OS Assignment 2

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Please Note:

1. We have used Microsoft excel for creating gantt charts importing data from output file generated by the code.
2. We have used Shortest Time to Completion First as STCS everywhere in the report as well as the code.
3. Our code for MLFQ didn't produce correct outputs, so we have commented it in the code.

1 Assumptions:

1: We have prior knowledge of the number of processes at the beginning.

2: Processes can arrive at any time and are not necessarily scheduled to start at time 0.

3: All time are taken in float non-negative.

4: The runtime and start time of each process are known before running scheduling algorithms.

5: We have knowledge of the size of the hashmap and minheap, as we have assumed their size in our code to be 30000.

6: We assume the maximum number of processes to be 20000, after that program was crashing.

7: Process IDs are taken as integers as input from the inputfile, which can be easily modified acccording to the input format if needed.

8: Process IDs are assumed to be integers starting from 1 when using exponential distribution for generating runtime and inter-arrival time of processes.

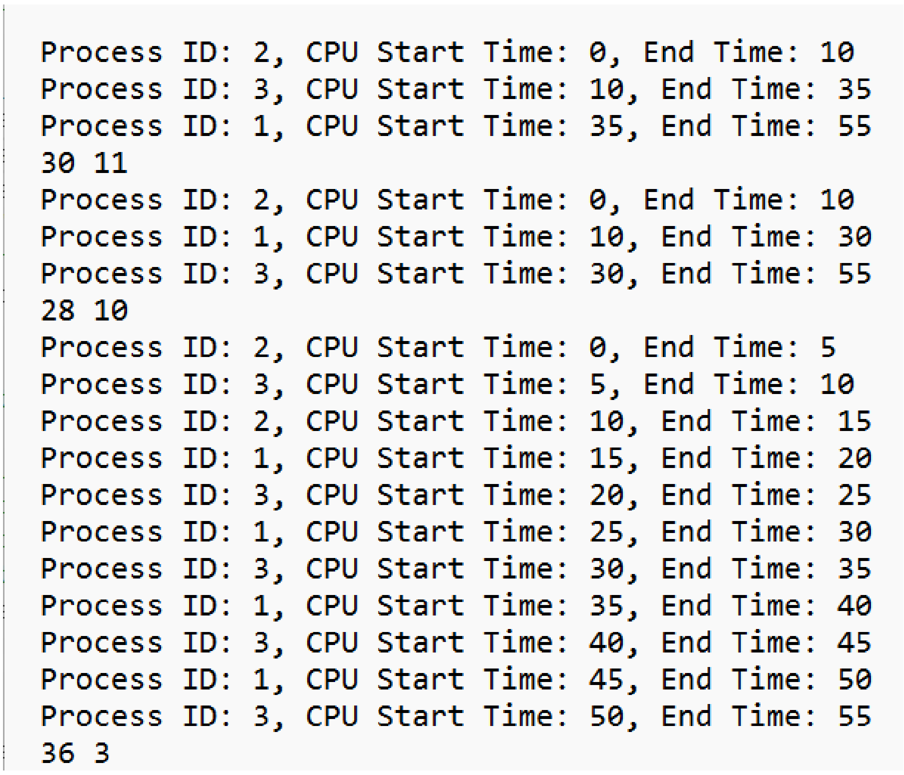
9: Priority in "MinHeap" in the code is based on the runtime of the process.

2 Observations:

1. Even if the list of pocesses contains the same processes, the schedule generated can be different depending on the sequence of processes in the input provided.
2. While running Round Robin Algorithm, if a process enters at time t, and another process already which was a part of RR was scheduled to run at time t, then the later one is given preference. Example shown below (Figure 1).
3. There is no particular monotonicity in pattern of Average Turnaround time and Average Response time while we are increasing slice size in Round Robin Algorithm in any fixed no. of processes (5,20, 200, 1000, 8000, or 20000) or any choice of lambda1 and lambda2.
4. When scheduling large no. of processes (around 1000 or more), for choice of lambda1 and lambda2 as [(1,0.03),(1,0.3),(0.1,0.3),(0.01,3)] in exponential, reducing 'slice; to strictly less than 1 (like 0.9 or 0.8 or 0.5) is crashing the program for Round-Robin Algorithm.
5. Green color highlights best turnaround time, yellow highlights best runtime, and blue highlights worst turnaround time or runtime. (best means least here) (figure 3, 4 and 5)
6. For small number of processes (less than or around 100), RR gives best response time out of the 4 algorithms, and STCS (mostly) as well as RR gives best turnaround time. (figure 2 and 3)

7. For large number of processes, STCF gives best turnaround time as well as best runtime compared to the 4 algorithms. (figure 4 and 5)

