INTRODUCTION TO ICT

Mid Semester Assignment

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Q 1. Watch animated movie “Incredible 1” and discuss the technologies used by characters of the movie. Further, take note of the technologies used in making of this movie.

Following are some technology used by characters of the movie (Incredible 1)

1. Fingerprint scanner
2. Eye scanner
3. Voice recognition
4. Robotics

Fingerprint scanner

A fingerprint scanner is a type of electronic security system that uses fingerprints for biometric authentication to grant a user access to information or to approve transactions. It used to be that fingerprint scanners were mostly seen in movies and TV shows, or read about in science fiction novels

Eye scanner

Retina scanning is a biometric verification technology that uses an image of an individual’s retinal blood vessel pattern as a unique identifying trait for access to secure installations. Biometric verification technologies are based on ways in which individuals can be uniquely identified through one or more distinguishing biological traits. Unique identifiers include fingerprints, hand geometry, earlobe geometry, retina and iris patterns, voice waves, DNA and signatures. Retina scanners are in use in many military bases, nuclear reactors and other high-security locations due to their strength as a security measure. Retina scans are nearly impossible to fake. Furthermore, because the retina decays so quickly after death, a scan can only be accessed from a living human. Although some smartphone apps claim to be based on retina scanning they are usually based on iris scanning, a method of identifying people based on unique patterns within the ring-shaped region surrounding the pupil of the eye. Retinas scans are about 70 times more accurate than iris scans and 20,000 times more accurate than fingerprint-based methods. However, a retina scan does require the subject to focus on a single point for the entire 15-second duration. Retina scanning goes back as far as 1935 in conception, by Doctors Carleton Simon and Isadore Goldstein. Commercialized use goes back to 1984 with the company Eyedentity, which pioneered the first devices that used retina scanning technology.

Voice recognition

Voice recognition is a technique in computing technology by which specialized software and systems are created to identify, distinguish and authenticate the voice of an individual speaker. Voice recognition evaluates the voice biometrics of an individual, such as the frequency and flow of their voice and their natural accent.

Voice recognition is also known as speaker recognition.

Robotics

Even though the technology was misused by the antagonist (Syndrome), its structure was still based upon the idea of (AI) technology and supervised learning. But how supervised learning? Since the idea of supervised learning is using "collective data", the Robot (Omnidriod) is learning during his first fight against Mr. Incredible and making up decisions on how to over-come his fight patterns. Also, the robot is based GUI because, GUIs are often associated with software-only products. However, the interface you use to control your robot is almost certainly a GUI if it uses graphical icons, buttons, etc.

Note of the technologies used in making of this movie.

Adobe Illustrator

It is a 2-D software for producing and editing vector graphics such as character design and creative design that may be used in designing for the web, brochures, business cards and 2-D rendering.

Adobe Photoshop

This is a very popular and widely used graphics creation and editing software used widely in the industry in all sectors related to graphics (GFX) and design. This software is mainly used for image editing, retouching, digital painting, image morphing, video editing, creative design and for crafting textures for 3-D models.

Adobe Flash

This is a vector-based software mainly used for delivering high-impact, rich designs, animation and application user interfaces (UI).

Adobe After Effects

This software is mostly used in the postproduction process of filmmaking and television production and is mainly used for creating motion graphics and visual effects. You can use this software to animate, alter and composite media in 2-D and 3-D space with various built-in tools. It allows you to add various effects like fire, explosions and noise.

Autodesk Maya

This comprehensive 3-D animation software can be used for 3-D computer animation, modelling, simulation, rendering and compositing to generate interactive 3-D applications, including video games, animated film, TV series or visual effects. It has next generation display technology, accelerated modelling workflows and new tools for handling complex data.

Autodesk 3ds Max

This 3-D computer graphics software can be used for 3-D modelling, animation, rendering and compositing by games, film and motion graphics artists.

AutoDesk Mudbox

This is a digital painting and digital sculpting software that can create highly realistic 3-D characters, engaging environments, detailed props and compelling concept designs.

Autodesk MotionBuilder

This is yet another 3-D character animation software from Autodesk that can be used for virtual production and to control and refine data.

Eyeon Fusion

Also known as "Fusion," this image compositing software program is primarily used to generate visual effects and digital compositing for film, HD and commercials.

Foundry Nuke

This digital compositing software is node-based and mainly used for film and television postproduction. It has a wide range of flexible and easy to use tools.

Houdini

Houdini is a flexible 3-D animation software package renowned for its high-quality graphics pipeline. It can provide all key areas of 3-D production such as modeling, character, rendering, compositing, lighting and animation.

Sound Forge

This is an audio editing software by Sony Creative Software that can be used to cover all aspects of audio editing and mastering.

Keep in mind that a tool is only as good as the skills of the craftsperson using it. A sound knowledge of some or most of these combined with your creativity and artistic talent may help you achieve success in the field of animation. You should aim to learn the craft of animation at your animation college. The software can become secondary if you're already proficient with the principles of animation. The animation tools may change from studio to studio, but you may be able to animate regardless, if you get your basics right.

Q 2. Write a note on the following embedded technologies in detail.

