# COSE436

# Lecture 1:
# Intro. to Interactive Visualization

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KOREA UNIVERSITY

# Outline

- What is interactive visualization?
- About the course

**vi·su·al·i·za·tion** noun \ˌvi-zhə-wə-lə-ˈzā-shən

1: formation of mental visual images

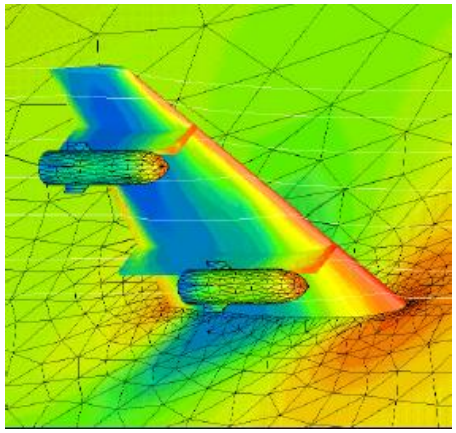
2: the act or process of interpreting in visual terms or of putting into visible form

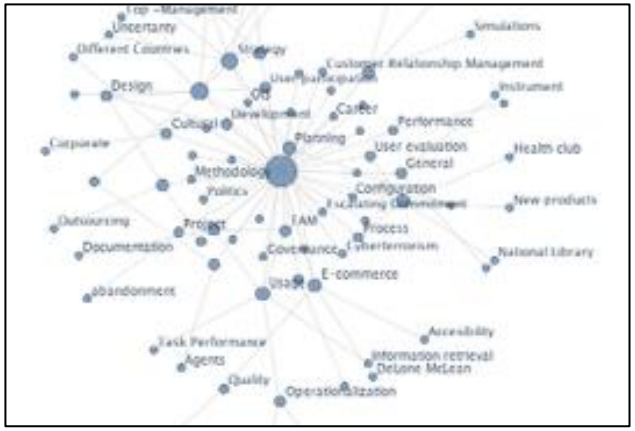
3: the process of making an internal organ or part visible by the introduction (as by swallowing) of a radiopaque substance followed by radiography

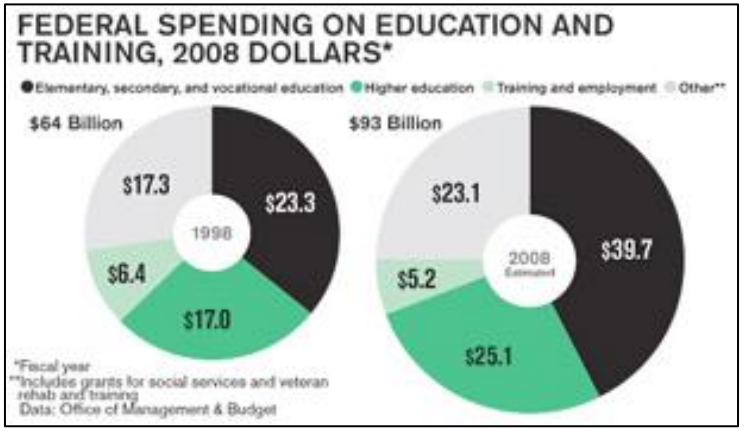
*"a cognitive process performed by humans in forming a mental image of a domain space. In computer and information science it is, more specifically, the visual representation of a domain space using graphics, images, animated sequences, and sound augmentation to present the data, structure, and dynamic behavior of large, complex data sets that represent systems, events, processes, objects, and concepts"*
[Williams et al. 95]

# Visualization

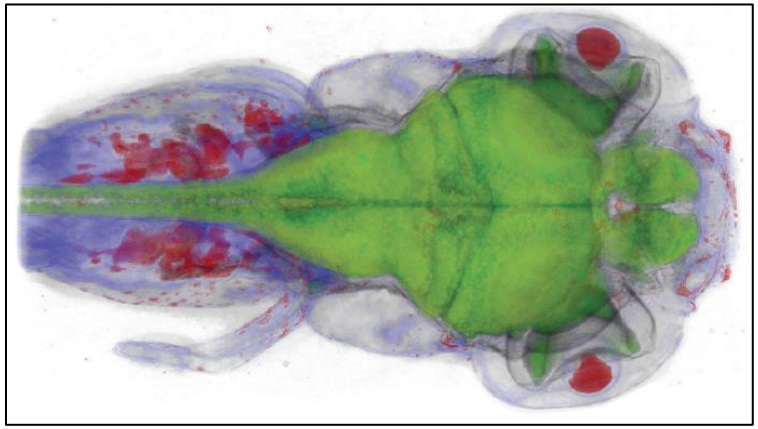
- Convey information through graphical representations of data





