과제1 결과보고서

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5. to improve the understanding of technology, its appropriate application, and potential consequences;

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학 부: 전자공학과

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전자공학운영체계 과제1 결과보고서

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□ 소스 코드

○ part 1

```c
#include <linux/init.h>
#include <linux/module.h>
#include <linux/kernel.h>
#include <linux/sched.h>
#include <linux/sched/task.h>
#include <linux/list.h>
#include <linux/slab.h>

/* performs a depth-first traversal of the list of tasks in the system. */
void traverse(struct task_struct *ptr){
/* fill in your code */
        struct task_struct *child;
        struct list_head *list;

        printk("name: %20s  ||  pid: %6d  ||  parent pid: %6d  ||  state:
%6li\n", ptr->comm, ptr->pid, ptr->parent->pid, ptr->state);
        list_for_each(list,&ptr->children){
                child = list_entry(list,struct task_struct, sibling);
                traverse(child);
        }
        return;
}

int simple_init(void)
{
        //struct task_struct *task;
        //struct list_head *list;

        //struct task_struct *c;

        printk(KERN_INFO "\nLoading Module\n");

        traverse(&init_task);

        return 0;
}
```

```c
struct BFSQ {
    struct task_struct *task;
    struct list_head blist;
};

static LIST_HEAD(BFSH);

void add(struct task_struct *a){
        struct BFSQ *two;
        two = kmalloc(sizeof(*two), GFP_KERNEL);
        two->task = a;
        INIT_LIST_HEAD(&two->blist);
        list_add_tail(&two->blist,&BFSH);
        return;
}

void BFtraverse(struct task_struct *bfss){

        struct BFSQ *child1;
        struct task_struct *child2,*child3;
        struct list_head *kk,*ll,*dum;

        add(bfss);

        while(!list_empty(&BFSH)){
                list_for_each_safe(kk, dum,&BFSH){

                        child1 = list_entry(kk,struct BFSQ, blist);
                        child2 = child1->task;
                        printk("name: %20s  ||  pid: %6d  ||  parent pid: %6d  ||
state: %6li\n", child2->comm, child2->pid, child2->parent->pid, child2->state);

                        list_for_each(ll,&child2->children){
                                child3 = list_entry(ll,struct task_struct, sibling);
                                add(child3);
                        }

                        list_del(kk);
                }
        }
        return;
}


void simple_exit(void){
        printk(KERN_INFO "\nRemoving Module\n");

        BFtraverse(&init_task);

        return;
```

```
    }

    module_init( simple_init );
    module_exit( simple_exit );

    MODULE_LICENSE("GPL");
    MODULE_DESCRIPTION("Process Module");
    MODULE_AUTHOR("SGG");
```

DFS는 list_for_each를 사용하여 하나의 노드의 모든 자식을 방문하되, 재귀적으로 구성하여 가장 깊게 내려간 후 다시 재귀를 종료하여 올라오는 방식으로 구현하였다. 이때 부모 관계를 쉽게 확인하기 위해 부모의 PID를 표시하고 각 print에서 고정 너비를 주어 가독성을 높였다.

BFS는 연결 리스트를 사용하여 While 문 안에서 큐가 빌 때까지 순환하도록 구현하였다. task 포인터와 list haed 포인터를 가지는 구조체를 선언하여 연결 리스트로 사용하였다. 해당 리스트에 새로운 노드를 추가하는 함수 add를 선선하였다. 이는 주어진 예제였던 Simple.c 파일로부터 참고하였다. 실제 BFS가 구현되는 함수 BFtraverse는 시작 task를 받아서 큐로서 취급 가능한 연결 리스트에 추가하는 것으로 시작하여 큐가 빌 때 까지 큐의 노드를 하나 꺼내어 출력하고 해당하는 모든 자식 노드를 큐에 추가하는 작업을 반복하는 것으로 BFS를 구현한다. 이때 list_del 매크로 사용을 위해 list_for_each_safe를 사용하였다.

○ part 2

```
/**
 * Simple shell interface program.
 *
 * Operating System Concepts - Ninth Edition
 * Copyright John Wiley & Sons - 2013
 */

#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/wait.h>
#include <string.h>
#include <stdlib.h>

#define MAX_LINE        80 /* 80 chars per line, per command */
```

```c
void strip_down(char *cmmd,char **args,int *halt );
int execute(char **args,int halt );

int main(void){

        char *args[MAX_LINE/2 +1]={'\0',};    /* command line (of 80) has max
of 40 arguments */
        char history[5][MAX_LINE]={'\0',};
        char cmmd[MAX_LINE]={'\0',};
        char orig[MAX_LINE]={'\0',};
        pid_t pid;
        int should_run =1;
        int halt =0;
        int i;

        /*****************************************************/
        /* After reading user input, the steps are:          */
        /* (1) fork a child process                          */
        /* (2) the child process will invoke execvp()        */
        /* (3) if command included &, parent will invoke wait()    */
        /*****************************************************/


        while (should_run){

                printf("osh>");
                fflush(stdout);

                halt =0;
                for ( i =0 ; i < MAX_LINE/2 +1 ; i++) args[i]= NULL;
                for ( i =0 ; i < MAX_LINE ; i++){ cmmd[i]='\0'; orig[i]='\0';}

                fgets(cmmd,sizeof(cmmd), stdin);
                i =0;while ( cmmd[i]!='\n'){ i++;} cmmd[i]='\0';
                strcpy(orig, cmmd);
                strip_down( cmmd, args,&halt );

                if ( !args[0] ) printf("No command entered\n");

                else if ( !strcmp(args[0],"") ) printf("No command entered\n");

                else if (!strcmp(args[0],"exit")&&!args[1]){
                        printf("Exiting now... goodbye\n");
                        break;
                }

                else if (!strcmp(args[0],"history")&&!args[1]){
                        if(!strcmp(history[0],""))printf("Empty\n");
                        else {for ( i =5 ; i >0 ; i--)
                                printf("%d - %s \n", i, history[i-1]);
```

```c
                    }
                }

                else if ( args[0][0]=='!'&& args[0][2]=='\0'&&!args[1]){
                    if ( args[0][1]=='!'){
                        printf("Execute from most recent history\n");
                        strcpy( cmmd, history[0]);
                        strcpy( orig, cmmd);
                        strip_down( cmmd, args,&halt );
                        if(        args[0][0]=='\0'){printf("Nothing        from
history!\n");continue;}
                        printf("Executing : %s\n", orig);
                        if ( execute( args, halt ))return 0;
                        for ( i =4 ; i >0 ; i--)strcpy(history[i],history[i-1]);
                        strcpy(history[0], orig);
                    }
                    else if ( args[0][1]>'0'&& args[0][1]<'6'){
                        printf("Execute    from    history   -    %d\n",
args[0][1]-'0');
                        strcpy( cmmd, history[args[0][1]-'1']);
                        strcpy( orig, cmmd);
                        strip_down( cmmd, args,&halt );
                        if(        args[0][0]=='\0'){printf("Nothing        from
history\n");continue;}
                        printf("Executing : %s\n", orig);
                        if ( execute( args, halt ))return 0;
                        for ( i =4 ; i >0 ; i--)strcpy(history[i],history[i-1]);
                        strcpy(history[0], orig);
                    }
                    else printf("False history command\n\n");
                }

                else {
                    if ( execute( args, halt ))return 0;
                    for ( i =4 ; i >0 ; i--)strcpy(history[i],history[i-1]);
                    strcpy(history[0], orig);
                }

        }
        return 0;
}


void strip_down(char *cmmd,char **args,int *halt ){

        int c=0, a=0;

        while ( cmmd[c]!='\0'){
                while (cmmd[c]==' '|| cmmd[c]=='\t'){ cmmd[c]='\0'; c++;}
```

```
                args[a]=&cmmd[c];
                while  (cmmd[c]!='  '&&  cmmd[c]!='\t'&&  cmmd[c]!='\0'&&
cmmd[c]!='\n') c++;
                if (cmmd[c]=='\n') cmmd[c]='\0';
                if (args[a][0]=='&'&& args[a][1]=='\0'){*halt =1; a--;}
                a++;
        }
        cmmd[c]='\0';
        args[a]='\0';

        return;
}

int execute(char **args, int halt ){
        pid_t pid = fork();

        if(pid <0){
                printf("Error while fork\n");
                return 1;
        }
        else if (pid ==0){
                if ( execvp(args[0], args)){
                 printf("Error while execvp\n");
                return 1;
                }
        }
        else {
                if(halt==0){
                        printf("  Child now runs in Fore-Ground\n");
                        while(wait(NULL)!= pid);
                        printf("  Fore-Ground ended\n\n");
                }
                else printf("  Child now runs in Back-Ground\n\n");
        }
        return 0;
}
```

우선 입력받은 커맨드를 저장할 변수와 이를 다섯 개 저장할 곳, 임시로 커맨드를 저장하는데 사용할 변수를 선언한다.

각 반복마다 변수를 초기화하고 커맨드를 입력받아 이를 처리한다. 이때 fgets를 사용하며 줄바꿈은 제거한다. 또한 입력된 그대로의 커맨드를 따로 저장해둔 후 history에 저장할 때 사용한다.

strip down함수는 입력 커맨드를 적절하게 처리해서 args에 할당한다. 이때 불필료

한 공백, 탭을 지우고 BG, FG 선택 문자인 &가 있을 경우 halt 라는 변수를 on-off 하고 args에는 &를 포함하지 않는다. 이는 프로세스에 의도하지 않은 argument가 넘어가지 않게 하기 위함이다.

따라서 입력된 명령어는 각 단어의 끝을 표시하기 위해 수정되므로 history에 저장 되더라도 이루 로딩 과정에서 에러가 발생하게 되므로 처리하기 전의 입력을 따로 저장하고 그것을 명령어의 실행 이후 history에 추가한다. history에서 불러온 명령 어는 상기한 처리 과정과 원본 백업, 실행 이후 백업을 저장하는 과정을 거친다.

