IPSW - Modelling Change of Website Archives

Group 4

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The Problem

- Decades of web archives with lots of vital historic information
- Gets overridden from history when the website is updated
- Ever increasing amount of data
- Scale overwhelms the search for the meaningful information

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Can we

- find out when large changes have occurred?
- predict when a big change is going to occur?

Aims for this week

- Find and explore ways to quantify change in a website
- Compare these quantifications
- See if we can identify big changes in an organisation from our research

Big events in the NDP

- 28 November 2005: election called.
- 23 January 2006: federal election.
- 14 October 2008: federal election.
- 2 May 2011: federal election.
- July 2011: NDP leader announces leave of absence; replaced by interim.
- 22 August 2011: NDP leader dies.
- 24 March 2012: New NDP leader selected.
- 19 October 2015: federal election.
- 10 April 2016: NDP leader loses vote of confidence.
- 1 October 2017: New NDP leader selected.

Attempted Approaches

- How many words on the domain change?
- How do the links out of the domain change?
- How does the way the website looks change?
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Start by looking only at the homepage

Four Metrics for Text

- Byte-wise comparison:
  - If any change in characters has occurred, $= 1$
  - If text is *exactly* the same, $= 0$
- TF·IDF
  - Calculates cosine distance between two different vectors of characters $\boldsymbol{p}$ and $\boldsymbol{p}'$

$$1 - \frac{\boldsymbol{p} \cdot \boldsymbol{p}'}{||\boldsymbol{p}||_2 ||\boldsymbol{p}'||_2}$$

- Word distance
  - How many words have changed

$$1 - \frac{2|\mathit{common\ words}|}{m + n}$$

- Edit distance
  - "Edit distance" δ is the amount of insertion/deletion/substitution needed to turn one sequence into the other

