OS II Overview: A Few Topics

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Advanced Topics in Operating Systems

Focusing on building distributed systems

▶ $N > 1$ computers cooperating to provie a service

Who use them?

Why do we need them?

Scalability, reliability, and security

- ▶ Storage
- ▶ Transaction systems
- ▶ Processing "big data"
- ▶ Authentication services
- ▶ . . .

Why challenging?

We must deal with a number of problems:

- ▶ Concurrency
- ▶ Complex interactions
- ▶ Performance bottlenecks
- ▶ Partial failure
- ▶ . . .

Building Blocks

Consider the following

- ▶ (scalability) increase capacity: via parallel processing
- ▶ (reliability) tolerate faults: via replication
- ▶ (security) reducing attack surfaces: via isolation

Why do we want to study these topics

Learning Components

- ▶ lectures: providing big ideas, facilitate paper discussions, and discussing lab/project guidances
- ▶ research papers: students present research papers (discussing problems, ideas, implemenation details, and evaluation)
- ▶ student presentations and discussions: students presentations and instructor-led discussions
- ▶ labs and projects: experiment/implement techniques; learn distributed programming

Example Topics

Consistency

Archieving well-defined behavior.

▶ Consider service: read(x), what should be its behavior?

Performance

Archieving scalable throughput

▶ Add more computers (N computers). When N increases, do you get N times throughput? .

The goal: scalable throughput

Tradeoffs Among Goals

Fault-tolerance, consistency, and performance are often cannot optimized at the same time.

▶ Communication: required for fault tolerance and consistency, but communication is often slow.

▶ What to do? Often trade consistency for speed

Implementation Building Blocks

- ▶ RPC
- ▶ Threads and processes
- ▶ Concurrency control
- ▶ . . .

Real-world Applications

▶ All big Web sites
▶ All big mobile apps
▶ All big machine learning hosts
▶ . . .
▶ What is our first topic?