



Class VI

My Dream Book of
**ARTIFICIAL
INTELLIGENCE**

CBSE CODE 417

Learning challenges
Experience online!
Python Turtle
Build a game!
Mini Projects
Block Coding
AI Games



ISO 9001:2015 Certified Company



Class VI



My Dream Book of
ARTIFICIAL
INTELLIGENCE

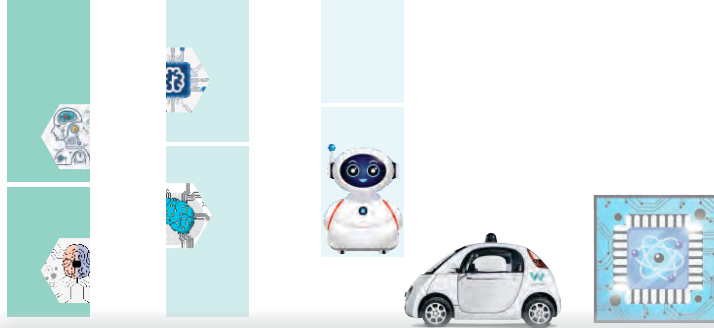
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A WORD TO THE LEARNERS AND THE MENTORS

MACHINES ARE COMING! They aren't dumb anymore! Machines are processing language, identifying pictures, recognising faces, voices and patterns, sensing trends, controlling vehicles, making forecasts using enormous data produced in past decades and still continued as you read this.

Our children are growing up with smart devices loaded with intelligence and intuitive interactions. When they grow up, the world would be unimaginably different. How? In terms of career opportunities, smart public services, smart homes, schools and hospitals and a daily life inhabited by smart machine-citizens.

This is the time to prepare them for the rapidly changing future.

This book – **My Dream Book of Artificial Intelligence**, is a primary effort in this direction. As CBSE has already announced about its endeavours in integrating AI with every subject and exposure to children about artificial intelligence in a fun oriented way, this book fulfils that very requirement.

HOW THIS BOOK IS ORGANISED?

Considering the very young age of the learners, this book brings fun to the learning desk. Children will explore AI concepts through the following:

- Fun activities to explore concepts.
- Games and challenges to understand the techniques.
- Mini projects (assignments and online exploration) to reinforce their learning.
- Exposure to computer programming logic development through Python Turtle library.
- Key Learning is a set of keywords used in the chapter.
- Learning Point to summarize the chapter.

GAME DEVELOPMENT

The book encourages kids to design and develop a game to inculcate in them the strong traits of problem solving, critical thinking, team dynamics and communication skills.

We strongly believe that our sincere efforts in bringing this book to you will surely help learners explore AI concepts in the most interesting ways and at the same time, teachers will enjoy conducting this course.

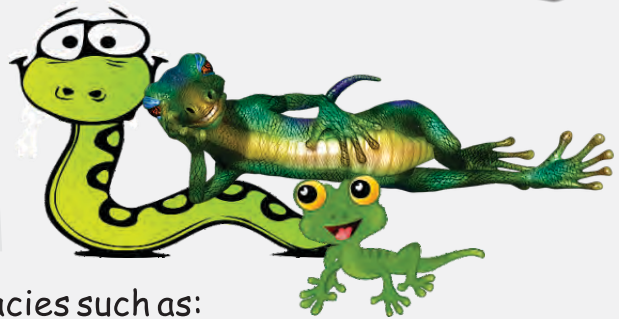
1

Understanding Intelligence

Delicious Dinner Data Processing



Sarpa, the snake; **Liz**, the lizard and **Kamal**, the Chameleon are friends. They move out to eat dinner in their favourite buffet.



Activity

The **dinner menu** included several delicacies such as:

- Grasshopper burgers
- Spider sandwiches
- Ants rolls
- Smelly fish gooey

- Fresh fried flies
- Earthworm noodles
- Turtle eggs
- Toad curry

- Cockroach cookies
- Stuffed frogs
- Snail dessert
- Mixed-insects chocolate

	Sarpa	Liz	Kamal
Grasshopper burgers			
Fresh Fried flies			
Cockroach cookies			
Spider sandwiches			
Earthworm noodles			
Stuffed frogs			
Ants rolls			
Turtle eggs			



Snail dessert			
Smelly fish gooey			
Toad curry			
Mixed insects sweet			

Can you find out who ate what by the help of the details given below?

1. No one took fish dish in dinner.
2. Sarpa didn't like most of the menu but managed to eat some noodles and eggs.
3. Liz is very fond of insects but began with cookies as snacks.
4. No one ate less than 2 dishes.
5. Kamal took burgers but did not like the smell so he gave them to Sarpa who reluctantly ate them lest they should be wasted and thrown away.
6. Liz had tough time catching flies that escaped from the oven and decided to eat some noodles.
7. Everyone had dessert except Liz. She took some sweet instead.
8. Kamal is quite large in size and very fond of fresh water animals.
9. Liz avoids eating snails and spiders at night.
10. Kamal is allergic to fish and earthworms.

How was it? What you did was comparison of data with the given information and reaching the conclusions. How many of them were correct? Was the information straight or needed logical thinking? Any idea how computer could have done it because computers do not know English language or any language for that matter? They know only machine language. Well, this is where AI comes in picture. We shall discover in this course, how a machine – the computer could have processed such diverse facts and data.

Exploring Intelligence

Brain is far superior than a computer. Computers are faster but they are not as smart as the brain is.

Let us try to decode the term *intelligence*. Many a times we hear that such and such person is very intelligent. Scientists are intelligent. Astronauts are intelligent.

Dog and horse are most intelligent animals. Parrot and Cockatoos are among most intelligent birds. Ants, Bees and Termites are intelligent insects.

You must have noticed that while you are good at one thing, your friends are good in other things. One likes mathematics and the other likes to compose poetries. One of your friends is a good dancer while another has a nice voice. Some other people play musical instruments and some are very good at making friends. You agree? People possess multiple skills, talents and abilities.

Can you name five of your friends who are good at different things?

Let us see how our intelligence works.

FRIEND	EXCELLENCE

Challenge 1



Can you fill in the blank with the next possible number in the following series?

1	1	2	3	5	8	13	21	34	
---	---	---	---	---	---	----	----	----	--

Great!

Can you tell how did you solve this problem? Which knowledge or learning helped you in finding the next number?

Would you like to solve this puzzle?

Challenge 2



Complete this 8 letters verb. [Hint: You are doing it now.]

		I			I		
--	--	---	--	--	---	--	--

Bravo! You did it.

Can you tell which type of learning helped you in completing this word?

Sometimes we need to think fast!

Challenge 3



Write any English word in 10 SECONDS that begins with letter E and ends with E. For example: ENVELOPE. Think fast!

E		E
---	--	---

How long did you take to solve this? Which skill helped you in solving this?

Yes, recollection and English vocabulary in your long-term memory.

Well, if you had looked closely in the question, one hint was right in front of eyes. So, this puzzle needed a little more than just English vocabulary.

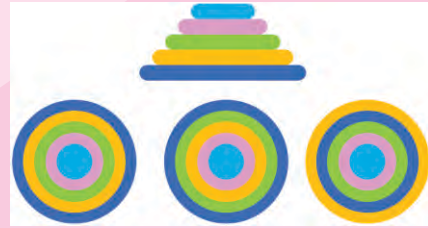
Sometimes we need to think fast!

Challenge 4



Which of these top views fits the stack?

That was easy, no?
How did you do it?



Play this game with your friends.

Challenge 5



Try reading out the name of the colour of the words a little quickly.

green	red	blue	orange
orange	white	yellow	
black	red	yellow	black
black	green	blue	
red	orange	white	blue

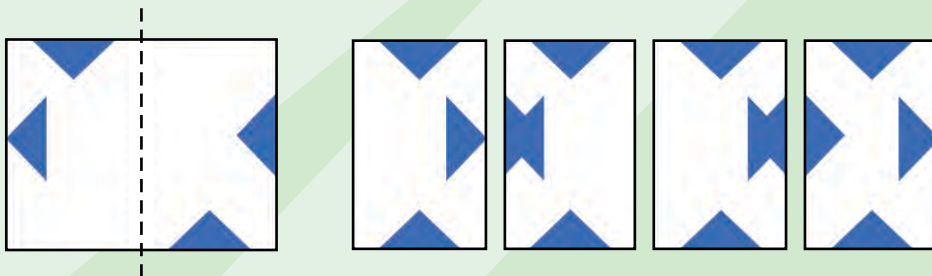
What difficulty did you face? Did you have to stop and think before speaking? What could be the reason? Because, you were processing two pieces of information at a time - *the visual colour* and *the written colour*.

Play this game with your friends.

Challenge 6



If the left half of this transparent sheet is folded at the dotted line to cover the right half then which of the following 4 patterns would it match with?



This comparison was fun. Right? And, easy too.

Let us now meet the family.



Challenge 7

Can you create the family tree after reading the following paragraph?

Sameer and Sam are cousin brothers. Sam lives in New York city with his parents Rajesh and Adela. Sameer lives in Mumbai with his sister Suman and parents Rajiv and Anita. Mr. Amol is a farmer and he has two sons - Rajiv and Rajesh and a daughter - Rajni. Rajiv became an engineer at Mumbai and got married with Dr Anita. Rajesh settled in USA and married with a scientist named Adela. Rajni runs a school in the village with her father. She is not married yet. She also helps her father in farming. Suman's maternal grandparents are Shashi and Rukmani.

Draw the tree here:



This time you compared and processed the facts to create a visual output. It included your reasoning skills and presentation skills.

Lend your ear now. You undivided attention is required.



Challenge 8

Let the teacher play initial tune of some famous songs on a computer or cell phone and you have to guess which song it is.

How many songs could you identify correctly? Were there some songs you had never heard? Were there some songs you could hardly identify while others did it in a jiffy? Who identified maximum number of songs correctly in the class?

So, you sure have enjoyed these teasers.

But what was the purpose of having you go through these activities?

To help you discover the facts that:

Intelligence comes from learning.

Intelligence is used to draw conclusions and solve problems.

To solve different types of problems, different types of intelligence are needed.

Different Types of Intelligence

Can you confidently tell who is intelligent and who isn't? Do you think dogs and parrots are intelligent? If yes, how? Ants are not good at math but they sure are great engineers!

We all have a combination of various types of intelligence, if not all. Let us have a look at them.

Verbal Intelligence

Such people love words. They love reading, writing and making speeches. They like to argue, debate and discuss things. They have good vocabulary and they compose poetries, write essays, participate in spellathons. They make great writers, poets, scriptwriters, lyricists and orators.



Logical Intelligence

Such people love numbers. They like solving math problems and analysing numbers and data values. They make good computer programmers and strategy game players such as Chess and Go. They believe in deriving the conclusions from the given facts.

Spatial Intelligence

Such people love visuals. They perceive and think about things in graphics. They have strong visualisation power. They are creative in designing things. They are good at reading maps, drawing pictures and depicting concepts in graphical forms such as charts and diagrams. They make good graphics designers, animators and film makers.



Kinaesthetic Intelligence

These people love activity, movement and touch. They are dynamic in spirit. They like to do the things and experience first-hand. They would like to visit the place instead of learning about it in the books. They are outgoing and like to meet people. They make good sportspersons, soldiers, dancers, stage performers, mountaineers, travellers, builders, engineers, sculptors, carpenters and makers.

Musical Intelligence

They are feelers and thinkers. They like to perceive through listening. They look for harmony and balance in everything. They have a special knack to understand music and master it. They make good composers and singers, meditators, nature-healers and counsellors since they are good listeners.



Interpersonal Intelligence

These people love to meet other people, connect with them, develop contacts and have a good social circle. They possess strong communication skills irrespective of language. They have many friends and they are popular among the masses. Such people make businessmen, teachers, sales persons, counsellors, lawyers, public figures, political leaders and influencers.



Intrapersonal Intelligence

These people are often labelled as introverts or shy. They feel, think and ponder. They do not haste. They take their time to reach at conclusions. They are deeply aware of their needs and wants. They love to do things alone and stay away from the crowd. They are reluctant in sharing their ideas openly with others. Such people make great thinkers, spiritual personalities and writers, painters, seekers and mentors.



Naturalistic Intelligence

These people are empathetic, feelers and kind in nature. People find them sweet and forgiving. Such people are closely interested in nature and its phenomena. They have a special knack to identify characteristics of living beings, plants and other natural elements such as rocks, soil etc. They are highly sensitive towards the threats to the nature. They are concerned about the ill practices that destroy

natural bodies such as water, forests, animals and natural beauty. They make farmers, social workers, philanthropists, nature activists, geologists, environmental scientists, green fighters, marine or wildlife researchers and forest officers.



Learning Styles

Just like people possess a mix of different types of intelligence, they tend to have different approaches towards learning. Yes, people do learn in style too. Let us explore major learning styles adopted by people naturally.

Learning is perceiving facts and analysing them to extract meaningful information and conclusions. This learnt information adds to our intelligence. There are four major learning styles:

Visual

These learners perceive inputs better when they are in visuals or graphical form such as charts, flow charts, diagrams, animations, pictures, video clips and real places. They are imaginative and have strong ability to envisage.



Aural

They are good listeners and possess excellent concentration ability. They like discussions and debates. They store information in aural codes – spoken words. They have sharp memory and retention power. These learners like to attend more lectures than practical or field sessions.

Verbal and Written

These learners are readers and writers. They like to take notes (during lectures) and make notes (after lectures). They take instructions easily and clearly. Since they are fond of reading, their visualisation power is also good.



Kinaesthetic

These learners are doers. They learn better when they involve in practical aspect of the concepts. They like to move to field activities, fiddle with equipment, touch and create. They have animated gestures while explaining things. They find lectures, books and instructions boring that is why they are mistaken as poor listeners.

Now that you have better understanding of various types of intelligence and learning styles can you rethink on the challenges you did earlier as to which type of intelligence helped you in solving them.

Which types of intelligence helped in solution?

For which types of learner was it easier?

Challenge 1

Challenge 2

Challenge 3



Challenge 4

Challenge 5

Challenge 6

Challenge 7

Challenge 8

So, if humans know about the type of intelligence they possess and know their learning styles then they can work better in the direction to improve their learning and intelligence. There are many online tools that help you in assessing your learning styles such as:

<https://www.how-to-study.com/learning-style-assessment/>

<http://www.whatismylearningstyle.com>

<http://www.educationplanner.org/students/self-assessments/learning-styles-quiz.shtml>

Intelligence testing is a complex process and involves different types of assessments carried out by experts. However, to assess yourself as to which mix of intelligence type you possess, you can use this online assessment.

<https://www.literacynet.org/mi/assessment/findyourstrengths.html>

Learning Points

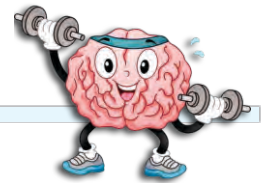


- 👁 Intelligence comes from learning.
- 👁 Intelligence helps us draw conclusions and solve problems.
- 👁 Intelligence is of different types.
- 👁 There are various learning styles.



- 👁️ **Verbal:** Related to reading, writing and speech.
- 👁️ **Logical:** Related to reasoning.
- 👁️ **Spatial:** Related to visuals.
- 👁️ **Kinaesthetic:** Related to movement and touch.
- 👁️ **Interpersonal:** Among the people.
- 👁️ **Intrapersonal:** Within one-self.
- 👁️ **Naturalistic:** Having inclination towards nature and environment.
- 👁️ **Visual:** Related to vision and graphics.
- 👁️ **Aural:** Related to listening and hearing.

Exercise



A. Select the correct answer.

1. The process of learning enhances our _____.
a. Knowledge b. Intelligence
c. Both a) and b) d. None of these
2. Our intelligence helps in which of the following?
a. Draw conclusions from the facts b. Solve problems
c. Learn more d. All of these
3. To solve different types of problems, different types of _____ are needed.
a. People b. Plans
c. Places d. Intelligence
4. People with which type of intelligence make great writers and poets?
a. Verbal b. Logical
c. Musical d. Kinaesthetic
5. Find the odd one out of these learning styles.
a. Visual b. Interpersonal
c. Aural d. Verbal

B. Match the functions in Column A with their use in Column B.

A

B

- | | |
|-------------------------------|--|
| 1. Verbal intelligence | a. Good at reading maps, designing things, animators. |
| 2. Logical intelligence | b. Love reading, writing, compose poetries, orators. |
| 3. Spatial intelligence | c. Composers, singers, good listeners. |
| 4. Musical intelligence | d. Mostly quiet, spiritual thinkers, painters. |
| 5. Kinaesthetic intelligence | e. Empathetic, feelers, philanthropists. |
| 6. Interpersonal intelligence | f. Have good social circle, strong communication skills. |
| 7. Naturalistic intelligence | g. Outgoing, dynamic, like to explore things themselves. |
| 8. Intrapersonal intelligence | h. Drive conclusions from facts, good at analysis. |

C. Write the correct style of learning against the following traits.

- | | |
|---|-------|
| 1. These learners strong ability to visualise and imagine: | _____ |
| 2. Good listeners and possess strong concentration: | _____ |
| 3. Fond of reading and writing, visualise well: | _____ |
| 4. Like to involve in practical implementation of concepts: | _____ |

D. Mark the following statements as True or False.

1. Some people are intelligent while some are utter fools.
2. Computers only know English language.
3. Computers are faster but not smarter than human brain.
4. Everyone is intelligent in different ways.
5. People can have multiple intelligences.



E. Answer the following questions.

1. What do you mean by learning?
2. How can you say that all the people are intelligent in different ways?
3. Where does intelligence come from? How does it help us?
4. List various types of intelligence.
5. Write one trait each of four learning styles.



Mini Project...

Prepare a set of 10 questions asking the likes and dislikes of people. Identify any 3 of your friends. Ask them to fill answer the questions. Then, analyse their answers to the questions and find out the combination of intelligence types they possess.



www.eduitspl.com

www.youtube.com/edusoftknowledgeverse






2

Introduction to Artificial Intelligence

The learning so far



We have learnt...

-  ...that computers work differently than human brain.
-  ...everyone is intelligent in their own ways.
-  ...about different types of intelligence.
-  ...that there are different types of learning styles.
-  ...how different types of learning aid in different types of intelligence.

Dear children,

We now know that human brain is capable to process information in various forms and ways. Since birth, even before birth (remember the story of brave Abhimanyu?), brain develops the tendency to take inputs and process them to train itself. As tiny tots, we used to identify various objects around us by their properties and behaviour. Properties such as shape, size, colour, features etc. Behaviour such as speaking, walking, rolling, turning, stopping, starting etc. How does a child record the learning about a television in his mind? Infants do not have language. They express in gesture, giggles and cries. Slowly, as they grow, the brain grows in learning about surroundings. Language is learnt in bits and pieces – alphabets, words, phrases, simple sentences, basic grammar and so on. By the time we grow up past our teenage, our mind is mature enough to learn about new things faster depending on our interest and aspirations. Then the learning becomes deeper instead of broader. Deeper learning means detailed knowledge in a particular subject or field. This deeper learning becomes expertise which is utilised in earning our livelihood and in making discoveries, inventions and innovations.

Defining Artificial Intelligence

At what level of learning do you think today's machines are? Are they novice or intelligent or expert? Do you think the machine that beat Kasparov in Chess was expert? Or, the robots that work in factories are intelligent? Or, the device that recognises you by your voice or face is sharper than a human being?

