Spring 2013

Math 532
Credit: 3 hrs
MWF 1 pm

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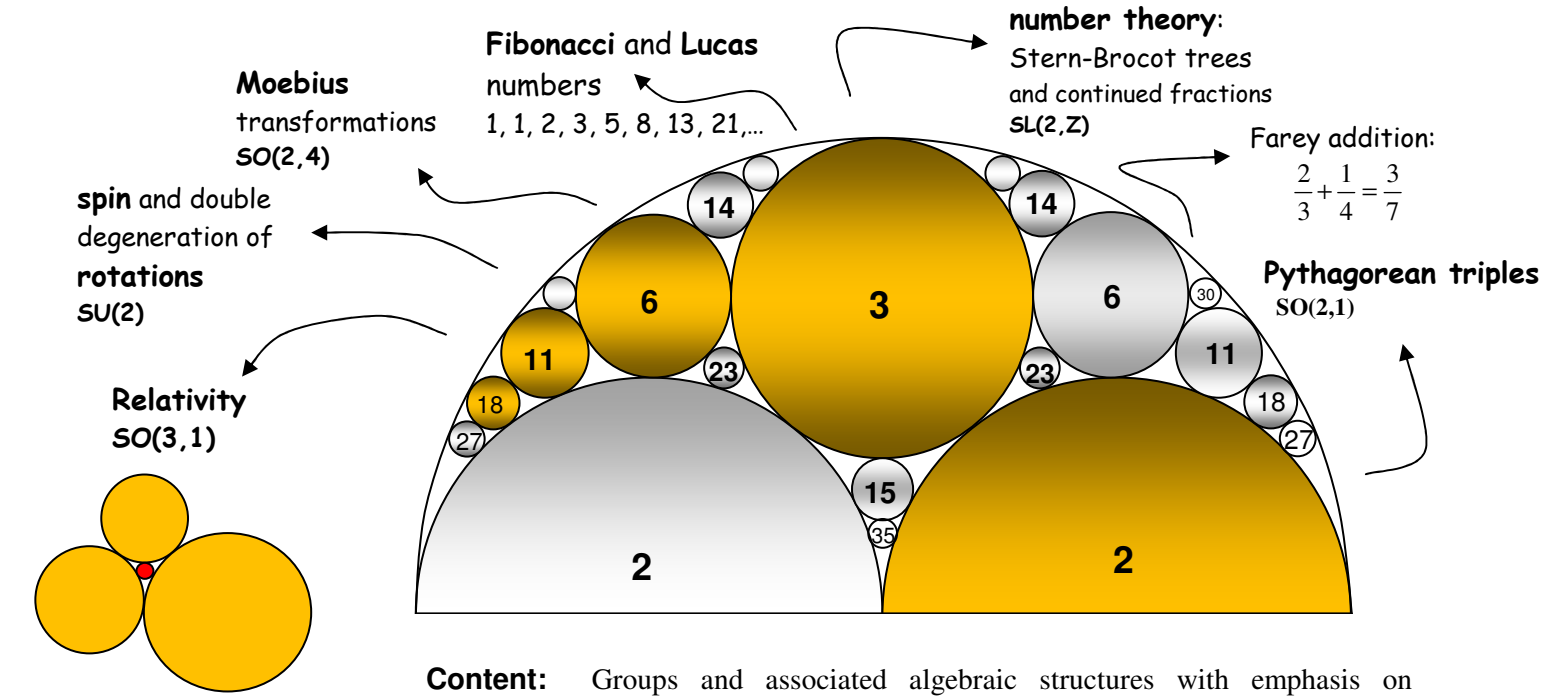
Special topic in math

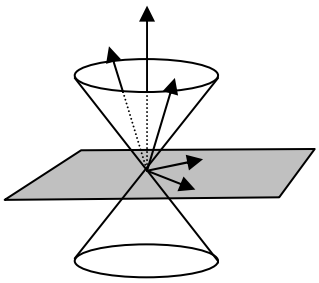
Symmetry and geometry:

applications of group theory

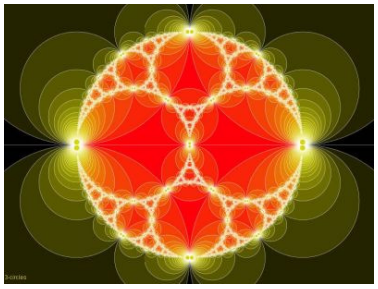
Symmetries, groups, algebras, geometry. From aesthetics to applications in science. Develop your geometric imagination and mathematical intuition by learning the language of group theory.



Descartes configuration of circles corresponds to a vector in **space-time** (an event).



Geometry of **inversions**



Content: Groups and associated algebraic structures with emphasis on understanding some low-dimensional examples and their matrix representations. Special attention will be given to rotations, the Moebius group, SL(n,**Z**), SL(2,**C**), pseudorotations SO(n,1), Apollonian group.

Topics will include algebraic structures like quaternions, octonions, Lie algebras, Clifford algebras, spin structure, Pythagorean triples, integer sequences, geometry of Descartes configuration in $\mathbf{R}^n$, projective and inversive geometry, elements of fractal geometry.

Art of recognizing the geometric content of different areas of math and physics. Intuitive approach and interesting examples.

Apollonian window (a fractal design shown above) will be our toy model exemplifying many of the ideas and concepts. It conceals surprisingly many seemingly unrelated structures: from space-time relativity to quantum spin structure to Moebius transformations to number theory to some cool geometry.

Requirements: basics of linear algebra.

Text: Lots of handouts, including necessary book chapters.

Who should take it? Besides **math** majors (learn concrete approach to symmetry and group theory — the mathematics of *beauty*), also students of **physics** (isn't symmetry the heart of physics?) and **computer science** (lots of ideas for graphics and interactive software projects).

For more see

http://www.math.siu.edu/kocik/symmetry.html