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CLASS 9TH • COMPUTER SCIENCE

4

Computational Thinking

Class 9th Computer Science Notes

INTRODUCTION

Computational thinking is a key skill for solving complex problems using methods from computer science. It involves four core components: decomposition (breaking problems into smaller parts), pattern recognition (identifying trends), abstraction (focusing on relevant details), and algorithms (creating step-by-step solutions). These skills benefit not only computer scientists but anyone looking to improve problem-solving across fields. The unit also highlights hands-on practice in algorithm design and evaluation, such as through LARP activities, to help students effectively tackle computational problems.

COMPUTATIONAL THINKING

Q.1: What is Computational Thinking and how can decomposition break a task? (09504001)

Ans: ★ Key Points: Computational Thinking | Decomposition

1. Computational Thinking (CT)

Computational Thinking (CT) is a problem-solving process that involves a set of skills and techniques to solve complex problems in a way that it can be executed by a computer. This approach can be used in various fields beyond computer science, such as biology, mathematics, and even in daily life.

2. Decomposition

Decomposition is the method of breaking down a complicated problem into smaller, more convenient components. Decomposition is an important step in computational thinking. It involves dividing a complex problem into smaller, manageable tasks.

Example: Building a Birdhouse

This task might look tough at first, but if we break it down, we can handle each part one at a time.

Here's how we can decompose the task of building a birdhouse:

1. **Design the Birdhouse:** Decide on the size, shape, and design. Sketch a plan and gather all necessary measurements.
2. **Gather Materials:** List all the materials needed such as wood, nails, paint, and tools like a hammer and saw.
3. **Cut the Wood:** Measure and cut the wood into the required pieces according to the design.

4. **Assemble the Pieces:** Follow the plan to assemble the pieces of wood together to form the structure of the birdhouse.
5. **Paint and Decorate:** Paint the birdhouse and add any decorations to make it attractive for birds.
6. **Install the Birdhouse:** Find a suitable location and securely install the birdhouse where birds can easily access it.

DID YOU KNOW?

Q: Is computational thinking only used in computer science?

Ans: No, it is also used in everyday problem solving, like planning a trip or organizing tasks.

Q.2: What is pattern recognition in computational thinking? Also define abstraction with an example.

Ans: ★ Key Point: Pattern Recognition

Pattern Recognition

Pattern recognition is an essential aspect of computational thinking. It involves identifying and understanding regularities or patterns within a set of data or problems.

Example: Recognizing patterns in the areas of squares

Side Length	Area	Pattern
1	1	1
2	4	1 + 3
3	9	1 + 3 + 5
4	16	1 + 3 + 5 + 7
5	25	1 + 3 + 5 + 7 + 9

We can see that the area of each square can be calculated by adding consecutive odd numbers. For example, the area of a square with a side length of 3 can be found by adding the first three odd numbers: 1 + 3 + 5 = 9

Abstraction

Abstraction is a fundamental concept in problem solving, especially in computer science.

Definition: Abstraction is the process of hiding the complex details while exposing only the necessary parts. It helps reduce complexity by allowing us to focus on the high-level overview without getting lost in the details.

Example: Making a Cup of Tea

High-level Steps:

1. Boil water.
2. Add tea leaves or a tea bag.
3. Wait for a few minutes.
4. Pour into a cup and add milk/sugar if desired.

Q.3: What is an algorithm? Explain with an example.

Ans: ★ Key Point: Algorithm

Algorithms

An algorithm is a step-by-step set of instructions to solve a problem or complete a task, similar to following a recipe to bake a cake. An algorithm is a precise sequence of instructions (steps) that can be followed to achieve a specific goal, like a recipe or a set of directions that tells you exactly what to do and in what order.

Example: Planting a Tree

Here is a simple algorithm to plant a tree:

1. Choose a suitable spot in your garden.
2. Dig a hole that is twice the width of the tree's root ball.
3. Place the tree in the hole, making sure it is upright.
4. Fill the hole with soil, pressing it down gently to remove air pockets.
5. Water the tree generously to help it settle.
6. Add mulch around the base of the tree to retain moisture.
7. Water the tree regularly until it is established.

This algorithm gives clear instructions on how to plant a tree, making it easy to follow for anyone.

DID YOU KNOW?

Q: Are algorithms only used in computers, or can they be found in everyday activities as well? (09504003a)

Ans: Algorithms are not just used in computers; they are everywhere. Following directions to a friend's house or playing a board game with rules are examples of using algorithms, which help us solve problems logically.

PRINCIPLES OF COMPUTATIONAL THINKING

Q.4: What are the principles of computational thinking, and how do problem understanding, problem simplification, and solution selection and design help in solving a problem effectively? (09504004)

Ans: ★ Key Points: Principles of Computational Thinking | Problem Understanding | Problem Simplification | Solution Selection and Design

Principles of Computational Thinking

Computational thinking involves several key principles that guide the process of problem-solving in a structured manner.

1. Problem Understanding

Understanding a problem involves identifying the core issue, defining the requirements, and setting the objectives. Understanding the problem is the first and most important step in problem-solving, especially in computational thinking. This involves thoroughly analyzing the problem to identify its key components and requirements before attempting to find a solution.

2. Problem Simplification

Simplifying a problem involves breaking it down into smaller, more manageable subproblems.

Example: To design a website, break down the tasks into designing the layout, creating content, and coding the functionality.

3. Solution Selection and Design

Choosing the best solution involves evaluating different approaches and selecting the most efficient one. Designing the solution requires creating a detailed plan or algorithm.

TIDBITS

Q: Who said, "If I had an hour to solve a problem I'd spend 55 minutes thinking about the problem and 5 minutes thinking about solutions"? (09504004a)

Ans: Albert Einstein.

Q: What is the importance of thoroughly understanding a problem before trying to solve it? (09504004b)

Ans: It is important to take time to fully understand a problem before starting to solve it. This includes asking questions, gathering relevant information, and clarifying any doubts. A clear understanding of the problem helps in identifying the real issue and leads to more effective and accurate solutions.

