Introduction to Dynamic Infrastructure

By Alan G. Labouseur

MARIST SCHOOL OF COMPUTER SCIENCE & MATHEMATICS

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IBM
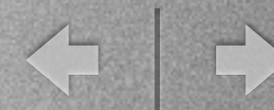
MODULE ONE
WELCOME, POLICIES, BACKGROUND

Introduction to Dynamic Infrastructure

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REMARKS

Welcome. My name is Alan Labouseur and I'll be your guide on our journey through the world of Dynamic Infrastructure in Theory and Practice. You can read all about me -- more than you likely care to know, actually -- over at www.labouseur.com.

In this introductory course we'll look at the ~~seven~~ 007 core "pillars" of Dynamic Infrastructure from both end-user and technical angles. We'll be necessarily broad, yet still take some time to dig deep here and there.

Strap in and get ready.

It's time to start this trip.

REVIEW

Let's review... what exactly? This is the first module, so what could we possibly review? Good question. Let me think . . .

(Time passes.)

You are standing in an open field west of a white house.

Oh, I know. Let's just add a "P" to the slide title.

PREVIEW

That's better. Let's preview the "distance learning" experience.

This course is very much if not entirely **unlike** a traditional, in-person, synchronous course.

- You are not sitting in a classroom.
- You are not in the physical presence of your classmates.
- You are not in my physical presence, though I am with you in spirit.

There are plenty of good things about distance learning.

- We are not constrained by the laws of space and time.
  - You can be anywhere in the world and still learn from me.
  - I can be anywhere in the world and still learn from you.
  - You and I do not need to be engaged in this course at the same time.
  - I get to produce the material at my own pace, within our schedule.
  - You get to consume the material at your own pace, within our schedule.
- These materials, once delivered to you, are then available to you On Demand.
- Most e-learning courses, this one included, contain links to interactive content.

Preview

There are some drawbacks in distance learning.

- This is not interactive in real time.

  ‣ When you have questions or wish to ask for clarifications or simply want to make a funny comment (and please do) you'll have to do it on our discussion board or via e-mail.

  ‣ This format discourages impulsive responses. But do try; it's more fun that way.

  ‣ I am not with you. I cannot judge your body language, hear your sighs, or see your eyes. That means that it's harder for me to tell when I've confused you or just lost you to boredom. (Or perhaps you're still playing Zork from an earlier slide).

  ‣ Because we are not together as a group, there is far less social and cultural interaction than I would like. We will try and make up for this in the discussion board, but it's still not the same.

- Our medium is primarily visual. There will be some video links, but most of our material is in presentations like this one.

There are many ways to mitigate these issues.

- Let me Google that for you.

PREVIEW > OBJECTIVES AND ASSESSMENT

Course Objectives - At the end of this course you will be measurably able to:

- Describe the seven core pillars of Dynamic Infrastructure

- Make a business case for each of the seven core pillars of Dynamic Infrastructure

- Describe to someone who has not had the benefit of this course
  ‣ some reasons why Dynamic Infrastructure is cool (and important)
  ‣ how to implement the various aspects of Dynamic Infrastructure

Assessment Methods

- I will grade your . . .
  ‣ assignments and projects
  ‣ tests
  ‣ discussions
- . . . and provide personal feedback.

PREVIEW › ROADMAP

What's Ahead?

- The seven pillars of Dynamic Infrastructure

  ‣ Information Infrastructure

  ‣ Service Management

  ‣ Asset Management

  ‣ Energy Efficiency

  ‣ Business Resiliency

  ‣ Security

  ‣ Virtualization

- Two tests

- Six assignments

- Lots of discussions

- Bad jokes, geeky references, puzzles, ciphers, and other silliness.

H KNUD CXMZLHB
HMEQZRSQTBSTQD

IBM = HAL

POLICIES > COMMUNICATION

E-Mail

I love e-mail. I'm always checking my e-mail; on my iPhone, on my iPad, occasionally even on a desktop computer.

