186.828 Seminar Wissenschaftliches Arbeiten
186.046 Seminar aus Visualisierung

WS 2018

Organizer: Hsiang-Yun Wu

Teaching staff: Aleksandr Amirkhanov, Tobias Klein, David Kouřil, Haichao Miao, Peter Mindek, Renata Raidou, Manuela Waldner, Christoph Heinzl, Eduard Gröller

Institute of Visual Computing&Human-Centered Technology

TU Wien, Austria

Important

- Always check up-to-date information on institute webpage https://www.cg.tuwien.ac.at/courses/WissArbeiten/

- Always check up-to-date information on TUWEL page https://tuwel.tuwien.ac.at/course/view.php?id=16180

- Contact: wu@cg.tuwien.ac.at

Seminar

- Get an idea how scientific work is carried out (in Visualization / CG)
  - Practice to review literature and get familiar with a particular scientific topic
    - Selecting, reading and understanding
    - Summarizing and explaining (orally and written)
    - Comparing and discussing
  - Practice to give a talk
  - Active discussion participation

Seminar - Procedure

1. **Select a topic**

Topic

- Students can work alone or in groups of 2
- Topic abstracts are available at http://cg.tuwien.ac.at/courses/WissArbeiten/index.html
- TUWEL: https://tuwel.tuwien.ac.at/course/view.php?id=16180

Important!!

Register on TU WEL

Enrolment: 4th-10th October 2018

Topic selection start:
20th October 2018, 08:00

Topic selection due to:
22th October 2018, 23:59

First come first serve

Seminar - Procedure

1. Select a topic
2. **Submit a literature list**

Submit a Literature List

- Meeting with Supervisor
- List of papers related to the topic

- Literature List Deadline: **27.10.2018**

Seminar - Procedure

1. Select a topic
2. Submit a literature list
3. **Attend 3 lectures**

Attend 3 Lectures

- **07.11.2018 13:00 - 15:00 (s.t.)**

  Wie schreibt man eine wissenschaftliche Arbeit

  Professor Wimmer

- **21.11.2018 13:00 - 15:00 (s.t.)**

  Wie halte ich einen Vortrag

  Professor Purgathofer

- **22.11.2018 13:00 - 15:00 (s.t.)**

  Forschung und wie sie funktioniert

  Professor Gröller

Seminar - Procedure

1. Select a topic
2. Submit a literature list
3. Attend 3 lectures
4. **Write a report**

Write a Report

- State-of-the-Art Report
- Final Report: 6-8 pages (12-16 pages / group)
- In English
- Format as for a scientific paper
  - LaTeX (Template on the wepage)
- Regular Meetings with Supervisor

Deadline 1st Version Report: **7.12.2018**

Deadline Final Version Report: **11.01.2019**

Seminar - Procedure

1. Select a topic
2. Submit a literature list
3. Attend 3 lectures
4. Write a report
5. **Give a presentation**

Give a Presentation

- Use institute's PowerPoint template for presentations (template is on the webpage)
- In English
- 15 + 3 minutes
- Active discussion participation

Presentation Day: **20.12.2018**

In case of too many students, an additional presentation day will be announced and/or the length of the presentation will be adjusted. This will be communicated in advance.

Seminar - Procedure

1. Select a topic
2. Submit a literature list
3. Attend 3 lectures
4. Write a report
5. Give a presentation

Grading

- Two parts
  - 1st (central) part: 17% of the grade
  - 2nd part: 83% of the grade
    - It is necessary to attend the 3 lectures to get a positive grade!
    - Grading criteria:

      50% written report

      40% presentation

      5% attendance during the presentations

      5% active discussion after the presentations

Report Grading

- Grading criteria:
  - Structure, figures,...
  - Language
  - Content
  - References
- Points will be deducted for:
  - Delayed submission
  - Page number below 6 (12)
- Plagiarism check!

Plagiarism

“plagiarism involves the use of another person's work without full and clear referencing and acknowledgement”

http://www.usq.edu.au/library/referencing/what-is-plagiarism

Presentation Grading

- Grading Criteria
  - Content Expertise
  - Didactic / Preparation
  - Presentation Technique
  - Overtime

Important Dates

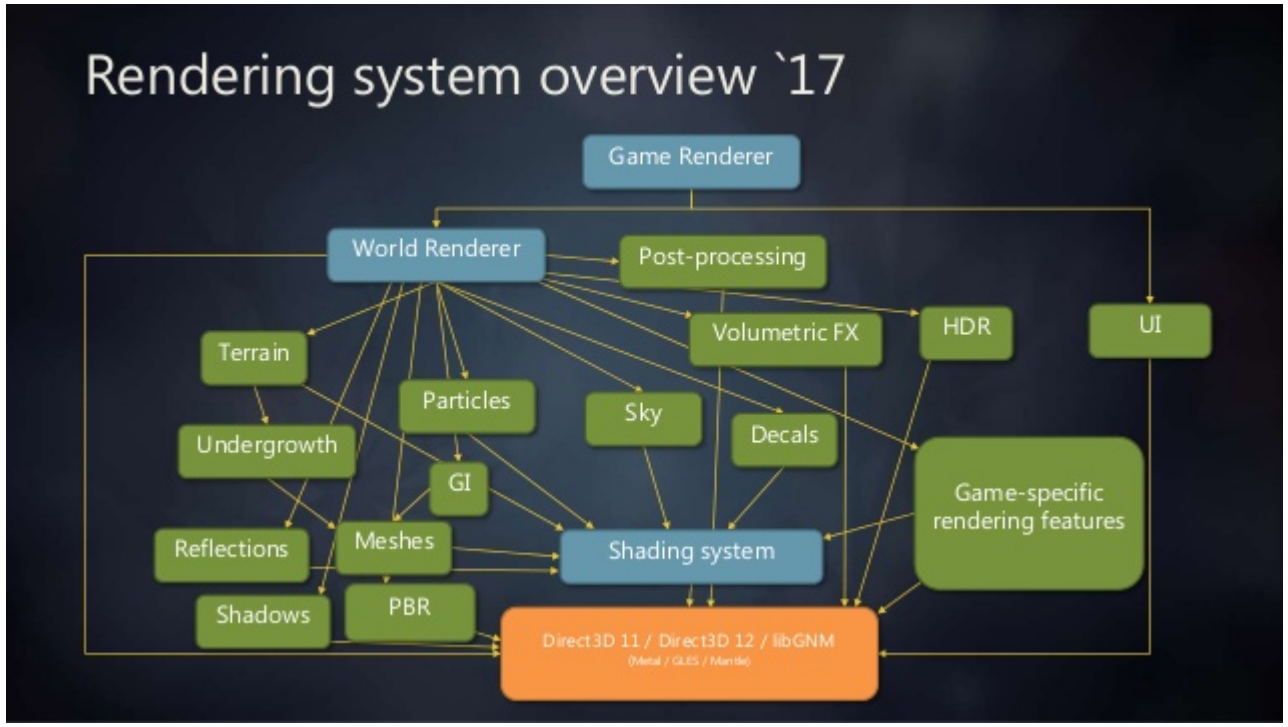
- **20.10.2018:** Select your topic
- **27.10.2018:** Submit your literature list
- Attend 3 lectures (in ICGA seminar room):
  - **07.11.2018, 13:00 (s.t.):**
    Wie schreibt man eine wissenschaftliche Arbeit
  - **21.11.2018, 13:00 (s.t.):**
    Wie halte ich einen Vortrag
  - **22.11.2018, 13:00 (s.t.):**
    Forschung und wie sie funktioniert
- **07.12.2018:** Submit draft report
- **20.12.2018:** Talks (in seminar room)
- **11.01.2019**: Submit final report

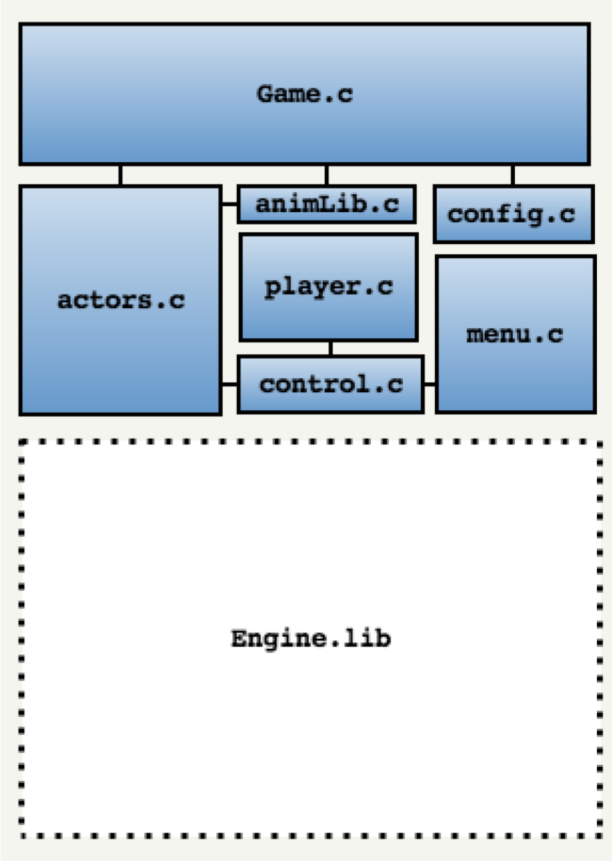
All submissions are done on TUWEL https://tuwel.tuwien.ac.at/course/view.php?id=16180

