COSE436

Lecture 1:
Intro. to Interactive Visualization

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Outline

- What is interactive visualization?

- About the course

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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

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"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"
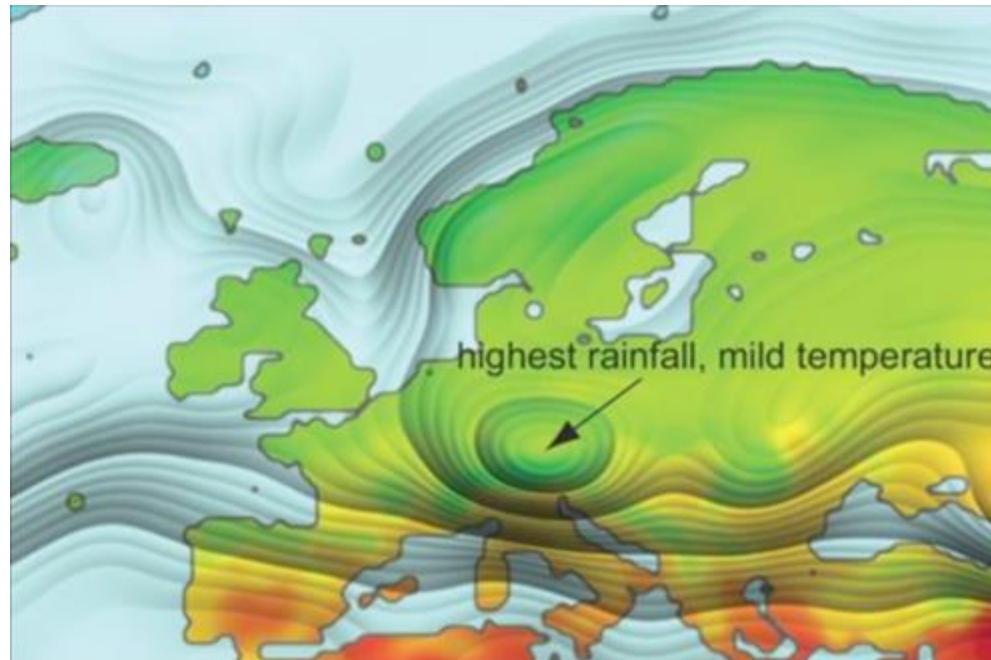[Williams et al. 95]

Visualization

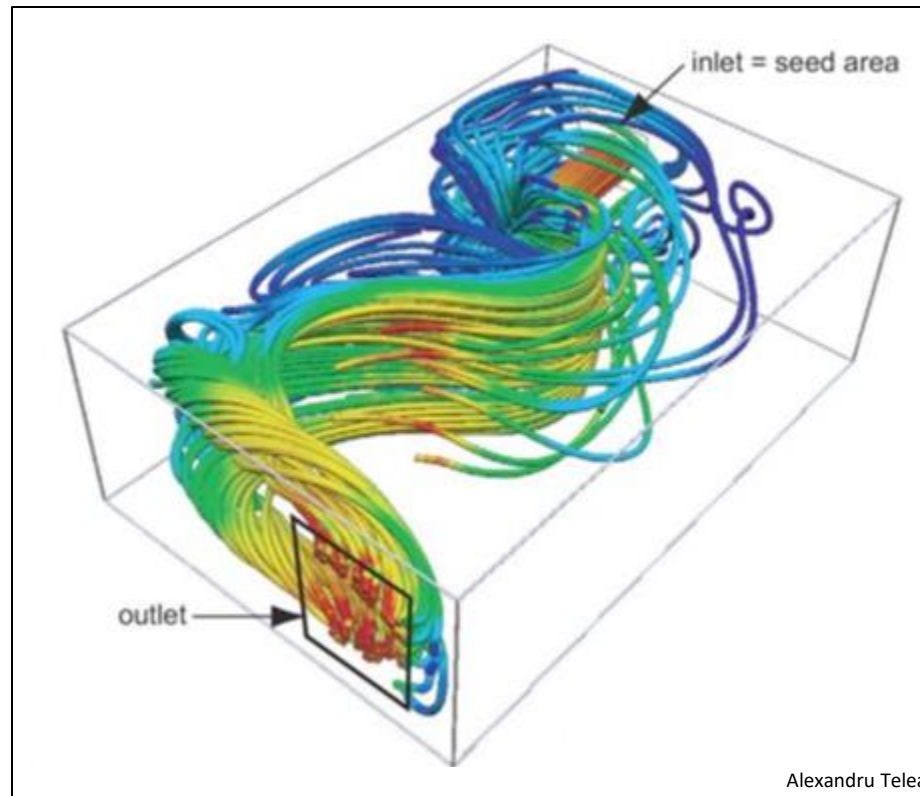- Convey information through graphical representations of data
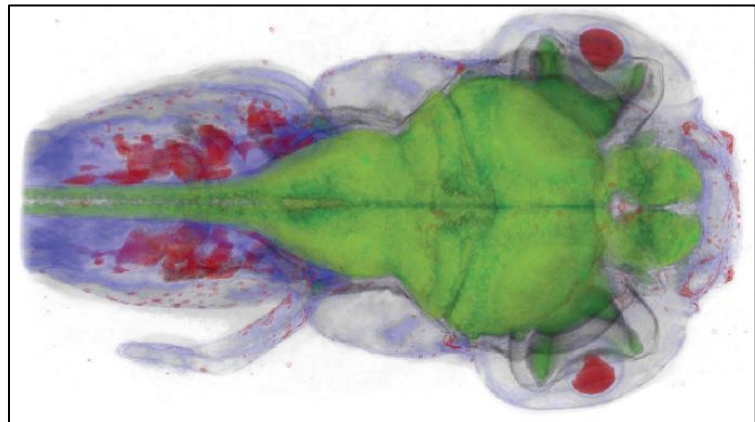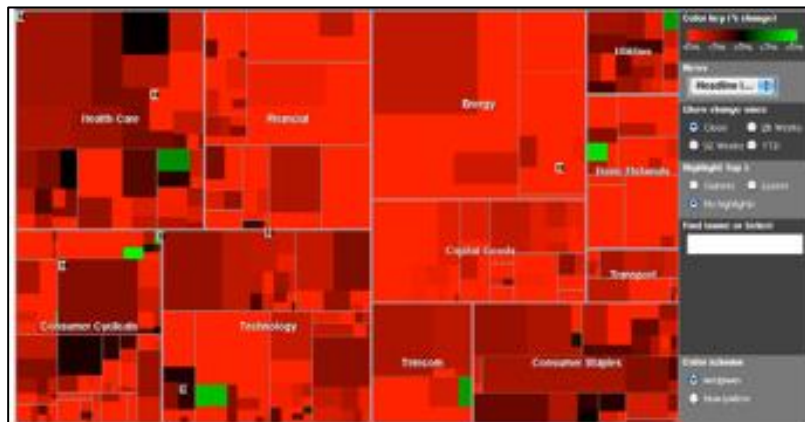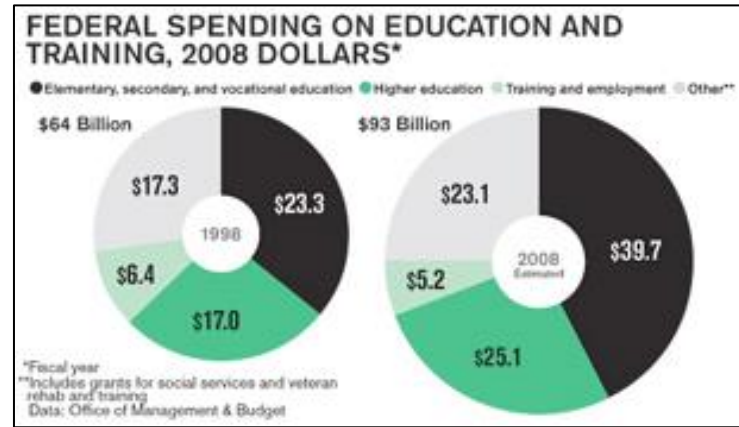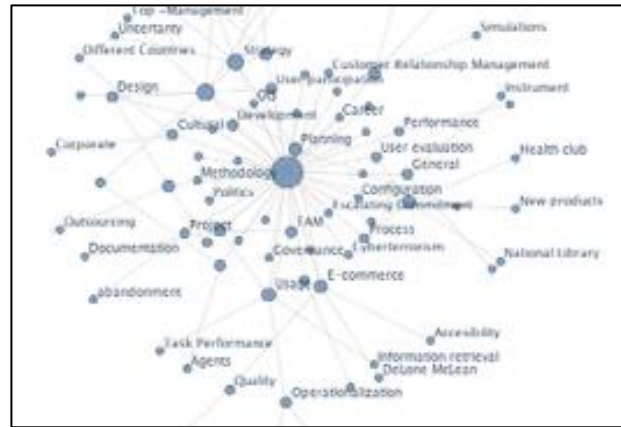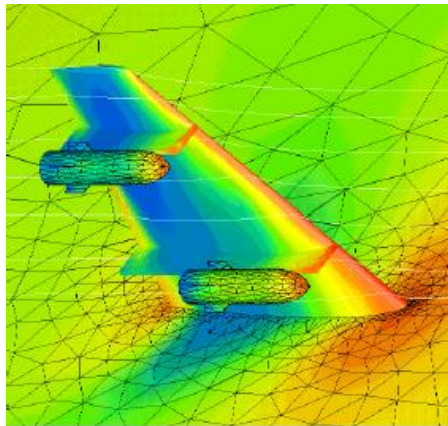
Example

