Exam - sample questions

Explain the lease concept used in ubicomp/Explicați conceptul de leasing utilizat în ubicomp

> 💡 The resources allocated for remote peers are associated with a lease, which has to be renewed regularly. If the lease expires due to a missing renewal, the system can automatically reclaim the associated resources.

Give a practical example (a concrete distributed system other than in the textbook) for the following advantage of a distributed system over other kinds of systems: communication / Dati un exemplu practic (a unui sistem distribuit altul decat cel din manual) pentru urmatorul avantaj al sistemelor distribuite asupra altor feluri de sisteme: comunicare.

> 💡 Apache Kafka employs a distributed design. It is distributed across multiple servers, known as brokers
> • Each broker in the Kafka cluster stores a portion of the data and can serve read and write requests independently.
> • Each broker can communicate with all other brokers in the cluster, creating a network for efficient data transfer.
> • It facilitates real-time event streaming, allowing events to be processed and shared globally without restrictions based on location.
> • Transactions can occur without considering the physical location of the data or processing

Explain the difference between the multicasting and broadcasting techniques / Explicați diferența dintre tehnicile de multicasting și broadcasting.

> 💡 Broadcasting will sent data from one sender to all receivers connected to all possible receivers in the network, it is a one to all communication. In contrast, multicasting is a one to many communication because it will send data from one sender to all registered listeners.
> So → broadcasting - everyone
>   → multicasting - everyone
> **who wants to listen**

Consider a vector of 4 integer elements with given values. Write it in SOAP encoding style / Luați în considerare un vector de 4 elemente întregi cu valori date. Scrieți-l în stil de codare SOAP.

```
[4, 12, 7, 91]

<SOAP-ENC:Array SOAP-ENC:arrayType="xsd:int[4]">
    <SOAP-ENC:int>4</SOAP-ENC:int>
    <SOAP-ENC:int>12</SOAP-ENC:int>
    <SOAP-ENC:int>7</SOAP-ENC:int>
    <SOAP-ENC:int>91</SOAP-ENC:int>
</SOAP-ENC:Array>
```

Servent is referring to:

a. a special type of server

b. double role of client and server

c. the user that serves

d. a tool for cloud computing

Consider a distributed system based on 2 sensors and each of those has associated a process that ensure active replication. What is the degree of fault tolerance in the case when the sensors are expected to fail silent? / Luați în considerare un sistem distribuit bazat pe 2 senzori și fiecare dintre aceștia are asociat un proces care asigură replicarea activă. Care este gradul de toleranță la defecțiune în cazul în care se așteaptă ca senzorii să cada silentios?

> 💡 We know that having k+1 components is enough to provide k fault tolerance.
> We have 2 sensors → k+1=2 → degree of fault tolerance = 1

Explain the difference between the detection approach and the prevention approach used in handling deadlocks / Explicați diferența dintre abordarea de detectare și abordarea de prevenire utilizată la tratarea blocajelor.

> 💡 In detection we let deadlocks occur, we detect them and try to recover.
> In prevention statically make deadlocks structurally impossible.

Explain the difference between the selective broadcast and adaptive broadcast in P2P systems / Explicați diferența dintre difuzarea selectivă și difuzarea adaptivă în sistemele P2P.

> 💡 In adaptive broadcast we can limit the growth of discovery and searching by predefining a resource tolerance level that if exceeded will begin to curtail the process. It requires monitoring resources.

Give a concrete example of a distributed system functionality to explain following concept: Replication transparency / Dati un exemplu concret de functionalitate a unui sistem distribuit pentru a explica urmatorul concept: Transparenta replicarii.

> 💡 We content delivery networks that replicate web content across multiple servers globally.
> The users access websites without knowing that their request may be served by the nearest replica for improved performance.

Which device can be a node in Edge computing environment?

a. Router

b. Car

c. Network switch

d. Sensor

Explain the differences between application virtualization and desktop virtualization / Explicați diferențele dintre virtualizarea aplicației și virtualizarea desktop.

> 💡 In application virtualization, the applications compiled into byte code become logical entities that can be executed on different physical systems.
> In contrast, desktop virtualization makes the graphical console of any supported system into a logical entity that can be accessed and used on different physical computer systems, but it does so using standard client/server display software.

