**Mid Semester Assignment**

Course Title: INTRODUCTION TO ICT

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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.

**Incredible 1; *The Incredibles*** is a 2004 American [computer-animated](https://en.wikipedia.org/wiki/Computer_animation) [superhero film](https://en.wikipedia.org/wiki/Superhero_film) written and directed by [Brad Bird](https://en.wikipedia.org/wiki/Brad_Bird), produced by [Pixar Animation Studios](https://en.wikipedia.org/wiki/Pixar_Animation_Studios), released by [Walt Disney Pictures](https://en.wikipedia.org/wiki/Walt_Disney_Pictures), and starring the voices of [Craig T. Nelson](https://en.wikipedia.org/wiki/Craig_T._Nelson), [Holly Hunter](https://en.wikipedia.org/wiki/Holly_Hunter), [Sarah Vowell](https://en.wikipedia.org/wiki/Sarah_Vowell), [Spencer Fox](https://en.wikipedia.org/wiki/Spencer_Fox), [Jason Lee](https://en.wikipedia.org/wiki/Jason_Lee_%28actor%29), [Samuel L. Jackson](https://en.wikipedia.org/wiki/Samuel_L._Jackson), and [Elizabeth Peña](https://en.wikipedia.org/wiki/Elizabeth_Pe%C3%B1a). Set in an alternate version of the 1960s, the film follows the Parrs, a family of superheroes who hide their powers in accordance with a government mandate, and attempt to live a quiet suburban life. Mr. Incredible's desire to help people draws the entire family into a confrontation with a vengeful fan-turned-foe and his killer robot.

Bird, who was Pixar's first outside director, developed the film as an extension of the 1960s comic books and [spy films](https://en.wikipedia.org/wiki/Spy_film) from his boyhood and personal family life. He pitched the film to Pixar after the box office disappointment of his first feature, [*The Iron Giant*](https://en.wikipedia.org/wiki/The_Iron_Giant) (1999), and carried over much of its staff to develop *The Incredibles*. The animation team was tasked with animating an all-human cast, which required creating new technology to animate detailed human anatomy, clothing and realistic skin and hair. [Michael Giacchino](https://en.wikipedia.org/wiki/Michael_Giacchino) composed the film's [orchestral](https://en.wikipedia.org/wiki/Orchestral) score.

The film premiered on October 27, 2004, at the [BFI London Film Festival](https://en.wikipedia.org/wiki/BFI_London_Film_Festival) and had its general release in the United States on November 5, 2004. It performed well at the box office, grossing $633 million worldwide during its original theatrical run. *The Incredibles* received widespread approval from critics and audiences, winning two [Academy Awards](https://en.wikipedia.org/wiki/Academy_Awards) and the [Annie Award for Best Animated Feature](https://en.wikipedia.org/wiki/Annie_Award_for_Best_Animated_Feature). It was the first entirely animated film to win the prestigious [Hugo Award for Best Dramatic Presentation](https://en.wikipedia.org/wiki/Hugo_Award_for_Best_Dramatic_Presentation). A sequel, *[Incredibles 2](https://en.wikipedia.org/wiki/Incredibles_2%22%20%5Co%20%22Incredibles%202)*, was released on June 15, 2018.

**Writing:**

*The Incredibles* as a concept dates back to 1993 when Bird sketched the family during an uncertain point in his film career. Personal issues had percolated into the story as they weighed on him in life. During this time, Bird had signed a production deal with [Warner Bros. Feature Animation](https://en.wikipedia.org/wiki/Warner_Bros._Animation) and was in the process of directing his first feature, [*The Iron Giant*](https://en.wikipedia.org/wiki/The_Iron_Giant). Approaching middle age and having high aspirations for his filmmaking, Bird pondered whether his career goals were attainable only at the price of his family life. He stated, "Consciously, this was just a funny movie about superheroes. But I think that what was going on in my life definitely filtered into the movie." After the box office failure of *The Iron Giant*, Bird gravitated toward his superhero story.

He imagined it as a homage to the 1960s comic books and [spy films](https://en.wikipedia.org/wiki/Spy_film) from his boyhood and he initially tried to develop it as a [2D cel animation](https://en.wikipedia.org/wiki/Traditional_animation#Cels). When *The Iron Giant* became a [box office bomb](https://en.wikipedia.org/wiki/Box_office_bomb), he reconnected with old friend [John Lasseter](https://en.wikipedia.org/wiki/John_Lasseter) at [Pixar](https://en.wikipedia.org/wiki/Pixar) in March 2000 and pitched his story idea to him. Bird and Lasseter knew each other from their college years at [CalArts](https://en.wikipedia.org/wiki/California_Institute_of_the_Arts) in the 1970s. Lasseter was sold on the idea and convinced Bird to come to Pixar, where the film would be done in [computer animation](https://en.wikipedia.org/wiki/Computer_animation). The studio announced a multi-film contract with Bird on May 4, 2000. *The Incredibles* was written and directed solely by Brad Bird, a departure from previous Pixar productions which typically had two or three directors and as many screenwriters with a history of working for the company. In addition, it would be the company's first film in which all characters are human.