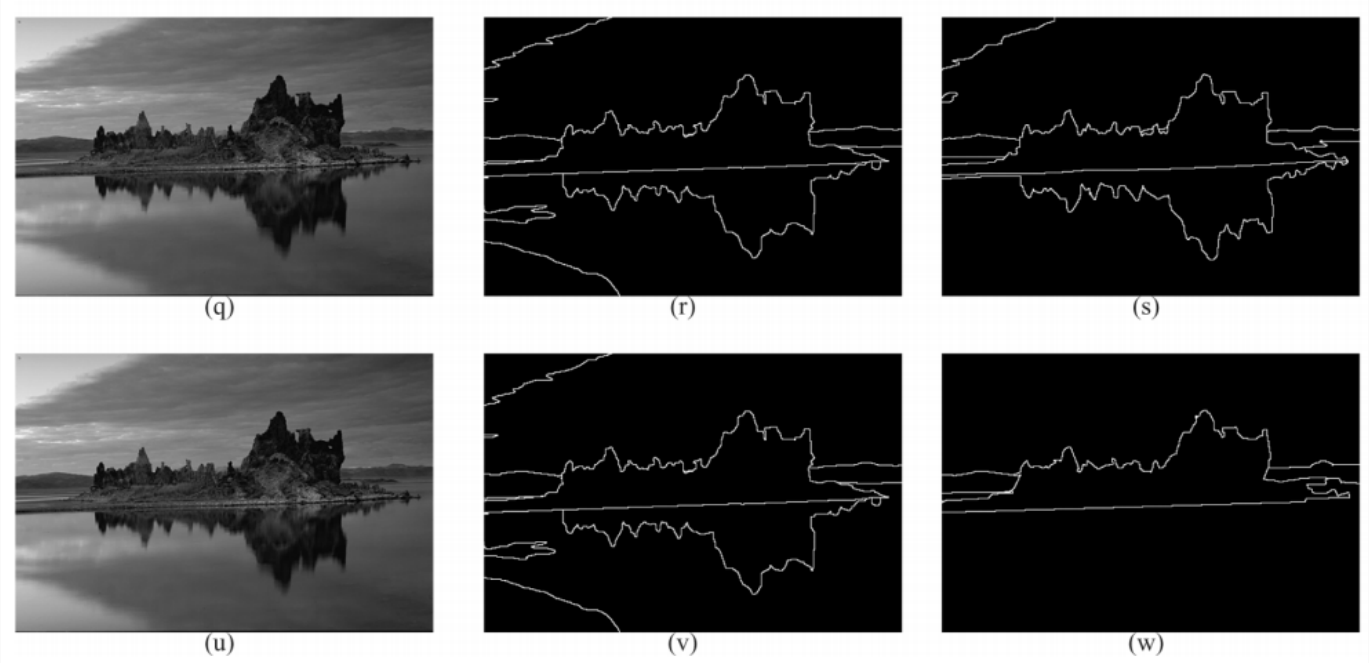
$$\frac{\delta}{m + n}$$

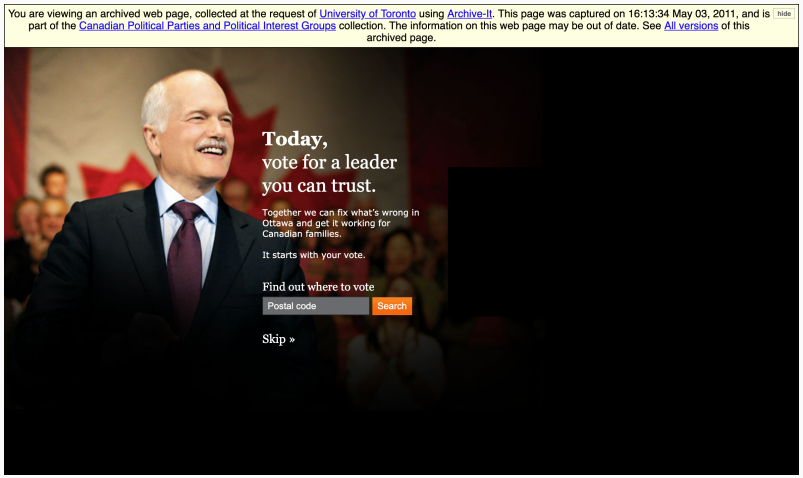
External Links

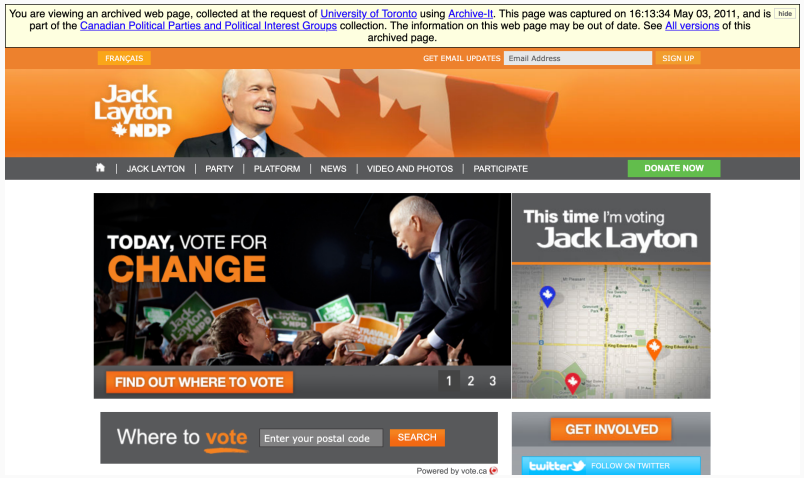
- Justification
  - Links to other websites are important to the website designer
  - If these change, the topic of the website has most likely changed as well
- Method
  - Compare vector of links on homepage at t_i and t_{i+1} as $\mathbf{v}_i$ and $\mathbf{v}_{i+1}$

