Computer Networks 2021 Exercises - Unit 5

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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:  fa52 2ac3 0484 c58f 9e55 2b58 8847 0001   .R*......U+X.G..
# 0x0010:  0d93 4500 0041 0000 4000 0406 0000 b7ee   ..E..A..@.......
# 0x0020:  2ca0 6854 0965 535a 47e5 3a65 ce60 5734   ,.hT.eSZG.:e.`W4
# 0x0030:  1e4e 50be 1012 0000 000c 88a2 3abd d9f2   .NP.........:...
# 0x0040:  cf81 602d bd86 3ab9 5774 d335 0bf7 9798   ..`-..:.Wt.5....
# 0x0050:  2375 63                                   #uc
```

Find the value of the following fields:

Question ID	Field	Type
ab	MPLS TTL	Integer: Answer with the decimal value of the field.
ac	TCP SYN	Boolean: Answer Y or N
ad	TCP CWR	Boolean: Answer Y or N
ae	IP ECN	Integer: Answer with the decimal value of the field.
af	IP TTL	Integer: Answer with the decimal value of the field.
ag	IP length	Integer: Answer with the decimal value of the field.

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Considering the following packet:

```
# 0x0000:   b3a8 b2dd 1cae d63d 871e 477b 8848 0000   .......=..G{.H..

# 0x0010:   7bbc 4500 0032 0000 0000 3011 0000 1068   {.E..2....0....h

# 0x0020:   5537 695f ef61 7193 616c 006e 7d16 c7a6   U7i_.aq.al.n}...

# 0x0030:   a695 d33c ccee 0af4 3901 b202 400e 4b11   ...<....9...@.K.

# 0x0040:   044f 5005                                 .OP.
```

Find the value of the following fields:

Question ID	Field	Type
ah	IP source address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ai	UDP destination port	Integer: Answer with the decimal value of the field.
aj	IP TTL	Integer: Answer with the decimal value of the field.
ak	IP FLAGS	Integer: Answer with the decimal value of the field.
al	IP TTL	Integer: Answer with the decimal value of the field.
am	IP Protocol of payload	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000:   8733 8751 d9a9 f06b 8a7b d45b 0806 0001   .3.Q...k.{.[....
# 0x0010:   0800 0604 0001 ad3d 3464 f41f 75b4 9827   .......=4d..u..'
# 0x0020:   c8d9 5e12 8868 e297 77f8 209c 4ca7 77ab   ..^..h..w...L.w.
# 0x0030:   5c14 d4dc 0bad 53f6 c9f1 f26a d4a6 602a   \.....S....j..`*
# 0x0040:   dcdf d117 717e 864b e979 25a0 4b63 d780   ....q~.K.y%.Kc..
# 0x0050:   0827 8915 e462 045f 1d4c 09a9 ca81 59c5   .'...b._.L....Y.
# 0x0060:   6e53 9026 950d 2648 2ec2 c9cb 5ab0 f7f3   nS.&..&H....Z...
# 0x0070:   4327 1184 45b8 5673 8288 5004 1306 3547   C'..E.Vs..P...5G
# 0x0080:   bd83 004d de64 7f63 6719 d467 6dd0 e2be   ...M.d.cg..gm...
# 0x0090:   e259 2ed1 36                              .Y..6
```

Find the value of the following fields:

Question ID	Field	Type
an	ARP target IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ao	ARP reply	Boolean: Answer Y or N
ap	Frame is MPLS	Boolean: Answer Y or N
aq	ETH source address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
ar	ETH destination address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
as	Frame is 802.1ad	Boolean: Answer Y or N

