MAI: Matrices, Audio and Images – What's in Common

Friday, April 11, 2014

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Terms

- Audio – Frequencies or signals in the audible range
- Image – Graphical representation in visual spectrum
- GUI – Graphical User Interface
- Iteration – Repetition of statement(s) in program
- Matrix – Mathematics structure to store data
- Video – Elements of signal that pertain to the image

Experiential Learning

John Dewey - 19th & 20th century psychologist and philosopher

functionalism, individual takes an active role in learning based on environment

Jean Piaget – 20th & 21st century psychologist

theory of cognitive development, how we learn, order and use knowledge; biological and environmental

Embedded Mathematics

- Coordinates
- Functions
- Modular Arithmetic
- Matrices
- Real and Discrete Numbers
- Vectors

Benefits

- Cross-disciplinary, mathematics and technology
- Hands on applications
- Problem solving
- Work individually or in groups
- MATLAB is available (educational rates)

Observations

- Students discuss projects with classmates
- Students ask questions
- Students want to share how they solve a problem
- Mathematics becomes real, necessary and useful
- Final oral presentation incorporated into project

Today's Focus

- Matrices
- Audio
- Images
- Video

Matrices

- Structure to handle large data sets
- Efficient with technology
- Intro 2 x 2 or 3 x 3 systems & row reduction

$$2x + 5y = -4$$
$$x - 3y = 9$$

$$x + y - z = 2$$
$$2x + 3y - z = 7$$
$$3x - 2y + z = 9$$

2	5	-4
1	-3	9

1	1	-1	2
2	3	-1	7
3	-2	1	9

Portion of One Image Matrix (32 x 32)

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170 153 153 136 170 153 153 136 136 153 153 170 170 153 136 102  85  85 102  85 119 102 102 102 119 102 102 102 119 102 119 136
170 153 170 153 153 153 153 153 170 153 187 153 187 153 153 102 102  85 102 102 102  85 102 102 102  85 102 102 136 102 136 102
153 153 170 153 153 136 153 153 153 153 170 153 170 153 119 102  68  85  85 102 102 102  85 102 102 102 119 102 119 136 119 136
170 153 153 153 170 153 153 153 153 153 187 153 187 153 153 102 102  85 102 102 119 102 102  85 119 102 119 102 136 102 136 102
170 153 153 136 136 153 136 136 170 153 153 153 170 153 119 102  68  85  85  85 119 102 102 102  85 102 102 102 102 102 119 136
170 136 153 153 170 136 153 153 187 153 187 153 170 136 153 102 102  85 102 102 119  85 102 102 102  85 119 102 119 102 136 102
153 153 170 153 170 153 153 153 170 153 170 153 170 153 136 102  85  85  85 102 102  85 119 102 102 102 119 102 119 119 119 136
170 153 153 153 153 153 170 153 187 153 153 153 153 153 102 102  68 102 102 119 102 102 102 119 102 102 102 136 102 136 119
170 153 153 153 170 153 170 187 170 153 153 136 170 153 119 102  85  85  85  85  85 102 102  85  85 102 102 102 119 102 119 136
170 153 170 153 170 153 187 153 170 153 153 153 153 153 102  85  68 102 102 102  85 102 102  85 102  85  85 102  85 119 136 119 102
170 153 153 153 187 153 153 136 153 153 170 153 170 153 153 102 102  85 102  85 102 102 102 102 102 102 119 102 136 102 136 102
170 153 153 187 170 153 136 136 136 153 153 153 170 153 119 102  68  85  85  85  85 102  68 102  85 102 102  85 119 102 119 136
153 153 187 153 170 119 136 119 153 153 187 153 187 153 153 102  85  85 102 102 102  85 102 102 119  85 119 102 136 119 136 102
153 153 170 153 153 119 119 136 153 153 170 153 170 153 136 102  68  85  85  85 102  85 102 102  85 119 102 119 119 119 119 102
153 153 187 153 153 102 102 119 153 153 187 153 170 153 153 102  85  51 102  85 102  85 102  85 102 102 102 102 136 102 136 102
170 153 153 136 119  85  85 136 136 153 170 153 170 153 119 102  68  51  85  85  85  85  85  85  85 102 102  85 119 102 102 102
187 153 153 136 102  51 102 119 153 153 187 153 187 153 153 102  85  68 102  85 102  85 102 102 102 102 102 102 136  85 136 102
170 153 153 102  68  85 102 136 153 187 153 170 153 119 102  51  85  85  85  85 102  85  85  85  85 102 102 119 102 119 102
187 153 153  68  85  51 102 119 153 153 187 153 170 153 153 102  85  68 102  85 119  85 102  85 102 102 102 102 119 102 102 102
170 136 102  68  85  68  85 136 136 153 153 153 170 153 119 102  68  51  85  85  85  85 102  85 102 102 119 102 102 136
153 119  85  85 102  68 102 119 153 153 187 153 187 136 153 102  85  68  85  85 102  85 102 102 102  85 102 102 119 102 119 102
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102  85 102  85 102  85 102 119 153 153 187 153 187 153 153 102  85  68  85  85 102 102 102  85 119  85 102 102 102 102  85 221
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Audio

