Assignment 5: 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  
\texttt{done}: BOOLEAN  
\hfill -- Did I convince a worker?  

\texttt{convince} (a\_worker: separate \texttt{WORKER})  
\hfill -- Convince 'a\_worker' that he is not done as soon as he thinks that he is done.  
  
\texttt{require}  
  
\texttt{a\_worker.don}'.  
\texttt{do}  
  
\texttt{a\_worker.be\_not\_done}  
  
\texttt{done := true}  
  
\texttt{print ("evil supervisor: I am done.")}  
  
end

end

class *NICE_SUPERVISOR*

feature  
\texttt{done}: BOOLEAN  
\hfill -- Did I convince a worker?  

\texttt{convince} (a\_worker: separate \texttt{WORKER})  
\hfill -- Convince 'a\_worker' that he is done as soon as he thinks that he is not done.  
  
\texttt{require}  
  
\texttt{not a\_worker.don}'.  
\texttt{do}  
  
\texttt{a\_worker.be\_done}  
  
\texttt{done := true}  
  
\texttt{print ("nice supervisor: I am done.")}  
  
end

end

class *WORKER*

create  
\texttt{make}

feature  
\texttt{make}  
\hfill -- Create the worker and make him not done.  
  
\texttt{do}  
  
\texttt{done := false}  
  
\texttt{ensure}  
  
\texttt{not done: not done}  
  
end

\texttt{done}: BOOLEAN  
\hfill -- 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

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:

\[
\begin{align*}
\text{bread}. \text{cut} \\
\text{toaster}. \text{toast} \\
\text{pan}. \text{fry} \\
\text{meal}. \text{compose}
\end{align*}
\]

\[
\text{Result} := \text{meal}. \text{is\_cooked} \text{ and } \text{bread}. \text{is\_delicious}
\]

\[
\text{meal}. \text{eat}
\]

The object-processor associations are given as follows: \textit{pan} is handled by processor p, \textit{bread} and \textit{toaster} by processor q, and \textit{meal} by processor r. The call \textit{bread}.\textit{cut} takes 20 time units until it returns, \textit{toaster}.\textit{toast} 30 time units, \textit{pan}.\textit{fry} 20 time units, \textit{meal}.\textit{compose} 40 time units, \textit{meal}.\textit{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
