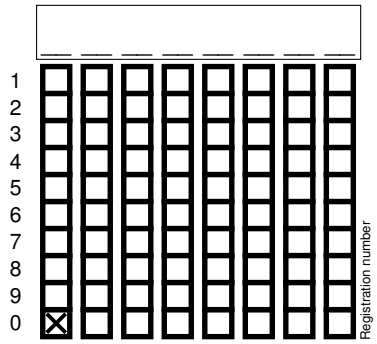
Chair of Distributed Systems and Security
School of Computation, Information and Technology
Technical University of Munich



Signature

Note:
- Cross your immatriculation number in the crossboxes. It will be evaluated automatically.
- Sign in the signature field.
- Allowed tools are only a pocket calculator and an analog dictionary English $\leftrightarrow$ native language without notes.
- Potentially helpful information from the cheat sheet is printed at the page ends.
- Do not write with red or green colors nor use pencils.

This quiz contains multiple choice/multiple answer sub-tasks, i.e. at least one answer option is correct in each case. These sub-tasks are scored with 1 point per correct answer and -1 point per incorrect answer. Missing answers have no effect. The minimum score per sub-task is 0 points.

Do not open the quiz until the start of the working time was announced!

Routing

In the following subtasks we consider a router that should forward a packet with Longest Prefix Matching (LPM).

Entry	Destination	Next-Hop	Iface
①	10.0.0.0/24	192.168.2.254	eth2
②	192.168.1.0/24	0.0.0.0	eth1
③	192.168.2.0/24	0.0.0.0	eth2
④	10.0.0.0/8	192.168.2.254	eth2

Table 1.1: Routing Table A

a)* Using **Routing Table A**, which entry will be selected to forward a packet with destination address **10.0.20.5**?

☐ ① ☐ ② ☐ ③ ☐ ④ ☐ none

b)* Using **Routing Table A**, which entry will be selected to forward a packet with destination address **172.18.3.55**?

☐ ① ☐ ② ☐ ③ ☐ ④ ☐ none

c)* Is there an entry that can be omitted from **Routing Table A** without affecting the result of forwarding decisions, and if so, which one?

☐ ① ☐ ② ☐ ③ ☐ ④ ☐ not possible

Entry	Destination	Next-Hop	Iface
⑤	172.17.0.0/28	0.0.0.0	eth1
⑥	192.168.0.0/25	172.17.0.2	eth1
⑦	192.168.128.0/25	0.0.0.0	eth2
⑧	192.168.0.0/17	0.0.0.0	eth3

Table 1.2: Routing Table B

d)* Using **Routing Table B**, which entry will be selected to forward a packet with destination address **172.17.0.1**?

☐ ⑤ ☐ ⑥ ☐ ⑦ ☐ ⑧ ☐ none

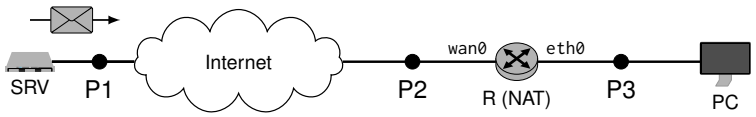
e)* Using **Routing Table B**, which entry will be selected to forward a packet with destination address **192.168.0.254**?

☐ ⑤ ☐ ⑥ ☐ ⑦ ☐ ⑧ ☐ none

dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary
0	00	00000000	16	10	00010000	32	20	00100000	48	30	00110000	64	40	01000000	80	50	01010000	96	60	01100000	112	70	01110000
1	01	00000001	17	11	00010001	33	21	00100001	49	31	00110001	65	41	01000001	81	51	01010001	97	61	01100001	113	71	01110001
2	02	00000010	18	12	00010010	34	22	00100010	50	32	00110010	66	42	01000010	82	52	01010010	98	62	01100010	114	72	01110010
3	03	00000011	19	13	00010011	35	23	00100011	51	33	00110011	67	43	01000011	83	53	01010011	99	63	01100011	115	73	01110011
4	04	00000100	20	14	00010100	36	24	00100100	52	34	00110100	68	44	01000100	84	54	01010100	100	64	01100100	116	74	01110100
5	05	00000101	21	15	00010101	37	25	00100101	53	35	00110101	69	45	01000101	85	55	01010101	101	65	01100101	117	75	01110101
6	06	00000110	22	16	00010110	38	26	00100110	54	36	00110110	70	46	01000110	86	56	01010110	102	66	01100110	118	76	01110110
7	07	00000111	23	17	00010111	39	27	00100111	55	37	00110111	71	47	01000111	87	57	01010111	103	67	01100111	119	77	01110111
8	08	00001000	24	18	00011000	40	28	00101000	56	38	00111000	72	48	01001000	88	58	01011000	104	68	01101000	120	78	01111000
9	09	00001001	25	19	00011001	41	29	00101001	57	39	00111001	73	49	01001001	89	59	01011001	105	69	01101001	121	79	01111001
10	0a	00001010	26	1a	00011010	42	2a	00101010	58	3a	00111010	74	4a	01001010	90	5a	01011010	106	6a	01101010	122	7a	01111010
11	0b	00001011	27	1b	00011011	43	2b	00101011	59	3b	00111011	75	4b	01001011	91	5b	01011011	107	6b	01101011	123	7b	01111011
12	0c	00001100	28	1c	00011100	44	2c	00101100	60	3c	00111100	76	4c	01001100	92	5c	01011100	108	6c	01101100	124	7c	01111100
13	0d	00001101	29	1d	00011101	45	2d	00101101	61	3d	00111101	77	4d	01001101	93	5d	01011101	109	6d	01101101	125	7d	01111101
14	0e	00001110	30	1e	00011110	46	2e	00101110	62	3e	00111110	78	4e	01001110	94	5e	01011110	110	6e	01101110	126	7e	01111110
15	0f	00001111	31	1f	00011111	47	2f	00101111	63	3f	00111111	79	4f	01001111	95	5f	01011111	111	6f	01101111	127	7f	01111111

