

Beyond DCG: User Behavior as a Predictor of a Successful Search

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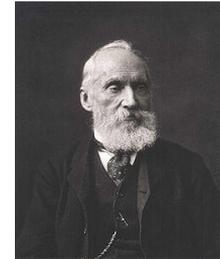
³Carnegie Mellon University



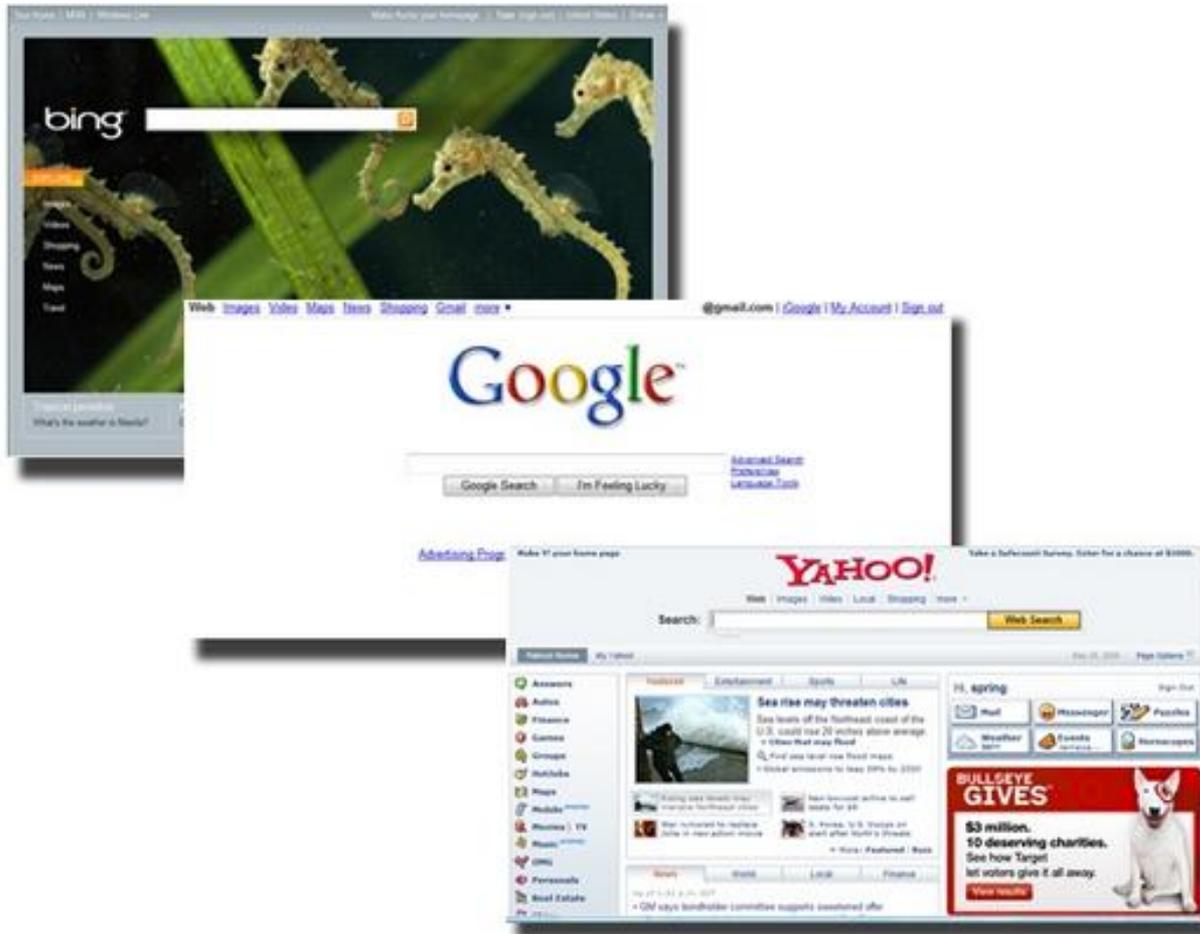
User Satisfaction

“ If you cannot measure it,
you cannot improve it.”

William Thomson, Lord Kelvin
(1824-1907)



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Results 1 - 10 of about 21,700,000 for playoffs. (0.27 seconds)

News results for playoffs



TV ratings up for first day of NFL playoffs - 27 minutes ago
The first day of the NFL playoffs drew the best preliminary television ratings in a decade. The Cowboys' 34-14 win over the Eagles on NBC on Saturday night ...