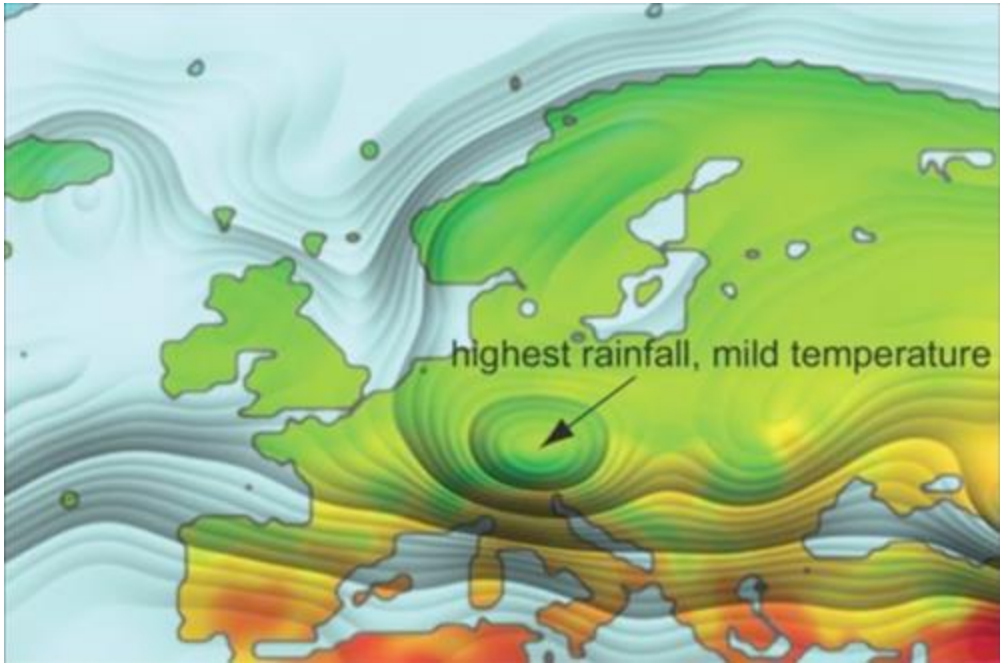







# Example

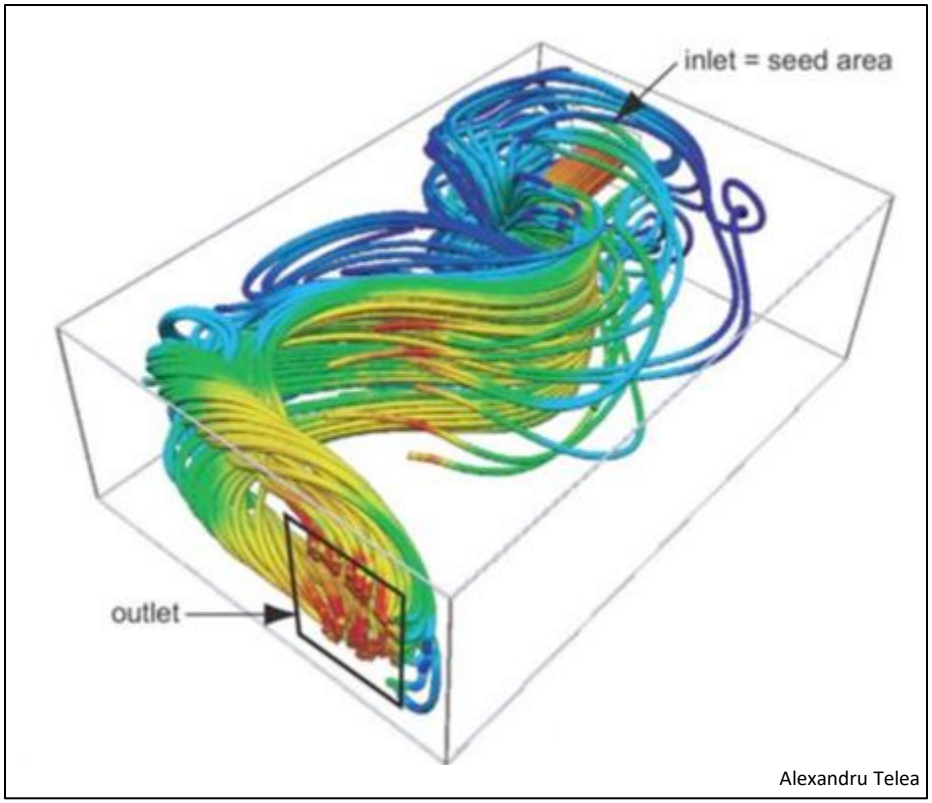
- Rainfall - temperature



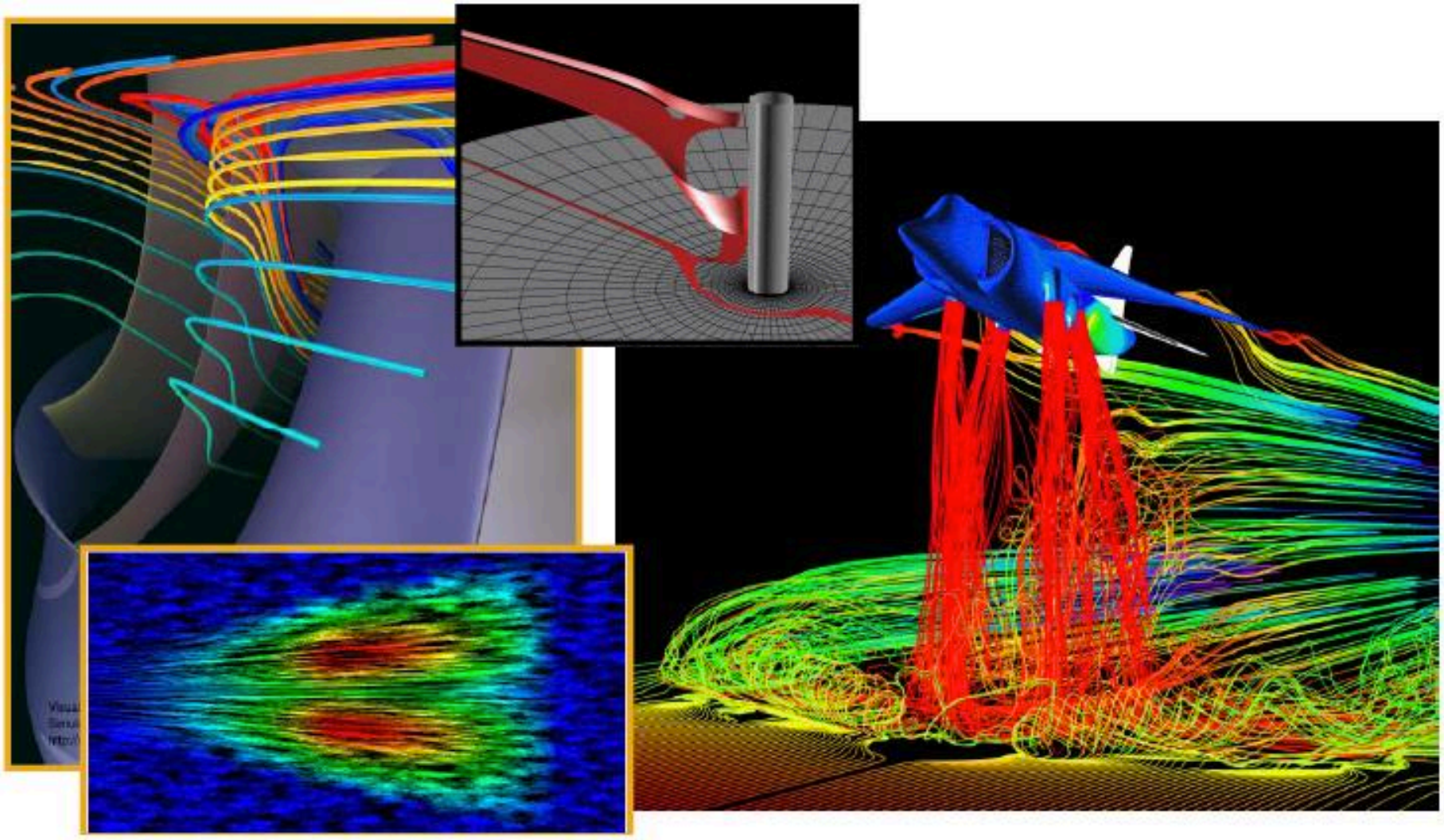

Alexandru Telea

# Example

- Fluid flow

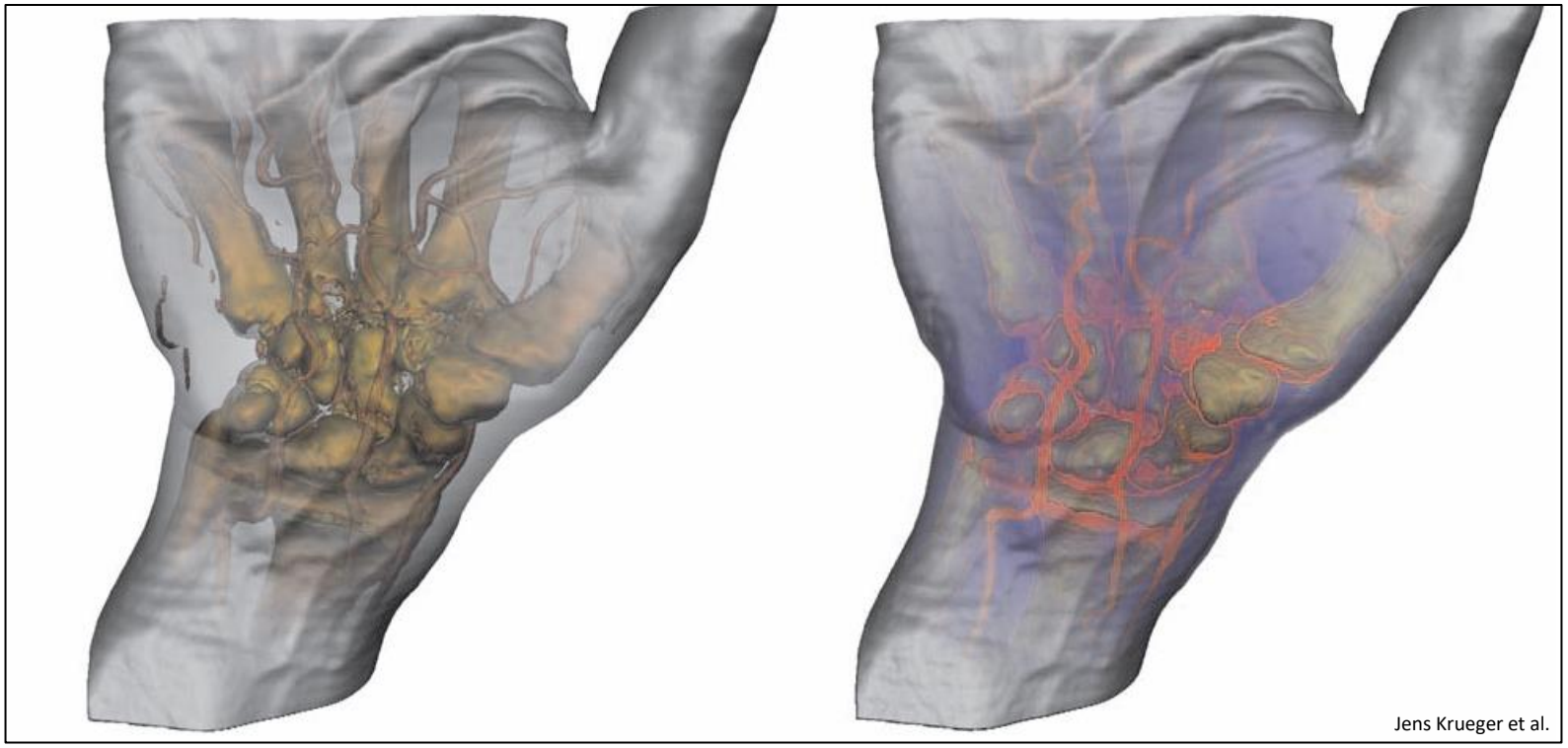


# Example



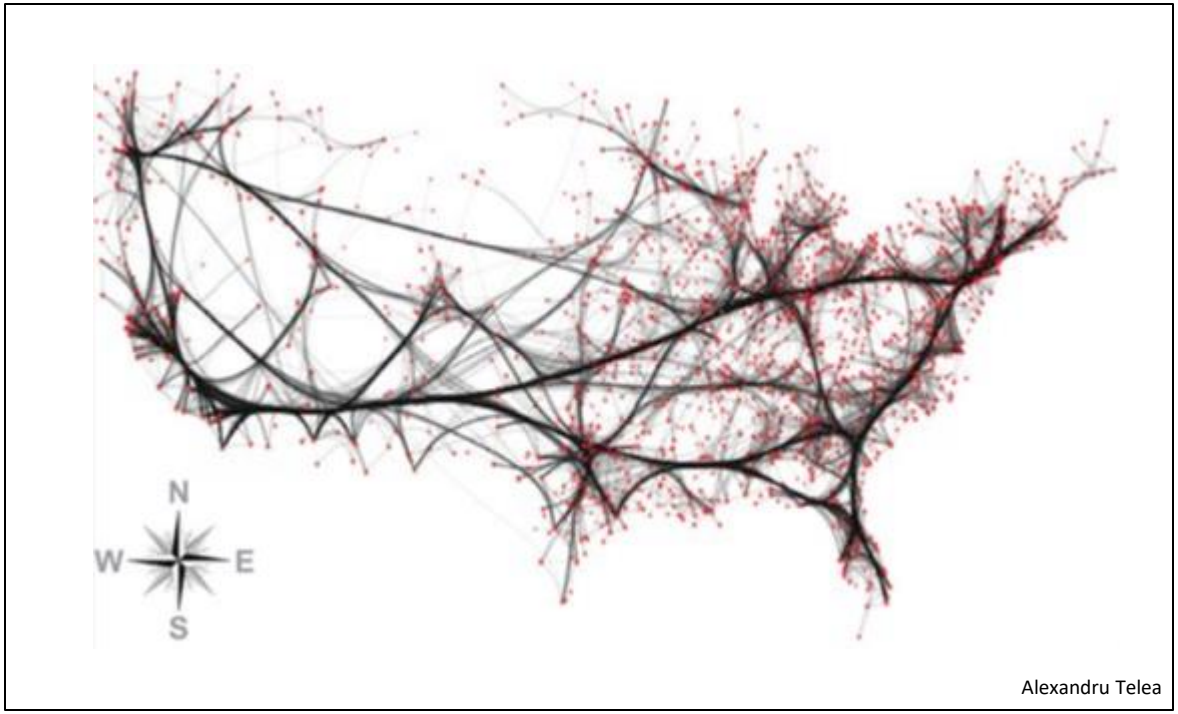
# Example

- Focus + context



# Example

- Population migration pattern



