Tribhuvan University

Institute of Science and Technology

2080

Bachelor Level / Fifth Semester / Science

Computer Science and Information Technology (CSC315)

System Analysis and Design

Full Marks: 60 + 20 + 20 Pass Marks: 24 + 8 + 8 Time: 3 Hours

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Section A
Attempt any two questions.

What activities are at the heart of the systems development process? List and explain some of the problems with the traditional waterfall SDLC. Explain Agile development in brief.

Core Activities in the Systems Development Process

1. **Requirement Analysis**:
    - **Description**: Gather detailed information from stakeholders on what the system needs to do.
    - **Activities**: Conducting interviews, surveys, and reviewing documents.
2. **System Design**:
    - **Description**: Creating architectures and detailed designs to meet the gathered requirements.
    - **Activities**: Designing data models, user interfaces, and system architectures.
3. **Implementation**:
    - **Description**: Converting the system design into executable code.
    - **Activities**: Writing code, unit testing, and code reviews.
4. **Testing**:
    - **Description**: Verifying that the system works as intended and meets the requirements.

    - **Activities**: System testing, integration testing, and user acceptance testing.
5. **Deployment**:
    - **Description**: Making the system available for use in a production environment.
    - **Activities**: Installing the system, migrating data, and user training.
6. **Maintenance**:
    - **Description**: Ongoing support and enhancement of the system post-deployment.
    - **Activities**: Bug fixing, performance tuning, and adding new features.

Problems with the Traditional Waterfall SDLC

1. **Inflexibility**:
    - **Issue**: The linear and sequential nature makes it difficult to go back and make changes.
    - **Impact**: If requirements change mid-project, it can be costly and time-consuming to adapt.
2. **Late Testing**:
    - **Issue**: Testing is performed only after the implementation phase.
    - **Impact**: Errors discovered late in the process are more expensive to fix.
3. **Delayed Feedback**:
    - **Issue**: Stakeholder feedback is typically obtained only after the project is complete.
    - **Impact**: Misunderstandings or misinterpretations of requirements may go unnoticed until too late.
4. **Risk of Requirement Misunderstanding**:
    - **Issue**: Initial requirements are fixed early in the project.
    - **Impact**: If initial requirements are misunderstood, the whole project can be off-track.
5. **Long Development Cycles**:
    - **Issue**: Each phase must be completed before the next one begins.

    - **Impact**: This can lead to long project durations with no deliverables for months or years.

Agile Development in Brief

- **Definition**: Agile development is an iterative and incremental approach to software development that emphasizes flexibility, collaboration, and customer feedback.
- **Principles**:
    - **Customer Collaboration**: Continuous involvement of the customer throughout the development process.
    - **Responding to Change**: Agile processes accommodate changing requirements, even late in development.
    - **Working Software**: Delivering functional software frequently, with a preference for shorter timescales.
    - **Individual and Interaction**: Emphasizes communication and collaboration among all project stakeholders.
    - **Simplicity**: Focuses on simplicity in design and execution.
- **Practices**:
    - **Iterative Development**: Development occurs in small, manageable cycles called iterations or sprints.
    - **Continuous Integration**: Regularly integrate and test code to catch issues early.
    - **Daily Standups**: Short, daily meetings to discuss progress, plans, and obstacles.
    - **Retrospectives**: Regularly reflecting on what went well and what could be improved.

Summary

The systems development process involves requirement analysis, system design, implementation, testing, deployment, and maintenance. Traditional Waterfall SDLC is often criticized for its inflexibility, delayed testing, and long development cycles, leading to potential risks and inefficiencies. Agile development addresses these

issues by promoting iterative progress, continuous feedback, and adaptability to change, resulting in a more flexible and responsive development process.

Core Activities (in Points):

- **Understand the Problem:** Analyze current systems, identify issues, and define new system needs (Systems Analysis).
- **Blueprint the Solution:** Design system architecture, interface, data structures, and functionalities (Systems Design).
- **Build the System:** Develop the system through programming, database creation, and configuration.
- **Test Thoroughly:** Ensure the system meets requirements, is bug-free, and performs optimally (Testing).
- **Deploy and Train:** Implement the system with user training, data migration, and system cutover.
- **Maintain and Adapt:** Fix bugs, address changing needs, and keep up with technology (Maintenance).

Problems with Waterfall SDLC (in Points):

- **Inflexible:** Changes require rework in earlier stages.
- **Late Feedback:** Users don't see the system until later, hindering early feedback.
- **High Risk:** Late-stage errors are expensive to fix.
- **Limited User Involvement:** This may not meet user needs.

Agile Development (in Points):

- **Short Dev Cycles:** Break work into small, deliverable "sprints".
- **Continuous Delivery:** Get working versions of the system early for feedback.
- **Teamwork:** Developers, designers, and users collaborate closely.
- **Adaptability:** Adjust requirements as needed for better user experience and changing priorities.

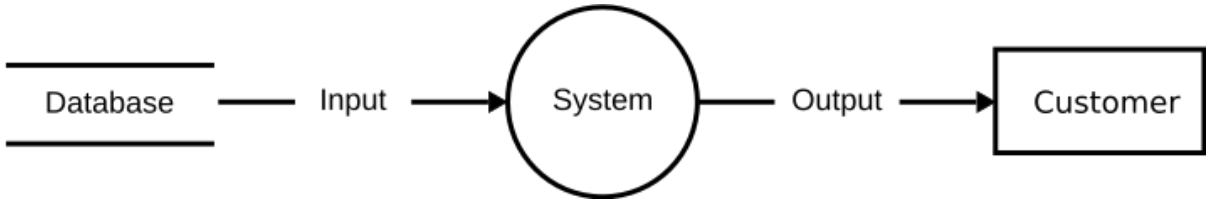
A **data-flow diagram** is a way of representing a flow of data through a process or a system (usually an information system). The DFD also provides information about the outputs and inputs of each entity and the process itself. A data-flow diagram has no control flow — there are no decision rules and no loops. Specific operations based on the data can be represented by a flowchart.[1]

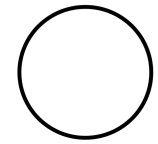
There are several notations for displaying data-flow diagrams. The notation presented above was described in 1979 by Tom DeMarco as part of a structured analysis.

For each data flow, at least one of the endpoints (source and/or destination) must exist in a process. The refined representation of a process can be done in another data-flow diagram, which subdivides this process into sub-processes.

