Work-Break-Down Structure Dictionary

WBS LEVEL	WBS CODE	WBS NAME	WBS DESCRIPTION	WBS DURATION
1	1	Music Genre Classification	The overarching project aiming to classify music into distinct genres using machine learning.	56
2	1.1	Know About the Goal	Understanding and defining the primary objective of the project.	3
3	1.1.1	Choose Problem	Selecting the specific challenge or issue within music genre classification to address.	1
3	1.1.2	Problem Understanding	Gaining a deeper comprehension of the nuances, implications, and specifics of the chosen problem.	1
3	1.1.3	Problem Analysis	Investigating the problem's intricacies, potential solutions, and expected challenges.	1
2	1.2	Planning	Outlining the approach, resources, and timeline for addressing the problem.	5
3	1.2.1	Scope/Size Estimation	Gauging the breadth and depth of the project, including the data volume and expected outcomes.	1
3	1.2.2	Cost Estimation	Projecting the financial requirements for successfully executing the project.	1
3	1.2.3	Time Estimation	Forecasting the duration and milestones for the project's completion.	1
3	1.2.4	Effort Estimation	Evaluating the manpower and hours required for each phase of the project.	1
3	1.2.5	Software Project Management Planning (SPMP) Validation.	Confirming that the project management plan aligns with best practices and project goals.	1
2	1.3	Data Collection and Analysis.	Gathering relevant data for the project and conducting preliminary analysis.	11
3	1.3.1	Dataset Preparation	Organizing the collected data into a structured format suitable for model training.	2

3	1.3.2	Dataset Analysis	Examining the dataset's properties, distribution, and potential challenges	2
3	1.3.3	Model Requirement Specification.	Documenting the technical requirements for the model and validating these requirements.	2
3	1.3.4	SRS Validation.	Documenting the technical requirements for the model and validating these requirements.	3
2	1.4	Data Preprocessing.	Enhancing the quality and structure of the data to ensure its readiness for model training.	10
3	1.4.1	Cleaning	Removing inconsistencies, translating data into a uniform format, and merging different data sources.	2
3	1.4.2	Mapping	Removing inconsistencies, translating data into a uniform format, and merging different data sources.	4
3	1.4.3	Integration	Removing inconsistencies, translating data into a uniform format, and merging different data sources.	2
3	1.4.4	Unit Testing of Data Preprocessing Module.	Checking the data preprocessing steps to ensure accuracy and correctness.	2
2	1.5	Data Transformation	Modifying data to better fit the model's needs, including normalization or standardization.	7
3	1.5.1	Train Test Split.	Dividing data into training and testing subsets, and applying any final transformations	1
3	1.5.2	Selection and Transformation.	Dividing data into training and testing subsets, and applying any final transformations	3
3	1.5.3	Processed Labeled Data	The final output after preprocessing, ready for model training.	2
3	1.5.4	Unit Testing of Data Transformation Module	Verifying that data transformation has been correctly executed.	1
2	1.6	Model Building	Crafting and training the machine learning model for genre classification.	22
3	1.6.1	Sequential Model Creation	Implementing different algorithms and neural network architectures to find the best model.	3

3	1.6.2	Accuracy Testing	Evaluating the model's performance against known benchmarks.	1
3	1..6.3	Implement K-Nearest Neighbor (KNN) algorithm	Implementing different algorithms and neural network architectures to find the best model.	3
3	1.6.4	Use Convolutional Neural Network	Implementing different algorithms and neural network architectures to find the best model.	4
3	1.6.5	Accuracy Testing	Evaluating the model's performance against known benchmarks.	1
3	1.6.6	Use Parallel Recurrent Convolutional Neural Network	Implementing different algorithms and neural network architectures to find the best model.	4
3	1.6.7	Overfitting Prevention Techniques	Implementing strategies to ensure the model generalizes well to new, unseen data.	2
3	1.6.8	Model optimization (using various optimizers)	Fine-tuning the model for better performance using different optimization techniques.	2
3	1.6.9	Unit Testing of Data Model Building Module	Checking the integrity and functionality of the model-building process.	1
2	1.7	Model Testing and Evaluation.	Assessing the model's overall performance and ensuring it meets project objectives.	6
3	1.7.1	Training Accuracy vs Testing Accuracy.	Comparing the model's performance on training data versus unseen testing data.	2
3	1.7.2	White Box Testing.	Testing the model's internal workings and its functionality from an end-user's perspective.	1
3	1.7.3	Black Box Testing.	Testing the model's internal workings and its functionality from an end-user's perspective.	1
3	1.7.4	Testing on Random Data.	Evaluating the model's predictions on new, unstructured data.	1
3	1.7.5	Model Output Analysis and Testing.	Reviewing the model's predictions for accuracy and relevance.	1

2	1.8	Data Visualization.	Representing data and results graphically for better understanding and interpretation	2
3	1.8.1	Correlation Analysis using Seaborn/Matplotlib.	Assessing relationships between variables in the dataset using visualization libraries.	1
3	1.8.2	Unit Testing on Data Visualization.	Ensuring the integrity and accuracy of data visualization components.	1

Introduction

1.1 Purpose of this Document

Music genre classification serves several valuable purposes in the field of music analysis and recommendation. The primary objectives of music genre classification include:

- **Music Recommendation:** Music streaming platforms and recommendation systems use genre classification to provide personalized playlists and song recommendations to users. By categorizing songs into genres, the system can suggest music that aligns with the user's musical taste, enhancing the overall listening experience.
- **Content Organization:** Music libraries, both personal and commercial, can benefit from genre classification to organize their vast collections efficiently. This enables users to navigate through music libraries with ease, searching for and discovering music that suits their mood or preferences.
- **Market Segmentation:** In the music industry, genre classification helps identify and target specific listener demographics. Record labels, artists, and event organizers use this data to tailor their marketing and promotional efforts to reach the appropriate audience for a particular genre.
- **Music Analysis:** Researchers and musicologists use genre classification to analyze musical trends and patterns. This aids in understanding the evolution of music over time, tracking the popularity of specific genres, and exploring the cultural and historical context of music.
- **Enhanced Music Discovery:** Genre classification allows users to discover new music within their preferred genres and related styles. It promotes music exploration and can lead to the discovery of artists and tracks that might otherwise remain hidden.
- **Curated Playlists:** Music streaming services and radio stations use genre classification to create curated playlists, themed radio stations, and genre-specific channels, delivering a more immersive and engaging listening experience.
- **Music Licensing and Rights Management:** In the context of licensing and royalty distribution, genre classification helps ensure that artists and content creators receive fair compensation for their work when their music is used in various media, such as films, commercials, and video games.
- **Automated Content Tagging:** Music platforms and content management systems employ genre classification to automatically tag and categorize newly uploaded music. This simplifies the process of metadata assignment, making music search and retrieval more efficient.

- **Educational and Historical Analysis:** Music educators and historians can use genre classification to teach students about the rich diversity of musical styles across different eras and cultures. This supports the preservation and dissemination of musical heritage.
- **Artistic Exploration:** Musicians and composers can draw inspiration from genre classification by exploring different genres and styles, experimenting with hybrid genres, and pushing the boundaries of musical creativity.

In summary, music genre classification plays a pivotal role in the modern music ecosystem, enhancing user experiences, supporting the music industry, enabling research, and contributing to the broader understanding and appreciation of the art of music.

1.2 Scope of the Development Project

In the context of developing a music genre classification system, the scope of the project encompasses various critical dimensions that need to be considered for its successful implementation. These dimensions include:

- **Functionality:** The system's functionality pertains to its ability to accurately categorize music into distinct genres based on audio features, lyrics, and other relevant data. It should encompass a wide range of musical genres and be capable of adapting to new and emerging genres. Additionally, the system's functionality must account for scalability to accommodate a growing and evolving music library.

- **Efficiency:** Efficiency in music genre classification involves optimizing the algorithm's resource usage, such as CPU and memory, to process and classify music tracks swiftly. This includes ensuring that the classification process doesn't consume excessive computational resources and can be deployed in real-time applications without significant delays.

- **Performance:** The system's performance is measured by how quickly it can analyze and classify a large dataset of music tracks. It should also provide efficient response times for user queries, enabling users to access genre-specific playlists and recommendations promptly.

- **Reliability:** Reliability is paramount in music genre classification. The system should consistently produce accurate genre labels for various music tracks, even when dealing with noisy or incomplete data. It should be robust against variations in audio quality, song length, and stylistic diversity, ensuring dependable results.

- **Usability:** The usability aspect involves designing a user interface that is intuitive and user-friendly. Users should be able to interact with the system effortlessly, whether they are casual listeners, music enthusiasts, or professionals in the music industry. The interface should facilitate easy navigation, music discovery, and customization of playlists.

- **Availability:** Availability refers to the system's ability to be accessible to users whenever they require its services. Music genre classification should be available and responsive as promised, offering uninterrupted access to categorized music libraries, personalized recommendations, and genre-specific content.

- **Adaptability:** The system should be adaptable to changes in the music landscape, such as evolving genres and subgenres, emerging artists, and shifts in musical trends. It should be designed to incorporate new data sources and features that enhance genre classification accuracy.

- **Interoperability:** Interoperability is crucial for integrating the music genre classification system with various music platforms, applications, and databases. It should support APIs and data exchange formats that enable seamless interaction with other music-related services.

- **Data Security:** The project should address data security and privacy concerns, especially when dealing with user-generated content. Protecting user data and ensuring the confidentiality of sensitive information is paramount.

In summary, the scope of the music genre classification development project encompasses the functional, efficiency, performance, reliability, usability, availability, scalability, adaptability, interoperability, and data security aspects required to create a robust and user-friendly system for classifying and accessing music genres.

1.3 Overview

Music genre classifier is a kind of data driven approach , under this we will be using a certain machine learning algorithm to categorize the music tracks into their individual genres. This technique has a variation in its applications including the following:

- **Understanding User Preferences:**Music genre classification provides valuable insights into how users group and categorize music. This understanding enables music platforms, artists, and record labels to create more targeted marketing campaigns, allowing them to tailor their content and promotions to specific listener preferences.

- **Providing Personalized Recommendations:** The application of music genre classification is instrumental in generating personalized music recommendations for users. By identifying the genres that resonate with a listener based on their listening history, music platforms can offer curated playlists, artist suggestions, and song recommendations that align with individual tastes and preferences.

- **Enhancing Music Discovery:** Music genre classification plays a pivotal role in helping users discover new music within their preferred genres and related styles. It facilitates the creation of genre-specific playlists and thematic radio stations, enriching the overall music exploration experience.

- **Supporting Content Licensing and Rights Management:** Accurate genre classification is crucial for music licensing and rights management. It ensures that artists, songwriters, and copyright holders receive fair compensation when their music is used in various media, including films, commercials, and video games. Accurate genre labeling is key to ensuring that music is appropriately licensed and attributed.

- **Enabling Cultural and Historical Analysis:** Researchers, musicologists, and educators use music genre classification to study the evolution of music, track genre popularity over time, and explore the cultural and historical context of musical styles. This supports a deeper understanding of the art form and its societal impact.

