



ARTIFICIAL INTELLIGENCE FOUNDATION

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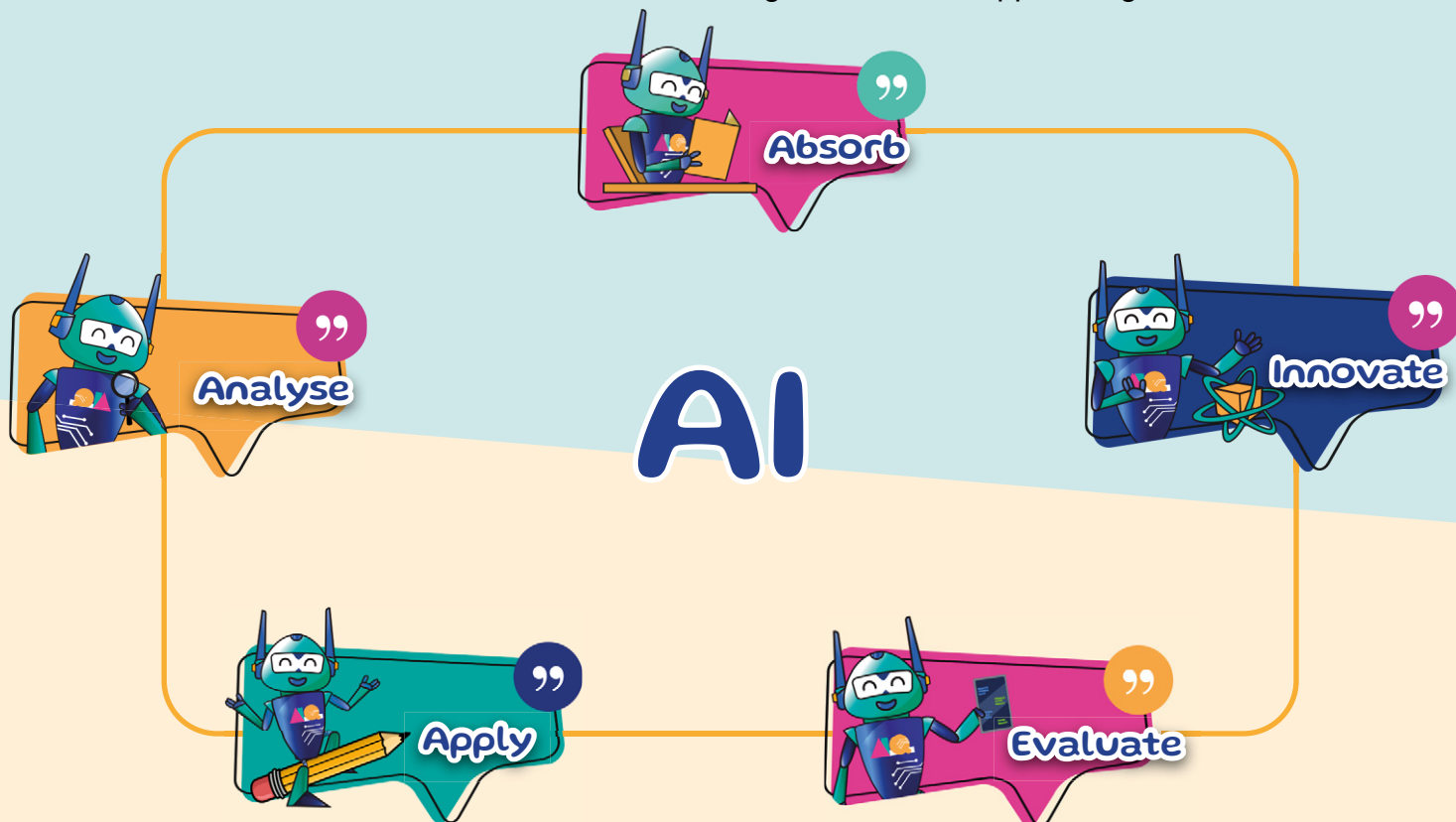
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About this Book

This is a self-learning material with graphics, interactive activities, and short knowledge checks. Since we are talking about AI, this book will be full of internet links and hands-on activities that will help them master the basics.