Topics 2018/2019

Rendering Systems Architectures

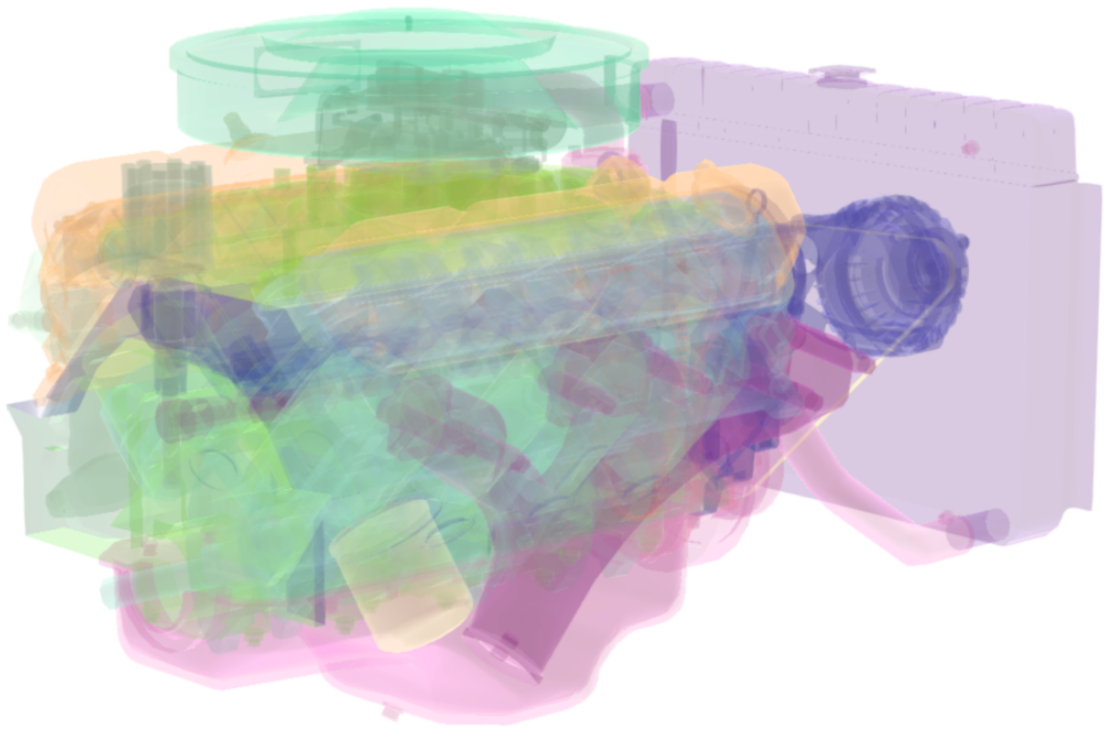
- Research the approaches to designing rendering systems used in i.e. video games.

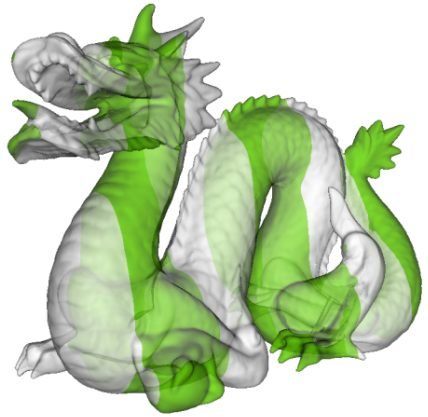




Real-time Transparency

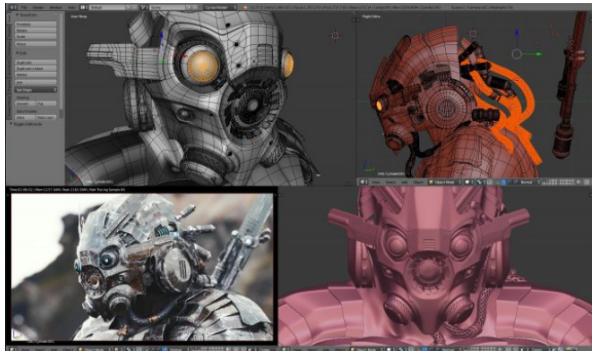
- Research and summarize various approaches that have been suggested to solve transparency in real-time rendering systems





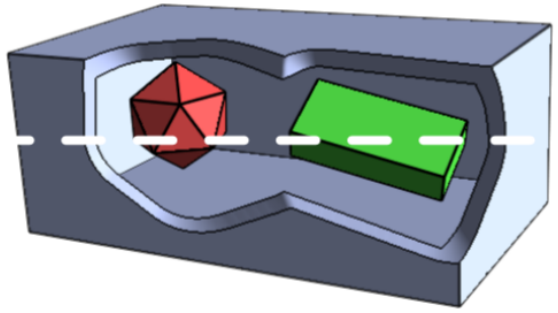
Occlusion Management in 3D Environments

- Problem of occlusion of objects in 3D environments
- Different methods and strategies to manage occlusion
- Multiple views, transparency, explosion, cutaway view etc.



Multiple views
[blender.org]

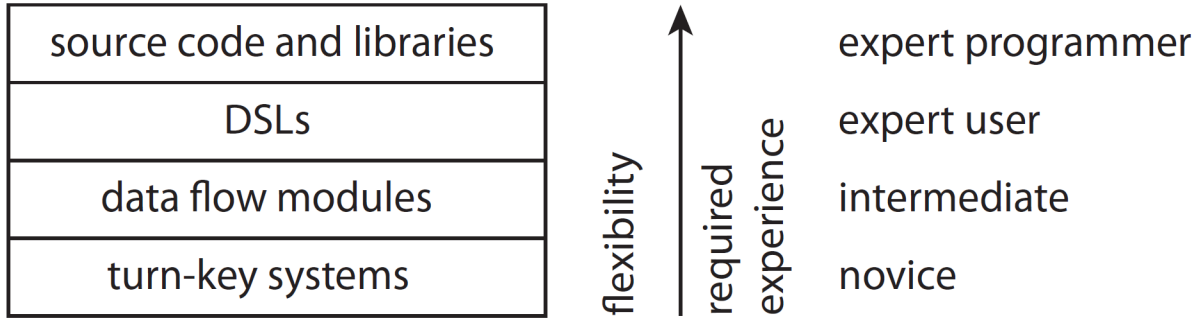
Importance-driven transparency
[Viola et al. 2004]

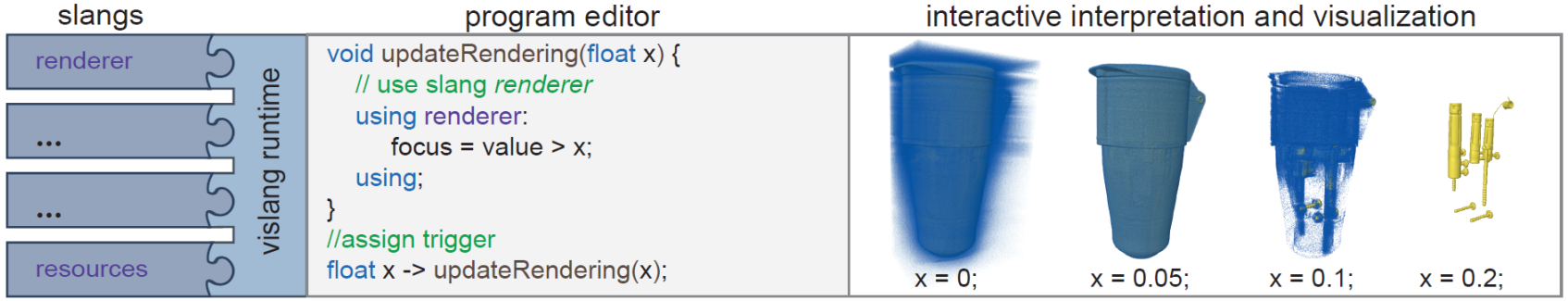


Adaptive cutaway view
[Viola et al. 2004]

DSLs in Visualization

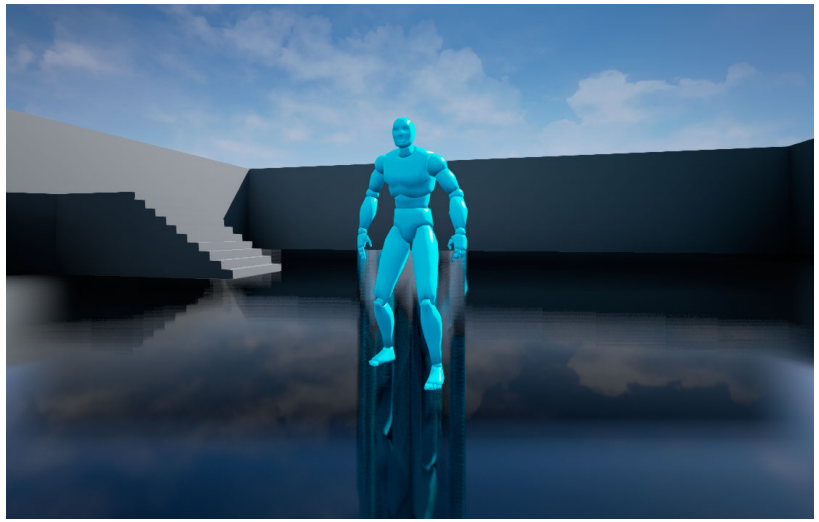
- DSL = Domain-specific language
- How to incorporate domain knowledge in a language





