CSC 137 Cokgor Homework 4 (5 points)

All contemporary general-purpose microprocessors are designed based on a microprogrammed control unit. You are tasked with designing the microprogram for the **MOV Reg A, inbus** instruction for a microprocessor. <u>You will use a microprogrammed control unit</u> (Refer to "CSC 137 Cokgor-6-Microprocessor Architecture_2" lecture notes, page 9 for the generic microprogrammed control unit schematic).

MOV instruction is a two-address instruction. The destination address is Reg A. The source address can be the inbus or Register B. You are tasked with designing only the case where the source address is the inbus, and you can assume that inbus is already selected by the address selection bit (A.S.)

The processing hardware design for this instruction is as follows:
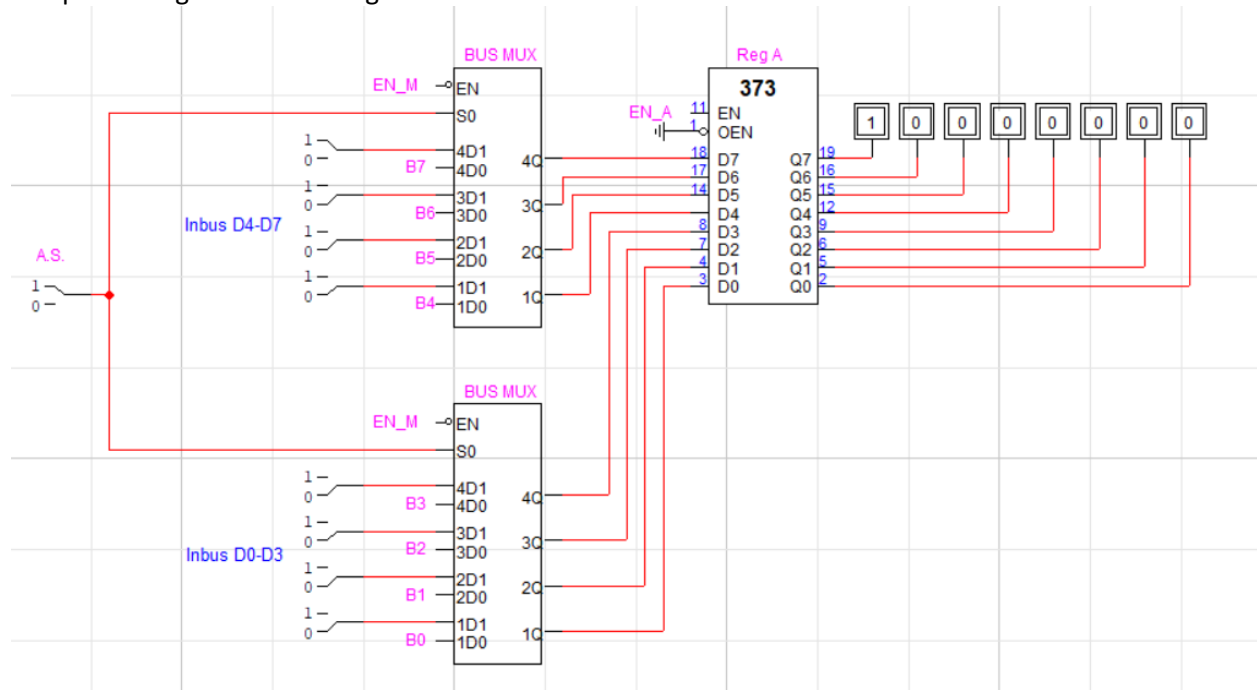
The pseudo microprogram is given as follows:
- Enable the BUS MUX and RegA
- Latch the output of RegA
- Disconnect the BUS MUX from RegA
- Wait

The function table of 74xx373 (RegA) is given below:

INPUTS			Output
$\overline{OE}$	EN	D	Q
L	H	H	H
L	H	L	L
L	L	X	Q_0
H	X	X	Z

Homework Assignment:
- Write the *microprogram* for the Control Unit.
- Develop the control unit hardware and the processing unit hardware (given above) in LogicWorks and simulate your circuit to verify that it works. *Refer to the instructions at the end of this document on how to create a memory module in LogicWorks and how to implement a microprogram counter.*
- Submit your .cct file.

Hints:
1) Determine what control signals you will need to make the hardware work. This will determine the number of control bits necessary. Note that some of the control signals need to be LOW ACTIVE.
2) Determine how many states are required to complete the operation. This will determine the number of memory locations, and hence the number of address bits, necessary.
3) Determine the conditional execution requirements. This will determine the number of condition bits necessary.
4) Determine the control word for each state with condition, branch address and control function bits.
5) Implement your microprogrammed control unit circuit.

Instructions on how to create a memory module in LogicWorks and how to implement a microprogram counter are on the next page.

