DAT204-G utsatt skoleeksamen 26.2.18

DAT204-G, general information

Subject code: DAT204

Subject name: Datakommunikasjon

Date: 26.02.2018

Duration: 3 hours

Permitted aids: Calculator

Comments. The exam is in English and each correctly answered assignment gives from 2 to 10 points, in total

100 points. For each part of an assignment

- Correct answer gives 0.5 – 2 points for each question, depending on difficulty
- Wrong answer gives 0 points for all questions except multiple-answer assignments
- Wrong answer for multiple-answer assignments gives a negative score so that clicking all options in an

  assignment sums up to 0 points. A negative score is not possible.

The exam contains a mix of multiple choice, multiple answer, pull-down menu, fixed-text and calculation

assignments. There is an open text field on the last page which may be used for writing additional comments and

assumptions to the assignments of the exam. This text field does not give any points in itself, but it may impact

the judgement of other assignments. It is not necessary to use the text field, since correct answer on all

questions will give full score.  If the question is not correct, then you may get additional points if you explain

a partially correct solution or good assumption in the text field.

There are also requests for using exam answers for educational and teaching purposes. The University

needs the candidate's permission to use this.  The answer will be anonymous.

Do you permit that your exam answer is used for such purposes?

Select one alternative

○ Yes

○ No

---

1  Mail Access Protocols  (Maks poeng: 2)

Which one(s) of the following protocols are defined as mail access protocols (I.e. IMAP4)?

Select one or more alternatives

☐ HTTP

☐ POP3

☐ Microsoft Outlook

☐ SMTP

☐ IMAP

2  UDP sockets  (Maks poeng: 2)

Below are some statements related to how UDP sockets work. Assume that this application communicates over

one well-known UDP port at the client side with another well-known UDP port at the server side (e.g. client at

port 67/UDP, server at port 68/UDP). Which statement is then true?

Select one alternative

○ UDP traffic towards the same application in a server uses a common socket even if the traffic comes from

different clients.

○ UDP traffic towards the same application in a server uses different sockets when the traffic comes from

different clients.

○ UDP traffic towards different applications in a server uses a common socket if the traffic comes from the

same client.

○ A UDP session socket is identified by the sender and receiver port and IP address.

3 HTTP protocol (Maks poeng: 2)

Below are some statements related to the behaviour of different types of HTTP connections. One of the following

statements is true, select the correct alternative.

Select one alternative

○ A user requests a Web page using HTTP GET that consists of a HTML page and three images. The web

client will then send one request message and receive four response messages from the server.

○ The Date–header in the HTTP response message indicates when the object in the response was last

modified.

○ With non-persistent connections between browser and origin server, it is possible for a single TCP

segment to carry two distinct HTTP request messages.

○ Several Web pages can be sent over the same persistent connection.

4 Packet scheduling (Maks poeng: 2)

Which packet scheduling discipline ensures that each data flow gets an equal share of the total bandwidth, but

does not support assigning different bandwidth shares?

Select one alternative

○ Round Robin (RR)

○ Weighted Fair Queueing

○ Priority scheduling

○ First In First Out (FIFO)

5 HTTP GET request (Maks poeng: 2)

The Wireshark log shows response to a HTTP GET request. How many bytes data are returned to the application

layer from the current TCP segment?

Select one alternative

○ 432

○ 436

○ 490

○ 502

6 Application Layer Protocol (Maks poeng: 2)

Below is a list of protocols. Which one belongs to the application layer?

Select one alternative

○ UDP

○ ARP

○ ICMP

○ SMTP

○ IPv6

7 UDP claims (Maks poeng: 2)

Below are some claims about how the UDP protocol works. Select the correct alternative.

Select one alternative

○ UDP uses go-back-N so that many segments can be sent back to back before receiving an acknowledgement.

○ UDP segments that are received with the wrong checksum are discarded and retransmitted on timeout by

the transport layer.

○ When UDP is used, then any fault correction is up to the application.

○ UDP segments with wrong sequence number are discarded.

8 TCP congestion handling (Maks poeng: 2)

Below are some claims about how the TCP protocol works. Select the correct claim.