- **User-Driven Playlist Creation:** Music genre classification enables users to create their own playlists and organize their music libraries effectively. By categorizing tracks into genres, users can curate their own music collections, fostering a more personalized and organized listening experience.
- **Industry Insights:** For the music industry, genre classification provides valuable insights into market segmentation. Record labels, artists, and event organizers can tailor their promotional strategies, music releases, and live performances to target specific listener demographics.

- **Efficient Content Management:** Music libraries and content management systems benefit from the organization and categorization provided by genre classification. It simplifies the process of metadata assignment, content tagging, and search and retrieval, leading to more efficient content management.

- **Scalability and Adaptability:** The world of music is constantly evolving with new genres and subgenres emerging. Music genre classification systems must be scalable and adaptable to incorporate these changes, ensuring they remain relevant in an ever-expanding musical landscape.

2 Product Functions

Its functionality will be accessed by evaluation of the data set that we will provide. We can evaluate the overall accuracy of the model which we will make. Another important thing to consider here is how many different genres there are in the world. As this would help us out in training the model better.

It must be efficient and can be defined as the ability to achieve an end goal with little to no waste, effort, or energy. Being efficient means you can achieve your results by putting the resources you have in the best way possible.

How quickly can the CNN algorithm process a large dataset of wines? What is the response time for queries?

How dependable is the CNN algorithm? Does it produce consistent results, and how does it handle noisy or incomplete data?

Availability is the measurement of how “available” a service is. Quite simply, if a customer wants to use the service at a time when we promised it would be there for them, they expect it to be available.

2.1 User Characteristics

Internal Users:

Testers: These are individuals responsible for testing the functionality and accuracy of the music genre classification system. They evaluate the system's performance, report issues, and help ensure its reliability.

Music Curators: Music cultivators or curators play a significant role in organizing and categorizing music content. They use the genre classification system to maintain music libraries, create playlists, and ensure that tracks are appropriately tagged with the correct genres.

Board Members: Board members may have a strategic interest in the success and development of the music genre classification system, particularly if it is part of a larger music-related organization.

External Users:

Music Communities: Music communities, including listeners and enthusiasts, have a strong interest in the accuracy and efficiency of music genre classification. They rely on genre information to explore and discover music that aligns with their preferences.

Educational Institutions: Educational institutions play a vital role in training individuals interested in music technology and data analysis. They promote initiatives related to music genre classification and may offer courses or programs in this field.

Musicians and Artists: Musicians and artists may use genre classification as a tool for understanding the market and the preferences of their audience. They may also explore genre classification to experiment with different musical styles.

Music Platforms and Streaming Services: Music platforms and streaming services use genre classification to provide users with personalized playlists and recommendations. Accurate genre information is crucial for delivering a satisfying user experience.

2.2 General Constraints, Assumptions and Dependencies

Constraints:

- The Data set must be clean and well-formatted.
- The Deep learning method used is Parallel Recurrent Convolutional Neural Network which will allow our classifier to learn better and efficiently.

Assumptions:

- The data set which is feeding for the training purpose or for validation purpose should only contain the different musics, as this must be the prior requirement before training the model, otherwise no point going further.
- CNN algorithm must be able to correctly identify the hidden patterns that are there within the dataset by correctly identifying the data and training the model to utmost accuracy.

2.3 Apportioning of the requirements

CNN Analysis:

- Know about the Goal
- Planning
- Data collection and analysis
- Data Pre-processing
- Exploratory Data analysis
- Feature Engineering
- Model testing and Evaluation
- Data Visualisation
- Completion

3 Detailed Description of Functional Requirements

Purpose - A description of the functional requirements and its reasons

Inputs -What are the inputs.

Processing - It Describes the outcome rather than the implementation

Outputs - The Genre of the Music.

Table 3:

Activities	**Description**
Data set	Collection of data
Data Pre-processing	It involves cleaning and transforming the data to prepare it for the Prediction of music
Load Data	All features are relevant for CNN, so it is important to select the features that are most informative.

Data cleaning	It involves transforming the data so that all of the features have the same scale.
Feature Selection	Involves selecting the features that will the most to the prediction of the music genre
CNN Algorithm	It aims to predict the genre using an audio signal as its input. The objective of automating the music classification is to make the selection of songs quick and less cumbersome.

3.1 Performance requirements

Speed: The Parallel Recurrent CNN must be able to correctly identify the music genre in a reasonable amount of time.

Accuracy: The Accuracy of the model should be good because , if a new music comes for validation then , it should correctly identify the genre associated with that music.

Usability: The Model should be usable for the end users , that means, it should be user friendly in nature, interface should not be that complex.

Flexibility: The model which we are developing should accommodate different musics into it , so that if a new music comes for classification then it should correctly tell the prediction based on the training on the large amount of datasets containing multiple music genres.

Software Project Management Planning

PROJECT - "MUSIC GENRE CLASSIFICATION"

1.1 Introduction:

The project aims to classify music into various genres using machine learning techniques. This involves data acquisition, preprocessing, and modeling. The end goal is to accurately predict the genre of a given piece of music, aiding in music categorization and recommendation systems.

1.2 Project Deliverables:

- Cleaned and preprocessed GTZAN music dataset.
- An interactive user interface for music genre prediction.
- Trained and tested machine learning model for music genre classification.
- Comprehensive documentation including user and technical guides.
- Software Requirements Specification (SRS) and Software Design Description (SDD) documents.

1.3 Definitions and Acronyms:

GTZAN	A widely recognized dataset used for music genre classification.
MFCC	Mel-frequency cepstral coefficients - a representation of the short-term power spectrum of sound.
CNN	Convolutional Neural Networks, a deep learning algorithm that can recognize patterns.
ML	Machine Learning.
UI	User Interface.

