

CS615 - System Administration



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<https://stevens.netmeister.org/615/>

New Rules

Close your laptops! (Silence phones etc.)

New Rules

Close your laptops! (Silence phones etc.)

Open your eyes!
(Mind, too.)

The Job of a System Administrator

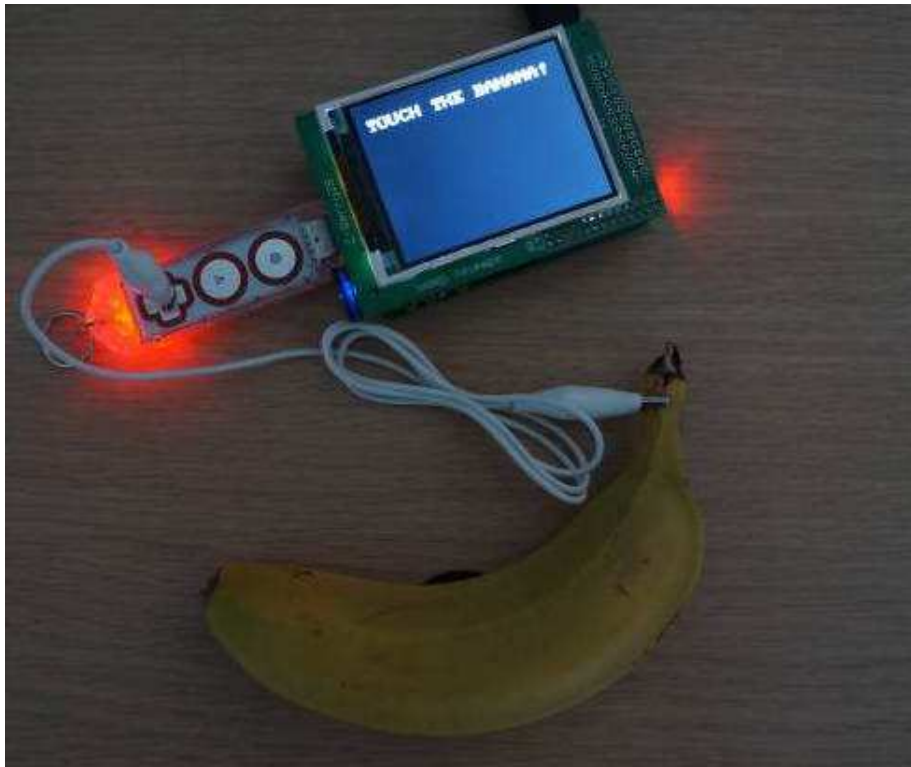
What exactly does a *System Administrator* do?

The Job of a System Administrator



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<https://is.gd/8vKPh1>

The Job of a System Administrator



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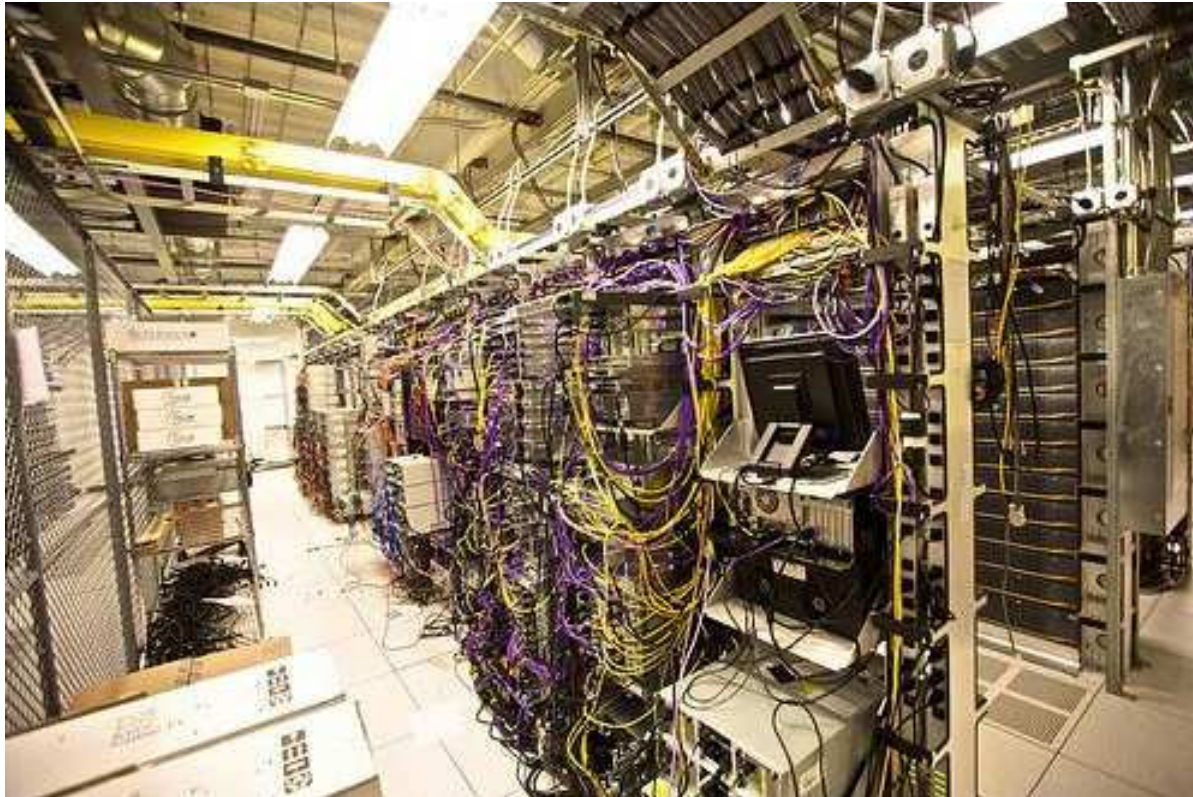
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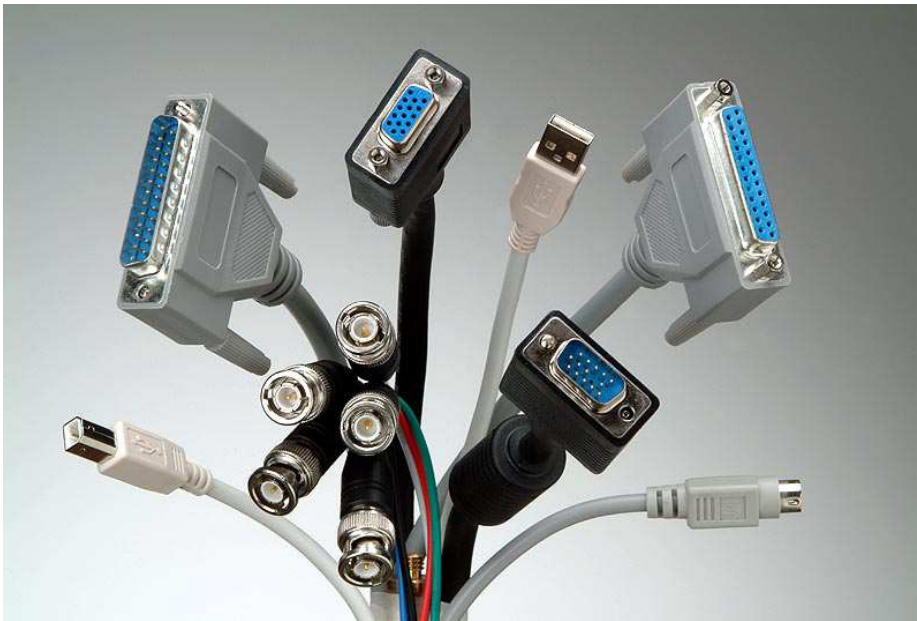
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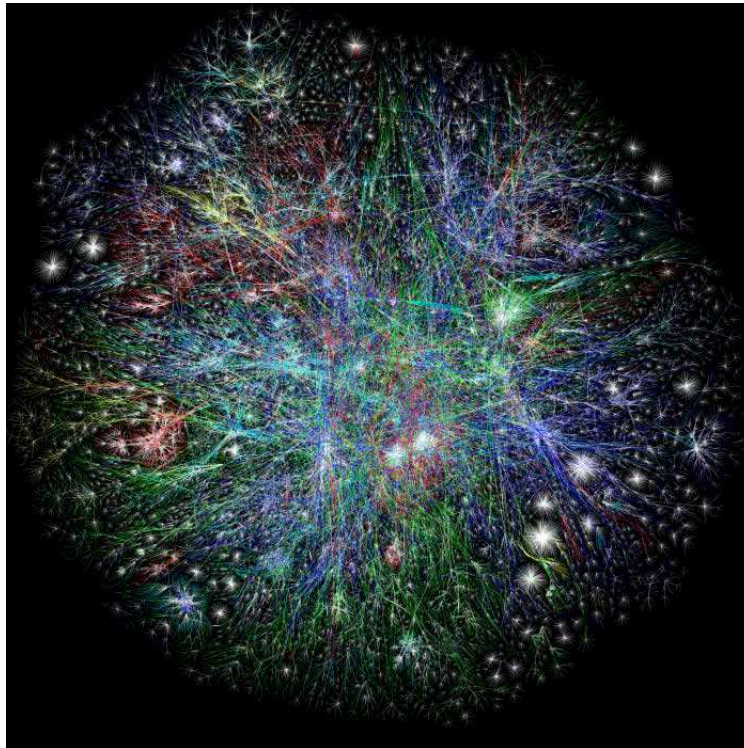


