BITI 3533: ARTIFICIAL INTELLIGENCE IN PROJECT MANAGEMENT

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PROJECT

RAIN PREDICTION USING ARTIFICIAL NEURAL NETWORK (ANN)

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FORMAT OF THE REPORT (Standard Report complete with sub topics):

Present only documentation

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3. Introduction

Background:

Accurate rain forecasting is essential for many industries, such as water resource management, and emergency preparedness. Meteorological data and statistical models are the foundation of conventional weather forecasting techniques. However, the investigation of cutting-edge technology like Artificial Neural Networks (ANNs) has been prompted by the growing complexity of climate patterns and the requirement for precise, localised forecasts.

Case Study:

Artificial neural networks (ANNs) and machine learning have demonstrated the potential to raise the precision of rainfall prediction models in recent times. Conventional models are less suited to handle the nonlinear and dynamic nature of weather patterns because they may find it difficult to represent the complex correlations found in huge datasets. ANNs are well suited for weather prediction jobs because they are adept at learning intricate patterns and relationships, a skill that is inspired by the neural structure of the human brain.

This project's case study focuses on creating and deploying an ANN-based rain forecast model. The objective is to improve the accuracy and dependability of rain forecasts by utilising neural network capabilities. The model attempts to understand complex patterns and connections by training the ANN on historical weather data. This will enable the model to produce well-informed rainfall predictions in certain geographic locations and time frames.

4. Detail about the software used

Python for Machine Learning:

Python is a versatile programming language widely used in the field of machine learning and data science. Its extensive libraries, such as NumPy, Pandas, and Scikit-Learn, make it a preferred choice for developing predictive models. In the context of rain prediction using an ANN, Python provides a robust ecosystem for handling data, implementing machine learning algorithms, and visualizing results.

Key Python Libraries for Rain Prediction:

1. NumPy and Pandas:

- NumPy: Essential for numerical operations, providing support for large, multi-dimensional arrays and matrices.
- Pandas: Ideal for data manipulation and analysis, facilitating the preprocessing of weather datasets.

2. Scikit-Learn:

- This library offers tools for machine learning, including modules for data preprocessing, model training, and evaluation. For rain prediction, algorithms like neural networks are available in the neural_network module.

3. TensorFlow or PyTorch:

- For implementing neural networks, deep learning frameworks such as TensorFlow or PyTorch are commonly used. These frameworks offer high-level APIs for building and training complex neural network architectures.

4. Matplotlib and Seaborn:

- These libraries aid in data visualization, allowing for the creation of informative plots and graphs to interpret model performance and predictions.

Implementation Steps:

1. Data Collection and Preprocessing:

- Acquire historical weather data containing features like temperature, humidity, wind speed, and atmospheric pressure.
- Use Pandas for data cleaning, handling missing values, and organizing the dataset.

2. Feature Engineering:

- Identify relevant features that influence rainfall predictions.
- Use NumPy and Pandas for creating new features or transforming existing ones.

3. Model Development with ANN:

- Choose TensorFlow or PyTorch to build the neural network architecture.
- Define the input layer, hidden layers, and output layer, specifying activation functions and other hyperparameters.

4. Training and Evaluation:

- Utilize Scikit-Learn to split the dataset into training and testing sets.
- Train the ANN on historical data and evaluate its performance using metrics such as accuracy, precision, recall, and F1 score.

5. Visualization:

- Use Matplotlib and Seaborn to visualize the model's predictions against actual rainfall data.
- Create plots to illustrate the learning curve, convergence, and model evaluation.

5. Detail on AI project management eg planning, WBS, Cost, time management etc.

a) Initiating processes

The organization recognizes that a new project exists;

Business Case: Rain Prediction Using Artificial Neural Networks (ANN)

1. Executive Summary:

Objective: To develop an accurate rain prediction system using Artificial Neural Networks (ANN) to enhance decision-making in various industries that rely on weather conditions.

2. Business Problem:

Unpredictable weather patterns pose challenges for industries such as agriculture, transportation, and event planning. Accurate rain prediction is crucial for optimizing operations, minimizing risks, and ensuring resource-efficient planning.

3. Solution:

Implementing an ANN-based rain prediction system capable of analyzing historical weather data and current atmospheric conditions to forecast rain with high accuracy.

4. Key Features:

- **Data Collection**: Gather historical weather data, including temperature, humidity, wind speed, and pressure.

- **ANN Model Development:** Train an Artificial Neural Network using historical data to learn complex patterns and relationships between various weather variables and rain occurrence.

- **Real-time Data Integration:** Incorporate real-time weather data into the model for continuous learning and immediate prediction updates.

- **Accuracy Enhancement**: Implement mechanisms for model validation and fine-tuning to improve accuracy over time.

5. Benefits:

- **Improved Planning:** Agriculture can optimize irrigation schedules, transportation companies can plan for weather-related delays, and event organizers can make informed decisions based on accurate rain predictions.

- **Resource Efficiency:** Farmers can conserve water resources by aligning irrigation with expected rain, reducing costs. Transportation companies can enhance fuel efficiency by optimizing routes, and event planners can avoid weather-related disruptions.

- **Risk Mitigation:** Reduce the impact of adverse weather conditions on operations, leading to decreased losses and improved overall efficiency.

