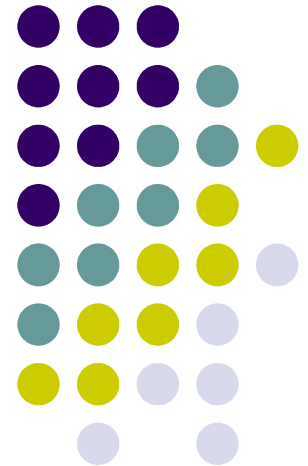
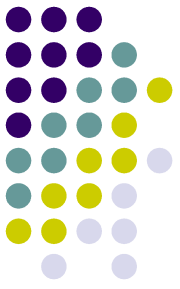


Layout and Memory

- ✓ Stick Diagram
- ✓ Type of memory



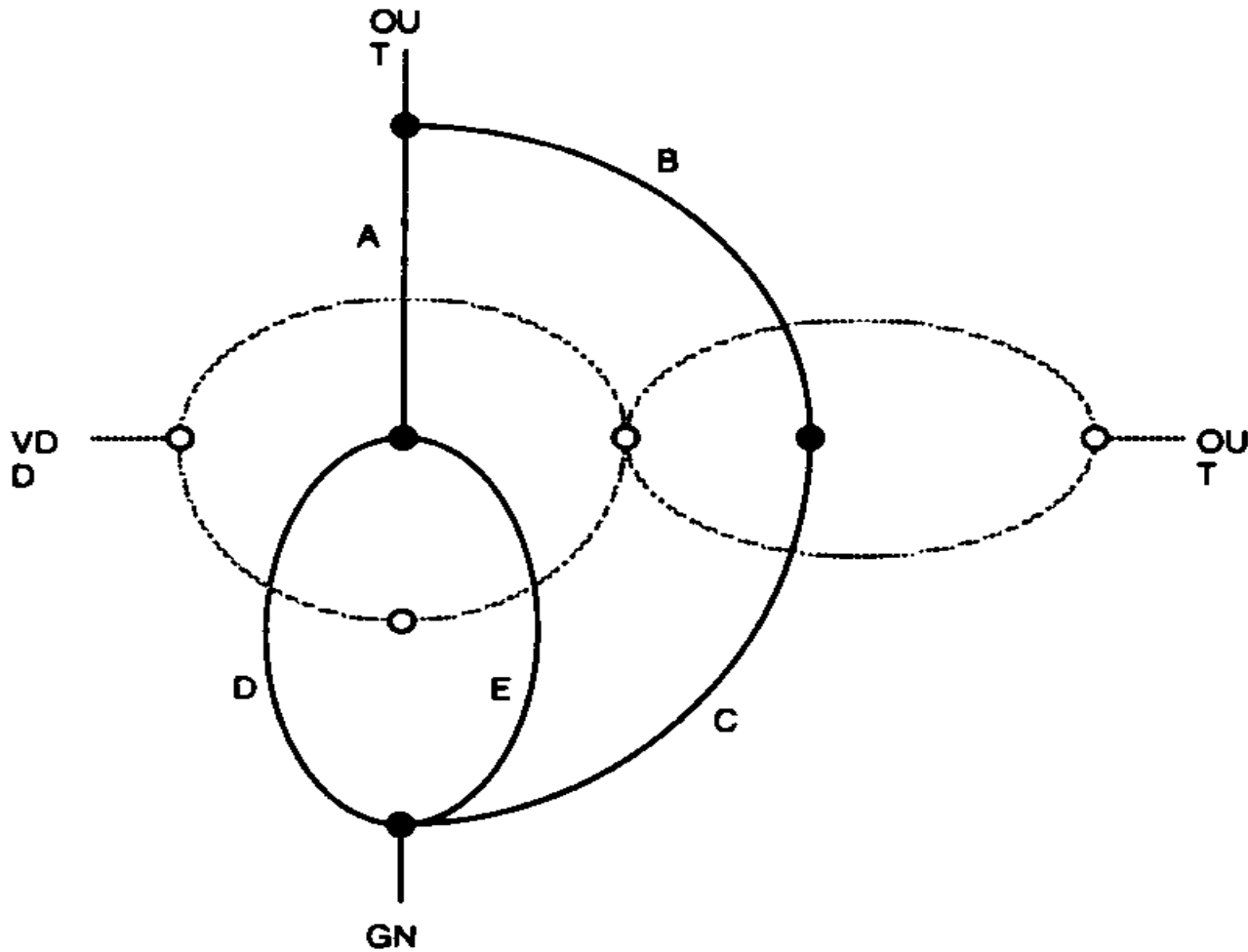
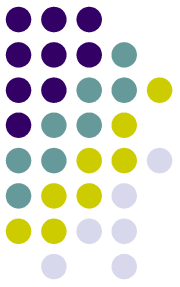


