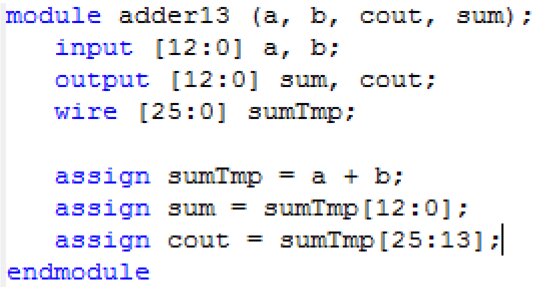
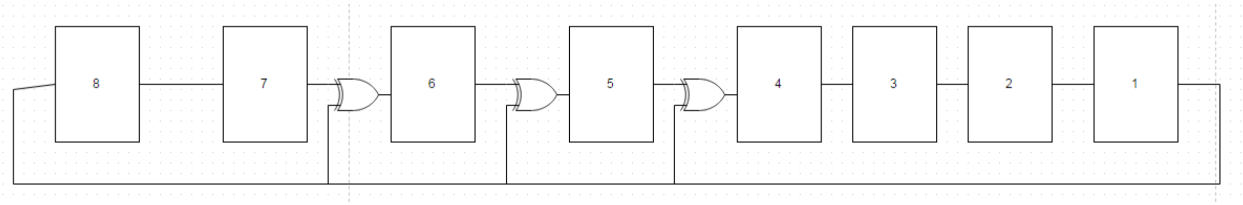
David DeGraw
Lab 10: Response Game Components
3/24/2015

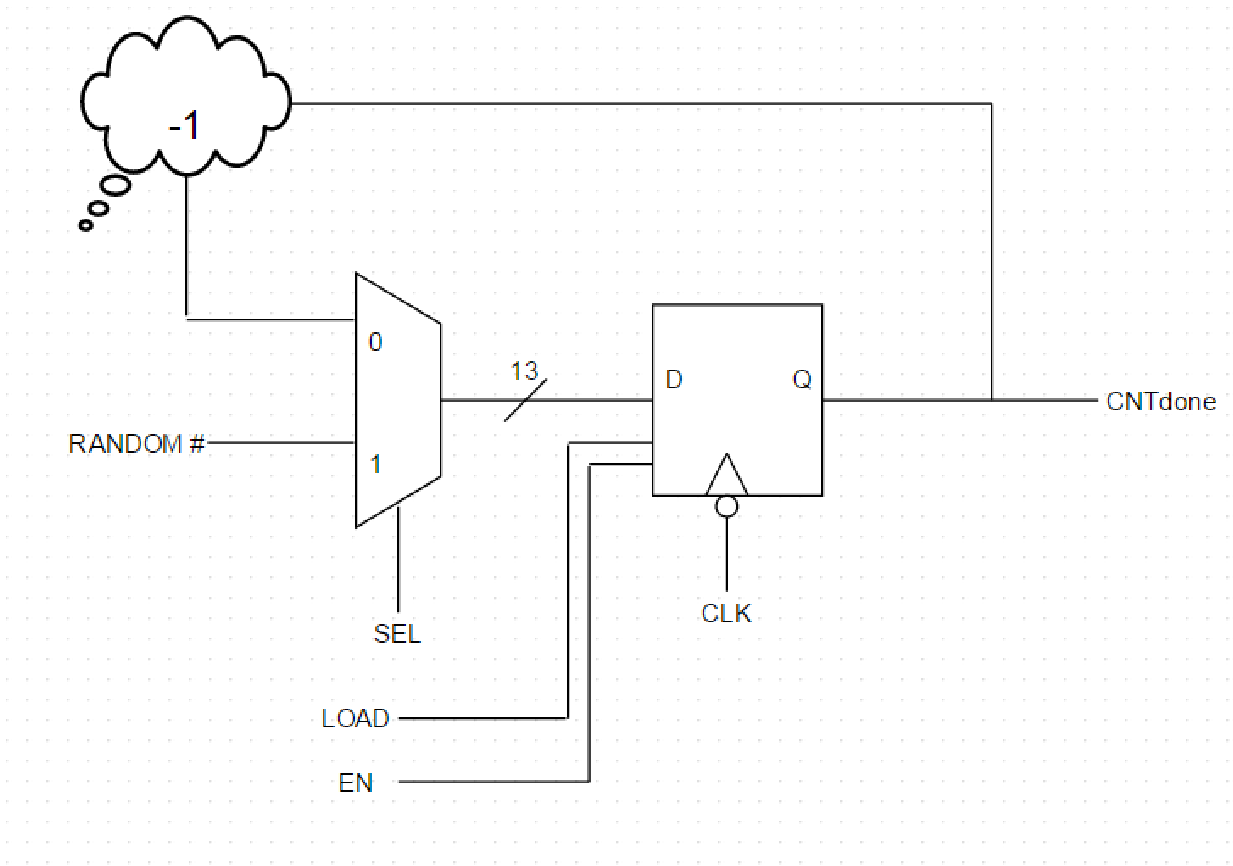
Preparation:



```
module adder13 (a, b, cout, sum);
   input [12:0] a, b;
   output [12:0] sum, cout;
   wire [25:0] sumTmp;

   assign sumTmp = a + b;
   assign sum = sumTmp[12:0];
   assign cout = sumTmp[25:13];
endmodule
```





