

Configuration Manual

MSc Research Practicum
Programme Name: MSc FinTech Information

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MSc Project Submission Sheet
School of Computing



Student Name:Sanjana Gandrathi.....
X23290692
Student ID:
MSc in FinTech 2024-25
Programme:..... **Year:**
Practicum
Module:
Victor del Rosal
Lecturer:
Submission Due Date: 11th Aug 2025
.....
Multi-Timeframe Transformer Architecture for Bitcoin Price Prediction: Deep Dive into the
Project Title: Research Project
.....
Word Count: 792
Page Count:6.....

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.

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Sanjana Gandrathi
Signature
:
11th Aug 2025
Date:
.....

PLEASE READ THE FOLLOWING INSTRUCTIONS AND CHECKLIST

Attach a completed copy of this sheet to each project (including multiple copies)	• ☐
Attach a Moodle submission receipt of the online project submission, to each project (including multiple copies).	• ☐
You must ensure that you retain a HARD COPY of the project, both for your own reference and in case a project is lost or mislaid. It is not sufficient to keep a copy on computer.	• ☐

Assignments that are submitted to the Programme Coordinator Office must be placed into the assignment box located outside the office.

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Configuration Manual

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1 Project Overview

Multi-Timeframe Bitcoin Price Prediction Research: Complete implementation comparing Transformer vs LSTM architectures for Bitcoin price prediction using multi-timeframe technical indicators and sentiment analysis. The system processes raw Bitcoin data, creates engineered features across hourly/daily/weekly timeframes, and evaluates model performance with comprehensive metrics including sentiment ablation studies and market regime analysis.