- Rainfall - temperature

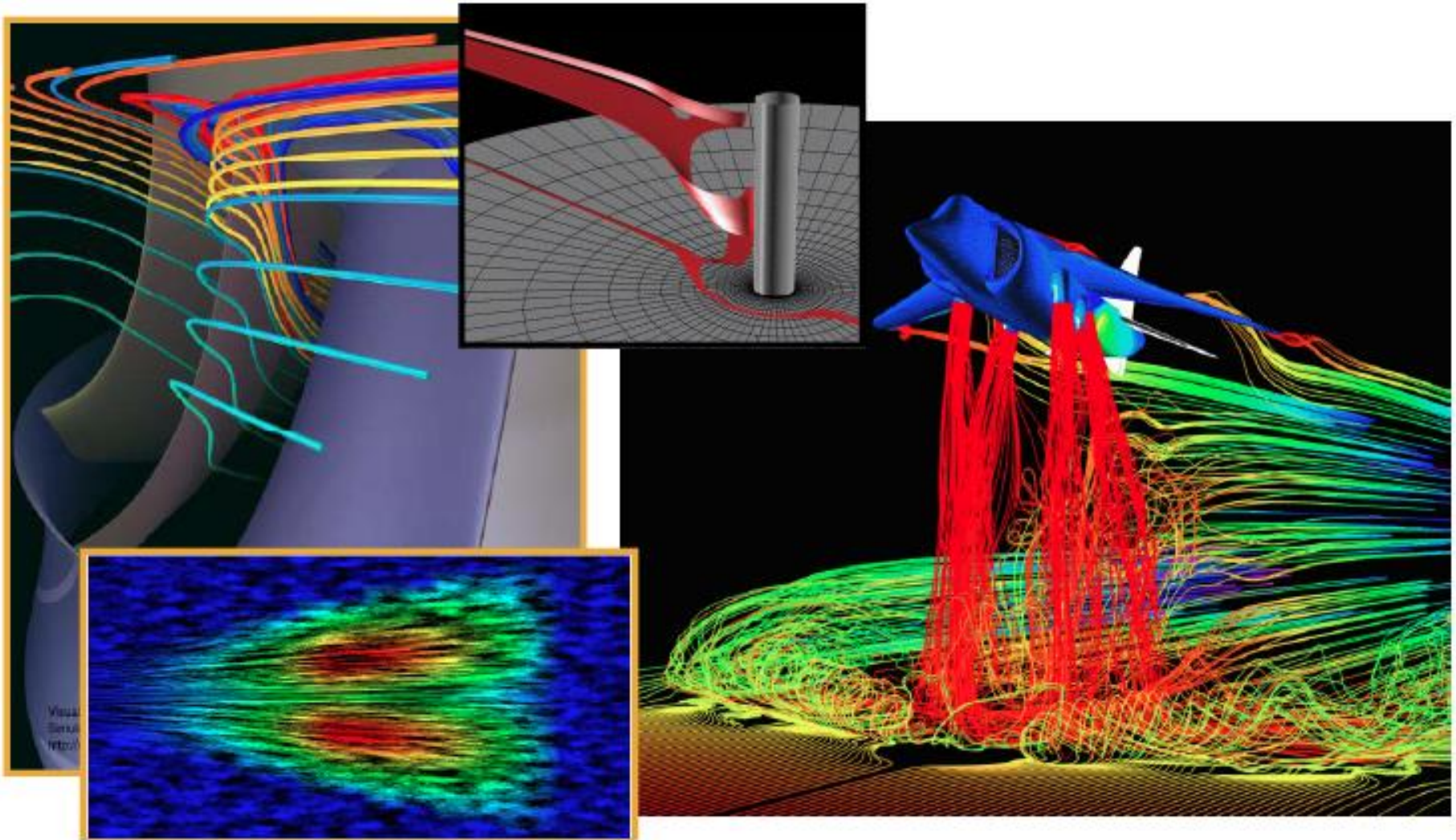highest rainfall, mild temperature

Alexandru Telea

Example

- Fluid flow

inlet = seed area

outlet

Alexandru Telea

Example
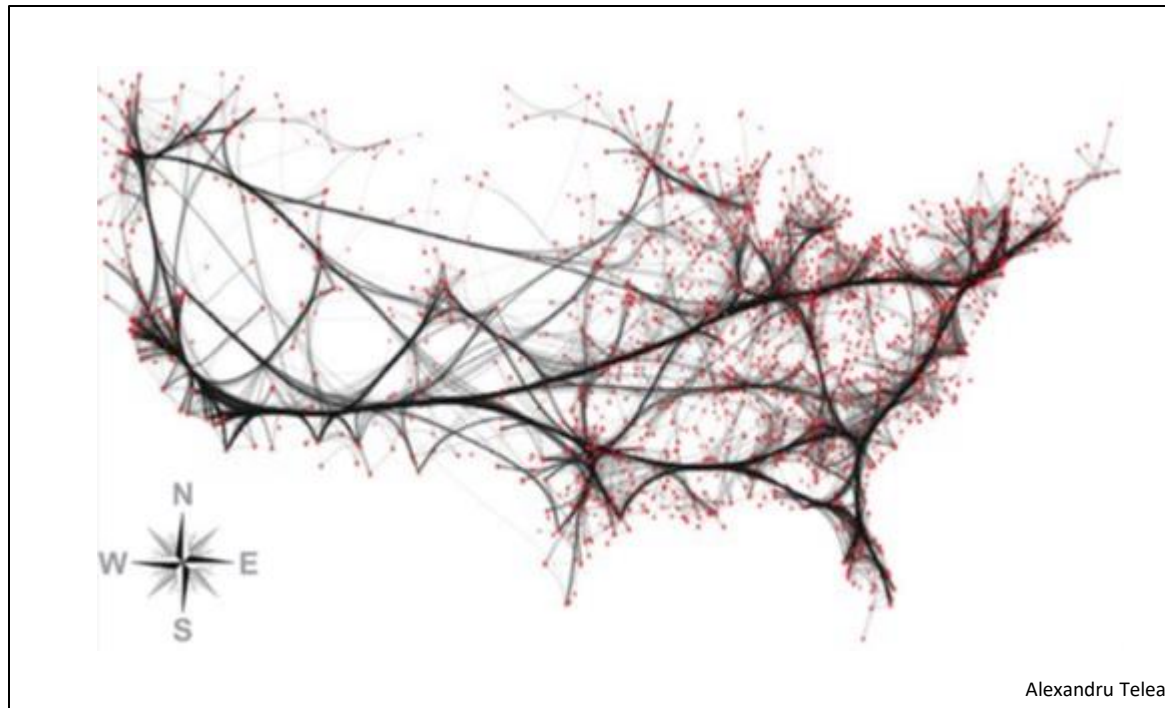
Example

- Focus + context

Jens Krueger et al.
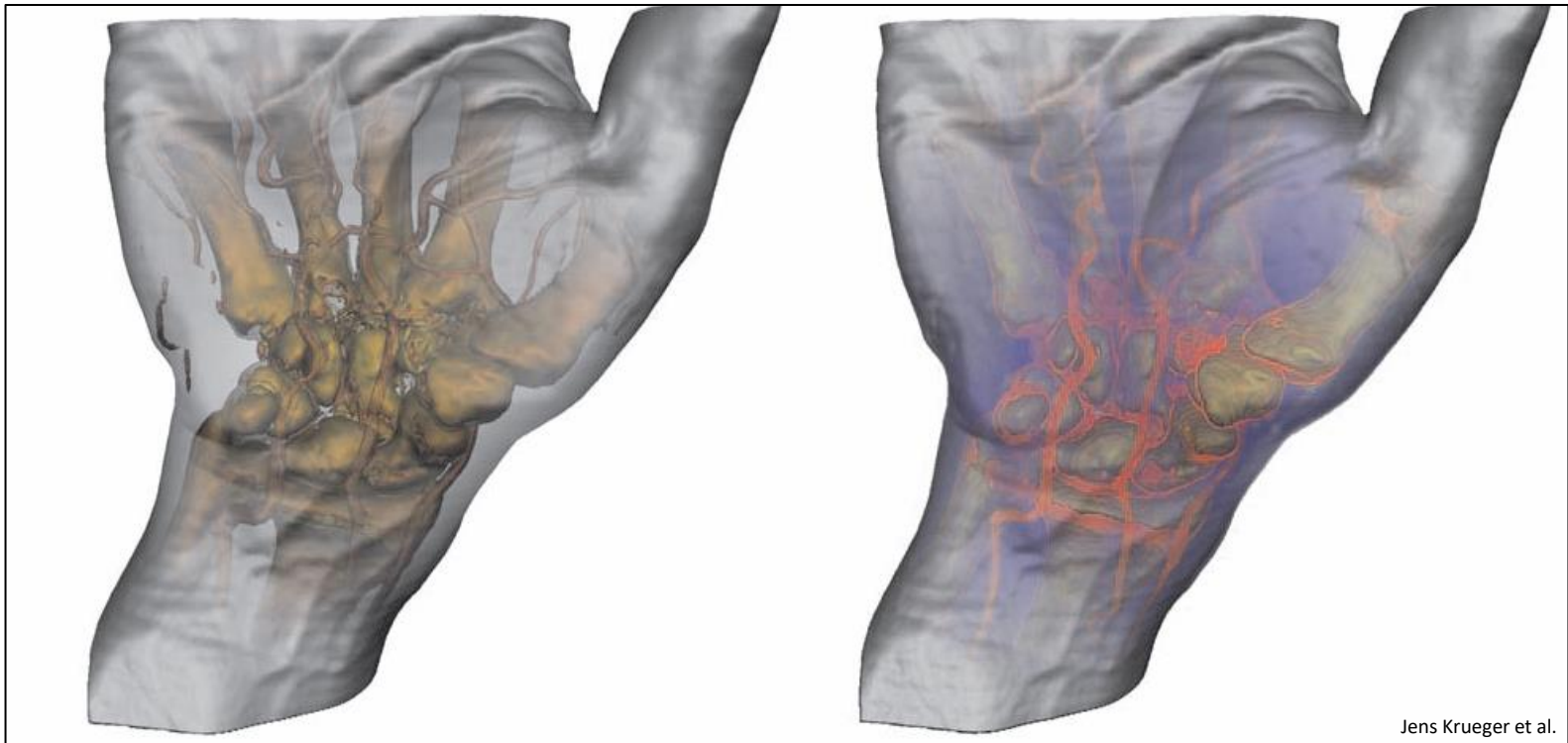
Example

- Population migration pattern

Alexandru Telea

Example

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

TRIGLYCERIDE LEVEL

