**Development of Real-Time Systems – Assignment 3**

## Theory Assignment:

Objective: To determine optimal frame size to prove the feasibility of scheduling every associated task.

Procedure:

Hyper period H is divided into equal size parts: Frames with size f. Then F = h/ f is the number of frames in H. Largest f that fulfils 3 requirements.

Requirement 1: $f >= \max(e_i)$ where $1<= i <= n$

Requirement 2: Then create a candidate frame sizes which are valid with these requirements.

Candidate frame size are all possible frame size as per the requirement 2.

Requirement 3: To satisfy the below criterion i.e

$2f - \gcd(P_i , f) <= Di$

Task set 1:

T1(15, 1, 14) T2(20, 2, 26) T3(22, 3)

Requirement 1: f >= 3

Requirement 2: Candidates that divide the Hyper Period H evenly are,

f = { 22, 20, 15, 11, 10, 5}

Requirement 3: We have the candidates

f = { 22, 20, 15, 11, 10, 5}

And the criterion is : $2f - \gcd(P_i , f) <= Di$

| *F* | *T1(15, 1, 14)* | *T2(20, 2, 26)* | *T3(22, 3)* |
|---|---|---|---|
| *22* | 44 - 1 <= 14 X | | |
| *20* | 40 - 5 <= 14 X | | |
| *15* | 30 - 15 <= 14 X | | |
| *11* | 22 - 1 <= 14 X | | |
| *10* | 20 - 5 <= 14 X | | |
| *5* | 10 - 5 <= 14 √ | 10 - 5 <= 26 √ | 10 - 1 <= 22 √ |
| | | | |

From the above phenomenon it implies the optimum frame size to have chosen for these particular tasks is **5**.

Task set 2:

T1(4, 1) T2(5, 2, 7) T3(20, 5)

Requirement 1: f >= 5

Requirement 2: Candidates that divide the Hyper Period H evenly are,

f = { 20, 10, 5, 4, 2, 1}

Requirement 3: We have the candidates

f = { 20, 10, 5, 4, 2, 1}

And the criterion is : $2f - gcd(P_i, f) <= D_i$

| ***F*** | *T1(4, 1)* | *T2(5, 2, 7)* | *T3(20, 5)* |
|---|---|---|---|
| *20* | 40 - 4 <= 4 X | | |
| *20* | 20 - 2 <= 4 X | | |
| *5* | 10 - 1 <= 14 X | | |
| *4* | 8 - 4 <= 44 √ | 8 - 1 <= 7 √ | 8 - 4 <= 20 √ |
| *2* | | | |
| *1* | | | |
| | | | |

From the above phenomenon it implies the optimum frame size to have chosen for these particular tasks is **4**.

But it can also be observed that it violates the requirement 1. In order to fulfil the requirement 1 the task which has execution time more than the frame size is spilt into parts. In our case it is the task 3, which could be sliced into two different jobs such as Job 3.1 and Job 3.2 with execution times 3 & 2 or converse respectively.

Task set 3:

T1(5, 0.1) T2(7,1) T3(12, 6) T3(45, 9)

