```c
typedef struct{
  int space;           //number of free resources
  struct process *P; //a list of queueing producers
  struct process *C; //a list of queueing consumers
} semaphore;
semaphore S;
S.space = 5;
```

```c
void down(S){
  S.space--;
  if(S.space == 4){
    rmFromQueue(S.C);
    wakeup(S.C);
  }
  if(S.space < 0){
    addToQueue(S.P);
    sleep();
  }
}
```

```c
void up(S){
  S.space++;
  if(S.space > 5){
    addToQueue(S.C);
    sleep();
  }
  if(S.space >= 0){
    rmFromQueue(S.P);
    wakeup(S.P);
  }
}
```