



# Case Management | Augmented Intelligence

Never Stand Still

Computer Science and Engineering

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# Agenda

- Part 1: Cognitive Case Management
- Part 1: Augmentation : Data Curation | Digital assistance
- Part 2: Activity :digital assistants

# Case Management

- Managing work processes: interactions among **people, services, processes, devices.**
- **Interaction channels and services:** email, video/text chat, messaging apps, task management | information management apps
- **Information | tasks | collaboration**
- There may be descriptions of processes, protocols, policies/regulations but the overall **workflow is flexible**

# Example-Inquiry Process

- Hypotheses, questions, planning
- **Information items: inquiry content stream** (evidence items, notes, decision items, organization sheets)
- **Line of inquiries | tasks** (information collection, analysis, (cross-) verification)
- **Briefs** (authoring | summarizing)

# Inquiry Process

- **Information stream:** evidence items, notes
- **Tasks | Line of inquiries | Activity stream :** search, analysis, coding, authoring

# Data Sources By the Numbers

Number of data stores in a typical enterprise:

5,000

Number of data stores in a LARGE telco company:

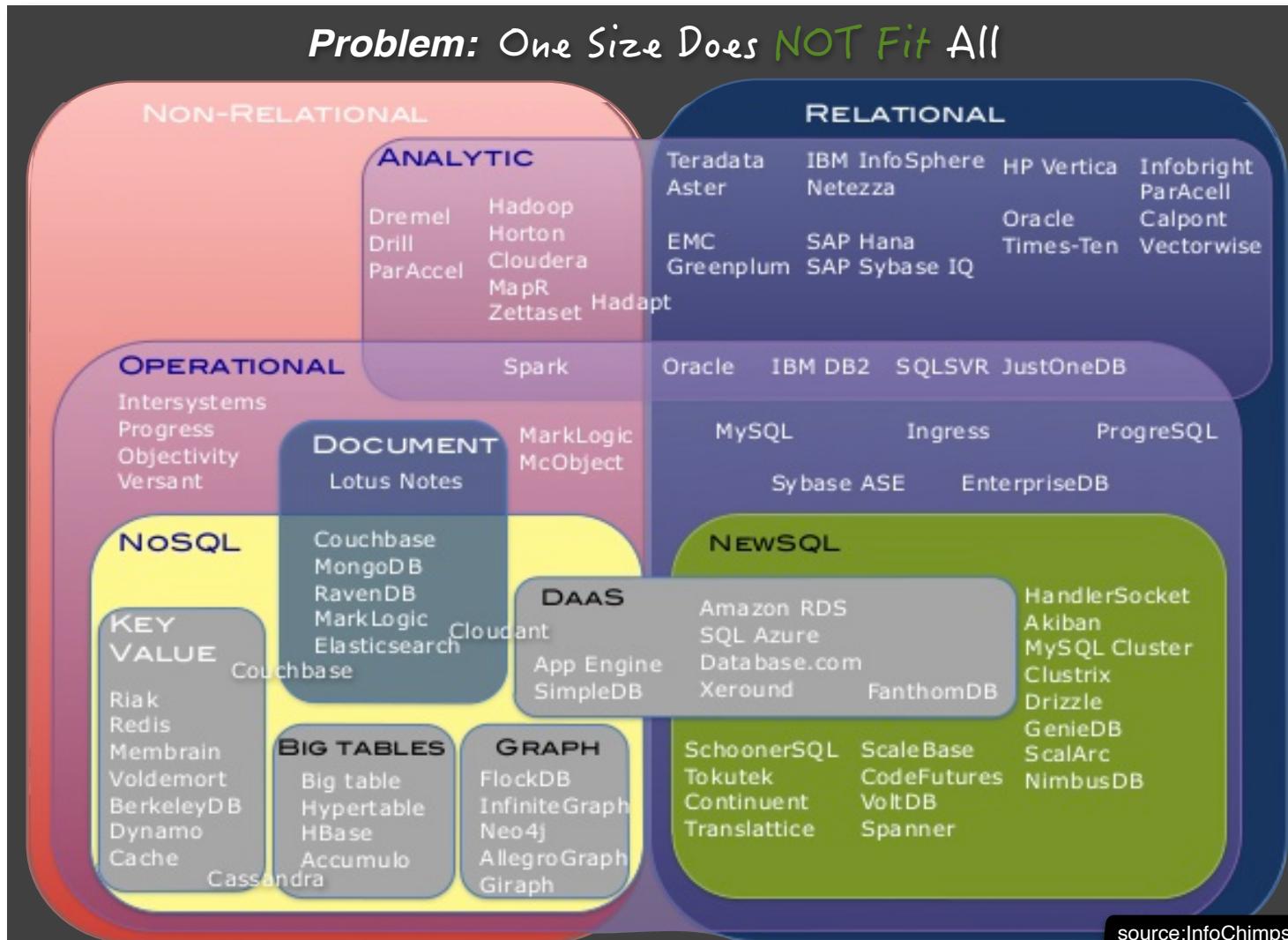
10,000

Source: Mike Stonebraker (MIT)

