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Unit 1
Computational Thinking

1.0 Structure of the Unit

1.1. Unit Outcomes
1.2. Introduction to computational thinking
1.3. Computational thinking approaches
1.4. Information and data
1.5. Converting Information to Data
1.6. Data Types and Encoding
1.7. Self-Assessment Questions
1.8. Multiple-Choice Questions
1.9. Keys to Multiple Choice Questions
1.10. Summary of the Unit
1.11. Recommended Resources for Further Reading

1.1 Unit Outcomes

After the successful completion of this unit, the student will be able to:

1. Define computational thinking.
2. Compare information and data.
3. Discuss the importance of data types and encoding.

1.2 Computational Thinking

In every walk of life, the computer plays an important role. Computers are used in the form of laptops, desktops, and tablets, and embedded in many electronic devices. Driverless cars, automated traffic control, home and office automation, government, education, banking, business, Internet applications, healthcare, etc. are the applications where computers have shown phenomenal impact. Computer systems or computers include *hardware* and *software.* Physical devices such as keyboards, monitors, memory, hard drive, mouse, processor, etc. constitute computer hardware. Software is a set of computer programs performing a given task. Programs include a set of instructions performed in a specific order to do a task. The computer hardware responds to the instructions to perform the task. The computer hardware is incomplete without software. Programs are commonly known as code or also referred to as software products. Software products are classified as generic or bespoke or customized. Generic software products include operating systems, compilers, web browsers such as google chrome, Firefox, music players, data processing, management systems, and so on. There are many customized software products developed for finance, offices, educational institutes, hospitals, pharmacies supermarkets, science and mathematics, security, etc. The software can be embedded in different products and can be installed. For example, software installed on cell phones is commonly known as apps. Many computer applications are useful in applying computer hardware for performing a specific task. Programming is done by people called software developers or programmers. Software developers who are into coding are called problem solvers. The developers have knowledge that includes hardware/software and the basics of computer technology. Many software engineers are trained in different branches of computer science such as computer architecture, software engineering, data science, artificial intelligence, etc. Software engineers/developers/computer engineers/computer scientists work with the knowledge of these areas and are called modern problem solvers. There is a thinking or reasoning of these people to work in today's automated or computerized world and it is called computational thinking.

Computational thinking is defined as a process or thought or strategy to solve complex problems based on the approaches from computer science. In computational thinking, a problem is divided into smaller parts and a solution is found using suitable logic. Artificial intelligence techniques enable computers to do those things which people do better.

The various fields such as mathematics, science and engineering, natural sciences, social sciences, and day-to-day life situations are using techniques based on computational thinking. With the help of computational thinking, people can use structured methods for solving a problem. Developing logical reasoning skills can be applied in various fields, including computer science, mathematics, engineering, natural sciences, social sciences, and even in everyday life situations. It helps people to develop logical reasoning capabilities and problem-solving skills to solve complex problems.

1.3 Approaches in Computational Thinking

With the help of the features of computational thinking, today's computers help understand those things which were too complicated, very small, too fast, or distant in nature. The approaches to computational thinking are given below.

- **Problem Decomposition**: This method is also known as Divide and Conquer. In problem decomposition, a large problem is divided into smaller parts. The division is based on the hierarchy and the connections or interface among the parts are identified. This method makes the job of solving the problem easier and each subproblem can be tackled individually with more focus.
- **Pattern Recognition:** In this method, the emphasis is on recognizing similar features, patterns, or parts in a given problem or data. With this method, the similarity of the data can be recognized, and the developed programs can be reused. The solution to the problem can be more efficient due to the identification of similar structures, data, and processes.
- **Abstraction:** Highlighting important features and hiding irrelevant details to focus on the basic problem. With abstraction, the problem can be expressed clearly, and unnecessary details or irrelevant information can be ignored. For example, consider a person selling a car, the details such as make, mileage, safety features, and cost are explained to the customer, whereas engine functionality or working model of the steering or technology in the brakes, etc., features are hidden. These details are shared with the automobile or mechanical engineer who is involved in the production. Abstraction is helpful in the development of general solutions.
- **Algorithm:** A given problem is solved using a step-by-step procedure by considering different

situations and constraints using algorithms. With the help of an algorithmic approach, the necessary inputs, sequence of operations, and desired output can be designed systematically.

