

Embedded Systems

Note: In this problem set all processes are periodic, and should be scheduled on a uniprocessor machine.

Problem 1 (Scheduling)

[30 points]

Let $\Gamma = \{\tau_1, \tau_2, \tau_3\}$ be a task set with

$$\begin{array}{ll} T_1 = D_1 = 3 & C_1 = 1 \\ T_2 = D_2 = 4 & C_2 = 1 \\ T_3 = D_3 = 6 & C_3 = 2 \end{array}$$

Exhibit for Γ :

- (a) an RM-schedule; [10 points]
- (b) an EDF-schedule; [10 points]
- (c) a nonpreemptive schedule. [10 points]

For the EDF-schedule, if more than one process with the same earliest deadline are active, select the process with the smallest index.

Problem 2 (Scheduling)

[20 points]

- (a) Admits the task set $\Gamma = \{\tau_1, \tau_2, \tau_3, \tau_4\}$ with

$$\begin{array}{ll} T_1 = D_1 = 200 & C_1 = 4 \\ T_2 = D_2 = 10 & C_2 = 1 \\ T_3 = D_3 = 40 & C_3 = 2 \\ T_4 = D_4 = 50 & C_4 = 6 \end{array}$$

an RM-schedule, when an additional instance of τ_1 is added? [10 points]

- (b) Let $\Gamma = \{\tau_1, \tau_2, \tau_3, \tau_4, \tau_5\}$ be a task set with

$$\begin{array}{ll} T_1 = D_1 = 10 & C_1 = 1 \\ T_2 = D_2 = 100 & C_2 = 18 \\ T_3 = D_3 = 20 & C_3 = 2 \\ T_4 = D_4 = 50 & C_4 = 5 \\ T_5 = D_5 = 25 & C_5 = x \end{array}$$

Compute the maximal value of C_5 for which the existence of an RM-schedule is guaranteed under the criteria of [Liu and Layland, 1973]. [10 points]

Problem 3 (Scheduling)

[30 points]

For each of the following tasks sets, determine whether an EDF-schedule and/or an RM-schedule exists.

$\Gamma = \{\tau_1, \tau_2, \tau_3\}$	$T_1 = D_1 = 3$	$C_1 = 1$
	$T_2 = D_2 = 4$	$C_2 = 2$
	$T_3 = D_3 = 8$	$C_3 = 1$
$\Delta = \{\tau_1, \tau_2, \tau_3\}$	$T_1 = D_1 = 2$	$C_1 = 1$
	$T_2 = D_2 = 3$	$C_2 = 1$
	$T_3 = D_3 = 4$	$C_3 = 1$
$\Pi = \{\tau_1, \tau_2, \tau_3, \tau_4\}$	$T_1 = D_1 = 2$	$C_1 = 1$
	$T_2 = D_2 = 5$	$C_2 = 1$
	$T_3 = D_3 = 8$	$C_3 = 2$
	$T_4 = D_4 = 10$	$C_4 = 1$

Problem 4 (Synthesis)

[20 points]

Consider the following code fragment:

```
while (d>0) {
  a=b+c;
  d=d-b;
  e=a+f;
  if (e!=0)
    f=a-d;
  else {
    b=d+f;
    e=a-c;
  }
  b=a+c;
}
```

- (a) Construct the control flow graph. [5 points]
- (b) Construct the data dependence graph. [5 points]
- (c) Compute the set of live variables at the beginning of each statement under the assumption that b , c , d , e , and f are live at the end of the loop. [10 points]