ECEN 454 Lab 1 Report

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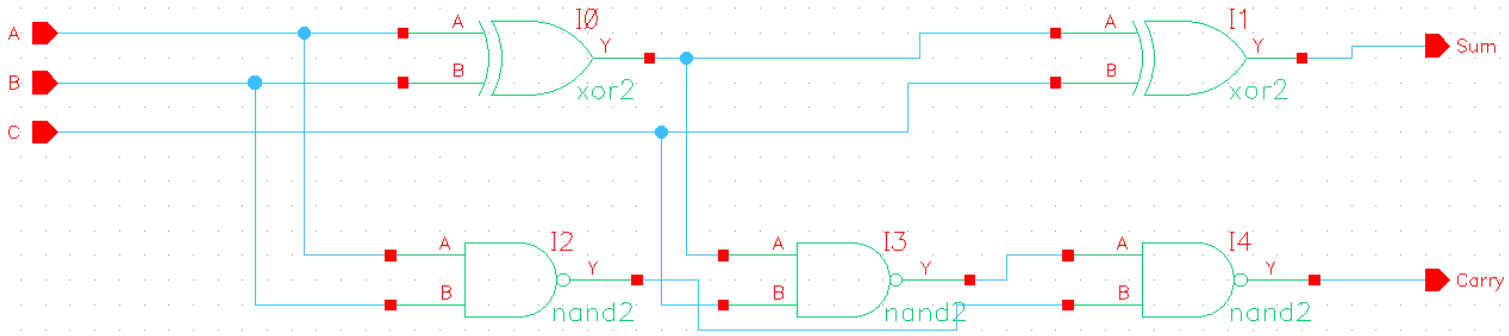
Due Date: June 14, 2018

Schematics and Testbenches

Full Adder

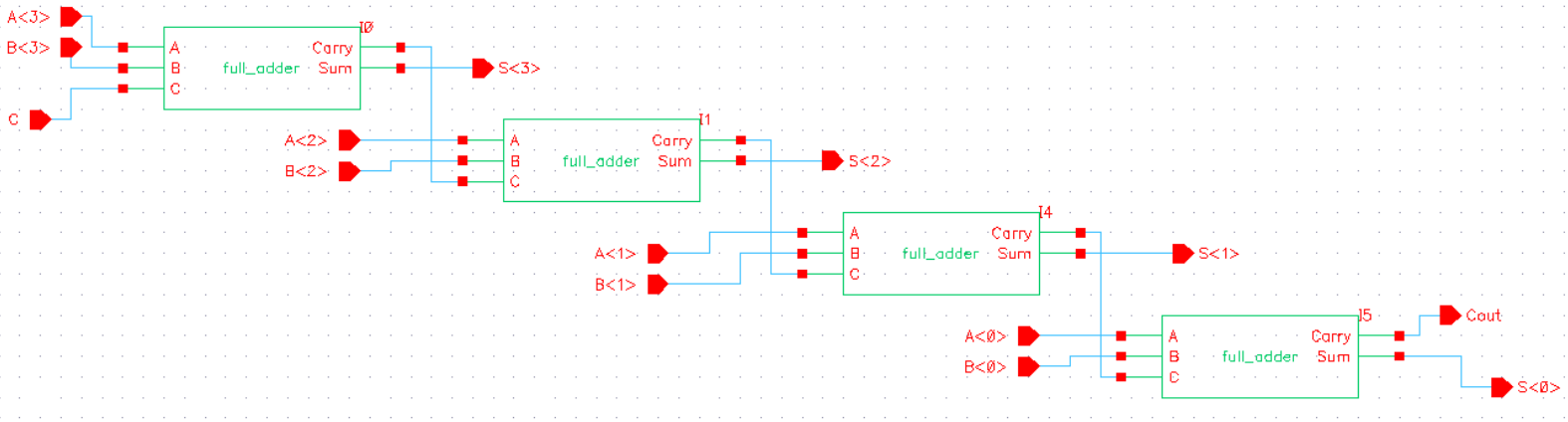
Schematic:



