

**Geel2000 Language Schools**



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**Second Term**  
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# Unit 3: Programming and Artificial Intelligence

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## Lesson 1: The Historical Development of Artificial Intelligence

### Learning Outcomes

By the end of this lesson, the student is expected to be able to:

1. **\*\*Distinguish\*\*** between the working mechanism of **\*\*traditional programs\*\*** and **\*\*Artificial Intelligence (AI)\*\***.
2. **Identify** the historical development and key milestones of Artificial Intelligence.
3. **State** the importance of AI in solving real-world problems.

### Let's Learn: The Journey of Artificial Intelligence

Dear student, have you ever wondered how your phone has become so smart that it understands what you say? Or how cars can drive themselves (**Self-driving**)? All of this is possible thanks to the amazing technology of **Artificial Intelligence (AI)**.

It is important to know that the idea of AI is not new. It has evolved over a very long period. In this lesson, we will explore the history of AI, from the earliest human dreams of thinking machines to the modern AI we use today.

#### 1. The Human Dream of Thinking Machines

Long before the invention of the computer, humans dreamed of creating machines that could think and work like them. Ancient civilizations had early concepts of **automation** and **thinking machines**, which were often found in myths, philosophy, and early mechanical devices. These efforts are considered the **initial roots** of automated systems.

### **Activity: Guess the Intelligence**

Work with your teacher and classmates to play the "Guess the Intelligence" game.

Discuss the following:

- After a "Human" and a "Machine" both answer the same question, can you guess which is which?
- What does this game teach us about the intelligence of machines?

### **2. The Modern Era of Artificial Intelligence**

The modern history of AI can be divided into several key stages:

Period	Key Event/Concept	Description
**1950**	**Alan Turing**	The British mathematician Alan Turing posed the question: "Can machines think?" He introduced the <b>Turing Test</b> as a way to determine if a machine can successfully mimic human thinking.
**1956**	**Dartmouth Conference**	A group of scientists met at Dartmouth College. Their goal was to create machines that could think and learn like humans. The term <b>"Artificial Intelligence"</b> was officially coined here.
**1956–1970**	**Years of Enthusiasm**	Scientists created the first AI programs, such as <b>Logic Theorist</b> and <b>General Problem Solver</b> . However, they faced challenges due to the <b>slow speed</b> and <b>limited memory</b> of computers at the time.
**1970–1980**	**Expert Systems**	The focus shifted to teaching machines specialized knowledge from human experts. Programs like <b>MYCIN</b> (a medical diagnosis system) were created, showing that AI could rival the accuracy of human experts in narrow fields.

<p><b>**1980–1990**</b></p>	<p><b>**AI Winter**</b></p>	<p>A period of disappointment due to <b>**exaggerated promises**</b>, <b>**high costs**</b>, and <b>**limited technical capabilities**</b>. Scientists learned that AI was much harder than initially thought, requiring more patience and better development.</p>
<p><b>**1990–2010**</b></p>	<p><b>**The Renaissance**</b></p>	<p>The rise of the <b>**Internet**</b> provided huge amounts of <b>**data**</b>. This led to the new approach of <b>**Machine Learning**</b>, where machines learn from data instead of being explicitly programmed. The computer <b>**Deep Blue**</b> defeated the world chess champion during this era.</p>
<p><b>**2010–Present**</b></p>	<p><b>**Deep Learning Revolution**</b></p>	<p>An advanced type of Machine Learning that uses <b>**Artificial Neural Networks**</b> to mimic the human brain. This led to breakthroughs like <b>**AlphaGo**</b> defeating the world champion in the complex game of Go, changing everything we know about AI.</p>



## Exercises and Questions

### Part One: True (✓) or False (X)

No.	Statement	Answer
1.	The idea of AI is a very modern idea that appeared in the last few years.	( )
2.	The idea of AI faced many challenges in its beginnings.	( )
3.	The Turing Test is a way to know if a machine can successfully mimic human thinking.	( )
4.	Machine Learning is a branch of AI that allows computers to learn from experience.	( )
5.	AI is used only in games and entertainment.	( )
6.	Deep Learning is an advanced type of Machine Learning.	( )
7.	AI will be a helpful tool in many future jobs.	( )

### Part Two: Choose the Correct Answer

#### **1. What is the best description of Artificial Intelligence?**

- A. Making machines bigger.
- B. Making machines think and learn like humans.
- C. Making machines smaller in size.
- D. Making machines faster and stronger.

#### **2. Who is the scientist who invented a famous test to know if a machine is intelligent?**

- A. Isaac Newton.
- B. Albert Einstein.
- C. Alan Turing.
- D. Al-Khwarizmi.

**3. Why is learning about AI important for your future?**

- A. Because it will disappear soon.
- B. Because it will become an essential part of our jobs and daily lives.
- C. Because it is a complex and difficult subject only for scientists.
- D. Because it is just an entertainment tool.

**4. A computer learning to play chess and winning against top players is an early example of:**

- A. Machine Learning.
- B. The Internet.
- C. 3D Printing.
- D. Using office software.

**5. How can AI help in solving the problem of traffic congestion?**

- A. By manufacturing more cars.
- B. By analyzing data and organizing traffic flow intelligently.
- C. By canceling traffic lights.
- D. By disrupting car movement.

**6. The phrase "AI is a powerful tool" means that:**

- A. We should be afraid of it and avoid it.
- B. We must understand its impact and direct it to serve humanity.
- C. No one can control it.
- D. To use it irresponsibly.

# Lesson 2

## How Machines Think and Change Our World

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### Let's Interact Together

How does a machine think? Explain with examples.

### Let's Learn

Dear student... Have you ever noticed your phone suggesting a song you didn't ask for? Or an educational app knowing exactly which topics you need help with? This isn't magic; it's the incredible power of **Artificial Intelligence (AI)**. This amazing technology makes machines act as if they are thinking and interacting with us using intelligence that mimics human intelligence.

In Your Phone	In Games	On the Internet
Voice assistants, facial recognition, and predictive text.	Smart characters that interact with you and adapt to your playstyle.	Smart search engines and personalized content suggestions.

**Activity:** Dear student... With the help of your teacher and in cooperation with your classmates, think about and discuss the electronic devices you use daily (such as a smartphone, tablet, smart TV, or even your favorite video game). Is there an app or feature in these devices that uses Artificial Intelligence?

### 1. What is Artificial Intelligence (AI)?

**Artificial Intelligence = The ability of machines to "think," make decisions, and solve problems.**

AI can be defined as the ability of computer systems to simulate certain human cognitive abilities, such as:

- Learning from data.
- Making decisions.
- Solving problems.
- Understanding natural language.
- Recognizing patterns in images and sounds.

### A Deeper Understanding of AI

Imagine we are building a "digital brain" for a machine. This brain does not have feelings or self-awareness like a human brain, but it is designed to be brilliant at processing massive amounts of information at lightning speed, searching for relationships and patterns to make logical and accurate decisions.

### Examples of AI in Your Daily Life

**Video Games:** Non-Player Characters (NPCs) use AI to make complex decisions, such as choosing the best strategy to attack or escape, and learning from your playstyle to become more challenging.

**Voice Assistants:** Siri, Alexa, and Google Assistant use Natural Language Processing (NLP) techniques to understand your speech, convert voice to text, and analyze the meaning to fulfill your request or answer your questions.

### Comparison Between Human Intelligence and Artificial Intelligence

AI is powerful and amazing; it mimics human intelligence but is not an exact copy of it.

Human Intelligence is characterized by	Artificial Intelligence is characterized by
Emotions and Awareness: We experience complex feelings like joy, sadness, love, and empathy, and we possess self-awareness.	Pure Data Processing: It does not feel or understand emotions and has no self-awareness; it only processes information and data.

Original Creativity and Innovation: We create entirely new ideas and solve problems in unconventional ways.	Super Speed and Accuracy: It processes trillions of data points in seconds and performs complex tasks with extreme precision.
Deep Understanding and Context: We understand jokes, sarcasm, and hidden meanings, and we grasp complex social situations.	Pure Logic and Data: Decisions are based on data and programmed rules, without intuition or an ethical conscience.

Illustrative Example: Imagine showing a painting to an AI. It will analyze the painting very accurately to identify the colors used, line patterns, and the number of people in it. However, it will not be able to feel the beauty of the painting, the sadness or joy expressed by the artist, or the deep message of the artwork. This ability for deep emotional and aesthetic understanding is a human capability.



### [Why is AI Important to Us Today?](#)

Imagine having a robotic assistant that can learn, think, and make decisions just like humans. This is the essence of AI. It is everywhere around us: when Google searches for your answer, when Facebook suggests a new product, or when you and your friends play video games. AI is a massive force; it is not just a technology, but a tool that can help us solve big problems, make our lives easier, and even open doors we never imagined before!

### [GPT and the Language Model Revolution](#)

Programs like ChatGPT can now have natural conversations and help you with your schoolwork!

