CMP

COMMERCE MENTORSHIP PROGRAM

REVIEW SESSION

COMM 204

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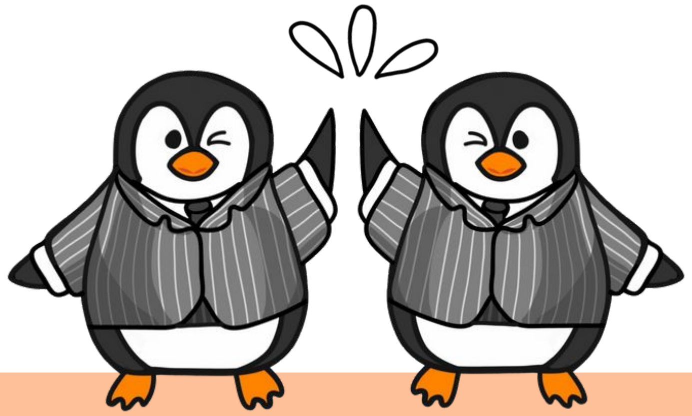

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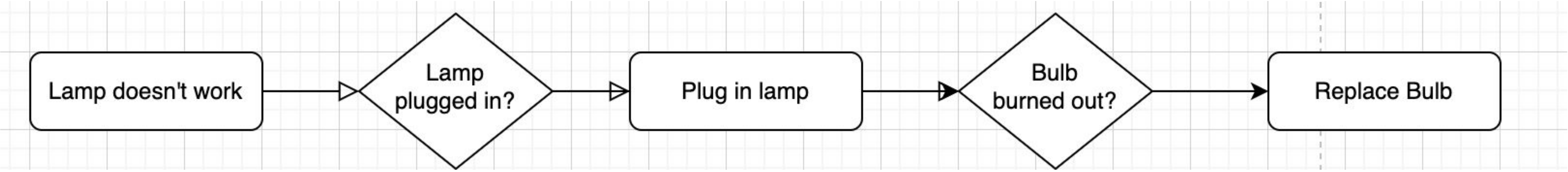
Flow Chart

Linear



Task	Duration
A	10 mins
B	15 mins
C	12 mins
D	15 mins
E	8 mins

Key Terms

- Activity: A step in the process
- Resources: The performer of the activity
- Flow unit: The basic unit of analysis in any given scenario (customer, sandwich, phone calls, etc.)
- Theoretical Flow Time/Flow Time: The amount of time a flow unit spends in a business process from beginning to end.
- Unit load: Total amount of time that a resource needs to process a flow unit
- Capacity rate: Maximum output rate at which units can flow through a resource or process
- Bottleneck: Resource/activity with the slowest capacity rate in a process
- Throughput rate/flow rate: Actual output rate of the process.
- Utilization Rate = Throughput rate / Capacity Rate <= 100%

Practice Question

For a certain chemical test at a medical company the below activity-resource chart is provided. Based on the information calculation the following.

A) The flow time of the process
B) The flowtime of the bottleneck activity.
C) Capacity rate of Person C
D) Capacity rate of the process
E) What happens to the capacity if there is another individual, Person F working alongside Person B?

Person	Activity	Flow Time
A	Identify Requirements	1 min
B	Testing Solutions	3 min
C	Preparing Solutions	2 min
D	Performing Reaction	5 min
E	Test Analysis	7 min

Practice Question

For a certain chemical test at a medical company the below activity-resource chart is provided. Based on the information calculation the following.

A) The flow time of the process

For calculating flow time,

(1 + 3 + 2 + 5 + 7) min = 18 min

Person	Activity	Flow Time
A	Identify Requirements	1 min
B	Testing Solutions	3 min
C	Preparing Solutions	2 min
D	Performing Reaction	5 min
E	Test Analysis	7 min

Practice Question

For a certain chemical test at a medical company the below activity-resource chart is provided. Based on the information calculation the following.

B) The flowtime of the bottleneck activity.

For identifying the bottleneck activity, select the person with highest flow time here.