Vectors of Real Numbers

Applause	23,487
Bells	32,149
Gong	42,028
Handel	73,113
Buzzer	6,097
Mouse Click	2,320
(30 of 2,320)	

-0.0078
0.0156
0.0078
0.0078
-0.0078
-0.0078
0.0078
0
0.0078
0
-0.0234
0.0078
0.1016
0
-0.0469
0.0547
0.0938
0.0078
-0.0391
0.0625
0.0391
0.0391
0.0625
0.0234
-0.0234
-0.0313
0.1328
0.1172
-0.0313
-0.0078

MATLAB

- Command Line – enter command at screen prompt
- Script – type commands in a text file, i.e. program
- GUIDE - GUI environment
- Program GUI directly without GUIDE
- Available functionality, i.e. matrices, computation, etc.
- Audio, Image and Video file support
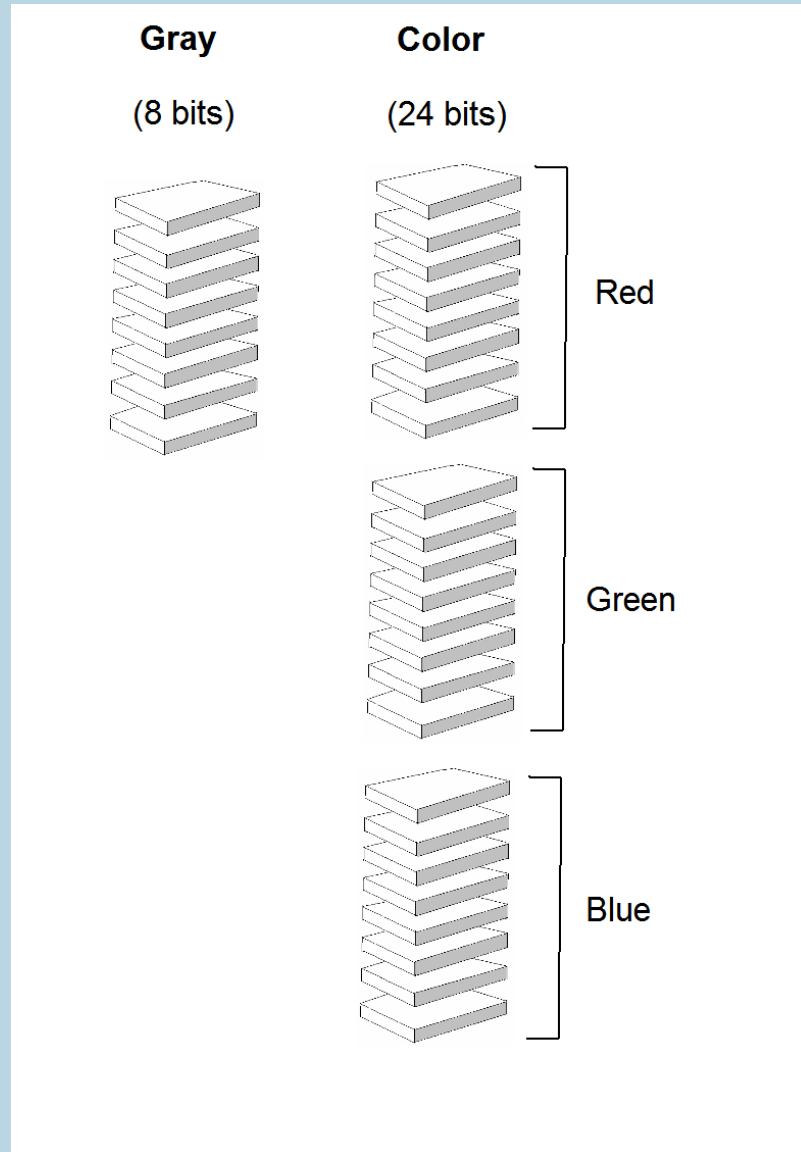- See references

