UE22CS320A- Project Phase - 2

Capstone Project –Phase 2 –review 1

Project Title :Cost estimation tool for manufacturing units
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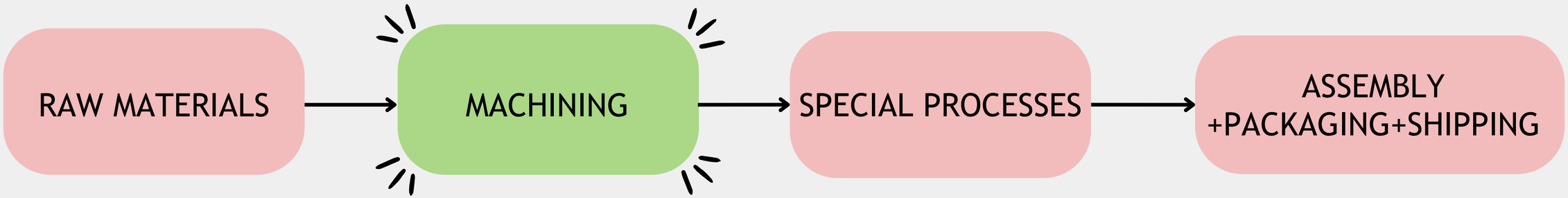
INDEX

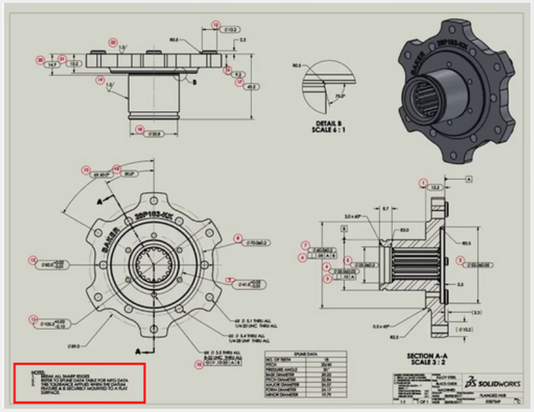
PROBLEM STATEMENT

COST ESTIMATION TOOL FOR MANUFACTURING UNITS

Flow of chain regarding estimation of cost



PROBLEM STATEMENT



VENDOR DRAWINGS

1. FEATURE EXTRACTION

   Material,size,complexity,reach,tools

2. DETERMINE MACHINES TO BE USED

   One part usually requires 2-3 machines in sequence

3. HAVE MACHINE HOURLY RATE(MHR) DATA

   Machine operating cost on the hourly bases

4. CALCULATE PART CYCLE-TIME(CT)

   Amount of time needed per part per machine

5. CALCULATE ESTIMATED MACHINING COST

   COST=MHR X CT

MULTI-PURPOSE MACHINES (MPM)

DATASETS

DATASET FOR MACHINE HOURLY RATE (MHR)

MACHINE -ID	QUANTITY	TYPE	AXIS	AREA	MHR
V3A0.5M	6	VERTICAL	3	0.5	1689
H3A0.8M	8	HORIZONTAL	3	0.8	1729
V6A2.0M	7	VERTICAL	6	2	2389
V5A2.0M	4	VERTICAL	5	2	2316

DATASET FOR FEATURES AND CYCLE TIME

PART -ID	MATERIAL	TOOLS	MACHINE	CYCLE TIME
PNL-AL2024-1500x500-R1	AL	EM	V3A0.5M	6
BRKT-AL-200x50-WLD-R2	AL	DB	V6A2.0M	8
RIB-SS-500x200-LAY-R1	SS	FM,DM	V5A2.0M	16

FUNCTIONAL REQUIREMENTS

1. INTERFCACE TO ACCEPT DESIGN DETAILS FOR FURTHER PROCESSING
2. STORED AND DYNAMICALLY UPDATED MHR TABLE
3. MACHINE LEARNING MODEL TRAINED ON HISTORICAL DATA TO PREDICT CT
4. CALCULATION AND VALIDATION OF ESTIMATED COST
5. FRONT-END DISPLAY AND GRAPHICAL REPRESENTATIONS

NON-FUNCTIONAL REQUIREMENTS

Performance Requirements

- The system shall respond to user queries within a defined time frame to ensure efficient interaction and decision-making.
- The application shall maintain high accuracy against industry benchmarks to ensure reliable aerospace cost assessments.
- The system shall ensure efficient performance even during peak usage periods, maintaining responsiveness and minimizing delays.

