

Schedulability Calculation

1) Define Tasks.

- Task (1): {Periodicity: 50 , Deadline: 50 , Execution time: 0.018ms }
- Task (2): {Periodicity: 50 , Deadline: 50 , Execution time: 0.018ms }
- Task (3): {Periodicity: 100 , Deadline: 100 , Execution time: 0.084ms }
- Task (4): {Periodicity: 20 , Deadline: 20 , Execution time: 0.025ms }
- Task (5): {Periodicity: 10 , Deadline: 10 , Execution time: 5ms }
- Task (6): {Periodicity: 100 , Deadline: 100 , Execution time: 12ms }

2) Analytic Method (Rate - Monotonic).

$$U = \sum_{i=1}^n \frac{C_i}{P_i} \leq n(2^{\frac{1}{n}} - 1)$$

U = Total Utilization
C = Execution time
P = Periodicity
N = Number of tasks

- Hyper Period = 100ms
- Utilization = (Total Time / Period) * 100 = $1 * (4 * 0.018 + 0.084 + 5 * 0.025 + 10 * 5 + 12) = 62.281\%$
- CPU(LOAD) = $2(0.018/50) + (0.084/100) + (0.025/20) + (5/10) + (12/100) = 0.6228$
- URM = $6 * (2^{(1/6)} - 1) = 0.7347$
- System Is Schedulable.

3) Analytic Method (Time Demand).

$$w_i(t) = e_i + \sum_{k=1}^{i-1} \left\lceil \frac{t}{p_k} \right\rceil e_k \quad \text{for } 0 < t \leq p_i$$

W = Worst response time
E = Execution time
P = Periodicity
T = Time instance

- Hyper Period = 100ms

- Task (5): {Periodicity:10 , Deadline:10 , Execution time:5ms}

- W (1) = 5 ms >>>>>>>>>>>>>>>>>>>>>> - W (10) = 5ms
- W (10) < Deadline (10) ->Schedulable

- Task (4): {Periodicity:20 , Deadline: 10 , Execution time: 0.025ms}

- W (1) = $0.025 + (1/10) * 5 = 5.025$ >>>>>>>>>>>>>>>>>>>>>> - W (20) = $0.025 + (20/10) * 5 = 10.025$
- W (20) < Deadline (10) ->Schedulable

- Task (1): {Periodicity:50 , Deadline: 50 , Execution time: 0.018ms}

- W (1) = $0.018 + (1/10) * 5 + (1/20) * 0.025 = 5.043$ >>>>>>>>>> - W (50) = $0.018 + (50/10) * 5 + (50/20) * 0.025 = 25.093$

- W (50) < Deadline (50) ->Schedulable

- Task (2): {Periodicity:50 , Deadline: 50 , Execution time: 0.018ms}

- $W(50) = 0.018 + (50/10) * 5 + (50/20) * 0.025 + (50/50) * 0.018 = 25.111$
- $W(50) < \text{Deadline}(50) \rightarrow \text{Schedulable}$

- Task (3): {Periodicity:100 , Deadline:100 , Execution time:0.084ms}

- $W(100) = 0.084 + (100/10) * 5 + (100/20) * 0.025 + (100/50) * 0.018 + (100/50) * 0.018 = 50.281$
- $W(100) < \text{Deadline}(100) \rightarrow \text{Schedulable}$

- Task (6): {Periodicity:100 , Deadline: 100 , Execution time: 12ms}
- $W(100) = 12 + (100/10) * 5 + (100/20) * 0.025 + (100/50) * 0.018 + (100/50) * 0.018 + 0.084 * (100/100) = 62.281$
- $W(100) < \text{Deadline}(100) \rightarrow \text{Schedulable}$

1) SimSo Simulation



	Total load	Payload	System load
CPU 1	0.6228	0.6228	0.0000
Average	0.6228	0.6228	0.0000

Computation time:					
Task	min	avg	max	std dev	occupancy
TASK T1	0.018	0.018	0.018	0.000	0.000
TASK T2	0.018	0.018	0.018	0.000	0.000
TASK T3	0.084	0.084	0.084	0.000	0.001
TASK T4	0.025	0.025	0.025	0.000	0.001
TASK T5	5.000	5.000	5.000	0.000	0.500
TASK T6	12.000	12.000	12.000	0.000	0.120

4) Keil Simulation

Keil MDK-ARM simulation interface showing the FreeRTOS demo project.

