G4120: Introduction to Computational Biology
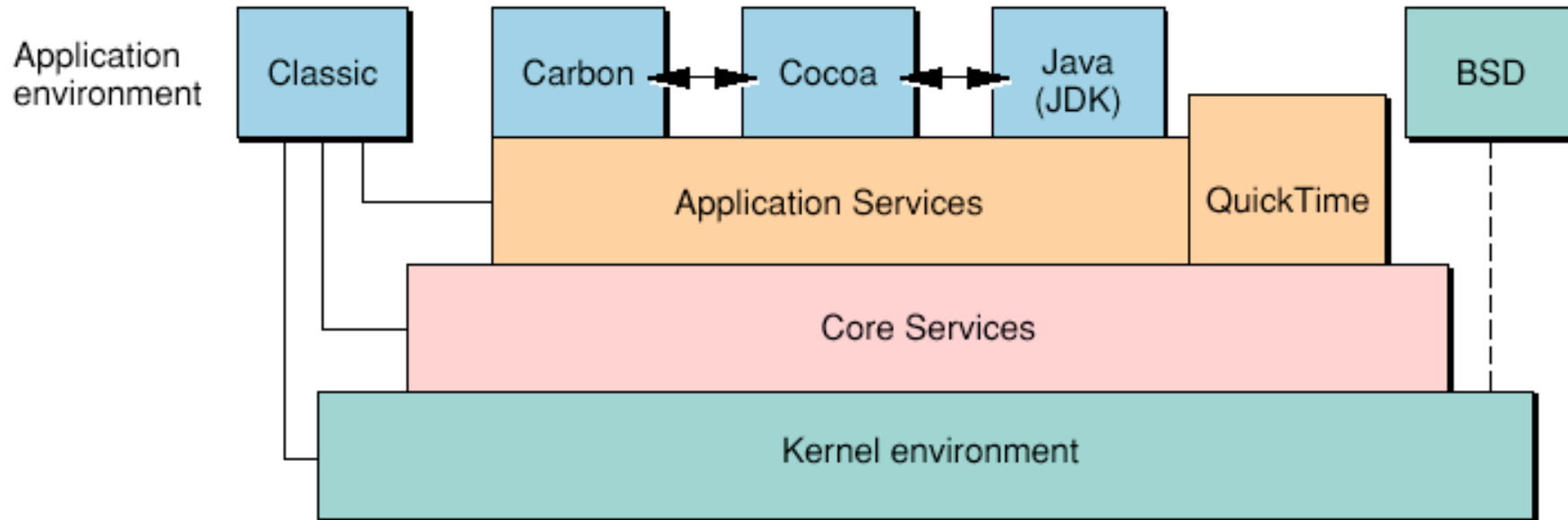
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Macintosh OS X
System Architecture

Application
environment

| Classic | | Carbon | ⬌ | Cocoa | ⬌ | Java (JDK) | | | BSD |

Application Services

QuickTime

Core Services

Kernel environment

Macintosh OS X File System

The OS X file system is based on extensions to the BSD Unix file system with a VFS (Virtual Files System) design which allows for stacking of file systems, and supports both aliases and symbolic links.

Filenames

Can be 255 characters long. Do not begin a file name with a period, and avoid colons and slashes in a file name (slashes are used to designate folders or directories, e.g. **/Applications/Utilities**). For cross-platform use you may have to shorten the length of a file name and remove blank spaces.

Alias

A reference to a specific named file. They will follow a file wherever it is moved, as long as the name is not changed. They can be created in the Finder with the **Make Alias** command in the **File** menu (**Command** and **F**), or by holding **Option** and **Command** while **dragging** a file.

Symbolic Link

A Unix reference to a specific named file. If you move a file without replacing it with a file with the identical name, a symbolic link will break, unlike an alias.

Directory

Information as to the numbers, names, locations, types, and sizes of all files and folders saved on a disk volume is stored in a structured central directory. Computer crashes, resets, brownouts and power failures can cause directory damage. Journaled file systems (including OS X 10.4) keep a backup record of changes to a disk, and are less prone to suffering directory damage. **Disk Utility** (free) or **DiskWarrior** (commercial) may be able to repair a damaged directory.

Macintosh OS X Supported Volume Formats

Mac OS Extended Format (Journaled)

Also known as **Journaled HFS+**, this is a version of Macintosh Extended Format that is journaled to protect the integrity of the file system in the event of unplanned shutdowns or power failures. It is the default format used by Macintosh OS X 10.4 and up.

Mac OS Extended Format

Also known as **Heirarchical File System Plus (HFS+)** this is a version of the older Macintosh HFS format, extended to more flexibly handle data stored on large hard disks. It is the default format used by Macintosh OS 8.1, OS 9 and older versions of OS X. The original HFS was the standard format for Mac OS prior to 8.1. HFS supports files with data and resource forks.

NTFS

The standard file system of Windows NT and later. Macs can usually read, but not write to it.

