Questions

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Question 1

1 point possible (graded)

Which figure corresponds to an M/M/C/C system?

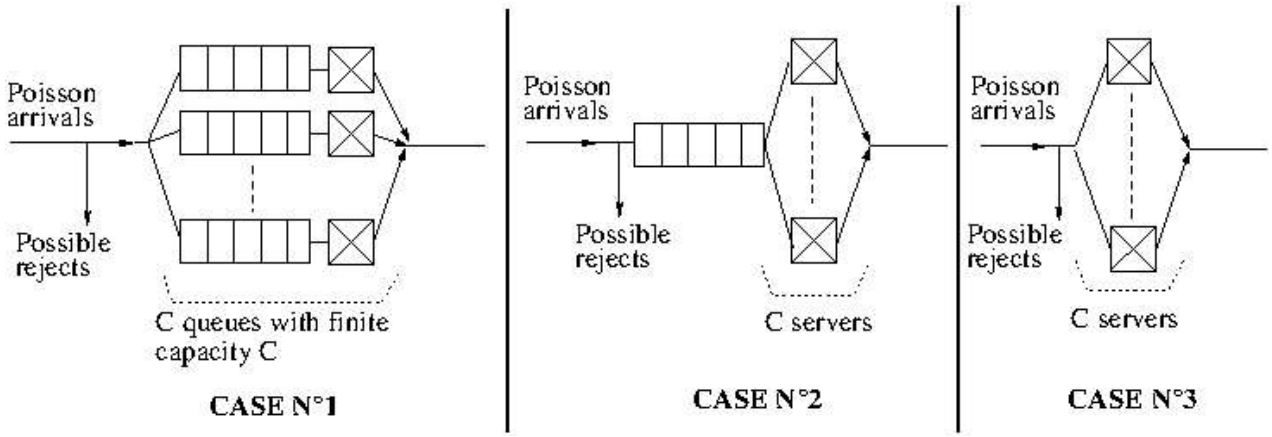

Figure 1. Question 1

- Case number 1
- Case number 2
- Case number 3

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Question 2

1 point possible (graded)

Consider an M/M/C/C system for which input interarrivals are equal on average to 10 seconds. The time unit is one second. Which of the following statements are true?

- [ ] The number of arrivals per minute is 60.
- [ ] The arrivals do not follow a Poisson process.
- [ ] The arrivals follow a Poisson process with rate $\lambda = 0.1\ \mathbf{sec}^{-1}$.
- [ ] The arrivals follow a Poisson process with rate $\lambda = 10\ \mathbf{sec}^{-1}$.
- [ ] The arrival times follow a Poisson distribution with rate $\lambda = 10\ \mathbf{sec}$.

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Question 3

1 point possible (graded)

Consider a queue. There are on average 30 arrivals per minute and the mean service time is 40 seconds.

What is the load in Erlangs?

What is the load in Erlangs?

- 0.75 Erlangs
- 1.33 Erlangs
- 20 Erlangs
- 45 Erlangs
- 80 Erlangs
- 1200 Erlangs

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Question 4

0.0/3.0 points (graded)

Consider an M/M/C/C queue loaded at 15 Erlangs. We want a loss probability less than or equal to 1%.

What is the minimum number of channels?

