

# Teaching Computer Science in the Cloud

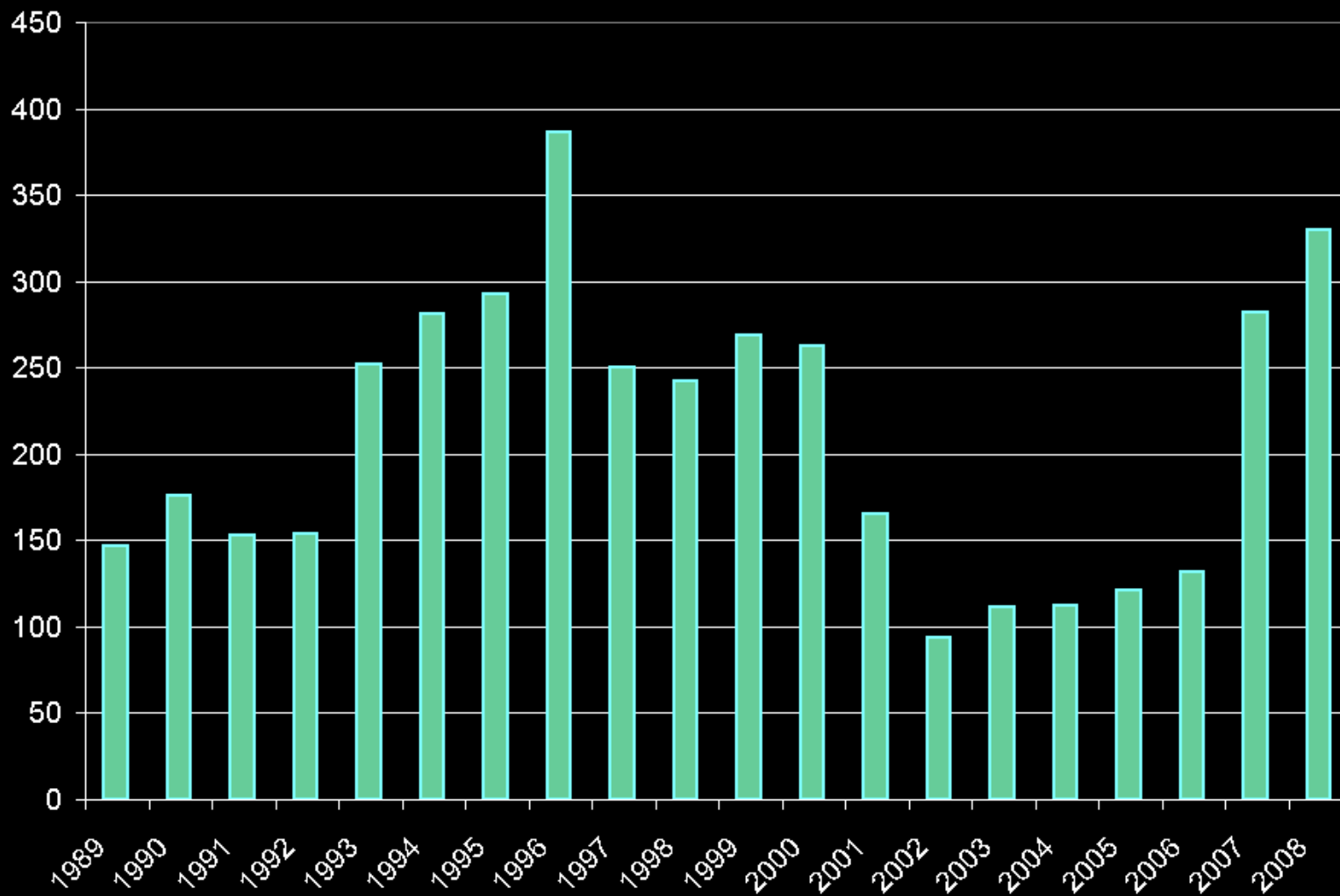
**David J. Malan**

Harvard University

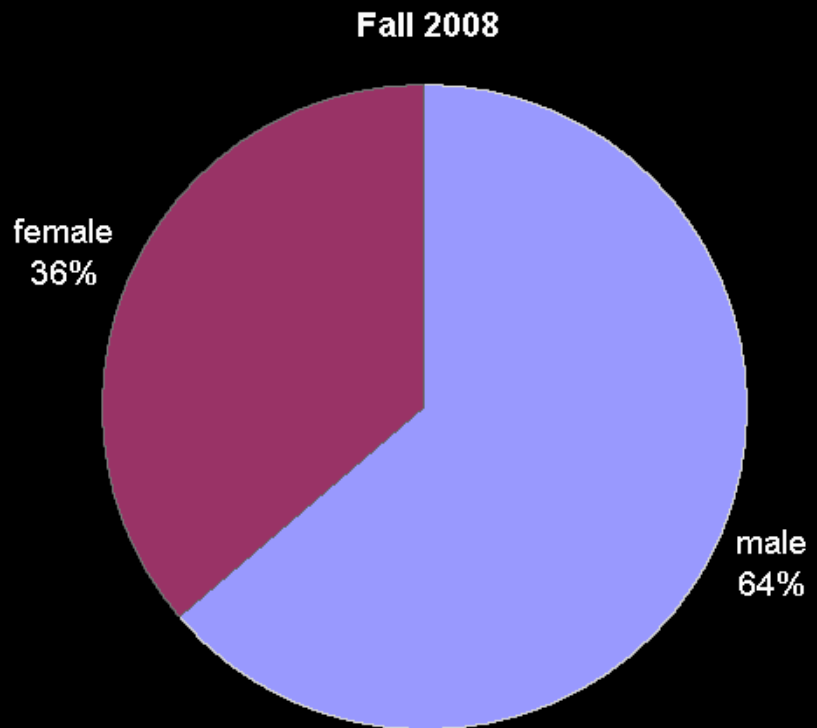
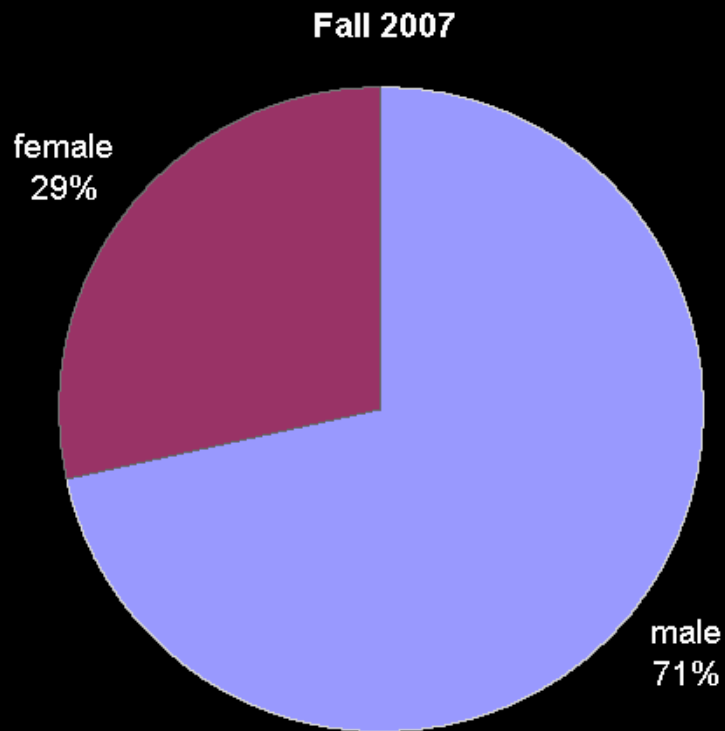
malan@post.harvard.edu

This is CS 50.

