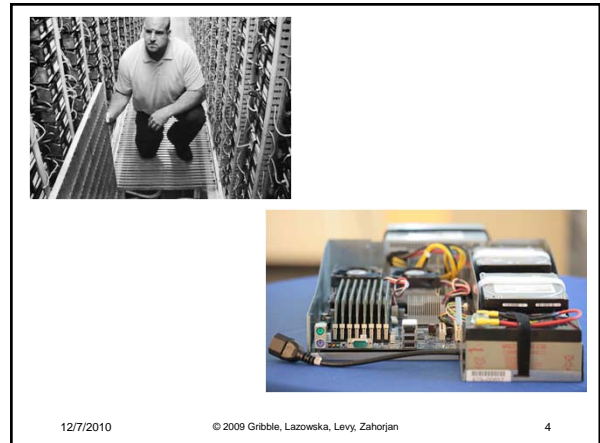
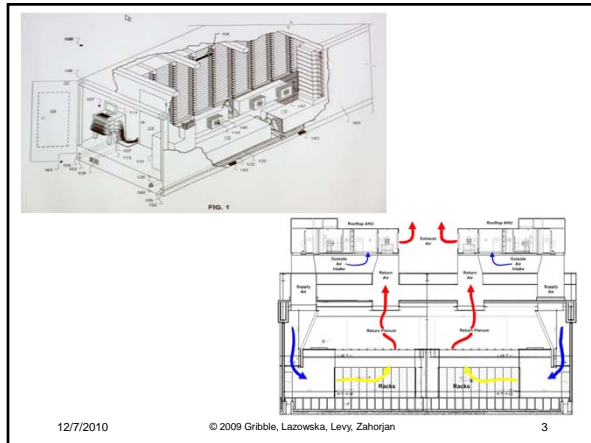
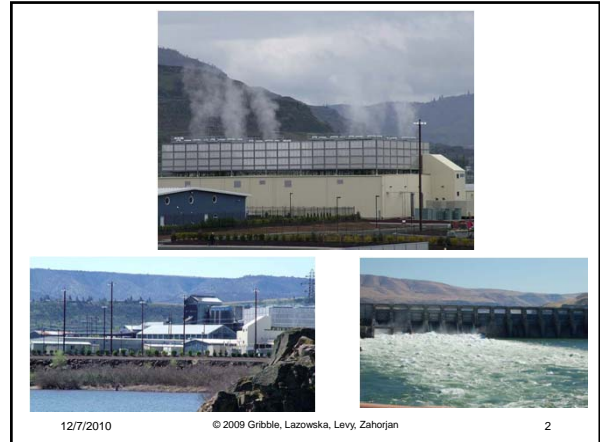