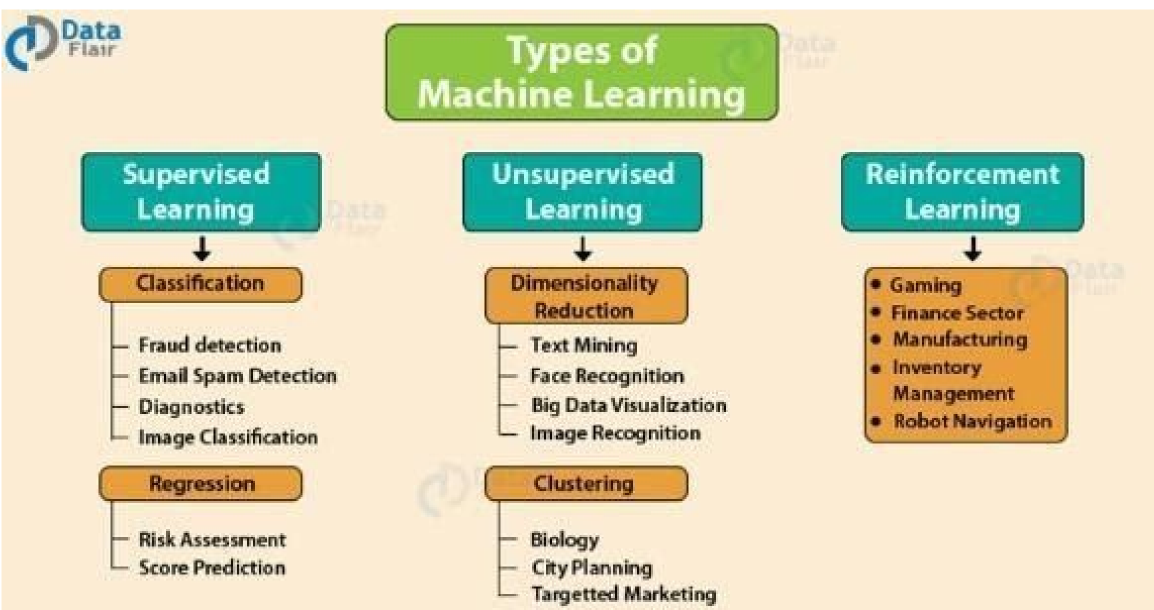
1. Machine Learning
2. 5G Technology
3. Virtual reality

4. Robotics

Machine Learning

Machine learning (ML) is the scientific study of algorithms and statistical models that computer systems use to perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task. Machine learning algorithms are used in a wide variety of applications, such as email filtering and computer vision, where it is difficult or infeasible to develop a conventional algorithm for effectively performing the task.

Types of learning algorithms



The types of machine learning algorithms differ in their approach, the type of data they input and output, and the type of task or problem that they are intended to solve.

Supervised learning

Supervised learning algorithms build a mathematical model of a set of data that contains both the inputs and the desired outputs. The data is known as training data, and consists of a set of training examples. Each training example has one or more inputs and the desired output, also known as a supervisory signal. In the mathematical model, each training example is represented by an array or vector, sometimes called a feature vector, and the training data is represented by a matrix. Through iterative optimization of an objective function, supervised learning algorithms learn a function that can be used to predict the output associated with new inputs. An optimal function will allow the algorithm to correctly determine the output for inputs that were not a part of the training data. An algorithm that improves the accuracy of its outputs or predictions over time is said to have learned to perform that task.

Supervised learning algorithms include classification and regression. Classification algorithms are used when the outputs are restricted to a limited set of values, and regression algorithms are used when the outputs may have any numerical value within a range. Similarity learning is an area of supervised machine learning closely related to regression and classification, but the goal is to learn from examples using a similarity function that measures how similar or related two objects are. It has applications in ranking, recommendation systems, visual identity tracking, face verification, and speaker verification.

In the case of semi-supervised learning algorithms, some of the training examples are missing training labels, but they can nevertheless be used to improve the quality of a model. In weakly supervised learning, the training labels are noisy, limited, or imprecise; however, these labels are often cheaper to obtain, resulting in larger effective training sets.

Unsupervised learning

Unsupervised learning algorithms take a set of data that contains only inputs, and find structure in the data, like grouping or clustering of data points. The algorithms, therefore, learn from test data that has not been labeled, classified or categorized. Instead of responding to feedback, unsupervised learning algorithms identify commonalities in the data and react based on the presence or absence of such commonalities in each new piece of data. A central application of unsupervised learning is in the field of density estimation in statistics, though unsupervised learning encompasses other domains involving summarizing and explaining data features.

Cluster analysis is the assignment of a set of observations into subsets (called clusters) so that observations within the same cluster are similar according to one or more predesigned criteria, while observations drawn from different clusters are dissimilar. Different clustering techniques make different assumptions on the structure of the data, often defined by some similarity metric and evaluated, for example, by internal compactness, or the similarity between members of the same cluster, and separation, the difference between clusters. Other methods are based on estimated density and graph connectivity.

Semi-supervised learning

Semi-supervised learning falls between unsupervised learning (without any labeled training data) and supervised learning (with completely labeled training data). Many machine-learning researchers have found that unlabeled data, when used in conjunction with a small amount of labeled data, can produce a considerable improvement in learning accuracy.

Reinforcement learning

Reinforcement learning is an area of machine learning concerned with how software agents ought to take actions in an environment so as to maximize some notion of cumulative reward. Due to its generality, the field is studied in many other disciplines, such as game theory, control theory, operations research, information theory, simulation-based optimization, multi-agent systems, swarm intelligence, statistics and genetic algorithms. In machine learning, the environment is typically represented as a Markov Decision Process (MDP). Many reinforcement learning algorithms use dynamic programming techniques. Reinforcement learning algorithms do not assume knowledge of an exact mathematical model of the MDP, and are used when exact models are infeasible. Reinforcement learning algorithms are used in autonomous vehicles or in learning to play a game against a human opponent

5G Technology

Before we explain how 5G works, it's probably a good idea to explain what 5G is. There are a lot of specifics, which we talk about later in this post, but here's a quick primer.

