

Visualization and Algorithms

–old teaching paradigms in new contexts–



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The power of scripting



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DGS decisions

Audience

... → school → highschool → college → university → ...

Granularity

detailed control ← → complex building blocks



DGS decisions

Audience

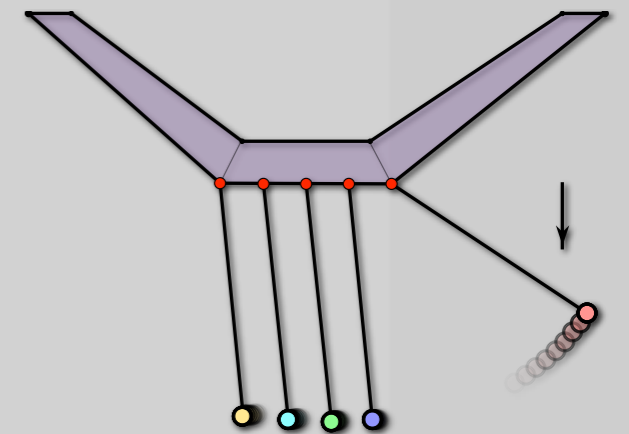
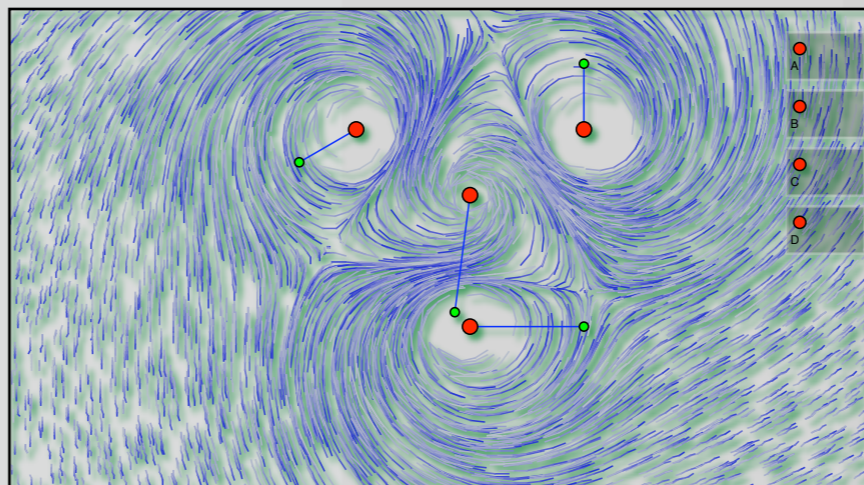
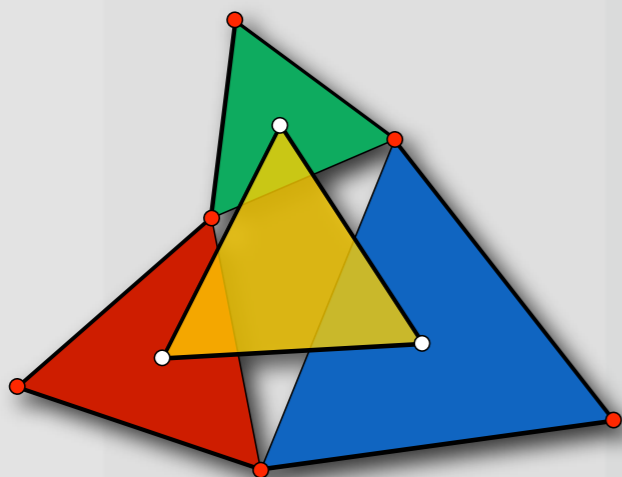
... → school → highschool → college → university → ...

Granularity

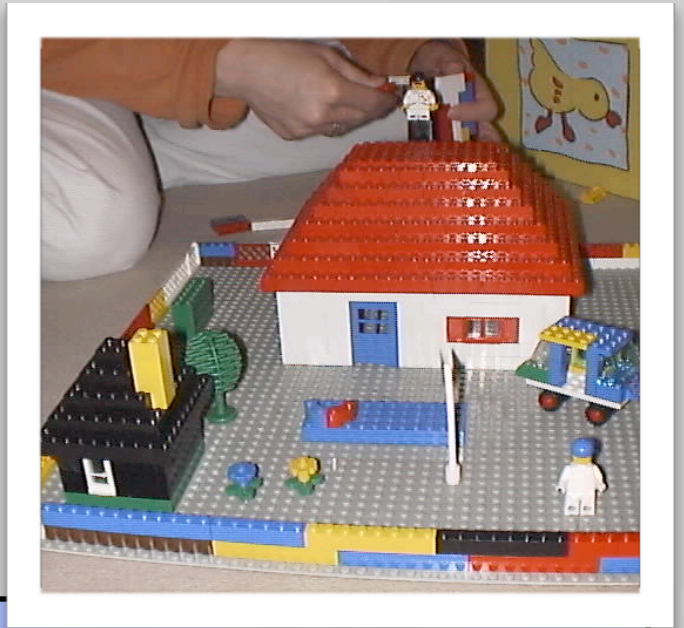
detailed control ↔ complex building blocks

Flexibility

geometry ↔ all math, physics, comput. science, ...



D-Scripting



Geometry alone is too inflexible

Requirements

- easy to learn
- direct feedback
- real-time interactivity
- fast prototyping
- high-level math
-



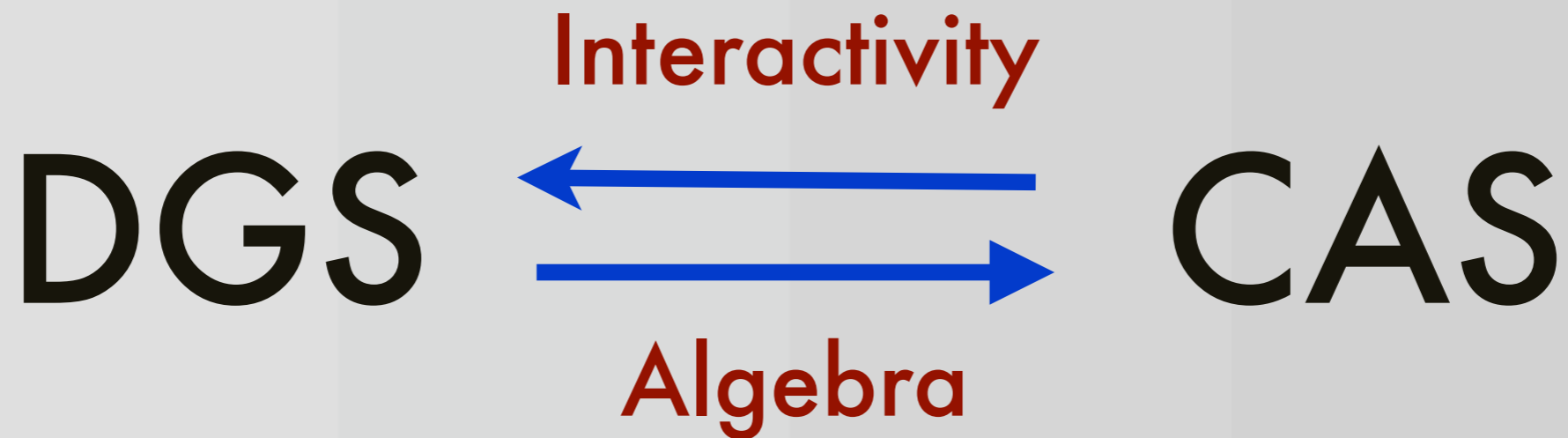
Novice:

should be able to do easy things fast

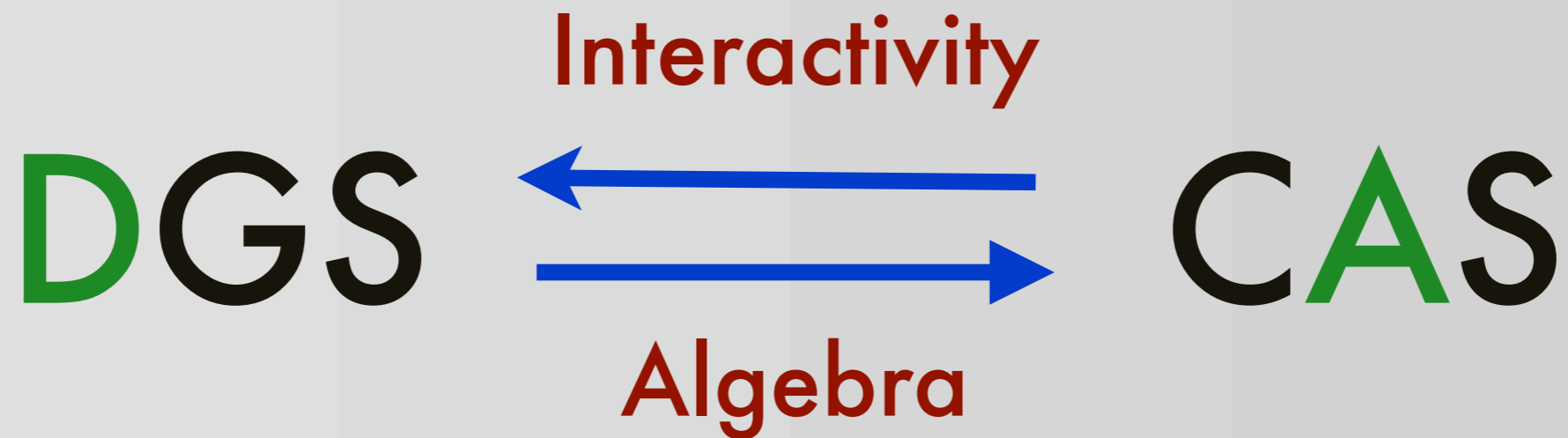
Expert:

should be able to create open ended scenarios

Convergence from two sides



Convergence from two sides



Convergence from two sides

Wolfram Research | *Mathematica* | *MathWorld* | Wolfram Science | More » **WOLFRAM WEB RESOURCES**

Wolfram Demonstrations Project

HOME TOPICS LATEST ABOUT FAQs PARTICIPATE AUTHORIZING AREA »

Wheels on Wheels on Wheels

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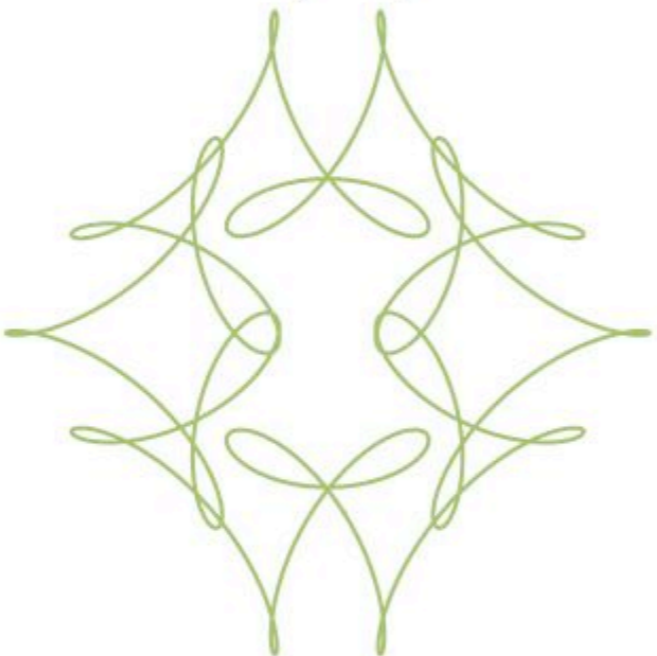
frequency 1 1

frequency 2 7

frequency 3 -15

Multiply by i :

first term second term third term

$$z(t) = e^{it} + \frac{1}{2} e^{7it} + \frac{1}{3} e^{-15it}$$


7 **MATHEMATICA 7 JUST RELEASED**
Get *Mathematica Player 7 Free*
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Related Topics

- Exponential Functions
- Patterns
- Trigonometric Functions

[Browse all topics](#)

