Artificial Intelligence Notes Class 9

Academic Year 2022-23

Unit No.	Unit Name	Marks
1	Introduction to Artificial Intelligence (AI)	**10**
2	AI Project Cycle	**15**
3	Neural Network	**5**
4	Introduction to Python	**10**
Total		**40**

Unit 1 Introduction to Artificial Intelligence

Topic	Learning Outcomes
Excite	• To identify and appreciate Artificial Intelligence and describe its applications in daily life. • To relate, apply and reflect on the Human-Machine Interactions. • To identify and interact with the three domains of AI: Data, Computer Vision and Natural Language Processing. • To undergo an assessment for analysing progress towards acquired AI-Readiness skills. • To imagine, examine and reflect on the skills required for futuristic job opportunities.
Relate	• Application of Artificial Intelligence in their daily lives. • To unleash their imagination towards smart homes and build an interactive story around it. • To relate, apply and reflect on the Human-Machine Interactions
Purpose	• To understand the impact of Artificial Intelligence on Sustainable Development Goals to develop responsible citizenship.

Prepared by: Sanjay Parmar, PGT – Computer Science

Possibilities	• To research and develop awareness of skills required for jobs of the future. • To imagine, examine and reflect on the skills required for the futuristic opportunities. • To develop effective communication and collaborative work skills.
AI Ethics	• To understand and reflect on the ethical issues around AI. • To gain awareness around AI bias and AI access. • To let the students analyse the advantages and disadvantages of Artificial Intelligence

Excite

Excite Artificial Intelligence class 9 begins with the understanding of the meaning of these words: Artificial and Intelligence

Artificial Intelligence is made up of two words. As you know, **Artificial** refers to something which is made or produced by human beings rather than occurring naturally, especially as a copy of something natural.

Intelligence refers to the ability to acquire and apply knowledge and skills.

Now a days we have smartphones, smart televisions, smart calendars, smart cards etc. These appliances basically works on technology which is a part of Artificial Intelligence.

Meanwhile, in the new technological world, you hear words something like big data, machine learning, neural networks, etc. These all words are directly or indirectly connected to Artificial Intelligence.

Who coined the word Artificial Intelligence?

It is very important to point to remember for Artificial Intelligence class 9 students that the word Artificial Intelligence coined by **John McCarthy,** who is one of the "founding fathers" along with Alan Turing, Marvin Minsky, Allen Newell, and Herbert A. Simon.

John McCarthy is one of the "founding fathers" of **artificial intelligence**, together with Alan Turing, Marvin Minsky, Allen Newell, and Herbert A. Simon.

McCarthy **coined** the term "**artificial intelligence**" in 1955 and organized the famous Dartmouth Conference in Summer 1956. This conference started **AI** as a field. - Source: en.wikipedia.org

Click on image to watch video for more understanding:

Play Video

Definition of AI

AI can be defined as the ability of computer systems i.e. hardware and software, to do tasks that normally required human beings to use intelligence.

According to various organizations

Artificial Intelligence is defined by different organizations in a different manners.

Niti Ayog: National Strategy for Artificial Intelligence

AI refers to the ability of machines to perform cognitive tasks like thinking, perceiving, learning, problem-solving, and decision making. Initially conceived as a technology that could mimic human intelligence, AI has

evolved in ways that far exceed its original conception. With incredible advances made in data collection, processing, and computation power, intelligent systems can now be deployed to take over a variety of tasks, enable connectivity, and enhance productivity.

World Economic Forum

Artificial Intelligence defined by the world economic forum and it is mentioned in the curriculum handbook of Artificial Intelligence class 9 published by CBSE can be considered in excite artificial intelligence.

Artificial intelligence (AI) is the software engine that drives the Fourth Industrial Revolution. Its impact can already be seen in homes, businesses, and political processes.

In its embodied form of robots, it will soon be driving cars, stocking warehouses, and caring for the young and elderly. It holds the promise of solving some of the most pressing issues facing society but also presents challenges such as inscrutable "black box" algorithms, unethical use of data, and potential job displacement.

As rapid advances in machine learning (ML) increase the scope and scale of AI's deployment across all aspects of daily life, and as the technology itself can learn and change on its own, multi-stakeholder collaboration is required to optimize accountability, transparency, privacy, and impartiality to create trust.

One more definition is given in the curriculum handbook published by CBSE for for excite Artificial Intelligence is as follows:

European Artificial Intelligence (AI) leadership, the path for an integrated vision

AI is not a well-defined technology and no universally agreed definition exists. It is rather a cover term for techniques associated with data analysis and pattern recognition. AI is not a new technology, having existed since the 1950s.

While some markets, sectors and individual businesses are more advanced than others, AI is still at a relatively early stage of development, so that the range of potential applications, and the quality of most existing applications, have ample margins left for further development and improvement.

Watch this video for more understanding:

Play video

Applications of AI in our daily life

There are numerous things in our daily life today, those are influenced by AI. Few of them are:

Applications of AI is one of the important factors that should be considered by excite Artificial Intelligence class 9 students for learning more in this field. **Smartphones**: The smartphone has many applications that running and provided services with the help of AI. Ex. Google Assistant, Alexa, Apple Siri, etc.

Social Media

- Social media websites like Twitter, Facebook, Instagram, or Snapchat sending notification and managing timelines by AI.
- AI takes all your past behavior, web searches, interactions, and everything else that you do when you are on these websites and tailors the experience just for you.

Music and Media streaming

- Apps like Spotify, NetFlix, or Youtube AI is making a decision for the users.
- AI records playlist history and generating some recommendations for watching or playing songs.

Video Games

- Video games companies are most earlier adopters of AI. AI generate random levels in video games.
- In many games, AI defeated world champions. PUBG, Dota 2, Fortnite all are AI integrated games.

Smart Home

- Many smart home devices use AI to learn the behavior of the members of the family and can adjust settings accordingly.
- Smart voice assistants playing a vital role in smart homes.
- Smart thermostats used to adjust the temperature based on the user's preferences.
- Smart lights change the color and intensity of lights based on time and much more.

An ice breaker activity is given in the activity section for the chapter Excite Artificial Intelligence to draw a layout for your dream smart home.

Security and Surveillance

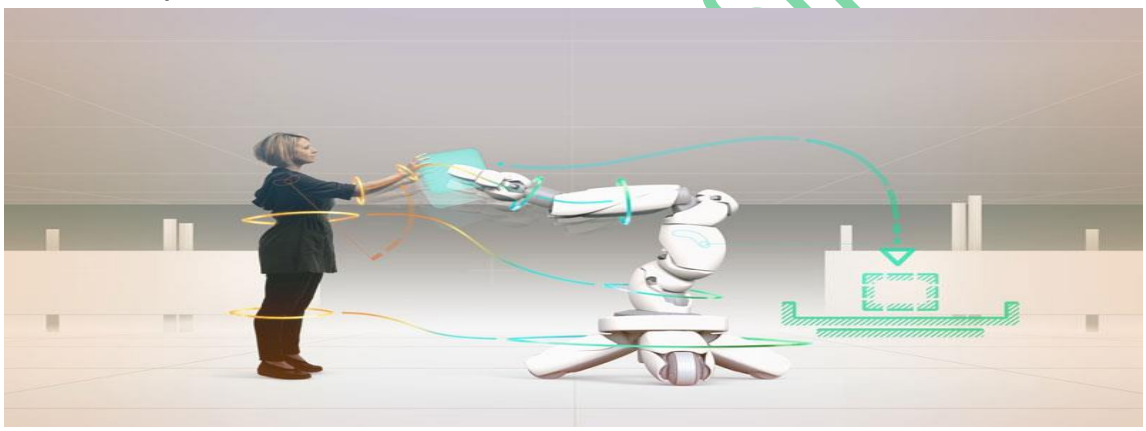
- Thousands of cameras keep monitoring at the same time by AI only.
- Object recognition and face recognition getting better and better day by day.

Smart Keyboard and Apps

- Smart Keyboards provide comfort for users while typing on the screen.
- It generates suggestions based on the writing style of users.
- It also displays a few words and emojis.

Healthcare

- With an introduction to AI-powered machines detection of disease and treatment becomes a bit easier and convenient.
- AI-powered machines make the process of treatment and management simplified research to cure some disease done by AI-based systems.



More applications of AI

E-Commerce

- Online shopping on Amazon and eBay like websites using chatbots to collect data of customers and building a good rapport with buyers.

Smart Email

- Modern email apps like spark provides the facility to get rid of spam email and unwanted emails.
- It also categorizes email, so users can quickly read the important ones.

- The smart reply concept also giving a few suggestions with a reply text like in Gmail.

Smart Cars

- Tesla is a prime example of AI is impacting in our daily life.

Smart Drones

- Companies like Amazon and Walmart are heavily investing in drone delivery programs and it will become a reality far sooner than what you expect.

Banking and Finance

- The banking and finance industry relies on AI for providing customer services, protection against fraud, investment suggestions, and so on.
- While using the chat service of banks the chat is represented by Bots only. In the finance industry, AI is used to analyze data.

Online Ads Network

- AI just not tracking records of users but also serve the ads based on statistics.
- With the help of AI Ads network displaying random Ads online.

Navigation and Travel

- While traveling or enjoying rides like ola, uber, or any other services, google map navigation help to find a perfect route for the journey.
- Moreover, AI can give you real-time traffic data.

Short history of AI

The continuous development in IT sector leads many revolutions in recent decades. Many tools are available in personalized manner in our hands such as smart phone, smart cards, smart vehicles, smart homes etc.

Machines are developed rapidly to understand and work with human intelligence. As of now you may have seen that YouTube is showing videos according to your recent searches, Amazon is displaying brands of your choices, google assistant, Alexa and many more devices are result of these revolutions.

Between 1940s and 1950s many scientists were encouraged to think of intelligent machines. They thought about those machines capable to perform the task which needs human intelligence.

In **1956 at Dartmouth conference** (was considered as 'brainstorming session'), **Sir John McCarthy** an American Computer Scientist coined the work Artificial Intelligence for the first time.

In other words, Artificial Intelligence is concern with development of machines those are capable to perform the tasks which needs human intelligence.

So this means that the involvement of artificial devices to capture the idea of human intelligence. Some of the tasks which human performs are very easy, easy, or hard.

Let's have look on the following example u understand Excite Artificial Intelligence Class 9.

For Ex. Identifying electronic appliances and appliances running by other sources is easy for us but Solving a complex algorithm is not easy for all. Similarly, many tasks are there which are not easy for us but easy for

computers. Sometimes what seems easy for us is actually difficult and the same way that seems difficult is actually quite easy.

Watch this video for more understanding:

Play Video

Definitions of AI

Wikipedia

A definition characterizes AI as "a system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation".

Artificial intelligence is the ability of the machines or computer programs to carry out tasks that require human beings to use their intelligence.

Simply these definitions focuses on these words broadly: Learning, Understanding and intelligence.

Learning refers to learning from past set of activities and computer system will prepare results based on past data and improve them time to time by understanding the system's behaviour and intelligence.

Another thing is there some numbers we can compare very easily from two human beings but we cannot compare intelligence of two persons.

AI in our daily life

Click on below given link to read about AI in our daily life.

AI in our Daily Life

In Excite Artificial Intelligence Class 9, one ice breaker activity is discussed. So the next section we will do the same.

Ice breaker activity (Dream Smart Home idea)

Everyone is living in a dream house. A dream smart home idea is linked with a dream house. A home equipped with sensors, smart gadgets, neural networks, engineering, and Artificial Intelligence appliances and components.

This idea of a dream smart home leads to develop a home with comfort, reduce energy consumption, and enable technology-based household routine automation activity.

These homes provide better-quality entertainment, provide health assistants, smart gadgets can adjust room temperature according to the behavior of personals living in the home. They can also provide a smart way to switch on or off electronic appliances, open or close doors, and windows, smart curtains allow proper sunlight and ventilation.

Recommended activity

There are three activities recommended which are based on different games. So these activities for Excite Artificial Intelligence Class 9 are as following:

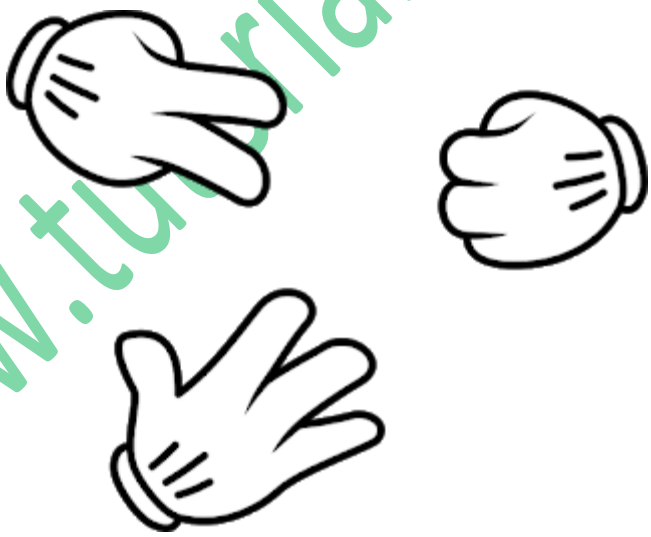
AI used in games

The video games are made up of graphics and animated characters. The graphics are used to display background and develop different levels or stages of game. The animated characters movement plays a role in generating score or points. Some special effects or graphics are developed to score more points. AI is used to generate reactions and intelligent behavior of the characters. Each game has its own set of rules for winning and its own equipment.

Game 1 Rock - Paper - Scissors

It is a game of hand movements. Rules are:

1. Requires two or more players.
2. Each player simultaneously forms one of the three shapes with an outstretched hand. These shapes have meanings as following:
    1. Flat hand → Paper
    2. Closed fist → Rock
    3. A fist with index finger and middle finger like V → Scissor
3. This game has only two results: i. Draw or ii. Win
4. A player who decides too play a rock wins over the one who shows scissors (rock crushes scissors) but lose to one who plays a paper (Paper covers a rock). Scissors win over a paper (as Scissors cut paper). If both player shows same shape, the game is draw.
5. The players usually count 1,2,3 or speak Rock, Paper, Scissor and swing it in front of another.



AI Game 1 Rock - Paper - Scissors

Play the Game: Click here and click on the Play the Game button. (Internet connection required)

Game 2 Mystery Animal

This game is based on Natural Language Processing (NLP). Rules of the game are:

1. A microphone must required to connected to the computer.
2. Ask question to computer that answer must "YES" or "NO".
3. The participant gets a chance to ask 20 questions to decide upon the name of animal.

Play the Game: Click here (Internet connection required and microphone required)

Game 3 Emoji Scavenger Hunt

1. A camera is required any a webcam or smartphone camera.
2. The player must have access to a few of objects used in everyday lives.

Play the Game: Click here (Internet connection required, Use either mobile or laptop with webcam)

Important Questions: Introduction to Artificial Intelligence

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AI Domains

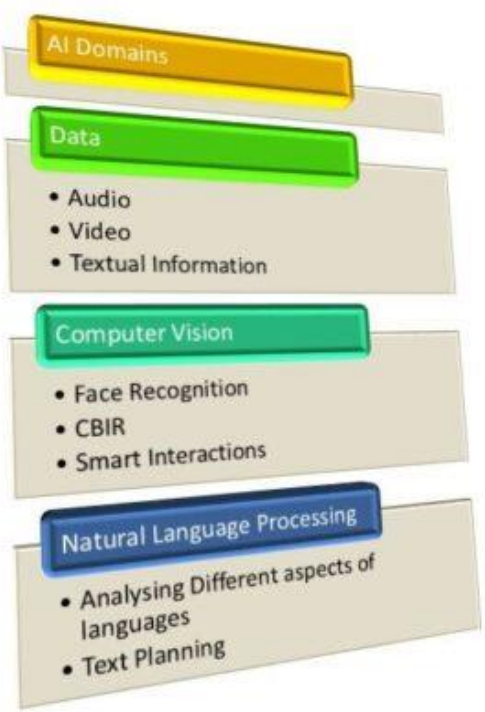
In this topic AI domain for class 9, first, we will discuss human and machine interactions.

Human-Machines interactions

Human-machine interactions refer to the contact between humans and machines to fulfil a specific task or operation. As we know about computers while working with computers human-machine interaction takes place. In human-machine interactions, hardware and software play a vital role in communication. The machine itself considered as hardware and the interface should be user friendly. It will be built upon tangible and attentive user interface principles. Data can be accessed through software and stored on storage devices.

In AI human-machine interactions done through the following domains:

1. Data
2. Computer Vision (CV)
3. Natural Language Processing (NLP)



AI domains for Class 9

Prepared by: Sanjay Parmar, PGT – Computer Science

So in the next section of AI Domains for Class 9, we will discuss the first domain of AI i.e. Data.

Data

If a person thinks of automate any system or want a report or analysis of customers' feedback, data is required.

For example: Taking student's daily attendance we need data of students like class, roll number, student name, etc.

Data can be the backbone of AI. Almost 98% of AI systems are dependent on data. As system development grows processing of data also increases.

This data can be in any form textual information, audio, video, big data like predictions, insights, forecasts, decision making, etc.

If students have opted for AI in class VIII they might play these games.

Play the game:

Rock Paper Scissor

In the next section of AI domains for class 9, you will be familiar with Computer Vision.

Computer Vision (CV)

It is a field of science that deals with how computers gain a high level of understanding from digital images or videos. It is a flown that studies how the human visual system works.

The computer vision includes the following methods to produce information:

1. Acquiring Images
2. Processing Images
3. Analysing Images
4. Understanding Images

It is used in various areas, some of them are as follows: Computer Vision is mainly used for Face recognition systems to recognize the faces in images and videos. The application areas like google photos, spam chat, Facebook, Instagram etc.

Content-Based Image Retrieval systems identify images based on image properties like composition, colour, texture etc. The application areas are search engines like google & bing, used in different CT scans and MRIs in hospitals, etc.

Computer Vision also helpful in smart interactions to supply input to computers. It is mainly used in games, systems designed for differently-abled individuals, etc.

Computer vision also helps in Environment Perception such as analyzing videos, images, or video feeds for identifying patterns and perceiving the environment. Application areas are Home security systems, Office security systems, Drone-based surveillance systems etc.

Play the game

Emoji Scavenger Hunt

Natural Language Processing (NLP)

The programming languages work on their own principles, syntax, and keywords. The aim of NLP is developing such systems that work on human natural language on oral as well-spoken language.

It has two main components:

1. **Natural Language Understanding (NLU):** It is used for spoken or written language to provide a link between natural language inputs and what they present. It analyses different aspects of language.

2. **Natural Language Generation (NLG):** It helps to produce meaningful phrases and sentences along with Text planning, Sentence Planning, and Text realization.

Play the game

Mystery Animals

Questions : Domains of AI

Practical Activities

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Relate

As you learnt about smart home in previous chapter. You will learn about application of AI in daily life. In this chapter relate - applications of AI, we will cover the introduction to smart cities. I recommend to watch few YouTube videos to understand a little bit about smart cities:

Watch these three videos to understand Relate Applications of AI in Daily Life:

1. https://youtu.be/d1DndVz9dAs
2. https://youtu.be/RKWuj1OlDPo
3. https://youtu.be/VRRPy-yEKRM

Relate Applications of AI in Daily Life , we will start with the smart cities.

Introduction Smart Cities

There is no standard definition is found for a smart city yet. Because it depends on a few factors. These factors are:

1. **Country:** If we talk about countries then there is a huge difference between the two countries in the adaptation and implementation of technology.
2. **City:** Cities of one country have a great difference in term technological development.
3. **Level of development:** The level of development of cities based on their administration, city residents and government.
4. **Willingness to change and reform:** This is also one important factor because technological evolution bring changes in many things. Because technology requires its latest equipment and component to which it is compatible. Some AI systems may not work on a few devices. So first we need to update that one. So change and reform is necessary.

5. **Resources and aspirations of city residents:** A city is made up of resources and aspirations of city residents. A city can be defined by the people living in the city.

Smart city refers to the city that use AI along with other digital and ICT based components to make life of inhabitants better and more comfortable.

In smart cities smart homes can connect with each other to provide number benefits. Following are few benefits provided by smart cities:

1. Providing door step services
2. Communicate with each other
3. It has few censors
4. It can provide data and use data to analyse different aspects of citizens

Now in the next section of Relate Applications of AI in Daily Life , we will discuss smart buildings.

Smart building data connect to smart cities

Smart building data work on many areas, few of them are as following:

1. **Electricity:** In terms of electricity uses, smart building records the need and use of electricity in homes. They can reduce and save electricity as per the behaviour of family members. It can regulate power generations supply by helping power companies.
2. **Maintenance:** The smart building data helps to provide better maintenance services and replacement.
3. **Health:** It can also help to provide data of sick people from the building. Doctors can also provide monitoring to patients at their doorsteps.

After smart buildings let us discuss about smart citizens for Relate Applications of AI in Daily Life.

Smart citizens

Smart cities required smart citizens or may converted them into smart. Smart cities help government to attain the sustainable development goals. It can reduce the wastage, save water, work on data of poverty line etc.

Smart citizens lives life smartly called smart living. Smart living is the next topic of Relate Applications of AI in Daily Life.

