



Computer Organization “Computer Systems”

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- You must complete the course registration process at the beginning of the fall and summer semesters each year.
- Are there any students who have not completed the course registration process?
Interpreting and predicting
- Did you take physics class?

Transistor

- Semiconductor circuit element that controls the flow of electrons.
- Subatomic particles (Quantum Mechanics): Proton, Neutron, Electron, Phototron
- Electrical current or signal is created from the flow of electrons.
- The transistor memory element stores the bit (0/1) state on it. Performs Switching. Or it strengthens the signal.
- Transistor is the most used electronic circuit element in the world.
- The smallest basic electronic circuit element of a microprocessor is the transistor.
- As transistors turn on and off millions or even billions of times per second, the CPU's basic function cycles occur at a dizzying speed.

Computer Science

- Computer Science is the study of how computers work and how to make them do useful things.
- It combines mathematics, logic, and engineering to understand and design systems that process information.
- What computer science involves: It's the science of computation. Understanding how to represent, process, and store information using computers.
- Computer Science focuses on both theoretical foundations (like algorithms and data structures) and practical applications (like software design and artificial intelligence).

Main Areas of Computer Science

- Algorithms and Data Structures: How to solve problems efficiently and organize data for fast access.
- Programming Languages: How to express instructions to a computer in different languages (Python, JavaScript, C++, C-Sharp, ...).
- Software Engineering: How to design, develop, and maintain large, reliable software systems.
- Machine Learning (Artificial Intelligence): How to make computers “learn” from data set and make decisions.
- Computer Architecture: How hardware components like CPUs, memory, and networks work together.
- Networks and the Internet: How computers communicate with each other securely and efficiently.
- Cybersecurity: How to protect data and systems from unauthorized access or attacks.
- Data Science and Databases: How to store, manage, and analyze large amounts of information. Information obtains from data.
- Human-Computer Interaction (HCI): How people interact with computers and how to make systems user-friendly.
- Theory of Computation: What problems can (and cannot) be solved by computers, and how efficiently. Goal of Computer Science is to understand computation itself
 - how problems can be described and solved by machines.
 - To build systems that improve human life
 - from mobile apps to AI assistants and self-driving cars.

Data Collection, Storage and Preparation

- Data Analytics: Data collection, classification, analysis, visualization (two or three-dimensional graphical drawing), interpreting and predicting.
- Data preparation: debugging, normalization, missing data, manipulated data
- Data Mining: It is the storage of large amounts of information designed for query and analysis and the process of transforming data into information.
- Data Lake: It is a data pool that can store large amounts of structured, semi-structured and unstructured data.
- Data Lake uses the ELT (Extract Load Transform) process, while Data Warehouse uses the ETL (Extract Transform Load) process.
- Data structuring: Classification, clustering, regression
- Database
- Common programming languages: Python, C++, Java Script, Matlab
- Artificial intelligence is the development of behaviors that are independent of humans, which we call autonomous. It is about determining the coefficients in mathematical expressions from the data set. Especially in machine learning and deep learning algorithms, algorithms are developed by making intelligent decisions through the classification, clustering and regression of the data set.

Data Sources

- Symbols: Decimal and binary number systems, digits, alphabets, documents, images, graphics, tables, video, keyboard keys, etc.
 - Decimal Numbers: Integer, floating point, complex, character, string
 - Binary Number System: Arithmetic, logic circuits, comparison. All data within a computer is defined by bits. Bit: 0/1
- Signals: Acoustic, electrical, electromagnetic, particle, vibration, gravitational forces, temperature



“Computer”

The Concept of “Computer”

- The word "computer" has been used in English since 1646.
- In dictionaries prior to 1940, "computer" was the professional designation given to someone who performed calculations.
- Calculator: A machine that performs calculations.
- The modern definition and use of the term "computer" emerged with the development of the first electronic computing devices.
- Almost all devices used today contain computers.

What is a “Computer”?

- Computer is a electronic device that receives any data as input (voice, text, image, video, sensing signal, analog signal, EM signals, vibration...), all datas convert to digital signal (bit:0/1 as electrical signal), stores them, processes them, and produces them as output. It is electronic and consists of transistors. Computer performs its calculations based on the processing and transmission of electrical signals.
- A computer is an electronic circuit that processes a set of instructions stored in program memory that tell it what to do.
 - It is fast: It processes faster than the human brain.
 - It is stupid: It has no emotion or intuition of its own. It does what its pre-given commands tell it to do and nothing else.
 - It is compliant: It does what it is told to do.

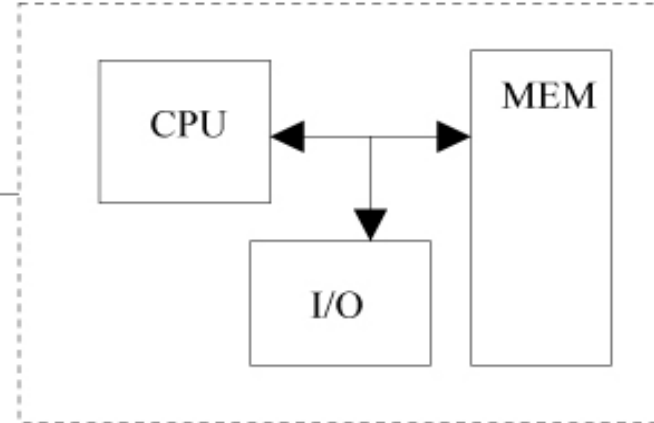
Basic Operations on the Computer

- Data Input: The computer receives data from outside to be processed within it.
- Data Storage: Data to be processed on the computer is stored in memories. (Register: Special Purpose Temporary Stores, Cache: Cache Memory, Ram: read or write memory (Volatile Memory), Rom: Read Only Memory (Permanent Memory,...))
- Data Processing: The computer processes data on the Registers in the Microprocessor (Arithmetic, Logic, Comparison, **Transferring data between Registers or memories according to the written commands, and reads or writes the data from the RAM memory. It carries out its work according to the codes on the ROM memory.**)
- Data Output: The computer produces the data it processes for external use.
- How can data be define inside computer? (Bit:0/1, binary numbering system)

Basic Components of the Computer

- Microprocessor
- Memories (Cache, Ram / Rom)
- I/O
- Timing and Clock
- Communication Buses (System Bus): Address, Data and Control
 - On address bus lines, only one way. CPU selects memory and memory cell or I/O units by using address bus lines.
 - On data bus lines, two directional. CPU writes data to memory cell or I/O units. Also, CPU reads data from memory cell or I/O units.
 - On control bus, CPU synchronize the all process.

Basic Components of a Computer System



Basic Components of a Computer System:

- CPU – Central Processing Unit
- Main Memory: Stores data and programs to be written and read. (RAM is a data memory, ROM is a program memory, Cache, Register, CMOS)
- Input and output (I/O) unit – Peripherals
- System Bus: data, address and control. System Bus communicates CPU with in memories and I/O's
- Clock – Timing: Synchronization data functions

CPU Function Cycles:

- Processor Main Function Cycle(Fetching and execution cycles)
- Fetching: Writing and Reading data from or to Memory or I/O.
- Execution cycles (bit) : Arithmetic, Logic, Comparison processing.
- Address Decoding: Selects memory and memory cells to prevent the memory cells from overlapping. Which memory and which cell is selected by CPU. In the same, only one memory and memory cell is selected by CPU.
- Clock and Timing Signals: It enables synchronous (simultaneous) processing of data.
- Pipelining – Pipelined command processing: These are functions in which a series of commands are arranged sequentially and executed simultaneously in parallel in order to increase efficiency of CPU.