The Job of a System Administrator

```
jschauma — panix [jschauma] — ssh — 80x24
Copyright (c) 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005,
2006, 2007, 2008, 2009
The NetBSD Foundation, Inc. All rights reserved.
Copyright (c) 1982, 1986, 1989, 1991, 1993
The Regents of the University of California. All rights reserved.

NetBSD 5.0.2 (PANIX-VC) #2: Tue Oct 19 16:30:57 EDT 2010
root@juggler.panix.com:/misc3/obj/misc2/devel/netbsd/5.0.2/src/sys/arch/
amd64/compile/PANIX-VC
total memory = 768 MB
avail memory = 732 MB
timecounter: Timecounters tick every 10.000 msec
mainbus0 (root)
hypervisor0 at mainbus0: Xen version 3.4
vcpu0 at hypervisor0: Intel 686-class, 2333MHz, id 0x10676
debug virtual interrupt using event channel 3
xenbus0 at hypervisor0: Xen Virtual Bus Interface
xencons0 at hypervisor0: Xen Virtual Console Driver
xencons0: console major 143, unit 0
xencons0: using event channel 2
timecounter: Timecounter "clockinterrupt" frequency 100 Hz quality 0
Xen clock: using event channel 4
timecounter: Timecounter "xen_system_time" frequency 1000000000 Hz quality 10000
/var/run/dmesg.boot 50%
```

The Job of a System Administrator



<http://www.opte.org/maps/>

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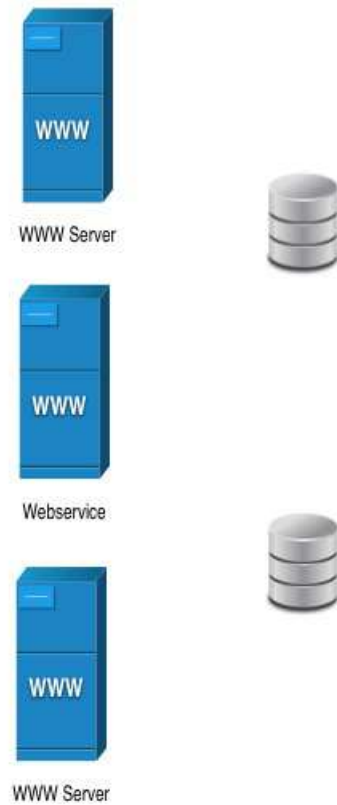


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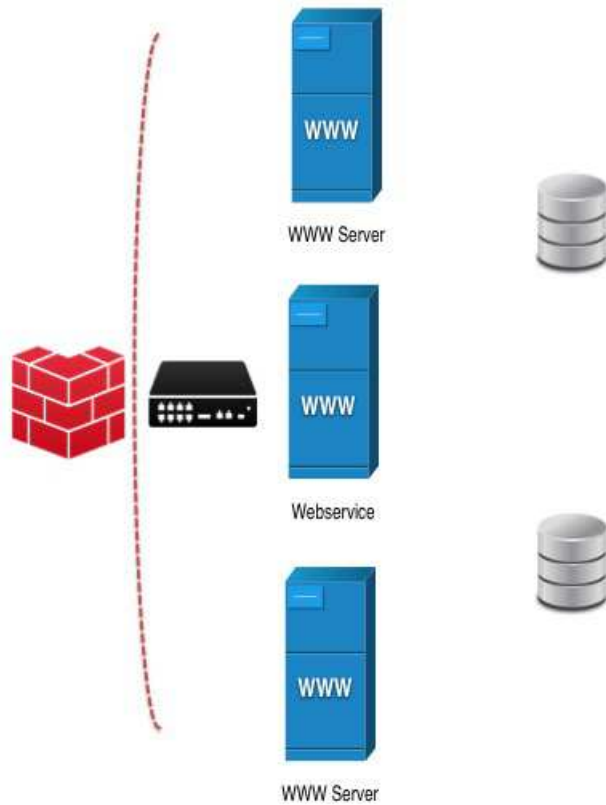


