Visualizing Digital Collections of Web Archives

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Web Archiving Collaboration: New Tools and Models

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http://ws-dl.cs.odu.edu

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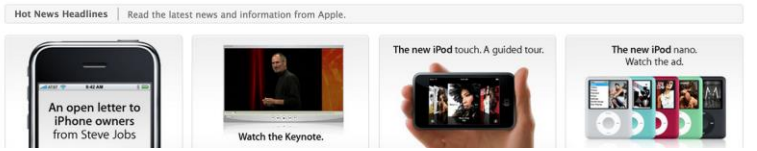
Motivation for Thumbnail Summarization

- Change over time - aboutness



Apple.com has > 17k mementos

Many Nearly Identical

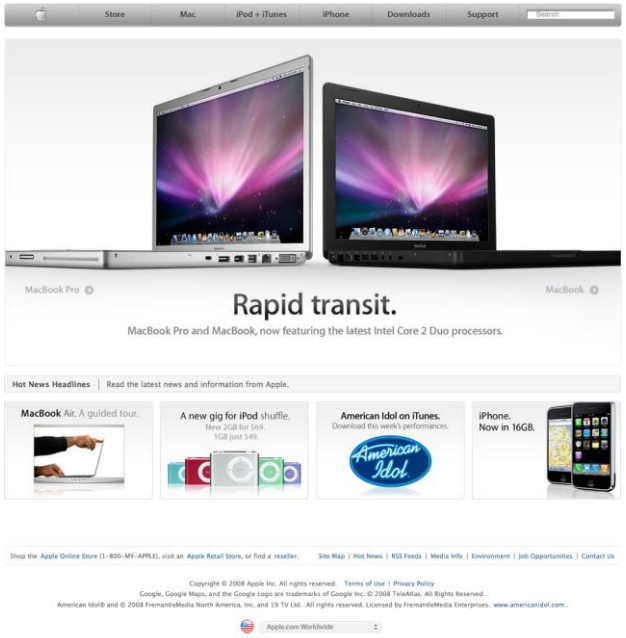
(apple.com)

Methods of Summarization

- Including all mementos
  - many redundant thumbnails
  - temporally/spatially/cognitively expensive
- Naively excluding images
  - missing important captures in summary
- Compare image thumbnails
  - temporally expensive for identifying unique thumbnails

Comparing mementos' markup can identify sufficiently unique mementos

Analyzing Markup



apple.com at Mar 17, 2008

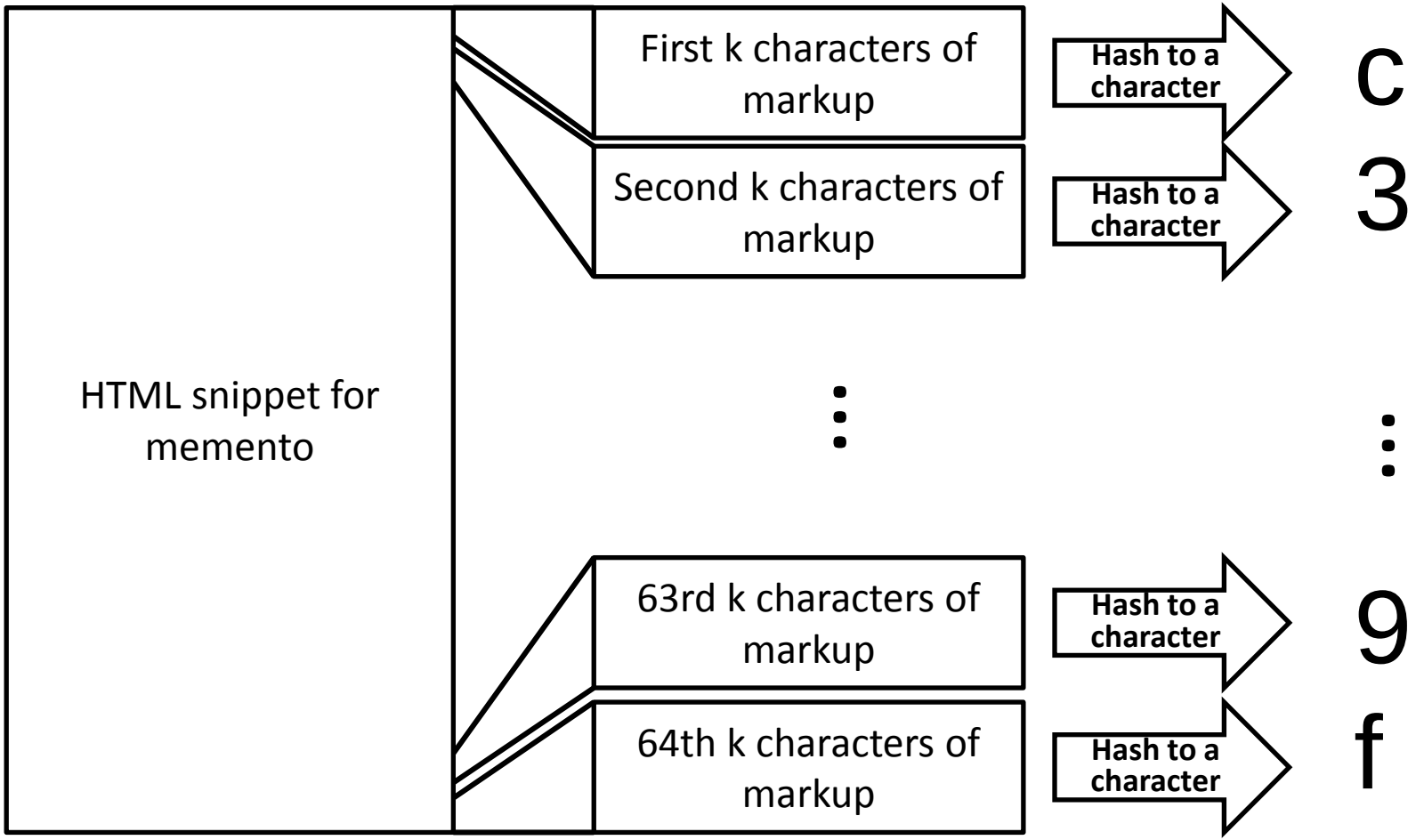
```
<title>Apple</title>
        <meta property="analytics-
track" content="Apple - Index/Tab"
/>
        <meta property="analytics-s-
channel" content="homepage" />
<meta property="analytics-s-
bucket-0"
content="appleglobal,applehome"
/>
<meta property="analytics-s-
bucket-1"
content="apple{COUNTRY_CODE}gl
obal,apple{COUNTRY_CODE}home"
/>
```

HTML for memento

8664ee964799c38c156d8f0
39dae8330

SimHash for HTML

SimHash?



$$k = \frac{\text{markup length}}{64}$$

SimHash vs. Other Hashes

- md5(“aaaaaaa**a**aaaaaaa”)
  - ➔12f9cf6998d52dbe773b06f848bb3608
- md5(“aaaaaaa**b**aaaaaaa”)
  - ➔e984cee68697eb77577717b532171493

- simhash(“aaaaaaa**a**aaaaaaa”)
  - ➔8664ee964799**c3**8c156d8f039dae8330
- simhash(“aaaaaaa**b**aaaaaaa”)
  - ➔8664ee964799**a4**8c156d8f039dae8330

Why SimHash?

