

# CSE125 Lab5 Write-up

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## State Machine:

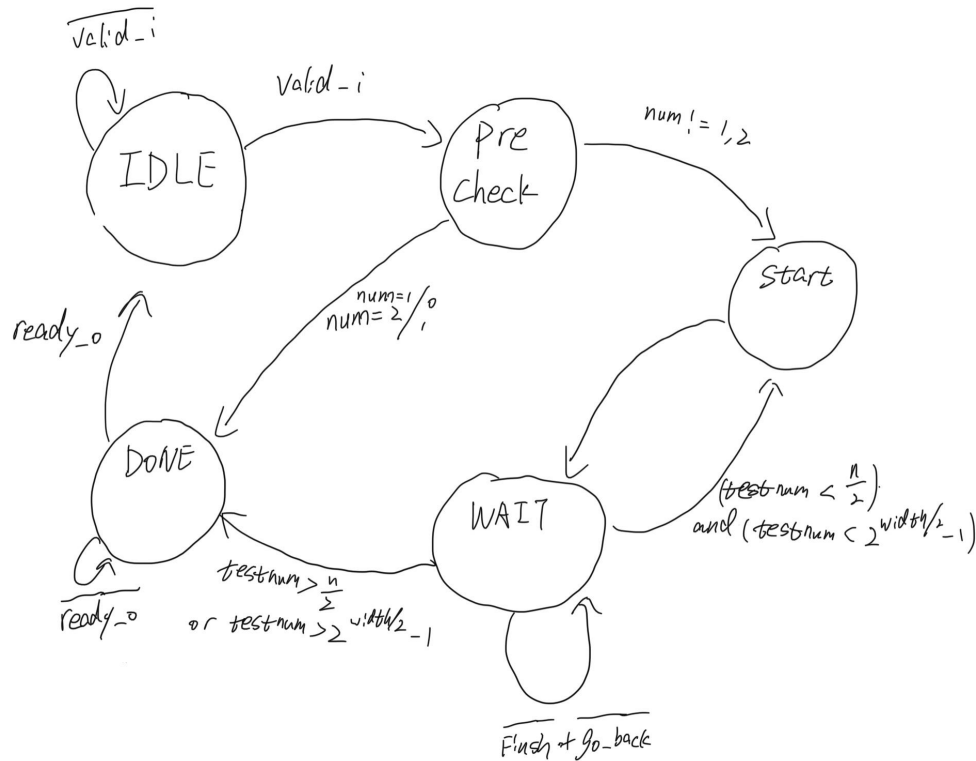


Figure 1: State Machine of is\_prime

When the IsPrime module get the valid\_i signal, it goes into PRECHECK state. In this state, the module will check if the number is 1 or 2. If it is either 1 or 2, go straight to DONE state and output result. If not, got to next stage and setup the testnumber. And it will go to WAIT state at next clock cycle, and wait for sub\_valid\_o from modulo. When the testnumber < n/2 or smaller than MAX\_NUM^0.5, it will let the testnumber plus one and go back to START state, or it will go to DONE state.

## Simulation:

The total runtime of the simulation prime\_tb is 152ms.

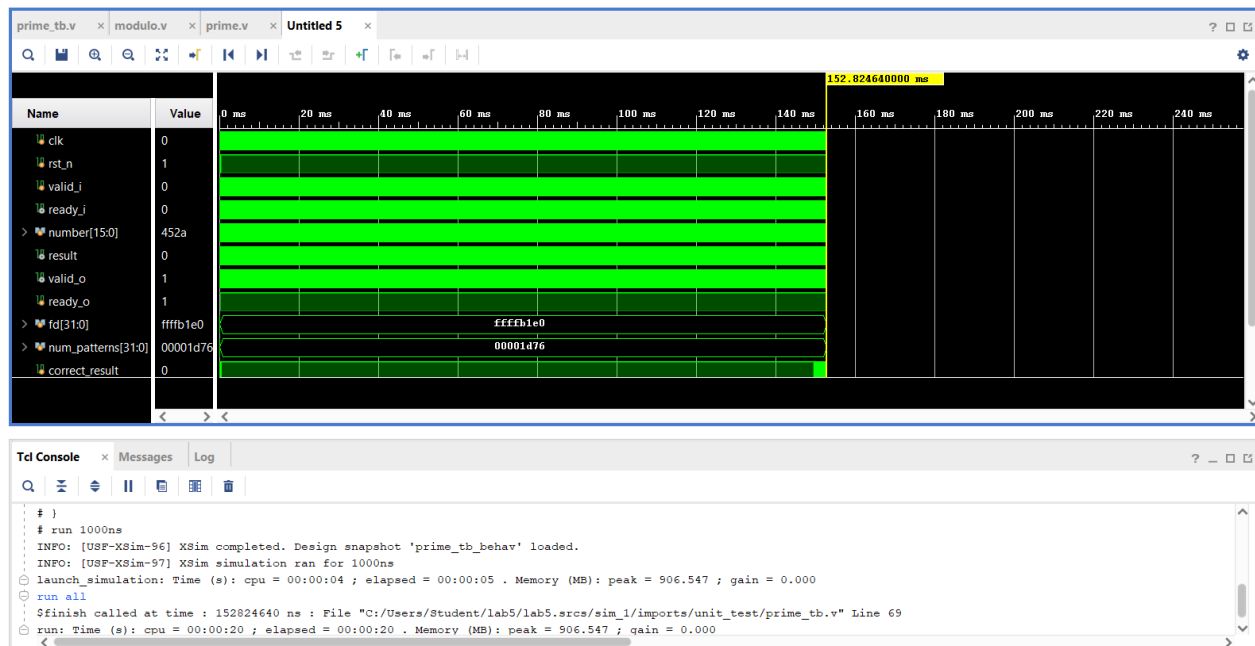


Figure 2: Waveform and the simulation of is\_prime.v

## Optimizations:

1. While we are doing this lab, we found out that one of the factors of the given number will be smaller than the square root of the given number and the other one is larger. Thus, we can optimize the whole system by just count from 2 to  $2^{WIDTH/2} - 1$ , which can help us optimize by 100X faster than we used to be.
2. Then, we found out that if we checked 2 as a factor, we don't need to check other even numbers later because all even numbers can be perfectly divided by 2. So To optimize it, when the least significant bit equals to 0, which means the number is even, we plus 2 on test number instead of 1 which will save us half of cycles.

