Bridging the Digital Accessibility Gap through MAISON Services

Syed Toufeeq Ahmed, K. Selcuk Candan, Mijung Kim, Shruti Gaur, Renwei Yu, Xinxin Wang, Suganthi Cidambaram, Wei Huang, Jong Kim, Rajeev Singla, Hari Sundaram, Hasan Davulcu, and Terri Hedgpeth

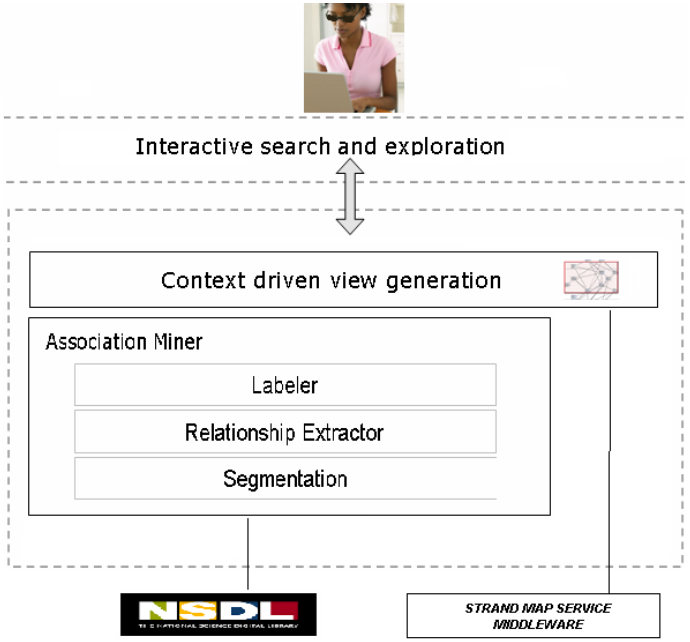
Ira A. Fulton Schools of Engineering
ARIZONA STATE UNIVERSITY

Funded By
The National Science Foundation

Need

- According to American Foundation for the Blind (AFB), the current rate of unemployment for people who are legally blind is around 70%.

- There is impending need to improve participation to education by teachers, librarians, and students who are blind.



Solution

We are developing MAISON (Middleware for Accessible Information Spaces on NSDL) to enhance the accessibility of
- NSDL's internal and external resources,
- existing NSDL services (such as science literacy maps), and
- NSDL community tools (such as blogs, wiki, and RSS newsfeeds).

Accessibility Challenges

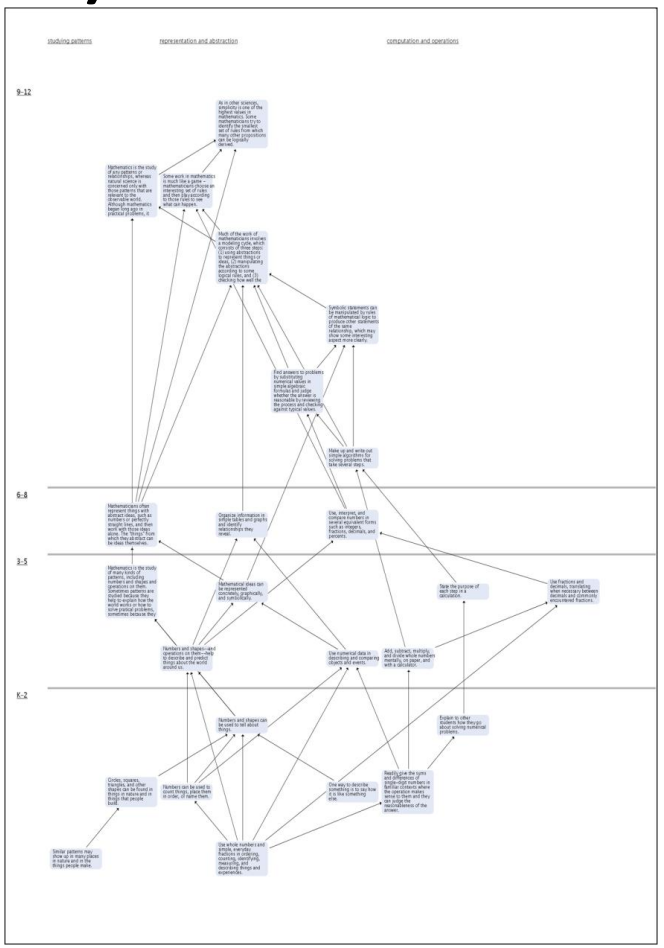
Most of the web interfaces are primarily designed for people with sight, with visually rich features that makes effective use of these tools, but almost impossible for users who are blind or visually impaired to use these.

Ira A. Fulton Schools of Engineering
ARIZONA STATE UNIVERSITY

Example: Science Literacy Maps (StrandMaps)

- Concept maps and other graph structured information spaces are very effective in representing relationships and order dependencies among information units to individuals with sight.

- But for visually impaired users who cannot rely on graphical and mouse driven maps, these pose impossible challenges.



