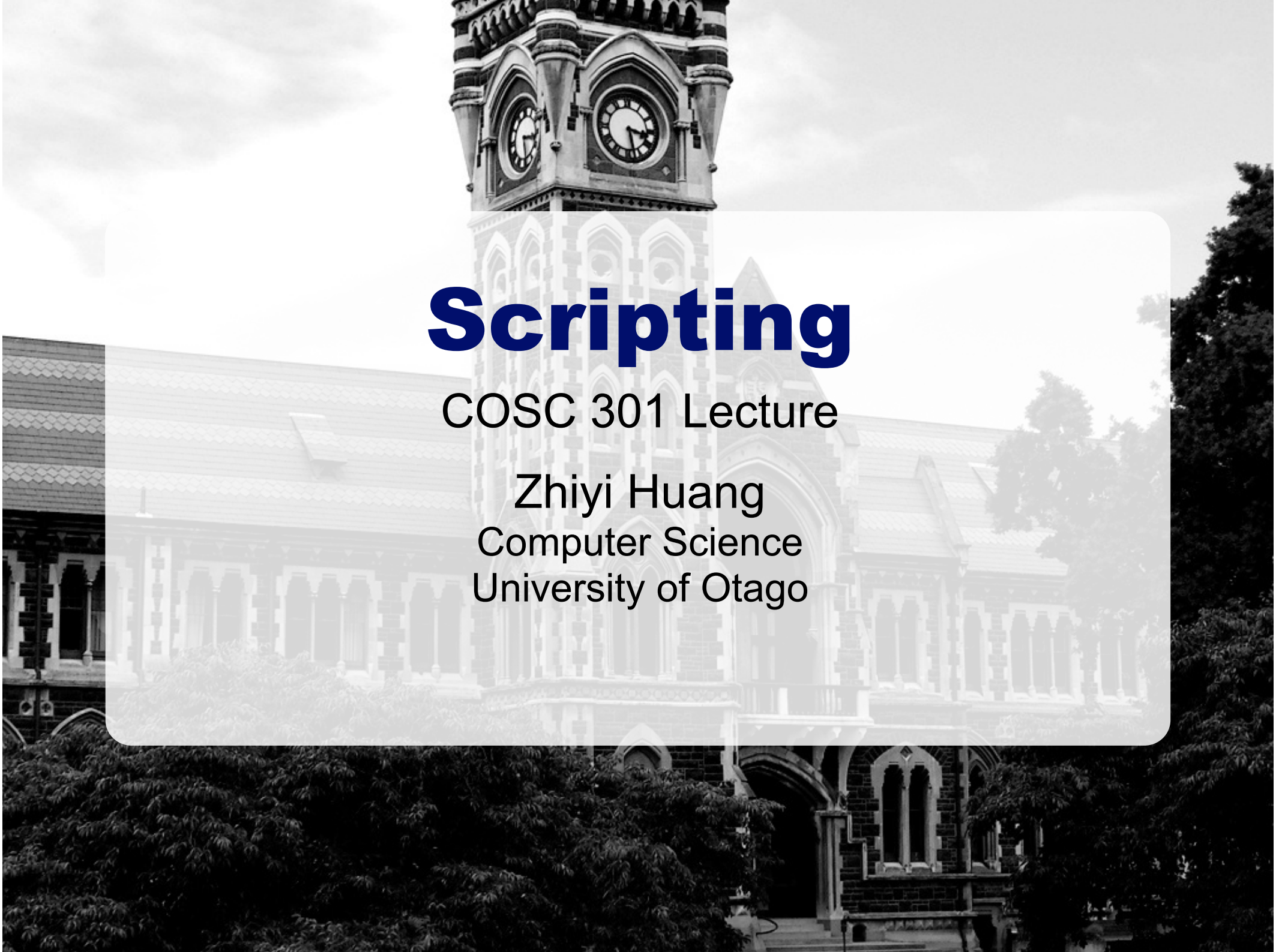

Scripting

COSC 301 Lecture

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Outline

- Purpose, History
- Unix scripting
- Unix failings
- Other solutions

Scripting is...

- ‘Easier’
- Glue
- Weakly typed
- Interpreted

Who scripts?

Users

Power users

Administrators

Developers

Testers

Developments

- Job Control Language
- 1960s Unix pipe
- 1993 Applescript
- 2005 Automator
- 2006 Windows PowerShell
- Available shells in Linux
  - bash, sh, tcsh, csh; use **cat /etc/shells**

Unix Shell Scripting

Unix Philosophy

- Write programs that do one thing and do it well. Write programs to work together. Write programs to handle text streams, because that is a universal interface.

