WEEK 6

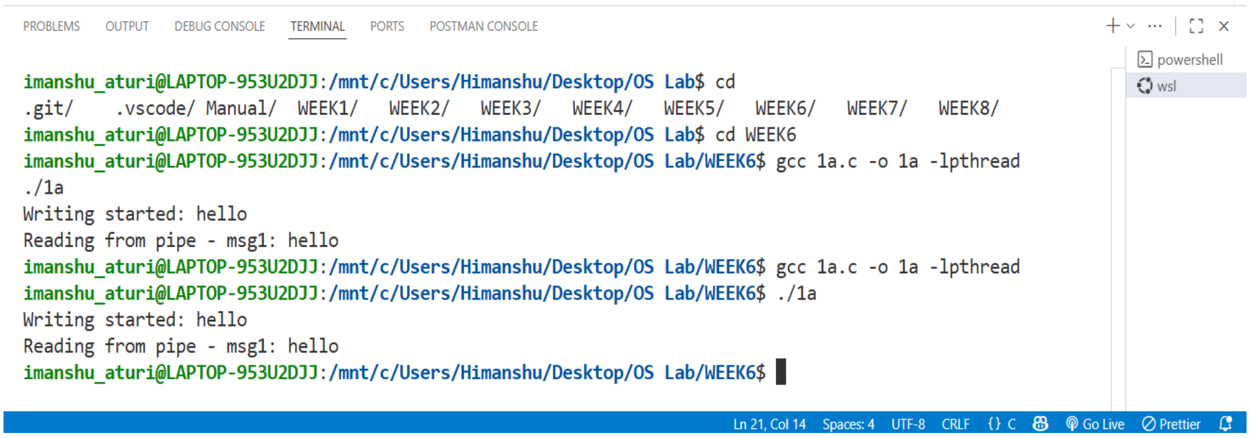
Program 1) Write a program to communicate parent and child process with each other in such a way that whenever child writes something, parent process can read it. Consider mode of communication is through.

a. pipe

Source Code:

```
#include <stdio.h>
#include <unistd.h>
#include <string.h>
int main()
{
   int p[2];
   int returnstatus;
   char writing[2][25] = {"hello", "world"};
   char readmsg[25];
   returnstatus = pipe(p);
   if (returnstatus == -1)
   {
      printf("Pipe not created\n");
      return 1;
   }
   printf("Writing started: %s\n", writing[0]);
   write(p[1], writing[0], strlen(writing[0]) + 1);
   read(p[0], readmsg, sizeof(readmsg));
   printf("Reading from pipe - msg1: %s\n", readmsg);
   return 0;
}
```

OUTPUT



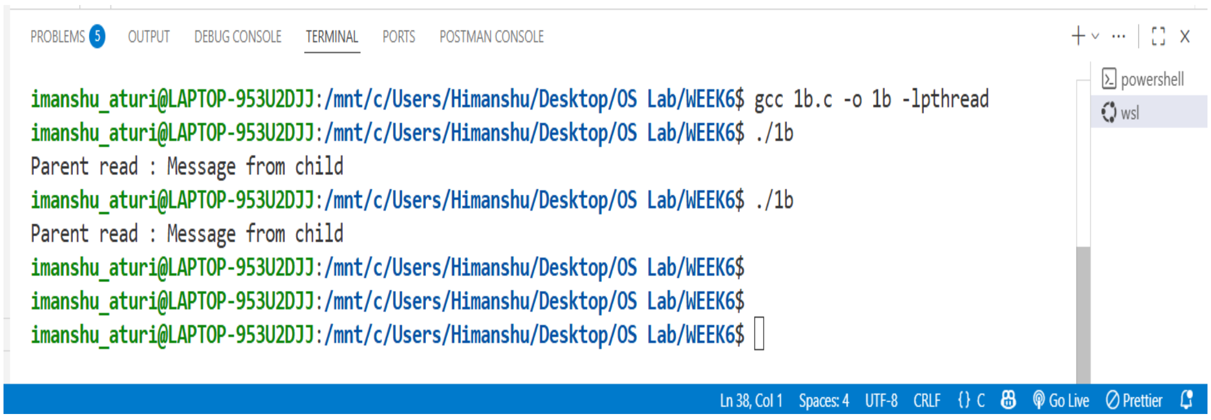
```
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab$ cd
.git/    .vscode/ Manual/  WEEK1/   WEEK2/   WEEK3/   WEEK4/   WEEK5/   WEEK6/   WEEK7/   WEEK8/
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab$ cd WEEK6
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ gcc 1a.c -o 1a -lpthread
./1a
Writing started: hello
Reading from pipe - msg1: hello
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ gcc 1a.c -o 1a -lpthread
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ ./1a
Writing started: hello
Reading from pipe - msg1: hello
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$
```

b) message passing

Source Code:

```
#include <stdio.h>
#include <stdlib.h>
#include <sys/ipc.h>
#include <sys/msg.h>
#include <string.h>
#include <unistd.h>
struct msg_buffer
{   long msg_type;
    char msg_text[100];
} message;
void main()
{
    key_t key;
    int msgid;
    key = ftok("progfile", 65);
    msgid = msgget(key, 0666 | IPC_CREAT);
    message.msg_type = 1;
    if (fork() == 0)
    {   strcpy(message.msg_text, "Message from child");
        msgsnd(msgid, &message, sizeof(message), 0);
    }
    else
    {       msgrcv(msgid, &message, sizeof(message), 1, 0);
        printf("Parent read : %s\n", message.msg_text);
        msgctl(msgid, IPC_RMID, NULL);
    }
}
```