ALGORITHM DESIGN METHODS

Q.5: What are algorithm design methods? Explain flowchart and its symbols. (09504005)

Ans: ★ Key Points: Algorithm Design Methods | Flowchart | Flowchart Symbols

Algorithm Design Methods

Algorithm design methods are used to create efficient algorithms, such as using flowcharts and pseudocode to represent logical solutions. Algorithm design methods provide tools and techniques to solve computational problems effectively. Each method has strengths and weaknesses.

1. Flowcharts (Graphical)

Flowcharts are visual representations of the steps in a process or system, drawn using different symbols connected by arrows. They are widely used in various fields, including computer science, engineering, and business, to model processes, design systems, and communicate complex workflows clearly and effectively.

2. Flowchart Symbols (Pictorial)

Flowchart symbols are visual representations used to illustrate the steps and flow of a process or system:

Symbol	Name	Description
Oval	**Terminal**	**Represents the start or end of a process. Often labeled as "Start" or "End."**
Rectangle	Process	Represents a process, task, or operation that needs to be performed.
Parallelogram	Input/ Output	Represents data input or output (e.g., reading input from a user or displaying output on a screen).
Diamond	Decision	Represents a decision point in the process where the flow can branch based on a yes/no question or true/false condition.
Arrow	Flowline	Shows the direction of flow within the flowchart, connecting the symbols to indicate the sequence of steps.

3. Importance of Flowcharts

- **Clarity:** Flowcharts provide a clear and concise way to represent processes, making them easier to understand at a glance.
- **Communication:** They are excellent tools for communicating complex processes to a wide audience, ensuring everyone has a common understanding.
- **Problem Solving:** Flowcharts help identify bottlenecks and inefficiencies in a process, aiding in problem-solving and optimization.
- **Documentation:** They serve as essential documentation for systems and processes, which is useful for training and reference purposes.

DID YOU KNOW?

Q: Which computer scientists helped popularize flowcharts in the early days of computing? (09504005a)

Ans: Flowcharts were popularized by computer scientists such as John Von Neumann and Herman Goldstine in the early days of computing.

Q.6: Draw a flowchart to add two numbers. (09504006)

Ans: ★ Key Point: Example of Flowchart

Flowchart for Adding Two Numbers:

Steps shown: input numbers, adding the numbers and saving in "Sum", and finally displaying the "Sum".

[Flowchart Diagram - Start → Input A, B → Sum = A + B → Display Sum → End]

Q.7: Draw a flowchart that takes a number from user and determines if it is Even or Odd. (09504007)

Ans: ★ Key Point: Example of Flowchart

Flowchart for Finding Even or Odd Number:

1. Input number in variable "No."
2. Calculate modulus of No. with 2
3. Compare with 0
4. If condition is true (modulus is 0), display "No. is Even"
5. Otherwise display "No. is Odd"

[Flowchart Diagram - Start → Input No. → No. % 2 == 0? → Yes: Print "Even" / No: Print "Odd" → End]

Q.8: Draw a flowchart for a login system. (09504008)

Ans: ★ Key Point: Example of Flowchart

Flowchart for a Login System:

Steps shown:

- Inputting a username and password
- Verifying credentials
- Granting access
- Maximum of five attempts

[Flowchart Diagram - Start → Input Username, Password → Verify Credentials → If correct: Grant Access / If incorrect: Try Again (max 5 attempts) → End]

PSEUDOCODE

Q.9: What is pseudocode and how does it work? Why use pseudocode? Explain with examples. (09504009)

Ans: ★ Key Points: Pseudocode | Use of Pseudocode

1. Pseudocode

Pseudocode is a method of representing an algorithm using simple and informal language that is easy to understand. It combines the structure of programming clarity with the readability of plain English, making it a useful tool for planning and explaining algorithms.

2. How Pseudocode Works

Pseudocode is not actual code that can be run on a computer, but rather a way to describe the steps of an algorithm in a manner that is easy to follow. It helps programmers and students focus on the logic of the algorithm without worrying about the syntax of a specific programming language.

3. Why Use Pseudocode (Benefits of Pseudocode)

Using pseudocode has several benefits:

- **Clarity:** It helps in understanding the logic of the algorithm without worrying about syntax.
- **Planning:** It allows programmers to outline their thoughts and plan the steps of the algorithm.
- **Communication:** It is a universal way to convey the steps of an algorithm, making it easier to discuss with others.

Example 1: Determining whether a number is even or odd

Algorithm 1: Pseudocode for determining if a number is even or odd.

text

1. Procedure CheckEvenOdd(number)
2. Input: number {The number to be checked}
3. Output: "Even" if number is even, "Odd" if number is odd
4. Begin
5. if (number % 2 == 0) then
6. print "number is Even"
7. else
8. print "number is Odd"
9. End if
10. End

Example 2: Determining whether a number is prime

Algorithm 2: Pseudocode for determining if a number is prime.

text

1. Procedure IsPrime(number)
2. Input: number {The number to be checked}

3. Output: True if number is prime, False otherwise

4. Begin

5. if (number <= 1) then

6. return False

7. end if

8. for i from 2 to sqrt(number) do

9. if (number % i == 0) then

10. return False

11. end if

12. end for

13. return True

14. End

DID YOU KNOW?

Q: Why is pseudocode often used in software development before writing the actual code? (09504009a)

Ans: Pseudocode is often used in software development before writing the actual code to ensure that the program logic is correct and easy to understand. It also helps facilitate communication between team members who may be using different programming languages.

DIFFERENCE BETWEEN FLOWCHARTS AND PSEUDOCODE

Q.10: What is the difference between Flowcharts and Pseudocode? Also give an example of Pseudocode. (09504010)

Ans: ★ Key Point: Difference between Flowcharts and Pseudocode

Flowcharts and pseudocode are both tools used to describe algorithms, but they do so in different ways. Understanding their differences can help you decide which method is most suitable to use for your scenario.

Feature	Pseudocode	Flowcharts
Format	**Uses plain language and structured text to describe steps.**	**Uses graphical symbols (rectangles, diamonds, ovals) connected by arrows.**
Reading Style	Read sequentially like a story, step by step.	Read visually or graphically, following arrows to see the process flow.
Communication Style	Narrative-like; explains each step in detail.	Visual; shows process, steps, and decisions at a glance.
Purpose	Useful for documenting algorithms in a way that can be easily converted into code.	Useful for understanding the overall flow and identifying decisions quickly.
Strength	Good for precise, detailed instructions and programming logic.	Good for visualizing processes and spotting bottlenecks or decision points.
Analogy	Like reading a story or recipe step by step.	Like watching a movie of the process unfold.