### Animation:

Upon Pixar's acceptance of the project, Brad Bird was asked to bring in his own team for the production. He brought up a core group of people he worked with on *The Iron Giant*. Because of this, many 2-D artists had to make the shift to 3-D, including Bird himself. Bird found working with CG "wonderfully malleable" in a way that traditional animation is not, calling the camera's ability to easily switch angles in a given scene "marvelously adaptable." He found working in computer animation "difficult" in a different way than working traditionally, finding the software "sophisticated and not particularly friendly." Bird wrote the script without knowing the limitations or concerns that went hand-in-hand with the medium of computer animation. As a result, this was to be the most complex film yet for Pixar. The film's characters were designed by Tony Fucile and [Teddy Newton](https://en.wikipedia.org/wiki/Teddy_Newton), whom Bird had brought with him from Warner Bros. Like most computer-animated films, *The Incredibles* had a year-long period of building the film from the inside out: modeling the exterior and understanding controls that would work the face and the body—the articulation of the character—before animation could even begin. Bird and Fucile tried to emphasize the graphic quality of good 2-D animation to the Pixar team, who had only worked primarily in CG. Bird attempted to incorporate teaching from [Disney's Nine Old Men](https://en.wikipedia.org/wiki/Disney%27s_Nine_Old_Men) that the crew at Pixar had "never really emphasized."

For the technical crew members, the film's human characters posed a difficult set of challenges. Bird's story was filled with elements that were difficult to animate with [CGI](https://en.wikipedia.org/wiki/Computer-generated_imagery) back then. Humans are widely considered to be the most difficult things to execute in animation. Pixar's animators filmed themselves walking to better grasp proper human motion. Creating an all-human cast required creating new technology to animate detailed human anatomy, clothing, and realistic skin and hair. Although the technical team had some experience with hair and cloth in [*Monsters, Inc.*](https://en.wikipedia.org/wiki/Monsters%2C_Inc.) (2001), the amount of hair and cloth required for *The Incredibles* had never been done by Pixar up until this point. Moreover, Bird would tolerate no compromises for the sake of technical simplicity. Where the technical team on *Monsters, Inc.* had persuaded director [Pete Docter](https://en.wikipedia.org/wiki/Pete_Docter) to accept pigtails on Boo to make her hair easier to animate, the character Violet had to have long hair that obscured her face; in fact, this was integral to her character. Violet's long hair, which was extremely difficult to animate, was only successfully animated toward the end of production. In addition, animators had to adapt to having hair both underwater and blowing through the wind. Disney was initially reluctant to make the film because of these issues, thinking that a live-action film would be preferable, but Lasseter denied this.

### Casting:

[Lily Tomlin](https://en.wikipedia.org/wiki/Lily_Tomlin) was originally considered for the role of Edna Mode, but later turned it down. After several failed attempts to cast Edna Mode, Bird took on her voice role himself. It was an extension of the Pixar custom of tapping in-house staff whose voices came across particularly well on scratch dialogue tracks [Sarah Vowell](https://en.wikipedia.org/wiki/Sarah_Vowell) was offered the role of Violet unexpectedly; Bird wanted to cast Vowell as Violet after hearing her voice on the [National Public Radio](https://en.wikipedia.org/wiki/National_Public_Radio) program, [*This American Life*](https://en.wikipedia.org/wiki/This_American_Life).Bird stated that she was "perfect" for the part and immediately called her to offer her the role.

### Music:

###  *Main article:*[*The Incredibles (film score)*](https://en.wikipedia.org/wiki/The_Incredibles_%28film_score%29)

*The Incredibles* is the first Pixar film to be scored by [Michael Giacchino](https://en.wikipedia.org/wiki/Michael_Giacchino). Brad Bird was looking for a specific sound as inspired by the film's [retrofuturistic](https://en.wikipedia.org/wiki/Retrofuturistic%22%20%5Co%20%22Retrofuturistic) design – the future as seen from the 1960s. [John Barry](https://en.wikipedia.org/wiki/John_Barry_%28composer%29) was the first choice to do the film's score, with a [trailer](https://en.wikipedia.org/wiki/Trailer_%28film%29) of the film given a rerecording of Barry's theme to [*On Her Majesty's Secret Service*](https://en.wikipedia.org/wiki/On_Her_Majesty%27s_Secret_Service_%28soundtrack%29). However, Barry did not wish to duplicate the sound of some of his earlier soundtracks;the assignment was instead given to Giacchino.[[31]](https://en.wikipedia.org/wiki/The_Incredibles#cite_note-31) Giacchino noted that recording in the 1960s was largely different from modern day recording and Dan Wallin, the recording engineer, said that Bird wanted an old feel, and as such the score was recorded on analog tapes. Wallin noted that brass instruments, which are at the forefront of the film's score, sound better on analog equipment rather than digital. Wallin came from an era in which music was recorded, according to Giacchino, "the right way", which consists of everyone in the same room, "playing against each other and feeding off each other's energy". Many of Giacchino's future soundtracks followed suit with this style of mixing, which has divided [critics](https://en.wikipedia.org/wiki/International_Film_Music_Critics_Association) who feel that the recordings sometimes don't sound natural. Tim Simonec was the conductor/orchestrator for the score's recording.

The film's orchestral score was released on November 2, 2004, three days before the film opened in theaters. It won numerous awards for best score including [Los Angeles Film Critics Association Award](https://en.wikipedia.org/wiki/Los_Angeles_Film_Critics_Association_Award), [BMI Film & TV Award](https://en.wikipedia.org/wiki/BMI_Film_%26_TV_Award), [ASCAP](https://en.wikipedia.org/wiki/ASCAP) Film and Television Music Award, [Annie Award](https://en.wikipedia.org/wiki/Annie_Award), Las Vegas Film Critics Society Award and [Online Film Critics Society Award](https://en.wikipedia.org/wiki/Online_Film_Critics_Society_Award) and was nominated for [Grammy Award for Best Score Soundtrack for Visual Media](https://en.wikipedia.org/wiki/Grammy_Award_for_Best_Score_Soundtrack_for_Visual_Media), [Satellite Award](https://en.wikipedia.org/wiki/Satellite_Award) and [Broadcast Film Critics Association Award](https://en.wikipedia.org/wiki/Broadcast_Film_Critics_Association_Award).

