How would you design a register (D-flipflop) using logic gates?

![D-flipflop circuit diagram](image)

How would you design a series of registers to a 4-bit memory?

![Series of D-flipflops and 4-bit memory diagram](image)

Where do you use the register (on-chip or off-chip)? What is its speed for storing or retrieving data (how many clock cycle)?

1. Register will be used on-chip.
2. Only one clock cycle needed for storing or retrieving data.
How would you design a Static RAM (SRAM) using transistors?

How would you construct a series (16-word x 4-bit) of SRAM in an organisation?

Where do you use SRAM (on-chip or off-chip)? What is its speed for storing or retrieving data? What is the usual size of a SRAM?

1. On-chip as cache
2. As quick as approaching the CPU clock speed
3. From 64 KB to 2 MB
How would you design a Dynamic RAM (DRAM) using transistor and capacitor?

Can you show a Dynamic RAM schematic with 4 by 4 row and column address selection?
Where do you use the DRAM (on-chip or off-chip)? What is its speed for storing or retrieving data? What is the usual size of a DRAM?

1. DRAM will be arranged as Off-chip memory.
2. The frequency can be updated to 100MHz.
3. The size can be going up to 10GB.
How would you design a ROM with 3 inputs (a, b, c) and 3 outputs (f, g, h) using inverter, AND gates and OR gates?

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Where do you use the ROM (on-chip or off-chip)? What is its speed for storing or retrieving data? What is the usual size of a ROM?

1. Off-chip
2. It will take a long way, as to go through the SRAM and DRAM. More than 20 cycle to do an access would be normal.
3. ROM can be large, as much as go up to 256 GB per chip.
Can you draw the design of a Flash memory? (it is similar to a design of a transistor)

Is Flash memory similar a ROM or a RAM? And how fast (speed) does it retrieve or store data? Comparing to a normal ROM, what are the advantages of using a Flash memory?

1. Flash memory is similar to the RAM, apart from the fact that Flash can store the data when the machine is switch off.
2. Slow, as slow as ROM
3. Flash memory is more flexible and values stored can be modified easily.