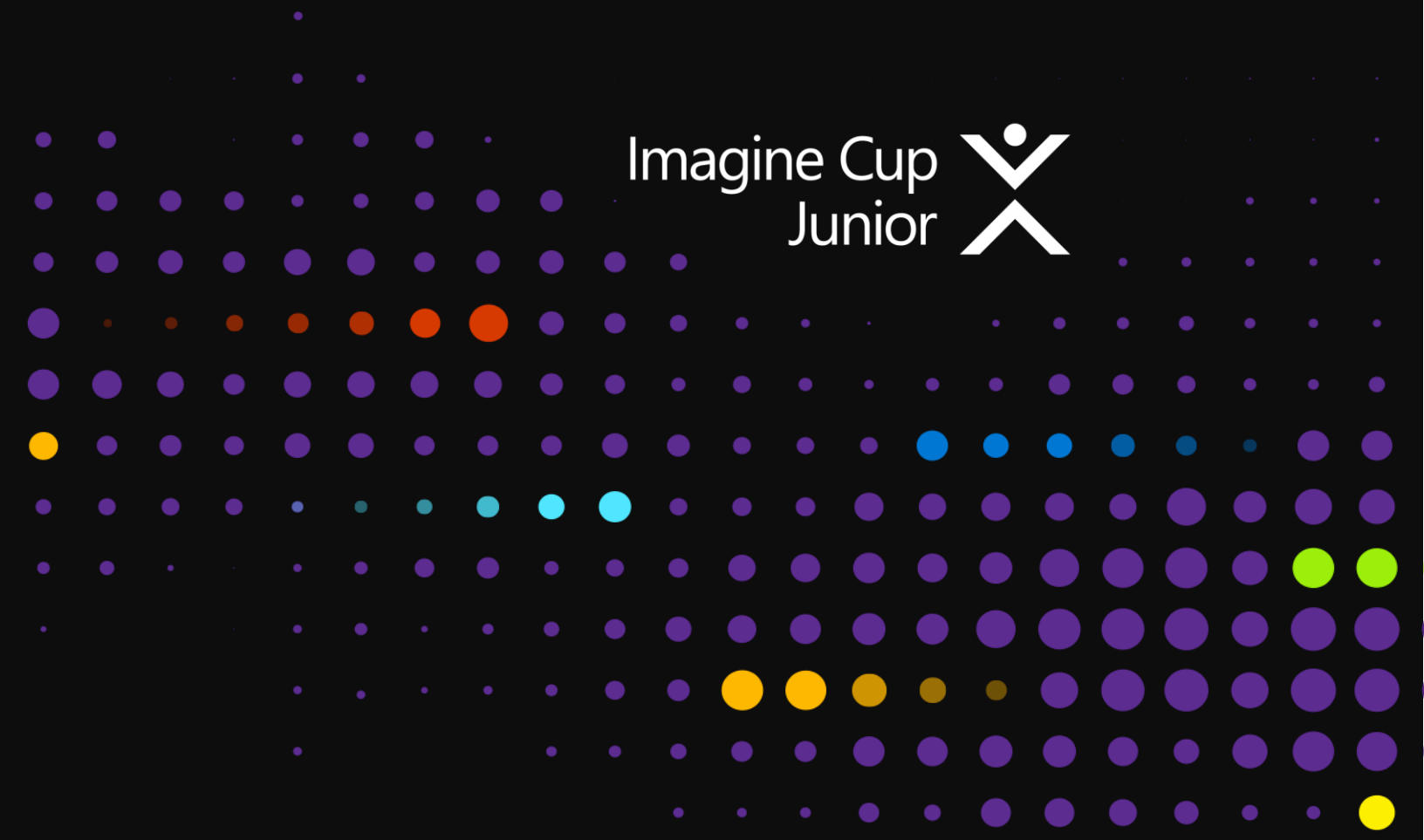

Fundamentals of Artificial Intelligence

Module 1

Microsoft

Table of Contents

Disclaimer:

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Introduction

This content has been created in order to support educators in providing their students with an understanding of Artificial Intelligence (AI), to increase knowledge of this emerging technology, and to inspire engagement in Imagine Cup Junior.

The content makes use of real life scenarios and how AI can have an impact on the world around them. Educators can use real life scenarios, case studies, research-based action-oriented tasks, and examples from everyday life as part of the student learning. The hands-on-activities are designed to reinforce experiential learning and effective retention of the subject matter.

The content is designed to be used as follows:

- Educators can use the content to explain the theory of AI, as well as give practical demonstration of the concepts via real-life examples and prompt students to put forward their own real-life examples in order to demonstrate the comprehension of the concept and its possible applications.
- Having been provided with a handbook, students should be encouraged to collaborate, research, explore, and utilize the various resources available .

Learning Outcomes

By the end of the module, the students will be able to:

- Understand the meaning of intelligence from an AI perspective.
- Identify the application of AI in real life, how we are surrounded by it, and use it in everyday life.
- Understand methods of data collection and its importance in machine learning.
- Get exposure to digital assistants and how they can help humans in their personal and professional life.
- Conduct a project that involves the use of AI and create a report on its impact.

Overview of AI

Artificial Intelligence

Artificial Intelligence (AI) has been an integral part of our lives whether we have realized it or not. When we book a ticket online, scroll through our newsfeed on our social networking account, or read the recommendations from an ecommerce site, we are engaging with an AI component in the background (Medium, 2019). Even the simple chat assistant that we sometimes encounter whilst shopping online or ordering food is driven by AI.

Fig 1.1: Applications of Artificial Intelligence

Artificial Intelligence is an attempt to make a computer, a robot, or other piece of technology 'think' and process data in the same way as we humans do. AI therefore has to study how the human brain 'thinks', learns, and makes decisions when it tries to solve problems or execute a task. The aim of AI is to improve technology by adding functionality related to the human acts of reasoning, learning, and problem-solving. Here are a few practical examples to demonstrate how AI has penetrated our everyday lives to provide services that we can use extensively to make our lives easier.

Microsoft Connected Life

Home automation systems such as Microsoft Connected Life allows home appliances such as lights, thermostats, speakers, TVs and other home appliances to be connected to a local Wi-Fi network and therefore the Internet. These devices can then be controlled from any Windows 10 Device, including Tablets. Other appliances can be added to the network via 'Smart' Plugs allowing older devices also to be controlled. When linked to AI supported systems such as Cortana (see below), the devices can not only be controlled via your personal Windows 10 device but also by your voice, allowing you to stream music or video from your favorite provider to capable appliances such as TVs and Speakers. In the future these systems will learn your individual life routine at home using AI and control devices accordingly.

