Math 203: Contemporary Mathematics
Chapter 2 worksheet
Tuesday, January 27

Work on at least two of the sections of this worksheet.

Section 1: Tilings, geometry, and the Pythagorean theorem

You may find it helpful to refer to Section 2.1 of the textbook.

1. Cut out a strange-looking quadrilateral (i.e., not a square, a rectangle, or a parallelogram), and trace it a bunch of times on a piece of paper to form a tiling.
2. Read the paragraph about exterior angles before Problems 13 and 14 in Section 2.1, and do Problem 14.
3. Read about semiregular tilings in Section 2.1, and do Problem 20 from Section 2.1.
4. Do Problem 26 from Section 2.1.
5. Read about the Pythagorean theorem in Section 2.1, and do Problems 34, 36, and 37 from Section 2.1.

Section 2: Polyominoes

Read the attached pages about polyominoes and work on at least two of the questions at the end. The information about polyominoes is also available online at

`http://www.math.unl.edu/~s-bkell1/203-2009s/polyominoes.html`

Section 3: Symmetry

You may find it helpful to refer to Section 2.2 of the textbook.

1. Do Problems 3 and 4 from Section 2.2.
2. Do Problem 6 from Section 2.2.
3. Draw shapes with the following properties:
   (a) Draw a shape that has reflection symmetry but not rotation symmetry. Show the line of symmetry.
   (b) Draw a shape that has rotation symmetry but not reflection symmetry. Describe the reflection symmetry (how many degrees do you need to rotate the shape to have it look the same?).
   (c) Draw a shape that has neither reflection symmetry nor rotation symmetry. Explain why this shape has neither of these symmetries.
   (d) Draw a shape that has both reflection symmetry and rotation symmetry. Show the line of symmetry and describe the reflection symmetry.
   (e) Is there a shape that has *two* lines of symmetry but does *not* have rotation symmetry? If so, give an example. If not, why not?
4. Do Problems 13 and 14 from Section 2.2.
5. Classify the patterns on the attached pages into groups according to their symmetry, so that patterns in the same group have the same kinds of symmetry. You may use the classification system described in Section 2.2, or you can invent your own system.

Section 4: Fractals

Read about fractals on pages 109–111 of the textbook.

1. Do Problem 51 from Section 2.2.
2. Do Problem 52 from Section 2.2. If you continued the process of constructing the Cantor set, what do you think will happen to the total length of the line segments?
3. The Koch snowflake.
   (a) Do Problem 54 from Section 2.2.
   (b) Part (c) of Problem 54 asks what happens to the perimeter of the Koch snowflake at each stage of the process. The Koch snowflake itself is the result if you continue this process infinitely many times. What do you think the perimeter of the finished Koch snowflake is?
   (c) Here's something strange: Even though the Koch snowflake gets a little bigger in area at each step, it will never grow beyond a circle which is drawn around the original triangle. So the area of the finished Koch snowflake can be no greater than the area of this circle. Think about how this relates to your answer in part (b). What about this makes the Koch snowflake a counterintuitive or seemingly impossible shape?
4. Invent your own rule for creating a fractal, and draw the first few stages.

Section 5: Fibonacci numbers and recursion

You may find it helpful to refer to Section 2.3 of the textbook.

1. Do Problem 4 from Section 2.3.
2. Do Problem 8 from Section 2.3.
3. Do Problems 9 and 10 from Section 2.3.
4. Read about the Lucas sequence before Problem 17. Basically, the Lucas sequence is generated according to the same rule as the Fibonacci sequence, except that the first two numbers are 1 and 3 instead of 1 and 1. Do Problem 17 from Section 2.3.
5. Do Problems 27 and 28 from Section 2.3. Find some other patterns in Pascal's triangle.