Testbench:

```
initial
begin

  A = 1'b0;
  B = 1'b0;
  C = 1'b0;
$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, Sum, Carry);
#50 A=1'b0; B=1'b0; C=1'b1;                 //ABC=001
$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, Sum, Carry);
#50 A=1'b0; B=1'b1; C=1'b0;                 //ABC=010
$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, Sum, Carry);
#50 A=1'b0; B=1'b1; C=1'b1;                 //ABC=011
$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, Sum, Carry);
#50 A=1'b1; B=1'b0; C=1'b0;                 //ABC=100
$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, Sum, Carry);
#50 A=1'b1; B=1'b0; C=1'b1;                 //ABC=101
$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, Sum, Carry);
#50 A=1'b1; B=1'b1; C=1'b0;                 //ABC=110
$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, Sum, Carry);
#50 A=1'b1; B=1'b1; C=1'b1;                 //ABC=111
$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, Sum, Carry);

end
```

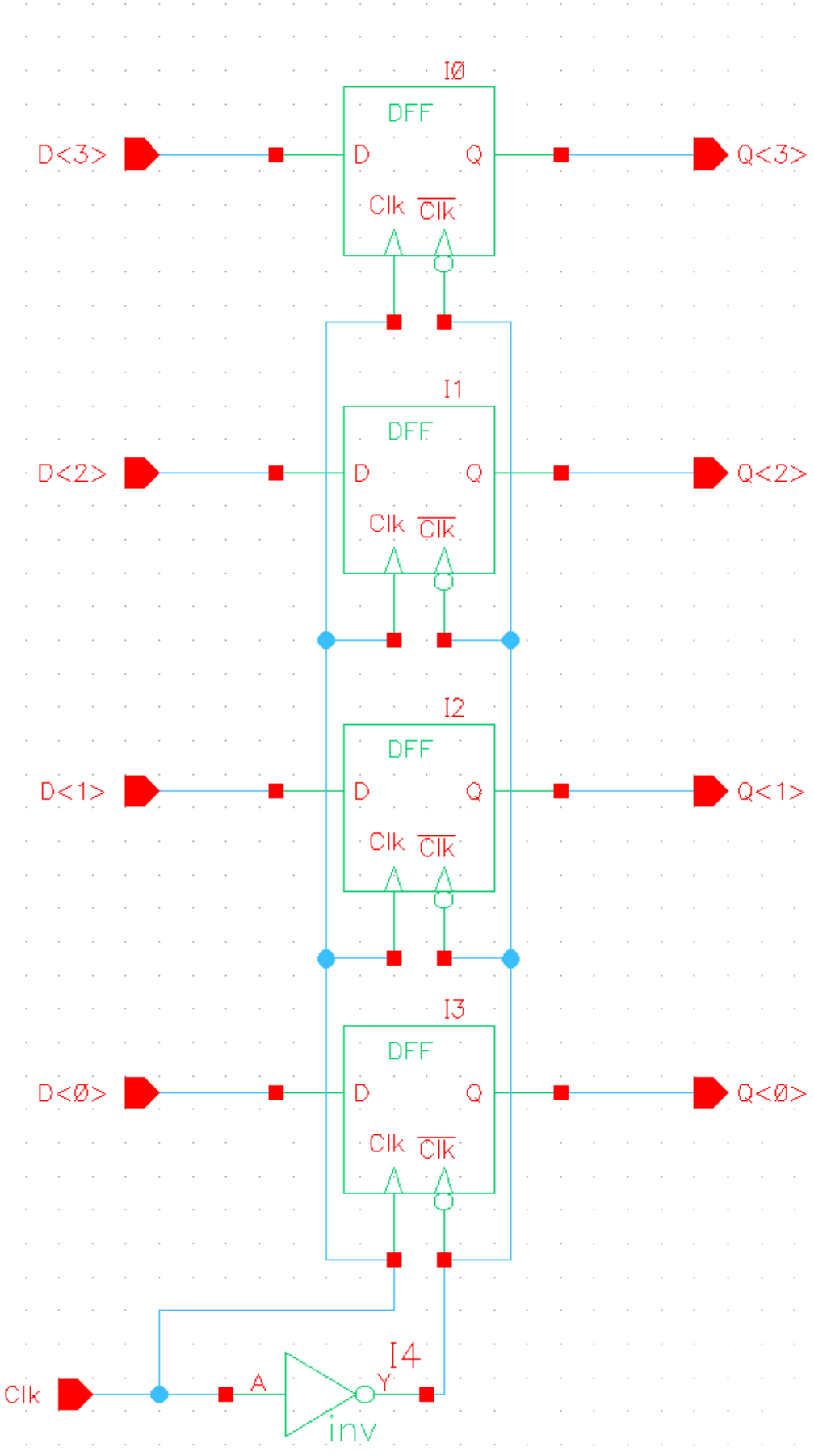
4-bit Adder



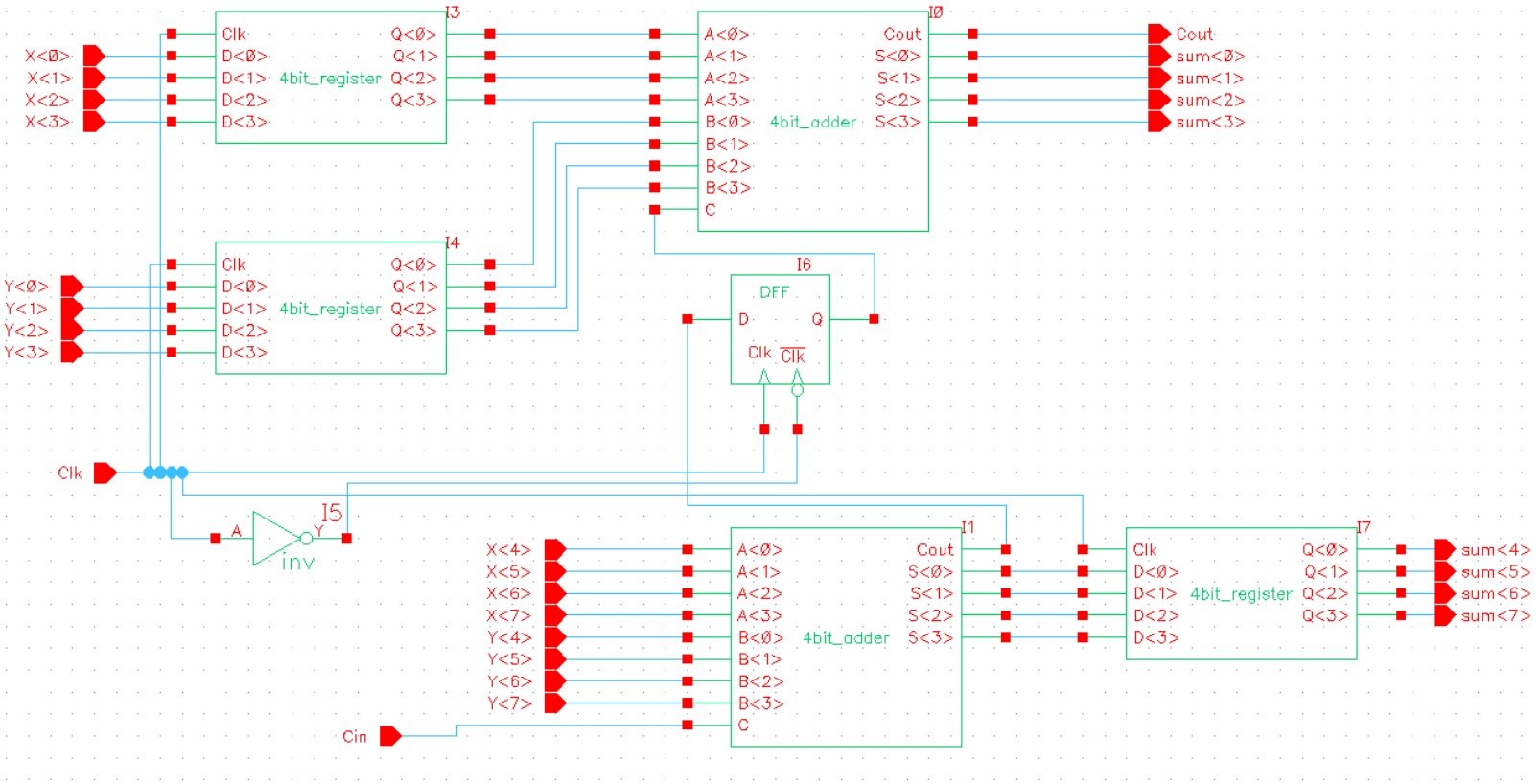
Testbench:

```
initial
begin

  A = 4'b0000;
  B = 4'b0000;
  C = 1'b0;

$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, S, Cout);

#50 A=4'b1111; B=4'b1111; C=1'b0;
$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, S, Cout);

#50 A=4'b1010; B=4'b1010; C=1'b1;
$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, S, Cout);

#50 A=4'b0101; B=4'b0101; C=1'b1;
$monitor ($time," A=%b, B=%b, C=%b, Sum=%b, Carry=%b", A, B, C, S, Cout);


end
```