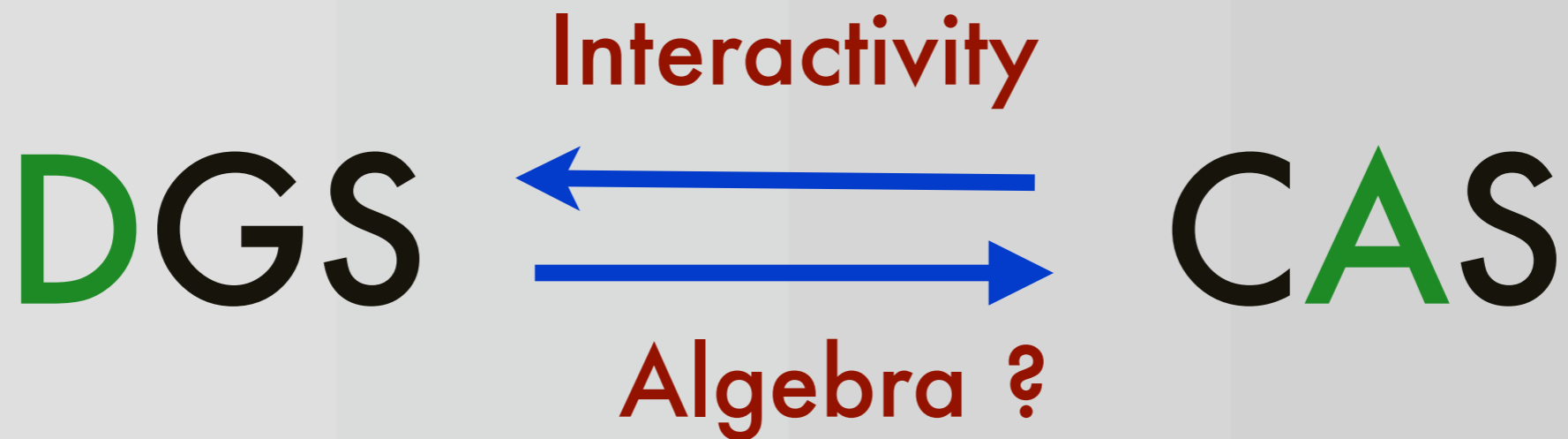
Some Related Demonstrations

- Farris Wheels
- Elementary Transcendental Functions and Their Inverses
- Tetraviews of Elementary Functions
- 3D Lambda
- Gulloché Patterns
- Phase Plots of Trigonometric Functions
- Rolling Wheel with Spoke
- Mapping Rectangles by the Elementary Transcendental Functions
- Complex Exponential and Logarithm Functions
- Damped 3D Lissajous Figures

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Convergence from two sides



95% is advanced
number crunching

Our approach: CindyScript

- simple syntax
- *fast prototyping*
- typefree
- functional
- easy to learn

Compute
Control
Draw

```
list(x):=(
  gsave();
  repeat(length(x),
    turtle(x_#));
  grestore();
);

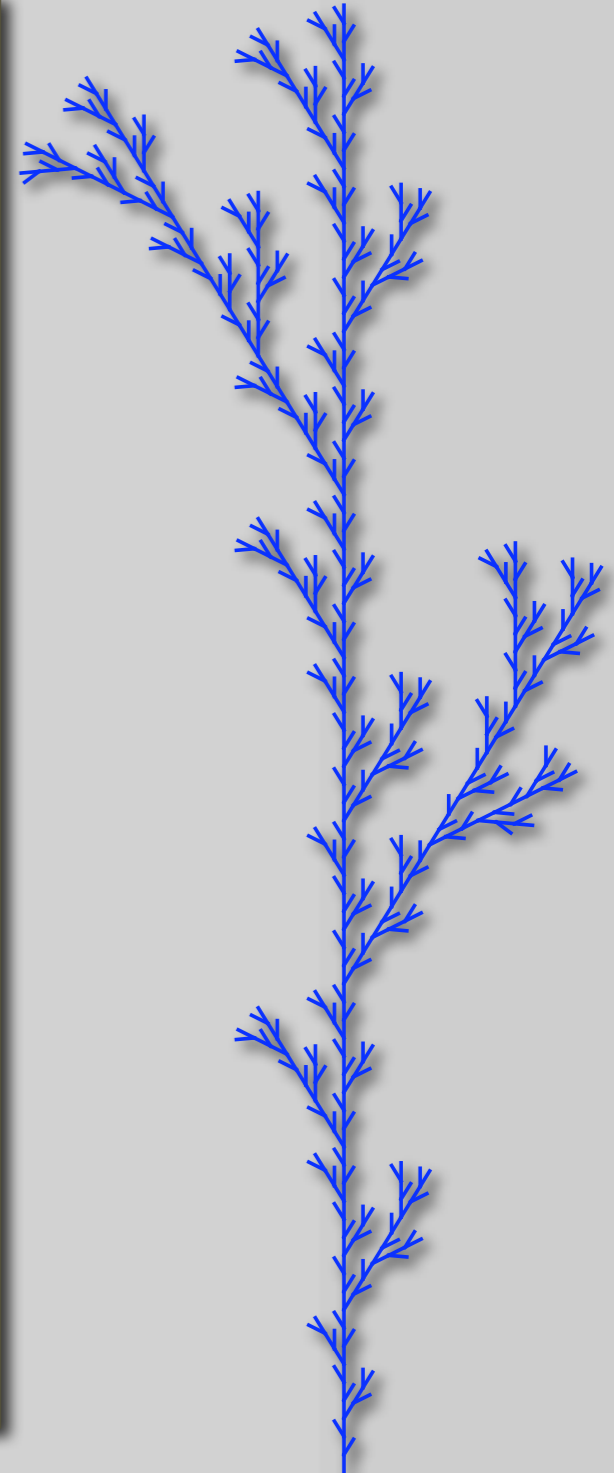
turtle(x):=(
  (if(x=="F",foreward));
  (if(x=="+",left));
  (if(x=="-",right));
  (if(x=="[",open));
  (if(x=="]",close));
);

foreward:=(draw((0,0),(1,0));
  translate((1,0)));
left:=rotate(angle);
right:=rotate(-angle);
open:=gsave();
close:=grestore();

l=0.2;
angle=A.x/4;

n=4;
s="F";
repeat(n,s=replace(s,
  "F","F[+F]F[-F]F"));

rotate(pi/2);
list(s)
```



Language Characteristics

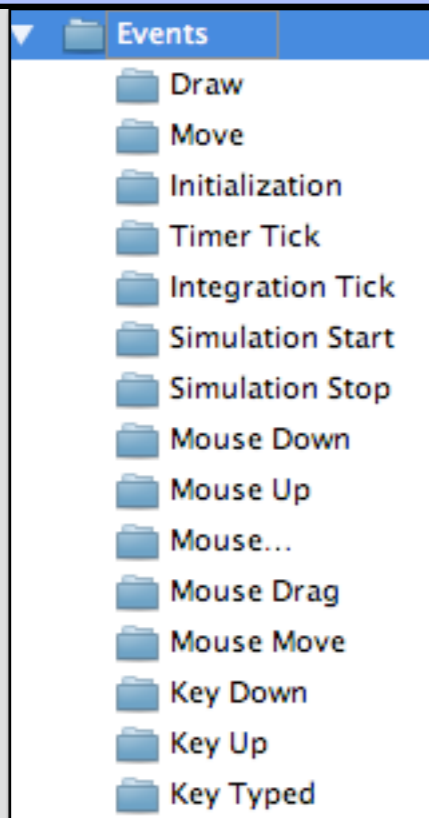
implicit typing

```
a=2+3*i;  
b=|a|<1;  
c=if(b, "yes", a)
```

