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Curriculum
Interview Preparation - Algorithms
Average: **95.83%**

The OSI Model

Welcome to the networking track ! \o/

Introduction

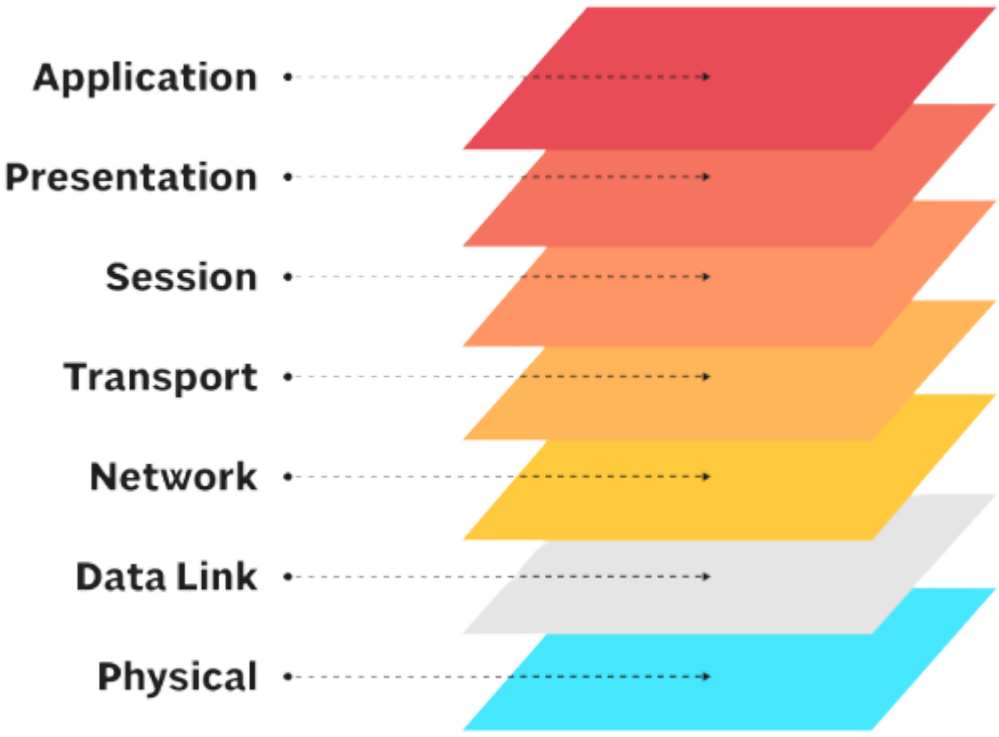
Before we start learning about networking fundamentals, it is mandatory to understand `the OSI model`.
This model serves as a foundational framework that categorizes and defines the various layers involved in network communication.

It is strongly advised to search the internet for help if you have any question.

What is the OSI model?

The OSI model (**The Open Systems Interconnection model**) is a conceptual framework that establishes a standard set of communication functions for telecommunication and computing systems.
It focuses on enabling interoperability between different communication systems through the use of standardized protocols.

The initial version of the OSI model defined a total of `seven layers`**.**



Let's have some fun exploringthe OSI model.
We'll start with the first layer, the physical layer. Let the adventure begin!!

• Layer 1: `Physical Layer`

Simply put, **layer one** refers to the physical and electrical characteristics of the communication system where it ensure the transmission of bits (0's and 1's) across devices.
Additionally, **the physical layer** handles tasks such as synchronizing bits, optimizing bandwidth usage, and implementing multiplexing strategies

Examples at Layer 1

- Radio Frequencies (Wireless data transmission)
    - Bleutooth (Connects devices over short distances).
    - Wifi (802.11 standards)
    - Zigbee (Low-power radio frequency technology suitable for IoT.)
- Cables
    - Fiber optic cables (Offer much higher speeds for LANs and wide area networks (WANs))
    - Ethernet Cables (LANs)

• Layer 2: `Data Link Layer`

The Data Link Layer, also known as Layer 2 in the OSI model, encompasses several important concepts. Some of these is packaging data into frames, performing error detection and correction, assigning unique MAC addresses to devices, and managing flow control. It closely interacts with the **`Physical Layer`** for addressing and network topology.
The Data Link Layer utilizes **LLC** for connection services and synchronizes transmissions.

