

COL380 Introduction to Parallel and Distributed Programming

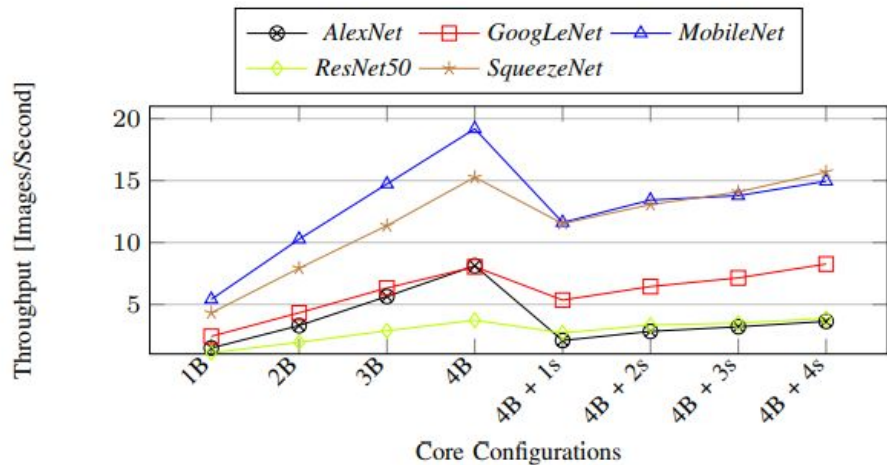
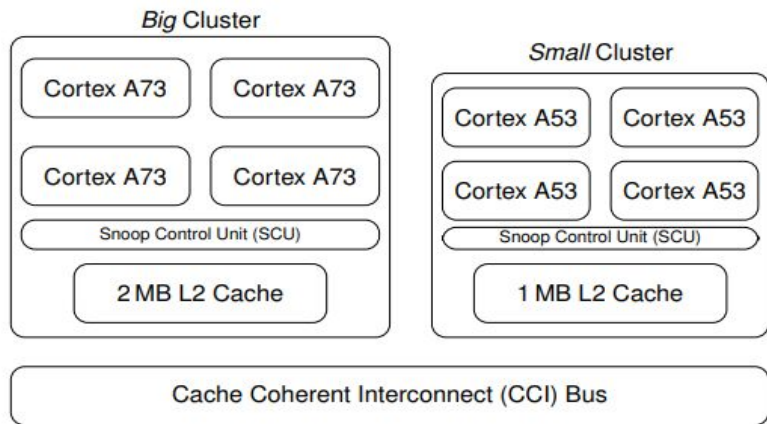
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www.cse.iitd.ac.in/~riju/teaching.html

Parallel systems, parallel programming, parallel computing: why?

- Performance is important
 - Scientific computing
 - Data mining
 - AI/ML model training
 - IoT and embedded devices
- Hardware trends
 - Single core performance saturation
 - Multi-core, distributed systems

