

Operating Systems(24802)

Project #1

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<Simple Shell Algorithm>

1. main loop 가 should_run 을 체크하며 반복함.
2. 한 줄의 입력을 받음.
3. 입력은 “”(공백)을 기준으로 각각 args 배열에 저장됨.
 - 3-1. 입력이 exit 라면 should_run 을 0 으로 바꿈.
 - 3-2. 입력이 ‘&’ 로 끝난다면 back_is_ampersand 를 1 로 바꿈.
4. 자식프로세스 생성
 - 4.1. pid<0(생성 오류) 일 경우 Fork Failed 를 출력하며 프로그램 종료.
 - 4.2 pid==0(자식프로세서)일 경우 명령어 실행 (execvp 사용)
 - 4.3 pid>0(부모프로세서)는 back_is_ampersand 변수를 기준으로 자식 프로세스를 wait 하거나 wait 하지 않음.
5. 자식프로세서가 잘 생성되었다면 args 에 저장된 명령어들을 확인함.
 - 5.1 명령어에 ‘>’ 이 포함된 경우 :
‘>’ 이전까지의 입력에 대한 실행 결과를 ‘>’ 이후 파일에 저장.(dup2 사용)
 - 5.2 명령어에 ‘<’ 이 포함된 경우 :
‘<’ 이후의 파일의 내용을 불러와 출력 (dup2 사용)
 - 5.3 명령어에 ‘|’ 이 포함된 경우 :
‘|’ 왼쪽의 실행 결과를 ‘|’ 오른쪽의 프로세스로 넘김.(pipe 사용)

<Program source file>

```
#include<stdio.h>
#include<sys/types.h>
#include<sys/wait.h>
#include<unistd.h>
#include<string.h>
#include<stdlib.h>
#include<fcntl.h>
#define MAX_LINE 80 /* The maximum length command */

/* function to initialize shell */
void InitializeShell(){
    for(int i=5;i>0;i--){
        system("clear");
        printf("\n\n\n");
        printf("\t\t*****\n");
        printf("\t\t*                *\n");
        printf("\t\t*                *\n");
        printf("\t\t*    OS project #1    *\n");
        printf("\t\t*division of computer science*\n");
        printf("\t\t*    2017011912    *\n");
        printf("\t\t*    Namjeonghoon    *\n");
        printf("\t\t*                *\n");
        printf("\t\t* It starts in %d seconds *\n",i);
        printf("\t\t*                *\n");
        printf("\t\t*****\n");
        printf("\n\n\n");
        sleep(1);
        system("clear");
    }
}

/*
function to check the command is "exit".
if the command is "exit", return 1, or return 0.
this return value will be used to determine whether to continue running the
main loop.
*/
int CheckExit(char** args){
    if(!strcmp(args[0],"exit")) return 1;
    else return 0;
}

/*
function to take input.
first,initialize args with (null).
then recive a single line of input on my_buf,
cut my_buf by ' ' or '\n'. and store them in the my_args.(args)
the return value idicates the length of args.
*/
int TakeInput(char** my_args){
```

```

char my_buf[MAX_LINE];
int my_cnt = 0;
char* my_ptr;
fgets(my_buf, sizeof(my_buf), stdin);
my_ptr = strtok(my_buf, " \n");
for(; my_ptr != NULL; my_cnt++){
    my_args[my_cnt] = strdup(my_ptr);
    if(my_args[my_cnt][strlen(my_args[my_cnt])-1] == '\n'){
        my_args[my_cnt][strlen(my_args[my_cnt])-1] = '\0';
    }
    my_ptr = strtok(NULL, " \n");
}
return my_cnt;
}
/*
function to check ampersand.
if the end of command is &,
the child process run in the background
*/
int CheckBack(char ** my_args, int my_cnt){
    if((my_cnt-1 != 0) && !strcmp(my_args[my_cnt-1], "&")){
        my_args[my_cnt-1] = NULL;
        return 1;
    }
    else return 0;
}
int main(){
    char *args[MAX_LINE/2+1]; /* command line arguments */
    int should_run = 1; /* flag to determine when to exit program */

    InitializeShell();
    while(should_run){
        int cnt, back_is_ampersand;
        pid_t pid;
        int fd[2];
        int status;
        memset(args, '\0', sizeof(args)); /* initialize args to (null) */

        printf("\nosh>");
        fflush(stdout);

        cnt = TakeInput(args);
        should_run = !CheckExit(args);
        back_is_ampersand = CheckBack(args, cnt);
        pid = fork();

        if(pid < 0){
            fprintf(stderr, "Fork Failed");
            return 1;
        }
    }
}