Smart Living

Smart living refers to using AI enabled technologies into daily life. It involves gadgets which are using such sensors and alerts to deal with environmental conditions. Closing and opening the doors, windows etc., Maintaining room temperature etc.

In such critical situation like fire or gas leak or any other emergencies it can help by generating alerts.

Smart buildings can also generate danger alerts and warning systems in disasters. It also helps to the government in disaster management.

It provides information alerts to the people at different level.

Now try to understand the concept Relate Applications of AI in Daily Life by playing the below given games.

Playing the game

Game 1: Semantris (Based on data)

1. This games is based on machine learning and data.
2. It recognize the associated words.
3. It provides millions of word associations.
4. It highlights the limitations that data can create.
5. It only guess the word association for which its trained.

Requirements

1. A laptop or desktop computer
2. An internet

The game can be played in two forms:

1. **Arcade:** In this mode game user need to think and type the word fast. User need to type the clue that comes in mind while thinking about the word in blue. The typed word will come in sorted form at bottom. Player will get points for clearing the word and for words that fall below the line. Game ends when word reaches the top of the screen.
2. **Blocks:** In block mode player have time to think and entering the clues. A player can a clue of any word displayed on screen. The AI system compares the clue with words on the screen and tires to guess the word that the player wants to remove. AI will remove that word and all blocks with same color.

Play the game now

The next game is based on NLP for Relate Applications of AI in Daily Life.

Game 2: LUIS (Based on NLP)

1. It is a game based on NLP in smart homes.
2. The AI LUIS is trained to control lighting in the house.

Requirements

1. Any computing device
2. An internet
3. Microphone (Optional)

This game is based on Microsoft Cognitive Service Language Understanding. LUIS tries to interprets the command and act accordingly. It is also limited and extended as its trained.

You have three options:

1. You can speak the command using microphone
2. You can type the command
3. You can select from the preset commands

Make list of commands which it understands and which is not understand.

Play the game

Game 3: Microsoft Computer Vision

It is somewhat related to how google use the technology for conducting image searches.

Requirements

1. Any computing device
2. An internet

Play the game

Game 4: Semiconductor

Requirements

1. Any mobile with camera and speakers
2. An internet

Play the game

Purpose

The impact of AI on SDG class 9

There are 17 SDG Goals adopted in the General Assembly in 2015 by the United Nations. It was built upon **"leaving no one behind"** principle.

For more details on Sustainable Development Goal watch this video:

After watching this video you may clear about what are these 17 SDG goals. They were adopted for:

1. Better Environment
2. Better Society
3. Better Economy

In relation to this Artificial Intelligence can contribute towards accomplishing these goals and making the Earth a better place for all of us and other inhabitants. So let we talk about **the impact of AI on SDG.**

Prepared by: Sanjay Parmar, PGT – Computer Science

The major challenges for the world are to provide clean water, clean air, natural resources, sustainable energy, and education. As we all know that there so many problems we are facing with environments, problems with people like poverty and starvation. So far with the advancement of technological growth, we did not succeed with these problems yet. So Artificial Intelligence can help to solve such problems. How Artificial Intelligence can provide a solution?

Watch this video to know more about 17 Sustainable Development Goals:

https://youtu.be/0XTBYMfZyrM

In the next section of the impact of AI on SDG class 9, we will see some societal impacts.

AI societal Impacts

AI Societal impacts

AI-based system or tools can provide the best results on the following goals:

- **No poverty (SDG - 1):**
- **Zero Hunger (SDG - 2):**
- **Good Health and Well Being (SDG - 3):** AI can help in preparing data for people living under the poverty line and help them by providing food, health, water, and energy easily.
- **Quality Education (SDG - 4):** AI systems can be trained for quality education and can provide the solution.
- **Gender Equality (SDG - 5):** AI tools don't recognize gender. In some areas, AI can result in negative impacts also. For example, the AI systems or tools are trained based on the situation and requirements of the country where they developed. If we talk about SDG 5 - Gender Equality, there is inefficient research done. The tools which are available such as voice agents and chatbots like Alexa or Siri gendered as female only. To improve this more research required for smart algorithms, image recognition, reinforced learning, or discrimination.
- **Clean water and Sanitation (SDG - 6):** AI tools can be used for supplying clean water and sanitation to the people.
- **Affordable and Clean Energy (SDG - 7)**: AI can be trained to provide affordable and clean energy but the IA product design should require proper resources and tools.
- **Sustainable Cities and Communities (SDG - 11):** AI is capable to create smart cities that provide efficient resources to the people.
- **Peace Justice and Strong institutions (SDG - 16)**: Justice and strong institutions based on the rules formed by the different groups of people. So it is very highly impacted through AI. The tools can be trained for the laws and enforcement according to the need.
- **Partnerships for the goals (SDG - 17)**: AI can help to provide a partnership and support the partner to achieve the goal.

The next section of the impact of AI on SDG class 9 will discuss AI economic impact.

AI economic Impacts

AI economical impacts

The positive impacts of AI on economy goals are:

- **Decent Work and Economic Growth (SDG - 8):** The market heavily relies on data analysis. These data may not available in low and middle-income countries. Hence the work culture may be impacted.
- **Industry Innovation and Infrastructure (SDG - 9):** AI system helps in industry innovation in terms of solving complex problems. It can handle complex operations easily. It can also handle the infrastructural issues with advancement.
- **Reduce Inequalities (SDG - 10)**: By using AI tools inequalities can be reduced as AI tools do not have any emotions. They can produce the results better than other tools. If we take the example of AI used by social media websites to show up the contents of users' interest in his profile. Another example is job creation using AI tools.

AI Environmental Impacts

AI can impact on following SDGs related to the environment:

- **Climate action (SDG - 13):** AI can be useful in generating an alert in climatic situations. It can produce the alerts and warn the concerned department about climate change and leads to act accordingly.
- **Life below water (SDG - 14):** The life below water like animals living under the sea, under the river plays an important role in maintaining temperature and makes the earth suitable for all of us. AI can impact on these by recording their needs and improve the supply chain.
- **Life on Land (SDG - 15):** AI systems can be helpful for life on land as well. It can promote the use of ecosystems through various platforms like social media, search engines, and so on.

Watch the complete video with explanation:

Play Video

Prepared by: Sanjay Parmar, PGT – Computer Science

Possibilities

The possibilities of Artificial Intelligence in various fields increasing day by day. If we compare our today's life with a few years ago then we can understand one thing i.e. Life has changed a lot nowadays. We have so many systems, devices, a technology that serve something which is according to our need and behavior.

As we think about possibilities of artificial intelligence, we can think it can influence 90% of fields with numerous opportunities. As the use of technology increases the demand of talented and trained people also increased rapidly in recent years.

So at one side people are losing job, simultaneously AI is creating opportunities to trained people at the other end. AI related jobs are increasing day by day. These jobs needs good knowledge of Maths, Science, Computers, IT and Technology.

The graduate's degree holders can get a job at entry-level and then can go ahead. The advanced level jobs-based research and data modelling require higher educational credentials for taking a job.

Skills required for jobs of the future

1. **Communication skills**: This is an essential skill for every job. Communication helps a person in many ways.
2. **Knowledge of Basic Maths and Science**: A person must have good knowledge of basic maths and science principles to understand and work with AI.
3. **Applied mathematics**: Many systems and AI tools using applied mathematics concepts. Some AI research also requires applied mathematics principles.

4. **English speaking and Listening:** As dealing with technology and other concerns the English language will be an added advantage for future high paying jobs.
5. **Techno Savvy**: Techno savvy refers to the knowledge of basic computers and online communication medium which is very essential in today's scenarios too.
6. **Machine Learning**: It essential for future jobs related to AI. A person who deals with AI that also deals with Machine Learning projects.
7. **Data Science**: As you are familiar with the domain of AI, Data is playing a key role in jobs related to AI.
8. **Programming Languages**: Programming languages like python, R, Go, etc. are part of AI tools and technology. So it is also a mandatory part for job seekers.
9. **Data Analysis**: Many big companies have a job role as a Data Analyst who is responsible for data analysis. Data analysis help in taking the right decision.
10. **AI research**: It is advanced skill for job for future development and implementation of AI as well current growth.

Possibilities of Artificial Intelligence technology in Health

Infervision

It is developed in China that uses Artificial Intelligence in medical services. It is using deep learning and computer vision. Recently, it was used in China for fighting against COVID-19. In China, it generates about 1.5 billion CT scans per year only for lung cancer. It detects cancer accurately and efficiently and helps radiologists.

Read more about how Infervision helped china against COVID-19?

Read more about infervision from their official website

DeepMind

DeepMind is created by Google influenced by Neuroscience. It is designed to copy the human brain's behaviour. In past, it defeated many human players in different games. Now Google is expanding this system to the healthcare sector to reduce the time required for planning treatments and diagnose the sickness. Read more...

Possibilities of Artificial Intelligence technology by Google

Google Fishing watch

This can be used by law agencies to prevent illegal fishing. It is also product of google that uses cloud computing, machine learning and geo-mapping using AI and Satellite to predict the for vessels at sea. It identifies the instances of illegal fishing.

Google Brain

It was started in 2011 and used for image recognition at initial stage. As time goes, now it used for many purposes as following:

1. Image Enhancement
2. Natural Language Processing
3. Youtube video recommendations

Possibilities of AI technology for customer experience

Walmart

It is a mall and retailer like D-mart which is serving through its offline stores as well as online stores. It is using AI technology for improving its customer experience for in-store and online. It uses AI with IoT with Scan and Go, Pick up towers. It is also experimenting with facial recognition technology to measure a customer's mood is happy or sad inside the store.

Hello Barbie

My daughters are playing a few games on mobile and watching videos on youtube related to Barbie dolls. In the market, dolls are also available which can talk with human beings. These toys use AI concepts like Language Processing, Machine Learning, and Advanced Analytics. These toys having a microphone that records the voice of the child and selects the dialog from the server and gives the response.

Talking with machines

It is one audio drama created by BBC. It allows listeners to have a conversation with machines and allows listeners to answer the questions. By these questions and add to something to the story. It works with google Echo and Google Home.

Possibilities of AI technology for vehicles

Volvo

Volvo is a car company, use AI for car servicing and replacement of different components. It collects data of vehicles and improve in stressful situations and increasing the driver and passenger experience. It also used these data for research and development.

BMW

30 million raw parts handled by BMW's logistic team daily, shipped from 4500 suppliers around 31 different countries. BMW uses AI to perform some tasks and handle the manufacturing of cars for quality control. In 2019 BMW released on OpenSource algorithm so by that software developers can review, edit and improve the source code for quality control. Even AI helps to make some decisions from car manufacturing to sales and sales-servicing. BMW has set target that they will manufacture a self-driving car without any human interventions by 2021.

IBM Watson

IBM Watson facilitates enterprise-based services, apps, and tools for developing and managing products or apps or various corporate services. It is using many services like IBM Cloud, AWS, Azure, Google, or your own private cloud platform. Click here to read more....

John Deer

John Deere tractors are popular in our country. It provides farm vehicles that use GPS and AI technology named FramSight for automatic ploughing and sowing the farms. This company uses AI technology in Agriculture. It checks the availability of pest on the crop and report any pesticides needs to be applied or not.

Possibilities of Artificial Intelligence technology for Media

RADAR (Reporters and Data Robots)

It is popularly used as RADAR AI. It is a service which collects data fro various sources like government, local authorities, and public services and release news. It writes around 30K stories monthly and using Natural Language Technology to write them.

Netflix

Netflix using AI for predictions of watch of their customers. Then this data will be provided to content providers and content creators. Based on AI recommendations new contents will be created and this way AI helps netflix to commit new seasons on the new shows.

Cortana

Cortana is a product Microsoft. If you have windows 10 installed then you might have used it or you might have seen it. It is a virtual assistant performs various roles. For example - it can be work as chatbot on skype, display news, weather travels etc.

AI Ethics

As we are human beings and we are following some moral principles for doing certain activities as well as to make our life comfortable with good manners and behavior.

These concerns and principles related to good manners, good behavior is known as ethics.

Similarly certain ethics are also associated with AI systems and tools. These ethics are known as AI ethics. So finally AI ethics can be defined as following:

AI ethics refers to the basic principles of AI system design that use the good code of conduct and produces the results.

In other words ethics means what is right and unethical means what is wrong.

Here are the key components of the chapter AI ethics class 9.

AI ethics are classified into two categories:

1. AI bias
2. AI access

Watch this video before going ahead:

https://www.youtube.com/watch?v=vgUWKXVvO9Q

Ethical concerns related to AI access

If you are developing a system or a new technology, you may face some ethical issues related to that system or new technology. Similarly AI systems also facing these ethical concerns.

When AI is coming to your way, you need to think about data management. This is the first concern because AI is mostly rely on data. The AI system is nothing without data.

Whenever you think about data you should think about their storage, collection, privacy and many more concerns.

Now a days internet has the entire world. We are using smartphones and internet. Daily we are accessing lots apps and websites. Can you answer these questions:

When you install any app on your mobile what type of permissions the app is asking for?

So the answers is as following:

1. Contacts
2. Location
3. Email
4. Storage
5. Notes

specific apps may ask specific permission to allow.

Data management AI ethics class 9

Prepared by: Sanjay Parmar, PGT – Computer Science

These all data Google is using for the exchange of the details whenever such apps are used in your mobile. Sometimes it improves user experience as well. You will get the information from your app as per your previous transactions and actions on the app.

In next section of AI ethics class 9 we will discuss two main categories of AI ethics.

AI Bias

When you tap on allow button on your mobile or smart phone you are giving your details for simple access. That means whatever data you fed in that particular app is your identity according to the app you have used.

As you have seen that most of the robots or assistants are available in female voice only. This is because the computer system trained on the specific data and common observation for those kind of jobs.

But identification and understanding of such things are not an easy task. Sometimes the result produced by these systems are also not up to the mark. It happens in AI systems because sometimes the developer also cannot understand the behavior of these systems.

Many AI systems do exactly what they have designed for! They cannot take their decisions. They uses the provided data and training material. They never understand the data nor interprets them.

Components of a good AI Policy

Good policy refers to the concerns which should be in consumers' favor. The following topics can be considered as good AI policy:

1. Transparent System
2. Right of data collection
3. Freedom of leaving the system
4. Design
5. Data deletion

Transparent System

A transparent system refers to the guideline and system purposes should be very clear to its users. While collecting data the purpose and the detailed guide about what to be done with the data should be known to the users.

Right of data collection

When the data is collected by the AI system it must be right to the data which the system is collecting. Without the collection of data, it cannot take the right decision for the user.

Freedom of leaving system

The user must have the freedom to leave the system. After using such system if user want to leave the system, the freedom should be given to the users.

Design

The system should be designed in such a manner that the data collection and purpose should be limited. This helps the users to stay and use the system in a good manner. The interface itself provides such controls to users.

Data Deletion

When the user leave the system, his data should be deleted. Or sometimes user requests to delete their data it should be provided in the system itself.

In next section of AI ethics class 9 we will discuss another category of AI ethics.

AI access

The AI access is a set of ethical concerns related to the adoption of AI systems.

These concerns are as follows:

1. Unemployment
2. Inequalities
3. Negative Adoptions
4. Black Box problem

Unemployment

This is very the important topic of debate. Many says that AI adoption can increase the jobs and employment opportunities, many says that it reduces the employment and takes many jobs from human being and many says there is no effect of AI on employment.

Do a research on this topic on google.

Increasing Inequalities

By adopting AI, results in a reduction in the number of people required for particular jobs. It will definitely affect the economy and increase the gap in the economy hence increase inequalities.

Negative Adoptions

Negative adoptions are part of our life. The negative minded community like hackers, terrorists and some other mafias can use this technology for some other purposes and misuses them.

Black Box problem

The black box problem refers to the situation that is created by a system itself and the developer of system cannot resolve them. This happens quite often with AI systems.

Watch this video lesson to understand more about ai ethics:

Play Video

Important Questions on AI Ethics

Unit 2 AI Project Cycle

Topic	Learning Outcomes
Problem Scoping	• Identify the AI Project Cycle framework. • Learn problem scoping and ways to set goals for an AI project • Identify stakeholders involved in the problem scoped. • Brainstorm on the ethical issues involved around the problem selected. • Understand the iterative nature of problem scoping for in the AI project cycle. • Foresee the kind of data required and the kind of analysis to be done. • Share what the students have discussed so far.
Data Acquisition	• Identify data requirements and find reliable sources to obtain relevant data.
Data Exploration	• To understand the purpose of Data Visualisation • Use various types of graphs to visualise acquired data
Modelling	• Understand, create and implement the concept of Decision Trees. • Understand and visualise computer's ability to identify alphabets and handwritings.

Prepared by: Sanjay Parmar, PGT – Computer Science

Problem Scoping

Computer Science has many branches and Artificial Intelligence is also one of them. Mainly the field of Computer Science focuses on Problem Solving. This problem solving has a specific cycle. So AI is also following the AI project cycle.

Introduction to Problem Scoping

In AI project cycle frame work there are certain stages. These stages are:

1. Problem Scoping
2. Data Acquisition
3. Data Modelling
4. Evaluation and Development

Problem Scoping is the first stage of the AI project cycle. In this stage of AI development, problems will be identified. It is then followed by designing, developing, or building, and finally testing the project.

In AI project cycle everything will be failed if problem scoping is failed or without appropriate problem scoping. Incorrect problem scoping also leads to failure of the project as well.

What is Problem Scoping?

Whenever we are starting any work, certain problems always associated with the work or process. Actually we are surrounded by problems! These problems can be small or big, sometimes we ignore them, sometimes we need an urgent solution otherwise your work will suffer.

The problem scoping refers to the identification of a problem and the vision to solve it.

The 4Ws of Problem Scoping

The 4Ws are very helpful in problem scoping. They are:

1. **Who?** - Refers that who is facing a problem and who are the stakeholders of the problem

2. **What?** - Refers to what is the problem and how you know about the problem
3. **Where?** - It is related to the context or situation or location of the problem
4. **Why?** - Refers to why we need to solve the problem and what are the benefits to the stakeholders after solving the problem

The final outcome of problem scoping in ai class 9 is the problem statement template.

The problem statement template

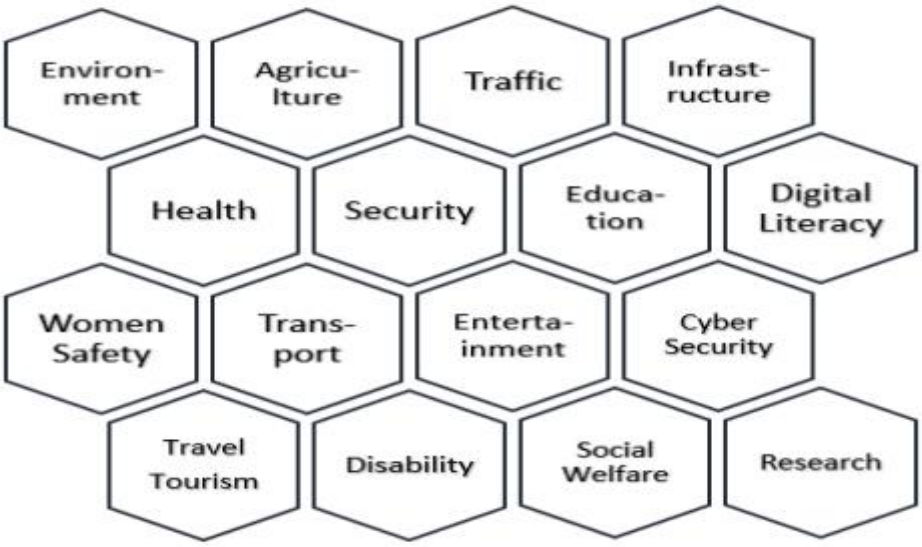
When the above 4Ws are completely filled you need to prepare a summary of these 4Ws. This summary is known as the problem statement template. This template explains all the key points in a single template. So if the same problem arises in the future this statement helps to resolve it easily.

Activity - Brainstorm around the theme and set a goal for the AI project

In this activity you need to select a theme for problem scoping.

Select the Theme

In CBSE Study Material they have given the following themes for problem scoping:



Reference CBSE Study Material

Prepared by: Sanjay Parmar, PGT – Computer Science

Students can select any of these or they can choose their own as well.

For Example,

1. **The environment** is your theme. So think about the various problems such as polluted air, water, and land, etc.
2. Suppose you have selected **an Agriculture** theme, then there are various pesticides used in agriculture to increase the productions, sowing and harvesting problems, etc.
3. Traffic is also one of the themes given in the handbook. Here you can think about traffic issues and to reduce the accidents or any other related problem.

Similarly you can take any theme and think about the various problems of that theme.

Place the problems into a problem statement template

As per the handbook they have given a sun and fill the rays with the problems found in your theme.

Now list down the problems and topic for your theme.

Set up the goal

After understanding and writing the problems, set your goals, and make them your AI project target. Write your goals for your selected theme.

Suppose you have selected theme of agriculture then write how AI will help farmers to solve their problems.

1. Determine what will a good time for seeding?
2. Determine what will be a good time for harvesting?
3. Determine when and how much fertilizer will be applied to the selected crop?