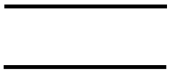
The data-flow diagram is a tool that is part of structured analysis and data modeling. When using UML, the activity diagram typically takes over the role of the data-flow diagram. A special form of data-flow plan is a site-oriented data-flow plan.

Data-flow diagrams can be regarded as inverted Petri nets, because places in such networks correspond to the semantics of data memories. Analogously, the semantics of transitions from Petri nets and data flows and functions from data-flow diagrams should be considered equivalent.





Function



File/Database

Input/Output

Flow

Explain physical database design. Why is physical database design important? Differentiate logical database design with physical database design.

Physical Database Design

Physical database design refers to the process of translating a logical data model into the actual physical structure that will be used to store data in a database management system (DBMS). This includes defining the specific hardware configurations, storage structures, indexing schemes, and access methods to ensure efficient data retrieval and storage. The goal is to optimize the database performance while maintaining data integrity and security.

Key Components of Physical Database Design:

1. **Storage Structures**:
    - Determining how tables, indexes, and other database objects will be stored on disk.
2. **Indexes**:
    - Creating indexes to improve the speed of data retrieval operations.
3. **Partitioning**:

    - Dividing large tables into smaller, more manageable pieces to enhance performance and manageability.
4. **File Organization**:
    - Deciding on the arrangement of data files and how they are physically stored.
5. **Data Clustering**:
    - Grouping related data together to minimize I/O operations and improve access speed.
6. **Performance Tuning**:
    - Adjusting various database parameters and configurations to ensure optimal performance.
7. **Backup and Recovery**:
    - Setting up mechanisms for data backup and recovery to protect against data loss.

Importance of Physical Database Design:

1. **Performance Optimization**:
    - Ensures that the database can handle large volumes of transactions and queries efficiently.
2. **Efficient Storage Management**:
    - Maximizes the use of available storage resources and reduces storage costs.
3. **Scalability**:
    - Facilitates future growth by designing a structure that can easily accommodate increasing amounts of data.
4. **Data Integrity and Security**:
    - Implements mechanisms to protect data from unauthorized access and corruption.
5. **Backup and Recovery**:
    - Ensures that there are robust systems in place for data recovery in case of failure.

Differences Between Logical and Physical Database Design:

Aspect	Logical Database Design	Physical Database Design
Definition	The abstract model defines the structure and relationships of data without considering how it will be physically stored.	Concrete implementation of the logical model that considers hardware and software constraints.
Focus	Focuses on data requirements and the relationships between data entities.	Focuses on the performance, storage, and retrieval aspects of the database.
Components	Includes entities, attributes, and relationships.	Includes tables, indexes, partitions, storage files, and access methods.
Independence	Independent of DBMS and hardware.	Dependent on specific DBMS and hardware configurations.
Output	Entity-relationship diagrams, normalized tables, and data models.	SQL scripts, physical schema definitions, and storage configurations.
Objective	To ensure that the database accurately reflects the data requirements and relationships.	To ensure that the database is optimized for performance, storage efficiency, and data integrity.

Summary

Logical database design is concerned with the abstract representation of the data requirements and relationships within a system, focusing on what data needs to be stored and how it is related. **Physical database design** translates this abstract model into a concrete implementation, focusing on how data will be stored,

accessed, and managed on specific hardware and DBMS platforms. The importance of physical database design lies in its ability to optimize database performance, ensure efficient use of storage resources, maintain data integrity, and provide robust mechanisms for data backup and recovery.

Physical Database Design

Physical database design is the final stage of transforming a conceptual model of your data into the actual physical structure used by a specific database management system (DBMS). It focuses on optimizing how data is stored and accessed for efficient retrieval and manipulation. Here are some key aspects:

- **Storage Decisions:** Deciding on data types, storage options (e.g., tablespaces), and data compression methods for optimal storage utilization.
- **Indexing Strategies:** Creating indexes on frequently used columns to speed up query performance.
- **Normalization:** Further refining the logical design by eliminating data redundancy and ensuring data integrity.
- **Physical Constraints:** Implementing constraints like primary keys, foreign keys, and check constraints on the database server to enforce data validation and relationships.
- **Tuning for Performance:** Consider hardware (storage, memory) and software (query optimization) aspects to further optimize database performance.

Importance of Physical Database Design

- **Performance:** Good physical design ensures quick access to data, leading to faster queries and overall system efficiency.
- **Scalability:** A well-designed database can handle growing data volumes or increased user traffic without performance degradation.
- **Maintainability:** Clear organization and well-defined structures make it easier to manage and maintain the database over time.

- **Data Integrity:** Constraints and proper normalization minimize data redundancy and inconsistencies.
- **Reduced Costs:** Efficient data storage and retrieval reduces storage needs and processing workloads, ultimately saving resources.

Logical vs. Physical Database Design

Logical and physical database design are distinct but interconnected stages:

- **Logical Design:** Focuses on the **conceptual** representation of data. It defines entities, attributes, and relationships between them, independent of specific DBMS implementation details. It's about "what" data is stored and the "relationships" between them.
- **Physical Design:** Focuses on the **physical** implementation of the logical model within a specific DBMS. It considers storage structures, data types, indexing, and performance optimization techniques. It's about "how" the data is stored and accessed for efficient use.

Here's an analogy: Imagine a library. Logical design is like designing the library catalog, and defining book categories and author names. Physical design is like organizing the books on shelves, using the Dewey Decimal System, and considering book size for optimal storage and retrieval.

GROUP - B

Describe different activities performed by the project manager during project planning.

Project planning is a critical phase in project management where the foundation for project execution, monitoring, and control is established. A project manager's activities during this phase can be extensive and include the following key tasks:

1. Define Project Scope

- **Activities**:
    - Clearly outline the project objectives and deliverables.
    - Identify the boundaries and constraints of the project.
    - Document the requirements and expectations of stakeholders.

2. Develop a Project Plan

- **Activities**:
    - Create a detailed project schedule using tools like Gantt charts.
    - Define the major milestones and deliverables.
    - Outline the tasks and subtasks needed to complete the project.

3. Resource Planning

- **Activities**:
    - Identify the required resources, including human resources, equipment, and materials.
    - Assign roles and responsibilities to team members.
    - Plan for resource allocation and utilization.

4. Budget Planning

- **Activities**:
    - Estimate the costs associated with project activities.
    - Develop a project budget, including contingency funds.
    - Track and control project costs against the budget.

5. Risk Management

- **Activities**:
    - Identify potential risks and uncertainties that could impact the project.
    - Assess the likelihood and impact of each risk.
    - Develop risk mitigation strategies and contingency plans.

