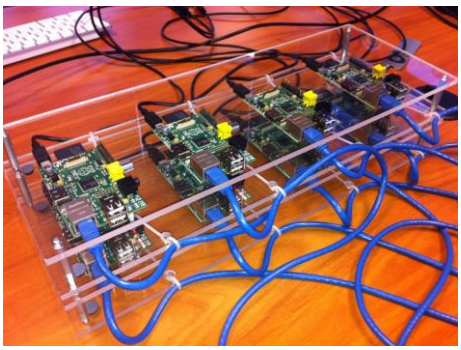
Topic for today:

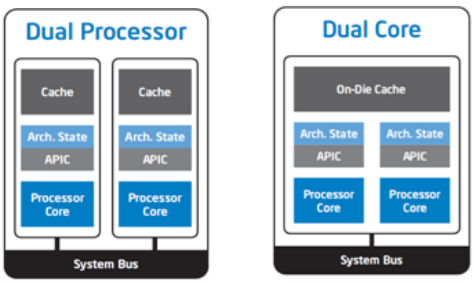
Alternative architectures

Recall: Von Neumann model of computing

- A program is stored in memory (along with data)
- There is a single processor to do basic operations



Multiple Processor vs. Multicore



Flynn's Taxonomy

I = Instruction stream

D = Data stream

S = Single

M = Multiple

Flynn's Taxonomy – so:

SISD = Single instruction, single data

SIMD = Single instruction, multiple data

MIMD = Multiple instruction, multiple data

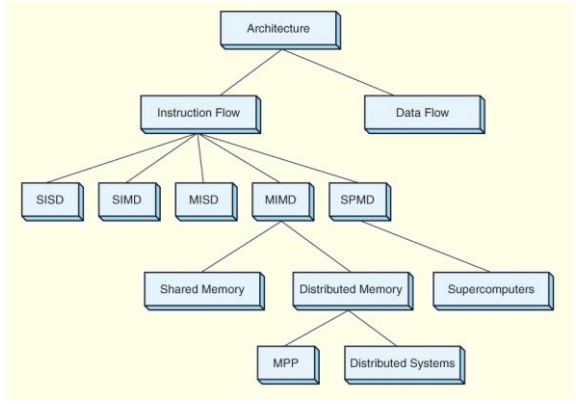
[MISD = Multiple instruction, single data]

How are SIMD and MIMD similar? How are they different?

MIMD Architectures

- Symmetric multiprocessors (SMP) - fewer processors + shared memory + communication via memory
- Massively parallel processors (MPP) - many processors + distributed memory + communication via network
- A **network of workstations** (NOW) uses otherwise idle systems to solve a problem.
- A **collection of workstations** (COW) is a NOW where one workstation coordinates the actions of the others.
- A **dedicated cluster parallel computer** (DCPC) is a group of workstations brought together to solve a specific problem.
- A **pile of PCs** (POPC) is a cluster of (usually) heterogeneous systems that form a dedicated parallel system.

Why are distributed systems desirable?



Vector Processors

- SIMD
- One instruction is processed on multiple sets of data
- Applications: image processing, numerical solutions of partial differential equations, weather prediction

Parallel MIMD networks

- Each processor carries out its own instructions on its own data
- Issues:
  - Synchronization
  - Communication between processors: requires a choice of *topology*

Superscalar design

- Uses parallel processors in SISD
- Similar to pipelining – speed up the fetch/decode execute
- Fetch several instructions at once – see if they can be executed simultaneously
- *Decoding unit* check if simultaneous execution is possible, and distributes instructions
- Requires smart compilers

Describe write-through and write-back cache modification as they are used in shared memory systems, and the advantages and disadvantages of both approaches.