11th Class Computer Science Notes

Full Book - Chapter-wise Notes

Federal Board (FBISE) - HSSC Part 1

National Book Foundation (NBF) Book

Concept summaries - Key definitions - Short questions and answers - Long questions and answers - MCQs with answer key - for every chapter

These are original study notes written in simple language to help students revise the whole book and prepare for exams. They explain the ideas of each chapter, give the important definitions, and provide practice questions with answers.

Please note: The chapter list in these notes follows the current National Book Foundation (NBF) book for Class 11 Computer Science under the Federal Board, as reported by several current study sources. The official FBISE/NBF chapter list could not be confirmed directly from an official website during preparation. Students should check the chapter titles against their issued book, and follow their teacher's guidance if any title differs.

These notes are a study aid only. They do not replace the textbook. For paper pattern, marks distribution, and exam dates, always follow the official FBISE announcements and your school or college.

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How to use these notes

- First read the concept summary of a chapter and understand the ideas in your own words.
- Then learn the key definitions - they are the base of short questions and MCQs.
- Next, read the short questions and answers and try to answer each one before reading the answer.
- Then study the long questions, which explain bigger topics step by step.
- Finally, attempt the MCQs without looking at the key, then check your answers.
- For Chapter 3, practise the Python examples on a computer. Reading code is not enough - run it, change it, and see what happens.

> **Exam tip:** In answers, use the correct technical terms, give short headings where possible, and support your answer with one example. A short, clear, well-organised answer scores better than a long, confused one.

Chapter 1 - Computer Systems

Data representation, logic gates, Boolean algebra, software development, networks, cloud computing, and cybersecurity

Concept Summary - Part 1: Data and Signals

- A computer is an electronic machine that takes input, processes it according to instructions, and gives output. Its main parts are input devices, the processor, memory, storage, and output devices.
- All data inside a computer is stored in binary form, using only the digits 0 and 1. Each 0 or 1 is called a bit. A group of 8 bits is called a byte.
- Numbers, text, images, and sound are all converted into binary patterns. For example, each character of text is stored as a binary code, and a digital image is stored as a grid of tiny dots called pixels.
- An analog signal changes smoothly and continuously, like a sound wave. A digital signal has only two states, on and off, which match the binary digits 0 and 1. Computers work with digital signals because they are easier to store, copy, and protect from noise.
- Data representation means the method used to store data inside a computer. Integers are stored as binary numbers, characters are stored as binary codes, and images are stored as pixel values.
- The speed and capacity of a computer are measured in units such as hertz for processing speed, and bytes, kilobytes, megabytes, gigabytes, and terabytes for storage.

Concept Summary - Part 2: Logic Gates and Boolean Algebra

- A logic gate is a small electronic circuit that takes one or more binary inputs and gives one binary output, following a fixed logical rule.
- The AND gate gives 1 only when all its inputs are 1. The OR gate gives 1 when at least one input is 1. The NOT gate reverses its single input: 1 becomes 0 and 0 becomes 1.
- Other useful gates are NAND (AND followed by NOT), NOR (OR followed by NOT), XOR (gives 1 when the inputs are different), and XNOR (gives 1 when the inputs are the same).
- A truth table lists every possible combination of inputs and the output for each combination. It is the standard way to describe what a logic gate or a logic circuit does.
- Boolean algebra is the mathematics of true and false values, named after George Boole. Its basic operations are AND, OR, and NOT, and its laws (such as the identity, complement, commutative, associative, and distributive laws) are used to simplify logic expressions.
- A Karnaugh map (K-map) is a grid method for simplifying Boolean expressions. Values that differ in only one variable are grouped together, and each group removes one variable from the expression, giving a simpler circuit that uses fewer gates.
- Simplification matters because a simpler circuit is cheaper to build, uses less power, and works faster.

Concept Summary - Part 3: Software Development, Networks, Cloud, and Security

- The Software Development Life Cycle (SDLC) is the set of stages used to build software: planning, analysis, design, implementation, testing, deployment, and maintenance.
- In the waterfall model, the stages run in order, one after another, and each stage is finished before the next begins. In agile models, the software is built in small cycles, with regular feedback and improvements.
- A computer network connects computers so they can share data and resources. Common topologies are bus (all devices on one main cable), star (all devices connected to a central hub or switch), ring (devices in a closed loop), and mesh (devices connected to several others).
- Cloud computing means using computing services over the internet instead of owning the hardware yourself. In Software as a Service (SaaS) you use ready software, in Platform as a Service (PaaS) you get a platform to build your own software, and in Infrastructure as a Service (IaaS) you rent raw computing resources such as storage and servers.
- Cybersecurity is the protection of computer systems and data from theft, damage, or unauthorised use. Common threats include viruses, malware, phishing (fake messages that try to steal passwords), and hacking.
- Protection methods include strong passwords, two-factor authentication, antivirus software, firewalls, regular updates, and backups of important data.

Key Definitions - Chapter 1

Computer: An electronic machine that accepts data, processes it according to instructions, and produces useful output.

Bit: The smallest unit of data in a computer, a single binary digit, 0 or 1.

Byte: A group of 8 bits, the basic unit for measuring storage.

Analog signal: A signal that changes smoothly and continuously over time.

Digital signal: A signal that has only two states, on and off, matching binary digits.

Logic gate: An electronic circuit that performs a basic logical operation on binary inputs.

Truth table: A table showing the output of a logic circuit for every possible input combination.

Boolean algebra: The algebra of true and false values, using the operations AND, OR, and NOT.

Karnaugh map (K-map): A grid diagram used to simplify Boolean expressions by grouping neighbouring values.

SDLC: The Software Development Life Cycle, the stages followed to plan, build, test, and maintain software.

Network topology: The layout or pattern in which the devices of a network are connected.

Cloud computing: The delivery of computing services such as storage and software over the internet.

Phishing: A fraud in which fake messages or websites try to trick people into revealing passwords or personal information.

Short Questions and Answers - Chapter 1

Q1. What is the difference between a bit and a byte?

A bit is a single binary digit, 0 or 1, and is the smallest unit of data. A byte is a group of 8 bits and is the basic unit used to measure storage.

Q2. Why do computers use digital signals instead of analog signals?

Digital signals have only two states, on and off, so they are easier to store, copy, and process, and they are less affected by noise than analog signals.

Q3. What does the XOR gate do?

The XOR gate gives output 1 when its two inputs are different, and output 0 when its two inputs are the same.

Q4. What is a truth table?

A truth table lists all possible combinations of inputs to a logic circuit and the output for each combination. It fully describes the behaviour of the circuit.

Long Questions and Answers - Chapter 1

Q1. Explain the stages of the Software Development Life Cycle (SDLC) and compare the waterfall model with agile development.