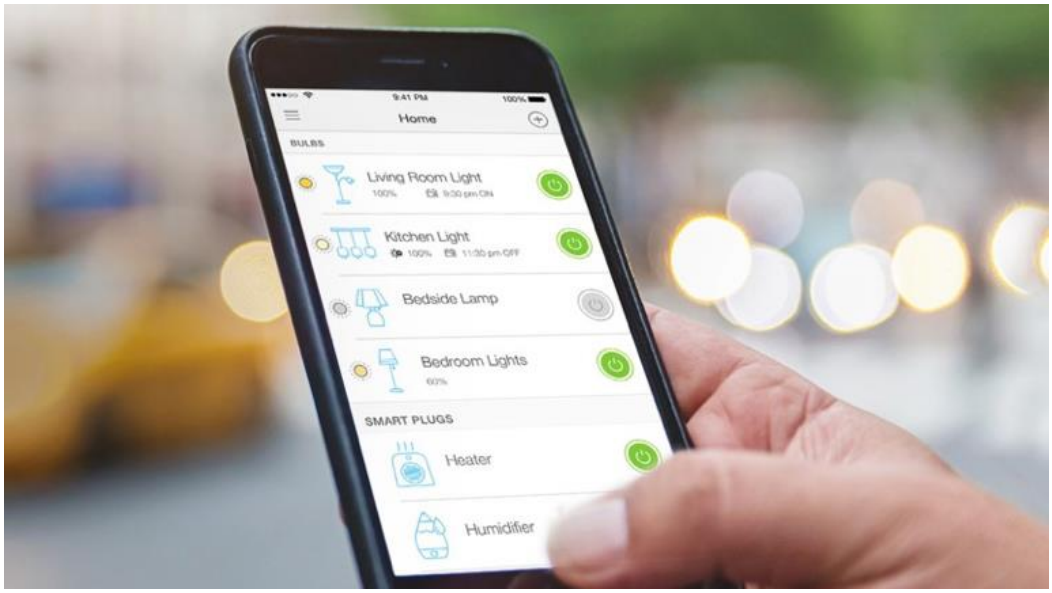

Fig 1.2: Home Automation from a Mobile device

Cortana

As mentioned above, Cortana is example of a voice controlled intelligent system. It uses the Bing search engine to carry out searches for the user and uses the data stored on the user's device to make personalized recommendations. Cortana is fully integrated into Windows 10 allowing it not only to search the Internet but via integration with the rest of the operating system can remind you of Calendar events, search for files on your device, open applications, and many other automated functions. Cortana is also integrated into the Xbox allowing you to voice control the entire system.

Fig 1.3: Cortana - Personal Digital Assistant

Intelligence can be loosely defined as the capability to obtain knowledge and skills and to apply those to various situations without supervision. As is the case with children, intelligence is often linked to learning. As a child grows they learn from the parents, siblings, teachers, friends and the society in general as well as how they interact with their environment. While some learning is taught, other concepts are acquired and developed by a child through observation.

Whilst machines are traditionally known to follow rigid instructions, contemporary machines are designed to 'think' and have the capability to perform tasks by learning. The branch of science and technology devoted to the creation of machines that learn and think as intelligently as human beings is known as Artificial Intelligence or AI. According to the father of Artificial Intelligence, John McCarthy, AI is "*The science and engineering of making intelligent machines, especially intelligent computer programs*".

The fundamental premise of AI is that it can create machines that can intelligently think in the same, or similar, way that humans think. It is designed to acquire knowledge or awareness (cognizance) from its environment, its circumstances, and entities (humans) by learning

AI operates where efforts are made to make a computer, a robot, or a machine think in the same way a smart human being thinks. AI is thus a replication of how the human brain thinks, learns, decides, and works, when it tries to solve problems (Bermudez, 2017) resulting in the creation of an intelligent software system. The purpose of AI is to achieve improvisation in the functionality of computers by way of functions related to human knowledge, such as problem-solving, reasoning, and learning.

Intelligence is made up of

- Reasoning
- Learning
- Problem Solving
- Perception
- Linguistic Intelligence

The Need for AI

The need for AI is fueled by the fact that it is a technology that can enhance machines by equipping them with intelligence. The technology is used to have machines help humans by teaching themselves to adjust, adapt, refer to more data and process that quickly in order to provide a for a better or alternative answer where possible.

The introduction of AI is to create technology that allows machines to function in an intelligent manner with or without human supervision (Bermudez, 2017). The huge task of simulating or creating intelligence is broken down into sub-problems in order to:

- Create intelligent systems which can exhibit smart behavior with an in-built ability to learn, validate, explain, and suggest a suitable course of action to its users.
- Help machines find solutions to complex problems in a similar way that humans do and apply similar logic in the form of heuristic (self-learning) algorithms to calculate and display the required output.

An AI system is composed of two main elements - an agent and its surrounding environment. An agent can be either a human or a machine. An agent can be anything that can perceive its environment through sensors and act upon that environment through effectors. The intelligence of agents is calculated by their ability to create goals and achieve them. Common applications of AI include - Natural Language Processing, Gaming, Speech Recognition, Vision Systems, and more, whose applications can be found across the Healthcare and Automotive sectors etc.

Cloud Computing Services

Cloud Computing is the system of using a robust network of remote servers to store, manage, and process data. It operates via a network of computers connected to each other and the user via the Internet rather than a local server or individual personal computer. A cloud computing system keeps its critical data on remote servers rather than distributing copies of the same data files to individual client devices. Video-steaming cloud services stream data across the Internet to a player application on the viewing device rather than using the local storage such as Digital Versatile Discs (DVD's) or Compact Discs (CD's).

