Lab2 (Satisfiability Modulo Theory)

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July 9, 2021

1 Part I: Installation on your own computer

1. Go to Python website and install the 3.7+ version of python3.
   - You can also install python from Microsoft store.
2. Detailed information about installation provided here
3. Open the command line in your Windows, by clicking Windows-key + R and writing `cmd`
   - For OSX/Linux, please use `terminal` or `xterm`, respectively.
4. Check that python3 is installed by typing `python` in your command line.
   - This should open the python prompt, with the version shown.
5. Exit the python prompt by typing `exit()` in the python prompt.
6. Check that `pip` command is installed on your command line, by writing `pip` on the command line.
7. Once `pip` is installed, type the following command:
   - `pip install -U --user z3-solver`. This will install the z3 solver and python bindings to the z3 solver.

2 Part II: The hardware circuit equivalence problem.

- It is your job is to check the equivalence of two 1-bit full adder circuits using a SMT solver.

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- The problem is as follows: A new hardware engineer designs a 1-bit full adder with carry as shown in Figure 1. The experienced hardware design engineer wants to implement an alternative circuit, which he/she claims is an equivalent 1-bit full adder with carry, but uses less number of gates and hence, is more efficient. Experienced engineer's implementation is presented in Figure 2.
- *Prove using the SMT solver that the two circuits are equivalent.*

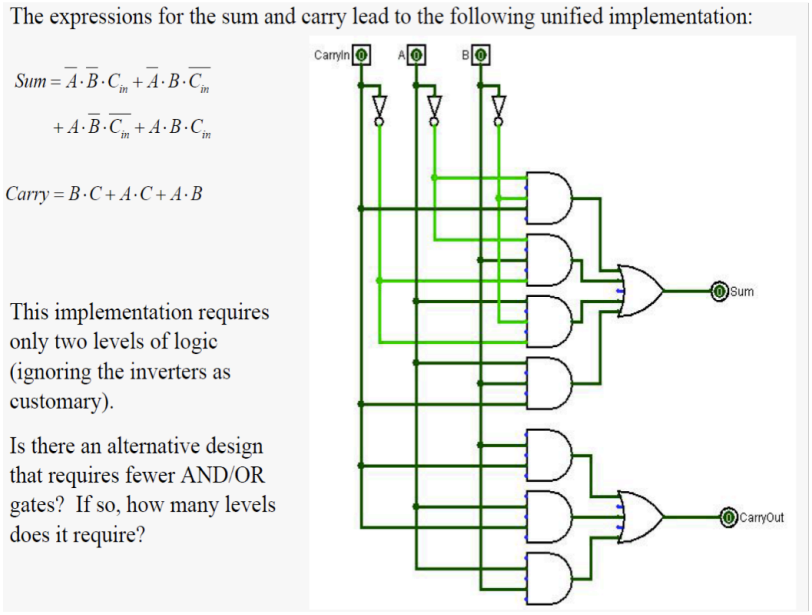

Figure 1: Full adder specification

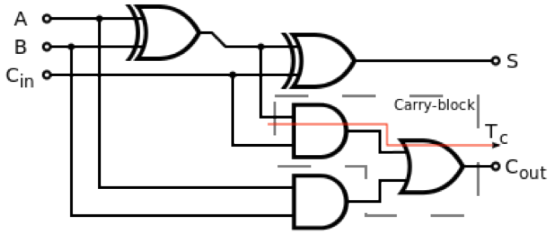

Figure 2: Full adder implementation

3 Steps for solving the problem

- Download the python file `hw.py`, from canvas, which implements the full adder specification and implementation.
- Run the python encoding of the SMT full adder problem as follows: `python hw.py`
- Result should be: `Circuits are equivalent`
- You can change the encoding, and see if you get the `Circuits not equivalent` result.
  - In this case, the reason for circuits not being equivalent will also be printed.