

# Situated Conversational Interaction

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*CONTRIBUTORS:*

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*TWEET COMMENTS/QUESTIONS: #IEEEGLOBALSIP*

Global SIP 2013



# Situated Conversational Interaction

Leverage the situation or context of the user to create a conversational natural user interfaces to the world's knowledge

INTERSPEECH 2013



## Leveraging Knowledge Graphs for Web-Scale Unsupervised Semantic Parsing

Larry Heck, Dilek Hakkani-Tür, Gokhan Tur

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### Abstract

The past decade has seen the emergence of web-scale structured and linked semantic knowledge resources (e.g., Freebase, DBPedia). These semantic knowledge graphs provide a scalable “schema for the web”, representing a significant opportunity for the spoken language understanding (SLU) research community. This paper leverages these resources to bootstrap a web-scale semantic parser with no requirement for semantic schema design, no data collection, and no manual annotations. Our approach is based on an iterative graph crawl algorithm. From an initial seed node (entity-type), the method learns the related entity-types from the graph structure, and automatically annotates documents that can be linked to the node (e.g., Wikipedia articles, web search documents). Following the branches, the graph is crawled and the procedure is repeated. The resulting collection of annotated documents is used to bootstrap web-scale conditional random field (CRF) semantic parsers. Finally,

training instances (i.e., the instances are manually labeled with the true domains, intents, slots). These characteristics of statistical SLU systems have forced developers to spend considerable energy crafting one domain at a time and ultimately limit the ability of the systems to scale in breadth of domains and external knowledge sources, as well as remain flexible to changes in task definition.

As a result, there has been an increased level of research over the past several years to address these limitations. New *lightly supervised* and *unsupervised* training methods rely on side information to automatically provide training labels (domain, intent, and slots). An example is our previous work on leveraging web search query click logs for mining additional training data and enriching classification features. With these methods, we have seen significant reductions in domain [6], intent [7], and slot filling [8] error rates.

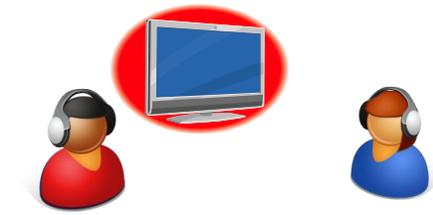
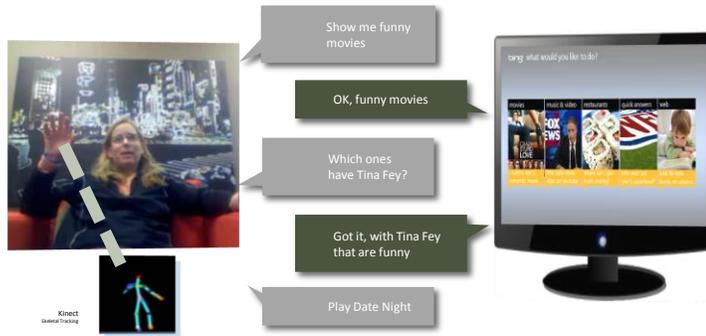
In our recent work, we have begun to exploit the combination of statistical approaches with methods inspired by the deep



# Modes of Situated Conversations

Human computer interaction

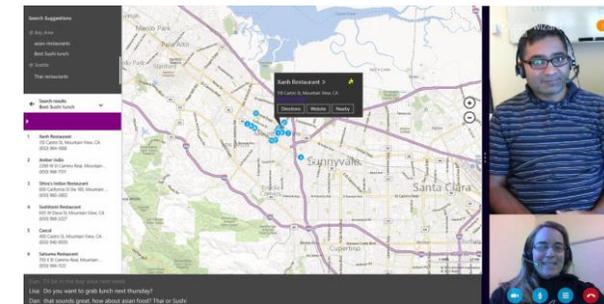
Augmented multi-party interaction



## Personal Assistant for Phones



## Other Screens:



# Conversational Browser

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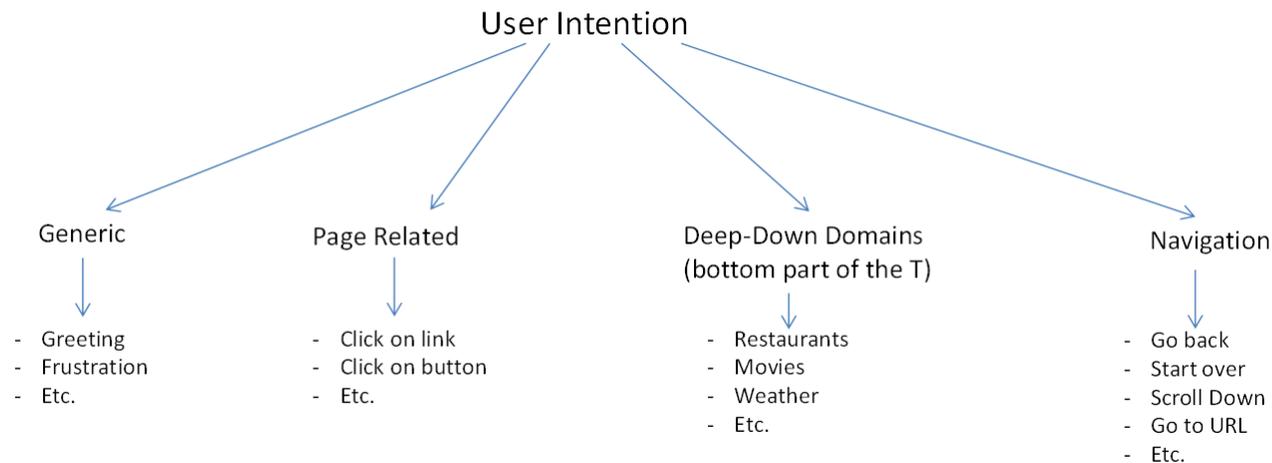
SITUATED INTERACTION WITH THE WEB OF DOCUMENTS AND APPS

# Creating a “Web Scale” Conversational Browser

## *Situated Interactions: Dynamically Adapt to the Page Content*

Browsing to a new web page or App affects ASR and SLU

- ASR: Dynamic adaptation of LMs to ngrams of page content → 16% ERR in WER
- SLU:
  - Add 100s of **click intent** actions to *static SLU*
  - Multi-tiered logic determines final intent



# Creating a “Web Scale” Conversational Browser

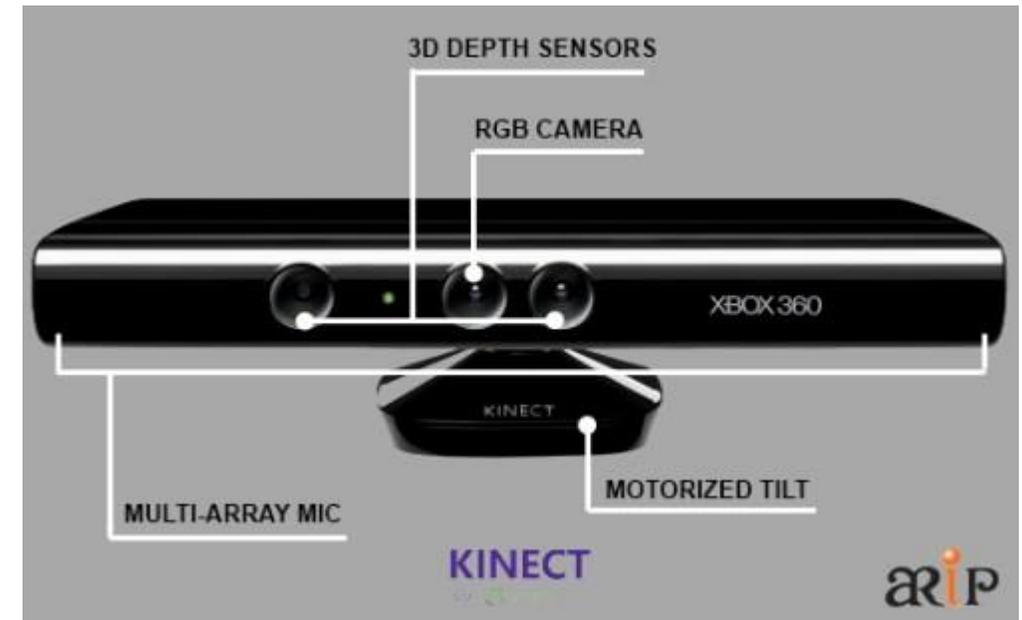
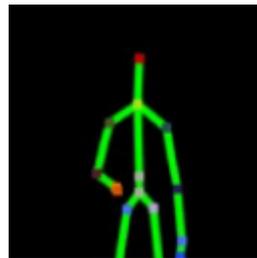
## *Situated Interactions: Multimodal Processing*

