Lab 02: Variables, Arrays and Scripts

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August 30, 2021

1 SCRIPT FILE

```
% Math 3341, Fall 2021
   % Lab 02: Variables, Arrays and Scripts
   % Author: Melissa Butler
   % Date: 08/30/2021
 5
 6
    clc
                    % clear command window
                    % clear variables workspace
 7
    clear
    format compact % show results in compact format
 9
10 | %% 1 1-D Array: Vector
11 % 1(a)
12 | \text{vec1} = \text{linspace}(1, 9, 9)
13 | vec2 = 18:-2:1
14 | vec1Length = length(vec1)
15 | vec2Length = length(vec2)
16 | % 1(b)
17 | vec1Product = prod(vec1)
18 | vecProduct = vec1 .* vec2
19 dotProduct1 = dot(vec1, vec2)
20 dotProduct2 = vec1 * vec2'
21 dotProduct3 = sum(vec1 .* vec2)
22
23 | %% 2 2-D Array: Matrix
24 % 2(a)
25 \mid mat1 = magic(3)
26 \mid mat1ColSum = sum(mat1, 1)
27 \mid mat1RowSum = sum(mat1, 2)
28 | mat1DiagSum = sum(diag(mat1))
29
   % 2(b)
30 | mat2 = reshape(vec1, 3, 3)'
31 | matProduct1 = mat1 * mat2
32 | matProduct2 = mat1 .* mat2
33 % 2(c)
34 mat3 = [matProduct1;matProduct2]
35 | sumAll = sum(mat3, 'all')
36 \mid mat3ColMin = min(mat3, [], 1)
37
   mat3RowMax = max(mat3, [], 2)
38 | [rowIndex, colIndex] = find(mat3 <= 20)
39 % 2(d)
40 \mid mat3(:, 4) = mat3(:, 2)
```

```
mat3(:, end + 1) = int8(rand(6, 1) * 255)
41
42 \mid mat3 = [mat3, colon(0, 36, 200)']
43 mat3Size = size(mat3)
44
45
   %% 3 Array: Char Array vs. String Array
46
47 | helloChar = 'hello '
   worldChar = 'world'
48
49 helloString = "hello "
50 worldString = "world"
51 helloWorldChar1 = [helloChar,worldChar]
52 helloWorldString1 = [helloString,worldString]
53 | helloWorldChar2 = strcat(helloChar, worldChar)
54 | helloWorldString2 = strcat(helloString, worldString)
   % 3(b)
55
   helloWorldChar1Class = class(helloWorldChar1)
56
   helloWorldChar2Class = class(helloWorldChar2)
57
58 | helloWorldString1Class = class(helloWorldString1)
59
   helloWorldString2Class = class(helloWorldString2)
60
   helloWorldChar1Length = length(helloWorldChar1)
   helloWorldChar2Length = length(helloWorldChar2)
62
   helloWorldString1Length = length(helloWorldString1)
63
   helloWorldString2Length = length(helloWorldString2)
64
65
   %% 4 Application: Image Processing
66 | % 4(a)
   uwGray = imread('UW_gray.png');
67
68 uwGraySize = size(uwGray)
69 [V, D] = eig(double(uwGray));
70 maxEigenvalue = max(D, [], 'all')
71
   % 4(b)
72 imshow(uwGray)
73 | steamboatLeft = uwGray(1:650, 171:650);
74 | steamboatRight = fliplr(steamboatLeft);
75
   steamboat = [steamboatLeft, steamboatRight];
   % 4(c)
76
   uwName = uwGray(651:960, :);
77
78
   uwGrayNew = [steamboat;uwName];
79
   imshow(uwGrayNew)
   imwrite(uwGrayNew, 'UW_gray_new.png')
81 uwGrayNewSize = size(uwGrayNew)
82
   whos
```

2 Output File

```
lab_02_script
 2
    vec1 =
               2
 3
         1
                      3
                                   5
                                                      8
                                                            9
 4
    vec2 =
                                                            2
 5
        18
              16
                     14
                           12
                                 10
                                         8
                                               6
                                                      4
 6
    vec1Length =
 7
         9
 8
    vec2Length =
 9
         9
10
    vec1Product =
11
          362880
12
    vecProduct =
13
        18
              32
                     42
                           48
                                 50
                                        48
                                              42
                                                     32
                                                           18
14
    dotProduct1 =
15
       330
16
    dotProduct2 =
17
       330
    dotProduct3 =
18
19
       330
20
    mat1 =
21
         8
               1
                      6
22
         3
               5
                      7
23
         4
               9
                      2
24
    mat1ColSum =
25
        15
                     15
26
    mat1RowSum =
27
        15
28
        15
29
        15
30
    mat1DiagSum =
31
        15
32
    mat2 =
33
         1
               2
                      3
34
               5
                      6
35
         7
               8
                      9
36
    matProduct1 =
37
        54
                     84
              69
38
        72
              87
                    102
39
        54
              69
                     84
40
    matProduct2 =
41
         8
               2
                     18
42
        12
              25
                     42
43
        28
              72
                     18
44
    mat3 =
45
        54
              69
                     84
```

```
46
        72
                    102
               87
47
        54
               69
                     84
48
         8
                2
                     18
49
        12