# Data-driven Insights

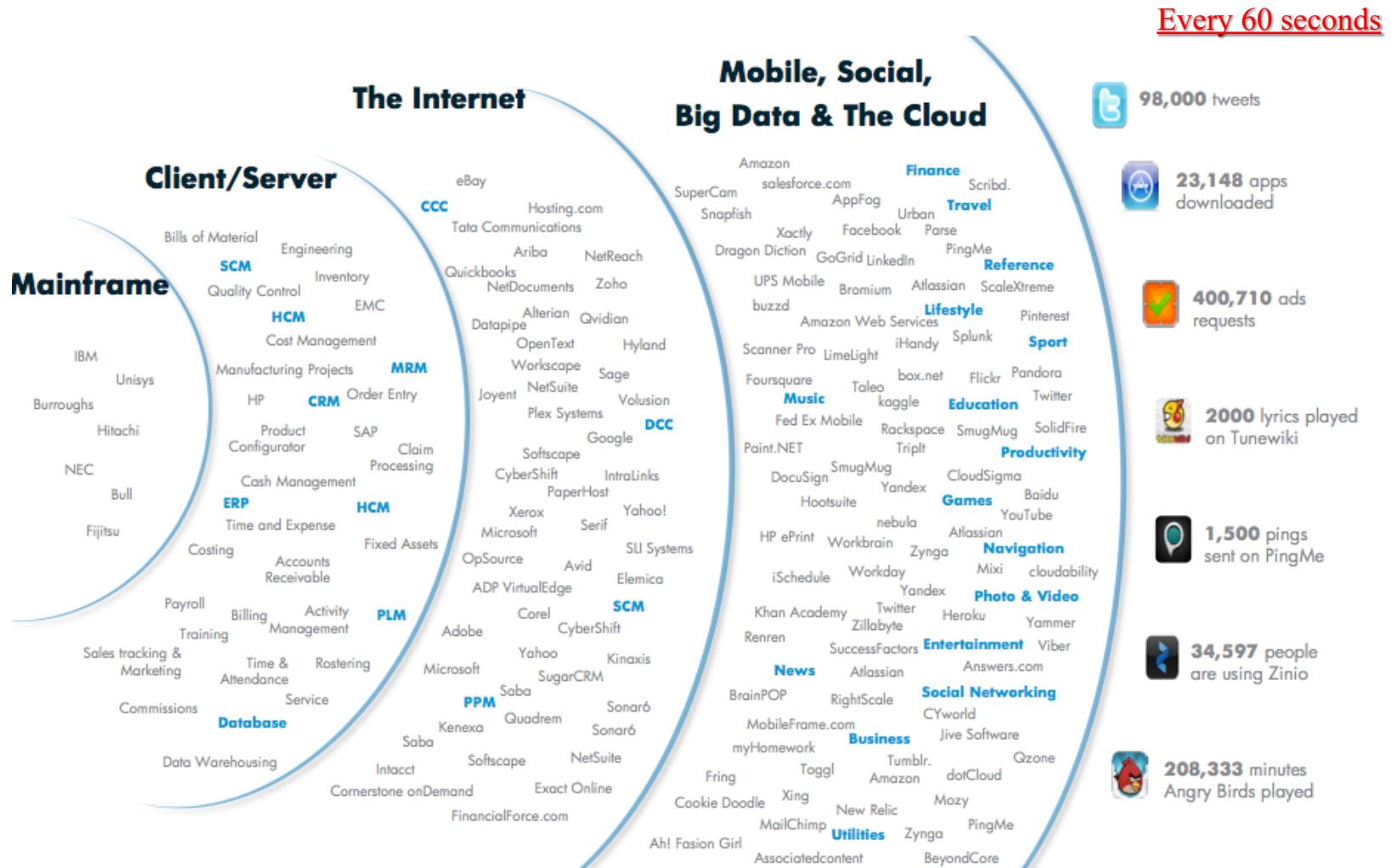
- “Every day, 2.5 quintillion bytes of data are created. This data comes from digital pictures, videos, posts to social media sites, intelligent sensors, purchase transaction records, cell phone GPS signals to name a few.” (ODBMS.org)
- “Big Data: The next frontier for innovation, competition, and productivity” (McKinsey Global Institute)
- Personalize ads in elections; market products and services; unravel human trafficking activities; analysis of financial risks; accelerate scientific discovery; improve net safety and public health

# Data / Knowledge



source:InfoChimps

# Processes | Apps Overload



Source : Dejan Milojicic, IEEE 8th World Congress on Services, 2012



API's basically allow your product or service to talk to another product or service...

Much of the information we receive about the world will be API-regulated

# Case management : Cognitive Augmentation

## Drivers

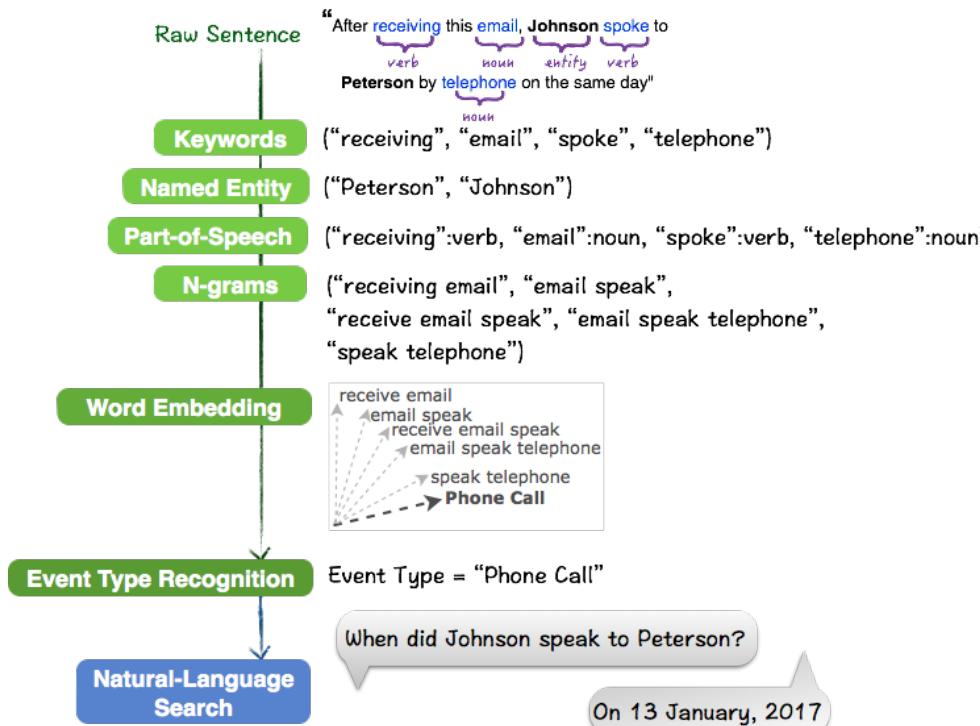
- Data
- Processing power
- Devices | User channels
- AI

## Implications

- Automation
- Increased efficiency | productivity
- Insights | effective decision –making
- *Augmentation*

# Augmentation: Item tagging | Curation

- **Content augmentation:** knowledge extraction | enrichment (e.g., entities, events, codes)
- **Natural language : search, conversations**



# Augmentation | Interactions with services

The diagram illustrates the integration of multiple messaging platforms (Facebook Messenger, Twitter, Slack, IBM Sametime) with external services (Travel desk, Project manager). A central interface shows a conversation between the Project manager and Travel desk, with annotations indicating specific actions taken by the system.

**Messaging Platforms:**

- Facebook Messenger
- Twitter
- Slack
- IBM Sametime

**Service Integration:**

- Project manager:** Handles travel arrangements and scheduling meetings.
- Travel desk:** Provides travel information and booking details.

