PERFORMANCE ISSUES

Designing for Performance

- Today's laptops have the computing power of an IBM mainframe from 10 or 15 years ago.
- Today's microprocessor-based systems applications includes Image processing, 3D rendering, Speech recognition, Videoconferencing, Multimedia authoring, Simulation.
- Workstation systems now support highly sophisticated engineering and scientific applications and have the capacity to support image and video applications.
- Businesses are relying on increasingly powerful servers to handle transaction and database processing and to support massive client/server networks that have replaced the huge mainframe computer centers of yesteryear.

Microprocessor Speed…

- Moore's law, prediction made by American engineer Gordon Moore in 1965 that the number of transistors per silicon chip doubles every year.

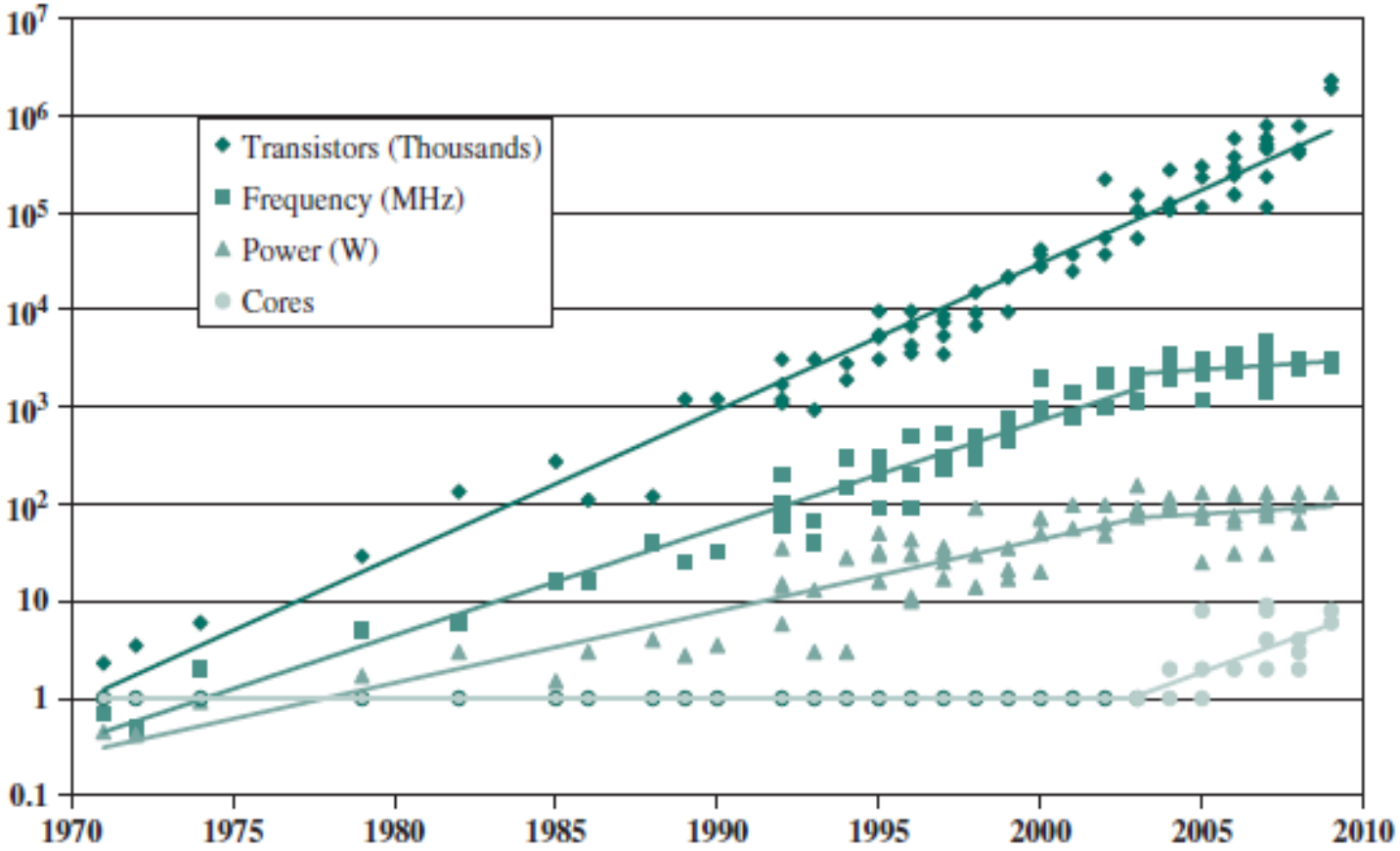
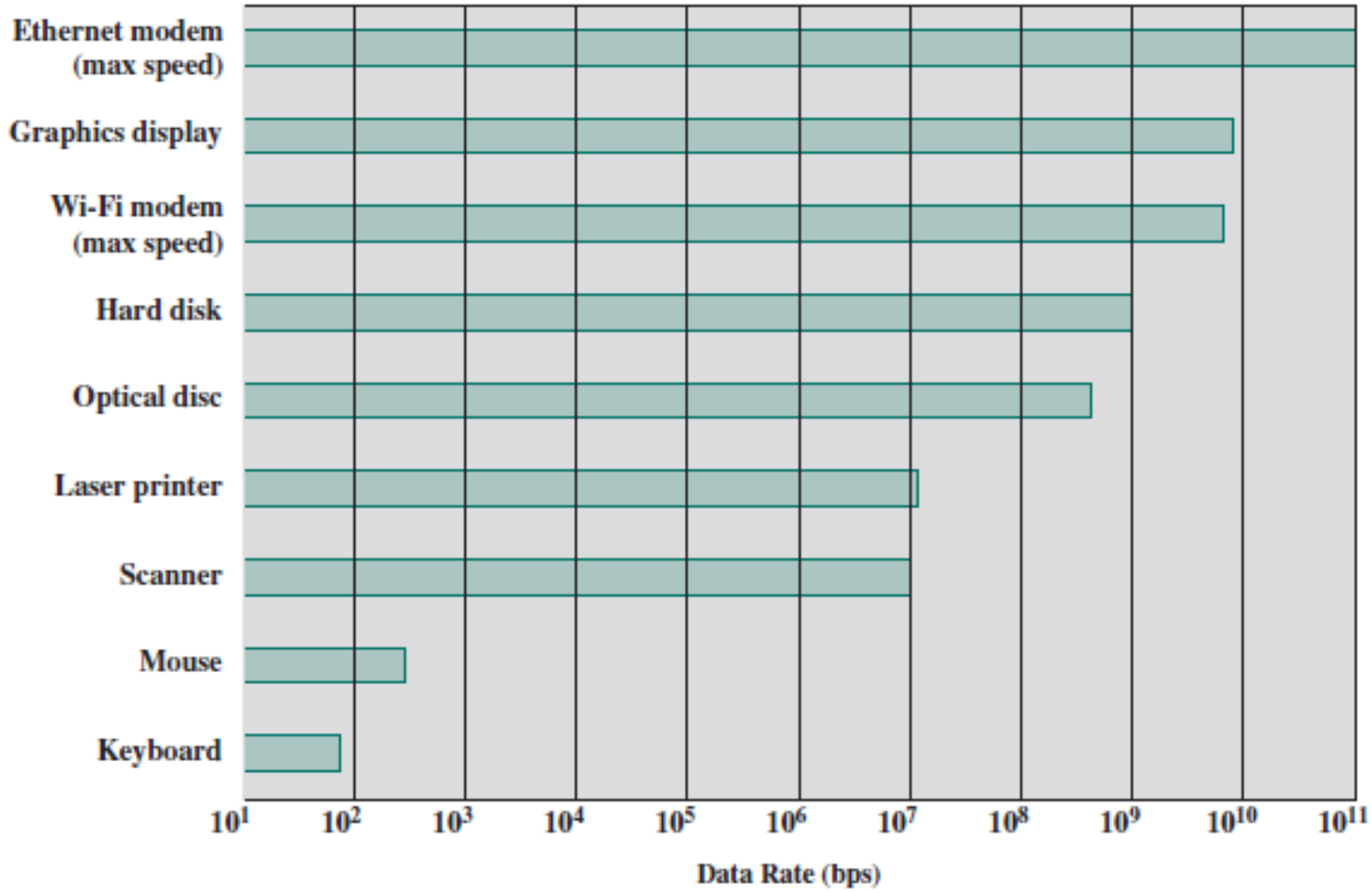


