Problem 1: (34 points – 2 pts each)

1. Waiting times of entities WQ1, WQ2, …., represent a discrete-paramter or tally statistic.
   a. True
   b. False

2. One of the worst casse measures in a simulation is
   a. Number of produced items
   b. Maximum waiting time in queue
   c. Low average number enities in queue
   d. Average total time in system
   e. Average waiting time in queue

3. Time-average number of parts waiting in the queue is a
   a. Time-persistent statistic
   b. Tally statistic
   c. Counter
   d. None of the above

4. The best indication of how much floor spapce is neded to have room at all times is
   a. Maximum total time in system
   b. Average total time in system
   c. Maximum number of parts waiting in queue
   d. Time-average number of parts waiting in queue
   e. Maximum waiting time in queue

5. A common characterstic of all entities with a specific value that can differ from one entity to another
   a. Attribute
   b. Variable
   c. Entity
   d. Queue
   e. Statistcial accumulator

6. Variables can be used to represent something that changes during the simulation
   a. True
   b. False

7. The time (simulation clock) is a variable, while the current length of the queue is not
   a. True
   b. False

8. A supermarket manager tried actual different policies for inventory control to see which policy gives the highest performance. This is not a simulation.
   a. True
   b. False

9. If a model is simple enough, it is better to use traditional mathematical tools like queueing theory, differential-equation methods, or something like linear programming.
   a. True
   b. False

10. The Buffon needle problem to estimate the value of π, is an example of a dynamic simulation.
    a. True
    b. False

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11. If a system changes significantly with respect to time, it is said to be stochastic.
    a. True
    b. False

12. The more details used in modeling a system, the less validity of the model.
    a. True
    b. False

13. The random output resulted from random input in simulation is considered one of the advantages of simulation.
    a. True
    b. False

14. We can simulate a system that does not exist and still being designed.
    a. True
    b. False

15. The maximum number of arrivals in CREATE module is one method of the simulation's stopping rules.
    a. True
    b. False

16. Incorrectly specifying the time units in the CREATE module (For example, if it is 1 hour and you set it as 1 minute) is an issue that you should realize by
    a. Validation
    b. Verification
    c. Type II error
    d. Steady-state system

17. In the simulation, doing more than one replication will make the system valid.
    a. True
    b. False

Simulation
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Problem 2: (20 points - 4 pts each)

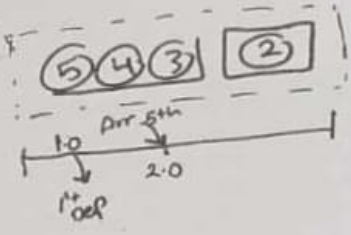
A. If a resource has a variable number of units, resource utilization should be calculated as

how much the resource is busy in a specific time

B. In the model state snapshot shown below, how many times each of the simulation events have happened so far?

① arrival of new entity to the system (entity 5)

② departure an entity from a process (entity 1)



entity	service time
1	1.0
2	2.7
3	4.1
4	0.5
5	2

① departure from the system
② end
③ arrival of

C. What do we simulate? System or model?

System

- we represent the system in a mathematical relationship model and simulate this system

D. Explain the terms verification and validation.

→ verification: process of making sure the system behaves the way it was intended according the model assumptions

→ validation: process of making sure the model is represent the real system

E. Which is better and why? Simulation or traditional methods?

traditional methods is better because it more accurate, and give you the exact answer but you can't use it if the system is complex. It can be use for simple models only so we use simulation if it's impossible (or difficult) to use the traditional methods

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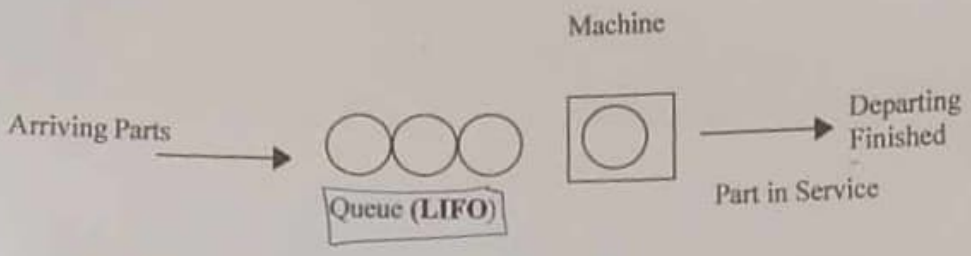
Simulation
Mid-Term Exam/Spring 2023 **Printed Name**_____ **ID** _____

Problem 4: (50 points)