IC Layout

- The physical (mask layout) design of CMOS logic gates is an iterative process.
- If the logic gate contains more than 4-6 transistors, the topological graph representation and the Euler-path method allow the designer to determine the optimum ordering of the transistors.
- A simple stick diagram layout can now be drawn, showing the locations of the transistors, the local interconnections between the transistors and the locations of the contacts.

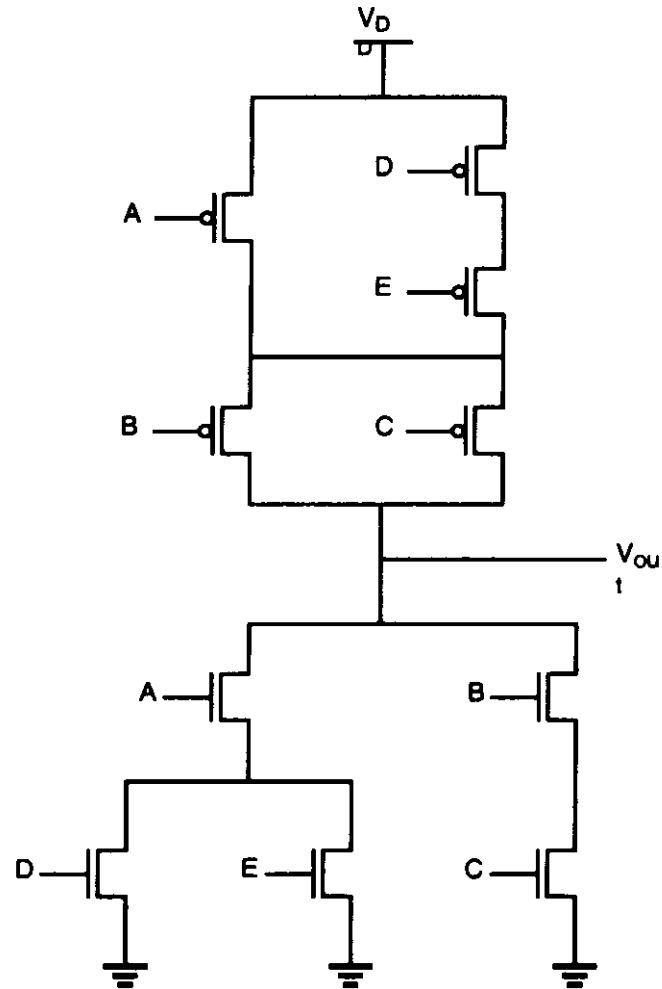
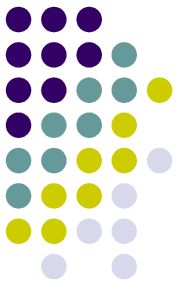
Pull-up Graph

