Syllabus for FYOS 1001, Fall, 2011

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Office:	Room 540 Boyd Graduate Studies Building
Classroom:	Room 220 Boyd Graduate Studies Building
Classtime:	11:00AM-12:00AM Tuesday
Office Hours:	2:30–3:30pm Monday and Friday or by appointment
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Teaching Plan for Mathematics for Digital Images

Instructor: Dr. Ming-Jun Lai

We start with digital images and find out that they are just blocks of integers which are called matrices. They can be various sizes. For matrices, we introduce elementary algebra: addition, subtraction, scalar multiplication, matrix multiplication and division. We shall explain the geometry meaning of addition and subtraction of matrices in terms of images. This leads to our first project: Add a signature into a favorable image.

Next we introduce matrix operators: shift, rotation, transpose, reflection, down-sample, and etc.. We will view iI will explain eigenvalues and singular values. This leads to our second project: miniature of images. While learning elementary theory of matrices, we will learn do loops of MATLAB.

Then we can view an image as a 2D function defined on a rectangular domain. They are functions of locations. View 2D images in 3D perspective setting. This leads to our last project: Create a 3D view of an image. We will learn MATLAB commands for plotting graphs.

Finally, we can put a lot of images together to create a movie. I will show you how to use MATLAB to generate a movie.

There will be three activities you have to participate which are described as follows: attending two colloquium talks at Dept. of Math. and interview professors to know about the other uses of matrices.

This is a Freshman Seminar class. There are 15 class meeting times. My plan for each class time is as follows.

Week 1. Introduction to Everyone; Introduction to MATLAB; Read a jpg file; Show an image; RGB components; ColorMaps;

Week 2. What is a digital image? The concept of matrices will be introduced. Write a jpg file;

Week 3. Attend a colloquium talk in Room 328, Boyd Graduate Studies Building on Thursday, Sept. 1, 2011 at 3:30pm–4:30pm.

Week 4. Basic operation of Matrices. Addition, Subtraction, Scale Multiplication, Matrix Multiplication and division.

Project 1. Create an image with your signature.

Week 5. More operations of matrices: Shifts, transpose, reflection, rotation, Up2Down, Left2Right.

Week 6. Submatrices. Do Loops; Local Modifications; Eigenvalues and Singular Values.

Week 7. Image Compression using SVD;

Project 2. Create miniature images.

Week 8. Interview with other math. professors for usefulness of matrices

Week 9. Images as 2D functions (time domain analysis)

Week 10. Image In-Painting; Function Interpolation.

Project 3. Create a mini movie.

Week 11. Image Smoothing (convolution operator)

Week 12. Image Decomposition (low-pass and high pass filters)

Week 13. Attend another colloquium talk in Room 328, Nov. 11., 2011.

Project 4. Write a report on usefulness of matrices.

Week 14. Image Edge Detection (high frequency components) and Image Denoising (soft and hard thresholding)

Week 15. Presentation of your reports.