Requirement 1: f >= 9

Requirement 2: Candidates that divide the Hyper Period H evenly are,

f = { 45, 12, 7, 6, 3, 2, 1}

Requirement 3: We have the candidates

f = { 45, 12, 7, 6, 3, 2, 1}

And the criterion is : $2f - gcd(P_i, f) <= D_i$

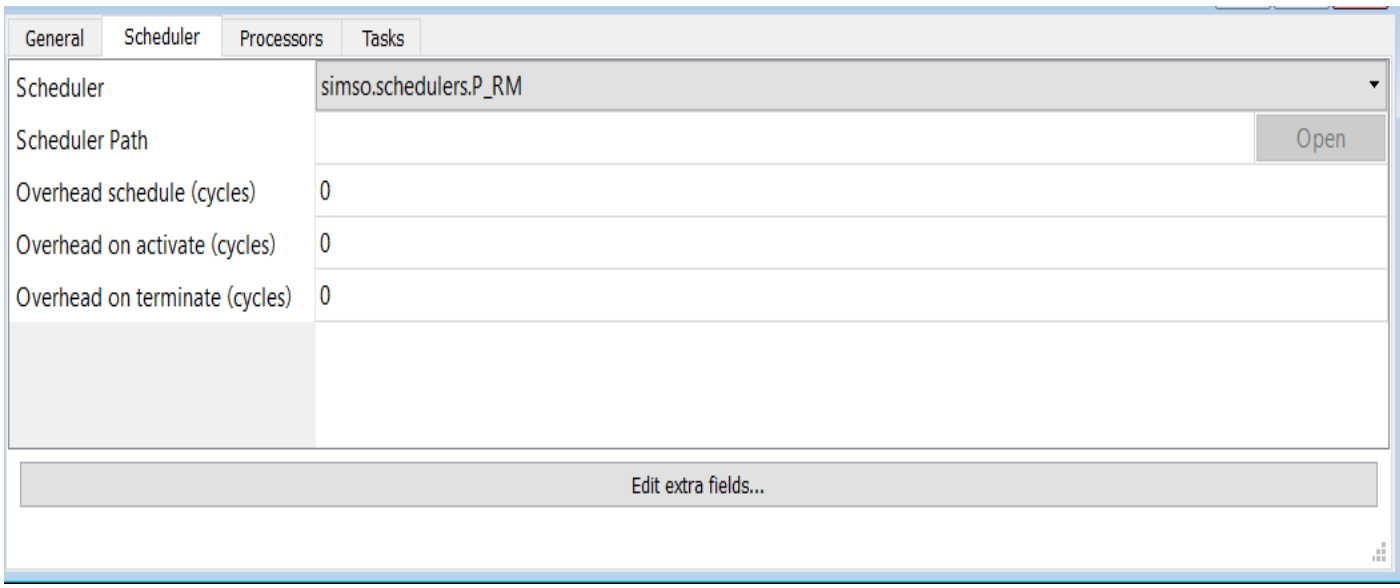
| *f* | *T1(5, 0.1)* | *T2(7, 1)* | *T3(12, 6)* | *T3(45, 9)* |
|---|---|---|---|---|
| *45* | 90 - 5 <= 5 X | | | |
| *12* | 24 - 1 <= 5 X | | | |
| *7* | 14 - 1 <= 5 X | | | |
| *6* | 12 - 1 <= 5 X | | | |
| *5* | 10 - 5 <= 5 √ | 10 - 1 <= 7 X | | |
| *3* | 6 - 1 <= 5 √ | 6 - 1 <= 7 √ | 6 - 3 <= 6 √ | 6 - 3 <= 9 √ |
| | | | | |

From the above phenomenon it implies the optimum frame size to have chosen for these particular tasks is **3**.

But it can also be observed that it violates the requirement 1. In order to fulfil the requirement 1 the tasks which have execution time more than the frame size is spilt into parts. In our case they are the tasks 3 and 4, which could be sliced into two different jobs such as Job 3.1, Job 3.2, Job 4.1 and Job 4.2 respectively at any suitable manner.

## **Simulation Assignment**:

a) Input the tasks T1(2, 0.5), T2(3, 1.2), T3(6, 0.5) and the RM scheduler into the SimSo simulator



Model data

General | Scheduler | Processors | Tasks

| id | Name | Task type | Abort on miss | Act. Date (ms) | Period (ms) | List of Act. dates (ms) | Deadline (ms) | WCET (ms) | Followed by |
|---|---|---|---|---|---|---|---|---|---|
| 1 | TASK T1 | Periodic | Yes | 0 | 2 | - | 2 | 0.5 | |
| 2 | TASK T2 | Periodic | Yes | 0 | 3 | - | 3 | 1.2 | |
| 3 | TASK T3 | Periodic | Yes | 0 | 6 | | 6 | 0.5 | |

Edit data fields...