Safety Requirements

- The system shall employ robust data validation and verification mechanisms to ensure the accuracy and integrity of information, preventing data corruption or loss.
- The system shall ensure the integrity of cost estimation data to prevent inaccuracies or inconsistencies that could lead to erroneous decisions in the aerospace manufacturing process.

Integration requirements

- Seamless integration with existing tools like excel and SAP

TECHNOLOGIES PLANNED

Part to Cycle-Time (CT) Estimation: XGBoost model is used for this step

Price Prediction: Random Forest Regressor model is considered to accurately estimate the machining cost

Dashboard: ReactJS framework, tailwind CSS and SQLite for database

DESIGN DETAILS

1. Machine Learning Model for Cost Estimation

Algorithm: Regression-based models (Random Forest, XGBoost) for cost estimation.

Training Data: Historical machining cost data, including Machine Hourly Rate (MHR) and Cycle Time (CT).

Feature Engineering: Factors like machine type, complexity, material type, energy consumption, and reach.

Deployment: Model is trained offline and periodically updated; APIs serve predictions based on stored trained models.

2. Tech Stack

Backend

Programming Language: Python (Flask/FastAPI for API development).
Database: SQLite for lightweight database
Data Processing: Pandas, NumPy, SciPy for feature engineering.

Frontend

Tech: React.js
Charts & Visualization: Chart.js for cost breakdown and statistics
Version Control: GitHub for collaboration.

3. System Architecture

Data Flow

User → Web UI → API Server → ML Model → Database → Response.

Process:

User inputs parameters (material type, machining process, etc.).

ML model fetches historical data, processes inputs, and generates cost prediction.

The estimated cost is displayed with breakdowns and analysis.

Security & Performance

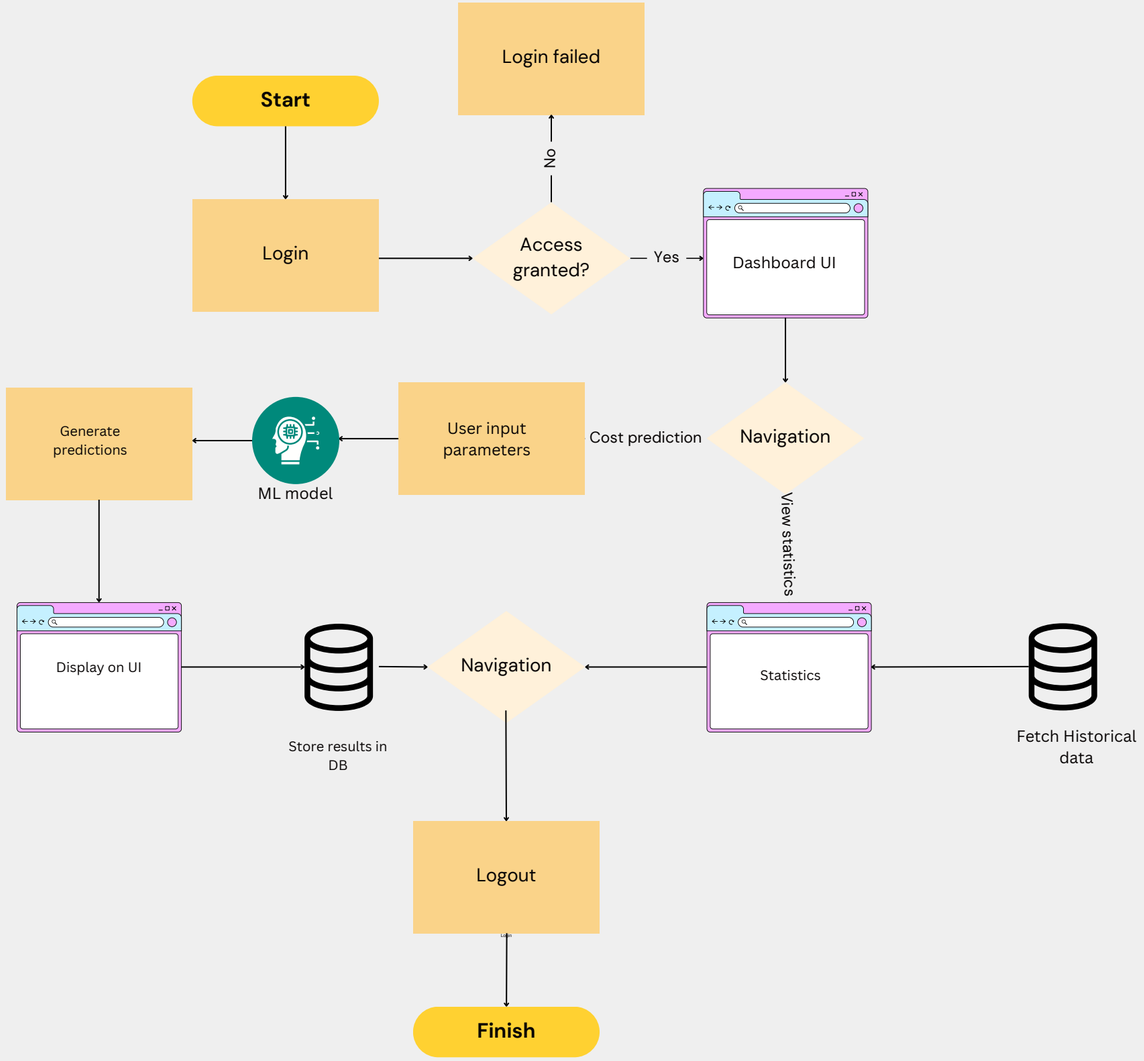
Data Security: Role-based authentication for different access levels.