## Resources:

The LUT is 440 and FF is 569 used by the prime\_checker IP with width 16.

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✓ synth_1 (active)		constrs_1		synth_design Complete!														0		0		0.0		0		0		6/1/22, 1:54 PM		00:00:31		Vivado Synthesi			
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Figure 3: Resources of the prime\_checker IP

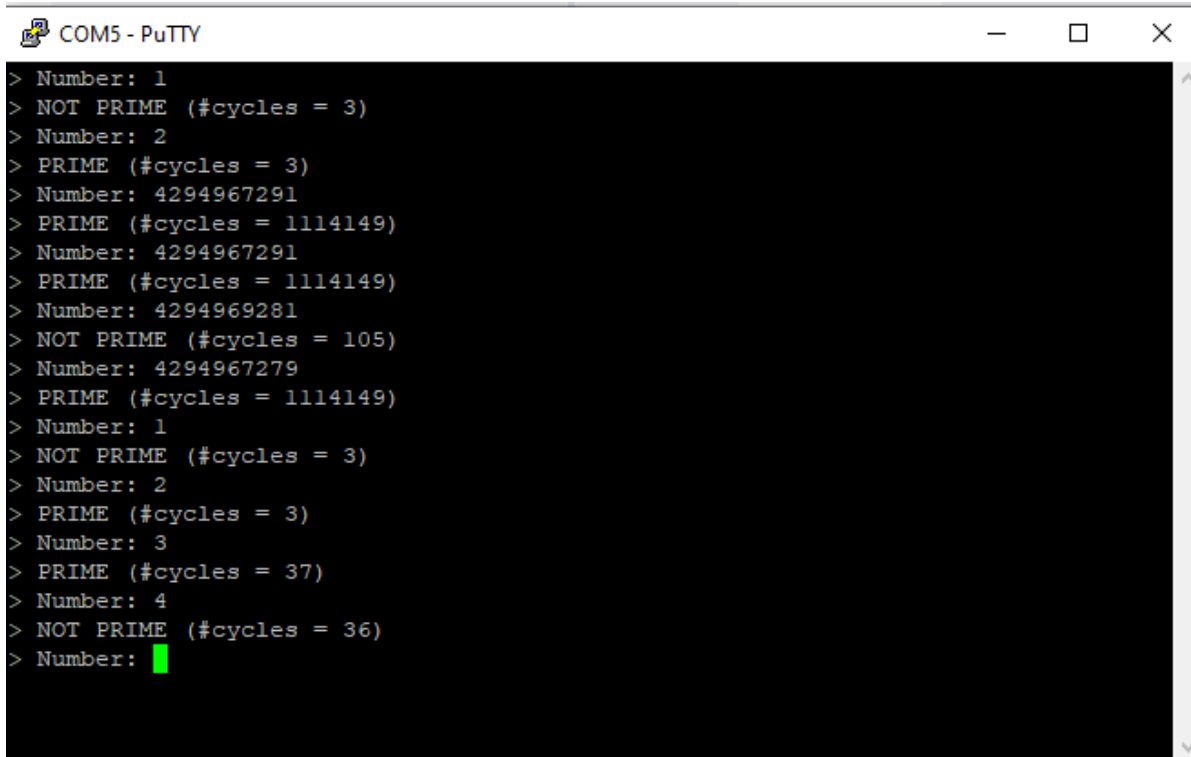
## Part-4:

```

COM5 - PuTTY
> NOT PRIME (#cycles = 57)
> Number: 1
> NOT PRIME (#cycles = 3)
> Number: 2
> PRIME (#cycles = 3)
> Number: 3
> PRIME (#cycles = 21)
> Number: 4
> NOT PRIME (#cycles = 20)
> Number: 5
> PRIME (#cycles = 39)
> Number: 6
> NOT PRIME (#cycles = 21)
> Number: 7
> PRIME (#cycles = 39)
> Number: 8
> NOT PRIME (#cycles = 19)
> Number: 9
> NOT PRIME (#cycles = 39)
> Number: 10
> NOT PRIME (#cycles = 21)
> Number: 11
> PRIME (#cycles = 57)
> Number:

```

Figure 3:PuTTY result of small numbers



```
> Number: 1
> NOT PRIME (#cycles = 3)
> Number: 2
> PRIME (#cycles = 3)
> Number: 4294967291
> PRIME (#cycles = 1114149)
> Number: 4294967291
> PRIME (#cycles = 1114149)
> Number: 4294969281
> NOT PRIME (#cycles = 105)
> Number: 4294967279
> PRIME (#cycles = 1114149)
> Number: 1
> NOT PRIME (#cycles = 3)
> Number: 2
> PRIME (#cycles = 3)
> Number: 3
> PRIME (#cycles = 37)
> Number: 4
> NOT PRIME (#cycles = 36)
> Number: 
```

Figure 4: Putty results of extra credits check