이렇게 입력된 커맨드를 적절히 처리하고 해당 커맨드에 따라 아무것도 없으면 메시 지를 출력, exit라면 프로그램의 종료를, history라면 실행 내역을 출력한다. 그리고 느낌표가 입력되었다면 이어진 문자가 느낌표일 때 가장 최근 내역을 실행하고 1~5 라면 해당 순번의 내역을 실행한다. 이는 0의 아스키 코드를 빼서 사용한다. 이외의 경우 에러 메시지를 출력하고 스킵한다. 내역으로부터 실행할 때 최근 다섯 개의 내 역을 저장하는 history 배열에서 해당 내역을 커맨드 cmmd로 불러오고 이를 strip down 하여 args에 할당한 뒤 실행한다. 여기까지의 명령어는 하나의 단어로 끝나기 때문에 args[1]은 NULL이어야 하므로 if 조건에 추가하였다.

일반 입력에 대해 입력될 때 execute 함수로 넘겨서 pid = fork()로 프로세스를 생 성, 리턴 값을 기준으로 부모와 자식 프로세스를 구분한다. 이때 &가 붙어 halt가 활 성화되었다면 새로 생성된 프로세스의 종료를 기다리지 않고 돌아오지만 붙지 않는 다면 자식 프로세스가 끝나는 것을 기다린다. 또한 execvp 함수로 arguments를 핸 들링한다. 이의 리턴 값에 따라 에러가 발생하였다면 알 수 있으므로 메시지를 출력 한다. 그리고 이 함수는 int를 반환하여 에러가 발생하였을 시 main에서 return 0; 로 자식 프로세스를 종료시키도록 한다.

모든 실행 후에는 history를 한 칸씩 밀고 새로 추가한다.

□ 실행 결과

○ part 1

- DFS

```
[ 2558.203271] process: loading out-of-tree module taints kernel.
[ 2558.203492]
              Loading Module
[ 2558.203493] name:        swapper/0 || pid:       0 || parent pid:       0 || state:   0
[ 2558.203493] name:          systemd || pid:       1 || parent pid:       0 || state:   1
[ 2558.203494] name:  systemd-journal || pid:     216 || parent pid:       1 || state:   1
[ 2558.203495] name:    systemd-udevd || pid:     251 || parent pid:       1 || state:   2
[ 2558.203495] name:   systemd-timesyn || pid:     282 || parent pid:       1 || state:   1
[ 2558.203496] name:         rsyslogd || pid:     624 || parent pid:       1 || state:   1
[ 2558.203497] name:  accounts-daemon || pid:     632 || parent pid:       1 || state:   1
[ 2558.203497] name:             cron || pid:     633 || parent pid:       1 || state:   1
[ 2558.203498] name:            cupsd || pid:     636 || parent pid:       1 || state:   1
[ 2558.203498] name:             dbus || pid:     674 || parent pid:     636 || state:   1
[ 2558.203499] name:             dbus || pid:     675 || parent pid:     636 || state:   1
[ 2558.203500] name:             dbus || pid:     676 || parent pid:     636 || state:   1
[ 2558.203500] name:             dbus || pid:     677 || parent pid:     636 || state:   1
[ 2558.203501] name:             dbus || pid:     678 || parent pid:     636 || state:   1
[ 2558.203501] name:             dbus || pid:     679 || parent pid:     636 || state:   1
[ 2558.203502] name:             dbus || pid:     680 || parent pid:     636 || state:   1
[ 2558.203503] name:     avahi-daemon || pid:     647 || parent pid:       1 || state:   1
[ 2558.203503] name:     avahi-daemon || pid:     654 || parent pid:     647 || state:   1
[ 2558.203504] name:      dbus-daemon || pid:     648 || parent pid:       1 || state:   1
[ 2558.203504] name:     cups-browsed || pid:     657 || parent pid:       1 || state:   1
[ 2558.203505] name:    systemd-logind || pid:     660 || parent pid:       1 || state:   1
[ 2558.203506] name:            acpid || pid:     661 || parent pid:       1 || state:   1
[ 2558.203506] name:   NetworkManager || pid:     668 || parent pid:       1 || state:   1
[ 2558.203507] name:         dhclient || pid:     951 || parent pid:     668 || state:   1
[ 2558.203508] name:          dnsmasq || pid:     960 || parent pid:     668 || state:   1
[ 2558.203508] name:            snapd || pid:     669 || parent pid:       1 || state:   1
[ 2558.203509] name:          polkitd || pid:     747 || parent pid:       1 || state:   1
[ 2558.203510] name:          lightdm || pid:     758 || parent pid:       1 || state:   1
[ 2558.203510] name:             Xorg || pid:     775 || parent pid:     758 || state:   1
[ 2558.203511] name:          lightdm || pid:     841 || parent pid:     758 || state:   1
[ 2558.203511] name:          upstart || pid:    1187 || parent pid:     841 || state:   1
[ 2558.203512] name:   upstart-udev-br || pid:    1267 || parent pid:    1187 || state:   1
[ 2558.203513] name:      dbus-daemon || pid:    1274 || parent pid:    1187 || state:   1
[ 2558.203513] name:  window-stack-br || pid:    1286 || parent pid:    1187 || state:   1
[ 2558.203514] name:            fcitx || pid:    1317 || parent pid:    1187 || state:   1
[ 2558.203514] name:        bamfdaemon || pid:    1327 || parent pid:    1187 || state:   1
[ 2558.203515] name:   upstart-dbus-br || pid:    1338 || parent pid:    1187 || state:   1
[ 2558.203516] name:      dbus-daemon || pid:    1341 || parent pid:    1187 || state:   1
[ 2558.203517] name:   upstart-dbus-br || pid:    1345 || parent pid:    1187 || state:   1
[ 2558.203517] name:             gvfsd || pid:    1349 || parent pid:    1187 || state:   1
[ 2558.203518] name:        gvfsd-fuse || pid:    1354 || parent pid:    1187 || state:   1
[ 2558.203518] name:  fcitx-dbus-watc || pid:    1356 || parent pid:    1187 || state:   1
[ 2558.203519] name:   upstart-file-br || pid:    1358 || parent pid:    1187 || state:   1
[ 2558.203519] name:   at-spi-bus-laun || pid:    1368 || parent pid:    1187 || state:   1
[ 2558.203520] name:      dbus-daemon || pid:    1373 || parent pid:    1368 || state:   1
[ 2558.203521] name:   at-spi2-registr || pid:    1376 || parent pid:    1187 || state:   1
[ 2558.203522] name:       notify-osd || pid:    1384 || parent pid:    1187 || state:   1
[ 2558.203522] name:        gpg-agent || pid:    1399 || parent pid:    1187 || state:   1
[ 2558.203523] name:      hud-service || pid:    1414 || parent pid:    1187 || state:   1
```

```
[ 2558.203523] name:       hud-service || pid: 1414 || parent pid:  1187 || state:   1
[ 2558.203524] name:   unity-settings- || pid: 1416 || parent pid:  1187 || state:   1
[ 2558.203524] name:   gnome-session-b || pid: 1428 || parent pid:  1187 || state:   1
[ 2558.203525] name:   unity-fallback- || pid: 1605 || parent pid:  1428 || state:   1
[ 2558.203526] name:   gnome-software  || pid: 1606 || parent pid:  1428 || state:   1
[ 2558.203526] name:         nautilus  || pid: 1608 || parent pid:  1428 || state:   1
[ 2558.203527] name:   polkit-gnome-au || pid: 1613 || parent pid:  1428 || state:   1
[ 2558.203527] name:         nm-applet || pid: 1620 || parent pid:  1428 || state:   1
[ 2558.203528] name:   zeitgeist-datah || pid: 1884 || parent pid:  1428 || state:   1
[ 2558.203529] name:   update-notifier || pid: 2103 || parent pid:  1428 || state:   1
[ 2558.203529] name:   deja-dup-monito || pid: 2186 || parent pid:  1428 || state:   1
[ 2558.203530] name:   unity-panel-ser || pid: 1435 || parent pid:  1187 || state:   1
[ 2558.203531] name:     dconf-service || pid: 1473 || parent pid:  1187 || state:   1
[ 2558.203531] name:   indicator-messa || pid: 1482 || parent pid:  1187 || state:   1
[ 2558.203532] name:   indicator-bluet || pid: 1486 || parent pid:  1187 || state:   1
[ 2558.203533] name:   indicator-power || pid: 1489 || parent pid:  1187 || state:   1
[ 2558.203533] name:   indicator-datet || pid: 1491 || parent pid:  1187 || state:   1
[ 2558.203534] name:   indicator-keybo || pid: 1495 || parent pid:  1187 || state:   1
[ 2558.203534] name:   indicator-sound || pid: 1497 || parent pid:  1187 || state:   1
[ 2558.203535] name:   indicator-print || pid: 1501 || parent pid:  1187 || state:   1
[ 2558.203536] name:   indicator-sessi || pid: 1503 || parent pid:  1187 || state:   1
[ 2558.203536] name:   indicator-appli || pid: 1505 || parent pid:  1187 || state:   1
[ 2558.203537] name:           compiz  || pid: 1508 || parent pid:  1187 || state:   0
[ 2558.203537] name:        pulseaudio || pid: 1547 || parent pid:  1187 || state:   1
[ 2558.203538] name:   evolution-sourc || pid: 1548 || parent pid:  1187 || state:   1
[ 2558.203538] name:   evolution-calen || pid: 1591 || parent pid:  1187 || state:   1
[ 2558.203539] name:   evolution-calen || pid: 1618 || parent pid:  1591 || state:   1
[ 2558.203540] name:   evolution-calen || pid: 1640 || parent pid:  1591 || state:   1
[ 2558.203540] name:   evolution-addre || pid: 1643 || parent pid:  1187 || state:   1
[ 2558.203541] name:   evolution-addre || pid: 1670 || parent pid:  1643 || state:   1
[ 2558.203542] name:   gvfs-udisks2-vo || pid: 1661 || parent pid:  1187 || state:   1
[ 2558.203542] name:   gvfs-gphoto2-vo || pid: 1682 || parent pid:  1187 || state:   1
