Oct 23, 2024

CS 350 DISCUSSION 7

GPS (Generalized Processor Scheduling)

SRT

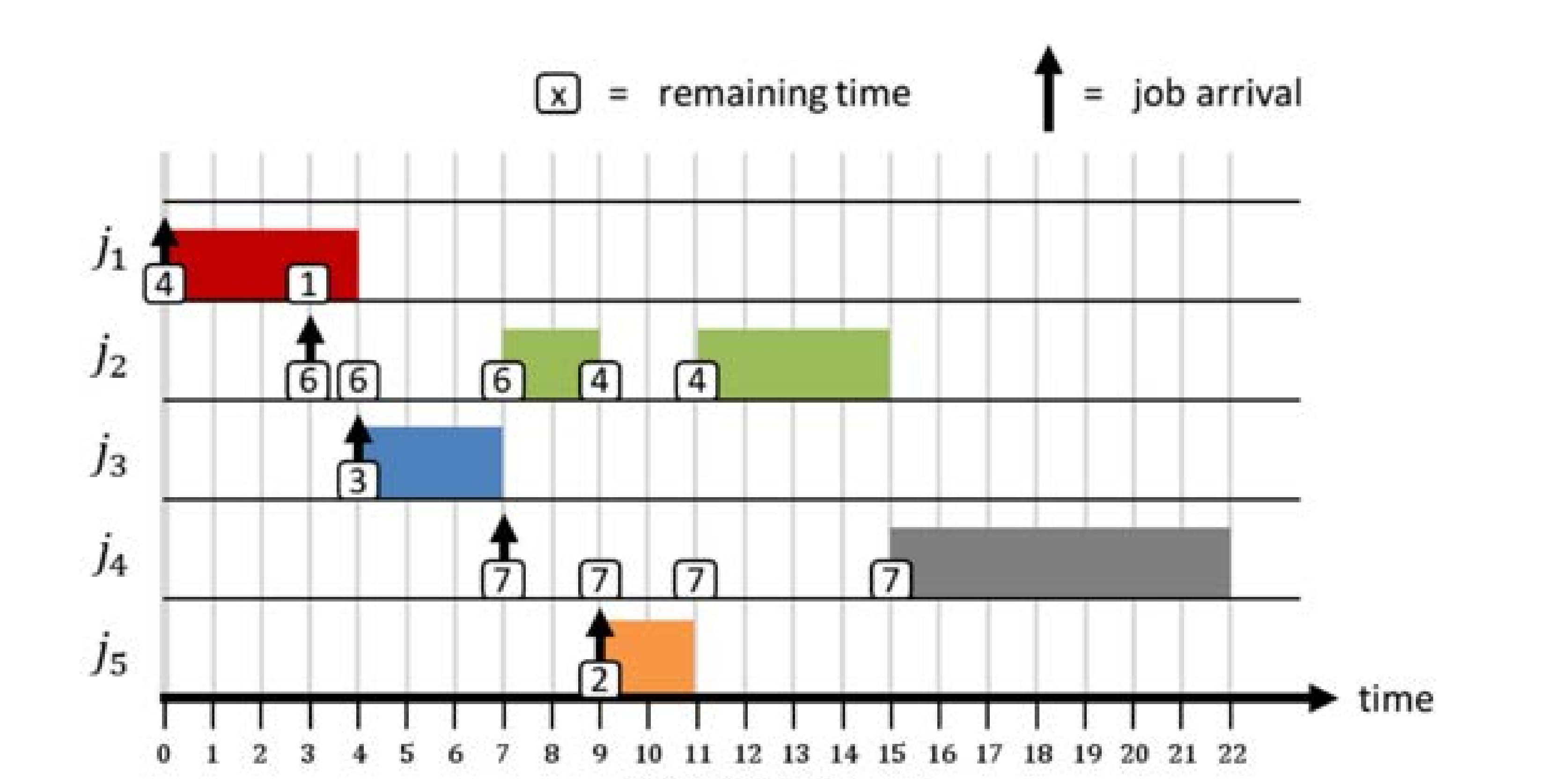

Figure 15.2:Example of SRT schedule.