More hardware does not automatically mean more performance



Performance depends on code

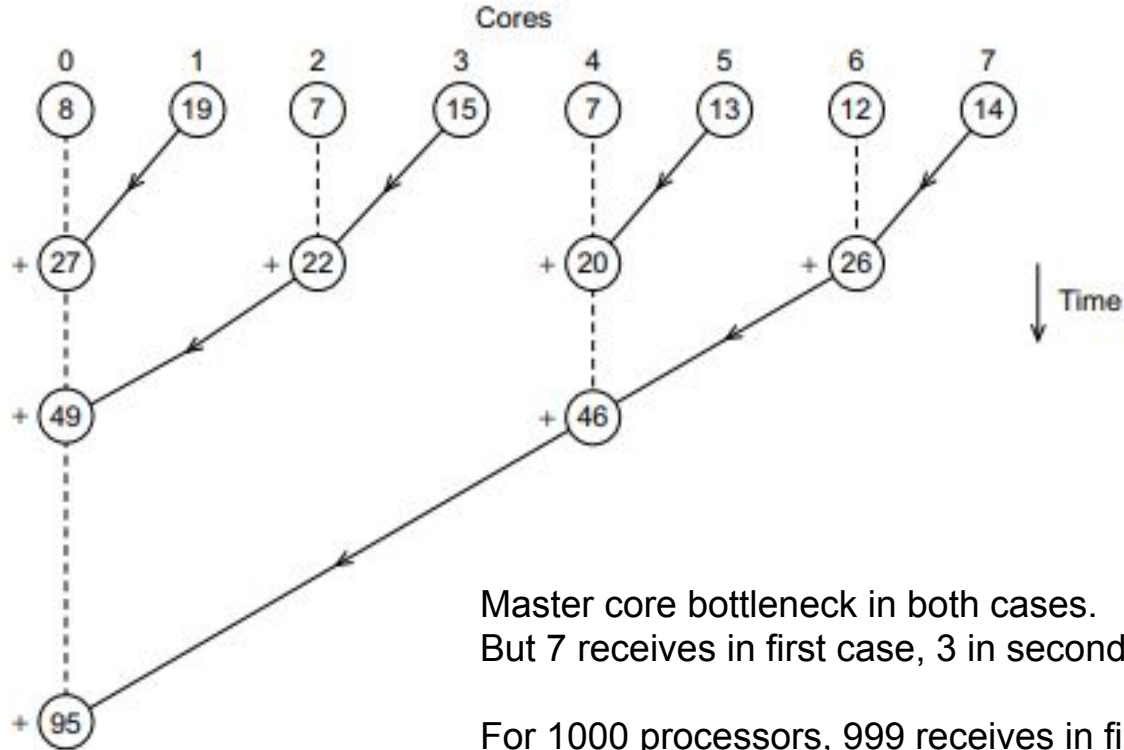
```
sum = 0;
for (i = 0; i < n; i++) {
    x = Compute_next_value(. . .);
    sum += x;
}
```

```
my.sum = 0;
my.first_i = . . . ;
my.last_i = . . . ;
for (my_i = my.first_i; my_i < my.last_i; my_i++) {
    my_x = Compute_next_value(. . .);
    my_sum += my_x;
}
```

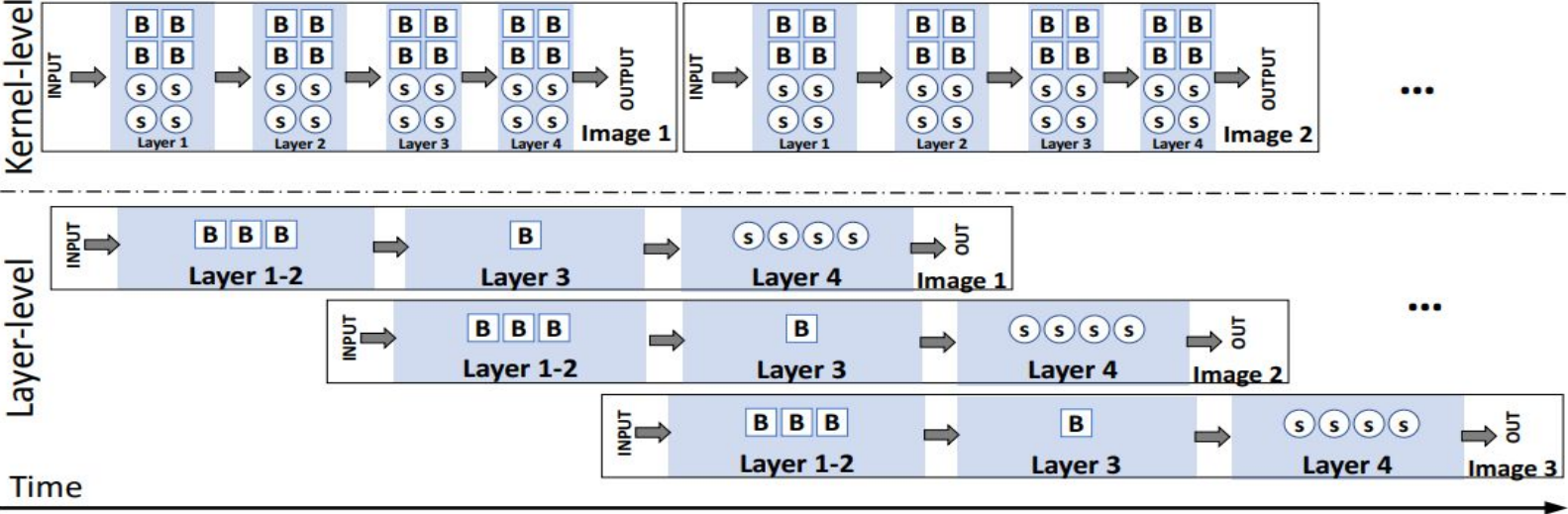
```
if (I'm the master core) {
    sum = my_x;
    for each core other than myself {
        receive value from core;
        sum += value;
    }
}
```