4-bit Register



8-bit Adder



Testbench:

```
initial
begin

  Cin = 1'b0;
  Clk = 1'b0;
  X[0] = 1'b0;
  X[1] = 1'b0;
  X[2] = 1'b0;
  X[3] = 1'b0;
  X[4] = 1'b0;
  X[5] = 1'b0;
  X[6] = 1'b0;
  X[7] = 1'b0;
  Y[0] = 1'b0;
  Y[1] = 1'b0;
  Y[2] = 1'b0;
```

```
  Y[3] = 1'b0;
  Y[4] = 1'b0;
  Y[5] = 1'b0;
  Y[6] = 1'b0;
  Y[7] = 1'b0;

$monitor ($time," X=%b, Y=%b, Cin=%b, Sum=%b, Cout=%b", X, Y, Cin, sum, Cout);

#50 X=8'b01111110; Y=8'b11100111; Cin=1'b0; Clk = 1'b0;
#5 Clk = 1'b1;
$monitor ($time," X=%b, Y=%b, Cin=%b, Sum=%b, Cout=%b", X, Y, Cin, sum, Cout);

#50 X=8'b11111111; Y=8'b00000000; Cin=1'b1; Clk = 1'b0;
#5 Clk = 1'b1;
$monitor ($time," X=%b, Y=%b, Cin=%b, Sum=%b, Cout=%b", X, Y, Cin, sum, Cout);

#50 X=8'b10101010; Y=8'b01010101; Cin=1'b0; Clk = 1'b0;
#5 Clk = 1'b1;
$monitor ($time," X=%b, Y=%b, Cin=%b, Sum=%b, Cout=%b", X, Y, Cin, sum, Cout);

#50 X=8'b10101010; Y=8'b01010101; Cin=1'b1; Clk = 1'b0;
#5 Clk = 1'b1;
$monitor ($time," X=%b, Y=%b, Cin=%b, Sum=%b, Cout=%b", X, Y, Cin, sum, Cout);

#50 X=8'b11001100; Y=8'b00110011; Cin=1'b0; Clk = 1'b0;
#5 Clk = 1'b1;
$monitor ($time," X=%b, Y=%b, Cin=%b, Sum=%b, Cout=%b", X, Y, Cin, sum, Cout);

#50 X=8'b11001100; Y=8'b00110011; Cin=1'b1; Clk = 1'b0;
#5 Clk = 1'b1;
$monitor ($time," X=%b, Y=%b, Cin=%b, Sum=%b, Cout=%b", X, Y, Cin, sum, Cout);

end
```

