Assignment 2 Notes

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1 Read and Writer

- Reader don't modify the data so we can have multiple readers, but only one writer
- Are examples of a common computing problem in concurrency
- Is a part of semaphore problem

2 Product/Consumer

```
producer() {
  while(1) {

    add_to_buf()

  }
}
```

```
consumer() {
  while(1) {

    remove_from_buf()

  }
}
```

- Is essentially how `pipes()` are implemented
- Has bounded buffer as a shared variable
  - Bounded buffer is also used when piping the output of one program into another

    Example

    `grep foo file.txt | wc -l`

    * `grep`
      - searches the input files for lines containing a match to a given pattern lis
      - when it finds a match in a line, it copies the line to standard output (by default)
    * `wc -l`
      - stands for word count
      - is used to find the number of lines (in this case)
    * `grep` is the producer
    * `wc` is the consumer
- Single buffer producer/consumer solution

- Is to use two different conditial variables
  - Is nice, trouble free and simple

```
1  cond_t  empty, fill;
2  mutex_t mutex;
3
4  void *producer(void *arg) {
5      int i;
6      for (i = 0; i < loops; i++) {
7          Pthread_mutex_lock(&mutex);
8          while (count == 1)
9              Pthread_cond_wait(&empty, &mutex);
10         put(i);
11         Pthread_cond_signal(&fill);
12         Pthread_mutex_unlock(&mutex);
13     }
14 }
15
16 void *consumer(void *arg) {
17     int i;
18     for (i = 0; i < loops; i++) {
19         Pthread_mutex_lock(&mutex);
20         while (count == 0)
21             Pthread_cond_wait(&fill, &mutex);
22         int tmp = get();
23         Pthread_cond_signal(&empty);
24         Pthread_mutex_unlock(&mutex);
25         printf("%d\n", tmp);
26     }
27 }
```

Conditional variable 1

Conditional variable 2

YES

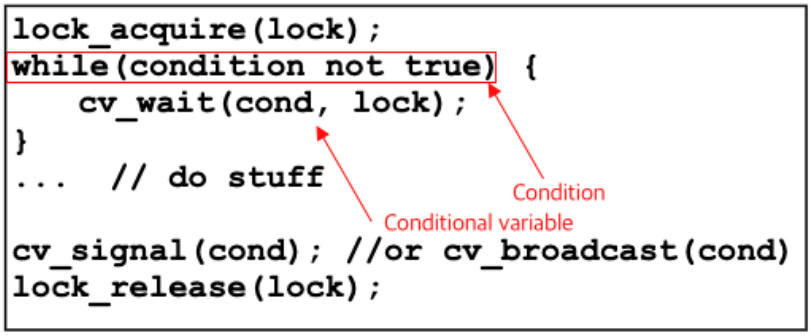
```
1  int loops;
2  cond_t  cond;
3  mutex_t mutex;
4
5  void *producer(void *arg) {
6      int i;
7      for (i = 0; i < loops; i++) {
8          Pthread_mutex_lock(&mutex);            // p1
9          while (count == 1)                     // p2
10             Pthread_cond_wait(&cond, &mutex);  // p3
11         put(i);                                // p4
12         Pthread_cond_signal(&cond);            // p5
13         Pthread_mutex_unlock(&mutex);          // p6
14     }
15 }
16
17 void *consumer(void *arg) {
18     int i;
19     for (i = 0; i < loops; i++) {
20         Pthread_mutex_lock(&mutex);            // c1
21         while (count == 0)                     // c2
22             Pthread_cond_wait(&cond, &mutex);  // c3
23         int tmp = get();                       // c4
24         Pthread_cond_signal(&cond);            // c5
25         Pthread_mutex_unlock(&mutex);          // c6
26         printf("%d\n", tmp);
27     }
28 }
```

Same conditional variable

NONO

- The general correct producer/consumer solution

3 Condtional Variable



- is a queue of waiting threads
- has two operations associated with it:
  1. `cv_wait(struct cv *cv, struct lock *lock)`
     - Is executed when a thread wishes to put itself to sleep
     - Releases lock, waits, re-acquires lock before return
       - Is to prevent race condtions from occuring when a thread is trying to put itself to sleep
  2. `cv_signal(struct cv *cv, struct lock *lock)`
     - Wakes one enqueued thread
  3. `cv_broadcast(struct cv *cv, struct lock *lock)` [from notes]
     - Wakes all enqueued threads
- If no one is waiting, signal or broadcast has no effect
- has rules
  - always use with `while` loops
    - on waking up, tread checks for condition in while loop
    - if condition is true, then thread goes back to sleep
- is always used together with locks

4 Semaphore

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