

# Bash Next Steps

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# Bash and Me

- **Used throughout career**
- **Never learned formally**
- **Stumbled around, lots of mistakes**
- **Slowly learned concepts and key points**
- **Wrote a book (Learn Bash the Hard Way)**

# This Course

- **Follows on from Introduction to Bash**
- **Live Walkthroughs**
  - **Encourage you to follow - 'Hard Way' Method**
- **Exercises**
- **Group chat**
- **Materials:**
  - <https://github.com/ianmiell/introduction-to-bash>

# Pre-Requisites

- **Familiar with command line**
- **Bash version 4+**
  - `$ echo $SHELL`
  - `$ bash --version`
  - <4 is still ok
- **Using zsh (eg on Mac)**
  - **Type 'bash' to get a bash shell**
- **Basic shell utilities (eg grep, cat, ls)**
- **Any editor (I use vim)**

# Why This Course?

- **Bash is everywhere**
- **Shells are everywhere**
- **Work with it every day**
- **Taken for granted that it's known**
- **Studying it pays massive dividends**
  - Gateway to deeper OS concepts

# Poll - Experience

- **Never used bash**
- **Used bash for <2 years**
- **Used bash for >2 years**
- **Used bash for >5 years**
- **Studied bash seriously**

# Structure of Course

- **Part I - Recap + Advanced Basics**
- **Part II - Advanced Scripting**
- **Part III - Advanced Bash Topics**

# Discussion

- **What do you want to achieve in bash?**
- **Any specific goals?**
- **What have you been frustrated by with bash?**



# Part I - Bash Recap

- **Variables**
- **Globbing**
- **Pipes and redirects**
- **Functions**
- **Tests**
- **Loops**
- **Command substitution**
- **Scripts**

# Part II - Bash Scripting

- **Subshells**
- **Process substitution**
- **Here docs**
- **Internal Field Separator**

# Subshells - Recap

- **Variables**
- **Working directories**
- **Redirection**

# Process Substitution - Recap

- **Signals**
- **man signal**
- **'kill' and signals**
- **trap signals**
- **fg and bg**

# Here Docs - Recap

- **Here docs**
- **Here strings**
- **Here docs and variables**

# Internal Field Separator - Recap

- **Problem - files with spaces**
- **The IFS shell variable**
- **The null byte as separator**

# Part III - Advanced Scripting

- **Job Control**
- **Traps and Signals**
- **cheapci / bashtop**

# Job Control - Recap

- **Single jobs**
- **Killing jobs**
- **Waiting for jobs**
- **Jobs, waiting, and exit codes**



# Traps and Signals - Recap

- **Signals**
- **man signal**
- **'kill' and signals**
- **trap signals**
- **fg and bg**

# Wrapup

- <https://github.com/ianmiell/bash-next-steps>
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# Bash Next Steps

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# Variables - Recap

- **\$ dereferences**
- **Variables in double quotes are interpreted, single quotes not**
- **Exported variables are passed to programs run within the shell**
- **Env shows exported variables, compgen -v shows all variables**

## 1.3 Globbing

- **What is a glob?**
- **What does '\*' mean?**
- **Differences to regular expressions**
  - **Not familiar with regexes?**
- **Dotfiles**

# Globbing - Walkthrough

- **Basic globbing with '\*'**
- **Other glob characters**
- **Dotfiles**
- **Differences to regexps**

# Recap - Globs

- **What a glob is**
- **What a dotfile is**
- **Special directory files**
- **Globs, regexps and dots**



# 1.4 Pipes and Redirects

- **Basic redirects**
- **Basic pipes**
- **File descriptors**
- **Special files**
- **Standard out vs standard error**

# Pipes and Redirects - Walkthrough

- **Simple pipes and redirects**
- **Standard in/out/error**
- **File Descriptors**

# File Descriptors (I)

- **Every process gets three file descriptors:**
  - **0 - 'standard input'**
  - **1 - 'standard output'**
  - **2 - 'standard error'**
- **'Normal' output goes to file descriptor 1**
- **Programs generally output errors to file descriptor 2**
- **Normally 'stderr' and 'stdout' both go to the terminal - but you can change that!**