This book follows the A3EI design (Absorb, Analyse, Apply, Evaluate, Innovate)

- **Absorb/Acquisition** – Explaining a concept
- **Analyse/Adaptation** – Scenarios/Examples
- **Apply/Iteration** – MCQs/Discussion Questions/Challenges/Apps
- **Evaluate/Generalization** – Self-Check/Peer Evaluation/Given Scenarios/Given Problem
- **Innovate/Evaluate** – Solutions – Create Challenges/Questions/Apps/Designs/Ideas



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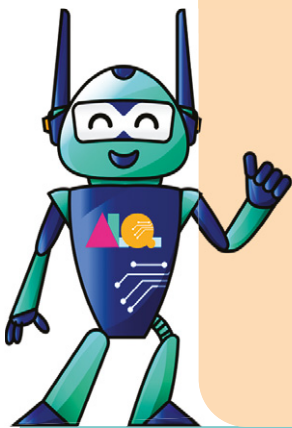




01

Introduction to AI

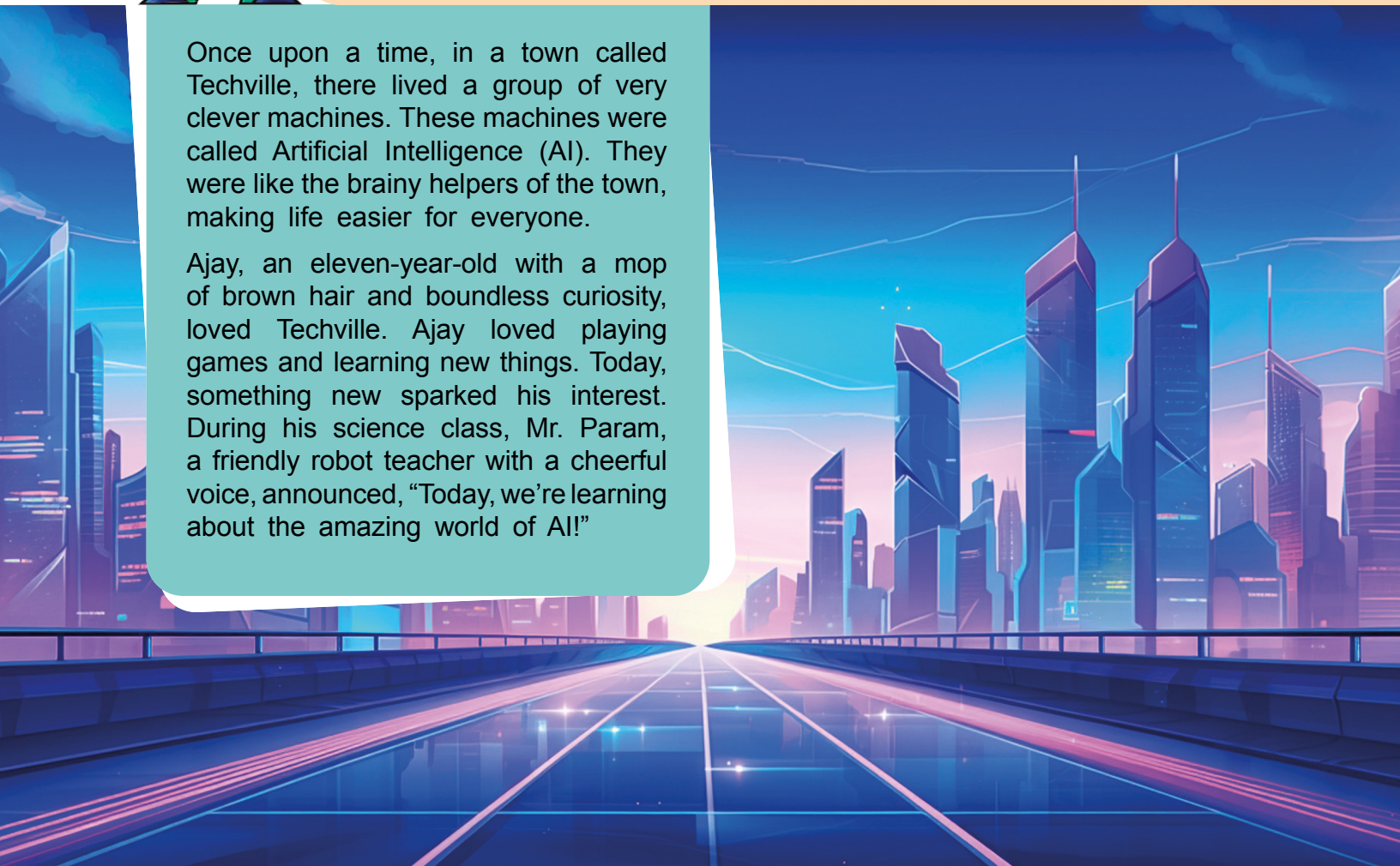
Module Objectives:



- Explain Artificial Intelligence (AI) in own words.
- Identify the real-world examples of AI around us.
- Differentiate between machine learning, neural networks, and deep learning.
- Explain application of each learning technique (supervised, unsupervised, reinforcement learning) in different situations.
- Explain the role of mathematics as the basis of AI.

Once upon a time, in a town called Techville, there lived a group of very clever machines. These machines were called Artificial Intelligence (AI). They were like the brainy helpers of the town, making life easier for everyone.

Ajay, an eleven-year-old with a mop of brown hair and boundless curiosity, loved Techville. Ajay loved playing games and learning new things. Today, something new sparked his interest. During his science class, Mr. Param, a friendly robot teacher with a cheerful voice, announced, “Today, we’re learning about the amazing world of AI!”





Ajay, ever the inquisitive one, shot his hand up. “Are you powered by AI, Mr. Param?” “Yes I am powered by AI. Imagine having a friend who can think and learn like you but does not get tired,” Mr. Param said, smiling. “That is AI!” Ajay’s eyes widened with curiosity. A friend that could learn and keep up with him? That was incredible! “But how does it work, Mr. Param?” Ajay asked.



“Think of AI as a super-smart brain. It learns from information, just like you do in school. But instead of textbooks, it uses massive amounts of data to get smarter. This lets AI do incredible things, like recognize your voice, understand your words, and even help with homework!” Mr. Param explained. Ajay nodded, beginning to understand. “So, when I ask my computer to find a cool new video game, it uses AI to understand what I want and shows me the best options?”

“Exactly!” Mr. Param replied. “AI helps your computer understand what you are looking for and finds it quickly.” “And don’t forget me! Though you speak to me like any other teacher, I am also a robot powered by AI and empowered to recognise each one of you and answer all your queries!”

1.1 AI and Its Significance in Modern Society



Ever wondered how music apps like Spotify, Wynk or Amazon recommend songs you love? That’s AI, a super-smart helper working behind the scenes! AI analyses your listening habits and finds similar artists or genres you’d enjoy.

AI is the ability of the computer to do tasks that normally need human intelligence. AI is everywhere these days. In hospitals, AI helps doctors diagnose illnesses faster. On the road, AI helps self-driving cars navigate safely. And when you’re chilling, AI even suggests movies you might enjoy, just like a friend with great taste!

But can AI make mistakes? Of course, AI is still learning, just like you. But with our help, it can keep getting smarter. Just like us, AI too learns from its mistakes. The more it learns, the smarter it gets. Plus, humans are always there to guide and correct it.

Doesn’t AI sounds like a fantastic friend to have? So next time you use an app or gadget, remember, AI might be your invisible friend working in the background to make life easier and more fun!

DID YOU KNOW?

Param 8000 is India’s first supercomputer. PARAM is a series of supercomputers designed and developed by India, widely used for performing tasks that require highly efficient computational powers. The Param series consists of 10 supercomputers now, as of June 2020.



A. State whether the statements are true or false:

- 1. If AI makes a mistake, it can't learn from it to improve future performance. _____
- 2. According to Mr. Param, AI can become tired just like humans after working for long hours. _____

1.2 Meet AI's Power Packed Team!



When you use a calculator to do math, it's no big deal. Even for a complex math problem, you enter a formula and, the calculator will get you the answer. But what if you could just ask your phone a question, like "What's 23 times 47?" and it gives you the answer right away? Cool, right?