Basic Components of the CPU

CPU (Central Processing Unit) basically consists of three main parts:

- ALU (Arithmetic Logic Unit) – Performs arithmetic and logical operations.
- CU (Control Unit) – Analyzes the instructions and determines which operation to perform.
- **Registers** – Holds temporary data during operation.

Internal architecture of the CPU

- Registers
- ALU – Arithmetic Logic Unit
- Control Unit
- Flags
- Clock & Timing
- System Bus: Address, Data, and Control
- Cash Memory
- Pipeline Architecture: Processing different commands simultaneously in different units within the CPU. (Read/Write, ALU, Transfer,)
- Production: Intel / Motorola

Computer Types-Supercomputer

- It can perform trillions of calculations per second.
- It has large processing and storage capabilities.
- Midrange computers are also known as workstations.
- Microcomputers are the least powerful but fastest-developing type. PCs used today are in this class.
- Laptop
- Pocket-sized computers (Smartphones, Personal Digital Assistants (PDAs))

Computer System

- The most fundamental electronic circuit element of a computer is the transistor. Transistor is manufactured at the atomic scale. It operates using electrical signals. It has reached its limit. Quantum computers operate using quanta of electrons. The units of the computer system:
- CPU (Microprocessor)
- Memory: RAM, ROM, CMOS, Cache, SSD, Register
 - RAM: R/W, Volatile
 - ROM: R, Non-volatile
 - CMOS: W/R, Electrical power (Battery), non-volatile
- I/O
- System Bus
- Clock and Timing

RAM (Random Access Memory)

- RAM (Random Access Memory) is a type of computer memory that stores data and instructions temporarily while your computer is running.
- RAM acts like your computer's short-term memory. It keeps the data your CPU (Central Processing Unit) needs right now — such as open programs, active files, and system processes. When you turn off your computer, everything stored in RAM is lost (it's volatile memory).
- When you open a program (like a web browser or a game), it is loaded from your hard drive (long-term storage) into RAM. The CPU reads data from RAM much faster than from a hard drive or SSD. This speed allows for quick access and smooth performance while multitasking.

ROM (Read-Only Memory)

- ROM (Read-Only Memory) is a type of non-volatile memory that permanently stores data and instructions your computer needs to start and operate properly.
- ROM contains essential programs that run automatically when you turn on your computer — for example, the BIOS or UEFI firmware, which starts the hardware and loads the operating system. Unlike RAM, data in ROM does not disappear when the power is turned off. It's usually written once (by the manufacturer) and cannot be easily modified.
- When you power on the computer, the CPU looks into the ROM to find startup instructions. These instructions tell the computer how to:
 - Test the hardware (keyboard, memory, etc.).
 - Find and load the operating system from the hard drive or SSD.
 - Because the data is permanent, the system can always boot — even if the hard drive is empty.

CMOS Memory

- CMOS memory is a small, special type of memory chip on a computer's motherboard that stores system configuration settings — things like the date, time, and hardware settings (e.g., boot order, CPU settings, memory information).
- CMOS = Complementary Metal-Oxide Semiconductor. It's actually the technology used to build the chip, not the data itself. This chip is used because it consumes very little power, making it ideal for holding settings even when your computer is turned off.
- CMOS stores settings that the BIOS/UEFI firmware uses when starting up the computer. For example, it keeps:
 - System date and time
 - Boot sequence (which drive to start first) CPU and memory configuration
 - Hardware passwords
 - Fan and voltage settings,
- CMOS memory is volatile, which means it loses data when power is off. To prevent this, it's powered by a small coin-cell battery (usually a CR2032) on the motherboard. If this battery dies: The system clock resets. BIOS settings return to defaults. You may see an error like: "CMOS Checksum Error" or "Date and Time Not Set"

Cache memory

- Cache memory is a very fast type of memory that stores frequently used data and instructions close to the CPU, so the processor can access them much faster than if it had to get them from RAM.
- Cache acts as the CPU's high-speed assistant. When the CPU needs data, it first checks the cache. If the data is there (a cache hit), it's retrieved instantly. If not (a cache miss), the CPU must fetch it from RAM, which is slower. This process greatly improves system speed and efficiency.
- You open a program or run a task. The CPU starts using certain data repeatedly (like instructions in a loop). That data gets copied into the cache, because it's likely to be used again soon. The next time the CPU needs it, it's already waiting there — no delay.

Cache memory

Modern processors have multiple levels of cache memory:

Level	Location	Size	Speed	Description
L1 Cache	Inside CPU core	Very small (32–256 KB)	Very fast	Stores the most frequently used instructions and data
L2 Cache	On CPU chip (shared or per core)	Medium (256 KB–8 MB)	Fast	Holds data not found in L1
L3 Cache	Shared across all cores	Large (4–64 MB)	Slower than L1/L2	Coordinates data between cores

SSD (Solid State Drive) memory

- SSD (Solid State Drive) memory is a type of storage device used in computers to store data permanently, like your operating system, programs, and files — but it's much faster than traditional hard drives (HDDs).
- SSD = Solid State Drive “Solid state” means no moving parts — unlike older hard drives that use spinning magnetic disks. SSDs store data using flash memory chips (like those in USB drives or smartphones).
- Data is stored in memory cells made of NAND flash chips. Each cell holds electrical charges that represent bits (0s and 1s). The controller inside the SSD manages where and how the data is stored, read, and erased. Because it's all electronic (no spinning parts), data can be accessed almost instantly.
- Much faster than HDDs — boots Windows in seconds
- No moving parts, so more resistant to drops or shocks
- Uses less power, good for laptops. Compact and lightweight. Completely silent.
- More expensive per GB than HDDs
- SSD memory = fast, durable, silent storage that permanently holds your data. It makes computers boot faster, load programs instantly, and run more smoothly overall.

Registers inside CPU

- Registers are the fastest and smallest type of memory inside the CPU (Central Processing Unit).
- They are used to store data, instructions, and addresses that the CPU is currently working on — in other words, they are the CPU's working desk. Let's explain it clearly.
- Registers hold tiny pieces of data that the CPU needs immediately — like numbers to add, memory addresses to fetch, or results to store. They are built directly into the processor chip, so accessing them is much faster than accessing cache or RAM. The CPU uses them for arithmetic, logic, control, and data storage operations.
- When you run a program:
 - The CPU fetches an instruction from memory (RAM).
 - That instruction and its data are loaded into registers.
 - The ALU (Arithmetic Logic Unit) performs operations using the data in those registers.
 - The result may be stored back into another register, cache, or main memory.
 - Every CPU instruction works directly with registers — they are the “hands” of the processor.

