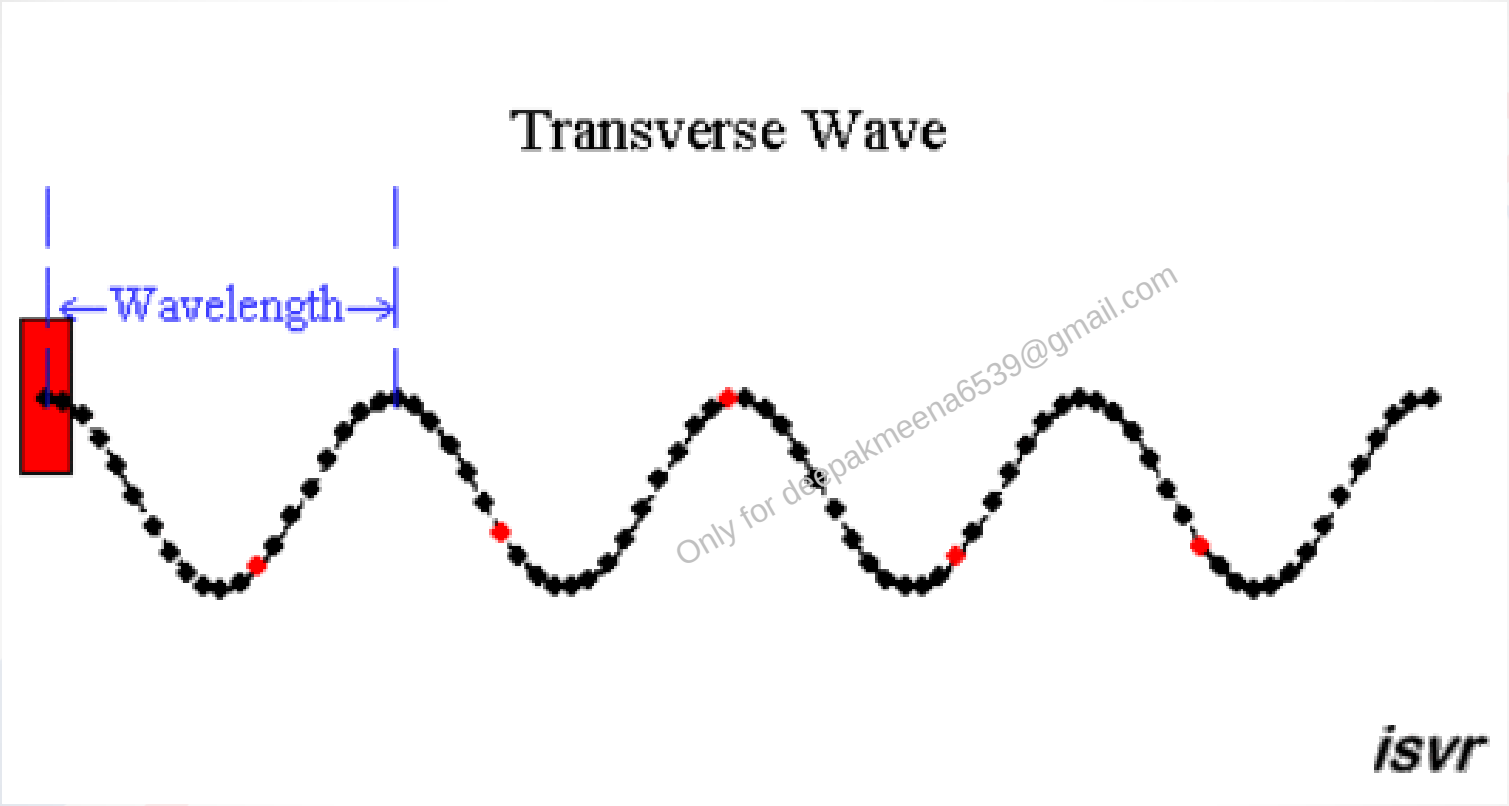
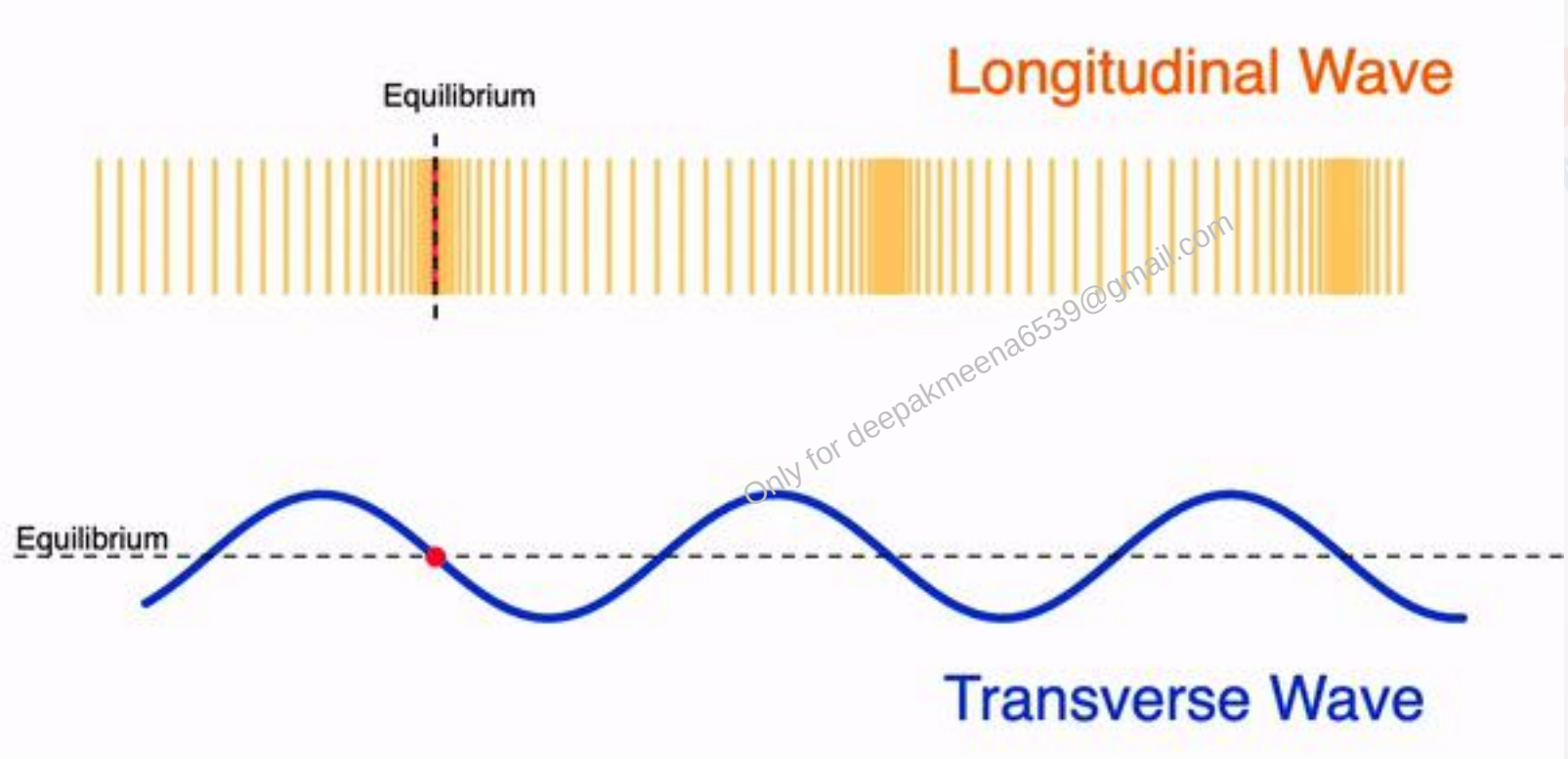
ICT

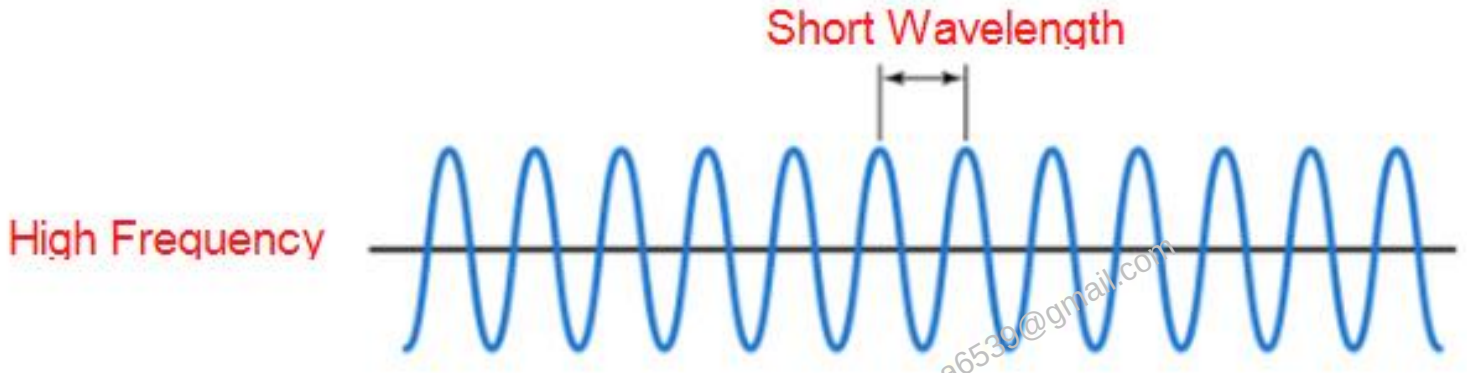
Topics

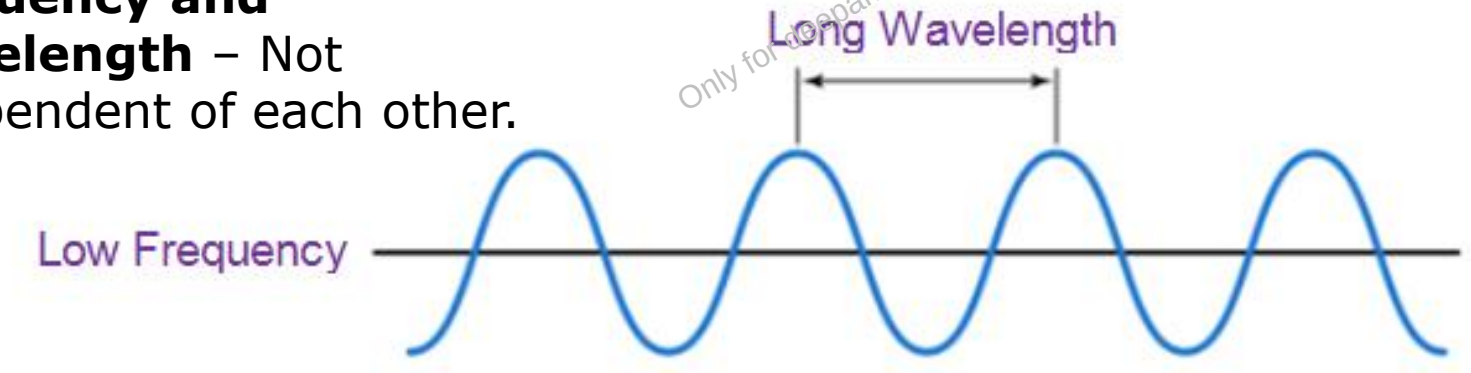
- Communication Technologies:
  - Mobile Network – 5G
  - Internet, WiFi, Satellite Based Internet, Dark Web
  - LiFi, FSOC
- Advancements in Computing
  - Super Computing, Cloud Computing and Edge Computing
  - Quantum Computing
  - AI
  - Blockchain Technology and Cryptocurrencies

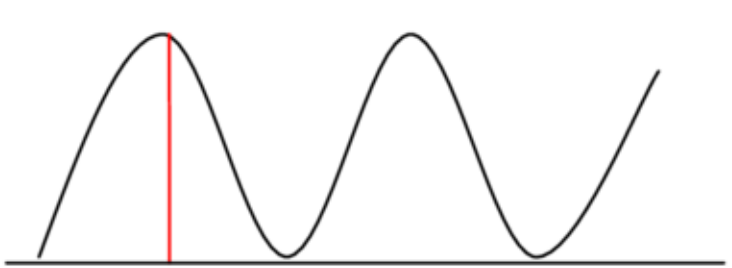




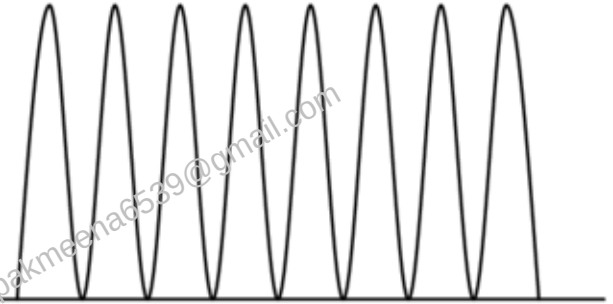
Frequency and Wavelength – Not independent of each other.