I expect the same devotion to e-mail from you. Checking your mail should be like voting in Chicago: do it early and often.

It's the best way for you to reach me. Please make sure that it's the best way for me to reach you too.

Policies > Timing and Effort

The effort requirements are simple:

Everybody participates in every class. No exceptions. No excuses.

This means that you will get the material for every module in a timely manner and . . .

- thoroughly read (re-read, rinse, and repeat) the entire presentation.
- investigate the links in the presentation.
- investigate the links in the additional reading sections.
  - There will be both required reading and optional reading.
    - Required reading may be noted with the "Required Reading" icon interspersed among the slides or noted at the end of each module (or possibly both, depending on my OCD).
    - Required reading is fair game for tests.
    - Do the optional reading if you are especially interested in the topic or want to impress me.
- complete and turn in any and all assignments by the stated due date.
  - No late assignments will be accepted. No exceptions. Really.
- Actively and constructively participate in the discussions for that module.

Required Reading

Letter grades will be assigned based the percentage of all possible points you earn over the course of this class.

F	D	C-	C	C+	C++	B-	B	B+	A-	A
	65%	70%	73%	77%	79%	80%	83%	87%	90%	93%
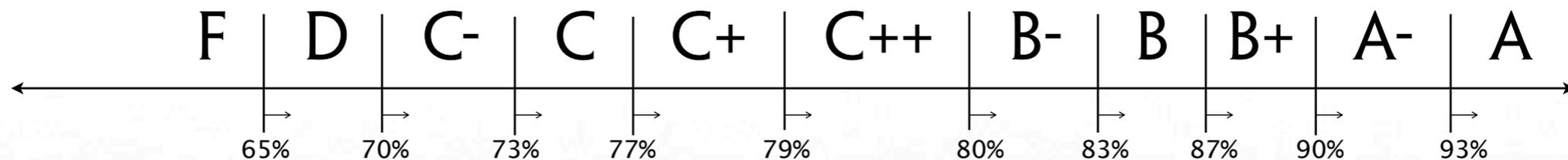
There are 1000 possible points, broken down as follows:

- Two (2) tests/projects at 200 points each = 400 possible points

- Active and constructive participation in our eight (8) **discussions** will earn you up to 60 points each for a total of 480 points. (More on discussions soon.)

- **Not** being lazy will earn you up to 60 points.

- **Not** whining will earn you up to 60 points.

Policies > Grades > Discussions

Since we are not physically together and as a result have a priori social and cultural deficits to overcome, discussions are really (*rilly rilly*) important. As such, they make up 50% of your grade. That's quite a bit for something subjective, so let's talk about my expectations to be sure that we're all clear about this from the very beginning.

But first, let's consider what "discussion" really means.

Discussion refers to each student's participation on the on-line discussion boards. I require each student to post comments and questions to the discussion board on a regular basis. You do not have to participate in all discussion threads, just most of the them.

POLICIES > GRADES > DISCUSSIONS

Discussion board ground rules:

- All students must participate in the discussion board throughout the semester.

- A minimum of 2-3 substantive posts per week is expected from each student.

  ‣ Postings that introduce the student to the rest of the class, or help to form a project team, or ask logistical questions about the course do not count towards the minimum number of posts.

  ‣ Copy and pasting from the readings (or any other source not your own) into the discussion is considered cheating. Read the Academic Honesty section for see what kind of smackdown you can expect in that case.

- No messages that simply say "Me too" or the like. All postings must contribute information or insight.

- I will periodically create new discussion threads as discussion-starters, but you should feel free to create your own threads on any topic of interest. That makes it more fun.

- Plan to read the discussion board at several times per week. You are responsible for anything that is posted there.

- Any questions related to the course should be posted to the discussion board, not e-mailed to me.

- I encourage students to answer each other's questions whenever possible. For this reason, I will wait a while before answering any questions posted to the discussion board in order to encourage other students to answer it first. I will (gently and maybe tactfully, but don't count on it) correct any answers posted by students if needs be.

- I will not answer any questions that have been previously addressed.