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

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Example

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

TRIGLYCERIDE LEVEL
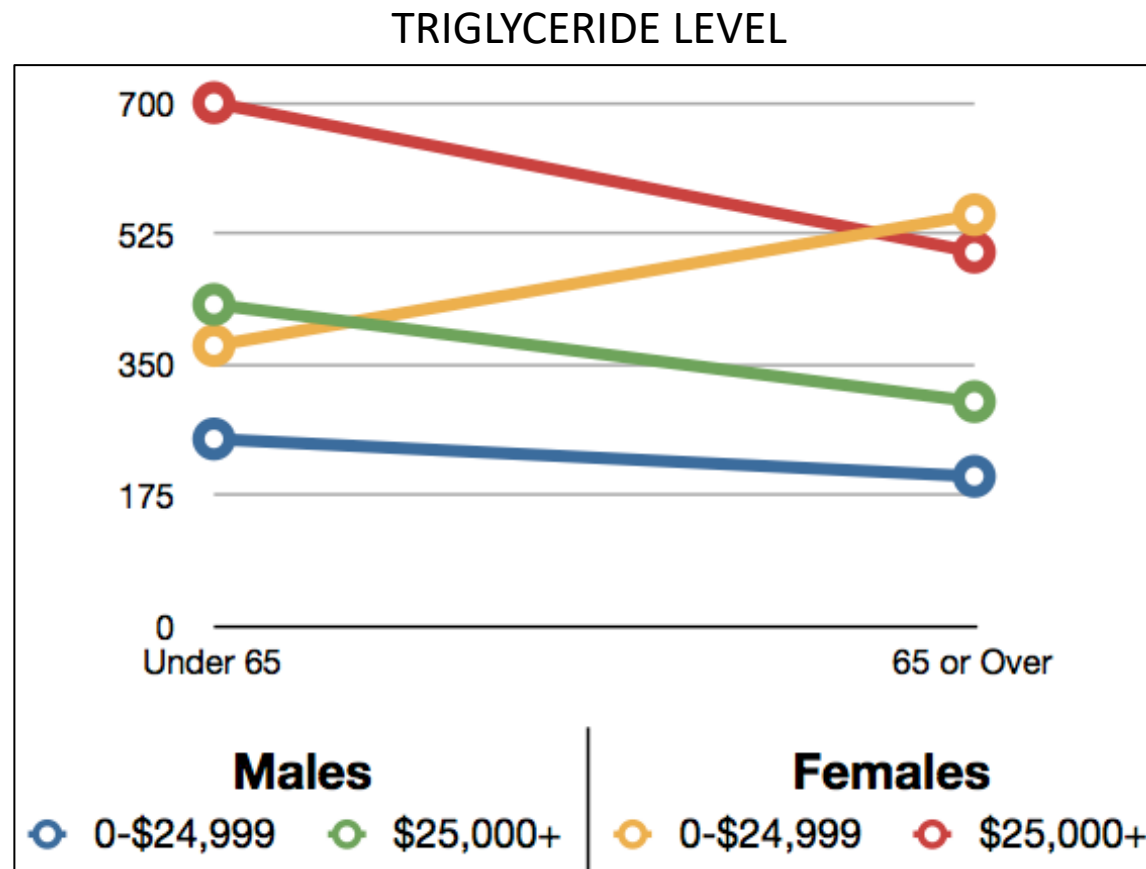
Why Visualization?
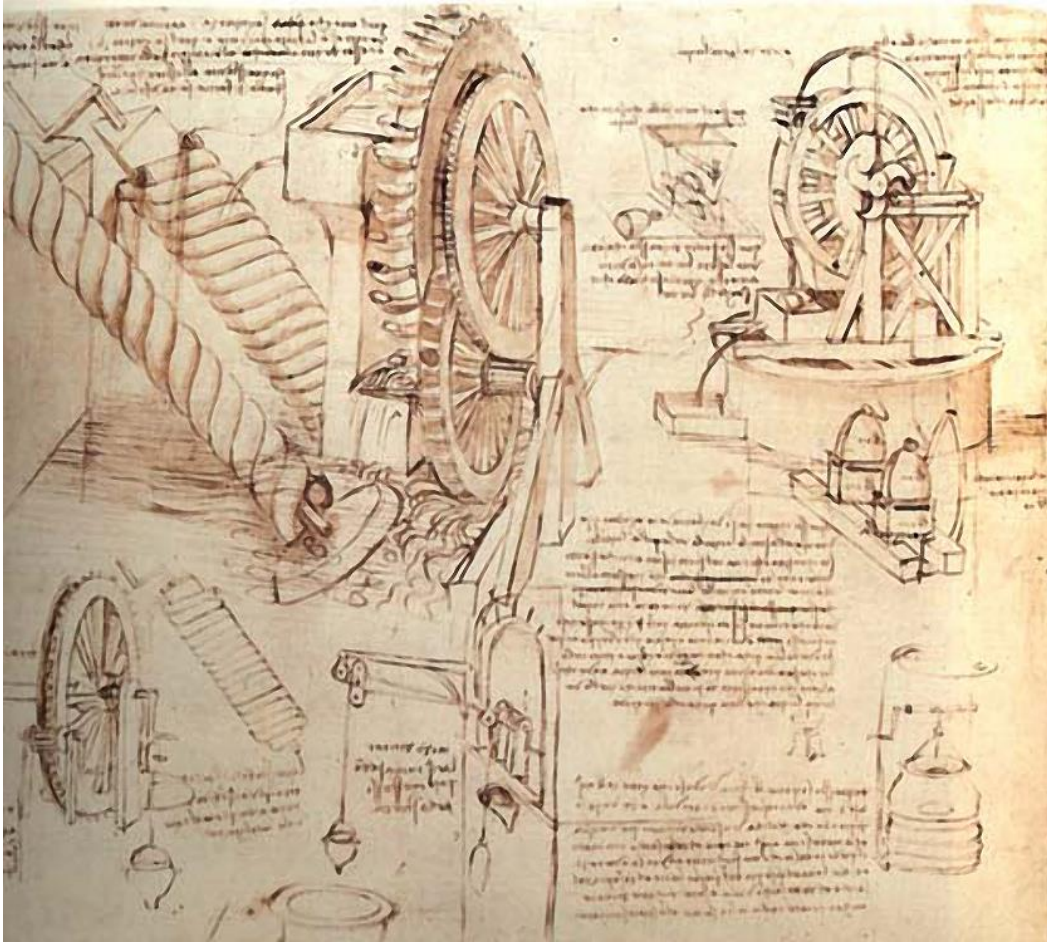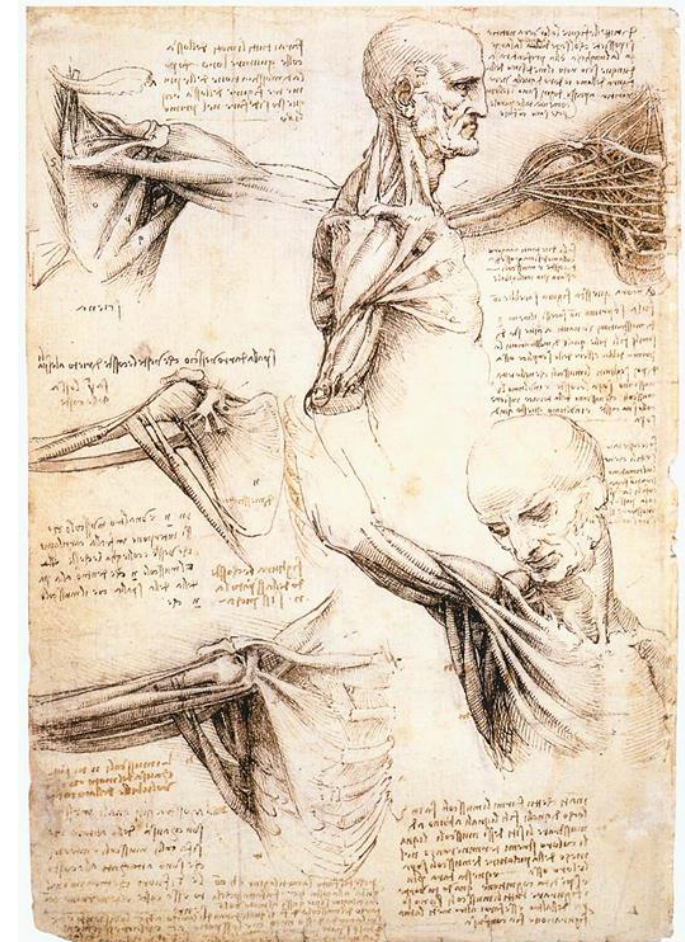
- **Record** information
  - Blueprints, photographs

- **Analyze** data to support reasoning
  - Find patterns, develop and assess hypothesis

