

A graphic featuring dark blue silhouettes of two people facing each other, engaged in conversation. Above them are several colorful speech bubbles in shades of pink, blue, yellow, and green, suggesting dialogue or communication.

DIALOGUE SYSTEMS

Manoj Agarwal ** Puneet Agrawal



Agenda

- Dialogue Systems : today and tomorrow
- Major components of a dialogue system
- Deep dive in couple of components

- Ask lot of questions, have fun!

What is dialogue system?

From WIKIPEDIA:

A **dialog system** is a computer system intended to converse with a human, with a coherent structure.

But practically ...

*In today's world, a **dialog system** is a computer system intended to converse with human, with a coherent structure.*

It tries to improve usability and user satisfaction through interaction with human which is natural or human-like.

What is natural?



VS

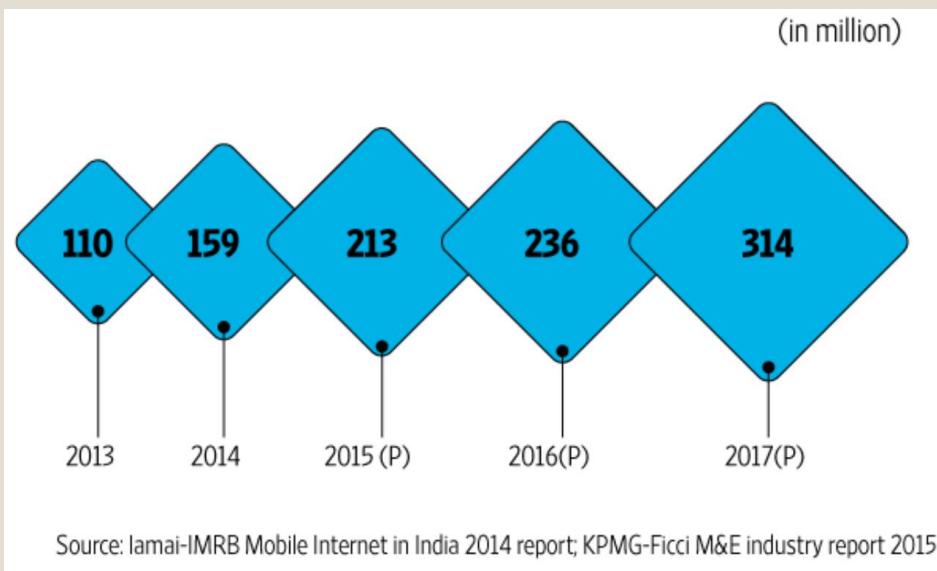


Yesterday, today and tomorrow

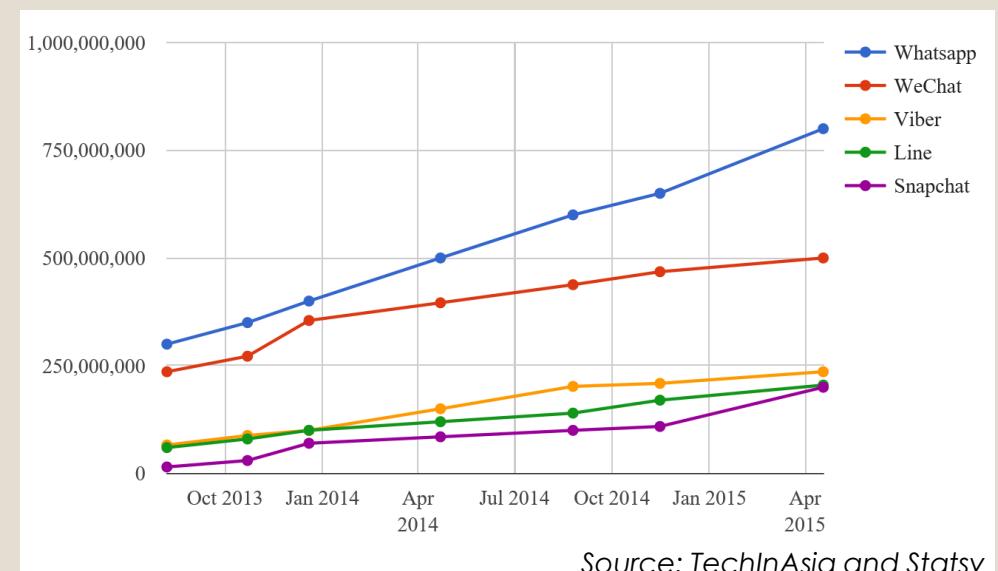
- Dialogue systems are not new!
- In 1960s, ELIZA was an AI bot, used rules, patterns etc.
- Today, explosion of products and services
- Siri, Echo, Cortana, M, WeChat, Telegram, Xiaolce
- What enabled this explosion? Where are we heading?
- Far from being perfect, but lot of impressive systems.

