

## ABSTRACT UPDATES: FIORE AND ZLATOS; MAY AND ANNO

There are two additional short series of talks, beyond those already posted. The first, by Andrej Zlatos, will take place during the first week, from 4:00 to 5:30 M–F.

ABSTRACT. Partial Differential Equations: Reactive Processes and PDEs.

We will look at a simple reaction-diffusion equation, a partial differential equation (PDE) modeling processes such as chemical reactions, spreading of fire, and invasions of environments by species. After seeing how such mathematical models are constructed, we will study the behavior of the solutions of the PDE - functions representing quantities such as concentration, temperature, and density. The main goal is a simple introduction to a few of the methods and techniques used in the study of this and other PDEs.

The course will be independent of Math 275, with a minimal overlap in the covered material. A prerequisite is Math 204 or equivalent and an interest in analysis. A prior exposure to some basic ordinary differential equations may be useful but is by no means necessary.

The second, by Tom Fiore, will take place during the third week, 1:00 to 2:00, M–F, and may possibly spill over into the fourth week.

ABSTRACT. Mathematics and Music

Have you ever wondered if the relationship between mathematics and music extends to the composition and interpretation of musical works? If you have, then this mini-course is for you. A central concern of music theory is to find a good way of hearing a piece of music and to communicate that way of hearing. Music theorists often draw upon mathematics to create conceptual categories towards this end. In recent years, basic tools from group theory, combinatorics, and topology have entered the realm of musical analysis.

We will discuss two currents in modern mathematical music theory: Scale Theory and Transformational Theory. A *scale* is the pitch material upon which a composer draws, a kind of universe in which a melody takes place. The major scale and minor scale are commonly heard on the radio, and have been in use for hundreds of years. In the twentieth century, composers such as Bartok, Debussy, and numerous Jazz artists have experimented with the pentatonic scale, octatonic scale, and whole tone scale. The pentatonic and octatonic scales were used long before the twentieth century, and can be found in several non-Western cultures. Each scale has its own symmetries, and accommodates certain chord progressions. Why is the major scale so prevalent in Western music? Which properties uniquely characterize it? Scale theory answers some of these questions, and raises more. Scale theory is currently experiencing a renaissance, with newfound applications of combinatorial word theory. We will discuss recent breakthroughs and insights in this fascinating subject.

The second topic we will pursue is Transformational Theory, initiated by David Lewin. Transformational Theory asks: which transformations are idiomatic for a work of music? For example, any fugue contains transpositions and inversions of the subject, and recognizing this pattern makes a fugue more enjoyable for both listener and performer. Another instance of a transformation assigns to a major chord its relative minor, something that we hear on the radio every day. Lewin applied the theory of groups and group actions to great effect in his analyses, and we will recount how in various musical examples. Group theory is used both as a language and as a vehicle for musical insight.

Familiarity with any notions mentioned above is certainly not necessary for this mini-course. Nor is the ability to read music a prerequisite, since we aim to see and hear mathematics in action.

In addition, May will be joined by Rina Anno, and the two will give a more expanded sequence of talks than was indicated on the preliminary schedule. Probable times and days may be found on the updated schedules posted on this web site. The first three weeks are as originally scheduled, but many more talks may be given during the remaining weeks, depending on demand. There will be a mix of topics, including lots of diagram chasing in some introductory homological algebra.