Intro to Software as a Service (SaaS) and Cloud Computing

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Software as a Service: SaaS

- Traditional SW: binary code installed and runs wholly on client device
- SaaS delivers SW & data as service over Internet via thin program (e.g., browser) running on client device
  - Search, social networking, video
- Now also SaaS version of traditional SW
  - E.g., Microsoft Office 365, TurboTax Online

SaaS in 1996

One Person Can Immediately Affect Millions

Auction Web

[Menu] [Listings] [Buyers] [Sellers] [Search] [Contact/Help] [Site Map]

Welcome to today's online
marketplace...

...the market that brings buyers
and sellers together in an honest
and open environment...

Welcome to eBay's AuctionWeb.

Welcome to our community. I'm glad you found us. AuctionWeb is dedicated to bringing together buyers and sellers in an honest and open marketplace. Here, thanks to our auction format, merchandise will always fetch its market value. And there are plenty of great deals to be found!

Take a look at the listings. There are always several hundred auctions underway, so you're bound to find something interesting.

If you don't find what you like, take a look at our **Personal Shopper.** It can help you search all the listings. Or, it can keep an eye on new items as they are posted and let you know when something you want appears. If you want to let everyone know what you want, post something on our wanted page.

welcome to eBay's AuctionWeb.

such as daily updates and the right to participate in our user feedback forum and the bulletin board.

Please **read on** about the AuctionWeb vision...

From the founder:

February 26, 1996

I launched eBay's AuctionWeb on Labor Day, 1995. Since then, this site
has become more popular than I ever expected, and I began to realize
that this was indeed a **grand experiment** in Internet commerce.

By creating an open market that encourages **honest** dealings, I hope to

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Why SaaS?

1. No installation hassles
2. No worries about data loss
3. Easy for groups to interact with same data
4. Data is large or changes frequently
5. No compatibility hassles for developers
6. Easier upgrades

SaaS Needs Infrastructure

1. Communication: allow customers to interact with service

2. Scalability: fluctuations in demand during + new services to add users rapidly

3. Dependability: service and communication continuously available 24x7

Sun E-10000 "supermini" c.1996

Machine	Processor cores	RAM	Disk
E10000, 1996	64 x 250MHz	64 GB	20 TB
PC, 1996	1 x 250 MHz	32 MB	4 GB
Ratio	64:1	2000:1	5000:1
Datacenter computer, 2010	8 x 1 GHz	16 GB	2 TB
PC, 2010	2 x 3 GHz	4 GB	0.5 TB
Ratio	< 2:1	4:1	4:1

Modern datacenters use commodity computers.

- "Workstation price-performance is improving at 80% per year, while that of supercomputers is improving at only 20-30% per year."

Why?

- "Instead of small computers for interactive use and larger computers for demanding applications, we propose using NOWs for **all the needs of computer users.**"