What is driving growth?

Mobile Internet Users in India are growing rapidly

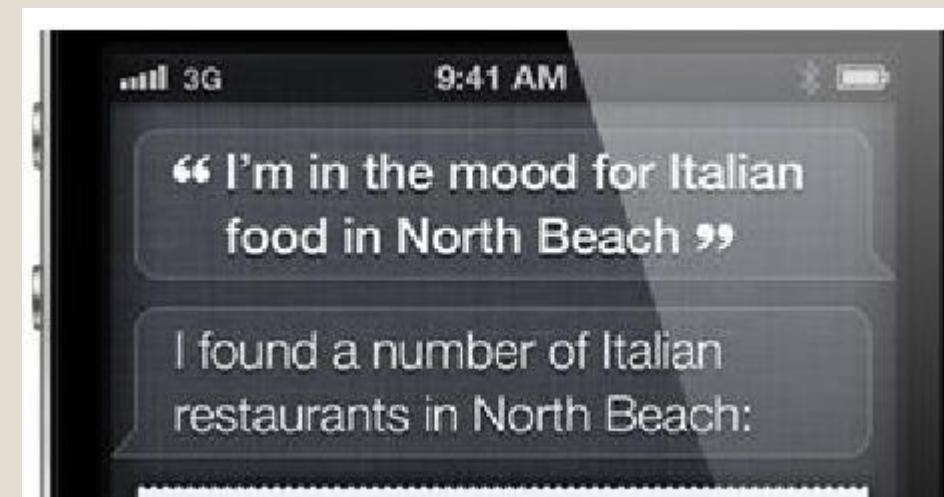


Messaging Apps are exploding, are very sticky

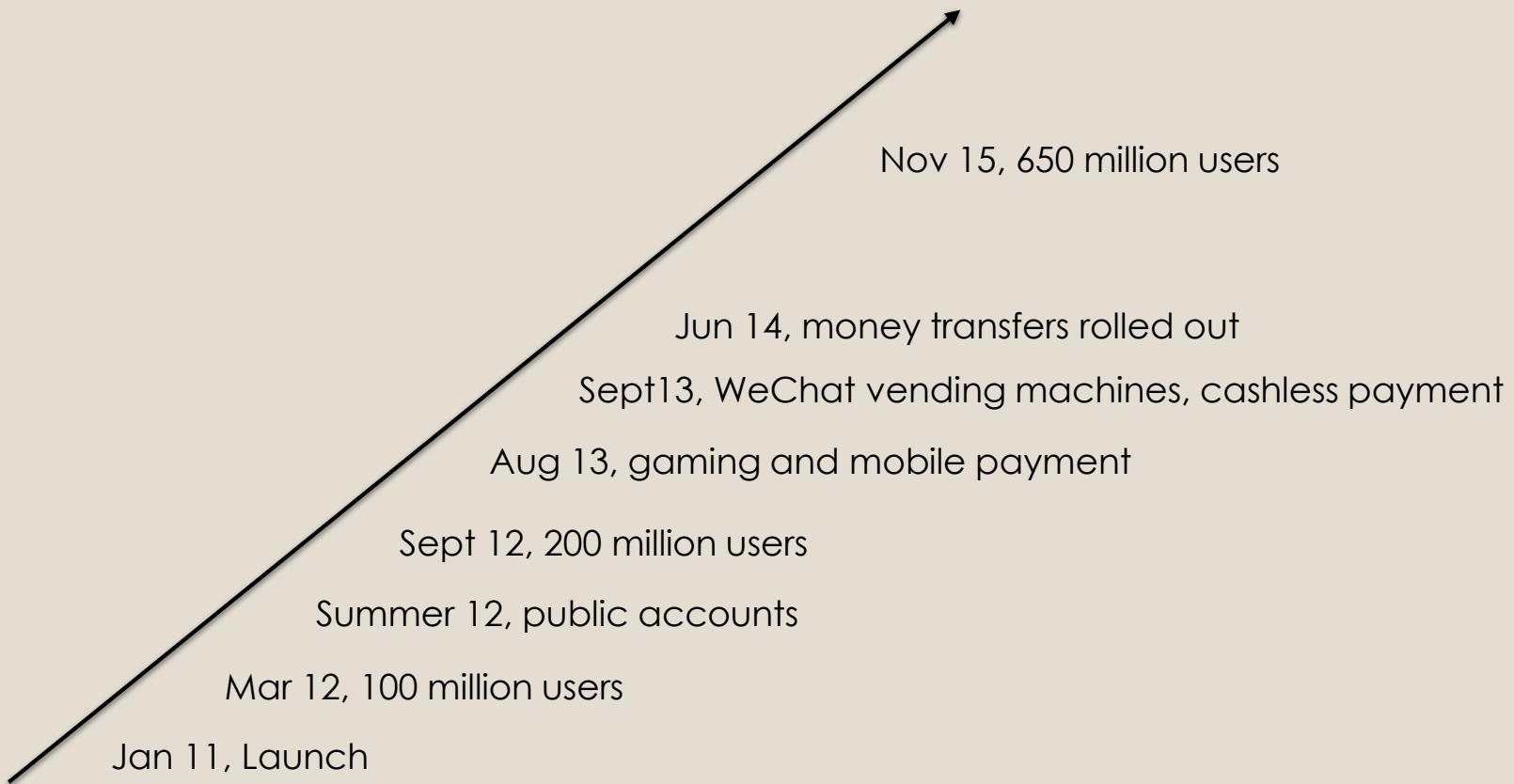


SIRI

- Voice driven personal assistant on iPhone
- Perhaps, one of the first visible applications of modern dialogue systems.

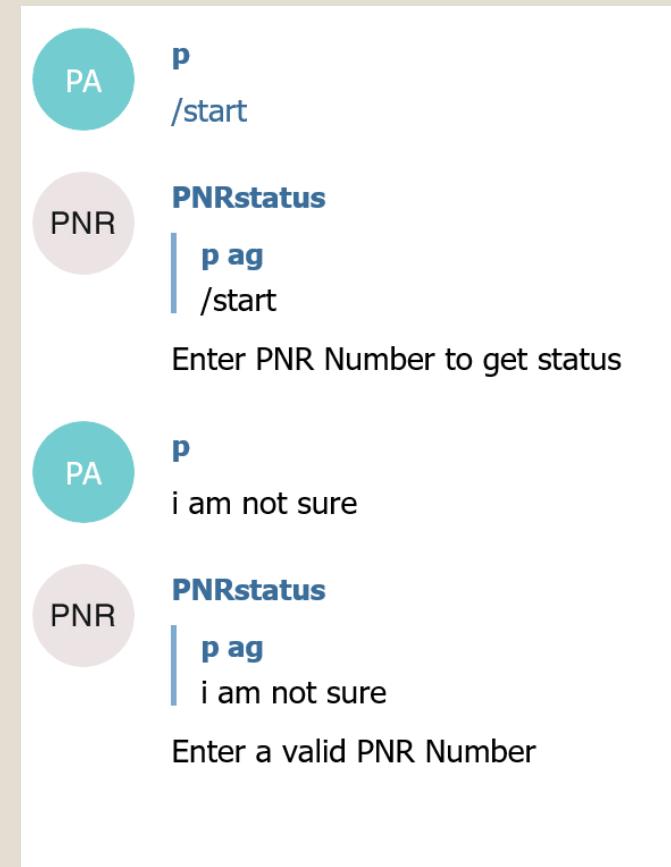


WeChat



Telegram Bots

- Fast growing eco-system
- 100 million users, emerging markets
- Loads of bots, for almost everything, even a **PNR status bot from Indian Railways!**



Xiaoice

- AI from Microsoft
- 40 million registered users
- One of Weibo's top influencer
- Reads weather data on dragon TV
-



We are not yet there ...

<http://www.cc.com/video-clips/h40j2n/the-colbert-report-talking-iphone-4s>

Towards Talking Machines

- “Our technology, our machines, are part of our humanity. We created them to **extend ourselves**, and that is what is unique about human beings” - Ray Kurzweil.



Game of Go



- Total Number of positions in Go are more than number of atoms in the Universe.

