Distributed system

Student book

Maria Grazia Maffucci

20161024

This book is under construction.

Contents

Unit 1 - Transport Protocol

Vocabulary

Match the words (1-3) with the correct definition (A-C).

1	UDP	A	is a numbered logical construct allocated specifically for each of the communication channels an application needs. For many types of services, they have been standardized so that client computers may address specific services of a server computer without the involvement of service announcements or directory services.
2	TCP	B	uses a connectionless transmission model with a minimum of protocol mechanism. It has no handshaking dialogues, and thus exposes the user's program to any unreliability of the underlying network and so there is no guarantee of delivery, ordering, or duplicate protection.
3	Port	C	provides reliable, ordered, and error-checked delivery of a stream of octets between applications running on hosts communicating by an IP network.

Language for thinking: defining

This list contains language for expressing thinking processes which learners are required to engage in lessons. Each category is divided into question which teachers ask learners, and statements. Some of the items are too formal to use with young children: they are in italics.[1]

Defining

Teacher questions

What is a...?
Give me definition of a...
How would you define a...?
Who can define/give me a definition of...?
Can anyone give me a definition of...?
What do we call this?
What is the name/(technical) *term* for this?

Statements

<table>
<tr><td rowspan="2">(A)</td><td rowspan="2">……</td><td rowspan="2">is a</td><td rowspan="2">(generic term)
place
person
thing
concept
entity
device
instrument
tool
etc</td><td>where
who
which
that</td><td>……</td></tr>
<tr><td>for</td><td>…-ing ...</td></tr>
</table>

... is called ...
The *term*/name for this is…
We call this…

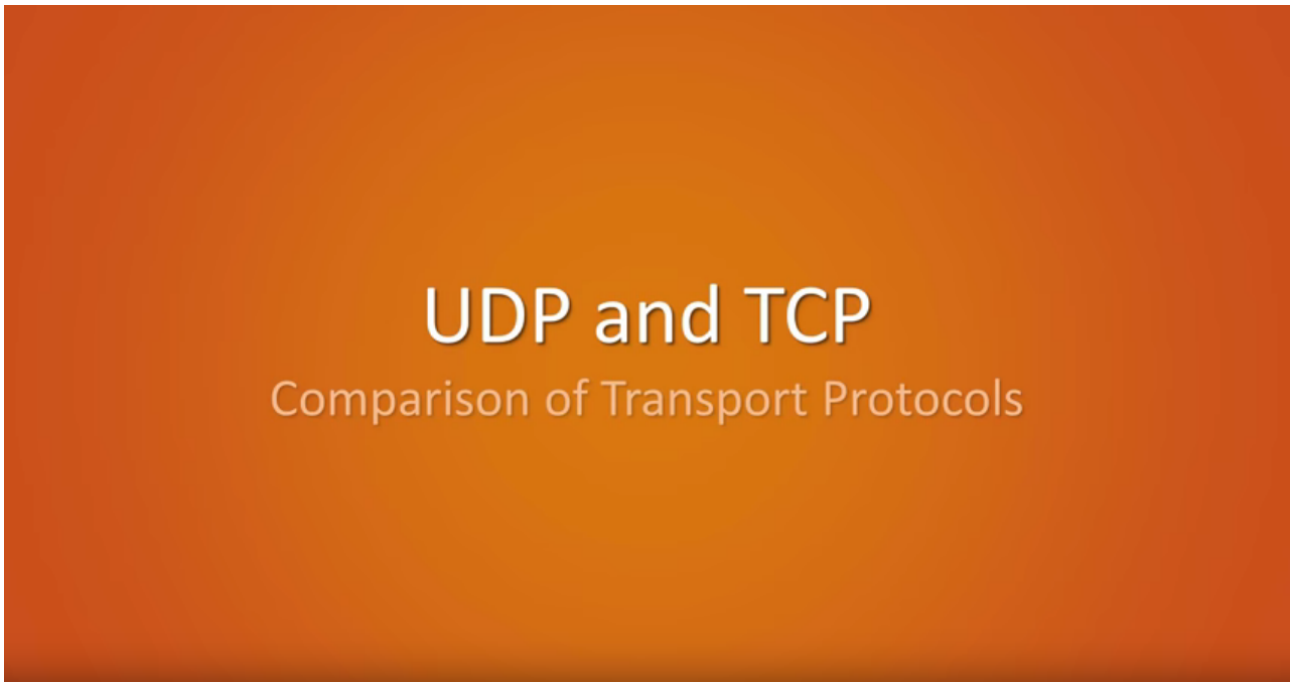
1 Barbero T., Clegg J., *Programmare Percorsi CLIL*, Carocci, Roma 2005

Anticipation guide

Try to respond to the following questions about the Transport Protocol before watching the video, and try again after you will have watched it.

Transport Protocol characteristics
What is the main purpose of the Transport Protocol?
What are the main characteristics of UDP?
What are the main characteristics of TCP?
What is a port in the Transport Protocol?
What kind of applications use TCP?
What kind of applications use UDP?

Comparison of Transport Protocols: UDP and TCP



https://youtu.be/Vdc8TCESIg8

UDP and TCP: Comparison of Transport Protocols – PieterExplainsTech

The transport layer provides multiple applications to use one network connection simultaneously, creating 65,536 **ports** on the computer that are reserved and used by applications. An **application can use multiple ports at the same time**, and they are used to **multiplex and demultiplex** the different messages sent and received by the communication nodes.

The two transport protocols differ heavily:

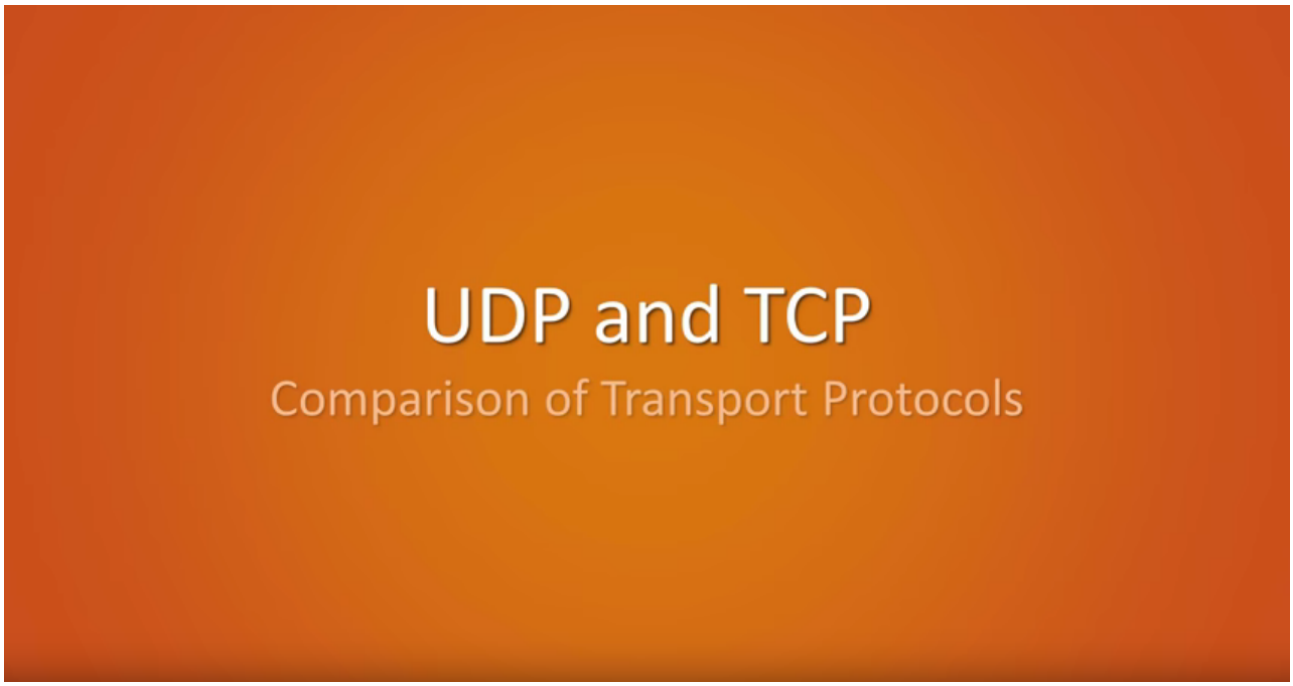
- **UDP** is **connectionless** and does not create a connection before sending out of data. Instead, **TCP** is **connection-oriented** and the two nodes have to create a connection in order to communicate.
- UDP **header** size is smaller than the TCP one.
- UDP does not try to recover corrupted datagrams, and does not guarantee in order datagrams delivery and congestion control. Instead, **TCP is more reliable than UDP** because the two nodes have to negotiate a connection using the three-way handshake. TCP offers also segments retransmission, implements in order messages delivery, and include congestion control.
- **UDP is a message oriented protocol** which means that applications send their data using independently datagram. **TCP** on the other hand **is a stream oriented protocol** that uses a continuous flow of data, and applications do not need to know how data they sent are sliced into segment and recomposed on the other hand.

When an application is designed, it is necessary to decide which protocol fits better its

requirements. For example, TCP is appropriate for a text communication application or a file download application because it is guaranteed an ordered delivery and retransmission of missing or corrupted segments. UDP is preferred when it is important to reduce the transmission overhead or to reduce the bandwidth occupation, and it is tolerated some amount of packets loss, like small question and answer transactions such as DNS lookups.

Activity: Comparison of Transport Protocols

Watch the video below and create a concept map, using Cmap, to explain the main characteristics of the Transport Protol. Send to your teacher your final product or the link to it.



https://youtu.be/Vdc8TCESIg8

UDP and TCP: Comparison of Transport Protocols – PieterExplainsTech

Unit 2 - Interprocess communication - Sockets

Vocabulary

Use the following table to write as many different words you know about **Transport protocols**, **sockets** and **interprocess communication**. You have **two minutes** to write down all the words you know and each word has to start with the corresponding letter of the list. After you finished the list, compare and discuss it with your classmates.

Words that start with…	
A	
B	
C	
D	
E	
F	
G	
H	
I	
J	
K	
L	
M	
N	
O	
P	
Q	
R	
S	
T	
U	
V	
W	
X	
Y	
Z	

Language for thinking: linking words

You need some simple linking words and natural phrases to communicate your ideas.

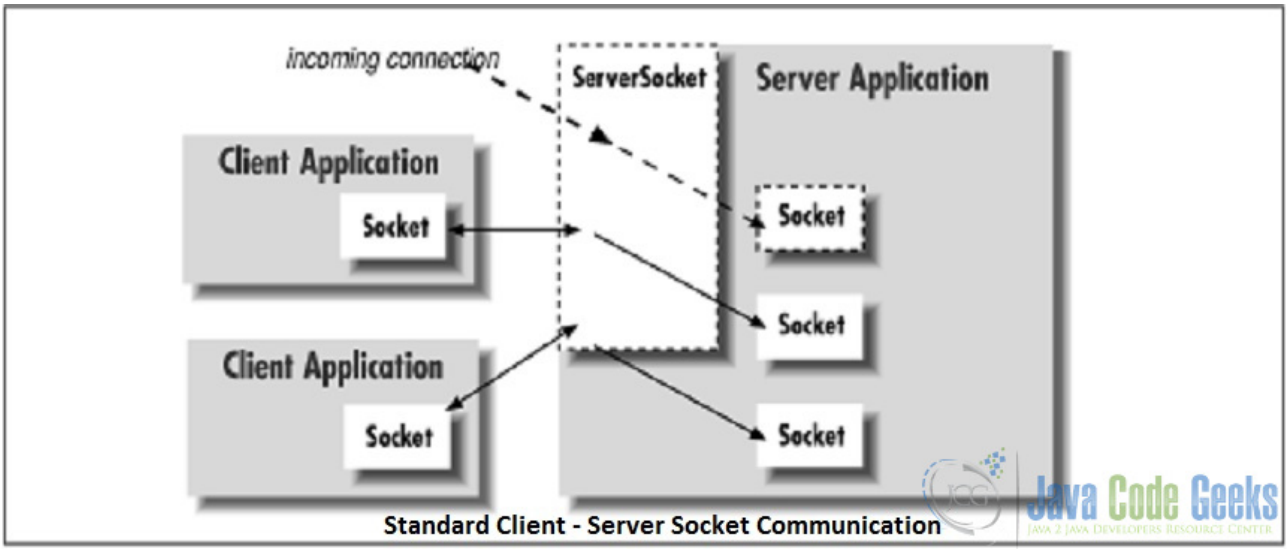
Adding more information	**Time phrases**	**Causes and solutions**
and also as well as another reason is In addition / additionally / an additional Furthermore	now at the moment at present right now these days nowadays in the past before then at that time years ago when I was younger	I guess it's because The main reason is It was caused by Because (of) I suppose the best way to deal with this problem is I reckon the only answer is to The best way to solve this is For Since As
Expressing ideas	**Examples**	**Being clear**
I think one important thing is I guess one difference is I suppose the main difference between X and Y is	for example for instance such as like That is (ie) Including Namely	What I mean is What I want to say is As I was saying
Contrasting and concessions	**Sequence**	**Result**
but on the other hand while or However Nevertheless Nonetheless Still Although / even though Though Yet Despite / in spite of In contrast (to) / in comparison Whereas On the contrary	First / firstly, second / secondly, third / thirdly etc Next, last, finally In addition, moreover Further / furthermore Another Also In conclusion To summarise	So As a result As a consequence (of) Therefore Thus Consequently Hence Due to

Emphasise	**Comparison**	
Undoubtedly Indeed Obviously Generally Admittedly In fact Particularly / in particular Especially Clearly Importantly	Similarly Likewise Also Like Just as Just like Similar to Same as Compare compare(d) to / with Not only...but also	

Interprocess communication characteristics

This unit is concerned with some communication aspects of **middleware**. The previous unit topic was the Internet transport level protocols UDP and TCP. In that unit was said anything about how middleware and application programs could use these protocols. This unit introduces some characteristics of interprocess communication and UDP and TCP are discussed from a programmer's point of view.