- Email me questions only if they are confidential or unrelated to this course. If I receive an e-mail from which I feel the rest of the class would benefit I will post it to the board.

Policies > Grades > Discussions

Your discussion participation will be assessed on the following scale:

- 76% to 100%
  - asks good questions
  - makes valuable observations
  - answers questions effectively on a consistent basis
  - a leader, especially when in murky waters
  - is able to synthesize ideas and bring discussion into focus
  - listens well to others and incorporates their ideas into follow up argument.
- 51% to 75%
  - frequent participation, but questions, answers, or observations are not always effective
  - tends to discourage effectiveness

Policies > Grades > Discussions

Discussion participation scale, continued:

- 26% to 50%
  - participates infrequently
  - questions and answers do not reflect adequate preparation
  - late to the discussion
  - exhibits difficulty in responding to questions from instructor
- 1% to 25%
  - hardly ever participates
  - questions and answers reflect little or no preparation
  - very late to discussions
  - exhibits much difficulty in responding to questions from instructor
- 0%
  - displays no sign of life

POLICIES > GRADES > DISCUSSIONS

Things I view positively in grading discussion participation:

- Does the contribution . . .
  - represent a solid analysis and some insight into the case or is it just a reiteration of case facts?
  - demonstrate an ability to listen to and build from what others have said?
  - demonstrate useful ideas, coherently and succinctly expressed?
  - move the discussion to an important area or does it just rephrase what has already been said?
- Does the contributor . . .
  - regard, respect and acknowledge others' contributions?
  - offer constructive disagreement If the contributor disagrees with others' positions?
  - demonstrate a good sense of humor?

Things I view negatively in grading discussions:

- lack of involvement - silence, detachment, or disinterest
- leading our discussion into unrelated topics
- spending undue amounts of time on minor points
- long, rambling, or boring comments (I have to read a lot of these, so I really hate boring comments.)
- being absent or unprepared

POLICIES > GRADES > APPEALS

I have an appeals process to handle any questions you might have about fairness related to my grading your work.

Rules for Submitting an Appeal

- Appeals must be in the form of a neatly written letter or e-mail.
- Appeals must make explicit reference to the work in question.
- Every appeal (if there is more than one) requires its own paragraph.
- Appeals are due within a week after the work is returned to you.
- Appeals must be very specific.
- Appeals must be content-based, not personal or emotional.
- You must communicate what action you would like me to take, i.e., give full credit, add points, etc.

This process empowers students and advances learning. As such, it benefits both you and me. Further, you are given a method to argue points in an appropriate manner and explain your reasoning, while I get an opportunity to learn whether or not I have understood your reasoning.

Policies > Tests and/or Projects

Tests and projects cover and make use of material up to the class in which the test is administered.

No makeup tests will be given. No late projects will be accepted.

Ever.

Really.

I'm serious.

Rilly.

If you anticipate missing a test, make arrangements with me in advance to complete the exam prior to its due date.

Policies > Academic Honesty

All assignments are **individual** efforts. All work must be your own. I mean **100% original**.

Any violation of this will result in failure for the test or assignment and quite likely for the entire course.

I hold my students to a very high standard. I will expel you from this course for even the appearance of impropriety. This includes failing to cite references.

This is a <u>Turnitin.com</u> analysis of an assignment I gave a while back. The results are ordered by similarity: the most egregious cheaters at the top and the honest students at the bottom. This is one list on which you do not want to be highly ranked.

BACKGROUND > HARDWARE AND SOFTWARE

Computer **hardware** refers to the actual "bare metal" machines we use for computation and communication in the 21st century.

- iPhone, Android, and WebOS smartphones

- iPad and other tablets

- Desktop computers like the PC, Mac, and AlienWare Area-51 ALX

- Servers like the Apple Xserve, Dell's PowerEdge and OptiPlex, and HP's ProLiant

- Midrange computers like those in IBM's Power Systems line

- Mainframe computers like IBM's z-Series

- Supercomputers like the Chinese Nebulae system at the National Supercomputing Centre in Shenzhen

Computer **software** are programs and procedures that provide computer hardware the ability to perform a task. There are two kinds of software:

- System software runs the computer hardware and lets it talk to the application software.

