Flynn’s Taxonomy

Prof. Mike Flynn’s famous taxonomy of parallel computers
Computer Instruction Cycle
**FETCH CYCLE**

1. Fetch Instruction

2. Decode Instruction

**EXECUTION CYCLE**

3. Get Data

4. Execute Instruction

Main Memory
Flynn’s Taxonomy

Proposed by Prof. Mike Flynn in 1966

how many instructions vs how much data

can be processed simultaneously
SISD

Instruction Pool

Data Pool

Single Instruction
Single Data

PU
Von-Neumann Architecture
SIMD

Instruction Pool

Data Pool

PU

PU

PU

PU

Single Instruction
MULTIPLE Data

Same processing instruction runs on all processors

Data level parallelism
NOT Concurrency

Applications:
* Image editing
* Multimedia processing
Arm NEON technology is an advanced SIMD (single instruction multiple data) architecture extension for the Arm Cortex-A series.
MULTIPLE Instruction
SINGLE Data

DIFFERENT processing instructions run on
SAME data

Pipelining!!!
No real example in real life

Applications:
* convolution
* matrix operations
* data sorting
MULTIPLE Instruction Pool

MULTIPLE Instruction
MULTIPLE Data

DIFFERENT processing instructions can run on DIFFERENT data

Processing: async, independent
Memory: shared or distributed
Applications:
* Simulation
* Emulation (VM)
* CAD/CAM
* Modeling
More MIMD

**SPMD**
- Same *program* multiple data
- Program executed at independent execution points
- Most common style of parallel programming

**MPMD**
- Multiple *program* multiple data
- At least 2 programs
- One program is master/controller
- Others ‘nodes’ receive program from master
SPMD

Single Program Multiple Data (SPMD)

SPMD program

Input data

Instances 0, 1, 2, 3, 4

OpenHPI | Parallel Programming Concepts | Dr. Peter Tröger
Playstation 3 – Cell Processor (MPMD)
Pop Quiz!

What architecture is this???

AMD GPU Hardware Architecture

- AMD 5870 – Cypress
- 20 SIMD engines
- 16 SIMD units per core
- 5 multiply-adds per functional unit (VLIW processing)
- 2.72 Teraflops Single Precision
- 544 Gigaflops Double Precision

Source: Introductory OpenCL SAAHPC2010, Benedict R. Gaster
Flynn’s Taxonomy

• quite difficult to fit parallel architectures
  – Ancient – 1966!!!
  – Where do these fit??? << UNCLEAR
    • instruction level parallel
    • fine-grain speculative multithreading

• Most important distinction is between SIMD and MIMD