```

```

else if(pid == 0){
    for(int i=0;i<cnt && args[i]!=NULL;i++){
        if(!strcmp(args[i],">")){ /* redirects the output of a command to a
file */
            args[i]=NULL;
            fd[0]=open(args[i+1],O_WRONLY|O_CREAT,0666);
            dup2(fd[0],STDOUT_FILENO);
            close(fd[0]);
        }
        else if(!strcmp(args[i],"<")){ /* redirects the input of a command
from a file */
            args[i]=NULL;
            fd[0]=open(args[i+1],O_RDONLY,0666);
            dup2(fd[0],STDIN_FILENO);
            close(fd[0]);
        }
        else if(!strcmp(args[i],"|")){ /* allow the output of one command to
serve as input to another using a pipe */
            args[i]=NULL;
            pipe(fd);
            pid_t pid2 = fork();
            if(pid2 < 0) fprintf(stderr, "Fork Failed");
            else if(pid2 == 0){
                dup2(fd[1],1);
                close(fd[0]);
                execvp(args[0],args);
            }
            else{
                dup2(fd[0],0);
                close(fd[1]);
                execvp(args[i+1],&args[i+1]);
            }
        }
    }
    execvp(args[0],args);
}
else{
    if(back_is_ampersand){
        waitpid(pid,&status,WNOHANG);
        printf("Child Complete");
    }
    else{
        waitpid(pid,&status,0);
        printf("Child Complete");
    }
}
}
return 0;
}

