Cloud Computing in Numbers

- Datacenter instance:
  - Costs in billion range
  - > 100,000 servers

- By 2010
  - Over 15mil of servers installed in US
  - Over 45B to power and cool servers

Why does Cloud Computing Matter?

- Fundamental change
  - The way applications are written and deployed
  - Internet traffic: Internet becomes last-hop between hosts and datacenter
  - Economics

- Opportunity to rethink:
  - Large scale distributed systems
  - Network architectures
  - Tradeoffs in computer systems

How is Cloud Computing Different?

- How is different from distributed systems?
- How is different from parallel systems?

- Axis:
  - Environment constraints
  - Scale
  - Type of failures
  - Application requirements
  - ...

Academia Challenges

- Rapid evolving field
  - Need to be in the avantgarde of understanding challenges and trends
  - Unfortunately, academia trails industry
    - Very hard to achieve the scale and generate the workload that reveal main challenges

- How to address above challenges?

Grading

- Project: 60%
- Class presentations: 40%
- See Randy's guidelines for leading discussion on papers
  - http://brng.eecs.berkeley.edu/~randy/Courses/CS294.F07/Lea
dingPapers.pdf
Papers
- Is the problem real?
- What is the solution’s main idea (nudget)?
- Why is solution different from previous work?
  - Are system assumptions different?
  - Is workload different?
  - Is problem new?
- Does the paper (or do you) identify any fundamental/hard trade-offs?

Papers (cont’d)
- Do you think the work will be influential in 10 years?
  - Why or why not?
- Predicting the future always hard, but worth a try
  - Look at past examples for inspiration

Streaming Over TCP
- Countless papers:
  - Why cannot be done…
  - New protocols to do it…
- Today
  - Virtually all streaming over TCP
  - During inauguration, Akamai served “…over 800 Gbps of Flash streaming”

Why did it Succeed?

Multicast
- Countless papers:
  - Why world will come to a standstill without multicast…
  - New protocols to do it…
- Today
  - Multicast is used only in enterprise settings at best
  - Overlay multicast widely used in the Internet
    - During inauguration Akamai served “…over 800 Gbps of Flash streaming”

Why Did it Fail?
Consistency Everywhere

- Many papers & systems:
  - Group synchronous communication
  - Causally ordered message delivery
  - ...

- Today:
  - Almost never used in WANs, and rarely used in LANs

Why Did it Fail?

Shared Memory

- Countless papers:
  - How shared memory simplifies programming parallel computers
  - Many, many systems proposed and build

- Today:
  - Message passing (MPI) took over as the de facto standard for writing parallel applications

Why Did it Fail?

Network Computer

- Big in 90s
  - Promoted by an alliance of Sun, Oracle, Acorn

- Promise: many of advantages of cloud computing
  - Easy to manage
  - Application sharing
  - ...

- Failed miserably

Why Did it Fail?
What are Hard/Fundamental Tradeoffs?

- Brewer’s CAP conjecture: “Capability, Availability, Partition-tolerance”, you can have only two in a distributed system

- In a in-order, reliable communication protocol cannot minimize overhead and latency simultaneously

- Hard to simultaneously maximize evolvability and performance