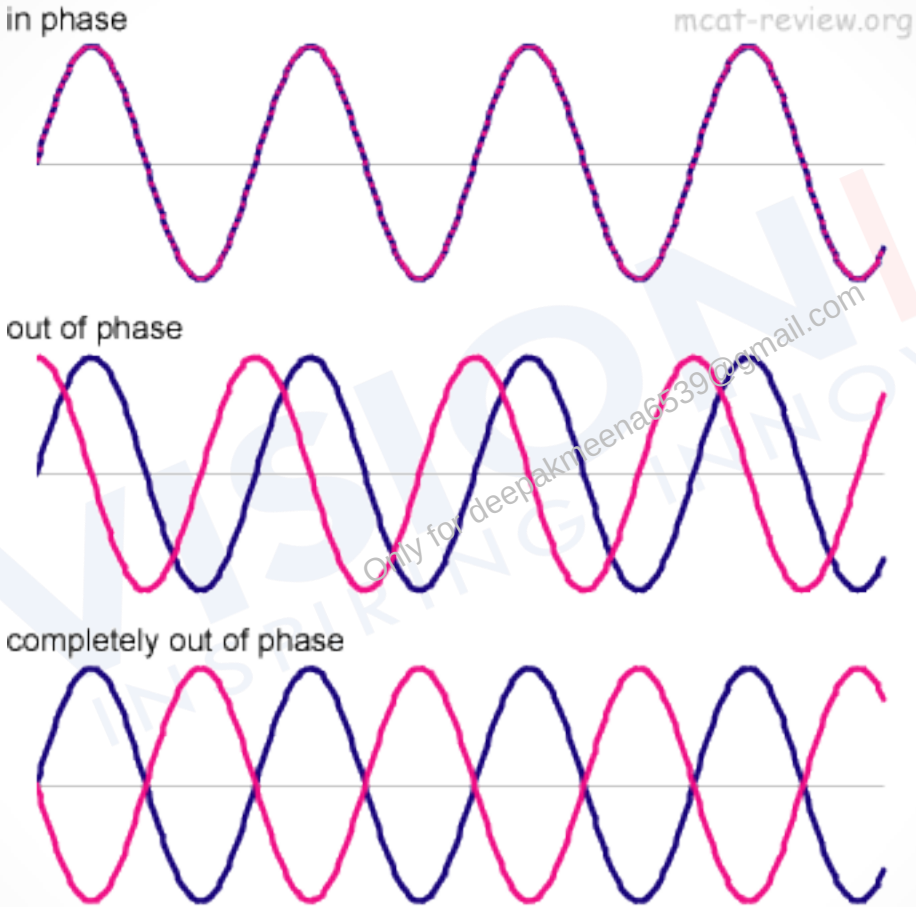


Low Frequency

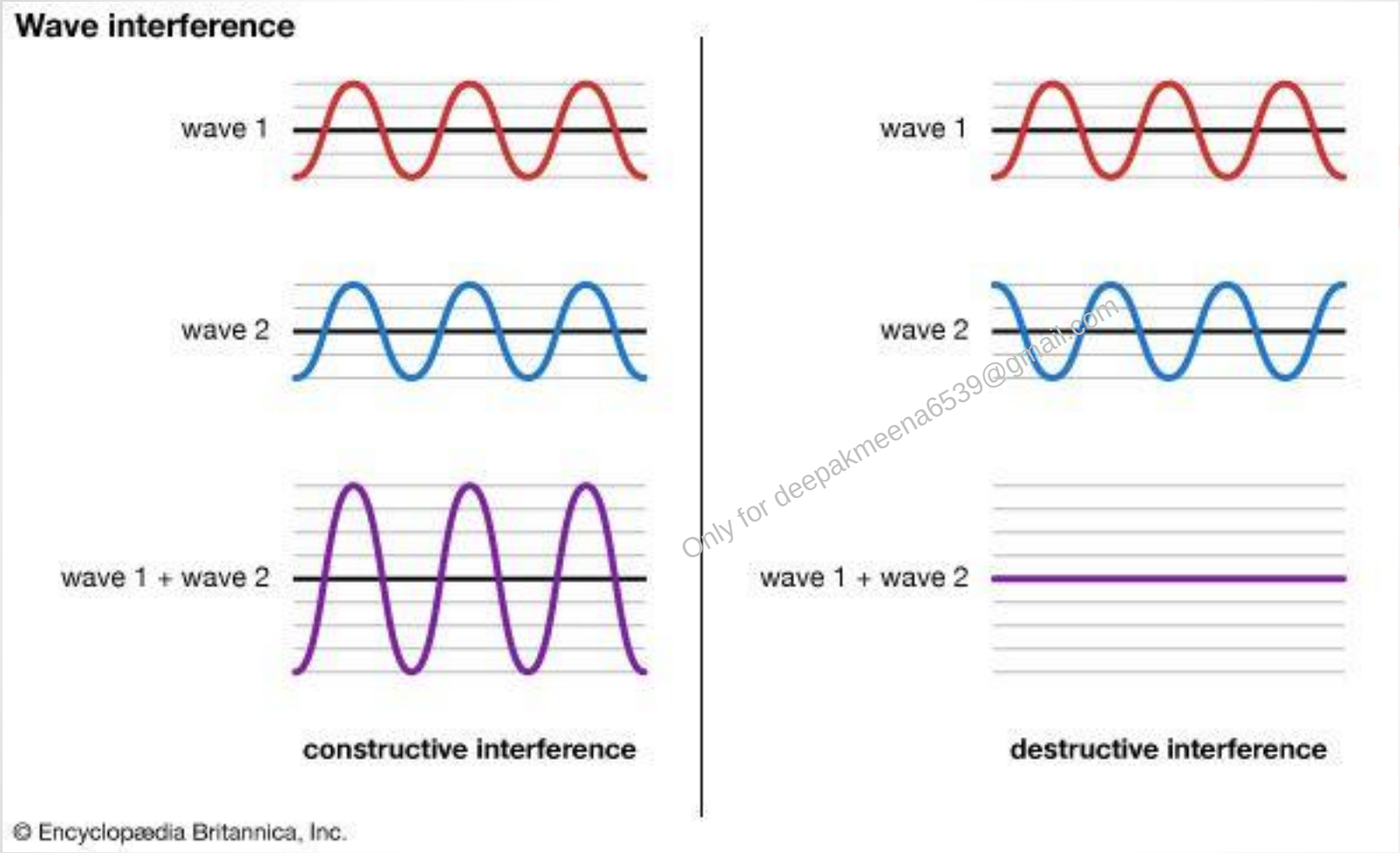


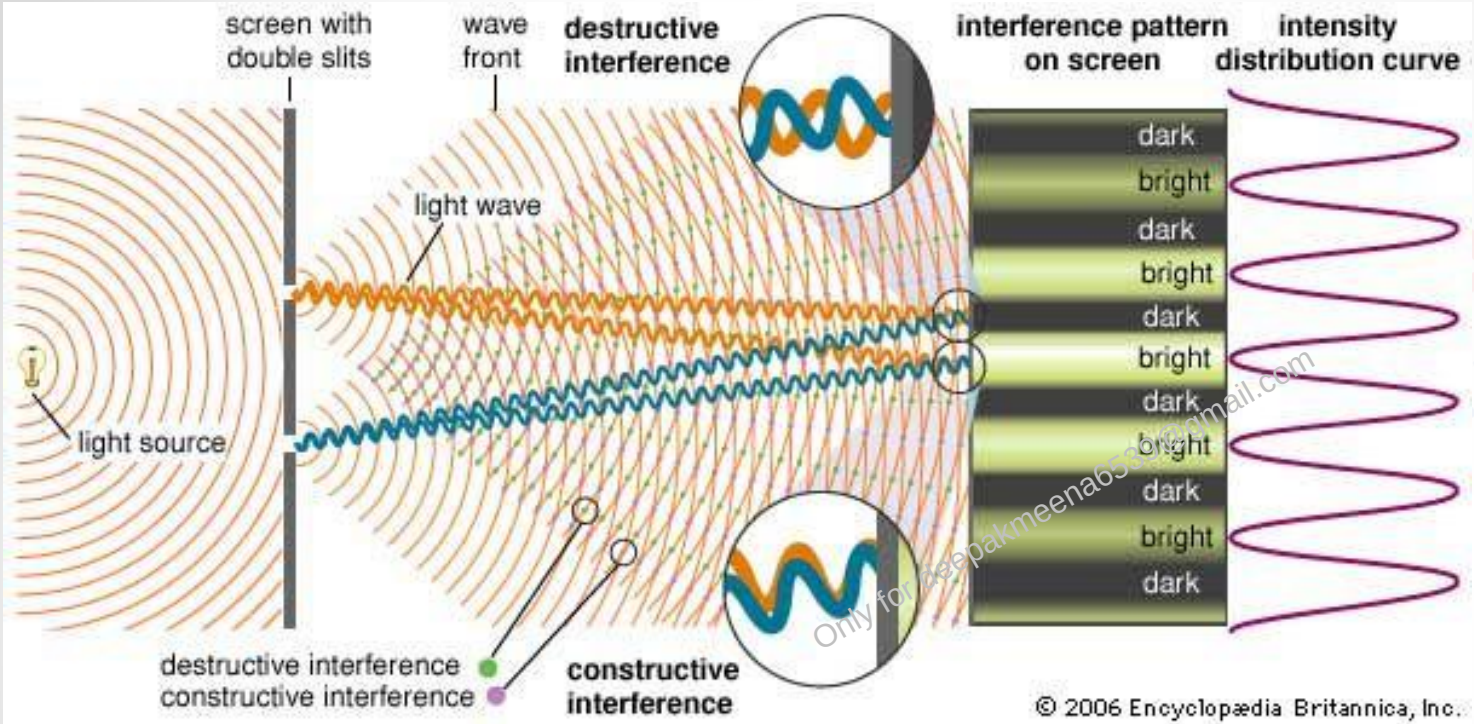
High Frequency

Amplitude – Related to the intensity of wave

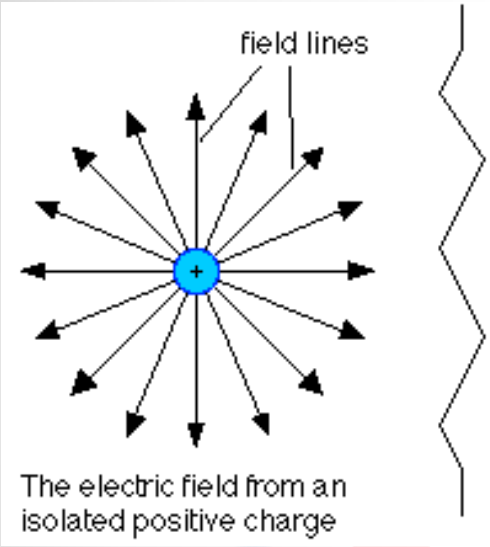


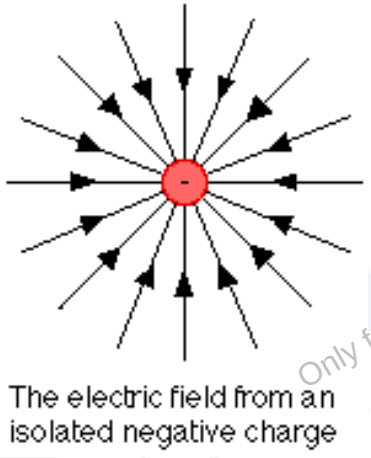
Phase of wave

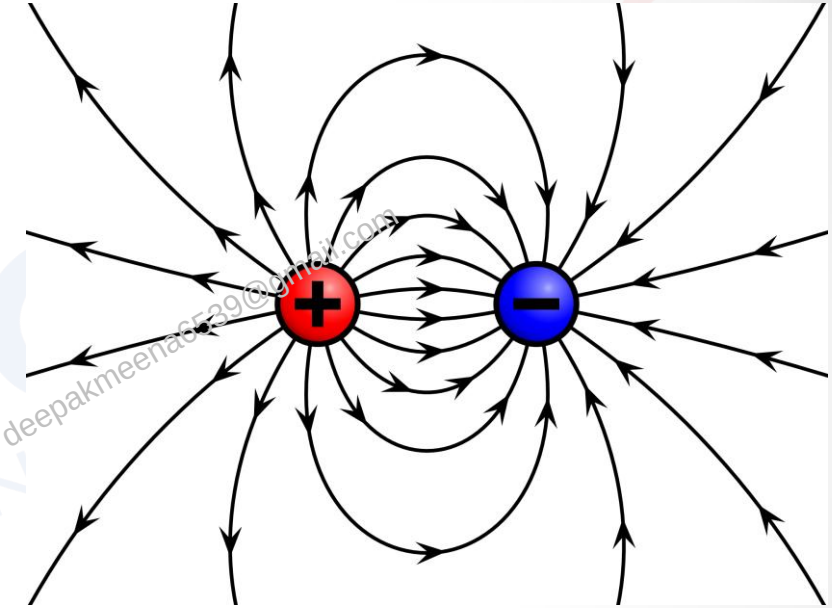




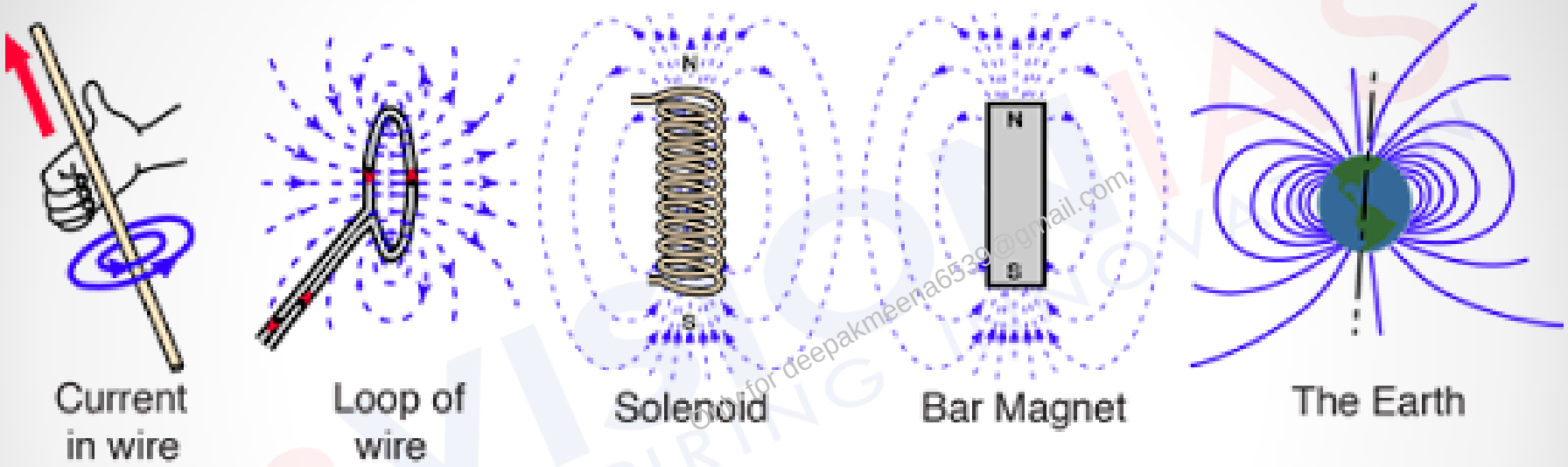
Young's double slit experiment





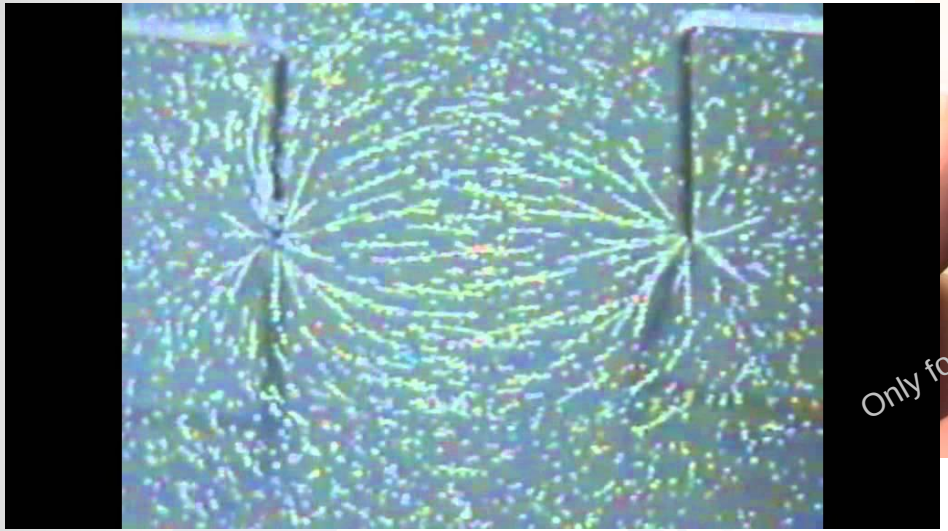


Electric Field due to static charges



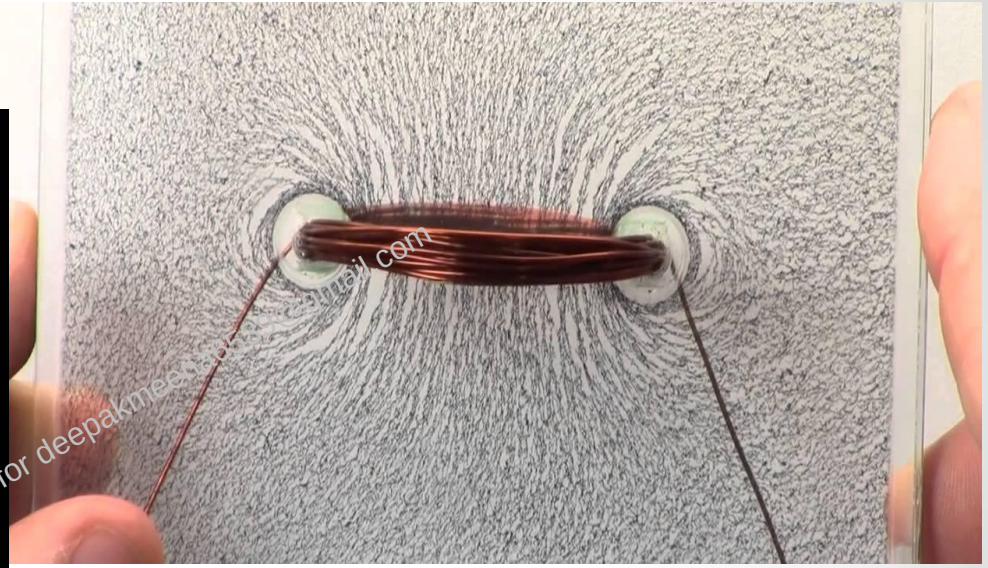
Magnetic Field Sources

Magnetic Field due to moving charges



https://www.youtube.com/watch?v=7vnmL853784

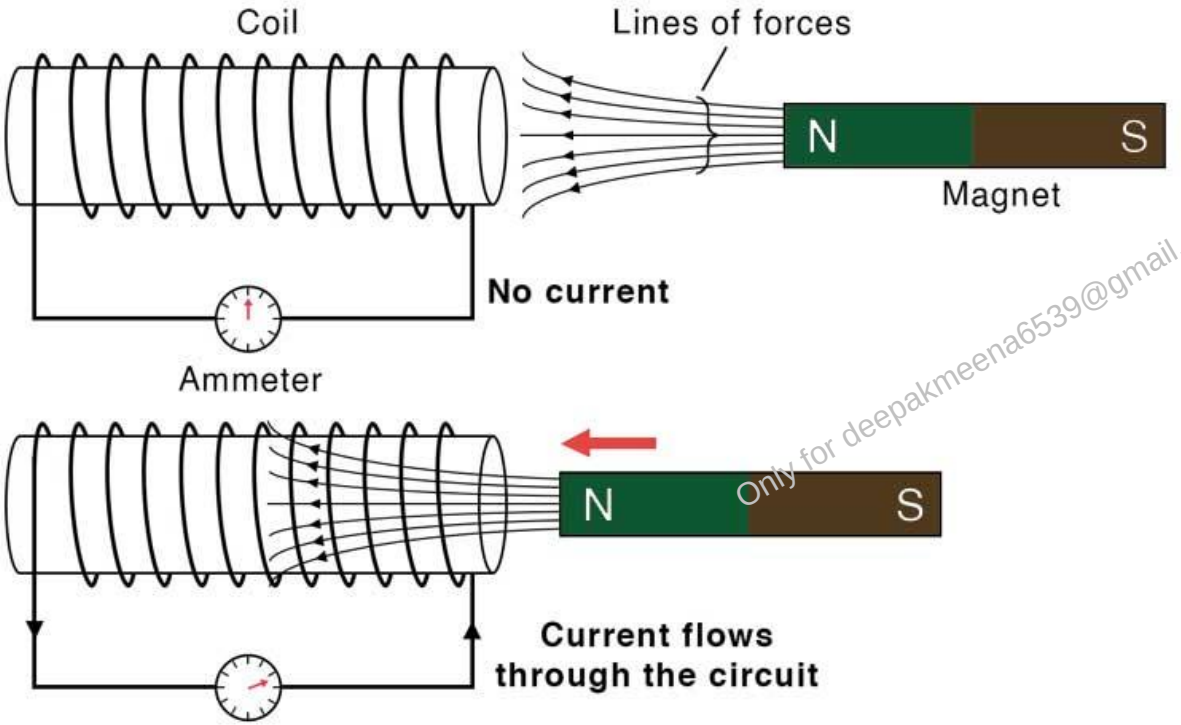
Electric Field Demonstration



https://www.youtube.com/watch?v=V-M07N4a6-Y

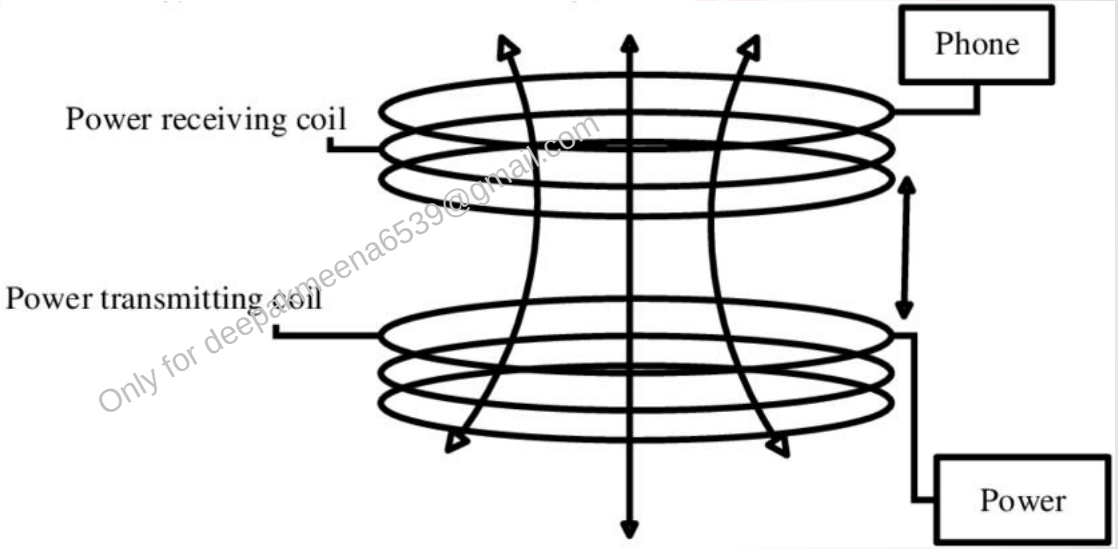
Magnetic Field Demonstration

Electromagnetic Induction



A changing magnetic field produces an electric field and vice versa.

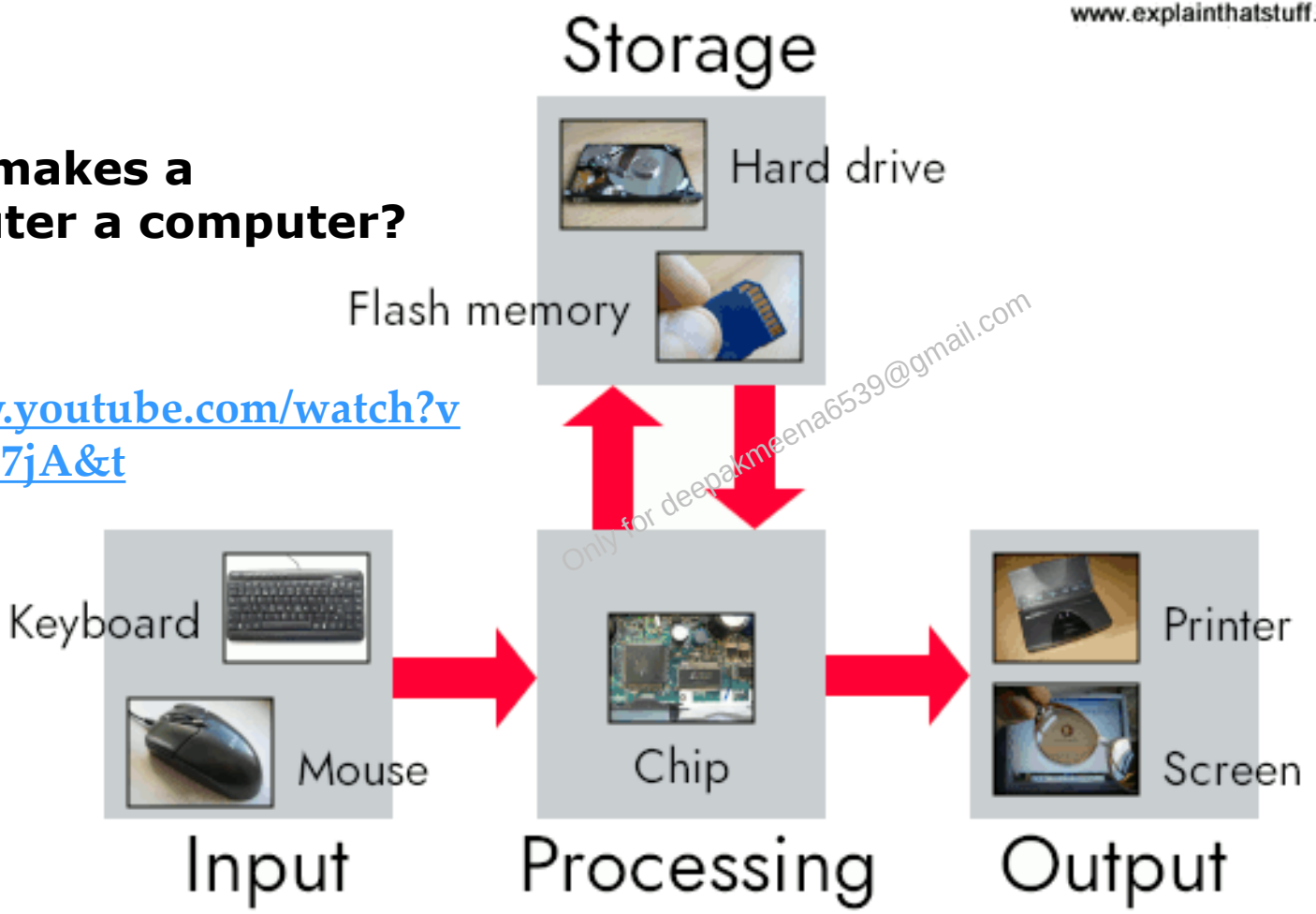
https://www.youtube.com/watch?v=KUihEkvabpo



At the core of Wireless Charging is induction.

What makes a computer a computer?

https://www.youtube.com/watch?v=mCq8-xTH7jA&t



Why Binary?

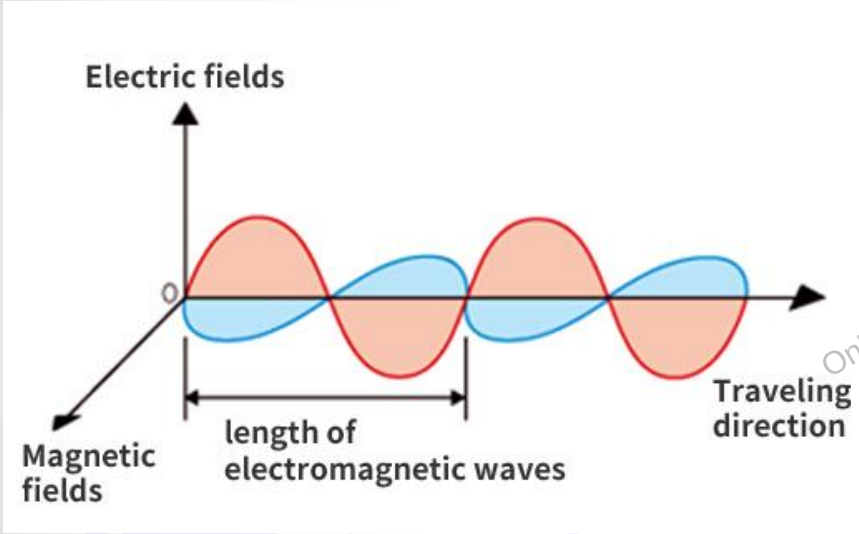
https://www.youtube.com/watch?v=USCBCmwMCDA

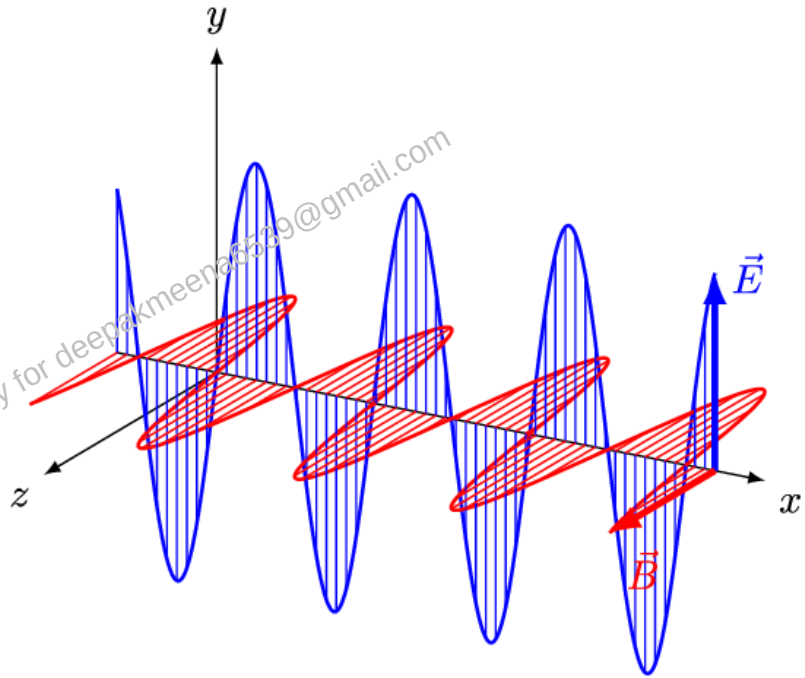
https://www.youtube.com/watch?v=ZoqMiFKspAA

https://www.youtube.com/watch?v=DKGZlaPlVLY

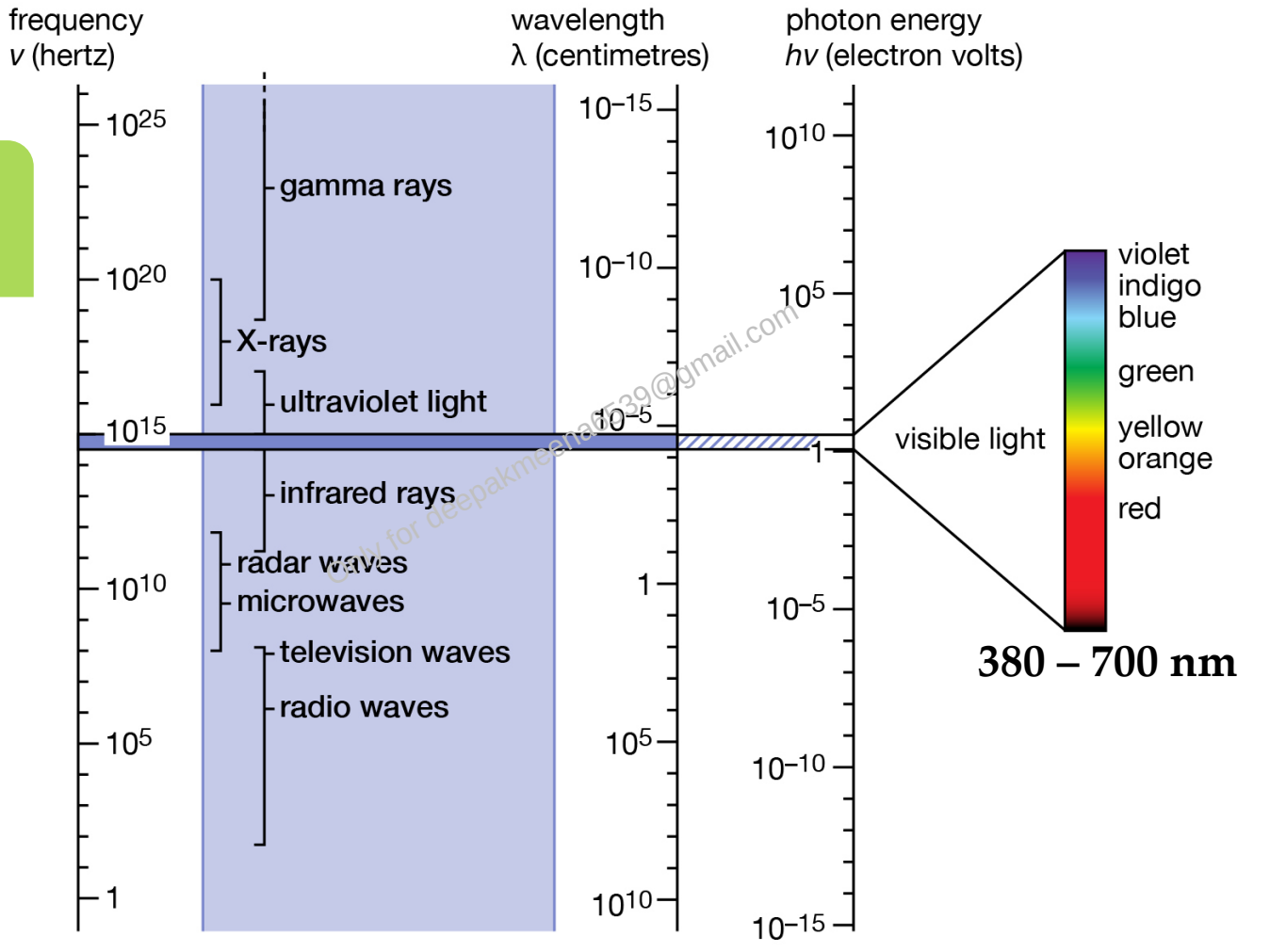
- **Simple representation of on/off states**: directly related to the physical states of electronic components, like **transistors**, which can be either "on" (1) or "off" (0).
- **Foundation of digital logic**: allowing computers to perform complex operations by manipulating these two states.
- **Efficient circuitry**: simpler and faster to design and build than circuits that would handle more than two states.
- **Data storage and processing**: Binary code is used to store and represent all types of data, including text, images, audio, and video, notes.