6. Communication Planning

- **Activities**:

    - Establish a communication plan that outlines how information will be shared among stakeholders.
    - Define the frequency, methods, and channels of communication.
    - Identify key stakeholders and their information needs.

7. Quality Planning

- **Activities**:
    - Define quality standards and criteria for project deliverables.
    - Develop a quality management plan.
    - Plan for quality assurance and quality control activities.

8. Procurement Planning

- **Activities**:
    - Identify goods and services that need to be procured externally.
    - Develop a procurement plan, including vendor selection and contract management.
    - Establish procurement policies and procedures.

9. Develop a Work Breakdown Structure (WBS)

- **Activities**:
    - Break down the project into manageable sections.
    - Define the hierarchy of tasks and subtasks.
    - Assign task ownership and accountability.

10. Schedule Development

- **Activities**:
    - Sequence project activities and determine dependencies.
    - Estimate the duration of each task.
    - Develop a project timeline with start and end dates for each task.

11. Stakeholder Management

- **Activities**:

    - Identify all project stakeholders and their interests.
    - Develop strategies for engaging and managing stakeholders.
    - Plan for stakeholder communication and involvement.

12. Develop Project Controls

- **Activities**:
    - Establish performance metrics and key performance indicators (KPIs).
    - Develop monitoring and reporting mechanisms.
    - Plan for regular progress reviews and adjustments.

13. Integration Planning

- **Activities**:
    - Ensure all elements of the project plan are aligned and integrated.
    - Develop a plan for project integration management.
    - Coordinate activities across different project areas.

Summary

During project planning, a project manager performs a wide range of activities to ensure that the project is well-defined, resourced, budgeted, and managed effectively. These activities include defining the project scope, developing detailed plans for resources, budget, risks, communications, quality, and procurement, and creating a work breakdown structure. Additionally, the project manager focuses on schedule development, stakeholder management, establishing project controls, and ensuring integration across all project elements. Effective project planning sets the stage for successful project execution and delivery.

Project planning is a crucial phase that sets the stage for a project's success. Here are some key activities performed by a project manager during this stage:

1. Define Project Scope and Goals:

- **Gather Requirements:** Meet with stakeholders to understand their needs, expectations, and project objectives. This might involve interviews, workshops, and document reviews.
- **Define Scope Baseline:** Clearly define the project's boundaries – what's included and excluded. This document serves as a reference point for managing expectations and preventing scope creep.
- **Set SMART Goals:** Establish Specific, Measurable, Achievable, Relevant, and Time-bound goals for the project. These goals will guide decision-making and track progress.

2. Break Down Work and Create a Schedule:

- **Work Breakdown Structure (WBS):** Break down the project into smaller, manageable tasks (work packages) and subtasks. This allows for clearer task dependencies and facilitates resource allocation.
- **Task Estimation:** Estimate the time and effort required for each task. Techniques like timeboxing, analogy estimating, or expert judgment can be used.
- **Project Schedule:** Develop a project schedule using tools like Gantt charts or PERT charts. This visualizes task dependencies, durations, and deadlines.

3. Resource Management:

- **Identify Resource Needs:** Determine the human resources, equipment, software, and materials required for each task.
- **Resource Allocation:** Assign resources (people) to tasks based on existing skills and availability. Consider workload balancing to avoid overallocation.
- **Develop a Resource Plan:** Document the resources required throughout the project lifecycle. This ensures their availability throughout the project's execution.

4. Cost Estimation and Budgeting:

- **Estimate Project Costs:** Estimate the costs associated with resources, materials, equipment, and potential risks. Factor in labor costs, software licenses, and other expenses.

- **Develop a Project Budget:** Create a budget that allocates funds to different project activities. This provides a financial roadmap and helps track spending.

5. Risk Management:

- **Identify Potential Risks:** Brainstorm and document potential risks that could impact the project's success (e.g., technical issues, resource constraints, stakeholder changes).
- **Risk Assessment:** Evaluate the likelihood and impact of each risk. This helps prioritize risks and develop mitigation strategies.
- **Develop a Risk Management Plan:** Define actions to address and minimize the impact of identified risks.

6. Communication and Stakeholder Management:

- **Develop a Communication Plan:** Define how project information will be communicated to stakeholders, including frequency, methods (meetings, reports), and escalation procedures.
- **Identify Stakeholders:** Recognize all individuals and groups who may be impacted by the project or have a vested interest in its outcome.
- **Manage Stakeholder Expectations:** Communicate project goals, deadlines, and potential risks clearly to stakeholders. Regularly update them on progress to maintain alignment.

7. Project Monitoring and Control:

- **Define Performance Metrics:** Establish key performance indicators (KPIs) to track progress and measure success against goals. These could include task completion, budget adherence, and schedule milestones.
- **Develop a Change Management Plan:** Define procedures for handling changes in scope, requirements, or resources during project execution.
- **Schedule Regular Reviews:** Plan for regular project meetings to assess progress, identify issues, and make adjustments as needed.

By effectively performing these activities, project managers lay the groundwork for a well-defined, well-resourced, and well-communicated project that is more likely to achieve its goals.

Describe the steps involved in corporate strategic planning.

Corporate strategic planning is a crucial process for businesses to define their long-term direction and achieve sustainable growth. Here's a breakdown of the key steps involved:

1. Define Mission and Vision:

- **Mission:** This clarifies the company's core purpose and what value it provides.
- **Vision:** This describes the company's aspirations and what it wants to achieve in the future.

A clear mission and vision provide a foundation for decision-making and guide resource allocation toward achieving the desired future state.

2. Conduct a Comprehensive Assessment:

- **Internal Analysis:** This involves evaluating the company's strengths and weaknesses. This may include assessing resources, capabilities, finances, organizational structure, and company culture.
- **External Analysis:** This involves analyzing the external environment – opportunities and threats. This might involve examining market trends, competitor analysis, economic conditions, and technological advancements. Tools like SWOT analysis can be used to synthesize this information.

Understanding both internal capabilities and external factors helps identify potential growth areas and challenges.

3. Set the Organizational Direction:

- **Strategic Goals:** Based on the internal and external assessment, define the overarching strategic goals for the organization. These goals should be ambitious yet achievable, and aligned with the mission and vision.
- **Strategic Objectives:** Break down the strategic goals into smaller, more specific objectives. These objectives should be measurable and time-bound (SMART objectives).

Clear goals and objectives provide direction and focus for the organization's actions.

