

Email Processing and Question Answering System (EPQAS)

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Human Language Technology Unit

Date: 29 March 2018



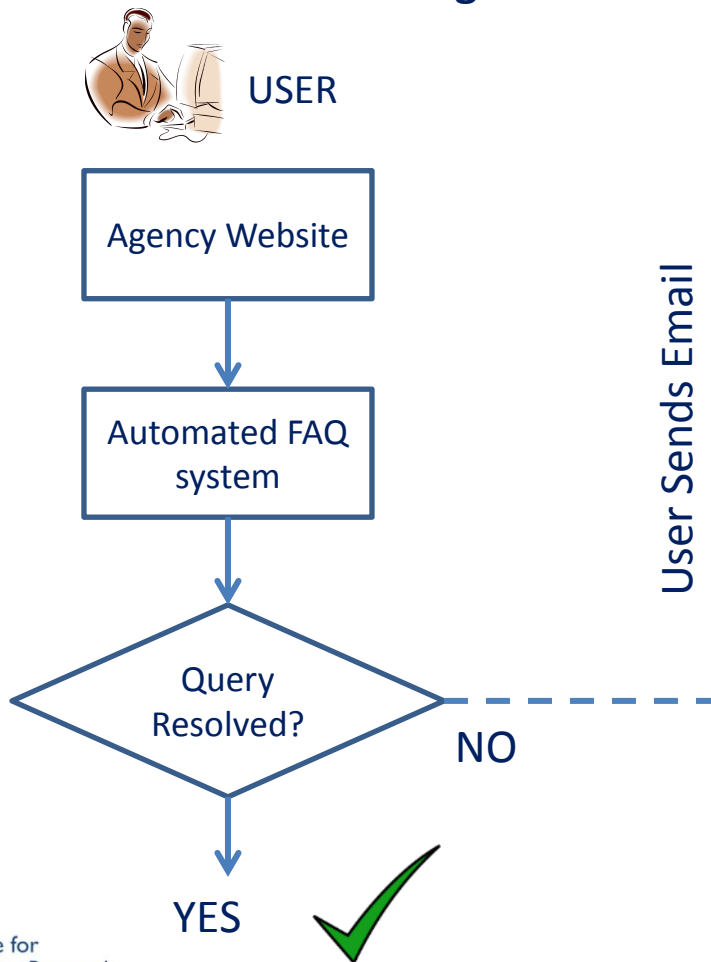
HOW IT STARTED

Problem Statement and Objectives

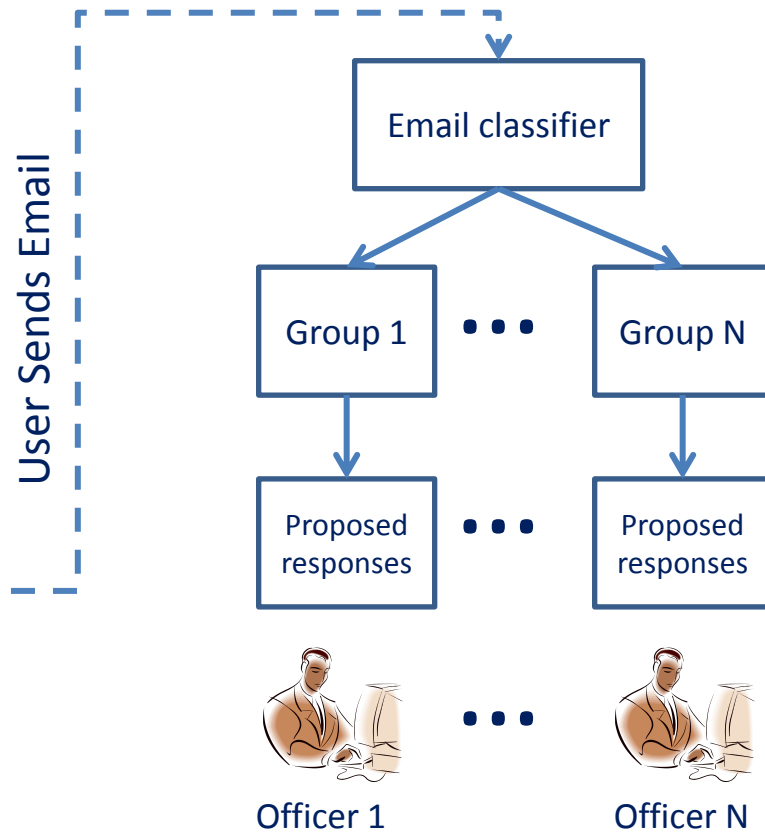
- Agency receives a high volume of emails that need to be dealt with on a daily basis demanding significant amount of resources and long response times
- Main objectives: to use state-of-the-art natural language processing technologies to
 1. Reduce the volume of incoming emails by supporting advance FAQ online support at agency's website
 2. Automatically redirect the incoming emails to the appropriate officer or group
 3. Provide officers with pre-selected responses based on similar past email responses