```

<Compilation Process>

```
proj1 — zsh — 104x37
(base) namjeonghun@songhae proj1 % gcc -v os_project_1.c
Apple clang version 11.0.3 (clang-1103.0.32.62)
Target: x86_64-apple-darwin19.4.0
Thread model: posix
InstalledDir: /Library/Developer/CommandLineTools/usr/bin
"/Library/Developer/CommandLineTools/usr/bin/clang" -cc1 -triple x86_64-apple-macosx10.15.0 -Wdeprecate
d-objc-isa-usage -Werror=deprecated-objc-isa-usage -emit-obj -mrelax-all -disable-free -disable-llvm-ver
ifier -discard-value-names -main-file-name os_project_1.c -mrelocation-model pic -pic-level 2 -mthread-m
odel posix -mframe-pointer=all -fno-strict-return -masm-verbose -munwind-tables -target-sdk-version=10.1
5.4 -target-cpu penryn -dwarf-column-info -debugger-tuning=lldb -target-linker-version 556.6 -v -resourc
e-dir /Library/Developer/CommandLineTools/usr/lib/clang/11.0.3 -isysroot /Library/Developer/CommandLineT
ools/SDKs/MacOSX.sdk -I/usr/local/include -internal-isystem /Library/Developer/CommandLineTools/SDKs/Mac
OSX.sdk/usr/local/include -internal-isystem /Library/Developer/CommandLineTools/usr/lib/clang/11.0.3/inc
lude -internal-externc-isystem /Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/usr/include -internal
-externc-isystem /Library/Developer/CommandLineTools/usr/include -Wno-objc-signed-char-bool-implicit-int
-conversion -Wno-extra-semi-stmt -Wno-quoted-include-in-framework-header -fdebug-compilation-dir /Users/
namjeonghun/Desktop/proj1 -ferror-limit 19 -fmessage-length 80 -stack-protector 1 -fstack-check -mdarwin
-stkchk-strong-link -fblocks -fencode-extended-block-signature -fregister-global-dtors-with-atexit -fobj
c-runtime=macosx-10.15.0 -fmax-type-align=16 -fdiagnostics-show-option -fcolor-diagnostics -o /var/folde
rs/53/gwrl58gs1gz6y235vtypd5r0000gn/T/os_project_1-0ffcf5.o -x c os_project_1.c
clang -cc1 version 11.0.3 (clang-1103.0.32.62) default target x86_64-apple-darwin19.4.0
ignoring nonexistent directory "/Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/usr/local/include"
ignoring nonexistent directory "/Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/Library/Frameworks"
#include "...": search starts here:
#include <...>: search starts here:
  /usr/local/include
  /Library/Developer/CommandLineTools/usr/lib/clang/11.0.3/include
  /Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/usr/include
  /Library/Developer/CommandLineTools/usr/include
  /Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/System/Library/Frameworks (framework directory)
End of search list.
"/Library/Developer/CommandLineTools/usr/bin/ld" -demangle -lto_library /Library/Developer/CommandLineT
ools/usr/lib/libLT0.dylib -no_deduplicate -dynamic -arch x86_64 -platform_version macos 10.15.0 10.15.4
-syslibroot /Library/Developer/CommandLineTools/SDKs/MacOSX.sdk -o a.out /var/folders/53/gwrl58gs1gz6y2
35vtypd5r0000gn/T/os_project_1-0ffcf5.o -L/usr/local/lib -lSystem /Library/Developer/CommandLineTools/us
r/lib/clang/11.0.3/lib/darwin/libclang_rt.osx.a
(base) namjeonghun@songhae proj1 %
```

```

(base) namjeonghun@songhae proj1 % gcc -v os_project_1.c
Apple clang version 11.0.3 (clang-1103.0.32.62)
Target: x86_64-apple-darwin19.4.0
Thread model: posix
InstalledDir: /Library/Developer/CommandLineTools/usr/bin
"/Library/Developer/CommandLineTools/usr/bin/clang" -cc1 -triple x86_64-apple-
macosx10.15.0 -Wdeprecated-objc-isa-usage -Werror=deprecated-objc-isa-usage -emit-
obj -mrelax-all -disable-free -disable-llvm-verifier -discard-value-names -main-
file-name os_project_1.c -mrelocation-model pic -pic-level 2 -mthread-model posix -
mframe-pointer=all -fno-strict-return -masm-verbose -munwind-tables -target-sdk-
version=10.15.4 -target-cpu penryn -dwarf-column-info -debugger-tuning=lldb -
target-linker-version 556.6 -v -resource-dir
/Library/Developer/CommandLineTools/usr/lib/clang/11.0.3 -isysroot
/Library/Developer/CommandLineTools/SDKs/MacOSX.sdk -I/usr/local/include -internal-
isystem /Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/usr/local/include -
internal-isystem /Library/Developer/CommandLineTools/usr/lib/clang/11.0.3/include -
internal-externc-isystem
/Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/usr/include -internal-externc-
isystem /Library/Developer/CommandLineTools/usr/include -Wno-objc-signed-char-bool-
implicit-int-conversion -Wno-extra-semi-stmt -Wno-quoted-include-in-framework-
header -fdebug-compilation-dir /Users/namjeonghun/Desktop/proj1 -ferror-limit 19 -
fmessage-length 80 -stack-protector 1 -fstack-check -mdarwin-stkchk-strong-link -
fblocks -fencode-extended-block-signature -fregister-global-ctors-with-atexit -
fobjc-runtime=macosx-10.15.0 -fmax-type-align=16 -fdiagnostics-show-option -fcolor-
diagnostics -o /var/folders/53/gwrl58gs1gz6yf235vtypd5r0000gn/T/os_project_1-
0ffcf5.o -x c os_project_1.c
clang -cc1 version 11.0.3 (clang-1103.0.32.62) default target x86_64-apple-
darwin19.4.0
ignoring nonexistent directory
"/Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/usr/local/include"
ignoring nonexistent directory
"/Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/Library/Frameworks"
#include "...": search starts here:
#include <...>: search starts here:
/usr/local/include
/Library/Developer/CommandLineTools/usr/lib/clang/11.0.3/include
/Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/usr/include
/Library/Developer/CommandLineTools/usr/include
/Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/System/Library/Frameworks
(framework directory)
End of search list.
"/Library/Developer/CommandLineTools/usr/bin/ld" -demangle -lto_library
/Library/Developer/CommandLineTools/usr/lib/libLT0.dylib -no_deduplicate -dynamic -
arch x86_64 -platform_version macos 10.15.0 10.15.4 -syslibroot
/Library/Developer/CommandLineTools/SDKs/MacOSX.sdk -o a.out
/var/folders/53/gwrl58gs1gz6yf235vtypd5r0000gn/T/os_project_1-0ffcf5.o -
L/usr/local/lib -lSystem
/Library/Developer/CommandLineTools/usr/lib/clang/11.0.3/lib/darwin/libclang_rt.osx
.a