Fun Fact



IBM DEEP BLUE

In 1997, the world chess champion Gary Kasparov was beaten by IBM's Deep Blue - a chess playing supercomputer. Earlier versions of Deep Blue were beaten by Kasparov. Deep Blue was capable of computing 200 million positions or moves per second with a processing speed of 11 Gigaflops. The Deep Blue program was written in C programming language and it ran on AIX operating system over 480 VLSI chips.



So, how do you define the term Artificial Intelligence?



Artificial intelligence is the field to develop machines which should learn and act like humans.

In simple terms:

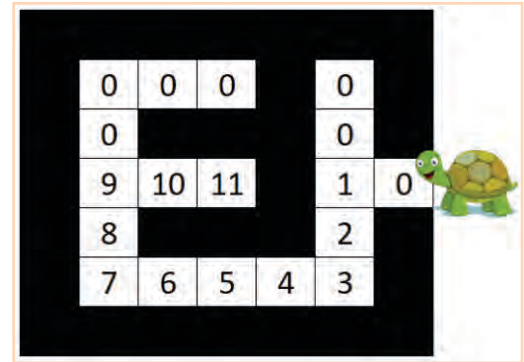
Artificial intelligence is the art and science of developing machines intelligent like humans.

We know human intelligence is of different types. Same goes for artificial intelligence. Some machines are good at playing different sports, some are good at driving a vehicle on road or fly a drone, other machines can detect cancer cells while others can churn huge amount of numbers to do useful predictions yet there are some machines which can understand natural language to execute voice commands, classify documents and process hundreds of thousands of pages of text.

Artificial Intelligence Game

Below are the 3 sets of rules which will help Tinu the turtle to reach to the square number 11. Tinu is at square numbered 0 currently.

The game begins with reading instructions from **Rule Set 1**. Whenever an instruction fails (false), jump to the next rule set. If rule set 3 is finished then come back to rule set 1 and this cycle goes on until the task is accomplished. Let's take out a sheet of paper and begin the workout.



Rule Set 1

Check Front
If White
Move Forward
 If Number Smaller
 Move Backward
Turn Left

Rule Set 2

Check Front
If Black
Turn Left
 If White
 Move Forward
 If Number Smaller
 Move Backward
Turn Right

Rule Set 3

Check Front
If Black
Turn Left
 If Black
 Turn Right
 If White
 Move Forward
 If Number Smaller
 Move Backward

After several passes through all the rule sets and turning multiple times left and right, finally Tinu will reach square number 11.

This is a very simple and limited demo of intelligence. If a robotic machine is loaded with an algorithm developed on the above four rule sets then that robot will find its way through to square 11.

How will artificial intelligence work in this scenario?

Artificial intelligence of the robot will try to learn from every successful move and finally make its own rule set (learning) for this particular grid. The learning is given here.



Move 1 step

Turn Left

Move 3 steps

Turn Left

Move 4 steps

Turn Right

Move 2 steps

Turn Right

Move 2 steps

Stop

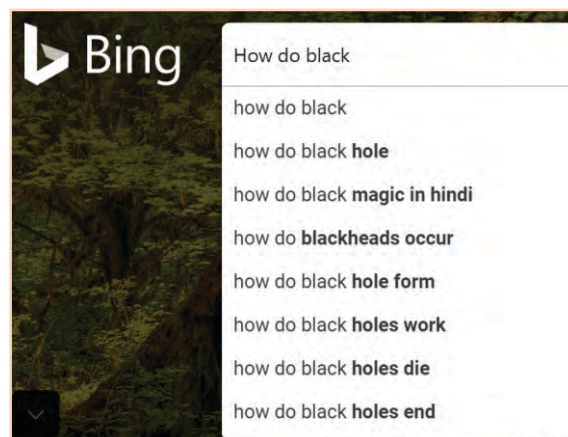
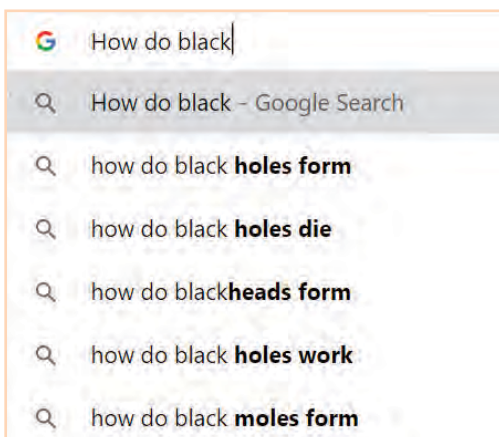
This way, machine has chucked out all the unsuccessful (unnecessary) moves and learnt exact moves and turns to reach the destination.

Applications of Artificial Intelligence

Before delving deep into the concepts of artificial intelligence (AI), let us explore how AI has already begun influencing our lives and industries in various exciting ways as we read this.

Smart Search

Go to Google or Bing or any popular search engine. As you type what you need to search, the search engine displays recommended words for you. These recommendations are generated by AI algorithms on the basis of your previous searches and the data collected about you from your online activities. Such predictions of words in search is called *predictive search*.



Product Recommendations

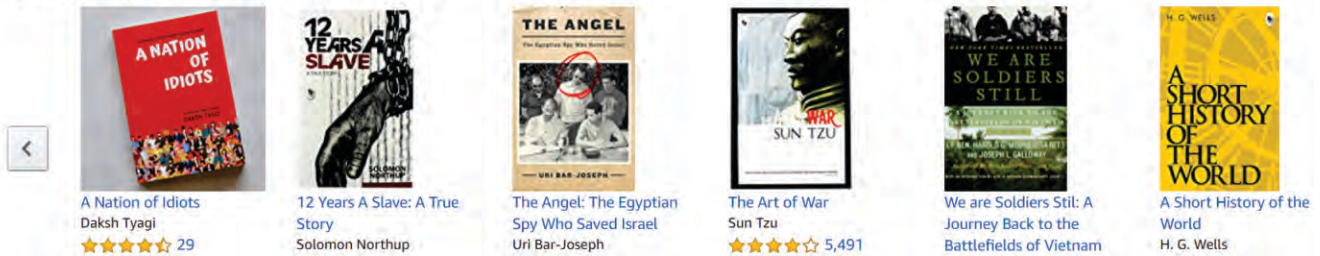
Try buying online your favourite book or running shoes and see how similar books and shoes are recommended to you. Along with this, other products related to these are also listed e.g. you buy a wallet and the belts are also recommended. AI algorithms do this by analysing the data collected about your buying habits and preferences in the past. This also happens when you browse new movies, music and articles online.

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Fraud Detection and Prevention

Ask your parents or elders, if a transaction of huge amount is done online, the bank sends an alert on the phone of the customer. AI algorithms on financial websites, such as banks and loan companies, are programmed to look for unusual trends like huge amount, number and speed of transactions in an account at a time, repeated attempts of login in an account etc. In such cases AI algorithms respond in different ways such as

Oops... Are you human?
Please complete the CAPTCHA to proceed to the requested content...

I am human Submit

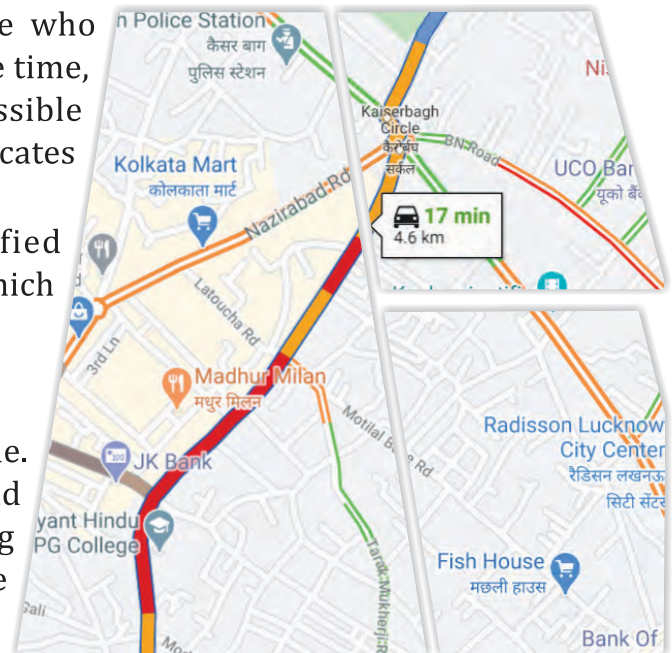
confirming user's identity in multiple ways before executing the transaction, blocking the account temporarily, asking customer to call the bank, alerting authorities in case of huge amounts.

Such detections also help in tracing terrorist funding activities, black money trail, fraudulent businesses, illegal finances etc.

Location and Directions

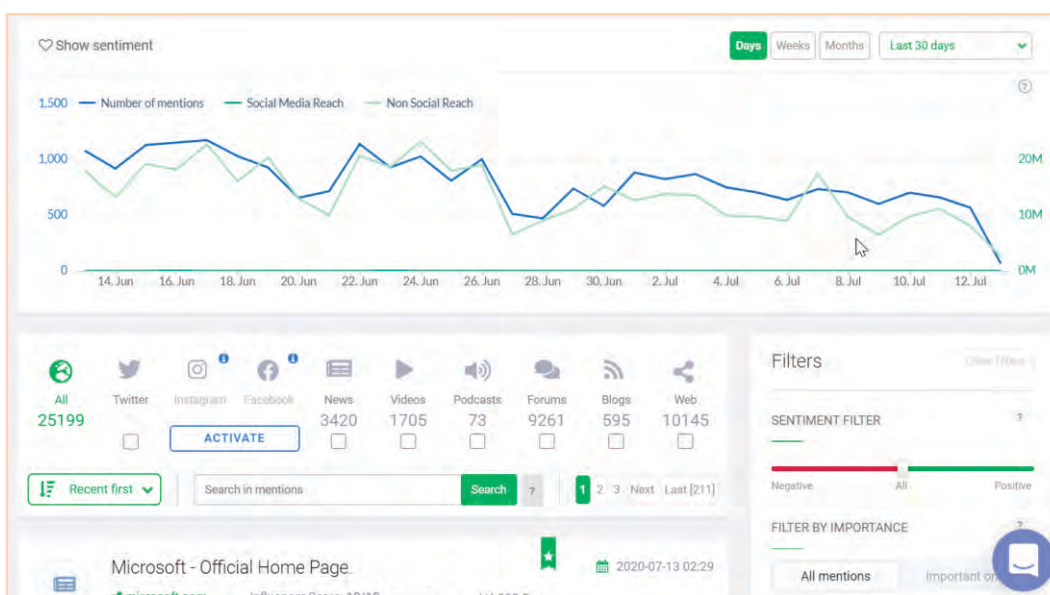
Google Maps is indispensable today for those who travel. Its AI enabled system calculates commute time, displays traffic conditions, finds the best possible shortest or fastest route e.g. orange route indicates busy road while red means traffic jam.

Depending on your live location and specified destination, the apps display the current rides which you can share.



Sentiment Analysis

We interact with friends and other people online. We share tweets, messages, pictures, videos and we do online chat. All these details help in training AI algorithms to learn more about us and analyse our reactions towards things, events and personalities. These reactions help AI algorithms classify us as potential customers, assess our satisfaction level, likes/dislikes for a product or movie or song. This analysis helps businesses devise their marketing and advertisement strategies. Sentiment analysis helps celebrities and political parties assess their popularity among masses. Our online responses make the digital pattern of our sentiments.

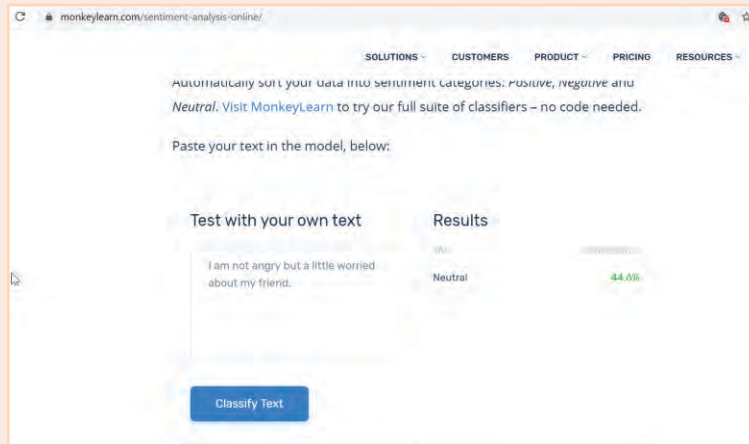


Activity



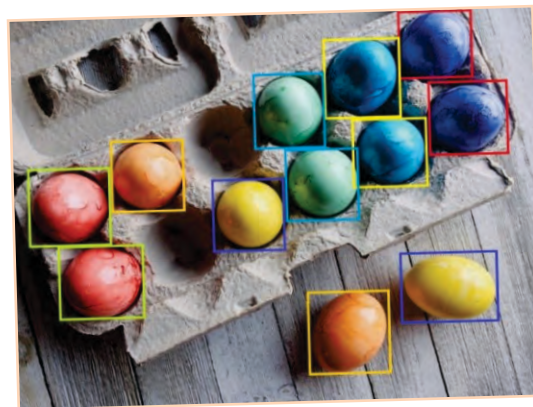
Sentiment Analysis

Go to monkeylearn.com/sentiment-analysis-online and try out different sentences expressing different emotions. See how the AI engine performs sentiment analysis.



Object Detection

AI algorithms are today detecting faces to unlock devices and matching fingerprints to access applications. This is called **biometrics**. Some AI algorithms can record the 3D details of your face using several thousand infrared dots that fall on your face and a unique facial signature is created. Algorithms can detect specific objects in an image or a video still. E.g. detecting forest fire, emerging storm, dangerous tidal waves, approaching flying object or underwater object, identifying species of birds, animals and fish, creating visual patterns of population distribution, traffic control, self-driven cars etc. Object detection and object classification is a very useful application aided by AI. It can be used in all major industries to serve humanity.



Fun Fact



Self-driven Car - Waymo

Google's subsidiary Waymo developed this self-driven car after research that began in 2007. After several test drives and improvements the self-driven version of Waymo with no driver and any human help was tested successfully on real roads in Texas.

Waymo is equipped with a rooftop camera - LiDAR to create a 3D vision for the car 200 meters around. Overall, it has 6 such sensors. It has GPS sensors to help it assess road conditions and lane positions. Gyroscopes, tachometers and altimeters fitted inside the car help it maintain its direction and balance. The car is able to identify other vehicles and obstacles in front and around. It identifies traffic signals and hand gestures made by other commuters.

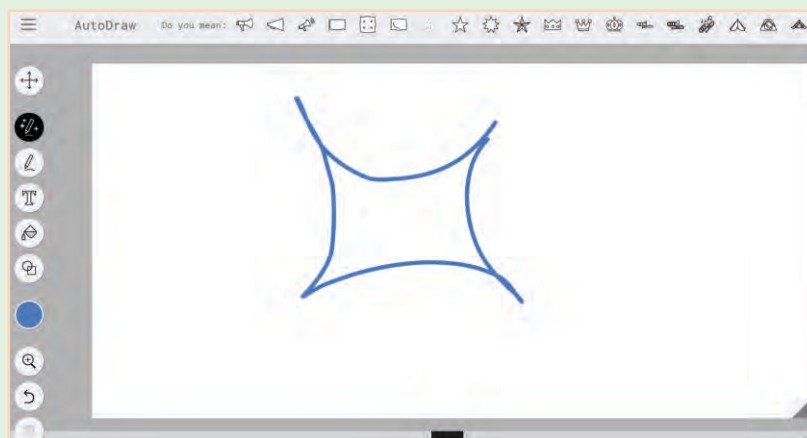


Activity



Drawing with Object Detection

Go to www.autodraw.com. This site detects the drawing strokes made by you, tries to guess the closest shapes and lists them. Users can select the shape they try to draw from among the list of shapes.



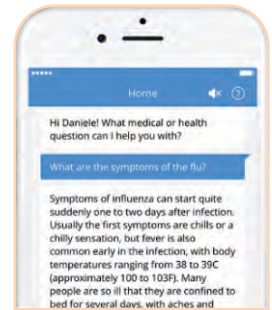
Language Processing

Computers equipped with AI algorithms are able to process language in various forms – spoken and written. This is called **Natural Language Processing (NLP)**.

AI algorithms can identify keywords in the text and execute tasks accordingly. Digital assistants such as Amazon Alexa use NLP AI algorithms to understand human spoken language and respond in human-like voice (identified as Alexa's voice). NLP can also be used to identify and classify various documents like categorising books in a library under different genre. In any field where text, documents and speech are involved, NLP has its tremendous use.

There are two interesting terms worth knowing about – **Speech recognition**, which means recognising *what* is spoken and **Voice recognition**, which means who has spoken. Most of the applications work on speech recognition rules. Voice recognition is important where authorisation of a person is required.

One of the most popular applications of NLP are Digital Assistants and Chatbots. Digital Assistants can understand speech and execute the routine tasks such as playing a song, switching on the TV, checking email etc. Chatbots are used to handle customer queries and execute common requests such as placing request for cheque book with the bank, ordering food, securing appointment with the doctor etc.



Fun Fact



Amazon Alexa, Google Assistance, Apple Siri And Microsoft Cortana

Alexa, Assistant, Siri and Cortana are voice driven virtual assistants by their respective companies. They are just like voice-

driven wizards, equipped with speech recognition and natural language processing technologies, which can do a lot of things for you such as answering almost any question on any topic, set reminders for you, doing weather forecasts, playing your preferred music, delivering messages, switch to various channels such as sports, education, markets, entertainment etc. Today Alexa has around 90000 functions and skills that it can perform for the user. Google Assistant identifies objects, songs, user preferences and allows E-commerce by voice. Users can set voice shortcuts for common commands. Siri can navigate locations. Cortana is available with Windows 10 systems to provide voice based commands and search features using Microsoft's search engine Bing.



Siri
2011



Cortana
2014



Alexa
2014



Assistant
2016



M
Coming Soon



maya
in the making

Activity



My Smart School

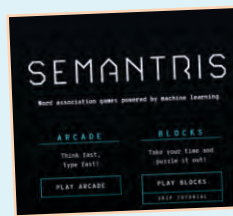
Imagine that your school needs to run on artificial intelligence software. Right from coming to the school till leaving the school, think of various tasks and areas where AI can be used. Use your imagination and creativity to suggest what amazing things you would like AI to do for your school.

Activity



Word Association

Go to <https://research.google.com/semantris/> and click on PLAY BLOCK button. It shows a set of blocks with words. You need to enter a clue for any word and AI system tries to guess the related word. For example, if you type: vast blue waves then it will guess the word Ocean.



The AI system is trained into several million examples and variations of text pieces so that it is capable to relate the phrase entered by you with the closest possible word.

Semantris is built by Ben Pietrzak, RJ Mical, Steve Pucci, Maria Voitovich, Mo Adeleye, Diana Huang, Catherine McCurry, Tomomi Sohn, and Connor Moore.

How does it work? This is a demonstration of how a computer can understand what you speak to it in everyday language.

Several millions of lines of human conversations have been used to teach this AI system to figure out how real human conversations occur.

Once the AI is trained, it is able to predict how likely one statement would follow another as a response. The AI is simply taking in what you type and doing a lookup into a pool of many possible responses to find the most likely ones. The technique used is called **machine learning**. In the next section you will learn about machine learning.