**Annotations and Actions:**

- A blue oval encloses a message from the Project manager: "I want to book flight ticket from Sydney to Melbourne tomorrow and return on Sunday." An arrow points from this message to another blue oval containing the text "Action : Book Flight".
- A red oval encloses a message from Travel desk: "Can you provide exact time to book the flights?" An arrow points from this message to another blue oval containing the text "Action : Schedule meeting".
- A red oval encloses a message from the Project manager: "Thanks. You can schedule meeting to discuss the travel arrangements." An arrow points from this message to another blue oval containing the text "Action : Schedule meeting".

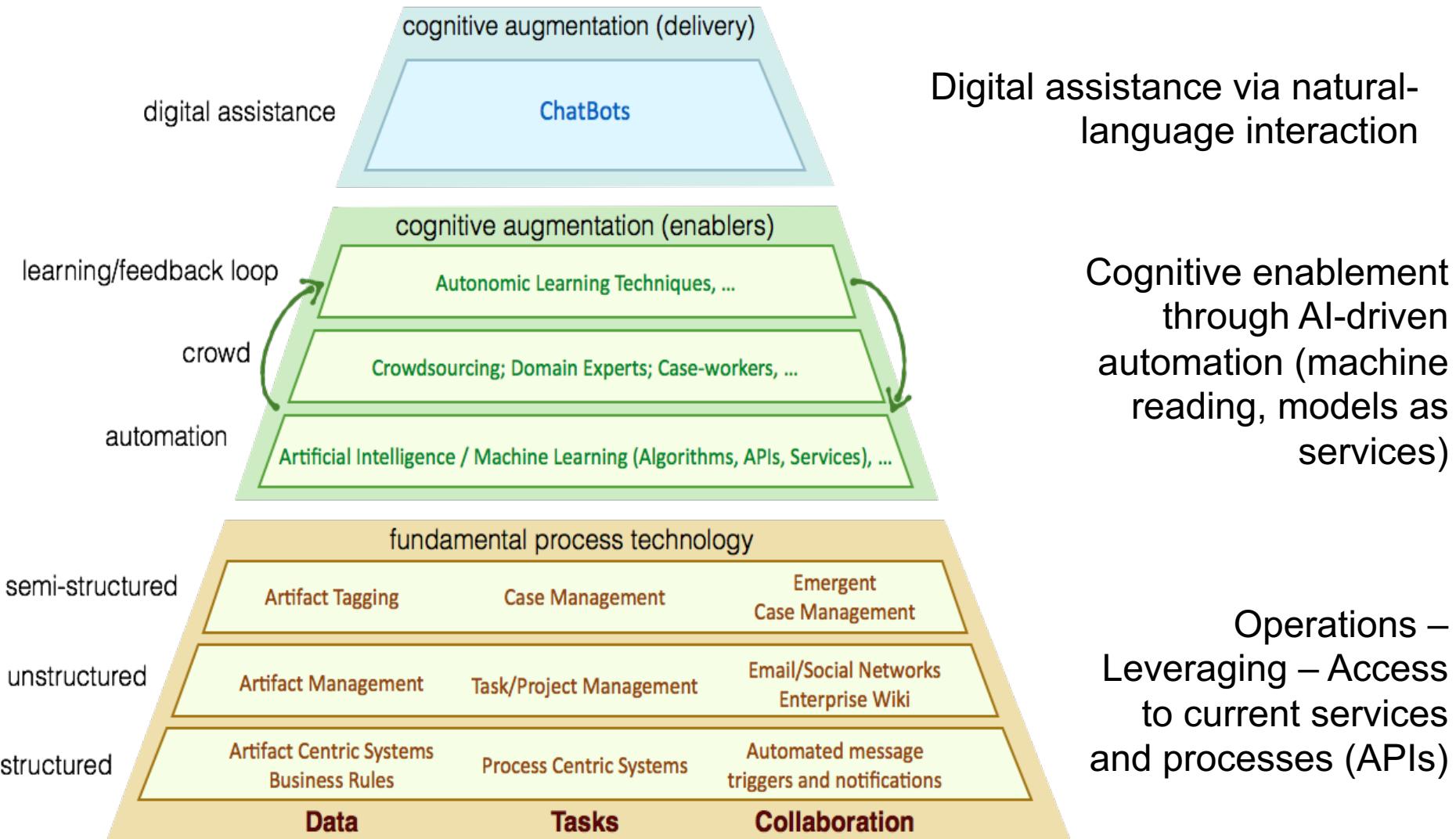
**Message Thread (Screenshot):**

- Sales team** (Travel desk): Hello
- Project manager**: Hello
- Travel desk**: Hi
- Project manager**: I want to book flight ticket from Sydney to Melbourne tomorrow and return on Sunday.
- Travel desk**: Can you provide exact time to book the flights?
- Project manager**: I want to travel early morning 25th april and return on 28th april afternoon.
- Travel desk**: I will check the available flights and book it
- Project manager**: Thanks. You can schedule meeting to discuss the travel arrangements.
- Travel desk**: okay. Will schedule meeting later today.

