

# Math 241: Workshop on Geometry Software

Syllabus: Fall 2015

## BASIC COURSE INFORMATION

**Class Meets:** GMCS 421, Tu Th 2:00-3:15, 10 days total, (details below).

**Schedule number** 22128

**Instructor:** Michael E. O’Sullivan

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Office: GMCS 413 (the math department office).

Phone: 594 -0175

Office Hours: Tu Th, 3:15-4:00 , and other times by appointment.

**Description:** This one-credit software workshop provides prospective secondary mathematics teachers an opportunity to explore a geometry software program (GS).

**Materials:** We will use GeoGebra, which is an open-source product similar to The Geometer’s Sketchpad. GeoGebra is available free on the web. It is installed in the computer lab GMCS 421. Each student will create an account on the web with GeoGebra and save their work to this account. The instructor will access it and grade it via the web.

### Schedule:

Week 1	Tu Sept. 1	Th Sept. 3	Euclidean Geometry
Week 2	Tu Sept. 8	Th Sept. 10	Beyond Euclid
Week 3	Tu Sept. 22	Th Sept. 24	Algebra and Geometry
Week 4	Tu Sept. 29	Th Oct. 1	Trigonometric Functions
Week 5	no meeting	Th Oct. 8	Exponential Functions
Week 6	Tu Oct. 13	no meeting	Explorations and Final Project

## STUDENT LEARNING OUTCOMES

1. Geometric constructions: Students will use the GS to do key constructions from Euclidean geometry and explain the properties of these constructions. Examples include the circumcircle of a triangle and quadrilaterals with special properties (rhombus, kite, parallelogram) and the midpoint quadrilateral. Students will also construct parabolas, ellipses and hyperbolas using their foci (or directrix).
2. Graphs of polynomial equations and intersections of curves: Students will use the GS to graph lines, parabolas and other polynomial equations and explain how varying parameters affects the graphs. They will explore and explain how the intersection points of curves vary as the parameters vary.
3. Graphs of trigonometric, exponential and logarithmic functions: Students will use the GS to graph trigonometric, exponential and logarithmic functions and explain how varying parameters affects the graphs.
4. Transformations and creative geometry: Students will use rotations, reflections, dilations, and other transformations to produce complex and aesthetically appealing geometric objects.

5. Functionality of Geogebra: Students will become adept with key capabilities of Geogebra that make it useful for teaching: creating tools, exporting files, labeling figures, adding explanations, and publishing their work.

#### GRADING

**Class Discussions:** [5 points each week, 25 total]

Each week, we will discuss a few of the math topics that GSP enables us to explore. There will be a participation grade for each class meeting.

**Weekly Projects:** [12 points each of 4 weeks, 48 total]

Each unit will involve submitting 1 GS file with several pages. Although each student is required to submit his or her own file, students are encouraged to collaborate when completing these projects. All assignments will be graded on a scale from 12 points (3 points for correct construction, 3 points for mathematical explanation, 3 points for quantity, 3 points for quality of presentation).

**Final Project:** [30 points]

The final project is a cumulative portfolio of all the work you have done for the course. You should update and revise your previous work, add additional content on a particular topic of interest. The goal of this entire little course is to help you think about how a GS might be useful in your future courses and future teaching. Therefore, the final project should display your capability to use this tool in a creative way. (6 points for correct construction, 6 points for mathematical explanation, 6 points for quantity, 6 points for quality of presentation, 6 points for effective organization).

**Grading scale:**

94-103 A  
90-93 A-  
87-89 B+  
83-87 B  
80-82 B-  
77-79 C+  
73-77 C  
70-72 C-  
60-69 D

#### POLICIES

- A student in need of special accomodation should speak with me at the beginning of the course and contact Student Disability Services for authorization. I am very willing to provide the opportunity for all students to succeed.
- Students are expected to be engaged in class and not be distracted by phones, social media etc.
- Students are encouraged to work with one another and to use online resources to learn the material. Students should submit their own work and be able to explain and justify their submitted work.
- Violation of academic integrity or honesty will be justification for a grade of 0 on an assignment or, in serious cases, for a failing grade in the course.

## SCHEDULE OF TOPICS

Here is a rough idea of the topics we will explore. Subject to revision.

Week 1: Euclidean geometry.

- Tuesday: Terrific Triangles.  
The circumcircle and incircle of a triangle. Review of the bisector of a segment and bisector of an angle. The centroid and orthocenter.
- Thursday: Quazy Quadrilaterals.  
The midpoint quadrilateral. Review of properties of parallel lines. The degree of freedom in construction of rhombus, rectangles, kites, and parallelograms. Properties of diagonals.

Week 2: Beyond Euclid.

- Tuesday: Classical Conics.  
Constructions of parabolas, ellipses and hyperbolas using foci, and their practical properties.
- Thursday: Exciting Exploration.  
Symmetry and transformations of the plane, tilings of the plane, 3-dimensional geometry.

Week 3: Algebra and geometry.

- Tuesday: Algebra Arrives.  
Coordinate axes and graphing lines and parabolas. Exploring changing parameters using sliders. How do the parameters affect the graph?
- Thursday: Intriguing Intersections.  
Graphing polynomials of degree 2 and higher. What is happening under the hood? (How does the GS create these graphs?) Bezout's theorem about intersections of curves.

Weeks 4 and 5: Transcendental Functions.

- Tuesday: Tricky Trig.  
Classical constructions and the graphs of trigonometric functions. How do the parameters affect the graph?
- Thursday: Signals and Sines.  
Transformations of sine functions; phase, amplitude, frequency. Adding sinusoidal functions. A glimpse at signal processing.
- Thursday: Experiencing Exponentials.  
Exponential and logarithmic functions and transformations of them. Half-life.

Week 6: Final Project.