Webservice

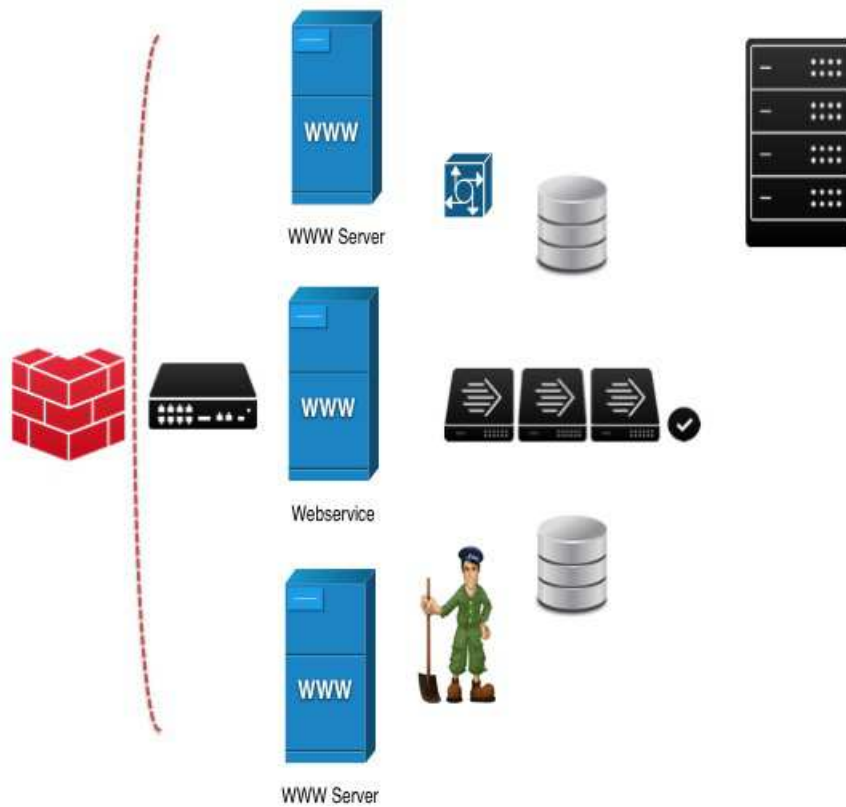
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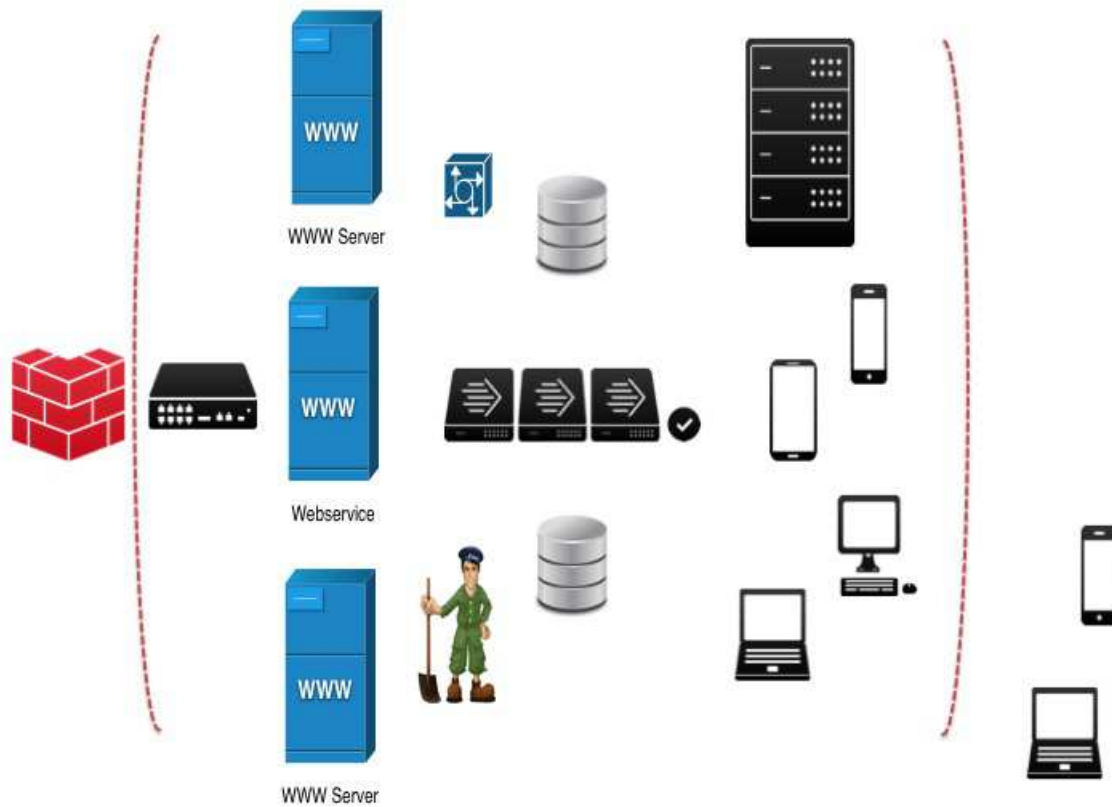
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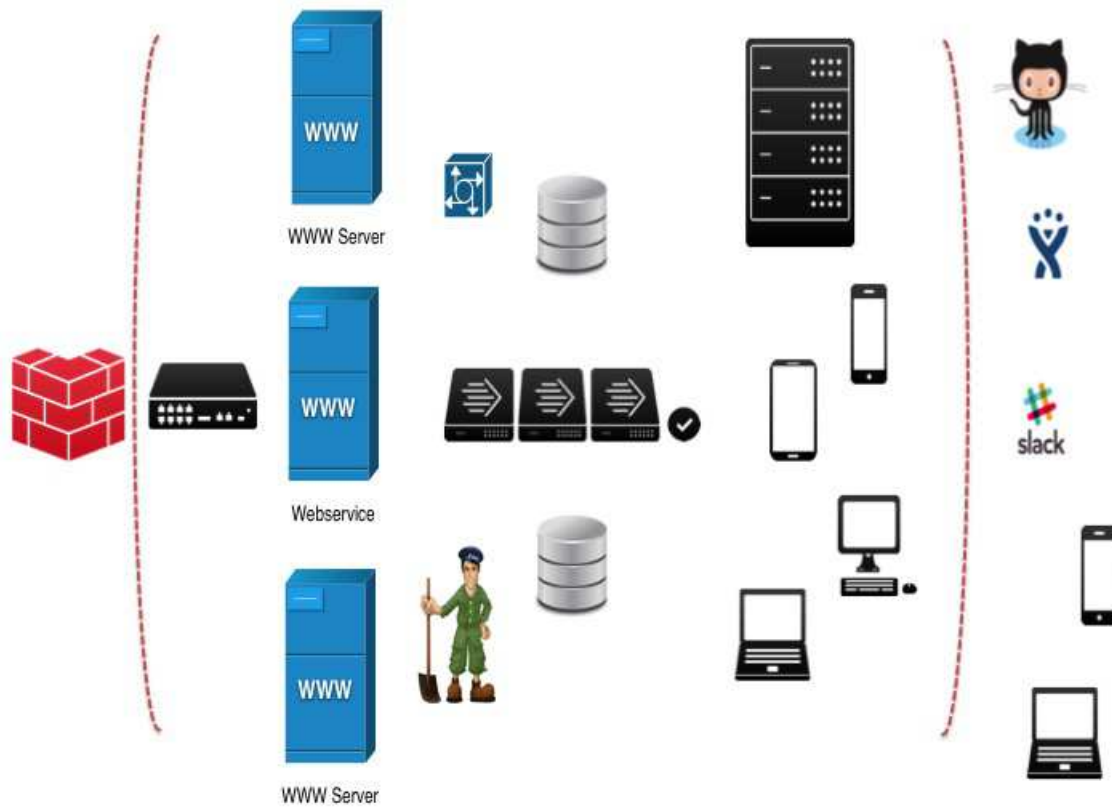
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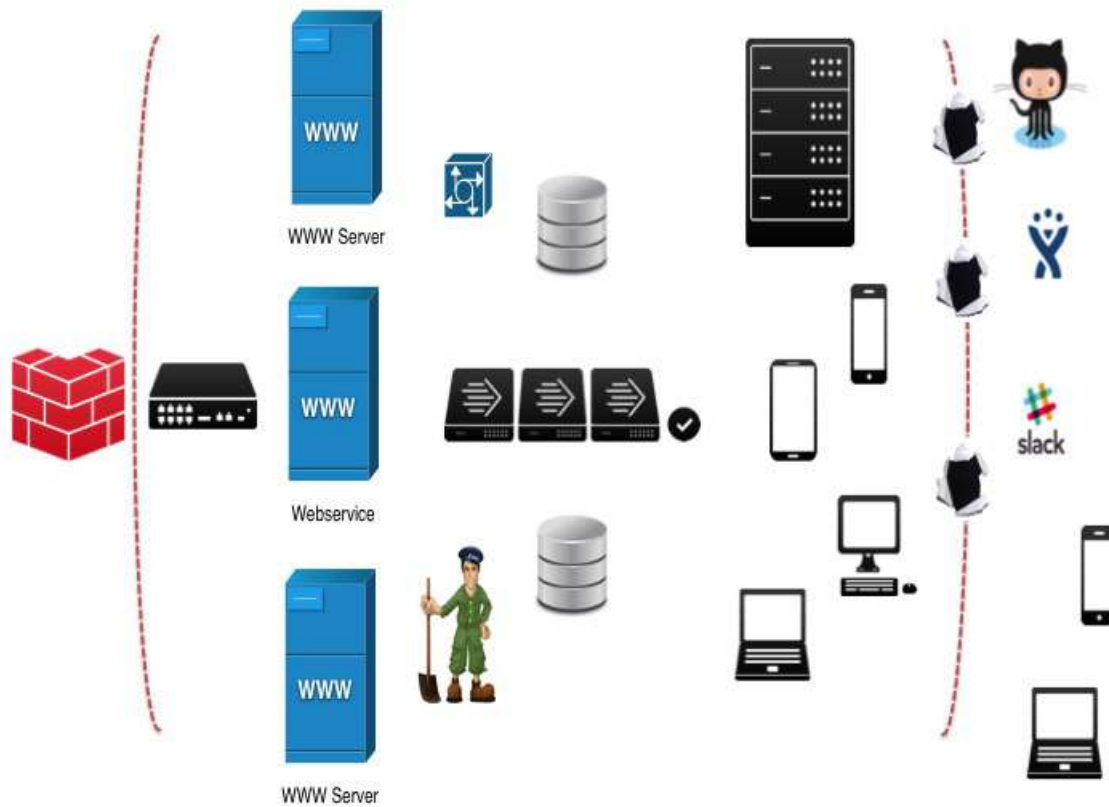
