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Solution to Exercise 1 (Image Processing and Pattern Recognition)

Q1. Using vectorization and the colon operator, use a single command each to generate:

a. the first 15 cubes,

Solution

```
>> first_fifteen_cubes = [1:15] .^ 3

first_fifteen_cubes =

  Columns 1 through 6

           1           8          27          64         125         216

  Columns 7 through 12

         343         512         729        1000        1331        1728

  Columns 13 through 15

        2197        2744        3375
```

b. the values sin(nπ/16) for n from 1 to 16.

Solution

```
>> sine_function_ans = sin([1:16] .* pi / 16)

sine_function_ans =

  Columns 1 through 8

    0.1951    0.3827    0.5556    0.7071    0.8315    0.9239    0.9808    1.0000

  Columns 9 through 16

    0.9808    0.9239    0.8315    0.7071    0.5556    0.3827    0.1951    0.0000
```

Q2. Enter the following matrices:

$$A=\begin{bmatrix}1 & 2 & 3\\ 2 & 3 & 4\\ 3 & 4 & 5\end{bmatrix}, B=\begin{bmatrix}-1 & 2 & -1\\ -3 & -4 & 5\\ 2 & 3 & -4\end{bmatrix}, C=\begin{bmatrix}0 & -2 & 1\\ -3 & 5 & 2\\ 1 & 1 & -7\end{bmatrix},$$

Calculate

1. 2A – 3B **2. A^T** **3. AB – BA**

4. BC^{-1} **5. $(AB)^T$** **6. B^TA^T**

7. $A^2 + B^3$

Solution

```
>> A = [1 2 3; 2 3 4; 3 4 5]

A =

     1     2     3
     2     3     4
     3     4     5

>> B = [-1 2 -1; -3 -4 5; 2 3 -4]

B =

    -1     2    -1
    -3    -4     5
     2     3    -4

>> C = [0 -2 1; -3 5 2; 1 1 -7]

C =

     0    -2     1
    -3     5     2
     1     1    -7

>> calc_21_ans = 2 * A - 3 * B

calc_21_ans =
```

```
     5    -2     9
    13    18    -7
     0    -1    22
```

>> calc_22_ans = A'

```
calc_22_ans =

     1     2     3
     2     3     4
     3     4     5
```

>> calc_23_ans = A * B - B * A

```
calc_23_ans =

    -1     3    -3
    -7     2    -3
    -1     8    -1
```

>> calc_24_ans = B * C^(-1)

```
calc_24_ans =

    0.2333    0.4333    0.3000
    4.9000    1.1000    0.3000
   -3.3000   -0.7000   -0.1000
```

>> calc_25_ans = (A * B)'

```
calc_25_ans =

    -1    -3    -5
     3     4     5
    -3    -3    -3
```

>> calc_26_ans = B' * A'

```
calc_26_ans =
```

```
    -1    -3    -5
     3     4     5
    -3    -3    -3
```

```
>> calc_27_ans = A^2 + B^3
```

```
calc_27_ans =

    90   103   -92
  -154  -132   286
   163   167  -147
```

Q3. Type following commands in MATLAB and see what it gives

```
>> w = imread('tire.tif');
>> figure, imshow(w), impixelinfo
```

Solution

Pixel info: (X, Y) Intensity

RGB Image

```
>> a = imread('autumn.tif');
>> figure, imshow(a), impixelinfo
>> size(a)
```

Solution

Pixel info: (X, Y) [R G B]

```
ans =

   206   345     3
```

Information about your image

```
>> imfinfo('autumn.tif')
```

Solution

```
ans =

                    Filename: 'D:\MATLAB\MATLAB Production Server\R2015a\too...'
                FileModDate: '04-Dec-2000 08:12:54'
                    FileSize: 213642
                      Format: 'tif'
                FormatVersion: []
                       Width: 345
                      Height: 206
                    BitDepth: 24
                   ColorType: 'truecolor'
             FormatSignature: [73 73 42 0]
                   ByteOrder: 'little-endian'
              NewSubFileType: 0
               BitsPerSample: [8 8 8]
                 Compression: 'Uncompressed'
PhotometricInterpretation: 'RGB'
              StripOffsets: [1x30 double]
```

```
      SamplesPerPixel: 3
         RowsPerStrip: 7
      StripByteCounts: [1x30 double]
          XResolution: 72
          YResolution: 72
       ResolutionUnit: 'Inch'
             Colormap: []
    PlanarConfiguration: 'Chunky'
            TileWidth: []
           TileLength: []
          TileOffsets: []
       TileByteCounts: []
          Orientation: 1
            FillOrder: 1
     GrayResponseUnit: 0.0100
       MaxSampleValue: [255 255 255]
       MinSampleValue: [0 0 0]
         Thresholding: 1
               Offset: 213218
```

Q4. Pick a grayscale image, say cameraman.tif or wombats.tif. Using the imwrite function, Write it to files of type JPEG, PNG and BMP.

What are the sizes of those files?

Solution

```
>> cameraman = imread('cameraman.tif');
>> imwrite(cameraman,'cameramanpng.png','png');
>> imwrite(cameraman,'cameramanbmp.jpg','jpg');
>> imwrite(cameraman,'cameramanbmp.bmp','bmp');
```

Figure 1: cameraman (JPG)

Figure 2: cameraman (PNG)

Figure 3: cameraman (BMP)

Size of cameraman (JPG) is **10.4 KB.**

Size of cameraman (PNG) is **37.3 KB.**

Size of cameraman (BMP) is **65.0 KB.**