```


<Deliverables and Descriptions>

zshell(mac os)

my_shell

1. 명령어 + 옵션

ls -l

실행결과 :

```
(base) namjeonghun@songhae proj1 % ls -l
total 56
-rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:40 a.out
-rw-r--r--@ 1 namjeonghun  staff   4321  3 28 16:44 os_project_1.c
(base) namjeonghun@songhae proj1 %
```

```
osh>ls -l
total 56
-rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:51 a.out
-rw-r--r--@ 1 namjeonghun  staff   4321  3 28 16:44 os_project_1.c
Child Complete
osh>
```

2. 명령어 + 옵션 &

ls -l &

실행결과 :

```
(base) namjeonghun@songhae proj1 % ls -l &
[2] 7201
(base) namjeonghun@songhae proj1 % total 56
-rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:51 a.out
-rw-r--r--@ 1 namjeonghun  staff   4321  3 28 16:44 os_project_1.c
[2]  done      ls -l
```

```
Child Complete
osh>ls -l &
Child Complete
osh>total 56
-rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:51 a.out
-rw-r--r--@ 1 namjeonghun  staff   4321  3 28 16:44 os_project_1.c
```

3. 명령어 + 옵션 > 파일명

ls -l > myout1.txt

실행결과 :

```
(base) namjeonghun@songhae proj1 % ls -l > out1.txt
(base) namjeonghun@songhae proj1 %
```

```
osh>ls -l > myout1.txt
Child Complete
osh>
```

cat -n myout1.txt

실행결과 :

```
osh>cat -n myout1.txt
 1 total 64
 2 -rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:53 a.out
 3 -rw-r--r--  1 namjeonghun  staff      0  3 28 16:54 myout1.txt
 4 -rw-r--r--@ 1 namjeonghun  staff   4321  3 28 16:44 os_project_1.c
 5 -rw-r--r--  1 namjeonghun  staff   195  3 28 16:53 out1.txt
Child Complete
```

myout1.txt 파일 :

```
>total 64
-rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:53 a.out
-rw-r--r--  1 namjeonghun  staff      0  3 28 16:54 myout1.txt
-rw-r--r--@ 1 namjeonghun  staff   4321  3 28 16:44 os_project_1.c
-rw-r--r--  1 namjeonghun  staff   195  3 28 16:53 out1.txt
```

4. 명령어 + 옵션 > 파일명 &

ls -l > myout2.txt &

실행결과 :

```
proj1 - zsh - 80x24
(base) namjeonghun@songhae proj1 % ls -l > out2.txt &
[2] 7224
(base) namjeonghun@songhae proj1 %
done      ls -l > out2.txt

proj1 - ls - a.out - 68x24
Child Complete
osh>ls -l > myout2.txt &
Child Complete
osh>
```

cat -n myout2.txt

실행결과 :

```
osh>cat -n myout2.txt
 1 total 80
 2 -rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:53 a.out
 3 -rw-r--r--  1 namjeonghun  staff    258  3 28 16:54 myout1.txt
 4 -rw-r--r--  1 namjeonghun  staff      0  3 28 16:54 myout2.txt
 5 -rw-r--r--@ 1 namjeonghun  staff  4321  3 28 16:44 os_project_1.c
 6 -rw-r--r--  1 namjeonghun  staff    195  3 28 16:53 out1.txt
 7 -rw-r--r--  1 namjeonghun  staff    319  3 28 16:54 out2.txt
Child Complete
```

myout2.txt 파일 :

```
myout2.txt
total 80
-rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:53 a.out
-rw-r--r--  1 namjeonghun  staff    258  3 28 16:54 myout1.txt
-rw-r--r--  1 namjeonghun  staff      0  3 28 16:54 myout2.txt
-rw-r--r--@ 1 namjeonghun  staff  4321  3 28 16:44 os_project_1.c
-rw-r--r--  1 namjeonghun  staff    195  3 28 16:53 out1.txt
-rw-r--r--  1 namjeonghun  staff    319  3 28 16:54 out2.txt
```

5. 명령어 + 옵션 < 파일명

sort -u < myout1.txt (3 의 파일과 동일)