Overview of Screen Space Effects

Screen Space
Amienbt Occlusion

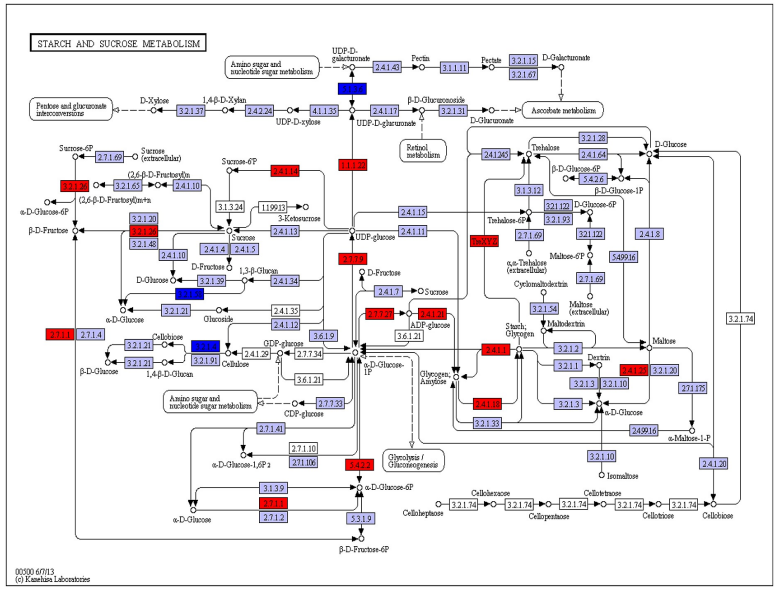


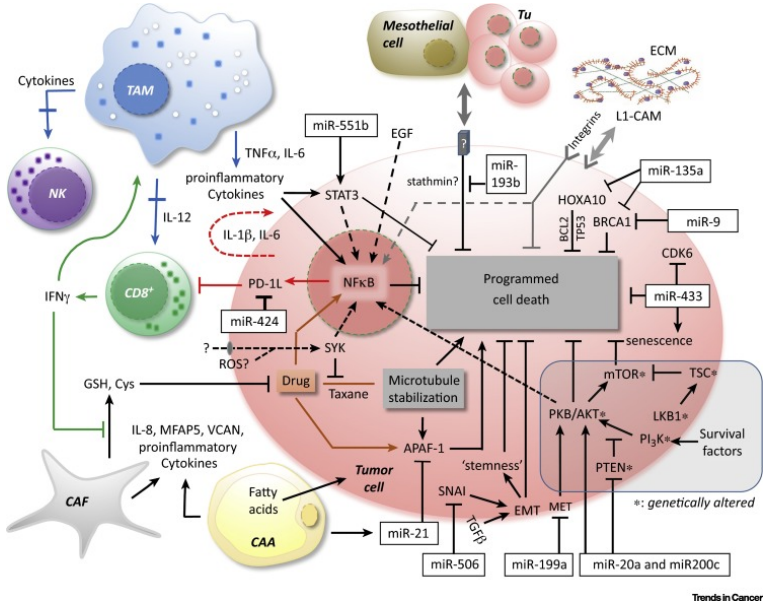
Screen Space
Reflection

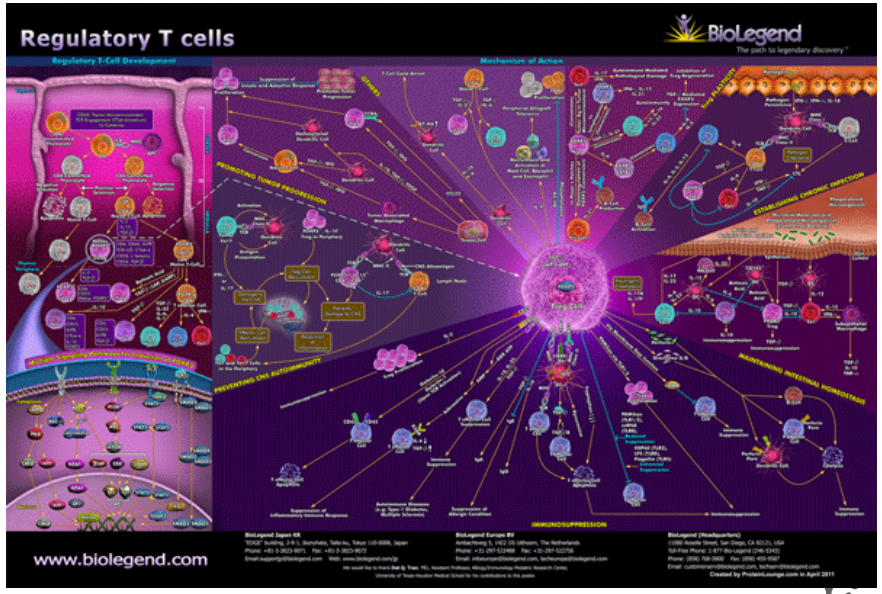
Title: Network Visualization for Biological Pathways

Challenge:

1) Layout simplification and arrangement
2) Scalability, complexity, and usability



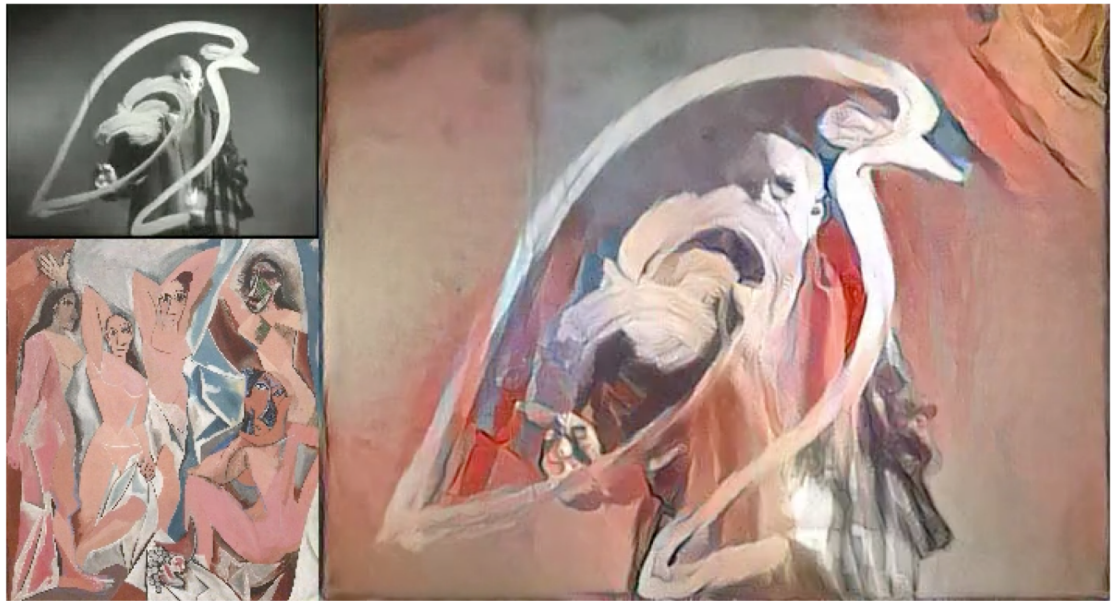




Title: Style transfer techniques and their Complexity

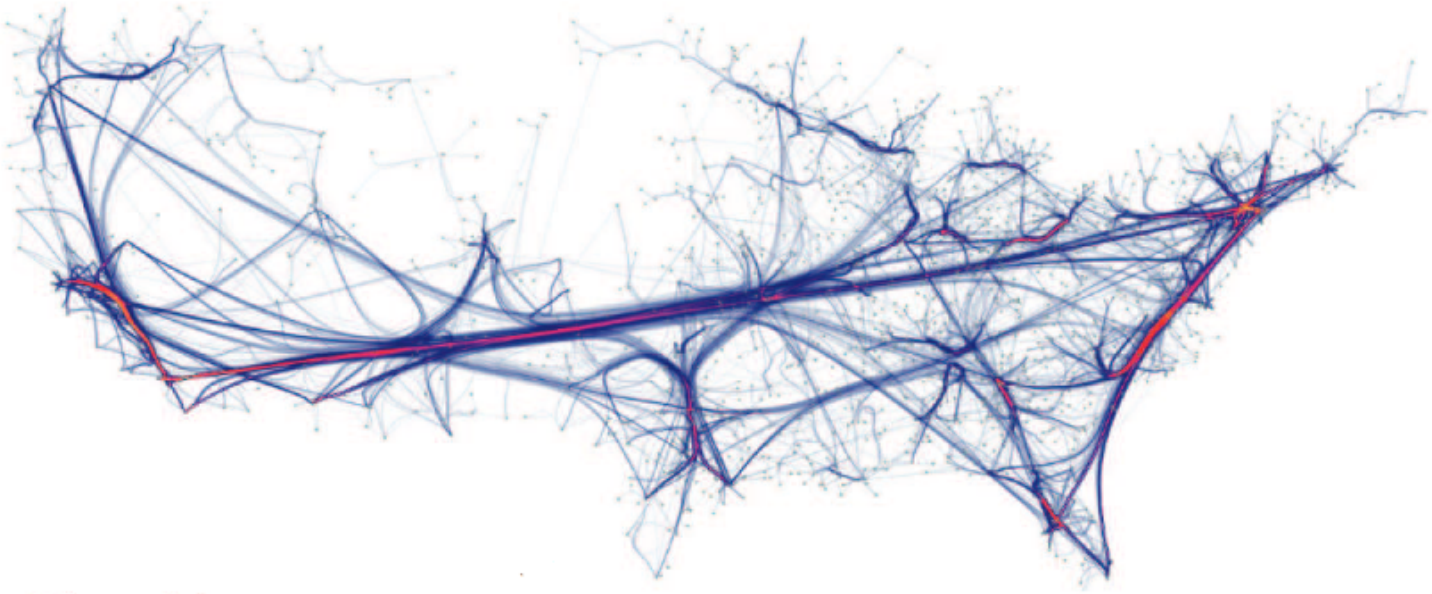
Challenge:

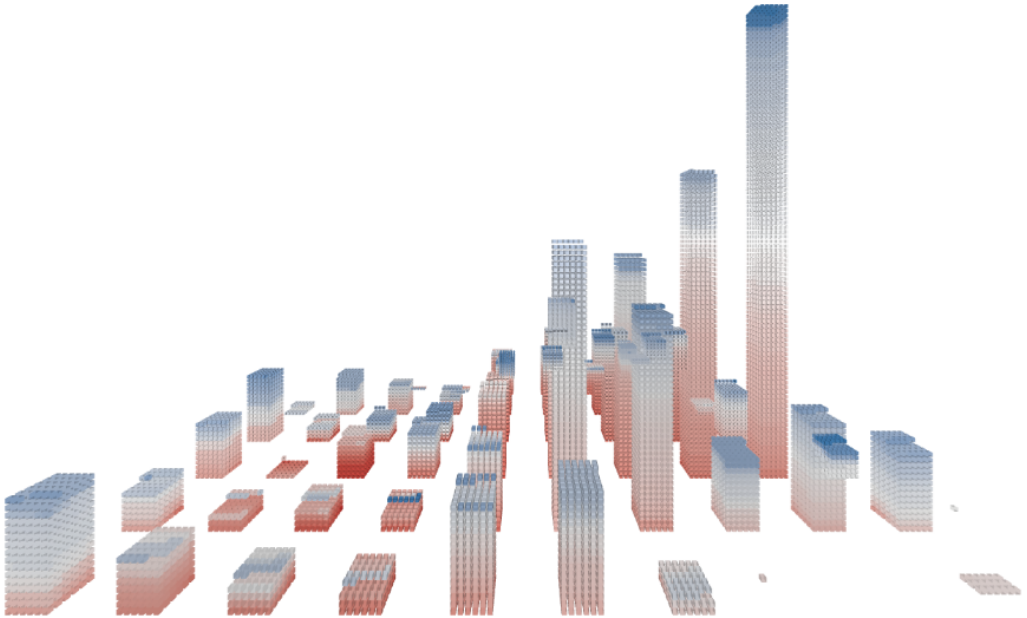
1) Semantics beyond fonts and images
2) Computational time and limitation