6. Target Industries:

- **Agriculture:** Precision farming, optimal resource utilization.

- **Event Planning:** Outdoor event scheduling, and logistics planning.

7. Revenue Model:

Implement a subscription-based service where businesses pay for access to the rain prediction system, with different tiers based on the level of accuracy, frequency of updates, and additional features.

8. Implementation Plan:

- **Data Gathering:** Establish data sources and collection methods.

- **Model Development:** Train the ANN model using historical data.

- **Real-time Integration:** Implement mechanisms for continuous learning using real-time data.

- **Validation and Fine-tuning:** Regularly validate and fine-tune the model for accuracy enhancement.

9. Risks and Mitigations:

- **Data Quality:** Ensure the quality and reliability of historical and real-time data through rigorous validation processes.

- **Model Overfitting:** Regularly monitor and fine-tune the model to prevent overfitting and ensure continuous accuracy.

- **Regulatory Compliance**: Stay abreast of any regulatory requirements related to weather prediction and data usage.

10. Conclusion:

Implementing an ANN-based rain prediction system presents a valuable solution to address the challenges posed by unpredictable weather patterns, offering businesses in various industries the ability to make informed decisions and optimize their operations.

Project Charter

Project Name	**Rain Prediction By Neural Network For Classification**
Project Description	Weather forecasting plays a crucial role in various sectors such as agriculture, transportation, and disaster management. This project focuses on using neural networks for rain prediction, leveraging historical weather data for accurate classification.
Project Objectives	• Develop a neural network model to classify weather conditions into "rain" or "no rain" categories. • Utilize features such as temperature, humidity, wind speed, and atmospheric pressure for training the model. • Enhance the accuracy of rain prediction to aid in better decision-making and planning.
Project Participants	Marshitah Binti Azhar (Project Manager) Aliyah Najma Binti Nadzri (QA Engineer) Siti Azalia Binti Mehat (Developer)

	Priyadharshni A/P Mohanathan (Developer)
Available Resources	• Laptop(Intel i5, 10th gen, 8gb ram, Intel iris graphics) • Pycharm, Jupyter notebook
Milestones	1. Data collection 2. Data Preprocessing 3. Feature engineering(Feature Engineering) 4. Train/Test split 5. Neural Network ANN implementation 6. ANN architecture optimization 7. Model testing 8. Model validation 9. Model Deployment
Potential Risks	1. The model might be trained with a lot of training data which will result in overfitting. 2. The team might have a lack of time due to the limited resources available as ANN is quite heavy for a basic laptop.
Approval	Project Manager: Marshitah Binti Azhar Signature: Marshitah Date: 22/11/2023

- **Scope:**

The scope for rain prediction using ANN projects is broad and includes a variety of potential applications, such as:

Agriculture: Farmers can use ANN-based rainfall prediction models to make informed decisions about planting, irrigation, and harvesting.

Water resource management: Water managers can use ANN-based rainfall prediction models to optimize reservoir operations and flood forecasting.

Disaster management: Emergency responders can use ANN-based rainfall prediction models to prepare for and respond to floods, landslides, and other weather-related disasters.

Insurance: Insurance companies can use ANN-based rainfall prediction models to assess risk and set premiums.

- **Work Breakdown Structure**

WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION	% of TASK COMPLETE
1	Project Conception & Initiation					
1.1	Define project scope and objectives	Azalia	1/1/2023	1/5/2023	4	100%
1.2	Create project plan and timeline	Azalia	1/6/2023	1/11/2023	5	100%
1.3	Develop project plan	Azalia	1/12/2023	1/16/2023	4	
2	Research and Requirements					
2.1	Review existing gesture recognition technologies	Azalia	1/17/2023	1/22/2023	5	100
2.2	Identify user requirements	Azalia	1/23/2023	1/28/2023	5	100
2.3	Research accessibility guidelines	Azalia	1/29/2023	2/4/2023	6	100
3	Hardware Selection and Setup					
3.1	Asses hardware options	Priya	2/5/2023	2/11/2023	6	100%
3.2	Procure necessary hardware	Priya	2/12/2023	2/18/2023	6	100%
3.2.1	Set up development environment	Priya	2/19/2023	2/26/2023	7	100%
4	Software Development					
4.1	Design gesture recognition algorithms	Priya	2/27/2023	3/7/2023	8	
4.2	Implement software	Priya	3/8/2023	3/18/2023	10	100%
4.3	Integrate software with hardware	Priya	3/19/2023	3/30/2023	11	100%
5	Testing and debugging					
5.1	Conduct unit testing	Priya	5/7/2022	5/10/2022	3	100%
5.2	Perform integration testing	Priya	5/12/2022	5/15/2022	3	100%
6	User Interface Design					
6.1	Design user-friendly interface					
6.2	Implement interface	Aliyah	5/15/2022	5/17/2022	2	100%
6.3	Gather user feedback	Aliyah	5/18/2022	5/22/2022	4	100%
7	Documentation and Training					
7.1	Prepare user manuals	marshitah	5/24/2022	5/26/2022	2	100%
7.2	Develop training materials	marshitah	5/30/2022	6/2/2022	3	100%
8	Hyperparameter tuning					
8.1	Hyperparameter optimization	marshitah	6/3/2022	6/5/2022	2	83
8.2	Model fine-tuning	marshitah	6/6/2022	7/8/2022	2	85
9	Final Model Testing					
9.1	Final model evaluation	marshitah	7/11/2022	7/12/2022	1	100%
9.2	Model comparison and selection	marshitah	7/13/2022	7/14/2022	1	100%
10	Documentation and Reporting					
10.1	Results interpretation and analysis	Aliyah	7/18/2022	7/19/2022	1	70
10.2	Report writing	Aliyah	7/21/2022	7/24/2022	3	60
11	Project Review and Conclusion					
11.1	Final project review	Aliyah	7/25/2022	7/27/2022	2	70
11.2	Project conclusion and lessons learned	Aliyah	7/28/2022	7/30/2022	2	30