- Image Recognition: Your smartphone can now recognize your face to unlock!
- Self-Driving Cars: Cars that drive themselves!

### **AI in Our Daily Life**

AI is all around us:

#### **In Mobile Phones:**

- Voice Assistants (Siri, Google Assistant).
- Phone cameras that automatically enhance photos.
- Apps that instantly translate text.

#### **In Games:**

- Smart opponents in video games.
- Personalized tips to improve your performance.

#### **In Entertainment:**

- Watch IT suggests suitable movies for you.
- Spotify discovers songs you will love.

#### **At Home:**

- Smart devices that control lighting.
- Smart vacuum cleaners.

Activity: Dear student... In cooperation with your classmates, discuss the future services that AI could provide.

## questions and Exercises

### **I. Put a (✓) for the correct statement and an (X) for the incorrect statement:**

1. Artificial Intelligence can feel human emotions. ( )
2. AI relies on data processing only without self-awareness. ( )
3. Characters in video games can learn from the user's playstyle. ( )
4. Human intelligence possesses creativity, while AI mimics and does not innovate. ( )
5. A phone camera that automatically enhances photos uses AI. ( )
6. Smart search engines like Google do not rely on AI. ( )
7. AI can understand sarcasm and emotions with the same accuracy as a human. ( )
8. Robots can be programmed to make decisions based on data. ( )
9. Smart home devices like a smart vacuum cleaner rely on AI. ( )

### **II. Choose the correct answer:**

#### **1. Artificial Intelligence is:**

- A. The machine's ability to feel.
- B. The machine's ability to 'think' and make decisions.
- C. Human ability to control the computer.
- D. A program for displaying images.

#### **2. An example of using AI in mobile phones is:**

- A. Writing messages only.
- B. Playing songs.
- C. Facial recognition.
- D. Opening the camera manually.

**3. Which of the following is a human capability and not an AI one?**

- A. Pattern recognition.
- B. Data processing speed.
- C. Creativity and innovation.
- D. Analyzing millions of data points.

**4. Games use AI to:**

- A. Display backgrounds.
- B. Move characters in a fixed way.
- C. Make characters adapt to the player's style.
- D. Increase the number of players.

**5. An example of using AI on the internet is:**

- A. Changing screen color.
- B. Suggesting appropriate content.
- C. Blocking the internet.
- D. Increasing browser speed.

**6. AI is characterized by:**

- A. Having feelings.
- B. Understanding sarcasm.
- C. Having self-awareness.
- D. Processing data at super speed.

**7. Siri is an example of:**

- A. Image processing.
- B. A voice assistant based on AI.
- C. A drawing program.
- D. An internet browser.

**8. What can AI NOT do yet?**

- A. Analyze light.
- B. Learn from data.
- C. Feel the beauty of a painting.
- D. Recognize voices.

**9. One of the capabilities of AI is:**

- A. Understanding deep social relationships.
- B. Making decisions based on data.
- C. Feeling sadness and joy.
- D. Free artistic creativity.

**10. Self-driving cars are an example of:**

- A. AI in homes.
- B. AI in education.
- C. AI in transportation.
- D. AI in medicine.

## Lesson 3

### Artificial Intelligence Around Us

#### Let's Learn Together

**Dear students**, in the previous lesson, we studied some examples of artificial intelligence in our daily lives and learned about virtual reality and augmented reality. In this lesson, we will continue what we have learned and explore many applications that depend on artificial intelligence in our lives.

#### Ethical Responsibility in Using Artificial Intelligence

With great power comes great responsibility. Artificial intelligence has enormous capabilities and power that can change the world for the better. However, we must use it wisely and with ethical responsibility to ensure safety, security, and benefit for everyone.

#### Justice and Transparency

AI systems should be designed in a fair and equitable way for all individuals, without discrimination.

#### Golden Rule:

#### Data Privacy and Protection

Your personal information must remain safe and secure. No one has the right to use your data without your permission.

***Tip: Always read the privacy settings for any new application or program you use.***

#### Human Oversight and Control

Artificial intelligence is a powerful tool with tremendous capabilities, but it remains a tool that human's control and direct. Humans set its goals and design the algorithms associated with it.

Critical decisions that affect people's lives (such as a doctor's diagnosis, a harsh judgment, or a judicial ruling) must always be made by humans. Why? Because humans possess awareness, ethics, and the ability to empathize, and they

understand the social context in ways that AI cannot possess—the complex cultural and social aspects.

- **Humans set the values and principles that AI technology must follow.**
- **Important decisions that humans must make:**

**Remember:**

**The final decision-maker is the human.**

**The Problem of Bias in Artificial Intelligence**

If an AI system is trained on incomplete or unfair data, it may "learn" this bias and make unfair decisions.

**For example:** If a facial recognition system is trained on data that mainly contains faces of people from one ethnicity, it may have difficulty accurately recognizing faces from other ethnicities. This is what we call "bias" in AI. Therefore, we must be very careful about the quality and diversity of the data we use to train AI systems to ensure justice and fairness in their outputs.



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**Your Role as a Smart User**

**How can you use AI technology responsibly as a smart user?**

<b>Think critically:</b>	<b>Learn how to verify information:</b>	<b>Use responsibly</b>
<ul style="list-style-type: none"><li>• Don't trust everything the AI shows you;</li></ul>	<ul style="list-style-type: none"><li>• Learn how to verify the true of information</li></ul>	<ul style="list-style-type: none"><li>• use technology to improve your life and the lives of others</li></ul>

## activity: "Young AI Innovator" Project

With the help of your teacher and in cooperation with your classmates:

Think of a simple problem you face at school or home, and imagine how an AI system could solve it. Follow these guiding steps (What – Why – Where – How – When):

- What is the problem?      What data is needed?
- Where .....?      Why .....?
- When .....?

### **Dear students,**

**Remember:** Artificial intelligence is not something hidden; it is a great force that can improve the world if guided correctly.

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### **Questions and Training**

**First: Place a checkmark (✓) for correct statements and an (X) for incorrect statements**

2. AI should be designed to be fair and equitable for everyone. ( )
3. No one has the right to use your personal data without your permission. ( )
4. AI can make critical decisions better than humans. ( )
5. Humans are the final decision-makers because they possess ethics and awareness. ( )
6. Bias in AI can occur due to incomplete or unfair data. ( )
7. It is safe to trust all results from AI without verification. ( )
8. Using AI responsibly means using it to improve others' lives. ( )
9. Facial recognition accuracy is not affected by the quality of training data. ( )
10. Part of a smart user's role is critical thinking and verifying information. ( )

11. The proposed student project encourages finding solutions using artificial intelligence to real-world problems.

**Second: Choose the correct answer from the following options**

**1. What is meant by justice in AI systems?**

- a. Designing systems that work faster
- b. Designing systems that work without human intervention
- c. Designing systems that are fair and equitable for all individuals
- d. Monitoring all data

**2. Examples of protecting privacy include:**

- a. Sharing your data with any application without review
- b. Reading privacy settings before using a new application
- c. Publishing all your information on the internet
- d. Giving your password to a friend

**3. Who makes critical decisions in systems that depend on AI?**

- a. AI alone
- b. Voice assistants
- c. Humans
- d. Robots

**4. Why must humans make important decisions?**

- a. Because AI is wrong
- b. Because humans possess ethics, awareness, and empathy
- c. Because AI cannot analyze data
- d. Because humans don't make mistakes

**5. When does bias occur in AI?**

- a. When data is diverse
- b. When data is incomplete or unfair
- c. When data is recent
- d. When data is large

**6. As a result of training a facial recognition system on data from only one ethnicity:**

- a. It works efficiently for everyone
- b. It may fail to recognize faces from other ethnicities
- c. It improves in translation

d. It may fail to recognize faces from other ethnicities

**7. Part of a smart user's role when dealing with AI:**

- a. Trusting everything that appears
- b. Critical thinking and verifying information
- c. Avoiding the use of technology
- d. Verifying information

**8. Which of the following is an example of responsible use of AI?**

- a. Using it to harm others
- b. Using it to improve people's lives
- c. Using it without reviewing data
- d. Spreading rumors

**9. What element does AI possess but humans do not?**

- a. The ability to store data
- b. The ability to analyze numbers
- c. The ability to understand values and feelings
- d. The ability to understand values and feelings

**10. The goal of the "Young AI Innovator" project is:**

- a. Only game design
- b. Thinking about solutions using AI for simple problems
- c. Using AI in everything without caution
- d. Writing difficult code

## Lesson 4: The Artificial Neuron

### Let's Learn Together

Dear students, in previous classes, we learned the concept of artificial intelligence and some concepts related to reality, virtual reality, and augmented reality. In this lesson, we will shed light on how AI technology works, and we will see how we can design simple models for some of the processes that AI understands.