System Bus

- The System Bus is the main communication pathway that connects the CPU (Central Processing Unit), memory, and input/output (I/O) devices inside a computer. It allows data, addresses, and control signals to move between these components — much like a highway that carries cars between cities. All buses originate from the CPU. Each bus has a lot of lines. Each line has a 0 or 1 state (bit).
- Without the system bus, the CPU couldn't: Fetch instructions from memory, Read or write data, Send commands to I/O devices. In short, the system bus enables all communication inside the computer system.
- There are 3 bus:
 - **Address Bus:** Originates from the CPU and goes to the memory and I/O units. It selects the memory and memory cell. It is unidirectional and is represented by a 2^n byte value. In here, n is number of the address bus. It defines the memory capacity.
 - **Example:** The number of the address bus lines which are originates by CPU are 47. Calculate the access memory capacity of the CPU. $2^n = 2^{47} = 2^7 * 2^{40} = 128 \text{ Terabyte}$.
 - **Data Bus:** CPU sends or reads data to the memory and registers in the I/O unit. It is bidirectional and is represented by a 10^m bit/s value.
 - **Control Bus:** Groups originate from the CPU and are unidirectional. Each line operates independently. Some lines originate from the CPU, while others enter the CPU. They perform functions such as synchronous, w/r, reset, halt, and interrupt.

Modern Improvements

- In modern computer systems: The Front-Side Bus (FSB) was used to connect the CPU to the main memory and chipset.
- Today, newer systems use high-speed point-to-point connections such as:
 - PCI Express (PCIe) — for connecting peripherals
 - HyperTransport or Intel QuickPath Interconnect (QPI) — for CPU-memory communication
- These are advanced versions of the traditional bus system, designed for higher bandwidth and performance.



“Binary Numbering Systems”

Binary Numbering System

- In a computer, all data (numbers, characters, sounds, signals, symbols, images, etc.) consists of 0s and 1s. This is because the hardware (transistors) can only distinguish two states: on (1) and off (0). Therefore, all arithmetic operations are performed in this binary system.
- Bit: 0/1
- Arithmetic: 0/1
- Comparison: 0/1
- Logic: 0/1
- Data Transfer: 0/1

How Does the CPU Perform Arithmetic Operations?

- The Central Processing Unit (CPU) performs arithmetic operations — like addition, subtraction, multiplication, and division — using specialized hardware circuits and binary logic. Let's break this down step by step:

1. Binary Representation

- All data in a computer is represented in binary form (0s and 1s).
- For example:
 - Decimal 5 → Binary 0101
 - Decimal 3 → Binary 0011
- Before any arithmetic operation, numbers are converted into this binary format.

Example: $(398)_d = (?)_b$

1- find 2^n

$398 - 256 = 142$, $256 = 2^8$

$142 - 128 = 14$, $128 = 2^7$

$14 - 8 = 6$, $8 = 2^3$

$6 - 4 = 2$, $4 = 2^2$

$2 - 2 = 0$, $2 = 2^1$

2- find max index, 8

3-Indexing

4- If there is 2^n take 1, no take 0

8 7 6 5 4 3 2 1 0

(1 1 0 0 0 1 1 1 0)_b

5- Grouping (right to left 4 digit grouping)

(1 1000 1110)_b

Example: $(100110010)_b = (?)_d$

1) Indexing from right to left

- 1 0 0 1 1 0 0 1 0
- 8 7 6 5 4 3 2 1 0
- If there is 1 take 2^n ; If there is 0 take none
- $2^8 + 2^5 + 2^4 + 2^1 = (306)_d$

2. Arithmetic Logic Unit (ALU)

- The ALU (Arithmetic Logic Unit) is the part of the CPU responsible for performing arithmetic and logical operations.
- It can perform:
 - Addition
 - Subtraction
 - Multiplication
 - Division
 - Bitwise operations (AND, OR, NOT, XOR, etc.)
- Each of these operations is implemented through electronic circuits made of logic gates.

3. Binary Addition

- Addition is the most fundamental operation. Other operations (like subtraction and multiplication) are built from it.

- $0 + 0 = 0$; $0 + 1 = 1$; $1 + 0 = 1$; $1 + 1 = \underline{10}$; $1 + 1 + 1 = \underline{11}$

- Example:

- 111--- Cary
 0101 (5)
+ 0011 (3)

 1000 (8)

- The ALU uses a binary adder circuit (like a full adder) to add bits one by one, handling carries automatically.

Example:

- $(100111)_b + (011001)_b = (1000000)_b = (64)_d$

4. Binary Subtraction

- Subtraction is done using the two's complement method. To compute $A - B$, the CPU:
 1. Finds the two's complement of B (invert bits and add 1).
 2. Adds it to A .
- Example:

5 - 3 in binary:

$A = 0101$

$B = 0011 \rightarrow \text{invert } (1100) + 1 \rightarrow 1101$

$0101 + 1101 = 10010 \rightarrow \text{result} = 0010 (2)$
- $C = A - B$; $A = C + B$

Multiplication and Division

5. Binary Multiplication

- Multiplication is performed through repeated addition and bit shifting.
- Example:
- 3×5 (0011 $\times$ 0101)
- $\rightarrow$ CPU adds 0011 to itself, shifting bits left based on position (like long multiplication).
- Modern CPUs use Booth's algorithm or hardware multipliers for faster processing.

6. Binary Division

- Division is handled by repeated subtraction and bit shifting, similar to long division in decimal.
- Hardware implementations use restoring or non-restoring division algorithms.

7. Floating-Point Operations

- For real numbers (like 3.14 or -0.25), CPUs use a **Floating Point Unit (FPU)**. It follows the **IEEE 754 standard** to represent and calculate with fractions and exponents efficiently.



“IT Based Technologies”

IoT (Internet of Things)

- IoT, internet of things, are smart machines equipped with sensors that connect to each other, communicate with each other and produce information in a smart network structure using different protocols. With the development of mobile (mobile) networks and the internet, it has become easier for smart machines to communicate with people, and people have the opportunity to observe and control them from anywhere, anytime.
- In the near future, the amount of data that will emerge thanks to smart machines connected to each other will increase incredibly and analyzing and processing this big data will become difficult and complex.
- In addition, the confidentiality and security of data also emerge as an important issue.
- We will enter a period in which mutual interaction will enter into every object and different objects will move freely for common purposes. Meanwhile, how people will respond to this change physiologically and psychologically is also an important question.

IoT- Nesnelerin İnterneti

- IoT (Internet of Things) , nesnelerin interneti, farklı protokolleri kullanarak birbirleri ile akıllı ağ yapısında haberleşen ve algılayıcılardan toplanan verilerden bilgi üreten akıllı nesnelerdir. Gezgin (mobil) ağlar ve internetin gelişimiyle birlikte akıllı nesnelerin kişiler ile iletişim kurmaları kolaylaştı ve insanlar da onları her yerden, her zaman gözlemleme ve kontrol etme şansına sahip oldu.
- Yakın gelecekte akıllı nesneler sayesinde ortaya çıkacak veri miktarı inanılmaz derecede arttacak ve bu büyük verilerin çözümlenerek işlenmesi zor ve karmaşık hale gelecektir. Otonom yazılımlar stratejik rol oynayacaktır.
- Verilerin gizliliği ve güvenliği de önemli bir konu olarak karşımıza çıkmaktadır.
- Karşılıklı etkileşimin her nesnenin içine gireceği ve farklı nesnelerin ortak amaçlar için gezgin hareket edeceği bir döneme gireceğiz.
- Bu arada insanların fizyolojik ve psikolojik olarak bu değişime nasıl karşılık vereceği de önemli soru olarak kendini göstermektedir.
- Sürücüsüz araçlarda, insanlar can güvenliklerini nesneler teslim etmişlerdir.