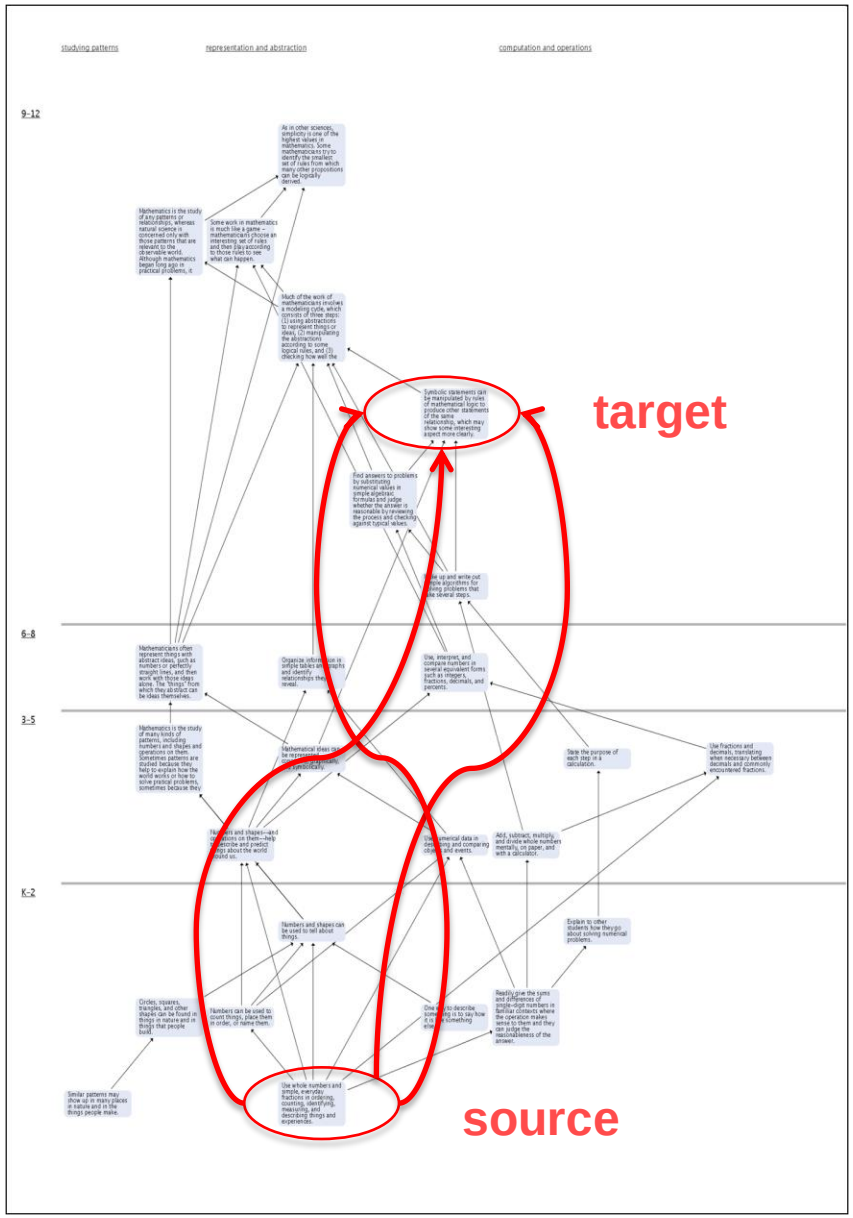
Our Contributions

- Providing accessibility to complex information spaces, where navigation towards a target requires constantly contemplating answers to questions of the form *“which of the available links should I follow?”* and *“what is beyond this link?”*
- Goal is to provide open services to enable accessible education tool design.