The SDLC is the process of building software in organised stages. Planning defines the problem and checks whether the project is possible. Analysis studies what the users need. Design plans the structure of the software, its screens, and its data. Implementation is the actual coding. Testing checks the software for errors. Deployment puts the software into real use. Maintenance fixes problems and adds improvements after release.

In the waterfall model, these stages run in strict order, and one stage must be finished before the next starts. It is simple and easy to manage, but it is hard to go back and change an earlier stage. In agile development, the software is built in short cycles, and users give feedback after each cycle, so changes can be made quickly. Agile suits projects where requirements may change, while waterfall suits small projects with fixed, clear requirements.

Q2. What is cloud computing? Describe SaaS, PaaS, and IaaS with one example of each.

Cloud computing means using computing services over the internet instead of buying and maintaining your own hardware and software. The user pays for what is used and can increase or decrease the service as needed.

Software as a Service (SaaS) provides ready-to-use software over the internet, for example an online email service. Platform as a Service (PaaS) provides a platform with tools for developers to build and run their own applications, for example an online app-hosting platform. Infrastructure as a Service (IaaS) rents basic resources such as virtual servers and storage, for example an online storage service. The main benefits are lower cost, easy access from anywhere, and automatic updates and backups, while the main risks are dependence on internet access and on the provider's security.

MCQs - Chapter 1

1. How many bits are there in one byte? (a) 2 (b) 4 (c) 8 (d) 16

2. Which gate gives output 1 only when all inputs are 1? (a) OR (b) AND (c) NOT (d) XOR

3. A K-map is used to: (a) store data (b) simplify Boolean expressions (c) draw networks (d) write programs

4. In which network topology are all devices connected to a central hub? (a) Bus (b) Ring (c) Star (d) Mesh

5. Which cloud model provides ready-to-use software over the internet? (a) IaaS (b) PaaS (c) SaaS (d) None of these

6. Phishing is: (a) a type of hardware (b) a fraud using fake messages to steal information (c) a network cable (d) a programming language

Answer Key: 1-(c) 2-(b) 3-(b) 4-(c) 5-(c) 6-(b)

Chapter 2 - Computational Thinking and Algorithms

Thinking like a computer scientist, designing solutions, and the classic sorting and searching algorithms

Concept Summary - Part 1: Computational Thinking

- Computational thinking is a way of solving problems by breaking them into clear steps that a computer, or a person following instructions, can carry out.
- Its four main parts are: decomposition (breaking a big problem into smaller parts), pattern recognition (finding similarities between problems), abstraction (ignoring unimportant details and keeping only what matters), and algorithm design (writing the step-by-step solution).
- A computational artifact is something created by a human using a computer, such as a program, a website, a simulation, or a digital presentation. It is the product of a computational process.
- When designing an artifact, we judge it by parameters such as correctness (does it give the right result?), efficiency (does it use reasonable time and memory?), clarity (is it easy to understand and change?), and usability (is it easy for people to use?).
- An algorithm is a finite, ordered set of steps that solves a problem. A good algorithm must be clear, must end after a finite number of steps, and must give the correct result for all valid inputs.
- Algorithms can be written in plain language, shown as flowcharts, or written in pseudocode, which is a simple, code-like way of writing steps without following the strict rules of a programming language.

Concept Summary - Part 2: Sorting and Searching Algorithms

- Sorting means arranging data in order, for example numbers from smallest to largest. Searching means finding a particular value in a collection of data.
- In bubble sort, neighbouring pairs are compared again and again, and the larger value is moved towards the end. After each full pass, the largest remaining value reaches its correct place. It is simple but slow for large lists.
- In insertion sort, the list is divided into a sorted part and an unsorted part. Each new value is picked from the unsorted part and inserted into its correct place in the sorted part. It works well for small or nearly sorted lists.
- In linear search, values are checked one by one from the start until the wanted value is found or the list ends. It works on any list, sorted or not, but it can be slow for long lists.
- In binary search, the list must be sorted. The middle value is compared with the wanted value. If they are equal, the search ends. If the wanted value is smaller, the search continues in the left half; if larger, in the right half. The search area halves at each step, so binary search is much faster than linear search for large sorted lists.
- The efficiency of an algorithm is often described by how the number of steps grows as the input grows. Sorting by comparing neighbours grows roughly with the square of the list size, while binary search grows only with the logarithm of the list size.

Key Definitions - Chapter 2

Computational thinking: A problem-solving approach that breaks problems into clear, step-by-step solutions a computer can carry out.

Decomposition: Breaking a large problem into smaller, easier parts.

Pattern recognition: Finding similarities between problems so that a known solution can be reused.

Abstraction: Ignoring unimportant details and keeping only the information needed to solve a problem.

Algorithm: A finite, ordered set of steps that solves a problem.

Computational artifact: A product created by a human using a computer, such as a program or a simulation.

Pseudocode: A simple, code-like way of writing an algorithm without strict programming language rules.

Flowchart: A diagram that shows the steps of an algorithm using shapes such as ovals, rectangles, and diamonds.

Bubble sort: A sorting method that repeatedly compares neighbouring pairs and swaps them if they are in the wrong order.

Insertion sort: A sorting method that builds the sorted list one value at a time by inserting each new value into its correct place.

Linear search: A search method that checks values one by one from the start of a list.

Binary search: A fast search method for sorted lists that repeatedly halves the search area by comparing with the middle value.

Short Questions and Answers - Chapter 2

Q1. Name the four parts of computational thinking.

Decomposition, pattern recognition, abstraction, and algorithm design.

Q2. What is a computational artifact? Give one example.

A computational artifact is something created by a human using a computer. For example, a program, a website, or a simulation.

Q3. What condition must a list satisfy for binary search to work?

The list must be sorted. Binary search compares the middle value and halves the search area, which only works if the values are in order.

Q4. Why is binary search faster than linear search for a large sorted list?

Linear search may have to check every value, while binary search halves the remaining values at each step, so it needs far fewer comparisons.

Long Questions and Answers - Chapter 2

Q1. Explain bubble sort with a worked example on the list 5, 2, 4, 1.

Bubble sort compares neighbouring pairs and swaps them if they are in the wrong order, repeating passes until no swaps are needed. Start with 5, 2, 4, 1. First pass: compare 5 and 2, swap to get 2, 5, 4, 1. Compare 5 and 4, swap to get 2, 4, 5, 1. Compare 5 and 1, swap to get 2, 4, 1, 5. The largest value, 5, is now at the end. Second pass: compare 2 and 4 (no swap), compare 4 and 1, swap to get 2, 1, 4, 5. Third pass: compare 2 and 1, swap to get 1, 2, 4, 5. No more swaps are needed, so the list is sorted. Bubble sort is easy to understand but slow for long lists, because each value moves only one place per comparison.

