CHALMERS
EXAMINATION / TENTAMEN

Course code/ kurskod	Course name / kursnamn			
EDA387	Computer Networks			
Anonymous code Anonym kod		Examination date Tentamensdatum	Number of pages Antal blad	Grade Betyg
EDA387-16		2013-10-25	11	5

[redacted]

Solved task Behandlade uppgifter. No / nr		Points per task Poäng på uppgiften.	Observe: Areas with bold contour are to be completed by the teacher. Anmärkning: Rutor inom bred kontur ifylles av lärare.
1	X	12	
2	X	4	
3	X	5	
4	X	5	
5	X	5	
6	X	2	
7	X	5	
8	X	6	
9	X	12.5	
10			
11			
12			
13			
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15			
16			
17			
18			
Total examination points Summa poäng på tentamen		56,5	

1

CHALMERS	Anonymous code Anonym kod EDA387-16	Points for question (to be filled in by teacher) Poäng på uppgiften (ifylles av lärare) 12	Consecutive page no. Löpande sid nr 1 Question no. Uppgift nr 1

1a) The user wants to know the mail servers (MX resource records, specified in the first parameter of dig) of the domain chalmers.se (second parameter of dig command). 1

1b) The query is directed to ns1.chalmers.se, as indicated in the third parameter to dig. 1

1c) Yes, the queried server responds with two MX resource records in the answer section. In addition, the IP addresses of these two mail servers are provided in the additional section. 1

1d) The answer is authoritative, since the AA flag („"Authoritative Answer") is set (line 6 of output). Another indicator is the fact that the queried nameserver (ns1.chalmers.se) is also listed in the authority section of the answer. 2

1e) The answer section contains two resource records. The first one states that the host with the domain name "putnam.ita.chalmers.se" is ~~one a~~ ~~mail ser~~ accepts incoming eMails for ~~Ch~~ the domain chalmers.se and that it has a priority preference value of 10. This resource record is allowed to be cached with a timeout of 172800 seconds. 2+

TTL

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1

CHALMERS	Anonymous code	Points for question (to be filled in by teacher)	Consecutive page no. Löpande sid nr 2
	Anonym kod EDA387 - 16	Poäng på uppgiften (ifylles av lärare)	Question no. Uppgift nr 1

1f) These numbers specify the ~~timeou~~ time in seconds, for which the corresponding resource records are allowed to be ~~et~~ cached by other nameservers. It is used by ~~secondary~~ nameservers to ~~et~~ cache obtained answers, which helps to reduce the load on ~~primary~~ authoritative nameservers. 1

1g) MX stands for Mail Exchange. Such a ~~resour~~ RR specifies the SMTP servers that accept incoming eMails for their domain.

NS stands for Name Server and defines usually an authoritative name server in the authority section.

A represents an ~~IP address~~ IPv4 address. It is used to map names to addresses.

AAAA is similar to A, but represents an IPv6 address. 2

1h) The answering server has the IP address 129.16.2.40, as indicated in the footer. 1

1i) The protocol is not explicitly stated, but for such small amounts of data DNS uses commonly UDP. As visible in the footer, port 53 is used by the server. 1

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1

CHALMERS	Anonymous code Anonym kod EDA387-16	Points for question (to be filled in by teacher) Poäng på uppgiften (ifylles av lärare) 4	Consecutive page no. Löpande sid nr 3 Question no. Uppgift nr 2

2a) The scope determines the "network boundary" of the communication to that address. The scope can for example be ~~g~~ global* or restricted to the same subnet (Link-Local).

*What is meant by?

1+

2b) 2ØØ1:6bØ:2:10:: Is the prefix for a ~~global~~ unicast or anycast address with a global scope. 1

FF02:: Is the prefix for a multicast address with a link-local scope. 1

FE80:: is the prefix for a ~~link unicast a~~ Link-Local address with a scope restricted to the same subnet. unicast!

1+

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CHALMERS	Anonymous code	Points for question (to be filled in by teacher)	Consecutive page no. Löpande sid nr 4
	Anonym kod EDA387-16	Poäng på uppgiften (fylles av lärare) 5	Question no. Uppgift nr 3

3a) The link-local address ~~with~~, which is a unicast address with a link-local scope, is configured:

fe80::a288:b4ff:fe5c:c774 1

3b) The node will combine the prefix that is advertised by the router with its interface identifier:

2001:06B0:2:10:A288:B4FF:FE5C:C774.

This is a global unicast address, which can be used to communicate with the Internet. 1

3c) IPv6 uses ICMPv6 messages ~~that are~~ and multicast to allow neighbor discovery, which replaces ARP. A node sends via ICMPv6 a "neighbor solicitation" message to a special multicast group, in order to retrieve the link-layer address on another node. This will respond with a "neighbor advertisement" message, containing the requested address.

3

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4a) Because of limited resources, an actual implementation of the algorithm would very likely use a bounded variable (for example a long integer) for the clock value. As self-stabilizing algorithms do not terminate, it might eventually happen that during a long execution of the system the boundary is reached ~~and~~ and the variable wraps around to a negative or zero value.

1

and then what?

4b) Yes. It is only necessary to change ~~the~~ the assignment in line 8 ~~4~~ to the following:

$$clock_i := (max + 1) \bmod ((n+1)d + 1)$$

5 4

Where d is the diameter of the communication graph.

