

04834580 Software Engineering (Honor Track) 2025-26

UNIX Shell

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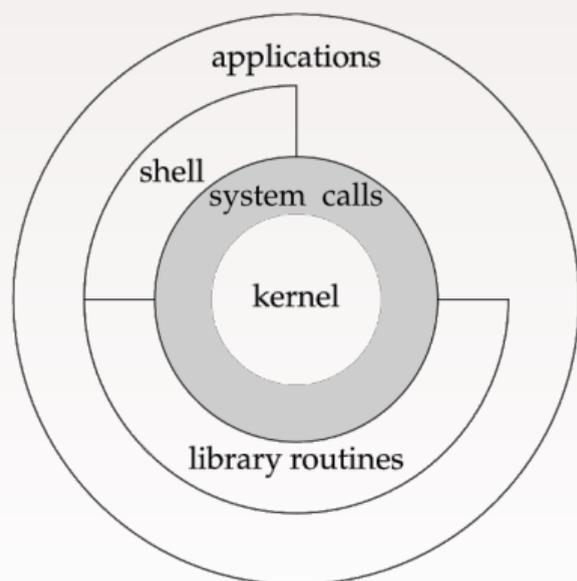
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The shell is a special application that provides an interface for running other applications. [1]

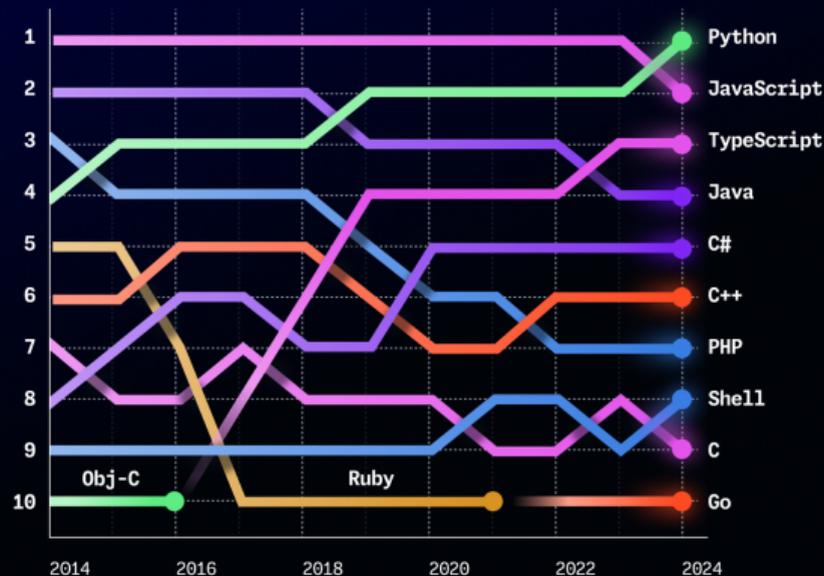
A Unix shell is both a command interpreter and a programming language. [2]

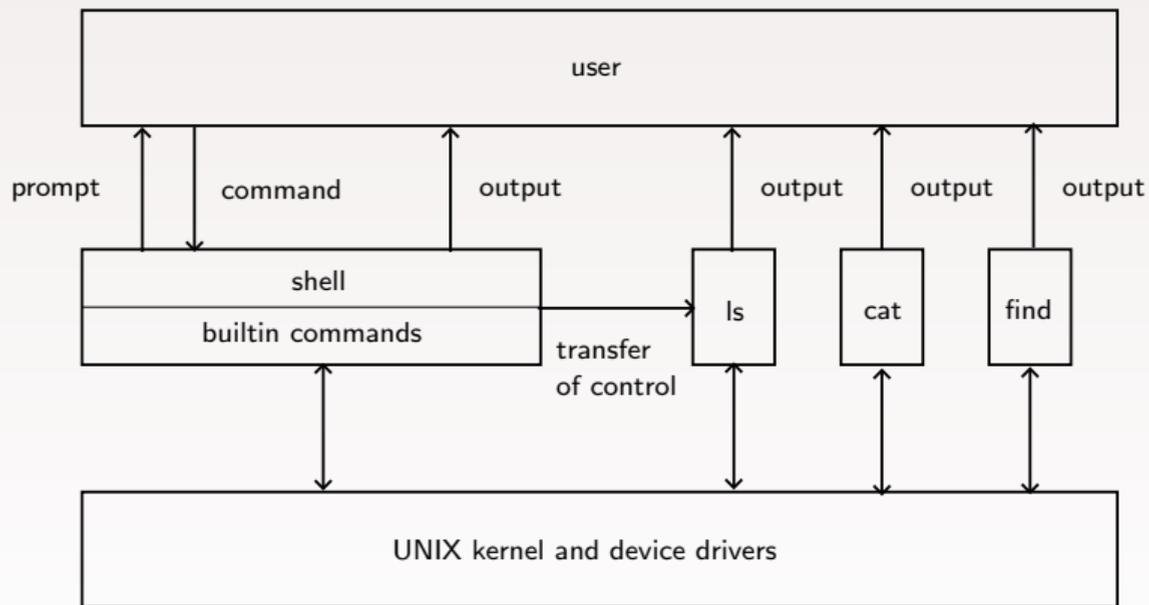
- ▶ Thompson shell (1971)
 - ▶ Bash (1989) — default on many Linux distributions
 - ▶ Zsh (1990) — default on MacOS
- ▶ Non-UNIX shells
 - ▶ cmd.exe (1987) — Windows
 - ▶ PowerShell (2006) — Windows



Top programming languages on GitHub

RANKED BY COUNT OF DISTINCT USERS CONTRIBUTING TO PROJECTS OF EACH LANGUAGE.







