INTRODUCTION TO ICT

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Course Title: INTRODUCTION TO ICT
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Note: Attempt all Questions.

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.

ANS). 'The Incredibles' Production Process’

The production of "The Incredibles" followed a familiar Pixar process. Here's a look:

Creating an animated film involves multiple, carefully planned stages. First, the story is written and preliminary storyboards are drawn to help tell the story visually in the earliest stages. The storyboards are then turned into a form of early animation -- known as "reels" or "animatics" -- that allows the filmmakers to fine-tune the sequences before actually animating them.

Simultaneously, the art department is hard at work, illustrating every last physical detail of the individual characters and the entire universe in which they exist while also brainstorming the design of "virtual" sets, props, buildings, surfaces, and color palettes. Once the story and look of the film are decided upon, actors are brought in to record the voice performances -- giving the characters distinct personalities, which are, in turn, used to inspire the rest of the creative process.

Then the process of metamorphosing these 2-D representations into a 3-D reality begins. The first step is for the modeling group to build the characters and sets in the computer. The layout crew is instrumental in the next phase -- fine-tuning the characters and the shots to create environments that will tell the story to its greatest effect. Following this, the characters are fully animated -- move by move, shot by shot -- and they come to life with a full range of expressions, movements, and emotions.

Nuanced shading and digital lighting complete the production phase, and the entire movie is rendered. In rendering, all of the information that makes up the motion picture is translated from digital data into actual frames of film. Finally, the film is completed much like any other motion picture -- via final editing, scoring, and the addition of sound and special effects.

Technical Challenges of "The Incredibles"

With "The Incredibles," director Brad Bird asked his team at Pixar to innovate, expand upon, and find new ways to push this process to its furthest creative extremes. Says producer John Walker, "This film started with a personal vision and a passion that spread throughout Pixar. It's an exciting thing to break new ground, pioneer new techniques, and invite audiences into an experience that is as emotional and fun as it is innovative."

Adds Bird, "As director, I became well acquainted with what I called the 'Pixar Glaze,' where these complete technical geniuses would just grow pale and start looking at each other like, 'Does he know what he's asking?' But no one ever gave up. Every problem found a solution that kept pushing the film's creativity. It's a real testament to Pixar that they kept coming up with magic from thin air."

In the end, "The Incredibles" took everyone involved on an imaginative ride. "The creation of 'The Incredibles' required a tour de force," executive producer John Lasseter says. "Fortunately, our guys at Pixar keep getting better and better. When you see the characters in this movie

act, and you look into the pools of their eyes, you can feel what's going on inside their soul. The subtleties of their facial animation and their body gestures are remarkable. You get so caught up with the characters and the story, you don't think about what genre of movie it is. You simply know you are watching a remarkable story."

'The Incredibles' Animation Process'

After tackling the sheer scale and intricacy of production design for "The Incredibles," the filmmakers took on their most difficult task: animating the characters so that they appeared alive throughout the broadest possible gamut of human-like movements and expressions.

This would take the film's crew into a "forbidden zone": It was widely believed that computer animation wasn't equipped to generate subtle human qualities. For instance, it was considered impossible to animate muscles that would flex and ripple, hair that would flip and bounce, skin that would pucker and stretch, and clothing that would move independently of the body. Because of this, computer animators had long avoided human-like characters. Director Brad Bird, however, was convinced the technology could be invented to allow his characters far more "life."

"Everyone at Pixar knows that the closer to reality you try to make something, the easier it is to fail -- but the secret Brad used with 'The Incredibles' was to produce something that the audience knows doesn't exist, something so stylized that they are ready to believe in it if it all works seamlessly," executive producer John Lasseter explains. "With the technology that we've been pioneering at Pixar, we were ready to achieve that. Our goal on 'The Incredibles' was to create very stylized human beings who could never pass as real humans but have hair, skin, and clothing so true-to-life that their reactions have a stronger, more dramatic impact."

Skeletons and Muscles

The skeleton and its surrounding musculature is where all human motion begins, so this, obviously, was where the Pixar team started. It began with the body of Bob Parr, Mr. Incredible, and literally created him from the inside out.

