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Math 362

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Class Prep 1

Key Concept: In this section we see how matrices can be used to express pixel value information corresponding to digital images. We look at basic matrix concepts; greyscale and RGB color images; and matrix thresholding. At the conclusion of this section, we will see that thresholding raw digital signal data does not produce desirable results, and that a transformation approach is needed.

Section 1.3

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| Section 1.3.1  a.)  >> A=[1,2;5,-3]  A =  1 2  5 -3  >> size(A)  ans =  2 2  >> A(2,:)  ans =  5 -3  >> A(:,2)  ans =  2  -3  >> size(A(2,:))  ans =  1 2  >> size(A(:,2))  ans =  2 1  >> A'  ans =  1 5  2 -3 |  |
| Section 1.3.2  >> x=[255,0,255,0,255]  x =  255 0 255 0 255  >> size(x)  ans =  1 5  >> r1=[255 255 255 255 255];  >> r2=[255 0 255 0 255];  >> r3=[255 255 255 255 255];  >> r4=[255 0 0 0 255];  >> r5=[255 255 255 255 255];  >> A=[r1;r2;r3;r4;r5]  A =  255 255 255 255 255  255 0 255 0 255  255 255 255 255 255  255 0 0 0 255  255 255 255 255 255  >> MatrixPlot(A) |  |
| Section 1.3.3  >> r1=[127,127,127,127,127,127,127,127];  >> r2=[127,0,0,0,0,0,0,127];  >> r3=[127,255,255,255,255,255,255,127];  >> r4=[127,255,0,255,255,0,255,127];  >> r5=[127,255,255,255,255,255,255,127];  >> r6=[127,255,0,0,0,0,255,127];  >> r7=[127,255,0,0,0,0,255,127];  >> r8=[127,127,127,127,127,127,127,127];  >> A=[r1;r2;r3;r4;r5;r6;r7;r8];  >> MatrixPlot(A)  >> size(A)  ans =  8 8  >> A=imread('bwmtn.jpg');  >> MatrixPlot(A)  >> B=A(94:101,341:348)  B =  250 255 255 252 253 251 255 239  239 246 254 255 255 245 255 247  227 237 251 255 255 236 255 247  149 243 255 253 245 255 244 253  154 127 131 251 255 252 248 240  180 190 164 156 239 249 218 176  179 185 163 117 162 187 161 131  187 164 144 161 138 139 156 162  >> MatrixPlot(B)  >> x=[154, 127, 131, 251, 255, 252, 248, 240]  x =  154 127 131 251 255 252 248 240  >> x=B(5,:)  x =  154 127 131 251 255 252 248 240  >> VectorPlot(x,0,10,0,300)  >> A=imread('MaroonBells.jpg');  >> image(A)  >> plot(A(154,:))  >> A=imread('MaroonBells.jpg');  >> image(A)  >> B=A(105:112,405:412,:);  >> image(B)  >> PixelBox(A,108,408)  >> B\_red=A(105:112,405:412,1)  B\_red =  253 252 253 246 250 225 197 227  251 254 255 254 204 179 67 57  255 255 251 235 135 137 142 161  230 255 255 240 145 151 121 106  210 227 239 240 136 160 154 122  65 85 127 171 118 117 147 138  121 136 132 130 152 177 151 176  105 160 151 116 117 139 127 198  >> B\_green=A(105:112,405:412,2)  B\_green =  251 250 251 245 251 226 201 231  249 252 254 254 202 180 69 61  254 254 250 234 133 138 144 163  229 253 252 238 144 151 122 107  208 224 236 238 134 158 154 123  65 82 124 169 115 117 148 141  121 133 128 126 147 176 151 178  105 159 149 111 116 138 128 199  >> B\_blue=A(105:112,405:412,3)  B\_blue =  255 255 255 255 255 255 239 255  254 255 255 255 223 208 108 109  255 255 255 248 155 169 185 214  237 255 255 255 175 189 168 161  232 251 255 255 174 205 204 177  103 125 169 218 168 171 202 196  175 190 187 187 211 236 211 235  165 219 212 175 176 198 185 253  >> A=imread('MaroonBells.jpg');  >> color2gray(A)  >> size(A)  ans =  450 600 3  >> G=imread('color2graypic.jpg');  >> size(G)  ans =  450 600  >> GB=G(105:112,405:412)  GB =  251 250 251 245 253 229 204 235  248 251 255 255 205 183 73 65  253 255 249 235 136 141 148 168  228 254 255 240 148 155 127 113  210 228 239 242 139 164 160 129  69 88 130 175 122 123 154 146  127 140 136 134 156 183 158 184  112 166 157 120 123 145 134 205 |  |
| Section 1.3.4  >> r1=[127,255,255,255,127];  >> r2=[127,0,255,0,127];  >> r3=[127,255,191,255,127];  >> r4=[127,0,0,0,127];  >> r5=r1;  >> A=[r1;r2;r3;r4;r5];  >> MatrixPlot(A)  >> MatrixThresh(A,150)  Original\_Matrix =  127 255 255 255 127  127 0 255 0 127  127 255 191 255 127  127 0 0 0 127  127 255 255 255 127  Thresholded\_Matrix =  0 255 255 255 0  0 0 255 0 0  0 255 191 255 0  0 0 0 0 0  0 255 255 255 0  Compression\_Ratio =  'The compression ratio is 20 to 10, or 2.000000 to 1.'  Percent\_Reduction =  50  >> A=imread('bwmtn.jpg');  >> B=A(94:101,341:348);  >> RawImageThreshBW(B,80)  Percent\_Reduction =  'The percent reduction is 79.687500.'  Compression\_Ratio =  'The compression ratio is 64 to 13, or 4.923077 to 1.'  >> RawImageThreshBW(A,80)  Percent\_Reduction =  'The percent reduction is 80.000083.'  Compression\_Ratio =  'The compression ratio is 483402 to 96680, or 5.000021 to 1.' |  |

