Digital System Design Project 1 – ROBDD Generation

Due: 23:59, Sep. 28, 2023

Binary Decision Diagram (BDD) is a directed acyclic graph useful to represent the Boolean function. Each BDD node is associated with one Boolean variable. Two outgoing edges exist in each internal node: the *then-edge* and the *else-edge*. The *then-edge* indicates that the Boolean variable is "1," and the *else-edge* indicates that the Boolean variable is "0". The true/false decision is made by evaluating variables from the root node to the leaf node. Given a fixed BDD variable ordering, we can generate a unique ordered BDD (OBDD) for every distinct Boolean function. An OBDD is said to be a reduced OBDD (ROBDD) when the following properties are satisfied: (1) all isomorphic nodes (i.e., Boolean variable, *then-edge*, and *else-edge* are the same) are merged into one single unique node and (2) The redundant node (i.e., both of its *then-edge* and *else-edge* point to the same node) is removed. In this project, your C/C++ program reads a single-output Boolean function in PLA format and outputs the corresponding ROBDD in pictorial DOT format.

Please submit your report and program according to the following rules:

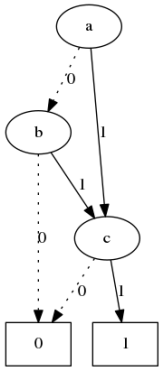
1- The font size of your report is 12 in PDF format.
2- The filename of your report is your student ID (e.g., B12345678.pdf).
3- Generate your own 2 PLA files (4 and 5 variables).
4- Post the Boolean functions and the content of your PLA files.
5- Post the content of your DOT files.
6- Post the screenshots of your ROBDD.
7- Upload a tarball (e.g., B12345678.tgz) of your program source code, your PLA files, and a text ReadMe file, which illustrates how your program to be compiled and executed in Ubuntu Linux environment (e.g., WSL).

```
PLA Example: input.pla

.i 3
.o 1
.ilb a b c
.ob f
.p 2
1-1 1
-11 1
.e

SYNOPSIS
%> PROGRAM PLA_FILE DOT_FILE

Run-time Example:
%> robdd input.pla output.dot
```



Basic DOT (graph description language) Reference

Install Graphviz if you want to visualize your DOT file.

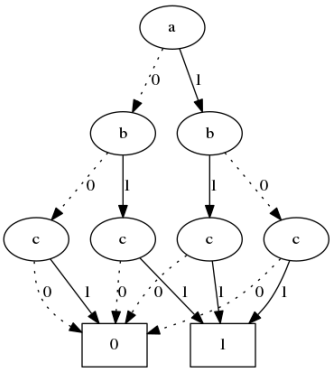
```
%> sudo apt install graphviz
```

```
%> cat obdd.dot
digraph OBDD {
   {rank=same 1}
   {rank=same 2 3}
   {rank=same 4 5 6 7}

   0 [label="0", shape=box]
   1 [label="a"]
   2 [label="b"]
   3 [label="b"]
   4 [label="c"]
   5 [label="c"]
   6 [label="c"]
   7 [label="c"]
   8 [label="1", shape=box]

   1 -> 2 [label="0", style=dotted]
   1 -> 3 [label="1", style=solid]
   2 -> 4 [label="0", style=dotted]
   2 -> 5 [label="1", style=solid]
   3 -> 6 [label="0", style=dotted]
   3 -> 7 [label="1", style=solid]
   4 -> 0 [label="0", style=dotted]
   4 -> 0 [label="1", style=solid]
   5 -> 0 [label="0", style=dotted]
   5 -> 8 [label="1", style=solid]
   6 -> 0 [label="0", style=dotted]
   6 -> 8 [label="1", style=solid]
   7 -> 0 [label="0", style=dotted]
   7 -> 8 [label="1", style=solid]
}
```

```
%> dot -T png obdd.dot > output.png
```




```
%> cat robdd.dot
digraph ROBDD {
   {rank=same 1}
   {rank=same 2}
   {rank=same 7}

   0 [label=0, shape=box]
   1 [label="a"]
   2 [label="b"]
   7 [label="c"]
   8 [label=1, shape=box]

   1 -> 2 [label="0", style=dotted]
   1 -> 7 [label="1", style=solid]
   2 -> 0 [label="0", style=dotted]
   2 -> 7 [label="1", style=solid]
   7 -> 0 [label="0", style=dotted]
   7 -> 8 [label="1", style=solid]
}
```

```
%> dot -T png robdd.dot > output.png
```