**Information for students in Math 30720, Spring 2018**

**Instructor:** Nancy Stanton 268 Hurley, 631-7436
email: stanton.1@nd.edu

**Office hours:** by appointment and Monday 4-5 p.m. and Tuesday 3:30-5 p.m.

**Text and software:**

Goodman, *Discrete Fourier and Wavelet Transforms: An Introduction through Linear Algebra with Applications to Signal Processing*

*MATLAB R2017b* available for download from OIT

**Course description:**

Although you might not be aware of it, you use signal processing regularly, for example, in your cell phone and computer. It is used in digital cameras, medical imaging and digital television. Among other things, it is used to convert sounds and images to a digital form and to manipulate them. Cars use signal processing to monitor and control functions. Have you ever wondered how — and why — facebook compressed a photo you uploaded? How can unwanted noise be reduced?

The oldest technique for signal processing is Fourier series, introduced by Fourier in the early 19th century. Fourier series decompose functions (signals) into simple pieces, sines and cosines. A sine or cosine has a definite frequency but its graph is spread out in space. Wavelets are modern mathematics. In contrast to Fourier series, wavelets give a way of decomposing functions into pieces localized in frequency *and* space. They are so important that the 2017 Abel Prize of 6 million Norwegian Krone (about $750,000) was awarded to the mathematician Yves Meyer "for his pivotal role in the development of the mathematical theory of wavelets." Wavelets have been used in a wide range of applications, including data compression, noise reduction, digital cinema, the study of economic and financial data, medical imaging, archiving, and gearbox fault detection. They are now being used in art history, conservation and restoration, for example to reconstruct the missing ninth panel of the 14th century Ghissi altarpiece. They were used in the recent LIGO detection of gravitational waves; the 2017 Nobel Prize in Physics was awarded to Rainer Weiss, Barry C. Barish and Kip S. Thorne "for decisive contributions to the LIGO detector and the observation of gravitational waves."

In this course we will develop discrete Fourier and wavelet transforms through linear algebra and illustrate their use for signal processing. We'll use MATLAB implementations of both transforms to represent sounds and two dimensional images and manipulate them. No prior knowledge of MATLAB is assumed.

**Web Page:** The web page for this course is
http://www3.nd.edu/∼nancy/Math30720/info.html
On this page you will find general information about the course (including a copy of this handout), tips for doing well, an errata page for the textbook, assignments, any material used in class and additional resources.

**Exams:** There will be quizzes, two midterms and a final exam.

Exam 1: Wednesday, February 21

Exam 2: Wednesday, April 11

Quizzes: weekly on Wednesdays, except for the weeks of the exams, a total of 10–12 quizzes (not counting Quiz 0)

Final: Monday, May 7, 8-10 a.m.

**Homework:** The first two homework assignments, Assignment 0 (your mathematical autobiography) and Assignment 1 are posted on the course web page and due January 24. Future assignments will be posted by the due date of the previous assignment. The homework is due at the *start* of class on the due date (usually a week after it is assigned).

I will not take late homework. Regardless of how much you have left to do or how good your reason is, the grader will only grade the work that you give me at the beginning of class the day it's due. If you think you've got a good reason (e.g. medical emergency or something equally dire) for not finishing some assignment, we can talk about how I will handle it.

**Paper/project:** There may be a paper or project, an opportunity to study a topic related to the course that you really want to learn about or to do a computer project related to it.

**Grading:**

Midterms 200 points (100 points each)

Quizzes 100 points (after dropping the lowest quiz score and scaling)

Final 150 points

Homework 100 points (after scaling)

Paper/project 50 points if assigned (decision by February 9)

**Absence from examinations and quizzes:** If you are absent from an exam or quiz without an official excuse, you will receive a grade of zero for that exam or quiz. If you are officially excused, you will not be penalized. If you miss a test or quiz for any reason, send me an email message, call me or call the Mathematics Department as soon as possible.

**Honor Code:** Testing will be done under the Honor Code. On homework, I allow and encourage you to work together and discuss the problems. However, your solutions must be written in your words. Copying from ANY source, including the solutions in the book, is a violation of the Honor Code.