Guiding and Grading Mathematical Art

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Course Details

- Queens College
  - Urban Commuter Campus
  - Diverse Student Population

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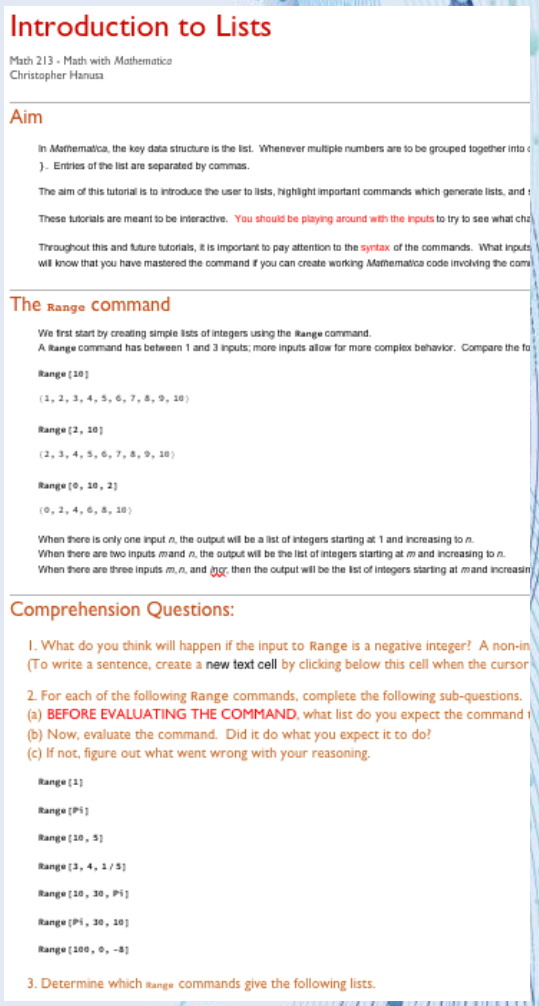
- Queens College
  - Urban Commuter Campus
  - Diverse Student Population
- Math with Mathematica
  - First course in computing
  - Varied math, programming levels
  - Satisfies writing requirement

Teaching Philosophy

- Give students the tools to succeed
  - Stand-alone tutorials
  - Comprehension Questions



Introduction to Lists

Math 213 - Math with *Mathematica*
Christopher Hanusa

Aim

In *Mathematica*, the key data structure is the list. Whenever multiple numbers are to be grouped together into
}. Entries of the list are separated by commas.

The aim of this tutorial is to introduce the user to lists, highlight important commands which generate lists, and

These tutorials are meant to be interactive. You should be playing around with the inputs to try to see what cha

Throughout this and future tutorials, it is important to pay attention to the syntax of the commands. What inputs
will know that you have mastered the command if you can create working *Mathematica* code involving the com

The Range command

We first start by creating simple lists of integers using the Range command.
A Range command has between 1 and 3 inputs; more inputs allow for more complex behavior. Compare the fo

```
Range[10]
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}

Range[2, 10]
{2, 3, 4, 5, 6, 7, 8, 9, 10}

Range[0, 10, 2]
{0, 2, 4, 6, 8, 10}
```

When there is only one input *n*, the output will be a list of integers starting at 1 and increasing to *n*.
When there are two inputs *m* and *n*, the output will be the list of integers starting at *m* and increasing to *n*.
When there are three inputs *m*,*n*, and *inc*, then the output will be the list of integers starting at *m* and increasin

Comprehension Questions:

1. What do you think will happen if the input to Range is a negative integer? A non-in
(To write a sentence, create a new text cell by clicking below this cell when the cursor