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Multimodal Sensor for Study: Kinect™

- RGB camera
- Depth sensor
- Multi-array microphone running proprietary software

Kinect enables full-body 3D motion capture, facial recognition and voice recognition



# Creating a “Web Scale” Conversational Browser

## *Situated Interactions: Multimodal Processing*

Lexical Click Intent

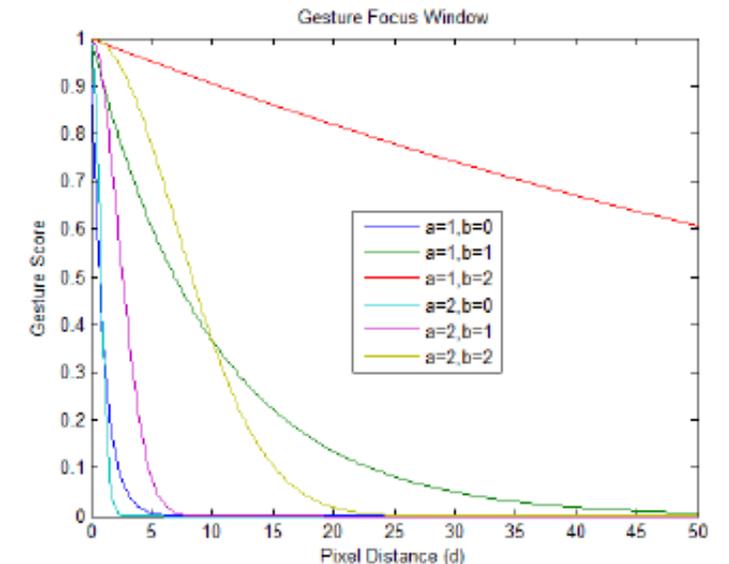
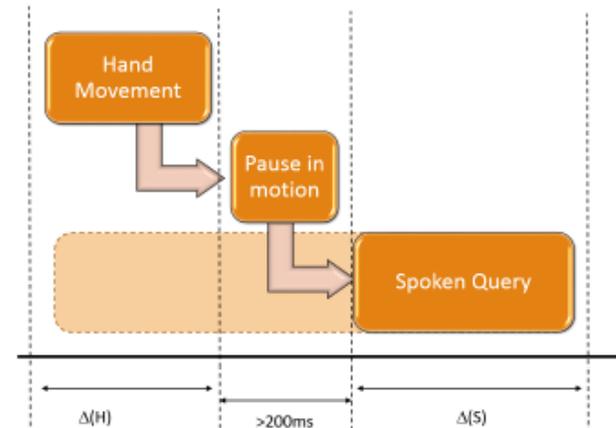
$$\text{TF-IDF}(q, p_k) = \sum_{t \in q} \text{tf-idf}_{t, p_k}$$

Gesture Click Intent

$$\text{Gesture Score} = \exp\left(\frac{-|d|^a}{10^b}\right)$$

Combining Intents

$$\begin{aligned} S_{M_k} &= (1 - \alpha) \text{TF-IDF}(q, p_k) + \alpha \cdot \text{Gesture Score} \\ &= (1 - \alpha) \sum_{t \in q} \text{tf-idf}_{t, p_k} + \alpha \cdot \exp\left(\frac{-|d|^a}{10^b}\right) \quad (3) \end{aligned}$$

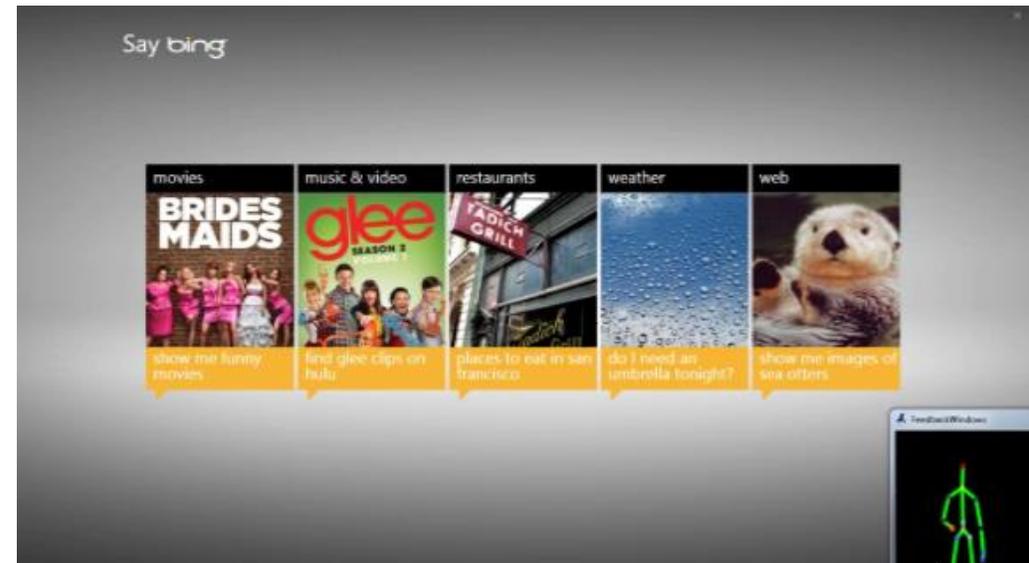
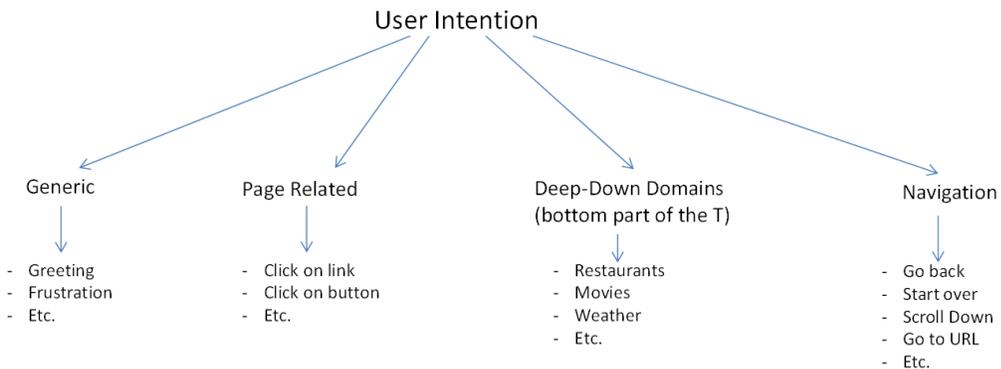


# Experimental Setup

Living Room: users seated 5-6 feet away from TV

## Two Data Collections

- Set #1: 8 speakers over 25 sessions
  - 2,868 user turns
  - 917 (31.9%) with click intent
- Set #2: 7 speakers over 14 sessions
  - 1,101 user turns
  - 284 (25.8%) with click intent



# Gesture Intent Model

## Results

Studied errors in gesture intent model

- False Accepts (random arm movement triggers intent)
- Miss (system misses pointing intent)

Removed all display control utts (e.g., “scroll up”)

558 remaining turns (ones with/without hand gesture)

