Heterogeneous
Parallel
Programming

Lesson 1.3

# Portability and Scalability in Heterogeneous Parallel Computing

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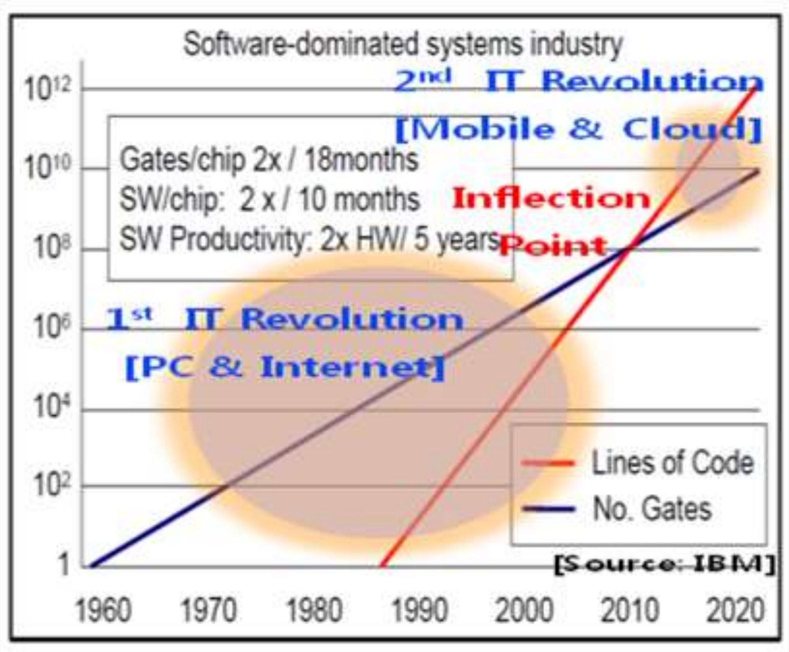
# Objectives

- To understand the importance and nature of scalability and portability in parallel programming

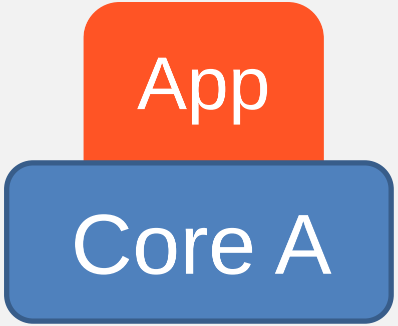
# Software Dominates System Cost

- SW lines per chip increases at 2x/10 months
- HW gates per chip increases at 2x/18 months
- Future system must <u>minimize software redevelopment</u>



[Source: IBM]

# Keys to Software Cost Control

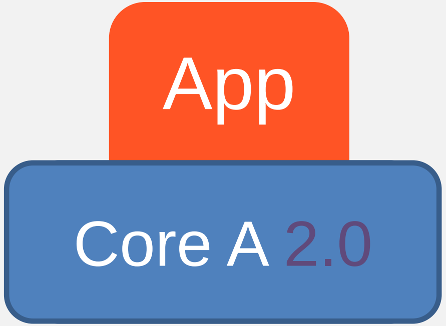


App

Core A

- Scalability

# Keys to Software Cost Control

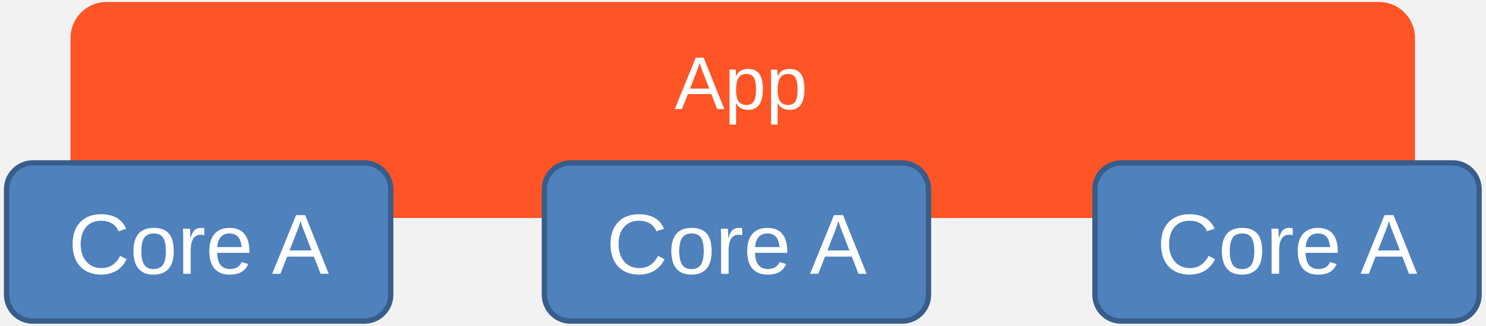


App

Core A 2.0

- Scalability
  - The same application runs efficiently on new generations of cores