3



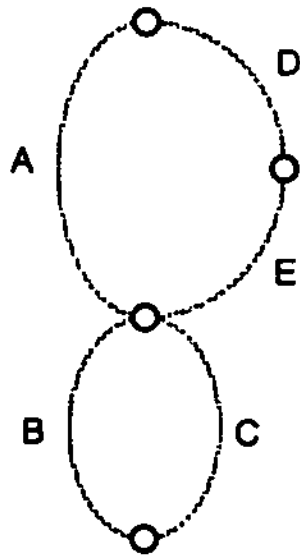
CMOS Logic

4

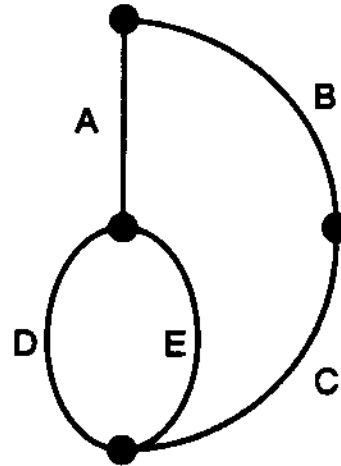




CMOS Logic



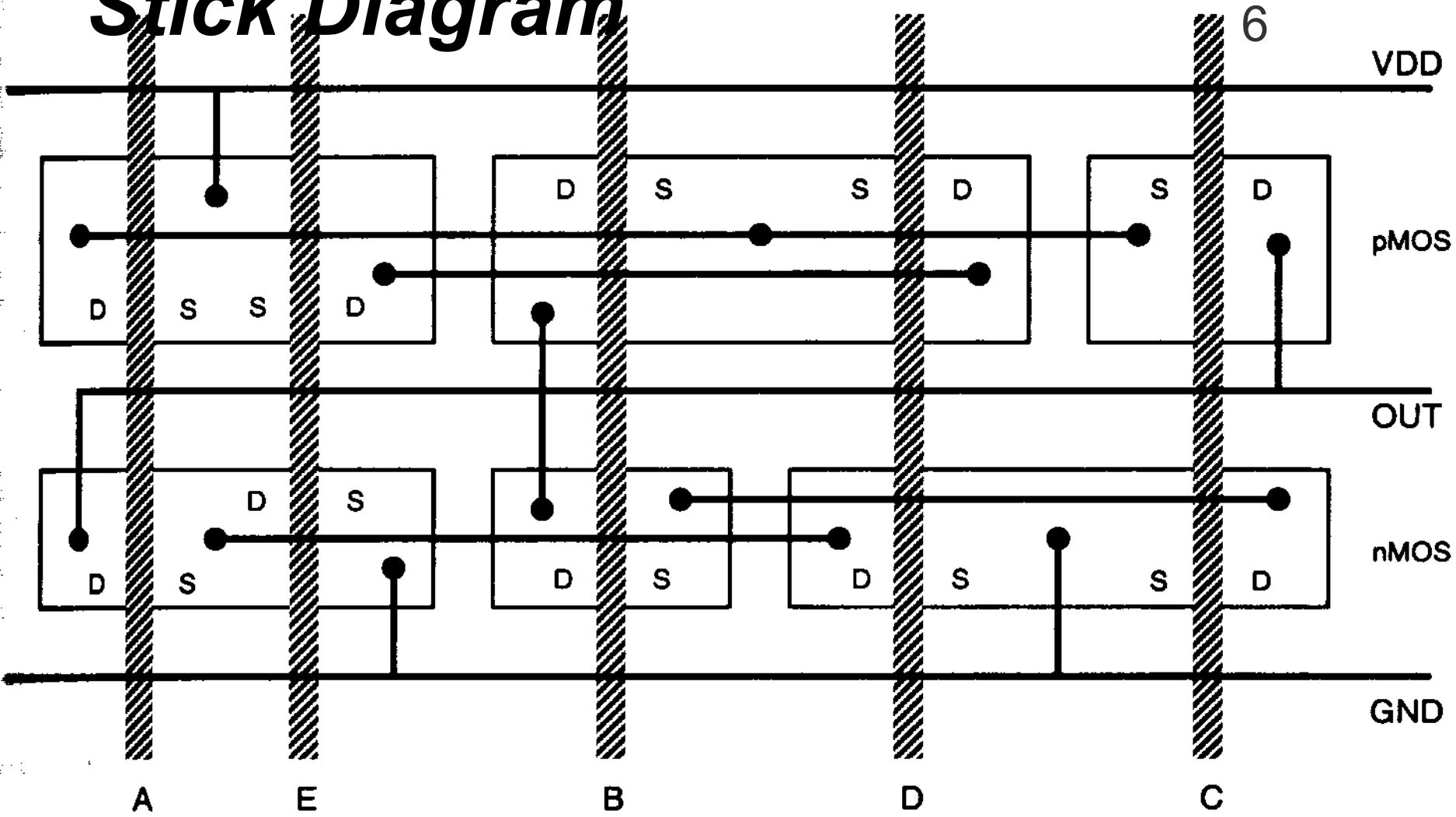
pMOS network graph