[ 2558.203543] name:   gvfs-mtp-volume || pid: 1690 || parent pid:  1187 || state:   1
[ 2558.203543] name:   gvfs-goa-volume || pid: 1696 || parent pid:  1187 || state:   1
[ 2558.203544] name:   gvfs-afc-volume || pid: 1710 || parent pid:  1187 || state:   1
[ 2558.203545] name:       gvfsd-trash || pid: 1730 || parent pid:  1187 || state:   1
[ 2558.203545] name:           firefox || pid: 1770 || parent pid:  1187 || state:   1
[ 2558.203546] name:               sh  || pid: 1891 || parent pid:  1187 || state:   1
[ 2558.203546] name:   zeitgeist-daemo || pid: 1895 || parent pid:  1891 || state:   1
[ 2558.203547] name:     zeitgeist-fts || pid: 1903 || parent pid:  1187 || state:   1
[ 2558.203548] name:   unity-scope-hom || pid: 1998 || parent pid:  1187 || state:   1
[ 2558.203548] name:   unity-files-dae || pid: 2011 || parent pid:  1187 || state:   1
[ 2558.203549] name:   unity-scope-loa || pid: 2010 || parent pid:  1187 || state:   1
[ 2558.203549] name:   unity-music-dae || pid: 2037 || parent pid:  1187 || state:   1
[ 2558.203550] name:     gvfsd-network || pid: 2825 || parent pid:  1187 || state:   1
[ 2558.203551] name:    gvfsd-metadata || pid: 2847 || parent pid:  1187 || state:   1
[ 2558.203551] name:       gvfsd-dnssd || pid: 2858 || parent pid:  1187 || state:   1
[ 2558.203552] name:        sd_generic || pid: 2993 || parent pid:  1187 || state:   1
[ 2558.203553] name:         sd_espeak || pid: 2996 || parent pid:  1187 || state:   1
[ 2558.203553] name:          sd_dummy || pid: 3001 || parent pid:  1187 || state:   1
[ 2558.203554] name:         sd_cicero || pid: 3004 || parent pid:  1187 || state:   1
[ 2558.203555] name:         sd_cicero || pid: 3005 || parent pid:  3004 || state: 128
[ 2558.203555] name:   speech-dispatch || pid: 3008 || parent pid:  1187 || state:   1
[ 2558.203556] name:   gnome-terminal- || pid: 3398 || parent pid:  1187 || state:   1
```

```
[ 2558.203556] name:        gnome-terminal- || pid:  3398 || parent pid:  1187 || state:     1
[ 2558.203556] name:                   bash || pid:  3403 || parent pid:  3398 || state:     1
[ 2558.203557] name:                   sudo || pid:  4205 || parent pid:  3403 || state:     1
[ 2558.203557] name:                  insmod || pid:  4206 || parent pid:  4205 || state:     0
[ 2558.203558] name:           rtkit-daemon || pid:   905 || parent pid:     1 || state:     1
[ 2558.203559] name:                upowerd || pid:   927 || parent pid:     1 || state:     1
[ 2558.203559] name:                 colord || pid:   942 || parent pid:     1 || state:     1
[ 2558.203560] name:               whoopsie || pid:  1108 || parent pid:     1 || state:     1
[ 2558.203561] name:                 agetty || pid:  1113 || parent pid:     1 || state:     1
[ 2558.203561] name:                systemd || pid:  1133 || parent pid:     1 || state:     1
[ 2558.203562] name:               (sd-pam) || pid:  1134 || parent pid:  1133 || state:     1
[ 2558.203562] name:        gnome-keyring-d || pid:  1176 || parent pid:     1 || state:     1
[ 2558.203563] name:                udisksd || pid:  1665 || parent pid:     1 || state:     1
[ 2558.203564] name:               kthreadd || pid:     2 || parent pid:     0 || state:     1
[ 2558.203564] name:             kworker/0:0H || pid:     4 || parent pid:     2 || state:  1026
[ 2558.203565] name:            mm_percpu_wq || pid:     6 || parent pid:     2 || state:  1026
[ 2558.203565] name:             ksoftirqd/0 || pid:     7 || parent pid:     2 || state:     1
[ 2558.203566] name:               rcu_sched || pid:     8 || parent pid:     2 || state:  1026
[ 2558.203567] name:                  rcu_bh || pid:     9 || parent pid:     2 || state:  1026
[ 2558.203567] name:             migration/0 || pid:    10 || parent pid:     2 || state:     1
[ 2558.203568] name:              watchdog/0 || pid:    11 || parent pid:     2 || state:     1
[ 2558.203569] name:                 cpuhp/0 || pid:    12 || parent pid:     2 || state:     1
[ 2558.203569] name:               kdevtmpfs || pid:    13 || parent pid:     2 || state:     1
[ 2558.203570] name:                   netns || pid:    14 || parent pid:     2 || state:  1026
[ 2558.203570] name:         rcu_tasks_kthre || pid:    15 || parent pid:     2 || state:     1
[ 2558.203571] name:                 kauditd || pid:    16 || parent pid:     2 || state:     1
[ 2558.203572] name:               khungtaskd || pid:    17 || parent pid:     2 || state:     1
[ 2558.203572] name:              oom_reaper || pid:    18 || parent pid:     2 || state:     1
[ 2558.203573] name:               writeback || pid:    19 || parent pid:     2 || state:  1026
[ 2558.203574] name:              kcompactd0 || pid:    20 || parent pid:     2 || state:     1
[ 2558.203574] name:                    ksmd || pid:    21 || parent pid:     2 || state:     1
[ 2558.203575] name:              khugepaged || pid:    22 || parent pid:     2 || state:     1
[ 2558.203575] name:                  crypto || pid:    23 || parent pid:     2 || state:  1026
[ 2558.203576] name:             kintegrityd || pid:    24 || parent pid:     2 || state:  1026
[ 2558.203577] name:                 kblockd || pid:    25 || parent pid:     2 || state:  1026
[ 2558.203577] name:                  ata_sff || pid:    26 || parent pid:     2 || state:  1026
[ 2558.203578] name:                      md || pid:    27 || parent pid:     2 || state:  1026
[ 2558.203579] name:             edac-poller || pid:    28 || parent pid:     2 || state:  1026
[ 2558.203579] name:               devfreq_wq || pid:    29 || parent pid:     2 || state:  1026
[ 2558.203580] name:               watchdogd || pid:    30 || parent pid:     2 || state:  1026
[ 2558.203581] name:              kworker/0:1 || pid:    32 || parent pid:     2 || state:  1026
[ 2558.203581] name:                 kswapd0 || pid:    34 || parent pid:     2 || state:     1
[ 2558.203582] name:          ecryptfs-kthrea || pid:    35 || parent pid:     2 || state:     1
[ 2558.203582] name:                kthrotld || pid:    77 || parent pid:     2 || state:  1026
[ 2558.203583] name:          acpi_thermal_pm || pid:    78 || parent pid:     2 || state:  1026
[ 2558.203584] name:                scsi_eh_0 || pid:    79 || parent pid:     2 || state:     1
[ 2558.203584] name:               scsi_tmf_0 || pid:    81 || parent pid:     2 || state:  1026
[ 2558.203585] name:                scsi_eh_1 || pid:    82 || parent pid:     2 || state:     1
[ 2558.203586] name:               scsi_tmf_1 || pid:    83 || parent pid:     2 || state:  1026
[ 2558.203586] name:              kworker/u2:3 || pid:    84 || parent pid:     2 || state:  1026
[ 2558.203587] name:             ipv6_addrconf || pid:    85 || parent pid:     2 || state:  1026
[ 2558.203587] name:                   kstrp || pid:    95 || parent pid:     2 || state:  1026
[ 2558.203588] name:          charger_manager || pid:   112 || parent pid:     2 || state:  1026
[ 2558.203589] name:             kworker/0:1H || pid:   154 || parent pid:     2 || state:  1026
```

```
[ 2558.203589] name:             kworker/0:1H || pid:   154 || parent pid:     2 || state:  1026
[ 2558.203589] name:                scsi_eh_2 || pid:   155 || parent pid:     2 || state:     1
[ 2558.203590] name:               scsi_tmf_2 || pid:   156 || parent pid:     2 || state:  1026
[ 2558.203591] name:               jbd2/sda1-8 || pid:   179 || parent pid:     2 || state:     1
[ 2558.203591] name:          ext4-rsv-conver || pid:   180 || parent pid:     2 || state:  1026
[ 2558.203592] name:           iprt-VBoxWQueue || pid:   388 || parent pid:     2 || state:  1026
[ 2558.203593] name:                 ttm_swap || pid:   524 || parent pid:     2 || state:  1026
[ 2558.203593] name:              kworker/0:0 || pid:  2875 || parent pid:     2 || state:  1026
[ 2558.203594] name:              kworker/u2:1 || pid:  3174 || parent pid:     2 || state:  1026
[ 2558.203595] name:              kworker/u2:0 || pid:  3381 || parent pid:     2 || state:  1026
[ 2566.655123]
```