Learning Points

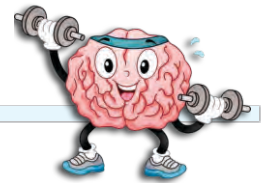


- Artificial intelligence is the field to develop machines which should learn and act like humans.
- An intelligent machine tries to learn from every successful move and finally make its own rule set.
- Prediction of words while typing search string in a search engine is called predictive search.
- Some common applications of AI are smart search, fraud detection, product recommendation, location and direction, sentiment analysis, object detection and language processing.











- Biometrics:** Process and applications of detecting fingerprints, faces etc.
- NLP:** Natural Language Processing - a domain of AI.
- Sentiment:** Like/ dislike about something or someone.
- Predictive:** To be predicted or forecasted on the basis of collected data.

Exercise



A. Select the correct answer.

- Shape, size and colour are the examples of _____.
a. Behaviour b. Property
c. Both a) and b) d. None of these
- Artificial intelligence is the _____ and _____ of developing intelligent machines.
a. math, science b. math, art
c. art, science d. math, engineering
- An artificially intelligent robot will try to learn from every successful move and finally make its own _____.
a. Program b. Moves
c. Scenario d. Rule set

4. While typing search string in a search engine, automatic suggestions are the feature of which of the following?
- | | | | |
|----------------------|---|----------------------|---|
| a. Smart typing |  | b. Predictive search |  |
| c. Predictive typing |  | d. Guesswork typing |  |
5. How we feel and think about a product is called our _____.
- | | | | |
|---------------|---|-------------|---|
| a. Sentiment |  | b. Nature |  |
| c. Experience |  | d. Feedback |  |






B. Match the terms in Column A with the statements in Column B.

- | A | B |
|---------------------------|---|
| 1. Predictive search | a. Identify a face in a video clip. |
| 2. Fraud detection | b. Our buying habits and preferences. |
| 3. Product recommendation | c. Words recommended based on the previous searches. |
| 4. Sentiment analysis | d. Transfer of a huge amount from one account to other. |
| 5. Object detection | e. Our online interactions about a product or service. |

C. Fill in the blanks.

- | |
|--|
| Red, Behaviour, Rules, NLP, Natural Language, Properties |
|--|
- An infant identifies objects by their _____ and _____.
 - Machines that execute voice command are able to understand _____.
 - A learning machine makes its own set of _____.
 - In routing apps like Google Map, _____ coloured route indicates traffic jam.
 - _____ can be used to classify documents into various categories or genres.

D. Mark the following statements as True or False.

- Speech recognition means what has been spoken. 
- Voice recognition means what has been spoken. 
- Chatbots are applications of NLP. 
- Fingerprint recognition is a feature of fraud detection. 
- The features of AI can be used to serve humanity. 

E. Answer the following questions.

- What do you mean by artificial intelligence?
- Can all machines be equally artificially intelligent? Why/Why not?
- How does search engine determine what words to recommend while typing the search text?

4. Mentions ways through which AI algorithm detects online fraudulent transactions.
5. How does an online map application help us?
6. What is sentiment analysis?
7. List any 3 applications of Object detection.
8. What is NLP?
9. How is speech recognition different from voice recognition?
10. What are digital assistants and chatbots?



Mini Project...



Train A Computer



This project will give you a simple experience of how machine algorithms are trained with data and how they perform the desired task based on the training. This is called supervised machine learning since you are telling the machine what it is supposed to do with the data.

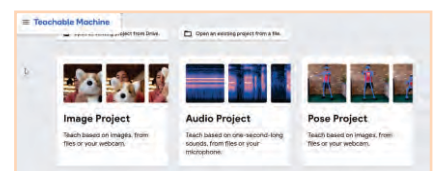
In Teachable machine project, we are taking up image project to train the machine algorithm in identifying some image. After training, the machine will be able to identify and match the image shown through the web cam if a match is really found.

A. Preparing and Uploading the Data

Follow the steps given in the sections below:

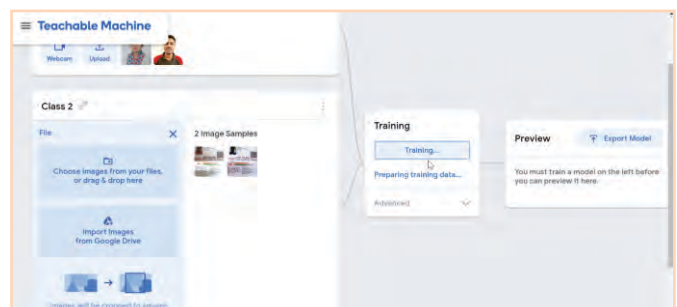
Arrange a dozen of images of which 4 should be yours and rest of other people. Then upload the images following the steps given here.

1. Visit <https://teachablemachine.withgoogle.com/> and click on **Get Started**.
2. Click on **Image Project**.
3. Upload 6 images in each class (Class 1 and Class 2) one-by-one by clicking **Upload button**.



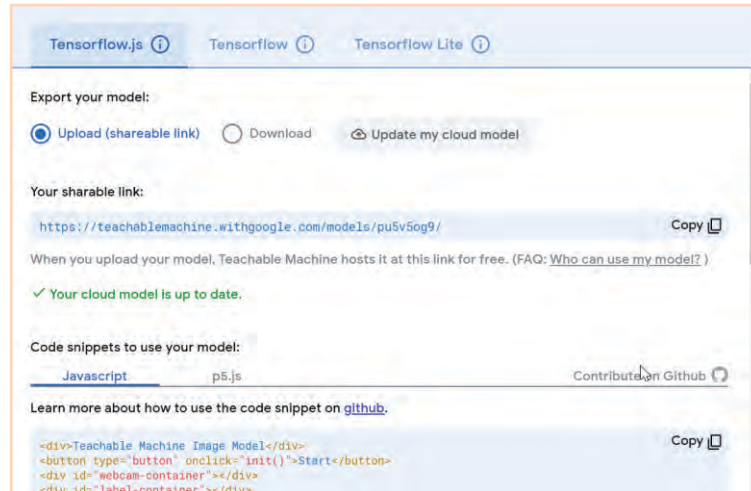
B. Train the Algorithm

1. When all the images are uploaded, click on **Train Model** button. It will take a while to train the algorithm with the uploaded images.



C. Export and Test your Model

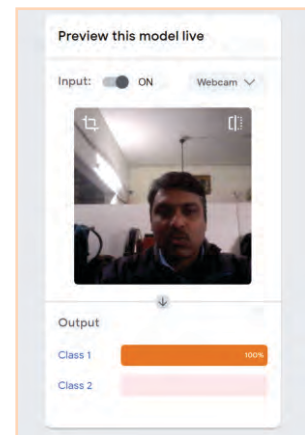
1. After training, click on **Export Model** button.
2. In the popup, Click on **Update my cloud model**. A link to your teachable machine will be created.
3. Copy this link and paste it in new browser window to test.



Note: During the test, webcam should be on and working. The machine algorithm will try to recognise your face with the trained data and tell you how much percentage your face match was found. Also, try any other different printed image in front of web cam or ask a friend to show his/her face in the web cam. See if algorithm is able to tell that the match was not found.

Way Ahead

Similarly, try out **Audio project** and **Pose projects** also. **Have fun!**



www.eduitspl.com

www.youtube.com/edusoftknowledgeverse

3

Artificial Intelligence Domains

The learning so far



We have learnt...

- ...that computers work differently than human brain.
- ...about different types of intelligence.
- ...that there are different types of learning styles.
- ...how different types of learning aid in different types of intelligence.
- ...what is Artificial Intelligence.
- ...about major applications of AI.

Dear children,

Today, some machines are good at playing different sports, some are good at driving a vehicle on road or fly a drone, other machines can detect cancer cells while others can churn huge amount of numbers to do useful predictions yet there are some machines which can understand natural language to execute tasks, classify documents and process huge amount of text.

The term domain refers to an area of common application or practice. AI domains define broad areas in which all the AI techniques and applications work. There are 3 major AI domains namely **data**, **computer vision** and **natural language processing**.

Data: The Source of Learning

When we talk about developing intelligence of a machine, we are actually referring to making a machine learn. The question is, what is the source of this learning? The answer is **Data**. A machine needs data to learn what it is supposed to do.

For example, if a machine needs to unlock itself by seeing your face then it must be trained into learning **unique features** of your face. What will be the data in such a case? The facial features. Another scenario is where a machine needs to predict if a customer will buy a particular product then the dataset will contain a lot of details such as **buying history** of that customer. A machine meant to negotiate the path of a vehicle through a busy road will work on constant **real-time visual data** it captures from various sensors (speed, distance, motion, light, gesture, road signs etc.)

In a state library, a machine is supposed to classify scanned documents into various genres, subjects or categories. It needs to learn **natural human language** to do so.

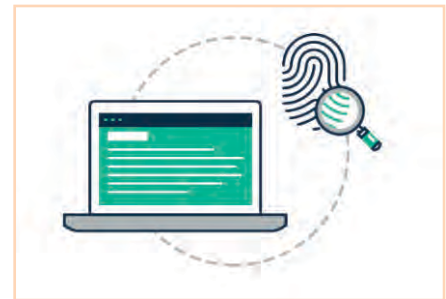
Did you notice the variety of data in the above 4 scenarios? That is why making a machine learn is a complex task and probably that is why it is interesting.

To analyse and learn from data, machines need its constant feed and as much bulk amount as possible. That is why **data is one of the core domains of AI.**

Source of Bulk Data

We are a generation of social media. We all spend a considerable part of the day in online activities such as chat, buying, browsing, watching and sharing videos and images, learning and searching information. Our presence on social media and on E-commerce websites is tracked by AI applications. Some instances are given here.

- Web pages and other websites visited.
- Sections of a web page visited.
- Links and buttons clicked.
- Amount of time spent on a web page or website.
- Products and services clicked.
- Products bought/rejected/returned/marked favourite.
- Our frequent friends and groups and their likes/ dislikes.
- Which websites we often visit.



The above activities are just a few examples. So, while browsing we leave a trail of data behind us which describes our browsing habit or trend. This browsing habit makes our **browsing signature or fingerprint.**

Common sources of data are:

- E-commerce websites (Amazon, OLX, Flipkart, eBay etc.).
- Social media (Facebook, Twitter, Instagram etc.).
- Online/Net banking.
- Online Financial Transactions.
- Entertainment portals (Movies, Youtube, games, songs etc.).
- Educational websites.
- Government (G2C) portals.
- Tour, travel and hotel websites.

In addition to these, there are:

- Internal data of enterprises and various industries.
- Data generated by software, computer systems and devices.
- E-mails.

Today, AI algorithms analyse data collected about us and as a result we are recommended new products likely to interest us thereby increasing the chances of ending up buying them. Isn't it intelligent?

Imagine the size of this data about all the people who are online now and then! AI algorithms compile such huge data chunks from millions of visitors daily and churn out the intelligent results out of it.

Do you think human brain is capable to do this? No. Volume of data, its constant generation and variety make it difficult for human brain and even for traditional computer systems to process such data. Here, the role of machine learning is important.



Computer Vision

We know that computers understand numbers but in real life, data is in many forms such as numbers, text, symbols, images, audio and video. As far as numbers are concerned, there is no problem for a computer to process them but, what about images and language?

How do computers understand visuals and human language? This is where the other two domains of AI come into picture.

Computer vision is the AI domain that deals with analysing visual data such as images, spatial data (images taken by satellite), video frames and live feed of data like face, video recording etc.

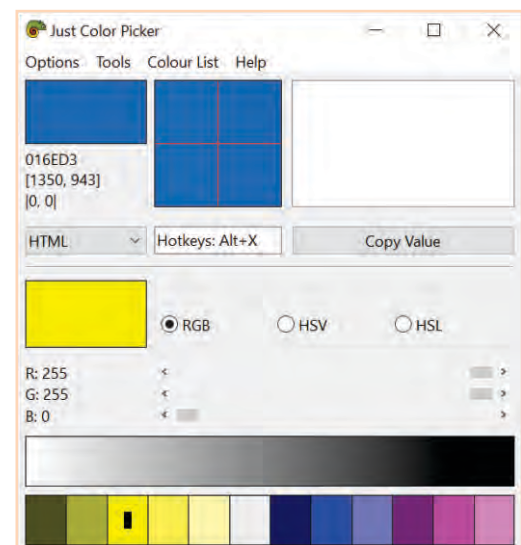
How do we recognise people by their faces? Our brain is made up of millions of neurons. These neurons store the features of the faces we see and later when we meet those people, we recognise them even from a distance or by their picture. Brain is very clever in recording unique features of faces and things so that we remember them.

How does a computer do this? For a computer, everything should be in the form of a number. When we click a photograph using a digital camera, the image captured by the camera is converted into its numeric form and stored in the memory of the device.

How Computer Understands Colours?

When you make a painting with water colours, you mix some colours to get new colours. You mix different quantities of water to have different colour intensity. A similar concept (but no water!) works with digital images.

To understand how digital images are understood by computers, first we need to understand the basics of colours.



Download [Just Color Picker](http://annystudio.com/software/colorpicker) from annystudio.com/software/colorpicker

Open Just Color Picker.

Select **RGB**. **RGB** stands for **Red**, **Green** and **Blue**. These are 3 basic digital colours. Their combinations make other colours.

You will notice that each of the 3 colours have a range of intensity from 0 to 255.

Change the intensity of Blue to 0 and that of other 2 colours to 255. Which colour did you get? Yes, Yellow.

0 to 255 is the intensity of these colours. If you set all three colours' intensities to 0, you will get black. Check it out. What will you get if you set all three colours' intensities to 255 (maximum)? White? Correct.

Now try out blends of various intensities of these 3 basic colours to get different colours. There are $256 \times 256 \times 256 = 16777216$ colours in RGB model.

This way, computers store the colour information.

There are other colour models also like **Cyan**, **Magenta**, **Yellow**, **black** (CMYK) used by printers but RGB is most common of all.

Do You Know?

Try mixing equal intensities of all 3 colours such as 100,100,100 or 65,65,65 or 150,150,150. Observe which shades of a particular colour are produced.

How Computer Understands Images?

So, colour basics are clear.

All the basic colours – Red, Green and Blue have intensity 0 to 255. Digital images are composed of tiny elements called **pixels** (Picture elements). Think of an image as a grid of several thousand tiny pixels. Here is a conceptual representation of pixels. Notice that pixel 1 is blue, pixel 446 is white and pixel 198 is dark.

1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273	289	305	321	337	353	369	385	401	417	433	449	465	481	497	513
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274	290	306	322	338	354	370	386	402	418	434	450	466	482	498	514
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275	291	307	323	339	355	371	387	403	419	435	451	467	483	499	515
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276	292	308	324	340	356	372	388	404	420	436	452	468	484	500	516
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277	293	309	325	341	357	373	389	405	421	437	453	469	485	501	517
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278	294	310	326	342	358	374	390	406	422	438	454	470	486	502	518
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279	295	311	327	343	359	375	391	407	423	439	455	471	487	503	519
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280	296	312	328	344	360	376	392	408	424	440	456	472	488	504	520
9	25	41	57	73	89	105	121	137	153	169	185	201	217	233	249	265	281	297	313	329	345	361	377	393	409	425	441	457	473	489	505	521
10	26	42	58	74	90	106	122	138	154	170	186	202	218	234	250	266	282	298	314	330	346	362	378	394	410	426	442	458	474	490	506	522
11	27	43	59	75	91	107	123	139	155	171	187	203	219	235	251	267	283	299	315	331	347	363	379	395	411	427	443	459	475	491	507	523
12	28	44	60	76	92	108	124	140	156	172	188	204	220	236	252	268	284	300	316	332	348	364	380	396	412	428	444	460	476	492	508	524
13	29	45	61	77	93	109	125	141	157	173	189	205	221	237	253	269	285	301	317	333	349	365	381	397	413	429	445	461	477	493	509	525
14	30	46	62	78	94	110	126	142	158	174	190	206	222	238	254	270	286	302	318	334	350	366	382	398	414	430	446	462	478	494	510	526
15	31	47	63	79	95	111	127	143	159	175	191	207	223	239	255	271	287	303	319	335	351	367	383	399	415	431	447	463	479	495	511	527
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288	304	320	336	352	368	384	400	416	432	448	464	480	496	512	528

Note

This is just a conceptual presentation. Actual pixels are microscopic in size and there are millions in an image.

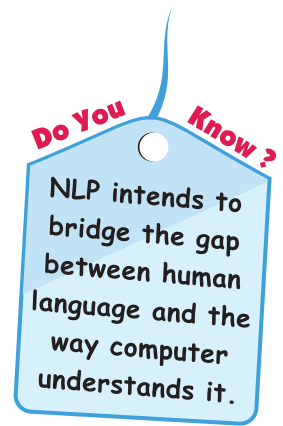
Natural Language Processing

We have understood the basics of computer vision which deals with how machines understand visuals and use them in various fields.

Now let us understand how computers process natural language spoken by humans. The process is called Natural Language Processing (NLP).

The applications and devices that fall in this domain are called NLP-enabled applications or simply NLP applications and NLP devices. The digital assistants and chatbots are common examples of NLP devices and application.

Natural language is a complex thing to deal with. At your age, as you are growing, even you need a few years in getting well conversant in English language. And, in spite of being well conversant, it cannot be said that one has mastered the entire language. Then, think how challenging it is for a machine to do so as it understands everything in the form of numbers only.



Natural Language Challenges for a Machine

There are many challenges in the way a machine should be able to process natural language.

Language Syntax and Semantics

Syntax refers to the structure and grammar of the language that you have been reading in as your English subject.

Semantics refers to the underlying meaning and sense that the words and description hold.

Can you translate and describe what the following sentence means?



The dog's bark was louder than the bark of the tree.



What did you notice?

The sentence is grammatically correct but it has a logical mistake. You can translate it and tell but a machine can only translate it without figuring out its sense.

Context, Emotions and Multiple Meanings

Can a machine understand the meaning of the message in a certain context?

See the following examples:

fast colour - the colour that does not stay and is removed by washing.

fast runner - talking about speed.

Observing fast - religious connotation, keeping fast (not eating).

Hold fast - holding in one place firmly (this is contrast of fast colour).

There are numerous such examples in natural language which pose a challenge for a machine in understanding the message accurately.

Meanings of words change as the context changes. There are also, emotions and sarcasm. Various emotions can be expressed while using the same word. For example:

I feel **sorry** for his condition. (feeling)

I am **sorry** for my mistake. (apology)

I am **sorry**, I can't help you in this. (helplessness)

Sorry, where was I? (Picking the conversation thread)

Activity



Text processing by a machine

You need to determine the central topic of a document. Human brain can do so just by reading it. This activity will give you a glimpse how a machine does it. Consider the following text:

Pollution is a major problem of metro cities. Commonly air pollution and water pollution need more attention. There is also a third type that is land pollution but it is more of a concern in rural areas.

A machine can be fed with the words to be removed from the document.

Remove the unnecessary words and punctuations.

Pollution ~~is a~~ major problem ~~of~~ metro cities. Commonly, air pollution ~~and~~ water pollution need more attention. There ~~is also a~~ third type ~~that is~~ land pollution ~~but it~~ ~~is~~ more ~~of a~~ concern ~~in~~ rural areas.