MS-DOS File System (FAT, FAT32)

The file system used by MS-DOS and Windows computers. Macs can read and write it. 4 GB files.

Unix File System (UFS)

A format based on the 4.4 BSD Unix FFS (Fast File System) that is similar to the standard volume format of most Unix operating systems.

Universal Disk Format (UDF)

The standard cross-platform format for DVD volumes.

ISO 9660

The standard cross-platform format for CD-ROM volumes.

Macintosh OS X File and Application Structure

A Macintosh OS X application can have a fairly complex structure. What appears to be a single file will generally have at least metadata and a data fork, and possibly a resource fork.

File (HFS/HFS+) → **Data Fork** → **Metadata**
                    → **Resource Fork**

Further, most OS X applications are actually bundles. A **bundle** is a folder which has had a **bundle bit** set such that the Finder displays it as a single application. This is also known as a **package**. A bundle actually contains multiple files, each with their own resource and data fork. It is possible to view the contents of a bundle by **Control clicking** it in the Finder, then selecting **Show Package Contents**.

Bundle bit ON

   FantasticStuff

Bundle bit OFF

▽ 📁 FantasticStuff
      FantasticStuff
▷ 📁 Contents
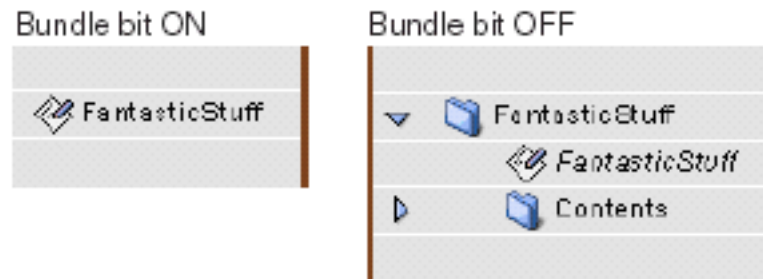
As a result, moving a Macintosh application across platforms, or via email, can be tricky, as metadata and resource forks may be lost. This is why it is important to use an application such as Mail, which is aware of the Macintosh file structure, when emailing files, or use a disk imaging utility such as Disk Copy (**.dmg**), or a compression utility, such as Archive (**.zip**), compress (**.z**), gzip (**.gz**) or Stuffit Deluxe (**.sit**), all of which can convert an application into a single file with only a data fork.

Macintosh OS X and Unix File Ownership and Permissions

File Ownership

A file is typically owned by the account that created it. There are three levels of file access: **owner, group** and **other**. Each can have different levels of access. A user can belong to more than one group, and a file can have more than one owner, with different access levels for each. The default group in OS X is **staff**. Users with administrative privileges also belong to the group **admin**.

File Permission Mappings

Decimal Number	Permission	English translation
0	---	No permissions
1	--x	Execute only
2	-w-	Write only
3	-wx	Write and execute
4	r--	Read only
5	r-x	Read and execute
6	rw-	Read and write
7	rwx	Read, write, and execute

Permissions and ownership information can be viewed (and changed) for a given file in the Finder by selecting **Get Info** from the **File** menu, then expanding the **Ownership & Permissions** section.

In general, one should not change these values. Disk Utility can repair common permission problems.

One can also lock and unlock a file or disk images from Get Info to temporarily create a read only file or volume. It is also possible to create a read only disk image (**.dmg**) in Disk Utility by changing the preferences.

In Unix, file permissions are commonly noted in the order: **owner, group, other.** Thus, a file with permissions **755** can be read, written and executed by the owner, but only read and executed by members of the group or others. The **chmod** command is used to change permissions.

File Extension

A three letter extension following a period at the end of a file name which indicates what type of document it is. It is one of the factors (metadata is another) that governs which application the Finder will use to open a file (this can be set under **File > Get Info > Open With**).

Text (Plain text)   .txt

Based on the ASCII (American Standard Code for Information Interchange) or Unicode standards for exchanging plain text information. *Macintosh text files use a slightly different system of line breaks from Unix or Windows,* although most software compensates for it.

Word (Word processing)   .doc

The industry standard for word processing. Works well with EndNote to handle citations to references. More compatible than the newer **.docx** format.

Excel (Spreadsheet)   .xls

The industry standard for spreadsheets. Capable of sophisticated charting and graphing as well, though it requires some effort. More compatible than the newer **.xlsx** format.

PowerPoint (Presentations)   .ppt

The industry standard for presentations. On the Macintosh OS X platform, has competition from Apple's Keynote (**.key**).

PDF (Portable Document Format)   .pdf

A high quality cross platform bitmap and vector graphics format that is native to OS X, and ideal for distributing complex figures or papers. Any document in OS X can be saved in PDF format by first selecting **Print** from the **File** menu, then clicking **Save As PDF...**

Graphics File Formats

GIF (Graphics Interchange Format)   **.gif**
A graphics file format optimized for onscreen viewing. Images are automatically compressed using a lossless compression scheme, and decent compression can be achieved for line art images, or images with few colors.

