# of Questions: 15
Exam Folder: School of Computing\Computer Science\AY 2024-2025 SEM1\CS4226

Question #: 1

Consider the scenario where two flows F_1 and F_2 traverse through the same link, which is modelled by an M/M/1 queueing model.

The arrival rates of the two flows are λ_1=1 and λ_2=2, respectively. The service rate of the link is μ=5.

Suppose flow F_1 has a higher priority such that the system behaves as follows:

1. if there are packets from flow F_1 in the system, they are served first in a FIFO manner,
2. if no packets from flow F_1, then packets from flow F_2 are served in a FIFO manner, and
3. if a packet from F_1 arrives when a packet from F_2 is being served, the server will stop processing F_2's packet immediately and process the packets from F_1; the server will resume to the unfinished packet of F_2 after all packets from F_1 are served.

What is the average queueing time $E[Q_1]$ for all the packets from flow F_1?

A. 0.05
B. 0.125

C. 0.25
D. 0.5
E. 0.625

Question #: 2

Consider the scenario where two flows F_1 and F_2 traverse through the same link, which is modelled by an M/M/1 queueing model.

The arrival rates of the two flows are λ_1=1 and λ_2=2, respectively. The service rate of the link is μ=5.

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What is the average sojourn time E[W] for all the packets from both flows?

A. 0.05
B. 0.125
C. 0.25
D. 0.5
E. 0.625

Question #: 3

Consider the scenario where two flows F_1 and F_2 traverse through the same link, which is modelled by an M/M/1 queueing model.

The arrival rates of the two flows are λ_1=1 and λ_2=2, respectively. The service rate of the link is μ=5.

Suppose flow F_1 has a higher priority such that the system behaves as follows:

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3. if a packet from F_1 arrives when a packet from F_2 is being served, the server will stop processing F_2's packet immediately and process the packets from F_1; the server will resume to the unfinished packet of F_2 after all packets from F_1 are served.

What is the average sojourn time $E[W_2]$ for all the packets from flow F_2?

A. 0.05
B. 0.125
C. 0.25
D. 0.5
E. 0.625

Question #: 4

Consider a variation of the M/M/1 model where there are two servers serving a single infinity-sized queue. The service times of the two servers are IID exponential random variables. The average service times of the two servers are $E[S_1]=1$ second and $E[S_2]=4$ seconds, respectively. Supppose when you make a random observation at the system and find that both servers are busy.

How long (in units of seconds) on average do you need to wait until you see a customer is fully served by a server, i.e., a customer's departure from one of the servers?

A. 0.2
B. 0.25
C. 0.5
D. 0.75
E. 0.8

Question #: 5

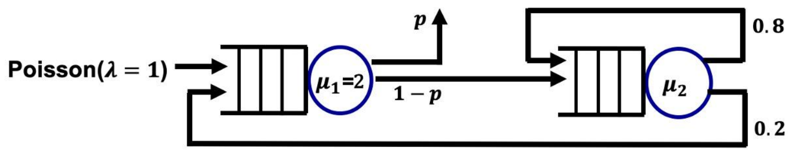
Consider a variation of the M/M/1 model where there are two servers serving a single infinity-sized queue. The service times of the two servers are IID exponential random variables. The average service times of the two servers are $E[S_1]=1$ second and $E[S_2]=4$ seconds, respectively. Supppose when you make a random observation at the system and find that both servers are busy.

What is the probability that the customer from server 1 complete the service first?

A. 0.2
B. 0.25
C. 0.5

D. 0.75
E. 0.8

Question #: 6

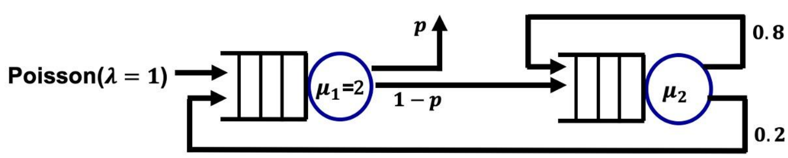


Consider the above Jackson network.

When p=0.8 and μ_2 is large enough to ensure the system stability, which of the following equals the effective arrival rate λ_1 to the first server?

