

POSIX Command Line Utilities

Just A Glimpse

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► **POSIX: Portable Operating System Interface**

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- **POSIX: Portable Operating System Interface**
- **CLI: Command Line Interface**

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- ▶ **POSIX: Portable Operating System Interface**
- ▶ **CLI: Command Line Interface**
- ▶ Part of **POSIX** are CLI utilities, the subject today.

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- ▶ **POSIX**: **P**ortable **O**perating **S**ystem **I**nterface
- ▶ **CLI**: **C**ommand **L**ine **I**nterface
- ▶ Part of **POSIX** are CLI utilities, the subject today.
- ▶ **kernel**: The kernel of OS is a program that manages resources and implement IPC.

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- ▶ **POSIX**: **P**ortable **O**perating **S**ystem **I**nterface
- ▶ **CLI**: **C**ommand **L**ine **I**nterface
- ▶ Part of **POSIX** are CLI utilities, the subject today.
- ▶ **kernel**: The kernel of OS is a program that manages resources and implement IPC.
- ▶ **shell**: Opposite of kernel. The machine/human interface.

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► Solve various tasks efficiently.

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- Solve various tasks efficiently.
- Solve programming-needed tasks, without programming.

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- Solve various tasks efficiently.
- Solve programming-needed tasks, without programming.
- Functional programming like experience: simple utilities pipelined to solve complex problems.

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- ▶ Solve various tasks efficiently.
- ▶ Solve programming-needed tasks, without programming.
- ▶ Functional programming like experience: simple utilities pipelined to solve complex problems.
- ▶ Most servers don't have a GUI, so CLI may be your only choice.

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- ▶ Solve various tasks efficiently.
- ▶ Solve programming-needed tasks, without programming.
- ▶ Functional programming like experience: simple utilities pipelined to solve complex problems.
- ▶ Most servers don't have a GUI, so CLI may be your only choice.
- ▶ **Bigger** than **bigger**.

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- ▶ Solve various tasks efficiently.
- ▶ Solve programming-needed tasks, without programming.
- ▶ Functional programming like experience: simple utilities pipelined to solve complex problems.
- ▶ Most servers don't have a GUI, so CLI may be your only choice.
- ▶ **Bigger** than **bigger**.
- ▶ ... Just because it's a lot of fun :-)

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► `cd, pwd, ls`

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► `cd, pwd, ls`

► `cp, mv, rm`

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► `cd, pwd, ls`

► `cp, mv, rm`

► `echo`

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- ▶ `cd`, `pwd`, `ls`
- ▶ `cp`, `mv`, `rm`
- ▶ `echo`
- ▶ Running an executable.

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- ▶ `cd`, `pwd`, `ls`
- ▶ `cp`, `mv`, `rm`
- ▶ `echo`
- ▶ Running an executable.
- ▶ Interrupting a running command: `Ctrl+C`.

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- ▶ `cd, pwd, ls`
- ▶ `cp, mv, rm`
- ▶ `echo`
- ▶ Running an executable.
- ▶ Interrupting a running command: `Ctrl+C`.
- ▶ Input an End Of File: `Ctrl+D`.

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- ▶ `cd, pwd, ls`
- ▶ `cp, mv, rm`
- ▶ `echo`
- ▶ Running an executable.
- ▶ Interrupting a running command: `Ctrl+C`.
- ▶ Input an End Of File: `Ctrl+D`.
- ▶ Suspending a running command: `Ctrl+Z`.

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- ▶ `cd, pwd, ls`
- ▶ `cp, mv, rm`
- ▶ `echo`
- ▶ Running an executable.
- ▶ Interrupting a running command: `Ctrl+C`.
- ▶ Input an End Of File: `Ctrl+D`.
- ▶ Suspending a running command: `Ctrl+Z`.
- ▶ ... and resuming: `fg`.

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► `ls /etc` lists the contents of `/etc`

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- ▶ `ls /etc` lists the contents of `/etc`
- ▶ ... where `ls` is the name of the command,

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- ▶ `ls /etc` lists the contents of `/etc`
- ▶ ... where `ls` is the name of the command,
- ▶ ... and `/etc` is the **SECOND** argument (`argv[1]`).

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- ▶ `ls /etc` lists the contents of `/etc`
- ▶ ... where `ls` is the name of the command,
- ▶ ... and `/etc` is the **SECOND** argument (`argv[1]`).
- ▶ Where has the **FIRST** argument gone?