Example: Pseudocode for checking a valid username and password.

text

1. Procedure: CheckCredentials(username, password)
2. Input: username, password
3. Output: Validity message
4. Begin
5. validUsername = "user123" {Replace with the actual valid username}
6. validPassword = "pass123" {Replace with the actual valid password}
7. if (username == validUsername) then
8. if (password == validPassword) then
9. print "Login successful"
10. else
11. print "Invalid password"
12. end if
13. else

14. print "Invalid username"

15. end if

16. End

EVALUATION TECHNIQUES FOR AN ALGORITHM

Q.11: What are evaluation techniques for an algorithm? Explain Time and Space Complexity. (09504011)

Ans: ★ Key Points: Evaluation Techniques for an Algorithm | Time Complexity | Space Complexity

Evaluation Techniques for an Algorithm

Evaluation techniques help determine how efficiently an algorithm solves a problem. They focus on measuring its performance in terms of time and memory usage, which helps in comparing and improving different algorithms.

1. Time Complexity

Time Complexity measures how fast or slow an algorithm performs. It shows how the running time of an algorithm changes as the size of the input increases.

Example: Imagine you have a list of names, and you want to find a specific name. If you have 10 names, it might only take a few seconds to look through the list. But what if you have 100 names? Or 1,000 names? The time it takes to find the name increases as the list gets longer. Time complexity helps us understand this increase.

DID YOU KNOW?

Q: How is time complexity expressed?

Ans: Time complexity is usually expressed using Big O notation, like O(n), O(log n), or O(n^2). It helps us compare different algorithms to see which one is faster!

2. Space Complexity

Space complexity measures the amount of memory an algorithm uses relative to input size. It is essential to consider both the memory required for the input and any extra memory used by the algorithm.

Designing and evaluating algorithms involves activities like dry runs and simulations to ensure they work as intended.

DRY RUN

Q.12: Explain the dry run of a flowchart with an example. (09504012)

Ans: ★ Key Point: Dry Run of a Flowchart

Dry Run of a Flowchart

A dry run of a flowchart involves manually walking through the flowchart step-by-step to understand how the algorithm works without using a computer. This helps identify any logical errors and understand the flow of control.

Example: Calculating the Sum of Two Numbers

Steps to dry run this flowchart:

1. Start
2. Input the first number (e.g., 3)
3. Input the second number (e.g., 5)
4. Add the two numbers (3 + 5 = 8)
5. Output the result (8)
6. Stop

Q.13: What is the purpose of a dry run and how is it applied to pseudocode? (09504013)

Ans: ★ Key Points: Dry Run | Dry Run of Pseudocode

1. Dry Run

A dry run involves manually going through the algorithm with sample data to identify any errors. It helps verify whether the algorithm gives the correct output and confirms that the logic is correct before actual application, helping to detect errors early.

2. Dry Run of Pseudocode

A dry run of pseudocode involves manually simulating the execution of the pseudocode line by line. This helps in verifying the logic and correctness of the algorithm.

Example: Finding the Maximum of Two Numbers

Pseudocode for finding the maximum of two numbers:

text

Algorithm: FindMax

1. Input: num1, num2

2. if num1 > num2 then

3. max = num1

4. else

5. max = num2

6. end if

7. Output: max

Steps to dry run this pseudocode:

1. Input num1 and num2 (e.g., 10 and 15)
2. Check if num1 > num2 (10 > 15: False)
3. Since the condition is False, max = num2 (max = 15)
4. Output max (15)

DID YOU KNOW?

Q: What is the importance of dry running in programming? (09504013a)

Ans: Dry running helps to detect errors and ensures that an algorithm works correctly before actual execution, saving time and effort.

SIMULATION

Q.14: What is simulation, and how does it help in testing algorithms, exploring different scenarios, and understanding real-world systems? Also, explain its benefits and give examples of its use. (09504014)

Ans: ★ Key Points: Simulation | Use of Simulation | Benefits of Simulation

1. Simulation

Simulation is the use of computer programs to create a model of a real-world process or system. This helps us understand how things work by testing different ideas or algorithms without needing to try them out in real life.

2. Why Use Simulation?

- **Testing Algorithms:** We can use simulation to see how well an algorithm works with different types of data. For example, if we want to test a new way to sort numbers, we can simulate it with different sets of numbers to see how fast it is.
- **Exploring Scenarios:** Simulation allows us to create many different situations to see what happens. For example, in a science experiment about plant growth,

we can simulate different amounts of water or sunlight to find out which conditions help plants grow best.

Benefits of Simulation

- **Cost-Effective:** It is often cheaper and faster to run simulations than to conduct real experiments.
- **Safe:** We can test dangerous situations, like a fire in a building, without putting anyone at risk.
- **Repeatable:** We can run the same simulation multiple times with different settings to observe how things change.

Examples of Simulation

- **Weather Forecasting:** Meteorologists use simulations to predict the weather. They input data about temperature, humidity, and wind speed into a computer model to see how the weather might change over the next few days.
- **Traffic Flow:** City planners can simulate traffic to see how changes to roads or traffic lights might affect the flow of cars. This helps them design better roads and reduce traffic jams.

INTRODUCTION TO LARP

Q.15: What is LARP and why is it important? (09504015)

Ans: ★ Key Point: LARP

Introduction to LARP (Logic of Algorithms for Resolution of Problems)

LARP stands for **Logic of Algorithms for Resolution of Problems**. It is a fun and interactive way to learn how algorithms work by actually running them and seeing the results. Think of it as a playground where you can experiment with different algorithms and understand how they process data.

2. Why is LARP Important?

LARP helps you:

- Understand how algorithms work.
- See the effect of different inputs on the output.
- Practice writing and improving your own algorithms.