Electromagnetic Waves

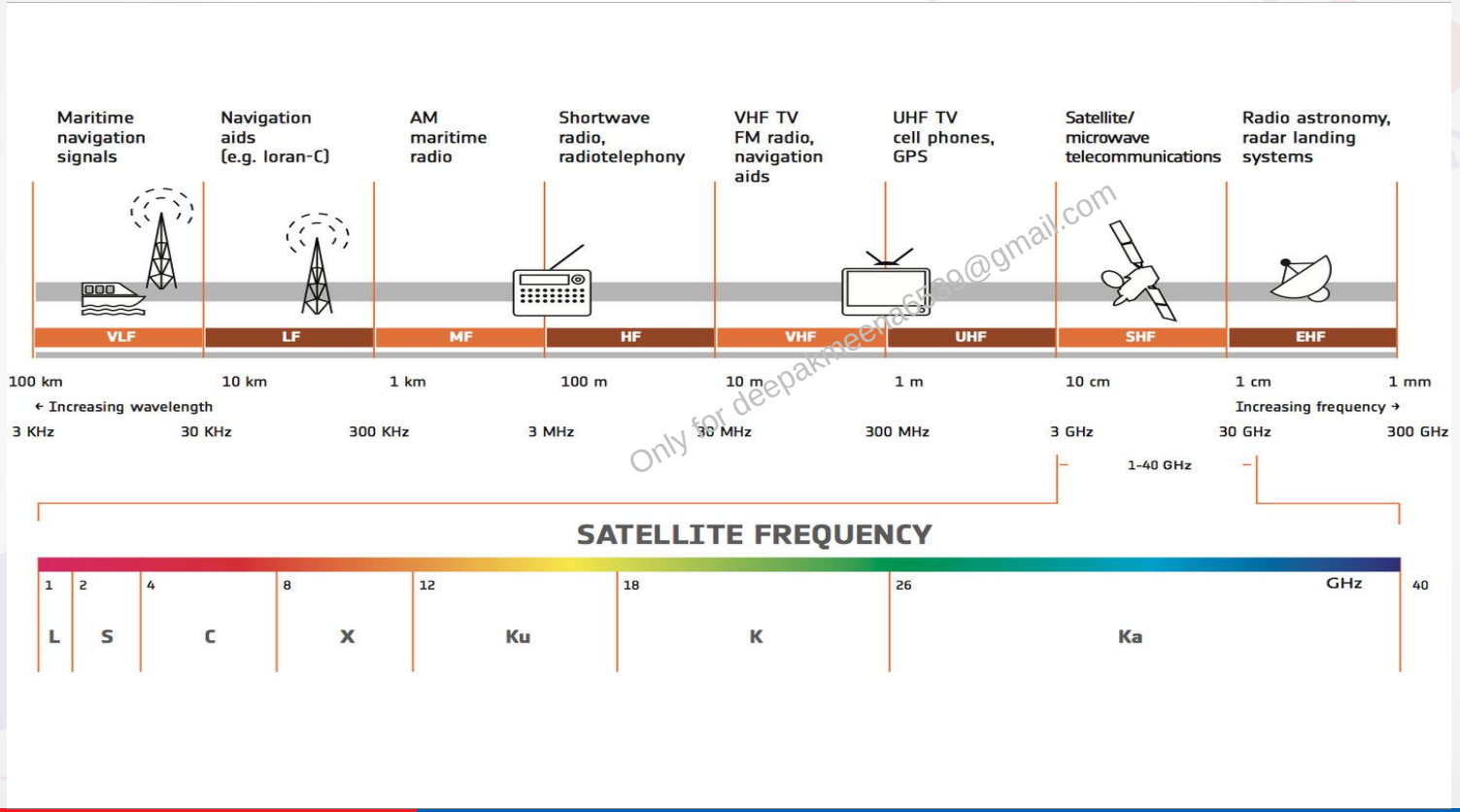




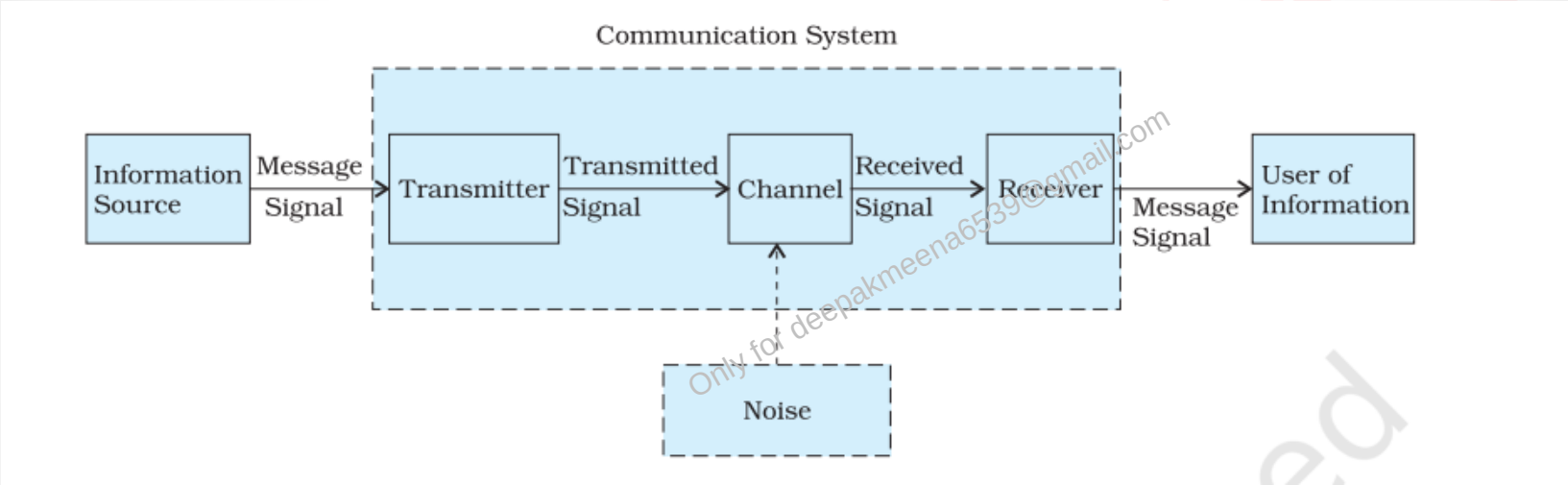
Electromagnetic Spectrum

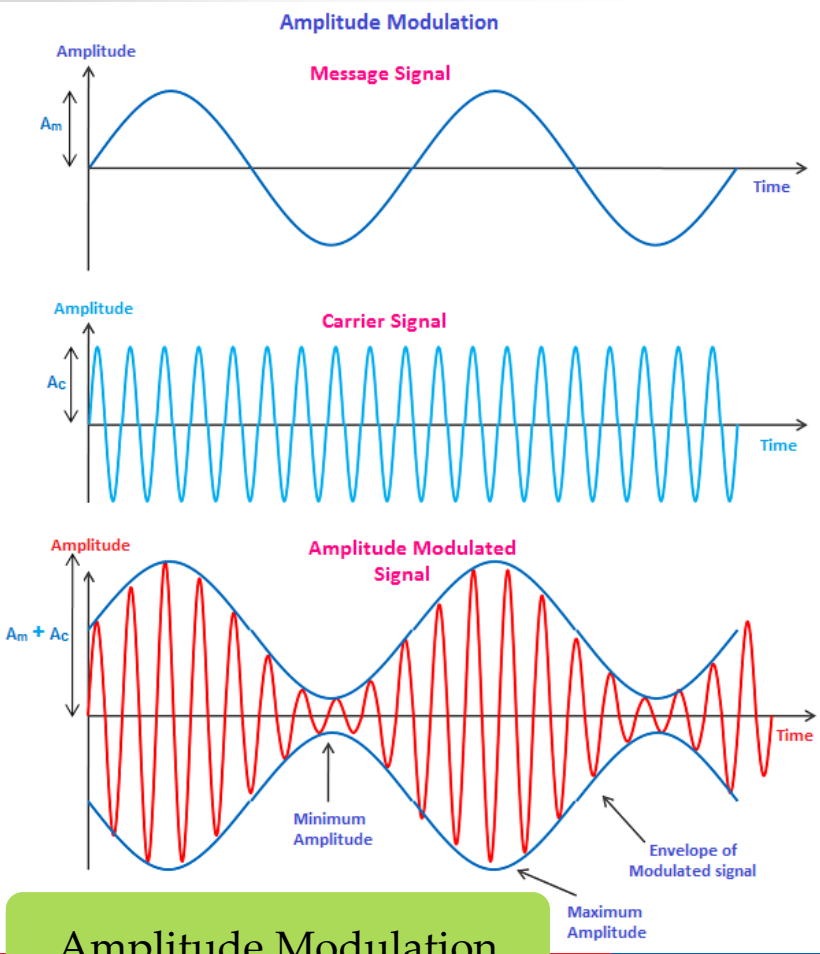


Satellite Frequency

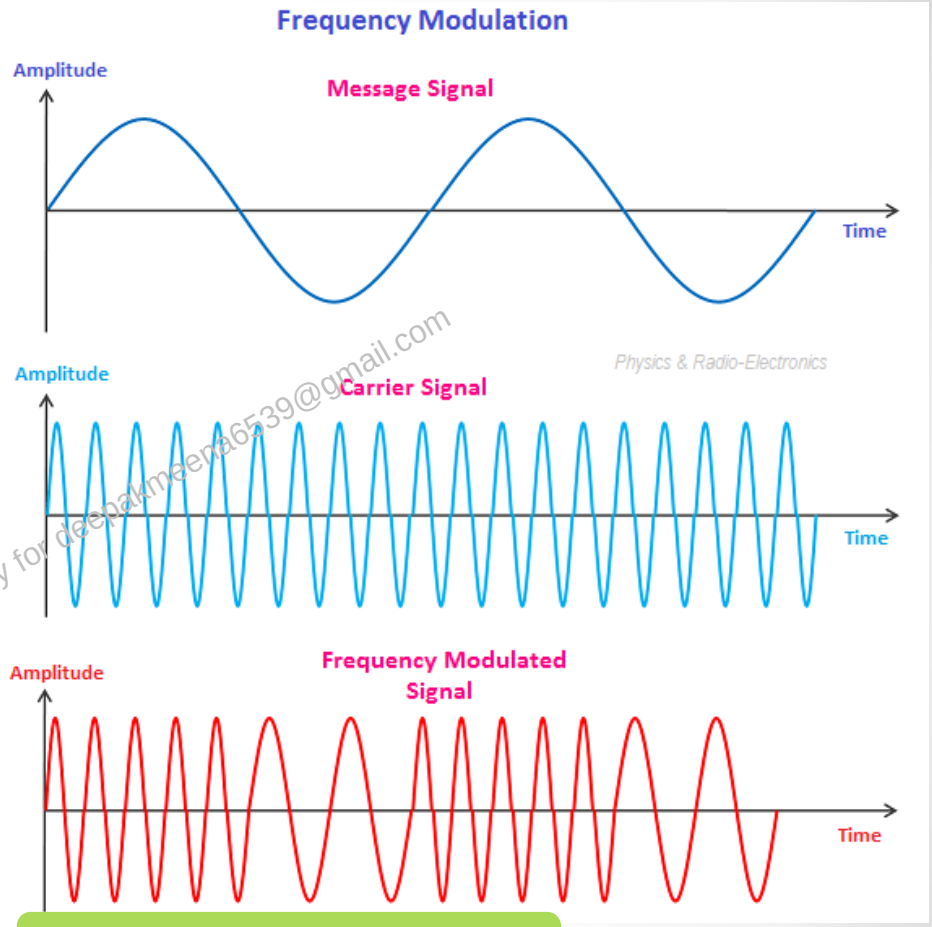


Generalized Communication System

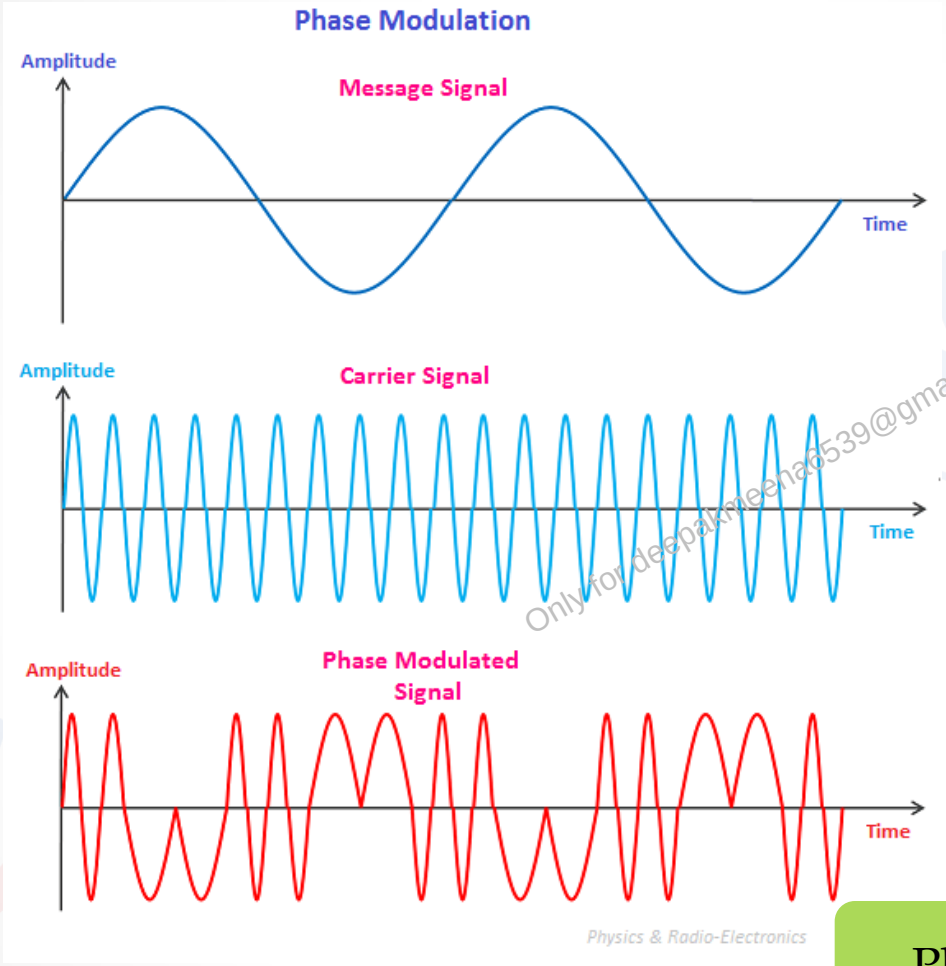




Amplitude Modulation

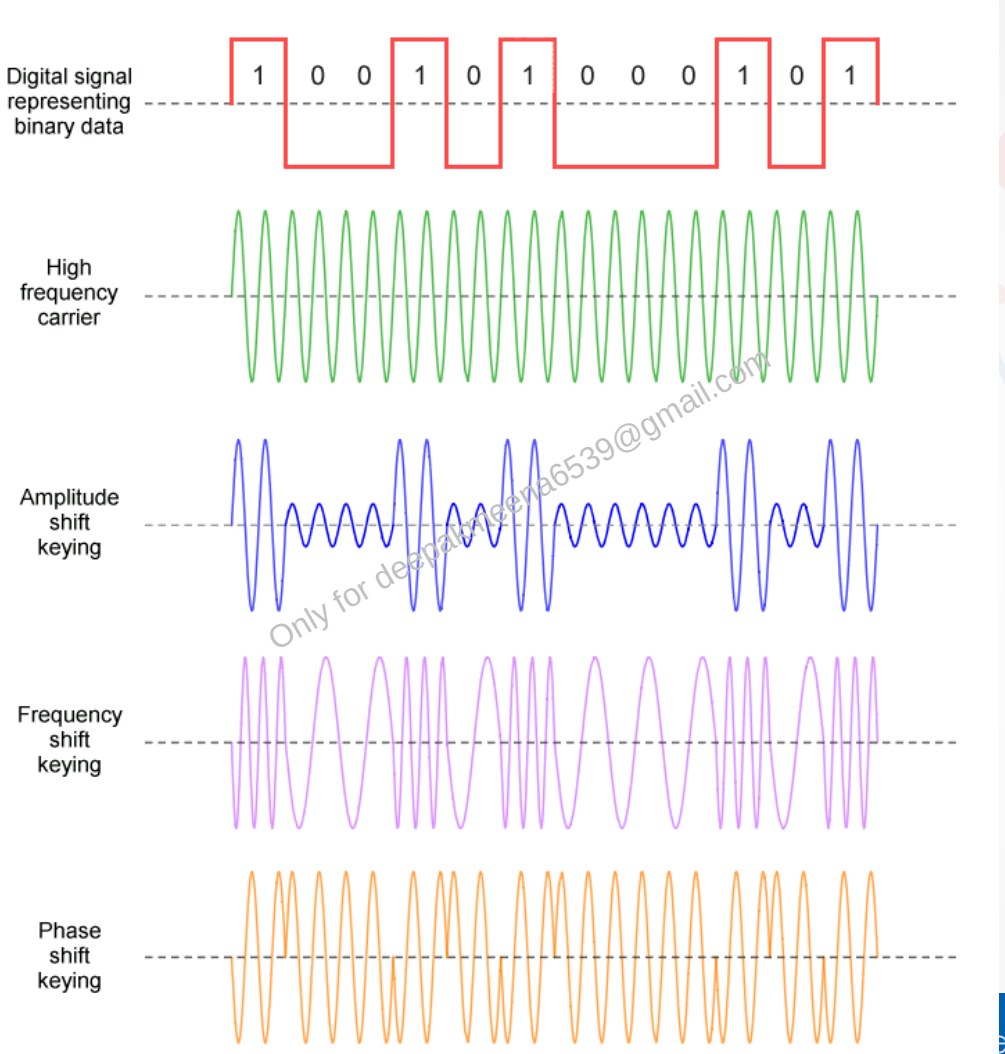


Frequency Modulation

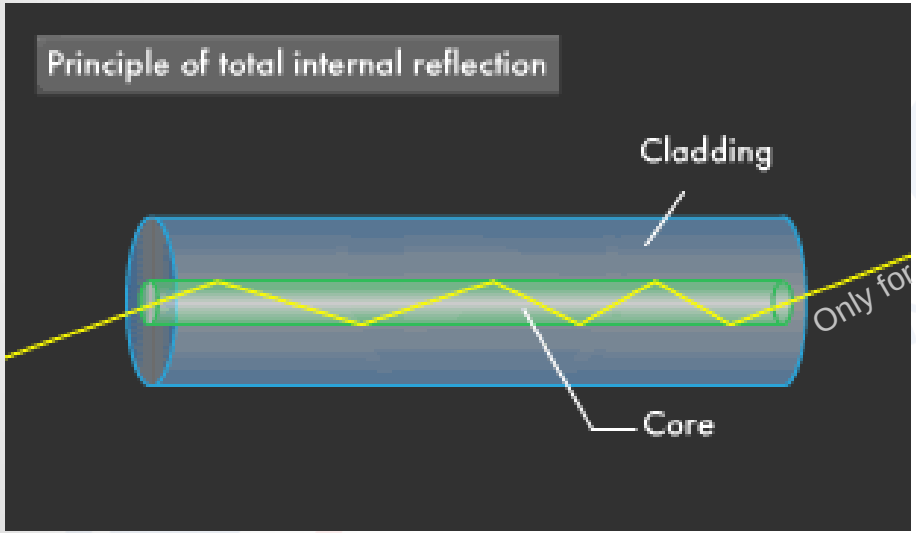


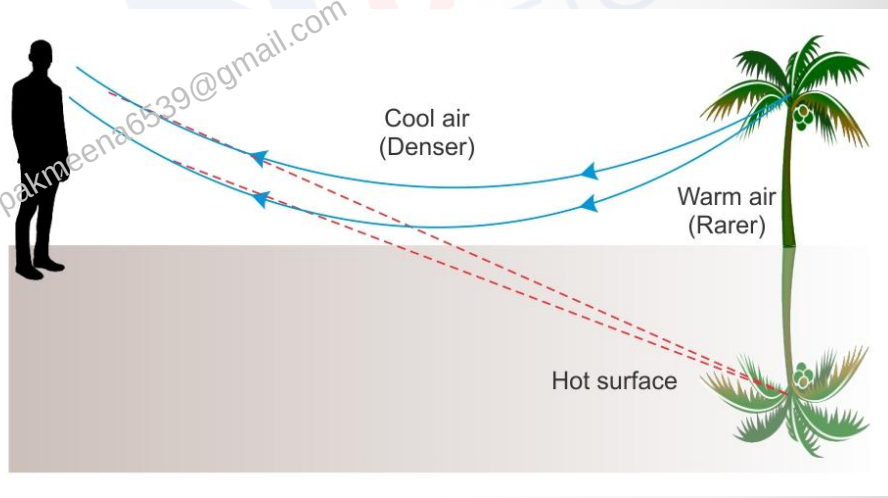
Phase Modulation

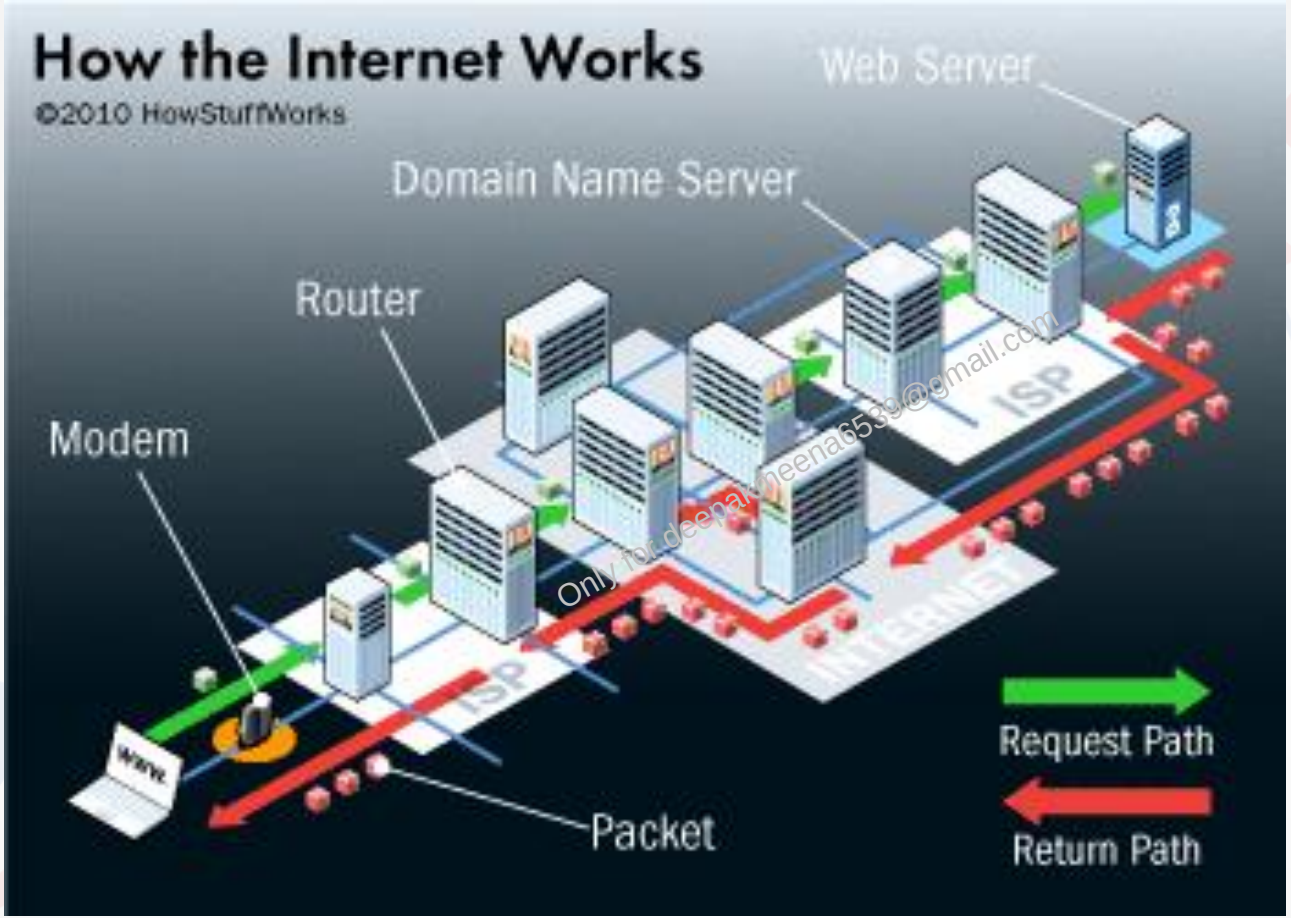
Modulation of Digital Signal



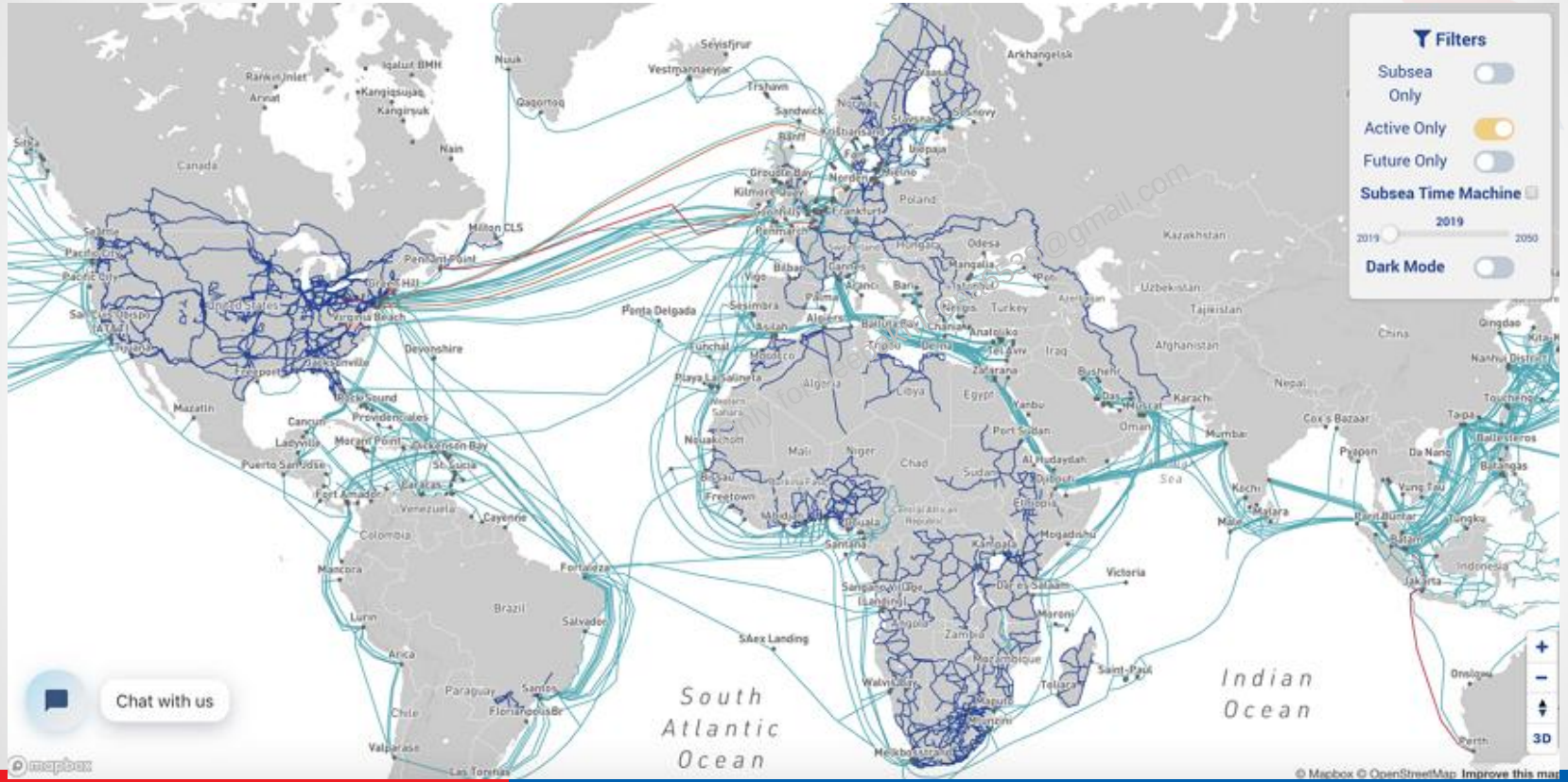
Optical Fibre Cables



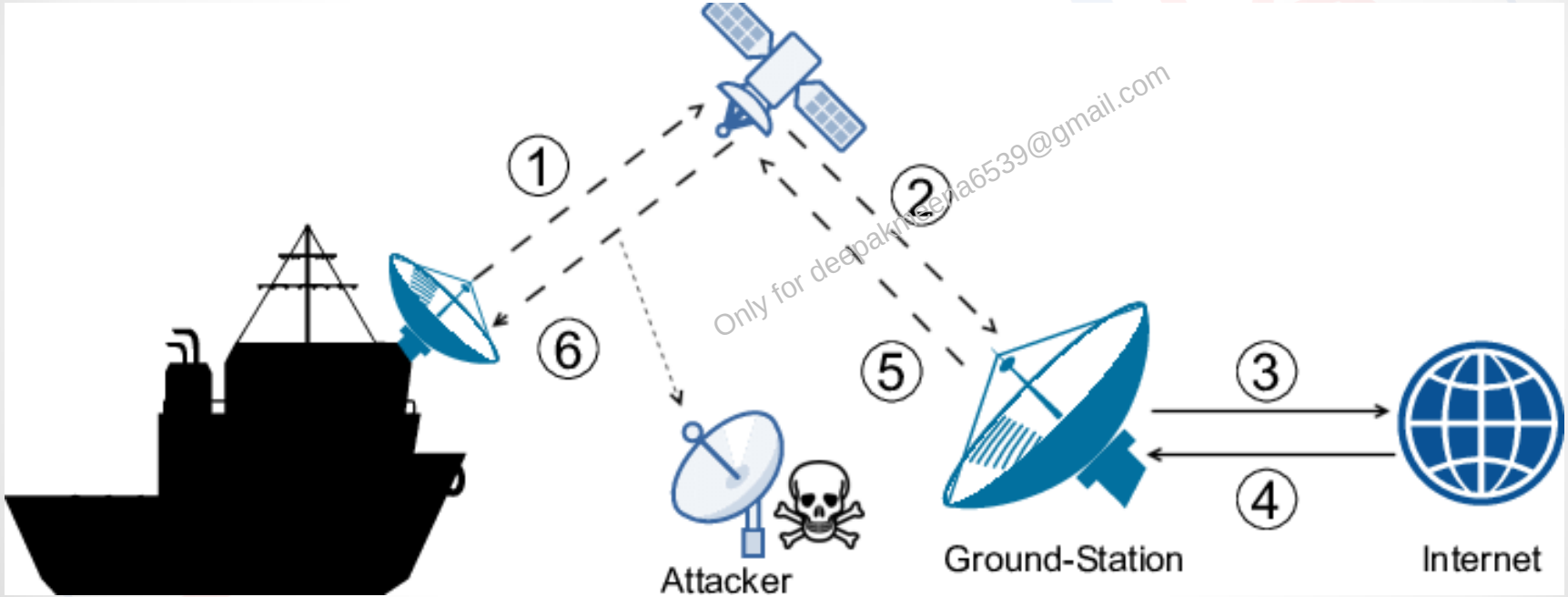




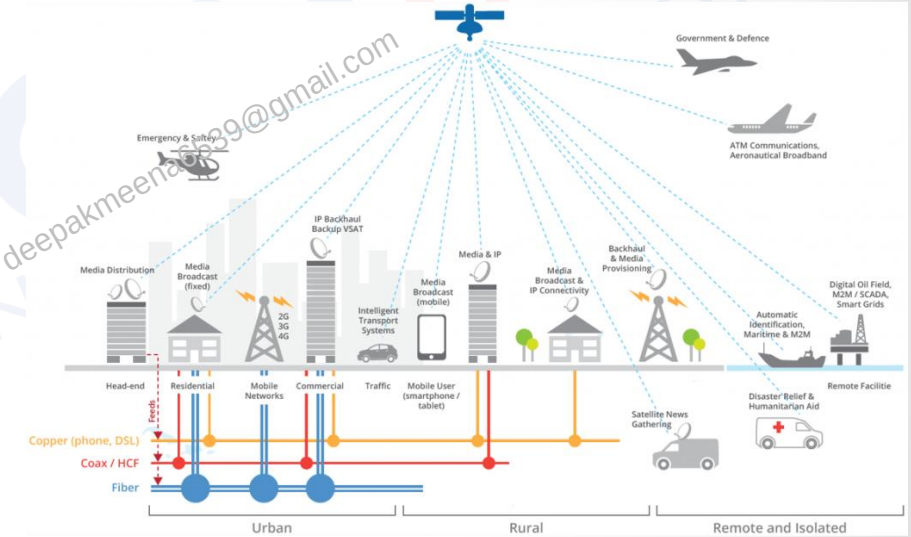
Subsea Network

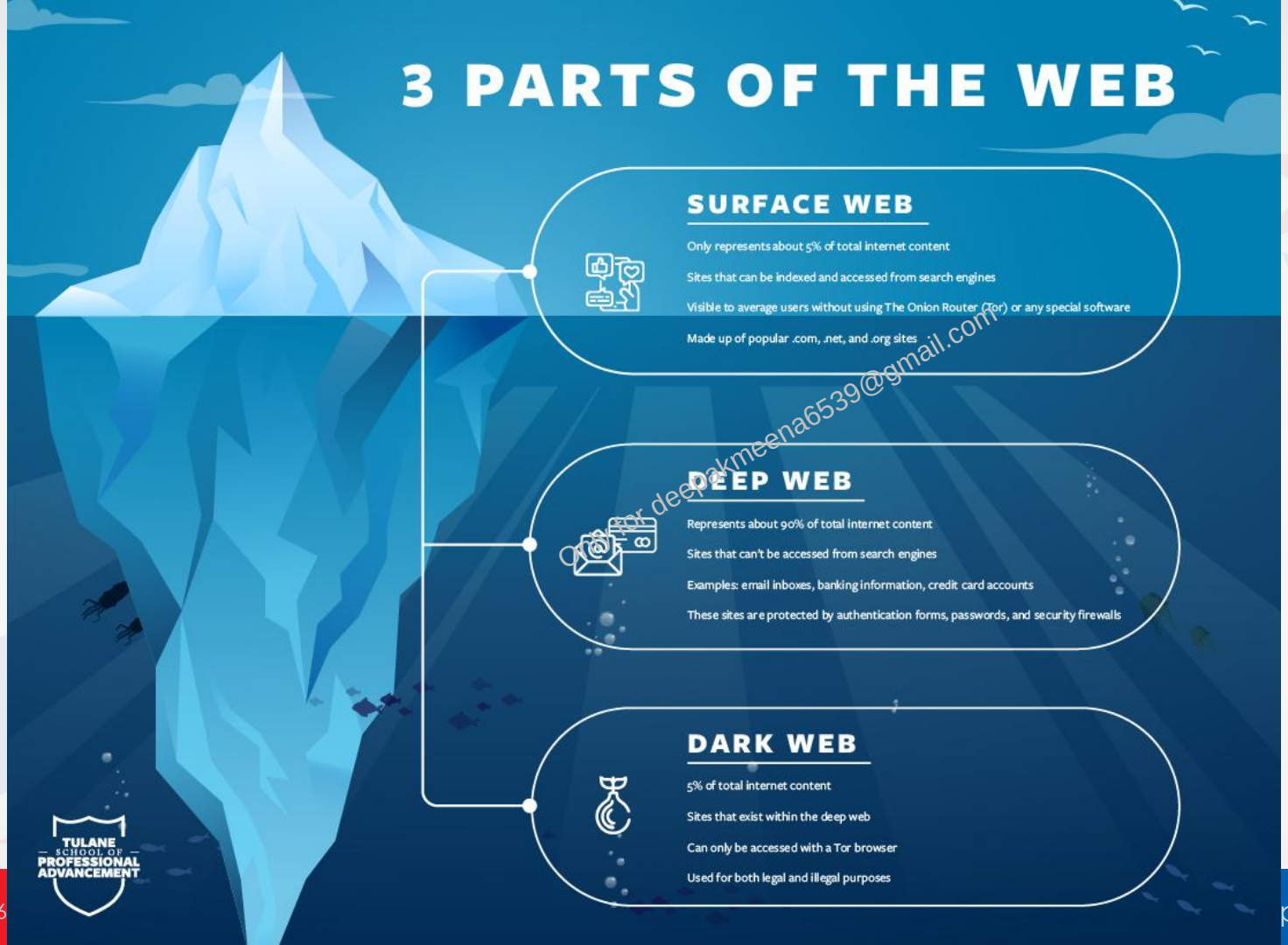


Maritime VSAT Netork

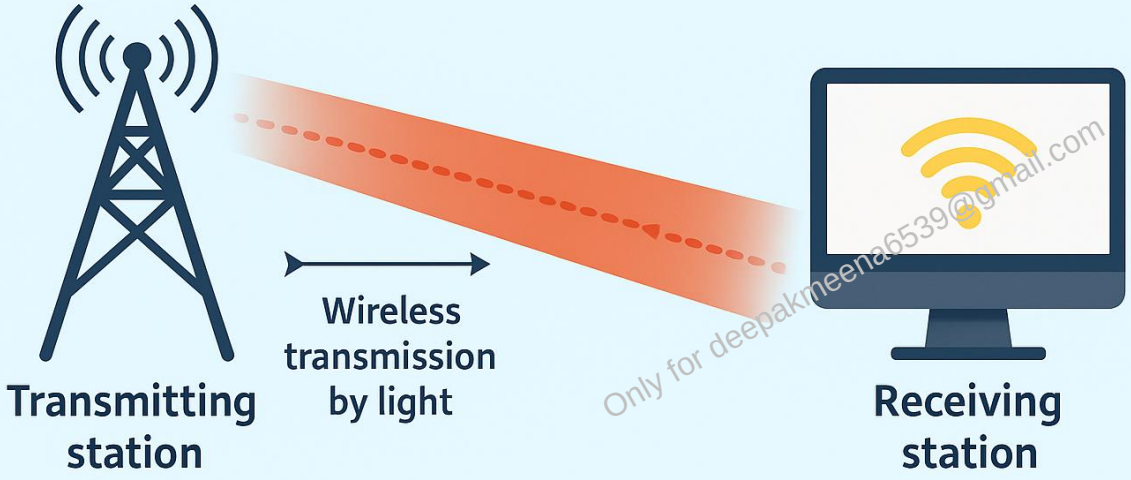


Starlink





FREE-SPACE OPTICAL COMMUNICATION

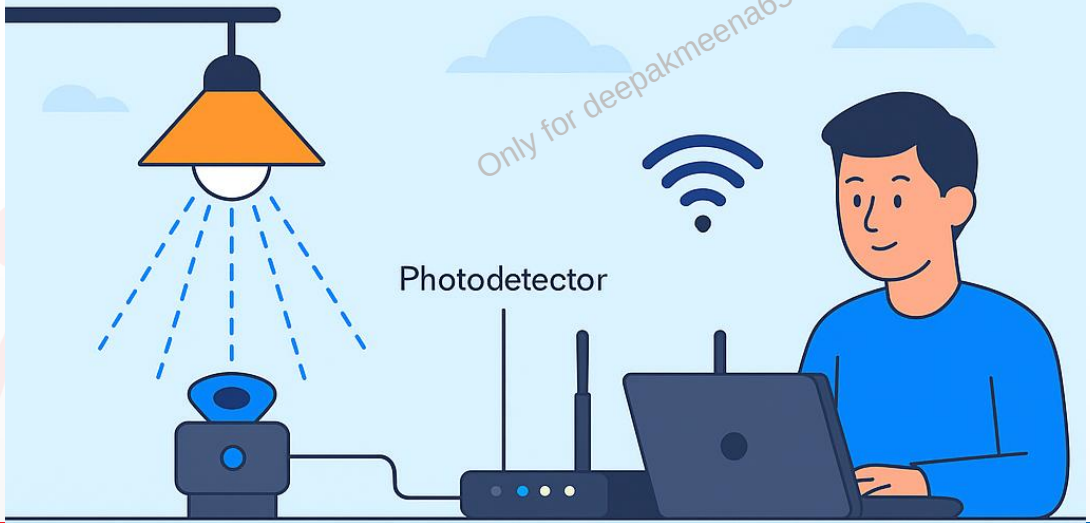


Free-space optical communction (FSOC) is a wireless technology that uses light to transmit data through the air.

FSOC

Li-Fi