Which statements are true? / Ce afirmații sunt adevărate? Selectați unul sau mai multe:

a. A special compiler reads the client specification and generates the server stub / Un compilator special citește specificațiile clientului și generează stub de server

b. A special compiler reads the client specification and generates the client stub / Un compilator special citește specificațiile clientului și generează stubul clientului

c. A special compiler reads the server specification and generates the server stub / Un compilator special citește specificațiile serverului și generează fișierul stub de server

d. Stubs are usually generated automatically / Stuburile sunt de obicei generate automat

e. A special compiler reads the server specification and generates the client stub / Un compilator special citește specificațiile serverului și generează stubul clientului

Explain the difference between a logical clock and a physical clock./Explicați diferența dintre un ceas logic și un fizic ceas.

> 💡 We speak of logical clocks in the context of a certain class of algorithms where the internal consistency of the clocks matters, not whether they are particularly close to the real time.
>   • For example, it's adequate that all machines agree that is's 10:00 even if it is really 10:02.
> We speak of physical clocks when the following constraint is added: clocks must not only be the same, but must not deviate from the real time by more than a certain amount.

Explain how an UDDI registry can be used / Explicați cum poate fi utilizat un registru UDDI.

> 💡 UDDI registry can be used by providers, who offer services with the purpose of advertising it for clients, to register the service.
> Also, a service requestor can make an inquiry to the UDDI registry to find the information for a specific functionality.

Explain the differences between storage virtualization and operating system virtualization / Explicați diferențele dintre virtualizarea stocării și virtualizarea sistemului de operare

Purpose	Abstracts physical storage resources into a single virtual storage pool	Abstracts the hardware resources of a single physical server to create multiple isolated environments, each with its own OS instance.
Functionality	Aggregates physical storage devices and presents them as logical storage units to users or applications.	Enables the creation of virtual machines (VMs) on a physical server.

💡 In summary, storage virtualization abstracts physical storage resources into a unified storage pool, while operating system virtualization abstracts physical server resources to create multiple isolated environments running on a single server.

What are the "servents"? / Ce sunt "servantii"?

💡 A term formed from server + clients, partners in computing opportunity.

Consider a distributed applications with four processes with the identifiers 1, 2, 3 and 4. The coordinator, process 4 crashes and process 1 identify this situation and starts an election. In the case of a Bully algorithm how many messages are send in the system until the new coordinator is know? And in the case of Ring algorithm?/ Luați în considerare o aplicație distribuită cu patru procese cu identificatorii 1, 2, 3 și 4. Coordonatorul, procesul 4 se blochează și procesul 1 identifică această situație și începe alegerile. În cazul unui algoritm Bully câte mesaje sunt trimise în sistem până când noul coordonator este cunoscut? Și în cazul algoritmului inelului?

💡 Bully algo: A process P holds an election as follows
   1. P sends an ELECTION message to all processes with higher numbers.
   2. If no one responds, P wins the election and becomes coordinator.
   3. If one of the higher-ups answers, it takes over. P's job is done.
When a message of ELECTION arrives from a lower-numbered colleagues, receiver sends OK message back then it holds an election, unless it is already holding one.
Eventually, all processes give up but one.

Process 1 starts election → send messages to process 2, 3, 4 - 3
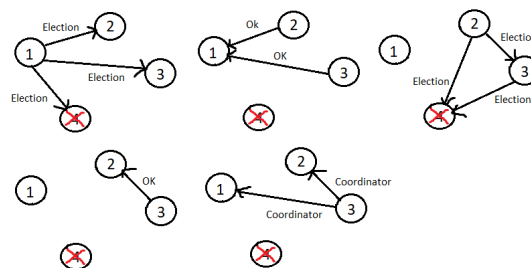Process 2, 3 respond with OK back - 2
Process 2 starts election → send messages to 3, 4 - 2
Process 3 responds with OK back - 1
Process 3 starts election → send message to 4 - 1
Process 3 becomes coordinator → send message to 1,2 - 2
⇒ 11 messages