# **File Descriptors (II)**

- **'>' operator sends standard output to a file**
  - **'1>' is the same (1 is assumed)**
- **'2>' sends standard error to a file**
- **Advanced, but often seen:**
  - **2>&1 sends standard error to whatever standard output is pointed at**
  - **A way of sending 'all' output to a file**

# Recap - Pipes vs Redirects

- **The main 3 file descriptors**
- **'>' vs '>>'**
- ***n*> and standard error**
- **2>&1 and ordering**

# Part I Recap

- **Globs**
  - **vs regexps**
- **Variables, arrays**
- **Pipes and redirects**
- **File descriptors**

# Exercise I / Break



# Part II - Further Bash Basics

- **2.1 Command Substitution**
- **2.2 Functions**
- **2.3 Tests**
- **2.4 Loops**
- **2.5 Exit Codes**



# Discussion

- **Is bash a programming language?**
- **What is a programming language?**
- **Why has bash lasted so long?**

## 2.1 Command Substitution

- **The '\$()' operator**
- **\$() vs ``**
- **Nesting**

## 2.2 Functions in Bash

- **Four types of command:**
  - **Function**
  - **Alias**
  - **Program**
  - **Builtin**

## 2.3 Tests

- **Bash tests**
- **Different ways of writing tests**
- **Logical operators**
- **Binary and unary operators**
- **'if' statements**

## 2.4 Loops

- **‘C’-style for loops**
- **‘for’ loops over items ‘in’ lists**
- **‘while’ loops**
- **‘case’ statements**

## 2.5 Exit Codes

- **What an Exit Code is**
- **The '\$?' variable**
- **How to set one**
- **Exit Code conventions**
- **Other 'special' parameters**

# Standard Exit Codes

- **0 - OK**
- **1 - General Error**
- **2 - Misuse of shell builtin**
- **126 - Cannot execute**
- **127 - No file found matching command**
- **128 - Invalid exit value**
- **(128 + n) - Process killed with signal 'n'**
- **(Signals covered in Part IV)**

# Recap - Exit Codes

- **Standard exit codes**
- **Exit code usage (eg grep)**
- **Setting exit codes**
- **'return'ing from functions**
- **Special parameters**



# Discussion / Recap - Part II

- **Bash more as programming language:**
  - **Functions**
  - **Tests / ifs**
  - **Loops**
  - **Return/Exit codes**
  - **Process and command substitution**
- **`$()` vs ```**

