

From Cluster to Cloud to Appliance

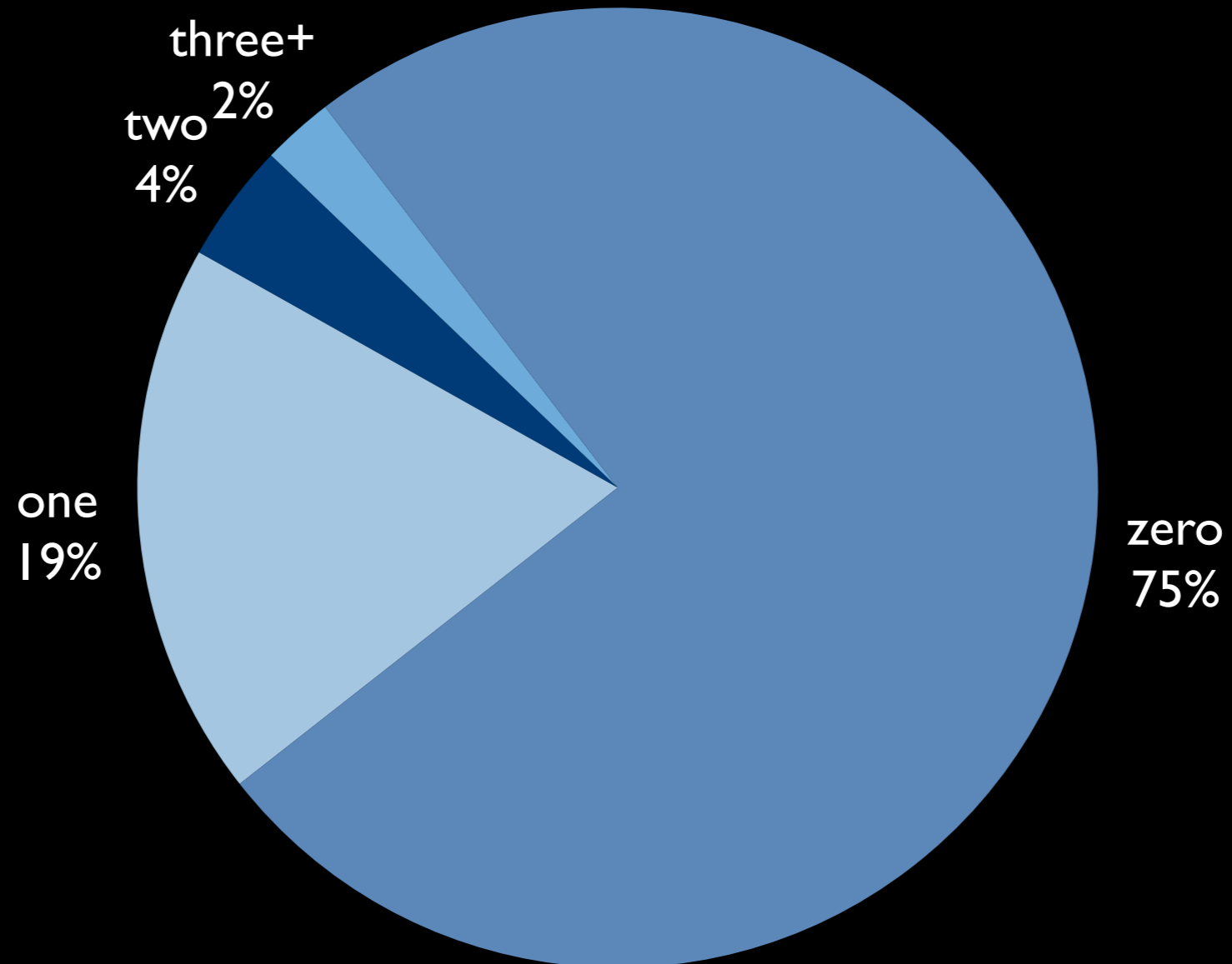
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CS50