These goals can be more!

Now think and apply the 4Ws strategy for each problem or goal.

Your final problem statement will look likes the following table:

Who	Stakeholders
	Farmers, Fertilizer Producers, Labours, Tractor Companies
What	The problem, Issue, Need
	Determine what will a good time for seeding or crop harvesting?
When	Context/Situation
	Decide the mature age for the crop and determine its time
Ideal Solution	Benefits
	Take the crop on time and supply against market demand on time

Watch this video lesson for more understanding:

Play Video

Important Questions

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Data Acquisition

Understanding data acquisition

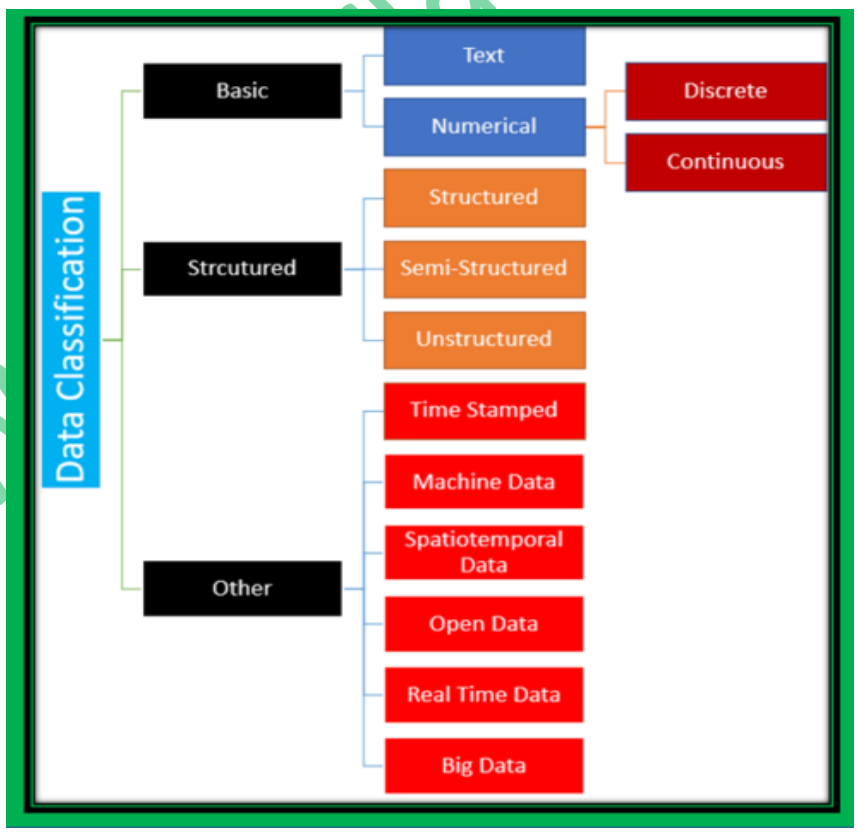
Data Acquisition consists of two words:

1. **Data** : Data refers to the raw facts , figures, or piece of facts, or statistics collected for reference or analysis.
2. **Acquisition**: Acquisition refers to acquiring data for the project.

The stage of acquiring data from the relevant sources is known as data acquisition.

Classification of Data

Now Observe the following diagram to for the data classification, we will discuss each of them in detail:



Classification of Data

Prepared by: Sanjay Parmar, PGT – Computer Science

Basic Data

Basically, data is classified into two categories:

1. **Numeric Data**: Mainly used for computation. Numeric data can be classified into the following:
    - **Discrete Data: Discrete data only contains** integer numeric data. It doesn't have any decimal or fractional value. The countable data can be considered as discrete data. For example 132 customers, 126 Students etc.
    - **Continuous Data**: It represents data with any range. The uncountable data can be represented in this category. For example 10.5 KGS, 100.50 Kms etc.
2. **Text Data**: mainly used to represent names, collection of words together, phrases, textual information etc.

Structural Classification

The data which is going to be feed in the system to train the model or already fed in the system can have a specific set of constraints or rules or unique pattern can be considered as structural data.

The structure classification is divided into 3 categories:

1. **Structured Data**: As we discussed the structured data can have a specific pattern or set of rules. These data have a simple structure and stores the data in specific forms such as tabular form. Example, The cricket scoreboard, Your school time table, Exam datasheet etc.
2. **Unstructured Data:** The data structure which doesn't have any specific pattern or constraints as well as can be stored in any form is known as unstructured data. Mostly the data that exists in the world is unstructured data. Example, Youtube Videos, Facebook Photos, Dashboard data of any reporting tool etc.

3. **Semi-Structured Data**: It is the combination of both structured and unstructured data. Some data can have a structure like a database whereas some data can have markers and tags to identify the structure of data.

Other Classification

This classification is sub divided into the following branches:

1. **Time-Stamped Data**: This structure helps the system to predict the next best action. It is following a specific time-order to define the sequence. This time can be the time of data captured or processed or collected.
2. **Machine Data**: The result or output of a specific program, system or technology considered as machine data. It consists of data related to a user's interaction with the system like the user's logged-in session data, specific search records, user engagement such as comments, likes and shares etc.
3. **Spatiotemporal Data**: The data which contains information related to geographical location and time is considered as spatiotemporal data. It records the location through GPS and time-stamped data where the event is captured or data is collected.
4. **Open Data:** It is freely available data for everyone. Anyone can reuse this kind of data.
5. **Real-time Data**: The data which is available with the event is considered as real-time data.
6. **Big Data**: You may hear this word most often. The data which cannot be stored by any system or traditional data collection software like DBMS or RDBMS software can be considered as Big data. Big data itself a very deep topic.

Data Features

Data features refer to the type of data you want to collects. Here two terms are associated with this:

1. **Training Data**: The collected data through the system is known as training data. In other words the input given by the user in the system can be considered as training data.
2. **Testing Data:** The result data set or processed data is known as testing data. In other words, the output of the data is known as testing data.

To understand the topic in detail watch this video:

Play Video

Important Questions

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Data Exploration

What is data exploration?

So the first question comes in your mind is What is Data Exploration?

Data Exploration refers to the techniques and tools used to visualize data through complex statistical methods.

Advantages of Data Visualization

- A better understanding of data
- Provides insights into data
- Allows user interaction
- Provide real-time analysis
- Help to make decisions
- Reduces complexity of data
- Provides the relationships and patterns contained within data
- Define a strategy for your data model
- Provides an effective way of communication among users

Till now you learned about problem scoping and data acquisition. Now you have set your goal for your AI project and found ways to acquire data. When you acquired data the main problem with data is - the data is very complex. Because it's having numbers. To make use of these numbers user need a specific pattern to understand the data.

For example if you are going to reading a book. You went to library and selected a book. The first thing you try to do is, just turning the pages and take a review and then select a book of your choice. Similarly, when you are working with data or going to analyze data you need to use data visualization.

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Data Visualization Tools

There are many data visualization tools available. In next section of Data Exploration AI we will discuss about them.

Here I made a list of 20 data visualization tools for you. Although there are many more tools available and these numbers increasing day by day.

1. Microsoft Excel
2. Tableau
3. Qlikview
4. FusionCharts
5. DataWrapper
6. MS Power BI
7. Google Data Studio
8. Sisense
9. HiCharts
10. Xplenty
11. HubSpot
12. Whatagraph
13. Adaptive Discovery
14. Teammate Analytics
15. Jupyter
16. Dundas BI
17. Infogram
18. Google Charts
19. Visme
20. Domo

Do a small research and learn how to visualize your data with above tools.If want to know how to create charts in MS excel follow this link:

Charts in MS Excel

How to select a proper graph?

Now you are familiar with various chart types. Now the next step is to select an appropriate chart for data visualization. The selection of chart all depends on the data and the goal you are going to achieve through your model. Although some basic purposes of charts that let you select an appropriate chart, they are as follows:

1. Comparison of Values - Show periodical changes i.e. Bar Chart
2. Comparison of Trends - Show changes over a period of time i.e. Line Chart

3. Distribution of Data according to categories - Show data according to category i.e. Histogram
4. Highlight a portion of a whole - Highlight data according to value i.e. Pie Chart
5. Show the relationship between data - Multiple charts can be used

Now in the next section of Data Exploration AI Class 9, we will discuss a few activities given in your CBSE curriculum handbook.

This website is given in the curriculum handbook for the activity.

Activities

Activity 1 - MS Excel

- Open MS Excel
- Prepare data of results
- Prepare 5 different types of charts and make a comprehensive report with these points
  - Name of the chart
  - Description of the chart
  - How to draw it
  - Suitable for which type of data

Activity 2 - Sketchy Graphs

Materials required - Chart Paper, Sketch-pens, Ruler, Basic Stationary

In this activity, you have to make a graph on chart paper. You can select any chart to plot the data and draw them. Ensure that you are able to relate this graph to the goal of your project and describe the trends or patterns you have witnessed in your chart.

Play the video

Important Questions

Modelling

Introduction

Before starting AI project Cycle modelling class 9, you need to understand what is modelling? So it can be defined as follows:

So as in previous article data exploration, we have seen how we can represent data in graphics using various tools. This graphical representation makes data easy to understand for the humans to take a decision or prediction. But when it comes to machine to access and analyse data, machine requires mathematical representation of data. Hence every model needs a mathematical approach to analyse data.

In the next section of AI project Cycle modelling class 9 we will talk about AI modelling approaches.

AI modelling approaches

Basically there are two approaches broadly taken by researchers for AI modelling. They are:

1. Rule-Based Approach
2. Learning-Based Approach
3. Decision Tree

Let us begin with rule-based approach.

Rule Based Approach

A Rule-based approach is generally based on the data and rules fed to the machine, where the machine reacts accordingly to deliver the desired output.

In other words, rule-based learning follows the relationship or patterns in data defined by the developer. The machine follows the instructions or rules mentioned by the developer and performs the tasks accordingly. It uses coding to make a successful model.

Consider the following scenarios and try to understand the rule-based approach for AI project Cycle modelling:

Suppose you have data of 100 employees and 100 businessmen. The following steps you need to follow to train your machine:

1. Input your data and label them accordingly for employees and businessman.
2. Now if the data is related to employee, the machine will compare its rules defined by you as employee and label it as employee and this way it will identify the data of employee.
3. Similarly it will follow the rules for businessman as well.

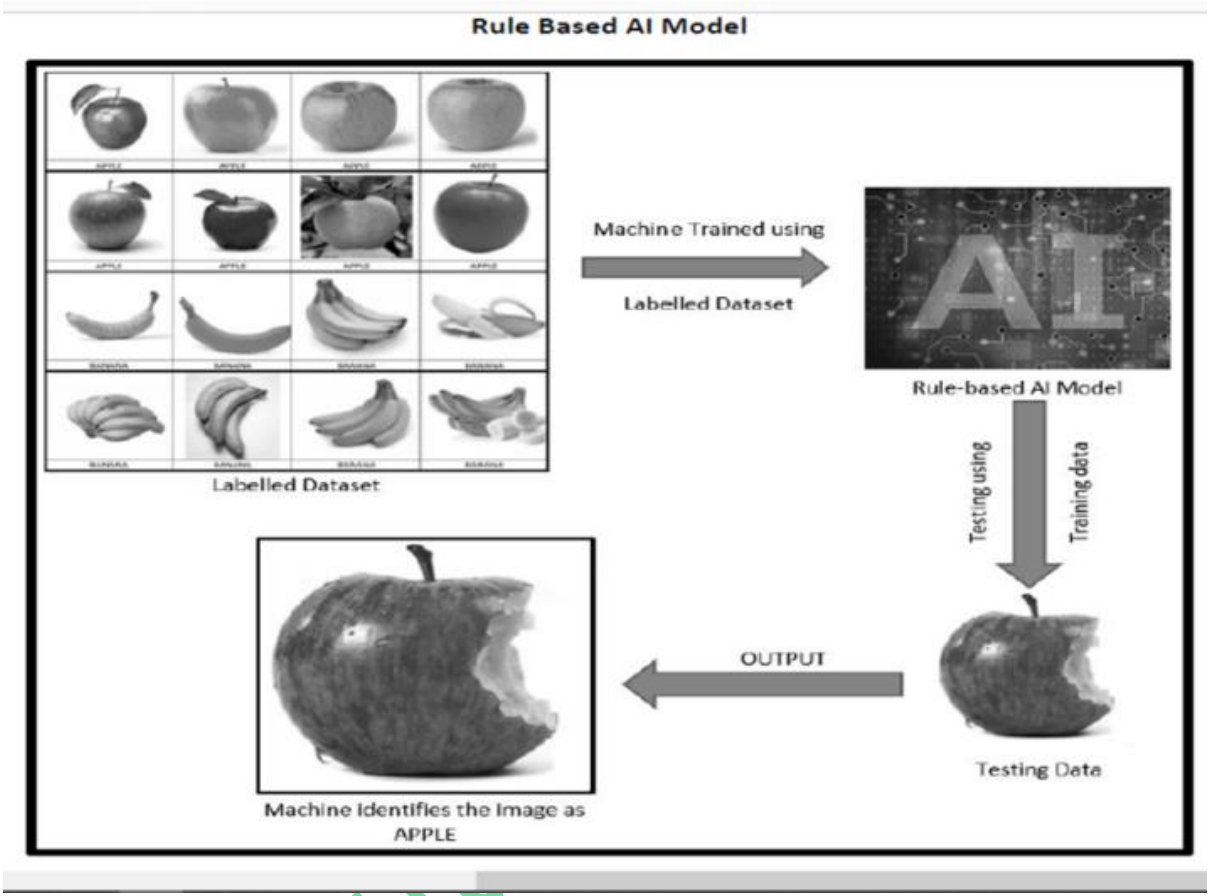
Here in the machine, you need to feed some of the characteristics of employees like earning money and provide service whereas businessman investing money and provide service to train the machine.

In CBSE curriculum handbook they have following example for rule-based approach.

Suppose you have a dataset comprising of 100 images of apples and 100 images of bananas. To train your machine, you feed this data into the machine and label each image as either apple or banana.

Now if you test the machine with the image of an apple, it will compare the image with the trained data and according to the labels of trained images, it will identify the test image as an apple.

This is known as Rule-based approach. The rules given to the machine in this example are the labels given to the machine for each image in the training dataset. Observe the following image:



rule based approach AI project Cycle modelling class 9

The second approach in AI project Cycle modelling class 9 is learning based discussed in the next section.

Learning Based

The machine is fed with data and the desired output to which the machine designs its own algorithm (or set of rules) to match the data to the desired output fed into the machine to train.

In the learning-based approach, the relationship or pattern in data is not defined by the developer.

This approach takes random data which is fed into the machine and it is left to the machine to figure out the patterns or required trends.

In general this approach is useful when the data is not labelled and random for a human to use them.

Thus, the machine looks at the data, tries to extract similar features out of it and clusters the same datasets together.

In the end as output, the machine tells us about the trends which are observed in the training data.

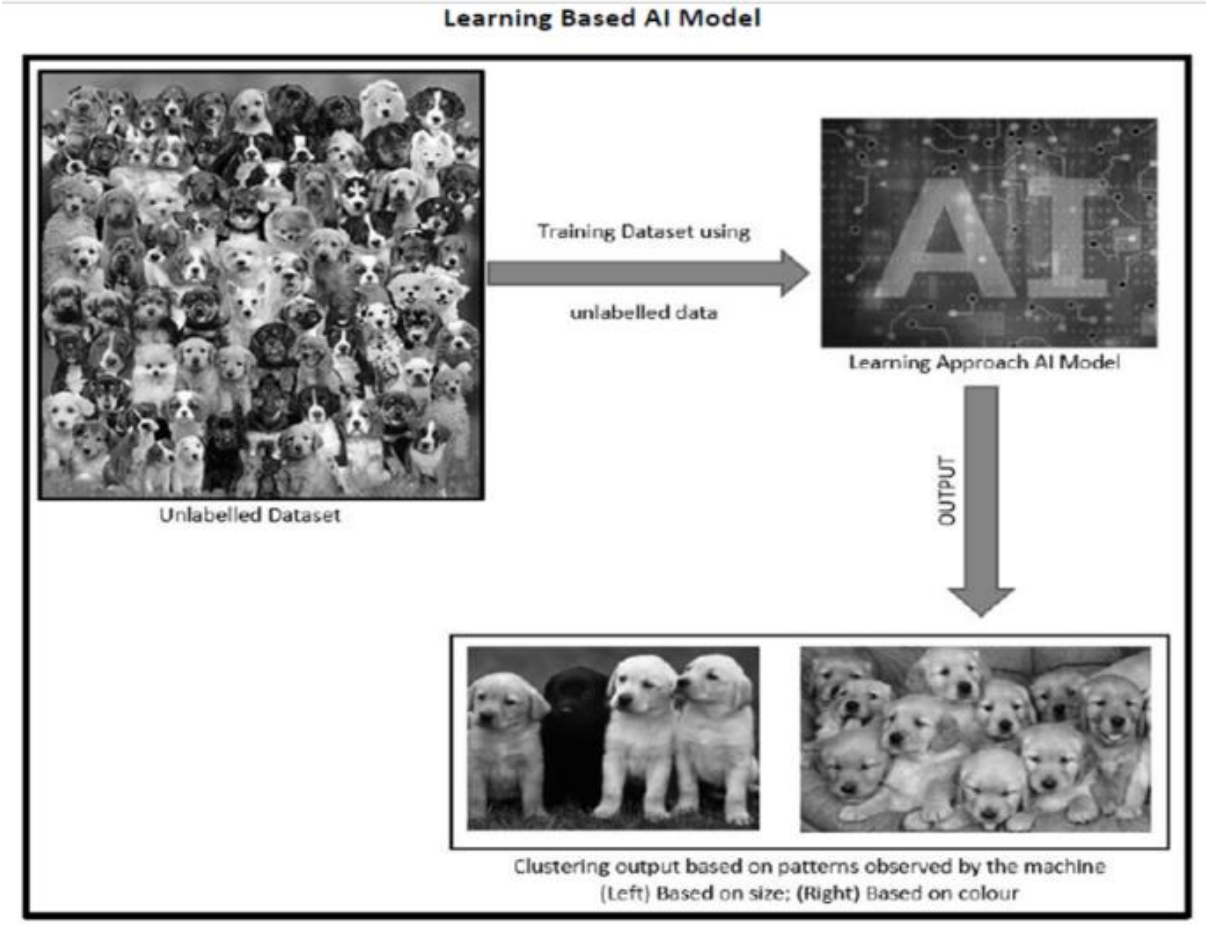
This approach is used to train the data which is unpredictable or the users have no idea about it. Let us take a look at the example given in your curriculum handbook for AI project Cycle modelling class 9.

For example, suppose you have a dataset of 1000 images of random stray dogs of your area.

Now you do not have any clue as to what trend is being followed in this dataset as you don't know their breed, or colour or any other feature.

Thus, you would put this into a learning approach based AI machine and the machine would come up with various patterns it has observed in the features of these 1000 images.

It might cluster the data on the basis of colour, size, fur style, etc. It might also come up with some very unusual clustering algorithm which you might not have even thought of!



Learning based approach - AI project cycle modelling

In the next section of AI project Cycle modelling class 9 we will discuss about decision tree.

Decision Tree

The decision tree is one of the most common and basic models in data science. It follows a tree like structure of the decisions with all possible results. It is similar like rule-based approach.

The decision tree is made up of various node. It follows top to bottom approach. The top most node of the decision tree is known as **root.**

Then it continues till the down to the terminal node or leaf node. All these nodes are connected with each other by arrow lines.

So let us talk about the common terms associated with decision tree.

Now we will talk about common terms of decision tree for AI project Cycle modelling class 9.

Common Terms

1. **Root Node**: We have already seen this in the above paragraph.
2. **Splitting:** Splitting is a process by which a node is divided into two or more sub-nodes.
3. **Decision or interior node:** It is the node where the splitting takes place. In other words, it is a place where the sub-node is divided into another sub-nodes.
4. **Leaf node or terminal node:** We have already seen this.
5. **Branch or Subtree**: A subsection of the decision tree is known as a branch or subtree.
6. **Parent node and child node:** The bottom node which derives from the top node is known as child node whereas the top node is known as the parent node.