GPU-Accelerated Information Visualization

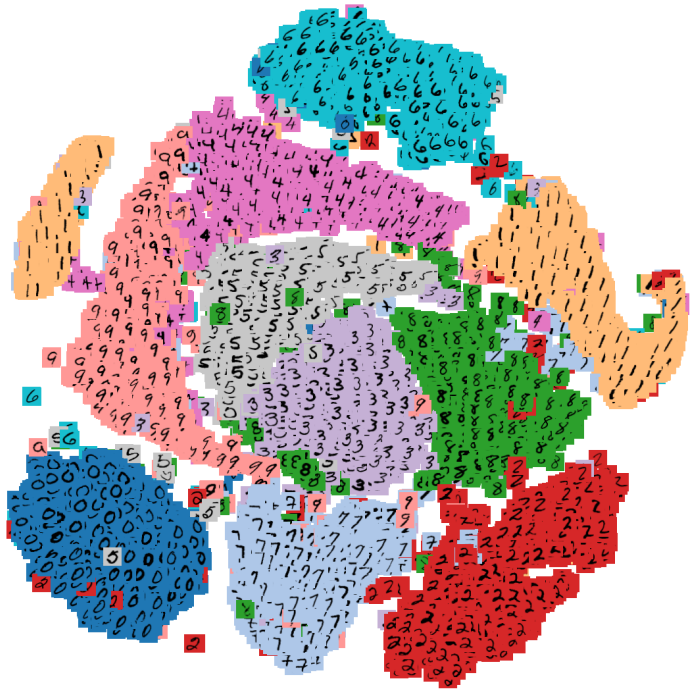
- Explore InfoVis toolkits and techniques using GPU processing or rendering of abstract data
  - Shaders for fast rendering
  - GPGPU for efficient data processing



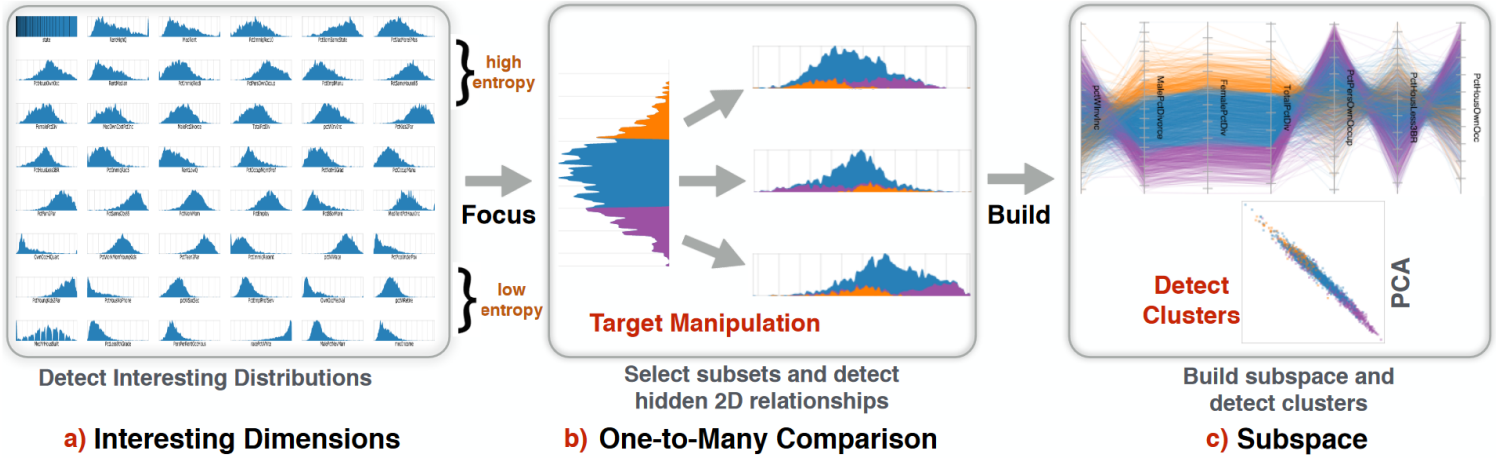


Visualization of High-Dimensional Data

Visualization of abstract data with hundrets and thousands of dimensions

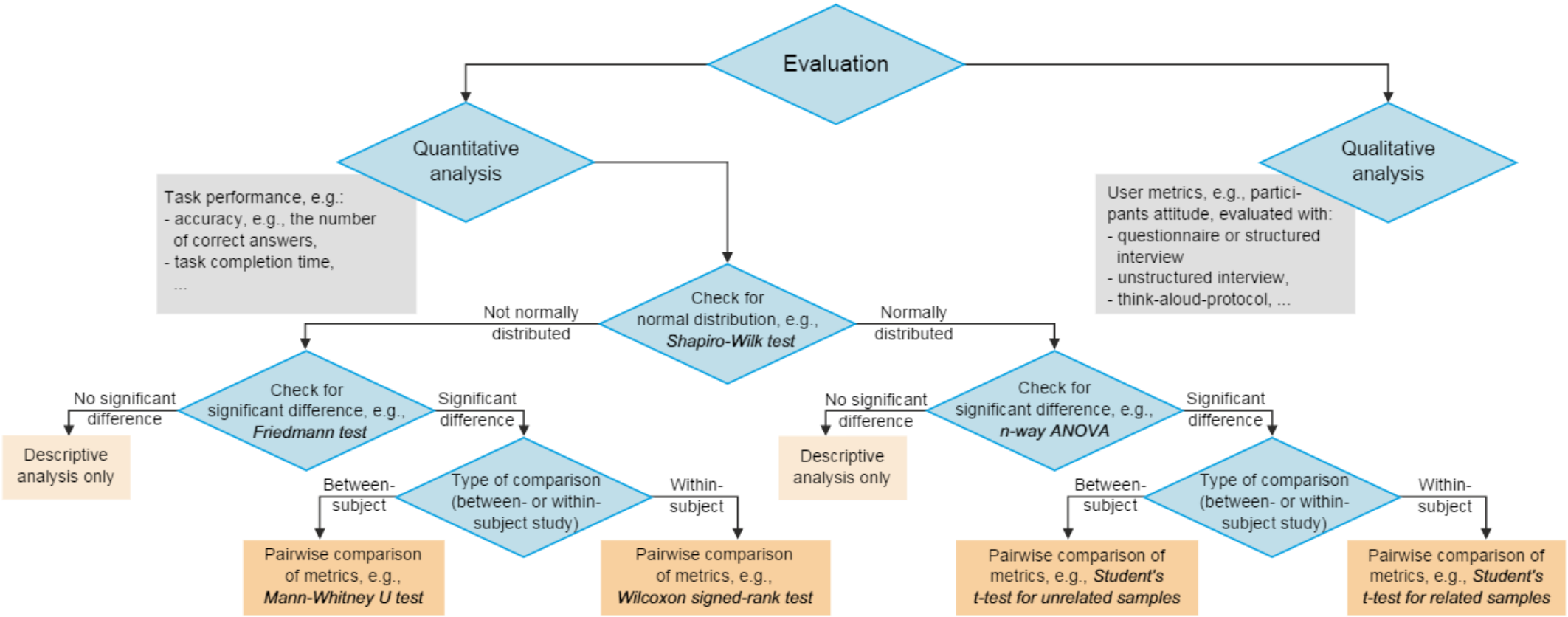


http://projector.tensorflow.org/



[Krause et al., 2007]

Evaluation methods in Medical Visualization



How to evaluate medical visualizations on the example of 3D aneurysm surfaces [Glasser et al. 2016]

Visualizing Time-Varying Medical Data

Visualization and Exploration of Time-Varying Medical Image Data Sets
[Zhe Fang et al. 2007]

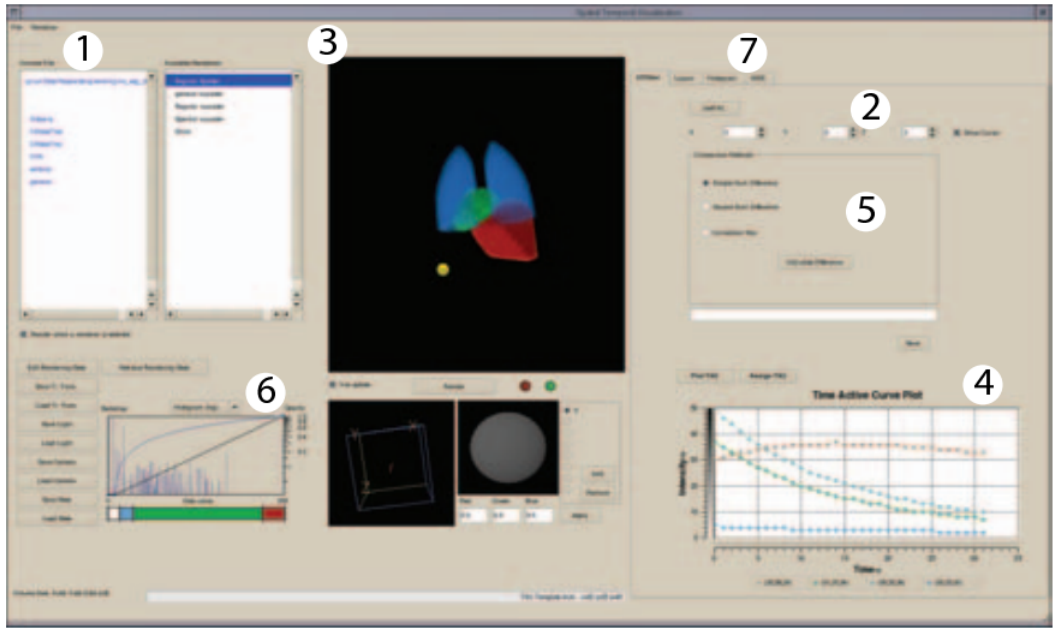


Figure 8: Screen-capture of the TVMID visualization and exploration application. The GUI includes panes for volume rendering (3), viewing TACs (4), 1D histograms and specifying a 1D transfer function (6), 2D histograms and a 2D transfer function (under a different tab (7)), MDS layout (7), choice of TAC dissimilarity metric (5) and more. The left half part is for loading a TVMID, specifying a transfer function and performing volume rendering and the right half is where the user can choose one of the different methods which can be used to analyze data sets.