# Example

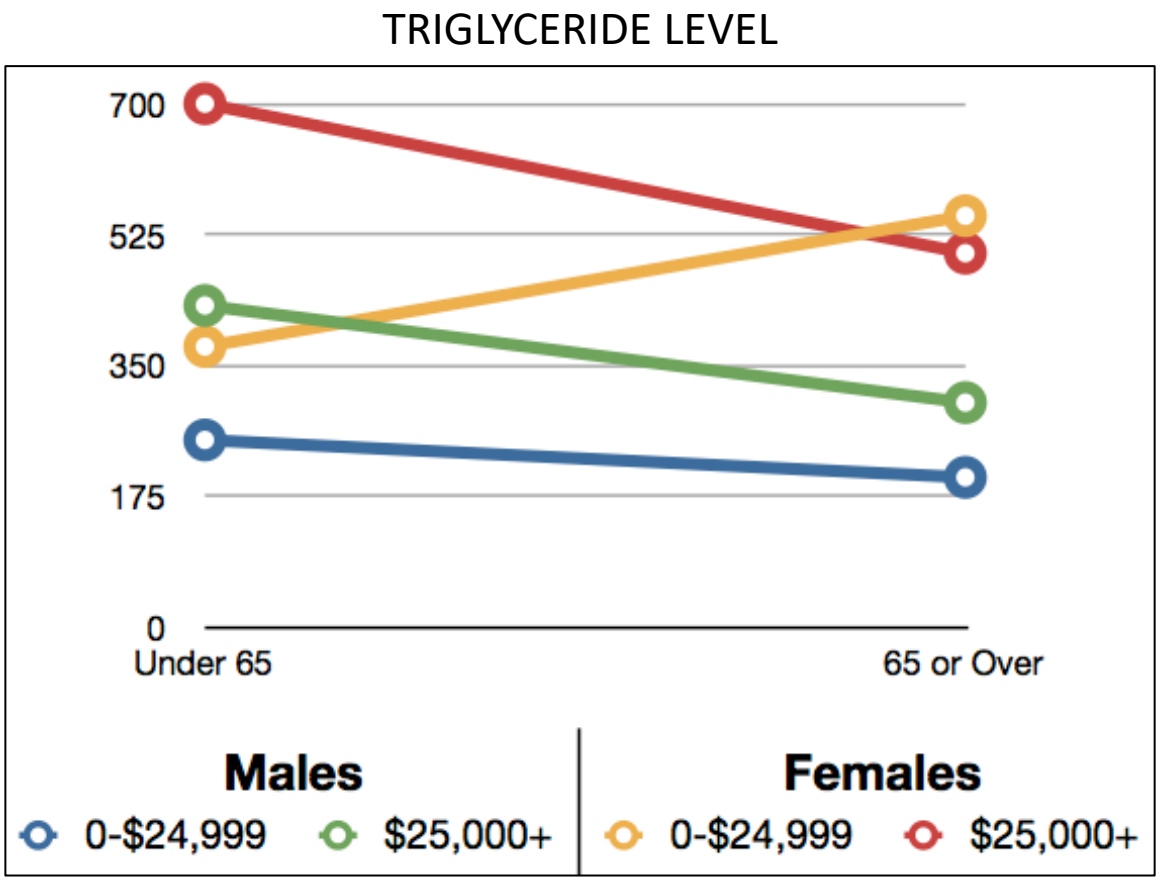
- Which gender and income level shows a different effect of age on triglyceride levels?

TRIGLYCERIDE LEVEL

| | Males | | Females | |
|---|---|---|---|---|
| **Income Group** | Under 65 | 65 or Over | Under 65 | 65 or Over |
| **0-$24,999** | 250 | 200 | 375 | 550 |
| **$25,000+** | 430 | 300 | 700 | 500 |