Q.16: How does LARP help in writing algorithms, and what are the basic commands and structures used in developing logical solutions? (09504016)

Ans: ★ Key Point: Writing Algorithms

Writing Algorithms

Writing algorithms using LARP involves a structured and simplified approach to developing logical solutions for computational problems. LARP employs a clear syntax that begins with a START command and ends with an END command, ensuring that each step of the algorithm is easy to follow. Within this framework, instructions are provided in a straightforward manner, such as using WRITE to display messages, READ to input values, and conditional statements like IF...THEN...ELSE to handle decision-making processes.

Example: Write an algorithm to check if a number is even or odd.

Q.17: How are flowcharts drawn and executed in LARP, and how does this process help in understanding the step-by-step logic of an algorithm? (09504017)

Ans: ★ Key Point: Flowcharts in LARP

Drawing Flowcharts in LARP

Drawing flowcharts in LARP involves visually representing the algorithm's steps using standard flowchart symbols such as rectangles for processes, diamonds for decisions, and parallelograms for input/output operations. Once the flowchart is created, it can be executed in LARP by translating the flowchart into LARP syntax, which uses straightforward commands like START, WRITE, READ, IF...THEN...ELSE, and END.

This process allows students to visualize the logic of their algorithm and see its step-by-step execution. For example, a flowchart for determining whether a student's grade is above 'A' or not can be executed to verify its correctness. This hands-on approach reinforces understanding of how a flowchart works.

ERROR IDENTIFICATION AND DEBUGGING

Q.18: What is error identification and debugging in LARP? (09504018)

Ans: ★ Key Points: Error Identification and Debugging | Types of Errors

1. Error Identification and Debugging

When we write algorithms or create flowcharts in LARP, we sometimes make mistakes called errors or bugs. These mistakes can prevent our algorithms from functioning correctly. Error handling and debugging are processes that help us find and fix these errors.

2. Types of Errors

There are three main types of errors you might encounter:

1. **Syntax Errors:** These occur when we write something incorrectly in our algorithm or flowchart. For example, missing a step or using the wrong symbol.
2. **Runtime Errors:** These happen when the algorithm or flowchart is being executed. For example, trying to perform an impossible operation, such as dividing by zero.
3. **Logical Errors:** These are mistakes in the logic of the algorithm that cause it to behave incorrectly. For example, using the wrong condition in a decision step.

3. Common Error Messages in LARP

These are some common error messages you might see in LARP and what they mean:

- **Missing Step:** You probably forgot to include an important step in your algorithm.
- **Undefined Variable:** You are using a variable that hasn't been defined yet.
- **Invalid Operation:** You are trying to perform an operation that is not allowed, like dividing by zero.

DID YOU KNOW?

Q: What do you know about debugging? (09504018a)

Ans: The term "debugging" comes from an actual bug - a moth that was found causing problems in an early computer. The moth was removed, and the process was called "debugging".

Q: What is the difference between syntax errors and logical errors in programming? (09504018b)

Ans: Syntax errors are the easiest to find because tools like LARP (or other compilers/interpreters) usually point them out immediately. Logical errors are harder to detect because the program runs without crashing but produces incorrect results, meaning the algorithm does not behave as intended.

TIDBIT

Q: What is a good practice when dealing with errors in programming? (09504019a)

Ans: Always read error messages carefully, because they often indicate exactly where the problem is and provide clues on how to fix it.

TOPIC WISE SHORT QUESTIONS (ADDITIONAL)

Computational Thinking

Q.1: What is Computational Thinking? (09504019)

Ans: Computational Thinking is a problem-solving process that involves a set of skills and techniques to solve complex problems. It allows solutions to be executed by a computer and can be applied in fields beyond computer science, like biology, mathematics, or daily life.

Q.2: What is Decomposition? (09504020)

Ans: Decomposition is the method of breaking a complicated problem into smaller, manageable tasks. It helps in handling each part of a complex problem step by step, making it easier to solve.

Q.3: What is Pattern Recognition? (09504021)

Ans: Pattern recognition is identifying and understanding regularities or patterns within data or problems. It helps in predicting structures and simplifying problem-solving in computational thinking.

Q.4: What is Abstraction? (09504022)

Ans: Abstraction is the process of hiding complex details while showing only the necessary parts. It reduces complexity and allows focusing on the high-level overview without getting lost in details.

Q.5: What is an Algorithm? (09504023)

Ans: An algorithm is a step-by-step set of instructions to solve a problem or complete a task. It provides a precise sequence to achieve a specific goal, like following a recipe.

Q.6: What are the key principles of Computational Thinking? (09504024)

Ans: Computational Thinking is based on key principles such as decomposition, pattern recognition, abstraction, and algorithm design, which help in structured problem-solving.

Q.7: What is Problem Understanding? (09504025)

Ans: Problem understanding involves identifying the core issue, defining requirements, and setting objectives. It is the first and most important step in computational thinking, requiring thorough analysis before finding a solution.

Q.8: What is Problem analysis in CT? (09504026)

Ans: Problem analysis in computational thinking is the process of understanding a problem by breaking it into smaller parts and identifying its inputs, outputs, and requirements before finding a solution.

Q.9: What is Problem Simplification? (09504027)

Ans: Problem simplification involves breaking a problem into smaller, more manageable sub-problems. For example, designing a website can be simplified by separating tasks into layout design, content creation, and coding functionality.

Q.10: What is Solution Selection and Design? (09504028)

Ans: Solution selection involves evaluating different approaches and choosing the most efficient one. Solution design requires creating a detailed plan or algorithm to implement the chosen approach effectively.

Algorithm Design Methods

Q.11: What are Algorithm Design Methods? (09504029)

Ans: Algorithm design methods are used to create efficient algorithms, such as using flowcharts and pseudocode to represent logical solutions. Algorithm design methods provide tools and techniques to solve computational problems effectively. Each method has strengths and weaknesses.

Q.12: What is a Flowchart? (09504030)

Ans: A flowchart is a visual representation of steps in a process or system, using symbols connected by arrows. It is widely used in computer science, engineering, and business to model processes, design systems, and communicate workflows clearly.

Q.13: What is the purpose of connector symbol in flowcharts? (09504031)

Ans: A connector in a flowchart is used to link different parts of flowchart and continue the flow without drawing long or confusing lines.

