



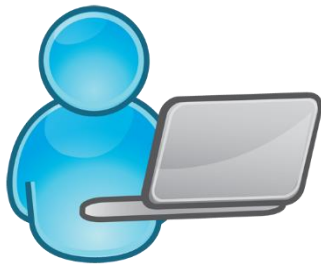
# Shells

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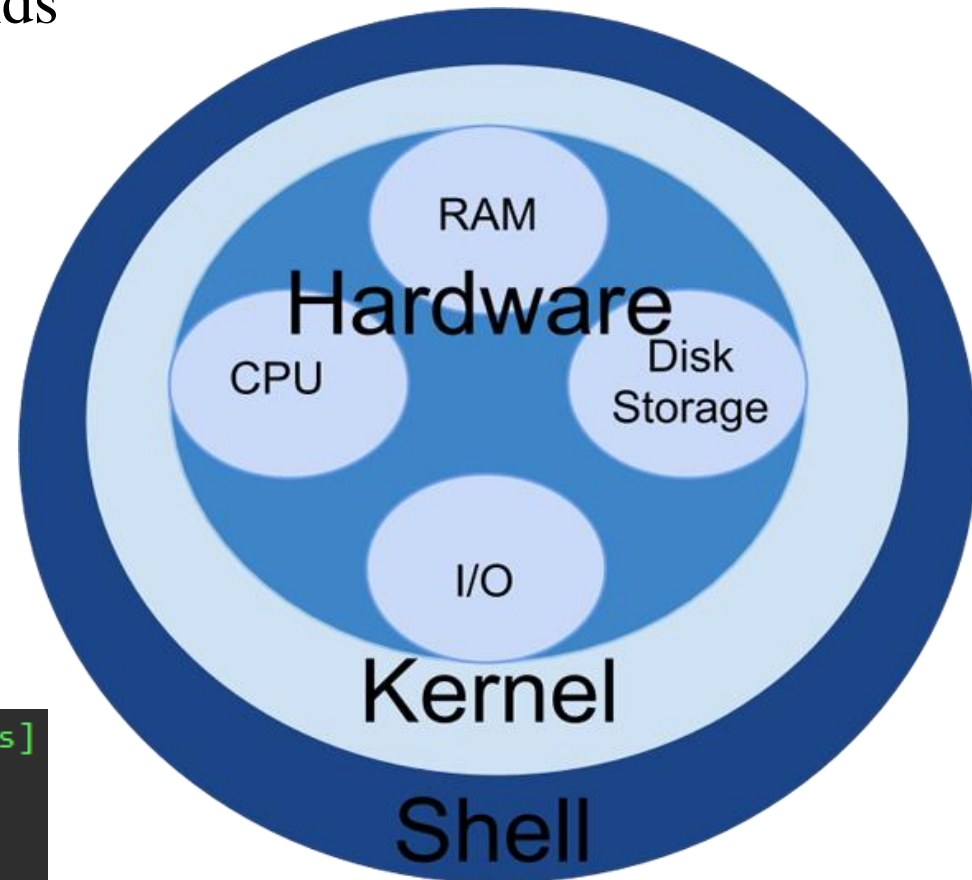
lctseng