- **Automation:** Using technology for routine tasks that are done repetitively is known as automation. With the help of automation, computer programs are used for mundane tasks with which the developer can focus more on core tasks. Automation can be visualized with simulation. Simulation is a model that gives a virtual representation of the real world.
- **Evaluation:** Evaluation is a method of judging the effect and productivity of the solution. After evaluation, if necessary, the solution is optimized or refined. The optimized solutions are more robust and improve problem-solving skills.

These approaches are used in combination with each other in various contexts. Computational thinking includes making use of these approaches and exposure to various problem-solving skills. Computational thinking is introduced mainly in computers. Modern computer history and its relevance with various other entities are given below.

1.3.1 History of Devices Towards Computers

- Chinese abacus was once a very commonly used computing and numeric tool in East Asia, mainly in China. The abacus was a calculating tool till the invention of calculators. An Abacus device is a square or rectangular frame holding an arrangement of small balls on metal rods or wires, used for counting or for doing calculations. The abacus was the first portable computing device till the invention of electronic equipment. The abacus gave the concept of the following in modern computers.
    1. Storage
    2. Representation
    3. Calculation
    4. User interfaces
- Abacus introduced the idea of storage in the form of beads. With the idea of storage, the word *data* was invented. The Abacus stores only one number at a time, whereas computers were invented to store any number of data. The abacus can store only integers in the form of a bead on a spindle, whereas the computer can save data in an electronic form, which can be transformed into *information*. The third concept is calculations, in an abacus, there are very limited calculations of adding or subtracting a bead, but this is extended to millions of operations in computers. The fourth concept is the user interface. Any calculation was done manually in the old days, the abacus introduced the interface concept of using a device for calculation. This is explored in modern computers with a variety of peripheral devices. The word graphical user interface (GUI) is a well-known word today.
- The next invention that led to computations was a device. Napier Bones was introduced by scientist John Napier. This device was made up of small rectangular sticks with numbers and lines. This device was useful in performing multiplication, division, square roots, etc. This was one important step towards computers.
- In the next step, two important inventions of calculators were made by scientists in Europe. A scientist named Blaise Pascal invented a calculator in 1643, followed by its advanced version in 1647 by the German mathematician and philosopher Gottfried Leibniz. These devices were

like huge mechanical machines to perform arithmetic operations such as addition, subtraction, multiplication, or division. This improved the human capacity to speed up the calculations.

- Some devices were also used for doing operations other than calculations. The Antikythera mechanism is a device invented by Greek scientists that was made up of 30 interconnected gears of metal brass of different dimensions. The Antikythera device was capable of finding the locations of the sun, moon, and other planets. The device was called a computer of the first century BC.

1.3.2 The First Modern Computer

The first modern computer has three characteristics as given below.

1. It must be an electronic device
2. It must be digital
3. The stored program concept is used.

- The Analytical Engine invented by Babbage was incapable of satisfying these three requirements. In 1890, a scientist named Herman Hollerith invented a calculating device for recording the US census that ran on electricity. This machine fulfilled the three characteristics and can be called the first modern computer. In 1924, the International Business Management (IBM) company merged with Hollerith and developed a tabulating machine. But these machines were analog or mechanical and could store information.
- The first electronic computer was introduced in the United States in 1930. It was an analog device invented by Vannevar Bush. This machine has vacuum tubes to switch electrical signals to perform calculations in a few minutes. This was known as Differential Analyzer.
- In 1946, the Electronic Numerical Integrator and Computer (ENIAC) was developed as the first electronic computer by two researchers in the USA. Several other researchers proposed the programming concept in computers, but in 1960 the same ENIAC was modified with the stored program concept. So, ENIAC is considered the first modern computer. There are five generations of computers with ENIAC as the first-generation computer. These generations are listed as given below.
- First Generation (1940 to 1956): Using Vacuum Tubes
- Second Generation (1956 to 1963): Using Transistors
- Third Generation (1964 to 1971): Using Integrated Circuits
- Fourth Generation (1971 to present): Using Microprocessors
- Fifth Generation (Present and Next): Using Artificial Intelligence

The fifth-generation laptop, desktops, and notebook computers are used today. The modern computer with relevant accessories today is depicted in Figure 1.2.

