



**Institute of Information Technology  
University of Dhaka**  
**Bachelor of Science in Software Engineering (BSSE)**  
**3<sup>rd</sup> Year 6<sup>th</sup> Semester Final Examination, 2023**  
**SE 611: Software Metrics**  
**Marks: 50 # Duration: 2.5 hours**



Professionalism	Excellence	Respect
<i>(Answer any five (5) of the following questions. When answering a question, please answer all the subsections of it at once)</i>		
<p>1. a) Explain the differences between base attributes and derived attributes in software metrics. 4 Classify the following as either base or derived attributes with brief explanation:</p> <ul style="list-style-type: none"><li>• Cyclomatic Complexity</li><li>• Defect density</li><li>• Halstead volume</li><li>• Number of identified bugs</li><li>• Requirement stability</li><li>• Project completion time</li></ul> <p>b) Consider the following rating formats in empirical relation. Give at least one real-life scenario for each case where you should use the rating formats. 4</p> <ol style="list-style-type: none"><li>i. Verbal Frequency Scale</li><li>ii. Ordinal Scale</li></ol> <p>c) "Lack of conformance of requirements is lack of quality". In that case how do you measure quality? 2</p>		
2.	a) "What is Not Measurable Make Measurable"- Explain this statement concerning software metric. 4 b) Consider the following scenarios and answer the questions below: 6	
<p><b>Scenario A:</b> A software development team measures the number of lines of code (LOC) in a module. The LOC count for Module X is 1,500, and for Module Y, it is 750.</p> <p><b>Scenario B:</b> The same team measures the complexity of modules using a complexity index. Module X has a complexity index of 10, and Module Y has a complexity index of 5.</p> <ol style="list-style-type: none"><li>i. Explain why the measurement of lines of code (LOC) in Scenario A is an example of a ratio scale.</li><li>ii. Explain why the complexity index in Scenario B is an example of an absolute scale.</li><li>iii. Discuss the implications of using an absolute scale for measuring complexity in software modules.</li></ol>		
3.	a) Consider the following goal of a team in a software company: "Enhance the usability of the software system by increasing the user satisfaction score for the user interface by 20% within the next three months, as measured through user feedback surveys" 3	
	<ol style="list-style-type: none"><li>i. Formulate three specific questions that the team needs to answer to evaluate whether they are achieving the goal. These questions should help the team understand the current state of usability and identify areas for improvement.</li><li>ii. For each question, identify at least one metric that can be used to answer it. Explain how the metric relates to the question and how it will help the team measure progress toward the goal.</li><li>iii. How can the team ensure that the metrics are actionable and meaningful?</li></ol> 2	

b) Considering the CMMI framework, discuss the characteristics of a Level 4 software company. 2

- ✓ 4. a) Define empirical research in software engineering. 1  
b) Consider the following three cases: 6

**Case 1:** A software company wants to understand the challenges and outcomes of adopting Agile methodologies in a large-scale, distributed team working on a critical healthcare application.

**Case 2:** A software development team wants to evaluate the effectiveness of a new automated code review tool compared to manual code reviews. They hypothesize that the tool will reduce the time taken to identify defects while maintaining the same level of accuracy.

**Case 3:** A research team wants to investigate the adoption of DevOps practices across the software industry and identify the most common barriers to implementation.

Identify the appropriate empirical study type that is appropriate for each individual case above. Explain your answer.

c) What is conclusion validity and external validity in software engineering empirical study. 3  
Mention some threats on these two validities.

✓ 5. a) What is Constructive Cost Model for estimating the software cost. What are the limitations of this model? 2

b) Consider the following case: 8

ABC is a car shop that sells new and used vehicles, provides vehicle servicing, and offers financing options for customers. The shop plans to develop a **Car Shop Management System (CSMS)** to streamline its operations. The development team will use **Function Point Analysis (FPA)** to estimate the system size and cost.