Introduction to Computer Science I

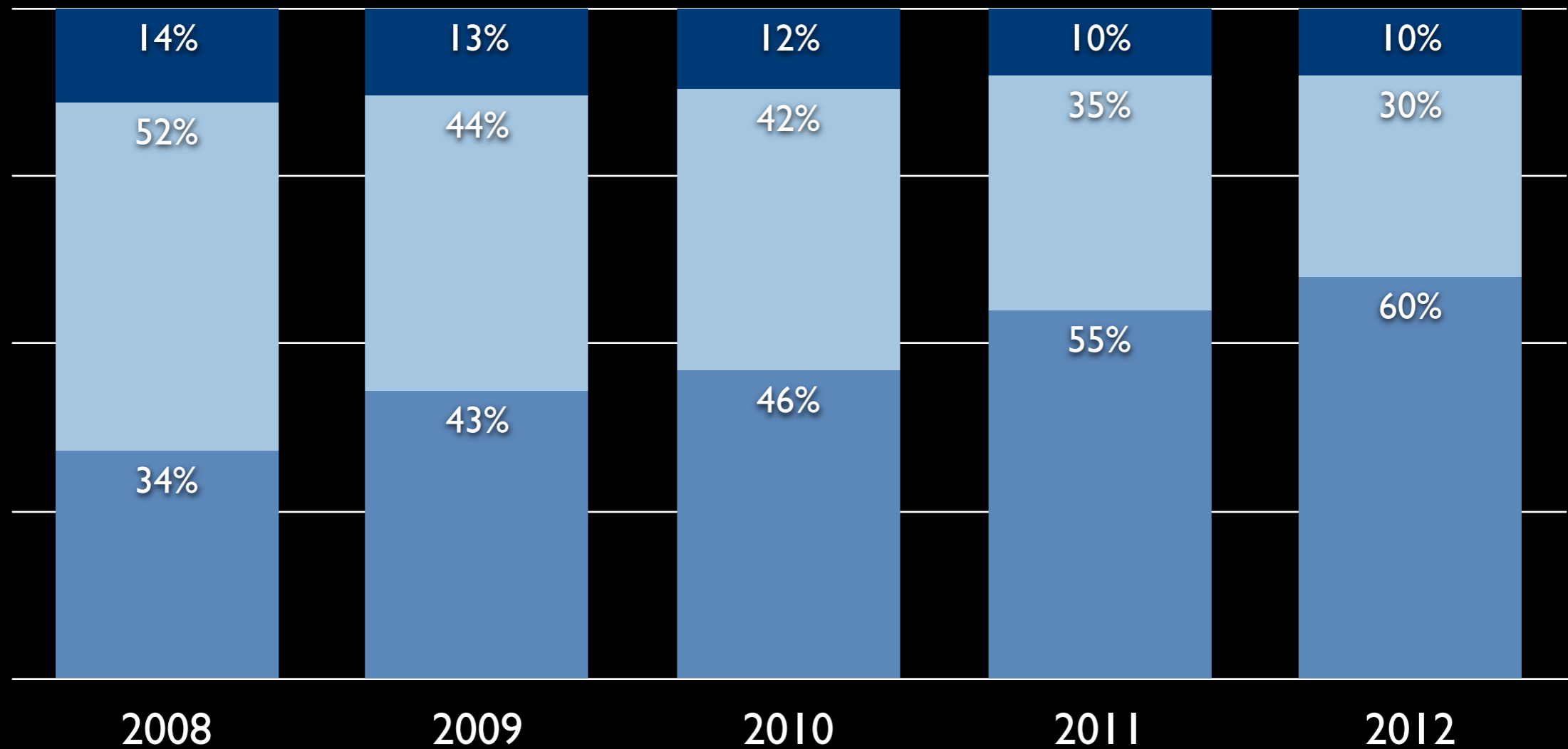
714

prior cs courses



comfort level

