

# How do I figure out if I'm doing the right optimizations?

## Hyrax & IIIF as a case study

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Data Curation Experts



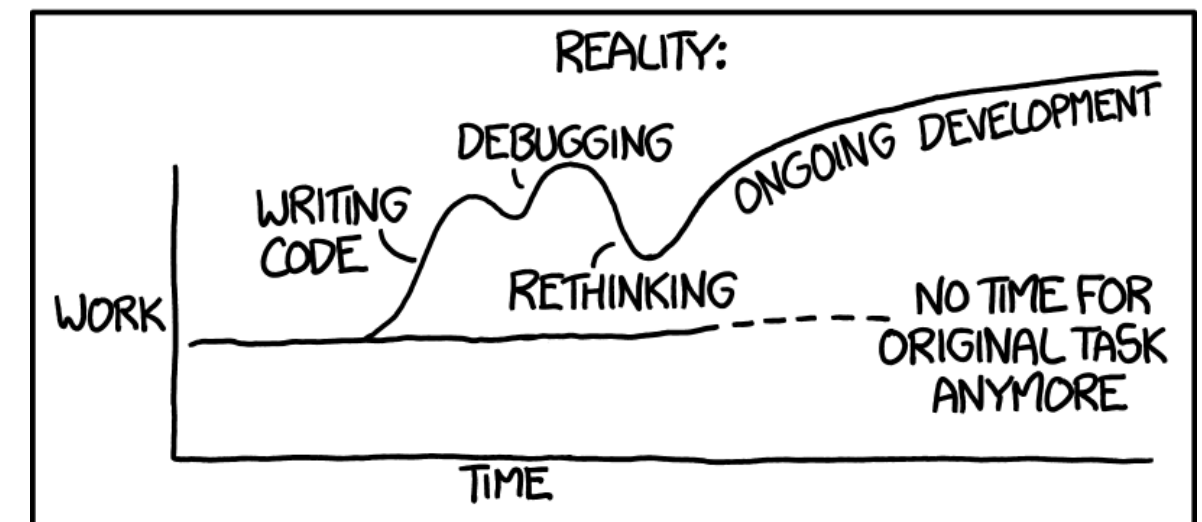
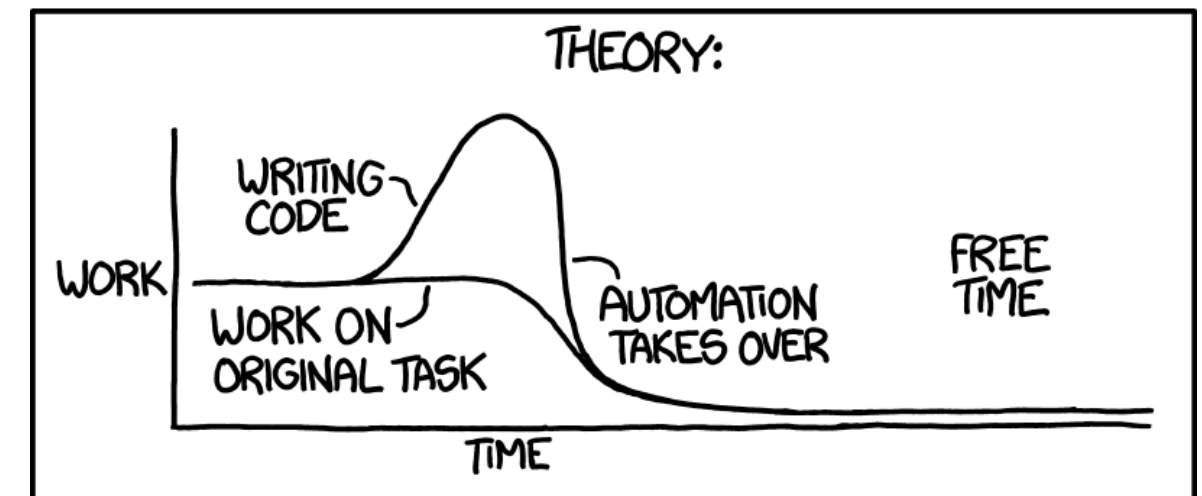
# The Optimization Problem

HOW LONG CAN YOU WORK ON MAKING A ROUTINE TASK MORE EFFICIENT BEFORE YOU'RE SPENDING MORE TIME THAN YOU SAVE?  
(ACROSS FIVE YEARS)

		HOW OFTEN YOU DO THE TASK					
		50/DAY	5/DAY	DAILY	WEEKLY	MONTHLY	YEARLY
HOW MUCH TIME YOU SHAVE OFF	1 SECOND	1 DAY	2 HOURS	30 MINUTES	4 MINUTES	1 MINUTE	5 SECONDS
	5 SECONDS	5 DAYS	12 HOURS	2 HOURS	21 MINUTES	5 MINUTES	25 SECONDS
	30 SECONDS	4 WEEKS	3 DAYS	12 HOURS	2 HOURS	30 MINUTES	2 MINUTES
	1 MINUTE	8 WEEKS	6 DAYS	1 DAY	4 HOURS	1 HOUR	5 MINUTES
	5 MINUTES	9 MONTHS	4 WEEKS	6 DAYS	21 HOURS	5 HOURS	25 MINUTES
	30 MINUTES		6 MONTHS	5 WEEKS	5 DAYS	1 DAY	2 HOURS
	1 HOUR		10 MONTHS	2 MONTHS	10 DAYS	2 DAYS	5 HOURS
	6 HOURS				2 MONTHS	2 WEEKS	1 DAY
	1 DAY					8 WEEKS	5 DAYS

<https://xkcd.com/1205/>

"I SPEND A LOT OF TIME ON THIS TASK.  
I SHOULD WRITE A PROGRAM AUTOMATING IT!"



<https://xkcd.com/1319/>

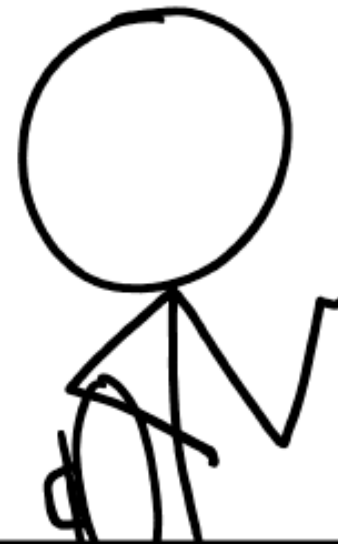
I'M TRYING TO FIGURE OUT WHICH OF THESE CREDIT CARD REWARDS PROGRAMS IS BEST GIVEN MY SPENDING.