ARCHITECTURE

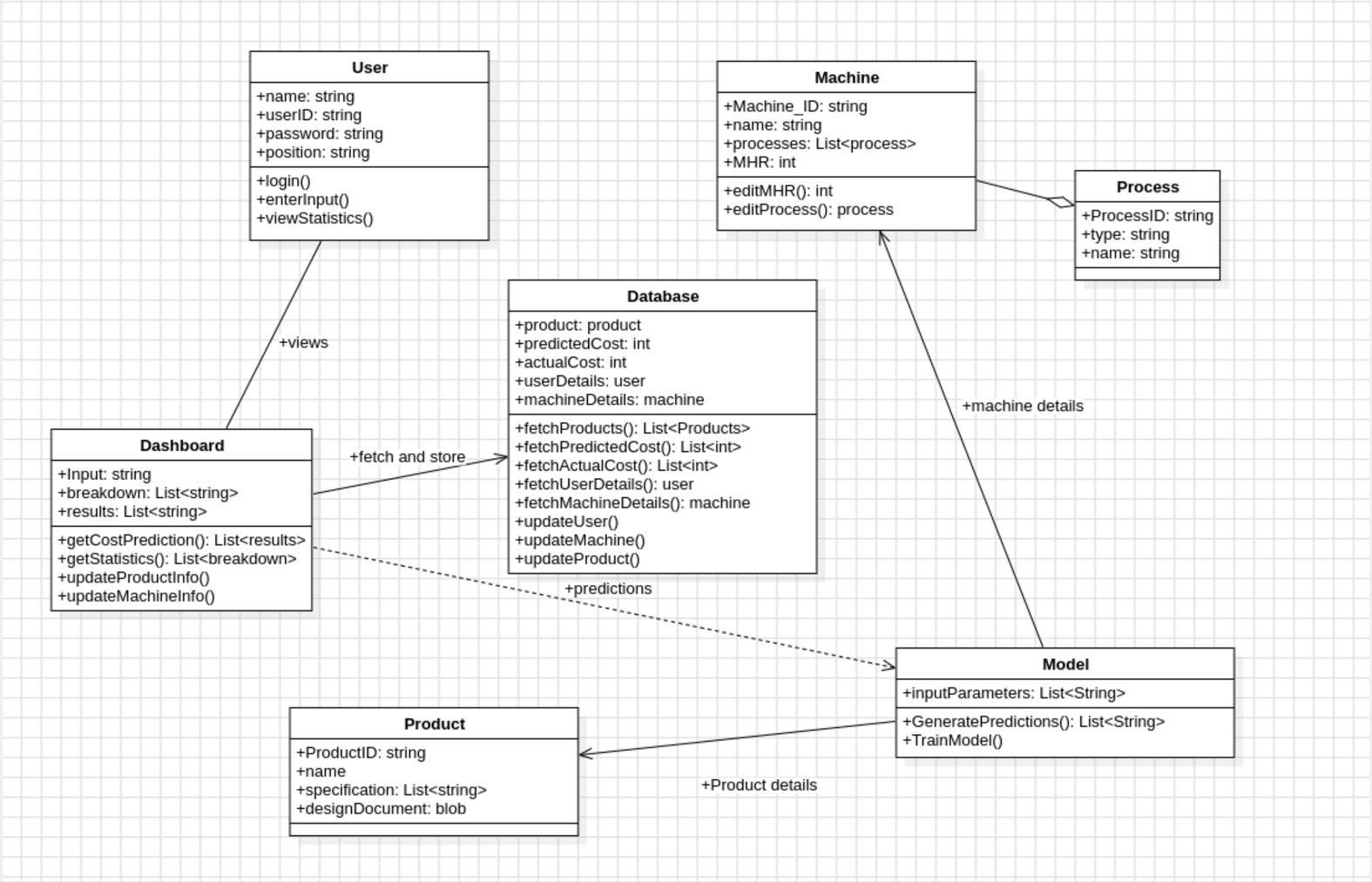
<u>Choice of Architecture:</u> In our case, microservices architecture would be more suitable as cost estimation has various stages that are independent of each other and creating independent modules for each framework with easy integration would be the best course of action for this particular use case.