OUTPUT



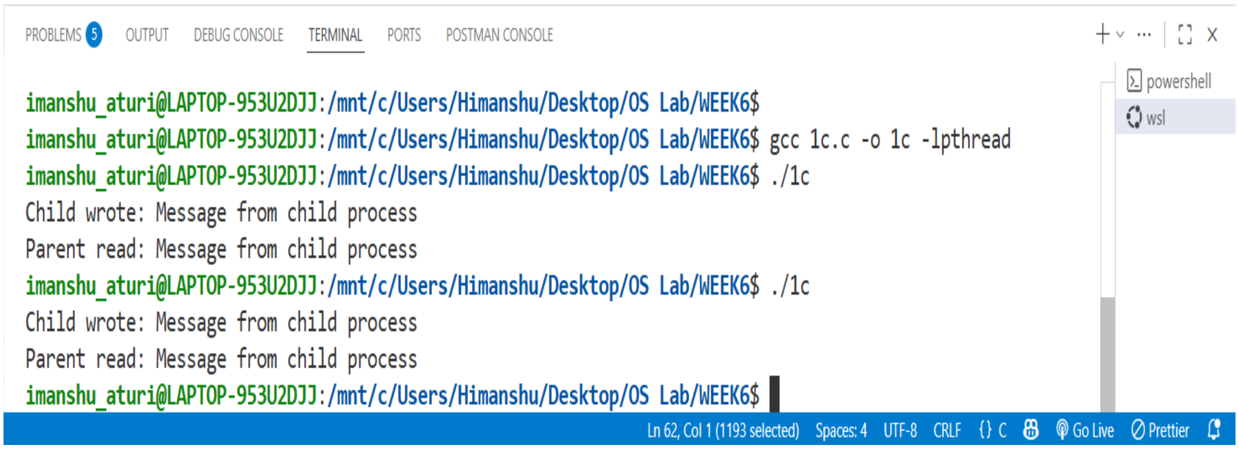
```
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ gcc 1b.c -o 1b -lpthread
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ ./1b
Parent read : Message from child
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ ./1b
Parent read : Message from child
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$
```

c) shared memory

Source Code:

```
#include <stdio.h>

#include <stdlib.h>

#include <string.h>

#include <sys/ipc.h>

#include <sys/shm.h>

#include <sys/types.h>

#include <unistd.h>

int main()

{

    key_t key;

    int shmid;

    char *shared_memory;

    key = ftok(".", 65);

    if (key == -1)

    {

        perror("ftok");

        exit(1);

    }

    shmid = shmget(key, 1024, 0666 | IPC_CREAT);

    if (shmid == -1)

    {

        perror("shmget");

        exit(1);

    }

    if (fork() == 0)

    {

        shared_memory = (char *)shmat(shmid, NULL, 0);
        if (shared_memory == (char *)(-1))
        {
            perror("shmat");
            exit(1);
        }

        strcpy(shared_memory, "Message from child process");
        printf("Child wrote: %s\n", shared_memory);

        shmdt(shared_memory);
    }
    else
    {
        sleep(1);

        shared_memory = (char *)shmat(shmid, NULL, 0);
        if (shared_memory == (char *)(-1))
        {
            perror("shmat");
            exit(1);
        }

        printf("Parent read: %s\n", shared_memory);

        shmdt(shared_memory);
        shmctl(shmid, IPC_RMID, NULL);
    }
    return 0;
}
```

OUTPUT:



```
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ gcc 1c.c -o 1c -lpthread
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ ./1c
Child wrote: Message from child process
Parent read: Message from child process
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ ./1c
Child wrote: Message from child process
Parent read: Message from child process
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$
```

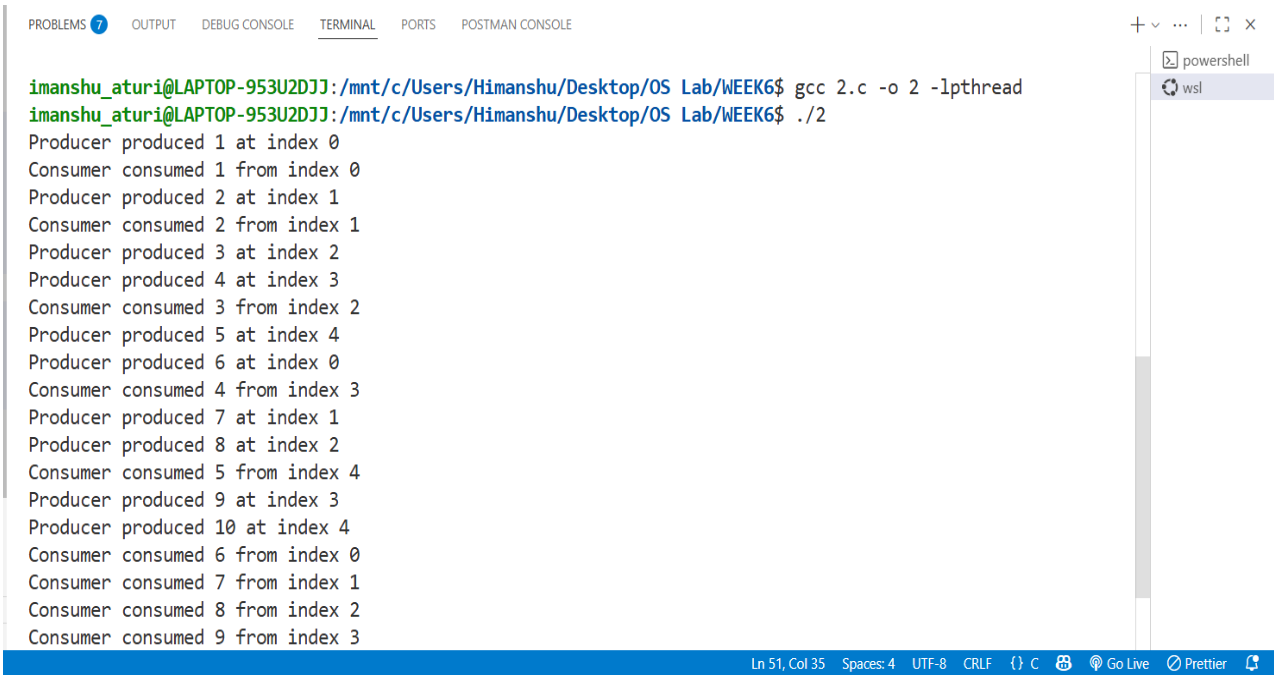
Program2) Write a program to implement the concept of Producer-Consumer problem using semaphores.

