

Computational Thinking for Everyone Workshop I

The National Academies, 2/19- 2/20/2009

Panel 3 – Computational Thinking Everywhere (Part II)

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Professor, Department of Computer Science (at VT since 1983)

Chair, Undergraduate Program Committee, Computer Science

Director, Digital Library Research Laboratory

(Local)PI: LIKES (CPATH), Ensemble (NSDL), DL416 (CTR), ETANA (Archaeology)...

Executive Director, Networked Digital Library of Theses & Dissertations

Lead, Rebooting group on National Curriculum for Multidisciplinary Collaboration

Former: Chair, IEEE Technical Committee on Digital Libraries

Chair, ACM Special Interest Group on Information Retrieval

Mentors: JCR Licklider & Mike Kessler at MIT; Gerry Salton at Cornell

Outline

- Handouts
- Broad view of computing
- KID perspective -> digital libraries
 - Knowledge, Information, and Data
 - Rules, Text colls, Data structures, Databases
- Multidisciplinary connections
- Education and learning

Handouts

- Living In the KnowlEdge Society (LIKES)
... Building Collaboration between ...
- The National Science Digital Library ...
CITIDEL and the Ensemble pathways ...
- CC2001 App. A: CS Body of Knowledge
- Cyber-Enabled Learning with Games in
Middle School (Evans & Fox)

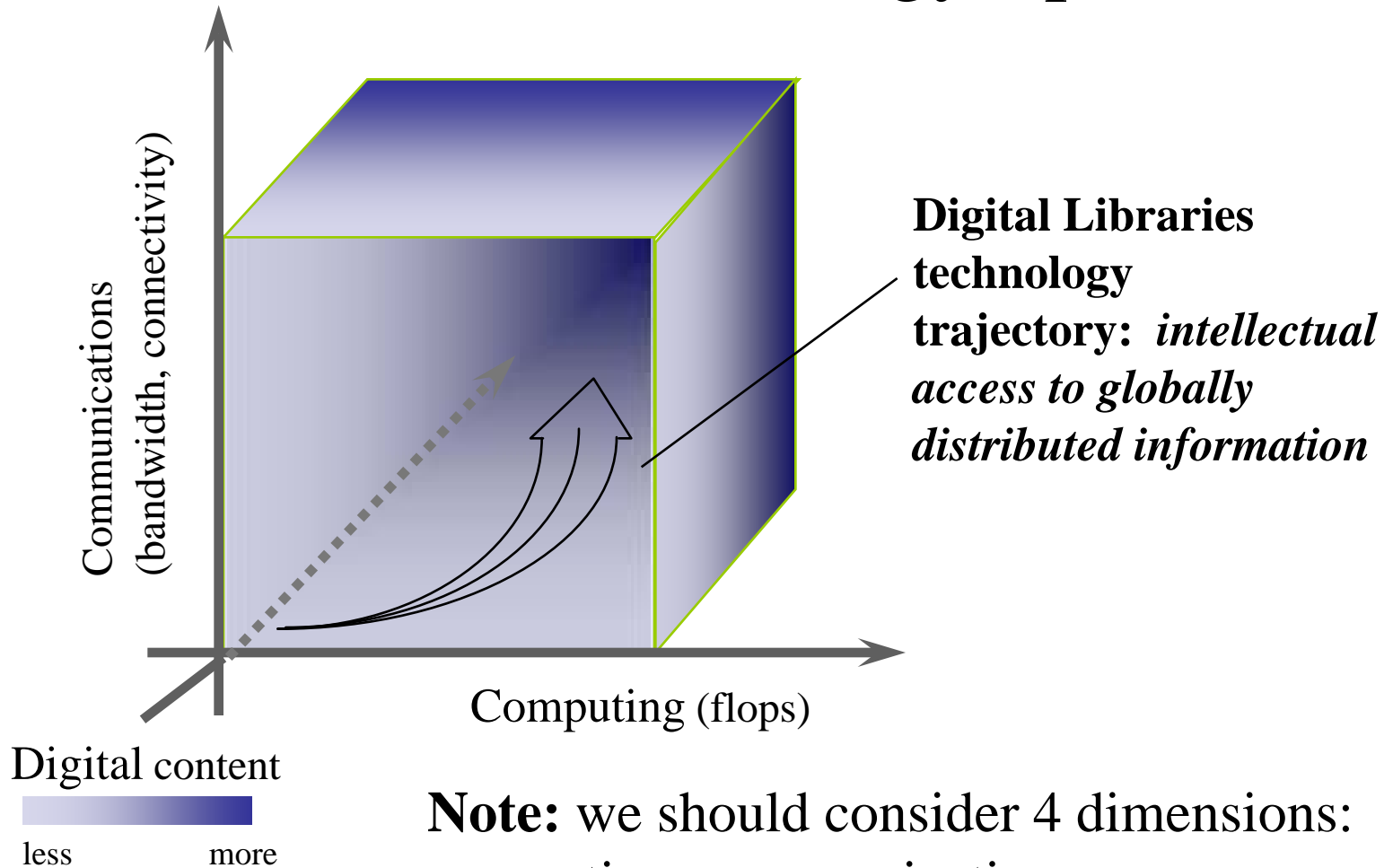
Broad View of Computing (CC2001)

- Discrete Structures
- Programming Fndmntls
- Algorithms, Complexity
- Architecture, Organiztn
- Operating Systems
- Net-Centric Computing
- Programming Languages
- Human-Computer Intrct
- Graphics & Visual
- Intelligent Systems
- Information Managmnt
- Social & Professional
- Software Engineering
- Computational Science & Numerical Methods

Net-Centric, Info Management

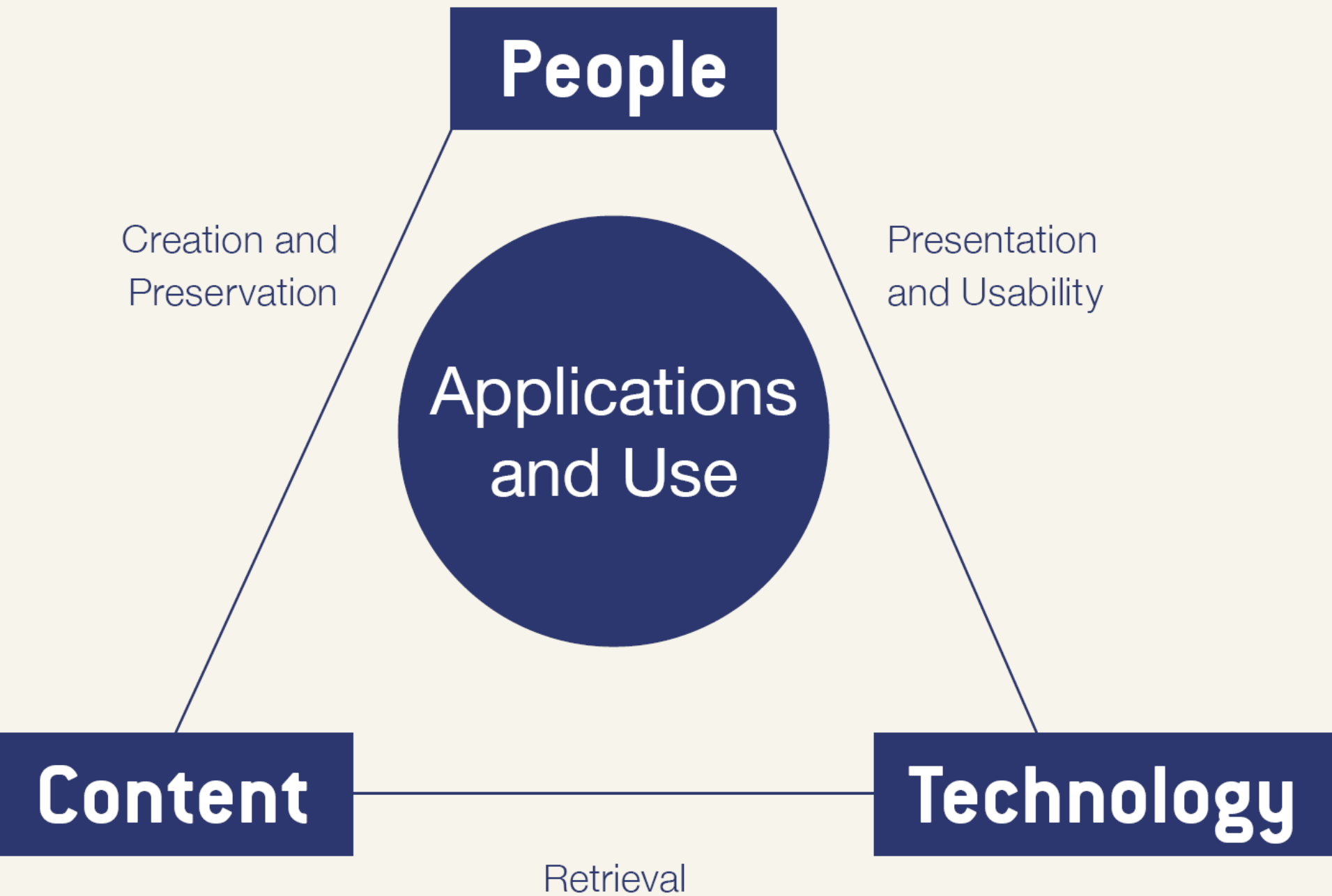
- Security
- Web client-server
- Web applications
- Compression
- Multimedia data technologies
- Models, systems
- Database systems
- Data modeling
- (Distrib) RDBMS, Queries
- Transaction processing
- Data mining
- Information retrieval
- Hypertext, hypermedia, multimedia info / systems
- Digital libraries