Doug McIlroy

Inventor of the | construct

./hello

No extension

```
#!/bin/sh
echo “Hello, World!”
```

```
$ chmod +x ./hello
$ ./hello
Hello, World!
$ sh ./hello
Hello, World!
```

The correct UNIX way

```
echo -e “no newline\c”
```

Another example

```
#!/bin/bash
clear
echo "This is information provided by mysystem.sh.  Program starts
now."
echo "Hello, $USER"
echo
echo "Today's date is `date`, this is week `date +"%V"`."
echo
echo "These users are currently connected:"
w | cut -d " " -f 1 | grep -v USER | sort -u
echo
echo "This is `uname -s` running on a `uname -m` processor."
echo
echo "This is the uptime information:"
uptime
echo
echo "That's all folks!"
```

#! “Sh-Bang”

- **First** line
  - `#!/bin/sh`
  - `#!/usr/bin/perl -wnl`
  - `#!/usr/bin/env python`
  - Default is `/bin/sh`
- SetUID **not** honoured
- # is also used for comments

Design Patterns

- Source: `ls`
  - `read from file and write to stdout`
- Filter: `sort`
  - `read from stdin and write to stdout`
- Sink: `less`
  - `read from stdin and write to file`
- “Cantrip”: `rm`
  - `do something but return nothing`
- Compiler: tar
  - read from file and write to another file

Good scripts

- A sensible name
  - don’t clash with existing commands and programs
- No errors
- Perform the intended task
- Have a clear logic
- Efficient, no unnecessary work
- Informative, notifying users about what it is doing
- Reusable

BASH basics

- Files read by bash
  - /etc/profile, .bash_profile, .bashrc
  - depending on login, interactive, non-interactive, or use **sh** directly
- Built-in commands like cd and eval, exit, exec, export, …
- Three types of commands
  - built-in, function, executable programs
- debugging a script: **bash -xv script_file**
- Some self-study required. Read **Bash Beginners Guide**

I/O Channels

- stdin prev pipe or terminal
  ^D to ‘end-of-file’
- stdout next pipe or terminal
- stderr not piped
- FD 0,1,2 respectively

Redirection

- *command > file-overwriting*
- *command >> file-appending*
- *command 2> file*
  - *redirect stderr to file*
- echo “Warning to stderr” >&2
  - redirect stdout to stderr
- echo “To black hole” 2> /dev/null >&2
- *command < f1_in > f2_out 2> f3_err*

| “Pipe”

- 5 biggest dirs in the current dir
-
```
du -xkd 1 \
  |grep -v "^[0-9]*[[:space:]]*\.$"\
  |sort -rn | head -5
```
- All I/O via kernel, slow

Variables

- *varname*=*value* — Assignment
  no spaces around '='
- $*varname* — Deference
- Global and local variables
- Seen by subshell/child processes if
  `export PATH=$HOME/bin:$PATH`
- Beware white-space!
  varname="foo bar"

Interpolation

- *'non-interpolated string'*
- *`command`*
- *"interp. string $varname `command`"*
- ```
  foo=`command \`command\``
  foo=$(command $(command))
  ```
  (Bash specific)
- ```
  html="$1"; txt="${html:%.html}.txt"
  links -dump "$html" > "$txt"
  ```

Conditions—if

see test(1)

```
if␣[␣$# -lt 2 ]; then
  if-less-than-two-arguments
elif␣[␣\(␣"$1"␣=␣'foo'␣\)␣-a␣\
        \(␣-r␣/etc/foorc␣\)␣]; then
  if-arg1-is-foo-and-foorc-is-readable
else
  if-otherwise
fi
```

```
if␣!␣grep -q ...; then
  if-grep-did-not-find
fi
```

Conditionals—case

```
case "$fo_proc" in
  'fop')
    command;;
  'xep')
    command1; commandN;;
  *)
    default-command >&2
    exit 1;;
esac
```

Loops—for

- ```
  for i in foo bar baz
  do
   echo $i
  done
  ```

- ```
  (( ... ; ... ; ... )) is a Bash-ism

  for ((i=128; i<160; i++)); do
   printf "ip%03d\tA\t192.168.1.%d\n" $i $i
  done
  ```

Loops—while

```
ls | while read filename
do
  do stuff with "$filename"
done
```

```
while true
do
  infinite loop body
done
```

Subshells

- 139.80.32.2 - - [26/Mar/2007:17:28:34 +1200] ↩
  "GET /path/to/file.html HTTP/1.0" 304 -

- ```
  (echo "IP Freq";
    (cat access_log;
     gzcat access_log.*.gz)
    | cut -d' ' -f1 | sort | uniq -c
    | sort -rn | awk '{print $2,$1}'
  ) | column -t
  ```