# Example

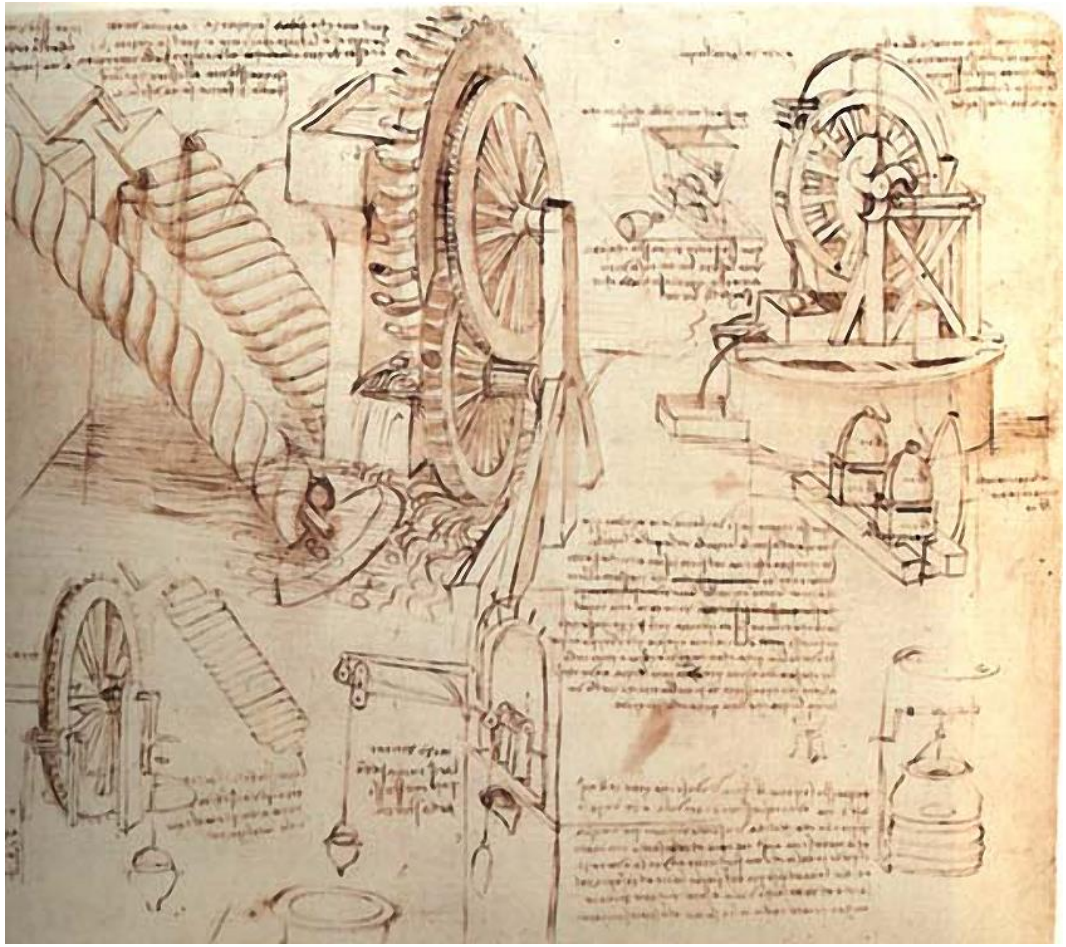
- Which gender and income level shows a different effect of age on triglyceride levels?

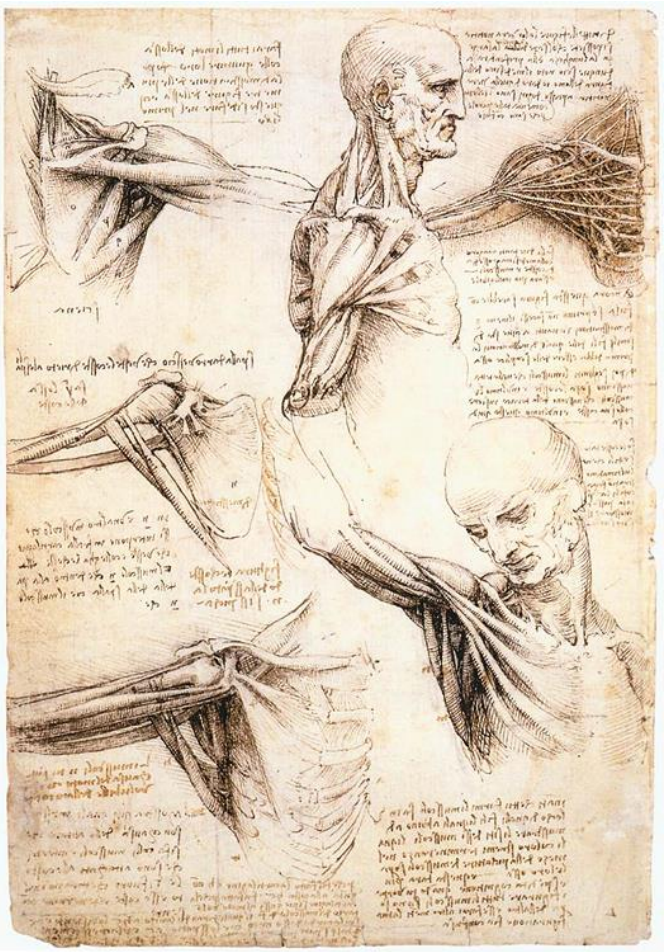


# Why Visualization?

- **Record** information
  - Blueprints, photographs
- **Analyze** data to support reasoning
  - Find patterns, develop and assess hypothesis
- **Communicate** ideas to others
  - Share information and persuade