Erlang B Traffic Table

Maximum Offered Load Versus E_a and C

E_a is in %

C/E_a	0.01	0.05	0.1	0.5	1.0	2	5	10	15	20	30	40
1	.0001	.0005	.0010	.0050	.0101	.0204	.0526	.1111	.1765	.2500	.4286	.6667
2	.0142	.0321	.0458	.1054	.1526	.2235	.3813	.5954	.7962	1.000	1.449	2.000
3	.0868	.1517	.1938	.3490	.4555	.6022	.8994	1.271	1.603	1.930	2.633	3.480
4	.2347	.3624	.4393	.7012	.8694	1.092	1.525	2.045	2.501	2.945	3.891	5.021
5	.4520	.6486	.7621	1.132	1.361	1.657	2.219	2.881	3.454	4.010	5.189	6.596
6	.7282	.9957	1.146	1.622	1.909	2.276	2.960	3.758	4.445	5.109	6.514	8.191
7	1.054	1.392	1.579	2.158	2.501	2.935	3.738	4.666	5.461	6.230	7.856	9.800
8	1.422	1.830	2.051	2.730	3.128	3.627	4.543	5.597	6.498	7.369	9.213	11.42
9	1.826	2.302	2.558	3.333	3.783	4.345	5.370	6.546	7.551	8.522	10.58	13.05
10	2.260	2.803	3.092	3.961	4.461	5.084	6.216	7.511	8.616	9.685	11.95	14.68
11	2.722	3.329	3.651	4.610	5.160	5.842	7.076	8.487	9.691	10.86	13.33	16.31
12	3.207	3.878	4.231	5.279	5.876	6.615	7.950	9.474	10.78	12.04	14.72	17.95
13	3.713	4.447	4.831	5.964	6.607	7.402	8.835	10.47	11.87	13.22	16.11	19.60
14	4.239	5.032	5.446	6.663	7.352	8.200	9.730	11.47	12.97	14.41	17.50	21.24
15	4.781	5.634	6.077	7.376	8.108	9.010	10.63	12.48	14.07	15.61	18.90	22.89
16	5.339	6.250	6.722	8.100	8.875	9.828	11.54	13.50	15.18	16.81	20.30	24.54
17	5.911	6.878	7.378	8.834	9.652	10.66	12.46	14.52	16.29	18.01	21.70	26.19
18	6.496	7.519	8.046	9.578	10.44	11.49	13.39	15.55	17.41	19.22	23.10	27.84
19	7.093	8.170	8.724	10.33	11.23	12.33	14.32	16.58	18.53	20.42	24.51	29.50
20	7.701	8.831	9.412	11.09	12.03	13.18	15.25	17.61	19.65	21.64	25.92	31.15
21	8.319	9.501	10.11	11.86	12.84	14.04	16.19	18.65	20.77	22.85	27.33	32.81
22	8.946	10.18	10.81	12.64	13.65	14.90	17.13	19.69	21.90	24.06	28.74	34.46
23	9.583	10.87	11.52	13.42	14.47	15.76	18.08	20.74	23.03	25.28	30.15	36.12
24	10.23	11.56	12.24	14.20	15.30	16.63	19.03	21.78	24.16	26.50	31.56	37.78
25	10.88	12.26	12.97	15.00	16.13	17.51	19.99	22.83	25.30	27.72	32.97	39.44
26	11.54	12.97	13.70	15.80	16.96	18.38	20.94	23.89	26.43	28.94	34.39	41.10
27	12.21	13.69	14.44	16.60	17.80	19.27	21.90	24.94	27.57	30.16	35.80	42.76
28	12.88	14.41	15.18	17.41	18.64	20.15	22.87	26.00	28.71	31.39	37.21	44.41
29	13.56	15.13	15.93	18.22	19.49	21.04	23.83	27.05	29.85	32.61	38.63	46.07
30	14.25	15.86	16.68	19.03	20.34	21.93	24.80	28.11	31.00	33.84	40.05	47.74
31	14.94	16.60	17.44	19.85	21.19	22.83	25.77	29.17	32.14	35.07	41.46	49.40
32	15.63	17.34	18.21	20.68	22.05	23.73	26.75	30.24	33.28	36.30	42.88	51.06
33	16.34	18.09	18.97	21.51	22.91	24.63	27.72	31.30	34.43	37.52	44.30	52.72
34	17.04	18.84	19.74	22.34	23.77	25.53	28.70	32.37	35.58	38.75	45.72	54.38
35	17.75	19.59	20.52	23.17	24.64	26.44	29.68	33.43	36.72	39.99	47.14	56.04
36	18.47	20.35	21.30	24.01	25.51	27.34	30.66	34.50	37.87	41.22	48.56	57.70
37	19.19	21.11	22.08	24.85	26.38	28.25	31.64	35.57	39.02	42.45	49.98	59.37
38	19.91	21.87	22.86	25.69	27.25	29.17	32.62	36.64	40.17	43.68	51.40	61.03
39	20.64	22.64	23.65	26.53	28.13	30.08	33.61	37.72	41.32	44.91	52.82	62.69
40	21.37	23.41	24.44	27.38	29.01	31.00	34.60	38.79	42.48	46.15	54.24	64.35
41	22.11	24.19	25.24	28.23	29.89	31.92	35.58	39.86	43.63	47.38	55.66	66.02
42	22.85	24.97	26.04	29.09	30.77	32.84	36.57	40.94	44.78	48.62	57.08	67.68
43	23.59	25.75	26.84	29.94	31.66	33.76	37.57	42.01	45.94	49.85	58.50	69.34

Figure 3. Erlang tables (Question 4)

- ○ 15

- 19
- 24
- 28
- 31
- 42

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Question 5

1 point possible (graded)

Which of the following systems can be modeled by an M/M/C/C?

- The waiting queues at the post office in the case where there are as many queues as there are desks.
- The waiting queue at the post office in the case where there is a single shared queue for all the desks.
- Phone channels.

- A communication network in which the data flow duration follows a Pareto distribution probability.

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Question 6

0.0/2.0 points (graded)

Consider an M/M/1 queue with two input sources: source 1 generates "positive" clients according to a Poisson process with rate λ_p, while source 2 generates "negative" clients according to a Poisson process with rate λ_n.

When a negative client arrives in the queue, if there is a positive client in the queue, the negative client destroys one positive client and it is itself also destroyed. If the queue is empty, the negative client is destroyed as soon as it arrives. Positive clients are processed normally.

