L14: Multi-Thread & Multi-Core

Name: ______

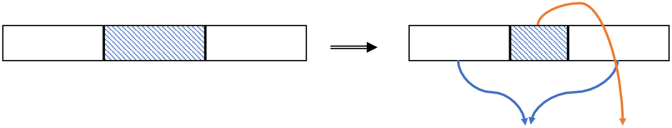
ID: ______

Encountering Amdahl's Law

Speedup due to enhancement E is

$$\text{Speedup w/ E} = \frac{\text{Exec time w/o E}}{\text{Exec time w/ E}}$$

Suppose that enhancement E accelerates a fraction F ($F<1$) of the task by a factor S ($S>1$) and the remainder of the task is unaffected



ExTime w/ E = ExTime w/o E * ((1-F) + F/S)

Speedup w/ E = 1 / ((1-F) + F/S)

Example 1: Amdahl's Law

Consider an enhancement which runs 20 times faster but which is only usable 25% of the time.

Speedup w/ E =

What is its usable only 15% of the time?

Speedup w/ E =

1. 1/(.75 + .25/20) = 1.31
2. 1/(.85 + .15/20) = 1.17

Example 2: Amdahl's Law

Consider summing 10 scalar variables and two 10 by 10 matrices (matrix sum) on 10 processors

Speedup w/ E =

What if there are 100 processors ?

Speedup w/ E =

What if the matrices are100 by 100 (or 10,010 adds in total) on 10 processors?

Speedup w/ E =

What if there are 100 processors ?

Speedup w/ E =

1. 1/(.091 + .909/10) = 1/0.1819 = 5.5
   10/110 operations = 0.091
2. 1/(.091 + .909/100) = 1/0.10009 = 10.0
3. 1/(.001 + .999/10) = 1/0.1009 = 9.9
   10/10010 operations = 0.000999
4. 1/(.001 + .999/100) = 1/0.01099 = 91