RC Quick Byte: Maximizing Efficiency Using Parallelization

Research Computing
UNIVERSITY OF COLORADO BOULDER

Maximizing Efficiency Using Parallelization

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- Website: www.rc.colorado.edu/rc
- Documentation: https://curc.readthedocs.io
- Helpdesk: rc-help@colorado.edu
- Survey: http://tinyurl.com/curc-survey18

Slides

https://github.com/ResearchComputing/max_efficiency_parallel_quick_byte

Learning Objectives and Outline

- What is parallelization?
- Types of parallelization
- Is parallelization for me?

What is parallelization?

Serial

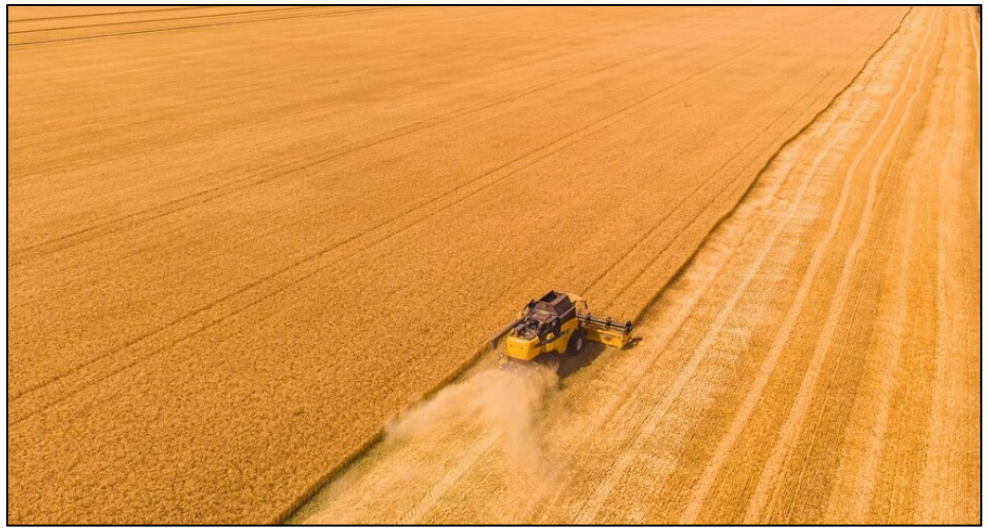


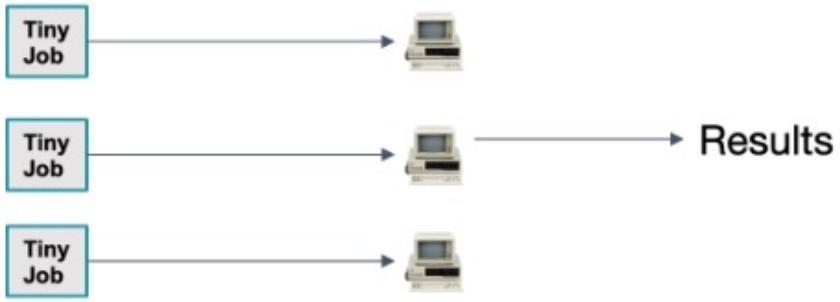
Image source: https://www.freepic.com

Parallel

Image source: https://bxjmag.com

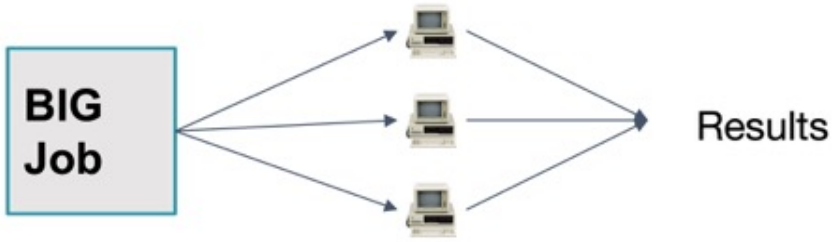
Types of parallelization

Code-**external** parallelization



Example: Image processing

Code-**internal** parallelization



Example: Climate Model

Code-external parallelization

- Also referred to as:
  - HTC: High throughput computing
  - "Embarrassingly" parallel computing
- Used for repetitive, independent tasks
  - Processing images from satellites, microscopes
  - Monte Carlo-type statistical modeling
- CURC has lots of tools to facilitate HTC!
  - https://github.com/ResearchComputing/easy_parallelization_htc_primer