5G is the next generation of mobile broadband that will eventually replace, or at least augment, your 4G LTE connection. With 5G, you'll see exponentially faster download and upload speeds. Latency, or the time it takes devices to communicate with wireless networks, will also drastically decrease.

How does 5G work?

Now that we know what 5G is, it's a good idea to understand how it works, since it's different from traditional 4G LTE. First, let's talk spectrum.

Spectrum

Unlike LTE, 5G operates on three different spectrum bands. While this may not seem important, it will have a dramatic effect on your everyday use.

Low-band spectrum

can also be described as a sub-1GHz spectrum. It's the primary band used by carriers in the U.S. for LTE, and bandwidth is nearly depleted. While low-band spectrum offers great coverage area and wall penetration, there is a big drawback: Peak data speeds will top out around 100Mbps. T-Mobile is the key player when it comes to low-band spectrum. The carrier picked up a massive amount of 600MHz spectrum at a Federal Communications Commission (FCC) auction in 2017 and is using it to quickly build out its nationwide 5G network.

Mid-band spectrum

Provides faster speeds and lower latency than low-band. It does, however, fail to penetrate buildings as effectively as low-band spectrum. Expect peak speeds up to 1Gbps on mid-band spectrum. Sprint has the majority of unused mid-band spectrum in the U.S. The carrier is using Massive MIMO to improve penetration and coverage area on the mid-band. Massive MIMO groups multiple antennas onto a single box, and at a single cell tower, to create multiple simultaneous beams to different users. Sprint will also use Beamforming to bolster 5G service on the mid-band. This sends a single focused signal to every user in the cell, and systems using it to monitor each user to make sure they have a consistent signal.

High-band spectrum

is what delivers the highest performance for 5G, but with major weaknesses. It is often referred to as mm Wave. High-band spectrum can offer peak speeds up to 10Gbps and has extremely low latency. The main drawback of high-band is that it has low coverage area and building penetration is poor. AT&T, T-Mobile, and Verizon are all rolling out high-band spectrum. 5G coverage for the carriers will piggyback off LTE while they work to build out nationwide networks. Since high-band spectrum sacrifices building penetration and coverage area for high speed, it will rely on many small cells. These are low-power base stations that cover small geographic areas and can be combined with beamforming to bolster coverage.

How fast is 5G?

The International Telecommunication Union (ITU) is a specialized agency at the United Nations that develops technical standards for communication technologies, and it sets the rules for radio spectrum usage and telecommunications interoperability. In 2012, the ITU created a program called "IMT for 2020 and beyond" (IMT-2020) to research and establish minimum requirements for 5G. After years of work, the agency created a draft report with 13 minimum requirements for 5G in 2017. Once the ITU set the minimum requirements for 5G, the 3rd Generation Partnership Project (3GPP), a collaboration of telecommunications standards organizations, on creating standards for 5G. In December 2017, 3GPP completed its non-standalone began work (NSA) specifications, and in June 2018 it followed up with its stand-alone specifications (SA).
Both NSA and SA standards share the same specifications, but NSA uses existing LTE networks for rollout while SA will use a next-generation core network. Carriers are starting with the NSA specification, which means you will fall back on 4G LTE in a non-5G environment.
The standards set by 3GPP closely correspond with IMT-2020 performance targets and are somewhat complex, but here's a general rundown:

Peak data rate: 5G will offer significantly faster data speeds. Peak data rates can hit 20Gbps downlink and 10Gbps uplink per mobile base station. Mind you, that's not the speed you'd experience with 5G (unless you have a dedicated connection) — it's the speed shared by all users on the cell.

Real-world speeds: While the peak data rates for 5G sound pretty impressive, actual speeds won't be the same. The spec calls for user download speeds of 100Mbps and upload speeds of 50Mbps.

Latency: Latency, the time it takes data to travel from one point to another, should be at 4 milliseconds in ideal circumstances, and at 1 millisecond for use cases that demand the utmost speed. Think remote surgeries, for instance.

Efficiency: Radio interfaces should be energy efficient when in use, and drop into low-energy mode when not in use. Ideally, a radio should be able to switch into a low-energy state within 10 milliseconds when no longer in use.

Spectral efficiency: Spectral efficiency is “the optimized use of spectrum or bandwidth so that the maximum amount of data can be transmitted with the fewest transmission errors.” 5G should have a slightly improved spectral efficiency over LTE, coming in at 30bits/Hz downlink, and 15 bits/Hz uplink.

Mobility: With 5G, base stations should support movement from 0 to 310 mph. This means the base station should work across a range of antenna movements — even on a high-speed train. While it’s easily done on LTE networks, such mobility can be a challenge on new millimeter wave networks.

Connection density: 5G should be able to support many more connected devices than LTE. The standard states 5G should be able to support 1 million connected devices per square kilometer. That’s a huge number, which takes into account the slew of devices that will power the Internet of Things (IoT).

What can 5G do?

Improve broadband

The shift to 5G will undoubtedly change the way we interact with technology on a day-to-day basis, but it’s also an absolute necessity if we want to continue using mobile broadband. Carriers are running out of LTE capacity in many major metropolitan areas. In some cities, users are already experiencing slowdowns during busy times of the day. 5G adds huge amounts of spectrum in bands that haven’t been used for commercial broadband traffic.

Autonomous vehicles

Expect to see autonomous vehicles rise at the same rate that 5G is deployed across the U.S. In the future, your vehicle will communicate with other vehicles on the road, provide information to other cars about road conditions, and offer performance information to drivers and
automakers. If a car brakes quickly up ahead, yours may learn about it immediately and preemptively brake as well, preventing a collision. This kind of vehicle-to-vehicle communication could ultimately save thousands of lives.