Proposed Solution

Frequently Asked Questions (FAQ) Service Engine

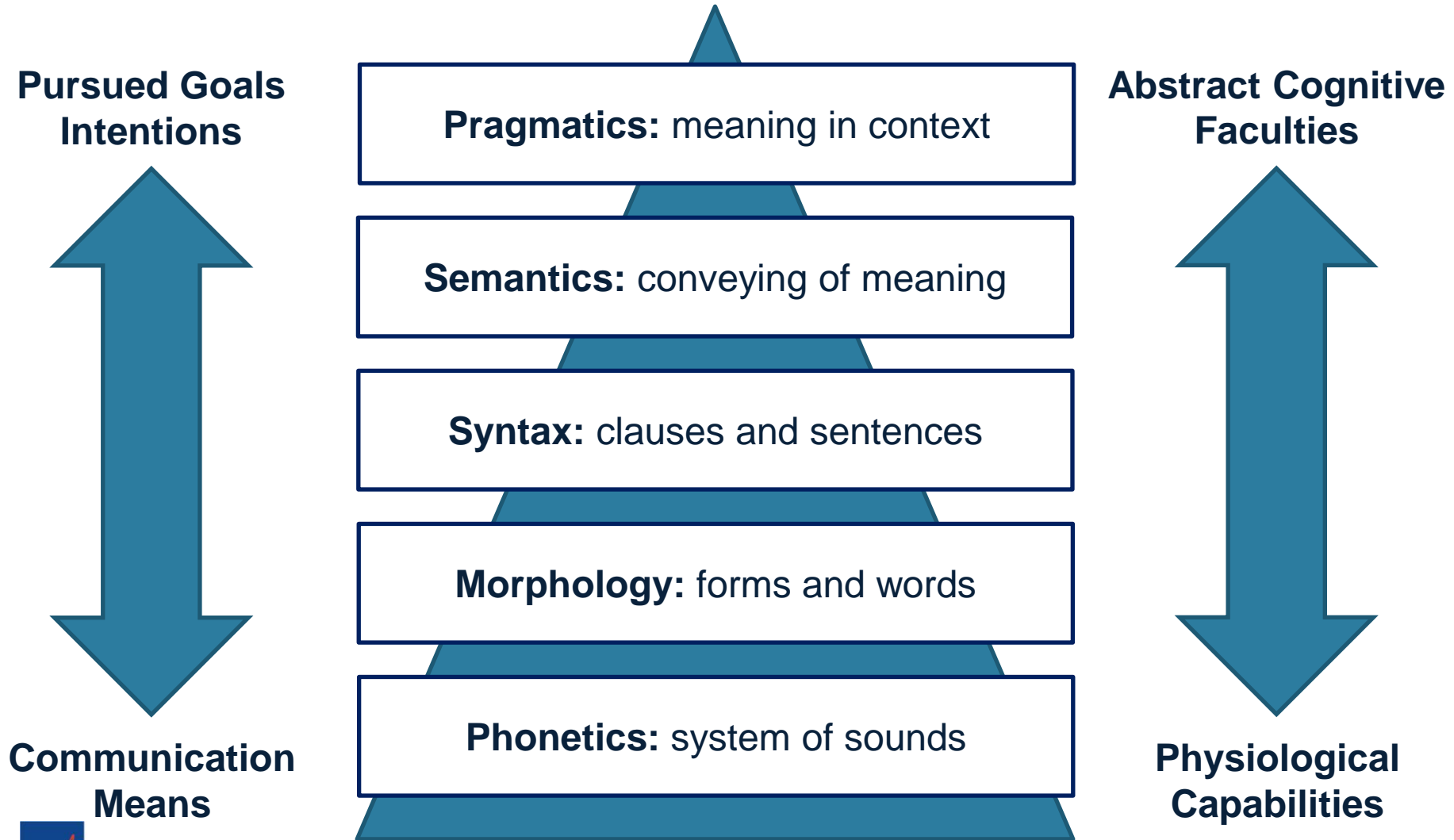


Email classification and Response Recommendation Engine

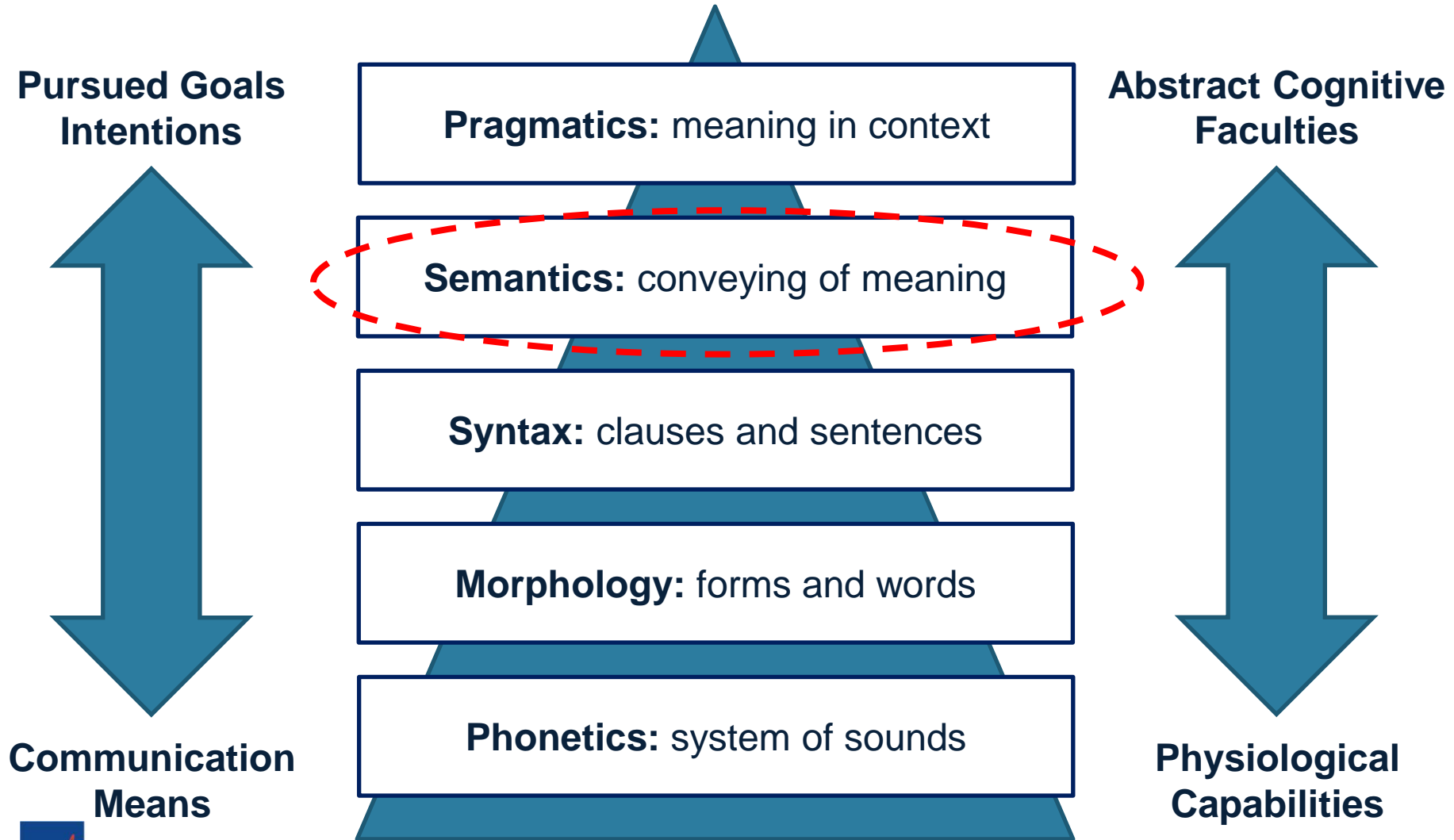


WHAT WE FACED

Levels of Linguistic Phenomena



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Natural Language Understanding

- The process of transforming a natural language statement into a semantic representation (frame):
 - Subtask 1: Intent Detection
 - Subtask 2: Entity Extraction

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Ok, I will meet you in Starbucks at 6pm

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Intent Detection:
`Confirm_meeting`

Natural Language Understanding

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Ok, I will meet you in Starbucks at 6pm



Entity Extraction:
Action: Meet
Place: Starbucks
Time: 6:00pm



Intent Detection:
Confirm_meeting

Transactional vs Informational

- Transactional natural language applications

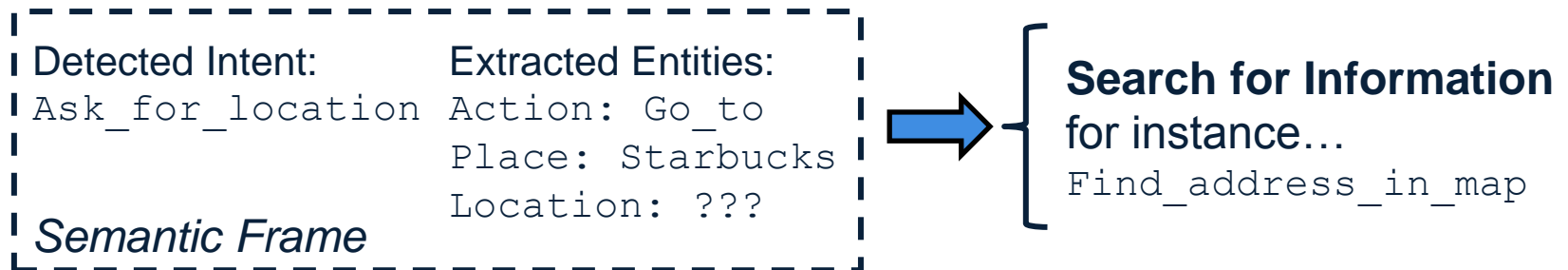


Transactional vs Informational

- Transactional natural language applications



- Informational natural language applications

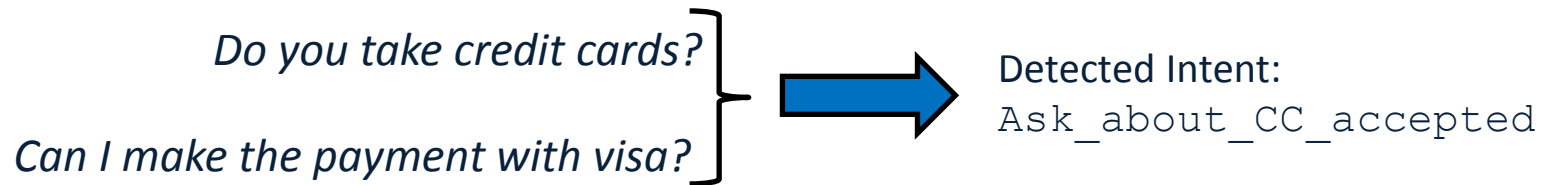


Question Answering

- Q&A is typically an informational application
- There are two different approaches, depending on the type of information available:
 - Question search: matching intents and entities over a database of available question answer pairs (FAQs).
 - Response selection: matching intents and entities over a collection of statements that might contain the answer.

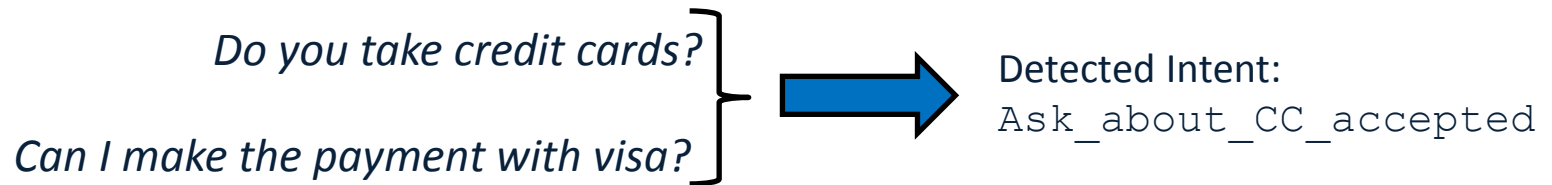
NLU in Question Answering

- Intents have to be identified among different language constructions:

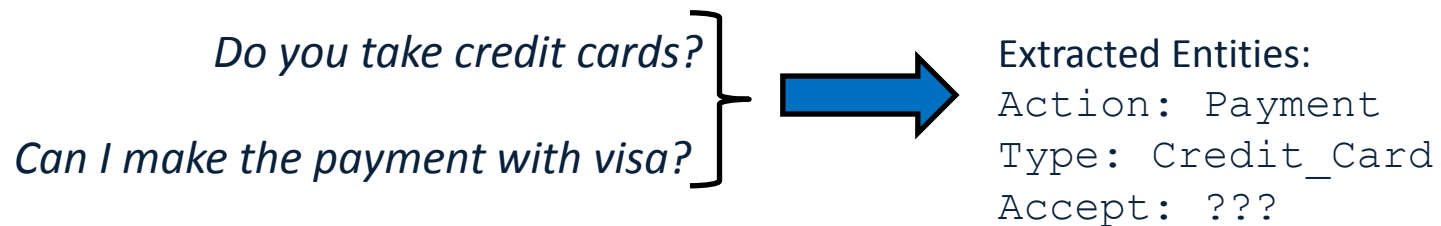


NLU in Question Answering

- Intents have to be identified among different language constructions:



- Entities have to be identified among different references:



Problems of Discrete Representation

Consider the following sequences of words

Do you take credit cards?