2.1 Project Organization:

Project organization refers to the way a project is set up to be managed and executed. It encompasses the system of roles, responsibilities, and processes established to ensure the effective management, planning, and execution of a project.

2.2 Process Model:

The Waterfall model is used, ensuring a linear progression from one phase to the next, starting with gathering data and ending with deploying the model.
Waterfall model: A traditional method in software development where one phase must be completed before moving on to the next. It's sequential, and each phase depends on the deliverables of the previous one.

2.3 Organizational Structure:

Organizational structure outlines how activities related to the project (like task allocation, supervision, and coordination) are directed towards the achievement of project objectives. It defines a hierarchy within the project team and delineates the relationships between team members.

- Project Manager: Oversees project tasks, communicates with stakeholders, and ensures timely achievement of milestones.
- Data Acquisition Team: Sources the GTZAN dataset and confirms its authenticity and completeness.
- Data Cleaning Team: Processes audio files and extracts essential audio features.
- Model Building Team: Builds, trains, and validates the machine learning algorithm.
- UI Development Team: Constructs a platform for users to engage with the model.
- Documentation Team: Produces all necessary documentation.

2.4 Project Responsibilities:

Project responsibilities delineate the specific duties, tasks, or actions that individuals or teams are expected to undertake within the project. They are defined to ensure that every task associated with the project has a clear owner.

- Project Manager: Oversees project tasks, communicates with stakeholders, and ensures timely achievement of milestones.
- Data Acquisition Team: Sources the GTZAN dataset and confirms its authenticity and completeness.
- Data Cleaning Team: Processes audio files and extracts essential audio features.
- Model Building Team: Builds, trains, and validates the machine learning algorithm.
- UI Development Team: Constructs a platform for users to engage with the model.
- Documentation Team: Produces all necessary documentation.

3 Managerial Process:

The managerial process refers to the systematic series of actions, methods, or procedures that managers follow to design, plan, organize, lead, control, and evaluate project tasks, resources, and goals to achieve desired outcomes. It's the way managers oversee and direct the activities of the project or organization to ensure its objectives are met efficiently and effectively.

3.1 Management Objectives and Priorities:

Definition:

These are the primary goals and focal points that guide the managerial decision-making process throughout the project. They serve as the yardstick against which project progress and success are measured.

Importance:

- Sets clear targets for the team.
- Helps in resource allocation and prioritization of tasks.
- Provides a direction for the project, ensuring that all team members are aligned towards a common goal.

3.2 Assumptions,Dependencies, and Constraints:

Assumptions:

Assumptions are beliefs or things we consider to be true or certain without concrete evidence, yet they form the basis on which we plan and act.

- Data Availability: It's assumed that the GTZAN dataset is readily available and can be used without legal or licensing issues.
- Tool Efficacy: Libraries like Librosa and frameworks like TensorFlow or Scikit-learn will be suitable and efficient for the required data processing and model building tasks.
- Team Expertise: The project team possesses the necessary skills in machine learning, data processing, and software development to complete the project.
- Hardware and Software Compatibility: The tools and technologies chosen for the project will be compatible with the available hardware infrastructure.

Dependencies:

Dependencies are conditions that rely on something else for the project to move forward.

- Data Preprocessing: The success of the model-building phase is highly dependent on the proper cleaning and preprocessing of the GTZAN dataset.
- Team Availability: Timely completion of tasks depends on the consistent availability of team members. If one team finishes late (e.g., Data Cleaning), it could delay the subsequent teams (e.g., Model Building).
- External Libraries: The project relies on third-party libraries and tools. Any updates or changes to these tools could impact the project's progress.
- Infrastructure: Efficient model training and testing are dependent on the availability of required computational resources, especially if deep learning models are employed.

Constraints:

Constraints are the limitations or restrictions the project must work within.

- Timeline: The project has a fixed start and end date, which constrains the amount of time available for each phase of the project.
- Budget: There may be a fixed budget allocated for the project. This could limit the tools, resources, or manpower that can be utilized.
- Computational Resources: There might be limitations on available computational power, especially for intensive tasks like training machine learning models.
- Dataset Limitations: The GTZAN dataset, while popular, has its own limitations in terms of diversity, size, and possible biases. This could constrain the model's overall performance and generalization capabilities.
- Software and Licensing: There could be constraints related to the software licenses, especially if proprietary tools are used. This may limit the number of installations or the duration of usage.

3.3 Risk Management:

- It is the process of identifying, evaluating, and prioritizing potential risks, followed by coordinated actions to minimize, control, or accept the consequences of uncertain and unpredictable events.

- In this project, it entails foreseeing potential problems that might arise during the phases of data acquisition, preprocessing, model building, and deployment and ensuring mechanisms are in place to address these problems.

3.4 Risk Management Plan:

A Risk Management Plan is a detailed roadmap for how a project or organization will address potential challenges. It identifies risks, assesses their potential impact, and outlines strategies to manage and mitigate those risks. This plan acts as a guideline, ensuring that risks are managed proactively, rather than reactively.

For this project, this means foreseeing challenges that could arise during the various phases (data acquisition, preprocessing, modeling, etc.) and ensuring there are mechanisms in place to tackle these challenges efficiently.

3.4.1 Risk Analysis:

- It is the process of understanding the nature, sources, and causes of the risks that you face. It also involves determining the level of risk by considering the consequences and the likelihood of potential outcomes.
- This could involve studying the previous projects of a similar nature, discussions with experts in the field, and researching common pitfalls in music genre classification endeavors.