Public safety and infrastructure

5G will allow cities and other municipalities to operate more efficiently. Utility companies will be able to easily track usage remotely, sensors can notify public works departments when drains flood or streetlights go out, and municipalities will be able to quickly and inexpensively install surveillance cameras.

Remote device control

Since 5G has remarkably low latency, remote control of heavy machinery will become a reality. While the primary aim is to reduce risk in hazardous environments, it will also allow technicians with specialized skills to control machinery from anywhere in the world.

Health care

The ultra-reliable low latency communications (URLLC) component of 5G could fundamentally change health care. Since URLLC reduces 5G latency even further than what you’ll see with enhanced mobile broadband, a world of new possibilities opens up. Expect to see improvements in telemedicine, remote recovery, and physical therapy via AR, precision surgery, and even remote surgery in the coming years.

Remember massive Machine-Type Communications? mMTC will also play a key role in health care. Hospitals can create massive sensor networks to monitor patients, physicians can prescribe smart pills to track compliance, and insurers can even monitor subscribers to
determine appropriate treatments and processes.

IoT

One of the most exciting and crucial aspects of 5G is its effect on the Internet of Things. While we currently have sensors that can communicate with each other, they tend to require a lot of resources and are quickly depleting LTE data capacity.

With 5G speeds and low latencies, the IoT will be powered by communications among sensors and smart devices (here's mMTC again). Compared to current smart devices on the market, mMTC devices will require fewer resources, since huge numbers of these devices can connect to a single base station, making them much more efficient.

Where is 5G now?

So, when should you expect to see 5G in your neighborhood? Well, it depends on the neighborhood you live in. Some neighborhoods already have 5G access — meaning that all you need to take advantage of the blazingly fast speeds is a 5G-enabled smartphone. All of the major U.S. carriers are working furiously to build out 5G networks, yet deployment across the entire country will nonetheless take several years. If you're interested in seeing if your city has access to 5G, check out this guide. It's also worth noting that each carrier has a different 5G rollout strategy. This means your 5G experience may vary greatly depending on your carrier. Here are all the details we currently have concerning each carrier's deployment plans.

Verizon

In its quest to be the first carrier to provide 5G, Verizon began offering pre-standard fixed 5G in homes in October 2018. Verizon's fixed 5G service is currently available in portions of Houston, Indianapolis, Los Angeles, and Sacramento, California. Since then, however, Verizon has also started rolling out its mobile 5G offering — and so far has brought mobile 5G to dozens of cities around the country, including New York, Los Angeles, and more.

Virtual reality

The definition of virtual reality comes, naturally, from the definitions for both 'virtual' and 'reality'. The definition of 'virtual' is near and reality is what we experience as human beings. So the term 'virtual reality' basically means 'near-reality'. This could, of course, mean anything but it usually refers to a specific type of reality emulation.

We know the world through our senses and perception systems. In school we all learned that we have five senses: taste, touch, smell, sight and hearing. These are however only our most obvious sense organs. The truth is that humans have many more senses than this, such as a sense of balance for example. These other sensory inputs, plus some special processing of sensory information by our brains ensures that we have a rich flow of information from the environment to our minds.

Everything that we know about our reality comes by way of our senses. In other words, our entire experience of reality is simply a combination of sensory information and our brains sense-making mechanisms for that information. It stands to reason then, that if you can present your senses with made-up information, your perception of reality would also change in response to it. You would be presented with a version of reality that isn't really there, but from your perspective it would be perceived as real. Something we would refer to as a virtual reality.

So, in summary, virtual reality entails presenting our senses with a computer generated virtual environment that we can explore in some fashion.

In technical terms…

Answering "what is virtual reality" in technical terms is straight-forward. Virtual reality is the term used to describe **a three-dimensional, computer generated environment** which can be explored and interacted with by a person. That person becomes part of this virtual world or is immersed within this environment and whilst there, is able to manipulate objects or perform a series of actions.

How is virtual reality achieved?

Although we talk about a few historical early forms of virtual reality elsewhere on the site, today virtual reality is usually implemented using computer technology. There are a range of systems that are used for this purpose, such as headsets, omni-directional treadmills and special gloves. These are used to actually stimulate our senses together in order to create the illusion of reality.

This is more difficult than it sounds, since our senses and brains are evolved to provide us with a finely synchronised and mediated experience. If anything is even a little off we can usually tell. This is where you'll hear terms such as immersiveness and realism enter the conversation. These issues that divide convincing or enjoyable virtual reality experiences from jarring or unpleasant ones are partly technical and partly conceptual. Virtual reality technology needs to take our physiology into account. For example, the human visual field does not look like a video frame. We have (more or less) 180 degrees of vision and although you are not always consciously aware of your peripheral vision, if it were gone you'd notice. Similarly when what your eyes and the vestibular system in your ears tell you are in conflict it can cause motion sickness. Which is what happens to some people on boats or when they read while in a car.

If an implementation of virtual reality manages to get the combination of hardware, software and sensory synchronicity just right it achieves something known as a sense of presence. Where the subject really feels like they are present in that environment.

Why have virtual reality?

This may seems like a lot of effort, and it is! What makes the development of virtual reality worthwhile? The potential entertainment value is clear. Immersive films and video games are good examples. The entertainment industry is after all a multi-billion dollar one and consumers are always keen on novelty. Virtual reality has many other, more serious, applications as well. There are a wide variety of applications for virtual reality which include:

- Architecture
- Sport

- Medicine
- The Arts
- Entertainment

Virtual reality can lead to new and exciting discoveries in these areas which impact upon our day to day lives.

