$Id: alien-design.txt,v 1.1 2012-05-12 18:06:03-07 dmfrank - $
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design document for aliens synchronization problem

GOAL:
   To assure that all three genders will wait to reproduce until there
   exists a combination of three different genders. At most two
   reproductions may occur simultaneously.

AVAILABLE RESOURCES:
   semaphores - described in detail in other design doc

DESIGN:
   The primary idea behind the design was to implement a set of barriers.
   All genders rely on their mates, but the third mate is most important
   since it determines the length of their raising of the offspring. The
   following implementation should allow for our goal to be satisfied,
   although the waiting time taken to raise the offspring is short
   compared to the time it takes for another group to begin to reproduce.

   Shared Semaphores:
      line 1 (1)
      line 2 (1)
      line 3 (1)
      mutex (1)
      depends (0)
      reproducing (2)
      raising (0)
      group (3)

   Shared Variables:
      int gathered = 0

   Gender One: pseudocode
      while (user specified number of reproductions)
         wait random time
         down on line 1 semaphore
         down on group semaphore
         down on mutex semaphore
         gathered += 1
         if (gathered == 0)
            gathered = 0
            down on reproducing semaphore
            up on depends semaphore
            up on depends semaphore
            up on depends semaphore
         up on mutex semaphore
         down on depends semaphore
         up on group semaphore
         down on raising semaphore

   Gender Two: pseudocode
      while (user specified number of reproductions)
         wait random time
         down on line 2 semaphore
         down on group semaphore

```
      down on mutex semaphore
      gathered += 1
      if (gathered == 0)
         gathered = 0
         down on reproducing semaphore
         up on depends semaphore
         up on depends semaphore
         up on depends semaphore
      up on mutex semaphore
      down on depends semaphore
      up on group semaphore
      down on raising semaphore

   Gender Three: pseudocode
      while (user specified number of reproductions)
      wait random time
      down on line 3 semaphore
      down on group semaphore
      down on mutex semaphore
      gathered += 1
      if (gathered == 0)
         gathered = 0
         down on reproducing semaphore
         up on depends semaphore
         up on depends semaphore
         up on depends semaphore
      up on mutex semaphore
      down on depends semaphore
      up on line 1 semaphore
      up on line 2 semaphore
      up on line 3 semaphore
      up on group semaphore
      wait random time
      up on raising semaphore
      up on raising semaphore
      up on reproducing semaphore
      down on raising semaphore

TESTING:
   It is necessary to specify the number of times an alien will reproduce.  In
   fact, these numbers should be equivalent in order to prevent sleeping
   processes from tying up a semaphore.  If a process is sleeping on a semaphore
   process list, then that semaphore cannot be deallocated.  So testing any
   single alien should never reproduce.  Any two should also not reproduce.
   When three different genders are waiting, then it is possible for a group
   of three to mate.  It is necessary to check that this condition is always
   satisfied.  There should never be more than two groups of three different
   genders reproducing and raising an offspring.  Printing the current status
   of an alien allows us to know what is going on.

      Example:
      bash-$ ./initaliens
      bash-$ ./alien 4 1 100 &
      bash-$ ./alien 5 2 100 &
      bash-$ ./alien 6 3 100 &
      bash-$ ./freealiens
```