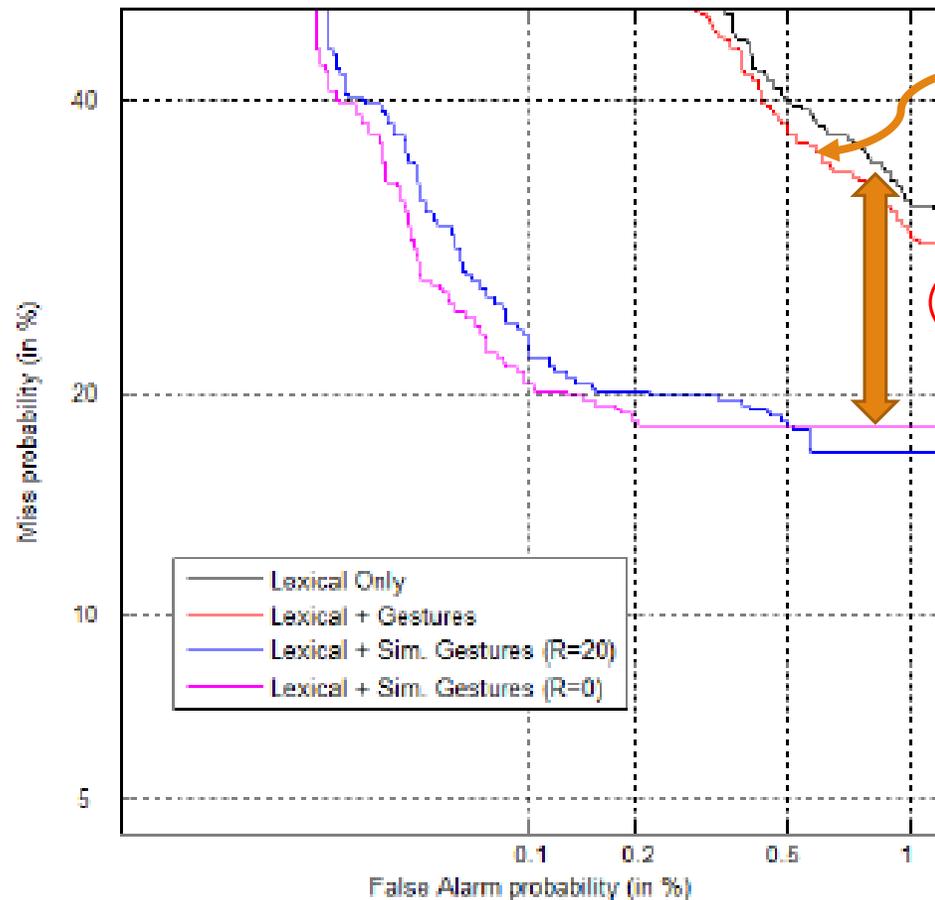
	Gesture Found	No Gesture Found	TOTAL
Click “that one”	15 (2.7%)	1 (0.1%)	16 (2.8%)
Click other	25 (4.5%)	102 (18.3%)	127 (22.8%)
Non-Click	127 (22.8%)	288 (51.6%)	415 (74.4%)
TOTAL	167 (30.0%)	391 (70.0%)	558

False Accepts

Miss

# Multimodal Click Intent Detection

## *Simulated vs Real Gestures*



Real Gesture  
~10% ERR

Simulated (always pointing)  
~50% ERR

What is the gesture accuracy of humans ?  
**[16.4 ↔ 28.6] pixels**

Do humans point every time they speak?  
**Humans only user gesture 30.0% of the time**

# To dig deeper...

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Larry Heck, et al, [Multimodal Conversational Search and Browse](#)

IEEE Workshop on Speech, Language and Audio in Multimedia, August 2013

# Conversational Insights

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SITUATED INTERACTION WITH DOCUMENTS

# Fall 2013 Guide to New York City

Frommer's - By Donna Heiderstadt on September 09, 2013 at 4:22:36 PM EDT

Like the classic Frank Sinatra hit asks, "Autumn in [New York](#)... why does it seem so inviting?" New Yorkers like to chalk up the city's third-quarter appeal to its generally sunny weather (with temperatures ranging from pleasingly warm to invigoratingly nippy), the waning of summer tourist crowds, festive parades, Broadway show openings, gargantuan harvest moons rising over the East River, and, of course, the famed New York City Marathon in early November. Here are some of the things that will keep you busy during a September-to-November visit.

## Autumn's Annual Events



Even though it's not officially Fall for a few more weeks, the season kicks off right after Labor Day with [Mercedes-Benz Fashion Week](#) (September 5-12) as style-savvy buyers, editors, celebrities, and fashionistas (as well as *Project Runway*'s Heidi Klum and Tim Gunn) descend on the city for nonstop couture shows and late-night parties—it's people-watching at its chicest.

To satisfy something other than your fashion sense, follow your nose to the [Feast of San Gennaro](#) (September 12-22), an annual rite of caloric overindulgence featuring favorite Italian foods like sausage and peppers and cannoli, as well as music and entertainment. You can *mangia* every day from 11:30 am to 11:30 pm on Mulberry and Grand streets in Little Italy.

Autumn plays host to some of NYC's top parades: The festivities along Fifth Ave. begin with oompah music on Sept 21 during the [Steuben Parade](#) (a celebration of German-American heritage), then march to a polka beat on Oct. 6 with the [Pulaski Day Parade](#) (feting Polish-Americans), and conclude on Oct. 14 with the [Columbus Day Parade](#) (an Italian-American extravaganza). On Oct. 31, head to the West Village for the [Village Halloween Parade](#) (6:30-8:30 pm on Sixth Ave. between Canal and Spring streets) to ogle outrageously costumed marchers. And on the morning of November 28, find a spot along Central Park West or Sixth Ave. above 34th St. to catch the world-famous balloons, floats, and marching bands in the 87th Annual [Macy's Thanksgiving Day Parade](#). Or gather outside the [American Museum of Natural History](#) on the evening of Nov. 27 to watch the giant balloons spring to life.

## Hot New Eats



Per usual, dozens of restaurants debuted in NYC over the last few months, but these three are getting tons of buzz: [Betony](#), where Chef Bryce Shuman and partner Eamon Rockey (both formerly of [Eleven Madison Park](#)) preside over a sophisticated and flavor-rich modern American menu served in a soaring space. In Nolita, New Zealand Chef Matt Lambert (formerly of [Public](#)) is helming [The Musket Room](#), where the menu is inspired by his homeland and features dishes like mushroom custard, cold smoked scallops, and red New Zealand deer flavored with gin.

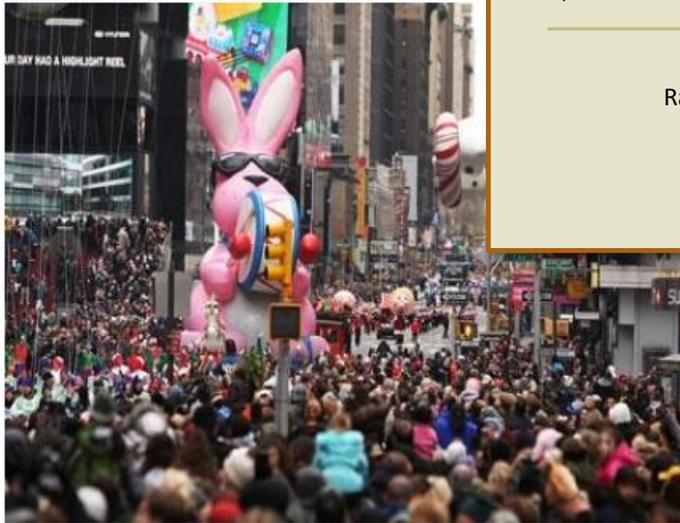
And given the late August opening of [Juni](#), you can be the among the first to try Australian chef Shaun Hergatt's seasonal tasting menus (his previous restaurant, [SHO Shaun Hergatt](#), had two Michelin stars).

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Quick Insights

## New York City Marat...



The New York City Marathon is an annual marathon that courses through the five boroughs of New York City. It is

one of the largest marathons in the world, with 45,103 finishers in 2010. Along with the Boston Marathon and C...

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The New York City Marathon i...



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See Web Results

# Knowledge: Foundation of Situated Conversations

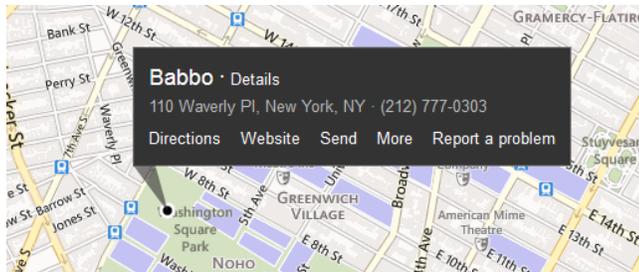
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A vast majority of user interactions are with people, locations, things.

Knowledge refers to these entities/concepts and to how they are interrelated.