Li-Fi (Light Fidelity) is a wireless communication technology that uses light to transmit data. LED lamps act as wireless access points, with modulated light being received by a photodetector and converted into an electrical signal. Li-Fi offers high-speed wireless connectivity and operates in environments where radio frequencies are restricted.

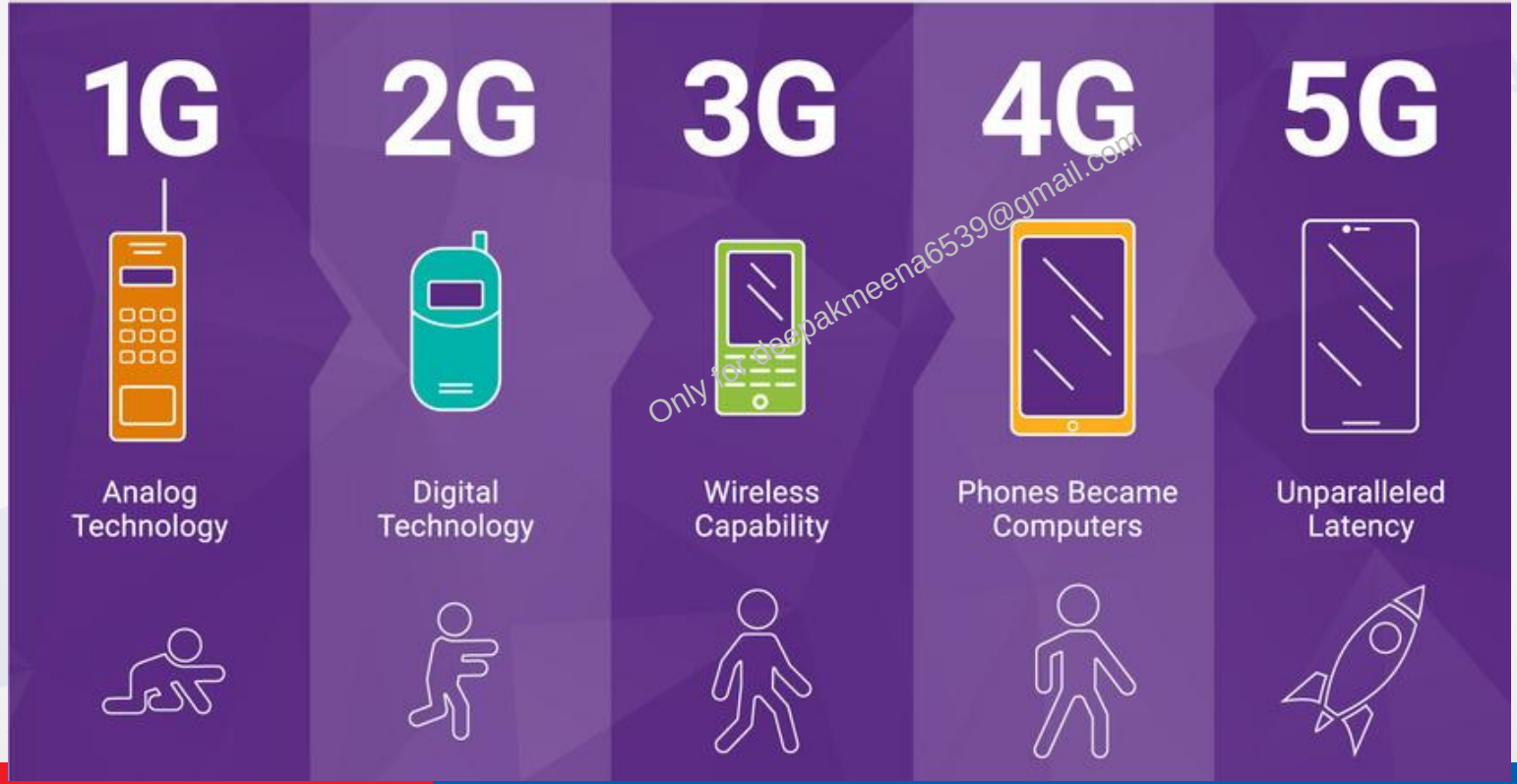


https://www.youtube.com/watch?v=NaoSp4NpkGg

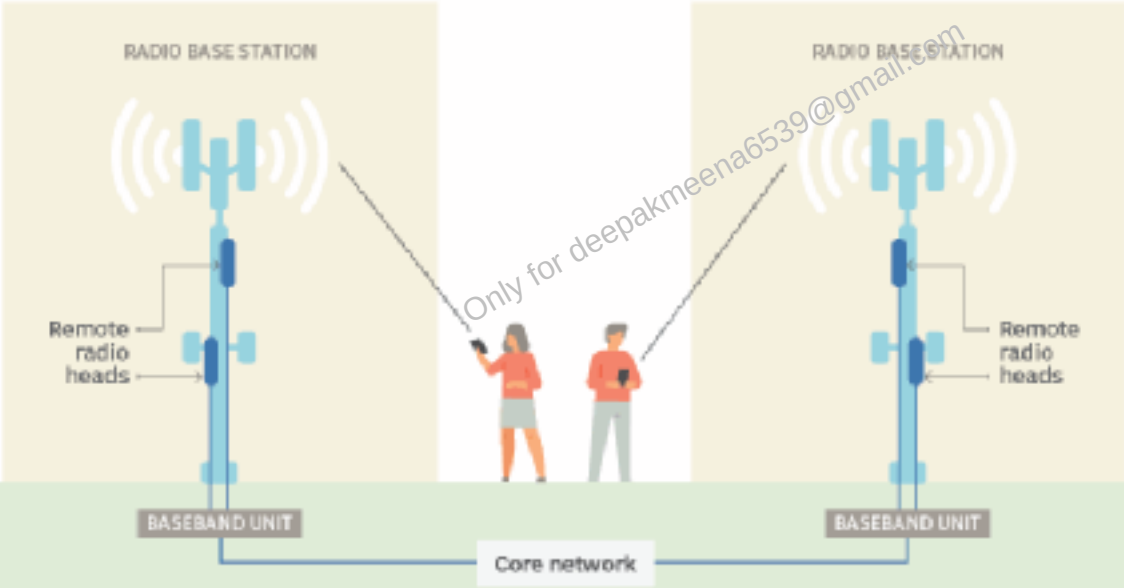
LiFi

History of Mobile Technology

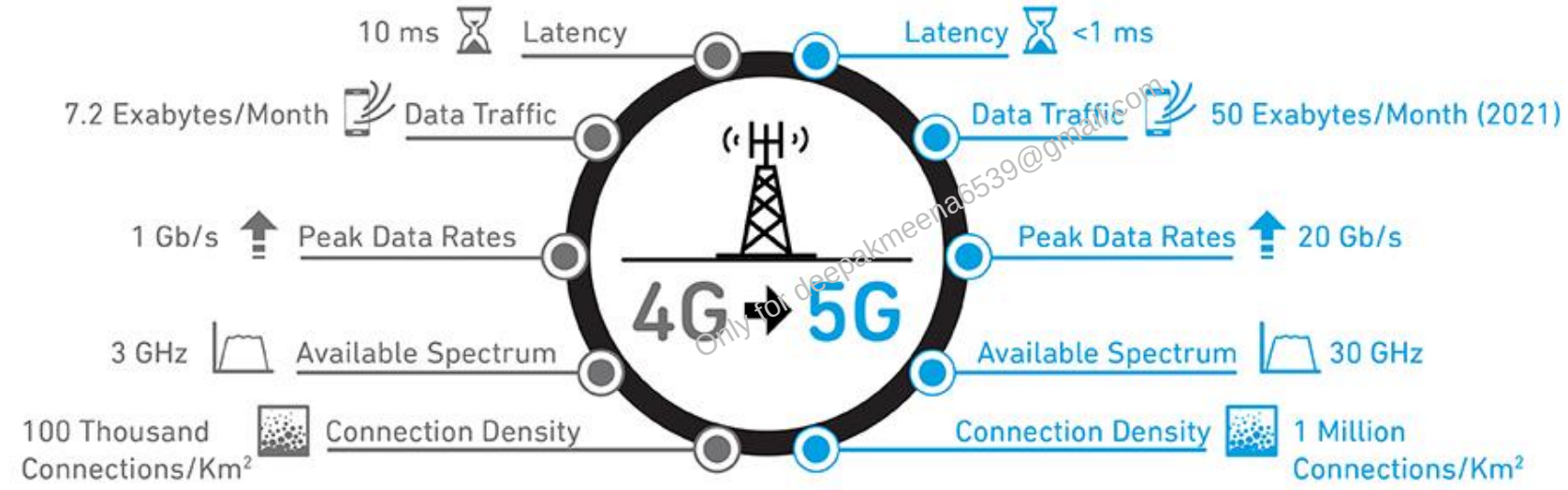
SYNOPSYS®



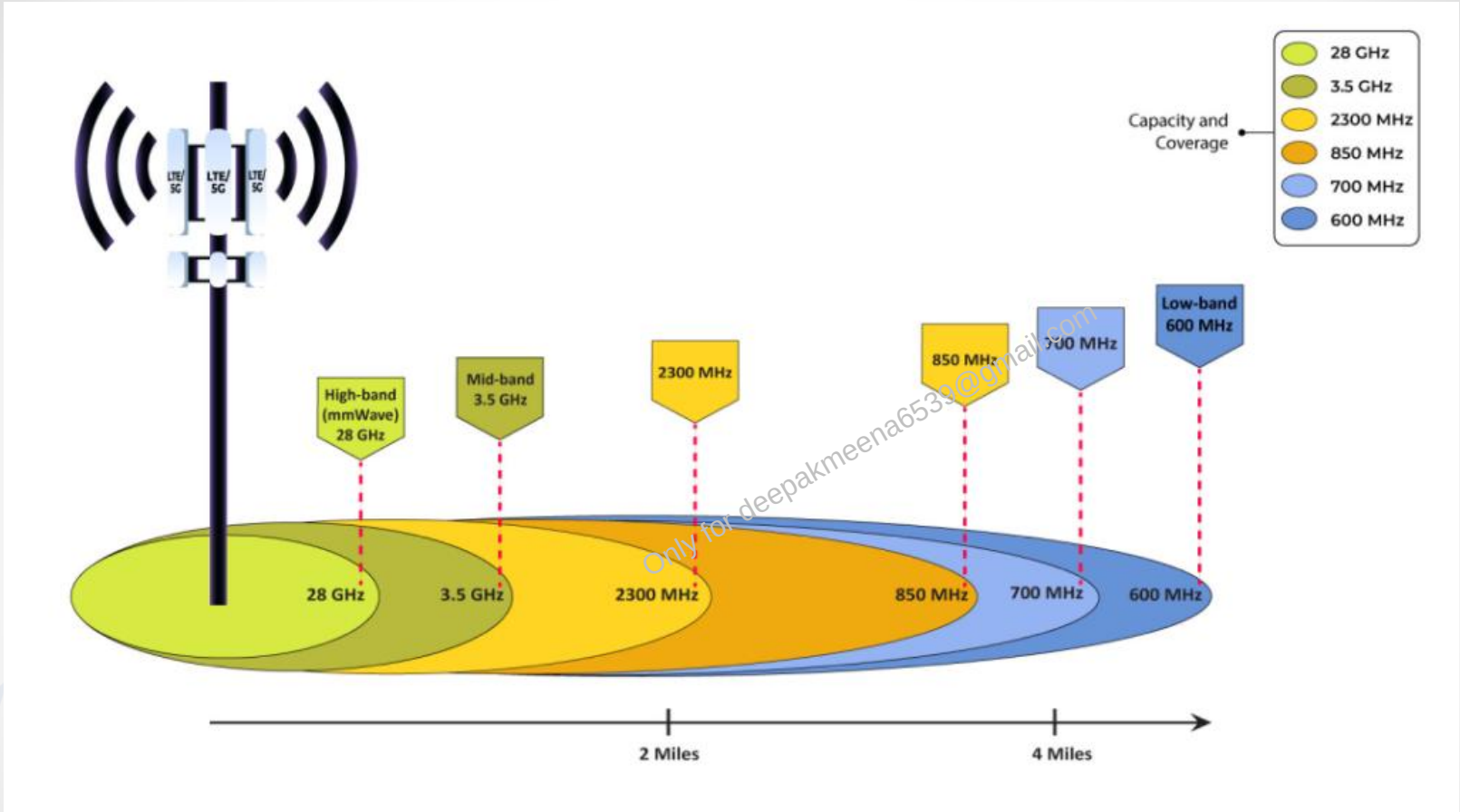
Basic RAN architecture



Comparing 4G and 5G



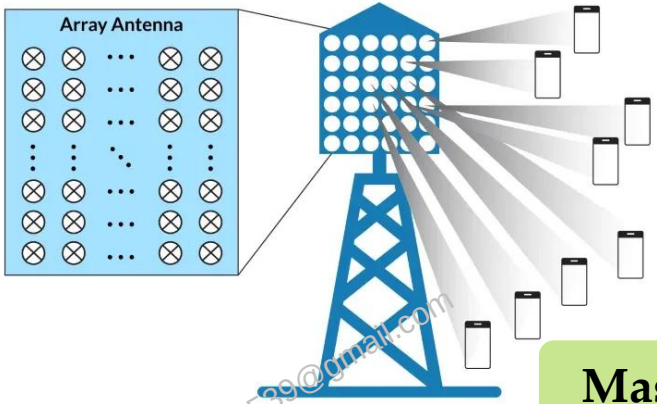
qorvo



5G Frequency Bands

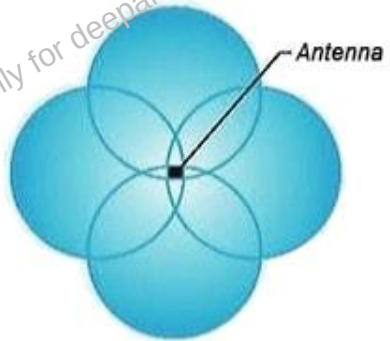
5G Technologies

Small Cell

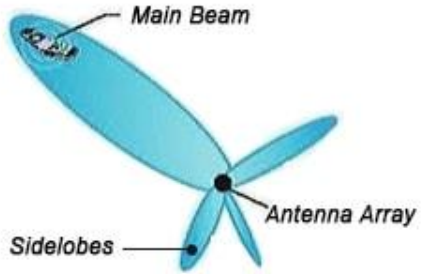


- More active antenna elements
- More focused energy
- Less interference
- More spatial multiplexing layers
- Better cellular throughput and coverage
- Large number of users served simultaneously
- Introduces 2 dimensional beamforming