- Application software - The stuff end users actually use.

    ‣ This includes programming software tools for writing application programs using different programming languages that run on some hardware.

    ‣ It also includes all business and end-user applications. Let's take a closer look at this.

Background › Hardware and Software

Application **software** is a subset of computer software that calls on the computer directly to perform a task.

- Application software allows users to accomplish both computer and non-computer related tasks.

- Note: Application refers to both the application software and its implementation in programming languages.

Just a few application software examples:

- Analytical - Statistical packages, website traffic analysis, recommendation systems, stock trading

- Collaborative - Blogs, Wiki's, StackOverflow, iWork.com, GoogleDocs

- Communication - e-mail, web browsers, instant message clients, twitter

- Business - Accounting systems, Customer Relationship Management, Enterprise Resource Planning

- Database - Postgres, MySQL, Ms-SQL Server, Oracle, DB2, and many more.

- Entertainment and Multimedia - console video games, web-based casual games, film editing

- Productivity - Microsoft Office, Apple's iWork, GoogleDocs, OpenOffice

All application software is created by people using programming software (computer languages, debuggers, bug trackers, source code management tools, etc.) to write code that runs on some hardware.

Background › Platforms and Operating Systems

A **platform** can be viewed as a framework (basically just a defined support structure on which another project can rely) where software runs. Most common platforms include a computer's architecture, operating system, and programming languages.

An **Operating System** (OS) is a type of software which manages the hardware and software resources of a computer. OS tasks include

- controlling and allocating memory
- prioritizing instruction processing
- controlling input and output devices
- facilitating networking
- managing files.

The kernel is the lowest level of any operating system. It's closest to the "bare metal" of the machine and has the most ability to control its resources (for better or for worse).

Most Operating Systems contain system software that manages a graphical user interface (GUI) like Apple's OSX and Microsoft Windows. Others use a command-line interface (CLI), as the many flavors of Unix do.

A few popular Operating Systems:

- Microsoft Windows
- UNIX
- Linux
- QNX
- Mac OSX
- z/OS
- iPhone OS4
- WebOS
- Android
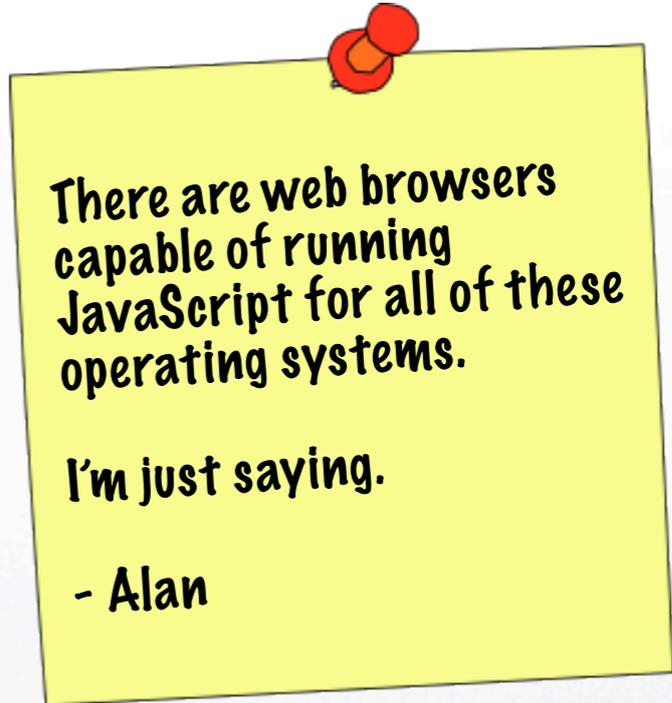
There are web browsers capable of running JavaScript for all of these operating systems.

I'm just saying.