Wherever it is too dangerous, expensive or impractical to do something in reality, virtual reality is the answer. From trainee fighter pilots to medical applications trainee surgeons, virtual reality allows us to take virtual risks in order to gain real world experience. As the cost of virtual reality goes down and it becomes more mainstream you can expect more serious uses, such as education or productivity applications, to come to the fore. Virtual reality and its cousin augmented reality could substantively change the way we interface with our digital technologies. Continuing the trend of humanising our technology.

Features of virtual reality systems

There are many different types of virtual reality systems but they all share the same characteristics such as the ability to allow the person to view three-dimensional images. These images appear life-sized to the person.

Plus they change as the person moves around their environment which corresponds with the change in their field of vision. The aim is for a seamless join between the person's head and eye movements and the appropriate response, e.g. change in perception. This ensures that the virtual environment is both realistic and enjoyable.

A virtual environment **should provide the appropriate responses** – in real time- as the person explores their surroundings. The problems arise when there is a delay between the person's actions and system response or latency which then disrupts their experience. The person becomes aware that they are in an artificial environment and adjusts their behaviour accordingly which results in a stilted, mechanical form of interaction.

The aim is for a natural, free-flowing form of interaction which will result in a memorable experience.

Summary

Virtual reality is the creation of a virtual environment presented to our senses in such a way that we experience it as if we were really there. It uses a host of technologies to achieve this goal and is a technically complex feat that has to account for our perception and cognition. It has both entertainment and serious uses. The technology is becoming cheaper and more widespread. We can expect to see many more innovative uses for the technology in the future and perhaps a fundamental way in which we communicate and work thanks to the possibilities of virtual reality.

Robotics

Robotics is the intersection of science, engineering and technology that produces machines, called robots, that substitute for (or replicate) human actions. Pop culture has always been fascinated with robots. R2-D2. Optimus Prime. WALL-E. These over-exaggerated, humanoid concepts of robots usually seem like a caricature of the real thing...or are they more forward thinking than we realize? Robots are gaining intellectual and mechanical capabilities that don't put the possibility of a R2-D2-like machine out of reach in the future.

As technology progresses, so too does the scope of what is considered robotics. In 2005, 90% of all robots could be found assembling cars in automotive factories. These robots consist mainly of mechanical arms tasked with welding or screwing on certain parts of a car. Today, we're seeing an evolved and expanded definition of robotics that includes the development, creation and use of bots that explore Earth's harshest conditions, robots that assist law-enforcement and even robots that assist in almost every facet of healthcare.

While the overall world of robotics is expanding, a robot has some consistent characteristics:

1. Robots all consist of some sort of mechanical construction. The mechanical aspect of a robot helps it complete tasks in the environment for which it's designed. For example, the Mars 2020 Rover's wheels are individually motorized and made of titanium tubing that help it firmly grip the harsh terrain of the red planet.
2. Robots need electrical components that control and power the machinery. Essentially, an electric current (a battery, for example) is needed to power a large majority of robots.
3. Robots contain at least some level of computer programming. Without a set of code telling it what to do, a robot would just be another piece of simple machinery. Inserting a program into a robot gives it the ability to know when and how to carry out a task.

The robotics industry is still relatively young, but has already made amazing strides. From the deepest depths of our oceans to the highest heights of outer space, robots can be found performing tasks that humans couldn't dream of achieving.

Historical Background

The idea of a machine that looks and behaves like a human being goes back at least 2,000 years. According

To Greek mythology, Hephaestus, the god of fire, constructed artificial women out of gold. These women were able to walk, talk, and even to think.

By the eighteenth century, scientists and inventors had created an impressive array of mechanical figures that looked and acted like humans and other animals. Swiss watchmaker Pierre Jacquet-Droz (1721–1790), and his son Henri-Louis (1752–1791), for example, designed and constructed animated dolls, called automata, and mechanical birds to help sell watches. One doll was able to play the piano, swaying in time with the music, and a young scribe who could write messages of up to 40 characters.

The modern robot is considered today to have been built by Serb-American physicist, engineer, and inventor Nikola Tesla (1856–1943). He constructed a remote-operated boat and showed its abilities at an 1898 exhibition in New York City. He also built remote vehicles for use in the air and on the ground. One of the first companies to build robots was Westinghouse in the 1930s. The company built Elektro, which was programmed to talk, walk, and move its head and arms. The first electrically operated robot was built in England by American-born English neurophysiologist W. Grey Walter (1919–1977).

Many of these early accomplishments had little practical value. They were built in order to impress or charm viewers, or to demonstrate the inventor's creative and technological skills. That line of research continues today. Many modern robots have little function beyond demonstrating what can be done in building machines that more and more closely resemble the appearance and function of humans.

One function for such robots is in advertising. They are used to publicize some particular product or to inform the public about the robots themselves. Robots of this kind are most commonly found at conventions, conferences, or other large meetings. As one example, a robot named

Argon was used in April 1983 to walk a dog through a veterinary congress in London, England, promoting the “Pets Are Good People” program.

Types of Robots

Mechanical bots come in all shapes and sizes to efficiently carry out the task for which they are designed. From the 0.2 millimeter-long “RoboBee” to the 200 meter-long robotic shipping vessel “Vindskip,” robots are emerging to carry out tasks that humans simply can’t. Generally, there are five types of robots:

Pre-Programmed Robots

Pre-programmed robots operate in a controlled environment where they do simple, monotonous tasks. An example of a pre-programmed robot would be a mechanical arm on an automotive assembly line. The arm serves one function — to weld a door on, to insert a certain part into the engine, etc. — and it's job is to perform that task longer, faster and more efficiently than a human.