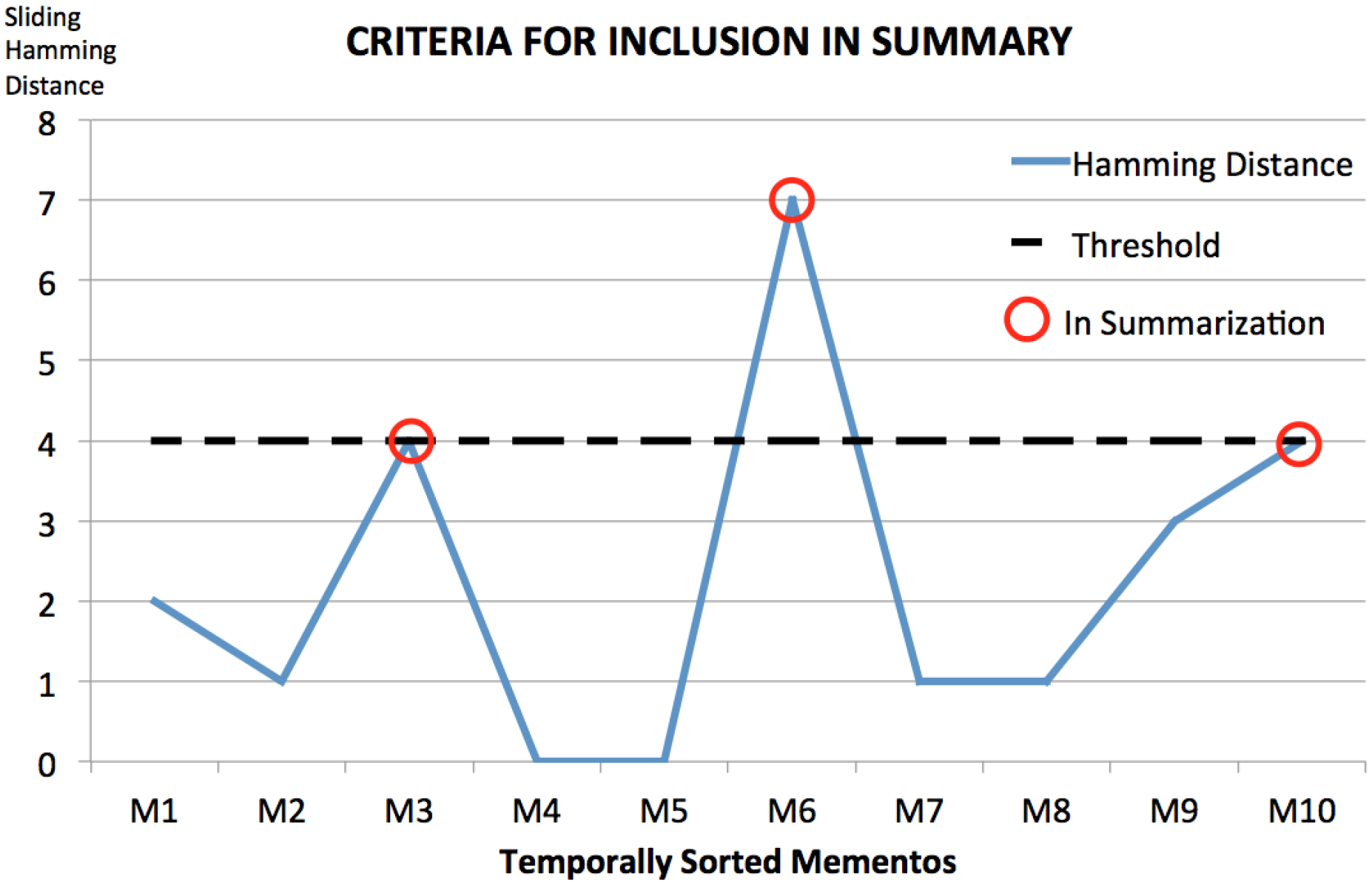
- SimHash identifies **similarities** between documents
- Conventional hashing algorithms are for identifying **differences**
  - Drastically different output from similar content
- To remove redundancies, we want to detect when temporally adjacent mementos are sufficiently dissimilar

SimHashes for Mementos

HTML of apple.com March 3, 2008	**c39f0abc...b9**
HTML of apple.com March 5, 2008	**c39d0abc...c9**
HTML of apple.com April 12, 2008	**c39d0abc...b9**
HTML of apple.com October 4, 2008	**c770ad1b...b9**

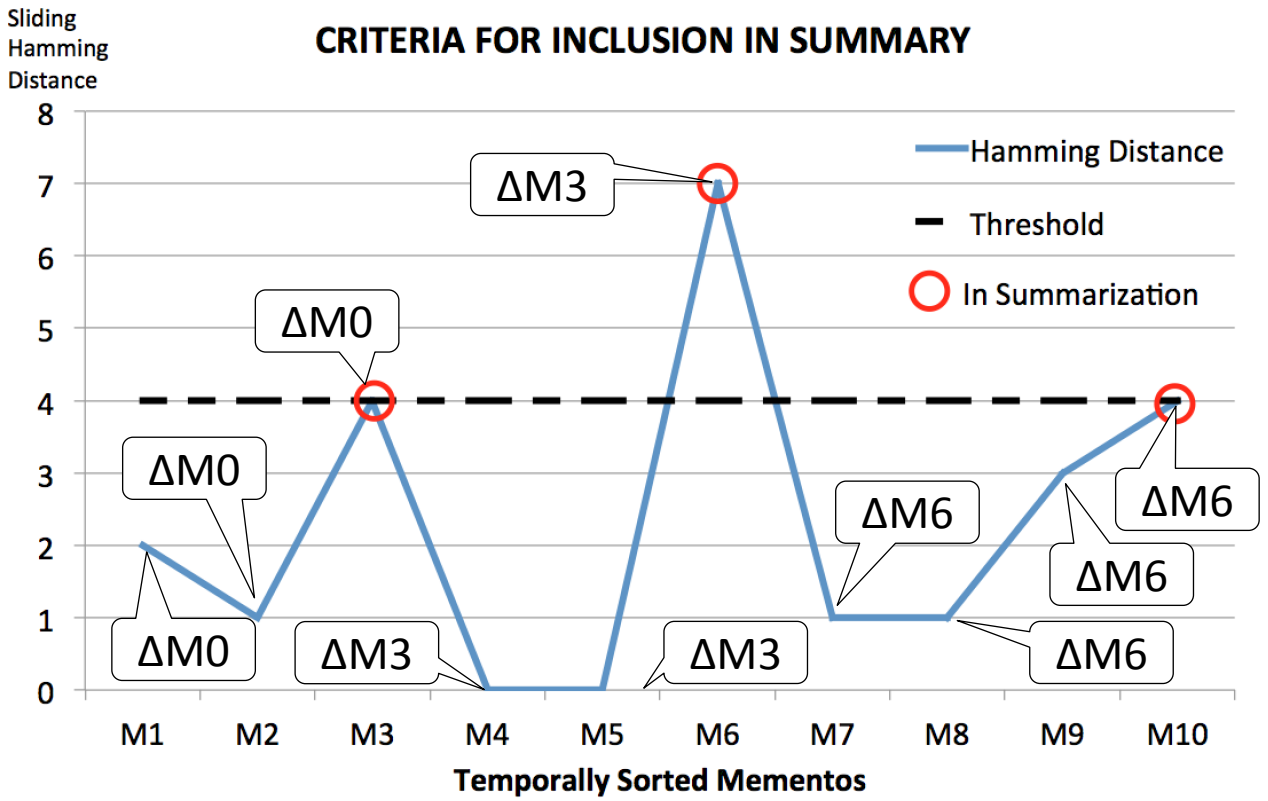
Identifying Similarity by Calculating Hamming Distance

