

3D Design in the Wolfram Ecosystem

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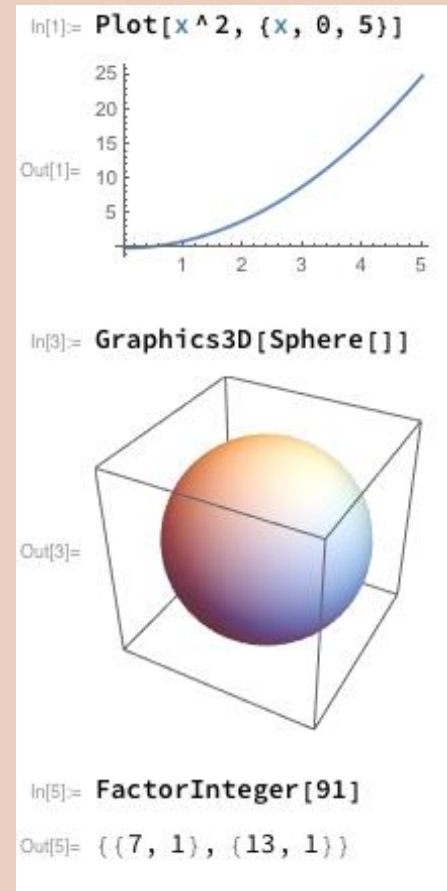
Slides & More at bit.ly/MMA3DP
qc.edu/~chanusa @mathzorro @hanusadesign

Today's Plan

- My Journey in *Mathematica*
- Quick Start to 3D Printing
- Using Curated Data from Wolfram
 - Biology, Chemistry, Astronomy, Geography, Knots, Polyhedra
- The *Math* in *Mathematica*
 - 3D Coordinates
 - Transformations, Geometric Computation
 - Parametric Equations
 - Incorporating Randomness

Why *Mathematica*?

- Symbolic computational software
 - Friendly syntax
 - Notebook interface: No point and click!

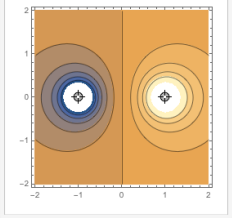


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Manipulate the electrostatic potential built from point charges:

```
In[1]:= Manipulate[ContourPlot[q1 / Norm[{x, y} - p[[1]]] + q2 / Norm[{x, y} - p[[2]], {{q1, -1}, -3, 3}, {{q2, 1}, -3, 3}, {{p, {{-1, 0}, {1, 0}}}, {-1, 1}], {q1, -3, 3}, {q2, -3, 3}, {p, {{-1, 0}, {1, 0}}}]
```

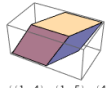


Out[1]=

Create a simple polyhedron property explorer:

```
In[1]:= Manipulate[Column[{PolyhedronData[g], PolyhedronData[g, p]}, {g, PolyhedronData[All]}, {p, Complement[PolyhedronData / #, {"F"}]}], {g, PolyhedronData[All]}, {p, Complement[PolyhedronData / #, {"F"}]}]
```

g AcuteGoldenRhombohedron
p AdjacentFacelIndices



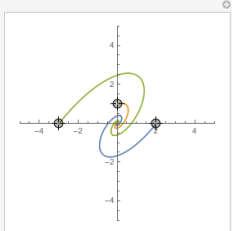
Out[1]=

```
{(1, 4), (1, 5), (4, 5), (2, 3), (3, 5), (2, 5), (1, 6), (4, 6), (3, 6)}
```

Visualize solutions to a linear system of differential equations $x' = Ax$:

```
In[1]:= A = {{-1.1, 0.9}, {-1.4, 0.3}};
```

```
In[2]:= Manipulate[ParametricPlot[Evaluate[MatrixExp[A t, #] & /@ pt], {t, 0, 10}], {{pt, {{2, 0}, {0, 1}, {-3, 0}}}, Locator], SaveDefinitions -> True]
```



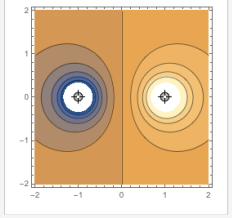
Out[2]=

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- One unified vision
 - Seamlessness / interoperability
 - Actively maintained

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```

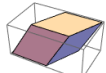


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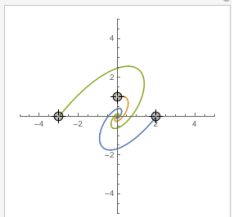
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```



Out[2]=

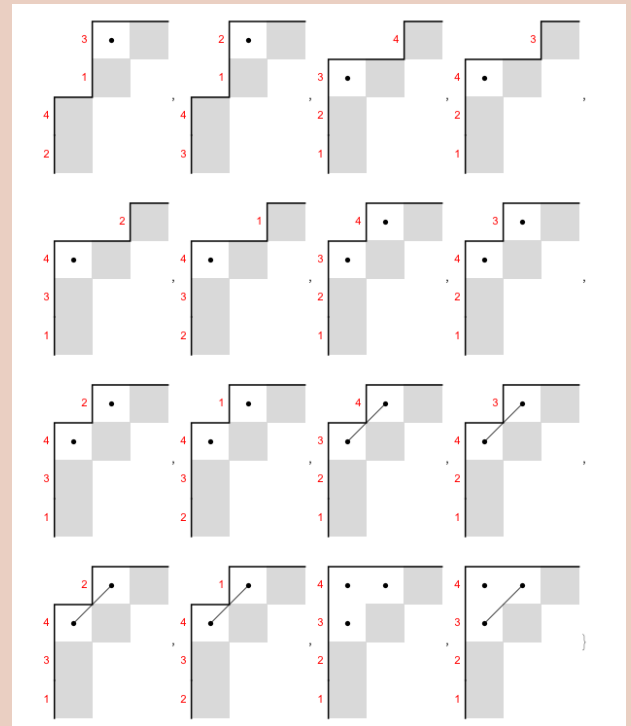
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 - Seamlessness / interoperability
 - Actively maintained
- Functional programming
 - **Table** and **Map** to apply systematically
 - Easy to add randomness and color