$$1 - \frac{2|\textit{common links}|}{|\mathbf{v}_i| + |\mathbf{v}_{i+1}|}$$

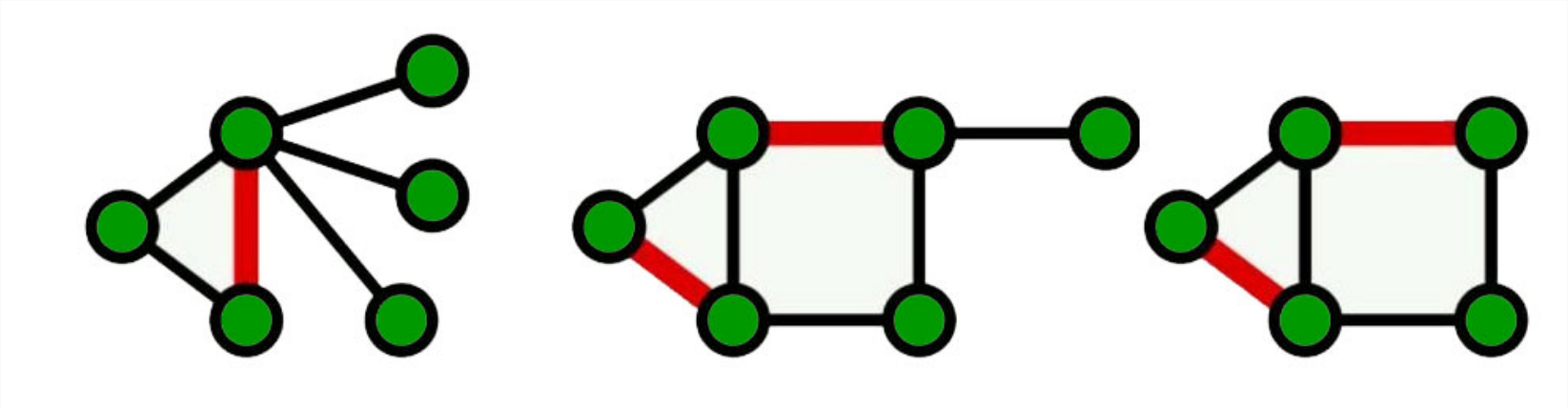
Image Comparison







Structure



https://www.geeksforgeeks.org/mathematics-matching-graph-theory/

Issues

- Data takes a long time to retrieve from servers
- Different languages
- Failed renderings
- Difficult to decipher where website fits in structure just from URL
- Internal links data showing strange behaviour