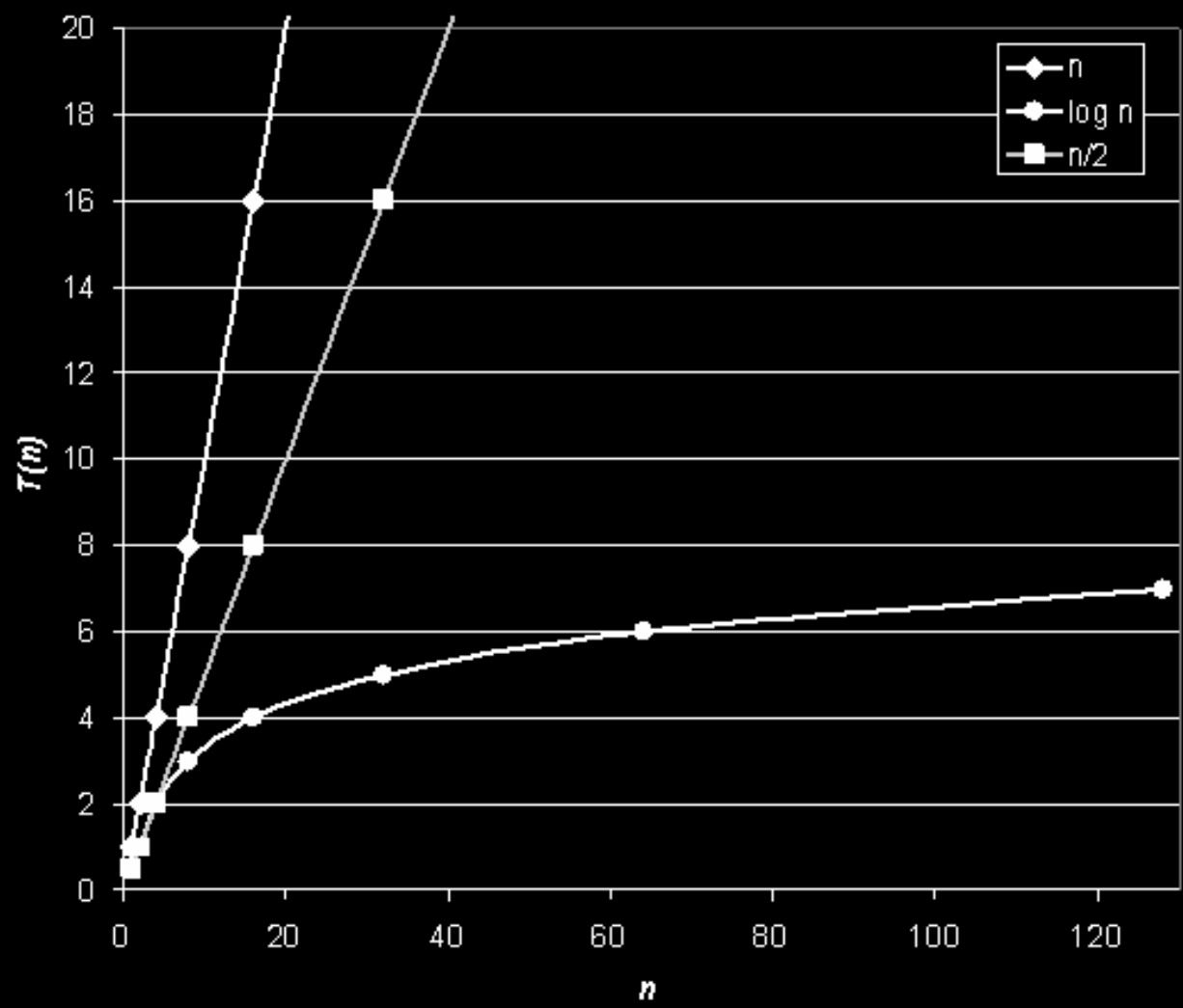
# Enrollment's Increased 150%



# Female Enrollment's Increased 48%









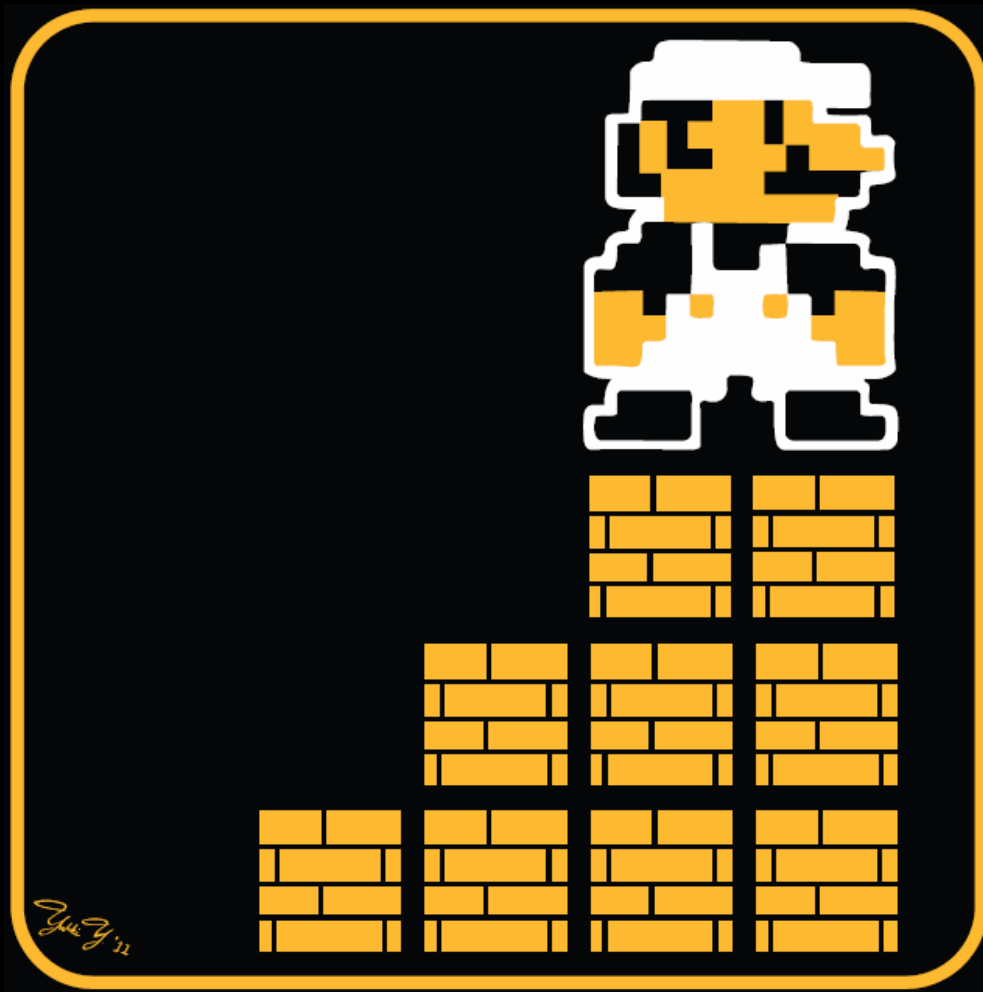




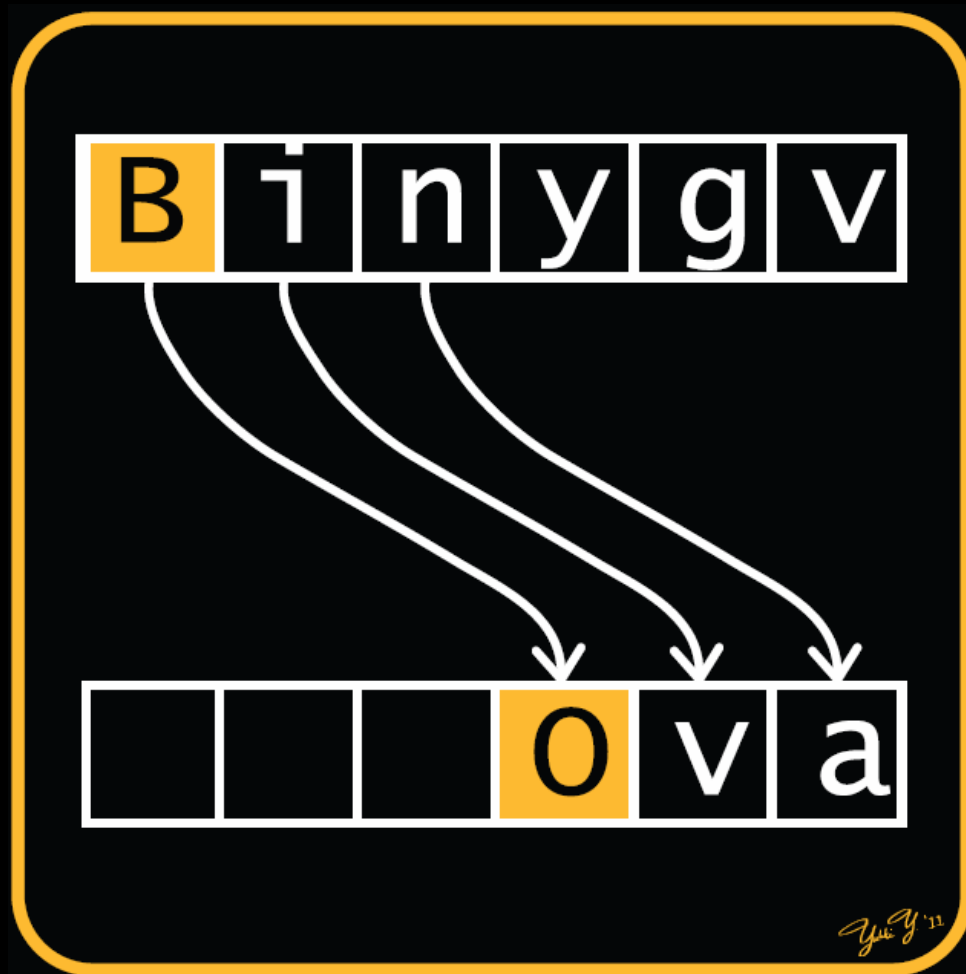
**“You will also become addicted to useless internet-memes, but that is expected, as with great power comes even more creative ways to procrastinate.”**



**0: Scratch**



1:C



2: Crypto



### 3: Game of Fifteen

# 数独

8			4		6			7
						4		
	1					6	5	
5		9		3		7	8	
				7				
	4	8		2		1		3
	5	2					9	
		1						
3			9		2			5

2011.11.11

4: Sudoku



## 5: Forensics

Teh Computer Sci-  
ence 50 learnz you  
about intertubes in  
teh cloudz. David J.  
Malan will pwn u  
ftw so watch out!