My *Mathematica* Journey

- Started in 2008
 - 3D printing since Spring '15
- Research Exploration
 - Experimental Math

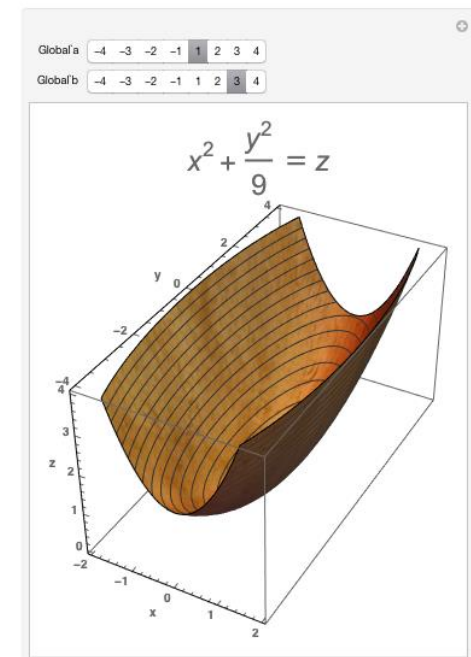


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- Teaching
 - Mathematical Computing, Multivar. Calc

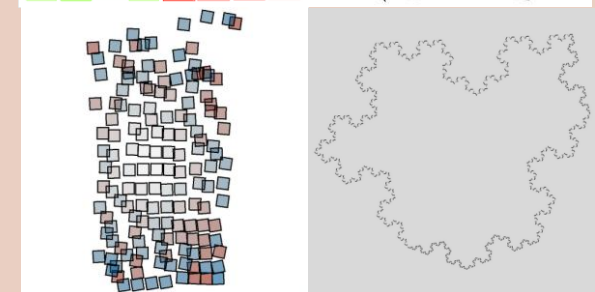
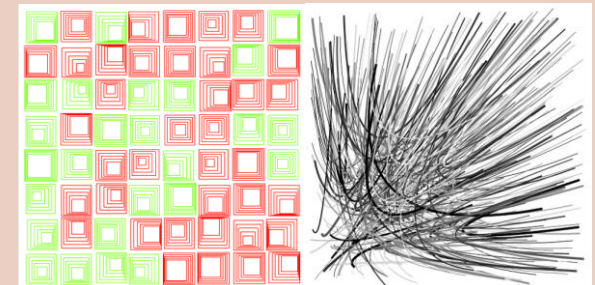
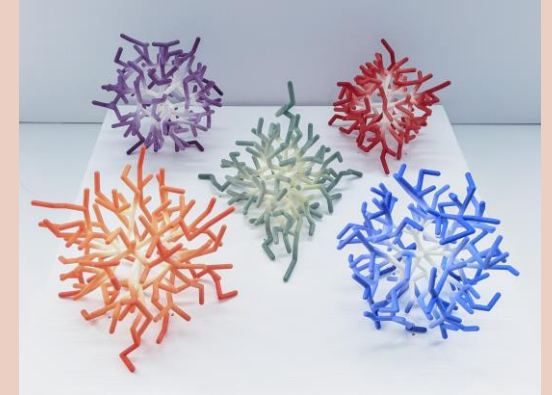
Paraboloids

Investigate the behavior of quadric surfaces of the form $\pm \frac{x^2}{a^2} \pm \frac{y^2}{b^2} = z$



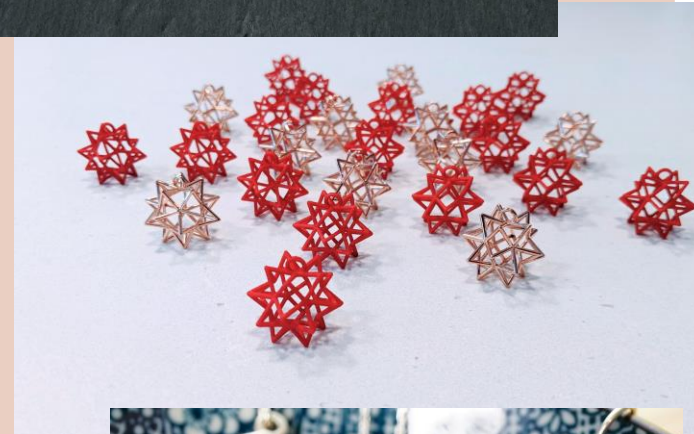
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 - Mathematical Computing, Multivar. Calculus
- Mathematical Art
 - christopherhanusa.com / artvote.net



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- Mathematical Jewelry
 - hanusadesign.com



Let's head over to
Mathematica!