1.1 Questions

1. Multiplying a 3x3 matrix with a 1x 3 vector requires:

9 multiplications
+ 6 additions
15 total operations

Multiplying a k x k matrix with a 1xk vector requires

k^2 multiplications
$+ \ (k^2 - k)$ additions
$(2k^2 - k)$ total operations

2. The control module works based on the following chart on the next page.
3. Describe Testbench

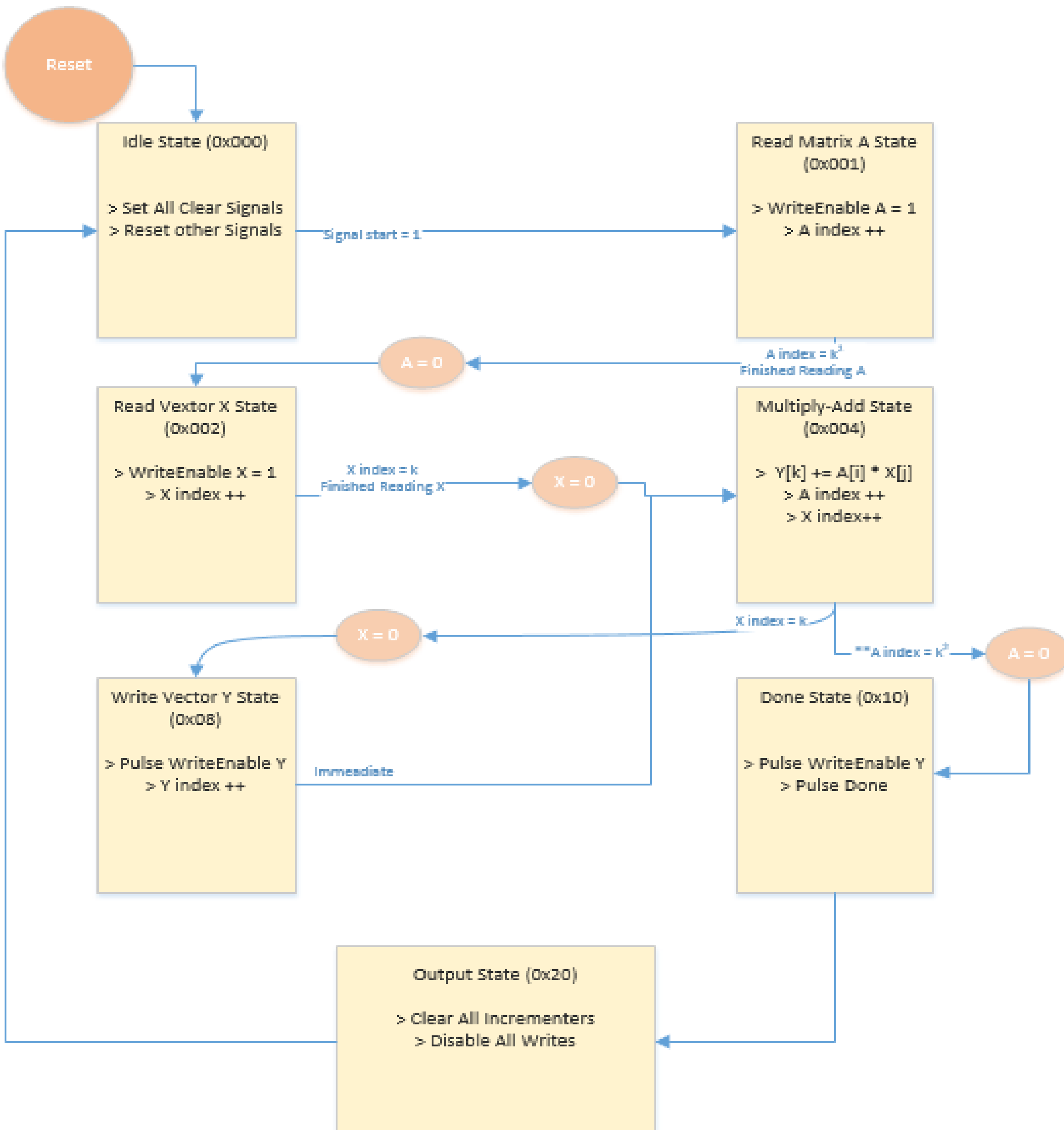

Illustration 1: Control Path Logic

*The above image illustrates our control path. The control path will stay in a state until the appropriate signal is set or condition is met. This can be an input from the overall system (i.e. start) or it can be a condition from the data path (e.g. X index = k). The ** symbol menas that this path take precedence. Also, Immediate means the control path switches from one state to another immediately, only staying in the state for 1 clock cycle.*

The operations in purple are completed by the datapath, but it helps to see what the overall system is doing base on the control path signals.