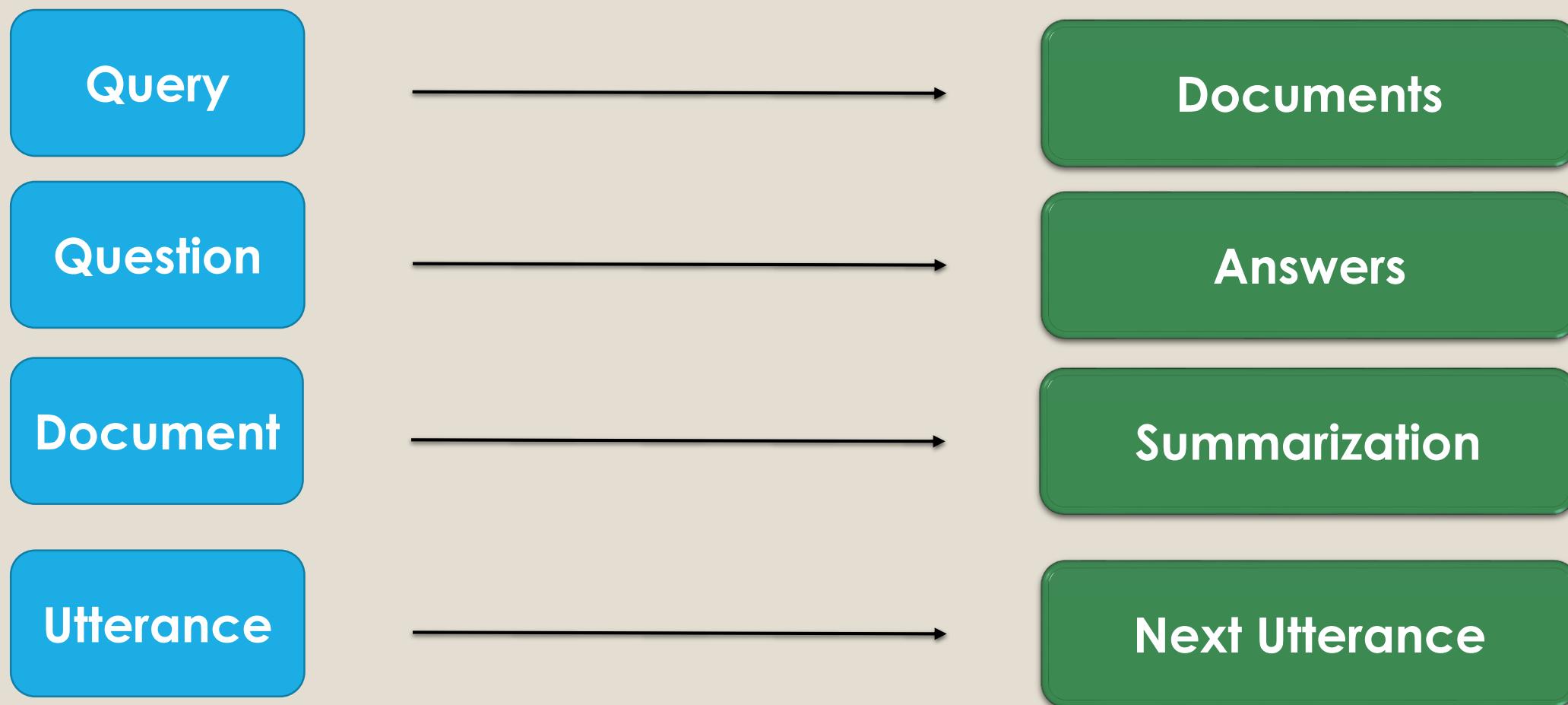
CADE METZ BUSINESS 03.15.16 5:01 AM

GOOGLE'S AI WINS FIFTH AND FINAL GAME AGAINST GO GENIUS LEE SEDOL

But can Machines..

- Answers human questions?
 - Quora, Yahoo answers, etc.
- Have a conversation with humans? (Turing Test)
 - Conversation is even more complex!!
- Why?
 - Can machines detect sarcasm??
 - OR can a machine find a joke funny?
- Long way to go ...

This is What we need to do



The knowledge stack

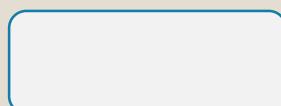
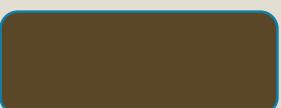
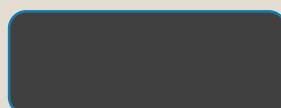
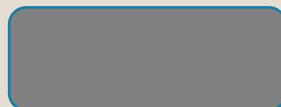
- **Consciousness**
- **Creativity**
- **Talking** **Reasoning? Deduction?**
- **Understanding** **Semantics? Analysis?**
- **Learning** **Syntax? Prediction?**