Person E: 7 min

Person	Activity	Flow Time
A	Identify Requirements	1 min
B	Testing Solutions	3 min
C	Preparing Solutions	2 min
D	Performing Reaction	5 min
E	Test Analysis	7 min

Practice Question

For a certain chemical test at a medical company the below activity-resource chart is provided. Based on the information calculation the following.

C) Capacity rate of Person C

60*(½) = 30 units per hour (multiply by 60 for conversion)

Person	Activity	Flow Time
A	Identify Requirements	1 min
B	Testing Solutions	3 min
C	Preparing Solutions	2 min
D	Performing Reaction	5 min
E	Test Analysis	7 min

Practice Question

For a certain chemical test at a medical company the below activity-resource chart is provided. Based on the information calculation the following.

D) Capacity rate of the process

60*(1/6) = 10 tests/hour

Accounting for the bottleneck activity for the process, the company is at a maximum capacity to conduct 10 tests an hour.

Person	Activity	Flow Time
A	Identify Requirements	1 min
B	Testing Solutions	3 min
C	Preparing Solutions	2 min
D	Performing Reaction	5 min
E	Test Analysis	6 min

Practice Question

For a certain chemical test at a medical company the below activity-resource chart is provided. Based on the information calculation the following.

E) What happens to the capacity if there is another individual, Person F working alongside Person B?

The capacity will not change since the bottleneck for the process remains unchanged besides adding Person F to assist with conducting the chemical test. The test is still constrained by Person E’s ability to conduct the test analysis.

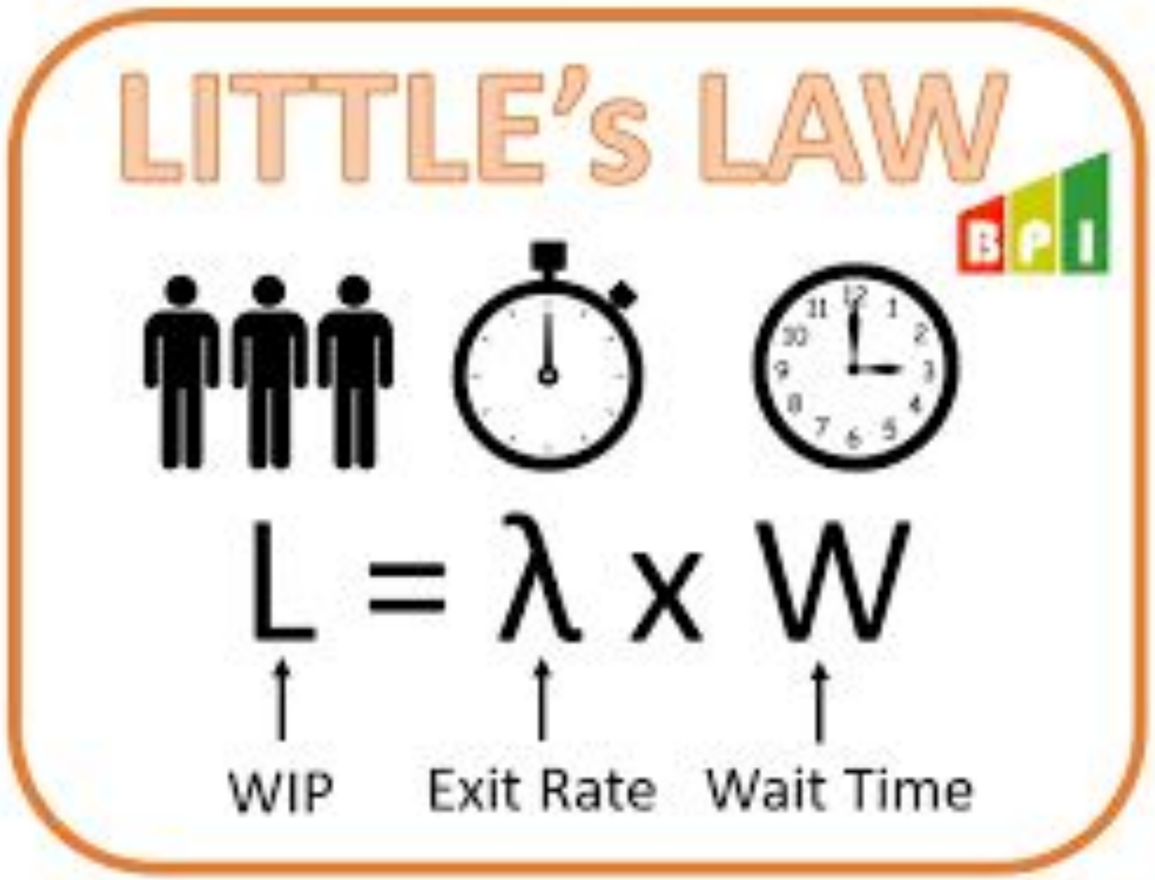
Person	Activity	Flow Time
A	Identify Requirements	1 min
B	Testing Solutions	3 min
C	Preparing Solutions	2 min
D	Performing Reaction	5 min
E	Test Analysis	6 min