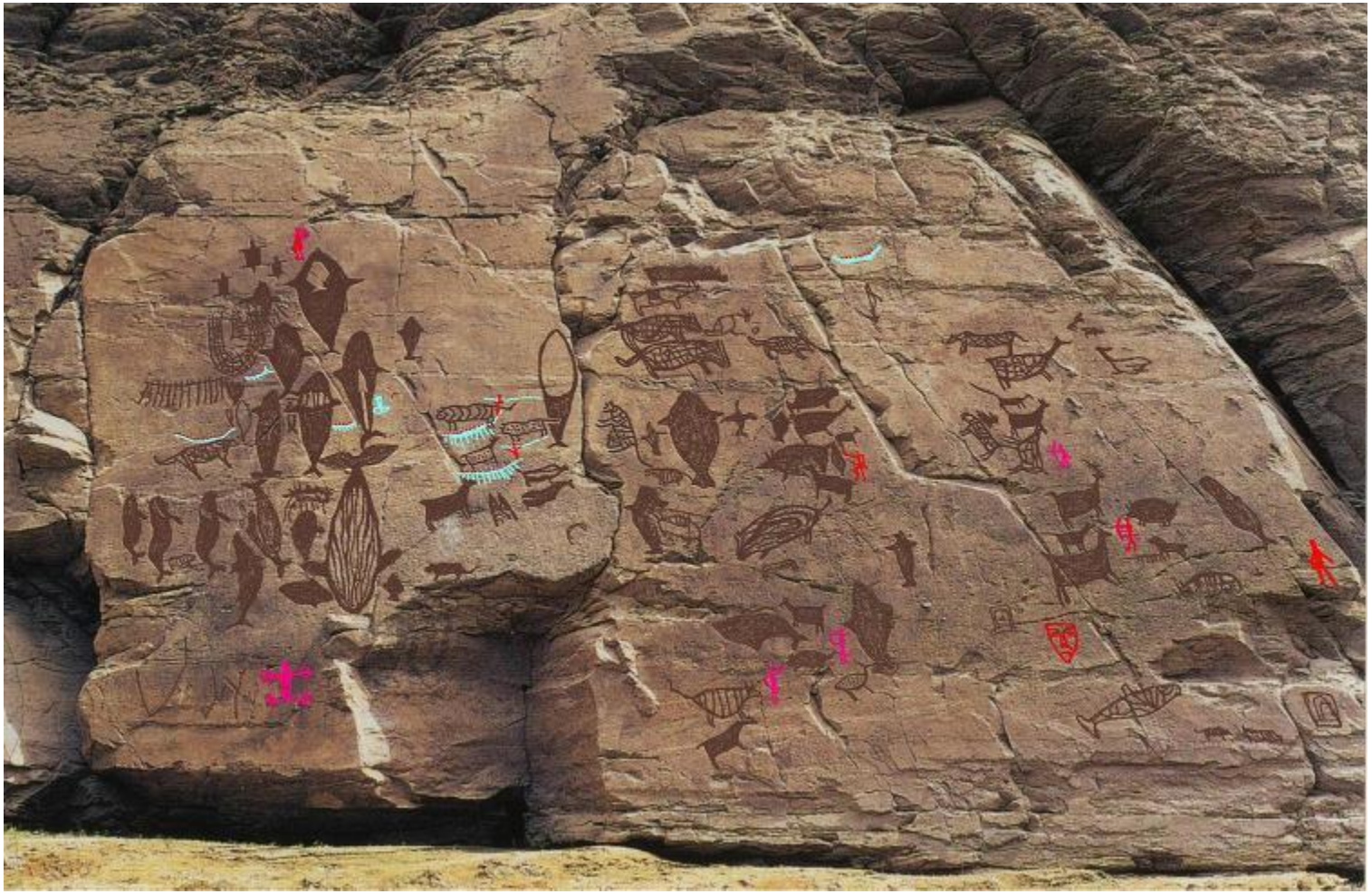
# Record





Leonardo Da Vinci

# Record

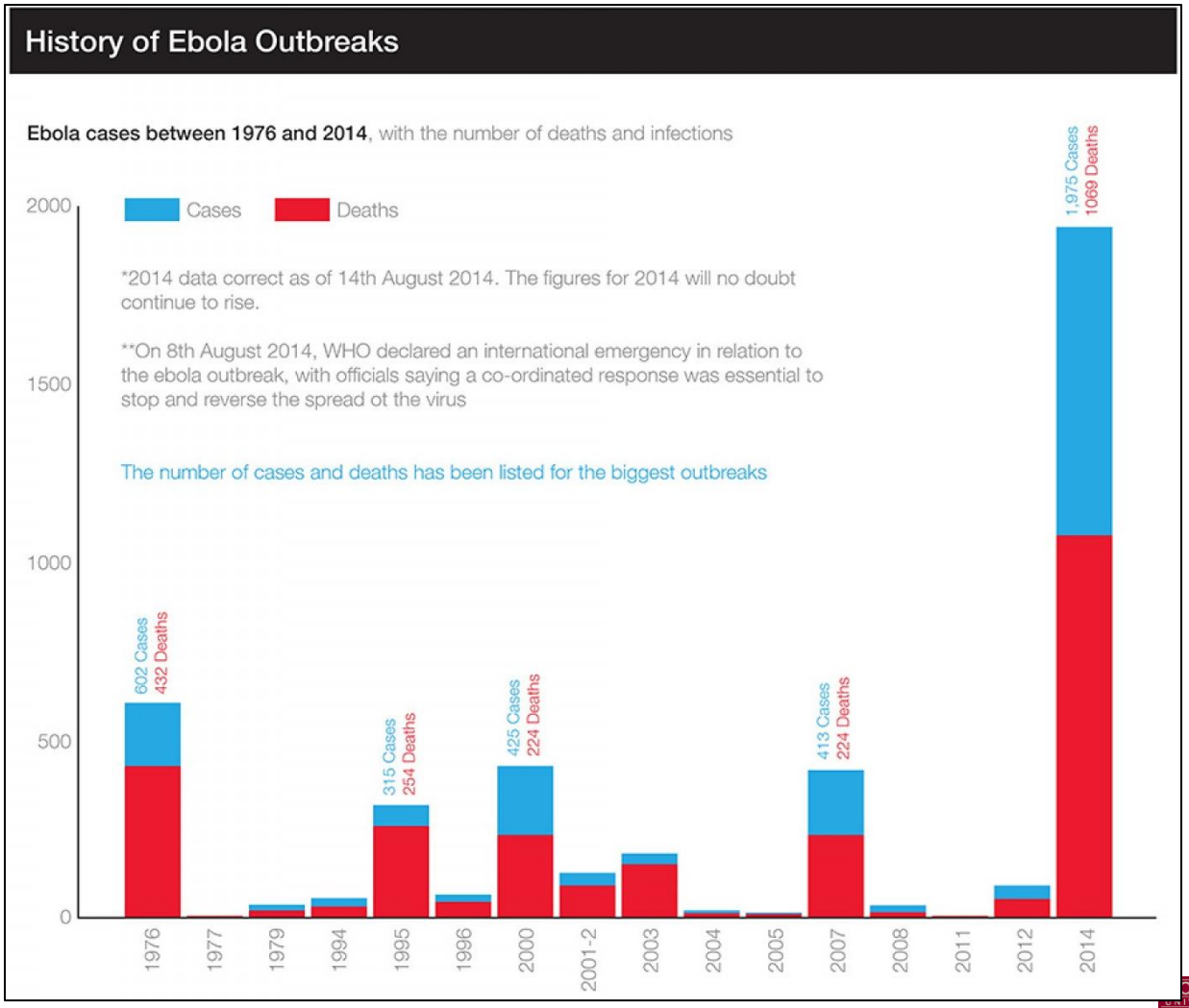


Petroglyphs of Bangudae Terrace

# Analyze


https://flourish.studio/blog/report-on-elections-with-flourish/

# Analyze




Visual.ly

# Communicate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# Classification

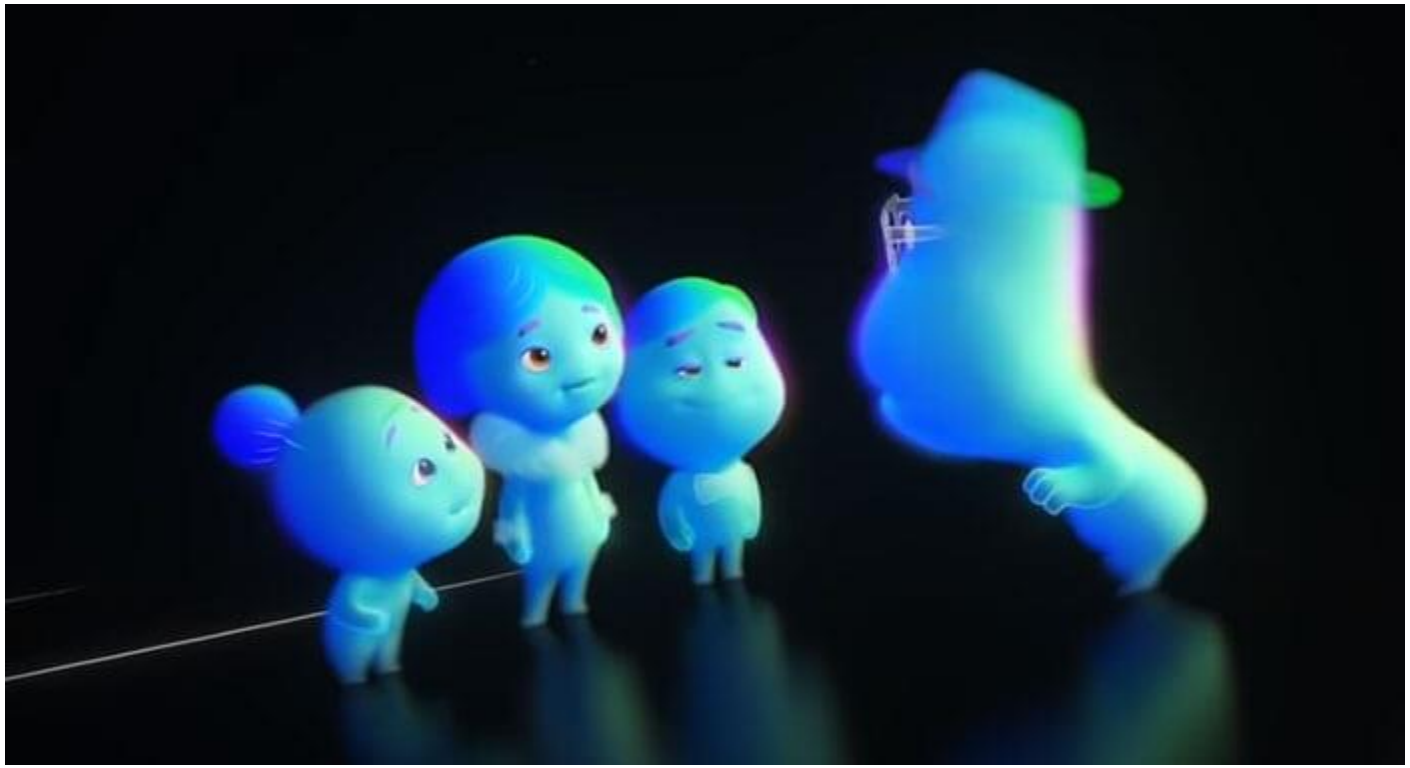
- Scientific Visualization (SciVis)
  - Spatial data
  - Image, volume, polygonal mesh, …
- Information Visualization (InfoVis)
  - Non-spatial data
  - Tree, graph, table, …
- Visual Analytics (VA)
  - Analysis of data using graphical tools

*"**Interactive visualization** or interactive visualisation is a branch of graphic visualization in computer science that involves studying how humans interact with computers to create graphic illustrations of information and how this process can be made more efficient."*