## Themes:

Several film reviewers drew precise parallels between the film and certain superhero comic books, like [*Powers*](https://en.wikipedia.org/wiki/Powers_%28comics%29), [*Watchmen*](https://en.wikipedia.org/wiki/Watchmen), [*Fantastic Four*](https://en.wikipedia.org/wiki/Fantastic_Four), and [*The Avengers*](https://en.wikipedia.org/wiki/Avengers_%28comics%29). The producers of the [2005 adaptation](https://en.wikipedia.org/wiki/Fantastic_Four_%282005_film%29) of *Fantastic Four* were forced to make significant script changes and add more special effects because of similarities to *The Incredibles*. Bird was not surprised that comparisons arose due to superheroes being "the most well-trod turf on the planet," but noted that he had not been inspired by any comic books specifically, only having heard of *Watchmen*. He did comment that it was nice to be compared to it, since "if you're going to be compared to something, it's nice if it's something good".

Some commentators took Bob's frustration with celebrating mediocrity and Syndrome's comment that "when everyone's super, no one will be" as a reflection of views shared by German philosopher [Friedrich Nietzsche](https://en.wikipedia.org/wiki/Friedrich_Nietzsche) or an extension of [Russian-American](https://en.wikipedia.org/wiki/Russian-American) novelist [Ayn Rand](https://en.wikipedia.org/wiki/Ayn_Rand%22%20%5Co%20%22Ayn%20Rand)'s [Objectivism](https://en.wikipedia.org/wiki/Objectivism_%28Ayn_Rand%29) philosophy, which Bird felt was "ridiculous." He stated that a large portion of the audience understood the message as he intended whereas "two percent thought I was doing [*The Fountainhead*](https://en.wikipedia.org/wiki/The_Fountainhead) or [*Atlas Shrugged*](https://en.wikipedia.org/wiki/Atlas_Shrugged)." Some purported that *The Incredibles* exhibited a right-wing bias, which Bird also scoffed at. "I think that's as silly of an analysis as saying *The Iron Giant* was left-wing. I'm definitely a [centrist](https://en.wikipedia.org/wiki/Centrism) and feel like both parties can be absurd.

The film also explored Bird's dislike for the tendency of the children's comics and Saturday morning cartoons of his youth to portray villains as unrealistic, ineffectual, and non-threatening. In the film, Dash and Violet have to deal with villains who are perfectly willing to use deadly force against children. On another level, both Dash and Violet display no emotion or regret at the deaths of those who are trying to kill them, such as when Dash outruns pursuers who crash their vehicles while chasing him, or when both of them witness their parents destroy several attacking vehicles with people inside, in such a manner that the deaths of those piloting them is undeniable. Despite disagreeing with some analysis, Bird felt it gratifying for his work to be considered on many different levels, which was his intention: "The fact that it was written about in the [op/ed](https://en.wikipedia.org/wiki/Op/ed) section of [*The New York Times*](https://en.wikipedia.org/wiki/The_New_York_Times) several times was really gratifying to me. Look, it's a mainstream animated movie, and how often are those considered thought provoking?

## Release:

The film opened on November 5, 2004, as Pixar's first film to be rated PG (for "action violence").Its theatrical release was accompanied with a Pixar short film *[Boundin'](https://en.wikipedia.org/wiki/Boundin%27%22%20%5Co%20%22Boundin%27)*. The promotional campaign included an official website with video segments, games, and printable memorabilia.While Pixar celebrated another triumph with *The Incredibles*, [Steve Jobs](https://en.wikipedia.org/wiki/Steve_Jobs) was embroiled in a public feud with the head of its distribution partner, [The Walt Disney Company](https://en.wikipedia.org/wiki/The_Walt_Disney_Company).This would eventually lead to the ousting of [Michael Eisner](https://en.wikipedia.org/wiki/Michael_Eisner) and Disney's acquisition of Pixar the following year.

In March 2014, Disney CEO and chairman [Bob Iger](https://en.wikipedia.org/wiki/Bob_Iger) announced that the film would be reformatted and re-released in 3D.

On May 11, 2018, Disney and [IMAX](https://en.wikipedia.org/wiki/IMAX) announced that the film would be reissued and digitally re-mastered for [IMAX](https://en.wikipedia.org/wiki/IMAX) theaters (alongside its sequel, *[Incredibles 2](https://en.wikipedia.org/wiki/Incredibles_2%22%20%5Co%20%22Incredibles%202)*) using their DMR Technology in a double feature for a one-day only, "Fan Event", on June 13.

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

**Embedded system**: An **embedded system** is a computer system—a combination of a [computer processor](https://en.wikipedia.org/wiki/Computer_processor), [computer memory](https://en.wikipedia.org/wiki/Computer_memory), and [input/output](https://en.wikipedia.org/wiki/Input/output) peripheral devices—that has a dedicated function within a larger mechanical or electrical system. It is *embedded* as part of a complete device often including electrical or electronic hardware and mechanical parts. Because an embedded system typically controls physical operations of the machine that it is embedded within, it often has [real-time computing](https://en.wikipedia.org/wiki/Real-time_computing) constraints. Embedded systems control many devices in common use today. Ninety-eight percent of all microprocessors manufactured are used in embedded systems.

Modern embedded systems are often based on [microcontrollers](https://en.wikipedia.org/wiki/Microcontroller) (i.e. microprocessors with integrated memory and peripheral interfaces), but ordinary microprocessors (using external chips for memory and peripheral interface circuits) are also common, especially in more complex systems. In either case, the processor(s) used may be types ranging from general purpose to those specialized in a certain class of computations, or even custom designed for the application at hand. A common standard class of dedicated processors is the [digital signal processor](https://en.wikipedia.org/wiki/Digital_signal_processor) (DSP).

