Advanced Unix Programming
Assignment-4

Group Members:
Vijesh Ghandare 111403013
Nikhil Gawande 111408013
Anupam Godse 111408016

Q1.Print all existing environment variables with their values. Later input a new variable and its value and add to the environment list. Once again print the list.

CODE:

a4q1.c (~/Desktop/AUP/Lab4) - gedit

Open

```c
#include<stdlib.h>
#include<stdio.h>
#include<string.h>
void Print_env(char **envp){
    int i;
    for (i = 0; envp[i] != NULL; i++)
        printf("\n%s", envp[i]);
}
int main(int argc, char *argv[], char * envp[]){
    char * name = (char*)malloc(sizeof(char)*128);
    char * value = (char*)malloc(sizeof(char)*128);
    char *nameValue = (char*)malloc(sizeof(char)*256);
    printf("Env list before adding of new var:\n");
    Print_env(envp);
    printf("\n\nEnter the name and value of the environment var:\n");
    scanf("%s%s",name,value);
    strcpy(nameValue,name);
    strcat(nameValue,"=");
    strcat(nameValue,value);
    putenv(nameValue);
    printf("\n\nEnv list after adding of new var:\n");
    Print_env(envp);
    printf("\n%s=%s\n",name,getenv(name));
    return 0;
}
```

Outputs:

```
vijesh1996@vijesh1996-HP-Pavilion-15-Notebook-PC:~/Desktop/AUP/Lab4$ cc a4q1.c
vijesh1996@vijesh1996-HP-Pavilion-15-Notebook-PC:~/Desktop/AUP/Lab4$ ./a.out
Env list before adding of new var:

XDG_VTNR=7
XDG_SESSION_ID=c2
XDG_GREETER_DATA_DIR=/var/lib/lightdm-data/vijesh1996
CLUTTER_IM_MODULE=xim
SESSION=ubuntu
GPG_AGENT_INFO=/home/vijesh1996/.gnupg/S.gpg-agent:0:1
TERM=xterm-256color
VTE_VERSION=4205
XDG_MENU_PREFIX=gnome-
SHELL=/bin/bash
QT_LINUX_ACCESSIBILITY_ALWAYS_ON=1
WINDOWID=62917219
UPSTART_SESSION=unix:abstract=/com/ubuntu/upstart-session/1000/1325
GNOME_KEYRING_CONTROL=
GTK_MODULES=gail:atk-bridge:unity-gtk-module
NO_PROXY=localhost,127.0.0.0/8,::1
NVM_DIR=/home/vijesh1996/.nvm
http_proxy=http://10.1.101.150:3128/
USER=vijesh1996
LS_COLORS=rs=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33;01:cd=40;33;01:or=40;31;01:mi=00:su=37;41:sg=30;43:ca=30;41:tw=30;42:ow=34;42:st=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.taz=01;31:*.lha=01;31:*.lz4=01;31:*.lzh=01;31:*.lzma=01;31:*.tlz=01;31:*.txz=01;31:*.tzo=01;31:*.t7z=01;31:*.zip=01;31:*.z=01;31:*.Z=01;31:*.dz=01;31:*.gz=01;31:*.lrz=01;31:*.lz=01;31:*.lzo=01;31:*.xz=01;31:*.bz2=01;31:*.bz=01;31:*.tbz=01;31:*.tbz2=01;31:*.tz=01;31:*.deb=01;31:*.rpm=01;31:*.jar=01;31:*.war=01;31:*.ear=01;31:*.sar=01;31:*.rar=01;31:*.alz=01;31:*.ace=01;31:*.zoo=01;31:*.cpio=01;31:*.7z=01;31:*.rz=01;31:*.cab=01;31:*.jpg=01;35:*.jpeg=01;35:*.gif=01;35:*.bmp=01;35:*.pbm=01;35:*.pgm=01;35:*.ppm=01;35:*.tga=01;35:*.xbm=01;35:*.xpm=01;35:*.tif=01;35:*.tiff=01;35:*.png=01;35:*.svg=01;35:*.svgz=01;35:*.mng=01;35:*.pcx=01;35:*.mov=01;35:*.mpg=01;35:*.mpeg=01;35:*.m2v=01;35:*.mkv=01;35:*.webm=01;35:*.ogm=01;35:*.mp4=01;35:*.m4v=01;35:*.mp4v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.asf=01;35:*.rm=01;35:*.rmvb=01;35:*.flc=01;35:*.avi=01;35:*.fli=01;35:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.cgm=01;35:*.emf=01;35:*.ogv=01;35:*.ogx=01;35:*.aac=00;36:*.au=00;36:*.flac=00;36:*.m4a=00;36:*.mid=00;36:*.midi=00;36:*.mka=00;36:*.mp3=00;36:*.mpc=00;36:*.ogg=00;36:*.ra=00;36:*.wav=00;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:
QT_ACCESSIBILITY=1
XDG_SESSION_PATH=/org/freedesktop/DisplayManager/Session0
XDG_SEAT_PATH=/org/freedesktop/DisplayManager/Seat0
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
ftp_proxy=ftp://10.1.101.150:3128/
DEFAULTS_PATH=/usr/share/gconf/ubuntu.default.path
SESSION_MANAGER=local/vijesh1996-HP-Pavilion-15-Notebook-PC:@/tmp/.ICE-unix/1553,unix/vijesh1996-HP-Pavilion-15-Notebook-PC:/tmp/.ICE-unix/1553
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/usr/share/upstart/xdg:/etc/xdg
all_proxy=socks://10.1.101.150:3128/
ALL_PROXY=socks://10.1.101.150:3128/
DESKTOP_SESSION=ubuntu
PATH=/home/vijesh1996/bin:/home/vijesh1996/.local/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin
QT_IM_MODULE=ibus
QT_QPA_PLATFORMTHEME=appmenu-qt5
PWD=/home/vijesh1996/Desktop/AUP/Lab4
JOB=dbus
XDG_SESSION_TYPE=x11
socks_proxy=socks://10.1.101.150:3128/
XMODIFIERS=@im=ibus
GNOME_KEYRING_PID=
LANG=en_IN
GDM_LANG=en_US
MANDATORY_PATH=/usr/share/gconf/ubuntu.mandatory.path
COMPIZ_CONFIG_PROFILE=ubuntu
IM_CONFIG_PHASE=1
https_proxy=https://10.1.101.150:3128/
GDMSESSION=ubuntu
SESSIONTYPE=gnome-session
GTK2_MODULES=overlay-scrollbar
SHLVL=1
HOME=/home/vijesh1996
XDG_SEAT=seat0
LANGUAGE=en_IN:en
no_proxy=localhost,127.0.0.0/8,::1
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
XDG_SESSION_DESKTOP=ubuntu
LOGNAME=vijesh1996
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
QT4_IM_MODULE=xim
DBUS_SESSION_BUS_ADDRESS=unix:abstract=/tmp/dbus-U3DuIZBb1q
LESSOPEN=| /usr/bin/lesspipe %s
INSTANCE=
XDG_RUNTIME_DIR=/run/user/1000
DISPLAY=:0
XDG_CURRENT_DESKTOP=Unity
GTK_IM_MODULE=ibus
LESSCLOSE=/usr/bin/lesspipe %s %s
XAUTHORITY=/home/vijesh1996/.Xauthority
_=./a.out

Enter the name and value of the environment var:
```