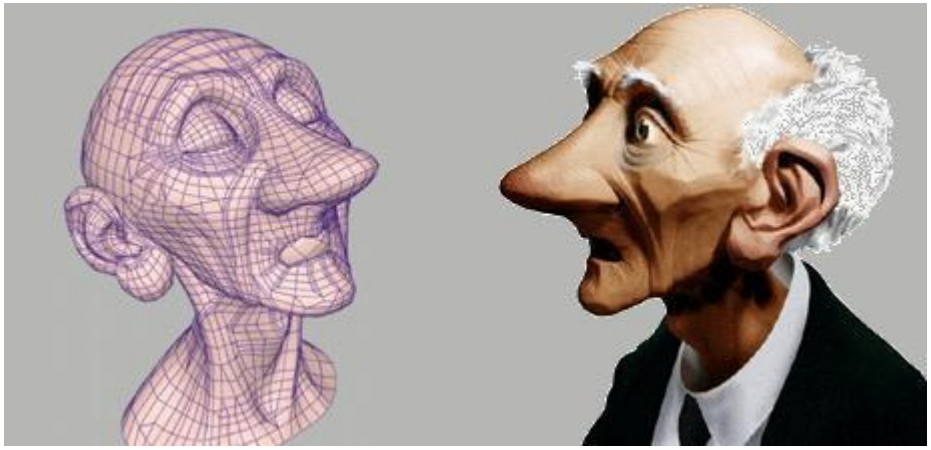
- Wikipedia

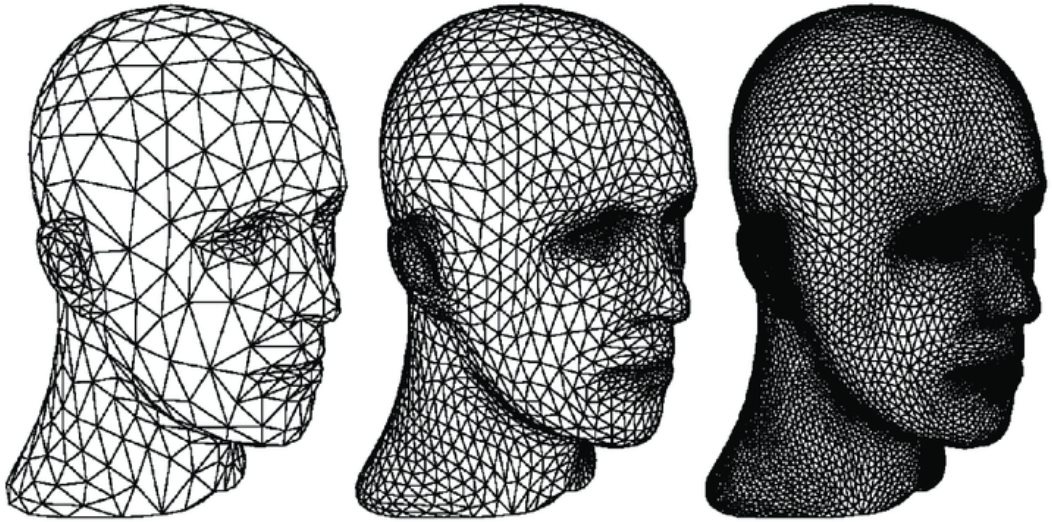
# Computer Graphics

- All about image generation using computers

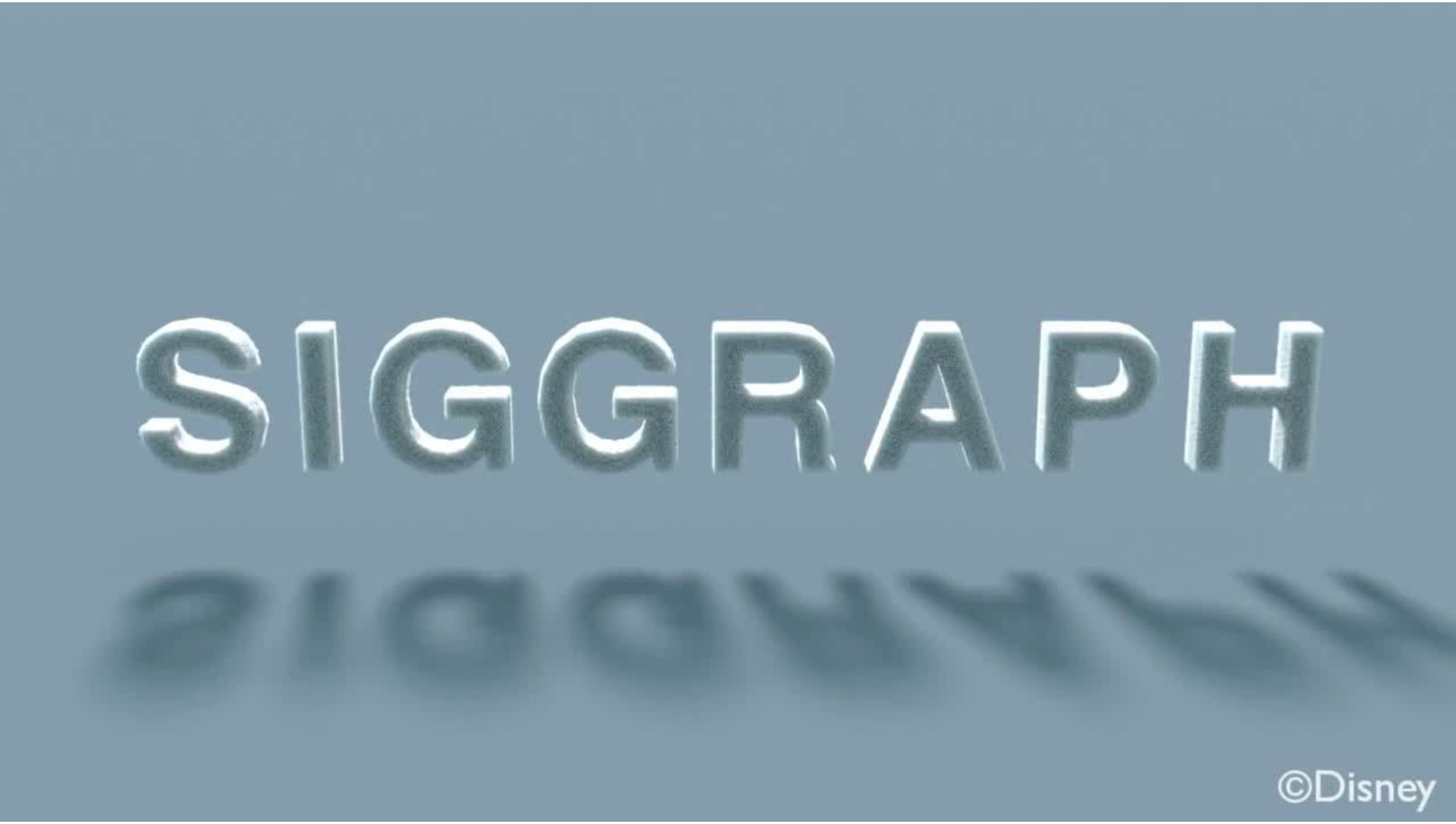


# Technique: Modeling





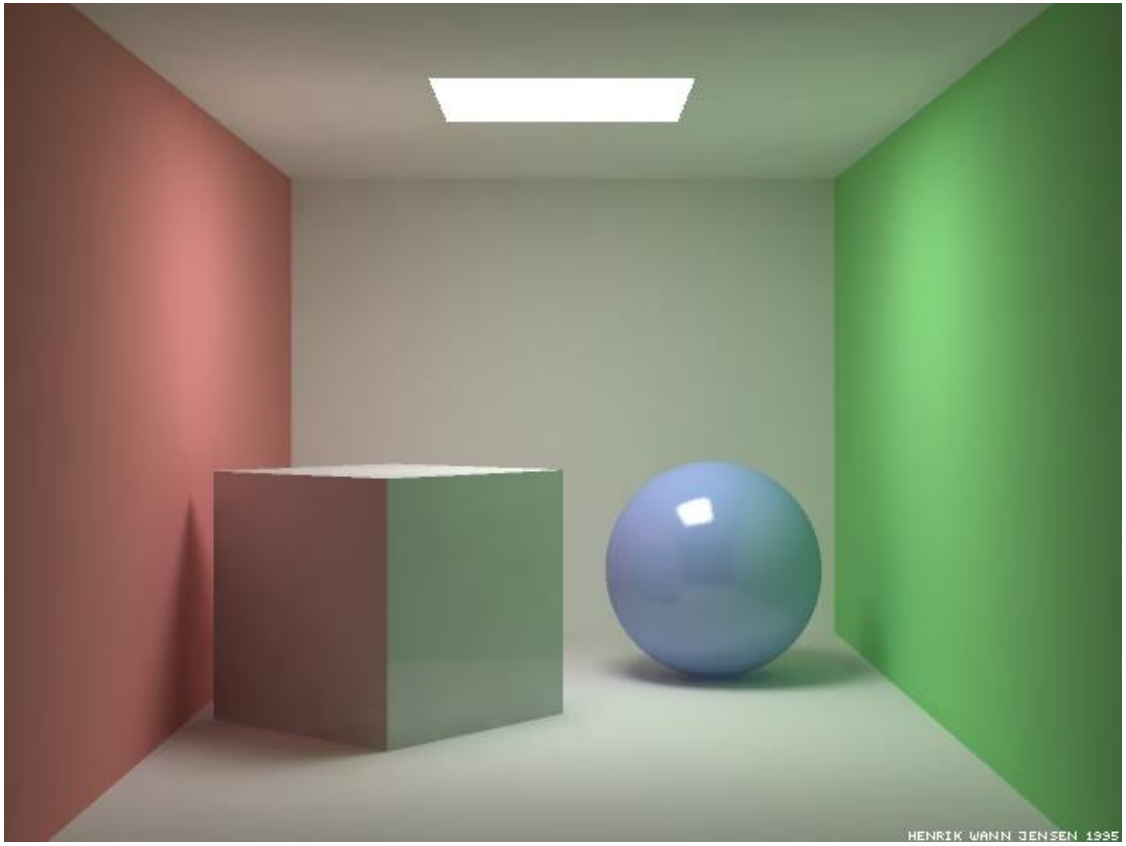
# Technique: Animation




DIsney's Frozen

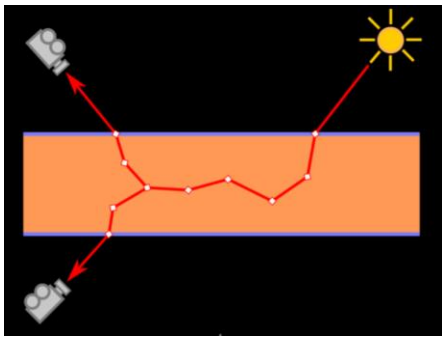
# Technique: Rendering

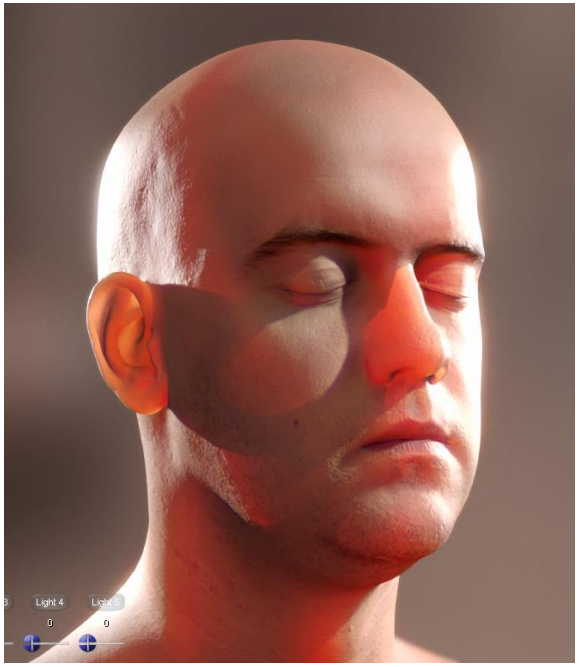
- Global illumination



# Technique: Rendering

- Subsurface scattering





# Technique: Rendering

- Radiance field rendering

This video contains a voice-over

## 3D Gaussian Splatting for Real-Time Radiance Field Rendering

SIGGRAPH 2023
(ACM Transactions on Graphics)

Bernhard Kerbl*
Inria UNIVERSITÉ CÔTE D'AZUR