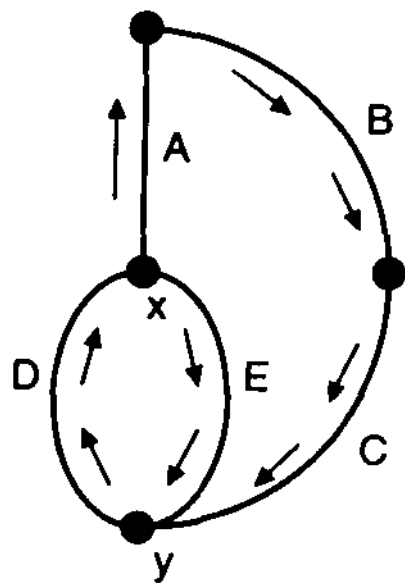


nMOS network



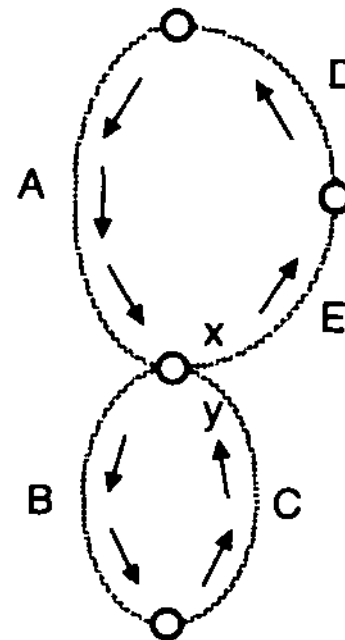
Stick Diagram





nMOS network

Common Euler path
:
E - D - A - B - C

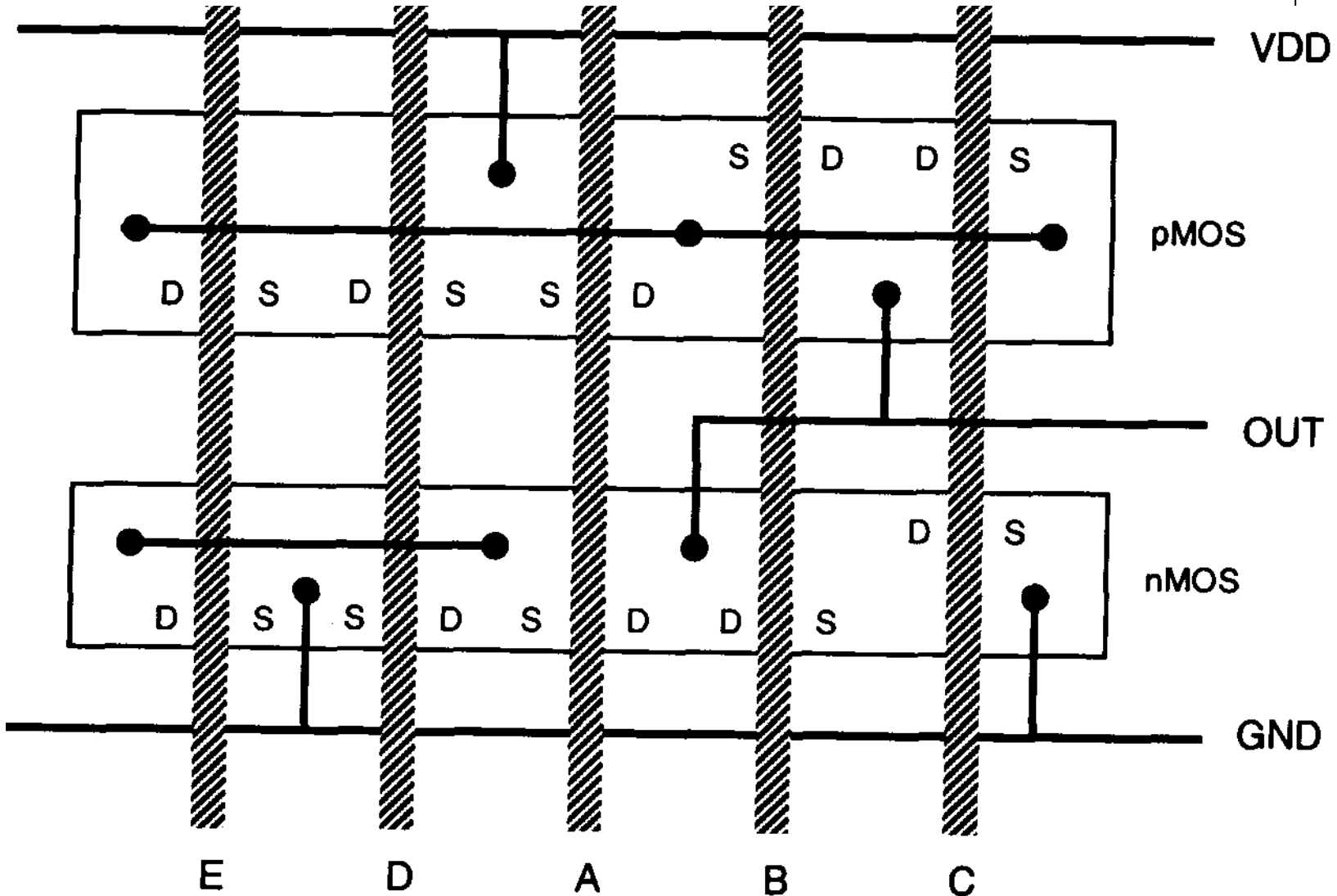


pMOS network