　　parent의 pid와 프로세스의 pid를 확인한 결과 1번 pid부터 출력되어 모든 자식들을 돌아가다 자식이 있는 프로세스가 나올 때 마다 해당 분기전을 타고 내려가서 다시 탐색을 진행한다는 것 즉 DFS가 이루어졌음을 확인할 수 있다.

- BFS

```
[ 2566.655123]
              Removing Module
[ 2566.655125] name:              swapper/0  ||  pid:     0  ||  parent pid:     0  ||  state:     0
[ 2566.655126] name:                systemd  ||  pid:     1  ||  parent pid:     0  ||  state:     1
[ 2566.655128] name:               kthreadd  ||  pid:     2  ||  parent pid:     0  ||  state:     1
[ 2566.655133] name:         systemd-journal  ||  pid:   216  ||  parent pid:     1  ||  state:     1
[ 2566.655133] name:          systemd-udevd  ||  pid:   251  ||  parent pid:     1  ||  state:     1
[ 2566.655134] name:         systemd-timesyn  ||  pid:   282  ||  parent pid:     1  ||  state:     1
[ 2566.655134] name:                rsyslogd  ||  pid:   624  ||  parent pid:     1  ||  state:     1
[ 2566.655135] name:         accounts-daemon  ||  pid:   632  ||  parent pid:     1  ||  state:     1
[ 2566.655135] name:                   cron  ||  pid:   633  ||  parent pid:     1  ||  state:     1
[ 2566.655136] name:                  cupsd  ||  pid:   636  ||  parent pid:     1  ||  state:     1
[ 2566.655137] name:            avahi-daemon  ||  pid:   647  ||  parent pid:     1  ||  state:     1
[ 2566.655138] name:             dbus-daemon  ||  pid:   648  ||  parent pid:     1  ||  state:     1
[ 2566.655139] name:            cups-browsed  ||  pid:   657  ||  parent pid:     1  ||  state:     1
[ 2566.655139] name:          systemd-logind  ||  pid:   660  ||  parent pid:     1  ||  state:     1
[ 2566.655140] name:                   acpid  ||  pid:   661  ||  parent pid:     1  ||  state:     1
[ 2566.655140] name:         NetworkManager  ||  pid:   668  ||  parent pid:     1  ||  state:     1
[ 2566.655141] name:                   snapd  ||  pid:   669  ||  parent pid:     1  ||  state:     1
[ 2566.655142] name:                 polkitd  ||  pid:   747  ||  parent pid:     1  ||  state:     1
[ 2566.655142] name:                 lightdm  ||  pid:   758  ||  parent pid:     1  ||  state:     1
[ 2566.655143] name:            rtkit-daemon  ||  pid:   905  ||  parent pid:     1  ||  state:     1
[ 2566.655143] name:                 upowerd  ||  pid:   927  ||  parent pid:     1  ||  state:     1
[ 2566.655144] name:                  colord  ||  pid:   942  ||  parent pid:     1  ||  state:     1
[ 2566.655145] name:                whoopsie  ||  pid:  1108  ||  parent pid:     1  ||  state:     1
[ 2566.655146] name:                  agetty  ||  pid:  1113  ||  parent pid:     1  ||  state:     1
[ 2566.655146] name:                 systemd  ||  pid:  1133  ||  parent pid:     1  ||  state:     1
[ 2566.655147] name:         gnome-keyring-d  ||  pid:  1176  ||  parent pid:     1  ||  state:     1
[ 2566.655147] name:                 udisksd  ||  pid:  1665  ||  parent pid:     1  ||  state:     1
[ 2566.655148] name:             kworker/0:0H  ||  pid:     4  ||  parent pid:     2  ||  state:  1026
[ 2566.655148] name:            mm_percpu_wq  ||  pid:     6  ||  parent pid:     2  ||  state:  1026
[ 2566.655149] name:              ksoftirqd/0  ||  pid:     7  ||  parent pid:     2  ||  state:     1
[ 2566.655150] name:               rcu_sched  ||  pid:     8  ||  parent pid:     2  ||  state:  1026
[ 2566.655150] name:                  rcu_bh  ||  pid:     9  ||  parent pid:     2  ||  state:  1026
[ 2566.655151] name:             migration/0  ||  pid:    10  ||  parent pid:     2  ||  state:     1
[ 2566.655151] name:              watchdog/0  ||  pid:    11  ||  parent pid:     2  ||  state:     1
[ 2566.655152] name:                  cpuhp/0  ||  pid:    12  ||  parent pid:     2  ||  state:     1
[ 2566.655153] name:                kdevtmpfs  ||  pid:    13  ||  parent pid:     2  ||  state:     1
[ 2566.655153] name:                   netns  ||  pid:    14  ||  parent pid:     2  ||  state:  1026
[ 2566.655154] name:         rcu_tasks_kthre  ||  pid:    15  ||  parent pid:     2  ||  state:     1
[ 2566.655154] name:                 kauditd  ||  pid:    16  ||  parent pid:     2  ||  state:     1
[ 2566.655155] name:               khungtaskd  ||  pid:    17  ||  parent pid:     2  ||  state:     1
[ 2566.655155] name:               oom_reaper  ||  pid:    18  ||  parent pid:     2  ||  state:     1
[ 2566.655156] name:               writeback  ||  pid:    19  ||  parent pid:     2  ||  state:  1026
[ 2566.655157] name:               kcompactd0  ||  pid:    20  ||  parent pid:     2  ||  state:     1
[ 2566.655157] name:                    ksmd  ||  pid:    21  ||  parent pid:     2  ||  state:     1
[ 2566.655158] name:               khugepaged  ||  pid:    22  ||  parent pid:     2  ||  state:     1
[ 2566.655158] name:                  crypto  ||  pid:    23  ||  parent pid:     2  ||  state:  1026
[ 2566.655159] name:              kintegrityd  ||  pid:    24  ||  parent pid:     2  ||  state:  1026
[ 2566.655160] name:                 kblockd  ||  pid:    25  ||  parent pid:     2  ||  state:  1026
[ 2566.655160] name:                 ata_sff  ||  pid:    26  ||  parent pid:     2  ||  state:  1026
[ 2566.655161] name:                      md  ||  pid:    27  ||  parent pid:     2  ||  state:  1026
[ 2566.655161] name:             edac-poller  ||  pid:    28  ||  parent pid:     2  ||  state:  1026
```

```
[ 2566.655161] name:          edac-poller || pid:   28 || parent pid:    2 || state: 1026
[ 2566.655162] name:          devfreq_wq || pid:   29 || parent pid:    2 || state: 1026
[ 2566.655162] name:           watchdogd || pid:   30 || parent pid:    2 || state: 1026
[ 2566.655163] name:         kworker/0:1 || pid:   32 || parent pid:    2 || state: 1026
[ 2566.655164] name:             kswapd0 || pid:   34 || parent pid:    2 || state:    1
[ 2566.655164] name:      ecryptfs-kthrea || pid:   35 || parent pid:    2 || state:    1
[ 2566.655165] name:            kthrotld || pid:   77 || parent pid:    2 || state: 1026
[ 2566.655165] name:      acpi_thermal_pm || pid:   78 || parent pid:    2 || state: 1026
[ 2566.655166] name:           scsi_eh_0 || pid:   79 || parent pid:    2 || state:    1
[ 2566.655166] name:          scsi_tmf_0 || pid:   81 || parent pid:    2 || state: 1026
[ 2566.655167] name:           scsi_eh_1 || pid:   82 || parent pid:    2 || state:    1
[ 2566.655168] name:          scsi_tmf_1 || pid:   83 || parent pid:    2 || state: 1026
[ 2566.655168] name:         kworker/u2:3 || pid:   84 || parent pid:    2 || state: 1026
[ 2566.655169] name:        ipv6_addrconf || pid:   85 || parent pid:    2 || state: 1026
[ 2566.655169] name:               kstrp || pid:   95 || parent pid:    2 || state: 1026
[ 2566.655170] name:      charger_manager || pid:  112 || parent pid:    2 || state: 1026
[ 2566.655171] name:        kworker/0:1H || pid:  154 || parent pid:    2 || state: 1026
[ 2566.655171] name:           scsi_eh_2 || pid:  155 || parent pid:    2 || state:    1
[ 2566.655172] name:          scsi_tmf_2 || pid:  156 || parent pid:    2 || state: 1026
[ 2566.655172] name:          jbd2/sda1-8 || pid:  179 || parent pid:    2 || state:    1
[ 2566.655173] name:      ext4-rsv-conver || pid:  180 || parent pid:    2 || state: 1026
[ 2566.655173] name:      iprt-VBoxWQueue || pid:  388 || parent pid:    2 || state: 1026
[ 2566.655174] name:            ttm_swap || pid:  524 || parent pid:    2 || state: 1026
[ 2566.655175] name:         kworker/0:0 || pid: 2875 || parent pid:    2 || state: 1026
[ 2566.655175] name:         kworker/u2:1 || pid: 3174 || parent pid:    2 || state: 1026
[ 2566.655176] name:         kworker/u2:0 || pid: 3381 || parent pid:    2 || state: 1026
[ 2566.655177] name:                dbus || pid:  674 || parent pid:  636 || state:    1
[ 2566.655177] name:                dbus || pid:  675 || parent pid:  636 || state:    1
[ 2566.655178] name:                dbus || pid:  676 || parent pid:  636 || state:    1
[ 2566.655178] name:                dbus || pid:  677 || parent pid:  636 || state:    1
[ 2566.655179] name:                dbus || pid:  678 || parent pid:  636 || state:    1
[ 2566.655179] name:                dbus || pid:  679 || parent pid:  636 || state:    1
[ 2566.655180] name:                dbus || pid:  680 || parent pid:  636 || state:    1
[ 2566.655180] name:         avahi-daemon || pid:  654 || parent pid:  647 || state:    1
[ 2566.655181] name:            dhclient || pid:  951 || parent pid:  668 || state:    1
[ 2566.655182] name:             dnsmasq || pid:  960 || parent pid:  668 || state:    1
[ 2566.655182] name:                Xorg || pid:  775 || parent pid:  758 || state:    1
[ 2566.655183] name:            lightdm || pid:  841 || parent pid:  758 || state:    1
[ 2566.655183] name:           (sd-pam) || pid: 1134 || parent pid: 1133 || state:    1
[ 2566.655184] name:             upstart || pid: 1187 || parent pid:  841 || state:    1
[ 2566.655190] name:       upstart-udev-br || pid: 1267 || parent pid: 1187 || state:    1
[ 2566.655191] name:          dbus-daemon || pid: 1274 || parent pid: 1187 || state:    1
[ 2566.655192] name:       window-stack-br || pid: 1286 || parent pid: 1187 || state:    1
[ 2566.655192] name:               fcitx || pid: 1317 || parent pid: 1187 || state:    1
[ 2566.655193] name:          bamfdaemon || pid: 1327 || parent pid: 1187 || state:    1
[ 2566.655193] name:       upstart-dbus-br || pid: 1338 || parent pid: 1187 || state:    1
[ 2566.655194] name:          dbus-daemon || pid: 1341 || parent pid: 1187 || state:    1
[ 2566.655194] name:       upstart-dbus-br || pid: 1345 || parent pid: 1187 || state:    1
[ 2566.655195] name:                gvfsd || pid: 1349 || parent pid: 1187 || state:    1
[ 2566.655195] name:           gvfsd-fuse || pid: 1354 || parent pid: 1187 || state:    1
[ 2566.655196] name:       fcitx-dbus-watc || pid: 1356 || parent pid: 1187 || state:    1
[ 2566.655197] name:       upstart-file-br || pid: 1358 || parent pid: 1187 || state:    1
[ 2566.655197] name:       at-spi-bus-laun || pid: 1368 || parent pid: 1187 || state:    1
[ 2566.655198] name:       at-spi2-registr || pid: 1376 || parent pid: 1187 || state:    1
```

```
[ 2566.655198] name:    at-spi2-registr || pid:  1376 || parent pid:  1187 || state:    1
[ 2566.655199] name:        notify-osd || pid:  1384 || parent pid:  1187 || state:    1
[ 2566.655199] name:         gpg-agent || pid:  1399 || parent pid:  1187 || state:    1
[ 2566.655200] name:       hud-service || pid:  1414 || parent pid:  1187 || state:    1
[ 2566.655201] name:    unity-settings- || pid:  1416 || parent pid:  1187 || state:    1
[ 2566.655201] name:    gnome-session-b || pid:  1428 || parent pid:  1187 || state:    1
[ 2566.655203] name:    unity-panel-ser || pid:  1435 || parent pid:  1187 || state:    1
[ 2566.655203] name:       dconf-service || pid:  1473 || parent pid:  1187 || state:    1
[ 2566.655204] name:    indicator-messa || pid:  1482 || parent pid:  1187 || state:    1
[ 2566.655204] name:    indicator-bluet || pid:  1486 || parent pid:  1187 || state:    1
[ 2566.655205] name:    indicator-power || pid:  1489 || parent pid:  1187 || state:    1
[ 2566.655206] name:    indicator-datet || pid:  1491 || parent pid:  1187 || state:    1
[ 2566.655206] name:    indicator-keybo || pid:  1495 || parent pid:  1187 || state:    1
[ 2566.655207] name:    indicator-sound || pid:  1497 || parent pid:  1187 || state:    1
[ 2566.655207] name:    indicator-print || pid:  1501 || parent pid:  1187 || state:    1
[ 2566.655208] name:    indicator-sessi || pid:  1503 || parent pid:  1187 || state:    1
[ 2566.655208] name:    indicator-appli || pid:  1505 || parent pid:  1187 || state:    1
[ 2566.655209] name:            compiz || pid:  1508 || parent pid:  1187 || state:    0
[ 2566.655210] name:        pulseaudio || pid:  1547 || parent pid:  1187 || state:    1
[ 2566.655210] name:    evolution-sourc || pid:  1548 || parent pid:  1187 || state:    1
[ 2566.655211] name:    evolution-calen || pid:  1591 || parent pid:  1187 || state:    1
[ 2566.655211] name:    evolution-addre || pid:  1643 || parent pid:  1187 || state:    1
[ 2566.655212] name:    gvfs-udisks2-vo || pid:  1661 || parent pid:  1187 || state:    1
[ 2566.655213] name:    gvfs-gphoto2-vo || pid:  1682 || parent pid:  1187 || state:    1
[ 2566.655213] name:    gvfs-mtp-volume || pid:  1690 || parent pid:  1187 || state:    1
[ 2566.655214] name:    gvfs-goa-volume || pid:  1696 || parent pid:  1187 || state:    1
[ 2566.655214] name:    gvfs-afc-volume || pid:  1710 || parent pid:  1187 || state:    1
[ 2566.655215] name:        gvfsd-trash || pid:  1730 || parent pid:  1187 || state:    1
[ 2566.655216] name:            firefox || pid:  1770 || parent pid:  1187 || state:    1
[ 2566.655216] name:                sh || pid:  1891 || parent pid:  1187 || state:    1
[ 2566.655217] name:      zeitgeist-fts || pid:  1903 || parent pid:  1187 || state:    1
[ 2566.655217] name:    unity-scope-hom || pid:  1998 || parent pid:  1187 || state:    1
[ 2566.655218] name:    unity-files-dae || pid:  2011 || parent pid:  1187 || state:    1
[ 2566.655219] name:    unity-scope-loa || pid:  2010 || parent pid:  1187 || state:    1
[ 2566.655219] name:    unity-music-dae || pid:  2037 || parent pid:  1187 || state:    1
[ 2566.655220] name:      gvfsd-network || pid:  2825 || parent pid:  1187 || state:    1
[ 2566.655220] name:     gvfsd-metadata || pid:  2847 || parent pid:  1187 || state:    1
[ 2566.655221] name:        gvfsd-dnssd || pid:  2858 || parent pid:  1187 || state:    1
[ 2566.655222] name:        sd_generic || pid:  2993 || parent pid:  1187 || state:    1
[ 2566.655222] name:          sd_espeak || pid:  2996 || parent pid:  1187 || state:    1
[ 2566.655223] name:          sd_dummy || pid:  3001 || parent pid:  1187 || state:    1
[ 2566.655223] name:          sd_cicero || pid:  3004 || parent pid:  1187 || state:    1
[ 2566.655224] name:    speech-dispatch || pid:  3008 || parent pid:  1187 || state:    1
[ 2566.655225] name:    gnome-terminal- || pid:  3398 || parent pid:  1187 || state:    1
[ 2566.655225] name:        dbus-daemon || pid:  1373 || parent pid:  1368 || state:    1
[ 2566.655226] name:    unity-fallback- || pid:  1605 || parent pid:  1428 || state:    1
[ 2566.655227] name:     gnome-software || pid:  1606 || parent pid:  1428 || state:    1
[ 2566.655227] name:            nautilus || pid:  1608 || parent pid:  1428 || state:    1
[ 2566.655228] name:      polkit-gnome-au || pid:  1613 || parent pid:  1428 || state:    1
[ 2566.655229] name:          nm-applet || pid:  1620 || parent pid:  1428 || state:    1
[ 2566.655229] name:    zeitgeist-datah || pid:  1884 || parent pid:  1428 || state:    1
[ 2566.655230] name:    update-notifier || pid:  2103 || parent pid:  1428 || state:    1
[ 2566.655230] name:    deja-dup-monito || pid:  2186 || parent pid:  1428 || state:    1
[ 2566.655231] name:    evolution-calen || pid:  1618 || parent pid:  1591 || state:    1
```

```
[ 2566.655231] name:    evolution-calen || pid:  1640 || parent pid:  1591 || state:    1
[ 2566.655232] name:    evolution-addre || pid:  1670 || parent pid:  1643 || state:    1
[ 2566.655233] name:    zeitgeist-daemo || pid:  1895 || parent pid:  1891 || state:    1
[ 2566.655233] name:          sd_cicero || pid:  3005 || parent pid:  3004 || state:  128
[ 2566.655234] name:              bash || pid:  3403 || parent pid:  3398 || state:    1
[ 2566.655234] name:              sudo || pid:  4208 || parent pid:  3403 || state:    1
[ 2566.655235] name:              rmmod || pid:  4209 || parent pid:  4208 || state:    0
yoon@yoon-VirtualBox:~/Documents/ECE-OS/hw1/part1$
```