BUT AT SOME POINT, THE COST OF THE TIME IT TAKES ME TO UNDERSTAND THE OPTIONS OUTWEIGHS THEIR DIFFERENCE IN VALUE.



SO I NEED TO FIGURE OUT WHERE THAT POINT IS, AND STOP BEFORE I REACH IT.  
BUT... WHEN I FACTOR IN THE TIME TO CALCULATE *THAT*, IT CHANGES THE OVERALL ANSWER.



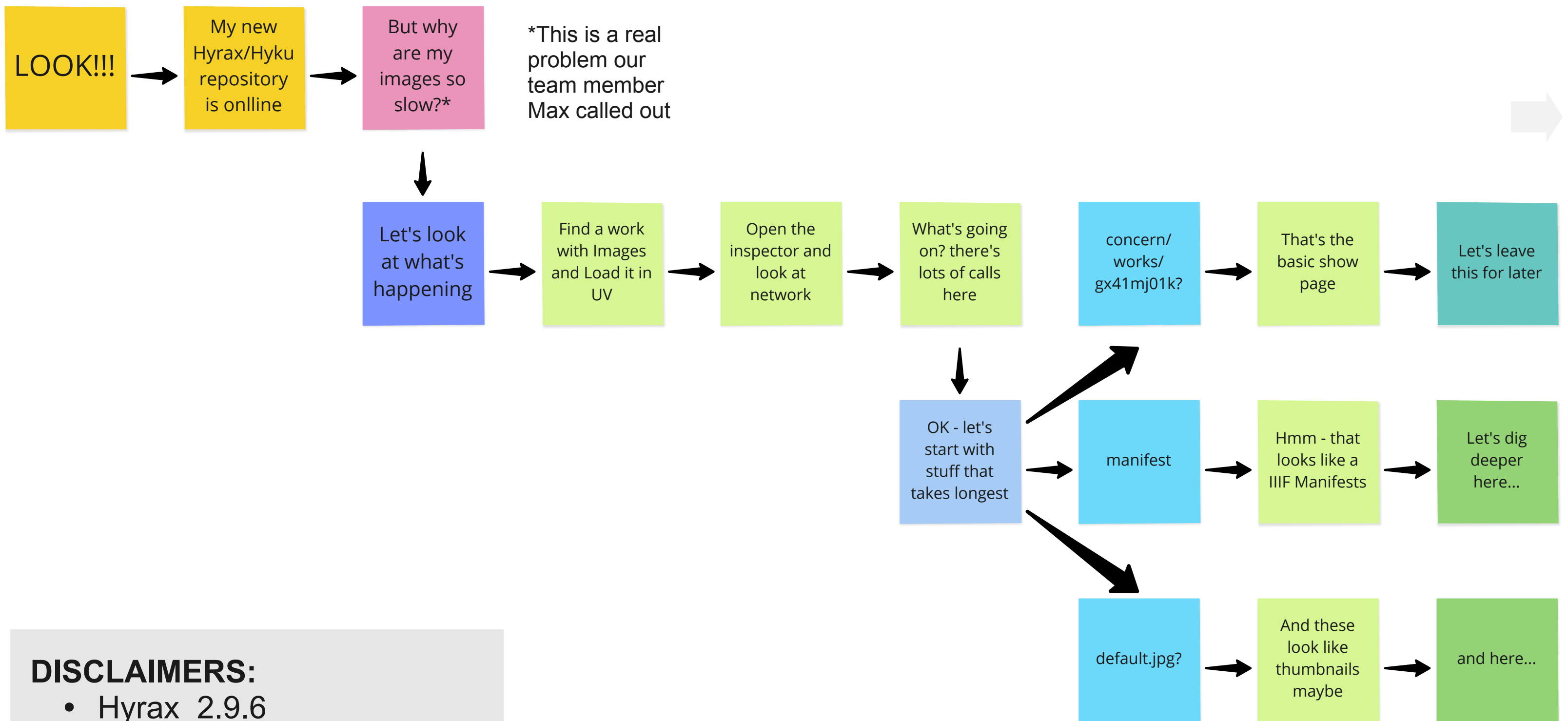
I QUESTION THE ASSUMPTION THAT YOU'D OTHERWISE BE SPENDING YOUR TIME ON SOMETHING MORE VALUABLE.

COME ON, I COULD BE FAILING TO OPTIMIZE SO MANY BETTER THINGS!



<https://xkcd.com/1908/>





## DISCLAIMERS:

- Hyrax 2.9.6
- Cantaloupe 5.0.3
- Your mileage will vary

## What we see (Single Image)

- Item view html: /concern/works/jm214p12r?locale=en
- CSS stylesheet
- Application Javascript + tinymce
- More Javascript and icons
- IIIF Manifest: /concern/works/jm214p12r/manifest
- More Javascript and icons (UV?)
- Images .../default.jpg