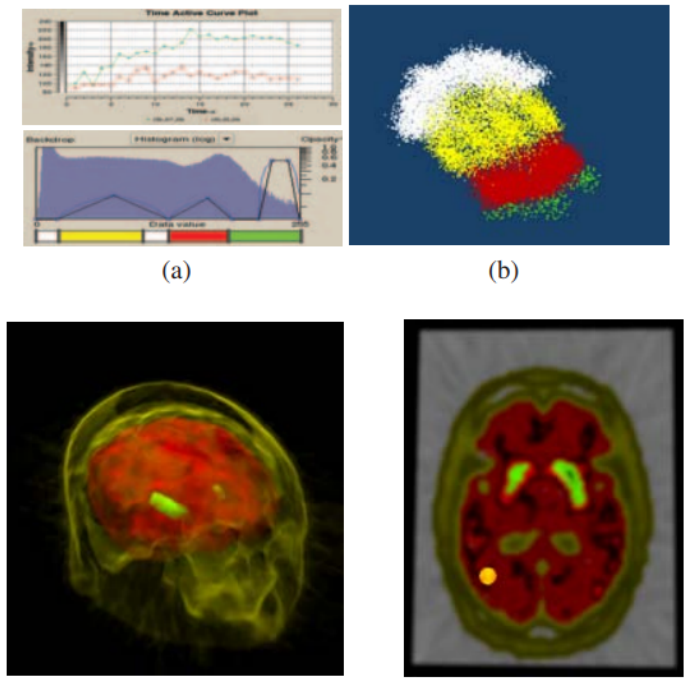


Figure 10: Simulated dynamic PET data set (based on PET-SORTEO): (a-top) The TAC of a voxel in the striatum (green) and the template TAC in the brain area (red). (a-bottom) The histogram (based on the red template TAC) and the transfer function used to render the image in (c). (b) The MDS layout using a similarity distance proportional to $0.5d_1 + 0.5d_E$. (c) Volume rendering based on the transfer function in (a-bottom) using a template TAC in the brain and the d_1 distance. (d) The position (yellow dot) of the template TAC.

Medical Health Record Visualizations

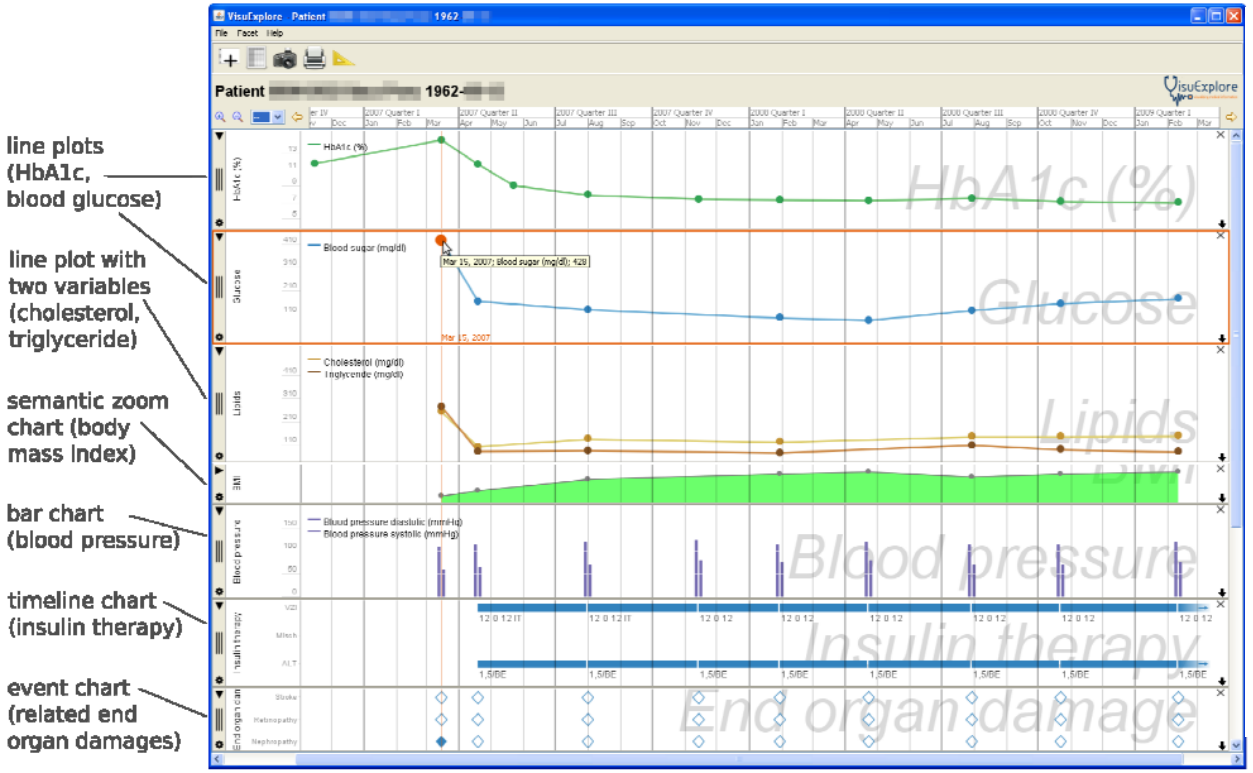


Fig. 1. Exploring a medical record using VisuExplore.

Patient Development at a Glance: An Evaluation of a Medical Data Visualization [Pohl et al. 2011]

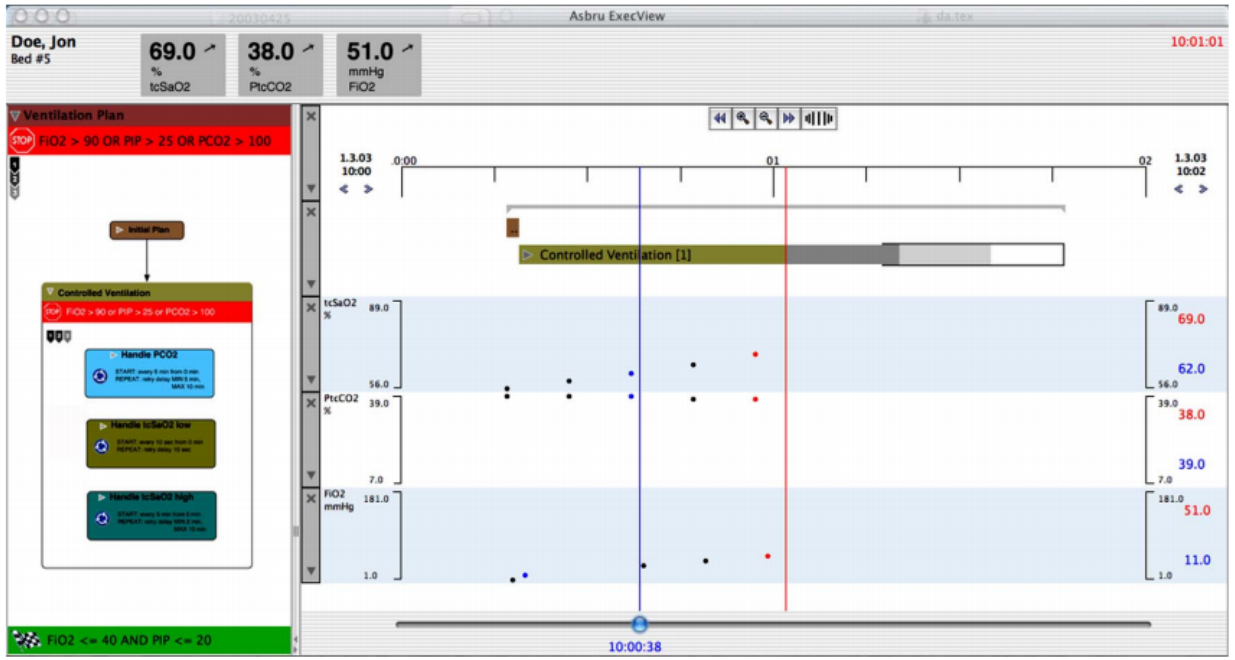
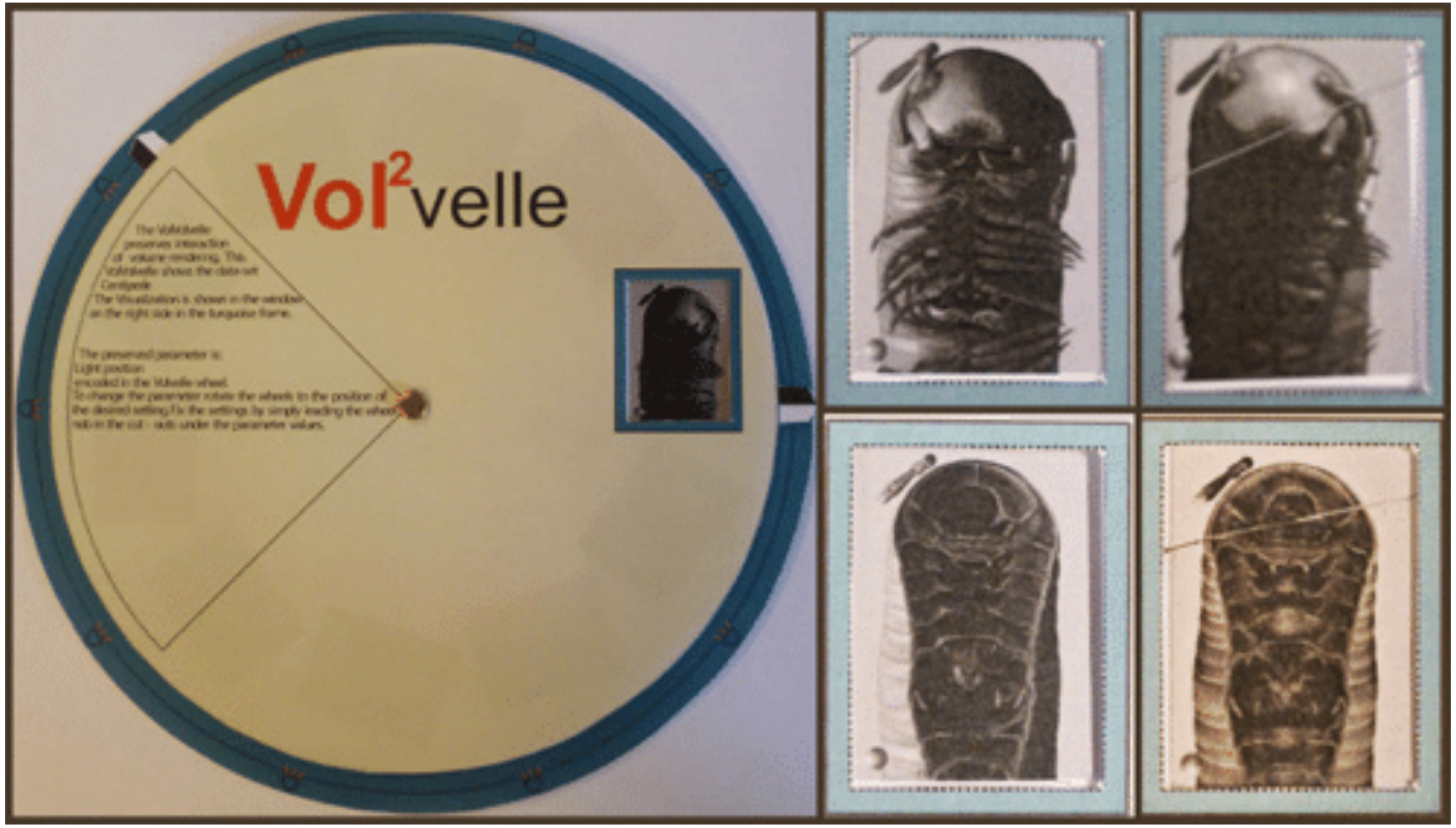