A. 1.2
B. 1.25
C. 1.5
D. 1.75
E. 1.8

Question #: 7



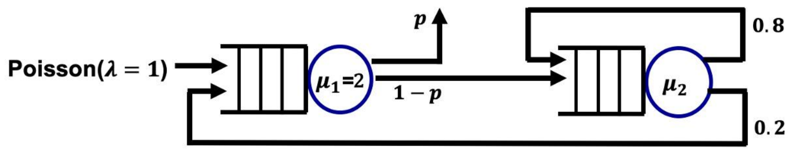
Consider the above Jackson network.

When p=0.8, which of the following equals the maximum service rate of the second server μ_2 such that the system is still unstable?

A. 1.2

B. 1.25
C. 1.5
D. 1.75
E. 1.8

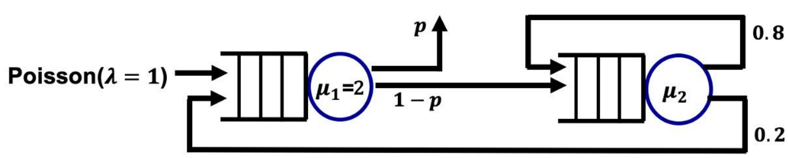
Question #: 8



Consider the above Jackson network.
When μ_2=3, which of the following equals the maximun value of p which will still make the system unstable?

A. 1/4
B. 3/8
C. 1/2
D. 5/8
E. 3/4

Question #: 9

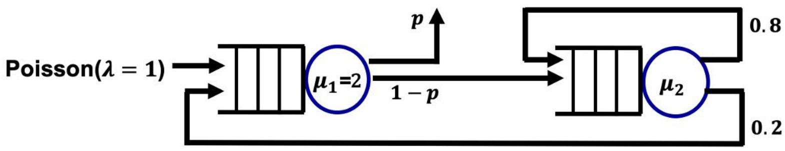


Consider the above Jackson network.
When μ_2=15, which of the following equals the maximun value of p which will still make the system unstable?

A. 1/4
B. 3/8

C. 1/2
D. 5/8
E. 3/4

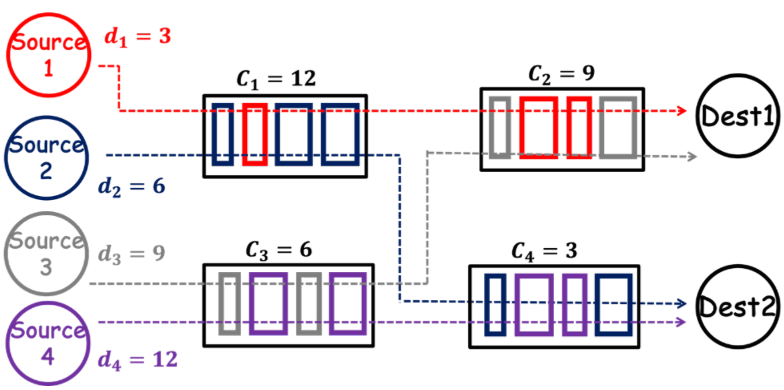
Question #: 10



Consider the above Jackson network.
When p=0.6 and μ_2=10, which of the following equals the average sojourn time E[W] of the packets?

A. 4
B. 4.5
C. 5
D. 5.5
E. 6

Question #: 11



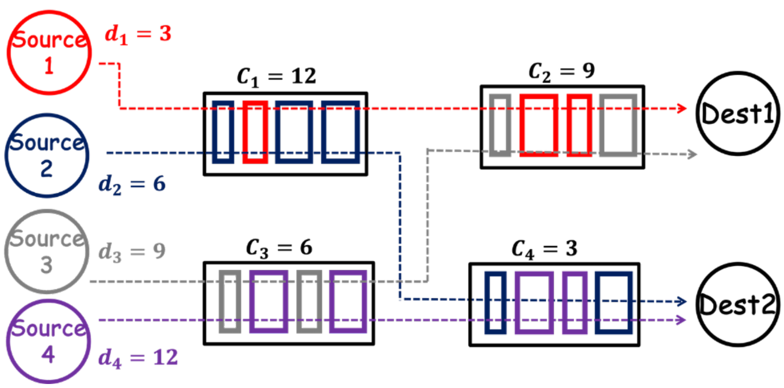
Consider a network path with four links 1, 2, 3 and 4 that have capacities $C_1 = 12$, $C_2 = 9$, $C_3 = 6$ and $C_4 = 3$ (Mbps), respectively. There are four traffic flows: flow $\mathbf{f_1}$ traverses links 1 and 2; flow $\mathbf{f_2}$ traverses links 1 and 4; flow $\mathbf{f_3}$ traverses links 2 and 3; flow $\mathbf{f_4}$ traverses links 3 and 4. Suppose the demand of the four flows are d