- Alan

Background > Networking

Computer **networking** is considered a multidisciplinary field combining science and engineering to provide communication among computer systems. It's also considered a sub-discipline of telecommunications.

A network involves two or more connected computers (an internet - note the lowercase "i") which can be separated by a few centimeters (as with Bluetooth) or thousands of kilometers, as with the (capital "I") Internet.

Computer networks are implemented using software protocol stacks (basically, layers) on physical computer hardware. There are two main protocol stacks: OSI and it's 007 layers and TCP/IP with 4 layers.

Background › Networking

OSI is the Open Systems Interconnection model for networking. It defines seven layers, each built on top of and depending on the layer beneath it.

TCP/IP is Transmission Control Protocol / Internet Protocol model for networking. It defines four layers, each built on top of and depending on the layer beneath it.

Both models accomplish the same thing in many of the same ways. In fact, with a little imagination, we can map one to the other.

OSI	TCP/IP
Application	Application
Presentation	
Session	
Transport	Transport
Network	Internet
Datalink	Network Access
Physical	

Background › Storage

The term "computer **storage**" broadly refers to integrated circuits, magnetic or optical disks, cartridge tapes, or holographic devices used by computer hardware to retain digital data for some interval of time.

Storage that we commonly refer to as "mass storage" (magnetic disks, removable optical disks, tape cartridges) is

- Much slower than computer memory (Random Access Memory, or RAM)
- Far less expensive than RAM
- Designed for permanent retention of data

Let's think of storage as a hierarchy of primary, secondary, tertiary, and off-line storage. The farther we move away from primary storage, the greater the distance from the computer hardware's central processing unit.

There are other ways to categorize storage . . .

- Volatility of data, ability to access non-contiguous information, ability to change data
- addressability of data, capacity and performance, stability of media over time

. . . but we'll focus on the hierarchy above.

Background > Storage

Primary storage, or internal memory . . .

- is computer memory that is accessible to the central processing unit of a computer via a high performance memory bus and without the use of computer's input/output channels.

- is used to store data that is likely to be actively used.

- is significantly more expensive than other types of storage media.

- may be built from dynamic (RAM) or fixed (ROM) memory, or some combination.

RAM (Random Access Memory) is . . .

- temporary storage where its contents are frequently modifying or replaced.

- extremely fast, when compared to other types of storage.

- expensive, when compared to other types of storage.

- volatile, losing its contents whenever the power is interrupted.

ROM (Read Only Memory) is . . .

- for fixed content; commonly used for data or code that does not change (like a system BIOS)

- extremely fast, when compared to other types of storage.

- expensive, when compared to other types of storage.

- non-volatile, retaining cell content regardless of whether or not power is applied

BACKGROUND › STORAGE

Secondary storage, also called external memory, is memory that is not directly attached to a computer's CPU, requiring the use of I/O.

Secondary storage is . . .

- used to maintain data that is not in active use.

- significantly slower than primary storage but has much greater capacity

- non-volatile, preserving stored data in an event of power loss.

Storage devices in this category include:

- Hard disks both internal and external, magnetic, optical, and solid-state

- Floppy disks (if you can ind one these days)

- CDs, DVDs, Blu-ray

- Magnetic tape

Network Attached Storage (NAS) is any type of secondary storage that involves accessing information over a computer network, including the Internet.