Georgios Kopanas*
Inria UNIVERSITÉ CÔTE D'AZUR

Thomas Leimkühler
mpii max planck institut informatik

George Drettakis
Inria UNIVERSITÉ CÔTE D'AZUR

* Denotes equal contribution

GraphDeco
GRAPHics and Design with hEterogeneous COntent

# Technique: Image Processing

- Style transfer

# Technique: Human Interactions

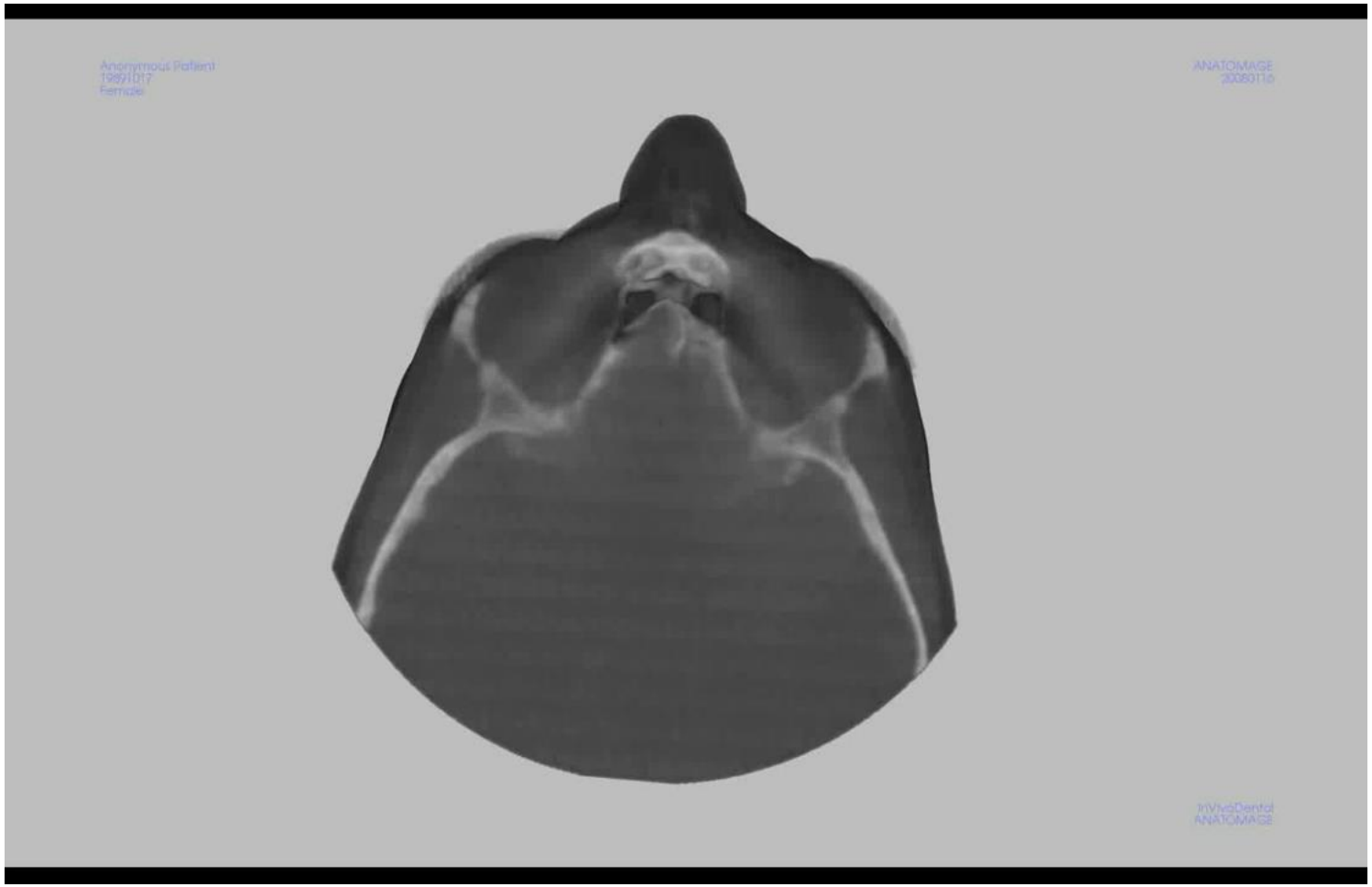
# Examples of Interactive Visualization

# Interaction with Scientific Data

## Demo

Experimental Environment:
- GPU cluster system
(each node is equipped with a Titan X / 1080ti)

# Medical Data Exploration



# Collaborative Visualization

https://www.youtube.com/watch?v=tmctoL42eQY

# Interactive Visual Analytics

# Outline

- What is visual computing?