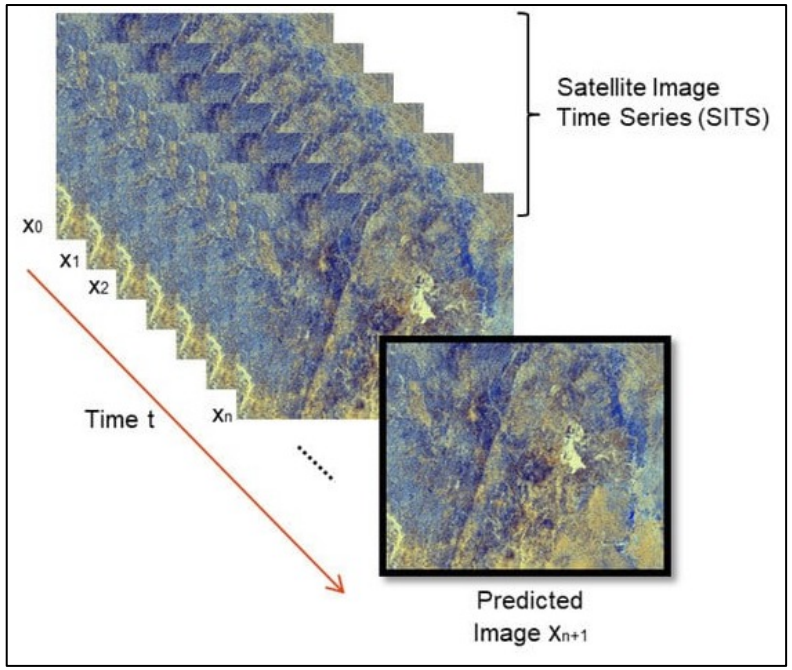


Image source: https://www.mdpi.com/journal/remotesensing/special_issues/AI_rs

Code-internal parallelization

- Types:
  1. Shared-memory ("multithreading")– single *node* (computer)
  2. Distributed-memory ("multiprocessing or "MPI") – multiple nodes
  3. Accelerated -- GPUs
- Used for dependent, independent tasks
  - Climate or earthquake simulations (PDEs)
  - Machine learning (GPUs)
- CURC supports all types of code-internal parallelization!

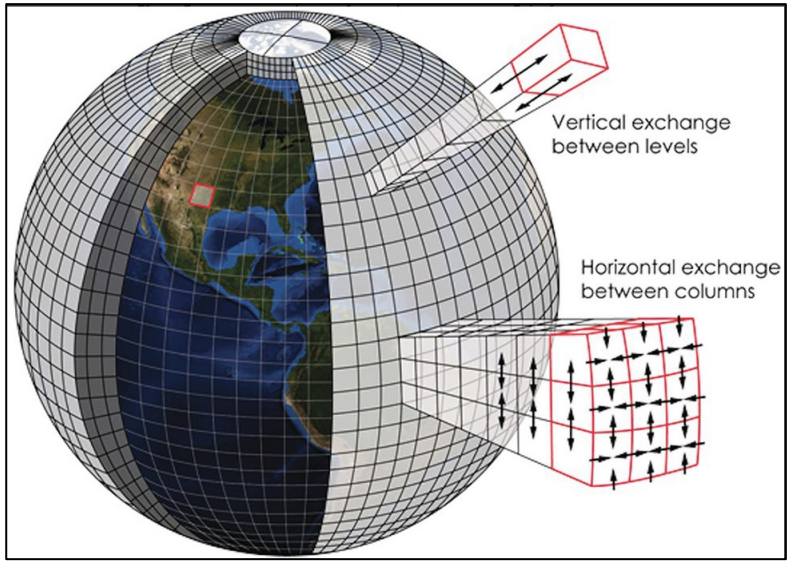


Image source: www.earthmagazine.org/article/todays-weather-forecast-good-strong-chance-improvement

Information source:
https://researchcomputing.princeton.edu/support/knowledge-base/parallel-code

Additional topics (if time allows)

- Is parallelization for me?
  - Computational time constraints?
  - Computational memory constraints?
  - Level of effort to parallelize?

- How do I get started with parallelization?
  - Look for existing code!
  - Consult with your Research Computing staff

Thank you!

Survey and feedback

http://tinyurl.com/curc-survey18