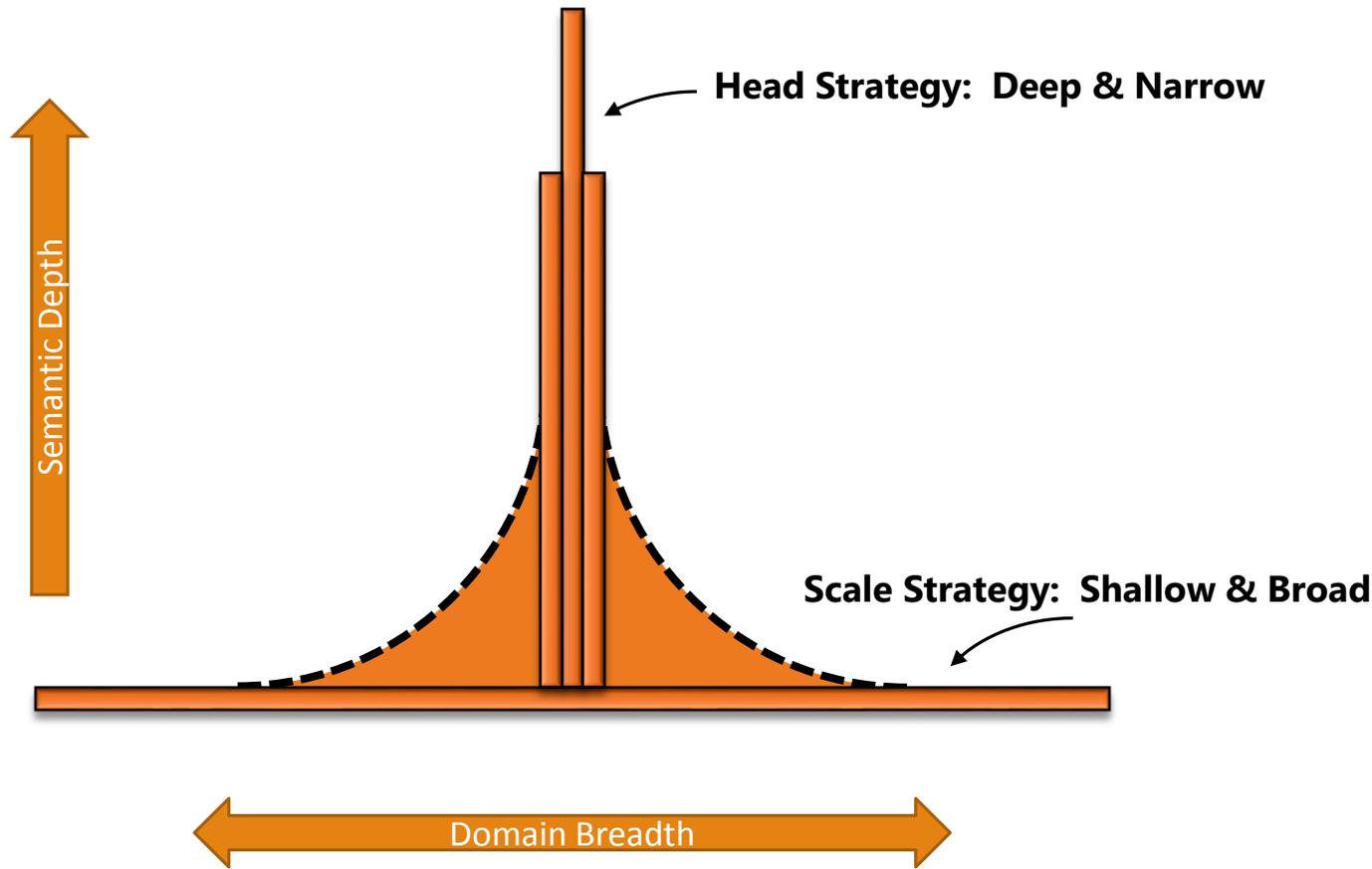
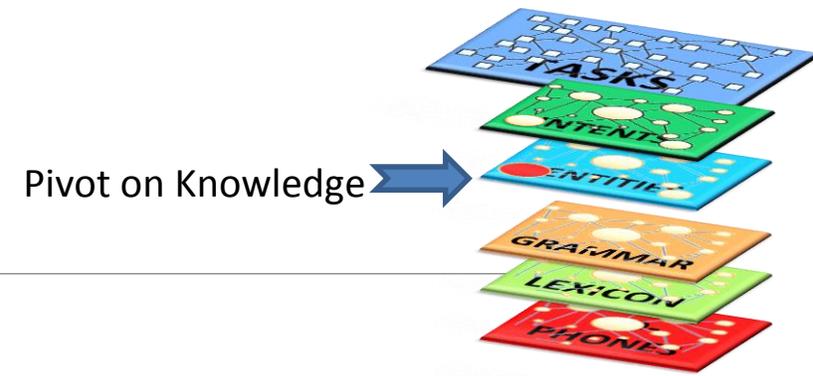
The dual-role of knowledge

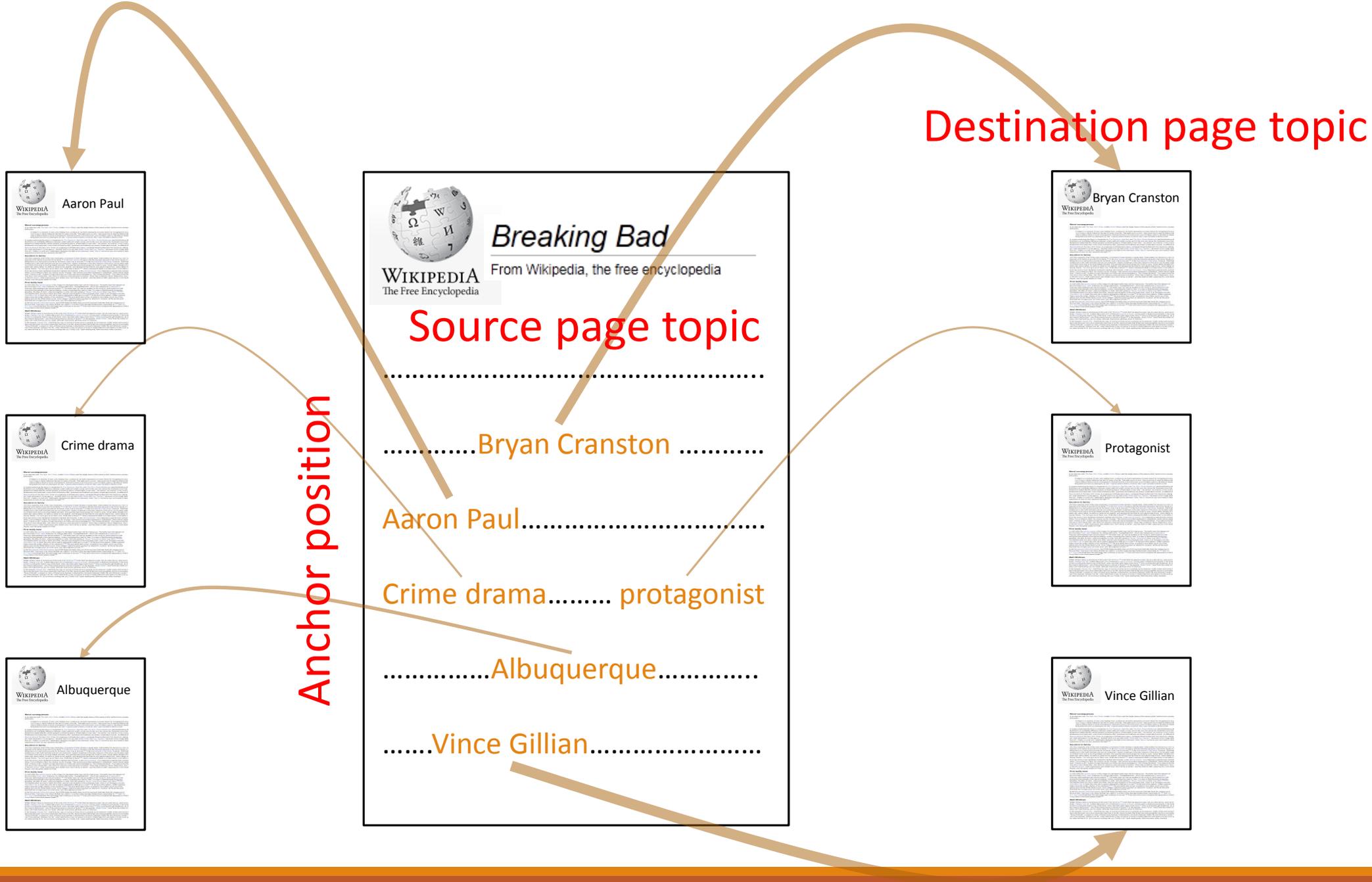
- People seek to **find information** about things, to **transact** on them, and to **browse for recommendations**.
- Knowledge “joined” with world → **situated conversation**.