Required Reading
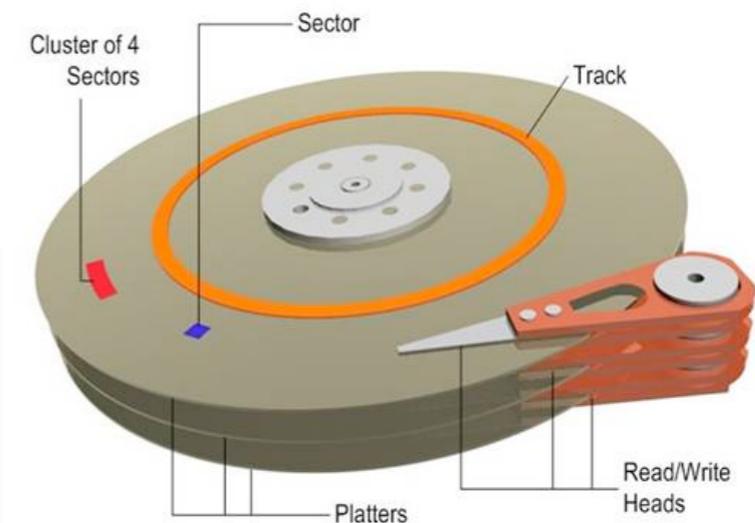
Tertiary storage refers to storage systems consisting of one or more storage drives and an automatic media library, for example a tape library or optical disc jukebox. NAS is also considered tertiary storage in some cases.

There are two sub-classifications to consider here:

- **Near-line storage** is a storage medium that can be recalled without manual intervention, but usually at the cost of incurring a significant delay. (I.e. – direct data retrieval from a tape library or optical jukebox.)

- **Off-line storage** is a computer storage medium which must be inserted into a storage drive by a human operator before a computer can access the information stored on the medium.

Offline storage is the lowest leaf on our storage tree. It's the cheapest and the slowest.

Cost

Speed

Primary

Secondary

Tertiary

Offline
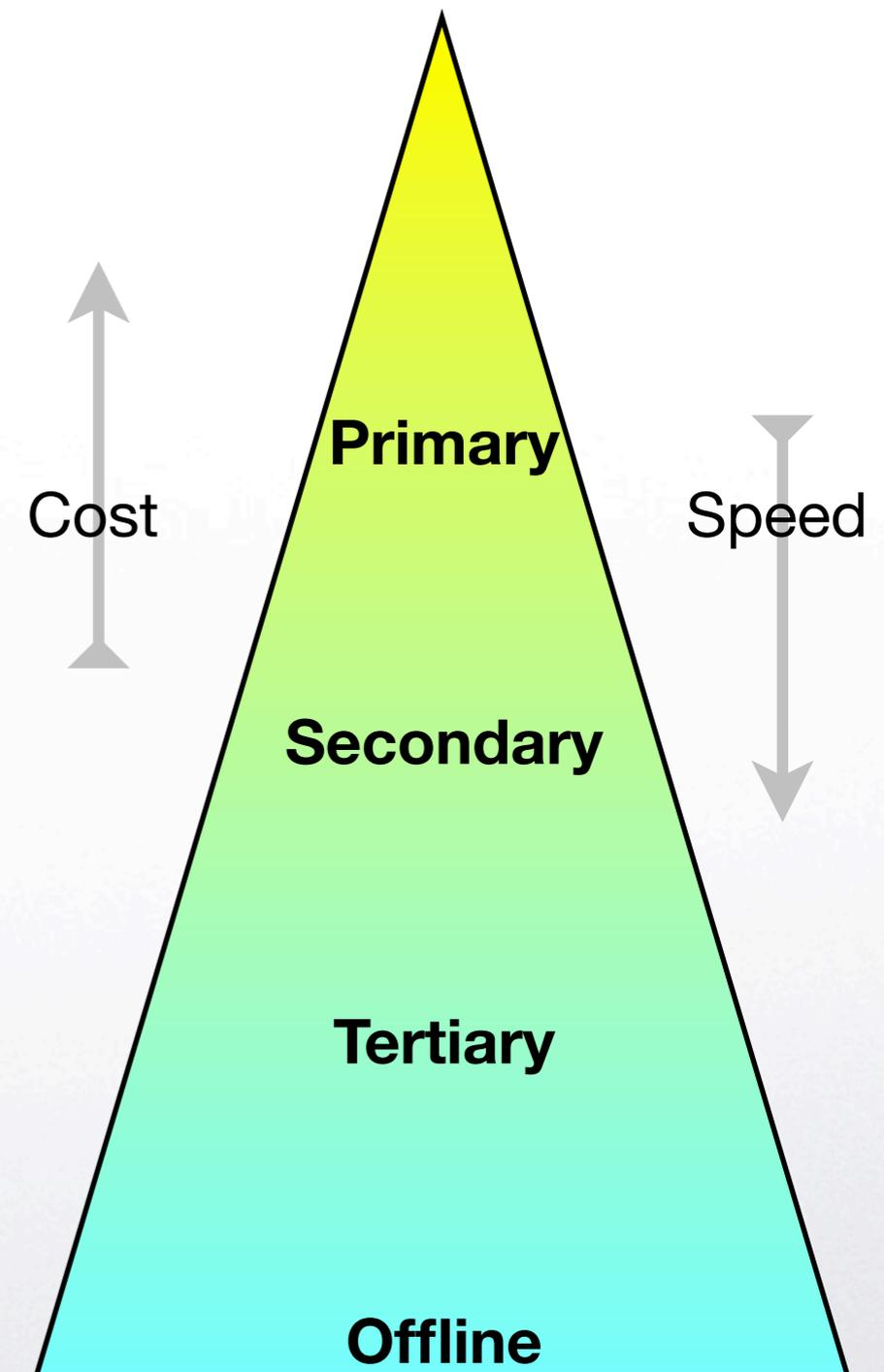
Background › Enterprise or ESM?