Adding new name value pair of environment variable:

```
Enter the name and value of the environment var:
VIJ temporary
```

Environment list after adding new variable:

```
ALL_PROXY=socks://10.1.101.150:3128/
DESKTOP_SESSION=ubuntu
PATH=/home/vijesh1996/bin:/home/vijesh1996/.local/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/b
in
QT_IM_MODULE=ibus
QT_QPA_PLATFORMTHEME=appmenu-qt5
PWD=/home/vijesh1996/Desktop/AUP/Lab4
JOB=dbus
XDG_SESSION_TYPE=x11
socks_proxy=socks://10.1.101.150:3128/
XMODIFIERS=@im=ibus
GNOME_KEYRING_PID=
LANG=en_IN
GDM_LANG=en_US
MANDATORY_PATH=/usr/share/gconf/ubuntu.mandatory.path
COMPIZ_CONFIG_PROFILE=ubuntu
IM_CONFIG_PHASE=1
https_proxy=https://10.1.101.150:3128/
GDMSESSION=ubuntu
SESSIONTYPE=gnome-session
GTK2_MODULES=overlay-scrollbar
SHLVL=1
HOME=/home/vijesh1996
XDG_SEAT=seat0
LANGUAGE=en_IN:en
no_proxy=localhost,127.0.0.0/8,::1
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
XDG_SESSION_DESKTOP=ubuntu
LOGNAME=vijesh1996
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
QT4_IM_MODULE=xim
DBUS_SESSION_BUS_ADDRESS=unix:abstract=/tmp/dbus-U3DuIZBb1q
LESSOPEN=| /usr/bin/lesspipe %s
INSTANCE=
XDG_RUNTIME_DIR=/run/user/1000
DISPLAY=:0
XDG_CURRENT_DESKTOP=Unity
GTK_IM_MODULE=ibus
LESSCLOSE=/usr/bin/lesspipe %s %s
XAUTHORITY=/home/vijesh1996/.Xauthority
_=./a.out
VIJ=temporary
vijesh1996@vijesh1996-HP-Pavilion-15-Notebook-PC:~/Desktop/AUP/Lab4$
```

Q2.With appropriate comments write a program using setjmp and longjmp to verify the status of different types of variables after invoking longjmp.