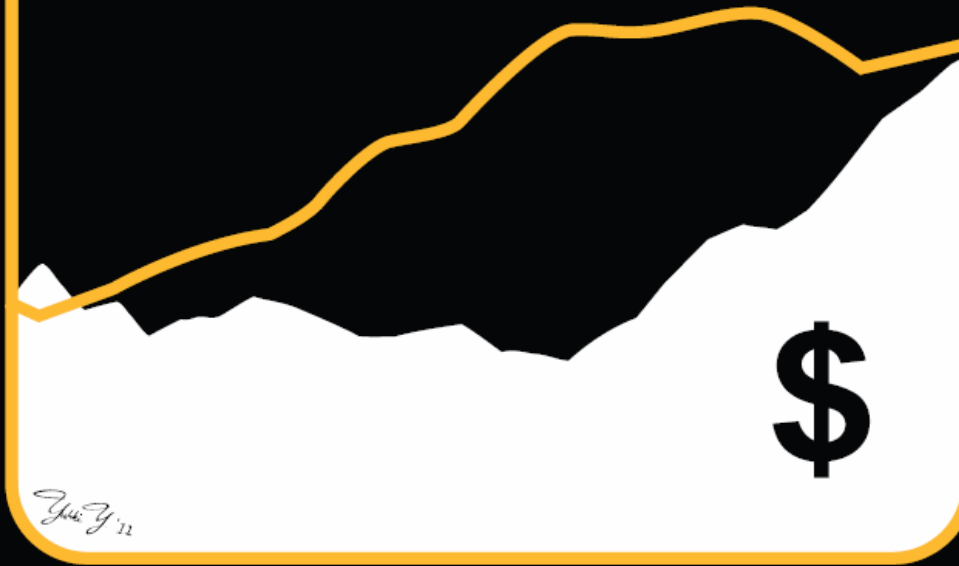
*David J. Malan*

## 6: Misspellings



**CS50**

↑ **120**



**7: C\$50 Finance**



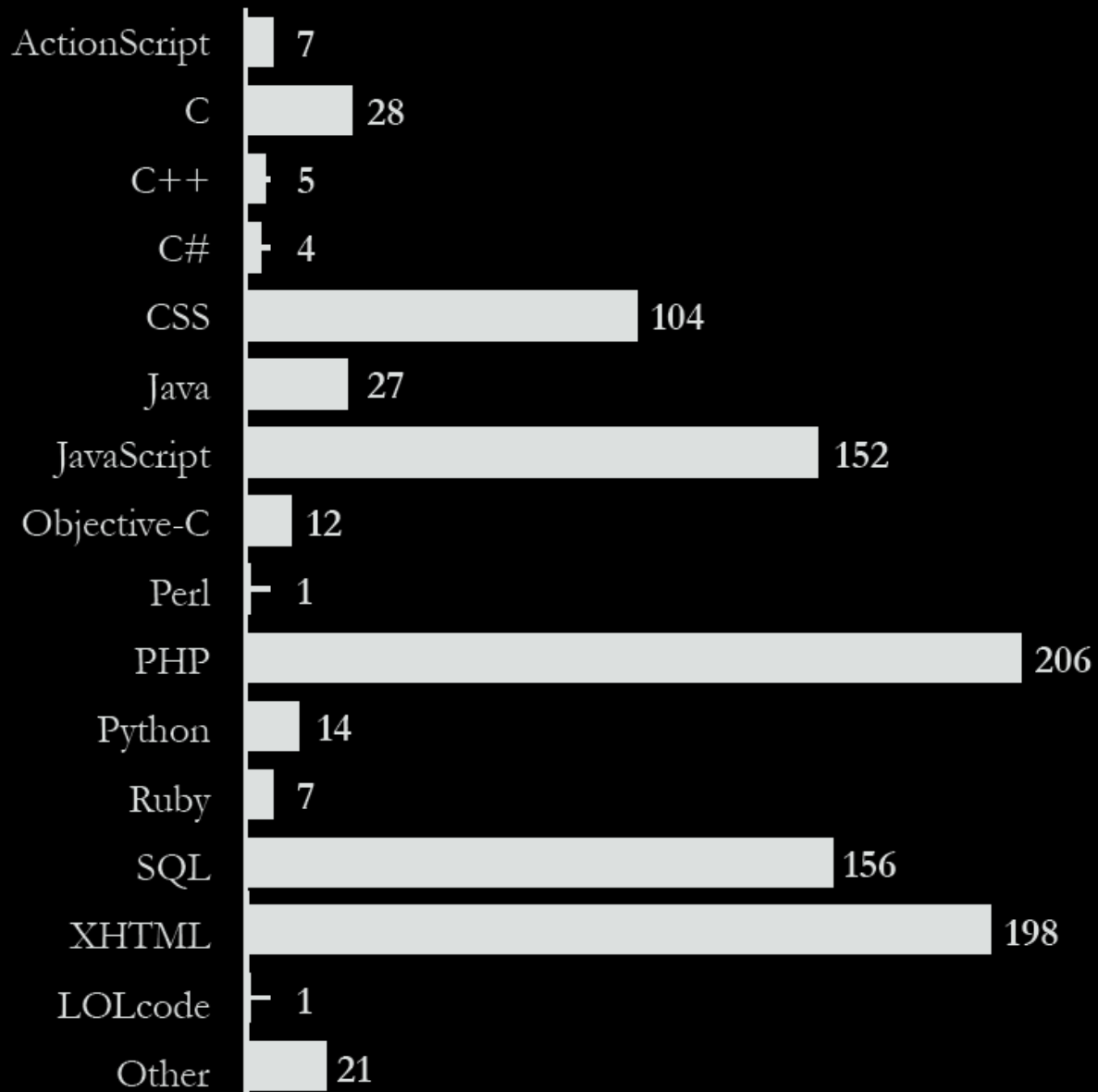
## 8: Mashup

THE

CS 50

FAIR

## What languages were used for the projects?



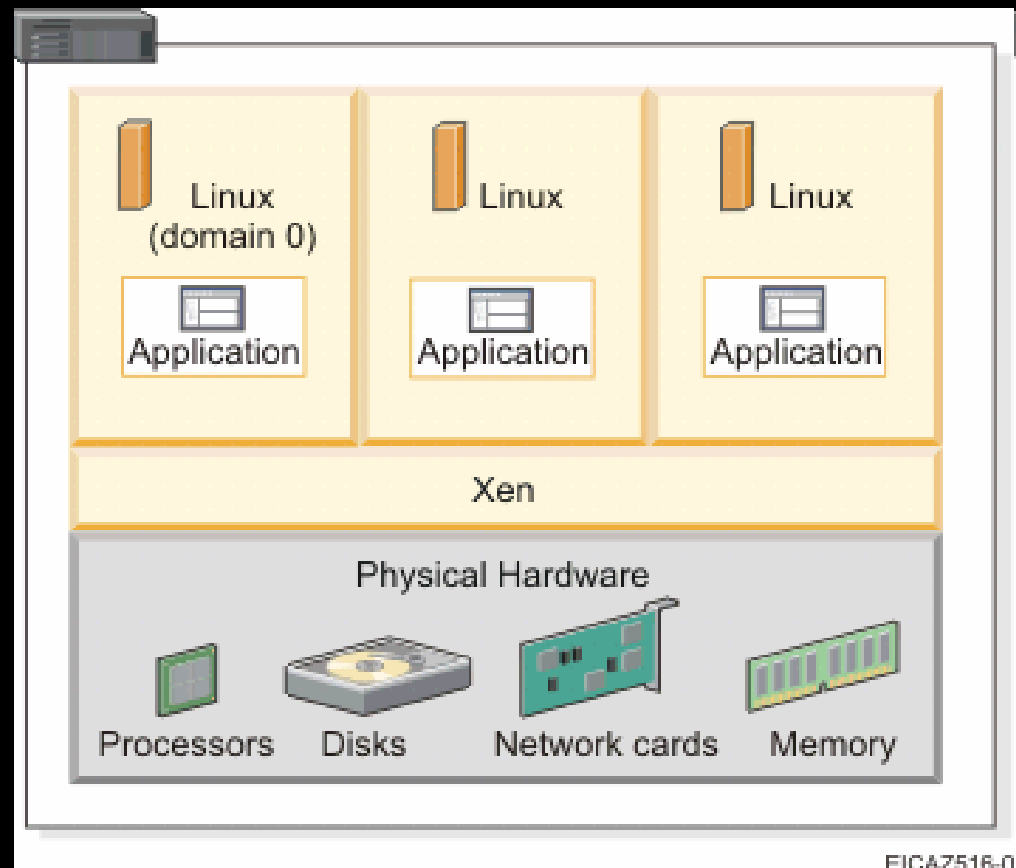


amazon  
web services™

# Self-service, Prorated Super Computing Fun!

- “The New York Times has decided to make all the public domain articles from 1851-1922 available free of charge. These articles are all in the form of images scanned from the