Text comparison results

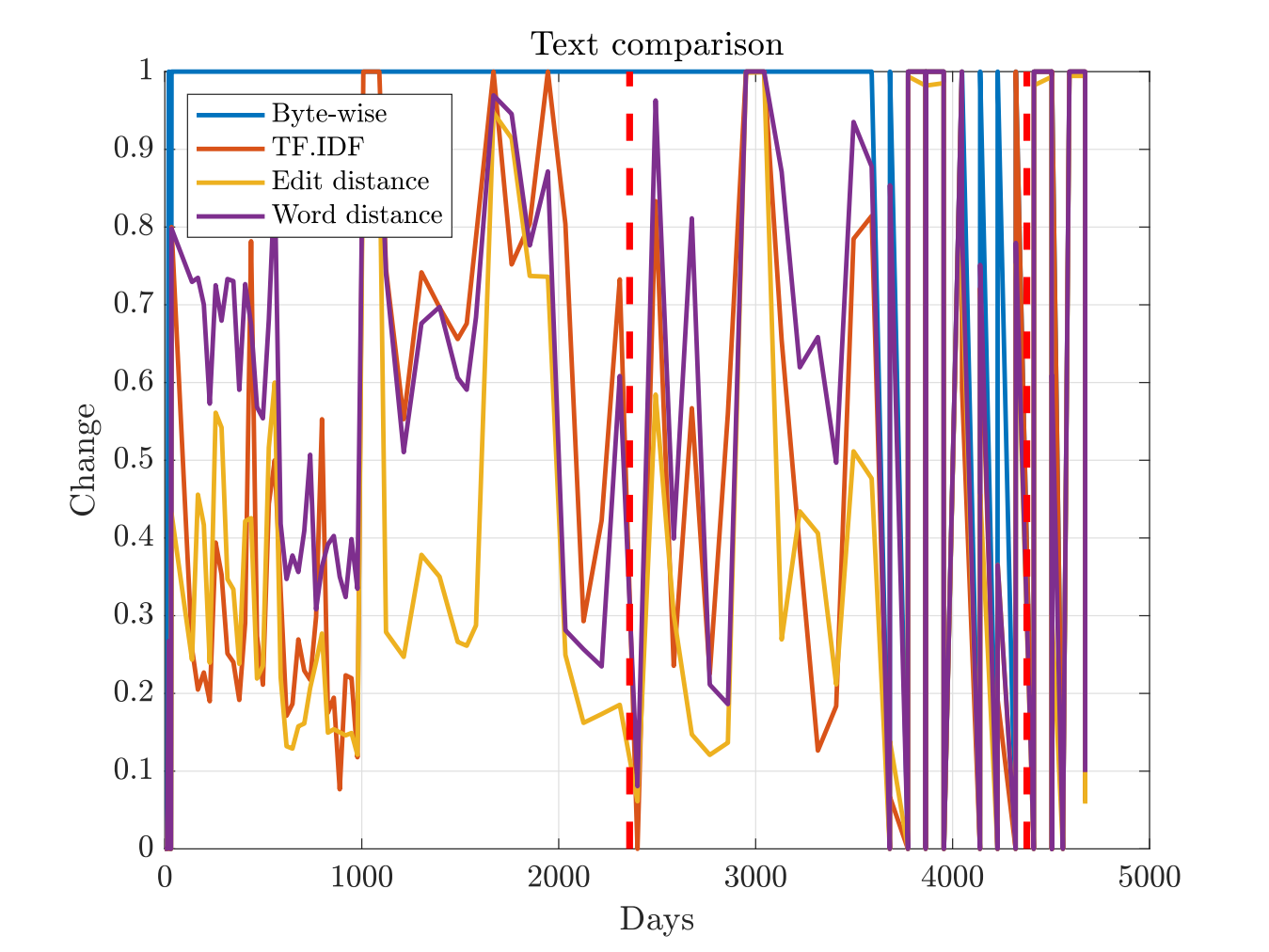


Figure 1: Red lines where new NDP leader selected.

Link comparison results

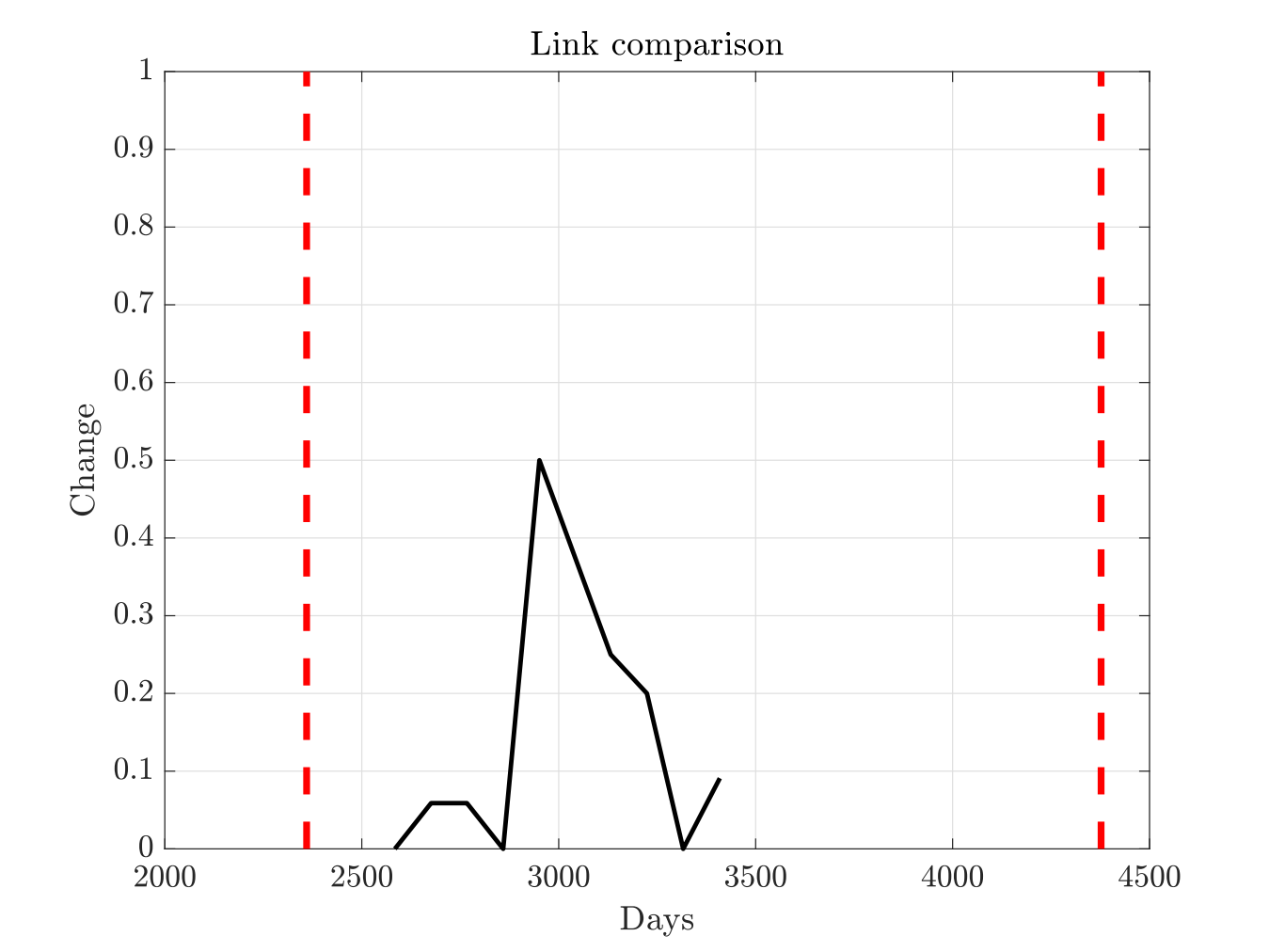


Figure 2: Red lines where new NDP leader selected.