Remove selected task(s) | Add task | Generate Task Set

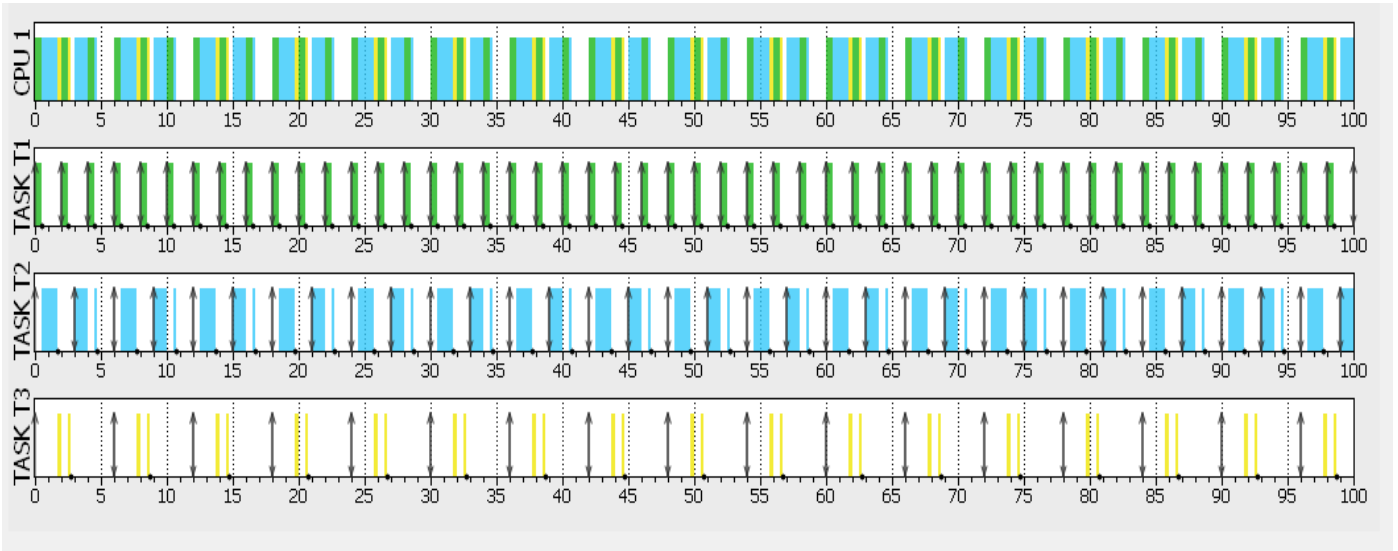
Results

General | Logs | Tasks | Scheduler | Processors

Observation Window:

from 0.00 to 100.00 ms | Configure...

| | Total load | Payload | System load |
|---|---|---|---|
| CPU 1 | 0.7410 | 0.7410 | 0.0000 |
| Average | 0.7410 | 0.7410 | 0.0000 |



1. What is the utilization factor of the system and what is the value for Urm(3)

A: 0.7410. Urm(n) = n * (pow(2, $\frac{1}{n}$) - 1 ) . Implies Urm(3) = 0.779.

2. What is the minimum/maximum/average response time of all tasks?

A: By above figure the minimum response time of all tasks are:

i) Task1 = 0.5
ii) Task2 = 0.5 + 1.2 = 1.7
iii) Task3 = 0.5 + 1.2 + 0.5 = 2.2

3. Is any task missing the deadline? Which task? Where?

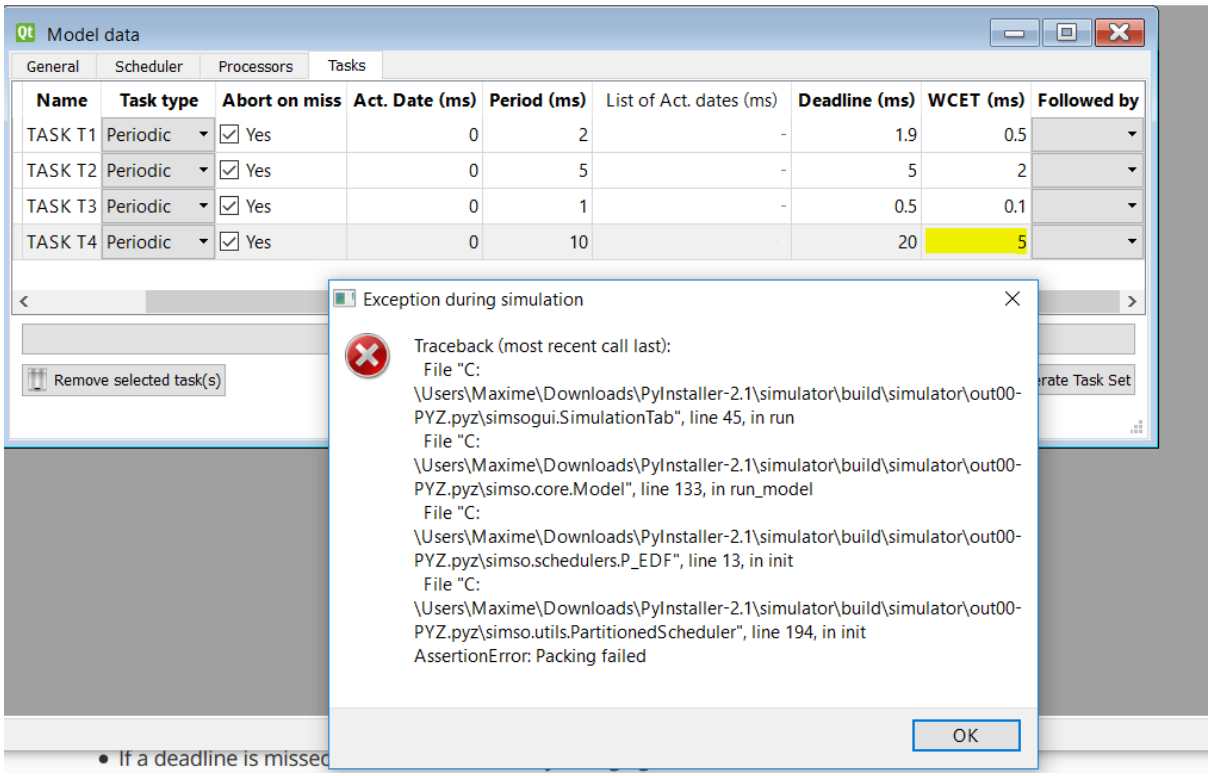
A: No. As per the answer of first question. The schedule is feasible by the justification U < Urm

Where U = 0.7410 and Urm = 0.779.

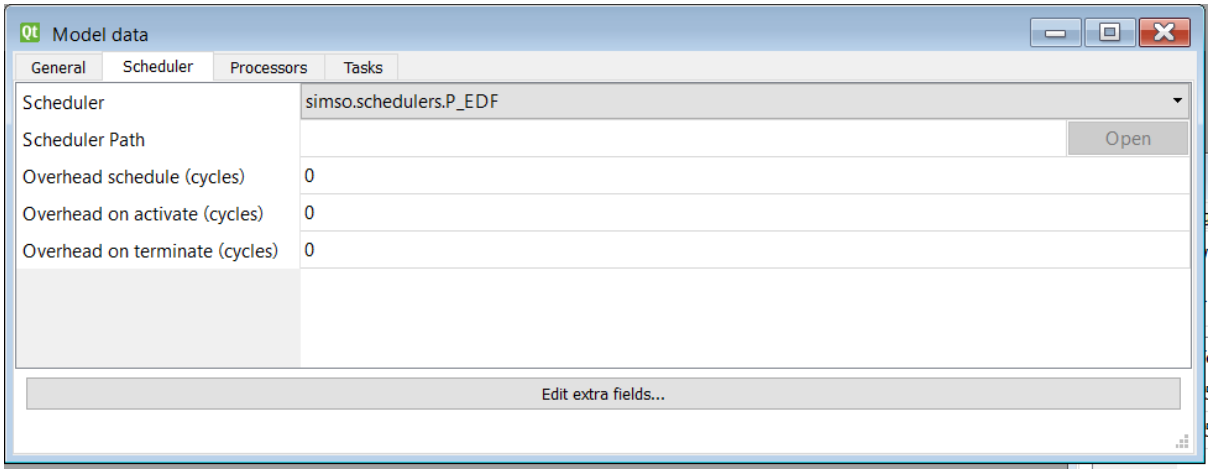
4. If a deadline is missed, could it be avoided by changing the scheduler?