Flying, Walking, Swimming and Integrating Nanorobots

- Scientists aim to use nanotechnology to create nanorobots that will serve as programmable antibodies.
- It will help protect against pathogenic bacteria and viruses that continue to mutate, and many drugs containing nanocomputers will neutralize microbes.
- It is predicted that nanorobots will be part of the future of human medicine.

Telemetry

- Telemetry is the remote monitoring or control of a system or monitor via cable or wireless. Today, when telemetry is mentioned, wireless communication is understood. The most commonly used ones are Radio modem devices, GSM GPRS and VSAT satellite systems.
- Systems that send commands to devices over wired, wireless networks or radio signals, transmit the measurement signals collected by the device from its physical environment, the status of the device as information to the center, and exchange information between the device and the center are called telemetry.

Ölçerseniz Yönetirsiniz

- Mesafe ölçümleri günlük hayatta alışık olduğumuz boyutlarda kolaydır; bir masanın uzunluğunu basit bir cetvel kullanarak rahatlıkla ölçebiliriz. Ancak mesafeler küçüldükçe veya büyüldükçe, elimizdeki cetvellerin hassasiyeti yetersiz olmaya başlar.
- Güneş'in Dünya'ya olan uzaklığını hiçbir cetvelle ölçemeyiz. Yapılması gereken, fizik yasalarını kullanarak elde edilmiş yeni bir astronomik cetvel icat etmektir.
- Yıldızlar, hidrostatik dengedeki dev plazma toplarıdır. Kütleçekimi içeriye doğru basınç uygulayıp yıldızı çökertmeye çalışırken, yıldız içerisindeki nükleer reaksiyonlar neticesinde oluşan ışıınım basıncı da buna karşı koyar. Bir yıldız ömrünün büyük kısmında hidrojeni helyuma dönüştürerek ışıınım basıncı elde eder. Helyuma dönüştürecek hidrojen kalmadığında ise yakıt olarak helyum kullanılır ve helyumdan karbon füzyonu elde edilir.

Transducer: Sensors

- Devices that detect changes in the physical environment (heat, light, pressure, sound, etc.) are called "sensors", and devices that convert the information they perceive into electrical signals are called transducers. A transducer is a device that converts one form of energy into other forms of energy. Conversion can be electrical, magnetic, electromagnetic, chemical or thermal forms of energy. **The transducer detects the parameter in one form of energy and converts it into another form of energy,** most often as an electrical signal. For example, the pressure sensor detects the pressure and measures it, allowing the value to be displayed on the manometer or remote display device.

Transducer Examples:

- Antenna
- Electric motor
- Potentiometer
- accelerometer
- Fluorescent Lamp
- Bulb, LED, Photodiode, photo resistor, Photocell
- Speaker, headphone - converts electrical signals into sound.
- Microphone - converts sound into an electrical signal.
- Piezoelectric – converts solid-state crystals to electrical signals and vice versa

Actuator

- **Actuators are devices that convert energy into movement.** Systems such as an engine, hydraulics, pneumatics and pulleys that control or move a mechanism or system. It is powered by an energy source. This source is usually electric current, hydraulic fluid pressure, or pneumatic pressure and is converted into energy by some type of movement.
- Electric motors, pneumatic actuators, hydraulic pistons, relays, piezoelectric sensors, electroactive polymers are examples of actuators.
- The performance of actuators can be measured by speed, acceleration and force (alternatively angular velocity, angular acceleration and torque), as well as energy efficiency and mass, volume, operating conditions, strength, etc. is also taken into account.

Nanobilgisayar

- Bilim adamları nanoteknolojiyi çok küçük yongalar ve mantık kapıları yapmak için kullanmaya çalışıyorlar.
- Nanoteknoloji kullanılarak geliştirilecek yongalar daha küçük cihazların yapılmasını sağlayacaktır.
- Sadece birkaç atomdan oluşacak ve nanoteller olarak adlandırılan elektrik iletkenleri sadece bir atom kalınlığında olacak ve bir veri biti bir elektronun superpozisyonu ve dolanıklığı ile temsil edilecektir.
- Uçan, Yüzen, yürüyen bütünleşik nanorobotların insan tıbbının geleceğinin bir parçası olacağı tahmin edilmektedir.

Nanotechnology

- Atomic-scale technologies are developed to produce very small chips and logic gates. Transistors, which control electron flow, are the basic electronic circuit elements of computer systems.
- The diameter of an atom, including the electron cloud, is around 10^{-8} cm. The diameter of the atomic nucleus is about 10^{-13} cm. Its mass varies between 1.67×10^{-27} - 4.52×10^{-25} kg.
- Smaller devices can be produced with chips developed using nanotechnologies.
- In quantum computers, electrical conductors called nanowires can be just one atom thick, and a data bit is represented as electron by the presence or absence of an electron.

MIT Biomechatronics - Hugh Herr

- At the age of 17, he became one of America's best climbers. However, while climbing a mountain, his legs were amputated because he was caught in a storm and froze. He currently owns immortal legs! “It is talents, not deficiencies, that count”, Andrew Carnegie .Hugh Herr is developing bionic limbs that mimic the function of natural limbs. Herr is responsible for groundbreaking advances in bionic limbs that provide greater mobility and new hope to people with physical disabilities.
- Herr's team developed the first autonomous exoskeleton to reduce the metabolic cost of human walking. Herr's Biomechatronics group developed gait-compatible knee prostheses and variable impedance for transfemoral amputees, for patients with foot drop, paralysis, cerebral palsy, and a gait pathology caused by multiple sclerosis. developed ankle-foot orthoses. He also designed his own bionic limbs, the world's first bionic lower leg, called the BiOM Ankle System. As published in the 2012 Proceedings of the Royal Society, the BiOM Ankle System has been clinically shown to be the first leg prosthesis to provide biomechanical and physiological normalization, allowing people with leg amputations to walk at normal speed and metabolic levels as their legs do.
- The biomechanics are different from ordinary dentures. Technological synthetic leathers are connected to the main body and understand what is intended to be done and act accordingly. In fact, they move so well that in trials with people without disabilities, it turns out that the support units work better than your biological limbs. Can you imagine? With the work done, biomechanical limbs that are sensitive enough to make a dancer dance again can be created.





Quantum Computer

Kuantum Hesaplama

- Makinenin makine (M2M – Machine to Machine) ile iletişimi
- Nesnelerin interneti (IoT: Internet of Things)
- Kuantum Hesaplama (QC - Quantum Computing)
- Makine Öğrenmesi (ML – Machine Learning)
- QC destekli ML ve Quantum ML (QML)
- Gezgin Akıllı Makineler
- 5G / 6G

What is a Quantum Computer?

➤ Quantum Computer

- Quantum süperpozisyon ve dolanma gibi cihazlar aracılığıyla veriler üzerinde işlemler gerçekleştirmek için kuantum mekaniği fenomeni kullanan bir bilgisayar.