Q.14: Why are Flowcharts important? (09504032)

Ans: Flowcharts provide clarity, making processes easier to understand at a glance. They improve communication, help identify bottlenecks for problem-solving, and serve as documentation for training and reference.

Q.15: What are common Flowchart symbols and their meanings? (09504033)

Ans: Common flowchart symbols are:

- **Oval:** Represents Start/End
- **Rectangle:** Represents a Process

- **Parallelogram:** Represents Input/Output
- **Diamond:** Represents a Decision
- **Arrow:** Shows the Flow direction

Each symbol visually represents steps and decisions to guide the process clearly.

Q.16: Who popularized Flowcharts? (09504034)

Ans: Flowcharts were popularized by computer scientists John von Neumann and Herman Goldstine in the early days of computing. They helped make processes easier to visualize and communicate.

Q.17: What is Pseudocode? (09504035)

Ans: Pseudocode is a method of representing an algorithm using simple, informal language. It combines programming structure with plain English readability to plan and explain algorithms.

Q.18: How does Pseudocode work? (09504036)

Ans: Pseudocode describes steps of an algorithm in a way that is easy to follow without being actual code. It helps programmers focus on logic without worrying about programming language syntax.

Q.19: What are the benefits of using Pseudocode? (09504037)

Ans: Pseudocode provides clarity, allows planning of algorithm steps, and facilitates communication among team members. It ensures that program logic is correct before actual coding begins.

Q.20: Difference between Flowcharts and Pseudocode? (09504038)

Ans: Flowcharts use visual symbols to show process flow, while pseudocode uses structured plain language to describe steps. Flowcharts are visual and show decisions at a glance, whereas pseudocode is sequential and narrative-like, suitable for converting into code.

Evaluation Techniques for an Algorithm

Q.21: What are Evaluation Techniques for an Algorithm? (09504039)

Ans: Evaluation techniques help determine how efficiently an algorithm solves a problem. They focus on measuring its performance in terms of time and memory usage, which helps in comparing and improving different algorithms.

Q.22: What is Time Complexity? (09504040)

Ans: Time complexity measures how fast or slow an algorithm runs as the size of the input increases. It shows how running time grows, for example, finding a name in a list takes longer as the list becomes larger.

Q.23: How is Time Complexity expressed? (09504041)

Ans: Time complexity is usually expressed using Big O notation, such as O(n), O(log n), or $O(n^2)$. This notation helps compare different algorithms to see which one is faster.

Q.24: What is Space Complexity? (09504042)

Ans: Space complexity measures the amount of memory an algorithm uses relative to the input size. It includes both memory needed for input and any extra memory used during processing.

Dry Run

Q.25: Define Dry Run. (Board 2026) (09504043)

Ans: A dry run is the process of manually executing an algorithm step-by-step using sample data to identify errors. It helps verify the logic, correctness, and expected output of the algorithm without using a computer.

Q.26: How is a Dry Run applied to a Flowchart? (09504044)

Ans: A dry run of a flowchart is performed by manually following each step of the flowchart. This identifies logical errors and helps understand the flow of control in the process.

Q.27: How is a Dry Run applied to Pseudocode? (09504045)

Ans: A dry run of pseudocode involves simulating the execution line-by-line with sample inputs. This helps verify the algorithm's logic and detect any errors before implementation.

Q.28: What is Simulation? (09504046)

Ans: Simulation is the use of computer programs to model a real-world process or system. It helps in testing, analyzing, and understanding algorithms or systems by experimenting with different scenarios without performing them in real life.

Q.29: Why do we use Simulation? (09504047)

Ans: Simulation helps test algorithms with different data and explore multiple scenarios safely. For example, sorting numbers or experimenting with plant growth conditions can be simulated to observe results.

Q.30: What are the benefits of Simulation? (09504048)

Ans: Simulation is cost-effective, safe, and repeatable. It allows testing dangerous or expensive scenarios multiple times to understand outcomes without real-world risks.

Introduction to LARP

Q.31: What is LARP? (09504049)

Ans: LARP stands for Logic of Algorithms for Resolution of Problems. It is an interactive way to learn how algorithms work by running them and observing results, allowing experimentation and understanding of data processing.

Q.32: Why is LARP important? (09504050)

Ans: LARP helps users understand how algorithms work, see the effect of different inputs on outputs, and practice writing and improving their own algorithms. It makes learning algorithm logic fun and hands-on.

Q.33: How does LARP help in writing algorithms? (09504051)

Ans: Writing algorithms in LARP uses a structured approach starting with START and ending with END commands. Instructions like WRITE, READ, and IF...THEN...ELSE are used to display messages, take input, and handle decisions logically.

Q.34: How are flowcharts drawn and executed in LARP? (09504052)

Ans: Flowcharts in LARP use standard symbols like rectangles for processes, diamonds for decisions, and parallelograms for input/output. Once drawn, they can be executed by translating the flowchart into LARP commands to visualize and verify the algorithm step-by-step.

Q.35: How does executing flowcharts in LARP help understanding? (09504053)

Ans: Executing flowcharts allows students to see the step-by-step logic in action. This hands-on approach reinforces understanding by showing how each decision and process affects the output of the algorithm.

Q.36: What is error identification and debugging in LARP? (09504054)

Ans: Error identification and debugging involve finding and fixing mistakes in algorithms or flowcharts that prevent correct execution. This ensures the algorithm works as intended and improves programming accuracy.

Q.37: What are the main types of errors in LARP? (09504055)

Ans: The three main types are syntax errors (mistakes in writing commands), runtime errors (errors during execution like dividing by zero), and logical errors (incorrect logic that produces wrong results).

Q.38: Where does the term "debugging" come from? (09504056)

Ans: The term comes from an actual bug - a moth found in an early computer that caused problems. Removing the moth to fix the issue became known as "debugging."

