

Homework Assignment 1

Total Points: 50

Professor Karem A. Sakallah

EECS 598-002: Formal Verification of Hardware & Software Systems

Assigned: January 16, 2024
Due: January 23, 2024

Guidelines

- The College of Engineering Honor Code applies to all work in this course.
- The due date is firm. Follow submission instructions (at the end).

Objectives

This assignment involves the basic use of the Colorado University Decision Diagram package (CUDD) through the RePyCUDD Python wrapper.

1 [BDD Construction Mechanics] (30 Points)

Write Python scripts to construct BDDs for each of the following functions. Label and order your variables according to $x_0 < x_1 < x_2 < \dots$

- (5 Points) $f(x_0, x_1, x_2) = x_0 x_1' x_2$.
- (5 Points) $f(x_0, x_1, x_2)$ is the 3-input majority function.
- (10 Points) $f(x_0, x_1, x_2, x_3)$ is the function that is 1 if exactly 2 of the variables are 1.
- (5 Points) $f(x_0, x_1, x_2, x_3) = x_0 \oplus x_1 \oplus x_2 \oplus x_3$
- (5 Points) Reorder the variables in part d to $x_3 < x_2 < x_1 < x_0$, and report the change in the number of nodes in the BDD of f compared to part d.

2 [Effect of Variable Ordering] (20 Points)

Construct the BDD for the 8-variable function

$$f = x_1 x_2 + x_3 x_4 + x_5 x_6 + x_7 x_8$$

- (5 Points) Using the variable order $x_1 < x_2 < x_3 < x_4 < x_5 < x_6 < x_7 < x_8$.

- b. (5 Points) Using the variable order $x_1 < x_3 < x_5 < x_7 < x_2 < x_4 < x_6 < x_8$.
- c. (10 Points) Derive formulas for the BDD size under these two orderings assuming the number of variable is $n \geq 2$).

Submission Instructions

1. Create a directory named `<your unquename>_hw1`
2. Place in the directory the following Python files corresponding to each of the problems or problem parts:
 - Problem 1: `h2p1.py`
 - Problem 2: `h2p2b.py`, `h2p2c.py`
3. Execute your Python files to produce similarly named dot files.
4. Use dot to generate similarly-named pdf files.
5. Use your favorite document editor to write the answers to problem 2.c.
6. Generate a single pdf file named `<your unquename>_hw1.pdf` that contains the written answers to problems 2.c.
7. Zip the entire directory using “`zip -r <your unquename>_hw1.zip <your unquename>_hw1`” and upload to Canvas.