		HAMMING DISTANCE
HTML of apple.com March 3, 2008	**c39f0abc...b9**	N/A pivot
HTML of apple.com March 5, 2008	**c39d0abc...c9**	2
HTML of apple.com April 12, 2008	**c39d0abc...b9**	1
HTML of apple.com October 4, 2008	**c770ad1b...b9**	7


CRITERIA FOR INCLUSION IN SUMMARY
Sliding Hamming Distance
8
7
6
5
4
3
2
1
0
Hamming Distance
Threshold
In Summarization
M1
M2
M3
M4
M5
M6
M7
M8
M9
M10
Temporally Sorted Mementos

Sliding Hamming Distance

- Selection based on previously selected memento
- Sliding pivot



Project Goals

Develop tools that implement thumbnail summarization for TimeMaps

- **Web Service**
  - Allows anyone to view TimeMap using thumbnail summarization
- **Wayback add-on**
  - Allows any archive using wayback to provide this service to users
- **Embeddable version**
  - Allow web page authors to embed overview of past versions of page on live web page

AlSummarization

- SimHash-based summarization scheme created by Ahmed AlSum
- AlSum + Summarization = AlSummarization

A. AlSum, and M. L. Nelson. “Thumbnail Summarization Techniques for Web Archives.” In Proceedings of the 36TH European Conference on Information Retrieval, ECIR 2014, 2014.

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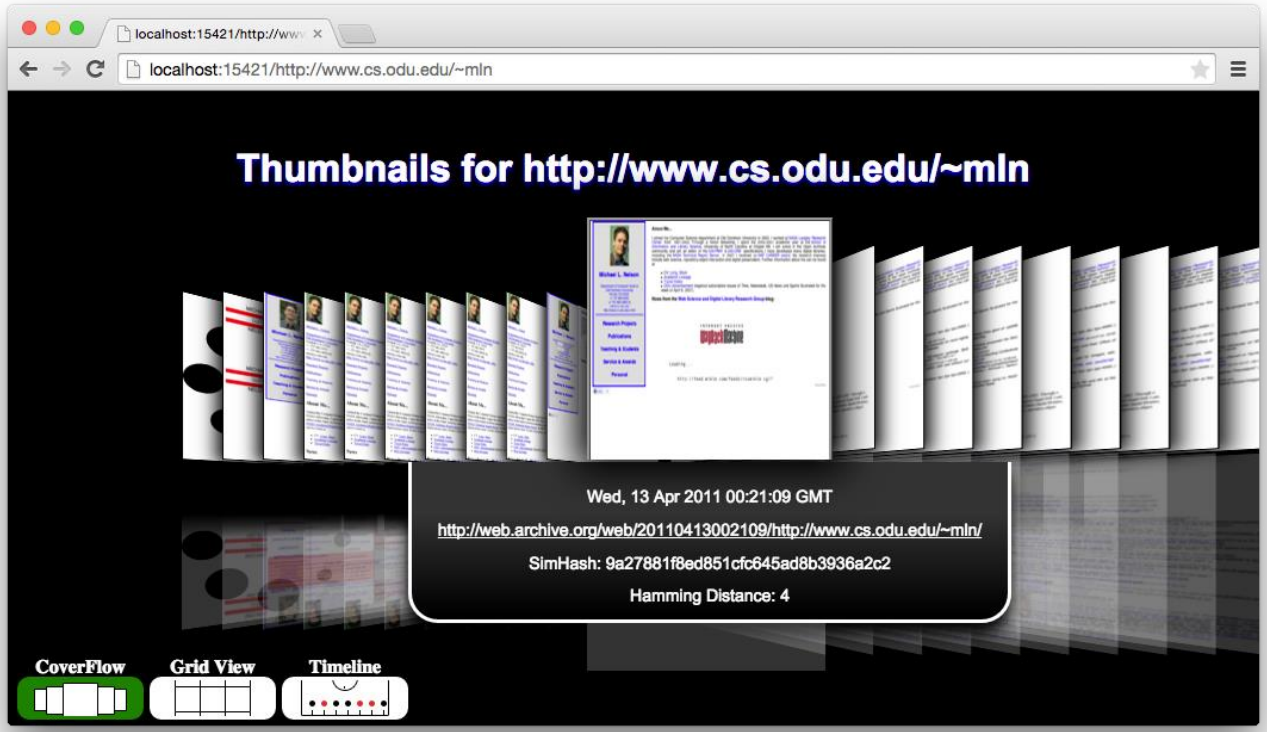
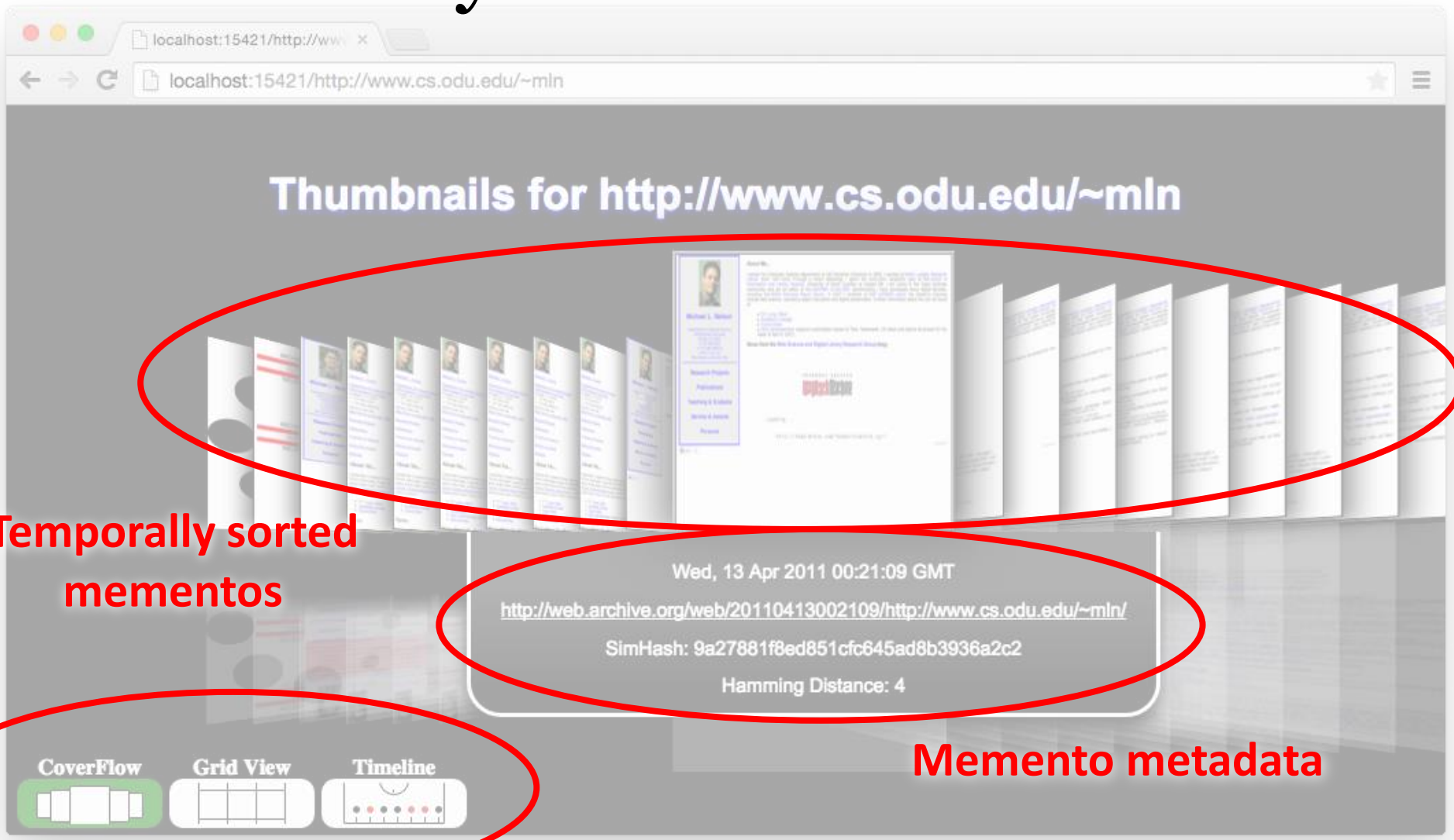
- URI-R: http://www.cs.odu.edu/~mln
- Append onto service URI for summary
  - http://service/http://www.cs.odu.edu/~mln



