

Leveraging Usage Data of Software Architecture Artefacts

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PRESENTATION OUTLINE

- Introduction
- Leveraging Usage Data in SAKM
- Our KaitoroCap Tool
- Future Work

MOTIVATION

- How do I understand a complex SA?
- How do I figure out how to do XYZ with this complex SA and its implementing APIs, etc???
- Great big PDF(s), generic, for whole-of-SA knowledge, hard to find stuff, don't know which bits "useful" for own tasks, ...
- What if we could use OTHERS navigation paths, recommended parts, comments, annotations, ratings of parts of the SA doc to help us???

INTRODUCTION

- Leveraging past usage data of SA artefacts could bring a number of benefits e.g.
 - most frequently accessed (could signify the most important artefact);
 - most frequently edited (could signify the most problematic artefact or centre of change).
 - other users use of document (could help others on similar tasks)

INTRODUCTION

- Types of usage data:
 - *Interaction data* - data generated from users' interaction with software artefacts such as selecting, clicking, traversing, opening, editing, ...
 - *Annotation data* - additional information users attach to the software artefacts, such as ratings, comments, and tags

EXISTING WORK ON LEVERAGING USAGE DATA

Existing Work	Key Features
Computational Wear (CW) [1, 2]	Creates ‘usage wear’ on computational objects by making users’ interaction history with the objects part of the objects.
Social Navigation (SN) [1, 3-10]	Uses ‘usage wear’ as navigation trace/‘footprint’ to help other users in navigating the same information space.
Collaborative Filtering (CF) [6, 11]	Uses annotations provided by users as collaborative filters to sieve the information to receive.
Social Filtering (SF) [12, 13]	Uses explicit collaboration enabled by exposed identities of a community’s members, for filtering , and to refine SN to center on explicitly created social networks.
Wear-based Filtering (WBF) [14-16]	Combines CW and CF, and uses users’ interaction history with source code elements to filter the UI of IDE.
Degree-Of-Interest (DOI) studies [17-22]	Emphasise the notion of task, uses a user’s own usage history to filter the UI of IDE.

LEVERAGING USAGE DATA IN SAKM

- Additional information derived from usage data can provide assistance for:
 - sense-making of materials
 - finding information
 - filtering information
 - exploring an information space by following other users
- Providing such assistance in SAKM could enhance AK sharing and AK using.
- Usage data + users' profiles + projects' profiles
 - could be a valuable dataset for empirical research related to usage data of AK - to study how CW, SN, CF, SF, WBF can enhance AK sharing and AK application/using.

USAGE DATA CAPTURE AND USE

Interaction Data (to support CW, SN, WBF)	
Type of data	Could be used to
Number of visits	Deduce importance of artefact.
Low-level interaction events with artefacts (such as mouse, keyboard and window events)	Deduce time spent on artefact. Deduce importance of artefact.
Visitation sequence	Create visualization of exploration path . Show possible hidden relationships between artefacts.
Timestamp of visit	Same as previous row, and Show recently-visited artefacts. Show timeline of artefacts visit.
Number of changes (edit, delete)	Identify problematic/unstable/center of change artefact.

USAGE DATA CAPTURE AND USE

Annotation Data (to support SN, CF and SF)

Type of data	Could be used to
Ratings	Capture scaled personal opinion on certain aspects of the artefacts (such as quality, relevance, importance, etc.).
Tags	Search artefacts. Group artefacts.
Comments	Capture mental note explicitly or more detailed personal opinion.
Ranking	Rank artefacts.
Vote	Gather collective preference.

USAGE DATA CAPTURE AND USE

User Profile (to support SN, CF and SF)

user ID, name, job title, experience, skills set and location.

Project Profile

project ID and name, start and end dates, members' IDs and roles in the project, application domain, and current status.

KEY REQUIREMENTS - CAPTURE

- Collect usage data of each user.
- Collect usage data for different levels of granularity of SA artefacts (for e.g. on a per element, per model, per page or per section basis).
- Separation of the content of the artefacts from the means of capturing usage data (for e.g. insert annotation fields dynamically alongside the artefacts).
- Collect usage data in machine-parsable format.

KEY REQUIREMENTS -VISUALIZATION

- Display usage data alongside artefacts (show number of visits or ratings directly).
- Create visualization that provides an overview of usage history of a group of artefacts (show number of visits as single graph, time line of visits, exploration path).
- Display raw usage data (number of visits and ratings) or in aggregated form (average ratings, % of users who visited).
- Automate analysis to produce aggregated usage data.
- Create alternative linkage structures between SA artefacts based on usage data (for e.g. linking SA artefacts based on exploration paths).

