UMBC

Semantic Knowledge and Privacy in the Physical Web

PRAJIT KUMAR DAS, ABHAY KASHYAP, GURPREET SINGH, CYNTHIA MATUSZEK, TIM FININ, ANUPAM JOSHI

Google

Motivation

Our goal is to provide contextually aware information, using the IoT, that is privacy preserving and ubiquitously helpful

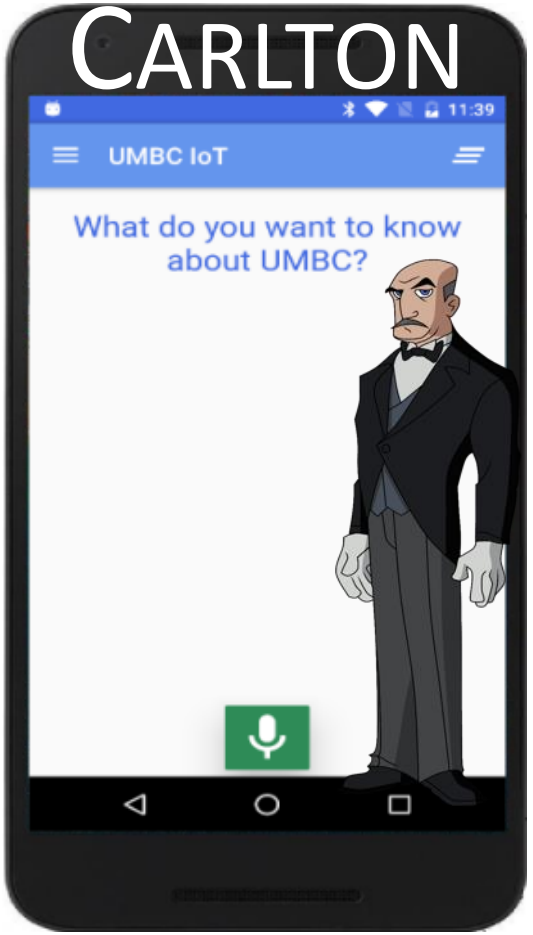
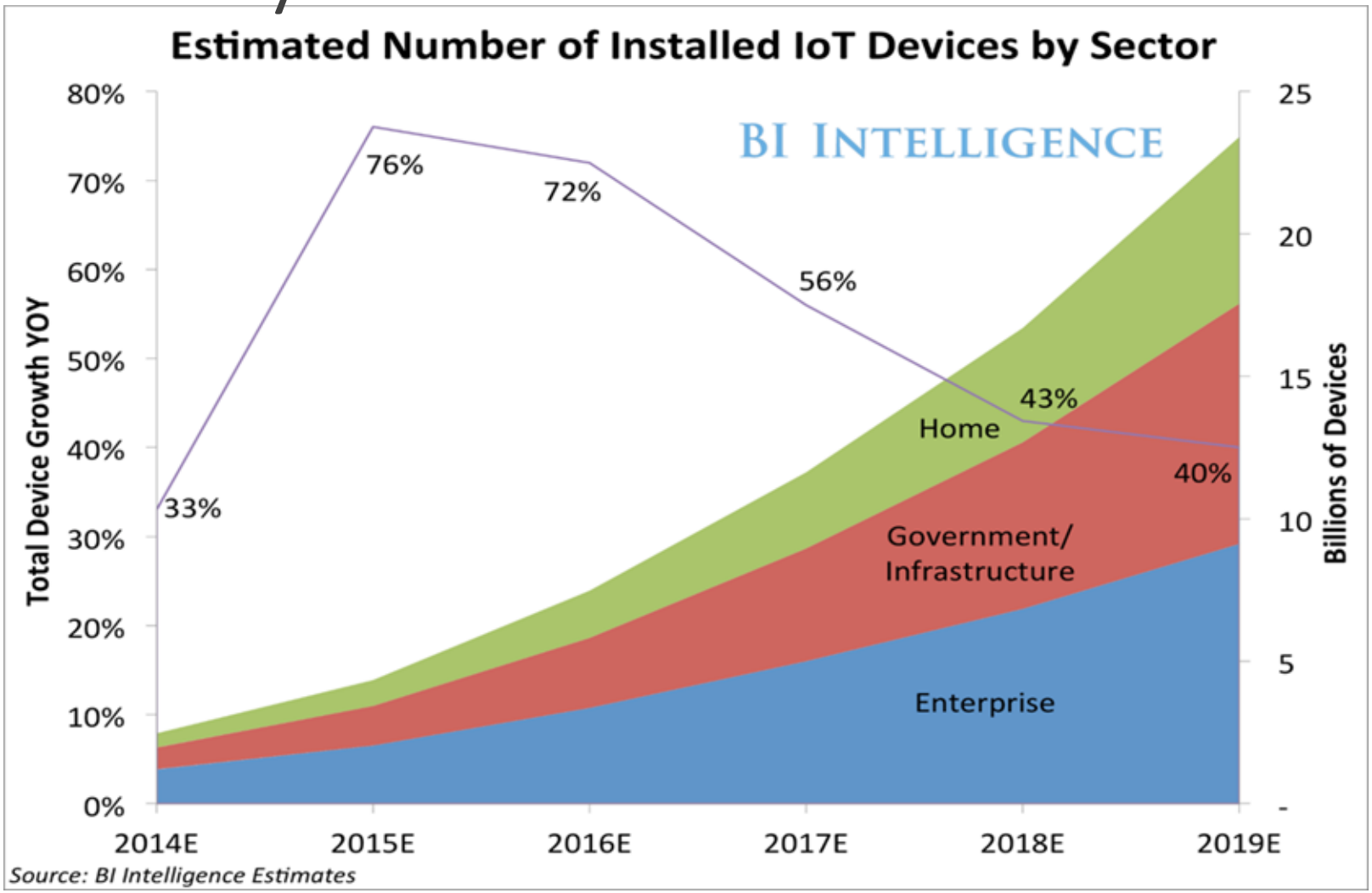