$_1 = 3$, $d_2 = 6$, $d_3 = 9$ and $d_4 = 12$ (Mbps), respectively.
Calculate the weighted max-min fair allocation $\mathbf{x} = (x_1, x_2, x_3, x_4)$ for the four flows, where the weights of the four flows are $\varphi = (\varphi_1, \varphi_2, \varphi_3, \varphi_4) = (1,2,3,4)$.

x_1=__1__ (Mbps).
x_2=__2__ (Mbps).
x_3=__3__ (Mbps).
x_4=__4__ (Mbps).

1. _______
2. _______
3. _______
4. _______

Question #: 12

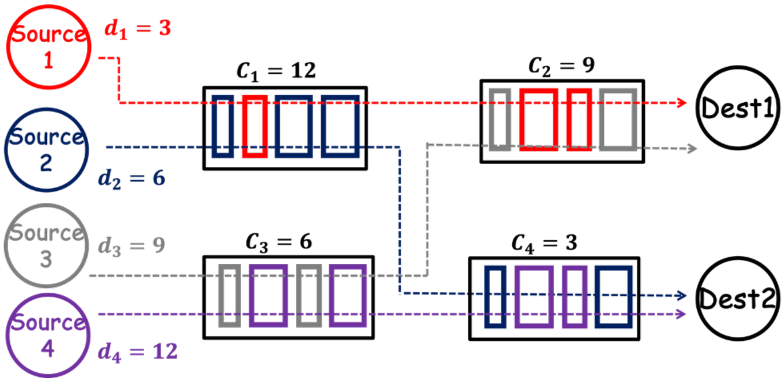


Consider a network path with four links 1, 2, 3 and 4 that have capacities $C_1 = 12$, $C_2 = 9$, $C_3 = 6$ and $C_4 = 3$ (Mbps), respectively. There are four traffic flows: flow $\mathbf{f_1}$ traverses links 1 and 2; flow $\mathbf{f_2}$ traverses links 1 and 4; flow $\mathbf{f_3}$ traverses links 2 and 3; flow $\mathbf{f_4}$ traverses links 3 and 4. Suppose the demand of the four flows are $d_1 = 3$, $d_2 = 6$, $d_3 = 9$ and $d_4 = 12$ (Mbps), respectively.
Under the weighted max-min fair allocation, where the weights of the four flows are $\varphi = (\varphi_1, \varphi_2, \varphi_3, \varphi_4) = (1,2,3,4)$, which of the following includes all the bottleneck links for flow $\mathbf{f_1}$?

