Randomizing Things

In some programming tasks, we want to randomize the order of something, such as the order of trials or conditions in an experiment, or the order of questions in a survey. We may want to simulate a process where events occur at random, or with a certain probability. To implementation these tasks, we use MATLAB functions to generate random numbers or sequences.

```matlab
% the function rand, with no inputs, returns a single
% floating point number between 0 and 1

num = rand

% random numbers can be used to make choices based on probabilities

if (num > 0.5)
    disp('heads')
else
    disp('tails')
end
```

```matlab
% rand(rows,cols) generates a matrix of random numbers between 0 and 1

nums1 = rand(1,5)

nums2 = rand(2,4)

% with one input, rand returns a square matrix of random numbers

nums3 = rand(3)
```

```matlab
% randi(n) generates a single random integer between 1 and n

randi(5)

% randi(n,rows,cols) generates a matrix of random integers between 1 and n

randi(10,1,6)

randi(10,3,2)
```

```matlab
% randperm(n) generates a random permutation of the integers from 1 to n

order = randperm(10)

% randperm(n,k) generates k unique random integers between 1 and n

unique = randperm(10,5)
```

```matlab
% generate a random ordering of conditions for an experiment or simulation

conditions = 3.0:0.5:6.0

order = randperm(length(conditions))

newConditions = conditions(order)
```

```matlab
% shuffle a deck of cards

cards = {'1h' '2h' '3h' '4h' '5h' '6h' '7h' '8h' '9h' '10h' 'jh' 'qh' 'kh' ...
         '1d' '2d' '3d' '4d' '5d' '6d' '7d' '8d' '9d' '10d' 'jd' 'qd' 'kd' ...
         '1s' '2s' '3s' '4s' '5s' '6s' '7s' '8s' '9s' '10s' 'js' 'qs' 'ks' ...
         '1c' '2c' '3c' '4c' '5c' '6c' '7c' '8c' '9c' '10c' 'jc' 'qc' 'kc'};

shuffle = cards(randperm(52))

% create an anagram of a string

str = 'rumpelstiltskin';

anagram = str(randperm(length(str)))
```
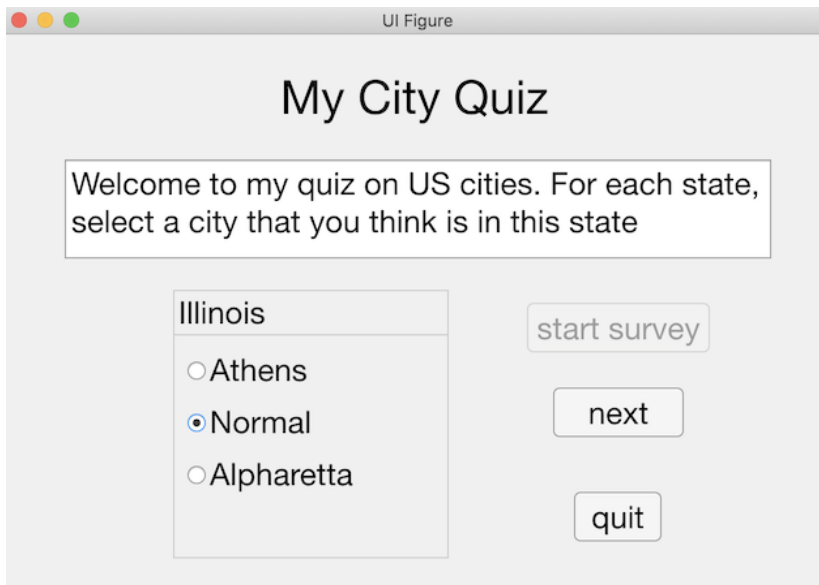
Randomizing Questions & Answers

Let's see how **randperm** can be used to randomize the order of questions and answers in the **cityQuiz** App

My City Quiz

Welcome to my quiz on US cities. For each state, select a city that you think is in this state

Illinois
- ○ Athens
- ◉ Normal
- ○ Alpharetta

start survey

next

quit

```matlab
properties (Access = private)
    % five states in the US
    states = {'Colorado' 'Massachusetts' 'Georgia' 'Oregon' 'Illinois'};
    % city options for the five states, with correct city listed first
    cities = { {'Loveland' 'Roswell' 'Smyrna'} ...
               {'Chicopee' 'Arvada' 'Longmont'} ...
               {'Rome' 'Parker' 'Palatine'} ...
               {'Aloha' 'Wheaton' 'Centennial'} ...
               {'Normal' 'Athens' 'Alpharetta'} };
    totalQuests = 5;           % total number of quiz questions
    correctAns = zeros(1,5);  % correct cities (1, 2, or 3)
    ...
end
```

```matlab
function startsurveyButtonPushed(app, event)
    % generate a random order for the five states
    order = randperm(app.totalQuests);
    % rearrange the order of the five state names and the
    % five cell arrays of city options
    app.states = app.states(order);
    app.cities = app.cities(order);
    % within each set of three city options, randomize the order
    % and record the location of the correct city name
    for i = 1:app.totalQuests
        order = randperm(3);
        app.correctAns(i) = find(order == 1);
        app.cities{i} = app.cities{i}(order);
    end
    ...
end
```