마찬가지로 parent의 pid와 프로세스의 pid를 확인한 결과 0번 ppid의 모든 자식이 출력
되었고 이어서 pid = 1의 모든 자식들, pid=2의 모든 자식들, 그리고 1번의 자식들 중 자식
이 있다면 다시 반복하는 것으로 마지막까지 출력되는 것을 볼 수 있다. 즉 BFS가 이루어졌
음을 확인할 수 있다.

- ps –el

```
yoon@yoon-VirtualBox:~/Documents/ECE-OS/hw1/part1$ ps -el
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
4 S     0     1     0  0  80   0 -  6054 -      ?        00:00:00 systemd
1 S     0     2     0  0  80   0 -     0 -      ?        00:00:00 kthreadd
1 I     0     4     2  0  60 -20 -     0 -      ?        00:00:00 kworker/0:0H
1 I     0     6     2  0  60 -20 -     0 -      ?        00:00:00 mm_percpu_wq
1 S     0     7     2  0  80   0 -     0 -      ?        00:00:00 ksoftirqd/0
1 I     0     8     2  0  80   0 -     0 -      ?        00:00:00 rcu_sched
1 I     0     9     2  0  80   0 -     0 -      ?        00:00:00 rcu_bh
1 S     0    10     2  0 -40   - -     0 -      ?        00:00:00 migration/0
5 S     0    11     2  0 -40   - -     0 -      ?        00:00:00 watchdog/0
1 S     0    12     2  0  80   0 -     0 -      ?        00:00:00 cpuhp/0
5 S     0    13     2  0  80   0 -     0 -      ?        00:00:00 kdevtmpfs
1 I     0    14     2  0  60 -20 -     0 -      ?        00:00:00 netns
1 S     0    15     2  0  80   0 -     0 -      ?        00:00:00 rcu_tasks_kthre
1 S     0    16     2  0  80   0 -     0 -      ?        00:00:00 kauditd
1 S     0    17     2  0  80   0 -     0 -      ?        00:00:00 khungtaskd
1 S     0    18     2  0  80   0 -     0 -      ?        00:00:00 oom_reaper
1 I     0    19     2  0  60 -20 -     0 -      ?        00:00:00 writeback
1 S     0    20     2  0  80   0 -     0 -      ?        00:00:00 kcompactd0
1 S     0    21     2  0  85   5 -     0 -      ?        00:00:00 ksmd
1 S     0    22     2  0  99  19 -     0 -      ?        00:00:00 khugepaged
1 I     0    23     2  0  60 -20 -     0 -      ?        00:00:00 crypto
1 I     0    24     2  0  60 -20 -     0 -      ?        00:00:00 kintegrityd
1 I     0    25     2  0  60 -20 -     0 -      ?        00:00:00 kblockd
1 I     0    26     2  0  60 -20 -     0 -      ?        00:00:00 ata_sff
1 I     0    27     2  0  60 -20 -     0 -      ?        00:00:00 md
1 I     0    28     2  0  60 -20 -     0 -      ?        00:00:00 edac-poller
1 I     0    29     2  0  60 -20 -     0 -      ?        00:00:00 devfreq_wq
1 I     0    30     2  0  60 -20 -     0 -      ?        00:00:00 watchdogd
1 I     0    32     2  0  80   0 -     0 -      ?        00:00:00 kworker/0:1
1 S     0    34     2  0  80   0 -     0 -      ?        00:00:00 kswapd0
1 S     0    35     2  0  80   0 -     0 -      ?        00:00:00 ecryptfs-kthrea
1 I     0    77     2  0  60 -20 -     0 -      ?        00:00:00 kthrotld
1 I     0    78     2  0  60 -20 -     0 -      ?        00:00:00 acpi_thermal_pm
1 S     0    79     2  0  80   0 -     0 -      ?        00:00:00 scsi_eh_0
1 I     0    81     2  0  60 -20 -     0 -      ?        00:00:00 scsi_tmf_0
1 S     0    82     2  0  80   0 -     0 -      ?        00:00:00 scsi_eh_1
1 I     0    83     2  0  60 -20 -     0 -      ?        00:00:00 scsi_tmf_1
1 I     0    84     2  0  80   0 -     0 -      ?        00:00:00 kworker/u2:3
1 I     0    85     2  0  60 -20 -     0 -      ?        00:00:00 ipv6_addrconf
1 I     0    95     2  0  60 -20 -     0 -      ?        00:00:00 kstrp
1 I     0   112     2  0  60 -20 -     0 -      ?        00:00:00 charger_manager
1 I     0   154     2  0  60 -20 -     0 -      ?        00:00:00 kworker/0:1H
1 S     0   155     2  0  80   0 -     0 -      ?        00:00:00 scsi_eh_2
1 I     0   156     2  0  60 -20 -     0 -      ?        00:00:00 scsi_tmf_2
1 S     0   179     2  0  80   0 -     0 -      ?        00:00:00 jbd2/sda1-8
1 I     0   180     2  0  60 -20 -     0 -      ?        00:00:00 ext4-rsv-conver
4 S     0   216     1  0  80   0 -  1791 -      ?        00:00:00 systemd-journal
4 S     0   251     1  0  80   0 -  3666 -      ?        00:00:00 systemd-udevd
4 S   100   282     1  0  80   0 -  3154 -      ?        00:00:00 systemd-timesyn
1 I     0   388     2  0  60 -20 -     0 -      ?        00:00:00 iprt-VBoxWQueue
1 I     0   524     2  0  60 -20 -     0 -      ?        00:00:00 ttm_swap
4 S   104   624     1  0  80   0 -  7683 -      ?        00:00:00 rsyslogd
```

```
4 S    104   624      1  0  80   0 -    7683 -      ?       00:00:00 rsyslogd
4 S      0   632      1  0  80   0 -   10340 -      ?       00:00:00 accounts-daemon
4 S      0   633      1  0  80   0 -    1717 -      ?       00:00:00 cron
4 S      0   636      1  0  80   0 -    3870 -      ?       00:00:00 cupsd
4 S    111   647      1  0  80   0 -    1481 -      ?       00:00:00 avahi-daemon
4 S    106   648      1  0  80   0 -    1723 -      ?       00:00:00 dbus-daemon
1 S    111   654    647  0  80   0 -    1481 -      ?       00:00:00 avahi-daemon
4 S      0   657      1  0  80   0 -    9392 -      ?       00:00:00 cups-browsed
4 S      0   660      1  0  80   0 -    1035 -      ?       00:00:00 systemd-logind
0 S      0   661      1  0  80   0 -     562 -      ?       00:00:00 acpid
4 S      0   668      1  0  80   0 -   20999 -      ?       00:00:00 NetworkManager
4 S      0   669      1  0  80   0 -  211673 -      ?       00:00:00 snapd
4 S      7   674    636  0  80   0 -    2810 -      ?       00:00:00 dbus
4 S      7   675    636  0  80   0 -    2810 -      ?       00:00:00 dbus
4 S      7   676    636  0  80   0 -    2810 -      ?       00:00:00 dbus
4 S      7   677    636  0  80   0 -    2810 -      ?       00:00:00 dbus
4 S      7   678    636  0  80   0 -    2810 -      ?       00:00:00 dbus
4 S      7   679    636  0  80   0 -    2810 -      ?       00:00:00 dbus
4 S      7   680    636  0  80   0 -    2810 -      ?       00:00:00 dbus
4 S      0   747      1  0  80   0 -   10677 -      ?       00:00:00 polkitd
4 S      0   758      1  0  80   0 -    9401 -      ?       00:00:00 lightdm
4 S      0   775    758  4  80   0 -   74937 -      tty7    00:02:10 Xorg
4 S      0   841    758  0  80   0 -    6986 -      ?       00:00:00 lightdm
4 S    118   905      1  0  81   1 -    5948 -      ?       00:00:00 rtkit-daemon
4 S      0   927      1  0  80   0 -   20273 -      ?       00:00:00 upowerd
4 S    113   942      1  0  80   0 -   11241 -      ?       00:00:00 colord
4 S      0   951    668  0  80   0 -    1504 -      ?       00:00:00 dhclient
4 S  65534   960    668  0  80   0 -    2602 -      ?       00:00:00 dnsmasq
4 S    109  1108      1  0  80   0 -   14669 -      ?       00:00:00 whoopsie
4 S      0  1113      1  0  80   0 -    1188 -      tty1    00:00:00 agetty
4 S   1000  1133      1  0  80   0 -    1598 ep_pol ?       00:00:00 systemd
5 S   1000  1134   1133  0  80   0 -    1954 -      ?       00:00:00 (sd-pam)
1 S   1000  1176      1  0  80   0 -    9984 -      ?       00:00:00 gnome-keyring-d
4 S   1000  1187    841  0  80   0 -    2130 poll_s ?       00:00:00 upstart
1 S   1000  1267   1187  0  80   0 -    1855 poll_s ?       00:00:00 upstart-udev-br
1 S   1000  1274   1187  0  80   0 -    1703 ep_pol ?       00:00:01 dbus-daemon
0 S   1000  1286   1187  0  80   0 -   11454 poll_s ?       00:00:00 window-stack-br
1 S   1000  1317   1187  0  80   0 -   20110 poll_s ?       00:00:00 fcitx
0 S   1000  1327   1187  0  80   0 -   18411 poll_s ?       00:00:01 bamfdaemon