That's the power of Artificial Intelligence, or AI for short. Artificial Intelligence is the ability of machines to think and learn. It's like having a super-smart friend inside your device! When you talk to it, it understands your question and helps you like a real friend would.

AI works, with the help of a powerful team: machine learning, neural networks, and deep learning. Let's see how they work together:

It is Ajay's birthday, and guess what? His aunt has got him the most amazing gift ever – a robot puppy! This robot puppy was named Robo and it could learn tricks!

At first, Robo doesn't know anything about catching balls. So, Ajay needs to show Robo how to catch a ball by throwing it gently. Slowly and steadily, Robo observes and tries to copy what Ajay did. Sometimes, Robo would catch the ball, and sometimes, it would miss it.



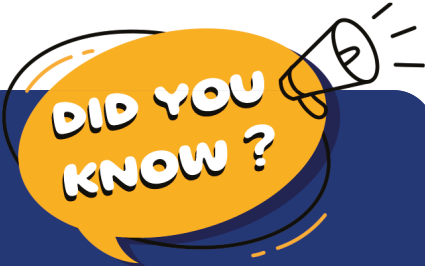


But here's the cool part: every time Robo catches or misses the ball, it learns from its mistakes. It remembers what worked and what didn't. With practice, Robo gets better and better at catching the ball. It starts predicting where the ball would land and moves its hands accordingly. Eventually, Robo becomes good at catching the ball all by itself!

1.2.1 Machine Learning

This is exactly how machine learning works. Instead of being programmed with specific instructions on how to catch the ball, Robo learns from experience and gets better over time. That's how AI learns too, just like Robo!

Machine learning (ML) is a powerful tool that lets AI learn and improve on its own, kind of like how you get better at riding a bike the more you practice. The process of learning begins with searching for patterns based on the examples provided. We will learn about it soon.



Machine learning is a core technology behind many popular applications, including YouTube, Netflix, and Google Photos. Here's how:

- **YouTube:** Recommends videos based on your watch history, searches, and what other users watch after similar videos.
- **Netflix:** Suggests movies and shows using your viewing habits and ratings.
- **Google Photos:** Recognizes people and objects in your photos, allowing you to search for photos by content, not just filenames.

Machine learning is all around us! It helps recommend movies you might enjoy on Netflix, based on what you've watched. It even helps self-driving cars learn how to navigate roads safely. So, machine learning is like giving a robot (or any AI!) the ability to learn from experience, just like you do by trying new things and maybe even making a few mistakes along the way!

Imagine you have a big box of crayons and want to sort them by colour. You could look at each crayon individually and decide where it belongs. But what if you have lots and lots of crayons? It would take a long time!

Let's say you have a special helper called a "Colour Detective." This Colour Detective has a special ability to quickly sort the crayons for you. But how does it do that. It does it with the help of the artificial neural network.

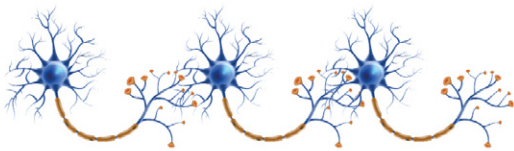
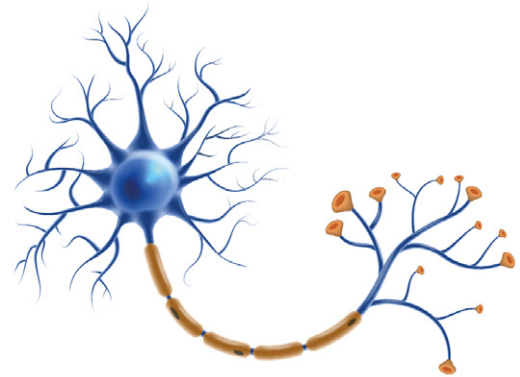




1.2.2 Artificial Neural Networks (ANN)

Neural networks are inspired by the human brain! They're like interconnected network of pathways that can process information.

Learning in humans occurs by neurons transferring signals to one another. When this neuron structure is built artificially to create this learning, we call 'artificial neural network'. **In an artificial neural network, we have artificial neurons that work together just like a chain of individuals passing information ahead.**



So, when you give the Colour Detective (neuron) a crayon, it looks at the colour and decides which group it belongs to, like red, blue, or green. Then, it passes this information to other Colour Detectives (neurons), who do the same thing. They keep passing the crayon along until it ends up in the right group. So, the more crayons you give it, the more intelligent it becomes at sorting them!