Can I make the payment with visa?

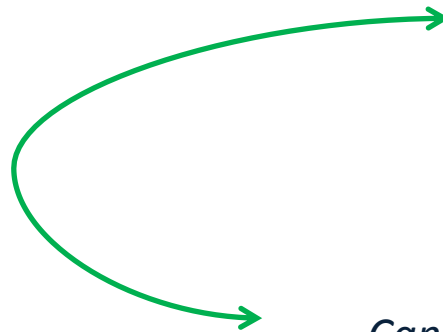
When can I make the payment for tourist visa application?

Problems of Discrete Representation

Consider the following sequences of words

SEMANTICALLY RELATED

WORD OVERLAP = 0%



Do you take credit cards?

Can I make the payment with visa?

When can I make the payment for tourist visa application?

Problems of Discrete Representation

Consider the following sequences of words

SEMANTICALLY RELATED

WORD OVERLAP = 0%

Do you take credit cards?

**NOT SEMANTICALLY
RELATED**

Can I make the payment with visa?

**WORD
OVERLAP = 70%**

When can I make the payment for tourist visa application?

Properties of Continuous Spaces

The Distributional Hypothesis

“a word is characterized for the company it keeps” (Firth 1957)

meaning is mainly determined by the context rather than from individual language units

- Continuous spaces represent semantic similarities by means of the geometric concept of proximity
- Offer much “better” smoothing capabilities
- Not constrained to the Markovian assumption

Similarity in Continuous Space

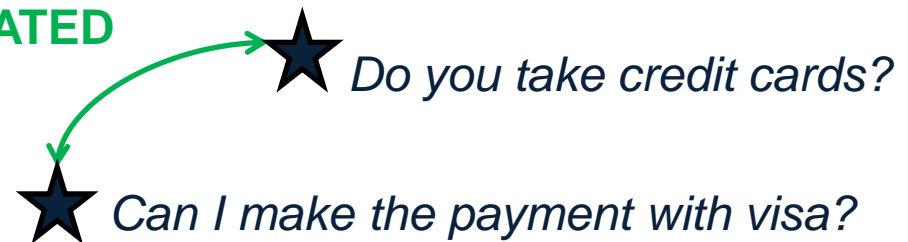
★ *Do you take credit cards?*

★ *Can I make the payment with visa?*

★ *When can I make the payment for tourist visa application?*

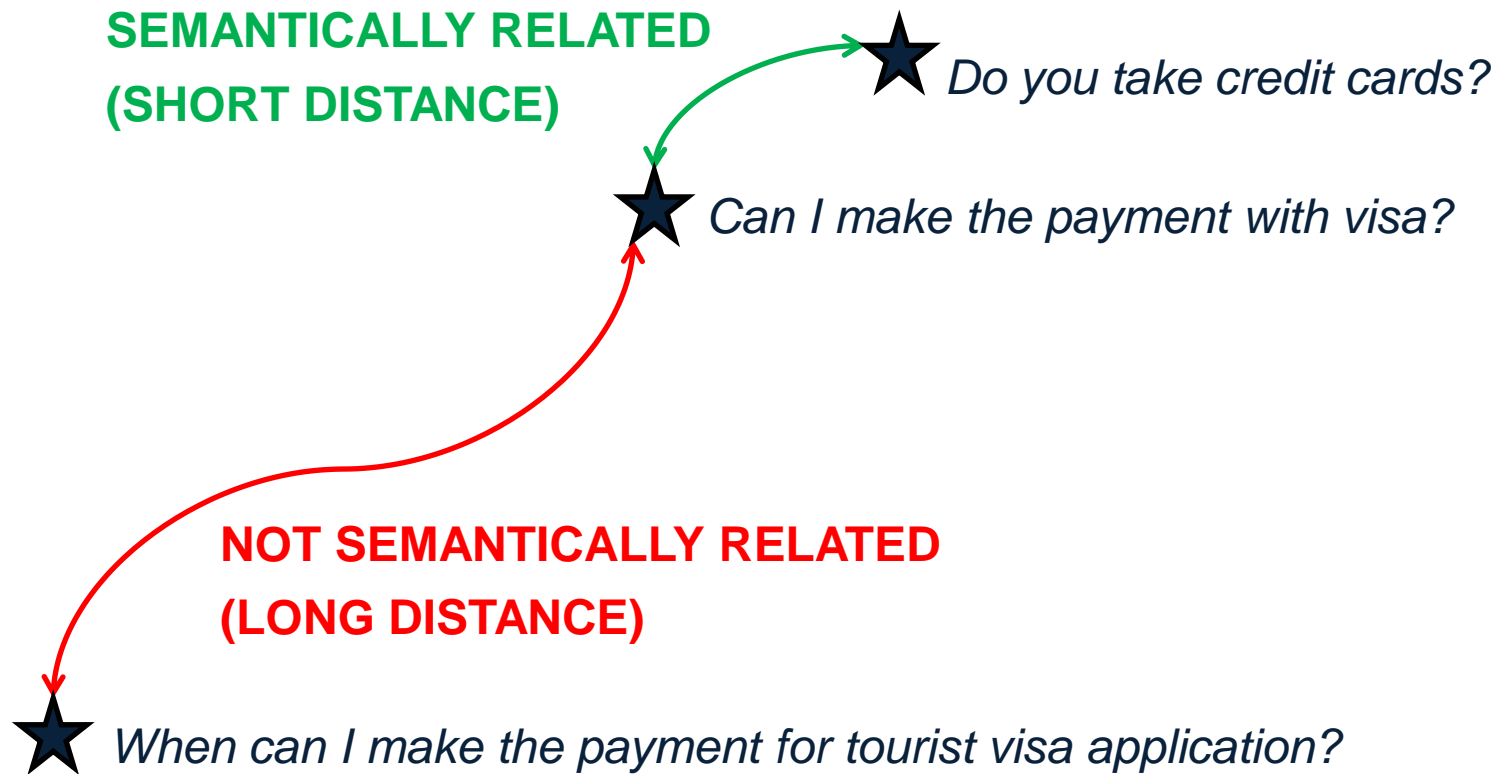
Similarity in Continuous Space

SEMANTICALLY RELATED
(SHORT DISTANCE)