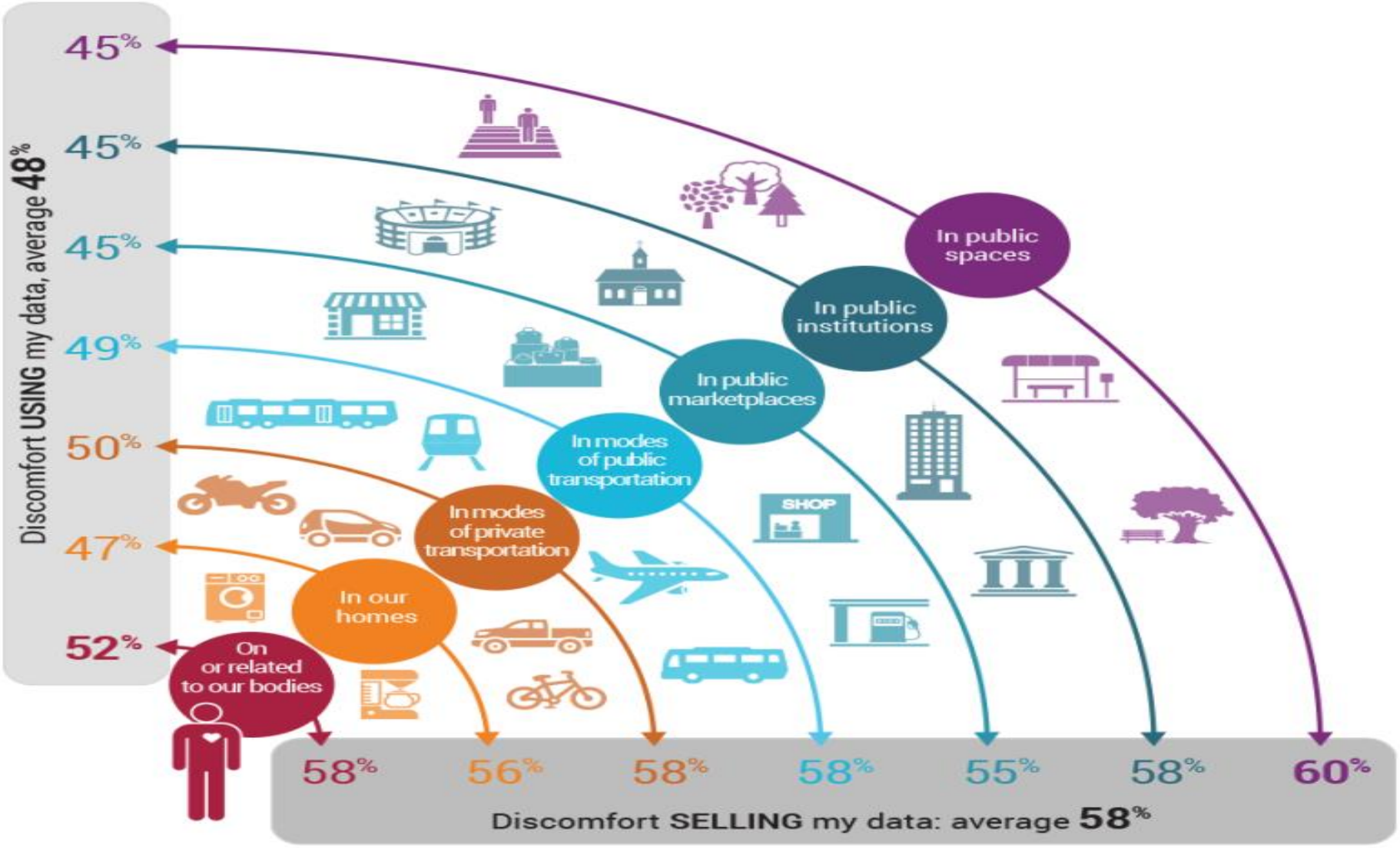
Image courtesy Batman Wikia

IoT by Volume



IoT by Domain

IoT by Privacy Concerns

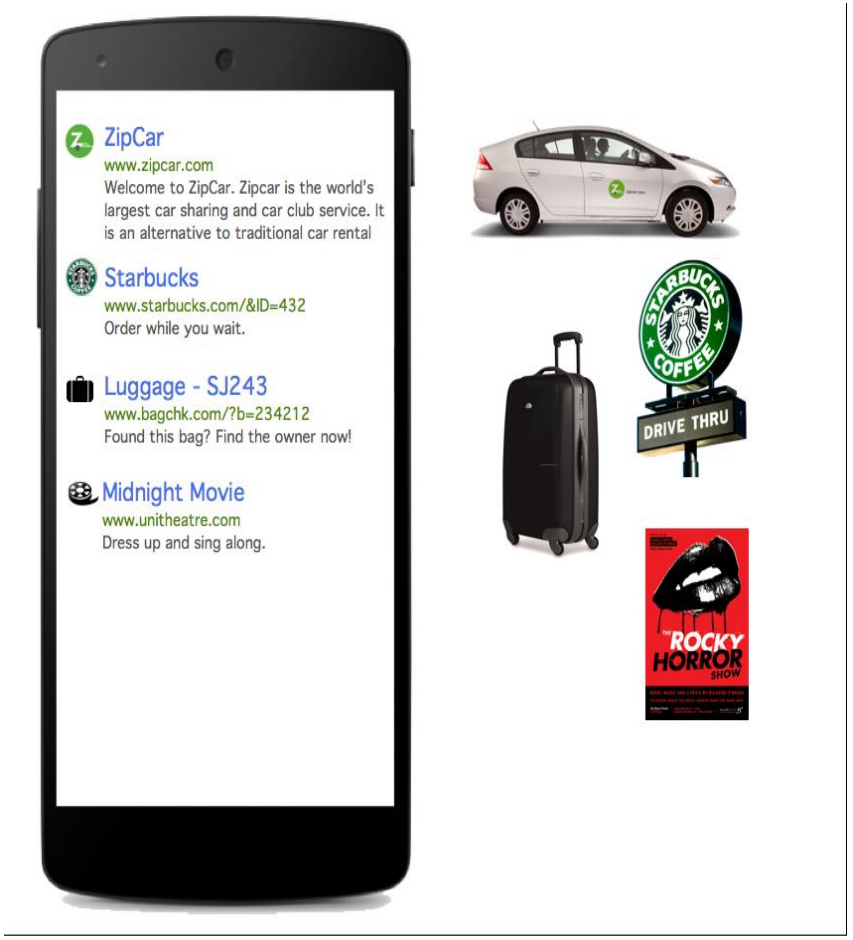


Salient features

- CARLTON: A context-aware, NL question-answer **BOT**
- Context derived from the **Physical Web** (IoT)
- Under development, prototype system
- Simple NLP using tools like Stanford CoreNLP
- Mobile app and Kiosk for front-end
- ABAC privacy model, Privacy rules using SWRL
- Hierarchical context ontology
- Optional authentication for UMBC people

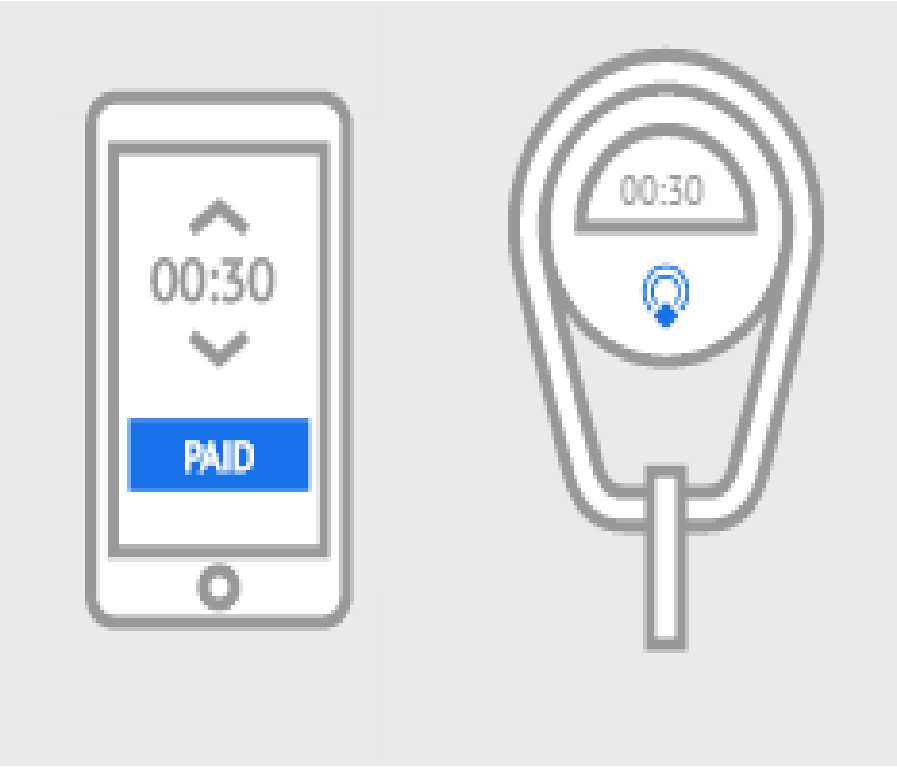
Physical web: What?

- Concretization of IoT
- Small, quick seamless interactions with physical objects and locations with your device



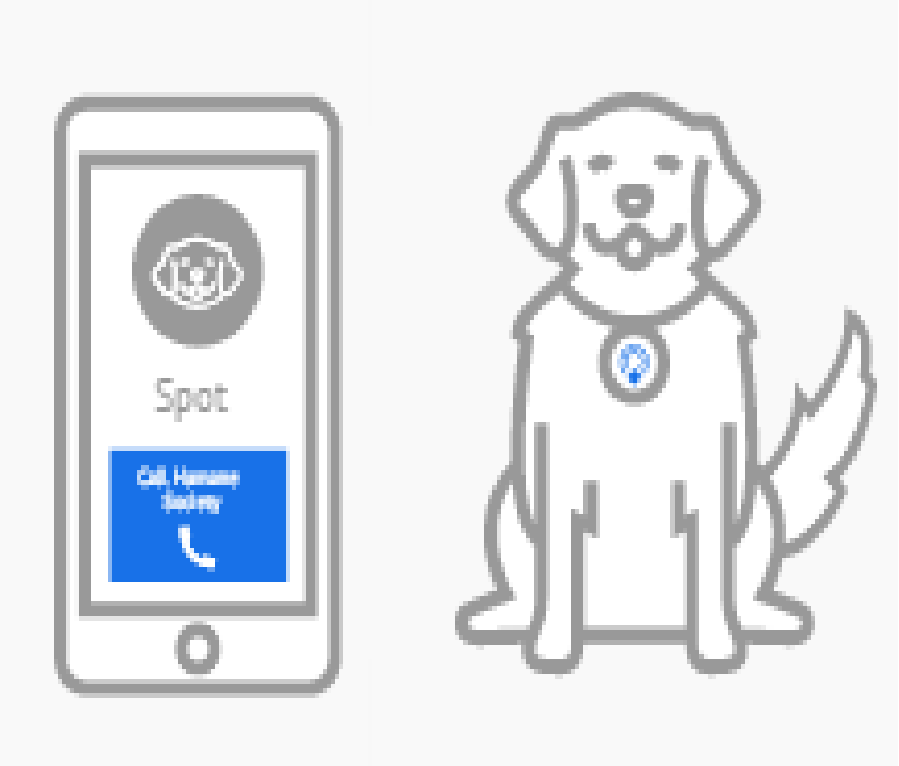
Physical web: What?