3.4.2 Risk Identification:

- It is the initial step in the risk management process. It involves spotting sources of risk, areas of impacts, events, and any other scenarios that could potentially harm the project.
- Common risks might include:
- Data-related risks: Data corruption, missing data, or data that isn’t representative of diverse music genres.
- Technical risks: Model overfitting, inefficiencies in the preprocessing phase, or the inability to scale the model.
- Resource risks: Lapses in team communication, unavailability of specific expertise, or computational resource constraints.

3.4.3 Risk Estimation:

- Once risks are identified, risk estimation involves assessing the potential impact of each risk and the likelihood that it will occur. This is often a combination of quantitative (numerical) and qualitative (descriptive) analysis.
- Quantitative: For example, determining that there's a 70% chance that the model might overfit given the complexity of the features and the size of the dataset.
- Qualitative: Describing the potential impact of a risk, like "High impact" for data corruption since it would halt the project, or "Medium impact" for overfitting, as it can be managed with certain techniques.

3.5 Monitoring and Controlling Mechanisms:

Tools, practices, and systems set in place to keep track of project performance against the established plan, ensuring corrective actions are taken when necessary.
Importance:

- Ensures that the project stays on track and within its defined constraints.
- Allows for timely interventions and corrections.
- Reduces the chances of cost overruns, delays, and quality issues.

3.6 Staffing Approach:

The strategy and methodology used to source, hire, train, and manage the human resources required for the project.

Importance:

- Ensures the right skills are available for the project's success.
- Impacts the efficiency, productivity, and morale of the project team.
- Affects the overall quality and timeline of the project deliverables.

4. Technical Process:

This pertains to the specific technical activities, methodologies, and tools that the project will employ. For the music genre classification project, the technical process will largely revolve around software development, modeling, and documentation

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4.1. Software Documentation:

- Documentation is pivotal for understanding, maintaining, and scaling the software. It provides a clear overview of how the software was designed, its requirements, and how to use it.

4.1.1 Software Requirements Specification (SRS):

- Definition: An SRS is a document that captures the complete software requirements in detailed terms. It defines the expected behavior, features, and constraints of the software.
- In context: For the project, the SRS would detail the need for a model to classify music genres, specific requirements regarding accuracy, the dataset to be used (GTZAN), and requirements related to the integration of the model into systems or platforms.

4.1.2 Software Design Description (SDD):

The SDD provides a detailed description of the software's architecture and design decisions. It's more about 'how' the software will achieve its requirements.

This would include the architecture of the machine learning model (e.g., CNN layers, activation functions), data preprocessing steps (using MFCC, other audio features), and possibly the user interface design if there's a frontend to the system.

- Work Breakdown Structure (WBS):
  A hierarchical decomposition of the total scope of work to be carried out by the project team to achieve project objectives.
  The WBS would segment tasks like "Data Gathering", "Data Cleaning", "Dataset Transformation", "Model Building", and "Documentation".
- Gantt Chart Representation:
  A visual representation of the project schedule, showing task durations, start and end dates, and dependencies.
  This chart would visually layout the timeline of each segment from the WBS, showing when "Data Gathering" starts and ends in relation to "Model Building", for example.
- (Critical Path Method):
  A technique used to identify the critical (longest) path through a set of tasks, considering dependencies. Tasks on this path define the project's shortest

duration. CPM would help identify the most critical tasks for the music genre classification project—those that, if delayed, would delay the whole project.

- PERT Chart Representation (Program Evaluation and Review Technique):
  A graphical representation of a project's timeline, showing the order of tasks and their interdependencies.
  It can showcase the sequence and dependencies, for instance, highlighting that "Data Cleaning" can't commence until "Data Gathering" is complete.
- Data Flow Diagram (DFD):
  A graphical representation of the flow of data within a system, detailing where data comes from, how it's processed, and where it goes.
  The DFD would depict how music data flows from the GTZAN dataset, through preprocessing steps, into the machine learning model, and then outputs as a genre classification.

4.1.3 Software Test Plan:

A detailed plan that outlines the strategy, objectives, resources, schedule, and scope of testing activities.
It would include testing the model's accuracy, ensuring no overfitting, and possibly user testing if there's an interface for genre predictions.

- User Documentation:
  Guides that help end-users understand how to use the software or system.
  This would be a guide on how to input a piece of music into the system and retrieve a genre prediction, detailing any interfaces or commands needed.
- Project Support Function:
  The infrastructure, tools, and resources supporting the successful execution of the project.
  This could include cloud storage for data backup, GPU resources for training, and tools like Slack or Teams for team communication.

5. Work Packages, Schedule, and Budget:

5.1 Work Packages:

These are essentially smaller, manageable tasks or units of work that make up a larger project. For this project, they might include:

- Data Acquisition: Fetching the GTZAN dataset.
- Data Preprocessing: Audio signal processing and feature extraction.
- Model Construction: Building and training the genre prediction model.
- UI Development: Crafting the user interface for genre predictions.
- Documentation: Preparing technical guides, user manuals, and architectural documentation.

5.2 Dependencies:

Dependencies refer to the sequence in which tasks should be performed and if one task relies on the completion of another. For this project:

- Data Preprocessing depends on Data Acquisition.
- Model Construction can only commence after Data Preprocessing.
- UI Development can start in parallel with Model Construction but will need final model integration.

- Documentation can partly start in parallel but will need finalized components for complete documentation.

5.3 Resource Requirements:

This encompasses both the human and technical resources necessary for the project.

- **Human Resources:**
  - Data scientists for model construction.
  - Data engineers for data acquisition and preprocessing.
  - UI/UX designers and developers for the user interface.
  - Technical writers for documentation.
- **Technical Resources:**
  - Servers or cloud space for data storage.
  - Computing power (like GPUs) for model training.
  - Software licenses, if any specific tools are being used.
  - Platforms like GitHub for version control.