Anatomy of the Visualization



3 presentations of the Summary

Additional (optional) Endpoint Parameters

- **Access** – tailors user interface
  - Interactive, Embed, Wayback
- **Strategy** – to use alternative summarization
  - alSummarization, yearly, skipListed, random
- http://service/?
  - access=wayback&URI-R=http://www.cs.odu.edu/~mln
  - access=wayback&strategy=random&URI-R=http://www.cs.odu.edu/~mln

Programmatic Flow

User's Browser

Thumbnails Service

Memento-Compliant Archive

User Requests URI-R Summary

User's Browser

Thumbnails Service

Memento-Compliant Archive

Service Relays URI-R to Archive

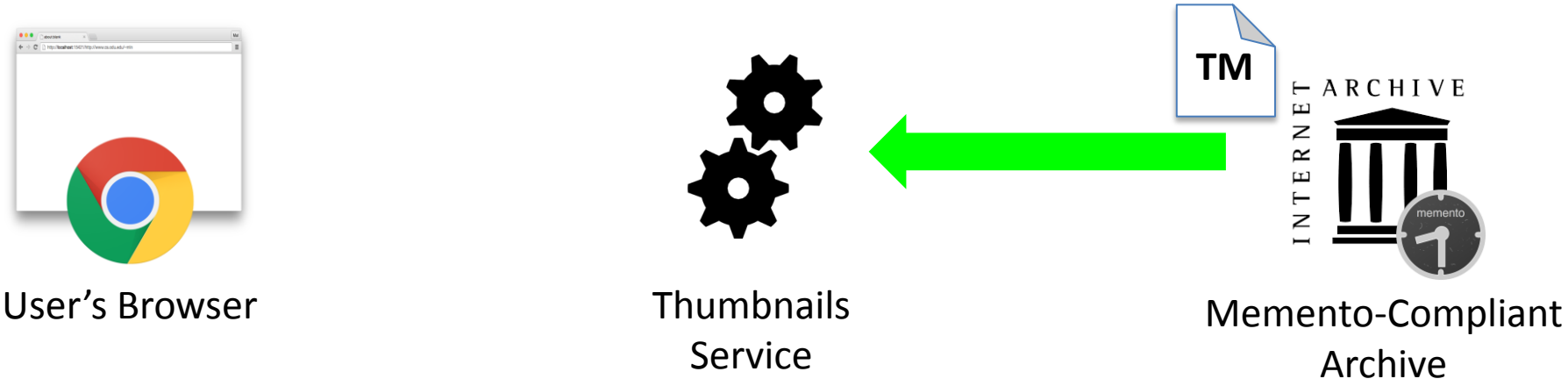
User's Browser

Thumbnails Service

Memento-Compliant Archive

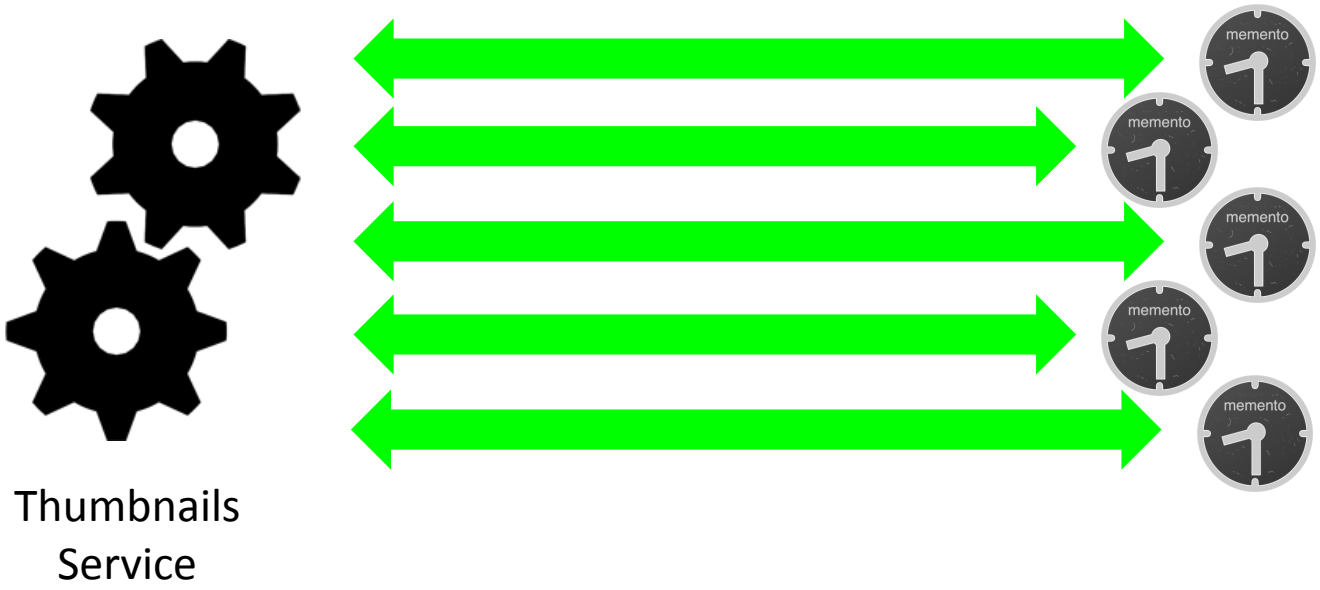
Service queries archive for all mementos for URI-R

