

LECTURE - 02

Performance Comparison

- What performance metric to use?
 - User cares about *response time*
 - Performance is inversely proportional
- What is execution time?
 - Response time
 - CPU time: User time + System time
- System performance vs. CPU performance
 - Throughput vs. response-time
- We will focus on CPU performance

Which Program's Execution Time?

- Real “workload” is ideal
- Practical options:
 - Real programs: compilers, office-suite, scientific...
 - Kernels: key pieces of programs
 - Example: Livermore loops
 - Toy benchmarks: small programs
 - Examples: Quick-sort, tower of Hanoi...
 - Synthetic benchmarks: try to capture “average” frequency of instructions in real programs
 - Example: Whetstone, Dhrystone

More on Performance Comparisons...

- Caveat of benchmarks
 - They are needed
 - But manufacturers tend to optimize for benchmarks
 - Need to be updated periodically
- Benchmark suite: collection of programs
 - E.g. SPEC92
- Reporting performance
 - Reproducibility: program version, compiler, flags
 - SPEC specifies compiler flags for baseline comparison

Some Numerics...

	Computer A	Computer B	Computer C
Program P1 (secs)	1	10	20
Program P2 (secs)	1000	100	20
Total (secs)	1001	110	40

- Total (or average) execution time is a possible metric
- Weighted execution time is better $\sum W_i x T_i$

Normalizing the Performance

	Norm(A)	Norm(A)	Norm(A)	Norm(B)	Norm(B)	Norm(B)	Norm(C)	Norm(C)	Norm(C)
	A	B	C	A	B	C	A	B	C
P1	1	10	20	0.1	1	2	0.05	0.5	1
P2	1	0.1	0.02	10	1	0.2	50	5	1
AM	1	5.05	10.01	5.05	1	1.1	25.03	2.75	1

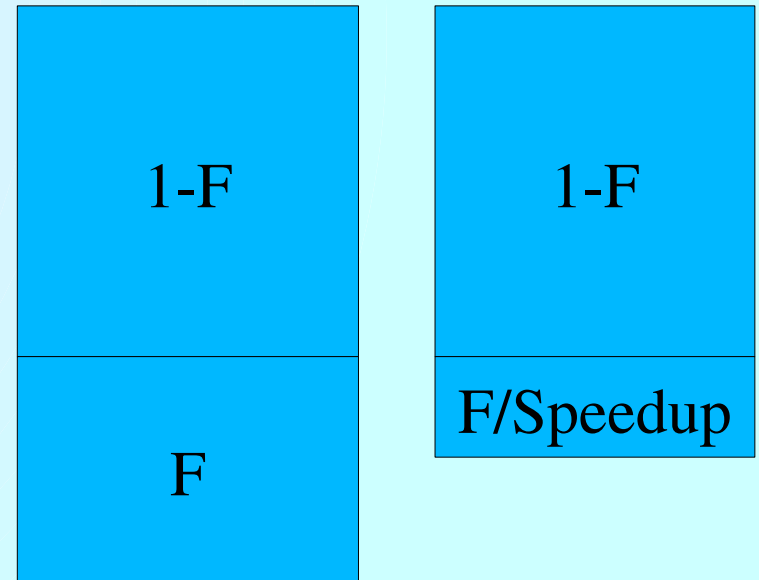
- Normalize such that all programs take the same time, on some machine
- Arithmetic mean predicts performance
- Geometric mean?

Summary

- Performance inversely proportional to execution-time
 - We are concerned with CPU time of unloaded machine
- Weighted execution time with weights from real workload is ideal
- Else, normalize w.r.t one machine

Amdahl's Law

- Amdahl's law:
 - Diminishing returns
 - Limit on overall speedup
- Corollary: make the common case fast



Tomorrow...

- CPI as a measure of performance
- Illustration of Amdahl's law