- **Communicate** ideas to others
  - Share information and persuade

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Record

Leonardo Da Vinci

Record
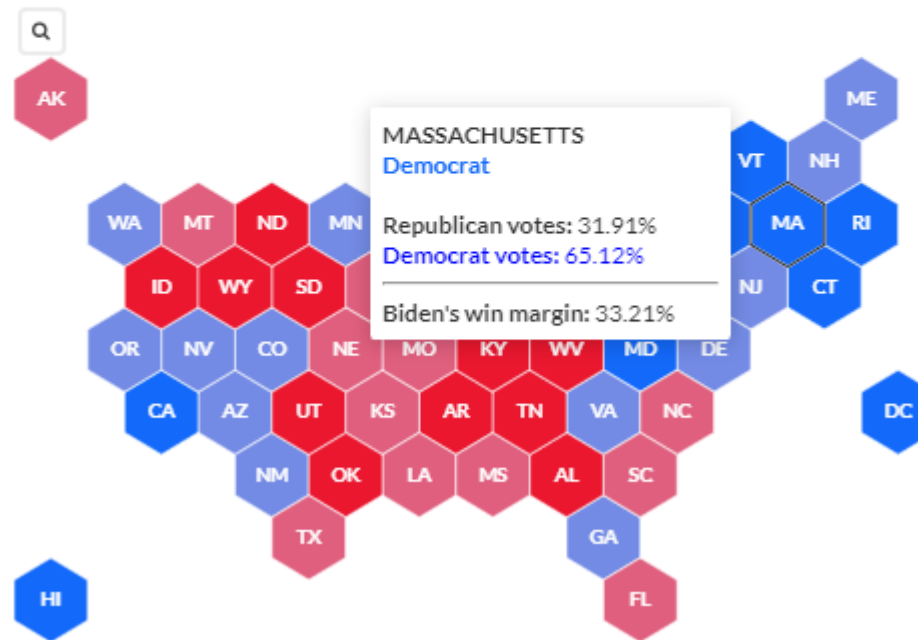

Petroglyphs of Bangudae Terrace

Analyze

State hex map

Presidential election results, 2020
A positive margin of victory means the state voted more in favor of the
Democrats. Values closer to **zero** suggest a politically divided district.