[BusinessWeek](#) - 1738 related articles »

The Jets Can Only Hope You Remain Bored By The NFL Playoffs -

[New York Magazine](#) - 71 related articles »

Ring on the Jets - 50 [Bolt Report](#) - 133 related articles »

NFL 2009 Playoff Race - CBSsports.com

During the regular season, the seeds reflect how the playoffs would stand if the season ended ... The NFL playoffs are not based on a pure bracket system. ...

[www.cbssports.com/nfl/standings/playoffrace/seeds](#) - [Cached](#)

NFL Schedule Playoffs

Playoff Picture Wild-Card Round Sat., Jan. 9-10, AFC: Sat., Jan. 9

N.Y. Jets: Cincinnati Sun., Jan. 10, 1:00 p.m. ET CBS ...

[www.nfl.com/schedule?seasonType=POST](#) - [Cached](#) - [Similar](#)

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News for playoffs



The Jets Can Only Hope You Remain Bored By The NFL Playoffs - 34 minutes ago

Of the eight teams left in the playoffs, six of them are openly offense-oriented, and considering the two that aren't, the Jets and Ravens, ...

[New York Magazine](#)

After Patriots blow out of playoffs, has Boston's title reign ended? - [SI.com](#)

Cowboys' Jones exercises demons of playoffs past - [Washington Post](#)

Latest results for playoffs - [Pause](#)

Making these lists have made me realize that there are a lot of Tweeps who disappeared right before the MLB playoffs.

[@seeshiz](#) - [twitter.com](#) - 1 minute ago

[@whatsthe](#) 2 years? Love is gone after next year if no playoffs! Bears need rebuilding everywhere!

[@cheapsports](#) - [twitter.com](#) - 1 minute ago

Miss some of the action this weekend, catch up with Rex's NFL Playoffs update from...

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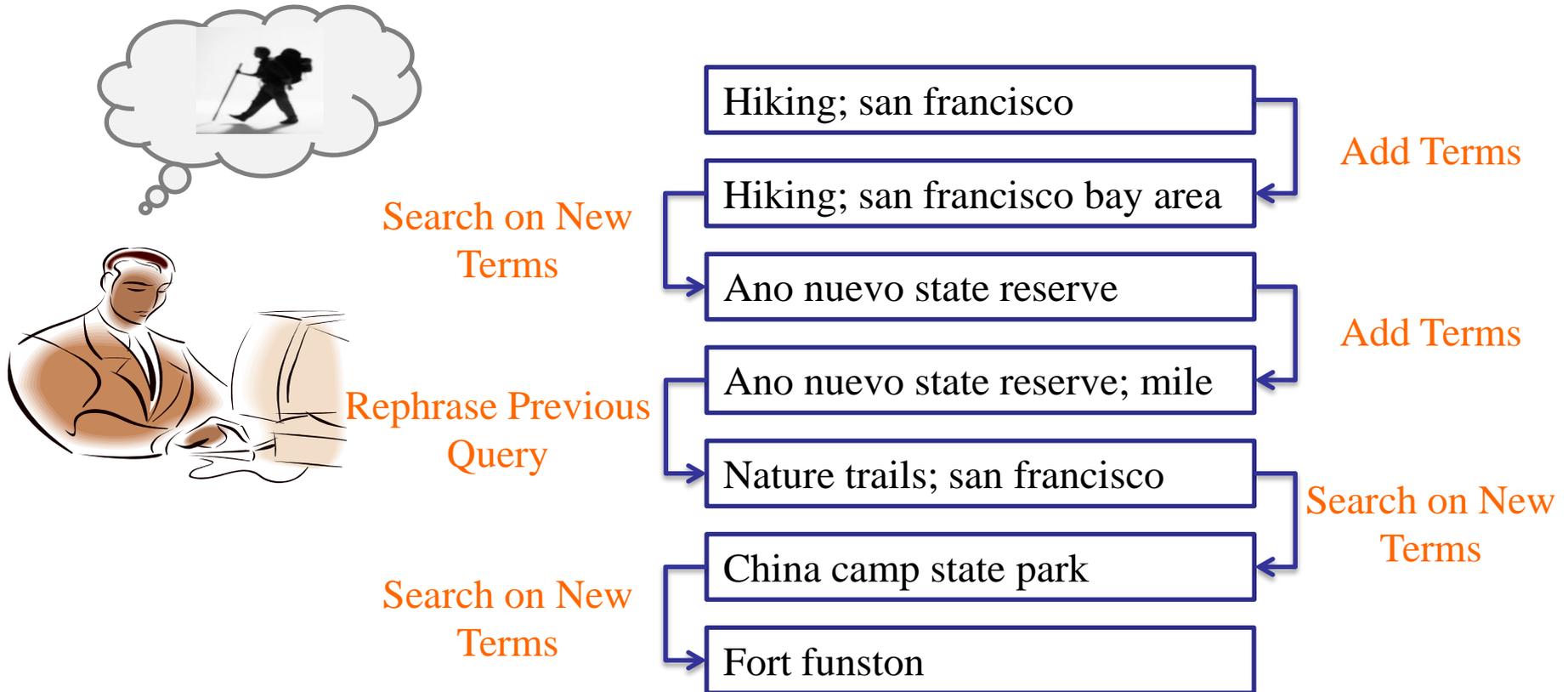
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Web Search is Interactive