### First: What is the Artificial Neuron?

The artificial neuron is a small unit in the computer that attempts to imitate the way human thinking works. Just as biological neurons in our brains help us think and learn, artificial neurons in computers have been created by scientists to enable computers to "think" and make decisions about the world around them, understand it, and decide and act.

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### Second: Components of the Artificial Neuron

The artificial neuron consists of 5 main parts:

#### 1. Inputs

These are the pieces of information that enter the neuron (such as an image, sound, or number).

#### 2. Weights

These are numbers that help the neuron determine the importance of each piece of information.

#### 3. Bias

A number that is added to the sum to adjust the neuron's operation.

Example: Imagine a student needs a score of **50** to pass an exam. However, the student was sick during the exam, so the school gave him **5** additional points as

assistance. These additional points resemble the (**Bias**), which is added to the result to help the artificial neuron reach the correct decision.

### **But what is the benefit of bias?**

- It makes the neuron more flexible
- It allows the neuron to give results even when inputs are zero
- It resembles the "personal bias" that can affect our decisions as humans

### **4. Activation Function**

This is the part of the artificial neuron that makes the final decision: Will the neuron send a signal or remain silent? This depends on the result of the calculations the neuron has performed (**Inputs × Weights + Bias**).

The activation function is like a switch that turns the neuron on or off. It determines whether the neuron will send a signal or not. Without it, the neuron won't know what to do with the calculations.

The name	This is a very simple function	Practical Exam
<b>Threshold</b>	What is it? It's a very simple function. It tells the cell: if the value is greater than a certain number (for example) 0.5, the result is 1; if it is less than or equal to the result is =	To imagine for example, if the exam is out of 100 points and passing is 50, then: <ul style="list-style-type: none"> <li>• If you scored 60 or more = Passed</li> <li>• If you scored less than 40 = Failed</li> </ul> (Give yes or no)
<b>Threshold Function</b>	This function doesn't just give "yes" or "no"; instead, it gives a probability or percentage between 0 and 1.	The computer analyzes an image and says (for example, "There is an 85%) chance this is a cat" = 0.85. This percentage gives us high confidence in the decision.
<b>ReLU Function</b>	This function gives the same value If it is positive (greater than zero),	microphone's sensitivity was positive (recording strong sounds). If it was recording a very weak sound, it ignores it (gives zero for negative or zero values, but activates values greater than zero - only concerned with positive values).

## 5. Output

**Dear students,** today we will learn how your grade is calculated in your subjects (Science, Mathematics, Computer Science), using a simple artificial neuron!

### Steps to calculate your grade:

Inputs	Weights	Bias	Calculation method	Activation Function
These are your grades in each subject (out of 10, for example): Science: Your grade Mathematics: Your grade Computer Science: Your grade	Each subject has a different level of importance. For example: Science has a weight of 0.4 Mathematics has a weight of 0.3 Computer Science has a weight of 0.3	A fixed number (such as) 1 is added to improve the result. For example, attendance during the study period or year work	We calculate each grade based on its weight, then add it together with the bias: Score = (Science × 0.4) + (Math × 0.3) + (Computer Science × 0.3)	To determine whether the student is "weak" or "excellent!", for example: if the result is greater than 5, "Excellent!"; if it is less, "Continue studying!"

### Example:

If your grades were:

- Science: 8
- Mathematics: 7
- Computer Science: 6

### Calculation:

$$(8 \times 0.4) + (7 \times 0.3) + (6 \times 0.3) + 1 = 3.2 + 2.1 + 1.8 + (\text{Bias}) 1 = 8.1$$

**Final Result: " 8.1" → Excellent**

### Now It's Your Turn!

Try it yourself: If your grades were (7, 6, 5), what would be the result? Calculate it using the same method!

### Remember:

**Artificial intelligence learns like you do. The more you work hard, the better your results become.**

**Remember: Artificial intelligence learns just like you; the harder you work, the better your results will be!**

### Questions and Training

**First: Place a checkmark (✓) for correct statements and an (X) for incorrect statements**

1. The artificial neuron attempts to imitate how neurons work in the human brain. ( )
2. Weights in the neuron do not affect the final decision. ( )
3. Bias helps the neuron give results even when inputs are zero. ( )
4. The activation function is responsible for executing the final decision of the neuron. ( )
5. The Threshold function gives values between 0 and 1 only. ( )
6. The Sigmoid function is used to give a probability or percentage. ( )
7. Inputs can be images, sounds, or numbers. ( )
8. Without the activation function, the neuron cannot make a decision. ( )
9. Weights are always constant fixed values. ( )
10. The output is the result of the neuron's operation. ( )

**Second: Choose the correct answer from the following options**

#### **1. What is the artificial neuron?**

- a. A program for running games
- b. A unit that attempts to imitate how human thinking works

- c. A real biological cell
- d. Part of the computer's memory

**2. What is the function of Inputs in the artificial neuron?**

- a. Storing results
- b. Receiving information
- c. Deleting data
- d. Recording decisions

**3. Weights are used for:**

- a. Determining the importance of each piece of information
- b. Decorating data
- c. Storing sounds
- d. Recording voices

**4. Bias resembles:**

- a. Deleting a grade
- b. Adding a simple number to help the neuron
- c. Reducing weights
- d. Duplicating data

**5. Functions of Bias include:**

- a. Preventing the neuron from working
- b. Reducing the accuracy of the neuron
- c. Making the neuron more flexible
- d. Canceling the use of inputs

**6. What is the function of the activation function?**

- a. Managing memory
- b. Making the final decision for the neuron
- c. Storing data
- d. Calculating weights

**7. The Threshold function works as:**

- a. A probability
- b. An on/off switch that depends on a specific threshold
- c. A sound system
- d. A color scale

**8. The Sigmoid function gives:**

- a. A negative number
- b. A probability or percentage between 0 and 1
- c. A number greater than 1
- d. A random number

**9. Which part of the neuron helps it make decisions even when inputs are zero?**

- a. Weights
- b. Inputs
- c. Input function
- d. Bias

# **Lesson Five:**

## **The Role of the Artificial Neural Cell in Artificial Intelligence**

### **Let's Learn**

**Dear Student**, in the previous lesson, we studied the components of the Artificial Neural Cell, the **Activation Function**, and its most famous types. In this lesson, we will learn a lot about Artificial Neural Networks.

**The Artificial Neural Cell is the basis for building what is known as Neural Networks, which are used in:**

- \* Image Recognition.
- \* Translation between languages.
- \* Talking with humans (like smart assistants).
- \* Predicting weather or prices.

### **1- How is an Artificial Neural Cell built?**

**To build an Artificial Neural Cell, we need to:**

- Determine the type of data that will be entered (e.g., numbers or images)
- Assign weights to the inputs.
- Collect the inputs and multiply them by their weights.
- Transfer the output to the Activation Function.
- Obtain the final output (Decision or Prediction).

### **2- How does the Artificial Neural Cell work?**

**Imagine you want to know if an image contains a cat or not:**

- The image is entered as an Input.
- The cell analyzes the image using weights.

- The Activation Function decides: Is this a cat? Yes or No.
- It sends the result to other cells or gives you a direct answer.

### 3- How are Artificial Neural Cells employed in Artificial Intelligence?

**When thousands of Artificial Neural Cells are connected together, we get a powerful Neural Network that can:**

- Learn from experiments.
- Improve itself over time.
- Solve complex problems like diagnosing diseases or driving cars.

### 4- Vital Applications of the Artificial Neural Cell

- Smart Assistants (e.g., Siri and Alexa).
- Smart Cameras that recognize faces.
- Self-Driving Cars.
- Instant Translation between languages.
- Diagnosing diseases in hospitals.
- Suggesting movies on platforms like Netflix and YouTube.

### Activity

**Dear Student**, imagine you are designing a neural cell to help determine if a student needs assistance in a specific subject.

\* What **inputs** would you use? (e.g., student grades, number of times they miss class). \* What **decision** will the cell make? (e.g., Does the student need help? Yes or No).

## Questions and Exercises

**First: Put a check mark (✓) in front of the correct statement and an (X) in front of the incorrect statement:**

- 1- The Artificial Neural Cell is the basic unit upon which the structure of Artificial Neural Networks is built. ( )
- 2- Artificial Neural Networks are used in translation between languages and prediction only, and not in image recognition. ( )
- 3- We must determine the type of input data (like numbers or images) as a necessary step to build an Artificial Neural Cell. ( )
- 4- The step that precedes the final output is transferring the output directly to the Activation Function. ( )
- 5- The final goal of the Artificial Neural Cell is to obtain the final output represented by the input multiplied by the weight, as in the example of recognizing a cat. ( )
- 6- The Activation Function is what determines whether the input is good or not. ( )
- 7- Among the vital applications of the Artificial Neural Cell is its use in diagnosing diseases in hospitals. ( )
- 8- When thousands of Artificial Neural Cells are connected together, they form a powerful network that can learn from experiments and improve itself over time. ( )
- 9- Self-driving cars are not considered a complex problem that powerful Artificial Neural Networks can solve. ( )
- 10- Smart cameras that recognize faces are an example of a vital application of the Artificial Neural Cell. ( )

Second: Choose the correct answer from the following choices:

- 1- What is the basis for building Artificial Neural Networks?
  - a. Algorithms
  - b. Artificial Neural Cell
  - c. Activation Function
  - d. Smart Assistants
  
- 2- What is the step that follows determining the type of data and assigning weights to the inputs in building an Artificial Neural Cell?
  - a. Obtaining the final output.
  - b. Transferring the output to the Activation Function.
  - c. Collecting the inputs and multiplying them by their weights.
  - d. Analyzing the weights.
  