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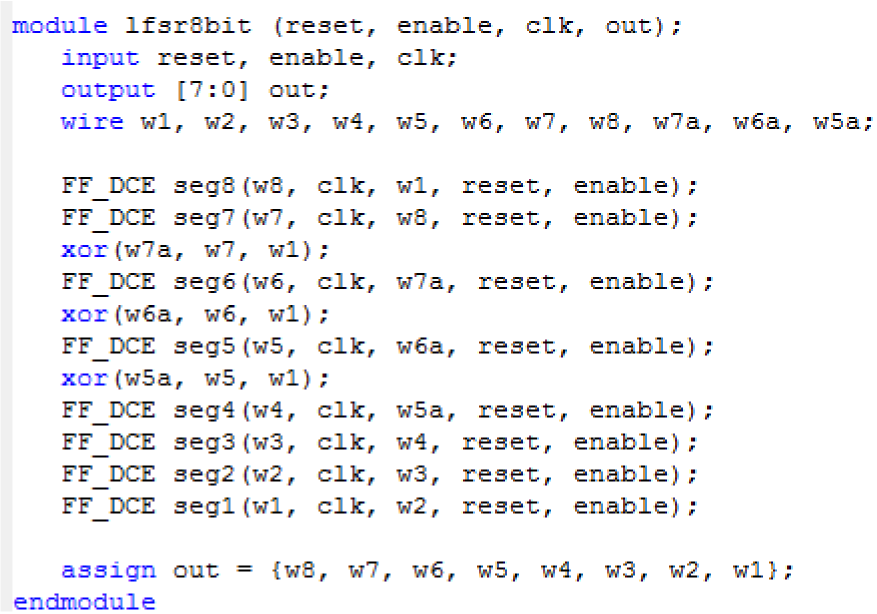
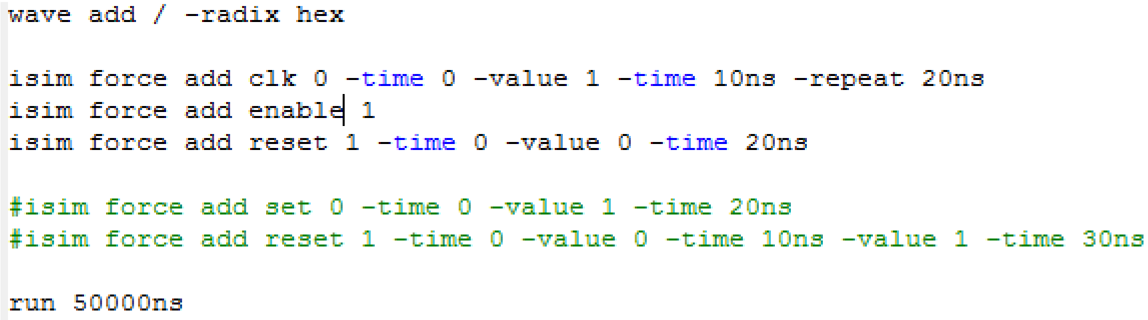
8 Bit LFSR:



```
module lfsr8bit (reset, enable, clk, out);
   input reset, enable, clk;
   output [7:0] out;
   wire w1, w2, w3, w4, w5, w6, w7, w8, w7a, w6a, w5a;

   FF_DCE seg8(w8, clk, w1, reset, enable);
   FF_DCE seg7(w7, clk, w8, reset, enable);
   xor(w7a, w7, w1);
   FF_DCE seg6(w6, clk, w7a, reset, enable);
   xor(w6a, w6, w1);
   FF_DCE seg5(w5, clk, w6a, reset, enable);
   xor(w5a, w5, w1);
   FF_DCE seg4(w4, clk, w5a, reset, enable);
   FF_DCE seg3(w3, clk, w4, reset, enable);
   FF_DCE seg2(w2, clk, w3, reset, enable);
   FF_DCE seg1(w1, clk, w2, reset, enable);

   assign out = {w8, w7, w6, w5, w4, w3, w2, w1};
endmodule
```

