Sequential Circuits

- Memory
- Time, clocks
- Sequential circuits

1) Memory

http://en.wikipedia.org/wiki/Flip-flop_%28electronics%29

![SR latch operation table]

- **SR latch operation**

<table>
<thead>
<tr>
<th>S</th>
<th>R</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Keep state</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>Q = 0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>Q = 1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Restricted combination</td>
</tr>
</tbody>
</table>

![The symbol for an SR latch]

Computer memories

Organization & addressing

Types

volatile / non-volatile

- SRAM (static RAM)
- DRAM (dynamic RAM)
- FLASH/EEPROM (non-volatile memory)
- (disk drive, DVD, ...)

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Memory organization:

SRAM cell:

EEPROM programming / erase:

2) Sequential Circuits
a) Clocks, latches
b) Finite state machines

Synchronous Sequential Circuit

Issues: Specification, design, clocking and timing

Coke Machine Example

- Coke costs $0.10
- Only nickels and dimes accepted
- FSM inputs:
  - 5: Nickel
  - 10: Dime
  - Coke: Give me a coke
  - Return: Give me my money back
- FSM outputs:
  - Drop: Drop a coke
  - Ret5: Return $0.05
  - Ret10: Return $0.10