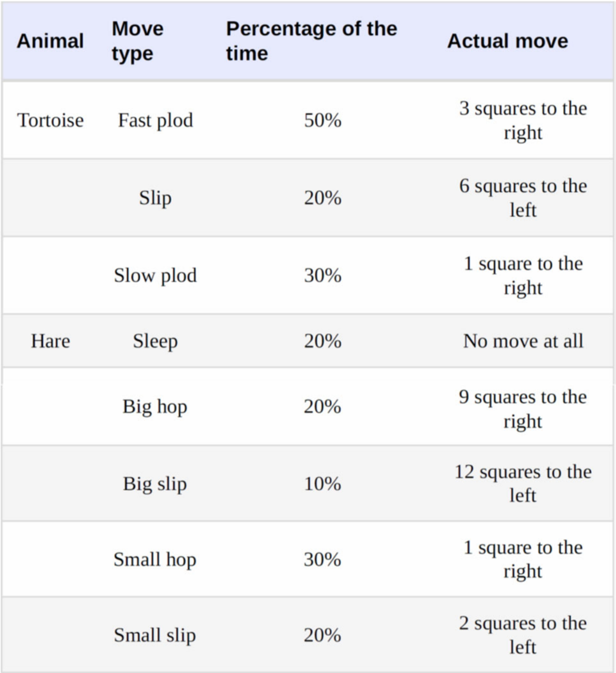
Assignment 2 – Spring 2019

Problem 7.28 (Simulation: The Tortoise and the Hare) In this problem, you'll recreate the classic race of the tortoise and the hare. You'll use $\underline{randomnumber}$ generation to develop a simulation of this memorable event. Our contenders begin the race at square 1 of 70 squares. Each square represents a possible position along the race course. The finish line is at square 70. The first contender to reach or pass square 70 is rewarded with a pail of fresh carrots and lettuce. The course weaves its way up the side of a slippery mountain, so occasionally the contenders lose ground. A clock ticks once per second. With each tick of the clock, your application should adjust the position of the animals according to the rules in Fig. 7.32. Use variables to keep track of the positions of the animals (i.e., position numbers are 1–70). Start each animal at position 1 (the "$starting\ gate$"). If an animal slips left before square 1, move it back to square 1.



Animal	Move type	Percentage of the time	Actual move
Tortoise	Fast plod	50%	3 squares to the right
	Slip	20%	6 squares to the left
	Slow plod	30%	1 square to the right
Hare	Sleep	20%	No move at all
	Big hop	20%	9 squares to the right
	Big slip	10%	12 squares to the left
	Small hop	30%	1 square to the right
	Small slip	20%	2 squares to the left

Percentage moves can be simulated through number ranges:

- ✓ Generate a random number between 0 and 9 (inclusive).
- ✓ 50% maybe simulated as a number between $0\ and\ 4$. i.e. if the random integer number generated is $\leq\ 4$, then perform a fast plod.
- ✓ Pick two numbers for performing $slip$ operation. e.g. $8\ and\ 9$.

Fig. 7.32 Rules for adjusting the positions of the tortoise and the hare.

Generate the percentages in Fig. 7.32 by producing a random integer i in the range $1\ \leq\ i\ \leq\ 10$. For the tortoise, perform a "$fast\ plod$" when $1\ \leq\ i\ \leq\ 5$, a "$slip$" when $6\ \leq\ i\ \leq\ 7$ or a "$slow\ plod$" when $8\ \leq\ i\ \leq\ 10$. Use a similar technique to move the hare.

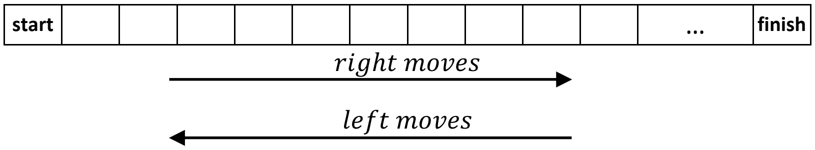
Begin the race by printing:

$ON\ YOUR\ MARK, GET\ SET$
$BANG$!!!!!
$AND\ THEY'RE\ OFF$!!!!!

Then, for each tick of the clock (i.e., each iteration of a loop), display a 70-position line showing the letter T in the position of the tortoise and the letter H in the position of the hare. Occasionally, the contenders will land on the same square. In this case, the tortoise bites the hare, and your application should display $OUCH$!!! beginning at that position. All output positions other than the T, the H or the $OUCH$!!! (in case of a tie) should be blank. After each line is displayed, test for whether either animal has reached or passed square 70. If so, display the winner and terminate the simulation. If the tortoise wins, display $TORTOISE\ WINS!!!\ YAY!!!$ If the hare wins, display $Hare\ wins. Yuch$. If both animals win on the same tick of the clock, you may want to favor the tortoise (the "underdog"), or you may want to display It's a tie. If neither animal wins, perform the loop again to simulate the next tick of the clock. When you're ready to run your application, assemble a group of fans to watch the race. You'll be amazed at how involved your audience gets!

Hints:

- ✓ Since you're using random numbers, outputs will be different.
- ✓ A unit of time is one full iteration in the program. i.e. a counter shows how many iterations were made until one wins. If the simulation takes 30 iterations, then this is treated as 30 seconds.
- ✓ Think of the 70 square runway as shown below. A right move means, advance forward, a left move means backwards.