## DELAY



## PAYLOAD



## On a Multi-Image work

- IIIF Manifest
- Images

## DELAY



## PAYLOAD



## Zoom

- Images

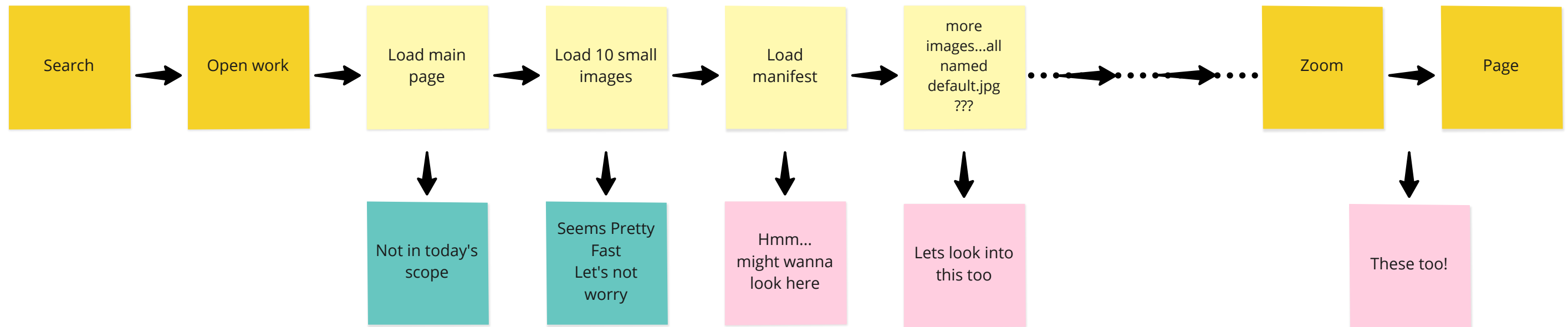
## DELAY



## PAYLOAD



# User Journey + Data Flow





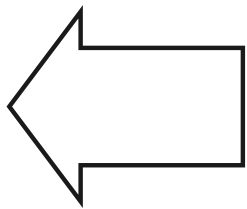
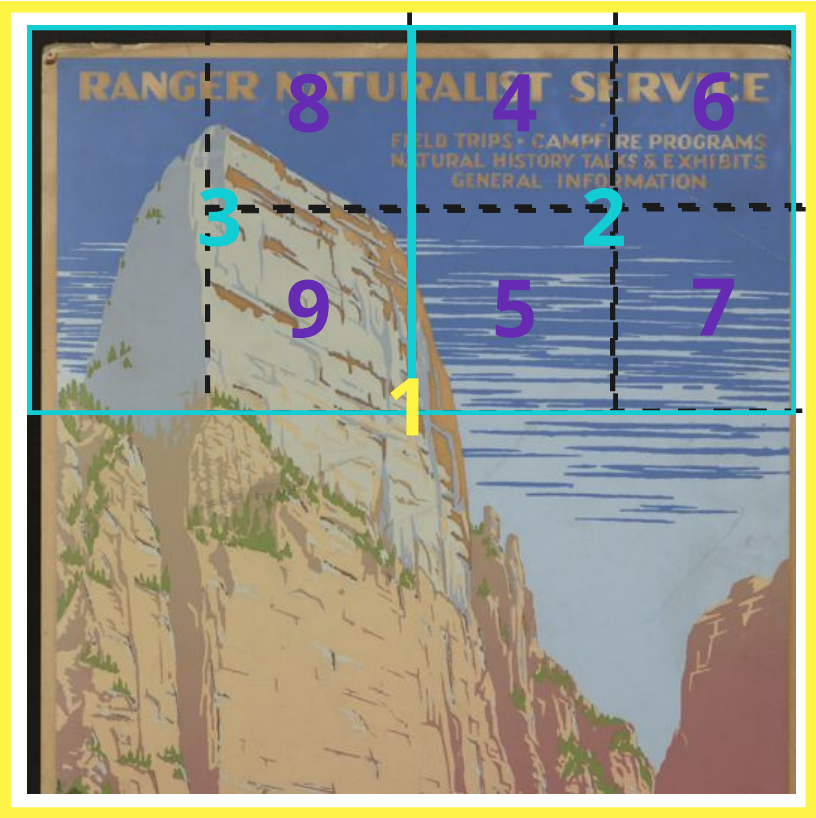
# Zooming in Universal Viewer

Preview <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/full/266./0/default.jpg>

- 1. <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/0.0.4096.4096/512./0/default.jpg>
- 2. <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/2048.0.2048.2048/512./0/default.jpg>
- 3. <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/0.0.2048.2048/512./0/default.jpg>
- 4. <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/2048.0.1024.1024/512./0/default.jpg>
- 5. <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/3072.0.1024.1024/512./0/default.jpg>
- 6. <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/2048.1024.1024.1024/512./0/default.jpg>
- 7. <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/3072.1024.1024.1024/512./0/default.jpg>
- 8. <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/1024.0.1024.1024/512./0/default.jpg>
- 9. <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/1024.1024.1024.1024/512./0/default.jpg>
- 10. <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/2560.512.512.512/512./0/default.jpg>
- 11. <https://tenejo.curationexperts.com/cantaloupe/iiif/2/sq87bt630%2Ffiles%2F04430f3b-a2e3-4b97-90f4-9151be0d3048%2Fcr:versions%2Fversion1/2560.0.512.512/512./0/default.jpg>

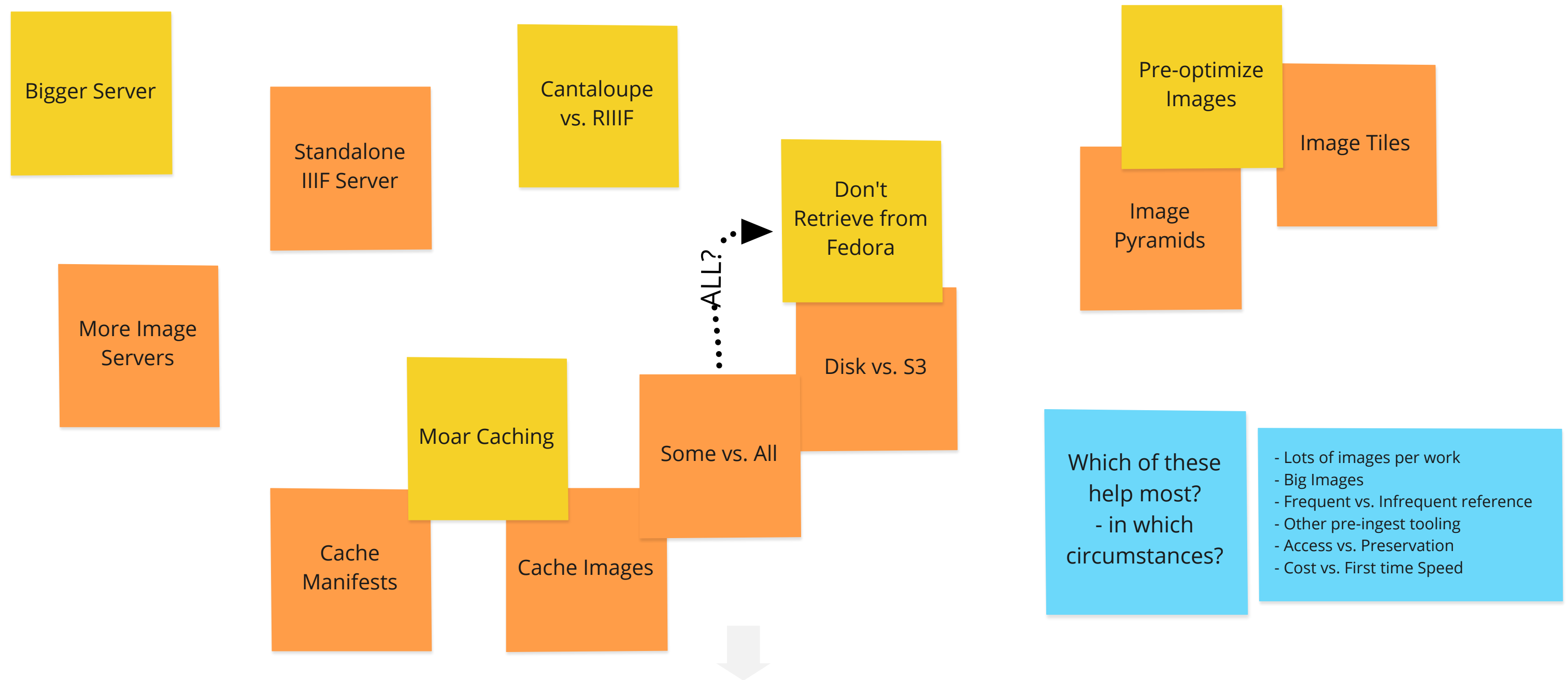
etc...