Figure 1.2 Computers Today

Every modern computer must have at least one of each of the following:

1. Input device
2. Output device
3. Memory
4. Processor

An input device is for entering data into a computer. Keyboard, mouse, trackpads, microphones, and touchscreens for tablets and smartphones. The output devices are computer monitors/displays, printers, etc. Some devices like CDs, DVDs, and pen drives can be used as both input/output devices. Computer memory is used for the storage of data. The processor is the most important part of a computer that processes the data. Today's processor can perform trillions of operations per second. The computer shown in Figure 1.2 uses the stored program concept. The components of a modern computer are shown in Figure 1.3.

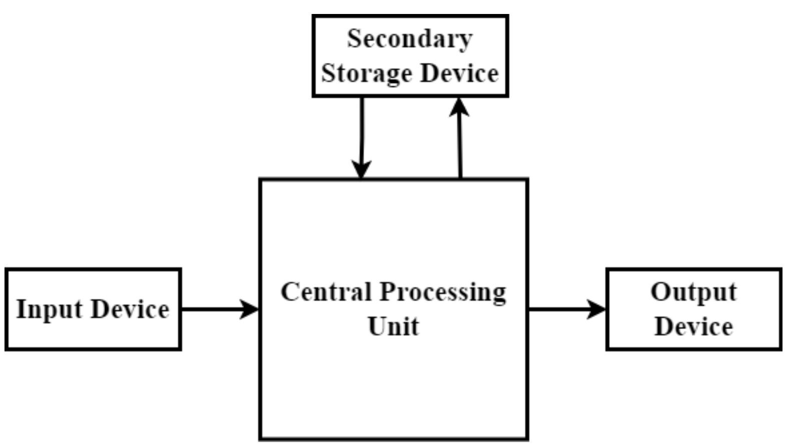

Figure 1.3 Components of Modern Computer

Definition of a Computer: A computer is an electronic device that can be programmed to accept data (input), process it, and generate results (output). A computer along with additional hardware and software together is called a computer system. A computer system primarily comprises a central processing unit (CPU), memory, input/output devices, and storage devices. All these components function together as a single unit to deliver the desired output. A computer system comes in various forms and sizes. It can vary from a high-end server to a personal desktop, laptop, tablet computer, or smartphone.

1.3.3. Moore's Law

In the 1950s and 1960s, vacuum tubes and relays were replaced by small, compact, and faster electronic devices. Silicon wafers were used to install several electronic switches called "transistors" on a single chip. This device was referred to as an integrated chip (IC). The computers were manufactured of a size that fits in a briefcase. Integrated circuits make it possible for us to carry computers in a briefcase compared to room full-sized computer machines. In 1965, scientist Gordon Moore published a paper with Moore's law stating that the number of components on ICs will double every 18 months. This law has become true and there are wristwatches embedded with computers today. Smartphones, tabs, and numerous electronic devices use computers in the smallest form. As more components are pushed on IC, the electricity must travel shorter distances and help in better performance.

1.3.4.The First Software

The devices explored in section 1.3.1 are used to perform computations with suitable configurations. But these devices cannot be used efficiently for programming. For every new problem, the previous configuration gets erased. Thus, it is important to load a copy of a program that contains a set of instructions, separated from the hardware. None of the devices described in Section 1.3 were truly programmable. It is necessary to build a concept of a stored program concept that instructs the computer to do the assigned task. The first programmable machine was developed for weaving cloth called the Jacquard loom in 1805. The programmable loom was manufactured that takes a card with punched holes. With the change in the cards with different hole designs, various cloth patterns were prepared. Punching cards were like programs. Similarly in 1843, a mathematician named Charles Babbage built a mechanical calculator performing calculations with more advanced logarithmic and trigonometric calculations. This did not contribute to the concept of programmability until the design of the analytical engine was adopted. The analytical engine was performing complex mathematical operations, but it was too complex and never came in full form. A woman with the name Ada Lovelace was interested in Charles Babbage's work, and she had written programs for analytical engines. She and several other people including Babbage are the first programmers.

1.4 Information and Data

In recent times the global economic environment is based on digital information. Digital information has striking features such as easy access, fast transfer, meaningful analysis, and so on. The information is stored, accessed, and transferred using electronic computers and networks. Personal computers were extremely popular in the 1970s. In the 1990s, the Internet was developed which brought data and computation together. The terms information and data are overlapping. The definition of these terms is given below.