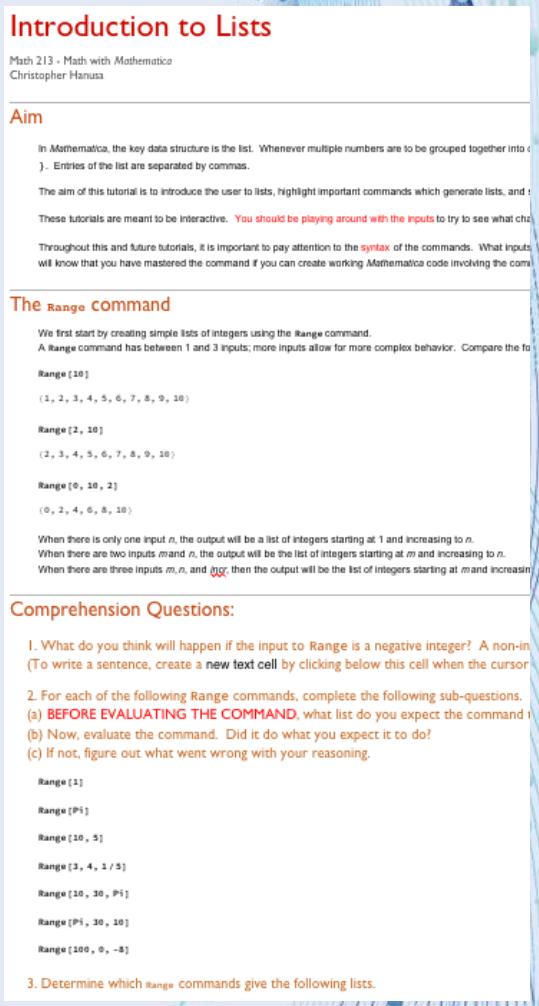
2. For each of the following Range commands, complete the following sub-questions.
(a) BEFORE EVALUATING THE COMMAND, what list do you expect the command
(b) Now, evaluate the command. Did it do what you expect it to do?
(c) If not, figure out what went wrong with your reasoning.

```
Range[1]

Range[Pi]

Range[10, 5]

Range[3, 4, 1/5]

Range[10, 30, Pi]

Range[Pi, 30, 10]

Range[100, 0, -8]
```

3. Determine which Range commands give the following lists.

Teaching Philosophy

- Give students the tools to succeed
  - Stand-alone tutorials
  - Comprehension Questions
  - How to: Documentation Center
  - One-on-one help



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- Give students the tools to succeed
  - Stand-alone tutorials
  - Comprehension Questions
  - How to: Documentation Center
  - One-on-one help
- Make learning active
  - Goal oriented: Projects
  - Inspires creativity
  - Each gains unique knowledge

Projects

1. Tutorial for a math class (4 weeks)

2. Piece of Mathematical Art (4 + 1.5 weeks)

3. Design an Interactive Interface (5 weeks)

Projects

1. Tutorial for a math class (4 weeks)
   - Learn specialized commands
   - Basic Mathematica concepts
   - Instills collaborative spirit
2. Piece of Mathematical Art (4 + 1.5 weeks)
3. Design an Interactive Interface (5 weeks)

Mathematical Art Project

- Goals
  - 3D Printing Process
  - 3D Design in Mathematica

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- Goals
  - 3D Printing Process
  - 3D Design in Mathematica
  - Creativity in Mathematics
  - Interdisciplinarity
- Deliverables
  - Artwork
  - Mathematica notebook
  - Four-page writeup

Guiding: Framework

- Mathematical basis
- Techniques: 3D modeling, functional

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- Techniques: 3D modeling, functional
- Artistic considerations taken into account
  - Visit by Matt Greco, QC Art Department

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- Commensurate with math, programming levels

Guiding: Framework

- Mathematical basis
- Techniques: 3D modeling, functional
- Artistic considerations taken into account
  - Visit by Matt Greco, QC Art Department
- Commensurate with math, programming levels
- Critiqued, refined, revised multiple times
- Timeline to stay on track

Guiding: Tutorials

- 2D Graphics (reminder of 2D coords)
- 3D Graphics (thinking in 3D coords)
- 3D Design (making printable, ⇝STL)
- MeshRegions (more advanced capabilities)