➤ Classical Computer (Binary)

- Tamamen klasik mekanik ile hesaplanabilen, devrelerden ve kapılardan geçen voltajı kullanan bir bilgisayar.

Quantum Computing

- Klasik bilgisayarlarda silikon tabanlı çipler kullanılırken, bilgiler elektriksel sinyaller ile taşınmakta, saklanmakta ve işlenmektedir.
- Kuantum bilgisayarlarda ise atom altı parçacıklar, foton veya elektron gibi kuantum sistemleri kullanılır. İşlemci, verileri çok hızlı işleyebilmesi için kuantalama hesaplama yaparken bitler elektronlar ya da fotonlar ile temsil edilmektedir.
- Elektronlar iletkenlerdeki bir atomdan diğerine akan elektrik akımını oluşturur. 1 amperlik akımın oluşabilmesi için iletkenin herhangi bir noktasından 1 saniyede $6,25 \times 10^{18}$ elektron akması gerekir.
- Transistör elektron akışını kontrol eden, yarı iletken teknolojisinde üretilen bir devre elemanıdır. Mikrodalga tüpleri elektron akışını hızlandırıp yavaşlatır.
- Kuantum bilgisayarlarda nanoteller olarak adlandırılan elektrik iletkenleri sadece bir atom kalınlığındadır ve bir veri biti bir elektronun superpozisyonu ve dolanıklığı ile temsil edilmektedir.
- Kuantum bilgi işlem, kuantum mekaniği kanunlarına göre davranır ve olasılık hesaplama, süper konum ve dolanıklık gibi kavramlardan yararlanır. Bu kavramlar, karmaşık sorunları çözmek için kuantum bilişiminin gücünden yararlanan kuantum algoritmalarının temelini oluşturur. Olasılık, tahmin ederek karar vermeye dönüştüğünden performansı artıracak yetenekler ve deneyimler kazandıran algoritmalara ihtiyaç duyulmaktadır.

Kuantum Makine Öğrenmesi

- Son yıllarda veri analizi uygulamaları ve akıllı makineler ilgili araştırmalar güçlü bir şekilde yeniden ortaya çıkmıştır.
- Bu güçlenen ilgi kısmen klasik hesaplama yöntemlerindeki gelişmeler ve kısmen de Kuantum Hesaplama (QC - Quantum Computing) ve ilgili kuantum teknolojileri tarafından sunulan muazzam paralellik potansiyelinden kaynaklanmaktadır.
- Hesaplama yöntemlerindeki bu gelişmeler, Makine Öğrenmenin (ML – Machine Learning), veri güdümlü öğrenme ve kuantum destekli hesaplama yöntemleri, hizmet odaklı tamamen akıllı bir iletişim ağının isteklerini gerçekleştirmede güçlü bir potansiyele sahiptir.
- Ortaya çıkan insan ve makine arası bağlantıyı artırma paradigmasında, ağ düğümü sayısı ve veri trafiğinde önemli bir artış beklenmektedir.
- Makine Öğrenmesi (ML) ve Quantum Hesaplama (QC) yöntemleri hacimli verilerin verimli bir şekilde işlenmesine yönelik olarak, Quantum ML (QML) teknolojilerini sağlayan yeni bir çerçeve sunacaktır.
- IOT
- 5G ve 6G



Artificial Intelligence

Öğrenerek Karar Veren Makineler

Öğrenerek karar veren makineler birer sistemdir ve sinyalleri işlerler, çıktı olarak da sinyal üretirler.

- İstatiksel veri analizi
- Olasılık
- Sinyaller ve Sistemler
- Algılayıcılar, ölçerler, transducer (güç çevirici, enerji aktarıcı)
- Uygulamalı matematik: Yörünge, Sapma, Kritik noktalar, kaotik davranış (Faz düzlemde diff. Denklemler)
- Filtre, Örnekleme, Analog – Sayısal dönüştürücüler
- Dönüştürücüler: Fourier, Laplace, Z
- Computer Organization (Mimari, Bellek, Bellek haritalama)
- Programlama: Matlab, C++, Python, Assemble
- Matematiksel modelleme, Algoritmalar, Kod üretme

Machines That Make Decisions by Learning -1

- Developing intelligence that learns from a mass of data in order to provide the ability of a computer-controlled system or device to perform its activities in a similar way to human intelligence may be possible with machine learning.
- The models represent the big data and the models learn from big data, also increase the performance by using the information inside the big data.
- It is the development of autonomous behavior independent of humans from the data stack with self-learning mathematical models and algorithms.
- Mathematical models and algorithms that develop data-based predictions and autonomous behavioral patterns are the basic software of computer systems in machine learning.

I ask:

- What happens in a person's mind when he makes a decision?
- What is vital for the decision maker?
- What is the key function in the human brain in decision making?

Machines That Make Decisions by Learning -2

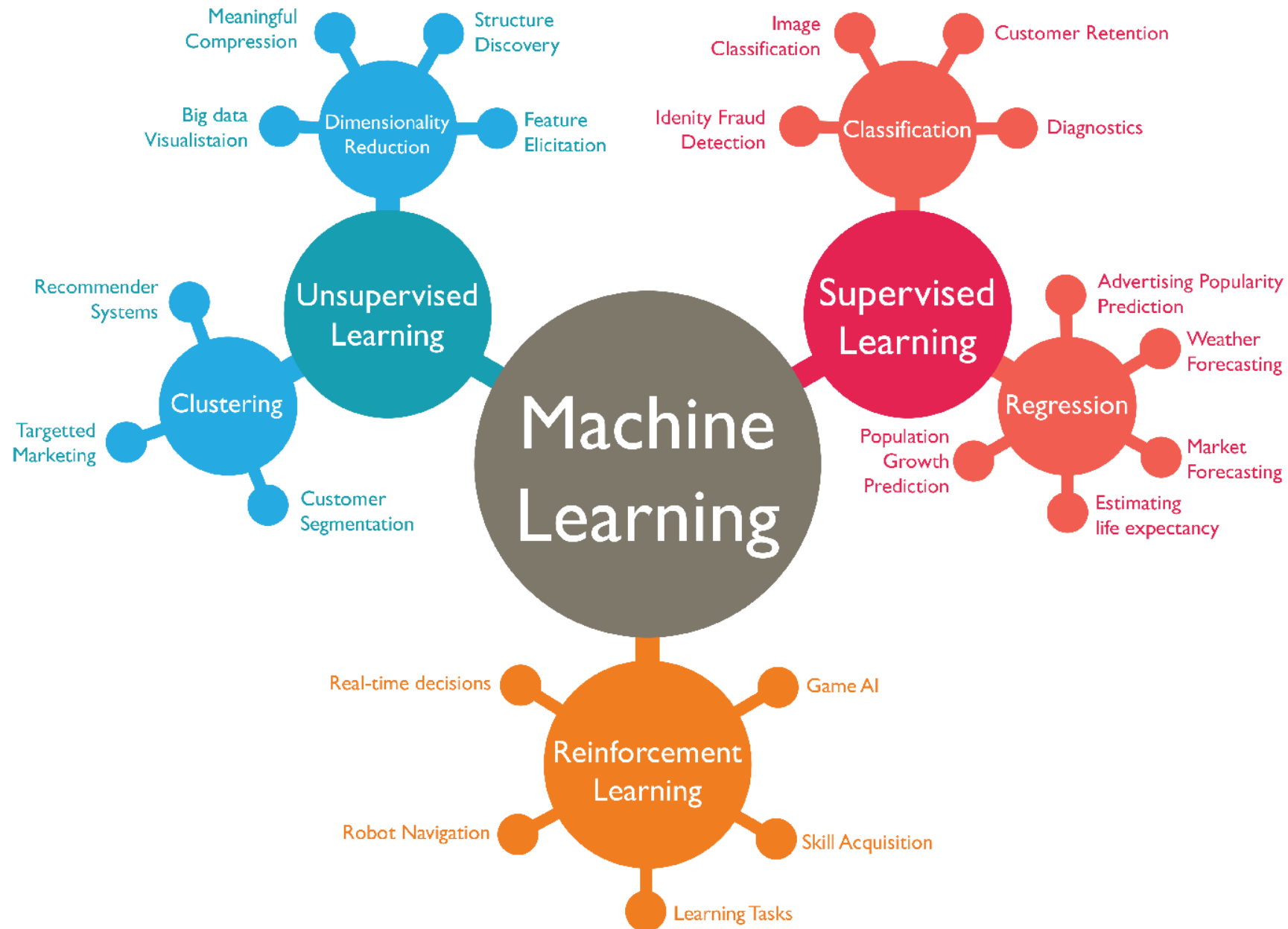
- Artificial intelligence is the general name of technologies that make any prediction or decision, whether using machine learning or not. Contrary to popular belief, artificial intelligence can be an algorithm that works without machine learning or deep learning algorithms. Until machine learning algorithms emerged, artificial intelligence studies were based on a structure that was described as "hard-coded", that is, all logical and mathematical operations were coded by the software developer. For example, the first chess player artificial intelligence algorithms were exactly like this. This type of artificial intelligence is called symbolic artificial intelligence.
- The area where artificial intelligence is most actively used is undoubtedly robotic technologies. The development of artificial intelligence has also directly affected the development of robotic technologies. Artificial intelligence, which can easily detect performance problems in robots, can fix the problems when necessary. Thus, robots can renew themselves.
- The feature that distinguishes machine learning from hard-coded symbolic artificial intelligence algorithms is that the algorithm learns entirely from data.
- The deep learning model discovers which parameters to give what weight according to the structure of the data.

