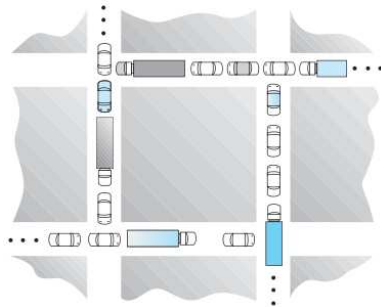# Problem Set 11

CS 411

Due at the beginning of class on the first class day of the following week.
Sections 8.1–4

1. Consider the traffic deadlock depicted in the figure below.

    (a) Show that the four necessary conditions for deadlock hold in this example.

    (b) State a simple rule for avoiding deadlocks in this system.

2. The program example shown below doesn't always lead to deadlock. Describe what role the CPU scheduler plays and how it can contribute to deadlock in this program.

```
/* thread one runs in this function */
void *do_work_one(void *param) {
   pthread_mutex_lock(&first mutex);
   pthread_mutex_lock(&second mutex);
   /* Do some work */
   pthread_mutex_unlock(&second mutex);
   pthread_mutex_unlock(&first mutex);
}

/* thread two runs in this function */
void *do_work_two(void *param) {
   pthread_mutex_lock(&second mutex);
   pthread_mutex_lock(&first mutex);
   /* Do some work */
   pthread_mutex_unlock(&first mutex);
   pthread_mutex_unlock(&second mutex);
}
```

3. When will the program example in the previous question lead to deadlock? Draw the resource allocation graph corresponding to this situation and show that the four necessary conditions all hold.