Similarly, when you give your AI friend any sort of data (picture/text/number), these pathways get stronger, helping it learn and recognize patterns. And just like you learn from experience, neural networks learn from the data they're given, improving their tasks over time!

1.2.3 Deep Learning

Remember Mr. Param, your favourite robot teacher in TechVille? He's not just friendly, he's a powerhouse of knowledge! He has a vast library of information within himself, which is constantly growing with every lesson. But that's not all. Mr. Param has a secret weapon: a team of tiny "Mr. Neural Params" working together inside him. These little helpers allow him to learn and adapt in real-time. This incredible combination makes Mr. Param the most efficient and popular teacher in TechVille!



Deep learning is like having a super-powered learning machine compared to regular machine learning. Let's understand the difference:



Machine Learning	Deep Learning
<ul style="list-style-type: none">• Imagine you have a friend who learns from experience, like you.	<ul style="list-style-type: none">• Now, imagine your friend has a whole team of helpers! Each helper looks at the pictures and shares what they see with the others.
<ul style="list-style-type: none">• You show them pictures of cats and dogs.	<ul style="list-style-type: none">• The more helpers there are (called layers), the more details they can consider.
<ul style="list-style-type: none">• They learn to tell the difference, but maybe not perfectly.	<ul style="list-style-type: none">• By working together, they can tell the difference between cats and dogs much more accurately, even with tricky pictures.

Benefits of Deep Learning:

- **Better Results:** The team effort helps deep learning achieve super-accurate results, like recognizing faces in blurry photos or translating languages really well.
- **Tackling Complex Problems:** Deep learning can handle super-confusing problems, like helping self-driving cars navigate tricky situations or analysing medical scans for diseases.

Drawback of Deep Learning – Brain Drain: Just like a big team needs a lot of resources, deep learning can use a lot of computer power to run all those helpers.



Deep Learning in Action: Deep learning is everywhere these days, working behind the scenes to make things smarter! Like, it allows voice assistants like Siri and Alexa to understand your questions better, like your friend understanding exactly what you need when you ask them to find information.

So, **deep learning is like having a super-powered learning machine with a team of helpers**, making AI even more powerful and opening doors to solve complex problems in the future!

DID YOU KNOW?

Deep learning allows computers to recognize objects in photos with greater accuracy and speed than humans, much like a superhero's vision!

Thus, Machine learning is the foundation, teaching AI to learn. Neural networks are the building blocks, processing information like a brain. Deep learning takes things a step further, making AI even more powerful. Together, they help AI make our lives easier!



Ask any question to Siri, Cortana or Alexa.

These AI assistants are using deep learning to help you find answers.

B. Now explain what is the role of each component of AI?

1. **Machine Learning:** _____
2. **Neural Networks:** _____
3. **Deep Learning:** _____

1.3 How AI Learns?

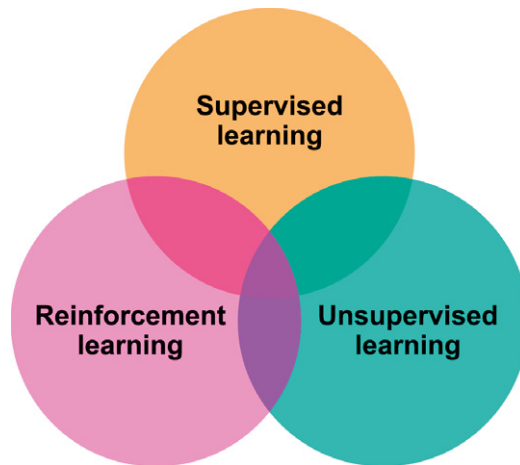


Ajay regularly watches his favourite cartoon series on YouTube. Considering his watch history, YouTube now regularly notifies Ajay on new released episodes of that show! But Ajay's mind is buzzed with questions. "How does the AI brain know what kind of cartoon series I like?" he thought. He went to Mr. Param for answer!



Mr. Param chuckled, “That’s a great question, Ajay. There are actually different ways AI learns.” He projected a holographic image on the classroom wall, displaying three colourful spheres. Let’s see what each of these spheres mean.

