Embarrassingly Parallel Computations

EAS520
High Performance Scientific Computing Course

UMass Dartmouth

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Embarrassingly Parallel Computations

A computation that can be divided into completely independent parts, each of which can be executed on a separate process(or) is called embarrassingly parallel

Advantages

- One of the easiest type or parallelization technique.
- Requires none or very little communication.
- Easier to program with nice speedup.

One only problem ...

Life is not that easy, not all problems can be transformed into embarrassingly parallel ones.

A nearly embarrassingly parallel is an embarrassingly parallel computation that requires initial data to be distributed and final results to be collected in some way. In between the processes can execute their task without any communication.

Widely Known Examples/Projects

- Your own computer program with many independent scenarios.
- Mandelbrot sets (Fractals).
- Monte Carlo Simulations.
- Rendering in computer graphics.
- Large scale face recognition that involves comparing thousands of arbitrary acquired faces.

Famous projects

- Folding@home project: Protein folding software that can run on any computer with each machine doing a small piece of the work.
- SETI project: Search for Extra-Terrestrial Intelligence.
- distributed.net: A worldwide distributed computing effort that is attempting to solve large scale problems using otherwise idle CPU or GPU time.

Ideal Speedup

$$S_p = \frac{T_1}{T_p}$$

- p is the number of processors or workers.
- T_1 is the execution time of the sequential algorithm.
- T_p is the execution time of the parallel algorithm with p processors or workers.

Linear speedup or **ideal speedup** is obtained when $S_p = p$ (hard to get due to communication). This ideal condition is considered very good scalability.

$$E_p = \frac{S_p}{p}$$

Average efficiency is a value, typically between zero and one, estimating how well-utilized the processors are in solving the problem, compared to how much effort is wasted in communication and synchronization.