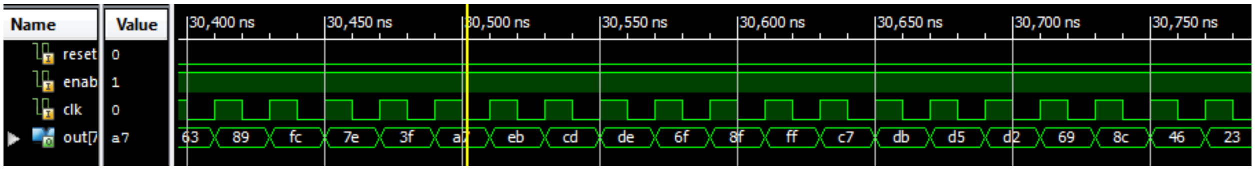


```
wave add / -radix hex

isim force add clk 0 -time 0 -value 1 -time 10ns -repeat 20ns
isim force add enable 1
isim force add reset 1 -time 0 -value 0 -time 20ns

#isim force add set 0 -time 0 -value 1 -time 20ns
#isim force add reset 1 -time 0 -value 0 -time 10ns -value 1 -time 30ns

run 50000ns
```



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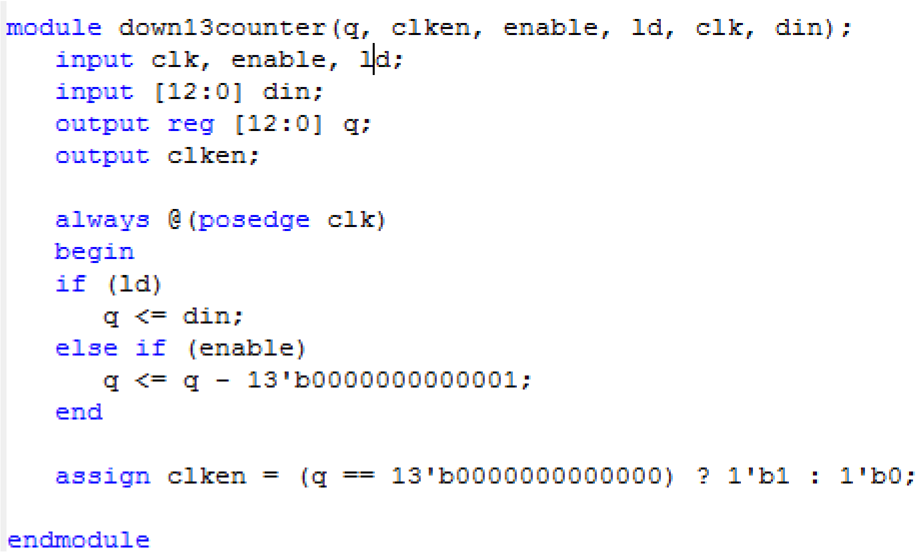
13 Bit Down Counter:

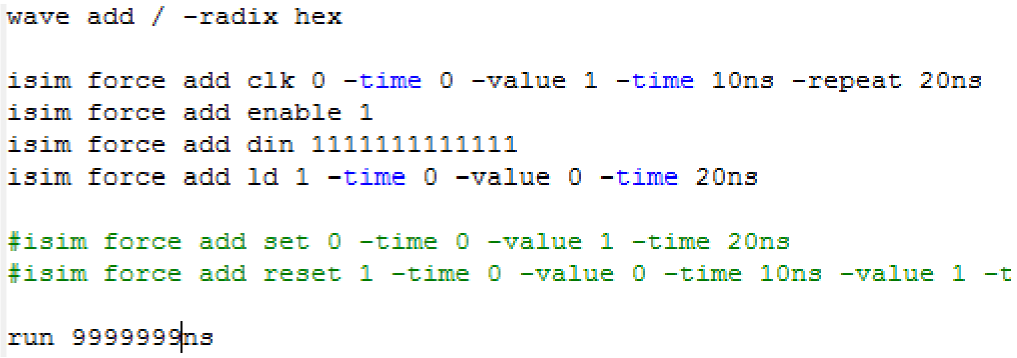


```
module down13counter(q, clken, enable, ld, clk, din);
   input clk, enable, ld;
   input [12:0] din;
   output reg [12:0] q;
   output clken;

   always @(posedge clk)
   begin
   if (ld)
      q <= din;
   else if (enable)
      q <= q - 13'b0000000000001;
   end

   assign clken = (q == 13'b0000000000000) ? 1'b1 : 1'b0;

endmodule
```

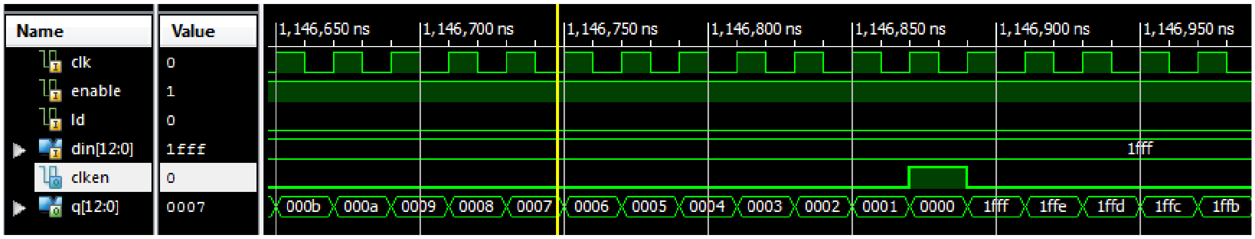


```
wave add / -radix hex

isim force add clk 0 -time 0 -value 1 -time 10ns -repeat 20ns
isim force add enable 1
isim force add din 1111111111111
isim force add ld 1 -time 0 -value 0 -time 20ns

#isim force add set 0 -time 0 -value 1 -time 20ns
#isim force add reset 1 -time 0 -value 0 -time 10ns -value 1 -t

run 9999999ns
```