RR

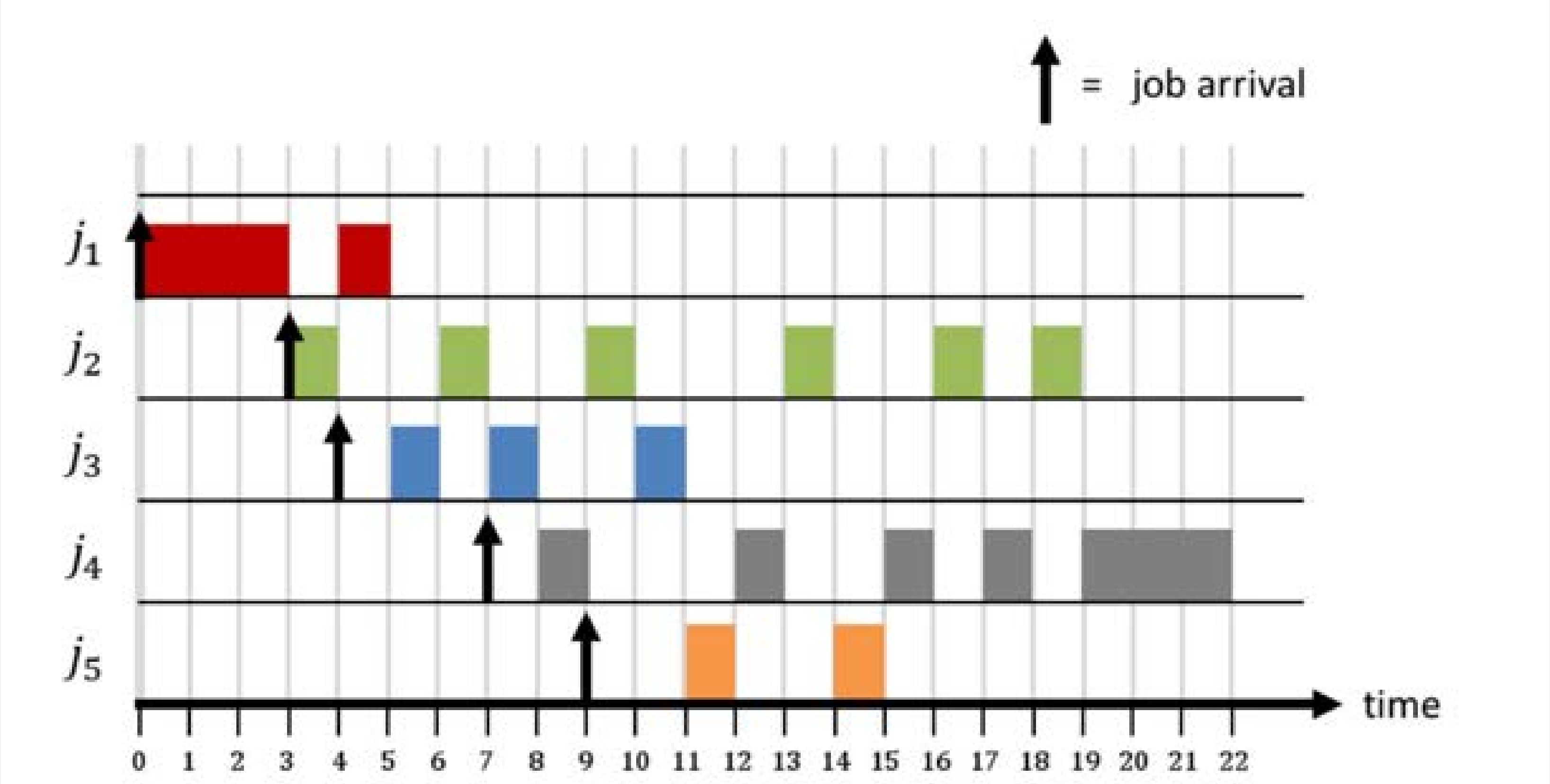

Figure 14.4:Example of Round-Robin schedule when ties are broken based on job index: higher index is ranked higher in case of a tie.

