CAS CS 350 HW6

Andrea Lopez

TOTAL POINTS

95 / 100

QUESTION 1

1 Q1 30 / 30

✓ - 0 pts Correct

part a)

- 2 pts Minor Errors with Graph
- 4 pts Mostly Incorrect
- 5 pts Incorrect

part b)

- 3 pts Incorrect

part c)

- 2 pts No Description
- 2 pts Minor Errors with Graph
- 5 pts Mostly Incorrect
- 6 pts Incorrect

part d)

- 2 pts No Description
- 2 pts Minor Errors with Graph
- 4 pts No Graph
- 5 pts Mostly Incorrect
- 6 pts Incorrect

part e)

- 3 pts No Description or Definition of Readiness
- 3 pts Minor Errors with Graph
- 5 pts No Graph
- 6 pts Mostly Incorrect
- 8 pts Incorrect

part f)

- 2 pts Incorrect

LATE

- 2 pts Click here to replace this description.
- 3.75 pts Click here to replace this description.
- 5.5 pts Click here to replace this description.
- 5.75 pts Click here to replace this description.
- 6.25 pts Click here to replace this description.
- 6.5 pts Click here to replace this description.
- 6.75 pts Click here to replace this description.
- 7 pts Click here to replace this description.
- 7.5 pts Click here to replace this description.

QUESTION 2

2 Q2 29 / 30

part a)

✓ - 0 pts correct

- 1 pts one mistake
- 2 pts two mistakes
- 4 pts more than two mistakes
- 8 pts incomplete/missing

part b)

✓ - 0 pts correct

- 8 pts incomplete/missing
- 4 pts incorrect with work shown
- 4 pts work shown but no final priority assignment

part c)

- 0 pts correct
- 8 pts incomplete/missing
- 4 pts several jobs incorrectly scheduled

✓ - 1 pts one job incorrectly scheduled

- 2 pts two jobs incorrectly handled

part d)

✓ - 0 pts correct

- 6 pts incomplete/missing/incorrect with no work
- 3 pts incorrect with work shown

- 7.5 pts LATE PENALTY
- 4 pts LATE PENALTY (on 4 points)

QUESTION 3

3 Q3 36 / 40

part a

✓ **- 0 pts correct**

- 8 pts missing/no work

- 2 pts minor errors in table

- 4 pts more than a few errors in table

part b

✓ **- 0 pts correct**

- 8 pts missing/no work

- 4 pts incorrect with work shown

- 2 pts no calculation for EDF

- 2 pts no calculation for RM

part c

✓ **- 0 pts correct**

- 4 pts missing/ no work

- 2 pts picked the uniprocessor with reasoning

part d

✓ **- 0 pts correct**

- 6 pts missing/ no work

- 1 pts minor issues with assignments

- 3 pts more than a few issues with assignments

part e

✓ **- 0 pts correct**

- 6 pts missing/no work

- 1 pts one job incorrectly scheduled

- 2 pts two jobs incorrectly scheduled

- 3 pts a few jobs incorrectly scheduled

part f

- 0 pts correct

- 8 pts missing/no work

- 2 pts one job incorrectly scheduled

- 3 pts two jobs incorrectly scheduled

✓ **- 4 pts a few jobs incorrectly scheduled**

- 4 pts did not produce a schedule to check

- 4 pts incorrect with work shown

- 10 pts LATE PENALTY

- 8 pts Late Penalty (did not have 10 points to deduct from)

Problem 1

a) graph using FIFO

b) Round Robin is not a good idea because it would be very time consuming to be switching to the tables necessary for each job, as the scheduler switches from job to job. Therefore, RR would take up too much time and be very inefficient.

c) Description:

- First graph (using SJN)
  - ↳ The new policy is to schedule all the jobs that use the currently loaded table. If multiple jobs occupy the same tables, schedule the shorter one (smaller ET).
- Second graph (using SSN)
  - ↳ The new policy is to schedule all the jobs that use the currently loaded table (like above). The difference is that if multiple jobs occupy the same tables, schedule the one with lower ID.

d) The policy I used followed the same logic as SJN. It loaded all the jobs that use the currently loaded tables, prioritizing the shortest job next (smallest ET).

e) Readiness, in this context, means that a job is ready to be served (or has arrived and is waiting to be served). In this case, the "next ready" would be the job that has arrived first, and therefore has been waiting the longest.

Problem 1 continued...

f) ① qt avg of last 3 lengths scheduled: ↗ sliding window avg (w=3)

- R5 → 1
- R4 → 5
- R6 → 3

$$\frac{1+5+3}{3} = \frac{9}{3} = 3$$

Therefore, the predicted execution time for the new query is 3 secs.