Locating Digital Libraries in Computing and Communications Technology Space



Acknowledgement: S. Griffin

Note: we should consider 4 dimensions: computing, communications, content, and community (people)



From: Report on Chatham NSF workshop on future directions in digital libraries ...

Digital Libraries

Shorten the Chain from

Author

Editor

Reviewer

Publisher

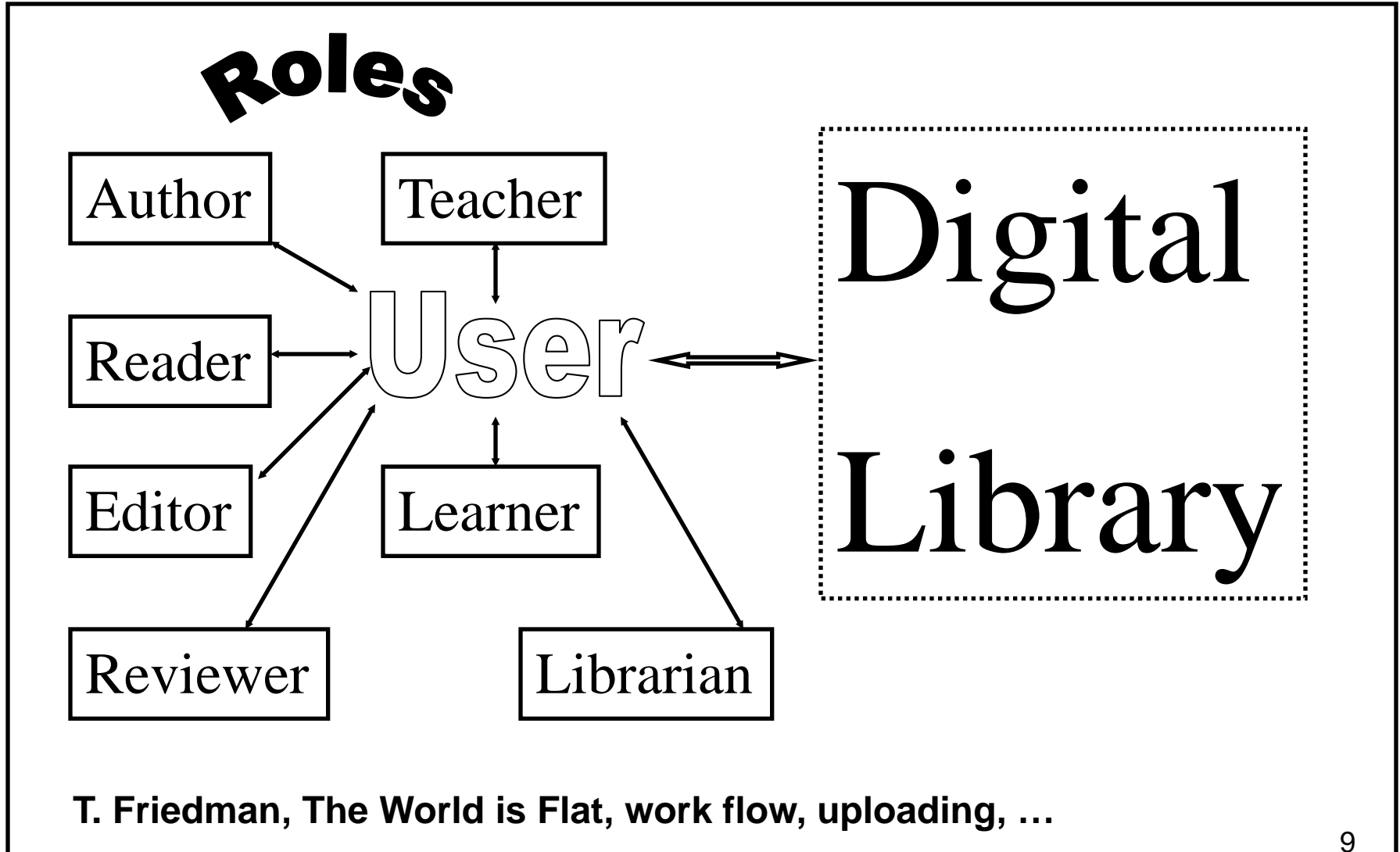
A&I

Consolidator

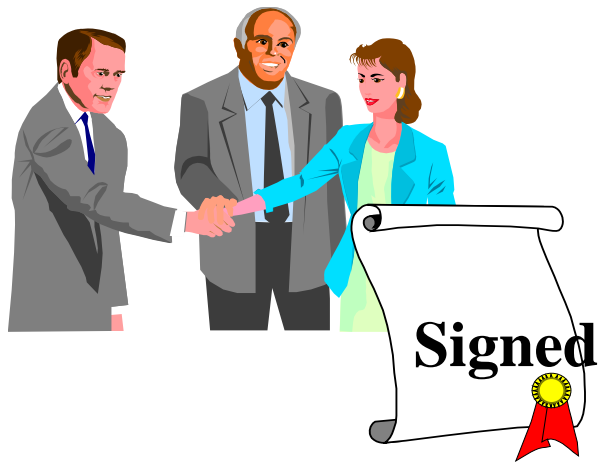
Library

Reader

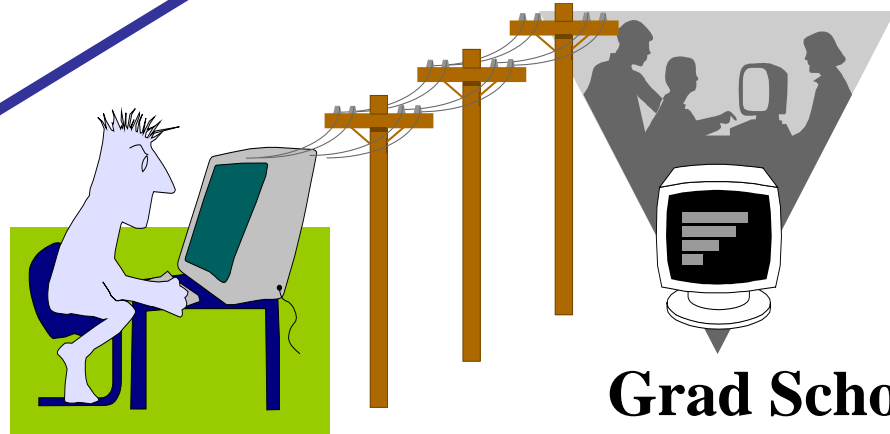
DLs Shorten the Chain to



Student Gets Committee Signatures and Submits ETD

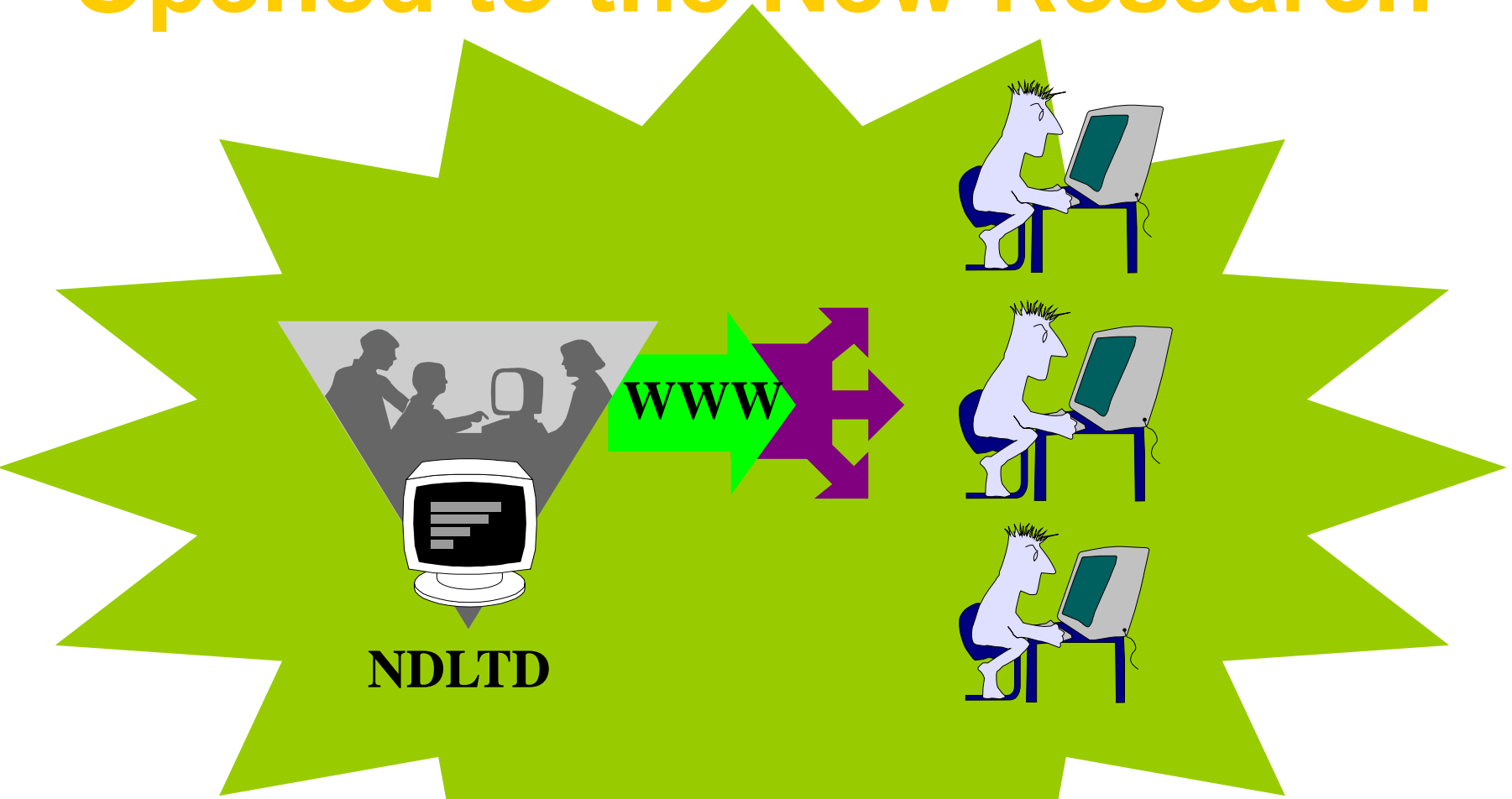


Approval form



ETDs = Electronic Theses and Dissertations

Library Catalogs ETD, Access is Opened to the New Research



Digital library access control

Home

Advanced Search

- General
- K-12
- Higher Education

Browse

- Science Literacy Maps
- Science Refreshers
- NSDL on iTunes U
- Collections

Resources for

- K-12 Teachers
- Higher Education
- Librarians

News and Information

- Expert Voices Blogs
- New in NSDL
- NSDL Wiki
- Publications

Participate in NSDL

- Annual Meeting
- Contribute Collections
- Recommend Resources
- Technical Network Services

Professional Development

- Classic Articles
- NSDL Brown Bags
- NSTA Web Seminars
- Outreach Materials

About NSDL

Search The National Science Digital Library

Search

NSDL is the Nation's online library for education and research in Science, Technology, Engineering, Mathematics.

Highlights

[Solving a Big Math Problem](#)

An understanding of mathematics may be considered essential for an educated person today, but many Americans seem almost allergic to math. While there is much discussion about the importance of mathematics to scientific research, engineering, and technological innovation, the performance of American math students on international assessments is below that of math students in many other countries. In a new special report—"Math: What's the Problem?"—the [National Science Foundation](#) (NSF) uses video interviews and online resources to examine the state of math education and discuss the roles of culture, technology, and research on improving math learning and proficiency.

[View Highlight Archives](#)



NSDL Pathways

[Learn More](#)