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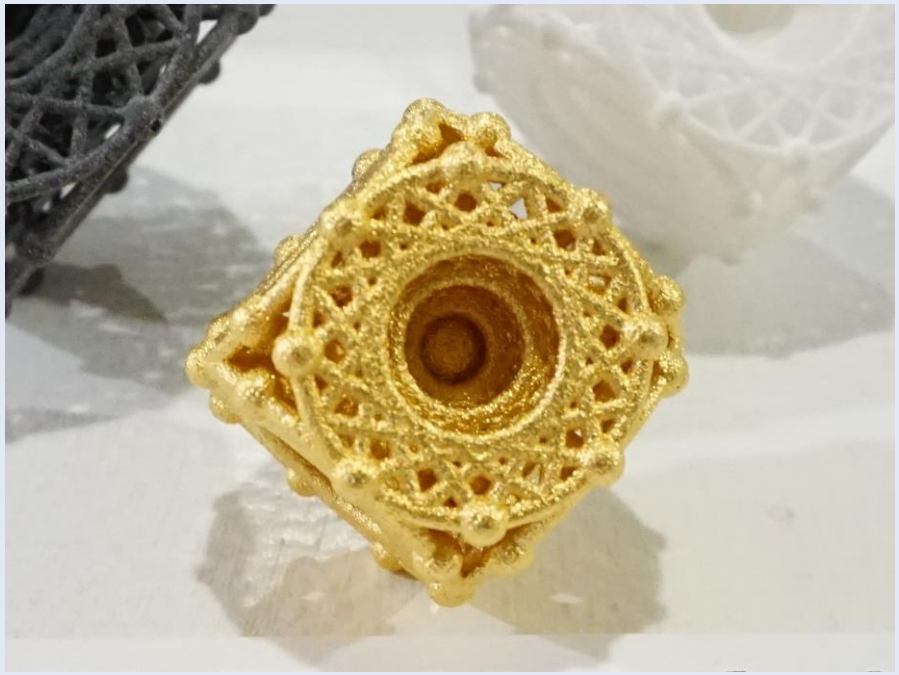
Minimal Working Examples

- 4 weeks to prototype, 1 week for revision

How to grade this?



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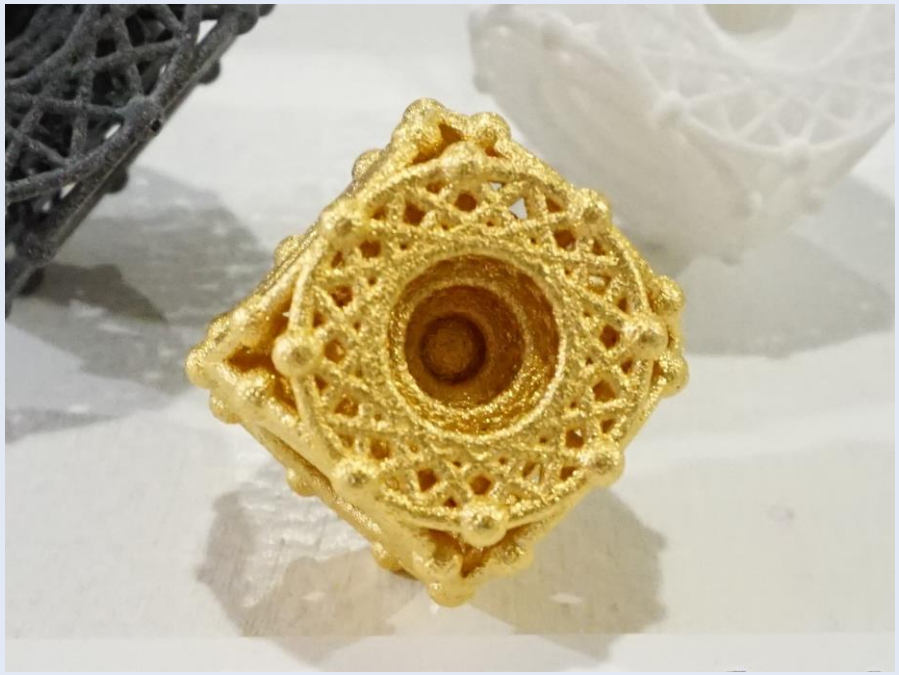

Different answers for different people!