- 3- What is the role of the Activation Function in the work of the Artificial Neural Cell?
  - a. Determining a weight for each input.
  - b. Collecting all weighted inputs.
  - c. Determining the final decision (Yes/No).
  - d. Entering the input.
  
- 4- When thousands of Artificial Neural Cells are connected together, we get a powerful network that can solve problems such as:
  - a. Writing programs.
  - b. Storing data.
  - c. Driving cars or diagnosing diseases.
  - d. Analyzing raw data.

- 5- Among the vital applications of the Artificial Neural Cell mentioned in the content is:
- a. Smart Assistants like Siri and Alexa.
  - b. Smart Cameras that recognize faces.
  - c. Self-Driving Cars.
  - d. All of the above.
- 6- The Artificial Neural Cell takes its inputs from the techniques used in:
- a. Analyzing the prices of fixed products.
  - b. Determining the price of all products manually.
  - c. Predicting weather or prices.
  - d. Displaying all old prices.
- 7- What is the ability that the powerful Neural Network acquires over time as a result of experiments?
- a. Changing the weights of inputs.
  - b. Increasing the number of cells.
  - c. Not needing the Activation Function.
  - d. Improving itself over time.
- 8- If the Neural Cell analyzes an image (e.g., a cat) that enters the cell (Input), what is the final output?
- a. The image.
  - b. The Activation Function.
  - c. Decision (Yes/No).
  - d. The final output.

- 9- Which of the following applications is an example of smart assistants that rely on the Artificial Neural Cell?
- a. Air conditioning devices.
  - b. Siri and Alexa.
  - c. Photography devices.
  - d. Computer operating systems.
- 10- After the Activation Function makes a decision (e.g., Is this a cat? Yes or No), what is the next step?
- a. Determining another type of data.
  - b. Collecting all weighted inputs.
  - c. Sending the result to other cells or giving a direct answer.
  - d. Assigning a weight to each input.

**Lesson Six:**  
**Introduction to Data Analysis with Python**

**Let's interact together**

How can data be analyzed using Python?

**Let's learn**

**Dear student...** In the first year of middle school, we studied the concept of big data and some examples of data analysis. We also studied the Python programming language. In this lesson, we will learn how to analyze data using Python.

**1- Why do we use the Python language to analyze data?**

Python is considered one of the best programming languages for data analysis because of:

- Ease of learning and use: Its simple syntax makes it suitable for beginners.

- Powerful libraries such as

**Pandas** for data processing.

**NumPy** for scientific calculations.

**Seaborn and Matplotlib** for graphical visualization.

- A large support community with numerous educational resources.

- Compatibility with artificial intelligence (AI) and machine learning (Machine Learning).

## Basic Concepts in Data Analysis

### 11- Arithmetic Mean (Mean):

It is the sum of all values divided by their count.

#### Example in Python:

```
import numpy as np
data = [10, 20, 30, 40, 50]
mean = np.mean(data)
print("The Arithmetic Mean:", mean) # Output: 30.0
```

Dear Student, here is a simple explanation for the code:

**import numpy as np:**

- Imports the NumPy library, which is used for scientific computing in Python.
- as np is an abbreviation for the library name to make it easier to use.

#### Example without abbreviation:

```
import numpy
mean = numpy.mean(data) # Longer to write
data = [10, 20, 30, 40, 50]
```

- **Function:** Create a list (List) containing the numbers whose average we want to calculate.
- **Note:** The list can contain any numbers (they do not need to be in order).

### Another Example:

```
data = [5, 15, 25, 35, 45]
```

```
mean = np.mean(data)
```

- `np.mean(data)`: Ready-made function in NumPy to calculate the arithmetic mean.

### How to calculate the Mean?

Mean = (Sum of values) / (Count of values)

**Here:  $50 + 40 + 30 + 20 + 10 = 150 / 5 = 30.0$**

### Example without NumPy:

```
sum_data = sum(data) # 150
```

```
count = len(data) # 5
```

```
mean = sum_data / count # 30.0
```

```
print("The Arithmetic Mean:", mean)
```

- **Function:** Display the result on the screen.
- **Output:** The Arithmetic Mean: 30.0
- **Note:** The result is of type float (decimal number) even if it is a whole number.

### 12- Maximum and Minimum Values (Max & Min):

- **Maximum Value (Max):** The largest value in a set of data.
- **Minimum Value (Min):** The smallest value in a set of data.

### **Example:**

```
maximum = np.max(data)
minimum = np.min(data)
print("The Maximum Value:", maximum) # 50
print("The Minimum Value:", minimum) # 10
```

## **2- Types of Data that can be analyzed**

### **a. Numerical Data:**

- **Integers:** Ages, product counts.
- **Decimal Numbers:** Heights, weights, prices.

### **b. Text Data:**

- **Texts:** Customer reviews, articles.
- Can be analyzed using **Natural Language Processing (NLP)**.

### **c. DateTime Data:**

- **Dates:** Purchase history, event dates.
- Can be analyzed using `pandas.to_datetime()`.

### **Example:**

```
import pandas as pd
dates = ["2023-01-01", "2023-01-02", "2023-01-03"]
date_series = pd.to_datetime(dates)
print(date_series)
```

### **Code Explanation:**

import pandas as pd: We use

```
import pandas as pd
```

to import the library and abbreviate it to pd for easier typing.

Creating a list containing text dates.

```
date_series = pd.to_datetime(dates):
```

13- We use the `pd.to_datetime()` function to convert the `dates` list into a time series

14- (`DateTimeIndex`) that allows us to perform time-based operations on it, such as:

\* Extracting the day, month, year.

- Calculating time differences.
- Filtering by date.
- Printing the result.      **Print(date\_series)**

### **The output will be:**

```
DatetimeIndex(['2023-01-01', '2023-01-02', '2023-01-03'], dtype='datetime64[ns]', freq=None)
```

This means the data is now ready to be treated as dates, not texts.

### **Why do we use `pd.to_datetime()`?**

**It enables time-based operations such as:**

- \* Calculating the period between two dates.
- \* Extracting date parts (day, month, year).
- \* Grouping by date, such as the total sales per month.
- \* Checking the validity of dates (e.g., it rejects an invalid date like “2023-13-01”).

**Dear Student**, remember that analyzing data is important for extracting valuable insights and making better decisions. Python is an ideal language for this because of its ease of use and specialized libraries.

## Questions and Exercises

First: Put a check mark (✓) in front of the correct statement and an (X) in front of the incorrect statement:

- 1- Data analysis helps in making decisions based on facts. (    )
- 2- Python is a language that does not contain libraries for data analysis. (    )
- 3- We use the Pandas library to handle and process data. (    )
- 4- We use the `np.mean` function to find the smallest value in the list. (    )
- 5- The arithmetic mean can be calculated without the NumPy library. (    )
- 6- Text data cannot be analyzed at all. (    )
- 7- The `pd.to_datetime` command rejects an invalid date like “2023-13-01”. (    )
- 8- The Maximum Value (Max) is the smallest value in the data. (    )
- 9- The arithmetic mean results in a decimal number even if the output is a whole number. (    )
- 10- Python can be used to analyze DateTime data. (    )

Second: Choose the correct answer from the following choices:

1- What is the definition of data analysis?

- a. Drawing charts.
- b. Dealing with texts.
- c. Scientific calculations.
- d. Examining data to extract useful information.

2- Why is Python considered a suitable language for data analysis?

- a. Because it is a difficult language to learn.
- b. Because it has powerful libraries like NumPy and Pandas.
- c. Because it only works on phones.
- d. Because it does not contain libraries.

3- What is the function of the NumPy library?

- a. Drawing charts.
- b. Dealing with texts.
- c. Scientific calculations.
- d. Analyzing images.

4- We use the `np.mean` function to calculate:

- a. The largest number.
- b. The smallest number.
- c. The arithmetic mean.
- d. The product of the values.

5- In the code `import numpy as np`, what does `as np` mean?

- a. Deleting the library.
- b. Abbreviating the library name for ease of use.
- c. Changing the Python language.
- d. Running the library automatically.

6- The Maximum Value (`Max`) is:

- a. The largest value in the data.
- b. The smallest value in the data.
- c. The average of the values.
- d. The product of the value

7- What type of data can be analyzed using NLP?