DESIGN DESCRIPTION

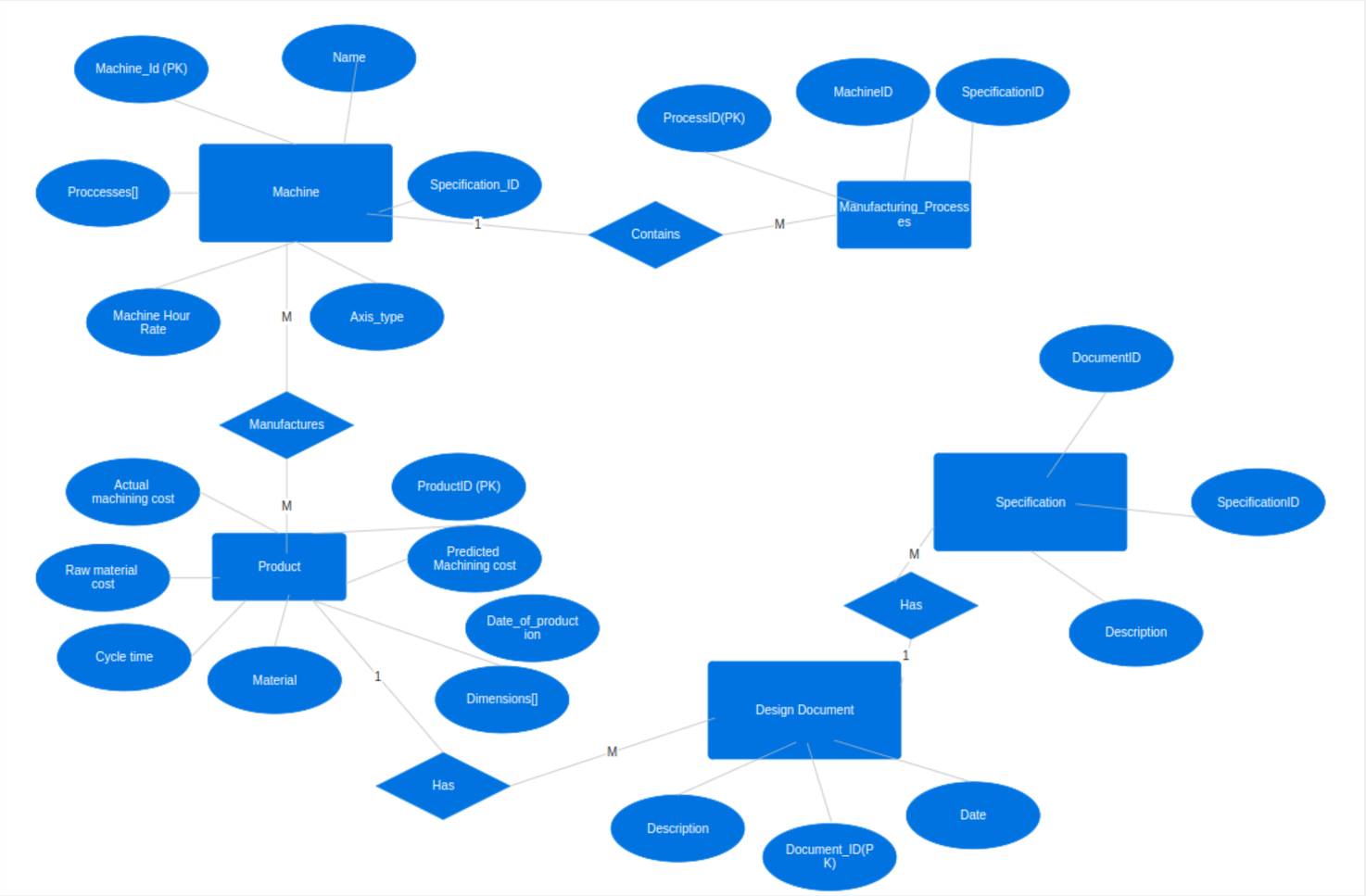
Activity diagram



Master class diagram



ER Diagram


Machine_Id (PK)
Name
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Machine
Specification_ID
Machine Hour Rate
Axis_type
ProcessID(PK)
MachineID
SpecificationID
Contains
Manufacturing_Processes
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M
M
Manufactures
Actual machining cost
ProductID (PK)
Raw material cost
Product
Predicted Machining cost