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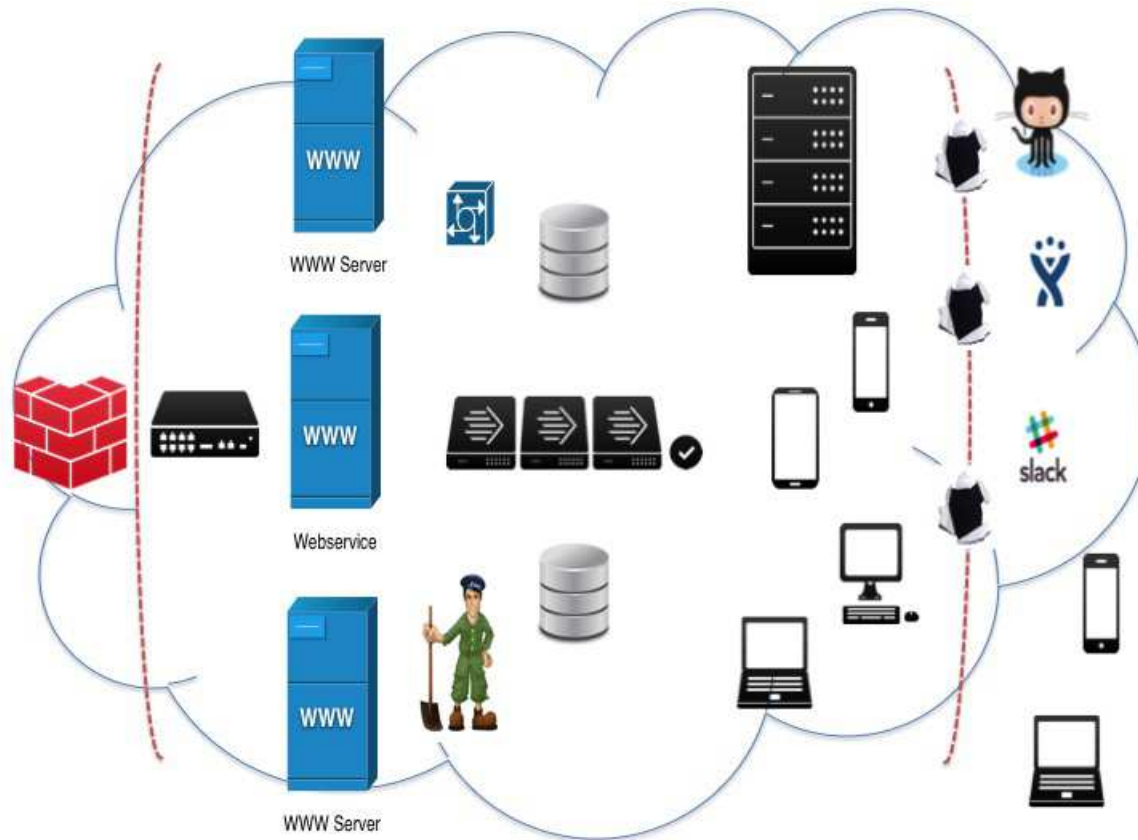
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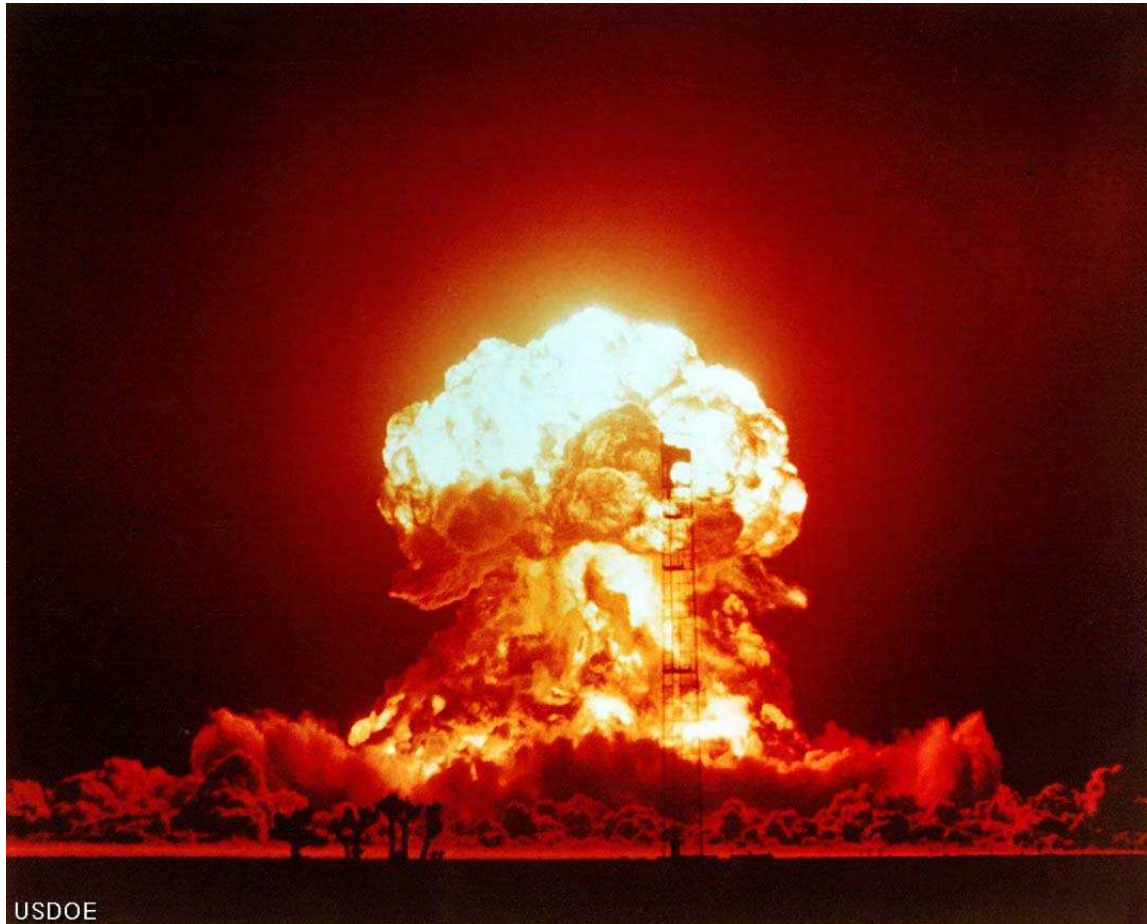
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See also: <http://is.gd/WUezLL>