# Cognitive Augmentation | Cognitive Processes

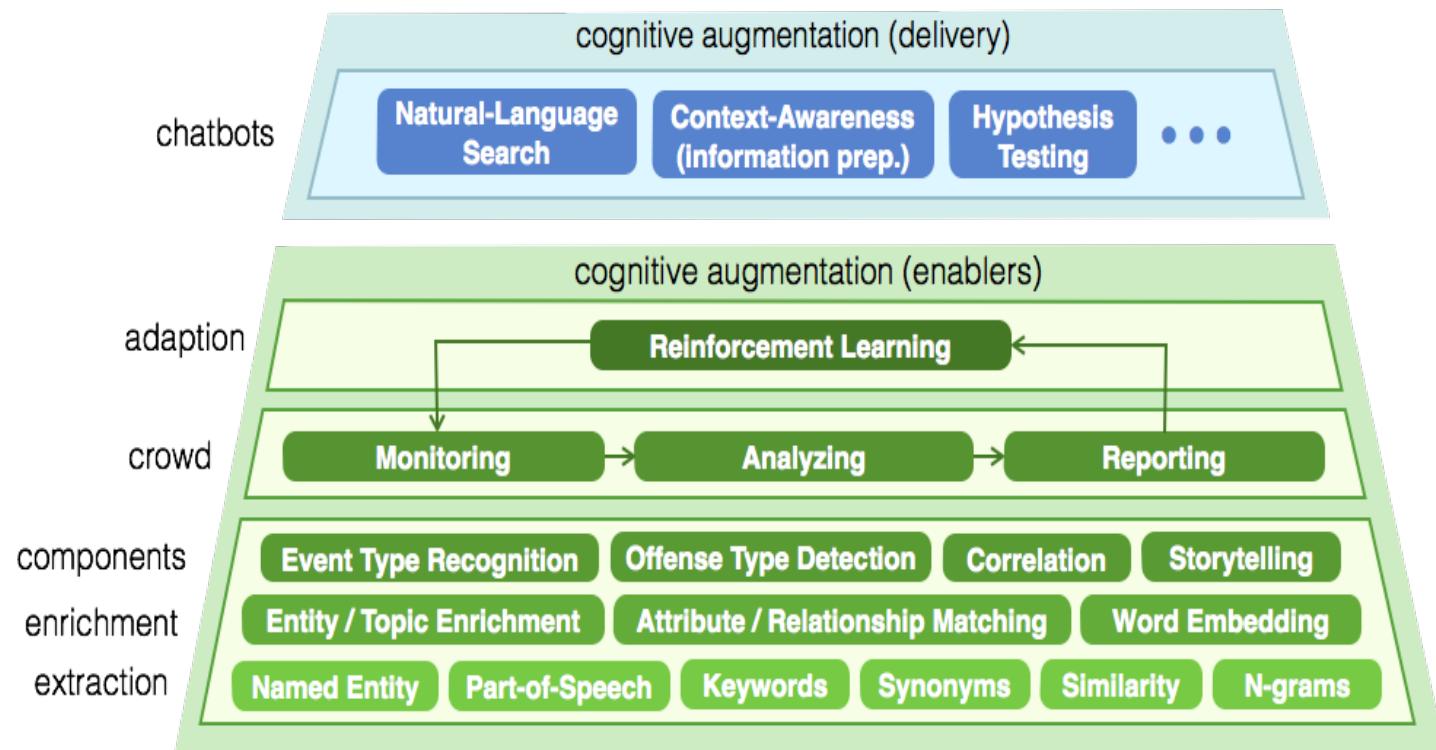
- **Annotation | Coding** (artefacts)
- **Context capture** (e.g., time | e,g. before or after meeting, collecting information for meeting)
- **Intent recognition** (e.g., texting a line of inquiry request)
- **Process augmentation:** In-task search prompt, interfacing with apps through digital assistants, workflow triggers, collaboration
- ***Natural language conversations with services*** (content, tasks, collaboration)

# Towards Cognitive Process Augmentation



# Use-Case: Data-driven Investigations

- “Entities, codes, events” could be identified from evidence logs
- “Line of inquiries” could be created from investigation workspace



# Empower workers with digital assistants

- Digital assistance (e.g., analysis of social media, search information, send alerts, prepare and organize meeting) through conversations between users and services
- **Augmentation | workers cognition:** increased productivity and effectiveness
- *“You’ll be paid in the future based on how well you work with robots”*  
Kevin Kelly, Freelancer | Futurist
- *“In this future, the AI revolution is less about “artificial intelligence” and more about “augmenting introspection” ”* Michael Schrage, MIT

# Cognitive case management (CCM)

- Ubiquitous, integrated and cognitive work environments (collaboration among **people, devices, services, processes, augmentation through automation | digital assistants**)
- **Data | Knowledge | AI | Human computation** as enabling technologies
- **Socio-computational services for augmented cognition** (integrated workspace, augmentation through AI and conversational assistants)

# Cognitive process management | Categories

## Class 1: Basic Process Automation

Solutions are not new to business and deliver 'basic process automation' of manual tasks such as service desks, order management, claims processing and invoicing.

## Class 2: Enhanced Process Automation

Solutions offer 'enhanced process automation' involving unstructured data and knowledge bases. Applications, some still maturing, include IT help desks, customer order completion and benefits claims processing.



## Class 3: Autonomic/Cognitive

Solutions are sophisticated technologies involving cognitive machine learning, elements of AI, language processing and big data analytics. This emerging technology that thinks and learns like humans is designed to deliver research and innovation for self-service processes and complex service operations.



**Source:** KPMG. Robotic Revolution – separating hype from reality, October 5 2015



**UNSW**  
AUSTRALIA

# CCM | Productivity | Efficiency

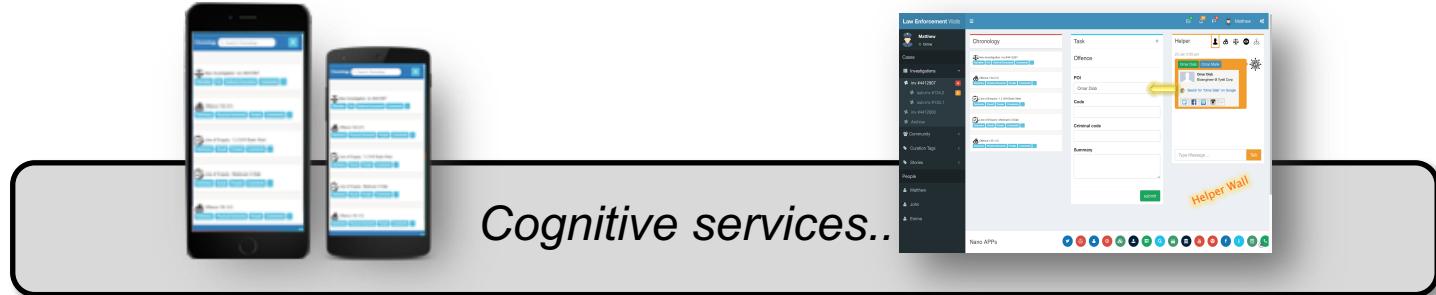
- Repetitive and time-consuming tasks automation:
  - Screen scraping, form filling, information collection
  - OCR
  - Rule-based workflows
- Augmentation with context and operations to avoid interruptions, switching and delay:
  - Recommendation
  - Context awareness, reminders, preparation
  - In-task search | operations