- Preview 266px
- Zoom x1 - 4096px - Tile 1 —> 512x512 tile
- Zoom x2 - 2048px - Tile 2 - right
- Zoom x2 - 2048px - Tile 3 - left
- Zoom x4 - 1024px - Tile 4
- Zoom x4 - 1024px - Tile 5
- Zoom x4 - 1024px - Tile 6
- Zoom x4 - 1024px - Tile 7
- Zoom x4 - 1024px - Tile 8
- Zoom x4 - 1024px - Tile 9
- Zoom x8 - 512px - Tile 10
- Zoom x8 - 512px - Tile 11
- Zoom x8 - 512px - Tile 12
- Zoom x8 - 512px - Tile 13
- Zoom x8 - 512px - Tile 14
- Zoom x8 - 512px - Tile 15
- Zoom x8 - 512px - Tile 16
- Zoom x8 - 512px - Tile 17
- Zoom x8 - 512px - Tile 18
- Zoom x8 - 512px - Tile 19
- Zoom x8 - 512px - Tile 20
- Zoom x8 - 512px - Tile 21
- Zoom x8 - 512px - Tile 22
- Zoom x8 - 512px - Tile 23
- Zoom x8 - 512px - Tile 24
- Zoom x8 - 512px - Tile 25



All the tiles needed to fill the screen at the current resolution, plus the tiles needed for each level of zoom out from there...

# Possible Interventions





# Set comparison metrics

Time to load  
manifest  
single image  
work

Time to load  
manifest  
many image  
work

Thumbnail  
sized image

Zoomed  
Image

Preview Sized  
Image

Scroll  
through toc

Load All  
images



## Test Script

- Single Image Work
  - Load manifest
  - Load preview image(s)
- Zoom
- Multi Image Work
  - Load manifest
  - Load preview image(s)
  - Page to title page
  - Scroll to Page 64 (i.e. a pretty image)
  - Rotate



# Test Plan

**v1** - Benchmark - Hyrax + RIIIF - t3a.xlarge

**v2** - Money - t3a.2xlarge

**v3** - Rails cache - clean vs. warm

**v4** - Cantaloupe

**v5** - Cantaloupe + cache - clean vs. warm

**v6** - Cantaloupe + ptiff

# v1 - Benchmark

Capture key requests into a JMeter script  
Run against an unmodified\* version of the application

EC2: t3a.xlarge

Hyrax: 2.9.6

IIIF Server: riiif

Manifest Cache: off

Cantaloupe Cache: n/a

PTIFFS: n/a

IIIF Benchmarking.jmx (/Users/mark/\_no\_backup\_/IIIF Benchmarking.jmx) - Apache JMeter (5.4.1)

IIIF Benchmarking

- A. Single
- C. Zoom
- B. Multi
- View Results Tree
- Summary Report

Summary Report

Name: Summary Report

Comments: v1 - Benchmark

Write results to file / Read from file

Filename 

Browse...

 Log/Display Only: ☐ Errors ☐ Successes 

Configure

Label	# Sam...	Average	Min	Max	Std. Dev.	Error %	Throughput	Received...	Sent KB/sec	Avg. Bytes
C. Zoom:x8 - tile 01	15	189	64	877	242.30	0.00%	30.4/min	23.94	0.23	28234.8
C. Zoom:x8 - tile 07	15	208	70	840	259.12	0.00%	1.2/sec	32.60	0.29	27515.8
B. Multi:Navigation Pane	15	130	60	852	193.62	0.00%	34.6/min	2.76	0.13	4904.2
B. Multi:Contents 09	15	212	60	865	287.42	0.00%	51.7/min	1.82	0.21	2158.8
C. Zoom:x2 - tile 2	15	224	64	891	286.56	0.00%	39.7/min	25.70	0.16	39748.2
C. Zoom:x8 - tile 02	15	224	68	909	301.35	0.00%	58.8/min	25.95	0.24	27137.5
C. Zoom:x4 - tile 5	15	221	62	913	287.09	0.00%	51.5/min	25.38	0.21	30268.6
C. Zoom:x8 - tile 03	15	201	64	950	268.28	0.00%	1.0/sec	27.20	0.25	27087.0
C. Zoom:x4 - tile 3	15	228	68	981	302.74	0.00%	46.9/min	27.50	0.19	36035.0
A. Single:Manifest	15	273	109	987	217.75	0.00%	47.7/min	1.54	0.12	1984.2
B. Multi:Contents 06	15	216	64	993	295.13	0.00%	45.6/min	1.89	0.19	2545.8
C. Zoom:x2 - tile 1	15	256	72	994	335.80	0.00%	38.3/min	28.12	0.16	45088.7
B. Multi:Contents 07	15	258	63	1040	362.68	0.00%	47.4/min	1.72	0.19	2236.8
C. Zoom:x4 - tile 6	15	249	70	1045	331.08	0.00%	54.1/min	36.90	0.22	41893.0
B. Multi:Contents 05	15	260	62	1060	374.87	0.00%	43.7/min	1.64	0.18	2308.8
B. Multi:Contents 02	15	276	60	1182	408.17	0.00%	39.8/min	2.01	0.16	3103.0
C. Zoom:x1	15	318	73	1197	381.61	0.00%	36.6/min	31.78	0.15	53395.2
B. Multi:x1 - tile 1	15	285	68	1226	390.03	0.00%	36.1/min	47.22	0.14	80391.1
C. Zoom:x4 - tile 4	15	280	71	1287	412.25	0.00%	48.6/min	26.17	0.20	33074.7
B. Multi:x1 - tile 2	15	274	58	1288	415.41	0.00%	37.3/min	10.23	0.15	16860.7
C. Zoom:Preview	15	379	69	1514	527.79	0.00%	34.8/min	13.99	0.13	24702.1
C. Zoom:x4 - tile 2	15	345	65	1534	524.50	0.00%	44.2/min	23.62	0.18	32859.9
A. Single:Contents Pane Thu...	15	411	61	1762	625.61	0.00%	2.6/sec	20.64	0.60	8117.4
C. Zoom:x4 - tile 1	15	386	63	1794	623.29	0.00%	40.8/min	22.85	0.17	34400.0
A. Single:Navigation Pane	15	670	62	2958	1062.97	0.00%	1.2/sec	3.52	0.27	3104.0
B. Multi:Manifest	15	2058	1527	3260	499.94	0.00%	31.5/min	113.04	0.08	220563.0
A. Single:Icon Sized	15	863	64	4423	1533.71	0.00%	1.5/sec	2.49	0.34	1715.0
A. Single:Faviocon sized	15	1359	70	6990	2461.13	0.00%	48.4/min	1.00	0.19	1274.0
TOTAL	780	291	58	6990	609.03	0.00%	25.9/sec	603.02	6.18	23846.3

☒ Include group name in label? 