By convention, all shells open three descriptors whenever a new program is run: **standard input**, **standard output**, and **standard error**. If nothing special is done, as in the simple command

```
ls
```

then all three are connected to the terminal.

exit status, by convention, 0 means OK, and a value between 1 and 255 means that an error occurred.

```
import sys

args = sys.argv[1:]

user_input = input("Enter something: ")
if user_input.lower() == "error":
    raise Exception("You triggered an exception!")

print(f"Arguments: {args}")
print(f"User Input: {user_input}", file=sys.stderr)
```

arguments

standard input

non-zero exit status, standard error

standard output

standard error



```
$ echo Hello!  
Hello!
```

```
$ ls foo
text1.txt  text2.txt  subdir1
$ echo $?
0
$ ls bar
ls: cannot access 'bar': No such file or directory
$ echo $?
1
```

standard error



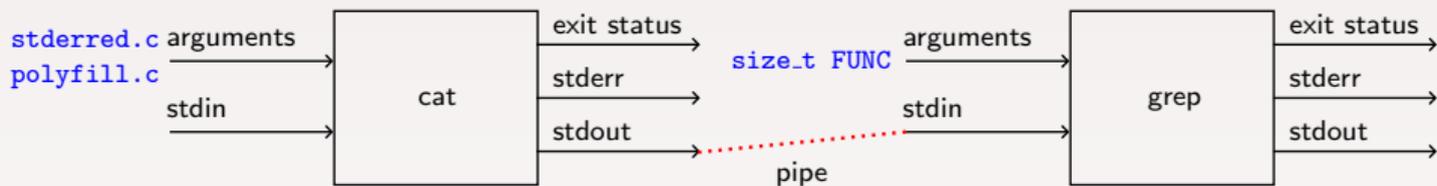
```
$ grep foo < text1.txt > result.txt
```

```
$ echo hello world
hello world
$ echo hello      world
hello world
```

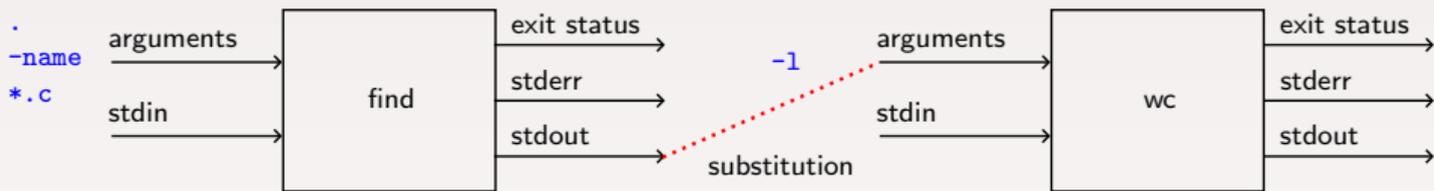
- ▶ spaces are separators, not parts of arguments

```
$ echo "hello world"
hello world
$ echo "hello    world"
hello    world
$ ec"ho" hello world
hello world
$ echo '''
'''
```

- ▶ quotes remove the special meaning of certain characters or words, e.g. spaces;
- ▶ single quotes disable all special characters or words;
- ▶ double quotes disable all special characters except for escape sequences, backquotes, variable expansion, etc. [2].



```
$ cat stderrred.c polyfill.c | grep "size_t FUNC"
ssize_t FUNC(write)(int fd, const void* buf, size_t count) {
size_t FUNC(fwrite_unlocked)(const void *data, size_t size, size_t count, FILE *stream)
size_t FUNC(fwrite)(const void *data, size_t size, size_t count, FILE *stream) {
ssize_t FUNC(__write_nocancel)(int fd, const void * cbuf, size_t nbyte) {
```



```
$ wc -l `find . -name '*.c'`  
 35 ./src/mocks.c  
199 ./src/polyfill.c  
446 ./src/stderrred.c  
331 ./src/test.c  
904 ./build/CMakeFiles/3.30.7/CompilerIdC/CMakeCCompilerId.c  
1915 total
```


Semicolon operator defines sequences of commands:

```
$ cd files; touch file.txt
```

Globbing recognizes and expands wild cards:

```
$ echo *.txt  
a.txt b.txt c.txt t2.txt test1.txt
```

Bash provides many features: variables, conditional statements, loops, here documents, etc.

Materials for self-study:

- ▶ The Missing Semester of Your CS Education [5]
- ▶ Bash Reference Manual [2]

- [1] W Richard Stevens and Stephen A Rago.
Advanced programming in the UNIX environment.
Addison-Wesley, 2013.
- [2] GNU Project.
Bash reference manual.
<https://www.gnu.org/software/bash/manual/bash.html>, 2022.
[Online; accessed 27-Jan-2025].
- [3] GitHub Staff.
Octoverse: Ai leads python to top language as the number of global developers surges.
<https://github.blog/news-insights/octoverse/octoverse-2024/#the-most-popular-programming-languages>, 2024.
[Online; accessed 27-Jan-2025].

- [4] Jerry Peek, Tim O'Reilly, Dale Dougherty, Mike Loukides, Chris Torek, Bruce Barnett, Jonathan Kamens, Gene Spafford, and Simson Garfinkel.
UNIX power tools.
Bantam Books, Inc., 1993.
- [5] Elaine Mello, Jim Cain, Anthony Zolnik, and Brandi Adams.
The missing semester of your cs education.
<https://missing.csail.mit.edu/>, 2020.
[Online; accessed 27-Jan-2025].