# CENG3420 Computer Organization & Design
# Lecture 12 Review: Multi-Threading & Multi-Core

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Spring 2016

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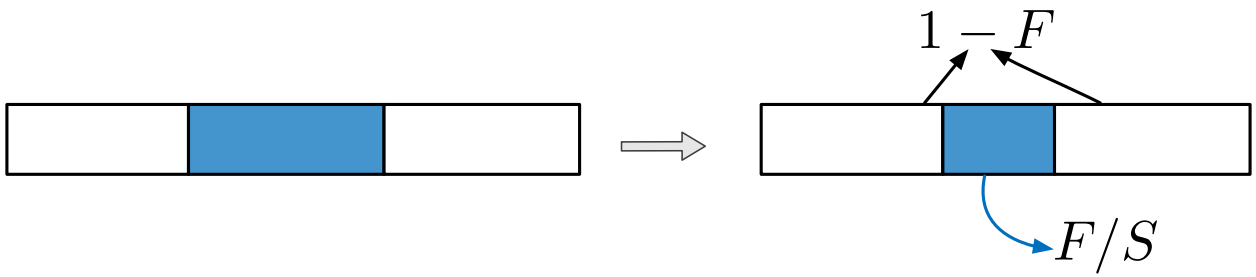
# Encountering Amdahl's Law

- Speedup due to enhancement E $= \dfrac{\text{Exec time w/o E}}{\text{Exec time w/ E}}$
- 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:




$$\text{Speedup w/ E} = \frac{1}{(1 - F) + F/S}$$

# EX-1: Amdahl's Law

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

- Answer: here $F = 0.25$, and $S = 20$.

$$\text{Speedup w/ E} = \frac{1}{0.75 + 0.25/20} = 1.31$$

What if its usable only 15% of the time?

- Answer: here $F = 0.15$, and $S = 20$.

$$\text{Speedup w/ E} = \frac{1}{0.85 + 0.15/20} = 1.17$$

# EX-2: Amdahl's Law

Consider summing $10$ scalar variables and two $10 \times 10$ matrices (matrix sum) on $10$ processors

- Answer: The summing of 10 variables is scalar, but summing of matrices is vector. Thus $F = \dfrac{10 \times 10}{10 \times 10 + 10} = 0.909$, and $S = 10$.

$$\text{Speedup w/ E} = \frac{1}{(1 - 0.909) + 0.909/10} = 5.5$$

What if there are 100 processors ?

- Answer: Here $S = 100$, thus

$$\text{Speedup w/ E} = \frac{1}{(1 - 0.909) + 0.909/100} = 10.0$$

Thanks. For any question:
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