Considering the following packet:

```
# 0x0000:   e52c ad53 5c0a 4ab2 a623 8ed8 8847 0000   .,.S\.J..#...G..
# 0x0010:   1773 4500 0074 0000 0000 1711 0000 ac0d   .sE..t..........
# 0x0020:   4719 3a7b 9096 277c ae76 0051 4d2b 6997   G.:{..'|.v.QM+i.
# 0x0030:   ce84 97ce f6cb fef5 dbba d18f 4646 fef8   ............FF..
# 0x0040:   cd55 e1fd 6bdd 0b72 9266 ac85 7ce5 0000   .U..k..r.f..|...
# 0x0050:   8ecb d000 f043 244c 748b 914e 79a8 17d0   .....C$Lt..Ny...
# 0x0060:   ea04 f1f9 4aa5 c60d e9c7 857c 5734 308d   ....J......|W40.
# 0x0070:   db8c dca4 cf99 ba26 11e9 37a9 be13 def1   .......&..7.....
# 0x0080:   b94c 333d bcff                            .L3=..
```

Find the value of the following fields:

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

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Considering the following packet:

```
# 0x0000:   2808 74f2 bc88 8271 3b65 15bb 88a8 59fa    (.t....q;e....Y.
# 0x0010:   0800 4500 0061 0000 4000 0d06 0000 f7df    ..E..a..@.......
# 0x0020:   1c47 23fe fe34 6dff 03a6 73ec 894d 0d96    .G#..4m...s..M..
# 0x0030:   d79a 501d 50a7 0000 0002 a306 7b24 2e46    ..P.P.......{$.F
# 0x0040:   3e15 f460 6697 c3e4 f1f0 51cc 306e 0ffb    >..`f.....Q.0n..
# 0x0050:   4cef 8af0 b362 8244 4e7e d735 e619 51de    L....b.DN~.5..Q.
# 0x0060:   af5d 9d81 a6d3 9325 c0e3 bd34 2120 715c    .].....%...4!.q\
# 0x0070:   3b28 6e                                    ;(n
```

Find the value of the following fields:

Question ID	Field	Type
az	TCP RST	Boolean: Answer Y or N
ba	IP source address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
bb	Frame is MPLS	Boolean: Answer Y or N
bc	IP DSCP	Integer: Answer with the decimal value of the field.
bd	IP ECN	Integer: Answer with the decimal value of the field.
be	TCP CWR	Boolean: Answer Y or N

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Considering the following packet:

```
# 0x0000:   75dc c819 2f14 cef6 4a8c 6c97 0800 4500   u.../...J.l...E.
# 0x0010:   0089 0000 4000 0c06 0000 eac5 ad2d 5267   ....@........-Rg
# 0x0020:   73a0 7a4d 1e76 3b59 862d 1cec 6442 50b4   s.zM.v;Y.-..dBP.
# 0x0030:   4909 0000 0000 e22d 6f01 d39e 78c9 382e   I......-o...x.8.
# 0x0040:   8a67 bd7d f106 57db b23e 4ac3 05d2 814e   .g.}..W..>J....N
# 0x0050:   fd11 ca49 41e1 5ad0 880a 664a 3fd1 710d   ...IA.Z...fJ?.q.
# 0x0060:   76b7 2516 5419 91ee 3978 42b7 d470 83b4   v.%.T...9xB..p..
# 0x0070:   cfe9 ef71 5850 6a3e cb95 d932 5bba e75f   ...qXPj>...2[.._
# 0x0080:   620c 8566 e019 ac82 a3d2 3320 a09a c45e   b..f......3....^
# 0x0090:   919f 061a 85d5 65                         ......e
```

Find the value of the following fields:

Question ID	Field	Type
bf	IP TTL	Integer: Answer with the decimal value of the field.
bg	IP Don't Frag	Boolean: Answer Y or N
bh	Frame is 802.1ad	Boolean: Answer Y or N
bi	IP ToS	Integer: Answer with the decimal value of the field.
bj	IP TTL	Integer: Answer with the decimal value of the field.
bk	TCP FIN	Boolean: Answer Y or N