The CSMS will have the following modules and functionalities:

- ✓ **Customer Management Module**
  - Allows customers to register by entering personal details.
  - Stores customer information for future interactions.
- ✓ **Vehicle Inventory Module**
  - Maintains a database of available cars (new and used).
  - Allows sales staff to update vehicle availability and pricing.
- ✓ **Service Appointment Module**
  - Allows customers to schedule servicing appointments.
  - Maintains a record of previous servicing history for each customer's vehicle.
- ✓ **Financing and Payment Module**
  - Provides loan and financing application forms.
  - Integrates with an external financial institution for loan approvals.
  - Records customer payments and tracks remaining balances.
- ✓ **User Authentication System**
  - Manages login, authentication, and role-based access for customers, sales staff, and administrators.
- ✓ **Reporting Module**
  - Generates sales reports, service records, and financial summaries for management.

Calculate the number of Function Points (FP) for this system. Use **Table 1** to find the corresponding weight factors for your calculation. The 14 complexity sub-factors are also provided for your convenience in **Table 2**.

**Table 1: Weight factors**

Parameter	simple	average	complex
users inputs	3	4	6
users outputs	4	5	7
users requests	3	4	6
files	7	10	15
external interfaces	5	7	10

**Table 2: Complexity factors**

F1. Data Communication	F8. End-user Efficiency
F2. Distributed Data Processing	F9. Complex Computations
F3. Performance Criteria	F10. Reusability
F4. Heavily Utilized Hardware	F11. Ease of Installation
F5. High Transaction Rates	F12. Ease of Operation
F6. Online Data Entry	F13. Portability
F7. Online Updating	F14. Maintainability

6. a) Describe the first-degree and second-degree data collection techniques in software engineering research with examples. 3
- b) Explain Type I and Type II errors in terms of Hypothesis testing with examples. 4
- c) Briefly describe the differences between ANOVA and t-test in the empirical study 3
7. a) Suppose that you propose to collect data to examine the effort of programmer experience on development effort. You are expecting that effort (staff-hours) will decrease as the experience of the people assigned increases. But the collected data shows effort increasing as experience increases. What may be wrong? 5
- b) What is the purpose of the Common Vulnerability Scoring System (CVSS)? What are the three main metric groups in CVSS? Briefly describe each. Describe the difference between Attack Vector (AV) and Attack Complexity (AC) in CVSS scoring



Institute of Information Technology  
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Bachelor of Science in Software Engineering (BSSE)  
3<sup>rd</sup> Year 6<sup>th</sup> Semester Final Examination, 2023  
CSE 601: Distributed Systems  
Marks: 30 # Duration: 2 hours



Professionalism	Excellence	Respect
<i>[Answer any three (3) of the following questions. When answering a question, please answer all the subsections of it at once]</i>		
1.	a) Define Distributed Systems. Explain what is meant by virtual organizations and how such organizations can be built. 1+3	
	b) Describe precisely what is meant by a scalable system? Scalability can be achieved by applying different techniques. What are these techniques. 1+3	
	c) Give an example of a self-managing system in which the analysis component is completely distributed or even hidden. 2	
2.	a) What is the role of middleware in a distributed system? How can a broker reduce the number of wrappers among distributed applications? Justify with an example. 3	
	b) Define the publish-subscribe architecture. Describe different types of coordination in publish-subscribe architecture with suitable examples. 5	
	c) What are the shortcomings of publish-subscribe architecture? 2	
3.	a) In this problem you are to compare reading a file using a single-threaded file server and a multithreaded server. It takes 45 msec to get a request for work, dispatch it, and do the rest of the necessary processing, assuming that the data needed are in a cache in main memory. If a disk operation is needed, as is the case one-third of the time, an additional 75 msec is required, during which time the thread sleeps. How many requests/sec can the server handle if it is single threaded? If it is multithreaded? 4	
	b) Assume a client calls an asynchronous RPC to a server, and subsequently waits until the server returns a result using another asynchronous RPC. Is this approach the same as letting the client execute a normal RPC? What if we replace the asynchronous RPCs with synchronous RPCs? 2	
	c) Using a figure show that the Connection-oriented communication pattern using sockets. Explain the difference between primitives <i>MPI_bsend</i> and <i>MPI_isend</i> in MPI? 2+2	
4.	a) What is the need of name service in distributed systems? What are the characteristics of a true identifier? Give some examples of true identifiers. 3	
	b) Illustrate the process of iterative and recursive name resolution for the following URL: <i>http://iit.du.ac.bd/notice/download/714</i> 4	
	c) Discuss the advantages and disadvantages of iterative and recursive name resolution. 3	
5.	Consider the following scenario: 10	