MULTIPLE CHOICE QUESTIONS

1. What does CT stand for? (09504057)
   - (a) Creative Thinking
   - (b) Critical Thinking
   - (c) Computational Thinking ✓
   - (d) Complex Thinking
2. Computational Thinking is primarily a: (09504058)
   - (a) Coding technique
   - (b) Problem-solving process ✓
   - (c) Mathematical formula
   - (d) Daily routine
3. Which of the following fields can Computational Thinking be applied to? (09504059)
   - (a) Biology
   - (b) Mathematics
   - (c) Daily life
   - (d) All of these ✓
4. What is Decomposition in CT? (09504060)
   - (a) Hiding details
   - (b) Recognizing patterns
   - (c) Breaking down a problem into smaller components ✓
   - (d) Writing code
5. Which is the first step in decomposing a birdhouse task? (09504061)
   - (a) Cut the wood
   - (b) Assemble the pieces
   - (c) Design the Birdhouse ✓
   - (d) Paint and Decorate
6. Which step involves gathering wood, nails, and tools in building a birdhouse? (09504062)
   - (a) Cut the wood
   - (b) Gather Materials ✓
   - (c) Install the birdhouse
   - (d) Design the birdhouse

7. What does Pattern Recognition involve in CT? (09504063)
    - (a) Hiding details
    - (b) Breaking problems
    - (c) Identifying regularities or patterns ✓
    - (d) Writing algorithms
8. Abstraction in CT means: (09504064)
    - (a) Breaking down tasks
    - (b) Hiding complex details and focusing on necessary parts ✓
    - (c) Identifying patterns
    - (d) Following a recipe
9. An algorithm is: (09504065)
    - (a) A pattern
    - (b) A decomposition
    - (c) Step-by-step instructions ✓
    - (d) Abstract thinking
10. Which step is NOT part of planting a tree algorithm? (09504066)
    - (a) Dig a hole
    - (b) Place the tree upright
    - (c) Water the tree
    - (d) Cut the wood ✓
11. Algorithm for baking a cake is similar to: (09504067)
    - (a) Identifying patterns
    - (b) Following a recipe ✓
    - (c) Abstraction
    - (d) Decomposition
12. CT helps solve complex problems in a way that: (09504068)
    - (a) Is only theoretical
    - (b) Can be executed by a computer ✓
    - (c) Is unsolvable
    - (d) Requires no steps
13. What guides the process of problem-solving in computational thinking? (09504069)
    - (a) Random guesses

- (b) Trial and error
- (c) Key principles ✓
- (d) Mathematical formulas

14. The first and most important step in problem-solving is: (09504070)
    - (a) Solution Selection
    - (b) Problem Simplification
    - (c) Problem Understanding ✓
    - (d) Designing the algorithm
15. Designing a solution in CT is similar to: (09504071)
    - (a) Hiding complexity
    - (b) Breaking down tasks
    - (c) Creating a detailed plan ✓
    - (d) Recognizing patterns
16. What is a flowchart? (09504072)
    - (a) A text-based programming language
    - (b) A visual representation of steps ✓
    - (c) A pseudocode example
    - (d) A dry run simulation
17. In flowchart the oval symbol is used for: (Board 2026) (09504073)
    - (a) Process
    - (b) Input/Output
    - (c) Decision
    - (d) Start or End ✓
18. Rectangle symbol in a flowchart represents: (09504074)
    - (a) Decision
    - (b) Input/Output
    - (c) Process, task, or operation ✓
    - (d) Start or End
19. Parallelogram symbol in a flowchart represents: (09504075)
    - (a) Decision
    - (b) Process
    - (c) Input/Output ✓
    - (d) Flow direction

20. Diamond symbol in a flowchart represents: (09504076)
    - (a) Start/End
    - (b) Input/Output
    - (c) Decision point ✓
    - (d) Process
21. Arrow (Flowline) in a flowchart shows: (09504077)
    - (a) A process step
    - (b) Input/Output
    - (c) Decision
    - (d) Direction of flow ✓
22. Pseudocode is: (09504079)
    - (a) A flowchart
    - (b) A method of representing an algorithm using simple and informal language ✓
    - (c) A programming language
    - (d) A dry run
23. Benefits of using pseudocode: (09504080)
    - (a) Only speed
    - (b) Clarity, Planning, Communication ✓
    - (c) Visual representation
    - (d) Replaces flowcharts
24. Why is pseudocode used before actual code? (09504081)
    - (a) To run faster
    - (b) To ensure program logic is correct and facilitate communication ✓
    - (c) To visualize as a movie
    - (d) To create flowcharts
25. Evaluation of an algorithm mainly focuses on: (09504082)
    - (a) Flowchart design
    - (b) Only coding
    - (c) Time and space complexities ✓
    - (d) User interface
26. Time Complexity measures: (09504083)
    - (a) Memory usage

- (b) How fast or slow an algorithm performs ✓
- (c) Number of errors in code
- (d) The length of pseudocode

27. Time Complexity is usually expressed using: (09504084)
    - (a) Binary code
    - (b) HTML
    - (c) Big O notation ✓
    - (d) Flowchart symbols

28. Why use Big O notation? (09504085)
    - (a) To draw flowcharts
    - (b) To ignore runtime
    - (c) To compare different algorithms to see which is faster ✓
    - (d) To simplify pseudocode

29. Space Complexity measures: (09504086)
    - (a) Execution speed
    - (b) Number of steps
    - (c) Amount of memory an algorithm uses ✓
    - (d) Flow of a process

30. Purpose of a dry run is? (09504087)
    - (a) Only to test speed
    - (b) To identify logical errors and understand flow of control ✓
    - (c) To convert into pseudocode
    - (d) To create graphics

31. Dry run of pseudocode involves: (09504088)
    - (a) Running the code on a computer
    - (b) Manually simulating execution line-by-line ✓
    - (c) Drawing flowchart symbols
    - (d) Ignoring conditions

32. What is simulation? (09504089)
    - (a) Drawing flowcharts
    - (b) Writing pseudocode
    - (c) Using computer programs to create a model of a real-world ✓
    - (d) Running a dry run

33. Benefits of simulation include: (09504090)
    - (a) Costly, risky, not repeatable
    - (b) Only visual output
    - (c) Cost-effective, Safe, Repeatable ✓
    - (d) Replaces flowcharts

34. What does LARP stand for? (09504091)
    - (a) Logical Algorithmic Recursive Programming
    - (b) Logic of Algorithms for Resolution of Problems ✓
    - (c) Learning Algorithms for Real Programming
    - (d) Logical Analysis of Recursive Procedures