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Considering the following packet:

```
# 0x0000:   740a 1736 376d f4a4 3cff 8247 88a8 10d0   t..67m..<..G....
# 0x0010:   0800 4500 0069 0000 4000 1906 0000 b09e   ..E..i..@.......
# 0x0020:   0db4 4b0f 627d 1355 90e2 65cd 7877 4147   ..K.b}.U..e.xwAG
# 0x0030:   c0ec 502e 2aa2 0000 0004 9a35 6556 1697   ..P.*......5eV..
# 0x0040:   f214 e1cd fd9e 7b64 6506 da6c 5f18 abe8   ......{de..l_...
# 0x0050:   5d54 6608 871e 0b68 6844 1fce 6401 b625   ]Tf....hhD..d..%
# 0x0060:   1743 5299 3874 8af9 a7c2 c177 bb57 8254   .CR.8t.....w.W.T
# 0x0070:   cc48 fd1f b5c7 499a e01e 18               .H....I....
```

Find the value of the following fields:

Question ID	Field	Type
bl	TCP ACK sequence number	Integer: Answer with the decimal value of the field.
bm	TCP destination port	Integer: Answer with the decimal value of the field.
bn	TCP source port	Integer: Answer with the decimal value of the field.
bo	IP More Fragments	Boolean: Answer Y or N
bp	Frame is MPLS	Boolean: Answer Y or N
bq	TCP FIN	Boolean: Answer Y or N

Considering the following packet:

```
# 0x0000:   a8ac b3e3 53e3 87a9 01f6 260a 8848 0000   ....S.....&..H..
# 0x0010:   b3e7 4500 0088 0000 4000 0c06 0000 b567   ..E.....@......g
# 0x0020:   6a46 42b7 99d8 e065 d993 7edd d4af 5ecf   jFB....e..~...^.
# 0x0030:   84ac 508d c819 0000 0007 898b fbcf d4f3   ..P.............
# 0x0040:   701c e601 d040 1278 2267 e0cd 0324 9e37   p....@.x"g...$.7
# 0x0050:   ae1f 9ae4 8e00 73cd 87ba b707 5fb8 0d6e   ......s....._..n
# 0x0060:   4ca6 ef58 1eab 9855 63bb 2fcc 767f 9dc9   L..X...Uc./.v...
# 0x0070:   919a 71c0 78b9 1680 5bff faf0 6c67 7ff4   ..q.x...[...lg..
# 0x0080:   8743 c0c9 48dc 2697 45b0 2fad ee02 58d0   .C..H.&.E./...X.
# 0x0090:   22b8 aaf8 5e16 856a 9393                  "...^..j..
```

Find the value of the following fields:

Question ID	Field	Type
br	IP DSCP	Integer: Answer with the decimal value of the field.
bs	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.
bt	MPLS last label?	Boolean: Answer Y or N
bu	IP FLAGS	Integer: Answer with the decimal value of the field.
bv	MPLS label	Integer: Answer with the decimal value of the field.
bw	IP destination address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21

Considering the following packet:

```
# 0x0000:   7080 dfc4 5529 6224 80fc 11f4 0800 4500   p...U)b$......E.
# 0x0010:   0049 0000 4000 2b06 0000 950e f297 4d9e   .I..@.+.......M.
# 0x0020:   7604 9a5d 5a75 2f8a b55d 6eb6 65ea 5086   v..]Zu/..]n.e.P.
# 0x0030:   ec80 0000 0003 bd85 1c8b dfe6 d4f4 8f61   ...............a
# 0x0040:   c997 f93e 2c3d c9b6 917f ca43 6fdb 9c40   ...>,=.....Co..@
# 0x0050:   4540 0ea3 6132 a6                         E@..a2.
```

Find the value of the following fields:

Question ID	Field	Type
bx	IP ECN	Integer: Answer with the decimal value of the field.
by	ETH source address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bz	TCP PSH	Boolean: Answer Y or N
ca	IP TTL	Integer: Answer with the decimal value of the field.
cb	Frame is MPLS	Boolean: Answer Y or N
cc	TCP sequence number	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000:   a31c a123 94e6 096c cd0b be75 8100 5905   ...#...l...u..Y.
# 0x0010:   0800 4500 0078 0000 4000 3711 0000 04af   ..E..x..@.7.....
# 0x0020:   3815 9be0 ae61 72f3 f96a 0082 91c2 e8d7   8....ar..j......
# 0x0030:   668a 3dd3 0315 1b6e a720 4569 8ef1 705a   f.=....n..Ei..pZ
# 0x0040:   88f9 a580 fea2 935f 549b 44da 595e 9a92   ......._T.D.Y^..
# 0x0050:   8628 b895 6dfb 293e 9254 f934 6977 b507   .(..m.)>.T.4iw..
# 0x0060:   fb02 ed9f 4ef8 1a7a 42e6 40c6 d772 daf1   ....N..zB.@..r..
# 0x0070:   babd 6b2f 68d5 455e eb82 7f61 7cb2 1a5b   ..k/h.E^...a|..[
# 0x0080:   b4f4 85d4 b634 3a7b 0fce                  .....4:{..
```

Find the value of the following fields:

Question ID	Field	Type
cd	IP More Fragments	Boolean: Answer Y or N
ce	UDP source port	Integer: Answer with the decimal value of the field.
cf	IP ECN	Integer: Answer with the decimal value of the field.
cg	UDP destination port	Integer: Answer with the decimal value of the field.
ch	Frame is MPLS	Boolean: Answer Y or N
ci	IP TTL	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000:   5a8b 7314 58d1 e352 13a3 fb94 0806 0001   Z.s.X..R........
# 0x0010:   0800 0604 0001 ad58 7d1a 6934 3e68 2710   .......X}.i4>h'.
# 0x0020:   49c8 0d3a 758d 2fbf 3a64 b434 a342 b177   I..:u./.:d.4.B.w
# 0x0030:   a023 f6b1 fbd8 de3d 33d5 1e7d ab50 c72f   .#.....=3..}.P./
# 0x0040:   8112 3d93 301b afc3 ea72 832c a28d 81ef   ..=.0....r.,....
# 0x0050:   281e d2be a409 1eb6 2ace b57b cfb5 f2ed   (.......*..{....
# 0x0060:   e222 e46d 303c 40be d0f5 aab3 6563 1c69   .".m0<@.....ec.i
# 0x0070:   79c9 a0ee df50 01ae                       y....P..
```

Find the value of the following fields:

Question ID	Field	Type
cj	ARP target IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ck	ETH source address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
cl	Frame is 802.1q	Boolean: Answer Y or N
cm	ARP HTYPE	Integer: Answer with the decimal value of the field.
cn	ARP source MAC	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
co	ARP reply	Boolean: Answer Y or N

```
# 0x0000:  fd60 2a7c 2602 43ce 183f a49d 8847 0001   .`*|&.C..?...G..
# 0x0010:  092f 4500 004b 0000 4000 1e06 0000 eb74   ./E..K..@......t
# 0x0020:  b382 2877 02f5 bfaf 90e9 4b80 924e 6e4e   ..(w......K..NnN
# 0x0030:  9343 509e 4187 0000 0001 d96a 77b6 af66   .CP.A......jw..f
# 0x0040:  5f7e 4403 865a af77 9452 fbce 7fb8 4b16   _~D..Z.w.R....K.
# 0x0050:  3973 3273 f04b 0de8 ca23 bb11 56          9s2s.K...#..V
```

Find the value of the following fields:

Question ID	Field	Type
cp	TCP CWR	Boolean: Answer Y or N
cq	IP destination address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
cr	TCP sequence number	Integer: Answer with the decimal value of the field.
cs	IP source address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ct	IP TTL	Integer: Answer with the decimal value of the field.
cu	TCP URG	Boolean: Answer Y or N