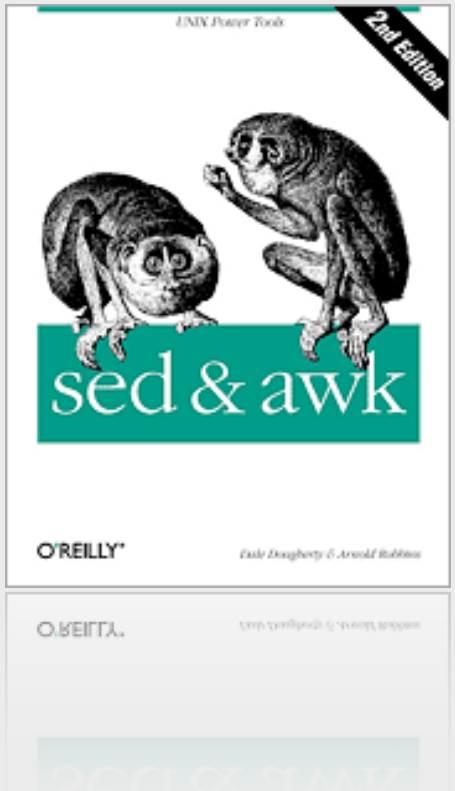
getting ugly, start making functions
  ```

Arithmetic

- `expr 2 \* 8`
  `16`
- `echo $((2 * 8))` *Bash-ism*
  `16`
- `echo 'scale=2; 1/3' | bc`
  `.33`
- `echo 'ibase=10; obase=2; 192' | bc`
  `11000000`

Sed and Awk

- Read a book!
- Regular expressions!
- Takes a while to learn
- A few recipes are useful



sed—Stream Editor

- Delete header on first line

```
sed -e 1d
```

- Disable FTP service in inetd

```
sed -e 's/^ftp/#&/' < inetd.conf > \
  inetd.conf.new
mv inetd.conf{,~}; mv inetd.conf{.new,}
```

- What requests got a 404?

```
gzcat access_log.*.gz | sed -ne '/ 404
[0-9]*/s/^.*"[A-Z]* \(.*\) HTTP\/[0-9.]*".*
$/\1/p'
```

awk

- Re-order fields

```
echo 'a b c a c b' | tr ' ' '\n' | sort \
 | uniq -c | awk '{print $2,$1}' \
 | sort -r -k2
```

- Collation

```
echo -e '1\n2\n3\n4' | awk '
 BEGIN{sum=0;max="?"}
 max=="?"{max=$1}
 {sum+=$1}
 $1>max{max=$1}
 END{print "Avg:" sum/NR "\nMax:" max}'
```

A command a day...

List descriptions of system commands

```
find /bin /usr/bin /sbin /usr/sbin \
 -type f -perm /111 | \
 xargs -L1 basename | \
 xargs -L1 whatis | grep '([18])'
```

Unix failings

- “Prayerful parsing”
- I/O is expensive
  obj → str ⇒ kernel ⇒ str → obj

  but easy concurrency, batching
- Interface inconsistency
- Lack of re-use

  Interface, validation, documentation, serialise, parse
- Security

Other Systems

Applescript example

Is 10% of disk available?

https://developer.apple.com/library/mac/documentation/applescript/conceptual/applescriptlangguide/conceptual/ASLR_lexical_conventions.html#//apple_ref/doc/uid/TP40000983-CH214-SW1

```
tell application "Finder"
   set the percent_free to ¬
      (((the free space of the startup disk) / ¬
       (the capacity of the startup disk)) * 100) div 1
end tell
if the percent_free is less than 10 then
   tell application (path to frontmost application as text)
      display dialog "The startup disk has only " & ¬
            the percent_free & ¬
            " percent of its capacity available." & return & return & ¬
            "Should this script continue?" with icon 1
   end tell
end if
```

PowerShell examples

- These examples from *Monad Manifesto*
- What is filling up my application logs?

  Verb Noun

```
Get-EventLog application|Group source|Select –
first 5|Format-Table
```

```
counter Property
======  ==========
  1,269 crypt32
  1,234 MsiInstaller
  1,062 Ci
    280 Userenv
    278 SceCli
```

Not text, but objects are passed around

- Why is MsiInstaller filling my log?

Object Property

```
Get-EventLog application |Where {$_.source -eq
“MsiInstaller”}|Group Message |Select –first 5
|Format-Table
```

```
counter Message
======= ============================================================…
    344 Detection of product '{90600409-6E45-45CA-BFCF-C1E1BEF5B3F7}…
    344 Detection of product '{90600409-6E45-45CA-BFCF-C1E1BEF5B3F7}…
    336 Product: Visual Studio.NET 7.0 Enterprise - English – Inter…
    145 Failed to connect to server. Error: 0x800401F0
      8 Product: Microsoft Office XP Professional with FrontPage --…
```

- Change Format-Table to output XML, CSV, LIST, HTML, Excel...

- Is my eventlog usage regular across the week?

```
Get-EventLog application | Group
{$_.Timewritten.DayOfWeek}
```

```
counter DayofWeek
======  ========
  1,333 Tuesday
  1,251 Wednesday
    744 Thursday
    680 Monday
    651 Friday
    556 Sunday
    426 Saturday
```

All these commands run in the same run-time environment (.NET) so I/O is cheap.

The shell can validate properties etc. using *reflection*, meaning it can look at what methods etc. are available.

Conclusions

- Small components
- Exposed interfaces
- Scripts to compose
- Extension via scripting

Suggested Reading

- *The Art of Unix Programming* Eric S. Raymond
- *The Unix Hater's Handbook* Simson Garfinkel, Daniel Weise, and Steven Strassmann
- ***Monad Manifesto*** Jeffrey P. Snover
- *Scripting: Higher Level Programming for the 21st Century* John K. Ousterhout (father of Tcl)
- Bash Guide for Beginners Machtelt Garrels
- [Reference] bash(1)