Little’s Law

Establishes a relationship between average inventory, average throughput rate, and average flow time:

I = R * T

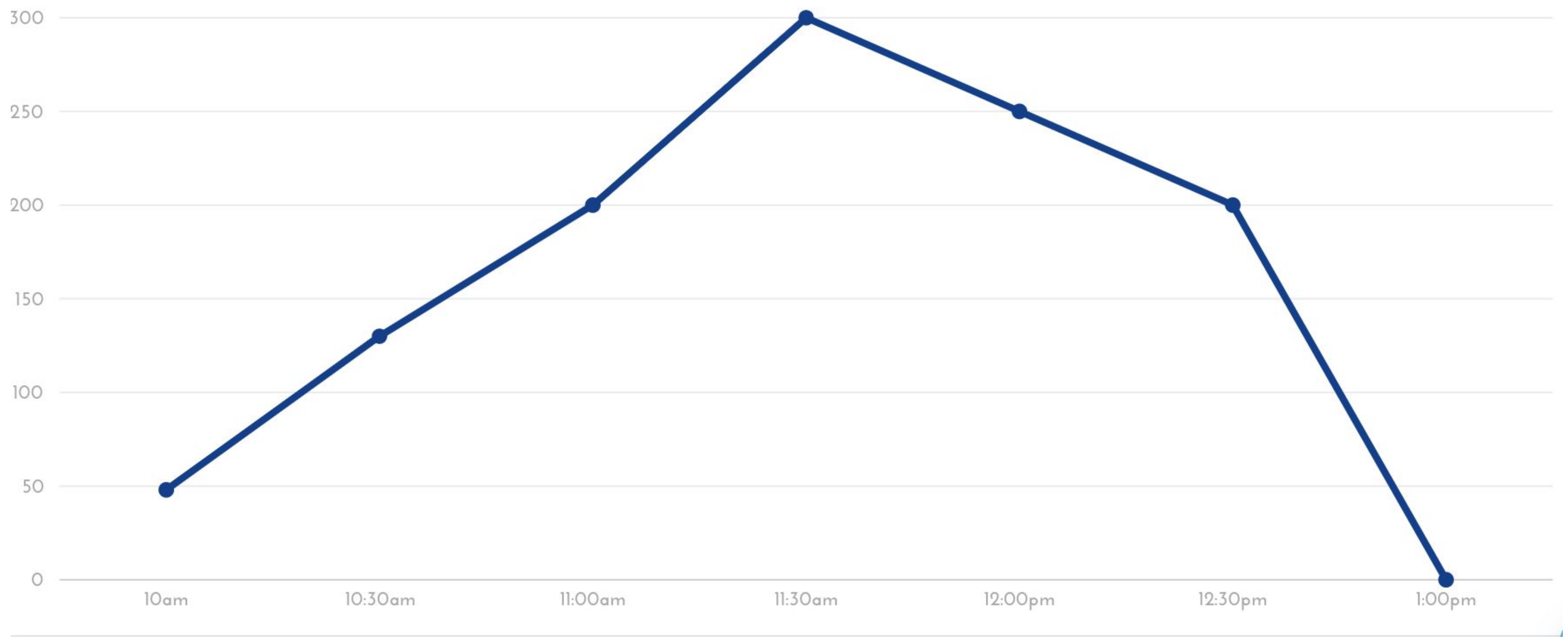
Average Inventory (I): Average number of units or customers in the system
Average Throughput Rate (R): The average actual output rate
Average Flow Time (T): The average for a unit to move through the system



Practice Question

Below is provided the inventory buildup diagram at Lululemon for a surprise flash sale outside the UBC bookstore.