35. Purpose of LARP is? (09504092)
    - (a) Only to write pseudocode
    - (b) Only to draw flowcharts
    - (c) To learn how algorithms work by running them and seeing results ✓
    - (d) To memorize programming commands

36. Basic commands in LARP include: (09504093)
    - (a) FOR, WHILE, DO
    - (b) PRINT, INPUT
    - (c) START, END, WRITE, READ, IF...THEN...ELSE ✓
    - (d) DRAW, EXECUTE

37. What does WRITE command do in LARP? (09504094)
    - (a) Input values
    - (b) Display messages or output ✓
    - (c) Execute flowchart
    - (d) End the program

38. What does READ command do in LARP? (09504095)
    - (a) Display output
    - (b) Execute a loop
    - (c) Input values from the user ✓
    - (d) Start a new flowchart

39. Error identification and debugging in LARP is for: (09504096)
    - (a) Drawing flowcharts
    - (b) Finding and fixing mistakes in algorithms or flowcharts ✓

- (c) Writing pseudocode only
- (d) Running simulations

40. Which is a syntax error in LARP? (09504097)
    - (a) Dividing by zero
    - (b) Writing something incorrectly ✓
    - (c) Using wrong input values
    - (d) Incorrect dry run

41. Which is a runtime error in LARP? (09504098)
    - (a) Missing a flowchart step
    - (b) Performing an impossible operation during execution, like dividing by zero ✓
    - (c) Writing pseudocode in plain English
    - (d) Using WRITE command

42. Which is a logical error in LARP? (09504099)
    - (a) Using an undefined variable
    - (b) Dividing by zero
    - (c) Using wrong condition in steps ✓
    - (d) Missing END command

43. Common error message "Undefined Variable" means: (09504100)
    - (a) Algorithm is perfect
    - (b) Using a variable that hasn't been defined yet ✓
    - (c) Missing END command
    - (d) Successful execution

44. The term "debugging" originates from: (09504101)
    - (a) A programming command
    - (b) An actual bug (moth) found in an early computer ✓
    - (c) Flowchart symbols
    - (d) Pseudocode errors

ANSWER KEY (MCQs)

Q#	Ans	Q#	Ans	Q#	Ans	Q#	Ans	Q#	Ans
1	c	10	d	19	c	28	c	37	b
2	b	11	b	20	c	29	c	38	c
3	d	12	b	21	d	30	b	39	b
4	c	13	c	22	b	31	b	40	b
5	c	14	c	23	b	32	c	41	b
6	b	15	c	24	b	33	c	42	c
7	c	16	b	25	c	34	b	43	b
8	b	17	d	26	b	35	c	44	b
9	c	18	c	27	c	36	c	45	b

SOLVED EXERCISE

Multiple Choice Questions

1. Which of the following best defines computational thinking? (09504102)

- (a) A method of solving problems using mathematical calculations only.
- (b) A problem-solving approach that employs systematic, algorithmic, and logical thinking. ✓
- (c) A technique used exclusively in computer programming.
- (d) An approach that ignores real-world applications.

2. Why is problem decomposition important in computational thinking? (09504103)

- (a) It simplifies problems by breaking them down into smaller, more manageable parts. ✓
- (b) It complicates problems by adding more details.
- (c) It eliminates the need for solving the problem.
- (d) It is only useful for simple problems.

3. Pattern recognition involves: (09504104)

- (a) Finding and using similarities within problems ✓
- (b) Ignoring repetitive elements

- (c) Breaking problems into smaller pieces
- (d) Writing detailed algorithms

4. Which term refers to the process of ignoring the details to focus on the main idea? (09504105)

- (a) Decomposition
- (b) Pattern recognition
- (c) Abstraction ✓
- (d) Algorithm design

5. Which of the following is a principle of computational thinking? (09504106)

- (a) Ignoring problem understanding
- (b) Problem simplification ✓
- (c) Avoiding solution design
- (d) Implementing random solutions

6. Algorithms are: (09504107)

- (a) Lists of data
- (b) Graphical representations
- (c) Step-by-step instructions for solving a problem ✓
- (d) Repetitive patterns

7. Which of the following is the first step in problem-solving according to computational thinking? (09504108)

- (a) Writing the solution
- (b) Understanding the problem ✓
- (c) Designing a flowchart
- (d) Selecting a solution

8. Flowcharts are used to: (09504109)

- (a) Code a program
- (b) Represent algorithms graphically ✓
- (c) Solve mathematical equations
- (d) Identify patterns

9. Pseudocode is: (09504110)

- (a) A type of flowchart
- (b) A high-level description of an algorithm using plain language ✓

- (c) A programming language
- (d) A debugging tool

10. Dry running a flowchart involves: (09504111)

- (a) Writing the code in a programming language
- (b) Testing the flowchart with sample data ✓
- (c) Converting the flowchart into pseudocode
- (d) Ignoring the flowchart details

ANSWER KEY (Solved Exercise)

Q#	Ans
1	**b**
2	a
3	a
4	c
5	b
6	c
7	b
8	b
9	b
10	b

SHORT QUESTIONS

Q.1: Define computational thinking. (09504112)

Ans: Computational thinking is a problem-solving process that uses skills like decomposition, pattern recognition, abstraction, and algorithms to solve complex problems in a way that can be executed by a computer.

Q.2: What is decomposition in computational thinking? (09504113)

Ans: Decomposition is the process of breaking a complex problem into smaller, more manageable parts. Example: Building a birdhouse can be decomposed into designing, gathering materials, cutting wood, assembling, painting, and installing.

Q.3: Describe abstraction in problem-solving. (Board 2026) (09504114)

Ans: Abstraction involves hiding complex details and focusing only on the necessary parts of a problem. Example: Making tea can be abstracted as: boil water → add tea → wait → pour into cup → add milk/sugar.

Q.4: What is an algorithm? (09504115)

Ans: An algorithm is a step-by-step set of instructions to solve a problem or complete a task. Example: Planting a tree involves choosing a spot, digging a hole, placing the tree, filling soil, watering, and adding mulch.