A. C_1 only.
B. C_2 only.
C. C_1 and C_2 only.

D. None.

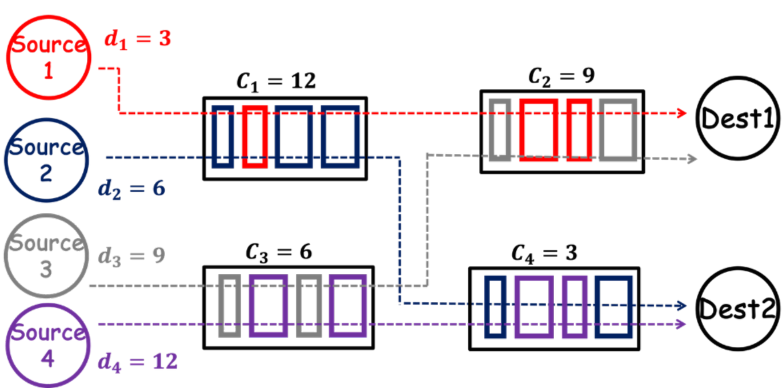
Question #: 13



Consider a network path with four links 1, 2, 3 and 4 that have capacities $C_1 = 12$, $C_2 = 9$, $C_3 = 6$ and $C_4 = 3$ (Mbps), respectively. There are four traffic flows: flow $\mathbf{f_1}$ traverses links 1 and 2; flow $\mathbf{f_2}$ traverses links 1 and 4; flow $\mathbf{f_3}$ traverses links 2 and 3; flow $\mathbf{f_4}$ traverses links 3 and 4. Suppose the demand of the four flows are $d_1 = 3$, $d_2 = 6$, $d_3 = 9$ and $d_4 = 12$ (Mbps), respectively.
Under the weighted max-min fair allocation, where the weights of the four flows are $\varphi = (\varphi_1, \varphi_2, \varphi_3, \varphi_4) = (1,2,3,4)$, which of the following includes all the bottleneck links for flow $\mathbf{f_2}$?

A. C_1 only.
B. C_4 only.
C. C_1 and C_4 only.
D. None.

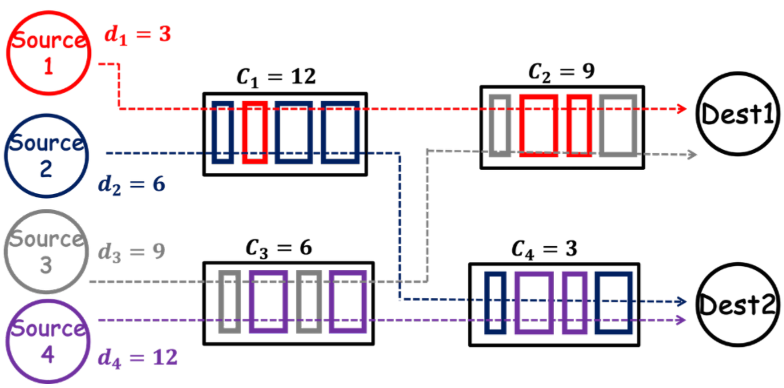
Question #: 14



Consider a network path with four links 1, 2, 3 and 4 that have capacities $C_1 = 12$, $C_2 = 9$, $C_3 = 6$ and $C_4 = 3$ (Mbps), respectively. There are four traffic flows: flow $\mathbf{f_1}$ traverses links 1 and 2; flow $\mathbf{f_2}$ traverses links 1 and 4; flow $\mathbf{f_3}$ traverses links 2 and 3; flow $\mathbf{f_4}$ traverses links 3 and 4. Suppose the demand of the four flows are $d_1 = 3$, $d_2 = 6$, $d_3 = 9$ and $d_4 = 12$ (Mbps), respectively.
Under the weighted max-min fair allocation, where the weights of the four flows are φ = (φ_1, φ_2, φ_3, φ_4) =(1,2,3,4), which of the following includes all the bottleneck links for flow $\mathbf{f_3}$?

A. C_2 only.
B. C_3 only.
C. C_2 and C_3 only.
D. None.

Question #: 15



Consider a network path with four links 1, 2, 3 and 4 that have capacities $C_1 = 12$, $C_2 = 9$, $C_3 = 6$ and $C_4 = 3$ (Mbps), respectively. There are four traffic flows: flow $\mathbf{f_1}$ traverses links 1 and 2; flow $\mathbf{f_2}$ traverses links 1 and 4; flow $\mathbf{f_3}$ traverses links 2 and 3; flow $\mathbf{f_4}$ traverses links 3 and 4. Suppose the demand of the four flows are $d_1 = 3$, $d_2 = 6$, $d_3 = 9$ and $d_4 = 12$ (Mbps), respectively.
Under the weighted max-min fair allocation, where the weights of the four flows are φ = (φ_1, φ_2, φ_3, φ_4) =(1,2,3,4), which of the following includes all the bottleneck links for flow $\mathbf{f_4}$?

A. C_3 only.

B. C_4 only.
C. C_3 and C_4 only.
D. None.