NAT

In the following subtasks, we inspect an *HTTPS 1.1 GET Response* **sent from the server SRV to the PC**. It is sent in response to a request made to the URL `https://cns.net.in.tum.de`.
The router **R** performs NAT with the NAT-Table given next to the topology. The first entry in the NAT-Table was caused by a no longer connected notebook.
We use the notation *device[.interface].address_type* to refer to the IP/MAC address of an interface of a specific device (e.g. *R7.wan5.IP* or *SRV.MAC*).



Local IP	Local Port	Global Port
Notebook.IP	12345	12345
PC.IP	12345	12346
PC.IP	12346	11755

f)* What is the **Layer 3 Destination Address** in the packet at point **P1**?

☐ unknown ☐ PC.IP ☐ SRV.IP ☐ R.eth0.IP ☐ R.wan0.IP

g)* What is the value of the ***Protocol* Field** in the Layer 3 header in the packet at point **P1**?

☐ 0x06 ☐ 11_{10} ☐ 0x443 ☐ 443_{10} ☐ 0x11 ☐ 0x8000 ☐ 0x86dd

h)* What is the **Layer 4 Source Port** in the packet at point **P1**?

☐ 65535 ☐ 80 ☐ 12345 ☐ 11755 ☐ 1024 ☐ 25 ☐ 443

Now we inspect the effect of the **router R** on the packet from point **P2** to point **P3**.

i)* To what value will the **Layer 2 Destination Address** be changed?

☐ PC.MAC ☐ R.wan0.MAC ☐ R.eth0.MAC ☐ not changed ☐ SRV.MAC

j)* To what value will the **Layer 3 Destination Address** be changed?

☐ PC.IP ☐ not changed ☐ SRV.IP ☐ R.wan0.IP ☐ R.eth0.IP

k)* To what value will the **Layer 4 Destination Port** be changed, given that the Destination Port has the value 12346 at point **P2**?

☐ 11755 ☐ not changed ☐ 443 ☐ 12345 ☐ 80

l)* Which protocol is used **above** the Transport Layer in a typical *HTTPS 1.1 GET Response*?