               25
                     42
50
        28
               72
                     18
51
    sumAll =
52
       900
53
    mat3ColMin =
54
         8
                2
                     18
55
    mat3RowMax =
56
        84
57
       102
58
        84
59
        18
60
        42
61
        72
62
    rowIndex =
63
         4
         5
64
65
         4
66
         4
67
          6
68
    colIndex =
69
         1
70
         1
71
         2
72
          3
73
         3
74
    mat3 =
75
        54
               69
                     84
                            69
76
        72
               87
                            87
                    102
77
        54
               69
                     84
                            69
78
         8
                2
                     18
                             2
79
        12
               25
                     42
                            25
80
        28
               72
                     18
                            72
    mat3 =
81
82
        54
               69
                     84
                            69
                                 127
                    102
83
        72
               87
                            87
                                 127
84
        54
               69
                     84
                            69
                                 124
85
         8
                2
                     18
                             2
                                 127
86
        12
               25
                     42
                            25
                                  36
87
        28
               72
                     18
                            72
                                  108
88
    mat3 =
89
                                          0
        54
               69
                     84
                            69
                                  127
90
        72
               87
                    102
                                 127
                                         36
                            87
91
        54
               69
                                 124
                                         72
                     84
                            69
92
         8
                2
                     18
                             2
                                  127
                                        108
93
        12
               25
                     42
                            25
                                  36
                                        144
```

```
94
         28
               72
                     18
                            72
                                 108
                                       180
95
    mat3Size =
96
          6
                6
97
    helloChar =
98
         'hello '
99
    worldChar =
100
         'world'
101
    helloString =
102
         "hello "
103
    worldString =
104
         "world"
105
    helloWorldChar1 =
106
         'hello world'
107
    helloWorldString1 =
108
       1x2 <a href="matlab:helpPopup string" style="font-weight:bold">string</a> array
109
110
    helloWorldChar2 =
111
         'helloworld'
112
    helloWorldString2 =
113
         "hello world"
    helloWorldChar1Class =
114
115
         'char'
116
    helloWorldChar2Class =
117
         'char'
118
    helloWorldString1Class =
119
         'string'
120
    helloWorldString2Class =
121
         'string'
122
    helloWorldChar1Length =
123
124
    helloWorldChar2Length =
125
126
    helloWorldString1Length =
127
128
    helloWorldString2Length =
129
130
    uwGraySize =
131
        960
              960
132
    maxEigenvalue =
133
        2.2850e+05
134
    uwGrayNewSize =
135
        960
              960
136
       Name
                                        Size
                                                             Bytes Class
                                                                              Attributes
137
138
       D
                                     960x960
                                                         14745600
                                                                    double
                                                                               complex
139
       ٧
                                     960x960
                                                         14745600
                                                                    double
                                                                               complex
140
       colIndex
                                        5x1
                                                                40
                                                                    double
141
       dotProduct1
                                        1x1
                                                                 8
                                                                    double
```