4. It takes 25 time cycles to perform one operation. The picture below shows our control path with timeing added in red.

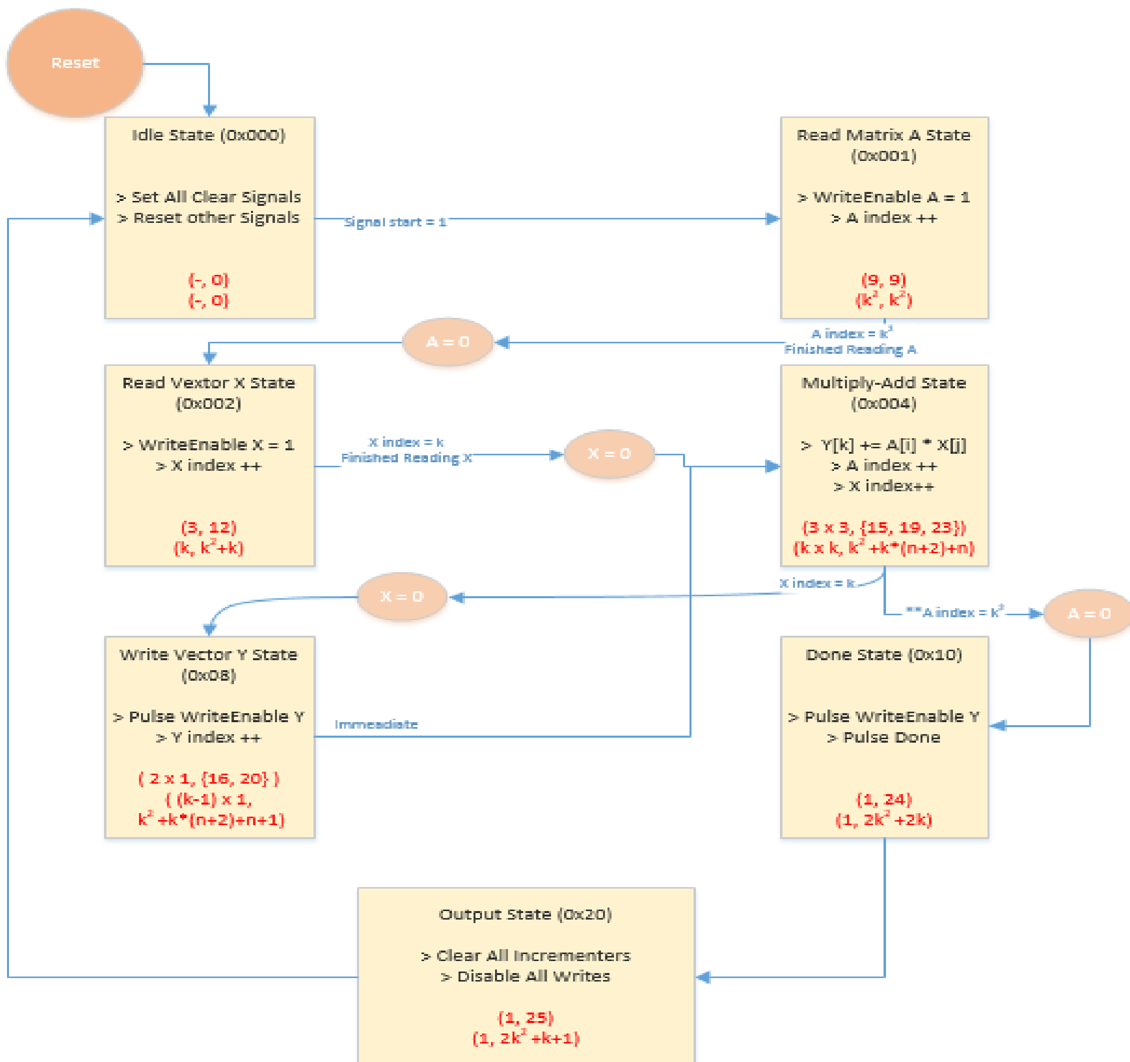

Illustration 2: Timing Diagram

The first number in the set represents the amount of time cycles T the control path stays in that state. For states that are reentrant, we show the N x T, where N is the number of times the state is reentered.

The second number in the set represents the time t at which the control path leaves that state. For states that are reentrant, we show {t_0, t_1, ...} for each time the control path leaves that state.

Below this numerical data, we generalized this data for multiplying a kxk matrix with a 1xk vector. We added the variable n to reentrant states to represent the number of times the user has entered the state. The the values for each t_n in the above {t_0, t_1, ...} sets can be calculated.

//will need to improve picture and edit it a little bit