math. operations

```
linearsolve(A,b);  
roots(poly);  
eigenvalues(A);  
[1,2,3]*[3,2,1];
```

event driven



real time interaction

```
if(A.x<0,  
    A.x=0;  
    A.color=(1,0,0)  
);
```

functional programming

Important functions

```
draw ( (x, y) ) ;
```

draws a point

```
draw ( (x, y) , (u, v) ) ;
```

draws a line

```
A.xy = (x, y) ;
```

moves a point

```
if (x < 0, . . . , . . . ) ;
```

if-conditional

```
repeat (100, . . . ) ;
```

simple loop

```
plot (sin (x) ) ;
```

draws a function

+math. fomulas, +lists, +recursion, +strings

Advanced features

`1..100`

list of numbers

`apply(1..10, i, ...);`

iterate through list

`select(list, i, ...);`

select from list

`drawtext((0,0), "abc");`

draw a text

`A.color`

color of point A

`f(x) := x^2 + 3*x + 2;`

define function

+vectors, +matrices, +complex numbers,...

NEW: Syntherella



`playtone (60) ;`

plays a C

`playtone (61) ;`

plays a C#

`playmelody (. . .) ;`

plays a melody

`instrument (. . .) ;`

set instrument

`playsin (440) ;`

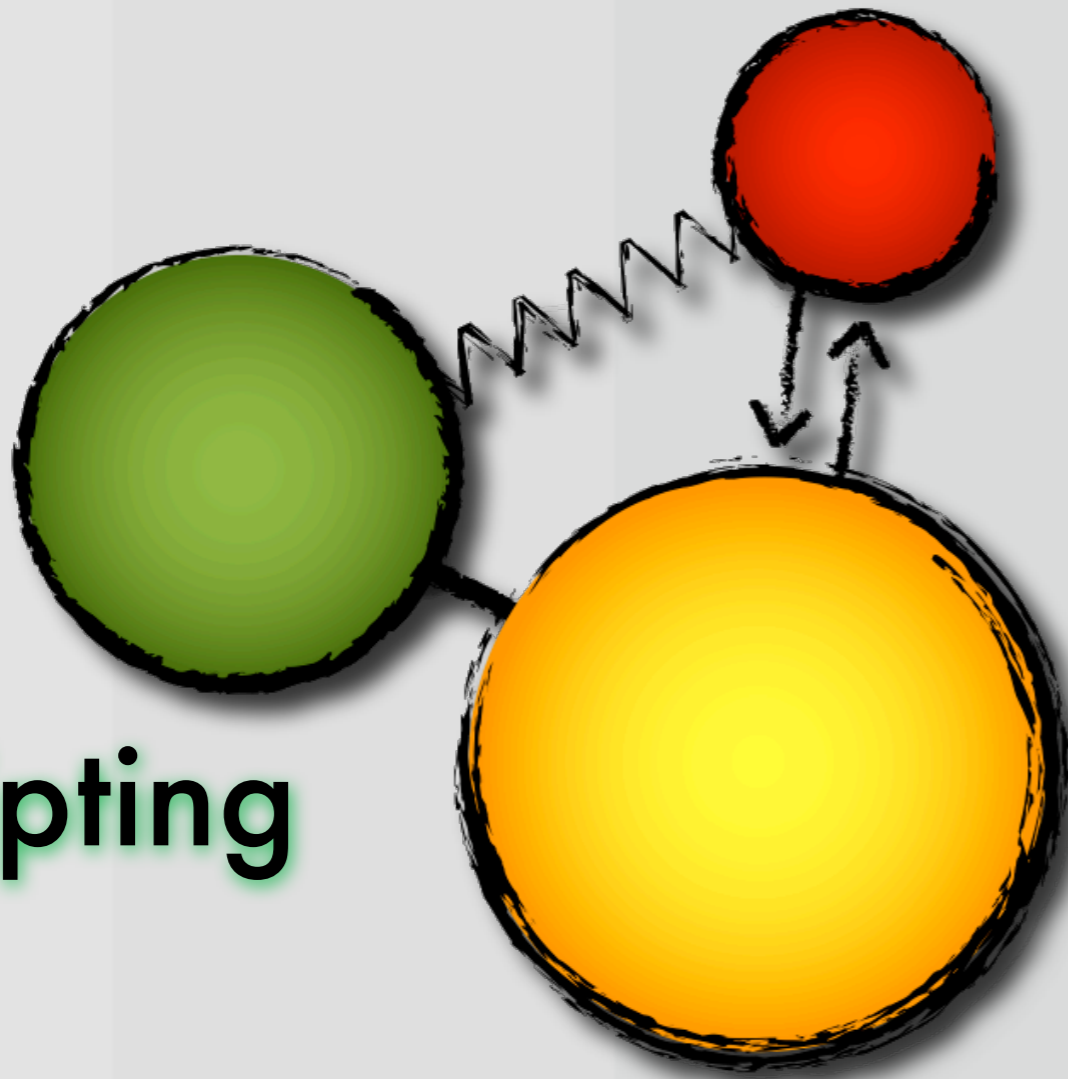
plays 440Hz

`stoptone (60) ;`

stops a tone

several modifiers á la MIDI, function sound,...