# **CCM | Effectiveness | Insights and improved decision - making**

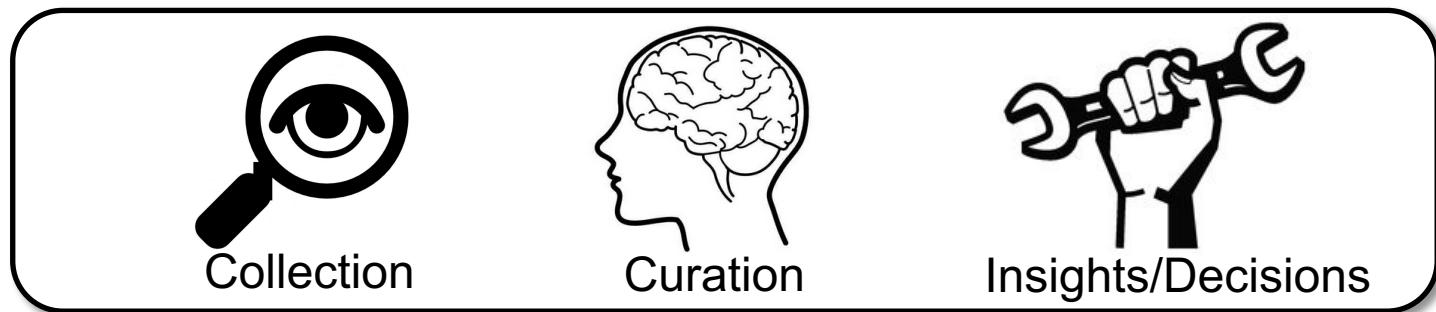
- Information analysis
  - Screening | classification
  - Entity | relationship | intent recognition
  - Tagging | Annotation
- Ticket recognition | manage process state | access apps | trigger workflows
- Rich insights on entity | event mentions in unstructured items | links to offenses
- Accelerated discovery | summarization (e.g., meetings, findings) | fact checking | compliance checking

# Data-driven Insights Chain

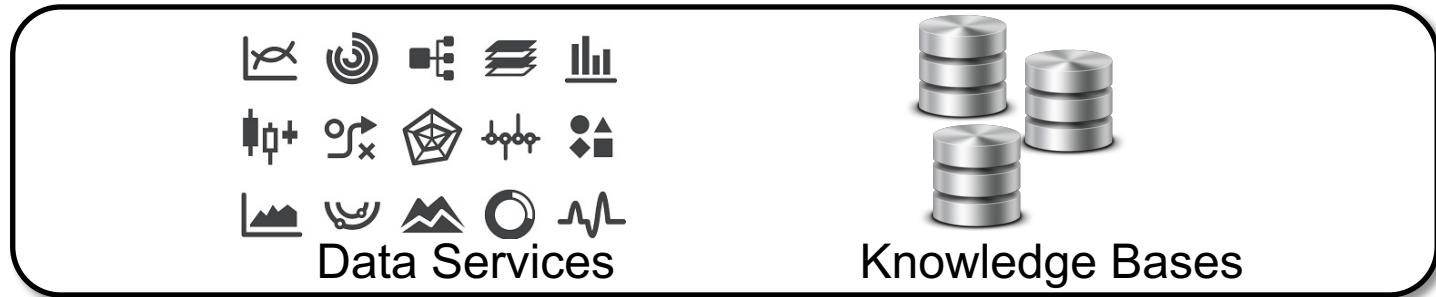
User Layer



Digital Layer | AI



Physical Layer



# Extraction and enrichment services:

## Entity | statement | intent

 Tweet

 **Malcolm Turnbull**  @TurnbullMalcolm · 19h  
I'm delighted to travel to the US in May to meet with **@POTUS** President Donald J Trump & attend 75th Battle of the Coral Sea commemorations

185 143 401

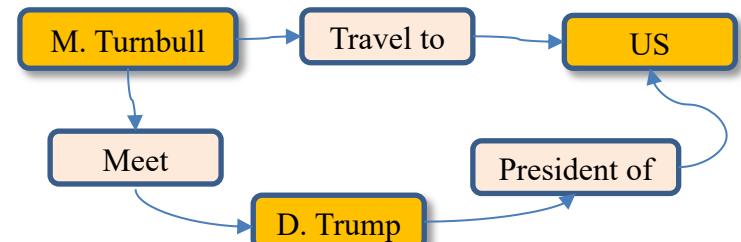
Extracted | inferred  
**Knowledge**

**Entities**

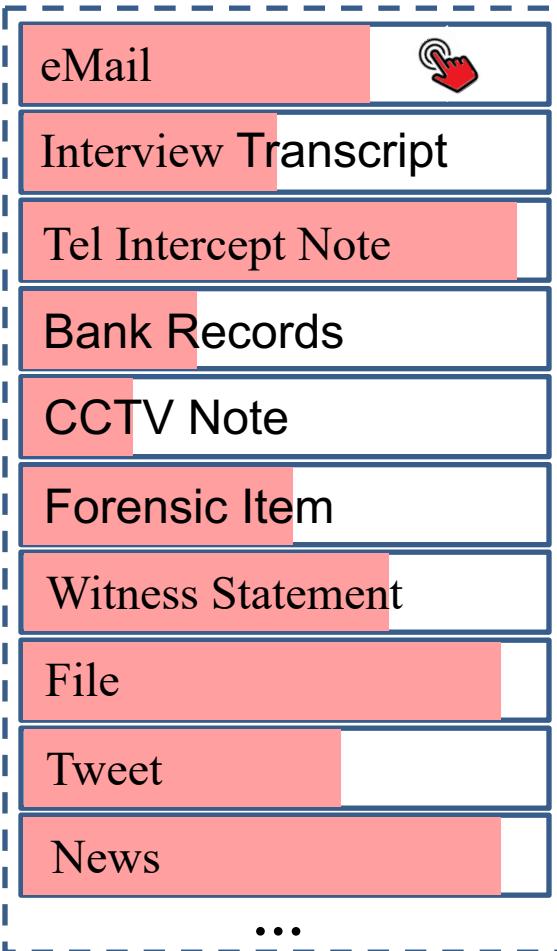
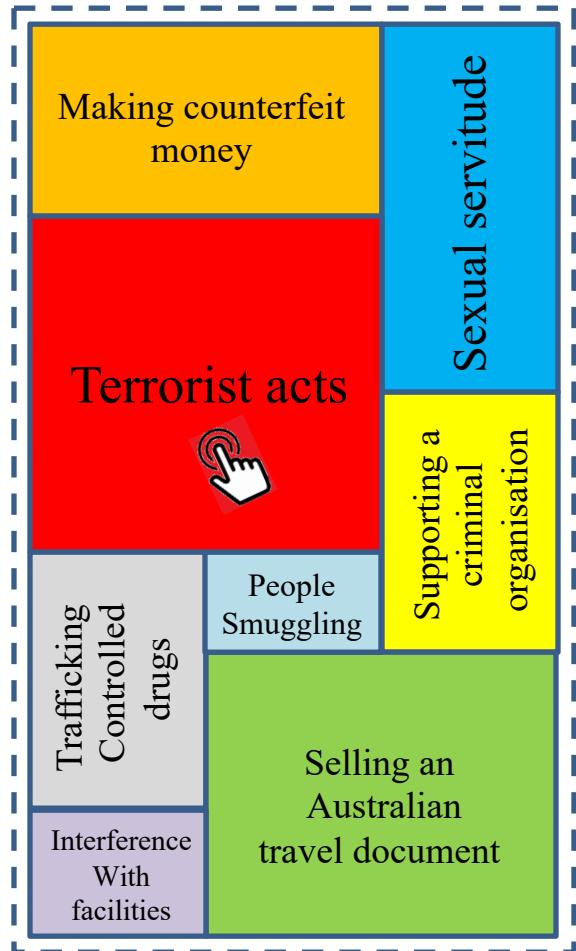