Examples at Layer 2:

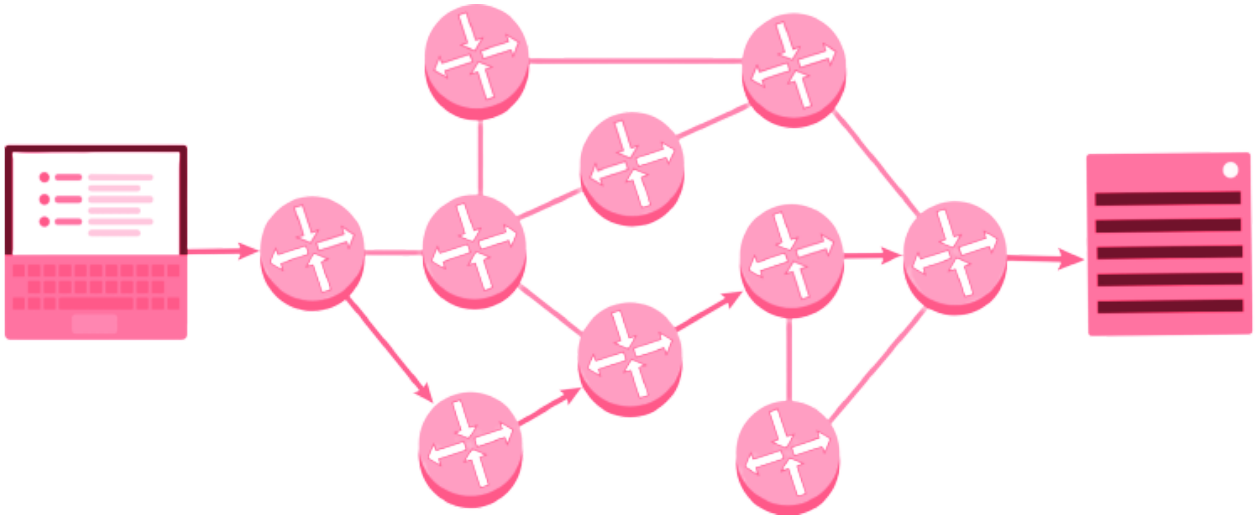
- Network Interface Cards (NICs):
    - NICs are hardware components that enable devices to connect to a network.
      They contain the necessary circuitry and firmware to interface with the network medium, such as Ethernet or Wi-Fi.
- Bridges:
    - Bridges are network devices that operate at Layer 2 and are used to connect multiple network segments together. They forward data between segments based on MAC addresses, creating a `single logical network`.
- Switches:
    - Switches are advanced versions of bridges that provide more ports and functionality. They use MAC addresses to forward data packets to their intended destinations within a local network. Switches improve network efficiency by creating dedicated communication paths between devices, reducing collisions and congestion.

• Layer 3: `Network Layer`

The third layer of the OSI model **Network Layer** is where the magic of routing & re-assembly of data takes place (from these small chunks to the larger chunk).

Firstly, routing simply determines the most optimal path in which these chunks of data should be sent. The factors that decide what route is taken is decided by the following:

- The Shortest Path.
- The most Reliable Path.
- The faster physical connection.



During this stage, we deal with logical addressing. `(IP Addresses)`.
These logical addresses bring organization to networks, allowing for proper categorization and sorting.
The most commonly used form of logical addressing presently is the IPv4 format, which you are likely already familiar with.
(For example, 10.0.0.1 is widely recognized and configured as a default address for home or small office routers, allowing users to access and manage their network settings.).

The next step is `layer 4` ! This is where we'll start to see how data is really transferred.

• Layer 4: `Transport Layer`

The transport layer is a crucial layer in the OSI model that oversees the transmission of data.

The transport layer uses two main protocols:

- `TCP` **(Transmission Control Protocol)**:
  - TCP is a connection-oriented protocol, which means that a connection is established between the sender and receiver before any data is sent. This ensures that all of the data arrives at the destination correctly at a cost of time.
- `UDP` **(User Datagram Protocol)**:
  - UDP is a connectionless protocol, which means that there is no connection established between the sender and receiver. This means that there is no guarantee that all of the data will arrive at the destination correctly but it will ensure a fast transmission.

The transport layer divides the transmission into smaller pieces so that it is easier to transmit the message successfully. These smaller pieces are called segments in TCP and datagrams in UDP.

(/) TCP UDP

The transport layer also provides other services, such as:

- Flow control:
  - It ensures that the sender does not send data too quickly for the receiver to handle.
- Error control:
  - It ensures that any errors that occur during transmission are detected and corrected.

• Layer 5: `Session Layer`

The session layer oversees the establishment and management of communication sessions between machines.
In order for two devices within a network to interact, a session is required to guarantee authentication.
The session layer is responsible for initiating, maintaining, and concluding these sessions.

