Laboratory 1

Olafur Jonsson Konstantinos Xyderos

September 14, 2020

3.3.2 The rate monotonic schedule.

1

The utilization of a periodic task $\tau_i(T_i, C_i)$ is defined as:

$$u_i = \frac{C_i}{T_i}$$

The total utilization for a set of tasks is defined as:

$$U = \sum_{i=1}^{n} u_i$$

The 3 tasks given are:

$$\tau_i(\phi_i, T_i, C_i, D_i)$$

$$\tau_1(100, 300, 100, 300)$$

$$\tau_2(100, 400, 100, 400)$$

$$\tau_3(100, 600, 100, 600)$$

Their respective utilizations are:

$$u_1 = \frac{C_1}{D_1} = \frac{100}{300} = \frac{1}{3}$$

$$u_2 = \frac{C_2}{D_2} = \frac{100}{400} = \frac{1}{4}$$

$$u_3 = \frac{C_3}{D_3} = \frac{100}{600} = \frac{1}{6}$$

The total utilization U can thus be calculated:

$$U = \frac{1}{3} + \frac{1}{4} + \frac{1}{6} = \frac{9}{12} = \frac{3}{4} = 0.75$$

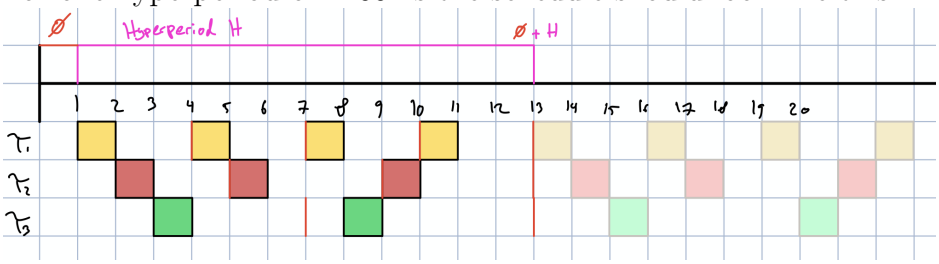
The hyperperiod H is defined as the least common multiplier from the set of task periods:

$$H = lcm(T_1, T_2, T_3) = lcm(300, 400, 600) = 1200$$

According to RMS the priorities should therefore be:

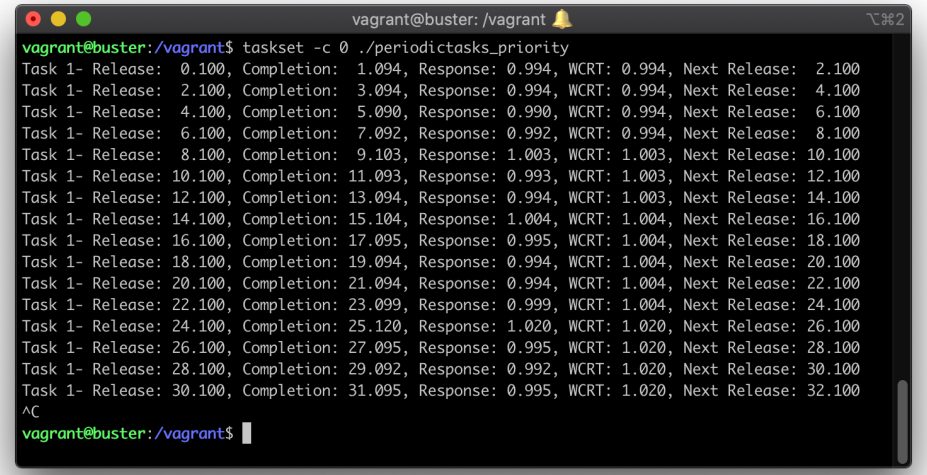
$$P_1 > P_2 > P_3$$

For one hyperperiod of 1200ms the schedule should look like this:



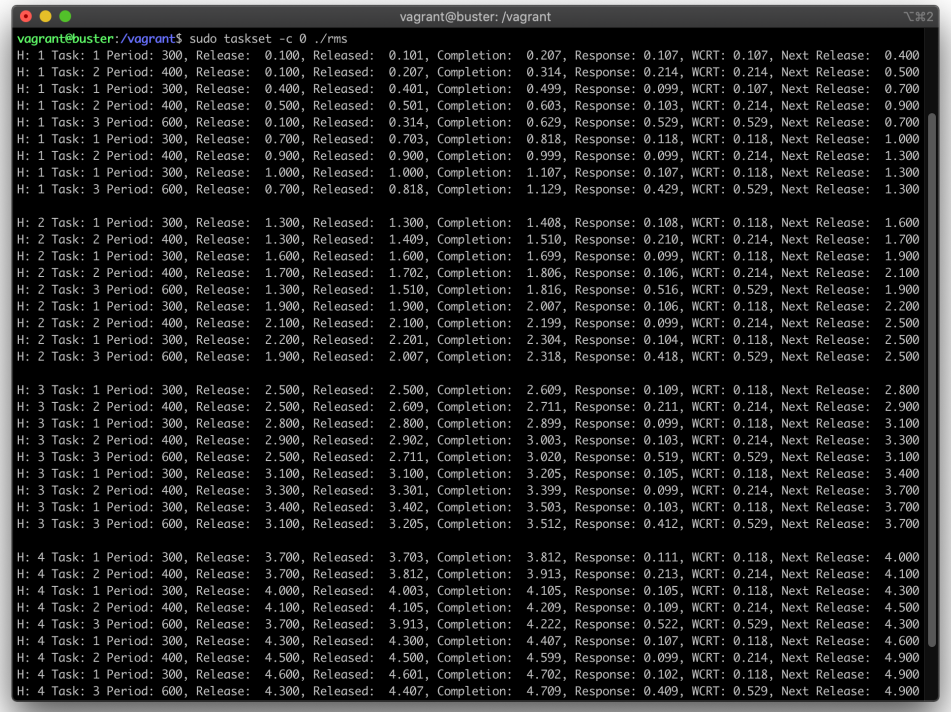
2

Constraining the execution of the program to use only a single CPU core using taskset was made possible on a macOS system by using a virtual machine. The calibration parameter was set to **1208** which produced the following output:



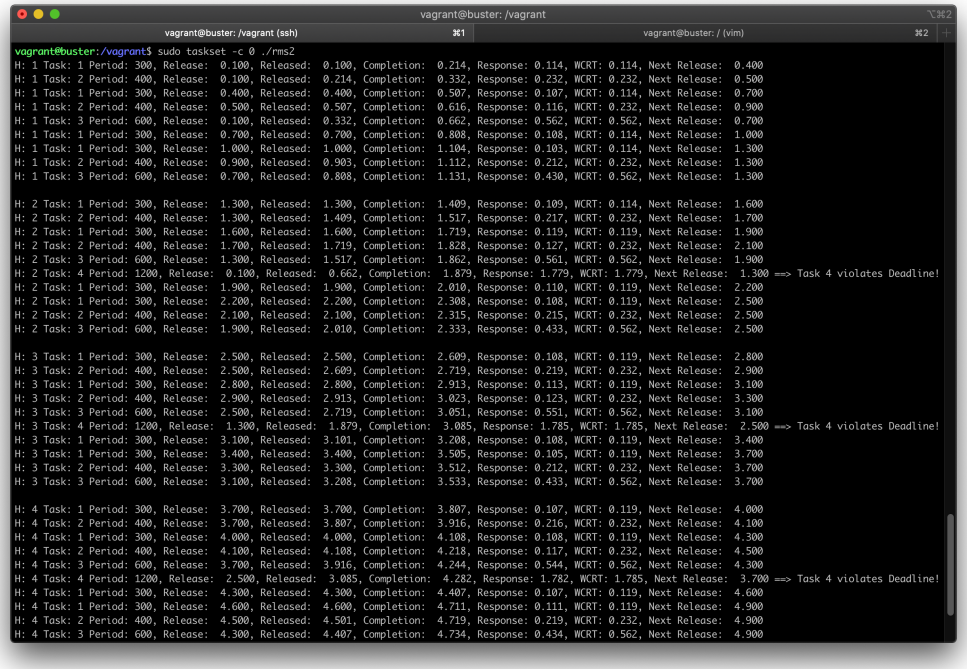
3

Running the rms on a single core produces the following output:



4

RMS2 output:


vagrant@buster: /vagrant
vagrant@buster: /vagrant (ssh)
vagrant@buster: / (vim)
vagrant@buster:/vagrant$ sudo taskset -c 0 ./rms2
H: 1 Task: 1 Period: 300, Release: 0.100, Released: 0.100, Completion: 0.214, Response: 0.114, WCRT: 0.114, Next Release: 0.400
H: 1 Task: 2 Period: 400, Release: 0.100, Released: 0.214, Completion: 0.332, Response: 0.232, WCRT: 0.232, Next Release: 0.500
H: 1 Task: 1 Period: 300, Release: 0.400, Released: 0.400, Completion: 0.507, Response: 0.107, WCRT: 0.114, Next Release: 0.700
H: 1 Task: 2 Period: 400, Release: 0.500, Released: 0.507, Completion: 0.616, Response: 0.116, WCRT: 0.232, Next Release: 0.900
H: 1 Task: 3 Period: 600, Release: 0.100, Released: 0.332, Completion: 0.662, Response: 0.562, WCRT: 0.562, Next Release: 0.700
H: 1 Task: 1 Period: 300, Release: 0.700, Released: 0.700, Completion: 0.808, Response: 0.108, WCRT: 0.114, Next Release: 1.000
H: 1 Task: 1 Period: 300, Release: 1.000, Released: 1.000, Completion: 1.104, Response: 0.103, WCRT: 0.114, Next Release: 1.300
H: 1 Task: 2 Period: 400, Release: 0.900, Released: 0.903, Completion: 1.112, Response: 0.212, WCRT: 0.232, Next Release: 1.300
H: 1 Task: 3 Period: 600, Release: 0.700, Released: 0.808, Completion: 1.131, Response: 0.430, WCRT: 0.562, Next Release: 1.300
H: 2 Task: 1 Period: 300, Release: 1.300, Released: 1.300, Completion: 1.409, Response: 0.109, WCRT: 0.114, Next Release: 1.600
H: 2 Task: 2 Period: 400, Release: 1.300, Released: 1.409, Completion: 1.517, Response: 0.217, WCRT: 0.232, Next Release: 1.700
H: 2 Task: 1 Period: 300, Release: 1.600, Released: 1.600, Completion: 1.719, Response: 0.119, WCRT: 0.119, Next Release: 1.900
H: 2 Task: 2 Period: 400, Release: 1.700, Released: 1.719, Completion: 1.828, Response: 0.127, WCRT: 0.232, Next Release: 2.100
H: 2 Task: 3 Period: 600, Release: 1.300, Released: 1.517, Completion: 1.862, Response: 0.561, WCRT: 0.562, Next Release: 1.900
H: 2 Task: 4 Period: 1200, Release: 0.100, Released: 0.662, Completion: 1.879, Response: 1.779, WCRT: 1.779, Next Release: 1.300 ==> Task 4 violates Deadline!
H: 2 Task: 1 Period: 300, Release: 1.900, Released: 1.900, Completion: 2.010, Response: 0.110, WCRT: 0.119, Next Release: 2.200
H: 2 Task: 1 Period: 300, Release: 2.200, Released: 2.200, Completion: 2.308, Response: 0.108, WCRT: 0.119, Next Release: 2.500
H: 2 Task: 2 Period: 400, Release: 2.100, Released: 2.100, Completion: 2.315, Response: 0.215, WCRT: 0.232, Next Release: 2.500
H: 2 Task: 3 Period: 600, Release: 1.900, Released: 2.010, Completion: 2.333, Response: 0.433, WCRT: 0.562, Next Release: 2.500
H: 3 Task: 1 Period: 300, Release: 2.500, Released: 2.500, Completion: 2.609, Response: 0.108, WCRT: 0.119, Next Release: 2.800
H: 3 Task: 2 Period: 400, Release: 2.500, Released: 2.609, Completion: 2.719, Response: 0.219, WCRT: 0.232, Next Release: 2.900
H: 3 Task: 1 Period: 300, Release: 2.800, Released: 2.800, Completion: 2.913, Response: 0.113, WCRT: 0.119, Next Release: 3.100
H: 3 Task: 2 Period: 400, Release: 2.900, Released: 2.913, Completion: 3.023, Response: 0.123, WCRT: 0.232, Next Release: 3.300
H: 3 Task: 3 Period: 600, Release: 2.500, Released: 2.719, Completion: 3.051, Response: 0.551, WCRT: 0.562, Next Release: 3.100
H: 3 Task: 4 Period: 1200, Release: 1.300, Released: 1.879, Completion: 3.085, Response: 1.785, WCRT: 1.785, Next Release: 2.500 ==> Task 4 violates Deadline!
H: 3 Task: 1 Period: 300, Release: 3.100, Released: 3.101, Completion: 3.208, Response: 0.108, WCRT: 0.119, Next Release: 3.400
H: 3 Task: 1 Period: 300, Release: 3.400, Released: 3.400, Completion: 3.505, Response: 0.105, WCRT: 0.119, Next Release: 3.700
H: 3 Task: 2 Period: 400, Release: 3.300, Released: 3.300, Completion: 3.512, Response: 0.212, WCRT: 0.232, Next Release: 3.700
H: 3 Task: 3 Period: 600, Release: 3.100, Released: 3.208, Completion: 3.533, Response: 0.433, WCRT: 0.562, Next Release: 3.700
H: 4 Task: 1 Period: 300, Release: 3.700, Released: 3.700, Completion: 3.807, Response: 0.107, WCRT: 0.119, Next Release: 4.000
H: 4 Task: 2 Period: 400, Release: 3.700, Released: 3.807, Completion: 3.916, Response: 0.216, WCRT: 0.232, Next Release: 4.100
H: 4 Task: 1 Period: 300, Release: 4.000, Released: 4.000, Completion: 4.108, Response: 0.108, WCRT: 0.119, Next Release: 4.300
H: 4 Task: 2 Period: 400, Release: 4.100, Released: 4.108, Completion: 4.218, Response: 0.117, WCRT: 0.232, Next Release: 4.500
H: 4 Task: 3 Period: 600, Release: 3.700, Released: 3.916, Completion: 4.244, Response: 0.544, WCRT: 0.562, Next Release: 4.300
H: 4 Task: 4 Period: 1200, Release: 2.500, Released: 3.085, Completion: 4.282, Response: 1.782, WCRT: 1.785, Next Release: 3.700 ==> Task 4 violates Deadline!
H: 4 Task: 1 Period: 300, Release: 4.300, Released: 4.300, Completion: 4.407, Response: 0.107, WCRT: 0.119, Next Release: 4.600
H: 4 Task: 1 Period: 300, Release: 4.600, Released: 4.600, Completion: 4.711, Response: 0.111, WCRT: 0.119, Next Release: 4.900
H: 4 Task: 2 Period: 400, Release: 4.500, Released: 4.501, Completion: 4.719, Response: 0.219, WCRT: 0.232, Next Release: 4.900
H: 4 Task: 3 Period: 600, Release: 4.300, Released: 4.407, Completion: 4.734, Response: 0.434, WCRT: 0.562, Next Release: 4.900