**Statements / Events**

- M. Turnbull **Travelled** to US.
- M. Turnbull **to meet** D. Trump

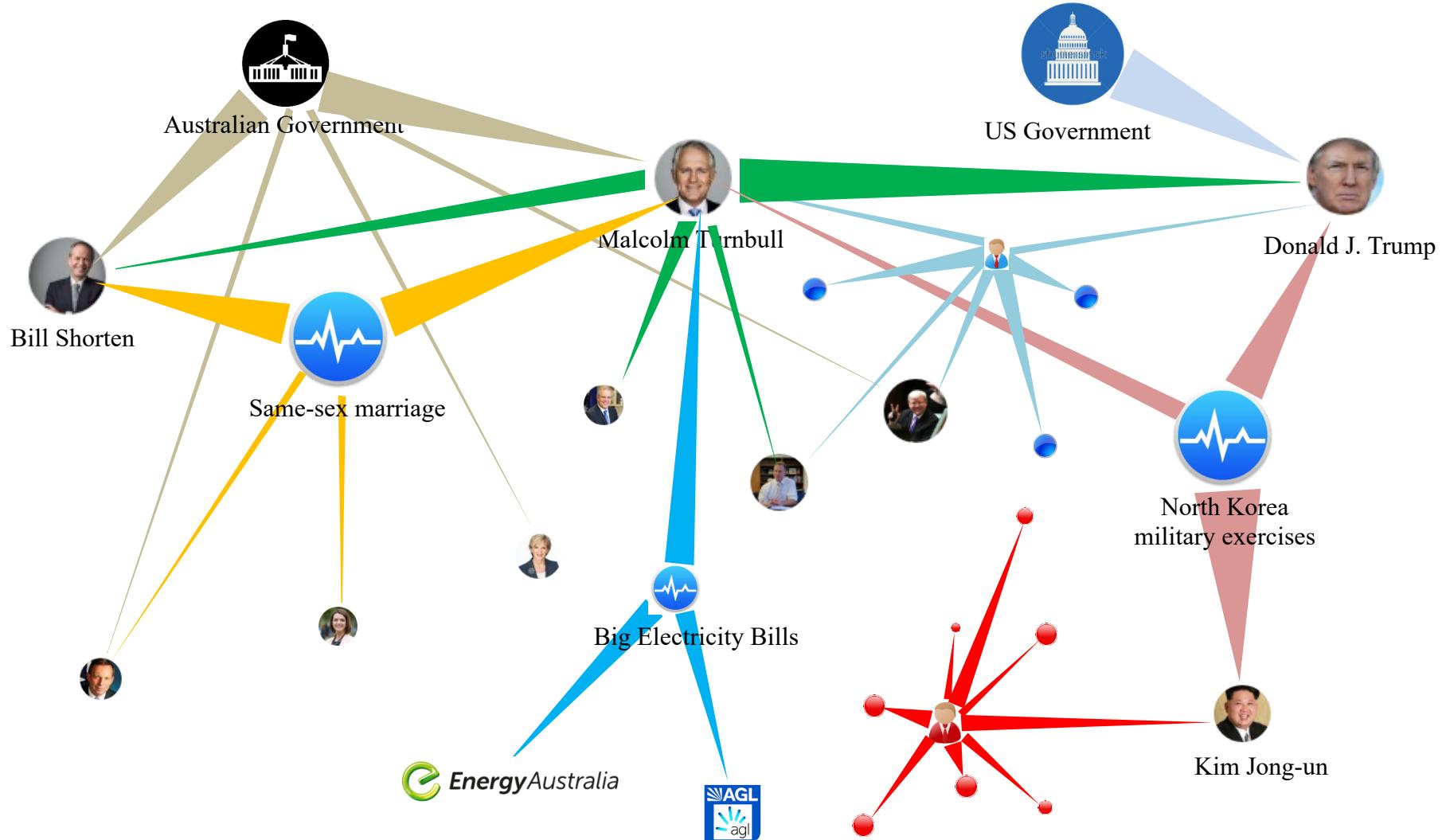


# Tagging | Screening | Information maps



McCall Pattern Company	Private preview of Marcy Tilton's Holiday fabrics for Vog	11:48 am
Offices.com	75% off PUMA   \$124 iPad 2   30% off Kathie's   \$276 59" H	11:49 am
Seamwork	Free bonus skirt for Arden Plus inspiring fall makes	11:49 am
6pm.com	Work It Out: PUMA, adidas and more on sale!	10:47 am
Petco	Food Frenzy! Up to 20% off dog & cat food statewide!	10:23 am
Goldstar	\$22.56 "Nutcracker (Net So) Suite" - Holiday Favorite #	10:12 am
Jo-Ann Stems	Just For Today! \$19 off \$49+ In-Store Purchase	9:42 am
The Muse	18 Ways to Thank Anyone Who's Helped You Get Ahead	9:36 am
Olive Garden	Don't miss out! Save 18% on ToGo & Catering.	9:16 am
Diaper Shops	Free Gift with \$84+ Orders	9:16 am
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Olive Garden	Don't miss out! Save 18% on ToGo & Catering.	9:16 am
Diaper Shops	Free Gift with \$84+ Orders	9:16 am
CB2	Last chance: 3 offers end today.	9:14 am
McCall Pattern Company	Private preview of Marcy Tilton's Holiday fabrics for Vog	11:48 am
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Motherhood	Mid-week treat: Free Shipping!	9:22 am
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The Muse	18 Ways to Thank Anyone Who's Helped You Get Ahead	9:36 am
Olive Garden	Don't miss out! Save 18% on ToGo & Catering.	9:16 am
Diaper Shops	Free Gift with \$84+ Orders	9:16 am
CB2	Last chance: 3 offers end today.	9:14 am
Motherhood	Mid-week treat: Free Shipping!	9:22 am
Overshoot.com	Our Black Friday Sneak Peak Continues with Deals You	7:53 am