Humanoid Robots

Humanoid robots are robots that look like and/or mimic human behavior. These robots usually perform human-like activities (like running, jumping and carrying objects), and are sometimes designed to look like us, even having human faces and expressions. Two of the most prominent examples of humanoid robots are Hanson Robotics’ Sophia (in the video above) and Boston Dynamics’ Atlas.

Autonomous Robots

Autonomous robots operate independently of human operators. These robots are usually designed to carry out tasks in open environments that do not require human supervision. An example of an autonomous robot would be the Roomba vacuum cleaner, which uses sensors to roam throughout a home freely.

Teleoperated Robots

Teleoperated robots are mechanical bots controlled by humans. These robots usually work in extreme geographical conditions, weather, circumstances, etc. Examples of teleoperated robots are the human-controlled submarines used to fix underwater pipe leaks during the BP oil spill or drones used to detect landmines on a battlefield.

Augmenting Robots

Augmenting robots either enhance current human capabilities or replace the capabilities a human may have lost. Some examples of augmenting robots are robotic prosthetic limbs or exoskeletons used to lift hefty weights.

Uses of Robots Manufacturing

The manufacturing industry is probably the oldest and most well-known user of robots. These robots and co-bots (bots that work alongside humans) work to efficiently test and assemble products, like cars and industrial equipment. It's estimated that there are more than three million industrial robots in use right now.

Logistics

Shipping, handling and quality control robots are becoming a must-have for most retailers and logistics companies. Because we now expect our packages arriving at blazing speeds, logistics companies employ robots in warehouses, and even on the road, to help maximize time efficiency. Right now, there are robots taking your items off the shelves, transporting them across the warehouse floor and packaging them. Additionally, a rise in last-mile robots (robots that will autonomously deliver your package to your door) ensure that you'll have a face-to- metal-face encounter with a logistics bot in the near future.

Home

It's not science fiction anymore. Robots can be seen all over our homes, helping with chores, reminding us of our schedules and even entertaining our kids. The most well-known example of home robots is the autonomous vacuum cleaner Roomba. Additionally, robots have now evolved to do everything from autonomously mowing grass to cleaning pools.

Travel

Is there anything more science fiction-like than autonomous vehicles? These self-driving cars are no longer just imagination. A combination of data science and robotics, self-driving vehicles are taking the world by storm. Automakers, like Tesla, Ford, Waymo, Volkswagen and BMW are all working on the next wave of travel that will let us sit back, relax and enjoy the ride. Rideshare companies Uber and Lyft are also developing autonomous rideshare vehicles that don't require humans to operate the vehicle.

Healthcare

Robots have made enormous strides in the healthcare industry. These mechanical marvels have use in just about every aspect of healthcare, from robot-assisted surgeries to bots that help humans recover from injury in physical therapy. Examples of robots at work in healthcare are Toyota's healthcare assistants, which help people regain the ability to walk, and "TUG," a robot designed to autonomously stroll throughout a hospital and deliver everything from medicines to clean linens.

Robots At Work: The Present Day

Robots have come to play a widespread and crucial role in many industrial operations today. These robots are almost always without human features — rather than the Jacquet-Droz doll-like style. The work that robots do can be classified into three major categories: in the assembly and finishing of products; in the movement of materials and objects; and in the performance of work in environmentally difficult or hazardous situations.

The most common single application of robots is in welding. About one-fourth of all robots used by industry have this function. In a typical operation, two pieces of metal will be moved within the welding robot's field and the robot will apply the heat needed to create the weld. Welding robots can have a variety of appearances, but they tend to consist of one large arm that can rotate in various directions. At the end of the arm is a welding gun that actually performs the weld. Closely related types of work now done by robots include cutting, grinding, polishing, drilling, sanding, painting, spraying, and otherwise treating the surface of a product. As with welding, activities of this kind are usually performed by one-armed robots that hang from the ceiling, project outward from a platform, or reach into a product from some other angle.

There are some obvious advantages for using a robot to perform tasks such as these. They are often boring, difficult, and sometimes dangerous tasks that have to be repeated over and over again in exactly the same way. Why should a human be employed to do such repetitive work, robotics engineers ask, when a machine can do the same task just as efficiently?

That argument can be used for many of the other industrial operations in which robots have replaced humans. Another example of such operations is the assembly of individual parts into some final product, as in the assembly of automobile parts in the manufacture of a car. At one time, only a crew of humans, each of whom had his or her own specific responsibility, could have done this kind of assembly: moving a body section into position, welding it into place, installing and tightening bolts, turning the body for the next operation, and so forth. In many assembly plants today, the assembly line of humans has been replaced by an assembly line of robots that does the same job, but more safely and more efficiently than was the case with the human team.

Mechanical robots have been successfully built to evolve the automobile assembly. Such an robotic system would eliminate most or all the human element. Its replacement would consist of automatic controls that guarantee a level of accuracy and quality that is beyond human skills. Advanced computerization has resulted in assembly lines that are completely run by computers controlling numerous types of industrial robots. Such robots perform repetitive, elementary tasks, but also are increasingly able to regulate or adjust their own performance to changing situations.

Movement Of Materials

Many industrial operations involve the lifting and moving of large, heavy objects over and over again. For example, a particular process may require the transfer of steel ingots onto a conveyor belt and then, at some later point, the removal of shaped pieces of steel made from those ingots. One way to perform these operations is with heavy machinery operated by human workers. But another method that is more efficient and safer is to substitute robots for the human and his or her machine.