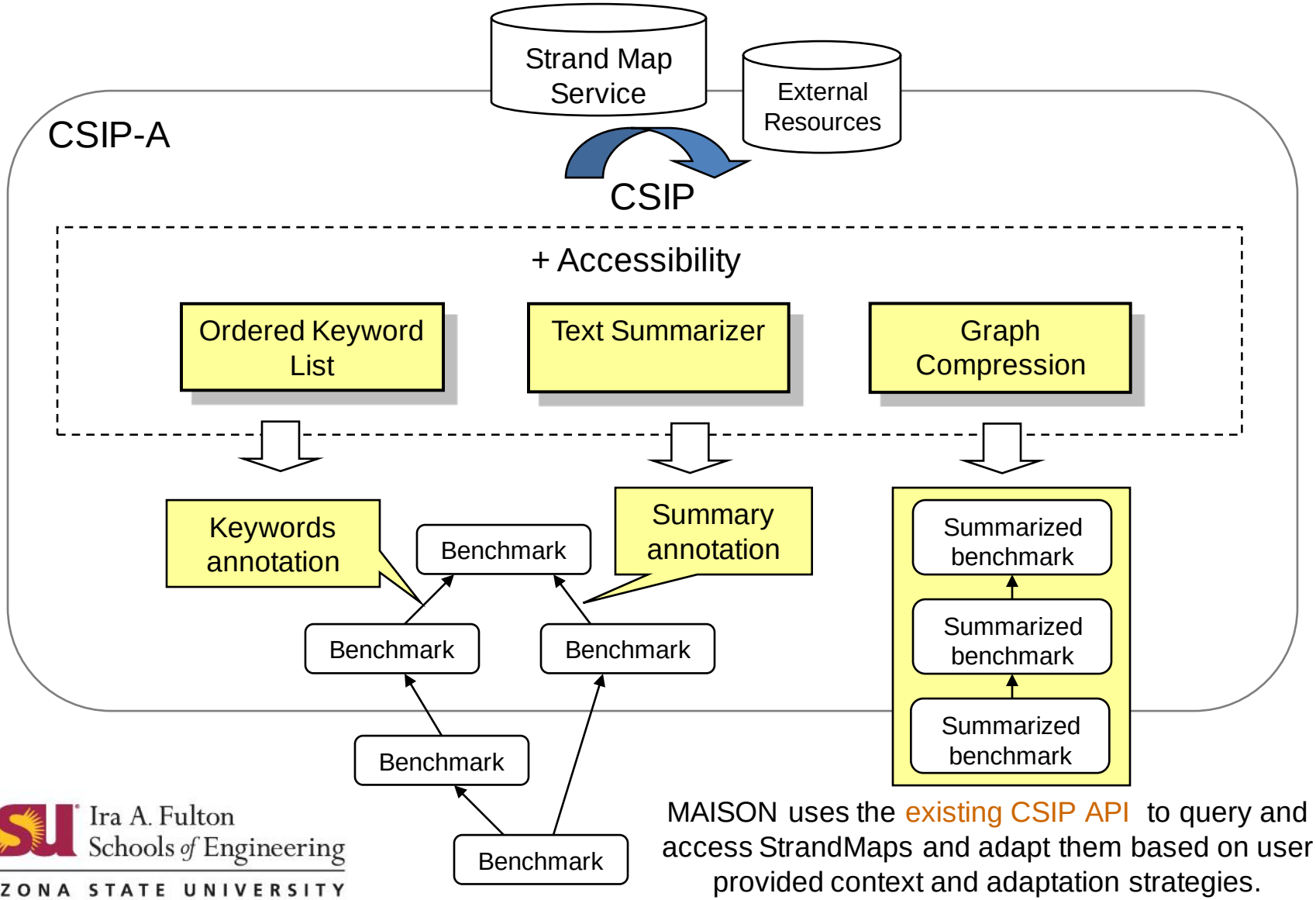
Presentation Outline

- MAISON CSIP-A services (and demo)
- User study results and feedback
- Personalization, and Navigation History (and demo)
- Resource link preview service (and demo)

How to Render StrandMaps Accessible



MAISON CSIP-Accessible Architecture (CSIP-A)



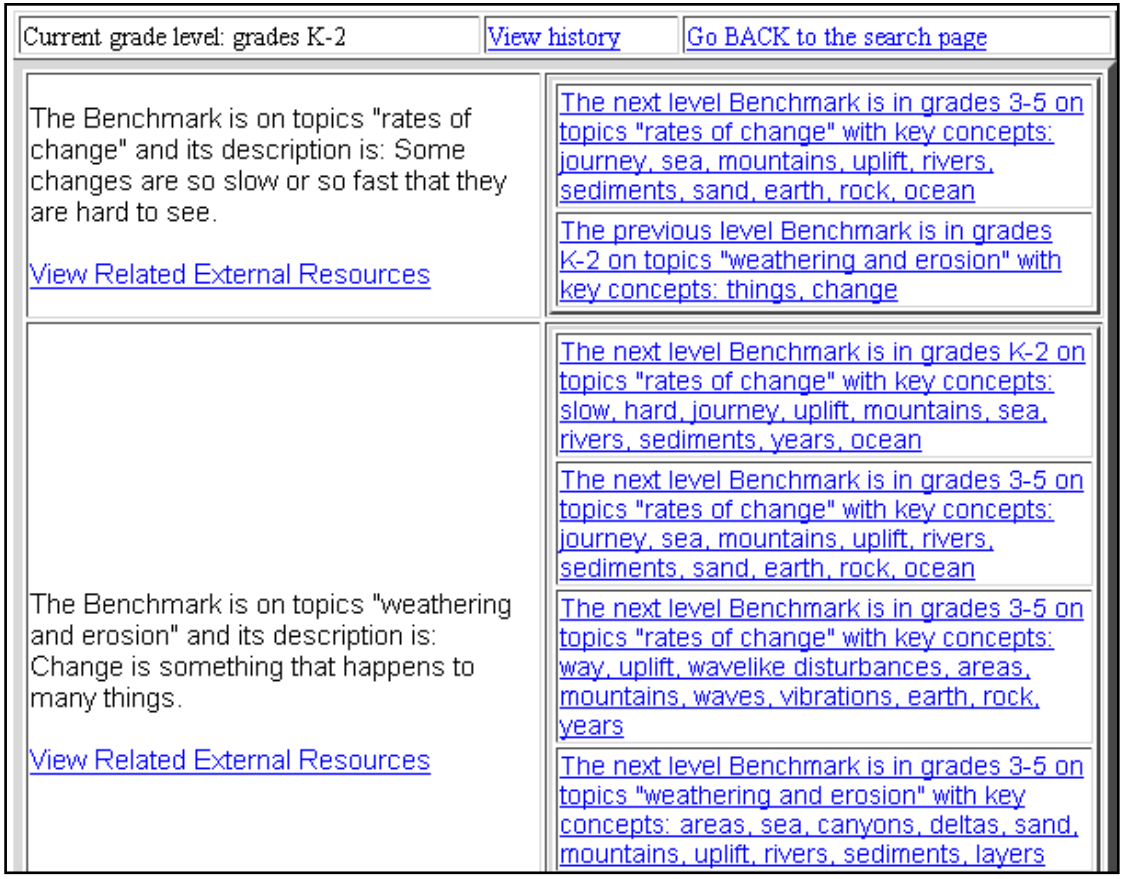
MAISON uses the existing CSIP API to query and access StrandMaps and adapt them based on user provided context and adaptation strategies.