Biden's win margin:
-40%   0%   40%

AK   ME

WA   MT   ND   MN   VT   NH

ID   WY   SD   MA   RI

OR   NV   CO   NE   MO   KY   WV   MD   DE   NJ   CT

CA   AZ   UT   KS   AR   TN   VA   NC   DC

NM   OK   LA   MS   AL   SC

TX   GA

HI   FL

MASSACHUSETTS
Democrat

Republican votes: 31.91%
Democrat votes: 65.12%

Biden's win margin: 33.21%

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Analyze
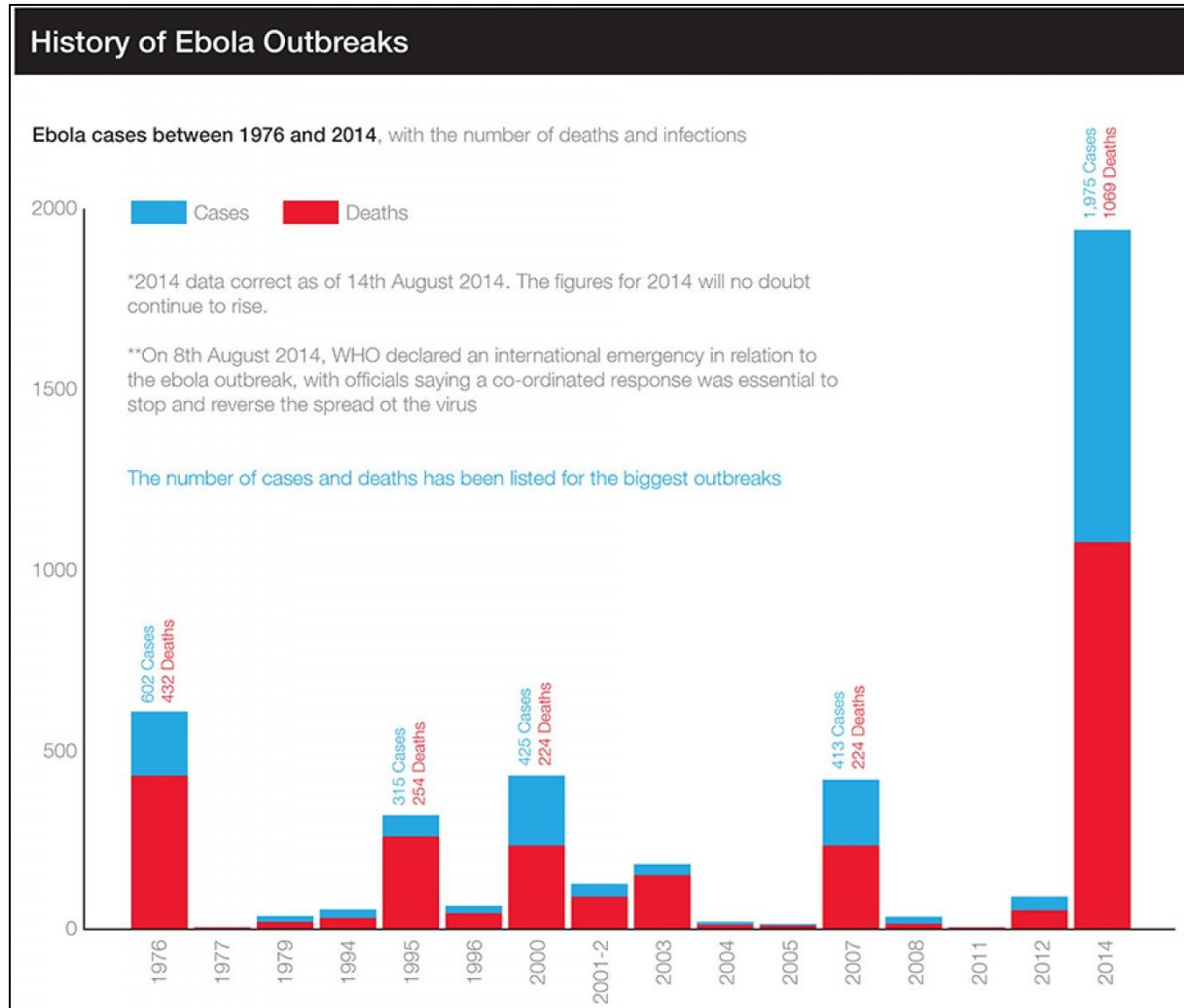
Visual.ly