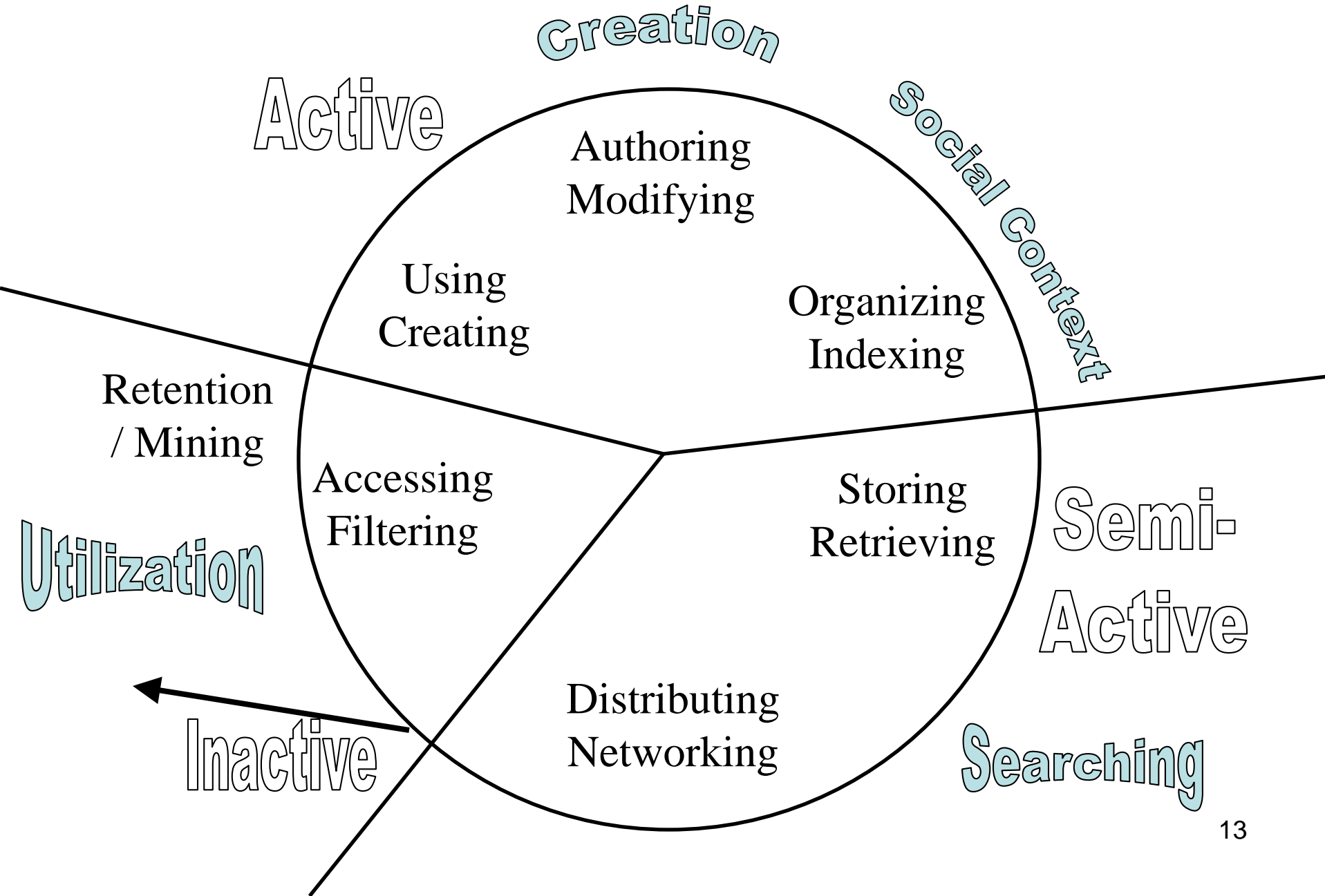
MathDL: Mathematics Pathway

The MathDL Pathway is the Mathematical Association of America's portal to mathematics materials created or collected by seventeen partners, ranging from a math encyclopedia to refereed journals to peer-reviewed collections.

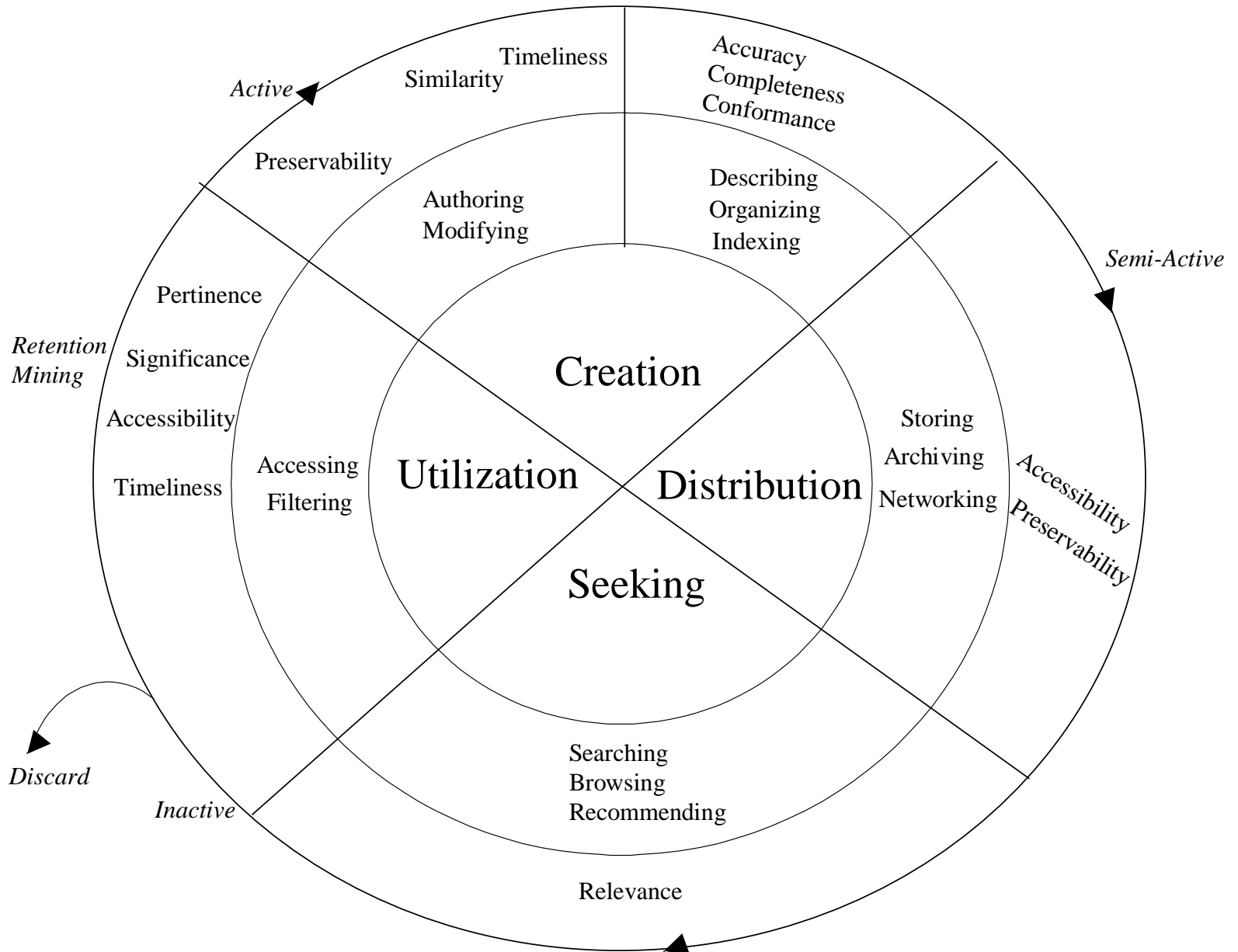
[NSDL Pathways News](#)



