CS3211 Parallel and Concurrent Programming – Week 9 tutorial

1. What action trace violates the following safety property?

   Property PS = (a -> (b->PS | a-> PS) | b->a->PS).

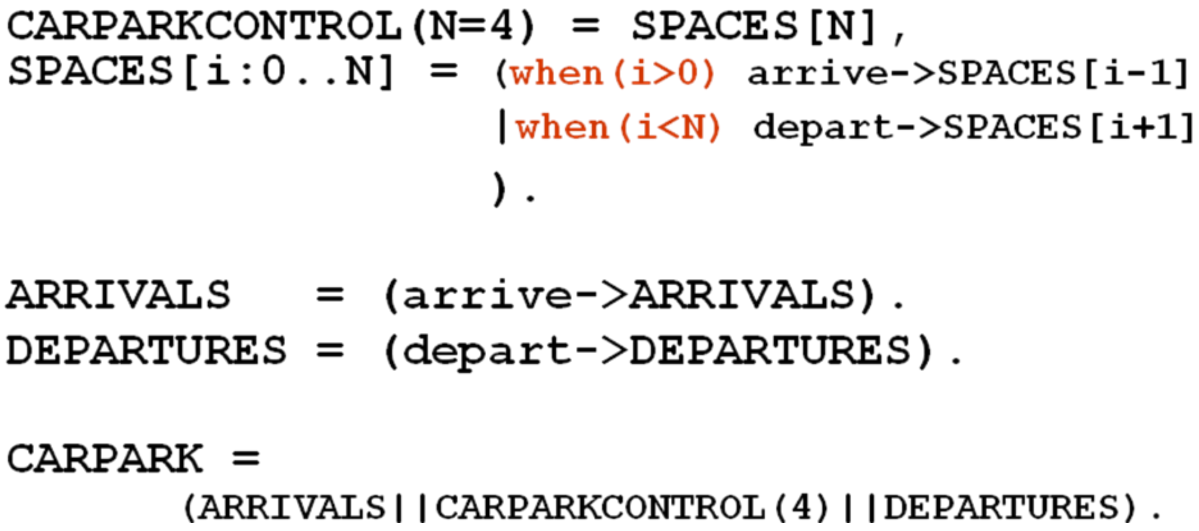
Answer:
```
/*
Trace to property violation in PS:
      b
      b
*/
```

2. A lift has a maximum capacity of ten people. In the model of the lift control system, passengers entering the lift are signalled by an enter action, and passengers leaving the lift are signalled by an exit action. Specify a safety property as a process equation which when composed with the lift will check that the system never allows the lift to have more than 10 occupants.

```
Property LIFTCAPACITY = LIFT[0]
LIFT[i] = (when (i < 10) enter -> LIFT[i+1]
            | when (i >0) exit -> LIFT[i-1]
            | when (i==0) exit -> LIFT[0]
           ).

/*
Trace to property violation in LIFTCAPACITY:
      enter
      enter
      enter
      enter
      enter
      enter
      enter
      enter
      enter
      enter
      enter
*/
```

3. Recall the car park problem discussed in our lecture on monitors (Lec6.ppt). A controller is required for a carpark, which only permits cars to enter when the carpark is not full and does not permit cars to leave when there are no cars in the carpark. Car arrival and departure are simulated by separate threads.



```
CARPARKCONTROL(N=4) = SPACES[N],
SPACES[i:0..N] = (when(i>0) arrive->SPACES[i-1]
                 |when(i<N) depart->SPACES[i+1]
                 ).

ARRIVALS   = (arrive->ARRIVALS).
DEPARTURES = (depart->DEPARTURES).

CARPARK =
        (ARRIVALS||CARPARKCONTROL(4)||DEPARTURES).
```

Specify a safety property which states that the car park does not overflow. Specify a progress property which asserts that cars eventually get to enter the car park. If car departure is lower priority than car arrival, does starvation occur?

Answer:

```
property OVERFLOW(N=4) = OVERFLOW[0],
OVERFLOW[i:0..N] = (arrive -> OVERFLOW[i+1]
                   |depart -> OVERFLOW[i-1]
                   ).

CHECK_CARPARK = (OVERFLOW(4) || CARPARK).

/* try safety check with OVERFLOW(3) */

progress ENTER = {arrive}

LIVE_CARPARK = CARPARK >>{depart}.
```

4. In an operating system, a binary semaphore is used to control access to the console. The console is used by user processes and system processes. Construct a model of this system and investigate the scheduling conditions under which user processes may be denied access to console.

```
BSEMA = (up -> down -> BSEMA).

PROCESS  = (console.up -> console.down -> PROCESS).

set Processes = {user[1..2],system[1..2]}

/* system processes have higher priority than user processes */
OS = (Processes:PROCESS || Processes::console:BSEMA)>>{user}.
```

5. Which of these properties can be considered as safety or progress properties that we studied in class last week? Which of these cannot be? You can assume that the following are all properties of a traffic light controller …

   – The light is *always* green.
   – *Whenever* the light is red, it *eventually* becomes green.
   – *Whenever* the light is green, it remains green *until* it becomes yellow.
   – *Whenever* the light is yellow, it becomes red *immediately after*.

Answer:

The first one is a safety property

The second one is a progress property

The third one demands more than the conventional progress.

The last one is neither safety nor progress property.