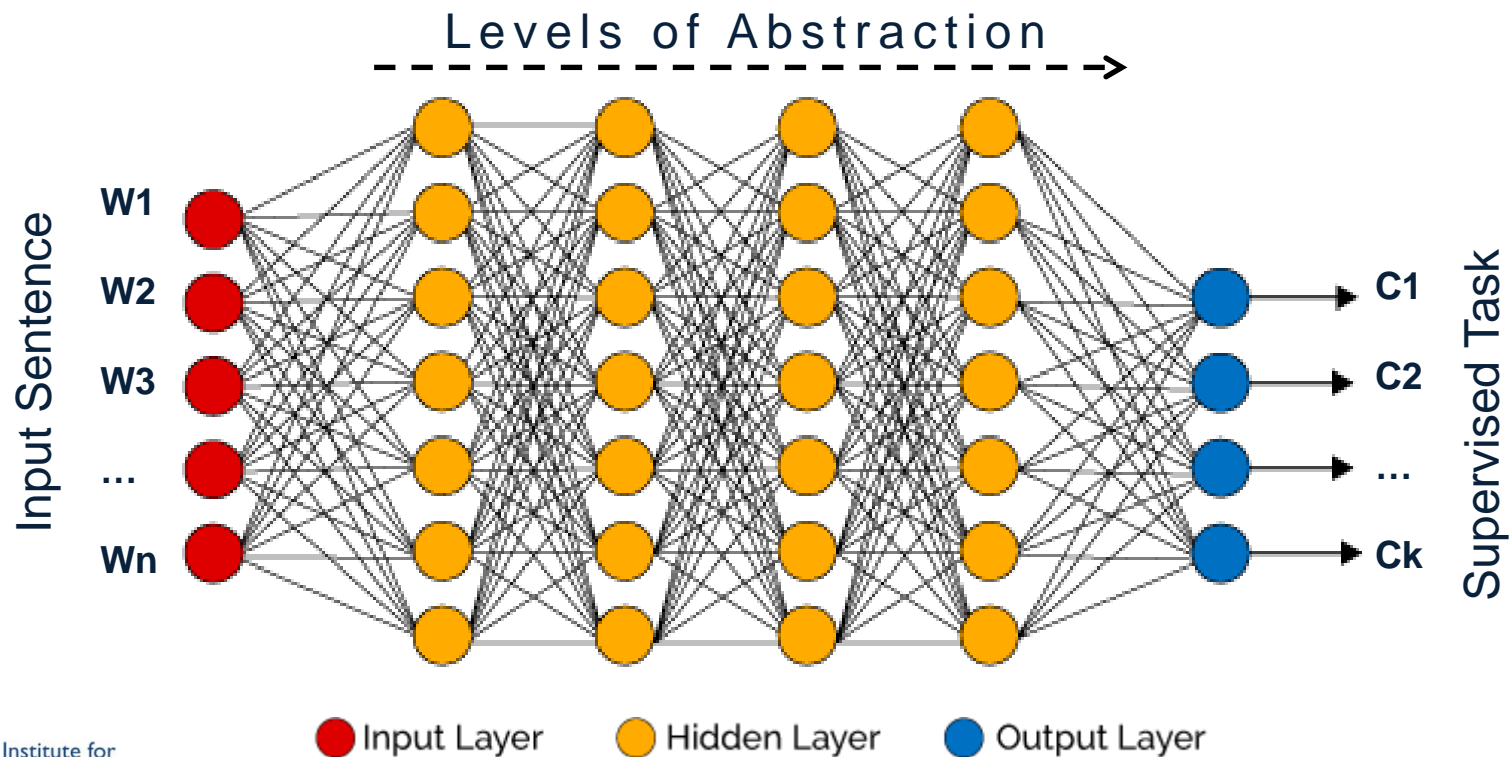
★ *When can I make the payment for tourist visa application?*

