Searching and Navigating Petabyte-Scale Files Systems Based on Facets

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Outline of Talk

- Introduction and Motivation
  - Challenges in Petabyte Scale file systems
- Faceted Metadata
  - What it is, Where it comes from
- Programatic Interface
  - ViewFS and QUASAR
- Search/Browse User Interface
  - Faceted Search Interfaces, Personalization and Collaboration
- Conclusion

Need for a New Approach

- Monolithic hierarchy in traditional file system could be disorienting
  - Assumes users are familiar with the layout of file repository (e.g. naming conventions)
  - Multiple reasonable locations to place a file
- Keyword-based search often fails
  - Need to know how the files are described
  - Bad for exploration
  - Does not support expert users
  - Relevance ranking is hard

Faceted Search as Navigation

- ✦ Faceted search can help
  - Avoid explicitly organizing the files
  - Convert search from an interrogation to a browsing scenario
- ✦ Search becomes the primary interaction method with a file system
  - For user: faceted search is easy navigation
  - Our goal: make search a first-class function

Faceted Search

- Information Retrieval technique popular for large data repositories
  - libraries and e-commerce sites
- Faceted metadata
  - key-value pairs (keys == facets)
  - Facets group values in semantically meaningful ways
- Each facet creates a parallel categorization scheme
- Users mix and match facet-value pairs to find their files
  - multiple valid "paths" to a file

Acquiring Faceted Metadata

- ✦ Explicit Metadata
  - Leverage the easily parseable existing metadata
  - Example: ID3Tags
- ✦ Automatically Generated Metadata
  - Extract metadata from parseable file contents
    - Example: "Call me at 555-1212" -> <phone=5551212>
  - Metadata can propagate to related unannotated files
    - Examples: Soules et al.'s Connections and Provenance
- ✦ User Annotations
  - Manually provided (e.g. tags)
  - Example: Graffiti [Maltzahn 2007]

Storing Faceted Metadata

- Many file system search tools store metadata and the index separately from the file store
- Problems with Separate Stores
  - Require frequent reindexing of the store
  - Require notification method to keep the store and index synced
  - Not POSIX compliant
- Proposed new file system: ViewFS

ViewFS

- ✦ Stores metadata within the file system
  - • Tight couple between the index and the store
- ✦ Modifies to POSIX interface to support both keyword and structured queries
- ✦ Queries can be used as file and directory names
  - • Newly created QUASAR query language
  - • Backwards compatible to existing POSIX paths
  - • Designed for faceted metadata
- ✦ Virtual directories become ubiquitous
  - • Current query is analogous to CWD

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Search/Browse User Interface

- ✦ User creates a complex query through a point-and-click interface
- ✦ User is presented with:
  - Ranked list of matching files
  - Current query
  - Suggestions for query refinement
- ✦ User refines the query or selects the file

Challenges for Faceted Search Interfaces

✦ Diverse File Types
- Large variety of file types, each with different facets

✦ Facet overloading problem
- Too much metadata to present to users

✦ Ranking files is hard
- Web search has explicit relationships among web pages
- Files on a disk have few links that are useful for search

Adaptive Personalization

- ✦ Many parts of the shared file system are irrelevant to a particular user, so don't display them.
- ✦ Personalization
  - Explicit and implicit feed on query results
  - Contents of files, user access patterns
- ✦ Collaborative Recommendations
  - Compares users to each other
  - Good when you have many users

Handling Diverse File Types

✦ Present the facets that both prevalent in the currently selected files, and have a suitable values
- Presents the major features of the search space
- As search narrows, facets unique to that segment of the search space become available for query refinement
- Used in mobile faceted search

✦ Meta-facets
- Some facets are semantically similar
- Cluster facets that have similar values together

Handling Facet Overload

- Present facets relevant to a specific user under a specific context
  - A user's interest is focused on only a small segment of the entire file system
  - System observes which files the user is most interested in
  - The facets in these documents are considered relevant to the user
- This information is shared among all the users through collaborative and content-based recommendations

Handling Ranking Challenge

✦ Modern IR ranking techniques leverage information about the relationship among documents
  • Anchor text in hyperlinks, Site reputation, link flux, etc.
✦ Files system typically do not have this information
✦ Using implicit user feedback
  • Connections [Soules 2005] and Provenance [Shah 2007]
✦ We propose to learn user models from implicit and explicit feedback

Conclusion

✦ Search should become a first-class function

✦ Faceted search allows both browsing and navigation

✦ Potential programatic interface for supporting faceted search (ViewFS, QUASAR)

✦ Outlined some problems with applying faceted search to file systems

 • Personalization and collaboration is an attractive method to overcoming some of these

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