When a **server accepts a connection**, it generally **creates a new thread** in which to communicate with the new client. The **advantage** of using a separate thread for each client is that the **server can block its thread** when waiting for input **without delaying other clients**.



The **application program interface (API) to UDP** provides a **message** passing abstraction that enables a sending process to transmit a single message to a receiving process. The independent packets containing these messages are called **datagrams**.

The **application program interface (API) to TCP** provides the abstraction of a **two-way stream** between pairs of processes. The information communicated consists of a stream of data items with no message boundaries. **Streams** provide a building block for **producer-consumer communication** (remember what you have studied last year).

Message passing between a pair of processes can be supported by two message communication operations, **send** and **receive**. To communicate, **one process sends a message** (a sequence of bytes) to a destination and **another process** at the destination **receives the message**. This activity involves the communication of data from the sending process to the receiving process and may involve the s**ynchronization of the two processes**.

Synchronous and asynchronous communication

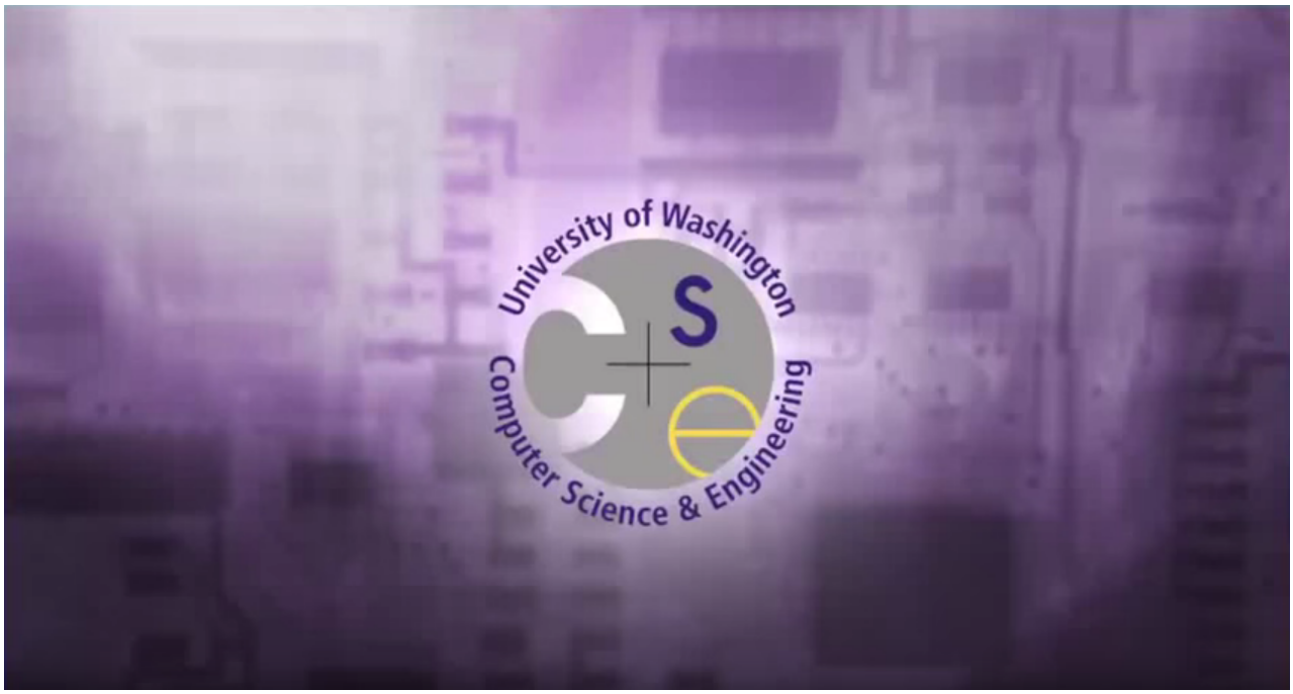
A **queue** is associated with each message destination. **Sending** processes cause **messages** to be **added** to **remote queues** and **receiving** processes **remove messages** from **local queues**. **Communication** between the sending and receiving processes may be either **synchronous or asynchronous**. In the **synchronous** form of communication, the sending and receiving processes

synchronize at every message. In this case, **both send and receive are blocking** operations. Whenever a send is issued the sending process (or thread) is blocked until the corresponding receive is issued. Whenever a receive is issued by a process (or thread), it blocks until a message arrives.

In the **asynchronous** form of communication, the use of the **send** operation is **non-blocking** in that the sending process is allowed to proceed as soon as the message has been copied to a local buffer. The **receive** operation can have **blocking and non-blocking variants**. The **most used** variant is the **blocking** one because in modern multi-threading system environment such as Java, a single thread can manage the receiving operation, and in the meanwhile other threads of the same process can provide for other executions.

Activity: Interprocess communication characteristics

After you have watched the video below and read the paragraph *Interprocess communication characteristics*, create a concept map or improve the last you have already done, to summarize the main concepts you have learnt about Interprocess communication. Use Cmap to create the concept map and send to your teacher your final product or the link to it.



https://youtu.be/TKJ5oobqcE0?list=PLkHsKoi6eZnzJl1qTzmvBwTxrSJW4D2Jj
Computer Networks 6-1: Transport Layer Overview** - **Online Courses

Activity: TCP stream communication

You will hear an explanation about TCP sockets and stream communication. After you have watched the video, complete the following exercises using what you have learnt by this explanation.

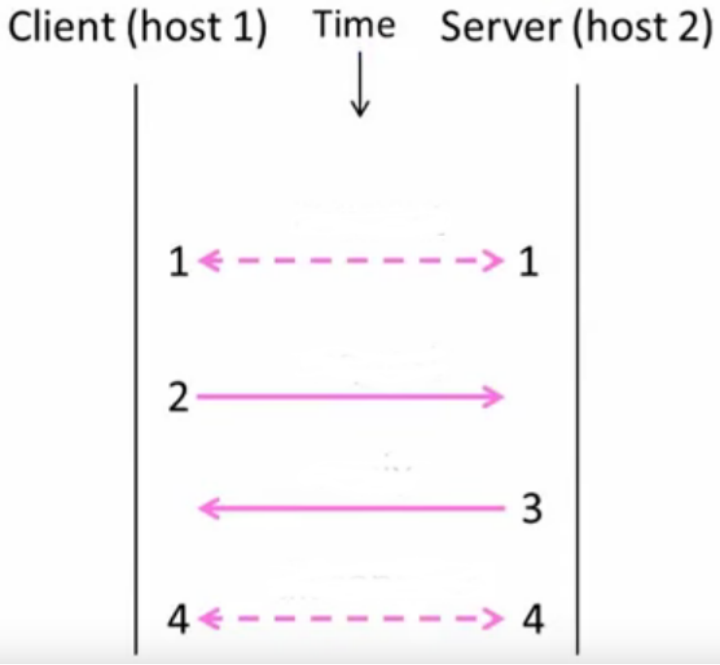
https://youtu.be/zWqLYby99EU
Computer Networks 1-4: Sockets, Online Courses

1. Select all the applications that use TCP sockets:
   - □ DNS
   - □ Web browsing
   - □ DHCP
   - □ Voice-over-IP
   - □ File transfer
   - □ RPC
   - □ Echo

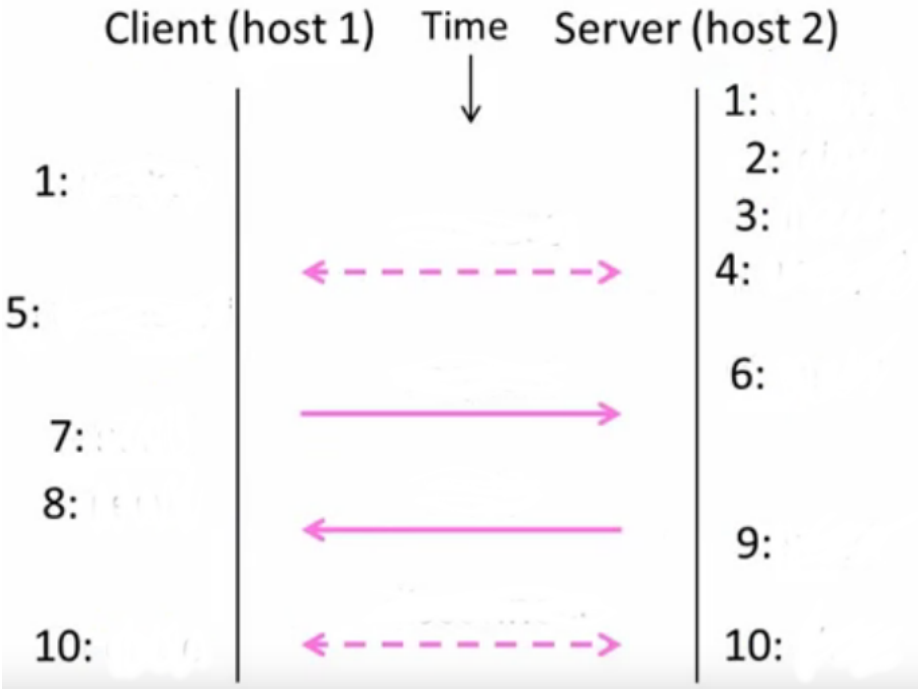
2. Given the following Berkeley APIs used for TCP stream communication, decide what Java class/method can be matched with each one or group of them. Specify also if the class/method is used by the server or the client.

Primitive	Meaning	Java class/method
SOCKET	Create a new communication endpoint	
BIND	Associate a local address with a socket	
LISTEN	Announce willingness to accept connection; give queue size	
ACCEPT	Passively establish an incoming connection	
CONNECT	Actively attempt to establish a connection	
SEND	Send some data over the connection	
RECV	Receive some data from the connection	
CLOSE	Release the connection	

3. Using the following image, put in the right order the all the phases of a TCP communication: REPLY, DISCONNECT, CONNECT, REQUEST



4. After you have done the previous exercise, complete the following image using the given APIs. Put a * near the blocking calls:
   RECV, SOCKET, CLOSE, RECVFROM, ACCEPT, SEND, LISTEN, SENDTO, CONNECT, BIND



Activity: UDP datagram communication

You will hear an explanation about UDP sockets and datagram communication. After you have watched the video, complete the following exercises using what you have learnt by this explanation.

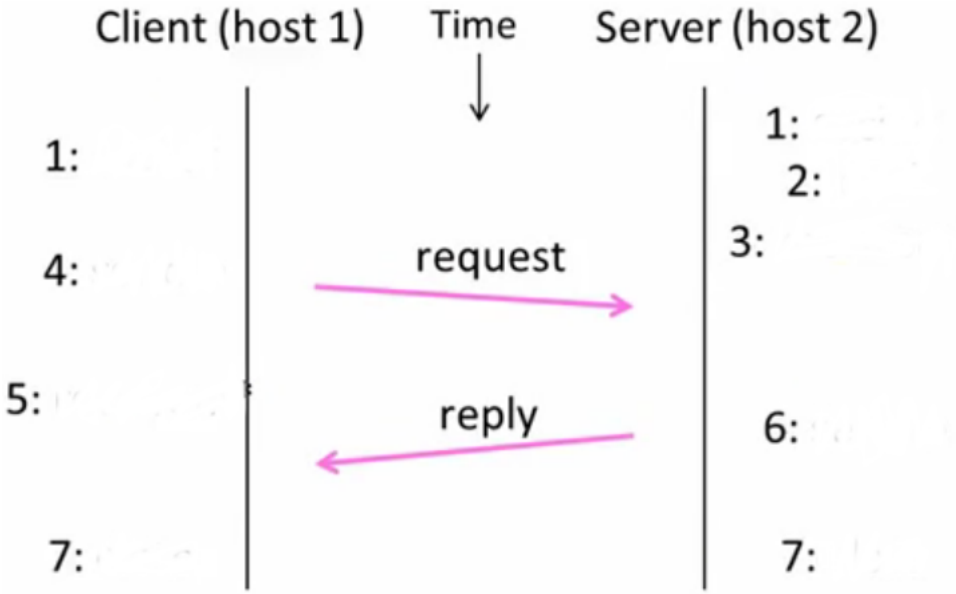
https://youtu.be/sP4BMunL3oI?list=PLkHsKoi6eZnzJl1qTzmvBwTxrSJW4D2Jj
Computer Networks 6-2: User Datagram Protocol (UDP)** - **Online Courses

1. Select all the applications that use UDP sockets:
   - ☐ DNS
   - ☐ Web browsing
   - ☐ DHCP
   - ☐ Voice-over-IP
   - ☐ File transfer
   - ☐ RPC
   - ☐ Echo

2. Given the following Berkeley APIs used for UDP stream communication, decide what Java class/method can be matched with each one or group of them. Specify also if the class/method is used by the server or the client.