Registers:

Register	Value
R0	0x00000000
R1	0x00000000
R2	0x00000000
R3	0x00000000
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000

main.c:

```
145 Queue_2=xQueueCreate(1,sizeof(char));
146 Queue_3=xQueueCreate(15,sizeof(char));
147 /*
148 xTaskCreate(Pin_18,"Button_1_Monitor",100,NULL,1,50,&Pin_18_Handler); //Periodicity: 50 , Deadline: 50 }
149 xTaskCreate(Pin_19,"Button_2_Monitor",100,NULL,1,50,&Pin_19_Handler); //Periodicity: 50 , Deadline: 50 }
150 xTaskCreate(Pin_20,"Periodic_Transmitter",100,NULL,1,100,&Pin_20_Handler); //Periodicity: 100, Deadline: 100 }
151 xTaskCreate(Pin_21,"Uart_Receiver",100,NULL,1,20,&Pin_20_Handler); //Periodicity: 20 , Deadline: 20 }
152 xTaskCreate(Pin_22,"Load_1_Simulation",100,NULL,1,10,&Pin_22_Handler); //Periodicity: 10 , Deadline: 10, Execut
153 xTaskCreate(Pin_23,"Load_2_Simulation",100,NULL,1,100,&Pin_23_Handler); //Periodicity: 20 , Deadline: 20, Execut
154 /*
155 xTaskStartScheduler();
```

Command Window:

```
LA ( (PORT0 & 0x00010000) >> 16 & 0x10000) >> 16
LA ( (PORT0 & 0x00020000) >> 17 & 0x20000) >> 17
LA ( (PORT0 & 0x00040000) >> 18 & 0x40000) >> 18
LA ( (PORT0 & 0x00080000) >> 19 & 0x80000) >> 19
LA ( (PORT0 & 0x00100000) >> 20 & 0x100000) >> 20
LA ( (PORT0 & 0x00200000) >> 21 & 0x200000) >> 21
LA ( (PORT0 & 0x00400000) >> 22 & 0x400000) >> 22
LA ( (PORT0 & 0x00800000) >> 23 & 0x800000) >> 23
```

Watch 1:

Name	Value	Type
Task_1_Time	1	uint
Task_2_Time	1	uint
Task_3_Time	5	uint
Task_4_Time	1	uint
Task_5_Time	301	uint
Task_6_Time	299	uint
Total_Time	493	uint
CPU_LOAD	65	uint
Idle_Time	277	uint

Logic Analyzer:

Setup: Load Save Min Time Max Time Grid Zoom Min/Max Update Screen Transition Jump to Signal Info Amplitude Timestamps Enable

0.000s >> 16 0.000s >> 17 0.000s >> 18 0.000s >> 19 0.000s >> 20 0.000s >> 21 0.000s >> 22 0.000s >> 23

0.2184s 0.36s 0.72s

Real-Time Agent: Not in target Simulation T1: 15.62398548 sec L141 C:17 CAP: NUM SCRL OVR: R/W

Watch 1		
Name	Value	Type
Task_1_Time	1	uint
Task_2_Time	1	uint
Task_3_Time	5	uint
Task_4_Time	1	uint
Task_5_Time	300	uint
Task_6_Time	8	uint
Total_Time	493	uint
CPU_LOAD	65	uint
Idle_Time	299	uint
<Enter expression>		