8. For large number of processes (around 1000 or more), FCFS gives worst runtime, and Round Robin gives worst turnaround time. (figure 4 and 5)



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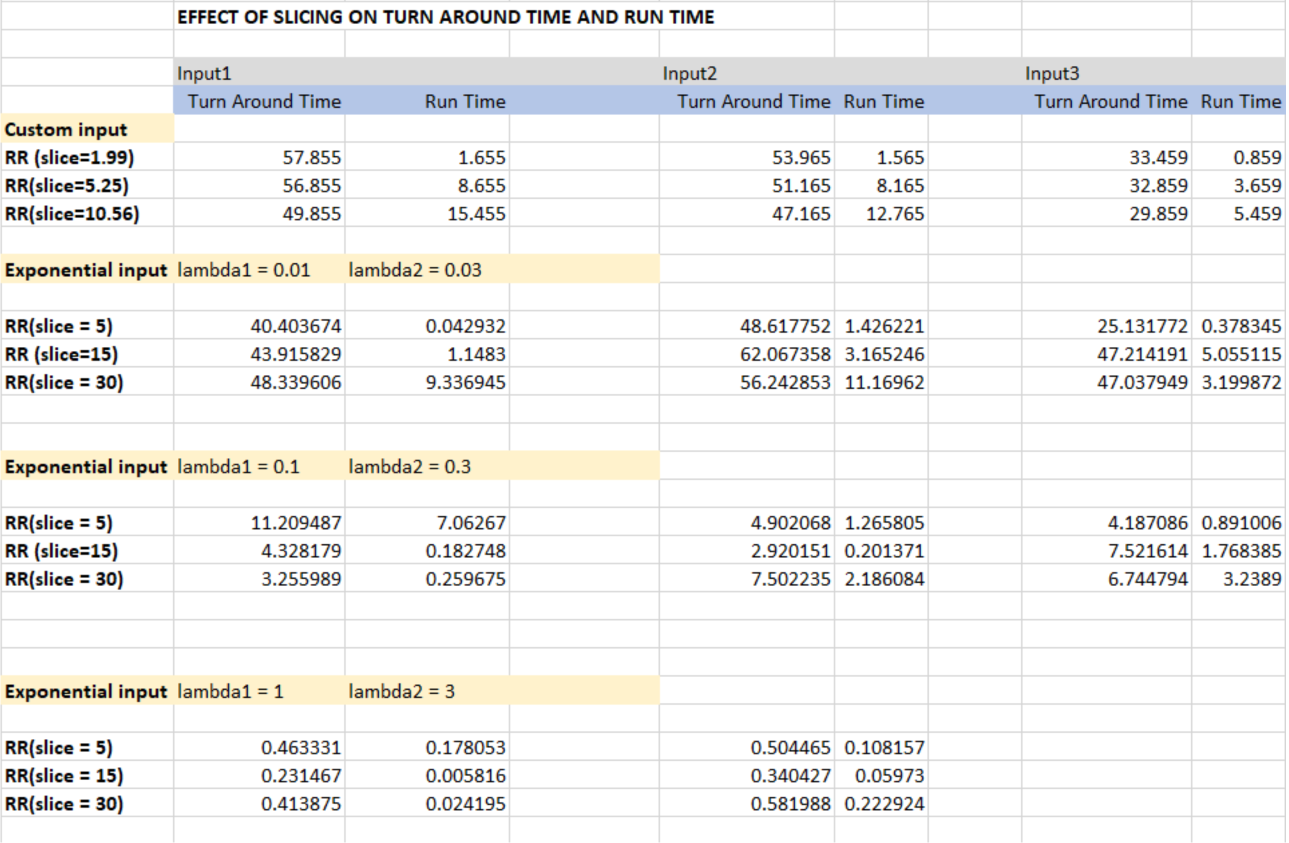
Process ID: 2, CPU Start Time: 0, End Time: 10
Process ID: 3, CPU Start Time: 10, End Time: 35
Process ID: 1, CPU Start Time: 35, End Time: 55
30 11
Process ID: 2, CPU Start Time: 0, End Time: 10
Process ID: 1, CPU Start Time: 10, End Time: 30
Process ID: 3, CPU Start Time: 30, End Time: 55
28 10
Process ID: 2, CPU Start Time: 0, End Time: 5
Process ID: 3, CPU Start Time: 5, End Time: 10
Process ID: 2, CPU Start Time: 10, End Time: 15
Process ID: 1, CPU Start Time: 15, End Time: 20
Process ID: 3, CPU Start Time: 20, End Time: 25
Process ID: 1, CPU Start Time: 25, End Time: 30