Q2. Explain binary search step by step and state its main advantage and limitation.

Binary search works only on a sorted list. Take the sorted list 2, 5, 8, 12, 16, 23, 38, 56, 72, 91 and search for 23. First compare with the middle value, 16. Since 23 is larger, ignore the left half and search 23, 38, 56, 72, 91. The middle value is 56. Since 23 is smaller, search 23, 38. The middle value is 23, which matches, so the search ends successfully. The main advantage is speed: the search area halves at each step, so even a very long list needs only a few comparisons. The main limitation is that the list must be sorted first, and sorting itself takes time.

MCQs - Chapter 2

1. Breaking a big problem into smaller parts is called: (a) abstraction (b) decomposition (c) sorting (d) searching

2. Which of these is a computational artifact? (a) A computer mouse (b) A program written by a student (c) Electricity (d) A paper notebook

3. Binary search requires the list to be: (a) unsorted (b) sorted (c) empty (d) reversed

4. In bubble sort, after the first complete pass, which value is in its final place? (a) The smallest (b) The middle (c) The largest (d) None

5. Insertion sort builds: (a) the sorted list one value at a time (b) a flowchart (c) a truth table (d) a network

6. Linear search checks values: (a) from the middle outwards (b) randomly (c) one by one from the start (d) in pairs only

Answer Key: 1-(b) 2-(b) 3-(b) 4-(c) 5-(a) 6-(c)

Chapter 3 - Programming Fundamentals (Python)

Python basics, variables, operators, decisions, loops, lists, functions, graphics, and debugging

Concept Summary - Part 1: Python Basics, Variables, and Operators

- Python is a high-level, easy-to-read programming language. Programs are written in an editor and run with a Python interpreter. An IDE (Integrated Development Environment) is a program that combines an editor, a runner, and debugging tools in one place.
- A variable is a named storage location that holds a value. In Python, you do not declare the type in advance; the type is decided by the value assigned, for example x = 10 stores an integer and name = "Ali" stores a string.
- Common data types are int (whole numbers), float (decimal numbers), str (text), and bool (True or False).
- Input is taken with the input() function, which always returns text. To use a number, convert it, for example int(input("Enter age: ")). Output is shown with the print() function.
- Arithmetic operators are + (add), - (subtract), * (multiply), / (divide), // (integer division), % (remainder), and ** (power).
- Comparison operators (==, !=, <, >, <=, >=) compare two values and give True or False. Logical operators are and, or, and not. Membership operators in and not in check whether a value exists inside a sequence such as a list or a string. Bitwise operators (&, |, ^, <<, >>) work on the binary form of integers.
- A library is a collection of ready-made functions. You bring it into a program with import, for example import math gives access to mathematical functions, and import turtle gives the Turtle graphics library.

Concept Summary - Part 2: Decisions, Loops, Lists, Functions, and Debugging

- Conditional statements let a program choose between paths. if runs a block when a condition is True, elif tests further conditions, and else runs when no condition is True. Indentation (spaces at the start of a line) shows which lines belong to a block.
- Loops repeat a block of code. A for loop repeats a fixed number of times, often over a range or a list. A while loop repeats while a condition stays True, so it must have a step that eventually makes the condition False, or it will run forever.
- A list is an ordered, changeable collection of values in square brackets, for example marks = [85, 90, 78]. Items are reached by index starting at 0, so marks[0] is 85. Useful operations include append() to add an item, remove() to delete a value, and len() to count the items.
- A function is a named block of code that does one job and can be used again and again. It is defined with def and may take parameters and return a value with return. Functions make programs shorter, clearer, and easier to fix.
- Turtle graphics lets beginners draw with a virtual turtle. Commands such as forward(100), left(90), and circle(50) move the turtle and draw shapes on the screen.
- Debugging means finding and fixing errors. A syntax error breaks the rules of the language, a logical error gives the wrong result, and a runtime error stops the program while it runs. The pdb debugger lets you run a program step by step, check variable values, and find where it goes wrong. The assert statement checks a condition during testing and stops the program with an error if the condition is False.

Python Code Examples

Read each example, then run it and try changing one value at a time.

```
# Example 1: input, condition, and output
marks = int(input("Enter marks: "))
if marks >= 50:
    print("Pass")
else:
    print("Fail")
```

```
# Example 2: a for loop over a list
numbers = [3, 7, 2, 9]
total = 0
for n in numbers:
    total = total + n
print("Total:", total)
print("Average:", total / len(numbers))
```

```
# Example 3: a simple function
def square(x):
    return x * x
print(square(6))  # Output: 36
```

Key Definitions - Chapter 3

Program: A set of instructions written to make a computer perform a task.

IDE: An Integrated Development Environment, a tool that combines a code editor, a runner, and debugging help.

Variable: A named storage location that holds a value which may change.

Data type: The kind of value stored, such as int, float, str, or bool.

Operator: A symbol that performs an operation on values, such as + for addition or == for comparison.

Conditional statement: A statement such as if, elif, and else that lets a program choose between different paths.

Loop: A structure that repeats a block of code, such as for or while.

List: An ordered, changeable collection of values written in square brackets.

Function: A named block of code that performs one job and can be reused.

Parameter: A value passed into a function when it is called.

Library: A collection of ready-made functions that can be imported into a program.

Debugging: The process of finding and fixing errors in a program.

Syntax error: An error caused by breaking the rules of the programming language.

Logical error: An error in which the program runs but gives the wrong result.

Short Questions and Answers - Chapter 3

Q1. Why does input() need int() around it when reading a number?

Because input() always returns text. int() converts that text into an integer so that arithmetic can be done on it.

Q2. What is the difference between == and = in Python?

The single = assigns a value to a variable, for example x = 5. The double == compares two values and gives True or False, for example x == 5.

Q3. What does the range of a list index start from, and what is marks[0] if marks = [85, 90, 78]?

List indexes start from 0. So marks[0] is 85, the first item of the list.

Q4. What is the difference between a syntax error and a logical error?

A syntax error breaks the language rules, so the program cannot run at all. A logical error lets the program run but gives the wrong result because the logic is wrong.

Long Questions and Answers - Chapter 3

Q1. Explain if, elif, and else with a program that prints the grade for given marks (90 or above: A, 75 or above: B, 60 or above: C, 50 or above: D, below 50: Fail).