The average service rate is $\mu = 10\ \mathrm{sec}^{-1}$. The arrival rates of positive and negative clients are $\lambda_p = 8\ \mathrm{sec}^{-1}$, and $\lambda_n = 2\ \mathrm{sec}^{-1}$.

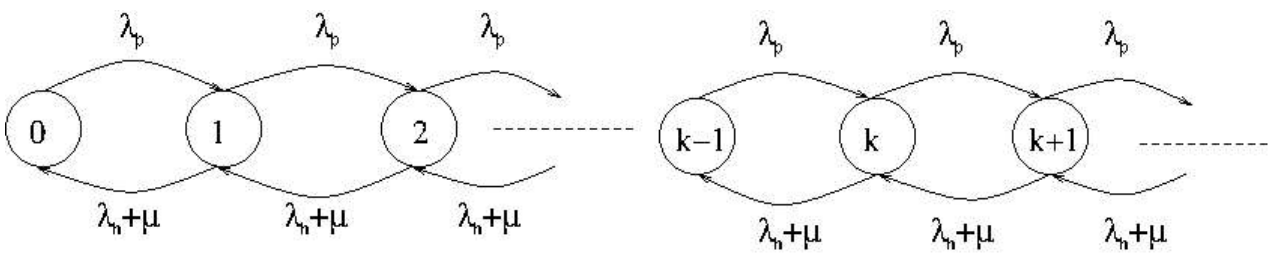

Figure 3. Question 8

What is the transition rate from state 2 to state 3?

sec^{-1}

What is the transition rate from state 3 to state 2?

sec^{-1}

What is the mean queue length?

clients

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Question 7

0.0/3.0 points (graded)

Consider an M/M/2 queue. Its arrival rate is λ and its service rate is μ (for each server).

Let us denote as $\rho = \lambda/\mu$and $\rho' = \lambda/2\mu$. The steady-state probability of the number of clients k, for k>0 is :

- $\rho'^k(1-\rho')$
- $\rho^k(1-\rho)$
- $2\rho'^k \frac{1-\rho'}{1+\rho'}$

- $\rho'^k \frac{1-\rho'}{1+\rho'}$
- $2\rho^k \frac{1-\rho}{1+\rho}$

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Question 8

0.0/3.0 points (graded)

Consider an M/M/2 queue. Its mean arrival rate is λ and its average service rate is μ (for each server).

What is its mean queue length? (with $\rho = \lambda/\mu$ and $\rho' = \lambda/2\mu$). Reminder $\sum_{k\geq 0} kx^{k-1} = 1/(1-x)^2$ if $x < 1$.

- $\frac{\rho'}{1-\rho'}$
- $\frac{2\rho'}{1-\rho'^2}$
- $\frac{\rho}{1-\rho}$
- $\frac{\rho'}{1-\rho'^2}$

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Question 9

0.0/2.0 points (graded)

Consider an M/M/2 queue. Its mean arrival rate is λ and its average service rate is μ (for each server).

What is its mean sojourn time?

- $\frac{2\rho'}{1-\rho'^2}\frac{1}{\mu}$
- $\frac{2\rho'}{1-\rho'^2}\frac{1}{\mu}+\frac{1}{\mu}$
- $\frac{1}{1-\rho'^2}\frac{1}{\mu}$

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Question 10

1 point possible (graded)

A small company has an old printer whose performance is no longer satisfying compared to recent models in manufacturers.

What is the solution which provides the minimum printing time, on average?

- Replace the old printer with a new printer, twice as fast as the old one.
- Buy a second printer, same model as the old one, and let users choose which one to use. The probability of choosing one printer or the other is the same.
- Buy a second printer, same model as the old one, and allow access via a server, which receives the jobs and balances traffic to one printer or the other as soon as one is available.

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Question 11

0.0/1.0 point (graded)

Consider an M/M/3 queue. The input rate is λ and the service rates is μ for each server.

What is the value of the transition rate from state $N(t) = 7$ clients to $N(t) = 6$?

- μ
- 2μ
- 3μ
- 7μ
- λ

What is the value of the transition rate from state $N(t) = 6$ clients to $N(t) = 7$?

- μ
- 2μ
- 3μ
- 7μ
- λ

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Question 12

2 points possible (graded)

Consider an M/M/∞ queue. The input rate is λ and the service rate is μ for each server.

What is the value of the transition rate from state $N(t) = 7$ clients to $N(t) = 6$?

- μ
- 2μ
- 3μ
- λ
- other

What is the value of the transition rate from state $N(t) = 6$ clients to $N(t) = 7$?

- μ
- 2μ
- 3μ
- λ
- other

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You have used 0 of 3 attempts

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Question 13

1 point possible (graded)

Let us compare an M/M/∞queue and an M/M/1/K queue.

Is the probability that the number of clients in the M/M/∞ queue is larger than $K+1$ equal to the blocking rate of the M/M/1/K queue: $P_{M/M/\infty}(X(t) \geq K+1) = P_{M/M/1/K}(X(t) = K))$

- Yes
- No

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