Similarity in Continuous Space



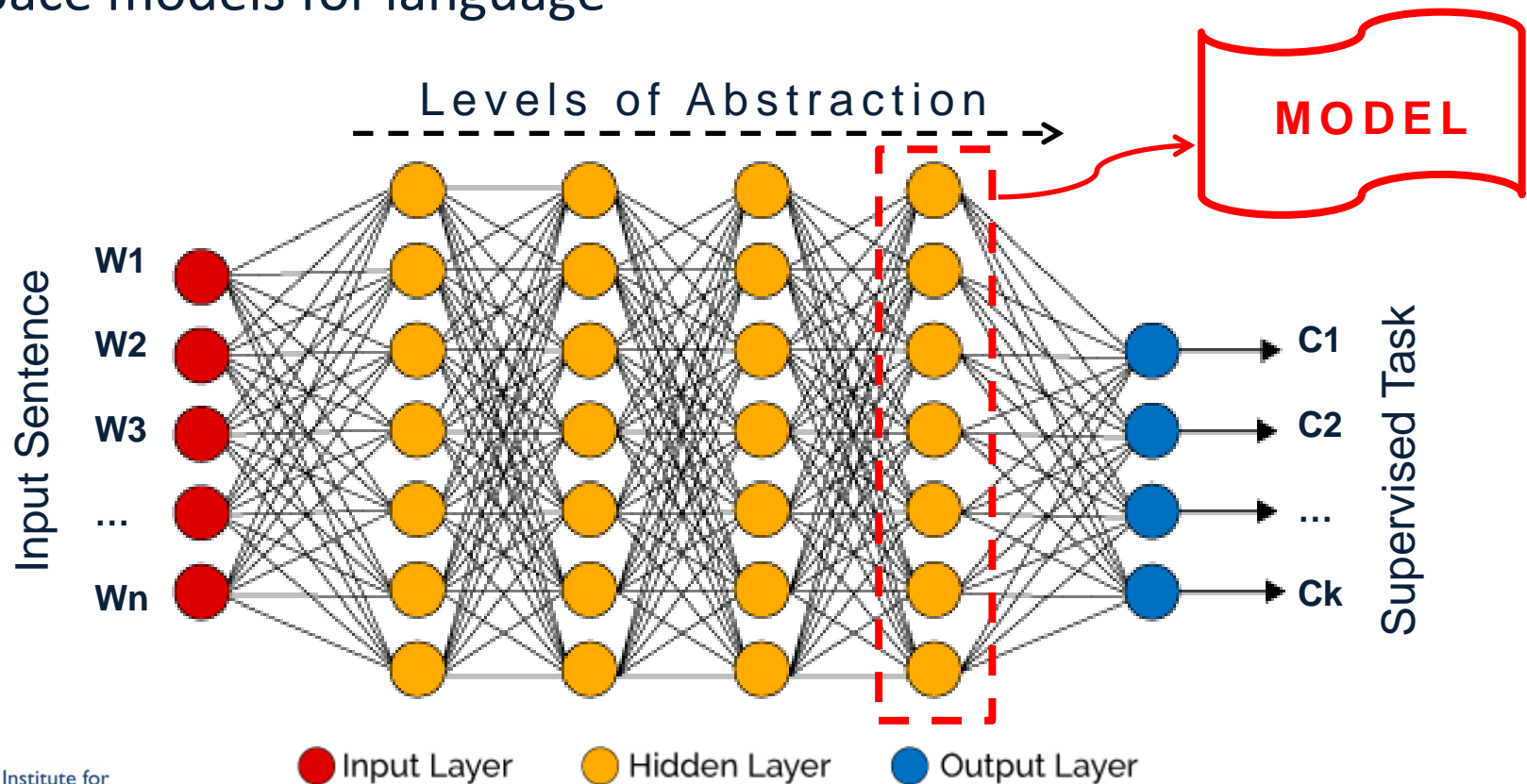
Building Continuous Space Models

1.- Train a deep learning network on a supervised task

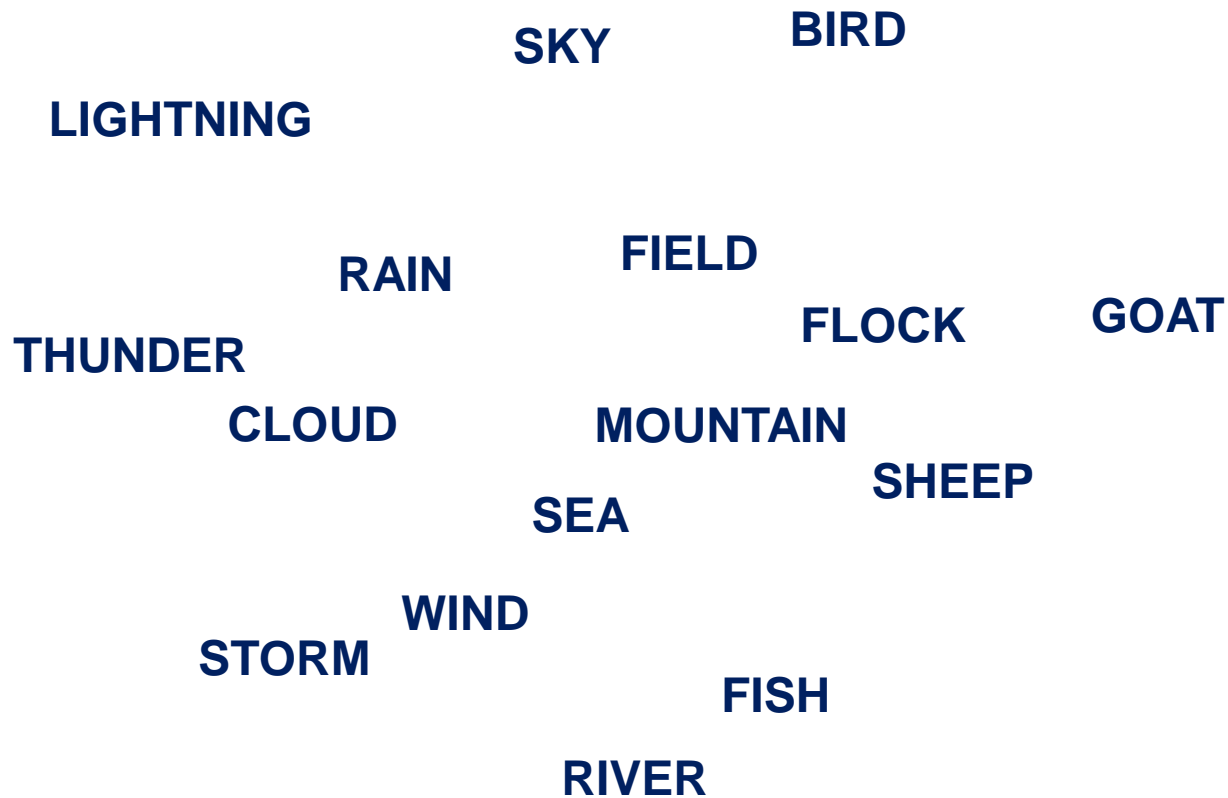


Building Continuous Space Models

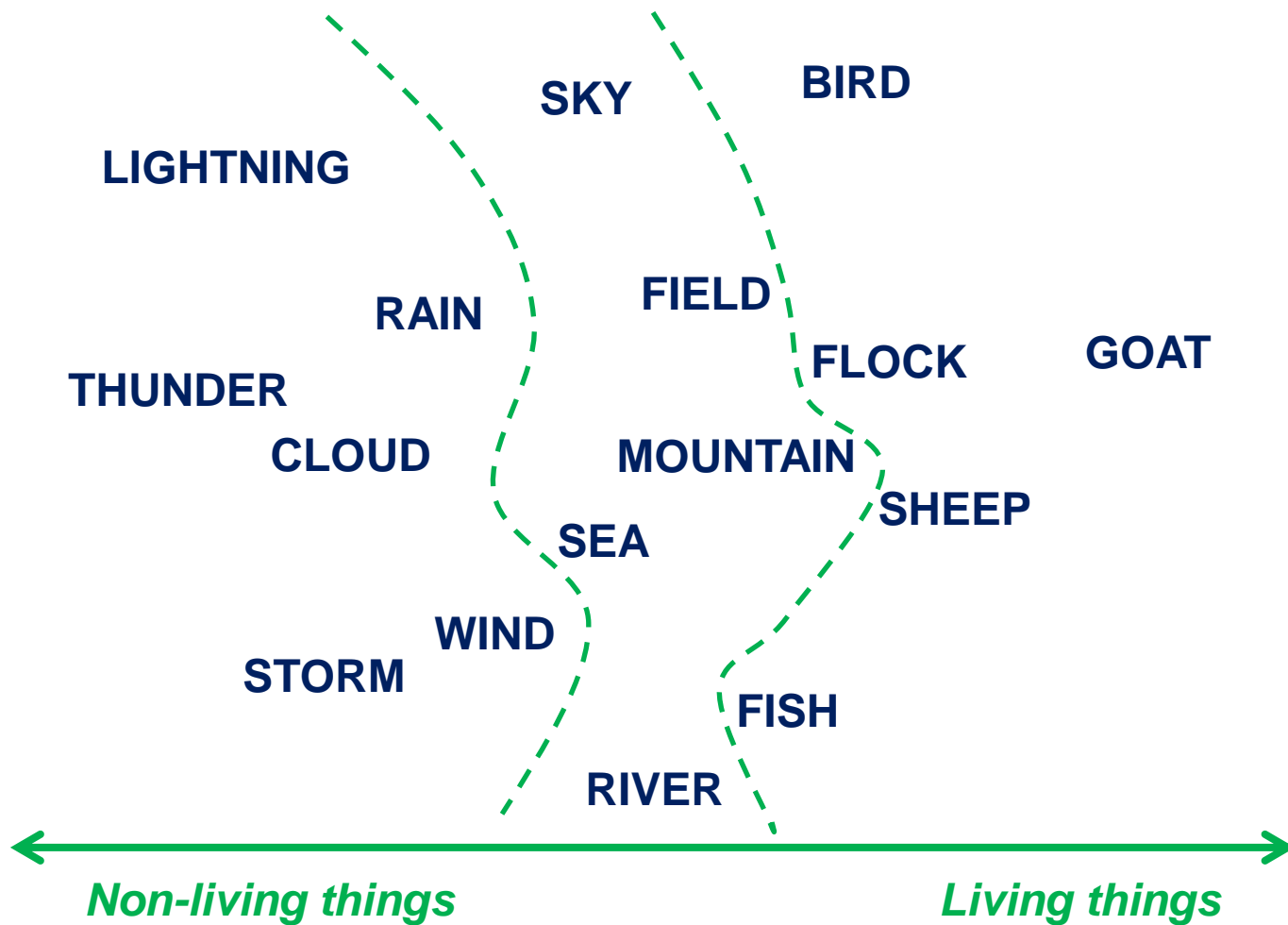
- 1.- Train a deep learning network on a supervised task
- 2.- Use some of its internal layer representations as continuous space models for language



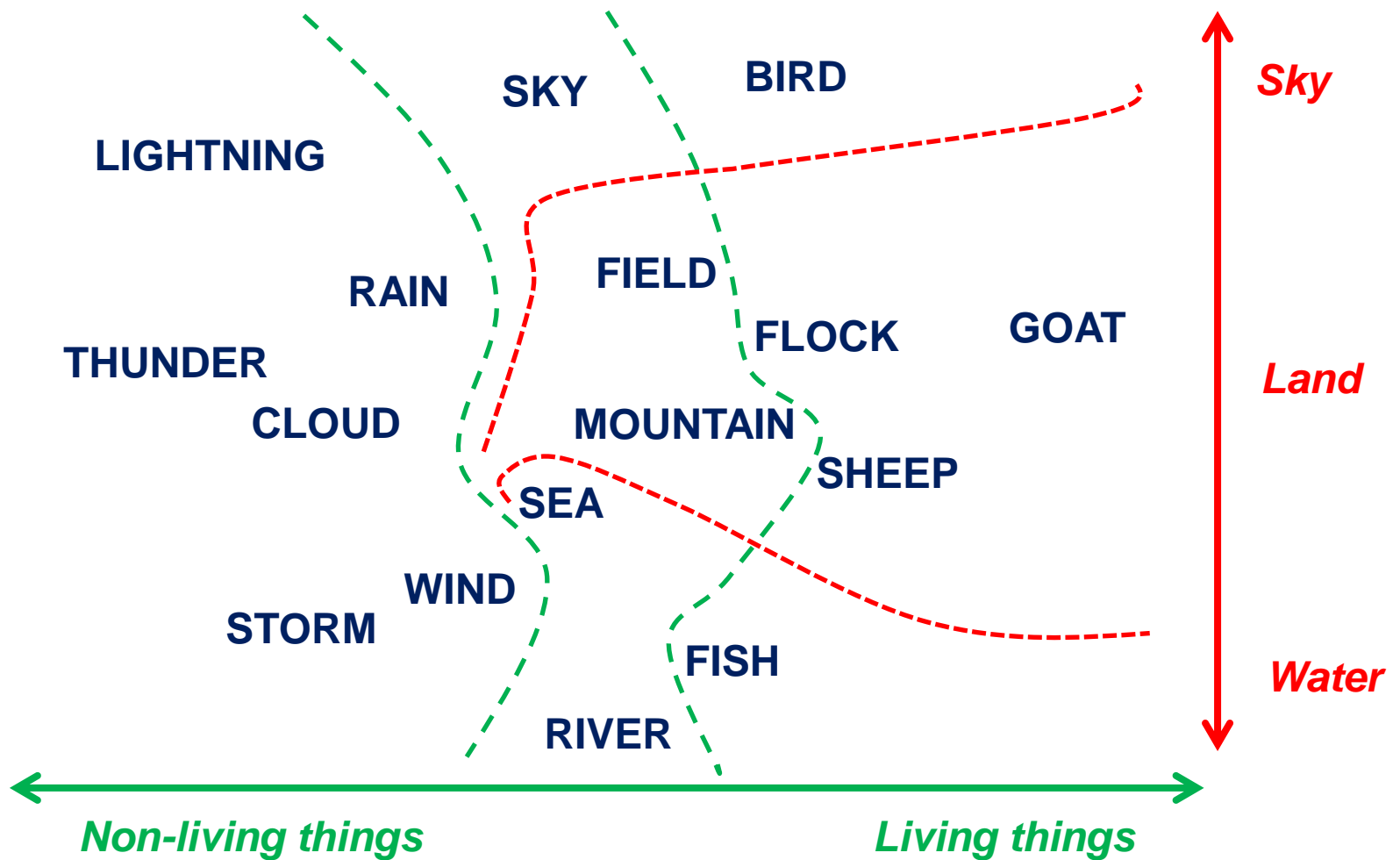
Semantic Maps of Words



Semantic Maps of Words



Semantic Maps of Words



(Banchs 2012)

