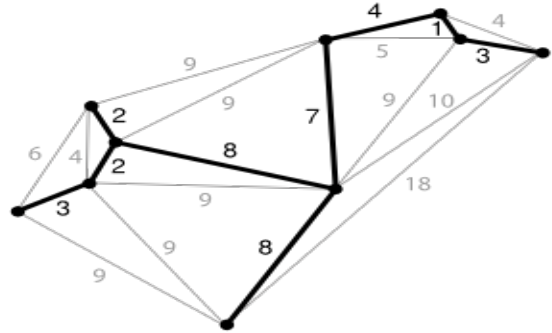


UROP projects in the Imaging and Computing Group (fall 2011)

Apply directly with Prof. Laurent Demanet. State your interest and qualifications in the application.
Deadline: first Friday of each term. Summer UROPs may also be possible.

Graph preconditioning vs. scientific computing.

Spielman and Teng have recently constructed a matrix preconditioner (i.e. a good guess for the inverse of a matrix) based on spanning trees and other ideas in graph theory. Their work is very original and has made a big splash in theoretical computer science. What is less clear is whether it could make a difference for practical applications in scientific computing, such as solving elliptic partial differential equations. This project consists in implementing and benchmarking the Spielman-Teng preconditioner for simple 2D problems. Prerequisites: background in **algorithms** and familiarity with Matlab (although the project can be done in another language.)



Signal and image registration. Humans can easily find a correspondence between two signals or images using similar features, but it is surprisingly difficult to get a computer to do the same. Try to pick the warping that gave rise to the red waveform from the blue waveform. Finding the map that links two such signals is in general a nonconvex optimization problem. Multiscale approaches are one attractive way of finding what we hope is the global optimum. In this project, we look into more challenging examples, understand the role of regularization, and devise good objective functions to minimize. Extension of the method to 2D images, i.e. image registration, may also be considered. Working matlab codes are available.