The text now looks like this:

Pollution major problem metro cities Commonly air pollution water pollution need more attention There third type land pollution more concern rural areas

Next, convert the various forms of the words into their simplest, root forms. Root is the basic word from which other variations are made by adding affixes. For example, strongest > strong, studies > studi > study. Let us do for our text.

Pollution major problem metro city Common air pollution water pollution need more attend There third type land pollution more concern rural area.

Let us now convert all the text into similar case. Our text will be in lowercase.

pollution major problem metro city common air pollution water pollution need more attend there third type land pollution more concern rural area.

Next, find out how many times each word has appeared in the text. This is called frequency of that word. Then see which words have maximum frequency.

The term **pollution** has highest frequency So, the machine can figure out that this term is most important in the text and machine can decide to classify this document as an article on **Pollution**.

Note

This is a very basic form of approach. Many other algorithms work together in processing the text for document classification. You will learn about their actual functioning and programming in higher classes.

Learning Points

- The term domain refers to an area of common application or practice.
- There are 3 major AI domains namely *data*, *computer vision* and *natural language processing*.
- A machine needs data to learn what it is supposed to do.
- While browsing we leave a trail of data which describes our browsing habit. This makes our *browsing signature* or *fingerprint*.
- Computer vision is the AI domain that deals with analysing visual data.
- For a computer, every kind of data should be in the form of numbers.
- RGB stands for **R**ed, **G**reen and **B**lue. These are 3 basic digital colours.
- Digital images are composed of tiny elements called **pixels** (Picture elements).
- NLP intends to bridge the gap between human language and the way computer understands it.



- **Domain:** An area of common application or practice.
- **CV:** Computer Vision.
- **NLP:** Natural Language Processing.
- **Browsing fingerprint:** Trail of data created by our habitual browsing.
- **RGB:** Colour model based on the basic colours red, green and blue.
- **CMYK:** Colour based on the basic colours cyan, magenta, yellow and black.
- **Pixel:** Smallest unit of a digital image that holds its colour information.
- **Syntax:** Structure and grammar of a language.
- **Semantics:** Underlying meaning of language.

Exercise



A. Select the correct answer.

1. A machine needs which of the following to learn what it is supposed to.

- a. Program
- c. Logic



- b. Data
- d. None of these



2. Data is one of the core _____ of AI.
- | | | | |
|------------|--------------------------|-----------------|--------------------------|
| a. Inputs | <input type="checkbox"/> | b. Outputs | <input type="checkbox"/> |
| c. Domains | <input type="checkbox"/> | d. Applications | <input type="checkbox"/> |
3. Our browsing habits make our which of the following?
- | | | | |
|-----------------------|--------------------------|-------------------------|--------------------------|
| a. Browsing signature | <input type="checkbox"/> | b. Browsing fingerprint | <input type="checkbox"/> |
| c. Both a) and b) | <input type="checkbox"/> | d. None of these | <input type="checkbox"/> |
4. Which of the following characteristics of data make it difficult to be processed by human brain?
- | | | | |
|--------------------------------|--------------------------|--------------------|--------------------------|
| a. Volume of data | <input type="checkbox"/> | b. Variety of data | <input type="checkbox"/> |
| c. Constant generation of data | <input type="checkbox"/> | d. All of these | <input type="checkbox"/> |
5. Which of the following domains of AI deals with visual data?
- | | | | |
|-------------------|--------------------------|-------------|--------------------------|
| a. NLP | <input type="checkbox"/> | b. CV | <input type="checkbox"/> |
| c. Both a) and b) | <input type="checkbox"/> | d. Robotics | <input type="checkbox"/> |
6. Which of the following domains of AI deals with human speech and language?
- | | | | |
|-------------------|--------------------------|-------------|--------------------------|
| a. NLP | <input type="checkbox"/> | b. CV | <input type="checkbox"/> |
| c. Both a) and b) | <input type="checkbox"/> | d. Robotics | <input type="checkbox"/> |
7. What is the range of intensity of basic colours in an RGB model?
- | | | | |
|----------|--------------------------|----------|--------------------------|
| a. 0-285 | <input type="checkbox"/> | b. 0-275 | <input type="checkbox"/> |
| c. 0-265 | <input type="checkbox"/> | d. 0-255 | <input type="checkbox"/> |
8. In the colour model CMYK, what does K stand for?
- | | | | |
|----------|--------------------------|---------|--------------------------|
| a. Grey | <input type="checkbox"/> | b. Blue | <input type="checkbox"/> |
| c. Black | <input type="checkbox"/> | d. Red | <input type="checkbox"/> |
9. The structure and grammar of a language is referred to as which of the following?
- | | | | |
|----------------------|--------------------------|-----------------------|--------------------------|
| a. Semantics | <input type="checkbox"/> | b. Syntax | <input type="checkbox"/> |
| c. Voice recognition | <input type="checkbox"/> | d. Speech recognition | <input type="checkbox"/> |
10. The underlying meaning of a language is referred to as which of the following?
- | | | | |
|----------------------|--------------------------|-----------------------|--------------------------|
| a. Semantics | <input type="checkbox"/> | b. Syntax | <input type="checkbox"/> |
| c. Voice recognition | <input type="checkbox"/> | d. Speech recognition | <input type="checkbox"/> |
11. The basic word from which other variations are formed is called the _____ of the word.
- | | | | |
|-----------|--------------------------|-----------|--------------------------|
| a. Affix | <input type="checkbox"/> | b. Prefix | <input type="checkbox"/> |
| c. Syntax | <input type="checkbox"/> | d. Root | <input type="checkbox"/> |
12. The language and visual data, all is understood by a machine in the form of _____
- | | | | |
|-----------------|--------------------------|------------|--------------------------|
| a. Algorithm | <input type="checkbox"/> | b. Numbers | <input type="checkbox"/> |
| c. Intelligence | <input type="checkbox"/> | d. Text | <input type="checkbox"/> |

B. Categorise the following into 3 domains of AI - DATA, COMPUTER VISIONS and NATURAL LANGUAGE PROCESSING.

A	B	C
1. Facial features	2. Student's photograph	3. Recorded voice
4. Fingerprint	5. Product image	6. Text typed into the computer
7. Voice command	8. Student's marks sheet	9. Document classification
10. Document scan	11. Customer feedback	12. Detecting traffic light
DATA	CV	NLP
_____	_____	_____
_____	_____	_____

C. Fill in the blanks.

Document classification, Numbers, Domain, Data, Real-time

1. The term _____ refers to an area of common application or practice.
2. _____ is found in the form of values, audio, visuals and natural language.
3. An auto-driven car is programmed to process _____ visual data it receives from its sensors.
4. _____ is an application of NLP.
5. To understand and process any data, computer needs it to be described in the form of _____.

D. Mark the following statements as True or False.

1. All AI-enabled machines are equally intelligent.
2. The data input need to be processed instantly is called real-time data.
3. Websites are the only source of bulk of data.
4. Human brain is capable to process any volume and complex type of data.
5. Maximum intensities of basic colours generate white colour.



E. Answer the following questions.

1. Discuss very briefly any 3 examples of data in the form of text, visual and natural language.
2. List 5 instances of source of bulk data from online media.
3. List 8 common sources of data.
4. Which kind of data human brain is not capable to process?
5. What do you mean by computer vision?
6. What is a pixel?
7. Explain how RGB model generates black and white colour.

8. What do you mean by NLP?
9. What do you mean by the term Syntax of a language? Give one small example.
10. What do you mean by the term Semantics of a language? Give one small example.



Mini Project...

Consider the following 2 documents. (You can also take any two moderate-sized paragraphs from any of your text books also.)

Document 1

Once upon a time, a clever monkey lived on a jamun tree at the bank of a river. A crocodile was his good friend. Crocodile would visit the monkey daily. Monkey used to give sweet jamuns to the crocodile to take to his wife.

Document 2

Crocodile's wife asked him to invite the monkey for dinner. Crocodile got the monkey on his back and swam in the middle of the river. Then he told the monkey the truth. Monkey said that he forgot his heart back on the jamun tree.

Do the following:

- a. Remove unnecessary words from the above documents.
You can also visit: demos.datasciencedojo.com/demo/stopwords/ to do so.
- b. Convert various forms of the words into their simplest form.
You can also visit: textanalysisonline.com/spacy-word-lemmatize to do so.
- c. Convert the text into lowercase.
You can also visit: caseconverter.com/ to do so.
- d. Make a table of words and write their frequencies for both the documents separately.
Then find out which words have highest frequencies.



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4

AI and Machine Learning

The learning so far



We have learnt...

- ...that computers work differently than human brain.
- ...about different types of intelligence.
- ...that there are different types of learning styles.
- ...how different types of learning aid in different types of intelligence.
- ...what is Artificial Intelligence.
- ...about major applications of AI.
- ...about the 3 domains of AI - Data, CV and NLP.

Dear children,

Now you have fundamental understanding of Artificial Intelligence as a field to design and develop machines that exhibit human-like intelligence.

AI is the vast field that is like an umbrella term for many approaches, techniques and technologies used to make machines intelligent for one or more purpose. Most popular techniques are **Machine Learning** and **Deep Learning**.

Both these techniques are used in all the 3 domains – Data analytics, Computer Vision and Natural Language Processing.

Machine Learning and Deep Learning

Machine learning is a sub-set of AI. There is another approach towards making a machine learn which is advanced than ML. It is called deep learning.

Machine Learning

ML is the approach that involves feeding a machine with a lot of data and make it learn from that data to perform some useful tasks such as identifying objects, processing text, classifying items, identifying relationships in data values and predicting some pattern or outcome.

Note

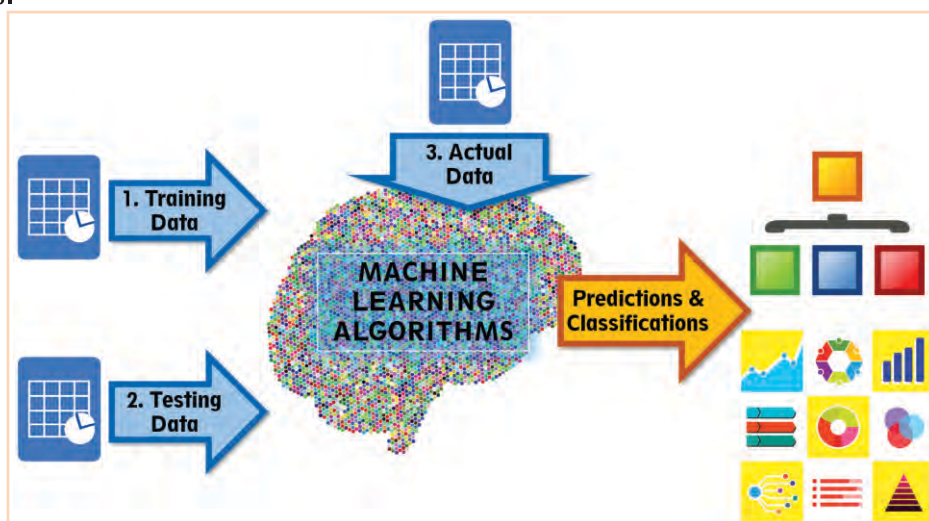
When we use the term **machine**, we actually refer to a device that runs on any software application which is based on certain algorithm designed to perform the **intelligence** function for the computer. Every software is not intelligent. By an intelligent algorithm we mean a piece of program which can be trained by the help of data. So, the terms **machine** and **algorithm** are used interchangeably.

Machine learning is used in finding relationship in numerous data values fed into the machine for training purpose. Such data is called **training data**. Depending on the relationship identified, machine learns from it and then its performance is tested with the help of **testing data**. Finally, it performs the same action on the new data. Some of the major uses of ML are:

- Finding relationship between one or more data values. For example, finding a relationship between **number of orders of fast food items** and **sales amount**.
- Classifying the objects and items on the basis of certain criteria or rules. For example, classifying number of items sold by an E-commerce website on the basis of the gender of the customer to find out which item is more popular among the customer of which gender.
- Classifying the objects or items on the basis of common properties. For example, an entertainment website classifies subscribers on their preferences of movie genre.

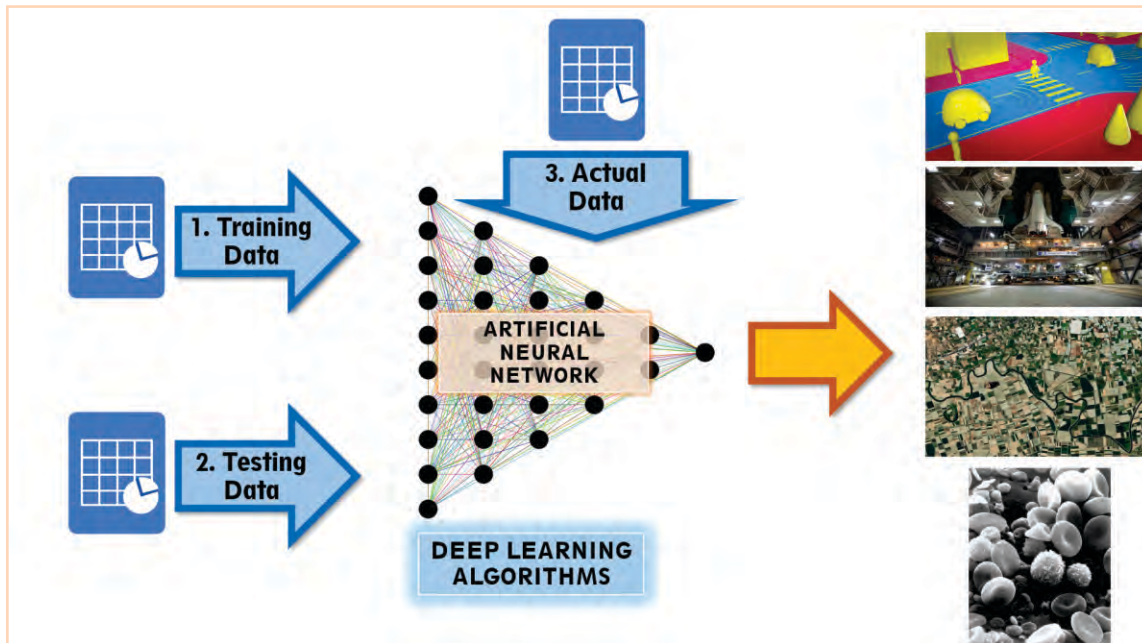
For the above three scenarios, how would a machine predict most preferred food item, most likely item to be bought by ladies and gents or most likely movie genre to be watched?

For this, machine needs the historical data of previous purchases and subscriptions. These data values would be analysed by the machine to do the predictions by applying statistical methods and techniques.



Deep Learning

Deep learning is an advanced form of machine learning. It works on the concepts that are based on the studies about how a human brain works. Human brain is composed of neurons – the nerve cells in our nervous system and brain to store and transfer information in the form of signals. On the same pattern, deep learning systems are based on the complex network of artificial neurons. Such a network is called **Artificial Neural Network (ANN)**. An ANN is nothing but a computer algorithm doing some calculation on the data values fed to it. Deep learning demands powerful computers and advanced software technology.



Deep learning is useful where accurate and precise predictions are needed which make the AI system reliable. Some of the common uses are given here with the domain in which they fall:

- Autonomous vehicles (CV, NLP).
- Identifying objects (CV).
- Detecting cancer cells (CV).
- Monitoring health of heavy machines thus preventing sudden breakdown (Data, CV).
- Space missions (Data, CV).
- Scientific researches (Data).

Deep learning systems are capable of evolving their learning to apply it with more new data available to them.

You shall learn about deep learning in detail in higher classes.

Types of Machine Learning

At this age you have learnt a lot of new things and you have knowledge about hundreds of things in the world and around you. Can you list any 36 things which you have learnt in your life?



Fill the worksheet below mentioning at least 3 most exciting and wonderful things for each of the categories that amazed you in your life.

PLACES

1. _____
2. _____
3. _____

PEOPLE

1. _____
2. _____
3. _____

GADGETS

1. _____
2. _____
3. _____

ART

1. _____
2. _____
3. _____

NATURE

1. _____
2. _____
3. _____

BOOKS

1. _____
2. _____
3. _____

HUMANS

1. _____
2. _____
3. _____

ANIMALS

1. _____
2. _____
3. _____

WWW

1. _____
2. _____
3. _____

MOVIES

1. _____
2. _____
3. _____

SPORTS

1. _____
2. _____
3. _____

LIFE

1. _____
2. _____
3. _____

Mention the sources of your learning and what other aids helped you in gathering the above knowledge.



Are there any of the above learnings or facts which you learnt without anyone's help? If not, check if your classmates have.

Briefly describe, how you learnt those facts yourself?

Supervised Learning

Supervised learning for a machine is just like you learn by the guidance from books, teachers, guides, parent and rules. Rules ensure that you study and learn. Teachers and guardians guide you. Books and internet are the source of information that you learn.

Similarly, supervised learning occurs when a machine is fed with the following:

- Data to learn from.
- Description of the data to identify it (also called labels).
- Rules and guidelines to follow to learn.
- Output expected of the machine.

Such machines are used to perform specific tasks better than the humans. For example, suspicious online transaction in a bank, predicting sales and forecasting events, identifying image amongst several etc.

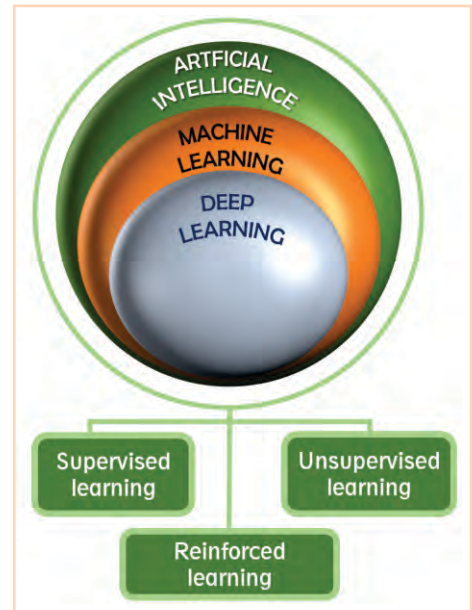
Unsupervised Learning

In the previous activity, you discovered that certain things have been learnt by you without anybody's guidance. You discovered and learnt them on your own. Unsupervised learning for a machine is just like this.

Unsupervised learning occurs when a machine is fed just with the data. It is not told what output is expected of it, it is not given any rules for guidance and not even the description (labels) of the data values. The machine is left on its own to figure out various relationships, patterns, impacts and connections between the data values. With this approach, machine may come out with its own patterns which usually human mind cannot see. It also comes out with certain set of new rules which can be used to train other machines on the same kind of data. Such machines have intelligent algorithms and they are used mostly in areas where researches are conducted such as medicine, education, defence etc., where objects need to be categorised on the basis of their similar properties or distinct properties etc.

Reinforced Learning

Consider the situations like moving objects such as autonomous vehicles, robotic vehicles, drones, virtual runners, combat vehicles, and nano-robots etc. For such moving machines, programmers decided to let them learn to negotiate their correct path from origin to destination through the obstacles around. Obstacles could be moving (e.g. traffic) or stationary (e.g. buildings). Machine learns from a reward function in a game-like, simulated environment or a controlled test environment. When a collision is avoided and/or a correct turn is taken by the machine, it is **rewarded** a point otherwise **punished** by a point lost. This reward and punishment approach of learning is called reinforced learning.