Primitive	Meaning	Java class/method
SOCKET	Create a new communication endpoint	
BIND	Associate a local address with a socket	
SENDTO	Send a message	
RECVFROM	Receive a message	
CLOSE	Release the resources used for communication	

3. Complete the following image using the given APIs. Put a * near the blocking calls: RECV, SOCKET, CLOSE, RECVFROM, ACCEPT, SEND, LISTEN, SENDTO, CONNECT, BIND



4. Complete the image of the UDP header and answer to the following question:

   a) Why there is an UDP checksum?

   _____

   _____

   _____

   b) What is the value used to set that there is no UDP checksum?

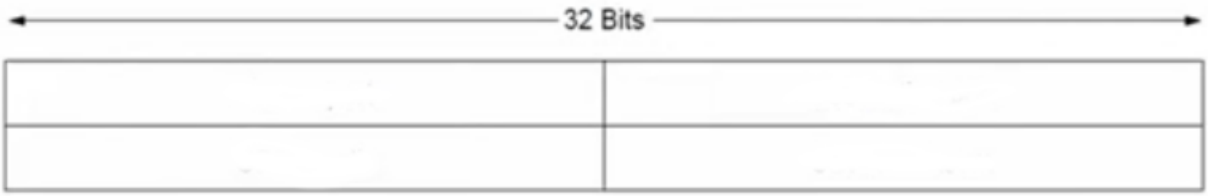
   _____

   _____

   c) What is the value used for a UDP checksum equal to zero?

   _____

   _____



Activity: UDP and TCP Sockets

After you have watched the two videos below, create a concept map or improve the last you have already done, to summarize the main concepts you have learnt about UDP and TCP sockets. Use Cmap to create the concept map and send to your teacher your final product or the link to it.

https://youtu.be/zWqLYby99EU
Computer Networks 1-4: Sockets, Online Courses

https://youtu.be/sP4BMunL3oI?list=PLkHsKoi6eZnzJl1qTzmvBwTxrSJW4D2Jj
Computer Networks 6-2: User Datagram Protocol (UDP) - Online Courses

Unit 3 - Introduction to Distributed systems

Vocabulary

Match the words (1-5) with the correct definition (A-E).

1	Hardware	A	a form of computation in which many calculations are carried out simultaneously, operating on the principle that large problems can often be divided into smaller ones, which are then solved at the same time
2	Message	B	a collection of physical elements that constitutes a computer system.
3	Network	C	a set of machine-readable instructions that directs a computer processor to perform specific operations
4	Parallelism	D	a communication unit used by the nods of a distributed system to communicate one another, because there is no physical memory shared between the nods of a distributed system
5	Software	E	a telecommunication network which allows computers to exchange data

Work in pairs, and discuss with your classmate about the following concepts. Use only your previous knowledge, do not try to find a definition using Internet or books. It is not important that you will give the right answers, it is important that you will try to remember what you know about these concepts.

1. LAN
2. WAN
3. Physical network interconnection
4. Media access protocols
5. Shared memory
6. Algorithm
7. Communication time (or message time)
8. Event computation time (or process time)

Language for thinking: defining

This list contains language for expressing thinking processes which learners are required to engage in lessons. Each category is divided into question which teachers ask learners, and statements. Some of the items are too formal to use with young children: they are in italics.[2]

Defining

Teacher questions

What is a...?
Give me definition of a...
How would you define a...?
Who can define/give me a definition of...?
Can anyone give me a definition of...?
What do we call this?
What is the name/(technical) *term* for this?

Statements

<table>
<tr><td rowspan="2">(A)</td><td rowspan="2">……</td><td rowspan="2">is a</td><td rowspan="2">(generic term)
place
person
thing
concept
entity
device
instrument
tool
etc</td><td>where
who
which
that</td><td>……</td></tr>
<tr><td>for</td><td>…-ing ...</td></tr>
</table>

... is called ...
The *term*/name for this is...
We call this...

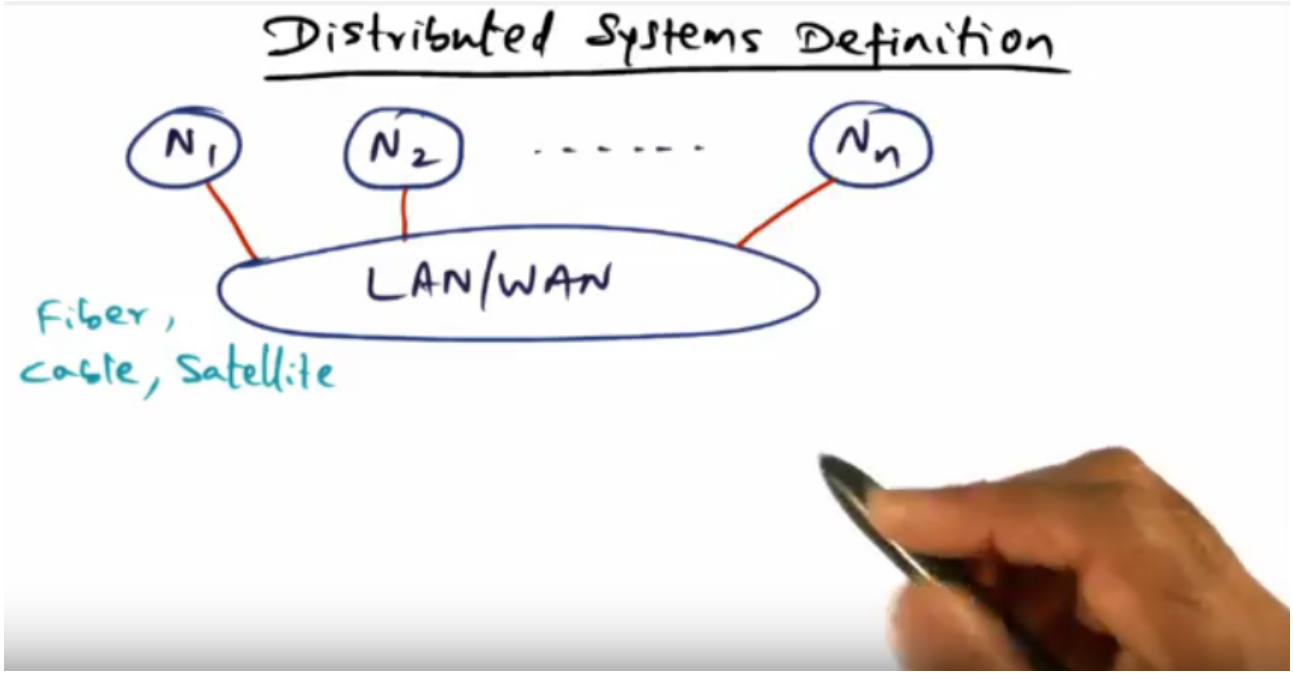
2 Barbero T., Clegg J., *Programmare Percorsi CLIL*, Carocci, Roma 2005

Anticipation guide

Try to respond to the following questions before watching the video about distributed systems, and try again after you will have watched it.

Distributed systems definition
What is a distributed system?
How can the computers of a distributed system communicate?
How does the distance between nodes in the network influence the communication in a distributed system?
What is a cluster?
What about the inequality between process time and communication time?

A definition of distributed system



https://youtu.be/nH9uwoyczFc?list=PLAwxTw4SYaPm4vV1XbFV93ZuT2saSq1hO
Distributed Systems Definition – Georgia Tech - Advanced Operating Systems, Udacity

A **distributed system** is made up[3] of **hardware** and **software** components located in **networked computers** spatially separated by any distance (separate continents, same building, same room, same rack or same chip). They communicate and coordinate their actions only by passing **messages**, because **they do not share a physical memory**.

A **distributed system** is made by a **collection of nodes** which are **physically interconnected by** a Local Area Network (**LAN**) or a Wide Area Network (**WAN**). A LAN may be implemented using a twisted pair, coaxial cable or optical fiber. A WAN could be implemented using a satellite communication, microwave link, etc. The **media access protocols** that may be available for communication in a LAN/WAN may be Ethernet, ATM, etc.

A fundamental property of distributed systems refers to the difference between the **communication** or **message time** (the time for communication between nodes of the system) that is **significantly larger than** the **event computation** or **process time** (the time a node takes to do some meaningful processing). **This inequality affects the design of the algorithm** that are going to span the nodes in the network: the **computation time of applications** developed to run on distributed nodes have to be **significantly larger than communication time**, otherwise it is impossible **to reap the benefits of parallelism**.

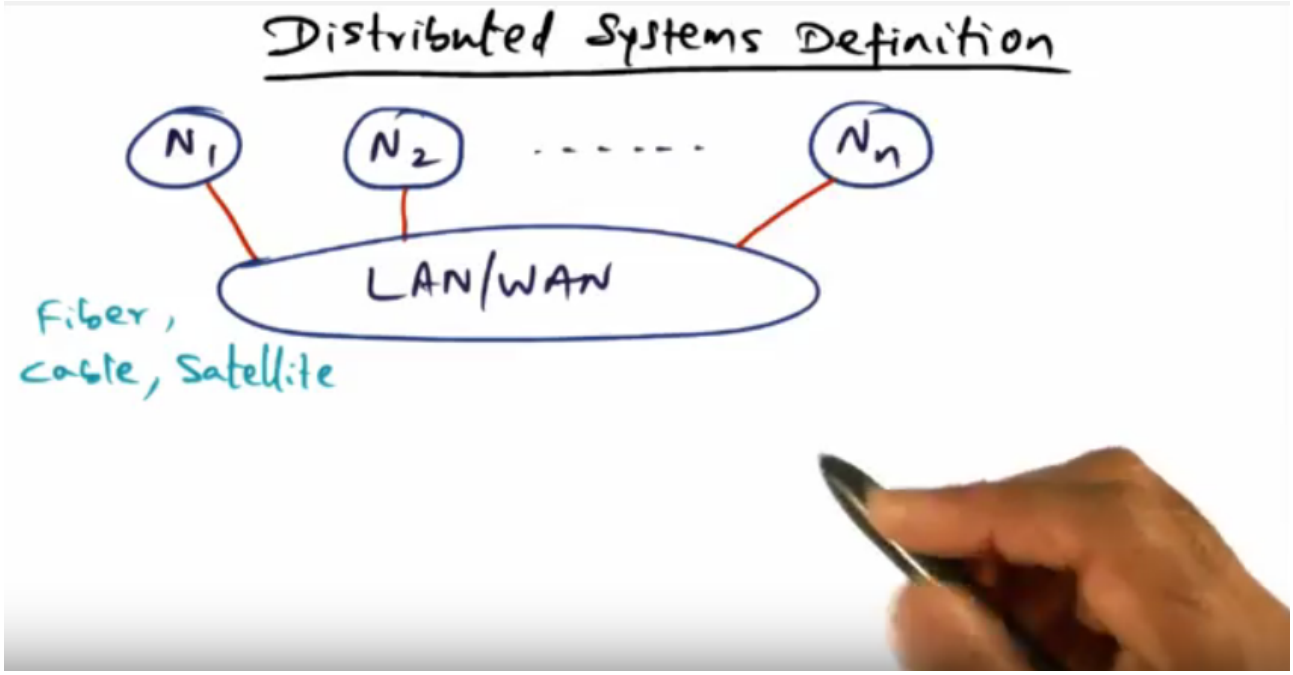
In the next unit we will be deeply explored the reasons of this inequality.

3 Passive form:
http://www.englishpage.com/verbpage/activepassive.html
http://www.engames.eu/passive-voice/

Activity: distributed systems definition

Watch the video below and create a concept map of the main characteristics of a distributed system using all the information you have learnt before, and **adding something original** about their characteristics.