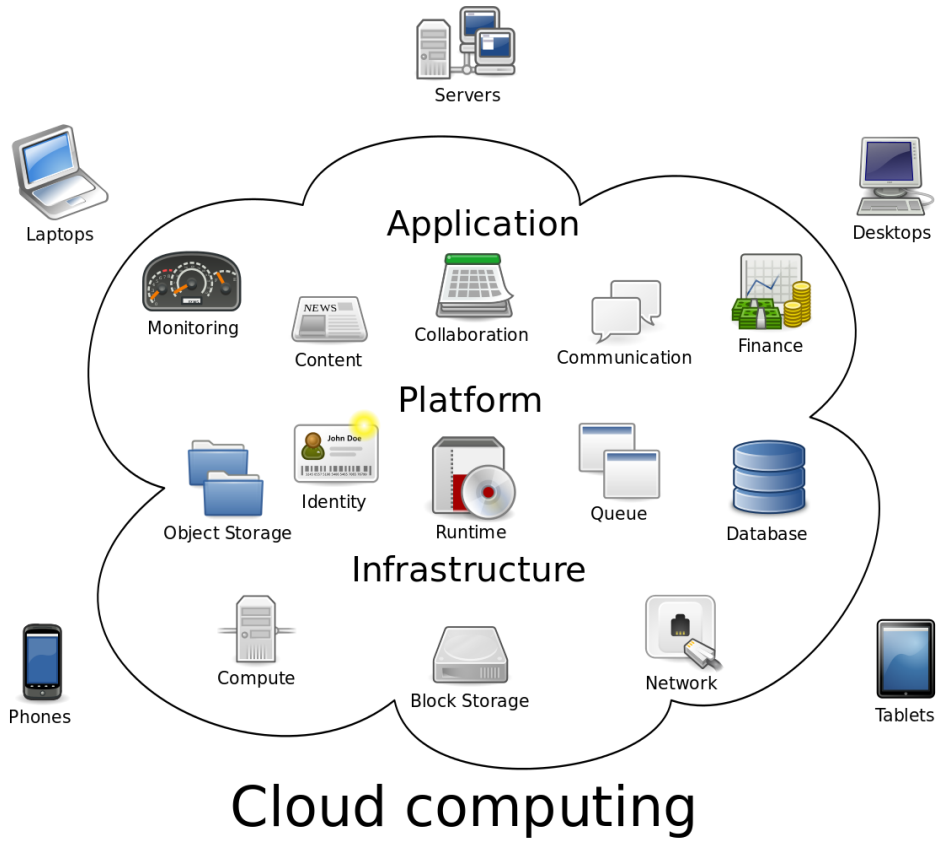

Fig 1.4: The working of cloud computing (Wikipedia)

Cloud Storage and its applications

The cloud is a term referred to as accessing data and software applications via a network connection of remote servers, often large data centers using Internet connectivity (SDxCentral, 2019). Almost all software-based resources can operate in the cloud: A program or application, a service, or even another simulated computer. Examples of cloud-based systems are – OneDrive and Office 365.

Categories of Cloud Computing

Cloud ownership is often divided into three categories based on who has access to the services or infrastructure. These are

- Private - Built by companies for use by their employees and partners only.
- Public - Available to anybody that wants to purchase or lease the services.
- Hybrid – Partly available to the public and partly kept for use by the employees.

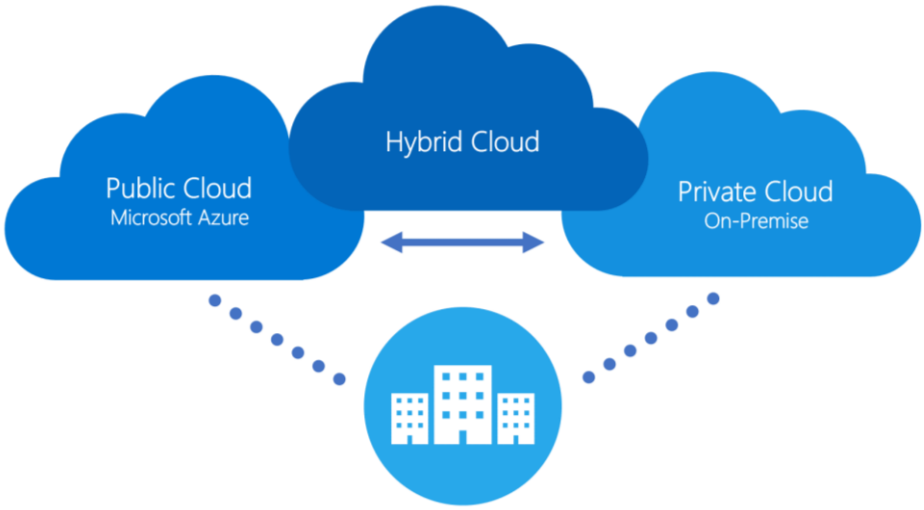

Fig 1.5: Types of Clouds

We all use cloud services in one way or other in our day-to-day life in various forms. For example, we listen to streamed music or watch streamed movies, shop online, store our documents and photos on OneDrive and other cloud services, manage our mails via various email providers, download applications to our phones, upload videos to share with others, and even use mobile phone applications to request a taxi. All of these services are provided via cloud-based services to us.

Cloud services can, with the relevant application, be used to gain faster access to unlimited data and can be accessed from your smartphone, laptop, desktop or any device that has access to the internet. Cloud storage services usually employ advanced data compression techniques, thus ensuring greater mobility of data at greater speed.

Categories of cloud computing services

Cloud computing services can be divided into three main categories (Giva, 2019) namely,

- Infrastructure as a Service (IaaS): provides the user, via a subscription (leasing), access to an infrastructure of servers, operating system, virtual machines, networks, and storage capabilities on lease to their clients. Examples - Microsoft Azure.
- Platform as a Service (PaaS): is a service used by companies to support the development and testing of software applications without the need for large internal infrastructure. PaaS also provides a range of tools for the developer which makes it ideally suited to the young entrepreneur. Examples – Microsoft Azure.
- Software as a Service (SaaS): enables users to connect to various cloud-based applications through the Internet for a subscription fee. Examples – Office 365, Microsoft 365, Minecraft for Education etc.

The above-mentioned services together constitute what is known as the Cloud Computing Stack consisting of IaaS on top, PaaS in the middle, and SaaS on the bottom.

Whilst the usage of cloud-based storage solutions and services to support day-to-day tasks are growing, it is necessary to keep in mind privacy and security concerns. It is imperative to address in order to be vigilant in ensuring the security of the environment. It is thus important to be aware of the security features used by many cloud service providers in order that the customers can keep the data secure (Rashid, 2016). There could be various issues regarding privacy and security of cloud storage such as:

- Data breaches
- Network security
- Data Access
- System vulnerabilities
- Account hijacking
- Malicious insiders
- Permanent data loss
- Compromised credentials and broken authentication
- Hacked interfaces and APIs

The first layer of security is provided by the cloud provider whilst the second layer is provided by the customer. The challenge here is that customers should be aware as to the extent of security provided by the cloud provider in order that they can add additional layers of security to secure their data.

Major Cloud Platforms and Applications

With cloud computing and the internet enjoying various services from the comfort of our homes or offices has become easy. This cost-saving option eliminates the need to invest and maintain costly local infrastructure (NewGenApps, 2019). Here is an example of a major cloud storage platform that is used extensively around the world:

Microsoft Azure

Formerly known as 'Windows Azure', Microsoft Azure is the cloud computing platform enabled primarily through Microsoft-managed data centers. This service has proved itself to be a reliable solution for the development, testing, deployment, and management of applications and services as well as the hosting of data and is used by a large number of data service providers due to the level of security and global infrastructure.

Areas of Application of AI in our Daily Life

Healthcare

One primary aim of health-related AI applications is to analyze the relationships between prevention/treatment techniques and patient outcomes. AI programs have been developed and applied amongst others to practices such as the entire diagnosis processes, treatment development, drug development, customized medication, and patient monitoring and care (PwC, 2019).

