

Introduction

Parallel computation is a fundamental technique by which computations can be accelerated, so the increasing availability of parallel hardware represents a tremendous opportunity. But implementing a parallel solution presents certain conceptual and programming challenges that this textbook is designed to address. To place the opportunities and challenges in perspective, this chapter sets the context and introduces basic ideas.

The Power and Potential of Parallelism

Parallelism arises frequently in everyday life. More importantly, parallelism has contributed in many ways to the steady performance improvement in computers over the past several decades. And now, new opportunities are available. Let's look closely.

Parallelism, a Familiar Concept

Parallelism is a familiar concept. Juggling is a parallel task that humans can perform. House construction is a parallel activity, because several workers can perform separate tasks simultaneously, such as wiring, plumbing, and furnace duct installation, and so on. Most manufacturing—cars, hairdryers, frozen dinners—is performed in parallel using an assembly line, or pipeline, in which many units of the product are under construction at once. A call center, where many employees service customers at the same time, is another organization that applies parallelism.

Although familiar, these forms of parallelism are different. The call center, for example, differs from house construction in a fundamental way: Calls are generally independent and can be serviced in any order with little interaction among the workers. In construction, some tasks can be performed simultaneously—wiring and plumbing—while others are ordered—framing must precede wiring. The ordering restricts the amount of parallelism that can be applied at once, limiting the speed at which a construction project can complete. The ordering also increases the degree