Different Parts of Decision Tree

The decision tree is made up of various nodes. These nodes are the parts of a decision tree. They are as follows:

1. **Decision Nodes:** It represents a decision, typically shown with square
2. **Chance Nodes**: It represents probability or uncertainty, shown in circle
3. **End Nodes**: It represents the result or final outcome, shown in triangle

Important Questions Modelling

Play Video

Activity 1 - make a decision tree

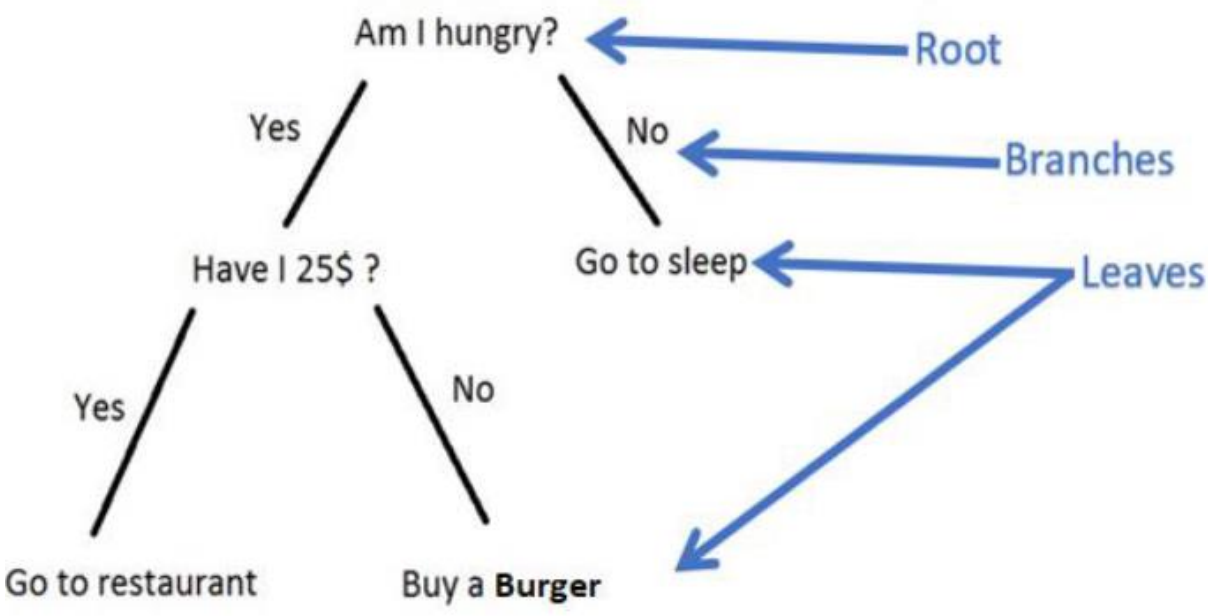
As you know the decision tree is an example of a rule-based approach.

The structure of decision starts with th**e root node** and ends with **leaves by connecting branches** having different conditions.

So following things you have to keep in mind before making the decision tree:

1. Observe your data carefully.
2. Decide what (data) will be your root
3. Decide what (data) will be your leaves
4. Now analyse the data properly and find out some unnecessary data

Observe the following picture given, it is a decision tree given in CBSE study material.



Class 9 AI How to make a decision tree

In the above picture, one decision tree is given.

Here the decision is something which is related to our daily activity.

The first condition is about you are hungry or not? If yes then if you have $25 you can go to the restaurant and if no then you can buy a burger or if you are not hungry then you can go to sleep.

So the top question or condition here is - **Am I Hungry?** will be considered as root and Yes or no will be branches.

The final decision like go to sleep, go to a restaurant and buy burger are leaves. Have I $25 is the interior node.

Based on this decision tree two questions are given in the curriculum handbook and here I will provide you the answers:

1. How many branches does the tree shown above have? - 2
2. How many leaves does the tree shown above have? - 3

Points to remember

While making a decision tree, remember following points:

1. Give a good look to your dataset
2. Try to figure out the pattern of your output leaf
3. Select any one output and find out the common links for similar output
4. Note the parameters for redundant data from the dataset
5. Choose the simple dataset for your decision tree

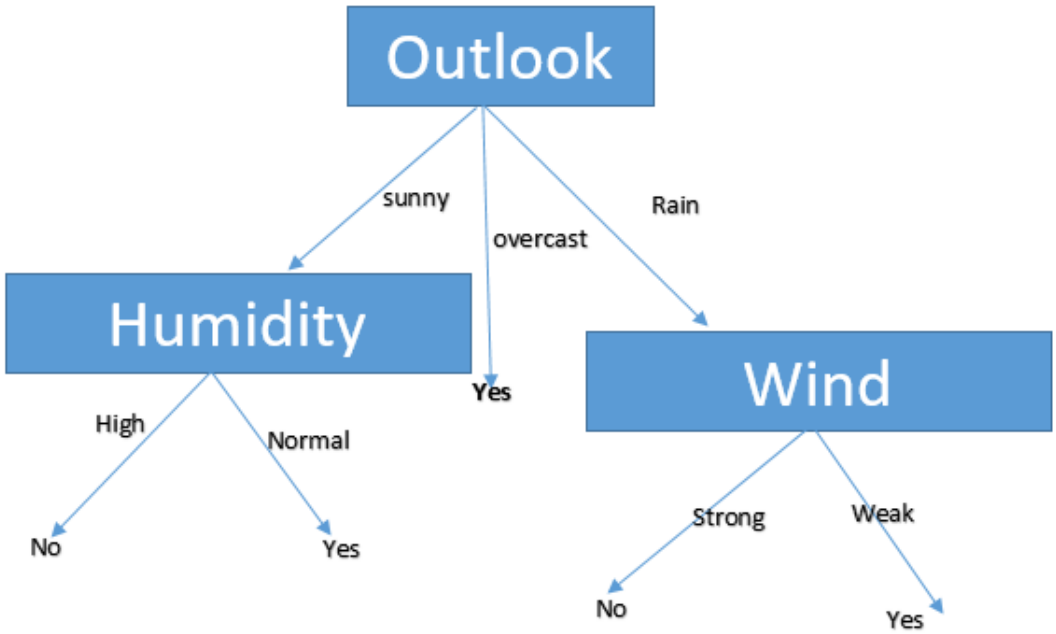
Now let we see one more example given in the CBSE study material as given dataset:

The following is a dataset comprising of 4 parameters which lead to the prediction of whether an Elephant would be spotted or not.

The parameters which affect the predictions are: Outlook, Temperature, Humidity and Wind.

Draw a Decision Tree for this dataset.

Outlook	Temperature	Humidity	Wind	Elephant Spotted?
Sunny	Hot	High	Weak	No
Sunny	Hot	High	Strong	No
Overcast	Hot	High	Weak	Yes
Rain	Mild	High	Weak	Yes
Rain	Cool	Normal	Weak	Yes
Rain	Cool	Normal	Strong	No
Overcast	Cool	Normal	Strong	Yes
Sunny	Mild	High	Weak	No
Sunny	Cool	Normal	Weak	Yes
Rain	Mild	Normal	Weak	Yes
Sunny	Mild	Normal	Strong	Yes
Overcast	Mild	High	Strong	Yes
Overcast	Hot	Normal	Weak	Yes
Rain	Mild	High	Strong	No



Prepared by: Sanjay Parmar, PGT – Computer Science

Common decisions are as following:

- If outlook = Sunny and Humidity = High, then Elephant Spotted = No
- If outlook = Sunny and Humidity = Normal, then Elephant Spotted = Yes
- If outlook = overcast, then Elephant Spotted = Yes
- If outlook = Rain and wind= Strong, then Elephant Spotted = No
- If outlook = Rain and wind = weak, then Elephant Spotted = Yes

Similarly you can prepare any decision tree according to given dataset.

If you want to use an online websites to draw decision trees you can use one of the following online apps:

1. Creately
2. Smart Draw
3. Lucid Chart

Play Video for practical demo

Activity 2 - Pixel It

This guide is given for a class 40 students with group of 4 students. The material required for Pixel It activity is as given below:

Item	Quantity
Pixel It Activity Sheet (given in Student Handbook)	40
Scissors	10
Glue	10
Sketch-pens	40

Purpose

The main purpose of this activity is to understand how the computer classifies the images as well as how a computer reads them. The graphics or images created in computers are pixel-based images.

As we have discussed earlier 1 pixel means 1 dot. So in this activity, you will understand how the images will be processed, classified and how computers see them.

This is one of machine learning approach used in CV(Computer Vision) applications.

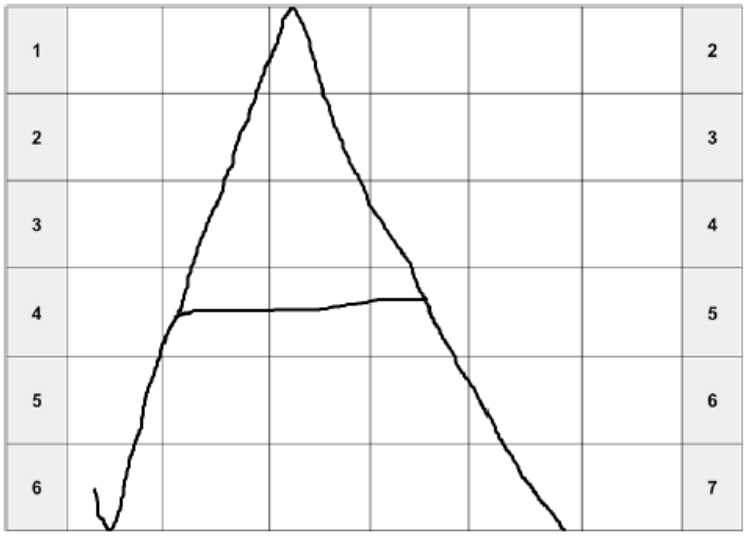
In modelling, we have seen that there are two basic approaches:

1. Rule Based
2. Learning Based

Rule bases approach we have covered, now this activity we are performing to understand the learning based approach for modelling.

Follow these steps:

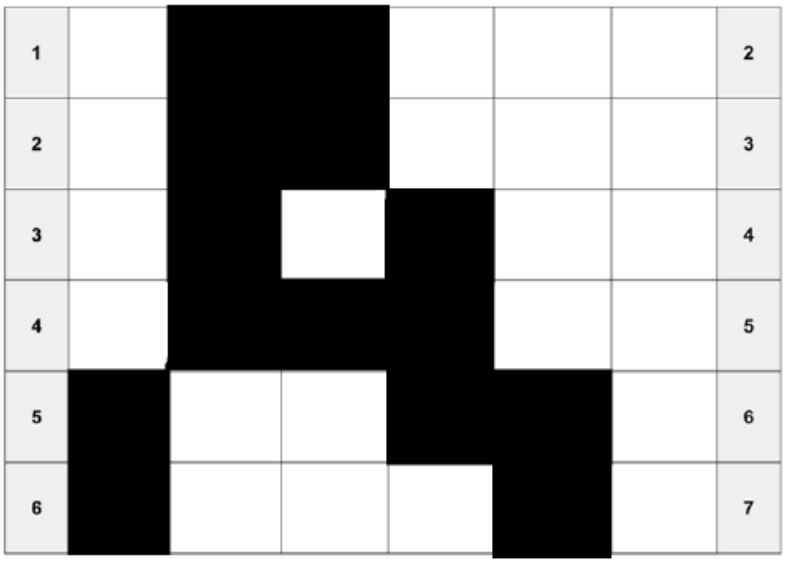
1. Cut the page or draw 6 x 6 matrix square boxes on the sheet
2. Write an upper case alphabet on the matrix with the equal height of the matrix.
3. It should cover all the boxes starting from top to bottom.



Pixel It activity for AI Class 9

Prepared by: Sanjay Parmar, PGT – Computer Science

4. Now apply colour to the boxes on which lines of that alphabet have fallen.

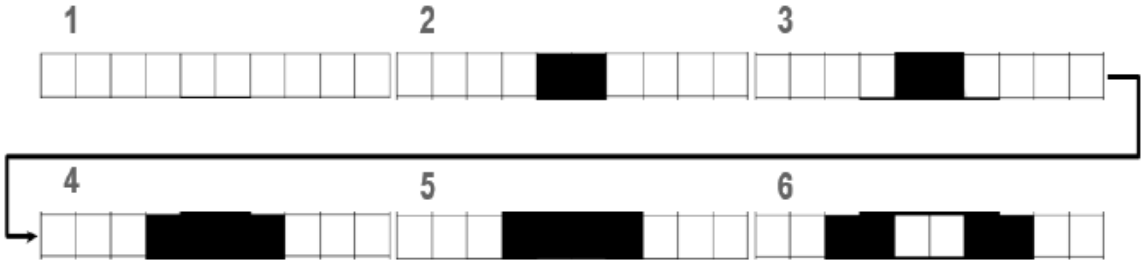


colour the boxes

5. Now cut the horizontal stripes of the matrix in this manner like 1-2,2-3,3-4,4-5,5-6 and 6-7.

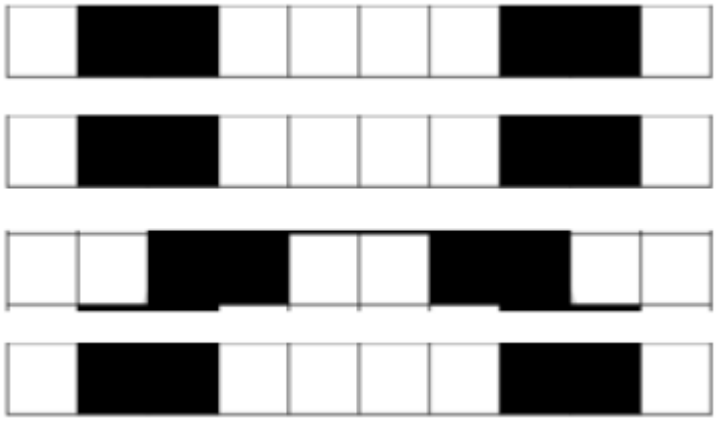
cut the horizontal stripes

6. Now, paste all these stripes together to form a single paper string. Make sure that the last block should neither be over the first block of the next line nor should there be any gap in between the first and the last blocks.



Paste all strips together

7. Find those students in your class who have chosen the same alphabet as you. Put their strings under your string and do the addition of all the coloured blocks to get a series of numbers.
8. Blocks without colour count as 0 while the coloured ones count as 1. If a column has 3 coloured boxes, the summation turns out to be 3.



count boxes

Learning outcome

Note down the points you learnt from this activity and submit.

This activity clarifies that:

- The images saved in the computer are divided into the pixels.
- Machine learning also uses the same approach for its applications.
- The computer analyses each pixel, whenever any comparison required it compares these pixels. If pixels are identical, this means that the images are the same.

By the above activity, we have created an intelligent model to identify the alphabet is same or not. We have divided the alphabet into 36 blocks and processed it.

Trained the model to process the same alphabet but different handwritings. Now when we testes it, the model would see if the coloured blocks are aligned or not.

If the majority of the blocks are aligned altogether, there exists a maximum probability that the alphabet is the same. Otherwise, the alphabet is different.

Watch this video for practical understanding:

Play Video

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Neural Networks

Introduction

The unit 3 neural networks consist of the learning outcome as understand and appreciate the concept of Neural Network through gamification. The session or activity or practical consists of following topics:

1. Relation between the neural network and nervous system in human body
2. Describing the function of neural network

Then we will discuss about an activity given in your syllabus creating human neural network.

The neural networks are the model that how neurons in the human brain behave. It is also known as ANN(Artificial Neural Network) that copy the working of the human brain neurons or cells inside the computers.

The greatest thing of ANN is it can extract the features of data without any programming or input. The computer can learn, recognise, and make decisions like human beings.

The neural network works on machine learning algorithms to fulfil the need of the user or perform the task. It is basically used to solve the problems for large dataset.

The traditional Machine Learning algorithm cannot improve the performance of the model after certain levels and then saturation will start.

Whereas Small ANN performs better than as Medium and Large Neural Network dataset.

Observe the following image given in your CBSE handbook:

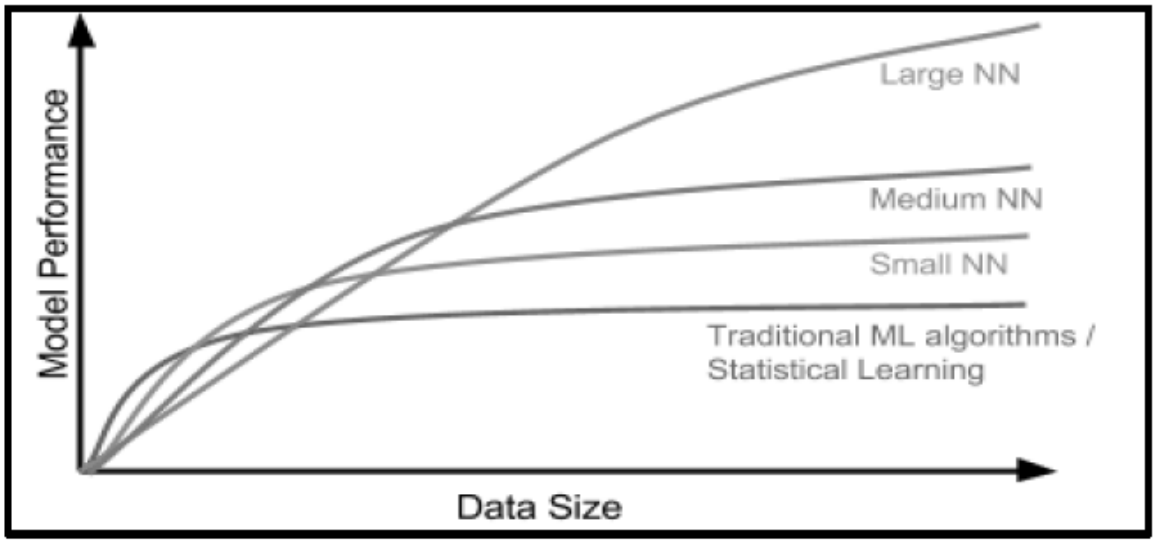


Image Credit - AI CBSE Curriculum Handbook

Now lets understand how neural networks works.

How neural network works?

Observe the image given below:

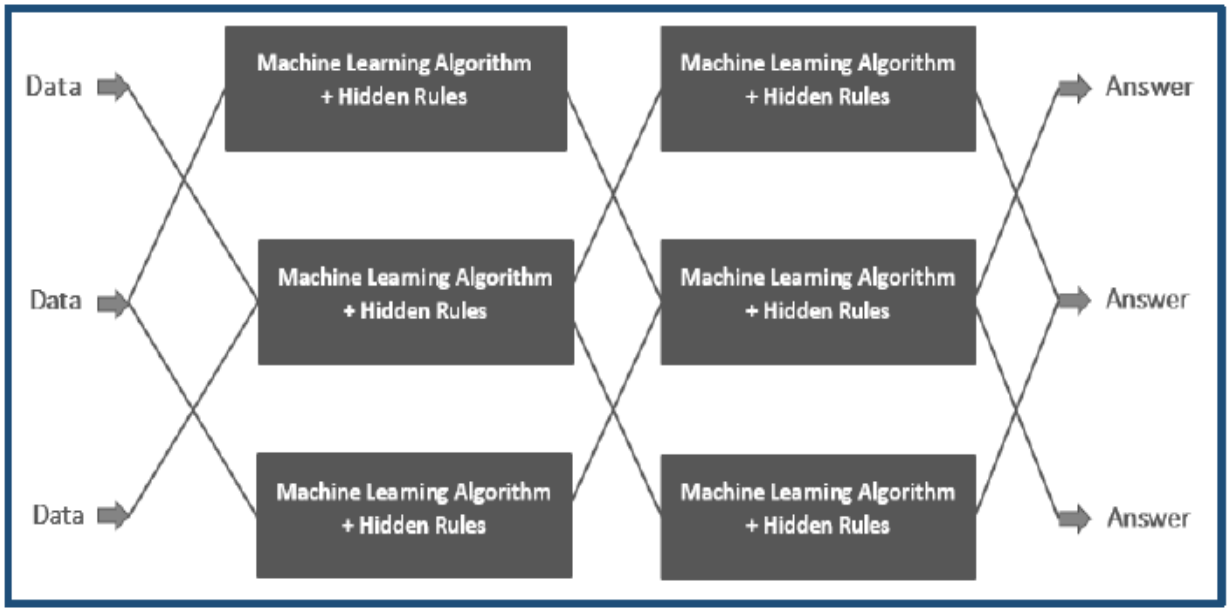


Image Credit - AI CBSE Curriculum Handbook

This image shows the representation of how neural networks work. This image shows that neural network is divided into different layers and each layer is divided into a block that accomplish its own task and then passes to the next layer.

The first layer of neural network is known as input layer that acquires the data and feed it to the neural network. Some hidden layers are there which are not visible but all processing occurs in these layers.

These hidden layers have its own machine learning algorithm which is executes on the data received from the input layer. Then the processed output is fed to subsequent hidden layer. Similarly, at the last hidden layer passes the final processed data to the output layer.

Now the next section of Notes Neural Networks for AI Class 9 we will talk about features of NN.

Features of Neural Network

1. NN systems are modelled on the human brain and nervous system
2. It can extract data without any input from the user
3. Every node is essentially a machine learning algorithm
4. Useful when solving problems for which the data set is very large

In the next section of Notes Neural Networks we will talk about neural networks vs nervous system.

Neural Networks Vs Nervous System

As you know computers can perform complex tasks which human beings can't do in an easy manner. We can't do complex millions of computations per second.

Similarly, computers also can't do some easy tasks. Here Artificial Intelligence plays a role.