- ## Planning

Project Timeline:

Phase 1: Planning (1-2 months)

- Identify the project stakeholders and their needs.
- Define the scope of the project and develop a project plan.
- Gather and prepare the data that will be used to train and evaluate the ANN model.

Phase 2: Model development (2-4 months)

- Develop the ANN model architecture.
- Train the ANN model on the prepared data.
- Evaluate the performance of the ANN model on a held-out test set.

Phase 3: Software development (2-3 months)

- Develop a software application that implements the ANN model.
- Test the software application to ensure that it is working as expected.

Phase 4: Deployment and training (1-2 months)

- Deploy the software application to the end users.
- Train the end users on how to use the software application and the rain prediction model.

Phase 5: Maintenance and support (ongoing)

1. Monitor the performance of the rain prediction model.
2. Provide support to the end users.
3. The total project timeline could range from 6 to 12 months, depending on the complexity of the project.

- Cost Estimation Acquisition

			OVERALL PROJECT	GRANT REQUEST	MATCH				
			Budget must account for all costs to complete the project	*Enter only the amount of the grant request*	*The Grant Request and Match should equal the total project cost and Budget Check cell should be 0. Sponsors must account for all sources and types of match need to complete the project.*				
			Amount	Funding amount	Match in PRISM	Funding not reported in PRISM	Source (Grant, Cash, Materials, Labor, Volunteers, etc)	Match Type (federal, state, local)	*Budget Check*
Property Costs									
Item	Qty	Rate							
Easement	1	$ 200.00	$ 200.00	$ 50	$ 150	$ -	Cash	Federal	0
Land and improvements	1	$ 150.00	$ 150.00	$ -	$ 150	$ -	Cash	Local	0
		$ -	$ -	$ -	$ -	$ -			0
		$ -	$ -	$ -	$ -	$ -			0
		$ -	$ -	$ -	$ -	$ -			0
		$ -	$ -	$ -	$ -	$ -			0
		STotal	$ 350	$ 50	$ 300	$ -			0
Incidental Costs									
Item	Qty	Rate							
Appraisal	2	$ 500.00	$ 1,000	$ 100	$ 800	$ 100	Materials	State	0
Baseline Inventory-Easement Only	5	$ 135.00	$ 675	$ -	$ 675	$ -	Grant	Local	0
Closing and Taxes	1	$ 4,500.00	$ 4,500	$ 1,500	$ 2,570	$ 430	Grant	State	0
Environmental Audit	1	$ 3,900.00	$ 3,900	$ -	$ 3,900	$ -	Cash	Federal	0
Fencing	5	$ 700.00	$ 3,500	$ 3,500	$ -	$ -	Cash	Local	0
Stewardship Plan	5	$ 150.00	$ 750	$ -	$ 550	$ 200	Grant	Federal	0
Title Reports and Insurance	1	$ 4,500.00	$ 4,500	$ 2,000	$ 2,500.00	$ -	Cash	State	0
Signs	5	$ 700.00	$ 3,500	$ 3,500	$ -	$ -	Cash	Local	0
NEPA Compliance	2	$ 600.00	$ 1,200	$ -	$ 1,200.00	$ -	Grant	State	0
Recording Fees	5	$ 100.00	$ 500	$ -	$ 450.00	$ 50	Cash	Local	0
		$ -	$ -	$ -	$ -	$ -			0
		$ -	$ -	$ -	$ -	$ -			0
		$ -	$ -	$ -	$ -	$ -			0
		$ -	$ -	$ -	$ -	$ -			0
		$ -	$ -	$ -	$ -	$ -			0
		$ -	$ -	$ -	$ -	$ -			0
		$ -	$ -	$ -	$ -	$ -			0
		$ -	$ -	$ -	$ -	$ -			0
		STotal	$ 24,025	$ 10,600.00	$ 12,645.00	$ 780			0

- Cost Estimation

Administrative Costs									
Item	Qty	Rate							
Data Scientist	3	$ 600.00	$ 1,800	$ -	$ 1,800	$ -	Labor	Local	0
Machine Learning Engineer	2	$ 700.00	$ 1,400	$ 400	$ 1,000	$ -	Labor	Local	0
Domain Expert	4	$ 1,800.00	$ 7,200	$ -	$ 7,000	$ 200	Labor	State	0
Project Manager	1	$ 2,000.00	$ 2,000	$ 700	$ 1,300	$ -	Labor	Local	0
		STotal	$ 12,400	$ 1,100	$ 11,100	$ 200			0
Indirect Costs									
Description	Approved Rate	Total Project Base							
Indirect Costs	60.000%	$ 600.00	$ 360	$ 360	$ -	$ -	Material	Local	0
Indirect Costs	34.000%	$ 780.00	$ 265	$ -	$ -	$ 265	Quality Assurance	Federal	0
		STotal	$ 625	$ 360	$ -	$ 265			0

