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Lab 4.1:

Câu 1:

```c
#include <stdio.h>
#include <pthread.h>
#include <stdlib.h>
#include <sys/types.h>
#include <unistd.h>

struct array{
        int a[100];
        int n;
};

void* thr1(void* ar){
        int i, sum = 0;
        struct array *test = (struct array*)ar;
        for(i = 0; i<test->n; i++){
                sum = sum + test->a[i];
        }
        float ave = (float) sum/test->n;
        printf("Gia tri trung binh: %f\n", ave);
}

void* thr2(void* ar){
        struct array *test = (struct array*)ar;
        int i, max = test->a[0];
        for(i = 0; i < test->n; i++){
                if(max < test->a[i]){
                        max = test->a[i];
                }
        }
        printf("Gia tri lon nhat: %d\n", max);
```

```
}

void* thr3(void* ar){
        struct array *test = (struct array*)ar;
        int i, min = test->a[0];
        for(i = 0; i < test->n; i++){
                if(min > test->a[i]){
                        min = test->a[i];
                }
        }
        printf("Gia tri nho nhat: %d\n", min);
}

int main(int argc, char ** argv[]){
        struct array test;
        test.n = argc - 1;
        int i;
        for(i = 1; i < argc; i++){
                test.a[i - 1] = atoi(argv[i]);
        }
        pthread_t tid[3];
        pthread_create(&tid[0], NULL, thr1, (void*)&test);
        sleep(2);
        pthread_create(&tid[1], NULL, thr2, (void*)&test);
        sleep(2);
        pthread_create(&tid[2], NULL, thr3, (void*)&test);
        sleep(2);
        return 0;
}
```

```
trongdat1108@ubuntu:~/lab4.1$ gcc -c bai1.c
bai1.c: In function ‘main’:
bai1.c:49:24: warning: passing argument 1 of ‘atoi’ from incompatible pointer ty
pe [-Wincompatible-pointer-types]
   test.a[i - 1] = atoi(argv[i]);
                        ^
In file included from bai1.c:3:0:
/usr/include/stdlib.h:147:12: note: expected ‘const char *’ but argument is of t
ype ‘char **’
 extern int atoi (const char *__nptr)
            ^
trongdat1108@ubuntu:~/lab4.1$ gcc -o bai1.out bai1.o
bai1.o: In function `main':
bai1.c:(.text+0x1c6): undefined reference to `pthread_create'
bai1.c:(.text+0x1f3): undefined reference to `pthread_create'
bai1.c:(.text+0x220): undefined reference to `pthread_create'
collect2: error: ld returned 1 exit status
trongdat1108@ubuntu:~/lab4.1$ gcc -o bai1.out bai1.o -lpthread
trongdat1108@ubuntu:~/lab4.1$ ./bai1.out 90 81 78 95 79 72 85
Gia tri trung binh: 82.857140
Gia tri lon nhat: 95
Gia tri nho nhat: 72
trongdat1108@ubuntu:~/lab4.1$
```

