- Previous topics:
  - Branching
  - Boolean expressions

- Now:
  - Introduction to **for**-loop

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!

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

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```
% one trial of the experiment
breakPt= rand;
shortPiece= min(breakPt, 1-breakPt);
```

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.

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Repeat n times

```
% one trial of the experiment
breakPt= rand;
shortPiece= min(breakPt, 1-breakPt);
```

Take average

Print result

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```
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\n', ...
                        aveLength)
```
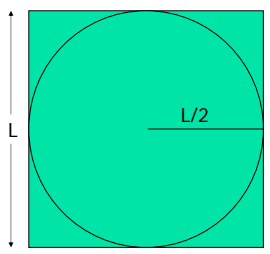
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Monte Carlo Estimation of π

Throw N darts

Sq. area = $N = L \times L$

Circle area = N_{in}

$\qquad = \pi L^2 / 4$

$\pi = 4\, N_{in} / N$

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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*hits/N

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Monte Carlo Pi with N darts on L-by-L board

```
for k = 1:N
    % Throw kth dart


    % Is it in the circle?




end
myPi = 4*hits/N;
```

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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.

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Pattern for doing something *n* times

```
n= _____
for k= 1:n

    % code to do
    % that something

end
```

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for loop examples

```
for k= 2:0.5:3        k  takes on the values _____
    disp(k)           Non-integer increment is OK
end
for k= 1:4            k  takes on the values _____
    disp(k)           Default increment is 1
end
for k= 0:-2:-6        k  takes on the values _____
    disp(k)           "Increment" may be negative
end
for k= 0:-2:-7        k  takes on the values _____
    disp(k)           Colon expression specifies a bound
end
for k= 5:2:1
    disp(k)
end
```

Lecture 5   18

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