Curtin University – Department of Computing

Operarting Systems Assignment Cover Sheet

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Unit name:	Operating Systems	Unit ID:	COMP2006
Lecturer / unit coordinator:	Sie Teng Soh	Tutor:	Friday 8-9am
Date of submission:	18/05/2020	Which assignment?	(Leave blank if the unit has only one assignment.)

I declare that:

- The above information is complete and accurate.
- The work I am submitting is *entirely my own*, except where clearly indicated otherwise and correctly referenced.
- I have taken (and will continue to take) all reasonable steps to ensure my work is *not accessible* to any other students who may gain unfair advantage from it.
- I have *not previously submitted* this work for any other unit, whether at Curtin University or elsewhere, or for prior attempts at this unit, except where clearly indicated otherwise.

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- It is my responsibility to ensure that my submission is complete, correct and not corrupted.

Signature: K.Prassana

Date of signature: 18/05/2020

(By submitting this form, you indicate that you agree with all the above text.)

Software Solution

lift.h

```
typedef struct
{
   int start;
   int dest;
}Lift;
```

lift_sim_A.c

```
#include <pthread.h>
#include <stdlib.h>
#include <unistd.h>
#include <stdio.h>
#include "lift.h"

pthread_mutex_t mutex;
pthread_cond_t prod = PTHREAD_COND_INITIALIZER;
pthread_cond_t cons = PTHREAD_COND_INITIALIZER;
int num = 0;/*number of elements in buffer*/
int add = 0;/*the next index to add to*/
int rem = 0;/*index that has been used*/
Lift *buffer;/*Array of Lifts*/
int bufSize;/*size of Lift array called buffer*/
FILE *f = NULL;/*input file -- sim_input*/
FILE *output = NULL;/*output file -- sim_output*/
int previousFloor = 1;/*Previous Floor*/
int requestsServed = 0;/*number of requests served*/
int requestNo = 0;/*number of requests put into the buffer*/

/*Consumer  thread Lift-x*/
void* lift(void * arg)
{
   int* buffSize = (void*)arg;
   int bufferSize = abs(*buffSize);
   int movement;/*previous position*/
   output = fopen("sim_output.txt", "w+");
   while(1)
   {
      pthread_mutex_lock(&mutex);
      while(num == 0)
      {
         pthread_cond_wait(&cons, &mutex);
      }
      fprintf(output,"\n%s %d" , "Previous Position: Floor ", previousFloor);
```

```
        fprintf(output, "\n%s %d %s %d " , "Floor ", buffer[rem].start, " to Floor ", buffer[rem].dest);
        fprintf(output,"\n%s" , "Detail Operations:");
        fprintf(output, "\n%s %d %s %d" , "    Go from Floor ", previousFloor, " to Floor ",
        buffer[rem].start);
        fprintf(output, "\n%s %d %s %d" , "    Go from Floor ", buffer[rem].start, " to Floor ",
        buffer[rem].dest);
        if((previousFloor > buffer[rem].start)&&(buffer[rem].dest > buffer[rem].start))
        {
           movement = (previousFloor - buffer[rem].start) + (buffer[rem].dest - buffer[rem].start);
        }
        else if((previousFloor > buffer[rem].start)&&(buffer[rem].start > buffer[rem].dest))
        {
           movement = (previousFloor - buffer[rem].start) + (buffer[rem].start - buffer[rem].dest);
        }
        else if((previousFloor < buffer[rem].start)&&(buffer[rem].dest > buffer[rem].start))
        {
           movement = (buffer[rem].start - previousFloor) + (buffer[rem].dest - buffer[rem].start);
        }
        else
        {
           movement = (buffer[rem].start - previousFloor) + (buffer[rem].start - buffer[rem].dest);
        }
        requestsServed++;
        fprintf(output, "\n%s %d", "    #movement for this request: ", movement);
        fprintf(output, "\n%s %d", "    #request: ", requestsServed);
        previousFloor = buffer[rem].dest;
        fprintf(output, "\n%s %d", "Current position: Floor ", previousFloor);
        rem = (rem + 1) % bufferSize;
        num--;
        pthread_mutex_unlock(&mutex);
        pthread_cond_signal(&prod);
    }
    return NULL;
}

/*Producer thread Lift-R*/
void* request(void * arg)
{
    int *buffSize = (void*)arg;
    int bufferSize = abs(*buffSize);
    int ii;
    int start, dest;
    f = fopen("sim_input.txt", "r");
    output = fopen("sim_output.txt", "w+");
```

```
    buffer = (Lift*)malloc(bufferSize*sizeof(Lift));/*Array of lifts*/
    for(ii=1; ii<=50; ii++)
    {
        pthread_mutex_lock(&mutex);
        while(num == bufferSize)
        {
            pthread_cond_wait(&prod, &mutex);
        }
        fscanf(f, "\n%d %d", &start, &dest);/*put the number of the starting floor and destination
        floor into variables "start and dest"*/
        (buffer[add].start) = start;
        (buffer[add].dest) = dest;
        add = (add+1) % bufferSize;
        num++;
        fprintf(output, "\n%s %d %s %d", "New Lift Request from Floor ", buffer[add].start, " to ",
        buffer[add].dest);
        requestNo++;
        fprintf(output, "\n%s %d", "Request No: ", requestNo);
        pthread_mutex_unlock(&mutex);
        pthread_cond_signal(&cons);

    }
    pthread_mutex_unlock(&mutex);
    return NULL;
}

int main(int argc, char *argv[])
{
    int i;
    pthread_t tid;

    pthread_create(&tid, NULL, lift, &argv[1]);

    for(i=1; i<=3; i++)
    {
        pthread_create(&tid, NULL, request, &argv[1]);
    }

    pthread_join(tid, NULL);
    fclose(f);
    fclose(output);
    free(buffer);
    return 0;
}
```