143 dotProduct2	149	dat Dua duat 2	11	0	م آمانیمام
144	142	dotProduct2	1x1	8	double
145					
146					
147 helloWorldCharlClass 1x4 8 char 148 helloWorldChar2 1x10 20 char 150 helloWorldChar2Class 1x4 8 char 151 helloWorldChar2Class 1x4 8 char 152 helloWorldString1Class 1x6 12 char 153 helloWorldString1Class 1x6 12 char 154 helloWorldString1Class 1x6 12 char 155 helloWorldString2Class 1x6 12 char 156 helloWorldString2Class 1x6 12 char 157 helloWorldString2Class 1x6 12 char 158 mat1 3x3 72 double 159 mat1ColSum 1x3 24 double 159 mat1Diagsum 1x1 8 double 160 mat1RowSum 3x1 24 double 161 mat2RowSum 3x1 24		· ·			_
148 helloWorldChar1Length 1x1 8 double 149 helloWorldChar2 1x10 20 char 150 helloWorldChar2Class 1x4 8 char 151 helloWorldString1 1x2 204 string 153 helloWorldString1Class 1x6 12 char 154 helloWorldString2Class 1x6 12 char 155 helloWorldString2Clength 1x1 166 string 156 helloWorldString2Length 1x1 8 double 157 helloWorldString2Length 1x1 8 double 158 mat1 3x3 72 double 159 mat1OlSum 1x3 24 double 160 mat1NoSum 3x1 24 double 161 mat1RowSum 3x1 24 double 162 mat2 3x3 72 double 163 mat3RowMax 6x1 48 <					
149					
150		_			
151					
152					
153		_		_	
154		_			•
155					
156 helloWorldString2Class 1x6 12 char 157 helloWorldString2Length 1x1 8 double 158 mat1 3x3 72 double 159 mat10 1x3 24 double 159 mat1ColSum 1x1 8 double 160 mat1DiagSum 1x1 8 double 161 mat1RowSum 3x1 24 double 162 mat2 3x3 72 double 163 mat3 6x6 288 double 164 mat3ColMin 1x3 24 double 165 mat3RowMax 6x1 48 double 166 mat3Size 1x2 16 double 167 matProduct1 3x3 72 double 168 matProduct2 3x3 72 double 169 maxEigenvalue 1x1 8 double 170 rowInd					
157		_			_
158 mat1 3x3 72 double 159 mat1ColSum 1x3 24 double 160 mat1DiagSum 1x1 8 double 161 mat1RowSum 3x1 24 double 162 mat2 3x3 72 double 163 mat3 6x6 288 double 164 mat3ColMin 1x3 24 double 165 mat3RowMax 6x1 48 double 166 mat3Size 1x2 16 double 167 matProduct1 3x3 72 double 168 matProduct2 3x3 72 double 169 maxEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 171 steamboat 650x960 624000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 suwGray 960x960 921600 uint8		_			
159 mat1ColSum 1x3 24 double 160 mat1DiagSum 1x1 8 double 161 mat1RowSum 3x1 24 double 162 mat2 3x3 72 double 163 mat3 6x6 288 double 164 mat3ColMin 1x3 24 double 165 mat3RowMax 6x1 48 double 166 mat3Size 1x2 16 double 167 matProduct1 3x3 72 double 168 matProduct2 3x3 72 double 169 maxEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 170 rowIndex 5x1 40 double 171 steamboatLeft 650x480 312000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 175 uwGrayNew 960x960 921600 u					
160 mat1DiagSum 1x1 8 double 161 mat1RowSum 3x1 24 double 162 mat2 3x3 72 double 163 mat3 6x6 288 double 164 mat3ColMin 1x3 24 double 165 mat3RowMax 6x1 48 double 166 mat3Size 1x2 16 double 167 matProduct1 3x3 72 double 168 matProduct2 3x3 72 double 169 maxEigenvalue 1x1 8 double 169 maxEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 170 rowIndex 5x1 40 double 171 steamboat 650x960 624000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 suwGray 960x960 921600 uint8					
161 mat1RowSum 3x1 24 double 162 mat2 3x3 72 double 163 mat3 6x6 288 double 164 mat3ColMin 1x3 24 double 165 mat3RowMax 6x1 48 double 166 mat3Size 1x2 16 double 167 matProduct1 3x3 72 double 168 matProduct2 3x3 72 double 169 matEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 170 rowIndex 5x1 40 double 171 steamboat 650x960 624000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 sumAll 1x1 8 double 175 uwGray 960x960 921600 uint8 176 uwGrayNew 960x960 921600					
162 mat2 3x3 72 double 163 mat3 6x6 288 double 164 mat3ColMin 1x3 24 double 165 mat3RowMax 6x1 48 double 166 mat3Size 1x2 16 double 167 matProduct1 3x3 72 double 168 matProduct2 3x3 72 double 169 maxEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 171 steamboat 650x960 624000 uint8 172 steamboatRight 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 suwGray 960x960 921600 uint8 175 uwGrayNew 960x960 921600 uint8 176 uwGrayNew					
163 mat3 6x6 288 double 164 mat3ColMin 1x3 24 double 165 mat3RowMax 6x1 48 double 166 mat3Size 1x2 16 double 167 matProduct1 3x3 72 double 168 matProduct2 3x3 72 double 169 maxEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 171 steamboat Left 650x960 624000 uint8 172 steamboat Right 650x480 312000 uint8 174 <td< td=""><td></td><td></td><td></td><td></td><td></td></td<>					
164 mat3ColMin 1x3 24 double 165 mat3RowMax 6x1 48 double 166 mat3Size 1x2 16 double 167 matProduct1 3x3 72 double 168 matProduct2 3x3 72 double 169 maxEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 171 steamboat 650x960 624000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 sumGray 960x960 921600 uint8 175 uwGrayNew 960x960 921600 uint8 176 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1 1x1 8 double 182		mat2	3x3		