JPEG (Joint Photographic Experts Group)   **.jpg**
A graphics file format based on lossy compression. It works particularly well with photographs, often reducing them to a tenth of their former size, but it does so by irrevocably discarding some data. Thus, one should be cautious when using this format with critical data.

TIFF (Tagged Image File Format)   **.tif**
The industry standard for displaying and printing bitmapped images. It supports lossless compression.

EPS (Encapsulated PostScript)   **.eps**
A format that can store both bitmapped and vector based information, making it suitable for very high resolution printing of text or figures.

PICT (Picture)   **.pct**   or   **BMP (Bitmap)**   **.bmp**
Older Macintosh (PICT) and Windows (BMP) graphics standards.

PNG (Portable Network Graphic)   **.png**
A new, royalty free standard for onscreen viewing which has some benefits over the GIF format.

RAW (Raw data)   **.raw**
An option on many digital cameras and microscopes, it gives the raw, uncorrected, uncompressed data.

Classic (68K or PPC)

An application developed for an earlier version of the Mac OS which can run in Classic emulation in OS X. A 68K application does not take advantage of the faster PowerPC architecture, while a PPC application will do so.
Example: *DNA Strider*

Carbon

Typically an application developed for an earlier version of the Mac OS or other operating system, then brought up to date for OS X by "Carbonizing" it. It will run native under OS X, faster than a Classic application, and may also run in OS 9 or earlier.
Examples: *Microsoft Office, EndNote*

Cocoa

An application developed specifically for OS X. It will run native under OS X, but will not run on earlier versions of the Mac OS. In general, this type of application is the fastest under OS X.
Examples: *Lab Assistant, EnzymeX, 4Peaks*

Java

An application developed in the cross-platform Java programming language. It will run native under OS X, but can be a bit slow, and the need for compatibility can limit its graphical user interface.
Example: *Sequence Analysis, JImage*

Unix

An application developed for Unix that has been compiled to run under OS X's BSD style Unix. It will typically have a command line interface, meant to be run by a user from a Unix command line, which Terminal gives access to in OS X.
Examples: *seqstat, clustalw*

Macintosh OS X Applications in Biology

Publishing Papers
Word, EndNote

Preparing Figures
Photoshop, Excel, OmniGraffle, DeltaGraph, Canvas, Illustrator

Presentations
PowerPoint, Keynote

Lab Notebooks
Word, TextWrangler, BBEdit, LabAssistant, FileMaker Pro

Lab Databases
EndNote, FileMaker Pro, iPhoto

Sequence Editing and Analysis
DNA Strider, Sequence Analysis, MacVector, TextWrangler, BBEdit, ClustalX, 4Peaks, Safari

Lab Utilities
DNA Artist, EnzymeX, JImage, LabAssistant

Organizing Files and Folders

1) Use nested folders of aliases in your home directory (i.e. **~/Aliases/Applications**, **~Aliases/Internet**, **~/Aliases/Utilities**) to organize aliases. Then drag the Aliases folder to your Dock.

2) Drag commonly used applications to your Dock.

3) Drag commonly used volumes and folders to the Sidebar. This will also add those volumes and folders to all Save and Save As... dialogue boxes, resulting in much easier navigation.

4) Customize your Toolbar by selecting Customize Toolbar... from the View menu to add a Path icon, which will help you find your current location (or **Command click** on the folder icon in the Toolbar).

5) Learn to drag files and folders to the Terminal window to quickly get their paths when using the command line.

6) Learn to use keyboard shortcuts when navigating. Examples include **Command Shift N** to create a new folder, **Command Option drag** or **Command L** to make an alias, using **Command Tab** to switch between applications, **Command S** to save, **Command P** to print, **Command Delete** to move files to the Trash, or using the **Tab**, **arrow** and other keys in the Save and Save As... dialogue boxes.

Terminal and the Unix Command Line

Terminal

Terminal, located in /Applications/Utilities, is the application which gives an OS X user command line shell access to the underlying Unix operating system. *One can drag a folder or application to the Terminal window to get its pathname,* which is often required when issuing Unix commands.

ls (list)

Lists the current directory's contents. Adding the **-a** option (**ls -a**) lists all contents, including what is normally invisible (file or directory names starting with a period, e.g. **.bash_profile**, are normally invisible). Adding the **-l** option (**ls -l**) lists long information about files: type, permissions, links, owner, group, size, modification date & time and name. The wild card character (*****) is often useful in arguments for this command, e.g. **ls *.doc** will list all Word files with that extension in a directory.

cd (change directory)

By itself, **cd** takes you to your home directory. Using an argument of two periods, i.e. **cd ..**, moves you to the directory directly above the current directory, while **cd /** moves you to the root directory. If you get lost, type **pwd** to print your working directory, that is, list your current directory as a pathname.

mv (move)

Copies the specified file(s). For more information on the syntax, type **man mv** to see the manual page for mv (when reading a manual page, press the space bar to page down, press q to quit the manual page).

rm (remove)

Removes/deletes the specified file(s). *This command should be used with great precision, particularly when combined with wild card characters. A single typo can accidentally delete important files.* The **-i** option (**rm -i**) runs **rm** in interactive mode, where it will ask if you really want to delete each file. Type **man rm** for more information.

sudo (superuser do)

Allows you to execute a single command as a root user, or superuser, who has no limitations. *This command also has the potential to cause serious problems, so use it with care and precision.*

exit

Type exit to logout of a Terminal session.

