3D Design in *Mathematica*

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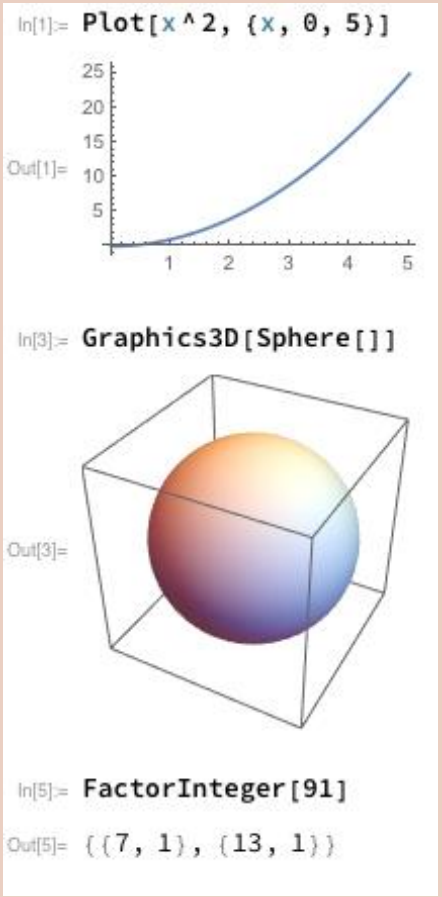
My *Mathematica* Experience

- **Symbolic computational software**
- **Starting in 2008**
  - **Friendly syntax**
  - **Extensive documentation**
  - **Visualization capabilites**



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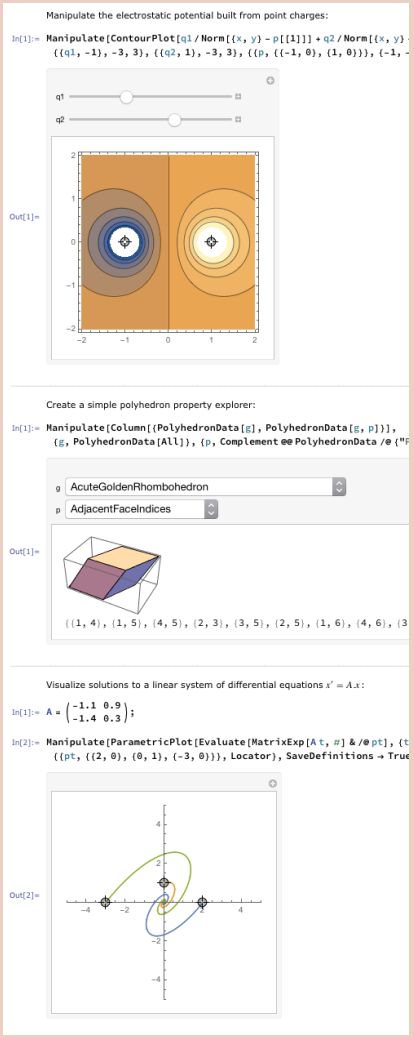

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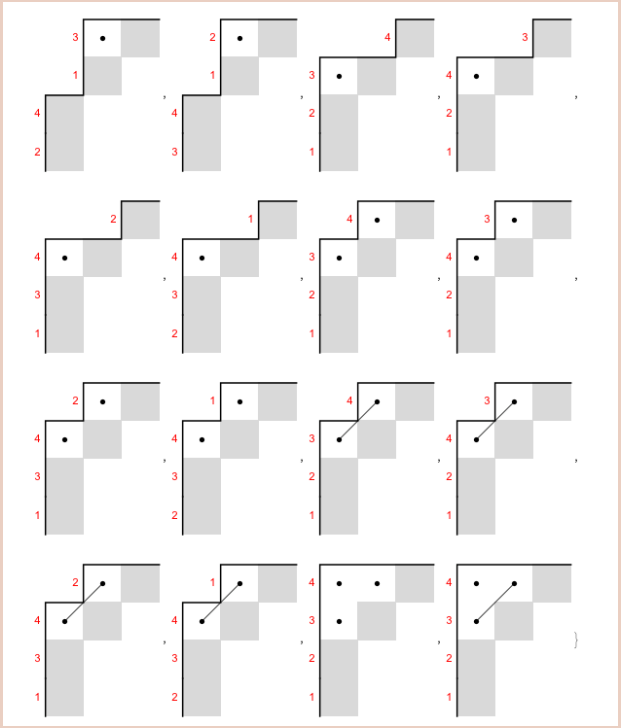
  - **Experimental Math**