CSIP-Accessible (CSIP-A) interface

- Our CSIP-Accessible (CSIP-A) interface takes various content adaptation options that are used for adapting the CSIP strand map results based on the user's preferences.
  - ***Grade/topic focus:*** This tells the MAISON middleware whether the adaptation should be grade- (or row-) centric or topic- (or column-) centric.
  - ***Clustering:*** If this option is yes, related benchmark nodes of the strand map maybe clustered together to reduce the number of nodes to be presented and the links that has to be followed by the user who is blind.
  - ***Link preview:*** This link previews are annotations for helping the user who is blind to decide whether to follow a forward or backward link.

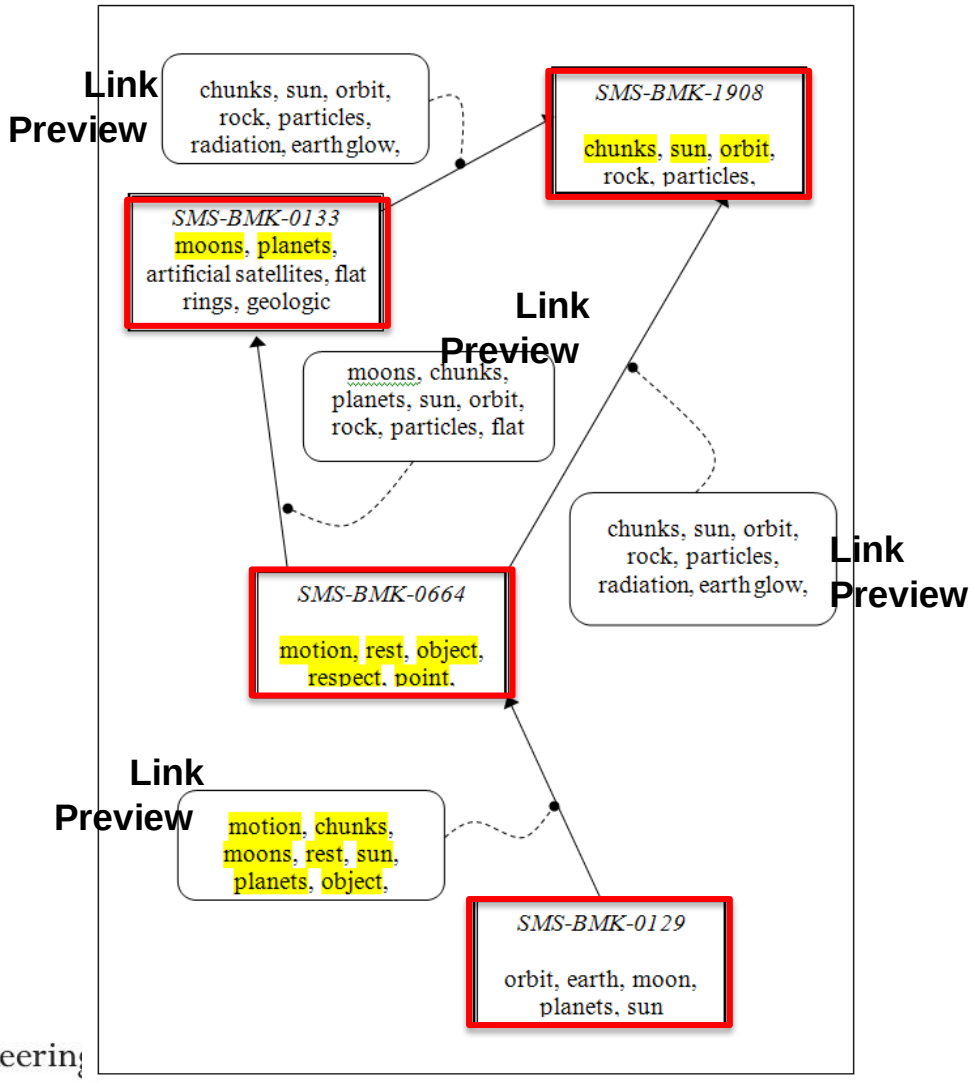
MAISON Link Previews

- **Content of the next node** option provides the text of the next benchmark;
- **Upcoming Key concepts** option identifies and annotates each edge on the resulting strand map with concepts that are dominant in upcoming (one or more) benchmarks
- **Summary of the upcoming nodes** option extracts a textual summary of the upcoming (one or more) benchmarks;



Current grade level: grades K-2	View history	Go BACK to the search page
The Benchmark is on topics "rates of change" and its description is: Some changes are so slow or so fast that they are hard to see. View Related External Resources	The next level Benchmark is in grades 3-5 on topics "rates of change" with key concepts: journey, sea, mountains, uplift, rivers, sediments, sand, earth, rock, ocean The previous level Benchmark is in grades K-2 on topics "weathering and erosion" with key concepts: things, change	
The Benchmark is on topics "weathering and erosion" and its description is: Change is something that happens to many things. View Related External Resources	The next level Benchmark is in grades K-2 on topics "rates of change" with key concepts: slow, hard, journey, uplift, mountains, sea, rivers, sediments, years, ocean The next level Benchmark is in grades 3-5 on topics "rates of change" with key concepts: journey, sea, mountains, uplift, rivers, sediments, sand, earth, rock, ocean The next level Benchmark is in grades 3-5 on topics "rates of change" with key concepts: way, uplift, wavelike disturbances, areas, mountains, waves, vibrations, earth, rock, years The next level Benchmark is in grades 3-5 on topics "weathering and erosion" with key concepts: areas, sea, canyons, deltas, sand, mountains, uplift, rivers, sediments, layers	

