Design Technologies for Integrated Systems – EPFL

Homework 1 Assigned: 27/09/2018 Due: 4/10/2018

Problem 1

Given the graph G(V,E) in Fig. 1:

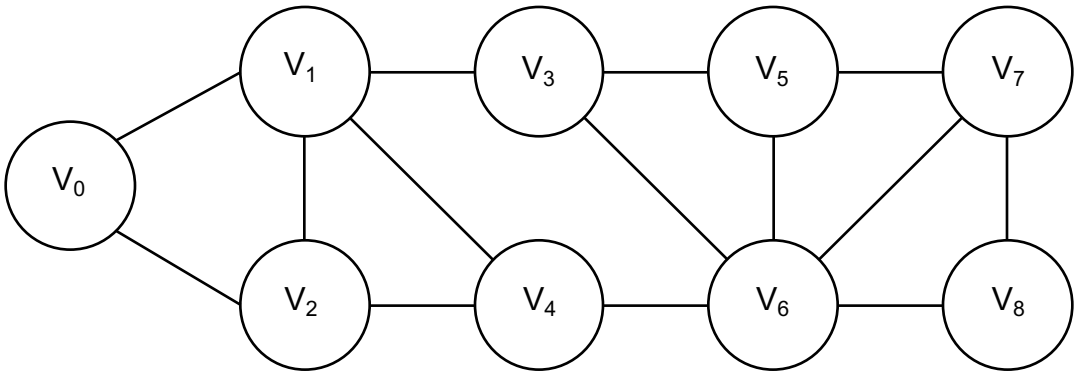

Figure 1: An undirected graph

(a) Show a minimum clique cover.

(b) Color the graph G with the smallest number of colors.

(c) Is the graph in Fig. 1 a perfect graph? Explain your answer.

Problem 2

We change the graph G(V,E) in Problem 1 to the *Directed Acyclic Graph* (DAG) G(V,E,W) in Fig. 2.

Consider vertex V_0 as the **source** and vertex V_8 as the **sink**. Find the shortest path from V_0 to V_8 by applying the following algorithms:

(a) Dijkstra algorithm.

(b) Bellman-Ford algorithm.

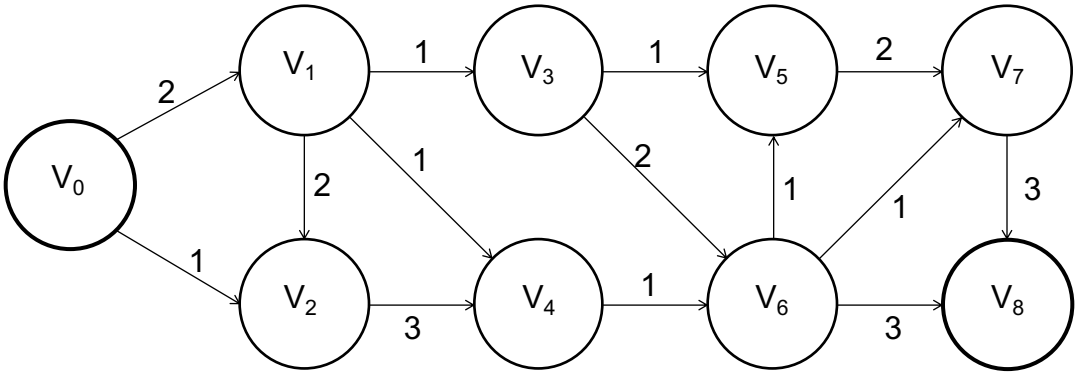

Figure 2: A directed acyclic graph

Problem 3

Write the Control-Flow Expression that executes the three programs in parallel. Make sure that you write unambiguous expressions! Use parentheses if you are unsure.

Code 1

always
while a **do**
  if i **then**
    P_1;
  else
    wait j
    P_2;
  end if
end while
end always

Code 2

if $\overline{c}$ **then**
  P_2;
  always
    wait $\overline{a}$
    P_3;
  end always
else
  P_4;
end if

Code 3

while $\overline{c}$ **do**
  P_5;
  wait a
  P_6;
  if b **then**
    P_2;
  else
    P_1;
  end if
end while

Problem 4

Given the following state transition table:

current_state	$X1$	$X2$	*next_state*	*output*
S0	0	0	S0	0
S0	0	1	S1	0
S0	1	-	S2	0
S1	0	0	S1	1
S1	0	1	S0	1
S1	1	0	S2	0
S1	1	1	S3	1
S2	1	-	S1	1
S2	0	-	S3	1
S3	0	1	S0	0
S3	1	1	S1	1
S3	-	0	S2	0

(a) Draw the FSM with one graphic formalism seen during the lecture (for example, state charts).

(b) Eliminate the edge connecting state S2 to S3. Comment on the resulting FSM.

Problem 5

Given the following equations:

$$x = (a \times b \times c + d) \times e + f$$
$$y = k + g \times h + g \times j \times h \times i$$
$$z = x + y$$

(a) Draw the data-flow graph using the operations as they appear in the expression, without any optimization. Assume additions and multiplications have 2 inputs.

(b) Apply **tree height** reduction to the data-flow graph drawn in (a).

(c) Discuss on the different resources usage between graph in (a) and graph in (b).

(d) Assume that a=2, b=3, c=2, d=2, h=3, j=4 and i=8 are constant. Apply **constant propagation** and **operator strength** reduction to the graph obtained in (b). Draw the resulting data-flow graph.