The medical world is increasingly using AI and the Internet of Medical Things (IoMT) for helping citizens via the range of consumer health applications available today (PwC, 2019). Such medical applications are a great source of encouragement and support for people to develop and follow a healthy lifestyle. With proactive health management, technology has put the person in control of their own health and holistic well-being.

Additionally, advancements in AI have increased the rate of correct diagnosis and error-free application of treatment options. This has led to a better understanding of patients' problems by doctors, and increased the rate of quality feedback, guidance and counselling, and the identification of other potentially related medical problems.

The inclusion of AI-based technologies in the medical world has improved services given the fact that the health sector generates large amounts of data which when processed leads to timely and appropriate decisions which can be taken by the doctors. This technology is known as predictive analytics and is often used to support data-based clinical decision making. AI uses pattern recognition to identify risk patterns in the patients or those who have a predisposition to certain diseases.

Fig 1.6 Areas of Use of AI and Robotics in Healthcare

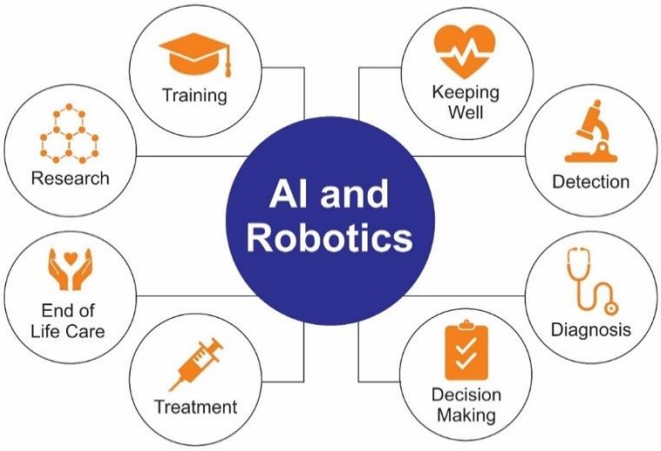

Image Courtesy - (PWC, 2019)

In the past, robot arms were used in medical labs, however, with current developments in technology, AI-supported robots assist the doctors even during complex surgeries performing repetitive tasks and in some cases, under control of the surgeon, take over elements of complex and delicate surgery.

Intelligent robots in the future will likely completely transform the way the elderly are cared for, giving them more independence and thus reducing the need of care homes and hospitalization. AI-based systems are being engaged to have human-like conversations with elderly people to keep their minds sharp as well as paying a variety of games to assist in warding off dementia.

Agriculture

AI is being used extensively in agriculture (Intel, 2019). From counting the number of blooms to predict the yield in the fields, to the detection of pests and predicting which of the sown crops will yield the best possible returns, technology is being readied to meet a future global challenge. According to United Nations' population division, the entire world population is estimated to touch 9.7 billion by the year 2050 (UN DESA, 2015) and the challenge we will face will be to feed such a growing population.

Microsoft in collaboration with ICRISAT, has developed an AI Sowing App powered by Microsoft Cortana Intelligence Suite including Machine Learning and Power BI. The app sends sowing advisories to participating farmers on the optimal date to sow. The best part – the farmers don't need to install any sensors in their fields or incur any capital expenditure. All they need is a feature phone capable of receiving text messages (Microsoft 2017).

Artificial Intelligence can be used in agriculture to assist in weather prediction and simulate the impact of current and emerging trends on yield, and therefore global produce. Here are three major categories of applications of AI in agriculture:

- **Agricultural Robots –** Development and programming of autonomous machinery to manage essential tasks in agriculture such as harvesting of the crops at a higher volume and faster pace than human laborers. This will save both cost and time.
- **Crop and Soil Monitoring –** Advanced computer vision together with deep-learning algorithms are being developed to process data captured by drones and other technologies to monitor crops and soil health of vast geographical areas that are difficult, by their size, to manage by people.
- **Predictive Analytics –** Models are being developed with machine learning technology to track and predict various environmental impacts on crop yield such as weather changes, spread of pest and agricultural diseases etc.

Retail

The future of retailing is in the partnership of employees with AI technology to introduce ways of optimizing the performance of the business. (Bayern, 2019).

AI in retail can be used in specific areas such as supply chain planning, demand forecasting, customer intelligence, marketing, advertising and campaign management, and pricing and promotion of products or services. AI can enable more efficient processing of supply chains and returns in the retail industry. It is also being used to develop chatbots which interact with customers to understand their enquiries or purchase and react accordingly. Development of customer-facing AI functionality such as self-service checkouts are designed to benefit retailers by reducing costs and increasing sales throughput, and assist customers in a trouble-free shopping experience, thereby increasing customer satisfaction.

How can AI help retailers in their business? As we all know AI is powered by data, the system needs to collect the right kind of data in order to recognize a pattern act on that pattern, learning as it goes, analyzing trends and commonalities in the data. Customer data is used to produce an appropriate model to solve specific problems such as customer satisfaction, purchasing trends, routes taken by customers through the store, maintain the correct stock level etc. (Hudson, 2019).

One of the many benefits of using AI-driven machines is that it can predict activities that increase sales (Trivedi, 2019). For example, if the customer is issued a cashback for a purchase, this may prompt them to buy more, therefore generating more sales. Another benefit of AI in retail is to improve the customer experience by strengthening engagement with the customer, with the aim of building a long-term loyal relationship.

The data set required in this example would be sales data correlated against customer information. This data set is run through the appropriate machine learning algorithm to produce an AI model. This model is translated into ways in which the retailer can increase turnover by providing the customer what they want and when they want it.

Productivity at work

AI-powered applications and apps are prevalent at work too, assisting the human resources department in workforce recruitment. The technology helps managers come up with convincing job requirements using data from similar job postings which have borne fruit (Greene, 2019). AI is also supporting scheduling meetings, writing emails, making appointments and reminding people of various important business and personal tasks that one might miss out, thus helping users to manage their time well. This document itself was created using AI techniques in language definition by checking for correct spelling and grammar and suggesting possible changes to the wording.

Artificial Intelligence works independently of following instructions to fulfill repetitive tasks. The program is built to understand patterns and draw intelligent connections, thus enabling it to predict and fulfill the next set of instructions and tasks. Considering all the important factors this helps it to suggest potentially smarter business decisions to managers. Over a period of

time and upon handling multiple cases, the learning element of AI becomes more intuitive in processing the information. For example, it can propose new operations based on past budgetary results, talent cost, employment plans, etc.

Organizations can use AI-based applications to allow job candidates to schedule their interview with the interview panel at a time suitable for all parties. Some applications such as those used by Stella and Koru (Greene, 2019) make use of AI technology components to match the requirement of the employers to that of the candidates based on the candidates' credentials, skills and the experiences. Another AI-based application known as the Palatine Analytics offers various tools to managers that help measure the performance of employees, and even select the right employee for promotion without the element of human bias.