Section 2.1

Key Concepts: We will review piecewise-defined functions, including piecewise-constant, piecewise-linear, and piecewise-continuous functions. We will use MATLAB to plot piecewise-defined functions that will be important to us in the book. We will also review what it means for a function to be bounded, and to satisfy Dirichlet Conditions. The section concludes with a review of periodicity, frequency and the periodic extension of a function.

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| 2.1.1  >> f(1:50)=1;  >> f(51:100)=0;  >> t=[0:0.01:0.99];  >> plot(t,f,'b'),title('Plot of f(t)'),axis([0 1 -1.2 1.2])  >> boxfcnplot  2.1.2  >> squarewaveplot  >> sawtoothplot  >> tentplot  >> sharpwaveplot  >> f(1:50)=4;  >> f(51:100)=8;  >> t=[0:0.01:0.99]';  >> plot(t,f,'b'),title('Plot of f(t)'),axis([0 1 -1.2 10.2])  >> t=[0:0.01:0.99]';  >> f(1:50)=t(1:50);  >> f(51:100)=t(51:100)-1;  >> plot(t,f,'b'),title('Plot of f(t)'), axis([0 1 -0.6 0.6])  >> N=1000;  >> t=[-1:1/N:(N-1)/N]';  >> f=t.\*sin(1./t);  >> plot(t,f,'b'),title('Plot of f(t)'),axis([-1 1 -0.4 1]) |  |

Section 2.2

Key Concepts: In this section we review key features of sine and cosine graphs including amplitude, period, frequency, and frequency index. We will see more precisely how sine waves play a role in modeling the sound waves of pure notes and chords.

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| 2.2.2  >> sinecosineplot(3,2\*pi\*2,1)  >> sinecosineplot(1,2\*pi\*3,1)  >> sinecosineplot(1,2\*pi\*2/3,3/2)  >> sinecosineplot(1,2\*pi\*4/5,5/4)  >> sinecosineplot(1,2\*pi\*5/16,16)  >> sinecosineplot(1,2\*pi\*4,1) |  |
| 2.2.3  >> sinenoteplot(440,1)  >> sinenoteplot(440,0.01)  >> sinenoteplot(261.6,1)  >> sinenoteplot(261.6,0.01)  >> mbiraplot  >> sinenoteplot(523.3,0.0113) |  |

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| >> sinechordplot(440,554.4,659.3,0.02) |  |