Conditional statements test conditions in order and run only the first block whose condition is True. The program reads the marks, then tests from the highest grade downwards. If marks are 90 or above, it prints A and skips the rest. Otherwise it tests 75, then 60, then 50. If none of the conditions is True, the else block prints Fail. Testing from the highest value downwards is important: if the test for 50 came first, every passing student would get D, because 50 or above would be True for them too.

Program: marks = int(input("Enter marks: ")); if marks >= 90: print("Grade A"); elif marks >= 75: print("Grade B"); elif marks >= 60: print("Grade C"); elif marks >= 50: print("Grade D"); else: print("Fail"). Each block is indented, because indentation shows which lines belong to which condition.

Q2. What is a function? Why are functions useful? Write a function that returns the largest of two numbers and show how to call it.

A function is a named block of code that performs one job. It is defined once with def and can be called many times with different values. Functions are useful because they avoid repeating the same code, they make programs easier to read and test, and a fault can be fixed in one place instead of everywhere the code appears.

Example: def largest(a, b): if a > b: return a; else: return b. The values a and b are parameters. Calling largest(12, 7) returns 12, and print(largest(12, 7)) shows 12. The return statement sends the result back to the caller, which is different from print, which only shows a value on the screen.

MCQs - Chapter 3

1. In Python, list indexes start from: (a) 1 (b) 0 (c) -1 (d) 2

2. Which function is used to take input from the user? (a) print() (b) input() (c) len() (d) append()

3. Which operator gives the remainder of a division? (a) / (b) // (c) % (d) **

4. Which keyword is used to define a function? (a) func (b) def (c) define (d) function

5. Which statement checks a condition during testing and stops the program if it is False? (a) print (b) import (c) assert (d) return

6. The membership operator in checks: (a) the type of a variable (b) whether a value exists in a sequence (c) the length of a list (d) the speed of a program

Answer Key: 1-(b) 2-(b) 3-(c) 4-(b) 5-(c) 6-(b)

Chapter 4 - Data and Analysis

Collecting data, statistical models, machine learning basics, and visualising data with Python

Concept Summary - Part 1: Data and Gathering Data

- Data means recorded facts and figures, such as numbers, words, and measurements. Information is data that has been processed and organised so that it becomes useful for a decision.
- Data can be quantitative (numbers, such as heights or marks) or qualitative (descriptions, such as opinions or colours). It can also be structured (neatly organised in tables) or unstructured (such as free text or images).
- Data gathering means collecting data for a purpose. Common methods are surveys, interviews, observations, experiments, and reading existing records or sensors.
- Good data gathering needs a clear question, a suitable method, and a fair sample. A sample is the smaller group actually studied, chosen to represent the larger population.
- Experimental design means planning an experiment properly: stating the question, deciding what to change (the independent variable) and what to measure (the dependent variable), keeping other factors constant, and repeating the experiment to check the result.
- Bad data leads to bad conclusions. Common problems are biased samples, unclear questions, missing values, and recording errors. Data must be cleaned before analysis, for example by removing duplicates and filling or dropping missing values sensibly.

Concept Summary - Part 2: Models and Visualisation

- A statistical model is a simple mathematical description of data that helps us understand patterns and make predictions. A model is judged by how well it fits the data and how well it predicts new data.
- In supervised learning, the computer learns from examples that already have answers (labelled data), such as pictures already marked as cat or dog. In unsupervised learning, the computer finds patterns in data without answers, such as grouping similar customers together.
- Regression is a supervised method that predicts a number, for example predicting a house price from its size. Classification is a supervised method that predicts a category, for example deciding whether an email is spam or not.
- Overfitting happens when a model memorises the training data, including its noise, and then performs badly on new data. The cure is to keep the model simple and test it on data it has not seen.
- Data visualisation means showing data as pictures so patterns are easy to see. A bar chart compares categories, a pie chart shows parts of a whole, a scatter plot shows the relationship between two numbers, and a boxplot shows the spread of values, including the median and the quartiles.
- In Python, the matplotlib library is used to draw charts. A scatter plot is drawn with scatter(), a bar chart with bar(), and a pie chart with pie(). Choosing the right chart matters: a pie chart suits a few parts of a whole, while a bar chart suits comparing many categories.

Key Definitions - Chapter 4

Data: Recorded facts and figures that have not yet been processed.

Information: Data that has been processed and organised so it is useful for decisions.

Quantitative data: Data in numbers, such as marks or heights.

Qualitative data: Data in descriptions, such as opinions or colours.

Sample: A smaller group chosen from a population to represent it in a study.

Population: The whole group about which a conclusion is to be drawn.

Independent variable: The factor that is changed on purpose in an experiment.

Dependent variable: The factor that is measured to see the effect of the change.

Supervised learning: Machine learning from labelled examples that already have answers.

Unsupervised learning: Machine learning that finds patterns in data without given answers.

Regression: A method that predicts a numerical value from other values.

Classification: A method that predicts a category for new data.

Overfitting: When a model memorises training data and performs badly on new data.

Visualisation: Showing data as charts and pictures so patterns are easy to understand.

Short Questions and Answers - Chapter 4

Q1. What is the difference between data and information?

Data are raw recorded facts, such as a list of marks. Information is data after processing and organisation, such as the class average, which helps in making a decision.

Q2. What is the difference between supervised and unsupervised learning?

In supervised learning, the computer learns from examples with known answers. In unsupervised learning, it finds patterns in data without any given answers.

Q3. When should you use a scatter plot?

A scatter plot is used to show the relationship between two numerical values, for example study hours and exam marks, so that a trend can be seen.

Q4. What is overfitting?

Overfitting happens when a model memorises the training data, including its random noise, and therefore performs badly on new, unseen data.

Long Questions and Answers - Chapter 4

Q1. Explain regression and classification with one example of each, and state which one predicts a number and which one predicts a category.

Both are supervised learning methods, meaning they learn from labelled examples. Regression predicts a numerical value. For example, a regression model can learn from past house sales, using size, rooms, and location, and then predict the price of a new house in rupees. The output is a number on a continuous scale.

Classification predicts a category. For example, a classification model can learn from old emails marked as spam or not spam, and then decide the category of a new email. The output is one of a fixed set of labels, not a number. In short: use regression when the answer is "how much", and use classification when the answer is "which type".

Q2. Describe the steps of a good experimental design and explain why controlling other factors matters.

A good experiment starts with a clear question, for example whether a new study method improves marks. Next, the independent variable (the study method) and the dependent variable (the marks) are decided. Other factors, such as study time and the test paper, are kept the same for all groups, so that any difference in results can be blamed only on the study method. The experiment is repeated with enough students to make the result reliable, and the data are recorded carefully and analysed.

Controlling other factors matters because, without control, a difference in results could be caused by any uncontrolled factor. For example, if one group also studied longer, we could not tell whether the method or the extra time caused the better marks. Control is what makes an experiment a fair test.