2 Google Colab Setup Guide

2.1 STEP 1: CONNECT

1. Open Google Colab (colab.research.google.com)
2. Create new notebook: **File** → **New notebook**

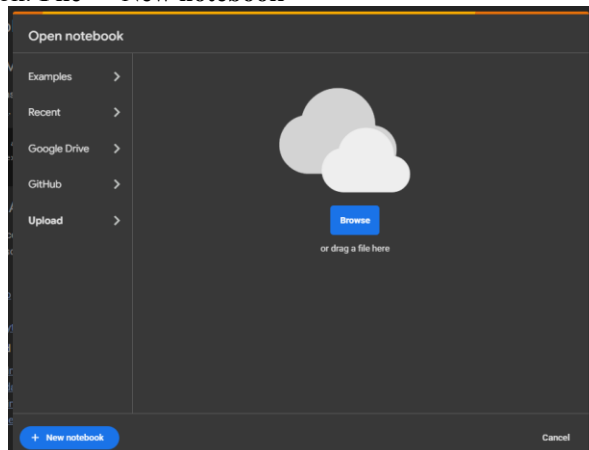


Figure 1 Notebook Upload

3. Connect to GPU: **Runtime** → **Change runtime type** → **GPU** → **T4**

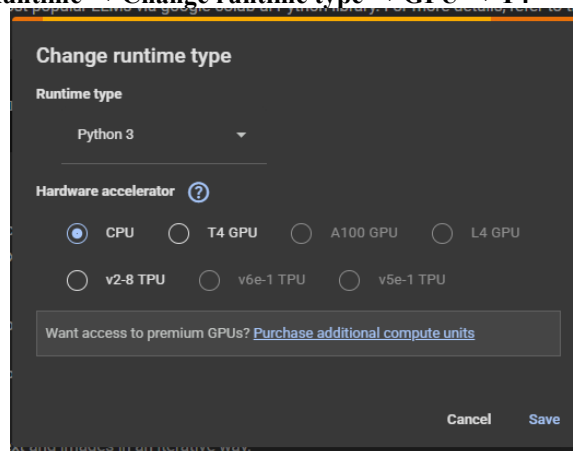


Figure 2 Runtime selection

4. Mount Google Drive: **Files panel** → **Mount Drive icon**

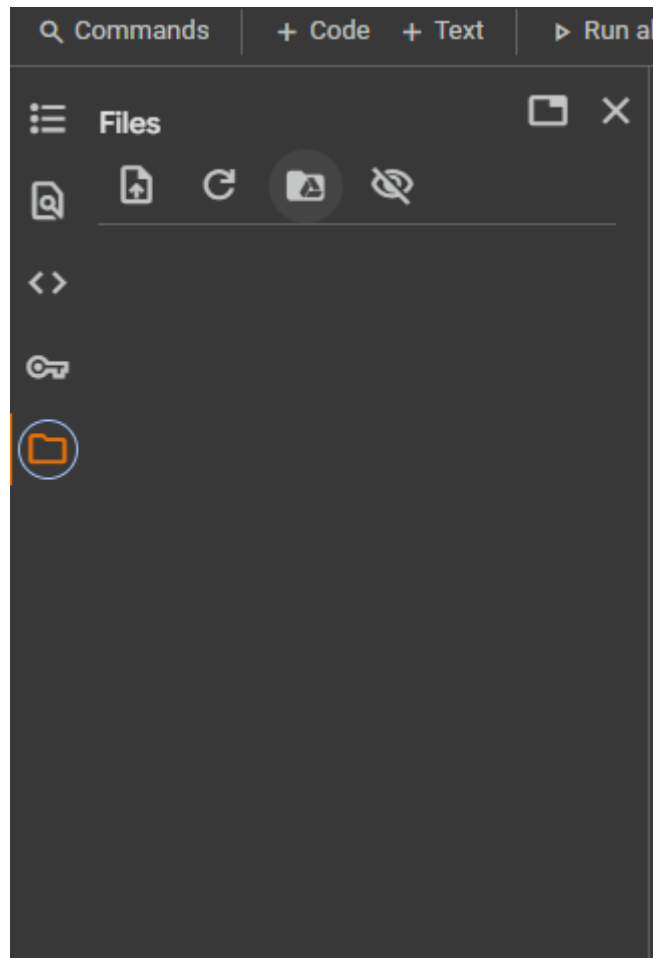


Figure 3 Google drive mount

2.2 STEP 2: UPLOAD

Upload your notebook file(s) to Google Colab:

- **FinalCodeDelivery.ipynb**

Required Data: None (uses online datasets automatically)

- Bitcoin price data: Onegai/BitcoinPrice (HuggingFace)
- Sentiment data: ckandemir/bitcoin_tweets_sentiment (HuggingFace)

2.3 STEP 3: INSTALL

Critical Dependencies (run these cells first):

Essential packages installation

```
!pip install datasets==3.6.0 torch torchvision torchaudio seaborn scikit-learn tqdm
```

Key Configuration Points:

python

Line 842: Output directory (change if needed)

```
csv_path = 'bitcoin_final_multiframe_dataset.csv' # <- Main dataset output
```

Line 45: GPU device selection

```
device = torch.device('cuda' if torch.cuda.is_available() else 'cpu') # <- Auto-detects GPU
```

Line 123: Training epochs (reduce for faster testing)

```
num_epochs: int = 20 # <- CHANGE to 5 for quick test
```

2.4 STEP 4: RUN

Execution Order:

1. **Run Data Preparation Section** (Cells 1-8): Creates processed dataset
2. **Run Model Training Section** (Cells 9-15): Trains all model variants
3. **Run Evaluation Section** (Cells 16-20): Generates comparison results

Expected Runtime: ~45-60 minutes on T4 GPU

Expected Outputs:

- bitcoin_final_multiframe_dataset.csv (main dataset)
- bitcoin_feature_details.csv (feature documentation)
- bitcoin_dataset_metadata.json (dataset statistics)
- research_results.json (model comparison results)
- research_results.png (performance visualizations)

2.5 Success Indicators:

-  Dataset shape: ~15,000+ rows × 200+ features
-  All 5 model variants trained successfully
-  Final research conclusions printed
-  Visualization showing Transformer vs LSTM comparison

3 Expected Research Results

4 MODEL COMPARISON

Overall Performance:

Model	Average RMSE	Average MAE	Direction Accuracy	F1 Score
LSTM Single WithSentiment	\$3,518.27	\$2,471.40	0.563	0.662
LSTM Multi WithSentiment	\$2,292.06	\$1,895.92	0.578	0.684
LSTM Multi NoSentiment	\$2,127.87	\$1,730.11	0.580	0.683
Transformer WithSentiment	\$3,135.48	\$2,328.01	0.566	0.685
Transformer NoSentiment	\$3,954.33	\$3,016.98	0.567	0.669

5 Performance by Market Regime

Model	Bear Market	Sideways Market
LSTM Single WithSentiment	0.611 (n=9)	0.563 (n=6,075)
LSTM Multi WithSentiment	0.528 (n=9)	0.578 (n=6,075)
LSTM Multi NoSentiment	0.528 (n=9)	0.580 (n=6,075)
Transformer WithSentiment	0.528 (n=9)	0.566 (n=6,075)
Transformer NoSentiment	0.500 (n=9)	0.567 (n=6,075)

6 SENTIMENT IMPACT ANALYSIS

Model	RMSE Change	MAE Change	Direction Accuracy Change	F1 Score Change
Transformer	\$-818.85	\$-688.97	-0.001	+0.016
LSTM Multi	\$+164.19	\$+165.81	-0.003	+0.001

Sentiment Impact by Prediction Horizon:

Model	1h	4h	24h	168h
Transformer	+0.005	+0.011	-0.036	+0.018
LSTM Multi	-0.001	-0.001	-0.004	-0.004