# Exercise II / Break



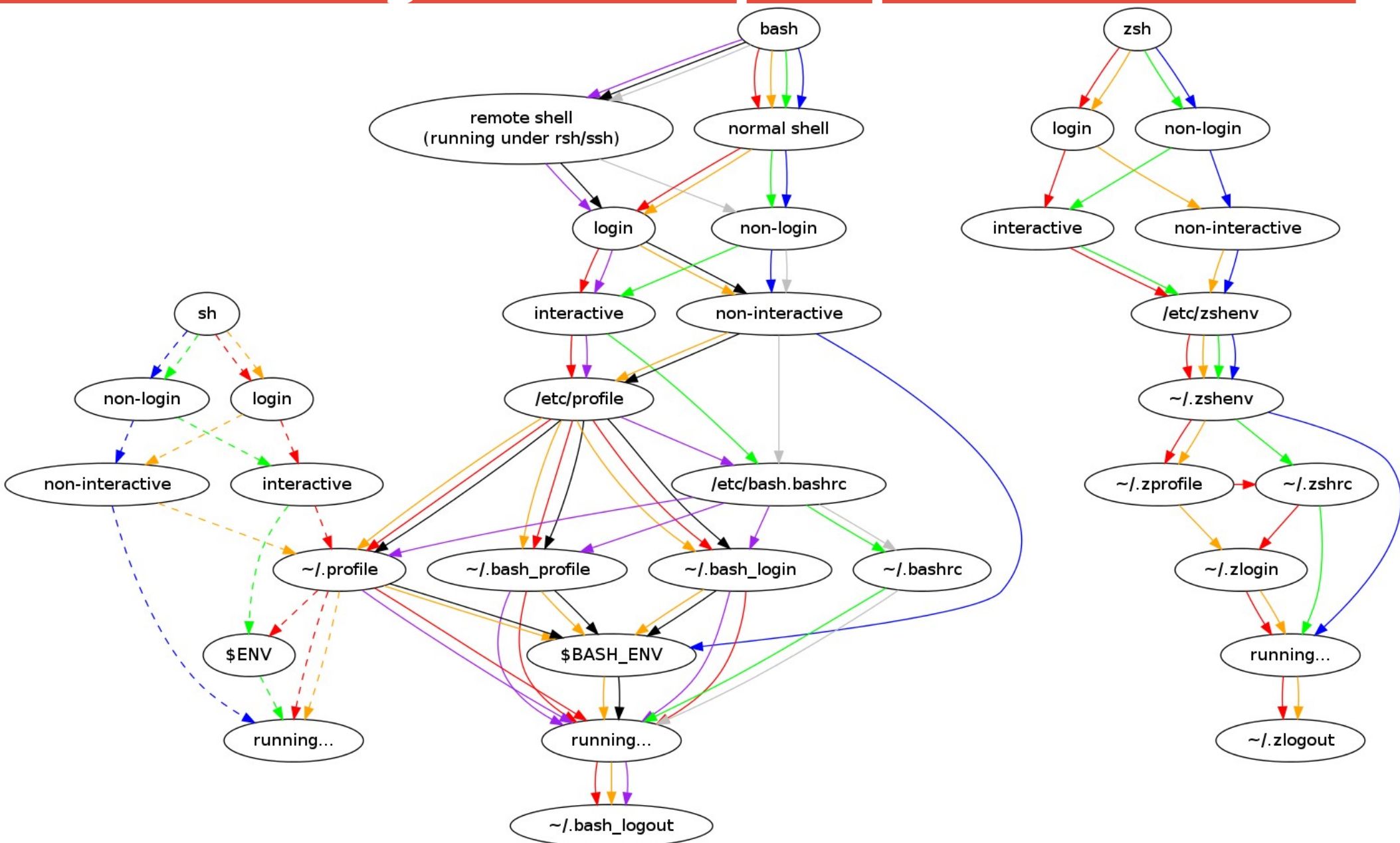
# Part III - Scripting

- **Scripts and Startup**
- **The 'set' Command**
- **Debugging in bash**
- **Subshells**
- **IFS**