Another type of heavy-duty robot is an exoskeleton, that is, a metallic contraption that surrounds a human worker. The human can step inside the exoskeleton, placing his or her arms and legs into the corresponding limbs of the exoskeleton. By operating the exoskeleton's controls, the human can magnify his or her strength many times, picking up and handling objects that would otherwise be much too heavy for the operator's own capacity.

Mobile robots are used for many heavy-duty operations. The robots operate on a system of wheels or legs, on a track, or with some other system of locomotion. They pick up a material or an object in one location and move it to a different location. The robots need not be designed to handle very large loads only. As an example, some office buildings contain tracks along which mobile robots can travel delivering mail to various locations within the building.

As another example of robots in everyday usage, automated guided vehicles (AGVs) are used in medical facilities, such as hospitals, to move materials such as medicines and supplies from one location to another with the use of markers. Some AGVs are laser-guided and do not even need markers to guide them. Consumers not are seeing advertisements for vacuum cleaners and lawn mowers that are robots. The RoboMower® from the company Friendly Robotics, is advertised to cut grass automatically without the use of human effort, gasoline, oil and harmful environmental emissions.

Hazardous Or Remote Duty Robots

A common application of robots is for use in places that humans can go only at risk to their own health or safety or that humans can not go at all. Industries where nuclear materials are used often make use of robots so that human workers are not exposed to the dangerous effects of radioactive materials. In one type of machine, a worker sits in a chair and places his or her hands and arms into a pair of sleeves. The controls within the sleeves are connected to a robot arm that can reach into a protected area where radioactive materials are kept. The worker can operate the robot arm and hand to perform many delicate operations that would otherwise have to be carried out by a human worker.

Robots have also been useful in space research. In 1975, for example, two space probes, code-named Viking 1 and Viking 2, landed on the planetMars. These probes were two of the most complex and sophisticated robots ever built at that time. Their job was to analyze the planet's surface. In order to accomplish this task, the probes were equipped with a long arm that was able to operate across a 120° radius, digging into the ground and taking out samples of Martian soil. The samples were then transported to one of three chemical laboratories within the robot, where they underwent automated chemical analysis. The results of these analyses were then transmitted by automatic telemetry to receiving stations on the Earth.

How Robots Work

In order for a robot to imitate the actions of a human being, it has to be able to perform three fundamental tasks. First, it must be conscious of the world around it, just as humans obtain information about the world from five senses. Second, the robot must somehow be programmed to know what to do. One way for it to get that knowledge is to have a human prepare a set of instructions that are then implanted into the robot's brain (central processing center). Alternatively, it must be able to analyze and interpret data it has received from its senses and then make a decision based on that data as to how it should react. Third, the robot must be able to act on the instructions or data it has received.

Not all robots have all of these functions. For example, some of the earliest 'for fun' robots like the Jacquet-Droz doll and scribe knew what to do because of the instructions that had been programmed into them by their inventors. The inventors also gave their toys the mechanical means with which to carry out their instructions: arms, fingers, torsos, eyes, and other body parts that were able to move in specific ways.

Mechanical Systems

The human-like movements that a robot makes as it works can be accomplished with a relatively small number of mechanical systems. One of those systems is known as the rectangular or Cartesian coordinate system. This system consists of a set of components that can move in any one of three directions, all at right angles to each other.

Think of a three-dimensional system in which an x-axis and a y-axis define a flat plane. Perpendicular to that plane is a third axis, the z-axis. A rule can be made to travel along the x-axis, along the y-axis, or along the z-axis. Overall, the ruler has the ability to move in three different directions, back and forth along the xand y-axes and up and down along the z-axis. A system of this type is said to have three degrees of freedom because it has the ability to move in three distinct directions.

Another type of mechanical system is the cylindrical coordinate system. This system consists of a cylinder with a solid column through the middle of it. The cylinder can move up and down on the column (one degree of freedom), and an arm attached to the outside of the cylinder can rotate around the central column (a second degree of freedom). Finally, the arm can be constructed so that it will slide in and out of its housing attached to the cylinder (a third degree of freedom).

A third type of mechanical system is the spherical coordinate system. To understand this system, imagine a rectangular box-shaped component attached to a base. The box can rotate on its own axis (one degree of freedom) or tilt up or down on its axis (a second degree of freedom). An arm attached to the box may also be able to extend or retract, giving it a third degree of freedom.

Many robots have more than three degrees of freedom because they consist of two or more simple systems combined with each other. For example, a typical industrial robot might have one large arm constructed on a Cartesian coordinate system. At the end of the arm, there might then be a wrist-type component with the same or a different mechanical system. Attached to the wrist might then be a hand with fingers, each with a mechanical system of its own. Combinations of mechanical systems like this one make it possible for an industrial robot to perform a variety of complex maneuvers not entirely different from those of a human arm, wrist, hand, and finger.

Sensory Systems

The component of modern robots that was most commonly missing from their early predecessors was the ability to collect data from the outside world. Humans accomplish this task, of course, by means of hands, eyes, ears, noses, and tongues. With some important exceptions, robots usually do not need to have the ability to hear, smell, or taste things in the world around them, but they are often required to be able to see an object or to feel it.

The simplest optical system used in robots is a photoelectric cell. A photoelectric cell converts light-energy into electrical energy. It allows a robot to determine yes/no situations in its field of vision, such as whether a particular piece of equipment is present or not. Suppose, for example, that a robot looks at a place on the table in front of it where a tool is supposed to be. If the tool is present, light will be reflected off it and sent to the robot’s photoelectric cell. There, the light waves will be converted to an electrical current that is transmitted to the robot’s computer-brain.