Source Code:

```
#include <stdio.h>

#include <pthread.h>

#include <semaphore.h>

#include <unistd.h>

#define BUFFER_SIZE 5

int buffer[BUFFER_SIZE];

int in = 0, out = 0;

sem_t empty;

sem_t full;

pthread_mutex_t mutex = PTHREAD_MUTEX_INITIALIZER;

void *producer(void *args)

{

   int item;

   for (int i = 0; i < 10; i++)

   {

      item = i + 1;

      sem_wait(&empty);

      pthread_mutex_lock(&mutex);

      buffer[in] = item;

      printf("Producer produced %d at index %d\n", item, in);

      in = (in + 1) % BUFFER_SIZE;

      pthread_mutex_unlock(&mutex);

      sem_post(&full);

      sleep(1);

   }

   return NULL;

}
```

```
void *consumer(void *args)
{
  int item;
  for (int i = 0; i < 10; i++)
  {
    sem_wait(&full);
    pthread_mutex_lock(&mutex);
    item = buffer[out];
    printf("Consumer consumed %d from index %d\n", item, out);
    out = (out + 1) % BUFFER_SIZE;
    pthread_mutex_unlock(&mutex);
    sem_post(&empty);
    sleep(2);
  }
  return NULL;
}
int main()
{
  pthread_t prod, cons;
  sem_init(&empty, 0, BUFFER_SIZE);
  sem_init(&full, 0, 0);
  pthread_create(&prod, NULL, producer, NULL);
  pthread_create(&cons, NULL, consumer, NULL);
  pthread_join(prod, NULL);
  pthread_join(cons, NULL);
  sem_destroy(&empty);
  sem_destroy(&full);
  pthread_mutex_destroy(&mutex);
  return 0;
}
```

OUTPUT:



```
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ gcc 2.c -o 2 -lpthread
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ ./2
Producer produced 1 at index 0
Consumer consumed 1 from index 0
Producer produced 2 at index 1
Consumer consumed 2 from index 1
Producer produced 3 at index 2
Producer produced 4 at index 3
Consumer consumed 3 from index 2
Producer produced 5 at index 4
Producer produced 6 at index 0
Consumer consumed 4 from index 3
Producer produced 7 at index 1
Producer produced 8 at index 2
Consumer consumed 5 from index 4
Producer produced 9 at index 3
Producer produced 10 at index 4
Consumer consumed 6 from index 0
Consumer consumed 7 from index 1
Consumer consumed 8 from index 2
Consumer consumed 9 from index 3
```

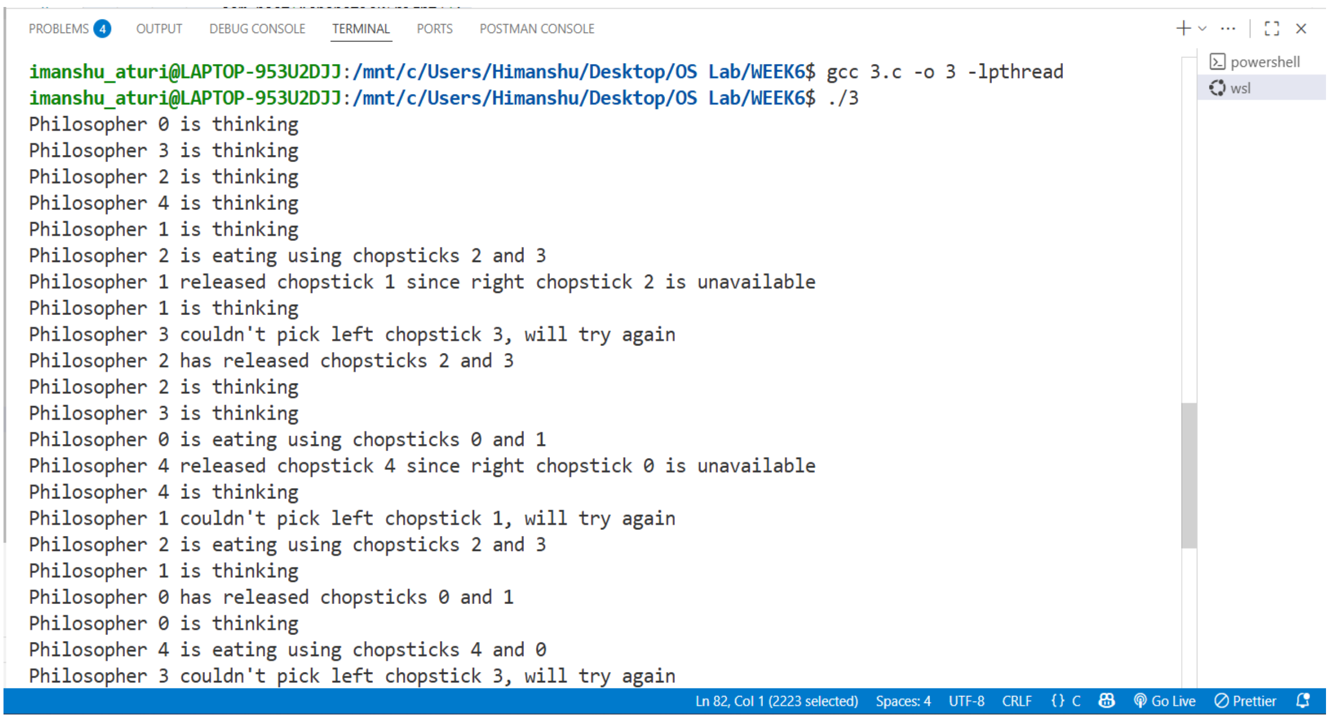
Program3) Write a program to implement the concept of Dining-Philosopher problem.