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Hiking; san francisco bay area



Ano nuevo state reserve



Ano nuevo state reserve; mile



Nature trails; san francisco



China camp state park



Fort funston



Web Search is Interactive



Hiking; san francisco

Hiking; san francisco bay area

Ano nuevo state reserve

Ano nuevo state reserve; mile

Nature trails; san francisco

China camp state park

Fort funston

**Learned about
three hiking areas**

Web Search is Interactive



Hiking; san francisco

Hiking; san francisco bay area

TASK AS CONTEXT

Ano nuevo state reserve

Ano nuevo state reserve; mile

PREDICT TASK SUCCESS

Nature trails; san francisco

China camp state park

Fort funston

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Actions: Q 4s

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Pattern: Q 4s RL 1s

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Pattern: Q 4s RL 1s SR 53s

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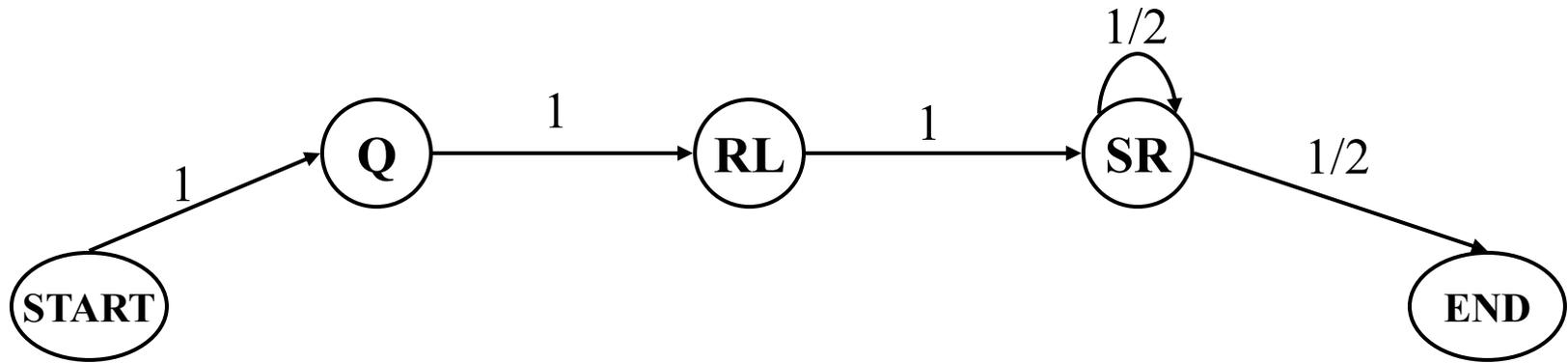
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Pattern: Q 4s RL 1s SR 53s SR 118s END