MCQs - Chapter 4

1. Processed and organised data that is useful for decisions is called: (a) data (b) information (c) noise (d) sample

2. Which method predicts a category? (a) Regression (b) Classification (c) Visualisation (d) Gathering

3. In an experiment, the factor that is changed on purpose is the: (a) dependent variable (b) independent variable (c) constant (d) sample

4. Which chart shows parts of a whole? (a) Scatter plot (b) Bar chart (c) Pie chart (d) Boxplot

5. In Python, charts are commonly drawn with the library: (a) turtle (b) math (c) matplotlib (d) pdb

6. Overfitting means a model: (a) is too simple (b) memorises training data and fails on new data (c) has no data (d) draws wrong charts

Answer Key: 1-(b) 2-(b) 3-(b) 4-(c) 5-(c) 6-(b)

Chapter 5 - Application of Computer Science

Internet of Things, embedded systems, blockchain, cryptography, and the impacts of AI systems

Concept Summary - Part 1: Internet of Things

- The Internet of Things (IoT) is a network of physical devices that collect data with sensors, share it over the internet, and act on it, often without human help. Examples are smart thermostats, fitness bands, and smart meters.
- An embedded system is a small computer built into a device to do one specific job, such as controlling a washing machine or an airbag. It is cheap, small, and uses little power, but it is not a general-purpose computer.
- A Wireless Sensor Network (WSN) is a group of small sensor devices that measure things such as temperature, humidity, or movement and send the readings wirelessly to a central point. WSNs are used in farming, weather monitoring, and health care.
- A typical IoT system has four parts: sensors that collect data, a network that carries the data, a processor or cloud service that analyses it, and an action, such as switching on a fan or sending an alert.
- The benefits of IoT are automation, saving time and energy, and better decisions from real data. The risks are weak security on cheap devices, loss of privacy when devices record personal habits, and heavy dependence on internet connections.

Concept Summary - Part 2: Blockchain, Cryptography, and AI Impacts

- A blockchain is a shared, ordered record of transactions grouped into blocks, where each block is linked to the previous one. Once a block is added, changing it is very hard, because all later blocks would also have to change, and all copies of the record would disagree.
- Because the record is shared and hard to change, blockchain is used where trust matters, such as recording payments, tracking goods in a supply chain, and keeping secure records.
- Cryptography is the science of protecting information by converting it into a secret form. Encryption converts readable text (plaintext) into unreadable text (ciphertext), and decryption converts it back. A key is the secret value used in this process.
- In symmetric encryption, the same key encrypts and decrypts. In asymmetric encryption, a public key encrypts and a private key decrypts, so anyone can send a secret message but only the key owner can read it.
- Artificial Intelligence (AI) systems can help society by improving health care, education, farming, and transport, but they can also cause harm, for example by spreading false information, replacing jobs, or making unfair decisions when trained on biased data.
- AI systems often face conflicting requirements: for example, collecting more data improves accuracy but harms privacy, and making a system fully automatic is efficient but removes human control. Designers must balance these trade-offs openly.

Key Definitions - Chapter 5

Internet of Things (IoT): A network of physical devices with sensors that collect, share, and act on data over the internet.

Sensor: A device that measures a physical quantity such as temperature, light, or movement and turns it into data.

Embedded system: A small computer built into a device to perform one specific task.

Wireless Sensor Network (WSN): A group of sensor devices that send their readings wirelessly to a central point.

Blockchain: A shared, ordered record of transactions in linked blocks that is very hard to change once written.

Block: A group of transactions in a blockchain, linked to the previous block.

Cryptography: The science of protecting information by converting it into a secret form.

Encryption: Converting readable plaintext into unreadable ciphertext.

Decryption: Converting ciphertext back into readable plaintext.

Key: A secret value used to encrypt or decrypt information.

Symmetric encryption: Encryption in which the same key is used to encrypt and decrypt.

Asymmetric encryption: Encryption in which a public key encrypts and a private key decrypts.

Artificial Intelligence (AI): Computer systems that perform tasks which normally need human intelligence, such as recognising patterns or making decisions.

Short Questions and Answers - Chapter 5

Q1. What is the Internet of Things? Give two examples.

The Internet of Things is a network of physical devices that collect data with sensors and share it over the internet. Examples are a smart thermostat and a fitness band.

Q2. What is an embedded system, and how is it different from a general-purpose computer?

An embedded system is a small computer built into a device for one specific job, such as controlling a washing machine. A general-purpose computer, by contrast, can run many different programs chosen by the user.

Q3. Why is a blockchain hard to change once a block is added?

Because each block is linked to the previous one, changing an old block would require changing all later blocks and all shared copies of the record, which is practically very hard.

Q4. What is the difference between symmetric and asymmetric encryption?

In symmetric encryption, the same key encrypts and decrypts. In asymmetric encryption, a public key encrypts and a different private key decrypts.

Long Questions and Answers - Chapter 5

Q1. Describe the four parts of a typical IoT system and explain one benefit and one risk of IoT, using a smart home example.

A typical IoT system has four parts. First, sensors collect data, for example a temperature sensor in a room. Second, a network, usually Wi-Fi, carries the data to a processor or cloud service. Third, the processor analyses the data, for example deciding that the room is too warm. Fourth, an action follows, such as switching on the air conditioner or sending an alert to the owner's phone.

One benefit is automation and saving energy: the system cools the room only when needed, without the owner remembering to switch it on. One risk is privacy and security: the same sensors record when people are at home, and if the device has weak security, an attacker could steal that information or take control of the device. So IoT gives comfort and savings, but only if devices are secured and personal data is protected.

Q2. What is cryptography? Explain encryption and decryption, and compare symmetric and asymmetric encryption.

Cryptography is the science of protecting information by converting it into a secret form so that only the intended receiver can read it. The original readable message is called plaintext. Encryption converts plaintext into ciphertext, which looks meaningless. Decryption converts ciphertext back into plaintext. Both steps use a key, a secret value without which the conversion cannot easily be reversed.

In symmetric encryption, the sender and receiver share one secret key, which is fast and simple, but sharing the key safely is itself a problem. In asymmetric encryption, each person has a pair of keys: a public key that anyone may use to encrypt a message for them, and a private key that only they hold and that decrypts it. This solves the key-sharing problem, but it is slower. In practice, systems often combine both: asymmetric encryption shares a temporary symmetric key, and symmetric encryption then protects the actual message.