- About the course

# Instructor

Won-Ki Jeong (정원기)
Office: Woojung ICT Bd 502
Email: wkjeong@korea.ac.kr
Office hours: by appointment

HVCL
Bridging computers and sciences

Image Processing & Visualization
http://hvcl.korea.ac.kr

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# Teaching Assistants

**Head TA**:
Suemin Jeon (전수민)
2nd year MS-PhD
orangeblush@korea.ac.kr

Gayeon Koh (고가연)
1st year MS
hellenkoh@gmail.com

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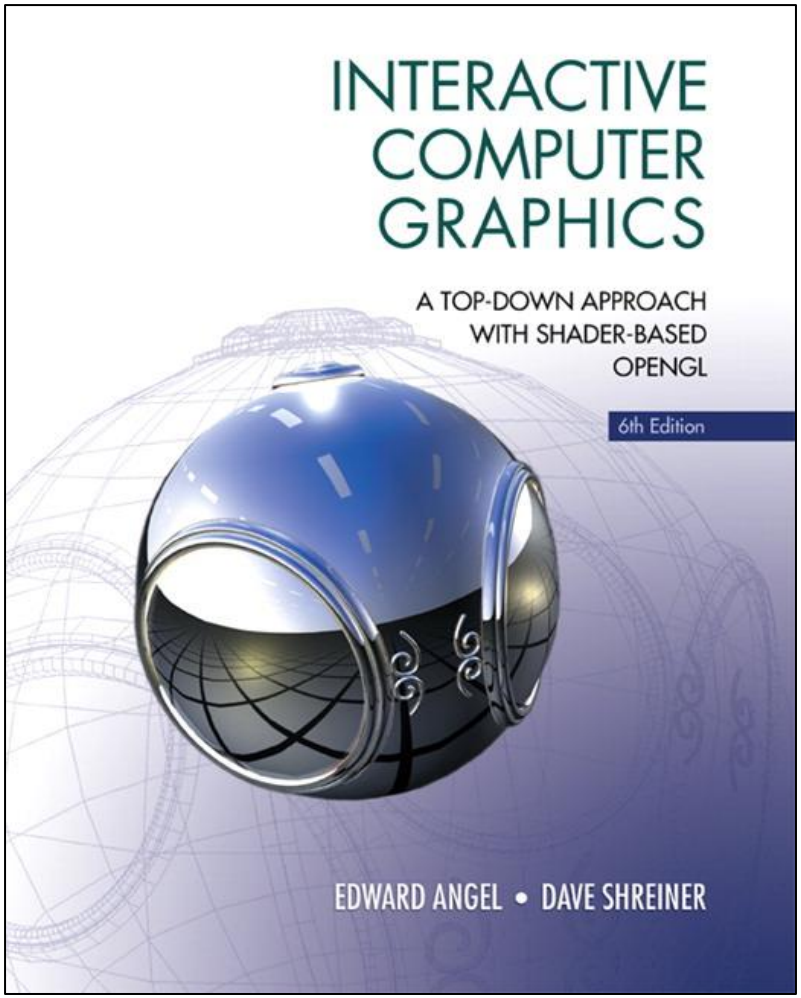
# COSE436 Goals

- Learn fundamental theories and algorithms for interactive visualization
  - Interactive graphics techniques
    - Raster graphics pipeline, GPU, user interface
  - Focus on scientific applications
    - Volume rendering, surface rendering, images, etc
- Get hands-on programming experience of graphics APIs and user interactions
  - OpenGL shaders, GLUT, C++

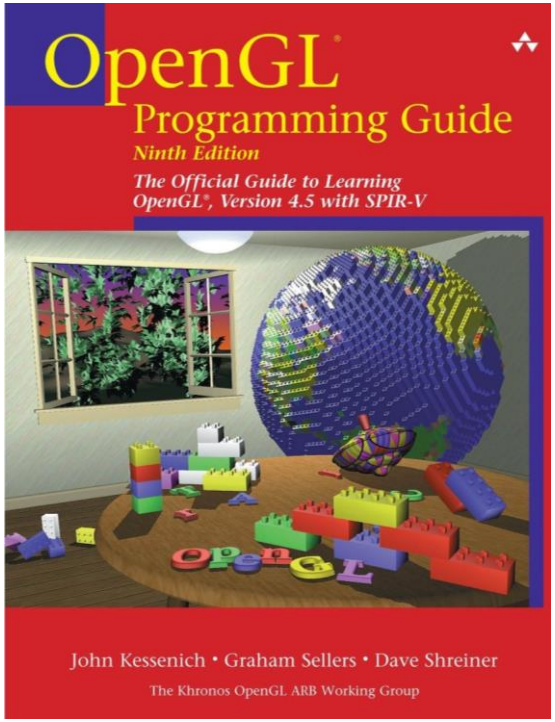
# Textbook

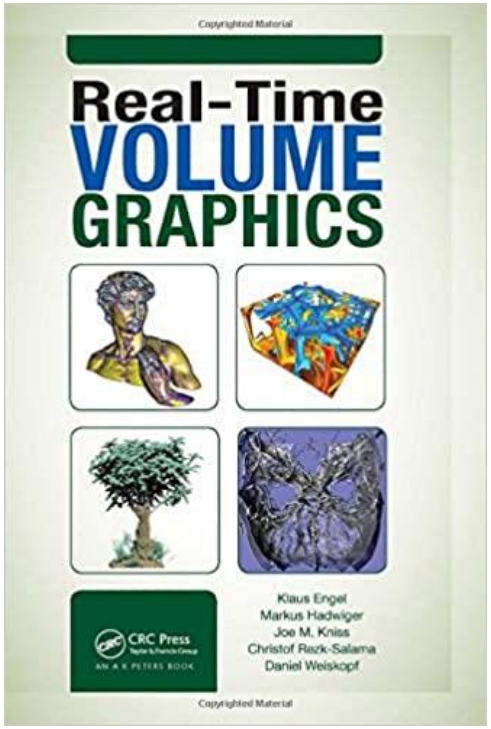


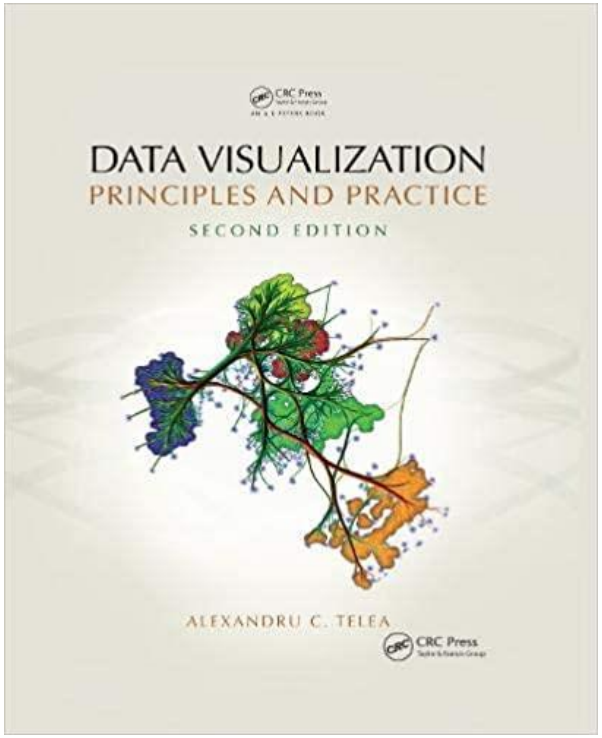

- Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL (6th Edition)
  - Edward Angel & Dave Shreiner
  - Addison-Wesley
- Lecture notes will cover the topics in the book
  - No purchase required

# References

- Will be covered by lecture notes




- OpenGL Programming Guide "the Red Book" (9th Edition) by Dave Shreiner
- Real-Time Volume Graphics by Engel et al.
- Data Visualization by Alexandru Telea (2nd Edition)

# Course Logistics

- Tue/Thu 15:00-16:15
  - Lectures
- Programming assignments
  - Need prior knowledge of C++
- Midterm & Final exams

# Grading Policy

- Points break-down
  - Homework (45%)
  - Exam (45%)
  - Class participation (attendance, etc) (10%)
- Homeworks are due Sundays midnight
  - You may use up to 4 days of grace period (no penalty for late submission) anytime during the course

# Academic Honesty

- Discussion among students are encouraged, but no code sharing between students
- External code/library is not allowed unless approved by instructor
  - Ask instructor/TA if you are not sure
- No reusing code from other courses
- Rule of thumb: consider homework as *take-home exam*

# Questions?

Send e-mails to wkjeong@korea.ac.kr