Process ID: 3, CPU Start Time: 30, End Time: 35
Process ID: 1, CPU Start Time: 35, End Time: 40
Process ID: 3, CPU Start Time: 40, End Time: 45
Process ID: 1, CPU Start Time: 45, End Time: 50
Process ID: 3, CPU Start Time: 50, End Time: 55
36 3
```

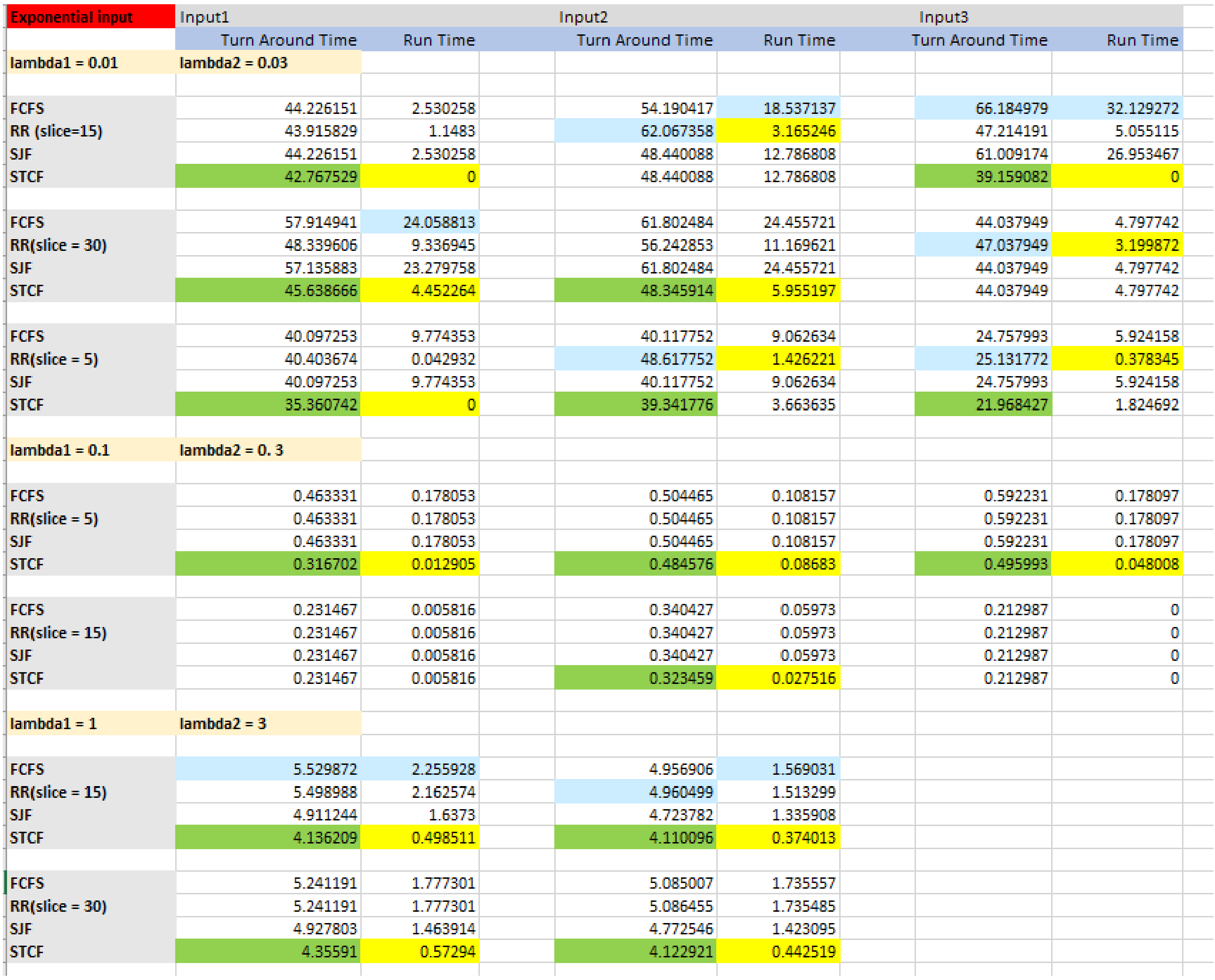
Figure 1: FCFS, SJF, RR



	EFFECT OF SLICING ON TURN AROUND TIME AND RUN TIME					
	Input1		Input2		Input3	
	Turn Around Time	Run Time	Turn Around Time	Run Time	Turn Around Time	Run Time
Custom input						
RR (slice=1.99)	57.855	1.655	53.965	1.565	33.459	0.859
RR(slice=5.25)	56.855	8.655	51.165	8.165	32.859	3.659
RR(slice=10.56)	49.855	15.455	47.165	12.765	29.859	5.459
Exponential input	lambda1 = 0.01	lambda2 = 0.03				
RR(slice = 5)	40.403674	0.042932	48.617752	1.426221	25.131772	0.378345