Considering the following packet:

```
# 0x0000:   e90e 9942 26d4 29da 9853 4118 8848 0000   ...B&.)..SA..H..
# 0x0010:   6548 4500 004f 0000 4000 2311 0000 9a91   eHE..O..@.#.....
# 0x0020:   6de2 fff2 a143 cb34 56b9 0095 23a4 ac0a   m....C.4V...#...
# 0x0030:   3a3a c308 f0cd 1299 9e6b 482a c7c0 f3dd   ::.......kH*....
# 0x0040:   ead6 92e7 1285 74bd 8c45 0026 da72 4631   ......t..E.&.rF1
# 0x0050:   4af6 f657 2fa7 5174 a488 37ea d51d 4a03   J..W/.Qt..7...J.
# 0x0060:   c3                                        .
```

Find the value of the following fields:

Question ID	Field	Type
cv	IP More Fragments	Boolean: Answer Y or N
cw	IP ECN	Integer: Answer with the decimal value of the field.
cx	IP destination address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
cy	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.
cz	IP ToS	Integer: Answer with the decimal value of the field.
da	IP Don't Frag	Boolean: Answer Y or N

Considering the following packet:

```
# 0x0000:   eb95 f8f3 8df9 9711 42f5 1efd 0800 4500   ........B.....E.
# 0x0010:   003c 0000 4000 2b06 0000 6cd6 6152 2a70   .<..@.+...l.aR*p
# 0x0020:   17d7 9688 020c 15be 9abf 7838 1ca0 5001   .........x8..P.
# 0x0030:   43ef 0000 0003 18f2 150d 8cf2 9cd8 9654   C..............T
# 0x0040:   09bf fb08 a57d 45d4 c082                   .....}E...
```

Find the value of the following fields:

Question ID	Field	Type
db	TCP ACK sequence number	Integer: Answer with the decimal value of the field.
dc	TCP SYN	Boolean: Answer Y or N
dd	IP source address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
de	ETH destination address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
df	IP DSCP	Integer: Answer with the decimal value of the field.
dg	IP length	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000:   5fb3 347b 8fd4 f57c 569d 5069 8100 7b00   _.4{...|V.Pi..{.

# 0x0010:   0800 4500 006a 0000 4000 1c11 0000 d0ac   ..E..j..@.......

# 0x0020:   5c15 d5da abcd 402f 4d69 0050 eaba 6c96   \.....@/Mi.P..l.

# 0x0030:   aabc 4051 563c 98d3 6fb7 4bae 9c65 40df   ..@QV<..o.K..e@.

# 0x0040:   1fae a3e2 527d 43bf 548b 0c84 4db0 5559   ....R}C.T...M.UY

# 0x0050:   6604 b883 cde1 88c1 1be6 6dbd 4692 3b3d   f.........m.F.;=

# 0x0060:   5c26 9e92 29b8 b3d0 3e5c 2ef4 4a51 a0e3   \&..)...>\..JQ..

# 0x0070:   37d7 fb0c c6a2 535e a0db 8108             7.....S^....
```

Find the value of the following fields:

Question ID	Field	Type
dh	IP TTL	Integer: Answer with the decimal value of the field.
di	IP Don't Frag	Boolean: Answer Y or N
dj	IP Protocol of payload	Integer: Answer with the decimal value of the field.
dk	IP TTL	Integer: Answer with the decimal value of the field.
dl	Frame is 802.1ad	Boolean: Answer Y or N
dm	IP ToS	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 70 of Chapter 2
dp	Write a **true** statement about the content of Slide 43 of Chapter 7
dq	Write a **false** statement about the content of Slide 47 of Chapter 7
dr	Write a **true** statement about the content of Slide 61 of Chapter 8
ds	Write a **false** statement about the content of Slide 30 of Chapter 7
dt	Write a **false** statement about the content of Slide 1 of Chapter 1
du	Write a **true** statement about the content of Slide 8 of Chapter 4
dv	Write a **false** statement about the content of Slide 13 of Chapter 4
dw	Write a **true** statement about the content of Slide 59 of Chapter 6
dx	Write a **false** statement about the content of Slide 30 of Chapter 3