# Introduction – UNIX Kernel and Shell

- ❑ Interface to communicate with kernel
- ❑ Where you type commands

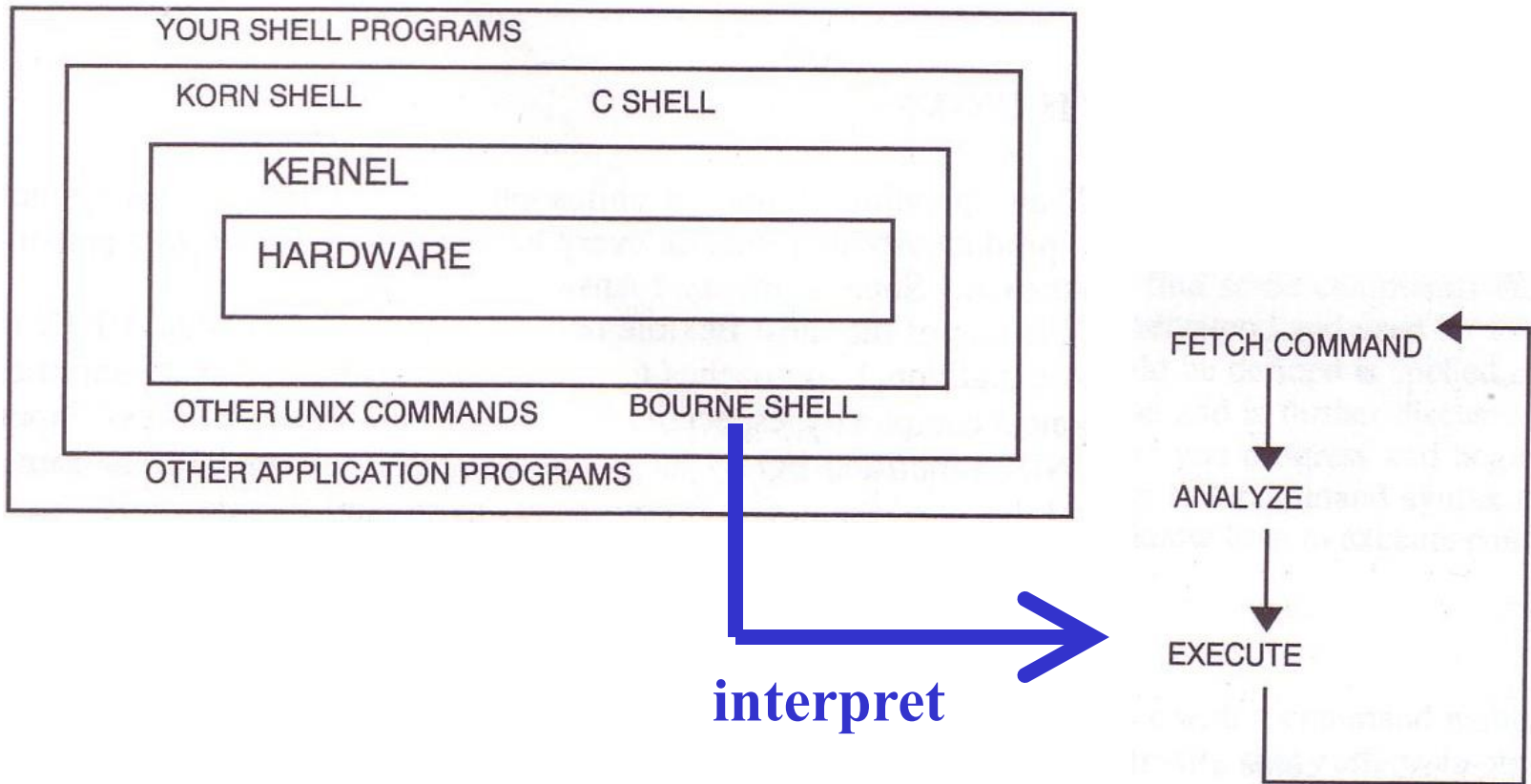


Commands...



```
15:51 lctseng@lctseng(10.0.2.15)[~/ports]
[^_^] > cd
16:08 lctseng@lctseng(10.0.2.15)[~]
[~_^] > setenv EDITOR ee
```

# Introduction - UNIX Kernel and Shell



# The UNIX Shells

## ❑ How shell works

- Fetch command → Analyze → Execute

## ❑ Unix shells

Shell	Originator	System Name	Prompt
Bourne Shell	S. R. Bourne	/bin/sh	\$
Csh	Bill Joy	/bin/csh	%
Tcsh	Ken Greer	/bin/tcsh	>
Korn Shell	David Korn	(shells/ksh93)	\$
Z Shell	Paul Falstad	(shells/zsh)	%

# Shell Startup Files

---

- ❑ sh
  - /etc/profile login shell, system wide
  - ~/.profile login shell
  - ENV
- ❑ csh
  - /etc/csh.cshrc always, system wide
  - /etc/csh.login login shell, system wide
  - ~/.cshrc always
  - ~/.login login shell
  - ~/.logout logout shell
  - /etc/csh.logout logout shell, system wide
- ❑ tcsh
  - ~/.tcshrc login shell
- ❑ bash
  - /etc/profile → ~/.bash\_profile or ~/.bash\_login or ~/.profile
  - ~/.bashrc
  - BASH\_ENV