4. Develop a Strategic Plan:

- **Strategic Initiatives:** Identify specific actions and projects that will help achieve the strategic objectives. These initiatives should be clearly defined and have allocated resources.
- **Action Plans:** Develop detailed plans for each initiative, including timelines, budget, responsible teams, and success metrics.

A well-defined strategic plan translates goals and objectives into actionable steps.

5. Align with Key Stakeholders:

- **Communicate the Plan:** Communicate the strategic plan to all relevant stakeholders, including employees, investors, and partners.
- **Gain Buy-in:** Ensure stakeholders understand the plan and are aligned with its goals. This fosters ownership and support for the strategic initiatives.

Alignment with stakeholders ensures everyone is working towards the same goals.

6. Execute and Manage the Plan:

- **Resource Allocation:** Allocate resources (people, budget) to support the strategic initiatives.
- **Performance Monitoring:** Track progress towards goals and objectives using defined metrics. Conduct regular reviews to identify any deviations or challenges.
- **Course Correction:** Be prepared to adapt the plan as needed based on changing market conditions, performance feedback, or unforeseen events.

Constant monitoring and flexibility ensure the plan stays relevant and drives successful execution.

7. Review and Revise the Plan:

- **Regular Assessment:** Periodically review the strategic plan to ensure it remains relevant and aligns with market dynamics.
- **Strategic Flexibility:** Be prepared to revise and adjust the plan based on new information, learnings, or changing priorities.

Regular review allows for adaptation to a dynamic business environment.

By following these steps and fostering a culture of strategic thinking, companies can map a clear path towards achieving their long-term goals and ensuring success in a competitive environment.

Corporate strategic planning is a systematic process used by organizations to define their direction and make decisions on allocating resources to pursue this direction. It typically involves a series of steps aimed at achieving long-term goals and ensuring the organization's sustainability and growth. Here's a detailed look at the steps involved in corporate strategic planning:

1. Environmental Scanning

- **Objective**: Understand the external and internal environments.
- **Activities**:
    - **External Analysis**: Assess the industry trends, market dynamics, competition, and economic, political, and technological factors.
    - **Internal Analysis**: Evaluate the organization's strengths, weaknesses, resources, capabilities, and core competencies.
    - Tools: SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats), PEST Analysis (Political, Economic, Social, Technological).

2. Mission and Vision Statement Development

- **Objective**: Define the organization's purpose and long-term aspirations.

- **Activities**:
    - Develop or review the mission statement that outlines the organization's purpose and primary objectives.
    - Craft a vision statement that describes what the organization aims to achieve in the future.
    - Ensure alignment with core values and culture.

3. Setting Goals and Objectives

- **Objective**: Establish clear, measurable goals to guide the organization.
- **Activities**:
    - Define long-term goals based on the vision statement.
    - Break down goals into specific, measurable, achievable, relevant, and time-bound (SMART) objectives.
    - Prioritize objectives based on importance and feasibility.

4. Strategy Formulation

- **Objective**: Develop strategies to achieve the set goals.
- **Activities**:
    - Analyze strategic options using frameworks like Porter's Five Forces, SWOT Analysis, Ansoff Matrix, and BCG Matrix.
    - Formulate business strategies (e.g., growth, stability, retrenchment).
    - Develop functional strategies for areas such as marketing, finance, operations, and human resources.

5. Strategy Implementation

- **Objective**: Put the chosen strategies into action.
- **Activities**:
    - Develop detailed action plans, including timelines, responsibilities, and resources needed.
    - Allocate budgets and resources.
    - Communicate the strategy across the organization and ensure buy-in from all levels.
    - Implement change management processes to support the transition.

6. Resource Allocation

- **Objective**: Ensure the necessary resources are available to execute the strategy.
- **Activities**:
    - Allocate financial, human, and technological resources to various strategic initiatives.
    - Optimize resource distribution based on strategic priorities and ROI considerations.

7. Monitoring and Control

- **Objective**: Track progress and make adjustments as needed.
- **Activities**:
    - Establish performance metrics and key performance indicators (KPIs).
    - Implement a system for regular monitoring, reporting, and performance reviews.
    - Conduct periodic strategy reviews to assess progress and address any deviations or challenges.

8. Evaluation and Feedback

- **Objective**: Evaluate the effectiveness of the strategy and learn from outcomes.
- **Activities**:
    - Analyze the results of strategic initiatives against the set goals and objectives.
    - Gather feedback from stakeholders, employees, and customers.
    - Identify lessons learned and areas for improvement.

9. Strategy Refinement

- **Objective**: Refine and adjust the strategy based on evaluation findings.
- **Activities**:
    - Update the strategic plan to address any changes in the internal and external environment.

    - Revise goals, objectives, and strategies to ensure continued alignment with the mission and vision.
    - Prepare for the next cycle of strategic planning.

Summary

Corporate strategic planning is a dynamic and iterative process that involves analyzing the current environment, setting a vision and mission, establishing goals, formulating strategies, implementing plans, allocating resources, and continuously monitoring and refining the strategy. By following these steps, organizations can effectively navigate complexities, seize opportunities, and achieve long-term success.

Define feasibility study. Explain economic and schedule feasibility in brief

Feasibility Study Explained

A feasibility study is a comprehensive analysis conducted to assess the practicality and viability of a proposed project, venture, or business idea. It aims to objectively evaluate all relevant factors to determine the likelihood of success before significant resources are committed. It helps decision-makers understand the potential benefits, drawbacks, risks, and limitations associated with the project.

The study typically involves detailed investigations in various areas, including:

- **Technical Feasibility:** Can the project be built or accomplished with existing or readily available technology?
- **Economic Feasibility:** Will the project be financially profitable?
- **Market Feasibility:** Is there a viable market for the product or service the project aims to deliver?
- **Legal Feasibility:** Does the project comply with all relevant laws and regulations?

- **Operational Feasibility:** Can the project be effectively implemented and managed within the organization's existing structure and resources?

By analyzing these aspects, the study provides valuable insights and helps make informed decisions about whether to proceed with the project, modify it to improve its viability, or abandon it altogether.

Economic Feasibility Explained

Economic feasibility focuses on the financial viability of the project. This involves analyzing the project's costs and potential benefits to determine its profitability. Key activities in this assessment include:

- **Cost Estimation:** All potential costs associated with the project are estimated, including development costs, materials, labor, marketing, and operational expenses.
- **Revenue Projection:** Forecasting the potential revenue streams the project can generate through sales, subscriptions, or other means.
- **Profitability Analysis:** Comparing the estimated costs and projected revenue to determine if the project can generate a positive cash flow and satisfactory return on investment (ROI).