Grading Scheme

Artwork (30%)

- Intrigue
- Mathiness
- Computational Techniques

Writeup (45%)

Organization (25%)

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- Intrigue
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- Artistic Qualities
- Math, Programming Discussion
- Revision Process

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- Intrigue
- Mathiness
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Writeup (45%)

- Artistic Qualities
- Math, Programming Discussion
- Revision Process

Organization (25%)

- Timeliness
- Name and Description
- Worksheet Organization
- Writeup Style

Grading (is also Guiding)

- Transparency
- Give weight to what I value.
  - Skill Development

Grading (is also Guiding)

- Transparency
- Give weight to what I value.
  - Skill Development
  - Intentionality
  - Creative Process

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  - Creative Process
  - Revision Process
  - Thoughtfulness

Grading (is also Guiding)

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- Give weight to what I value.
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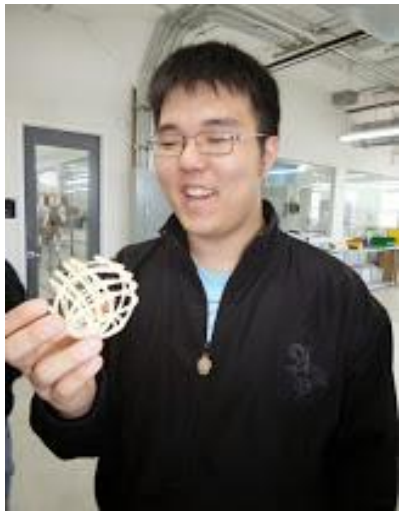
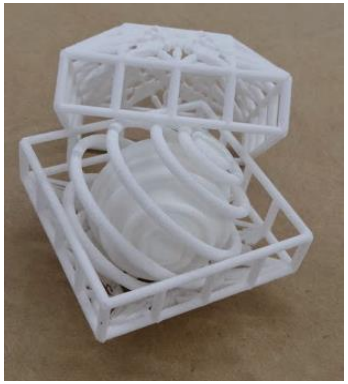
  - Creative Process
  - Revision Process
  - Thoughtfulness
  - Aesthetics

Grading (is also Guiding)

- Transparency
- Give weight to what I value.
  - Skill Development
  - Intentionality
  - Creative Process
  - Revision Process
  - Thoughtfulness
  - Aesthetics
  - Student responsibility

Success!





Trip to Shapeways
April 29, 2015

Student Comments

- **"This project allowed me to let my imagination soar while still learning about math concepts and modeling."**
- **"The art project was challenging but still managed to be fun … extremely satisfied when the object came to life."**
- **"I learned how to think in three dimensions."**
- **"Having a physical copy of the project was one of the greatest things ever."**
- **"I like the creative freedom that we given to complete this project."**
- **"The trip was very informative and was also very fun to attend. Thanks again Professor."**

Difficulties

- 3D Design in Mathematica is finicky

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- 3D Printing is finicky
  - Printability
  - Build in lots of time!

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Future

- Standards-based Grading Scheme
- More tutorials about three-dimensional mathematics

Thank YOU!

- Shapeways and Lauren Slowik!
- My students, who amaze and inspire EVERY TIME!

qc.edu/~chanusa

> Courses
Course Materials

> Research > 3D Design
3D Design in Mathematica

> Research > Talks
Slides Available

> Portfolio
Mathematical Art Gallery

hanusadesign.com
Mathematical Jewelry