Figure 2.2 Processor Trends

Microprocessor Speed

- In memory chips has quadrupled the capacity of **dynamic random-access memory (DRAM)** every three years.
- In microprocessors, the addition of new circuits, the speed boost that comes from reducing the distances between them, has improved performance four- or fivefold every three years.
- Raw speed of the microprocessor will not achieve its potential unless it is fed a constant stream of work to do in the form of computer instructions.
- New techniques came into existence: Pipelining, Branch Prediction, Superscalar Execution, Dataflow Analysis, and Speculative Execution.

Performance Balance



Amdahl's Law

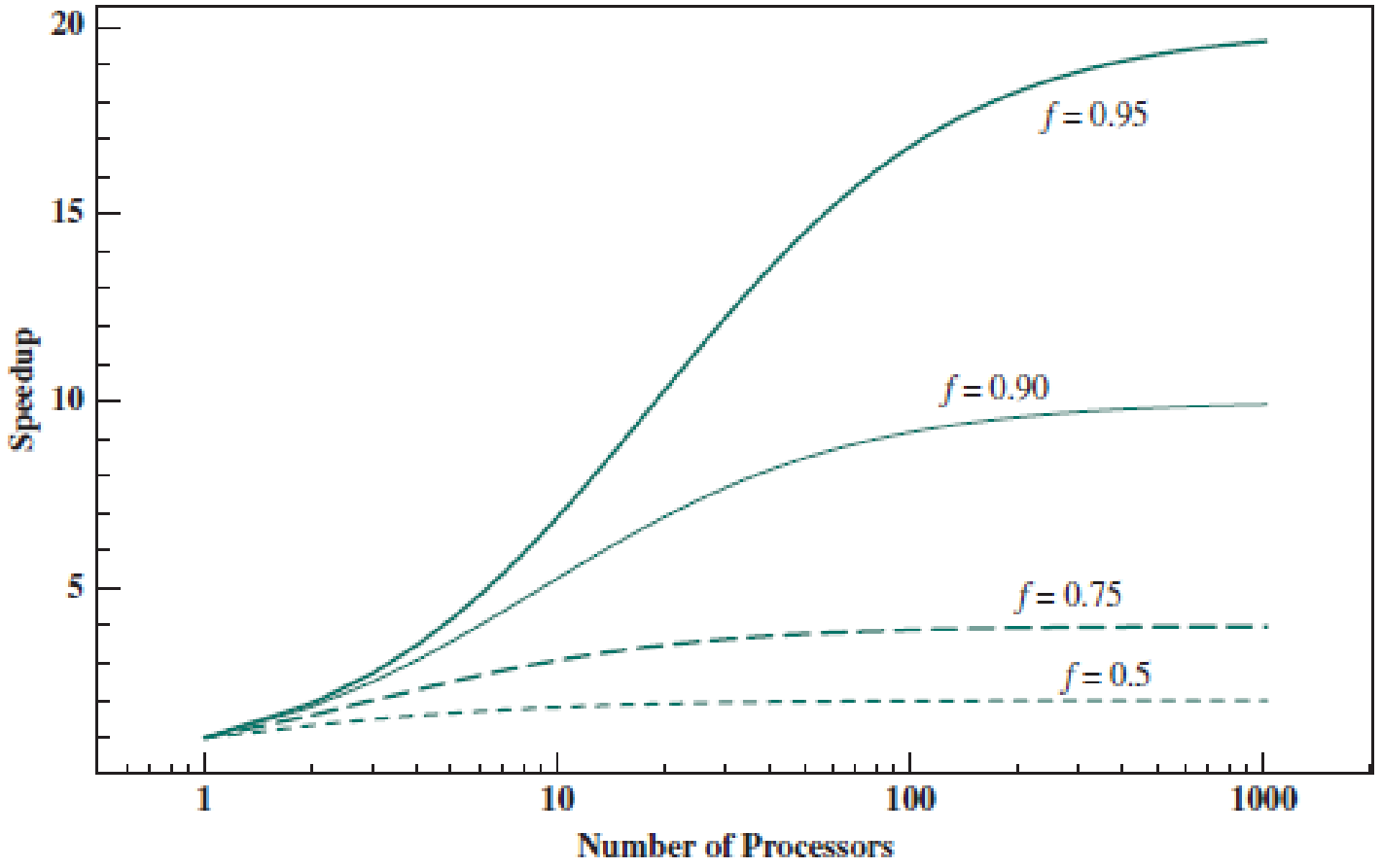
- Amdahl's law was first proposed by Gene Amdahl in 1967 and deals with the potential speedup of a program using multiple processors compared to a single processor.
- Consider a program running on a single processor such that a fraction (1 - *f*) of the execution time involves with **sequential coding,** and a fraction *f* that involves code that is infinitely **parallelizable.**
- Let *T* be the total execution time of the program using a single processor.

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

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

Amdahl's Law

- Amdahl's law illustrates the problems facing industry in the development of multicore machines with an ever-growing number of cores.
- The software that runs on such machines must be adapted to a highly parallel execution environment to exploit the power of parallel processing.



Benchmark Principles

- MIPS (million instructions per second)
- MFLOPS (million floating point operations per second)
- Measuring the performance of systems using a set of benchmark programs.
- The Standard Performance Evaluation Corporation (SPEC), an industry consortium. This organization defines several benchmark suites aimed at evaluating computer systems. SPEC CPU2006 is the industry standard suite for processor-intensive applications.