How to create the control memory in LogicWorks:

Create the control memory by selecting the *PROM/RAM/PLA Wizard* under the *Simulation* drop down menu in LogicWorks (see picture below).
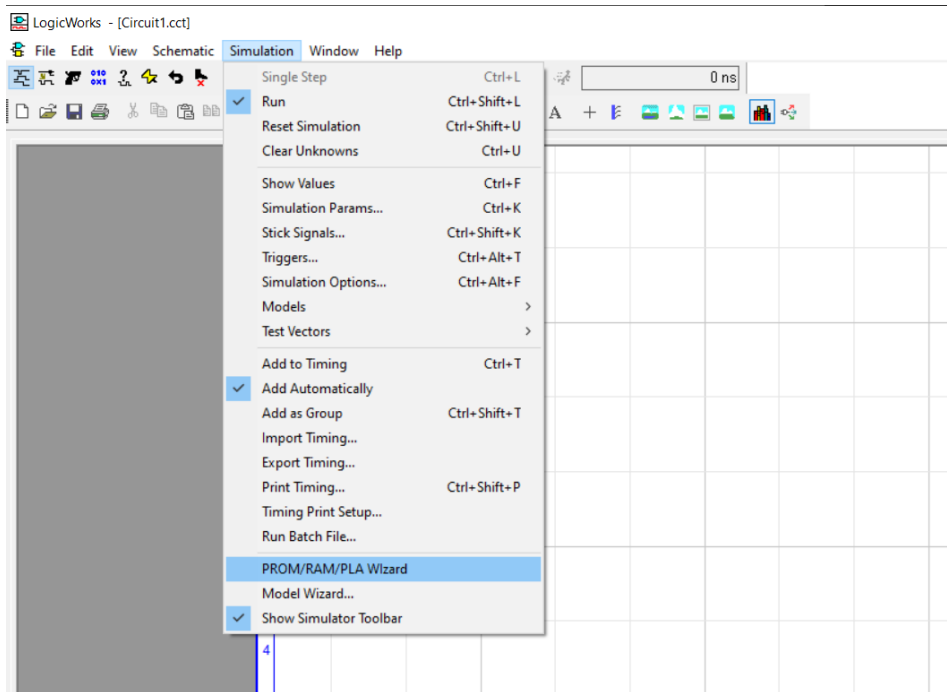
Inside the Wizard, select the Programmable Read Only Memory (see picture below)
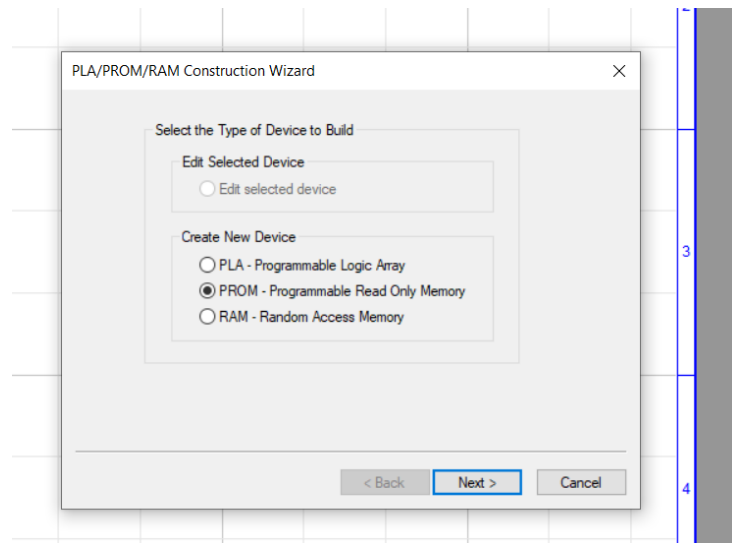
Select the number of Address Lines needed and Bits per Word (see picture below) and enter the memory contents manually. The number of Address Lines and Bits per Word, i.e. the width of the memory, will depend on the number of control words and the control word width, respectively. Note: Select the *'Enter hex data manually'* radio button.
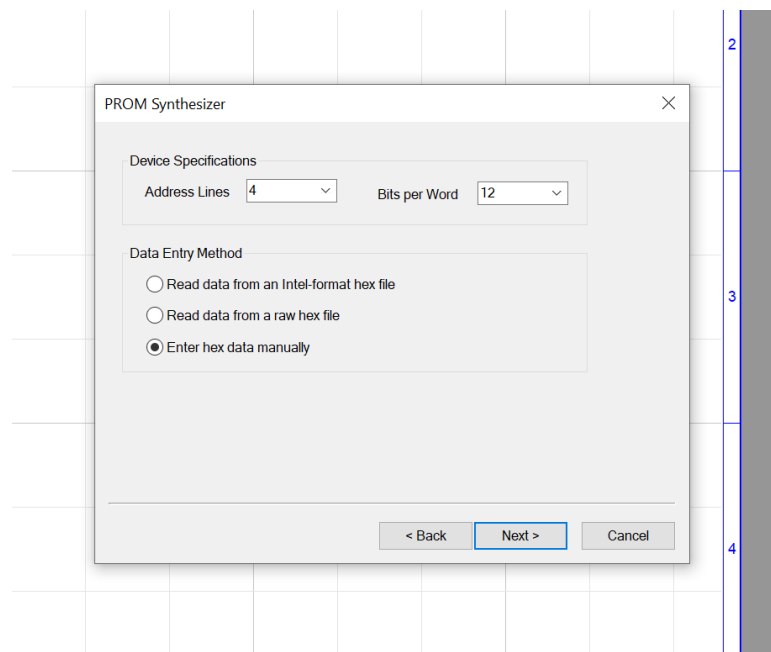
You can either insert your microprogram data in the memory, or leave the memory contents blank to insert the microprogram later. The microprogram needs to be written in HEX numbers with spaces between consecutive numbers.

Microprogram Counter:

You will need to use one of the counters available in the LogicWorks library to implement the Microprogram Counter. Search the component library in the Parts Palette window for the keyword 'counter'. Select the component 'Counter-4 UP wo/EN'. Apply the necessary connections to the counter, as well as the clock, and observe the counter output in simulation mode.