Since the embedded system is dedicated to specific tasks, [design engineers](https://en.wikipedia.org/wiki/Design_engineer) can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from [economies of scale](https://en.wikipedia.org/wiki/Economies_of_scale).

Embedded systems range from portable devices such as [digital watches](https://en.wikipedia.org/wiki/Digital_watch) and [MP3 players](https://en.wikipedia.org/wiki/MP3_player), to large stationary installations like [traffic light controllers](https://en.wikipedia.org/wiki/Traffic_light_control_and_coordination), [programmable logic controllers](https://en.wikipedia.org/wiki/Programmable_logic_controller), and large complex systems like [hybrid vehicles](https://en.wikipedia.org/wiki/Hybrid_vehicles), [medical imaging](https://en.wikipedia.org/wiki/Medical_imaging) systems, and [avionics](https://en.wikipedia.org/wiki/Avionics). Complexity varies from low, with a single microcontroller chip, to very high with multiple units, [peripherals](https://en.wikipedia.org/wiki/Peripheral) and networks mounted inside a large [equipment rack](https://en.wikipedia.org/wiki/Equipment_rack).

1. Machine Learning:

**Machine learning** (**ML**) is the study of computer algorithms that improve automatically through experience.[[1]](https://en.wikipedia.org/wiki/Machine_learning#cite_note-1) It is seen as a subset of [artificial intelligence](https://en.wikipedia.org/wiki/Artificial_intelligence). Machine learning algorithms build a [mathematical model](https://en.wikipedia.org/wiki/Mathematical_model) based on sample data, known as "[training data](https://en.wikipedia.org/wiki/Training_data)", in order to make predictions or decisions without being explicitly programmed to do so.[[2]](https://en.wikipedia.org/wiki/Machine_learning#cite_note-2)[[3]](https://en.wikipedia.org/wiki/Machine_learning#cite_note-bishop2006-3):2 Machine learning algorithms are used in a wide variety of applications, such as [email filtering](https://en.wikipedia.org/wiki/Email_filtering) and [computer vision](https://en.wikipedia.org/wiki/Computer_vision), where it is difficult or infeasible to develop conventional algorithms to perform the needed tasks.

Machine learning is closely related to [computational statistics](https://en.wikipedia.org/wiki/Computational_statistics), which focuses on making predictions using computers. The study of [mathematical optimization](https://en.wikipedia.org/wiki/Mathematical_optimization) delivers methods, theory and application domains to the field of machine learning. [Data mining](https://en.wikipedia.org/wiki/Data_mining) is a related field of study, focusing on [exploratory data analysis](https://en.wikipedia.org/wiki/Exploratory_data_analysis) through [unsupervised learning](https://en.wikipedia.org/wiki/Unsupervised_learning).[[4]](https://en.wikipedia.org/wiki/Machine_learning#cite_note-4)[[5]](https://en.wikipedia.org/wiki/Machine_learning#cite_note-5) In its application across business problems, machine learning is also referred to as [predictive analytics](https://en.wikipedia.org/wiki/Predictive_analytics).

1. 5G Technology:

**5G** is the fifth generation of wireless communications technologies supporting cellular data networks. 5G communication requires the use of communications devices (mostly [mobile phones](https://en.wikipedia.org/wiki/Mobile_phone)) designed to support the technology.

The [frequency spectrum](https://en.wikipedia.org/wiki/Electromagnetic_spectrum) of 5G is divided into millimeter waves, mid-band, and low-band. Low-band uses a similar frequency range as the predecessor, [4G](https://en.wikipedia.org/wiki/4G). 5G millimeter wave is the fastest, with actual speeds often being 1–2 Gbit/s down. Frequencies are above 24 GHz, reaching up to 72 GHz, which is above the [extremely high-frequency](https://en.wikipedia.org/wiki/Extremely_high_frequency) band's lower boundary. The reach is short, so more cells are required. Millimeter waves have difficulty traversing many walls and windows, so indoor coverage is limited.

5G mid-band is the most widely deployed, in over 30 networks. Speeds in a 100 MHz wide band are usually 100–400 Mbit/s down. In the lab and occasionally in the field, speeds can go over a gigabit per second. Frequencies deployed are from 2.4 GHz to 4.2 GHz. [Sprint](https://en.wikipedia.org/wiki/Sprint_Corporation) and [China Mobile](https://en.wikipedia.org/wiki/China_Mobile) are using 2.5 GHz, while others are mostly between 3.3 and 4.2 GHz. Many areas can be covered simply by upgrading existing towers, which lowers the cost. Mid-band networks have better reach, bringing the cost close to the cost of 4G. 5G low-band offers similar capacity to advanced 4G.

The industry project [3GPP](https://en.wikipedia.org/wiki/3GPP) defines any system using "[5G NR](https://en.wikipedia.org/wiki/5G_NR)" (5G New Radio) software as, "5G",[[1]](https://en.wikipedia.org/wiki/5G%22%20%5Cl%20%22cite_note-1) a definition that came into general use by late 2018. Previously, some reserved the term 5G for systems that deliver download speeds of 20 Gbit/s shared called for by [ITU](https://en.wikipedia.org/wiki/ITU) [IMT-2020](https://en.wikipedia.org/wiki/IMT-2020). 3GPP will submit their 5G NR to the ITU.[[2]](https://en.wikipedia.org/wiki/5G#cite_note-2) In addition to traditional mobile operator services, 5G NR also addresses specific requirements for private mobile networks ranging from industrial [IoT](https://en.wikipedia.org/wiki/Internet_of_things%22%20%5Co%20%22Internet%20of%20things) to critical communications.