RR (slice=15)	43.915829	1.1483	62.067358	3.165246	47.214191	5.055115
RR(slice = 30)	48.339606	9.336945	56.242853	11.16962	47.037949	3.199872
Exponential input	lambda1 = 0.1	lambda2 = 0.3				
RR(slice = 5)	11.209487	7.06267	4.902068	1.265805	4.187086	0.891006
RR (slice=15)	4.328179	0.182748	2.920151	0.201371	7.521614	1.768385
RR(slice = 30)	3.255989	0.259675	7.502235	2.186084	6.744794	3.2389
Exponential input	lambda1 = 1	lambda2 = 3				
RR(slice = 5)	0.463331	0.178053	0.504465	0.108157		
RR(slice = 15)	0.231467	0.005816	0.340427	0.05973		
RR(slice = 30)	0.413875	0.024195	0.581988	0.222924		

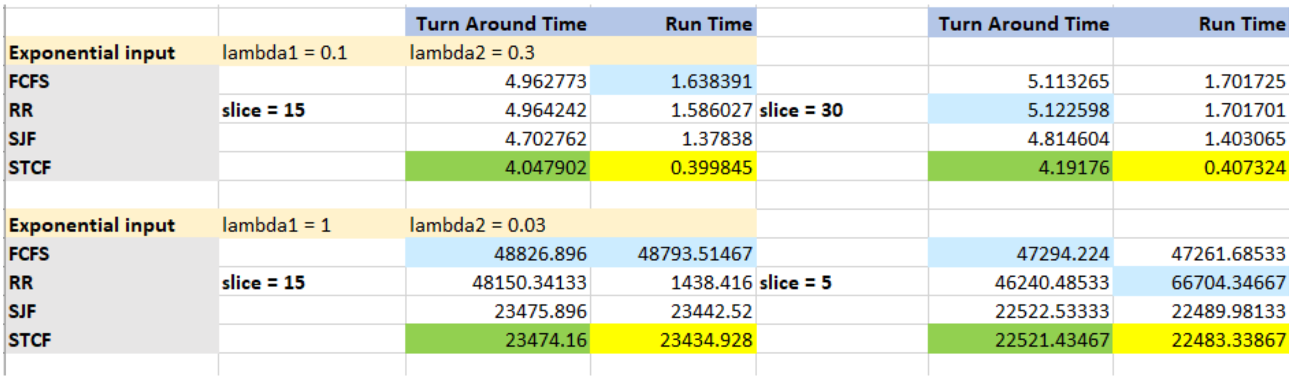
Figure 2: RR exponential 20 processes

Gantt charts



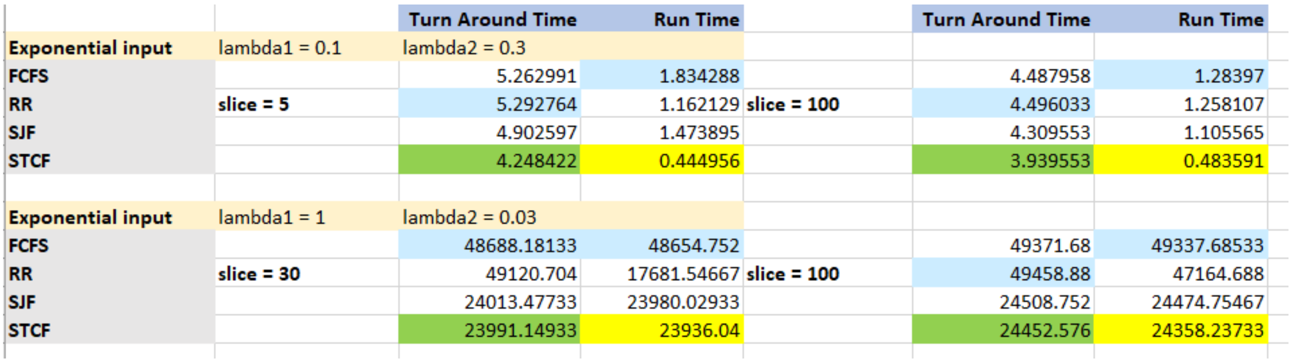
Exponential input	Input1		Input2		Input3	
	Turn Around Time	Run Time	Turn Around Time	Run Time	Turn Around Time	Run Time
