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**Project Report**

**Project Name: Seeking Tutor Problem**

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**Project Description:**

We have a club where undergraduate students get help with their programming assignments from tutors. The club has a coordinator and several tutors to assist the students. Here, students can come to the waiting area, if there is no available seat then they will go back to programming. Otherwise, they will wait in the waiting area. The coordinator will then prioritize students in a queue. Then tutor will find the student from the queue who has the highest priority and tutor them. If more than one student has the same priority the tutor will choose who came first. After getting the maximum amount of help students terminate. When all students will be finished getting help, the tutor will terminate and then the coordinator will be terminated.

**Methodologies we have used in our code:**

► Pthread\_create()

► Pthread\_join()

► Sem\_init()

► Sem\_wait()

► Sem\_post()

► Sem\_mutex()

**Flowchart:**

Diagram

Description automatically generated

**Description of each Function:**

**The student has three parts:**

Diagram

Description automatically generated

1. Student has to start programming and seek help from a tutor, the student needs to get a seat. After coming to get seat, if student does not find any seat, then has to go back to programming and try again later.
2. If a student gets a seat, then the coordinator gets a notice and then waits for a tutor to be assigned.
3. After getting the maximum amount of help, the student will stop seeking help.

**► Coordinate has 4 parts:**

Diagram

Description automatically generated

1. The coordinator waits for students to come to seek help.
2. And prioritize students according to who has come first.
3. Then coordinator assigns tutors to each student.
4. If all students in the waiting area get a tutor, then the coordinator notifies the tutor and leaves.

**Tutor has 3 parts:**

Diagram

Description automatically generated

1. Tutor waits for the coordinator to notify if a student has come to seek help.
2. Tutor selects to the student to help according to the priority of the student.
3. If all students have done seeking help from the tutor, the tutor waits for coordinators notification to finish work.

**Code:**

#include <stdio.h>

#include <stdlib.h>

#include <pthread.h>

#include <semaphore.h>

struct priority\_queue

{

int priority\_no;

int time;

};

int finished\_student\_no=0, finished\_tutor\_no = 0, request\_no = 0, student\_no=0, tutor\_no=0, help = 0, total\_chair = 0, occupied\_chairs=0;

int visited[100];

struct priority\_queue pq[100];

int priority[100];

int student\_ids[100];

int tutor\_ids[100];

sem\_t student;

sem\_t coordinator;

sem\_t tutor[100];

sem\_t mutex;

void \*student\_thread(void \*student\_id)

{

int s\_id=\*(int\*)student\_id;

while(1)

{

if(priority[s\_id-1] == help)

{

sem\_wait(&mutex);

finished\_student\_no++;

sem\_post(&mutex);

printf("\n\nstudent %d terminates\n\n",s\_id);

sem\_post(&student);

pthread\_exit(NULL);

}

sem\_wait(&mutex);

if(occupied\_chairs == total\_chair)

{

printf("\nStudent: Student %d found no empty chair.\n",s\_id);

sem\_post(&mutex);

continue;

}

occupied\_chairs++;

request\_no++;

visited[s\_id-1]=request\_no;

printf("\nStudent: Student %d takes a seat.\nStudent: Empty chairs = %d\n",s\_id,total\_chair-occupied\_chairs);

sem\_post(&mutex);

sem\_post(&student);

sem\_wait(&tutor[s\_id-1]);

printf("\nStudent: Student %d received help.\n",s\_id);

sem\_wait(&mutex);

priority[s\_id-1]++;

printf("\nStudent: Student %d priority now is %d\n",s\_id, priority[s\_id-1]);

sem\_post(&mutex);

}

}

void \*tutor\_thread(void \*tutor\_id)

{

int t\_id=\*(int\*)tutor\_id;

while(1)

{

if(finished\_student\_no==student\_no)

{

sem\_wait(&mutex);

finished\_tutor\_no++;

sem\_post(&mutex);

sem\_wait(&mutex);

printf("\n\ntutor %d terminates\n\n",t\_id);

if(finished\_tutor\_no == tutor\_no)

{

printf("\n\ncoordinator terminates\n\n");

}

sem\_post(&mutex);

pthread\_exit(NULL);

}

sem\_wait(&coordinator);

int max\_request=student\_no\*help+1, max\_priority = help-1 ,s\_id = -1;

sem\_wait(&mutex);

for(int i=0;i<student\_no;i++)

{

if(pq[i].priority\_no>-1 && pq[i].priority\_no<=max\_priority)

{

if (pq[i].time<max\_request)

{

max\_priority = pq[i].priority\_no;

max\_request=pq[i].time;

s\_id=student\_ids[i];

}

}

}

if(s\_id==-1)

{

sem\_post(&mutex);

continue;

}

pq[s\_id-1].priority\_no = -1;

pq[s\_id-1].time = -1;

occupied\_chairs--;

sem\_post(&mutex);

sem\_wait(&mutex);

printf("\nTutor: Student %d tutored by Tutor %d\n",s\_id,t\_id);

sem\_post(&mutex);

sem\_post(&tutor[s\_id-1]);

}

}

void \*coordinator\_thread()

{

while(1)

{

if(finished\_student\_no==student\_no)

{

for(int i=0;i<tutor\_no;i++)

{

sem\_post(&coordinator);

}

pthread\_exit(NULL);

}

sem\_wait(&student);

sem\_wait(&mutex);

for(int i=0;i<student\_no;i++)

{

if(visited[i]>-1)

{

pq[i].priority\_no = priority[i];

pq[i].time = visited[i];

printf("\nCoordinator: Student %d with priority %d in the queue.\n",student\_ids[i],priority[i]);

visited[i]=-1;

sem\_post(&coordinator);

}

}

sem\_post(&mutex);