Regularities as Vector Offsets

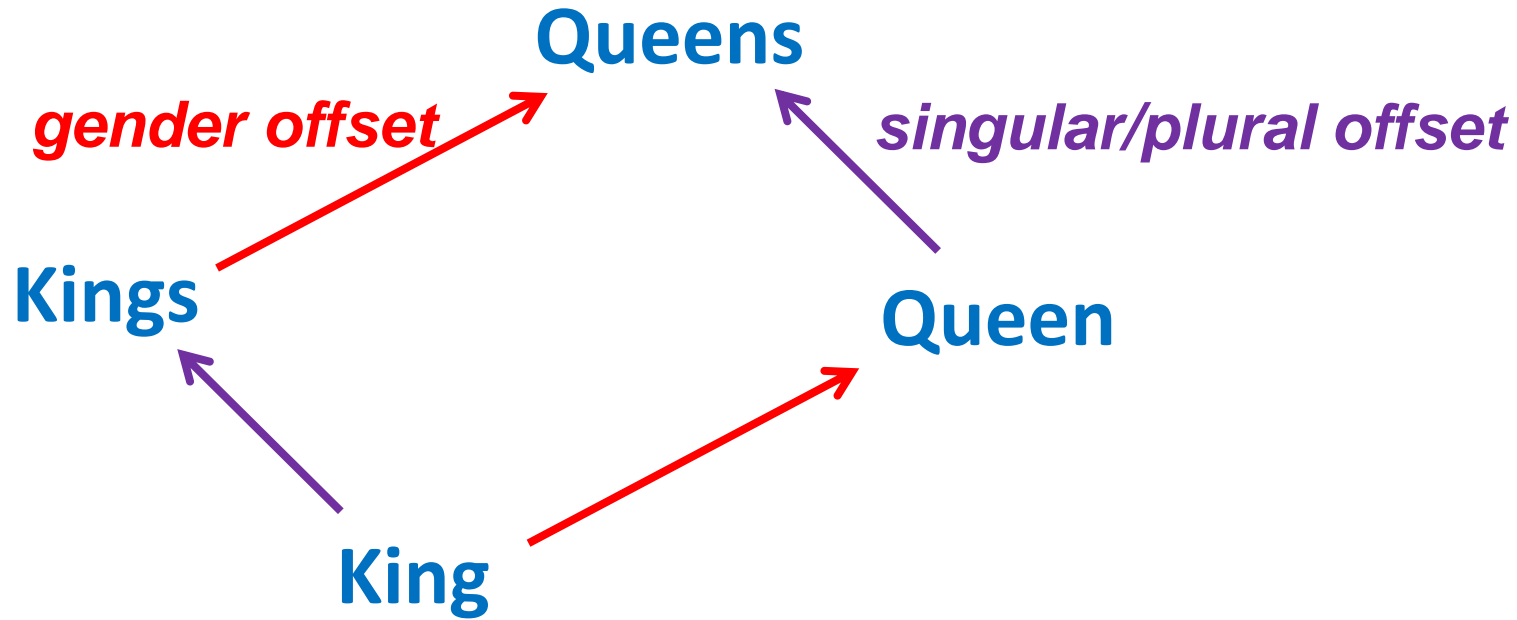
Queens

Kings

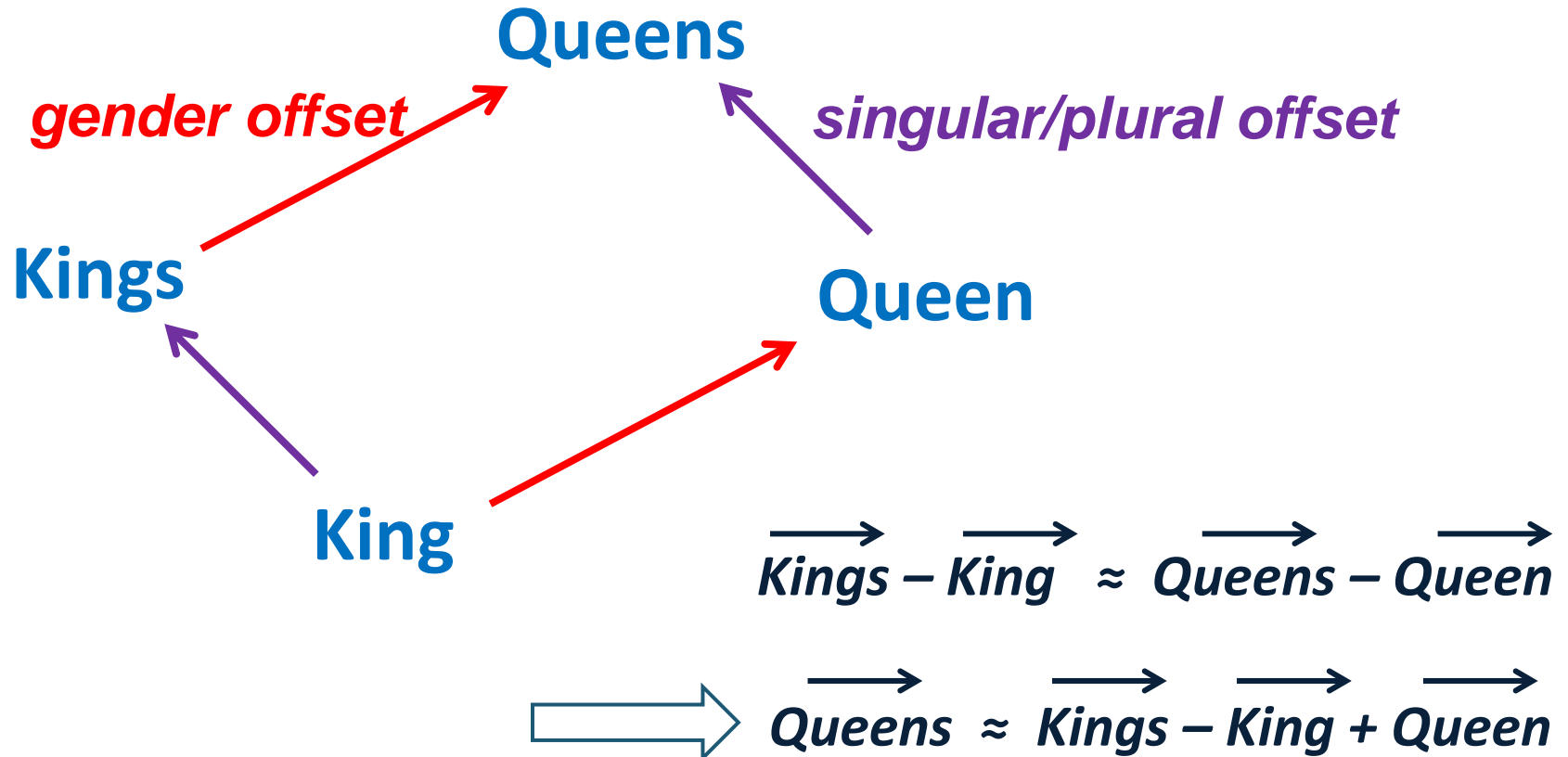
Queen

King

Regularities as Vector Offsets

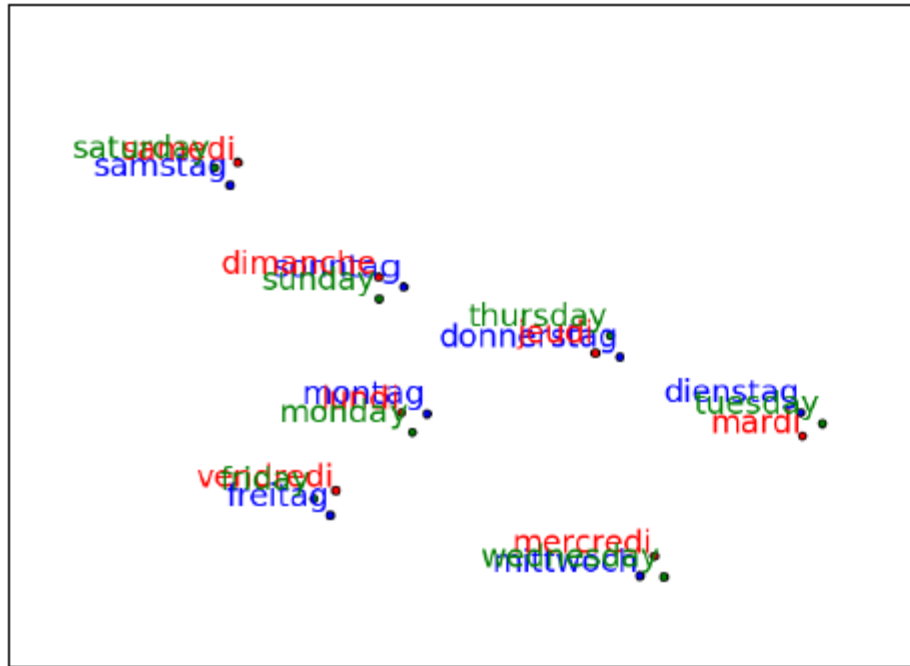


Regularities as Vector Offsets



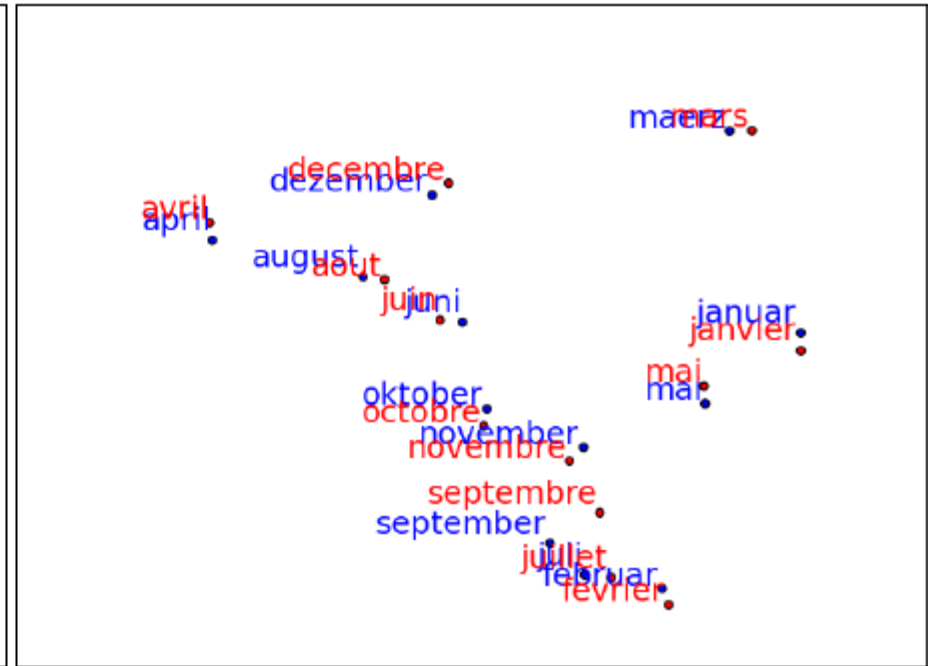
Regularities across Languages