URI-Ms returned to Service

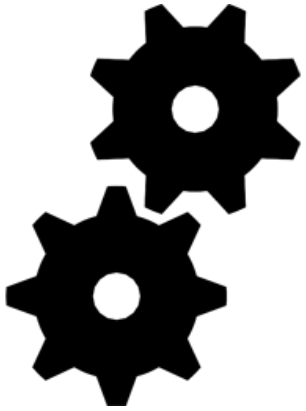


Archive returns TimeMap with URI-Ms to thumbnail service

Service fetches HTML for each Memento



Service generates SimHash for Each Mementos' HTML



Thumbnails Service

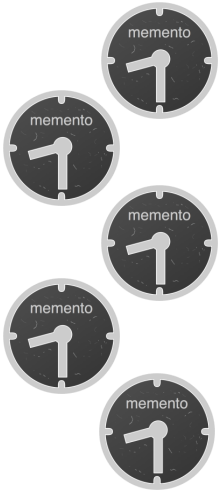
c39f0abc...b9

c39d0abc...c9

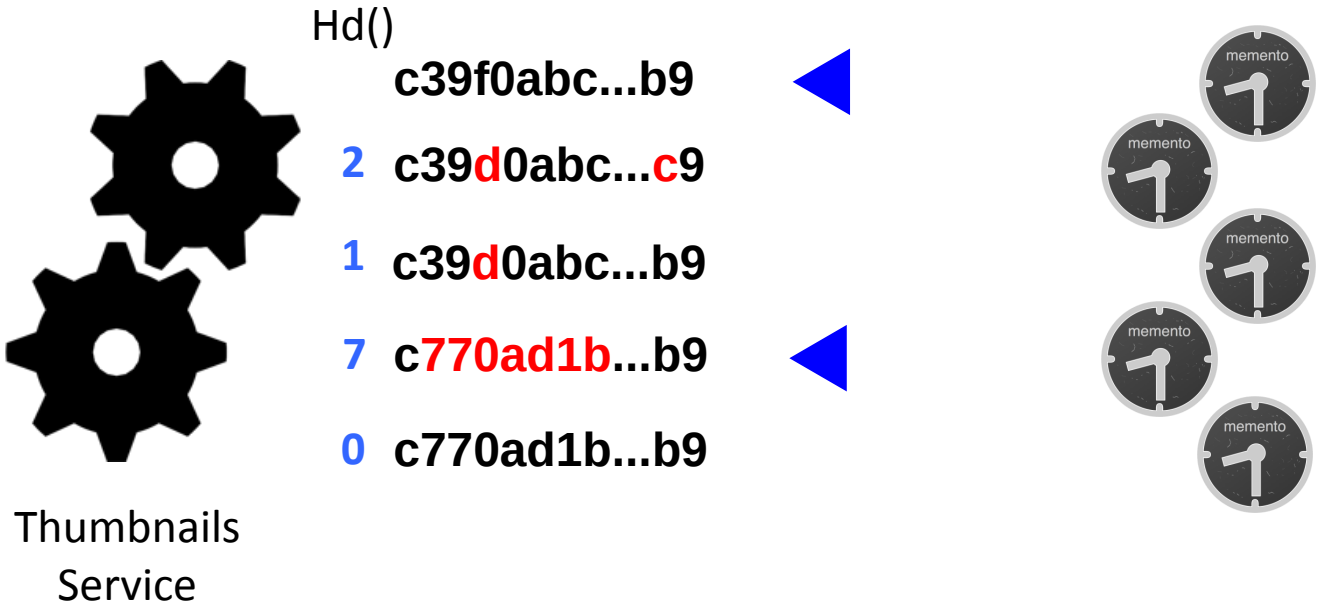
c39d0abc...b9

c770ad1b...b9

c770ad1b...b9

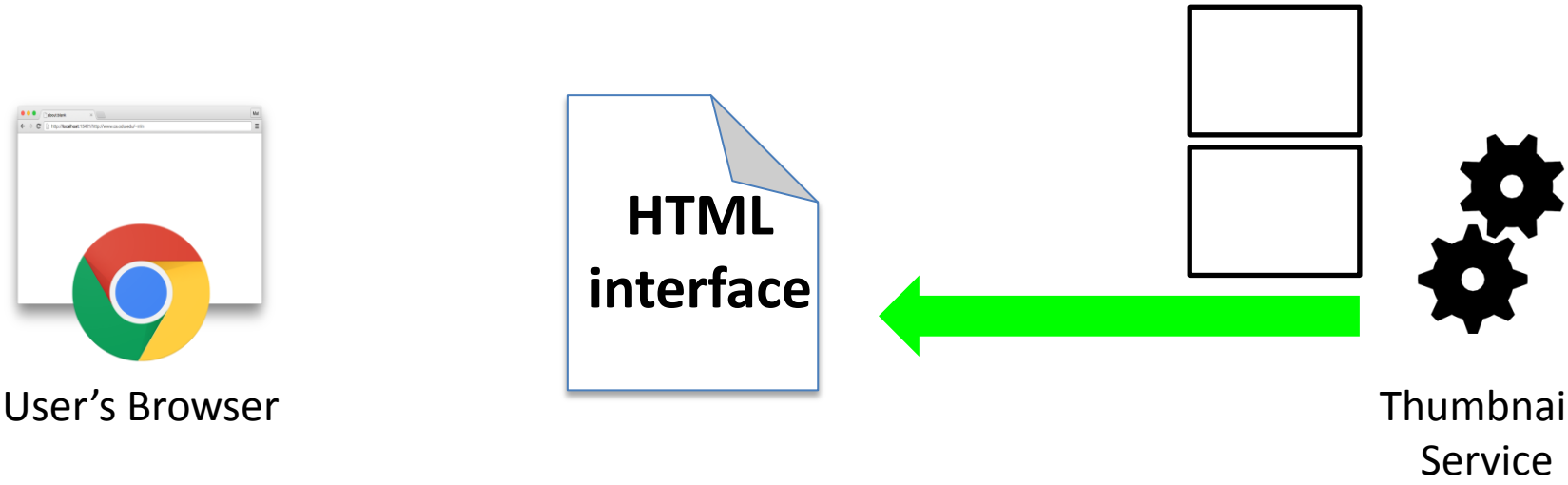


Service Calculates Hamming Distance



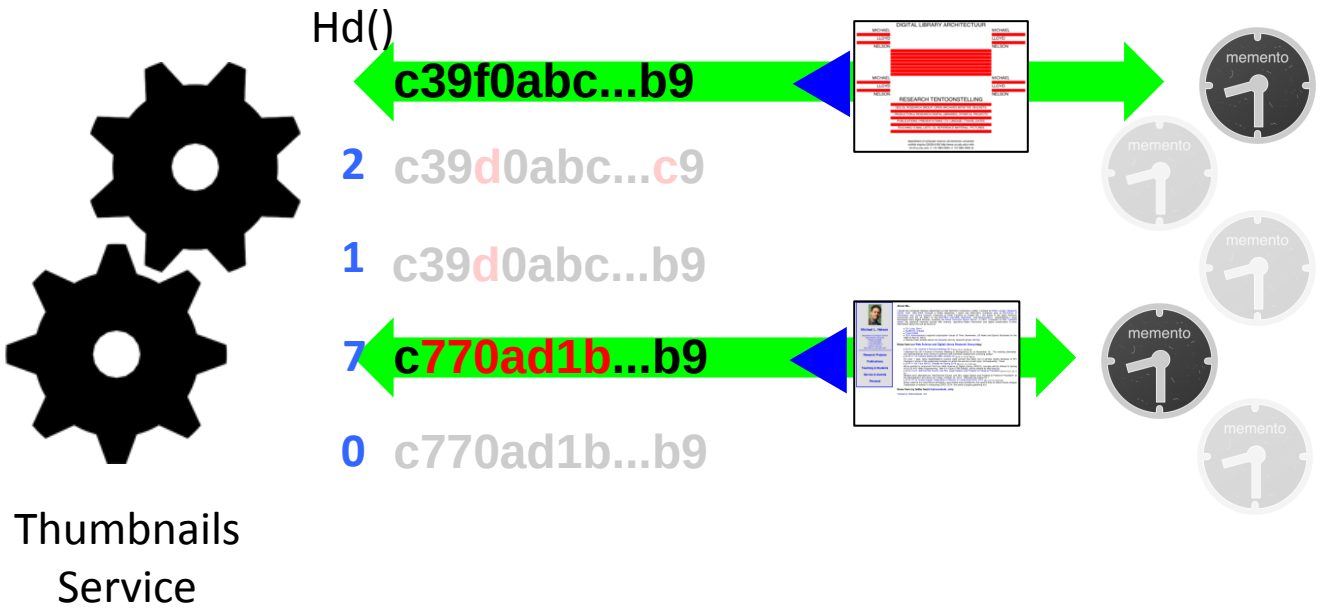
Mementos in summary selected based on hamming distance

Preliminary UI returned to user

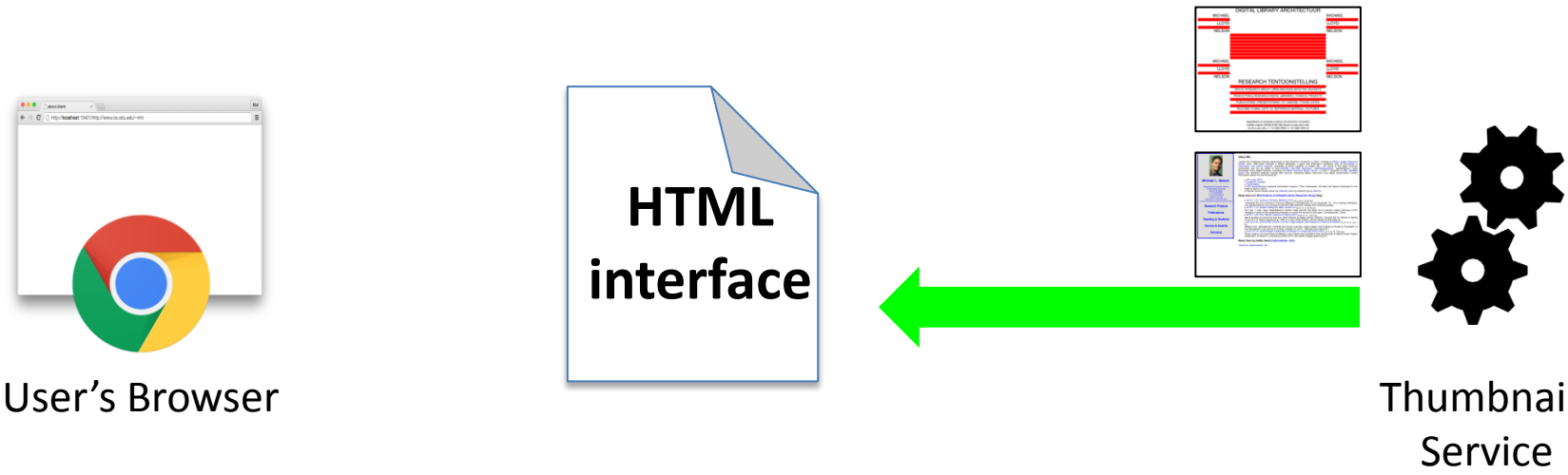


Templated HTML interface is returned to user with placeholders for thumbnails

Service Generates Thumbnails for Mementos in Summary



Thumbnails Served to User



Asynchronous polling from HTML pages populates placeholder images once available

Core Implementation

- 
-  for thumbnail generation
-  abstractions preserved for code reuse and extensibility
- Code documented to facilitate extensibility, usage, and fixes

http://github.com/machawk1/ArchiveThumbnails

Initializing the service