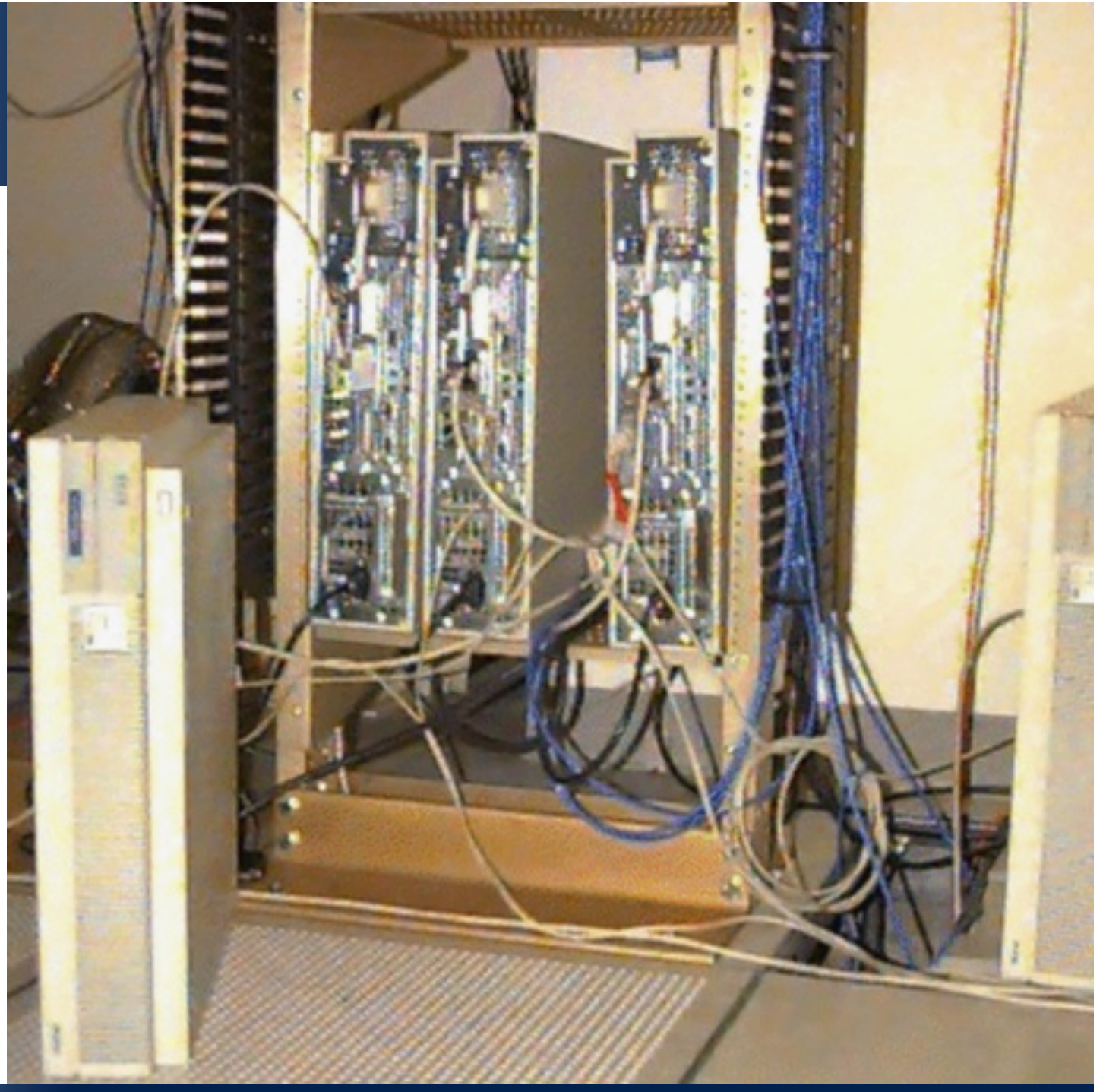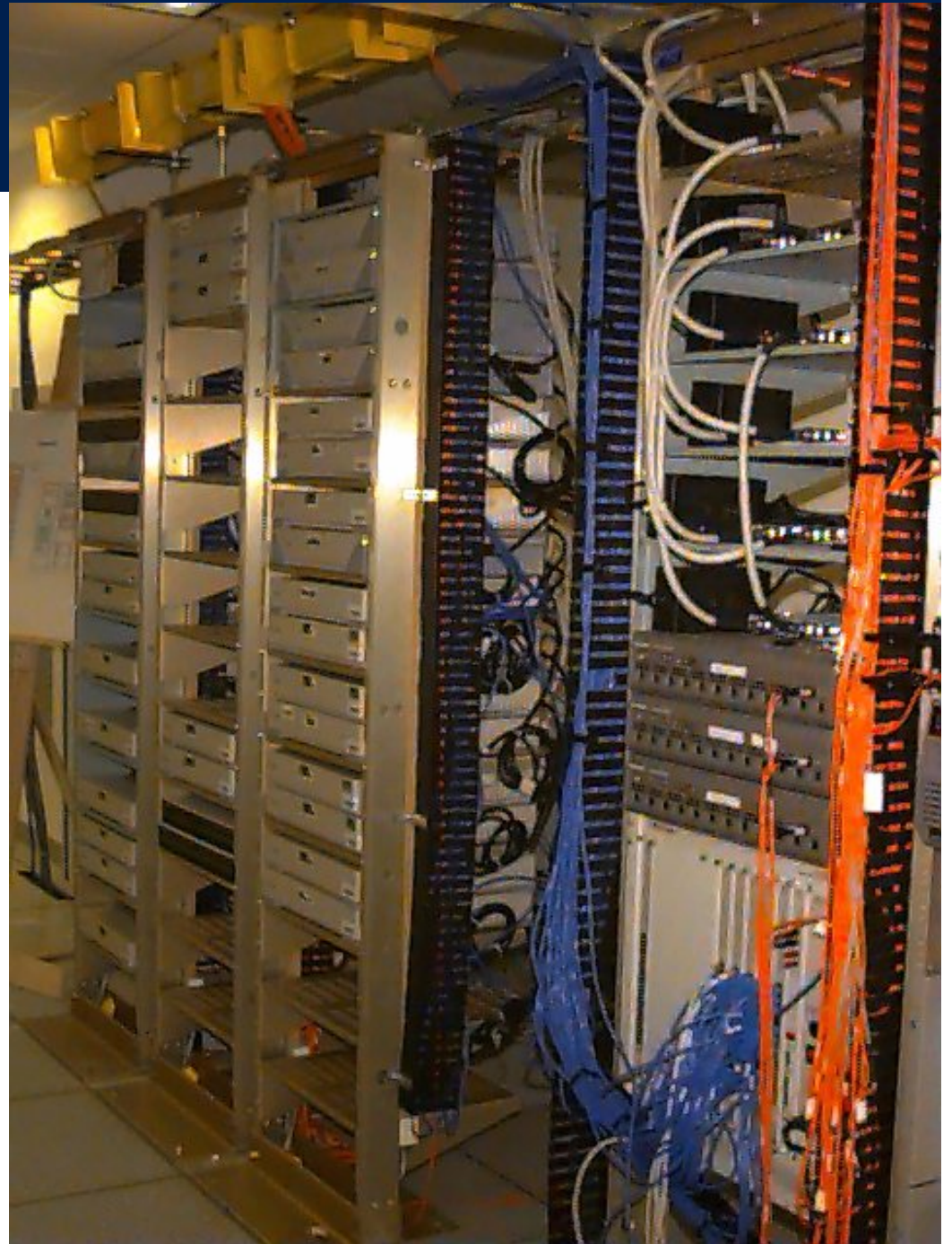Whoa.