Information Life Cycle



Quality and the Information Life Cycle



Informal 5S & DL Definitions

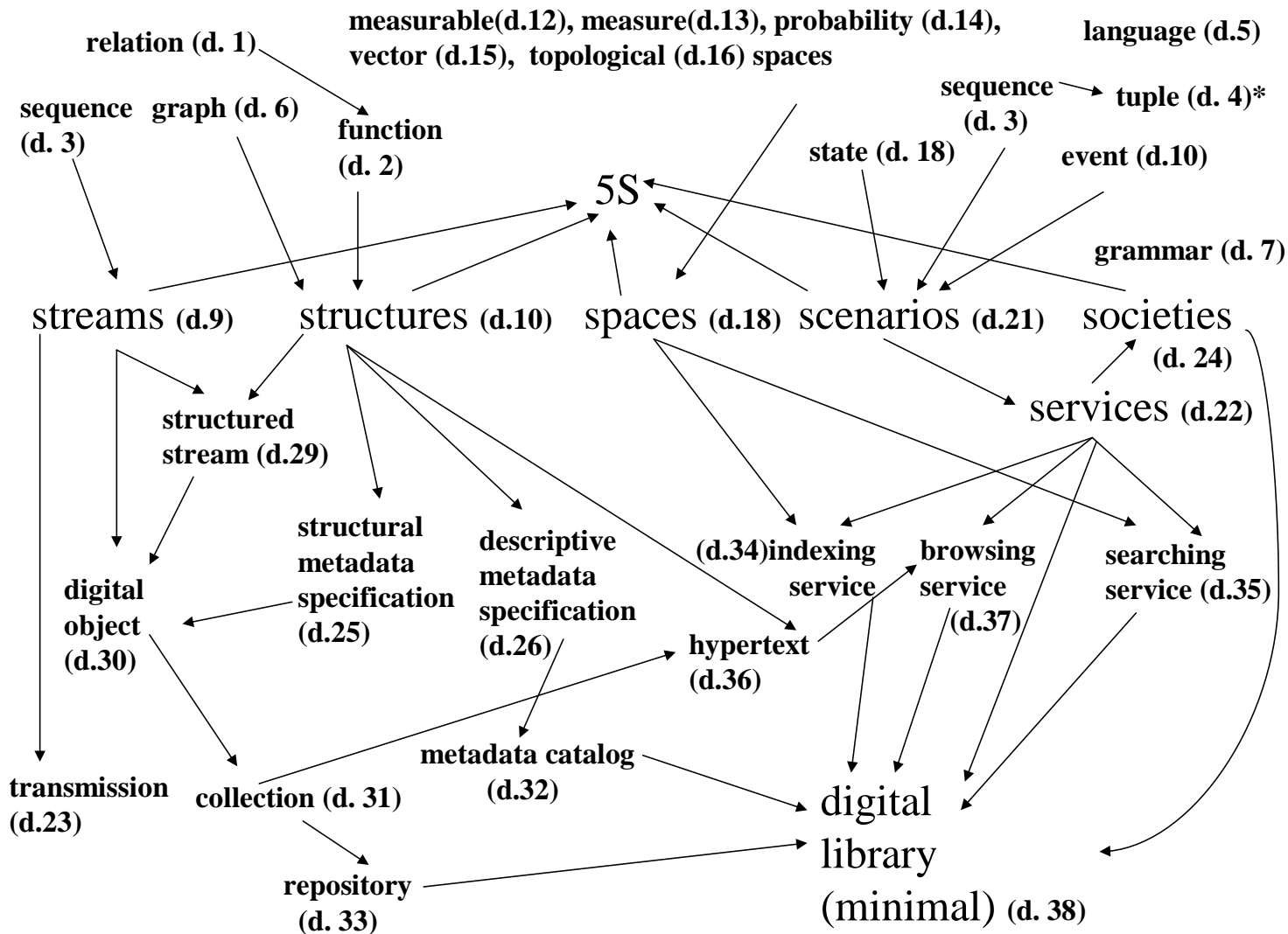
DLs are complex systems that

- help satisfy info needs of users (**societies**)
- provide info services (**scenarios**)
- organize info in usable ways (**structures**)
- present info in usable ways (**spaces**)
- communicate info with users (**streams**)

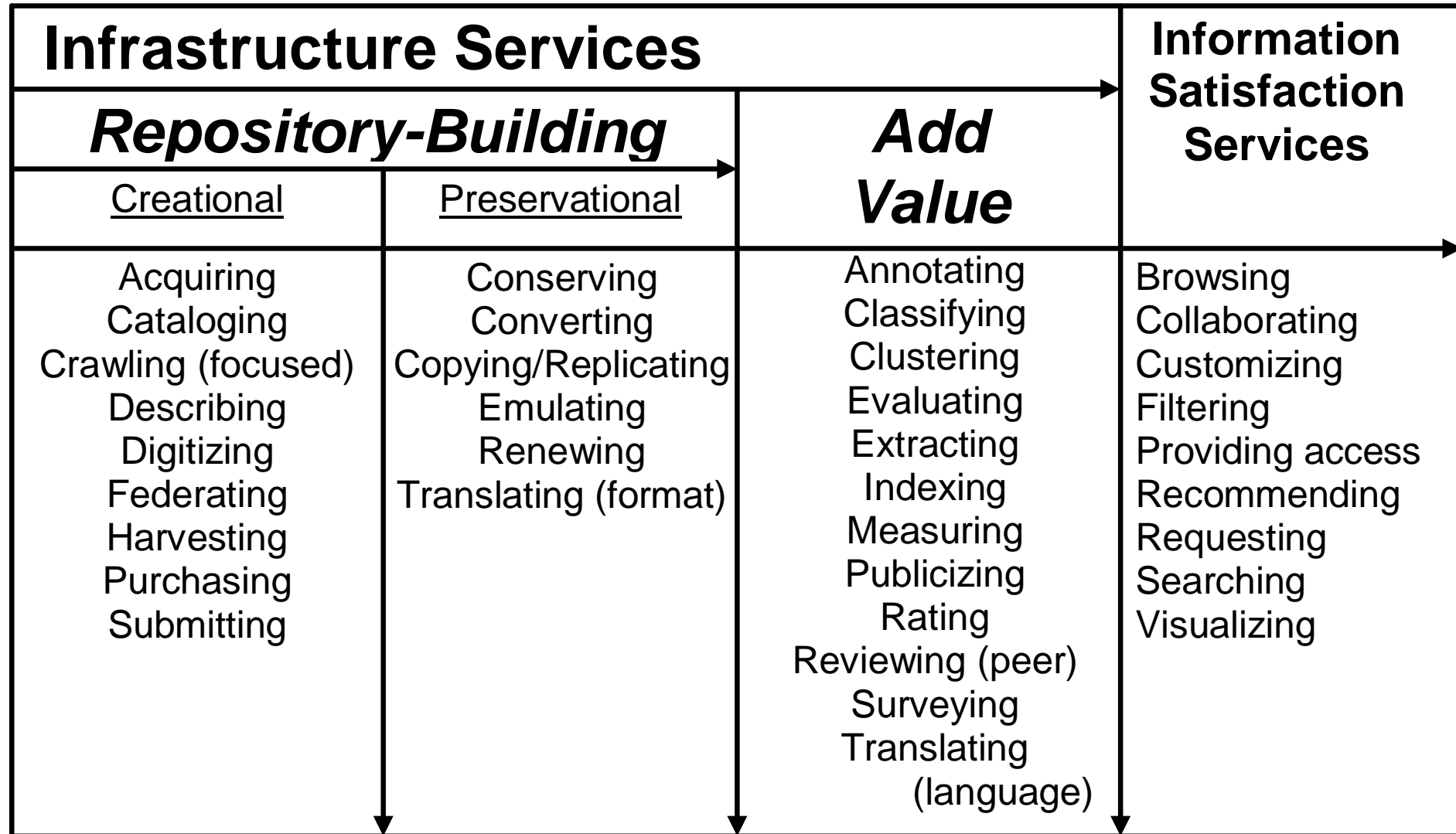
5Ss

| Ss | Examples | Objectives |
|-------------------|--|---|
| Streams | Text; video; audio; image | Describes properties of the DL content such as encoding and language for textual material or particular forms of multimedia data |
| Structures | Collection; catalog; hypertext; document; metadata | Specifies organizational aspects of the DL content |
| Spaces | Measure; measurable, topological, vector, probabilistic | Defines logical and presentational views of several DL components |
| Scenarios | Searching, browsing, recommending | Details the behavior of DL services |
| Societies | Service managers, learners, teachers, etc. | Defines managers, responsible for running DL services; actors, that use those services; and relationships among them |