Source Code:

```
#include <stdio.h>
#include <pthread.h>
#include <semaphore.h>
#include <unistd.h>
#include <stdlib.h>
#include <time.h>
#define N 5
sem_t chopstick[N];
void *philosopher(void *num)
{
  int id = *(int *)num;
  while (1)
  {
    printf("Philosopher %d is thinking\n", id);
    sleep(rand() % 3 + 1);
    int left = id;
    int right = (id + 1) % N;
    if (sem_trywait(&chopstick[left]) == 0)
    {
      if (sem_trywait(&chopstick[right]) == 0)
      {
        printf("Philosopher %d is eating using chopsticks %d and %d\n", id, left, right);
        sleep(rand() % 2 + 1); // eating time
        sem_post(&chopstick[left]);
        sem_post(&chopstick[right]);
        printf("Philosopher %d has released chopsticks %d and %d\n", id, left, right);
      }
```

```
            else
            {
                sem_post(&chopstick[left]);
                printf("Philosopher %d released chopstick %d since right chopstick %d is unavailable\n",
                       id, left, right);
            }
        }
        else
        {
            printf("Philosopher %d couldn't pick left chopstick %d, will try again\n", id, left);
        }
        usleep(200); // small delay to reduce CPU usage
    }
    pthread_exit(NULL);
}
void main()
{
    pthread_t tid[N];
    int ids[N];
    srand(time(NULL));
    for (int i = 0; i < N; i++)
        sem_init(&chopstick[i], 0, 1);
    for (int i = 0; i < N; i++)
    {
        ids[i] = i;
        pthread_create(&tid[i], NULL, philosopher, &ids[i]);
    }
    for (int i = 0; i < N; i++)
        pthread_join(tid[i], NULL);
}
```

OUTPUT:



```
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ gcc 3.c -o 3 -lpthread
imanshu_aturi@LAPTOP-953U2DJJ:/mnt/c/Users/Himanshu/Desktop/OS Lab/WEEK6$ ./3
Philosopher 0 is thinking
Philosopher 3 is thinking
Philosopher 2 is thinking
Philosopher 4 is thinking
Philosopher 1 is thinking
Philosopher 2 is eating using chopsticks 2 and 3
Philosopher 1 released chopstick 1 since right chopstick 2 is unavailable
Philosopher 1 is thinking
Philosopher 3 couldn't pick left chopstick 3, will try again
Philosopher 2 has released chopsticks 2 and 3
Philosopher 2 is thinking
Philosopher 3 is thinking
Philosopher 0 is eating using chopsticks 0 and 1
Philosopher 4 released chopstick 4 since right chopstick 0 is unavailable
Philosopher 4 is thinking
Philosopher 1 couldn't pick left chopstick 1, will try again
Philosopher 2 is eating using chopsticks 2 and 3
Philosopher 1 is thinking
Philosopher 0 has released chopsticks 0 and 1
Philosopher 0 is thinking
Philosopher 4 is eating using chopsticks 4 and 0
Philosopher 3 couldn't pick left chopstick 3, will try again
```

WEEK 7

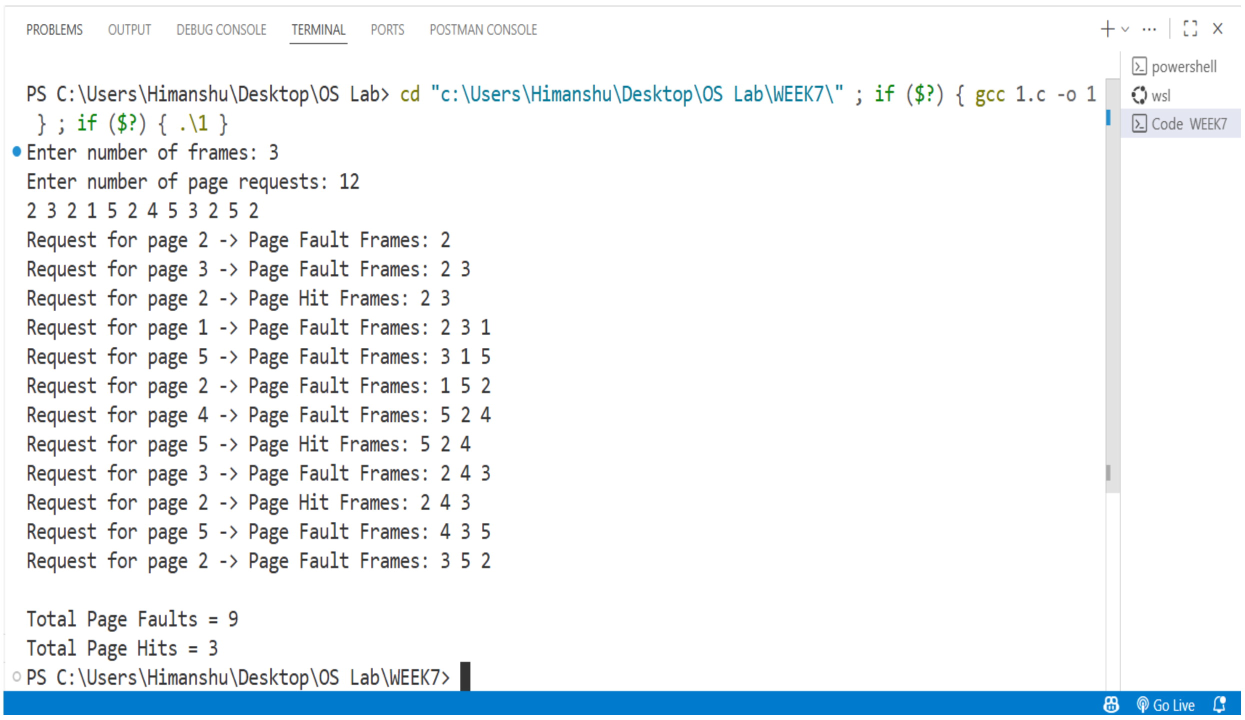
Program1) FIFO – First In First Out : page which came first (i.e. oldest page) need to be moved out.

