Instructor

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Office Hours: 1:25-2:15 MWF. The class meets in VinH 20, 12:20-1:10 MWF.
No official text has been chosen. Text material in the form of Notes will be placed on the class Web pages.
Unofficial text: *Learning to swim in a sea of wavelets,* by Adhemar Bultheel,
Bulletin of the Belgian Mathematical Soceity, 2 (1995) 1-44.

A small list of books on wavelets:
A first course on wavelets, by Eugenio Hernández and Guido Weiss, CRC Press, 1996, ISBN 0-8493-8274-2.
A wavelet tour of signal processing, by Stéphane Mallat, Academic Press, 1999, ISBN 0-12-466606-X.
Ten lectures on wavelets, by Ingrid Daubechies, SIAM, 1992, ISBN 0-89871-274-2.
An Introduction to Wavelets Through Linear Algebra, by Michael W. Frazier, Springer, 1999, ISBN 0-387-98639-1.
A first course on wavelets, by Albert Boggess and Francis J. Narcowich, Prentice Hall, 2001, ISBN 0-13-022809-5.
Wavelets: an analysis tool, by M. Holschneider, Oxford, 1995, ISBN 0 19 850521 3.
Wavelets: Algorithms and Applications, by Yves Meyer, translated by Robert Ryan, SIAM, 1993, ISBN 0898713099.
The World According to Wavelets, by Barbara Burke Hubbard, AK Peters, 1998, ISBN 1568810725.

Material covered

We will begin by finding out "where we are," mathematically. My guess, which may be wrong, is that we have to spend some time getting acquainted with vector spaces of functions, for this is the "universe" in which wavelets operate. The most important vector space of functions for our purposes is the Hilbert space $L^2(\mathbb{R})$, the *square-integrable complex-valued* functions defined on the real axis $\mathbb{R}$. But other spaces are important too: the integrable functions, the spaces of continuous and smooth functions. The background material will be presented in class as needed.

Grading

There will be Homework, Special Problems, 2 Tests, and a Final Exam. There will be a Project as well, that will count as three Special problems.
Tentative **Test** dates are **February 21** and **April 4.** Each Test may involve material covered in lecture up to the Test. Thus, you are responsible for material covered in the lectures!

You'll have a GPA grade for each Test, your homework, and the Final. The weighting of the grades, though subject to change, is, at present: 10% for each Test, 20% for homework, 26% for Speecial problems and 34% for the Final. Grades will perhaps amount to 80-85% for A, 65-70% for B, 50-55% for C, 40-45% for D.
Each grading item will have "Gradelines" assigned to it. For example, if the B gradeline is 70, the A gradeline is 85, and your score is 80, then your GPA grade, G, for that item is

$$G := 3 + \frac{80-70}{85-70}\text{“}=\text{”}3.67.$$

Here, G is rounded to 2 places after "." In other words, your GPA grade is a B, plus 2/3 of the way between B and A. Your GPA grade, G, on any grading item is computed using your score on it, and the numbers
g (the grade corresponding to the highest gradeline smaller or equal to your score),
glb (the highest gradeline smaller or equal to your score),
gla (the lowest gradeline *greater* than your score):

$$G = g + \frac{\text{your score} - glb}{gla - glb},$$

where *glb* is the gradeline just below your score,
gla is the next gradeline – *above* your score – and
g is the grade number:
5 for a 100% score, 4 for the A gradeline, 3 for B, etc.
If your score falls on a gradeline, then $G = g$.
If your score is 100% on a Test, your $G = 5$.
When the G's are combined with their weights and added, the total is your GPA grade for the course. If that total is within 0.1 of an integer, your grade is "borderline." Case-by-case decisions are made, in borderline cases, whether

to award the higher or the lower grade. An important factor then is the direction your grades have taken at course's end!

Be sure to talk to me in advance if you have to miss a Test! If you do and don't make arrangements in advance, your G for that Test is zero!

If, for documented reasons beyond your control, you're passing and you can't complete the course, the grade you have up to that point "stays with you" as part of an Incomplete; all I's must be issued according to department guidelines.

Scholastic Conduct

Please read the (appropriate for you) notices in the IT Bulletin, the CLA Bulletin, and so on. You are encouraged to work with others in understanding what problems say, setting up solutions, and so on, but you must submit as YOUR work only what YOU have written up yourself. If you get ideas from a reference or from someone else, GIVE CREDIT! Do not simply copy another person's work. Graders will be asked to bring answers that look alike to my attention.

Course Objectives

- To introduce you to wavelets in several ways:
- by example; the Haar System will be our first example of a wavelet basis.
- as part of multi-resolution analysis; this is a nested family of subspaces of L^2.
- as transforms; they turn a function of one variable into a *redundant* function of two variables (one positive).
- as tools for analysis and synthesis; take a function apart, put it (partly) back together.
- To acquaint you with a wide variety of orthonormal systems, including Fourier Series.
- To examine some real-world applications: your projects...
- To use wavelets to make a matrix sparse (an application).
- The material will give mathematics students the opportunity to learn an application tool, and give potential users of wavelets the mathematical background THEY may need.