1. Virtual reality:

**Virtual reality** (**VR**) is a [simulated](https://en.wikipedia.org/wiki/Simulation) experience that can be similar to or completely different from the real world. [Applications of virtual reality](https://en.wikipedia.org/wiki/Applications_of_virtual_reality) can include entertainment (i.e. [video games](https://en.wikipedia.org/wiki/Video_game)) and educational purposes (i.e. medical or military training). Other, distinct types of VR style technology include [augmented reality](https://en.wikipedia.org/wiki/Augmented_reality) and [mixed reality](https://en.wikipedia.org/wiki/Mixed_reality).

Currently standard virtual reality systems use either [virtual reality headsets](https://en.wikipedia.org/wiki/Virtual_reality_headset) or multi-projected environments to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual environment. A person using virtual reality equipment is able to look around the artificial world, move around in it, and interact with virtual features or items. The effect is commonly created by VR headsets consisting of a [head-mounted display](https://en.wikipedia.org/wiki/Head-mounted_display) with a small screen in front of the eyes, but can also be created through specially designed rooms with multiple large screens. Virtual reality typically incorporates [auditory](https://en.wikipedia.org/wiki/Auditory_feedback) and [video feedback](https://en.wikipedia.org/wiki/Video_feedback), but may also allow other types of sensory and force feedback through [haptic technology](https://en.wikipedia.org/wiki/Haptic_technology).

(d)Robotics:

**Robotics** is an [interdisciplinary](https://en.wikipedia.org/wiki/Interdisciplinarity) research area at the interface of [computer science](https://en.wikipedia.org/wiki/Computer_science)[[1]](https://en.wikipedia.org/wiki/Robotics#cite_note-1) and [engineering](https://en.wikipedia.org/wiki/Engineering). Robotics involves design, construction, operation, and use of [robots](https://en.wikipedia.org/wiki/Robot). The goal of robotics is to design intelligent machines that can help and assist humans in their day-to-day lives and keep everyone safe. Robotics draws on the achievement of [information engineering](https://en.wikipedia.org/wiki/Information_engineering_%28field%29), [computer engineering](https://en.wikipedia.org/wiki/Computer_engineering), [mechanical engineering](https://en.wikipedia.org/wiki/Mechanical_engineering), [electronic engineering](https://en.wikipedia.org/wiki/Electronic_engineering) and others.

Robotics develops machines that can substitute for humans and replicate human actions. Robots can be used in many situations and for lots of purposes, but today many are used in dangerous environments (including inspection of radioactive materials, [bomb detection](https://en.wikipedia.org/wiki/Bomb_detection) and [deactivation](https://en.wikipedia.org/wiki/Bomb_disposal)), manufacturing processes, or where humans cannot survive (e.g. in space, underwater, in high heat, and clean up and containment of hazardous materials and radiation). Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviors usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, or any other human activity. Many of today's robots are inspired by nature, contributing to the field of [bio-inspired robotics](https://en.wikipedia.org/wiki/Bio-inspired_robotics).

The concept of creating machines that can operate [autonomously](https://en.wikipedia.org/wiki/Autonomous_robot) dates back to [classical times](https://en.wikipedia.org/wiki/Classical_times), but research into the functionality and potential uses of robots did not grow substantially until the 20th century. Throughout history, it has been frequently assumed by various scholars, inventors, engineers, and technicians that robots will one day be able to mimic human behavior and manage tasks in a human-like fashion. Today, robotics is a rapidly growing field, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether [domestically](https://en.wikipedia.org/wiki/Domestic_robot), [commercially](https://en.wikipedia.org/wiki/Industrial_robot), or [militarily](https://en.wikipedia.org/wiki/Military_robot). Many robots are built to do jobs that are hazardous to people, such as defusing bombs, finding survivors in unstable ruins, and exploring mines and shipwrecks. Robotics is also used in [STEM](https://en.wikipedia.org/wiki/Science%2C_technology%2C_engineering%2C_and_mathematics) (science, [technology](https://en.wikipedia.org/wiki/Technology), engineering, and mathematics) as a teaching aid. The advent of nanorobots, microscopic robots that can be injected into the human body, could revolutionize medicine and human health.

Robotics is a branch of engineering that involves the conception, design, manufacture, and operation of robots. This field overlaps with [computer engineering](https://en.wikipedia.org/wiki/Computer_engineering), [computer science](https://en.wikipedia.org/wiki/Computer_science) (especially [artificial intelligence](https://en.wikipedia.org/wiki/Artificial_intelligence)), [electronics](https://en.wikipedia.org/wiki/Electronics), [mechatronics](https://en.wikipedia.org/wiki/Mechatronics), [nanotechnology](https://en.wikipedia.org/wiki/Nanotechnology) and [bioengineering](https://en.wikipedia.org/wiki/Bioengineering).

Q 3. Write a note on the following.

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

Computer: A **computer** is a machine that can be instructed to carry out [sequences](https://en.wikipedia.org/wiki/Sequence) of [arithmetic](https://en.wikipedia.org/wiki/Arithmetic) or [logical](https://en.wikipedia.org/wiki/Boolean_algebra) operations automatically via [computer programming](https://en.wikipedia.org/wiki/Computer_programming). Modern computers have the ability to follow generalized sets of operations, called [*programs*](https://en.wikipedia.org/wiki/Computer_program)*.* These programs enable computers to perform an extremely wide range of tasks. A "complete" computer including the [hardware](https://en.wikipedia.org/wiki/Computer_hardware), the [operating system](https://en.wikipedia.org/wiki/Operating_system) (main [software](https://en.wikipedia.org/wiki/Software)), and [peripheral](https://en.wikipedia.org/wiki/Peripheral) equipment required and used for "full" operation can be referred to as a **computer system**. This term may as well be used for a group of computers that are connected and wor k together, in particular a [computer network](https://en.wikipedia.org/wiki/Computer_network) or [computer cluster](https://en.wikipedia.org/wiki/Computer_cluster).