Deduction/Reasoning

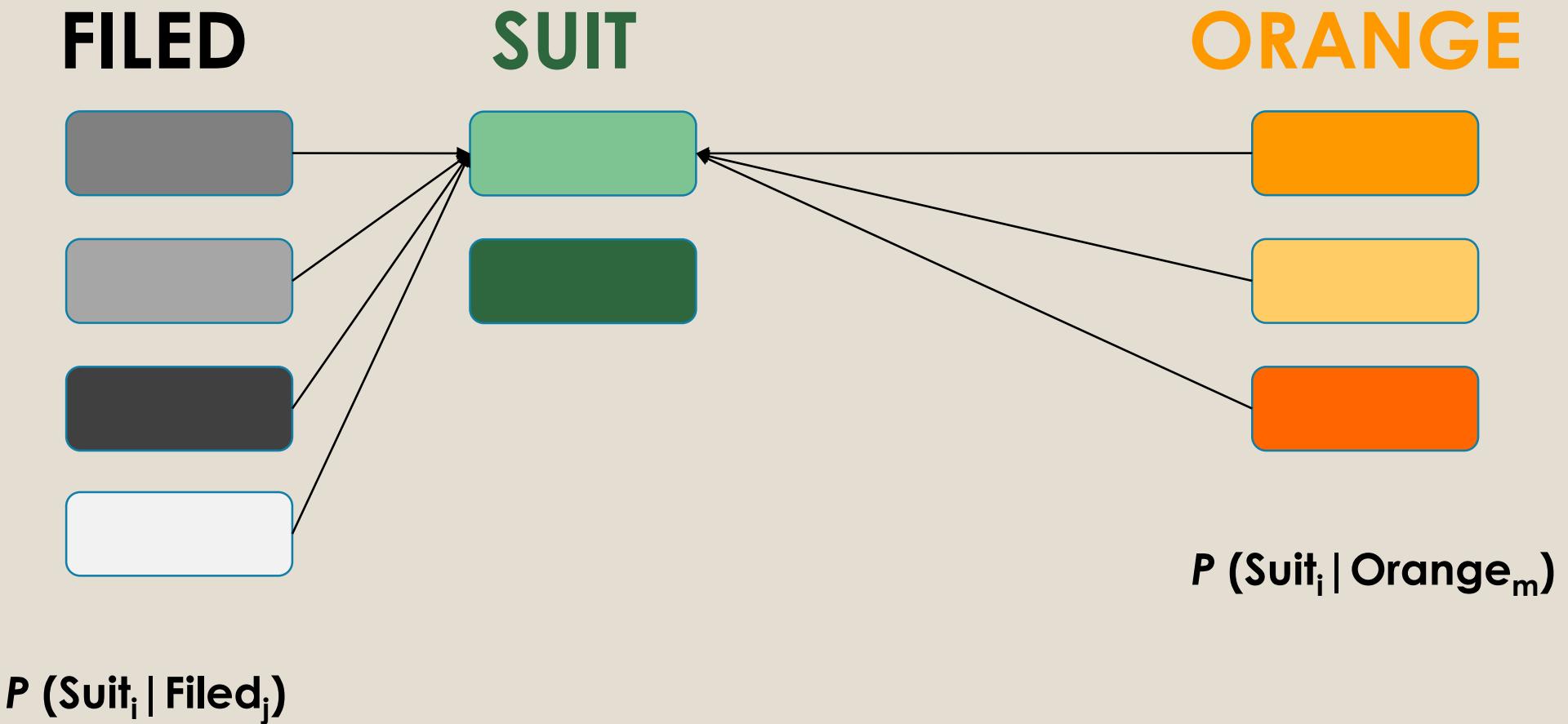
- **APPLE FILED A SUIT AGAINST ORANGE**
- Many words in this sentence have multiple meanings.
- If all the ‘correct’ meanings are put together, then only it makes sense..