💡 Ring algo: Each processor knows who its succesor is.
Processor P builds an election containing its process nr and sends the message to its succesor. If succesor is down, sender skips and goes to the next member along the ring. At each step the sender adds it own process nr to the list.
Eventually the message gets back to the process that started it all, message is changed to coordinator and circulated once again (coord. is chosen the largest nr in list)
⇒ 8 messages
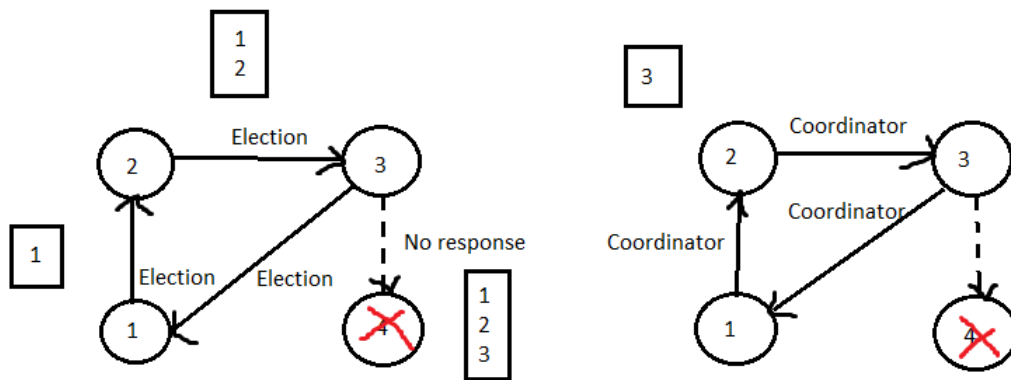
Give a concrete example of a distributed system functionality to explain following concept: Parallelism transparency / Dati un exemplu concret de functionalitate a unui sistem distribuit pentru a explica urmatorul concept: Transparenta paralelismului.

💡 MapReduce Framework a distributed execution framework within Apache Ecosystem. The parallelism transparency is achieved through its programming model. In the mapping step, the data is split between parallel processing tasks.

What is a purpose of an XSD document?/Care este scopul unui document XSD?

💡 An XSD document describes the structure of an XML document. It has information on the tags the corresponding XML document can have, the order of those tags, and so forth.

Give a practical example (a concrete distributed system other than in the textbook) for the following advantage of a distributed system over other kinds of systems: device sharing / Dati un exemplu practic (a unui sistem distribuit altul decat cel din manual) pentru urmatorul avantaj al sistemelor distribuite asupra altor feluri de sisteme: partajarea instrumentelor.

💡 Sharing of computing resources among users in a peer-to-peer (P2P) network for file storage and sharing, such as BitTorrent.

Explain the single-sign-on concept used in Grids / Explicați conceptul de conectare unică utilizat în Grid

💡 Single sign-on restricts the user authentication to one single password (keyboard) specification during a working session;

Which are the disadvantages of a client-server model? / Care sunt dezavantajele unui model client-server?

> 💡 The restriction to procedural programming paradigms excludes other approaches such as functional or declarative programming. Furthermore, even procedural paradigms cannot always ensure that transparency is maintained between local and remote procedure calls since transparency can no longer be achieved in the case of radical system failure. The concurrency mentioned earlier as an advantage can also lead to problems because of its requirement that processes be synchronized.

Which is the improvement in Web evolution provided by Web services? / Care este îmbunătățirea web-ului oferită de serviciile web?

> 💡 WSs separate the Web site or application (the service) from its HTML GUI.
> - the service is represented in XML and available via the Web as XML.
> - enable the application-to-application communication over the Internet

Consider a distributed system based on 3 sensors and each of those has associated a process that ensure active replication. Which is the degree of fault tolerance in the case when the sensors are expected to exhibit Byzantine failures?/Luați în considerare un sistem distribuit bazat pe 3 senzori și fiecare dintre aceștia are asociat un proces care asigură replicarea activă. Care este gradul de toleranță la erori în cazul în care se așteaptă ca senzorii să prezinte defecțiuni bizantine?

> 💡 Minimum of 2k+1 processors are needed to achieve k fault tolerance
> $2k+1 = 3 \Rightarrow k = 1$

Middleware refers to:

- hardware
- software
- neither software, neither hardware

Comment the differences between the RPC and SOA types of a Web service architecture.

