TimeMachine:
Timeline Generation for Knowledge-Base Entities
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The Problem
• Google is great but not perfect: Learning about some new topic’s history remains challenging
• Search engines do not provide representative view or support exploration of topic and its relationships

The Solution: Timeline Visualization
• Summarizes most relevant events/relationships
• Interactive exploration, e.g., zoom and topic-switch
• Adapts to available screen estate
• Our task: Given entity, generate timeline

Timeline for Robert Downey Jr.

Step 1: Event Generation
• Use knowledge base to generate events
• Filtering step to exclude non-informative events

Step 2: Event Selection
Optimization Problem
\[ T^* = \arg \max_{T \subseteq E} \text{Relevance}(T) \]
\[ \text{subject to } \text{TemporalDiversity}(T) \]
1. Correctness (Event Generation)
• Guaranteed by knowledge base & construction
2. Relevance Signals (Objective)
• Global: # of search queries for entity
• Entity-Entity & Entity-Date co-occurrence from 10B document web corpus (NER + CoRef + NPMI)
3. Content Diversity (Objective)
• Encode diminishing returns in objective
4. Temporal Diversity (Constraint)
• Enforce balanced layout during optimization as constraint

Conclusions
• Goal: Scalable timeline generation
• Challenge: Jointly optimize for relevance, content diversity, and temporal diversity
• Efficient algorithms with theoretical guarantees
• User studies show that all criteria are important
• Demo! cs.stanford.edu/~althoff/timemachine

Our Approach

Quality Criteria
1. Correctness: Only show actual events/relationships
2. Relevance: Only display most “relevant” events
3. Content Diversity: Display diverse set of event types
4. Temporal Diversity: Produce balanced layout

Experimental Evaluation
• User studies on AMT (>1200 raters)
• Pairwise comparisons \(\rightarrow\) relative judgments

Another Example: John F Kennedy