How it is done? Disambiguation

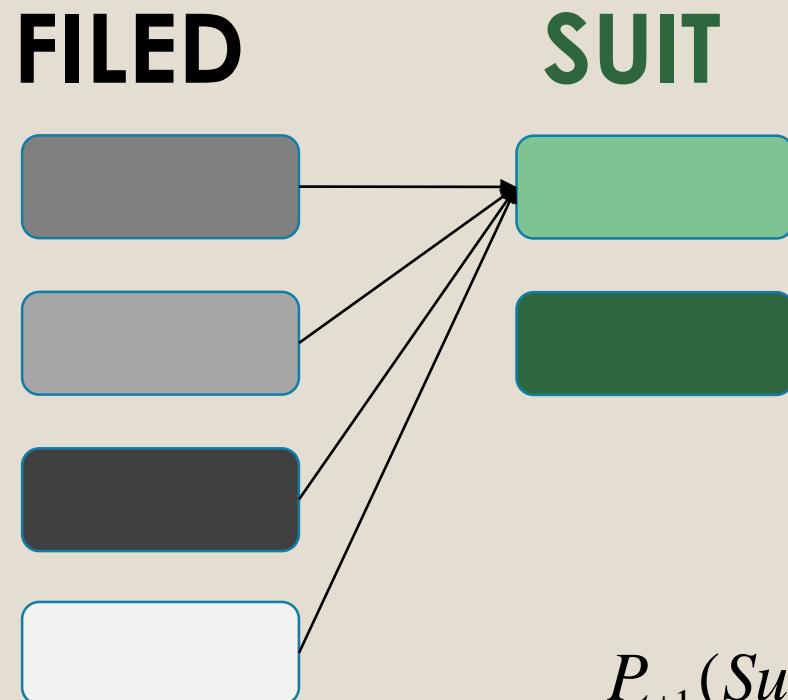
◦ **APPLE FILED A SUIT AGAINST ORANGE**



How it is done? Disambiguation



Sense of Context

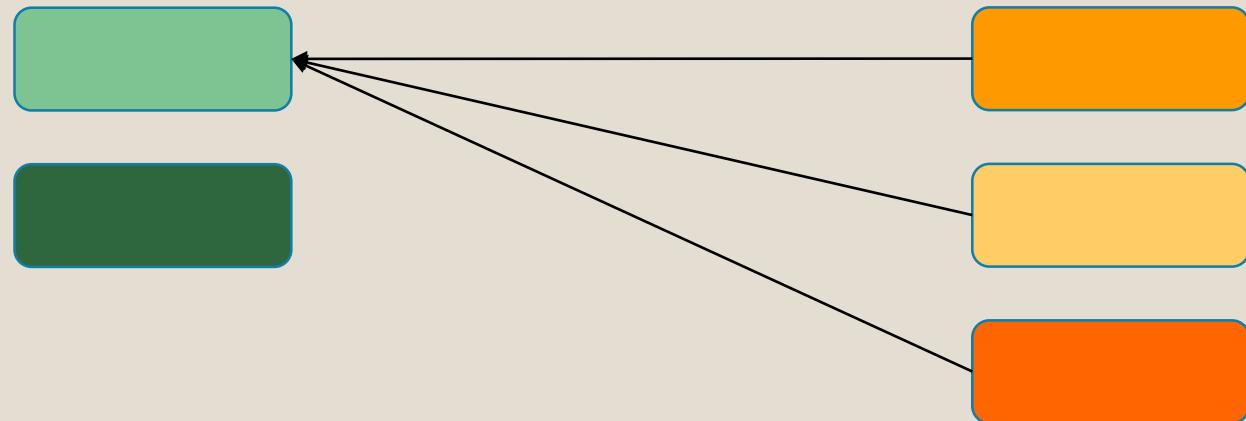


$$P_{t+1}(Suit_i \mid Filed) = \sum_{k=1}^K P(Suit_i \mid Filed_k) P_t(Filed_k)$$