Simulation



DEMO

Scripting

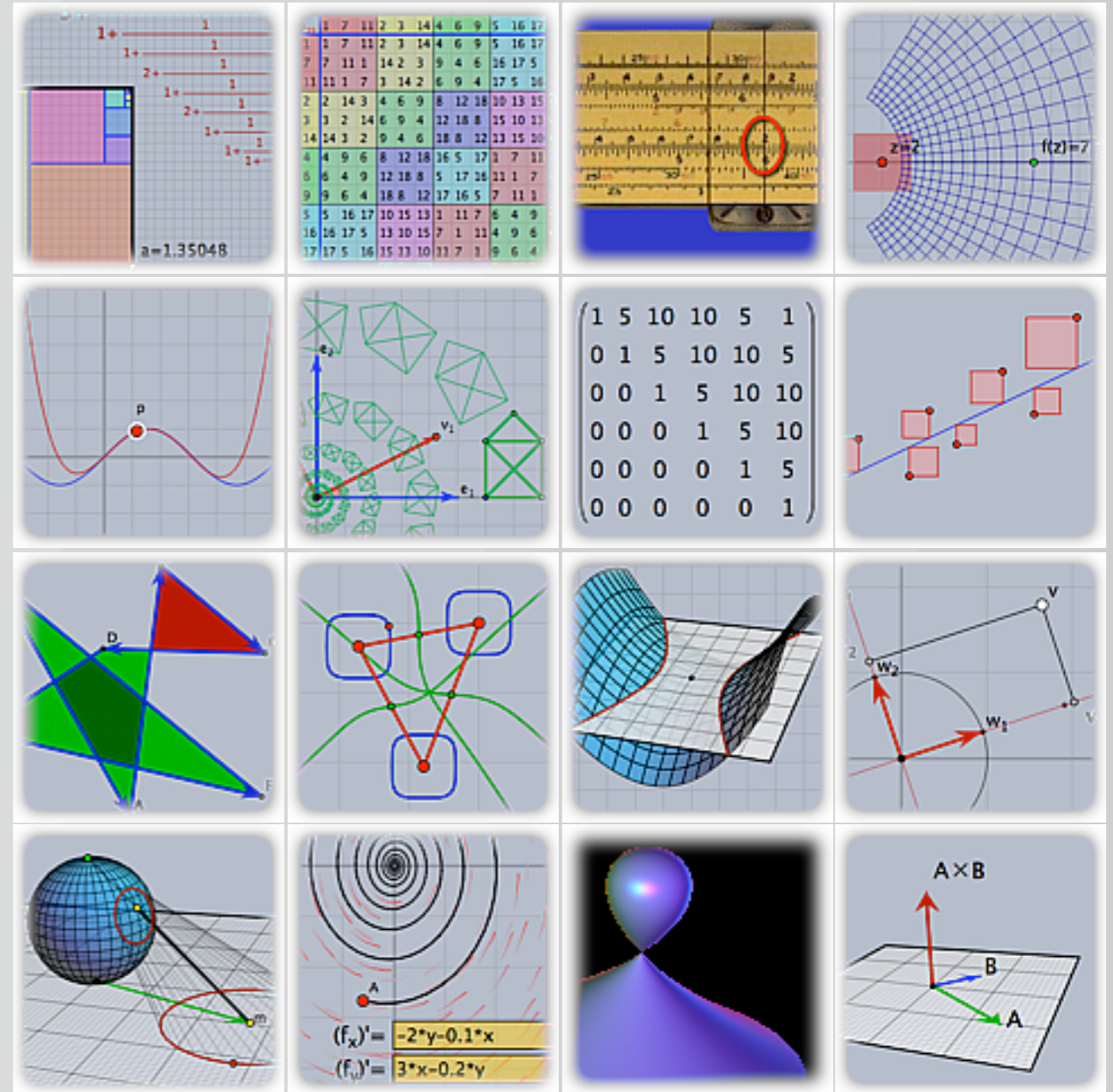
Geometry

Sister project:

mathematisch



math model collection (seit ≈ 1860)



virtuell high-quality model collection

Mathe Vital → Criteria for good pages

multi-disciplinary
well explained
virtual lab
versatile
exciting
triggers „exploration“
„hunger for more“

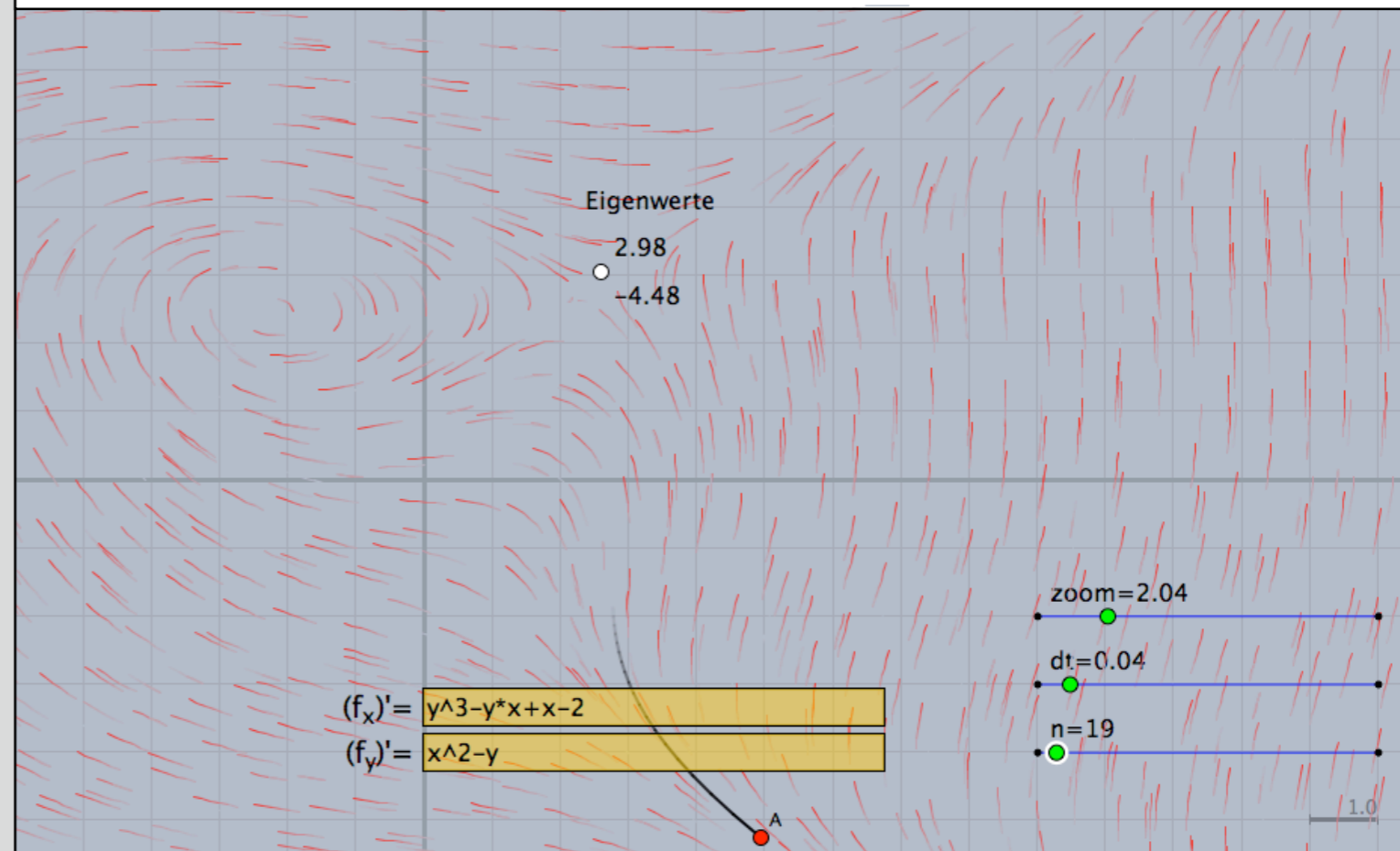
Einige interessante nicht-lineare Differentialgleichungen

