Interface and Visualization Metaphors

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Introduction

Our researches have been initiated by problems arising during processes of design and development of **specialized visualization systems**.

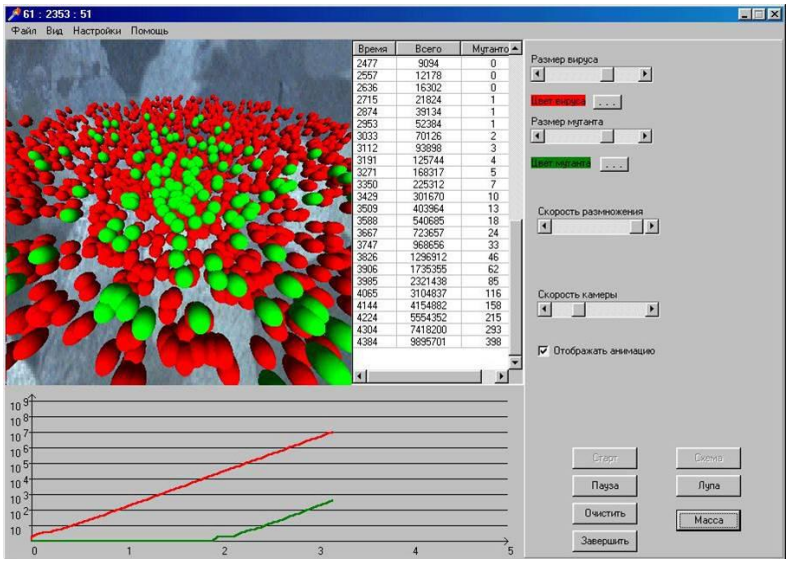

Figure: Visualization system showing kinetics of virus reproduction and a mutation.

The analysis of systems shows, that there is some basic idea of similarities between application domain entities and visual objects. We may consider this idea as metaphor.

Purpose of research

The practice of design and development of specialized visualization systems shows necessity of *specific metaphors*, and a stage of *metaphor searching and/or designing* is a part of development process.

Our goal is to design well the visualization interactive systems.

The choice of good (adequate) metaphors is the key to proper decisions.

Concept of Metaphor

Metaphor is considered as

- use of concepts and knowledge from one (source) domain of human experience to understand better and to structure the phenomena and concepts another (target) domain that as a rule is more abstract;
- as the basic mental operation, as a way of knowledge, structurizations and explanations of the universe.

Example

LIFE IS A JOURNEY, where LIFE is target domain, and JOURNEY is source domain.
Some structures of JOURNEY (beginning, ascent, descent, end, etc.) are considered in the given metaphor as a basis for the description of life structure.

Scientific metaphors

T. Kuhn, J. Lakoff.

Examples

- electromagnetic field;
- electromagnetic waves.

Examples of Metaphors in Computer Sciences

- memory
- file

Computer metaphors

Two types:

- interface metaphor;
- visualization metaphor.

Interface metaphors promote the best understanding of semantics of interaction, and also to determine the visual representation of dialog objects and a set of user manipulations with them.

Visualization metaphor is a mapping from concepts and objects of the application domain under modeling to a system of similarities and analogies generating a set of views and a set of methods for communication with visual objects.