EXAMPLES

Supervised	Unsupervised	Reinforced
Finding an object in a set of images by comparing with its original picture.	Clustering people as frequent and non-frequent buyers on a website, or seasonal buyers.	Self-driven vehicle (robot, car, drone) learning its way through obstacles.
Predicting weather from the climate data-set such as humidity, temperature, precipitation, air-pressure etc.	Finding associations like customers buying similar products or most students good in math have taken Coding Club membership.	Learning to suggest to sell, buy or hold a share in the stock market by analysing loss and profit of every transaction done for that share over a period of time.
Determining a customer sentiments by analysing their reviews and ratings.	Tourists who visited region A have also visited region B.	A question-answering machine that answers the questions asked by the students on a subject or topic.
Classifying people on the basis of a given property such as students and marks or smokers/non-smokers.	Students who select humanities as major also selecting a fine arts subject also.	A path-finding application that learns to determine the shortest or fastest path by observing traffic conditions, weather, road conditions and distance etc.

Learning Points

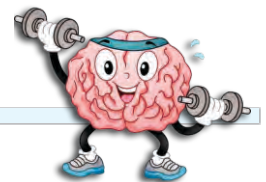


- Machine learning is a sub-set of AI.
- Deep learning is an advanced form of machine learning.
- Deep learning is based on the complex network of artificial *Artificial Neural Network(ANN)*.
- Supervised learning occurs when machine knows the expected output.
- Unsupervised learning occurs when machine has no guidance of output it is expected to give.
- In reinforcement learning, a machine learns from error/mistake (punishment) and success (reward).



- ANN:** Artificial Neural Network.
- Machine:** A computer or computer controlled machine.
- Algorithm:** The program that runs on the machine.
- Artificially intelligent machine:** A computer or computer controlled machine whose functions are governed by an AI algorithm.
- Label:** A name that identifies a data-value. E.g. city, class, section, date_of_birth etc.

Exercise



A. Select the correct answer.

- Machine learning is a/an _____ of artificial intelligence.
a. Application b. sub-set
c. super-set d. All of these
- _____ data is used to evaluate the performance of a Machine Learning algorithm.
a. Training b. Testing
c. Big d. All of these

3. Machine learning is basically used for _____ .
 - a. Classification, Identification
 - b. Analyse relationship among data values, classification
 - c. Analyse relationship among data values, identification
 - d. None of these
4. Which of the following is based on the Artificial Neural Network model?

a. Deep Learning <input type="checkbox"/>	b. Machine Learning <input type="checkbox"/>
c. Both a) and b) <input type="checkbox"/>	d. Artificial intelligence <input type="checkbox"/>
5. Which of the following is needed for accurate and reliable predictions?

a. Deep learning <input type="checkbox"/>	b. Smart machine <input type="checkbox"/>
c. Super computer <input type="checkbox"/>	d. Robotics <input type="checkbox"/>
6. Supervised learning requires which of the following?

a. Learning data <input type="checkbox"/>	b. Data labels <input type="checkbox"/>
c. Set of rules <input type="checkbox"/>	d. All of these <input type="checkbox"/>
7. Unsupervised learning requires which of the following?

a. Learning data <input type="checkbox"/>	b. Data labels <input type="checkbox"/>
c. Set of rules <input type="checkbox"/>	d. All of these <input type="checkbox"/>
8. In which of the following learning types, the machine needs to know the expected output?

a. Machine Learning <input type="checkbox"/>	b. Deep Learning <input type="checkbox"/>
c. Unsupervised learning <input type="checkbox"/>	d. Supervised learning <input type="checkbox"/>
9. In which of the following learning types, the machine does not need to know the expected output?

a. Machine Learning <input type="checkbox"/>	b. Deep Learning <input type="checkbox"/>
c. Unsupervised learning <input type="checkbox"/>	d. Supervised learning <input type="checkbox"/>
10. Which of the following machine learning types takes reward-punishment approach in training the machine?

a. Unsupervised learning <input type="checkbox"/>	b. Supervised learning <input type="checkbox"/>
c. Reinforced learning <input type="checkbox"/>	d. All of these <input type="checkbox"/>

B. Classify the following sentences into Supervised, Unsupervised and Reinforced Learning.

1. Matching a person's photograph in a set of photographs.
2. A path-finding robot trying to make way from point A to point B through various obstacles.
3. Trying to classify people on the basis of their properties such as gender, interests, income etc.

4. Predicting weather from the data values of temperature, humidity, wind, air pressure etc.
5. Deciding if a customer is happy or not by reading his reviews.
6. Identifying similar objects in a visual feed.
7. Learning by analysing which images of the products recommended by AI algorithm were clicked by the user and which were not.

C. Fill in the blanks.

Unsupervised, Reinforced, Machine, Supervised, Deep

1. Classification, identification and finding relationships are the functions of _____ learning.
2. _____ learning works on the concept of artificial neural networks.
3. A child being trained into how to use the keyboard is an example of _____ learning.
4. A child is left alone with a toy to discover its functions is an example of _____ learning.
5. Learning a game by minimising the wrong moves in each trial is an example of _____ learning.

D. Answer the following questions.

1. How is machine learning different from deep learning?
2. How is supervised learning different from unsupervised learning?
3. What do you mean by reinforcement learning?
4. List 3 applications or examples of supervised learning.
5. List 3 applications or examples of unsupervised learning.
6. List 3 applications or examples of reinforced learning.



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5

Think Like a Computer

The learning so far



We have learnt...

- ...that computers work differently than human brain.
- ...about different types of intelligence.
- ...that there are different types of learning styles.
- ...how different types of learning aid in different types of intelligence.
- ...what is Artificial Intelligence.
- ...about major applications of AI.
- ...about the 3 domains of AI - Data, CV and NLP.
- ...about machine learning and deep learning.
- ...supervised, unsupervised and reinforced learning.

Dear children,

Learning fundamentals of AI concepts is one aspect. The other aspect is to know how to write programs to develop AI algorithms. We know that computers can be instructed to perform various tasks. You must have heard people say “**program the computer**”. When we need to give similar set of instructions frequently to a computer then instead of typing all the instructions every time, we store the instructions in the desired sequence in a file. Such a file is called **executable file**. Then we just need to load that file in computer’s memory so that it reads the file and executes the instructions one-by-one. **Easy!**

Do You Know?

A set of instructions arranged in a logical sequence is called a program.

Computers only understand machine language (binary sequence of 0s and 1s) so our computer program is translated into machine language by a utility software called **translator**.

In programming, logical order or sequence of instructions is very important. Let us learn to think logically and type instructions for computer using an exciting tool called Python turtle library. *The purpose of this chapter is to develop your logical thinking and prepare you to understand serious programming in near future.*

What is Python?

Python is the most popular programming language today used to build programs for websites, artificial intelligence algorithms, games and robots. You will learn in detail about Python in higher classes. Let us have a quick look at its features:

- Python is absolutely free.
- Python is simple to learn and use.
- Python has a rich collection of built-in libraries of programs to pick and use. These libraries are arranged in uniquely named packages such as turtle, statistics, nlp etc.
- Python can run on all types of devices and operating systems.

Python Packages

Python has a huge collection of pre-designed programs called **python libraries**. These programs are organised in various collections called **packages**. To use the programs in a **package**, you just need to **import** that package in your Python script.

Note

Python programs are called **scripts**.

Opening Python Script Editor

To launch Python development environment, open the **Python n.x** folder in the **Start** menu and click on **IDLE (Python n.x...)** option.

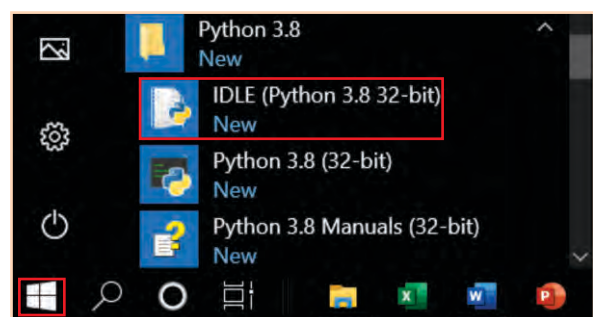
Python IDLE

IDLE is Python's **Integrated Development and Learning Environment**. It allows interactive as well as script modes to work with Python interpreter. It provides an editor to write and edit your scripts (programs) and to save them. Python shell is built into IDLE which interprets the commands and scripts submitted to it.

The script editor can be opened using Python shell window.

- Click File > **New File** (or press **Ctrl+N**).

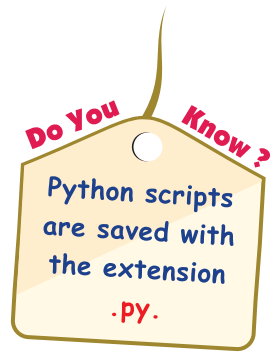
A separate window of script editor will open. Type the desired Python program.



Python Turtle Graphics

Turtle graphics is a drawing library of python which is used as an exciting tool to develop logical thinking while drawing amazing patterns and graphics on a canvas.

Let us dive right into drawing with turtle! From this point onwards, you are supposed to create your scripts by following the steps given here and understand the output by the explanation given along with.



Tom the turtle

Turtle is denoted by a small arrow which moves and draws on the canvas like a pen does on the paper. We call our turtle **Tom!** Let us begin. Open script editor and type the following lines as shown here:

Save the script by your_name_tom1.

```
tom1.py - C:/Users/ESOFT/Desktop/tom1.py (3.8.1)
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3 tom.forward(100)
4
```

To run the script, press **F5** or **Run** menu > **Run Module** option.

What did you notice? Let us understand what is happening in this 3-line program.

import turtle

All your turtle graphics scripts will begin with this line because **import** command is making **turtle** library available to your script.

tom = turtle.Pen()

All the functions of turtle library can be accessed by mentioning **turtle** followed by a dot and then the required function. Here, we are using a function **Pen()** and assign a name to it i.e. **tom**.

Now all the drawing capabilities are available in tom.

Note

Turtle can also be created by function **Turtle()** such as `tom = turtle.Turtle()`.

tom.forward(100)

Function **forward()** takes **100** as an argument and moves tom forward by 100 steps.

Note

By default, turtle faces east (rightward). Turtle always moves forward or back in its current direction.

Note

What is a function?

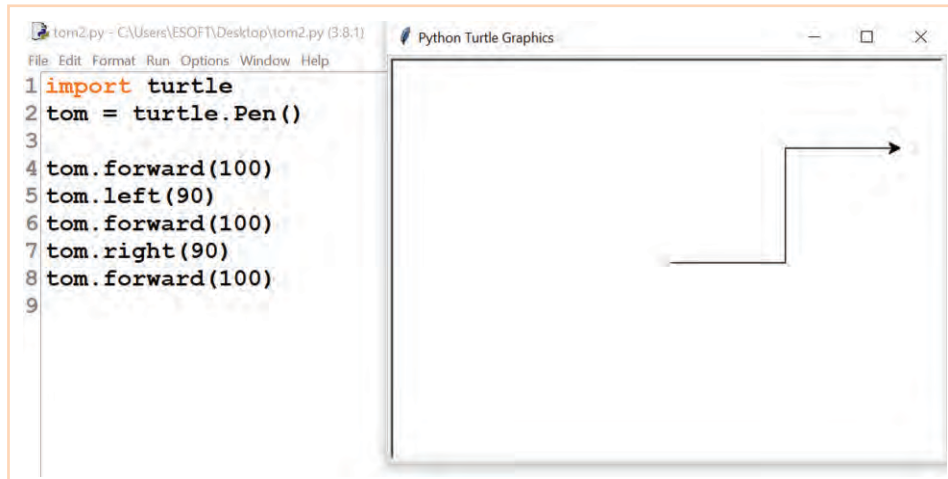
A function is a pre-designed program to do some useful task. It can be invoked by mentioning its name.

What is an argument?

Certain functions need some inputs to perform their task. Such inputs are called arguments. E.g. function `forward()` takes a number as argument to move the turtle as many steps.

Moving tom around

Let us try a small program to move our friend tom around on canvas as it draws. Open a new blank script and try this code:



```
tom2.py - C:\Users\ESOFT\Desktop\tom2.py (3.8.1) Python Turtle Graphics
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3
4 tom.forward(100)
5 tom.left(90)
6 tom.forward(100)
7 tom.right(90)
8 tom.forward(100)
9
```

Let us compare output with the script.

Line 4: `tom.forward(100)` - First horizontal line is drawn.

Line 5: `tom.left(90)` – tom turns left (i.e. north or up direction in canvas).

Line 6: `tom.forward(100)` - Vertical line is drawn.

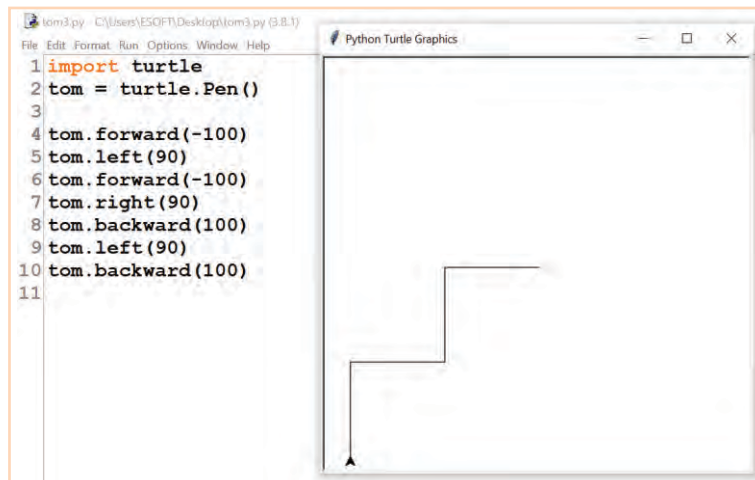
Line 7: `tom.right(90)` – tom turns right from its current position (i.e. east).

Line 8: `tom.forward(100)` – Second horizontal line is drawn.

What did you learn?

- Turtle can be turned left and right by certain degrees.
- Some functions take arguments to complete their task.

Try this script:



```
tom3.py - C:\Users\ESOFT\Desktop\tom3.py (3.8.1) Python Turtle Graphics
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3
4 tom.forward(-100)
5 tom.left(90)
6 tom.forward(-100)
7 tom.right(90)
8 tom.backward(100)
9 tom.left(90)
10 tom.backward(100)
11
```

Notice lines 4 and 8.

In line 4, **forward()** is passed **-100** that means 100 steps **backwards**. Same can be achieved by passing **100** to function **backward()** – see lines 8 and 10.

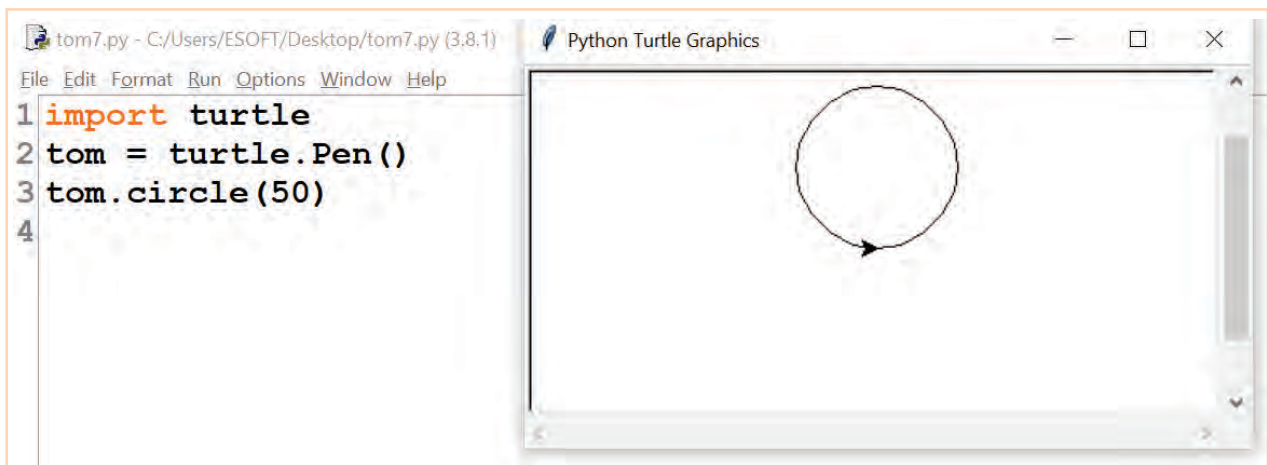
Also, compare this output with previous. Earlier, drawing is at the tail of the turtle while this drawing is at the mouth or tip of the turtle because it finally moved backwards while drawing.

Try Yourself

- A. Draw a square of 100 steps.
- B. Draw a rectangle of 100 steps by 50 steps.

Drawing Circle

Function **circle()** takes the radius as argument and draws the circle. See this script drawing a circle of radius 50.



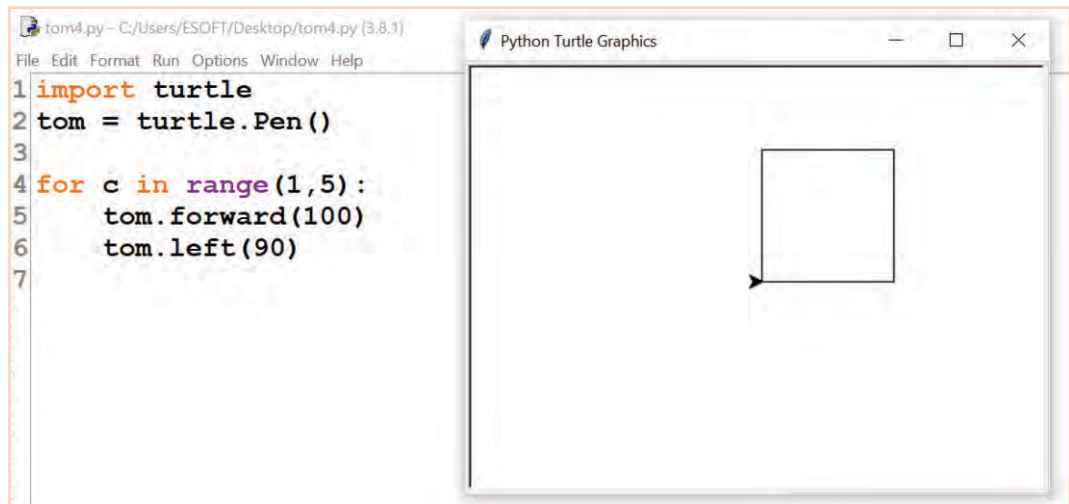
Repeating Tasks

One great aspect of programming is that computer can repeat tasks for you several times as long as you need. You just need to tell the computer how many times you need it to execute the tasks. Such process of executing tasks repeatedly is called **looping**.

Let us understand it. Try the following script:

To tell the computer how many times tasks should execute, use **for** keyword.

Notice line 4: **for c in range(1,5):** (it terminates with a colon)



Consider the function **range(1,5)**. This function creates a list of numbers in a range. Here, it is creating a list **1, 2, 3, 4**. (5 is the limit. List is created always one less from the upper limit.)

Now, see **for** keyword. It tells the computer to count from first number till last number of the list. But, **for** cannot count itself. It needs a name to identify each count. Here, that name is **c**. It is just an imaginary name given to each count. The value of **c** will be **1** for the first time.

Let us look at the task now. Notice lines 5 and 6. Line 5 will move the turtle 100 steps forward. Line 6 will turn the turtle left at right angle (90 degrees).

