

State Machines Intro

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State Machine Intro

- Synchronous Sequential Circuit
 - Synchronous
 - Outputs change on a clock edge
 - One common clock
 - Sequential
 - Involves memory
 - Register(s)
 - 2 generalized types
 - Finite State Machines
 - Pipelined Machines

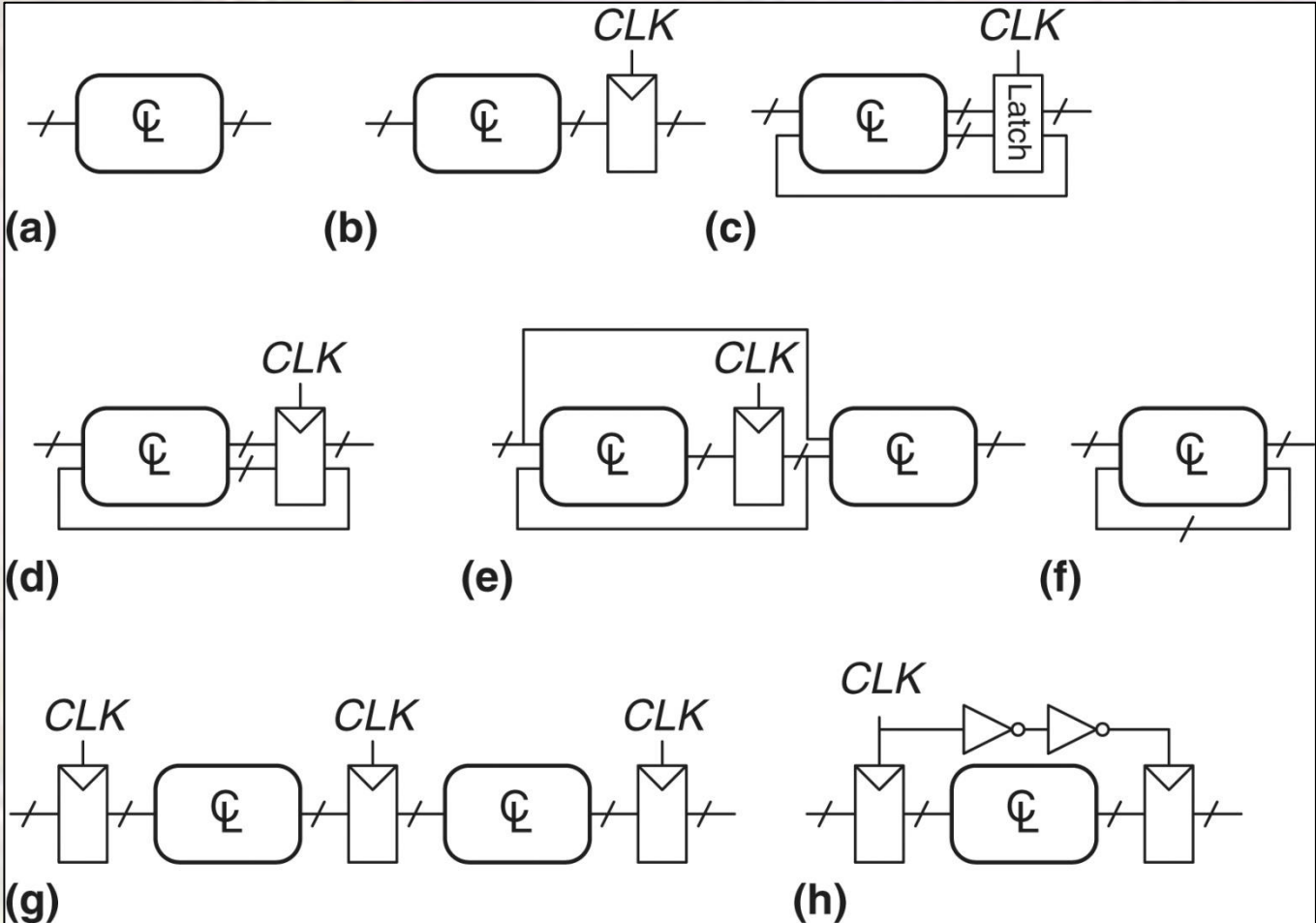
State Machine Intro

- State Machine
 - Rules
 - Every element is either a
 - Register
 - Combinational Logic
 - At least one element is a register
 - All registers are driven by the same clock
 - Every cyclic path contains at least one register