Save Table Data

☒ Save Table Header

## KEY INSIGHTS

- UV makes lots of image requests
- Uncached Images can take 1-6 seconds to load
- Multi-image manifest is slow
- Image sizes are all relatively small
- Re-running with warmed image cache still has some slow response times



# v2 - Money

Move the application to a server with 2x capacity  
Re-run the test scripts

EC2: **t3a.2xlarge**

Hyrax: 2.9.6

IIIF Server: riif

Manifest Cache: off

Cantaloupe Cache: n/a

PTIFFS: n/a

IIIF Benchmarking.jmx (/Users/mark/\_no\_backup\_/IIIF Benchmarking.jmx) - Apache JMeter (5.4.1)

IIIF Benchmarking

- A. Single
- C. Zoom
- B. Multi
  - View Results Tree
  - Summary Report

Summary Report

Name: Summary Report

Comments: v2 - Money (2xlarge)

Write results to file / Read from file

Filename  Browse...

Log/Display Only: ☐ Errors ☐ Successes

Label	# Sam...	Average	Min	Max	Std. Dev.	Error %	Throughput	Receive...	Sent KB/...	Avg. Bytes
C. Zoom:x4 - tile 5	15	209	63	840	237.71	0.00%	40.5/min	22.80	0.19	30208.0
B. Multi:Contents 08	15	204	55	853	231.50	0.00%	41.7/min	1.58	0.17	2324.8
B. Multi:Contents 13	15	212	58	898	260.85	0.00%	49.4/min	2.33	0.20	2895.2
C. Zoom:x8 - tile 07	15	213	57	919	254.32	0.00%	1.1/sec	28.50	0.26	27515.8
B. Multi:Contents 12	15	219	53	930	291.53	0.00%	47.8/min	1.75	0.20	2251.8
C. Zoom:x4 - tile 2	15	234	61	931	279.14	0.00%	41.9/min	22.39	0.17	32859.7
B. Multi:Contents 10	15	248	56	1023	313.74	0.00%	44.2/min	1.93	0.18	2683.8
B. Multi:Contents 11	15	218	56	1027	303.48	0.00%	45.8/min	2.34	0.19	3147.8
C. Zoom:x4 - tile 3	15	257	59	1028	325.28	0.00%	43.2/min	25.34	0.18	36035.0
C. Zoom:x8 - tile 03	15	263	62	1044	339.95	0.00%	53.3/min	23.49	0.22	27087.0
C. Zoom:x8 - tile 05	15	240	58	1063	298.94	0.00%	57.9/min	20.98	0.24	22256.2
B. Multi:Preview Image	15	294	57	1069	387.15	0.00%	32.6/min	10.26	0.13	19345.0
A. Single:Preview Image	15	273	86	1073	227.87	0.00%	2.3/sec	56.43	0.55	24706.7
B. Multi:Contents 07	15	267	54	1113	358.51	0.00%	40.4/min	1.47	0.17	2236.8
C. Zoom:x8 - tile 06	15	271	63	1195	362.09	0.00%	1.0/sec	27.59	0.24	28202.8
C. Zoom:x4 - tile 6	15	276	58	1210	358.43	0.00%	47.7/min	32.53	0.20	41893.0
A. Single:Manifest	15	398	99	1211	304.87	0.00%	44.9/min	1.46	0.12	1996.2
C. Zoom:x2 - tile 2	15	273	61	1217	370.52	0.00%	38.9/min	25.14	0.16	39749.1
B. Multi:x1 - tile 1	15	405	61	1310	474.18	0.00%	33.7/min	44.12	0.14	80392.1
C. Zoom:x2 - tile 1	15	350	61	1475	481.61	0.00%	36.9/min	27.07	0.15	45089.9
C. Zoom:Preview	15	312	63	1496	458.04	0.00%	31.9/min	12.82	0.12	24699.7
A. Single:Contents Pane Thu...	15	465	72	1921	616.28	0.00%	2.0/sec	15.55	0.46	8115.8
B. Multi:Navigation Pane	15	403	57	2362	681.79	0.00%	30.1/min	2.40	0.12	4904.2
C. Zoom:x1	15	753	70	3020	1080.85	0.00%	33.4/min	29.03	0.13	53394.9
B. Multi:Manifest	15	2205	1579	3233	496.52	0.00%	27.9/min	101.17	0.07	222670.6
A. Single:Navigation Pane	15	490	68	3452	896.91	0.00%	1.1/sec	3.27	0.25	3104.0
A. Single:Icon Sized	15	927	78	4092	1457.34	0.00%	1.4/sec	2.27	0.32	1715.0
A. Single:Favicoon sized	15	1551	76	8454	2853.44	0.00%	45.1/min	0.94	0.17	1274.0
TOTAL	780	320	53	8454	663.99	0.00%	23.2/sec	541.55	5.58	23887.0

☒ Include group name in label?  ☒ Save Table Header

## KEY INSIGHTS

- 2x the cost does not get 2x performance
- Average and Max times are actually somewhat worse
- With a warmed cache, average performance is only about 25% better than a t3a.xlarge
- Hourly on-demand = \$1,314 (reserved and university rates are lower)

Warmed

Average
70
70
70
70
70
70
71
71
71
71
71
71
71
71
71
71
72
72
72
74
75
75
75
80
81
83
100
109
118
241
76

# v3 - Manifest Cache

Turn on IIIF Manifest caching in the application  
Re-run the test scripts

EC2:	t3a.xlarge
Hyrax:	2.9.6
IIIF Server:	riiif
Manifest Cache:	on
Cantaloupe Cache:	n/a
PTIFFS:	n/a

IIIF Benchmarking.jmx (/Users/mark/\_no\_backup\_/IIIF Benchmarking.jmx) - Apache JMeter (5.4.1)

