Types of Parallel Work: Data and Task Parallelism

Module 2.1

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Module Learning Objectives

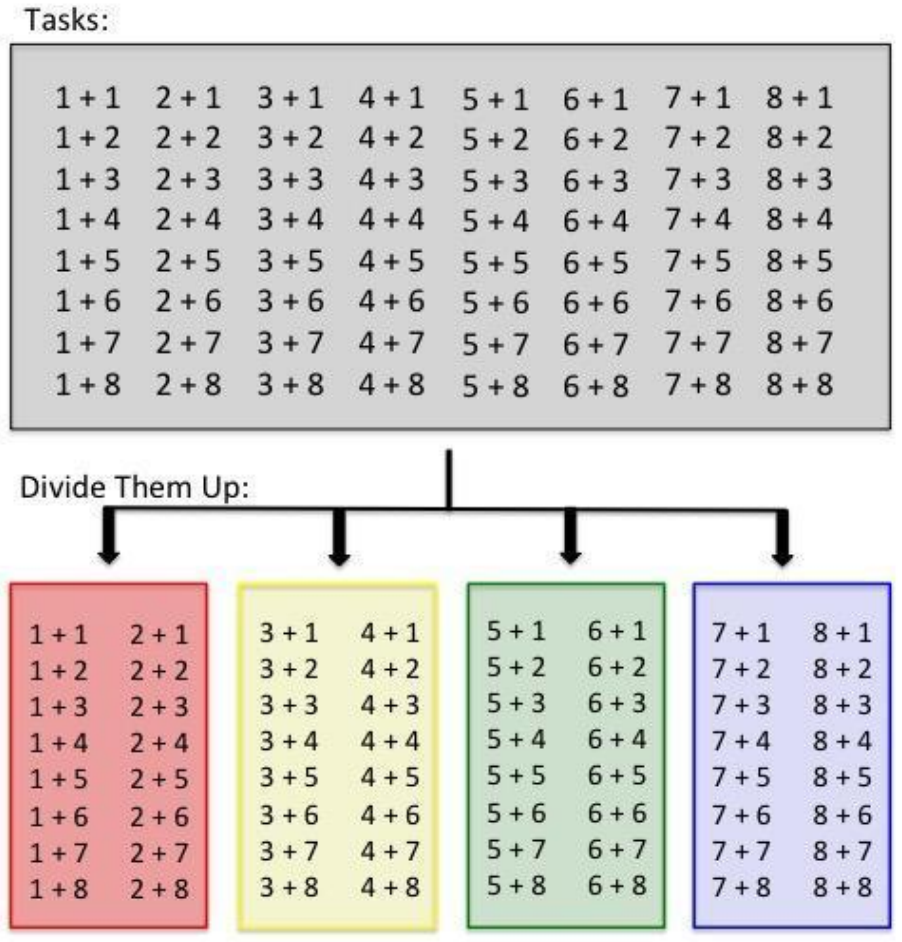
- Define data parallelism and describe an example of data parallelism.
- Define task parallelism and describe an example of task parallelism.
- Justify data parallelism aspects of a given problem.
- Justify task parallelism aspects of a given problem.

Data Parallelism

- Data Parallelism
  - Each processing element performs the same (or nearly same) computation on a small piece of the larger problem.
  - Problem is broken down into smaller chunks and each processing element performs the same task on one chunk of the larger problem.

Data Parallelism □

Building an addition table for 0-9:
(Adding a bunch of numbers together.)