Im folgenden Applet kann man frei mit Lösungen von zweidimensionalen Differentialgleichungen der Form

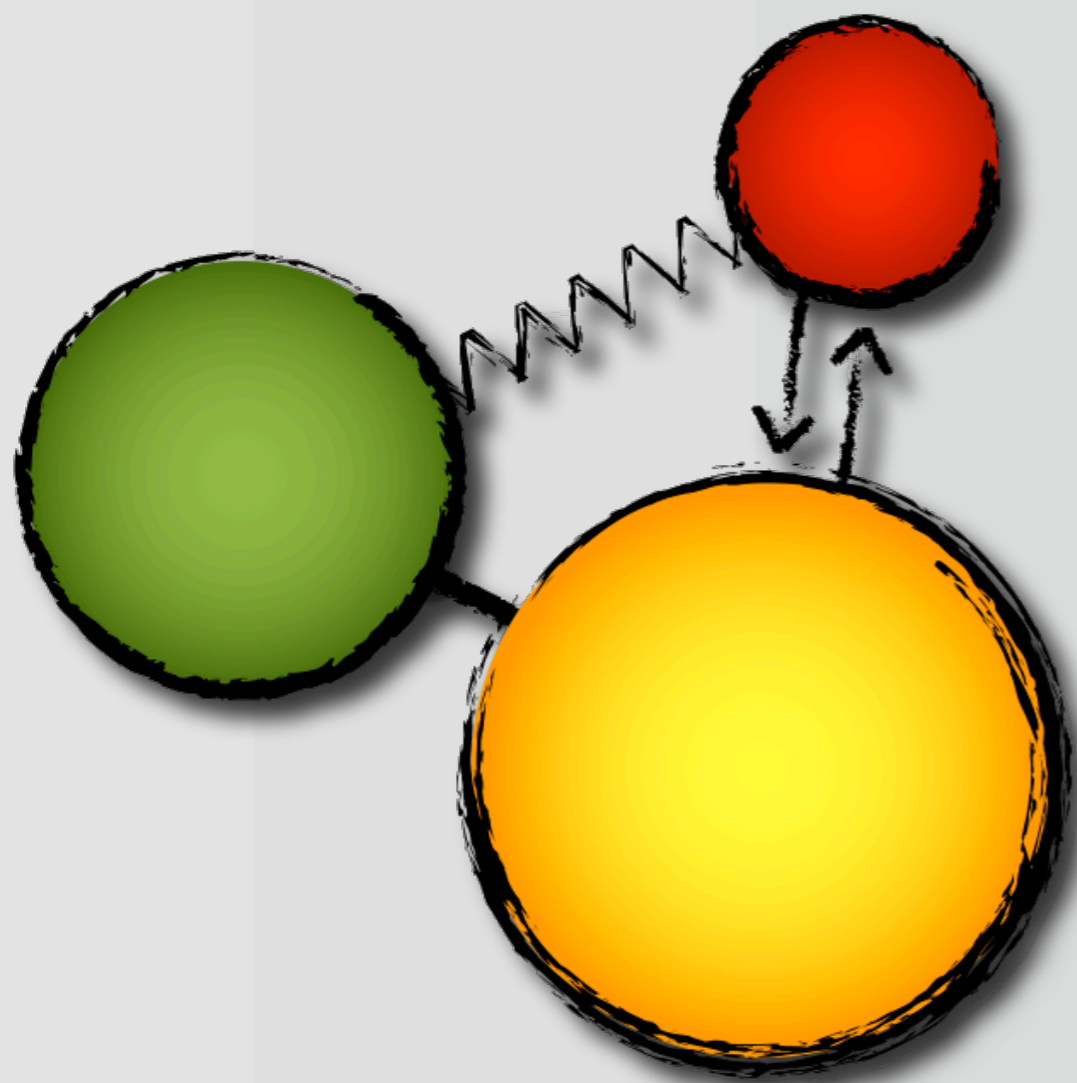
$$\frac{\partial f(x, y)}{\partial x} = f_1(x, y)$$

$$\frac{\partial f(x, y)}{\partial y} = f_2(x, y)$$

experimentieren. Man beachte, dass die Eigenwerte der Matrix der zweiten Ableitung die Lokale Struktur des Feldflusses widerspiegelt. Nachstehend sind einige interessante Differentialgleichungen durch Knopfdruck auswählbar.