- Everything is a tap away



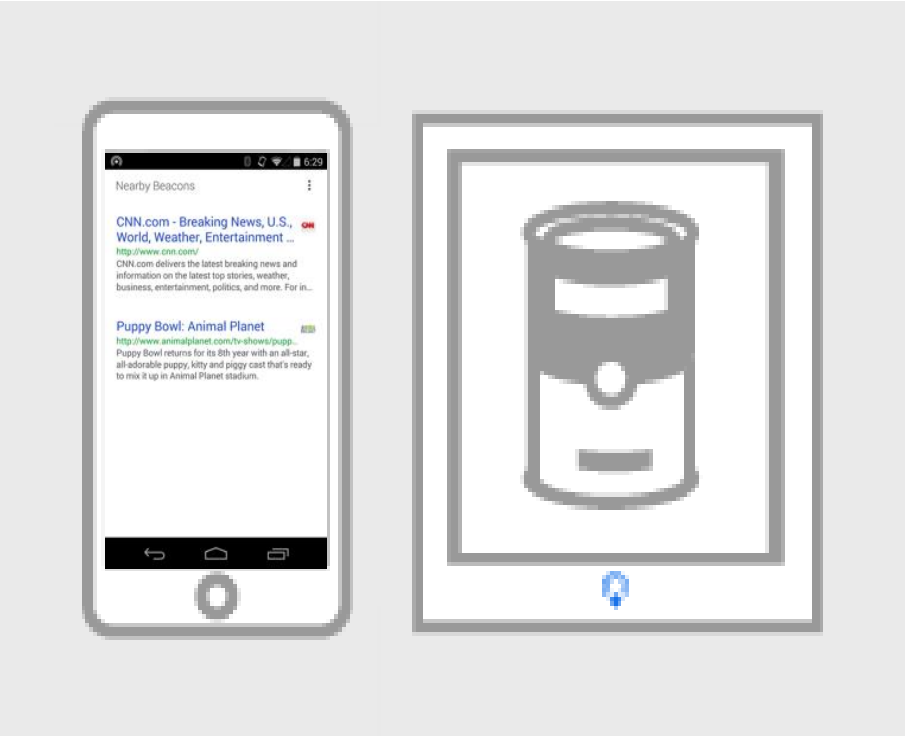
Physical web: What?

- See what's useful around you



Physical web: What?

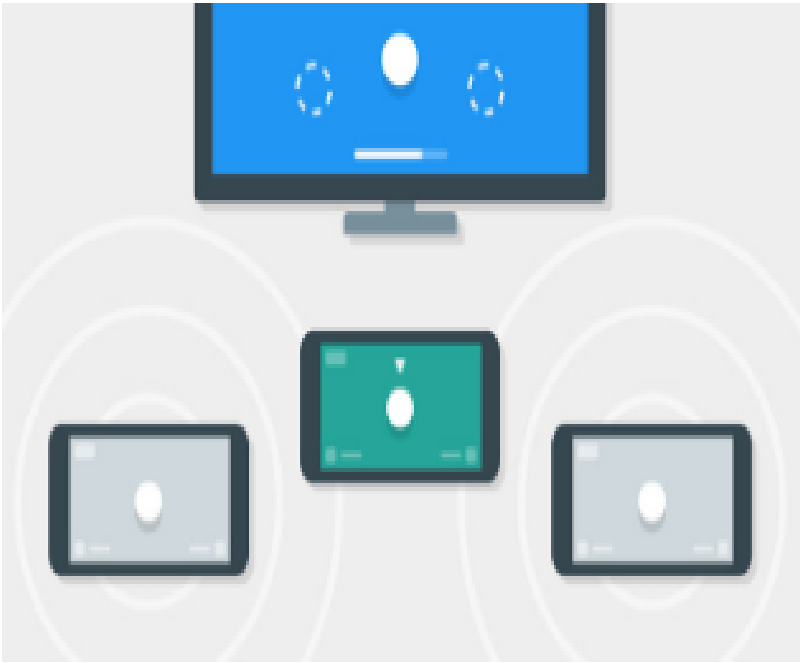
- Any object or place can broadcast content



Physical web: How?

Three main techniques

- Nearby Connections



Physical web: How?

Three main techniques

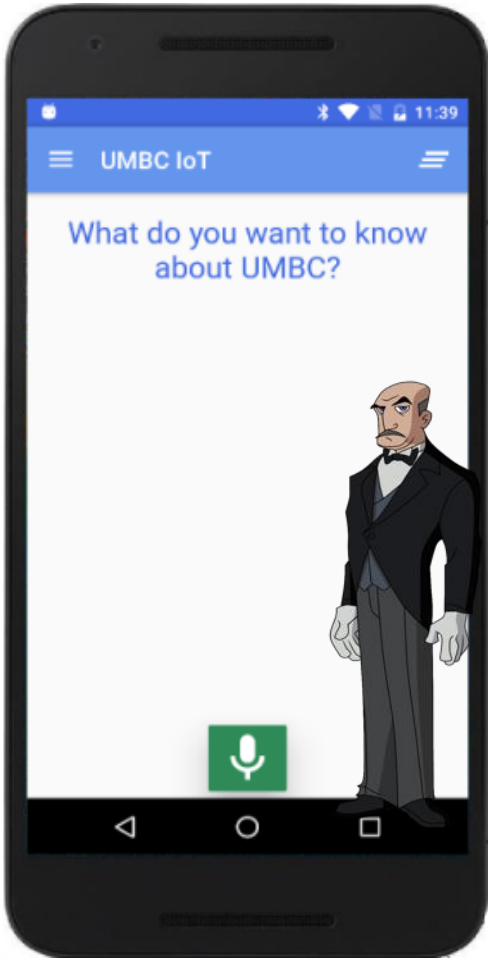
- Nearby Connections
- Nearby Notifications

Physical web: How?

Three main techniques

- Nearby Connections
- Nearby Notifications
- Nearby Messages

System Overview



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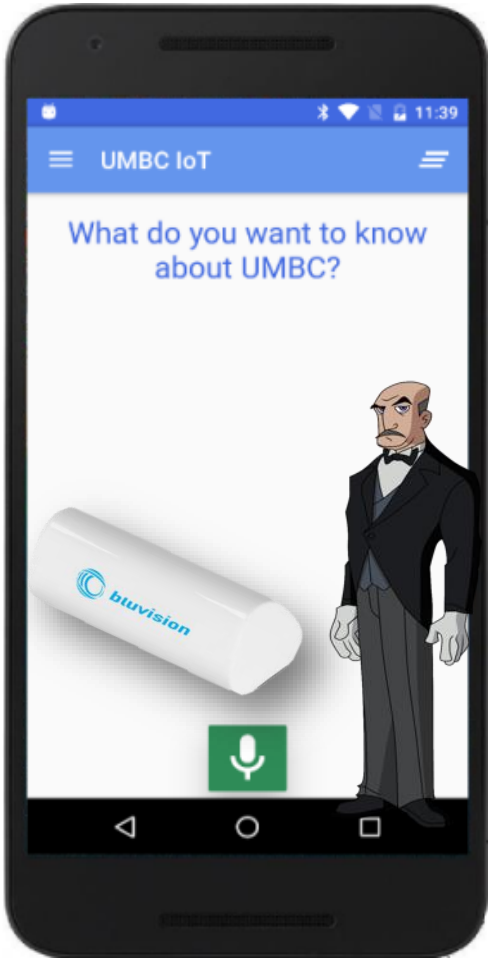

