Source task and conventions

Determine a valid state model for one and repeated back-button operations.

Conventional solution and proof

The current page alone is generally not a Markov state. Two histories ending at the same page x, one arriving from a and one from $b \neq a$, have different next-page distributions when the back action has positive probability. A state (previous page, current page) records enough information for one backward step but not arbitrary repeated backtracking. For repeated back actions, take the state to be the entire retained browser stack $(v_0, \ldots, v_k)$, with current page v_k. A hyperlink action appends its destination; a back action removes v_k when $k > 0$, and a declared rule handles an empty history, for example a self-transition. Assign action probabilities and hyperlink-choice probabilities as functions of this state. The next-stack distribution then depends only on the present stack, proving the Markov property. With an unbounded history the chain has a countable state space even on a finite web. With a history cap L, the state space is finite, bounded by $\sum_{j=1}^{L+1} N^j$ before restricting to valid link paths. A model including a forward button needs the stored forward history and its current index as well. Human action probabilities depending on unmodelled information are not made Markov merely by naming the process a chain.

Structural or analytic derivation

State augmentation converts a process with memory into a Markov process by retaining the information needed to determine the transition law. It is an exact representation of the specified stack policy, not an assertion that a real user follows stationary transition probabilities.