Computers are used as [control systems](https://en.wikipedia.org/wiki/Control_system) for a wide variety of [industrial](https://en.wikipedia.org/wiki/Programmable_logic_controller) and [consumer devices](https://en.wikipedia.org/wiki/Consumer_electronics). This includes simple special purpose devices like [microwave ovens](https://en.wikipedia.org/wiki/Microwave_oven) and [remote controls](https://en.wikipedia.org/wiki/Remote_control), factory devices such as [industrial robots](https://en.wikipedia.org/wiki/Industrial_robot) and [computer-aided design](https://en.wikipedia.org/wiki/Computer-aided_design), and also general purpose devices like [personal computers](https://en.wikipedia.org/wiki/Personal_computer) and [mobile devices](https://en.wikipedia.org/wiki/Mobile_device) such as [smartphones](https://en.wikipedia.org/wiki/Smartphone). The [Internet](https://en.wikipedia.org/wiki/Internet) is run on computers and it connects hundreds of millions of other computers and their users.

### First computing device:

### [Charles Babbage](https://en.wikipedia.org/wiki/Charles_Babbage), an English mechanical engineer and [polymath](https://en.wikipedia.org/wiki/Polymath), originated the concept of a programmable computer. Considered the "[father of the computer](https://en.wikipedia.org/wiki/Computer_pioneer)",he conceptualized and invented the first [mechanical computer](https://en.wikipedia.org/wiki/Mechanical_computer) in the early 19th century. After working on his revolutionary [difference engine](https://en.wikipedia.org/wiki/Difference_engine), designed to aid in navigational calculations, in 1833 he realized that a much more general design, an [Analytical Engine](https://en.wikipedia.org/wiki/Analytical_Engine), was possible. The input of programs and data was to be provided to the machine via [punched cards](https://en.wikipedia.org/wiki/Punched_card), a method being used at the time to direct mechanical [looms](https://en.wikipedia.org/wiki/Loom) such as the [Jacquard loom](https://en.wikipedia.org/wiki/Jacquard_loom). For output, the machine would have a printer, a curve plotter and a bell. The machine would also be able to punch numbers onto cards to be read in later. The Engine incorporated an [arithmetic logic unit](https://en.wikipedia.org/wiki/Arithmetic_logic_unit), [control flow](https://en.wikipedia.org/wiki/Control_flow) in the form of [conditional branching](https://en.wikipedia.org/wiki/Conditional_branching) and [loops](https://en.wikipedia.org/wiki/Program_loop#Loops), and integrated [memory](https://en.wikipedia.org/wiki/Computer_memory), making it the first design for a general-purpose computer that could be described in modern terms as [Turing-complete](https://en.wikipedia.org/wiki/Turing-complete).

The machine was about a century ahead of its time. All the parts for his machine had to be made by hand – this was a major problem for a device with thousands of parts. Eventually, the project was dissolved with the decision of the [British Government](https://en.wikipedia.org/wiki/British_Government) to cease funding. Babbage's failure to complete the analytical engine can be chiefly attributed to political and financial difficulties as well as his desire to develop an increasingly sophisticated computer and to move ahead faster than anyone else could follow. Nevertheless, his son, Henry Babbage, completed a simplified version of the analytical engine's computing unit (the *mill*) in 1888. He gave a successful demonstration of its use in computing tables in 1906.

Analog computers: During the first half of the 20th century, many scientific [computing](https://en.wikipedia.org/wiki/Computing) needs were met by increasingly sophisticated [analog computers](https://en.wikipedia.org/wiki/Analog_computer), which used a direct mechanical or electrical model of the problem as a basis for [computation](https://en.wikipedia.org/wiki/Computation). However, these were not programmable and generally lacked the versatility and accuracy of modern digital computers. The first modern analog computer was a [tide-predicting machine](https://en.wikipedia.org/wiki/Tide-predicting_machine), invented by [Sir William Thomson](https://en.wikipedia.org/wiki/William_Thomson%2C_1st_Baron_Kelvin) in 1872. The [differential analyser](https://en.wikipedia.org/wiki/Differential_analyser), a mechanical analog computer designed to solve differential equations by integration using wheel-and-disc mechanisms, was conceptualized in 1876 by [James Thomson](https://en.wikipedia.org/wiki/James_Thomson_%28engineer%29), the brother of the more famous Lord Kelvin.

The art of mechanical analog computing reached its zenith with the [differential analyzer](https://en.wikipedia.org/wiki/Differential_analyzer), built by H. L. Hazen and [Vannevar Bush](https://en.wikipedia.org/wiki/Vannevar_Bush%22%20%5Co%20%22Vannevar%20Bush) at [MIT](https://en.wikipedia.org/wiki/MIT) starting in 1927. This built on the mechanical integrators of [James Thomson](https://en.wikipedia.org/wiki/James_Thomson_%28engineer%29) and the torque amplifiers invented by H. W. Nieman. A dozen of these devices were built before their obsolescence became obvious. By the 1950s, the success of digital electronic computers had spelled the end for most analog computing machines, but analog computers remained in use during the 1950s in some specialized applications such as education ([control systems](https://en.wikipedia.org/wiki/Control_systems)) and aircraft ([slide rule](https://en.wikipedia.org/wiki/Slide_rule)).