Figure 1 Application window showing the execution of a plan.

CareVis: Integrated visualization of computerized protocols and temporal patient data [Aigner et al. 2006]

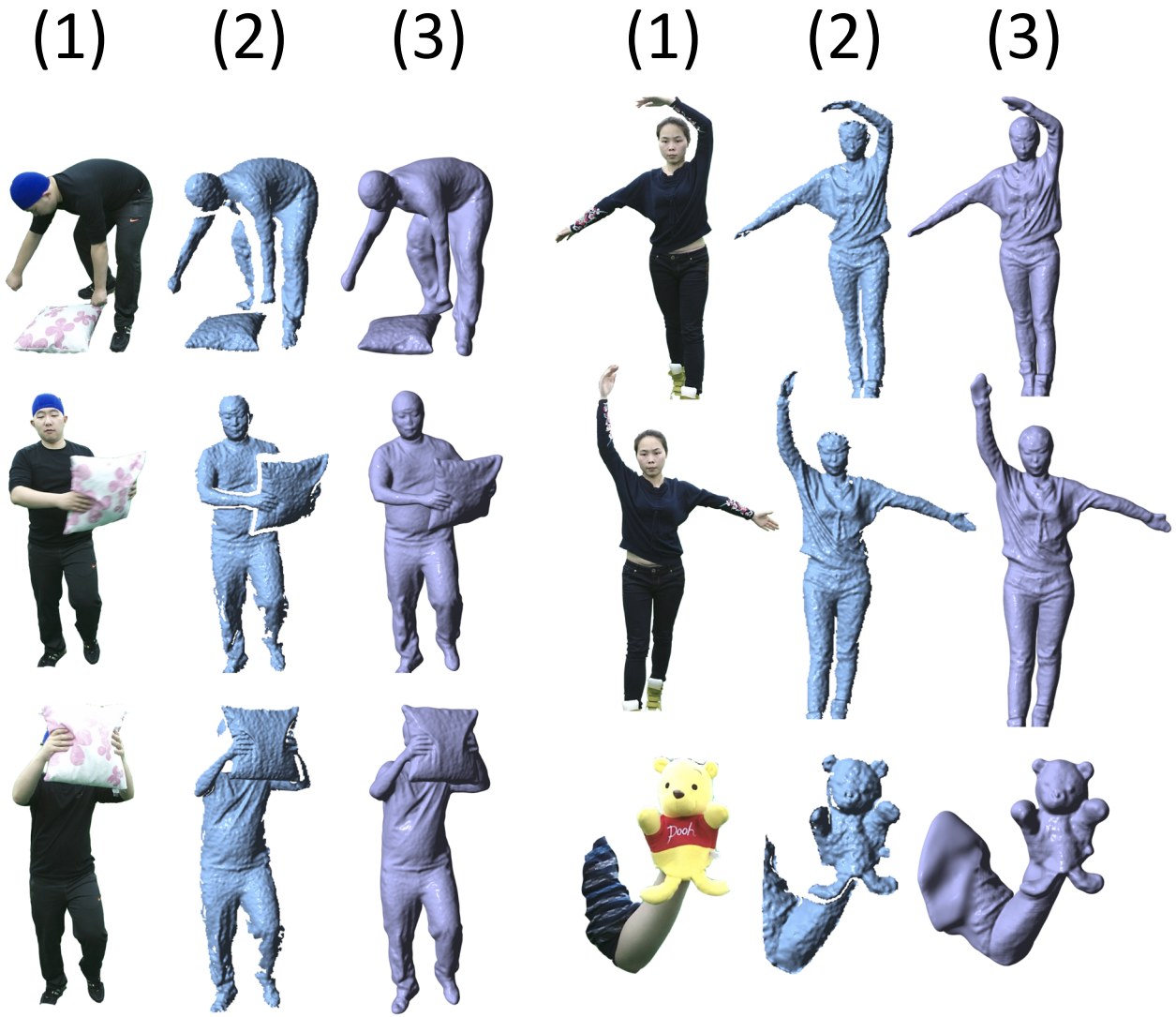
Alternative Methods for Medical Visualization



Vol2velle: Printable Interactive Volume Visualization
[Stoppel et al. 2017]

Motion tracking and geometry reconstruction

- RGB-D cameras such as Kinect or RealSense allow capturing 3D models of objects
- Explore methods to track motions of captured by RGB-D cameras



(1) Input color image
(2) Input depth image
(3) Reconstruction

Realistic teeth rendering

- Explore state-of-the-art approaches of realistic teeth modeling and rendering

Blockchain visualization

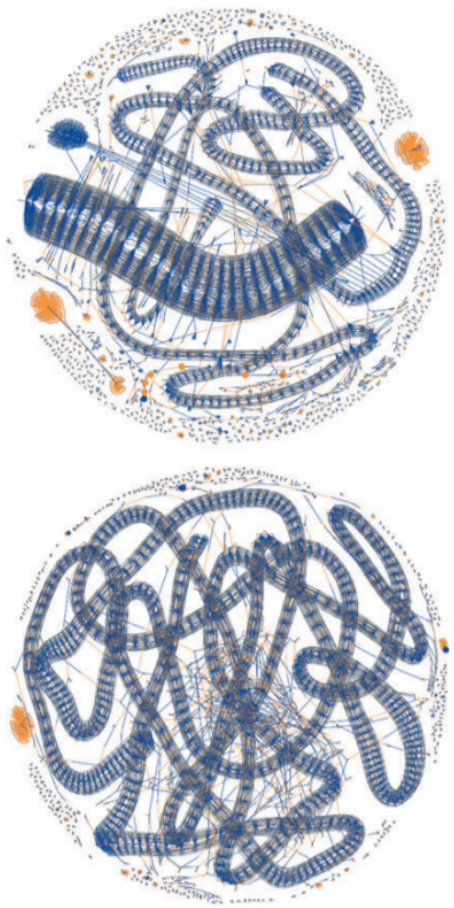


FIG. 7. Blocks#364133,364618: Initial "parasitic worm" transaction rate attack.