A music streaming platform allows users to listen to audio tracks over the internet. Users can register on the platform and log in to access their favorite music. The platform provides a catalog of songs categorized by genre, artist, album, and playlists. Users can search for specific tracks, create and manage playlists, and receive personalized recommendations based on their listening history. Additionally, users can upload their own music, and rate tracks uploaded by others.

Now, design a distributed system based on the scenario described above. The design must include, but is not limited to, specifications for the high-level architecture, microservices, APIs, database, and object storage. Use appropriate figures to explain your answer.



**Institute of Information Technology  
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3<sup>rd</sup> Year 6<sup>th</sup> Semester Final Examination, 2023  
SE 612: Software Security  
Marks: 50 # Duration: 2.5 hours**



Professionalism	Excellence	Respect
<i>(Answer any five (5) of the following questions. When answering a question, please answer all the subsections of it at once)</i>		
1. a) Software security touchpoints is identified as one of the three pillars for software security. What is meant by software security touchpoints in the context of software security. Explain briefly.		4
b) Explain the difference between the followings. i. Attack vector and attack surface ii. Software bugs and software flaws iii. Static analysis and dynamic analysis of a software		6
2. a) Critically assess the following statements/Briefly explain your opinion [i.e. whether you agree or disagree with the statement]. i. Uses of only cryptography cannot make a software secure ii. During a web application security review, Mr. Kamal discovered that one of his organization's applications is vulnerable to SQL injection attacks. In this context database server configuration would be the best place for Mr. Kamal to address the root cause issue. iii. Knowledge of attack pattern helps in developing abuse cases for software security testing iv. The idea of defense-in-depth is to force the attacker to find multiple exploitable vulnerabilities in order to produce a successful attack		10
3. a) 'Most programming languages were not designed with security in mind. Unintentional misuse of various functions built into these languages leads to very common and often exploited vulnerabilities. Review of code could support in this respect.' - What are the specific objectives of code review? Give a specific example of an automated code review tool.		3
b) What do you understand by Software Security Principles? Briefly explain the following security principles. i. Never depend on security through obscurity ii. SD3 (Secure by Design, by Default, and in Deployment) iii. Minimize your attack surface		1+6
4. a) Briefly explain how Cross Site Request Forgery (CSRF) attack works? Mention few approaches to defend CSRF attack.		5
b) What do you understand by Cross-Site Scripting (XSS) attack? What information can an attacker steal using XSS? How can one prevent XSS?		5
5. a) Suppose you're a security analyst reviewing a web application's code for vulnerabilities. During your assessment, you come across a login page where users input their username and password. The code handling the user input appears to be vulnerable to SQL injection. Explain in what ways you can initiate an SQL injection attack on this login page, and suggest a method to prevent or mitigate this vulnerability.		6
b) 'If we characterize functional testing as "testing for positives"—as in verifying that a feature properly performs a specific task—then penetration testing is in some sense "testing for negatives." - Define penetration testing in light of the above statement.		4

6. a) Password based authentication has been used in majority of applications. However, there are many types of attacks that can be exploited. Identify at least five main attack and their countermeasures in a password-based authentication system.