- Data is defined as characters, symbols, and characters that are stored in the form of electrical signals, recorded on I/O devices and memory units. Data is not organized, and it is in raw form. E.g., names of students in a class, account numbers of employees, single sale of a customer, and so on. Data can be in the form of numbers, text, images, the color of the skin, etc. Data is either in the continuous or discrete form. Continuous data can be a temperature of a person varying from a range X to Y, or the weight of an apple, etc. Discrete data corresponds to the list of possible values or finite values. E.g., the number of courses in a semester or the number of children to parents is a discrete value.
- Information is defined as knowledge about a subject, event, news, or intelligence which is obtained by data processing. E.g., the maximum sales of a restaurant in a year are information. Information is in a structured form.
- Data and Information Examples; For example, name, and marks in different subjects of a student are data, whereas a student with the highest marks is information. When a Ph.D. scholar collects different material for writing a research thesis, it is known as data; when the same data is presented in an organized manner, it is known as information.

A comparison of data and information is given in Table 1.1.

Table 1.1 Data versus Information

Data	**Information**
Data is a raw, unorganized, collection of facts.	Information is processed and it is knowledge of facts. Information is in a structured form.
Data includes numbers, characters, alphabets, lines of text, words, etc.	Information can refer to records, organized data files, tables, databases, etc.
In computer terms, data is an input.	Information is an output that is an outcome of the computer processing of data
Data cannot be useful in its original form	Information can be used in its original form.

1.5 Converting Information and Data

Converting data into information is a challenging task. For example, storing paintings, audio, or video files, texts, numbers, addresses, and phone numbers on cellphones, etc. need to be stored as information. This is done using encoding. Some of the important concepts in the conversion of information and data are:

- Encoding of data refers to the task of converting data into a form that is suitable for processing.
- In electronic terms, there are two types of data, analog and digital.
- Continuous data is encoded as analog and discrete data is called digital.
- Digital data is a set of discrete data values or possible data values.
- In digital form, the smallest unit of data is known as a bit or binary digit. A bit can take two forms 1 (ON) or 0 (OFF). The audio/video, images, text, and numbers can be encoded as a sequence of bits. The sequence of bits is referred to as bit strings as given in Table 1.2.

Table 1.2 Bit Strings

Number	Bit String
1	1
2	10
3	110
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010

The bit string is of the length ‘N’. The number of patterns generated using bit string patterns can be generated as 2^N. This pattern is given in Table 1.3.

Table 1.3 Number of Patterns by Bit Strings

Length of Bit String	**Number of Patterns**
1	$2^1 = 2$
2	$2^2 = 4$
3	$2^3 = 8$
4	$2^4 = 16$
5	$2^5 = 32$
8	$2^8 = 256$
N	2^N

In encoding, data capacity is of great importance. The quantity of information that can be encoded by a computer system is known as data capacity. The basic data capacity is measured using bits, bytes, words, and the other prefixes of the byte.

1 byte = 8 bits

1 word = 16 bits

The measure of data capacity for byte prefixes is given in Table 1.4.

Table 1.4 Prefix for data capacity

Prefix	Symbol	Power of 2	Decimal
Kilo	K	2^{10}	$\sim10^{3}$
Mega	M	2^{20}	$\sim10^{6}$
Giga	G	2^{30}	$\sim10^{9}$
Tera	T	2^{40}	$\sim10^{12}$
Peta	P	2^{50}	$\sim10^{15}$

Different types of information can be stored in terms of varying data capacity. Some examples are given in Table 1.5.

Table 1.5 Information and the data capacity

Type of Information	Data Capacity (Bytes)
keyboard symbol (letter)	1 B
10 page paper	40 KB
five minute MP3 audio recording	5 MB
high resolution digital picture	5 MB
CD audio disk	800 MB
DVD	8.5 GB
all of Wikipedia	6 TB*

1.6 Encoding of Different Data Types

Different kinds of data are represented using a sequence of bits. In this section, the representation of various data types is explained with an example.

The types of data are given as:

1) Numbers
2) Text
3) Images
4) Color
5) Sound

1) The most commonly used number systems are the base N number system.

Numbers: Numbers: Numeric data can be represented using different number systems such as Tally, Roman, decimal, binary, octal, hexadecimal, etc. The different representation of the number of '5' is shown in Figure 1.3.

Figure 1.3 Different Representation of Number 5

The numbers are represented using different number systems with a base value of N as shown below.

