Lecture 36:
Parallel Programming Systems and Models

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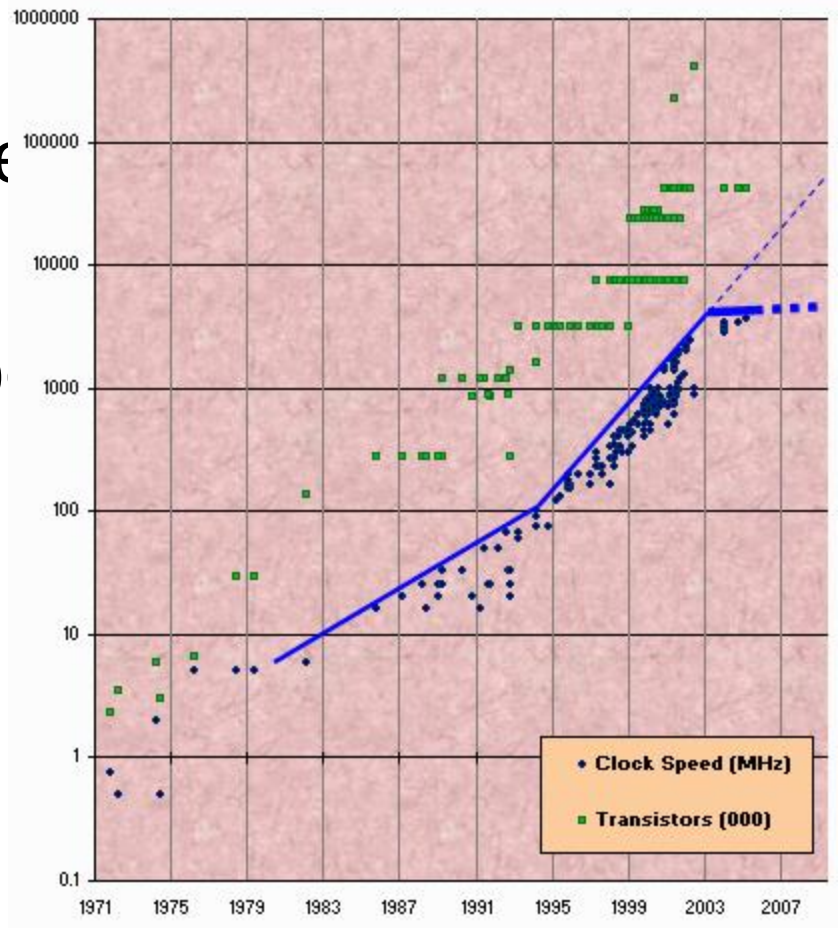
Introduction to Parallel Computing

- Moore's Law
  - The number of transistors that can be placed inexpensively on an integrated circuit will double approximately every 18 months.
  - Self-fulfilling prophecy
    - Computer architect goal
    - Software developer assumption

Introduction to Parallel Computing

- Impediments to Moore's Law
  - Theoretical Limit
  - What to do with all that die
  - Design complexity
  - How do you meet the exp increase?