The Job of a System Administrator

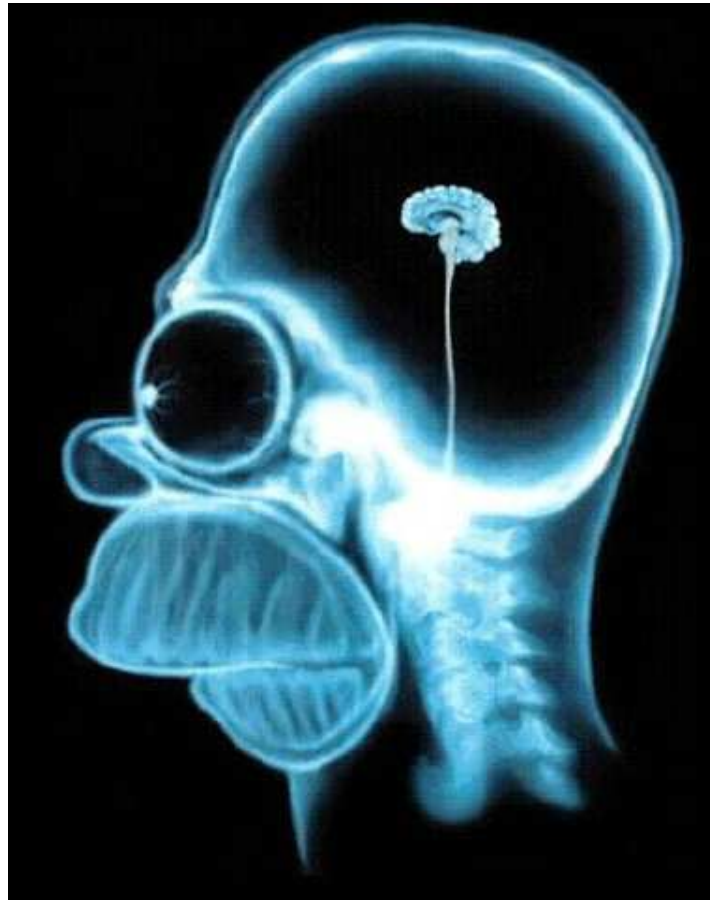


The Job of a System Administrator



<https://www.netmeister.org/blog/duct-tape-and-wd40.html>

The Job of a System Administrator



The Job of a System Administrator

What exactly does a *System Administrator* do?

The Job of a System Administrator

What exactly does a *System Administrator* do?

- no precise job description
- often learned by experience
- “makes things run”
- work behind the scenes
- often known as Operator, Network Administrator, System Programmer, System Manager, Service Engineer, Site Reliability Engineer etc.

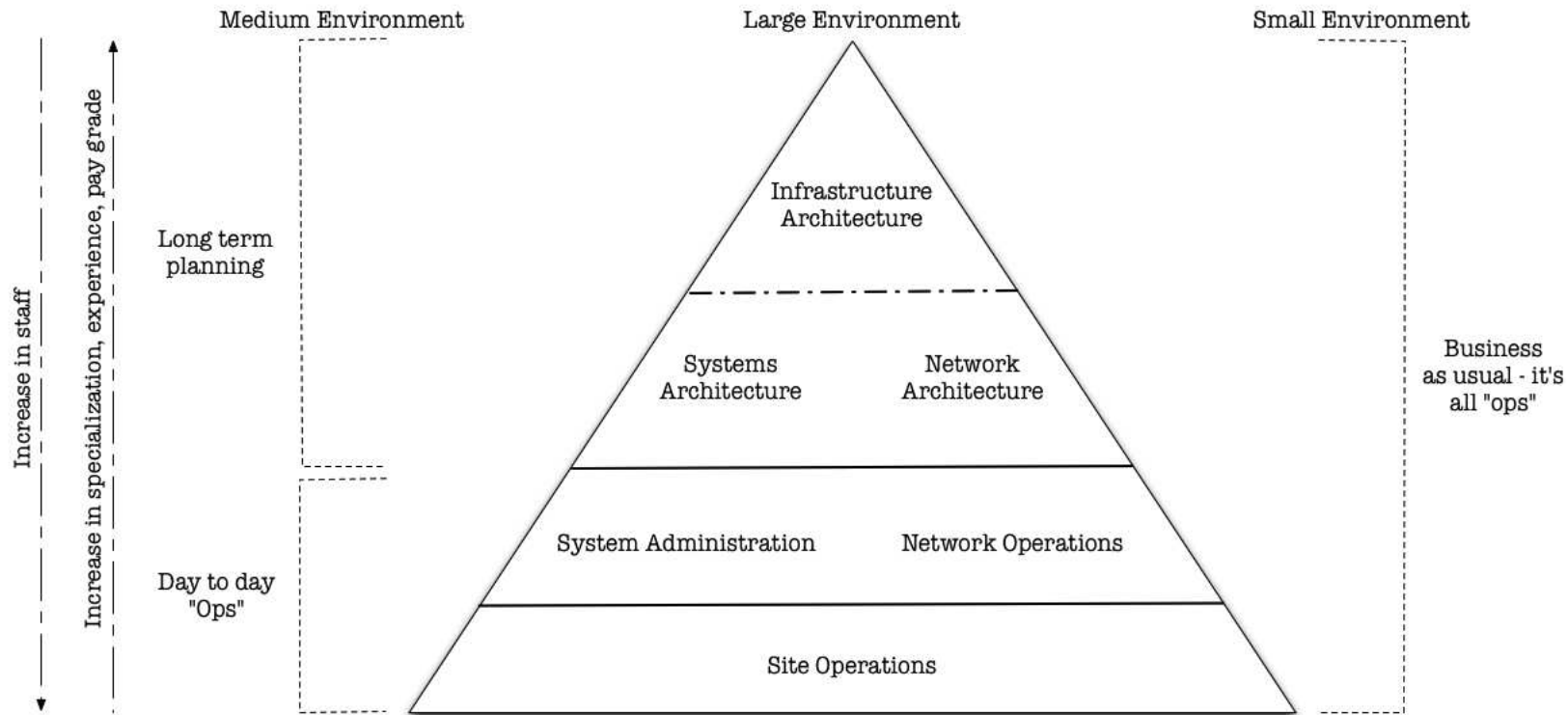
system administrator n.:

one who, as a primary job function, manages computer and network systems on behalf of another, such as an employer or client.

A rose by any other name...

	"Traditional" SysAdmin	DevOp	SRE
Hardware	knows how to rack a box, run cables	what hardware? VMs, Cloud, Containers	dockerdockerdockerdockerdocker
Javascript	is for hit counters and web tickers	pip install npm	pip install npm; npm install bower; bower install jquery
Format	ascii	markdown, erb	yaml, json
Editor	vi, emacs; can actually use ed	vim, ace	nano, eclipse
Productivity	mutt, irssi, gnupg, make	gmail, Slack, keybase	github pull requests, Slack
Go-to language	C, perl, bourne shell (not bash)	python, go, golang, nodejs, ruby	java, nodejs, ruby, rust
Common tools	tcpdump, [dks]trace, letherman, duct tape	curl, chef, puppet, homebrew	Chrome, git, jenkins, chef, splunk
Login shell	ksh	bash	zsh, fish
Login prompt	\$ or #, depending on euid	[user@hostname cwd]\$	git branch/status, newline, date/time, fqdn, newline, full path, last exit status color code and unicode symbol, newline, some ascii art
Social media	Usenet	Twitter	Facebook

The Job of a System Administrator



So what is a *System*?