☐ ARP ☐ NAT ☐ POP3 ☐ SSH ☐ TLS ☐ TCP ☐ HTTP

dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary
128	80	10000000	144	90	10010000	160	a0	10100000	176	b0	10110000	192	c0	11000000	208	d0	11010000	224	e0	11100000	240	f0	11110000
129	81	10000001	145	91	10010001	161	a1	10100001	177	b1	10110001	193	c1	11000001	209	d1	11010001	225	e1	11100001	241	f1	11110001
130	82	10000010	146	92	10010010	162	a2	10100010	178	b2	10110010	194	c2	11000010	210	d2	11010010	226	e2	11100010	242	f2	11110010
131	83	10000011	147	93	10010011	163	a3	10100011	179	b3	10110011	195	c3	11000011	211	d3	11010011	227	e3	11100011	243	f3	11110011
132	84	10000100	148	94	10010100	164	a4	10100100	180	b4	10110100	196	c4	11000100	212	d4	11010100	228	e4	11100100	244	f4	11110100
133	85	10000101	149	95	10010101	165	a5	10100101	181	b5	10110101	197	c5	11000101	213	d5	11010101	229	e5	11100101	245	f5	11110101
134	86	10000110	150	96	10010110	166	a6	10100110	182	b6	10110110	198	c6	11000110	214	d6	11010110	230	e6	11100110	246	f6	11110110
135	87	10000111	151	97	10010111	167	a7	10100111	183	b7	10110111	199	c7	11000111	215	d7	11010111	231	e7	11100111	247	f7	11110111
136	88	10001000	152	98	10011000	168	a8	10101000	184	b8	10111000	200	c8	11001000	216	d8	11011000	232	e8	11101000	248	f8	11111000
137	89	10001001	153	99	10011001	169	a9	10101001	185	b9	10111001	201	c9	11001001	217	d9	11011001	233	e9	11101001	249	f9	11111001
138	8a	10001010	154	9a	10011010	170	aa	10101010	186	ba	10111010	202	ca	11001010	218	da	11011010	234	ea	11101010	250	fa	11111010
139	8b	10001011	155	9b	10011011	171	ab	10101011	187	bb	10111011	203	cb	11001011	219	db	11011011	235	eb	11101011	251	fb	11111011
140	8c	10001100	156	9c	10011100	172	ac	10101100	188	bc	10111100	204	cc	11001100	220	dc	11011100	236	ec	11101100	252	fc	11111100
141	8d	10001101	157	9d	10011101	173	ad	10101101	189	bd	10111101	205	cd	11001101	221	dd	11011101	237	ed	11101101	253	fd	11111101
142	8e	10001110	158	9e	10011110	174	ae	10101110	190	be	10111110	206	ce	11001110	222	de	11011110	238	ee	11101110	254	fe	11111110
143	8f	10001111	159	9f	10011111	175	af	10101111	191	bf	10111111	207	cf	11001111	223	df	11011111	239	ef	11101111	255	ff	11111111

TCP, DNS and Security

m)* What is correct regarding **congestion control**?

- ☐ Attempts to increase load at the sender
- ☐ Attempts to prevent overload at the receiver
- ☐ Adjusts the receive window
- ☐ Adjusts the send window
- ☐ Attempts to prevent overload at the sender
- ☐ Attempts to prevent overload in the network

n)* What is the correct PTR record for the IPv4 address 188.95.232.13 that is reachable under the domain name `cns.net.in.tum.de.` (TTL and Class are omitted)?

- ☐ `188.95.232.13.in-addr.arpa.  PTR  cns.net.in.tum.de.`
- ☐ `13.232.95.188.in-addr.arpa.  PTR  cns.net.in.tum.de.`
- ☐ `cns.net.in.tum.de.  PTR  188.95.232.13.in-addr.arpa.`
- ☐ `de.tum.in.net.cns.  PTR  188.95.232.13`

o)* What is correct regarding **symmetric** encryption?

- ☐ Does not require a secure key exchange
- ☐ Usually quite slow
- ☐ Uses a pair of keys
- ☐ The key is publicly available
- ☐ Usually very fast
- ☐ Implicitly guarantees integrity in a limited way

p)* Which of the following properties are desirable properties of a cryptographic hash function?

- ☐ Variable-Length Output
- ☐ Reversibility
- ☐ Collision Resistance
- ☐ Input Similarity Preservation
- ☐ Second Pre-Image Resistance
- ☐ Pre-Image Preservation

q)* Which of these hash functions should **not** be used for cryptography under any circumstances?

- ☐ MD5
- ☐ BLAKE3
- ☐ BLAKE2
- ☐ SHA-3
- ☐ SHA-2
- ☐ KangarooTwelve

IP Protocol and Next Header Numbers

No / NH	Protocol
0x01	ICMPv4 (Internet Control Message P.)
0x06	TCP (Transmission Control Protocol)
0x11	UDP (User Datagram Protocol)
0x2c	Fragment Header
0x2f	GRE (General Routing Encapsulation)
0x3a	ICMPv6 (ICMP for IPv6)
0x3b	No Next Header
0x84	SCTP (Stream Control Transmission P.)

Selected well-known Ports

Port	Service Name	Port	Service Name	Port	Service Name
20	ftp (data)	53	domain (dns)	115	sftp
21	ftp (command)	67	bootps/dhcp server	143	imap
22	ssh	68	bootpc/dhcp client	443	https
23	telnet	69	tftp	514	syslog
25	smtp	80	http	546	dhcpv6-client
43	whois	110	pop3	547	dhcpv6-server

Application Layer - DNS

DNS Resource Records

Record Type	Function
SOA	(Start of Authority) marks the root of a zone
NS	specifies the FQDNs of authoritative name servers of a zone
A	associates an FQDN with an IPv4 address
AAAA	associates an FQDN with an IPv6 address
CNAME	Alias that maps to a „Canonical Name“ which itself is an FQDN
MX	associates an FQDN with a mail server
TXT	associates an FQDN with a string (text)
PTR	associates an IPv4 or IPv6 address with an FQDN (Reverse DNS)

Reverse DNS Zones

IPv4: `in-addr.arpa.`, IPv6: `ip6.arpa.`