Math 290 – Computational Origami
Fall 2012 Syllabus

Class Meetings:	PPHAC 331, MWF 8:55-10:05am
Office Hours:	PPHAC 215
	Mon, Wed 2:30-4:00pm, Thu 10:00-11:30am *or by appointment*
Instructor:	Kevin Hartshorn
e-mail:	hartshorn@math.moravian.edu
Website:	http://math.moravian.edu/hartshorn/290

1 Course Description and Goals

This will be a computational and geometric exploration of modern origami. When will a given crease pattern fold flat? How does one design a new origami model? Can you fold a given polygon to get a polyhedron? Addressing these questions will have us exploring connections between geometry, computational complexity, and optimization. We will build origami models that will serve as a springboard to new mathematical ideas.

In discovering and proving some of the latest results in mathematical origami, we will also explore what it means to do research in mathematics. Thus you will be invited to select a topic related to the course to explore on your own, presenting your findings to the class at the end of the semester.

Key Ideas

- Deep mathematical questions and concepts can be uncovered through origami.

- Mathematics requires a balance of both creative and logical thinking.

- Creating a complex origami design is a matter of technique, not just creativity.

Course Goals

1. Be able to read and follow instructions for creating origami sculptures.

2. Be able to analyze crease patterns for geometric and computational structure.

3. Be able to read and synthesize new mathematical material, presenting it to an audience of peers.

4. Be able to state and prove mathematical results motivated by paper-folding experiments.

2 Materials for class

There are two required textbooks for the class:

- *Genuine Origami: 43 Mathematically-Based Models, From Simple to Complex*, by Jun Maekawa (ISBN 978-4-88996-251-2)

- *How to Fold It: The Mathematics of Linkages, Origami, and Polyhedra*, by Joseph O'Rourke (ISBN 978-0-521-14547-3)

In addition, you are required to have the following material on-hand every day in class:

- 6-inch origami paper[1] (stacks of paper are available from the campus bookstore)

- A composition notebook or journal specifically for this class.

- Pencil and eraser.

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[1]I recommend plain paper with solid coloring on one side. Foil paper, patterned paper, or textured paper will not be conducive to most of our class activities.

3   Assessment

The components of the course will be weighted as shown in the table below.

25%	Mathematical submissions (average over all submissions)
20%	Discussion and journal reflection
10%	Origami folding
45%	Individual research project (see below for details)
100%	**Total**

Generally speaking, your final course grade translates to a letter grade loosely based on the standard 4-point system: generally 85% marks the difference between an "A" and a "B", 70% marks the difference between a "B" and a "C", 60% marks the difference between a "C" and a "D", and any score below 50% is considered failing. Note that these numbers are meant only as a guideline and are subject to change over the course of the semester. See the Student Handbook[2] for a qualitative description for the various grades.

3.1   Mathematical Homework

There will be regular worksheets on different mathematical topics throughout the class. Some will be started in-class, some will be assigned purely for homework (with a follow-up discussion at the time of submission). For all homework assignments, please keep in mind the following:

1. This is to be your own work. Internet searches, work with classmates, or using texts outside the class texts will not be allowed unless specifically permitted for an individual assignment. Please refer to the Student Handbook[3] for details on the honesty policy.

2. Responses to all homework questions should use complete sentences and grammar appropriate to a college setting. Any assertions (i.e.: any of your answers) should be justified and/or proven to the best of your ability.

3. If a piece of origami is needed for your homework assignment (*not all assignments require that you submit your origami models!*), please paper-clip the model to your write-up.

4. I generally score homework on a 10-point scale, following the letter grade correspondence described above for the final course grade (9-10 points is excellent, 7-9 points is good work, 5-6 points is passable work, less than 5 points is poor work).

5. All homework is due at the beginning of class. Your work will often serve as fodder for class discussion, so late work is not acceptable.

3.2   Origami folding

You will be folding many of the models in *Genuine Origami* as part of the work in this class. There is much that you learn about the role of origami bases, crease patterns, and the broad mathematical ideas through actually folding the model. Note that while the "Foundational Models" are very accessible, you will find even some of the "Simple Models" to be a challenge the first time you try to fold it.