SJN

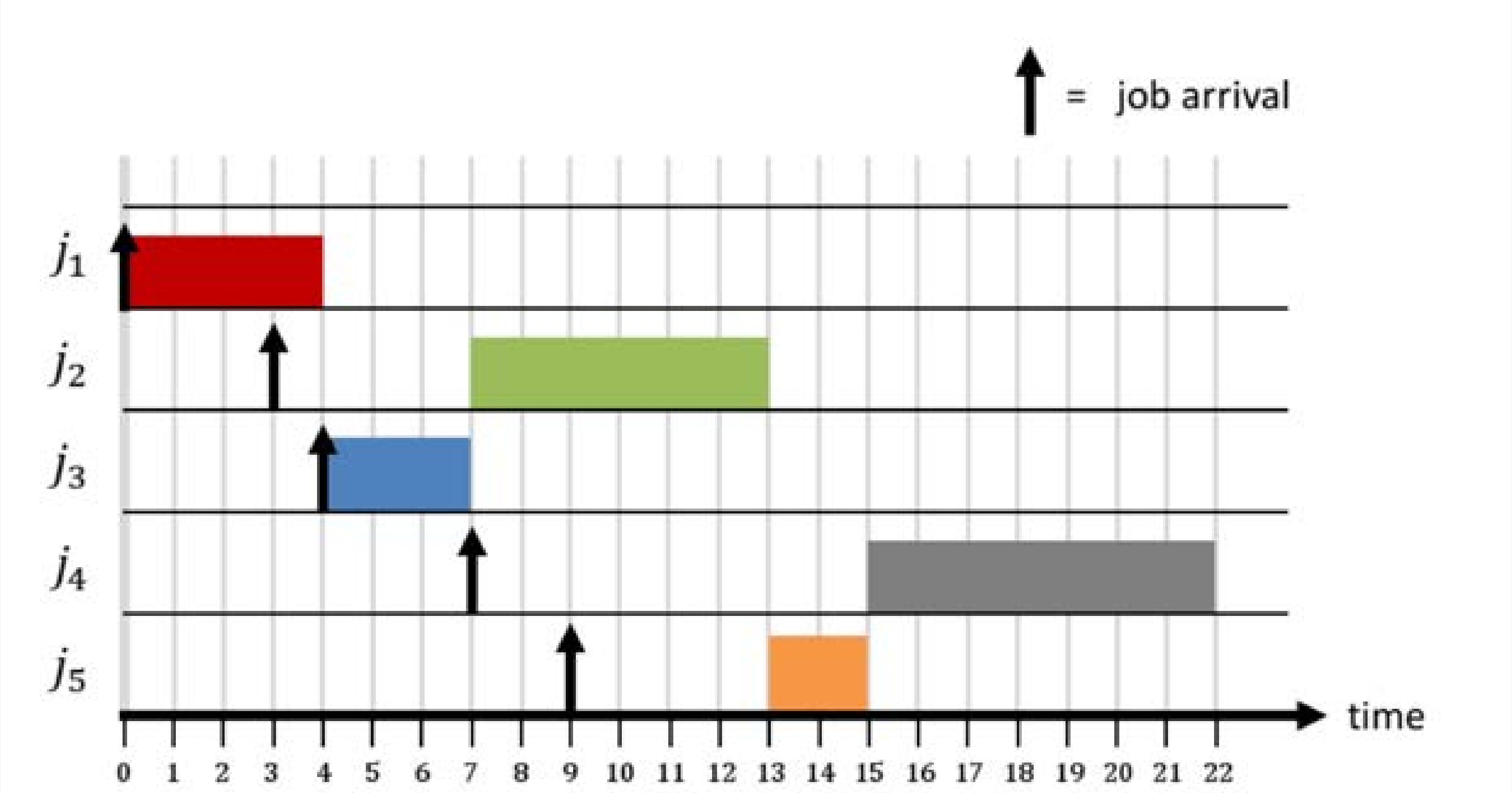

Figure 15.1:Example of SJN schedule.