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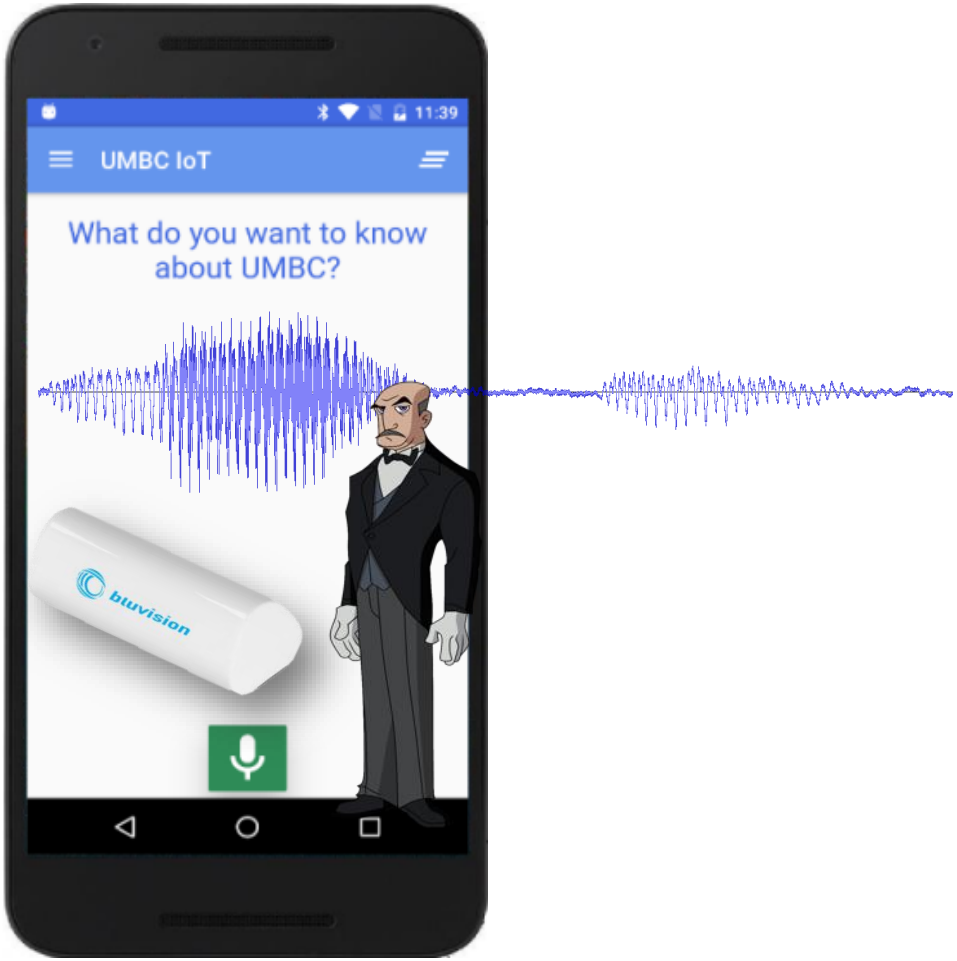


System Overview

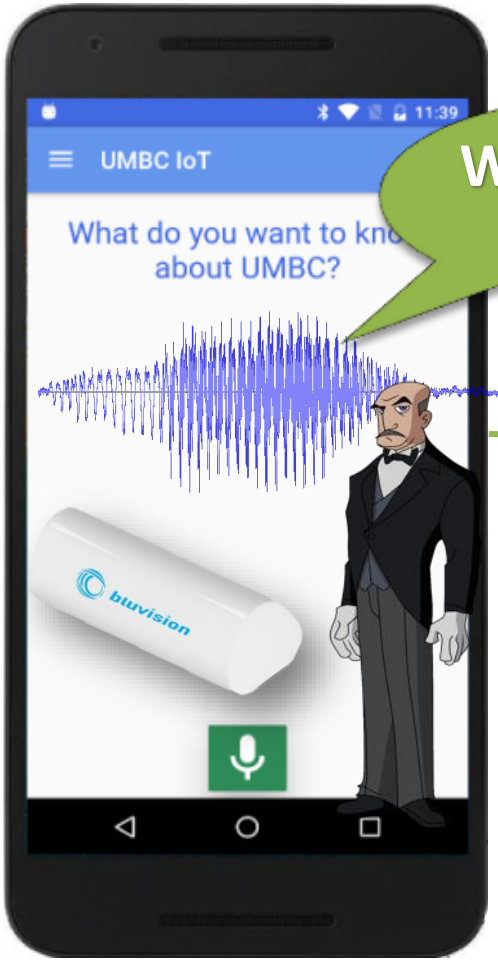
System Overview

Text to Semi-Structured Text

"Tim Finin": Person → Entity type

"*Who*": `WH query type` → Intent

System Overview



Who is Tim Finin?

Context

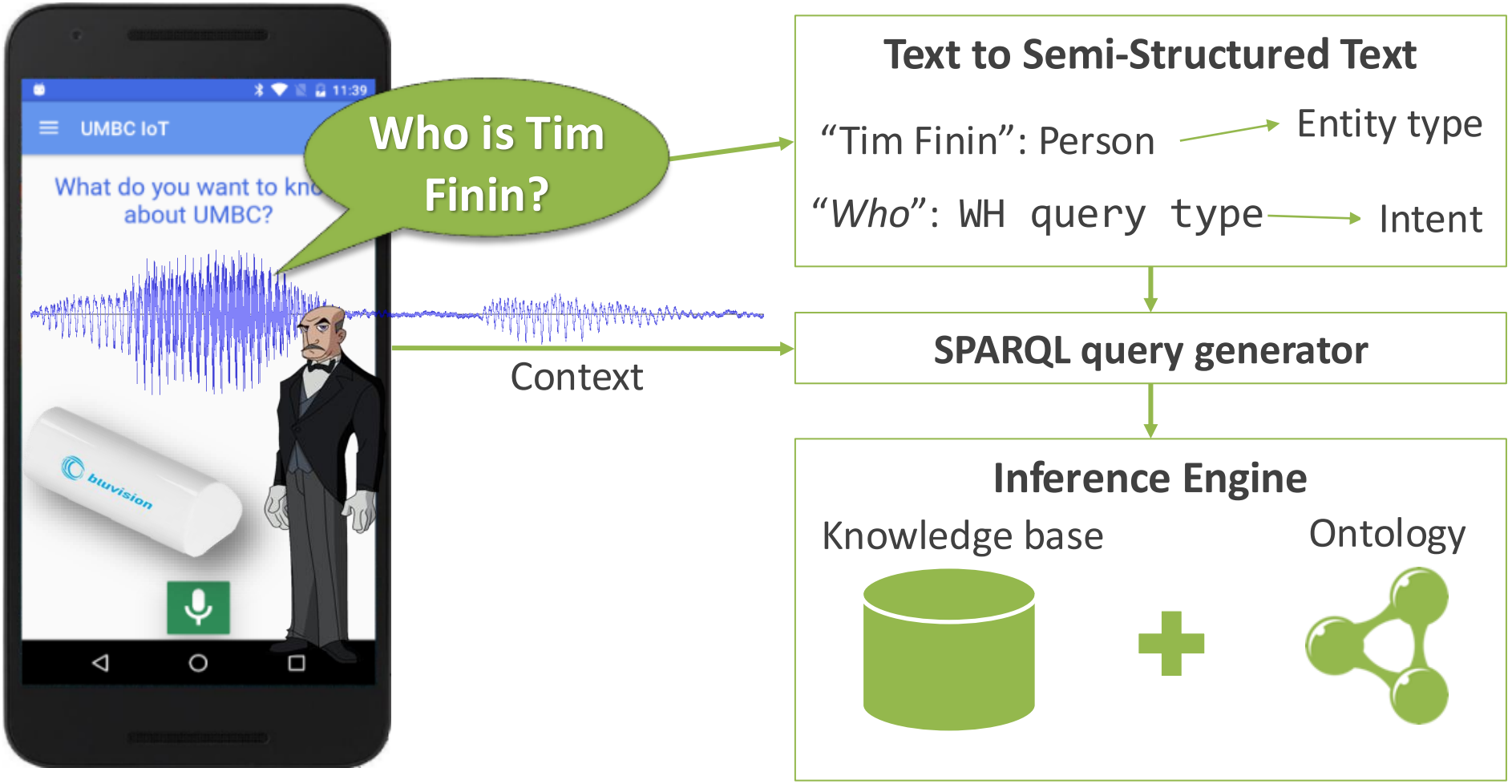
Text to Semi-Structured Text

"Tim Finin": Person → Entity type

"*Who*": WH query type → Intent

SPARQL query generator

System Overview



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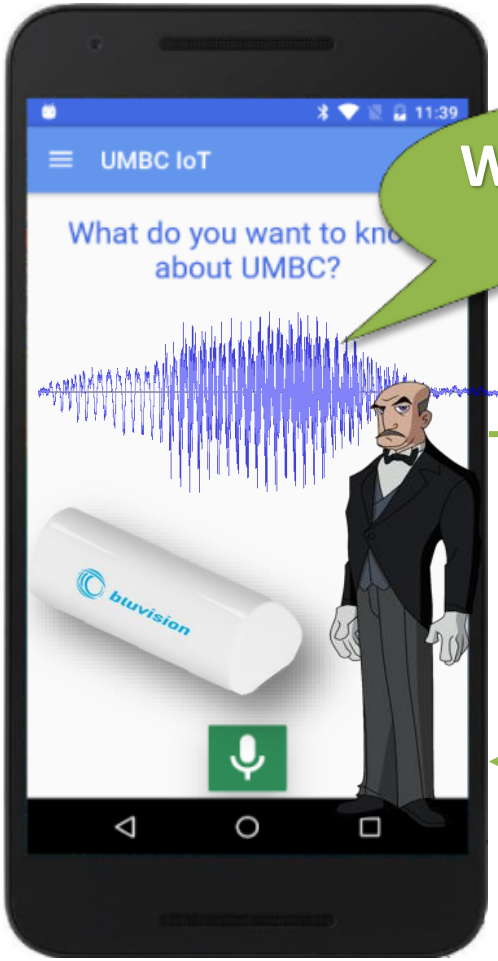


Who is Tim Finin?