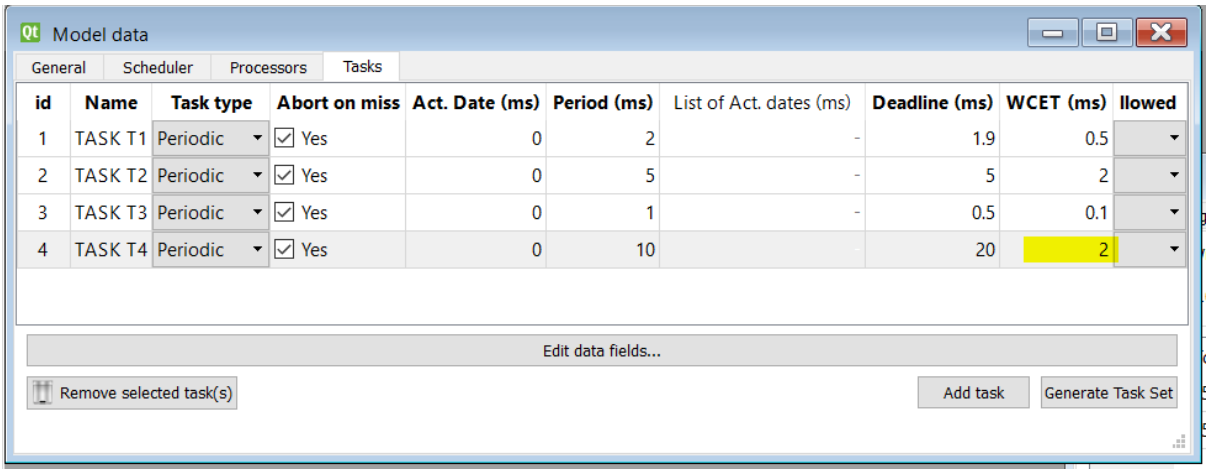
A: Maybe.

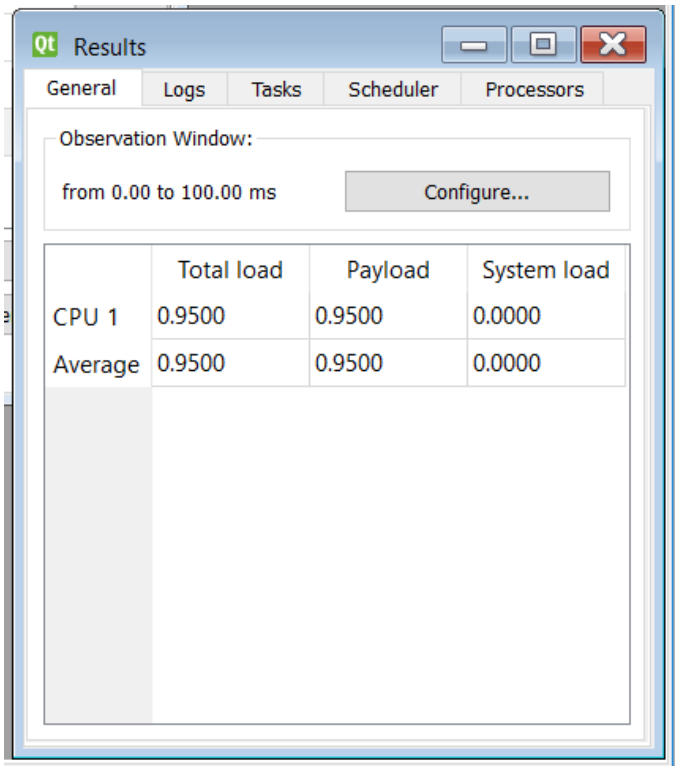
b) Input the tasks T1(2, 0.5, 1.9) T2(5, 2) T3(1, 0.1, 0.5) T4(10, 5, 20) and the EDF scheduler into the SimSo simulator

