Notes on navigation history

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DRAFT of 2016-06-20

Abstract

Some notes on a model of navigation history.

1 Introduction

[These are rough notes, working towards a model of navigation history for the web.]

2 Preliminaries

[Define forest, tree, root, total order, equivalence.]

3 Model

A *navigation history* $H = (D, A, \rightarrow, \leq, \sim)$ consists of:

- a set D (the *documents*),
- a subset $A \subseteq D$ (the *active* documents),
- a forest $(D, \rightarrow)$ (the *document hierarchy*),
- a total order $(D, \leq)$ (the *chronological order*), and
- an equivalence relation $(D, \sim)$ (the *same-session equivalence*).

such that:

- for every d there is a unique $d' \in A$ such that $d \sim d'$,
- for every $d \rightarrow e \sim e'$ we have $d \rightarrow e'$, and

- for every $d \to e$, we have $d \leq e$.

Define:

- d_0 is the unique active root document,
- $d \twoheadrightarrow e$ when $d \to e$ and $e \in A$,
- $FA = \{d \mid d_0 \twoheadrightarrow^* d\}$ (the *fully active* documents),
- $d \lesssim e$ whenever $d \sim e$ and $d < e$,
- the *session future* of d is $\{e \mid d \lesssim e\}$,
- the *session past* of d is $\{e \mid d \gtrsim e\}$,
- the *joint session future* is $\{e \mid \exists d \in FA \,.\, d \lesssim e\}$,
- the *joint session past* is $\{e \mid \exists d \in FA \,.\, d \gtrsim e\}$,

Define *deleting d from H*, when $d \notin FA$, to be H' where:

- $D' = d \setminus \{e \mid d \to^* e\}$,
- $e \in A'$ whenever $e \in A$,
- $e \leq' f$ whenever $e \leq f$,
- $e \to' f$ whenever $e \to f$, and
- $e \sim' f$ whenever $e \sim f$.

Define *replacing d by d' in H*, where $d \in A$ and $d' \notin D$, to be H' where:

- $D' = D \cup \{d'\}$,
- $e \in A'$ whenever $e \in A$ and $e \neq d$, or $e = d'$,
- $e \leq' f$ whenever $e \leq f$, or $f = d'$,
- $e \to' f$ whenever $e \to f$, or $e \to d$ and $f = d'$, and
- $e \sim' f$ whenever $e \sim f$, or $e \sim d$ and $f = d'$, or $d \sim f$ and $e = d'$.

Define *navigating from d to d' in H* to be the result of:

- deleting the session future of d, and
- replacing d by d'.

Define *traversing the history to d in H* to be H' where:

- D' is D,
- $e \in A'$ whenever $d \not\sim e \in A$, or $d = e$,

- $e \leq' f$ whenever $e \leq f$,
- $e \to' f$ whenever $e \to f$, and
- $e \sim' f$ whenever $e \sim f$.

Define H *traverses the history by* $+\delta$ *to* H' when:

- the joint session future of H is $d_1 > \cdots > d_\delta > \cdots$,
- H traverses the history to d_δ in H'

Define H *traverses the history by* $-\delta$ *to* H' when:

- the joint session past of H is $d_1 < \cdots < d_\delta < \cdots$,
- H traverses the history to d_δ in H'

Define H *traverses the history by* 0 *to* H' when $H = H'$.

[This defn is meant to align with the spec.]

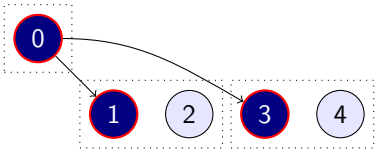
4 Properties

[State some goals, e.g. go(δ);go(δ') is the same as go($\delta + \delta'$), navigate;go(-1) has the same fully active documents as doing nothing, session history can be implemented effeciently in memory...]

