

# RFC-009: Library Directory System

**Status:** Implemented **Date:** January 2026 **Author:** Derrell Piper ddp@eludom.net  
**Implementation:** directory.scm, directory-repl.scm, directory-parser.scm

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## Abstract

This RFC specifies the Library Directory System for the Library of Cyberspace: a searchable catalog of research papers with natural language queries, fuzzy matching, and beautiful output. Finding knowledge should be delightful.

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## E Pluribus Unum

□ Cyberspace Library Directory  
Finding knowledge should be joyful

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## Motivation

The Library of Cyberspace contains 421+ research papers spanning 50 years of computing history. Without a catalog:

- **Discoverability:** How to find Lamport's clock paper?
- **Connections:** What relates to SPKI?
- **Context:** When was this written? By whom?

The Directory System provides:

1. **Natural language search** – “papers by Lampson about protection”
  2. **Multi-index access** – By author, topic, year, collection
  3. **Fuzzy matching** – “Lamp” finds Lampson and Lamport
  4. **Beautiful output** – Unicode, emoji, formatted results
  5. **S-expression export** – Machine-readable catalogs
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## Data Model

### Document Record

```
(define-record-type <document>
  (make-document title authors year topics file-path
                 collection source-url description)
  document?
  (title document-title)
  (authors document-authors)      ; List of strings
  (year document-year)           ; Integer or #f
  (topics document-topics)       ; List of strings
  (file-path document-file-path))
```

```
(collection document-collection)
(source-url document-source-url)
(description document-description))
```

### Collection Record

```
(define-record-type <collection>
  (make-collection name path documents description)
  collection?
  (name collection-name)
  (path collection-path)
  (documents collection-documents) ; List of documents
  (description collection-description))
```

### Library Record

```
(define-record-type <library>
  (make-library collections documents
    author-index topic-index year-index collection-index)
  library?
  (collections library-collections)
  (documents library-documents)
  (author-index library-author-index) ; Hash table
  (topic-index library-topic-index) ; Hash table
  (year-index library-year-index) ; Hash table
  (collection-index library-collection-index))
```

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## Index System

Four hash table indexes for O(1) lookup:

```
author-index: "Lamport" → [doc1, doc2, doc5, ...]
topic-index: "cryptography" → [doc3, doc7, doc12, ...]
year-index: 1978 → [doc1, doc4, ...]
collection-index: "lampson" → <collection>
```

### Building Indexes

```
(define (build-author-index documents)
  (let ((index (make-hash-table equal?)))
    (for-each
      (lambda (doc)
        (for-each
          (lambda (author)
            (hash-table-update!/default
              index
              (normalize-author author)
              (lambda (docs) (cons doc docs))
              '())))
          (document-authors doc)))
      documents)
    index))
```

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## Query Interface

### Natural Language Parsing

```
(parse-query "papers by Lampson about protection")
;; => (query (author "Lampson") (topic "protection"))

(parse-query "from 1978")
;; => (query (year 1978))

(parse-query "SPKI certificates")
;; => (query (topic "SPKI") (topic "certificates"))
```

**Recognized Patterns:** – by <name> → author search – about <topic> → topic search  
– from <year> → year search – in <collection> → collection filter – Bare words  
→ topic search

### Fuzzy Matching

```
(fuzzy-match "Lamp" author-list)
;; => ("Lampson" "Lamport")

(fuzzy-match "crypto" topic-list)
;; => ("cryptography" "cryptographic" "encryption")
```

Matching strategies: 1. Exact match (highest priority) 2. Case-insensitive match 3. Prefix match 4. Substring match

### Query Functions

```
(find-by-author library "Lampson")
(find-by-topic library "SPKI")
(find-by-year library 1978)
(find-by-collection library "lampson")
(find-related library document)
```