User/Service Administrator simply enters:

```
$ npm install
$ node alSummarization.js
```

Service responds and is ready for query:

```
* Local resource (css, js,etc.) server listening on Port 1338...
* Thumbnails service started on Port 15421
> Try localhost:15421/?URI-R=http://matkelly.com in your web browser for sample execution.
```

Online vs. Offline Generation

- Online Thumbnail Summarization
  - Fetch each mementos' HTML
  - Calculate SimHashes
  - Calculate Hamming Distance (HD)
  - Select Mementos That Pass HD threshold
  - Generate Thumbnails of Mementos
- Offline Thumbnail Summarization
  - All of the above performed a priori
  - Data potentially updated on access

Adaptive Strategies

- Very large TimeMaps are temporally expensive to generate
- Default behavior:

```
if(timeRequirement == tooLong):
    use(naiveStrategy)
```

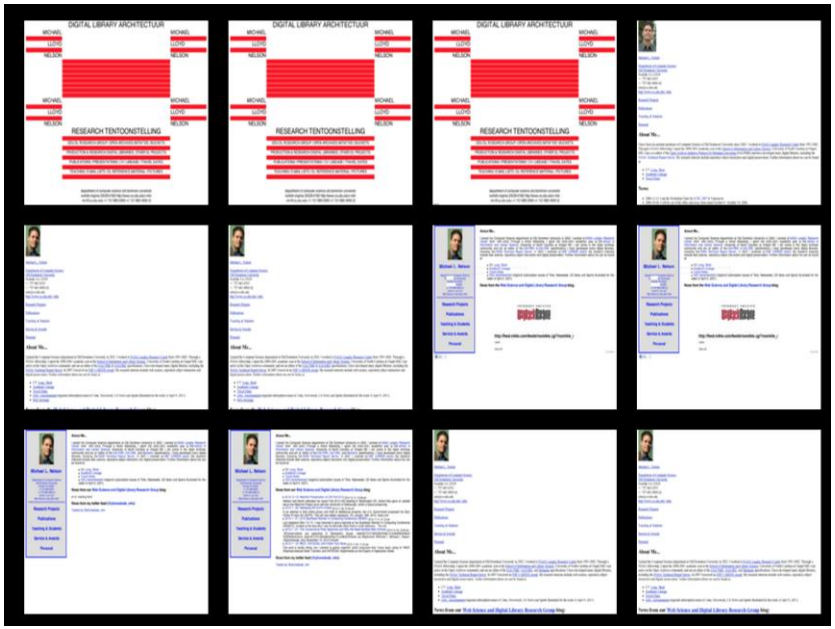
- User can explicitly override behavior

Other Summarization Strategies

- Random Selection
  - k mementos, uniform selection
- Interval
  - every m^{th} memento, $m = {}^{n}/_{k}$
- Temporal Interval
  - One memento/year, reverse chronological monthly back-fill

