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Sample Solution for Problem Set 9
Due: July 10, 2007, 9:14 am

Embedded Systems

Problem 1 (Scheduling)

See figure 1.

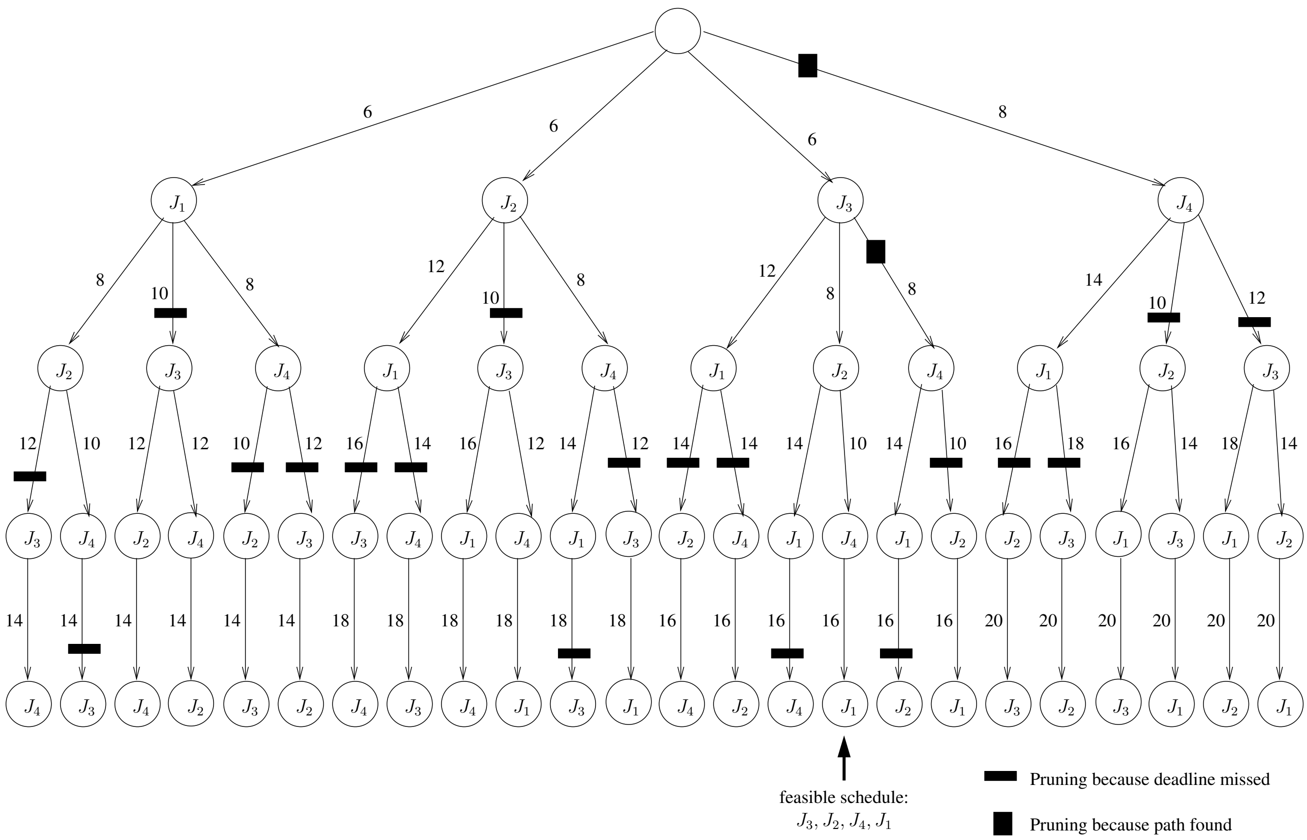

Figure 1: Exercise 1: Bratley's scheduling algorithm

Problem 2 (Scheduling)

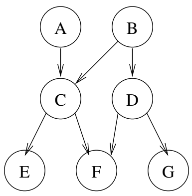

Figure 2: Exercise 2 (a): Connections between tasks

(a) The connections between the tasks are illustrated in figure 2. The algorithm proceeds as shown in the following tables:

Modification of arrival times

Selected task	A	B	C	D	E	F	G	Comment
(none)	0	0	0	0	0	0	0	Initial arrival times
A	0	0	0	0	0	0	0	A has no predecessors, $a_A^* = \max\{a_A\} = 0$
B	0	0	0	0	0	0	0	B has no predecessors, $a_B^* = \max\{a_B\} = 0$
C	0	0	3	0	0	0	0	predecessors A,B done, $a_C* = \max\{a_A^* + C_A, a_B^* + C_B, a_C\} = 3$
E	0	0	3	0	6	0	0	predecessor C done, $a_E* = \max\{a_C^* + C_C, a_E\} = 6$
D	0	0	3	3	6	0	0	predecessor B done, $a_D* = \max\{a_B^* + C_B, a_D\} = 3$
F	0	0	3	3	6	8	0	predecessors C,D done, $a_F* = \max\{a_C^* + C_C, a_D^* + C_D, a_F\} = 8$
G	0	0	3	3	6	8	8	predecessor D done, $a_G* = \max\{a_D^* + C_D, a_G\} = 8$

Modification of deadline

Selected task	A	B	C	D	E	F	G	Comment
(none)	25	25	25	25	25	25	25	Initial deadlines
E	25	25	25	25	25	25	25	E has no successors, $d_E^* = \min\{d_E\} = 25$
F	25	25	25	25	25	25	25	F has no successors, $d_F^* = \min\{d_F\} = 25$
G	25	25	25	25	25	25	25	G has no successors, $d_G^* = \min\{d_G\} = 25$
C	25	25	23	25	25	25	25	successors E,F done, $d_C* = \min\{d_E^* - C_E, d_F^* - C_F, d_C\} = 23$
A	20	25	23	25	25	25	25	successor C done, $d_A* = \min\{d_C^* - C_C, d_A\} = 20$
D	20	25	23	20	25	25	25	successors F,G done, $d_D* = \min\{d_F^* - C_F, d_G^* - C_G, d_D\} = 20$
B	20	15	23	20	25	25	25	successors C,D done, $d_B* = \min\{d_C^* - C_C, d_D^* - C_D, d_B\} = 15$

(b) See figure 3.

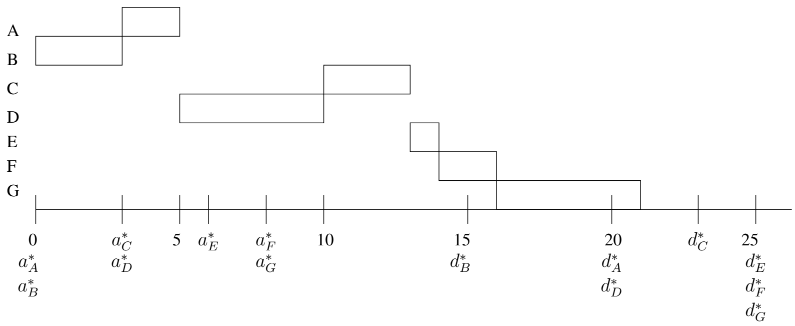

Figure 3: Exercise 2 (b): Schedule by EDF from modified parameters

Problem 3 (Fault tree analysis)

(a) If you transform the fault tree to a boolean function, you get:

$$f(A,B,C,D,E) = (B \wedge ((D \wedge \neg E) \vee A)) \vee (A \wedge (E \vee C))$$

$$\equiv (B \wedge ((D \wedge \neg E) \vee A)) \vee (A \wedge (E \vee C))$$

$$\equiv B \wedge D \wedge \neg E \vee A \wedge B \vee A \wedge E \vee A \wedge C$$

The Quine-McCluskey-Algorithm leads to no further reduction here: In step two of this algorithm you would build the tables ordered by numbers of positive variables. You would get only get the table $T_2 = \{AB, AC, AE, BD\neg E\}$. So in the third step you would not get any reduction, because there is no neighbor table. So, the prime implicants of this function are $\{BD\neg E, AB, AE, AC\}$.

(b) We use a method similar to the one from exercise sheet 6, problem 2 (c):

$$R > 1 - P(B)P(D)(1 - P(E)) + P(A)P(B) + P(A)P(E) + P(A)P(C) \approx 0.9771$$