Days of the Week



GERMAN FRENCH ENGLISH

Months of the Year



GERMAN FRENCH

(Hermann 2014)

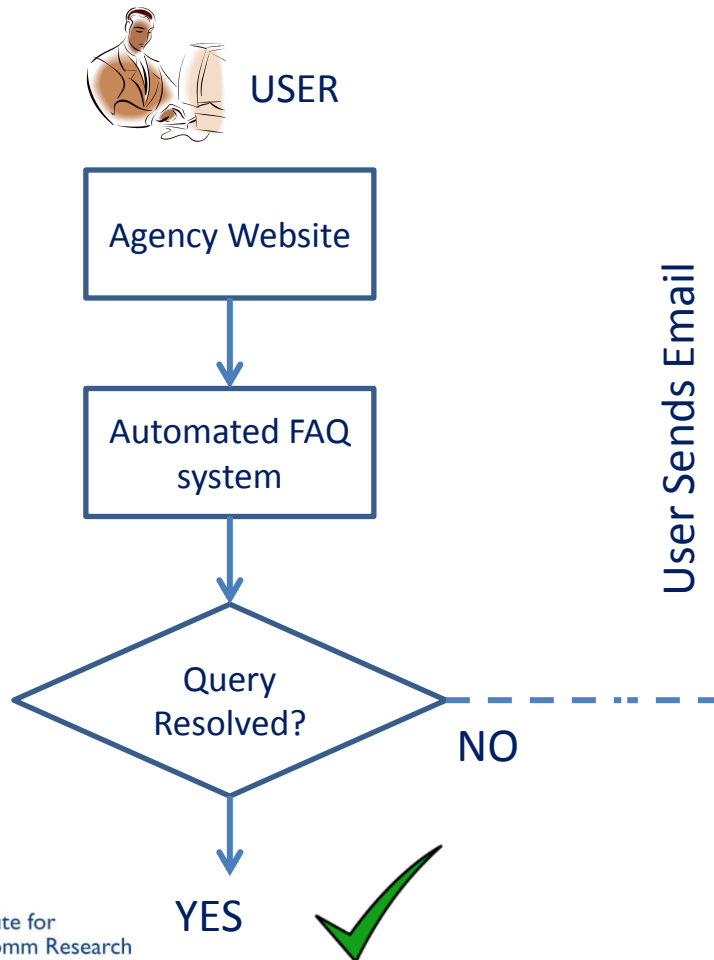
THE SOLUTION

Proposed Solution Revisited

Frequently Asked Questions (FAQ) Service Engine

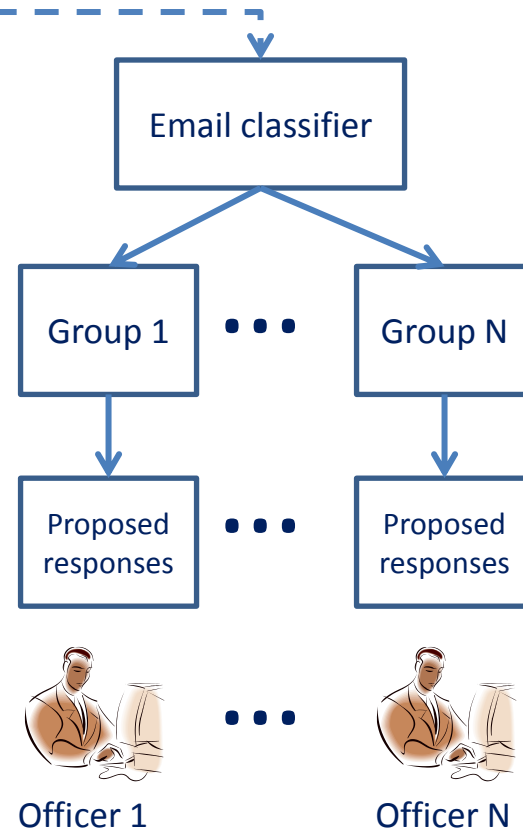
Email classification and Response Recommendation Engine

