Software Visualization

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Visualization

According to *Wikipedia*:

**Visualization** is any technique for creating images, diagrams, or animations to communicate a message. This form of communication is as old as cave drawings.
Everyday Example

When we see a traffic light, it is programmed into our brains that when we see a color displayed in the light, it means something to us while we are driving.

Red – Stop
Yellow – Caution
Green – Go

Other information that needs to be conveyed can be as easy as this.
Information visualization concentrates on the use of computer-supported tools to explore large amounts of abstract data. Creating visual cues from data where none existed.
Step 1: Scan existing applications selected for the analysis
Step 2: Create a knowledge base starting from the analysis of the scanned source-code with the identification of internal and external references in addition to the internal architecture.
Step 3: Repeatedly executed to find an optimized result based on user feedback. Analyzes knowledge bases to identify possible assets.
Step 4: Artifacts are presented. The user decides the relevance of the tool's output. An interface offers the option of ignoring, modifying, or importing a group of assets.
Interface
What is software visualization?

Software visualization uses visual representations to make software more visible.

Why do we need software visualization?

Visual representation is better than the text for human cognition!
(1) assist human comprehension of the information
(2) assist human’s reasoning on the information
An example of the Software Visualization

Citylizer is a 3D visualization tool that uses a city metaphor (like the well known CodeCity) to represent the code: classes are buildings and packages are districts[1].
What to visualize about software?

- source code
- software structure
- runtime behavior
- component interaction
- software evolution

all stages of software development
What makes a “good” SV[2]?

**Simple navigation with minimum disorientation:** the visualization should be structured and should include features to aid the user in navigating the visualization, for example using techniques such as landmarks to reduce the user’s chance of becoming ‘lost’.

**High information content:** “Visualizations should present as much information as possible without overwhelming the user.”

**Low visualization complexity, well structured:** Well structured information should result in easier navigation. Low complexity trades off with high information content.

**Varying levels of detail:** Granularity, abstraction, information content and type of information should vary to accommodate users’ interests.

**Resilience to change:** Small changes of content or shifts in attention should not cause major differences in the visualization (cf. ‘viscosity’, Green and Petre, 1996)

**Good use of visual metaphors:** Metaphors provide cues to understanding. Mackinlay (1986).

**Approachable user interface:** The user interface should be flexible and intuitive, and should avoid unnecessary overheads.

**Integration with other information sources:** It is desirable to be able to link between the visualization and the original information it represents (the source code). (cf. Charters et al.’s comments on “round trip visualizations”, 2003)

**Good use of interaction:** Interaction provides mechanisms for gaining more information and maintaining attention.

**Suitability for automation:** “A good level of automation is required in order to make the visualizations of any practical worth.”
Practical Example
American military science fiction film released through MGM and Carolco in 1994.
Practical Example

- Stargate SG-1 is a Canadian-American military science fiction television series and part of MGM.


- It has 10 seasons and 214 episodes.
Practical Example

StarGate

It is a portal device within the Stargate **fictional universe** that allows practical and rapid travel between two distant locations.

But… What is a fictional Universe?
A fictional universe is a self-consistent fictional setting with elements that differ from the real world. It can be called, variously, afictional realm, world or universe.
StarGate: A Unified, Interactive Visualization of Software Projects.

• A system which visualizes the code repository and social network of developers associated with a software project in one integrated representation.

• A novel system for visualizing software projects.

• The developers in the center of our design.

• You can see the trends in developer activity.

• Main Goals:

Use information visualization techniques to assist the user in understanding the complex interactions between developers and software repositories.
A Tour Of StarGate
A Tour Of StarGate

1) The Gate (The Ring of Directories)

• To visualize the software repository directory structure, it is uses a space-filling radial hierarchy.

• The inner-most ring of the Gate represents the root of the directory structure.

• For smaller directories, hovering over them with the mouse will display the directory name in a popup.

* The documents directory is colored green (at the top)

* The source code directory is colored in various shades of blue.
1) The Gate

- The user can change the size, shape and color of the Gate.

- The size of the ring thickness and center radius can be increased or decreased with slider interfaces.
2) The Stars (Developers in the Center)

- In the center of the Gate, the developers are represented as colored circles, or “stars”.
- The size of each star is proportional to the number of file modifications the developer has performed.
- Stars are positioned according the areas of the repository the developers have worked on.

* The top cluster (green) is the documenters.
* The bottom cluster (red) is the core developers.
* The blue stars in the middle are other software developers.
3) Constellations: Developer Connections

• Initially, there are no visible edges between the stars.

• Multiple stars may be selected by dragging a box around the desired ones.