Q.5: How does problem understanding help in computational thinking? (09504116)

Ans: Understanding a problem helps identify the core issue, requirements, and objectives, enabling the development of more accurate and effective solutions.

Q.6: Why do we use flowcharts? (09504117)

Ans: Flowcharts are used to visually represent steps in a process, making it easier to understand, communicate, document, and identify problems or bottlenecks.

Q.7: What is the purpose of pseudocode? (09504118)

Ans: Pseudocode is used to represent an algorithm in simple, readable language. It clarifies logic, helps plan steps, and allows easy communication before coding.

Q.8: How do you differentiate between flowcharts and pseudocode? (OR) Write one difference between flowchart and pseudocode. (Board 2026) (09504119)

Ans:

- **Flowcharts:** Use symbols and arrows, read visually, show process and decisions at a glance, good for understanding overall flow.
- **Pseudocode:** Uses plain text, read sequentially like a story, detailed narrative, useful for coding logic.

SOLVED ACTIVITIES

ACTIVITY-1: Human Network Activity (09503203)

Objective: Simulate a simple computer network to understand how data moves between devices, and the role of routers.

Materials Needed:

- A ball (represents a data packet)
- Strings or ropes (represent Ethernet cables)
- Name tags or labels for roles: Computer, Router, Data Packet

Steps to Perform the Activity:

1. Assign Roles

- Select a few students to act as computers (sender and receiver).
- Select one or more students as routers.
- The ball represents the data packet being transmitted.

2. Set Up the Network

- Arrange the students in a small network using strings to connect the computers and routers.
- Example layout: Computer A → Router → Computer B
- The strings act as the Ethernet cables connecting devices.

3. Simulate Data Transmission

- Step 1: Computer A wants to send data to Computer B.
- Step 2: Student acting as Computer A passes the ball (data packet) along the string to the Router.
- Step 3: Router student checks the "address" (predefined destination) and directs the ball along the correct string to Computer B.
- Step 4: Computer B receives the ball and confirms receipt.

4. Add Complexity (Optional)

- Introduce multiple routers or computers.
- Simulate errors or lost packets (ball dropped) to show why retransmission might be needed.
- Demonstrate different optimal paths the router could take to deliver data efficiently.

5. Discussion

- Discuss how the router decides the path.
- Explain how data packets are sent one by one and how addressing ensures they reach the correct device.
- Highlight the role of network cables and protocols in guiding data.

ACTIVITY-2: Star Topology Model (09503204)

Objective: Simulate a star network topology to understand how a central switch or hub connects to multiple nodes.

Materials Needed:

- 1 paper cup for the central switch
- Several paper cups for peripheral nodes (computers/printers/etc.)
- Strings (represent network cables)
- Marker or labels to identify each node and the switch

Steps to Create the Model:

1. Label the Cups

- Central cup = Switch
- Peripheral cups = Computer 1, Computer 2, etc.

2. Connect the Nodes

- Cut strings of equal length.
- Tie one end of each string to the central switch cup.
- Tie the other end to each peripheral cup.

Note: In star topology, every node has its own dedicated connection to the central switch. No node connects directly to another node.

3. Arrange the Model

- Place the central switch cup in the center.
- Spread the peripheral nodes around it.
- Ensure strings are taut to visually represent network cables.

4. Simulate Data Transmission

- Use a small ball or note as a data packet.
- Pass the ball from one node to the central switch cup.
- The switch "forwards" it to the destination node via its string.

5. Observation and Learning

- Only the central switch controls communication.

- If a string (cable) breaks, only that particular node is affected, not the whole network.
- Discuss advantages like easy troubleshooting and disadvantages like central point of failure.

ACTIVITY-3: Half-Duplex Communication (09503205)

Objective: Understand Half-Duplex communication, where data flows both ways but only one direction at a time.

Materials Needed:

- Walkie-talkies or toy telephones (enough for pairs of students)
- Optional: labels for "Speaker" and "Listener"

Steps:

1. Form Pairs

- Divide students into pairs.
- Each pair gets a walkie-talkie or toy telephone.

2. Explain the Rules

- In Half-Duplex, only one person can speak at a time.
- The other person must listen and wait before responding.

3. Simulate Communication

- Student A speaks a message into the device.
- Student B listens carefully and waits until Student A finishes.
- Student B then responds using the same device.
- Continue taking turns to simulate conversation.

4. Observation

- Discuss how only one-way communication happens at a time.
- Compare it with Full-Duplex, where both can talk simultaneously.

5. Optional Twist

- Introduce a small "delay" or pretend the line is busy to illustrate real-world limitations of Half-Duplex systems like walkie-talkies.

ACTIVITY-4: Session Layer Role-Play (09503207)

Objective: Understand how a network session is established, maintained, and terminated, using a phone call as an analogy.

Materials Needed: No special materials - just students and imagination.

Steps for the Role-Play:

1. Assign Roles

- Student A → Caller
- Student B → Receiver
- Optional Student C → Network/Protocol, to guide session management.

2. Session Establishment (Setup the Call)

- Student A "dials" Student B (pretend to make the call).
- Student B answers: This represents establishing a session, where both parties agree to communicate.
- Network/Protocol student can announce: "Session established".

3. Session Maintenance (During the Call)

- Both students talk back and forth, passing messages.
- Discuss how the session keeps track of the conversation, ensuring messages are sent and received in order.
- Optional: Network/Protocol student can monitor for interruptions or delays, showing how sessions manage communication reliability.

4. Session Termination (Ending the Call)

- When the conversation is done, Student A or B says "Goodbye" and "hangs up."
- Network/Protocol student announces: "Session terminated", showing that resources are freed and the communication ends.

Discussion Points:

- The Session Layer manages communication between applications.
- It ensures the call (session) starts, continues smoothly, and ends cleanly.
- Real-world examples: Video calls, online gaming, remote desktop sessions.

ACTIVITY-5: Application Layer Applications (09503208)

Objective: List the applications you use daily and identify which rely on the Application Layer for network services.

Application	Purpose	Application Layer Protocol/ Service Used
Web Browser (Chrome, Edge, Firefox)	**Access websites, view content**	**HTTP / HTTPS**
Email (Gmail, Outlook)	Send and receive emails	SMTP, POP3, IMAP

END OF NOTES