Core	0	1	2	3	4	5	6	7
my_sum	8	19	7	15	7	13	12	14

Performance depends on code



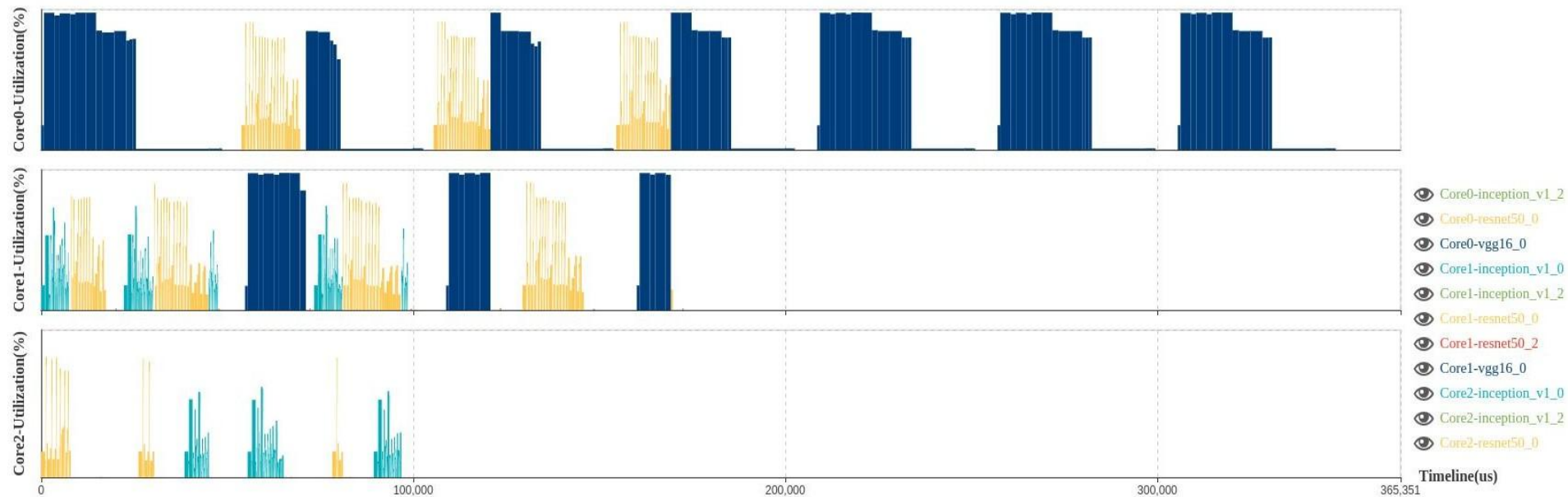
Performance depends on “code mapping to hardware”



Performance depends on “code mapping to hardware”

DeePhi DSight

DPU Utilization: Core0: 44.7% Core1: 51.9% Core2: 25.3%
Schedule Efficiency: Core0: 90.9% Core1: 34.0% Core2: 11.0%



Some closely related terms

Software Component	Details
Sensing	PM (0.5 Hz), GPS (0.5 Hz), BME (0.5 Hz) Image (0.5 Hz) and IMU (50 Hz)
Processing	Mobilenet-SSD/ Tiny-YOLO for image processing SVM/ LSTM-RNN for IMU data processing
Storage	write data and inferences to SD card
Communication	read from SD card and communicate to cloud, if cellular signal is good

Concurrent Systems

Aerogram's concurrent processes (Python)/threads (Java and C++)
1. Read PM on UART, GPS on UART, BME on I2C, write to SD card
2. Read image from camera, run DNN, write to SD card
3. Read IMU on I2C, run SVM/LSTM-RNN, write to SD card
4. Read data and inferences from SD card, communicate to backend server

Parallel Systems

Distributed Systems