1 S   1000  1338   1187  0  80   0 -    1836 poll_s ?       00:00:00 upstart-dbus-br
1 S   1000  1341   1187  0  80   0 -    1520 ep_pol ?       00:00:00 dbus-daemon
1 S   1000  1345   1187  0  80   0 -    1836 poll_s ?       00:00:00 upstart-dbus-br
0 S   1000  1349   1187  0  80   0 -    9566 poll_s ?       00:00:00 gvfsd
0 S   1000  1354   1187  0  80   0 -   13205 futex_ ?       00:00:00 gvfsd-fuse
1 S   1000  1356   1187  0  99  19 -    1272 poll_s ?       00:00:00 fcitx-dbus-watc
1 S   1000  1358   1187  0  80   0 -    1916 poll_s ?       00:00:00 upstart-file-br
0 S   1000  1368   1187  0  80   0 -   11549 poll_s ?       00:00:00 at-spi-bus-laun
0 S   1000  1373   1368  0  80   0 -    1517 ep_pol ?       00:00:00 dbus-daemon
0 S   1000  1376   1187  0  80   0 -    7294 poll_s ?       00:00:00 at-spi2-registr
0 S   1000  1384   1187  0  80   0 -   15730 poll_s ?       00:00:00 notify-osd
1 S   1000  1399   1187  0  80   0 -    6027 -      ?       00:00:00 gpg-agent
0 S   1000  1414   1187  0  80   0 -   36882 poll_s ?       00:00:00 hud-service
0 S   1000  1416   1187  0  80   0 -   64321 poll_s ?       00:00:00 unity-settings-
0 S   1000  1428   1187  0  80   0 -   19055 poll_s ?       00:00:00 gnome-session-b
```

```
0 S  1000  1428  1187   0  80   0 -  19055 poll_s ?          00:00:00 gnome-session-b
0 S  1000  1435  1187   0  80   0 -  33180 poll_s ?          00:00:01 unity-panel-ser
0 S  1000  1473  1187   0  80   0 -   6352 poll_s ?          00:00:00 dconf-service
0 S  1000  1482  1187   0  80   0 -  12286 poll_s ?          00:00:00 indicator-messa
0 S  1000  1486  1187   0  80   0 -  11697 poll_s ?          00:00:00 indicator-bluet
0 S  1000  1489  1187   0  80   0 -  12235 poll_s ?          00:00:00 indicator-power
0 S  1000  1491  1187   0  80   0 -  33296 poll_s ?          00:00:00 indicator-datet
0 S  1000  1495  1187   0  80   0 -  29977 poll_s ?          00:00:00 indicator-keybo
0 S  1000  1497  1187   0  80   0 -  79039 poll_s ?          00:00:00 indicator-sound
0 S  1000  1501  1187   0  80   0 -  21049 poll_s ?          00:00:00 indicator-print
0 S  1000  1503  1187   0  80   0 -  17912 poll_s ?          00:00:00 indicator-sessi
0 S  1000  1505  1187   0  80   0 -  14500 poll_s ?          00:00:00 indicator-appli
0 S  1000  1508  1187  11  80   0 - 140632 poll_s ?          00:05:22 compiz
1 S  1000  1547  1187   0  69 -11 -  41805 poll_s ?          00:00:04 pulseaudio
0 S  1000  1548  1187   0  80   0 -  30944 poll_s ?          00:00:00 evolution-sourc
0 S  1000  1591  1187   0  80   0 -  41103 poll_s ?          00:00:00 evolution-calen
0 S  1000  1605  1428   0  80   0 -  19636 poll_s ?          00:00:00 unity-fallback-
0 S  1000  1606  1428   0  80   0 -  37374 poll_s ?          00:00:00 gnome-software
0 S  1000  1608  1428   0  80   0 -  52025 poll_s ?          00:00:02 nautilus
0 S  1000  1613  1428   0  80   0 -  15563 poll_s ?          00:00:00 polkit-gnome-au
0 S  1000  1618  1591   0  80   0 -  37392 poll_s ?          00:00:00 evolution-calen
0 S  1000  1620  1428   0  80   0 -  29557 poll_s ?          00:00:00 nm-applet
0 S  1000  1640  1591   0  80   0 -  37087 poll_s ?          00:00:00 evolution-calen
0 S  1000  1643  1187   0  80   0 -  29616 poll_s ?          00:00:00 evolution-addre
0 S  1000  1661  1187   0  80   0 -  10222 poll_s ?          00:00:00 gvfs-udisks2-vo
4 S     0  1665     1   0  80   0 -  13996 -      ?          00:00:00 udisksd
0 S  1000  1670  1643   0  80   0 -  33344 poll_s ?          00:00:00 evolution-addre
0 S  1000  1682  1187   0  80   0 -   9277 poll_s ?          00:00:00 gvfs-gphoto2-vo
0 S  1000  1690  1187   0  80   0 -   8970 poll_s ?          00:00:00 gvfs-mtp-volume
0 S  1000  1696  1187   0  80   0 -   8966 poll_s ?          00:00:00 gvfs-goa-volume
0 S  1000  1710  1187   0  80   0 -  19710 poll_s ?          00:00:00 gvfs-afc-volume
0 S  1000  1730  1187   0  80   0 -  12210 poll_s ?          00:00:00 gvfsd-trash
4 S  1000  1770  1187   1  80   0 - 216455 poll_s ?          00:00:41 firefox
4 S  1000  1804  1770   0  80   0 -  51367 poll_s ?          00:00:00 Socket Process
4 S  1000  1840  1770   0  80   0 - 127714 poll_s ?          00:00:05 Privileged Cont
0 S  1000  1884  1428   0  80   0 -  19813 poll_s ?          00:00:00 zeitgeist-datah
0 S  1000  1891  1187   0  80   0 -    593 wait   ?          00:00:00 sh
0 S  1000  1895  1891   0  80   0 -  13625 poll_s ?          00:00:00 zeitgeist-daemo
0 S  1000  1903  1187   0  80   0 -  17748 poll_s ?          00:00:00 zeitgeist-fts
4 S  1000  1916  1770   0  80   0 - 154795 poll_s ?          00:00:07 Web Content
4 S  1000  1941  1770   0  80   0 - 115299 poll_s ?          00:00:00 WebExtensions
0 S  1000  1998  1187   0  80   0 -  27245 poll_s ?          00:00:00 unity-scope-hom
0 S  1000  2010  1187   0  80   0 -  28286 poll_s ?          00:00:00 unity-scope-loa
0 S  1000  2011  1187   0  80   0 -  26339 poll_s ?          00:00:00 unity-files-dae
0 S  1000  2037  1187   0  80   0 -  18081 poll_s ?          00:00:00 unity-music-dae
0 S  1000  2103  1428   0  80   0 -  20256 poll_s ?          00:00:00 update-notifier
0 S  1000  2186  1428   0  80   0 -  18332 poll_s ?          00:00:00 deja-dup-monito
0 S  1000  2825  1187   0  80   0 -  12323 poll_s ?          00:00:00 gvfsd-network
0 S  1000  2847  1187   0  80   0 -   6963 poll_s ?          00:00:00 gvfsd-metadata
0 S  1000  2858  1187   0  80   0 -  14015 poll_s ?          00:00:00 gvfsd-dnssd
1 I     0  2875     2   0  80   0 -      0 -      ?          00:00:00 kworker/0:0
4 S  1000  2961  1770   0  80   0 - 275738 poll_s ?          00:00:16 Web Content
0 S  1000  2993  1187   0  80   0 -  39586 pipe_w ?          00:00:00 sd_generic
0 S  1000  2996  1187   0  80   0 -  45329 pipe_w ?          00:00:00 sd_espeak
```

```
0 S  1000  2993  1187  0  80   0 -  39586 pipe_w ?              00:00:00 sd_generic
0 S  1000  2996  1187  0  80   0 -  45329 pipe_w ?              00:00:00 sd_espeak
0 S  1000  3001  1187  0  80   0 -  39582 pipe_w ?              00:00:00 sd_dummy
0 S  1000  3004  1187  0  80   0 -  39581 pipe_w ?              00:00:00 sd_cicero
1 Z  1000  3005  3004  0  80   0 -      0 -      ?              00:00:00 sd_cicero <defunct>
1 S  1000  3008  1187  0  80   0 -   3876 poll_s ?              00:00:00 speech-dispatch
4 S  1000  3072  1770  0  80   0 - 142769 poll_s ?              00:00:03 Web Content
4 S  1000  3104  1770  0  80   0 -  51335 poll_s ?              00:00:00 RDD Process
1 I     0  3174     2  0  80   0 -      0 -      ?              00:00:00 kworker/u2:1
4 S  1000  3249  1770  0  80   0 - 195340 poll_s ?              00:00:03 Web Content
4 S  1000  3323  1770  0  80   0 - 157499 poll_s ?              00:00:01 Web Content
1 I     0  3381     2  0  80   0 -      0 -      ?              00:00:00 kworker/u2:0
0 S  1000  3398  1187  0  80   0 -  27734 poll_s ?              00:00:01 gnome-terminal-
0 S  1000  3403  3398  0  80   0 -   1716 wait   pts/1          00:00:00 bash
1 I     0  4278     2  0  80   0 -      0 -      ?              00:00:00 kworker/0:2
4 S  1000  4312  1770  0  80   0 - 109927 poll_s ?              00:00:00 Web Content
4 S     0  4411     1  0  80   0 -    865 -      ?              00:00:00 systemd-hostnam
4 R  1000  4417  3403  0  80   0 -   1872 -      pts/1          00:00:00 ps
yoon@yoon-VirtualBox:~/Documents/ECE-OS/hw1/part1$
```