"Bob was definitely the toughest character for us to model and rig because he is such a muscular guy," says Rick Sayre, the film's supervising technical director. "As we began to create him, we developed a completely new and different approach for his skeleton and the way muscle, skin, bones, and fat would attach to it. We used a fantastic new technology called 'goo,' which allows the skin to react to the muscles sliding and sticking underneath in a very true fashion."

This changed the entire animating process. Animators are not so much technicians as they are artists -- actors or puppeteers who creatively choreograph the characters' movements and expressions through specially programmed computer controls. Now the animators had more control of the characters than ever before.

"You may have noticed that it is very hard to get a convincing shoulder motion in CG animation," Sayre says. "This is why you often see animated characters that have shoulders that are too broad. We wanted to make a shoulder breakthrough on this film, so to speak."

Skin and Hair

The qualities that truly create realism in a character are the appearance of skin and hair. This is where Pixar made its most important breakthroughs, with new approaches to lighting and shading the skin and sculpting hairstyles. Pixar came up with a new technology called "subsurface scattering," which gave more translucency to the skin and made the characters seem alive. With hairstyles ranging from Helen's short, well-manicured coif to Violet's long, free-flowing locks, new programs and approaches were also required to sculpt the tops of the characters' heads.

The most difficult character to animate from a hair standpoint was Violet. She remained an "unsolved research project" well into the production of the film, due to her long, flowing hair -- the bane of an animator's existence. In fact, no one had ever animated this kind of hair before for a CG film. Henne and his team came up with five different sculpted hairstyles for Violet for the different phases of the film. Each of these styles could then be modified to reflect the various environmental conditions she encounters, including rain, wind, and the zero gravity of her own force field. Eventually, Violet's hair became one of the film's triumphs.

Clothing

Even in regard to wardrobe, "The Incredibles" was more complicated than any animated film in history, and more akin to an epic costume drama. More than 150 garments had to be specially designed and tailored to fit the lead and background characters.

The director didn't simply want great-looking clothes for his characters -- he wanted clothes that would move like actual fabric. Pixar was already famous for its pioneering work in cloth motion, thanks to advances made with Boo's T-shirt in "Monsters, Inc." For "The Incredibles," the team found an inventive way to "bake" garments onto the characters, especially in the case of tight-fitting super suits. Instead of simulating the clothing for each individual frame, this process analyzes the different poses and motion patterns for a character and automatically creates the appropriate movement for the clothing. For example, when Bob sits in a chair, wearing his super suit, the suit knows what to do and where to crease because it has already been through a comprehensive training set.

Special Effects

The special effects included every possible natural element -- from water to fire to ice (for Frozone's super-cool antics) -- and needed to be created for more than one-third of the final 2,200-plus shots in the film.

"The effects seen in 'The Incredibles' are completely fresh and spectacular," says Sandra Karpman, effects supervisor. "The biggest leap from an effects standpoint is the fact that we have beautiful, amazing, 3-D volumetric clouds that you can actually fly through. Most clouds in other effects movies, or even previous CG films, are matte paintings or stock photography. In our film, when Helen is in the airplane flying through the clouds, it's very 3-D, and you see the clouds moving against each other. They're transparent, and if you stack them, they become opaque."

As great as the special effects are, the personalities of the characters are what really give "The Incredibles" its human feel. In the next section, we'll take a closer look at each character.

'The Incredibles' Characters'

As he embarked on the intense journey of making "The Incredibles," writer/director Brad Bird knew that he would need to surround himself with devoted talent to bring his vision to life -- not

just on the technical side, but also through gifted actors who could give his characters depth and dimension. He began the process by making sure the storyboards would communicate enough to the actors to elicit multi-tonal performances. Bird worked with story supervisor Mark Andrews, artist Teddy Newton, and supervising animator Tony Fucile, who each played a major role in designing the characters and bringing them fully to life.

"Brad would simply describe the characters to me -- he wouldn't use too many adjectives, but he would often do an impression or a voice for them," says Newton, who was the first to draw many of the film's characters. "Sometimes the voice alone would put enough pictures and ideas in my head. It's like when you listen to the radio and you start to imagine what the person would look like. You get inspired and everything starts to take shape."

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

A). Machine Learning:

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. **Machine learning focuses on the development of computer programs** that can access data and use it learn for themselves.

The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. **The primary aim is to allow the computers learn automatically** without human intervention or assistance and adjust actions accordingly.