Source Code:

```
#include <stdio.h>
void enqueue(int q[], int *front, int *rear, int v, int n)
{
  if (*rear - *front + 1 == n)
  {
    printf("Queue is full\n");
    return;
  }else
  {
    if (*front == -1)
      *front = 0;
    q[++(*rear)] = v;
  }
}
int dequeue(int q[], int *front, int *rear)
{
  int v;
  if (*front == -1)
  {
    printf("Queue is empty\n");
    return -1;
  }
  else
  {
    v = q[*front];
    (*front)++;
```

```
        if (*front > *rear)
        {
            *front = -1;
            *rear = -1;
        } }
    return v;
}
int isPresent(int q[], int front, int rear, int page)
{
    if (front == -1)
        return 0;
    for (int i = front; i <= rear; i++)
    {   if (q[i] == page)
            return 1; }
    return 0;
}
void display(int q[], int front, int rear)
{
    if (front == -1)
    {
        printf("Queue is empty\n");
        return;
    }
    for (int i = front; i <= rear; i++)
        printf("%d ", q[i]);
    printf("\n");
}
void main()
{
    int n, m;
    printf("Enter number of frames: ");
    scanf("%d", &n);
    printf("Enter number of page requests: ");
    scanf("%d", &m);
    int pages[m];
    for (int i = 0; i < m; i++)
        scanf("%d", &pages[i]);
    int q[20];
    int front = -1, rear = -1;
    int pageFaults = 0;
    for (int i = 0; i < m; i++)
    {
        int page = pages[i];
        printf("Request for page %d -> ", page);
        if (!isPresent(q, front, rear, page))
        {  pageFaults++;
            if (front == -1 || rear - front + 1 < n)
                enqueue(q, &front, &rear, page, n);
            else{
                dequeue(q, &front, &rear);
                enqueue(q, &front, &rear, page, n);
            }
            printf("Page Fault Frames: ");
        } else
            printf("Page Hit Frames: ");
        display(q, front, rear);
    }
    printf("\nTotal Page Faults = %d\n", pageFaults);
    printf("Total Page Hits = %d\n", m - pageFaults);
}
```

OUTPUT:



```
PS C:\Users\Himanshu\Desktop\OS Lab> cd "c:\Users\Himanshu\Desktop\OS Lab\WEEK7\" ; if ($?) { gcc 1.c -o 1
 } ; if ($?) { .\1 }
Enter number of frames: 3
Enter number of page requests: 12
2 3 2 1 5 2 4 5 3 2 5 2
Request for page 2 -> Page Fault Frames: 2
Request for page 3 -> Page Fault Frames: 2 3
Request for page 2 -> Page Hit Frames: 2 3
Request for page 1 -> Page Fault Frames: 2 3 1
Request for page 5 -> Page Fault Frames: 3 1 5
Request for page 2 -> Page Fault Frames: 1 5 2
Request for page 4 -> Page Fault Frames: 5 2 4
Request for page 5 -> Page Hit Frames: 5 2 4
Request for page 3 -> Page Fault Frames: 2 4 3
Request for page 2 -> Page Hit Frames: 2 4 3
Request for page 5 -> Page Fault Frames: 4 3 5
Request for page 2 -> Page Fault Frames: 3 5 2

Total Page Faults = 9
Total Page Hits = 3
PS C:\Users\Himanshu\Desktop\OS Lab\WEEK7>
```

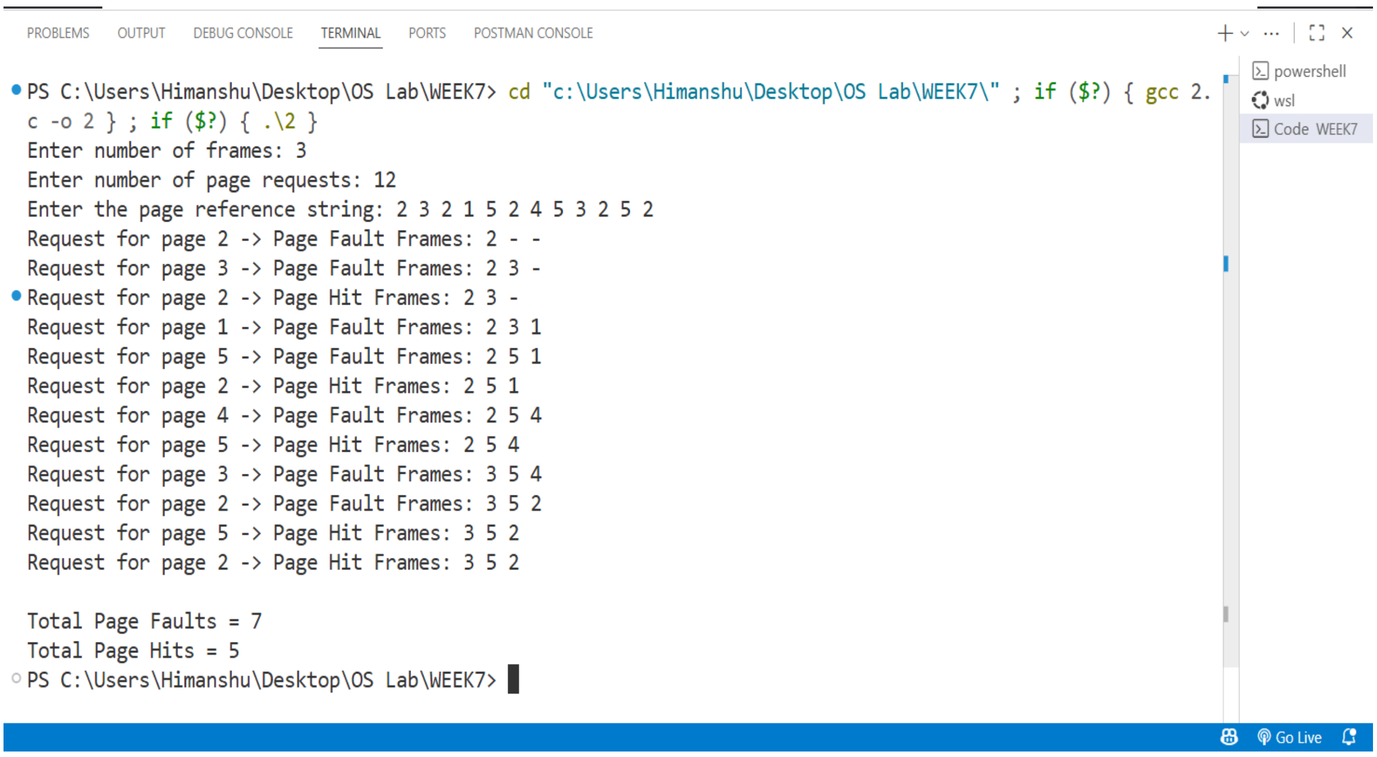
Program2) LRU – Least Recently Used : page which is has not been used for longest Ame need to be moved out.