상기했던 두 탐색의 결과는 ps –el의 결과와 비교할 수 있고 그 결과 잘 수행되었음을 알 수 있다.

○ part 2

- argument handling

```
yoon@yoon-VirtualBox:~/Documents/ECE-OS/hw1/part2$ ./osh
osh>ps
  Child now runs in Fore-Ground
  PID TTY          TIME CMD
 4494 pts/1    00:00:00 bash
 4506 pts/1    00:00:00 osh
 4509 pts/1    00:00:00 ps
  Fore-Ground ended

osh>ps -ael
  Child now runs in Fore-Ground
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY            TIME CMD
4 S     0     1     0  0  80   0 -   6054 -      ?          00:00:00 systemd
1 S     0     2     0  0  80   0 -      0 -      ?          00:00:00 kthreadd
1 I     0     4     2  0  60 -20 -      0 -      ?          00:00:00 kworker/0:0H
1 I     0     6     2  0  60 -20 -      0 -      ?          00:00:00 mm_percpu_wq
1 S     0     7     2  0  80   0 -      0 -      ?          00:00:00 ksoftirqd/0
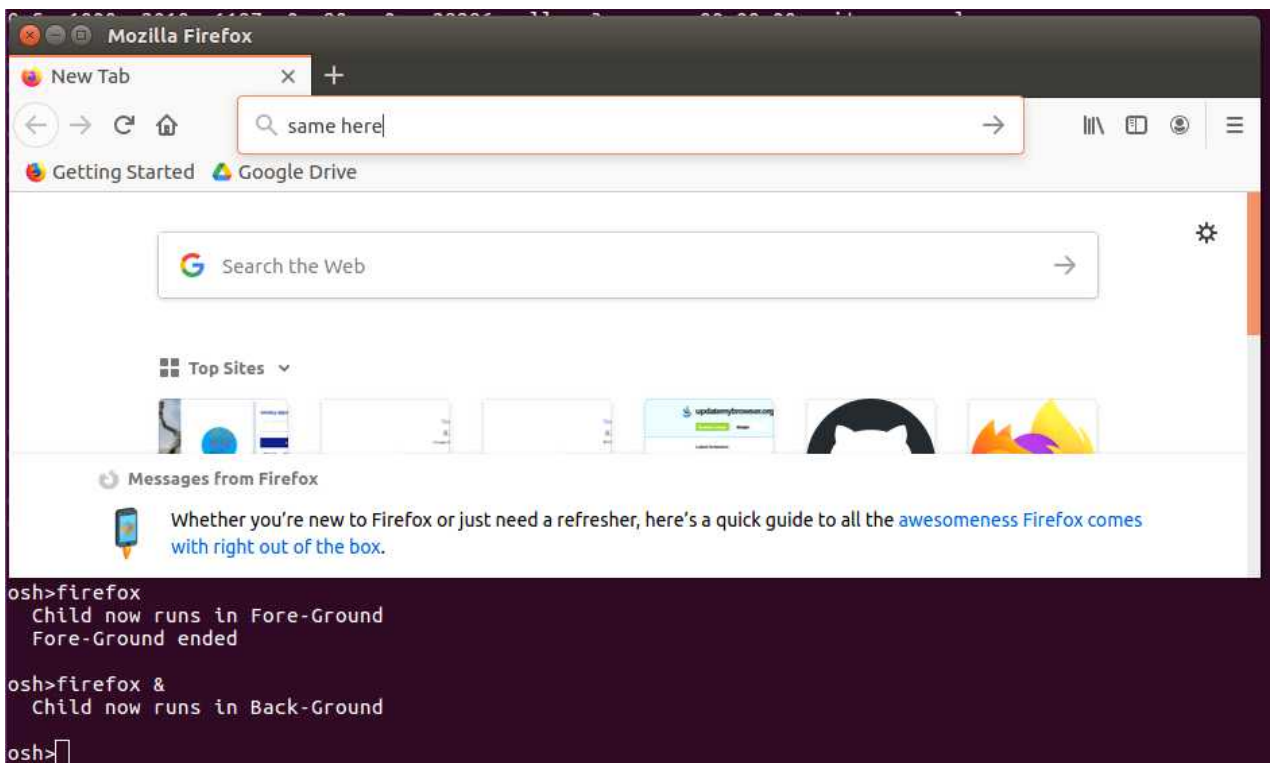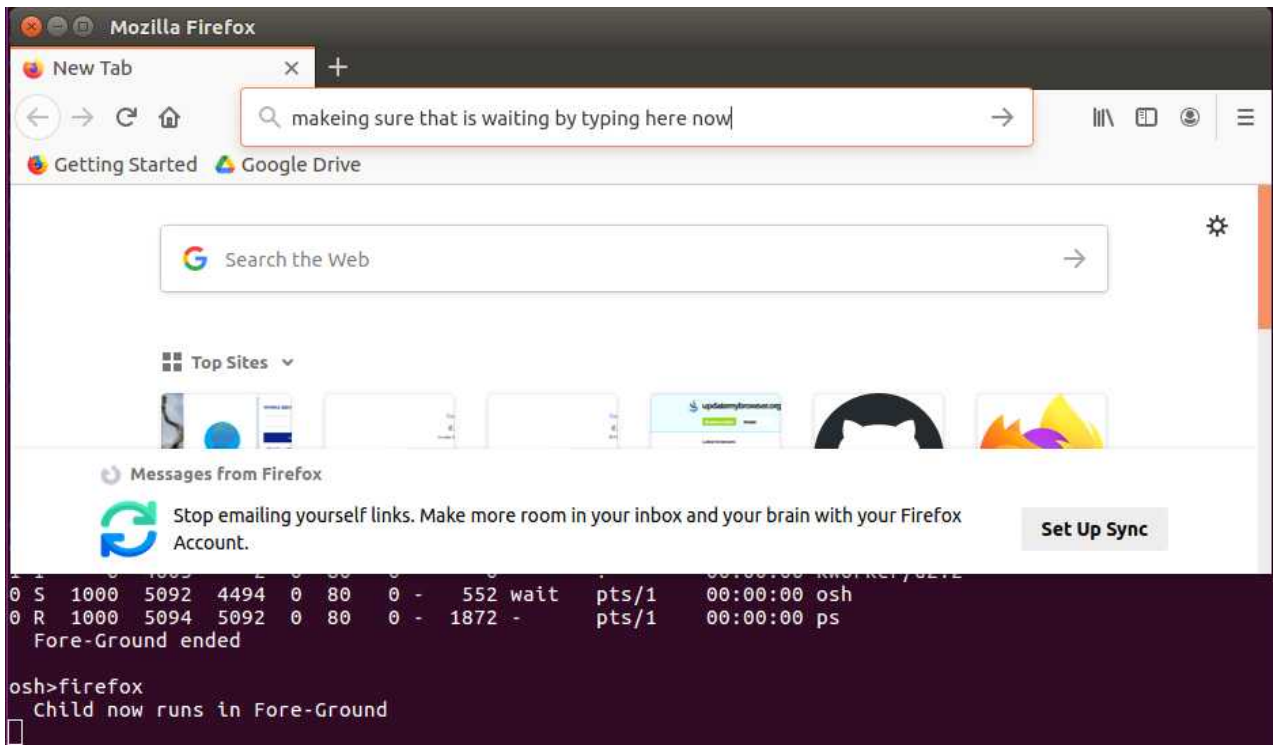```