AI learning can be broken down into three main categories:

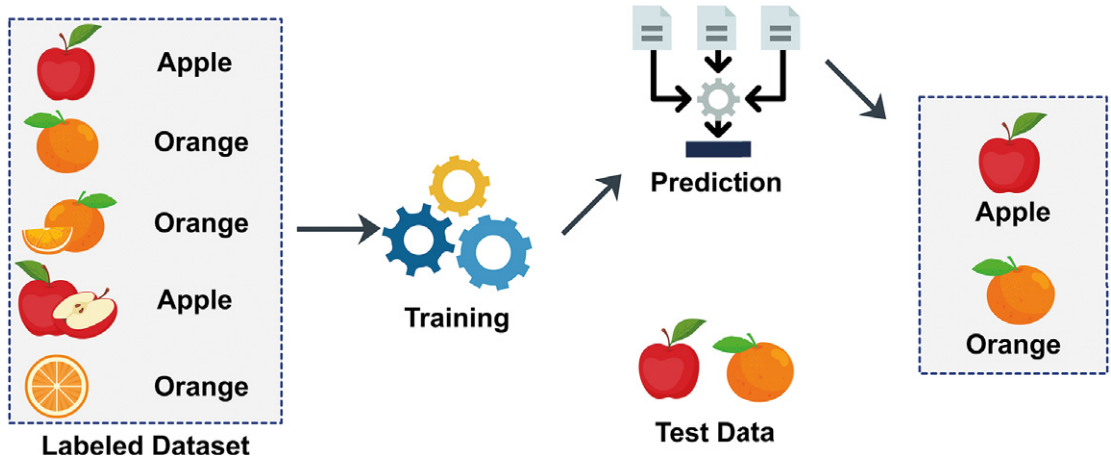


1.3.1 Supervised Learning

Imagine you’re training your pet to shake your hand. You show your pet your hand (the input) and say “shake” (the desired output). This is supervised learning! The AI is given data (pictures of hands) with clear labels (which is a handshake or not a handshake) to learn from, like a student getting guidance from a teacher.

It is an approach to train AI using a set of labelled instructions. Let us understand this with one more example:

You provide AI with a set of different pictures of apple and orange, with clear labels which is an apple’s picture and which is orange’s picture. Now, based on this data, when the AI has to recognize the image on its own the next time, it will be able to do so based on the previously provided information and comparison.





1.3.2 Unsupervised Learning

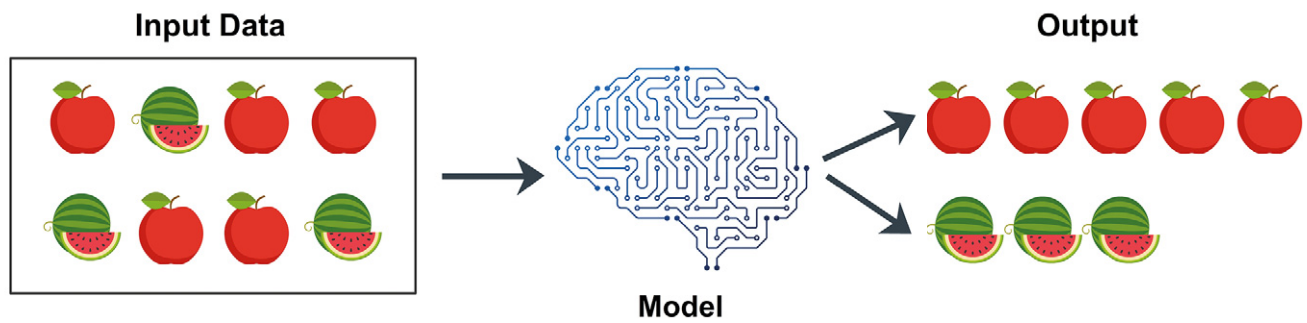
Imagine you have a giant bag of colourful candies. Instead of being told which candies are chocolate, coffee, or strawberry flavour, you just dump them all out. **Unsupervised learning is like AI sorting those candies all by itself (without any labels).** The AI analyses the data (the candies) on its own, looking for hidden patterns. It might group candies by colour (red, blue, green), by shape (round, square, squiggly) or by flavour (chocolate, coffee, and strawberry). The AI figures things out on its own, without anyone showing it exactly how.