Context

Response: JSON
{"text": "He's a Professor in the Computer Science department!"}

Text to Semi-Structured Text

"Tim Finin": Person → Entity type

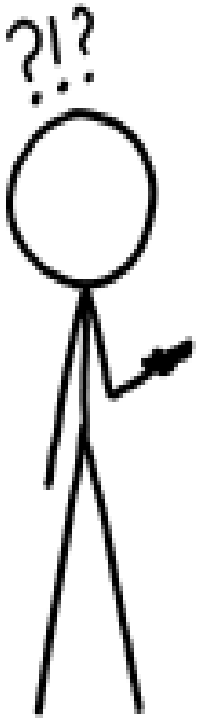
"*Who*": WH query type → Intent

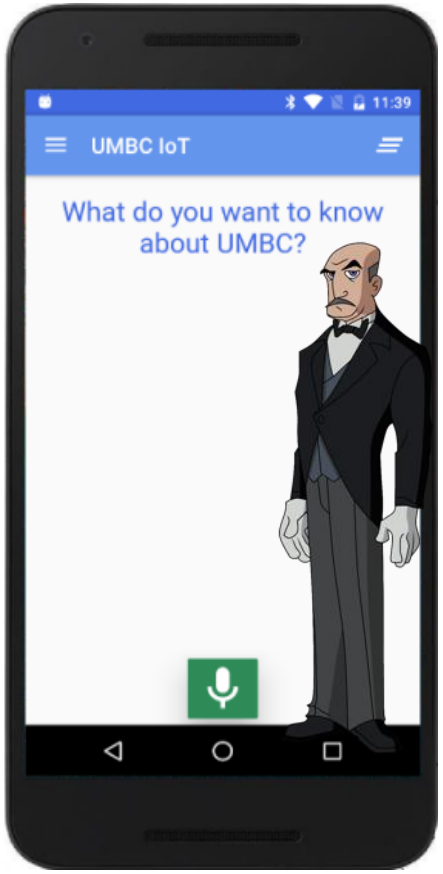
SPARQL query generator

Inference Engine

Knowledge base + Ontology

Example query





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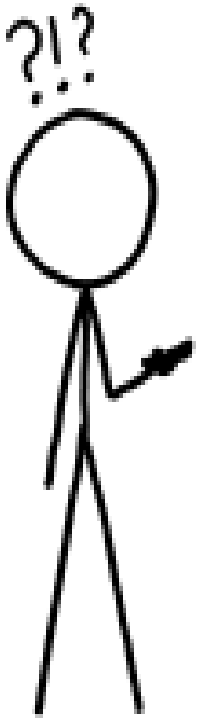
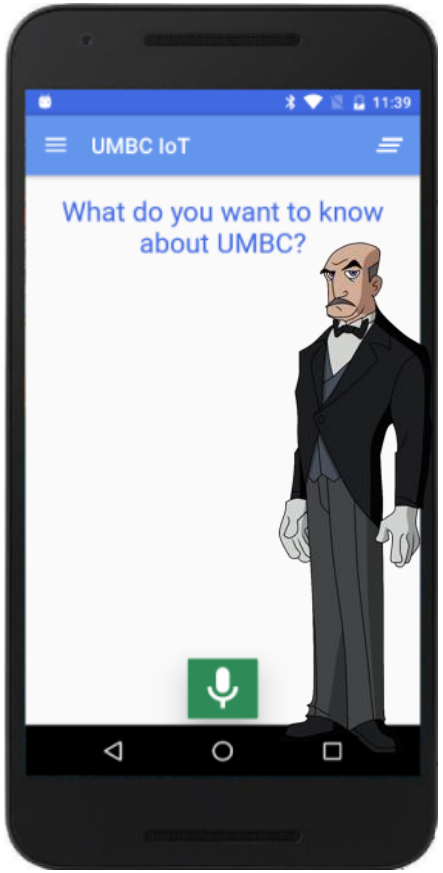
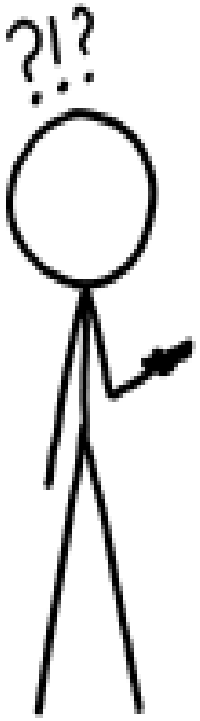


Is this room booked from 2PM-3PM?



Example query

User is a faculty and is in front of Conf. room 1.



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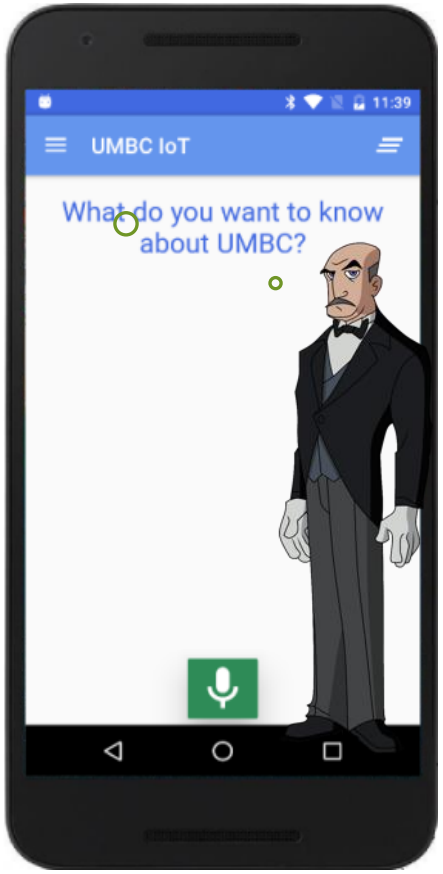
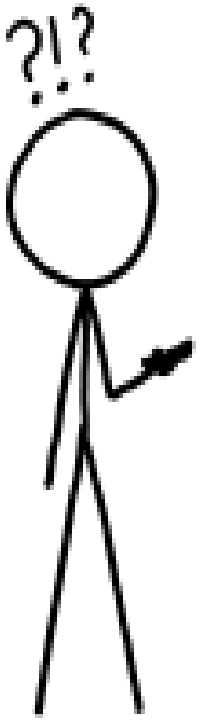


Example query

Conf. room 1 calendar has no events during that time.



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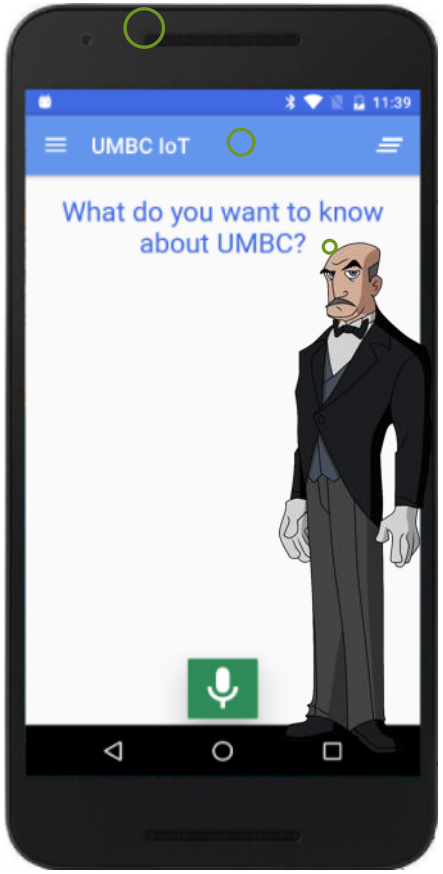

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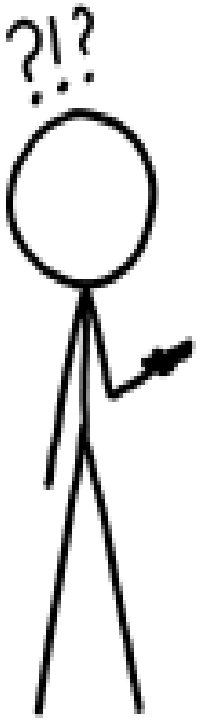
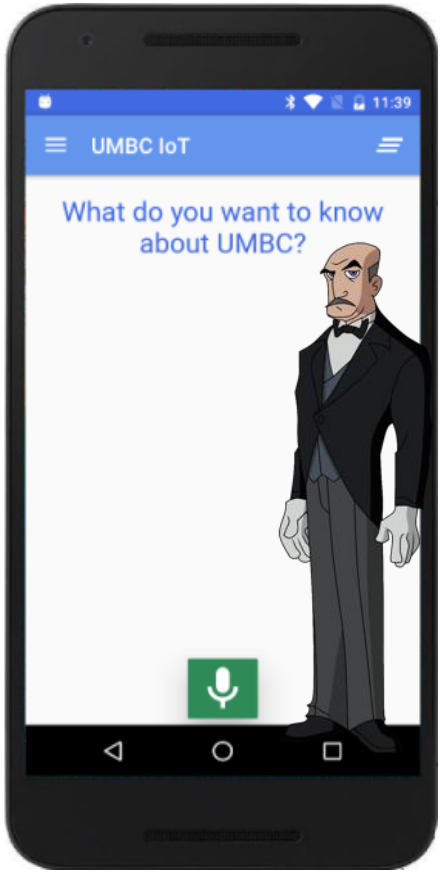


Is this room booked from 2PM-3PM?

