

# Registers

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## 1 Administrivia

### Announcements

### Assignment

Read 7-6, 7-9.

### From Last Time

VHDL for sequential circuits.

### Outline

1. Definitions.
2. Parallel registers.
3. VHDL for registers.

### Coming Up

Shift registers.

## 2 Definitions

1. Register: A set of flip-flops which have common clock and control signals and load related bits — a whole word, data on a bus.

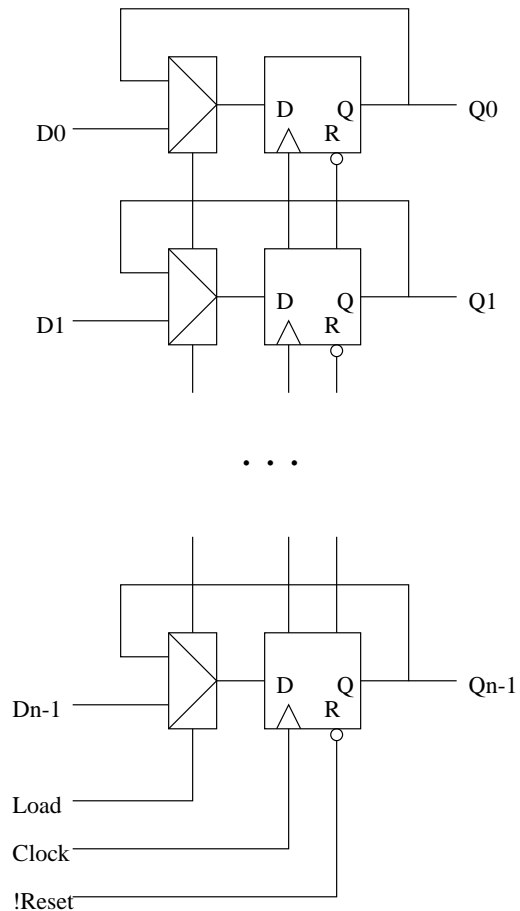
Examples: register file, MDR, MAR.

2. Counter: A register which passes through a pre-determined set of states. Usually they count by one from 0 to  $n - 1$ .

Example: program counter.

## 3 Parallel Registers

Use a mux approach:



Gating the clock will save the muxes, but clock gating is usually a bad idea — clock skew problems.

1. Really bad: `clockToFF = load and clock`
2. Just as bad: `clockToFF = !load or clock`

Show waveforms and show what skew looks like and why we care.

## 4 VHDL for Registers

Note: The handling of the load signal could be used to implement a synchronous reset.

```
-- VHDL for 32 bit parallel load register with asynchronous low
-- reset.

library ieee;
use ieee.std_logic_1164.all;

entity parallel_register is

    port (
        clock, load, reset_n : in  std_logic;
        d                     : in  std_logic_vector (31 downto 0);
        q                     : out std_logic_vector (31 downto 0));

end parallel_register;

architecture dataflow of parallel_register is

    signal state : std_logic_vector (31 downto 0);

begin -- dataflow

    q <= state; -- Output process.

    state_reg : process (clock, reset_n)
    begin -- process state
        if (reset_n = '0') then -- asynchronous reset (active low)
```

```
    state <= X"00000000";
elseif (clock'event and clock = '1') then -- rising clock edge
    if (load = '1') then
        state <= d;
    else
        state <= state;
    end if;
end if;
end process state_reg;

end dataflow;
```