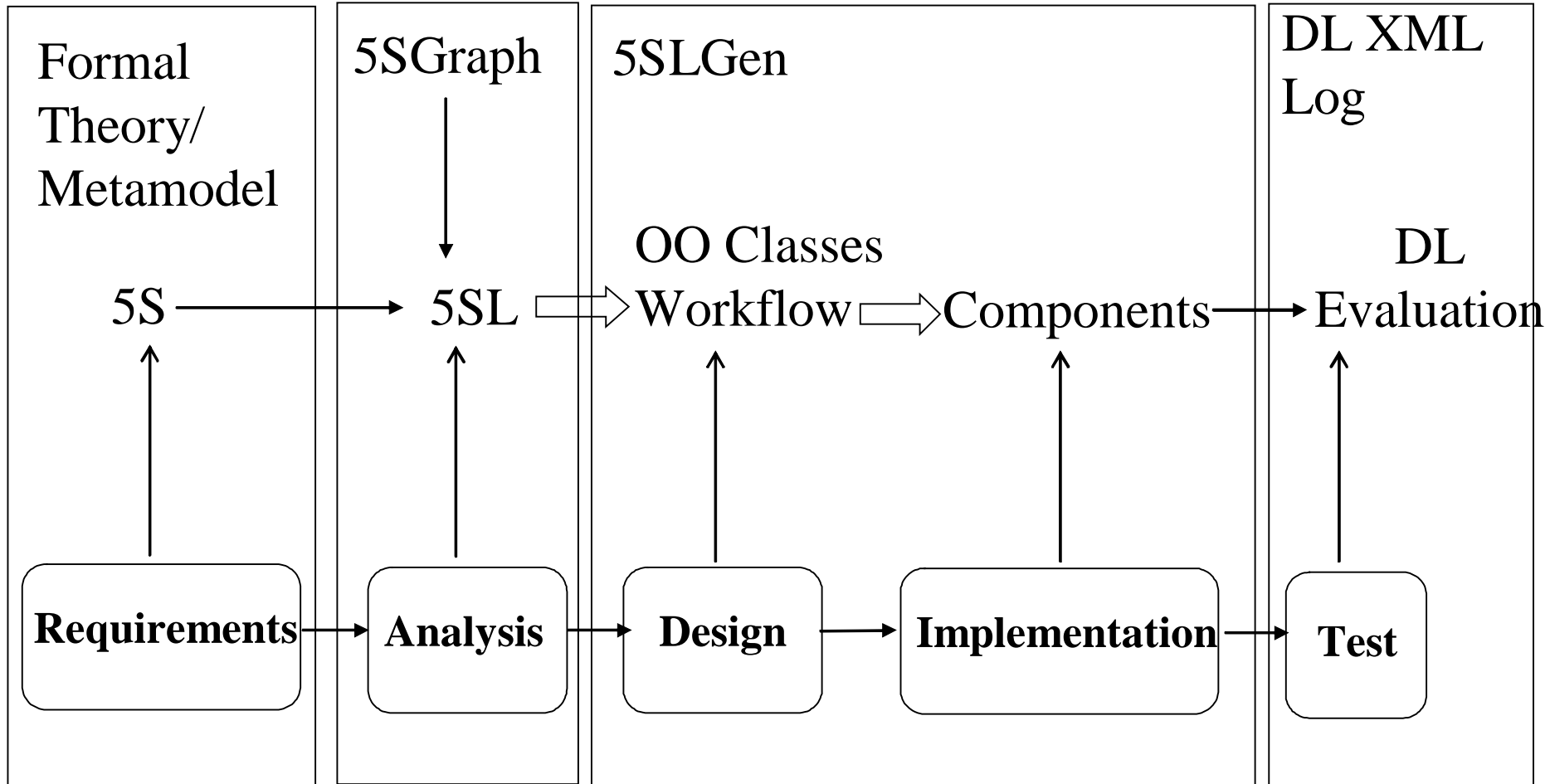
5S and DL formal definitions and compositions (April 2004 TOIS)