Administrative Budget Check		**GTOTAL**	$ 12,110	$ 24,045	$ 1,245
A&E maximum allowed in PRISM	*$1,179.75*		PRISM Project Total	$ 36,155	
A&E validation	*-$11,020.25*		**RCO Percentage**	**Match Percentage**	
			$ 0	0.665053243	

- Cost estimation Design Project

				OVERALL PROJECT	GRANT REQUEST	MATCH				
				Budget must account for all costs to complete the project	Enter only the amount of the grant request	The Grant Request and Match should equal the total project cost and Budget Check cell should be 0. Sponsors must account for all sources and types of match need to complete the project.				Budget Check
				Amount	Amount	Match	Funding not reported in PRISM	Source (Grant, Cash, Materials, Labor, Volunteers, etc)	Match Type (federal, state, local)	
Design Costs										
Category	Task Description	Qty	Rate							
Data collection	*Collect rainfall data*	10	$ 100.00	$ 1,000	$ 700	$ 300	$ -	Cash	Local	0
Assessments (geologic, hydraulic, etc.)	*Geologic assessment*	1	$ 1,500.00	$ 1,500	$ 500	$ 1,000	$ -	Grant	Local	0
Conceptual design	*Develop ANN model*	1	$ 2,500.00	$ 2,500	$ 678	$ 1,822		Labor	State	0
Preliminary design	*Model validation*	1	$ 1,200.00	$ 1,200	$ -	$ 1,200	$ -	Labor	State	0
Final design	*Fine-tuning and optimization*	1	$ 1,800.00	$ 1,800		$ 1,450	$ 350	Labor	State	0
Cultural resources	*Impact assessment*	1	$ 2,000.00	$ 2,000	$ 1,850	$ 100	$ 50	Cash	Federal	0
Permits	*Obtain necessary permits*	1	$ 800.00	$ 800	$ 800		$ -	Grant	Local	0
Equipment	*Purchase hardware*	1	$ 3,000.00	$ 3,000	$ 100	$ 2,500	$ 400	Materials	Federal	0
Survey	*Site survey*	1	$ 1,000.00	$ 1,000		$ 950	$ 50	Grant	Local	0
Administrative	*Project management*	1	$ 3,500.00	$ 3,500	$ 500	$ 2,500	$ 500	Labor	Federal	0
Other	*Miscellaneous tasks*	1	$ 1,500.00	$ 1,500	$ -	$ 1,500	$ -	Volunteers	State	0
			$ -	$ -	$ -	$ -	$ -			0
			$ -	$ -	$ -	$ -	$ -			0
			STotal	$ 19,800	$ 5,128	$ 13,322	$ 1,350			
Indirect Costs										
	Description	Approved Rate	Total Project Base							
	Indirect	20.000%	$ 194,000.00	$ 38,800	$ 11,300	$ 27,500	$ -	Grant	Local	0
	Indirect	50.000%	$ 194,000.00	$ 97,000	$ 7,000	$ 75,000	$ 15,000	Cash	Federal	0
			STotal	$ 135,800	$ 18,300	$ 102,500	$ -			
			GTOTAL	**$ 155,600**	**$ 23,428**	**$ 115,822**	**$ 1,350**			
					PRISM Project Total	$ 139,250				
					RCO Percentage	**Match Percentage**				
					0.1682441652	**83.18%**				