README File

In order to compile, type "make" to compile the program using the makefile
This will create an executable file called "program"

In order to run this program type: ./program m
m is whatever number you want the buffer size to be. I was unable to implement t, the time taken for each request.

Although a segmentation fault occurs, the program still partially works.
If you get an abort message, simply run the program again.

Mutual Exclusion

The main problem in this program is the bounded buffer producer consumer problem. There are four threads, in total, accessing the shared buffer and as such there will be multi thread synchronization problems.

Without proper synchronization, the errors that may occur are, a producer doesn't block when a buffer is full, a consumer consumes an empty slot in the buffer, two producers write to the same slot and two consumers read the same slot. In order to implement the bounded buffer, a finite size array in memory is shared by the producer and consumer threads. Producer threads "produce" a value and places it in the buffer, consumer threads consume a value in the buffer by removing it. Information about the state of the buffer is also stored such as which slots in the buffer are free, which slot the next data item should be stored(this is the add global variable), which slots in the buffer are filled and from which slot should the next data item be read(this is the rem global variable).

In the producer thread pthread_cond_wait() forces the producer to wait, if the buffer is full, until there is an empty slot in the buffer. pthread_cond_signal() signals the consumer to begin it's function indicating that there is free space in the buffer. In the consumer pthread_cond_wait() forces the consumer to wait if there is no item in the buffer. If the buffer has items in it then it will enter it's critical section. After that it will signal the producer as there is once again free space in the buffer to produce an item. This way mutual exclusion is ensured.

Sample Input and Output

compiled using command "./program 1"
1 is the buffer size. I was unable to implement t, the time taken for each request.

sim_input.txt

20 3
20 9

sim_output.txt

Current position: Floor 0
Previous Position: Floor 0

Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 26
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 27
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 28
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 29
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 30
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0

#movement for this request: 0
#request: 31
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 32
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 33
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 34
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 35
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 36
Current position: Floor 0
New Lift Request from Floor 0 to 0

Request No: 51
New Lift Request from Floor 0 to 0
Request No: 52
New Lift Request from Floor 0 to 0
Request No: 53
New Lift Request from Floor 0 to 0
Request No: 54
New Lift Request from Floor 0 to 0
Request No: 55
New Lift Request from Floor 0 to 0
Request No: 56
New Lift Request from Floor 0 to 0
Request No: 57
New Lift Request from Floor 0 to 0
Request No: 58
New Lift Request from Floor 0 to 0
Request No: 59
New Lift Request from Floor 0 to 0
Request No: 60
New Lift Request from Floor 0 to 0
Request No: 61
New Lift Request from Floor 0 to 0
Request No: 62
New Lift Request from Floor 0 to 0
Request No: 63
New Lift Request from Floor 0 to 0
Request No: 64
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 37
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 38
Current position: Floor 0
New Lift Request from Floor 0 to 0

Request No: 65
New Lift Request from Floor 0 to 0
Request No: 66
New Lift Request from Floor 0 to 0
Request No: 67
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 39
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 40
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 41
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 42
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 43

Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 44
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 45
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 46
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
#movement for this request: 0
    #request: 47
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 48
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:

Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 49
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 50
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 51
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 52
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 53
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 54

Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 55
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 56
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 57
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 58
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
D#request: 25ons:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 59
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:

Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 60
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 61
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 62
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 63
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 64
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 65

Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 66
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 67
Current position: Floor 0
New Lift Request from Floor 0 to 0
Request No: 68
New Lift Request from Floor 0 to 0
Request No: 69
New Lift Request from Floor 0 to 0
Request No: 70
New Lift Request from Floor 0 to 0
Request No: 71
New Lift Request from Floor 0 to 0
Request No: 72
New Lift Request from Floor 0 to 0
Request No: 73
New Lift Request from Floor 0 to 0
Request No: 74
New Lift Request from Floor 0 to 0
Request No: 75
New Lift Request from Floor 0 to 0
Request No: 76
New Lift Request from Floor 0 to 0
Request No: 77
New Lift Request from Floor 0 to 0
Request No: 78
New Lift Request from Floor 0 to 0
Request No: 79
New Lift Request from Floor 0 to 0
Request No: 80
New Lift Request from Floor 0 to 0