No, would you like me to book it from 2PM – 3PM?



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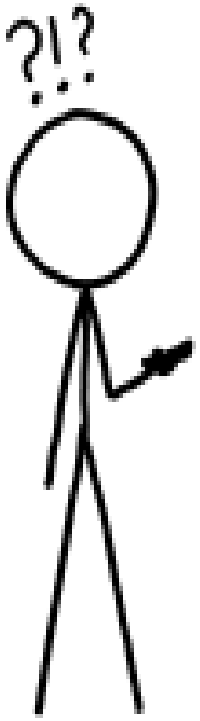
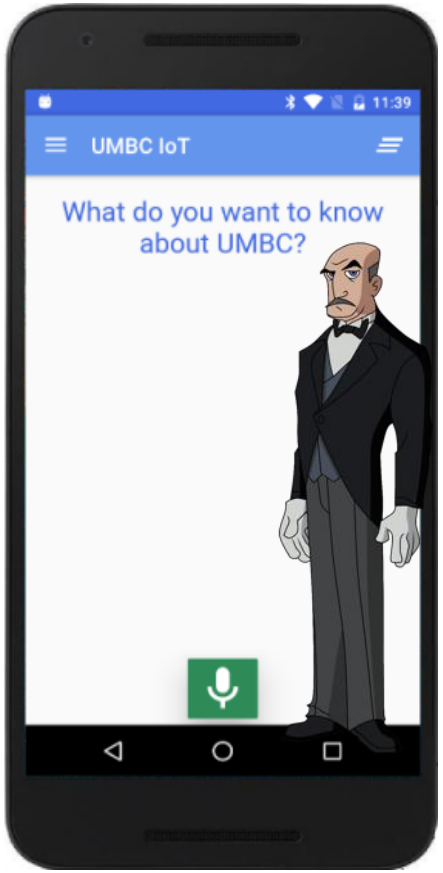


Is this room booked from 2PM-3PM?

Yes, please!

No, would you like me to book it from 2PM – 3PM?



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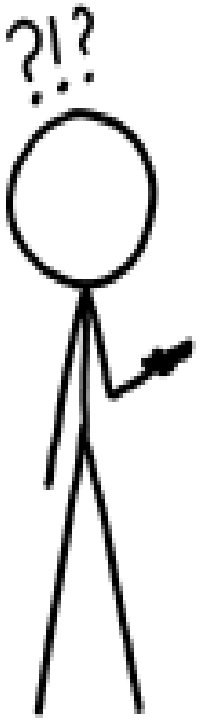

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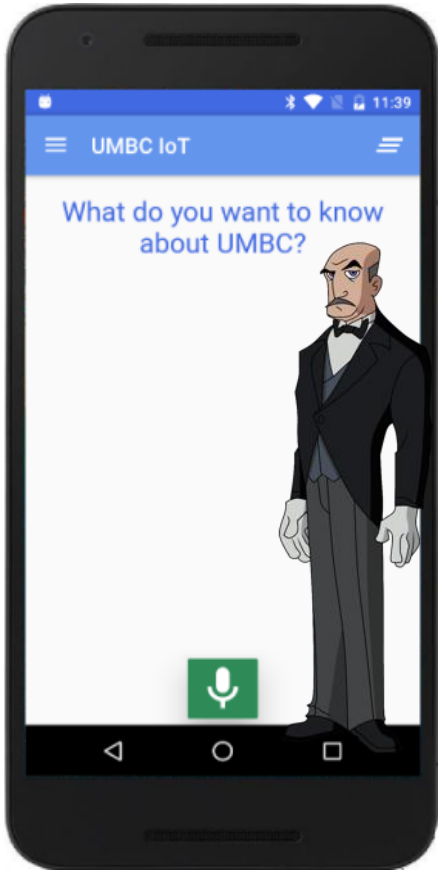
Yes, please!

No, would you like me to book it from 2PM – 3PM?

Okay, the room has been booked in your name from 2PM – 3PM



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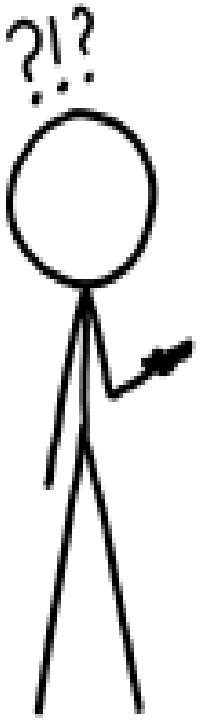

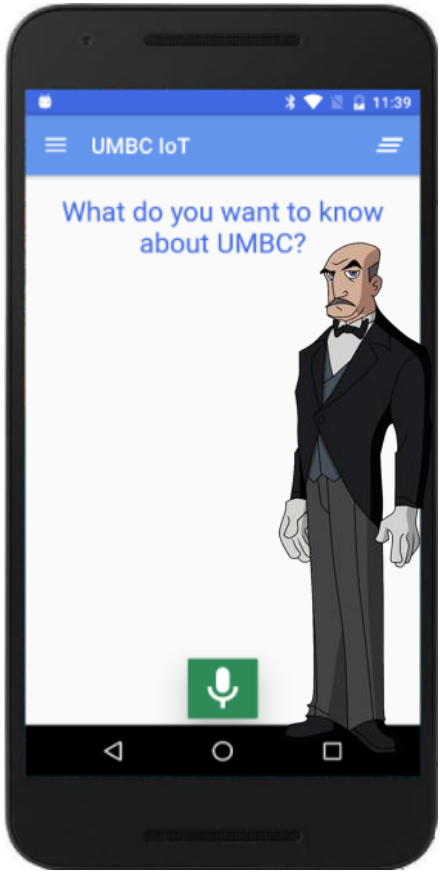

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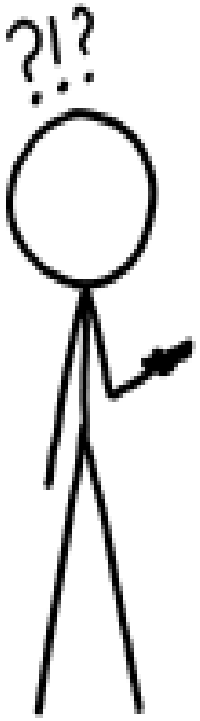
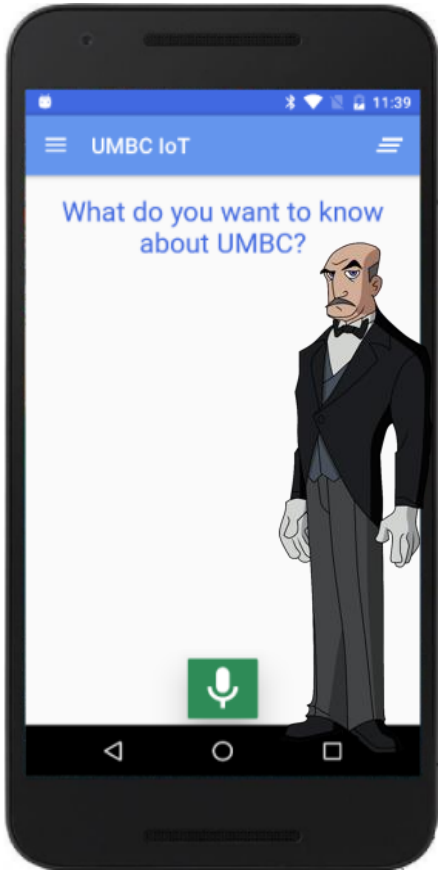
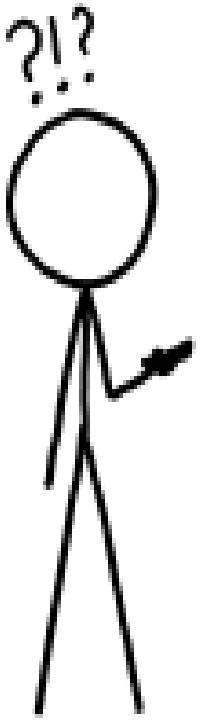


Is Dr. Joshi here?