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- ▶ `ls /etc` lists the contents of `/etc`
- ▶ ... where `ls` is the name of the command,
- ▶ ... and `/etc` is the **SECOND** argument (`argv[1]`).
- ▶ Where has the **FIRST** argument gone?
- ▶ It's the name of the executable:
here, the first argument is `ls`.

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► Completion: Tab

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- Completion: Tab
- Fast cursor movement:
`Ctrl/Alt+F`, `Ctrl/Alt+B`, `Ctrl+A/E`

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- Completion: Tab
- Fast cursor movement:
Ctrl/Alt+F, Ctrl/Alt+B, Ctrl+A/E
- Repeat: Alt+A.

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- ▶ Completion: Tab
- ▶ Fast cursor movement:
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- ▶ Repeat: Alt+A.
- ▶ Clear: Ctrl+L

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- ▶ Completion: Tab
- ▶ Fast cursor movement:
Ctrl/Alt+F, Ctrl/Alt+B, Ctrl+A/E
- ▶ Repeat: Alt+A.
- ▶ Clear: Ctrl+L
- ▶ Fast line editing:
Alt+D / Ctrl+W, Alt+W / Ctrl+K, Ctrl+H/D

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- ▶ Completion: Tab
- ▶ Fast cursor movement:
Ctrl/Alt+F, Ctrl/Alt+B, Ctrl+A/E
- ▶ Repeat: Alt+A.
- ▶ Clear: Ctrl+L
- ▶ Fast line editing:
Alt+D / Ctrl+W, Alt+W / Ctrl+K, Ctrl+H/D
- ▶ Reverse search: Ctrl+R
– it is awesome!

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► *: matches anything, greedily.

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► *: matches anything, greedily.

► {}:

`abc{1, 2}` expands into `abc1 abc2`

`abc{1..10}` expands into `abc1 abc2 abc3 abc4 ... abc10`

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- ▶ Example: `echo 1 2 | ./a.out`
- ▶ Example: `./a.out` and then input `1 2`

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► >, >>

► <

► Special: <<.

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► /dev/stdin: stdin. Any explanation needed?

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- ▶ /dev/stdin: stdin. Any explanation needed?
- ▶ /dev/stdout: stdout. ?

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- ▶ `/dev/stdin`: stdin. Any explanation needed?
- ▶ `/dev/stdout`: stdout. ?
- ▶ `/dev/zero`, `/dev/one`: zero and one.

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- ▶ `/dev/stdin`: stdin. Any explanation needed?
- ▶ `/dev/stdout`: stdout. ?
- ▶ `/dev/zero`, `/dev/one`: zero and one.
- ▶ `/proc/meminfo`, `/proc/cpuinfo`:
Memory/CPU information.

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- ▶ `/dev/stdin`: stdin. Any explanation needed?
- ▶ `/dev/stdout`: stdout. ?
- ▶ `/dev/zero`, `/dev/one`: zero and one.
- ▶ `/proc/meminfo`, `/proc/cpuinfo`:
Memory/CPU information.
- ▶ `/proc/<id:int>`:
Information of the process with pid `id`.

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- ▶ /dev/stdin: stdin. Any explanation needed?
- ▶ /dev/stdout: stdout. ?
- ▶ /dev/zero, /dev/one: zero and one.
- ▶ /proc/meminfo, /proc/cpuinfo:
Memory/CPU information.
- ▶ /proc/<id:int>:
Information of the process with pid id.
- ▶ /dev/null:
BLACK HOLE.

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► What black hole?

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- ▶ What black hole?
- ▶ Why black hole?

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- ▶ What black hole?
- ▶ Why black hole?
- ▶ Example: `cat > /dev/null`

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- ▶ What black hole?
- ▶ Why black hole?
- ▶ Example: `cat > /dev/null`
- ▶ Jokes:

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- ▶ What black hole?
- ▶ Why black hole?
- ▶ Example: `cat > /dev/null`
- ▶ Jokes:
- ▶ Please send complains to /dev/null.

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- ▶ What black hole?
- ▶ Why black hole?
- ▶ Example: `cat > /dev/null`
- ▶ Jokes:
- ▶ Please send complains to /dev/null.
- ▶ I've learned all my courses and remembered them using my /dev/null.

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- ▶ What black hole?
- ▶ Why black hole?
- ▶ Example: `cat > /dev/null`
- ▶ Jokes:
- ▶ Please send complains to /dev/null.
- ▶ I've learned all my courses and remembered them using my /dev/null.
- ▶ I surely saved my money from 11.11. I put them in my /dev/null.

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► `man`: Read manual for the command.

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- ▶ `man`: Read manual for the command.
- ▶ `apropos`: Search manual page title and description.

