Instructions

INSTRUCTIONS

The exam consists of 7 subparts, corresponding to module 0-6 of the course, with 5 points each.

In order to pass this exam, you must:

1. Score at least 2 points in each of the 7 subparts
2. Score at least 31.5 points in total (90% of the maximum score)

The majority of the problems are multiple choice. For each problem, there is one correct answer or statement.

If you think there is more than one correct answer, pick the best one. Based on the context and what has been covered in the course, use your judgement to select the best answer.

For questions that require an answer in writing, you may answer in English or Swedish. Write brief and clear answers; ambiguous answers will give zero points. Do not answer questions not asked in the exam; stick to answering the asked questions.

If you have a result from part B on the exam that was given in March 2021, that can be accounted for in this exam towards an exam grade of 4 or 5. Otherwise, the exam is only graded U/3.

Assumptions

Assumptions

If you think that some essential information is missing from a question, you should make a reasonable assumption that supports your answer.

In the case that you have to do such an assumption, state that assumption in the text field below. Remember to for each assumption clearly state which question it is related to.

State assumptions here

1 Mixed concepts

In the below table you find 25 statements. Each statement is identified by a single letter label (A-Y).

A	Runs an executable file in the context of an existing process
B	Used to establish or shut down a reliable byte stream service in TCP/IP
C	Requesting service from the kernel of the operating system
D	Solves the problem with external fragmentation
E	Using the same key for encryption as for decryption
F	Requires mutual exclusion
G	Number of processes that complete their execution per time unit
H	A notification sent to a process to notify it of an event that occured
I	Can together with a netmask be used to identify the network prefix of a network
J	Total memory space exists to satisfy a request, but it is not contiguous
K	Amout of time from when a request was submitted until the first response
L	Entire process will block if a thread makes a blocking system call

M	Based upon on random access for coordination
N	A variation on linked allocation
O	Translates local addresses to non-local
P	Assigns a fixed time unit per process, and cycles through them
Q	Provides a service that can deliver messages to a specific process
R	Requires a priori information
S	Can preempt a running job that previously was estimated to finish first
T	Estimate of how much data can be sent without overloading the network
U	Improves virtual address translation speed
V	Zombie-slaying system call
W	Used to translate network layer addresses to physical
X	Architectural principle that promotes parsing data even when it is not perfect
Y	Controls hardware and coordinates its use among different applications

Pair each of the 10 concepts below with the statement (A -Y) above that best describes the concept or best relates to the concept. For each concept, answer by entering the chosen statement label (exactly one letter, A - Y). There are 10 concepts and 25 statements, hence only 10 of the 25 statements will be among the valid pairings.

Grading: Each correct pairing will result in **0.5 point**.

Concept	Statement
Critical section	
Congestion window	
CSMA/CA	
External fragmentation	
ARP	
IP address	
System call	
exec()	
Signal	

Concept	Statement
Wait	

Totalpoäng: 5

2 Transition from user mode to kernel mode

A transition from user mode to kernel mode:

- can only be initiated by a system call.
- can be caused by a system call or interrupt but not by an exception.
- is initiated by the kernel.
- can be caused by an interrupt, exception or a system call.

Totalpoäng: 1

3 System calls

System calls:

- Prior to handling a system call, the caller places the return address on the stack.
- An interrupt is used to initiate a system call.
- An exception is used to initiate a system call.
- System calls are implemented using a special function call from user space to kernel space.

Totalpoäng: 1

4 The process

An executing process:

- is a passive entity stored on secondary storage.
- resides is in memory.
- is an active entity stored on secondary storage.
- is the result of compiling a program.

Totalpoäng: 1

5 Sliding window

Why do we want to use a sliding window at the sender side?
Välj ett alternativ:

- To support pipelined transmissions with selective repeat
- To support reordering of datagrams in the network
- To support varying delays in the network
- To support usage of cumulative acknowledgments

Totalpoäng: 1

6 Internet protocol stack

The Internet protocol stack

The picture below illustrates the four layers in the Internet architecture protocol stack. In the left column, specify the name of each layer. In the right column, specify what is sent at each layer from in the case of an application that uses TCP. Answer by dragging the right term to each box.

