

# SNIF-ACT: A Cognitive Model of User Navigation on the World Wide Web

**Wai-Tat Fu (wfu@uiuc.edu)**

Human Factors Division and Beckman Institute  
University of Illinois at Urbana-Champaign  
405 North Mathews Avenue  
Urbana, IL 61801, USA

**Peter Pirolli (pirolli@parc.com)**

Palo Alto Research Center  
3333 Coyote Hill Rd  
Palo Alto, CA 94304, USA

**Keywords:** Information Seeking, Cognitive Models, Reinforcement Learning, Bayesian Satisficing Model.

We will present a computational cognitive model that simulates how people seek information on the Web (Fu & Pirolli, 2007). This model is called SNIF-ACT, which stands for *Scent-based Navigation and Information Foraging* in the ACT architecture. SNIF-ACT provides an account of how people use information scent cues, such as the text associated with Web links, in order to make navigation decisions such as judging where to go next on the Web, or when to give up on a particular path of knowledge search. SNIF-ACT is shaped by rational analyses of the Web developed by combining the Bayesian satisficing model (Fu & Gray, 2006; Fu, 2007) with the information foraging theory (Pirolli & Card, 1999). We will describe the current status of the SNIF-ACT model and the results from testing the model against two data sets from real-world human subjects. At this point, our goal is to validate the model's predictions on unfamiliar information-seeking tasks for general users. Our model was successful in predicting users' behavior in these tasks, especially in identifying the "attractor" pages that most users visited.

We will focus on the newest development of the model called SNIF-ACT 2.0 here. In this version, we included an adaptive link selection mechanism that sequentially evaluates links on a Web page according to their position. The mechanism was derived based on a rational analysis of link selection on a Web page and the process of satisficing in action selection (Simon, 1956). The mechanism allowed the model to dynamically update the evaluation of actions (e.g., to follow a link or leave a Web site) based on sequential assessments of link texts on a Web page. This dynamic assessment allows online adjustment of the aspiration levels of different actions in the satisficing process based on the information scent values of links as well as implicit feedback (or reinforcement) received during each action cycle (Fu & Anderson, 2006), such that the action selection process is directly influenced by the content of the Web page. For example, the model's decision on when to click on a link or leave a page will be sensitive to experiences with previously visited links and

pages. SNIF-ACT 2.0 was validated on a data set obtained from 74 subjects. Monte Carlo simulations of the model showed that SNIF-ACT 2.0 provided better fits to human data than SNIF-ACT 1.0 and a Position model that used position of links on a Web page to decide which link to select. We conclude that the combination of the IFT and the BSM provides a good description of user-Web interaction. Practical implications of the model will be discussed.

## Acknowledgments

Portions of this research have been supported by funding from the Human Factors Division and Beckman Institute of the University of Illinois at Urbana-Champaign to the first author, and an Office of Naval Research Contract No. N00014-96-C-0097 and Advanced Research and Development Activity, Novel Intelligence from Massive Data Program Contract No. MDA904-03-C-0404 to the second author.

## References

- Fu, W.-T. (2007). Adaptive Tradeoffs between Exploration and Exploitation: A Rational-ecological Approach. Exploitation: A Rational-Ecological Approach. In Gray, W.D. (Ed), *Integrated Models of Cognitive Systems*, Oxford: Oxford University Press.. In Gray, W.D. (Ed), *Integrated Models of Cognitive Systems*, Oxford: Oxford University Press.
- Fu, W.-T., Anderson, J. R. (2006). From Recurrent Choice to Skilled Learning: A Reinforcement Learning Model Learning: A Reinforcement Learning Model. *Journal of Experimental Psychology: General*, 135(2), 184-206.
- Fu, W.-T., & Gray, W. D. (2006). Suboptimal Tradeoffs in Information-Seeking. *Cognitive Psychology* 52, 195-242.
- Fu, W.-T., & Pirolli, P. (2007). SNIF-ACT: A Cognitive Model of User Navigation on the World Wide Web. *Human Computer Interaction*.
- Pirolli, P. & Card, S.K. (1999). Information foraging. *Psychological Review*, 106, 643-675.
- Simon, HA. (1956). Rational choice and the structure of environments. *Psychological Review*, 63, 129-13