Use the tool that you prefer (bubbl.us, Cmap or others) and send to me your final product or the link to it.



https://youtu.be/nH9uwoyczFc?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM

Distributed Systems Definition – Georgia Tech - Advanced Operating Systems, Udacity

Unit 4 - Consequences of distributed systems

Vocabulary

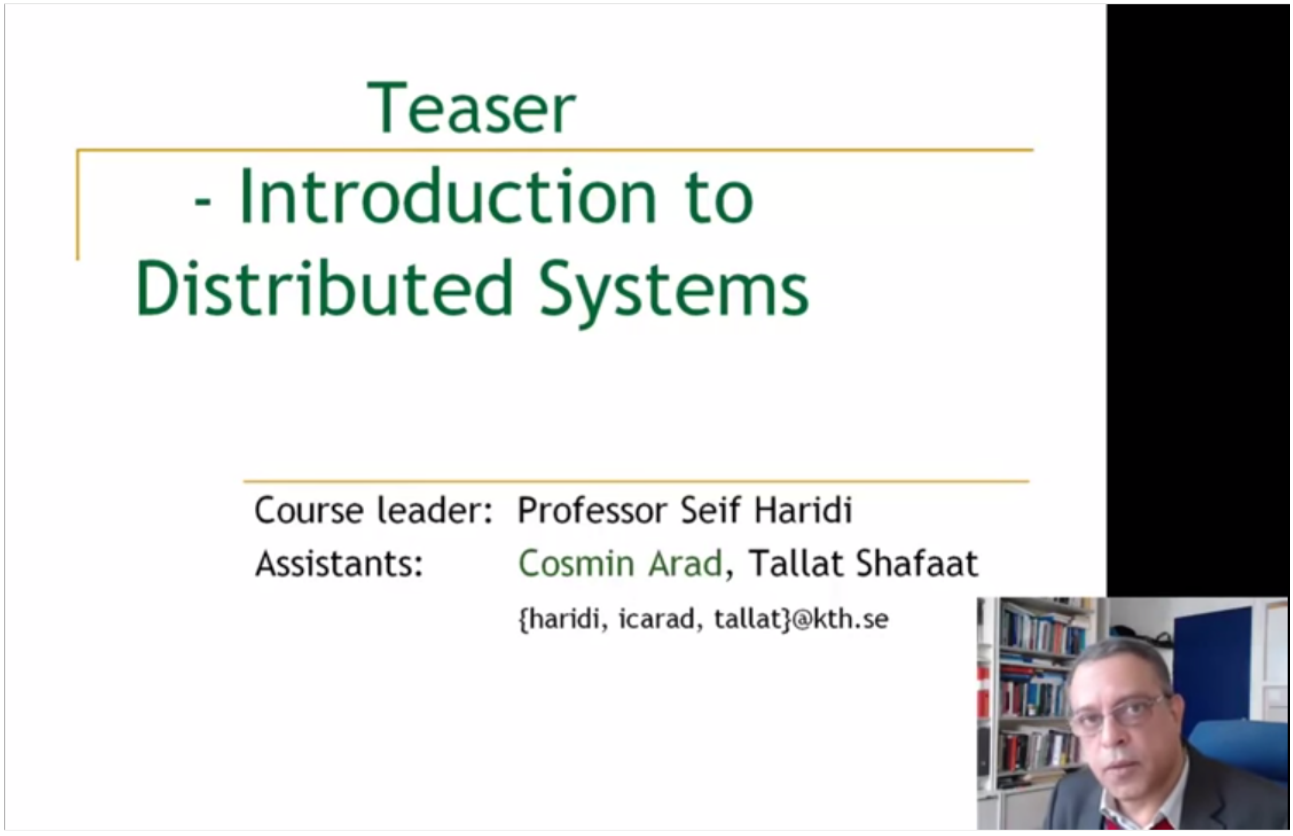
Work in pairs and match the words (1-4) with the correct definition (A-D).

1	Concurrency	A	a specific programming mechanism that allows processes or threads to cooperate.
2	Cooperate	B	in computing is when a computer program (such as a software application or an operating system) stops functioning properly.
3	Crash	C	a property of systems in which several computations are being executed simultaneously, and potentially interacting with each other. The computations may be executed on multiple cores in the same chip or on preemptively time-shared threads on the same processor or may be executed on physically separated processors.
4	Synchronization	D	when processes share data and can influence or be influenced by other processes running on the system.

Thinking aloud

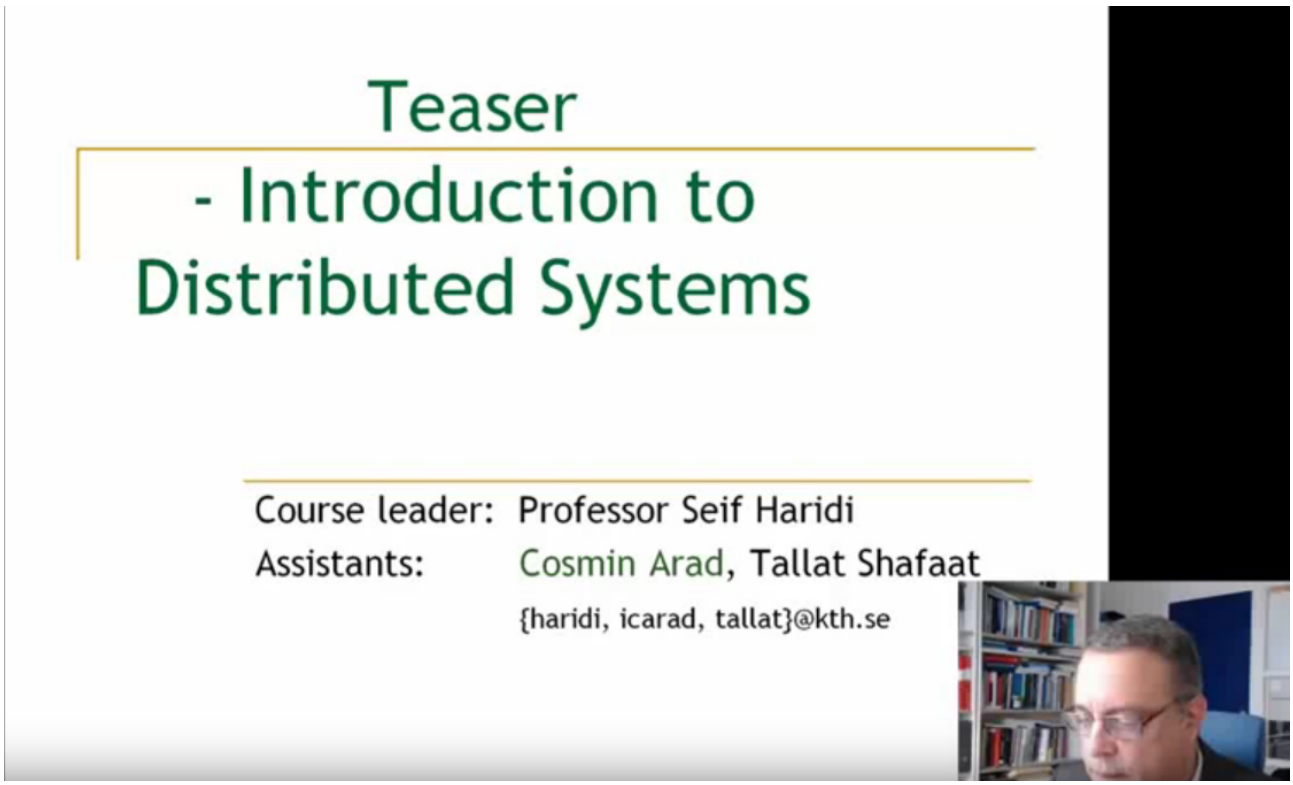
Watch the two videos below twice and discuss with your classmates about the following questions.

- If a computer fails in a distributed system, how can the other computers of the distributed system be affected?
- How can distributed systems and concurrency be related?
- If two computers need to cooperate, do you think they can synchronize their clocks?



https://youtu.be/F_4BCNl0iVk?list=PL700757A5D4B3F368

Lecture 1. Unit 1. Introduction to distributed systems (compact) (min. 0-7:56) - Seif Haridi



https://youtu.be/V7K-qN8-8Ow?list=PL700757A5D4B3F368

Lecture 1. Unit 2. Models, failure detectors (min. 0-9:32) - Seif Haridi

Concurrency, timing and failures

The definition of distributed systems has the following significant consequences:

Concurrency: In a network of computers, concurrent program execution is the norm. I can do my work on my computer while you do your work on yours, sharing resources such as web pages or files when necessary. The capacity of the system to handle shared resources can be increased by adding more resources (for example computers) to the network.

No global clock: When programs need to **cooperate** they coordinate their actions by exchanging messages. Close coordination often depends on a shared idea of the time at which the programs' actions occur. But it turns out that there are limits to the accuracy with which the computers in a network can **synchronize** their clocks – there is no single global notion of the correct time. This is a direct consequence of the fact that the only communication is by sending messages through a network. ***(gerund after preposition: http://www.englishpage.com/gerunds/part_2.htm http://www.engames.eu/gerund-or-infinitive/)***
(possessive: http://www.engames.eu/possessive-case-explanation/)

Independent failures: All computer systems can fail, and it is the responsibility of system designers to plan for the consequences of possible failures. Distributed systems can fail in new ways. Faults in the network result in the isolation of the computers that are connected to it, but that doesn't mean that they stop running. In fact, the programs on them may not be able to detect whether the network has failed or has become unusually slow. Similarly, the failure of a computer, or the unexpected termination of a program somewhere in the system (a **crash**), is not immediately made known to the other components with which it communicates. Each component of the system can fail independently, leaving the others still running. ***(present simple tense and negative form: http://www.engames.eu/present-simple-elementary-students/)***

Activity: concurrency, timing and failures

Improve your previous concept map, or create a second one, with the new knowledge you have learnt until now.

Start to create a presentation with your concept map that you will expose to your classmates and to your teacher. You can use shareable resources (eg. Google drive) or you can use a local tool. In both cases send to your teacher the link or the file of your presentation.

Next step

Now that you have understood the main characteristics of distributed systems, what do you know about client and server model?

What is cloud computing?

How can our personal life be affected by distributed systems?

Unit 5 - Client-server model

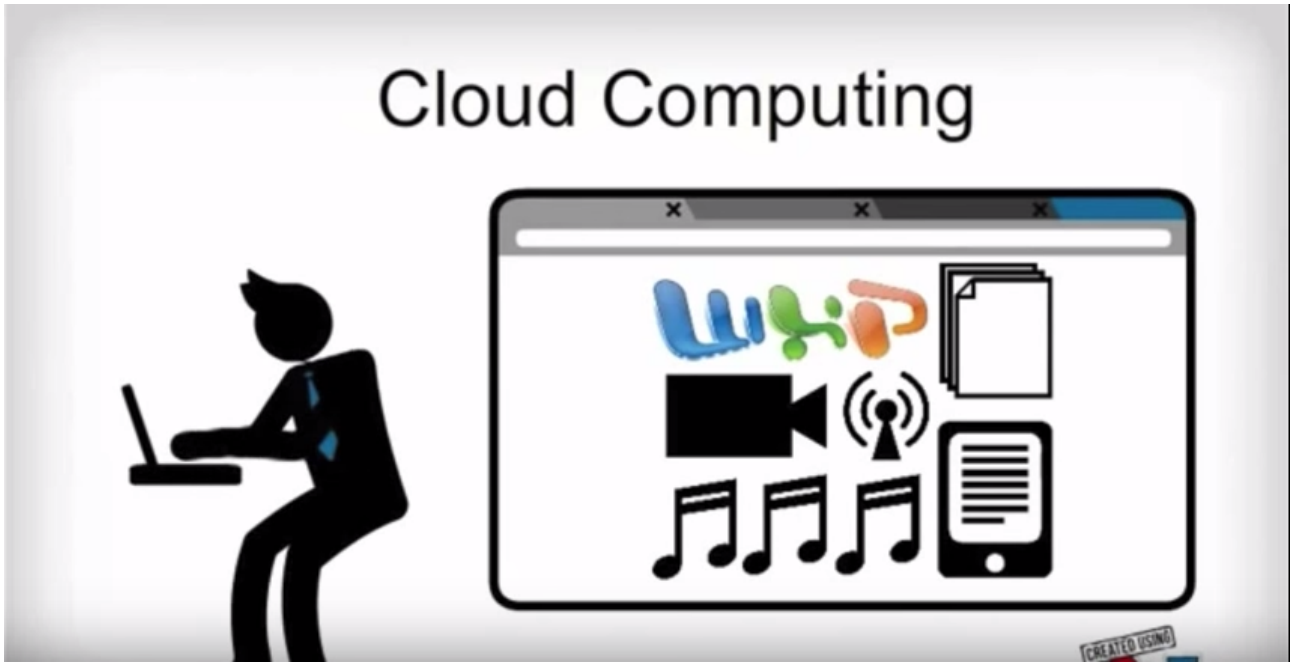
Vocabulary

Work in pairs and match the words (1-9) with the correct definition (A-I).