• The star's neighbor edges are displayed and colored according to star color.

• The blue stars in the middle have been selected.

Their network connections are colored
4) The Stardust (The Outer Ring of Edit History)

- The outer ring of stardust represents the lines which selected authors have modified.

- The color of the dot is the same as the star color of the developer who modified it.

- An early developer will have dots towards the inside and a later developer will have dots towards the outside.

- Initially, the stardust is not visible. When authors are selected via the stars, the lines they have modified are visible as stardust.
A Tour Of StarGate
What did happen in the past?

We have done many games in the class?

Results?
   Some people WON, others didn’t!

Results?
   Some people EAT, others didn’t!

So!!!!

Let’s do a game where everybody can WIN and EAT!
Since we are not rich, instead of,
Who wants to be a millionaire?

We are going to play….
Who wants to be fat?
Game: Who wants to be fat?

Rules:

• We are going to post 12 questions about the presentation, one by one.

• I will give 20 seconds to answer each question.

• The person who knows the answer and RAISES the hand FIRST, can respond:
  √ If the answer is correct, this person selects a gift…

  x If not, another person can answer.

RULE: if you get wrong 2 answers, you’re OUT

After two failed intents for one question… We’ll give the answer and we’re going to eat one of the gifts!
Game: Who wants to be fat?

Question 1: What is Visualization?

a) Seeing yourself as a successful student
b) Running a red light
c) Any technique for creating images, diagrams, or animations to communicate a message
d) Looking in a mirror in the morning
Game: Who wants to be fat?

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Question 2: What is a **StarGate**?

a) Portal device within the Stargate universe that allows practical, rapid travel between two distant locations.
b) Portal device within the Stargate fictional universe that allows impractical, rapid travel between two distant locations.
c) Portal device within the Stargate fictional universe that allows practical, rapid travel between two distant locations.
d) Portal device within the Stargate fictional universe that allows practical, slowly travel between two distant locations.
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Question 3: Information visualization concentrates on the use of computer-supported tools to explore large amounts of what kind of data?

a) Abstract  
b) Neutral  
c) Sorted  
d) Visual
**Game:** Who wants to be fat?

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- c) Sorted
- d) Visual
Question 4: what are good principals for software visualization?

a) Use the same color of different saturations for high information content
b) Make the little usage of visual metaphors to avoid unnecessary confusions
c) Showing all the details of the software to user by visualization
d) The user interface should be flexible and intuitive
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**Question 5:** What is the StarGate Interactive Visualization of Software used for?

a) Use information visualization techniques to assist the user in understanding the complex interactions between developers and software repositories.

b) Use information techniques to assist the user in understanding the complex interactions between developers and software repositories.

c) Use information visualization techniques to assist the user in understanding the complex interactions between developers.

d) Use information visualization techniques to assist the user in understanding the complex interactions between software repositories.
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Question 6: What determines the overall validity of the candidate assets?

a) User  
b) Indicator Engine  
c) Stargate  
d) Fate
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Question 7: What do the Stars represent in the StarGate’s Interactive Visualization Software?

a) The software repository directory structure.
b) The social network of developers.
c) The developers.
d) The developers’ activity.
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**Question 7:** What do the Stars represent in the StarGate’s Interactive Visualization Software?

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Question 8: why do we need visualization on software?

a) Images are more colorful and vivid than the texts.
b) Images can help with the Avatar’s reasoning on the information.
c) Images are more capable of representing the structure of the source code than the text.
d) Images can assist human comprehension.
Question 8: why do we need visualization on software?

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c) Images are more capable of representing the structure of the source code than the text.
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Question 9: What is analyzed to find candidate assets?

a) Code Repositories
b) Knowledge Bases
c) Architecture Documents
d) Indicators
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Question 10: what stages of the software development can be assist by the usage of visualization?

a. software evolution
b. component interaction
c. software structure
d. source code
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Question 11: Which of the following is the best format for human cognition, supposing that the content is a reusable library?

a. A plain text with detailed description of each component
b. An excel table, showing the properties of each component
c. A (graphical) hierarchical dendogram showing the components in the library
d. A database with a strong search engine, and the users are allowed to use natural language for information fetch
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Question 12: How is the social network of developers represented in the StarGate’s Interactive Visualization Software?

a) By a gate.
b) By a constellation.
c) By a stardust.
d) By a stargate.
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b) By a constellation.

c) By a stardust.

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References

[2] A gentle overview of software visualization, Marian Petre and Ed de Quincey, Centre for Research in Computing, The Open University, Walton Hall, Milton Keynes, UK