Artificial Intelligence -1

- The term “Artificial Intelligence” was created in 1956 by John McCarthy of the Massachusetts Institute of Technology. It is a branch of computer science that aims to make computers behave like humans.
- Artificial Intelligence is the development of computer algorithms and mathematical models to play interactive games to develop machines that make decisions in real-life situations.
- Programming computers by developing algorithms and mathematical models to perceive and respond to sensory (Sense Organs) and physical stimuli, and designing systems that mimic human intelligence by developing structures similar to the types of physical connections between neurons (neural networks) in the human brain.
- Developing sensors, transducers, actuators and computer-controlled autonomous mobile machines, robotic arms and robotic organs.

Artificial Intelligence-2

- Artificial Intelligence is defined as the process where a machine tries to make decisions like a human brain. A collection of technologies known as artificial intelligence (AI) enables computers to carry out a range of complex tasks, such as the ability to see, hear, interpret, and translate spoken and written language, analyze data, generate suggestions, and more.
- The reason behind its hype around the world today is its act of working and thinking like a human being.
- Users' identities are determined from the traces they leave on the internet.
- Product or service purchasing habits, beliefs, political preferences and economic situations are determined.
- They are those areas/fields where the scope of error is/should not be left behind and with this there's definitely a threat to human life as well. There have been many incidences where privacy breach has occurred.



Artificial intelligence has already entered our lives!

- We think of human intelligence as something mysterious that is unique to human biological organisms.
- In fact, artificial intelligence has already entered our lives without us realizing it.
- Machines are actually starting to behave intelligently. Machines also started to learn and think logically like us. The steps of emotional thinking are in the research and testing phase.
- There is no definition of artificial intelligence that we can say this is artificial intelligence.
- Artificial intelligence is a set of applications developed by humans.
- Artificial intelligence can simply be defined as the ability to achieve complex goals. In this case, artificial intelligence is just irrational intelligence.
- Machines will be considered artificially intelligent when they see, hear, understand and learn the world in ways similar to us.

What can we do with artificial intelligence?

- We can hear and see better with artificial intelligence.
- It can give us brand new skills that we didn't have before.
- A doctor using artificial intelligence can develop smart drugs that have never been designed in a laboratory before. The smart concept here is that it goes to the location where the drug will be effective, adjusts the dose according to the situation there, starts the treatment and reports the result.
- Life expectancy can be extended in a healthier way.
- The real question here is, at the point we have reached in our history of consciousness, are we smart enough to make the choices we want?
- Today, scientists have begun to create the artificial intelligence road map of the future by developing artificial intelligence systems.
- How artificial intelligence will affect our tomorrow, our near and distant future, is entirely up to us. If we use artificial intelligence correctly, our lifestyles will be incredibly different and as humanity; From the moment we exist in this world to the point where we become conscious, the most valuable gems within us will begin to emerge.

Artificial intelligence application areas today

- Natural language processing: It is too difficult for computers to understand the question to be able to discuss it with humans. We understand the question very easily, but our memory capacity is not developed enough to give valid answers.
- Discussion with computer system
- Driverless Cars
- drone swarm
- Artificial intelligence robots working with humans
- Human-Like Conscious Robots
- Learning in childhood
- Learning during adolescence
- Helping visually impaired people see

Applications of Artificial Intelligence(AI)

- Artificial Intelligence in E-Commerce
- AI in Education Purpose
- Artificial Intelligence in Robotics
- GPS and Navigations
- Healthcare
- Automobiles
- Agriculture
- Human Resource
- Lifestyle
- Social media
- Gaming
- Astronomy
- Chatbots
- Surveillance
- Finance
- Data Security
- Travel and Transport
- Marketing
- Entertainment
- Military

Artificial Intelligence in Military

- Artificial Intelligence is also about to help defense and the military in the coming days. The government is planning to use artificial intelligence for various military operational support. Also, it will help in some automatic artilleries and weapons. Let's take a closer look at AI applications in the Military.
- Decision Support: AI algorithms can analyze large amounts of data, including sensor inputs, intelligence reports, and historical information. These insights provide aid while taking an effective decision that includes stock management, resource allocation, and so on without actual human intervention.
- Cyberattack: AI plays a crucial role in detecting and responding to cyber threats in military networks. AI algorithms are capable enough to handle and manage vast datasets that can detect any abnormal activity before it actually occurs.
- Training: AI uses algorithms to train their staff in different situations that can make it more or less realistic. This can help them in making the right decision at the moment and strategies their plan effectively.