The value of **c** is **1** for the first time. A horizontal line is drawn. After that, program control will again return to line **4** and next count will occur. This time, value of **c** will become **2**. Still, upper limit is not reached, so lines 5 and 6 will execute the second time. Vertical line will be drawn at right angles to the horizontal line.

Next, program control will again return to line 4 and next count will occur. This time, value of **c** will become **3**. Still, upper limit is not reached, so lines 5 and 6 will execute the third time. Second horizontal line will be drawn at right angles to the vertical line.

Finally, program control will again return to line 4 and next count will occur. This time, value of **c** will become **4**. Still, upper limit is not reached, so lines 5 and 6 will execute the fourth and last time. Second vertical line will be drawn at right angles to the second horizontal line.

Program control will again return to line 4. This time count is over so looping will stop.

We got a square and turtle is back to home!

How does computer know which tasks to repeat? How did computer know in our program that line 5 and 6 are exactly the part of loop? Well, that is done by the help of **indentation**. Notice, lines 5 and 6 are shifted rightwards a little. This is called indentation. It is done by pressing **tab** key once. Python looks at indented lines and figures out which lines belong to which loop.

Activity



Draw the Output of the Script

Try this script and answer the questions that follow:

Q1: Which lines are the part of loop? How did you know?

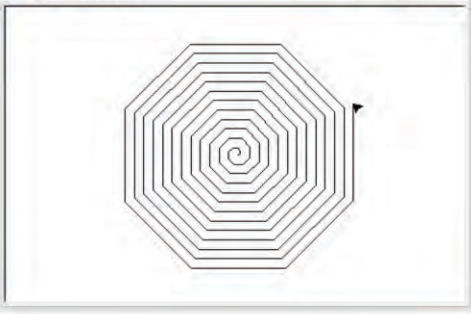
Q2: How many times lines 7 and 8 will execute?

```
tom5.py - C:/Users/ESoft/Desktop/tom5.py (3.8.1)
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3
4 for c in range(1,5):
5     tom.forward(100)
6     tom.left(90)
7 tom.left(45)
8 tom.forward(140)
9
```

Playing with loop counter

You can use loop counter to create interesting drawings. Try this script:

```
tom6.py - C:/Users/ESOFT/Desktop/tom6.py (3.8.1)
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3
4 for c in range(1,100):
5     tom.forward(c)
6     tom.left(45)
7
```



Line 4: **for** loop is counting **99** times. In line 5, function **forward(c)** is taking value of counter **c** which is changing every time the loop executes. That is why, the lines drawn get longer and longer in the output. The shape is an octagon (**8** sides) because of line 6 which turns the turtle **45 degrees**. ($45 \times 8 = 360$ degrees complete).

Try changing values of **c** and draw different patterns.

Try the following scripts and draw their outputs.

```
tom7.py - C:/Users/ESOFT/Desktop/tom7.py (3.8.1)
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3
4 for c in range(1,9):
5     tom.circle(50)
6     tom.right(45)
7
```

```
tom6.py - C:/Users/ESOFT/Desktop/tom6.py (3.8.1)
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3
4 tom.forward(50)
5 for c in range(1,28):
6     tom.forward(c)
7     tom.left(c)
8
9 tom.right(18)
10 tom.forward(50)
11
12 for c in range(1,28):
13     tom.forward(c)
14     tom.left(c)
```

Background Colour, Pen Colour and Pen Width

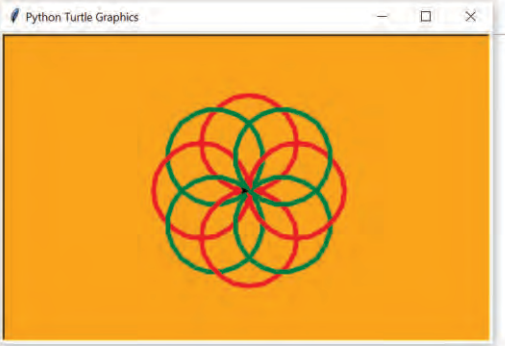
You can set the colour and width of the pen to draw.

The white background of the canvas can be set to a colour using function **turtle.bgcolor()**. It takes the name of the colour as argument.

Function **pencolor()** takes the name of the colour as argument and function **width()** takes a number for width as argument.

See this script.

```
tom8.py - C:/Users/ESOFT/Desktop/tom8.py (3.8.1)
File Edit Format Run Options Window Help
1 import turtle
2
3 tom = turtle.Pen()
4 tom.width(5)
5 turtle.bgcolor("orange")
6
7 for c in range(1,5):
8     tom.pencolor("red")
9     tom.circle(50)
10    tom.left(45)
11    tom.pencolor("green")
12    tom.circle(50)
13    tom.left(45)
14
```



Here, in line 4, width of the pen is set to 5 pixels.

In line 5, background colour of the canvas is set to **orange**.

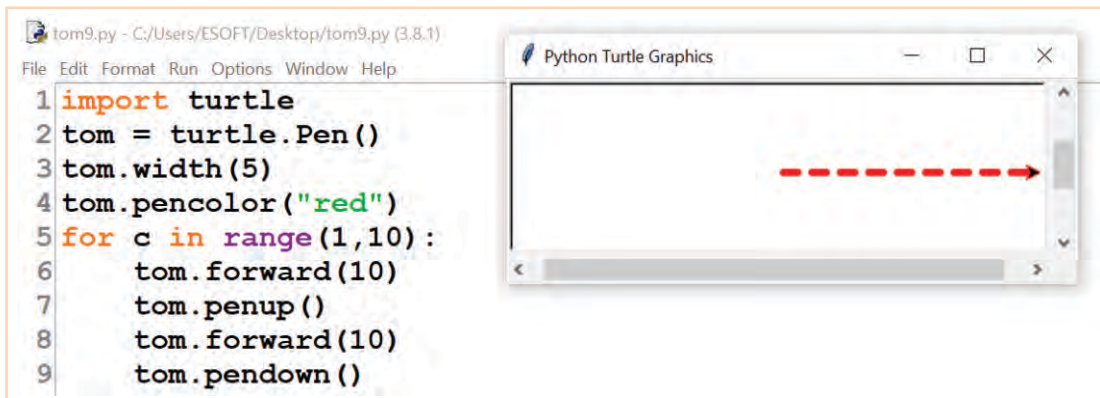
In lines 8 and 11, colour of the pen is set to **red** and **green** respectively.

The loop is running **4** times, drawing 8 circles. Every time a circle is drawn, the turtle turns **left** by **45** degrees and colour changes alternatively. (Every red circle is at 90 degree (45+45) and green circle at 45 degree.)

To draw or not to draw

Function **penup()** makes the turtle move without drawing. Function **pendown()** makes the turtle draw. Both these functions do not need any argument.

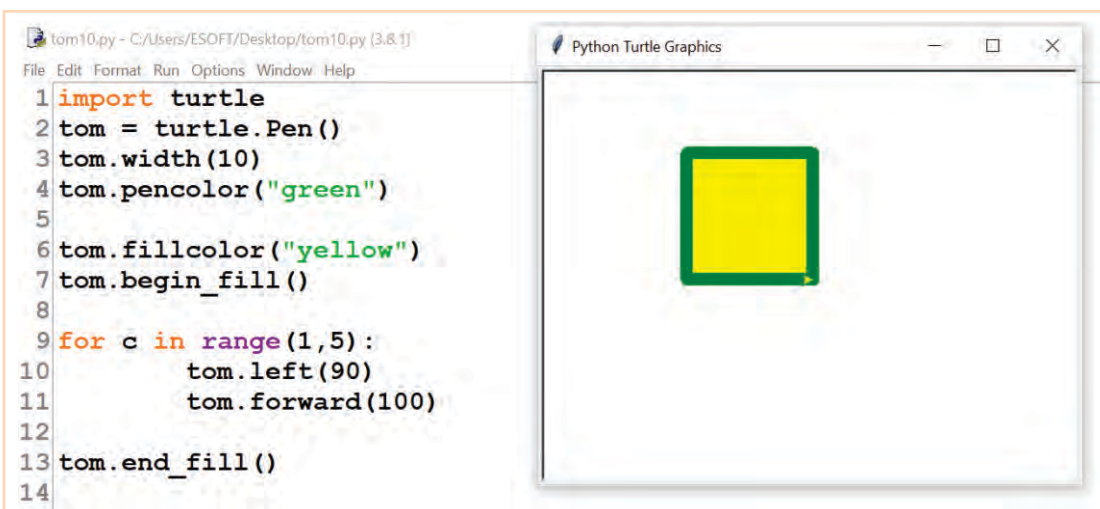
See this script that draws dashed line using **penup()** and **pendown()** alternatively in a loop which runs **9** times (notice the number of dashes is 9).



```
tom9.py - C:/Users/ESOFT/Desktop/tom9.py (3.8.1)
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3 tom.width(5)
4 tom.pencolor("red")
5 for c in range(1,10):
6     tom.forward(10)
7     tom.penup()
8     tom.forward(10)
9     tom.pendown()
```

Filling Colours in Drawings

Function **fillcolor()** takes the name of the colour as argument and fills colour in the drawing. To fill the colour, we must inform the computer when the drawing is beginning and when it is ending. To do this, functions **begin_fill()** and **end_fill()** are used. **fill_color()** always falls between them. See this script drawing a yellow square with green outline.



```
tom10.py - C:/Users/ESOFT/Desktop/tom10.py (3.8.1)
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3 tom.width(10)
4 tom.pencolor("green")
5
6 tom.fillcolor("yellow")
7 tom.begin_fill()
8
9 for c in range(1,5):
10     tom.left(90)
11     tom.forward(100)
12
13 tom.end_fill()
14
```

See line 6. In it, function **fillcolour()** is taking colour name **yellow** as argument.

Notice lines 7 and 13. They are marking the beginning and end of the drawing. Between them, the drawing is done by the code in lines 9, 10 and 11. When drawing ends, yellow colour is filled.

Note

Function `fillcolor()` also sets the colour of the turtle. Similarly, function `pencolor()` also sets the outline colour of the turtle.

Other Common Turtle Functions

There are certain other functions you can apply on the turtle such as:

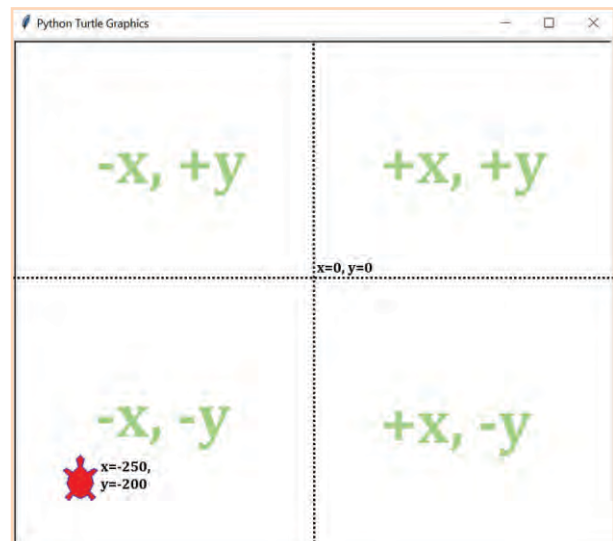
<code>shape()</code>	Changes the shape of the <i>turtle</i> to <i>turtle</i> , <i>arrow</i> , <i>triangle</i> , <i>circle</i> , <i>square</i> and <i>classic</i> .
<code>shapeseize()</code>	Changes the size of the turtle.
<code>setpos()</code>	Moves the turtle to specified x,y coordinates on the canvas.
<code>undo()</code>	Cancels the last action done by turtle.
<code>clear()</code>	Clears the canvas.
<code>reset()</code>	Clears the canvas, resets turtle to all default settings and brings the turtle to coordinates 0,0.

See the example below (lines 4, 6 and 8):

```

1 import turtle
2 tom = turtle.Turtle()
3
4 tom.shape("turtle")
5 tom.fillcolor("red")
6 tom.shapesize(2)
7 tom.penup()
8 tom.setpos(-250,-200)
9 tom.pencolor("blue")
10 tom.left(90)

```



Canvas Coordinates

The centre of the canvas is $x=0, y=0$. As you move **up**, **y** coordinate **increases** and as you move **down**, **y** coordinate **decreases**. As you move **right**, **x** coordinate **increases** and as you move **left**, **x** coordinate **decreases**.

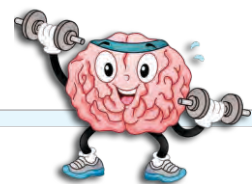
Learning Points

- Computers only understand machine language.
- Computer program is translated into machine language by a utility software called translator.
- Python programming language is free, simple to learn and loaded with powerful libraries.
- Python IDLE is an integrated learning and development environment to develop and manage Python programs.
- Python IDLE works in interactive and script modes.
- Python turtle library is useful to learn Python basics.
- Python files have extension .py.
- Python turtle draws on a canvas.



- **Translator:** Utility software that converts computer language program into machine language.
- **Library:** Collection of pre-designed programs.
- **Package:** Organisation of libraries.
- **Script:** A Python program.
- **Function:** An independent piece of code identified by a unique name.
- **Argument:** Value passed to a function.
- **Loop:** The block of program executing repeatedly.
- **Indentation:** Tab-shifting the line of code to align them as the part of a block.

Exercise



A. Select the correct answer.

1. A computer file containing a computer program is called a/an _____ file.
- | | | | |
|---------------|--------------------------|-----------------|--------------------------|
| a. Logic | <input type="checkbox"/> | b. Instructions | <input type="checkbox"/> |
| c. Executable | <input type="checkbox"/> | d. Icon | <input type="checkbox"/> |

2. A translator is which of the following types of software?
- | | | | |
|-------------|--------------------------|------------|--------------------------|
| a. Computer | <input type="checkbox"/> | b. Useful | <input type="checkbox"/> |
| c. Utility | <input type="checkbox"/> | d. Machine | <input type="checkbox"/> |
3. Python is which of the following?
- | | | | |
|-------------------------|--------------------------|---------------|--------------------------|
| a. Software | <input type="checkbox"/> | b. AI Program | <input type="checkbox"/> |
| c. Programming language | <input type="checkbox"/> | d. Utility | <input type="checkbox"/> |
4. Collections of useful, predesigned programs are called which of the following?
- | | | | |
|------------|--------------------------|-----------------|--------------------------|
| a. Library | <input type="checkbox"/> | b. Template | <input type="checkbox"/> |
| c. Theme | <input type="checkbox"/> | d. All of these | <input type="checkbox"/> |
5. Python libraries are organised as which of the following?
- | | | | |
|-------------------|--------------------------|--------------|--------------------------|
| a. Themes | <input type="checkbox"/> | b. Templates | <input type="checkbox"/> |
| c. Both a) and b) | <input type="checkbox"/> | d. Packages | <input type="checkbox"/> |
6. Python programs are called which of the following?
- | | | | |
|--------------|--------------------------|--------------|--------------------------|
| a. Utilities | <input type="checkbox"/> | b. Libraries | <input type="checkbox"/> |
| c. Packages | <input type="checkbox"/> | d. Scripts | <input type="checkbox"/> |
7. We can save our Python programs in which of the following modes of IDLE?
- | | | | |
|---------------------|--------------------------|------------------|--------------------------|
| a. Interactive mode | <input type="checkbox"/> | b. Script mode | <input type="checkbox"/> |
| c. Both a) and b) | <input type="checkbox"/> | d. None of these | <input type="checkbox"/> |
8. The extension of Python program files is which of the following?
- | | | | |
|---------|--------------------------|---------|--------------------------|
| a. .ipy | <input type="checkbox"/> | b. .pyt | <input type="checkbox"/> |
| c. .pyn | <input type="checkbox"/> | d. .py | <input type="checkbox"/> |
9. One of the most appealing features of Python is that it _____.
- | | | | |
|--|--------------------------|-------------------------------|--------------------------|
| a. is free | <input type="checkbox"/> | b. is simple to learn and use | <input type="checkbox"/> |
| c. has huge collection of useful libraries | <input type="checkbox"/> | d. All of these | <input type="checkbox"/> |
10. To use a package in our Python programs, we need to _____ it.
- | | | | |
|-----------|--------------------------|-----------|--------------------------|
| a. Insert | <input type="checkbox"/> | b. Export | <input type="checkbox"/> |
| c. Import | <input type="checkbox"/> | d. Select | <input type="checkbox"/> |
11. The two ways to run a Python script in Python IDLE are:
- | | |
|-------------------------------|--------------------------|
| a. Press F5, Run > Run Module | <input type="checkbox"/> |
| b. Press F6, Run > Run Module | <input type="checkbox"/> |
| c. Press F5, Run > Run Script | <input type="checkbox"/> |
| d. Press F6, Run > Run Script | <input type="checkbox"/> |
12. turtle.forward(50) - in this statement, what is 50?
- | | | | |
|-------------|--------------------------|--------------|--------------------------|
| a. A number | <input type="checkbox"/> | b. Direction | <input type="checkbox"/> |
| c. Argument | <input type="checkbox"/> | d. Output | <input type="checkbox"/> |

13. turtle.right(45) - in this statement, what is 45?
- | | | | |
|-----------|--------------------------|-------------------|--------------------------|
| a. Steps | <input type="checkbox"/> | b. Degree | <input type="checkbox"/> |
| c. Length | <input type="checkbox"/> | d. How many times | <input type="checkbox"/> |
14. turtle.backward(-50) and turtle.forward(50) means what?
- | | | | |
|------------------------|--------------------------|------------------|--------------------------|
| a. Same | <input type="checkbox"/> | b. Not same | <input type="checkbox"/> |
| c. Error in statements | <input type="checkbox"/> | d. None of these | <input type="checkbox"/> |
15. for x in range(1,10): - this loop should execute how many times?
- | | | | |
|-------|--------------------------|------------------|--------------------------|
| a. 11 | <input type="checkbox"/> | b. 10 | <input type="checkbox"/> |
| c. 9 | <input type="checkbox"/> | d. None of these | <input type="checkbox"/> |
16. The statement which are a part of a block such as loop are _____ together.
- | | | | |
|----------|--------------------------|-------------|--------------------------|
| a. Coded | <input type="checkbox"/> | b. Kept | <input type="checkbox"/> |
| c. Saved | <input type="checkbox"/> | d. Indented | <input type="checkbox"/> |
17. If Python turtle has to draw a dashed line (- - - -) then it must us _____.
- | | | | |
|-------------------|--------------------------|-----------------|--------------------------|
| a. penup() | <input type="checkbox"/> | b. pendown() | <input type="checkbox"/> |
| c. Both a) and b) | <input type="checkbox"/> | d. draw(yes/no) | <input type="checkbox"/> |
18. turtle.fillcolor("red") - this statement is doing what?
- | | |
|---|--------------------------|
| a. Filling colour in the figure drawn | <input type="checkbox"/> |
| b. Only setting the colour to be filled | <input type="checkbox"/> |
| c. Filling the outline colour | <input type="checkbox"/> |
| d. Only setting the outline colour | <input type="checkbox"/> |
19. To clear the canvas, reset default settings and bring the turtle to the centre of the stage, we use which of the following functions?
- | | | | |
|-------------------|--------------------------|------------|--------------------------|
| a. clear() | <input type="checkbox"/> | b. reset() | <input type="checkbox"/> |
| c. Both a) and b) | <input type="checkbox"/> | d. undo() | <input type="checkbox"/> |
20. The centre of the turtle canvas is denoted by which of the following values of coordinates x,y?
- | | | | |
|------------|--------------------------|------------|--------------------------|
| a. 0,0 | <input type="checkbox"/> | b. 100,100 | <input type="checkbox"/> |
| c. 500,500 | <input type="checkbox"/> | d. 1,1 | <input type="checkbox"/> |