Table 1.6 Base-N Number System

Base N
N Digits: 0, 1, 2, 3, 4, 5, …, N-1
Example: 1045N
Positional Number System

$$N^{n-1} \cdots N^4 N^3 N^2 N^1 N^0 d_{n-1} \cdots d_4 d_3 d_2 d_1 d_0$$

Digit d_o is the least significant digit (LSD).
Digit dn-1 is the most significant digit (MSD).

The different number systems discussed in this section are:

- Decimal
- Binary
- Hexadecimal

Table 1.7 Decimal Number System

Base 10
Ten Digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Example: 104510
Positional Number System

$$10^{n-1} \cdots 10^4 10^3 10^2 10^1 10^0 d_{n-1} \cdots d_4 d_3 d_2 d_1 d_0$$

Digit d0 is the least significant digit (LSD).
Digit dn-1 is the most significant digit (MSD).

Table 1.8 Binary Number System

Base 2
Two Digits: 0, 1
Example: 1010110 in Binary
Positional Number System

$$2^{n-1} \cdots 2^4 2^3 2^2 2^1 2^0 b_{n-1} \cdots b_4 b_3 b_2 b_1 b_0$$

Binary Digits are called Bits.
Bit b_o is the least significant bit (LSB).
Bit b_{n-1} is the most significant bit (MSB).

Example: A 4-bit binary number from 0 to 9 is shown as follows.

Binary	Decimal

0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	10

Table 1.9 Hexadecimal Number System

Base 16
Sixteen Digits: 0,1,2,3,4,5,6,7,8,9, A, B, C, D, E, F
Example: EF5616
Positional Number System

$$16^{n-1} \cdots 16^4\, 16^3\, 16^2\, 16^1\, 16^0$$

Examples

1) Convert a decimal number 25 to binary.

To convert a decimal number (base 10) to the binary form (base 2). The steps for this conversion are as follows.

Step 1: Divide 25 by 2. Use the integer quotient obtained in this step as the dividend for the next step. Repeat the process until the quotient becomes 0.

Step 2: Write the remainder from bottom to top i.e., in the reverse chronological order. This will give the binary equivalent of 25. Therefore, the binary equivalent of the decimal number 25 is 11001.

The conversion is done using remainder and quotient as given below. Number 25 is divided by 2, the result is a remainder. The remainder is recorded at every step, further, the quotient is divided by 2. This process is repeated till the quotient is 1. In the last step, the remainder is added to the result.

Divisor	Dividend	Remainder
2	25	1
2	12	0
2	6	0
2	3	1
	1	

	$(25)_{10}$	$(11001)_2$

2) Convert a decimal number 67 to binary.

Divisor	Dividend	Remainder
2	67	1
2	33	1
2	16	0
2	8	0
2	4	0
2	2	0
2	1	
	$(25)_{10}$	$(100011)_2$

3) Convert binary 1000011 to decimal.
   $=1x2^6 + 0x2^5 + 0x2^4 + 0x2^3 + 0x2^2 + 1x2^1 + 1x2^0$
   =1x64 + 0x32 + 0x16 + 0x8 + 0x4 + 1x2 + 1x1 = 64 + 0 + 0 + 0 + 0 + 2 + 1
   =64 + 0 + 0 + 0 + 0 + 0 + 0 + 2 + 1 = 67.
4) Convert $(11001)_2$ to decimal form.
   The stepwise description is as follows:
   Step 1: Write down the binary number:
   Step 2: Multiply each digit of the binary number by the corresponding power of two:
   Step 3: Solve the powers.
   Step 4: Add up the numbers after solving the power values.
   $=1x2^4 + 1x2^3 + 0x2^2 + 0x2^1 + 1x2^0$
   =1x16 + 1x8 + 0x4 + 0x2 + 1x1
   = 16 + 8 + 0 + 0 + 1
   = 25
5) Convert a decimal number 120 to hexadecimal form.
   (120)10 = (78)16
   The stepwise description of decimal to hexadecimal form is as follows:
   Step 1: Divide (120)10 successively by 16 until the quotient is 0:
   120/16 = 7, the remainder is 8
   7/16 = 0, remainder is 7
   Step 2: Read from the bottom (MSB) to top (LSB) as 78.
   So, 78 is the hexadecimal equivalent of the decimal number 120 (Answer).