More complex robot video systems make use of television cameras. The images collected by the cameras are sent to the robot’s brain, where they are processed for understanding. One means of processing is to compare the image received by the television camera with other images stored in the robot’s computer-brain.

The human sense of touch can be replicated in a robot by means of tactile sensors. One kind of tactile sensor is nothing more than a simple switch that goes from one position to another when the robot’s fingers come into contact with a solid object. When a finger comes into contact with an object, the switch may close, allowing an electrical current to flow to the brain. A more sophisticated sense of touch can be provided by combining a group of tactile sensors at various positions on the robot’s hand. This arrangement allows the robot to estimate the shape, size, and contours of an object being examined.

Microcomputer-Driven Robots

Probably the most important development in the history of robotics has been the evolution of the microcomputer. The microcomputer makes it possible to store enormous amounts of information as well as huge processing programs into the brain of a robot. With the aid of a microcomputer, a robot can not only be provided with far more basic programming than had been possible before, but it can also be provided with the programming needed to help the robot teach itself, that is, to learn. For example, some computers designed to carry out repetitious tasks have developed the ability to learn from previous mistakes and, therefore, to work more efficiently in the future.

Advancements

Robots are increasing used in hazardous conditions, such as bomb disposal robots that are used in the military. The iRobot Packbot is an explosive ordinance disposal (EOD) robot that is used when explosives are involved. Onboard the Packbot are cameras, laser pointers, sensors, and other equipment that can sense explosive materials. When identified as such, the robot is able to defuse the explosive so soldiers are not placed in danger. As of November 2006, hundreds of PackBots had been deployed by the United States military in the countries of Afghanistan and Iraq.

Other robots are being designed and constructed for more mundane efforts. Robots are being developed to provide companionship to people (social robots) such as robotic pets. Sony's AIBO pet dog is designed with a variety of preprogrammed behaviors. However, based on human interactions, the robot can learn other new behaviors. The dog is programmed to play with its pink ball, however, by petting the dog's head repeatedly, for example, it will begin to like such activity.

Q3.

(a) Write a note on prevailing generation of computers in use and discuss its characteristics in detail.

What Are the Five Generations of Computers?

Five generations of computers and the advances in technology that have led to the development of the many computing devices that we use today. Our journey of the five generations of computers starts in 1940 with vacuum tube circuitry and goes to the present day — and beyond — with artificial intelligence (AI) systems and devices.

1) First Generation: Vacuum Tubes (1940-1956)

The first computer systems used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms. These computers were very expensive to operate and in addition to using a great deal of electricity, the first computers generated a lot of heat, which was often the cause of malfunctions.

First generation computers relied on machine language, the lowest-level programming language understood by computers, to perform operations, and they could only solve one problem at a time. It would take operators days or even weeks to set-up a new problem. Input was based on punched cards and paper tape, and output was displayed on printouts.

The UNIVAC and ENIAC computers are examples of first-generation computing devices. The UNIVAC was the first commercial computer delivered to a business client, the U.S. Census Bureau in 1951.

2) Second Generation: Transistors (1956-1963)

The world would see transistors replace vacuum tubes in the second generation of computers. The transistor was invented at Bell Labs in 1947 but did not see widespread use in computers until the late 1950s.

The transistor was far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper, more energy-efficient and more reliable than their first-generation predecessors. Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube. Second-generation computers still relied on punched cards for input and printouts for output.

From Binary to Assembly

Second-generation computers moved from cryptic binary machine language to symbolic, or assembly, languages, which allowed programmers to specify instructions in words. High-level programming languages were also being developed at this time, such as early versions of COBOL and FORTRAN. These were also the first computers that stored their instructions in their memory, which moved from a magnetic drum to magnetic core technology.

The first computers of this generation were developed for the atomic energy industry.

3) Third Generation: Integrated Circuits (1964-1971)

The development of the integrated circuit was the hallmark of the third generation of computers. Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and efficiency of computers. Instead of punched cards and printouts, users interacted with third generation computers through keyboards and monitors and interfaced with an operating system, which allowed the device to run many different applications at one time with a central program that monitored the memory. Computers for the first time

became accessible to a mass audience because they were smaller and cheaper than their predecessors.
Fact:

(An integrated circuit (IC) is a small electronic device made out of a semiconductor material. The first integrated circuit was developed in the 1950s by Jack Kilby of Texas Instruments and Robert Noyce of Fairchild Semiconductor).

4) Fourth Generation: Microprocessors (1971-Present)

The microprocessor brought the fourth generation of computers, as thousands of integrated circuits were built onto a single silicon chip. What in the first generation filled an entire room could now fit in the palm of the hand. The Intel 4004 chip, developed in 1971, located all the components of the computer—from the central processing unit and memory to input/output controls—on a single chip.
In 1981 IBM introduced its first computer for the home user, and in 1984 Apple introduced the Macintosh. Microprocessors also moved out of the realm of desktop computers and into many areas of life as more and more everyday products began to use microprocessors.
As these small computers became more powerful, they could be linked together to form networks, which eventually led to the development of the Internet. Fourth generation computers also saw the development of GUIs, the mouse and handheld devices.

5) Firth Generation: Artificial Intelligence (Present)

Fifth generation computing devices, based on artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today. The use of parallel processing and superconductors is helping to make artificial intelligence a reality.
Quantum computation and molecular and nanotechnology will radically change the face of computers in years to come. The goal of fifth-generation computing is to develop devices that respond to natural language input and are capable of learning and self-organization.

(b) Multiply the given binary numbers 10001001 with 10010011.

Binary value: 10001001 × 10010011= 0100111010101011