KAITOROCAP

- A plug-in for the Atlassian Confluence Enterprise Wiki that captures and provides visualization of the usage data of software architecture documents (ADs).
- Exploration paths in KaitoroCap serve as usage ‘wear’ left by previous consumers.
- Visible usage data (e.g. exploration paths, ratings, tags and comments) serve as information ‘traces’ supporting forms of social navigation.

CREATING A NEW PAGE FOR AN ARCHITECTURE DESIGN

The screenshot shows a web-based editor interface. At the top, there is a header with a logo on the left and the title "9. Quality" in the center. Below the header, there are three tabs: "Rich Text" (selected), "Wiki Markup" (highlighted in blue), and "Preview". On the right side of the header, there are buttons for "Draft saved at 6:52 PM", "Save", and "Cancel". Below the tabs is a toolbar with various icons for text formatting (bold, italic, underline, font color, etc.) and other functions. The main content area contains the following Wiki Markup:

```
<div id="dynamic">
<h1>9. Quality</h1>
<h2>9.1 Resiliency</h2>
<p>It is anticipated that the Web Curator Tool will perform most of its harvests overnight during off-peak bandwidth periods. The operation of the system will, therefore, be largely unsupervised, leading to a need for the application to be highly resilient. </p>

<p>To meet this requirement, the harvester processes must attempt to recover from exceptions, or halt independent components without halting the full system. Specific resiliency requirements include:</p>
<ul>
<li>If the ARC File Server runs out of disk space, any Harvester attempting to store their ARC files must be able to retry saving the harvest at a later point. This is critical because a harvest may have taken many hours to collect, and should not be thrown away due to lack of disk space on the destination server.</li>
<li>An error from a single harvest thread must not interfere with other harvests.</li>
</ul>

<h2>9.2 Regression Testing</h2>
<p>It is always critical to ensure that new development does not break other components of the system.</p>
<h2>9.3 Load Testing</h2>
<p>Load testing will also be conducted on the Web Curator Tool's user interface to ensure that it is responsive and reliable.</p>
```

RESULTING PAGE WITH ANNOTATABLE SECTIONS CREATED DYNAMICALLY

9. Quality

Added by admin, last edited by admin on Jun 11, 2011 (view change)

9. Quality

9.1 Resiliency

Importance to question: ★★★★☆ Not Important Not sure
Importance to overall understandability of SA: ★★★★☆ Not Important Not sure

Tags:
Comment:

It is anticipated that the WCT will perform most of its harvests overnight during off-peak bandwidth periods. The operation of the system will, therefore, be largely unsupervised, leading to a need

[... read more](#)

9.2 Regression Testing

Importance to question: ★★★★☆ Not Important Not sure
Importance to overall understandability of SA: ★★★★☆ Not Important Not sure

Tags: JUnit
Comment: Too short More information needed

It is always critical to ensure that new development does not break other components of the software.

To ensure this, the WC build scripts optionally execute a set of JUnit testcases.