# Shell Startup Files - tcsh

## ❑ .tcshrc

```
66 setenv CLICOLOR
67 setenv TERM screen
68 alias ls 'ls -F \!*'
69 alias ll 'ls -al'
70 alias grep 'grep --color=auto'
71
72 if ($?prompt) then
73     set ip_str=''
74     if ($?first_ip) then
75         set ip_str=$first_ip
76     endif
77     if(! $?WINDOW ) then
78         set prompt="%{^[[1;36m}%T%{^[[m%} %{^[[1;33m}%n%
[[1;35m%}[^_^] %{^[[m%} %# "
79     else
80         set prompt="%{^[[1;36m}%t%{^[[m%} %{^[[1;33m}%n%
[[1;35m%}[W$WINDOW]%{^[[m%} %# "
81     endif
82     if ($?tcsh) then
83         set mail = (/var/mail/$USER)
84         bindkey "^W" backward-delete-word
85         bindkey -k up history-search-backward
86         bindkey -k down history-search-forward
87     endif
```

.tcshrc

[unix/TCSH]

lctseng.nasa:/usr~

# Shell Startup Files - tcsh

---

- ❑ A sample tcshrc for you to change your prompt
- ❑ <https://goo.gl/Shvc3L>
- ❑ How to use
  - Copy the content as your .tcshrc
- ❑ Simplest install steps
  - `$ cd ~`
  - `$ fetch https://goo.gl/Shvc3L -o .tcshrc`

```
[lctseng@lctseng ~ ] exit
```



# Shell Environment Variables



- ❑ Controlling shell behaviors
  - There are many environment variables that control the shell behavior
- ❑ To dump them: `env` command
- ❑ To get value: `$variable_name` or `${variable_name}`
  - `echo "$PATH"`
- ❑ Useful Environment Variables

sh	csh	description
	HOME	User's home directory
	MAIL	User's mailbox
	PATH	Search path
PS1	prompt	Primary prompt string (waiting for input commands)
PS2	prompt2	Secondary prompt string (after lines end with \)
	prompt3	Third prompt string (automatic spelling correction)
	history	Number of history commands



# Variables and Strings Quotes

Char.	Purpose
 var=value  set var=value	Assign value to variable
\$var \${var}	Get shell variable
`cmd`	Substitution stdout
'string'	Quote character without substitution
"string"	Quote character with substitution

- |                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <ul style="list-style-type: none"> <li>• % varname=`/bin/date`</li> <li>• % echo \$varname</li> <li>• % echo 'Now is \$varname'</li> <li>• % echo "Now is \$varname"</li> </ul> |  <ul style="list-style-type: none"> <li>• % set varname2=`/bin/date`</li> <li>• % echo \$varname2</li> <li>• % echo 'Now is \$varname2'</li> <li>• % echo "Now is \$varname2"</li> </ul> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Mon Oct 24 19:42:49 CST 2011

Now is \$varname

Now is Mon Oct 24 19:42:49 CST 2011

# Global Variables

## ❑ Assignment


	Bourne Shell	C Shell
Local variable	my=test	set my=test
Global variable	export my=test	setenv my test

- Example:

 ➤ \$ export EDITOR=/usr/bin/ee

 ➤ % setenv EDITOR /usr/bin/ee

 ➤ \$ current\_month=`date +%m`

 ➤ % set current\_month =`date +%m`

## ❑ Use “env” command to display global variables

# Shell Special Characters (1)

- ❑ Reduce typing as much as possible



Characters	Description
*	Match any string of characters
?	Match any single alphanumeric character
[...]	Match any single character within []
[!...]	Match any single character not in []
~	Home directory

- ❑ Example

- If following files:  
 test1 test2 test3 test4  
 test-5 testmess  
 are in current directory.

