Question

A stick of unit length is split into two pieces. The breakpoint is randomly selected. On average, how long is the shorter piece?

Physical experiment? ×
Thought experiment? → analysis
Computational experiment! → simulation ×

*Need to repeat many trials!

```matlab
% one trial of the experiment
breakPt = rand;
if breakPt < 0.5
    shortPiece = breakPt;
else
    shortPiece = 1 - breakPt;
end
```

Want to do many trials, add up the lengths of the short pieces, and then divide by the number of trials to get the average length.

```matlab
n = 10000;  % number of trials
total = 0;  % accumulated length so far
for k = 1:n
    % one trial of the experiment
    breakPt = rand;
    shortPiece = min(breakPt, 1 - breakPt);
    total = total + shortPiece;
end
aveLength = total / n
fprintf('Average length is %f
', aveLength)
```
Monte Carlo Estimation of $\pi$

- Throw $N$ darts
- Sq. area = $N = L \times L$
- Circle area = $N_{in} = \pi L^2 / 4$
- $\pi = 4 N_{in} / N$

Monte Carlo Approximation of Pi

For each of $N$ trials
- Throw a dart
- If it lands in circle
  - add 1 to total # of hits

$\pi$ is $4 \times \text{hits} / N$

Syntax of the for loop

```
for <var> = <start value>:<incr>:<end bound>
    statements to be executed repeatedly
end
```

Loop header specifies all the values that the index variable will take on, one for each pass of the loop.
E.g., $k = 3:1:7$ means $k$ will take on the values 3, 4, 5, 6, 7, one at a time.

Pattern for doing something $n$ times

```
n = ______
for k = 1:n
    % code to do
    % that something
end
```
**for loop examples**

```matlab
for k = 2:0.5:3
    disp(k)
end
```

- `k` takes on the values __________
- Non-integer increment is OK

```matlab
for k = 1:4
    disp(k)
end
```

- `k` takes on the values __________
- Default increment is 1

```matlab
for k = 0:-2:-6
    disp(k)
end
```

- `k` takes on the values __________
- “Increment” may be negative

```matlab
for k = 0:-2:-7
    disp(k)
end
```

- `k` takes on the values __________
- Colon expression specifies a bound

```matlab
for k = 5:2:1
    disp(k)
end
```

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**Example: count down to blast off**

- Write a script `countDown` that produces this screen output after asking user to input starting value (4 in this example):
  
  - T = 4 seconds
  - T = 3 seconds
  - T = 2 seconds
  - T = 1 second
  - Blast off!!!!

```matlab
% What will be printed?
for k = 1:2:6
    fprintf('%d ', k)
end
```

- A: 1 2 3 4 5 6
- B: 1 3 5 6
- C: 1 3 5
- D: error (incorrect bounds)

```matlab
% What will be printed?
for k = 10:-1:14
    fprintf('%d ', k)
end
fprintf('!
```

- A: error (incorrect bounds)
- B: 10 (then error)
- C: 10!
- D: 14!
- E: !