This information helps assess the financial soundness of the project and identify any potential financial risks that need to be addressed.

Schedule Feasibility Explained

Schedule feasibility focuses on the timeframe for completing the project. This involves evaluating the resources needed, project complexity, and potential dependencies to determine if the project can be completed within a realistic and achievable timeframe. Here's what this analysis typically entails:

- **Task Breakdown:** The project is broken down into smaller, manageable tasks.
- **Resource Allocation:** Required resources (people, equipment, etc.) for each task are identified and assigned.

- **Task Dependency Analysis:** Dependencies between tasks are identified to ensure the project can be completed in a logical sequence.
- **Time Estimation:** The time required to complete each task is estimated, considering resource availability and potential challenges.
- **Project Scheduling:** A project schedule is created using tools like Gantt charts or PERT charts, outlining task durations, dependencies, and overall project timeline.

This analysis helps ensure the project can be completed within a realistic timeframe and identifies potential scheduling bottlenecks that need mitigation strategies.

By considering both economic and schedule feasibility, project managers can determine if the project can be delivered within budget and on time, contributing to the overall success of the project.

Feasibility Study

A **feasibility study** is an analysis and evaluation of a proposed project to determine if it is technically feasible, economically viable, and practically achievable. The main objective of a feasibility study is to assess the potential for success of a project and to identify any potential problems that could impede its progress. It helps stakeholders decide whether to proceed with the project, modify it, or abandon it altogether.

Types of Feasibility Studies

1. **Technical Feasibility**: Evaluate whether the proposed technology, tools, and processes can be implemented and if they are adequate to meet the project requirements.
2. **Economic Feasibility**: Assesses the cost-effectiveness of the project by comparing the expected benefits with the estimated costs.
3. **Legal Feasibility**: Checks if the project complies with all relevant laws and regulations.

4. **Operational Feasibility**: Examines whether the organization has the capability to support the operation of the proposed system.
5. **Schedule Feasibility**: Determines if the project can be completed within the desired timeframe.

Economic Feasibility

Economic feasibility involves assessing the financial aspects of a project to determine if the expected benefits outweigh the costs. This includes a detailed cost-benefit analysis to evaluate the economic viability of the project.

Key Components of Economic Feasibility:

- **Cost Analysis**:
    - **Initial Costs**: Costs involved in starting the project, including capital investments in equipment, infrastructure, and technology.
    - **Operating Costs**: Recurring costs required to maintain and operate the project, such as salaries, utilities, and maintenance expenses.
    - **Maintenance Costs**: Costs associated with updating and repairing the system over its lifespan.
- **Benefit Analysis**:
    - **Tangible Benefits**: Measurable benefits, such as increased revenue, cost savings, and improved productivity.
    - **Intangible Benefits**: Non-measurable benefits, such as improved customer satisfaction, brand reputation, and employee morale.
- **Financial Metrics**:
    - **Return on Investment (ROI)**: A measure of the profitability of the project.
    - **Net Present Value (NPV)**: The difference between the present value of cash inflows and outflows over the project's lifespan.
    - **Internal Rate of Return (IRR)**: The discount rate that makes the NPV of all cash flows from a project equal to zero.

Importance:

- Ensures the project is financially viable and sustainable.

- Helps in making informed decisions about resource allocation.
- Identifies potential financial risks and uncertainties.

Schedule Feasibility

Schedule feasibility assesses whether the project can be completed within the desired or required timeframe. It involves analyzing the project timeline, identifying potential delays, and ensuring that the project milestones and deadlines are realistic.

Key Components of Schedule Feasibility:

- **Timeline Analysis**:
    - **Project Duration**: Estimate the total time required to complete the project, from initiation to completion.
    - **Milestones and Deadlines**: Define key milestones and deadlines that need to be met throughout the project lifecycle.
- **Resource Availability**:
    - **Human Resources**: Ensure that the necessary personnel with the required skills are available for the project.
    - **Material and Equipment**: Confirm that all materials and equipment will be available when needed.
- **Risk Assessment**:
    - **Potential Delays**: Identify factors that could cause delays, such as dependencies on external vendors, regulatory approvals, or unforeseen technical challenges.
    - **Contingency Planning**: Develop contingency plans to address potential delays and keep the project on track.

Importance:

- Ensures the project can be delivered on time, meeting stakeholder expectations.
- Helps in planning and coordinating project activities effectively.
- Identifies potential schedule risks and allows for the development of mitigation strategies.

Summary

A feasibility study is crucial for evaluating the viability of a proposed project across multiple dimensions. **Economic feasibility** ensures that the project is financially viable, while **schedule feasibility** ensures that the project can be completed within the desired timeframe. Both aspects are critical for making informed decisions, managing risks, and ensuring the successful execution of the project.

List traditional methods for determining system requirements. Explain the advantages and pitfalls of observing workers to determine system requirements.

Traditional Methods for Determining System Requirements:

Here are some of the traditional methods used to gather system requirements:

1. **Interviews:** Conducting one-on-one or group interviews with stakeholders (users, managers, etc.) to understand their needs, pain points, and desired functionalities.
- **Advantages:** Allows for in-depth questioning and clarification, and captures user perspectives.
- **Pitfalls:** Users may not articulate their needs clearly, and interviewer bias can influence responses.
2. **Questionnaires:** Distributing surveys to a wider audience to gather broader feedback on system needs and preferences.
- **Advantages:** Efficient way to collect data from a large group, allows for anonymity.
- **Pitfalls:** Limited scope of information, may miss out on detailed user experiences.
3. **Document Analysis:** Examining existing documentation like system manuals, reports, and user guides to understand existing functionalities and identify potential areas for improvement.
- **Advantages:** Provides historical context and a baseline for understanding the current system.

- **Pitfalls:** Documentation may be outdated or incomplete, and doesn't capture future needs.

4. **Joint Application Design (JAD):** A facilitated workshop where stakeholders (users, developers) collaboratively define system requirements.
- **Advantages:** Encourages open communication and collaboration, and fosters a sense of ownership among stakeholders.
- **Pitfalls:** Requires significant time commitment and skilled facilitation, and can be dominated by vocal participants.

5. **Observation:** Observing users perform their tasks in their actual work environment to understand their workflow and identify inefficiencies.
- **Advantages:** Provides a firsthand understanding of user behavior and pain points, and captures implicit needs users might not express.
- **Pitfalls:** Can be time-consuming, may not be representative of all users or situations, users may alter their behavior if observed.