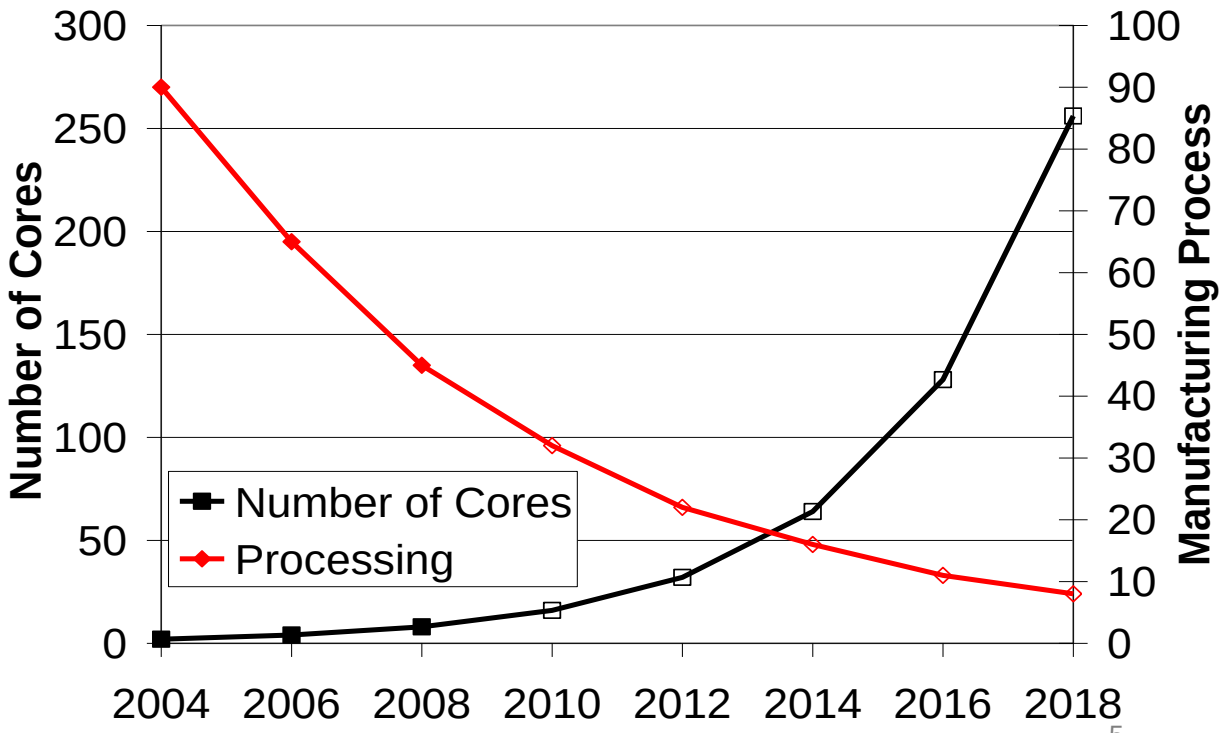


Introduction to Parallel Computing

- von Neumann model
  - Execute a stream of instructions (machine code)
  - Instructions can specify
    - Arithmetic operations
    - Data addresses
    - Next instruction to execute
  - Complexity
    - Track billions of data locations and millions of instructions
    - Manage with:
      - Modular design
      - High-level programming languages

Introduction to Parallel Computing

- Parallelism
  - Continue to increase performance via parallelism.

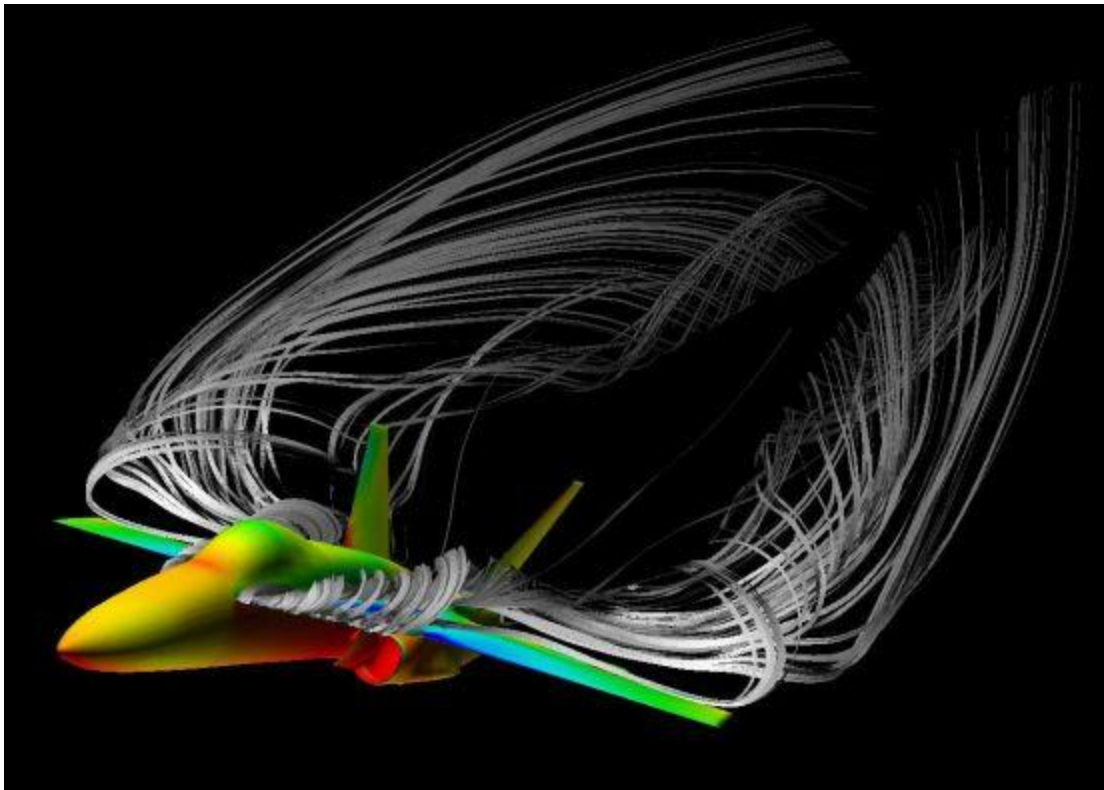


Introduction to Parallel Computing

- From a software point-of-view, need to solve demanding problems
  - Engineering Simulations
  - Scientific Applications
  - Commercial Applications
- Need the performance, resource gains afforded by parallelism