Personal Life

Our personal life is full of examples of AI being used daily. Our engagement is seamless and therefore goes almost unnoticed. However, many of the apps we run on our smartphones are all AI-powered. When we want to listen to music we speak a command, our phone analyses our speech, understands the task, and runs a search to find the song before playing it.

Reminders for a meeting, or to buy groceries on a particular day for your parents or reminding you to study a particular subject for an upcoming test are all AI interventions in our daily life. The email spam filters that keep unwanted emails away from your inbox, or the social networking site which uses AI to personalize your newsfeed and ensures that you are seeing posts that interest you, are all examples of how AI has become an integral part of our day to day life.

AI and Its Applications

AI is growing in its applications, some even with impressive capabilities such as self-driving vehicles or social humanoids. Though currently, we do not have a fully functional AI based robot, it seems just a matter of time before we will have a fully functional humanoid capable of working with us or even supporting us in our homes.

Here are a few applications which we regularly use which are extremely important in developing any technology that can engage in the same way humans can be in real life.

Natural Language Generation (NLG)

Natural Language Generation (NLG) is a sub-discipline of AI that recognizes human language in text form and converts it into a form which enables the computer system to communicate the data efficiently and accurately. For example, it is used to take raw market data and generate reports of market summaries. It can also be used to generate short pieces of text in interactive conversations (a chatbot) which might even be read out by a text-to-speech system.

Another important use of NLG is the classification of text. This is specifically used in the control of spam. Several email providers use similar NLG-based services to analyze the content of the emails in order to understand whether the mail is genuine or fake.

NLG can help us to do the following:

- Manually search data, comparing or scanning tables
- Analyzing charts, metrics or maps
- Developing recurring status reports

Fig 1.7 NLG creating reports
Image credit: https://narrativescience.com/what-is-natural-language-generation/

"A picture may be worth 1,000 words, but concise descriptions and annotations can help people understand and better interpret data. Natural language generation (NLG) technology interprets data and offers background context or analysis through textual descriptions."

Speech recognition

Speech recognition is a technology whereby the systems capture the natural conversations with a human, analyzes said data, and converts the same, when required to, into instructions to perform the given tasks. It is used in voice-response interactive systems and mobile apps. For example, almost all smartphones have the built-in ability to convert speech into text. The technology of recognizing speech is also used in the medical world, defense, home automation, gaming and even in general robotics (Lifewire, 2019).

However, there are times when speech recognition does not work the way it should. This happens at times when different people pronounce the same word in a totally different manner or accent altogether, although systems are becoming more adept at learning such differences. Another scenario where the software may fail is when there is a great deal of background noise. Unless good quality noise cancelling microphones are used, the software will pick up the noise and may therefore not be able to interpret it well.

Virtual Agents

A virtual agent is a computer program that is designed to interact with humans and can be seen in the chatbots that appear when using some applications or visiting some websites.

Gone are the days when the customers would be able to detect if they were chatting with a bot or a person. With the help of both artificial intelligence and machine learning the bot is designed to respond with a very specific and customized response to the user's query. From contact centers to catering to various business tasks such as IT support, virtual agents no longer perform just basic functions but also can handle complex situation based enquiries (IPsoft, 2019).

Exposure to AI and its applications across different industries

Building your own chatbot

Azure Bot Service enables you to build intelligent, enterprise-grade bots with ownership and control of your data. Begin with a simple Q&A bot or build a sophisticated virtual assistant.

Virtual Assistant allows your customers to interact with your services at home, at work and in your car.

News

Chatbots are smart as they understand the preference of a user and send similar news on related topics to the user on their social media feed or other media handles. The chatbot from CNN is quite famous for delivering quality output in terms of relevant news to the users.

Health

The Microsoft Healthcare Bot service empowers healthcare organizations to build and deploy an AI-powered, compliant, conversational healthcare experience. The service combines built-in medical intelligence with natural language capabilities, extensibility tools and compliance constructs, allowing healthcare organizations to give people access to trusted and relevant healthcare services and information.

Fig 1.8 Using Microsoft Health Bot to enquire about a glucola test

Deep Learning Platforms

Deep learning platforms use neural networks with layers of abstraction in an attempt to mimic the working of the human brain. It is designed to process data and create patterns from which

constructive decisions can be made. It is currently being used to identify patterns and categorize applications that are only compatible with large-scale data sets.

Biometrics

This technology is used to identify, measure, and analyze the physical aspects of the body's structure and form. It allows for technology to use more natural forms of interactions between humans and machines, including touch, fingerprints, gait, speech, eye, and body language recognition. It is often used as a way of confirming identity or identifying a command such as waving at your Xbox or putting your finger on a scanner.

Robotic Processes Automation (RPA)

Robotic processes automation is a form of business process automation. In traditional workflow automation tools, a software developer produces a list of actions to automate a task using a dedicated scripting language. RPA systems develop the action list by watching the user perform that task inside the software and then perform the automation by repeating those tasks directly in the software.

Conversational AI

Conversational AI is a set of technologies that enable computers to simulate conversations and refers to the use of messaging apps, speech-based assistants and chatbots to automate communication and create personalized customer experiences at scale. This form of AI is preferred because it is time-bound and engaging. In business, the element of conversation keeps the customer engaged whilst, in the background, it can simultaneously work on the customer satisfaction aspect of the transaction. The number of queries that can be handled by a business can be quite large and as such the use of Conversational AI can reduce the query resolution time and queries can be solved effectively.

Natural Language Processing (NLP)

Natural Language Processing is an application of Artificial Intelligence which enables machines to both process and comprehend human language in the way it is written. In recent times, deep learning models can not only analyze large volumes of text but can also come up with services such as those providing a summarization of text, language translation, context modelling, and even sentiment analysis (MadyMantha, 2019). Natural Language Understanding (NLU) is a branch of NLP that converts the natural language spoken by humans into structured data. It can perform two tasks - intent classification and entity extraction.

The intent of a user is defined as what a user is trying to convey or accomplish. For example, when we read a sentence, we immediately understand the meaning or intent behind that sentence. Intent classification is a two-step process. First, we feed an NLU model with labeled data that provides the list of known intents and example sentences that correspond to those intents. Once trained, the model can classify a new sentence that it feels fits wells into one of the predefined intents.

Entity extraction is defined as the process of recognizing key pieces of information in a given text. Things like the time, place and name of a user all provide additional context and information related to intent. Intent classification and entity extraction are the two primary drivers of conversational AI.

Application Program Interfaces (APIs)

An Application Program Interface (API) is a set of routines, protocols, and tools for building software applications. The aim of introducing APIs is to help developers build intelligent applications without having direct AI or data science skills or knowledge. The goal of Microsoft Azure Cognitive Services is to help developers create applications that can see, hear, speak, understand, and even begin to reason. It enables organizations to drive innovation and transformation across their business.