Requirements:

1. Your program should compile and run in order to be graded. A compilation error results in a grade of 0.
2. Separate your code into methods. Don't put all of your logic in $main$. Your code must have three methods:
   a. One for computing the $tortoise$ move
   b. One for computing the $hare$ move
   c. One to print the current position of the $tortoise$ and $hare$ with respect to start and finish. See the example output below.
3. Submit one class only. Include $main$ with that class.
4. Print the positions of the tortoise and hare at the end of each second (i.e. each iteration).

Grading:

Item	Points
Loop till one wins	2
Handling of logical errors (boundary checking)	1
At least two functions besides $main(\quad)$	3
Printing standings every second (B or H and T)	2
Print correct winner and total time elapsed	2
	10

Sample Output:

- B: means both are at that position
- T: means the $Tortoise$ is at that position
- H: means the $Hare$ is at that position

```
ON YOUR MARK, GET SET
BANG !!!!!
AND THEY'RE OFF !!!!!

Time: 0
B
---------------------------------------------------------------------------
Time: 1
B
---------------------------------------------------------------------------
Time: 2
 T       H
---------------------------------------------------------------------------
Time: 3
  T               H
---------------------------------------------------------------------------
Time: 4
   T                       H
---------------------------------------------------------------------------
Time: 5
      T                     H
---------------------------------------------------------------------------
Time: 6
T                            H
---------------------------------------------------------------------------
Time: 7
T                            H
---------------------------------------------------------------------------
Time: 8
   T                         H
---------------------------------------------------------------------------
Time: 9
      T                    H
---------------------------------------------------------------------------
Time: 10
         T                          H
---------------------------------------------------------------------------
Time: 11
          T                         H
---------------------------------------------------------------------------
Time: 12
           T                         H
---------------------------------------------------------------------------
Time: 13
              T                    H
---------------------------------------------------------------------------
Time: 14
        T                          H
---------------------------------------------------------------------------
Time: 15
           T                                H
---------------------------------------------------------------------------
Time: 16
              T                              H
---------------------------------------------------------------------------
```

```
Time: 17
               T                              H
---------------------------------------------------------------------------
Time: 18
                T                              H
---------------------------------------------------------------------------
Time: 19
                 T                             H
---------------------------------------------------------------------------
Time: 20
                  T                          H
---------------------------------------------------------------------------
Time: 21
                     T                       H
---------------------------------------------------------------------------
Time: 22
                        T                  H
---------------------------------------------------------------------------
Time: 23
                           T               H
---------------------------------------------------------------------------
Time: 24
                              T            H
---------------------------------------------------------------------------
Time: 25
                               T         H
---------------------------------------------------------------------------
Time: 26
                                  T    H
---------------------------------------------------------------------------
Time: 27
                                   T    H
---------------------------------------------------------------------------
Time: 28
                                    T   H
---------------------------------------------------------------------------
Time: 29
                                       TH
---------------------------------------------------------------------------
Time: 30
                                        H T
---------------------------------------------------------------------------
Time: 31
                                         H   T
---------------------------------------------------------------------------
Time: 32
                                              T   H
---------------------------------------------------------------------------
Time: 33
                                        T       H
---------------------------------------------------------------------------
Time: 34
                                           T     H
---------------------------------------------------------------------------
Time: 35
                                     T         H
---------------------------------------------------------------------------
Time: 36
                                        T      H
---------------------------------------------------------------------------
Time: 37
                                           T    H
---------------------------------------------------------------------------
```

```
Time: 38
                                     T        H
---------------------------------------------------------------------------
Time: 39
                               T               H
---------------------------------------------------------------------------
Time: 40
                         T         H
---------------------------------------------------------------------------
Time: 41
                          T         H
---------------------------------------------------------------------------
Time: 42
                           T         H
---------------------------------------------------------------------------
Time: 43
                              T      H
---------------------------------------------------------------------------
Time: 44
                                 T H
---------------------------------------------------------------------------
Time: 45
                       H            T
---------------------------------------------------------------------------
Time: 46
                        H              T
---------------------------------------------------------------------------
Time: 47
                        H                 T
---------------------------------------------------------------------------
Time: 48
                        H                  T
---------------------------------------------------------------------------
Time: 49
                        H                     T
---------------------------------------------------------------------------
Time: 50
                         H                       T
---------------------------------------------------------------------------
Time: 51
                                  H                 T
---------------------------------------------------------------------------
Time: 52
                                   H                 T
---------------------------------------------------------------------------
Time: 53
                                   H                  T
---------------------------------------------------------------------------
Time: 54
                                    H                    T
---------------------------------------------------------------------------
Time: 55
                                     H                      T
---------------------------------------------------------------------------
Time: 56
                                     H                an
---------------------------------------------------------------------------
Time: 57
                                   H                     T
---------------------------------------------------------------------------
Time: 58
                                            H               T
---------------------------------------------------------------------------
```

```
Time: 59
                                          H                    T
---------------------------------------------------------------------------
Time: 60
                                        H                T
---------------------------------------------------------------------------
Time: 61
                                         H                  T
---------------------------------------------------------------------------
Time: 62
                                         H                     T
---------------------------------------------------------------------------
Time: 63
                                          H                     T
---------------------------------------------------------------------------
Time: 64
                                        H                          T
---------------------------------------------------------------------------
Time: 65
                                        H                           T
---------------------------------------------------------------------------
Time: 66
                                      H                              T
---------------------------------------------------------------------------
TORTOISE WINS!!! YAY!!!
Time Elapsed = 66 seconds
```