- a. Numerical data.
- b. Texts.
- c. Images.
- D. Dates only

- 8- What is the function of the command `pd.to_datetime()`?
- a. Converting texts to numbers.
  - b. Converting text dates to a time series format.
  - c. Deleting dates.
  - d. Sorting data automatically.
- 9- What type of data is in the list: `data = [10, 20, 30, 40, 50]`?
- a. Text data.
  - b. Historical data.
  - c. Numerical data.
  - d. Audio data.
- 10- Which library is used for data visualization in Python?
- a. NumPy.
  - b. Pandas.
  - c. Matplotlib.
  - d. datetime.

## Unit Four: Python Language

### Lesson One:

#### Practical Application on Data Analysis from an Excel File

#### Let's Interact Together:

What is Excel software? Think about how to represent data using Excel software. Explain that.

#### Let's Learn:

Dear Student... There are several requirements that must be applied in the operating environment:

<b>Required Libraries (Python Packages)</b>	pip install pandas	pip install matplotlib
<b>Library Functions</b>	Used for data analysis and reading Excel files.	pandas
	Used for creating charts.	matplotlib
The Excel file named <b>grades.xlsx</b> must be in the same folder as the program.		

#### **File Contents**

<b>Name</b>	<b>Math</b>	<b>Science</b>	<b>English</b>
<b>Ali</b>	12	11	15
<b>Khaled</b>	14	14	12
<b>Mohammed</b>	13	15	13
<b>Sabah</b>	11	12	14
<b>Mustafa</b>	10	13	15
<b>Yousef</b>	15	13	12

## **Load the Data and Display It Using the Following Code**

```
import pandas as pd                # Load the Excel file
df = pd.read_excel('grades.xlsx')  # Display the first 5 rows
print(df.head())
```

Dear Student... Here is a simple explanation of the code.

### **Calling the Library:**

```
import pandas as pd
```

Here, we call the pandas library, which helps us deal with data and tables.

### **Reading the Excel File:**

```
import pandas as pd
```

Here, we call the pandas library, which helps us deal with data and tables.

### **Display the First 5 Rows:**

```
print(df.head())
```

Here, the first 5 rows of the file are printed so you can see the shape of the data and its beginning.

In this way, you can understand how to read data from an Excel file and display some basic information about it.

### **Basic Data Analysis:**

```
grades = df[['Math', 'Science', 'English']]
print("Average")
print(grades.mean().to_dict())          # Average grades for each subject
print("Maximum value")
print(grades.max().to_dict())          # Highest grade in each subject
print("Number of successful students")
print((grades > 13).sum().to_dict())    # Number of successful students in each subject
```

**Dear Student...** Let me explain this code in an easy and direct way.

<b>Meaning</b>	<b>Code</b>
We selected from the table (df) only the grades of three subjects: Math, Science, and English, and put them in a variable called grades.	<pre>grades = df[['Math', 'Science', 'English']]</pre>
We print the word "Average" then calculate the average grades for each subject (meaning the sum of students' grades ÷ their number) and convert it to an easy-to-read form (dictionary).	<pre>print("Average") print(grades.mean().to_dict())</pre>
We print "Maximum value" then display the highest grade any student got in each subject.	<pre>print("Maximum value") print(grades.max().to_dict())</pre>
We print "Number of successful students", then calculate the number of students who got more than 13 in each subject (i.e., successful) and display the number.	<pre>print("Number of successful students") print((grades &gt; 13).sum().to_dict())</pre>
<p><b>In summary:</b> This code performs statistical analysis on the data in the table and shows you:</p> <ul style="list-style-type: none"><li>- The average grades for each subject.</li><li>- The highest grade in each subject.</li><li>- How many students passed in each subject.</li></ul>	

## Graphical Representation of Data

Meaning	Code
Dear Student, the code in front of you draws a bar chart for the average grades of the subjects.	<pre>import matplotlib.pyplot as plt df.mean().plot(kind='bar') # Draw the averages of the subjects plt.show() # Display the chart</pre>
This line means that we are using a library called matplotlib, which helps us draw charts.	<pre>import matplotlib.pyplot as plt</pre>
Using a short name "plt" instead of the long name. This makes writing easier and saves time.	<pre>"as plt"</pre>
Here we tell the program: - Take the average grades for each subject through <code>grades.mean()</code> . - Then draw it in a pie shape using <code>plot(kind='pie')</code> . <code>plt.show()</code>	<pre>grades.mean().plot(kind='pie')</pre>
<p><b>Finally:</b> We ask the program to display the chart.</p> <p><b>Result:</b> A chart appears with bars; each bar represents the average grades of a subject from the subjects. This makes it easy for us to compare grades quickly and beautifully.</p>	

## **Interpreting the Results:**

```
print(df.corr( ))      # Calculate the correlation between subjects
```

It calculates the relationship between the subjects in the data table.

**What does that mean?** It means: Does one subject affect the other? For example, if a student is good at Math, is he usually good at science?

**What is the result of the code?** Numbers between -1 and 1 will appear.

- If close to  $\rightarrow 1$ , the relationship is strong and positive (both subjects increase together).
- If close to  $\rightarrow 0$ , there is no clear relationship.
- If close to  $\rightarrow -1$ , the relationship is inverse (if one increases, the other decreases).

### **Example:**

If the relationship between Math and Science = 0.9, this means that students who are good at Math are usually good at Science too. This is useful in understanding how subjects affect each other.

## Questions and Exercises

First: Put a check mark (✓) in front of the correct statement and an (X) in front of the incorrect statement:

1. The panda's library is used to read Excel files and analyze data. ( )
2. The head() function displays all the data in the table completely. ( )
3. The matplotlib library can create bar, pie, and line charts. ( )
4. The command grades.max() calculates the average grades of students. ( )
5. df.corr() helps in knowing the relationship between different subjects. ( )
6. plt.show() does not display the chart. ( )
7. Using grades > 13 gives true or false results for each student. ( )
8. The code grades.mean() gives the highest grade, not the average. ( )
9. The grades.xlsx file must be in the same folder as the Python program for the code to work without problems. ( )
10. Pandas can be used to create charts without needing the matplotlib library. ( )

Second: Choose the correct answer from the following choices:

1. What is the main function of the **pandas** library?
  - a) Drawing charts and graphs.
  - b) Playing audio files.
  - c) Analyzing data and reading Excel files.
  - d) Creating websites.
  
2. Which library is responsible for creating charts in Python?
  - a) numpy
  - b) pandas
  - c) Tkinter
  - d) Matplotlib

3. Which command is used to load an Excel file?
  - a. `pd.load_file`
  - b. `pd.read_excel`
  - c. `pd.open`
  - d. `df.read`
  
4. What does `df.head()` do?
  - a. Deletes the first 5 rows
  - b. Displays the first 5 rows
  - c. Displays the last 5 rows
  - d. Displays the number of columns
  
5. What type of chart is produced by:  
`grades.mean().plot(kind='bar')`?
  - a. Pie chart
  - b. Scatter plot
  - c. Line chart
  - d. Bar chart
  
6. What does `grades.mean()` do?
  - a) Finds the highest grade
  - b) Finds the lowest grade
  - c) Calculates the average grades
  - d) Deletes columns
  
7. What does `grades.max( )` do?
  - a) Finds the lowest grade
  - b) Finds the highest grade
  - c) Calculates total grades
  - d) Counts students
  
8. What does `(grades > 13).sum()` do?
  - a) Calculates student grades
  - b) Counts students with grades above 13
  - c) Compares students
  - d) Sorts grades

## **Lesson Two:** **Conditional Statements in Python**

### **Let's Interact Together:**

What are conditional statements? Give examples of how to use conditional statements in Python.

### **Let's Learn**

**Dear Student...** We studied the Python programming language and variables and their types in the first preparatory grade, and in this lesson, we will learn the concept of conditional statements and how to use them in Python.

### **Concept of Conditional Statements and How to Use Them:**

In Python language, conditional statements are used to make logical decisions based on whether a certain condition is met. These statements tell the program to execute a specific part of the code only if a certain condition is met.

**What is a Conditional Statement?** A conditional statement is a programming structure that allows the program to choose between several execution paths based on specified conditions.