“A group of interacting, interrelated, or interdependent elements that together form a complex whole.”

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“A group of interacting, interrelated, or interdependent elements that together form a complex whole.”

In the context of this class, we generally consider *computer-human systems* consisting of

- the computer(s)
- the network
- the user(s)
- the organization's goals and policies

The Job of a System Administrator



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The Job of a System Administrator

Computering, at its heart,
is a people problem.

Choose sides!



<https://stevens.netmeister.org/615/teams.html>

... and *Administration*?

Merriam Webster:

administer, v: *to manage or supervise the execution, use, or conduct of*

... and *Administration*?

Merriam Webster:

administer, v: *to manage or supervise the execution, use, or conduct of*

System Administration frequently also includes other tasks such as

- system design and architecture
- reliability studies
- resource management
- system fault diagnosis
- ...

...all of which may involve a fair amount of *software development, programming and scripting*.

Learning System Administration

System Administration is a profession with no fixed career path.

- few degree granting programs
- heavy reliance on practical experience
- specializations in many different areas possible
- breadth of expertise as necessary as depth in some areas
- background knowledge and requirements vary

Learning System Administration

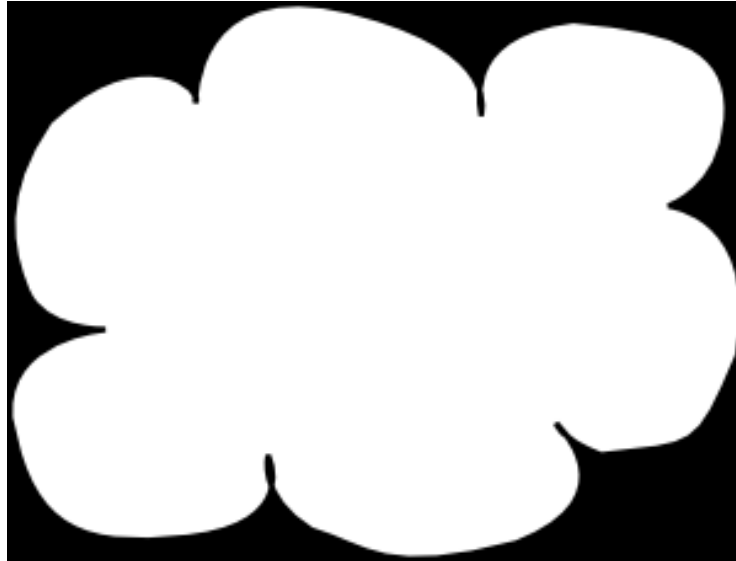
Breadth of knowledge:

- operating system concepts
- TCP/IP networking
- programming
- cloud computing
- ...

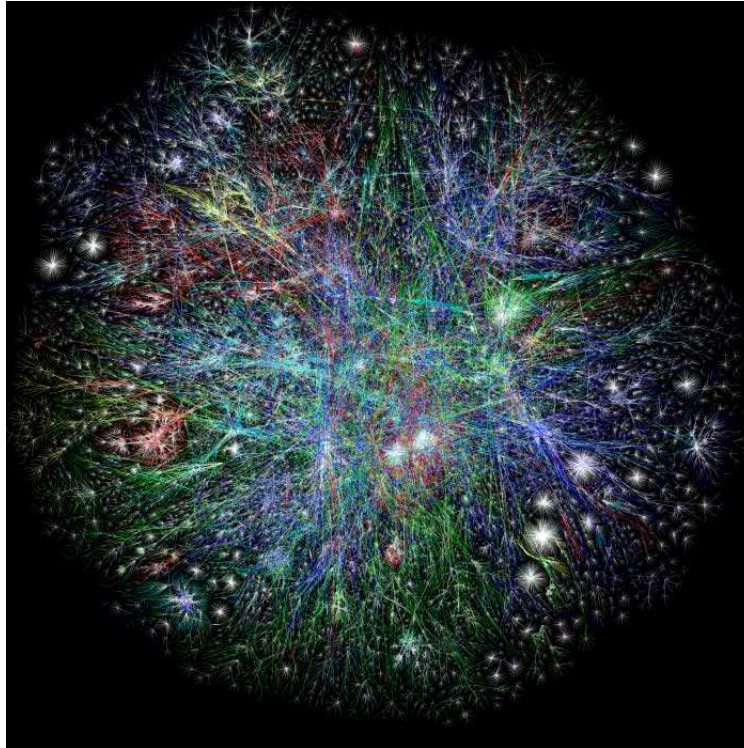
Depth of knowledge:

- certain OS flavor
- specific service (DNS, E-Mail, Databases, Content-Delivery, ...)
- specific implementation/vendor (Oracle, Hadoop, Apache, Cisco, ...)
- specific are of expertise (security, storage, network, data center, ...)
- ...

People think the internet looks like this.



Or like this.



<http://www.opte.org/maps/>

SysAdmins know it looks like this.



Syllabus

Dates and Topics subject to change:

- 01/27: Introduction, UNIX history and basics
- 02/03: Filesystems and Disks
- 02/10: Software Installation Concepts
- 02/17: Multi-user basics
- 02/24 - 03/02: Networking
- 03/09 - 03/23: DNS, SMTP, HTTP, HTTPS
- 03/30: Writing System Tools
- 04/06: Monitoring, Backup and Disaster Recovery
- 04/13: Configuration Management
- 04/20: System Security
- 04/27: Ethics and Social Responsibility

Grading

You are responsible for your work.
Know when assignments are due!

Grading:

- course participation, questionnaires, course notes
- team mission
- homework assignments
- group project(s)

Team missions, discussions, announcements etc.:

<https://lists.stevens.edu/mailman/listinfo/cs615asa>

Grading

You are responsible for your work.

There are no make-up assignments, no extra credit work at the end of the semester.

Allocate your time wisely. If medical or family emergencies arise, contact me *ASAP*, as late submissions are otherwise not allowed.

Course Notes

- create a git repository with a single text file for each lecture
- before each lecture, note:
 - what you read
 - what questions you have
- after each lecture:
 - answers you've found, or especially interesting new things you learned
 - what questions remain
 - what new questions arose
 - what additional reading might be relevant
- at the end of the semester, submit all your notes