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- ▶ `man`: Read manual for the command.
- ▶ `apropos`: Search manual page title and description.
- ▶ `awesome-command --help`: Show help for `awesome-command`.

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cat - concatenate file(s)

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cat

paste

head/tail

sort

uniq

wc

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Practice: Problem 2

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► Example: cat 1.txt

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- ▶ Example: `cat 1.txt`
- ▶ Example: `cat 1.txt 2.txt`

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- ▶ Example: `cat 1.txt`
- ▶ Example: `cat 1.txt 2.txt`
- ▶ Use case: stay tuned.

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Basic Utilities

paste - join lines of files

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► Example: `paste 1.txt 2.txt`

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- ▶ Example: `paste 1.txt 2.txt`
- ▶ Use case: `paste accounts passwords`

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head & tail - first/last n lines of file

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► Example: head longlongfile.log

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- ▶ Example: `head longlongfile.log`
- ▶ Example: `head -n 20 longlongfile.log`

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- ▶ Example: `head longlongfile.log`
- ▶ Example: `head -n 20 longlongfile.log`
- ▶ Example: `tail -f takeslongtime.log`

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► Example: sort accounts

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- ▶ Example: sort accounts
- ▶ Example: sort -n nums

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► Example: sort accounts

► Example: sort -n nums

► Practice:

du -d 1 can be used to find disk usage of every subdirectory in current working directory.

So, how can I find out the most space-consuming folder?

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► Example: `sort accounts`

► Example: `sort -n nums`

► Practice:

`du -d 1` can be used to find disk usage of every subdirectory in current working directory.

So, how can I find out the most space-consuming folder?

► Answer: `du -d 1 | sort -n | tail -n 2`

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► Example: `sort accounts`

► Example: `sort -n nums`

► Practice:

`du -d 1` can be used to find disk usage of every subdirectory in current working directory.

So, how can I find out the most space-consuming folder?

► Answer: `du -d 1 | sort -n | tail -n 2`

► How can you achieve the same using GUI, for instance, on Windows?

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► Example: `sort accounts`

► Example: `sort -n nums`

► Practice:

`du -d 1` can be used to find disk usage of every subdirectory in current working directory.

So, how can I find out the most space-consuming folder?

► Answer: `du -d 1 | sort -n | tail -n 2`

► How can you achieve the same using GUI, for instance, on Windows?

► Maybe **grouping**? $O(1)$ vs $O(\log n)$:-)

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Basic Utilities

uniq - remove duplicated lines

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► Example: `uniq dup.txt`

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`wc` - count words/lines of files

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► Example: `wc -l cool.cpp`

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Practise Time :-)

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► Problem Statement:

I'm in a folder, which contains numerous C++ source files.

I want to know how many lines of C++ code reside in this folder.

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- Problem Statement:
I'm in a folder, which contains numerous C++ source files.
I want to know how many lines of C++ code reside in this folder.
- Answer: `wc -l *.cpp`

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► Problem Statement:

For some reason (explained later), I want to concatenate all the c++ files in the current folder into a single file.

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Practise Time :-)

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- Problem Statement:
For some reason (explained later), I want to concatenate all the c++ files in the current folder into a single file.
- Answer: `cat *.cpp > total.cpp`

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Intermediate Utilities

xargs - build and execute commands from stdin

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► Example: `echo 1 2 3 | xargs echo`

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- ▶ Example: `echo 1 2 3 | xargs echo`
- ▶ Example: `echo 1 2 3 | xargs -n 1 echo`

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- ▶ Example: `echo 1 2 3 | xargs echo`
- ▶ Example: `echo 1 2 3 | xargs -n 1 echo`
- ▶ Example: `echo 1 2 3 | xargs -P 2 -n 1 echo`

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`find` - search for files in a directory hierarchy

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► Example: `find . -type f -name *.cpp`

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- ▶ Example: `find . -type f -name *.cpp`
- ▶ Example: `find . -type d -iname *a* -exec ls {}`

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- ▶ Example: `find . -type f -name *.cpp`
- ▶ Example: `find . -type d -iname *a* -exec ls {}`
- ▶ Practise:
I want to know how many lines of python code I wrote for a project.
Now I'm in `/`, and the project is in
`~/Documents/project/SYSU-Software-2015/`.
What should I do?

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- ▶ Example: `find . -type f -name *.cpp`
- ▶ Example: `find . -type d -iname *a* -exec ls {}`
- ▶ Practise:
I want to know how many lines of python code I wrote for a project.
Now I'm in /, and the project is in
`~/Documents/project/SYSU-Software-2015/`.
What should I do?