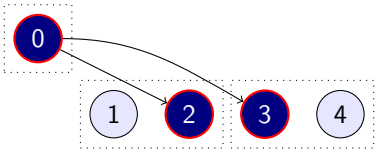
[I suspect none of these are true of the current spec, can we find a model in which they are true?]

Goal 1 *If H traverses the history by δ to H' and H' traverses the history by δ' to H'' then H traverses the history by $\delta + \delta'$ to H''.*

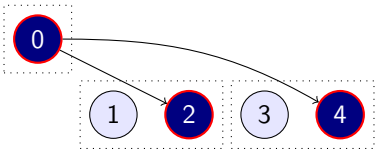
Counterexample 1 *Let H be:*



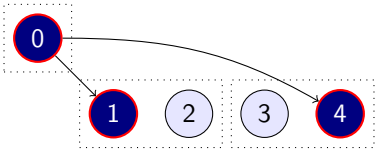
which traverses the history by 1 *to:*



which traverses the history by 1 *to:*



but H *traverses the history* 2 *to:*



This counterexample is caused by the definition of 'traverses the history by δ' which only traverses one document's session history. Instead, we should traverse the history of all δ documents.

Patch 1 *Define* H traverses the history by $+\delta$ to H' *when:*

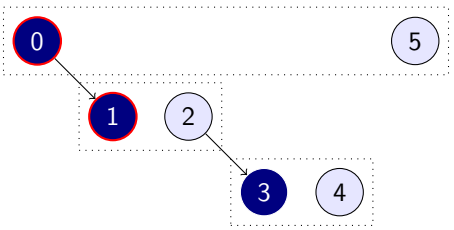
- *the joint session future of* H *is* $d_1 < \cdots < d_\delta < \cdots$,
- *there is some* $H = H_0, \ldots, H_\delta = H'$, *such that*
- H_{i-1} *traverses the history to* d_i *in* H_i *for each* $1 \leq i \leq \delta$.

Define H traverses the history by $-\delta$ to H' *when:*

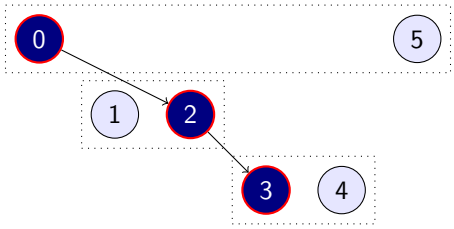
- *the joint session past of* H *is* $d_1 > \cdots > d_\delta > \cdots$,
- *there is some* $H = H_0, \ldots, H_\delta = H'$, *such that*
- H_{i-1} *traverses the history to* d_i *in* H_i *for each* $1 \leq i \leq \delta$.

Unfortunately, Goal 1 is not satisfied, even with this patch.

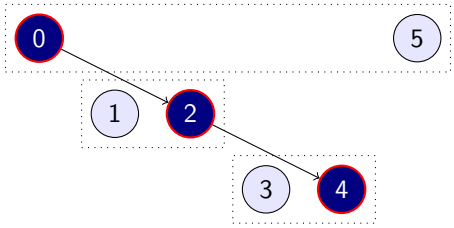
Counterexample 2 *Let* H *be:*



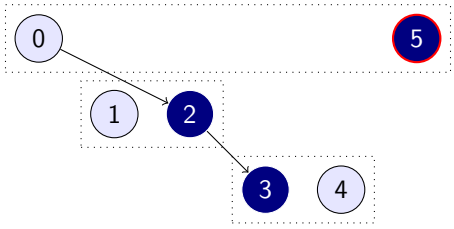
which moves forwards by 1 *to:*



which in turn moves forwards by 1 *to:*



but H *goes forward by* 2 *to:*

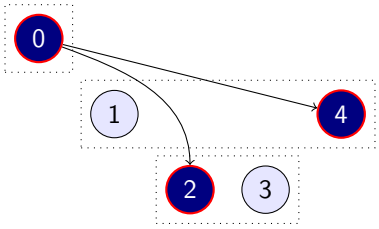


The problem this time is that the definition of 'joint session history' only includes the fully active documents, not all active documents.