00:00:12 0 0/9

**Summary Report**

Name: Summary Report

Comments: v3 - Manifest Cache

Write results to file / Read from file

Filename: Browse... Log/Display Only: ☐ Errors ☐ Successes

Label	# Sam...	Average	Min	Max	Std. Dev.	Error %	Throughput	Receive...	Sent KB/...	Avg. Bytes
A. Single:Navigation Pane	15	78	68	116	11.52	0.00%	5.6/sec	16.96	1.29	3104.0
B. Multi:Contents 02	15	85	64	118	16.51	0.00%	1.8/sec	5.46	0.44	3103.0
B. Multi:Contents 05	15	81	63	118	13.92	0.00%	1.8/sec	4.09	0.45	2308.8
C. Zoom:x8 - tile 06	15	87	69	119	12.52	0.00%	1.5/sec	42.28	0.37	28202.8
B. Multi:Contents 03	15	88	76	121	10.79	0.00%	1.8/sec	76.73	0.44	43512.8
C. Zoom:x8 - tile 04	15	86	65	123	14.33	0.00%	1.5/sec	45.75	0.37	30602.8
C. Zoom:x8 - tile 05	15	86	70	123	14.70	0.00%	1.5/sec	33.35	0.37	22257.0
B. Multi:Contents 16	15	81	66	123	15.24	0.00%	1.8/sec	8.32	0.43	4844.3
B. Multi:Contents 01	15	84	67	124	15.11	0.00%	1.8/sec	6.96	0.44	3971.0
C. Zoom:x4 - tile 2	15	93	76	127	16.91	0.00%	1.5/sec	48.97	0.37	32860.0
C. Zoom:x4 - tile 1	15	94	76	132	16.19	0.00%	1.5/sec	51.13	0.37	34400.0
C. Zoom:x8 - tile 01	15	90	62	132	17.53	0.00%	1.5/sec	42.07	0.37	28255.2
A. Single:Preview Image	15	89	70	136	18.25	0.00%	5.6/sec	134.70	1.29	24707.7
C. Zoom:x4 - tile 3	15	93	73	139	15.05	0.00%	1.5/sec	53.67	0.38	36035.0
C. Zoom:x8 - tile 14	15	87	67	141	16.62	0.00%	1.5/sec	61.34	0.37	41120.8
C. Zoom:x8 - tile 03	15	89	70	143	19.93	0.00%	1.5/sec	40.43	0.37	27087.0
C. Zoom:x4 - tile 4	15	91	73	146	18.12	0.00%	1.5/sec	49.37	0.38	33075.3
B. Multi:x1 - tile 1	15	99	81	147	19.02	0.00%	1.8/sec	140.24	0.43	80392.9
B. Multi:Contents 15	15	87	68	150	23.69	0.00%	1.8/sec	6.98	0.43	4064.0
C. Zoom:x2 - tile 1	15	92	71	159	20.65	0.00%	1.5/sec	67.11	0.37	45087.9
C. Zoom:x8 - tile 08	15	93	69	161	26.79	0.00%	1.5/sec	35.62	0.37	23805.4
B. Multi:Contents 12	15	87	61	182	28.43	0.00%	1.8/sec	3.95	0.44	2251.8
A. Single:Manifest	15	134	91	242	46.82	0.00%	5.2/sec	10.13	0.80	1984.2
C. Zoom:x1	15	125	71	242	59.67	0.00%	1.5/sec	79.00	0.36	53394.0
B. Multi:Contents 13	15	105	65	243	53.02	0.00%	1.8/sec	5.00	0.44	2895.2
C. Zoom:Preview	15	113	71	264	65.77	0.00%	1.5/sec	36.47	0.35	24702.5
B. Multi:Manifest	15	310	195	581	114.69	0.00%	1.7/sec	366.73	0.26	220561.7
TOTAL	780	92	59	581	41.74	0.00%	64.1/sec	1491.93	15.28	23846.3

☒ Include group name in label?  ☒ Save Table Header

## KEY INSIGHTS

- Manifest caching reduces average load time by over 85% (>1.2s)
- Aggregate averages are 3x faster (92ms vs 291ms)
- Average response time varies between 100-200ms with caches (Which still means a few seconds for all images in a multi-image work to load)



# v4 - Cantaloupe

Configure the application to use Cantaloupe instead of RIIF  
Modify the test script to call the cantaloupe endpoint  
Re-run the test scripts

EC2:	t3a.xlarge
Hyrax:	2.9.6
IIIF Server:	<b>cantaloupe</b>
Manifest Cache:	on
Cantaloupe Cache:	off
PTIFFS:	n/a

IIIF Benchmarking.jmx (/Users/mark/\_no\_backup\_/IIIF Benchmarking.jmx) - Apache JMeter (5.4.1)

IIIF Benchmarking

- A. Single
- C. Zoom
- B. Multi
- View Results Tree
- Summary Report

Summary Report

Name: Summary Report

Comments: v4 - Cantaloupe

Write results to file / Read from file

Filename  Browse...

Log/Display Only: ☐ Errors ☐ Successes

Configure

Label	# Sam...	Average	Min	Max	Std. Dev.	Error %	Throughput	Receive...	Sent KB/...	Avg. Bytes
B. Multi:Contents 08	15	416	324	767	110.98	0.00%	12.6/min	3.91	0.05	19024.0
C. Zoom:x8 - tile 08	15	455	305	781	124.00	0.00%	22.1/min	0.75	0.09	2087.8
B. Multi:Contents 05	15	442	299	812	161.28	0.00%	12.6/min	3.59	0.05	17571.0
C. Zoom:x8 - tile 05	15	652	513	842	97.87	0.00%	12.4/min	6.76	0.05	33392.0
C. Zoom:x4 - tile 6	15	670	509	855	112.66	0.00%	12.3/min	5.88	0.05	29294.0
B. Multi:x1 - tile 1	15	668	486	865	125.51	0.00%	21.8/min	23.33	0.09	65877.5
C. Zoom:x4 - tile 5	15	636	489	899	111.62	0.00%	12.4/min	4.87	0.05	24131.0
B. Multi:Contents 06	15	538	356	913	154.34	0.00%	22.0/min	0.81	0.09	2264.8
C. Zoom:x4 - tile 4	15	653	514	933	115.92	0.00%	12.4/min	5.42	0.05	26885.0
C. Zoom:x8 - tile 01	15	446	304	941	147.48	0.00%	12.5/min	4.69	0.05	23053.0
C. Zoom:x4 - tile 1	15	677	543	960	107.31	0.00%	12.3/min	5.51	0.05	27649.0
B. Multi:Contents 01	15	620	367	998	207.80	0.00%	21.8/min	1.24	0.09	3501.0
B. Multi:Contents 02	15	627	402	1006	179.33	0.00%	22.0/min	1.00	0.09	2785.0
B. Multi:Contents 03	15	319	215	1023	192.60	0.00%	22.2/min	12.06	0.10	33319.2
C. Zoom:x8 - tile 04	15	465	312	1080	192.63	0.00%	12.5/min	5.11	0.05	25071.0
B. Multi:Preview Image	15	674	401	1215	273.43	0.00%	21.5/min	5.78	0.09	16519.0
B. Multi:Navigation Pane	15	652	403	1324	269.85	0.00%	21.0/min	1.44	0.08	4207.0
C. Zoom:x2 - tile 2	15	1175	939	1412	121.23	0.00%	12.1/min	6.40	0.05	32358.0
C. Zoom:x2 - tile 1	15	1156	880	1483	193.04	0.00%	12.1/min	7.22	0.05	36658.0
C. Zoom:x4 - tile 2	15	1140	918	1501	170.31	0.00%	12.2/min	5.29	0.05	26652.0
C. Zoom:x1	15	2354	1965	2820	264.64	0.00%	11.9/min	8.38	0.05	43439.1
A. Single:Preview Image	15	2903	2494	3433	296.07	0.00%	15.4/min	5.03	0.06	20126.0
A. Single:Icon Sized	15	2730	2133	3459	411.59	0.00%	15.0/min	0.40	0.06	1653.0
A. Single:Contents Pane Thu...	15	2824	2163	3502	323.51	0.00%	15.3/min	1.69	0.06	6790.0
A. Single:Navigation Pane	15	2839	2178	3638	472.21	0.00%	14.8/min	0.67	0.06	2770.1
A. Single:Faviocon sized	15	3137	2475	4740	729.99	0.00%	14.3/min	0.30	0.06	1289.1
C. Zoom:Preview	15	3172	2474	4867	770.01	0.00%	11.5/min	3.78	0.05	20126.2
TOTAL	780	830	95	4867	854.10	0.00%	8.5/sec	166.85	2.10	20208.5