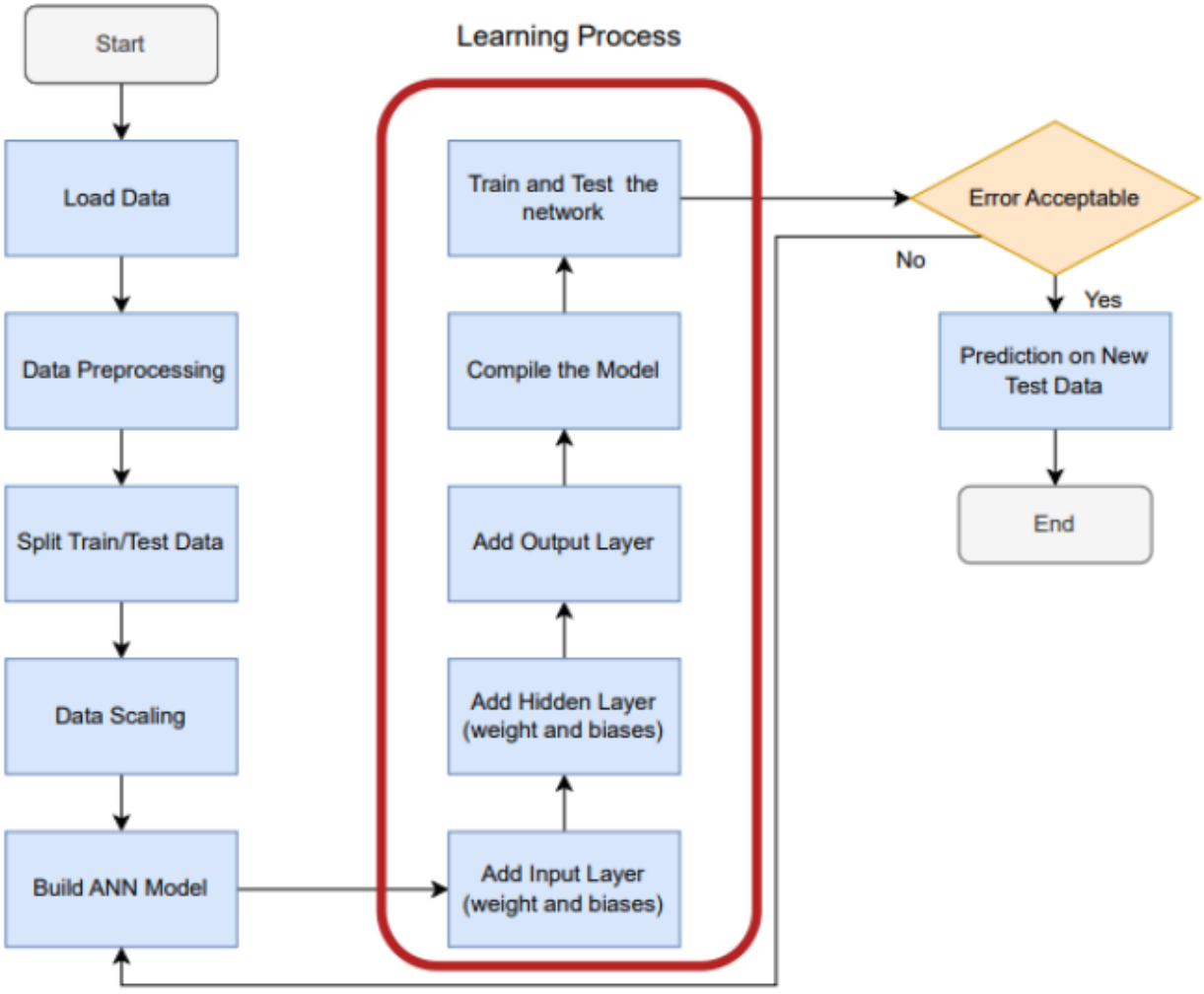
- Cost Estimation Restoration

				OVERALL PROJECT	GRANT REQUEST	MATCH				
				Budget must account for all costs to complete the project	Enter only the amount of the grant request	The Grant Request and Match should equal the total project cost and Budget Check cell should be 0. Sponsors must account for all sources and types of match need to complete the project.				Budget Check
				Amount	Amount	Match in PRISM	Funding not reported in PRISM	Source (Grant, Cash, Materials, Labor, Volunteers, etc)	Match Type (federal, state, local)	
Construction										
Category (choose one)	**Task Description**	**Qty**	**Rate**							
Construction supervision	*Project Management*	1.00	$ 20,000.00	$ 20,000	$ 18,000	$ 18,000	$ -	Cash	Local	(16000)
Construction labor	*Excavation*	1,000.00	$ 25.00	$ 25,000	$ 20,000	$ 20,000	$ -	Grant	Federal	(15000)
Equipment and equipment use	*Heavy machinery Rental*	1.00	$ 5,000.00	$ 5,000	$ 4,000	$ 5,000	$ -	Cash	Local	(4000)
Materials	*Concrete*	50.00	$ 100.00	$ 5,000	$ 4,000	$ 5,000	$ -	Materials	State	(4000)
Construction	*Building Construction*	1.00	$ 150,000.00	$ 150,000	$ 120,000	$ 120,000	$ -	Cash	Local	(90000)
Mobilization	*Site Preparation*	1.00	$ 10,000.00	$ 10,000	$ 8,000	$ 10,000	$ -	Volunteers	Local	(8000)
			STotal	**$ 215,000**	**$ 174,000**	**$ 178,000**	**$ -**			(137000)
Administrative, Architechtural & Engineering										
Category	**Task Description**	**Qty**	**Rate**							
Data collection	*Data Collection*	1.00	$ 10,000.00	$ 10,000.00	$ 8,000	$ 8,000	$ -	Materials	State	(6000)
Assessments (geologic, hydraulic	*Meteorological Assessment*	1.00	$ 18,000.00	$ 18,000.00	$ 15,000	$ 15,000	$ -	Cash	Local	(12000)
Conceptual design	*Conceptual Design*	1.00	$ 20,000.00	$ 20,000.00	$ 16,000	$ 16,000	$ -	Volunteers	Local	(12000)
Preliminary design	*Premilinary Design*	1.00	$ 22,000.00	$ 22,000.00	$ 18,000	$ 18,000	$ -	Cash	Local	(14000)
Final design	*Final design*	1.00	$ 30,000.00	$ 30,000.00	$ 24,000	$ 24,000	$ -	Grant	Federal	(18000)
Administrative	*Project coordination*	1.00	$ 15,000.00	$ 15,000.00	$ 12,000	$ 12,000	$ -	Cash	Local	(9000)
Administrative	*Reporting and Documentation*	1.00	$ 8,000.00	$ 8,000.00	$ 6,000	$ 6,000	$ -	Grant	Federal	(4000)
Other	*Site Planning*	1.00	$ 12,000.00	$ 12,000.00	$ 10,000	$ 10,000	$ -	Cash	Local	(8000)
			STotal	$ 135,000	$ 109,000	$ 109,000	$ -			
Indirect Costs										
	Description	**Approved Rate**	**Total Project Base**							
	Administrative Overhead	10.000%	$ 200,000.00	$ 20,000	$ 18,000	$ 2,000	$ -			2000
	Contigency Reserve	5.000%	$ 300,000.00	$ 15,000	$ 12,000	$ 3,000	$ -			0
			STotal	$ 35,000	$ 30,000	$ 5,000	$ -			0
			GTOTAL	**$ 385,000**	**$ 313,000**	**$ 292,000**	**$ -**			
					PRISM Project Total	$ 605,000				
					RCO Percentage	**Match Percentage**				
					51.74%	**48.26%**				

