Disclaimer: These are not all the representative questions, or an indicator mid-term. These questions are meant for sharpening the concepts, they do not form patterns of what may be asked in any examination.

Week 5 Saturday session
CS 3211

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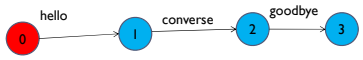
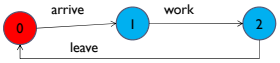
1. Describe as a process



hello -> converse -> goodbye -> STOP

STOP is a special pre-defined process which engages in no actions, and does not have any defining process equation

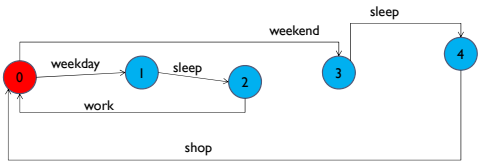
2. Describe as a process



P = arrive -> work -> leave -> P

A recursive process equation is needed in this case.

3. Describe as a process



P = (weekday -> sleep -> work -> P
| weekend -> sleep -> shop -> P
)

The choice operator is also needed here.

4. Describe a RADIO

- A FM radio has 3 controls
  - A on/off switch does the obvious.
  - When reset is pressed, the radio is tuned to high frequencies
  - When scan is pressed, the radio is tuned to low frequencies. It stops scanning when it locks to a station or when it reaches the bottom (an end action).
    - If the radio is currently tuned to a station and scan is pressed – it starts to scan from that station to downwards frequencies.
    - Similarly for reset, it scans from current station upwards.
- Write process equation for the RADIO process. The actions should be
  - {on, off, scan, reset, lock, end}

Answer:

RADIO = OFF,
OFF = (on -> TOP),
TOP = (scan -> SCANNING | reset -> TOP | off -> OFF),
SCANNING = (scan -> SCANNING | reset -> TOP | off -> OFF | lock -> TUNED | end -> BOTTOM),
TUNED = (scan -> SCANNING | reset -> TOP | off -> OFF),
BOTTOM = (scan -> BOTTOM | reset -> TOP | off -> OFF).

- Now describe the same behavior via a state machine.

5. Model concurrency in a museum

A museum allows visitors to enter through the east entrance and leave through west exit. Arrivals and departures are signaled to the museum controller by the turnstiles at entry/exit.

At opening time, the museum director communicates to the controller that the museum is open, and the controller allows arrivals/departures.

At closing time, the museum director communicates to the controller that the museum is closed, and the controller allows only departures.

Model the above as a concurrent program.

a. What will be the processes in such a program.
b. Describe the process equation for each process.

Answer a.

- The processes are
  - CONTROL
  - DIRECTOR
  - EAST (entry turnstile)
  - WEST (exit turnstile)

Answer b.

```
const N = 100   /* can put any upper bound  here  */

EAST = (arrive -> EAST).

WEST = (leave  -> WEST).

DIRECTOR = (open -> close -> DIRECTOR).

CONTROL        = CLOSED[0],
CLOSED[i:0..N] = (when (i==0) open -> OPENED[0]
                  |when (i>0)  leave -> CLOSED[i-1]
                 ),
OPENED[i:0..N] = (close -> CLOSED[i]
                 |when (i<N) arrive -> OPENED[i+1]
                 |when (i>0) leave  -> OPENED[i-1]
                ).

||MUSEUM = (EAST || WEST || DIRECTOR || CONTROL).
```

6. Recursive locks in Java

- Recall how we had described a basic lock as a process.
- Describe the recursive locks in Java, with the restriction that a thread can lock a shared object at most k times, for some k >= 2. The actions should be {acquire, release}
- Now show, the communication of the recursive lock process with a process which tries to acquire the lock k+1 times.

Answer

```
Klock(x,k) = ( when (x < k) acquire -> Klock(x+1,k)
             | when (x > 0) release -> Klock(x-1,k)
           ).
```

Acquire and release are shared actions, for the purpose of communicating with processes which acquire/release locks on the shared object in question.

So, the communication is via the shared actions {acquire, release}.

Coverage of concepts

- Questions 1, 2, 3
  - Basics – warm-up
- Question 4
  - Question on processes
    - Reading – chapter 2 of textbook
- Question 5
  - Question on concurrent execution
    - Reading – chapter 3 of textbook
- Question 6
  - Question on shared objects
    - Reading – chapter 4 of textbook

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