MCQs - Chapter 5

1. IoT stands for: (a) Internet of Things (b) Internal Office Tools (c) Internet of Telephones (d) Input Output Technology

2. A washing machine controller is an example of a(n): (a) supercomputer (b) embedded system (c) blockchain (d) search engine

3. In a blockchain, transactions are grouped into: (a) files (b) blocks (c) tables (d) keys

4. Readable original text in cryptography is called: (a) ciphertext (b) plaintext (c) keytext (d) blocktext

5. In asymmetric encryption, decryption uses the: (a) public key (b) private key (c) same key as encryption (d) no key

6. A WSN is a network of: (a) large computers (b) small sensor devices sending readings wirelessly (c) satellites only (d) printers

Answer Key: 1-(a) 2-(b) 3-(b) 4-(b) 5-(b) 6-(b)

Chapter 6 - Impacts of Computing

Trustworthy information, bias, verification, connectivity, assistive technology, and new innovations

Concept Summary - Part 1: Trust, Bias, and Copyright

- Not all information on the internet is equally trustworthy. Before using a source, check who wrote it, whether the writer is qualified, whether the information is recent, whether other reliable sources agree, and whether the source has a reason to be biased.
- Credibility means how believable a source is. Signs of a credible source are a known author or organisation, references to evidence, and a clear difference between facts and opinions.
- Bias means a one-sided view. A source can be biased by selecting only favourable facts, by using emotional language, or by hiding who paid for the content.
- Human bias in data happens when the data used to train a system already reflects unfair treatment of some groups. For example, if past hiring data favours one group, a system trained on it may unfairly favour the same group in future decisions.
- Copyright is the legal right of a creator over their work, such as text, images, music, and software. Using someone else's work without permission, and without giving credit, can be a legal offence and is called plagiarism when presented as your own work.
- Fair use of short parts of a work for study, review, or teaching is allowed in many systems, but copying large parts, or whole works, without permission is not.

Concept Summary - Part 2: Verification, Connectivity, and Assistive Technology

- Verification means checking whether something is true. Human verification uses judgement, context, and knowledge, and it is good at understanding meaning, but it is slow. Computer verification is fast and can check huge amounts of data, but it cannot understand meaning the way humans do, and it can be fooled by cleverly designed false content.
- The best results often come from combining both: computers flag suspicious content quickly, and humans make the final judgement.
- Increased connectivity has environmental effects: more devices mean more electricity use and more electronic waste, but connectivity also saves resources, for example by replacing travel with video meetings and paper with digital documents.
- Connectivity also has cultural effects: it spreads ideas, languages, and entertainment across the world, which can enrich cultures but can also push small languages and traditions aside.
- Assistive technologies help people with disabilities use computers. Examples are screen readers that read text aloud for blind users, speech recognition for users who cannot type, and switch devices for users with limited movement.
- Recent innovations such as 5G mobile networks and modern smartphones show how fast computing changes life: faster connections allow video calls, online classes, mobile banking, and instant access to information almost anywhere.

Key Definitions - Chapter 6

Credibility: How believable and trustworthy an information source is.

Bias: A one-sided view that favours one side unfairly.

Human bias in data: Unfairness in data that reflects past unequal treatment of some groups.

Copyright: The legal right of a creator to control the use of their original work.

Plagiarism: Presenting someone else's work or ideas as your own without credit.

Verification: Checking whether information or a claim is true.

Human verification: Checking by people, using judgement and context.

Computer verification: Checking by machines, fast and large-scale, but without human understanding of meaning.

Electronic waste (e-waste): Discarded electronic devices and parts, which can harm the environment if not recycled.

Assistive technology: Technology that helps people with disabilities use computers and devices.

Screen reader: Software that reads on-screen text aloud for blind users.

5G: The fifth generation of mobile networks, offering much faster data speeds and lower delay than earlier generations.

Short Questions and Answers - Chapter 6

Q1. Give three checks to judge whether an online source is credible.

Check who wrote it and whether they are qualified, check whether the information is recent, and check whether other reliable sources agree with it.

Q2. How can human bias enter data used by a computer system?

If the past data already reflects unfair treatment of a group, a system trained on that data learns the same unfair pattern and repeats it in future decisions.

Q3. What is plagiarism?

Plagiarism is presenting someone else's work or ideas as your own without giving credit to the original creator.

Q4. What is one advantage of computer verification over human verification, and one disadvantage?

Computer verification is much faster and can check huge amounts of data. Its disadvantage is that it cannot understand meaning the way humans do, so it can be fooled by cleverly designed false content.

Long Questions and Answers - Chapter 6

Q1. How can a student check the credibility of an online source? Explain with an example.

A student should check the author, the date, the evidence, and the purpose of the source. Suppose a student finds a health claim on an unknown blog. First, they check the author: is it a doctor or a health organisation, or an unknown writer selling a product? Second, they check the date: is the information recent? Third, they check the evidence: does the page give references to studies, or only opinions? Fourth, they check other sources: do trusted health websites agree? If the author is unknown, the page is old, there are no references, and trusted sources disagree, the source is not credible and should not be used. A credible source passes most of these checks.

Q2. Discuss one environmental and one cultural effect of increased connectivity, and explain how assistive technology helps users with disabilities.

One environmental effect is electronic waste: more devices and faster replacement mean more discarded phones and computers, which contain harmful materials and must be recycled properly. At the same time, connectivity saves resources, for example when video meetings replace travel and digital documents replace paper.

One cultural effect is the spread of global entertainment and ideas, which enriches cultures but can push small languages and local traditions aside when global content dominates. Assistive technology reduces barriers for users with disabilities: a screen reader reads text aloud for a blind student, speech recognition lets a student who cannot type write by speaking, and switch devices let a student with limited movement control a computer. In this way, connectivity and assistive tools together make computing more inclusive.

MCQs - Chapter 6

1. Which of these is a sign of a credible source? (a) Unknown author (b) References to evidence (c) Emotional language only (d) Hidden sponsor

2. Presenting someone else's work as your own is called: (a) copyright (b) plagiarism (c) verification (d) bias

3. Computer verification is mainly better than human verification in: (a) understanding meaning (b) speed and scale (c) judging context (d) detecting jokes

4. A screen reader helps: (a) deaf users (b) blind users (c) users with no internet (d) programmers only

5. 5G is the: (a) fifth generation of mobile networks (b) name of a phone brand (c) fifth version of Python (d) a type of cable

6. Discarded electronic devices are called: (a) malware (b) e-waste (c) spam (d) cache

Answer Key: 1-(b) 2-(b) 3-(b) 4-(b) 5-(a) 6-(b)

Chapter 7 - Digital Literacy

Collecting data well, running surveys and interviews, and presenting research clearly

Concept Summary - Part 1: Collecting Data for Research

- Digital literacy means the ability to find, judge, use, and share information with digital tools, safely and responsibly. It includes searching well, judging sources, protecting privacy, and communicating clearly.
- Research data can be collected in several ways. In a survey, many people answer the same set of questions. In an interview, a researcher talks to people in depth. In observation, behaviour is watched and recorded. In a simulation, a computer model imitates a real situation so it can be studied safely and cheaply.
- A qualitative interview collects opinions, feelings, and reasons in the person's own words. It gives deep understanding but takes time and covers fewer people than a survey.
- Participant selection means choosing who will take part. Participants should fairly represent the group being studied, not only the easiest people to reach.
- Consent means that participants agree freely to take part after understanding the purpose of the study, what they will be asked, and how their answers will be used. Consent must be asked before the study starts, and participants should be able to leave at any time.
- Interview guidelines are the rules and question plans prepared in advance: what to ask, in what order, how to record answers, and how to keep personal information private.
- A prototype is an early, simple version of a product built to test an idea. Prototypes let researchers and designers find problems early, before spending time and money on the final product.

