Special Functions for Creating Vectors

- Some vectors are used so often that there are special functions for creating them

```
zeros(1, 5)  % A vector of length 5 holding all zeros
                                    0   0   0   0   0

ones(1, 3)   % A vector of length 3 holding all ones
                                          1   1   1

rand(1, 4)   % A vector of length 4 holding random numbers
                    0.9501   0.2311   0.6068   0.4860
```

Row and Column Vectors

```
>> v = [1 2 3]

v =
     1     2     3

>> v = [1 ; 2 ; 3]

v =
     1
     2
     3
```

Note the semicolons

Length

```
>> v = randn(1, 5);
>> n = length(v)

n =
     5

>> u = randn(5, 1);
>> n = length(u)

n =
     5
```

The length function doesn't care about row or column orientation

Appending to a Vector

- Appending to a row vector

```
>> x = [11, 22]
x =

   11   22

>> x = [x 33]
x =

   11   22   33
```

- Appending to a column vector

```
>> x = [11 ; 22]
x =

   11
   22

>> x = [x ; 33]
x =

   11
   22
   33
```

Note the semicolons

Concatenating Vectors

- Concatenating row vectors

```
>> x = [11 22]
x =
   11   22

>> y = [33 44 55]
y =
   33   44   55

>> z = [x y]
z =
   11   22   33   44   55
```

- Concatenating column vectors

```
>> x = [11;22;33];
>> y = [44 ; 55];
>> z = [x ; y]

z =
   11
   22
   33
   44
   55
```

Note the semicolons

The Empty Vector

```
x = [ ];
for k=1:50
   if floor(sqrt(k)) == sqrt(k)
      x = [x; k];
   end
end
x
```

```
x =
     1
     4
     9
    16
    25
    36
    49
```

Another Shortcut for Creating Vectors

- We were already creating vectors when we were using for-loops
  - ":" notation

```
vec = 1:7;          % [1 2 3 4 5 6 7]
vec = 10: -2: 0     % [10 8 6 4 2 0]
```

- FYI
  - The for-loop actually converts the ":" notation into a vector before it executes
  - A for-loop will work with *any* vector!
    (e.g., **`for k = [2 3 5 7 11 13 17 19]`**)

A String is a Vector of Characters

- A string is made up of individual characters
  - The string 'CS100M rules' consists of 12 characters (8 letters, 3 digits, and 1 space)
- In Matlab, a string is a *vector* of characters
  - Since a string is a vector, it uses the same indexing scheme as any other vector

Strings as Vectors

Vectors

- Indexing

```
v = [ 7 0 5 ];
x = v(3);       % x is 5
v(1) = 1;       % v is [1 0 5]
```

- ":" notation

```
v = 2:5;        % v is [2 3 4 5]
```

- Appending

```
v = [7 0 5];
v(4) = 2;       % v is [7 0 5 2]
```

- Concatenation

```
v = [v [4 6]]
      % v is [7 0 5 2 4 6]
```

Strings

- Indexing

```
s = 'hello';
c = s(2);       % c is 'e'
s(1) = 'J';     % s is 'Jello'
```

- ":" notation

```
s = 'a' : 'g';  % s is 'abcdefg'
```

- Appending

```
s = 'duck';
s(5) = 's';     % s is 'ducks'
```

- Concatenation

```
s = [s ' quack']
      % s is 'ducks quack'
```

Some Useful String Functions

```
str = 'CS100M rules';

isletter(str)       % [ 1 1 0 0 0 1 0 1 1 1 1 1 ]
isspace(str)        % [ 0 0 0 0 0 0 1 0 0 0 0 0 ]

s = lower(str);     % s is 'cs100m rules'
s = upper(str);     % s is 'CS100M RULES'

ischar(str);        % Is str a char array?  1 (= true)
```

Character Arithmetic

- You can do "math" with characters

```
'd' – 'a'           % Produces 3
'9' – '8'           % Produces 1
'a' < 'd'           % Produces 1 (= true)
'd' < 'b'           % Produces 0 (= false)
'Z' < 'b'           % Produces 1 (= true)
                    % Because 90, the ASCII code for 'Z',
                    % is less than 98, the ASCII code for 'b'

'a' + 2             % Produces 99
char('a'+2)         % Produces 'c'
```

Example: toUpper

- Goal: Write toUpper( ), our own version of Matlab's upper( ), a function to convert a string to all uppercase
  - We want to do this without using Matlab's function upper( )
- Function header

```
function str = toUpper(str)
% Post: Convert string so all letters are upper case
% Pre: Input is a string
```

- Idea: Note that 'a' – 'A' has the same value as 'b' – 'B' which has the same value as 'c' – 'C', etc.
  - All we have to do is subtract the right number from a lowercase letter and we'll have the equivalent uppercase letter