Hjälp

Uppermost layer		sends:	
		sends:	
		sends:	
Lowermost layer		sends:	

Request	Session	Network	Routing	Client
Message	Application	Transport	Presentation	Transaction
Segment	Transmission	Control	Physical	Frame
Link	Socket	Packet		

Totalpoäng: 1

7 Process termination

Upon termination of a child process, when is the PCB deleted?

- When the child calls close().
- When the child calls exit().
- When the parent calls wait().
- When the parent calls exit().

Totalpoäng: 1

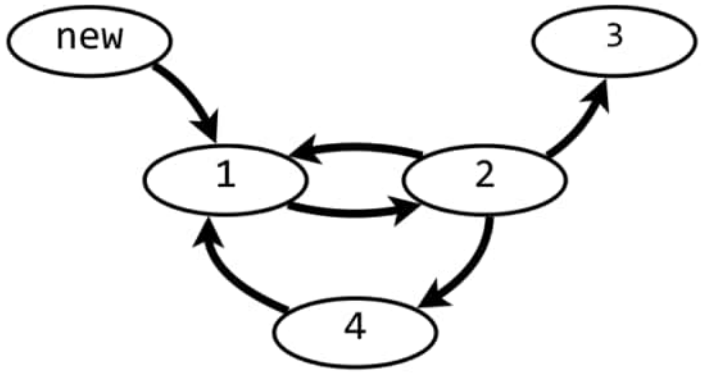
8 The data segment

The size of the data segment:

- is the same for all processes.
- is know at compile time.
- may shrink but not grow during runtime.
- may grow during runtime if necessary.

Totalpoäng: 1

9 Dispatch



A process can transition between various states as depicted in the above diagram. The dispatcher moves a process from state [ ] to state [ ].