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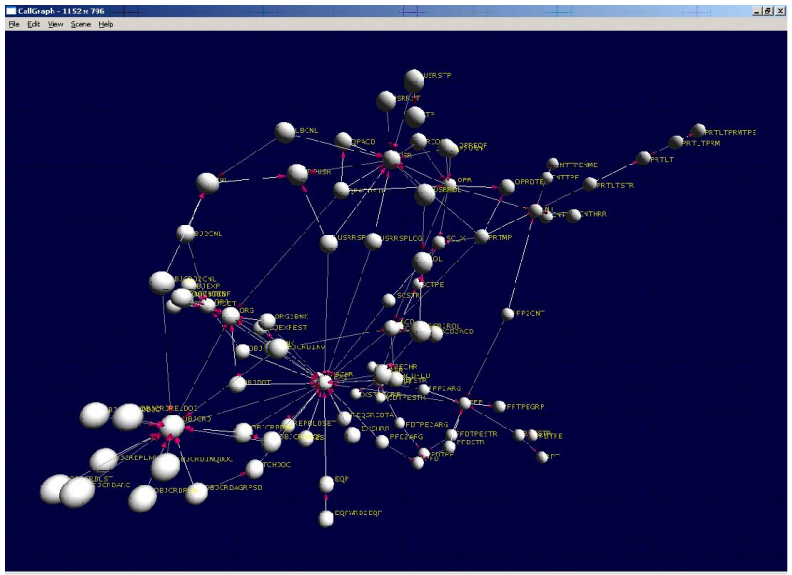
Visualization metaphors

It is proposed the approach to the understanding of metaphor as a main principle of mapping an application domain to visual universe. We consider the metaphoricalness of any visualization.



A result of visual metaphor consists of extractions of structures from target domain on the base of certain structures from source domain and transfer them in metaphor domain, which in this case has a visual nature. The metaphor is mapping (operator) to certain visualization world, where unshaped objects get its visual presentations.

Metaphor action

This characteristic is constructed by answers to the following questions:

- “How it is possible to represent the information by this metaphor?”
- “What do properties of metaphorical objects take place?”
- “What does actions or ideas result from user interaction (including seeing) with metaphorical objects?”

Example: Desktop Metaphor

The formula

Source domain: Desk with folders containing documents (documents are structured, but folders may be disordered);

Target domain: Office automation system;

Idea of likening:

- "Folders with papers" = "structure of the data, a set of files";
- "Opening of a folder" = "demonstration of file structures and/or files";
- "Processing of documents"= "execution of functions, by means commands of the visual language".

Result: The direct access to data structures by means manipulations of icons placed on the screen; calls of some [user] predetermined functions by means a visual dialogue language.

Microsoft Windows Desktop

Addition of source domain:

- A desk is combined with control panel where starting buttons are placed.
- The ”magic” idea is added: All actions within the framework of system are made by means of double click on icons.

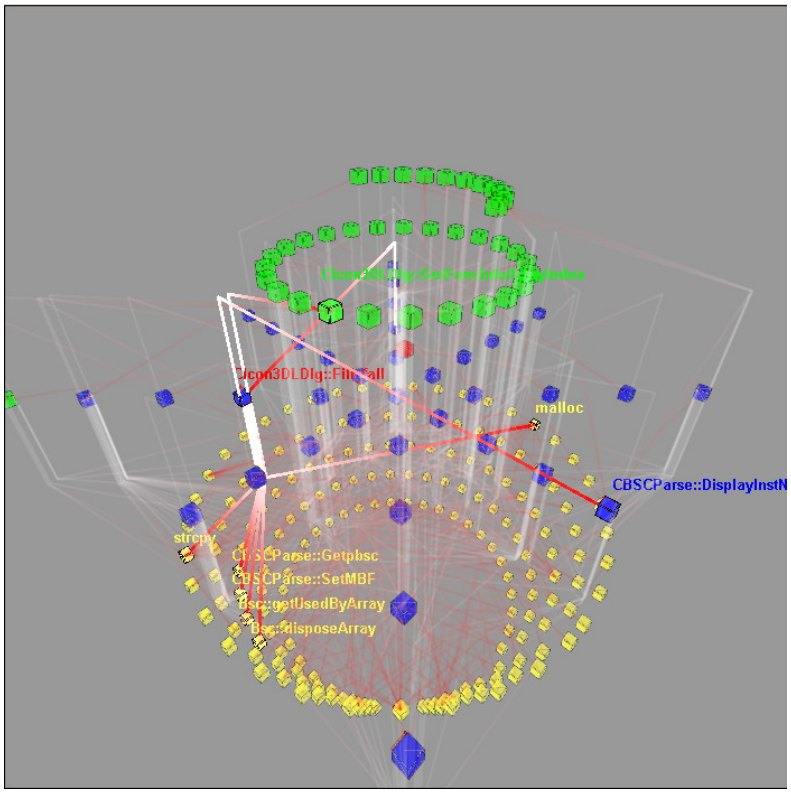
Result: icons representing data structures as well as programs.