5.4 Budget and Resource Allocation:

Define the financial allocation for each work package and resource.

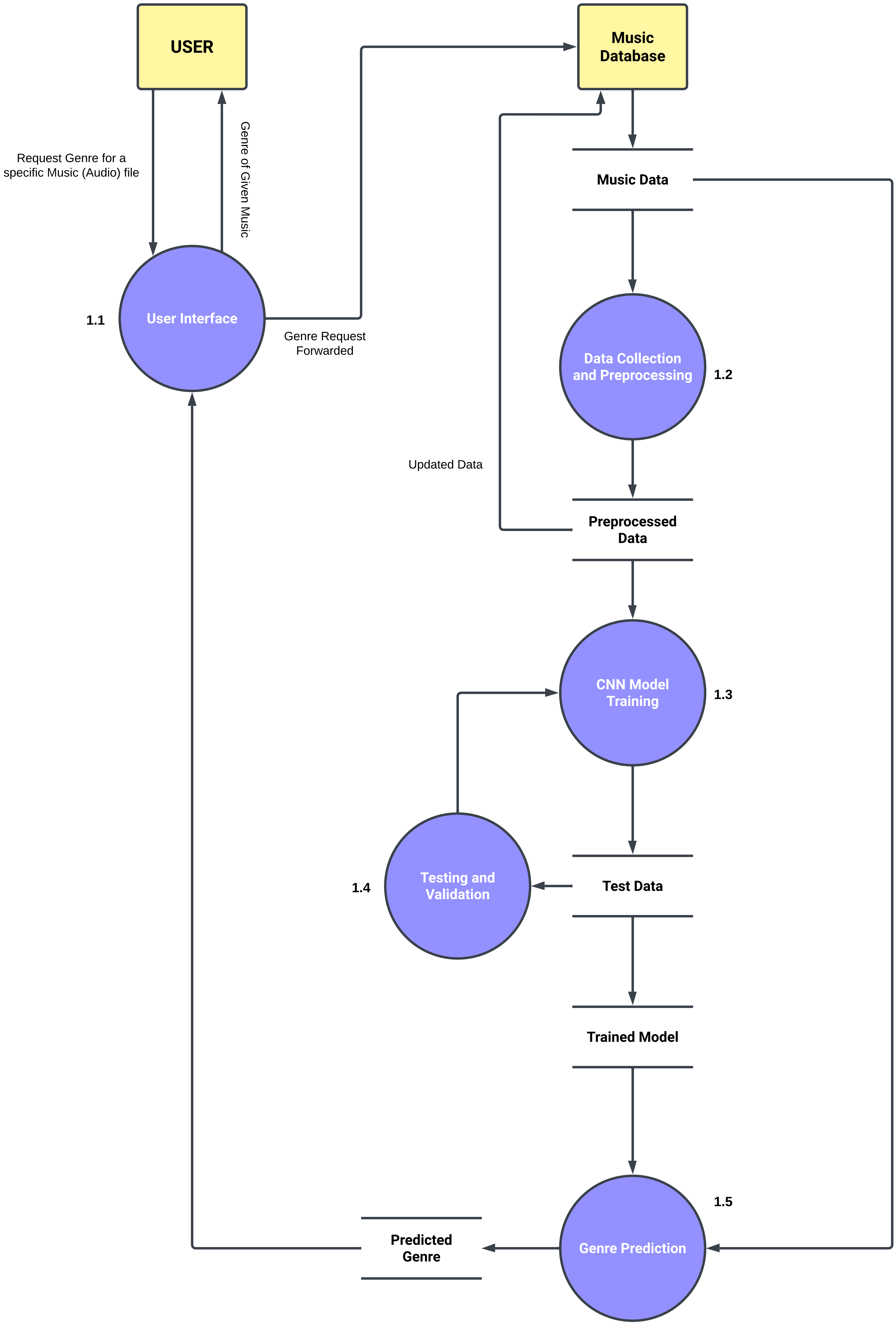
- Data Acquisition and Preprocessing might need budgeting for tools, platforms, or cloud storage.
- Model Construction could be resource-intensive, necessitating higher financial allocation especially for computational power.
- UI Development would need resources for designing and hosting the application.
- Documentation would require less budget compared to others, mostly for manpower.
- A clear budget allocation ensures that you have adequate funds for each phase, and it helps in keeping track of expenses to ensure the project doesn't overshoot its financial limits.

5.5 Schedule:

The schedule outlines the timeline for the entire project, including when each work package will start and finish, ensuring that tasks are completed in a coordinated and timely manner for successful wine clustering analysis.The project has started from 24.08.2023 August and will be finished around 11th November.