Request No: 81
New Lift Request from Floor 0 to 0
Request No: 82
New Lift Request from Floor 0 to 0
Request No: 83
New Lift Request from Floor 0 to 0
Request No: 84
New Lift Request from Floor 0 to 0
Request No: 85
New Lift Request from Floor 0 to 0
Request No: 86
New Lift Request from Floor 0 to 0
Request No: 87
New Lift Request from Floor 0 to 0
Request No: 88
New Lift Request from Floor 0 to 0
Request No: 89
New Lift Request from Floor 0 to 0
Request No: 90
New Lift Request from Floor 0 to 0
Request No: 91
New Lift Request from Floor 0 to 0
Request No: 92
New Lift Request from Floor 0 to 0
Request No: 93
New Lift Request from Floor 0 to 0
Request No: 94
New Lift Request from Floor 0 to 0
Request No: 95
New Lift Request from Floor 0 to 0
Request No: 96
New Lift Request from Floor 0 to 0
Request No: 97
New Lift Request from Floor 0 to 0
Request No: 98
New Lift Request from Floor 0 to 0
Request No: 99
New Lift Request from Floor 0 to 0
Request No: 100
New Lift Request from Floor 0 to 0
Request No: 101
New Lift Request from Floor 0 to 0
Request No: 102
New Lift Request from Floor 0 to 0

Request No: 103
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 68
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 69
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 70
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 71
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 72
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:

Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 73
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 74
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 75
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 76
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 77
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 78

Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 79
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
#movement for this request: 0
    #request: 80
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 81
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 82
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 83
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:

Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 84
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 85
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 86
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 87
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 88
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 89

Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 90
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 91
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 92
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 93
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 94
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:

Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 95
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 96
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 97
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 98
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 99
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
Go from Floor 0 to Floor 0
Go from Floor 0 to Floor 0
#movement for this request: 0
#request: 100

Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
#movement for this request: 0
    #request: 101
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 102
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 103
Current position: Floor 0
New Lift Request from Floor 0 to 0
Request No: 104
New Lift Request from Floor 0 to 0
Request No: 105
New Lift Request from Floor 0 to 0
Request No: 106
New Lift Request from Floor 0 to 0
Request No: 107
New Lift Request from Floor 0 to 0
Request No: 108
New Lift Request from Floor 0 to 0
Request No: 109
New Lift Request from Floor 0 to 0
Request No: 110
New Lift Request from Floor 0 to 0
Request No: 111
New Lift Request from Floor 0 to 0
Request No: 112
New Lift Request from Floor 0 to 0

Request No: 113
New Lift Request from Floor 0 to 0
Request No: 114
New Lift Request from Floor 0 to 0
Request No: 115
New Lift Request from Floor 0 to 0
Request No: 116
New Lift Request from Floor 0 to 0
Request No: 117
New Lift Request from Floor 0 to 0
Request No: 118
New Lift Request from Floor 0 to 0
Request No: 119
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 104
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 105
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 106
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 107

Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 108
Current position: Floor 0
New Lift Request from Floor 0 to 0
Request No: 120
New Lift Request from Floor 0 to 0
Request No: 121
New Lift Request from Floor 0 to 0
Request No: 122
New Lift Request from Floor 0 to 0
Request No: 123
New Lift Request from Floor 0 to 0
Request No: 124
New Lift Request from Floor 0 to 0
Request No: 125
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0
    #movement for this request: 0
    #request: 109
Current position: Floor 0
New Lift Request from Floor 0 to 0
Request No: 126
New Lift Request from Floor 0 to 0
Request No: 127
New Lift Request from Floor 0 to 0
Request No: 128
New Lift Request from Floor 0 to 0
Request No: 129
New Lift Request from Floor 0 to 0
Request No: 130
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
    Go from Floor 0 to Floor 0
    Go from Floor 0 to Floor 0

#movement for this request: 0
   #request: 110
Current position: Floor 0
New Lift Request from Floor 0 to 0
Request No: 131
New Lift Request from Floor 0 to 0
Request No: 132
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
   Go from Floor 0 to Floor 0
   Go from Floor 0 to Floor 0
   #movement for this request: 0
   #request: 111
Current position: Floor 0
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
   Go from Floor 0 to Floor 0
   Go from Floor 0 to Floor 0
   #movement for this request: 0
   #request: 112
Current position: Floor 0
New Lift Request from Floor 0 to 0
Request No: 133
New Lift Request from Floor 0 to 0
Request No: 134
New Lift Request from Floor 0 to 0
Request No: 135
New Lift Request from Floor 0 to 0
Request No: 136
Previous Position: Floor 0
Floor 0 to Floor 0
Detail Operations:
   Go from Floor 0 to Floor 0
   Go from Floor 0 to Floor 0
   #movement for this request: 0
   #request: 113
Current position: Floor 0
New Lift Request from Floor 0 to 0
Request No: 137
New Lift Request from Floor 0 to 0

There is a bug that causes the floor numbers to not show. This is most likely due to an issue with the incrementation of the add and rem indexes. However despite this error, the number of lines outputted seems to correspond with the input and buffer size.

The scenarios that this program would not be able to handle would be if the buffer size was greater than 100.