Hints:

① Look @ .out and .cmp files!

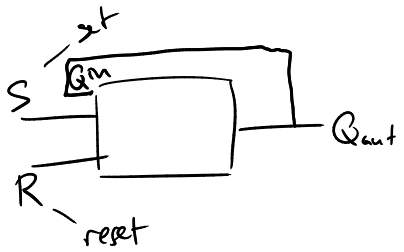
② You can send the same output multiple places!

eg

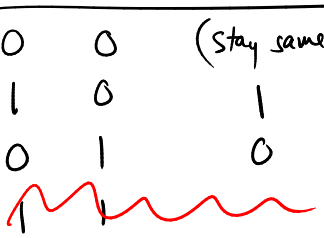
Mux16(.... , out = out, out = q, out[15] = ...)

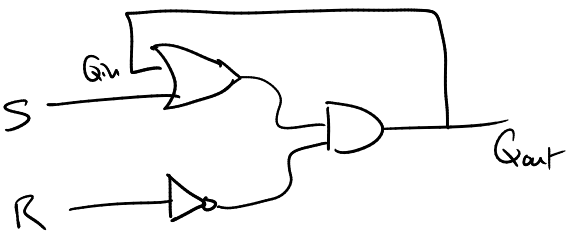
Memory.

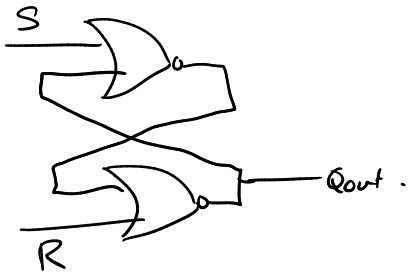
S-R latch.



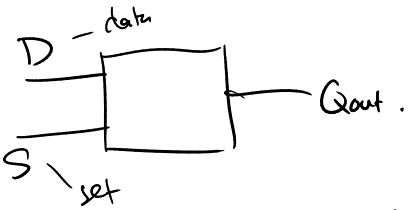
S	R	Qout
0	0	(stay same)
1	0	1
0	1	0



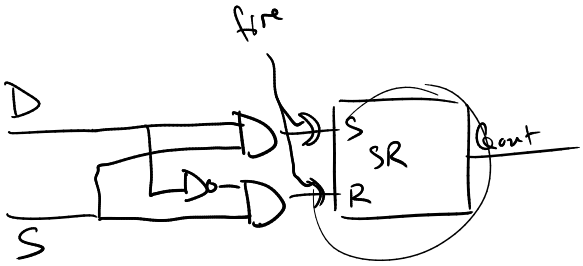




D latch (data latch)

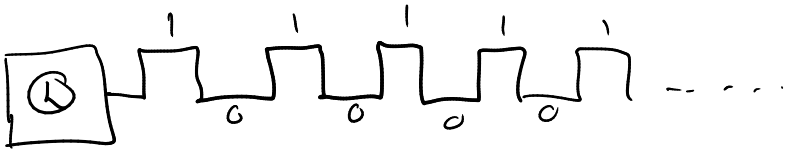


D	S	Qout
?	0	stay same
?	1	D

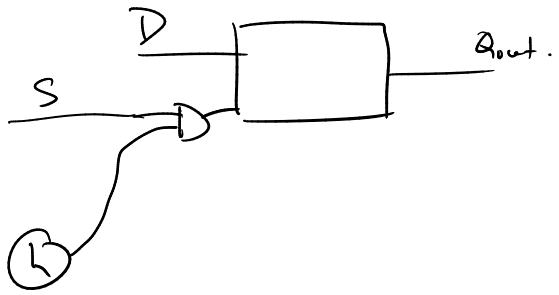


Problem: timing / synchronization!

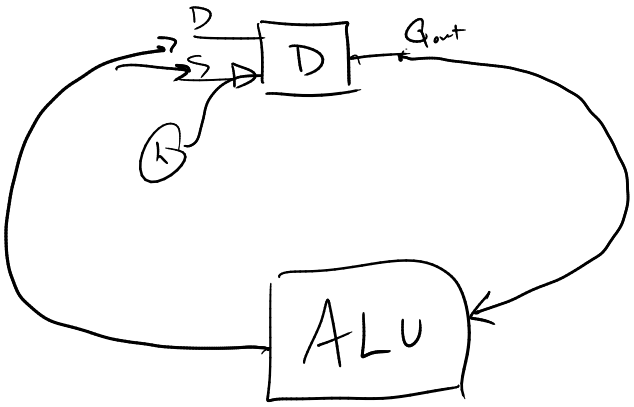
Solution: clock.



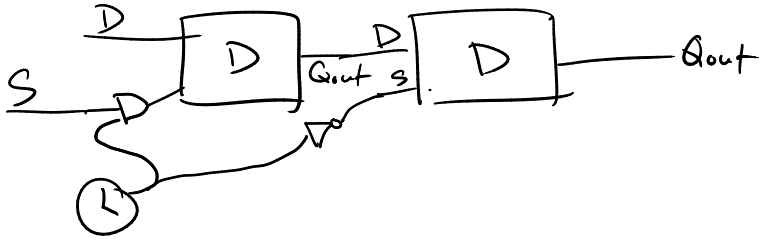
Clocked D-latch:



Better - updates when clock goes 0 → 1.



D flip-flop



RAM = Random Access Memory

└ can access any part equally fast.

Every location has an address which is an integer.

Hack computer: 15-bit addresses. → 2^{15} memory locations.

Each location stores 1 word = 16 bits.

→ $2^{15} \cdot 2^4 = 2^{19}$ bits.

1 byte = 8 bits. → 2^{19} bits = 2^{16} bytes.

1 KB (technically, "kibibyte" (KiB)) = $1024 = 2^{10}$ bytes.

So 2^{16} bytes = 2^6 KB = 64 kB. — ½ for screen, ½ for memory.

32-bit addresses = ____ memory?

2^{32} bytes = 2^{22} kB = 2^{12} MB = 2^2 = 4GB.

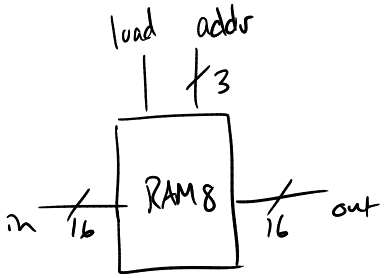
64-bit addresses?

2^{64} bytes = 2^{54} kB = 2^{44} MB = 2^{34} GB = 2^{24} TB = 2^{14} PB

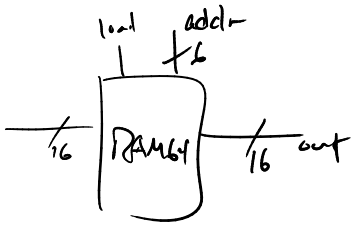
= 2^4 EB

Project 3

- Bit = DFF
- Register = 16 bits.
- RAM — build by stages.
  - RAM8 — 8 registers.



  - RAM64 — 8 RAM8.



  etc.

- PC (program counter).