Massive MIMO

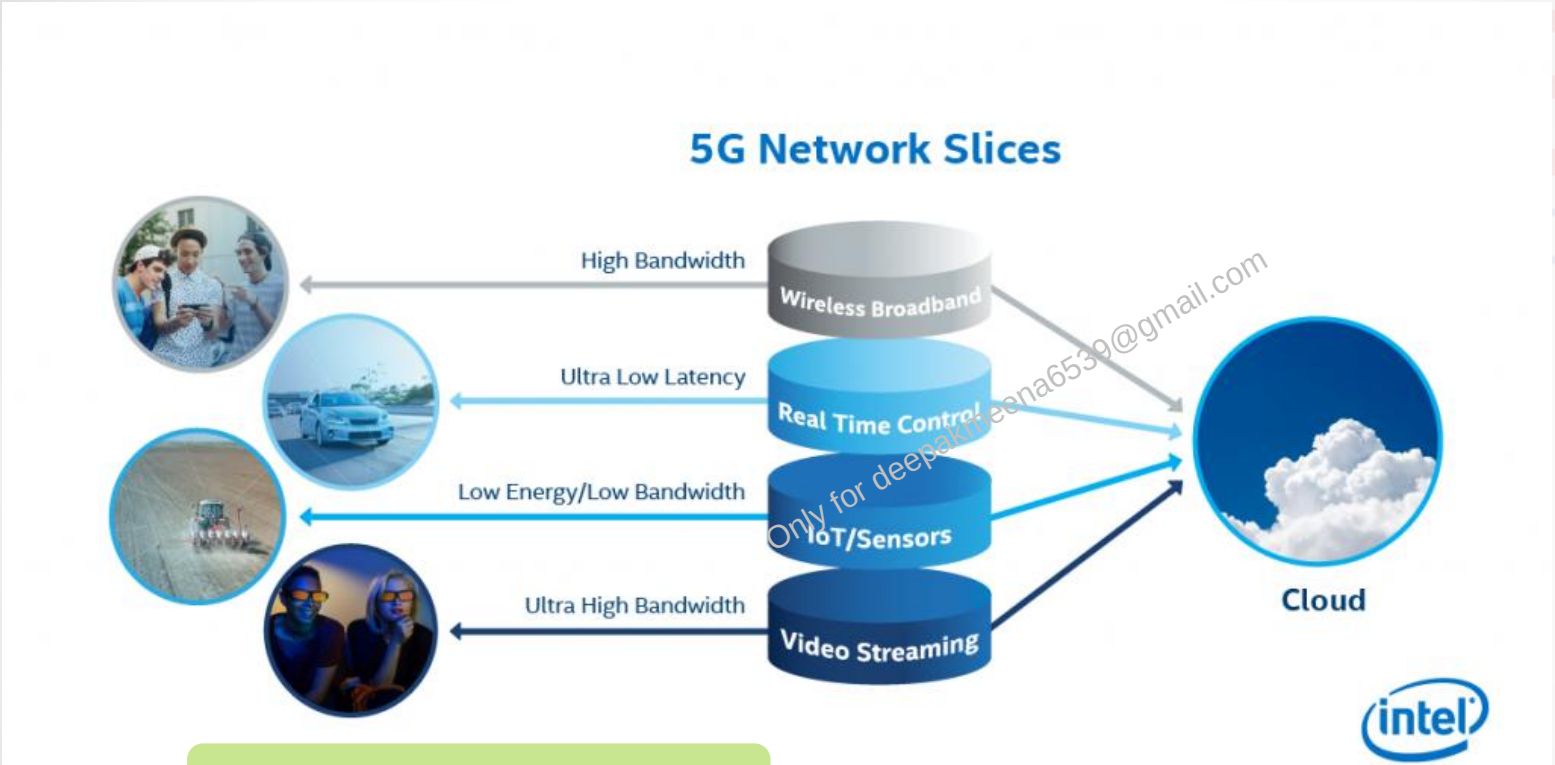


Conventional Array



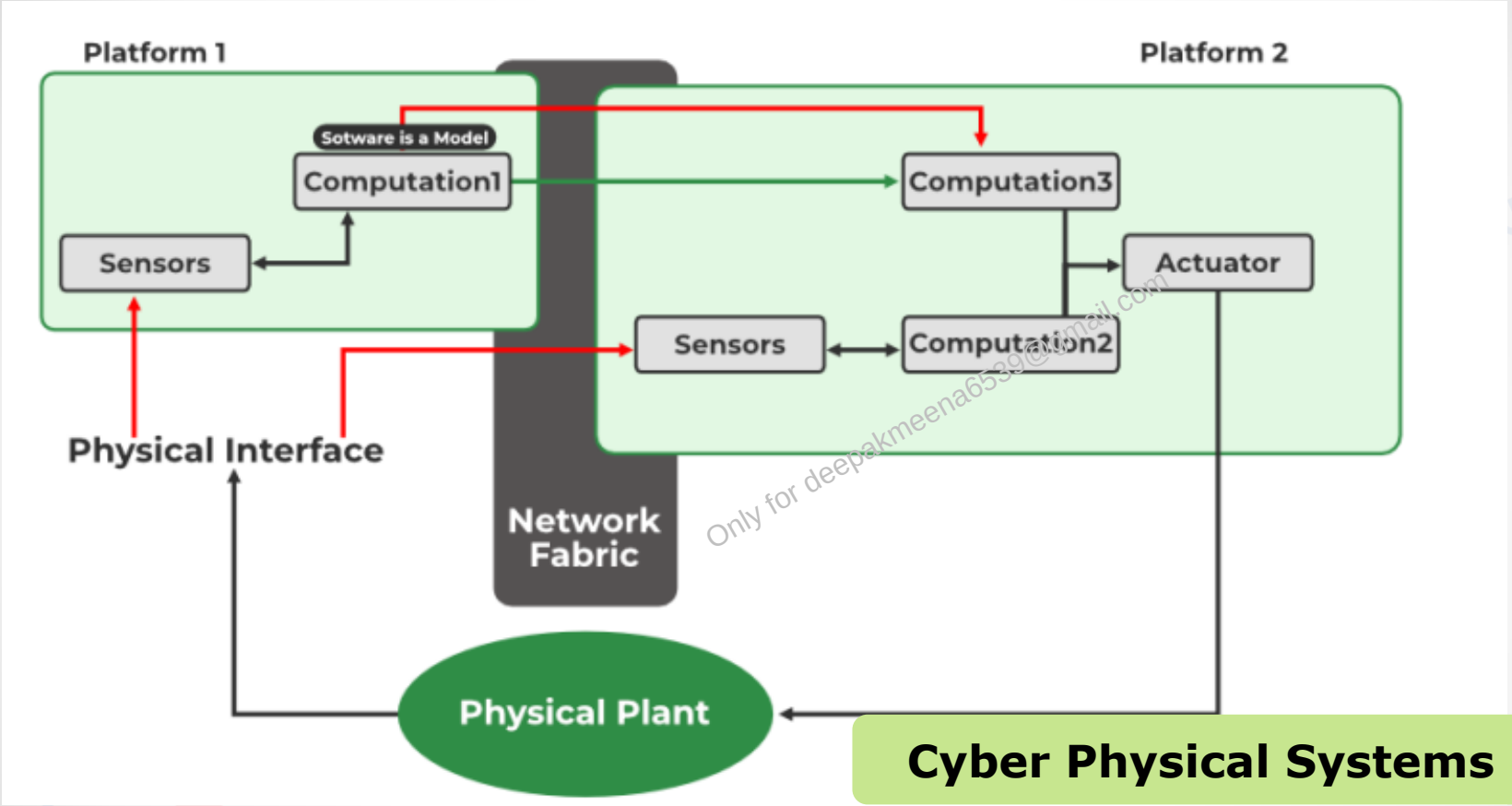
Beamforming Array

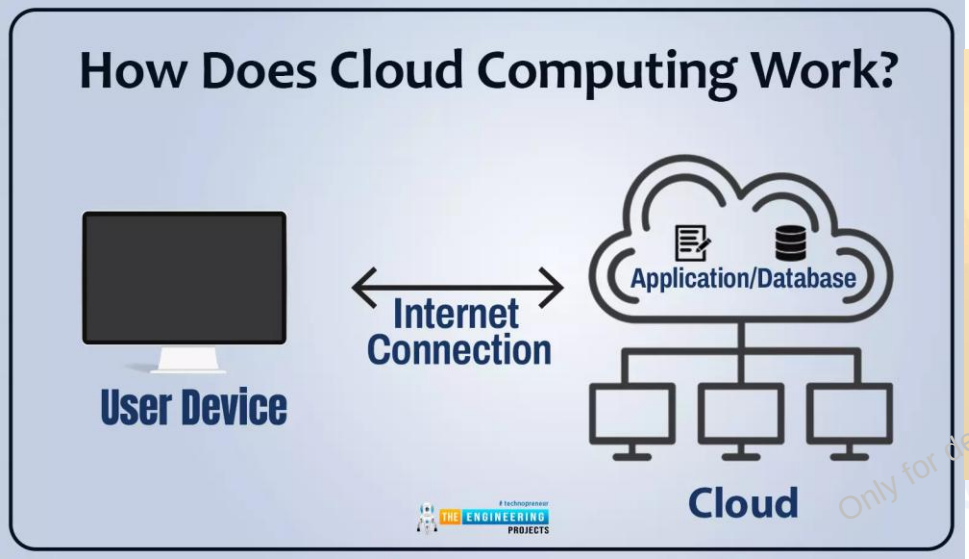
Beamforming

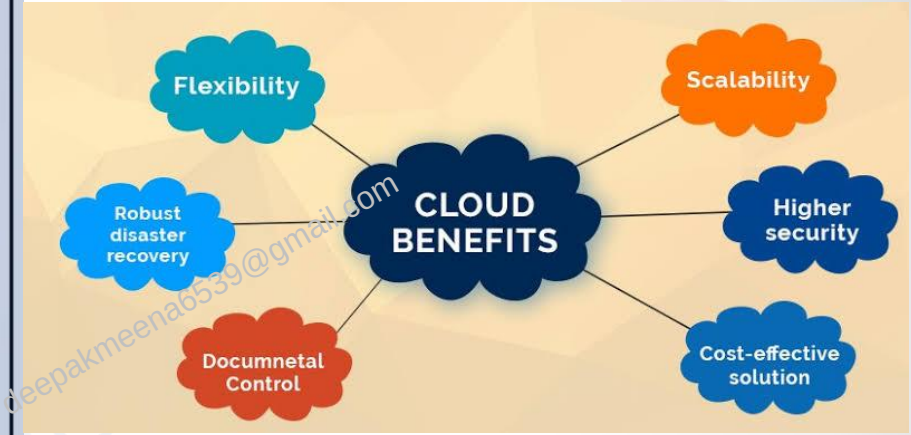


Network Slicing

Internet of Things

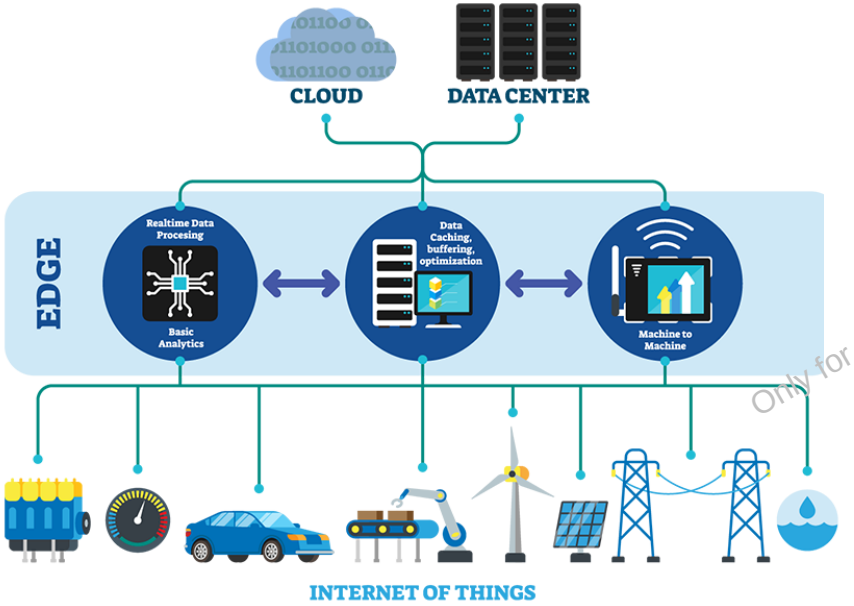


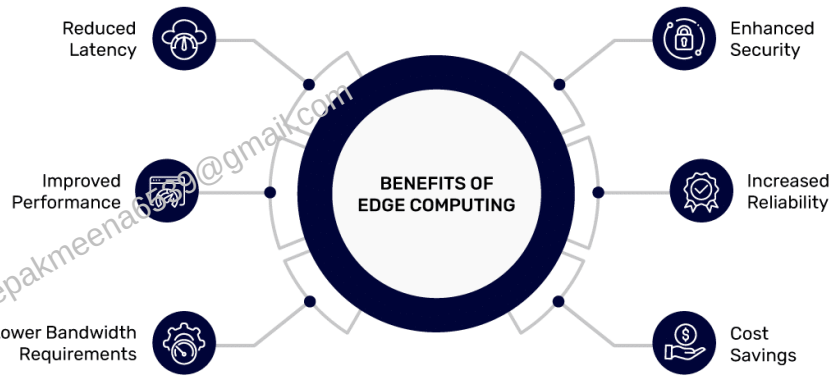




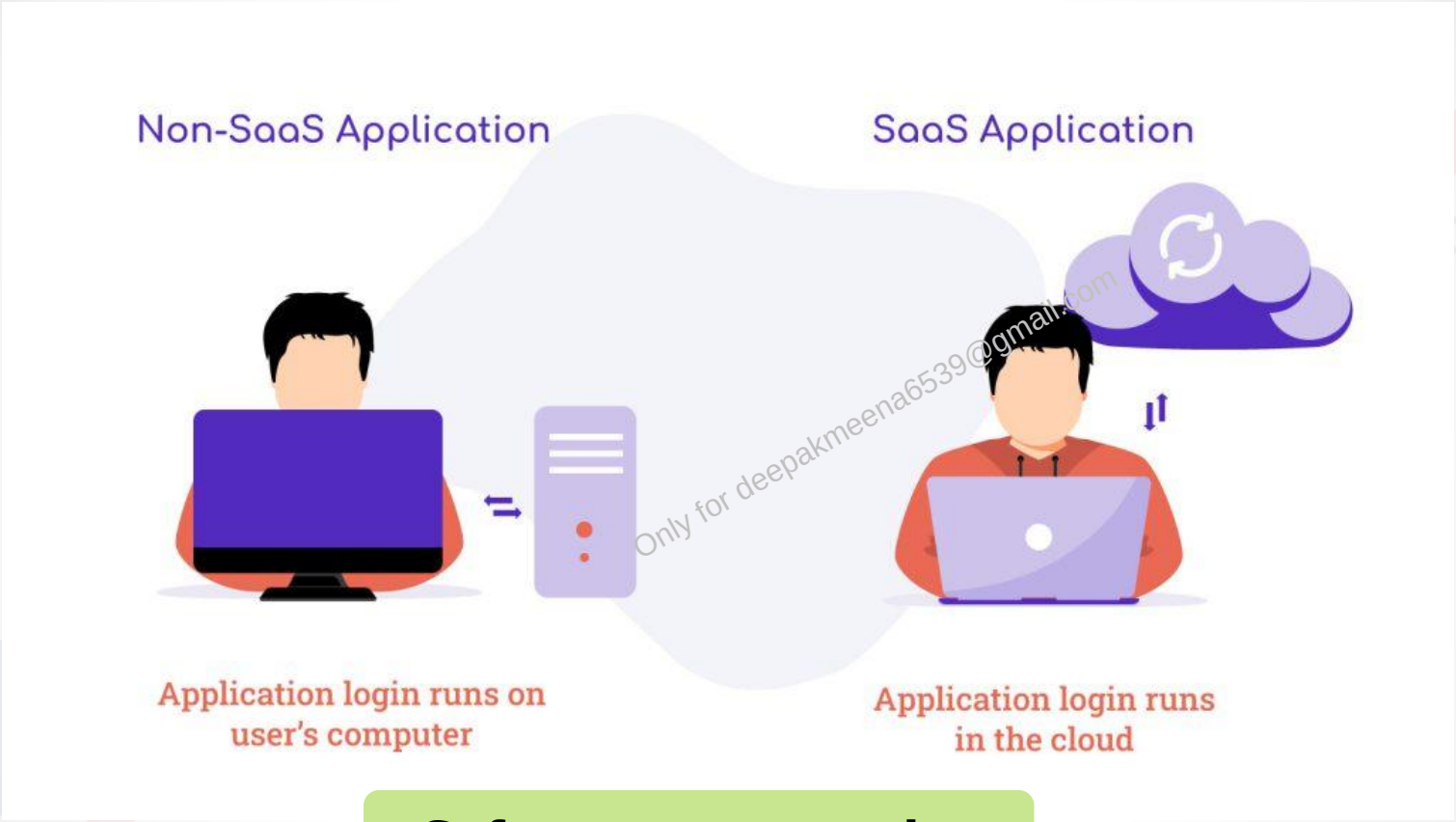
Cloud Computing

Edge Computing



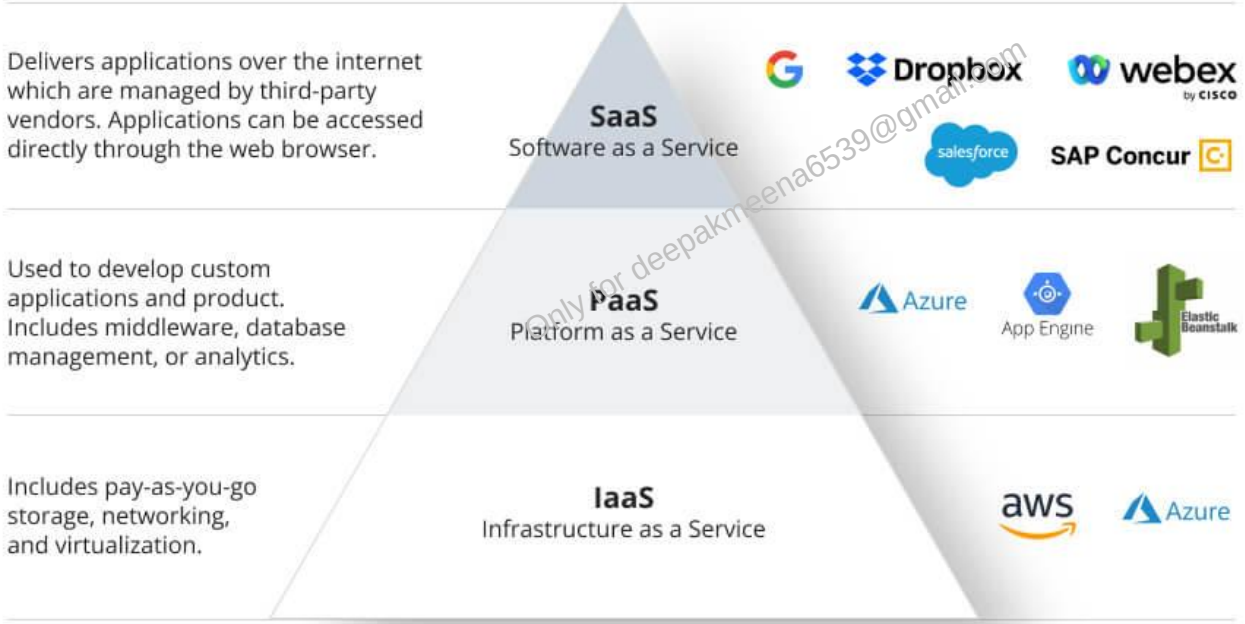


Edge Computing

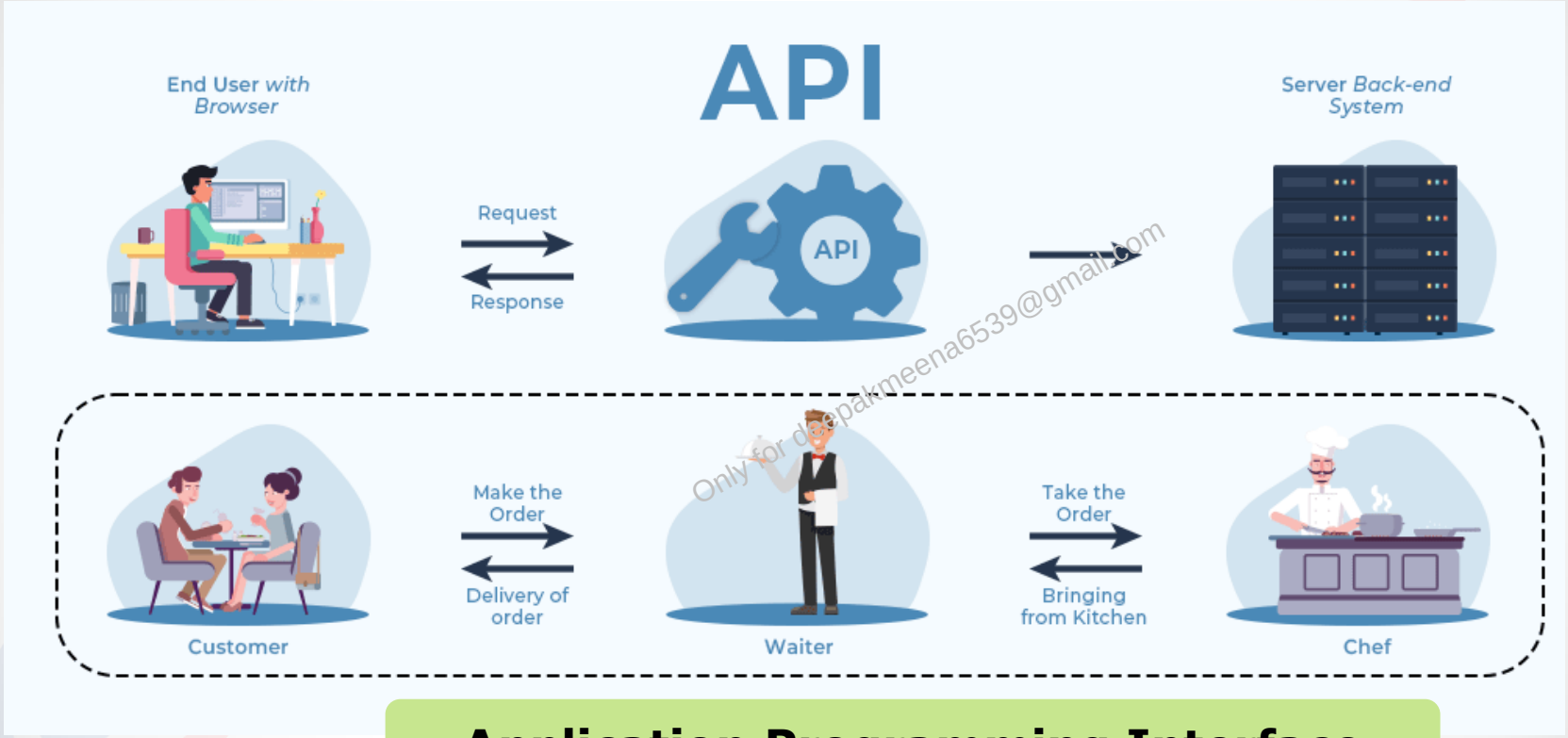


Software as a service

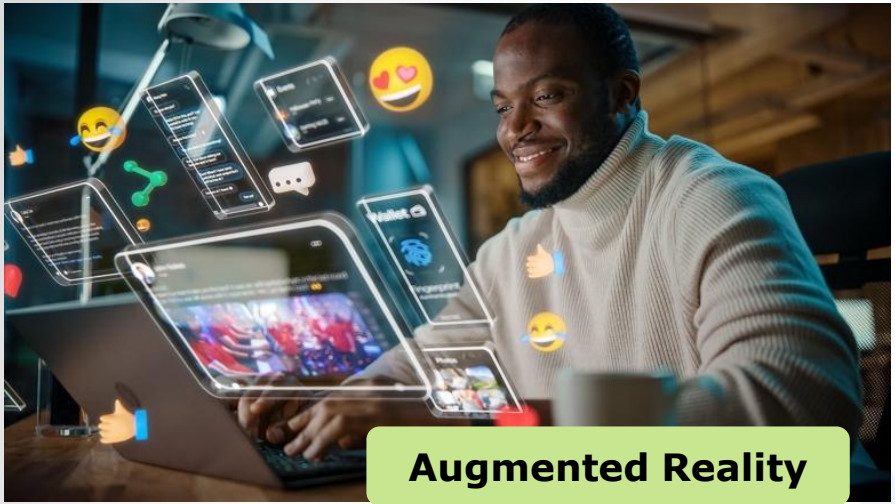
Differences between IaaS, PaaS and SaaS



Source: www.businesstechweekly.com/operational-efficiency/cloud-computing/saas-vs-paas-vs-iaas/



Application Programming Interface



Augmented Reality

Virtual Reality

Mixed Reality

Metaverse

32. With reference to 'Near Field Communication (NFC) Technology', which of the following statements is/are correct?

1. It is a contactless communication technology that uses electromagnetic radio fields.
2. NFC is designed for use by devices which can be at a distance of even a metre from each other.
3. NFC can use encryption when sending sensitive information.

Select the correct answer using the code given below.

(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

2015

5. With reference to 'LiFi', recently in the news, which of the following statements is/are correct?

1. It uses light as the medium for high-speed data transmission.
2. It is a wireless technology and is several times faster than 'WiFi'.

Select the correct answer using the code given below.

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

2016

66. When the alarm of your smartphone rings in the morning, you wake up and tap it to stop the alarm which causes your geyser to be switched on automatically. The smart mirror in your bathroom shows the day's weather and also indicates the level of water in your overhead tank. After you take some groceries from your refrigerator for making breakfast, it recognises the shortage of stock in it and places an order for the supply of fresh grocery items. When you step out of your house and lock the door, all lights, fans, geysers and AC machines get switched off automatically. On your way to office, your car warns you about traffic congestion ahead and suggests an alternative route, and if you are late for a meeting, it sends a message to your office accordingly.

In the context of emerging communication technologies, which one of the following terms best applies to the above scenario ?

(a) Border Gateway Protocol
(b) Internet of Things
(c) Internet Protocol
(d) Virtual Private Network

2018

With reference to communication technologies, what is/are the difference/differences between LTE (Long-Term Evolution) and VoLTE (Voice over Long-Term Evolution)?

1. LTE is commonly marketed as 3G and VoLTE is commonly marketed as advanced 3G.
2. LTE is data-only technology and VoLTE is voice-only technology.

Select the correct answer using the code given below.

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

2019

With reference to Visible Light Communication (VLC) technology, which of the following statements are correct ?

1. VLC uses electromagnetic spectrum wavelengths 375 to 780 nm.
2. VLC is known as long-range optical wireless communication.
3. VLC can transmit large amounts of data faster than Bluetooth.
4. VLC has no electromagnetic interference.

Select the correct answer using the code given below :

(a) 1, 2 and 3 only
(b) 1, 2 and 4 only
(c) 1, 3 and 4 only
(d) 2, 3 and 4 only

2020

Consider the following communication technologies :

1. Closed-circuit Television
2. Radio Frequency Identification
3. Wireless Local Area Network

Which of the above are considered Short-Range devices/technologies ?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

2022

48. Which one of the following words/phrases is most appropriately used to denote "an interoperable network of 3D virtual worlds that can be accessed simultaneously by millions of users, who can exert property rights over virtual items" ?

(a) Big data analytics

(b) Cryptography

(c) Metaverse **2024**

(d) Virtual matrix

In the context of digital technologies for entertainment, consider the following statements :

1. In Augmented Reality (AR), a simulated environment is created and the physical world is completely shut out.
2. In Virtual Reality (VR), images generated from a computer are projected onto real-life objects or surroundings.
3. AR allows individuals to be present in the world and improves the experience using the camera of smart-phone or PC.
4. VR closes the world, and transposes an individual, providing complete immersion experience.

Which of the statements given above is/are correct? **2019**

(a) 1 and 2 only
(b) 3 and 4
(c) 1, 2 and 3
(d) 4 only

17. The identity platform 'Aadhaar' provides open "Application Programming Interfaces (APIs)". What does it imply ?

1. It can be integrated into any electronic device.
2. Online authentication using iris is possible.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

2018

With reference to "Software as a Service (SaaS)", consider the following statements :

1. SaaS buyers can customise the user interface and can change data fields.
2. SaaS users can access their data through their mobile devices.
3. Outlook, Hotmail and Yahoo! Mail are forms of SaaS.

Which of the statements given above are correct ?

