Unleashing the Shell

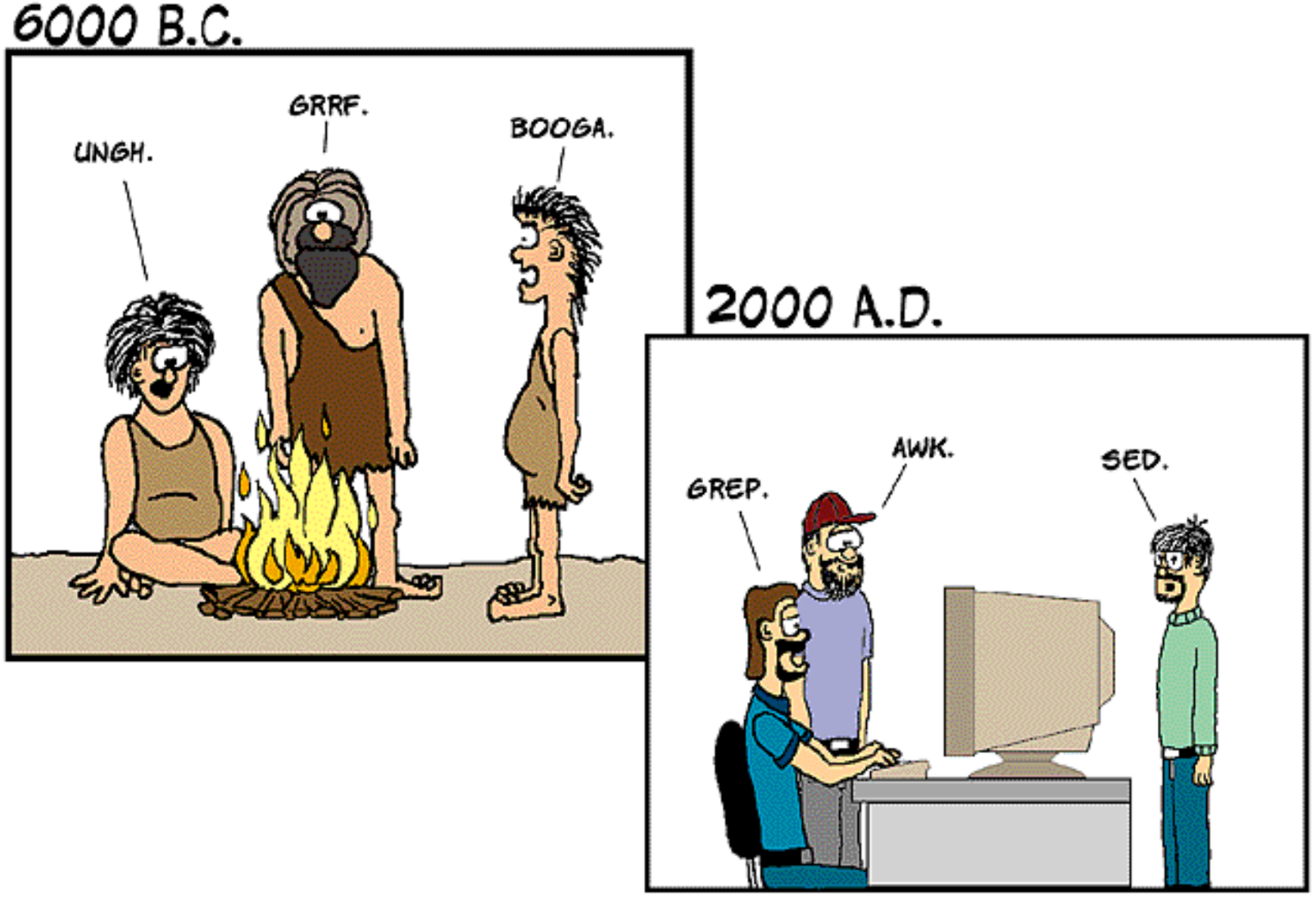
Hands-On UNIX System Administration DeCal

Week 6 — 27 February 2012

Last time

- Compiling software and the three-step procedure (`./configure && make && make install`).
- Dependency hell and package managers.

EVOLUTION OF LANGUAGE THROUGH THE AGES.



source: http://ars.userfriendly.org/cartoons/?id=19990815

Grok awk?

- **grep:** match input based on a pattern (or regular expression — more on that later). You've already used it, but today's lecture will let you unlock its full potential.
- **awk** and **sed:** powerful programming languages designed for text processing. We'll be using awk for field extraction and sed for regex find-and-replace searches.

source: http://xkcd.com/208/

Classical Regular Expressions

- Regular expressions denote formal languages, which are sets of strings (of symbols from some alphabet).
- Appropriate since internal structure not all that complex yet.
- Expression R denotes language $L(R)$:
  - $L(\epsilon) = L("") = \{""\}$.
  - If c is a character, $L(c) = \{"c"\}$.
  - If R_1, R_2 are r.e.s, $L(R_1R_2) = \{x_1x_2 | x_1 \in L(R_1), x_2 \in L(R_2)\}$.
  - $L(R_1|R_2) = L(R_1) \cup L(R_2)$.
  - $L(R*) = L(\epsilon) \cup L(R) \cup L(R\ R) \cup \cdots$.
  - $L((R)) = L(R)$.
- Precedence is '*' (highest), concatenation, union (lowest). Parentheses also provide grouping.

source: http://www-inst.eecs.berkeley.edu/~cs164/sp11/lectures/lecture2.pdf

Regular expressions

- … don’t worry, you don’t need to understand set theory to use regexes!
- Syntax and features vary from program to program (consult documentation to see what exactly you can do), but these basics are universal.