Communicate

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

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*"**Interactive visualization** or interactive visualisation is a branch of <u>graphic visualization</u> 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."*
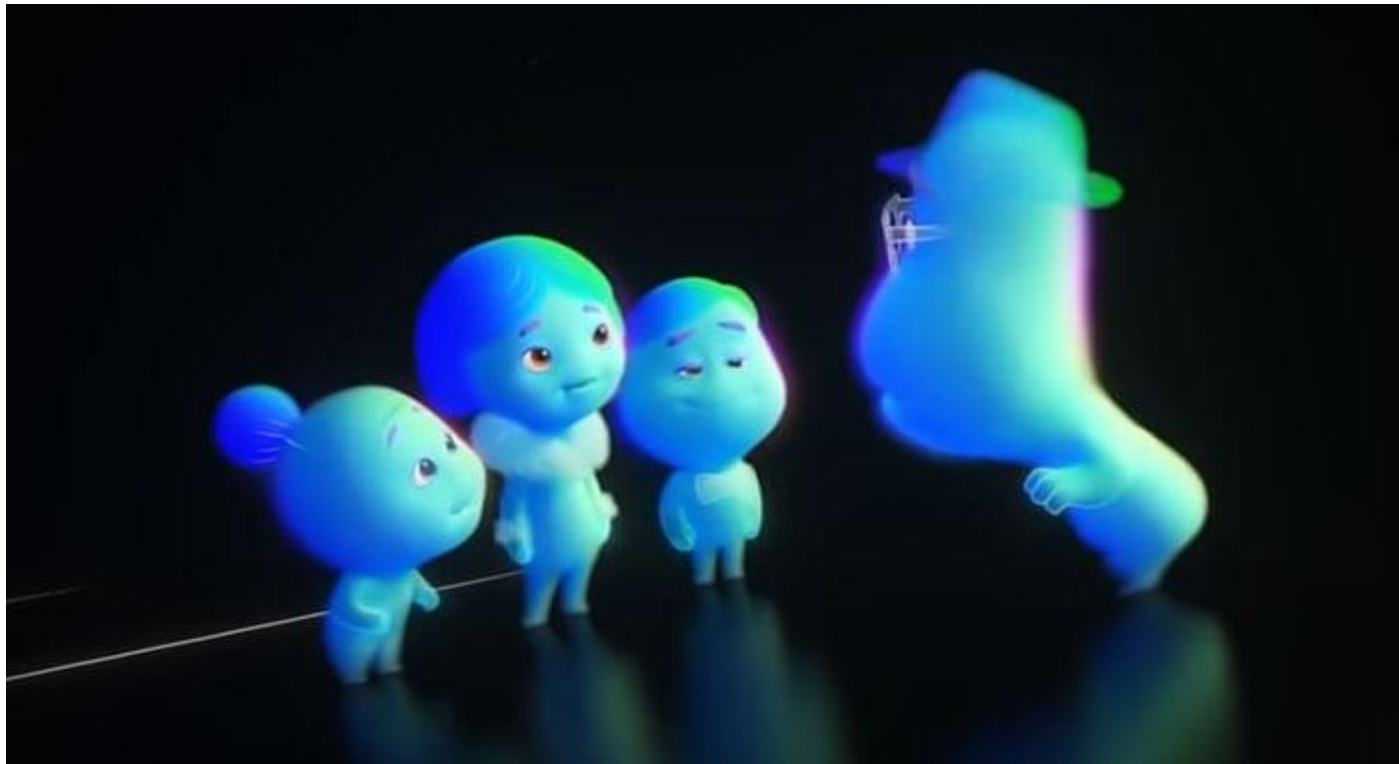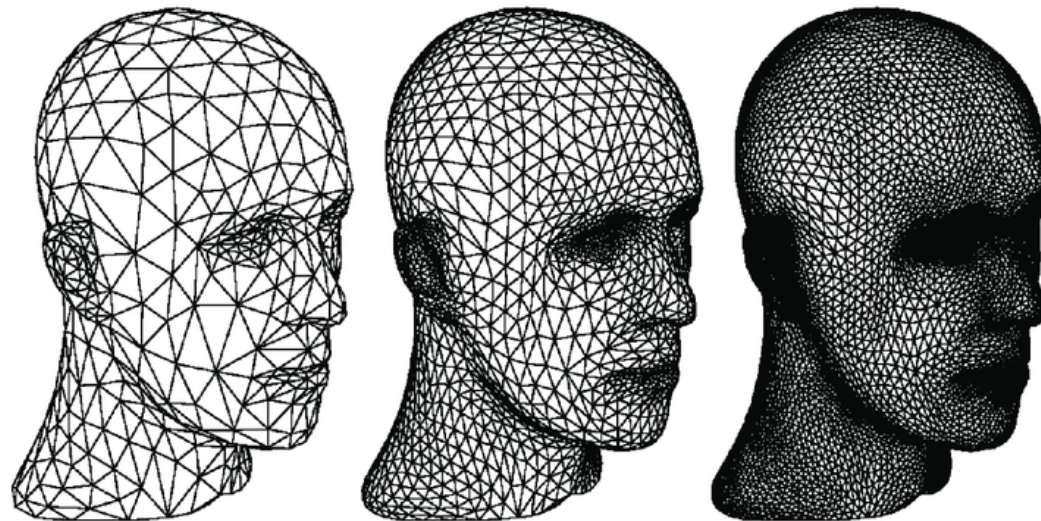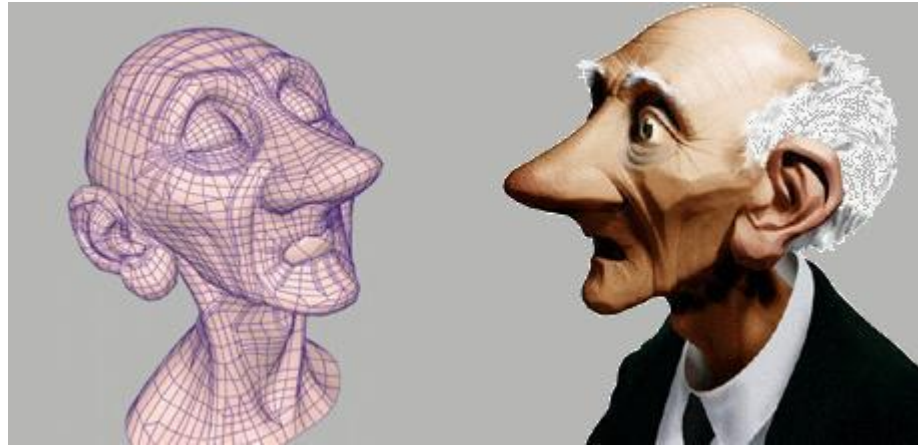
- Wikipedia

Computer Graphics

- All about image generation using computers
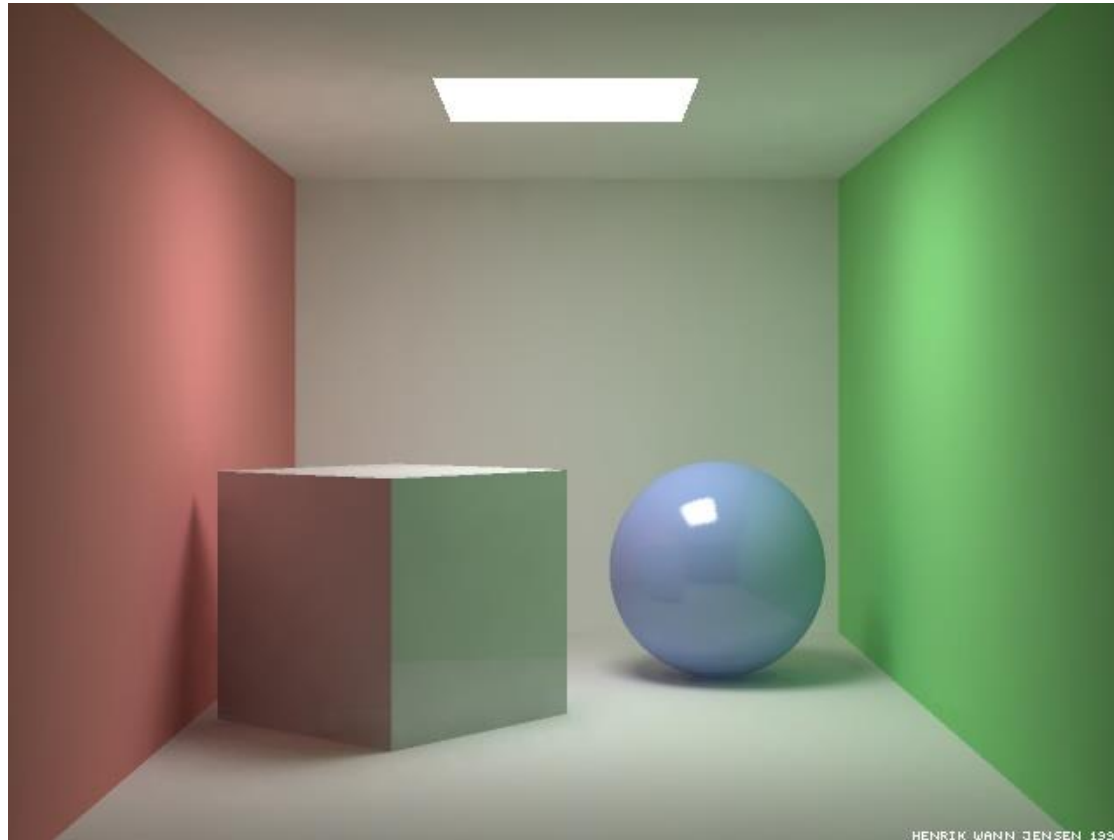
Technique: Modeling

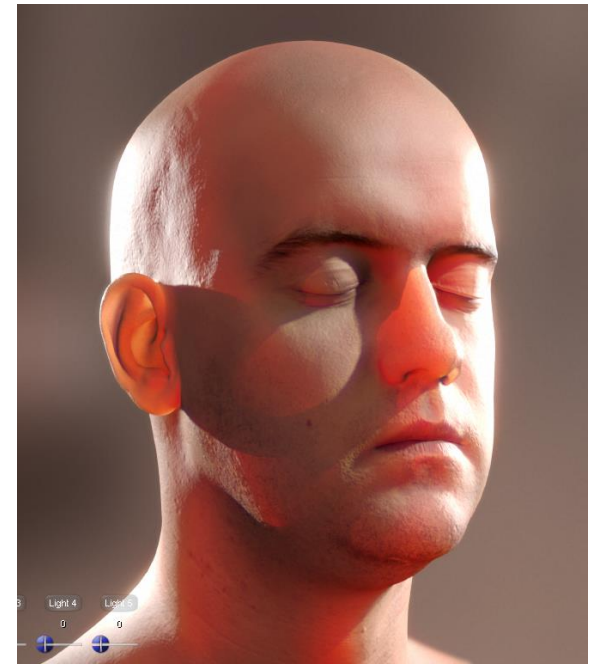# Technique: Animation

DIsney's Frozen

Technique: Rendering

- Global illumination

Technique: Rendering

- Subsurface scattering
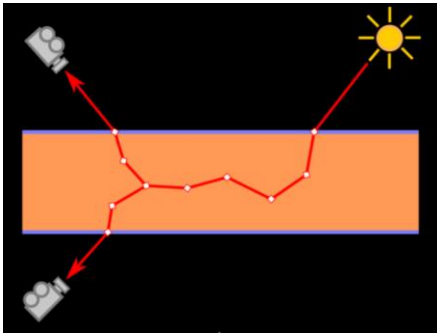
Technique: Rendering