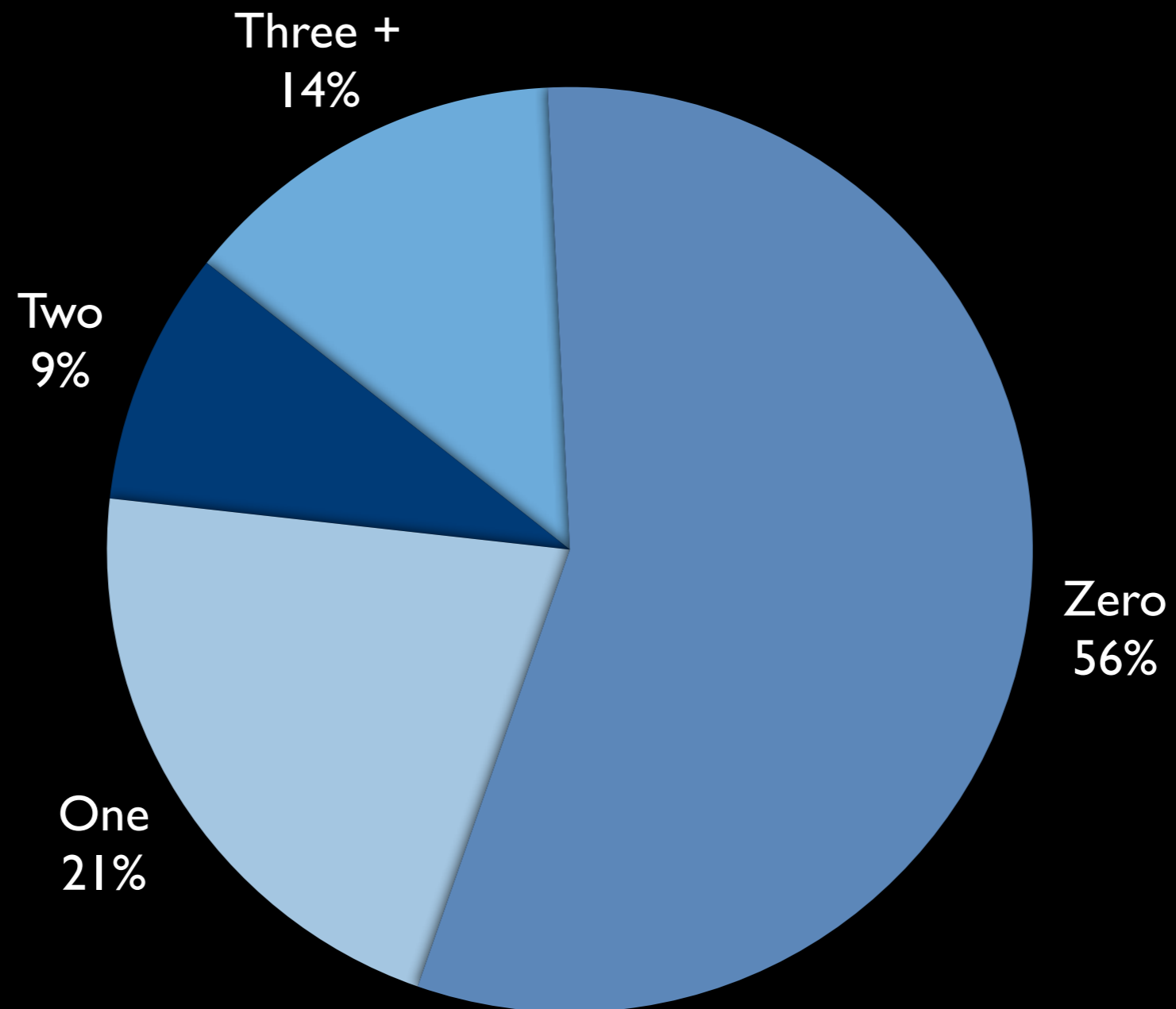
■ less comfortable ■ somewhere in between ■ more comfortable



