

Homework 6: Topology

*Due Tuesday, week 8 at the start of class**UCSB 2015*

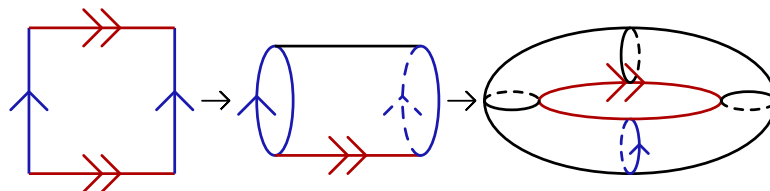
This week is like some of the earlier weeks! To get credit for this problem, just work on it; i.e. think about it, write down ideas, and otherwise spend a hour or two trying to figure out what's going on. Assignments that show effort (i.e. $> 1/2$ page of work and writing, coherent thoughts, good questions for me) will get credit.

1. You're now a civil architect! As such, you're responsible for helping people hook up their houses to the utility network.

At the moment, you have a bit of a problem. You have three houses A, B, C that have been built in an geologically active area, where lots of small micro-earthquakes happen. You want to hook up these three houses to the gas, water, and electric utilities; however, due to the risk of earthquakes, you want to do this in a way where none of the lines carrying these utilities have to cross (because if they did, then a small earthquake could cause your lines to cross and cause explosions/doom/etc.) Can you do this?

In other words: can you connect each of A, B, C to the utilities G, W, E so that the resulting graph is planar?

2. Take a square piece of paper. If you glue opposite edges as described below, you can turn this square into a **torus**, i.e. the doughnut shape below:



Can you glue the opposite sides of a hexagon in some clever way to get a torus? Can you glue together the sides of an octagon to get a “two-hole doughnut,” that is a torus with two holes?