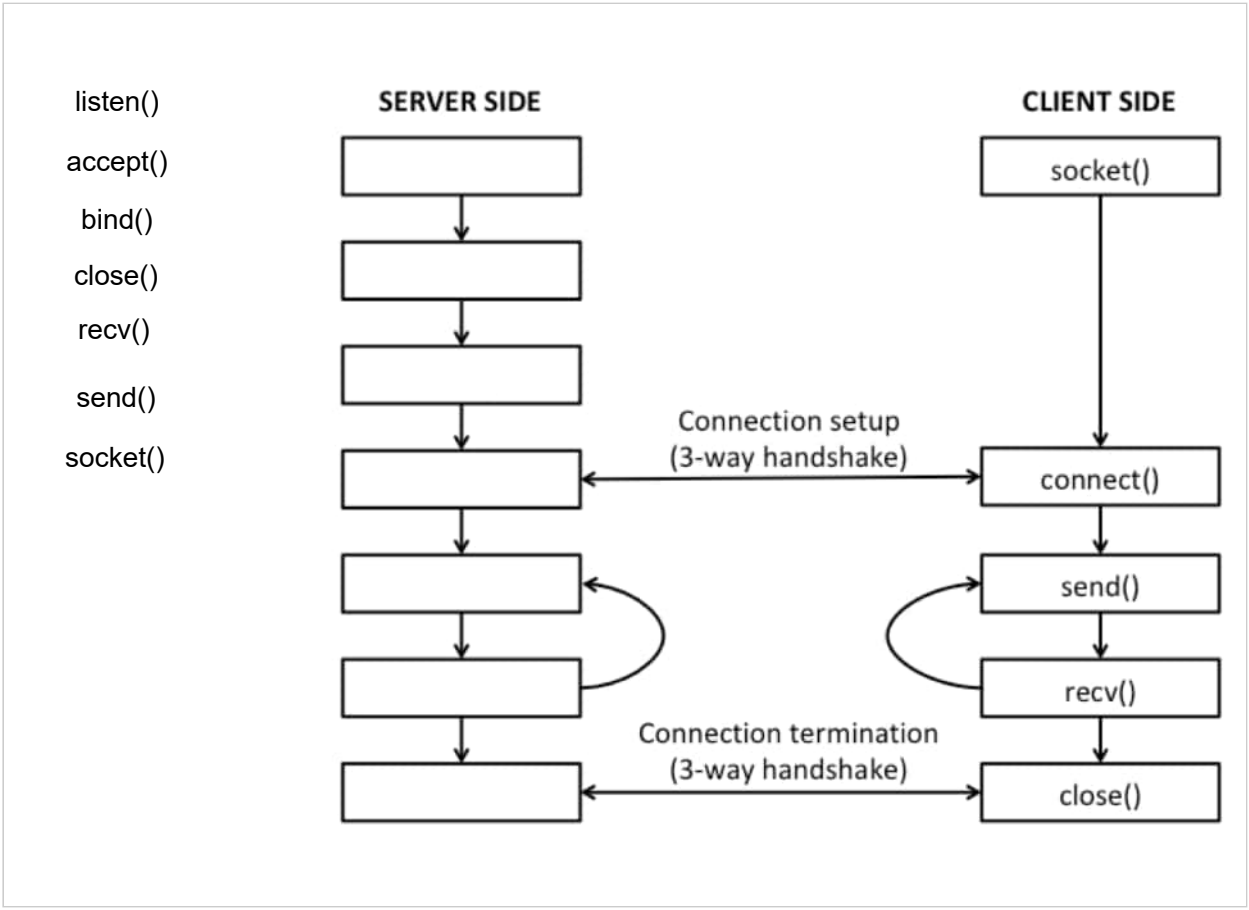
Totalpoäng: 1

10 TCP server sockets API

TCP server using Sockets API

The image below illustrates the system calls involved in setting up a TCP session between a server and a connecting client. Place the system calls on the server side in the correct order. 0.25p for each correctly placed system call, 2p if all are correct.

Drag each system call to the correct empty box



Totalpoäng: 1

11 TCP and UDP

What is true about the differences between TCP and UDP?
Välj ett alternativ:

- TCP establishes a connection before transmission, UDP does not
- TCP is segment-oriented, UDP is datagram-oriented
- TCP is secure, UDP is insecure
- TCP uses a checksum for integrity check, UDP has no checksum

Totalpoäng: 1

12 Process characterization

Interactive processes and batch processes.

- In general, there is no way to distinguish between interactive and batch processes.
- A batch process is always IO-bound.
- In general, batch processes has higher priority than interactive processes.
- A batch process is always CPU-bound.

Totalpoäng: 1

13 RR, q = 3

In a CPU scheduling simulation of **RR with q = 3**, processes arrives to the ready queue according to the following table.

PID	Arrival	CPU burst
1	1	4
2	4	2
3	5	5
4	9	6
5	13	3

If a process is preempted at the same time as a process arrives to the ready queue, the arriving processes should be placed ahead of the preempted process in the ready queue. This means that a process that arrives to the ready queue at the beginning of time slot *N* will always be added to the ready queue before a preempted process that executed in time slot *N-1* is added to the ready queue.

In the simulation trace bellow, fill in the PID of the processes that will execute in each time slot using **RR, q = 3**.

Grading: You must get the schedule exactly right to score 2 points. Even a small misstake will result in 0 points.

Time slot	PID
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

Time slot	PID
12	
13	
14	
15	
16	
17	
18	
19	
20	

Totalpoäng: 2

14 Network address

A network interface is configured to have the IPv4 address *A* with the netmask *M*, where both *A* and *M* can be represented as 32-bit binary numbers.