# Conversational Systems Challenge

*Scaling Through Situated Knowledge*





**Wikipedia & other document sources**

Article Talk Read Edit View source

**Life Is Beautiful**

From Wikipedia, the free encyclopedia  
(Redirected from Life is beautiful)

For other uses, see *Life Is Beautiful (disambiguation)*.

**Life Is Beautiful** (Italian: *La vita è bella*) is a 1997 Italian comedy-drama film directed by and starring Roberto Benigni. Benigni plays Guido Orefice, a Jewish Italian book shop owner, who must employ his fertile imagination to shield his son from the horrors of internment in a Nazi concentration camp. Part of the film came from Benigni's own family history; before Roberto's birth, his father had survived three years of internment at the Bergen-Belsen concentration camp. The film was a critical and financial success, winning Benigni the Academy Award for Best Actor at the 71st Academy Awards as well as the Academy Award for Best Original Dramatic Score and the Academy Award for Best Foreign Language Film.

Contents [hide]

1 Plot

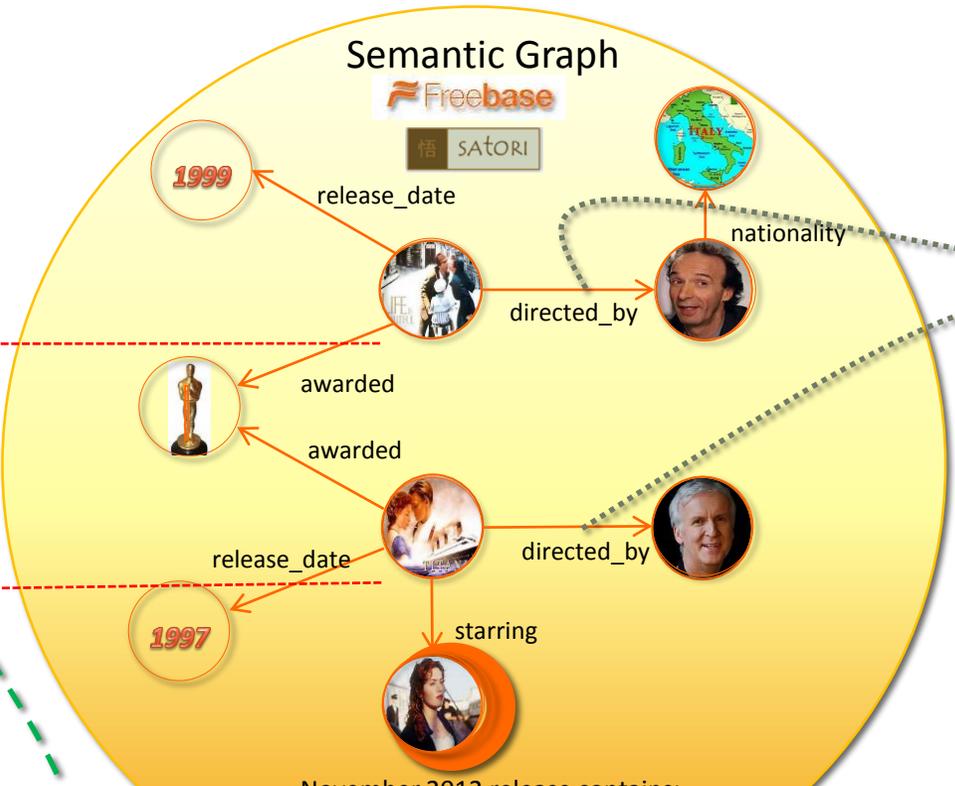
Article Talk Read View source

**Titanic (1997 film)**

From Wikipedia, the free encyclopedia

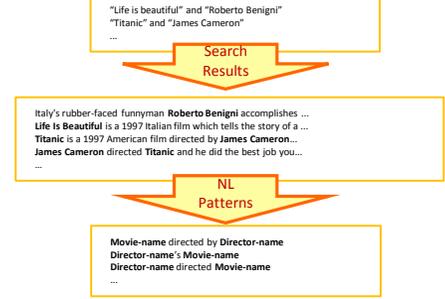
**Titanic** is a 1997 American epic romantic disaster film directed, written, co-produced, and co-edited by James Cameron. A fictionalized account of the sinking of the RMS *Titanic*, it stars Leonardo DiCaprio and Kate Winslet as members of different social classes who fall in love aboard the ship during its ill-fated maiden voyage.

Cameron's inspiration for the film was predicated on his fascination with shipwrecks; he wanted to convey the emotional message of the tragedy, and felt that a love story interspersed with the human loss would be essential to achieving this. Production on the film began in 1995, when Cameron shot footage of the actual *Titanic* wreck. The modern scenes were shot on board the *Akademik Mstislav Keldysh*, which Cameron had used as a base when filming the wreck. A reconstruction of the *Titanic* was built at Playas de Rosarito, Baja California, and scale models and computer-generated imagery were also used to recreate the sinking. The film was partially funded by Paramount Pictures and 20th Century Fox, and, at the time, was the most expensive film ever made, with an estimated budget of \$200 million.

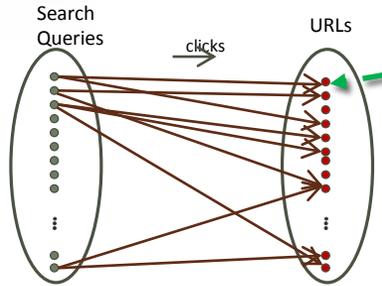


**Web Search**

Movie-Director search queries:



**bing Query Click Logs**



Who directed the movie *Life is beautiful*  
Director of *Life is beautiful*

**Data & features for training statistical CU models**

Sample user utterances:	"Show me movies by Roberto Benigni"	"Who directed Life is Beautiful?"
Corresponding relation on the knowledge graph		
User request in query language	SELECT ?movie { ?movie directed_by "Roberto Benigni". }	SELECT ?director { "Life is Beautiful" directed_by ?director. }
User request in logical form	$\lambda y. \exists x. x = \text{"Roberto Benigni"} \wedge \text{directed\_by}(x, y)$	$\lambda x. \exists y. y = \text{"Life is beautiful"} \wedge \text{directed\_by}(x, y)$

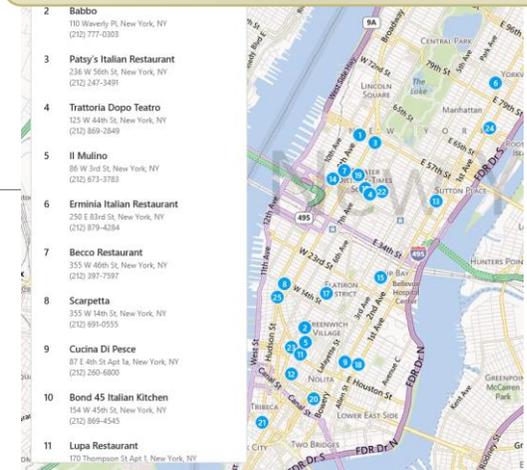
# Conversational Systems Approach *Scaling Through Situated Knowledge*

## Processing Flow of an Interaction with Knowledge

- Scoping
  - Linking the focus entity(ies) to the knowledge base
    - E.g., linking a touch on “marathon” to the Wikipedia ID for “NYC Marathon”; subselecting restaurants on a map after circling a region.
- Intent detection
  - Interpret the intent (what the user wants) in the context of the knowledge (and other context)
- Execution
  - Farm out the request to an appropriate execution engine

Key Point: There are very few intent categories that govern most interactions.

“Ones good for kids.”



tourist crowds, festive parades, Broadway show openings, gargantuan harvest moons rising over the East River, and, of course, the famed New York City Marathon in early November. Here are some of the things that will keep you busy during a September-to-November visit.