RPC	SOA
Communication typically revolves around invoking a procedure or function.	Communication revolves around exchanging messages between services.
Often tightly coupled and more synchronous in nature.	Allows for asynchronous communication and better support for heterogeneous environments.
Focuses on invoking methods/functions remotely.	Prioritizes interoperability, scalability, and flexibility due to loosely coupled services that communicate via messages.

Explain the difference between the ostrich algorithm and the detection approach used in handling deadlocks.

Ostrich	Detection
Prevention strategy where the system ignores the deadlock problem, assuming it won't occur or isn't significant.	Actively identifies deadlock situations within the system.
It does not actively detect or resolve deadlocks but rather avoids addressing them altogether.	It employs algorithms or mechanisms to periodically check for deadlock conditions.

	Once a deadlock is detected, appropriate actions can be taken to resolve it, such as process termination, resource preemption, or rollback.

Explain the difference between a blocking and an non-blocking sending primitive.

💡 Blocking primitives (synchronous primitives) - while the message is being sent, the sending process is blocked suspended.
Non-blocking primitives (asynchronous primitives) - returns control to the caller immediately, before the message is sent.

Explain the differences between machine virtualization and storage virtualization.

	Machine virtualization	Storage virtualization
Definition	Involves creating virtual instances of physical machines, known as virtual machines	Abstracts physical storage resources from the logical view presented to users or applications.
Functionality	It abstracts physical hardware resources, such as CPU, memory, and storage, allowing multiple virtual machines to run simultaneously on a single physical machine.	It aggregates multiple physical storage devices into a single virtual storage pool, which can be dynamically allocated and managed.

Explain the relationship between grids and clusters.

💡 • Grids can be built using clusters as the underlying computing infrastructure. In such cases, clusters serve as the building blocks of the grid.
• Clusters within a grid can be interconnected to form a larger, distributed computing environment

Give a practical example (a concrete distributed system other than in the textbook) for the following advantage of a distributed system over other kinds of systems: reuse.

💡 Authentication service - developed as a standalone microservice responsible for handling user authentication and authorization across multiple applications within an organization's ecosystem.

Reuse: Once developed, the authentication service can be reused across different applications and services within the organization. Instead of implementing authentication logic from scratch in each application, developers can simply integrate the existing authentication service via its API endpoints.

What problem of distributed systems is modelled with the two-army problem?

💡 Achieving consensus or agreement between processors in distributed systems over an unreliable communication channel.

Give an example when Cristian's algo for time synchronization is preferable to the Berkley algo.

> 💡 When the time server is passive so other machines ask it for the time periodically and all it does is respond to their queries.

Consider a vector of 5 string elements with given values. Write it in SOAP encoding style.

```
["mere", "pere", "lamai", "prune", "visine"]

<SymbolList SOAP-ENC:arrayType="xsd:string[5]">
    <symbol>mere</symbol>
    <symbol>pere</symbol>
    <symbol>lamai</symbol>
    <symbol>prune</symbol>
    <symbol>visine</symbol>
</SymbolList>
```

Which cloud resource management topic deals with the selection of an optimal set of physical machines to host virtual machines necessary for an application?
- Resource scheduling
- Resource monitoring
- Resource allocation
- Resource provisioning
- Resource discovery

The amount of network capacity consumed is a metric for:
- performance
- transparency
- flexibility
- scalability
- reliability

What is clock skew?

> 💡 Clock skew is the difference in time values among the clocks of computers in a distributed system due to slight differences in their crystal oscillator rates.

The computational grid:
- is a cluster of clusters
- suceed the metacomputing
- is based on web services
- uses only virtualized resouces

Name two advantages and two disadvantages of distributed systems over centralized ones.

💡 Advantages:
  1. Scalability: Distributed systems can easily scale by adding more machines
  2. Fault Tolerance: Distributed systems offer increased fault tolerance as they can continue operating even if individual components fail.