Example query

User could mean Dr. A. Joshi or Dr. K. Joshi.



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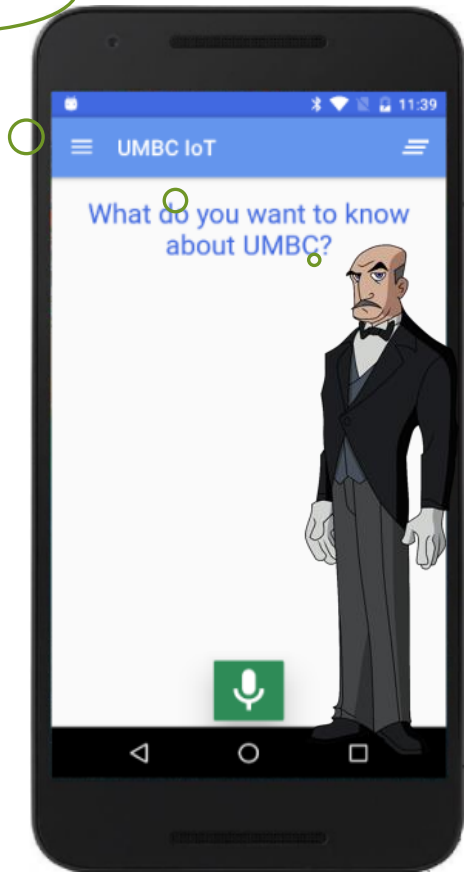
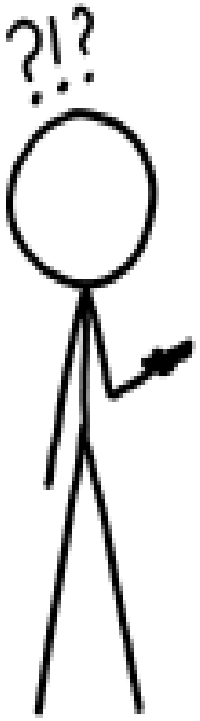


Example query

But user is in front of Dr. A. Joshi's office.



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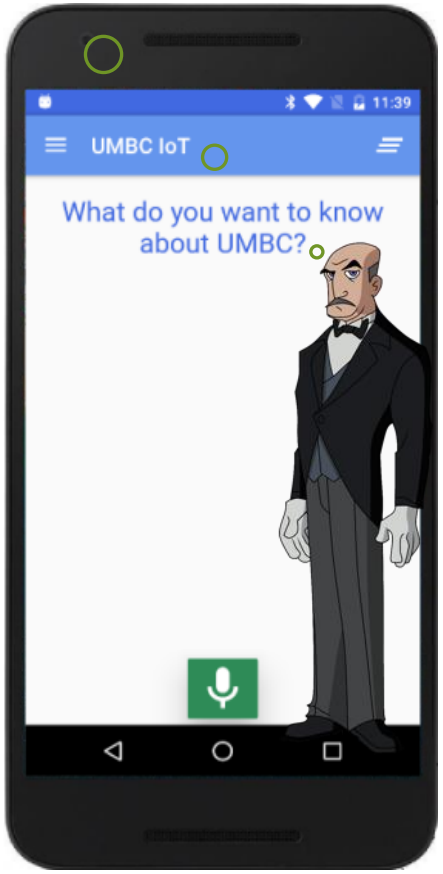
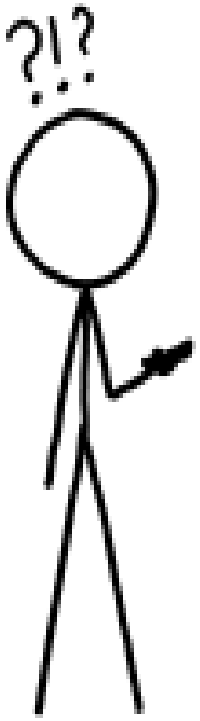


Example query

User is an advisee of Dr. A. Joshi



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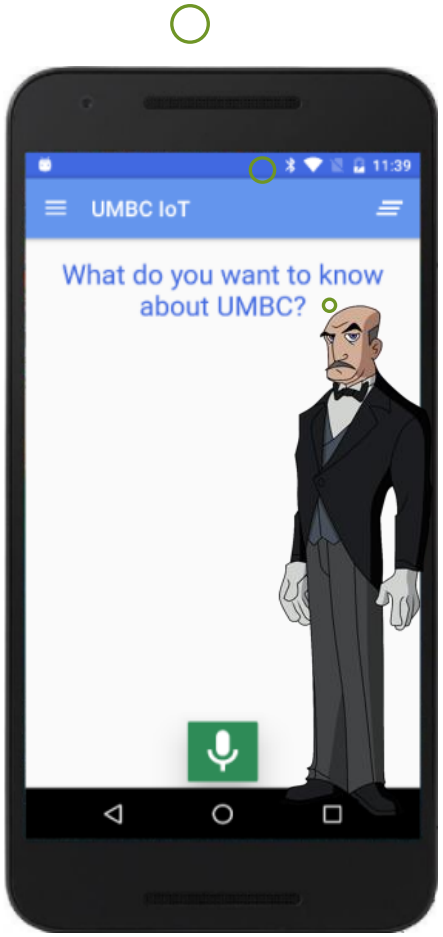

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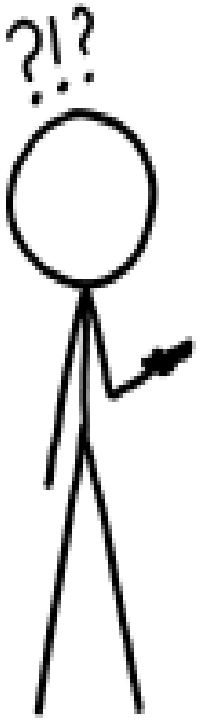
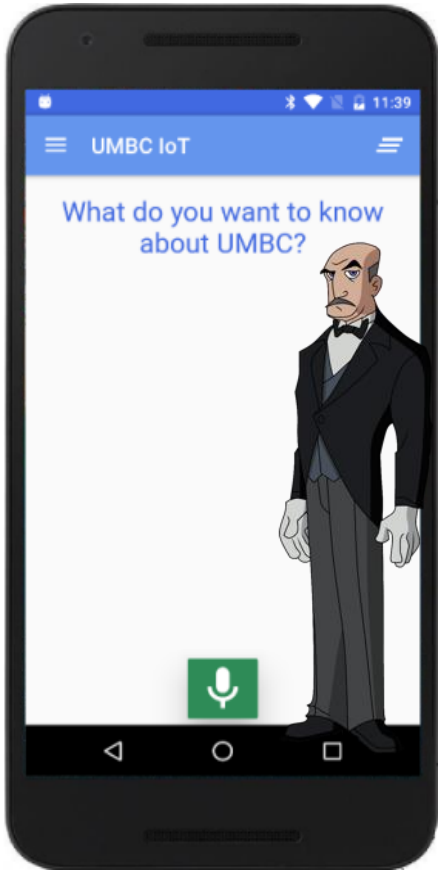


Is Dr. Joshi here?