(a) 1 and 2 only

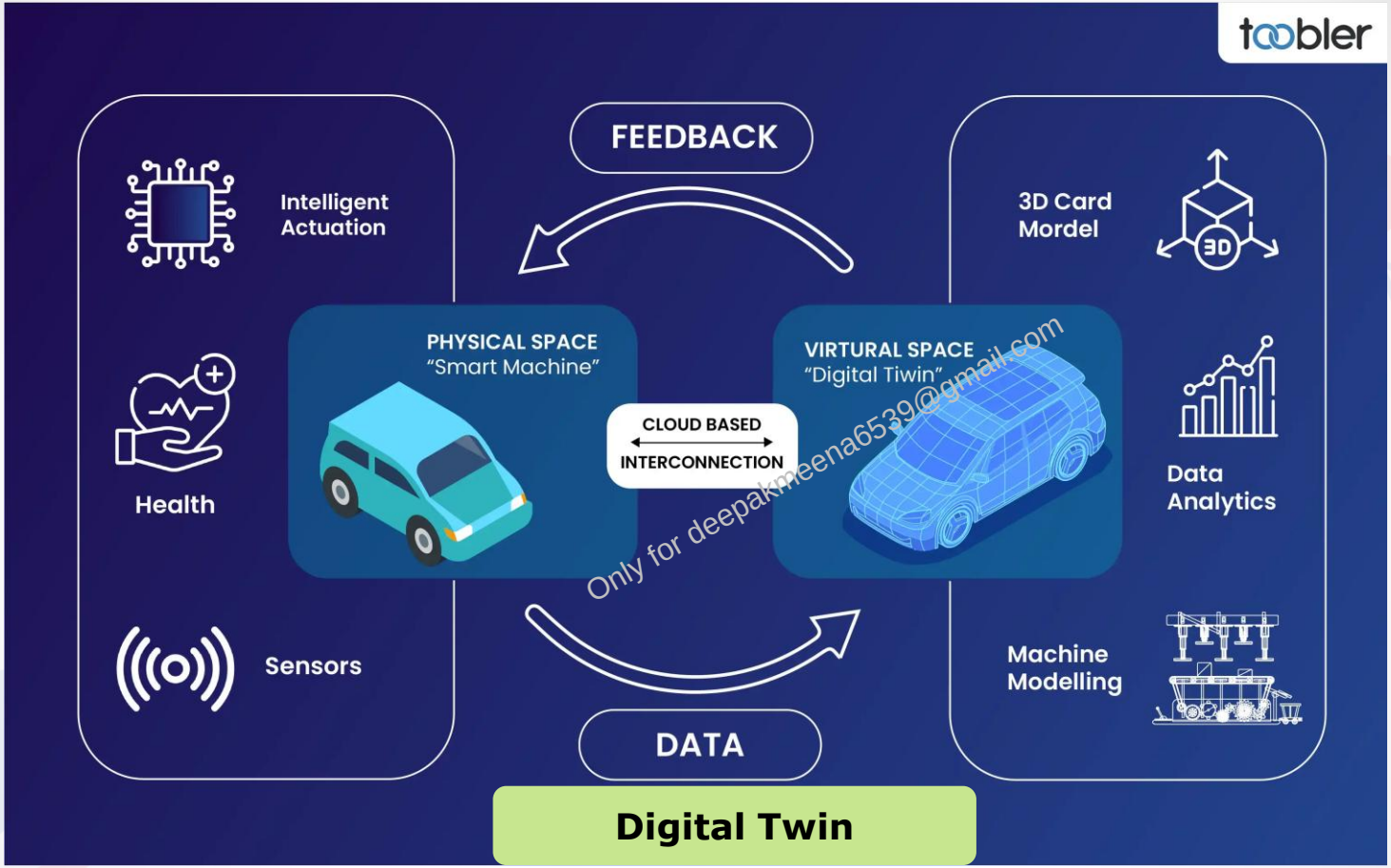
(b) 2 and 3 only

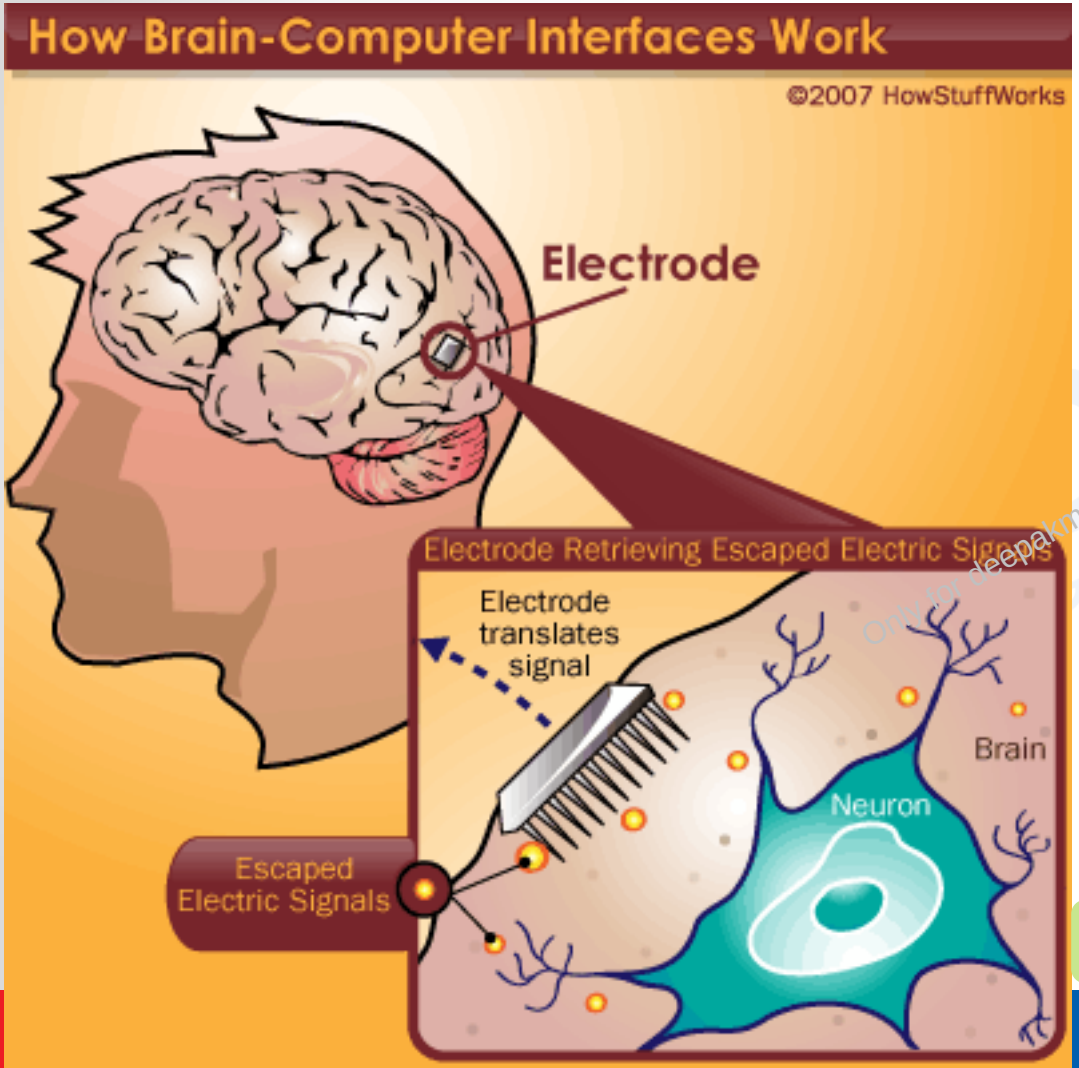
(c) 1 and 3 only

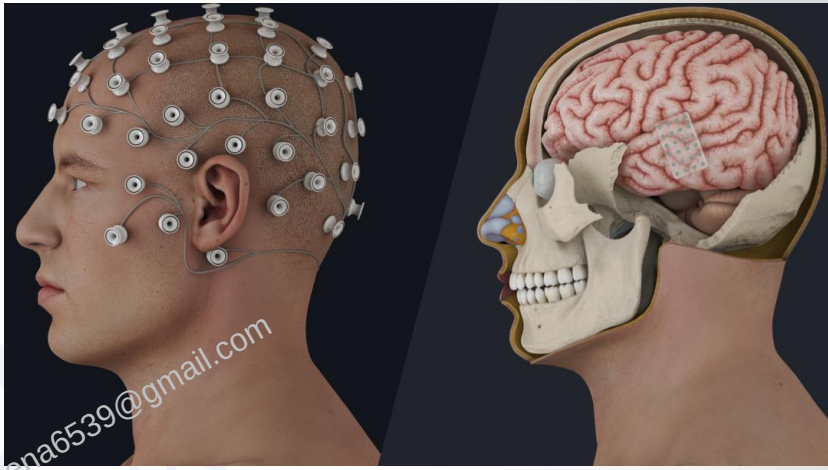
(d) 1, 2 and 3

2022

Airawat AI – fastest supercomputer of India



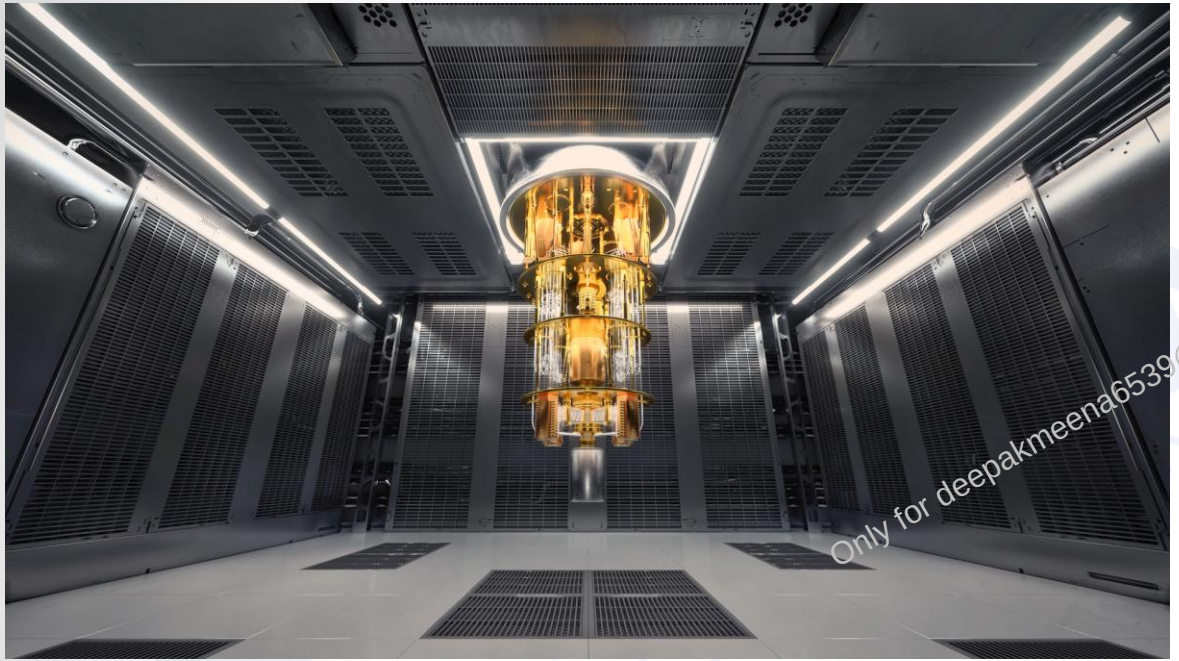


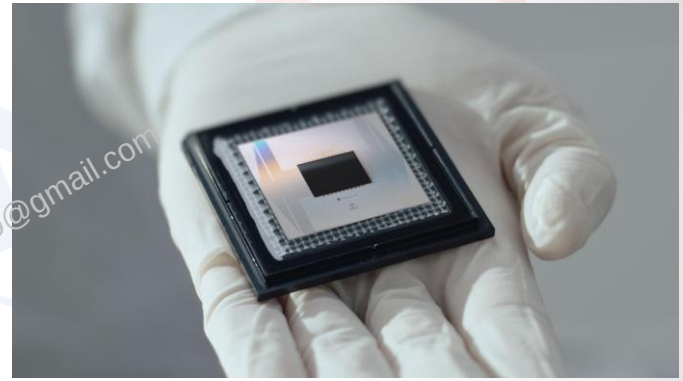


https://www.youtube.com/watch?v=v6K1hZqFBS4

https://www.youtube.com/watch?v=5SrpYZum4Nk

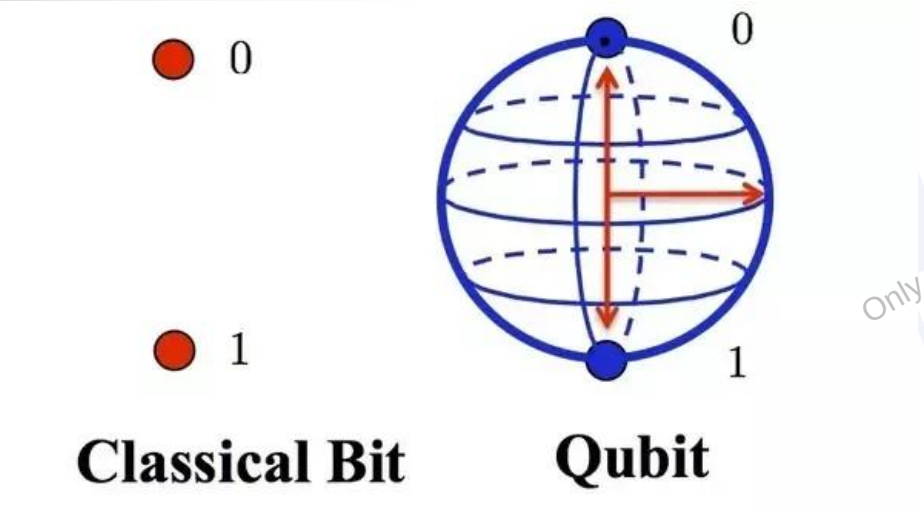
Brain Computer Interface

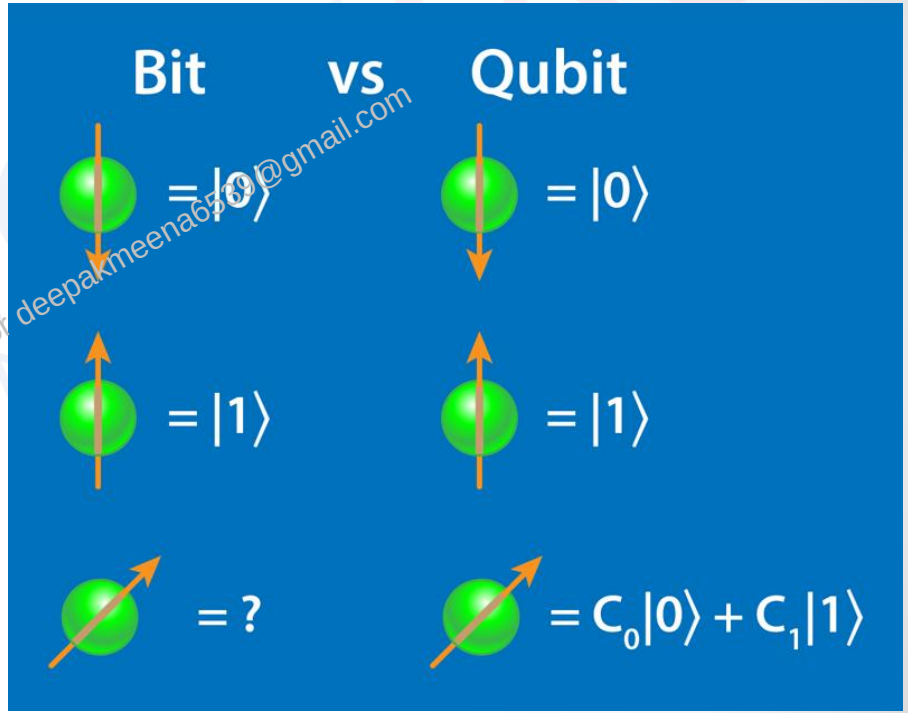


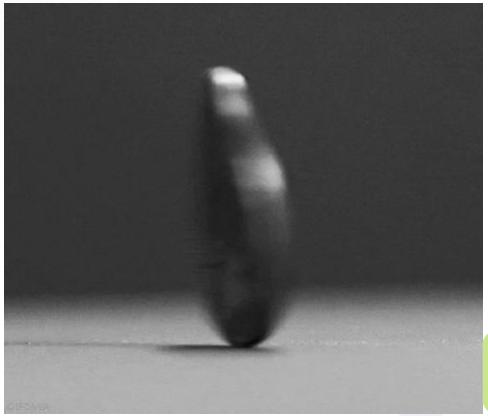


Quantum Computer

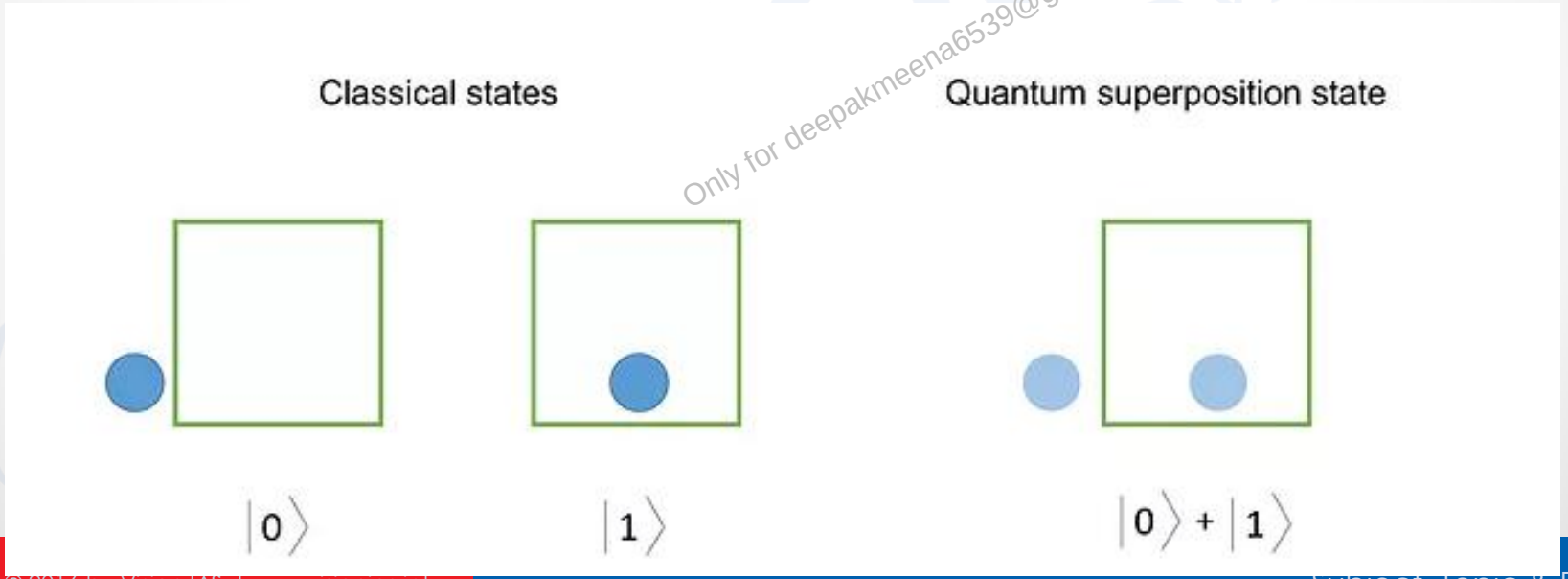
Bit vs Qubit

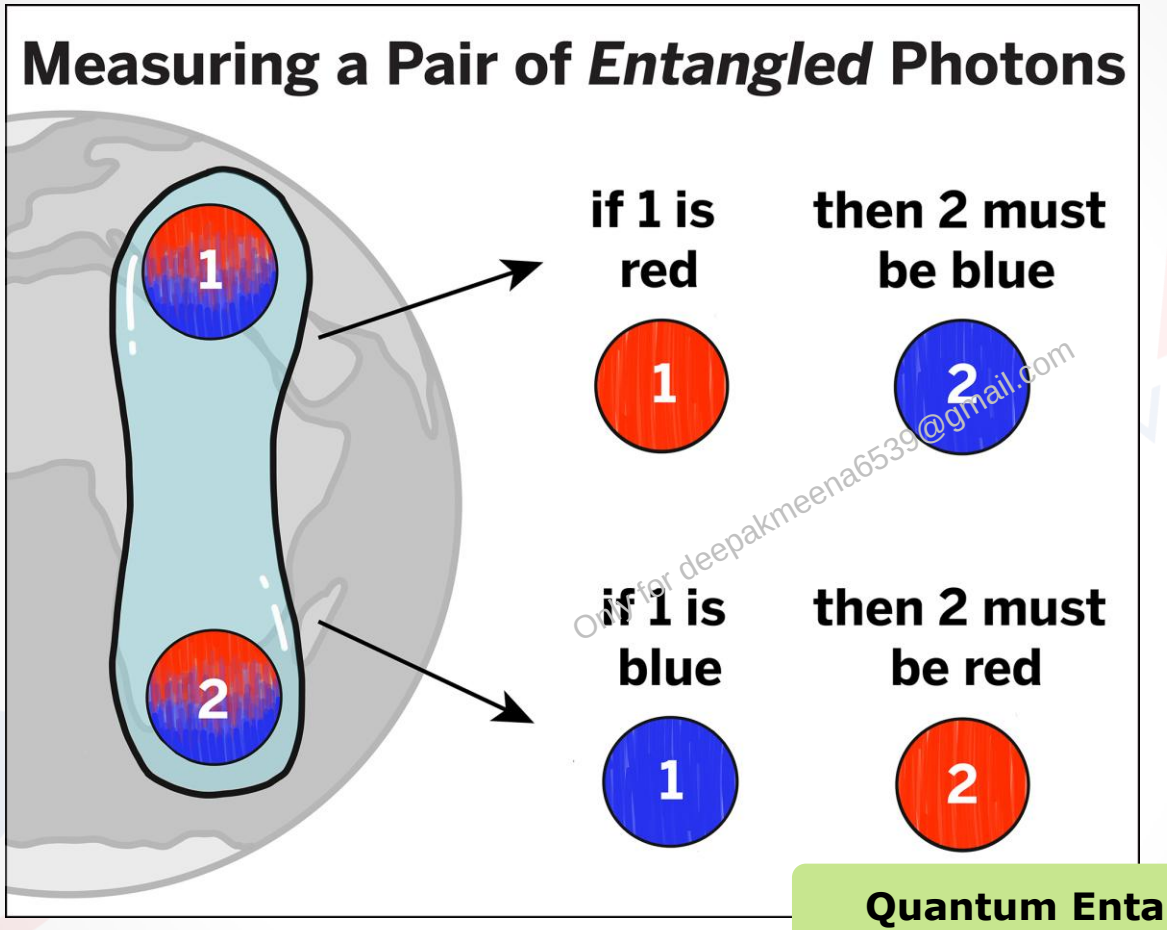




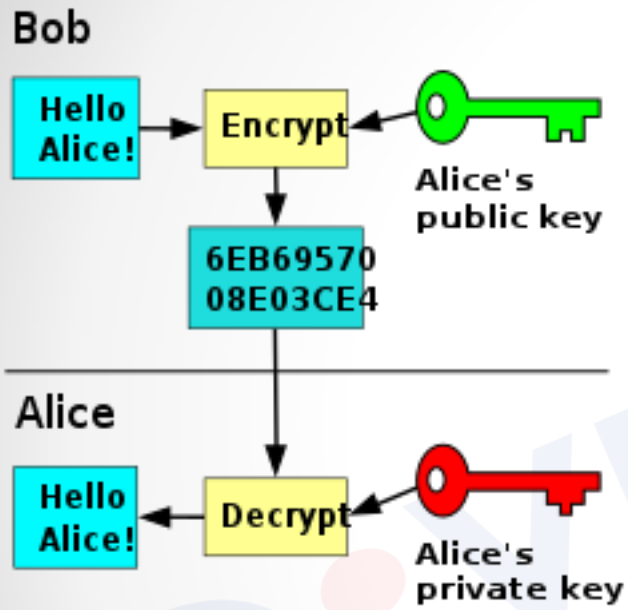


Quantum Superposition

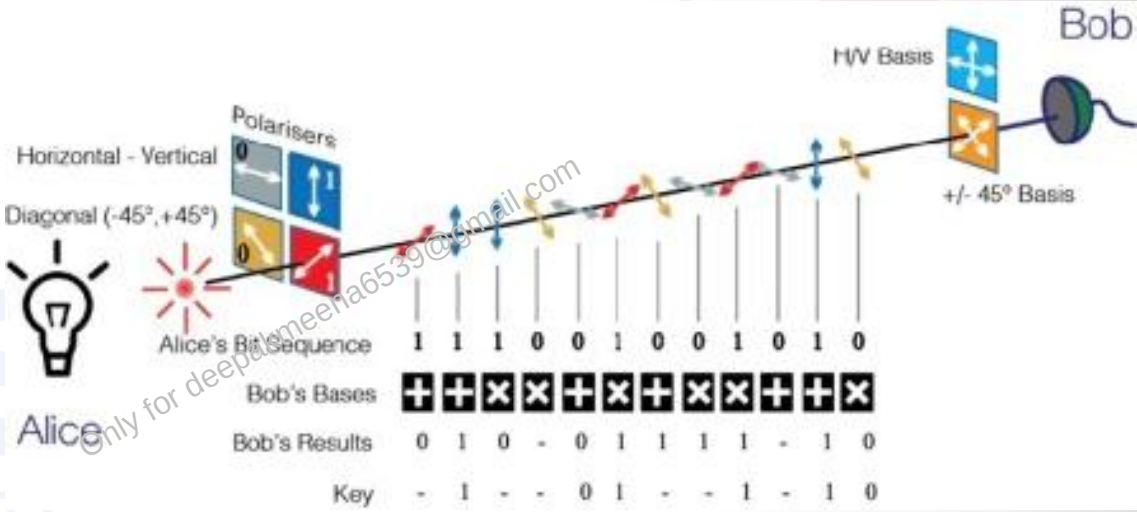




Quantum Entanglement



Public Key Distribution



Quantum Key Distribution

Which one of the following is the context in which the term "qubit" is mentioned ?

(a) Cloud Services

(b) Quantum Computing

(c) Visible Light Communication Technologies

(d) Wireless Communication Technologies

2022

With the present state of development, Artificial Intelligence can effectively do which of the following ?

