Anonymous ID

Answer sheet 1 of 2 for the NETMET 2021-2022 midterm exam

Multiple choice questions

M1	M4	M7	M10
M2	M5	M8	M11
M3	M6	M9	M12

Short answer questions

S1

S2

S3

S4

Anonymous ID

Answer sheet 2 of 2 for the NETMET 2021-2022 midterm exam

Multiple choice questions

M13	M16	M19
M14	M17	M20
M15	M18	M21

Short answer questions

S5

S6

S7

NETMET 2021-2022
Midterm exam – 23 November 2021
Duration: 1 ½ hours

Allowed: English dictionary or bilingual dictionary (printed books only, with no written notes)

Not allowed: Documents, computers, pocket calculators, mobile phones, etc.

Answer sheet and anonymous ID

The first sheet of paper in this exam is your answer sheet. It bears an anonymous ID number. This number, recorded on the attendance sheet for the exam, provides the connection between your answer sheet and your identity.

Please do not write your name on the answer sheet.

You will submit only the answer sheet at the end of the exam.

Multiple-choice questions numbered M1, M2, … (1 point each)

The multiple-choice questions each have four possible answers: A, B, C, and D.

A fifth choice X indicates "no answer". Mark your answers by writing A, B, C, D, or X in the box alongside the question number.

For each multiple-choice question, there is only one correct answer.

- Correct answer = 1 point
- Incorrect answer = ½ a point subtracted
- No answer = 0 (no points gained, none lost either)

Because of the penalty for an incorrect answer, it is not in your interest to make a random guess.

If there is ambiguity, and we cannot tell which answer you have provided, we will need to mark the answer as incorrect.

Short answer questions numbered S1, S2, … (1 point each)

Please use the space provided in which to write your answers to the short answer questions.

Additional remarks

Do not hesitate to raise your hand with any questions you might have. Best wishes for a successful exam!

Multiple choice questions for Answer Sheet 1

M1. Which of the following measurement tools performs passive measurements:

A) Ping
B) Tcpdump
C) iperf
D) Traceroute

M2. Consider RTT(X,Y) to be the round-trip time between X and Y, and delay(X,Y) to be the propagation delay between nodes X and Y. Bob was running some network measurements and obtained the below results.

i. RTT(X,Y) < 1 second
ii. RTT(X,Y) < delay(X,Y)
iii. RTT(X,Y) < 0

Which of the above test results indicate measurement errors?

A) All test results indicate measurement errors
B) Only result iii indicates measurement errors
C) Results ii, iii indicate measurement errors
D) None of these results indicate measurement errors

M3. Select the **false** statement:

A) To conduct active measurements of end-to-end paths, one must have direct access to routers within the network
B) Passive measurements collected from an end-host are useful for diagnosing the behavior of applications running on this host
C) Direct access to routers is essential to monitor routing protocol exchanges
D) Passive measurements raise privacy concerns

M4. Which of the following methods can be used to measure the available bandwidth on an end-to-end path?

A) Packet-pair method
B) Size-delay method
C) Stop-and-wait method
D) None of the above

M5. Which of the following statements is **true** about iperf?

A) It is an active measurement approach
B) It can be used to measure Bulk Transfer Capacity
C) It requires control of both the source and destination of a path
D) All of the above

M6. Packet-pair method estimates the capacity from the inter-probe gap. In the following example, what is the capacity of the narrowest link if the obtained inter-probe gap at B is 4 seconds; assuming no cross traffic on the path and that probes of size 1500 bytes were sent from A back-to-back?

A) 10 Mbps
B) 3 Mbps
C) 100 Mbps
D) None of the above

M7. Which of the following statements is **true**?

A) When running packet capture on an end host, it is only possible to capture packets destined to this end host
B) Flow capture provides the finest granularity of traffic measurement
C) With packet-sampling, flow records are created over the sampled packets only
D) All of the above

M8. Different traffic properties can be measured with different tools. Which of the following accurately matches the measured traffic properties with the measurement tool?