• Layer 6: `Presentation Layer`

The sixth layer of the OSI model (**The presentation layer**) is responsible for formatting the data exchanged between two hosts and securing that data with proper encryption.
The presentation layer ensures that the data is presented in a way that is understandable by both hosts, and that the data is secure from unauthorized access.
The presentation layer is a **critical layer** in the OSI model because it ensures that the data exchanged between two hosts is both understandable and secure.

Examples at Layer 6:

- Encoding:
  - HTML, XML, PHP, JavaScript, ..
  - ASCII, EBCDIC, UNICODE, …
  - GIF, JPG, TIF, SVG, PNG..
  - MPG, MOV..
- Encryptions:
  - TLS
  - SSL ..

Keep it up, We have reached the `7th layer` !
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• Layer 7: `Application Layer`

The application layer is the layer that users interact with directly. It is the layer where users communicate with the computer and where applications are executed. The application layer is responsible for presenting data to the user in a format that is understandable and useful.

Examples at Layer 7:

- E-mail (POP3, IMAP, SMTP)
- Web Browsing (HTTP, HTTPS)
- Domain Name Service (DNS)
- File Transfer Protocol (FTP, FTPS)
- Remote Access (TELNET, SSH)
- Simple Network Management Protocol (SNMP)

We've learned about the different layers of the OSI model, but how do they work together along?

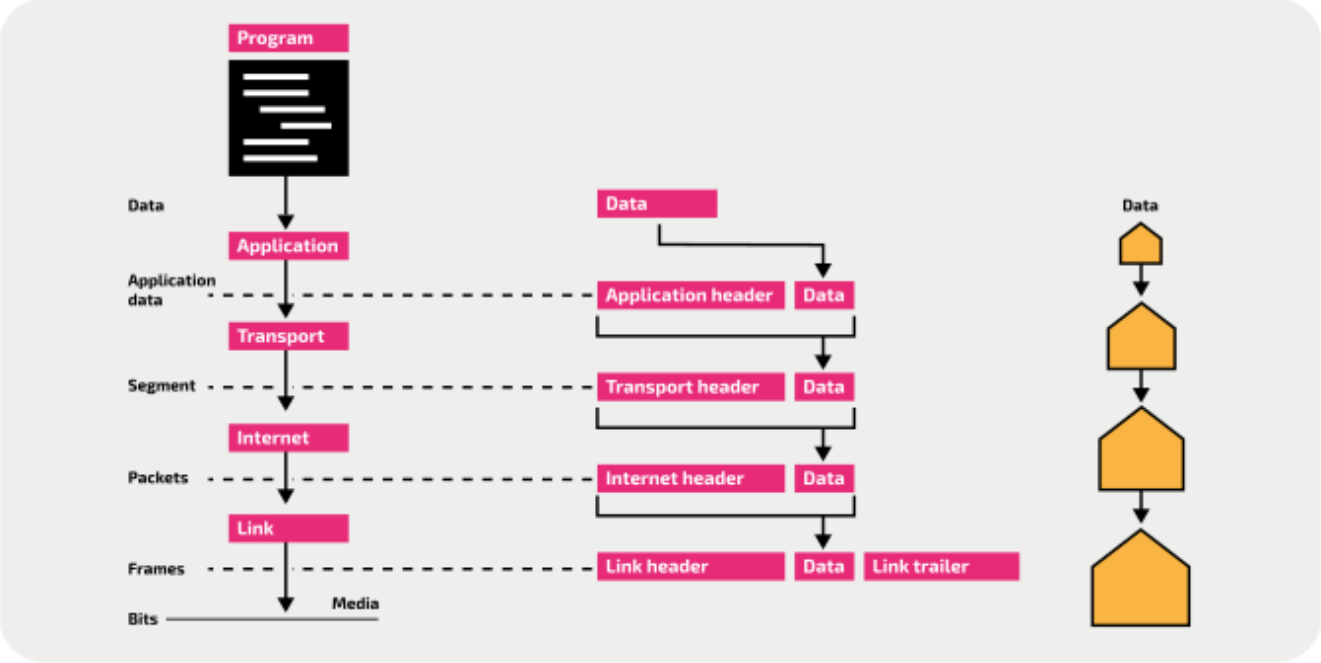
Encapsulation

Encapsulation is a key concept in the OSI model.

- Every layer adds information to the data it receives from the layer above it.
- The additional information is put into the so-called **header**.