B. Match the functions in Column A with their use in Column B.

- | A | B |
|---------------|---|
| 1. Pen() | a. Clear the canvas. |
| 2. range() | b. Creates a turtle by some name. |
| 3. bgcolor() | c. Marks the end of filling colour in a figure drawn. |
| 4. end_fill() | d. Brings turtle to coordinates 0,0. |


```
import turtle
t = turtle.Pen()

for x in [5, 10, 15]:
    t.forward(100)
    t.width(x)
    t.left(-120)
```

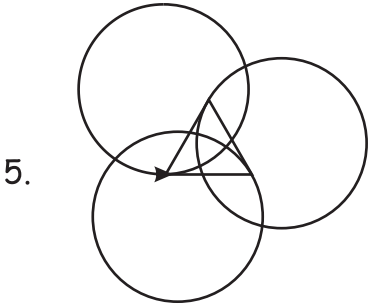
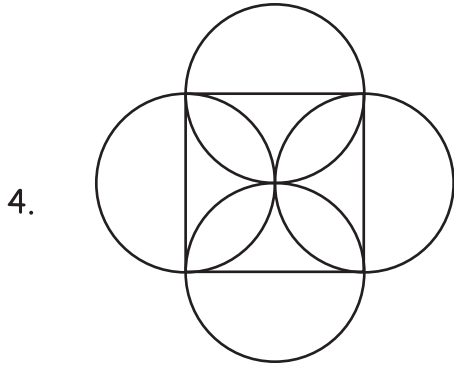
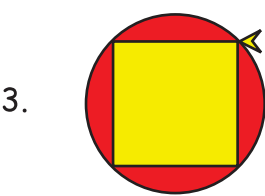
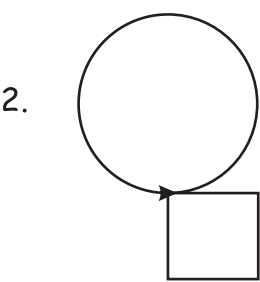
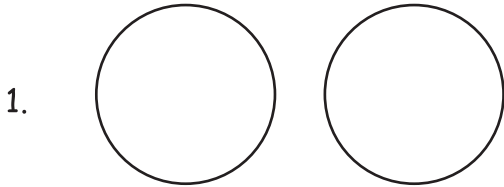
```
import turtle
t = turtle.Pen()

t.fillcolor("yellow")
turtle.bgcolor("blue")
t.circle(50)
```

```
import turtle
t = turtle.Pen()

t.fillcolor("red")
turtle.bgcolor("yellow")
t.pencolor("green")
t.width(10)
t.begin_fill()
t.circle(50)
t.end_fill()
```

F. Write Python turtle scripts to display following outputs.



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6

Programming with Python

The learning so far



We have learnt...

- ...that computers work differently than human brain.
- ...about different types of intelligence.
- ...that there are different types of learning styles.
- ...how different types of learning aid in different types of intelligence.
- ...what is Artificial Intelligence.
- ...about major applications of AI.
- ...about the 3 domains of AI - Data, CV and NLP.
- ...about machine learning and deep learning.
- ...supervised, unsupervised and reinforced learning.
- ...how a computer thinks one step at a time and in loops.

Dear children,

In this chapter, we shall look at Python programming in little more detail with complete input-process-output cycle and learn many powerful features of the language.

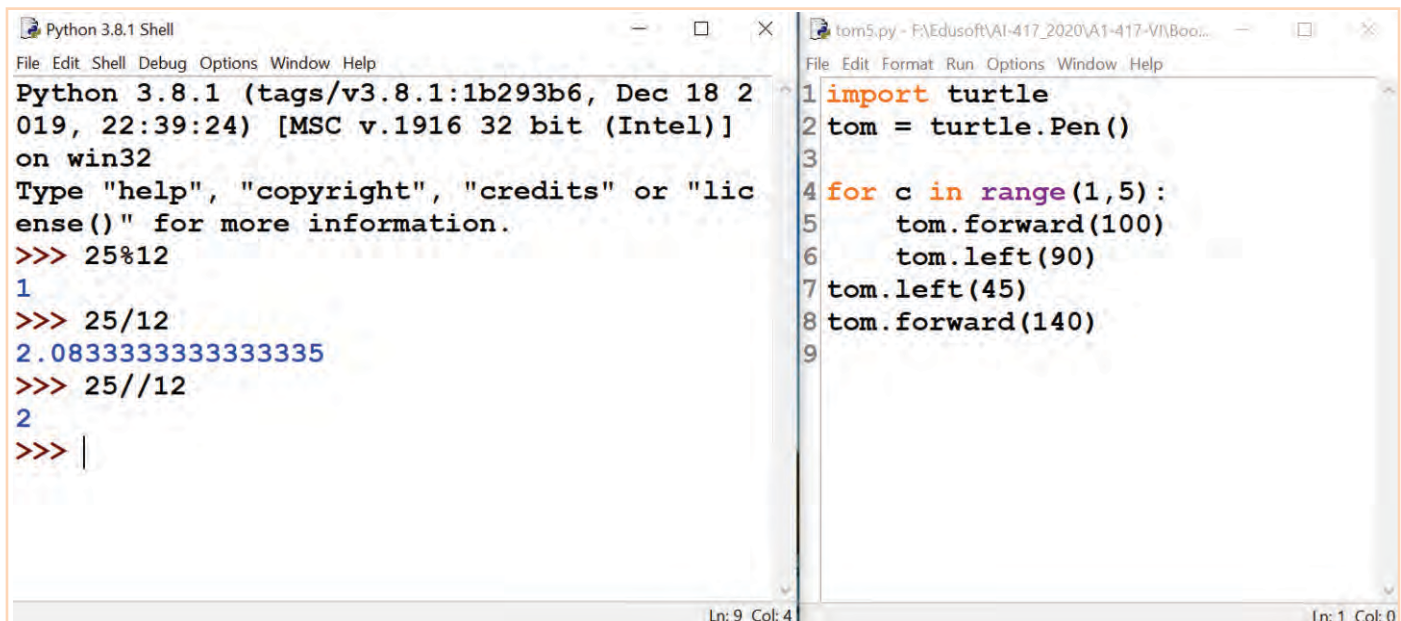
Fun with Python Arithmetic

Open Python IDLE and try out the following commands on the Python shell prompt >>> directly.

Command	Explanation
2 + 2	Simple addition using + operator.
43 - 7 * 9	Simple arithmetic using subtraction and multiplication operators.
(23 + 2 * 5)/5	Division using / operator.
15/2	This division will return float value that means number with decimal places.
17/3	Division with several decimal places.
17//3	Decimal places are suppressed using // instead of /.
5%2	Remainder of division will be returned using modulus (pron: modulo) operator %.
5**2	Calculating 5 to the power 2.
2**8	Calculating 2 to the power 8.

Python IDLE Working Modes

What did you notice and learn from the commands? What you have been working in is called **Interactive mode** of Python IDLE. IDLE stands for **I**ntegrated **D**evelopment & **L**earning **E**nvironment. IDLE is a combination of command prompt, script editor, Python interpreter to execute scripts and to debug (finding errors and fixing them) scripts. Such a development environment is called IDE. In interactive mode, we issue commands one at a time and get their output immediately. You have already worked in the other mode that is **Script mode** in which we write Python script (program), save it and can run it any time later.



Python Interactive Mode

Python Script Mode

Python Arithmetic Operators

Various arithmetic operators in Python you practiced are summarised here.

Operator	Type	Explanation	Example
+	Binary	Addition operator	a = 5 + 2
-	Binary	Subtracts the two number	a = 5 - 2

*	Binary	Multiplication	$a = 5 * 2$
/	Binary	Division	$a = 5 / 2$ (will return float 3.5) $b = 4 / 2$ (will return integer 2)
//	Binary	Division and discards decimal places in result	$a = 5 // 2$ (will return integer 2) $b = 23 // 5$ (will return integer 4)
%	Binary	Modulus (pronounced: modulo returns remainder of the division)	$a = 3 \% 2$ (will return 1) $b = 4 \% 2$ (will return 0)
**	Binary	Exponentiation (to the power of)	$a = 5 ** 2$ (will return 25)

Activity



Simple Calculations

Create a Python script and write statements to calculate the following:

- 25% discount of the amount 2947
- $(13 - 25)^2$ Consider the formula: $(a - b)^2 = a^2 + b^2 - 2ab$
- How many feet are there in 13 feet, 4 inches (13.4)?
- Inches from 12.8 feet. (i.e. 0.80)
- 8 to the power 4

Python Variables

What we input to the computer, goes into its memory. The values in scripts can be identified by unique names called **variables**. See this familiar example:

Here, loop counter *c* is holding values 1, 2, 3, and 4 after each iteration of the loop. *c* is a variable.

Value of a variable usually changes during the execution of the program hence the term **variable**.

Variables can store various values such as whole numbers (called integers), numbers with decimal places (called floats) and strings (any value enclosed in quotes e.g. "hello", "265", 'how are you?', 'I am in single quotes')

```
1 import turtle
2 tom = turtle.Pen()
3
4 for c in range(1, 5):
5     tom.forward(100)
6     tom.left(90)
```

Simple Input and Output

Every programming language has ways of receiving input from the user and to display the output.

input(): In Python, input() function is used to display a prompt to the user to enter a value and it returns the input from the user. The returned value can be stored in a variable. The value returned by input() is in string format. Even if a number has been entered, it would be returned by input() as a string.

```
n = input("What is your name?")
print("Welcome ", n)
```

For example, in this script, notice the first line. The prompt What is your name is passed into input() within double quotes.

This line will display this prompt to the user and when user enters the value, it will be returned into the variable n. The value returned by input() is assigned to the variable on the left hand side of the **assignment operator (=)**.

print(): Python's print() accepts values to be displayed as parameter and displays them as output. Values can be separated by comma or combined by arithmetic operators if any calculation is required. In the previous example, notice the second line. print() is passed two parameters, string Welcome and the variable n (which holds

```
What is your name?ARJUN
Welcome ARJUN
>>>
```

user's input). Notice that variable is not within quotes since its value will be substituted in its place when print() will execute. Can you figure the output? See for yourself. User had entered the string ARJUN.

Activity



Simple Swap

Create a Python script with 3 variables: x, y and z. Accept numbers in variables a and b. Then, swap (interchange) their values by the help of variable z and display them back to the user showing that now a has b's value and vice versa.

Dual role of + Operator

We know that + operator is an arithmetic operator to perform addition. But, with strings, it works as **concatenation** operator. In simple terms, it joins the strings.

```
File Edit Format Run Options Window Help
a = input("Enter a number:")
b = input("Enter another number:")
print(a + b)
```

For example, consider the script given here. What should be its output if user enters first number as 23 and second as 12?

Here, 23 entered by the user will be returned by input() into the variable a. Value 12 will be stored in variable b. Notice the output. Instead of performing addition, + operator has combined the two numbers to make them 2312. The reason is, input() returns every value as a string and + operator has concatenated (joined) the two. That is why explicit conversion of the values is needed to perform desired operation.

```
Enter a number:23
Enter another number:12
2312
```

Implicit and Explicit Data Type Conversion

During an arithmetic operation, if required, Python automatically does data conversion known as implicit data type conversion.

For example: `a = 2 * 3.5`

This will result into a float value since data conversion is automatically taken care of by Python. For explicit conversion, Python provides a set of built in data conversion functions as follows:

Function	Example
<code>int()</code>	<code>a = 3.5, b = 2 * int(a)</code> <code>int()</code> converts the given float value to integer. Here, value 3.5 of the variable <code>a</code> will be converted to 3 (note that it is not rounded off, just decimal part is discarded) <code>x = "3" y = 5 + int(x)</code> <code>int()</code> will convert string 3 into its numeric equivalent integer 3
<code>float()</code>	<code>a = 3 b = 2 * float(a)</code> <code>float()</code> converts the given value to integer. Here, value 3 of the variable <code>a</code> will be converted to 3.0 and variable <code>b</code> will store 6.0. Since, here the other number (ie. 2) is plicitly convert the result into float.
<code>str()</code>	<code>a = 62 b = str(a)</code> <code>str()</code> converts the given value to string. Here, integer value 62 of the variable <code>a</code> will be converted to string type 62

For example, in this program, the string type values are converted and returned as integers by `int()` function while they are now added by `+` operator, giving the desired result.

```
File Edit Format Run Options Window Help
a = input("Enter a number:")
b = input("Enter another number:")
print("The answer is:", int(a) + int(b))
```

```
Enter a number:23
Enter another number:12
The answer is: 35
```

Activity



Intelligent Swap

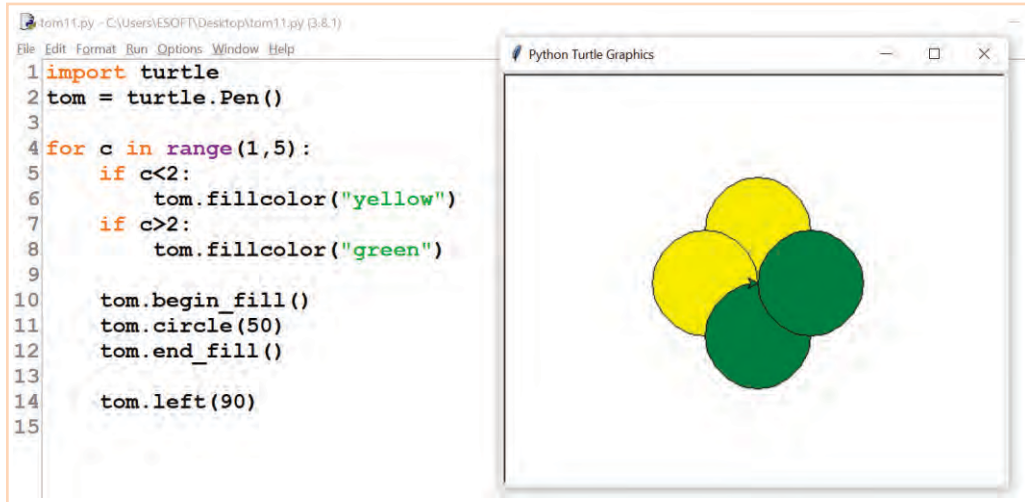
Consider the script created in the previous activity [Simple Swap](#). Optimise the script to do the same thing without using any third variable.

Decision Making

You can add ability of taking decisions into your scripts by using `if` keyword.

`if` checks a condition and if that condition is true, it allows required statements to be executed.

Let us understand this with a script shown here.



This is a very interesting script. Notice line 5: **if c<2:** (ending with colon)

if keyword is followed by a condition. **A condition compares two values.** Here, value of c is compared for less than (<) 2.

Line 6 is part of **if** and it will execute only if condition **c<2** is true.

Similarly, in line 7, value of c is compared with greater than (>) 2.

Line 8 is part of **if** and it will execute only if condition **c>2** is true.

Let us see the flow of the script:

```
5     if c<2:
6         tom.fillcolor("yellow")
```

```
7     if c>2:
8         tom.fillcolor("green")
```

Value of c	c<2	c>2	Statement executed	Output
1	True	False	<pre>5 if c<2: 6 tom.fillcolor("yellow") 10 tom.begin_fill() 11 tom.circle(50) 12 tom.end_fill() 13 14 tom.left(90)</pre>	Yellow circle
2	False	False	<pre>10 tom.begin_fill() 11 tom.circle(50) 12 tom.end_fill() 13 14 tom.left(90)</pre>	Yellow circle (yellow colour already set)
3	False	True	<pre>7 if c>2: 8 tom.fillcolor("green") 10 tom.begin_fill() 11 tom.circle(50) 12 tom.end_fill() 13 14 tom.left(90)</pre>	Green circle
4	False	True	<pre>7 if c>2: 8 tom.fillcolor("green") 10 tom.begin_fill() 11 tom.circle(50) 12 tom.end_fill() 13 14 tom.left(90)</pre>	Green circle

Here, most interesting thing is happening when value of **c** is **2**. In this case, neither of the two ifs will execute but last set fill colour yellow remains in computer memory so the second circle drawn will have yellow fill colour.

For values of **c** as **3** and **4**, line 8 will execute.

All comparison operators are given here.

Operator	Type	Example
<	Less than	5<10 (true) 5>10 (false)
>	Greater than	5<10 (false) 5>10 (true)
==	Equal to	5==5 (true) 5==10 (false)
<=	Less than or equal to	3<=5 (true) 5<=5 (true) 5<=3 (false)
>=	Greater than or equal to	5>=3 (true) 5>=5 (true) 3>=5 (false)
!=	Not equal to	3!=5 (true) 3!=3 (false)

Previous example of if is modified a little in this script (see lines 9 and 10). Can you guess the output?

```
tom11.py - C:\Users\ESOFT\Desktop\tom11.py (3.8.1)
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3
4 for c in range(1,5):
5     if c<2:
6         tom.fillcolor("yellow")
7     if c>2:
8         tom.fillcolor("green")
9     if c==2:
10        tom.fillcolor("blue")
11    tom.begin_fill()
12    tom.circle(50)
13    tom.end_fill()
14
15    tom.left(90)
```

This, otherwise that

Along with **if** keyword, we can use **else**. It executes when **if** fails (i.e. condition of if returns false).

Keyword **else** does not need to evaluate any condition. See this example.

```

1 import turtle
2 tom = turtle.Pen()
3
4 for c in range(1,5):
5     if c<2:
6         tom.fillcolor("yellow")
7     else:
8         tom.fillcolor("green")
9
10    tom.begin_fill()
11    tom.circle(50)
12    tom.end_fill()
13
14    tom.left(90)
15

```

Why 3 green circles? Line 7 is the reason. See the flow of the script.

Value of c	c<2	Else	Statement executed	Output
1	True	Skipped	<pre> 5 if c<2: 6 tom.fillcolor("yellow") 10 tom.begin_fill() 11 tom.circle(50) 12 tom.end_fill() 13 14 tom.left(90) </pre>	Yellow circle
2	False	Executes	<pre> 7 else: 8 tom.fillcolor("green") 10 tom.begin_fill() 11 tom.circle(50) 12 tom.end_fill() 13 14 tom.left(90) </pre>	Green circle
3	False	Executes	<pre> 7 else: 8 tom.fillcolor("green") 10 tom.begin_fill() 11 tom.circle(50) 12 tom.end_fill() 13 14 tom.left(90) </pre>	Green circle
4	False	Executes	<pre> 7 else: 8 tom.fillcolor("green") 10 tom.begin_fill() 11 tom.circle(50) 12 tom.end_fill() 13 14 tom.left(90) </pre>	Green circle

What figure should this script draw?

```

1 import turtle
2 tom = turtle.Pen()
3 tom.width(5)
4 for c in range(1,7):
5     if c<4:
6         tom.pencolor("pink")
7         tom.forward(100)
8         tom.left(120)
9     else:
10    tom.pencolor("red")
11    tom.forward(100)
12    tom.right(120)

```

Fun with Python Lists

Python allows to store various values as a list of items. We identify the list in our scripts by a unique name. Python lists look like this:

```
["yellow", "green", "pink", "red", "blue", "white", "black", "orange"]
```

```
[1, 2, 3, 4, 5, 6, 7, 8]
```

```
["delhi", "monkey", "spiderman", 22, 15.5, "welcome", 59]
```

Notice that list is heterogenous since it can store different types of values.

