# Topics for today:

Memory A final note on integrated circuits

### **Registers**

A *register* is a circuit which stores multiple bits of information.

It can be implemented as a set of parallel flip-flops with a common clock line.







## <u>RAM</u>

- "Random access memory"
- Misleading name
  - "Read/Write memory" would be more accurate
- Volatile
- Many alternative technologies

#### <u>ROM</u>

- "Read only memory"
- Data inserted at manufacture
- Improvements
  - PROM
  - EPROM
  - EEPROM
  - Flash memory

#### A comparison of various memory types.

-		-	Byte		
Type	Category	Erasure	alterable	volatile	Typical use
SRAM	Read/write	Electrical	Yes	Yes	Level 2 cache
DRAM	Read/write	Electrical	Yes	Yes	Main memory (old)
SDRAM	Read/write	Electrical	Yes	Yes	Main memory (new)
ROM	Read-only	Not possible	No	No	Large-volume appliances
PROM	Read-only	Not possible	No	No	Small-volume equipment
EPROM	Read-mostly	UV light	No	No	Device prototyping
EEPROM	Read-mostly	Electrical	Yes	No	Device prototyping
Flash	Read/write	Electrical	No	No	Film for digital camera

### Integrated circuits

The digital circuits we have studied can be created by wiring together individual gates (as in lab), or built as one solid device, called an *integrated circuit* (also called an "IC", or simply a "chip").

Integrated circuits can be roughly classified by their sizes.

#### **Integrated circuits**

- SSI Small-scale integration ~ 10 gates per chip
- MSI Medium-scale integration ~ 100 gates per chip
- LSI Large-scale integration ~ 10,000 gates per chip
- VLSI Very large-scale integration ~ 100,000 gates per chip