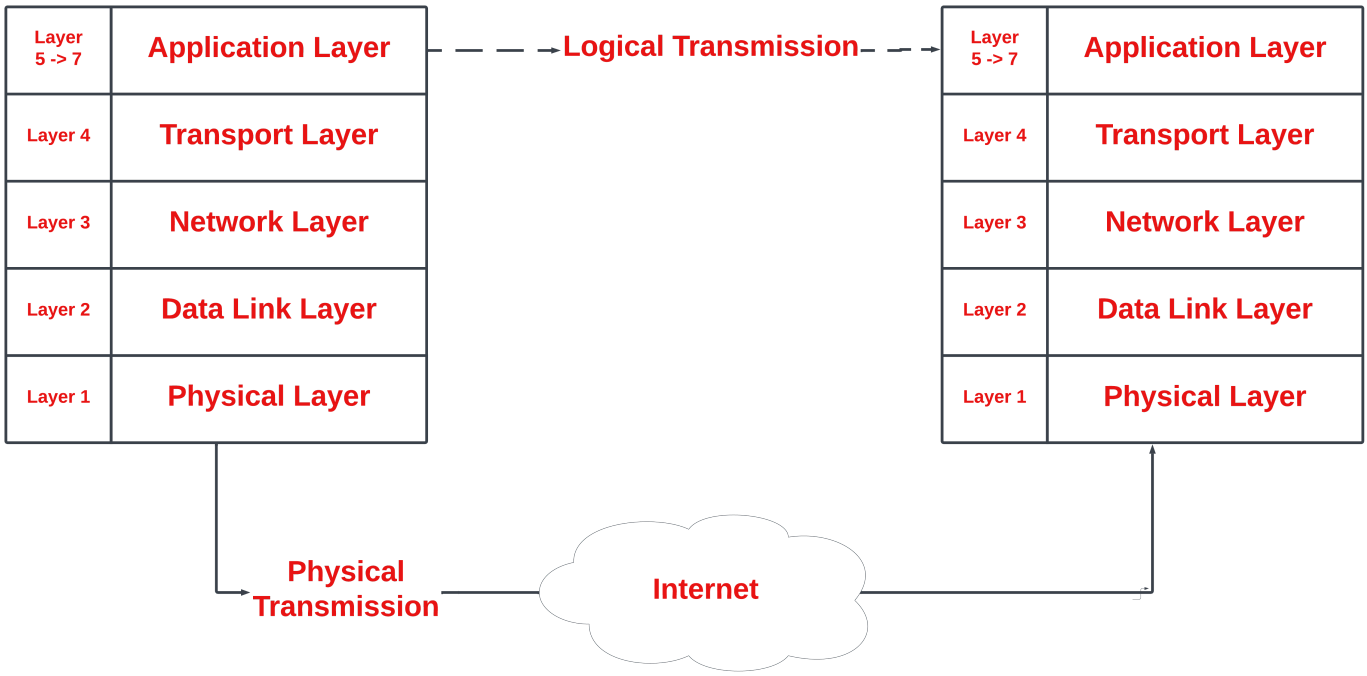
A header plus its data is also called `PDU` **(protocol data unit)**, meaning that packets, frames, segments, data are examples of PDU's.

Let's take a closer look at how it works.



When data moves from the **upper layer** to the **lower level** of the `TCP/IP model` stack (older version of `OSI model`), each layer includes a bundle of relevant information called a **header** along with the actual **data**. The data package containing the header and the data from the **upper layer** then becomes the **data** that is **repackaged** at the next **lower layer** with the lower layer's header. **Header** is the supplemental data placed at the beginning of a block of data when it is transmitted. This supplemental data is used at the receiving side to

extract the data from the encapsulated data packet.
This packing of data at each layer is known as **data encapsulation** and this whole process is referred to as **encapsulation**.



The **reverse process** of **encapsulation** (or `decapsulation`) occurs when data is received on the destination computer. As the data moves up from the **lower layer** to the **upper layer** of **TCP/IP protocol** stack (incoming transmission), each layer unpacks the corresponding header and uses the information contained in the header to deliver the packet to the exact network application waiting for the data.

Comparison between the TCP/IP and OSI models.

OSI	TCP/IP
Application	Application
Presentation	
Session	
Transport	Transport
Network	Internet
Data Link	Network Interface
Physical	

The processes of **encapsulation** and **de-encapsulation** work in exactly the same way with the `TCP/IP model` as they do with the `OSI model`.

I hope this helped understanding the OSI model and their layers.Now let's dive into the project! \o/

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