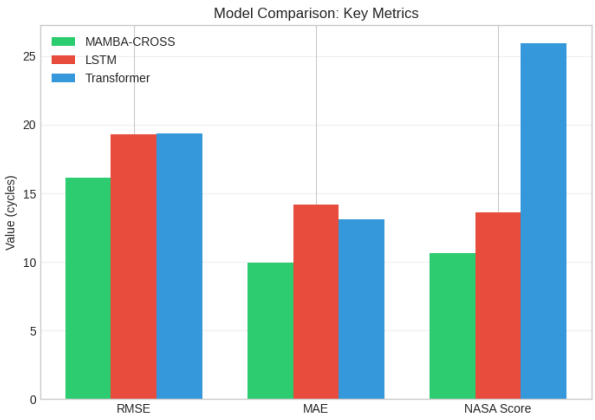
	Dataset	RMSE	MAE	R2	NASA	+-10cyc (%)	+-20cyc (%)	Samples
0	FD001	14.99	9.69	0.7456	6.91	67.23	83.52	10196
1	FD002	18.17	12.80	0.6561	9.39	55.47	76.88	26505
2	FD003	13.01	7.08	0.7604	6.71	76.80	88.70	13696
3	FD004	15.99	8.91	0.6572	14.24	72.34	84.38	34081











5 References

Google Colab. (n.d.). https://colab.research.google.com/

Carvalho, T.P., Soares, F.A., Vita, R., Francisco, R.D.P., Basto, J.P. and Alcalá, S.G. (2019) 'A systematic literature review of machine learning methods applied to predictive maintenance', *Computers & Industrial Engineering*, 137, p.106024.