Advantages and Pitfalls of Observing Workers:

While observing workers can be a valuable tool for understanding user needs, it's important to be aware of both its advantages and pitfalls:

Advantages:

- **Uncovers Implicit Needs:** Users may not always be able to articulate all their needs explicitly. Observing their behavior can reveal challenges they face in their workflow.
- **Identifies Inefficient Practices:** Inefficiencies in current work processes become more apparent when observing how tasks are actually performed.
- **Provides Context:** Observing users in their work environment provides valuable context for understanding their needs and the situations they encounter.

Pitfalls:

- **Limited Scope:** Observations may not capture the full range of user tasks or scenarios.

- **Reactivity:** Users may alter their behavior when they are being observed, potentially masking real-world behavior.
- **Observer Bias:** The observer's viewpoint can influence what they notice and interpret.
- **Time-consuming:** Observing users effectively can be time-consuming, especially if multiple users and tasks need to be covered.

To mitigate the pitfalls:

- **Observe multiple users in their natural environment.**
- **Triangulate observations with other data sources (interviews, questionnaires).**
- **Maintain a neutral and objective perspective during observation.**
- **Focus on behavior, not opinions.**

By understanding both the benefits and drawbacks of observing workers, you can use this method effectively in conjunction with other traditional requirement-gathering techniques to gain a more comprehensive understanding of user needs.

Traditional Methods for Determining System Requirements

1. **Interviews**:
    - **Description**: Conducting one-on-one or group discussions with stakeholders to gather detailed requirements.
    - **Advantages**:
        - Allows for an in-depth understanding of user needs and expectations.
        - Provides opportunities for clarifying doubts and probing deeper into issues.
        - Facilitates the collection of both explicit and tacit knowledge.
    - **Pitfalls**:
        - Time-consuming and may be biased based on the interviewer’s perspective.

        - Can be influenced by the communication skills of the interviewer and interviewee.
2. **Questionnaires and Surveys**:
    - **Description**: Distributing structured questionnaires or surveys to a large number of stakeholders to collect quantitative and qualitative data.
    - **Advantages**:
        - Efficient for gathering information from a large group of people.
        - Provides standardized data that is easy to analyze.
    - **Pitfalls**:
        - This may result in low response rates and non-responses.
        - Risk of misinterpretation of questions by respondents, leading to inaccurate data.
3. **Observation**:
    - **Description**: Observing workers in their natural environment to understand their workflow, tasks, and challenges.
    - **Advantages**:
        - Provides a direct view of actual work practices and processes.
        - Helps identify unspoken requirements and inefficiencies that users may not be aware of.
    - **Pitfalls**:
        - Can be intrusive and may alter the natural behavior of the observed individuals.
        - Time-consuming and may not cover all aspects of the system requirements.
4. **Document Analysis**:
    - **Description**: Reviewing existing documents, records, and reports to gather information on current systems and workflows.
    - **Advantages**:
        - Utilizes existing resources and information, saving time and effort.
        - Provides historical context and insights into previous system performance and issues.
    - **Pitfalls**:

        - Documents may be outdated or incomplete.
        - Can be overwhelming if there is a large volume of documentation.
5. **Workshops and Focus Groups**:
    - **Description**: Conducting group sessions where stakeholders discuss and brainstorm requirements collectively.
    - **Advantages**:
        - Facilitates collaboration and idea sharing among stakeholders.
        - This can lead to the generation of creative and innovative solutions.
    - **Pitfalls**:
        - Dominant personalities may overshadow quieter participants.
        - Risk of groupthink, where the desire for harmony leads to poor decision-making.
6. **Prototyping**:
    - **Description**: Creating a preliminary version of the system to gather user feedback and refine requirements.
    - **Advantages**:
        - Helps users visualize and understand the system, leading to clearer feedback.
        - Reduces ambiguity and misunderstandings about requirements.
    - **Pitfalls**:
        - Can be time-consuming and resource-intensive.
        - Risk of focusing too much on the prototype's appearance rather than functionality.
7. **Use Cases and Scenarios**:
    - **Description**: Describing system interactions and user behaviors through use cases and scenarios.
    - **Advantages**:
        - Provides a clear and structured way to describe system functionality from the user's perspective.
        - Helps in identifying system requirements and user interactions.
    - **Pitfalls**:
        - Can become complex and difficult to manage for large systems.

        - Requires detailed knowledge of user activities and system processes.

Observing Workers to Determine System Requirements

Advantages:

1. **Direct Insight**:
    - Provides firsthand observation of actual work practices, revealing real-world challenges and inefficiencies that may not be documented.
2. **Uncover Hidden Needs**:
    - Helps identify requirements that workers may not explicitly articulate, such as workarounds, informal processes, and pain points.
3. **Contextual Understanding**:
    - Offers a contextual understanding of the work environment, enabling the identification of requirements that align with users' workflows and daily activities.
4. **Improves User Acceptance**:
    - Observed data can lead to the development of a system that better fits users' needs, enhancing user satisfaction and acceptance.

Pitfalls:

1. **Observer Bias**:
    - Observers may unintentionally influence workers’ behavior, leading to data that does not accurately reflect natural work conditions.
2. **Intrusiveness**:
    - Can be perceived as intrusive, potentially causing discomfort or disruption to workers, which may affect their performance and the data's reliability.
3. **Time-Consuming**:
    - Requires significant time and effort to observe and analyze workflows, especially for complex systems or large user groups.
4. **Limited Scope**:

- Observations might not cover all aspects of the system or all user roles, potentially missing out on important requirements or perspectives.

Conclusion

Observing workers to determine system requirements is a valuable method for gaining deep insights into actual work practices and user needs. However, it must be carefully managed to mitigate biases, ensure non-intrusiveness, and maintain the reliability and validity of the collected data. Combining observation with other methods, such as interviews and surveys, can provide a comprehensive understanding of system requirements.

Draw an ER diagram to store data about students, programs, and courses at your college.

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- **Provides Context:** Observing users in their work environment provides valuable context for understanding their needs and the situations they encounter.

Pitfalls:

- **Limited Scope:** Observations may not capture the full range of user tasks or scenarios.
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By understanding both the benefits and drawbacks of observing workers, you can use this method effectively in conjunction with other traditional requirement-gathering techniques to gain a more comprehensive understanding of user needs.