Image comparison results

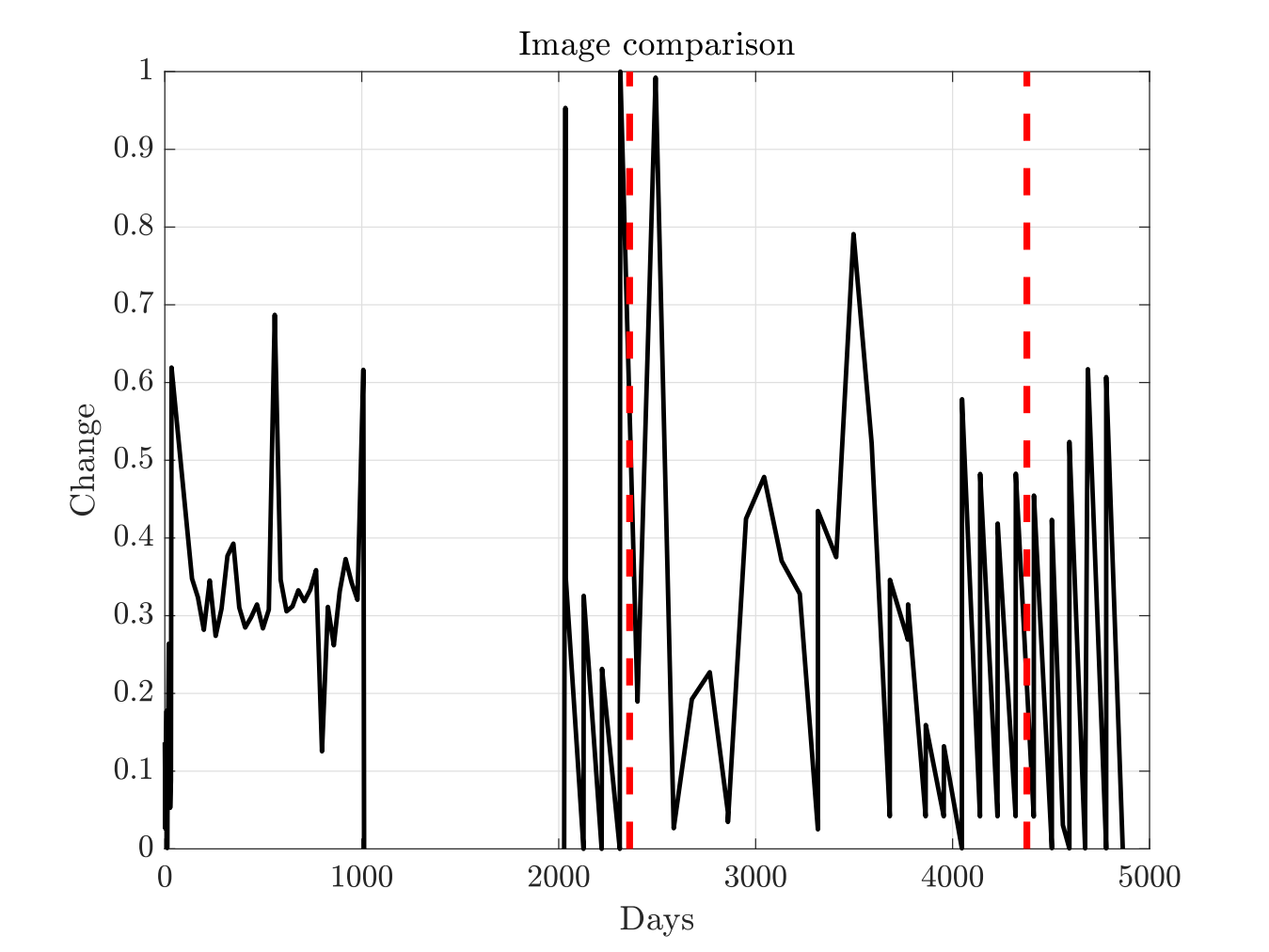
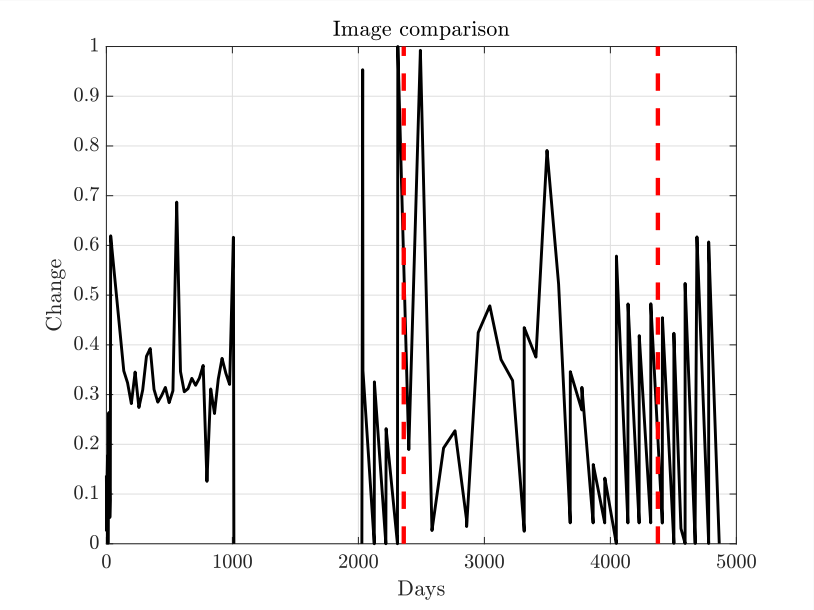
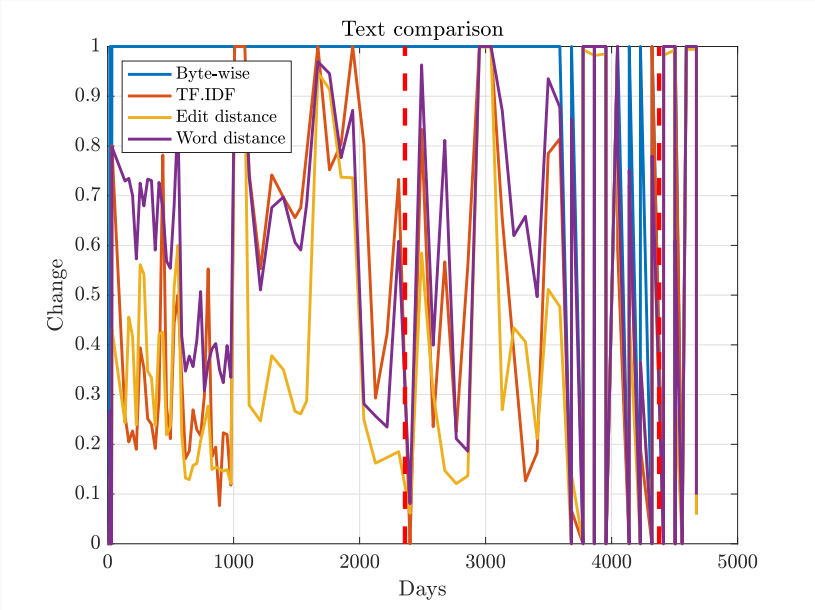


Figure 3: Red lines where new NDP leader selected.

Conclusions



(a) Image comparison



(b) Text comparison

Figure 4: Locations of high change correspond to new NDP leader selected.

Conclusions

- Different metrics are useful for different websites or for different types of change,
  - e.g. news websites update content every day but this might not indicate significant change – structural metric more informative than text metric,
  - e.g. governmental websites depend sensitively on text and content – text metric most informative,
  - e.g. job registers will link to new advertisements – link data most informative.
- We see that the text and screenshot metrics align for certain substantial changes.

Moving Forward

- Use more datasets to find which metrics are useful for which kind of websites
- Use more sophisticated language detection techniques to convey context (machine learning...)
- Computer science knowledge needed to understand greater indicators of substantial changes
- Full internal link data could be used to see website structure changes
- Distribution of the change could be used to predict when next crawl should be made (next study group?!)

QUESTIONS?

(SSIM $= 0.01$)