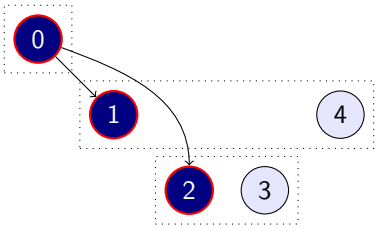
Patch 2 *Define:*

- *the* joint session future *is* $\{e \mid \exists d \in A \,.\, d \lesssim e\}$*, and*
- *the* joint session past *is* $\{e \mid \exists d \in A \,.\, d \gtrsim e\}$.

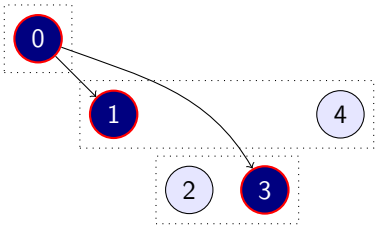
Counterexample 3 *Let* H *be:*



which traverses the history by -1 *to:*



which traverses the history by 1 *to:*



which is not the same as H*.*

[ASAJ: Not sure about this...]

Patch 3 *Define* H traverses the history from d' *when there is some* d *such that:*

- $d \lesssim d'$*,*
- *for any* $e \lesssim d'$ *we have* $e \leq d$*, and*
- H *traverses the history to* d*.*

Define H traverses the history by $-\delta$ to H' *when:*

- *the joint session past and active documents of* H *is* $d_1 > \cdots > d_\delta > \cdots$*,*
- *there is some* $H = H_0, \ldots, H_\delta = H'$*, such that*
- H_{i-1} *traverses the history from* d_i *in* H_i *for each* $1 \leq i \leq \delta$*.*

Goal 2 *If* d *in* H *navigates to* d' *in* H'*, and* H' *traverses the history by* -1 *to* H''*, then* $FA = FA''$*.*

5 Experiments

[In this section various different navigation and traversal scenarios are tested in popular web browsers to see where they differ in behaviour from both the spec and each other.]

Experiment 1 *In this experiment Goal 1 is tested.*

- H traverses the history by -4 to H'
- H' traverses the history by $+4$ to H''

By Goal 1, these traversals should be the same thing as H traversing by 0 *which is a no-op; therefore,* $H = H''$.

Firefox:

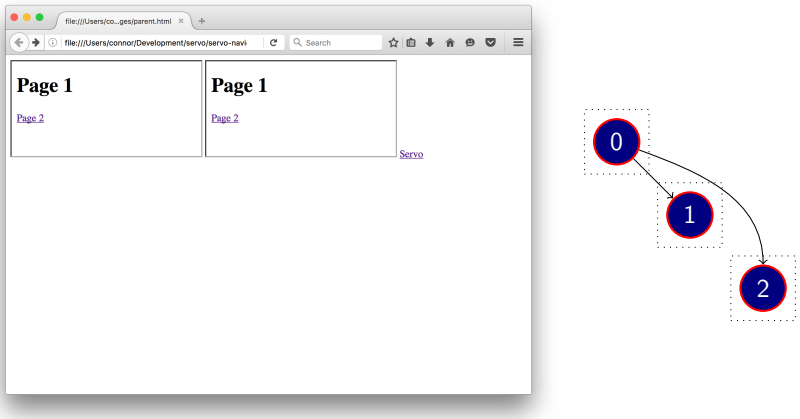


Figure 1: Initial State

Navigate document 1 *to Page 2:*

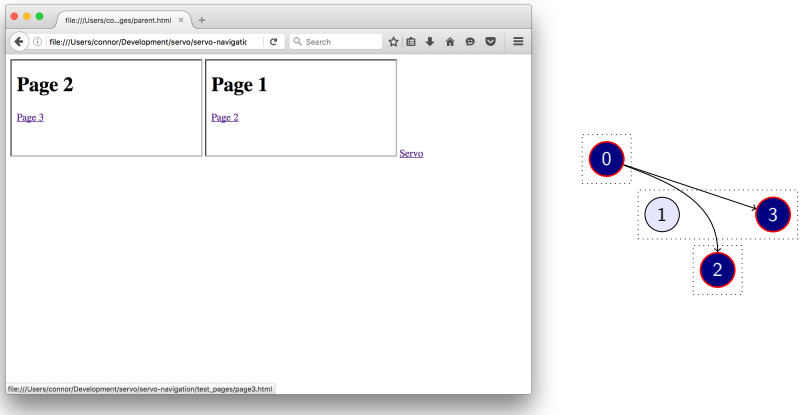


Figure 2: Navigate document 1 to Page 2.

Navigate document 3 *to Page 3:*

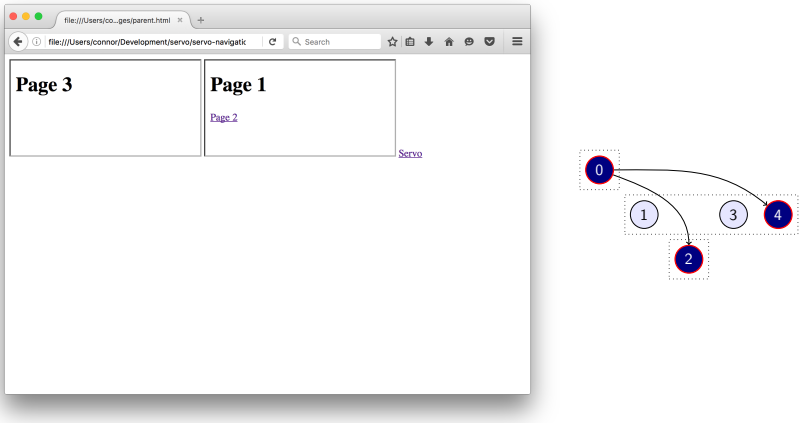


Figure 3: Navigate document 3 to Page 3.

Navigate document 2 *to Page 2:*

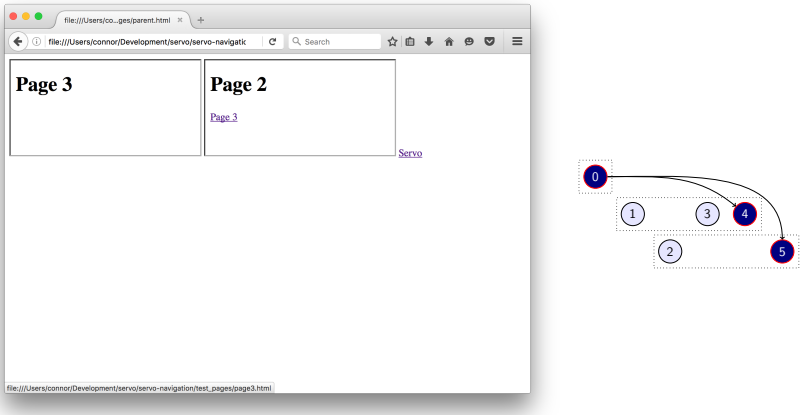


Figure 4: Navigate document 2 to Page 2.