Sense of Context

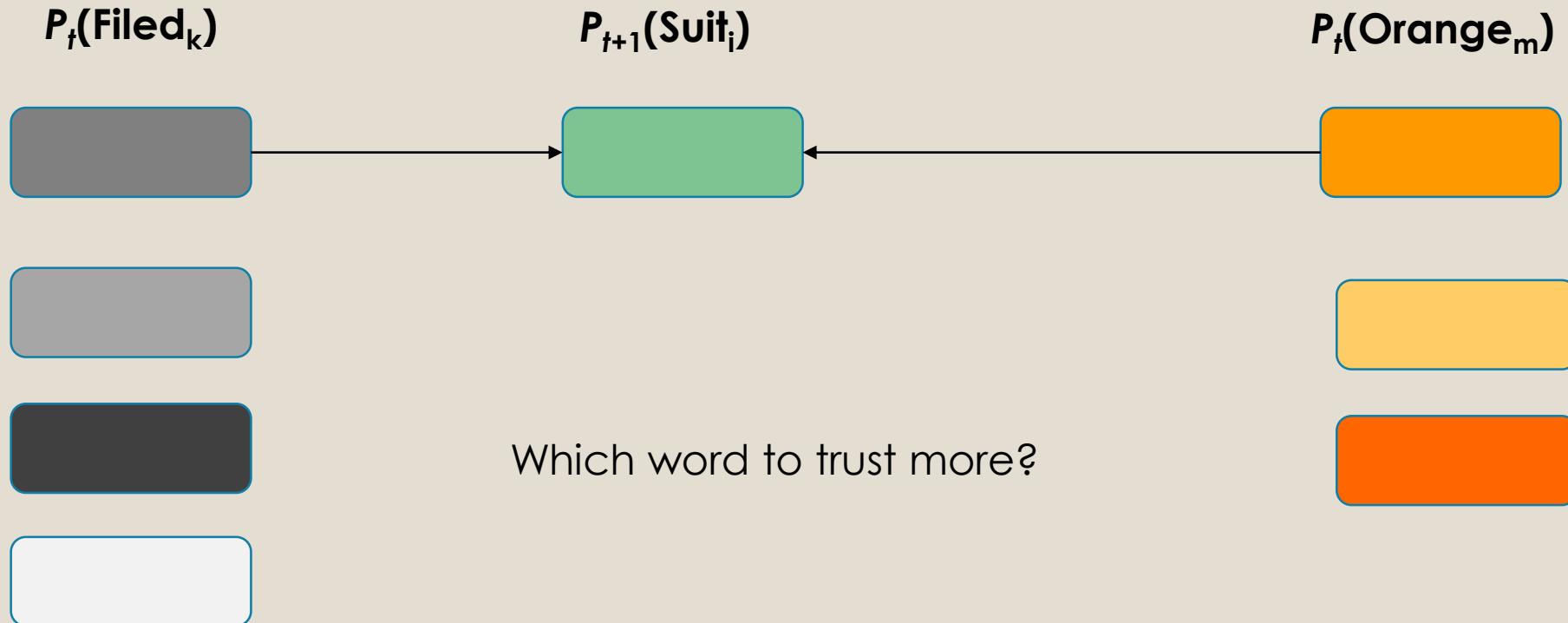
SUIT

ORANGE



$$P_{t+1}(Suit_i | Orange) = \sum_{m=1}^M P(Suit_i | Orange_m)P_t(Orange_m)$$

What does 'Suit' mean?



$$P_{t+1}(Suit_i) = \sum_{word} (1 - H(\{P_t(word_l)\})) P_{t+1}(Suit_i \mid word)$$

Equation of Understanding

$$P_{t+1}(S(w)) = \sum_{w'} (1 - H(\{P_t(w')\})) \sum_{w' \in S}^M P(S(w)_i | S(w')) P_t(S(w'))$$

Confidence in the context word w'