1	Cloud computing	A	a piece of computer hardware or software that accesses to a service made available by a server.
2	Cluster computers	B	an attribute of any computer-related component (software, or hardware, or a network, for example) that consistently performs according to its specifications.
3	Multimedia system	C	the control of many small, cheap computational devices that are present in users' physical environments, including home, office and even natural settings. These small computing devices will eventually become so pervasive in everyday objects that they will be scarcely noticed. That is, their computational behaviour will be transparently and intimately tied up with their physical function.
4	Ubiquitous computing	D	a resource, hardware or software, shared by a server and requested by a client.
5	Resource	E	a computational element that offers a service requested by a client.
6	Reliability	F	a set of Internet-based applications, storage and computing services which are sufficient to support most users' needs, thus enabling them to largely or totally avoid the use of local data storage and applications software.
7	Service	G	a set of loosely or tightly connected computers that work together so that, in many respects, they can be viewed as a single system.
8	Client	H	has the ability to support a range of media types in an integrated manner.
9	Server	I	every reusable component or not, both hardware and software, required by a process or a system.

Activity: Cloud computing

You will hear an explanation about what cloud computing is. Before you listen, read the sentences below and decide what sort of information you need in each space. You will also use this new information to improve your presentation. Send to me your improved presentation.



https://youtu.be/DGDtujmOBKc

How Cloud Computing Works – ovp

At first the speaker emphasises the problem (1) _____ for all our stuff, but this is no longer a problem because with cloud computing all our stuff (2) _____ the WWW.

She explains that in this way we do not need the space of our (3) _____ .

Even Jonathan Strickland's article explains that cloud computing is having (4) _____ in corporate setting and for personal computing.

When using cloud, data and applications are stored (5) _____ and they can be (6) _____ via the internet.

The collection of web servers used for storing data and applications are owned by (7) _____.

The speaker adds that we can access cloud by using its computing system interface that is (8) _____ using a web service.

Cloud computing is also useful because is more inexpensive, efficient and flexible than purchase, run and (9) _____ an in-house computing equipment.

An example is our web email: we login to our remote account (10) _____ a browser, but all our emails are on the provider cloud.

Language for thinking: linking words

You need some simple linking words and natural phrases to communicate your ideas[4].

Adding more information	**Time phrases**	**Causes and solutions**
and also as well as another reason is	now at the moment at present right now these days nowadays in the past before then at that time years ago when I was younger	I guess it's because The main reason is It was caused by Because I suppose the best way to deal with this problem is I reckon the only answer is to The best way to solve this is
Expressing ideas	**Giving Examples**	**Being clear**
I think one important thing is I guess one difference is I suppose the main difference between X and Y is	for example for instance such as like	What I mean is What I want to say is As I was saying
Contrasting and concessions		
but on the other hand while although or		

4 Linking Words for IELTS Speaking: Word List & Tips, http://ieltsliz.com/linking-words-for-ielts-speaking/

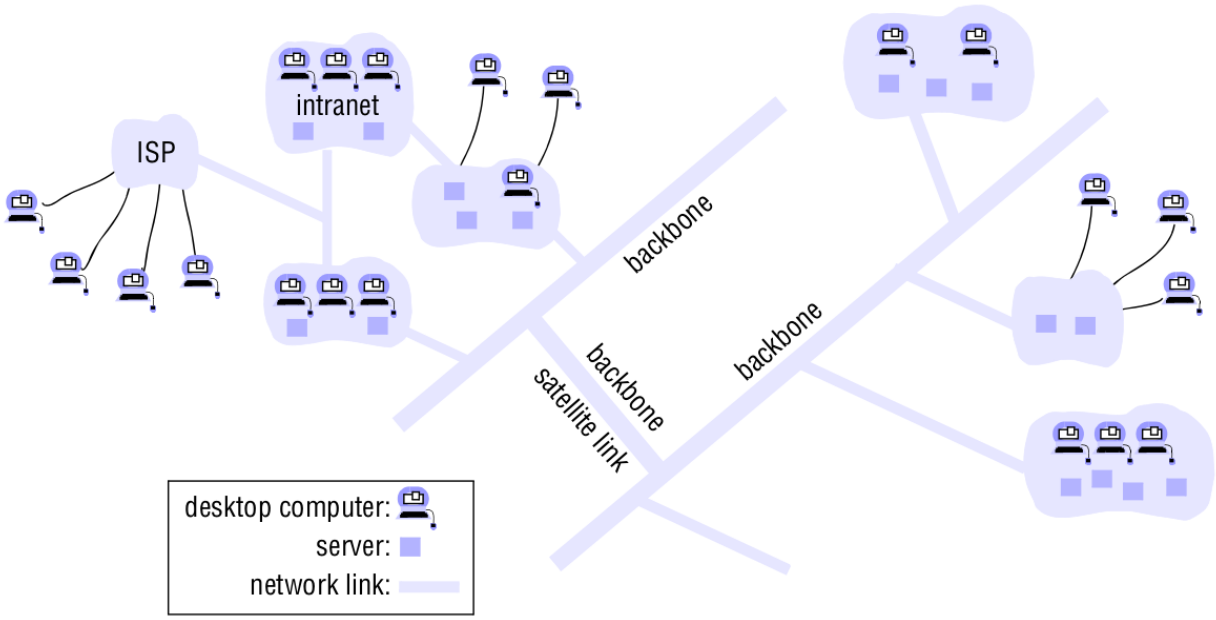
Activity: influential trends in distributed systems

Read the following paragraph about the influential trends in distributed systems and discuss with your classmates about the following questions. You will use this new information to improve your presentation. Send to me your improved presentation.

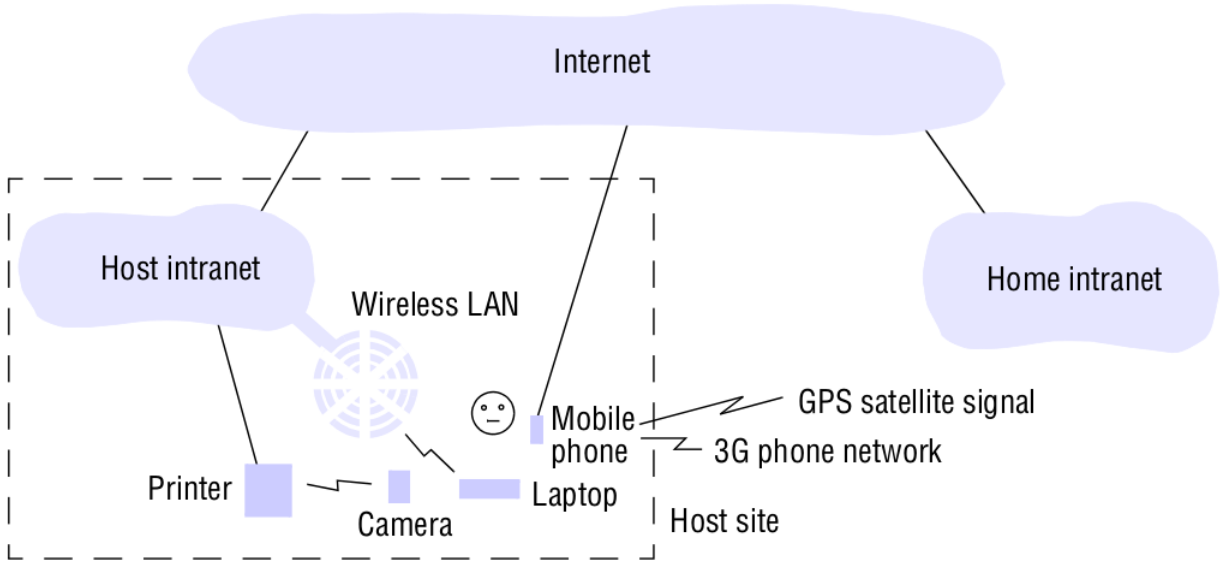
- What kind of multimedia services or cloud services do you use on the Internet?
- What different devices do you use to connect to the Internet?
- “Connect everyone to everything, everywhere, all the time”. What do you think about this assertion?

Distributed systems derive from a number of influential trends:

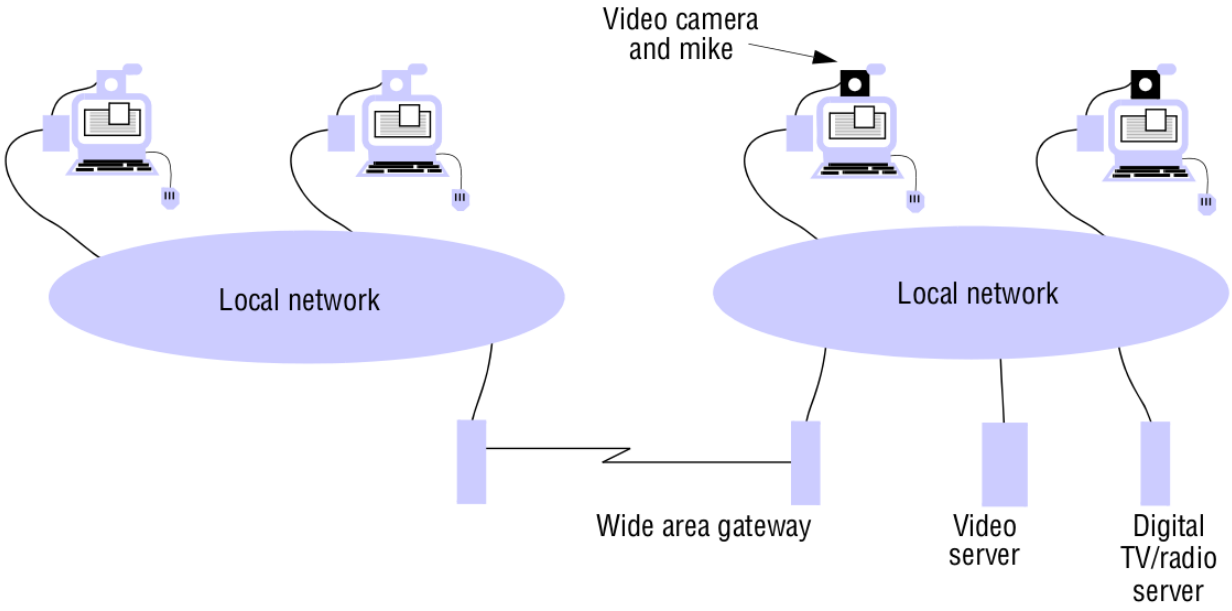
- the emergence of pervasive networking technology, such as the modern Internet composed by wired connections and wide range of wireless communication technologies (WiFi, Bluetooth and third-generation mobile phone networks);



A typical portion of the Internet



- the emergence of **ubiquitous computing** coupled with the desire to support user mobility in distributed systems using devices like laptop computers, mobile phones, smart phones, GPS-enabled devices, pagers, PADs, video and digital cameras;*Portable and handheld devices in a distributed system*
- the increasing demand for multimedia services for both discrete media types such as pictures or text messages, and continuous media types such as audio and video;



A distributed multimedia system

- the view of distributed systems as a utility or commodity where the physical resources (e.g. data centres, computational infrastructures and virtualization) or software services (e.g. email, distributed calendar, office applications) are provided by suppliers and rented rather than owned by the end user.

Language for thinking: contrasting

This list contains language for expressing thinking processes which learners are required to engage in lessons. Each category is divided into question which teachers ask learners, and statements. Some of the items are too formal to use with young children: they are in italics.[5]

Contrasting

Teacher questions

In what way/how is ...different from ...?
How does ...differ from...?
How can one/we/you distinguish ...from...?
What is the difference between... and ...?