# Keys to Software Cost Control



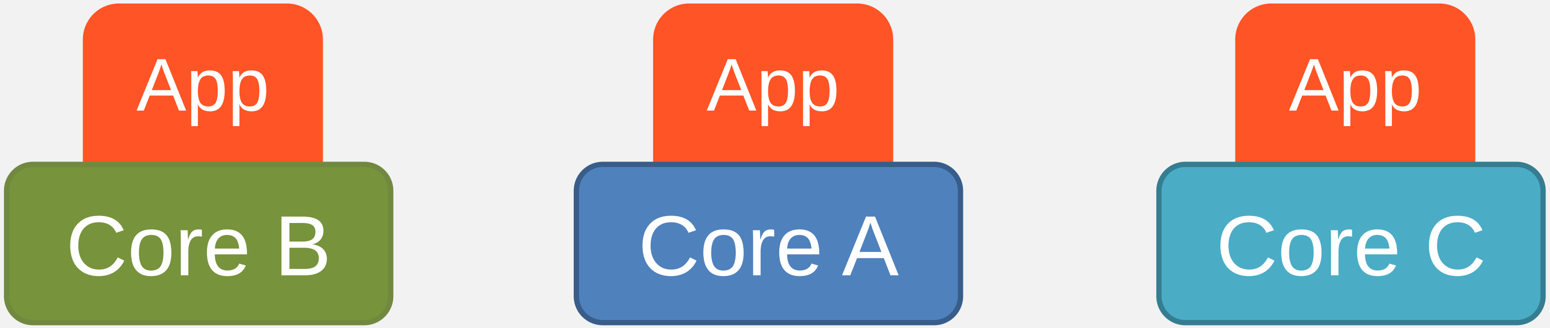
- Scalability
  - The same application runs efficiently on new generations of cores
  - The same application runs efficiently on more of the same cores

# More on Scalability

- Performance growth with HW generations
  - Increasing number of compute units
  - Increasing number of threads
  - Increasing vector length
  - Increasing pipeline depth
  - Increasing DRAM burst size
  - Increasing number of DRAM channels
  - Increasing data movement latency

The programming style we use in this course supports scalability through fine-rained problem decomposition and dynamic thread scheduling

# Keys to Software Cost Control

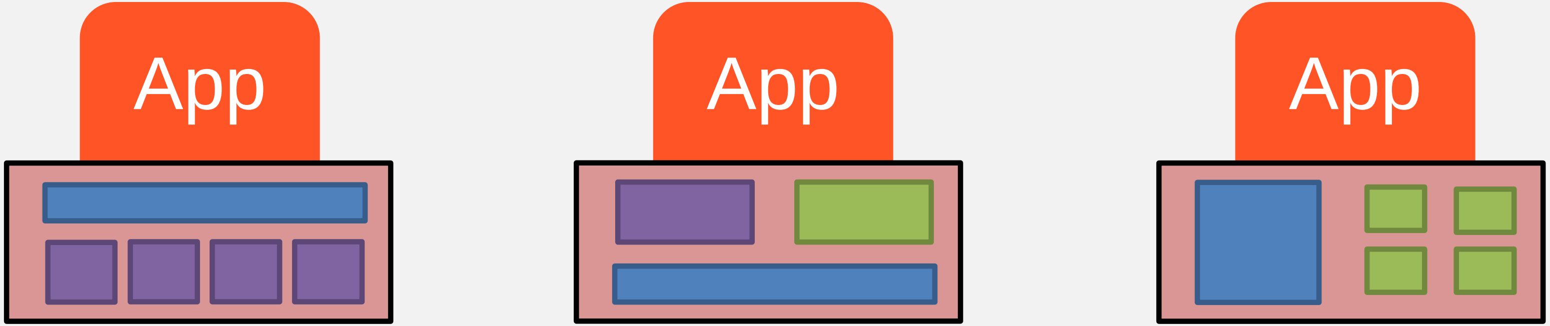


App App App

Core B Core A Core C

- Scalability
- Portability
  - The same application runs efficiently on different types of cores

# Keys to Software Cost Control



- Scalability
- Portability
  - The same application runs efficiently on different types of cores
  - The same application runs efficiently on systems with different organizations and interfaces

# More on Portability

- Portability across many different HW types
  - X86 vs. ARM, etc.
  - Latency oriented CPUs vs. throughput oriented GPUs
  - VLIW vs. SIMD vs. threading
  - Shared memory vs. distributed memory

Emerging standards such as OpenCL and Heterogeneous System Architecture help address portability

To Learn More, Read

Chapter 1