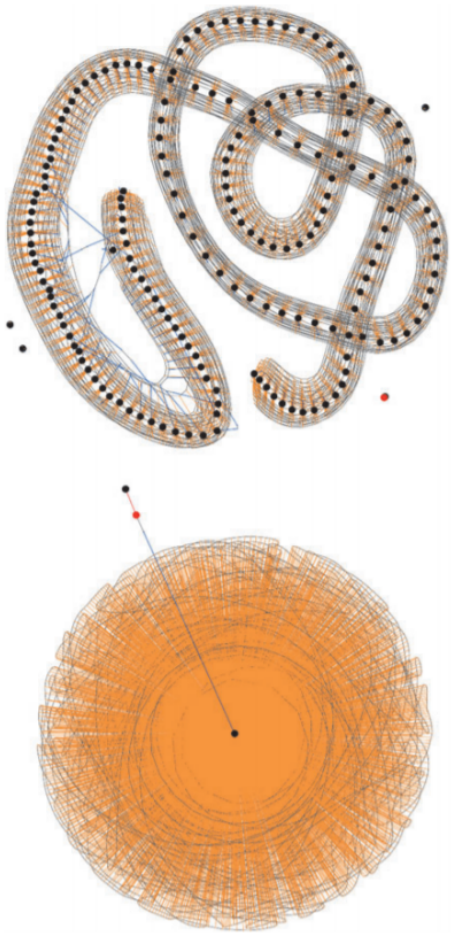
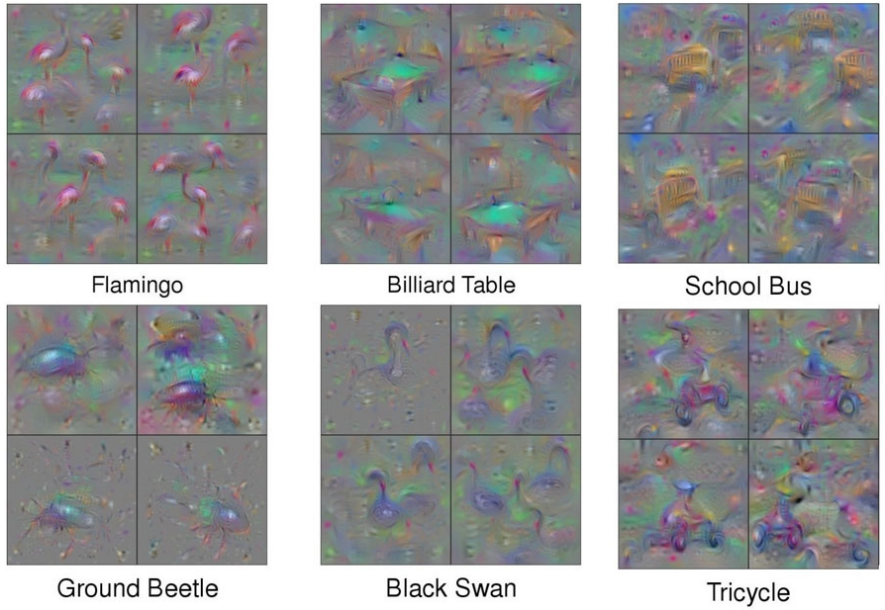
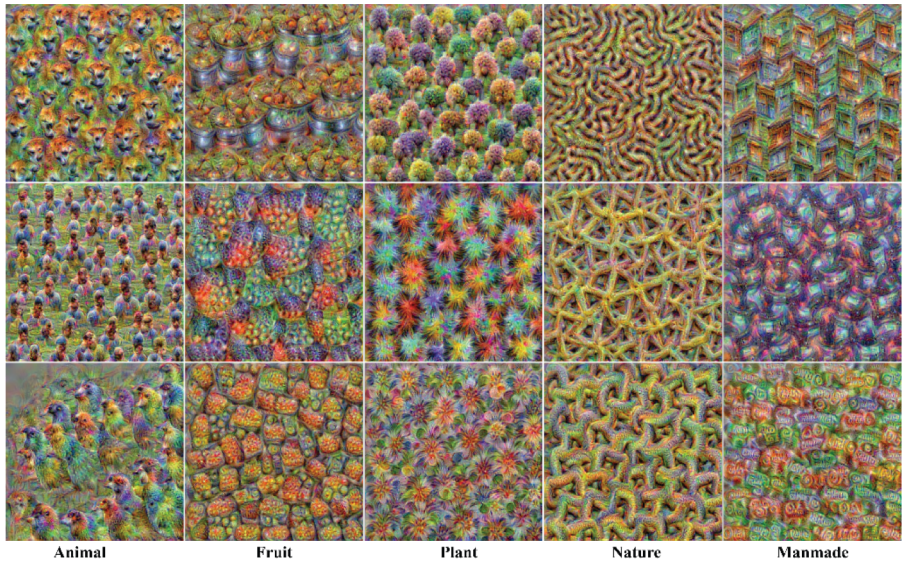


FIG. 8. Blocks#364281,364292: Initial algorithmic responses to spam, the lower block showing the largest possible transaction.