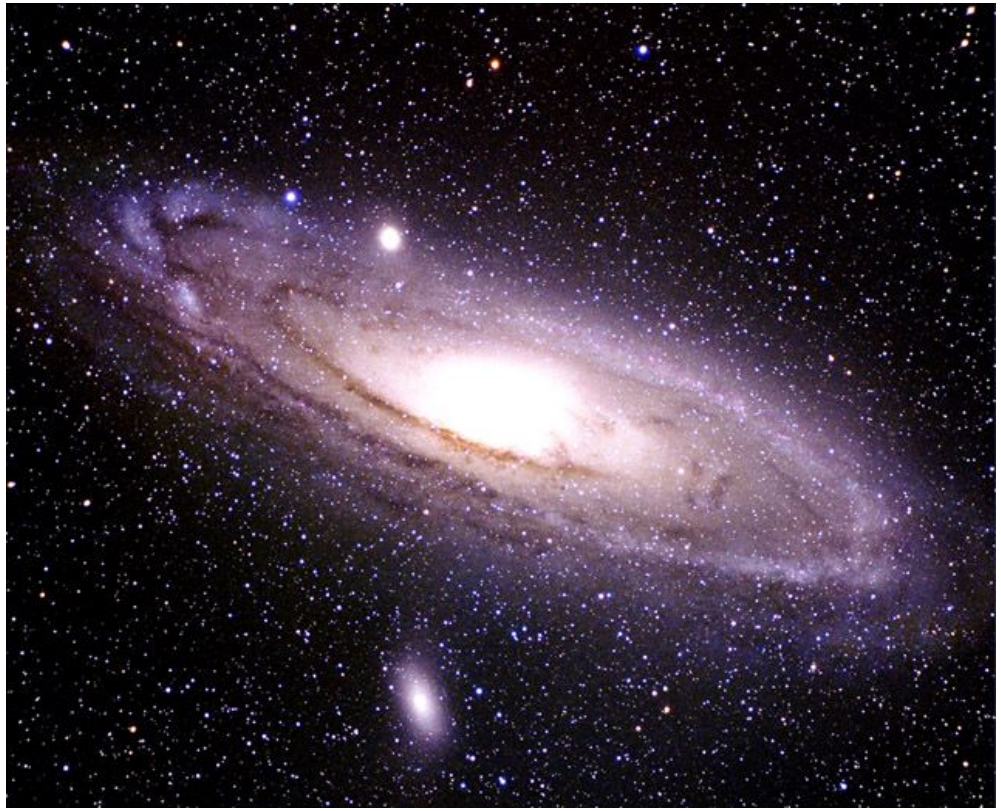


Task Parallelism

- Task Parallelism
  - Each processing element performs one task in solving the larger problem.
  - Each task handles all of the problem data set
  - Assembly line type process

Example 1 – Data or task parallel? Why?

- Simulating Galaxy Formations
  - *n*-Body Problem
  - Many particles moving in 3D
  - Particles exert force of all other particles
    - Each particle changes velocity and acceleration due to these forces
  - Need to know position of each particle at each point in time

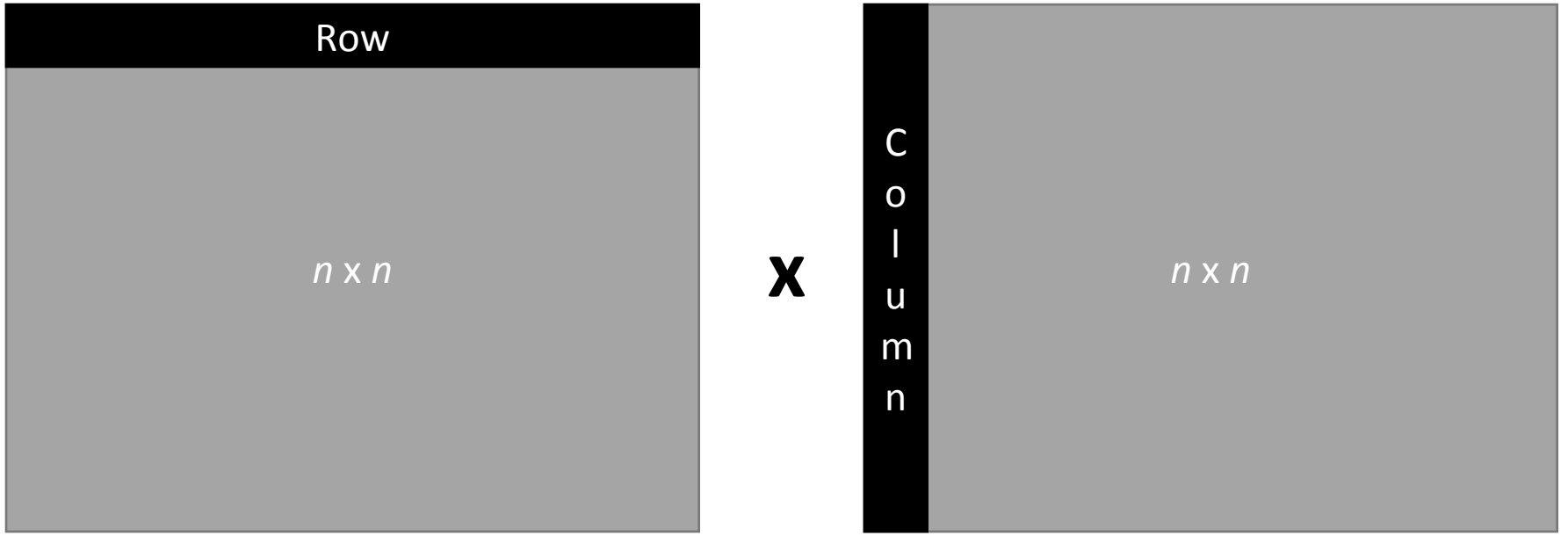


Example 2 - Data or task parallel? Why?

- Need to build 50 computers for a lab
- IT has a team of 5

Example 3 - Data or task parallel? Why?

- Matrix multiplication
- Multiply 2 *n* x *n* matrices



Summary

- Define data parallelism and describe an example of data parallelism.
  - Different data, same operations on many processing elements
- Define task parallelism and describe an example of task parallelism.
  - Different tasks processing all of the data set.
  - Think of an assembly line.
- Justify data parallelism aspects of a given problem.
- Justify task parallelism aspects of a given problem.
- **Problems may have both data and task parallelism.**