}

}

int main()

{

printf("Enter total student number: ");

scanf("%d", &student\_no);

printf("Enter total tutor number: ");

scanf("%d", &tutor\_no);

printf("Enter total chair number: ");

scanf("%d", &total\_chair);

printf("Enter maximum help number: ");

scanf("%d", &help);

for(int i=0;i<student\_no;i++)

{

visited[i]=-1;

pq[i].priority\_no = -1;

pq[i].time = -1;

priority[i]=0;

}

sem\_init(&student,0,0);

sem\_init(&coordinator,0,0);

sem\_init(&mutex,0,1);

for(int i=0;i<student\_no;i++)

{

sem\_init(&tutor[i],0,0);

}

pthread\_t students[student\_no];

pthread\_t tutors[tutor\_no];

pthread\_t coordinator;

for(int i = 0; i < student\_no; i++)

{

student\_ids[i] = i + 1;

if (pthread\_create(&students[i], NULL, student\_thread, (void\*) &student\_ids[i]) < 0)

{

perror("Error: thread cannot be created");

exit(1);

}

}

for(int i = 0; i < tutor\_no; i++)

{

tutor\_ids[i] = i + 1;

if (pthread\_create(&tutors[i], NULL, tutor\_thread, (void\*) &tutor\_ids[i]) < 0)

{

perror("Error: thread cannot be created");

exit(1);

}

}

if (pthread\_create(&coordinator,NULL,coordinator\_thread,NULL) < 0)

{

perror("Error: thread cannot be created");

exit(1);

}

for(int i =0; i < student\_no; i++)

{

pthread\_join(students[i],NULL);

}

for(int i =0; i < tutor\_no; i++)

{

pthread\_join(tutors[i],NULL);

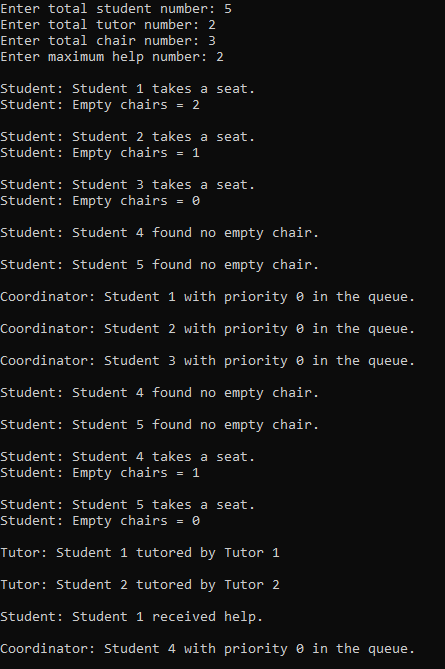
}

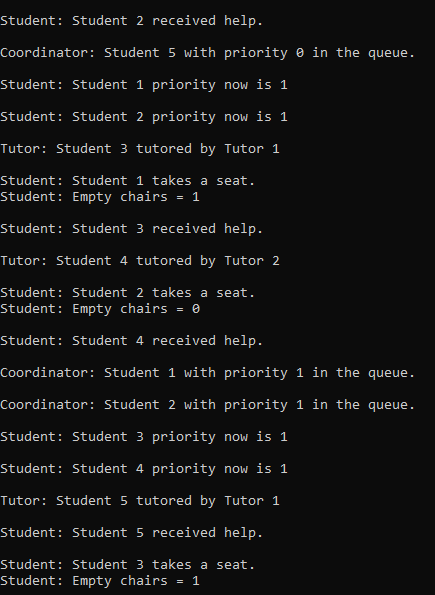
pthread\_join(coordinator, NULL);

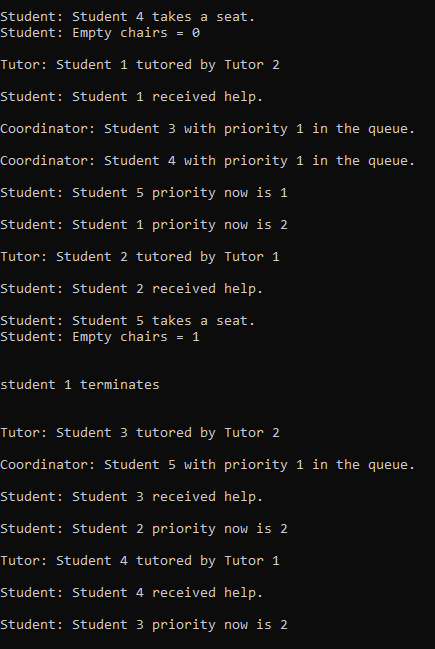
return 0;

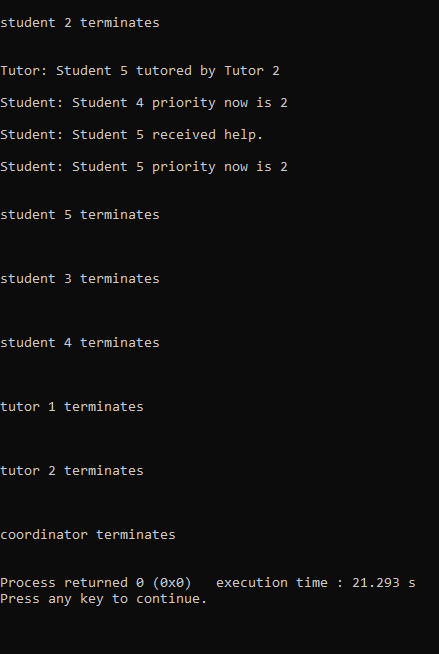
}

**Output:**









**Conclusion:**

This program synchronizes the tasks between the students, coordinator, and tutors. The students get help according to their priorities, so no one is left out.