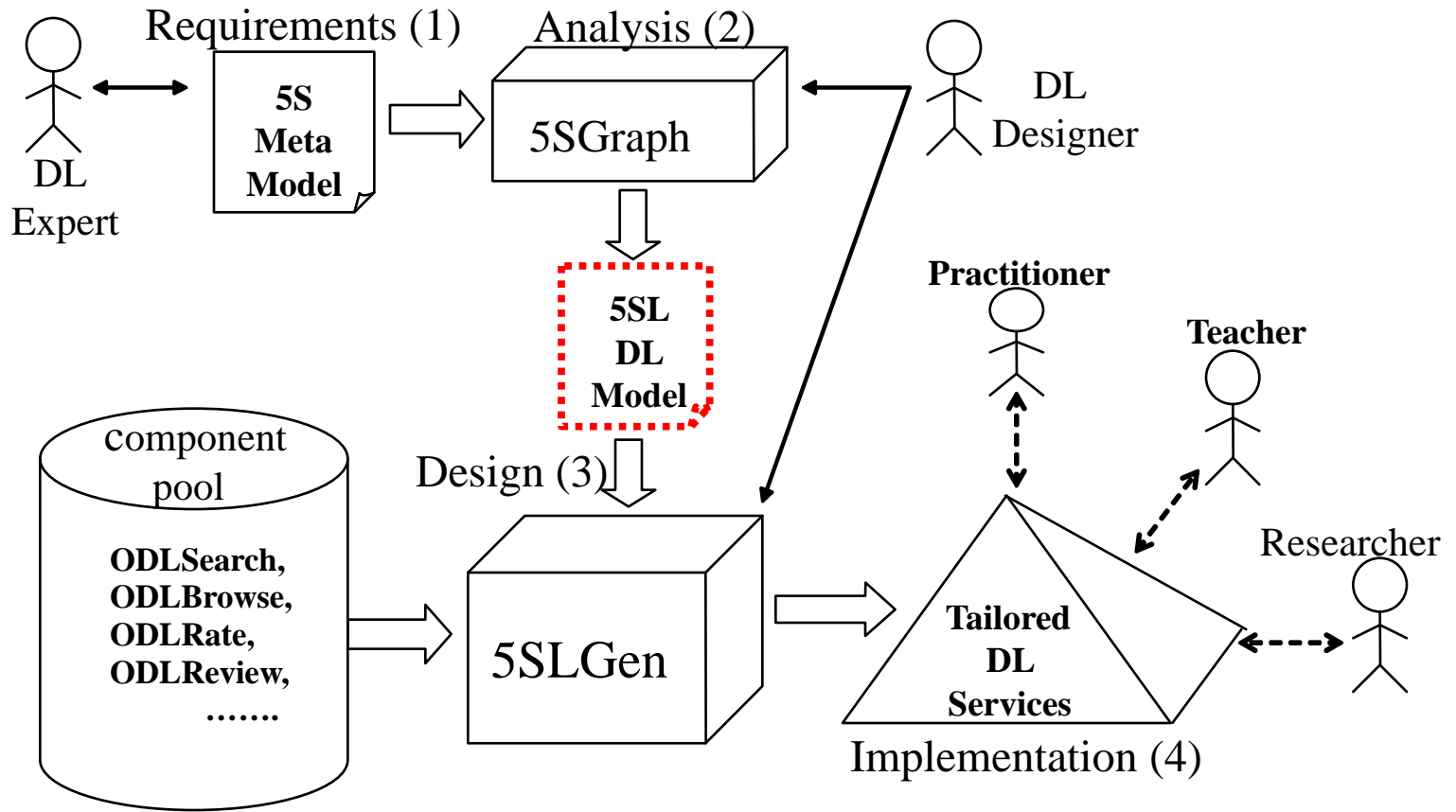


5S Services Taxonomy

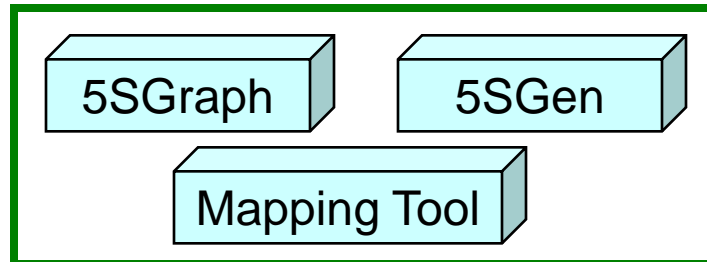


5S Software Engineering and HCI



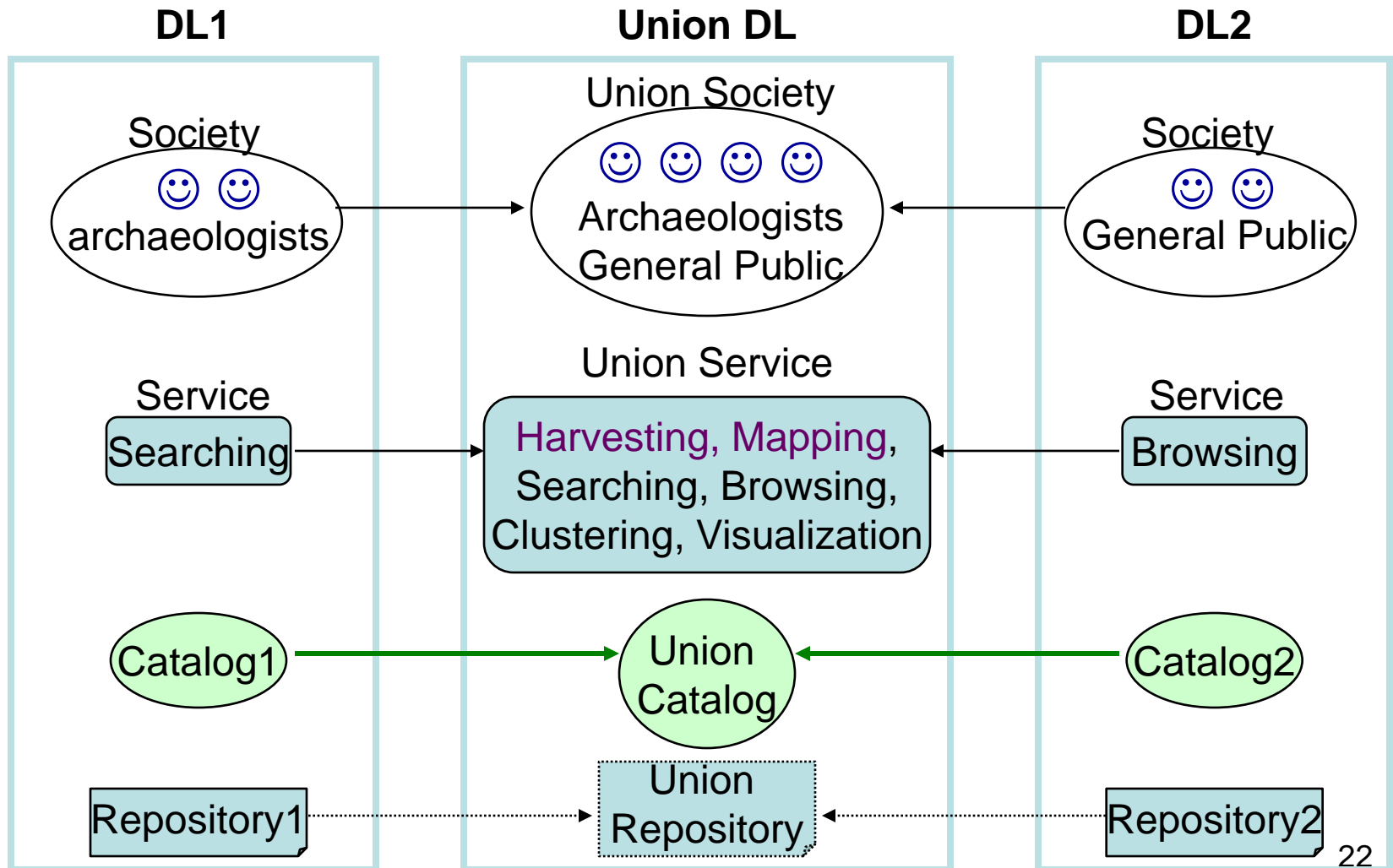


5SSuite

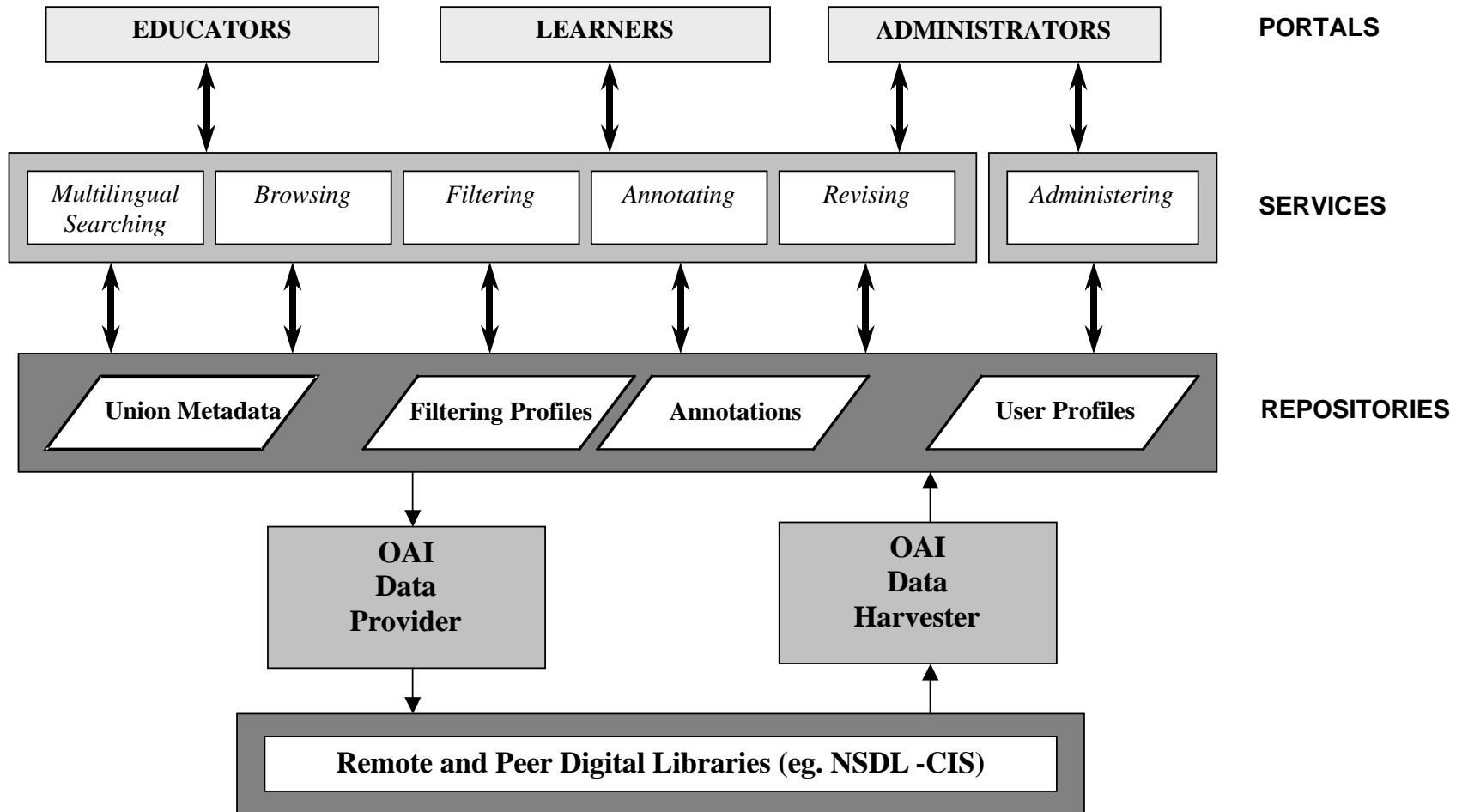


Data Fusion, Information Integration thru DL in Archaeology

Architecture of a Union DL



Digital library architecture for local and interoperable CITIDEL services



Example of Union Service: CitiViz

CitiViz

Data Compression Search

Search for ACM Only Search for all collections

X-axis attributes: Citation Y-axis attributes: Rank

Show all data in the scatter plot Reset the scatter plot

- ▶ D.4.3: File Systems Management (Del)
- ▶ D.4.7: Organization and Design (Del)
- ▼ E.1: Data Structures (Del)
 - Data compression with finite windows
 - Application of splay trees to data compression
 - Practical prefetching via data compression
- ▶ E.2: Data Storage Representations (Del)
- ▶ E.4: Coding And Information Theory (Del)
- ▶ E.5: Files (Del)
- ▶ F.1.3: Complexity Measures and Classes (Del)
- ▶ F.2.2: Nonnumerical Algorithms and Problems (Del)
- ▶ F.3.2: Semantics of Programming Languages (Del)
- ▶ G.2.2: Graph Theory (Del)
- ▶ H.2.1: Logical Design (Del)
- ▶ H.2.7: Database Administration (Del)
- ▶ H.2.8: Database Applications (Del)