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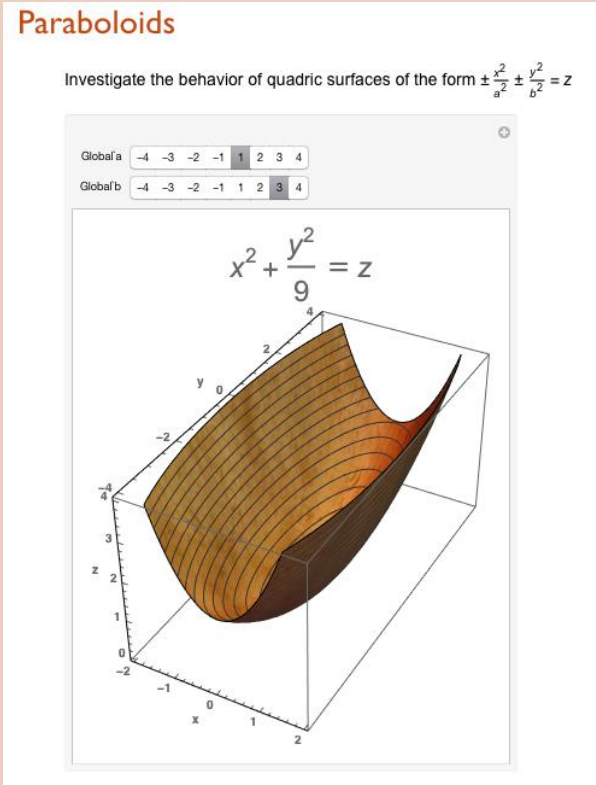
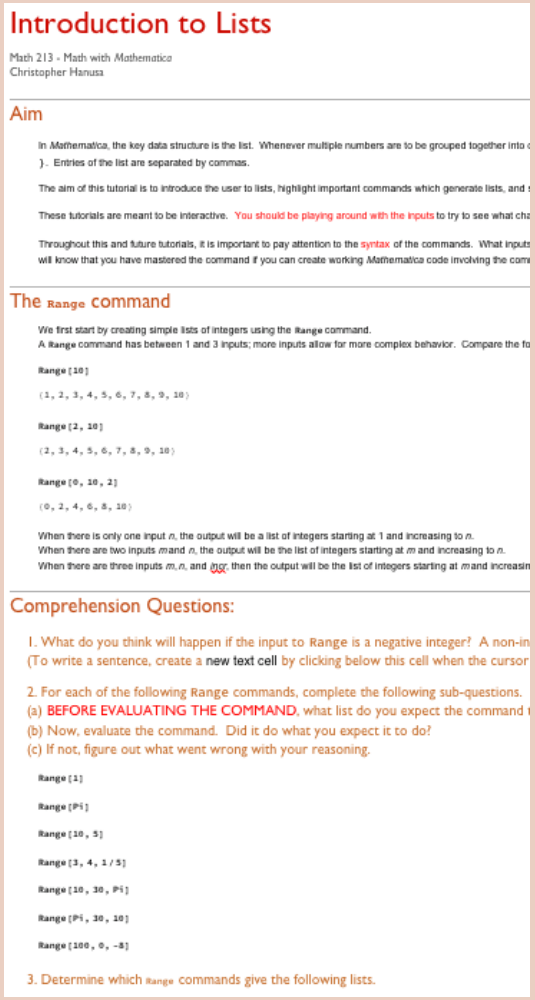
- **In my Teaching**
  - **Math Models, MV Calc, Math w/Mathematica**