Automation

One of the tasks computers are best at is performing highly repetitive tasks at great speed with great accuracy. Learning a programming language such as C or Perl allows you to fully utilize the power of a computer, but becoming fluent in a programming language can take significant time and effort. With a fraction of that effort, however, it is possible to learn to use macros, regular expressions, simple scripting languages such as AppleScript, certain applications, Unix shell scripts and the Unix command line interface to automate repetitive tasks and save a great deal of time and effort.

Common Tasks that can be Automated

- Entering passwords (Keychain Access, ssh)
- Filling out forms (Safari or Internet Explorer AutoFill)
- Searching and reformatting files (BBEdit, grep, regular expressions, shell scripts)
- Tabulating data in files (BBEdit, grep, regular expressions)
- Renaming files (File Buddy, Renamer4Mac, AppleScript, shell scripts)
- Entering repetitive information (macros, AppleScript, shell scripts)
- Readback of repetitive information (AppleScript)
- Assembly of repetitive information (AppleScript, regular exp., shell scripts)
- Repetitive tasks (cron, osascript, CronniX, shell scripts)
- Backups (Retrospect, SuperDuper!, AppleScript, rsync, shell scripts)

Automation Utilities
in OS X or Unix

Macros

A macro is a single, user-defined command that executes a series of one or more commands.

- QuickSilver (**http://www.blacktree.com/**)
- Typeit4me (**http://www.typeit4me.com/**)
- Keyboard Shortcuts (System Preferences > Keyboard & Mouse > Keyboard Shortcuts > +)
- alias (Unix shell command)

Renaming Utilities

- Renamer4Mac (**http://www.power4mac.com/renamer/**)
- File Buddy (**http://www.skytag.com/**) Shareware

Backup Utilities

- rsync and RsyncX (**http://archive.macosxlabs.org/rsyncx/rsyncx.html**)
- Retrospect (**http://www.dantz.com**) Commercial

Text Processing Utilities

- grep and regular expressions (Unix utilities)
- BBEdit (**http://www.barebones.com/**) Commercial (TextWrangler is free)

Scripting Languages

A scripting language is a simple language, typically written in a series of English-like statements that, when executed, sends commands to applications or to the operating system itself.

- AppleScript
- Automator
- bash Unix shell scripts

Startup

It is possible to automatically launch applications (including AppleScripts) in OS X when the computer starts up by adding them to the Login Items tab of the Accounts pane under System Preferences.

cron

Cron is a Unix system service that allows for scheduled (daily, weekly or monthly) execution of scripts, programs and applications. The lists of scheduled actions are kept in a formatted text file called a crontab. There is a system crontab, which normally should not be edited, and a personal crontab for each user, which is what you should edit to add a regularly scheduled task. Cron can be used with rsync or RsyncX to create an automated backup system.

   By default, OS X 10.4 has a number of regular maintenance functions handled by another process called launchd, scheduled to run between 3:15 A.M. and 5:30 A.M. (which will not take place if the computer is shut off or asleep at that time).

CronniX

CronniX provides an OS X Aqua graphical user interface to cron, which makes editing crontabs to schedule repetitive tasks easier. It can be downloaded from the Mac OS X section of VersionTracker (**http://www.versiontracker.com/**).

osascript

Osascript is a shell utility that allows you to run AppleScripts from the Unix command line (and thus use cron to run an AppleScript at scheduled intervals).

Automator

Automator is an automation application introduced in OS X 10.4 (found in /Applications). It allows users to assemble a series of steps (called **actions**) into a single sequence (called a **workflow**), without any programming required. Instead, it uses a simple drag-and-drop graphical user interface. Once created, workflows can be saved, modified and run again.

To create a workflow that would read back entered text, you would launch Automator, select TextEdit (from the Library column), then use the Ask for Text action, followed by the Speak Text action. An Automator workflow can be saved as a workflow, application or plug in.

A number of predefined Finder and application actions are included (stored in /System/Library/Automator). Other actions can be added, and third-party applications can be written in such a way that their own actions automatically become available for use in Automator.

Behind the scenes, Automator uses the AppleScript scripting language to create and carry out its actions. Although Automator can be used to create useful workflows, more powerful scripting requires the use of a scripting language and techniques such as regular expressions.