☒ Include group name in label? Save Table Data ☒ Save Table Header

## KEY INSIGHTS

- Cantaloupe default install does not enable caches
- Uncashed times are comparable between RIIF & Cantaloupe
- Bigger original images have a higher performance cost (e.g Poster vs. individual Page)

# v5 - Cantaloupe Caching

Enable caching on cantaloupe  
Re-run the test scripts

EC2: t3a.xlarge

Hyrax: 2.9.6

IIIF Server: riif

Manifest Cache: off

Cantaloupe Cache: **on**

PTIFFS: n/a

IIIF Benchmarking.jmx (/Users/mark/\_no\_backup\_/IIIF Benchmarking.jmx) - Apache JMeter (5.4.1)

00:00:07 0 0/9

IIIF Benchmarking

- A. Single
- C. Zoom
- B. Multi
- View Results Tree
- Summary Report

Summary Report

Name: Summary Report

Comments: v5 - Cantaloupe Caching

Write results to file / Read from file

Filename

Browse...

Log/Display Only: ☐ Errors ☐ Successes

Configure

Label	# Sam...	Average	Min	Max	Std. Dev.	Error %	Throughput	Receive...	Sent KB/...	Avg. Bytes
C. Zoom:x8 - tile 05	15	50	40	72	8.24	0.00%	2.3/sec	49.07	0.58	22033.0
C. Zoom:x8 - tile 07	15	50	40	72	8.24	0.00%	2.3/sec	50.29	0.58	22234.8
B. Multi:Contents 16	15	50	42	73	8.83	0.00%	2.5/sec	10.31	0.65	4187.0
C. Zoom:x4 - tile 1	15	51	43	62	5.29	0.00%	2.3/sec	61.96	0.58	27662.0
B. Multi:x1 - tile 2	15	51	43	66	6.43	0.00%	2.5/sec	35.82	0.64	14503.0
C. Zoom:x4 - tile 6	15	51	43	67	6.80	0.00%	2.3/sec	75.50	0.59	33404.0
C. Zoom:x8 - tile 13	15	51	43	71	7.36	0.00%	2.3/sec	50.22	0.59	21959.8
A. Single:Contents Pane Thu...	15	52	42	77	9.78	0.00%	6.8/sec	45.55	1.66	6825.0
C. Zoom:x4 - tile 4	15	52	43	76	9.97	0.00%	2.3/sec	60.49	0.59	26898.0
C. Zoom:x8 - tile 04	15	52	44	83	9.18	0.00%	2.3/sec	56.90	0.59	25091.0
C. Zoom:x8 - tile 15	15	52	43	78	11.61	0.00%	2.3/sec	37.94	0.60	16550.8
C. Zoom:x2 - tile 2	15	53	43	72	8.14	0.00%	2.3/sec	72.46	0.58	32370.0
B. Multi:Navigation Pane	15	53	42	71	7.81	0.00%	2.5/sec	10.44	0.61	4243.0
C. Zoom:x8 - tile 01	15	53	42	94	12.28	0.00%	2.3/sec	52.19	0.59	23073.0
C. Zoom:x8 - tile 14	15	53	43	109	15.28	0.00%	2.3/sec	77.79	0.60	33987.3
B. Multi:Contents 03	15	54	44	107	15.59	0.00%	2.5/sec	82.32	0.65	33329.8
C. Zoom:x8 - tile 10	15	55	39	138	23.21	0.00%	2.3/sec	32.64	0.59	14379.8
B. Multi:x1 - tile 1	15	59	48	102	12.75	0.00%	2.5/sec	162.73	0.63	65931.0
B. Multi:Contents 13	15	62	40	127	32.14	0.00%	2.5/sec	6.45	0.65	2617.2
A. Single:Preview Image	15	63	45	105	17.63	0.00%	6.8/sec	134.21	1.65	20147.0
C. Zoom:Preview	15	74	44	161	42.22	0.00%	2.3/sec	44.95	0.55	20140.0
B. Multi:Contents 06	15	83	39	596	137.00	0.00%	2.5/sec	5.69	0.65	2300.8
C. Zoom:x4 - tile 3	15	86	42	590	134.83	0.00%	2.3/sec	65.79	0.59	29307.0
C. Zoom:x2 - tile 1	15	88	41	596	135.80	0.00%	2.3/sec	82.08	0.58	36712.0
B. Multi:Preview Image	15	90	46	596	135.39	0.00%	2.5/sec	40.72	0.61	16547.0
A. Single:Manifest	15	130	89	218	44.52	0.00%	6.4/sec	12.42	0.98	1984.2
C. Zoom:x1	15	139	49	751	175.45	0.00%	2.3/sec	96.66	0.57	43492.7
B. Multi:Manifest	15	284	181	674	142.38	0.00%	2.4/sec	512.27	0.36	220561.5
TOTAL	780	61	39	751	62.35	0.00%	99.5/sec	1966.35	24.76	20236.1

☒ Include group name in label?

