

Parallel Processing

Concepts Behind the Method

Target Audience:

- This curriculum was developed for students at the middle school level.
- The instructor is operating under the assumption that very little or no knowledge of parallel processing has been presented.

What is Parallel Processing?

- The intricacies of parallel processing can rapidly become overwhelming.
- Therefore, our goal, as educators, was to provide a good analogy to convey the concepts behind the method.

Why Parallel Processing was Developed:

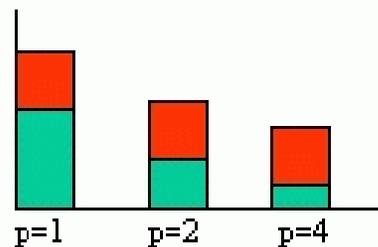
- The main objective of parallel processing is to reduce wall-clock time.
- A hole that takes 1 man 60 minutes to dig, can be accomplished by 60 men in one minute.

Amdahl's Law:

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Reduce sequential code as much as possible

- Time for parallel part of the application goes to zero as the number of processors increase (in green)
- Time A of sequential part stays constant (in red)



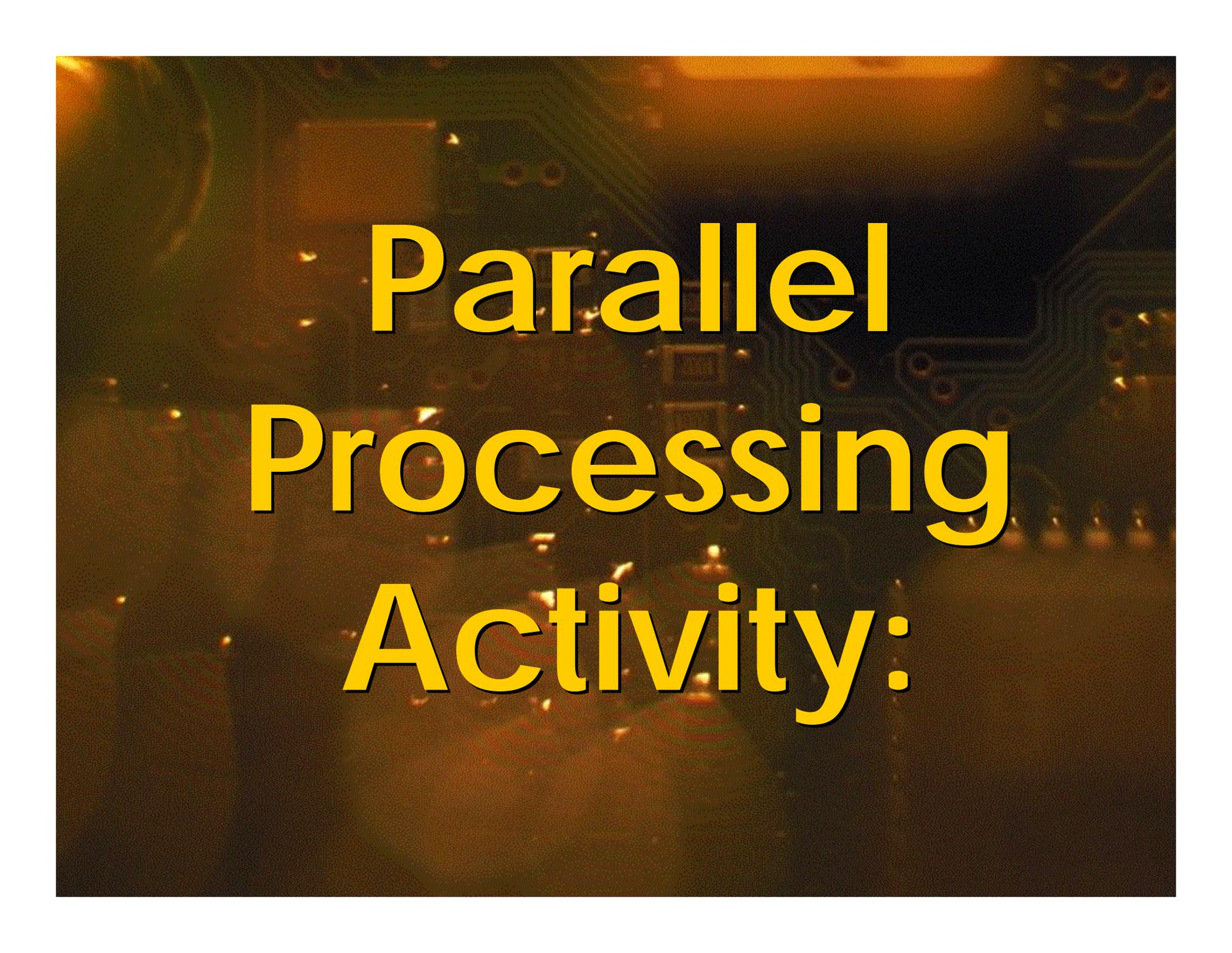
Max Speedup = $1/A$

Applications of Parallel Processing:

- Several of the applications that utilize parallel processing are: fossil energy research, combustion dynamics and fuel efficiencies.
- NETL utilizes the PSC and Beowolf clusters to solve complex algorithms related to fossil energy research.

Objective:

- The students will demonstrate how processors working in parallel accomplish a designated task faster than a single processor solving the same task by simulating the concept of parallel processing.



Parallel Processing Activity:

Summary:

- All of the processors in this activity were performing the same operation, but was working on a different part of the database.

Additional Lessons:

- **Binary Numbering: The Language of Computers.**
- **Fundamentals of Networking: Cable Construction.**

Binary Numbering:

- This activity was designed to clarify how data is exchanged between computers processing in parallel.
- The activity was created to simulate a code-breaking process, which utilizes parallel processing in real life applications.

Fundamentals of Networking:

- This “hands-on” approach allows the students to create various types of media (rollover, crossover, and straight-through cable). Thus, providing pathways for data exchange between parallel processing machines.

Summary:

- In conclusion, in order to prepare students for the more complex concepts underlying parallel processing, fundamentals must be mastered.
- Our approach to teaching data language, data exchange, and concepts of parallel processing are the basis for more complicated topics.

Future and Beyond

As educators, it is our belief that students must first master operating systems such as UNIX and LINUX before parallel processing can fully be understood and mastered.

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NETL Websites:

- NETL'S Main Website: www.netl.doe.gov
- Educational Website:
www.netl.doe.gov/coolscience/teacher/lesson-plans

Cool resources for teachers desiring science, environmental, and technology lesson plans that solve real world problems through projects developed by the National Energy Technology Laboratory.