Command	Result
% ls test*	test1 test2 test3 test4 test-5 testmess
% ls test?	test1 test2 test3 test4
% ls test[123]	test1 test2 test3
% ls test[!345]*	test1 test2 test-5 testmess
% ls ~	List files under your home

# Shell Special Characters (2)

Char.	Purpose	Example
#	Start a shell comment	# this is a comment
;	Command separator	% ls test*; ls test?
&&	executes the first command, and then executes the second if first command success (exit code=0)	% cd foo/bar && make install
	executes the first command, and then executes the second if first command fail (exit code≠0)	% cp x y    touch y
\	(1) Escape character (2) Command continuation indicator	% touch test\*; ls test\ % ls \ > test*
&	Background execution	% make buildworld & % sleep 5 &

# Built-in Shell Commands (1)

sh	csh	description
set/unset	set/unset	Set/Unset shell's parameters
	set/unset	Set/Unset a local variable
export	setenv/unsetenv	Set/Unset a global variable
set	@, set	Display or set shell variables
	login, logout	Logout
exit	exit	exit shell
cd	cd	change directory
	dirs	print directory stack
	popd, pushd	Pop/push directory stack
echo	echo	write arguments on stdout
alias/unalias	alias/unalias	command aliases
fg, bg	fg, bg	Bring a process to foreground/background (e.g. sleep 5 &)

## Built-in Shell Commands (2)

sh	csh	description
jobs	jobs	List active jobs (with job numbers)
%[job no.]	%[job no.]	Bring a process to foreground
	kill	Send a signal to a job ( <b>kill %job</b> or <b>kill pid</b> )
	stop	Suspend a background process(%job   pid)
exec	exec	execute arguments
	<b>nice</b>	Change nice value
	nohup	Ignore hangups
	notify	Notify user when jobs status changes
	<b><u>history</u></b>	Display history list
	<b>rehash</b>	Evaluate the internal hash table of the contents of directories
.	source	Read and execute a file

# Built-in Shell Commands (3)

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## ☐ References:

- [http://www.unet.univie.ac.at/aix/aixuser/usrosdev/list\\_bourne\\_builtin\\_cmds.htm](http://www.unet.univie.ac.at/aix/aixuser/usrosdev/list_bourne_builtin_cmds.htm)
  - <http://www.europa.idv.tw/UNIX-Shell/csh/V2-01-09.html>
  - [http://www.unix.org.ua/oreilly/unix/unixnut/ch04\\_06.htm](http://www.unix.org.ua/oreilly/unix/unixnut/ch04_06.htm)
  - [http://publib.boulder.ibm.com/infocenter/pseries/index.jsp?topic=/com.ibm.aix.doc/aixuser/usrosdev/list\\_c\\_builtin\\_cmds.htm](http://publib.boulder.ibm.com/infocenter/pseries/index.jsp?topic=/com.ibm.aix.doc/aixuser/usrosdev/list_c_builtin_cmds.htm)
- 
- sh(1)
  - tcsh(1)

# Input/Output Redirection

- ❑ 3 default file descriptors
  - ❑ 0(stdin) 、 1(stdout) 、 2(stderr)

Method	Description
cmd < file	Open the file as stdin of cmd
cmd > file	Write stdout of cmd in the following file ( <b>noclobber</b> ) (tcsh: set noclobber)
cmd >> file	Append stdout of cmd to the following file
2>&1	Merge stdout with stderr
cmd1   cmd2	Pipe stdout of cmd1 into stdin of cmd2

- ❑ “Redirection” in sh(1), or “Input/Output” in tcsh(1)



# File and Directory Related Commands

Command	Purpose
ls	List a directory's content
pwd	Print working directory
mkdir	Make(create) a new directory
rmdir	Remove existing empty directory
cat	Concatenate file
cp	Copy file
ln	Link files
mv	Move file
rm	Remove file
split	Split a file into n line chunks
stat	Display file status

# Select and File Processing Related Commands (1)

Command	Purpose
head	Display first lines of a file
tail	Select trailing lines
grep	Select lines
diff	Compare and select difference in two files
wc	Count characters, words or lines of a file
uniq	Select uniq lines
cut	Select columns
tr	Transform character
sort	Sort and merge multiple files together
join	Join two files, matching row by row
<u>sed</u>	Edit streams of data
<u>awk</u>	Pattern scanning and processing language

# Select and File Processing Related Commands (2)

## ❑ Example usage:

- Look first few lines or last few lines
  - % head /var/log/message
    - -n : specific how many lines
  - % tail /var/log/message
- Find the occurrence of certain pattern in file
  - % grep -l lctseng \*
    - Print the filename that has "lctseng" as content
- Print the line number when using grep
  - % grep -n lctseng /etc/passwd
- Ignore case-sensitive
  - % grep -i lctseng /etc/passwd
    - List any line contains any combination of "lctseng"
  - % ps auxww | grep ^lctseng | wc -l
    - Count number of processes owned by lctseng