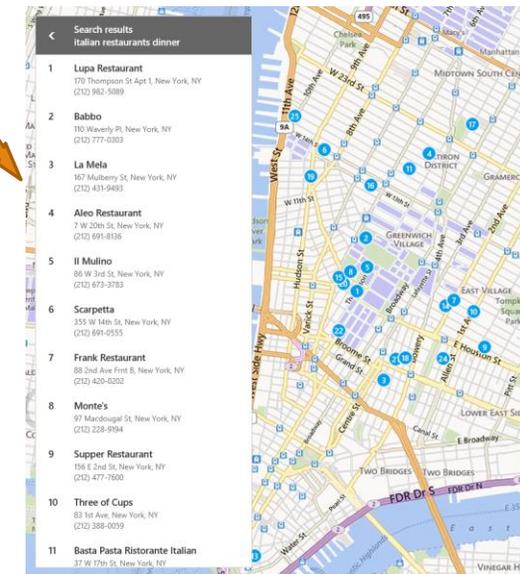
Informational

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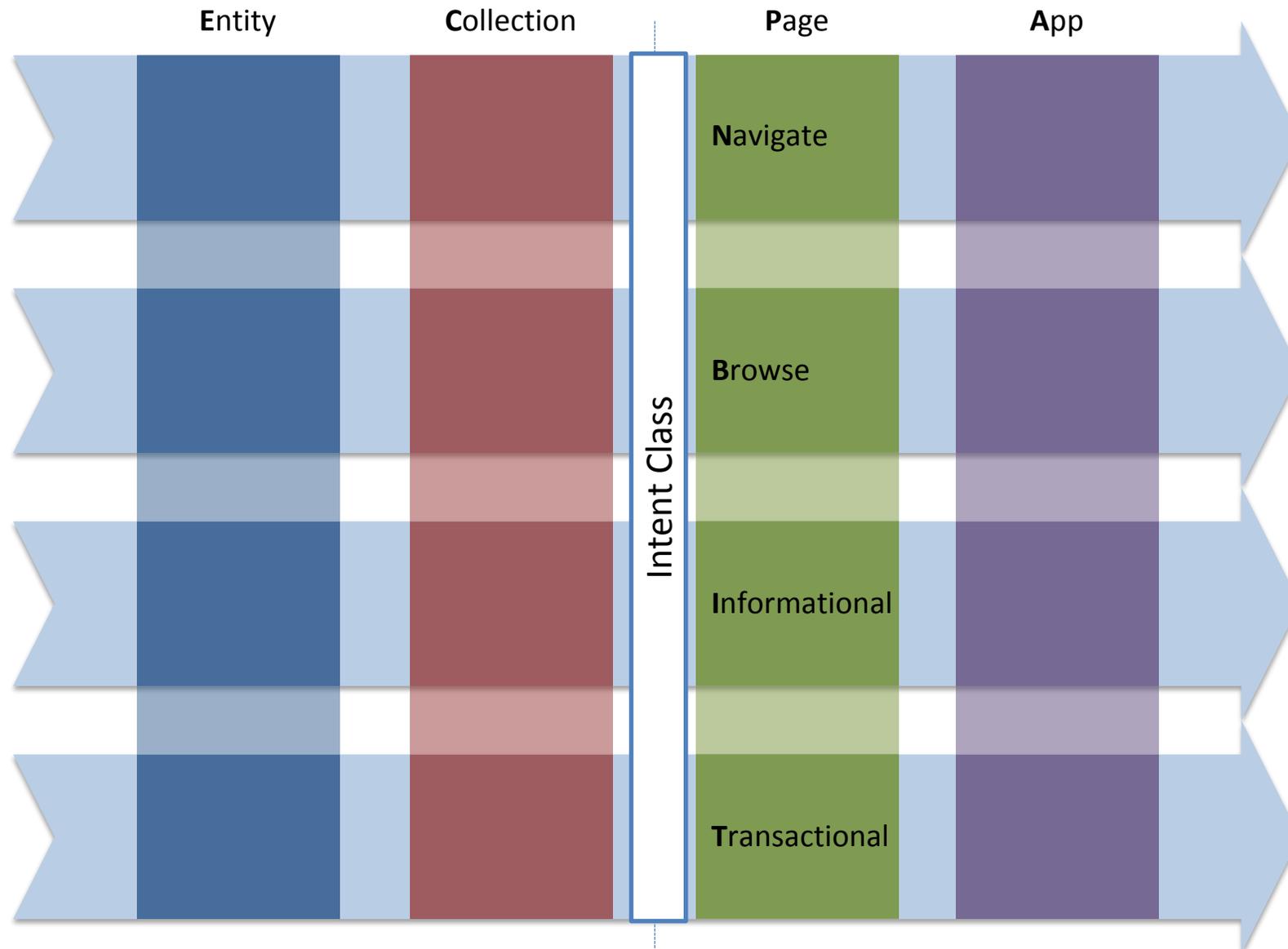
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Browse



# NUI Context: Scope

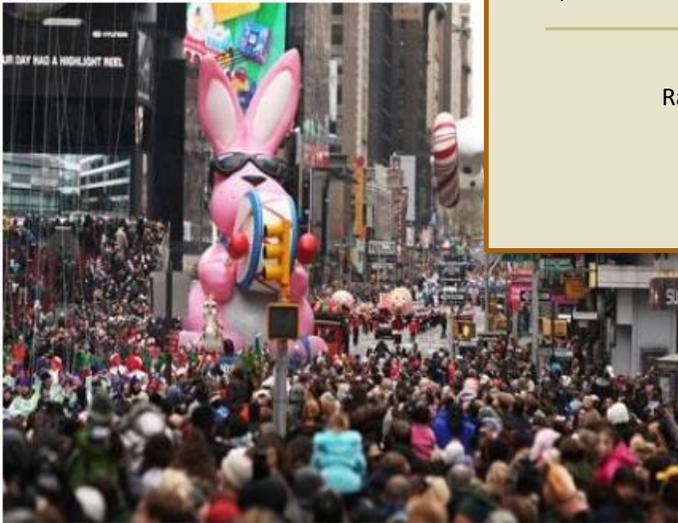


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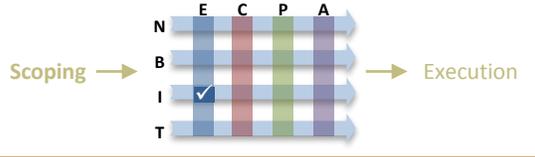
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Copy Insights Highlights Memos

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## Quick Insights Feast of San Gennaro

The Feast of San Gennaro, originally a one-day religious commemoration, began in September 1926 when newly arrived immigrants from Naples congregated along Mulberry Street in the Little Italy section of New York City, to continue the tradition they had followed in Italy to celebrate San Gennaro, the Patron Saint of Naples. Hi...

[See More](#)

### Explore On Wikipedia

- Mulberry Street (Manhattan...)**  
Mulberry Street is a principal t...
- Januarius - Wikipedia, the fr...**  
Januarius, Bishop of Naples, is...

[See More](#)

### See Web Results

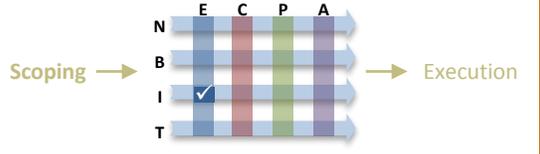
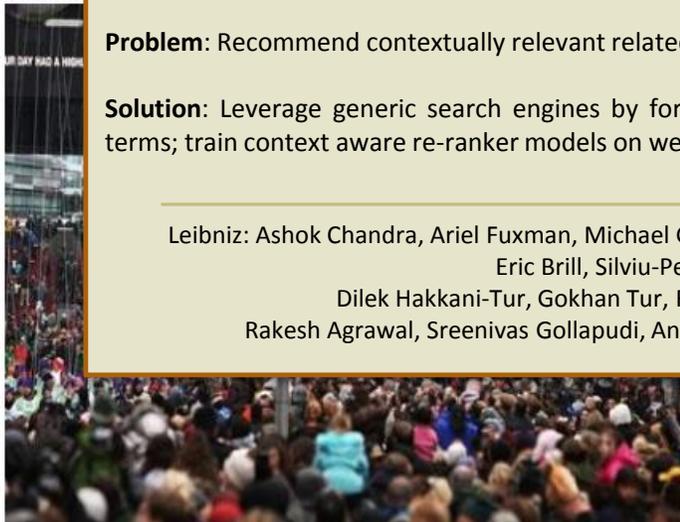
## Contextual Search

**Problem:** Recommend contextually relevant related content, pivoting on user selection.

**Solution:** Leverage generic search engines by formulating queries with contextually targeted terms; train context aware re-ranker models on web usage sessions to encourage diversity.