- Temporally Uniform Trimming when $k > 15$

Grid View
AlSummarization vs Random



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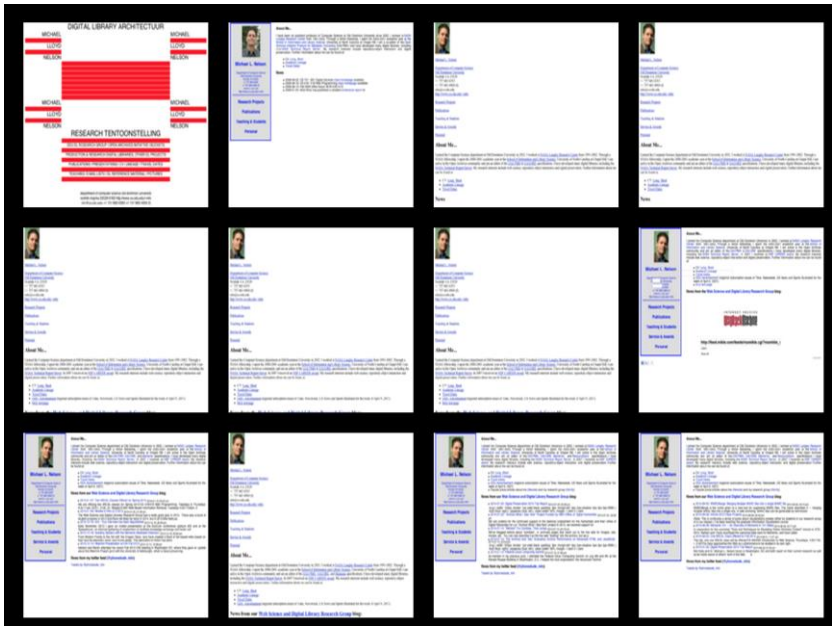
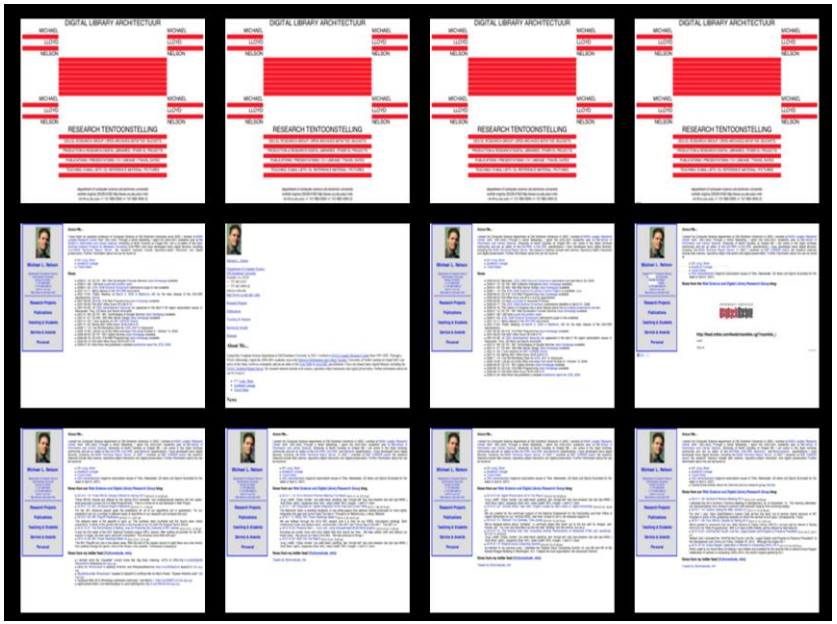
Random Strategy



Dr. Nelson's Homepage
AlSummarization Strategy

Grid View
AlSummarization vs Interval



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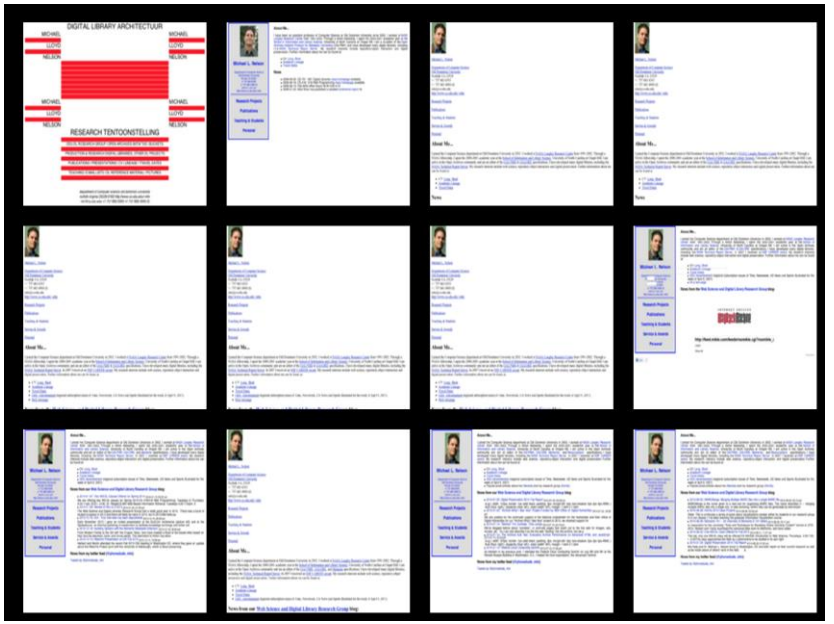
Interval Strategy