### **General Syntax:**

```
if condition:      # If the condition is true
                   #Execute this code
else:              #Otherwise
                   #Execute this code instead
```

### **Types of Conditional Statements in Python:**

#### **1. if**

Executes the code only if the condition is met.

```
age = 18
```

```
if age >= 18:
```

```
    print("You are allowed to enter")    #Execute this code
```

## **2. if ... else**

Executes one of the branches: If the condition is met, executes the first code; if not, executes the alternative code.

```
age = 16
```

```
if age >= 18:
```

```
    print("You are allowed to enter")
```

```
else:
```

```
    print("Sorry, you cannot enter")    #Execute this code
```

## **3. if ... elif ... else**

Used to test several different conditions. If one of the conditions is met, the program stops at it and executes its code.

```
mark = 85
```

```
if mark >= 90:
```

```
    print("Excellent")
```

```
elif mark >= 75:
```

```
    print("Very Good")
```

```
elif mark >= 60:
```

```
    print("Good")
```

```
else:
```

```
    print("Failed")
```

### **Practical Example:**

```
number = int(input("Enter a number: "))  
  
if number > 0:  
    print("The number is positive")  
  
elif number < 0:  
    print("The number is negative")  
  
else:  
    print("The number is zero")
```

### **Questions and Exercises**

**First: Choose the correct answer from the following choices:**

1. What is the goal of conditional statements in Python?
  - a) To repeat the code only.
  - b) To execute specific code when a condition is met.
  - c) To define functions.
  - d) To create variables.
2. What is the correct syntax for writing an if statement?
  - a) if: condition.
  - b) : if condition.
  - c) : condition if.
  - d) if (condition) then.
3. What happens if the condition in an if statement is not true?
  - a) Executes the if code.
  - b) The program stops completely.
  - c) Ignores the if statement and moves to what follows.
  - d) Shows a programming error.

4. The else statement is used when...

- a) The condition is always true.
- b) The condition does not exist.
- c) We want to execute alternative code when the condition is not met.
- d) We want to define a variable.

5. Which of the following is a correct example of an if...else statement?

- a) if x > 10: else:
- b) if x > 10 else x:
- c) if x > 10: else: print("NO")
- d) if x > 10: print("OK") else:

6. What does the word elif mean?

- a) End of the program.
- b) Repetition loop.
- c) Additional branch between if and else.
- d) Ready-made function.

7. Which statement is used to test several consecutive conditions?

- a) if only.
- b) else only.
- c) if...elif...else.
- d) print.

8. What happens if the first condition in a series of if...elif...else is met?

- a) All conditions are executed.
- b) Only the elif condition is executed.
- c) The rest of the conditions are ignored.
- d) A warning appears.

9. Which of the following is a correct condition in Python?

- a) if x = 5.
- b) if x == 5.
- c) if x => 5.
- d) if x <=< 5.

10. When writing:

```
age = 18
```

```
if age >= 18:
```

```
    print("Allowed")
```

What is the result?

- a) Nothing will be printed.
- b) An error will appear.
- c) "Allowed" will be printed.
- d) "Not allowed" will be printed.

**Second: Put a check mark (✓) in front of the correct statement and an (X) in front of the incorrect statement:**

1. The if statement is used to make a decision based on a condition. ( )
2. The else statement can be written without an if statement before it. ( )
3. More than one elif can be used in the same conditional statement. ( )
4. The condition in Python must end with a ; sign. ( )
5. The if statement can execute more than one line inside it. ( )
6. The elif statement is an abbreviation for the else if statement. ( )
7. The condition inside if must be a calculation operation only. ( )
8. It is possible for the conditional statement to contain if without else. ( )
9. The code inside if must be indented by only one space. ( )
10. The if...elif...else helps the program choose only one path to execute. ( )

## Lesson Three: Loops and Functions

### Let's Interact Together:

What are loops and functions?

### Let's Learn

#### **Loops:**

Dear Student... Loops help you execute a specific command several times without writing it more than once.

#### **For Loop for Repetition with a Known Number**

##### **General Syntax:**

```
for item in sequence:           # The code you want to repeat
    print(item)                 # Example: Print each item
```

##### **Example:**

```
for i in range(5):             # Repeat the command 5 times
    print("Hello!")           # This command will print 5 times
```

##### **Notes:**

- range(5) means from 0 to 4 (5 times).
- Each command under for is executed in each cycle.

#### **While Loop for Conditional Repetition**

##### **General Syntax:**

while condition:

The code that repeats as long as the condition is true

(There must be something that changes the condition, otherwise it will continue forever)

### **Example:**

```
x = 0
while x < 3:                # Repeat as long as x is less than 3
    print("I am learning")  # It will print 3 times.
    x += 1                  # Increase x by 1 in each cycle
```

### **Notes:**

- The loop continues as long as the condition ( $x < 3$ ) is true.
- Beware of infinite loops if you forget to increase  $x$ ; it will continue forever!

### **Examples**

#### **Printing numbers from 1 to 5:**

```
for num in range(1, 6):    # From 1 to 5
    print(num)
```

### **Notes:**

- `range(1, 6)` means from 1 to 5 (6 is not included).

#### **Summing the numbers in the list:**

```
numbers = [10, 20, 30]
sum = 0
for n in numbers:          # For each number in the list
    sum += n                # Add it to the sum
print("The sum =", sum)    # Result: 60
```

## Notes:

- n takes the value of each element in the list in order.

## Remember:

1. Use for when you know the number of times.
2. Use while when repetition depends on a condition.

## Functions:

Dear Student... Imagine a function like a small machine that performs a specific task when you ask it to. Instead of writing the same code repeatedly, we write it once in a function and call it whenever we want!

## What is a Function?

Its task: To perform a specific task (like calculating the sum of two numbers, printing a message, etc.).

Its benefit: It makes the code more organized, easier to understand, and modify.

## How to Create a Function:

```
def greet( ):                                # We use def to create a function.  
    print("Hello! I am a beginner function")  # The code inside the function
```

## Note:

The function does not work until we call it!

## Code Explanation:

- **def** is short for define (definition), we use it to create a function.
- **greet( )** is the function name (you can choose any name).
- **“ : ”** We put it after the function name.
- **Indentation (indent):** Necessary for all code inside the function.

### **How to Call the Function:**

```
greet()    # Call the function to execute the code inside it
```

**Result:** Hello! I am a beginner function

### **Function with Parameters (Input):**

```
def add(a, b):                # a and b are the function inputs
    result = a + b
    print(f"The sum is: {result}")

add(3, 5)                    # Pass the numbers 3 and 5 to the function
```

### **Result:**

The sum is: 8

### **Explanation of Parameters:**

- a, b: Values we pass to the function to work on them.
- {result}: We use f-string to display the result.

### **Function that Returns a Result (Return):**

```
def multiply(x, y):
    return x * y              # Returns the result instead of printing it

product = multiply(4, 6)     # Save the result in a variable

print("The product is:", product)
```

### **Result:**

The product is: 24

### **The Difference Between print and return:**

- print displays the result on the screen only.
- return returns the result to use it later in the code.

### **Remember:**

Functions make your programs faster and easier to modify.

### **Questions and Exercises**

#### **First: Choose the correct answer from the following choices:**

1. The for loop is used when:
  - a) Repetition depends on a condition.
  - b) The number of repetitions is unknown.
  - c) We want to run the code only once.
  - d) The number of repetitions is known.
2. A function in programming means:
  - a) Repeating the code.
  - b) A tool to perform a specific task.
  - c) Storing data.
  - d) Creating new variables.
3. The code inside the function must be:
  - a) Without indentation.
  - b) Written after a semicolon.
  - c) Written with indentation (Indentation).
  - d) Inside parentheses.
4. The keyword def is used for:
  - a) Creating a variable.
  - b) Creating a loop.
  - c) Defining a function.
  - d) Printing text.

5. The while loop continues to execute as long as:

- a) The number of repetitions is known.
- b) The condition is true.
- c) The number of repetitions = 0.
- d) The condition is false.

6. If we do not change the condition inside a while loop, it may cause:

- a) Immediate stop.
- b) System error.
- c) Infinite loop.
- d) Only one rotation.

7. The correct call to the function is by:

- a) Writing def only.
- b) Writing the function name followed by parentheses.
- c) Writing the variables inside print.
- d) Writing the file name.

8. Parameters in the function are:

- a) The values returned by the function.
- b) The values we pass to the function to work on them.
- c) The commands inside the function.
- d) The function name.

9. The difference between return and print is that return:

- a) Display the result on the screen.
- b) Store the result for later use.
- c) Repeats the code.
- d) Creates a new function.

10. The main purpose of functions is:

- a) Increasing the code length.
- b) Writing the same code several times.
- c) Making the program more organized.
- d) Eliminating the need for variables.

Second : Put a check mark (✓) in front of the correct statement and an (X) in front of the incorrect statement:

1. The for loop is suitable when you know the number of repetitions in advance. ( )
2. The while loop can work without a condition. ( )
3. Forgetting to change the condition inside a while loop may cause an infinite loop. ( )
4. The function does not work except when called. ( )
5. The function cannot contain parameters. ( )
6. The code inside the function must be indented. ( )
7. The return function is used to display the result on the screen only. ( )
8. Functions help organize the code and reduce repetition. ( )
9. The for loop always depends on a logical condition only. ( )
10. The function can be called more than once within the same program. ( )

## Lesson four: Data Structures or Collections

### Let's interact together:

- What is meant by data structures?
- What are data structures in the Python language?