- 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*

Ínría
UNIVERSITÉ CÔTE D'AZUR

Georgios Kopanas*

Ínría
UNIVERSITÉ CÔTE D'AZUR

Thomas Leimkühler

mpn
max planck institut informatik

George Drettakis

Ínría
UNIVERSITÉ CÔTE D'AZUR

* Denotes equal contribution

GraphDeco
GRAPHics and Design with hEterogeneous COntent

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Technique: Image Processing

- Style transfer

Technique: Human Interactions

Hanspeter Pfister

Examples of Interactive Visualization

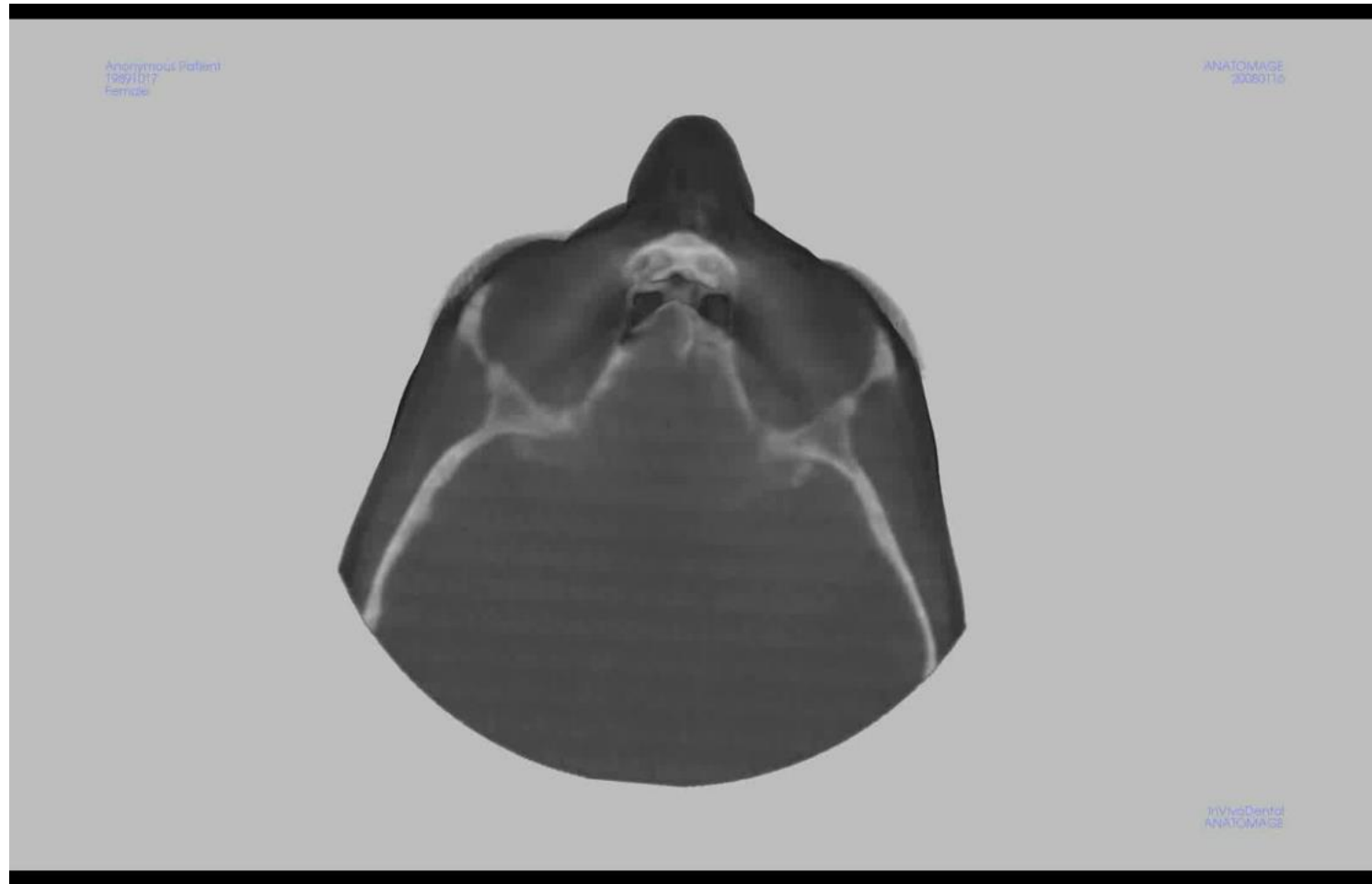# Interaction with Scientific Data

Demo

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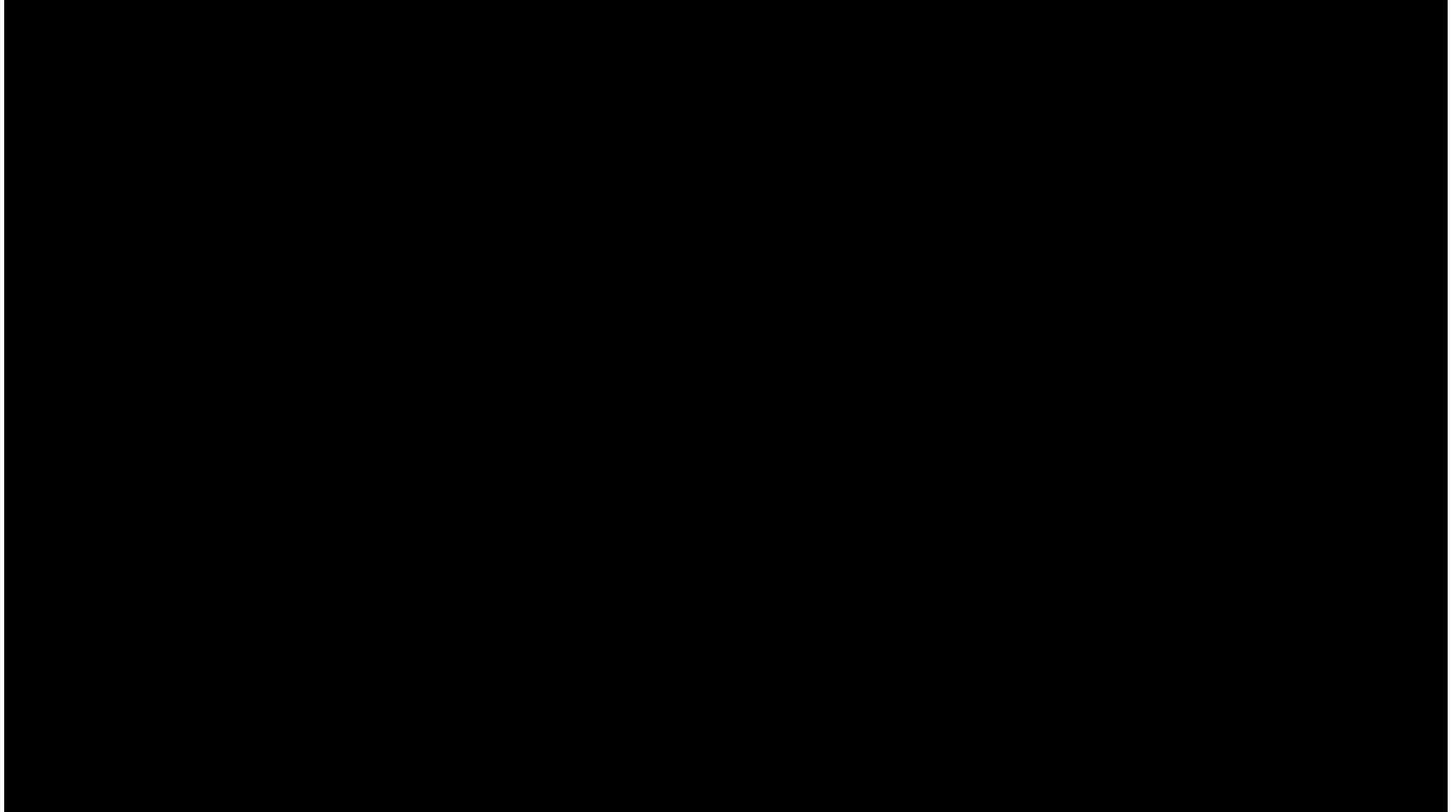
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Medical Data Exploration