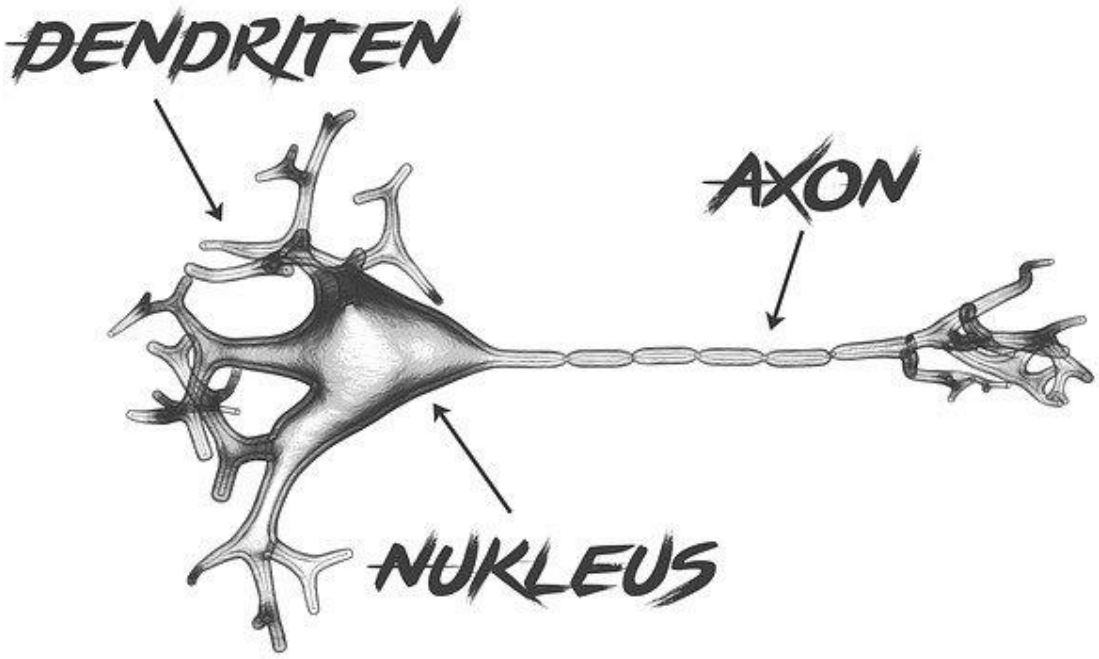
ANN creates that are based on the working of the human brain. These networks solve complex computation problems by regulating how the computing cells are activated.

Now in the next section of Notes Neural Networks for AI Class 9 we will see the human brain and its functions in short.

The human brain is made up of billions of interconnected neurons. The interconnections are highly complex. The neurons working in parallel exchanging information through their connectors 'synapses'.

Billions of connections among billions of neurons! Each neuron is talking to millions of other neurons. Each neuron of the brain is made up of a cell body. These cell bodies are tiny.

An area of a single square millimetre can contain approximately 100 cell bodies. There are several dendrites attached to the cell body and a single axon.



Nerve cell dendrites

How neural networks learn!

There are three ways of neural networks learning:

1. Supervised Learning
2. Unsupervised Learning
3. Reinforcement Learning

Supervised Learning

As the name supervised learning indicates there is a supervisor like teacher who teaches or trains the model with respect to the output.
In this type of learning, networks are trained to provide the correct output by using several example inputs.

For example, the network can be trained on the data of students and marks. After training the network will be able to calculate the marks based on various elements like the length of the answer, correct facts written in the answers, comprehension length etc.

Unsupervised Learning

In this learning no output related information received by the neural network and it provides only input. The system evaluates and find out how different elements are related. This method used for solving clustering problems, estimation problems, self-organizing maps etc.

Reinforcement Learning

Reinforcement learning, the neural network learn based on learning from experience. Unlike supervised learning, reinforcement learning doesn't have any output information.

It is employed by various software and machines to find the best possible behaviour or path it should take in a specific situation.

Important Questions

Play Video

Prepared by: Sanjay Parmar, PGT – Computer Science

Activity - Creating a human neural network

The **Five important Things To Know About Creating A Human Neural Network** are as follows:

1. Purpose
2. Material Required
3. Game Structure
4. Ground Rules
5. Game Instructions

Let's we discuss in detail now.

Purpose

The main purpose of this recommended activity is to understand and experience what a neural network is like. By this activity students will understand how the neural network works.

Each student will be considered as a node of layers either of following:

1. Input Layer
2. Hidden Layer - 1
3. Hidden Layer - 2
4. Output Layer

For this activity students presence is required. How to arrange the students, we will discuss in the rules and instructions.

For creating a human network you need to think about the session. In this stage, you need to prepare a session according to the strength of the class. In the CBSE study material handbook, they have given for 40 students. This activity is an individual activity.

Material Required

Now let's talk about material required for **create a human network**. Observe the following table for material required:

Material	Quantity
Images (To be kept with the facilitator)	2
Post-It Notes	80 (40 x 2)
Sketch Pens	40

materials required for create a human network

4 images given in your study material, you can use any image or download the same given there.

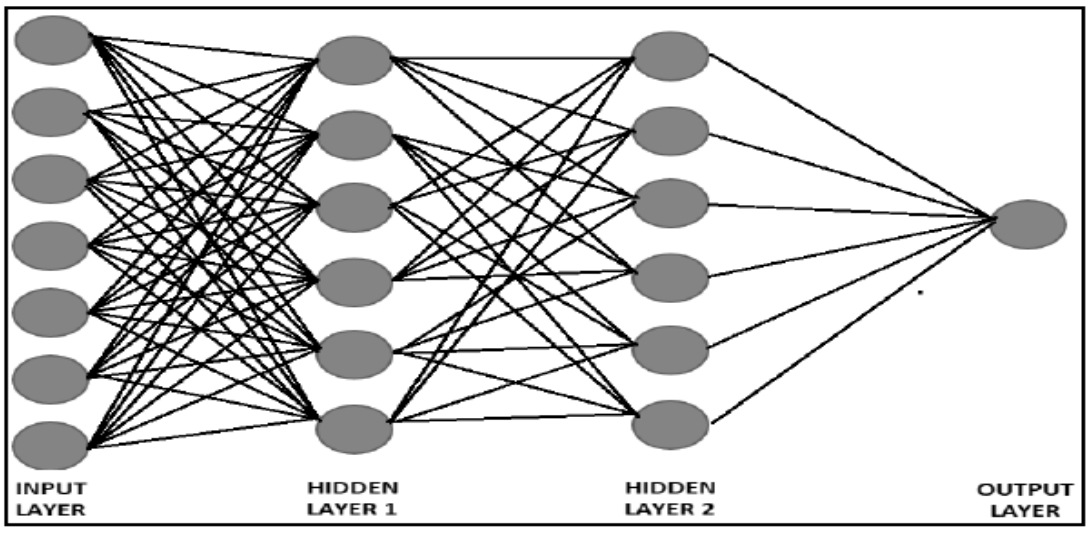
Game Structure

Now let's we talk about the game structure or arrangements. Observe this table for the game structure!

Layers	No. of students	Chits
Input Layer	7	6
Hidden Layer 1	6	4
Hidden Layer 2	6	2
Output layer	1	-
Total	20	-

Game structure - creating human neural network

The structure look likes something this:



Game structure - Creating A Human Neural Network

Ground Rules

- No one is allowed to talk or discuss till the game ends. Fun of the game lies in playing it honestly.
- Each layer should sit distant to each other.
- The image should only be shown to the Input layer and no one else.
- The game is supposed to be played silently. This means that one has to write a word on the chit and pass on the chit without speaking out aloud.
- One needs to process the data as fast as possible, hence not take much time can be taken to write and pass on the chits.
- Input layer nodes cannot discuss the image shown with each other. Everyone has to use their own discretion.
- No sentences or multiple words are to be written on the chit. Only one word per chit is allowed.
- Once the task of a layer is finished, that layer needs to go and sit aside and not disturb others till the game ends.

Now in the next thing is game instructions for **Creating A Human Neural Network**.

Game Instructions

Let's talk about input layer first for Creating A Human Neural Network.

Input Layer

- 7 students will be standing as the nodes of an input layer.
- All of them will be shown as an image. After looking at it, they need to write 6 different words on 6 different chits. They have to choose the words which describe the image in the best way possible. They can also repeat the words if needed.

- After making these chits, they need to pass on one chit to each of the nodes of hidden layer 1. That is, 1 chit will be given to one member.

The next layer is hidden layers, here hidden layer 1 for Creating A Human Neural Network.

Hidden Layer 1

- 6 students will be standing as the nodes of hidden layer 1.
- Each of them will receive 7 chits from 7 different input nodes. Now they have to take a good look at the chits and then write down 4 different words on 4 different chits.
- For this, they can either use the same words as the input layer did, or they can make their own information (relevant to the context) and write it.
- Now, these 4 chits are to be given randomly to any 4 nodes of Hidden Layer 2. Out of the 6 nodes of 2nd hidden layer, one can choose any 4 and give once chit to each. (For best results, each node of hidden layer 2 should get the almost same number of chits thus the division should be done properly)

Now let's discuss about hidden layer 2 for Creating A Human Neural Network.

Hidden Layer 2

- 6 students will be standing as the nodes of hidden layer 2.
- Each one of them will get some number of chits from the previous layer.
- Now they have to perform the same task as hidden layer 1 and have to write down 2 different words on 2 different chits and pass it on to the output layer.

The last layer of Creating A Human Neural Network is output layer.

Output Layer

- Finally, the output layer node will get 12 chits. Now s/he has to understand all the words and has to guess which image was shown to the input layer initially.
- Output layer will then write a summary out of all the words received to explain his/her deduction. The summary should not be more than 5 lines.
- Finally, the output layer presents this summary in-front of everyone and the real image is finally revealed to all.
- If the summary is accurate enough, the whole network wins else they lose.

Tools for Creating A Human Neural Network

1. **Cartoonify** - You have used your own cartoon on Instagram or Snapchat or any other social media, isn't it? Cartoonify converts your photo or image into outline cartoon. You can upload any picture on this platform and see the changes. It will produce different output every time when you are using the same image.
2. **Quick Draw** - This game allows you to draw a random figure in 20 seconds! It will try to guess that what you drawing during you are drawing it. You can create 6 drawings, each them in 20 seconds. Watch this video to understand how it is working!
3. **Handwriting with a Neural Net** - It generates the stroke based on input given by you. It shows the working of a neural network.
4. **Multi Predictor**: It will show the predicted image based on the partial drawing made by the user.
5. **Variational Auto Encoder** - Read this article for details.

Play Video for practical understanding

Unit 4 Introduction to Python

Topic	Learning Outcomes
Introduction to python through gamified portal	• Introduction to programming using Online Gaming portals like Code Combat

Python programming skills	• Introduction to Python language
	• Introducing python programming and its applications
	• Python Basics
	  ○ Variables, Arithmetic Operators, Expressions
	  ○ Data Types - integer, float, strings, using print() and input() functions
	• Students will try some simple problem-solving exercises on Python Compiler
	• Flow of control and conditions
	  ○ Students go through lessons on conditional and iterative statements (if, for and while)
	  ○ Students will try some basic problem-solving exercises using conditional and iterative statements on Python Compiler
	• Python Lists
	  ○ Students go through lessons on Python Lists (Simple operations using list)
	  ○ Students will try some basic problem-solving exercises using lists on Python Compiler

Prepared by: Sanjay Parmar, PGT – Computer Science

Introduction to Python

Introduction to Code Combat

Dear Students, as now you are aware that AI is using programming languages. So it is very difficult to say which programming language AI is favouring but now **Python** is one of them and CBSE is also given an introductory part in class 9 syllabus. So today we will discuss Code Combat. So get ready and learn new concepts.

What is Code Combat?

Code Combat is an online or web-based program that allows us to interprets python code with the fun of gaming designing and development.

By using this code you develop your games and play different games. So it adds excitement towards learning new skills.

How to start?

After understanding what is code combat now lets know how to start with Code Combat.

You need an internet connection and a good browser program to start with it. So let's go to your computer system and open a browser and follow these steps:

Sign up or Create an account

1. Click on this link to open: https://codecombat.com/ you will get this screen.

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2. Click on I'm a Student option.
3. Now it will ask class code. (The class code will be provided by your teacher, you request him/her for the same). Either you can create an individual account to by choosing the option "**Create an Individual account instead."**

4. Now it will ask for Date of birth. Select Month, Day, Year then click on the continue button.

5. Type email address, User Name, and Password or click on sign with google account or Facebook.
6. Click on Create Account button.

Creating an account with google account

Follow similar steps up to step 5. Then select Google account. In the next step, it will provide one message that code combat is linked with your Google account. Now type the username and finish the process. Then start playing.

Now get familiar with login for playing the game Code Combat.

Login for Playing

Now you are ready to play. Just login and start:

1. Click on this link to open: https://codecombat.com/ and click on the Play button.
2. It will ask your username and password.

3. Enter username and password or choose Connect with Facebook or Sign in with Google option.

Now understand how to start the game Code Combat.

Start the game

Now you will get a screen **Kithgard Dungeon.** Click on the play button there are 42 levels. For python basic learning part.

Now you will get a screen to start your Level.

Now click on the place where the yellow icon is displayed and new pop up will come out with the Play button, click on the Play button.

Select a hero and equip

1. Now choose your hero screen will come, select any character from the screen.

2. Click on the Next button.

3. Select the equipment for your hero. Double click on the equip button.

4. Now click on Play Button. It will open the start level screen. Click on the start Level button.

The next section talks about a few methods used while playing the game code combat in Code Combat.

Write methods and move you're here

There are four methods to move your hero

1. hero.moveRight()
2. hero.moveLeft()
3. hero.moveUp()
4. hero.moveDown()

Run the methods

Follow the instructions and use the above methods to move your hero as per the screen guide. Write the method and click on the run button. Now enjoy the game and learn how to write methods. Write all the movements as per screen guide and then Run.

Continue to the next level

1. When you finished the level, it will add XP and diamonds, continue the game, and complete all the levels.

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Introduction to Tools For AI

In this section of Introduction to Tools For AI, you will learn about some tools which are helpful for better understanding of AI, debugging code, and many more.

As you learn about 3 major AI Domains: Data, NLP and CV require various packages needs to be installed. You can install them in IDLE too, but it is very difficult to manage them. So in this article we will discuss about **anaconda and jupyter notebook**.

Anaconda Distribution

The anaconda distribution is the collection of certain packages that are used for **data science, R language, machine learning**, and **other platforms**. It is one of the IDE software with integration of multiple platforms.

Before downloading, check your OS version whether it is 32 bit or 64 bit. To download Anaconda follow this link:

Download Anaconda

Anaconda provides following applications:

1. CMD.exe prompt
2. Datalore
3. IBM Watson Studio Cloud
4. Jupyter lab
5. Jupyter Notebook
6. Powershell Prompt
7. Qt Console
8. Spyder
9. Glueviz
10. Orange 3
11. Pycharm professional
12. RStudio

These all applications run on base (root). It is suggested that you have to use jupyter notebook for the python introduction part in class 9 and Advanced Python in class 10.

So in the next section of Introduction to Tools For AI you will learn how to open jupyter notebook and how to work on it.

Introduction to Jupyter Notebook

The jupyter notebook is an integrated web application in anaconda distribution. It allows to create and share the live documents that contain live code, equations etc. If it is not integrated in your anaconda installations, you can find the installation guide by following this link:

Jupyter Notebook Install Guide

Jupyter notebook features

- The Jupyter Notebook is an incredibly powerful tool for interactively developing and presenting AI-related projects.
- The Jupyter project is the successor to the earlier IPython Notebook, which was first published as a prototype in 2010
- Although it is possible to use many different programming languages within Jupyter Notebooks, Python remains the most commonly used language for it.

How to access jupyter notebook?

Anaconda provides the easiest way to access jupyter notebook. Anaconda navigator application provides you different application under one root. There are two ways to access jupyter notebook:

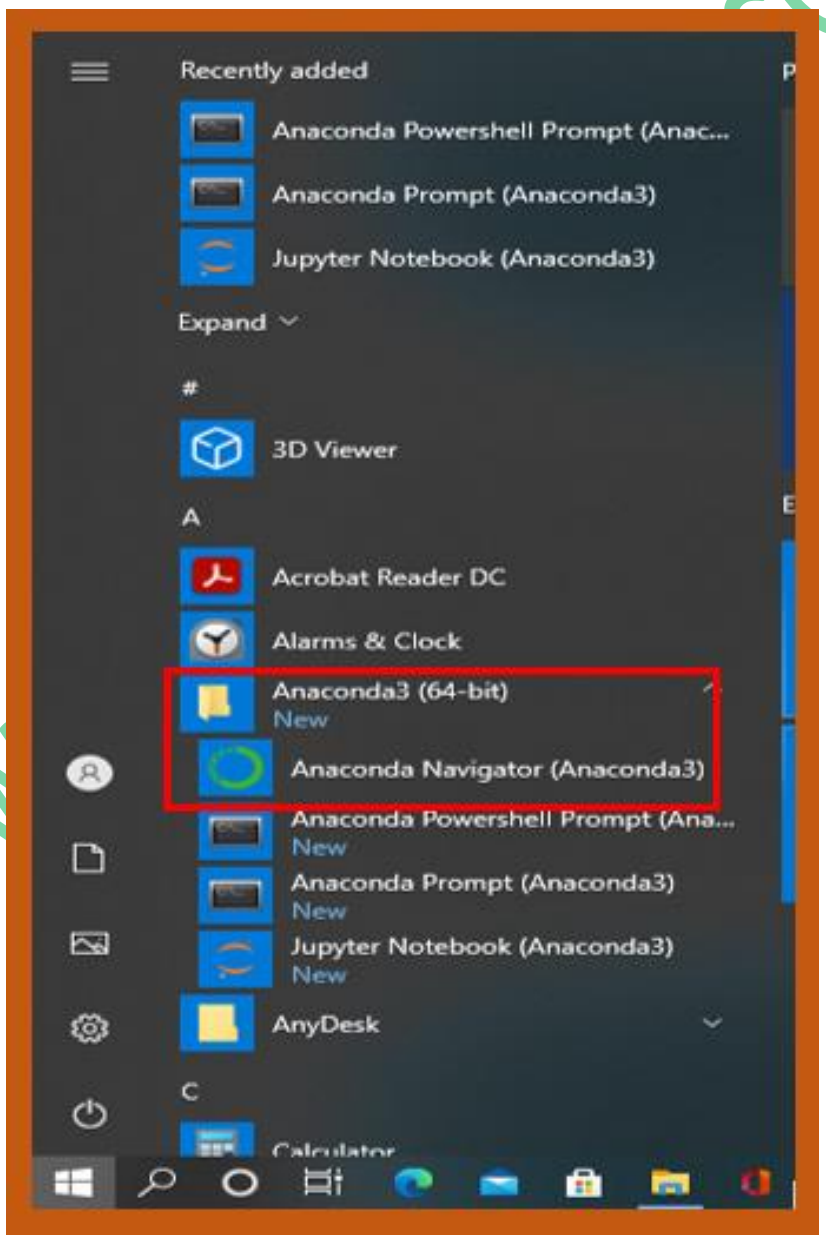
1. Anaconda Navigator
2. Anaconda Prompt

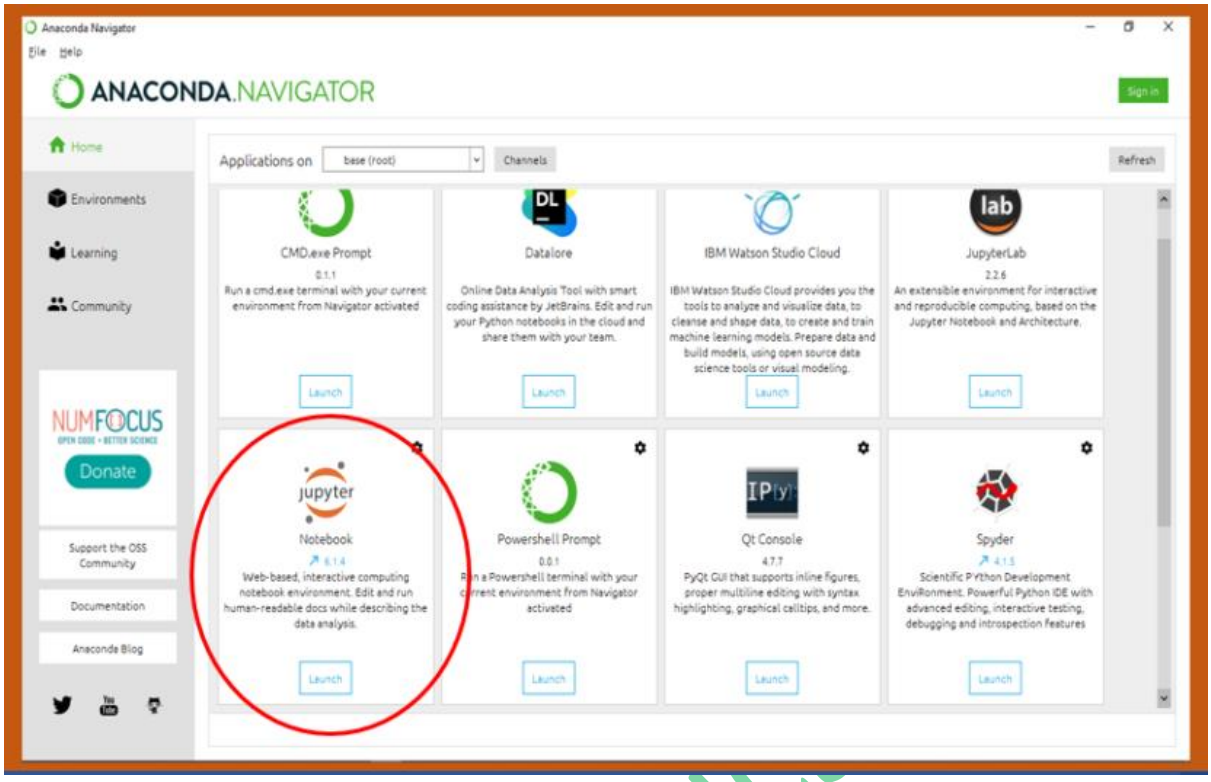
Anaconda navigator

This is a GUI based application that provides a way to launch jupyter notebook. Follow these steps to launch jupyter notebook.