Unsupervised learning is when the data provided is not clearly labelled. Here, a raw data is provided to the AI, which will recognize patterns, come with possible outcomes and keep learning on its own. Here's one more example:

Imagine you give your AI friend a bunch of pictures of apples and watermelons (without labels). Using machine learning, the AI can analyse those pictures and spot the differences between apples and watermelons itself. Then, the next time you show it a new picture of a fruit, it can use what it learned to guess if it's an apple or a watermelon!

Unsupervised Learning in ML



1.3.3 Reinforcement Learning

Imagine playing a video game where you learn by doing. You aim to get the character to the end of the level while avoiding obstacles. Every time you make a move, the game tells you if it's a good move (you get points) or a wrong move (you lose points). Reinforcement learning is similar.

The AI interacts with its environment (the game) and learns by trying different actions and seeing what the output is. It learns from the rewards (points) and punishments (penalties) it



receives. Over time, the computer learns which moves are good or bad by getting feedback from the game and it adjusts its actions to maximize the rewards.

So, **reinforcement learning is like learning by trial and error, like playing a video game in which you get points for making good moves and learning from your mistakes.** One more way to understand this could be:



Training a pet – You give it a treat (reward) when it does something good (like sits). But if it does something bad (jumps on the couch), you don't give it a treat. Reinforcement learning is like that!

To sum up, supervised learning needs clear instructions, unsupervised learning finds patterns on its own, and reinforcement learning learns by doing. These different approaches allow AI to tackle a wide range of tasks and keep getting smarter!



Test Yourself!

C. Fill in the blanks.

1. Unlike supervised learning, unsupervised learning does not use labeled data; instead, it uses _____ data to allow the AI to learn patterns and relationships on its own.
2. In reinforcement learning, an AI model learns to make decisions through _____ and _____, similar to playing a video game where actions lead to rewards or penalties.



1.4 The Magic of Math inside AI!

In TechVille's school, Ajay chats with Mr. Param, his teacher. Their conversation flows easily in English, but a question lingers: how does Mr. Param, a robot after all, truly understand what his students are saying? The answer lies in the invisible magic of mathematics, the secret language that empowers Artificial Intelligence (AI).



1.4.1 AI and Mathematics



Mathematics is like the basis of AI. It helps us understand and create the algorithms (rules) that make AI work. For example, when we teach a computer to recognize patterns or solve problems, we use math to write down these rules and equations. The various systems inside Mr. Param convert what Ajay is saying into logical mathematical algorithms, which is solved by Mr. Param and the output converted in a language Ajay understands! The amazing thing about it is that all these complex tasks are done in seconds!

1.4.2 Difference between AI and Computer Science

Like you, Ajay also uses computers and wonders why AI is not called computer Science. After all Mr. Param is nothing but a powerful computer, Right? Computer science is all about how computers work and how we can use them to solve problems. AI is a big part of computer science because it's about making computers more intelligent and more capable. Computer scientists write the programs and build the systems that make AI possible.

AI is a fascinating field because it mimics human intelligence. It involves understanding how our brains work and replicating that in computers. We explore different techniques, such as machine learning (teaching computers to learn from data), neural networks (building computer systems that work like our brains), and deep learning (creating complex systems with many layers of learning).



Let's Sum Up!

What is AI?

Machines that can think and do tasks that normally need human intelligence.



Meet the Team!

Machine Learning:

Helps AI learn on its own. Just like you get better at riding a bike the more you practice.

Neural Network:

A system similar to human brain. Here artificial neurons work together like a chain of individuals passing information ahead.

Deep Learning:

A type of machine learning that uses multiple layers of artificial neurons to perform complex tasks.

How AI Learns?

1

Supervised Learning

A way to train AI using labeled data. Pictures of with clear labels (which is an apple's picture and which is orange's picture).