State Machine Intro

- State Machine

- Rules



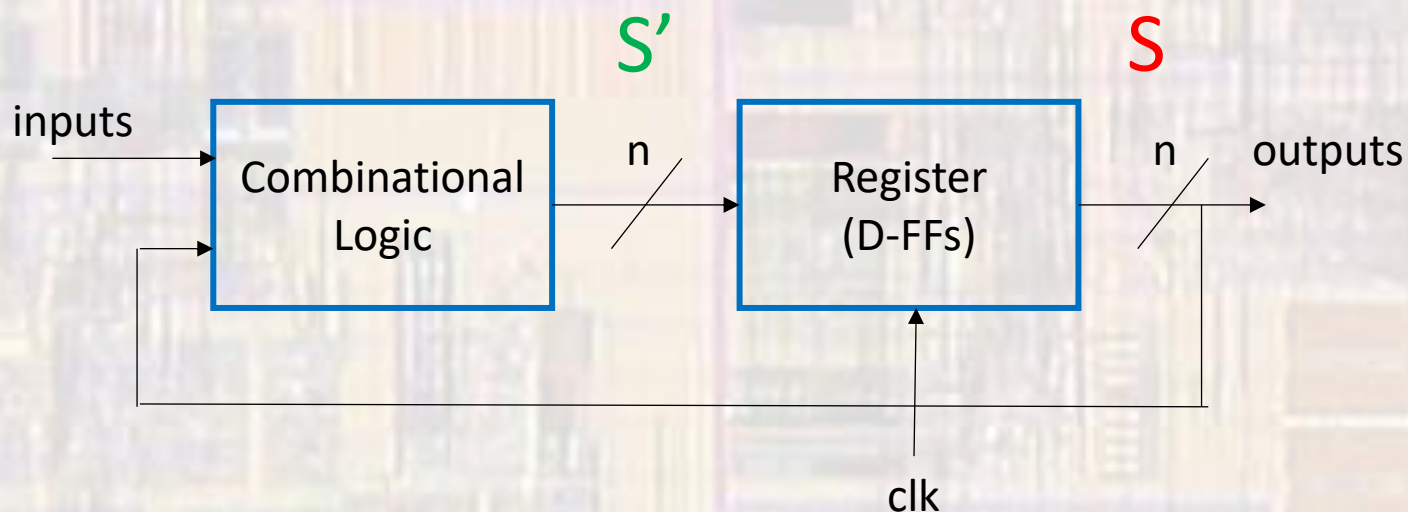
State Machine Intro

- State Machine Terms
 - State
 - Collection of all unique values held in memory elements
 - 1 D-FF can hold 2 states (0 or 1)
 - 4 D-FFs can hold 16 states (0000, 0001, 0010, ... 1111)
 - State Variable
 - Ordered collection of memory elements
 - Can hold any of 2^n states
 - 1 D-FF can have 1 state variable (Q)
 - 4 D-FFs can have 1 state variable (S) with 16 possible values

Actually, there are many more possible values – what are they?

State Machine Intro

- State Machine Circuit
 - State / Next State
 - State (S) - current value of a State Variable
 - Value stored in the register
 - Sometimes called Current State
 - Next State (S') - future value of a State Variable ([next clock cycle](#))
 - Value on the input of the register

