

VISUALIZING MATHEMATICS

THIS WILL BE AUTHORED BY MEMBERS OF THE COURSE

ABSTRACT. We look at some aspects of visualization in mathematics. This first handout tries to visualize the process of finding a theme to write on in this visualization course.

1. INTRODUCTION

1.1. Technology has enabled us to explore, interact and visualize with mathematics in new ways. The landscape of teaching has changed rapidly during the last decades. Within a short period of time we have seen the rise powerful computer algebra systems or the development of web technologies allowing interactive laboratories. Printing technologies enabled us to fabricate mathematical illustrations. Photographic advances allows to produce immersive panoramic views. Computer vision allows to produce digital implementations of real objects. Advancements in artificial intelligence opened innovative tools for shaping and visualizing mathematical structures. Free worlds in computer games allow even more immersive experiences. In the seminar, we illuminate a few aspects and write them down. Each student will pick a topic and write a paper which then will be merged into a common document.

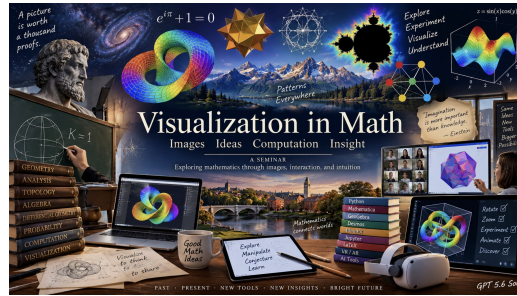


FIGURE 1. AI generated picture in 2026. My request was to build a slide to illustrate the theme. September 8 2026 has been a shock for mathematics. And it is a shock to see the improvements from last year. The current model was able to make a slide tailored to Oliver personally. It knows what I'm interested in, what I'm teaching etc.

2. VISUALIZING THE SEARCH

2.1. There are so many aspects to the topic of visualization that not everything can be covered. It is more like a selection. One way to organize knowledge is in the form of tables. It is formalized in the morphological box idea of Fritz Zwicky¹ Here is a start. Put some verbs related to visualization into one coordinate and some mathematical fields into the other coordinate. This is just one way to get to ideas:

Date: September 8, 2026.

Key words and phrases. Visualization.

¹Fritz Zwicky: "Discovery, invention, research through the morphological approach, 1969".

VISUALIZATION MATH

	Algebra	Geometry	Topology	Analysis	Dynamics	Probability
Share	Data visual	Sculpture			CA lab	
Play	Rubik		Hudini			Buffon
Present		SVG		Fractals		
Capture		LIDAR	Scan			
Feel	Cuisenaire	3Dprint			Pendulum	
Interact		Maze		Chaos		Dice
Remember	Quipu	Byrne	Models			Martingale

2.2. Here are some ideas for math topics or technology. There are of course a thousand times more possibilities. There are 63 two digit top level fields in the mathematics subject classification MSC 2020. Lets pick the 8 ancient roots of mathematics . Neuroscientists think we have at least 22 different senses. Lets pick the 5 primary one (seeing, hearing, tasting, touching, smelling) A rough taxonomy of core technology domains gives 5 (information, geospatial, immersive, machine learning, interactive visualizations). Building a taxonomy box has already $8*5*5=200$ different combinations. Here are some things which were mentioned in previous 99 R seminars here.

- Curves and surfaces, visualization, animation
- Visualization of higher dimensional spaces
- Visualization of topology, algebraic geometry,
- Solitaire Puzzles: building, insight, implementation
- Vision: camera types, panoramas, structure from motion
- Graphics technologies Gaussian splats versus triangulation
- Networks: visualizing graphs, large networks
- Mathematical models: historical and modern
- Early writing techniques on papyrus, tablets, Quipus
- Using computer games for math education
- Shape, text to topology recognition OCR type
- Tomography techniques, radon transform, inverse problems
- Visualizing ordinary differential equations
- Visualizing partial differential equations
- Webb applets, i.e. Java script applets, building labs
- Ray tracing technology like Povray, Blender
- 3D scanning object, 3d printing technology
- connections with art, music, sculptures, models
- Vector graphics on the web, SVG
- Gaussian splats versus triangulation,
- Networks: visualizing graphs, large networks
- Mathematical models: historical and modern
- Visualizing maps, systems chaos, fractals
- Story telling, historical aspects
- Mathematics of puzzles or 2-player games
- Visualizing any topic in math, like number theory
- Example: visualize an open problems, or an AI solution

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