165 mat3RowMax 6x1 48 double 166 mat3Size 1x2 16 double 167 matProduct1 3x3 72 double 168 matProduct2 3x3 72 double 169 maxEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 170 rowIndex 5x1 40 double 171 steamboat 650x960 624000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 sumGray 960x960 921600 uint8 175 uwGrayNew 960x960 921600 uint8 176 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1ength 1x1 8 double 182 <			6x6	288	
166 mat3Size 1x2 16 double 167 matProduct1 3x3 72 double 168 matProduct2 3x3 72 double 169 maxEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 170 rowIndex 5x1 40 double 171 steamboat 650x960 624000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 sumGray 960x960 921600 uint8 175 uwGrayNew 960x960 921600 uint8 176 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1product 1x1 8 double 184				24	
167 matProduct1 3x3 72 double 168 matProduct2 3x3 72 double 169 maxEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 170 rowIndex 5x1 40 double 171 steamboat 650x960 624000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 sumAll 1x1 8 double 175 uwGray 960x960 921600 uint8 176 uwGrayNew 960x960 921600 uint8 177 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec2Length 1x1 8 double 184 v		mat3RowMax	6x1		
168 matProduct2 3x3 72 double 169 maxEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 171 steamboat 650x960 624000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 sumAll 1x1 8 double 175 uwGray 960x960 921600 uint8 176 uwGrayNew 960x960 921600 uint8 177 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec2Product 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 <td< td=""><td></td><td>mat3Size</td><td>1x2</td><td>16</td><td>double</td></td<>		mat3Size	1x2	16	double
169 maxEigenvalue 1x1 8 double 170 rowIndex 5x1 40 double 171 steamboat 650x960 624000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 sumAll 1x1 8 double 175 uwGray 960x960 921600 uint8 176 uwGrayNew 960x960 921600 uint8 177 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worl		matProduct1	3x3	72	double
170 rowIndex 5x1 40 double 171 steamboat 650x960 624000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 sumAll 1x1 8 double 175 uwGray 960x960 921600 uint8 176 uwGrayNew 960x960 921600 uint8 177 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString<	168	matProduct2	3x3	72	double
171 steamboat 650x960 624000 uint8 172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 sumAll 1x1 8 double 175 uwGray 960x960 921600 uint8 176 uwGrayNew 960x960 921600 uint8 177 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldStr	169	maxEigenvalue	1x1	8	double
172 steamboatLeft 650x480 312000 uint8 173 steamboatRight 650x480 312000 uint8 174 sumAll 1x1 8 double 175 uwGray 960x960 921600 uint8 176 uwGrayNew 960x960 921600 uint8 177 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string	170		5x1	40	double
173 steamboatRight 650x480 312000 uint8 174 sumAll 1x1 8 double 175 uwGray 960x960 921600 uint8 176 uwGrayNew 960x960 921600 uint8 177 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string	171	steamboat	650×960	624000	uint8
174 sumAll 1x1 8 double 175 uwGray 960x960 921600 uint8 176 uwGrayNew 960x960 921600 uint8 177 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string	172	steamboatLeft	650×480	312000	uint8
175 uwGray 960x960 921600 uint8 176 uwGrayNew 960x960 921600 uint8 177 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string	173	steamboatRight	650x480	312000	uint8
176 uwGrayNew 960x960 921600 uint8 177 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string	174	sumAll	1x1	8	double
177 uwGrayNewSize 1x2 16 double 178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string	175	uwGray	960x960	921600	uint8
178 uwGraySize 1x2 16 double 179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string	176	uwGrayNew	960x960	921600	uint8
179 uwName 310x960 297600 uint8 180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string 188	177	uwGrayNewSize	1x2	16	double
180 vec1 1x9 72 double 181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string 188	178	uwGraySize	1x2	16	double
181 vec1Length 1x1 8 double 182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string 188	179	uwName	310x960	297600	uint8
182 vec1Product 1x1 8 double 183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string 188	180	vec1	1x9	72	double
183 vec2 1x9 72 double 184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string 188	181	vec1Length	1x1	8	double
184 vec2Length 1x1 8 double 185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string 188	182	vec1Product	1x1	8	double
185 vecProduct 1x9 72 double 186 worldChar 1x5 10 char 187 worldString 1x1 150 string 188	183	vec2	1x9	72	double
186 worldChar 1x5 10 char 187 worldString 1x1 150 string 188 188 189 180	184	vec2Length	1x1	8	double
187 worldString 1x1 150 string 188	185	vecProduct	1x9	72	double
188	186	worldChar	1x5	10	char
	187	worldString	1x1	150	string
189 diary off	188				
	189	diary off			

3 FIGURE FILE



Figure 1: UWyo Logo

4 Basics of LAT_EX

\subsection{Sine functions}

```
For given $x \in [0, 2\pi]$ with step size $\pi/12$, we can obtain the evaluations
of \eqref{eq:sine} at $x$ (see Table \ref{tab:sine}), and the corresponding plot
(see Figure \ref{fig:sine}).