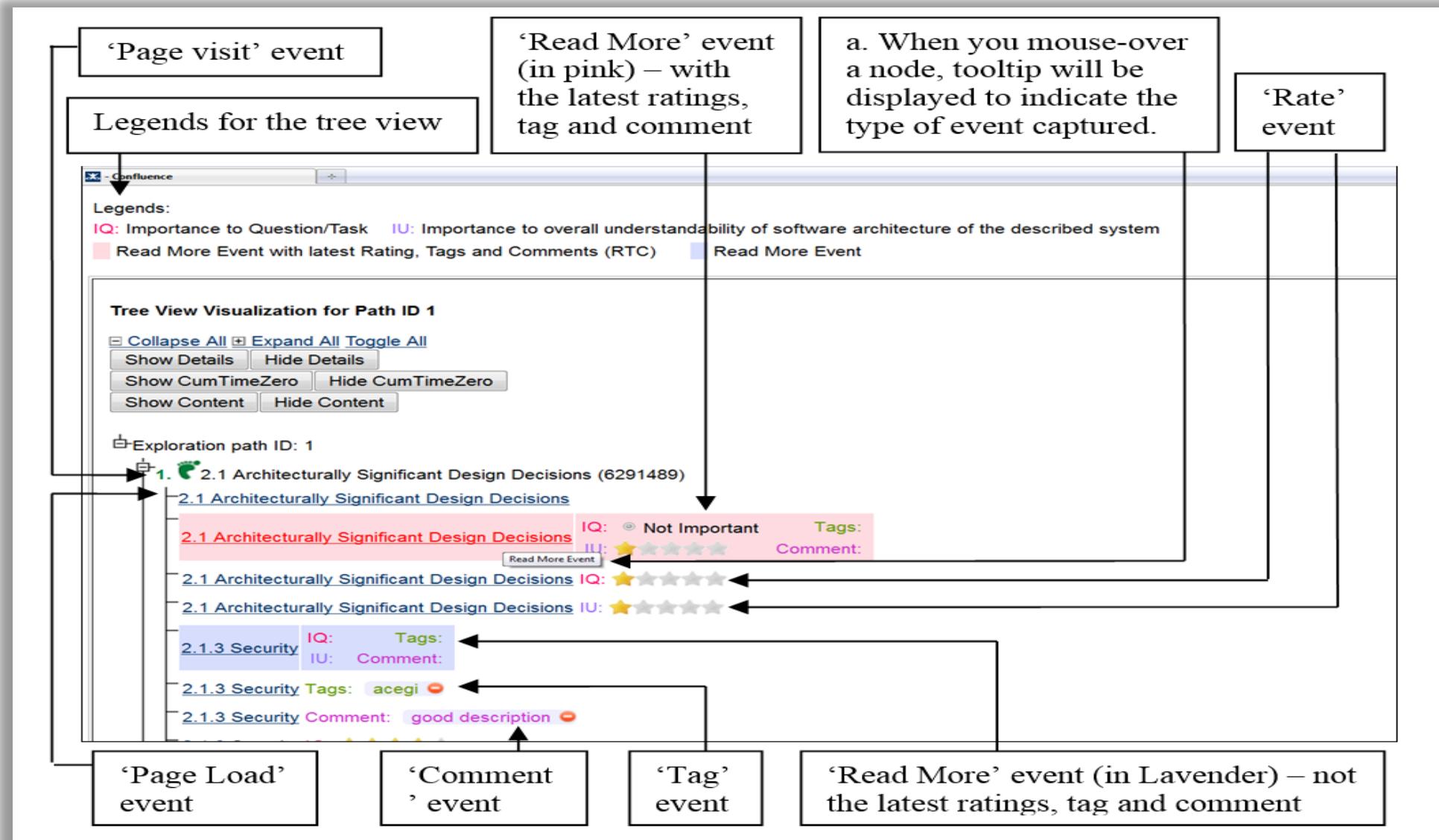
[\[collapse\]](#)

Annotation

Fields

Annotatable Sections

TREE VIEW OF EXPLORATION PATH - PART A



TREE VIEW OF EXPLORATION PATH - PART B

The number in green followed by the green footprint icon represents the sequence of the visitation of the page. For e.g. 1st page visited, 3rd page visited, etc.

The entire tree view can be collapsed and expanded or toggled between the two states.

Tree View Visualization for Path ID 1

Collapse All Expand All Toggle All

Show Details Hide Details

Show CumTimeZero Hide CumTimeZero

Show Content Hide Content

Exploration path ID: 1

- 1.  2.1 Architecturally Significant Design Decisions (6291489)
- 2.  9. Quality (6619161)
- 3.  2. Architectural Goals and Constraints (6291487)

2. Architectural Goals and Constraints

IQ: Not Important Tags:

IU: Not Important Comment:

2. Architectural Goals and Constraints IQ:

2. Architectural Goals and Constraints IU:

4.  2.1 Architecturally Significant Design Decisions (6291489) (Mouse Click on Hyperlink)

2. Architectural Goals and Constraints

The ‘-’ symbol indicates that the node can be collapsed.

The ‘+’ symbol indicates that the node can be expanded.

The content of the visited section can be shown embedded in the tree view under ‘Read More’ event (Figure 6). The content can also be hidden.

CONTENT OF THE VISITED SECTIONS EMBEDDED IN THE TREE VIEW

By clicking on ‘Show Content’, the content of the visited sections are shown under ‘Read More’ event.

Tree View Visualization for Path ID 1

Collapse All Expand All Toggle All
Show Details Hide Details
Show CumTimeZero Hide CumTimeZero
Show Content Hide Content

Exploration path ID: 1

1. 2.1 Architecturally Significant Design Decisions (6291489)
[2.1 Architecturally Significant Design Decisions](#)

2.1 Architecturally Significant Design Decisions IQ: Not Important Tags:
IU: ★★★★★ Comment:

2.1 Architecturally Significant Design Decisions

The WCT specifies several key requirements that influence the way the system is designed. These key requirements can be grouped into the following categories described in the subsequent sections: Modularity/Plugability, Supportability, Security, User Interface, Resource Use.