Câu 2:

```c
#include <stdio.h>
#include <pthread.h>
#include <stdlib.h>
#include <sys/types.h>
#include <unistd.h>

struct array{
        int a[100];
        int n;
};

void* thr1(int i){
        int j, sum = 0, t;
        if(i == 2){
                printf("%\n", i);
        } else{
                t = 0;
                for(j = 2; j < i/2 + 1; j++){
                        if(i % j == 0){
                                t = 1;
                                break;
                        }
                }
                if(t == 0){
                        printf("%d\n", i);
                }
        }
}
int main(int argc, char** argv[]){
        struct array ar;
        ar.n = argc - 1;
        int i;
        for(i = 1; i < argc; i++){
                ar.a[i - 1] = atoi(argv[i]);
        }
        pthread_t tid[4];
        for(i = 2; i <= ar.a[0]; i++){
                pthread_create(&tid[0], NULL, thr1, i);
                pthread_join(tid[0], NULL);
                if(i + 1 <= ar.a[0]){
                        pthread_create(&tid[1], NULL, thr1, i + 1);
                }
                pthread_join(tid[1], NULL);
                if(i + 2 <= ar.a[0]){
                        pthread_create(&tid[2], NULL, thr1, i + 2);
                }
                pthread_join(tid[2], NULL);
                if(i + 3 <= ar.a[0]){
                        pthread_create(&tid[3], NULL, thr1, i + 3);
                }
                pthread_join(tid[3], NULL);
                i = i + 3;
        }
        return 0;
}
```

```
 extern int pthread_create (pthread_t *__restrict __newthread,
            ^
bai2.c:50:40: warning: passing argument 4 of ‘pthread_create’ makes pointer from
 integer without a cast [-Wint-conversion]
    pthread_create(&tid[3], NULL, thr1, i + 3);
                                        ^
In file included from bai2.c:2:0:
/usr/include/pthread.h:233:12: note: expected ‘void * restrict’ but argument is
of type ‘int’
 extern int pthread_create (pthread_t *__restrict __newthread,
            ^
trongdat1108@ubuntu:~/lab4.1$ gcc -o bai2.out bai2.o -lpthread
trongdat1108@ubuntu:~/lab4.1$ ./bai2.out 30
%
3
5
7
11
13
17
19
23
29
trongdat1108@ubuntu:~/lab4.1$
```

Lab 4.2:

Câu 1:

```c
#include <stdio.h>
#include <pthread.h>
#include <stdlib.h>
#include <sys/types.h>
#include <unistd.h>
#define NUM_THREADS 2

struct array{
        int a[100];
        int n;
};

void* thr1(void* ar){
        int i, sum = 0;
        struct array *test = (struct array*)ar;
        for(i = 0; i<test->n; i++){
                sum = sum + test->a[i];
        }
        float ave = (float) sum/test->n;
        printf("Gia tri trung binh: %f\n", ave);
}

void* thr2(void* ar){
        struct array *test = (struct array*)ar;
        int i, max = test->a[0];
        for(i = 0; i < test->n; i++){
                if(max < test->a[i]){
                        max = test->a[i];
```

```
        for(i = 0; i < test->n; i++){
                if(max < test->a[i]){
                        max = test->a[i];
                }
        }
        printf("Gia tri lon nhat: %d\n", max);
}

void* thr3(void* ar){
        struct array *test = (struct array*)ar;
        int i, min = test->a[0];
        for(i = 0; i < test->n; i++){
                if(min > test->a[i]){
                        min = test->a[i];
                }
        }
        printf("Gia tri nho nhat: %d\n", min);
}

int main(int argc, char ** argv[]){
        struct timeval start, end;
        pthread_t threads[NUM_THREADS];
        gettimeofday(&start, NULL);
        double time_spent;

        struct array test;
        test.n = argc - 1;
        int i;
```

```
int main(int argc, char ** argv[]){
        struct timeval start, end;
        pthread_t threads[NUM_THREADS];
        gettimeofday(&start, NULL);
        double time_spent;

        struct array test;
        test.n = argc - 1;
        int i;
        for(i = 1; i < argc; i++){
                test.a[i - 1] = atoi(argv[i]);
        }
        pthread_t tid[3];
        pthread_create(&tid[0], NULL, thr1, (void*)&test);
        sleep(1);
        pthread_create(&tid[1], NULL, thr2, (void*)&test);
        sleep(1);
        pthread_create(&tid[2], NULL, thr3, (void*)&test);
        sleep(1);

        gettimeofday(&end, NULL);
        time_spent = ((double)((double)(end.tv_usec-start.tv_usec)/1000000 +
(double)(end.tv_usec-start.tv_usec)));
        printf("time of excution: %f seconds\n", time_spent);
        return 0;
}
```

```
trongdat1108@ubuntu:~/lab 4.2$ gcc -c bai1.c
bai1.c: In function ‘main’:
bai1.c:48:2: warning: implicit declaration of function ‘gettimeofday’ [-Wimplici
t-function-declaration]
  gettimeofday(&start, NULL);
  ^
bai1.c:55:24: warning: passing argument 1 of ‘atoi’ from incompatible pointer ty
pe [-Wincompatible-pointer-types]
   test.a[i - 1] = atoi(argv[i]);
                        ^
In file included from bai1.c:3:0:
/usr/include/stdlib.h:147:12: note: expected ‘const char *’ but argument is of t
ype ‘char **’
 extern int atoi (const char *__nptr)
            ^
trongdat1108@ubuntu:~/lab 4.2$ gcc -o bai1.out bai1.o -lpthread
trongdat1108@ubuntu:~/lab 4.2$ ./bai1.out 90 81 78 95 79 72 85
Gia tri trung binh: 82.857140
Gia tri lon nhat: 95
Gia tri nho nhat: 72
time of excution: 1850.001850 seconds
trongdat1108@ubuntu:~/lab 4.2$
```