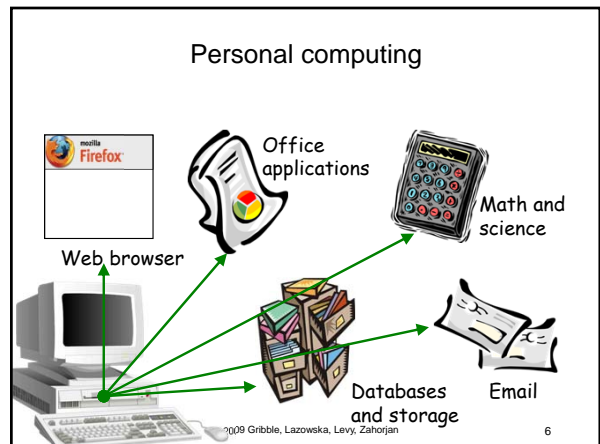
CSE 451: Operating Systems
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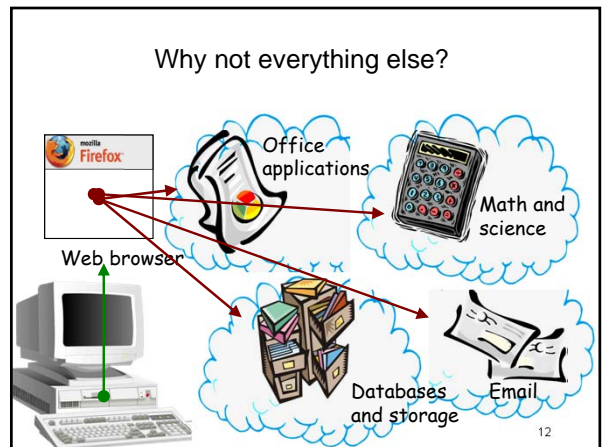
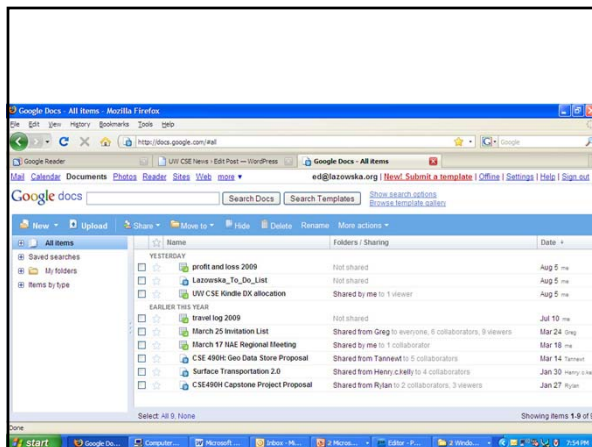
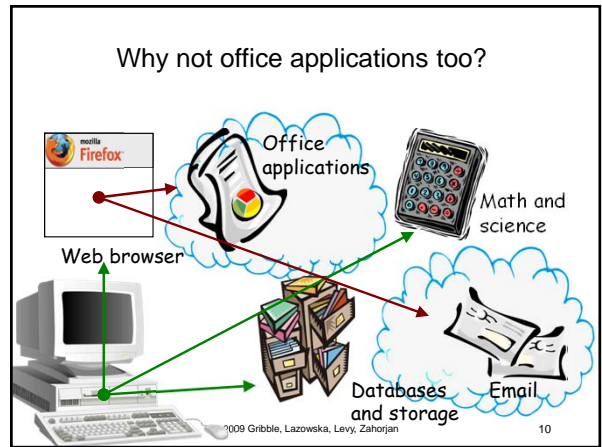
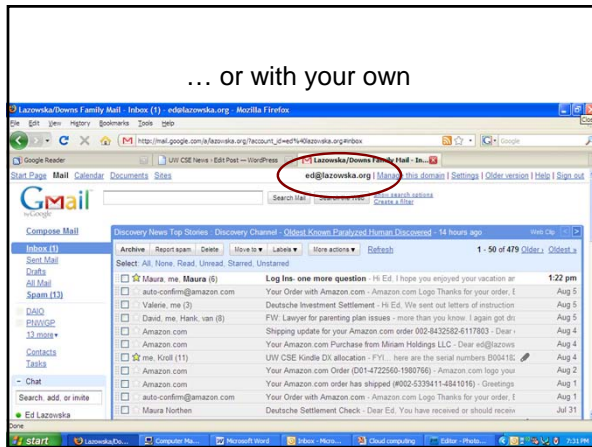
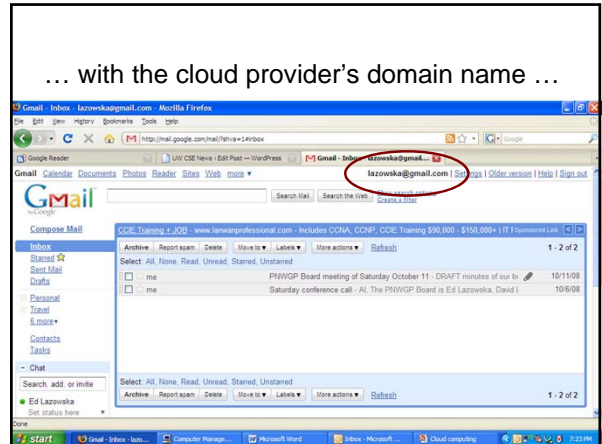
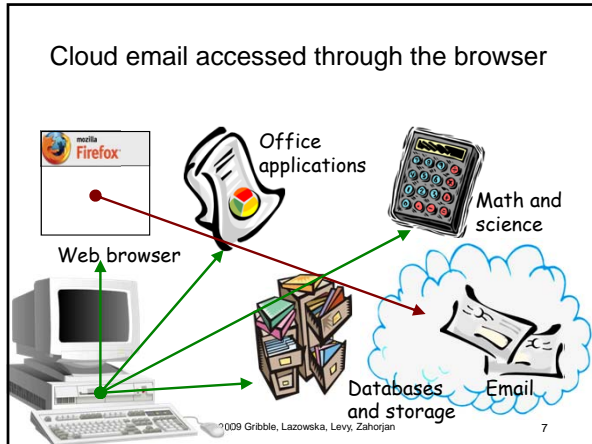
Module 25
Cloud Computing

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- A datacenter has 50 - 250 containers
- A container has 1,000 - 2,000 servers
- A server has two processors, 2 disks, tons of memory, battery backup
- Processors are chosen for power efficiency, not performance





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Consider ...

