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Statement: A. Thread synchronization using counting semaphores. Application to demonstrate: producerconsumer problem with counting semaphores and mutex.

Code:

```
#include<stdio.h>
```

```
#include<stdlib.h>
```

```
#include<sys/syscall.h>
```

```
#include<pthread.h>
```

```
#include<semaphore.h>
```

```
void* producer();
```

```
void* consumer();
```

```
int item;
```

```
int in = 0, out = 0;
```

```
sem_t mutex;
```

```
typedef struct
```

```
{
```

```
    int buff[20];
```

```
    sem_t full, empty;
```

```
}shared;
```

```
shared sh;
```

```
void* producer()
```

```
{
```

```
    int ptid;
```

```

while(1)
{
    item = in;

    sem_wait(&sh.empty);
    sem_wait(&mutex);

    sh.buff[in++] = item;

    printf("\nproducer thread id and producer item: %ld, %d\n",pthread_self(),item);

    sem_post(&mutex);
    sem_post(&sh.full);

    sleep(2);
}
}

```

```

void* consumer()
{
    int ctid;
    while(1)
    {
        while(out<=in)
        {
            sem_wait(&sh.full);
            sem_wait(&mutex);

            item = sh.buff[out++];

```

```

        printf("\nconsumer thread id and consumer item:: %ld, %d\n",pthread_self()
,item);

        sem_post(&mutex);
        sem_post(&sh.empty);
        sleep(2);

    }

}

int main()
{
    pthread_t ptid1, ptid2, ctid1;
    sem_init(&sh.empty, 0, 20);
    sem_init(&sh.full, 0, 0);
    sem_init(&mutex, 0, 1);

    pthread_create(&ptid1, NULL, producer, NULL);
    pthread_create(&ptid2, NULL, producer, NULL);
    pthread_create(&ctid1, NULL, consumer, NULL);

    pthread_join(ptid1, NULL);
    pthread_join(ptid2, NULL);
    pthread_join(ctid1, NULL);

    return 0;

}

```

OUTPUT:

```
student@student-OptiPlex-390:~/38$ gcc -o exe pract4.c -lpthread
```

```
student@student-OptiPlex-390:~/38$ ./exe
```

```
producer thread id and producer item: 139978617190144, 0
```

```
producer thread id and producer item: 139978608797440, 1
```

```
consumer thread id and consumer item:: 139978600404736, 0
```

```
producer thread id and producer item: 139978617190144, 2
```

```
producer thread id and producer item: 139978608797440, 3
```

```
consumer thread id and consumer item:: 139978600404736, 1
```

```
producer thread id and producer item: 139978617190144, 4
```

```
producer thread id and producer item: 139978608797440, 5
```

```
consumer thread id and consumer item:: 139978600404736, 2
```

```
producer thread id and producer item: 139978617190144, 6
```

```
producer thread id and producer item: 139978608797440, 7
```

```
consumer thread id and consumer item:: 139978600404736, 3
```

```
^C
```

```
student@student-OptiPlex-390:~/38$
```