Câu 2:

```c
#include <stdio.h>
#include <pthread.h>
#include <stdlib.h>
#include <sys/types.h>
#include <unistd.h>
#define NUM_THREADS 2

struct array{
        int a[100];
        int n;
};

void* thr1(int i){
        int j, sum = 0, t;
        if(i == 2){
                printf("%\n", i);
        } else{
                t = 0;
                for(j = 2; j < i/2 + 1; j++){
                        if(i % j == 0){
                                t = 1;
                                break;
                        }
                }
                if(t == 0){
                        printf("%d\n", i);
                }
        }
```

```c
int main(int argc, char** argv[]){
        struct timeval start, end;
        pthread_t threads[NUM_THREADS];
        gettimeofday(&start, NULL);
        double time_spent;

        struct array ar;
        ar.n = argc - 1;
        int i;
        for(i = 1; i < argc; i++){
                ar.a[i - 1] = atoi(argv[i]);
        }
        pthread_t tid[4];
        for(i = 2; i <= ar.a[0]; i++){
                pthread_create(&tid[0], NULL, thr1, i);
                pthread_join(tid[0], NULL);
                if(i + 1 <= ar.a[0]){
                        pthread_create(&tid[1], NULL, thr1, i + 1);
                }
                pthread_join(tid[1], NULL);
                if(i + 2 <= ar.a[0]){
                        pthread_create(&tid[2], NULL, thr1, i + 2);
                }
                pthread_join(tid[2], NULL);
                if(i + 3 <= ar.a[0]){
                        pthread_create(&tid[3], NULL, thr1, i + 3);
                }
```

```c
        }
        pthread_t tid[4];
        for(i = 2; i <= ar.a[0]; i++){
                pthread_create(&tid[0], NULL, thr1, i);
                pthread_join(tid[0], NULL);
                if(i + 1 <= ar.a[0]){
                        pthread_create(&tid[1], NULL, thr1, i + 1);
                }
                pthread_join(tid[1], NULL);
                if(i + 2 <= ar.a[0]){
                        pthread_create(&tid[2], NULL, thr1, i + 2);
                }
                pthread_join(tid[2], NULL);
                if(i + 3 <= ar.a[0]){
                        pthread_create(&tid[3], NULL, thr1, i + 3);
                }
                pthread_join(tid[3], NULL);
                i = i + 3;
        }

        ///
        gettimeofday(&end, NULL);
        time_spent = ((double)((double)(end.tv_usec-start.tv_usec)/1000000 +
(double)(end.tv_usec-start.tv_usec)));
        printf("time of excution: %f seconds\n", time_spent);
        ///
        return 0;
}
```


trongdat1108@ubuntu:~/lab 4.2$ ./bai2.out 30
%
3
5
7
11
13
17
19
23
29
time of excution: 1039.001039 seconds
trongdat1108@ubuntu:~/lab 4.2$