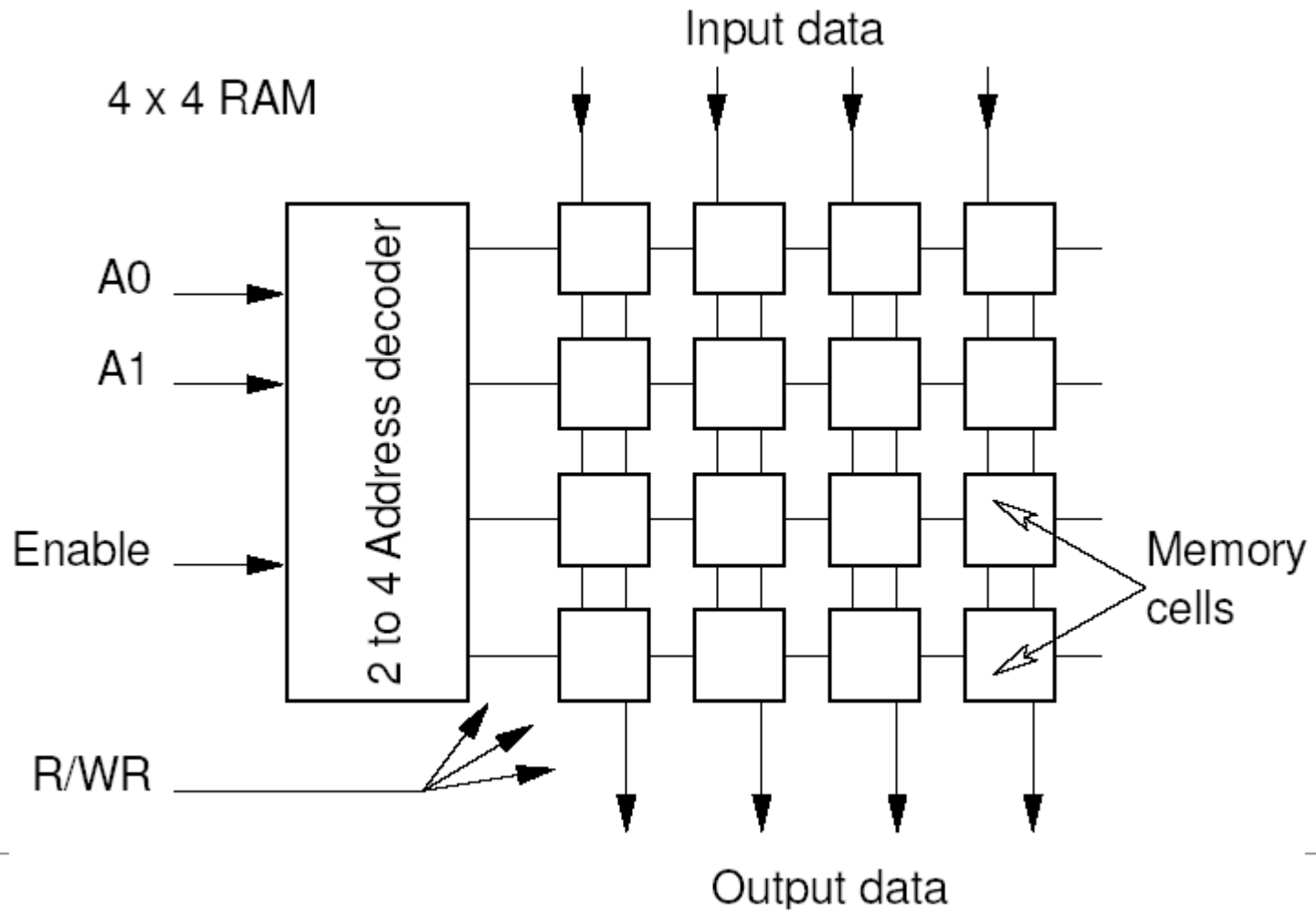
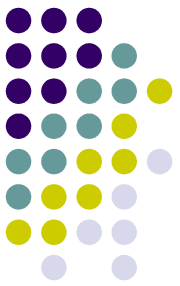
- The Euler path is defined as an uninterrupted path that traverses each edge (branch) of the graph exactly once