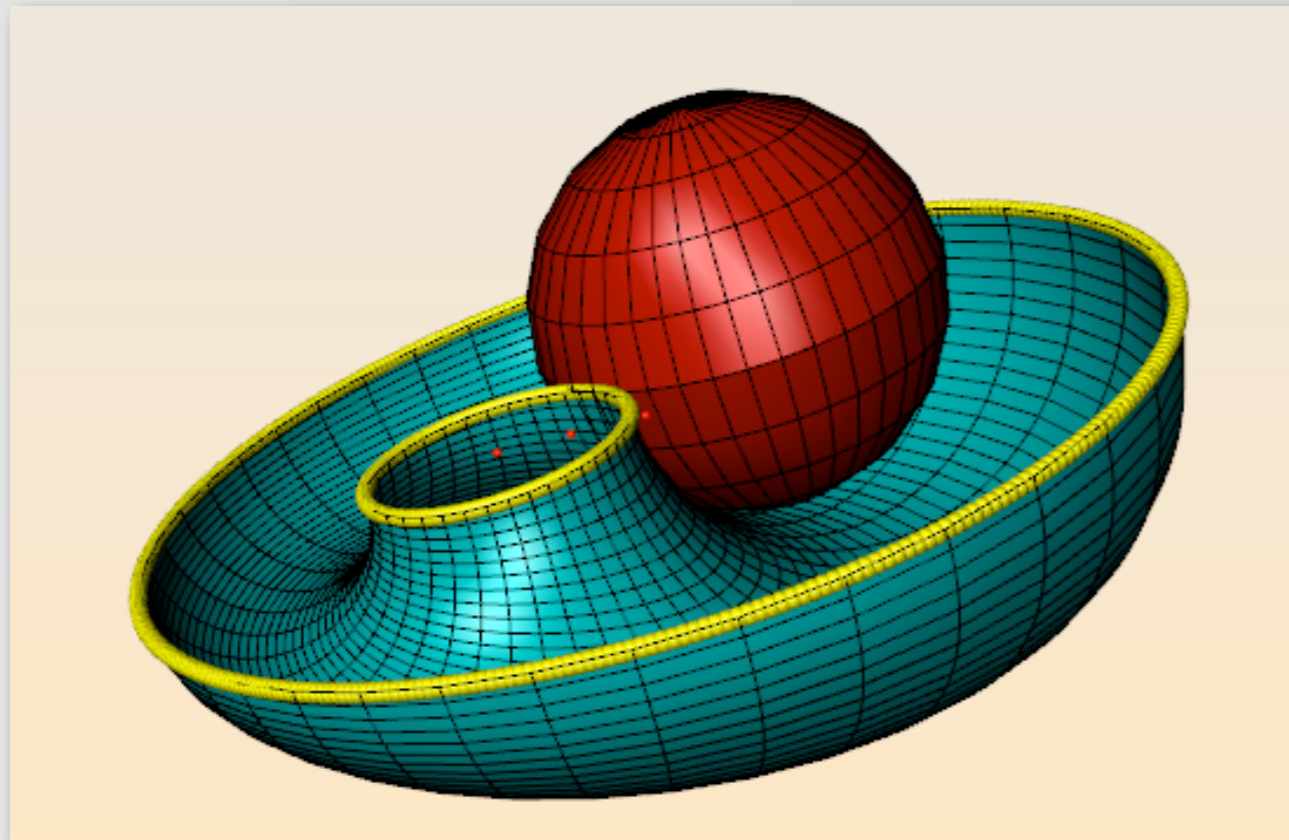


Linear algebra II – differential equations

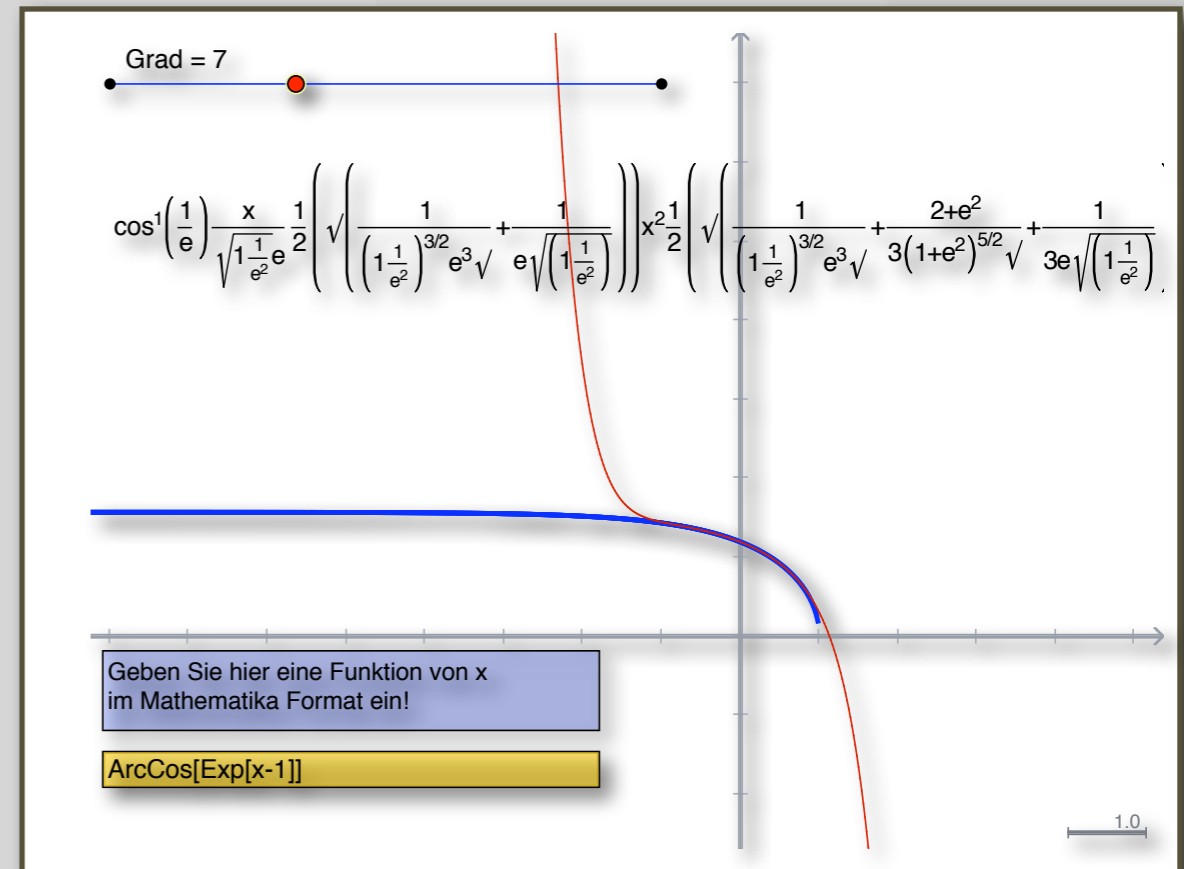


DEMO

Work in progress: plugins

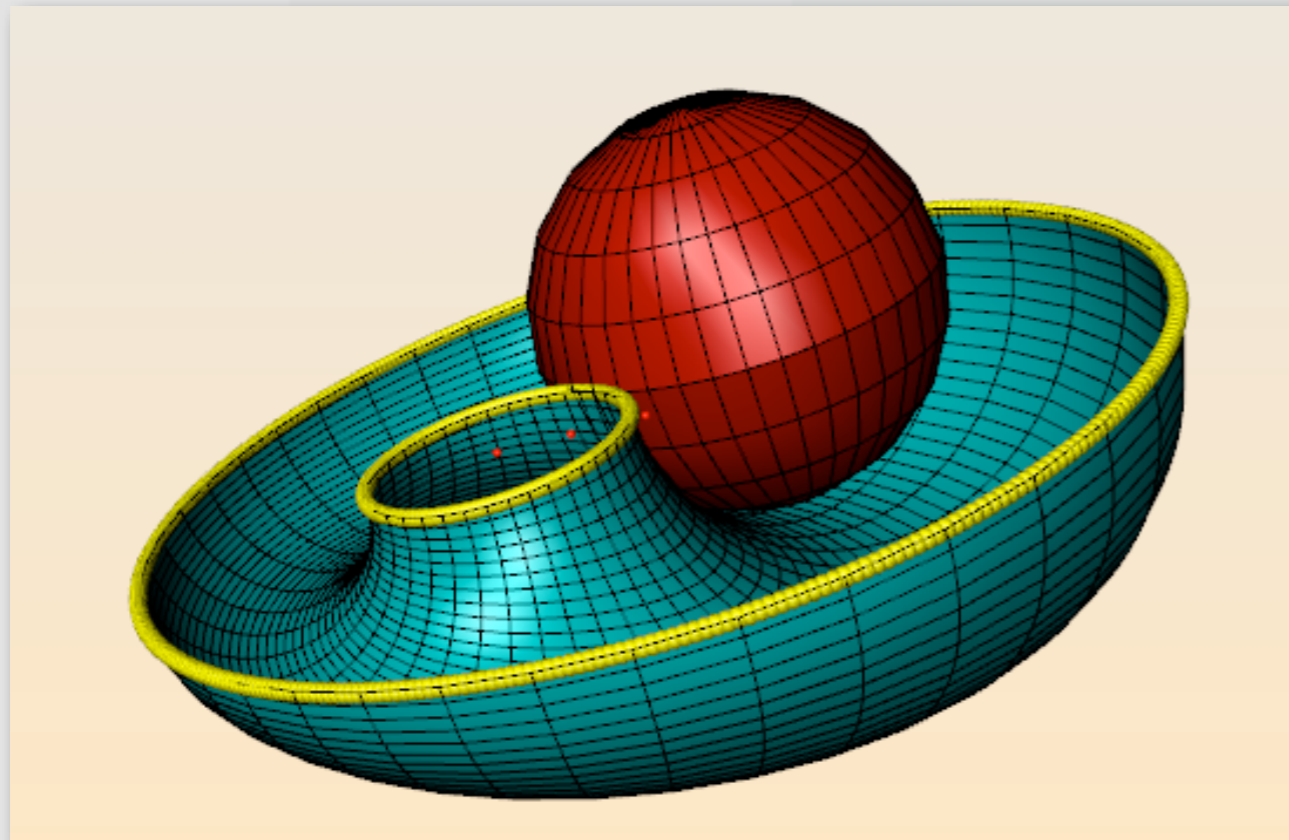


3D plugin in collaboration
with jReality (Berlin, Munich)

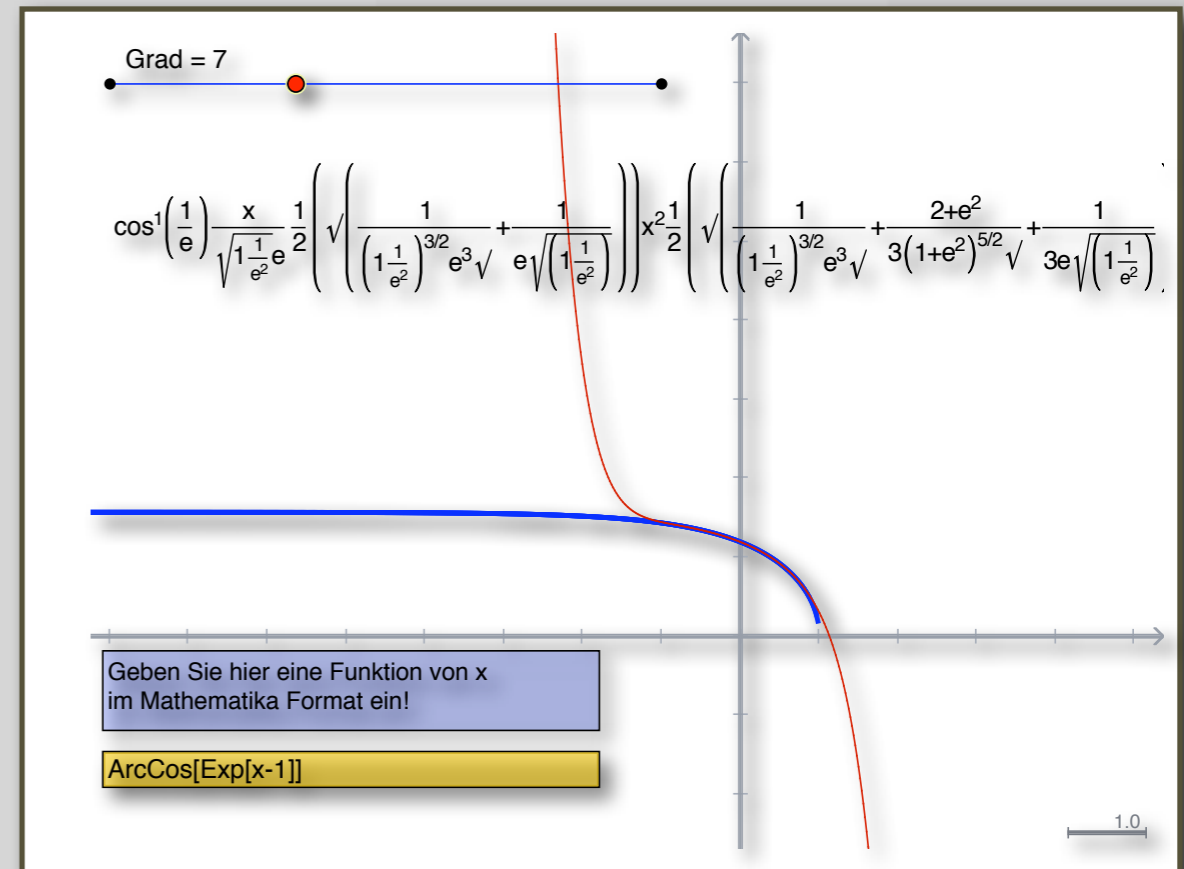


Linking to other systems
like Maple, Mathematica, ...