a4q2.c (~/Desktop/AUP/Lab4) - gedit

Open

```c
#include <stdio.h>
#include <setjmp.h>
#include<stdlib.h>
static jmp_buf env;     /* Declare a global jmp_buf variable that is available to both func and main */
static int e;   /*global value*/

void function2(void){
    printf("Starting function2\n");

    /* Return to main with a return code of 1 (can be anything except 0) */
    longjmp(env, 1);
    /* In case of longjmp call, the variables that are stored in memory will have values as of the time of longjmp, while variables stored in registers are restored to their values when setjmp was called.

       Therefore values of automatic and regiter get changed to their original value */
    printf("Finishing function2\n"); /* This will never be executed! */
}

void function1(int a,int b, int c,int d){
    printf("Starting function1\n");
    printf("auto a = %d static b = %d register c = %d volatile d = %d global e = %d\n",a,b,c,d,e);


    /* Return to main with a return code of 1 (can be anything except 0) */
    function2();

    /* Display a message indicating we are leaving func */
    printf("Finishing function1\n"); /* This will never be executed! */
}
```

```c
int main(int argc, const char * argv[]){
    /* Define temporary variables */
    auto int a;                    /*local auto var declaration */
    static int b;               /*static var declaration*/
    register int c;             /*register var declaration*/
    volatile int d;             /*volatile var declaration*/
    int result;

    /*setting values of variables before setjump */
    a = 1;
    b = 2;
    c = 3;
    d = 4;
    e = 5;

    printf("Starting main\n");
    printf("auto a = %d static b = %d register c = %d volatile d = %d global e = %d\n",a,b,c,d,e);


    /* If the result of setjump is not 0 then we have returned from a call to longjmp */
    if(setjmp(env) != 0){
         printf("\nValues of the variables after longjump:\n");
         printf("auto a = %d static b = %d register c = %d volatile d = %d global e = %d\n",a,b,c,d,e);
         exit(0);
    }
    a = 51;
    b = 52;
    c = 53;
    d = 54;
    e = 55;

    /* Call func */
    function1(a,b,c,d);
    printf("Finished main\n");
    exit(0);
}
```

Output:

*** Without optimization:**

```
vijesh1996@vijesh1996-HP-Pavilion-15-Notebook-PC:~/Desktop/AUP/Lab4$ cc a4q2.c
vijesh1996@vijesh1996-HP-Pavilion-15-Notebook-PC:~/Desktop/AUP/Lab4$ ./a.out
Starting main
auto a = 1 static b = 2 register c = 3 volatile d = 4 global e = 5
Starting function1
auto a = 51 static b = 52 register c = 53 volatile d = 54 global e = 55
Starting function2

Values of the variables after longjump:
auto a = 51 static b = 52 register c = 53 volatile d = 54 global e = 55
vijesh1996@vijesh1996-HP-Pavilion-15-Notebook-PC:~/Desktop/AUP/Lab4$
```

When we compile code without optimization all variable are stored in the memory so, after calling longjmp also all variables maintain their changed values.

***With optimization:**

```
vijesh1996@vijesh1996-HP-Pavilion-15-Notebook-PC:~/Desktop/AUP/Lab4$ ./a.out
Starting main
auto a = 1 static b = 2 register c = 3 volatile d = 4 global e = 5
Starting function1
auto a = 51 static b = 52 register c = 53 volatile d = 54 global e = 55
Starting function2

Values of the variables after longjump:
auto a = 1 static b = 52 register c = 3 volatile d = 54 global e = 55
```

But, when we compile with all variables except automatic and register get stored in memory but these two stored in registers, So auto and register vars are restored to their original values.

Q3. Measures the performance of the getpid() and the fork functions using gettimeofday to measure the the execution time. Measure the performance ten times for each of the two system calls in the program itself and provide the timing results and compute an average for each system call.

CODE:

```c
#include <stdio.h>
#include <stdlib.h>
#include <sys/time.h>
#include <time.h>
#include <unistd.h>
double getEffectiveTime(struct timeval startTime, struct timeval endTime){
    return (endTime.tv_usec - startTime.tv_usec) + (endTime.tv_usec - startTime.tv_usec);
}
int main(){
    struct timeval startTime, endTime;
    double totalTime;
    pid_t pid;
    int i;
    printf("Time analysis of getpid():\n");
    totalTime = 0.0;
    for(i = 0; i < 10; i++){
        gettimeofday(&startTime, NULL);
        pid = getpid();
        gettimeofday(&endTime, NULL);
        totalTime += getEffectiveTime(startTime, endTime);
    }
    printf("Average time of getpid() - %lf microsec\n", totalTime/10);
    printf("\n\n");
    printf("Time analysis of fork():\n");
    totalTime = 0.0;
    for(i = 0;i < 10; i++){
        gettimeofday(&startTime, NULL);
        int PID = fork();
        gettimeofday(&endTime, NULL);
        if(PID)
            totalTime += getEffectiveTime(startTime, endTime);

        else
            exit(0);
    }
    printf("Average time of fork() - %lf microsec\n", totalTime/10);
    return 0;
}
```

Output:

Average performance of fork() and getpid() in microseconds:

```
vijesh1996@vijesh1996-HP-Pavilion-15-Notebook-PC:~/Desktop/AUP/Lab4$ cc a4q3.c
vijesh1996@vijesh1996-HP-Pavilion-15-Notebook-PC:~/Desktop/AUP/Lab4$ ./a.out
Time analysis of getpid():
Average time of getpid() - 1.800000 microsec


Time analysis of fork():
Average time of fork() - 182.000000 microsec
```