AA&E Budget Check	
A&E maximum allowed in PRISM	$ 105,600.00
A&E validation	(112,400)

6. Flow, algorithm and problem solving

a) Flow



b) Algorithm

- **Load Data ;**
  Load the data from the dataset

- **Data Preprocessing;**
  Gather historical weather data, including variables such as temperature.

- **Split Train/ Test Data**
  Divide the dataset into training, validation and testing sets.

- **Data Scalling;**
  Input features are on similar scale, preventing certain features from dominating others during training process.

- **Build ANN Model**
  Building an effective ANN model involves an iterative process of experimentation and refinement to achieve desired level of accuracy.

- **Learning Process**
  Involves the adaptation and improvement of the model's performance over time based on the available data

c) Problem Solving

- Data Quality:
  Problem: Inaccurate or incomplete historical weather data can lead to poor model performance.
  Solution: Carefully preprocess and clean the data, handling missing values and outliers

- Continuous Learning:
  Problem: Weather patterns change over time, and a model trained on historical data may become less accurate over the long term.
  Solution: Implement a continuous learning approach by regularly updating the model with new data.

- Data Imbalance:
  Problem: Imbalanced datasets, where one class (rainy or non-rainy) is significantly more prevalent, can bias the model.
  Solution: Balance the dataset through techniques such as oversampling the minority class or undersampling the majority class.

7. Project implementation and output -

7.1 Project implementation

Importing the data

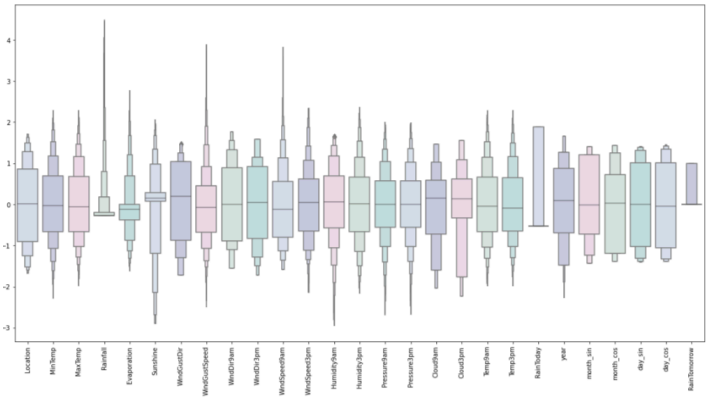
The dataset contains about 10 years of daily weather observations from different locations across Australia. Observations were drawn from numerous weather stations.
The use of data to predict whether or not it will rain the next day. There are 23 attributes including the target variable "Rain Tomorrow", indicating whether or not it will rain the next day or not.

Data visualization and cleaning

Data visualization refers to the graphical representations of data and information. Data cleaning, known as data cleansing or data scrubbing, is the process of identifying and correcting or removing errors, inconsistencies and inaccuracies from a dataset. The steps involved in this project are a count plot of the target column, the correlation amongst numeric attributes, parsing dates into datetime and encoding days and months as continuous cyclic features.

Data Preprocessing

In this section, some steps involved are label encoding columns with categorical data, performing the scaling of the features, detecting outliers and dropping the outliers based on data analysis.



It creates a boxen plot to visualize the distribution of the scaled features in the ‘features’ Dataframe after removing outliers. The plot helps in assessing the impact of outlier removal on the distribution of the data.

Overall this section detects outliers and the features data, removes the outliers based on specific filtering conditions and provides visualizations before and provides visualizations before and after outlier removal to assess the data distribution.

Model Building

In this part, the purpose is to build an artificial neural network. The steps involved in the model building are assigning X and Y the status of attributes and tags, splitting test and training sets, initializing the neural network, defining by adding layers, compiling the neural networks and training the neural networks.

```
history_df = pd.DataFrame(history.history)

plt.plot(history_df.loc[:, ['accuracy']], "#BDE2E2", label='Training accuracy')
plt.plot(history_df.loc[:, ['val_accuracy']], "#C2C4E2", label='Validation accuracy')

plt.title('Training and Validation accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.show()
```

This code is important as it allows you to visualize the training and validation accuracy trends over epochs. The plot helps you understand how the model's accuracy changes during training and whether it is overfitting or underfitting. If the training accuracy continues to improve while the validation accuracy plateaus or decreases, it indicates overfitting. On the other hand, if both the training and validation accuracy increase and converge, it indicates that the model is learning and generalizing well. By visualizing the accuracy, you can assess the model's performance and make informed decisions about its effectiveness.