Describe several methods for interacting with the system

There are many ways users can interact with a system, depending on the system's purpose and complexity. Here are some common methods:

1. Graphical User Interface (GUI): This is the most common method for interacting with modern computer systems. It uses visual elements like windows, icons, menus, and buttons to allow users to provide input and receive information. Users interact with the system using a mouse, keyboard, or touchscreen.

2. Command-Line Interface (CLI): This is a text-based interface where users interact with the system by typing commands and seeing text output on the screen. While less common for everyday users, CLIs are still used by programmers, system administrators, and for certain specialized applications where precise control is needed.

3. Voice Recognition: Voice-activated systems allow users to interact with the system using spoken commands or natural language. This method is becoming increasingly popular with smart speakers, virtual assistants, and voice-enabled applications.

4. Touchscreens: Touchscreens allow users to interact with the system directly by touching elements on the screen. This is commonly used in smartphones, tablets, and some kiosks or self-service terminals.

5. Gestures: Gesture recognition allows users to interact with the system using hand or body movements. This technology is still evolving but is used in some gaming applications, virtual reality experiences, and advanced user interfaces.

6. Virtual Reality (VR) and Augmented Reality (AR): VR and AR create immersive experiences where users interact with the system in a simulated or augmented environment. VR typically involves wearing a headset that blocks out the real world, while AR overlays digital elements onto the real world through a headset or smartphone camera.

7. Application Programming Interfaces (APIs): APIs are not a direct user interaction method but are used by other software applications to interact with a system. They provide programmatic access to a system's data and functionality, allowing for integration with other applications or creating custom tools.

The choice of interaction method depends on various factors like the target audience, the system's functionality, and the desired user experience. Some systems may employ a combination of these methods to cater to different user preferences or task requirements.

What are the major activities of system maintenance? Explain.

System maintenance is the ongoing process of keeping a system functioning effectively and efficiently throughout its lifecycle. It encompasses various activities to ensure the system remains reliable, secure, and meets evolving user needs. Here are some major activities involved in system maintenance:

1. **Corrective Maintenance:**

- This involves fixing bugs, errors, and defects identified in the system. This could be patching software vulnerabilities, repairing hardware malfunctions, or resolving compatibility issues.
- **Focus:** Ensuring the system functions as intended and addressing issues that prevent users from completing tasks.

2. **Preventive Maintenance:**

- This proactive approach aims to prevent problems before they occur. It includes activities like:
    - Regularly updating software with security patches and bug fixes.
    - Performing hardware diagnostics and cleaning to prevent equipment failures.
    - Backing up data regularly to ensure recovery in case of system crashes or data loss.
- **Focus:** Minimizing downtime, maximizing system uptime and availability.

3. **Perfective Maintenance:**

- This focuses on enhancing the system's performance, usability, and functionality. It might involve:
    - Optimizing software code for faster execution and improved resource utilization.
    - Adding new features or functionalities based on user feedback and changing requirements.
    - Redesigning user interfaces for better user experience.
- **Focus:** Improving the overall user experience and system effectiveness.

4. **Adaptive Maintenance:**

- This involves adapting the system to accommodate changes in the environment or user needs. This could include:
    - Modifying the system to comply with new regulations or industry standards.

    - Integrating the system with new technologies or external systems.
    - Modifying the system to support new business processes or workflows.
- **Focus:** Keeping the system relevant and aligned with evolving needs and technologies.

5. **Preventative Maintenance Scheduling:**

- Developing a maintenance schedule based on the system's criticality, usage patterns, and manufacturer recommendations. This ensures preventive tasks are performed regularly to minimize downtime and potential issues.

Effective system maintenance requires a combination of these activities. The specific mix will depend on the type of system, its purpose, and the organization's priorities. By prioritizing maintenance activities, organizations can ensure their systems continue to deliver value, operate reliably, and meet user needs over the long term.

Explain the class diagram with a suitable example.

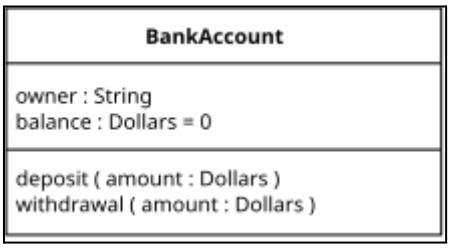
In software engineering, a **class diagram**[1] in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.

The class diagram is the main building block of object-oriented modeling. It is used for general conceptual modeling of the structure of the application, and for detailed modeling, translating the models into programming code. Class diagrams can also be used for data modeling.[2] The classes in a class diagram represent both the main elements, interactions in the application, and the classes to be programmed.

In the diagram, classes are represented with boxes that contain three compartments:

- The top compartment contains the name of the class. It is printed in bold and centered, and the first letter is capitalized.
- The middle compartment contains the attributes of the class. They are left-aligned and the first letter is lowercase.

- The bottom compartment contains the operations the class can execute. They are also left-aligned and the first letter is lowercase.



A class with three compartments

In the design of a system, a number of classes are identified and grouped together in a class diagram that helps to determine the static relations between them. In detailed modeling, the classes of the conceptual design are often split into subclasses.[3]

In order to further describe the behavior of systems, these class diagrams can be complemented by a state diagram or UML state machine.[4]

- **Relationships:** Classes can be related to each other in various ways. These relationships are represented by lines connecting the class rectangles. Some common relationships include:
  - **Association:** A general connection between classes. It indicates that objects of one class can interact with objects of another class. An association can be one-to-one, one-to-many, or many-to-many.
  - **Inheritance:** A hierarchical relationship where a subclass inherits attributes and methods from a parent class. The inheritance relationship is depicted by an arrow pointing from the subclass to the parent class.
  - **Aggregation:** A specific type of association where a whole object (aggregate) has one or more component parts. The aggregation relationship is depicted by a hollow diamond shape on the "has-a" side of the association line.
  - **Composition:** A strong form of aggregation where the component parts cannot exist independently of the whole object. The composition relationship is depicted by a filled diamond shape on the "has-a" side of the association line.

UML provides mechanisms to represent class members, such as attributes and methods, and additional information about them like constructors.

Visibility[edit]

To specify the visibility of a class member (i.e. any attribute or method), these notations must be placed before the members' name:[5]

+	Public
-	Private
#	Protected
~	Package

A **derived property** is a property whose value (or values) is produced or computed from other information, for example, by using values of other properties.

A derived property is shown with its name preceded by a forward slash '/'.

What are the major activities of system maintenance? Explain.