- Sharing is easy
- Someone else does backup
- Someone else handles software updates
- There's 7x24x365 operations support, auxiliary power, redundant network connections, geographical diversity
- Scalability – both up and down – is instantaneous
- Many fewer demands on the local operating system and machine

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Amazon Elastic Compute Cloud (EC2)

- \$0.68 per hour for
 - 4 cores of 2.5 GHz 64-bit 2007 Xeon or Opteron
 - 15 GB memory
 - 1.69 TB scratch storage
- Need it 24x7 for a year?
 - \$3900
- \$0.085 per hour for
 - 1 core of 1.2 GHz 32-bit Intel or AMD
 - 1.7 GB memory
 - 160 GB scratch storage
- Need it 24x7 for a year?
 - \$490

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- This includes
 - Purchase + replacement
 - Housing
 - Power
 - Operation
 - Reliability
 - Security
 - Instantaneous expansion and contraction
- 1000 processors for 1 day costs the same as 1 processor for 1000 days!

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Lowest Possible Price for a 3-year Rental of AWS Resources

Price per EC2 Compute Unit (amount of RAM, scratch storage, etc. varies)
Price per GB of RAM (number of EC2 compute units, total amount of RAM on the instance, amount of scratch storage, etc. varies)

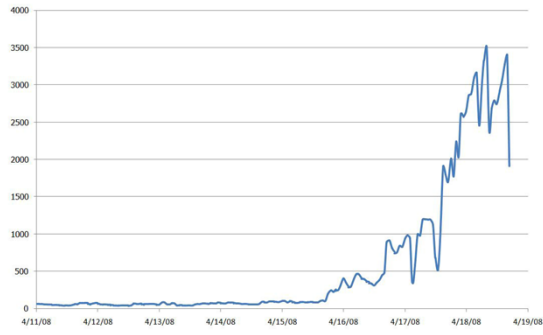
November 21, 2010

- Over time, the price to rent 1 unit of resources for three years of continuous usage has fallen dramatically as Amazon lowers prices, offers new instance types, and offers new long-term pricing plans.
- Price includes up-front reservation charge plus continuous hourly usage fees for 3 years
- The price is defined as the lowest possible price regardless of instance type. For example, a High CPU instance offers 20X the compute power, but only costs 6X the amount. Similarly, a High Memory instance type offers 10X the main memory, but only costs about 6X the price. So the cost per unit (either compute or memory) dropped when these new instance types were announced.
- The new reserves are normalized to 1 EC2 compute unit (1 core) (approximately equivalent to a 1.0 GHz CPU) and 1 GB of RAM (std).
- These prices are potentially overvalued, since existing customers benefit from a price reduction just like new customers. So your total cost for a 3-year deployment in 2007 is lower if prices are reduced in 2008.

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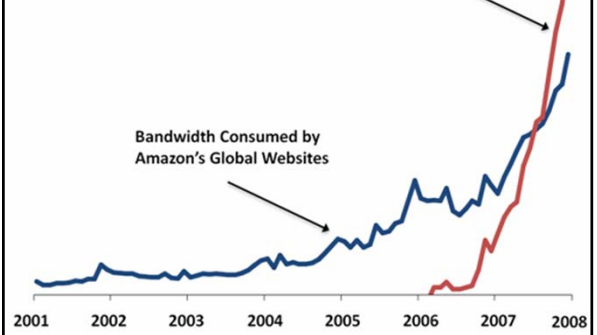
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Animoto: EC2 Instance Usage



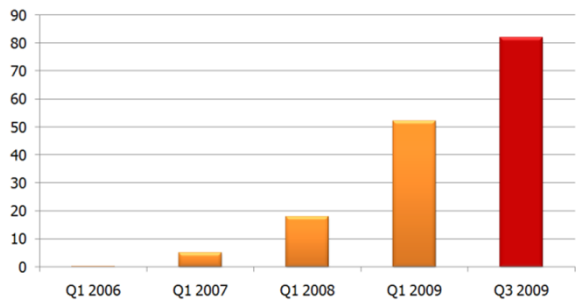
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Bandwidth Consumed by Amazon Web Services

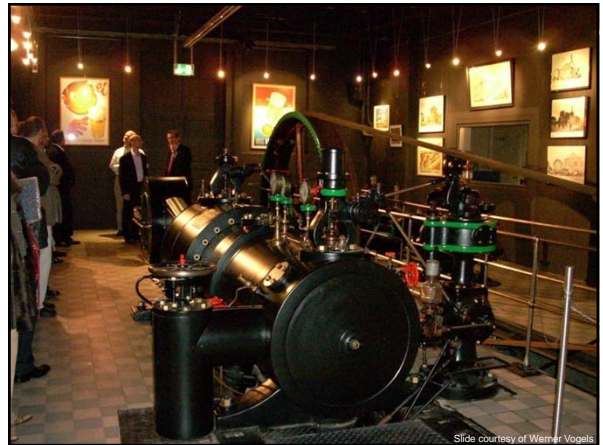


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82 Billion Objects in Amazon S3



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