Dr. Joshi is in a meeting till 3PM



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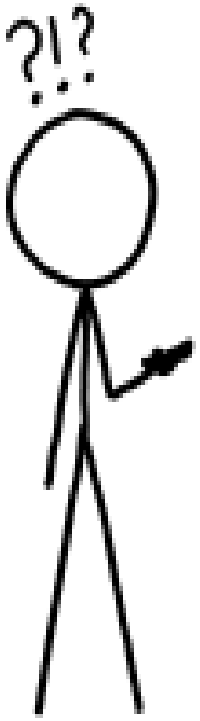

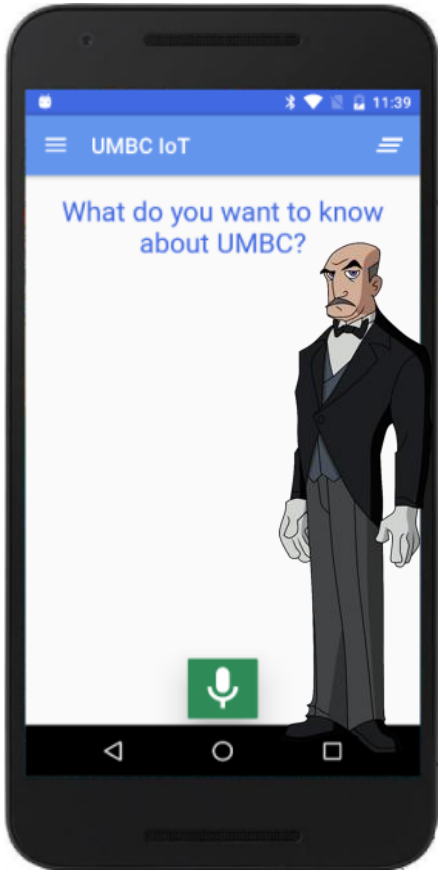

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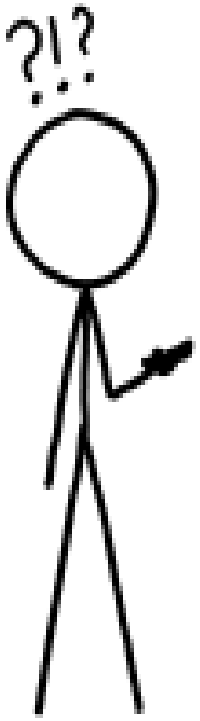
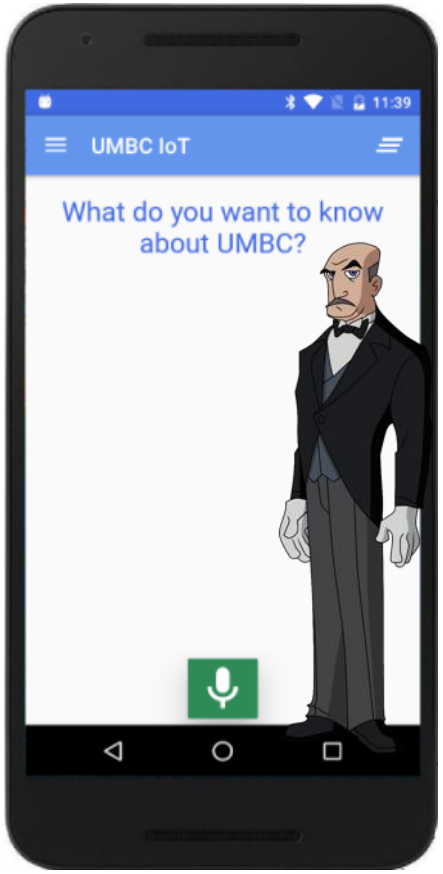
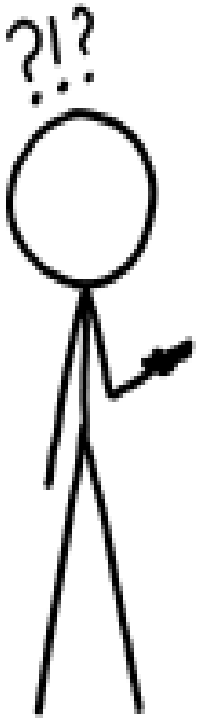


Where is Dr. Finin's office?



Example query

User is in CSEE building



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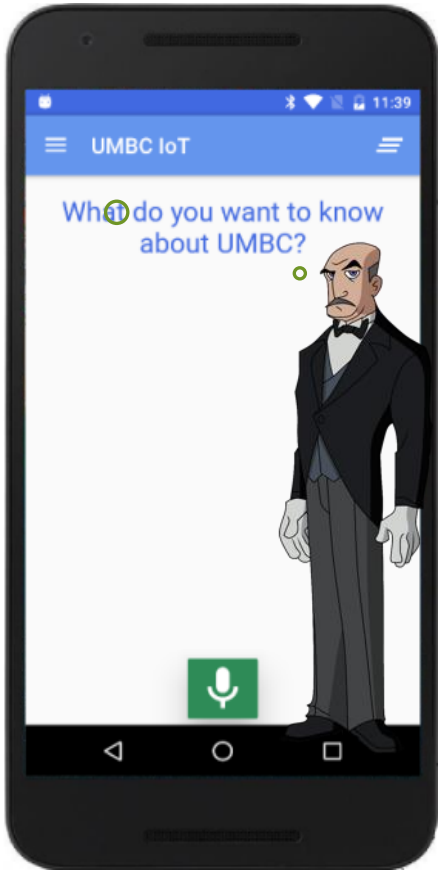
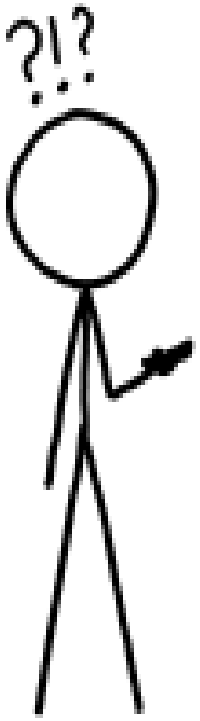


Example query

User is unknown to system



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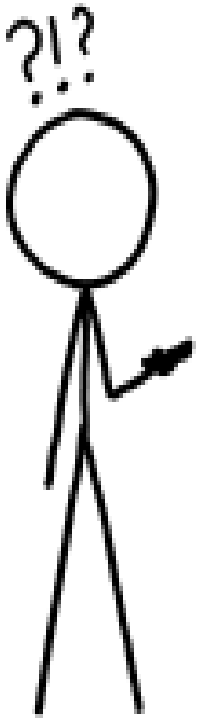
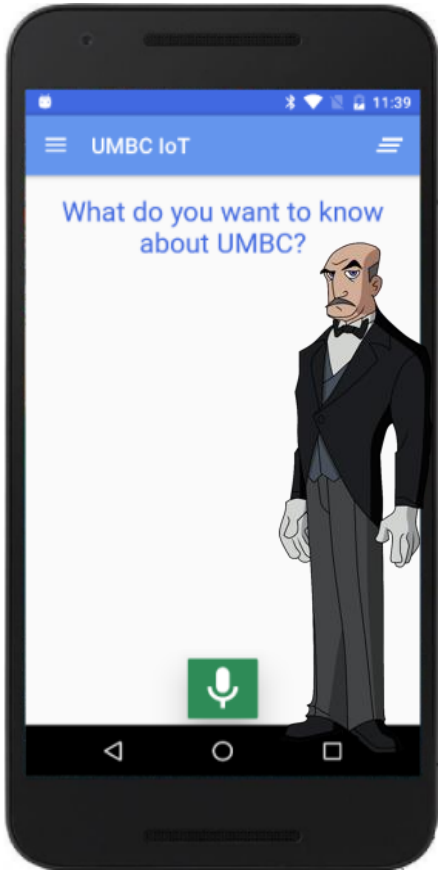


Where is Dr. Finin's office?

Please see CSEE front desk for required information



Policy Example

Example1.
@prefix crltn:<https://www.ebiquity.org/ontologies/carlton/0.1>.
@prefix swrlb:<http://www.w3.org/2003/11/swrlb>.
crltn: student(?requester)∧
(
crltn: supervises(“Xavier”,?requester)∨
(crltn: affiliatedWith(?requester,?labName)∧crltn: leads(“Xavier”,?labName))
)∧
crltn: hasCurrentLocation(?requester,?aBldgLocation)∧
crltn: room(?aBldgLocation)∧crltn: sitsIn(“Xavier”,?aBldgLocation)∧
crltn: currentTime(?currTime)∧swrlb: Exists(?anEvent)∧crltn: speakingAt(“Xavier”,?anEvent)∧
(
(crltn: startTime(?anEvent,?eventStartTime)∧swrlb:
greaterThan(?eventStartTime,?currTime))∨
(crltn: endTime(?anEvent,?eventEndTime)∧swrlb: greaterThan(?currTime,?eventEndTime))
)∧crltn: hasCurrentLocation(“Xavier”,?aLocation)∧crltn: Location(?aLocation)∧
crltn: requestLocation(“Xavier”)
⇒
shareLocation(?aLocation)

Policy Example

```
supervises(“Xavier”,?requester)
OR
(
        affiliatedWith(?requester,?labName)
        AND
        leads(“Xavier”,?labName)
)
```

Policy Example

hasCurrentLocation(?requester,?aBldgLocation)
AND
room(?aBldgLocation)
AND
sitsIn(“Xavier”,?aBldgLocation)
=>
shareLocation(?aLocation)

Future work

- Prototype system constantly adding conversations
- Beacons on robots
- Reason over robots near you
- How robots respond to instructions?
  - ✓ “Can you take me to Prof. Matuszek now?”
  - ✓ “Show me the way to the ITE 346 conference room”

Summary

- We presented **CARLTON**
- A context-aware, NL question-answer **BOT**
- Context derived from the **Physical Web** (IoT)
- Semantic web technologies used to preserve data privacy

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Google