A) Using the diagram, calculate the average numbers of customers who visited the flash sale.
B) What is the average waiting time given that the throughput rate is 6 customers/hour?



Practice Question

Below is provided the inventory buildup diagram at Lululemon for a surprise flash sale outside the UBC bookstore.

A) Using the diagram, calculate the average numbers of customers who visited the flash sale. (Inventory)

Area under the line graph

(50+130)/2*(0.5) = 45

(200+130)/2*(0.5) = 82.5

(200+300)/2*(0.5) = 125

(250+300)/2*(0.5) = 137.5

(250+200)/2*(0.5) = 112.5

(200)/2*(0.5) = 50

The average number of customers at the flash sale is 552.

Practice Question

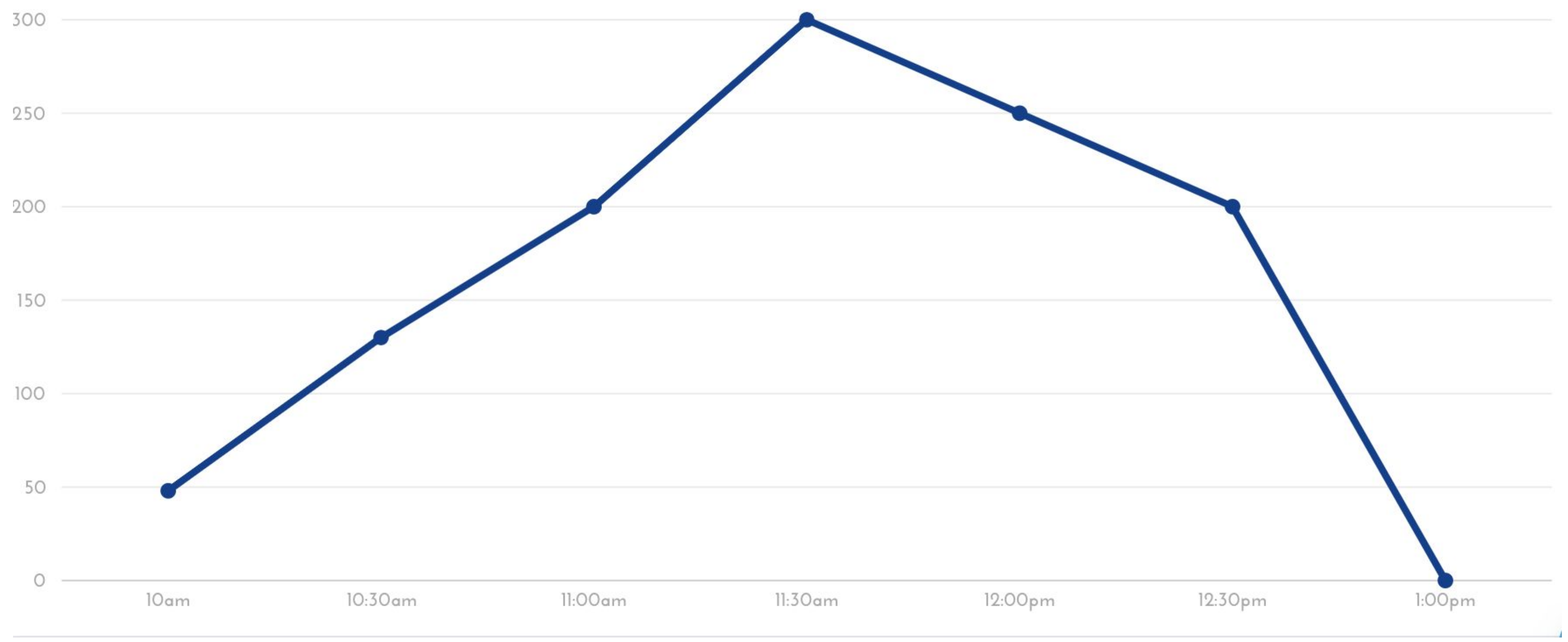
Below is provided the inventory buildup diagram at Lululemon for a surprise flash sale outside the UBC bookstore.