4

- b) Briefly describe the following class of coding errors with specific example.
- i. Input validation and representation
  - ii. Security Features
  - iii. Error handling

6

7. Write short notes on the following topics:

10

- a) Discretionary Access Control
- b) Role-based Access Control



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CSE 605: Software Testing and Quality Assurance

Marks: 50 # Duration: 2.5 hours

Professionalism	Excellence	Respect
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*(Answer any five (5) of the following questions.)*

*(When answering a question, please answer all the subsections of it at once)*

1. a) Why exhaustive testing is considered impractical? Justify your answer. Differentiate between exhaustive testing and effective testing. 5
- b) What is the need for automation testing activities? Differentiate between static and dynamic testing tools. 5
1. a) How does Equivalence Partitioning help in reducing the number of test cases while maintaining effective test coverage? 2
- b) Explain Verification and Validation Model with diagram. ✓ 3
- c) A mobile phone service provider uses a program that computes the monthly bill of customers as follows:

Minimum BDT 300 for up to 120 calls  
Plus BDT 1 per call for the next 70 calls  
Plus BDT 0.80 per call for the next 50 calls  
Plus BDT 0.40 per call for any call beyond 240 calls

Ques 1

Design test cases for this program using equivalence class testing technique.

3. Consider a program to determine whether a given number is prime or not and answer the following questions. 10

```
int main()
{
    int n, index;
1   cout << "Enter a number: " <> n;
3   index = 2;
4   while (index <= n - 1)
5   {
6       if (n % index == 0)
7       {
8           cout << "It is not a prime number" << endl;
9           break;
10      }
11      index++;
12  }
13  if (index == n)
14      cout << "It is a prime number" << endl;
15 } // end main
```

- a) Draw the DD graph for the program. ✓ 3
- b) Calculate the cyclomatic complexity of the program. ✓ 2
- c) List all independent paths. ✓ ✓ 2
- d) Design all test cases from independent paths. ✓ 3

Design test cases for the following system using decision table testing:

- A student is required to take three exams, for course A, course B and course C.
- The student will get a pass if he/she gets 50% or more marks in each of the three exams.
- The student will get a pass if he/she gets 50% or more marks in course A and course B, and gets an average of 65% in B and C together
- The student will get a pass if he/she gets an average of 75% in all the three courses put together
- The student will fail otherwise

a) Suppose you are testing a program that determines the eligibility for an IT job based on a candidate's age and experience. The program should accept input values between 18 and 65 years for the age, and between 0 and 10 years for the experience. Design test cases for this program using BVC and robust testing methods.

b) Consider the following graph.



- Represent this graph in the form of a graph matrix.
- Represent this graph in the form of a connection matrix.
- Find 2-link paths and 3-link path for each node.

c) What is Mutation testing? Differentiate between primary and secondary mutants.

6. Consider the program given below and answer the following questions. 10

```

int max( int a, int b, int c ) {
    if ( a > b && a > c ) {
        return a;
    } else if ( b > c ) {
        return b;
    } else {
        return c;
    }
}

int main() {
    int num1, num2, num3;
    scanf("%d %d %d", &num1, &num2, &num3);
    int result = max(num1, num2, num3);
    printf("Max: %d\n", result);
    return 0;
}
  
```

- Suppose module `max(int a, int b, int c)` is not ready when called in `main()`. Design stubs for this module. 2
- Find out the three possible mutants of the program. 3
- Check how many of them are killed by the following set of test data. 5

	num1	num2	num3
ID1	1	2	3
ID2	3	1	2
ID3	2	2	3

- 7 a) What is the role of quality control in software development? Differentiate between quality assurance and quality control. 4
- b) Consider the following program and derive all du-paths and dc-paths using data flow testing: 6

```
1 int foo(int a, int b, int c) {
2     int x, y, z;
3     x = a + 2;
4     y = b - 3;
5     z = c * 5;
6     if (x > y && y < z) {
7         x = y + z;
8     } else {
9         x = y - z;
10    }
11    return x;
12}
```