What does it mean to say Enterprise Systems Management?

- Was that Scotty's job description?

An "**Enterprise**", in this context anyway, refers to an entire company and everything in it, all-inclusive.

"**Systems**" here means information technology infrastructure: hardware, software, data, information, and processes.

"**Management**" can be thought of as monitoring and influencing stuff, like people or systems or Starfleet engineers.

Putting that all together, we get . . .

Enterprise Systems Management: The complete and total management of a company's IT elements and environment.

- I think I like Scotty's job better.
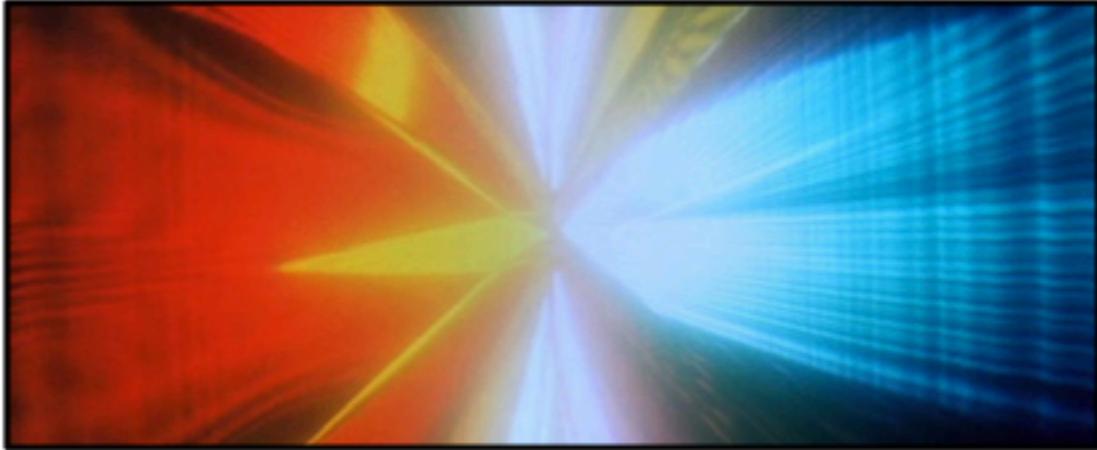
REQUIRED READINGS

Websites

- History of the Unix Operating System - http://www.bell-labs.com/history/unix/

- History of IBM Mainframes - http://www-03.ibm.com/ibm/history/exhibits/mainframe/mainframe_intro.html

- System/360 Announcement - http://www-03.ibm.com/ibm/history/exhibits/mainframe/mainframe_PR360.html

- The IBM PC - http://www-03.ibm.com/ibm/history/exhibits/pc25/pc25_intro.html

- TCP RFC - http://www.faqs.org/rfcs/rfc793.html

- Networking Fundamentals - http://www.tcpipguide.com/free/t_NetworkingFundamentals.htm

- IBM's Dynamic Infrastructure portal - http://www-03.ibm.com/systems/dynamicinfrastructure/

Papers

- ‣ EMC on Storage Management [*pdf*]

OPTIONAL VIEWINGS

Videos

- Let's build a Smarter Planet

- Dynamic Infrastructure for a Smarter Planet

- IT Challenges and Opportunities

Self-test

About this course

- What is Alan's favorite method of communication for this class?