\begin{equation}
  \label{eq:sine}
  \begin{cases}
   y_1 = \sin(x/2) \
   y_2 = \sin(x)
   y_3 = \sin(2x)
  \end{cases}
\end{equation}
\begin{table}[!hbtp]
\centering
\caption{Sine functions}
\label{tab:sine}
\begin{tabular}{ccrr}
\toprule
        $x$ & $\sin(x/2)$ & $\sin(x)$ & $\sin(2x)$ \\
\midrule
$0$
        & $0$
                       & $0$ & $0$ \\
$\pi/2$ & $\sqrt{2}/2$ & $1$ & $0$ \\
        & $1$
                       & $0$ & $0$ \\
$3\pi/2$ & $\sqrt{2}/2$ & $-1$ & $0$ \\
$2\pi$ & $0$
                       & $0$ & $0$ \\
\bottomrule
\end{tabular}
\end{table}
\begin{figure}[!hbtp]
  \centering
  \includegraphics[width=0.3\textheight]{./fig/sine.pdf}
  \caption{Sine functions}
  \label{fig:sine}
\end{figure}
\subsection{Goldbach's Conjecture}
Pursuing this type of analysis more carefully, Hardy and Littlewood in 1923 conjectured
(as part of their famous \textsl{Hardy-Littlewood prime tuple conjecture}) that for any
fixed $c \geq 2$, the number of representations of a large integer $n$ as the sum of $c$
primes n = p_1 + \cdot p_{c} with p_1 \leq p_c should be asymptotically
equal to
\begin{equation}
   \label{eq:hardy}
   \left( \frac{p} \frac{p} \frac{p} \frac{p} (n)}{(p - 1)^c}\right)
   \int_{2 \cdot x_1 \cdot x_2} |x_1 \cdot x_2 \cdot x_1| + \cdot x_2 = n
```

```
\frac{d x_1 \cdot d x_c}{1}{\ln{x_1} \cdot d x_c}
\end{equation}
where the product is over all primes p^{, q}, and q^{, q}
solutions to the equation n = q_1 + \cdot + q_c \pmod{p} in modular arithmetic,
subject to the constraints $q_1, \ldots, q_c \ne 0 \mod p$. This formula
\eqref{eq:hardy} has been rigorously proven to be asymptotically valid for
c \geq 3 from the work of Vinogradov, but is till only a conjecture when c = 2.
In the latter case, the above formula simplifies to $0$ when $n$ is odd, and to
$$
2 \Psi_2 \left( \frac{p - 2}{p - 2} \right)
\int_{2}^{n} \frac{dx}{(\ln\{x\})^2} \alpha 2 \pi^2
\left( \prod_{p|n; p \geq 3} \frac{p - 1}{p - 2} \right) \frac{n}{(\ln{n})^2},
when $n$ is even, where $\Pi_2$ is Hardy-Littlewood's twin prime constant
\pi_2 := \prod_{p \neq 3} \left(1 - \frac{1}{(p - 1)^2} \right) = 0.6601618158 \right
$$
This sometimes known as the \textsf{extended Goldbach conjecture}.
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\emph{Reference}: \href{https://en.wikipedia.org/wiki/Goldbach's_conjecture}{Goldbach's conjecture}.