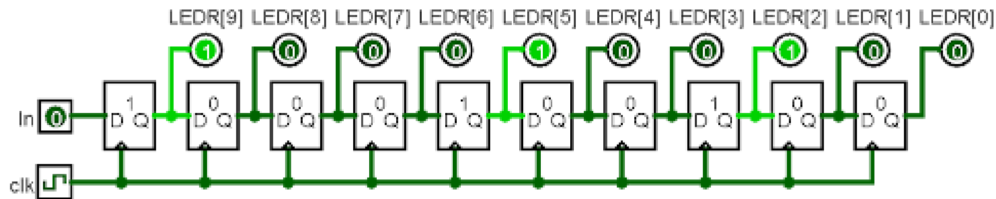
Exercise 1 –

a) Parameterize the Guessing Game module for bit-width N and secret number S:

```
// Game to check user's N-bit input guess against a hard-coded
    secret #, S
// - SW[2:0] is the guess, KEY[0] allows input to be checked
// - LEDR[0] is <, LEDR[1] is ==, LEDR[2] is >
module guessing_game
   (output logic [9:0] LEDR,
    input  logic [3:0] KEY, input  logic [9:0] SW);

    logic is_lt, is_eq, is_gt;

    comparator      number_comparator(
        .A(SW[2:0]),
        .B(3'b001),
        .is_lt, .is_eq, .is_gt
    );

    assign LEDR[0] = is_lt & ~KEY[0];
    assign LEDR[1] = is_eq & ~KEY[0];
    assign LEDR[2] = is_gt & ~KEY[0];

endmodule  // guessing_game
```

Exercise 2 – Creating a String of Lights

Finish the module called string_lights that implements the system shown below (a string of 10 flip-flops/1-bit registers tied to the LEDRs) for the DE1-SoC.



- Use SW[9] as the reset, SW[0] as In, and KEY[0] as clk.
  - Since we are using a KEY for the clock, no need for clock_divider.
- Hint: flip-flops can be module instances or inferred from an always_ff block.

```
// flip-flop that samples d on the rising edge of the clk
// and transfers it to q
module D_FF1 (output logic q,
    input logic d, reset, clk);
    always_ff @(posedge clk)
    if (reset)
        q <= 0;
    else
        q <= d;
endmodule  // D_FF1

module string_lights (output logic [9:0] LEDR,
                      input  logic [3:0] KEY,
                      input  logic [9:0] SW);
    logic clk, reset, in;
    // TODO: Finish creating the string of lights with or without the D_FF1 module!










endmodule  // string_lights
```

Exercise 3 – Sequential Logic Test Bench

Finish the test bench for string_lights.

```
module string_lights_tb();
    logic [9:0] LEDR;
    logic [3:0] KEY;
    logic [9:0] SW;

    string_lights dut (.*);

    // TODO: Finish the test bench!
    // Remember that KEY[0] is acting as a clock for this system.


endmodule  // string_lights_tb
```