lambda1 = 0.01	lambda2 = 0.03					
FCFS	44.226151	2.530258	54.190417	18.537137	66.184979	32.129272
RR (slice=15)	43.915829	1.1483	62.067358	3.165246	47.214191	5.055115
SJF	44.226151	2.530258	48.440088	12.786808	61.009174	26.953467
STCF	42.767529	0	48.440088	12.786808	39.159082	0
FCFS	57.914941	24.058813	61.802484	24.455721	44.037949	4.797742
RR(slice = 30)	48.339606	9.336945	56.242853	11.169621	47.037949	3.199872
SJF	57.135883	23.279758	61.802484	24.455721	44.037949	4.797742
STCF	45.638666	4.452264	48.345914	5.955197	44.037949	4.797742
FCFS	40.097253	9.774353	40.117752	9.062634	24.757993	5.924158
RR(slice = 5)	40.403674	0.042932	48.617752	1.426221	25.131772	0.378345
SJF	40.097253	9.774353	40.117752	9.062634	24.757993	5.924158
STCF	35.360742	0	39.341776	3.663635	21.968427	1.824692
lambda1 = 0.1	lambda2 = 0. 3					
FCFS	0.463331	0.178053	0.504465	0.108157	0.592231	0.178097
RR(slice = 5)	0.463331	0.178053	0.504465	0.108157	0.592231	0.178097
SJF	0.463331	0.178053	0.504465	0.108157	0.592231	0.178097
STCF	0.316702	0.012905	0.484576	0.08683	0.495993	0.048008
FCFS	0.231467	0.005816	0.340427	0.05973	0.212987	0
RR(slice = 15)	0.231467	0.005816	0.340427	0.05973	0.212987	0
SJF	0.231467	0.005816	0.340427	0.05973	0.212987	0
STCF	0.231467	0.005816	0.323459	0.027516	0.212987	0
lambda1 = 1	lambda2 = 3					
FCFS	5.529872	2.255928	4.956906	1.569031		
RR(slice = 15)	5.498988	2.162574	4.960499	1.513299		
SJF	4.911244	1.6373	4.723782	1.335908		
STCF	4.136209	0.498511	4.110096	0.374013		
FCFS	5.241191	1.777301	5.085007	1.735557		
RR(slice = 30)	5.241191	1.777301	5.086455	1.735485		
SJF	4.927803	1.463914	4.772546	1.423095		