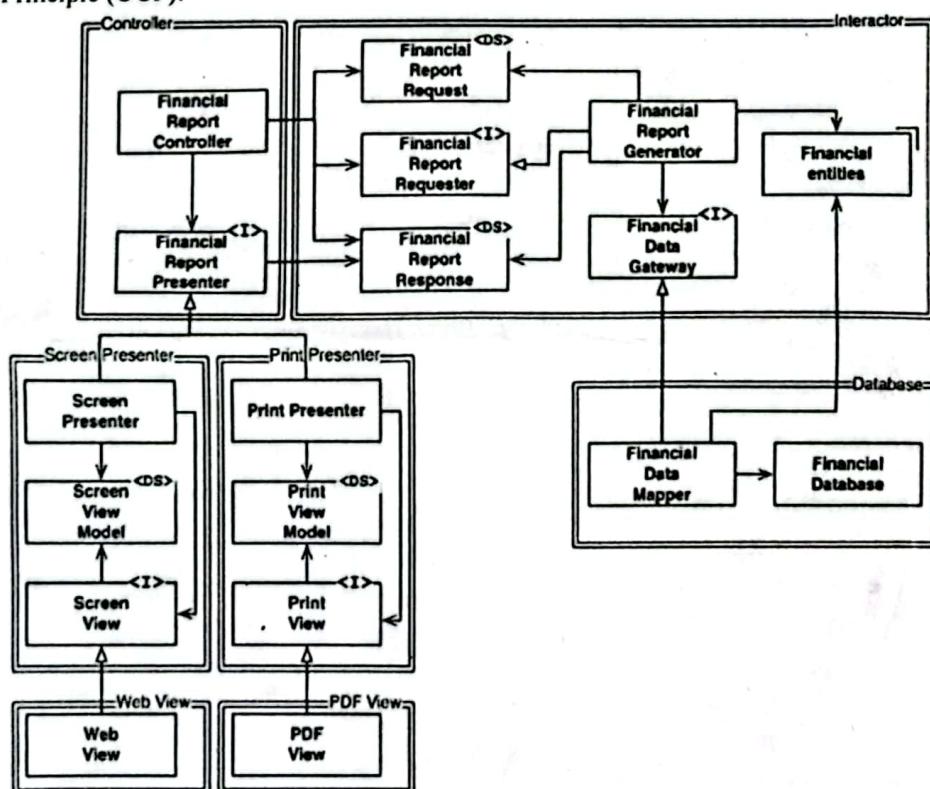


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*[Answer any five (5) of the following questions.]*

*[When answering a question, please answer all the subsections of it at once]*

1. ✓ a) Explain the **Interface Segregation Principle (ISP)** in object-oriented design. Provide an example of how violating ISP can lead to issues in software development, and describe how to refactor the design to comply with ISP. 5
- b) Explain your understanding of the statement - “Clean Architecture is Screaming” with an appropriate example. 5
2. ✓ Explain the design of the following diagram and its association with the Open-Closed Principle (OCP): 10



3. a) Explain how to choose the right parameters for a rate limiter and how to configure for both normal requests scenarios and peak demands? Also discuss the challenges involved in designing a rate limiter in a distributed environment along with their mitigation strategies. 6
- b) Select the appropriate rate limiter algorithm with justification for the given scenarios: 4
- i. A microservice based e-commerce platform experiencing large spikes in traffic during flash sales and holiday events.
  - ii. A file transfer protocol that requires stable and consistent speeds of downloading, able to handle any bursts and smooth traffic efficiently.
4. ✓ a) Explain the **CAP Theorem** in the context of distributed systems. Define **Consistency**, **Availability**, and **Partition Tolerance**, and discuss why a system cannot achieve all three simultaneously. Provide a real-world example of a distributed system and analyze how it balances the trade-offs among the three properties. 7

b) What is the difference between virtual scaling and horizontal scaling? Explain with suitable example. 3

5. Assume a popular video streaming application with 200 million global users among which the average concurrent active users is around 20% worldwide. Moreover, according to the analytics data, each user spends around 10 minutes watching HD videos with an average streaming bit rate of 5 Mbps. Other than content watching, users generally search for interesting content making 5 requests per minute. Based on the given information, estimate the following:

- a) number of requests (not streaming) per second (RPS) during peak usage. 2
- b) amount of bandwidth required to stream HD video content during peak usage. 2
- c) amount of servers required to handle peak load (assuming each server can handle 500 requests per second and 1GB bandwidth per minute). 3
- d) total server cost assuming \$10 per server and \$0.1 per GB video streaming. 3