Navigate document 5 *to Page 3:*

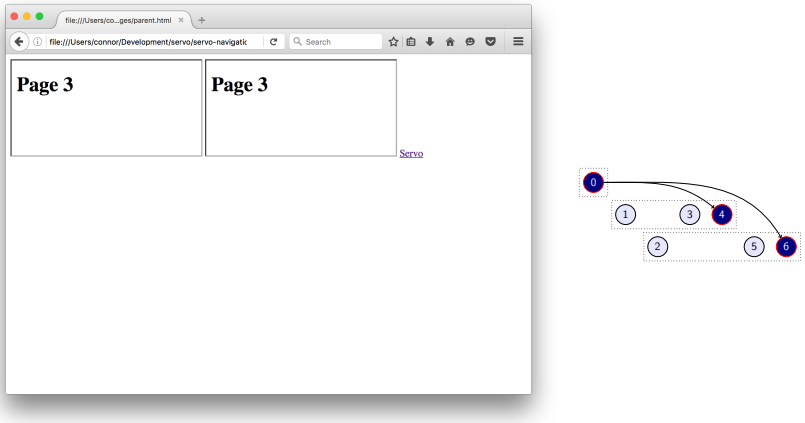


Figure 5: Navigate document 5 to Page 3.

H traverses the history by -4 to H':

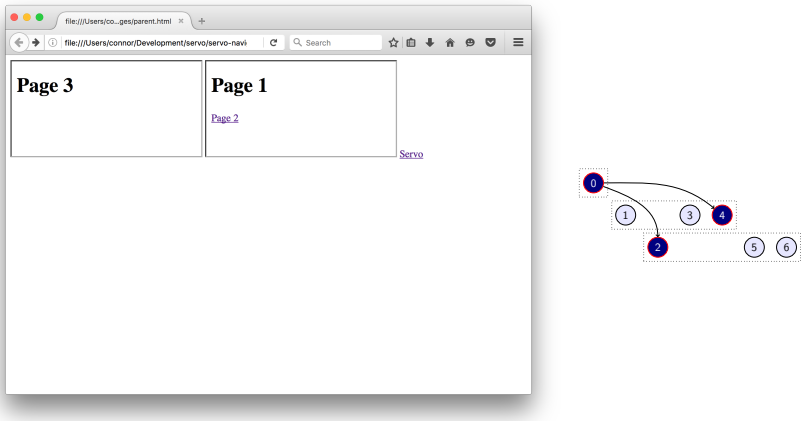


Figure 6: Traversal by -4.

This state is obviously wrong, as document 4 *should have traversed to document* 1*. This is similar to counterexample 1.*

H' traverses the history by 4 to H'':

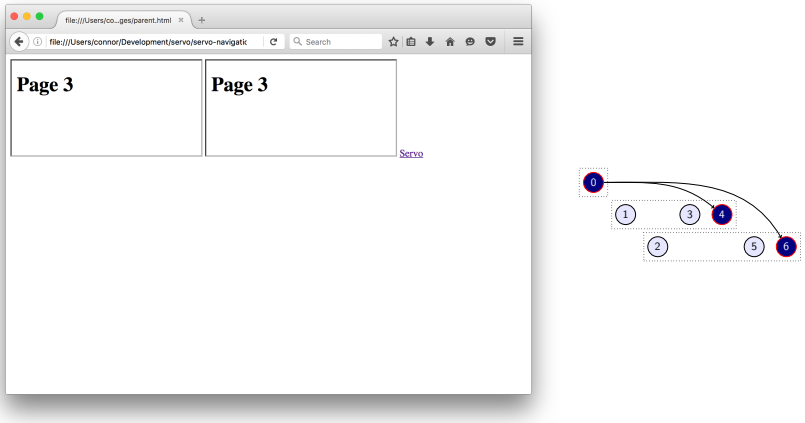


Figure 7: Traversal by 4.

While this result does satisfy Goal 1, there are still some issues:

- *Figure 6 yields an incorrect traversal. [CGB: I believe this actually does break Goal 1 as navigating by* -1 *four times should yield the correct state.]*
- *It is impossible to get back to Page 1 on both Frames. [CGB: Looks to be a bug in FF, when holding down the back button, the list of pages to traverse to shows up. Clicking on the oldest item on the list does nothing and does not activate that item.]*

6 Specification

[Suggested edits to the spec: 1. traverse to each document, not just the selected one, 2. keep all documents in the seession history, not just the fully active ones, 3. change the session history order.]

7 Conclusion

[We did stuff.]