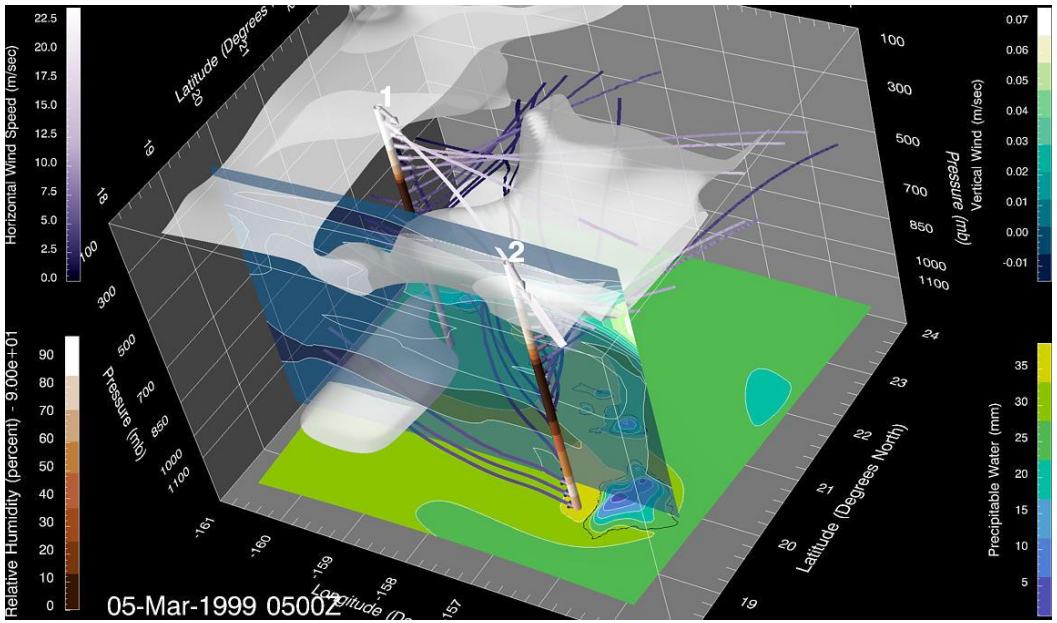
Introduction to Parallel Computing

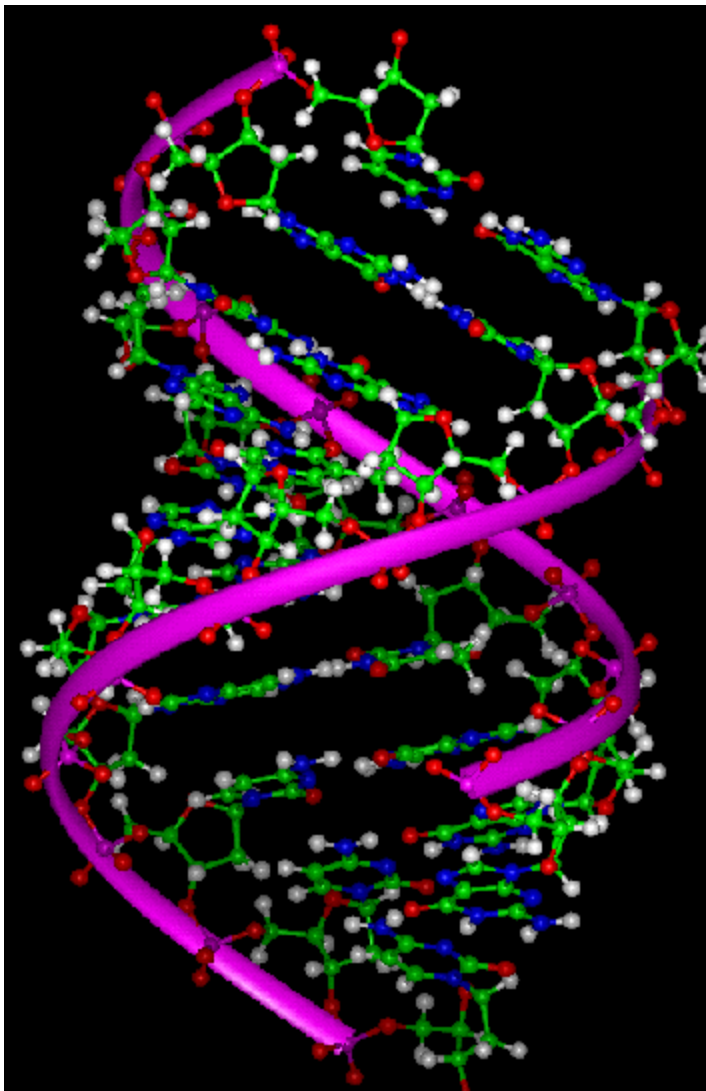
- Engineering Simulations
  - Aerodynamics
  - Engine efficiency



Introduction to Parallel Computing

- Scientific Applications
  - Bioinformatics
  - Thermonuclear processes
  - Weather modeling





Introduction to Parallel Computing

- Commercial Applications
  - Financial transaction processing
  - Data mining
  - Web Indexing

Introduction to Parallel Computing

- Unfortunately, greatly increases coding complexity
  - Coordinating concurrent tasks
  - Parallelizing algorithms
  - Lack of standard environments and support

Introduction to Parallel Computing

- The challenge
  - Provide the abstractions, programming paradigms, and algorithms needed to effectively design, implement, and maintain applications that exploit the parallelism provided by the underlying hardware in order to solve modern problems.

Questions