STCF	4.35591	0.57294	4.122921	0.442519		

Figure 3: Exponential inputs 200 processes



		Turn Around Time	Run Time		Turn Around Time	Run Time
Exponential input	lambda1 = 0.1	lambda2 = 0.3				
FCFS		4.962773	1.638391		5.113265	1.701725
RR	slice = 15	4.964242	1.586027	slice = 30	5.122598	1.701701
SJF		4.702762	1.37838		4.814604	1.403065
STCF		4.047902	0.399845		4.19176	0.407324
Exponential input	lambda1 = 1	lambda2 = 0.03				
FCFS		48826.896	48793.51467		47294.224	47261.68533
RR	slice = 15	48150.34133	1438.416	slice = 5	46240.48533	66704.34667
SJF		23475.896	23442.52		22522.53333	22489.98133
STCF		23474.16	23434.928		22521.43467	22483.33867

Figure 4: RR exponential 5000 processes



		Turn Around Time	Run Time		Turn Around Time	Run Time
Exponential input	lambda1 = 0.1	lambda2 = 0.3				
FCFS		5.262991	1.834288		4.487958	1.28397
RR	slice = 5	5.292764	1.162129	slice = 100	4.496033	1.258107
SJF		4.902597	1.473895		4.309553	1.105565
STCF		4.248422	0.444956		3.939553	0.483591
Exponential input	lambda1 = 1	lambda2 = 0.03				
FCFS		48688.18133	48654.752		49371.68	49337.68533
RR	slice = 30	49120.704	17681.54667	slice = 100	49458.88	47164.688
SJF		24013.47733	23980.02933		24508.752	24474.75467
STCF		23991.14933	23936.04		24452.576	24358.23733

Figure 5: RR exponential 15000 processes

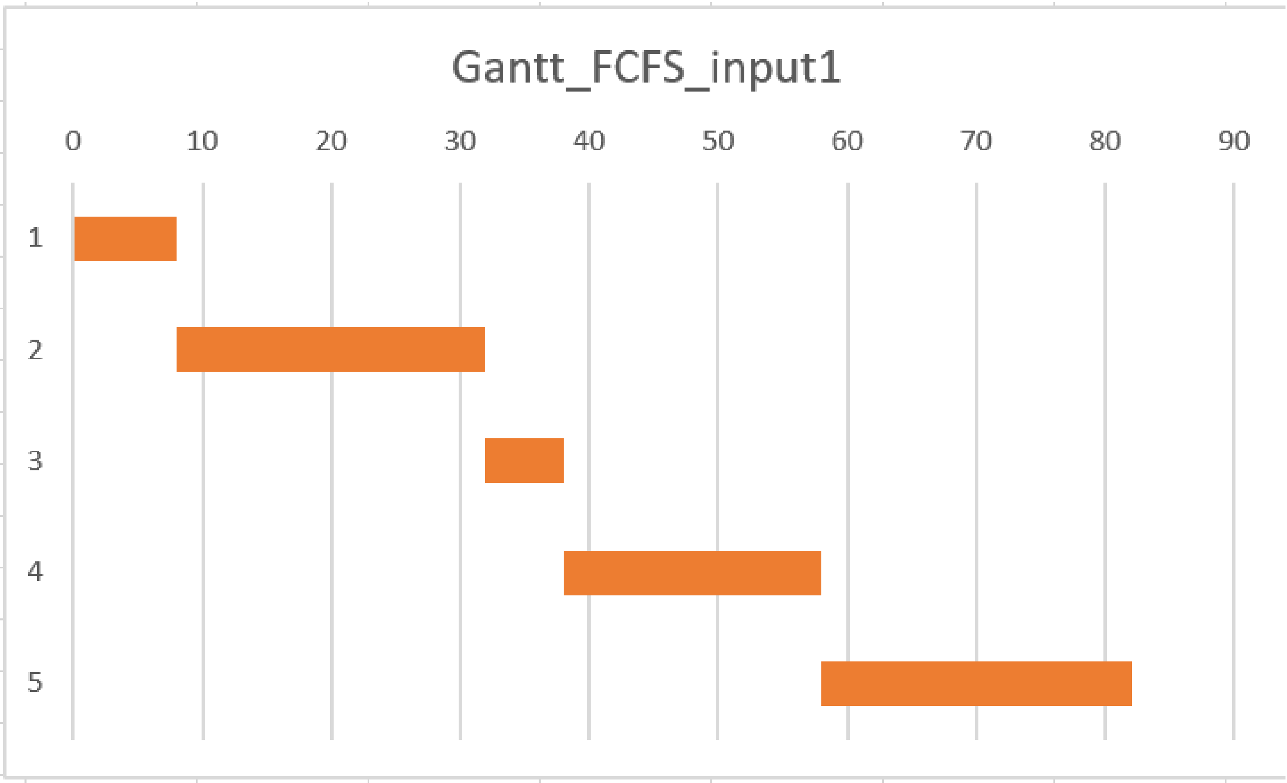


Figure 6: FCFS

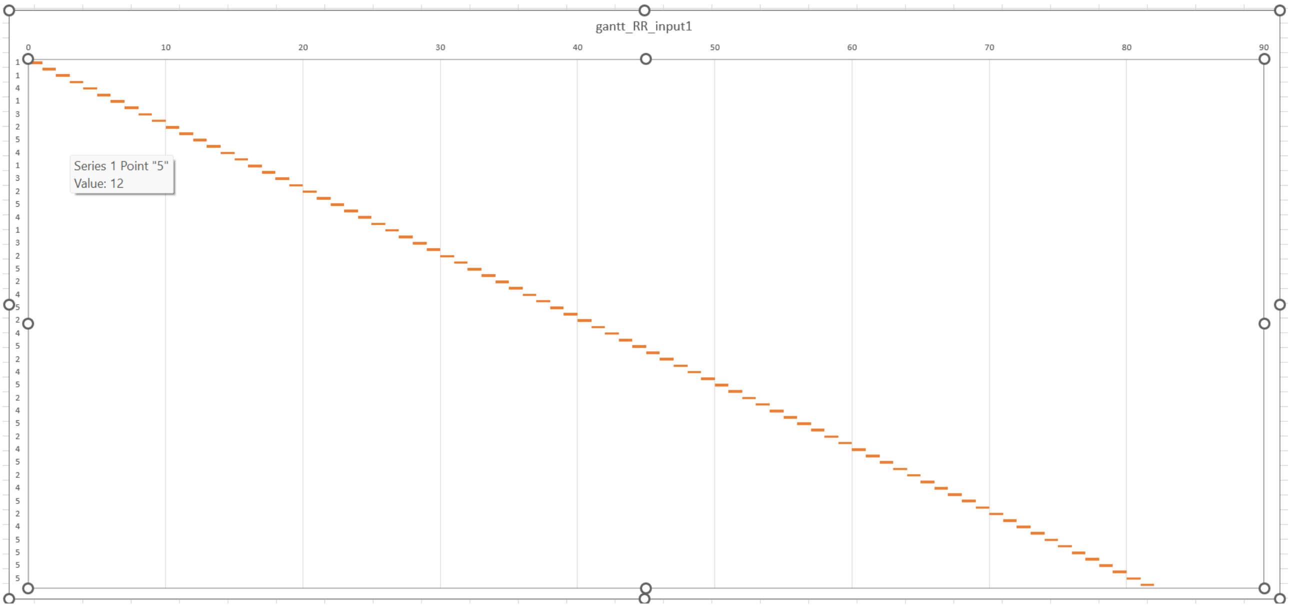


Figure 7: RR input1

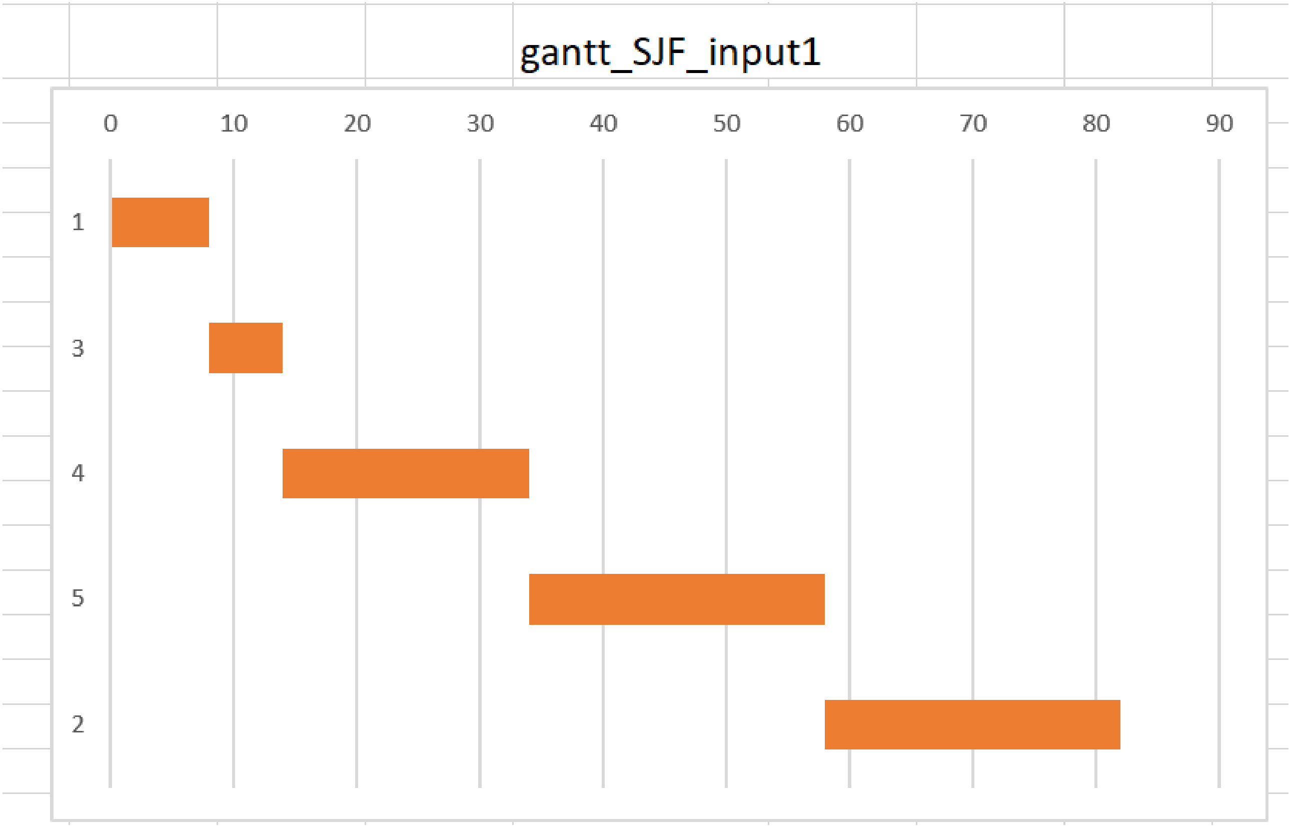


Figure 8: SJF

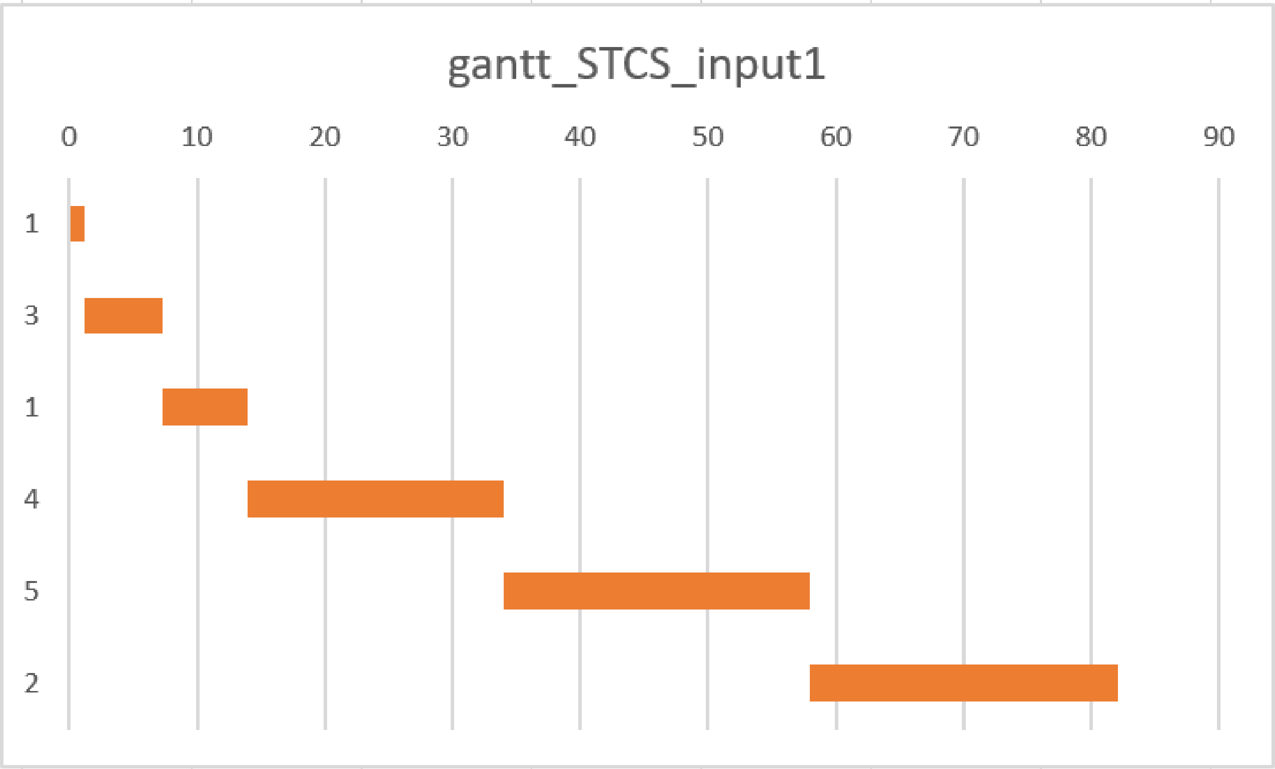


Figure 9: STCS

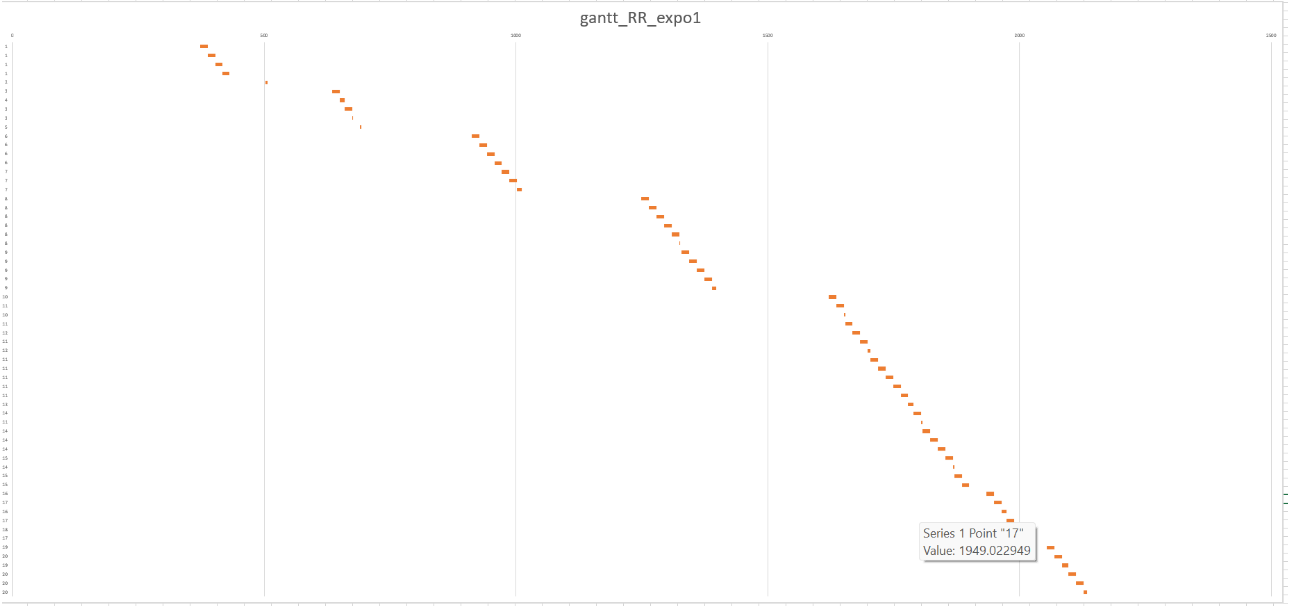


Figure 10: RR exponential 20 processes