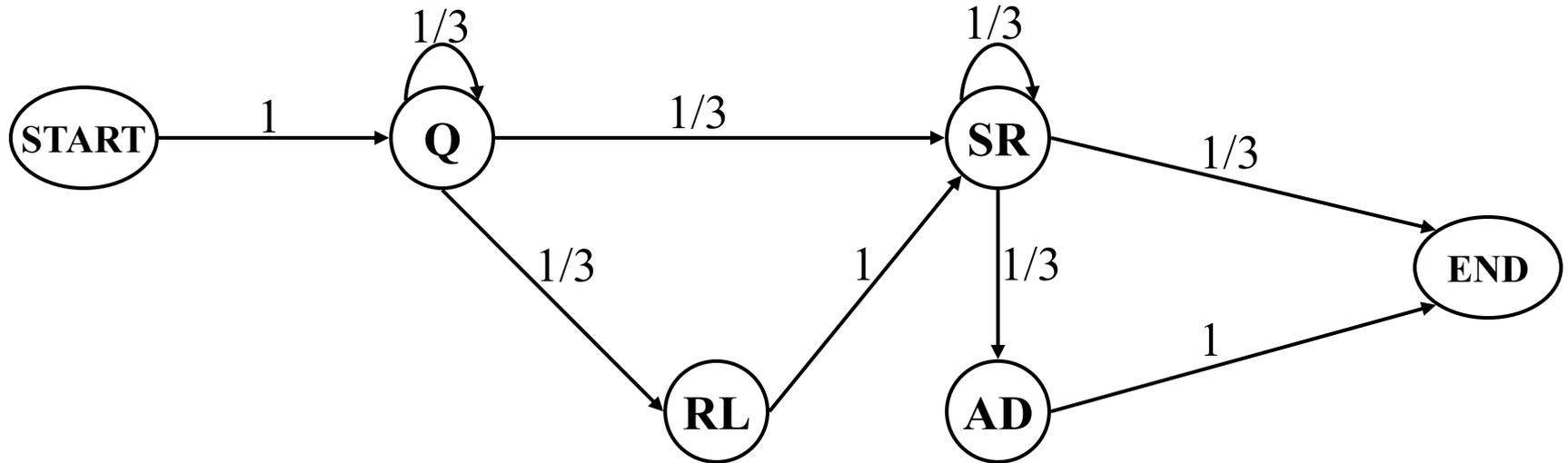
Clickstream Data

- Action sequence \rightarrow Graph.



Goal 1: Q 4s RL 1s SR 53s SR 118s END

Clickstream Data



Goal 1: Q 4s RL 1s SR 53s SR 118s END

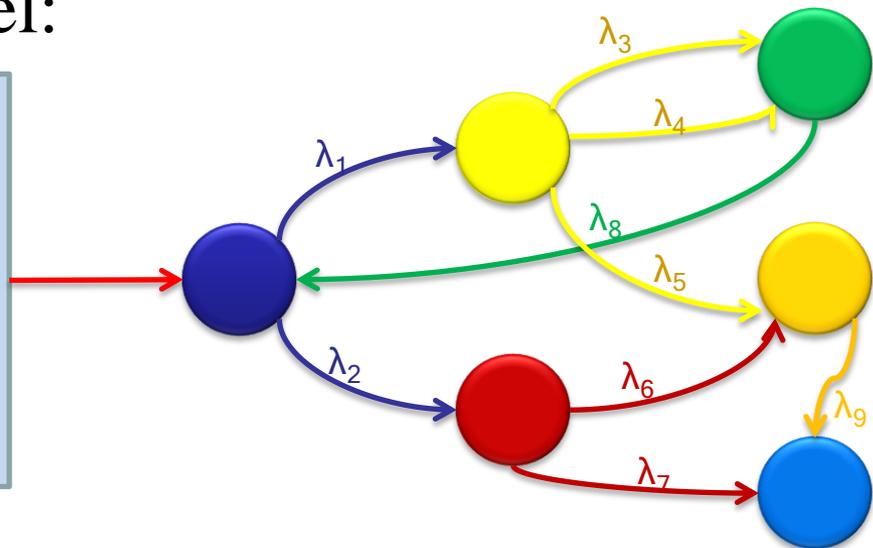
Goal 2: Q 3s Q 5s SR 10s AD 44s END

Modeling User Sessions

- Each set of goals may be represented by a first order Markov Model:

Goal₁: Q 4s RL 1s SR 53s SR 118s END
 Goal₂: Q 3s Q 5s SR 10s AD 44s END
 Goal₃: Q 4s RL 1s SR 53s SR 118s END
 Goal₄: Q 3s Q 5s SR 10s AD 44s END

 Goal_n: Q 4s RL 1s SR 53s SR 118s END
 Goal_{n-1}: Q 3s Q 5s SR 10s AD 44s END



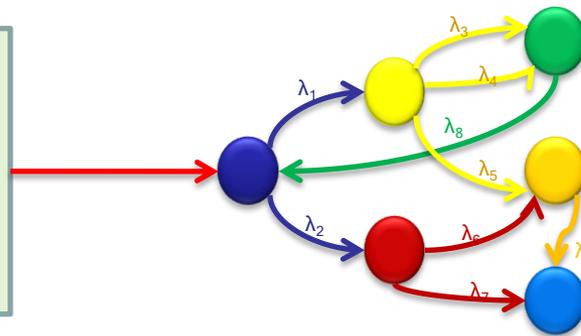
- Small state space: $\{Q, SR, AD, SC, RL, SP, OTH\}$
- Transition Probabilities: $\Pr(i, j) = \frac{Q_{i,j}}{Q_i}$