- ▶ Answer: `find ~/Documents/project/SYSU-Software-2015/ -type f -name *.py | wc -l`

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► Example: `grep iostream a.cpp`

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- ▶ Example: `grep iostream a.cpp`
- ▶ Example: `grep -n vector a.cpp`

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- ▶ Example: `grep iostream a.cpp`
- ▶ Example: `grep -n vector a.cpp`
- ▶ Example: `find . -type f -name *.py | xargs grep -ni taskhall`

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- ▶ Example: `grep iostream a.cpp`
- ▶ Example: `grep -n vector a.cpp`
- ▶ Example: `find . -type f -name *.py | xargs grep -ni taskhall`
- ▶ Example: `grep --include=*.py -rni taskhall`

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- ▶ Example: `grep iostream a.cpp`
- ▶ Example: `grep -n vector a.cpp`
- ▶ Example: `find . -type f -name *.py | xargs grep -ni taskhall`
- ▶ Example: `grep --include=*.py -rni taskhall`
- ▶ Example: `grep -rne '\d+'`

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sed - line based text processing

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► Example: `sed -i -- 's/127.0.0.1/10.1.10.1/g' *.conf`

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- ▶ Example: `sed -i -- 's/127.0.0.1/10.1.10.1/g' *.conf`
- ▶ Example: `sed -- '/^##/a\%666' posix_cli_tools.md`

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- ▶ Example: `sed -i -- 's/127.0.0.1/10.1.10.1/g' *.conf`
- ▶ Example: `sed -- '/^##/a\%666' posix_cli_tools.md`
- ▶ Example: `sed -- '/^##/i\%\\\\\\\\\\\\\\\\' posix_cli_tools.md`

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`diff` - find differences between files/folders

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- ▶ Example: `diff a.txt b.txt`
- ▶ Example: `diff 1.dir 2.dir`

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patch - apply difference file

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► Example: `patch orig patch`

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Conclusion

- ▶ The tools I am going to introduce to you are not part of POSIX.
- ▶ These great tools are not `*nix`-limited. Windows have them too!
- ▶ They all require some time to learn. Fear not, the time you spent on them will pay.

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Wonderful Tools

Holy War of Editors: `vim` or `emacs`?

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- Among numerous choices of editors, `vim` and `emacs` have distinguished themselves from the others.

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Conclusion

- ▶ Among numerous choices of editors, `vim` and `emacs` have distinguished themselves from the others.
- ▶ `vim`: The God of Editor.

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Conclusion

- ▶ Among numerous choices of editors, `vim` and `emacs` have distinguished themselves from the others.
- ▶ `vim`: The God of Editor.
- ▶ `emacs`: The Editor of God.

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Conclusion

- ▶ Among numerous choices of editors, `vim` and `emacs` have distinguished themselves from the others.
- ▶ `vim`: The God of Editor.
- ▶ `emacs`: The Editor of God.
- ▶ Demonstration.

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Wonderful Tools

Crafted by the Author of TAOCP: TeX

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Conclusion

- ▶ T_EX is the most widespread, most advanced and most professional typesetting system.
 - ▶ L^AT_EX handles content side of document, while T_EX handles the layout side.
- Together, marvelous documents are made.

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Universal Document Converter: `pandoc`

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- Ever fancied conversion between `docx` and `html`, `markdown` and `latex`, even `markdown` and `h5 slides`?

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Conclusion

- ▶ Ever fancied conversion between `docx` and `html`, `markdown` and `latex`, even `markdown` and `h5 slides`?
- ▶ `pandoc` comes to rescue!

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Conclusion

- ▶ Ever fancied conversion between `docx` and `html`, `markdown` and `latex`, even `markdown` and `h5 slides`?
- ▶ `pandoc` comes to rescue!
- ▶ **These** slides are converted from `markdown` :-)

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The Most Popular And Easy-to-use VCS: git

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► Use git, use git, use git!

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- Use git, use git, use git!
- Demonstration.

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- To learn them, use them to solve real problems (and for fun).

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- ▶ To learn them, use them to solve real problems (and for fun).
- ▶ Never feel ashamed for forgetting the command line options of a command. Just use `-help` or `man` when you need reference.

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- ▶ To learn them, use them to solve real problems (and for fun).
- ▶ Never feel ashamed for forgetting the command line options of a command. Just use `-help` or `man` when you need reference.
- ▶ Have fun with CLI!

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Conclusion

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Thank you!

Brought to you by *Siyuan Liu*, MSTC, SYSU.

Nov 22nd, 2015

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