<https://stevens.netmeister.org/615/course-notes.html>

Course Notes

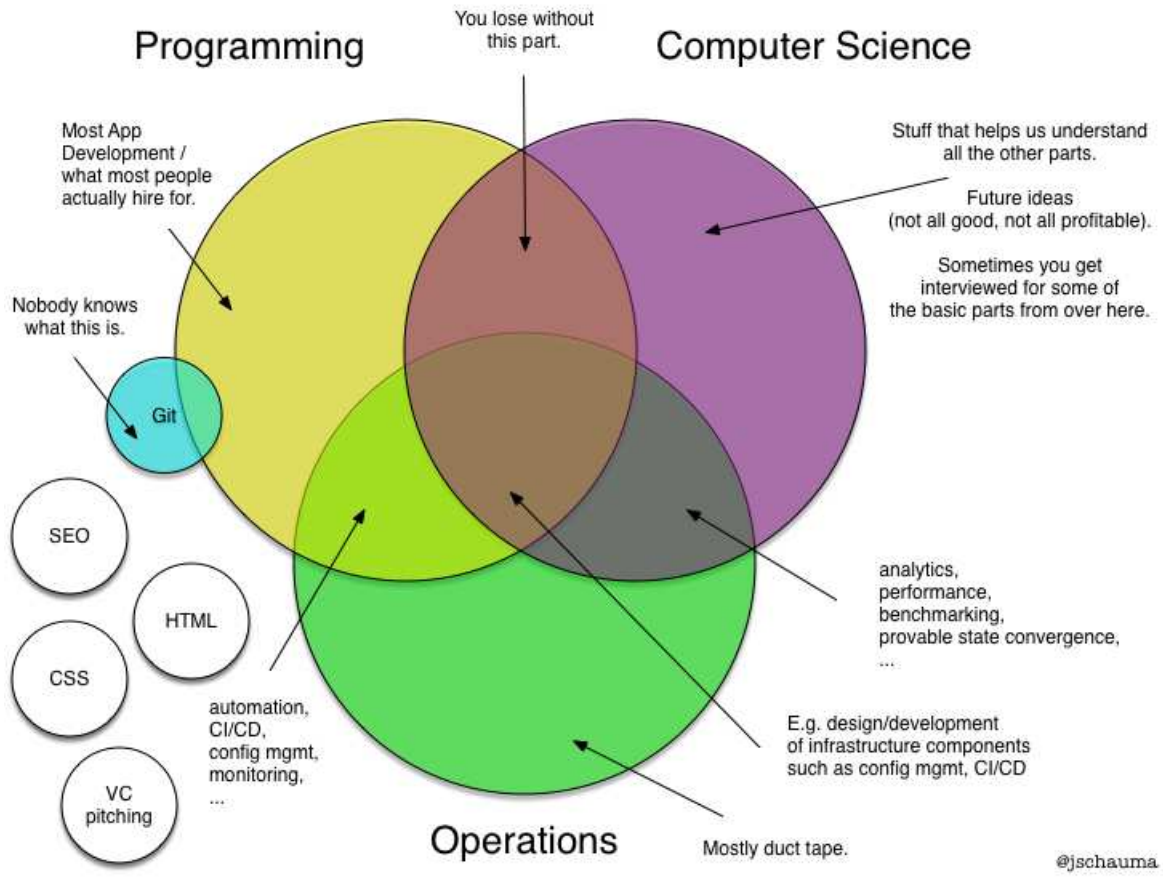
Let's set up `git` real quick...

<https://stevens.netmeister.org/615/git.html>

Hooray!

5 Minute Break

Computer Science



Three Pillars of Exceptional System Design

We will give particular attention to these three core features:

- Scalability
- Security
- Simplicity

Three Pillars of Exceptional System Design: Scalability



System Overload

Three Pillars of Exceptional System Design: Scalability



Scaling Vertically

Three Pillars of Exceptional System Design: Scalability



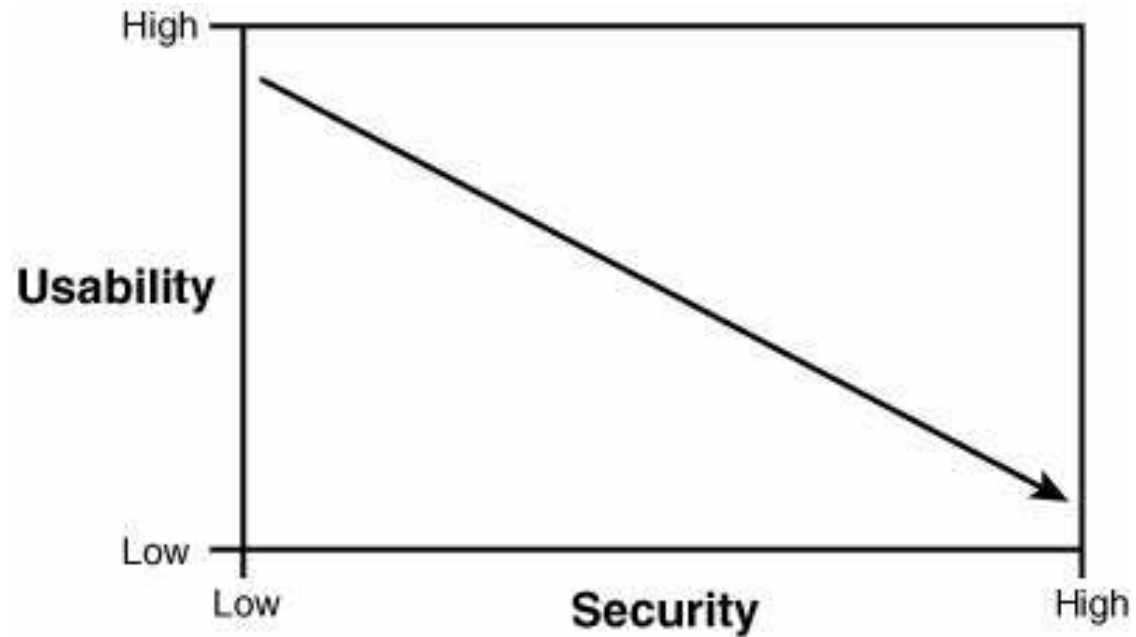
Scaling Horizontally

Three Pillars of Exceptional System Design: Scalability



Scaling Down

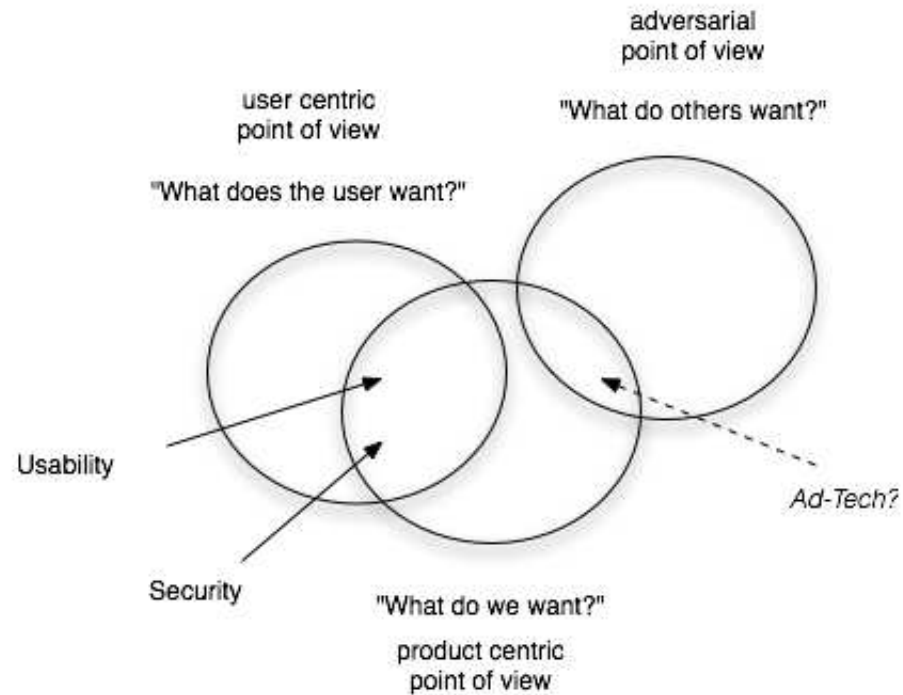
Three Pillars of Exceptional System Design: Security



Three Pillars of Exceptional System Design: Security



Three Pillars of Exceptional System Design: Security

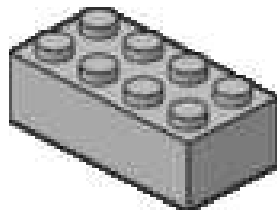


<https://www.netmeister.org/blog/infosec-basics.html>

Three Pillars of Exceptional System Design: Simplicity



Three Pillars of Exceptional System Design: Simplicity



Three Pillars of Exceptional System Design: Simplicity



Learning is critical

Know how to find answers:

- know *how* to ask questions
- know *where* to ask questions
- read critically
- know what you don't know (Dunning-Kruger effect)
- understand *what* you're doing
- understand *why* you're doing it
- seek information exchange

Learning is critical

“Computer Science projects are opportunities,
not assignments.”