Select one alternative

○ Congestion avoidance is related to the Receive window in the TCP header.

○ Fast recovery denotes the phases in a TCP transmission where the congestion window increases

exponentially fast.

○ TCP timer expiry triggers fast recovery.

○ Congestion avoidance denotes the phases in a TCP transmission where the congestion window increases

linearly.

9 TCP sequence (Maks poeng: 5)

Klient/client Tjener/server

Seq = 10, ACK = 20, payload = 30

Seq = a, ACK = b, payload = 50

Seq = 40, ACK = 70, payload = 60

Seq = 100, ACK = 70, payload = 10

Seq = c, ACK = d, payload = 20

Above is an excerpt from a TCP transmission.  What will the sequence number and acknowledgement number

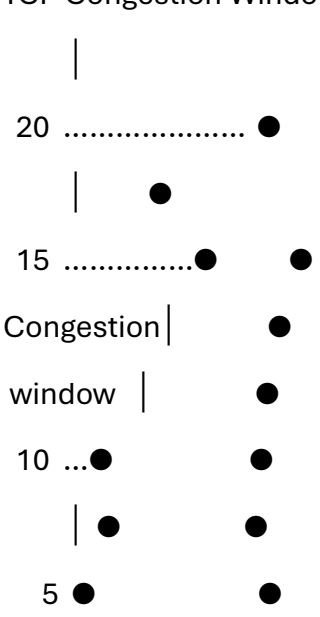
denoted a, b, c and d be in the segments shown in the figure?

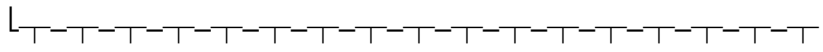
10  TCP congestion window  (Maks poeng: 5)

The third message is lost due to severe congestion in the network (both in forward and backward direction) which

lasts longer than  EstimatedRTT + RxDevRTT.  How does TCP ensure that this message is delivered?

- (Message is retransmitted on timeout.)
- (Message is retransmitted after receiving triple duplicate ACK.)
- (Link layer will ensure reliable data transfer in this case.)
- (Message is dropped, it is up to the application layer to retransmit it.)





1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Transmission round

The figure shows the size of TCP Reno's congestion window in number of segments as a function of

transmission round. Answer the following questions (5 points).

• Identify an interval where slow-start is operating

([1,5], [12,13], [9,10], [5,9])

• How is segment loss identified in transmission round 10?

(Timeout on ACK, Explicit Congestion Notification (ECN), RM cell w/ Congestion indication (CI),

Triple duplicate ACK)

• How is segment loss identified in transmission round 13?

(RM cell w/ CI, Triple duplicate ACK, Timeout on ACK, ECN)

• After segment loss is detected in transmission round 13, what is the slow-start threshold set to?

• Assuming the Maximum Segment Size (MSS) is 1460 bytes and the round-trip time RTT = 200 ms, what is

the average bandwidth in Mbit/s the TCP connection uses in transmission rounds [5,9]?

11 Select protocol (Maks poeng: 2)

Which of the following protocols identify the MAC addresses on the LAN corresponding to the IP addresses of

hosts on the LAN to allow link layer frames being sent from sender to receiver on the LAN segment?

Select one alternative

- ○ IEEE 802.11
- ○ ARP
- ○ DNS
- ○ IP
- ○ ICMP

12 IP Address Assignment (Maks poeng: 2)

How does a host usually get an IP address when it connects to a network?

Select one alternative

- ○ DNS
- ○ ARP
- ○ BGP
- ○ DHCP
- ○ NAT

13 Routing standards (Maks poeng: 2)

What is the de-facto standard for inter-AS routing?

Select one alternative

○ The Distance-Vector Algorithm (DV)

○ BGP – Border Gateway Protocol

○ The Link-State Algorithm (LS)

○ OSPF – Open Shortest Path First

○ RIP – Routing Information Protocol

14 TCP/IP router layers (Maks poeng: 2)

Which layers in the data plane are involved when a router forwards packets from an input port and to an output

port in the router?