실행결과 :

```
proj1 - zsh - 80x24
((base) namjeonghun@songhae proj1 % sort -u < myout1.txt
-rw-r--r--  1 namjeonghun  staff      0  3 28 16:54 myout1.txt
-rw-r--r--  1 namjeonghun  staff    195  3 28 16:53 out1.txt
-rw-r--r--@ 1 namjeonghun  staff  4321  3 28 16:44 os_project_1.c
-rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:53 a.out
>total 64
(base) namjeonghun@songhae proj1 %

proj1 - a.out - 69x24
Child Complete
osh>sort -u < myout1.txt
-rw-r--r--  1 namjeonghun  staff      0  3 28 16:54 myout1.txt
-rw-r--r--  1 namjeonghun  staff    195  3 28 16:53 out1.txt
-rw-r--r--@ 1 namjeonghun  staff  4321  3 28 16:44 os_project_1.c
-rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:53 a.out
>total 64
Child Complete
osh>
```

6. 명령어 + 옵션 < 파일명 &

sort -u < myout2.txt & (4 의 파일과 동일)

실행결과 :

```
proj1 - zsh - 80x24
((base) namjeonghun@songhae proj1 % sort -u < myout2.txt &
[1] 3570
(base) namjeonghun@songhae proj1 % -rw-r--r--  1 namjeonghun  staff      0  3 28 16:54 myout2.txt
-rw-r--r--  1 namjeonghun  staff    195  3 28 16:53 out1.txt
-rw-r--r--  1 namjeonghun  staff    258  3 28 16:54 myout1.txt
-rw-r--r--  1 namjeonghun  staff    319  3 28 16:54 out2.txt
-rw-r--r--@ 1 namjeonghun  staff  4321  3 28 16:44 os_project_1.c
-rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:53 a.out
total 80
[1] + done      sort -u < myout2.txt

proj1 - sort - a.out - 69x24
Child Complete
osh>sort -u < myout2.txt &
Child Complete
osh>-rw-r--r--  1 namjeonghun  staff      0  3 28 16:54 myout2.txt
-rw-r--r--  1 namjeonghun  staff    195  3 28 16:53 out1.txt
-rw-r--r--  1 namjeonghun  staff    258  3 28 16:54 myout1.txt
-rw-r--r--  1 namjeonghun  staff    319  3 28 16:54 out2.txt
-rw-r--r--@ 1 namjeonghun  staff  4321  3 28 16:44 os_project_1.c
-rwxr-xr-x  1 namjeonghun  staff  17868  3 28 16:53 a.out
total 80
```

7. 명령어 + 옵션 | 명령어 + 옵션

ls -a | less -a

실행결과 :

The screenshot shows four terminal windows. The top-left window, titled 'proj1 — less -a — 80x24', displays the output of 'ls -a' in a less pager, showing files like .DS_Store, a.out, myout1.txt, myout2.txt, os_project_1.c, out1.txt, and out2.txt. The top-right window, titled 'proj1 — less -a.out — 78x24', shows the output of 'less -a a.out'. The bottom-left window shows the command '(base) namjeonghun@songhae proj1 % ls -a | less -a' being executed. The bottom-right window shows the command 'osh>ls -a | less -a' being executed, with 'Child Complete' and 'osh>' displayed below.

8. 명령어 + 옵션 | 명령어 + 옵션 &

ls -a | less -a &

실행결과 :

The screenshot shows three terminal windows. The top-left window, titled 'proj1 — -zsh — 80x24', shows the command '(base) namjeonghun@songhae proj1 % ls -a | less -a &' being executed, followed by '[2] 7267 7268', '(base) namjeonghun@songhae proj1 %', '[2] + done ls -a |', 'suspended (tty output) less -a', and '(base) namjeonghun@songhae proj1 %'. The top-right window, titled 'proj1 — less -a.out — 78x24', shows the output of 'less -a a.out'. The bottom window shows the command 'osh>ls -a | less -a &' being executed, with 'Child Complete' and 'osh>' displayed below.

9. 종료 커맨드

exit

실행결과 :

The screenshot shows a terminal window titled 'proj1 — -zsh — 104x37'. The command 'osh>exit' is entered, followed by 'Child Complete' and '(base) namjeonghun@songhae proj1 %'.

10. 종료 커맨드 &

Exit &

실행결과 :

The screenshot shows a terminal window titled 'proj1 — -zsh — 80x24'. The command 'osh>exit &' is entered, followed by 'Child Complete' and '(base) namjeonghun@songhae proj1 %'.