Computer Networks 2021 Exercises - Unit 5

FAN: scha0174

NOTE: Each student's work unit is unique. You *must* use the work that has been generated for your FAN. If you do not, then you will fail this work unit.

NOTE: You must record your answers in the answer file EXACTLY as required, and commit and make sure your changes have been pushed to the github server, as they will otherwise not be counted.

NOTE: The topic coordinator will periodically run the automatic marking script, which will cause a file called unit5-results.pdf to be updated in your repository. You should check this file to make sure that your answers have been correctly counted. That file will contain the time and date that the marking script was last run, so that you can work out if it has been run since you last changed your answers. You are free to update your answers as often as you wish, until the deadline for the particular work unit.

1 TCP/IP And Related Protocol Packet Formats and Header Fields

For each question, you must record your answer in the unit5-answers.txt file in your git repository. Templates for each answer are provided in unit5-answers.txt *for your convenience.*

You will find information on the packet header formats in many places, including:

- *https://en.wikipedia.org/wiki/Ethernet_frame#Header*

- *https://en.wikipedia.org/wiki/IPv4#Header*

- *https://en.wikipedia.org/wiki/Address_Resolution_Protocol*

- *https://en.wikipedia.org/wiki/Transmission_Control_Protocol#TCP_segment_structure*

- *https://en.wikipedia.org/wiki/User_Datagram_Protocol#UDP_datagram_structure*

Considering the following packet:

```
# 0x0000:   0e51 3bda eaf8 afc7 1203 4621 0806 0001   .Q;.......F!....
# 0x0010:   0800 0604 0001 4cf8 6c51 808f 9978 e377   ......L.lQ...x.w
# 0x0020:   9c81 6276 8412 0a0b 9193 6315 fa79 aad4   ..bv......c..y..
# 0x0030:   2c5e 274f 4c88 8176 bb47 fd02 c66a 422c   ,^'OL..v.G...jB,
# 0x0040:   2dfb 922e 4302 aab6 52ea 6b26 4d4c addd   -...C...R.k&ML..
# 0x0050:   129e cdd6 cd3a 78b9 8093 bf9a 3d47 99fe   .....:x.....=G..
# 0x0060:   b890 848d afc0 4b2c 9d1f 786f 3a0f 103b   ......K,..xo:..;
# 0x0070:   d193 5e13 bae5 fae6                        ..^.....
```

Find the value of the following fields:

Question ID	Field	Type
ab	ARP request	Boolean: Answer Y or N
ac	Frame is 802.1ad	Boolean: Answer Y or N
ad	ARP PTYPE	Integer: Answer with the decimal value of the field.
ae	ETH destination address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
af	ARP target MAC	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
ag	ARP HTYPE	Integer: Answer with the decimal value of the field.

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Considering the following packet:

```
# 0x0000:   1c5b 2d44 66ea a8b2 7b77 afb1 8847 0000   .[-Df...{w...G..
# 0x0010:   9f72 4500 007e 0000 4000 0206 0000 3afa   .rE..~..@.....:.
# 0x0020:   6842 6b4b 445a cf14 0d82 3b51 584e 65bf   hBkKDZ....;QXNe.
# 0x0030:   210c 5011 3820 0000 0002 8002 e8fb 8fd8   !.P.8 ..........
# 0x0040:   1f0c 4c18 3ec5 b4c5 5e87 b724 b4f8 5d3a   ..L.>...^..$..]:
# 0x0050:   423a a935 d9e6 1685 a385 7210 db83 8c07   B:.5......r.....
# 0x0060:   ce87 6478 672d 0e3a d3bf c77a b623 910d   ..dxg-.:...z.#..
# 0x0070:   61c3 1f54 4391 1393 a9ef 84d4 b405 a356   a..TC..........V
# 0x0080:   2037 6a2d 5a4f 7359 09a4 e9a9 c2ce ee0d   .7j-ZOsY........
```

Find the value of the following fields:

Question ID	Field	Type
ah	Frame is 802.1ad	Boolean: Answer Y or N
ai	IP Protocol of payload	Integer: Answer with the decimal value of the field.
aj	IP length	Integer: Answer with the decimal value of the field.
ak	TCP ACK	Boolean: Answer Y or N
al	IP ECN	Integer: Answer with the decimal value of the field.
am	IP source address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21