B) What is the average waiting time given that the throughput rate is 6 customers/hour?

Applying Little's Law: I = RT

Waiting Time (Flow Time) = I/R

= 552/6 = 92 customers/hour



Gantt Chart

TASK 1
Code creation
TASK 2
Functional testing
TASK 3
Performance testing
TASK 4
Beta user tests & feedback
TASK 5
Deploy code update
0 days
5 days
10 days
15 days
20 days
25 days
30 days
TechTarget

Critical Path

Critical path method:

- Identify all paths between the start node and the end node (Enumeration Method)
  - For each path, add the activity times for all activities on that path
    - This path is called the critical path
    - This is the time required to finish the project

- Activity times are dependant on costs
- Crashing: refers to reducing the time it takes to complete the activity
- Crash time: the minimum possible time to complete an activity

- Crash cost: the cost associated with the crash time (in place of the normal cost)

Practice Question

The LA Clippers are building a new arena and the construction process activity timeline is shown below. Please help the team figure the critical path & duration of the process.

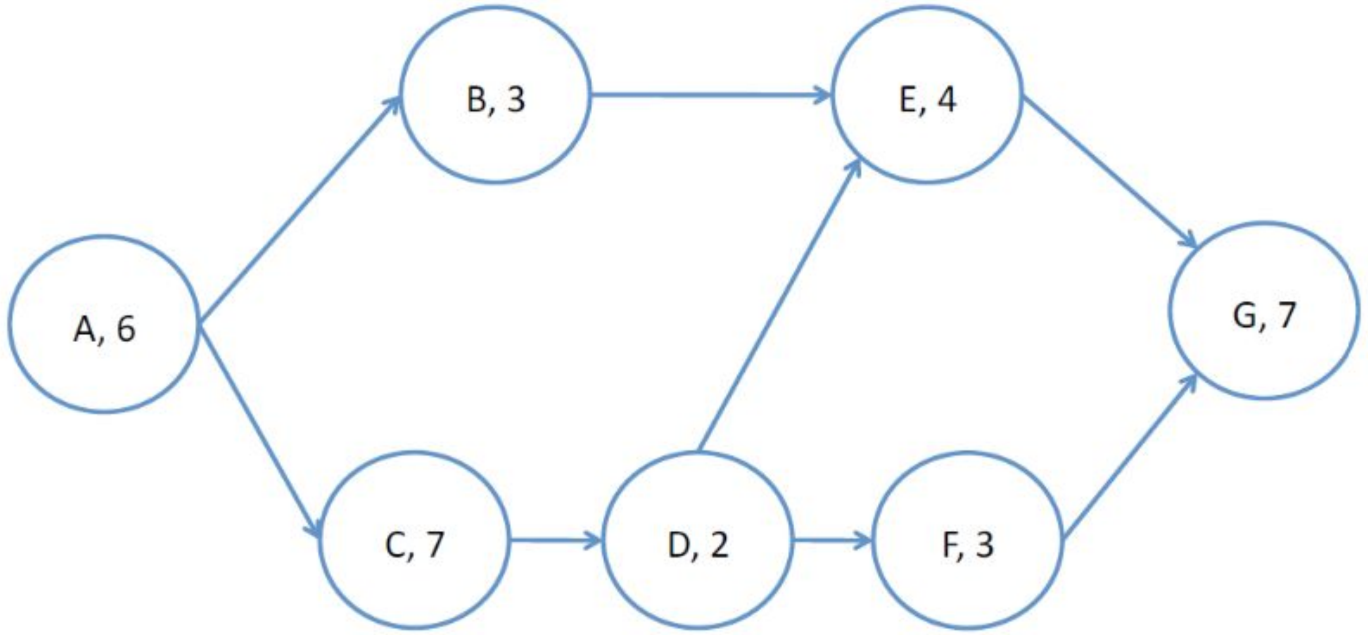
Activity	Predecessor	Time (weeks)
A		6
B	A	3
C	A	7
D	C	2
E	B, D	4
F	D	3
G	E, F	7