Disadvantages:
  1. Complexity: Distributed systems are inherently more complex to design, implement, and manage due to the need for communication and coordination among multiple components.
  2. Consistency: Maintaining consistency across distributed data can be challenging and may require complex synchronization mechanisms

Explain the difference between the simple broadcast and adaptive broadcast in P2P systems / Explicați diferența dintre difuzarea selectivă și difuzarea adaptivă în sistemele P2P.

💡 In adaptive broadcast we can limit the growth of discovery and searching by predefining a resource tolerance level that if exceeded will begin to curtail the process. It requires monitoring resources.

Simple broadcast	Adaptive broadcast
System sends the same message to all other peers in the network simultaneously.	Takes into account the state or characteristics of the receiving peers before sending the message.
Easy to implement but may lead to inefficient resource usage and network congestion	Strategies adjust dynamically based on the network conditions and the behavior of peers. More complex to implement

Explain the difference between a synchronous and asynchronous system.

Sync	Async
Events or processes occur in a coordinated manner with a known and fixed timing or schedule.	events or processes occur independently of a fixed timing or schedule.
Actions are initiated and completed according to a common clock or time reference.	Actions can start and finish at any time without waiting for synchronization signals or a common clock.
Processes wait for specific events or signals before proceeding, and there is a predictable order of execution.	There is no strict order of execution, and processes communicate via message passing or other asynchronous mechanisms.

Comment the following key benefit of using Web services: Programming productivity.

💡 Web services, by creating a common programming standard, help to enhance programming productivity. Because Web services introduce a common standard across the Web, vendors, in the interest of staying competitive, are more likely to develop better tools and technologies.

Describe the difference between the notions of ports associated with Java sockets and WSDL.

💡 Java sockets focus on low-level network communication between applications, whereas WSDL ports define endpoints for invoking operations on web services.

Java sockets	WSDL
A port refers to a specific endpoint for communication on a computer network.	A port refers to an endpoint for invoking a specific operation provided by a web service.
It is identified by a numeric value ranging from 0 to 65535, where certain well-known ports are reserved for specific protocols or services	It is defined within a WSDL document as part of a service definition and specifies the address where a particular service can be accessed.

Give two examples that show the difference between a transient facult and an intermittent fault.

💡 1. Network Packet Loss: In a networked application, occasional packet loss occurs due to temporary network congestion or interference.
  • Transient faults are temporary disruptions that occur sporadically and are usually resolved without intervention.

2. Faulty Hardware Connection: A hardware component, such as a loose cable or connector, periodically loses connection, causing intermittent disruptions.
  • Intermittent faults occur unpredictably but tend to reoccur periodically due to underlying hardware issues.

How does the hardware or software components located at networked computers communicate and coordinate their actions in a distributed system?

- Using global memory
- Using a global clock
- Passing messages

Give a practical example (a concrete distributed system other than in the textbook) for the following advantage of a distributed system over other kinds of systems: data sharing.

💡 In a distributed file sharing system like BitTorrent, users across the globe can share and access files stored on their computers with others.
  • Users can share large files, such as movies, software, or documents, by dividing them into smaller chunks and distributing these chunks across multiple peers.
  • Each peer in the network serves as both a client and a server, downloading chunks of files from other peers while simultaneously uploading chunks to others.
  • Data sharing is decentralized, as there is no single central server hosting all the files. Instead, files are distributed across multiple peers in the network.

Web services are supporting:

- machine to machine
- tightly coupled application components
- loosely coupled application components

- human to application interactions

What is specific for Edge and Fog compared with Cloud?
- use of mobile resources
- network traffic
- location awarness

Give a concrete example of a distributed system functikonality to illustrate the following concept: availability.

> 💡 Example: DNS = distributed system responsible for translating human-readable domain names into IP addresses that computers use to locate servers on the internet.
>   • operates using a hierarchical distributed database across multiple servers worldwide. If one server becomes unavailable other servers can handle DNS queries, ensuring continuous service availability.
>   • has load balancing techniques that enhance system availability by ensuring that DNS resolution requests are promptly handled even during periods of high traffic.

Explain the single-compute space used in Grids.

> 💡 In Grid computing, a single-compute space refers to a unified virtual environment where users can access and utilize distributed computational resources seamlessly through a common interface, enabling scalability and resource sharing across heterogeneous systems.