Automator in Bioinformatics
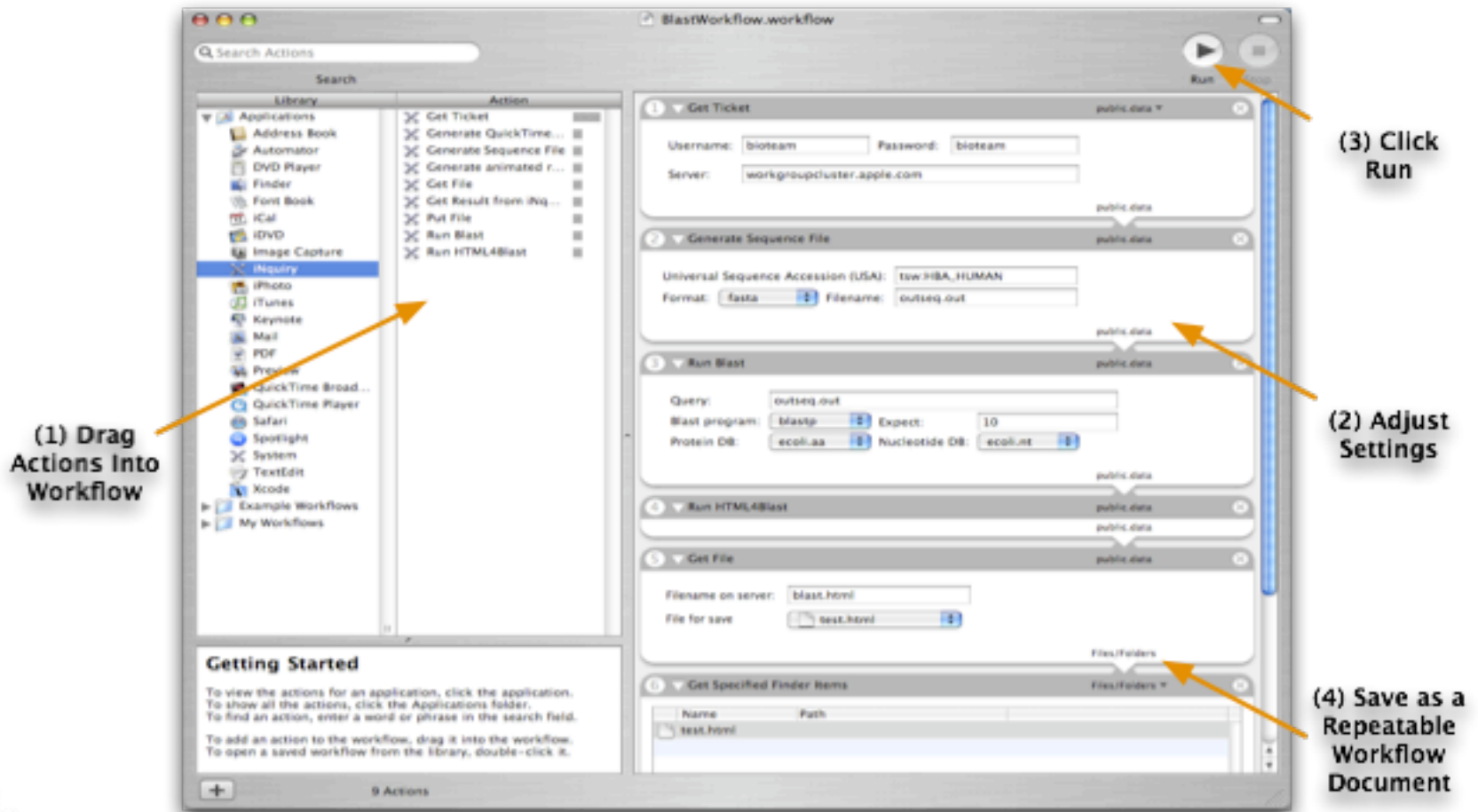
iNquiryXTE is an example of an Automator based bioinformatics application. It is an OS X Open Source application that functions both as a web services client to an iNquiry enabled Apple Workgroup Cluster and an Automator action generator.

AppleScript

AppleScript

AppleScript is a scripting language that provides direct control of scriptable Macintosh applications, including many parts of the Mac OS itself. Instead of using a mouse or keyboard to manipulate applications, you create scripts to automate tasks, control applications on local or remote computers, and even to access web services.

AppleScript allows scripters to extend and integrate features supplied by the operating system and by scriptable applications. To provide scripters with increased flexibility and power, developers make their applications scriptable, or capable of responding to Apple events. Applications can also execute scripts or send individual Apple events to take advantage of features of other applications. For example, a script that executes when the system boots could run a mail program, scan messages in the in box for URLs of a certain form, and then open those URLs in a web browser.