HSN

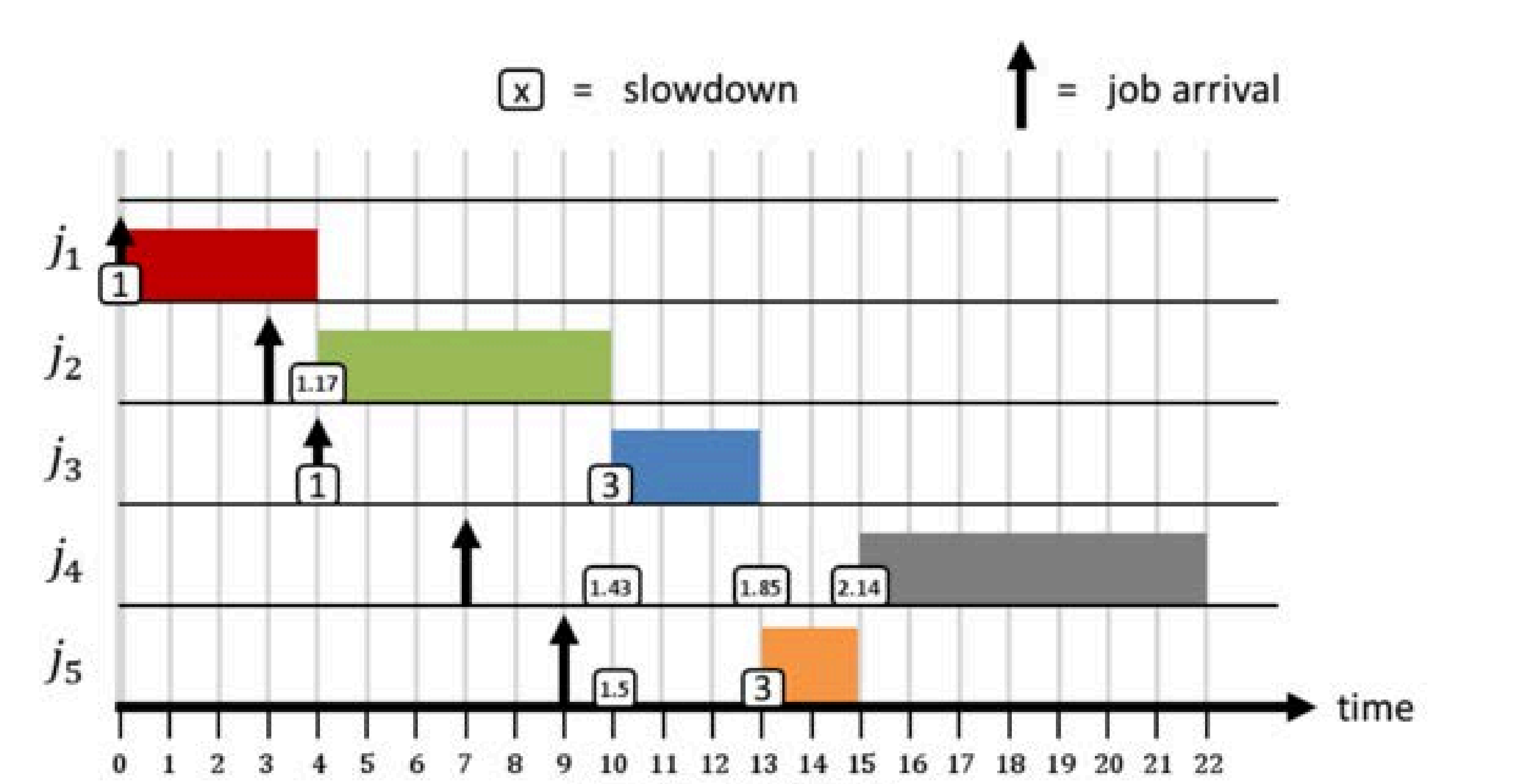

Figure 15.3:Example of HSN schedule.

QUESTION 1 (Problem 15.1 from TB)

Consider the mix of jobs with parameters described in Table 1. Assume that ties (if any) are broken by scheduling jobs with lower ID first. Compute the following:

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

a) The schedule produced by SRT (shortest remaining time). Try to use the same notation as in the lecture notes.

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

a) The schedule produced by SRT. Try to use the same notation as in the lecture notes.

Solution:

Figure 1:SRT

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

b) The schedule produced by HSN (Highest slowdown next). Try to use the same notation as in the lecture notes.

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

b) The schedule produced by HSN (Highest slowdown next). Try to use the same notation as in the lecture notes.

How to calculate Slowdown here?

$$\text{slowdown} = \frac{t + C_i - a_i}{C_i}$$

Where t = current time

Ci = job length and

ai =arrival time

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

b) The schedule produced by HSN. Try to use the same notation as in the lecture notes.

Solution:

Figure 2:HSN

$$\text{slowdown} = \frac{t + C_i - a_i}{C_i}$$

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

c) The schedule produced by SJN. Try to use the same notation as in the lecture notes.

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

c) The schedule produced by SJN. Try to use the same notation as in the lecture notes.

Solution:

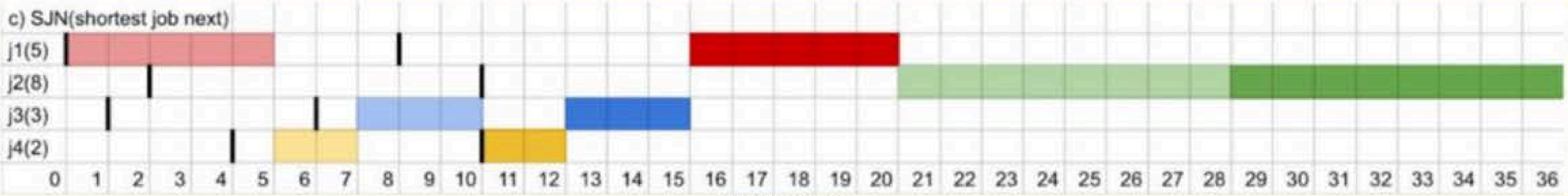

Figure 3:SJN

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

d) The schedule produced by Round Robin. Try to use the same notation as in the lecture notes.