1. Click Start > Anaconda3 > Anaconda Navigator(Anaconda3). It will open the Anaconda Navigator application.
2. Scroll and Find the Jupyter notebook.
3. Click on the launch button.

Observe these screenshots:





Launching Jupyter notebook through Anaconda Navigator

Anaconda Prompt

To launch jupyter notebook using Anaconda Prompt is a little bit different process then launching jupyter notebook through anaconda navigator. Anaconda prompt allows to launch jupyter notebook through the **kernel and IPython. IPython** is the **default kernel** for **jupyter notebook**. So this kernel is required to be installed inside the virtual environment.

Introduction to the virtual environment

A virtual environment is a tool that helps to keep dependencies required by different projects separated, by creating isolated Python virtual environments for them. This is one of the most important tools that most of the Python developers use.

Mostly it is used to avoid the conflict between multiple environments of the same programming language. A developer might need to work on Python 3.7 and Python 3.8 both.

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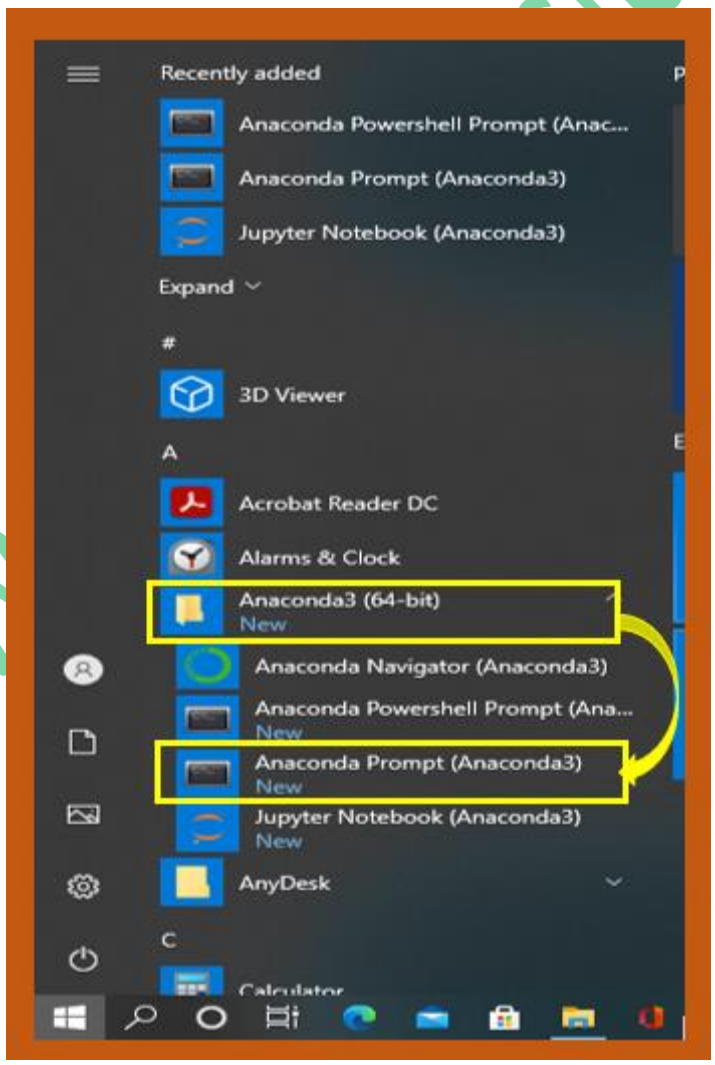
Now, in this case, a developer has to create a virtual environment so it will not affect the base environment and its dependencies. When a virtual environment is created, it will isolate the dependencies from the base environment.

How to create a virtual environment with anaconda distribution?

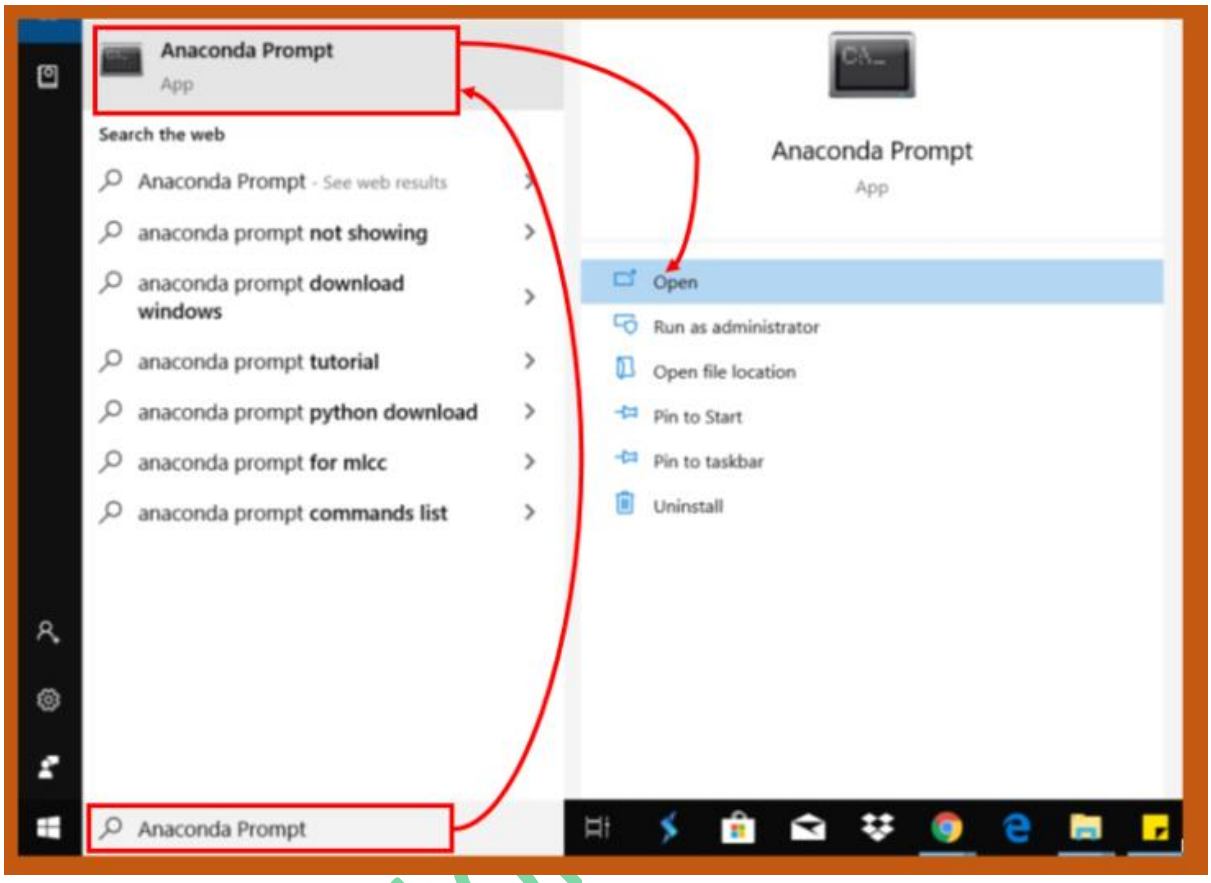
Create a virtual environment with Anaconda is very easy process. Follow these steps:

[1] Click on Start > Ananconda3(64-bit) > Anaconda Prompt(Anaconda3).

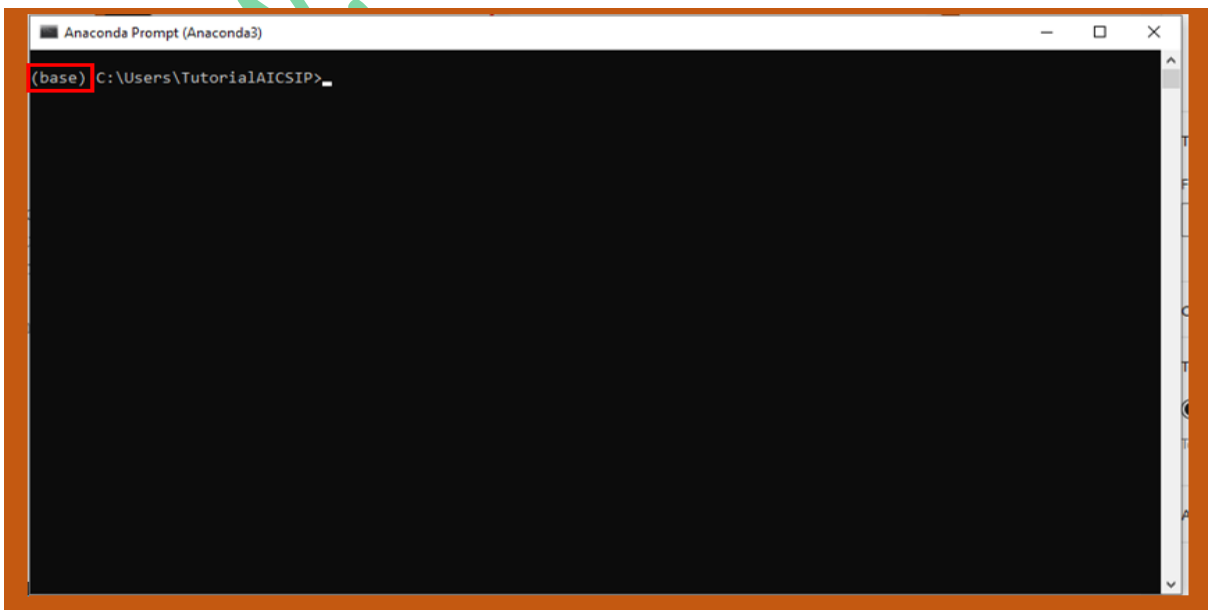


Open anaconda prompt

Or simply type Anaconda Prompt in the start menu search box and select Anaconda Prompt when it will display the list.

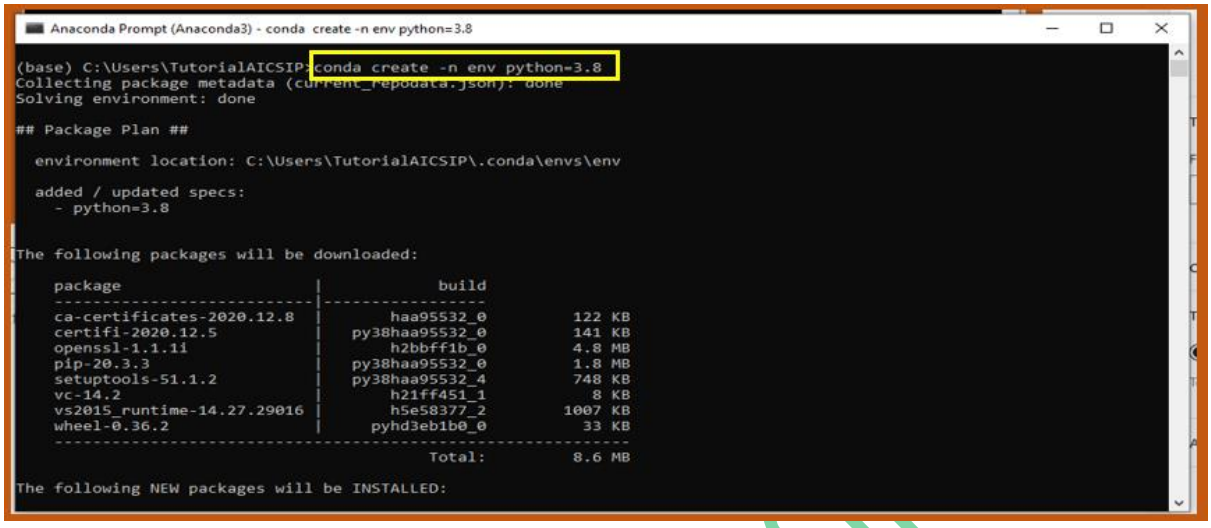


[2] Now the Anaconda prompt will open and you can find a word base is written before the user directory path. Observe the following screenshot.



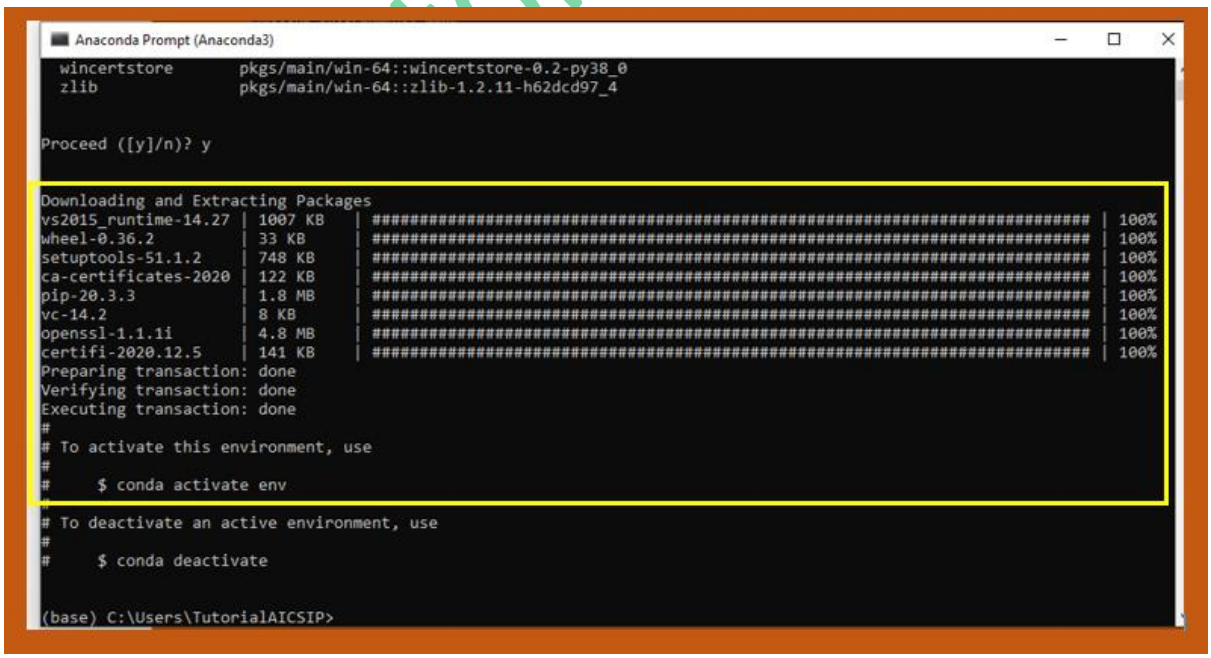
[3] Now type the command to create virtual environment:

conda create -n env python=3.8



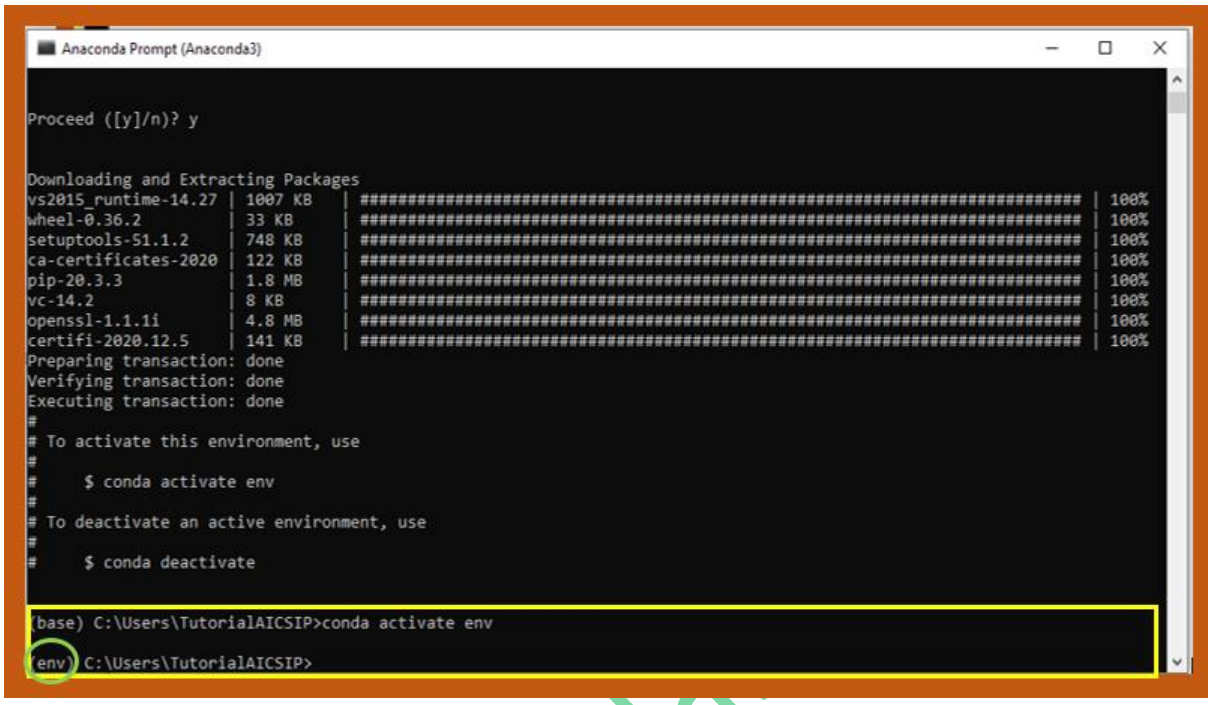
anaconda create virtual environment command

[4] Now, it will ask to process ([y]/n)? Press y, and it will download some required packages then ask o activate the virtual environment. Type the command conda activate env. Observe the below-given screenshot:



conda activate env command

[5] Now you can observe that the base word will be replaced by env. Observe this screenshot:



activated virtual environment

Install Jupyter notebook dependencies

To install jupyter notebook dependencies you need to type this command in active virtual environment:

conda install ipykernel nb_conda jupyter

It will again ask for yes/no proceed after sometime, press y and process ahead. It's done.

Virtual environment and anaconda navigator is having many packages, so if you are getting any error kindly register yourself with online community. You may get the your error solved there in the specific forum.

To understand how it works practically play this video:

Play Video

Python Basics Jupyter notebook

I have already written a detailed post on python basics part. Follow the below given links to read them:

Getting Started with Python

Python Fundamentals

Open Jupyter Notebook

If you missed the article how to install and create virtual environment for jupyter notebook, follow this link:

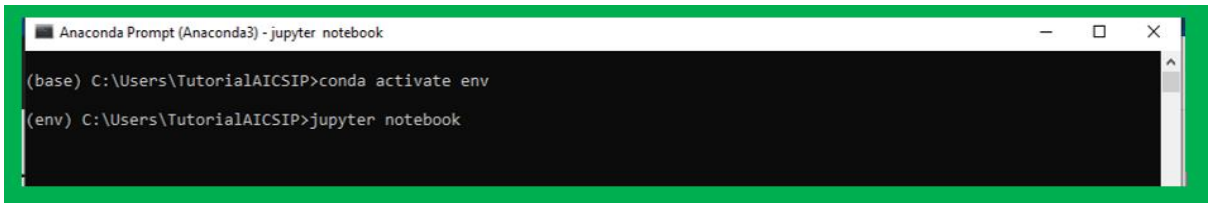
Creating Virtual Environment

In the next section of Python Basics Jupyter notebook, you will learn how to open Jupyter Notebook and start your programs.

Launching Jupyter Notebook in Virtual Environment

Follow the below given steps to open Jupyter notebook in virtual environment:

1. Click on Start > Anaconda Prompt. Anaconda Prompt will open.
2. Now type **conda activate env** command. It will activate the virtual environment.
3. Now type Jupyter Notebook.
4. After few seconds Jupyter notebook will be launched in the browser.