Azure Cognitive Services enable developers to easily add cognitive features into their applications. The catalogue of services within Azure Cognitive Services can be categorized into five main pillars - Vision, Speech, Language, Web Search, and Decision.

Vision APIs

Examples include

Computer Vision- The Computer Vision service provides access to advanced algorithms for processing images and returning information.

Custom Vision Service - The Custom Vision Service allows the building of custom image classifiers.

Face API - Face API provides access to advanced face algorithms, enabling face attribute detection and recognition.

Form Recognizer - Form Recognizer identifies and extracts key-value pairs and table data from the form documents; then provides outputs with structured data including the relationships in the original file.

Ink Recognizer - Ink Recognizer allows the recognition and analysis of digital ink stroke data, shapes and handwritten content, and output a document structure with all recognized entities.

Video Indexer - Video Indexer enables the extraction of insights from a video.

Speech APIs

Speech Services - Speech Service adds speech-enabled features to applications.

Speaker Recognition API - The Speaker Recognition API provides algorithms for speaker identification and verification.

Bing Speech - The Bing Speech API provides an easy way to create speech-enabled features in your applications.

Translator Speech - Translator Speech is a machine translation service.

Language APIs

Language Understanding (LUIS) - Language Understanding service (LUIS) allows the application to understand what a person wants in their own words.

QnA Maker - QnA Maker allows the building of a question and answer service from a semi-structured content.

Text Analytics - Text Analytics provides natural language processing over raw text for sentiment analysis, key phrase extraction and language detection.

Translator Text - Translator text provides machine-based text translation in near real-time.

Video Indexer - Video Indexer enables the extraction of metadata from a video.

Search APIs

Bing News Search - Bing News Search returns a list of news articles determined to be relevant to the user's query.

Bing Video Search- Bing Video Search returns a list of videos determined to be relevant to the user's query.

Bing Web Search - Bing Web Search returns a list of search results determined to be relevant to the user's query.

Bing Autosuggest - Bing Autosuggest allows you to send a partial search query term to Bing and get back a list of suggested queries.

Bing Custom Search - Bing Custom Search allows the creation of tailored search experiences for topics that you care about.

Bing Entity Search - Bing Entity Search returns information about entities that Bing determines are relevant to a user's query.

Bing Image Search - Bing Image Search returns a display of images determined to be relevant to the user's query.

Bing Visual Search - Bing Visual Search returns insights about an image such as visually similar images, shopping sources for products found in the image, and related searches.

Bing Local Business Search - Bing Local Business Search API enables your applications to find contacts and locate information about local businesses based on search queries.

Decision APIs

Anomaly Detector - Anomaly Detector allows the monitoring and detection of abnormalities in time series data.

Content Moderator - Content Moderator provides monitoring for possible offensive, undesirable, and risky content.

Personalizer - Personalizer allows you to choose the best experience to show to your users, learning from their real-time behavior.

Public Databases

Introduction to Public Datasets

Datasets can be described as "A collection of related sets of information that is composed of separate elements but can be manipulated as a unit by a computer" (Oxford, 2019).

There are mainly three kinds of datasets – private, public and semi-public.

- Public datasets are huge sets of data that are open to the public for their data science projects. These datasets are used to train the models used for machine learning and thus improve the function of the predictive analysis. One such example is Azure's Open Datasets which many use to share public datasets, and even use them for their own analysis (Azure, 2019). Azure's Open Datasets include datasets pertaining to the weather forecast, historical weather, list of holidays and many more.
- Private datasets are those sets of data that can be used or accessed by a limited number of people. These people are either a part of a group or an organization. The use of the datasets is limited to the group and cannot be shared with people outside the group. For example, enterprise datasets with access control of any organization or a group.
- Semi-public datasets are those which are open to the public and can be shared but require a login Id and password to access.

Using Public Use Datasets

Using public datasets can be easy as the data is free to use. However, there are certain pointers that need to be kept in mind to ensure that there are no concerns regarding the quality and availability of data. Ask yourself the following questions before choosing a publicly available data set (Price, 2015)

- What is the quality of the data in the dataset?
- Analyse the probable data collection methods
- Analyse the original purpose of data
- Check the author details or organisation credentials
- Is the data codebook or manual available to view?

- The kind of data depicted in the dataset
- The number of times the dataset has been used in the past by different people?
- What are the variables available in the dataset and how have they been defined?
- What kind of analysis can define the measurement of the variables?
- What is the actual or the estimated dataset? (How recent is the data?)
- Is there any missing data? What could be the possible place of origin of the data?

Apart from the above-mentioned points to be taken into consideration, it is important that before using a public dataset one must ensure that the speed of internet service is good and there is no limit to downloading. This is because a majority of the public dataset files tend to occupy a lot of memory and therefore are huge.

Data points collected over a period of time may, or may not, be associated with people. There is always a strong potential for misuse, breach of privacy, blackmail, and other illegal activities (Hand, 2018). For example, data collected through the usage of credit cards or recorded via interactions with a 'digital personal assistants' can be misused as there is immense personal data that can be extracted. This could be related to the personal routine of an individual or something related to their interests or even beliefs. Such possibilities can lead to someone knowing the pattern of daily activities of an individual (Hand, 2018). It may be possible that personal activities can reveal many aspects of the life of an individual and can lead to discomfort or embarrassment if their identity were to be revealed.

Computer Languages to Develop AI-based Applications

To recap, Artificial Intelligence is defined as the process of a machine to mimic human behavior in an intelligent manner. Thus, the technology equips the machine to comprehend the speech, analyze the images, read the data and make predictions based on the same. Cloud Computing is the system of using a robust network of remote servers hosted on the internet to store, manage, and analyze data. Using all of the above, the machine interacts naturally with users giving them a feeling of interacting with another human user. There are various languages to develop AI-based applications with such as:

- R-Programming
- Python

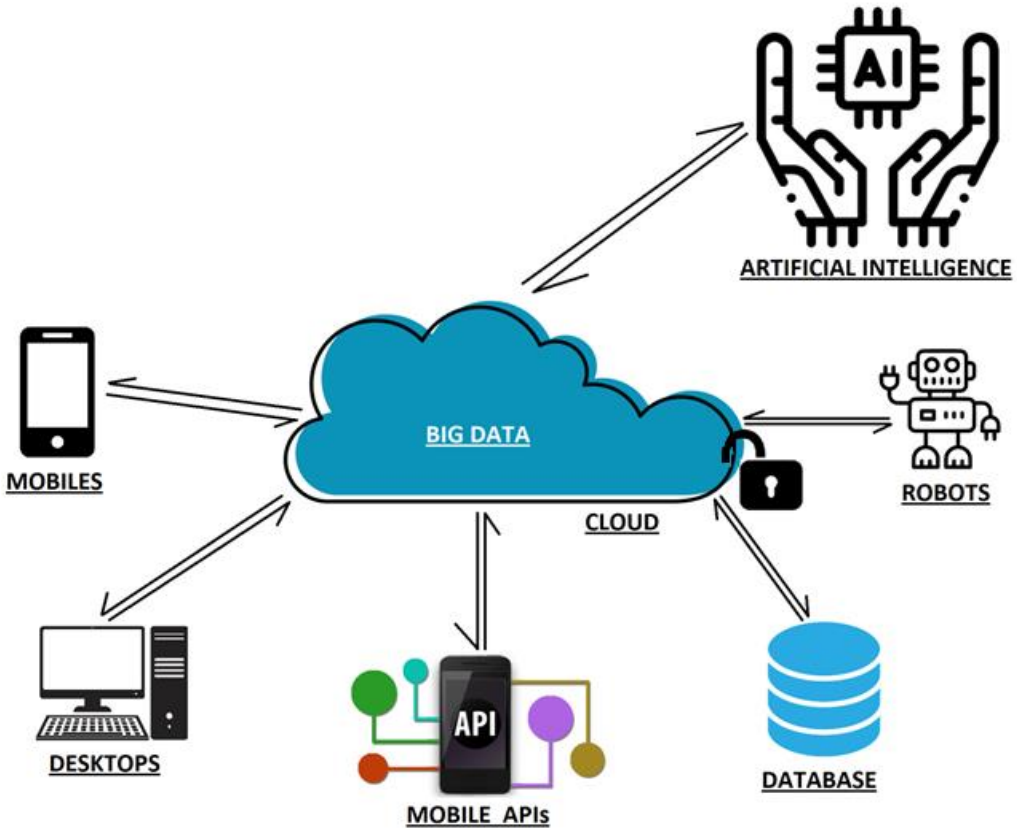

Fig 1.10: Interaction between Cloud Computing and Artificial Intelligence

Introduction to R –Programming

The R-language is a very prominent, free programming language that is used for statistical computing. Supported by the R Foundation for Statistical Computing, the language is mainly used by data miners and people with statistics and data analysis expertise. Although the R-programming language has a command-line interface, there are graphical user interfaces (GUI's) available such as R-Studio, which works on an integrated development environment similar to Python.

Introduction to Python

One of the many programming languages that are preferred by developers worldwide is Python. It is an 'interpreted', interactive, object-oriented programming language that incorporates classes, modules, higher level of data types which are dynamic in nature, and exceptions. Python was conceived by Guido van Rossum and the syntax designed to be clear and leave no room for ambiguity. It has a variety of features that are useful from a programming point of view and the language functionality can be extended in C or C++ (Python, 2019). This means it has a large standard library of functions which can be incorporated into the program via a C Script call.

The popularity of Python as a scripting language is due in the main to the fact that it is a highly productive language when compared to other languages such as Java, C++ etc. However, this is not the only reason for its immense popularity.

Here are some of the many reasons that contribute to its popularity amongst developers:

- Python is a platform-independent language which means that it can work on different platforms such as Windows, Mac, Linux, Raspberry Pi, etc.
- The working syntax of Python is simple and easy to understand as it is based on the syntax of English. This enhances its appeal globally.
- Python syntax allows developers to write their programs in fewer lines of code when compared to many other coding languages.
- The Python language runs on an interpretive platform. This means that as soon as it is written it can be executed without the phase of compilation to executable machine code. In other words, the language supports quick prototyping.
- Python as a language that can be used procedurally, object-orientated, or functionally depending on the requirement of the task.

The language is used extensively for server-side web development, mathematical problem solving, software development and even system scripting. As such, Python can be used for creating workflows, connecting database systems, and reading/writing and modifying files. It is also used for handling big data, performing complex mathematical functions and rapid prototyping.

Textbook Assessments

1. Write an example of AI which are associated with the following:

Smart Phones

Vehicles

Financial services

2. Describe what is meant by the term Artificial Intelligence? Then, list down 5 examples from real life where we experience machine learning.

3. Why do we use Cloud services? Give examples of cloud services that we use in daily life.

4. R-Programming Language is a language that is often used in machine learning. The language is supported by which organization?

5. Who is a creator of the Python language?

6. What are the benefits and drawbacks of using a public data set?

7. Why is Python a popular programming language despite being slow?

8. Where can we use conversational AI, quote an example?

9. What do we mean by natural language detection?

Practical Assignment/Lab Work

Discover contributions of AI in maintaining Road safety.

- https://news.microsoft.com/apac/features/artificial-intelligence-and-road-safety-a-new-eye-on-the-highway/
- https://www.entrepreneur.com/article/331202
- https://ramboll.com/media/rgr/artificial-intelligence-for-optimising-road-maintenance-work
- https://techcrunch.com/2016/07/13/how-iot-and-machine-learning-can-make-our-roads-safer/
- https://www.datasciencecentral.com/profiles/blogs/how-tensorflow-is-helping-in-maintaining-road-safety

Questions to ponder upon

1. Create a timeline of the evolution of AI.

- https://en.wikipedia.org/wiki/Timeline_of_artificial_intelligence

2. Analyze the statement "Can Artificial intelligence replace Human intelligence" and decide whether it is a fact or an opinion

- https://medium.com/@BrentMorgan/artificial-intelligence-can-it-replace-human-intelligence-b250b9aec153
- https://www.groupdiscussionideas.com/can-artificial-intelligence-replace-human-intelligence/
- https://hackernoon.com/5-reasons-ai-wont-replace-humans-it-will-make-us-superhuman-413c499e1e68

3. Examine the aspects of life that can be completely controlled by AI, and in what areas do you think human intelligence would outperform AI?

- https://hackernoon.com/how-artificial-intelligence-is-going-to-change-our-lives-48458706f6a
- https://technode.com/2016/09/06/ai-iflytek/

4. What is the human learning process? Illustrate the similarities and differences between human and machine learning?

- https://learningcommons.ubc.ca/tutoring-studying/selfassessment/the-learning-process/
- https://www.educba.com/artificial-intelligence-vs-human-intelligence/

5. Examine the various challenges related to privacy of data with cloud storage?

- https://www.cs.ru.nl/~jhh/pub/secsem/takabi2012security-privacy-cloud-challenges.pdf

6. Investigate how public cloud services provide data security to their users.

- https://securityintelligence.com/who-is-responsible-for-cloud-security/

7. Propose ways in which AI could make the education sector better.

- https://www.forbes.com/sites/bernardmarr/2018/07/25/how-is-ai-used-in-education-real-world-examples-of-today-and-a-peek-into-the-future/#7d939490586e
- https://elearningindustry.com/ai-is-changing-the-education-industry-5-ways
- https://towardsdatascience.com/4-ways-ai-is-changing-the-education-industry-b473c5d2c706