Optimized Stick Diagram

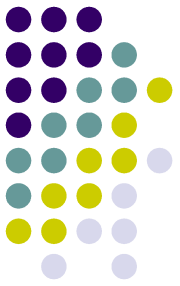
8



RAMs



RAMs



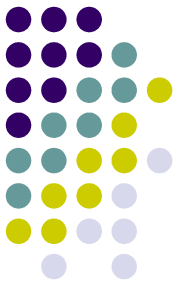
- Static RAM is faster and holds data as long as power supply is attached.
- Dynamic RAM provides a higher integration level.

RAMs



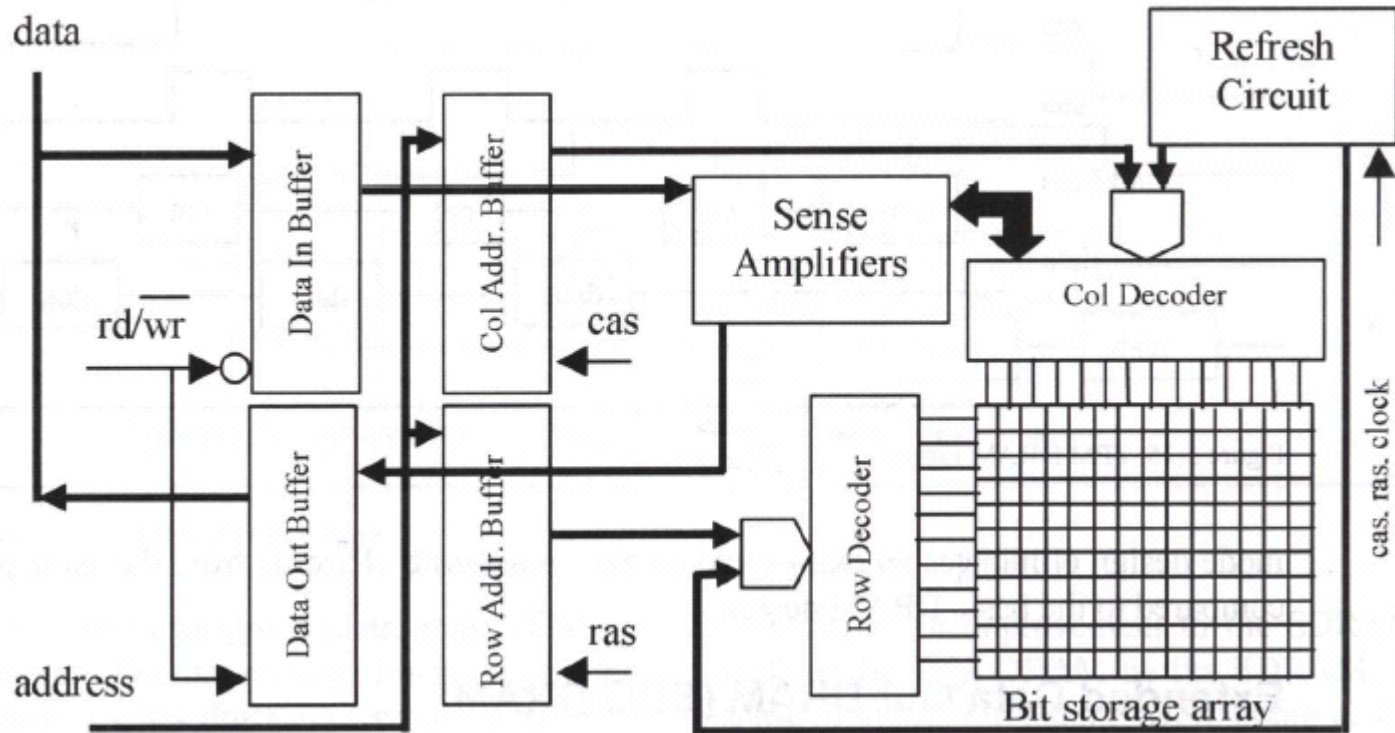
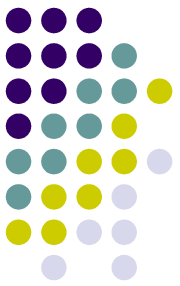
- **Static RAM (SRAM);**
 - fast;
 - low capacity;
 - simple interface (no additional circuits supporting prolonged holding of data).
- **Dynamic RAM (DRAM) - detailed description follows;**
 - very high capacity;
 - needs constant refreshing of data (each 10-20ms);
 - complicated interface;
 - row and column address select signals; once a row is selected, it gets “refreshed”.