Image Basics

.

128 x 128

256 x 256

Bit Planes

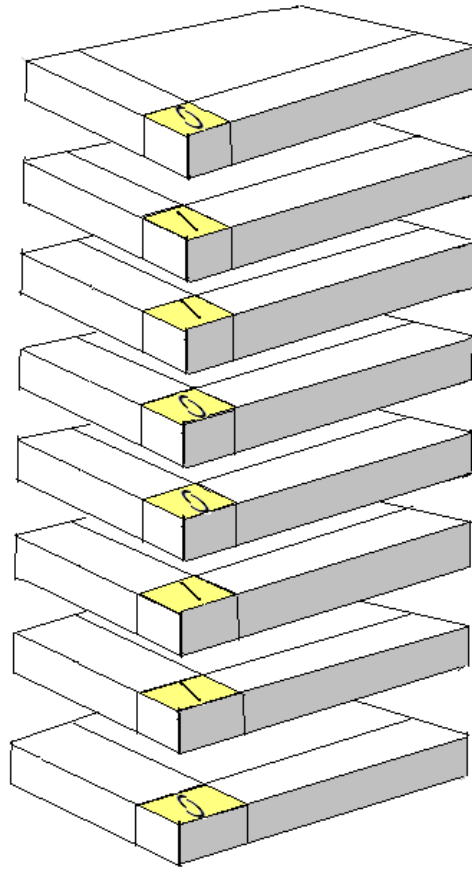Gray - one plane, values 0 - 255 stored in 8 bits

Color - three planes (Red, Green, Blue), values 0 – 255 stored in three 8-bit planes for a total of 24 bits

Bit Plane Basics

Gray Scale   example: 01100110

$$0 * 2^0 = 0$$
$$1 * 2^1 = 2$$
$$1 * 2^2 = 4$$
$$0 * 2^3 = 0$$
$$0 * 2^4 = 0$$
$$1 * 2^5 = 32$$
$$1 * 2^6 = 64$$
$$0 * 2^7 = 0$$

102

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170 153 153 136 170 153 153 136 136 153 153 170 170 153 136 102  85  85 102  85 119 102 102 102 119 102 102 102 119 102 119 136
170 153 170 153 153 153 153 153 170 153 187 153 187 153 153 102 102  85 102 102 102  85 102 102 102  85 102 102 136 102 136 102
153 153 170 153 153 136 153 153 153 153 170 153 170 153 119 102  68  85  85 102 102 102  85 102 102 102 119 102 119 136 119 136
170 153 153 153 170 153 153 153 153 153 187 153 187 153 153 102 102  85 102 102 119 102 102  85 119 102 119 102 136 102 136 102
170 153 153 136 136 153 136 136 170 153 153 153 170 153 119 102  68  85  85  85 119 102 102 102  85 102 102 102 119 102 119 136
170 136 153 153 170 136 153 153 187 153 187 153 170 136 153 102 102  85 102 102 119  85 102 102 102  85 119 102 119 102 136 102
153 153 170 153 170 153 153 153 170 153 170 153 170 153 136 102  85  85  85 102 102  85 119 102 102 102 119 102 119 119 119 136
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170 153 153 153 170 153 170 187 170 153 153 136 170 153 119 102  85  85  85  85  85 102 102  85  85 102 102 102 119 102 119 136
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Audio

MATLAB functions *wavread, sound*

Image

MATLAB functions *imread, image, imagesc*

Video

MATLAB supports embedded Microsoft

MATLAB file exchange *mmread, mmplay*

Demonstrations

- Basics

- Audio

- Image

- Video

Questions?

Contact Information

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