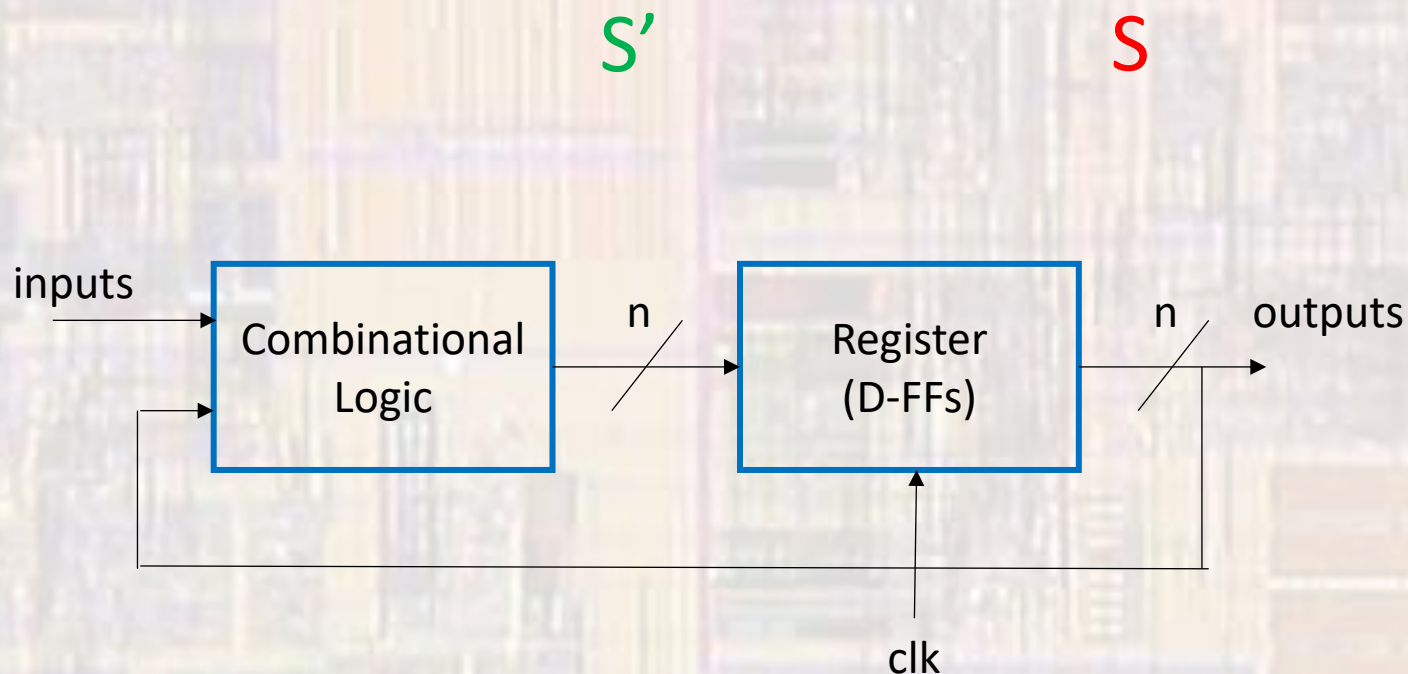


State Machine Intro

- State Machine Circuit

- State / Next State

- If we know what S is, we can figure out what S' is
- If we know what S' is, we know what S WILL BE after the next clock

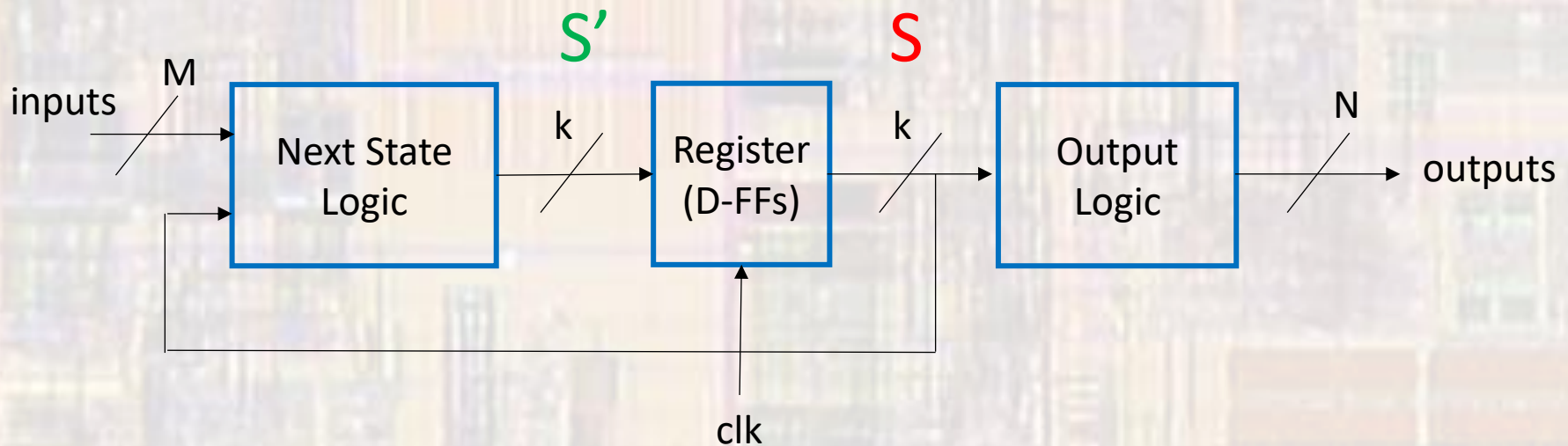


State Machine Intro

- Finite State Machine
 - Finite
 - n storage elements (D-FFs) $\rightarrow 2^n$ states – not infinite
 - State
 - Meets the requirements for a synchronous sequential circuit
 - 2 common types
 - Mealy Machine
 - Moore Machine

State Machine Intro

- Finite State Machine
 - Moore Machine
 - Outputs depend only on the current state(S)