Considering the following packet:

```
# 0x0000:  7815 daf3 19e9 a187 5b28 7144 8100 06c4  x.......[(qD....
# 0x0010:  0800 4500 003a 0000 0000 3f11 0000 5a59  ..E..:....?...ZY
# 0x0020:  0a6b 7e2b 6d12 e16c 704d 00c0 1bae b7cb  .k~+m..lpM......
# 0x0030:  e8cc 58d1 d81b 0c47 b460 8c22 e662 17cc  ..X....G.`.".b..
# 0x0040:  4d3e 5362 da9e 51ed 7669 a375            M>Sb..Q.vi.u
```

Find the value of the following fields:

Question ID	Field	Type
an	ETH destination address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
ao	IP source address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ap	Frame is MPLS	Boolean: Answer Y or N
aq	UDP destination port	Integer: Answer with the decimal value of the field.
ar	IP Protocol of payload	Integer: Answer with the decimal value of the field.
as	IP destination address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21

Considering the following packet:

```
# 0x0000:  d042 d1ad 370d 763e 8ec8 e335 0800 4500   .B..7.v>...5..E.
# 0x0010:  0058 0000 0000 2011 0000 6dd4 10b2 36fe   .X........m...6.
# 0x0020:  8e0f dcc4 70f7 006a 48b6 55b5 6c3f 1726   ....p..jH.U.l?.&
# 0x0030:  33b2 fd22 046e 49ce f7d5 e84b d818 6d5a   3..".nI....K..mZ
# 0x0040:  e5f6 fddb a181 99c2 b816 9d46 0c65 2910   ...........F.e).
# 0x0050:  ae8e d935 7774 e6ac fdd0 de7e 3276 5d0a   ...5wt.....~2v].
# 0x0060:  557c 42df c983                            U|B...
```

Find the value of the following fields:

Question ID	Field	Type
at	ETH destination address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
au	IP destination address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
av	IP More Fragments	Boolean: Answer Y or N
aw	IP TTL	Integer: Answer with the decimal value of the field.
ax	IP length	Integer: Answer with the decimal value of the field.
ay	Frame is 802.1ad	Boolean: Answer Y or N

Considering the following packet:

```
# 0x0000:   6fa1 dbea fdbb 920b 5960 e652 88a8 3df2   o.......Y`.R..=.
# 0x0010:   0800 4500 0083 0000 0000 1211 0000 36cf   ..E...........6.
# 0x0020:   cbcd fc55 8005 a8f4 e685 008c 7f9b 91de   ...U............
# 0x0030:   f209 db12 0766 1d4f ad56 f7bf 4aaa b2ed   .....f.O.V..J...
# 0x0040:   c2d9 bbc7 8818 3cf0 246b 29d8 e188 02e0   ......<.$k).....
# 0x0050:   0275 f4b8 b9c7 58ee 0c4d 0d5c e8d8 32fa   .u....X..M.\..2.
# 0x0060:   51a3 8b98 f4d1 c64b 89a1 d601 868d eb49   Q......K.......I
# 0x0070:   bc2d 60cb ba0b e0b0 6535 2aed 878e 6fb9   .-`.....e5*...o.
# 0x0080:   afba d1a8 4725 7588 1b48 163c d1be e9f1   ....G%u..H.<....
# 0x0090:   7355 ea0a a6                              sU...
```

Find the value of the following fields:

Question ID	Field	Type
az	UDP source port	Integer: Answer with the decimal value of the field.
ba	IP length	Integer: Answer with the decimal value of the field.
bb	IP Don't Frag	Boolean: Answer Y or N
bc	Frame is 802.1q	Boolean: Answer Y or N
bd	Frame is 802.1ad	Boolean: Answer Y or N
be	ETH destination address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00

Find the value of the following fields:

- bf (ARP HTYPE): 1
- bg (ARP reply): N
- bh (ARP target IP): 11.57.248.141
- bi (Frame is 802.1ad): N
- bj (ARP source MAC): 68:d9:f1:b1:73:17
- bk (ARP target MAC): 56:8d:e5:68:de:57

Considering the following packet:

```
# 0x0000:   5dc1 f5b9 5693 2bf1 2e11 3013 0800 4500   ]...V.+...0...E.
# 0x0010:   0069 0000 4000 2111 0000 743d c52a 77bc   .i..@.!...t=.*w.
# 0x0020:   1d2e 4969 b11c 0099 861a 9501 e40f 7b44   ..Ii.........{D
# 0x0030:   fcb5 2490 a799 acff 6c99 008c 32dc 3195   ..$.....l...2.1.
# 0x0040:   6eb0 25a3 d0df a552 d386 86a0 13c6 1f6c   n.%....R.......l
# 0x0050:   0e8b e3a8 2d13 ffdf 6723 5b9d 6e81 70cb   ....-...g#[.n.p.
# 0x0060:   e045 fe7e 0c1f cc33 73c0 80a7 b794 8866   .E.~...3s......f
# 0x0070:   5dd0 a94e acdb 84                         ]..N...
```