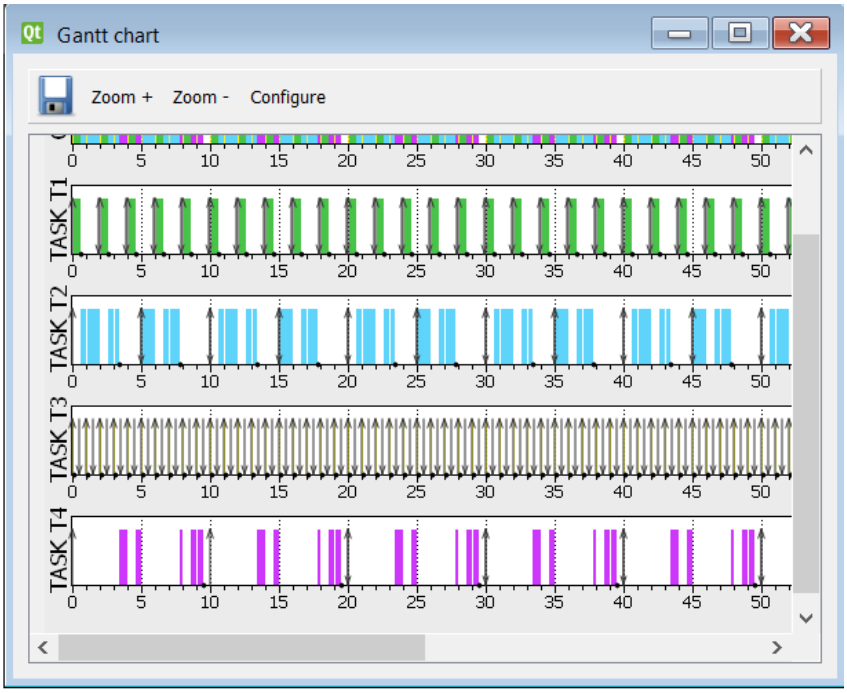



When chosen WCET as 5 the aboce traceback error is being thrown out. But when the WCET was chosen lesser than or equal to 2 it worked fine And below are the screenshots of the settings,


Model data
General
Scheduler
Processors
Tasks
Scheduler
simso.schedulers.P_EDF
Scheduler Path
Open
Overhead schedule (cycles)
0
Overhead on activate (cycles)
0
Overhead on terminate (cycles)
0
Edit extra fields...


Model data
General
Scheduler
Processors
Tasks
id
Name
Task type
Abort on miss
Act. Date (ms)
Period (ms)
List of Act. dates (ms)
Deadline (ms)
WCET (ms)
Ilowed
1
TASK T1
Periodic
Yes
0
2
1.9
0.5
2
TASK T2
Periodic
Yes
0
5
5
2
3
TASK T3
Periodic
Yes
0
1
0.5
0.1
4
TASK T4
Periodic
Yes
0
10
20
2
Edit data fields...
Remove selected task(s)
Add task
Generate Task Set


Results
General
Logs
Tasks
Scheduler
Processors
Observation Window:
from 0.00 to 100.00 ms
Configure...
Total load
Payload
System load
CPU 1
0.9500
0.9500
0.0000
Average
0.9500
0.9500
0.0000




1. What is the utilization factor of the system and what is the value for Urm(3)

A: 0.9500. Urm(n) = n * (pow(2, $\frac{1}{n}$) - 1 ) . Implies Urm(4) = 0.756.

2. What is the minimum/maximum/average response time of all tasks?

A: By above figure the minimum response time of all tasks are:

i) Task1 = 0.1 + 0.5 = 0.6
ii) Task2 = 0.1 + 0.5 + 2 = 2.6
iii) Task3 = 0.1
iv) Task4 = 0.1 + 0.5 + 2 + 2 = 4.6

3. Is any task missing the deadline? Which task? Where?

A: No. As per the answer of first question. The schedule have the possibilities of being feasible by the justification Urm < U < 1

Where U = 0.9500 and Urm = 0.756.

4. If a deadline is missed, could it be avoided by changing the scheduler?

A: Maybe.