Leibniz: Ashok Chandra, Ariel Fuxman, Michael Gamon, Yuanhua Lv, Patrick Pantel, Bo Zhao  
Eric Brill, Silviu-Petru Cucerzan  
Dilek Hakkani-Tur, Gokhan Tur, Rukmini Iyer, and Larry Heck  
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## Autu

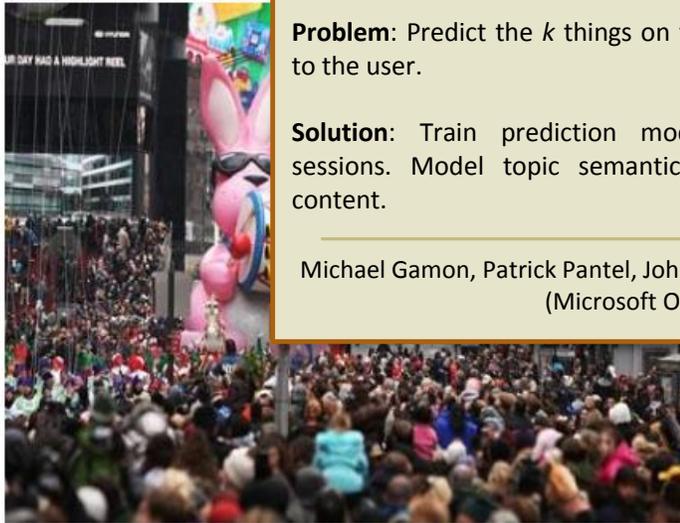


# Fall 2013 Guide to New York City

Frommer's - By Donna Heiderstadt on September 09, 2013 at 4:22:36 PM EDT

Like the classic Frank Sinatra hit asks, "Autumn in *New York*... why does it seem so inviting?" New Yorkers like to chalk up the city's third-quarter appeal to its generally sunny weather (with temperatures ranging from pleasingly warm to invigoratingly nippy), the waning of summer tourist crowds, festive parades, Broadway show openings, gargantuan harvest moons rising over the East River, and, of course, the famed New York City Marathon in early November. Here are some of the things that will keep you busy during a September-to-November visit.

## Autumn's Annual



**Interestingness**

**Problem:** Predict the  $k$  things on the page of most interest to the user.

**Solution:** Train prediction models on web browsing sessions. Model topic semantics of source and target content.

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Michael Gamon, Patrick Pantel, Johnson Apacible, Xinying Song  
(Microsoft Office)

Even though it's not officially Fall for a few more weeks, the season kicks off right after Labor Day with [Mercedes-Benz Fashion Week](#) (September 5-12) as style-savvy buyers, editors, celebrities, and fashionistas (as well as *Project Runway's* Heidi Klum and Tim Gunn) descend on the city for nonstop couture shows and late-night parties—it's people-watching at its chicest.

To satisfy something other than your fashion sense, follow your nose to the [Feast of San Gennaro](#) (September 12-22), an annual rite of caloric overindulgence featuring favorite Italian foods like sausage and peppers and cannoli, as well as music and entertainment. You can *mangia* every day from 11:30 am to 11:30 pm on Mulberry and Grand streets in Little Italy.

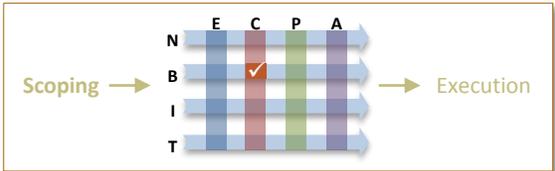
Some of NYC's top parades: The festivities along with pomph music on Sept 21 during the [Steuben](#) (of German-American heritage), then march to a with the [Pulaski Day Parade](#) (feting Polish-American). Oct. 14 with the [Columbus Day Parade](#) (an *vaganza*). On Oct. 31, head to the West Village [Halloween Parade](#) (6:30:30 pm on Sixth Ave. between 11th and 12th Sts) to ogle outrageously costumed marchers. And on November 28, find a spot along Central Park West or 5th St. to catch the world-famous balloons, floats, and marching bands in the 87th Annual [Macy's Thanksgiving Day Parade](#). Or gather outside the [American Museum of Natural History](#) on the evening of Nov. 27 to watch the giant balloons spring to life.

## Hot New Eats



Per usual, dozens of restaurants debuted in NYC over the last few months, but these three are getting tons of buzz: [Betony](#), where Chef Bryce Shuman and partner Eamon Rockey (both formerly of [Eleven Madison Park](#)) preside over a sophisticated and flavor-rich modern American menu served in a soaring space. In Nolita, New Zealand Chef Matt Lambert (formerly of [Public](#)) is helming [The Musket Room](#), where the menu is inspired by his homeland and features dishes like mushroom custard, cold smoked scallops, and red New Zealand deer flavored with gin.

And given the late August opening of [Juni](#), you can be the first to try Australian chef Shaun Hergatt's seasonal tasting menus (his previous restaurant, [SHO Shaun Hergatt](#), had two Michelin stars).



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## Conversational Search and Browse

**Problem:** Enable search and browse of content with voice.

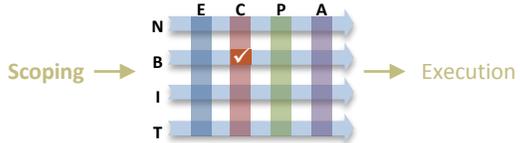
**Solution:** Dynamically adapt (at run-time) the speech language models and semantic parsers based on the content of the page; identify actionable elements on the page and add to intent list.

Larry Heck, Dilek Hakkani-Tur, Madhu Chinthakunta, Gokhan Tur, Rukmini Iyer, Partha Parthasarathy, Lisa Stifelman, Elizabeth Shriberg, and Ashley Fidler (IEEE SLAM'13)

## Autumn's Annual Events

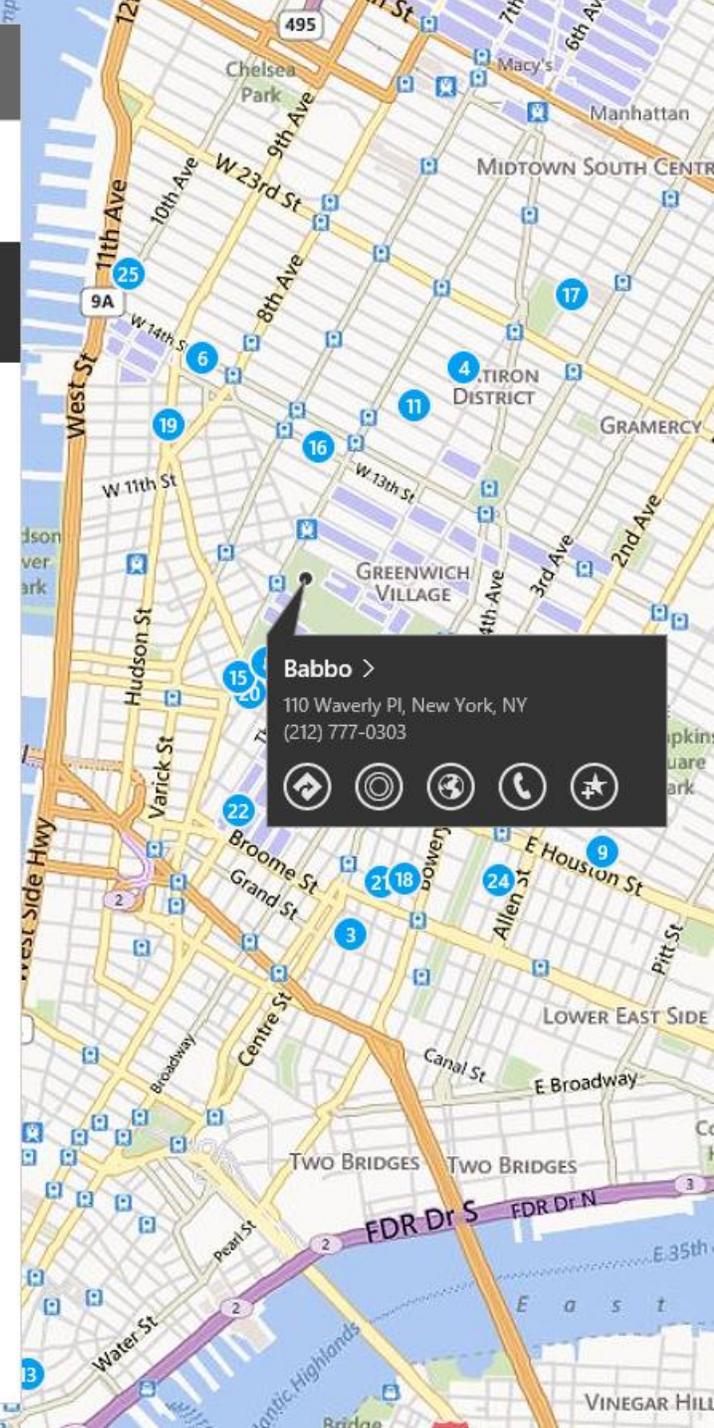
5-12) as style-savvy buyers, editors, celebrities, and fashionistas (as well as *Project Runway's* Heidi Klum and Tim Gunn) descend on the city for nonstop couture shows and late-night parties—it's people-watching at its chickest.