Name	Value
clk	0
enable	1
ld	0
din[12:0]	1fff
clken	0
q[12:0]	0007

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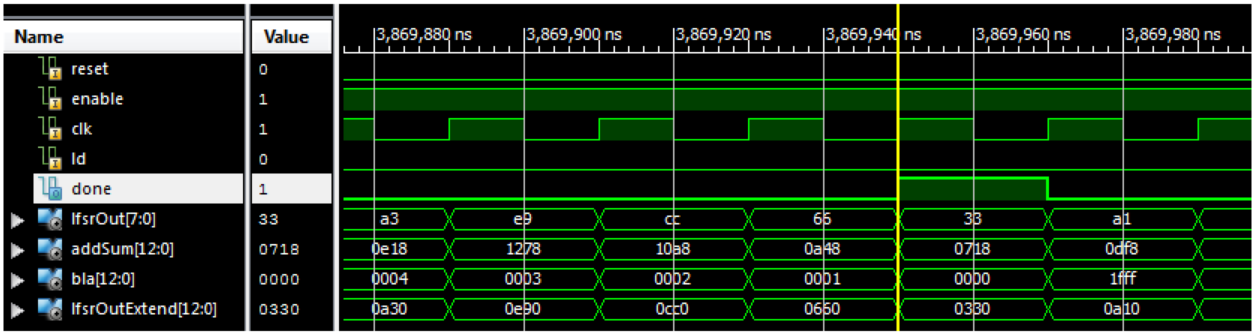
Delay Timer:

```
module delay(reset, enable, clk, ld, done);
   input reset, enable, clk, ld;
   output done;
   wire [7:0] lfsrOut;
   wire [12:0] addSum, bla, lfsrOutExtend;

   lfsr8bit lfsr(reset, enable, clk, lfsrOut);
   assign lfsrOutExtend = lfsrOut << 4'd4;
   adder13 a13(lfsrOutExtend, 13'd1000, addSum);
   down13counter dC(bla, done, enable, ld, clk, addSum);

endmodule
```

```
wave add / -radix hex

isim force add clk 0 -time 0 -value 1 -time 10ns -repeat 20ns
isim force add enable 1
isim force add reset 1 -time 0 -value 0 -time 20ns
isim force add ld 1 -time 0 -value 0 -time 50ns

run 9999999ns
```



Name	Value
reset	0
enable	1
clk	1
ld	0
done	1
lfsrOut[7:0]	33
addSum[12:0]	0718
bla[12:0]	0000
lfsrOutExtend[12:0]	0330