Practice Question

The LA Clippers are building a new arena and the construction process activity timeline is shown below. Please help the team figure the critical path & duration of the process.

- ABEG: 2O weeks (6+3+4+7)
- ACDEG: 26 weeks (6+7+2+4+7)*
- ACDFG: 25 weeks (6+7+2+3+7)

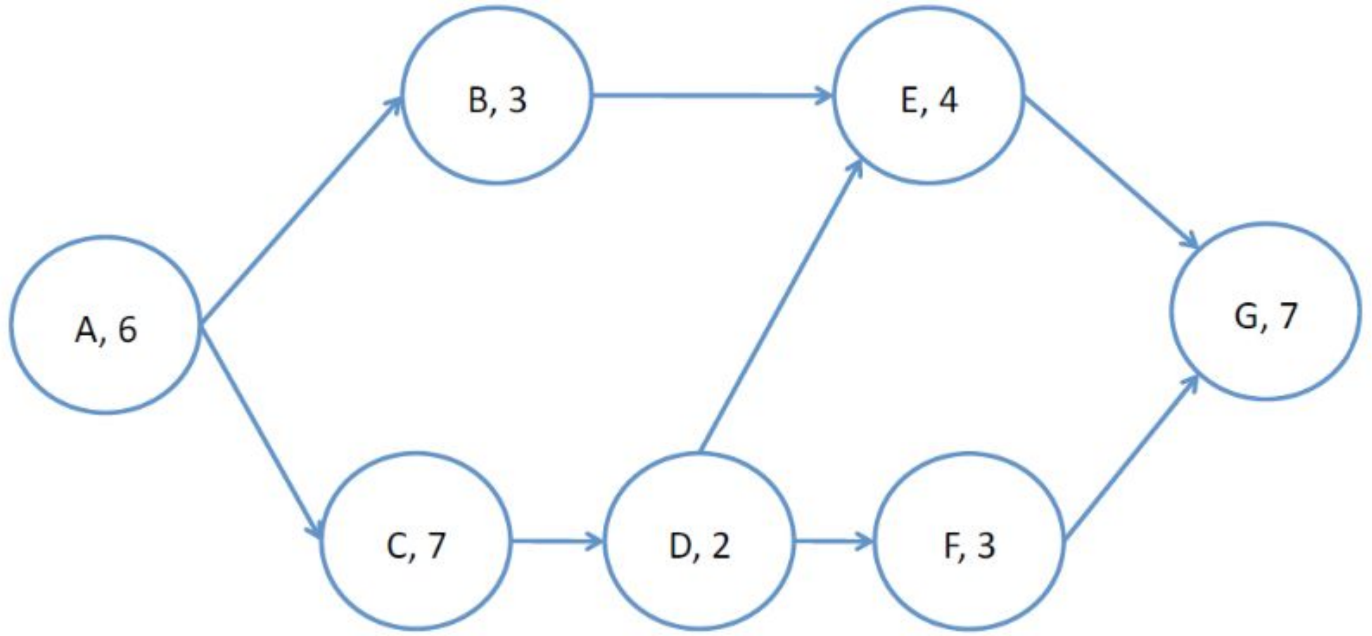
Therefore the duration of the project is 26 weeks since it takes the longest.



Activity	Predecessor	Time (weeks)
A		6
B	A	3
C	A	7
D	C	2
E	B, D	4
F	D	3
G	E, F	7

Practice Question

For the given project activity below, reduce the project completion time to 24 weeks if possible. Give the crashing cost as well. If not possible, clearly state why.