Aqua			AppleScript
Cocoa	Java 2	Carbon	Classic
Quartz	OpenGL	QuickTime	Audio
Darwin – Open Desktop			

Automating Macintosh OS X Applications with AppleScript

AppleScripts

In AppleScript, users write a series of English-like statements or scripts, that, when executed, send commands to applications or to the Mac operating system itself. These scripts can be far more complex than Automator workflows. The following script will use the TextEdit application to say hello:

```applescript
tell application "TextEdit"
    activate
    try
        set this_string to ("Hello world!") as string
        set default_voice to ("Ralph") as string
        say this_string using default_voice
    end try
end tell
```

Script Editor

This script can be run from Script Editor (in /Applications/AppleScript), which is normally used to edit, test and run AppleScripts Scripts can be saved as a text files, compiled scripts, run only compiled scripts or applications.

Regular Expressions

A regular expression is a pattern that describes a set of strings. Regular expressions are constructed analogously to arithmetic expressions, by using various operators to combine smaller expressions.

Wildcards

`.`   A period matches any character except a line break (i.e. a carriage return).
`^`   A caret matches the beginning of a line (unless used in a character class).
`$`   A dollar sign matches the end of line (unless used in a character class).

Character Classes

`[...]`   To match a set of characters, place square brackets around them. `[agct]` will match an `a, g, c` or `t.`
`[^...]`   To exclude a set of characters, place a caret after the opening bracket. `[^agct]` will not match an `a, g, c` or `t,` but will match any other character.
`-`   To specify a range of characters, use a hyphen within the backets. `[0-9]` will match any digit.

Quantifiers

`*`   An asterisk matches zero or more occurrences of the specified class or character that precedes it. `.*` will match no or any characters.
`+`   A plus sign matches one or more occurrences of the specified class or character that precedes it. `[0-9]+` will match at least one digit.

Escape Character

`\`   A backslash acts as an escape character, allowing you to search for wildcard or special characters, e.g. `\.` will actually match a period, and `\\` will match a backslash.

grep (Globally search for Regular Expression and Print)

Grep is a powerful Unix text searching utility that is available at both the command line in OS X and in certain applications such as TextWrangler or BBEdit, or in Window applications such as WindowsGrep. Grep can search the input for lines containing a match to a given pattern, using regular expressions if necessary, then output the lines that matched. Grep can thus greatly automate searching for information in text files.

The Unix **grep** utility can be invoked from the Terminal in OS X using the following syntax:
`grep -[options] 'pattern' filename(s)`

Useful grep Options

`-c`   print count of matching lines, rather than the matching lines themselves
`-i`   ignore case distinctions in pattern and file(s)
`-l`   print filenames containing matching lines, but not the matching lines

grep Results

grep normally prints a list of every line within the file(s) searched containing a match.

In Terminal, typing **`grep 'RNA' sars.txt`** will find all lines containing RNA within the **sars.txt** file. To automatically output those lines to a file called **sarsrna.txt**, one would type **`grep 'RNA' sars.txt > sarsrna.txt`** (in Unix, > redirects output).

`grep '>' sequences.fasta` will return the name of every sequence in the **sequences.fasta** file (in a fasta file, the sequence name is on a line beginning with >).

`grep -c '>' sequences.fasta` will only return the number of sequences in the file.

Searching for Regular Expressions with BBEdit and TextWrangler

Grep with BBEdit and TextWrangler

BBEdit and TextWrangler have a built-in grep utility which can be used through their Find & Replace function. To use it, simply make sure the Find & Replace Use Grep option is checked.

For example, to strip out all non-DNA characters (such as line numbers or spaces) from a text file containing a DNA sequence (such as **r751.dna**) in BBEdit or TextWrangler, one can simply enter `[^acgt]` in Search For, make sure Use Grep is checked, and Replace With nothing, then select Replace All (by default, it is case insensitive).

To strip all numbering and blank spaces from a text file containing a protein sequence (such as **gag.aa**), one can first enter `\d` in Search For and Replace With nothing, then enter a space in Search For and Replace With nothing.

Useful BBEdit Special Character Matches

`\r`   Line break (carriage return)
`\n`   Unix line break (line feed)
`\t`   Tab
`\f`   Page break (form feed)

`\d`   Any digit [0-9]
`\D`   Any non-digit character (including carriage return)

`\s`   Any whitespace character (space, tab, carriage return, line feed, form feed)
`\S`   Any non-whitespace character (any character not included by \s)

Subpatterns

A subpattern consists of a simple or complex pattern enclosed in a pair of parentheses. Subpatterns allow you to reorder the data as it is replaced. This is a feature of certain grep implementations such as the one in TextWrangler or in the Perl programming language.

```
&                       The entire matched pattern (replacement only).
(x)                     The pattern x is remembered (search only).
\1, \2, ..., \99        The nth subpattern in the entire search pattern.
```

If you have: **You will get:**

```
ccc         Search For:     [acgt$]+            Codon: ccc
gcg         Replace With: Codon: &             Codon: gcg
atg                                            Codon: atg
cga                                            Codon: cga
```

If you have: **You will get:**

```
2152aa      Search For:     (\d)aa              2152nt
623aa       Replace With: \1nt                 623nt
15aa                                           15nt
```
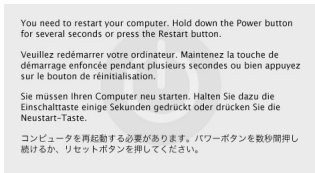
Macintosh OS X Troubleshooting: Potential Problems

Startup Crashes

The computer freezes or crashes upon startup. This can be caused by hardware trouble, directory damage, or file damage.