Launching Jupyter notebook through Anaconda Prompt

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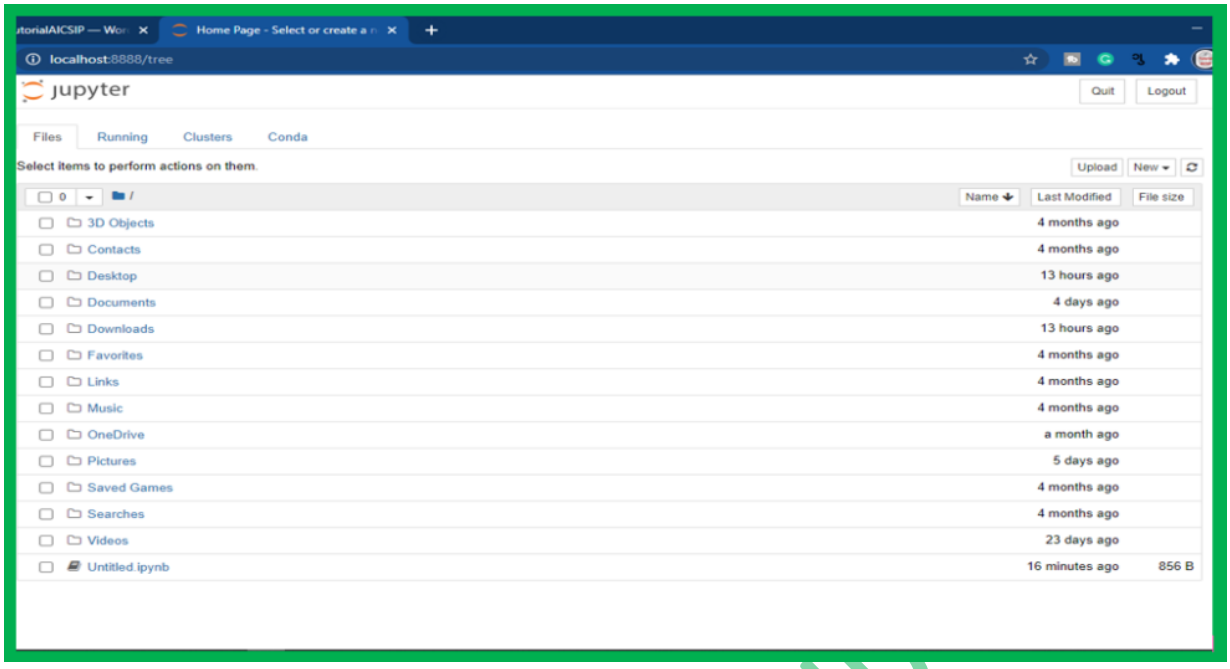


Jupyter Notebook Screen

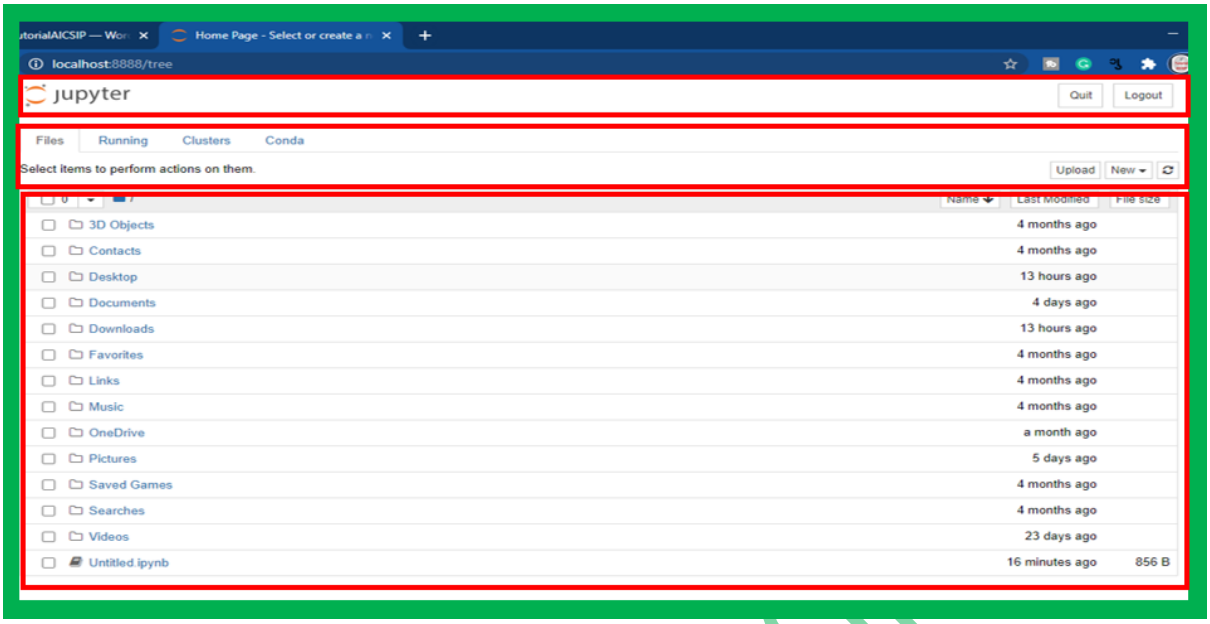
In the next section of Python Basics Jupyter notebook, you will get acquainted with the parts of jupyter notebook window.

Parts of Jupyter notebook window

Jupyter notebook window is mainly divided into 3 parts:

1. **Jupyter header with quit and logout button:** It contains Jupyter Notebook logo in left and Quit and Logout buttons to the left of the screen to exit from the jupyter notebook.
2. **Tabs and Action Buttons**: At the left side of this part, you will get tabs such as Files, Running, Clusters and Conda. In the next line, you will get buttons such as upload and New command.
3. **Folders and files on localhost**: It displays a list of files and folders available on localhost.

Observe the following screen:



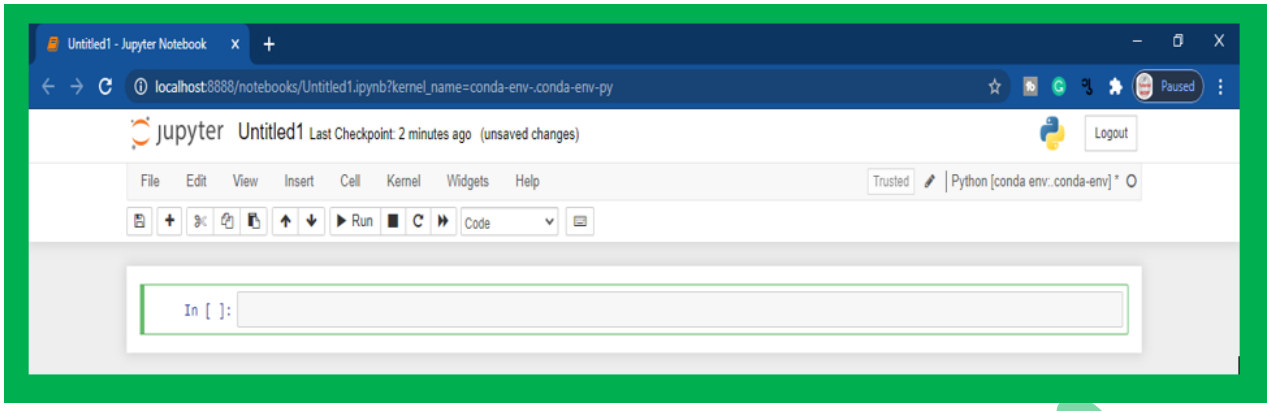
parts of Jupyter notebook window

In the next section of Python Basics Jupyter notebook, we will see how to start a new notebook for starting the work.

Open a New notebook file

To open the new file for writing in Jupyter notebook, follow these steps:

1. Click on New and select your choice to work with a particular environment. This option provides:
    1. Python 3
    2. Python [conda env:.conda-env]*
    3. Python [conda env:root]
2. Now you will get a new browser window in the new tab with Untitled 1 - Jupyter Notebook.



New Jupyter Notebook

The tool bar is available with different commands mostly used while using jupyter notebook. So understand the commands:

1. **Save**: This is used to save the notebook
2. **+**: Insert a new cell
3. **Cut, Copy, Paste:** Used to cut, copy and paste the written text
4. **Up and down arrows:** To move to up and down the cells
5. **Run, interrupt and restart the kernel**: Run command is used to run the code, interrupt is used to interrupt the current code, restart the kernel is used to restart the kernel
6. **Code**: Here you can change it according to your need out of **Code**, **MarkDown**, **Raw NBConvert**, **Heading**

using print() function in python

The print0 function is used to write the some text on the output console. Observe the following:

```
print("Hello, My Dear Student this is Python")
```

Remember this key points while using print() function in python:

1. The text must be enclosed with quotes.
2. You can use single or double quotes.
3. You can also print the value of variable that we will see later.

Using multiple print() statement

You can use multiple print() function to print more lines. As much lines you want as much print() function should be required. Observe the following lines, I want three lines, so I have used the print() function three times.

```
print("My name is Sanjay Parmar.\n")
print("I am very excited to learn python.\n")
print("I am using Jupyter Notebook.\n")
```

The python print() accepts three parameters:

1. The text as which you have seen above.
2. A separator as sep which provides a character to separate your variables.
3. By default new line character accepted by print function is '\n'. This can be changed using end parameter. Specify the character which you want to use as endline character for your output.

Observe this code and output:

```
In [4]: a = 5
        b = a * 2
        c = b + 3
        print(a,b,c,sep='@',end=' ')
        print('Thank you')

        5@10@13 Thank you
```

Play this video for practical explanation:

Play Video

Prepared by: Sanjay Parmar, PGT – Computer Science

Comprehensive notes Python basics

Statements

As we are writing the script of drama, essay or any language-related contents for speech or presentation etc. in languages like English, Hindi. Similarly, the program is also one type of scripts. So as we are writing sentences, similarly, in programs, we are writing **statements**.

A program statement is the instruction written in program to execute certain type of code.

There are certain number of lines written in the code to execute some specific tasks. These lines are known as **statements.**

For Example, The programmer want to print the product of 5 and 6, then he will write something like this:

```
print(5 * 6)
```

So here the python interpreter identifies the print() function and the * operator and display the product of 5 and 6 i.e. 30.

Python supports three types of statements:

1. Empty Statement: Written by using **pass** statement
2. Simple statement: A statement having a single line statement
3. Complex statement: Contains a block of code having more than one statements with indentation

Comments

Sometimes we need **some statements that are not going to be executed**, but some text needed for the programs. These type of text is known as comments. Whatever written in these **comments are ignored by the interpreter**.

Comments are the statements which are incorporated in the code to give a **better understanding of code statements** to the user.

There are two types of comments in python.

1. Single Line
2. Multi Line

Single Line comment

A single-line comment is used to add some explanatory text in the program for better understanding of the next line. A # sign is used to write a single line comment in the python program. For example,

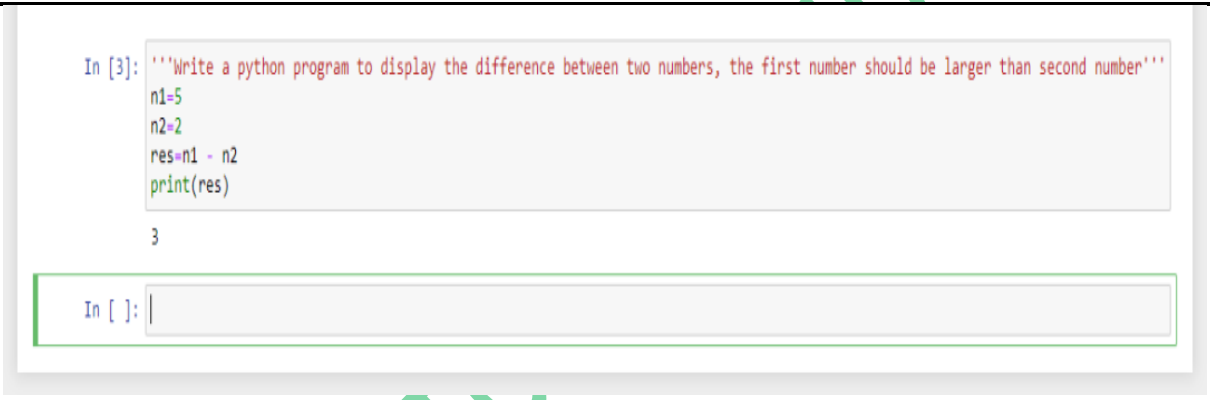
```
#A statement to add two numbers
res = 6 + 7
#Print the result
print(res)
```

Python single comment in Jupyter notebook

Multiline comments

The multiline comments are written in python using triple quotes. You can write number lines starting with triple quotes and end with triple quotes. For example,

```
'''Write a python program to display the difference between two numbers, the first number should be larger than second number'''
n1=5
n2=2
res=n1 - n2
print(res)
```



Multiline comments in python - Jupyter notebook

In the next section of Comprehensive notes Python basics we will discuss about keywords.

Keywords

Keywords are the reserved words or pre-defined words with a special meaning to the machine by default.

So the user cannot use them anywhere else or it cannot be changed or modified in the entire program. They are always case-sensitive.

You have to use the same for the entire program. Click here to see the list of keywords. The next section of Comprehensive notes Python basics will talk about the identifiers.

Identifiers

Identifiers are the names declared and used by the programmer.

- The identifiers are also **case-sensitive**.
- Identifiers can be used anywhere and anyway by the user in the program.
- You **cannot use any keyword** as an identifier.

Play this video for practical explanation:

Play Video

Variables

A program contains data like numbers and text. To hold these numbers and text you need some storage. So the variables come into the picture over here.

The variables are identifiers declared by the user and named storage location to hold a specific value.

The variable can change the value anywhere in the program. Follow some rules of naming convention while declaring a variable. These rules are:

1. It must start with an alphabet.
2. It should not have any space, special characters.
3. Keywords cannot be used as variable.

Datatypes

In program, you have a choice to use any type of data such as real numbers, numbers with decimals, numbers without decimals, text, etc. These type of data is defined by datatype in Python.

The python interprets the type of the variable according to the value stored in the variable. Follow the below-given link to know more about data types.

Python Datatypes

input() function

The input() function is used to accept values from the user at runtime. This function accepts and returns the text data by default. Therefore, you need to specify the data type if you want to use numbers or any other datatype. This process is known as typecasting.

Observe these screenshots code:

python input() function in jupyter notebook

python input() function in jupyter notebook 2

```
In [8]: a = input("Enter number 1:")
        b= input("Enter number 2:")
        c = a + b
        print(c)

        Enter number 1:5
        Enter number 2:8
        58
```

So in the above output, you have seen that the final output is 58 which is not an addition but python join both numbers and returned 58.

To avoid this you need to use typecasting in this manner. Observe the below-given code and understand it!

```
In [9]: a = int(input("Enter number 1:"))
        b = int(input("Enter number 2:"))
        c = a + b
        print(c)

        Enter number 1:5
        Enter number 2:8
        13
```

type casting into int in python

Operators

I have written a detailed article on python operators. Follow the below given link for the same.

Python Operators

Play this video for more understanding and explanation about python basics:

Play Video

Prepared by: Sanjay Parmar, PGT – Computer Science

Flow of control and conditions

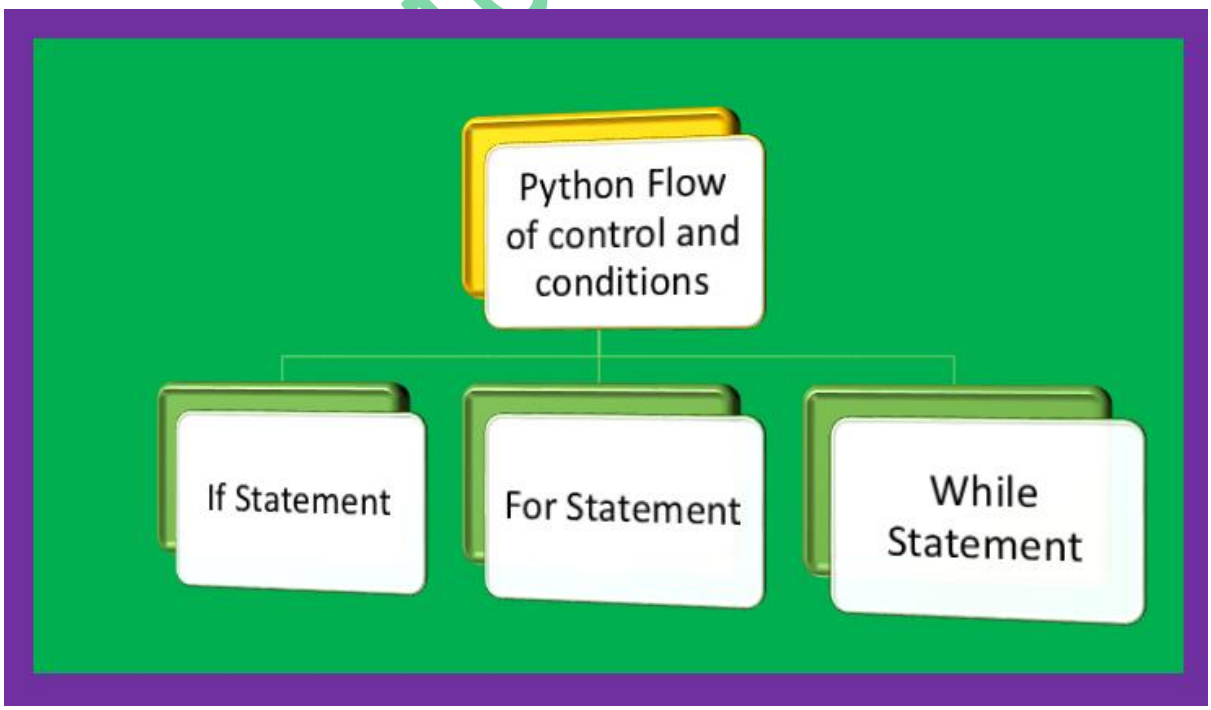
What is the flow of control?

The flow of control means executing the statement according to the conditions.

Suppose, you have two choices for going out according to the weather conditions. One, if weather conditions are good you can go for play otherwise stay at home. So here your flow will be something like **this if weather is good then Go for play, otherwise stay at home**.

The above said example is an example of flow of control. Python offers three types of flow of control and conditions.

1. If statement
2. For statement
3. While statement



Python flow of control and conditions

Prepared by: Sanjay Parmar, PGT – Computer Science

Python if else statements

In real life many times we are facing such situations where we have to make some decisions based on certain conditions what we need to do to overcome those situations or to get success!

Similarly in programming also this type of conditions arise where a programmer has to take the decision to solve a particular problem.

The flow of control statements are also known as **decision making statements** in programming.

As you are familiar now, **if else** statement is also one of the part of them. Python offers following types of if else statements:

1. Simple if
2. If-else
3. If-elif-else ladder

Simple if Statement

If you have only one condition to be execute or one possibility of output, **simple if statement** is useful for the same.

It executes the True condition block.

Suppose, If gate is open you are allowed to go inside! Let's see the syntax:

```
if <condition>:
  statement(s)
```

```
gate_status = "open"
if gate_status=="open":
    print("Entry is permitted")
```

- In the above example, we have taken one variable to store the status of gate as "open".
- In next line, the condition is checking the value of gate_status with "open".
- If both are equals then the message will be displayed on the screen.

Let's have a look at another example.

```
age = 14
if age>12 and age<20:
  print("You are teenager")
print("Be yourself!!!")
```

```
age=12
if age>12 and age<20:
  print("You are teenager")
print("Either your are child or adult")
```

Understand the above code by yourself.

In python, the **indentation plays an important role**. After a block of code python automatically start a new line with indentation. Observe the statement written after the colon (:). So while writing the python code in your notebook, be careful!

Python if-else statement

In the next section of Easy notes for AI Class 9 Python if else statements, you will learn about python if-else.

Python if-else statement is useful when you have two choices or possibilities. **"If this then this, otherwise that"** like condition is considered as python if-else statement.

For example, if a number is odd, otherwise even. If the gate status is open Entry is permitted, otherwise go back to home! Look at the syntax of python if-else statement:

```
if <condition>:
  statement(s)
else:
  statement(s)
```

Observe the following code:

```
gate_status = "open"

if gate_status=="open":
   print("Entry is permitted")
else:
   print("You have to go back to your home, Bye - Bye")
```

Here, if the status is open then it will execute the if block, otherwise else block. So here we have the gate_status variable and the value is "open" so, if block will execute. Try to understand following code:

```
age = 10
if age>12 and age<20:
  print("You are teenager")
else:
  print("Either your are child or adult")
```

What will be the output of the above code? Try this in jupyter notebook and observe the output by yourself.

Play this video for explanation and clear understanding:

Play Video

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Now in the next section of Easy notes for AI Class 9 Python if else statements, you will learn about if-elif-else ladder.

Python if-elif-else ladder

Python if-elif-else ladder is used in the case when you have more than two choices or possibilities. The elif is a short form of else if. The ladder means it will continue upto n possiblities. **Like if this then this, or if this then this,…., otherwise this.**

The syntax for python if-elif-else ladder is as following:

```
if <condition1>:
  statement(s)
elif <condition2>:
  statement(s)
elif <condition3>:
  statement(s)
....
....
....
else:
 statement(s)
```

Now we will see the example of if-elif-else ladder for Easy notes for AI Class 9 Python if else statements.

This program is all about to check whether the given number is of one-digit number or two-digit number or three-digit number or more than three-digit number.