Now, the computer wants to send an IP packet to a computer with IP address *B*. Which of the following statements is true if the packet can be sent directly to *B* without being sent to the default router for *A.*

Which statement is true if A does not have to send packets to B through its default router?

- (A AND M) is identical to (B OR M)
- (A AND M) is identical to (B AND M)
- (A XOR M) is identical to (B XOR M)
- (A OR M) is identical to (B OR M)

AND, OR and XOR are bitwise operations that works as follows:

x	y	x AND y	x OR y	x XOR y
0	0	0	0	0
0	1	0	1	1
1	0	0	1	1
1	1	1	1	0

Totalpoäng: 1

15 IPv4 addresses

IPv4 addresses are divided into network and host identifiers.
Välj ett alternativ:

- The host identifier can be extracted by using ARP
- The network identifier can be extracted using a netmask
- The network identifier is always shorter than the host identifier
- The host identifier can be extracted using longest prefix matching

Totalpoäng: 1

16 Deadlock

Name		Name	
A	Bounded starvation	K	Mutual exclusion
B	Bounded waiting	L	Mutual starvation
C	Circular inheritance	M	Mutual wait
D	Circular preemption	N	No preemption
E	Circular starvation	O	Petersson's problem
F	Circular wait	P	Petersson's solution
G	Dynamic preemption	Q	Preemption
H	Hold and preempt	R	Preemptive wait
I	Hold and wait	S	Priority inheritance
J	Individual exclusion	T	Priority inversion

Use the letters (A - T) in the above table to name the four necessary conditions for deadlock. One letter for each condition. The order of the names does not matter.

Condition 1:

Condition 2:

Condition 3:

Condition 4:

Totalpoäng: 1

17 Threads

Which of the following statements about threads is correct?

- Threads within a process share stack.
- Threads are guaranteed to execute in parallel with each other.
- Depending on how threads are implemented, storage for the CPU context (registers) for each thread can be kept in either user space or kernel space.
- Threads are always context switched in user space.

Totalpoäng: 1

18 Synchronization

How is synchronization achieved in an Ethernet network?
Välj ett alternativ:

- By sensing for a carrier before attempting to transmit
- With a preamble in every Ethernet frame
- By asking for permission to transmit before sending data frames
- With exponential backoff in case of a detected collisions

Totalpoäng: 1

19 Readers-writers problem

The readers-writers problem

A data set is shared among a number of threads. At any point in time, only one single writer can access the shared data set; any other writers or readers must be blocked. Allow multiple readers to read at the same time, any writers must be blocked.

Below you find the pseudo code for a system implementing the readers-writers problem.

In the init() function a mutex lock **mtx** is initialised to unlocked , a semaphore **wrt** is initialised to 1 and an integer **readers** is initialised to 0. The writers will execute the **writer()** function and the readers will execute the **reader()** function.

Att the correct pseudo code to the **reader()** function by dragging the corresponding line of code to each of the boxes to get a working implementation.

Hjälp

wait(wrt); | unlock(mtx); | readers-- | lock(mtx); | signal(wrt); | readers++

Bla bla bla

Initilisation	Writer	Readers

init() {
  mtx = new_mutex();
  wrt = new_semaphore(1);
  readers = 0;
}
	writer() {
	  wait(wrt);
	
	  // Write shared data
	
	  signal(wrt);
	}
		reader() {
		  [ ]
		  [ ]
		  if readers == 1 {
		  wait(wrt);
		  }
		
		  unlock(mtx);
		
		  // Read shared data
		
		  lock(mtx);
		  [ ]
		  if readers == 0 {
		  signal(wrt);
		  }
		  [ ]
		}

Totalpoäng: 1

20 CSMA/CA

What is an example of a key difference in CSMA/CA, when compared CSMA/CD, in the context of access networks?

In CSMA/CA, the sender...