Markov Model

- Build two models:

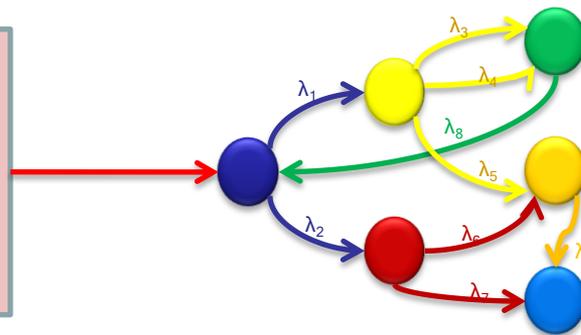
Successful Goals

Goal 1: Q 4s RL 1s SR 53s SR 118s END
Goal 2: Q 3s Q 5s SR 10s AD 44s END
Goal 3: Q 4s RL 1s SR 53s SR 118s END
Goal 4: Q 3s Q 5s SR 10s AD 44s END
.....
Goal n: Q 4s RL 1s SR 53s SR 118s END
Goal n-1: Q 3s Q 5s SR 10s AD 44s END

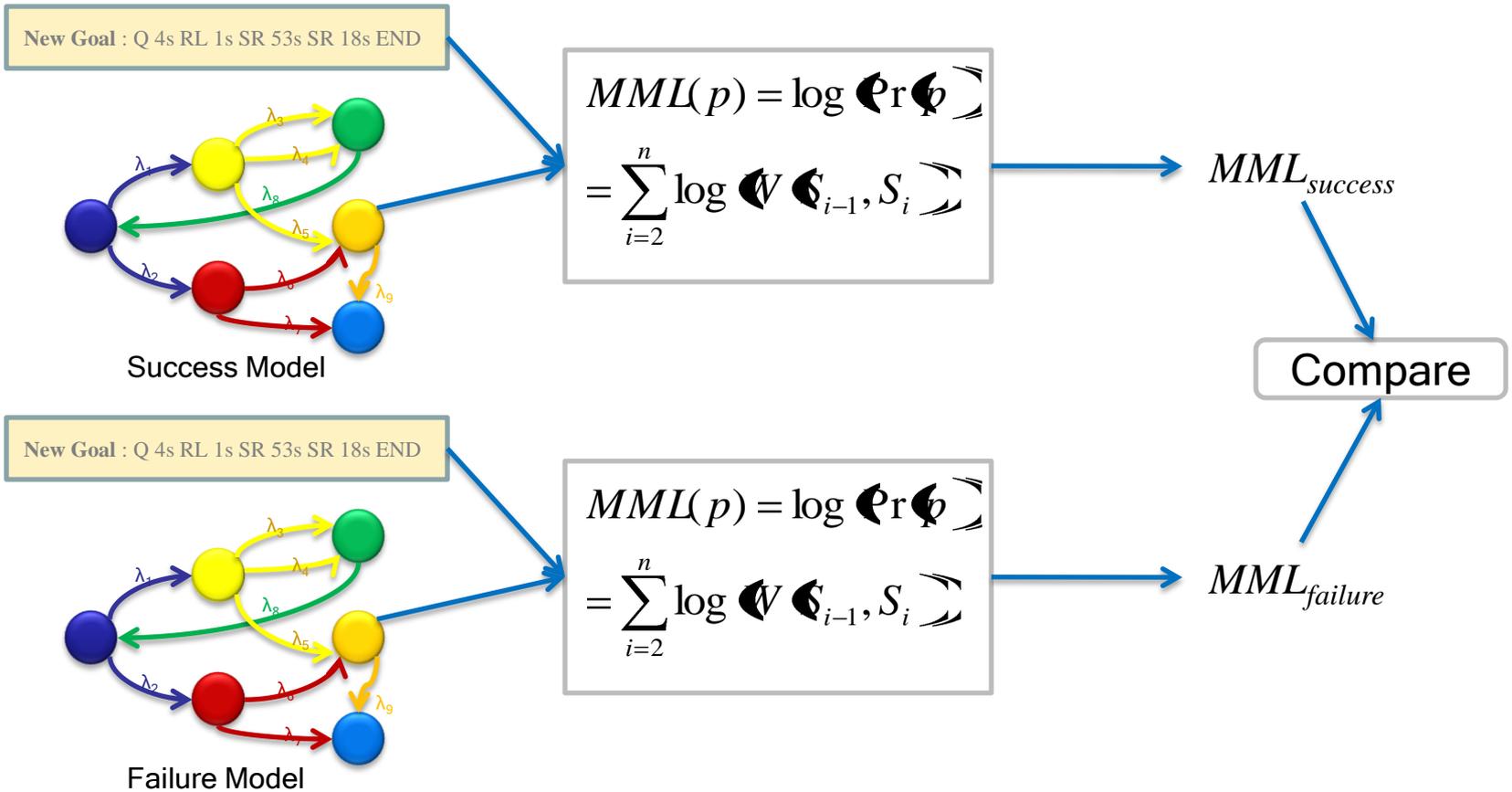


Unsuccessful Goals

Goal 1: Q 4s RL 1s SR 53s SR 118s END
Goal 2: Q 3s Q 5s SR 10s AD 44s END
Goal 3: Q 4s RL 1s SR 53s SR 118s END
Goal 4: Q 3s Q 5s SR 10s AD 44s END
.....
Goal n: Q 4s RL 1s SR 53s SR 118s END
Goal n-1: Q 3s Q 5s SR 10s AD 44s END