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

d) The schedule produced by Round Robin. Try to use the same notation as in the lecture notes.

Solution:

d) Round-Robin(q=1, lower index is ranked higher in case of a tie)																																				
j1(5)	0	0	0	1	0	1	2	0	1	2	3	4	4	0	1	2	3	4	5	0	1	2	3	4	0	1	2	0	1	2						
j2(8)			0	1	2	0	1	2	3	0	1	2	3	4	5	0,5	1,0	2,1	3,2	4,3	0,4	1,0	2,1	3,2	4,3	0,4	1,0	2,1	0,2	1,0	2,1	0,2	1,0	1	0	0
j3(3)		0	1	0	1	2	0	1	2	3	4	0	1	2	3	4	5	6	0	1	2	3	4													
j4(2)					0	1	2	3	0	1	2	3	4	5	4	5	6	0	1	2	3	4														
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36

Figure 4:RR

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

e) Which algorithm achieves better performance in terms of average response time? Motivate your answer.

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

e) Which algorithm achieves better performance in terms of average response time? Motivate your answer.

Solution:

$$SRT = \frac{15 + 12 + 26 + 26 + 3 + 3 + 2 + 2}{8} = 11.1$$

$$HSN = \frac{5 + 20 + 21 + 26 + 7 + 7 + 6 + 5}{8} = 12.1$$

$$SJN = \frac{5 + 12 + 26 + 26 + 9 + 9 + 3 + 2}{8} = 11.5$$

$$RR = \frac{12 + 22 + 31 + 26 + 7 + 10 + 12 + 9}{8} = 17.4$$

SRT yields a better performance regarding the average response time.

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

f) Which algorithm achieves better fairness? Motivate your answer.

Job ID	Job Length	Arrival times
1	5	0, 8
2	8	2, 10
3	3	1, 6
4	2	4, 10

Table 1: Job parameters.

f) Which algorithm achieves better fairness? Motivate your answer.

Solution:
If we consider the slowdown for the shortest job as the metric for fairness. Then the slowdown is shown as below

SRT
: $4/4 = 1$

HSN
: $11/4 = 2.75$

SJN
: $5/4 = 1.25$

RR
: $20/4 = 5$

A single-cpu web server is trying to be smart about the way it schedules processing for incoming page requests. The web server is running a sharing hosting service with three websites deployed on it. As page requests come in for the three websites, the web server classifies the requests depending on the page they target. It then tries to schedule the pending requests for each of the websites using Shortest Job Next. But the server does not know the future! This means that it needs to estimate, for each class of requests, how long the next request will last based on what it observed in the past.

Table 5 reports the *ground truth* on the actual runtime of a series of about 6 requests per website and their arrival times. Remeber: the webserver scheduler does not know the exact length of a job reported in the table until the job has completed. Also assume that when the scheduler has no knowledge of the requests at all, it will default to schedule a request for website 1 first, then website 2, and so on. This is also the priority ordering in case of any tie. Remeber also that if at any time there is more than one ready request for the same website that is ready, the FIFO ordering is followed.

	Website 1		**Website 2**		**Website 3**	
Index	Arrival	Length	Arrival	Length	Arrival	Length
1	0	3	1	4	2	2
2	9	2	9	5	9	3
3	15	4	18	3	16	2
4	28	2	25	2	23	1
5	37	2	30	3	30	3
6	–	–	37	4	37	2

Table 5: List of requests with arrival times and processing time.

	Website 1		Website 2		Website 3	
Index	Arrival	Length	Arrival	Length	Arrival	Length
1	0	3	1	4	2	2
2	9	2	9	5	9	3
3	15	4	18	3	16	2
4	28	2	25	2	23	1
5	37	2	30	3	30	3
6	–	–	37	4	37	2

Table 5: List of requests with arrival times and processing time.

a) Assume an impossible webserver that is able to foresee the future (the oracle server!), what would be the order in which the various requests are processed? Produce a time plot of the resulting schedule that goes until the last request has been completed.