Cycle time
Material
Date_of_production
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DocumentID
Specification
SpecificationID
Description
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Has
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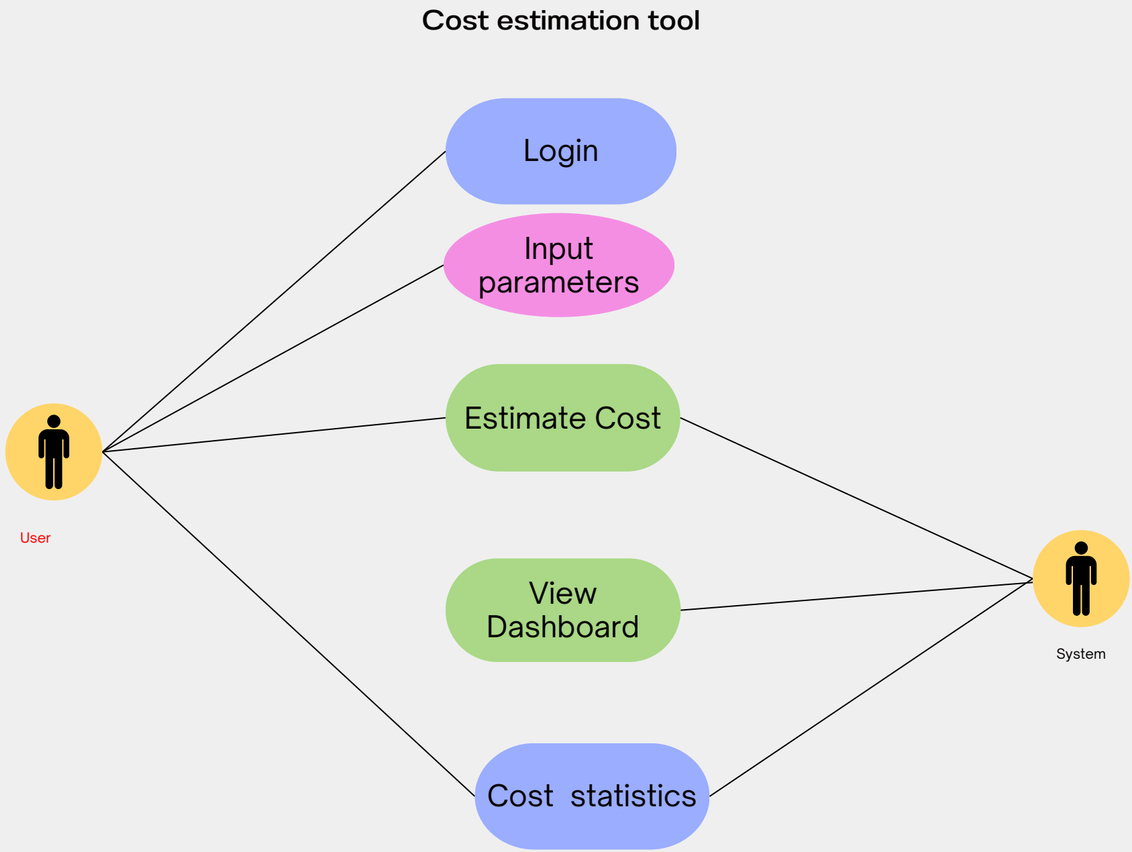
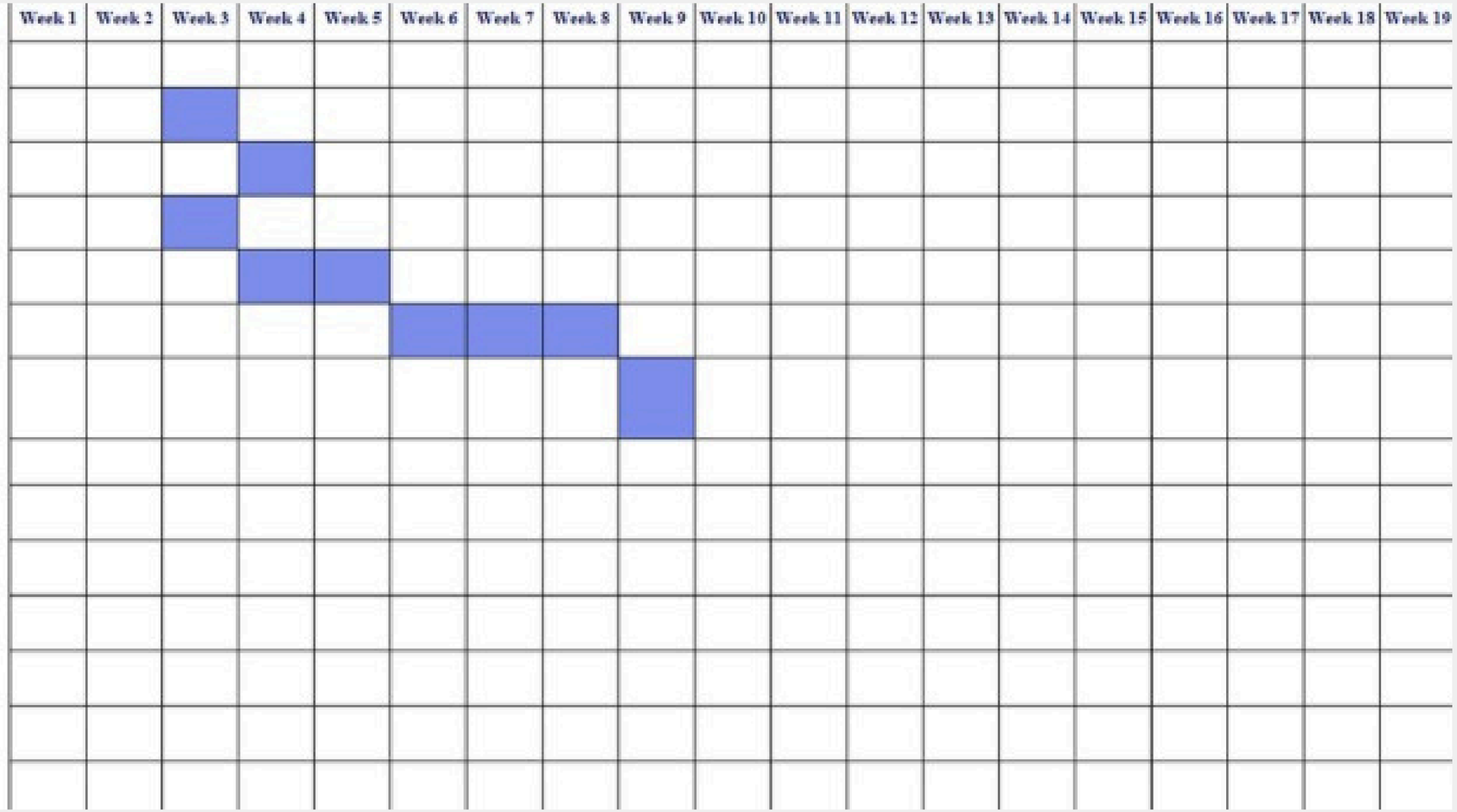
Use Case Diagram



GANTT CHART

Milestone description	Progress	Start Date	Weeks
Phase 1			
Define Problem Statement	100%	22-08-2024	1
Define Project Objectives	100%	29-08-2024	1
Determine Scope	100%	05-09-2024	1
Feasibility Study	100%	12-09-2024	2
Literature Survey	100%	26-09-2024	3
Combined Overall Project Plan & Detailed Project Plan for Phase II	100%	17-10-2024	1
Phase 2			
Project Requirement Specifications			1
High-Level Design Document (HLD)			1
Low-Level Design Document (LLD)			1
Design Philosophy (UI, Backend, Algorithms)			2
Dataset Preprocessing			2
Baseline Model Exploration/Implementation			2




THANK YOU