original paper. In fact from 1851-1980, all 11 million articles are available as images in PDF format. To generate a PDF version of the article takes quite a bit of work — each article is actually composed of numerous smaller TIFF images that need to be scaled and glued together in a coherent fashion. . . . I then began some rough calculations and determined that if I used only four machines, it could take some time to generate all 11 million article PDFs. But thanks to the swell people at Amazon, I got access to a few more machines and churned through all 11 million articles in just under 24 hours using 100 EC2 instances . . . . (In fact, it work so well that we ran it twice, since after we were done we noticed an error in the PDFs.)”

# Virtualization



# Virtualization

- **Xen**
- VMware
  - Workstation, Fusion, Server, ESXi, vSphere
- Parallels
  - Workstation, Server for Mac, Virtuozzo
- Microsoft
  - Hyper-V, Virtual PC
- Sun
  - VirtualBox
- QEMU
- FreeVPS
- Virtual Iron
- ...



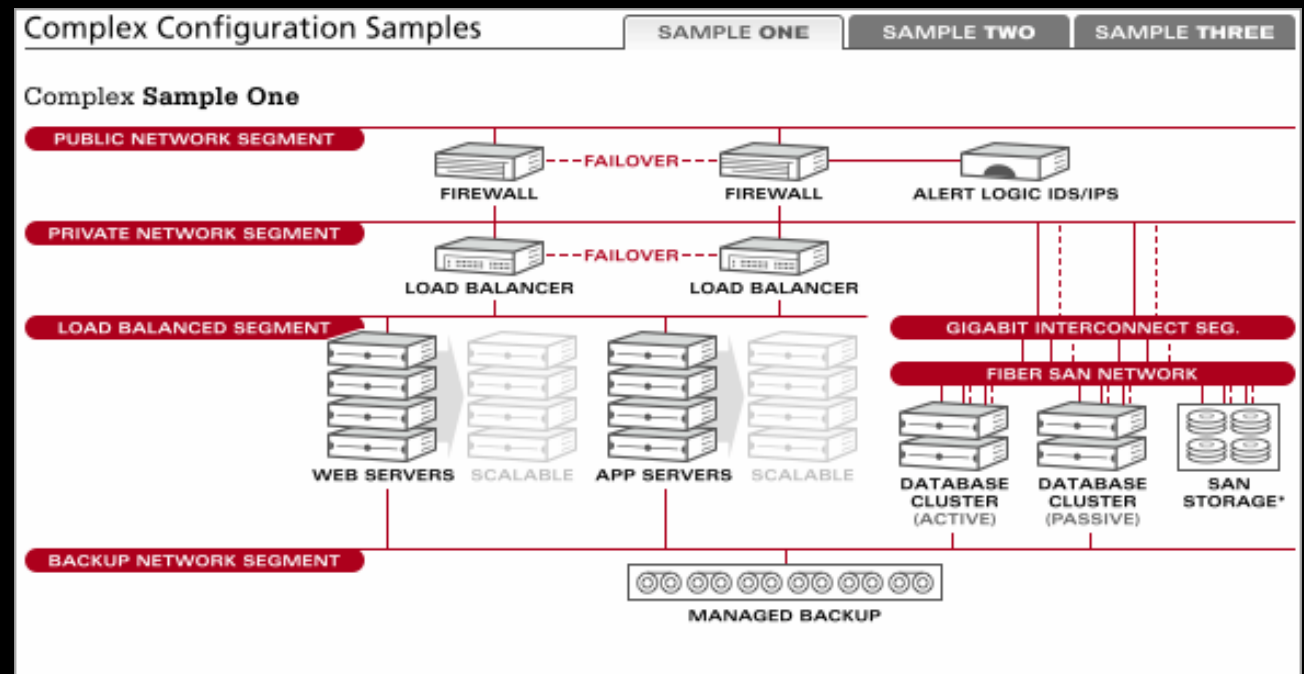
# Virtual Private Servers (VPSeS)