Example: Upcoming Concepts



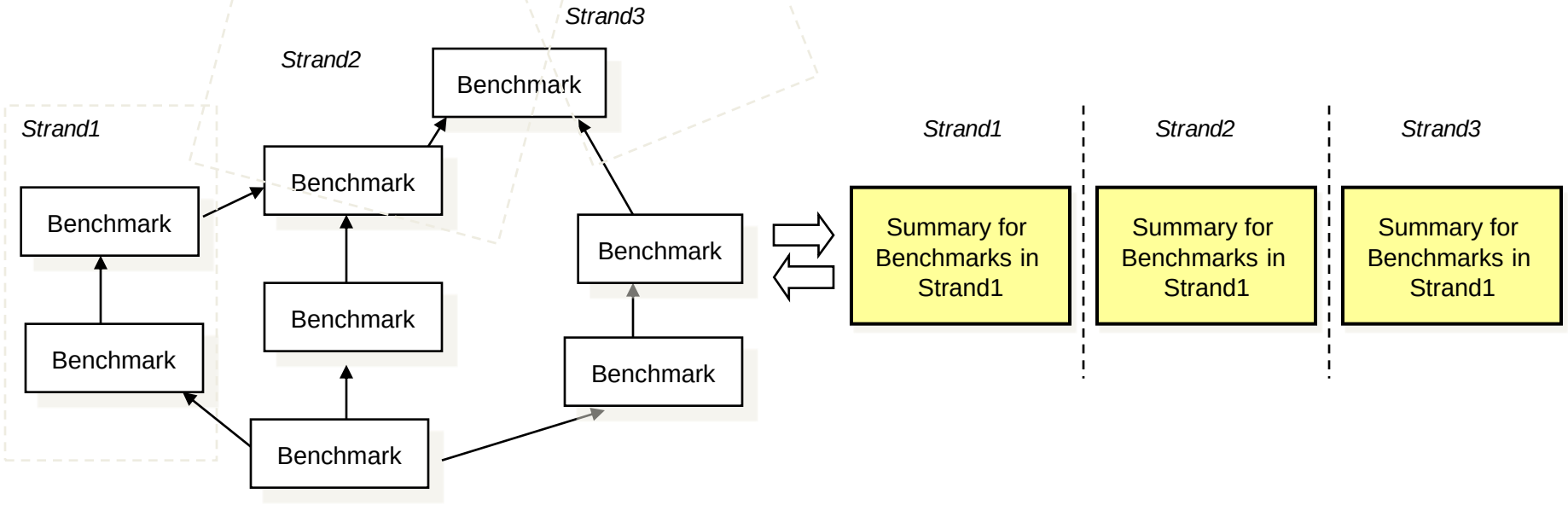
Leveraging Context

Two context-based preview adaptation techniques are introduced for more effective preview generation:

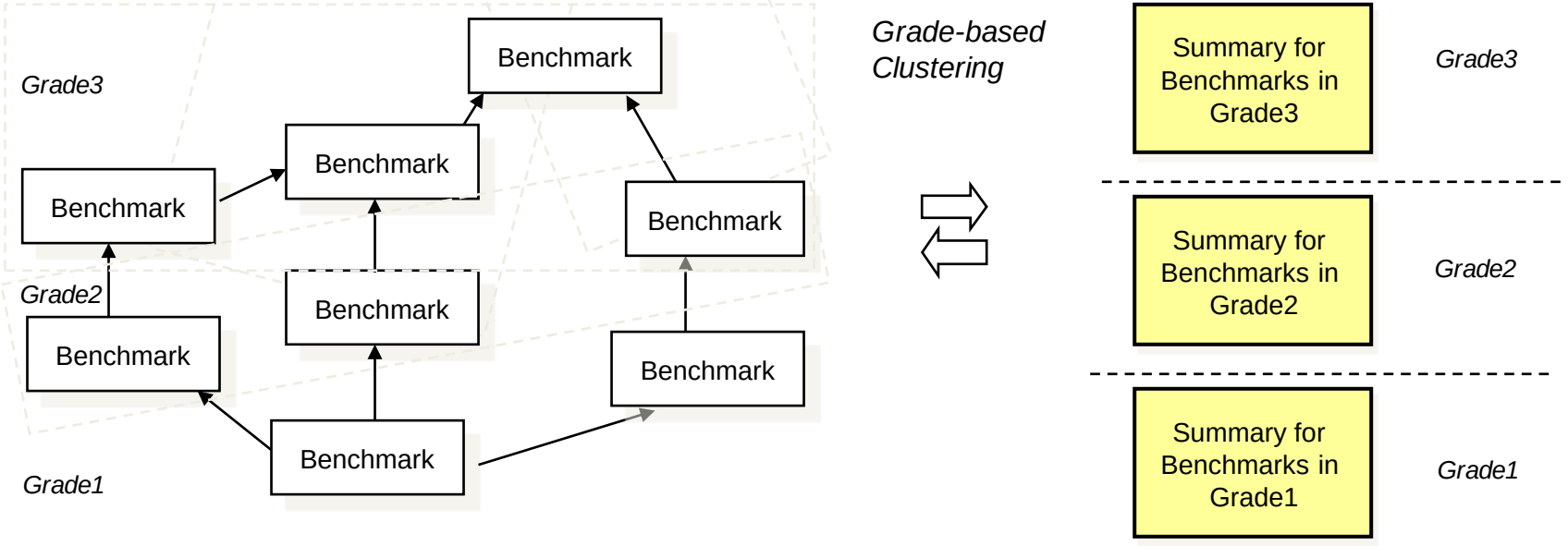
- In ***benchmark-adjusted concept weighting***, each benchmark is associated with a context score and the concepts extracted from that benchmark are given more or less weight based on this context score.