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Search results  
italian restaurants dinner

- Lupa Restaurant**  
170 Thompson St Apt 1, New York, NY  
(212) 982-5089
- Babbo**  
110 Waverly Pl, New York, NY  
(212) 777-0303
- La Mela**  
167 Mulberry St, New York, NY  
(212) 431-9493
- Aleo Restaurant**  
7 W 20th St, New York, NY  
(212) 691-8136
- Il Mulino**  
86 W 3rd St, New York, NY  
(212) 673-3783
- Scarpetta**  
355 W 14th St, New York, NY  
(212) 691-0555
- Frank Restaurant**  
88 2nd Ave Frnt B, New York, NY  
(212) 420-0202
- Monte's**  
97 Macdougall St, New York, NY  
(212) 228-9194
- Supper Restaurant**  
156 E 2nd St, New York, NY  
(212) 477-7600
- Three of Cups**  
83 1st Ave, New York, NY  
(212) 388-0059
- Basta Pasta Ristorante Italian**  
37 W 17th St, New York, NY



# Semantic Graphs for Conversational Interaction

## Experimental Setup

Scenario: conversational search over movies (Netflix)

### Training

- Freebase film (movies) domain, 56 relations with linked Wikipedia articles
- Focused on 4 Netflix properties: movies names, actors, genres, directors

Task: Entity spotting (F-Measures of precision/recall)

- Entity modeling only
- Entity *plus* relation modeling

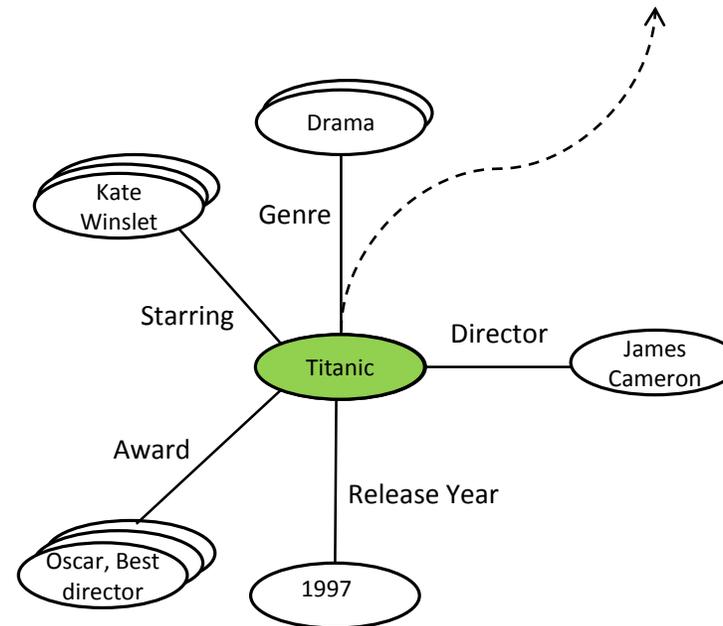
Article Talk Read View source View history

### Titanic (1997 film)

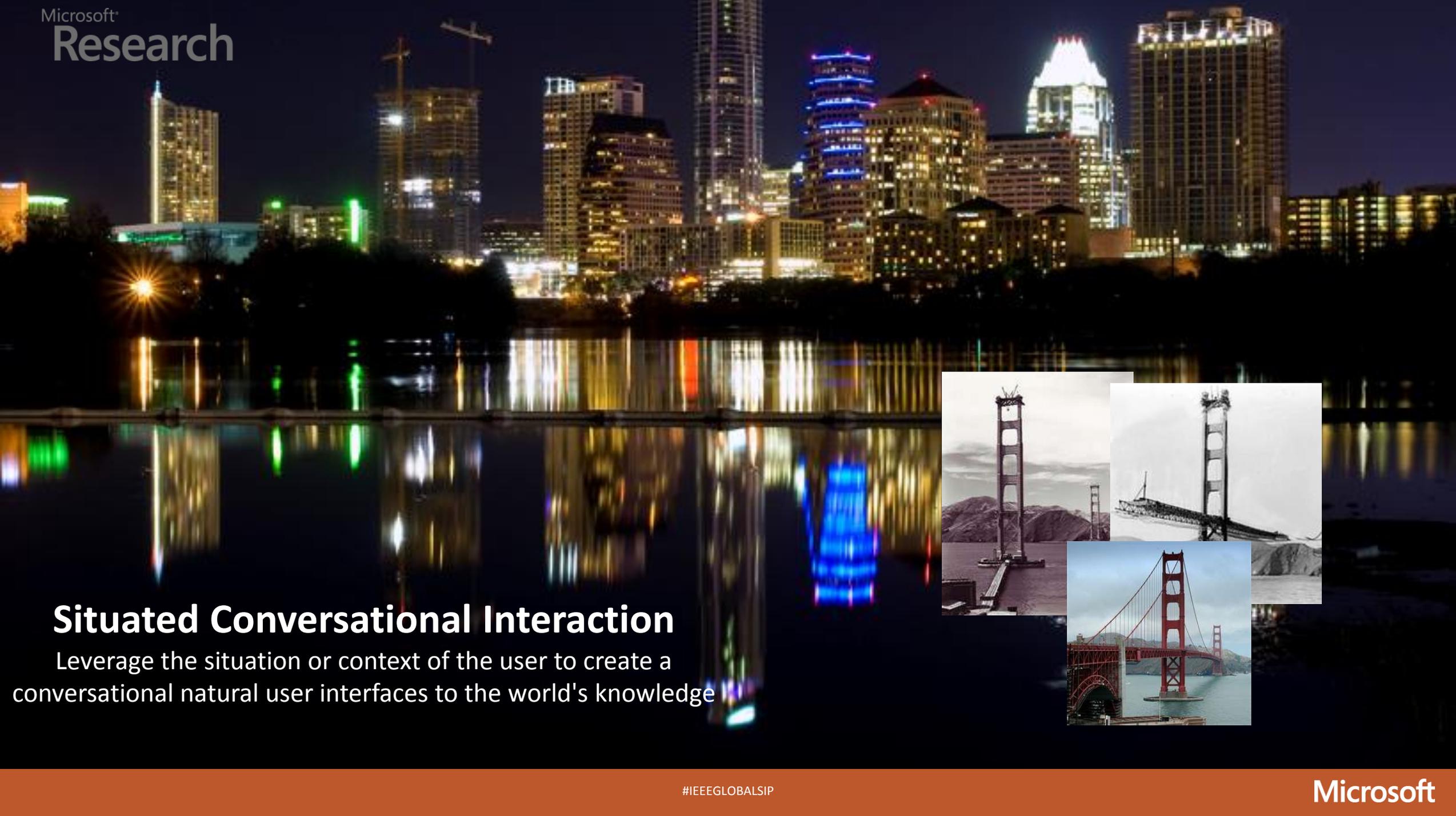
From Wikipedia, the free encyclopedia

**Titanic** is a 1997 American epic romantic disaster film directed, written, co-produced, and co-edited by James Cameron. A fictionalized account of the sinking of the RMS Titanic, it stars Leonardo DiCaprio and Kate Winslet as members of different social classes who fall in love aboard the ship during its ill-fated maiden voyage.

Cameron's inspiration for the film was predicated on his fascination with shipwrecks; he wanted to convey the emotional message of the tragedy, and felt that a love story interspersed with the human loss would be essential to achieving this. Production on the film began in 1995, when Cameron shot footage of the actual Titanic wreck. The modern scenes were shot on board the Akademik Mstislav Keldysh, which Cameron had used as a base when filming the wreck. A reconstruction of the Titanic was built at Playas de Rosarito, Baja California, and scale models and computer-generated imagery were also used to recreate the sinking. The film was partially funded by Paramount Pictures and 20th Century Fox, and, at the time, was the most expensive film ever made, with an estimated budget of \$200 million.







## Situated Conversational Interaction

Leverage the situation or context of the user to create a conversational natural user interfaces to the world's knowledge