Privacy

- Artificial Intelligence applications will hear, see and analyze us, challenging the perception of privacy.
- One of the most important reasons for privacy is that it has tremendous potential for surveillance.
- Facial recognition can detect the biological traces we leave in our environment and identify you.
- Beyond that, you will be able to hear what you have to say and understand your purpose.
- Cameras instead of eyes, microphones instead of ears, and artificial intelligence applications are being developed to understand what they see.
- What is the perception limit of computers?
- Artificial intelligence can find its way in three-dimensional spaces with computer vision. It allows driverless cars to see their surroundings. A person's facial expression can be understood. With facial analysis, people walking on the streets can be identified.
- He can take a photo of you anytime, anywhere. You may suddenly be exposed, sometimes in legal processes and sometimes in the virtual environment.
- The aim is to identify you within seconds. Anything you do wrong is sent to your home via mail. Your social circle is determined and sent to your friends.

The line between humans and machines

- Even if we don't want to, technology will continue to rain on us.
- The most ironic part is that we introduce these technologies into our homes completely voluntarily.
- You leave home and come to school. Your personality, political thoughts, beliefs, and even whether you can be provoked can be determined by an artificial intelligence application.
- Is it right that your belief, political opinion or whether you are a member of a social class can be determined based on your facial expressions? Do you know that studies on this subject have found 75% accuracy?
- Can artificial intelligence tell if someone is guilty just by looking at their face? Studies on this subject show that the probability of identifying thieves reaches 90%.
- Artificial intelligence applications that predict personality traits based solely on facial images have begun to serve. There is no database. An analysis is made by looking at your face based on past experiences. People are detected before they commit a crime, imagine if they were arrested before they even committed a crime.
- Artificial intelligence should definitely improve people's problem-solving skills and make them more prosperous and healthier.
- Artificial intelligence must contribute to the awareness process of humanity.
- Can a drug that will be beneficial for another disease be determined from the millions of drug literature produced?
- Artificial intelligence is still at the very beginning of its medical applications.
- Artificial intelligence can determine which drugs are more suitable for you and which diseases you are more prone to.

Artificial general intelligence

- The ultimate goal is to create something called artificial general intelligence (AGI). Thus, an adaptable mental being will emerge.
- You may find a machine that is at least as smart as humans or even smarter than them scary. They can suppress us somehow, take control away from us.
- The computer can find ways to write its own software.
- Can super artificial intelligence be made by humans? Or will machines do it?
- There will certainly be times when machines will teach other machines something. Millions of driverless vehicles will teach each other things without people knowing.
- We should not create a situation where human-level artificial intelligence is developed, or where robots are designed so that their will cannot be interfered with.
- Calculations show that it would be impossible to control a super-intelligent AI.
- To control Artificial Intelligence (AI) far beyond human understanding, we need to analyze the simulation created by the AI.
- However, if we cannot grasp the power of future artificial intelligence and understand the scenarios that artificial intelligence can reveal, it will be impossible for us to create such a simulation to have control over it.

Instant decisions made when human life is in danger

- What happens when artificial intelligence gets behind the wheel?
- Artificial intelligence once belonged to the world of science fiction, but now it seems to appear everywhere at any time.
- Ford's pizza robot delivers food to your door.
- The biggest discovery expected with artificial intelligence has been driverless cars.
- Artificial intelligence applications used in driverless car technologies will have incredible impacts on life.
- News about Google's test vehicles and Tesla's automatic cars began to be heard frequently.
- Driving is very difficult.
- In ordinary traffic, where everything goes well, there is no problem. It exceeds the capacity of artificial intelligence in conditions that even humans have difficulty with in crowded, dark and rainy weather.
- Tens of thousands of people die in traffic accidents every year.
- Driverless cars were mostly used on test tracks.

Reflections of Artificial Intelligence on the future

- If an anthill is within our project, does it make us bad to destroy that anthill? Our goals are not the same as those of ants. This situation has bad consequences for the ants. We should not put people in the situation of ants.
- When we were children, our parents were smarter than us. There was nothing to be afraid of. Because their goals and their children's goals are the same.
- Artificial intelligence will be made to create a better society.
- It will provide the opportunity to create a better, inspiring future.
- Artificial intelligence is a tool; It is a tool that will help a doctor or an engineer to become better at their job.
- It is a tool that will accelerate the scientist's discovery process.
- Artificial intelligence should not be put into frameworks that do everything for us.
- It should not be seen as a power that dominates us and takes away all control.
- Technology is a tool that allows us to achieve our goals.
- We decide who the technology will serve.



“Communication Systems”

Communication Systems

- Communication: It is the transmission of information such as voice, image, video, data, telemetry from one point to another in high efficiency, high quality and securely.
- Communication system; It consists of the source, sender, communication medium and receiver circuits from which the information to be sent is produced.
- Communication medium: 2/4 wire (Electrical signal), fiber cable (Light), coaxial cable (Electrical Signal), air/space (Electromagnetic signal); satellite, radiolink, GSM, Infrared)