Activity	Predecessor	Time (weeks)	Crash Time (weeks)	Cost
A		6	3	$90
B	A	3	2	$40
C	A	7	2	$50
D	C	2	N/A	
E	B, D	4	N/A	
F	D	3	N/A	
G	E, F	7	N/A	

Practice Question

For the given project activity below, reduce the project completion time to 24 weeks if possible. Give the crashing cost as well. If not possible, clearly state why.

Identify all the required paths.

- ABEG: 2O weeks (6+3+4+7)
- ACDEG: 26 weeks (6+7+2+4+7)*
- ACDFG: 25 weeks (6+7+2+3+7)

The critical path is ACDEG with 26 weeks needed for completion.

Cost of Crashing A: $30/week
Cost of Crashing B: $20/week
Cost of Crashing C: $25/week

Crashing the cheapest activity on the critical path, Activity C by 2 weeks.

Crashing cost = $50 (2*$25/week)

Therefore the crashing cost for reducing the project duration to 24 weeks is $50 if the team chooses to do so.

P-K Formula

P-K FORMULAS		
G/G/1	$I_q \cong \frac{\rho^2}{1-\rho} \times \frac{C_a^2 + C_s^2}{2}$	Inter-arrival times and service times are **generally distributed.** 1 server in queue.
M/M/1	$I_q = \frac{\rho^2}{1-\rho} = \frac{\lambda^2}{\mu(\mu-\lambda)}$	Inter-arrival times and service times are **exponentially distributed.** 1 server in queue
M/D/1	$I_q = \frac{\rho^2}{1-\rho} \times \frac{1}{2} = \frac{\lambda^2}{2\mu(\mu-\lambda)}$	Inter-arrival times are **exponentially distributed.** Service times are **deterministic.** 1 server in queue.
G/G/c	$I_q = \frac{\rho^{\sqrt{2(c+1)}}}{1-\rho} \times \frac{C_a^2 + C_s^2}{2}$	Inter-arrival times and service times are **generally distributed.** There are c servers.

Performance Measures		
I_q	Average Queue Length	$I_q = \lambda * T_q$
I_s	Average # of customers being served	$I_s = \lambda * T_s = \lambda / \mu$
$I = I_s + I_q$	Average # of customers in the process	$I = \lambda * T$
T_q	Average waiting time in queue	$T_q = I_q / \lambda$
T_s	Average service time (server)	$T_s = 1/\mu$
$T = T_s + T_q$	Average Flow Time in the process	$T = I / \lambda$

Practice Question

A shopkeeper installs an ATM and observes that the customers arrive at a rate of 15 customers per hour. The ATM has a fixed non-random service time of 3 minutes per customer.

(a) Calculate the average time spent by a customer in this system

(b) What is the percentage of time that the ATM is idle?

Practice Question

A bank installs an ATM and observes that the customers arrive at a rate of 15 customers per hour and the arrivals follow a Poisson distribution (the interval time between two customers has an exponential distribution). The ATM has a fixed non-random service time of 3 minutes per customer

(a) Calculate the average time spent by a customer in this system

By the P-K formula, $\lambda = 15$ customers/hr $\mu = 1/3 = 20$ customers/hr

$\rho = \lambda/\mu = 3/4$

$Iq = \rho^2/(1-\rho)*(Ca^2+Cs^2)/2 = 1.125$ customers

By Little's Law, $Tq = Iq/\lambda = 1.125/15 = 0.075$ hours

$Ts = 1/\mu = 1/20 = 0.05$ hour

$T = Ts + Tq = 0.075+0.05 = 0.125$ hours

Practice Question

A bank installs an ATM and observes that the customers arrive at a rate of 15 customers per hour and the arrivals follow a Poisson distribution (the interval time between two customers has an exponential distribution). The ATM has a fixed non-random service time of 3 minutes per customer

(b) What is the percentage of time that the ATM is idle?

As mentioned in the last part,

utilization: $\rho = \lambda/\mu = 3/4 = 0.75$ (or 75% of the time)

Idle Time (100-75) = 25%

Thus, the ATM is idle for 25% of the time.