- In ***decay-adjusted concept weighting***, the decay factor itself is decided based on the contextual scores of the benchmark.

Complexity Reduction through Strand-based Benchmark Clustering



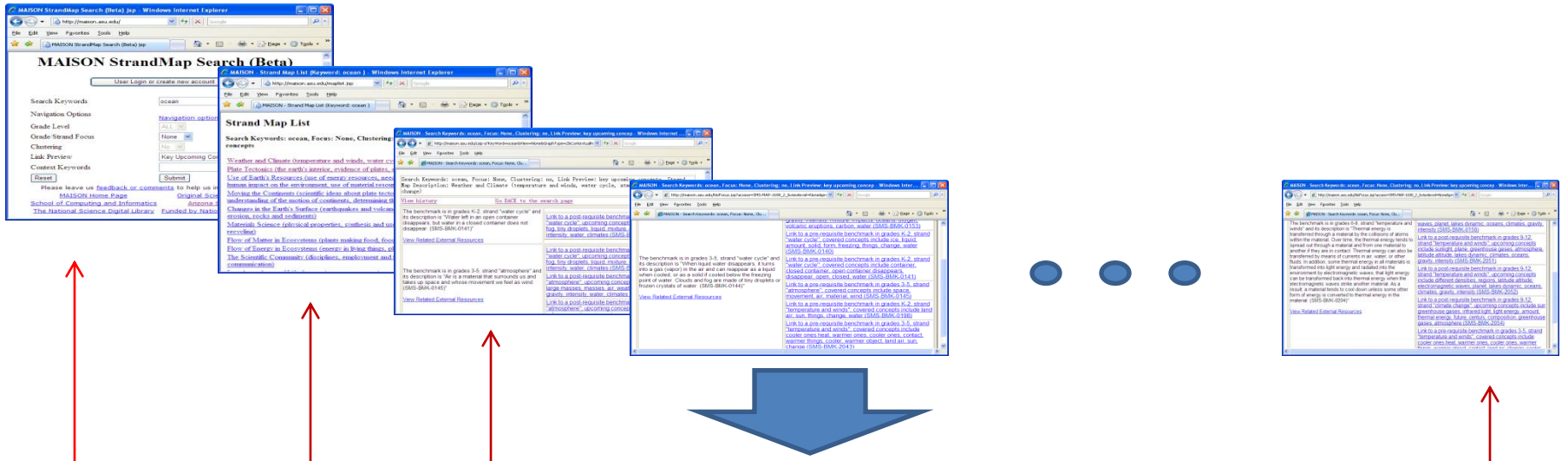
Complexity Reduction through Grade-based Benchmark Clustering