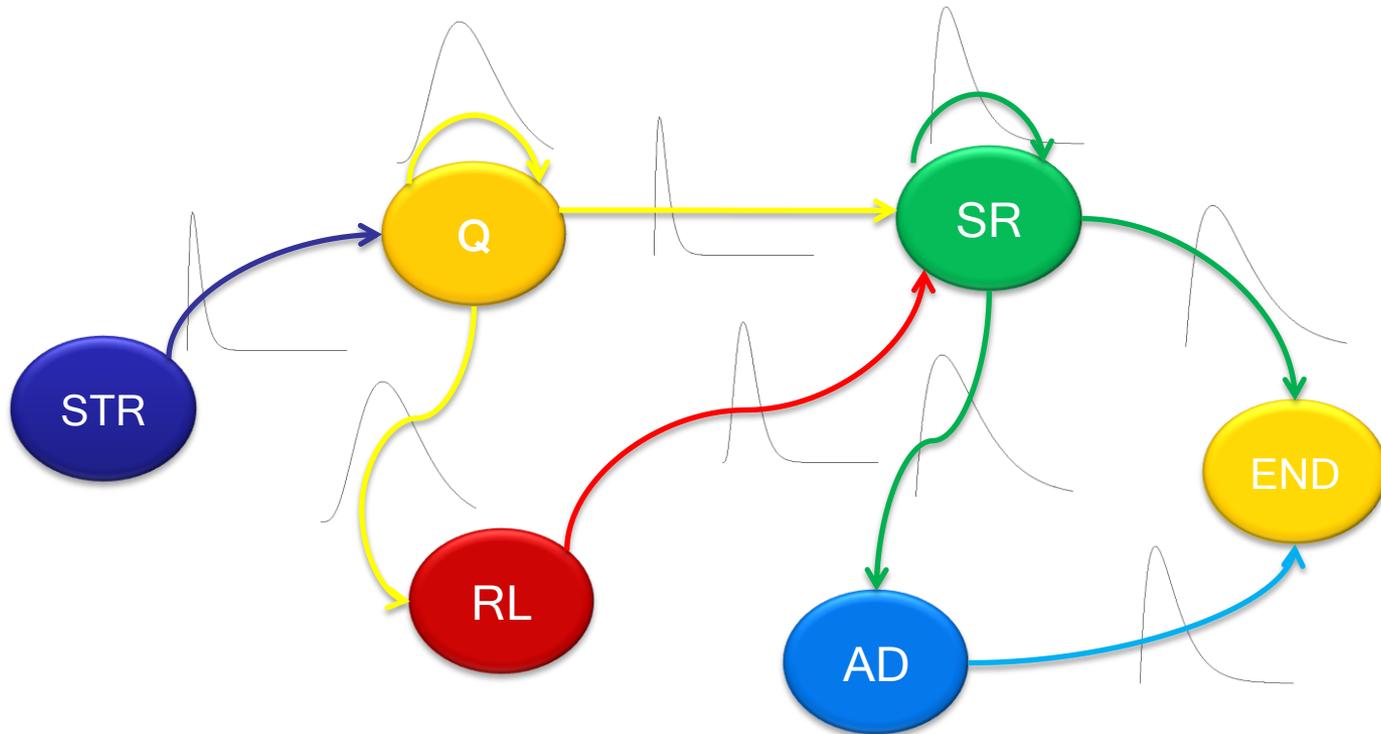


Classifying New Goals

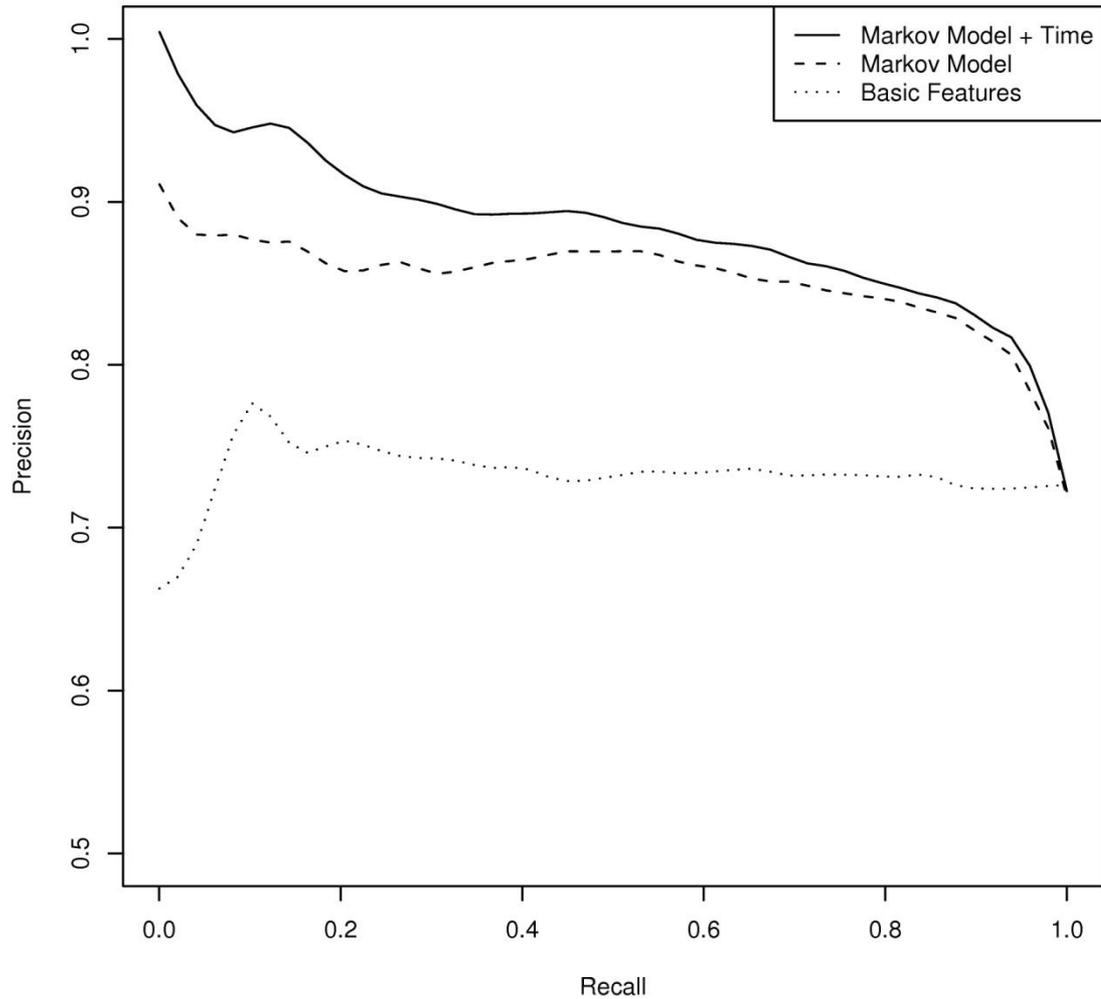


Modeling Time

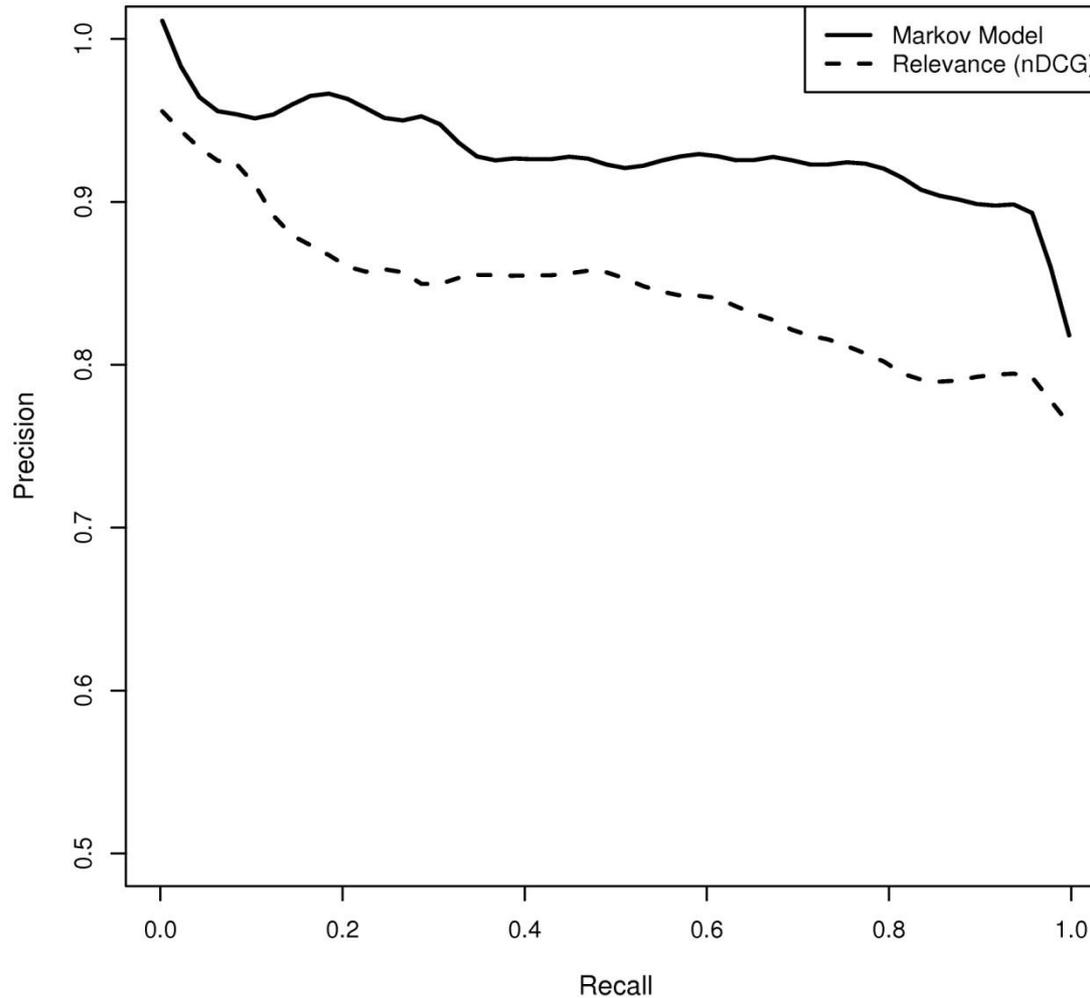
- Attach a time distribution to each transition in the Markov chain.



Markov Models Do Much Better Than Baseline



User Behavior Outperforms Relevance based Prediction



Successful Goals More Likely to Use Shortcuts

Action following query		Odds-ratio
SC	Shortcut	2.0