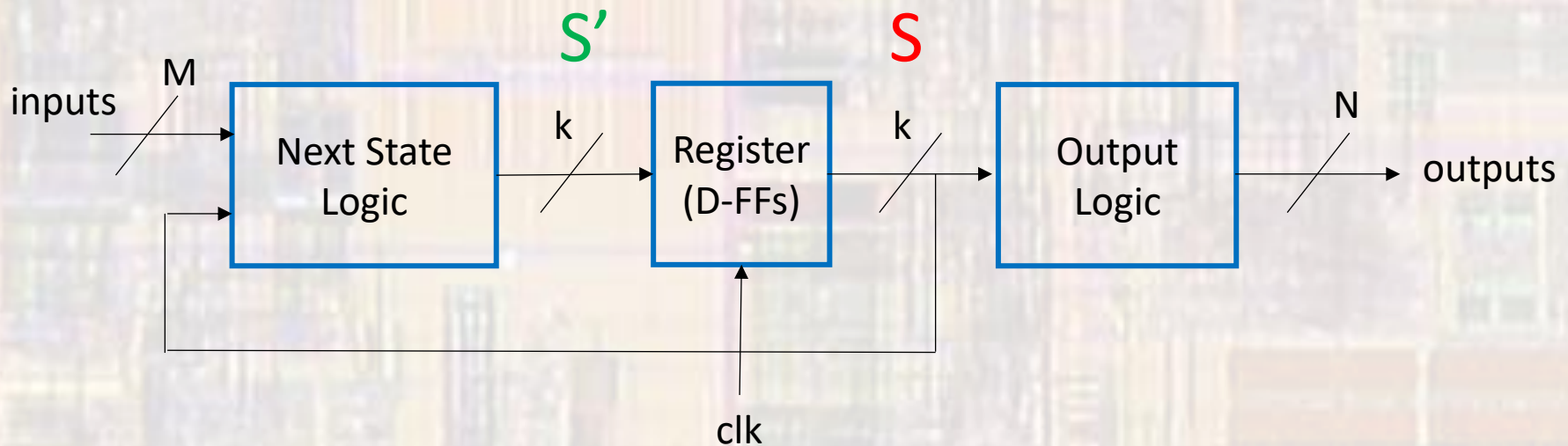


State Machine Intro

- Finite State Machine

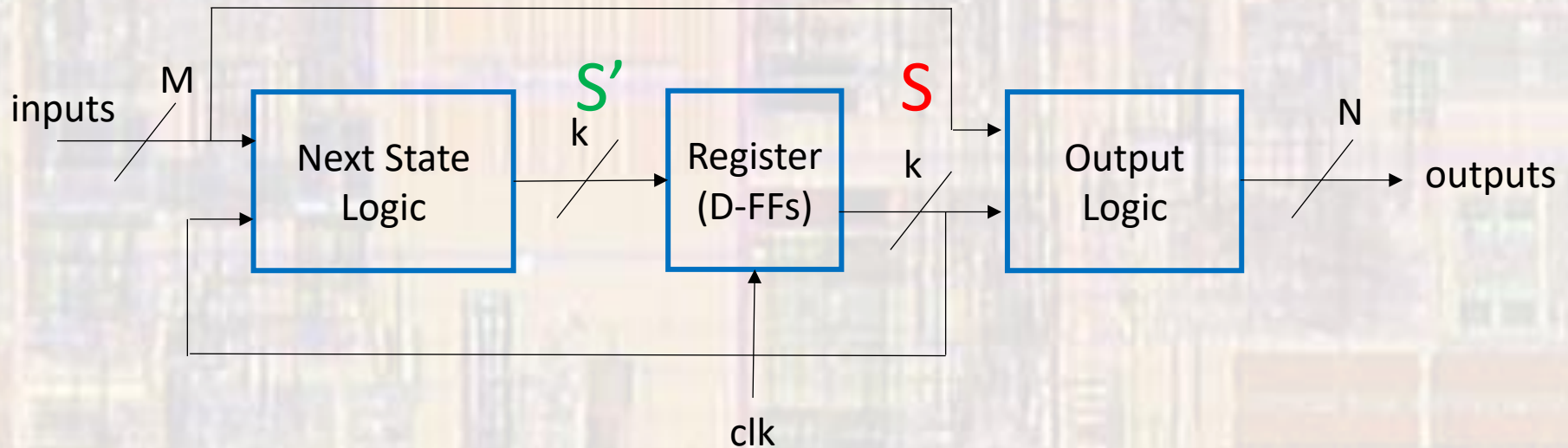
- Moore Machine

- Changes in the input cause S' to change
- When S' changes then the 'next state' S will be different than the current state S



State Machine Intro

- Finite State Machine
 - Mealy Machine
 - Outputs depend on the current state(S) and the inputs



State Machine Intro

- Finite State Machine

- Mealy Machine

- Changes in the input cause S' to change
- When S' changes then the 'next state' S will be different than the current state S