7.2 Output

	precision	recall	f1-score	support
0	0.87	0.95	0.91	20110
1	0.71	0.48	0.57	5398
accuracy			0.85	25508
macro avg	0.79	0.71	0.74	25508
weighted avg	0.84	0.85	0.84	25508

d) Monitoring and controlling processes

Measuring progress toward the project objectives, monitoring deviation from the plan and taking corrective action to match progress with the plan

Project Detail Review

Overall Performance Report:	
Project Name: Rain Prediction using Neural Network Classification	Date: 20/9/2023
Prepared By: Priyadharshni	Project Type(S/M/L): L
Project Manager: Marshitah Azhar	Project Sponsor: Dr Burhanudin

It outlines in detail some of the most important aspects to consider when looking at the project performance.

Number ID	Date Opened	Action Description	Assigned To	Date Closed
1	1/1/2022	Project Conception & Initiation	Azalia	16/1/2022
2	17/1/2022	Research and Requirements	Azalia	4/2/2022

3	5/2/2022	Hardware Selection and Setup	Priya	26/2/2022
4	27/2/2022	Software Development	Priya	30/3/2022
5	7/5/2022	Testing and debugging	Priya	15/5/2022
6	15/5/2022	User Interface Design	Aliyah	22/5/2022
7	24/5/2022	Documentation and Training	Aliyah	2/6/2022
8	3/6/2022	Hyperparameter tuning	Marshitah	8/7/2022
9	11/7/2022	Final Model Testing	Marshitah	14/7/2022

CHANGE REQUEST FORM

Change Description		
Project Name: Rain Prediction using Neural Network Classification	**Change Name: -**	**Number: 000324**
Requested By: Priya – Testing and Debugging Team	**Contact:** 014 3648606	**Date:** 10/5/2022
Description of Change: The purpose of this change request is to address a critical bug in the Rain Prediction system where inaccurate predictions are being made due to a data preprocessing error.		

Reason for Change:

The current bug poses a significant risk to the reliability of predictions, potentially leading to incorrect weather forecasts. Immediate attention is needed to maintain the project's credibility.

Priority [Circle One]: 1. High 2. Medium 3. Low

Impact on Deliverables:

The change is expected to require a thorough investigation, debugging, and testing phase. The timeline for the fix is estimated at one week, and it may impact the project schedule. The debugging team suggests identifying and resolving the data preprocessing error causing inaccurate predictions. This may involve code review, debugging sessions, and collaboration with the data engineering team. The proposed change aims to eliminate the critical bug, ensuring the accuracy and reliability of the Rain Prediction system. This, in turn, will enhance user trust and satisfaction.

Impact of Not Responding to Change (and Reason Why): The system is currently generating inaccurate predictions due to a data preprocessing issue. Immediate action is required to prevent further inaccuracies in weather predictions.

Date Needed: 14/5/2022	**Approval of Request:** Approved	**Date:** 13/5/2022

Sign Offs

[Circle One]: 1. Accepted 2. Deferred 3. Rejected 4. More Info Requested

Comments: The debugging team will provide regular updates on the progress of the bug fix

Project Manager Signature: *Marshitah*	**Date:** 13/5/2022
Decision Maker Signature: Azalia	**Date:** 13/5/2022

Updated Work Breakdown Structure

WBS Number	Task Tittle	Task Owner	Start Date	Due Date	% of Task Complete
1.0	Project Conception & Initiation				
1.1	Define project scope and objectives	Azalia	1/1/2023	1/5/2023	100%
1.2	Create project plan and timeline	Azalia	1/6/2023	1/11/2023	100%
1.3	Develop project plan	Azalia	1/12/2023	1/16/2023	100%
2.0	Research and Requirements				
2.1	Review existing gesture recognition technologies	Azalia	1/17/2023	1/22/2023	100%
2.2	Identify user requirements	Azalia	1/23/2023	1/28/2023	100%

2.3	Research accessibility guidelines	Azalia	1/29/2023	2/4/2023	100%
3.0	Hardware Selection and Setup				
3.1	Asses hardware options	Priya	2/5/2023	2/11/2023	100%
3.2	Procure necessary hardware	Priya	2/12/2023	2/18/2023	100%
3.2.1	Set up development environment	Priya	2/19/2023	2/26/2023	100%
4.0	Software Development				
4.1	Design gesture recognition algorithms	Priya	2/27/2023	3/7/2023	100%
4.2	Implement software	Priya	3/8/2023	3/18/2023	100%
4.3	Integrate software with hardware	Priya	3/19/2023	3/30/2023	100%
5.0	Testing and debugging				
5.1	Conduct unit testing	Priya	5/7/2022	5/10/2022	100%
5.2	Perform integration testing	Priya	5/12/2022	5/20/2022	60%