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<https://stevens.netmeister.org/615/meetup.html>

SysAdmins' favorite Laws

Ockham's Razor:

“Of two equivalent theories or explanations, all other things being equal, the simpler one is to be preferred.”

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Throw in some philosophy for good measure:

Causality: For every effect, there must be a cause.

UNIX History

UNIX history

<https://is.gd/TU0AB2>

- Originally developed in 1969 at Bell Labs by Ken Thompson and Dennis Ritchie.
- 1973, Rewritten in C. This made it portable and changed the history of OS
- 1974: Thompson, Joy, Haley and students at Berkeley develop the Berkeley Software Distribution (BSD) of UNIX
- two main directions emerge: BSD and what was to become “System V”

Notable dates in UNIX history

- 1984 4.2BSD released (TCP/IP), 1986 4.3BSD released (NFS)
- 1991 Linus Torvalds starts working on the Linux kernel
- 1993 Settlement of USL vs. BSDi; NetBSD, then FreeBSD are created
- 1994 Single UNIX Specification introduced
- 1995 4.4BSD-Lite Release 2 (last CSRG release); OpenBSD forked off NetBSD
- 2000 Darwin created (derived from NeXT, FreeBSD, NetBSD)
- 2003 Xen; SELinux
- 2005 Hadoop; DTrace; ZFS; Solaris Containers
- 2006 AWS ("Cloud Computing" comes full circle)
- 2007 iOS; KVM appears in Linux
- 2008 Android; Solaris open sourced as OpenSolaris

Notable dates in UNIX history

- 2010 Systemd
- 2011 Chrome OS; rise of Microservices
- 2013 Docker
- 2014 Kubernetes
- 2016 Windows Subsystem for Linux
- ...

Some UNIX versions

More UNIX (some generic, some trademark, some just unix-like):

1BSD	2BSD	3BSD	4BSD	4.4BSD Lite 1
4.4BSD Lite 2	386 BSD	A/UX	Acorn RISC iX	AIX
AIX PS/2	AIX/370	AIX/6000	AIX/ESA	AIX/RT
AMiX	AOS Lite	AOS Reno	ArchBSD	ASV
Atari Unix	BOS	BRL Unix	BSD Net/1	BSD Net/2
BSD/386	BSD/OS	CB Unix	Chorus	Chorus/MiX
Coherent	CTIX	Darwin	Debian GNU/Hurd	DEC OSF/1 ACP
Digital Unix	DragonFly BSD	Dynix	Dynix/ptx	ekkoBSD
FreeBSD	GNU	GNU-Darwin	HPBSD	HP-UX
HP-UX BLS	IBM AOS	IBM IX/370	Interactive 386/ix	Interactive IS
IRIX	Linux	Lites	LSX	Mac OS X
Mac OS X Server	Mach	MERT	MicroBSD	Mini Unix
Minix	Minix-VMD	MIPS OS	MirBSD	Mk Linux
Monterey	more/BSD	mt Xinu	MVS/ESA OpenEdition	NetBSD
NeXTSTEP	NonStop-UX	Open Desktop	Open UNIX	OpenBSD
OpenServer	OPENSTEP	OS/390 OpenEdition	OS/390 Unix	OSF/1
PC/IX	Plan 9	PWB	PWB/UNIX	QNX
QNX RTOS	QNX/Neutrino	QUNIX	ReliantUnix	Rhapsody
RISC iX	RT	SCO UNIX	SCO UnixWare	SCO Xenix
SCO Xenix System V/386	Security-Enhanced Linux	Sinix	Sinix ReliantUnix	Solaris
SPIX	SunOS	Tru64 Unix	Trusted IRIX/B	Trusted Solaris
Trusted Xenix	TS	UCLA Locus	UCLA Secure Unix	Ultrix
Ultrix 32M	Ultrix-11	Unicos	Unicos/mk	Unicox-max
UNICS	UNIX 32V	UNIX Interactive	UNIX System III	UNIX System IV
UNIX System V	UNIX System V Release 2	UNIX System V Release 3	UNIX System V Release 4	UNIX System V/286
UNIX System V/386	UNIX Time-Sharing System	UnixWare	UNSW	USG
Venix	Wollogong	Xenix OS	Xinu	xMach

UNIX Everywhere

Today, your desktop, server, cloud, TV, phone, watch, stereo, car navigation system, thermostat, door lock, etc. all run a Unix-like OS...

UNIX Everywhere

Today, your desktop, server, cloud, TV, phone, watch, stereo, car navigation system, thermostat, door lock, etc. all run a Unix-like OS...

...with all the risks that entails.

UNIX Basics

UNIX Basics

The OS is divided into

- kernel
- shell
- tools & applications

Basic UNIX features:

- multitasking
- multiuser
- portability
- networking capabilities

UNIX Basics

These features necessitate/result in:

- multi-user concepts
 - user privileges
 - file permissions
 - process ownership and priorities
 - disk quotas
- security considerations
 - protect users' data
 - protect communication
 - protect superuser account

UNIX Basics: Pipelines

What is the longest word found on the ten most frequently retrieved English Wikipedia pages?

```
for f in $(curl -L http://is.gd/c6F2fs | zgrep -i "^en " |
    sort -k3 -n | tail -10 |
    sed -e 's/en \(.*\) [0-9]* [0-9]*/\1/'); do
    links -dump http://en.wikipedia.org/wiki/${f}
done |
tr '[:punct:]' ' ' |
tr '[:space:]' '\n' |
tr '[:upper:]' '[:lower:]' |
egrep '^[a-z]+$' |
awk '{ print length() " " $0; }' |
sort | uniq | sort -n |
tail -1
```

See also: <https://blog.jessfraz.com/post/for-the-love-of-pipes/>

Program Design

https://en.wikipedia.org/wiki/Unix_philosophy

UNIX programs...

- ...are simple
- ...follow the element of least surprise
- ...accept input from `stdin`
- ...generate output to `stdout`
- ...generate meaningful error messages to `stderr`
- ...have meaningful exit codes
- ...have a manual page

HW

Make sure you have:

- an account on `linux-lab.cs.stevens.edu`
- an AWS account
- bookmarked the course website
- subscribed to the class mailing list
- started your course notes
- know your team and understood your team mission

`https://stevens.netmeister.org/615/course-notes.html`

`https://stevens.netmeister.org/615/s19-hw1.html`

`https://stevens.netmeister.org/cgi-bin/CS615-02.cgi`

`https://stevens.netmeister.org/615/filesystems-exercise.html`

The End



Hooray!

Reading

Miscellaneous:

- <http://www.opsschool.org/>
- <https://archive.is/Akjau>
- http://linuxcommand.org/lc3_learning_the_shell.php
- <https://is.gd/NNAIIIm>

UNIX history:

- <https://www.bell-labs.com/usr/dmr/www/>
- <https://www.bell-labs.com/usr/dmr/www/hist.html>
- <http://www.futuretech.blinkenlights.nl/admin/day1a.html>
- <http://www.levenez.com/unix/>
- https://en.wikipedia.org/wiki/Operating_system

Reading

UNIX basics:

- `chmod(1)`, `chown(1)`, `ls(1)`
- `intro(1)`, `login(1)`, `passwd(5)`
- `su(1)`, `sudo(8)`