Problem 1

Problem 1a)

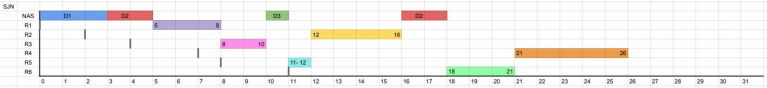
FIFO

Order	ID	AT (s)	ET (s)	Table
1	R1	0	3	D1, D2
2	R2	2	4	D1, D3
3	R3	4	2	D1, D2
4	R4	7	5	D2, D3
5	R5	8	1	D1, D3
6	R6	11	3	D2, D3

Table	LT (s)
D1	3
D2	2
D3	1

Problem 1c)

SJN



Order	ID	AT (s)	ET (s)	Table
1	R1	0	3	D1, D2
4	R2	2	4	D1, D3
2	R3	4	2	D1, D2
6	R4	7	5	D2, D3
3	R5	8	1	D1, D3
5	R6	11	3	D2, D3

Table	LT (s)
D1	3
D2	2
D3	1

SSN

Order	ID	AT (s)	ET (s)	Table
1	R1	0	3	D1, D2
3	R2	2	4	D1, D3
2	R3	4	2	D1, D2
6	R4	7	5	D2, D3
4	R5	8	1	D1, D3
5	R6	11	3	D2, D3

Table	LT (s)
D1	3
D2	2
D3	1

Problem 1d)

SJN

Order	ID	AT (s)	ET (s)	Table
1	R1	0	3	D1, D2
5	R2	2	4	D1, D3
3	R3	4	2	D1, D2
6	R4	7	5	D2, D3
2	R5	8	1	D1, D3
4	R6	11	3	D2, D3

Table	LT (s)
D1	3
D2	2
D3	1

Problem 1e)

- FCFS

Order	ID	AT (s)	ET (s)	Table
1	R1	0	3	D1, D2
3	R2	2	4	D1, D3
2	R3	4	2	D1, D2
5	R4	7	5	D2, D3
4	R5	8	1	D1, D3
6	R6	11	3	D2, D3

Table	LT (s)
D1	3
D2	2
D3	1

1 Q1 30 / 30

✓ - **0 pts** Correct

part a)

- **2 pts** Minor Errors with Graph
- **4 pts** Mostly Incorrect
- **5 pts** Incorrect

part b)

- **3 pts** Incorrect

part c)

- **2 pts** No Description
- **2 pts** Minor Errors with Graph
- **5 pts** Mostly Incorrect
- **6 pts** Incorrect

part d)

- **2 pts** No Description
- **2 pts** Minor Errors with Graph
- **4 pts** No Graph
- **5 pts** Mostly Incorrect
- **6 pts** Incorrect

part e)

- **3 pts** No Description or Definition of Readiness
- **3 pts** Minor Errors with Graph
- **5 pts** No Graph
- **6 pts** Mostly Incorrect
- **8 pts** Incorrect

part f)

- **2 pts** Incorrect

LATE

- **2 pts** Click here to replace this description.
- **3.75 pts** Click here to replace this description.
- **5.5 pts** Click here to replace this description.
- **5.75 pts** Click here to replace this description.
- **6.25 pts** Click here to replace this description.
- **6.5 pts** Click here to replace this description.
- **6.75 pts** Click here to replace this description.
- **7 pts** Click here to replace this description.
- **7.5 pts** Click here to replace this description.

Problem 2

a)

Task	WCET	Period	util.	priority
T_1	2	5	0.4	4
T_2	1	8	0.125	1
T_3	2	16	0.125	2
T_4	2	20	0.1	3

- find utilization of each task using $\frac{C_i}{T_i}$ — C_i = task's WCET, T_i = task's period

T_1:

$q = \frac{C_i}{T_i}$ ↘ plug in!

$q = \frac{2}{5}$

T_2:

$q = \frac{C_i}{T_i}$ ↘ plug in!

$q = \frac{1}{8}$

T_3:

$q = \frac{C_i}{T_i}$ ↘ plug in!

$q = \frac{2}{16} = \frac{1}{8}$

T_4:

$q = \frac{C_i}{T_i}$ ↘ plug in!

$q = \frac{2}{20} = \frac{1}{10}$

b) For RM, if $U \leq m \cdot (2^{1/m} - 1)$, then the task is schedulable.

① solve utilization

$q(T_1) + q(T_2) + q(T_3) + q(T_4) = q$ ↘ plug in!

$0.4 + 0.125 + 0.125 + 0.1 = \underline{0.75}$

② solve for $m \cdot (2^{1/m} - 1)$

$m \cdot (2^{1/m} - 1) = 4 \cdot (2^{1/4} - 1) = \underline{0.7568}$

b) ③ compare 2 values and determine if schedulable

$U \leq m \cdot (2^{1/m} - 1)$

$0.75 \leq 0.7568 \longrightarrow$ this is true!

Yes, because $U \leq m \cdot (2^{1/m} - 1)$, or $0.75 \leq 0.7568$, and this proves that the system is schedulable.