Concept Summary - Part 2: Presenting Research Data

- Presenting data well is as important as collecting it well. A good presentation matches the audience, shows the main findings first, and uses visuals that are honest and easy to read.
- An infographic combines short text, numbers, and pictures to explain one message quickly. It suits social media and posters, where readers spend little time.
- A presentation (slide show) suits explaining findings step by step to a live audience. Each slide should carry one main idea, with few words and one clear visual, while the speaker explains the detail.
- A report suits a full, permanent record. It has an introduction, a method section (how data were collected), results (what was found), discussion (what the results mean), and a conclusion.
- Common mistakes in presenting data are misleading charts (for example a graph axis that does not start at zero, making small differences look huge), too much text on one slide, and tables with no explanation.
- Ethical presentation means reporting honestly: show results that disagree with your expectations too, do not hide missing data, and give credit to sources and to participants' contributions without revealing their identities.

Key Definitions - Chapter 7

Digital literacy: The ability to find, judge, use, and share information with digital tools, safely and responsibly.

Survey: A method of collecting data by asking many people the same set of questions.

Interview: A method of collecting data by talking to people in depth about their views and experiences.

Qualitative interview: An interview that collects opinions and reasons in the person's own words.

Participant selection: Choosing who will take part in a study, fairly representing the group studied.

Consent: Free agreement to take part in a study after understanding its purpose and use of answers.

Interview guidelines: The prepared plan for an interview: questions, order, recording method, and privacy rules.

Simulation: A computer model that imitates a real situation so it can be studied safely and cheaply.

Prototype: An early, simple version of a product built to test an idea.

Infographic: A visual that combines short text, numbers, and pictures to explain one message quickly.

Report: A full written record of a study, including method, results, discussion, and conclusion.

Short Questions and Answers - Chapter 7

Q1. What is digital literacy?

Digital literacy is the ability to find, judge, use, and share information with digital tools, safely and responsibly.

Q2. What is the difference between a survey and a qualitative interview?

A survey asks many people the same set of questions and gives numbers that can be compared. A qualitative interview talks to fewer people in depth and collects opinions and reasons in their own words.

Q3. Why is consent needed before a study?

Consent is needed because participants must freely agree after understanding the purpose of the study, what they will be asked, and how their answers will be used, and they must be free to leave at any time.

Q4. When is an infographic a better choice than a full report?

An infographic is better when one main message must be understood quickly, for example on a poster or social media, while a report is better for a full, permanent record of a study.

Long Questions and Answers - Chapter 7

Q1. Explain how to plan a good qualitative interview, covering participant selection, consent, and guidelines.

A good qualitative interview starts with a clear research question, for example how students use the internet for study. Participant selection comes next: choose people who fairly represent the group studied, such as students from different classes and backgrounds, not only friends who are easy to reach. Before the interview, ask for consent: explain the purpose, what will be asked, how answers will be recorded and used, and that the person may stop at any time. Only then conduct the interview.

Interview guidelines are prepared in advance: a list of open questions in a sensible order, starting with easy background questions and moving to deeper ones, plus rules for recording answers and keeping identities private. During the interview, listen more than talk, ask follow-up questions when an answer is unclear, and do not lead the person towards a particular answer. After the interview, thank the participant and store the data safely. This planning is what makes interview results trustworthy.

Q2. Compare infographics, presentations, and reports as ways of presenting research data, and give one suitable use of each.

An infographic combines short text, numbers, and pictures to explain one message quickly. It suits a poster or social media post, where readers spend little time, for example showing the main result of a school survey in one picture. A presentation, or slide show, suits explaining findings step by step to a live audience: each slide carries one main idea with one clear visual, and the speaker explains the detail, for example presenting project results to a class. A report suits a full, permanent record: it has an introduction, method, results, discussion, and conclusion, for example a final project report kept by the school. The choice depends on the audience and purpose: quick message, live explanation, or complete record.

MCQs - Chapter 7

1. Digital literacy includes the ability to: (a) only type fast (b) find, judge, use, and share information safely (c) repair hardware (d) write viruses

2. A survey collects data by: (a) watching behaviour only (b) asking many people the same questions (c) building a prototype (d) running a simulation

3. Consent means participants: (a) are paid (b) agree freely after understanding the study (c) must answer every question (d) cannot leave

4. A prototype is: (a) the final product (b) an early, simple version built to test an idea (c) a survey form (d) a type of chart

5. A report of a study normally does NOT include: (a) method (b) results (c) discussion (d) the personal names of all participants

6. A misleading chart may use: (a) a clear title (b) an axis that does not start at zero (c) few words (d) honest labels

Answer Key: 1-(b) 2-(b) 3-(b) 4-(b) 5-(d) 6-(b)

Chapter 8 - Entrepreneurship in Digital Age

Building digital products, prototypes, testing with users, and launching a startup

Concept Summary - Part 1: Product Development and Prototypes

- Entrepreneurship means starting and running a new business to solve a problem or meet a need. In the digital age, many new businesses are built around apps, websites, and online services.
- Product development usually follows phases: find a real problem, study the users, think of possible solutions, design the product, build a prototype, test it with users, improve it, and finally launch it.
- A prototype is an early version of a product made to test an idea before the full product is built. Prototypes save time and money because problems are found when they are still cheap to fix.
- Prototypes range from low fidelity to high fidelity. A low-fidelity prototype is rough and cheap, such as a sketch on paper or a simple screen drawing. It tests the basic idea and layout. A high-fidelity prototype looks and behaves much like the final product, with working buttons and realistic screens. It tests fine details and real user behaviour.
- Paper prototypes are drawn by hand and are very cheap and fast to change. Digital prototypes are made with software and can be clicked through on a screen, which feels closer to the real product.
- The right prototype depends on the question being asked: use a paper prototype to test the basic idea early, and a digital prototype to test details before building the full product.