Telecommunications Media

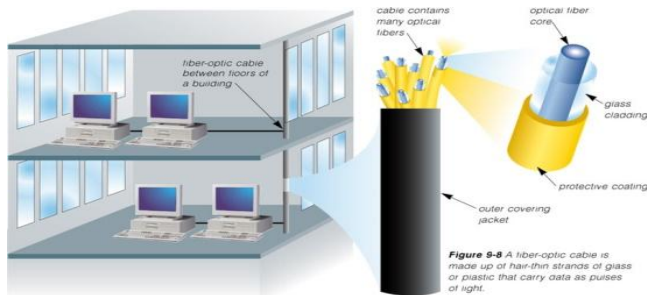
Conducted Media Radiated Media

Electrical Conductors

Wires
Coaxial
Cable

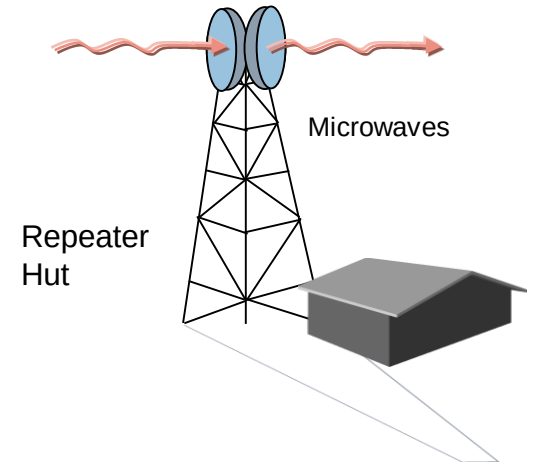
Light Conductors

Fiber Optics



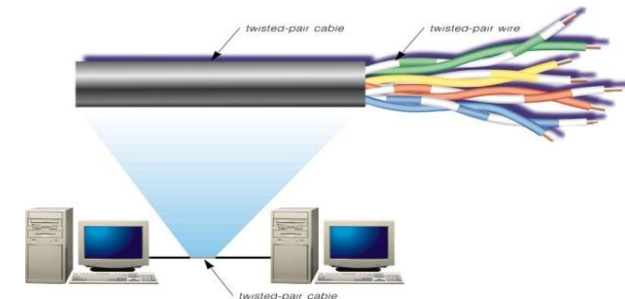
Radio Frequency

Broadcast
Microwave
Satellite
Broadband Internet

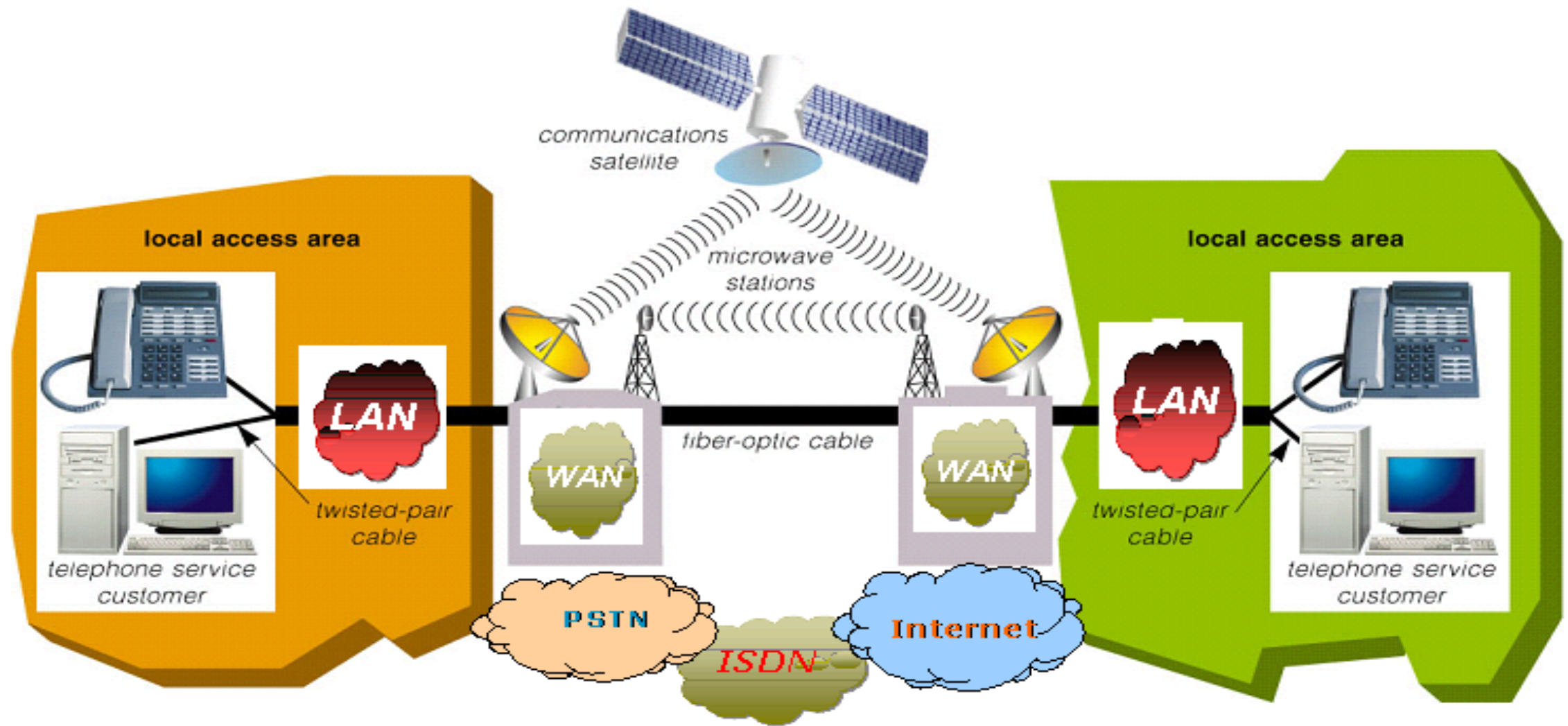


Light Frequency

Infrared



Communication Systems



The industry comes together at one point in communication.

Computer

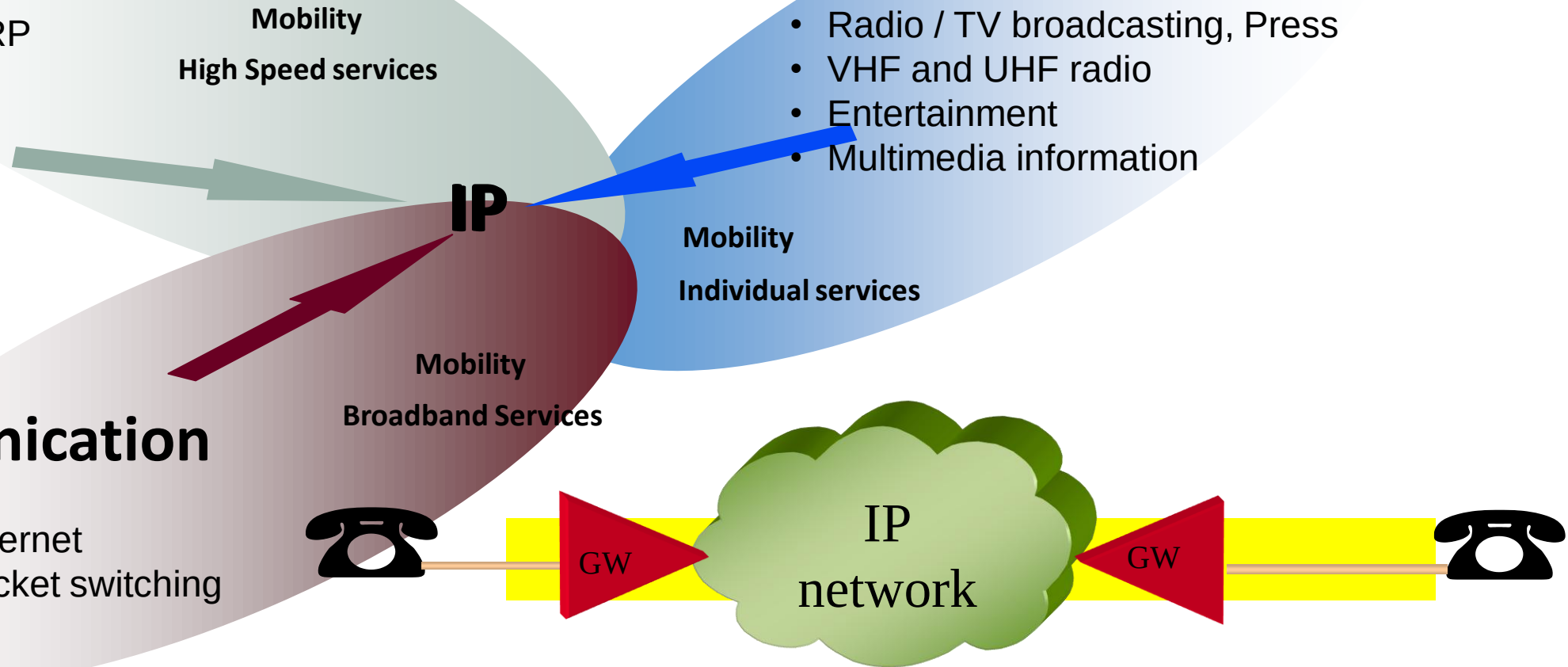
- internet access
- Intranet access/ERP
- E-mail
- E-Education
- E-Commerce
- E-Business

Mass Media

- TV / Radio / Data distribution
- Radio / TV broadcasting, Press
- VHF and UHF radio
- Entertainment
- Multimedia information

Telecommunication

- Mobility
- Phone call over the internet
- Circuit switching to packet switching
- Broadband data



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Sincerely,

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