Application Crashes

A specific application may freeze or crash intermittently without serious consequences. If an application keeps crashing consistently, there is a more serious problem.

Document Crashes

A specific document causes the application to crash when you try to open it. The application does not crash when opening other documents.

File Problems

A file cannot be deleted, is invisible, or otherwise misbehaves.

Volume Problems

A volume cannot be mounted, unmounted or ejected.

Startup Crash Recovery

Utilities

1) Run Disk Utility's First Aid. Boot from the Mac OS X Install CD by holding down the **C** key while restarting with the CD in the computer to boot from the CD, then run the Disk Utility application from the CD to repair the disk and repair permissions.

2) Run DiskWarrior, a commercial utility that can potentially repair directory damage that Disk Utility cannot. Others recovery utilities include Data Rescue II, TechTool Pro and Drive 10.

Boot in Safe Mode

1) Hold down the **Shift** key while restarting the computer to start in **S**afe Mode. This will disable third party kernel extensions and startup items.

2) If booting in Safe Mode solves the problem, it is likely caused by a third-party startup item. Remove likely candidates (check **System Preferences > Accounts > Login Items** or **/Library/StartupItems** and **/System/Library/StartupItems**).

Zap the PRAM

To clear the computer's parameter RAM and nonvolatile RAM, which contains certain system and device settings, hold down the **Command Option P** and **R** keys while restarting the computer. Hold the keys down until the computer restarts twice.

Reinstall OS X

1) As a last measure, if you do not have a recent backup, you can use the Archive and Install option to reinstall OS X from the Mac OS X Install CD.

2) If you have a current backup you are certain of, you can use Erase and Install instead.

Understanding Startup Crashes

Console and Log Files

The **Console** application, located in **/Applications/Utilities**, lets you view log files (located at **/Library/Logs/**) which can contain useful information about the cause of a crash. Particularly useful log files to review using Console include **console.log, system.log,** any **crash** logs and **panic.log** (see below).

Automatic Kernel Panic Logging

Macintosh OS X 10.4 uses automatic kernel panic logging. You may or may not see any visual indication of a kernel panic. You should check the kernel panic log any time you had to force restart your computer, using either the power button, interrupt button, or the **Control Command Power** key combination. The kernel panic text is saved to a log file named **panic.log** and can contain useful information about the cause of the kernel panic, suggesting a possible solution.

Verbose Mode

It is possible to start your computer up in Verbose mode by holding down **Command** and **V** at startup. This will display startup information that can potentially be useful in troubleshooting a problem.

Apple Startup Problems Guide

Apple has a detailed guide for resolving startup problems available at:
http://docs.info.apple.com/article.html?artnum=106805

Causes of Application Freezes

Application freezes are typically caused by bugs in a program, a corrupt application preference file, a corrupt font file, a permissions problem, or a corrupted application.

Fixing Application Freezes

Force Quit by pressing **Command Option Esc**, or holding **Option** down while **clicking** on the application's icon in the Dock. Then relaunch the application. Unlike OS 9 or Windows, there is no need to restart the computer, because memory is protected.

Fixing Recurring Application Crashes

1) Delete potentially corrupt application preference files. They will be recreated by the application the next time it is run. Look in **~/Library/Preferences** or **~/Library/Preferences/ByHost** for preference files that belong to that application and delete them. You may also need to look in **~/Library/Application Support**.

2) Run Disk Utility and repair permissions.

3) Check for corrupt font files. Look in **~/Library/Fonts**, **/Library/Fonts**, and **/System Folder/Fonts**.

4) Reinstall the application.

Lecture 3
Macintosh OS X
and Unix
October 8, 2009

Document Crashes

Causes of Document Crashes

Document crashes are typically caused by a corrupt document file.

Document Crash Recovery

1) Recover corrupted document from within application, if such an option exists.

2) Delete corrupted document and restore from a current backup/autosave.

3) Delete corrupted document and restore it from a recent backup.

4) Recover text from corrupted document with a utility such as CanOpener, BBEdit with CanOpener Text Extract, or MacLink Plus.

Undeleteable Files

1) Check locked status and permissions by selecting the file, then choosing Get Info (**Command I**) from the File menu. Locked files can be deleted from the Trash by holding down **Command** and **Shift** while emptying the Trash.

2) Check permissions by running Disk Utility's First Aid.

3) Delete the file from the Unix command line. Launch the Terminal application. Type **rm**, followed by a space ("**rm** "). Drag the file you want to delete to the Terminal window, then hit return. When done, type "**exit**" and hit return. If you need to delete a number of files in the Trash, they are located at "**~/.Trash**". If you are deleting a folder or an application bundle, you will need to type **rm -r**.