Select one or more alternatives

☐ Application layer

☐ Transport layer

☐ Network layer

☐ Link layer

☐ Physical layer

15 Wireshark IPv4 vs IPv6 (Maks poeng: 2)

The Wireshark log in the figure illustrates:

Select one alternative

○ IPv4 tunneling in IPv6

○ Transition from IPv4 to IPv6

○ IPv6 tunneling in IPv4

○ A construction scenario that is not permitted

○ IPv6 traffic

16 Binary to IP (Maks poeng: 2)

The IP address 00111000.11010010.10010101.10010000 can be written on dotted-decimal form as __?

17 IP og subnetting (Maks poeng: 6)

Suppose an ISP owns the block of addresses of the form 104.16.58.0/23. Suppose it wants to create four subnets

from this block, with each block having the same number of IP addresses.

What are the prefixes (of the form a.b.c.d/x) for the four subnets in increasing order?

Subnet 1: 104.16.___

Subnet 2: 104.16.___

Subnet 3: 104.16.___

Subnet 4: 104.16.___

18 Routing tables (Maks poeng: 5)

In this assignment, the objective is to determine the correct forwarding link given the routing table below.

A router has the following routes in its forwarding table

00001010.10101000.00000100.00000000/22 → link 1

00001010.10101000.00000110.00000000/23 → link 2

00001010.10101000.00000111.00000000/24 → link 3

00001010.10101000.00000000.00000000/16 → link 4

All other addresses link 5

Assume the router receives datagrams destined to the following addresses and decide which link they are

forwarded to. On which link will they be forwarded?

A. 00001010.10101000.00000111.00000001 → link ___

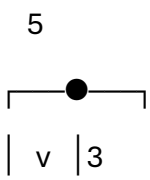
B. 00001010.10101000.00000110.10000000 → link ___

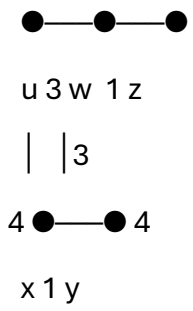
C. 00001010.10101000.00000101.00000000 → link ___

D. 00001010.10101000.00000100.00000001 → link ___

E. 00001010.10101000.00000111.11111110 → link ___

19 Link-state algorithm (Maks poeng: 10)






Run Dijkstra's link-state algorithm on the network of routers shown in the figure.

| Step | N | D(v),p(v) | D(w),p(w) | D(x),p(x) | D(y),p(y) | D(z),p(z) |
|---|---|---|---|---|---|---|
| 0 | {u} | | | | | |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |

Notation

N contains the visited nodes, listed in the order they are visited

D(x) is the distance to node x

p(x) is the previous node along this distance

Use the following 3-character notation for D(x),p(x): integer,letter, e.g. 4,x

If the graph is not reachable, use inf for D(x),p(x)

20 Link layer (Maks poeng: 2)

Below are some general statements about how the link layer works. Select the correct alternative(s).

☐ The link layer is the place in the protocol stack where software meets hardware.

☐ The link layer is implemented only in software.

☐ The link layer is implemented only in hardware.

☐ The link layer performs error detection.

☐ The link layer cannot offer any form of reliable delivery.

21 Link utilisation (Maks poeng: 4)

Consider an intercontinental fibre link between two hosts, where the round-trip delay between these two end

systems, RTT, is 200 ms. Suppose that the size of a packet is 6 000 bytes (including both header fields and

data), and that the transmission rate is 100 Mbit/s.

- What is the transmission delay in microseconds?
- How big would the window size have to be (in number of packets) for the channel utilisation to be greater

  than 98 %? Round up your answer.

22 Transmission and Propagation delay (Maks poeng: 8)

A gamer in Kviteseid is connected to a Massive Multiplayer Online (MMO) server in Oslo. The link distance from

Kviteseid to Oslo is 200 km, and the propagation speed in the medium is 200 000 km/s. The gamer has a

10 Mbit/s Internet connection, and all intermediate routers have low load and negligible transmission delay.

The game exchanges 184-byte game-state messages over TCP between clients and the server. Assume that the

TCP overhead is 20 bytes, the IP overhead is 20 bytes and the link layer overhead (Ethernet) is 26 bytes, and

that each game message is sent in separate TCP packets to increase interactivity.