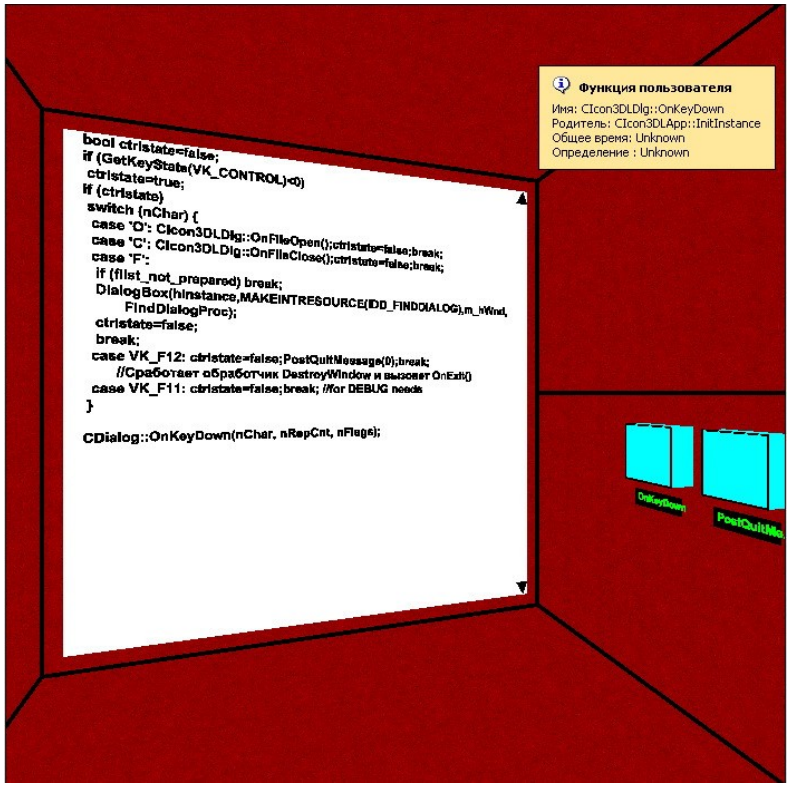
Example: the room metaphor

Properties:

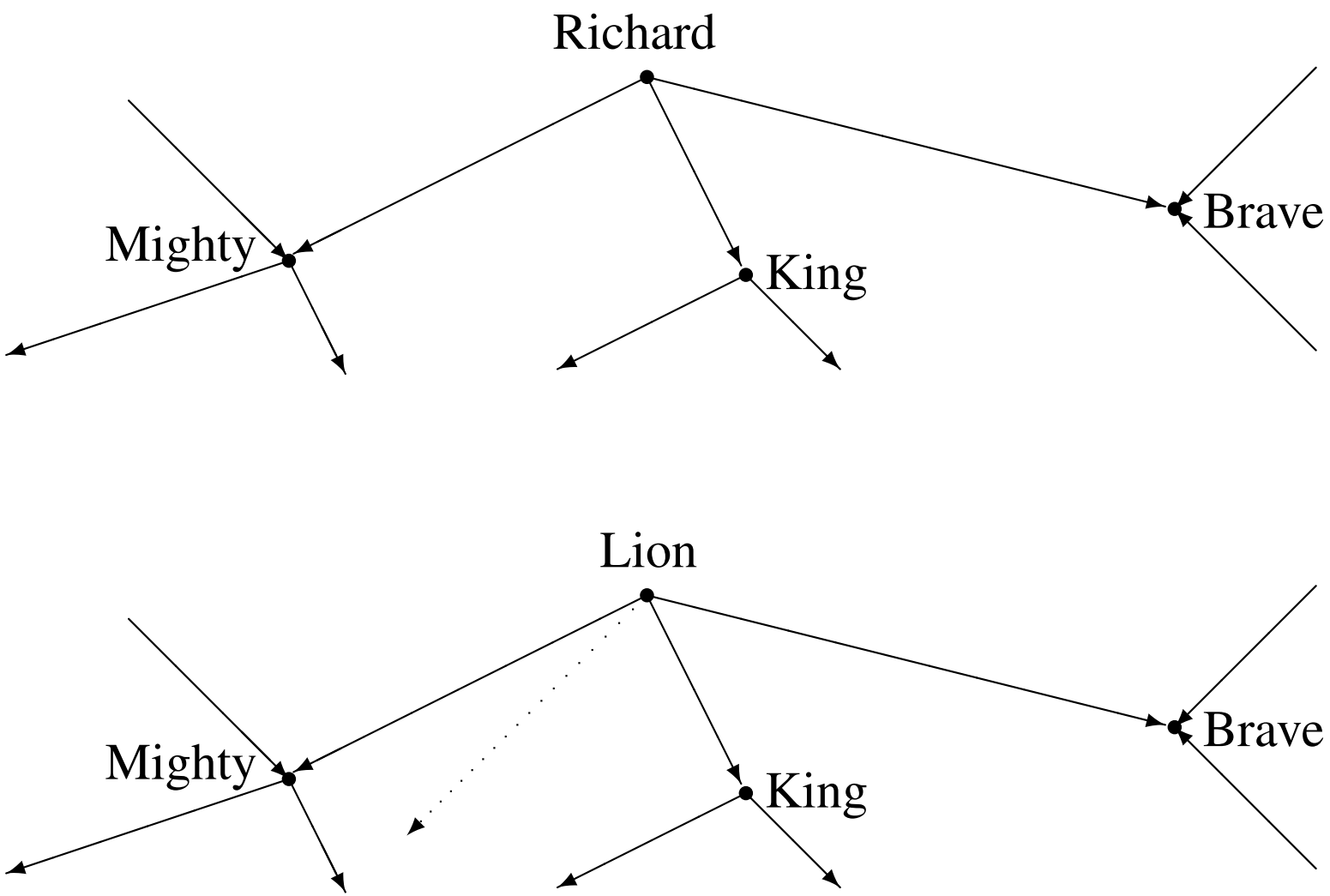
1. Ability to contain any objects inside itself. The room not only represents separate object, but also is the container for others ones.
2. Restriction of a perception context. Objects inside a room are considered in a separation from “external worlds”.
3. Closeness. There are no any additional elements to use Room metaphor (excepting possible inner objects).
4. Inclusion in structure. It is possible “to build buildings of rooms”, that is to consider set of rooms.
5. Naturalness of a metaphor. The room is natural metaphor, with presence of corresponding objects in the real world.

Example: the room metaphor





Metaphor generation



Searching of a metaphor is searching of the structure of interrelations which are similar to structure of interrelations in the target domain.

The metaphor has to generate integral and systematic interface and/or visualization systems.

Condition of “good” metaphor

The criteria, imposed on initial and target domains in a process of metaphor generation includes:

- similarity of object properties in source and target domains,
- ability to visual presentation for object in the source domain,
- habitualness (recognition) of objects in the source domain,
- rich set of interrelations between objects in the source domain.

Also we may write criteria of generation for views based on metaphors. Among them are truthfulness, laconicalness, expressiveness, clearness.

Condition of “good” visualization

- Construction of views may be based on such rule, that structure of the constructed visual image should not contradict to the structure of the initial entity.
- The successful visualization constructed on base “good” metaphors should base on already available model of phenomena (and/or processes) or even should not contradict to user representative cognitive structures.
- We need in direct user interpretation of visual object. We should depict, not describe by visual “texts”.
- Reduction of interpretation complexity may be considered as one more condition of “good” computer metaphor.

Example of visualization for medical information system

The End