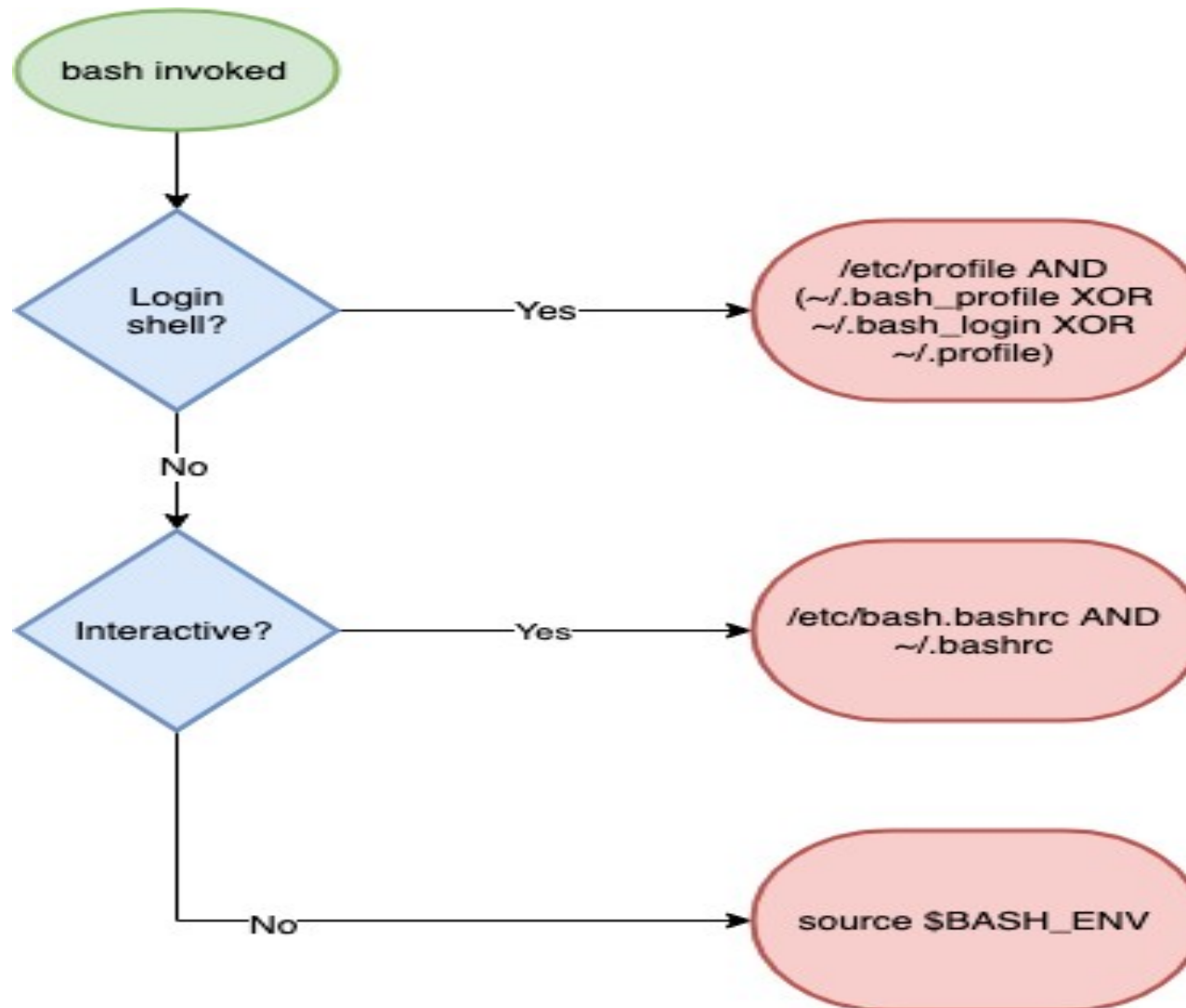
## 3.1 Scripts and Startup

- **What shell scripts are**
- **What happens on bash startup**
- **This has cost me many hours!**
- **Executable files**
- **'source' vs './'**

# Walkthrough - Startup Explained



# Walkthrough - Startup Explained (simpler)



# Recap - Scripts and Startup

- **What shell scripts are**
- **How complex bash startup can be**
- **Keep diagram handy!**

## 3.2 The 'set' builtin

- **Setting options in bash**
- **What POSIX is**
- **Most useful options:**
  - **nounset**
  - **xtrace**
  - **errexit**
- **'set' vs 'shopt'**



# Recap - 'set'

- **Options: + off, - on**
- **POSIX**
- **Most common options**
- **shopt and set**
- **xtrace, nounset, errexit**

# Exercise III / Break



## 3.3 Subshells

- **What is a subshell?**
- **How to create a subshell**
- **Why they are useful**
- **() vs {}**

## 3.4 Internal Field Separator

- **aka IFS**
- **Why it's important**
- **How to use it**

# Walkthrough - Spaces in Filenames

- **'for' looping over files**
- **The IFS shell variable**
- **The \$'' construct**

# Walkthrough - Spaces in Filenames

- **Setting IFS**
- **The 'find' command and 'xargs'**
- **find, xargs and the null byte separator**

# Part III - Discussion / Recap

- **Shell Startup**
- **Practical bash usage**
  - **Shell options**
  - **Shell debugging**
  - **IFS**

# Exercise IV / Break





# Part IV - Advanced Bash

- **Traps**
- **String manipulation**
- **Autocomplete**
- **Walkthrough a 'real' script**

## 4.1 Jobs and Traps

- **Background jobs**
- **Traps and signals**
- **The 'kill' command**
- **The 'wait' builtin**
- **Trapping signals**
- **Process groups**

# Standard Exit Codes - Refresher

- **0 - OK**
- **1 - General Error**
- **2 - Misuse of shell builtin**
- **126 - Cannot execute**
- **127 - No file found matching command**
- **128 - Invalid exit value**
- **(128 + n) - Process killed with signal 'n'**

## 4.2 Process Substitution

- **The '`<()`' operator**
- **Substitution of file arguments**

# Process Substitution - Walkthrough

- **The '`<()`' operator**
- **Substitution of file arguments**

# Exercise V



# Wrapup

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# Introduction to Bash

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