7 RESEARCH CONCLUSIONS

Finding	Result
Multi-Timeframe Transformer vs Single LSTM	Direction Accuracy Improvement: 0.3%
Transformer vs Multi-Timeframe LSTM	Direction Accuracy Improvement: -1.1%
Sentiment Impact	Varies by model and timeframe (see detailed analysis above)
Market Regime Performance	Models perform differently across bear/sideways/bull markets

 **Best Performing Model:** LSTM_Multi_NoSentiment (Lowest RMSE: \$2,127.87)

OUTPUTS

```

Cross-timeframe features: 0

🔴 TARGET VARIABLES:
Prediction horizons: 24h, 1h, 168h, 4h
Price targets: 4
Return targets: 4
Direction targets: 4

📊 KEY STATISTICS:

PRICE FEATURES:
hourly_close:  $\mu=3123.173866$ ,  $\sigma=3525.487692$ 
daily_close_daily:  $\mu=3127.493532$ ,  $\sigma=3531.964386$ 
weekly_close_weekly:  $\mu=3116.517705$ ,  $\sigma=3542.617615$ 

SENTIMENT FEATURES:
hourly_sentiment_score:  $\mu=0.003721$ ,  $\sigma=0.195553$ 
daily_sentiment_score_daily:  $\mu=0.111284$ ,  $\sigma=0.993801$ 
weekly_sentiment_score_weekly:  $\mu=0.115849$ ,  $\sigma=0.450213$ 

VOLUME FEATURES:
hourly_volume:  $\mu=428.021681$ ,  $\sigma=518.171499$ 
hourly_volume_ratio:  $\mu=1.011792$ ,  $\sigma=0.892634$ 
daily_volume_daily:  $\mu=10515.312536$ ,  $\sigma=7952.663481$ 

📁 FILES CREATED:
1. bitcoin_final_multiframe_dataset.csv - Main dataset (41,120 × 104)
2. bitcoin_feature_details.csv - Detailed feature information
3. bitcoin_dataset_metadata.json - Complete metadata and statistics

✅ DATASET IS READY FOR MODEL DEVELOPMENT!
Next steps:
1. Load the CSV file for model training
2. Create sequences for Transformer input
3. Apply feature scaling
4. Split into train/validation/test sets
5. Build and train the multi-timeframe Transformer model

=====
🎉 DATASET PREPARATION COMPLETED SUCCESSFULLY!
=====

```

Figure 4 Data generation Outputs

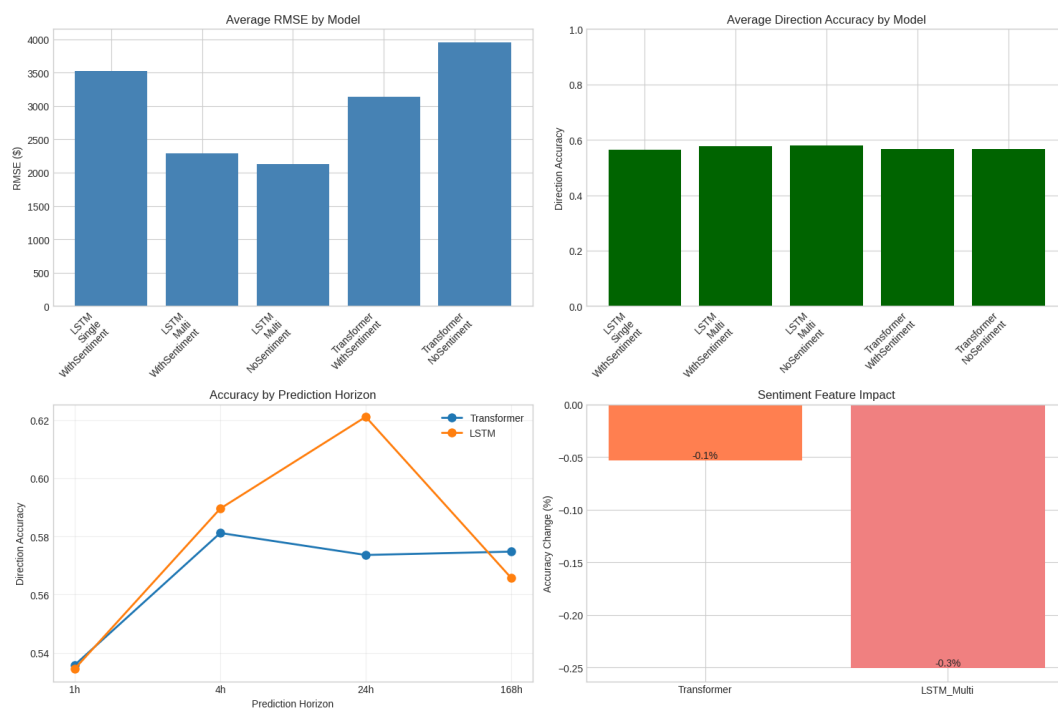


Figure 5 Modelling Results