Save Table Data

☒ Save Table Header

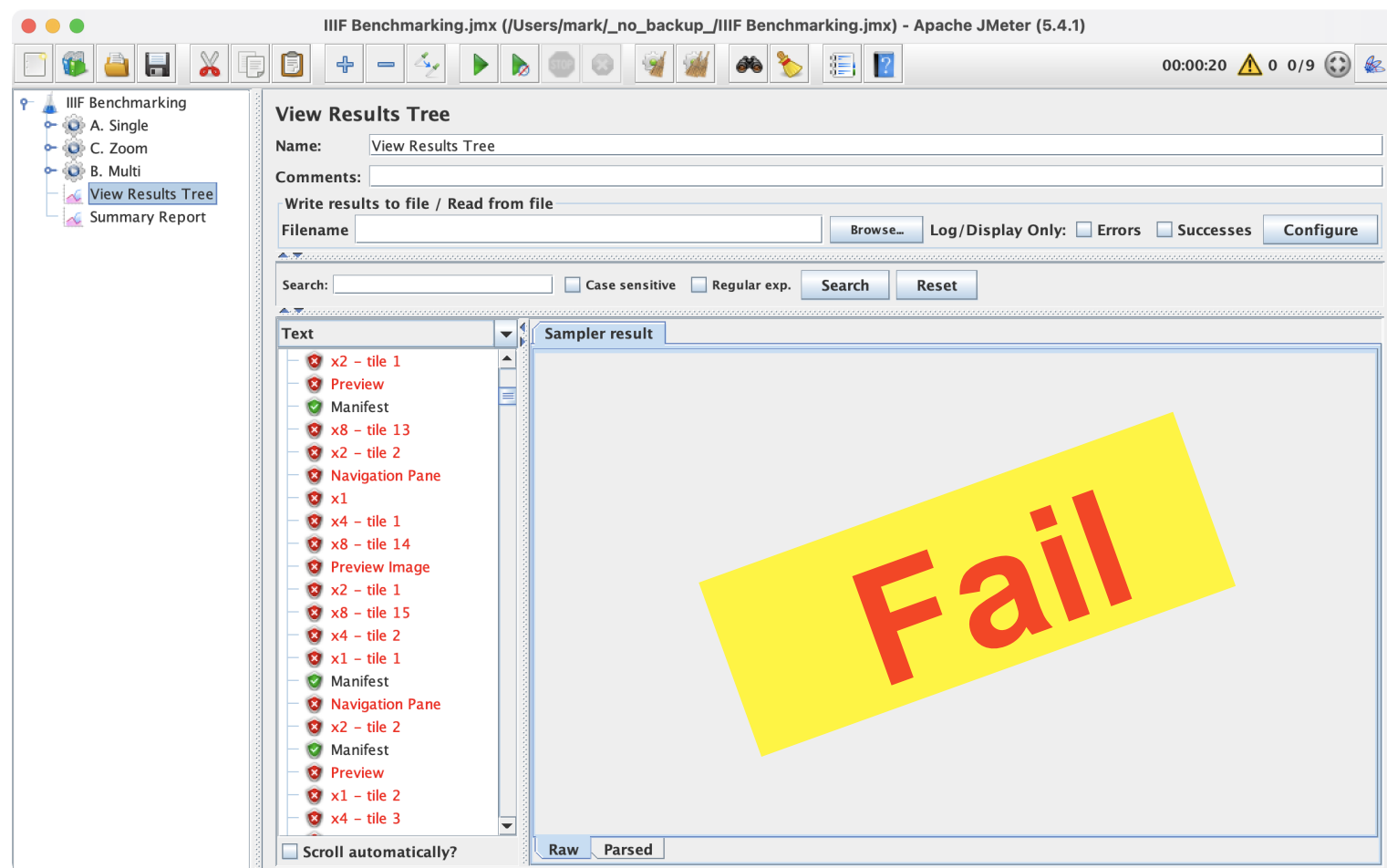
## KEY INSIGHTS

- With caches warmed, Cantaloupe is almost 2x as fast as riif
- Cantaloupe can be run on a standalone container or instance to allow fine tuning of it's behavior and resources
- Overall better performance than doubling the server size



# v6 - Disk + PTIFFs

Update delegate script to read from disk  
Use Pyramidal TIFF access derivatives  
Re-run the test scripts



EC2:	t3a.xlarge
Hyrax:	2.9.6
IIIF Server:	cantaloupe
Manifest Cache:	on
Cantaloupe Cache:	on
PTIFFS:	<b>yes</b>

## KEY INSIGHTS

- Delegate scripts are fussy
- Because of caching, this really only helps cold loads
- There's a trade-off here between cost (for extra storage) and speed

# Potential Enhancements

- **Manifests**
  - **Easy** - Buy a bigger server
  - **Easy** - Turn on Caching
  - **Intermediate** - Pre-cache manifests
  - **Advanced** - Managed manifest store
- **Images**
  - **Easy** - Buy a bigger server
  - **Easy** - Enable Caching
  - **Intermediate** - External IIF server
  - **Intermediate** - Store Images on disk or S3
  - **Advanced** - Presentation derivatives
  - **Advanced** - 16:9 tile aspect ratio



# Use Cases

- **Manifests**
  - **Bigger server** - *need a moderate improvement fast*
  - **Manifest caching** - *anytime you have multi-image works*
  - **Pre-cache manifests** - *many images per work*
  - **Managed manifest store** - *need custom behavior*
- **Images**
  - **Bigger server** - *need a moderate improvement fast*
  - **Image caching** - *never hurts, usually helps (a lot)*
  - **External IIF server** - *want to tune image performance separately from web server*
  - **Store Images on disk or S3** - *workflow already does this (if you have a know ID scheme)*
  - **Presentation derivatives** - *want the fastest possible load and willing to pay for extra storage*

## Resources used while preparing this talk

### IIIF Configuration

- IIIF Server Config in Hyrax <https://github.com/samvera/hyrax/wiki/Hyrax-Management-Guide#image-server>
- Troubleshooting RIIIF [https://samvera.github.io/troubleshooting\\_riiif.html](https://samvera.github.io/troubleshooting_riiif.html)
- Cantaloupe Caching <https://cantaloupe-project.github.io/manual/5.0/caching.html>
- Cantaloupe HTTP API (to clear cache) <https://cantaloupe-project.github.io/manual/5.0/endpoints.html#Caching>

### JMeter

- Install <https://www.ubik-ingenierie.com/blog/using-homebrew-to-install-and-configure-jmeter-under-mac-osx/>
- Writing the test script <https://www.blazemeter.com/blog/getting-started-jmeter-basic-tutorial>

### Clearing browser cache (Chrome)

- Command + Shift + R

### Clearing riif cache

- `rm -rf tmp/cache/*`

### Clearing cantaloupe cache (if HTTP API enabled)

- `curl -u cantaloupe_admin:password -X POST http://localhost:8182/tasks -H 'Content-Type: application/json' -d '{"verb": "PurgeCache"}'`