- What is the length of the link layer frame in bits?
- How large is the transmission delay in ms in this scenario?
- How large is the propagation delay in ms in this scenario?
- What is the minimum round-trip-time (RTT) in ms for the game?

23 Self-learning switches (Maks poeng: 6)

[Figure with four switches S1–S4 and hosts A–I]

The figure above shows a network with four self-learning Ethernet switches and nine hosts. The switches have

just been started, and the switch table is empty.

Assume the following frames are being sent:

D to H

H to B

C to H

Then A to B

How will the switch table in S4 be after this sequence?

Switch table for S4

Address | Interface

———————┼———————————

D | (L3,L1,L2,L4)

H | (L2,L4,L1,L3)

C | (L1,L2,L3,L4)

A,B,E | (L3,L4,L2,L1)

Which hosts receive the last frame?

○ Only B

○ A and B

○ A and C and B

○ All except sender

24 SSL Quality of Service (Maks poeng: 2)

Which service guarantees does SSL give?

Select correct answer(s)

☐ Data confidentiality

☐ Guaranteed bandwidth

☐ Server authentication

☐ Bounded delay

☐ Data integrity

25 SSL certificate (Maks poeng: 2)

What is the digital certificate used for in the TLS/SSL protocol?

Select one or more alternatives

☐ Authenticate the server

☐ Create a signature for SSL messages

☐ Authorise the client to communicate with the server

☐ Use public key to encrypt master secret

☐ Licence for legal sending of SSL messages

26 SSL statements (Maks poeng: 2)

Below are some clauses about the SSL protocol. What is the correct statement about SSL?

Select one alternative

○ SSL connections are closed by terminating the TCP connection.

○ SSL always uses AES after the handshake phase.

○ SSL implements sequence numbers in clear-text in the SSL record.

○ SSL allows agreeing on cryptographic algorithms during the handshake phase.

27 SSL nonces (Maks poeng: 2)

What is the purpose of nonces in SSL/TLS?

Select one alternative

- ○ Data authentication
- ○ Protect against chosen plaintext attacks
- ○ Protect against known plaintext attacks
- ○ Protect against replay attacks
- ○ Protect against Denial of Service attacks
- ○ Protect against man-in-the-middle attacks

28 SSL/TLS master secret encryption (Maks poeng: 2)

For SSL/TLS, how can the client securely send the master secret (MS) to the server?

Select one alternative

- ○ Encrypt the MS with the common session key
- ○ Use the signed hash value of MS as key
- ○ Encrypt the MS with the public key of the server
- ○ Encrypt the MS with the private key of the server

29 Wireshark SSL (Maks poeng: 11)

[Wireshark capture excerpt]

The figure above shows a TCP sequence from Wireshark. Answer the following questions:

- Which link layer protocol is used here? (DHCP, Ethernet, ARP, IP, HTTP, IEEE 802.11)
- Which protocol is encapsulated in the link layer frame? (IP, DHCP, ARP, SMTP, Ethernet, SSL, UDP, HTTP,

  TCP, IEEE 802.11)
- Packet 1821 shows "Win=151168". What type of window is this?

  (Sliding window in number of packets, Window size of the user interface, Congestion window, Receiver window)
- Which phase of a TCP connection do packets 3412-3446 belong to?

  (Data transfer, Three-way handshake, Disconnection, Connection, Listen for new connections (LISTEN))
- Who sends packet 1815? (Client, None, Server, Do not know)
- How many bytes payload are sent in segment 1815? _____
- How many bytes data are sent in the current SSL record? _____
- How many bytes payload have been sent (from client to server) and received in total from the start of the

  session until inclusive packet 3433?

  Sent: _____

  Received: _____
- Which application layer protocol(s) are used here? Select any that apply

  ☐ TCP ☐ TLS ☐ Frame ☐ HTTP ☐ IPv4 ☐ Ethernet

30 Comments and Assumptions (Maks poeng: 0)

Please fill in comments and assumptions for the multiple choice part here. These comments do not give any points

on their own, but may impact the evaluation of these questions.

Write your comments here.

_____