1. Bring down electricity consumption in industrial units
2. Create meaningful short stories and songs
3. Disease diagnosis
4. Text-to-Speech Conversion
5. Wireless transmission of electrical energy

Select the correct answer using the code given below :

(a) 1, 2, 3 and 5 only

(b) 1, 3 and 4 only

(c) 2, 4 and 5 only

(d) 1, 2, 3, 4 and 5

2020

Consider the following statements :

A digital signature is

1. an electronic record that identifies the certifying authority issuing it
2. used to serve as a proof of identity of an individual to access information or server on Internet
3. an electronic method of signing an electronic document and ensuring that the original content is unchanged

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

2019

In India, the term "Public Key Infrastructure" is used in the context of

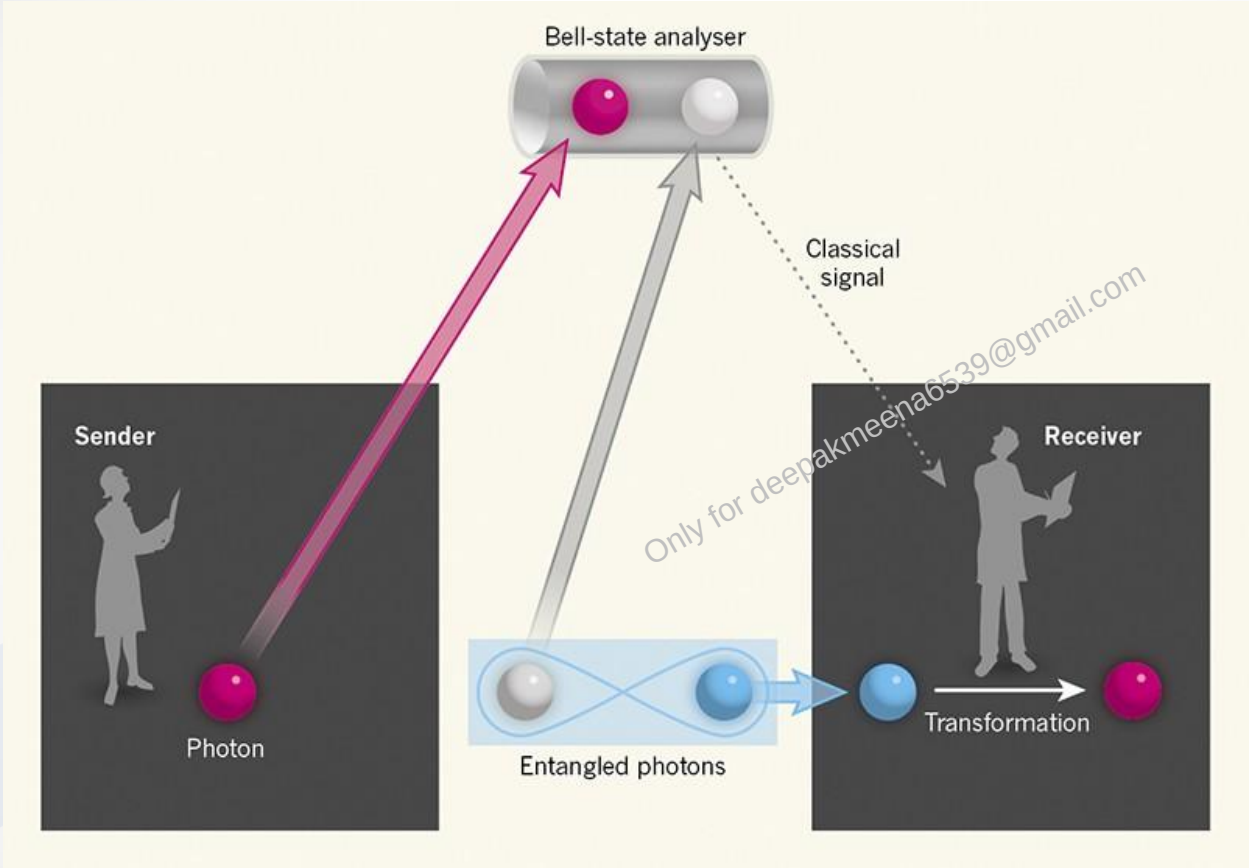
(a) Digital security infrastructure

(b) Food security infrastructure

(c) Health care and education infrastructure

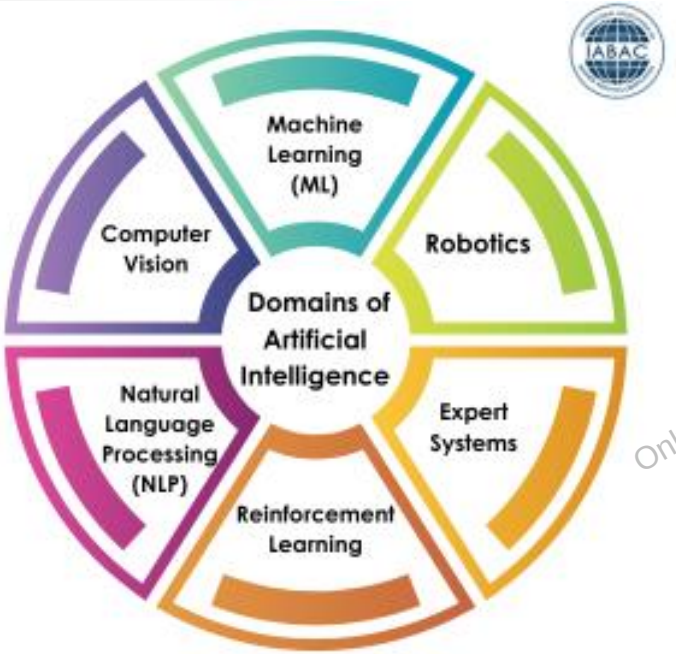
(d) Telecommunication and transportation infrastructure

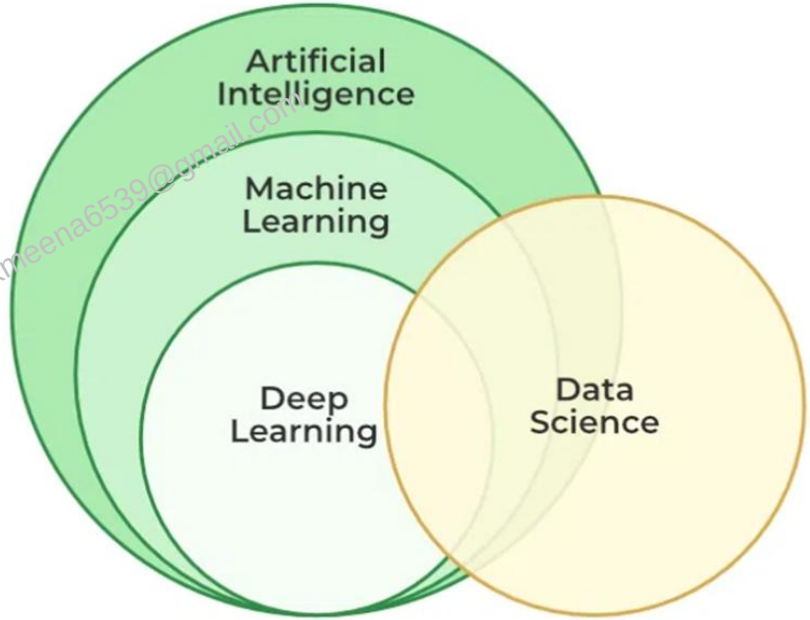
2020



Quantum Teleportation

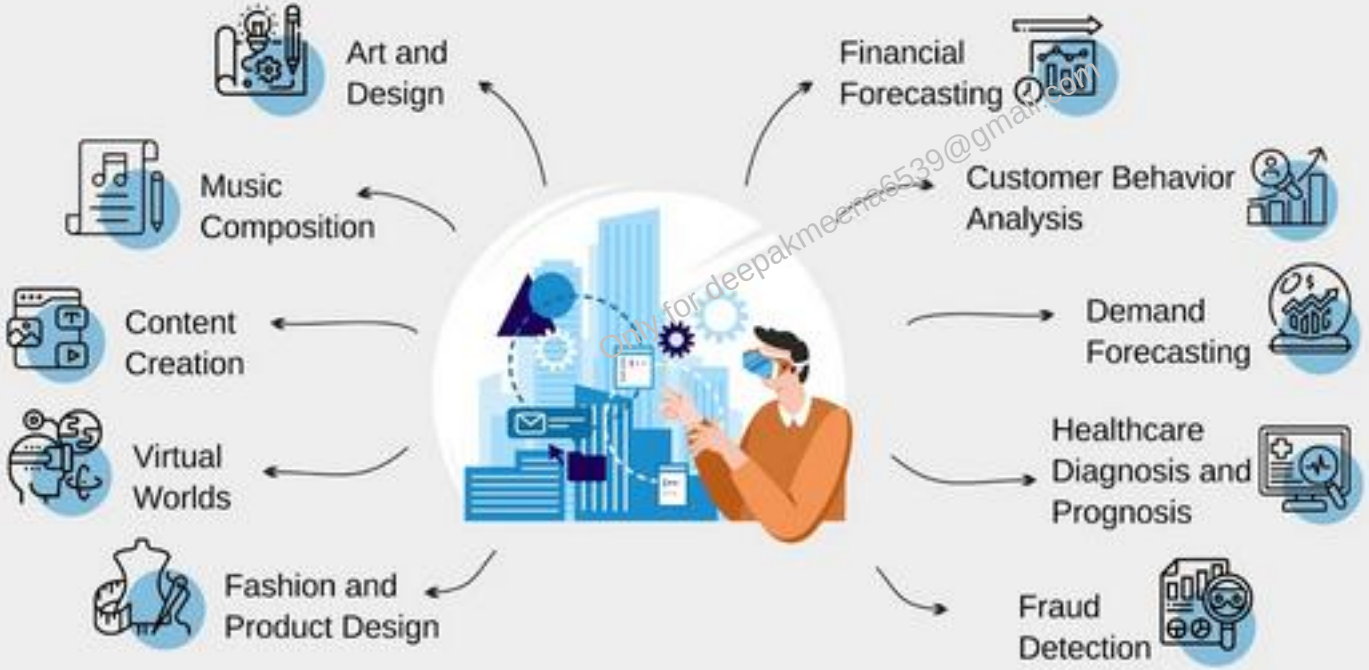
Artificial Intelligence





Generative AI Applications

Neebal Technologies
www.neebal.com

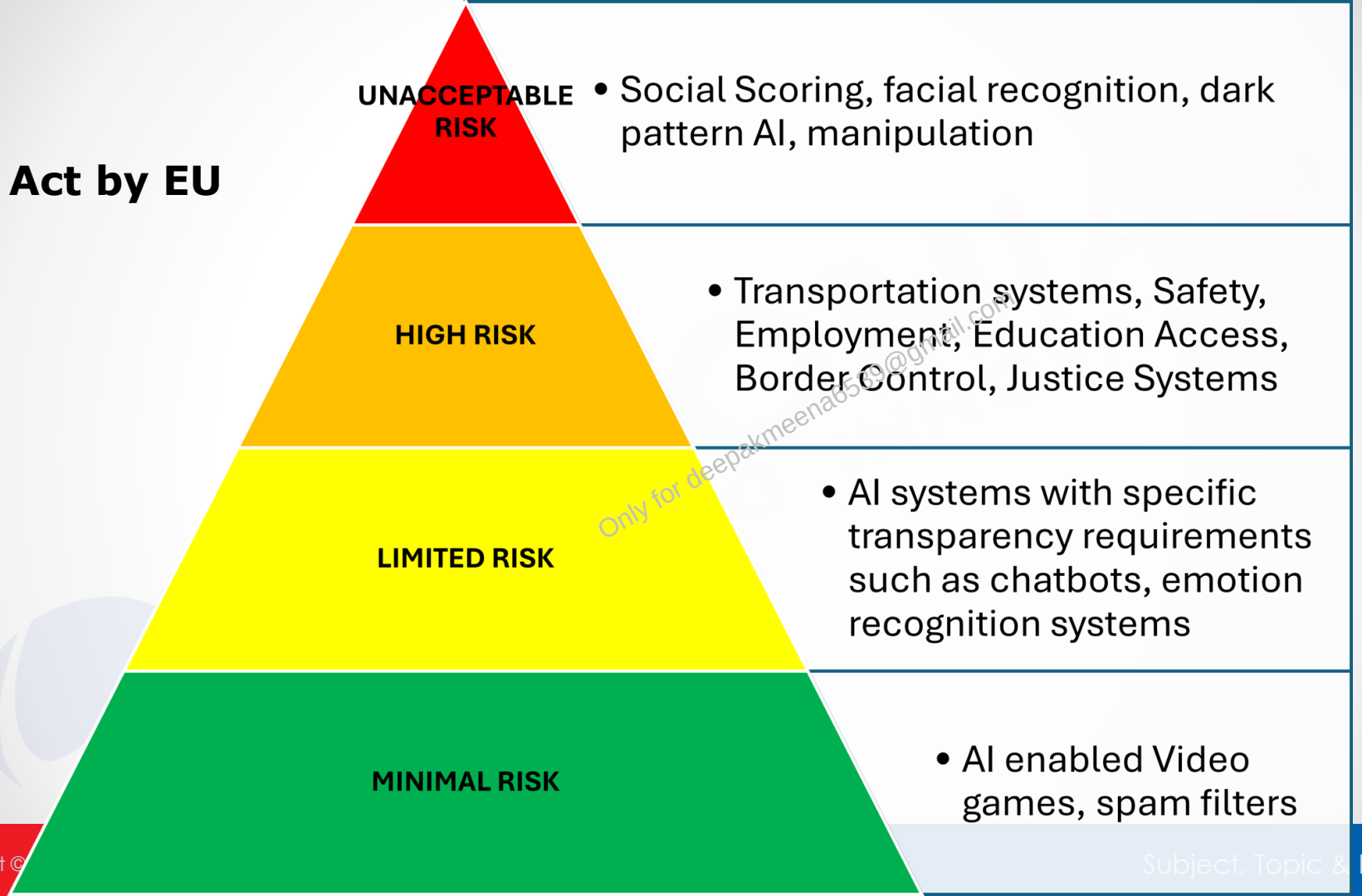


AI Regulation

https://indianexpress.com/article/explained/explained-sci-tech/delhi-declaration-gpai-regulation-ai-explained-9067865/

https://gpai.ai/about/

AI Act by EU



Nobel Prize in Physics 2024

John Hopfield
and
Geoffrey Hinton

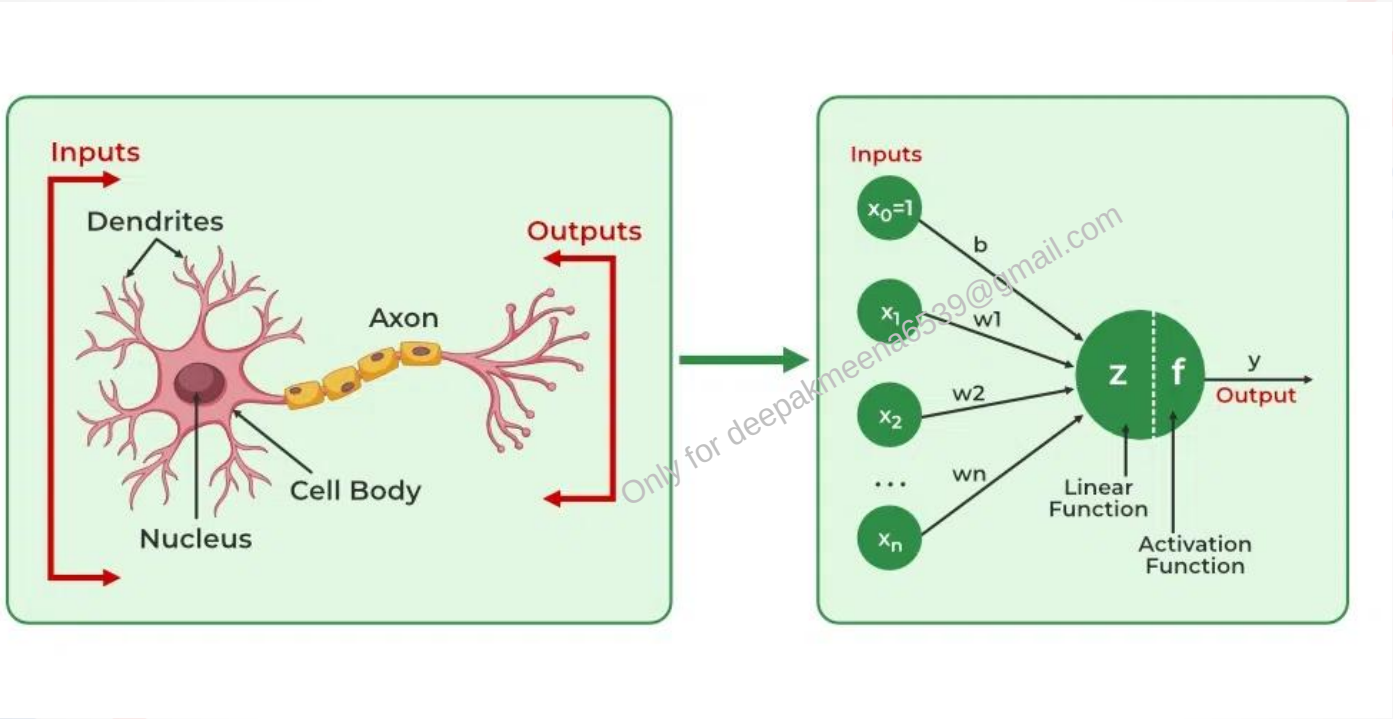
- laid the foundation for **machine learning with artificial neural networks**.

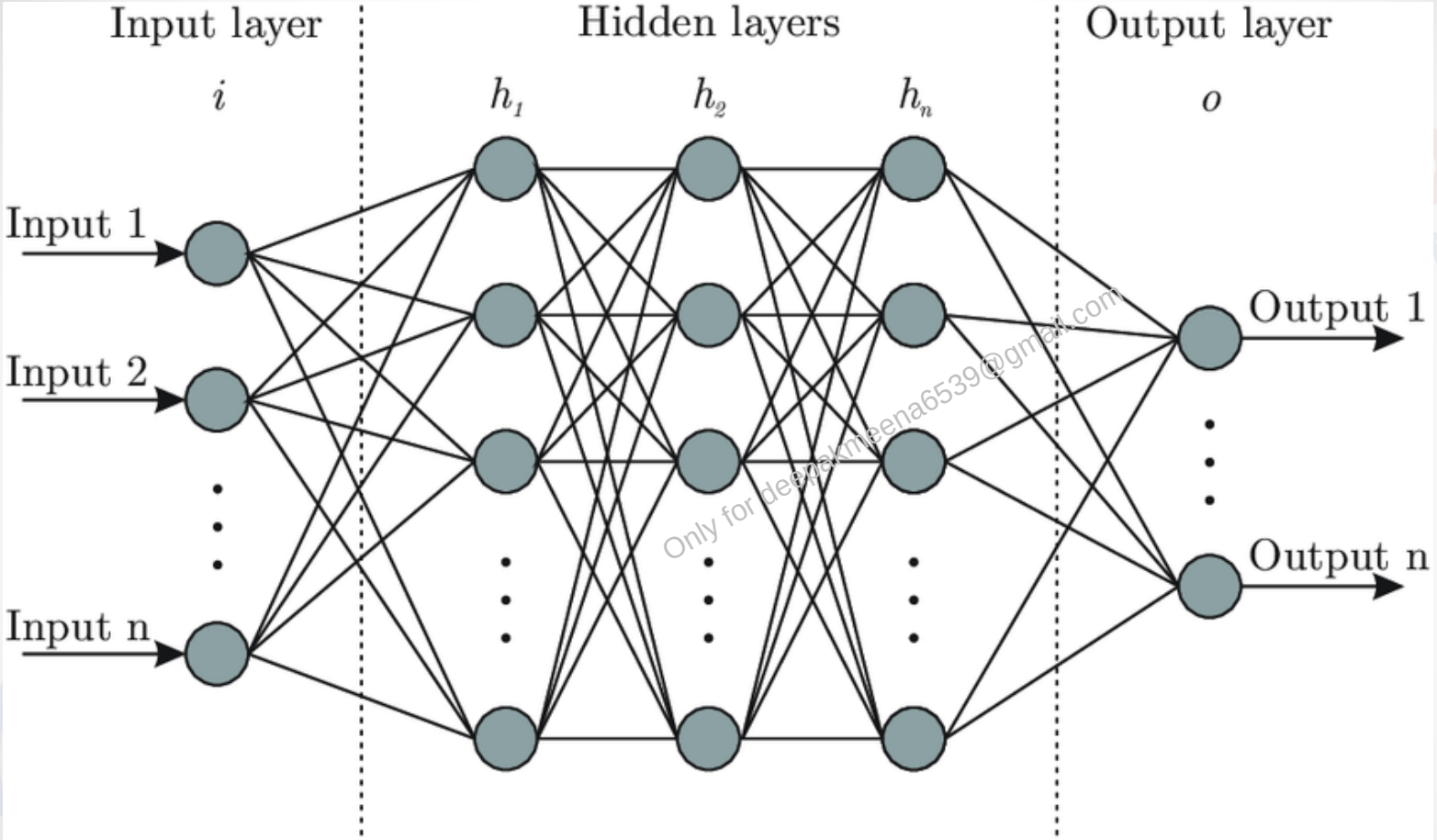
The Work

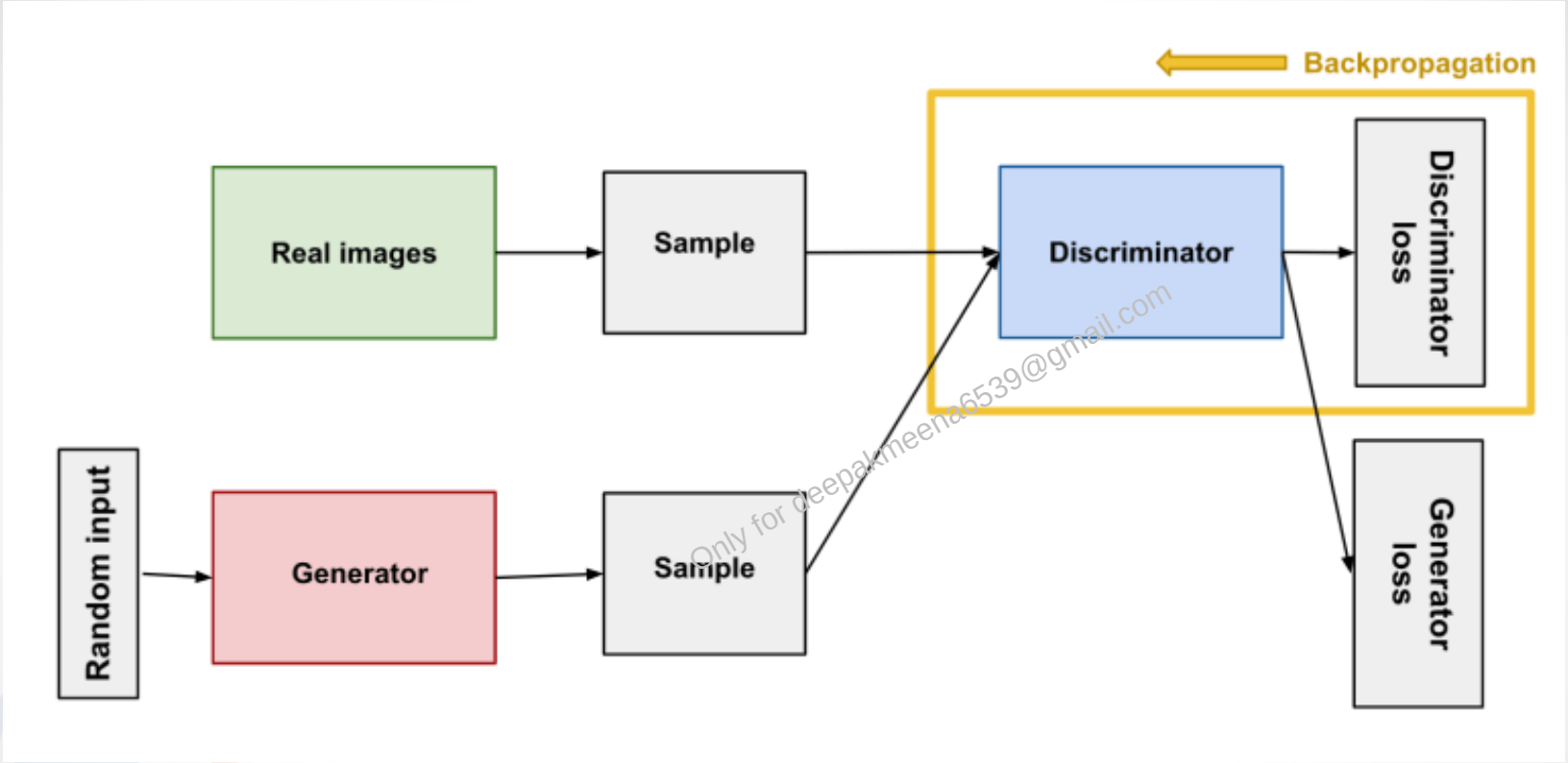
- **Hopfield network**: allows a computer to remember and fix incomplete or distorted data.
  - For example: like recognizing a face even if part of the picture is missing or blurry.
- **Geoffrey Hinton** took Hopfield's idea further by creating a network called the Boltzmann machine.
  - This system allows computers to learn on their own from examples,
  - For example: how a child learns to recognize patterns like cats and dogs by being shown pictures.

Artificial Neural Network

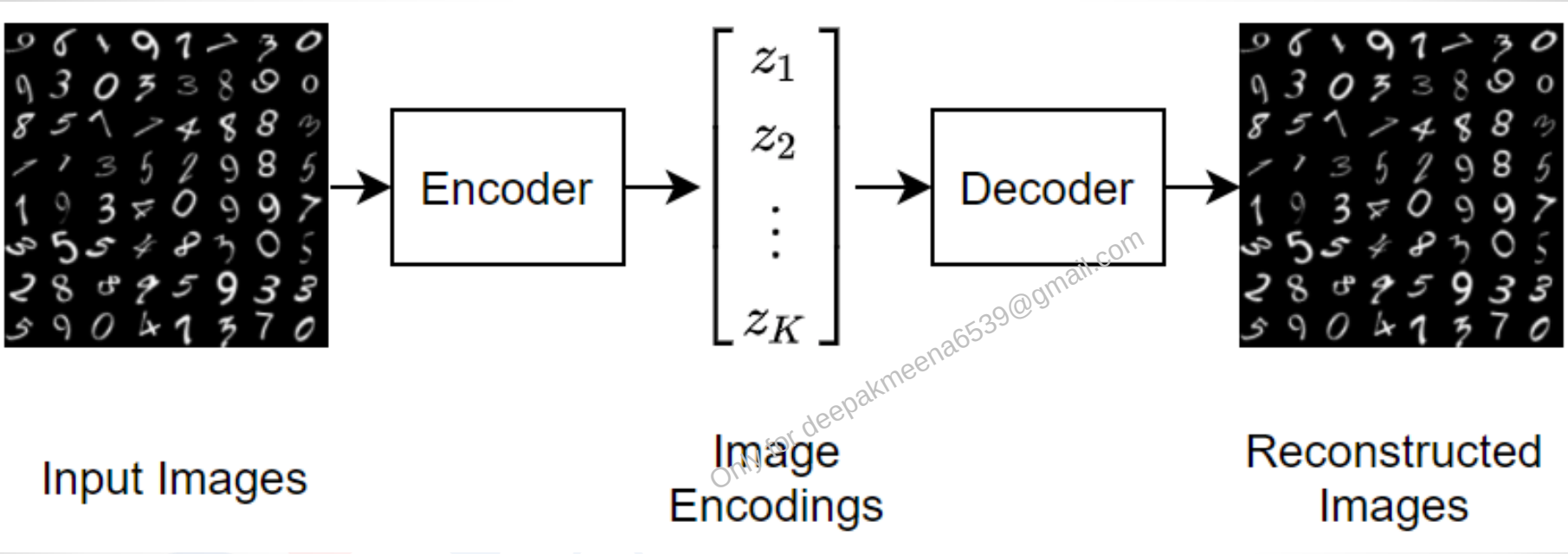
- An artificial neural network (ANN) is a computer system designed to simulate how the human brain processes information.
- It's made up of **layers of interconnected nodes**, similar to the way neurons in the brain are connected.
- These layers are usually organized in three parts:
  - **Input Layer**: This is the first layer, where data is fed into the network.
  - **Hidden Layers**: The nodes in these layers take in the input data, process it using weights (which are values that adjust based on the importance of the input), and pass the information forward to the next layer.
  - **Output Layer**: This layer provides the final result or prediction.
- **Applications**: Pattern Recognition, Decision Making, Learning from Data.
  - Used for predicting diseases, developing new drugs, optimizing supply chains, and even helping to design new materials with specific properties.





