Assignment # 4

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Section 4B

Question 1:

```c
#include<stdio.h>
#include<pthread.h>
#include<stdlib.h>

void* thread1(){
        for(int c=0 ; c<10 ; c++)
                printf("Hello\n");
}

void* thread2(){
        for(int c=0 ; c<10 ; c++)
                printf("World\n");
}

int main(){
        int status;
        pthread_t tid1, tid2;

        pthread_create(&tid1 , NULL , thread1 , NULL);
        pthread_create(&tid2 , NULL , thread2 , NULL);


        pthread_join( tid1 , NULL);
        pthread_join( tid2 , NULL);

        return 0;

}
```

Screenshot:

```
ahmed@ahmed-Inspiron-N4050:~/Documents/semester content/Operating/Assignment$ gcc assignment4q1_a.c -o out -lpthread
ahmed@ahmed-Inspiron-N4050:~/Documents/semester content/Operating/Assignment$ ./out
Hello
Hello
Hello
Hello
Hello
Hello
Hello
Hello
Hello
Hello
World
World
World
World
World
World
World
World
World
World
ahmed@ahmed-Inspiron-N4050:~/Documents/semester content/Operating/Assignment$
```

Question 2:

```c
#include<stdio.h>
#include<pthread.h>
#include<stdlib.h>

void* thread1(){
        for(int c=0 ; c<10 ; c++)
                printf("Hello\n");
}

void* thread2(){
        for(int c=0 ; c<10 ; c++)
                printf("World\n");
}

int main(){
        int status;
        pthread_t tid1 , tid2 , tid3 , tid4;

        pthread_create(&tid1 , NULL , thread1 , NULL);
        pthread_create(&tid2 , NULL , thread2 , NULL);
        pthread_create(&tid3 , NULL , thread1 , NULL);
        pthread_create(&tid4 , NULL , thread2 , NULL);

        pthread_join( tid1 , NULL);
        pthread_join( tid2 , NULL);
        pthread_join( tid3 , NULL);
        pthread_join( tid4 , NULL);

        return 0;

}
```

Screenshot:

Question 2:

```
      /* Includes */

/* Symbolic Constants */

#include <sys/types.h> /* Primitive System Data Types */

#include <unistd.h>
#include<stdio.h>

/* Errors +/

#include <stdio.h> /* Input/Output */

#include <stdlib.h> /* General Utilities */

#include <errno.h>

/* POSIX Threads */

#include <pthread.h>

#include <string.h> /* String handling */

#define NUM_RUNS 10000000

/* prototype for thread routine */
void handler (void *ptr);

int counter; /* shared variable */

      int main() {

      int i[2];

      pthread_t thread_a;

      pthread_t thread_b;

      i[0] = 0; /* argument to threads */

      i[1] = 1;

      pthread_create (&thread_a, NULL, (void *) &handler, (void *) &i[0]);
      pthread_create (&thread_b, NULL, (void *) &handler, (void *) &i[1]);

      pthread_join(thread_a, NULL);

      pthread_join(thread_b, NULL);
```

```c
printf("------------------------------------\n");

printf("Final counter value: %d\n", counter);

printf("Error: %d\n", (NUM_RUNS*2-counter));
exit(0);

}

void handler ( void *ptr) {

int iter = 0;
int thread_num;

thread_num= *((int *) ptr);
printf("Starting thread: %d \n", thread_num);

while(iter < NUM_RUNS) {

counter++;

iter += 1;

}

printf("Thread %d, counter = %d\n", thread_num, counter);
pthread_exit(0); /* exit thread */

}
```

Answer (a) :

Final counter value: 10409605

Answer (b) :

Final counter value: 10409605

Answer (c) :

Error: 9590395

Error at different run.

```
Error: 9471139
```

```
Error: 9324300
```

```
Error: 9272159
```

Answer (4) :

```
real    0m0.096s
user    0m0.182s
sys     0m0.004s
```

```
Final counter value: 10528861
Error: 9471139

real    0m0.095s
user    0m0.184s
sys     0m0.000s
ahmed@ahmed-Inspiron-N4050:~/Documents/semester content/Operating/Assignment$ gcc assignment4q2_a.c -o out1 -lpthread
ahmed@ahmed-Inspiron-N4050:~/Documents/semester content/Operating/Assignment$ time ./out1
Starting thread: 0
Starting thread: 1
Thread 1, counter = 10013145
Thread 0, counter = 10675700
-------------------------------------
Final counter value: 10675700
Error: 9324300

real    0m0.094s
user    0m0.175s
sys     0m0.008s
ahmed@ahmed-Inspiron-N4050:~/Documents/semester content/Operating/Assignment$ gcc assignment4q2_a.c -o out1 -lpthread
ahmed@ahmed-Inspiron-N4050:~/Documents/semester content/Operating/Assignment$ time ./out1
Starting thread: 1
Starting thread: 0
Thread 0, counter = 10058885
Thread 1, counter = 10497198
-------------------------------------
Final counter value: 10497198
Error: 9502802

real    0m0.098s
user    0m0.185s
sys     0m0.005s
ahmed@ahmed-Inspiron-N4050:~/Documents/semester content/Operating/Assignment$ gcc assignment4q2_a.c -o out1 -lpthread
ahmed@ahmed-Inspiron-N4050:~/Documents/semester content/Operating/Assignment$ time ./out1
Starting thread: 0
Starting thread: 1
Thread 1, counter = 10017877
Thread 0, counter = 10727841
-------------------------------------
Final counter value: 10727841
Error: 9272159

real    0m0.096s
user    0m0.182s
sys     0m0.004s
ahmed@ahmed-Inspiron-N4050:~/Documents/semester content/Operating/Assignment$
```