### Mobile computers

The first [mobile computers](https://en.wikipedia.org/wiki/Portable_computer) were heavy and ran from mains power. The 50lb [IBM 5100](https://en.wikipedia.org/wiki/IBM_5100) was an early example. Later portables such as the [Osborne 1](https://en.wikipedia.org/wiki/Osborne_1) and [Compaq Portable](https://en.wikipedia.org/wiki/Compaq_Portable) were considerably lighter but still needed to be plugged in. The first [laptops](https://en.wikipedia.org/wiki/Laptop), such as the [Grid Compass](https://en.wikipedia.org/wiki/Grid_Compass), removed this requirement by incorporating batteries – and with the continued miniaturization of computing resources and advancements in portable battery life, portable computers grew in popularity in the 2000s. The same developments allowed manufacturers to integrate computing resources into cellular mobile phones by the early 2000s.

These [smartphones](https://en.wikipedia.org/wiki/Smartphone) and [tablets](https://en.wikipedia.org/wiki/Tablet_computer) run on a variety of operating systems and recently became the dominant computing device on the market. These are powered by [System on a Chip](https://en.wikipedia.org/wiki/System_on_a_Chip) (SoCs), which are complete computers on a microchip the size of a coin.

**History of computing hardware:**

|  |  |  |
| --- | --- | --- |
| First generation (mechanical/electromechanical) | Calculators | [Pascal's calculator](https://en.wikipedia.org/wiki/Pascal%27s_calculator), [Arithmometer](https://en.wikipedia.org/wiki/Arithmometer%22%20%5Co%20%22Arithmometer), [Difference engine](https://en.wikipedia.org/wiki/Difference_engine), [Quevedo's analytical machines](https://en.wikipedia.org/wiki/Leonardo_Torres_y_Quevedo%22%20%5Cl%20%22Analytical_machines%22%20%5Co%20%22Leonardo%20Torres%20y%20Quevedo) |
| Programmable devices | [Jacquard loom](https://en.wikipedia.org/wiki/Jacquard_loom), [Analytical engine](https://en.wikipedia.org/wiki/Analytical_engine), [IBM ASCC/Harvard Mark I](https://en.wikipedia.org/wiki/Harvard_Mark_I), [Harvard Mark II](https://en.wikipedia.org/wiki/Harvard_Mark_II), [IBM SSEC](https://en.wikipedia.org/wiki/IBM_SSEC), [Z1](https://en.wikipedia.org/wiki/Z1_%28computer%29), [Z2](https://en.wikipedia.org/wiki/Z2_%28computer%29), [Z3](https://en.wikipedia.org/wiki/Z3_%28computer%29) |
| Second generation (vacuum tubes) | Calculators | [Atanasoff–Berry Computer](https://en.wikipedia.org/wiki/Atanasoff%E2%80%93Berry_Computer), [IBM 604](https://en.wikipedia.org/wiki/IBM_604), [UNIVAC 60](https://en.wikipedia.org/wiki/Remington_Rand_409), [UNIVAC 120](https://en.wikipedia.org/wiki/Remington_Rand_409) |
| [Programmable devices](https://en.wikipedia.org/wiki/List_of_vacuum_tube_computers) | [Colossus](https://en.wikipedia.org/wiki/Colossus_computer), [ENIAC](https://en.wikipedia.org/wiki/ENIAC), [Manchester Baby](https://en.wikipedia.org/wiki/Manchester_Baby), [EDSAC](https://en.wikipedia.org/wiki/Electronic_Delay_Storage_Automatic_Calculator), [Manchester Mark 1](https://en.wikipedia.org/wiki/Manchester_Mark_1), [Ferranti Pegasus](https://en.wikipedia.org/wiki/Ferranti_Pegasus), [Ferranti Mercury](https://en.wikipedia.org/wiki/Ferranti_Mercury), [CSIRAC](https://en.wikipedia.org/wiki/CSIRAC), [EDVAC](https://en.wikipedia.org/wiki/EDVAC), [UNIVAC I](https://en.wikipedia.org/wiki/UNIVAC_I), [IBM 701](https://en.wikipedia.org/wiki/IBM_701), [IBM 702](https://en.wikipedia.org/wiki/IBM_702), [IBM 650](https://en.wikipedia.org/wiki/IBM_650), [Z22](https://en.wikipedia.org/wiki/Z22_%28computer%29) |
| Third generation (discrete [transistors](https://en.wikipedia.org/wiki/Transistor) and SSI, MSI, LSI [integrated circuits](https://en.wikipedia.org/wiki/Integrated_circuit)) | [Mainframes](https://en.wikipedia.org/wiki/Mainframe_computer) | [IBM 7090](https://en.wikipedia.org/wiki/IBM_7090), [IBM 7080](https://en.wikipedia.org/wiki/IBM_7080), [IBM System/360](https://en.wikipedia.org/wiki/IBM_System/360), [BUNCH](https://en.wikipedia.org/wiki/BUNCH) |
| [Minicomputer](https://en.wikipedia.org/wiki/Minicomputer) | [HP 2116A](https://en.wikipedia.org/wiki/HP_2100), [IBM System/32](https://en.wikipedia.org/wiki/IBM_System/32), [IBM System/36](https://en.wikipedia.org/wiki/IBM_System/36), [LINC](https://en.wikipedia.org/wiki/LINC), [PDP-8](https://en.wikipedia.org/wiki/PDP-8), [PDP-11](https://en.wikipedia.org/wiki/PDP-11) |
| [Desktop Computer](https://en.wikipedia.org/wiki/Desktop_Computer) | [HP 9100](https://en.wikipedia.org/wiki/HP_9100) |
| Fourth generation ([VLSI](https://en.wikipedia.org/wiki/VLSI) integrated circuits) | Minicomputer | [VAX](https://en.wikipedia.org/wiki/VAX), [IBM System i](https://en.wikipedia.org/wiki/IBM_System_i) |
| [4-bit](https://en.wikipedia.org/wiki/4-bit) microcomputer | [Intel 4004](https://en.wikipedia.org/wiki/Intel_4004), [Intel 4040](https://en.wikipedia.org/wiki/Intel_4040) |
| [8-bit](https://en.wikipedia.org/wiki/8-bit) microcomputer | [Intel 8008](https://en.wikipedia.org/wiki/Intel_8008), [Intel 8080](https://en.wikipedia.org/wiki/Intel_8080), [Motorola 6800](https://en.wikipedia.org/wiki/Motorola_6800), [Motorola 6809](https://en.wikipedia.org/wiki/Motorola_6809), [MOS Technology 6502](https://en.wikipedia.org/wiki/MOS_Technology_6502), [Zilog Z80](https://en.wikipedia.org/wiki/Zilog_Z80%22%20%5Co%20%22Zilog%20Z80) |
| [16-bit](https://en.wikipedia.org/wiki/16-bit) microcomputer | [Intel 8088](https://en.wikipedia.org/wiki/Intel_8088), [Zilog Z8000](https://en.wikipedia.org/wiki/Zilog_Z8000%22%20%5Co%20%22Zilog%20Z8000), [WDC 65816/65802](https://en.wikipedia.org/wiki/WDC_65816/65802) |
| [32-bit](https://en.wikipedia.org/wiki/32-bit) microcomputer | [Intel 80386](https://en.wikipedia.org/wiki/Intel_80386), [Pentium](https://en.wikipedia.org/wiki/Pentium), [Motorola 68000](https://en.wikipedia.org/wiki/Motorola_68000), [ARM](https://en.wikipedia.org/wiki/ARMv7) |
| [64-bit](https://en.wikipedia.org/wiki/64-bit) microcomputer[[93]](https://en.wikipedia.org/wiki/Computer#cite_note-93) | [Alpha](https://en.wikipedia.org/wiki/DEC_Alpha), [MIPS](https://en.wikipedia.org/wiki/MIPS_architecture), [PA-RISC](https://en.wikipedia.org/wiki/PA-RISC), [PowerPC](https://en.wikipedia.org/wiki/PowerPC), [SPARC](https://en.wikipedia.org/wiki/SPARC), [x86-64](https://en.wikipedia.org/wiki/X86-64), [ARMv8-A](https://en.wikipedia.org/wiki/ARMv8-A) |
| [Embedded computer](https://en.wikipedia.org/wiki/Embedded_system) | [Intel 8048](https://en.wikipedia.org/wiki/Intel_8048), [Intel 8051](https://en.wikipedia.org/wiki/Intel_8051) |
| Personal computer | [Desktop computer](https://en.wikipedia.org/wiki/Desktop_computer), [Home computer](https://en.wikipedia.org/wiki/Home_computer), [Laptop](https://en.wikipedia.org/wiki/Laptop) computer, [Personal digital assistant](https://en.wikipedia.org/wiki/Personal_digital_assistant) (PDA), [Portable computer](https://en.wikipedia.org/wiki/Portable_computer), [Tablet PC](https://en.wikipedia.org/wiki/Tablet_computer), [Wearable computer](https://en.wikipedia.org/wiki/Wearable_computer) |
| Theoretical/experimental | [Quantum computer](https://en.wikipedia.org/wiki/Quantum_computer), [Chemical computer](https://en.wikipedia.org/wiki/Chemical_computer), [DNA computing](https://en.wikipedia.org/wiki/DNA_computing), [Optical computer](https://en.wikipedia.org/wiki/Photonic_computing), [Spintronics](https://en.wikipedia.org/wiki/Spintronics%22%20%5Co%20%22Spintronics)-based computer, [Wetware/Organic computer](https://en.wikipedia.org/wiki/Wetware_computer) |  |