# Select and File Processing Related Commands (3)

## □ Example usage:

- List lctseng's id, uid, home, shell in /etc/passwd
  - % `grep lctseng /etc/passwd | cut -f1,3,6,7 -d:`
    - `-f1,3,6,7` : fetch 1<sup>st</sup>, 3<sup>rd</sup>, 6<sup>th</sup>, 7<sup>th</sup> column
    - `-d` : separation symbol

```
lctseng:*:1001:20:Liang-Chi Tseng:/home/lctseng:/bin/tcsh
```

```
lctseng:1001:/home/lctseng:/bin/tcsh
```

- Cut out file permission and file name from ls output
  - % `ls -l | grep -v ^total | cut -c1-11 -c47-`
    - `-c1-12` : 1<sup>st</sup>~12<sup>th</sup> characters (start from 1, instead of 0)
    - `-c45-` : characters after 47<sup>th</sup> character (include 47<sup>th</sup>)

```
total 12
drwxr-xr-x  4 lctseng  staff  512  9 20 16:21 Unix-User-Config/
-rw-r--r--  1 lctseng  staff   274  9 19 16:09 sa.tmp
-rw-r--r--  1 lctseng  staff    0  9 19 16:38 yankring_history_v2.txt
```

```
drwxr-xr-x  Unix-User-Config/
-rw-r--r--  sa.tmp
-rw-r--r--  yankring_history_v2.txt
```

# Select and File Processing Related Commands (4)

## □ Example usage:

- Use awk to generate the same behavior of cut

- % `awk -F: '{print $1 " " $6}' /etc/passwd`

- -F : separation symbol

```
lctseng:*:1001:20:Liang-Chi Tseng:/home/lctseng:/bin/tcsh
```

```
lctseng /home/lctseng
```

- % `ls -l | grep -v ^total | awk '{print $1 " " $9}'`

- Result same as “`ls -l | grep -v ^total | cut -c1-11 -c47-`”

# Select and File Processing Related Commands (5)

---

## □ Example usage:

- Sort
  - -r : reverse
  - -u : unique keys
  - -n : numeric keys sorting
    - Default: string sorting, 14 > 123
  - -k : specific columns to sort with

# Select and File Processing Related Commands (6)

## □ Example usage:

- Sort

- % `ls -al | sort -k 5,5 -r`

- List directory contents and sort by file size decreasingly

```
-rw----- 1 lctseng staff 3954 9 20 18:39 .viminfo
-rw-r--r-- 1 lctseng staff 1066 9 20 00:05 .cshrc
-rw-r--r-- 1 lctseng staff 978 9 20 00:05 .shrc
-rw-r--r-- 1 lctseng staff 817 9 20 00:05 .profile
```

- % `sort -t: -k 1,1 /etc/passwd | grep -v ^#`

- List records in /etc/passwd increasingly by id

```
games:*:7:13:Games pseudo-user:/usr/games:/usr/sbin/nologin
git_daemon:*:964:964:git daemon:/nonexistent:/usr/sbin/nologin
hast:*:845:845:HAST unprivileged
user:/var/empty:/usr/sbin/nologin
kmem:*:5:65533:KMem Sandbox:/:/usr/sbin/nologin
lctseng:*:1001:20:Liang-Chi Tseng:/home/lctseng:/bin/tcsh
```

# Select and File Processing Related Commands (7)

## □ Example usage:

- Sort

- `% sort -t. -n -k 1,1 -k 2,2 -k 3,3 -k 4,4 '/etc/hosts' | grep -v ^#`
  - List records in /etc/hosts sorted by IPv4 address

```
# In the presence of the domain name service or NIS, this file may
# not be consulted at all; see /etc/nsswitch.conf for the
# resolution order.
#
#
::1          localhost localhost.my.domain
127.0.0.1    localhost localhost.my.domain
140.113.17.26 nctucs.tw
64.233.187.95 www.googleapis.com googleapis.l.google.com
```

```
::1          localhost localhost.my.domain
64.233.187.95 www.googleapis.com googleapis.l.google.com
127.0.0.1    localhost localhost.my.domain
140.113.17.26 nctucs.tw
```