QUESTION SEARCH PROBLEM

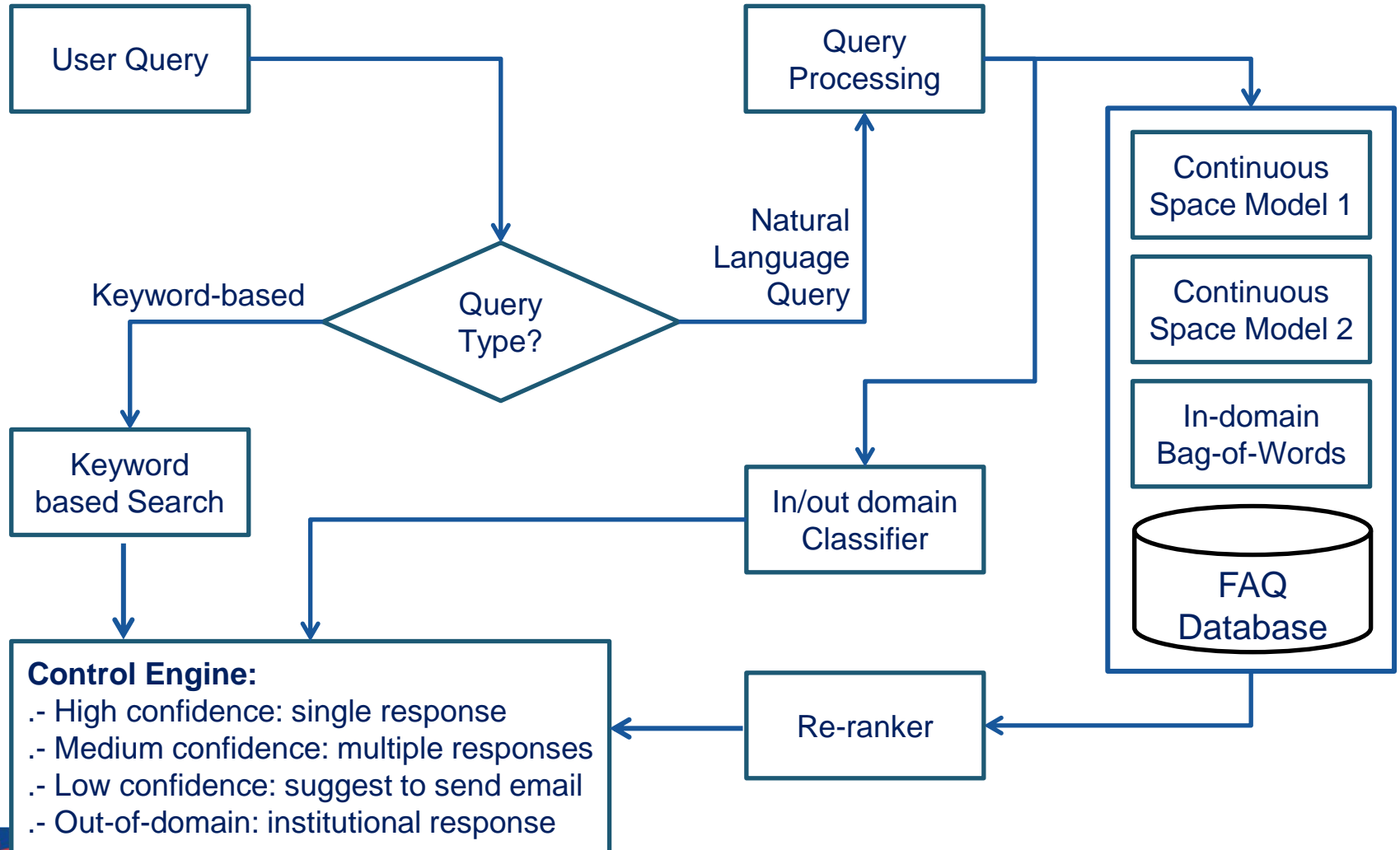


User Sends Email

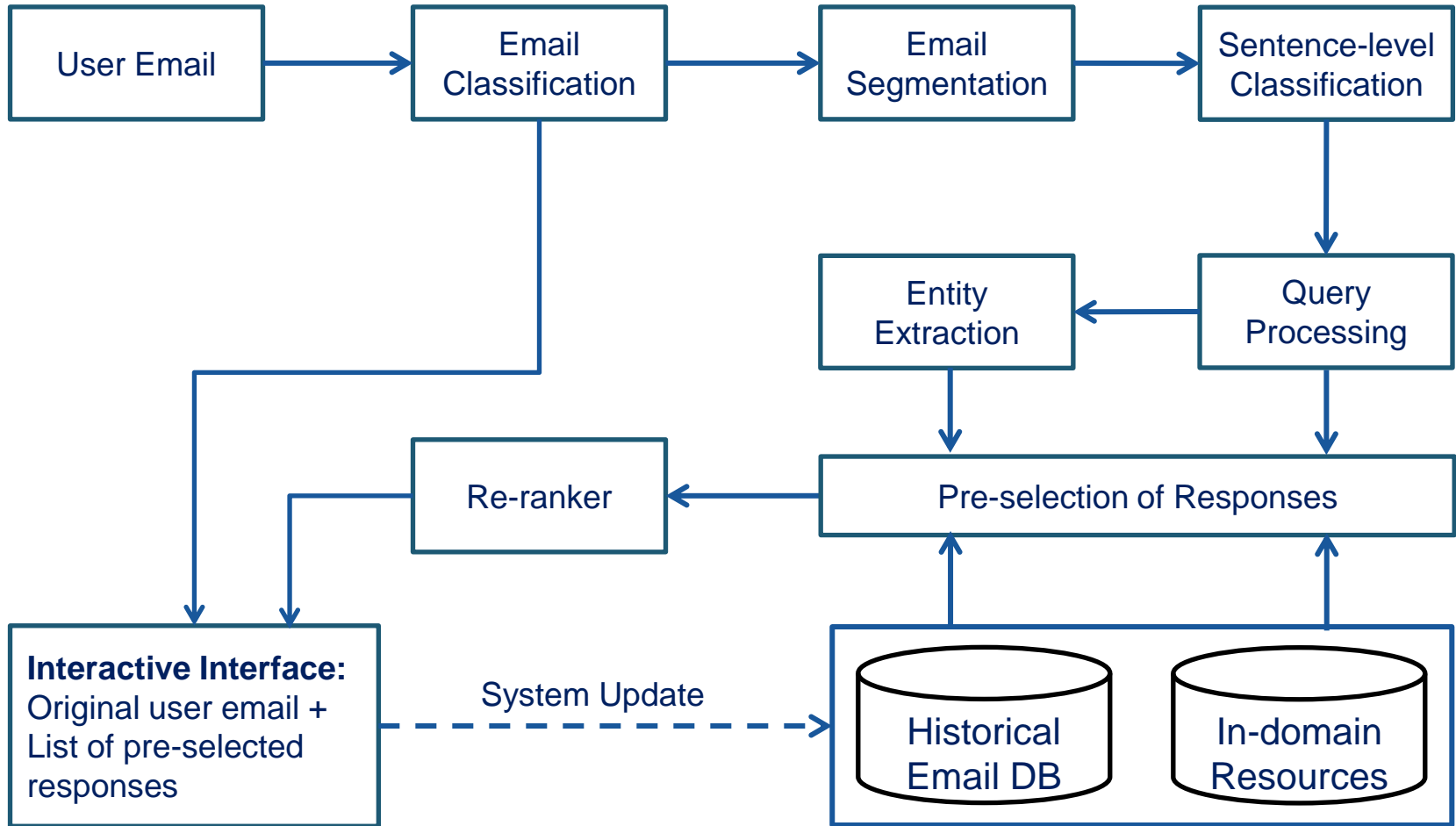
RESPONSE SELECTION PROBLEM



Overall FAQ System Architecture



Overall Email System Architecture



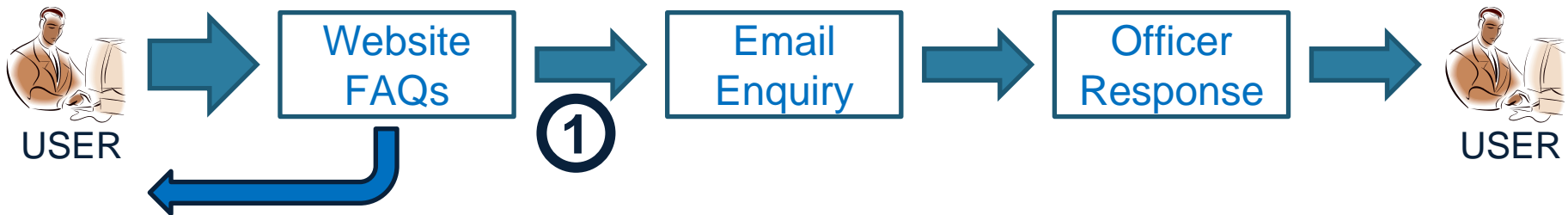
Outcome and Output Indicators

Customer Journey - Value Chain



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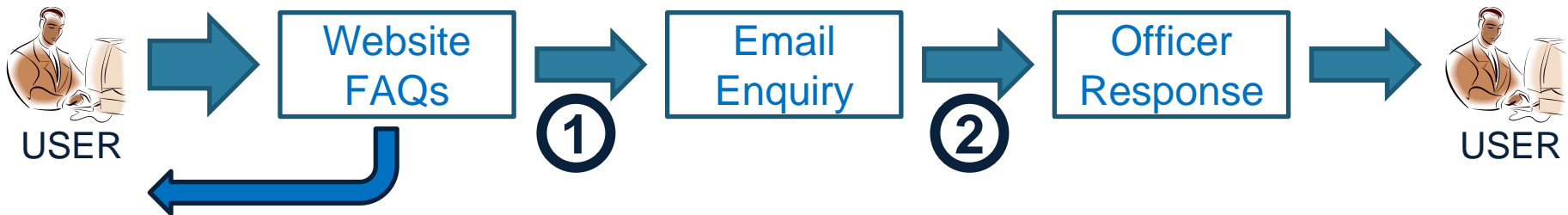


1. Reduction of incoming email volume (10%-20% less)

- User finds more information in the website, and faster
- Lower average number of emails per day sent to agency

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Customer Journey - Value Chain



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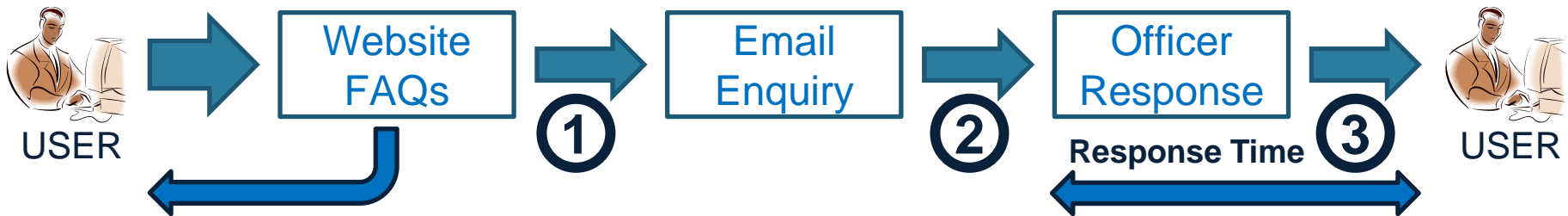
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2. Reduction in human effort (20%-30% less)

- Less human effort to re-route and reply to emails
- Larger volume of emails processed per time unit

Outcome and Output Indicators

Customer Journey - Value Chain



1. Reduction of incoming email volume (10%-20% less)

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2. Reduction in human effort (20%-30% less)

- Less human effort to re-route and reply to emails
- Larger volume of emails processed per time unit

3. Reduction on email response time (20%-30% less)

- Faster internal processing of emails
- Lower average response time to the user



Institute for
Infocomm Research

Thank you

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Human Language Technology Unit

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