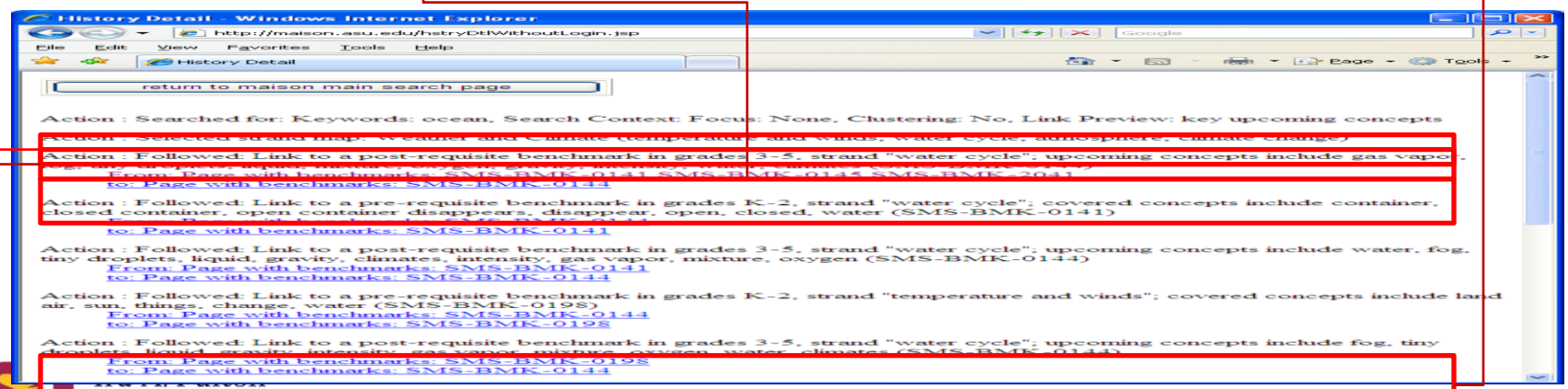


Personalization and Usage History

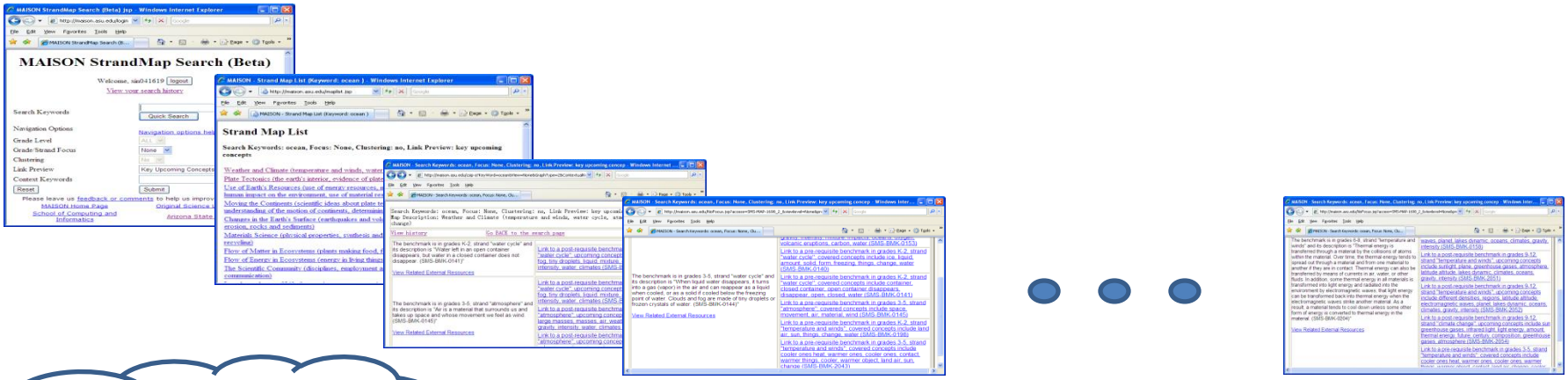
- Helping users find a benchmark is only half of the story.
- In order to help them leverage relevant pathways along the StrandMap, we need to provide quick reference to
  - past navigation and usage history,
  - bookmarked benchmarks,
  - bookmarked pathways or StrandMap fragments (or personalized StrandMaps)

Navigation History without Login

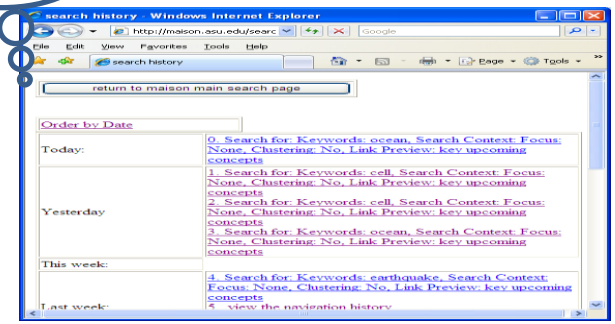


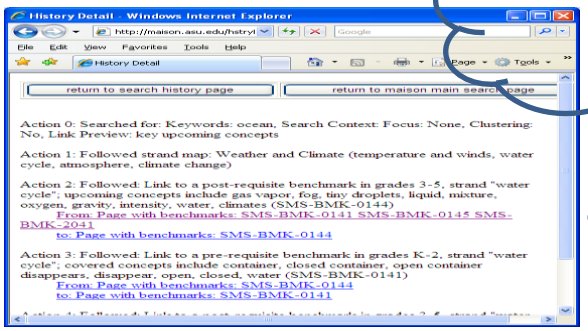


Navigation History with Login



One more window, which summarize each series of navigation history and presents by order of date





Same as anonymous history

Ira A. Fulton Schools of Engineering
ARIZONA STATE UNIVERSITY

MAISON StrandMap Interface

- Available at
  - http://maison.asu.edu

User Study Results

- User studies with both sighted users and users who are blind (approved and supervised by IRB at ASU)
- **Study 1:** user study with 10 users with sight
- **Study 2:** We report results only for those users without sight that completed all tasks and only relying on JAWS screen reader; there were 4 such users
- Tests were double randomized, both the order of tests and the order of results links.

Study 1: Users with Sight

LINK COUNT				TIME		
SP	KUC	KU		SP	KUC	KU
5	5	5		69	66	46
6	4	10		125	45	115
10	4	6		183	126	78
19	3	5		206	36	75
9	3	13		113	38	119
3	3	2		51	35	25
15	13	3		75	147	13
4	4	4		59	60	41
5	3	3		109	55	104
9	4	4		109	30	43
8.5	4.6	5.5		109.9	63.8	65.9

SP – Simple preview (Content of the node)
KUC – Key Upcoming Concepts with context
KU - Key Upcoming Concepts
Link count – no. of links clicked to reach target page
Time – time taken to reach target page in seconds