Source Code:

```
#include <stdio.h>

int isPresent(int frames[], int n, int page) {

   for (int i = 0; i < n; i++) {

      if (frames[i] == page)

         return 1;

   }

   return 0;

}

int findLRU(int time[], int n) {

   int min = time[0], pos = 0;

   for (int i = 1; i < n; i++) {

      if (time[i] < min) {

         min = time[i];

         pos = i; }

   }

   return pos;

}

void display(int frames[], int n) {

   for (int i = 0; i < n; i++) {

      if (frames[i] != -1)

         printf("%d ", frames[i]);

      else

         printf("- ");

   }

   printf("\n");

}

void main()
```

```
{
    int n, m;
    printf("Enter number of frames: ");
    scanf("%d", &n);
    printf("Enter number of page requests: ");
    scanf("%d", &m);
    int pages[m];
    printf("Enter the page reference string: ");
    for (int i = 0; i < m; i++)
        scanf("%d", &pages[i]);
    int frames[n], time[n];
    int counter = 0, pageFaults = 0;
    for (int i = 0; i < n; i++)
    {
        frames[i] = -1;
        time[i] = 0;
    }
    for (int i = 0; i < m; i++)
    {
        int page = pages[i];
        printf("Request for page %d -> ", page);

        if (isPresent(frames, n, page))
        {
            for (int j = 0; j < n; j++)
            {
                if (frames[j] == page)
                    time[j] = ++counter;
            }
            printf("Page Hit Frames: ");
        }
        else
        {
            pageFaults++;

            int emptyPos = -1;
            for (int j = 0; j < n; j++)
            {
                if (frames[j] == -1)
                {
                    emptyPos = j;
                    break;
                }
            }
            if (emptyPos != -1)
            {
                frames[emptyPos] = page;
                time[emptyPos] = ++counter;
            }else {
               int pos = findLRU(time, n);
                frames[pos] = page;
                time[pos] = ++counter;
            }
            printf("Page Fault Frames: ");
        }
        display(frames, n);
    }
    printf("\nTotal Page Faults = %d\n", pageFaults);
    printf("Total Page Hits = %d\n", m - pageFaults);
}
```

OUTPUT:



```
PS C:\Users\Himanshu\Desktop\OS Lab\WEEK7> cd "c:\Users\Himanshu\Desktop\OS Lab\WEEK7\" ; if ($?) { gcc 2.
c -o 2 } ; if ($?) { .\2 }
Enter number of frames: 3
Enter number of page requests: 12
Enter the page reference string: 2 3 2 1 5 2 4 5 3 2 5 2
Request for page 2 -> Page Fault Frames: 2 - -
Request for page 3 -> Page Fault Frames: 2 3 -
Request for page 2 -> Page Hit Frames: 2 3 -
Request for page 1 -> Page Fault Frames: 2 3 1
Request for page 5 -> Page Fault Frames: 2 5 1
Request for page 2 -> Page Hit Frames: 2 5 1
Request for page 4 -> Page Fault Frames: 2 5 4
Request for page 5 -> Page Hit Frames: 2 5 4
Request for page 3 -> Page Fault Frames: 3 5 4
Request for page 2 -> Page Fault Frames: 3 5 2
Request for page 5 -> Page Hit Frames: 3 5 2
Request for page 2 -> Page Hit Frames: 3 5 2

Total Page Faults = 7
Total Page Hits = 5
PS C:\Users\Himanshu\Desktop\OS Lab\WEEK7>
```

