

## Assignment 4 -- Final ush assignment

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### \$? processing and reporting signals

- \$? is exit value of the last command on which the shell waited  
or a specified value if the command did not exit

### Processing \$? happens in several places:

- When you wait on a process: (reporting signals happens here also)
  - determine if dead process called exit
  - set a global variable with exit value or error value
- During built-in processing
  - built-in is successful -- set global value to 0
  - built-in is not successful -- set global value to 1
- During expand() -- just turn global variable value into ASCII and add to expanded string.

Reporting Signals -- done after the waitXXX() system call returns:

- Determine if signaled
  - extract signal number, print signal text if not SIGINT
  - determine if core dumped, if so print " (core dumped)"

## Command Expansion -- \$(.....) processing

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Done in expand:

- Find the \$(
- Save the index of or pointer to the start of the command
- Find the matching )
- Temporarily store a end-of-string over the )
- Create a pipe (check for errors)
- Process the line with the write end of the pipe as stdout
  - processline() will need 2 new arguments, outfd, wait/don't flag
  - processline() must not wait for the child to finish, just return
  - processline() should return the pid of the child started or an error value
- Close write end of pipe so next loop will get EOF
- Read LOOP
  - Best to directly read into the new expanded string
  - Keep reading until EOF or buffer full
- AFTER completing the read, if last character is \n "remove it", all other \n should be made spaces.
- Cleanup -- close read end of pipe, wait for child if one started
  - Remember the value for \$?

## Processline changes:

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- Prototype: `int processline (char *line, int outfd, int flags)`
- Change to main, new call: `processline(buffer, 1, WAIT);`
  - output should go to stdout and we should wait for the child
- Change to processline:
  - in child only -- if outfd is not 1, put the outfd on 1
  - in parent only -- should we wait or not?
    - #define WAIT 1
    - #define NOWAIT 0
  - if flags say to wait, wait and process \$? and report signals
  - if flags say to no wait, just return the pid of the child started

## Processing order

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- In main(): Remove Comments
- In processline():
  - Expansion
  - Pipeline identification
  - On each element of the pipeline / only element
    - Argument Parsing
    - Execution
      - Built-in or fork/exec

## Implementing Pipelines

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```
ps aux | grep xfce | grep -v grep | cut -c1-5
```

stdin -> ps aux -> stdout/pipe/stdin -> grep dh -> ...

### processline()

- expand, then find pipelines
- "ps aux" a complete command
  - use processline ... but no expand, no wait
- loop over all pipeline elements ...
  - never need to have more than 2 pipes open at same time
  - uosh needs to close both ends of every pipe opened
  - uosh (parent and child) does not read or write to any pipes or files
- processline (line, infd, outfd, flags)
  - flags => NOWAIT, NOEXPAND
- wait on last process in list (if this call waits)
  - envset N \$(ps aux | grep dh | grep -v grep | cut -c1-5)
  - kill -9 \${N}