# Select and File Processing Related Commands (8)

- **tr** – Translate characters
  - % `tr "A-Z" "a-z" < file1 > file2`
    - Change all alphabet to uppercase
  - % `grep lctseng /etc/passwd | tr ":" "\n"`

```
lctseng
*
1001
20
Liang-Chi Tseng
/home/lctseng
/bin/tcsh
```

- % `tr -d "\t" < file1`
  - Delete tab in file1
- % `tr -s " " " " < file1`
  - Delete multiple space in file1

# xargs Command (1)

❑ xargs – construct argument list(s) and execute utility

-n number

-I replstr (every)

-J replstr (first )

-s size

...

```
% ls
2.sh 3.csh 4.csh 4.sh bsd1.ping testin
% ls | xargs echo
2.sh 3.csh 4.csh 4.sh bsd1.ping testin
% ls | xargs -n1 echo
2.sh
3.csh
4.csh
4.sh
bsd1.ping
testin
```

```
% ls | xargs -I % -n1 echo % here %
2.sh here 2.sh
3.csh here 3.csh
4.csh here 4.csh
4.sh here 4.sh
bsd1.ping here bsd1.ping
testin here testin
```

```
% ls | xargs -J % -n1 echo % here %
2.sh here %
3.csh here %
4.csh here %
4.sh here %
bsd1.ping here %
testin here %
```

## xargs Command (2)

---

### ❑ Example : ping all hosts in file

- File “host”

```
www.google.com  
bsd5.cs.nctu.edu.tw  
linux3.cs.nctu.edu.tw  
cs.nctu.edu.tw
```

- `$ cat host | xargs -n1 ping -c 1 | grep "bytes from"`

```
64 bytes from 64.233.188.103: icmp_seq=0 ttl=47 time=6.944 ms  
64 bytes from 140.113.235.135: icmp_seq=0 ttl=57 time=1.451 ms  
64 bytes from 140.113.235.153: icmp_seq=0 ttl=57 time=1.612 ms  
64 bytes from 140.113.235.47: icmp_seq=0 ttl=57 time=1.856 ms
```

# The Unix Way

## ❑ Lots of little tools, each good at one thing

- Use them together to achieve your goal

## ❑ Example

- Quest: To get all cs101 student id/account/cname/ename
- Hints

All user home dir are created by his/her student id.

User command can get some useful info.

```
% user lchtseng
```

```
username: lchtseng studentID: 0116057 曾亮齊 Liang-Chi Tseng
```

- Approach

```
➤ % cd /u/cs/101
```

```
➤ % ls # you will get all cs101 student id
```

```
➤ % ls | xargs -n 1 # print student id each in one line
```

```
➤ % ls | xargs -n 1 user # get data you want
```

```
➤ % ls | tr -d "/" | xargs -n 1 user | awk '{print $4 " " $2 " " $5 " " $6}'  
# format the data to get the result
```

# Appendix

---

## Command History in (t)csh

# Command History in (t)cs

- ❑ `!n` - exec previous command line `n`
- ❑ `!-n` - exec current command line minus `n`
- ❑ `!!` - exec last command (the same as `!-1`)
- ❑ `!str` - exec previous command line beginning with `str`
- ❑ `!?str?` - exec previous command line containing `str`

```
% history
9  8:30      nroff -man ypwhich.1
10 8:31      cp ypwhich.1 ypwhich.1.old
11 8:31      vi ypwhich.1
12 8:32      diff ypwhich.1.old ypwhich.1
13 8:32      history
% !?old?
```

# Command History in (t)csH

- ❑ `!!:n` - use the nth word of previous command
- ❑ `!!:m-n` - select words m ~ n of previous command
- ❑ `!!:*` - use all arguments of previous command
- ❑ `!!:s/str1/str2/` - substitute str1 with str2 in previous command

```
% history
```

```
15 8:35 cd /etc
```

```
16 8:35 ls HOSTS FSTAB
```

```
17 8:35 history
```

```
% cat !-2:*:s/HOSTS/hosts/:s/FSTAB/fstab
```

- ❑ “History Substitution” in tcsh(1)