### Let's learn

What are Data Structures in Python?

They are ways to store data in a program in an organized way.

### **Examples:**

- **Shopping list (List):** We write the items we want to buy.
- **School timetable (Tuple):** It is fixed and does not change during the week.
- **Glossary (Dictionary):** A data structure that stores data as pairs of **keys** and **values**.

### **Lists**

- A list is changeable. You can add or remove items.
- It uses square brackets [ ].

### Example of Data Analysis:

Suppose we have students' grades in Mathematics, and we want to calculate the average:

```
grades = [85, 90, 78, 92, 88]           # List of grades
average = sum(grades) / len(grades)     # Sum of grades ÷ number of grades
print("The average is:", average)
```

**Output:** The average is: 86.6

### **Important Operations:**

Operation	Code	Explanation
Adding	<code>grades.append(95)</code>	Add a new grade
Removing	<code>grades.remove(78)</code>	Remove a grade
Sorting	<code>grades.sort()</code>	Sort grades

### **Tuple**

- A tuple is not changeable (fixed).
- It uses round brackets ( ).

### **Data analysis example**

Suppose we have the days of the week and we cannot change them:

```
days = ("Saturday", "Sunday", "Monday", "Tuesday", "Wednesday", "Thursday",  
"Friday")
```

```
print("The third day is:", days[2])           # Counting starts from 0
```

**Output:** The third day is: Monday

### **When do we use a tuple?**

- When we need fixed data such as:
- Days of the week
- Location coordinates (latitude and longitude)

### **Dictionary**

1. The dictionary is a collection of elements stored as a pair: value.
2. The dictionary is written between curly braces {} and separated by a colon:.
3. Used for quick access to data using the key instead of the index as in lists.
4. Keys must be unique and can be text or numbers.
5. We can add new items or change existing values easily.

### **Exercise (1):**

```
student = {"name": "Ali", "age": 15, "grade": "A"}
print(student["name"])           # Print student name
student["age"] = 16              # Change age
student["city"] = "Cairo"       # Add new key
print(student)
```

### **Practical Exercises:**

#### **Looping Through the List**

##### **Exercise 1:**

You have a list of students' ages, write a program to count the number of students older than 15 years.

```
ages = [14, 16, 15, 17, 14, 16]           # List containing students' ages
count = 0                                  # Variable starting from zero to count students older than 15
for age in ages:                           # Loop through each age in the list
    if age > 15:                             # Condition: Is the current age greater than 15?
        count += 1                           # If the condition is true, increase the counter by 1
print("The number of students older than 15 is:", count)    # Print the number of
students older than 15
```

##### **Exercise 2:**

Loop through a list of names:

```
names = ["Mohamed", "Mona", "Haba", "Asmaa"]           # List of names
for name in names:                                     # Iterate over each name in the list
    print(name)                                         # Print each name
```

## Questions and Exercises

First: Choose the correct answer from the following choices:

1. What is meant by Data Structures?
  - a. Ways to beautify the program's appearance.
  - b. Ways to implement loops only.
  - c. Ways to store data in the program in an organized manner.
  - d. Commands to print texts.
2. Lists are characterized by:
  - a. Fixed and non-modifiable.
  - b. Written with regular parentheses ().
  - c. Modifiable to add and remove elements.
  - d. Cannot store more than one data type.
3. Which of the following uses square brackets?
  - a. Tuple
  - b. Set
  - c. Dictionary
  - d. List
4. The append() method is used for:
  - a. Removing an element from the list.
  - b. Adding a new element to the list.
  - c. Sorting elements.
  - d. Changing the list type.

5. Tuples are characterized by:
  - a. Modifiable.
  - b. Elements change automatically.
  - c. Non-modifiable (fixed).
  - d. Written with curly braces {}.
6. We use Tuple when we want data that is:
  - a. Constantly changing.
  - b. Fixed and unchanging.
  - c. Automatically deleted.
  - d. Dependent on keys and values.
7. The Dictionary stores data as:
  - a. List inside a list.
  - b. Key-value
  - c. Values only without keys.
  - d. Unordered elements.
8. Which of the following is used to write the dictionary?
  - a. []
  - b. ()
  - c. {}
  - d. <>
9. One of the properties of dictionary keys is that they:
  - a. Can be repeated.
  - b. Must be unique.
  - c. Cannot be texts.
  - d. Must be numbers only.

10. The dictionary is useful for storing:
- a. Fixed data only.
  - b. Organized data like student data.
  - c. Unique numbers only.
  - d. Unordered elements.

**Second: Put a check mark (✓) in front of the correct statement and an (X) in front of the incorrect statement:**

- 1. Lists can be changed after creation. ( )
- 2. Tuple elements can be changed. ( )
- 3. Dictionary uses keys to access values. ( )
- 4. Dictionary keys can be repeated. ( )
- 5. List uses square brackets [ ]. ( )
- 6. Tuple uses curly brackets { }. ( )
- 7. Dictionary is suitable for students' data. ( )
- 8. List can store only one data type. ( )
- 9. Tuple is suitable for fixed data like days of the week. ( )
- 10. We cannot add new items to a dictionary. ( )

**Lesson five:**  
**Introduction to Encryption Using Python**

**Let's interact together:**

- What is encryption?
- How can encryption be performed using Python?

**Let's learn**

Have you ever wondered: How can you send a secret "encrypted" message that no one understands except the person it's addressed to?

Today, we will learn how to do that using Python, in an easy and fun way.

**What is Cryptography?**

**Cryptography:** It is the art of converting information from its original clear and understandable form called "**Plaintext**" into another unreadable form called "**Ciphertext**" that no one can read except the person who has the key to decrypting it. Think of it as a secret box with a lock and key!

**1. Correct and Incorrect Uses of Cryptography:**

Type of Use	Examples	Explanation
<b>Correct use (Security)</b>	Protecting messages (WhatsApp), securing passwords, secure websites (https://)	Used to protect your messages and data from hackers
<b>Incorrect use (Harmful)</b>	Ransomware viruses	Used to harm people by encrypting their files and asking for money

## 2. Types of Cryptography:

Type	Explanation (Basic Idea)	Example
Simple encryption	Uses fixed and simple rules like shifting letters by a number (this is what we will learn)	Caesar Cipher
Complex encryption	Uses complex math equations and very long keys	AES (used by banks and companies)

### Our Magic Tools in Python: ord( ) and chr( ) functions:

Computers do not understand letters; they understand numbers.

So, we use these functions to convert between them.

Function	Purpose	Example
ord( )	Converts a letter to its secret number using Unicode	ord('A') → 65
chr( )	Converts a number back to its letter	chr(65) → 'A'

### Simple Examples:

1. Find the code of a letter 'S':

```
print(ord('S'))
```

**Output: 83**

2. Find the letter of a code '72':

```
print(chr(72))
```

**Output: H**

3. Try shifting a letter 'D'(+1):

```
code_D = ord('D') ..... (1)
```

```
shifted_code = code_D + 1 ..... (2)
```

```
print(chr(shifted_code)) ..... (3)
```

```
Output: E ..... (4)
```

### **Explanation:**

1. Using the `ord( )` function, it converts the letter 'D' to its number in the UNICODE table and stores it in the variable `code_D`.
2. It increases the resulting number by 1 to get the number of the next letter in the order.
3. It converts the new number to a letter using the `chr( )` function and prints it on the screen.
4. The final output is the letter E.

### **Note:**

The letters used are **capital letters**.

### **Encryption and Decryption in Python:**

We will use the shift method (Caesar Cipher) which relies on:

- **Encryption:** Original letter code + encryption key = encrypted letter code
- **Decryption:** Encrypted letter code – encryption key = original letter code

### **Summary of Important Points**

Point	Summary
Cryptography	Converting plaintext to ciphertext using a key
<code>ord( )</code>	Converts a letter to its Unicode number
<code>chr( )</code>	Converts a number to its letter
Shift Encryption	Adding a fixed number (key) to the letter code
Decryption	Subtracting the same number to get the original letter

## Questions and Exercises

First: Choose the correct answer from the following choices:

1. What is meant by Plaintext?
  - a. The encrypted text.
  - b. The unreadable text.
  - c. The original clear text.
  - d. The text protected by a key.
2. Ciphertext is:
  - a. The original text.
  - b. The text understandable by everyone.
  - c. The text after transformation to become incomprehensible.
  - d. The text that does not contain a key.
3. Which of the following is considered a correct use of encryption?
  - a. Spreading viruses.
  - b. Demanding ransom.
  - c. Protecting messages and passwords.
  - d. Deleting data.
4. Which of the following is an incorrect use of encryption?
  - a. Securing accounts.
  - b. Encrypting data for protection.
  - c. Securing websites.
  - d. Ransomware viruses.