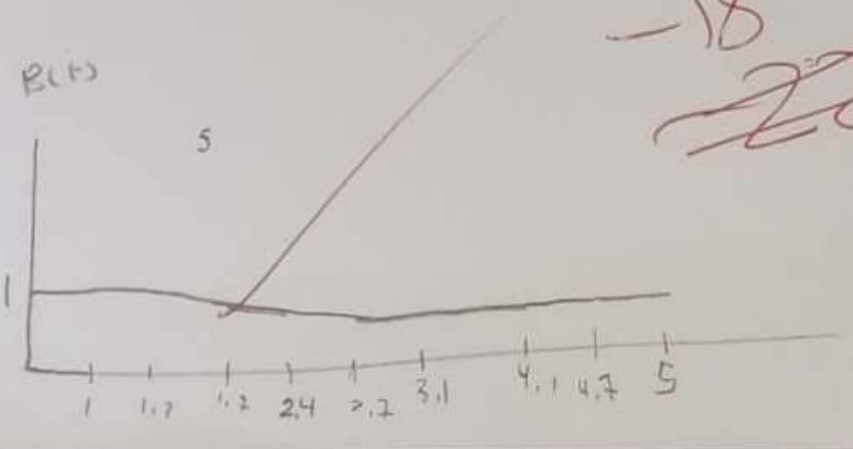
In a production line, items arrive at the mixing station where **one worker** is available to do the process, one item at a time. The worker process items according to the **Last-In-First-Out** rule. The probability distributions for both inter-arrival time and processing time were used to generate time values, as shown in the table below (Time is in minutes). It makes sense to assume that the system starts working with no parts from the previous work shift and the worker is ready to process the first item. The first part arrives at time **0**. Use the data provided below to perform a hand simulation for the first **8 minutes** and estimate the following:

a) Total processed parts
b) The average waiting time in the queue
c) The maximum waiting time in the queue
d) Average total time in the system
e) Maximum total time in the system
f) The average number of parts in queue
g) Maximum number of parts in queue
h) Servers utilization
i) Plot the current number is waiting in queue with time. Also, plot the status of the servers with time.

Note: the table is repeated along with the hand simulation sheet for your convenience.

Part number	Inter-arrival Time	Processing Time
1	1.0	1.3
2	0.7	1.4
3	0.7	1.7
4	0.3	1.9
5	0.4	2.0
6	1.0	1.8
7	0.9	1.1
8	2.5	1.4
9	3.1	2.3
10	1.6	2.4
11	2.6	0.3
12	2.0	1.1
13	0.3	1.6
14	0.6	1.2

arrival time
0
1
1.7
2.4
2.7
3.1
4.1
5
7.5
10.6



LIFO / mid 2nd - 2023

Just- Finished Event			Variables		Statistical Accumulators									Event Calendar		
Entity No.	Time t	Event Type	$Q(t)$	$B(t)$	P	N	$\sum WQ$	WQ^*	$\sum TS$	TS^*	$\int Q$	Q^*	$\int B$	Entity	Time	Type
-	0	init	0	0	0	0	0	0	0	0	0	0	0	~~1~~ -	0.0	arr
															8.0	end
1	0	Arr	0	1	0	1	0	0	0	0	0	0	0	2	1.0	arr
2	1	arr	1	1	0	1	0	0	0	0	0	1	1	1	1.3	dep
1	1.3	dep	0	1	1	2	0.3	0.3	1.3	1.3	0.3	1	1.3	3	1.7	arr
3	1.7	arr.	1	1	1	2	0.3	0.3	1.3	1.3	0.3	1	1.7	3	1.7	dep
4	2.4	arr.	2	1	1	2	0.3	0.3	1.3	1.3	1	2	2.4	2	2.7	arr
2	2.7	dep.	1	1	2	3	0.6	0.3	3.0	1.7	1.7	2	2.7	4	2.4	dep
5	2.7	arr.	2	1	2	3	0.6	0.3	3.0	1.7	1.6	2	2.7	2	2.7	arr
6	3.1	arr.	3	1	2	3	0.6	0.3	3.0	1.7	2.4	3	3.1	2	2.7	dep
7	4.1	arr.	4	1	2	3	0.6	0.3	3.0	1.7	5.4	4	4.1	5	2.7	arr
4	4.6	dep.	3	1	3	4	1.1	0.5	5.2	2.2	7.4	4	4.6	5	2.7	arr
8	5.0	arr.	4	1	3	4	1.1	0.5	5.2	2.2	8.6	4	5.0	4	4.6	dep
														6	3.1	arr
														4	4.6	dep
														7	4.1	arr
														4	4.6	dep
														4	4.6	dep
														8	5.0	arr
														8	5.0	arr
														7	5.7	dep
														9	7.5	arr

* إضافة عند كل سطر

-	8.0	end

event calender

Just- Finished Event			Variables		Statistical Accumulators									Event Calendar		
Entity No.	Time t	Event Type	$Q(t)$	$B(t)$	P	N	$\sum WQ$	WQ^*	$\sum TS$	TS^*	$\int Q$	Q^*	$\int B$	Entity	Time	Type
7	5.7	dep.	3	1	4	5	1.8	0.7	6.8	2.2	11.4	4	5.7	8 9	7.1 7.5	dep arr
8	7.1	dep.	2	1	5	6	5.8	4.0	8.9	2.2	15.6	4	7.1	9 6	7.5 8.9	arr dep
9	7.5	arr	3	1	5	6	5.8	4.0	8.9	2.2	16.4	4	7.5	– 6 10	8.0 8.9 10.6	end dep arr
–	8.0	end	3	1	5	6	5.8	4.0	8.9	2.2	17.9	4	8.0	6 10	8.9 10.6	dep arr