**Other hardware**

|  |  |  |
| --- | --- | --- |
| [Peripheral](https://en.wikipedia.org/wiki/Peripheral) device ([input/output](https://en.wikipedia.org/wiki/Input/output)) | Input | [Mouse](https://en.wikipedia.org/wiki/Mouse_%28computing%29), [keyboard](https://en.wikipedia.org/wiki/Keyboard_%28computing%29), [joystick](https://en.wikipedia.org/wiki/Joystick), [image scanner](https://en.wikipedia.org/wiki/Image_scanner), [webcam](https://en.wikipedia.org/wiki/Webcam), [graphics tablet](https://en.wikipedia.org/wiki/Graphics_tablet), [microphone](https://en.wikipedia.org/wiki/Microphone) |
| Output | [Monitor](https://en.wikipedia.org/wiki/Computer_monitor), [printer](https://en.wikipedia.org/wiki/Printer_%28computing%29), [loudspeaker](https://en.wikipedia.org/wiki/Computer_speaker) |
| Both | [Floppy disk](https://en.wikipedia.org/wiki/Floppy_disk) drive, [hard disk drive](https://en.wikipedia.org/wiki/Hard_disk_drive), [optical disc](https://en.wikipedia.org/wiki/Optical_disc) drive, [teleprinter](https://en.wikipedia.org/wiki/Teleprinter%22%20%5Co%20%22Teleprinter) |
| [Computer buses](https://en.wikipedia.org/wiki/Bus_%28computing%29) | Short range | [RS-232](https://en.wikipedia.org/wiki/RS-232), [SCSI](https://en.wikipedia.org/wiki/SCSI), [PCI](https://en.wikipedia.org/wiki/Conventional_PCI), [USB](https://en.wikipedia.org/wiki/USB) |
| Long range ([computer networking](https://en.wikipedia.org/wiki/Computer_networking)) | [Ethernet](https://en.wikipedia.org/wiki/Ethernet), [ATM](https://en.wikipedia.org/wiki/Asynchronous_Transfer_Mode), [FDDI](https://en.wikipedia.org/wiki/Fiber_Distributed_Data_Interface) |

1. Multiply the given binary numbers 10001001 with 10010011.

Ans: 100100101010001