Warwick School: SnapPy part 1 Monday, September 11, 2017.

For links for SnapPy, SageMath, and other needed topics see: http://dunfield.info/warwick2017.

1. (a) Load the manifold $v1234$ and name it V.

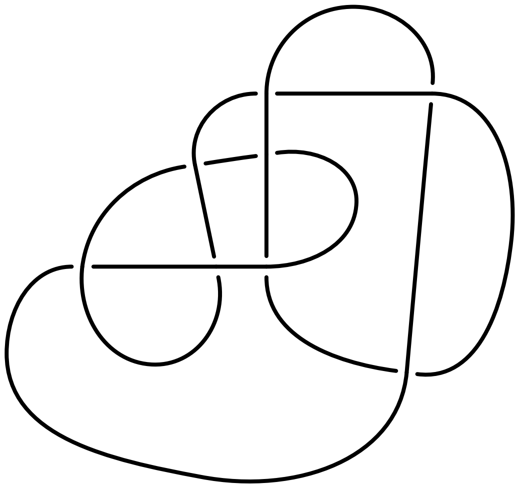
   (b) Use the browser to find the volume, Dirichlet domain, and symmetry group of V.

   (c) Like any manifold in SnapPy, the object V is really a particular *triangulation* of this hyperbolic manifold. Back at the command line, determine the number of tetrahedra in the triangulation V. Hint: Use tab completion by typing `V.<tab-key>`.

   (d) The manifold V has one cusp. Back the browser, do Dehn filling along the meridian curve. What closed manifold do you get?

2. (a) Use SnapPy to find the name in the Rolfsen table for the link shown at right.

   (b) Is the projection at right the same as the one that's stored in SnapPy?



3. In the morning session, I mostly focused on manifolds with cusps, but SnapPy also works with closed manifolds. In particular, it comes with the Hodgson-Weeks census of small-volume closed hyperbolic 3-manifolds, which is called `OrientableClosedCensus`.

   (a) Use the "?" operator to find out more about `OrientableClosedCensus`; in particular, how many manifolds are in it?

   Also, interrogate the orientable *cusped* census to get ideas on how to select various types of manifolds for the later parts of this question.

   (b) Closed manifold in SnapPy are represented as Dehn fillings on cusped manifolds. You can do Dehn filling in the browser, via the `dehn_fill` method, or as part of the specification that you given to `Manifold`. For example, typing `A = Manifold('4_1(1,2)')` gives the closed 3-manifold which is $\frac{1}{2}$-Dehn surgery on the figure 8 knot. Use the method `is_isometric_to` to show that A is the sixth manifold the `OrientableClosedCensus`. Warning: In Python, lists are numbered starting from 0 rather than 1.

   (c) Find the unique manifold M in the original `OrientableClosedCensus` whose volume is between 3.0 and 3.1 and whose first homology is $\mathbb{Z}/3\mathbb{Z} \oplus \mathbb{Z}/3\mathbb{Z} \oplus \mathbb{Z}/3\mathbb{Z}$.

   (d) Find a description of M as Dehn surgery on a 3-component link in S^3. Hint: Unfill the cusp in the default description of M and then drill out the shortest geodesic twice.