Start Date	24.08.2023
Finish Date	9.11.2023

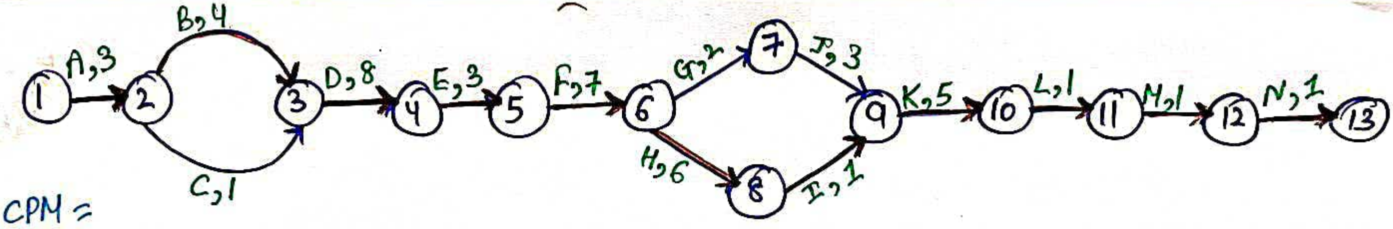
MUSIC GENRE CLASSIFICATION
DFD LEVEL 1



CPM ACTIVITY TABLE

Activity	Name of the Activity	Duration	Predecessor
A	Know about the goal	3	-
B	Planning	4	A
C	SPMP	1	A
D	Data Collection And Analysis	8	B,C
E	SRS Validation	3	B,D
F	Data Pre Processing	7	D,E
G	Unit Testing Of Data PreProcessing Module	2	F
H	Data Transformation	6	F
I	Unit Testing Of Data Transformation	1	H
J	Model Building	3	I,G
K	Model Testing And Evaluation	5	J,I
L	Model Output Analysis And Testing	1	K
M	Data Visualization	1	L
N	Unit Testing And Data Visualization	1	M

PERT(program evaluation review technique)



CPM =

$A \rightarrow B \rightarrow D \rightarrow E \rightarrow F \rightarrow H \rightarrow I \rightarrow K \rightarrow L \rightarrow M \rightarrow N$

OPTIMISTIC TIME = 2+2+7+2+5+4+1+4+1+1+1 = 30

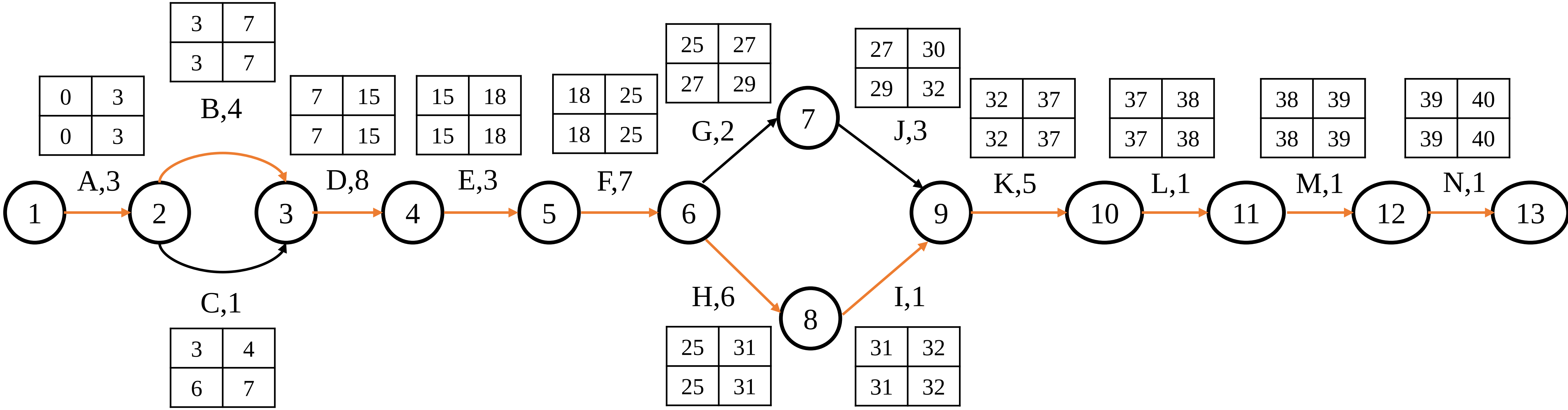
.PESSIMISTIC TIME = 5+6+10+4+10+7+3+7+3+3+3 = 61

MOST PROBABLE TIME = 3+4+8+3+7+6+1+5+1+1+1 = 40

Expected time = $\frac{O \cdot T + 4(M \cdot P) + P \cdot T}{6} = \frac{30 + 4(40) + 61}{6} = \frac{30 + 160 + 61}{6} = 41 \cdot 83$

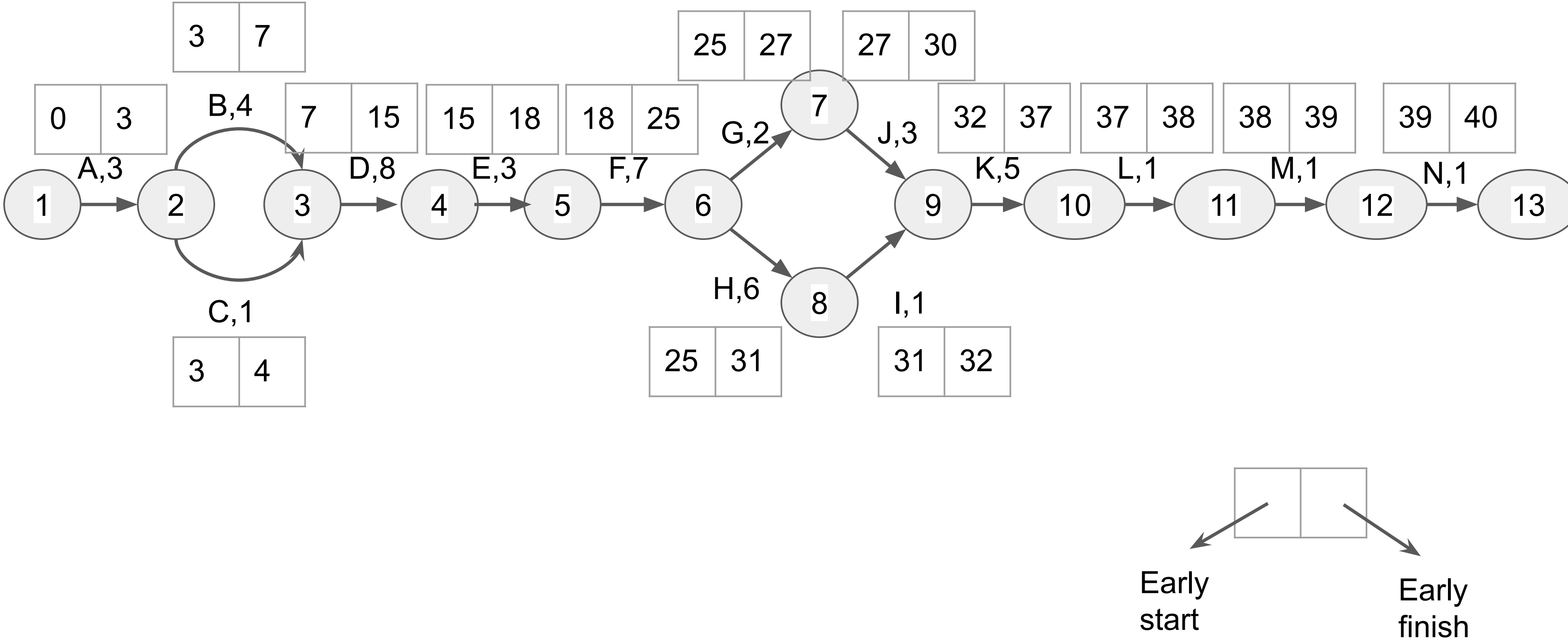
Balancing factor = $\frac{P \cdot T - O \cdot T}{6} = \frac{61 - 30}{6} = 5 \cdot 16$