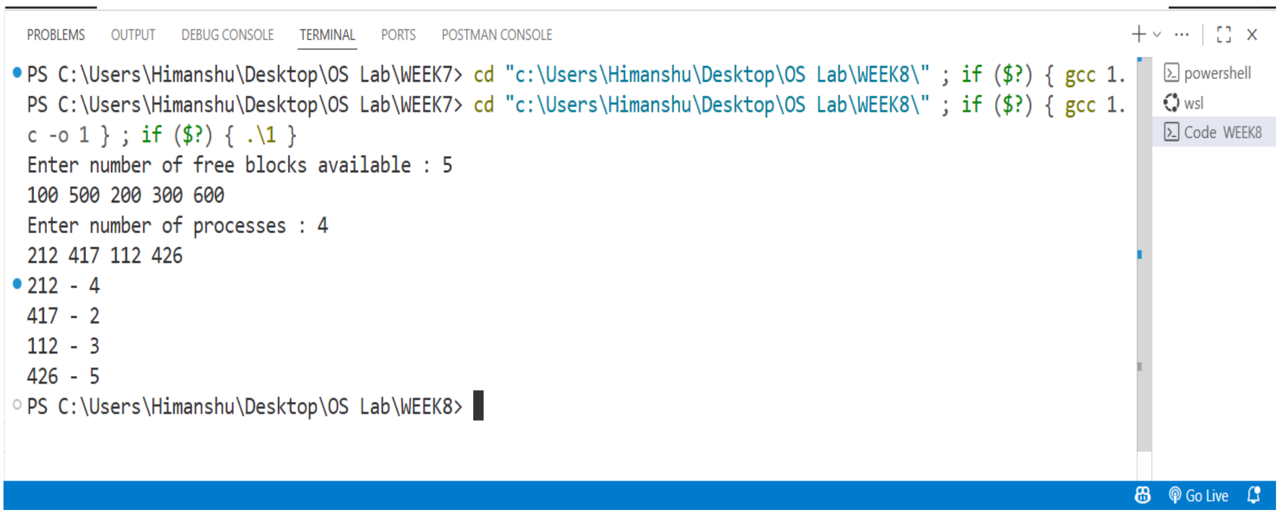
WEEK 8

Program1) Best Fit – block which is closes to the size of request is allocated i.e. the smallest hole that is big enough to allocate to the requesting program.

Source Code:

```
#include <stdio.h>
int main()
{
    int b, p;
    printf("Enter number of free blocks available : ");
    scanf("%d", &b);
    int block[b];
    for (int i = 0; i < b; i++)
        scanf("%d", &block[i]);
    printf("Enter number of processes : ");
    scanf("%d", &p);
    int process[p];
    for (int i = 0; i < p; i++)
        scanf("%d", &process[i]);
    int allocated[p];
    for (int i = 0; i < p; i++)
        allocated[i] = -1;
    for (int i = 0; i < p; i++)
    {
        int bestIdx = -1;
        for (int j = 0; j < b; j++)
        {
            if (block[j] >= process[i])
            {
                if (bestIdx == -1 || block[j] < block[bestIdx])
                    bestIdx = j;
            }
        }
        if (bestIdx != -1)
        {
            allocated[i] = bestIdx;
            block[bestIdx] -= process[i];
        }
    }

    for (int i = 0; i < p; i++)
    {
        if (allocated[i] != -1)
            printf("%d - %d\n", process[i], allocated[i] + 1);
        else
            printf("%d no free block allocated\n", process[i]);
    }

    return 0;
}
```

OUTPUT:



```
PS C:\Users\Himanshu\Desktop\OS Lab\WEEK7> cd "c:\Users\Himanshu\Desktop\OS Lab\WEEK8\" ; if ($?) { gcc 1.
PS C:\Users\Himanshu\Desktop\OS Lab\WEEK7> cd "c:\Users\Himanshu\Desktop\OS Lab\WEEK8\" ; if ($?) { gcc 1.
c -o 1 } ; if ($?) { .\1 }
Enter number of free blocks available : 5
100 500 200 300 600
Enter number of processes : 4
212 417 112 426
212 - 4
417 - 2
112 - 3
426 - 5
PS C:\Users\Himanshu\Desktop\OS Lab\WEEK8>
```

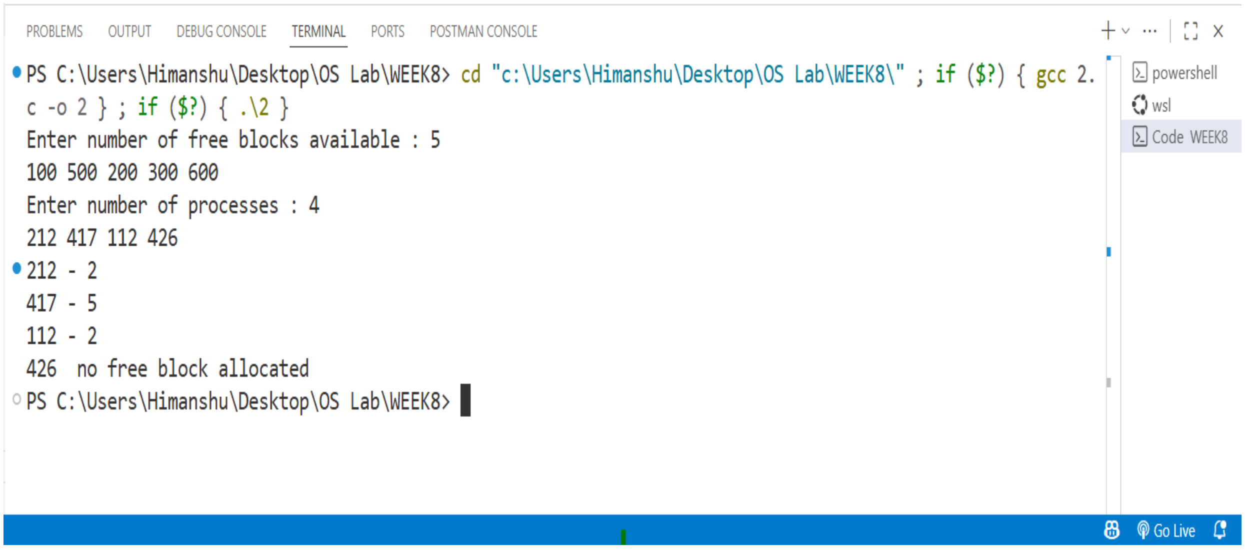
Program 2) First Fit – start searching the list from beginning, take the first block whose size is greater than or equal to the requesting program size and allocate it to program.