Regular expressions

- Most characters match themselves ("cat" matches "cat," "bobcats," "catastrophe"…).
- **[a-z]** is a *character class* that matches one character from the specified set. **[^a-z]** matches one character *not* in the set.
- **.** (dot) matches any character.
- **^** and **$** match start and end of line.

Regular expressions

- * matches the preceding symbol any number of times, **+** at least one time, and **?** at most one time.
- **()** (parentheses) group symbols and **|** (pipe) separates alternatives (“hat|cat”).
- **\1**, **\2**, **\3**… refer to the *n*th grouped subexpression. “(cat)\1” matches “catcat”.

Examples…

- Experiment! Any good editor will have regular expression support (or use grep).
- ^$ matches an empty line. Hint: `grep -v`.
- #.*$ matches everything from a hash mark to end-of-line (config file comment).
- `[a-z]+@[a-z]+\.(org|net|com)` naively matches email addresses. To do it right…

source: http://www.ex-parrot.com/pdw/Mail-RFC822-Address.html

Examples…

- Backreferences (\1, \2, \3…) are most useful when doing regex replacements.

  Garcia, Dan
  Harvey, Brian
  Hilfinger, Paul
  Sinclair, Alistair
  Shewchuk, Jonathan

- What does `sed -E -e 's/([A-Za-z]+), ([A-Za-z]+)/\2 \1/g'` do to this file?

sed

- `sed -e 's/old/new/g'` replaces *old* with *new* **g**lobally. Add the `-E` flag for extended (modern) regular expressions.
- `sed -e 's/old/new/g' file > file` will clobber your file, not update it — be careful! To edit **i**n-place, use `-i`.
- And there's more! RTFM for details.

awk

- awk '{print $1}' prints its input's first *field*. By default, fields are delimited by any number of spaces (change the field separator with the -F option).
- ls -l /etc | awk '{print $NF " is owned by " $3}' extracts the filename and owner fields.

Miscellany

- **cut** extracts sections of its input — you can select arbitrary bytes, characters, or fields (with whatever delimiter you like).
  e.g., `getent passwd | cut -f1,5 -d:`
- **tr** deletes or replaces (translates) characters. Only uses stdin (not UUOC!).
  e.g., `cat /etc/group | tr -d '\n'`
  e.g., `echo "go bears" | tr a e`

Anatomy of a script

- A shell script is, at its simplest, a plain text file containing a list of commands.
- Scripts usually have *shebang lines* (e.g., `#!/usr/bin/env bash`) indicating what program to process them with, so they can be run like ordinary programs.
- Shell scripts can have variables, functions, control flow…

Variables

- **Assignment:** `VARNAME=value`.
  Variables can be lowercase, but are usually uppercase. Can also use substitution, as in `EDITOR=\`whereis vim\``.

- **Reference:** `echo $VARNAME`.
  Note that `echo '$VARNAME'` doesn't evaluate the variable.

Variables

- bash provides some variables to aid in shell scripting. Here are a few:
  - $# — number of arguments passed to your script. (./script foo bar baz => 3.)
  - `$0`, `$1`, `$2`… — arguments ($0 is your script, like argv[0] in C's main() function).
  - $@ — all arguments in one variable.

Functions

- Function declarations, by example:

```
defenestrate() {
        echo “Throwing $@ out the
            window.”
}
defenestrate your homework
```

- Note that arguments are handled with special variables, not declared as in C.

Control flow

- **For loops** iterate over everything in a list. If you need to work with numbers, use {0..100} or `seq 0 100`. Example:

```
for DOCTOR in {hartnell,troughton,pertwee,baker,
davison,colin,mccoy,mcgann,eccleston,tennant,smith}
do
    mkdir -p /mnt/$DOCTOR
    mount -o loop /xen/domains/$DOCTOR/disk.img \
                  /mnt/$DOCTOR
done
```

Control flow

- bash also supports **while loops**. E.g.:

```
while true; do
    sleep 100
    uptime    # includes load info
done
```

(If you actually want to do something like this, try the `watch` command.)

Control flow

- **If expressions** rely on a command called `test`, which is often abbreviated to [. There are *lots* of tests available — test(1) is well worth a read. Here's an example:

```
if [ $# -eq 0 ]; then
    echo “Usage:  $0 [args]”
    exit 1
fi
```

…and more!

This was just a high-level overview. If there's something specific you'd like to see an example of, please ask!