# Math 732 Project List
**due Mon., May 2nd, 2pm**

Report on a knot theory topic of your choosing. You should complete a 6-12 page, typed mathematical paper. Your paper should have a substantial mathematics component, which could include proofs, definitions, and sketches. Proofs may be adapted from other sources or may be your own original work.

In addition, prepare a 20 minute presentation on your work. The presentations are scheduled 2-5pm on Monday, May 2nd. Your presentation may utilize overhead slides, poster, or an electronic format.

Below, many possible topics are listed, or you may propose your own topic (subject to my approval); our textbooks are excellent sources. By April 1st, you should choose one of them to explore, and let me know which one you are investigating. For most of these topics, I can suggest some outside resources for you to pursue. Almost all of these topics are too broad; you will need to narrow your focus to a small (but not too small) subset of the relevant material.

**Project Topics** (numbers refer to M&T chapters)

1. Explore stick number – restrict to certain cases.
2. Unknotting number – again, narrow to certain cases.
3. Braids – a huge subject, refine to one idea
4. Knot polynomials – we will cover the Alexander polynomial briefly. You could explore it in more depth, or tackle another polynomial (Jones, Homfly, Conway)
5. Gauss diagrams for knots
6. Vassiliev invariants (finite-type invariants)
7. Dowker notation for knots
8. Symmetries of knots – which families of knots have known symmetries? what is known about $-$ amphichiral knots? about $+$ amphichiral knots? about 'no symmetry' knots?
9. Symmetries of links – explore symmetries of 2-component links further, or explore symmetries of 3-component, 4-component, 5-component links.
10. the Borromean rings
11. Brunnian links, in general
12. Cromwell, ch. 6 – matrix invariants – we won't cover this
13. Cromwell, ch.8 – more on rational tangles

14. energy of knots
15. superbridge number
16. random polygonal knots (often drawn on a 3-d lattice)
17. *Seifert surfaces*: these are surfaces whose boundary forms a knot. The (minimal) genus of such a surface is of great importance in knot theory. We'll cover these in some detail.
18. prime vs. composite knots. There's a nice, readable survey article by Michael Sullivan on uniqueness of prime decomposition. If you're bold, extend this to prime vs. composite links.
19. applications of knot theory to biology, chemistry, physics (Adams, ch.7)
20. knot groups – calculating the fundamental group of the complement to a knot
21. ropelength – how much rope does it take to tie a knot? The answer is known as the *ropelength* of a knot; it is scale invariant and measures the ratio of length of rope to its radius. Somewhat surprisingly, it is not explicitly known for all but a couple knots.