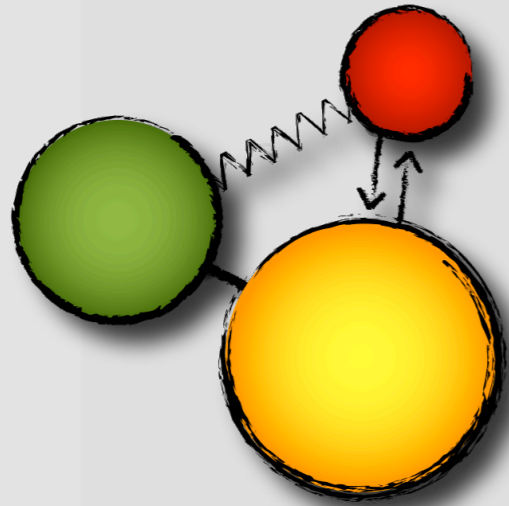
Work in progress: plugins



3D plugin in collaboration
with jReality (Berlin, Munich)



Linking to other systems
like Maple, Mathematica, ...



www.cinderella.de

[www. !\[\]\(2e897e890e69d81eae4503a8342c36b0_img.jpg\) mathematical.de](http://www.mathematical.de)
Visual Interactive Tools for Advanced Learning

Workshop: tomorrow 14:00