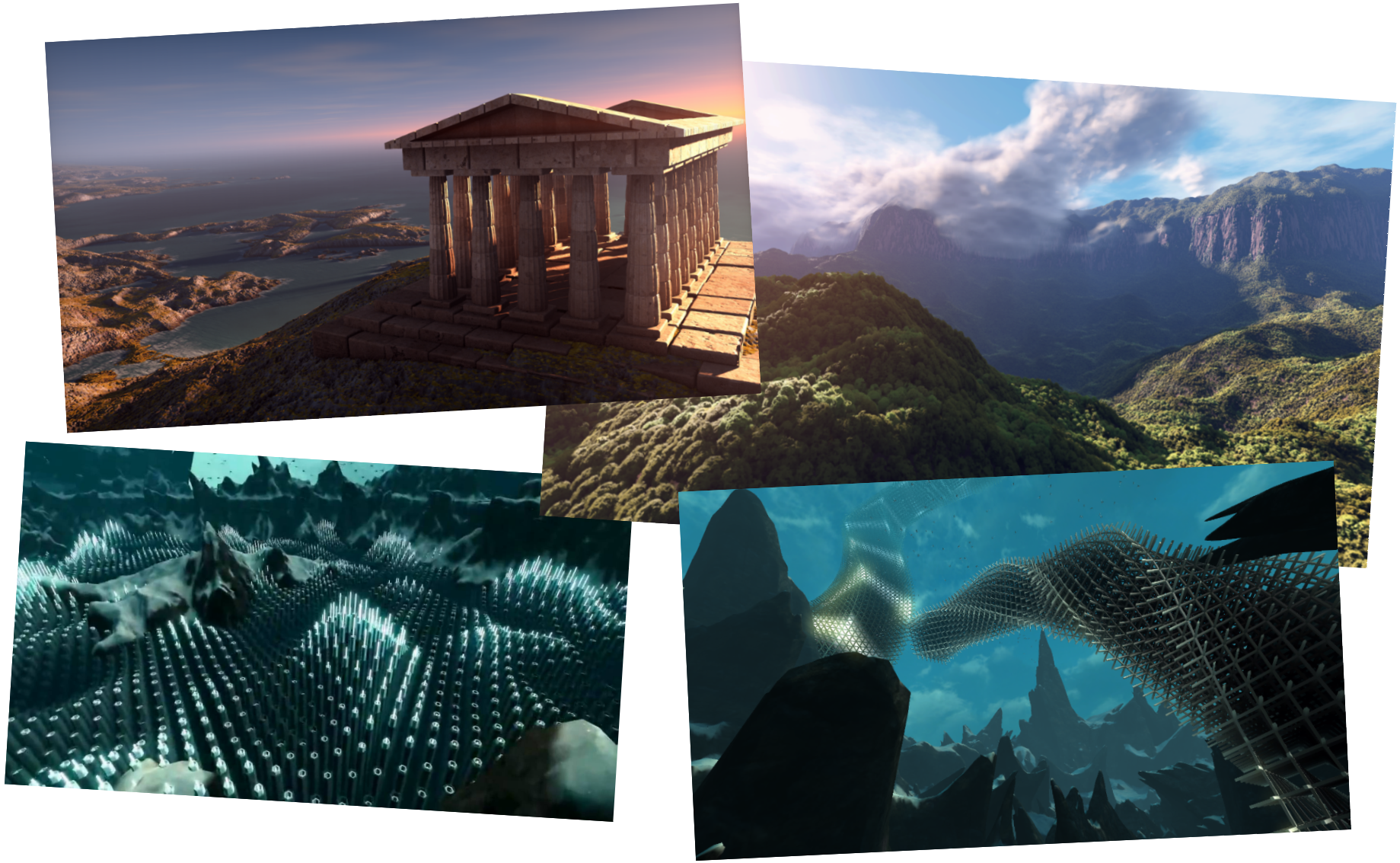
Visualization of neural networks



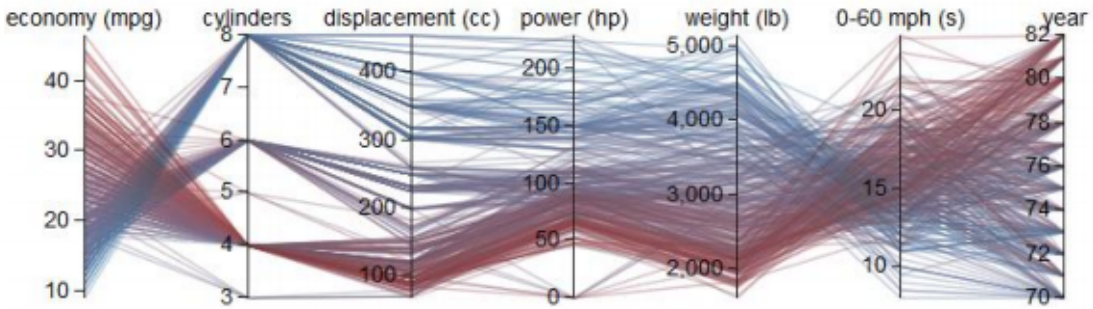


Modern Particle Systems

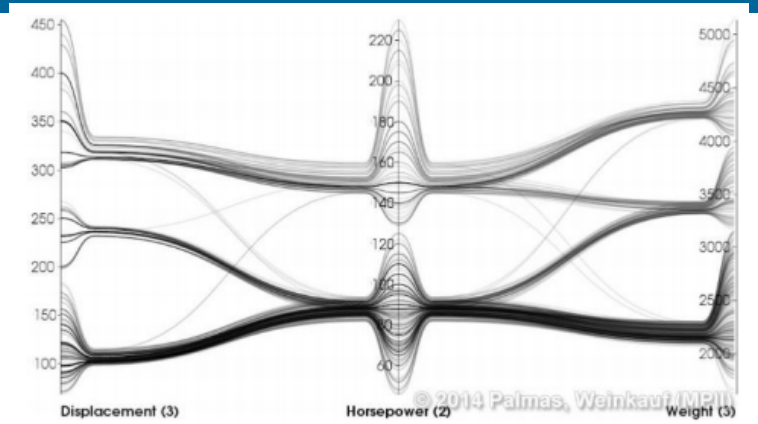
Special Effects in Computer Graphics



Edge Bundling Method for Parallel Coordinates



Parallel Coordinates View



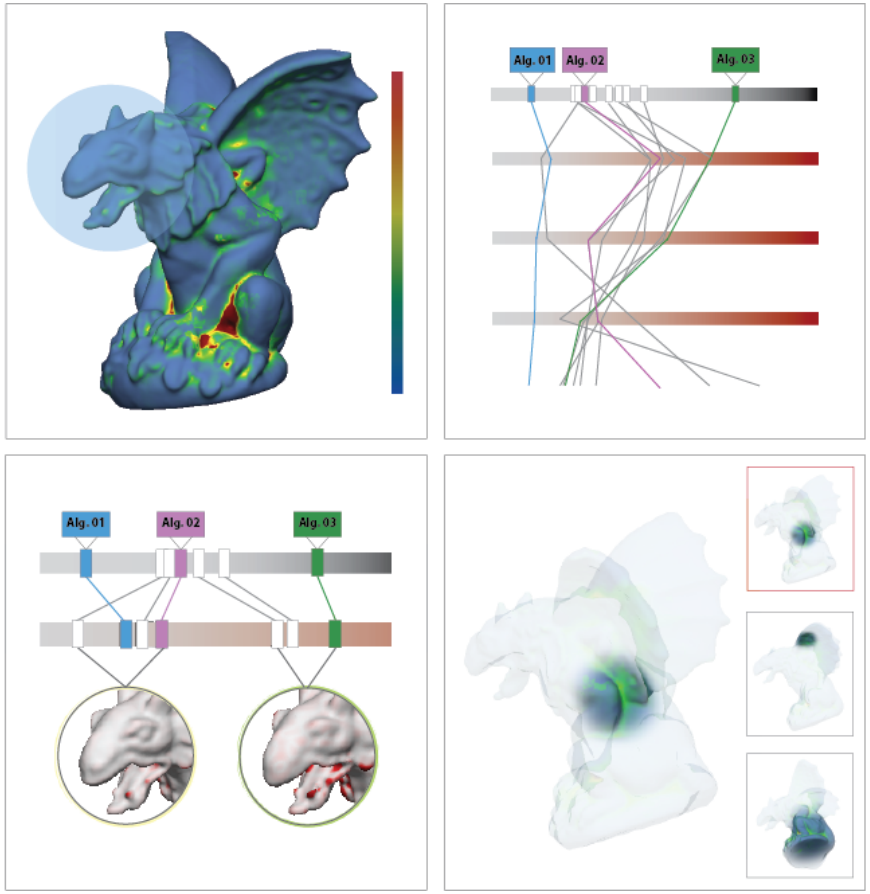
Parallel Coordinates View with Edge Bundling

Parallel coordinates is a data visualization technique designed for multivariate data. To display the data for an n-dimensional space, the technique utilizes n-parallel lines, usually vertical. Each point of the data is represented as a polyline running though the lines. The problem using parallel coordinates on big data is that many polylines are overlapping each other and result in visual clutter, which makes the parallel coordinates hard to read.

One modification of parallel coordinates is **edge bundling**. This method merges similar polylines into bundles, which makes the parallel coordinates look much clearer without losing displayed information.

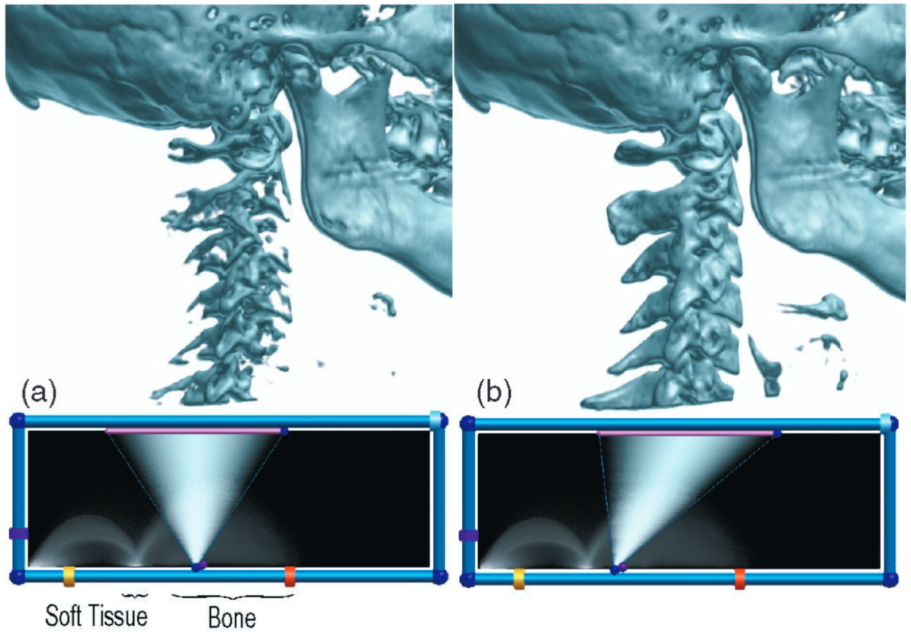
Comparative Visualization for Polygonal Dataset

Scientists as well as practitioners often need to compare multiple polygonal datasets, for example results of image segmentation algorithms. Your task is to provide an overview over the state-of-art in methods for comparing multiple polygonal datasets.



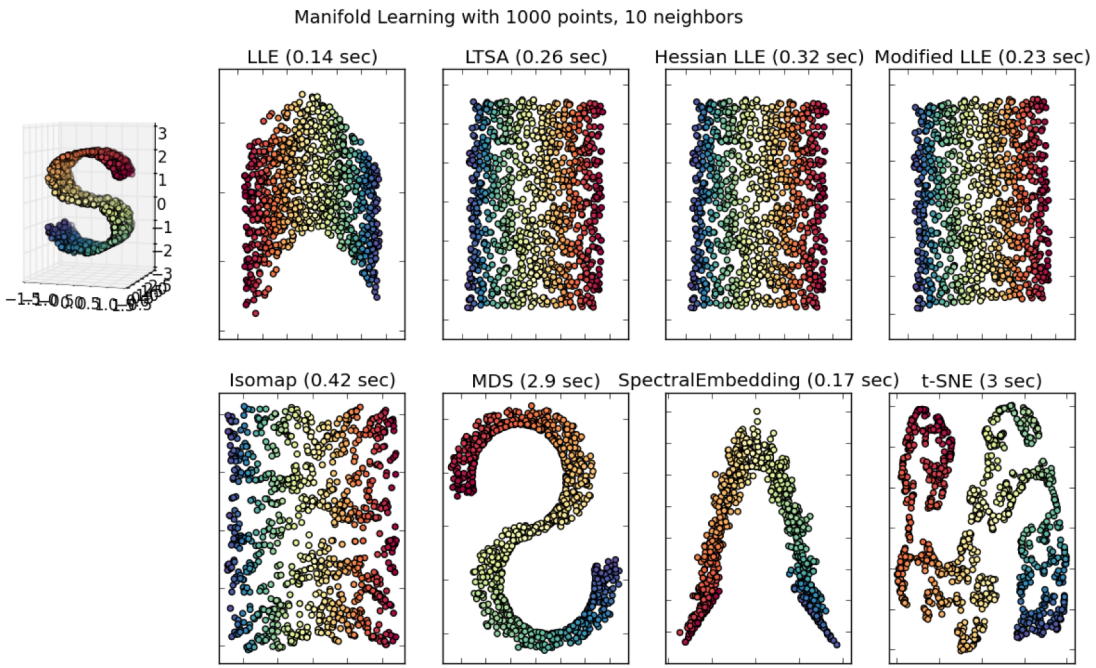
Transfer Function Design for Multi-modal Data

In domains like medicine and industrial inspection, imaging methods have been developed for inspecting objects non-destructively, for example PET, MR and CT. Each modality has its distinct advantages and disadvantages, for example MRI can resolve soft tissue very well, while CT is good in resolving bone structures. Therefore, techniques have been developed for a meaningful combined visualization of multiple imaging modalities. Your task is to provide an overview over the state-of-the-art in designing transfer functions to visualize multi-modal data.



Dimensionality Reduction Methods in Visualization

When analyzing multi-dimensional data (>= 3 dimensions), a typical approach is to project the data into lower dimensions (for example 2D), to be able to visualize the data directly. Many methods exist for this projection, e.g. Principal Component Analysis (PCA), Multi-Dimensional Scaling (MDS), or T-distributed Stochastic Neighbor Embedding (t-SNE). Your task is to provide an overview over the available dimensionality reduction methods, how they are used in visualization and their individual advantages and disadvantages.



Topics 2018/2019

1. Rendering Systems Architectures
2. Real-time Transparency
3. Occlusion Management in 3D Environments
4. DSLs in Visualization
5. Overview of Screen Space Effects
6. Network Visualization for Biological Pathways
7. Style transfer techniques and their Complexity
8. GPU-Accelerated Information Visualization
9. Visualization of High-Dimensional Data
10. Evaluation methods in Medical Visualization
11. Visualizing Time-Varying Medical Data
12. Medical Health Record Visualizations
13. Alternative Methods for Medical Visualization
14. Motion tracking and geometry reconstruction
15. Realistic teeth rendering
16. Blockchain visualization
17. Visualization of neural networks
18. Modern Particle Systems
19. Special Effects in Computer Graphics
20. Edge Bundling Method for Parallel Coordinates
21. Comparative Visualization for Polygonal Dataset
22. Transfer Function Design for Multi-modal Data
23. Dimensionality Reduction Methods in Visualization

LaTeX

A very short introduction to LaTeX

- Document markup language
  - „programming“ a text document
- Similarities to HTML
- No WYSIWYG
- Most convenient to use a LaTeX distribution and a LaTeX IDE (integrated development environment)

A very short introduction to LaTeX

- First install a LaTeX Distribution
  - MiKTeX (for Windows)

- Then a LaTeX IDE
  - TeXnicCenter
  - Texmaker
  - LEd

A very short introduction to TEXnicCenter

- Extract the archive *acmsiggraph.zip*
- In TeXnicCenter open *template.tex*
  1. Select LaTeX=>DVI=>PDF output profile
  2. Select LaTeX=>PS output profile
     - Convert PS to PDF using Adobe Distiller
  3. Select LaTeX=>PDF output profile (pdflatex)
     - For eps images use \usepackage{epstopdf}

A very short introduction to LaTeX

- Work with 2 files:
  - A *.tex* file for the text
  - A *.bib* file for the bibliography which is used by the citations command \cite

Questions?

Always check up-to-date information on institute webpage
https://www.cg.tuwien.ac.at/courses/WissArbeiten/

Always check up-to-date information on TUWEL page
https://tuwel.tuwien.ac.at/course/view.php?id=16180