
CSE 374

Programming Concepts & Tools

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(Thanks to Hal Perkins)

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Lecture 4 – Shell Variables, More Shell Scripts

Where we are

- We understand most of the bash shell and its “programming language”. Final pieces we’ll consider:
 - Shell variables
 - Defining your own
 - Built-in meanings
 - Exporting
 - Arithmetic
 - For loops
- End with:
 - A long list of gotchas (some bash-specific; some common to shells)
 - Why long shell scripts are a bad idea, etc.

Shell variables

- We already know a shell has **state**: current working directory, streams, users, aliases, history.
- Its state also includes shell variables that hold **strings**.
 - Always strings even if they are “123” – but you can do math
- Features:
 - Change variables’ values: foo=blah
 - Add new variables: foo=blah or foo=
 - Use variable: \${foo} (braces sometimes optional)
 - Remove variables: unset foo
 - See what variables “are set”: set
- Omitted feature: Functions and local variables (see manual)
- Roughly “all variables are global (visible everywhere)”
- Only assignment is similar to mainstream “real” programming languages

Why variables?

- Variables are useful in scripts, just like in “normal” programming.
- “Special” variables affect shell operation. 3 most (?) common:
 - PATH
 - PS1
 - HOME
- Some variables make sense only when the shell is reading from a script:
 - `$#`, `$n` (where `n` is an integer), `$@`, `$*`, `$?`

Export

- If a shell runs another program (perhaps a bash script), does the other program “see the current variables that are set”?
 - i.e., are the shell variables part of the initial environment of the new program?
- It depends.
 - `export foo` – yes it will see value of `foo`
 - `export -n foo` – no it will not see value of `foo`
 - Default is no
- If the other program sets an exported variable, does the outer shell see the change?
- No.
 - Somewhat like “call by value” parameters in conventional languages
 - Remember, each new program (and shell) is launched as a separate process with its own state, environment, etc.

Arithmetic

- Variables are strings, so `k=$i+$j` is not addition
- But `((k=$i+$j))` is (and in fact the `$` is optional here)
- So is `let k="$i + $j"`
- The shell converts the strings to numbers, silently using 0 as necessary

For loops

- Syntax:

```
for v in w1 w2 ... wn
do
  body
done
```

- Execute body n times, with v set to w_i on ith iteration (Afterwards, v=w_n)
- Why so convenient?
 - Use a filename pattern after in
 - Use list of argument strings after in: "\$@"
 - Not "\$*" – that doesn't handle arguments with embedded blanks the way you (usually) want

Quoting

- Does `x=*` set `x` to string-holding-asterisk or string-holding-all-filenames?
- If `$x` is `*`, does `ls $x` list all-files or file named asterisk?
- Are variables expanded in double-quotes? single-quotes?
- Could consult the manual, but honestly it's **easier to start a shell and experiment**. For example:

```
x="*"
echo x
echo $x
echo "$x"   (Double quotes suppress some substitutions)
echo '$x'   (Single quotes suppress all substitutions)
...
```


Gotchas: A very partial list

1. Typo in variable name on left: create new variable
oops=7
2. Typo in variable use: get empty string – Is \$oops
3. Use same variable name again: clobber other use
HISTFILE=uhoh
4. Spaces in variables: use double-quotes if you mean
“one word”
5. Non-number used as number: end up with 0
6. set f=blah: apparently does nothing (assignment in
csh)
7. Many, many more...

Shell programming revisited

- How do Java programming and shell programming compare?
- The shell:
 - “shorter”
 - convenient file-access, file-tests, program-execution, pipes
 - crazy quoting rules and syntax
 - also interactive
- Java:
 - none of the previous gotchas
 - local variables, modularity, typechecking, array-checking, . . .
 - real data structures, libraries, regular syntax
- Rough rule of thumb: Don't write shell scripts over 200 lines?

Treatment of strings

- Suppose foo is a variable that holds the string hello

	Java	Bash
Use variable (get "hello")	foo	\$foo
The string foo	"foo"	foo
Assign variable	foo = hi	foo=hi
Concatenation	foo + "oo"	\${foo}oo
Convert to number	library call	silent and implicit

- Moral: In Java, variable-uses are easier than string-constants
- Opposite in Bash
- Both biased toward common use
- Consider what each language is designed for

More on shell programming

- **Metapoint: Computer scientists automate and end up accidentally inventing (bad) programming languages. It's like using a screwdriver as a pry bar.**
- HW3 in part, will be near the limits of what seems reasonable to do with a shell script (and we'll end up cutting corners as a result)
- There are plenty of attempts to get “the best of both worlds” in a scripting language: Perl, Python, Ruby, . . .
- Personal opinion: it raises the limit to 1000 or 10000 lines? Gets you hooked on short programs.
- Picking the bash shell was a conscious decision to **emphasize the interactive side** and see “how bad programming can get”.
- Next: Regular expressions, grep, sed, others.

Bottom line

- Never do something manually if writing a script would save you time, but choose your battles
 - See <http://xkcd.com/1319/>
 - And <http://xkcd.com/1205/>
 - And <http://xkcd.com/974/>
- Never write a script if you need a large, robust piece of software
- Some programming languages try to give the “best of both worlds” – you now have seen two extremes that don’t (Java and bash)