6.0	User Interface Design				
6.1	Design user-friendly interface	Aliyah	5/21/2022	5/23/2022	100%
6.2	Implement interface	Aliyah	5/24/2022	5/28/2022	100%
6.3	Gather user feedback	Aliyah	5/25/2022	5/28/2022	100%
7.0	Documentation and Training				
7.1	Prepare user manuals	Marshitah	5/28/2022	5/30/2022	80%
7.2	Develop training materials	Marshitah	5/31/2022	6/3/2022	100%
8.0	Hyperparameter tuning				
8.1	Hyperparameter optimization	Marshitah	6/4/2022	6/8/2022	95%
8.2	Model fine-tuning	Marshitah	6/9/2022	6/11/2022	98%
9.0	Final Model Testing				
9.1	Final model evaluation	Marshitah	6/12/2022	6/13/2022	100%
9.2	Model comparison and selection	Marshitah	6/14/2022	6/15/2022	100%

10.0	Documentation and Reporting				
10.1	Results interpretation and analysis	Aliyah	6/16/2022	6/17/2022	80%
10.2	Report writing	Aliyah	6/18/2022	6/21/2022	75%
11.0	Project Review and Conclusion				
11.1	Final project review	Aliyah	6/22/2022	6/24/2022	89%
11.2	Project conclusion and lessons learned	Aliyah	6/25/2022	6/27/2022	40%

e) Closing processes

Formal acceptance of the work and creation of closing documents

Final Report:

Project Overview

The objective of the project was to develop an ANN-based rain prediction system that can analyze historical weather data and current atmospheric conditions to forecast rain with high accuracy. The project was initiated to address the business problem of unpredictable weather patterns that pose challenges for industries such as agriculture, transportation, and event planning.

Project Achievements

The project was completed within the allotted time and budget. The team was able to develop a functional rain prediction system that can forecast rain with high accuracy. The system was tested using real-world data and was found to be effective in predicting rain.

Lessons Learned

Throughout the project, several key lessons have been identified. First and foremost, it became evident that the model's training data volume significantly impacted the risk of overfitting. Additionally, the team faced time constraints stemming from the limited resources available, particularly due to the heavy computational demands of artificial neural networks (ANN) on basic laptop setups. To address these challenges and mitigate potential risks, the following recommendations are put forward. It is essential to ensure that the model is trained with an optimal amount of data to strike a balance between performance and overfitting. Furthermore, leveraging cloud-based solutions can alleviate the computational burden placed on local hardware, thereby facilitating smoother and more efficient project execution.

Conclusion

The project was a success and achieved its objectives. The rain prediction system developed by the team can be used to optimize operations, minimize risks, and ensure resource-efficient planning in industries such as agriculture, transportation, and event planning. The project closeout report summarizes the project's achievements, lessons learned, and recommendations for future projects.

Project Archive:

List the criteria which must be met to confirm that the project is completed. For each criterion listed, assess whether or not it has been achieved to the satisfaction of the customer.

Category	Criteria	Complete?
Project Overview	focuses on using neural networks for rain prediction, leveraging historical weather data for accurate classification.	☑
Project Objective	Develop a neural network model to classify weather conditions into "rain" or "no rain" categories.	☑
	Utilize features such as temperature, humidity, wind speed, and atmospheric pressure for training the model.	☑
	Enhance the accuracy of rain prediction to aid in better decision-making and planning.	☑
Project Team	Marshitah Binti Azhar (Project Manager)	☑
	Aliyah Najma Binti Nadzri (QA Engineer)	☑
	Siti Azalia Binti Mehat (Developer)	☑
	Priyadharshni A/P Mohanathan (Developer)	☑
Project Phase	Data collection	☑
	Data processing	☑
	Feature engineering	☑
	Train/ test split	☑
	Artificial Neural Network (ANN) implementation	☑
	ANN architecture optimization	☑
	Model testing	☑
	Model validation	☑
	Model deployment	☑
Lessons Learned	The model might be trained with a lot of training data which will result in overfitting.	☑
	The team might have a lack of time due to the limited resources available as ANN is quite heavy for a basic laptop	☑
Conclusion	Achieved its objectives, providing industries with a reliable tool to optimize operations in the face of unpredictable weather.	☑

8. Conclusion

Traditional weather forecasting methods, while valuable, often struggle with the intricate and dynamic nature of climate patterns. This has created a demand for more accurate and localised predictions, leading researchers towards innovative solutions like Artificial Neural Networks (ANNs).

This project delves into the promising potential of ANNs for rain forecasting by developing and deploying a dedicated model. By leveraging the learning capabilities of neural networks, the model aims to achieve:

- Enhanced Accuracy: The model, trained on extensive historical data, will capture complex relationships and hidden patterns, leading to more precise rainfall predictions than conventional methods.
- Improved Reliability: The model's ability to adapt and learn continuously will enhance its predictive accuracy over time, increasing reliability for future forecasts.
- Localized Predictions: The model can be tailored to specific geographical regions and timeframes, providing valuable insights for local decision-making in areas like agriculture, water management, and disaster preparedness.

The successful implementation of this ANN-based rain forecasting model represents a significant advancement in addressing the critical need for accurate and dependable weather predictions. This advancement promises to benefit diverse sectors and communities, ultimately contributing to a more informed and resilient future in the face of complex climate patterns.