Hierarchical Software Landscape Visualization for System Comprehension: A Controlled Experiment

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Landscape visualization to comprehend large software landscapes
State of the art often provides flat graph-based visualizations
Can be ineffective for large software landscapes
Introduction

Landscape visualization to comprehend large software landscapes

State of the art often provides flat graph-based visualizations

Can be ineffective for large software landscapes

Hierarchical landscape visualization

Controlled experiment to evaluate its effectiveness and efficiency
Most visualizations in application performance management (APM) tools

For example: AppDynamics, Foglight, Dynatrace

Mainly commercial tools

Survey and own implementation of a mixture of landscape visualizations
Flat Visualization in ExplorViz

Compared Visualizations

Hierarchical Landscape Visualization
Hierarchical Visualization in ExplorViz

Compared Visualizations

Workgroup Software Engineering

OpenStack Dashboard
OpenStack Glance
OpenStack Cinder
Keystone
MySQL
Cloud Controller Server

Kieker WebGUI
SVN
Confluence
JIRA
Gitlab

postgresql
samoa

Git
Database
build.se

OpenStack Network
OpenStack Nova

Cloud Node Server 1 - Cloud Node Server 8
Hypotheses

Controlled Experiment

- **H1:** Flat Group and Hierarchical Group require different times for completing typical system comprehension tasks.
- **H2:** The correctness of solutions to typical system comprehension tasks differs between Flat Group and Hierarchical Group.
Between-subjects design with random assignment

Object landscape: Modeled technical IT infrastructure of the Kiel University landscape (140 applications)

29 students (M.Sc.) from the master course “Software Engineering for Parallel and Distributed Systems”

5 system comprehension tasks

Pilot study
Automated tutorial

Step 2 of 21

The software landscape consists of several systems, and the communication between them. Thicker lines mean more communication.

To get a better overview over a landscape, it can be helpful to minimize the systems, so they take up less space. The ability to do so is indicated by the - in the top right corner.

To complete the first tutorial step, minimize the OCD Editor by double clicking it.

Electronic questionnaire

Screen recording
## Descriptive Statistics of the Results

### Controlled Experiment

<table>
<thead>
<tr>
<th></th>
<th>Time Spent</th>
<th>Correctness</th>
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<tbody>
<tr>
<td></td>
<td>Flat</td>
<td>Hierarchical</td>
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<tr>
<td>mean</td>
<td>23.49</td>
<td>23.45</td>
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<tr>
<td>difference</td>
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<td>+14.24 %</td>
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</table>
Qualitative Feedback

Controlled Experiment

- Flat Visualization Group:
  - Some labels representing the request count overlapped (5 users)
  - Tabular representation for some tasks (2 users)

- Hierarchical Visualization Group:
  - Animations for opening and closing (3 users)
  - Highlight nodes or connections (2 users)
Sources of Error

Controlled Experiment

- Distinction between nodes and applications
- Direction of communication
- Finding duplicate applications in hierarchical visualization was harder for the subjects (non-zero learning curve)
Content of Evaluated Artifact

Available online¹

- Source code and binaries
- Input files
- Tutorial material
- 29 screen recordings
- Raw results
- R scripts

¹http://dx.doi.org/10.5281/zenodo.18853
Summary and Outlook

Conclusions

- Hierarchical landscape visualization
- +14% in correctness and no significant time difference
- Open source\(^2\) and replication package provided

**Explor\(\)rViz**

Future Work:

- Replications for higher external validity
- Using metaphors for landscape visualization and compare them

\(^2\)http://www.explorviz.net