Some machine learning methods

Machine learning algorithms are often categorized as supervised or unsupervised.

- **Supervised machine learning algorithms** can apply what has been learned in the past to new data using labeled examples to predict future events. Starting from the analysis of a known training dataset, the learning algorithm produces an inferred function to make predictions about the output values. The system is able to provide targets for any new input after sufficient training. The learning algorithm can also compare its output with the correct, intended output and find errors in order to modify the model accordingly.

- ★ In contrast, **unsupervised machine learning algorithms** are used when the information used to train is neither classified nor labeled. Unsupervised learning studies how systems can infer a function to describe a hidden structure from unlabeled data. The system doesn't figure out the right output, but it explores the data and can draw inferences from datasets to describe hidden structures from unlabeled data.
- ★ **Semi-supervised machine learning algorithms** fall somewhere in between supervised and unsupervised learning, since they use both labeled and unlabeled data for training – typically a small amount of labeled data and a large amount of unlabeled data. The systems that use this method are able to considerably improve learning accuracy. Usually, semi-supervised learning is chosen when the acquired labeled data requires skilled and relevant resources in order to train it / learn from it. Otherwise, acquiring unlabeled data generally doesn't require additional resources.
- ★ **Reinforcement machine learning algorithms** is a learning method that interacts with its environment by producing actions and discovers errors or rewards. Trial and error search and delayed reward are the most relevant characteristics of reinforcement learning. This method allows machines and software agents to automatically determine the ideal behavior within a specific context in order to maximize its performance. Simple reward feedback is required for the agent to learn which action is best; this is known as the reinforcement signal.

Machine learning enables analysis of massive quantities of data. While it generally delivers faster, more accurate results in order to identify profitable opportunities or dangerous risks, it may also require additional time and resources to train it properly. Combining machine learning with AI and cognitive technologies can make it even more effective in processing large volumes of information.

(b) 5G Technology:

5G also incorporates many technologies, many of which are new, to enable the it to provide the very high levels of performance required of it.

The technologies for 5G mobile communications include:

- ❖ ***Waveforms & modulation:*** One of the major discussions when 5G was being developed was based around the type of waveform to be used. In the end the scheme was based around OFDM, with actual modulation formats dependent upon the link and these include QPSK, 16QAM, 64QAM, 256QAM and for the uplink when DFT-OFDM is used, π/2-BPSK can be used.

  For the future, other forms of waveform may be developed, but currently the waveform is based around OFDM.

- ***Multiple Access:*** Again, a variety of access schemes were discussed, but for the 5G New Radio, OFDMA was implemented. For the downlink CP-OFDM was used and in the uplink either CP-OFDM or DFT-OFDM could be used.
- ***Millimeter-Wave communications:*** Millimeter wave mobile communications was not implemented for the initial deployments of the 5g mobile communications system as the technology for cost effective millimeter wave communications had not been sufficiently developed. The use of mm Wave for 5G mobile communications will require a large number of base stations to give the required coverage.

  In preparation for the implementation of mm Wave, frequencies are being allocated and fall within the FR2 (Frequency Range 2) set of allocations.
- ***Massive MIMO with beam-steering:*** The antenna technologies for 5G have provided significant opportunities for enhancement of the performance over 4G. Although MIMO was used with 4G LTE, the technology has been taken further.

  Beam-steering technology has also been adopted to enable the transmitter and receiver antenna beams to be focussed towards the mobiles with which they are communicating. Each mobile can have its own beam, using advanced antenna technology, and this focussed the transmitted power where it is required and reduces interference between mobiles. This gives a significant improvement in performance.
- ***Dense networks:*** Reducing the size of cells provides a much more overall effective use of the available spectrum. Whilst the large macro cells will be retained for general communications, many more small cells will be deployed to ensure that the data capacity can be provided.

  The use of smaller cells gives much greater frequency re-use and as a result the overall network can provide a significantly increased level of data capacity. As data usage is increasing rapidly, this is a clear and pressing requirement.

These are a few of the main techniques being developed and discuss for use within 5G.

(c) 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*.

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.

(d) 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.

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 its 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.

Q 3. Write a note on the following.

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

ANS). 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.

ANS). Binary value: 10001001 × 10010011= 0100111010101011.