Find the value of the following fields:

Question ID	Field	Type
bl	IP DSCP	Integer: Answer with the decimal value of the field.
bm	UDP destination port	Integer: Answer with the decimal value of the field.
bn	IP length	Integer: Answer with the decimal value of the field.
bo	IP TTL	Integer: Answer with the decimal value of the field.
bp	Frame is 802.1ad	Boolean: Answer Y or N
bq	IP Don't Frag	Boolean: Answer Y or N

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Considering the following packet:

```
# 0x0000:  efc3 e328 6dfd b1ef b1ca 6084 0800 4500   ...(m.....`...E.
# 0x0010:  0045 0000 4000 3d06 0000 3eef cf0e 3817   .E..@.=...>...8.
# 0x0020:  7d9c caa1 59e7 03fa 8c15 3ac3 fb0e 501a   }...Y.....:...P.
# 0x0030:  4432 0000 000a 1ade 9c0d 9d62 8303 8219   D2.........b....
# 0x0040:  6483 0738 a691 31bf 5a54 4f9a d88f 62a7   d..8..1.ZTO...b.
# 0x0050:  ff82 16                                   ...
```

Find the value of the following fields:

Question ID	Field	Type
br	TCP window size	Integer: Answer with the decimal value of the field.
bs	Frame is 802.1q	Boolean: Answer Y or N
bt	TCP URG	Boolean: Answer Y or N
bu	TCP PSH	Boolean: Answer Y or N
bv	IP ToS	Integer: Answer with the decimal value of the field.
bw	TCP RST	Boolean: Answer Y or N

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Answers:

Question ID	Field	Value
bx	IP Protocol of payload	6
by	IP destination address	169.233.134.105
bz	TCP RST	Y
ca	TCP source port	19084
cb	Frame is 802.1ad	N
cc	Frame is MPLS	Y

Considering the following packet:

```
# 0x0000:  b96d e6bc 54e6 8779 72d2 821c 8100 41f9   .m..T..yr.....A.
# 0x0010:  0800 4500 0062 0000 4000 1d06 0000 2ad6   ..E..b..@.....*.
# 0x0020:  6cfd c6c8 8ad6 adcc cba0 5561 7cb0 117b   l.........Ua|..{
# 0x0030:  9863 5028 40e9 0000 0004 c89e 98a0 714a   .cP(@.........qJ
# 0x0040:  ef86 8345 ba54 ecf7 adf7 ab72 a8cc 6f7e   ...E.T.....r..o~
# 0x0050:  eeb8 20f3 55c7 9c5b 7728 2d4e b1ea c7a9   ....U..[w(-N....
# 0x0060:  cc2e 59c2 a7f5 4c3b 4edf 032a ddb6 5efb   ..Y...L;N..*..^.
# 0x0070:  6359 57f9                                 cYW.
```

Find the value of the following fields:

Question ID	Field	Type
cd	TCP ACK sequence number	Integer: Answer with the decimal value of the field.
ce	TCP source port	Integer: Answer with the decimal value of the field.
cf	IP TTL	Integer: Answer with the decimal value of the field.
cg	TCP sequence number	Integer: Answer with the decimal value of the field.
ch	IP ToS	Integer: Answer with the decimal value of the field.
ci	Frame is 802.1ad	Boolean: Answer Y or N

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Considering the following packet:

```
# 0x0000:  9dac b3f3 b014 6468 10e7 f652 8100 4621   ......dh...R..F!
# 0x0010:  0800 4500 008d 0000 4000 2211 0000 d239   ..E.....@."....9
# 0x0020:  6390 02a2 41e6 636f 5333 0077 c711 4dd5   c...A.coS3.w..M.
# 0x0030:  6c5e 90e9 b42c 8e88 8c71 2689 4ab0 b661   l^...,...q&.J..a
# 0x0040:  3c66 6686 1fc8 e90c 05f1 2f04 25ef 4583   <ff......./.%.E.
# 0x0050:  aa63 5b2b a01d 6202 2675 d3e9 7450 fbb6   .c[+..b.&u..tP..
# 0x0060:  469e 9c13 c2f8 dc01 cb40 bea2 45e2 277e   F........@..E.'~
# 0x0070:  c33e c99e f6ed 2f3d 0183 edbe 095d 1933   .>..../=.....].3
# 0x0080:  dba4 37c1 2d9c 4329 fbdc 7bc6 1fe9 b525   ..7.-.C)..{....%
# 0x0090:  48dc 6fb9 ecab 5042 7a90 a5d6 8275 fc     H.o...PBz....u.
```