NOW-0

1994

Four

HP-735's

NOW-1

1995

## 32 Sun SPARC-stations

NOW-2

1997

60 Sun SPARC-2

RAD Lab

- The first mobile Web browser with graphics was developed by:

(a) ~~Apple~~ Stanford

(b) ~~Google~~ Berkeley

(c) ~~Motorola~~ MIT

(d) None of the above

- Faculty: Profs. Katz & Brewer

- Idea: Use the "cloud" for *services!*

  – First truly *scalable* search engine (Inktomi)

  – First mobile Web browser enabled by content transformation (TopGun)

  – *Vision: Anywhere, anytime access to data & services, supported by the "cloud"*
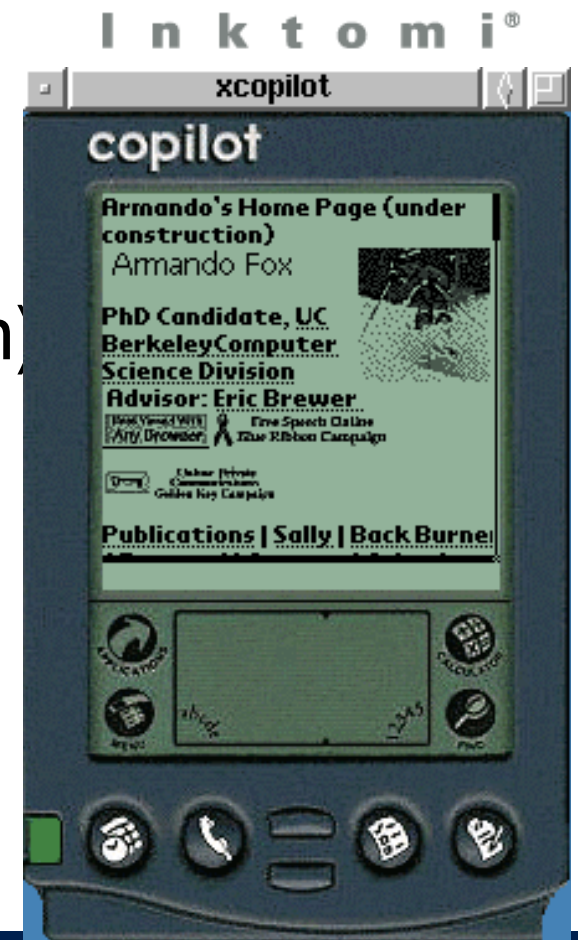
Datacenter is new "server"

