| ECE4638 | Advanced Digital Logic Design | Spring 2020 |

Homework 1: Due Wednesday, January 15 by midnight.

Post your homework solution to Blackboard. For question 1, upload a python file. Name your file `<last_name>_hw1q1.py`. For questions 2 and 3 handwritten, scanned solutions are fine. If you scan your homework, make sure it is legible! Blank logic slices are given on the second page for questions 2 and 3. Use as many copies of this page as you need.

1. (25 points) Write a Python function that completes the following function definition. Input and output are each a list of integers.

```
def divide_by_three(integerlist):
    """This function outputs a list where, if the integer on
        the input list is divisible by three, the corresponding
        output is  1 else the output is 0
    """
```

2. (25 points) Implement a full adder on simplified, configurable logic slices (see Lect01, slide 35). Show your inputs and outputs, truth table for the computation and the final design. Two logic slices are sufficient for this design. The next page shows two blank logic slices that you can use. Your solution should clearly mark inputs and outputs, and indicate the values of all the memory cells in a logic slice.

3. (50 points) Design a 101 string recognizer as a finite state machine, and implement it on as many configurable logic slices as you need. Your design has one input x and one output z. The output should be a 1 when the sequence 101 is seen on the input, and 0 otherwise. Sequences can overlap. Your solution should include:

   (a) A state diagram for your string recognizer.
   (b) An assignment of states to binary values.
   (c) Equations for the output and next state as a function of the input and current state.
   (d) An implementation of the state machine using configurable logic slices.

   Show all your design steps. Clearly mark inputs and outputs for each logic slice.

A_0

A_1

A_2

A_3

D   Q

FLIP-
FLOP

A_0

A_1

A_2

A_3

D   Q

FLIP-
FLOP