CS50x

150,349

prior cs courses



on-campus cluster

1990s – 2007

upsides of cluster

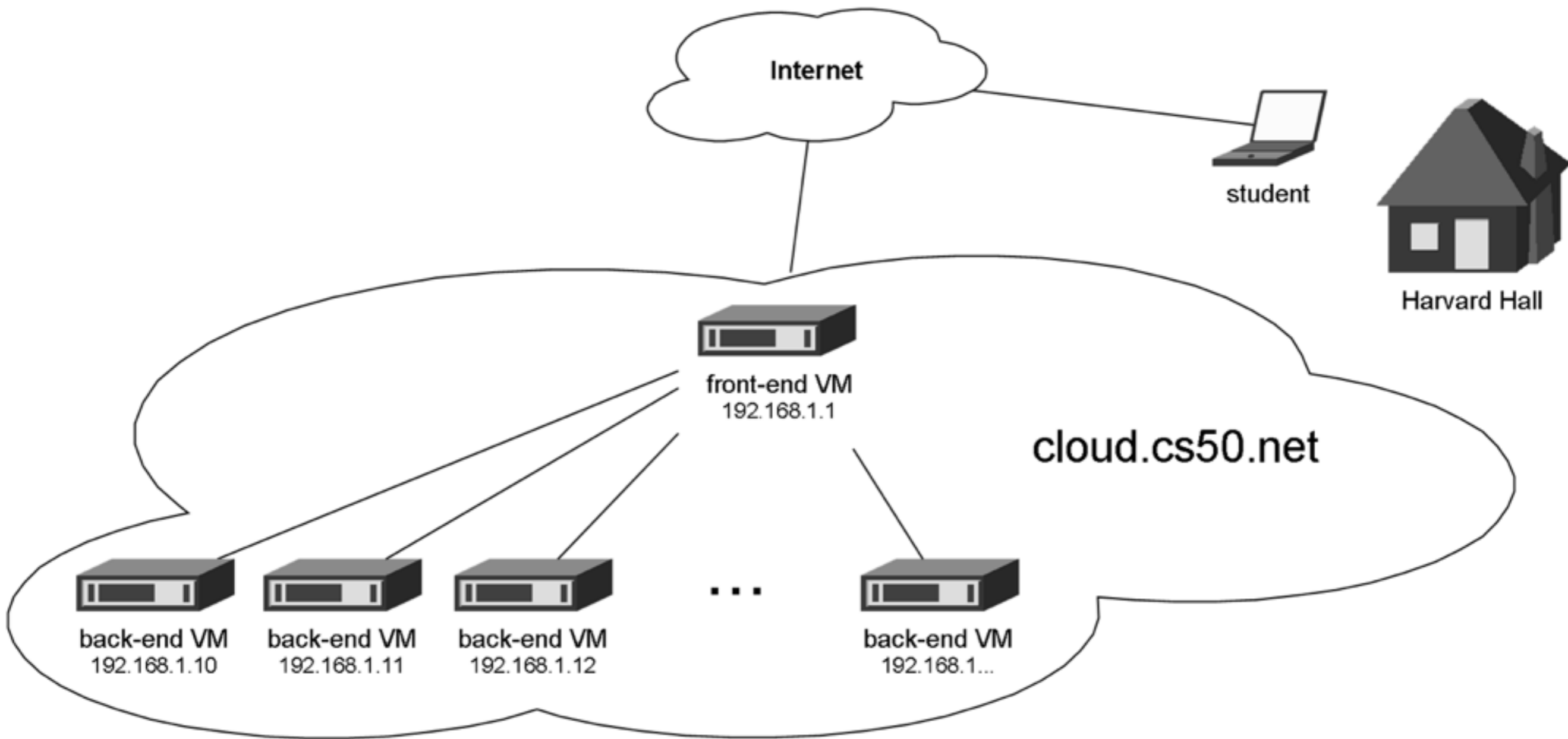
- + managed by university
- + familiar to students

downsides of cluster

- no root access
- outdated software
- no support after hours

off-campus cloud

2008 – 2010



cost \$15 per student

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

upsides of cloud

- + root access
- + examine students' code in situ
- + no need for space, power, or cooling
- + more reliable
- + more scalable
- + topical for class

downsides of cloud

- time-consuming
- difficult (at the time) to configure
- unfamiliar to students
- latency
- mistakes made

CS50.tv

OpenCourseWare

client-side appliance

2011 –



Home



Trash

hello.c (~/.Dropbox) - gedit

File Edit View Search Documents Help

Source Code

hello.c x

Functions

main

```
1 #include <stdio.h>
2
3 int main(void)
4 {
5     printf("hello, world");
6 }
```

Run Program...