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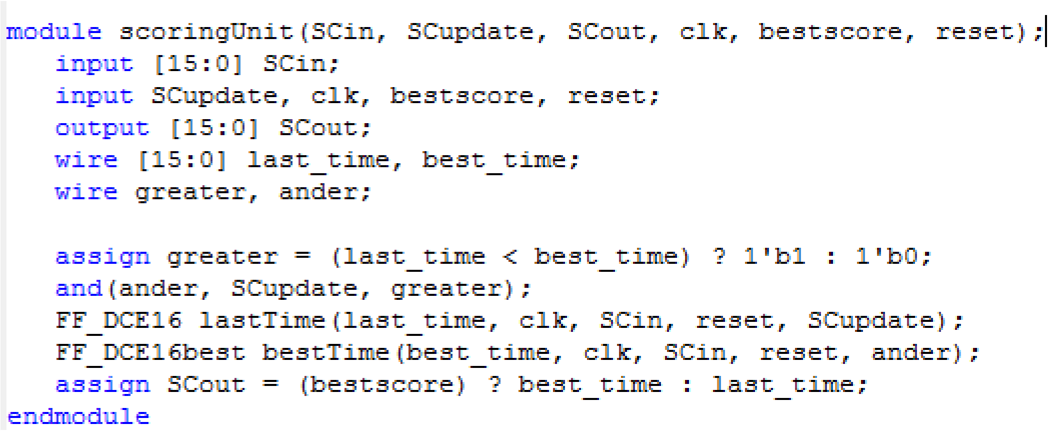
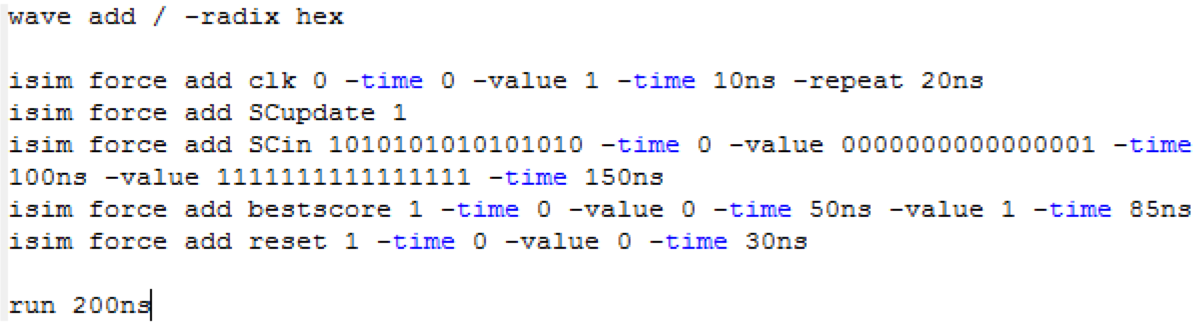
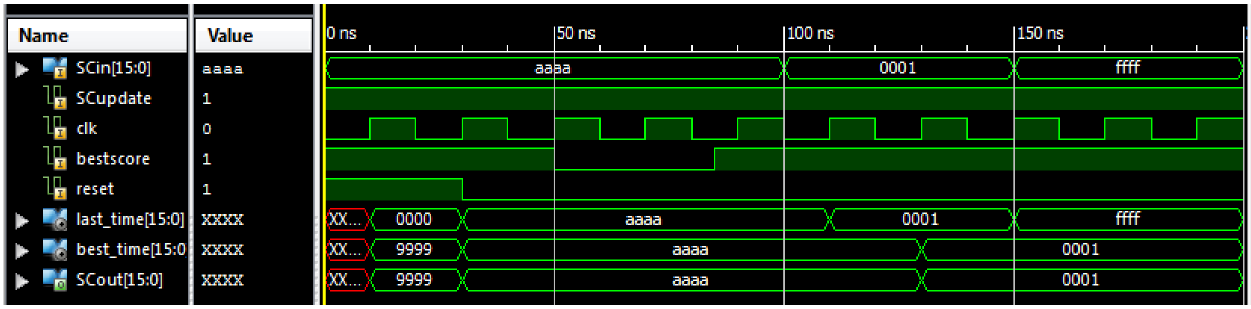
Scoring Unit:



```
module scoringUnit(SCin, SCupdate, SCout, clk, bestscore, reset);
   input [15:0] SCin;
   input SCupdate, clk, bestscore, reset;
   output [15:0] SCout;
   wire [15:0] last_time, best_time;
   wire greater, ander;

   assign greater = (last_time < best_time) ? 1'b1 : 1'b0;
   and(ander, SCupdate, greater);
   FF_DCE16 lastTime(last_time, clk, SCin, reset, SCupdate);
   FF_DCE16best bestTime(best_time, clk, SCin, reset, ander);
   assign SCout = (bestscore) ? best_time : last_time;
endmodule
```



```
wave add / -radix hex

isim force add clk 0 -time 0 -value 1 -time 10ns -repeat 20ns
isim force add SCupdate 1
isim force add SCin 1010101010101010 -time 0 -value 0000000000000001 -time
100ns -value 1111111111111111 -time 150ns
isim force add bestscore 1 -time 0 -value 0 -time 50ns -value 1 -time 85ns
isim force add reset 1 -time 0 -value 0 -time 30ns

run 200ns
```



Name	Value
SCin[15:0]	aaaa
SCupdate	1
clk	0
bestscore	1
reset	1
last_time[15:0]	XXXX
best_time[15:0	XXXX
SCout[15:0]	XXXX

Anomalies:

This lab was not really too bad at all. The instructions were infinitely more helpful than any previous lab. The only caveat with that was that the TA's did not have experience with this lab so they weren't able to help as much, which was okay because they didn't really need to.