

# 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

---

## 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.

---

## E Pluribus Unum

□ Cyberspace Library Directory  
Finding knowledge should be joyful

---

## Motivation

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

- **Discoverability:** How to find Lampport'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 Lampport
  4. **Beautiful output** - Unicode, emoji, formatted results
  5. **S-expression export** - Machine-readable catalogs
- 

## 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))

```

---

## 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))
```

---

## 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)
```

---

## 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

## 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"))
  ...))
```

---

## Export Formats

### S-expression Export

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

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.

---

## 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

---

## 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

---

## References

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

## Changelog

- **2026-01-06** - Initial specification
- 

**Implementation Status:** Complete **Test Status:** Passing (test-directory.scm) **Documents Indexed:** 421+