Range = $40 + 5 \cdot 16 = 45 \cdot 16$
$40 - 5 \cdot 16 = 34 \cdot 84$

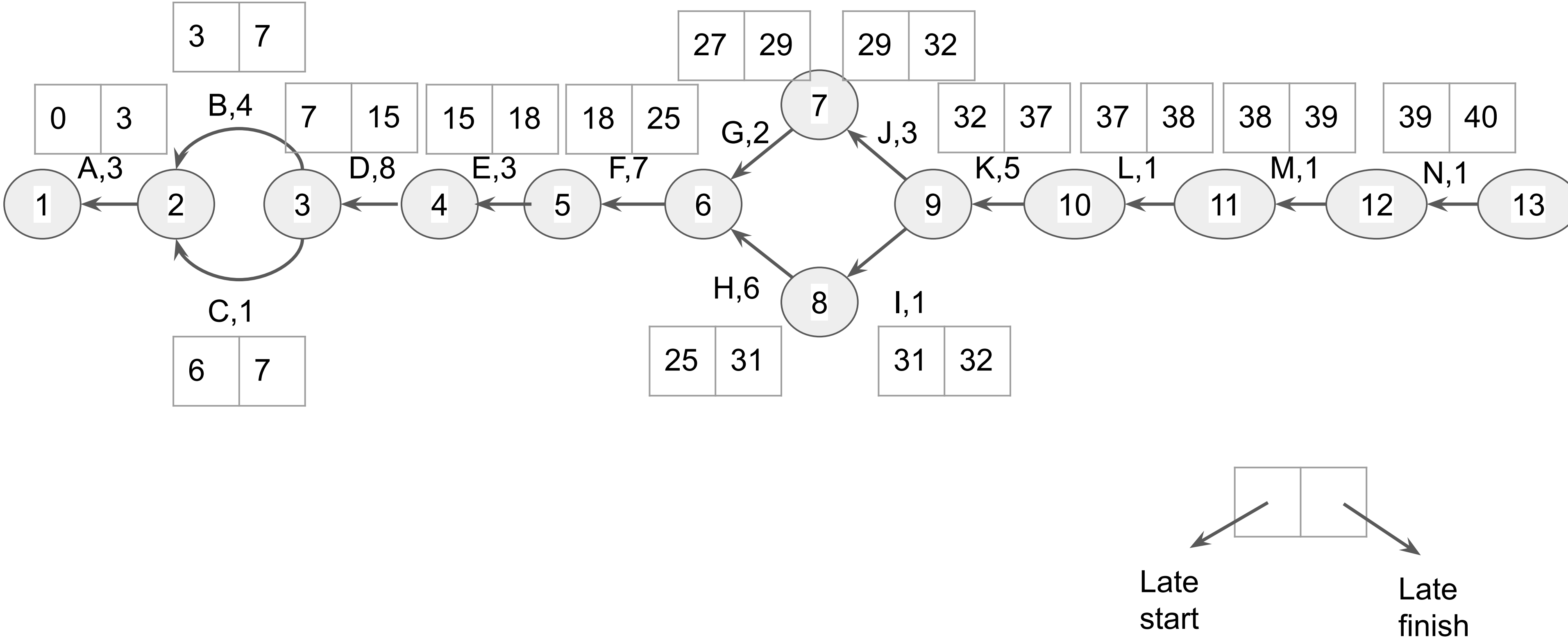


1
2
3
4
5
6
7
8
9
10
11
12
13
A,3
0 3
0 3
B,4
3 7
3 7
C,1
3 4
6 7
D,8
7 15
7 15
E,3
15 18
15 18
F,7
18 25
18 25
G,2
25 27
27 29
H,6
25 31
25 31
J,3
27 30
29 32
I,1
31 32
31 32
K,5
32 37
32 37
L,1
37 38
37 38
M,1
38 39
38 39
N,1
39 40
39 40

Forward Pass



Backward Pass


3
7
27
29
29
32
0
3
B,4
7
15
15
18
18
25
7
G,2
J,3
32
37
37
38
38
39
39
40
A,3
D,8
E,3
F,7
K,5
L,1
M,1
N,1
1
2
3
4
5
6
9
10
11
12
13
H,6
8
I,1
C,1
25
31
31
32
6
7
Late start
Late finish