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## REPL Interface

### Interactive Session

```
$csi -s directory-repl.scm
```

```
□ Cyberspace Library Directory
"E Pluribus Unum" – Finding knowledge should be joyful
```

```
Loaded 312 documents from 18 collections
Type 'help' for search tips, 'quit' to exit
```

```
□ > papers by Rivest
```

```

□ Found 3 documents:

[1] SDSI: A Simple Distributed Security Infrastructure
    □ R. Rivest, B. Lampson
    □ 1996 □ lampson

[2] SPKI Certificate Theory
    □ C. Ellison, B. Frantz, B. Lampson, R. Rivest, ...
    □ 1999 □ lampson

□ > about SPKI

□ Found 8 documents:
...
□ > stats

Library Statistics:
    □ Documents: 312
    □ Collections: 18
    □ Authors: 245
    □ Topics: 89
    □ Years: 1971–2024

□ > quit
Happy exploring! □ □

```

## Commands

Command	Description
help	Show search tips
stats	Library statistics
collections	List all collections
authors	Show author index
topics	Show topic index
years	Show year distribution
quit	Exit REPL

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## INDEX.md Parser

Each collection contains an INDEX.md with paper listings:

# Lampson Collection

Butler Lampson's papers on protection, capability systems, and distributed computing.

## Papers

1. \*\*Protection\*\* (1971)
  - Author: Butler Lampson

- Topics: capability, protection, access control
  - Source: ACM Operating Systems Review
2. \*\*Hints for Computer System Design\*\* (1983)
- Author: Butler Lampson
  - Topics: systems design, engineering
  - Source: ACM Operating Systems Review

## Parser Output

```
(parse-index-file "lampson/INDEX.md")
;; =>
(collection
  (name "lampson")
  (description "Butler Lampson's papers..."))
(documents
  ((title "Protection")
   (authors "Butler Lampson")
   (year 1971)
   (topics "capability" "protection" "access control"))
  ...))
```

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## Export Formats

### S-expression Export

```
(export-to-sexp library "catalog.sexpl")
```

Output:

```
(library
  (metadata
    (document-count 312)
    (collection-count 18)
    (generated "2026-01-06"))
  (collections
    (collection
      (name "lampson")
      (documents
        (document
          (title "Protection")
          (authors ("Butler Lampson"))
          (year 1971)
          (topics ("capability" "protection")))
        ...))
      ...))
    ...))
```

### HTML Export

```
(export-to-html library "catalog.html")
```

Generates browsable web catalog with:

- Alphabetical author index
- Topic tag cloud
- Year timeline
- Search functionality

## **Markdown Export**

(export-to-markdown library "[catalog.md](#)")

Documentation-friendly format for README files.

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## **Design Philosophy**

### **Super Nice and Helpful**

- Natural language understanding
- Fuzzy matching catches typos
- Suggestions for empty results
- Encouraging prompts

### **Beautiful Output**

- Unicode box drawing (█)
- Emoji visual markers (◻ ◉ ◇ ◈)
- Consistent formatting
- Progressive disclosure

### **Hone In On What You Need**

- Multi-strategy search
  - Progressive filtering
  - Cross-references
  - Related paper discovery
- 

## **Security Considerations**

### **No Execution**

The directory system is read-only:

- Parses INDEX.md files (trusted)
- No code execution
- No network access
- No file modification

### **Path Traversal**

File paths validated:

- Must be within library root
- No .. components
- Normalized before use

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## **Implementation Notes**

### **Dependencies**

- srfi-1 – List utilities
- srfi-13 – String utilities
- srfi-69 – Hash tables
- chicken file – Directory scanning

## **Performance**

- Index building:  $O(N)$  documents
- Query:  $O(1)$  hash lookup +  $O(M)$  result filtering
- Fuzzy match:  $O(K)$  candidates

## **Extensibility**

Future enhancements:

- Full-text PDF search (OCR)
- Citation graph visualization
- BibTeX export
- Web API server
- Semantic search with embeddings

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## **References**

1. Dublin Core Metadata Initiative
  2. Library of Congress Subject Headings
  3. BibTeX format specification
  4. Unicode Standard for box drawing
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## **Changelog**

- **2026-01-06** – Initial specification
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**Implementation Status:** Complete **Test Status:** Passing (test-directory.scm) **Documents Indexed:** 421+