A) Packet count and flow arrivals, with packet capture
B) Traffic mix and bytes count, with interface counts
C) Packet arrivals and flow duration, with flow capture
D) None of the above

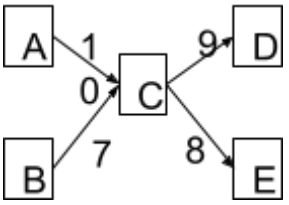
M9. Select the **true** statement about measuring network traffic with interface counts.

A) Routers periodically push their interface counts to a collection server
B) One disadvantage of interface counts is that it is not universally supported
C) One advantage of interface counts is that it has little impact on routers and requires little storage needs
D) None of the above

M10. Given the wide adoption of encryption today, how do network operators identify applications in the traffic crossing their networks?

A) Port-based identification
B) Content-based identification
C) Behavior-based identification
D) None of the above

M11. In the topology below, nodes represent border routers in a small network and links are annotated with the byte count in MB during a 5-minute interval (note that links are directed according to traffic flow). Select the **true** statement about the traffic matrix of this network.



A) There is only one possible traffic matrix for this network and it is represented in the following table:

	D	**E**
A	4	6
B	5	2

B) We cannot infer the traffic matrix from these measurements. If we use SNMP to collect byte counters from router A, then we will be able to find the traffic matrix

C) We cannot infer the traffic matrix from these measurements. If we use Netflow to collect flow statistics from router A, then we will be able to find the traffic matrix

D) None of the above

M12. The following table presents the PoP-PoP traffic matrix of Internet2 in April 2004 (in Mbps). This matrix uses a 5-min time bin. Select the **true** statement:

	Destination												
Source	1	2	3	4	5	6	7	8	9	10	11	12	Row sum
1	0.07	0.07	0.43	0.00	0.06	0.12	0.06	0.00	0.05	0.00	0.00	0.25	1.12
2	0.00	4.09	6.42	0.06	7.07	4.42	1.59	0.02	3.24	0.03	0.16	11.09	38.18
3	0.00	4.70	25.48	4.11	13.99	11.53	3.31	87.27	5.22	0.01	0.08	7.70	163.38
4	0.00	1.93	10.25	1.68	5.63	6.11	2.59	0.01	4.11	2.60	0.04	5.92	40.88
5	0.00	4.76	0.25	0.01	24.06	0.04	0.01	0.02	1.24	0.02	0.03	18.05	48.49
6	0.00	2.87	23.73	1.55	13.53	4.78	2.89	0.01	9.45	0.08	0.50	7.64	67.02
7	0.00	0.67	4.79	1.92	3.50	2.24	1.25	0.00	0.93	0.02	0.03	3.31	18.67
8	0.00	4.18	2.58	5.80	26.35	0.17	0.16	1.41	10.88	2.11	3.64	16.67	73.97
9	0.00	8.61	12.34	5.71	18.21	11.05	3.84	0.41	36.36	0.02	0.52	17.31	114.37
10	0.00	0.18	0.04	1.71	1.69	0.00	0.06	5.61	0.96	1.82	8.44	0.36	20.86
11	0.00	3.47	3.28	0.54	8.60	0.13	0.93	3.92	1.77	0.81	0.61	2.32	26.38
12	0.00	18.20	16.04	0.83	34.03	11.18	5.64	0.09	25.57	0.08	0.80	47.02	159.47
Column sum	0.07	53.74	105.61	23.94	156.73	51.76	22.34	98.77	99.77	7.59	14.84	137.65	772.80

A) Given that network operators cannot measure the traffic matrix directly, the data in this table must have been estimated from SNMP counts

B) We observe that the volume of inter-PoP traffic is mostly symmetric

C) PoP-12 has the highest volume of intra-PoP traffic

D) All of the above

S1. Network measurement is essential for different entities. List two examples and give a reason why each entity needs to conduct network measurements.

