Assignment 4: SCOOP principles

ETH Zurich

1 Interpreting a SCOOP program

1.1 Background

The code in listing 1 shows the participants of a crazy office. Note that the BOSS class is the root of this system.

Listing 1: crazy office classes

class BOSS

create
  make

feature
  evil_supervisor : separate EVIL_SUPERVISOR
  nice_supervisor : separate NICE_SUPERVISOR
  worker: separate WORKER

make
  -- Create supervisors and a worker and use the supervisors to drive the worker.
  do
    create evil_supervisor
    create nice_supervisor
    create worker
    print ("boss: I am about to ask the supervisors to do their job.")
    run ( evil_supervisor, nice_supervisor )
    print ("boss: I am done.")
  end

run ( a_evil_supervisor : separate EVIL_SUPERVISOR; a_nice_supervisor: separate NICE_SUPERVISOR )
  -- Use the supervisors to drive the worker.
  do
    a_evil_supervisor . convince (worker)
    a_nice_supervisor . convince (worker)
    a_evil_supervisor . convince (worker)
    a_nice_supervisor . convince (worker)

    if ( a_evil_supervisor . done and a_nice_supervisor . done) then
      print ("boss: The supervisors are done.")
    end
  end
end
class EVIL_SUPERVISOR

feature done: BOOLEAN
  -- Did I convince a worker?
convince (a_worker: separate WORKER)
  -- Convince 'a_worker' that he is not done as soon as he thinks that he is done.
  require a_worker.done
do  a_worker.be_not_done
done := true
  print ("evil supervisor: I am done.")
end

class NICE_SUPERVISOR

feature done: BOOLEAN
  -- Did I convince a worker?
convince (a_worker: separate WORKER)
  -- Convince 'a_worker' that he is done as soon as he thinks that he is not done.
  require not a_worker.done
do  a_worker.be_done
done := true
  print ("nice supervisor: I am done.")
end

class WORKER

create
make

feature make
  -- Create the worker and make him not done.
do  done := false
ensure not done: not done
end

done: BOOLEAN
  -- Do I think that I am done with my task?
be_not_done
    -- Make me realize that I am not done.
    do
        print("worker: I am not done.")
        done := false
    end

be_done
    -- Make me realize that I am done.
    do
        print("worker: I am done.")
        done := true
    end
end

1.2 Task
Write down one possible output of the program. Does this system terminate (i.e. all processors finish their tasks)?

2 Breakfast Running Time
2.1 Background
Reasoning about the execution times of a concurrent SCOOP program, in the context of breakfast.

2.2 Task
Consider the following SCOOP program being executed on a processor z:

bread. cut
toaster. toast
pan. fry
meal. compose
Result := meal. is_cooked and bread. is_delicious
meal. eat

The object-processor associations are given as follows: pan is handled by processor p, bread and toaster by processor q, and meal by processor r. The call bread. cut takes 20 time units until it returns, toaster. toast 30 time units, pan. fry 20 time units, meal. compose 40 time units, meal. eat 20 time units. Assume the queries are instantaneous. What is the minimum time for execution of this program? Justify your answer.

3 Baboon Crossing
3.1 Background
This task is adapted from Downey [1] and Tanenbaum [2]. There is a deep canyon somewhere in Kruger National Park, South Africa, and a single rope that spans the canyon. Baboons can cross the canyon by swinging hand-over-hand on the rope, but if two baboons going in opposite directions meet in the middle, they will fight and drop to their deaths. Furthermore, the rope
is only strong enough to hold $n$ baboons. If there are more baboons on the rope at the same time, it will break.

### 3.2 Task

Design and implement a SCOOP synchronization scheme with the following properties:

- Once a baboon has begun to cross, it is guaranteed to get to the other side without running into a baboon going the other way.
- There are never more than $n$ baboons on the rope.
- A continuing stream of baboons crossing in one direction should not bar baboons going the other way indefinitely (no starvation).

### References