CS50 Manual >

Dropbox

TeamViewer

Administration >

Settings >

Accessories >

Graphics >

Internet >

Programming >

Sound & Video >

Log Out

jharvard@appliance (~): gcc hello.c

Terminal

C Tab Width: 4

Ln 6, Col 3

INS

Menu



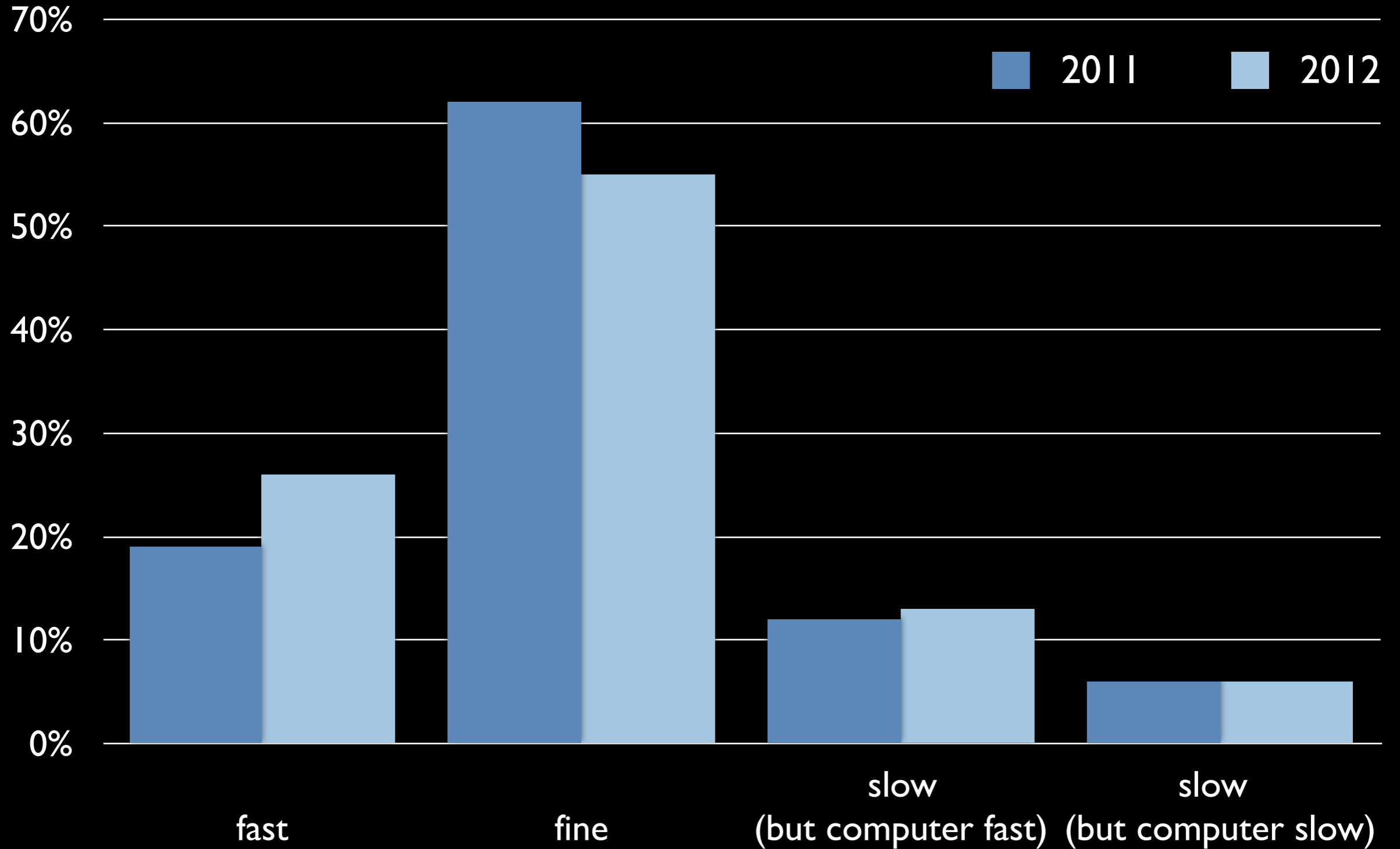
hello.c (~/.Dropbox) - gedit



implementation details

- Fedora Linux, Xfce
- Kickstart
- Boxgrinder
- RPMs (appliance50, cs51, ...)
- VirtualBox, VMware Fusion, VMware Player
- ...

performance



upsides of appliance

- + more familiar environment
- + graphical tools
- + distributed load
- + Apache, MySQL, ...
- + students could add software
- + anyone could engage actively

downsides of appliance

- time-consuming to prepare
- virtualization overhead
- brickable (hypervisor bugs)

key improvements

- TeamViewer
- Guest Additions, VMware Tools
- Dropbox

server-side appliance

2013 –

recommendations

- for large courses
- for departments
- for OpenCourseWare
- for web programming

cs50.net/appliance