Collaborative Visualization

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

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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
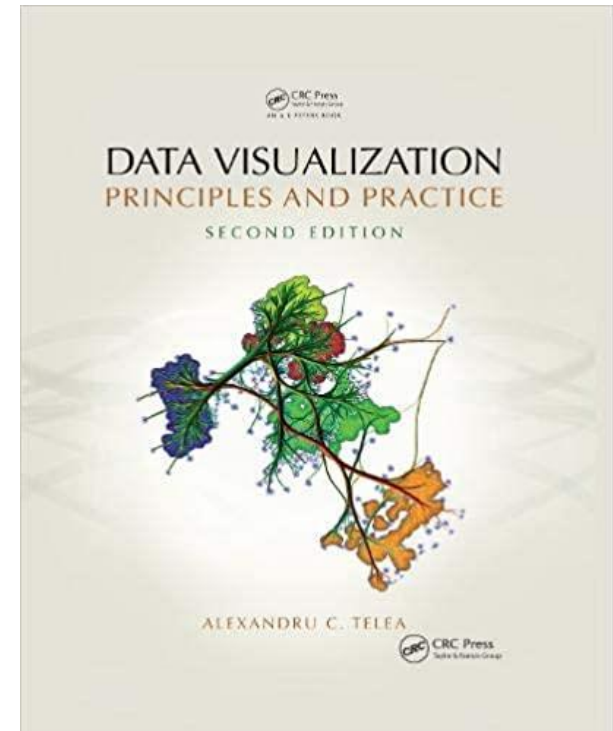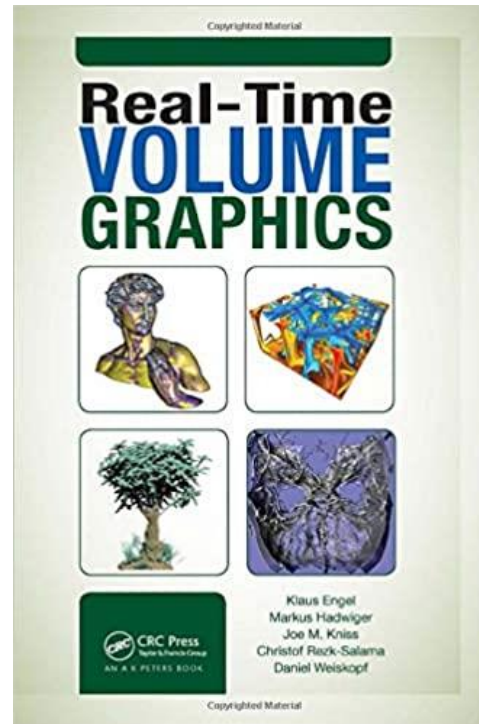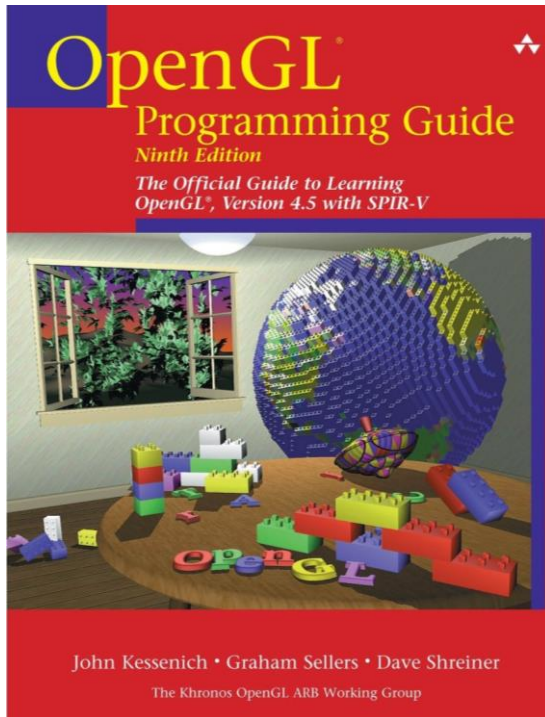 - OpenGL shaders, GLUT, C++

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Textbook
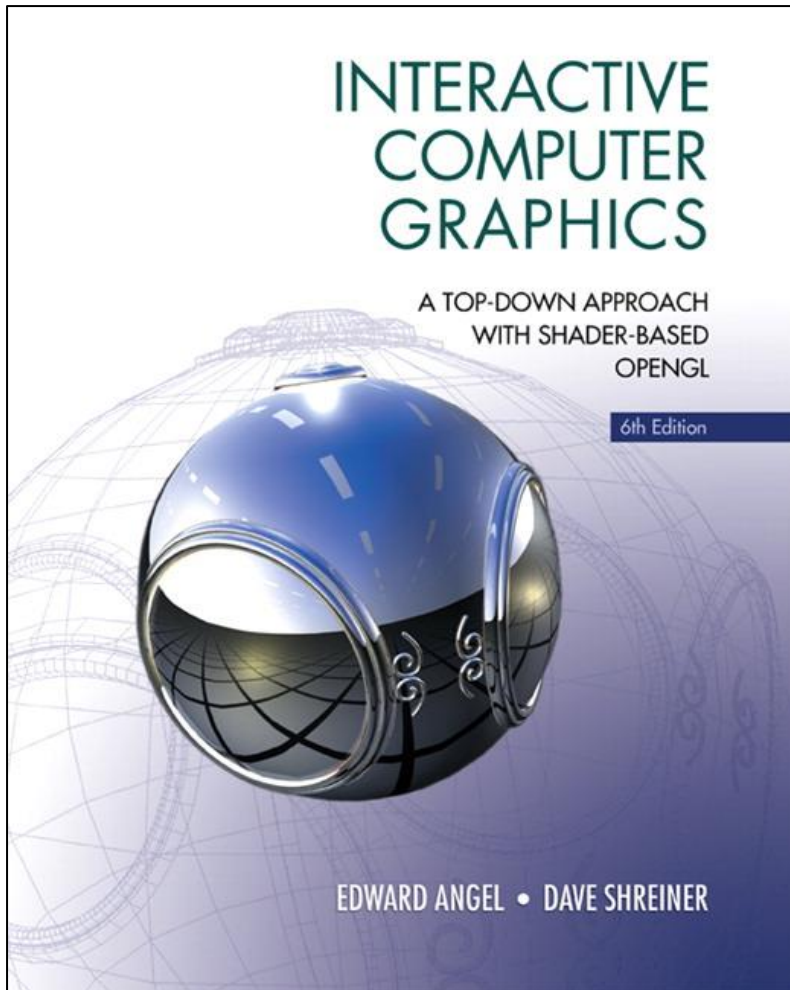
- Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL (6th Edition)
  - Edward Angel & Dave Shreiner
  - Addison-Wesley

- 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)

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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*

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Questions?

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