A systems approach to teaching computer systems

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At M.I.T. we teach a class titled "computer system engineering", a required class that provides an introduction to computer systems. It provides a broad and in-depth introduction to the main principles and abstractions of engineering computer systems, be it an operating system, a client/server application, a database application, a secure Web site, or a fault-tolerant disk cluster. These principles and abstractions are timeless and are of value to any computer science or computer engineering student, whether specializing in computer systems or not.

Many fundamental ideas such as design principles, modularity, abstraction, virtualization, concurrency, communication, fault tolerance, and atomicity are common to several of the upper-division electives of the computer science curriculum. Most curricula start with two beginning subjects (introduction to software and hardware) and then branch out to: operating systems, networks, database systems, distributed systems, programming languages, software engineering, etc. The problem is that this list has grown over the last 20 years and there isn't time for most students to take all or even several of those subjects. The typical response is "choose three" or "take operating systems plus two more". The result is that most students end up with no background at all in the remaining topics.

As a solution, we have developed a text that cuts across all of these subjects, identifying common mechanisms and design principles, and explaining in depth a carefully chosen set of ideas in each area. This approach provides an opportunity to teach a core undergraduate subject that can be taken by all computer science students, followed by the same set of electives listed above, but those electives can now explore their topic more effectively and more thoroughly. We found this course structure to be effective at M.I.T., and it has been enthusiastically received by the students.