6. Explain the following concepts and their difference(s) in brief:

- a) Stateless architecture and Stateful architecture 2.5
- b) Presenters and Views in component-based design 2.5
- c) Component and Service in software design 2.5
- d) Object Oriented Programming and Functional Programming Paradigm 2.5

7. a) Why is consistent hashing preferred over simple modulo-based sharding in distributed systems, especially when considering node additions or removals? Discuss the real-world implications of data redistribution during scaling events. 5
- b) Virtual nodes (or replicas) are used to address non-uniform node partitioning and improve load balancing in consistent hashing. Discuss the benefits and trade-offs of increasing the number of virtual nodes. How do these impact memory usage, efficiency, and the overall complexity of the system? Is there an upper limit? 5

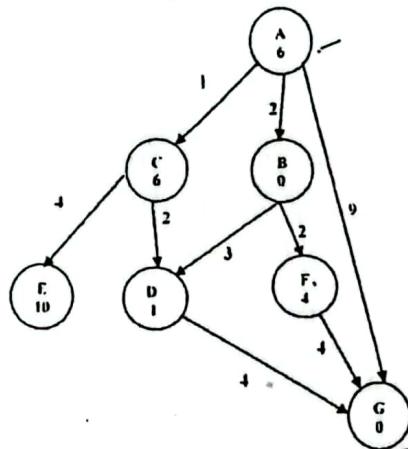


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*[Answer any five (5) of the following questions.]*

*[When answering a question, please answer all the subsections of it at once]*

1. a) Briefly explain the “thinking humanly” approach to AI. Discuss the main challenges of developing AI based on this approach. 4
- b) For each of the following AI agents, characterize its task environment (with proper justification) in terms of whether it is fully or partially observable, single or multiagent, stochastic or deterministic, episodic or sequential, static or dynamic, discrete or continuous.
- i. An interactive English tutor.
  - ii. A software that automatically bids on items at an online auction. 6
2. a) Can alpha-beta pruning guarantee the same decision as minimax? Why or why not? 2
- b) In what situations does alpha-beta pruning fail to provide significant improvements in search efficiency? 2
- c) Your AI agent needs to find a path from A to G in the following graph. The number attached to each edge in the graph represents the actual cost of traversing the edge. The heuristic distances to the goal from each node are given inside the node. 6



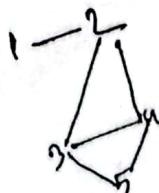
Answer the following questions from the given graph:

- i. Is the given heuristic admissible? Explain your answer.
- ii. Perform Uniform Cost Search on this graph. Show your work (the search tree and the states of the stack/queue). Use alphabetical order to break any ties.
- iii. Perform A\* Search on this graph. Show your work (the search tree and the states of the stack/queue). Use alphabetical order to break any ties.

3. a) Prove that A\* is optimal if the heuristic is admissible. 4
- b) You are in charge of scheduling meetings for an organization. There are 5 meetings on a given day and 3 managers who will preside over the meetings. You are constrained by the fact that each manager can only chair one meeting at a time. 6

The Meetings are:

- Meeting 1 - time 10:00-11:00am
- Meeting 2 - time 10:30-11:30am
- Meeting 3 - time 11:00am-12:00 noon
- Meeting 4 - time 11:00am-12:00 noon
- Meeting 5 - time 11:30am-12:30pm



The managers are:

- Manager A, who can preside over meetings 1, 2, 3, 4, 5
- Manager B, who can preside over meetings 2, 3, 4, and 5.
- Manager C, who can preside over meetings 3 and 4

Formulate this problem as a Constraint Satisfaction Problem (CSP), draw the constraint graph, and solve the CSP using backtracking, forward checking, and appropriate heuristics.

4. a) A hospital follows strict rules to determine whether a patient needs immediate isolation due to an infectious disease. The decision is based on the following conditions:

- If a patient has a high fever and a persistent cough, they are suspected of having an infection.
- If a patient has an infection and has recently traveled to a high-risk area, they are classified as a high-risk case.
- If a patient has an infection and shows breathing difficulties, they are also classified as a high-risk case.
- Any high-risk case must be isolated.