5. Simple encryption relies on:
  - a. Complex equations.
  - b. Very long keys.
  - c. Fixed rules like shifting.
  - d. Artificial intelligence.
6. Which of the following types is used in banks and companies to ensure maximum security?
  - a. Simple encryption.
  - b. Complex encryption.
  - c. Manual encryption.
  - d. Shift encryption.
7. The ord() function is used for:
  - a. Converting text to a sentence.
  - b. Converting number to letter.
  - c. Converting letter to its number in Unicode.
  - d. Decryption only.
8. The chr() function's function is:
  - a. Deleting letters.
  - b. Converting letter to number.
  - c. Converting number to letter.
  - d. Encrypting texts.
9. Shift encryption relies on:
  - a. Subtracting a random number.
  - b. Swapping words.
  - c. Adding a fixed value to the letter's number.
  - d. Changing sentence order.

10. Shift decryption is done through:

- a. Adding the encryption key.
- b. Deleting the first letter.
- c. Subtracting the key from the encrypted letter's number.
- d. Automatically swapping letters.

**Second: Put a check mark (✓) in front of the correct statement and an (X) in front of the incorrect statement:**

- 1. Encryption is a way to protect information from unauthorized access. ( )
- 2. Anyone can easily read the encrypted text without the encryption key. ( )
- 3. Incorrect use of encryption includes encrypting files and demanding money to decrypt them. ( )
- 4. Simple encryption like Caesar cipher is still used in protecting major banks. ( )
- 5. The ord( ) function converts the letter to a number. ( )
- 6. The chr( ) function converts the number to the corresponding letter. ( )
- 7. Complex encryption relies on long keys and mathematical equations. ( )
- 8. In shift encryption, a fixed value is subtracted to produce the encrypted text. ( )
- 9. Shift decryption is done using the subtraction operation. ( )
- 10. Encryption is not used in daily applications like WhatsApp or banks. ( )

## Lesson six:

### Encryption in Python: How to turn messages into secrets using the XOR operator?

#### Let's interact together:

How can you do encryption using Python?

#### Let's learn

#### **Introduction: From Simple to Smarter Encryption**

In the previous lesson, you learned a simple encryption method: adding a fixed number to a character's code. This is a good start but easy to break. Today, we will learn a smarter, stronger method using **XOR** and **bitwise operations**, which is the real first step into the world of encryption!

#### **1. Basics of Encryption:**

##### **Bitwise Operations**

Imagine your computer is a large box of small lamps, each lamp is either lit (representing 1) or off (representing 0). This is the **bit, the smallest unit of information storage on the computer.**

**So, how does the computer talk?** Instead of exchanging complex words or numbers, it talks in the language of lights: 0 and 1. Here comes the role of the magic of bitwise operations.

If these lamps are the words and the alternative to using them in the computer, then bitwise operations are the grammatical rules!

They are mathematical and logical operations performed directly on the state of these lamps (i.e., on zeros and ones). These operations allow the computer to "read" the state of the lamps and change them at an extremely fast speed to make decisions and perform complex calculations. In other words, those lamps are the basic

components, and these operations are the engine that drives everything the computer does!

### **What are bitwise operations?**

They are a way to process numbers based on their internal representation consisting of zeros and ones.

### **Their function and uses:**

- **Processing speed:** It is the fastest way to perform many arithmetic and logical operations.
- **Encryption:** And this is our exciting use today! As it is the basis for building encryption algorithms.

### **2. The Secret Star: XOR (Exclusive OR) Operation:**

Now, let's get to know the most important operation in our lesson: the XOR operator, read as "ex or" or logical exclusion, and symbolized by ^ in Python.

### **XOR Rule of Operation:**

- Imagine you are studying the state of two bits.
- The possible result is that the lamp is on (1) if the states of the two bits are different (one on and the other off),
- but if the states of the two bits are similar (both on or both off), the result is off (0).

### **Using XOR in Encryption: "The Secret of the Reversible Operation":**

- If you combine the message with the secret key using the XOR operator, you get the encrypted message.
- If you take the encrypted message and combine it with the same secret key using the XOR operator again, you will get the original message!

### **3. Encryption and Decryption in Python**

In Python, we can deal with texts, where we need to convert each letter in it to a number so that we can apply the XOR operator on it.

#### **Helper Tools:**

**ord( )(**letter**):** Converts the letter to the number corresponding to this letter in the "Unicode" table.

**chr( )(**number**):** Converts the number to the corresponding letter in the "Unicode" table.

**The fixed secret key:** We will use the key 10 in all examples.

#### **Encryption Process:**

Encrypting a Single Letter (A):

#### **Explanation:**

The letter "A" is encrypted directly without a loop, where it is converted to a number, the XOR operation is applied with key 10, then converted to an encrypted letter through the following code in Python:

```
secret_key = 10 ..... (1)
original_char = "A" ..... (2)
encrypted_char_num = ord(original_char) ^ secret_key ..... (3)
cipher_text = chr(encrypted_char_num) ..... (4)
print(f"Cipher: {cipher_text}") ..... (5)
```

### **Explanation:**

1. The variable `secret_key` represents the encryption key, and its value here is 10 and is used in the encryption process.
2. The variable `original_char` contains the original letter to be encrypted, which is "A".
3. The letter 'A' is converted to its number in the Unicode table using `ord( )`, then the XOR operation (`^`) is performed on it with the key `secret_key` to encrypt it.
4. The numerical result from the XOR operation is converted to an encrypted letter using the `chr( )` function.
5. The final encrypted letter is displayed on the screen using text formatting (f-string).

### **Remember some of the following concepts:**

<b>Concept</b>	<b>Explanation</b>
<b>Bit</b>	Smallest unit of storage: 0 (off) or 1 (on)
<b>Bitwise Operations</b>	Fast mathematical/logical operations on 0s and 1s
<b>XOR (^)</b>	Encryption operator: 1 if bits different, 0 if the same
<b>Secret Key</b>	Number used for both encryption and decryption
<b>Reversibility</b>	XOR allows returning to original message

### **Decryption code for the previous code:**

```
secret_key = 10          The same encryption key used previously #
cipher_text = "K"       The code text (example: the output from line (4) in the encryption)
encrypted_char_num = ord(cipher_text)
                        Converting a code character to a number (Unicode value) #
original_char_num = encrypted_char_num ^ secret_key
                        Once again, to restore the original number, XOR application #
decrypted_char = chr(original_char_num)
                        Convert the retrieved number to the letter #
print(f"Decrypted: {decrypted_char}")
                        Print the unseen letter #
```

### **Questions and Exercises**

#### **First: Choose the correct answer from the following choices:**

1. The bit is:
  - a. The largest unit of measurement in data.
  - b. A complex electrical circuit.
  - c. The smallest storage unit representing 0 or 1.
  - d. A decimal number.
2. Bitwise operations are used because they are:
  - a. Very slow.
  - b. Complex and cannot be executed by the computer.
  - c. The fastest way to process data.
  - d. No relation to encryption.

3. One of the features of XOR that makes it suitable for encryption is:
  - a. That it completely changes the shape of the data.
  - b. That it is an irreversible operation.
  - c. That it is a reversible operation that can be used for encryption and decryption.
  - d. That it works only on texts.
4. Bitwise operations are:
  - a. Operations performed directly on words.
  - b. Operations performed only on images.
  - c. Operations performed on zeros and ones inside the computer.
  - d. Slow and complex operations.
5. The ord( ) function in Python is:
  - a. Converting text to random numbers.
  - b. Converting text to a list.
  - c. Converting the letter to its number in Unicode.
  - d. Converting the number to a letter.
7. XOR operation in Python is implemented using the symbol:
  - a. +
  - b. \*
  - c. &
  - d. ^
8. The reversible property of XOR means:
  - a. That the operation is performed only once.
  - b. That XOR cannot be used for decryption.
  - c. That performing it twice with the same key restores the original value.
  - d. That the operation always changes the data.

9. The secret key used in encryption must:
- a. Change in each step.
  - b. Be the same in both encryption and decryption operations.
  - c. Not be used in decryption.
  - d. Be a letter only.
10. Bitwise operations are important because they are:
- a. Work only on words.
  - b. A fundamental part of the computer's implementation of decisions and operations.
  - c. Not used in modern applications.
  - d. Limited to games only.

**Second: Put a check mark (✓) in front of the correct statement and an (X) in front of the incorrect statement:**

- 1. The bit is the smallest storage unit in the computer. ( )
- 2. XOR operation gives the result 1 only when the two values are equal. ( )
- 3. XOR operator can be used in encryption because it has a reversible property. ( )
- 4. Bitwise operations are slow compared to regular arithmetic operations. ( )
- 5. The chr( ) function in Python converts the number to the corresponding letter in the Unicode table. ( )
- 6. One of the properties of XOR is that it is not suitable for encryption because it cannot be reversed. ( )
- 7. The computer internally deals with data in the form of 0 and 1. ( )
- 8. The secret key should not be the same when decrypting. ( )
- 9. Bitwise operations are the basis for encryption and pattern detection inside the computer. ( )