- What percentage of your grade do you earn by not being lazy and not whining?

Background

- Hardware and software
  - What's the difference between systems software and application software?

- Operating Systems
  - Why do hackers trying to attack a system want to get control of its OS kernel?

- Networking
  - The "s" in HTTPS:\\ means "secure". It's sometimes referred to as "TLS". Why?

- Storage
  - Explain the trade offs in speed and cost as you traverse the storage tree.

- Enterprise
  - What does the "NCC" in "NCC 1701" stand for?

Self-test Answers

About this course

- What is Alan's favorite method of communication for this class? **E-mail**

- What percentage of your grade do you earn by not being lazy and not whining? **5% each**

Background

- What's the difference between systems software and application software? **Systems software runs "under the covers" while application software is what end users make use of.**

- Why do hackers trying to attack a system want to get control of its OS kernel? **The kernel has the most control over the resources of the hardware.**

- The "s" in HTTPS:\\ means "secure". It's sometimes referred to as "TLS". Why? **It stands for Transport Layer Security.**

- Explain the trade offs in speed and cost as you traverse the storage tree. **Faster storage costs more, slower storage costs less.**

- What does the "NCC" in "NCC 1701" stand for? **That depends. Matt Jefferies, who designed and built the original Enterprise, said that it doesn't stand for anything. Other sources maintain that it stands for "Naval Construction Code". Since Mr. Jefferies designed and built the ship, I think we ought to believe him. I do.**

ASSIGNMENTS

Homework

- Fiddle around in the eLearning system until you become really comfortable with it.

- Write a one-paragraph essay about the number 42 and submit it for grading via your student drop box facility in our eLearning system.

Discussions

Post a paragraph about yourself

- Who are you?

- What do you do?

- What's your background in computing?

- Why are you taking this class?

- What do you hope we accomplish together?

- What's so special about 42?

Spin the Dynamic Infrastructure Wheel

- at http://www-03.ibm.com/systems/smarter/resources/info/solution_finder/index.html

and write about your result.

Remember our discussion expectations and guidelines.

Acknowledgements

Some of the source material in this and future modules was based upon the initial compilation and authoring by David Graves and Paul Kontogiorgis of IBM in 2006.

- By using these materials you agree to the IBM Terms of Use, found at http://www.ibm.com/legal/us/ .
- The IBM copyright and trademark information webpage is incorporated herein by reference: http://www.ibm.com/legal/copytrade.shtml.

Additional material from:

- iStockphoto.com
- The dark recesses of Alan's brain.
- "Computer Networks, A Systems Approach" 3rd edition, by Peterson and Davie. Published by Morgan Kaufmann in 2003.
- Alan's friend and colleague Anne Matheus.

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Colophon

This work was authored in Keynote by Alan G. Labouseur in June 2010 from his home in Pleasant Valley, NY.

This is the view from Alan's home office on the rainy afternoon when he wrote this Colophon page.

Distractions that made the writing slower

- The Daring Fireball blog

- "Under the Dome" by Stephen King in ePub form on my iPhone and iPad

- The Definitive ANTLR Reference by Terence Parr (Dynamic Infrastructure is cool, but compilers are really awesome!)

Music that made the writing faster

- iTunes Genius Mixes: AOR Classic Rock, Funk

- Specific artists: Earth, Wind & Fire / Rush / Maceo Parker / Katie Webster / James Brown / Tower of Power / Van Halen