Statements

……	is	*unlike* different from	……	*in that* *insofar as*	……
One can distinguish		……	*from*	……	*in ... respect(s).*	*(Firstly, etc)*

...although... (subordinate clauses)
...though... (ditto)
....*whereas... (main clauses)*
... but.… (ditto)

However
But
Nevertheless
On the one hand, on the other hand
It is true that... Nevertheless...
Admittedly... Nevertheless

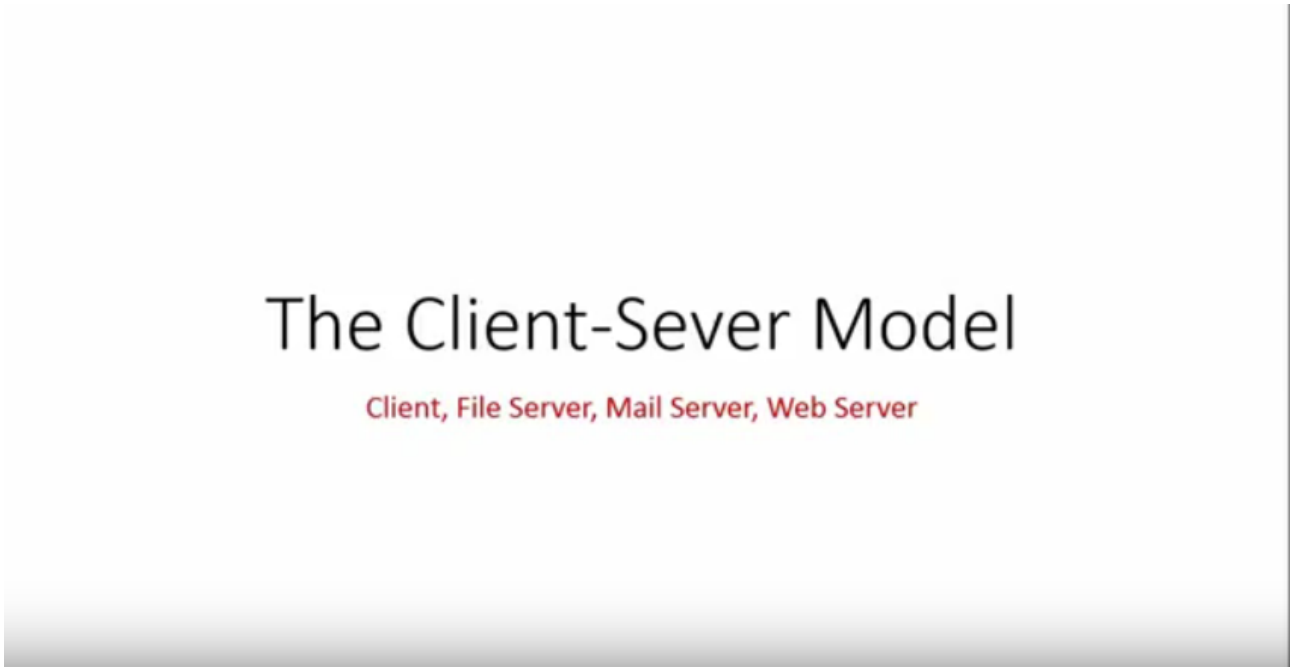
5 Barbero T., Clegg J., *Programmare Percorsi CLIL*, Carocci, Roma 2005

Thinking aloud

Watch the video twice and discuss with your classmates about the following questions.

You will use this new information to improve your presentation. Send to me your improved presentation.

- What are the main characteristics of peer-to-peer model?
- What is the difference between client and server?
- What is the difference between resources and services?



https://youtu.be/IOnWn5u-sXE
Client-Server Model - Christopher Kalodikis

Language for thinking: giving reasons

This list contains language for expressing thinking processes which learners are required to engage in lessons. Each category is divided into question which teachers ask learners, and statements. Some of the items are too formal to use with young children: they are in italics.[6]

Giving reasons

Teacher questions

Why?
Why does/did...?
Who can tell me why...?
What is/was the reason for that?
Give me a reason for that
What will/would happen if...happens/happened?

Statements

This is/was because...
The reason for this is that...
There are three reasons for this.
This is/was due to...
This is/was the cause of...
This causes/caused ...
If...happens, (then) ... will happen.
When...happens, (then)... will happen.
Because...happens, then ...will happen.
This means that...will happen.
So
Therefore
Thus
For this reason
That is why

6 Barbero T., Clegg J., *Programmare Percorsi CLIL*, Carocci, Roma 2005

Activity: The client-server model

Read the following paragraph about the client-server model and try to write simple sentences in response of the questions that follow. Some of those questions will be used in you next assessment.

You will use this new information to improve your presentation. Send to me your improved presentation.

The prime motivation for constructing and using distributed systems is based on a desire to share resources. The term '**resource**' is referred to the range of things that can usefully be shared in a networked computer system. It extends from hardware components such as disks and printers to software-defined entities such as files, databases and data objects of all kinds. ***(plurals: http://www.engames.eu/plurals-elementary-students/)***

We use the term **service** for a distinct part of a computer system that manages a collection of related resources and presents their functionality to users and applications. For example, we access shared files through a file service; we send documents to printers through a printing service; we buy goods through an electronic payment service.

The only access we have to the service is via the set of operations that it exports. For example, a file service provides read, write and delete operations on files, and for effective sharing each resource must be managed by a program that offers a communication interface enabling the resource to be accessed and updated **reliably** and consistently.

The term **server** refers to a running program (a process) on a networked computer that accepts requests from programs running on other computers to perform a service and responds appropriately. The requesting processes are referred to as **clients**, and the overall approach is known as client-server computing. In this approach, requests are sent in messages from clients to a server and replies are sent in messages from the server to clients. When the client sends a request for an operation to be carried out, we say that the client invokes an operation upon the server. A complete interaction between a client and a server is called a remote invocation.

The same process running in a computer may be both a client and a server, since servers sometimes invoke operations on other servers. The terms 'client' and 'server' apply only to the roles played in a single request. Clients are active (making requests) and servers are passive (only waking up when they receive requests); servers run continuously, whereas clients last only as long as the applications of which they form a part need a service.

Questions

1. Why do we use distributed systems?

   _____

   _____

2. What is a resource in a distributed system?

   _____

   _____

3. What is a server?

   _____

   _____

4. What is a client?

   _____

   _____

5. What is a service in a client-server model?

   _____

   _____

6. Who offer a service and to whom?

   _____

   _____

7. How is it a complete interaction called between client and server?

   _____

   _____

8. Why a server has to run continuously?

   _____

   _____

9. What are the main influential trends for distributed systems?

   _____

   _____

10. Why is used cloud computing?

_____

_____

11. Why can cloud computing be deemed to be as a commodity?

_____

_____

12. What is the main difference between peer-to-peer model and client-server model?

_____

_____

13. What are the main consequences in using distributed systems?

_____

_____

14. What is a distributed system?

_____

_____

15. How can the computers of a distributed system communicate?

_____

_____

Unit 6 - Distributed hardware architecture

Activity: Quantum Computers Explained – Limits of Human Technology (creare attività)

https://youtu.be/JhHMJCUmq28

Quantum Computers Explained – Limits of Human Technology – Kurzgesagt – In a Nutshell

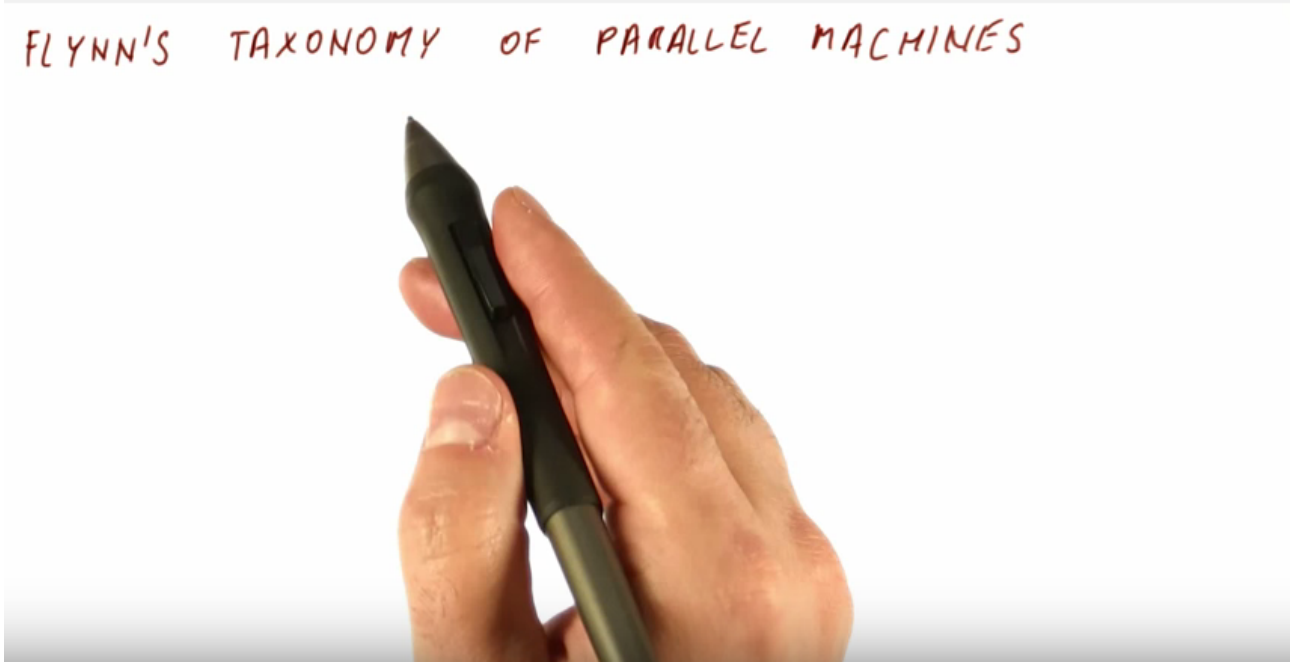
Activity: Transistors & The End of Moore's Law

https://youtu.be/rtI5wRyHpTg
Transistors & The End of Moore's Law – 2veritasium

Activity: Flynn's taxonomy

Watch the video and create a concept map that you can use to answer to the following questions. If you need more information you can use the Web to complete your concept map.

1. What are the main differences among the four different distributed hardware architectures described in Flynn's taxonomy?
2. What are the main real application of the four distributed hardware architectures described in Flynn's taxonomy?



https://youtu.be/WKXbvhkzBUo?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM

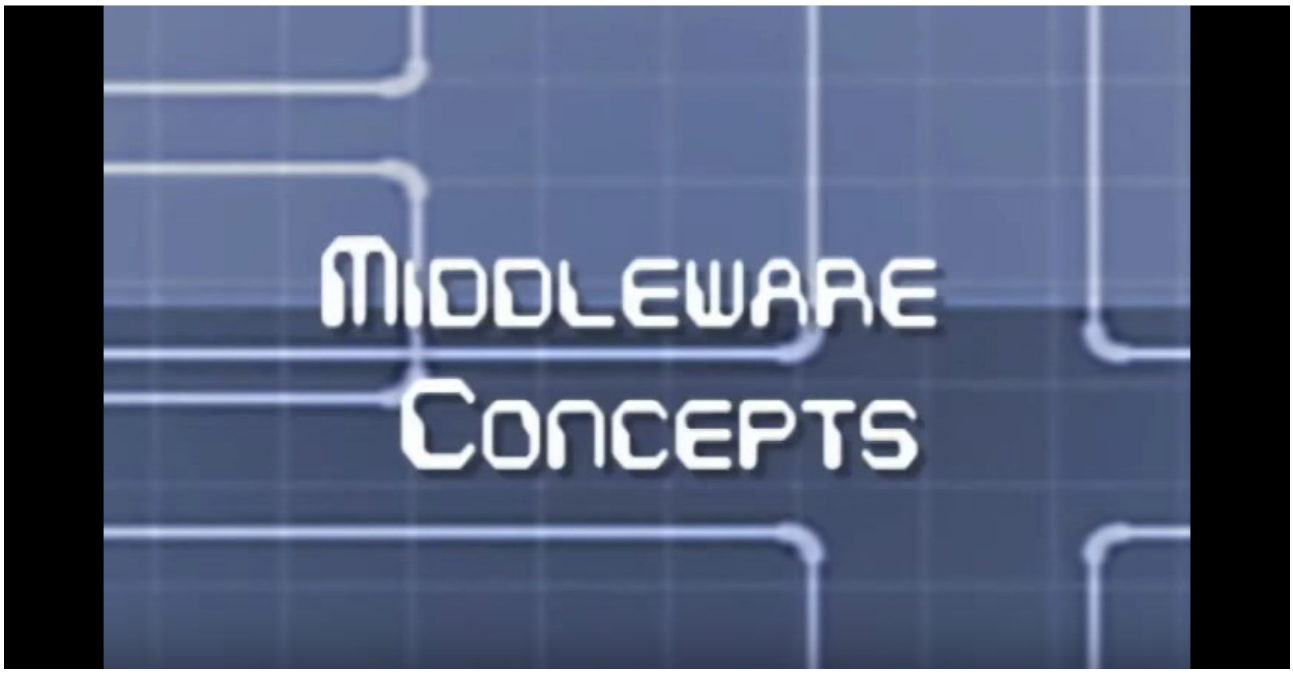
Flynn's Taxonomy of Parallel Machines – Georgia Tech – HPCA: Part 5 - ***Udacity***

Unit 7 - Multi-layer architectures and middleware

Activity: Middleware

Watch the video and create a concept map that you can use to answer to the following questions. If you need more information you can use the Web to complete your concept map.