SR	Search result	1.8
RL	Also-Try	1.2
SP	Spell-correction	0.9
Q	Query	0.5
END	End of goal	0.1

Odds-ratio of transitions from query to other actions in successful goals, compared to unsuccessful goals.

Highly Probable Successful Paths

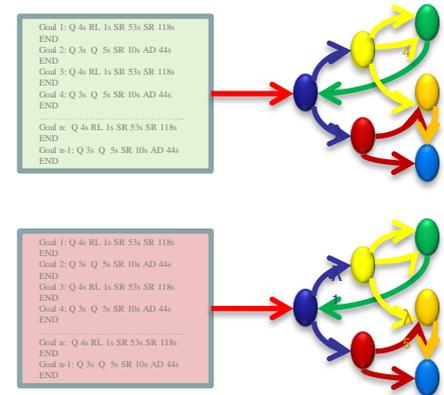
Highly probable successful paths
Q SR END
Q SR SR END
Q SR SR SR END
Q SR SR SR SR END
Q AD END
Q SC END
Q SR Q SR SR END

Highly Probable Unsuccessful Paths

Highly probable unsuccessful paths
Q END
Q Q END
Q OTH END
Q SR Q END
Q Q Q END
Q RL END
Q Q SR Q SR Q END

Conclusions and Future Work

- Predict success using a Markov model that captures user behavior
- We can predict goal success with 82% accuracy
- The Markov model outperforms relevance based models
- Build other predictive models for sessions



Questions?

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