RAMs

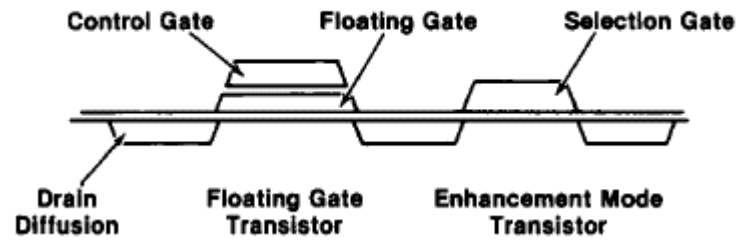
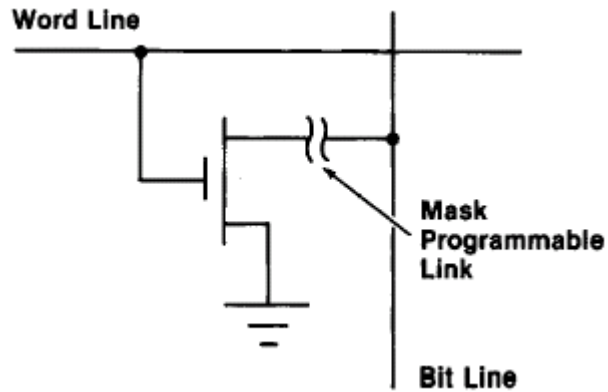
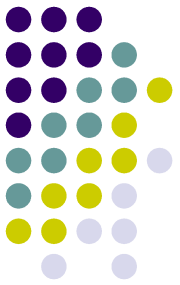


- **Nonvolatile RAM (NVRAM);**
 - battery-backed;
 - very fast (as SRAM);
 - no limit on the number of cell rewritings;
 - no special programming needed;

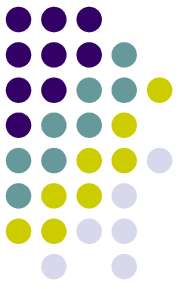
DRAM



ROMs



ROMs



- Mask programmable ROM
 - Pre-programmed at fabrication
- One-time programmable ROM
 - Fuses blown during programming
- Erasable programmable ROM (EPROM)
 - use MOS transistors with floating gate.
 - Programming ~ electrons are injected into the floating gate; this keeps the transistor constantly open.
 - Erasing ~ electrons escape the gate when the potential barrier is lowered by means of UV radiation; this forces the transistor to stay closed.