Facts about a specific patient:

The patient has a high fever, has a persistent cough, has breathing difficulties, did NOT travel to a high-risk area, and has had recent contact with an infected person.

Write the four rules above as Horn clauses using proposition symbols of your choice. Then construct an AND-OR graph, and prove using Forward Chaining whether the given patient should be isolated.

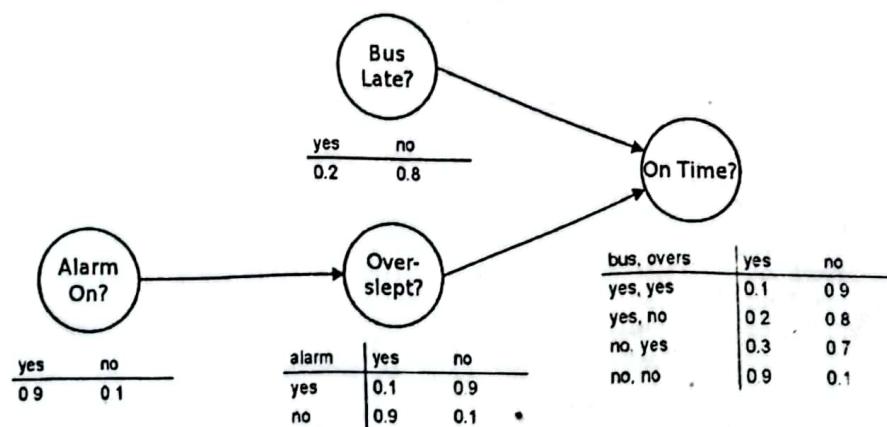
- b) Consider a vocabulary with the following symbols:

- Occupation (p, o): Predicate. Person p has occupation o.
- Customer (p1, p2): Predicate. Person p1 is a customer of person p2.
- Boss (p1, p2): Predicate. Person p1 is a boss of person p2.
- Doctor, Surgeon, Lawyer, Actor : Constants denoting occupations.
- Shuvra, Himel: Constants denoting people.

Use the given symbols to write the following assertions in First Order Logic.

- Shuvra has a boss who is an actor.
- No lawyers are surgeons.
- Himel does not have a doctor.
- Some doctors do not have lawyers.
- Some lawyers have doctors.

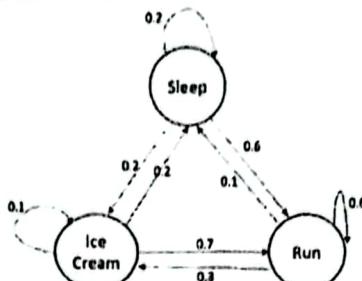
5. a) Consider the following Bayesian network which shows the probabilities based on the variables *AlarmOn* (whether the alarm was on), *BusLate* (whether the bus was late), *OverSlept* (whether the person over-slept) and *OnTime* (whether the person came to class on time).



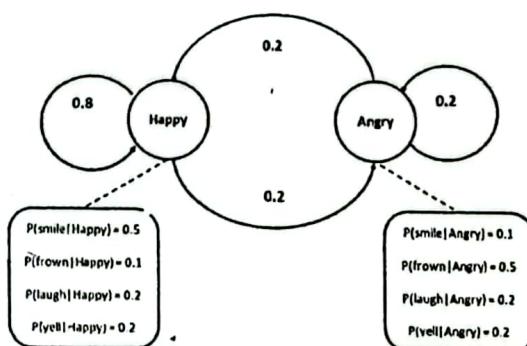
Based on the network, answer the following questions:

- What is conditional independence? Show with an example. Which pairs of variables in the given Bayesian network are conditionally independent of each other?
- What is the probability of coming to class late if the alarm was on?
- What is the probability of coming to class in time if the bus was not late?

b) Consider the following Markov chain:



- If the initial state ( $T_0$ ) is "Sleep", find the probability distribution of the states at  $T_2$
  - Suppose the initial state probabilities are: Sleep 20%, Ice Cream 30% and Run 50%. Now find the probability distribution at  $T_2$
6. Mr. X is happy someday and angry on other days. We can only observe when he smiles, frowns (expression indicating disapproval), laughs, or yells (make loud noise) but not his actual emotional state. Let us start on day 1 in the happy state. There can be only one state transition per day. It can be either to happy state or angry state. The HMM is shown below: 10



Assume that  $q_t$  is the state on day  $t$  and  $o_t$  is the observation on day  $t$ . Answer the following questions:

- What is  $P(q_2 = \text{Happy})$ ?
- What is  $P(o_2 = \text{frown})$ ?
- What is  $P(q_2 = \text{Happy} | o_2 = \text{frown})$ ?
- What is  $P(o_1 = \text{frown} o_2 = \text{frown} o_3 = \text{frown} o_4 = \text{frown} o_5 = \text{frown}, q_1 = \text{Happy} q_2 = \text{Angry} q_3 = \text{Angry} q_4 = \text{Angry} q_5 = \text{Angry})$  if  $\pi = [0.7, 0.3]$ ?

7. a) Which of the following propositions are tautologies? Which are contradictions? Why? 3

- Three is a prime number.
- It is raining or it is not raining.
- It is raining ( $P$ ) and it is not raining ( $\neg P$ ).

b) Which of the two following propositions are equivalent in the sense that one can always be substituted for the other one in any proposition without changing its truth value? Why? 3

- first proposition:  $P \Rightarrow Q$  second proposition:  $\neg P \vee Q$
- first proposition:  $\neg P$  second proposition:  $P \Rightarrow \text{False}$
- first proposition:  $\neg P$  second proposition:  $\text{False} \Rightarrow P$

2

c) Prove that  $P \wedge Q \models P \vee Q$

2

d) Express the following in FOL and construct a proof using resolution refutation:

1. Everyone has a parent
2. For any persons x, y, and z, if z is y's parent and y is x's parent, then z is the grandparent of x.
3. Therefore, everyone has a grandparent.

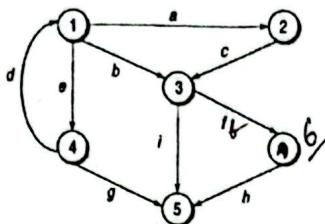
What is the role  
of assurance and quality  
testing?  
b) Consider the following

Design test cases for the following system using decision table testing:

- A student is required to take three exams, for course A, course B and course C.
- The student will get a pass if he/she gets 50% or more marks in each of the three exams.
- The student will get a pass if he/she gets 50% or more marks in course A and course B, and gets an average of 65% in B and C together.
- The student will get a pass if he/she gets an average of 75% in all the three courses put together.
- The student will fail otherwise.

- 5 a) Suppose you are testing a program that determines the eligibility for an IT job based on a candidate's age and experience. The program should accept input values between 18 and 65 years for the age, and between 0 and 30 years for the experience. Design test cases for this program using BVC and robust testing methods. 4

- b) Consider the following graph: 3



- Represent this graph in the form of a graph matrix.
- Represent this graph in the form of a connection matrix.
- Find 2-link paths and 3-link path for each node.

- c) What is Mutation testing? Differentiate between primary and secondary mutants. 3

6. Consider the program given below and answer the following questions: 10

```
int max(int a, int b, int c) {
    if (a > b && a > c) {
        return a;
    } else if (b > c) {
        return b;
    } else {
        return c;
    }
}
int main() {
    int num1, num2, num3;
    scanf("%d %d %d", &num1, &num2, &num3);
    int result = max(num1, num2, num3);
    printf("Max: %d\n", result);
    return 0;
}
```

- a) Suppose module `max(int a, int b, int c)` is not ready when called in `main()`. Design stubs for this module. 2

- b) Find out the three possible mutants of the program. 3

- c) Check how many of them are killed by the following set of test data. 5

	num1	num2	num3
TD1	1	2	3
TD2	3	1	2
TD3	2	2	3