Let us see its use through some examples:

Example 1

Script

```
list.py - F:/Edusoft/AI-417_2020/A1-417-VI/Book-v2/py/list.py (3.8.1)
File Edit Format Run Options Window Help
1 mylist = ["red", 25, "delhi", 45.56, "saturday"]
2
3 print("Full list is: ")
4 print(mylist)
5
6 print("\nFirst item in list ")
7 print(mylist[0])
8
9 print("\nLast item in list ")
10 print(mylist[4])
11
12 i = int(input("\nWhich item:"))
13 print(mylist[i])
14
15 print("\nALL ITEMS:")
16 for c in range(0,5):
17     print(mylist[c])
```

Output

```
Full list is:
['red', 25, 'delhi', 45.56, 'saturday']

First item in list
red

Last item in list
saturday

Which item:4
saturday

ALL ITEMS:
red
25
delhi
45.56
saturday
```

\n is a special character that inserts a new blank line.

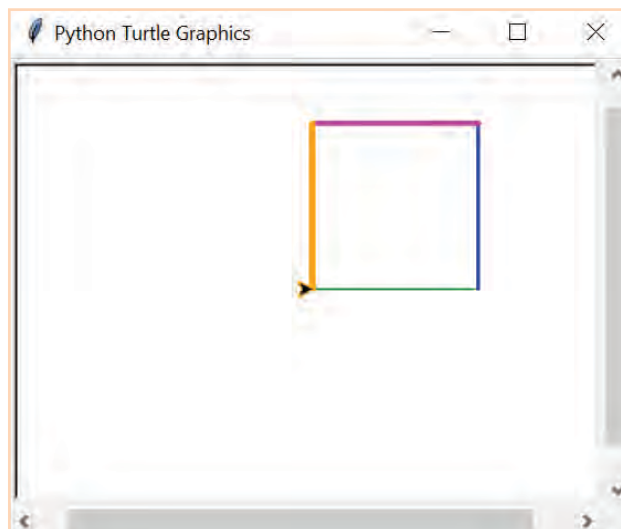
Command	Explanation
1	A list mylist declared with 5 items (3 strings, 1 integer, 1 float).
4	Function print() takes list name mylist to display it completely.
7	Lists use zero based index, hence mylist[0] refers to value red .
10	mylist[4] refers to value saturday .
12	Value of variable i is given by user which is used as index.
17	mylist[c] has current value of c substituted. One by one, all value at index 0 to 4 are displayed.

Example 2

Script

```
list1.py - F:\Edusoft\AI-417_2020\A1-417-VI\Book-v2\py\list1.py (3.8.1)
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3
4 colors = ["red", "green", "blue", "magenta", "orange"]
5
6 for c in range(1,5):
7     tom.pencolor(colors[c])
8     tom.width(c)
9     tom.forward(100)
10    tom.left(90)
```

Output

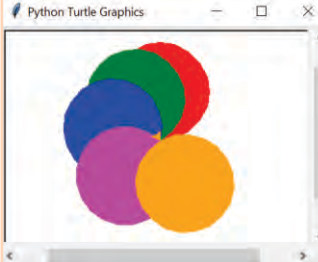


Line #	Explanation
4	A list colors declared with 5 colour names.
7	Function pencolor() takes list name colors along with c as index in [and]. Current value will fetch colour name at current index in the list.
8	Function width() takes current value of variable c to set the pen width. Notice the output - every next line is thicker than the previous one due to increasing value of c (1, 2, 3, 4).

Read the previous script and explain why red line was not drawn in the output.

Example 3

```
list2.py - F:\Edusoft\AI-417_2020\A1-417-VI\Book-v2\py\list2.py (3.8.1)
File Edit Format Run Options Window Help
1 import turtle
2 tom = turtle.Pen()
3
4 colors = ["red", "green", "blue", "magenta", "orange"]
5 angles = [30, 45, 60, 75, 90]
6
7
8 for c in range(0,5):
9     tom.begin_fill()
10    tom.pencolor(colors[c])
11    tom.circle(50)
12    tom.fillcolor(colors[c])
13    tom.left(angles[c])
14    tom.end_fill()
```



Line #	Explanation
4	A list colors declared with 5 colour names.
5	A list angles declared with 5 integers.
9, 11	Functions pencolor() and fillcolor() take list name colors along with c as index. Current value will fetch colour name at current index in the list. Notice the output - every circle has outline and fill in the current color.
12	Function left() takes current value of variable c to set the angle of turning left. Notice the output - every circle is at different angle (30, 45, 60, 75, 90).

Example 4

Script

```
list3.py - F:\Edusoft\AI-417_2020\A1-417-VI\Book-v2\py\list3.py (3.8.1)
File Edit Format Run Options Window Help
1 students = ["ravi", "ajay", "amit", "kunal", "sameer"]
2 math = [89, 92, 66, 75, 55]
3 IT = [98, 86, 74, 78, 91]
4
5 print("RESULT:")
6 print("STUDENT\tMATH\tIT")
7 print("-----")
8 for i in range(0,5):
9     print(students[i], "\t", math[i], "\t", IT[i])
```

Output

RESULT:		
STUDENT	MATH	IT

ravi	89	98
ajay	92	86
amit	66	74
kunal	75	78
sameer	55	91

Note that `\t` is a special character to display a tab (usually 6 spaces).

List `students` stores the names of 5 students and their marks in `math` and `IT` are in lists `math` and `IT` respectively.

Loop runs five times (0 to 4) to display values of lists in a formatted output. Values in the lists are accessed by using the values of variable `i` as index.

Read the following script and fill the values of variables `i`, `x` and `y` in the table. Then write the final output.

```
list4.py - F:/Edusoft/AI-417_2020/A1-417-VI/Book-v2/py/list4.py (3.8.1)
File Edit Format Run Options Window Help
1 math = [89, 92, 66, 75, 55]
2 IT = [98, 86, 74, 78, 91]
3 x=y=0
4
5 for i in range(0,5):
6     x = x + math[i]
7     y = y + IT[i]
8
9 print(x)
10 print(y)
11 print(x/5)
12 print(y/5)
```

Iteration	i	x	y
1			
2			
3			
4			

Output

Example 5

Script

```
list5.py - F:/Edusoft/AI-417_2020/A1-417-VI/Book-v2/py/list5.py (3.8.1)
File Edit Format Run Options Window Help
1 nums = [1, 17, 4, 28, 19, 72, 103, 68, 47]
2 x=0
3
4 for i in range(0,9):
5     x = nums[i]%2
6     if x==0:
7         print("Yes")
8     else:
9         print("No")
```

Output

No
No
Yes
Yes
No
Yes
No
Yes
No

Explanation

List `nums` has 9 odd and even numbers. Inside the loop, each number in the list is accessed by its index determined by the value of variable `i` and **modulus** by 2 (line 5). If the number is even, the value in variable `x` will be 0 and **if** will display **Yes** (line 7) otherwise **No** (line 9).

Breaking the loop

Sometimes you need to come out of a loop while loop is still continued. In Python, **break** keyword terminates the loop and brings you out of the loop. See this script.

```
tom17.py - F:/Edusoft/AI-417_2020/A1-417-VI/Book-v2/py/tom17.py (3.8.1)
File Edit Format Run Options Window Help
1 for c in range(1,10):
2     x = int(input("Enter a number between 1 and 10 or 0 to end. "))
3     if x==c:
4         break
5     if x==0:
6         break
7     print("Looping...")
8 print("End")
```

Here, line 2 is accepting a number from the user in variable `x`. Line 3 checks, if entered number equals (`==`) counter `c` then loop is terminated (line 4: `break`). Same will happen if user enters `0` in variable `x` (lines 5 and 6). The two outputs of the script are given here.

```
Enter a number between 1 and 10 or 0 to end.4
Looping...
Enter a number between 1 and 10 or 0 to end.3
Looping...
Enter a number between 1 and 10 or 0 to end.2
Looping...
Enter a number between 1 and 10 or 0 to end.4
End
>>>
===== RESTART: F:/Edusoft/AI-417_
Enter a number between 1 and 10 or 0 to end.0
End
```

Generating Random Numbers

Every programming language allows to generate numbers randomly. Python allows to provide a range of numbers to the computer and computer generates numbers randomly between that range. To use random number generator, you need to import `random` package. See the script given here.

```
tom16.py - F:/Edusoft/AI-417_2020/A1-417-VI/Book-v2/py/tom16.py (3.8.1)
File Edit Format Run Options Window Help
1 import random
2 x = 0
3 n=0
4 for c in range(1,4):
5     x = int(input("Guess a number between 1 and 5. "))
6     n = random.randint(1,5)
7     if x==n:
8         print("LUCKY YOU!")
9         break
```

```
Guess a number between 1 and 5.2
Guess a number between 1 and 5.3
LUCKY YOU!
```

Here, in line 6, function `randint()` of package `random` is generating a random number between `1` and `5` which are the arguments passed to it. Generated random number is returned in variable `n`. In line 7, if user's input equals the random number then loop breaks (line 9) after a message (line 8).

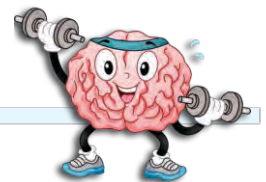
Learning Points

- The values in scripts can be identified by unique names called **variables**.
- **if** checks a condition and if that condition is true, it allows required statements to be executed.
- A condition compares two values.
- Comparison operators are $<$, $>$, $<=$, $>=$, $==$, $!=$
- It executes when condition with **if** returns false.
- Python allows to store various values as a list of items.
- **\n** is a special character that inserts a new blank line.
- Note that **\t** is a special character to display a tab (usually 6 spaces).
- **break** keyword terminates the loop and brings you out of the loop.
- Lists use zero-based index to access items in it.
- To use random number generator, you need to import **random** package.



- **Condition:** An expression composed of values and comparison operators.
- **List:** A set of values which can be browsed by the help of loop or index.
- **List Index:** Position of an item in the list. It is zero-based i.e. first item is at index zero and last is at (count of list items - 1).
- **Random:** That which is not fixed. It is a library (random) in Python also used to generate random numbers.

Exercise



A. Select the correct answer.

- Which Python IDLE mode lets you run the program in the form of .py file?

a. Interactive mode	<input type="checkbox"/>	b. Script mode	<input type="checkbox"/>
c. Both a) and b)	<input type="checkbox"/>	d. Program mode	<input type="checkbox"/>
- Values in a program are identified by unique names called _____.

a. IDs	<input type="checkbox"/>	b. Labels	<input type="checkbox"/>
c. Variables	<input type="checkbox"/>	d. Command	<input type="checkbox"/>

3. Numbers with decimal places are called which of the following?
- a. floats b. strings
c. integers d. None of these
4. Which of the functions does not return any value?
- a. print() b. input()
c. range() d. randint()
5. Find the odd one out.
- a. print b. input
c. break d. range
6. Which of the following does not need a condition to evaluate?
- a. for b. else
c. if d. import
7. A Python list stores different types of values hence it is called _____.
- a. Heterogenous b. Homogenous
c. Variable d. None of these
8. Which of the following special character inserts a new line in the output?
- a. \t b. \c
c. \m d. \n
9. Which of the following special character inserts a tab in the output?
- a. \t b. \c
c. \m d. \n
10. A different number generated between a range of two numbers is called _____ number.
- a. Random number b. Counter
c. Both a) and b) d. Loop
11. mylist[8] refers to which of the following elements in the list of 10 items?
- a. 10th b. 9th
c. 8th d. 7th

B. Write the output of the following scripts.

1.

```

1 a = 10
2 b = 7
3 print(a, '\t', b)
4 a = a + b
5 b = a - b
6 a = a - b
7 print(b, '\t', a)

```

2.

```

1 str = "ARCHIPELAGO"
2 print(str[0])
3 print(str[5])
4 print(str[9])
5 print(str[10])

```

3. If input is 0 and 150.

```
1 #Simple decision making
2 MAX_OVERS=20
3 OVER_SIZE=6
4
5 ballsPlayed, runsMade=0,0
6
7 ballsPlayed = int(input("HOW MANY BALLS DID THIS PLAYER PLAY? "))
8
9 if ballsPlayed < 0:
10     print("Minimum balls played can be 0. Setting balls played to 0.")
11     ballsPlayed = 0
12
13 if ballsPlayed > (MAX_OVERS * OVER_SIZE):
14     print("Too many balls played. Setting balls played to 0.")
15     ballsPlayed = 0
16
17 print("BALLS PLAYED = ",ballsPlayed, "RUNS MADE = ",runsMade)
```

4. If input is 10, 32 and 60

```
1 i = input("Enter a number: ")
2 i = int(i)
3 f = i%12
4 if f!=0:
5     f = i//12
6     i = i %12
7 else:
8     f=i
9     i=0
10 print(f, '.', i)
```

5.

```
1 import turtle
2 t = turtle.Pen()
3
4 for i in range(1,4):
5     t.forward(50)
6     t.left(90)
7     t.backward(50)
```

6.

```
1 import turtle
2 t = turtle.Pen()
3
4 for i in range(1,9):
5     t.forward(50)
6     t.left(90)
7     t.backward(50)
8     t.right(45)
```

```

7. 1 import turtle
    2 t = turtle.Pen()
    3
    4 for i in range(1,4):
    5     t.forward(100)
    6     t.left(60)
    7     t.left(60)
    8
    9 t.right(90)
   10 for i in range(1,4):
   11     t.forward(100)
   12     t.left(90)

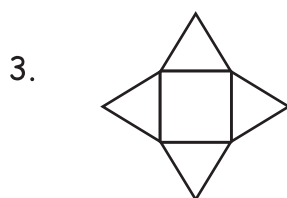
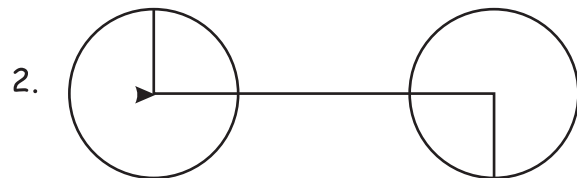
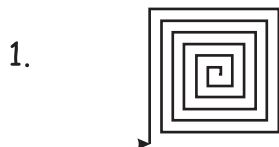
```

```

8. 1 import turtle
    2
    3 spiral = turtle.Turtle()
    4 x = 10
    5 a = 100
    6 spiral.width(5)
    7 for i in range(1,5):
    8     spiral.forward(a)
    9     spiral.left(90)
   10
   11 spiral.left(90)
   12
   13 for i in range(1,10):
   14     spiral.forward(a)
   15     spiral.left(120)
   16     if i==3:
   17         spiral.left(210)
   18     if i==5:
   19         spiral.left(210)
   20     if i==7:
   21         spiral.left(210)

```

C. Write the turtle scripts to generate following outputs.



Assessment ...

NOTE: It is advised to assess the students in this chapter for practical only. Skills of chapter 5 should also be included in assessment.



www.eduitspl.com

www.youtube.com/edusoftknowledgeverse



TURTLE BET RACING GAME

NOTICE: To develop this project, you need to apply your Python knowledge. In addition to this, you will learn certain things which you need to explore and find on Internet how to add certain enhancements such as pausing the game for a few seconds, setting text font and size etc.

Project Objectives

1. The purpose of the project is to engage the learner into gathering around their learning of Python and think in a stepwise manner to layout the game and execute it.
2. Explore for more information online to add certain features to the game by their own efforts.



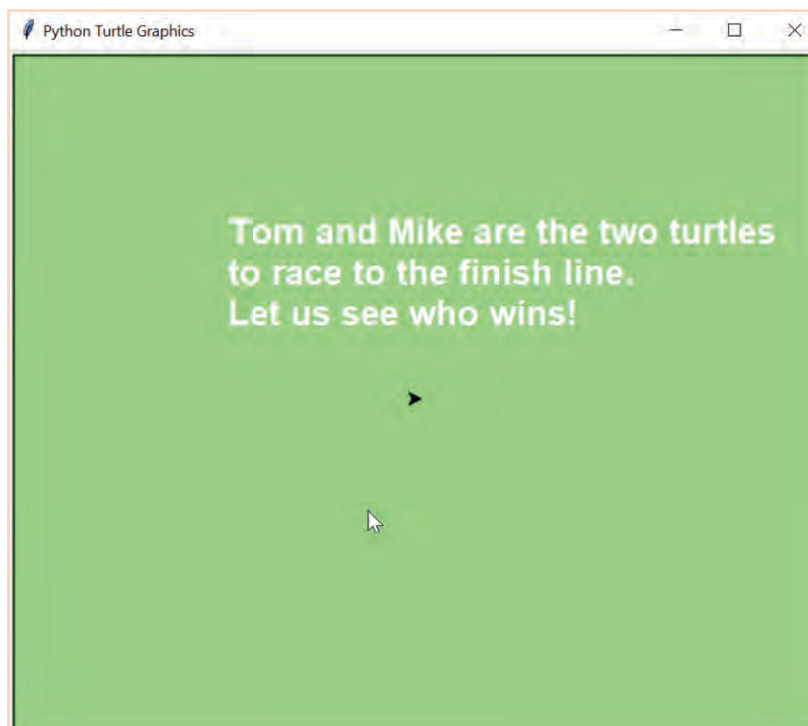
The Simple Game



Tom and Mike are two turtles who will run random steps in the direction of yellow finish line.

Opening Screen

The game should begin by displaying the message as shown here.



Game Layout

Next, following is done as shown here:

1. The yellow finish line is drawn.
2. Turtles - Tom and Mike are placed on the starting points (notice their colour and size).
3. A countdown to zero begins at a pause of 1 second.



Game Begins

The turtles leave a trail behind and with every move they display the number of steps covered. Whichever turtle touches the finish line, the final result is displayed accordingly.



Go ahead and create this game. You can even add your ideas once it is made. All the best and enjoy!



Class VI

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Artificial Intelligence is the fuel of the future. Its subsets – Machine Learning, Deep Learning and regression have the power to revolutionise the way industries function. It is also going to influence economic growth and social development.

My Dream Book of Artificial Intelligence series is developed for classes VI and VII to introduce the children with the basics of artificial intelligence in an exciting way through lots of fun and engaging activities. The purpose of this course is to engage young minds to prepare easily to learn emerging technology as they grow and move to higher classes. The series is designed considering the recommendations done by CBSE to integrate AI at different levels. This short course can be taken up by the students to prepare for a different line of career in future.

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- **Objective:** Preparing young minds to explore about AI, its applications and related technologies in easiest possible way.
- **Skill development:** Developing skills like problem understanding, creative thinking, critical analysis and problem solving.
- **Challenge-based activities:** Engage students in solving puzzles and accomplish tasks to explore understanding about human intelligence and machine intelligence.
- **Mini Projects:** Small, workable projects to assimilate learnt concepts easily.
- **Fun Facts:** Keep the interest of the learners in the lesson and rouses curiosity to learn more.
- **Game Development with Python Turtle:** Inculcates programming and logical techniques through simple game.

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- A smart phone with authentic Google Play Store account.
- An Internet connection - preferably 3G or higher.

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"Is artificial intelligence less than our intelligence?"

— Spike Jonze aka Adam Spiegel (American filmmaker)



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