Teaching Methods

- **Give students the tools to succeed**
  - **How to use the Documentation Center**
  - **Stand-alone tutorials**
  - **One-on-one help**



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 comi

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 *incr*, 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]
```

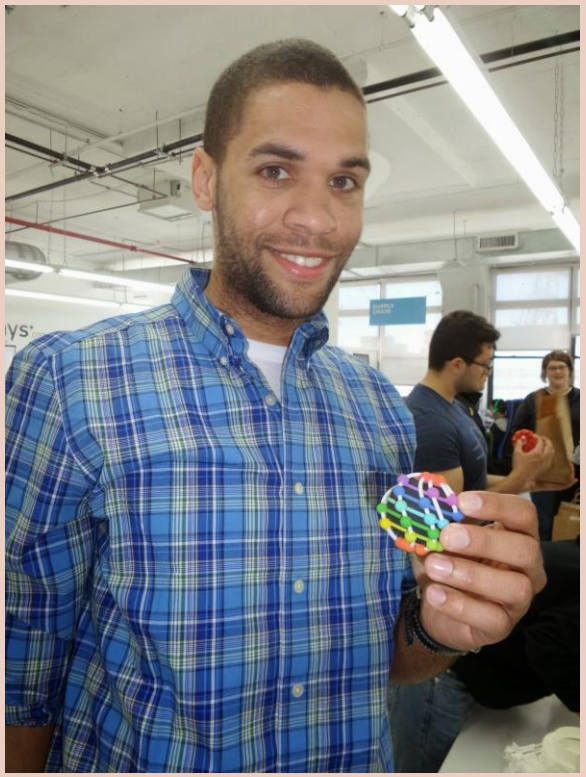
```
Range[Pi, 30, 10]
```

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

3. Determine which Range commands give the following lists.

Teaching Methods

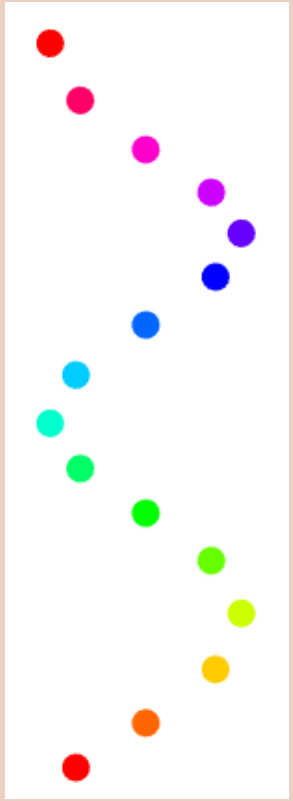
- **Give students the tools to succeed**
  - How to use the Documentation Center
  - Stand-alone tutorials
  - One-on-one help
- **Project-based learning**
  - Let them explore individually
  - Clear instructions and rubric
  - 3D printing since Spring ‘15



Mathematics in 3D Printing

Design in *Mathematica* requires specifying coordinates

- 3D Coordinate System
- Transformations
  - Rotation, Translation, Scaling
- Parametric Curves / Vector Functions
- Trigonometry
  - Angles between lines, sine, arctan,
- Geometric Objects
  - Equations of Torus, Ellipsoid, …
  - Polyhedra



Mathematica's Power

- **Programmable & Algorithmic approach to all**
  - **Notebook interface: No point and click!**
  - Table **and** Map **to apply systematically**
  - **Easy to add randomness.** RandomReal[]
  - **Easy to add color.** Hue[]
- **Exports to multiple file formats**
  - Export["filename.stl",model]
- **Visualization Capabilities**
- **Scheduled Updates**

Drawbacks

- 3D printing rather new to *Mathematica*.
- It doesn't "just work".
  - Certain commands not exportable at all
  - Never know when it will export or crash
  - Difficult to understand error messages
- Requires license ($$$)
- Colleagues use Sage