TASK	WCET	period	util.	priority
T_1	2	5	0.8	4
T_2	1	8	0.125	3
T_3	2	16	0.125	2
T_4	2	20	0.1	1

c) graph using EDF

d) WCET for Task 3 is 6 because that is the longest possible length for task 3 where each task still meets their deadline. (See diagram for proof of schedulability)

scheduling guaranteed equation (EDF): $U \leq 1$

$$U = \sum_{i=1}^{4} \frac{C_i}{T_i} = \frac{2}{5} + \frac{1}{8} + \frac{X}{6} + \frac{1}{10} \leq 1$$

$$\frac{X}{16} + 0.625 \leq 1$$

$$\frac{X}{16} \leq 0.375$$

$$\boxed{X \leq 6}$$

Problem 2

Problem 2c)

EDF

Task	WCET	Period	Utilization
T1	2	5	0.4
T2	1	8	0.125
T3	2	16	0.125
T4	2	20	0.1

Problem 2d)

EDF

Task	WCET	Period	Utilization
T1	2	5	0.4
T2	1	8	0.125
T3	6	16	0.125
T4	2	20	0.1

Problem 3

Problem 3e)

KEY
MDT
LPD
FVT

Problem 3f)

KEY
MDT
LPD
FVT

2 Q2 29 / 30

part a)

✓ **- 0 pts correct**

- 1 pts one mistake

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- 3 pts incorrect with work shown

- 7.5 pts LATE PENALTY

- 4 pts LATE PENALTY (on 4 points)

Problem 3

a)

	Task	(C_i) WCET	(T_i) Period	(U_i) Util
	SF	0.8 mcc	2.5 ms	0.32
	AS	2.3 mcc	7 ms	0.3286
	AESA	5 mcc	200 ms	0.025
DAS	1. MDT	4 mcc	10 ms	0.4
DAS	2. LPD	6 mcc	20 ms	0.3
DAS	3. FCCM	3 mcc	12.5 ms	0.24
DAS	4. FVT	5 mcc	25 ms	0.2
	CNI	12 mcc	20 ms	0.6
			total:	2.4136

change time period (to account for Hz)

$\text{period} = \frac{1000}{10\ Hz} = 100\ ms$

b) EDF:

$$U \cdot \frac{10^9}{f} \leq 1$$

↓

① $2.4136 \cdot \frac{10^9}{f} \leq 1$

② $\frac{2.4136 \cdot 10^9}{f} \leq 1 \cdot f$

③ $2.4136 \cdot 10^9 \leq f$

④ $2.4136\ GHz \leq f$

For EDF, the frequency is 2.4136 GHz

RM:

$$U \cdot \frac{10^9}{f} \leq m(2^{\frac{1}{m}} - 1)$$

↓

① $2.4136 \cdot \frac{10^9}{f} \leq 8(2^{\frac{1}{8}} - 1)$

② $\frac{2.4136 \cdot 10^9}{f} \leq \frac{0.73(f)}{0.73}$

③ $3.301\ GHz \leq f$

For RM, the frequency is 3.301 GHz

c) Compare the efficiency of single processor vs. multi-processor

single processor:

C^X

$50^{2.41}$) plug in!

$12431.\overline{3}$

multi processor:

C[X]) plug in!

3[50]

150

I would go for the multiprocessor solution because multi processor is more efficient (bc $150 < 12431.\overline{3}$)

d) min # of processors required = 3

Task-to-processor assignment:

Processor 1	
Task	Util.
SF	0.32
AS	0.3286
AESA	0.025
LPD	0.3

total util. = 0.9736

Processor 2	
Task	Util.
MDT	0.4
CNI	0.6

total util = 1

Processor 3	
Task	Util.
FCCM	0.24
FVT	0.2

total util = 1

e) see graph

f) RM:

$U \leq m(2^{\frac{1}{m}} - 1)$

$U \leq 3 \cdot 2^{\frac{1}{3}} - 1$

$U_t \leq .78$

↳ plug in U_t

$0.9 \leq .78$ ← this is not true, graph to make sure it is schedulable

$U_t = MDT_{U_i} + LPD_{U_i} + FVT_{U_i}$ ↓ plug in!

$U_t = 0.4 + 0.3 + 0.2 = 0.9$

(see graph)

↳ Yes

after we graph it, we see that no deadlines are missed so therefore, the system is schedulable (even though the equation presented otherwise).

Problem 2

Problem 2c)

EDF

Task	WCET	Period	Utilization
T1	2	5	0.4
T2	1	8	0.125
T3	2	16	0.125
T4	2	20	0.1

Problem 2d)

EDF

Task	WCET	Period	Utilization
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Problem 3

Problem 3e)

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MDT
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Problem 3f)

KEY
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FVT

3 Q3 36 / 40

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