Study 2: Users who are blind

Users	Time				Keystroke				Link		
	SP	KUC	KU		SP	KUC	KU		SP	KUC	KU
1	313	138	134		113	57	57		8	3	4
2	272	143	315		130	75	146		2	3	7
3	362	575	195		119	107	64		9	40	6
4	182.62	200.33	69.3		127	69	37		3	7	3
average	282.4	264.08	178.3		122.25	77	76		5.5	13.25	5

SP – Simple preview (Content of the node)
KUC – Key Upcoming Concepts with context
KU - Key Upcoming Concepts
Link count – no. of links clicked to reach target page
Time – time taken to reach target page in seconds
Keystrokes – no. of keystrokes pressed

Sample User Comments

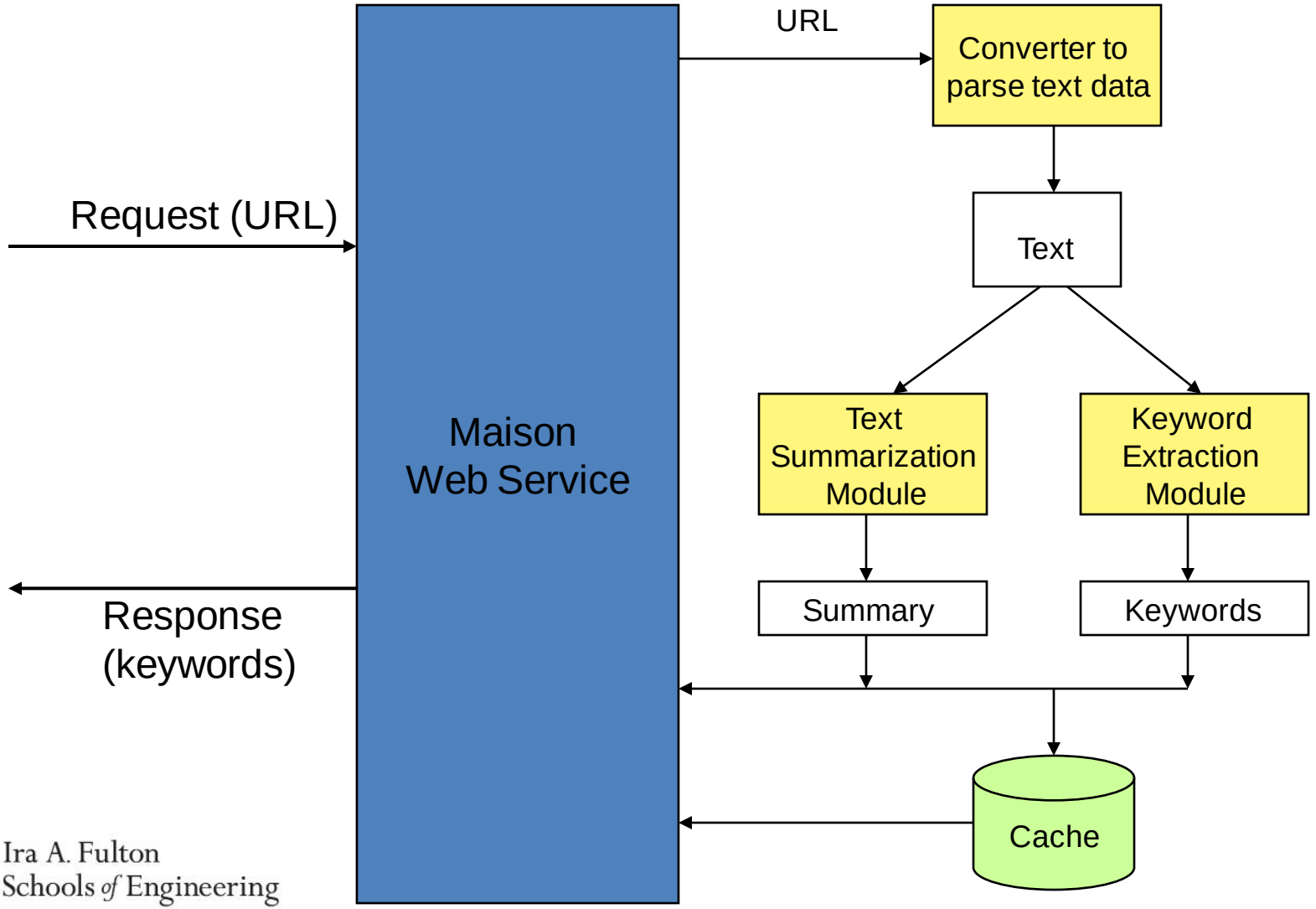
- "….faster to hear keywords then sentences"
- "..lot quicker than say amazon.com.."
- "… its easier, more description…"

- " don't give entire content on the link, because some users skip links and read the text.."

How About Other Internal and External Resources

- Link Previews
  - Annotates the (selected) links with preview keywords
  - Enables user to ***know*** what the education resource (webpage, PDF, powerpoints, blog) is about in a given context without accessing (clicking, reading, coming back to old page) the resource.
  - Firefox plugin prototype is ready, IE plugin is in development, backend services are in alpha.

Link Preview Annotation Backend (MAISON 2.0)



Link Preview Annotation Demo

- Let's give it a try
  - http://www.ucar.edu/news/features/climatechange/faqs.jsp

Thank You!

- Questions, comments and feedback, you can email to:
  - Candan@asu.edu (MAISON Principal Investigator)
  - Toufeeq@asu.edu (me)