Observe this code:

```
n = int(input("Enter no. to check:"))
if n>0 and n<10:
  print("The no. is one digit number")
elif n>0 and n<10:
  print("The no. is two digit number")
elif n>0 and n<10:
  print("The no. is three digit number")
else:
  print("The no. is more than 3 digit number")
```

In the above program for Easy notes for AI Class 9 Python if else statements we have **4 possibilities** such as the **number is 1 digit number or 2 digit number or 3 digit number or more than 3 digit number**.

So started with if...then elif.... at the last we have used else block. So it will check the statements as per the number values entered as input.

Watch this video for more understanding and explanation:

Play Video

Nested if statement

The nested if statement consists of if within if statement. One if statement contains another if statement inside is called nested if. Look at the syntax:

```
if <condition>:
   if <condition>:
      statement(s)
...
...
```

In nested if the in one condition another condition will be checked.

Follow the below given link for the programs based on if-else statement:

Python Program list on if-else

Prepared by: Sanjay Parmar, PGT – Computer Science

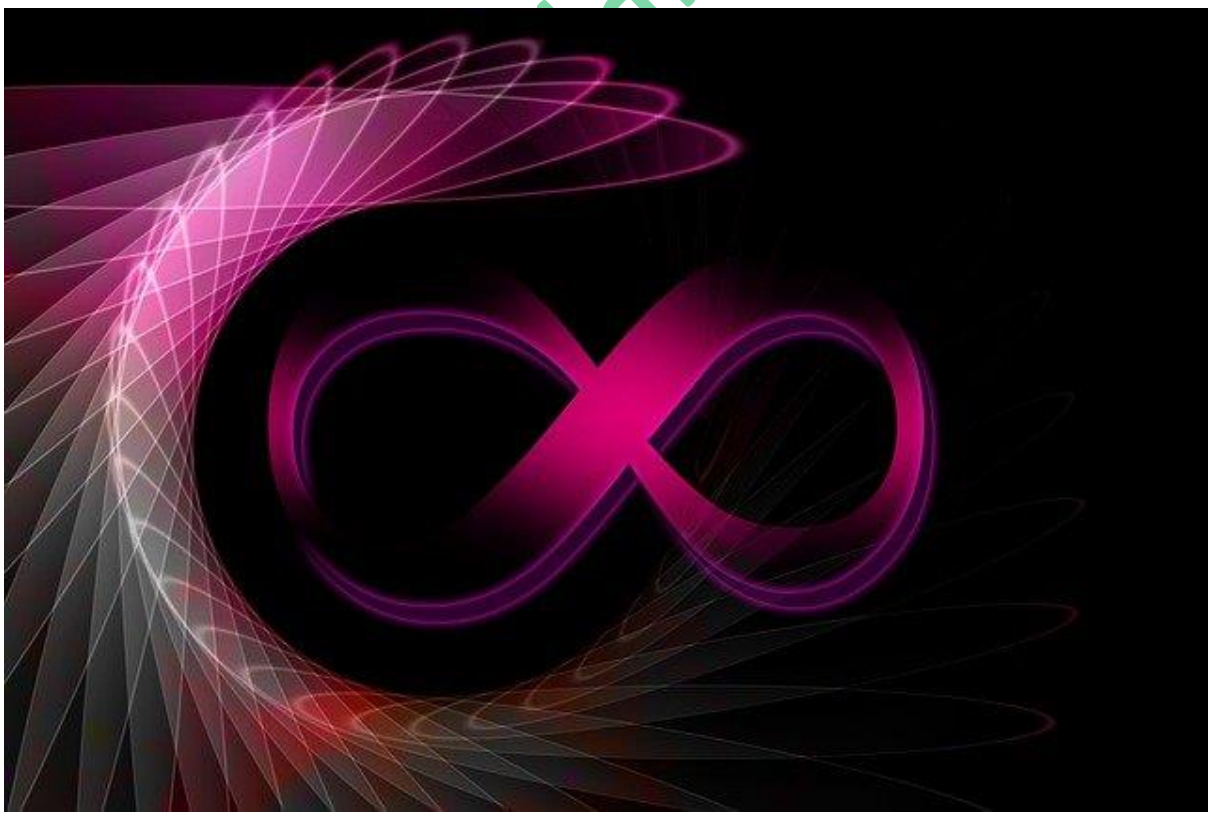
Loops in Python

Loops are used to execute some repetitive statements in python until the condition is not satisfied. As you know, many cycles are there which are running around us based on some criteria. Similarly, in python when we have such things like this we can use python loops.

Loops are a collection of statements executed repeatedly until the condition evaluates to false. It is also known as iteration or iterative statements.

It can be also considered as step by step execution of python statements until the condition evaluates to false. Now let us talk about the parts of the loop.

Parts of Loop



Loops in Python AI Class 9

Prepared by: Sanjay Parmar, PGT – Computer Science

There are three parts of Loops:

1. Iterator - The starting value point
2. Condition - Specify the condition
3. Update Statement - Changing the value for the next step

Types of Loop

Python support two kinds of loops.

1. **While:** A while loop is used when you have different repetitive statements with a single condition. When the condition gets false, your loop will terminate itself. While loop may have else block too quite often.
2. **For:** The easy and popular loop is for a loop. It is very easy to write and understand because all the parts of loops are written in the same line in for loop. It will reduce the lines of codes as three parts of loops are written in a single line.

While loop

The while syntax is as follows:

```
iterator
while <condition>:
   statement(s)
   update_statement
```

Here in the syntax:

- **iterator** - Iterator means that starting point
- **while condition** - Here you can write the condition
- **statement(s)** - The statements which you are going to execute repeatedly
- **Update Statement** - The arithmetic statement which changes the value for the next step

Observe this code which display a series of numbers from 1 to 10.

```
i=1
while i<=10:
  print(i)
  i = i + 1
print("End of loop")
```

- This code will print the number from 1 to 10.
- In the while loop, the condition will be tested first and then it will enter inside the body of the loop and execute the statement.
- If update statement is missing or not available there then the loop is infinite loop.

Watch these programs videos for more understanding:

Play Video

While loop video explanation in Python IDLE:

Play Video

Reverse number program in Python:

Play Video

Series based programs:

Play Video

Armstrong Number, Palindrome Number program video:

Play Video

In the next section of Loops in Python AI Class 9, I am going to discuss about the for loop.

For Loop

The for loop is used to execute the sequence of statements executed in a series. It is the most popular loop among python developers. It is also work in a similar way as while loop is working.

Observe the syntax of for loop:

```
for <variable> in <sequence>:
    body loop
```

So here variable is a variable from and then you can take a sequence to execute the statements. The in operator is used to take check the value in the specified sequence. For the sequence, you can use the range function.

Observe this example in which for loop is used for Loops in Python.

```
for i in range(1,10,1):
    print(i)
```

Python for loop in jupyter notebook:

Play Video

Watch this video for explanation and understanding:

Play Video

- In the above code, the range function is used. The range() function takes three basic parameters.
- The first is a start, the second is a stop and the third is a step.
- So in the above code, the loop starts with 1, stops with 10 and taking one step in every execution.
- The output will be 1 to 10 numbers only.

More programs video on for loop:

Play Video

Python pattern programs using for loop:

Play Video

Python Lists

Introduction to list in python

A list of a sequence of similar or different values in a single unit of a different type.

Observe the following line of code for a simple list in python:

l=[10,30,50,70,90]

A python list has the following common properties:

- Each value of a list item is known as element or item.
- Each value is separated by commas.
- Values must be enclosed by square brackets.
- It is most versatile data type used in python.

Creating list in python

As you know list python supports different types of data types like numbers, strings and boolean values.

These values you can store in different variables. But sometimes we need a list of similar or different types of data in a single unit. Or we need something which prepares a set of similar or different values.

For example, Let's assume a student as an object. Now a student can have roll no, name, class, date of birth etc. These details we want to use in the program all should come in a single unit. So here the list will help to serve this purpose.

Definition of List

A list a type of a python collection that can store and manipulate similar as well as different types data values.

Those who are familiar with other programming languages may familiar with Arrays. Python lists are quite similar to that but only one difference is there that the array is a collection of homogeneous (similar kind) data whereas the python list is a collection of heterogeneous (different type) data.

Creating a list in python

To create a list square brackets are used. It can be represented in the following forms:

1. **Empty List: []** --> Empty lists can be created when you need add values later or size is not fixed
2. **List of numeric values:** [11,22,33,44,55] --> This list contains numbers as elements.
3. **List of mixed numbers:** [11,22.22,33.33,44] --> This list is a collection of integers and float numbers.
4. **List of letters:** ['x','y','z'] --> This list is collection of letters or alphabets
5. **List of words:** ['Hello','How','are','you'] --> This list is collection few words
6. **List of mix different data types**: ['00001','Sagar',10001,'12/12/2005'] --> This list is collection of a student record with different data values

in the next section of Creating list in python, we are going to discuss creating an empty list.

Creating An Empty List

To create an empty list declare one list and initialize with square brackets without any value.

```
l = []
```

In the above statement, I have created an empty list named l. Now, whenever I want to access elements from this list I will use l and then manipulate the list with different expressions.

In the next section of Creating list in python, I will cover the topic of creating lists with multiple values.

Creating lists with multiple values

To create lists with multiple values initialize your list with values you want to put in the list.

```
l = [22,33.33,45,'17/08/2001','Hetal','Parmar']
```

The list values can be accessed by its index.

Index	Value
0 - l[0]	22
1 - l[1]	33.33
2 - l[2]	45
3 - l[3]	17/08/2001
4 - l[4]	Hetal
5 - l[5]	Parmar

Creating nested list

A list can be an element of another list. This type of list is known as a nested list.

```
l = [1,'Manish',[56,67,89]]
```

The values can be access in following:

```
l[0]=1
l[1]=Manish
l[2][0]=56
l[2][1]=67
l[2][2]=89
```

Creating list from a word or text

The text initialized with list function returned as a list.

```
l = list('Python Lists')
print(l)
Output --> ['P', 'y', 't', 'h', 'o', 'n', ' ', 'L', 'i', 's', 't', 's']
```

Now in the next section of Creating list in python class-11, we will cover the topic creating list from user input.

Creating list from user input

Use input function to create a list in following manner.

```
l = list(input("Enter a value"))
print(l)
Output -->
Enter values:4567
['4', '5', '6', '7']
```

Observe the output given above, when you take values from input it always returns the numbers as string with single quotes in a list. To avoid this you can use this.

To do this use eval function and enter values with square brackets:

```
l = eval(input("Enter values"))
print(l)
Output-->
Enter values: [4,5,6,7]
[4,5,6,7]
```

Whenever the eval function is used with the input you can enter the values in form of a list itself at the input console.

Watch this video for more understanding of the topic Creating list in python:

Play Video

List manipulations

In previous session you learned how to create a lists, now its time to learn how to use and manipulate these lists and its elements. Basically lists are mutable i.e. values can be changed in place.

At first sight, lists are similar to strings. So the list manipulation is also similar to string manipulation. The following are ways to access lists:

1. Index
2. Slicing
3. Membership Operator
4. Concatenation
5. Replication
6. Comparing Lists
7. Making a true copy of lists

Now we will discuss each topic of List manipulation in detail.

Accessing/Traversing Lists by Index

List elements are stored with indexes. Each element of lists is having a specific index like a string. There are two ways to access lists:

1. Positive indexing
2. Negative Indexing
3. Using loop

Positive Indexing

The positive indexing allows to access the value starting with 0,1,2,3 and so on.

```
l = [11,22,33,44,55]
print("L[0]=>",l[0])
print("L[1]=>",l[1])
print("L[2]=>",l[2])
print("L[3]=>",l[3])
print("L[4]=>",l[4])
```

Negative Indexing

Negative indexing refers to access or traverse the list from reverse order in means when the negative index is used, it will display the last element first.

```
l = [11,22,33,44,55]
print("L[0]=>",l[-1])
print("L[1]=>",l[-2])
print("L[2]=>",l[-3])
print("L[3]=>",l[-4])
print("L[4]=>",l[-5])
```

Using Loop

You can use for loop to access list elements. Observe the following code:

```
l = [11,22,33,44,55]
for i in range(0,5):
    print("L[",i,"]=>",l[i])
```

I have used range to display the value of i in output, You can avoid range function as well in following manner:

```
l = [11,22,33,44,55]
for i in l:
    print(i)
```

Slicing Lists

You can extract specified elements by slicing lists. Consider the following syntax for slicing lists:

```
slice1 = l [start : stop : step]
```

The start refer to the starting index value of list slice and stop refer to the end index value.

Let's have a look at the following example:

```
l = [11,22,33,44,55]
slice1 = l[0:4]
print(slice1)
```

The negative index value extract the list in reverse order.

```
l = [11,22,33,44,55]

slice1=l[2:-1]
print(slice1)
```

It will slice the list from index 2 i.e. 33 to index -1 i.e. 44. Hence the output will be [33,44].

Now just take a look at the following code:

```
l = [11,22,33,44,55]

slice1=l[2:33]
print(slice1)
```

In the above code, list slicing is starting with index 1 i.e. 33 to index 33 i.e not available in the list, hence it will print the rest of all the values. Python executes the statement without errors.

When both lists are given out of bounds it will return empty lists.

Now let's have a look at following examples:

```
l=[11,22,33,44,55,66,77,88,99]
print(l[0:10:2])
```

The above code slice the lists elements and display alternative index values. Similarly you can change the step value and slice the list accordingly. Consider these examples:

```
l=[11,22,33,44,55,66,77,88,99]
print(l[0:10:3])
print(l[:5:3])
print(l[::3])
print(l[4::2])
```

Type above examples and observe the output, if you have any doubt ask in the comment.

Membership Operator

There are two membership operators as we have covered in string manipulations:

1. in
2. not in

in operator

It returns true if the specified number is present in the list.

```
l=[11,22,33,44,55,66,77,88,99]
print(44 in l)
```

This code returns **True** as 44 is present in the list.

not in Operator

The not in Operator results exactly opposite compared to in operator.

```
l=[11,22,33,44,55,66,77,88,99]
print(44 not in l)
```

This code returns False as 44 is present in the list.

Concatenation

It is also known as joining lists. To join or concatenate the lists, '+' operator is used. For example,

```
l1 = [4,5,6]
l2 = [7,8,9]
l3 = l1 + l2
print(l3)
```

The above code joins the elements of l1 and l3 into l3. So the output will be [4,5,6,7,8,9].

Replication

It is use to repeat the list number of times.

```
l= [1,2,3]
l = l * 4
```

The output of above code is [1,2,3,1,2,3,1,2,3,1,2,3]

Comparing Lists

To compare lists relational operator is used.

```
l1 = [4,5,6]
l2 = [7,8,9]
if l1>l2:
 print("L1 is greater than L2")
else:
  print("L2 is greater than L1")
```

It will compare the list values and display the results accordingly.

Making true copy of a list

To make a true copy of a list copy function is used.

```
l1 = [1,2,3]
l2 =l1.copy()
print(l2)
```

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Python list functions

As you are well aware that python has many library functions that reduced the coder efforts to perform some operations in an efficient manner. These built-in functions can be used for list manipulation as well. In this section of Python list functions, we will discuss them as per your syllabus.

When we declare a list object in python code, this list object is an instance of List class. To use any built-in for list manipulation, you need to write it in this manner:

```
<listobject>.<function>()
```

Some of the library functions not required the alias names.

These functions are:

1. len()
2. list()
3. index()
4. append()
5. extend()
6. insert()
7. pop()
8. clear()
9. count()
10. remove()
11. reverse()
12. sort()
13. sorted()

The len() function()

This function returns the length of the list. The length of the list is equal to the number of elements present in the list. It is a standard library function.

Syntax:

```
len(list_object)
```

Have a look at the following code:

```
>>> l = ['Mon','Tue','Wed','Thurs','Fri','Sat']
>>> print(len(l))
```

The output of the above code is 6, as there are 6 elements specified in the list.

If the list contains the nested list, it will be something like this:

```
>>> l=[['Mon','Tue','Wed'],['Thu','fri'],'Sat','Sun']
>>> print(len(l))
```

The output of the above code is 4, as there are 2 sub lists elements and 2 main list elements specified in the list.

The list() method

This function will convert the passed parameters into list. If no arguments passed then it will create an empty list.

Syntax:

```
list([elements])
```

Take a look at this code:

```
>>> list()
```

It returns [], empty list.

```
>>> list("TutorialAICSIP")
```

It will return ['T', 'u', 't', 'o', 'r', 'i', 'a', 'l', 'A', 'I', 'C', 'S', 'I', 'P'] as output.

```
rno=int(input("Enter the rollno:"))
stu_name=input("Enter the name:")
fees=int(input("Enter the Fees:"))
stu_rec=list([rno,stu_name,fees])
print(stu_rec)
```

In the above code, three separate elements merged into a list, using list() method.

Similarly you can convert any tuple, dictionary elements into the list using list() function.

In the next section of python list functions, we will discuss the functions used with the list instance.

The index() method()

This method returns the matched index of element from the list.

Syntax:

```
<list_obj>.index(<element>)
```

Observe this code:

```
>>> l=[11,22,27,34,67,98]
>>> l.index(27)
```

The above code will return 2 as output. The element value 27 at index 2.

If the number which is not present in the list elements and passed as parameter python will return as error.

```
>>> l=[11,22,27,34,67,98]
>>> l.index(2)
```

The above code raise following error:

```
Traceback (most recent call last):
  File "<pyshell#11>", line 1, in <module>
    l.index(2)
ValueError: 2 is not in list
```

The next section explains the functions which are used to insert elements into the list for python list functions.

The append() method

The append() method will add elements into the existing list. The element which is added by append() method will add at the end of the list.

Syntax:

```
<list_obj>.append(<element>)
```

Have a look at this code:

```
l=[]
l.append(10)
print(l)
```

The append() method exactly takes one argument to add the values. The value can be a scalar value, tuple, list, dictionary, etc.

The extend() method

The extend() method add multiple values into the list.

Syntax:

```
<list_obj>.extend(<element>)
```

Observe the following code:

```
l=[]
l.extend([11,22,33,44])
print(l)
```

The insert() method

As you learn how to add or insert elements into the list at the end using append() method and extend() method. In this section we will see one more method to insert() element at desired location.

Syntax:

```
<list_obj>.insert(<idx>,<element>)
```

The insert() method takes two parameters:

1. idx - Index position of the element
2. Element - Value of needs to be insert

Observe the following code:

```
l=['Jan','Mar','Apr']
l.insert(1,'Feb')
print(l)
```

The output will be:

['Jan', 'Feb', 'Mar', 'Apr']

It can also takes a negative index to be inserted.

The next section of python list functions explains the functions which are used to remove the elements from the list.

The pop() method

The pop() is used to remove element from the list.

Syntax:

```
<list_obj>.pop(<idx>)
```

Look at the following example:

```
l=['Jan','Feb','Mar','Apr']
l.pop()
print(l)
```

When the pop() method is used without any parameter, it will delete the last element.

The output will be:

['Jan', 'Feb', 'Mar']

You can delete a specific element by passing the index value of that particular element.

```
l=['Jan','Feb','Mar','Apr']
l.pop(2)
print(l)
```

The output will be:

['Jan', 'Feb', 'Apr']

The remove() method

The remove method is used to remove the elements by its value. If you are not aware about the index of the element and you know the value, you can use remove method.

Syntax:

```
<list_obj>.remove(<element_value>)
```

Observe this code:

```
l=['Jan','Feb','Mar','Apr']
l.remove('Feb')
print(l)
```

The output will be:

['Jan', 'Mar', 'Apr']

The clear() method

It will remove all elements from the list. This function doesn't require any parameter.

Syntax:

```
<list_obj>.clear()
l=['Jan','Feb','Mar','Apr']
l.clear()
print(l)
```

It will return [] i.e. empty list.

In the next section of python list functions, we will discuss some functions with common operations of a list.

The count() method

It will count the presence of element passed as an argument from the list. If the element is not available in the list, it will return zero.

Syntax:

```
<list_obj>.count(element)
```

Let us have look at the following code:

```
l=['Jan','Feb','Mar','Apr','Jan']
l2=l*2
print(l2.count('Jan'))
```

The reverse() method

It will display the list in the reverse form. It will reverse the list element in place. It doesn't require any value as parameter or argument.

Syntax:

```
<list_obj>.reverse()
```

Look at this code:

```
l=['Jan','Feb','Mar','Apr']
l.reverse()
print(l)
```

The sort() method

It sorts the elements in ascending or descending order. The default order is ascending order.

Syntax:

```
<list_obj>.sort([reverse=False/True])
```

The code:

```
l=['Jan','Feb','Mar','Apr']
l.sort()
print(l)
```

The output will be:

['Apr', 'Feb', 'Jan', 'Mar']

To display the list in descending order use the reverse parameter and pass it with the value "reverse=True".

Observe this code:

```
l=['Jan','Feb','Mar','Apr']
l.sort(reverse=True)
print(l)
```

The output will be:

['Mar', 'Jan', 'Feb', 'Apr']

The next function of python list functions is a standard library function which is used to sort the results.

The sorted() method

This function sorted() function also sort the list but it will return a new sorted list. Observe the following code:

```
l=['Jan','Feb','Mar','Apr']
l1=sorted(l)
print(l1)
```

Moreover you can also use some of the following functions:

1. max()
2. min()
3. sum()

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