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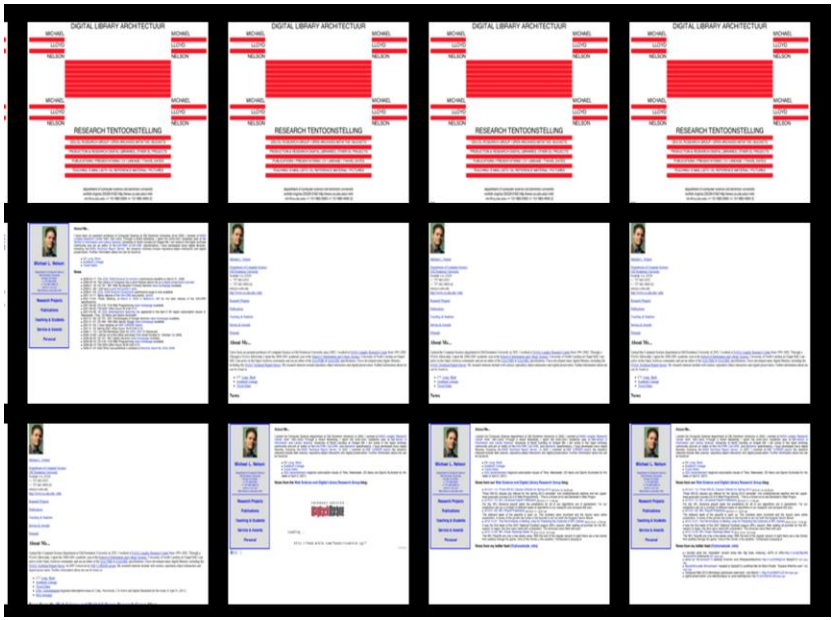
AlSummarization Strategy

Grid View
AlSummarization vs Temporal Interval



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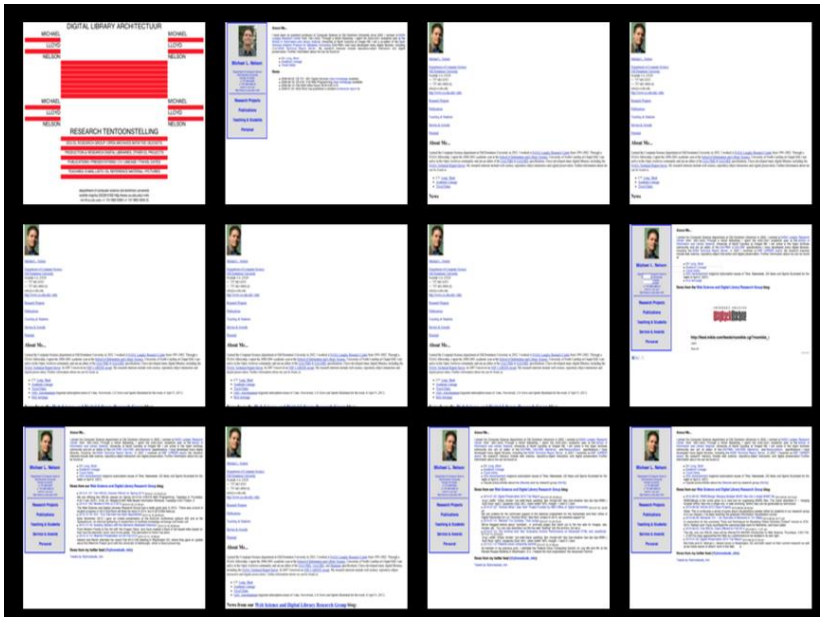
Temporal Interval Strategy



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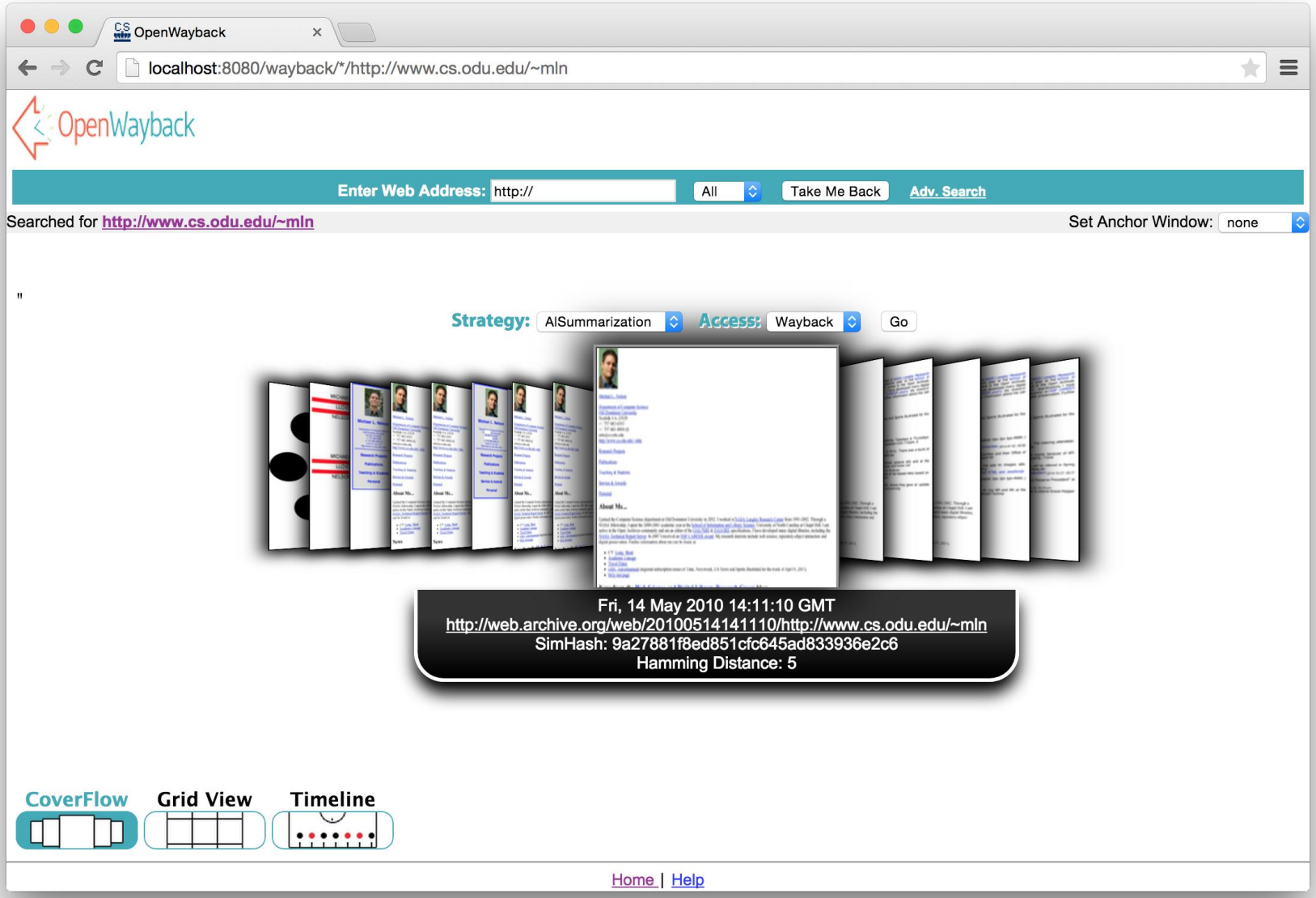
AlSummarization Strategy

Asynchronous Polling

Server-side SimHash Caching

Four Summarization Strategies

OpenWayback Integration



Service Embedding

- <object data=http://service/http://yourурl.com" type="text/html"> </object>

-or-

- <iframe src="http://service/http://yourурl.com"> </iframe>

Visualizing Digital Collections of Web Archives

- Codebase:
  - github.com/machawk1/ArchiveThumbnails
- Service URI:
  - http://wsdl-docker.cs.odu.edu:15421

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Live Demo