- ▶ H.3: Information Storage And Retrieval (Del)

Previous Next

| | |
|----------------|---|
| Rank | 15 |
| Title | Application of splay trees to data compression |
| Author | D. W. Jones |
| Published date | 1988 |
| Collection | ACMDL |
| Abstract | The splay-prefix algorithm is one of the simplest and fastest adaptive data compression algo... |
| url | http://www.citidel.org/?op=getobj&identifier=oai:ACMDL:articles.63036 |
| Citation | 12 |

H.3: Information Storage And Retrieval

E.4: Coding And Information Theory

D.4.3: File Systems Management

Multidisciplinary Connections

- Problem orientation
 - Grand challenges, problem based learning
- Theme orientation
 - Living In the KnowlEdge Society (LIKES)
- Bilateral
 - Digital government, e-commerce, ...
 - Computing + (science|humanities|arts|...)
- National curriculum for computing + others
 - Which sub-areas of computing fit best?
 - Best examples, educational resources

LIKES Goals

- Transform computing education so graduates can help build (systems, services, tools, ... for) the knowledge society.
- Establish collaboration between computing educators and all other disciplines to guide the emergence of the knowledge society.

LIKES

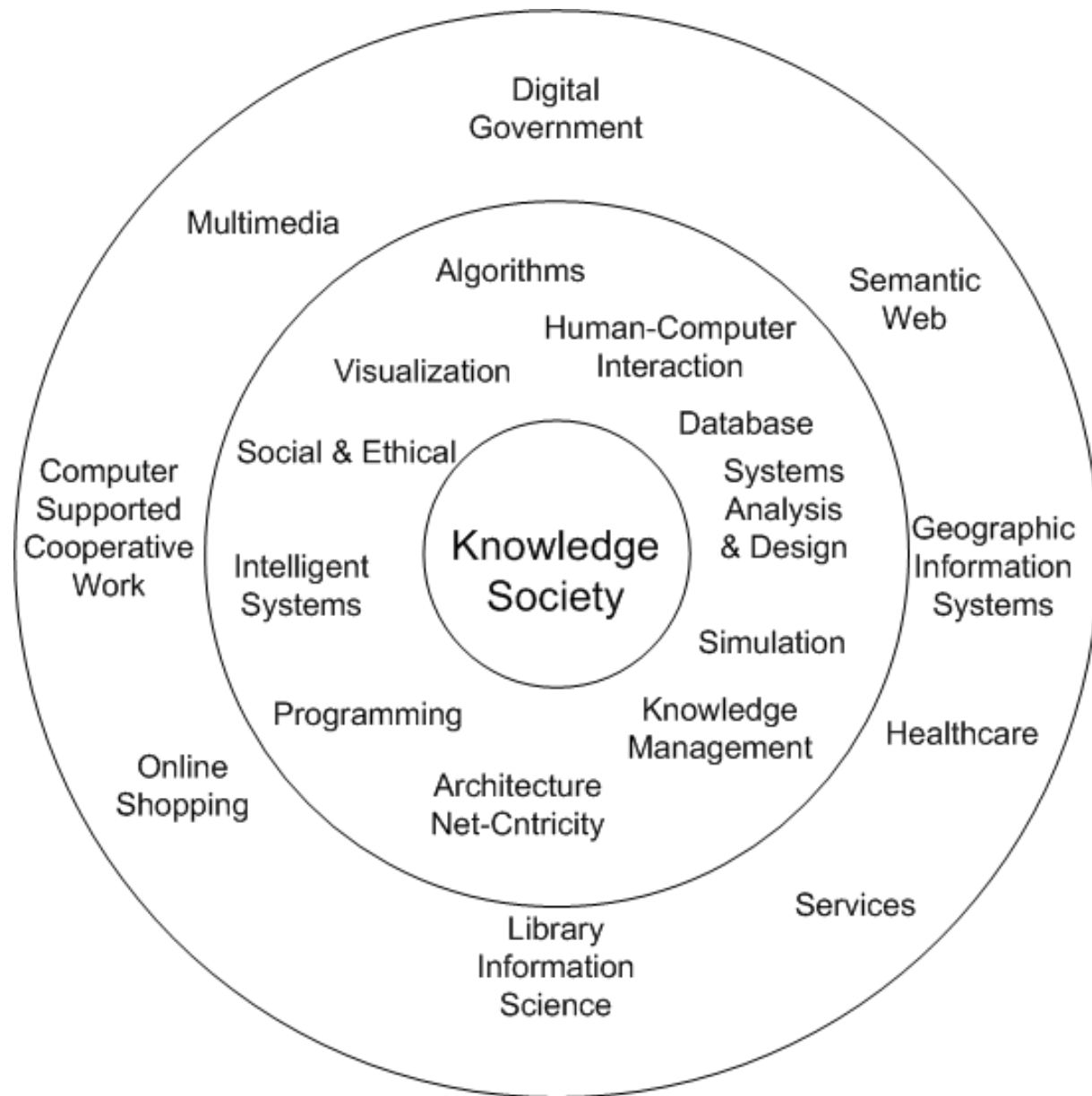
- Promote
- Educate
- Spread
- Utilize

Computing
concepts

Computing tools

Computational
thinking

Collaboration
among different
disciplines



Multidisciplinary Connections cont'd

- J.T. Klein, A Platform for a Shared Discourse of Interdisciplinary Education, J. Social Sci. Educ. 5(2): 10-18, Sept. 2006
- Disciplinarity: functional differentiation -> distinct worldview or discourse; system of power -> nature of work in discipline
- Historical context & pedagogy: integration, new interdisciplinary fields, themes, projects, constructivism, complex issues and problems

Education and Learning

- Education, pedagogy – see Evans & Fox
- Learning resources – NSDL, Ensemble
- Student publishing – ETDs, reports
- University settings
 - Majors
 - Minors
 - Core / Liberal education / general education / interdisciplinary studies
 - Service / team teaching courses
 - Pathways – LIKES

Education and Learning cont'd

- Levels of understanding
 - Core
 - Important
 - Worthwhile
- Contextualization, analogy, transfer
 - Learn in context, with special motivation
 - Generalize, connect, analogical reasoning
 - Patterns, re-use, application of methods

Summary

- Handouts
- Broad view of computing
- KID perspective -> digital libraries
- Multidisciplinary connections
- Education and learning