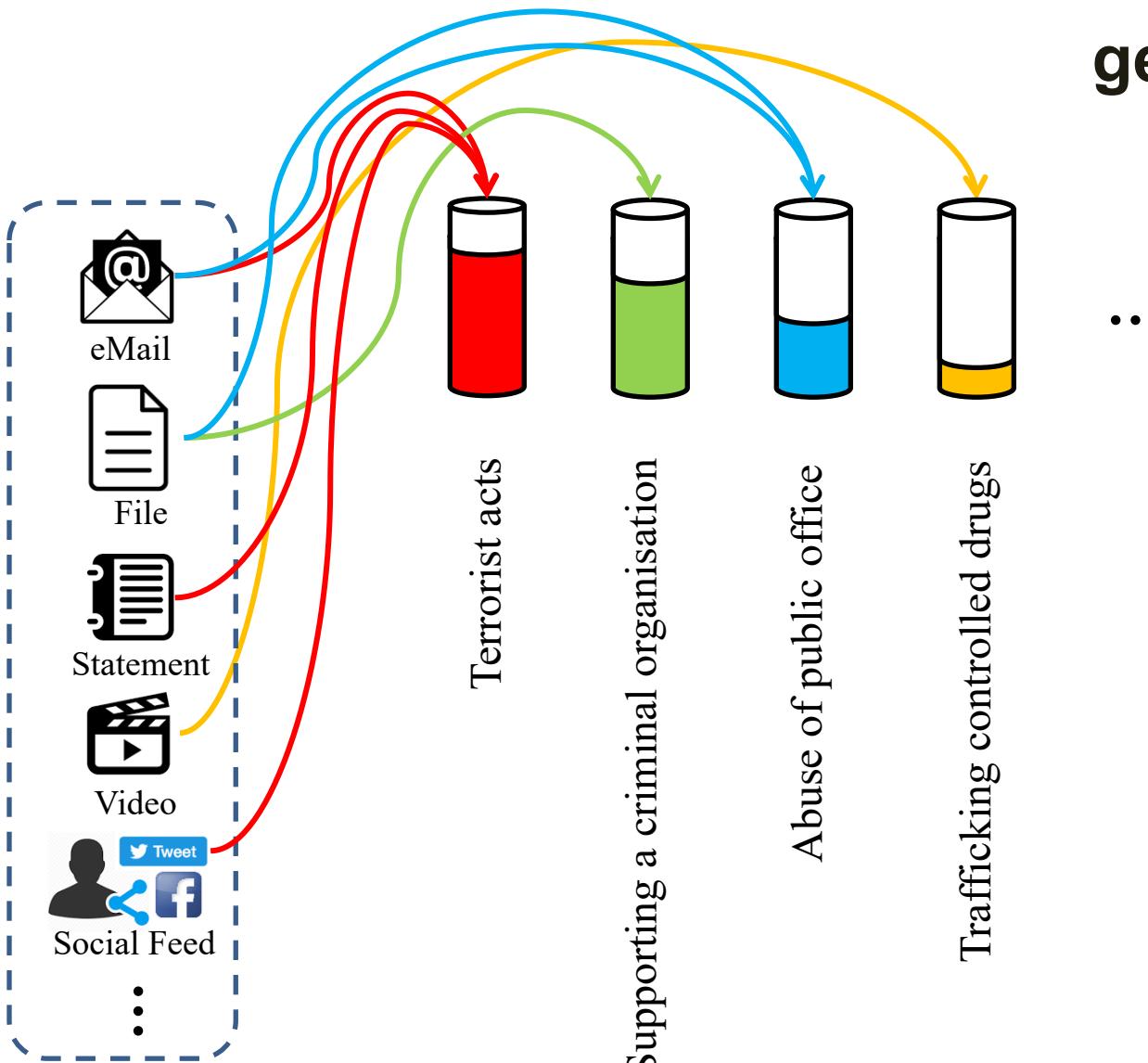
# Interactions | links analysis



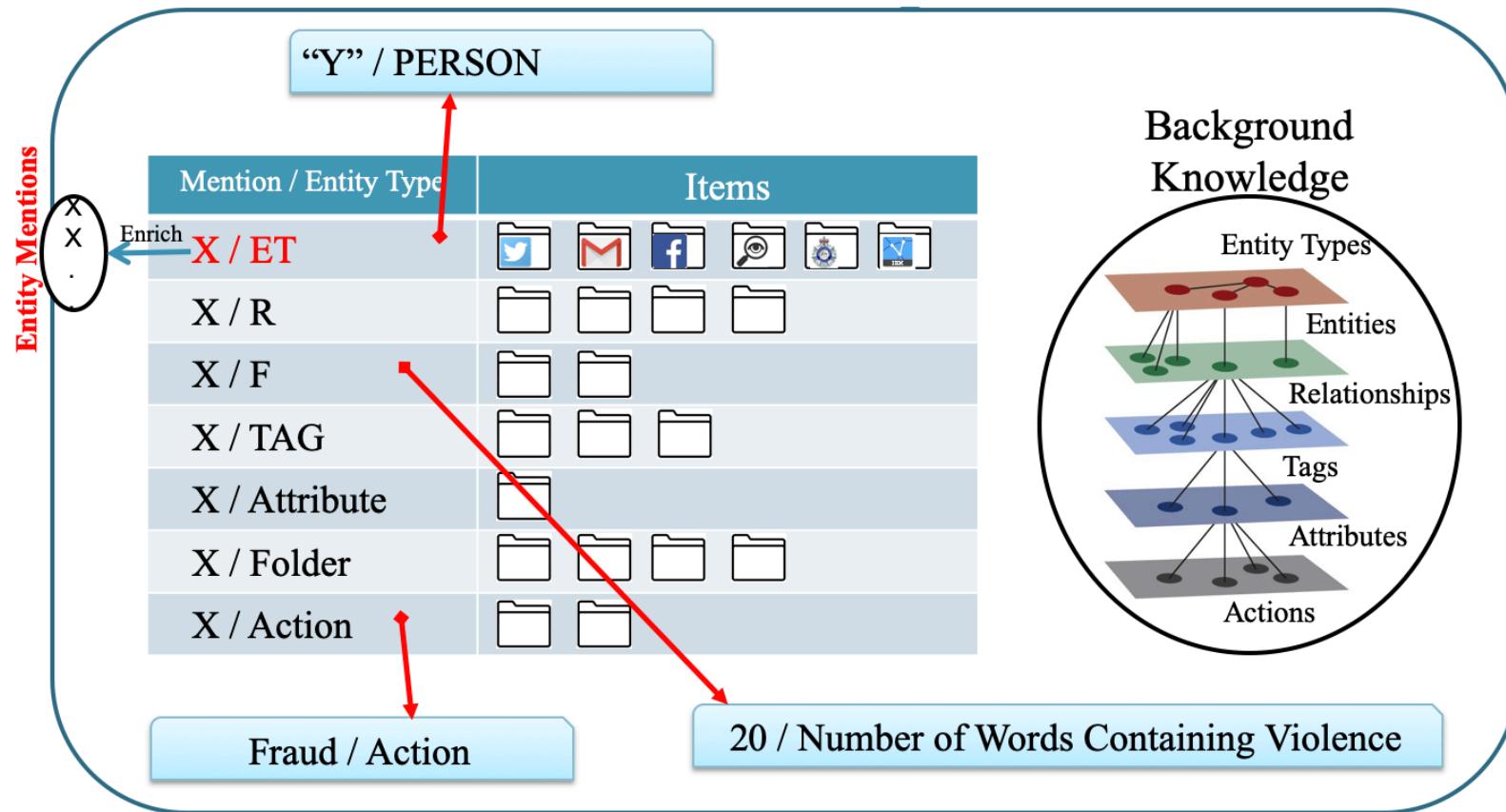
# Recognizing | items to hypothesis | hypothesis

