UNIVERSITY OF TEHRAN
Electrical and Computer Engineering Department
Digital Logic Design, ECE 367, Digital System I, 894, Fall 1403
Computer Assignment 4
## State Machine Coding, Pre- and Post-Synthesis

Name:	Username:
Date:	Student Number:

In this assignment, you are to design a system that reads values stored in a ROM and calculates the harmonic sum for an input n. the controller for this machine is an Orthogonal State Machine FSM. The harmonic sum is defined by:

$$S_n = \frac{1}{1} + \frac{1}{2} + \frac{1}{3} + \cdots + \frac{1}{n}$$

You are to design a harmonic sum calculator in Verilogan after performing Pre-Synthesis simulation in ModelSim, implement and test your design in Quartus II. You will use pre-synthesis and post-synthesis descriptions of the machine to see simulation results.

You have the input n which shows how many terms of the harmonic are going to be summed. Based on the value of n, you have to read the corresponding terms that are previously stored in your ROM. Then you have to calculate the sum of all n terms and store it in a register for further usage.
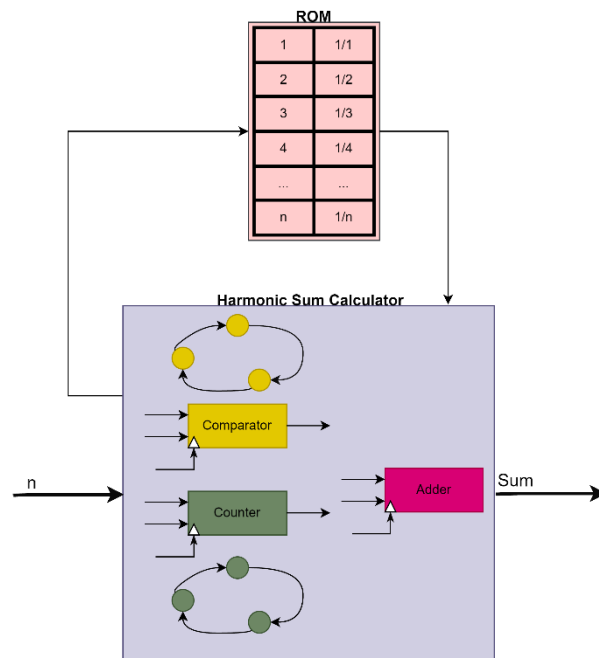
A) Design the orthogonal state machine of the harmonic sum calculator.

B) Write a complete behavioral Verilog code for the description of the machine of Part A. To describe and store S_n terms in ROM you can use *(* rom_style = "block" *)* attribute. To know more about ROM description using attribute, check this link.
Use ModelSim to completely simulate your circuit. This is your pre-synthesis description.

C) Instantiate the circuit of Part B in a test project in Quartus II and Implement this design using the Cyclone II FPGA and see its floor-plan, timing, chip area and utilized cells. The simulations you are running here are on post-synthesis descriptions.

D) Compare simulations of Parts B and C and see the timing differences between pre- and post- synthesis descriptions.

Deliverables:

Generate a report that includes all the items below:

a) For Part A show your state machine diagram on paper.
b) For other parts, show simulation results. Your simulation run and the project built for this purpose must be demonstrated to the TA.
c) For all parts, project files, and results must be demonstrated to the TA. Using waveforms, circuit diagrams, and other circuit representations justify your answers.

Make a PDF file of your report and name it with the format shown below:

FirstinitialLastnameStudentnumber-CAnn-ECEmmm

Where *nn* is a two-digit number for the Computer Assignment, *mmm* is the three-digit course number under which you are registered, and hopefully you know the rest. For the *Firstinitial* use only one character. For *Lastname* and for the multi-part last names use the part you are most identified with. Use the last five digits of your student id (exclude 8101) for the *Studentnumber* field of the report file name.