```
1 I     0  3174     2  0  80   0 -      0 -      ?          00:00:00 kworker/u2:1
4 S  1000  3249  1770  0  80   0 - 195340 poll_s ?          00:00:03 Web Content
4 S  1000  3323  1770  0  80   0 - 157499 poll_s ?          00:00:01 Web Content
1 I     0  3381     2  0  80   0 -      0 -      ?          00:00:00 kworker/u2:0
1 I     0  4278     2  0  80   0 -      0 -      ?          00:00:00 kworker/0:2
4 S  1000  4312  1770  0  80   0 - 109927 poll_s ?          00:00:00 Web Content
1 I     0  4476     2  0  80   0 -      0 -      ?          00:00:00 kworker/0:1
0 S  1000  4489  1187  0  80   0 -  27304 poll_s ?          00:00:00 gnome-terminal-
0 S  1000  4494  4489  0  80   0 -   1717 wait   pts/1      00:00:00 bash
0 S  1000  4506  4494  0  80   0 -    552 wait   pts/1      00:00:00 osh
4 R  1000  4510  4506  0  80   0 -   1872 -      pts/1      00:00:00 ps
  Fore-Ground ended

osh>
```

ps의 결과와 ps -ael의 결과 화면을 비교하여 argument handling이 잘 되고 있음을 알 수 있다.

- Background


```
0 S  1000  5092  4494  0  80   0  -   552 wait    pts/1   00:00:00 osh
0 R  1000  5094  5092  0  80   0  -  1872 -       pts/1   00:00:00 ps
  Fore-Ground ended

osh>firefox
  Child now runs in Fore-Ground
```



```
osh>firefox
  Child now runs in Fore-Ground
  Fore-Ground ended

osh>firefox &
  Child now runs in Back-Ground

osh>
```

firefox의 결과 부모 프로세스가 대기하고 있고(Fore-Ground) firefox & 입력 시 바로 돌아와서 osh>를 출력, 즉 자식 프로세스를 기다리지 않고 다음 입력을 기다리는 상태(Back-Ground)로 돌아가는 것을 확인할 수 있다.

- history

```
osh>firefox
  Child now runs in Fore-Ground
  Fore-Ground ended

osh>firefox &
  Child now runs in Back-Ground

osh>who
  Child now runs in Fore-Ground
yoon      tty7            2021-10-13 02:04 (:0)
  Fore-Ground ended

osh>history
5 - ps
4 - ps -ael
3 - firefox
2 - firefox &
1 - who
osh>
```

실행 내역이 잘 저장되고 있음을 확인할 수 있다.

```
osh>history
5 - ps
4 - ps -ael
3 - firefox
2 - firefox &
1 - who
osh>whoami
  Child now runs in Fore-Ground
yoon
  Fore-Ground ended

osh>date
  Child now runs in Fore-Ground
Wed Oct 13 03:06:10 KST 2021
  Fore-Ground ended

osh>history
5 - firefox
4 - firefox &
3 - who
2 - whoami
1 - date
osh>
```

실행 내역이 잘 갱신되고 있음을 확인할 수 있다.

```
osh>history
5 - firefox
4 - firefox &
3 - who
2 - whoami
1 - date
osh>!!
Execute from most recent history
Executing : date
  Child now runs in Fore-Ground
Wed Oct 13 03:06:33 KST 2021
  Fore-Ground ended

osh>
```

```
osh>!!
Execute from most recent history
Executing : date
  Child now runs in Fore-Ground
Wed Oct 13 03:08:28 KST 2021
  Fore-Ground ended

osh>history
5 - firefox &
4 - who
3 - whoami
2 - date
1 - date
osh>
```

!! 명령어가 가장 최근 명령을 수행하였음을 확인할 수 있다.

```
osh>history
5 - date
4 - firefox &
3 - whoami
2 - date
1 - whoami
osh>!1
Execute from history - 1
Executing : whoami
  Child now runs in Fore-Ground
yoon
  Fore-Ground ended

osh>
```

```
osh>history
5 - date
4 - date
3 - firefox &
2 - whoami
1 - date
osh>!2
Execute from history - 2
Executing : whoami
  Child now runs in Fore-Ground
yoon
  Fore-Ground ended

osh>
```
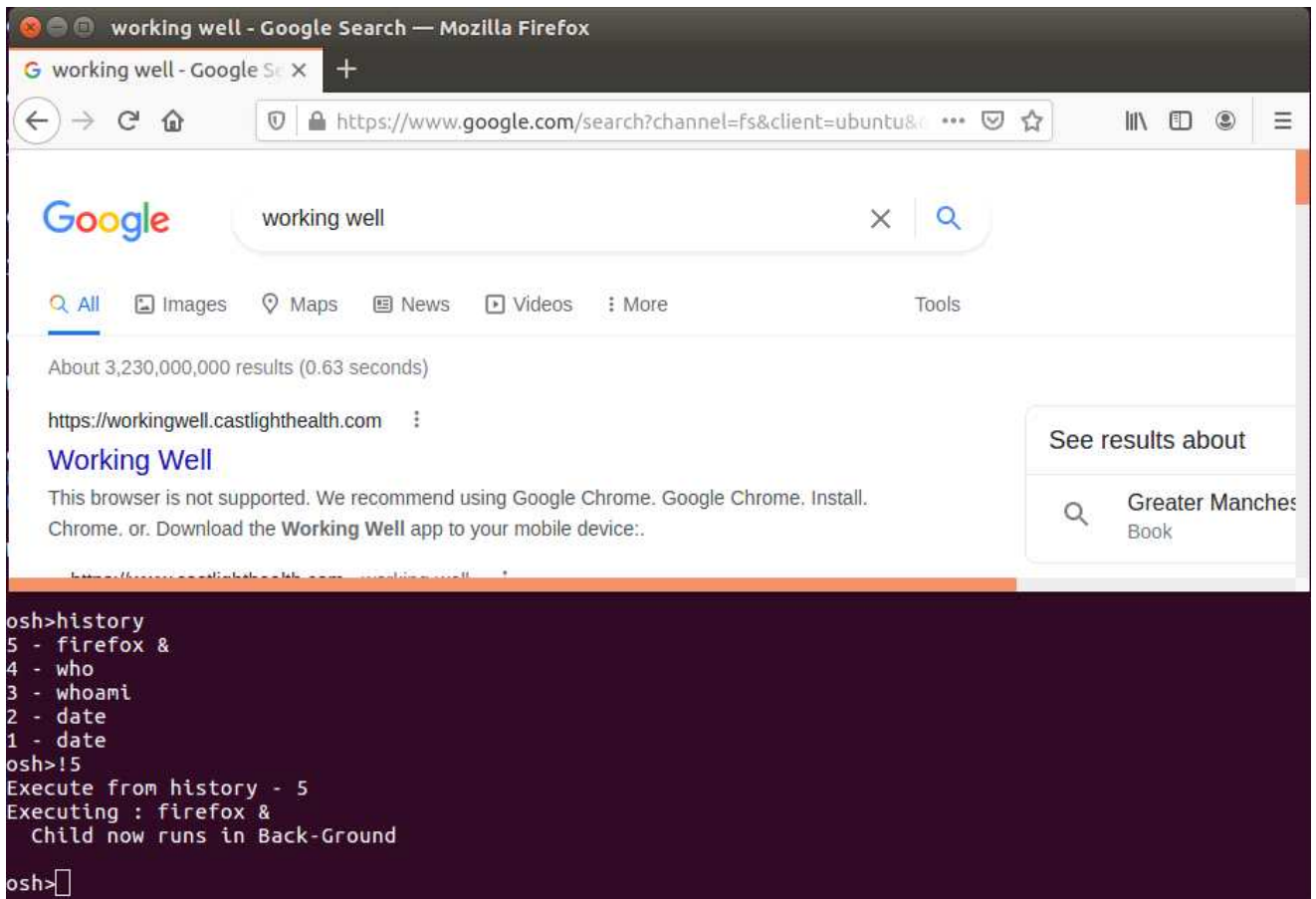
```
osh>history
5 - whoami
4 - date
3 - date
2 - firefox &
1 - whoami
osh>!3
Execute from history - 3
Executing : date
  Child now runs in Fore-Ground
Wed Oct 13 03:09:58 KST 2021
  Fore-Ground ended

osh>
```

```
osh>history
5 - who
4 - whoami
3 - date
2 - date
1 - firefox &
osh>!4
Execute from history - 4
Executing : whoami
  Child now runs in Fore-Ground
yoon
  Fore-Ground ended

osh>
```

!1부터 !5까지의 명령어가 잘 수행되고 있음을 확인할 수 있다.

공백문자 혹은 바로 엔터를 누를 시 알림 메시지를 출력한다.

```
osh>!1
Execute from history - 1
Executing : whoami
  Child now runs in Fore-Ground
yoon
  Fore-Ground ended

osh>exit
Exiting now... goodbye
yoon@yoon-VirtualBox:~/Documents/ECE-OS/hw1/part2$
```

exit로 정상 종료되고 있음을 확인할 수 있다.

이로서 주어진 모든 수행과제가 달성되었음을 확인하였다.