Amdahl’s law uses factors - Enhancement.

- Fraction enhanced using N processors
- Speedup before and after enhancement

Speedup

- Consider any enhancement to a feature of a system that results in a speedup.
- The speedup can be expressed as

$$\text{Speedup} = \frac{\text{Performance after enhancement}}{\text{Performance before enhancement}} = \frac{\text{Execution time before enhancement}}{\text{Execution time after enhancement}}$$

- Suppose that a feature of the system is used during execution a fraction of the time *f*, before enhancement, and that the speedup of that feature after enhancement is SU_f. Then the overall speedup of the system is

$$\text{Speedup} = \frac{1}{(1-f) + \dfrac{f}{SU_f}}$$

Speedup

- Then the speedup using a parallel processor with N processors that fully exploits the parallel portion of the program is as follows:

$$\text{Speedup} = \frac{\text{time to execute program on a single processor}}{\text{time to execute program on N parallel processors}}$$

$$= \frac{T(1-f) + Tf}{T(1-f) + \dfrac{Tf}{N}} = \frac{1}{(1-f) + \dfrac{f}{N}}$$

Problem

- Suppose that we are considering developing a parallel program to improve on an existing sequential program and that we determine that 10% of the execution time of the sequential program is spent in inherently sequential code. (We have to inspect the code to determine this.) The remaining code can be parallelized, although we do not as yet know how many processors would be optimal. What is the maximum possible speedup that could be obtained if we were to develop a parallel version that used ten processors?

Max. Speedup= $$\frac{1}{0.1 + 0.9/10} = \frac{1}{0.1 + 0.09} \approx 5.26$$

Problem

- Suppose that we know that 20% of inherently sequential computation in the problem of interest is made parallel. What is the least number of processors that we need to use to obtain a speedup of 6.0?

$$\text{Speedup} = \frac{\text{time to execute program on a single processor}}{\text{time to execute program on N parallel processors}}$$

$$= \frac{T(1-f) + Tf}{T(1-f) + \dfrac{Tf}{N}} = \frac{1}{(1-f) + \dfrac{f}{N}}$$

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Amdhal’s - Speedup Based Problem

- Consider a CPU used in Web servicing. We need to enhance 30% of the processor by increasing the computation speed 10 times faster on computation process in web service applications.

Solution

$\text{Fraction}_{\text{enhanced}}$= f= 30% =0.3

$\text{Speed}_{\text{enhanced}}$ $=SU_f = 10$

$\text{Speedup}_{\text{overall}}$ = 1/(1-0.3)+(0.3/10)

= 1/0.7+0.03

=1/0.73

≈ 1.369

Amdahl's Law, cont.

- Example: f_x = 95 % and S_x = 1.10

$$Speedup_{overall} = \frac{1}{(1-0.95) + (0.95/1.10)} = 1.094$$

- Example: f_x = 5% and S_x = 10

$$Speedup_{overall} = \frac{1}{(1-0.0.5) + (0.05/10)} = 1.047$$

Amdhal's - Speedup Based Problem

- Consider a CPU used in Web servicing. We need to enhance 30% of the processor by increasing the computation speed 10 times faster on computation process in web service applications.

Solution

$Fraction_{enhanced}$= f= 30% =0.3

$Speed_{enhanced}$ =SU_f = 10

$Speedup_{overall}$ = 1/(1-0.3)+(0.3/10)

= 1/0.7+0.03

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