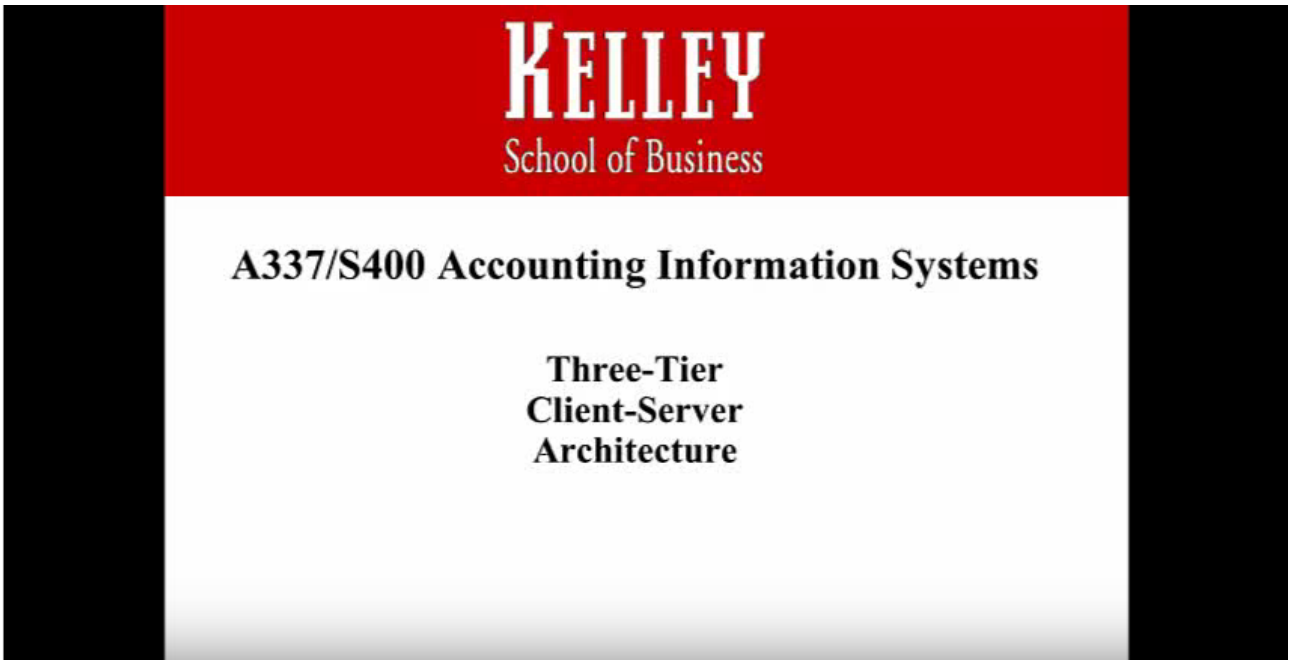
1. Give a definition of what middleware is. (plumbing data = immettere dati)
2. Give the main reason that gives birth to middleware. (framework = impalcatura, struttura, underpin = sostenere, sorreggere)
3. Describe the purpose of middleware today. (deployment, development)



https://youtu.be/S8sgGXUqw30?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM
Middleware Concepts – Regis University CPS SCIS

Activity: 3-Tier client-server architecture

You will hear an explanation about what 3-tier client-server architecture is. Before you listen, read the sentences below and decide what sort of information you need in each space.



https://youtu.be/jJYv-nfkMXk?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM
3 Tier Client Server Architecture – A337 | S400

At first the speaker defines what servers (1) _____ , programs that constantly run and exchange (2) _____ with remote users. On the other (3) _____ clients are the programs that access and exchange information (4) _____ servers.

The speaker continues with the definition of applications that are software programs for some functional use (5) _____ for accounting, communications, email and so on.

She explains also databases are all (6) _____ centrally by a relational database management system or RDBMS for short.

After these first explanations, the speaker gives the definition of the three tier. The first (7) _____ is the presentation tier. This creates the views that users see, in other words it receives input and displays (8) _____. The second tier is the application tier, and this process is the (9) _____ and makes (10) _____. The third tier is the database tier which stores and manages the data.

The speaker continues with an example, an (11) _____ configuration, and after explains the SAP R/3 architecture.

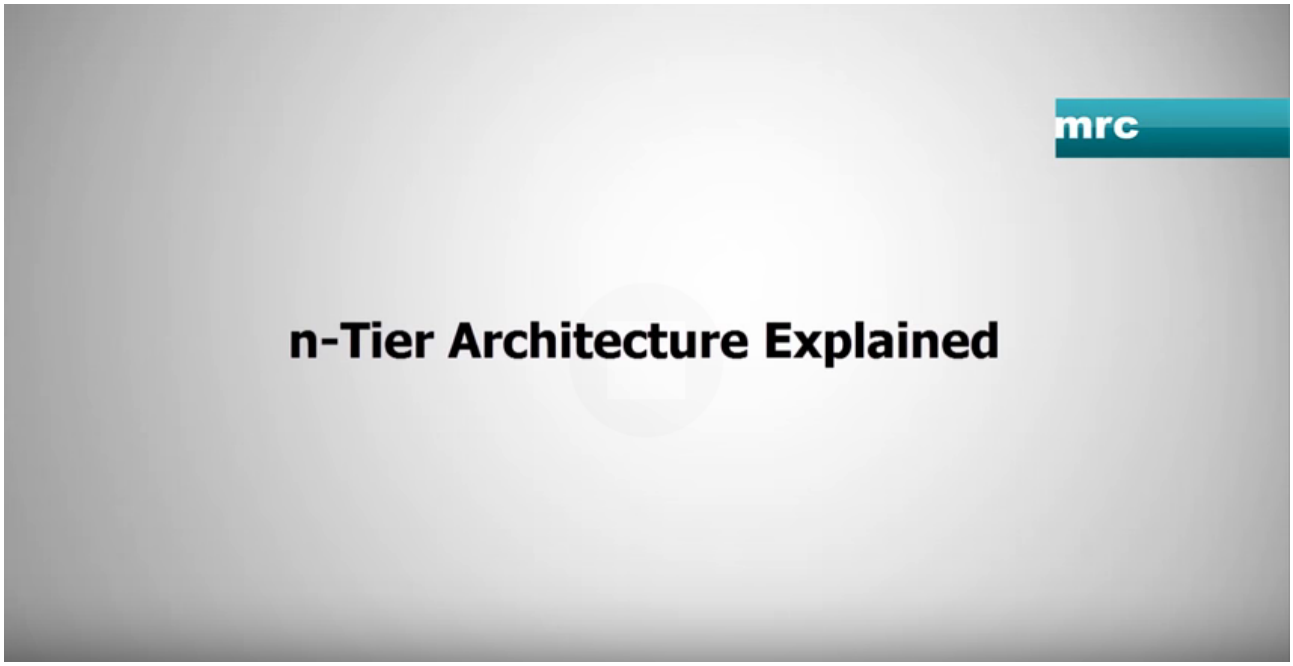
At the end she explains the main advantages of a three-tier architecture. The first advantage is that there (12) _____ be increased efficiency; each tier has their own function to perform which (13) _____ the work over several systems. There is increased security of the data since the relational database management system (14) _____ a single point of access and

governance who is retrieving the data and how the date it is updated. There is increased scalability up and down since the structure can run on (15) _____ different types of hardware and operating systems, and lastly there is increase (16) _____ since this type of architecture can support many types and sizes of businesses.

Activity: n-Tiers architecture

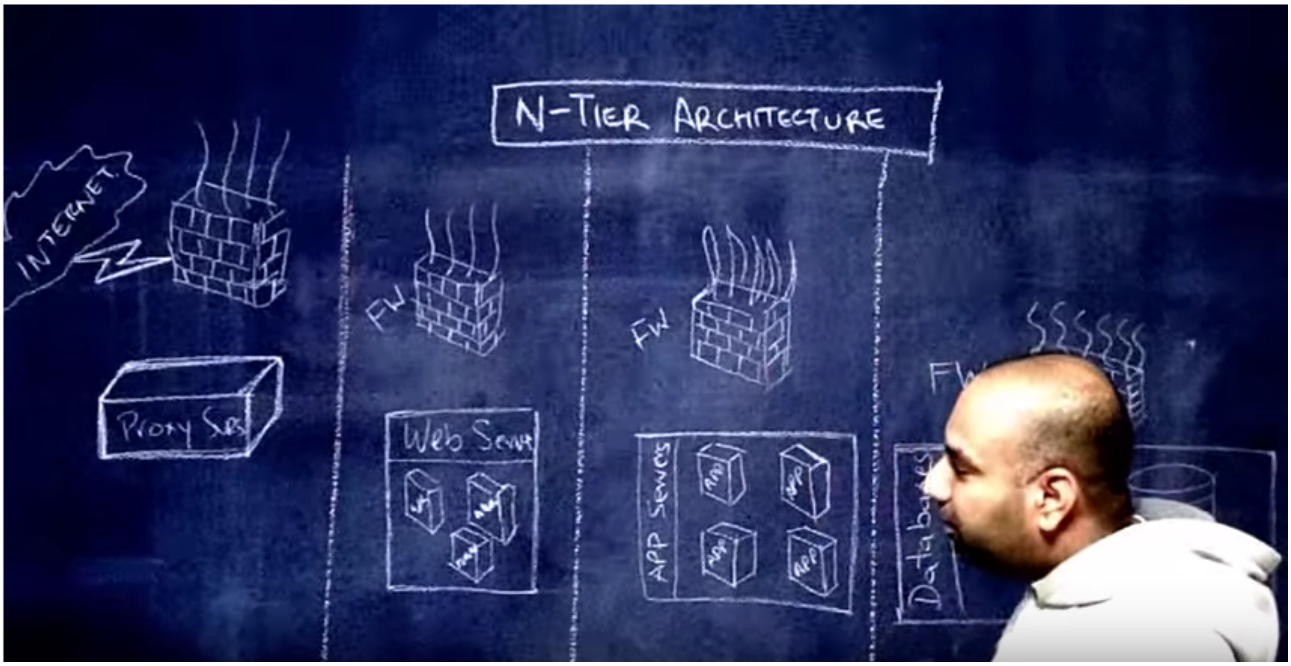
Watch the videos and create a concept map that you can use to answer to the following questions. If you need more information you can use the Web to complete your concept map

1. What are the three logical layers in a multi-layer architecture?
2. How can you organize the three logical layer in a multi-tier architecture?
3. How can you organize the three layers in a multi-tier architecture?
4. What are the main advantages in using multi-tier architecture?



https://youtu.be/KlHvRKSH4pk

n-Tier Architecture Explained – The m-Power Platform



https://youtu.be/8gfTBQhh1kM?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM

N-Tier Architecture for kids – Navneet Grewal

https://youtu.be/E2jFOTDK0tY?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM

Middleware Concepts – Regis University CPS SCIS

Unit 8 - Events order in distributed systems

Vocabulary

Work in pairs and match the words (1-4) with the correct definition (A-D).

1	Process	A	multiple processes are to join up or handshake at a certain point, in order to reach an agreement or commit to a certain sequence of action.
2	Concurrency	B	a system that has no global clock and do not depend on strict arrival time of events for reliable operation; coordination is achieved via some kind of events (packet arrival, changes of signals, handshake protocols, etc.)
3	Synchronization	C	when processes share data and can influence or be influenced by other processes running on the system.
4	Asynchronous	D	an instance of a computer program that is being executed.

Language for thinking: linking words

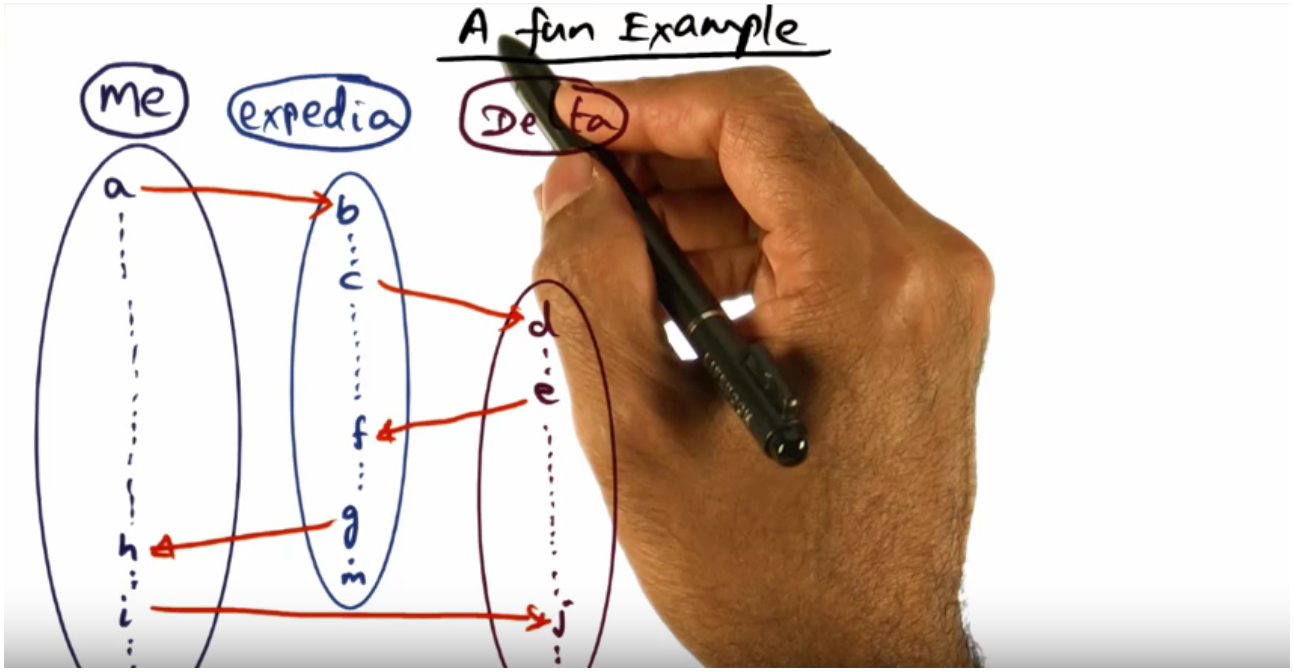
You need some simple linking words and natural phrases to communicate your ideas.