- asks for permission to send a frame before transmitting it
- waits for a random time when a collision is detected
- listens for activity on the physical medium before transmitting a frame
- partitions each frame into multiple transmissions to avoid starvation

Totalpoäng: 1

21 Unix files

In Unix:

- files are guaranteed to a have a single unique name.
- the file control block (FCB) contains pointers to inodes.
- files are not guaranteed to a have a single unique name.
- the file allocation table (FAT) contains pointers to inodes.

Totalpoäng: 1

22 The TLB

The translation lookaside buffer:

- is used to reduce the time taken to access a user memory location.
- is needed to support shared pages contains a list of all free frames.
- is needed to support shared pages.
- is a replacement for the page table.

Totalpoäng: 1

23 Internet governance

What organisation has the ambition to "*assure the open development, evolution and use of the Internet for the benefit of all people throughout the world*" ?

Välj ett alternativ:

- The Internet Engineering Task Force (IETF)
- The Internet Research Task Force (IRTF)
- The Internet Governance forum (IGF)
- The Internet Society (ISOC)

Totalpoäng: 1

24 End-to-end principle

The end-to-end principle in computer networks was deduced from the end-to-end argument in system design, which is a classic guideline in the design of distributed systems and services. Which of the following is an example of following the end-to-end principle in TCP/IP?

Välj ett alternativ:

- Using the IP TTL field to implement traceroute
- The domain name system (DNS)
- Feedback from routers about status of forwarding queues
- Best-effort delivery of datagrams based on destination address only

Totalpoäng: 1

25 Internet timeline

Below is a list of statements that relate to the development, and use, of the Internet. Associate each statement with a 5-year interval in the table by dragging the statements to the right box.

Hjälp

iPhone is launched and introduces the "mobile Web"

ARPANET connects UCLA and Stanford

The web is invented by Tim Berners-Lee

The first web page in Sweden

ADSL networks are introduced to private homes in Sweden

CYCLADES network is demonstrated

An internet dial-up set is "the christmas gift of the year" in Sweden

A sudden global increase in online teaching creates challenges for Internet service providers

TCP/IP becomes standard in the Internet

The last IPv4 address in Europe is assigned

More than 75% of all traffic in ARPANET is Email

Video streaming services like Netflix and HBO are widely introduced

Year	Event
1965-1969	
1970-1974	
1975-1979	
1980-1984	
1985-1989	
1990-1994	
1995-1999	
2000-2004	
2005-2009	
2010-2014	
2015-2019	

Year
2020

Totalpoäng: 1

26 Attack vectors

What type of attack does salting protect against?
Välj ett alternativ:

- Known plaintext attacks
- Man-in-middle attacks
- Dictionary attacks
- Side-channel attacks

Totalpoäng: 1

27 CAs purpose

What is the main purpose of having CAs?
To simplify...

- construction of keypairs
- verification of public keys
- establishment of private session keys
- management of private keys

Totalpoäng: 1

28 Digital certificates

What is normally not included in a digital certificate issued by a CA?
Välj ett alternativ:

- Information about the identity of the owner of the certificate
- The public key of the issuing CA
- The public key of the owner of the certificate
- A digital signature by the issuing CA

Totalpoäng: 1

29 Denial-of-Service

Assume that a user wants to carry out a Denial-of-Service (DoS) attack against a server on another network, but lacks the opportunity to use many computers for this purpose. Which of the following features of IPv4 could be (ab)used to deploy a small-scale DoS attack against the server?
Välj ett alternativ:

- IPv4 fragmentation
- Translating IPv4 addresses to FQDN
- The IPv4 broadcasting address
- The TTL field in the IPv4 header

Totalpoäng: 1

30 IPsec

When using IPsec in transport mode:
Välj ett alternativ:

- Senders can not be informed of packets dropped due to a zero TTL field
- A network tunnel must be established for transporting encrypted IP packets
- Only the payload of a packet is authenticated or encrypted
- Fragmentation is not allowed

Totalpoäng: 1