Explanation:

With an induction over the distance from the processor having the maximum clock value, it can be shown that the algorithm needs d steps to converge to that value. This happens directly when this maximum value is at least d pulses below the upper bound, i.e. it does not wrap around before convergence. In the ~~oter~~ other case, where it wraps around before convergence, it can be shown using the pigeonhole principle, that there are two values x, y which span an interval with a size of at least $d+1$, i.e. $y - x \geq d+1$. When this interval reaches the upper bound of values, it is guaranteed that no wrap-around occurs in at least $d+1$ pulses, allowing the algorithm to converge.

CHALMERS	Anonymous code Anonym kod EDA387-16	Points for question (to be filled in by teacher) Poäng på uppgiften (ifylles av lärare)	Consecutive page no. Löpande sid nr 6 Question no. Uppgift nr 5

5)

Lemma 2.3: For every configuration there exists at least one integer j, such that for every processor p_i, the variable x_i is not equal to j.

Proof: We are going to show that there is one value, which can never be assigned to any register in a ~~specific~~ configuration. 5

We know that any configuration can at most store n unique values, as we have n processors with one register. We further know that the range of values in each register is bounded by mod$(n+1)$ in line 3 of the code. We see clearly that ~~$n < n+1$~~ the number of registers is smaller than ~~the r~~ their value range $(n < n+1)$, which ~~by the application of~~ according to the pigeonhole principle means that even when all registers contain a different value, they can not cover the whole range of possible values and there is one value left, which does not show up in any register x_i for any processor ~~$\neq$~~ p_i in any configuration. □

1

CHALMERS	Anonymous code Anonym kod EDA387-16	Points for question (to be filled in by teacher) Poäng på uppgiften (ifylles av lärare)	Consecutive page no. Löpande sid nr. 7 Question no. Uppgift nr 6

6a) We say that the configuration c is a safe configuration with respect to the set of legal executions, LE, if every system execution that starts from c is in the set of legal executions, LE.

2

6b) We say that execution R is in LE_{leader} if for every configuration in that execution it holds that there exists exactly one processor with the property of being a leader.

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CHALMERS	Anonymous code Anonym kod EDA387-16	Points for question (to be filled in by teacher) Poäng på uppgiften (ifylles av lärare)	Consecutive page no. Löpande sid nr 8 Question no. Uppgift nr 7

7a) A configuration for the shown algorithm is safe, if for every processor p_i the value of $leader_i$ ~~equals the ID of the~~ is equal to the ID of the processor with the smallest ID (p_{min}) and the value of dis_i is equal to the distance of p_i to p_{min}. Furthermore must ~~the~~ for any neighbor p_j the values of $leader_i[j]$ and $dis_i[j]$ be equal to $leader_j$ and dis_j.

who is the leader?

7b) ~~In configuration~~ Starting from config. c, all neighbors of a processor p_i will put correct values in their leader and distance shared registers. At the end of the for loop, after evaluating the shared registers of all neighbors, p_i can only choose the same leader again, as all neighbors advertise the same leader (or p_i is the leader ~~anyway~~ itself). For the distance, it chooses the minimal distance that is advertised by a neighbor + 1, which with an induction over the distance to the leader can be shown to yield the same value as before. As the values for $leader_i$ and $dist_i$ stay the same in c and c', c' is also a safe configuration.

3

5

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CHALMERS	Anonymous code Anonym kod EDA387-16.	Points for question (to be filled in by teacher) Poäng på uppgiften (Ifylles av lärare)	Consecutive page no. Löpande sid nr 9 Question no. Uppgift nr 8

8 a) A safe configuration is defined by the following value of the variant function:

$VF(n, 0, 0, 0)$ 2

Such a configuration means that we have a maximal matching, i.e. all nodes are either matched or single, since the first value of $VF(c)$ is defined as the sum of the number of matched and single nodes ($n = m + s$). The given definitions of the states "matched" and "single" imply the conditions (1) and (2) in the question. 6

8 b) The if-statements do not evaluate to "true" in a safe configuration: 4

Line 2: Is only executed for processors in state "free", which are not present in a safe configuration.

Line 3: Is only executed for processors in state "free", which are not present in a safe configuration.

Line 4: Is only executed for "chaining" ~~and "waiting"~~ processors, which do not exist in a safe configuration.

Thus in all cases $VF(c) = VF(c')$.

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~~8~~

9 a) It could result in process state corruption because of packets that belong to a previous connection.

~~Furthermore it can lead to a connection~~

1.5

Furthermore can it lead to an improper ~~a~~ reset of the connection when the second FIN in the 4-way-handshake is lost.

9b) The number of file descriptors that a process or the whole system is allowed to open simultaneously is ~~usually~~ a hard limit. How much?

0

9c) Congestion control in the Internet is done ~~used~~ using an end-to-end method in the ~~the~~ transport layer, ~~so~~ using protocols like TCP or DCCP.

3p

9 d) Congestion control involves understanding transport layer protocols. Routers do however only understand packets up to network layer, in order to reduce processing complexity.

3p

9e) TCP maintains a congestion window, which allows to reduce the ~~stat~~ sliding window. ~~It is~~ It reacts on duplicate ACKs or timeouts with a multiplicative decrease of the window. Then a slow start and additive increase algorithm is used to approximate ~~a~~ the congestion window.

2p

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CHALMERS	Anonymous code Anonym kod EDA 387-16	Points for question (to be filled in by teacher) Poäng på uppgiften (ifylles av lärare)	Consecutive page no. Löpande sid nr 11 Question no. Uppgift nr 9

9f) The mechanisms can cause timing differences ("Jitter") and slow connection starts.

3p

Therefore buffering is used or ~~UP~~ UDP is ~~used in favor of TCP.~~ preferred over TCP, as less of single packets might be more tolerable than jitter.

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