Diviso r	Dividend	Remainder
16	120	8
16	7	7

16	0	0
	$(120)_{10}$	$(78)_{16}$

6) Convert 546 in decimal to hexadecimal form. data to be encoded in a computer system is encoded in a pattern of sequence of bits.

Diviso r	Dividend	Remainder
16	546	2
16	34	2
16	2	0
	$(546)_{10}$	$(222)_{16}$

7) Convert a hex number $(A1)_{16}$ to decimal.
$Ax16^1 + 1x16^0$
$10x16 + 1x1 = (161)_{10}$
This can be proved by converting decimal $(161)_{10}$ to Hex.
61/16 = 10, the remainder is 1
10/16 = 0, the remainder is 10
Read from the bottom (MSB) to the top (LSB) as A1.
So, A1 is the hexadecimal equivalent of the decimal number 161.
8) Converting real numbers to hexadecimal numbers.
Although we can represent an integer as a sequence of bits, is it possible to represent a real number such as 2.31 or 2.125, or even 3.1415926? Consider extending the meaning of a positional numbering system to the right of the decimal such that the positions start at –1 and decrease with distance from the decimal.
For example, in base 10, the value 1.625 means
$(1 \times 10^0) + (6 \times 10^{-1}) + (2 \times 10^{-2}) + (5 \times 10^{-3})$.
We can then represent real numbers as binary bit strings assuming that we can determine the decimal location.
Consider, for example, the meaning of $(1.101)_2$. The details are as below.

$$1 = 101_2 = 1\times 2^0 + 1\times 2^{-1} + 0\times 2^{-2} + 1\times 2^{-3}$$
$$= 1\times 1 + 1\times\frac{1}{2} + 0\times\frac{1}{4} + 1\times\frac{1}{8}$$
$$= 1 + \frac{1}{2} + \frac{1}{8}$$
$$= 1.625$$

2) Text: The text data is represented in different sizes and weights. The different forms of test characters are depicted in Figure.

Figure 1.4 Letter Q in Five Different Font Family

The text characters are encoded using American Standard Code for Information Interchange (ASCII). The ASCII code table is shown in Table.

Table 1.6 ASCII Characters Set

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29	30	31	32	! 33	" 34	# 35	$ 36	% 37	& 38	’ 39
(40	) 41	* 42	+ 43	, 44	- 45	. 46	/ 47	0 48	1 49	2 50	3 51	4 52	5 53	6 54	7 55	8 56	9 57	: 58	; 59
< 60	= 61	> 62	? 63	@ 64	A 65	B 66	C 67	D 68	E 69	F 70	G 71	H 72	I 73	J 74	K 75	L 76	M 77	N 78	O 79
P 80	Q 81	R 82	S 83	T 84	U 85	V 86	W 87	X 88	Y 89	Z 90	[91	\ 92	] 93	^ 94	_ 95	` 96	a 97	b 98	c 99
d 100	e 101	f 102	g 103	h 104	i 105	j 106	k 107	l 108	m 109	n 110	o 111	p 112	q 113	r 114	s 115	t 116	u 117	v 118	w 119
x 120	y 121	z 122	{ 123	| 124	} 125	~ 126	127	128	129	130	131	132	133	134	135	136	137	138	139

ASCII values express the relationship between the number and the character. The uppercase A is with the number 65, and the lowercase ‘a’ is 97. All the other symbols, numbers, and alphabets are related to numbers as shown in the table. Empty cells in the table represent the nonprintable characters such as backspace. The texts are represented using different font images such as times new roman, Helvetica, aerial, etc.

3) Colors: There are three fundamental colors perceived by the human eye, these are namely red (R), green (G), and blue (B), commonly known as RGB. The encoding of these three colors uses 24 bits as shown in Figure. The other different colors are created using a combination of RGB.

Color	Name	Bits red green blue	Decimal
	red	111111110000000000000000	(255,0,0)
	green	000000001111111100000000	(0,255,0)
	yellow	111111111111111100000000	(255,255,0)

Figure 2.18 Figure Encoding of Colors in Bit Strings

The other different colors are created using a combination of RGB. Figure 2.18 shows how the three colors red, green, and yellow (which is a mixture of red and green) would typically be encoded as 24 bits within a computing system. The corresponding interpretation of the three decimal values is given in the right-most column.