Concept Summary - Part 2: Iterative Design, User Testing, and Launch

- Iterative design means improving a product in repeated cycles: build a version, test it, learn from the results, improve it, and test again. Each cycle makes the product a little better.
- User testing means watching real users try the product and noting where they get confused or stuck. The goal is to learn, not to prove the product is perfect, so testers should be encouraged to speak honestly.
- Common user testing methods are asking users to complete a task while thinking aloud, giving a short questionnaire after use, and recording how many users complete the task and how long it takes.
- A Minimum Viable Product (MVP) is the smallest version of a product that still solves the main problem for real users. Launching an MVP early lets a startup learn from real use before spending more money.
- After launch, a startup keeps measuring: how many users sign up, how many return, what they complain about, and what they ask for. These signals guide the next round of improvements.
- Pakistan has successful digital startups in areas such as online shopping, digital payments, property listings, and health technology. Their common lessons are: solve a real local problem, start small, listen to users, and improve step by step rather than waiting for a perfect product.

Key Definitions - Chapter 8

Entrepreneurship: Starting and running a new business to solve a problem or meet a need.

Startup: A young company built around a new product or service, usually designed to grow quickly.

Product development: The phases of creating a product, from finding a problem to launching the solution.

Prototype: An early version of a product made to test an idea before the full product is built.

Low-fidelity prototype: A rough, cheap prototype, such as a paper sketch, used to test the basic idea.

High-fidelity prototype: A detailed prototype that looks and behaves much like the final product.

Paper prototype: A prototype drawn by hand on paper.

Digital prototype: A prototype made with software that can be clicked through on a screen.

Iterative design: Improving a product in repeated cycles of building, testing, learning, and improving.

User testing: Watching real users try a product to find where they get confused or stuck.

Minimum Viable Product (MVP): The smallest version of a product that still solves the main problem for real users.

Launch: Releasing a product to real users for the first time.

Short Questions and Answers - Chapter 8

Q1. What is a prototype, and why is it useful?

A prototype is an early version of a product made to test an idea. It is useful because problems are found early, when they are still cheap and fast to fix.

Q2. What is the difference between a low-fidelity and a high-fidelity prototype?

A low-fidelity prototype is rough and cheap, such as a paper sketch, and tests the basic idea. A high-fidelity prototype looks and behaves much like the final product and tests fine details and real user behaviour.

Q3. What is an MVP?

An MVP, or Minimum Viable Product, is the smallest version of a product that still solves the main problem for real users, launched early to learn from real use.

Q4. What is the goal of user testing?

The goal of user testing is to learn where real users get confused or stuck, so the product can be improved. It is not meant to prove the product is perfect.

Long Questions and Answers - Chapter 8

Q1. Explain the phases of product development and show where prototypes are used.

Product development starts with finding a real problem, for example students struggling to find tutors. Next, the users are studied: who they are and what they need. Then possible solutions are thought of and the best one is designed. A prototype is built to test the design before the full product is made. The prototype is tested with real users, and what is learned is used to improve the design. This cycle repeats until the product is good enough, and then it is launched to real users, with further improvements after launch.

Prototypes are used in the middle of this process, between design and full building. Early on, a low-fidelity paper prototype tests whether the basic idea and layout make sense. Later, a high-fidelity digital prototype tests details such as buttons, screens, and steps. Using prototypes at both stages avoids building a full product that users do not understand or want.

Q2. What is iterative design? Explain it with an example of a student building a study-planner app.

Iterative design means improving a product in repeated cycles of building, testing, learning, and improving, instead of trying to make it perfect in one attempt. Suppose a student builds a study-planner app. In the first cycle, she makes a simple paper prototype with screens for adding tasks. She tests it with three classmates and learns that they cannot find the button to add a task. In the second cycle, she makes the button bigger and clearer and tests again. Now users find the button, but they want reminders. In the third cycle, she adds a simple reminder feature and tests again. Each cycle is small, but after a few cycles the app is much easier to use than the first version was. The key lesson is that feedback from real users, not guessing, drives each improvement.

MCQs - Chapter 8

1. A prototype is: (a) the final product (b) an early version made to test an idea (c) a business plan (d) a marketing poster

2. A paper sketch of an app is an example of a: (a) high-fidelity prototype (b) low-fidelity prototype (c) launched product (d) database

3. Iterative design means: (a) building once perfectly (b) improving in repeated cycles of testing and learning (c) copying a rival product (d) advertising widely

4. An MVP is: (a) the most expensive product (b) the smallest version that still solves the main problem (c) a product with every feature (d) a finished company

5. The main goal of user testing is to: (a) prove the product is perfect (b) find where users get confused or stuck (c) sell the product (d) write code faster

6. Which of these is tested FIRST in product development? (a) Full product launch (b) Basic idea with a low-fidelity prototype (c) Final advertising (d) Profit counting

Answer Key: 1-(b) 2-(b) 3-(b) 4-(b) 5-(b) 6-(b)

Final Revision Checklist

Before your exam, make sure you can do each of these without looking at the notes:

- **Chapter 1:** Convert between bits and bytes, draw the truth tables of AND, OR, NOT, NAND, NOR, XOR, name the SDLC stages, and name one threat and one protection method in cybersecurity.
- **Chapter 2:** Name the four parts of computational thinking, trace bubble sort on a short list, and run binary search on a sorted list by hand.
- **Chapter 3:** Write a Python program with input, an if-elif-else chain, a for loop over a list, and a function with a return value. Explain the difference between == and = and between a syntax error and a logical error.
- **Chapter 4:** Explain supervised vs unsupervised learning, regression vs classification, and choose the right chart (bar, pie, scatter, boxplot) for a given data set.
- **Chapter 5:** Draw the four parts of an IoT system, explain why a blockchain is hard to change, and compare symmetric and asymmetric encryption.
- **Chapter 6:** Judge the credibility of a source with four checks, explain how bias enters data, and give one example of assistive technology.
- **Chapter 7:** Plan a qualitative interview (selection, consent, guidelines) and choose between an infographic, a presentation, and a report for a given audience.
- **Chapter 8:** Explain low vs high fidelity prototypes, iterative design, user testing, and MVP with one example of each.

> **Good luck!** Revise one chapter at a time, attempt its MCQs honestly, and practise the Python programs on a computer. Short, regular revision beats one long night of cramming.

Note: These are original study notes prepared as a revision aid for the Class 11 Computer Science book (Federal Board, NBF). Chapter titles follow the current NBF book as reported by several current study sources; please check them against your issued book. For paper pattern and exam dates, follow official FBISE announcements.