BE PATIENT! There is no magic to folding. It just take a little patience, a little care, and a little attention to detail. You will find that a "Simple Model" may take 20-30 minutes, while an "Intermediate" or "Complex" model may take an hour to complete. You will also find that the more complex models are easier with larger paper. I have a supply of 9-inch paper that you may use for some of the more complex models, or you can purchase your own at any art store.

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[2]http://www.moravian.edu/studentLife/handbook/academic/academic.html
[3]http://www.moravian.edu/studentLife/handbook/academic/academic2.html

For each model that you are asked to fold, you will both bring a completed model and a short (less than one page) reflection on the model. Your reflection should indicate any new ideas you learned in the process of folding, connections of this model to mathematical topics discussed in class, or discussion of the stipulated role of the given model for the given mathematical topic in the text.

Each model will be scored on a 3-point scale ($3 \rightarrow$ excellent work, $2 \rightarrow$ good work with only a few problems or errors, $1 \rightarrow$ incomplete or improperly done). A similar 3-point scale will be used to assess the mathematical reflection. I will record the average of these two scores in the grade book for the origami assignment.

3.3   Discussion and journals

Much of our time in class will be spent in a workshop environment. You will be asked to fold models, experiment with new ideas, participate in discussion. To help keep track of the learning process, you will be asked to keep a composition book with your notes, thoughts and reflections. I will expect that at least 4 times a week, you add to your journal, indicating work and thinking connected to this class.

Once a week or so, I will quickly look through your journals to ensure that you are keeping up with your work. You will be credited for completion of the journals. The precise content of the journals is for you and will not be assessed.

In addition, I will ask you once each week to submit a short reflection of your work as an active participant in the class. This should be more more than one page, and will conclude with an argument for what grade you deserve for discussion for that week. If I agree with your assessment, I will mark your grade for the week in my grade book. If I disagree with your assessment, I will contact you so that we can better calibrate our expectations.

3.4   Class presentations

During the first few weeks of class, each person will select a chapter of the book to research. For your research project, you will:

- Provide a short presentation to the class introducing your classmates to the topic.

- Create a 30-minute presentation and accompanying handout to share your topic with the rest of the class.

- Write a report on your research in the topic.

- Provide a final presentation to the class of your findings.

To help you accomplish these, there will be several opportunities for you to discuss your topic with me (both in writing and in person). I will help you find and read articles related to your research topic to complement the reading in the text. You will have a chance to peer-review your classmate's writing. Finally, I will ask for you to complete a portfolio showcasing the work that you put in to this project.

Note that the final draft and portfolio of this project will serve in lieu of a "final exam" for this class.

3.5   Research project

The research project should be broken down as follows

5%	Initial presentation on topic
5%	Presentation and handout on chapter
5%	Final presentation of results
10%	Average of three progress reports
5%	Completed first draft
5%	Peer review of paper draft
10%	Final draft and portfolio of individual research project
45%	**Total**

4 Attendance and other Issues

4.1 Attendance

While I expect you to attend every session, I expect that you have registered for this course because you want to learn the subject. Thus this course does not have an official attendance policy. However, keep in mind the following:

- If your homework is not turned in on the date due, you will get a zero for that assignment, regardless the reason for your absence. If you know that you will be missing a class, it is your responsibility to get the homework to me or speak to me about alternate arrangements.

- Note days on which you will there will be presentations: not only do you need to be in class for your presentation, but you should make a special effort to attend your fellow students' presentations for moral support.

- Any material covered in class is your responsibility, whether or not you attend class.

4.2 Final reminders and disclaimers

- Students who wish to request accommodations in this class for a disability should contact Elaine Mara, assistant director of learning services for academic and disability support at 1307 Main Street, or by calling 610-861-1510. Accommodations cannot be provided until authorization is received from the Academic Support Center.

- *Visit my office!* I would love to hear feedback about which aspects of the course are or are not going well. You have a great deal of power to determine the path this class takes – take advantage of it.

  You can also reach me by e-mail (hartshorn@math.moravian.edu).

- This syllabus is subject to change through the semester. The most recent version of the syllabus can be found at http://www.math.moravian.edu/hartshorn/225/.

- Final determination of your course grade is subject to my discretion as professor of the course.