2

Unsupervised Learning

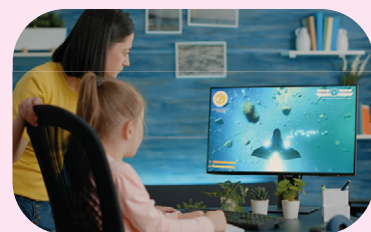
A way to train AI using unlabeled data. Imagine being given a bag of candies to sort by colour or flavour on your own.



3

Reinforcement Learning

A way to train AI through trial and error. Similar to learning a video game by getting points for good moves and penalties for mistakes.





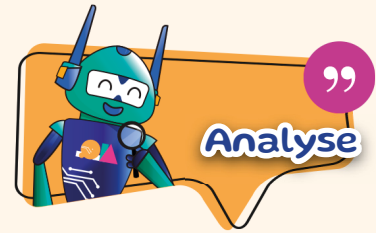
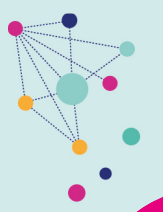
Scan the QR code and enhance your learning EXPERIENCE!



Quick Knowledge Check!

D. Choose the correct alternative.

1. What does the story of Techville suggest about the role of AI in everyday life?
 - a) AI is only used for entertainment.
 - b) AI is primarily for scientific calculations.
 - c) AI improves various aspects of daily life by assisting in tasks.
 - d) AI is unreliable and often makes mistakes.
2. How does Machine Learning (ML) differ from traditional programming?
 - a) ML requires constant human supervision.
 - b) ML programs follow very specific instructions without deviation.
 - c) ML involves systems improving over time through experience.
 - d) ML is less effective in pattern recognition.
3. Which of the following is true about neural network?
 - a) They function independently without any data input.
 - b) They simplify tasks by working individually.
 - c) They cannot learn from previous experiences.
 - d) They work together quite similar to a human brain.



Let's THINK AI

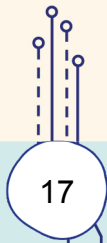
E. Read the scenario and answer the question:

1. Imagine you are a developer tasked with designing an AI system for a school library. Which of the team member of AI can help you manage and recommend books to students based on their past reading habits?

2. Imagine you want the AI system to not only recommend books based on reading history but also understand the content and themes of those books. Who on your team would be most helpful?

3. Let's say you want the AI to analyse student borrowing data to identify hidden patterns, such as popular book combinations or genres that students often read together. Which type of learning AI should engage in for this?

4. Imagine developing a system where the AI recommends books and receives feedback from students (positive or negative). The AI then uses this feedback to refine its recommendations over time. Which type of learning AI should use for this purpose?





F. Design a concept for an AI-based app that helps students learn a new language by interacting with them conversationally. What key features would you include to enhance their learning experience? Do you think any of the AI terms we learnt above can be helpful to you?

“ Answer Key

A.

1. False
2. False

B.

1. **Machine Learning:** Learn from experience
2. **Neural Networks:** Interconnected neurons that form a system similar to a human brain
3. **Deep Learning:** Super powered learning machine

C.

1. Unlabelled/raw data
2. Trials and errors

D.

1. c)

2. c)

3. d)

E.

1. **Machine learning** – Just like AI uses user’s history and list of favorites to recommend him new videos on YouTube, the same technology could be applied to recommend books to the students based on past reading habits.
2. An expert in **deep learning** – Deep learning uses complex neural networks to analyse vast amounts of text data, allowing the AI to grasp the nuances of books and make more nuanced recommendations.
3. **Unsupervised learning** allows the AI to discover patterns in unlabelled data, which would be useful in this case for uncovering hidden trends in student borrowing habits.
4. **Reinforcement learning** allows the AI to learn through trial and error, receiving good feedback for successful recommendations and adjusting its approach based on negative feedback. This would be ideal for creating an AI system that continuously improves its book recommendations based on student preferences.

“

Glossary

1. **Neurons** – Tiny cells in the brain that transmit information throughout the body. They are the building blocks of the nervous system.
2. **Supercomputer** – an extremely powerful computer that can perform complex calculations very quickly.
3. **To program a computer** – to give it a set of instructions that it can follow to perform a task.
4. **Holographic image** – a 3D image projected by light that appears to float in air.
5. **Trial and error** – a method of solving a problem by trying different things and seeing what works.
6. **Algorithm** – a set of instructions that a computer follows to perform a task.