System maintenance is the ongoing process of ensuring a system functions effectively, efficiently, and securely throughout its lifecycle. It encompasses various activities to address issues, improve performance, and adapt to changing needs. Here are the major activities involved:

1. **Corrective Maintenance:**

- Focus: Fixing bugs, errors, and defects identified in the system. This could involve:
    - Patching software vulnerabilities.
    - Repairing hardware malfunctions.
    - Resolving compatibility issues between the system and other software or hardware.

- When: Performed reactively upon encountering problems reported by users or identified during system monitoring.

2. **Preventive Maintenance:**

- Focus: Preventing problems before they occur. This includes:
    - Regularly updating software with security patches and bug fixes.
    - Performing hardware diagnostics and cleaning to prevent equipment failures.
    - Backing up data regularly to ensure recovery in case of system crashes or data loss.
- When: Performed proactively on a scheduled basis to minimize downtime and potential issues.

3. **Perfective Maintenance:**

- Focus: Enhancing the system's performance, usability, and functionality. This might involve:
    - Optimizing software code for faster execution and improved resource utilization.
    - Adding new features or functionalities based on user feedback and changing requirements.
    - Redesigning user interfaces for a better user experience.
- When: Performed when the system needs improvement to address user needs, industry standards, or new technologies.

4. **Adaptive Maintenance:**

- Focus: Adapting the system to accommodate changes in the environment or user needs. This could include:
    - Modifying the system to comply with new regulations or industry standards.
    - Integrating the system with new technologies or external systems.
    - Modifying the system to support new business processes or workflows.
- When: Performed when the environment or user needs change, requiring the system to adapt to remain relevant and effective.

5. **Preventive Maintenance Scheduling:**

- Developing a maintenance schedule based on factors like:
    - System criticality: More critical systems require more frequent maintenance.

    - Usage patterns: Systems used heavily may require more frequent maintenance.
    - Manufacturer recommendations: Following recommended maintenance schedules for hardware or software.

Effective system maintenance requires a combination of these activities. The specific mix will depend on the type of system, its purpose, and the organization's priorities. By prioritizing maintenance activities, organizations can ensure their systems continue to deliver value, operate reliably, and meet user needs over the long term.

Short Notes:

a. Network Diagrams:

- Visual representations of a computer network infrastructure.
- Depict network devices (routers, switches, firewalls) and their connections.
- Can be used for:
    - Documenting network topology (physical layout)
    - Planning network expansion
    - Troubleshooting network issues

Types of Network Diagrams:

- **Physical Network Diagrams:** Show the physical layout of cables and devices.
- **Logical Network Diagrams:** Show the logical connections between devices and subnets, independent of physical layout.

b. Structural Diagrams (UML):

- Focus on the static structure of a system, including its components and relationships.
- Common types:

    - **Class Diagrams:** Show classes, attributes, methods, and relationships between classes (inheritance, association, aggregation).
    - **Object Diagrams:** Show instances (objects) of classes and relationships between them at a specific point in time.
    - **Component Diagrams:** Depict the system as a collection of interacting components with their interfaces and dependencies.

c. Behavioral Diagrams (UML):

- Focus on the dynamic behavior of a system, how components interact and how the system responds to events.
- Common types:
    - **Sequence Diagrams:** Show the sequence of messages exchanged between objects to perform a specific task.
    - **Activity Diagrams:** Show the flow of activities within a system or process, including decisions, loops, and parallel execution.
    - **State Machine Diagrams:** Show the different states an object can be in and the events that cause it to transition between states.

Relationship Between Structural & Behavioral Diagrams:

- Structural diagrams define the building blocks (classes, components).
- Behavioral diagrams explain how these building blocks interact to achieve system functionality.
- Used together, they provide a comprehensive view of a system's structure and behavior.

Network Diagram

A Network Diagram is a visual representation of a computer or telecommunications network. It depicts the various components of the network and how they are interconnected. Network diagrams are essential tools in network design, implementation, and troubleshooting. They provide a clear and organized view of the network's architecture, making it easier to understand and manage.

Key Elements of a Network Diagram:

- **Nodes**: Represent devices such as computers, servers, switches, routers, and other hardware components.
- **Links**: Represent the connections between nodes, such as cables, wireless signals, or other transmission media.
- **Labels**: Provide additional information about nodes and links, such as IP addresses, device names, and network protocols.

Types of Network Diagrams:

1. **Physical Network Diagram**: This shows the physical layout of the network, including the physical locations of devices and the physical connections between them.
2. **Logical Network Diagram**: Illustrates the logical relationships between network components, including subnets, VLANs, IP addressing schemes, and routing paths.

Uses:

- Planning and designing new networks
- Documenting existing networks
- Troubleshooting network issues
- Educating and training network administrators and engineers

b. Structural and Behavioral Diagrams

In software engineering, particularly in the Unified Modeling Language (UML), diagrams are categorized into structural and behavioral diagrams. These diagrams help in modeling the static and dynamic aspects of a system, respectively.

Structural Diagrams:

Structural diagrams depict the static structure of a system, showing the system's components and their relationships. They provide a blueprint of the system's architecture, making it easier to understand and design.

1. **Class Diagram**: Shows the system's classes, their attributes, methods, and relationships (associations, generalizations, dependencies).

2. **Object Diagram**: Represents instances of classes at a specific moment in time, showing objects and their relationships.
3. **Component Diagram**: Depicts the organization and dependencies among software components.
4. **Deployment Diagram**: Illustrates the physical deployment of artifacts on nodes (hardware).
5. **Package Diagram**: Shows the organization of the system into packages and their dependencies.

Behavioral Diagrams:

Behavioral diagrams represent the dynamic behavior of a system, showing how the system changes over time and interacts with its environment and users.

1. **Use Case Diagram**: Captures the system's functional requirements by illustrating actors, use cases, and their interactions.
2. **Sequence Diagram**: Shows the sequence of messages exchanged between objects to carry out a particular function or process.
3. **Activity Diagram**: Represents the flow of activities or operations within a system, often used to model workflows.
4. **State Diagram**: Depicts the states of an object and the transitions between those states in response to events.
5. **Communication Diagram**: Similar to sequence diagrams but emphasizes the structural organization of objects and their interactions.
6. **Interaction Overview Diagram**: Combines aspects of activity and sequence diagrams to provide an overview of the control flow of interactions.
7. **Timing Diagram**: Focuses on the timing constraints of messages exchanged between objects.

Uses:

- **Structural Diagrams**: Provide a static view, useful for understanding the system's organization and planning its architecture.
- **Behavioral Diagrams**: Offer a dynamic view, essential for understanding how the system behaves, interacts, and performs over time.

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