Adding more information	**Time phrases**	**Causes and solutions**
and also as well as another reason is In addition / additionally / an additional Furthermore	now at the moment at present right now these days nowadays in the past before then at that time years ago when I was younger	I guess it's because The main reason is It was caused by Because (of) I suppose the best way to deal with this problem is I reckon the only answer is to The best way to solve this is For Since As
Expressing ideas	**Examples**	**Being clear**
I think one important thing is I guess one difference is I suppose the main difference between X and Y is	for example for instance such as like That is (ie) Including Namely	What I mean is What I want to say is As I was saying
Contrasting and concessions	**Sequence**	**Result**
but on the other hand while or However Nevertheless Nonetheless Still Although / even though Though Yet Despite / in spite of In contrast (to) / in comparison Whereas On the contrary	First / firstly, second / secondly, third / thirdly etc Next, last, finally In addition, moreover Further / furthermore Another Also In conclusion To summarise	So As a result As a consequence (of) Therefore Thus Consequently Hence Due to

Emphasise	**Comparison**	
Undoubtedly Indeed Obviously Generally Admittedly In fact Particularly / in particular Especially Clearly Importantly	Similarly Likewise Also Like Just as Just like Similar to Same as Compare compare(d) to / with Not only...but also	

Concepts by example

Work in pairs and try to answer to the following questions after you have watched the video below. It is important that you try to understand the main concepts of the video, they are explained by an example.

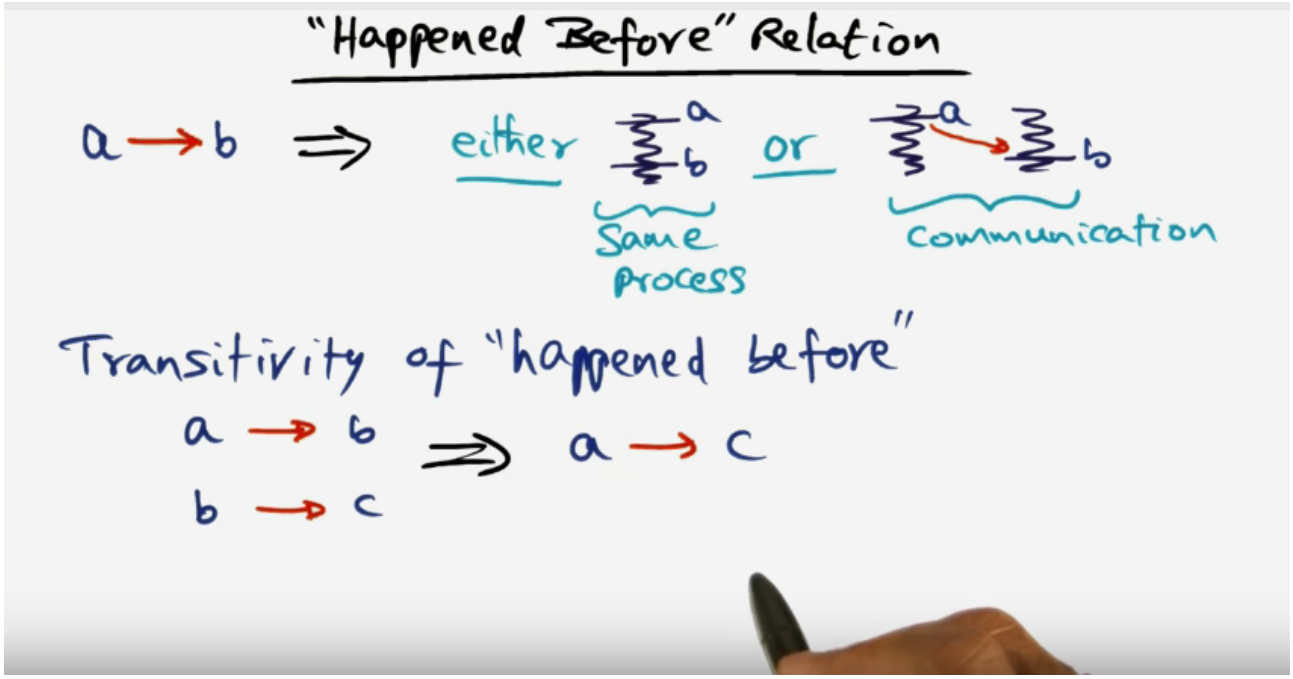


https://youtu.be/HxwBEQphQ5c?list=PLAwxTw4SYaPm4vV1XbFV93ZuT2saSq1hO

A Fun Example - Georgia Tech - Advanced Operating Systems, Udacity

1. What does it means that events are totally ordered within a single process?
2. What is the timing relationship between two processes that communicate using messages?
3. Try to identify the timing relationship among all the events in the video example.

The happened-before relationship



https://youtu.be/gGilgOSYbaI?list=PLAwxTw4SYaPm4vV1XbFV93ZuT2saSq1hO
Happened Before Relationship - Georgia Tech - Advanced Operating Systems, Udacity

The **happened-before relation** of two events in the **same process** means that they are **sequentially ordered**. For instance, if A and B are two events in the same process and A is sequentially before B, then A happened-before B, namely **A → B**.

Similarly, if A is the sending event in a **sender process**, and B is the receiving event in a **receiver process**, then this **communication event** needs that A happened-before B, namely **A → B**.

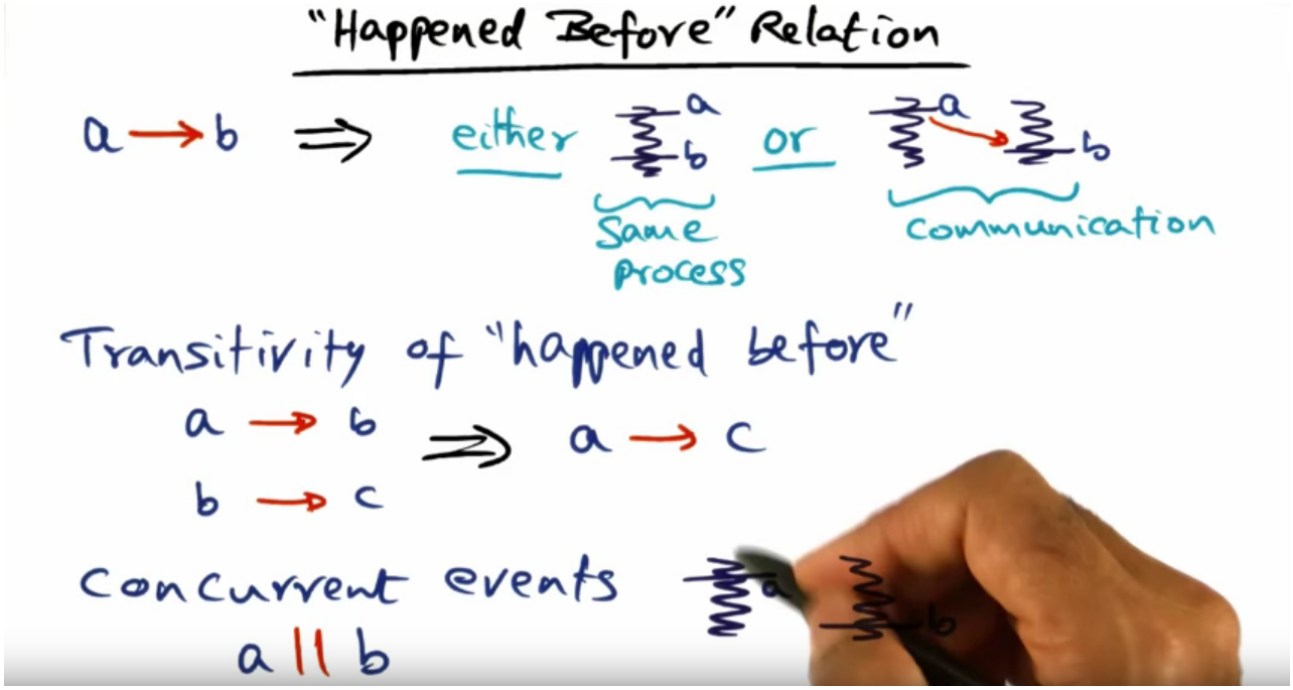
The last property of the happened-before relation is the **transitive property**. If there are three events, regardless if they are process events or communication events, and exist these two happened-before relations: **A → B** and **B → C**, then **A → C**.

Think aloud

Work in pairs and find an explanation about the following questions.

1. In your opinion, why is so important to define a happened-before relation among process and communication events?
2. Giving two processes running in a distributed system, and communicating by messages, is it possible to define a relation among all the events (process and message events) of the two processes?

Concurrent events



https://youtu.be/q-CwESo9UsM?list=PLAwxTw4SYaPm4vV1XbFV93ZuT2saSq1hO
Happened Before Relation (cont) - Georgia Tech - Advanced Operating Systems, Udacity

In a distributed system, if there is **no communication between two events**, A and B, in two different nodes, there is also **no ordering** between them, and they are named **concurrent events**, namely **A || B**.

In this case it is **impossible** to say something about the **ordering** of concurrent events in a distributed system because it is **not possible to determinate a happened-before relation** among them.

Using the **happened-before** relation and the relative **transitive property**, it is possible to **give at best a partial order** for all the events in a distributed system because there are events that are concurrent. **Concurrent processes** are **executed asynchronously** with respect to one another, and in real time the sequence of events in concurrent processes may be completely different in two different executions.

For these reasons, **in structuring a distributed algorithm** it is important to **recognize** what **events** are connected with a **happened-before relationship**, and what events are **concurrent**, in order to **build robust distributed applications**. In fact, the bane of distributed programs are synchronization, communication and timing bugs.

Think aloud

Work in pairs and try to answer to these two questions.

Unit 9 - Clock and time

Unit 10 - Final task.

Create a presentation using what you have learnt about distributed systems. You have to show it to your classmates and answer the questions will be asked you.

References

2veritasium, *Transistors & The End of Moore's Law*, https://youtu.be/rtI5wRyHpTg

A337 | S400, *3 Tier Client Server Architecture*, https://youtu.be/jJYv-nfkMXk?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM

Barbero T., Clegg J., *Programmare Percorsi CLIL*, Carocci, Roma 2005.

Bubble.us, https://bubbl.us/

CLIL Media, http://clilmedia.com/

Cmap, http://www.cmaptools.com/

Christopher Kalodikis, *Client-server model*, https://youtu.be/ntp9XZ4hOrY?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM

English tutorial, http://www.englishpage.com/

G. Coulouris, J. Dollimore, T. Kindberg, G. Blair, *Distributed system*, *Concept and Design*, Fifth Edition, Addison-Wesley, May 2011, http://www.cdk5.net/wp/

Games to learn English, http://www.engames.eu/

Google, http://www.google.it

Grewal, *N-Tier Architecture for kids*, https://youtu.be/8gfTBQhh1kM?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM

C. Kalodikis, *Client-Server Model*, *https://youtu.be/IOnWn5u-sXE*

Kurzgesagt – In a Nutshell, *Quantum Computers Explained – Limits of Human Technology*, https://youtu.be/JhHMJCUmq28

Linking Words for IELTS Speaking: Word List & Tips, http://ieltsliz.com/linking-words-for-ielts-speaking/

ovp , *How Cloud Computing Work*, https://youtu.be/DGDtujmOBKc

Online Courses, *Computer Networks*, https://www.youtube.com/playlist?list=PLkHsKoi6eZnzJl1qTzmvBwTxrSJW4D2Jj

PieterExplainsTech, *UDP and TCP: Comparison of Transport Protocols*, https://youtu.be/Vdc8TCESIg8

S. Haridi, *Distributed Algorithms*, https://www.youtube.com/playlist?list=PL700757A5D4B3F368

Regis University CPS SCIS, *Middleware Concepts*, https://youtu.be/S8sgGXUqw30?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM

Regis University CPS SCIS, *Middleware Architecture*, https://youtu.be/E2jFOTDK0tY?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM

The m-Power Platform, *n-Tier Architecture Explained*, https://youtu.be/KlHvRKSH4pk

Udacity, Georgia Tech, *Advanced Operating Systems part 2 of 4*, https://www.youtube.com/playlist?list=PLAwxTw4SYaPm4vV1XbFV93ZuT2saSq1hO

Udacity, Georgia Tech, *HPCA: Part 5*, https://youtu.be/WKXbvhkzBUo?list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM

WhatIs.com, http://whatis.techtarget.com/

Wikipedia, The Free Encyclopedia, https://www.wikipedia.org/