Simulation Outputs

Full Adder:

```
Relinquished control to SimVision...
ncsim>
ncsim> source /softwares/Linux/cadence/INCISIV102/tools/inca/files/ncsimrc
ncsim> database -open shmWave -shm -default -into shm.db
Created default SHM database shmWave
ncsim> probe -create -shm test  -all   -depth 1
Created probe 1
ncsim> run
              0 A=0, B=0, C=0, Sum=0, Carry=0
             50 A=0, B=0, C=1, Sum=1, Carry=0
            100 A=0, B=1, C=0, Sum=1, Carry=0
            150 A=0, B=1, C=1, Sum=0, Carry=1
            200 A=1, B=0, C=0, Sum=1, Carry=0
            250 A=1, B=0, C=1, Sum=0, Carry=1
            300 A=1, B=1, C=0, Sum=0, Carry=1
            350 A=1, B=1, C=1, Sum=1, Carry=1
ncsim> ^C
ncsim> exit
TOOL:   ncxlmode         10.20-s073: Exiting on Jun 07, 2018 at 15:18:20 CDT  (total: 00:06:12)
```

4-bit Adder:

```
Relinquished control to SimVision...
ncsim>
ncsim> source /softwares/Linux/cadence/INCISIV102/tools/inca/files/ncsimrc
ncsim> database -open shmWave -shm -default -into shm.db
Created default SHM database shmWave
ncsim> probe -create -shm test  -all   -depth 1
Created probe 1
ncsim> run
              0 A=0000, B=0000, C=0, Sum=0000, Carry=0
             50 A=1111, B=1111, C=0, Sum=1110, Carry=1
            100 A=1010, B=1010, C=1, Sum=0101, Carry=1
            150 A=0101, B=0101, C=1, Sum=1011, Carry=0
ncsim> ^C
ncsim> exit
TOOL:   ncxlmode         10.20-s073: Exiting on Jun 14, 2018 at 16:02:58 CDT  (total: 00:01:30)
```

8-bit Adder:

```
Relinquished control to SimVision...
ncsim>
ncsim> source /softwares/Linux/cadence/INCISIV102/tools/inca/files/ncsimrc
ncsim> database -open shmWave -shm -default -into shm.db
Created default SHM database shmWave
ncsim> probe -create -shm test  -all   -depth 1
Created probe 1
ncsim> run
                0 X=00000000, Y=00000000, Cin=0, Sum=xxxxxxxx, Cout=x
               50 X=01111110, Y=11100111, Cin=0, Sum=xxxxxxxx, Cout=x
               55 X=01111110, Y=11100111, Cin=0, Sum=01100101, Cout=1
              105 X=11111111, Y=00000000, Cin=1, Sum=01100101, Cout=1
              110 X=11111111, Y=00000000, Cin=1, Sum=00000000, Cout=1
              160 X=10101010, Y=01010101, Cin=0, Sum=00000000, Cout=1
              165 X=10101010, Y=01010101, Cin=0, Sum=11111111, Cout=0
              215 X=10101010, Y=01010101, Cin=1, Sum=11111111, Cout=0
              220 X=10101010, Y=01010101, Cin=1, Sum=00000000, Cout=1
              270 X=11001100, Y=00110011, Cin=0, Sum=00000000, Cout=1
              275 X=11001100, Y=00110011, Cin=0, Sum=11111111, Cout=0
              325 X=11001100, Y=00110011, Cin=1, Sum=11111111, Cout=0
              330 X=11001100, Y=00110011, Cin=1, Sum=00000000, Cout=1
ncsim> ^C
ncsim> exit
TOOL:   ncxlmode          10.20-s073: Exiting on Jun 14, 2018 at 16:20:30 CDT  (total: 00:01:11)
```