4) Pictures: The picture can be formed using a two-dimensional grid of colors. Each element of the grid is called a pixel. A pixel is an abbreviation of a picture element. Each pixel is a representation of a tiny rectangle of a single color. Color is encoded as a 24-bit string; thus, the picture is considered as an order of 24. The images of high definition (HD) are represented using the resolution: 1920 X 1080 = 2,073,00 pixels.
5) Sound: Th audio data in a computer is generated using sound waves that propagate through the air. A microphone converts the waveform into an analog electric signal. These signals are measured and sampled to produce a digital encoding. Sampling is a process where the strength of a changing signal is measured at regular time intervals and those measurements are then recorded. In this way, the sound wave is converted into a sequence of numeric values. The unit of measurement for sound is Hertz (Hz). The average person can hear sound waves 20 Hz up through about 20,000 Hz or 20 kHz.
6) Data Compression: Data compression is a method with which the encoding is done with fewer bits. The compressed data can be transferred on a smaller hard disk or sent off the Internet. Compression is time-consuming and it adds to the overload. Run-Length Encoding is one of the simplest types of compression techniques that can be used on images and even text.

1.7 Self-Assessment Questions

Q1. List the approaches in computational thinking. [8 marks, L1]

Q2. Discuss the history of devices leading to the invention of the computer. [6 marks, L4]

Q3. Describe the modern computer and its history. [10 marks, L1]

Q4. Define Moore's Law for the development of computers. [3 marks, L1]

Q 5 . Compare data and information [5 marks, L2]

Q6. Discuss different number systems used for encoding in computers. [5 marks, L2]

Q7. Explain pictures, colors, and sound data on the computer. [8 marks, L1].

Q8. What is the need for data compression? [2 marks, L1]

Q9. Convert the following decimal numbers to binary. [5 marks, L2]

a) 95
b) 18
c) 20
d) 55

Q10. Convert the following binary numbers to decimal form. [8 marks, L2]

a) 1010
b) 1101
c) 1110110
d) 110111

Q11. Convert the following hexadecimal to decimal and vice versa. [8 marks, L3]

a) A1
b) B2
c) F5
d) 28

1.8Multiple-Choice Questions

Q1. The interconnected network of computers is_____

A. Internet
B. Network
C. Memory
D. CPU

Q2. The father of a computer is_______

A. Abacus
B. Charles Babbage
C. Steve Jobs
D. James Gosling

Q3. The correct order of the four major functions of a computer is________
__

A. Input, Output, Process, Store
B. Store, Input, Process, Output
C. Input, Process, Store, Output
D. Input, Process, Store, Output

Q4. A smallest unit if information is__________

A. Byte
B. Bit
C. Word
D. Megabyte

Q5. The decimal equivalent of the binary number 1011 is____

A. 10
B. 11
C. 8
D. 9

Q6. One color pixel on a computer is made up of____ colors.

A. 4
B. 256
C. 8
D. 3

Q7. Any entity in a raw form such as numbers, words, and details is called as_____

A. Information
B. Output
C. Data
D. Tables

Q8. The first Computing devices used by humans is_____

A. Calculation by fingers
B. The Pascaline
C. The Abacus
D. The Napier Bones

Q9. ________________ of the following is both input/output devices.

A. Monitor
B. Keyboard
C. Pen Drive
D. Speaker

Q10. The smallest data from the following is__________

A. Gigabytes
B. Megabytes
C. Kilobytes
D. Terabytes

1.9 Keys to Multiple-Choice Questions

Q1. Internet (A)

Q2. Charles Babbage (B)

Q3. Input, Output, Process, Store (A)

Q4. Bit (B)

Q5. 11 (B)

Q6. 3 (D)

Q7. Data (C)

Q8. The Abacus (C)

Q9. Pen Drive (C)

Q10. Kilobytes (C)

1.10 Summary of the Unit

Every human being is capable of computational thinking that includes different skills and attitudes. Computational thinking includes computational steps and algorithms to generate a solution. A modern computer includes computational thinking input/output devices, a CPU, and a memory unit. The modern computer reads the data and converts it into the form of information using CPU, I/O devices, and memory. The data and information are transferred between two points using networks and the

Internet. The data is converted into information using encoding schemes.

1.11 Keywords

- Computer
- Data
- Information
- Computational Thinking
- Number System

1.12 Recommended Learning Resources

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