S2. List which bandwidth metrics the “self-induced congestion” method can measure, and briefly explain how this method achieves this.

S3. How can we capture packets on a point-to-point link? List at least two different ways to achieve this and briefly explain one advantage and one limitation of each approach.

S4. Describe the two different types of traffic matrices.

Multiple choice questions for Answer Sheet 2

M13. In latency measurements, what is the order of magnitude of propagation delays for packets travelling across a country the size of France?

A. Nanoseconds
B. Microseconds
C. Milliseconds
D. Seconds

M14. In latency measurements, what is the order of magnitude of propagation delays for packets travelling across a country the size of France?

A) Nanoseconds
B) Microseconds
C) Milliseconds
D) Seconds

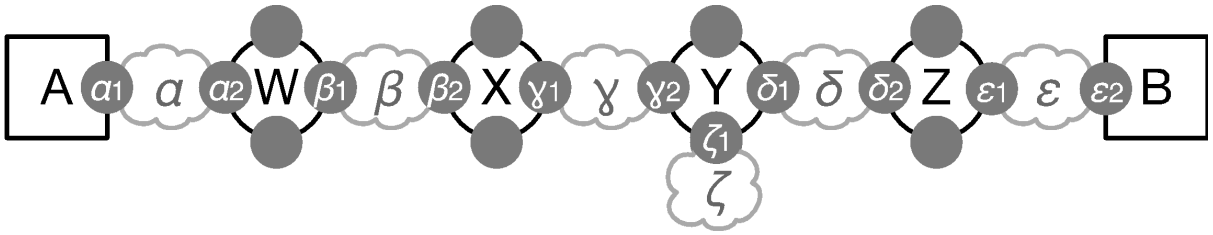
M15. At which layers of the network stack are queueing delays encountered?

A. application
B. TCP/UDP
C. IP
D. MAC & PHY

M16. Which of the following factors contribute to transmission delay?

A. CSMA/CD backoffs
B. frame size
C. the bandwidth of the transmission medium
D. all of the above

M17. Suppose a traceroute from A to B in the topology below elicits responses from interfaces α_2, β_2, ζ_1, δ_2, and ε_2.



Which network does the traceroute fail to reveal anything about?

A. β
B. γ
C. ζ
D. δ

M18. What type of packet is used for classic pings?

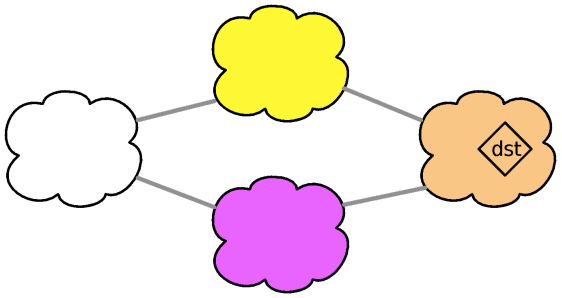
E. DNS
F. BGP

G. TCP
H. ICMP

M19. What variant of BGP will an AS use to propagate, within the AS itself, information about how to reach an advertised destination prefix?

A. eBGP
B. iBGP
C. BGPv1
D. None of the above

M20. In the diagram below, the AS on the right is announcing the prefix dst to the ASes in the middle. Which routes to dst will the AS on the left learn?



A) Either the route via the top AS or the route via the bottom AS, but not both.
B) Both routes.
C) Neither route.
D) It depends upon the policies applied by the middle ASes.

M21. How many prefixes (IPv4 and IPv6 combined) are currently being announced in the Internet (order of magnitude)?

A. 100,000
B. 1 million
C. 10 million
D. 100 million

Short answer questions for Answer Sheet 2

S5. How can we measure one-way delays?

S6. Give an example of a classic traceroute, with just one probe packet per TTL, through a load balancing router, and show what sort of information might be missing and what sort of incorrect inferences might be made.

S7. Listening to BGP updates does not give us a full picture of changes in inter-domain routing. Name or briefly describe three limits to the information that BGP updates provide.