- Linode
- ServInt
- TekTonic
- VPSLAND
- ...

SuperVPS	SuperVPS 125	SuperVPS 2x <small>Best Value!</small>
<b>75 GB Disk Space</b> <b>3 TB Monthly Transfer</b> <b>4 GB Guaranteed (8 GB Burst RAM)</b> 1 CPU Core Guaranteed (Burst to 4 Cores) Hardware RAID 10 CentOS 5 Operating System 4 IP Addresses Unlimited Domains and User Accounts FREE Virtuozzo Power Panel FREE nightly backups FREE cPanel or Plesk 9 Available [details] No set-up fee <b>\$199 monthly</b> <a href="#">Features, Upgrades and Options</a>	<b>125 GB Disk Space</b> <b>3.5 TB Monthly Transfer</b> <b>4 GB Guaranteed (8 GB Burst RAM)</b> 1 CPU Core Guaranteed (Burst to 4 Cores) Hardware RAID 10 CentOS 5 Operating System 4 IP Addresses Unlimited Domains and User Accounts FREE Virtuozzo Power Panel FREE nightly backups FREE cPanel or Plesk 9 Available [details] No set-up fee <b>\$229 monthly</b> <a href="#">Features, Upgrades and Options</a>	<b>150 GB Disk Space</b> <b>6 TB Monthly Transfer</b> <b>8 GB Guaranteed (16 GB Burst RAM)</b> 2 CPU Cores Guaranteed (Burst to 8 Cores) Hardware RAID 10 CentOS 5 Operating System 4 IP Addresses Unlimited Domains and User Accounts FREE Virtuozzo Power Panel FREE nightly backups FREE cPanel or Plesk 9 Available [details] No set-up fee <b>\$349 monthly</b> <a href="#">Features, Upgrades and Options</a>
<a href="#">ORDER</a>	<a href="#">ORDER</a>	<a href="#">ORDER</a>

# Managed Colocation

- Rackspace
- ...



# Clouds

- Amazon Elastic Compute Cloud (Amazon EC2)
- Google App Engine
- Microsoft Azure Services Platform
- ...

# Amazon Web Services (AWS)

- **Amazon Elastic Compute Cloud (Amazon EC2)**
- Amazon Simple Storage Service (Amazon S3)
- Amazon SimpleDB
- Amazon CloudFront
- Amazon Simple Queue Service (Amazon SQS)
- Amazon Elastic MapReduce