Find the value of the following fields:

Question ID	Field	Type
cj	IP ECN	Integer: Answer with the decimal value of the field.
ck	ETH frame type	Four-digit Hex: Answer with the four digit hexadecimal value of the field, e.g., 02AF. Do not put a leading 0x or $ on the front of the hexadecimal number.
cl	IP Don't Frag	Boolean: Answer Y or N
cm	IP More Fragments	Boolean: Answer Y or N
cn	ETH destination address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
co	UDP source port	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000:   4a20 4db9 fcd1 ac9a 0231 68c3 8848 0000   J.M......1h..H..
# 0x0010:   f31a 4500 008a 0000 4000 1106 0000 df40   ..E.....@......@
# 0x0020:   cee9 afc6 7b76 d648 da93 65fe 2a36 2ca2   ....{v.H..e.*6,.
# 0x0030:   0a9b 5086 1f89 0000 0000 b8d1 5080 2fbb   ..P.........P./.
# 0x0040:   2c21 8f71 ffd6 6a28 31e4 8928 da62 4c71   ,!.q..j(1..(.bLq
# 0x0050:   ccb9 9e22 fd77 b574 7038 a295 530e 2cbb   ...".w.tp8..S.,.
# 0x0060:   22b8 07d7 a586 9f08 0a27 dc69 9693 d3aa   "........'.i....
# 0x0070:   bc27 6d89 077c d2db e594 6998 ec73 b44b   .'m..|....i..s.K
# 0x0080:   1381 379d 7b78 2ca1 9149 96ec d7ac 3d33   ..7.{x,..I....=3
# 0x0090:   20f0 b72c 973e 724c a8f5 e4a1             ...,.>rL....
```

Find the value of the following fields:

Question ID	Field	Type
cp	TCP ACK sequence number	Integer: Answer with the decimal value of the field.
cq	IP Protocol of payload	Integer: Answer with the decimal value of the field.
cr	IP FLAGS	Integer: Answer with the decimal value of the field.
cs	MPLS TTL	Integer: Answer with the decimal value of the field.
ct	Frame is 802.1ad	Boolean: Answer Y or N
cu	TCP FIN	Boolean: Answer Y or N

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Considering the following packet:

```
# 0x0000:   02b9 a4f8 09b0 f68b b4cd 4389 0800 4500   ..........C...E.
# 0x0010:   003d 0000 0000 0911 0000 ffd6 3794 4b80   .=..........7.K.
# 0x0020:   e2d2 42a2 7829 0093 a693 f2bb 3e03 7e73   ..B.x)......>.~s
# 0x0030:   8caf b1a7 0390 04e4 dcff 89e8 173e 9567   .............>.g
# 0x0040:   5122 9bde 3ba1 4718 f5ef 3d               Q"..;.G...=
```

Find the value of the following fields:

Question ID	Field	Type
cv	IP Don't Frag	Boolean: Answer Y or N
cw	ETH source address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
cx	IP length	Integer: Answer with the decimal value of the field.
cy	IP TTL	Integer: Answer with the decimal value of the field.
cz	IP destination address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
da	ETH frame type	Four-digit Hex: Answer with the four digit hexadecimal value of the field, e.g., 02AF. Do not put a leading 0x or $ on the front of the hexadecimal number.

Considering the following packet:

```
# 0x0000:   a5e0 5121 5d96 39c7 aa06 f516 8848 0000   ..Q!].9......H..

# 0x0010:   a163 4500 0082 0000 0000 2f11 0000 ebd5   .cE......./.....

# 0x0020:   9dc9 d4b9 296d b834 94b5 006d 5d53 fd02   ....)m.4...m]S..

# 0x0030:   bed8 8861 29b3 2ac8 526a ccdb 80a4 5785   ...a).*.Rj....W.

# 0x0040:   d72b 3299 6931 19a0 160a 64f5 e025 7a5d   .+2.i1....d..%z]

# 0x0050:   aed5 3661 61c0 fc77 ea27 83fb cd2c 533e   ..6aa..w.'...,S>

# 0x0060:   c201 80c9 1b0f 3c21 293f 7b83 76a5 274d   ......<!)?{.v.'M

# 0x0070:   7376 64ea d6d5 f3ef 5a57 a88f 6951 bdf9   svd.....ZW..iQ..

# 0x0080:   e671 8dfa e5fd a6a6 c8d6 5c29 31b0 e989   .q........\)1...

# 0x0090:   a08f f7e7                                 ....
```

Find the value of the following fields:

Question ID	Field	Type
db	*Frame is MPLS*	*Boolean: Answer Y or N*
dc	*IP ToS*	*Integer: Answer with the decimal value of the field.*
dd	*IP Protocol of payload*	*Integer: Answer with the decimal value of the field.*
de	*UDP destination port*	*Integer: Answer with the decimal value of the field.*
df	*ETH frame type*	*Four-digit Hex: Answer with the four digit hexadecimal value of the field, e.g., 02AF. Do not put a leading 0x or $ on the front of the hexadecimal number.*
dg	*IP source address*	*IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21*

Considering the following packet:

```
# 0x0000:  cbfd e18e 44ee f7a4 cd29 2f6c 0800 4500   ....D....)/l..E.
# 0x0010:  005e 0000 0000 0311 0000 38cd 0b66 a128   .^........8..f.(
# 0x0020:  dc41 1b33 4748 006c 063a 3165 41e8 9c4c   .A.3GH.l.:1eA..L
# 0x0030:  51bd 2410 28bd 7295 2d08 4744 c458 43fb   Q.$.(.r.-.GD.XC.
# 0x0040:  7f8d bc37 d7a2 3d4e 0b49 c9f5 96de 2841   ...7..=N.I....(A
# 0x0050:  9567 9e93 9069 4de9 44ef 01c9 d8b5 3e48   .g...iM.D.....>H
# 0x0060:  b61a fa89 97f4 8416 b2eb cd55             ..........U
```

Find the value of the following fields:

Question ID	Field	Type
dh	UDP source port	Integer: Answer with the decimal value of the field.
di	Frame is 802.1q	Boolean: Answer Y or N
dj	ETH source address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
dk	Frame is 802.1ad	Boolean: Answer Y or N
dl	IP DSCP	Integer: Answer with the decimal value of the field.
dm	UDP destination port	Integer: Answer with the decimal value of the field.

2 Lecture Material Comprehension

The following questions are designed with two purposes in mind:

1. To help you engage with the lecture materials; and

2. To help generate a wide range of questions for the quizzes in this topic.

The second goal is not mandatory for you. However, if you are willing for the answers you provide to the questions in this section to be used in future quizzes in this topic, you are requested to answer the following question as follows *you will not be penalised if you do not give this permission*

Question#	Description
dn	Are you willing to release your following answers in this section from all copyrights, i.e., release them into the public domain, including so that they can be included in quizzes in this topic? *you will not be penalised or treated any differently if you do not choose to give this permission*

It is important that you answer this question with 'y', if you do decide that you would like to do this (but again, you have no obligation to do so, and you will not be treated differently whether or not you give permission).

The entry in `unit5-answers.txt` would thus look like:

```
# Question 'dn': Do you commit the following answers to the public domain

#  and disclaim all copyrights in them?

dn=y
```

For each question, you must record your answer in the unit5-answers.txt file in your git repository. For each question, you are required to write a statement that is either true or false about the material in the indicated lecture slide.

*For example, if you were asked 'write a **true** statement about the content of Slide 2 of Chapter 1', you would put the statement at the end of the* `rj=` *line in the file* `unit5-answers.txt`*. For example, if your statement was 'One of the problems addressed in this chapter is how to build scalable networks', you would write:*

Question#	Description
pz	*Write a **true** statement about the content of Slide 2 of Chapter 1*

The entry in `unit5-answers.txt` would thus look like:

```
# Question 'pz': Write a true statement about the content of Slide 2 of Chapter 1

pz=One of the problems addressed in this chapter is how to build scalable networks
```

Templates for each answer are provided in `unit5-answers.txt` for your convenience.

If you are asked to write a statement that is false, i.e., untrue, think about statements that someone who has not worked through the material might think would be true. Be creative! Be devious!

Question#	Description
do	Write a **true** statement about the content of Slide 51 of Chapter 6
dp	Write a **true** statement about the content of Slide 28 of Chapter 6
dq	Write a **false** statement about the content of Slide 44 of Chapter 5
dr	Write a **false** statement about the content of Slide 8 of Chapter 4
ds	Write a **false** statement about the content of Slide 78 of Chapter 2
dt	Write a **true** statement about the content of Slide 36 of Chapter 1
du	Write a **false** statement about the content of Slide 89 of Chapter 6
dv	Write a **false** statement about the content of Slide 85 of Chapter 2
dw	Write a **false** statement about the content of Slide 31 of Chapter 3
dx	Write a **false** statement about the content of Slide 3 of Chapter 9