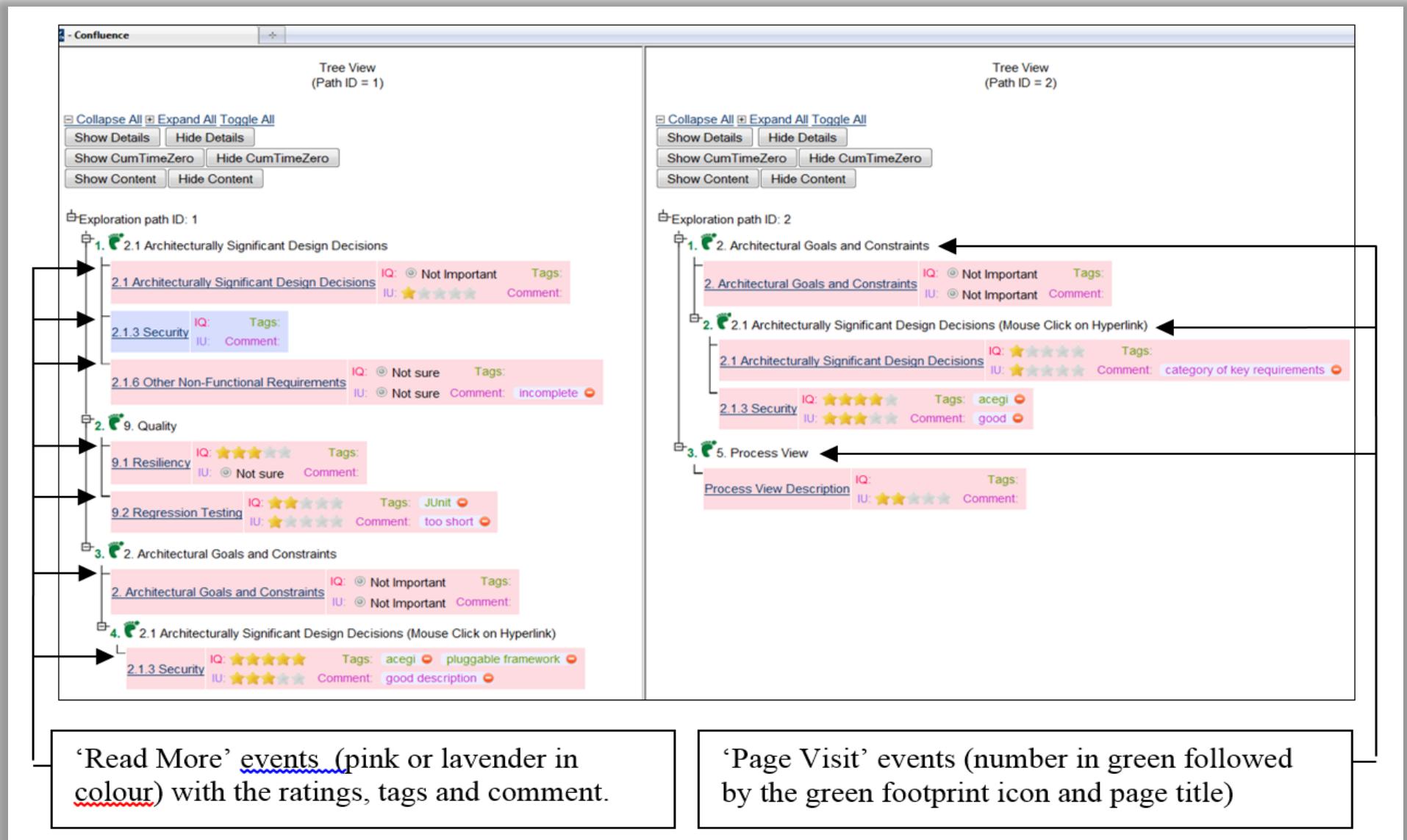
2.1 Architecturally Significant Design Decisions IQ: ★★★★★
2.1 Architecturally Significant Design Decisions IU: ★★★★★

2.1.3 Security IQ: Tags:
IU: Comment:

2.1.3 Security

The identified security requirements 6.5.1 and 6.5.2 allow for a pluggable security framework that integrates with either an

COMPACT TREE-VIEW OF EXPANDED EXPLORATION PATHS



KEY CHALLENGES

- **Difficulty in identifying noise (generated by non-intentional actions) in interaction data.**
 - Can verify some findings from interaction data with findings from annotation data (explicit conscientious judgements of users).
- **Success is dependent on users of SAKM tools**
 - Have to convince AK producers and consumers of the benefits leveraging usage data could bring and motivate them to use usage data capturing features.
- **A robust framework**
 - To reduce implementation overlap in different SAKM tools, needs to develop a robust framework containing generic usage data capturing and visualization functionalities that can be customized and extended by different SAKM tools.
 - Such a framework can be a part of the community-wide infrastructure for architecture-based software engineering.

CONCLUSION

- We propose including usage data capture and visualization as essential features of SAKM tools.
- Usage data can serve as a valuable unbiased dataset for empirical research in AK usage and support sharing of “usage” knowledge among team members.
- Future work:
 - Explore how leveraging further SA artefact usage data could provide further insights to improve SAKM tools.
 - Repository of usage / annotation data for set of SA docs

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Q & A

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