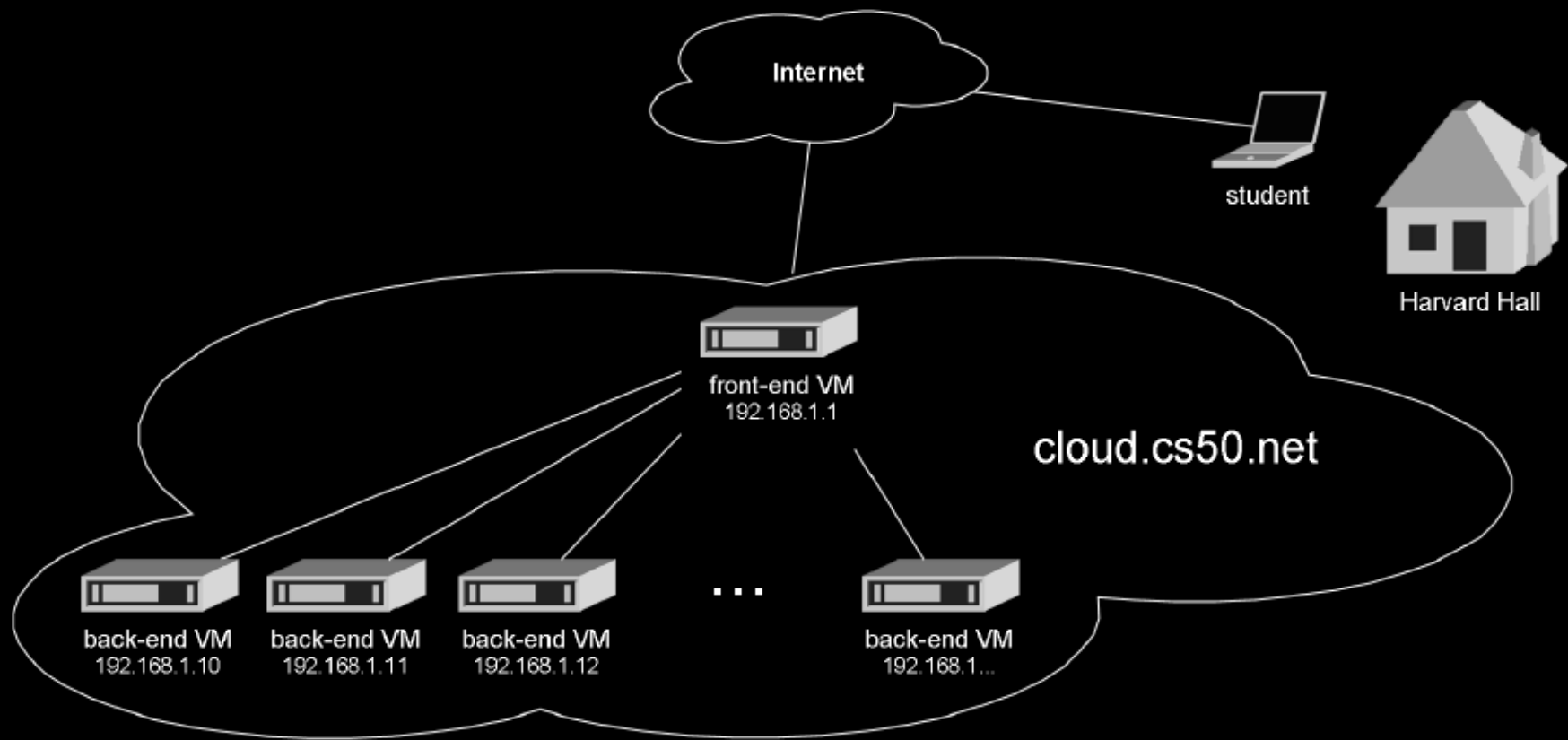
# Amazon Machine Images (AMIs)

- Debian
- Fedora
- Gentoo Linux
- Red Hat Enterprise Linux
- OpenSolaris
- openSUSE Linux
- Oracle Enterprise Linux
- Ubuntu Linux
- Windows Server 2003
- ...

# On-Demand Instances

United States	Europe	
<b>Standard On-Demand Instances</b>	<b>Linux/UNIX Usage</b>	<b>Windows Usage</b>
Small (Default)	\$0.10 per hour	\$0.125 per hour
Large	\$0.40 per hour	\$0.50 per hour
Extra Large	\$0.80 per hour	\$1.00 per hour
<b>High CPU On-Demand Instances</b>	<b>Linux/UNIX Usage</b>	<b>Windows Usage</b>
Medium	\$0.20 per hour	\$0.30 per hour
Extra Large	\$0.80 per hour	\$1.20 per hour

# cloud.cs50.net



# Cost Less than \$15 per Student

	<b>CPU</b>	<b>Disk</b>	<b>I/O Requests</b>	<b>Bandwidth</b>
<b>Sep</b>	2,275 Hrs	125 GB	45,348	14 GB
<b>Oct</b>	3,425 Hrs	108 GB	93,257,314	191 GB
<b>Nov</b>	5,484 Hrs	199 GB	337,019,916	239 GB
<b>Dec</b>	5,206 Hrs	300 GB	427,639,962	52 GB
<b>Jan</b>	5,208 Hrs	300 GB	1,502,614,186	62 GB



# Concerns

- Time
- No \_\_\_\_\_
- PEBKAC
- “cloud is laggy”
- “Cloud is wicked laggy”
- Bandwidth Costs
- “Lightning Strike Triggers Amazon EC2 Outage”

**“Sometimes he spends a long time on broad concepts that we already understand, rather than focusing on details like return types or proper usage of functions. For example, he explained cloud computing like 17,000 times, and we don't even need to understand it for the psets.”**

# AWS in Education

- Educators
- Researchers
- Students
- Education IT

# CS 50 in a Box



# Ultra Hal

## New Contestants On the Turing Test

Posted by [CmdrTaco](#) on Wednesday October 08, @11:15AM  
from the **game-on** dept.

vitamine73 writes

"At 9 a.m. next Sunday, six computer programs — 'artificial conversational entities' — will [answer questions posed by human volunteers](#) at the University of Reading in a bid to become the first recognized 'thinking' machine. If any program succeeds, it is likely to be hailed as the most significant breakthrough in artificial intelligence since the IBM supercomputer Deep Blue beat world chess champion Garry Kasparov in 1997. It could also raise profound questions about whether a computer has the potential to be 'conscious' — and if humans should have the 'right' to switch it off."



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