<u>Source Code:</u>

```
#include <stdio.h>

int main()

{

   int b, p;

   printf("Enter number of free blocks available : ");

   scanf("%d", &b);

   int block[b];

   for (int i = 0; i < b; i++)

      scanf("%d", &block[i]);

   printf("Enter number of processes : ");

   scanf("%d", &p);

   int process[p];

   for (int i = 0; i < p; i++)

      scanf("%d", &process[i]);

   int allocated[p];

   for (int i = 0; i < p; i++)

      allocated[i] = -1;

   for (int i = 0; i < p; i++)

   {

      for (int j = 0; j < b; j++)

      {

         if (block[j] >= process[i])

         {

            allocated[i] = j;

            block[j] -= process[i];

            break;

         }
```

```
        }
    }

    for (int i = 0; i < p; i++)
    {
        if (allocated[i] != -1)
            printf("%d - %d\n", process[i], allocated[i] + 1);
        else
            printf("%d  no free block allocated\n", process[i]);
    }

    return 0;
}
```

OUTPUT:



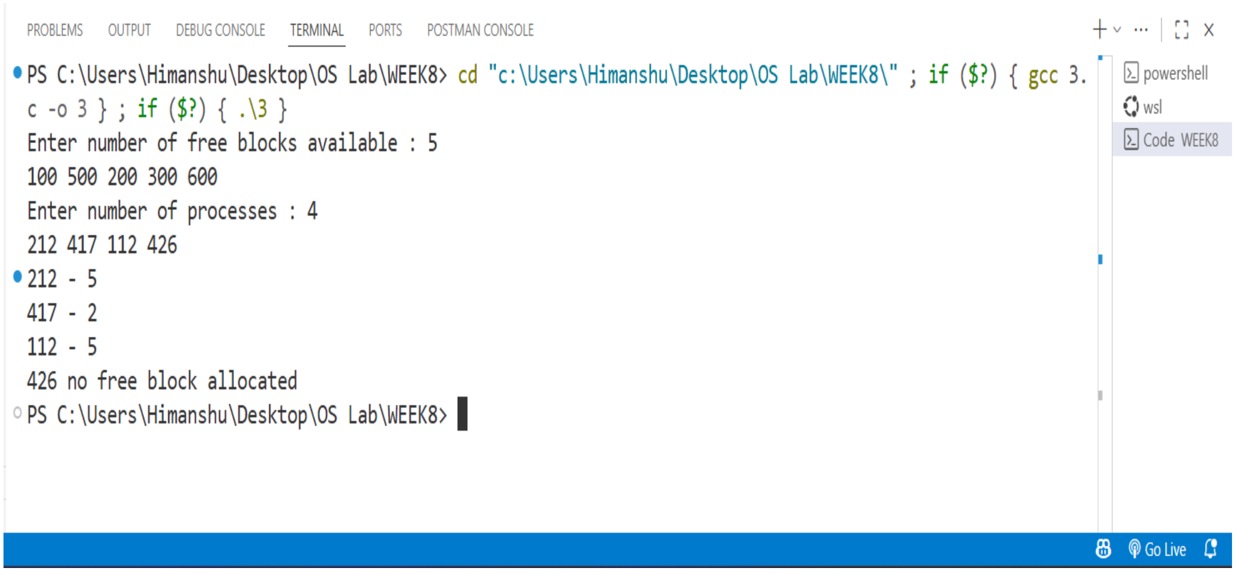
```
PS C:\Users\Himanshu\Desktop\OS Lab\WEEK8> cd "c:\Users\Himanshu\Desktop\OS Lab\WEEK8\" ; if ($?) { gcc 2.
c -o 2 } ; if ($?) { .\2 }
Enter number of free blocks available : 5
100 500 200 300 600
Enter number of processes : 4
212 417 112 426
212 - 2
417 - 5
112 - 2
426  no free block allocated
PS C:\Users\Himanshu\Desktop\OS Lab\WEEK8>
```

Program3) Worst Fit – block which is largest among all is allocated for the program.

Source Code:

```
#include <stdio.h>
int main()
{
    int b, p;
    printf("Enter number of free blocks available : ");
    scanf("%d", &b);

    int block[b];
    for (int i = 0; i < b; i++)
        scanf("%d", &block[i]);

    printf("Enter number of processes : ");
    scanf("%d", &p);

    int process[p];
    for (int i = 0; i < p; i++)
        scanf("%d", &process[i]);

    int allocated[p];
    for (int i = 0; i < p; i++)
        allocated[i] = -1;

    for (int i = 0; i < p; i++)
    {
        int worstIdx = -1;
        for (int j = 0; j < b; j++)
        {
            if (block[j] >= process[i])
            {
                if (worstIdx == -1 || block[j] > block[worstIdx])
                    worstIdx = j;
            }
        }
        if (worstIdx != -1)
        {
            allocated[i] = worstIdx;
            block[worstIdx] -= process[i];
        }
    }

    for (int i = 0; i < p; i++)
    {
        if (allocated[i] != -1)
            printf("%d - %d\n", process[i], allocated[i] + 1);
        else
            printf("%d no free block allocated\n", process[i]);
    }

    return 0;
}
```

OUTPUT:



```
PS C:\Users\Himanshu\Desktop\OS Lab\WEEK8> cd "c:\Users\Himanshu\Desktop\OS Lab\WEEK8\" ; if ($?) { gcc 3.
c -o 3 } ; if ($?) { .\3 }
Enter number of free blocks available : 5
100 500 200 300 600
Enter number of processes : 4
212 417 112 426
212 - 5
417 - 2
112 - 5
426 no free block allocated
PS C:\Users\Himanshu\Desktop\OS Lab\WEEK8>
```