4) If that still does not work, use the same approach, but type "**sudo rm -ri** " at the beginning of the line, drag the file, then hit return. Type your password and hit return, then type "**y**" and hit return if correct, and when done type "**exit**" and hit return. *Whenever working from the Unix command line be careful to be very precise, otherwise you may delete more then you expected.*

Invisible Files

1) Files whose name begins with a "**.**" are automatically made invisible by OS X. This is a rare problem with downloaded files. Utilities such as XRay allow you to rename such files, otherwise you cannot use them.

2) Files can also have an Invisibility bit set on. XRay can be used to change an incorrectly set Invisibility bit.

3) OS X further keeps a special root level **.hidden** file which is a list of files that are meant to be kept invisible, typically system files which should not be altered.

Volume Problem Recovery

Mounting Network Volumes

Various network volumes, including those from UNIX and Windows servers, can be mounted by selecting Connect to Server... from the Finder's Go menu (**Command K**).

Ejecting/Unmounting Volumes

1) Drag the volume to the Trash (which changes into an Eject icon when a volume is selected and dragged).

2) Select the volume and select Eject (**Command E**) from the Finder's File menu.

3) Click the the volume's eject icon in the Sidebar.

4) Holding down the **Eject** button (not just pressing it) ejects a CD or opens the CD drive.

Unejectable/Unmountable Volumes

1) If an error message comes up saying that the volume is "**in use**", a file or application on that volume is open. Quit any applications that may be using documents or files on that volume.

2) Log Out from the Apple menu, then log back in.

3) Restart the computer and hold down the **mouse button** while it restarts to eject a CD.

4) Use a paper clip to manually eject the disk by pressing the manual release (typically a small hole near the drive opening).

Fixing Recurring Crashes

1) Select Log Out or Restart from the Apple menu.

2) If the Apple menu commands are not responding, press **Control Command Eject** to do a soft restart.

3) If that doesn't work, press **Control Command Power** to do a hard restart.

4) You can force a shut down by holding down the power button for 5 seconds.

5) Try a hard reset by pressing and holding the **Shift Control Option** and **Power** keys (or pushing the reset button on older iBooks).

6) Run Disk Utility and repair permissions.

7) Try running Cache Out X to resolve potential cache problems.

8) Zap the PRAM and NVRAM (parameter RAM and nonvolatile RAM settings) by restarting the computer and holding down the **Option Command P** and **R** keys until the computer restarts for a second time (so that you hear the startup sound at least twice).

9) Reset the PMU (Power Management Unit) on the iBook by turning it off, disconnecting the power adapter, removing the battery, then press and hold **Shift Control Option** and **Power** for a second, then release (for older iBooks, press the reset button instead). After five seconds, reconnect the power adaptor, replace the battery, and turn the iBook back on. This will also reset the date and time.

10) Check troubleshooting web sites for a possible solution.

11) Reinstall OS X.

Macintosh OS X Backup

Recovering Deleted Files

Unix file systems (i.e. OS X) allow deleted files to be immediately overwritten, making it difficult or impossible to recover a file once you have emptied the Trash (particularly if you used Secure Empty Trash), which is why backups are critical. Certain utilities, such as Data Rescue II, may be able to recover deleted files, but are not guaranteed to work reliably.

Backup Strategies

1) Keep applications installed in the Applications directory, keep all of your documents and other files installed in your Home directory. This way, a backup of your Home directory will cover everything important.

2) Many applications have an Autosave option which will back up an application you are working on every few minutes. However, when making major changes, it is still wise to manually save a new version by selecting Save As... from the File menu of the application.

3) Regularly back up your Home directory by burning it onto a CD-R, copying it to another hard drive, or backing it up onto another backup device.

4) Back up critical files more regularly, including using Save As... to make a second copy, emailing them to yourself, or one of the above backup methods.

5) Backup utilities, such as Time Machine *(free)*, rsync *(free)* or Restrospect *(commercial),* allow you to automatically schedule daily, weekly or monthly complete or incremental backups.

6) Make a backup schedule and stick to it (i.e. CD-R home backup once a month, network backup once a week, critical file backup once a day).

7) Full backups that exactly duplicate your entire hard drive can be created and restored using Disk Utility, SuperDuper! or Time Machine *(OS X 10.5 and up only)* but require another volume of equal or larger size than the hard drive you are duplicating (e.g. an external FireWire hard drive).

Troubleshooting References

Books

Mac OS X Unleashed by John Ray & William C. Ray
Mac OS X Help Line by Ted Landau & Dan Frakes

Websites

http://www.info.apple.com
http://discussions.apple.com
http://www.macosxhints.com
http://fixa.troubledmac.com

Utilities

Data Rescue II *(commercial)*
Disk Utility *(free, located in /Applications/Utilities/Disk Utility)*
DiskWarrior *(commercial)*
rsync *(free, located in /usr/bin/rsync)*
SuperDuper! *(free)*

(To download these and other utilities, search for them on
 http://www.versiontracker.com*)*