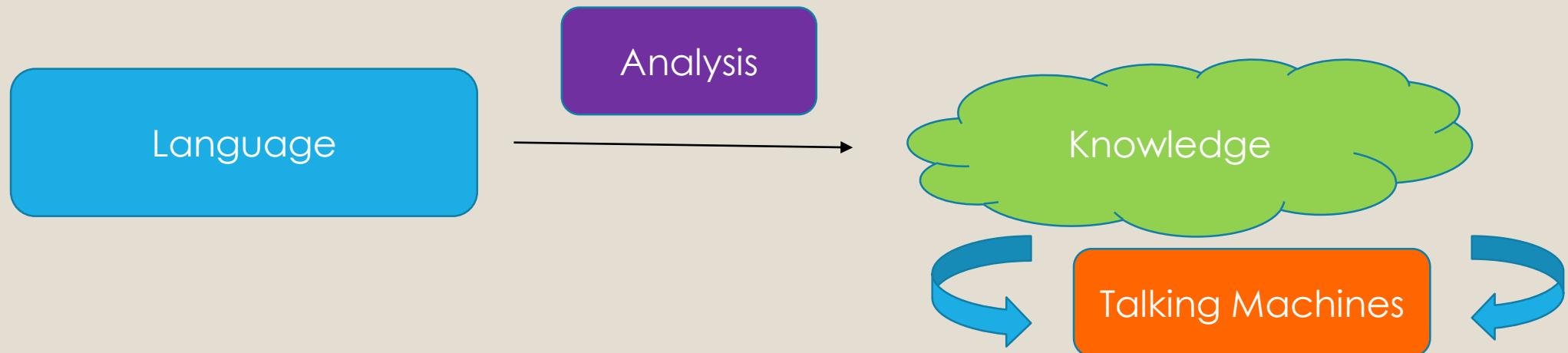
Knowledge

Sense of word in the **next** iteration

Sense of word in the current iteration

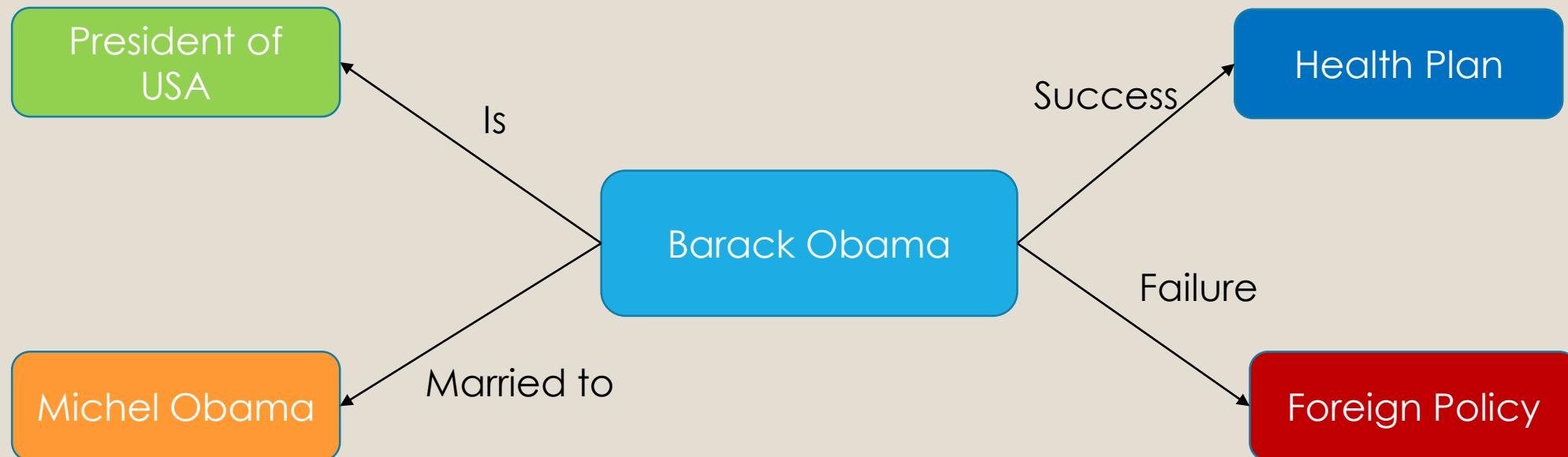
Role of Language in Understanding

- Language plays a central role in order for having a meaningful conversation.
 - How important is actually the language is?
 - We do NLP, statistical NLP, text mining, sentiment analysis,



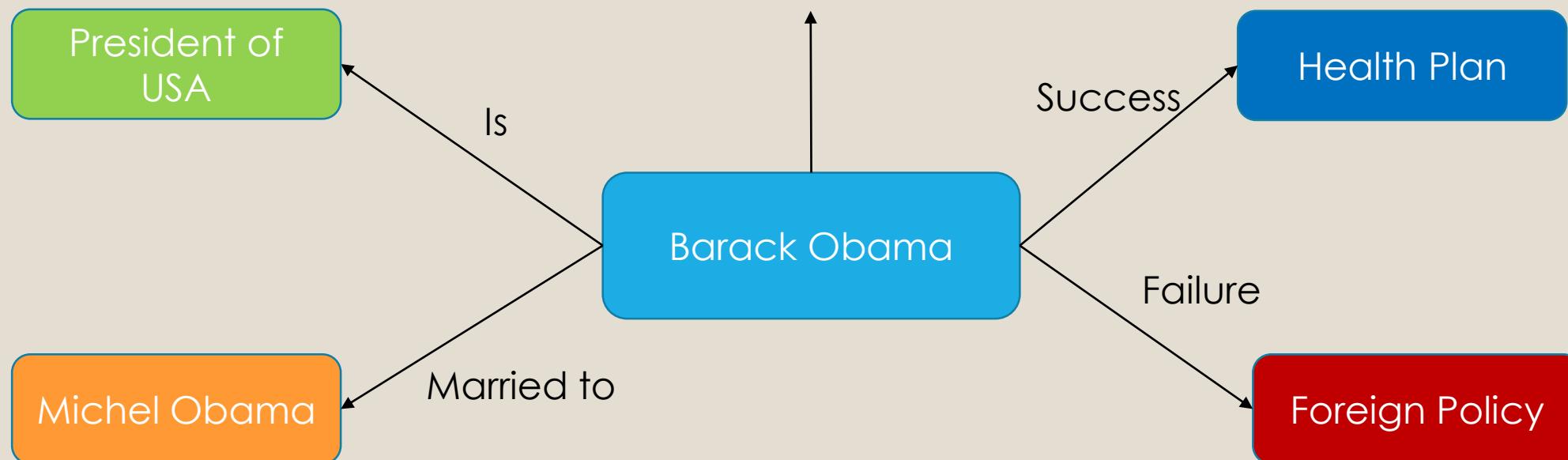
Language → Knowledge

- President [Barack Obama](#) is ineligible for re-election due to term limits established in the [Constitution](#) of United states. He is married to Michel Obama. Obama is credited for bringing a new health plan but is considered a failure on foreign policy front.



Knowledge Graph

**Answer Questions
Have Conversations**



Key to synthesis and analysis of language in a conversational system is **Knowledge**