	Website 1		Website 2		Website 3	
Index	Arrival	Length	Arrival	Length	Arrival	Length
1	0	3	1	4	2	2
2	9	2	9	5	9	3
3	15	4	18	3	16	2
4	28	2	25	2	23	1
5	37	2	30	3	30	3
6	–	–	37	4	37	2

Table 5: List of requests with arrival times and processing time.

a) Assume an impossible webserver that is able to foresee the future (the oracle server!), what would be the order in which the various requests are processed? Produce a time plot of the resulting schedule that goes until the last request has been completed.

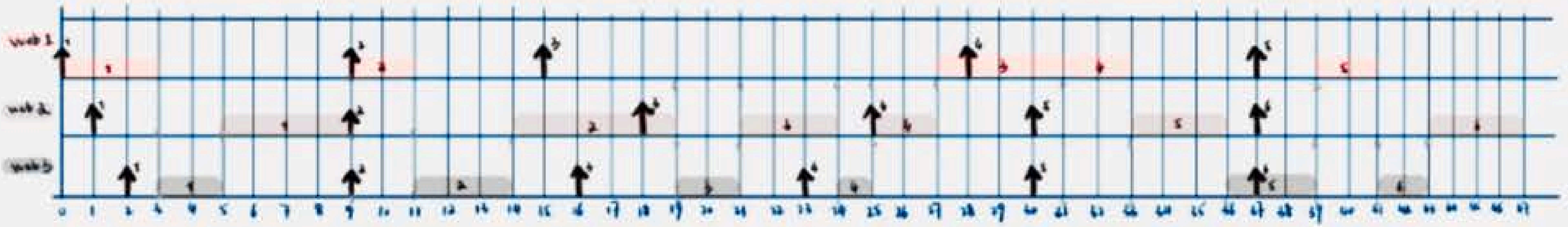

Figure 9: Problem 3a. Clairvoyant schedule.

Index	Website 1		Website 2		Website 3	
	Arrival	**Length**	**Arrival**	**Length**	**Arrival**	**Length**
1	0	3	1	4	2	2
2	9	2	9	5	9	3
3	15	4	18	3	16	2
4	28	2	25	2	23	1
5	37	2	30	3	30	3
6	–	–	37	4	37	2

Table 5: List of requests with arrival times and processing time.

b) Now consider a realistic scheduler without clairvoyance capabilities. What is the resulting schedule if the server tries to predict the length of the next request directed to each website using an exponentially weighted moving average with parameter $\alpha = 0.5$? Show your work where it is clear at every step of the way how the scheduler it making predictions and taking decisions.

b) Now consider a realistic scheduler without clairvoyance capabilities. What is the resulting schedule if the server tries to predict the length of the next request directed to each website using an exponentially weighted moving average with parameter $\alpha = 0.5$? Show your work where it is clear at every step of the way how the scheduler it making predictions and taking decisions.

C(n)	web 1	web 2	web 3
C(0)	N/A	N/A	N/A
C(1)	3	4	2
$\overline{C}(2)$	$0.5 \times 2 + 0.5 \times 3 = 2.5$	$0.5 \times 5 + 0.5 \times 4 = 4.5$	$0.5 \times 3 + 0.5 \times 2 = 2.5$
$\overline{C}(3)$	$0.5 \times 4 + 0.5 \times 2.5 = 3.25$	$0.5 \times 3 + 0.5 \times 4.5 = 3.75$	$0.5 \times 2 + 0.5 \times 2.5 = 2.25$
$\overline{C}(4)$	$0.5 \times 2 + 0.5 \times 3.25 = 2.625$	$0.5 \times 2 + 0.5 \times 3.75 = 2.875$	$0.5 \times 1 + 0.5 \times 2.25 = 1.625$
$\overline{C}(5)$	$0.5 \times 2 + 0.5 \times 2.625 = 2.3125$	$0.5 \times 3 + 0.5 \times 2.875 = 2.9375$	$0.5 \times 3 + 0.5 \times 1.625 = 2.3125$

Table 6: Problem 3b. Prediction table.

	Website 1		**Website 2**		**Website 3**	
Index	Arrival	Length	Arrival	Length	Arrival	Length
1	0	3	1	4	2	2
2	9	2	9	5	9	3
3	15	4	18	3	16	2
4	28	2	25	2	23	1
5	37	2	30	3	30	3
6	–	–	37	4	37	2

Table 5: List of requests with arrival times and processing time.