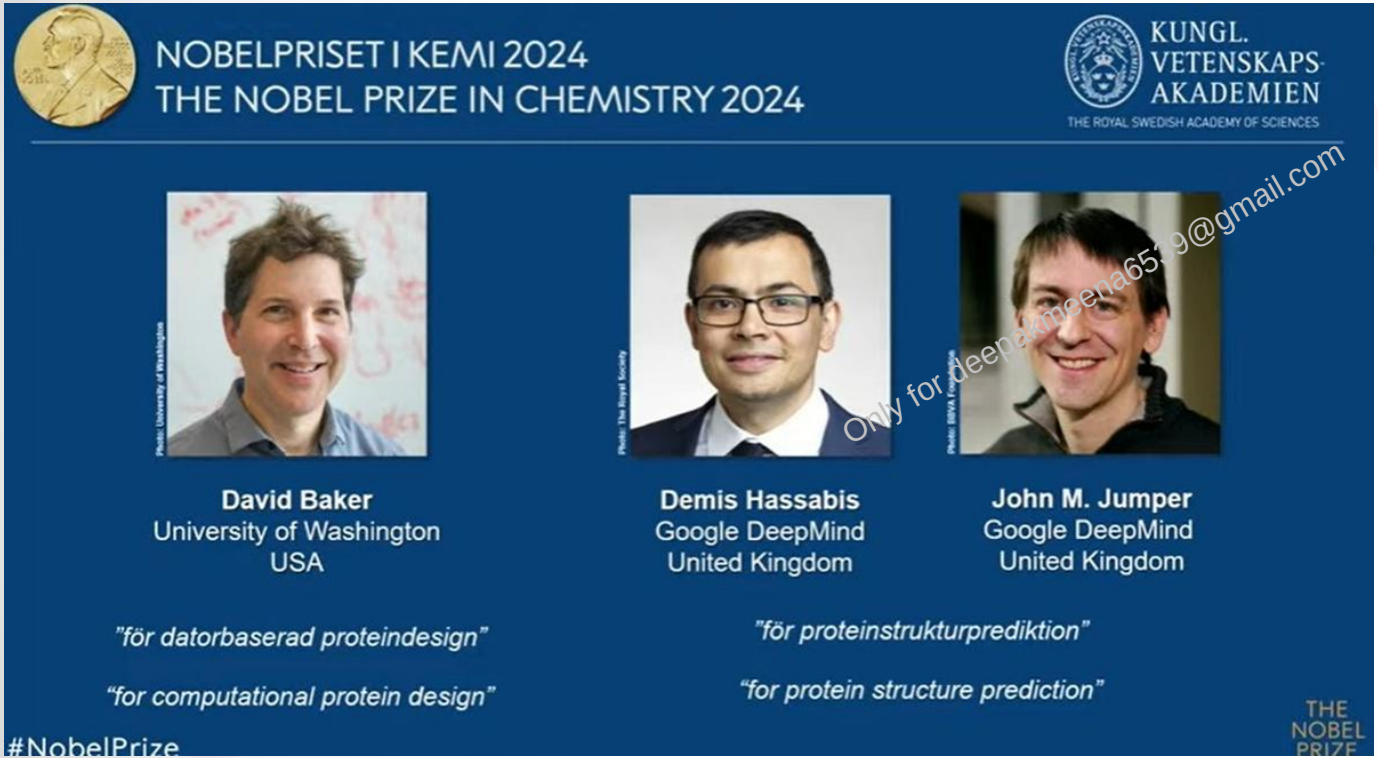


GAN



Variational Auto Encoders

Nobel Prize in Chemistry 2024

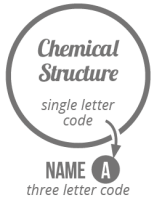


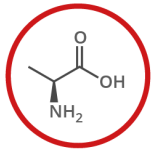
David Baker, received half for his work on **computational protein design**, and **Demis Hassabis** and **John Jumper** from Google DeepMind, who received the other half for their breakthrough in **protein structure prediction**.

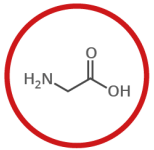
A GUIDE TO THE TWENTY COMMON AMINO ACIDS

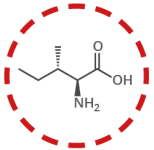
AMINO ACIDS ARE THE BUILDING BLOCKS OF PROTEINS IN LIVING ORGANISMS. THERE ARE OVER 500 AMINO ACIDS FOUND IN NATURE - HOWEVER, THE HUMAN GENETIC CODE ONLY DIRECTLY ENCODES 20. 'ESSENTIAL' AMINO ACIDS MUST BE OBTAINED FROM THE DIET, WHILST NON-ESSENTIAL AMINO ACIDS CAN BE SYNTHESISED IN THE BODY.

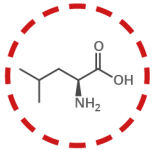
Chart Key: ALIPHATIC · AROMATIC · ACIDIC · BASIC · HYDROXYLIC · SULFUR-CONTAINING · AMIDIC · NON-ESSENTIAL · ESSENTIAL

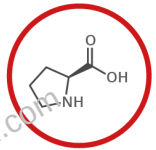



ALANINE A
ala


GLYCINE G
gly


ISOLEUCINE I
ile


LEUCINE L
leu


PROLINE P
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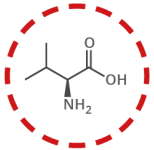
VALINE V
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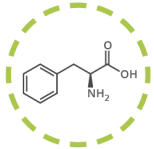
PHENYLALANINE F
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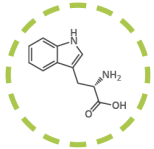
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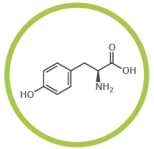
TYROSINE Y
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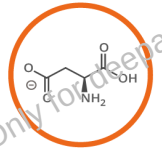
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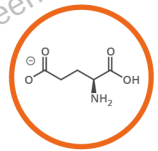
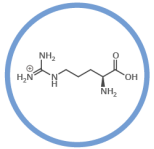

GLUTAMIC ACID E
glu


ARGININE R
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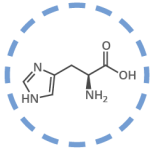
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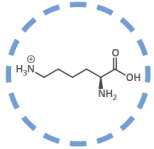
LYSINE K
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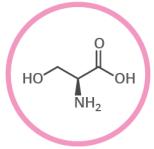
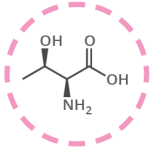
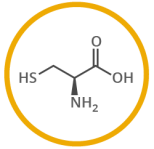

SERINE S
ser


THREONINE T
thr


CYSTEINE C
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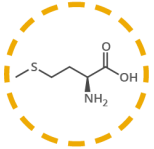
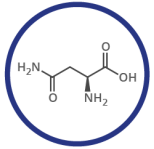
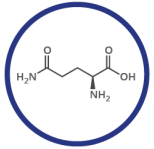
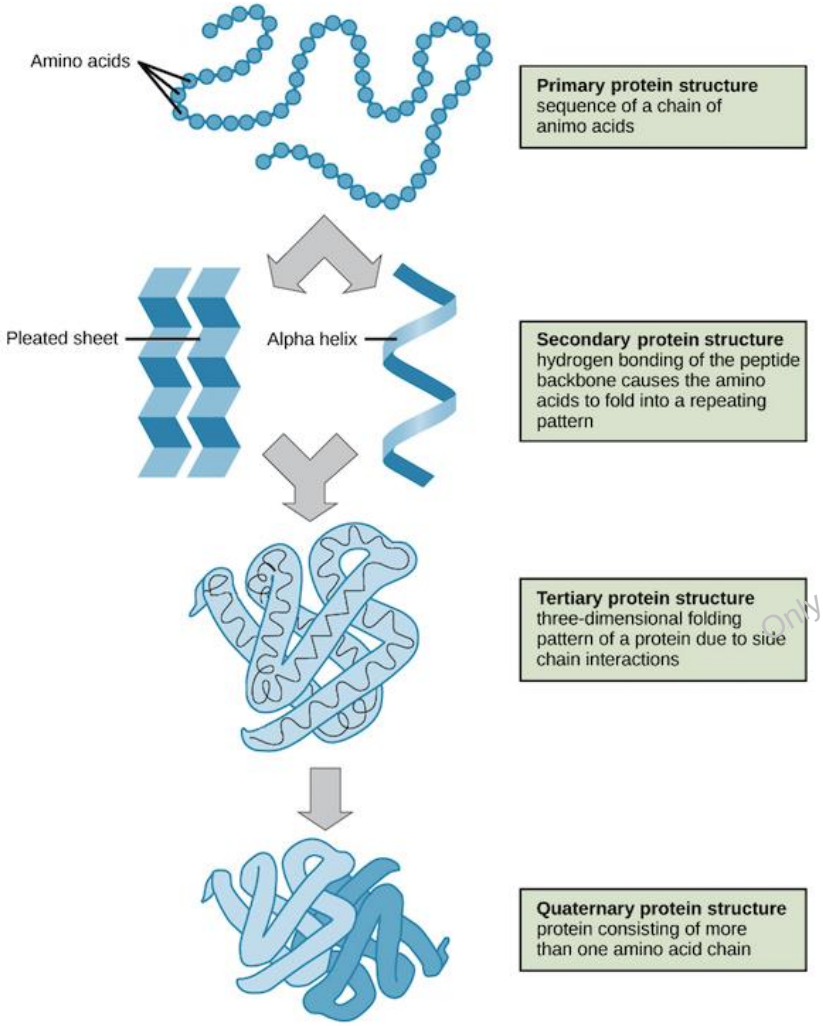

METHIONINE M
met


ASPARAGINE N
asn


GLUTAMINE Q
gln

Note: This chart only shows those amino acids for which the human genetic code directly codes for. Selenocysteine is often referred to as the 21st amino acid, but is encoded in a special manner. In some cases, distinguishing between asparagine/aspartic acid and glutamine/glutamic acid is difficult. In these cases, the codes asx (B) and glx (Z) are respectively used.



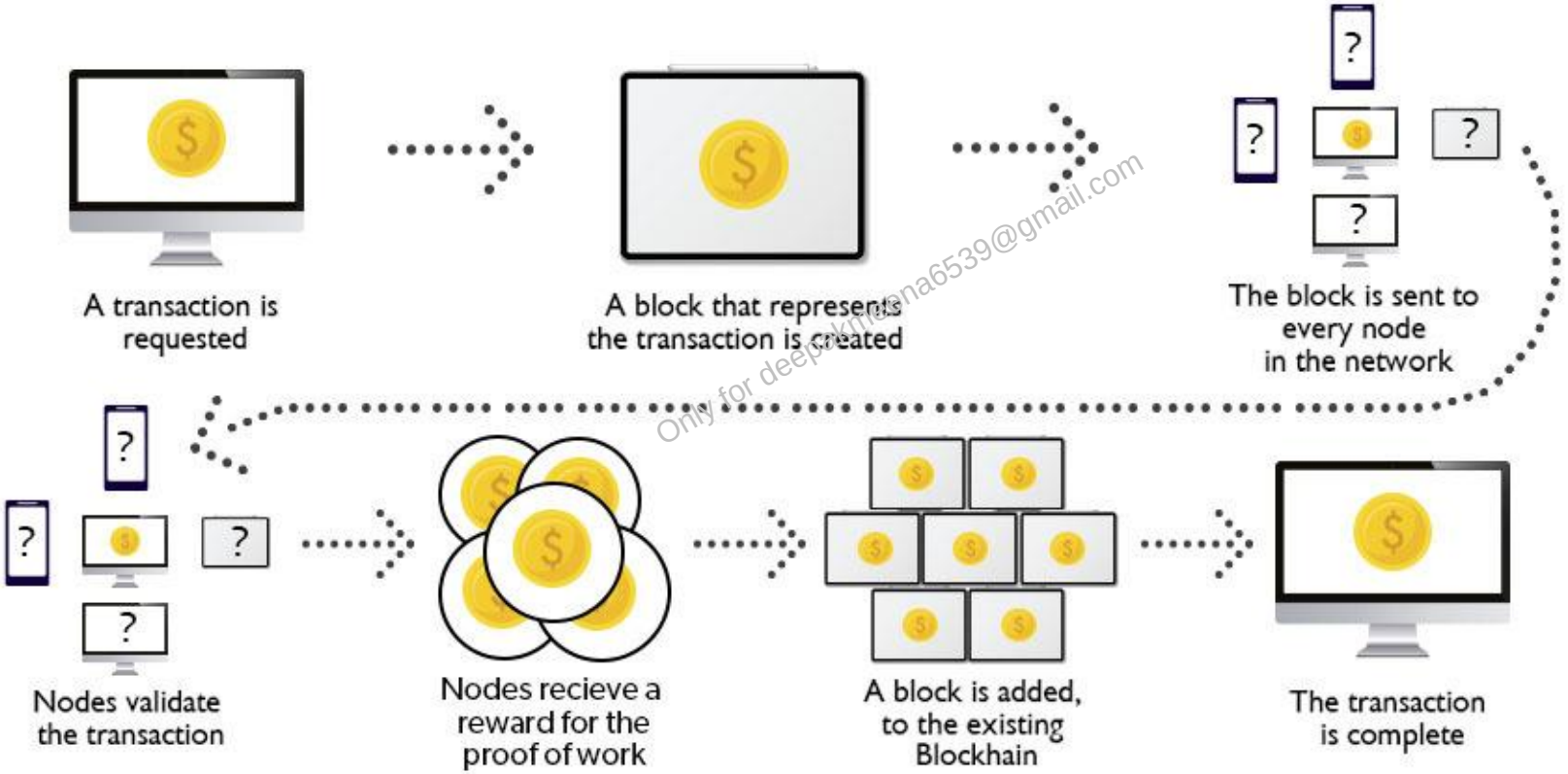
As researchers can now both predict and design proteins with specific, targeted functions there is tremendous potential for

- drug development,
- biotechnology,
- solving major environmental problems among other

The work

- **David Baker:** ability to **design completely new proteins** that do not exist in nature.
  - Using his computer program **Rosetta**,
  - Baker and his team have designed proteins for a range of applications
  - https://boinc.bakerlab.org/rosetta/
- **Hassabis and Jumper:** predicting the 3D structure of proteins from their amino acid sequences.
  - Use of AI model, Alphafold
  - Alphafold3, can now predict protein structures with incredible accuracy, revolutionizing biological research.
  - https://alphafoldserver.com/about

How Blockchain Works?



The Properties of Distributed Ledger Technology (DLT)

Programmable
A blockchain is programmable (i.e. Smart Contracts)

Distributed
All network participants have a copy of the ledger for complete transparency

Secure
All records are individually encrypted

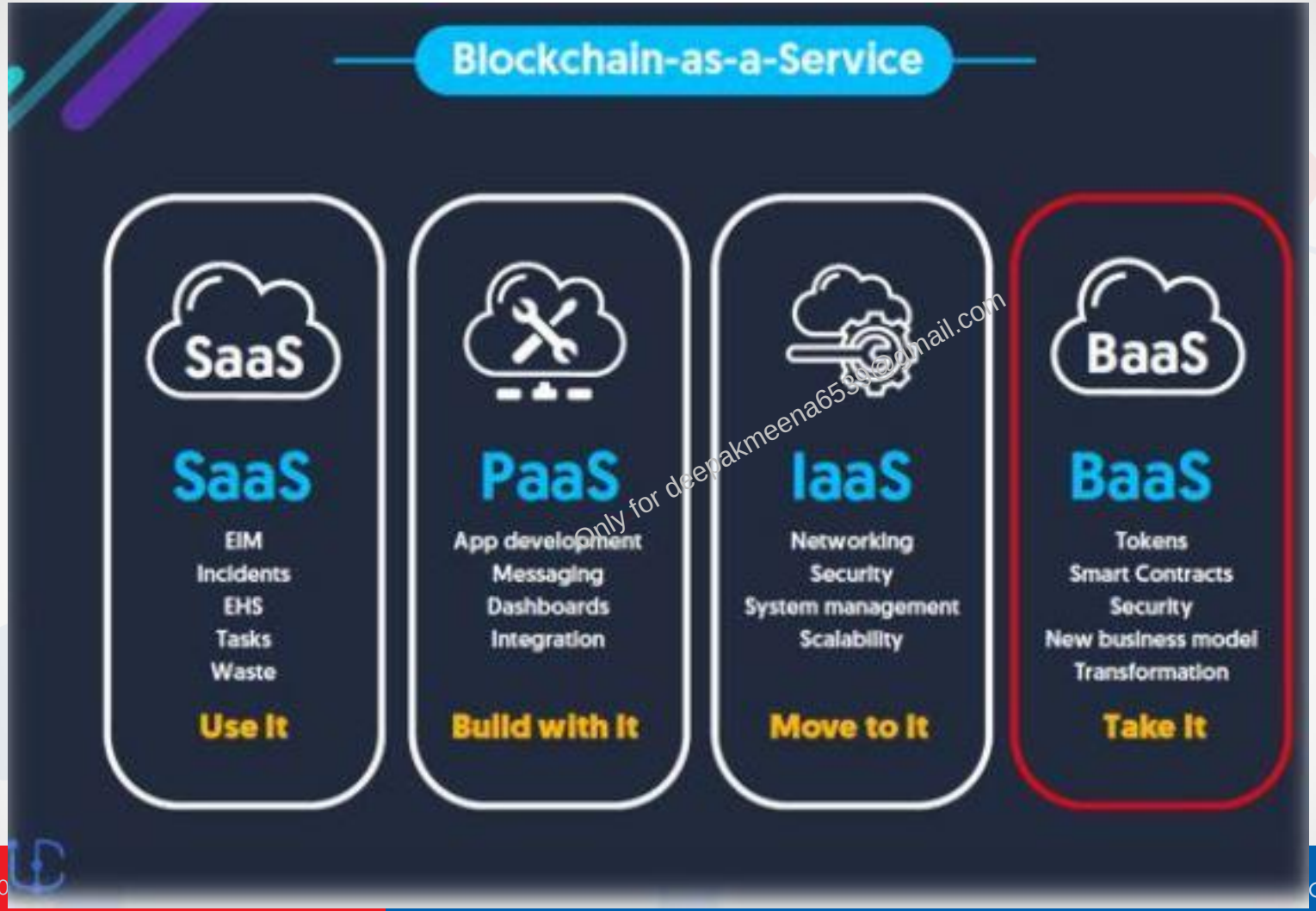
Immutable
Any validated records are irreversible and cannot be changed

Anonymous
The identity of participants is either anonymous or pseudonymous

Unanimous
All network participants agree to the validity of each of the records

Time-stamped
A transaction timestamp is recorded on a block

https://www.youtube.com/watch?v=_160oMzblY8



Bitcoin's Price after Halvings

Proof of Work VS Proof of Stake

Mining capacity depends on computational power

Validating capacity depends on the stake in the network

Miners receive block rewards to solve a cryptographic puzzle

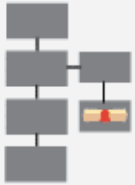
Validators do not receive a block reward, instead, they collect transaction fees as reward

Hackers would need to have a computer powerful than 51% of the network to add a malicious block, leading to 51% attack

Hacker would need to own 51% of all the cryptocurrency on the network, which is practically impossible and therefore, making 51% attacks impossible.

Smart Contracts

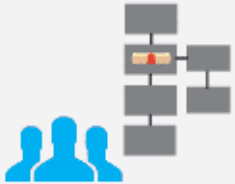
Option contract written as code into a blockchain.



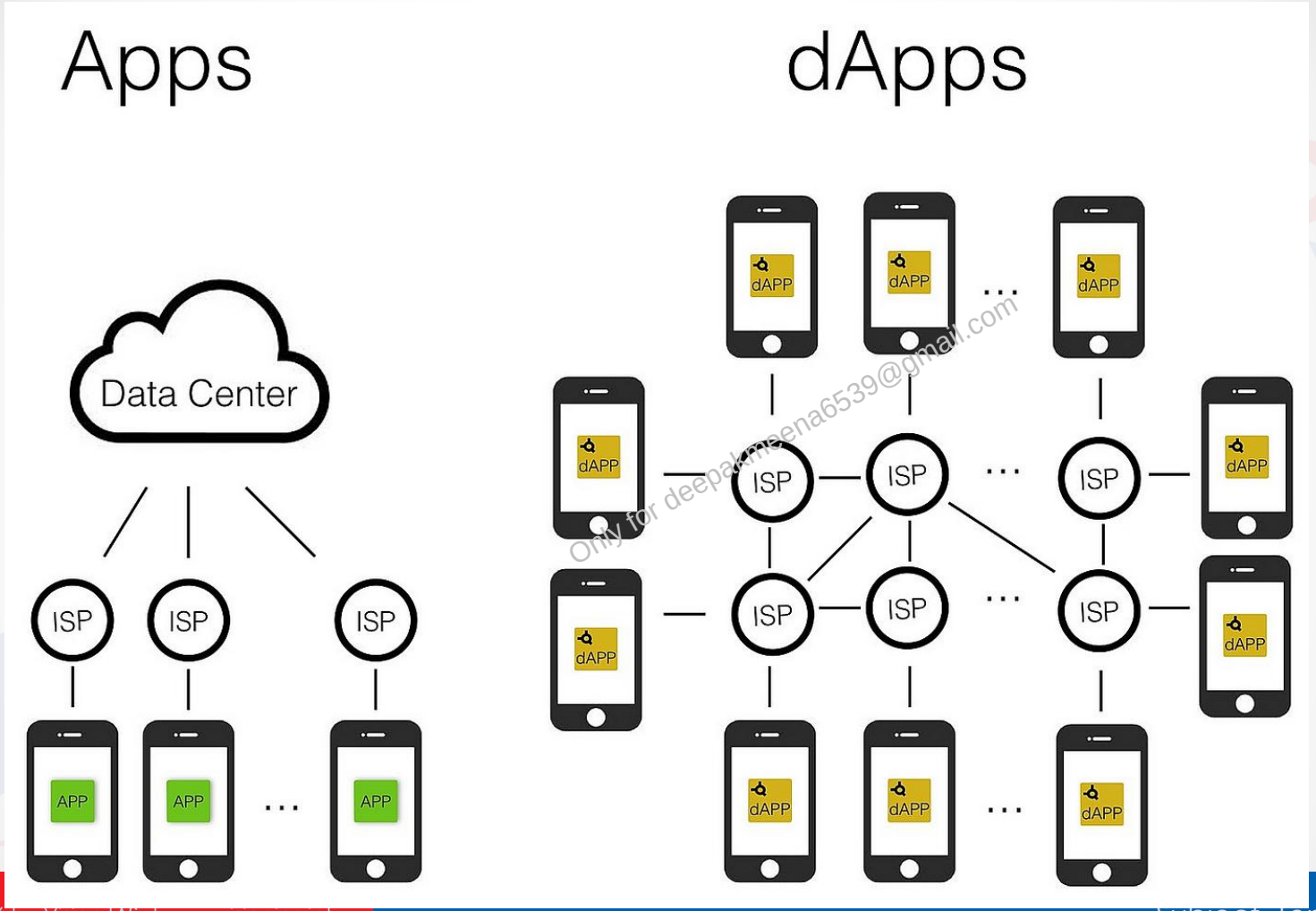
Contract is part of the public blockchain.

Parties involved in the contract are anonymous.

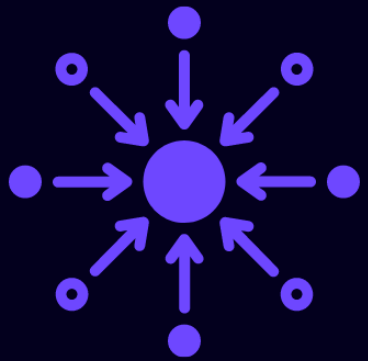
Contract executes itself when the conditions are met.



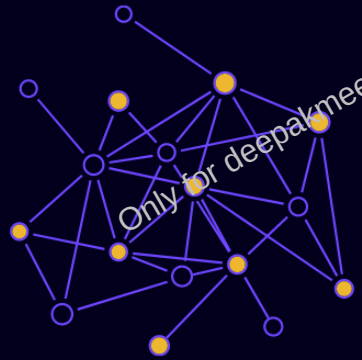
Regulators use blockchain to keep an eye on contracts.



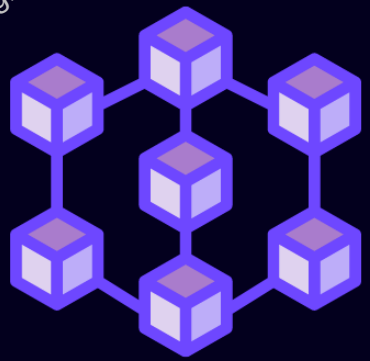
Web 1.0



Web 2.0



Web 3.0



With reference to "Blockchain Technology", consider the following statements :

1. It is a public ledger that everyone can inspect, but which no single user controls.
2. The structure and design of blockchain is such that all the data in it are about cryptocurrency only.
3. Applications that depend on basic features of blockchain can be developed without anybody's permission.

Which of the statements given above is/are correct ?

(a) 1 only
(b) 1 and 2 only
(c) 2 only
(d) 1 and 3 only

2020

With reference to Web 3·0, consider the following statements :

1. Web 3·0 technology enables people to control their own data.
2. In Web 3·0 world, there can be blockchain based social networks.
3. Web 3·0 is operated by users collectively rather than a corporation.

Which of the statements given above are correct ?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

2022

66. With reference to 'Bitcoins', sometimes seen in the news, which of the following statements is/are correct?

1. Bitcoins are tracked by the Central Banks of the countries.
2. Anyone with a Bitcoin address can send and receive Bitcoins from anyone else with a Bitcoin address.
3. Online payments can be sent without either side knowing the identity of the other.

Select the correct answer using the code given below.

(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

2016

With reference to Non-Fungible Tokens (NFTs), consider the following statements :

1. They enable the digital representation of physical assets.
2. They are unique cryptographic tokens that exist on a blockchain.
3. They can be traded or exchanged at equivalency and therefore can be used as a medium of commercial transactions.

Which of the statements given above are correct ?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

2022

Which of the following adopted a law on data protection and privacy for its citizens known as 'General Data Protection Regulation' in April 2016 and started implementation of it from 25th May, 2018?

(a) Australia

(b) Canada

(c) The European Union

(d) The United States of America

2019

54. Consider the following actions :

1. Detection of car crash/collision which results in the deployment of airbags almost instantaneously

2. Detection of accidental free fall of a laptop towards the ground which results in the immediate turning off of the hard drive

3. Detection of the tilt of the smartphone which results in the rotation of display between portrait and landscape mode

In how many of the above actions is the function of accelerometer required?

(a) Only one

(b) Only two

(c) All three

(d) None

2023

Consider the following activities :

1. Spraying pesticides on a crop field
2. Inspecting the craters of active volcanoes
3. Collecting breath samples from spouting whales for DNA analysis

At the present level of technology, which of the above activities can be successfully carried out by using drones ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

2016

In the context of wearable technology, which of the following tasks is/are accomplished by wearable devices?

1. **Location identification of a person**
2. **Sleep monitoring of a person**
3. **Assisting the hearing impaired person**

Select the correct answer using the code given below.

(a) **1 only**

(b) **2 and 3 only**

(c) **3 only**

(d) **1, 2 and 3**

2019

Consider the following :

1. Aarogya Setu
2. CoWIN
3. DigiLocker
4. DIKSHA

Which of the above are built on top of open-source digital platforms ?

(a) 1 and 2 only

(b) 2, 3 and 4 only

(c) 1, 3 and 4 only

(d) 1, 2, 3 and 4

2022

35. 'Project Loon', sometimes seen in the news, is related to

(a) waste management technology

(b) wireless communication technology

(c) solar power production technology

(d) water conservation technology

2016