- *"Program"* => Web search, email, map/GIS, …
- *"Computer"* => 1000's computers, storage, network
- Warehouse-sized facilities and workloads

photos: Sun Microsystems, CNET, & datacenterknowledge.com

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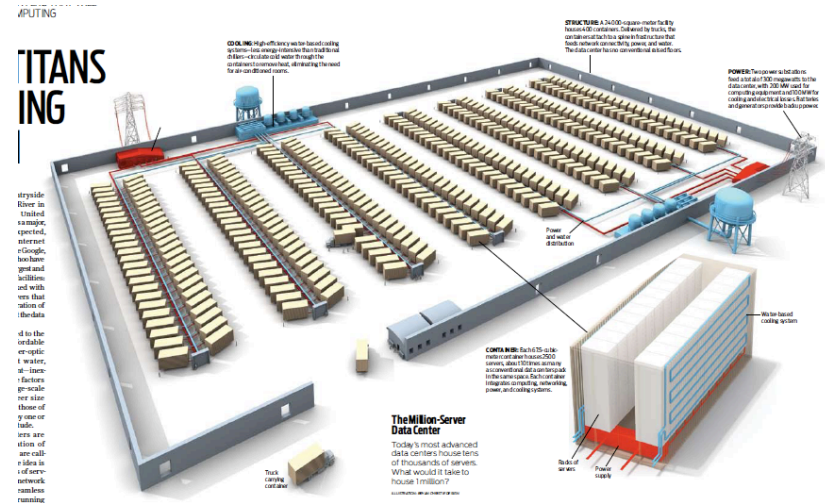
- What: Pay-as-you-go access to racked commodity servers
  - from **0.02/server-hour**, no minimum
  - 100 servers x 1h costs same as 1 server x 100h
- Eliminates financial barrier to deploy SaaS
  - FarmVille: 4 days =1M players; 2 months = 10M; 9 months = 75M!
  - A cloud-based system is world's 42nd fastest supercomputer, at $700/hr
  - IBM Watson would cost about $290/hr
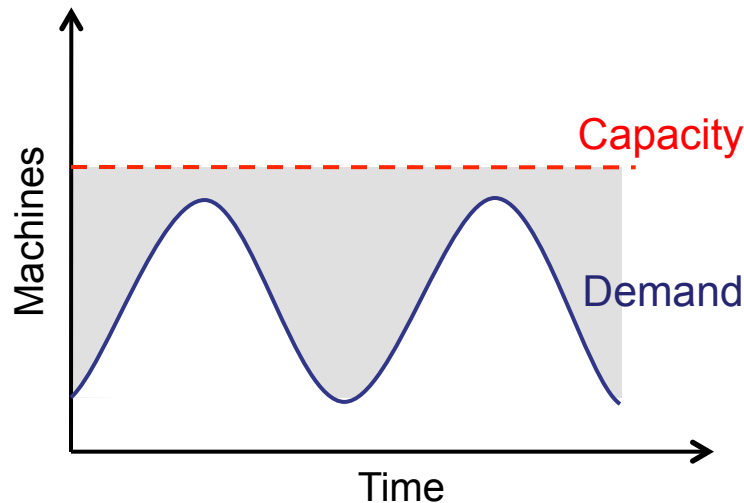
- The first working prototypes of the Internet and of computing as a utility were demonstrated in:

(a) 1969

(b) 1978

(c) 1983

(d) 1990

Why Now?
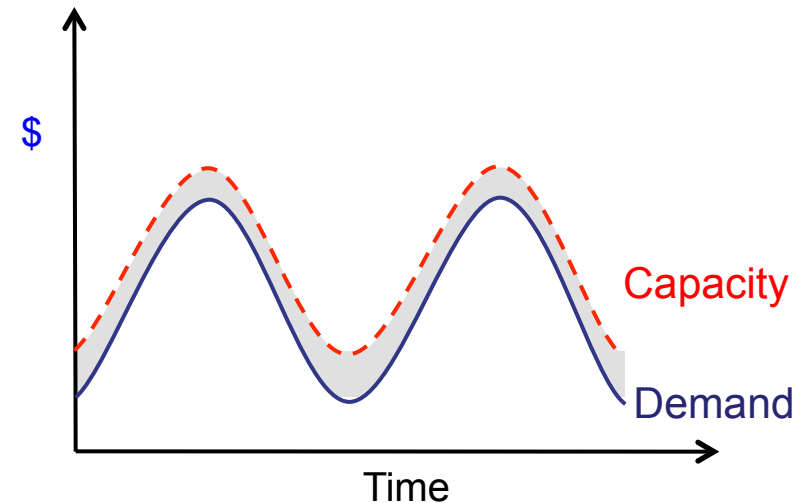
- Communication

- Scalability

- Dependability

Cloud Economics 101

- Provisioning for peaks: wasteful, but necessary

"Statically provisioned" data center

"Virtual" data center in the cloud

Unused resources

Risk Transfer
(or: who remembers Friendster?)