8. Evaluate scenarios from real life both with and without cloud-based AI services.

- https://www.brookings.edu/research/how-artificial-intelligence-is-transforming-the-world/
- https://www.ibm.com/blogs/cloud-computing/2013/04/04/how-cloud-computing-is-impacting-everyday-life/
- https://bigdata-madesimple.com/pros-and-cons-of-combining-artificial-intelligence-and-cloud-computing/

9. What are the pros and cons of using public or open datasets?

- https://www.datamation.com/big-data/big-data-pros-and-cons.html

10. What are the different sources of public datasets?

- https://medium.com/free-code-camp/https-medium-freecodecamp-org-best-free-open-data-sources-anyone-can-use-a65b514b0f2d

11. How can AI enhance Biometrics and other security measures?

- https://sightcorp.com/blog/how-biometric-facial-recognition-is-improving-security/

12. Can AI outsmart biometric scanners?

- https://gizmodo.com/ai-can-now-fake-fingerprints-that-fool-biometric-id-sca-1830464777
- https://www.engadget.com/2018/11/16/ai-fingerprints-biometric-scanners/
- https://www.futurity.org/artificial-intelligence-fingerprint-scanners-1927212/

Practical Question

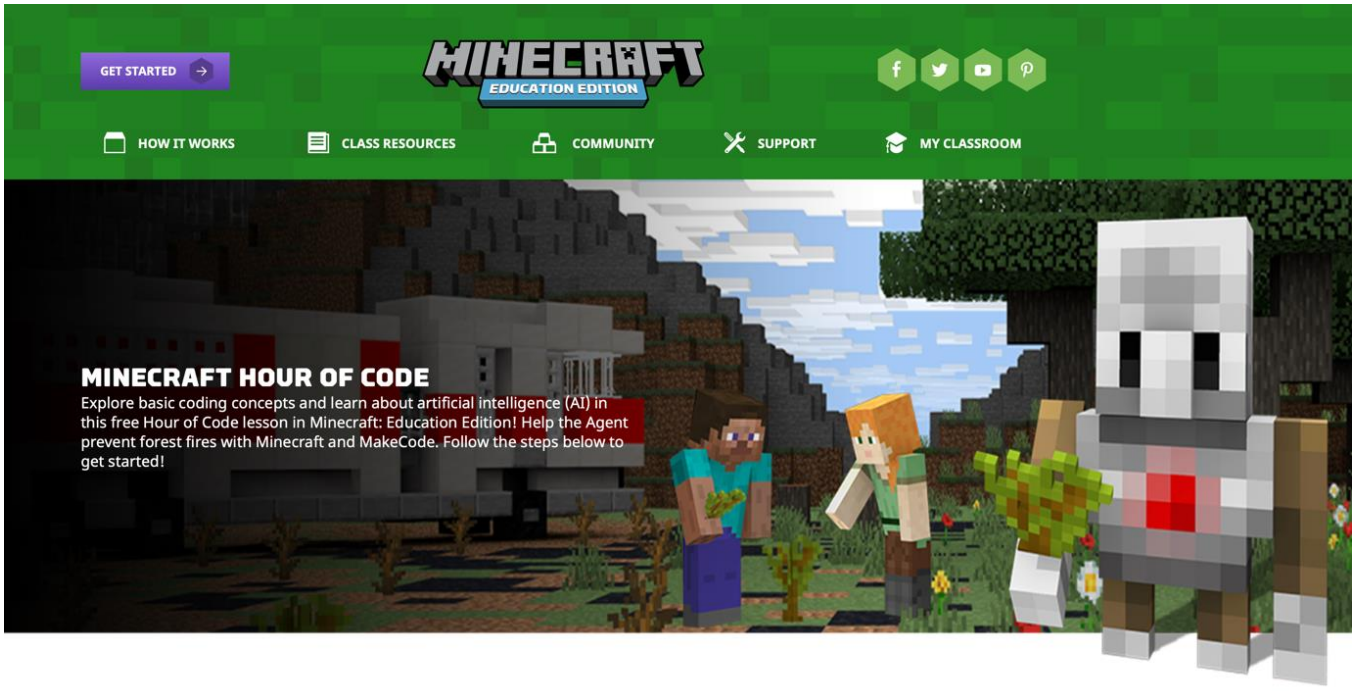

Fig 1.11: Minecraft Hour of Code

Complete the Minecraft Hour of Code course.

Explore basic coding concepts and learn about artificial intelligence (AI) in this free Hour of Code lesson in Minecraft: Education Edition! Help the Agent prevent forest fires with Minecraft and MakeCode.

The course with full instructions can be found on this link:
https://education.minecraft.net/hour-of-code

Links for Further Reading

- Introduction to Artificial Intelligence
- Video: What is Artificial Intelligence (AI)?
- No longer science fiction, AI and robotics are transforming healthcare
- The 20 Best Examples Of Using Artificial Intelligence For Retail Experiences
- Internal Customer Service, AI, And The Overall Customer Service Experience
- What is cloud computing?
- Video: Cloud Computing Tutorial For Beginners
- Who Is Responsible for Cloud Security?
- Intelligent Edge Analytics: 7 ways machine learning is driving edge computing adoption in 2018
- How conversation (with context) will usher in the AI future
- Python - Overview
- Python.org

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Glossary

Algorithm – A process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer.

Alphanumeric – A character that is either a letter or a number.

Analyze - Examine (something) methodically and in detail, typically in order to explain and interpret it.

Big Data – Extremely large data sets that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions.

Breach – An act of breaking or failing to observe a law, agreement, or code of conduct.

Cognitive – Relating to the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses.

Forecasting – Predict or estimate (a future event or trend).

Fundamental – A central or primary rule or principle on which something is based.

Innovation – The action or process of innovating, a new method, idea, product, etc.

Intelligence – capability to obtain knowledge and skills and apply it to various situations without supervision.

Kiosks – A small open-fronted hut or cubicle from which newspapers, refreshments, tickets, etc. are sold.

Modelling – The activity of making models.

Operators – A symbol or function denoting an operation (e.g. ×, +).

Premise – A previous statement or proposition from which another is inferred or follows as a conclusion.

Protocols – A set of rules governing the exchange or transmission of data between devices.

Scripting language – A scripting or script language is a programming language for a special run-time environment that automates the execution of tasks.

Server – A computer or computer program which manages access to a centralized resource or service in a network.

Simulation – The production of a computer model of something, especially for the purpose of study.

Syntax – The structure of statements in a computer language.

Thermostat – A device that automatically regulates temperature, or that activates a device when the temperature reaches a certain point.

Transaction – An input message to a computer system dealt with as a single unit of work.

Virtual – Not physically existing as such but made by software to appear to do so.