Lost revenue

Lost users
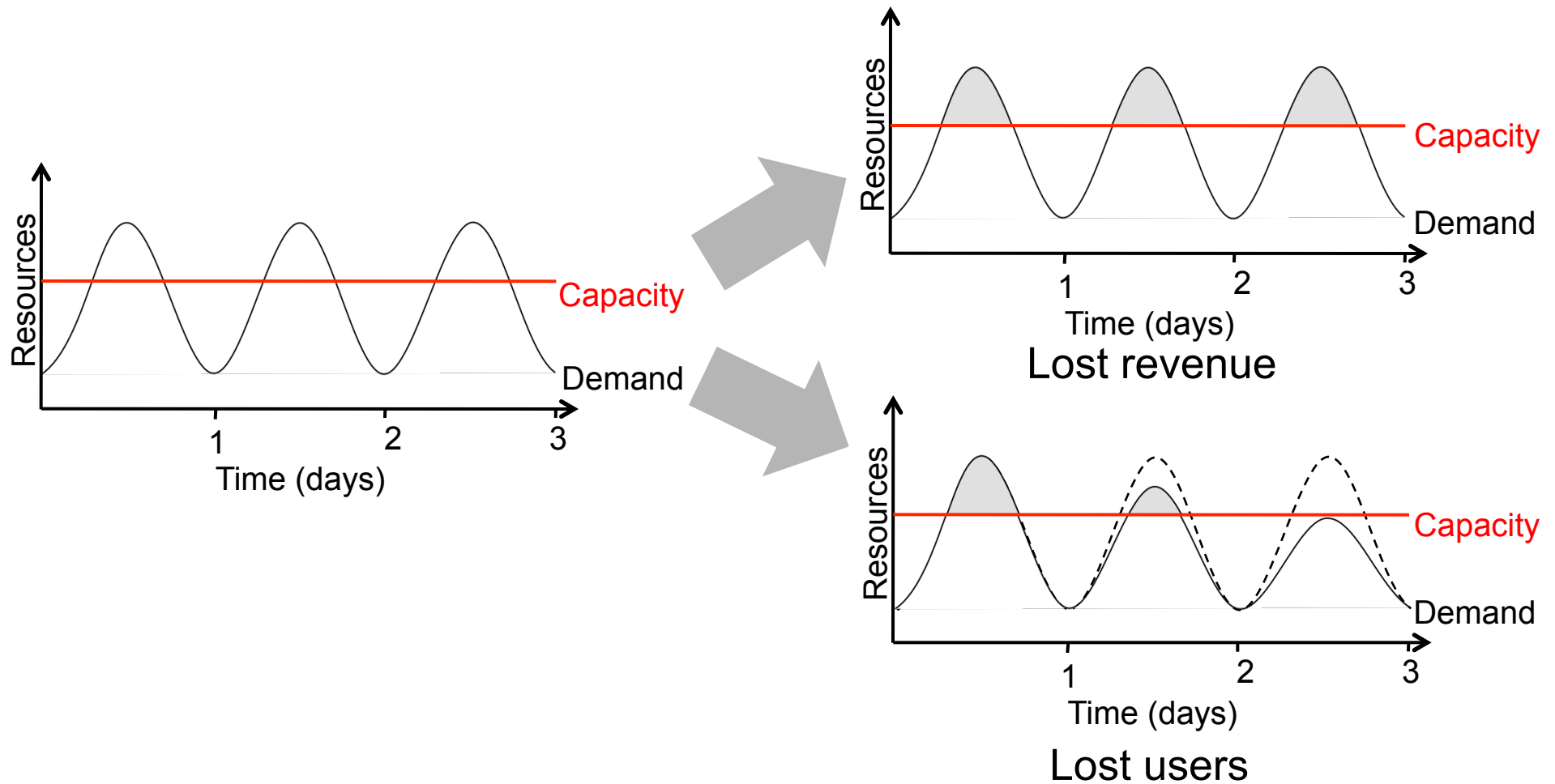
Cost Associativity

- 1,000 CPUs for 1 hour same price as 1 CPU for 1,000 hours

- Washington Post converted Hillary Clinton's travel documents to post on WWW
  - Conversion time: **<1 day** after released
  - Cost: less than $200

- RAD Lab graduate students demonstrate improved MapReduce scheduling—on 1,000 servers

What cool things can we do with the cloud in academia?

CS 169: cloud supports SW *development* too!

- Develop your app

- Keep track of your code

- Test your app on different browsers

- Deploy it to the world

Total UCB computer resources: zero

2012: Cloud Computing and a MOOC*

- saas-class.org: first 5 weeks of CS 169
- >75,000 students learning SaaS programming!
- Cloud computing for autograding
  - What happens when 25,000 students submit a programming HW on the same day…?
- July 24, 2012: UC Berkeley joins edX
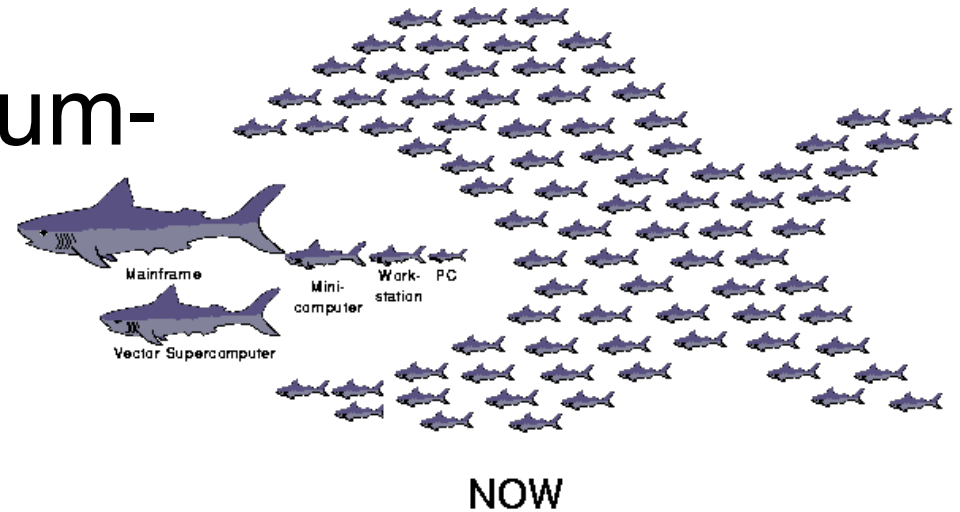
* massive open online class

Future of Software:

- Cloud *democratizes access* to large-scale computing, accelerates "SaaS-ification"

- Students, researchers, entrepreneurs can now have even greater impact

- New research & education opportunities

- **2000**: using medium-sized clusters for Internet services => several PhD's

- **2010**: CS169 students do it in 6-8 weeks and deploy on cloud computing, which is also used to grade their work.

- **2020**: ?

Thank you!

RAD Lab, 2011