generation

Analyst

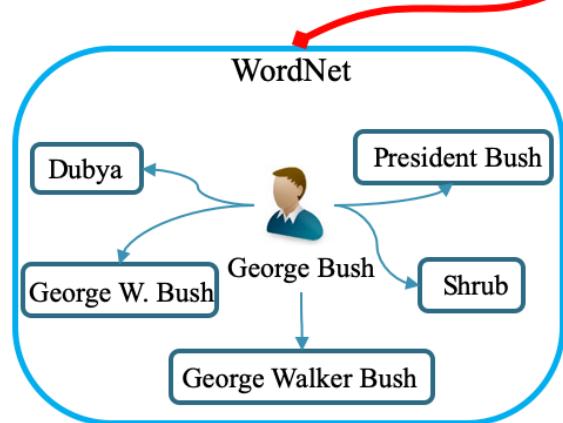


# Tech stack: Mention-based Indexing | structure embeddings



# Tech Stack: Distance Supervision

Entity	Mentions
George Bush	President Bush, George W. Bush, Dubya, Shrub



Data Curation  
Rules



Entity  
Enrichment



Topic  
Enrichment



Relationship  
Recognition



Attribute  
Matching

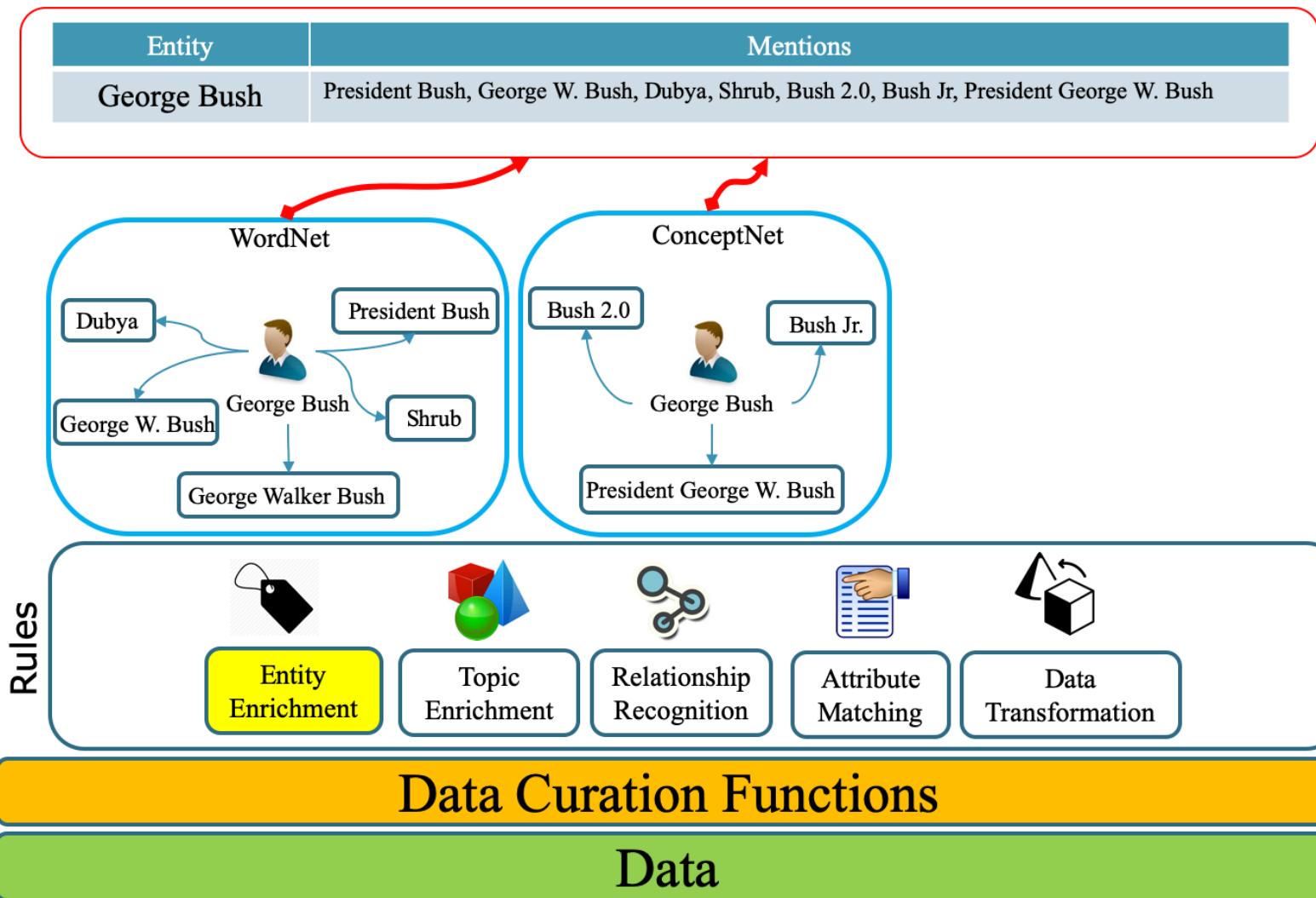


Data  
Transformation

Data Curation Functions

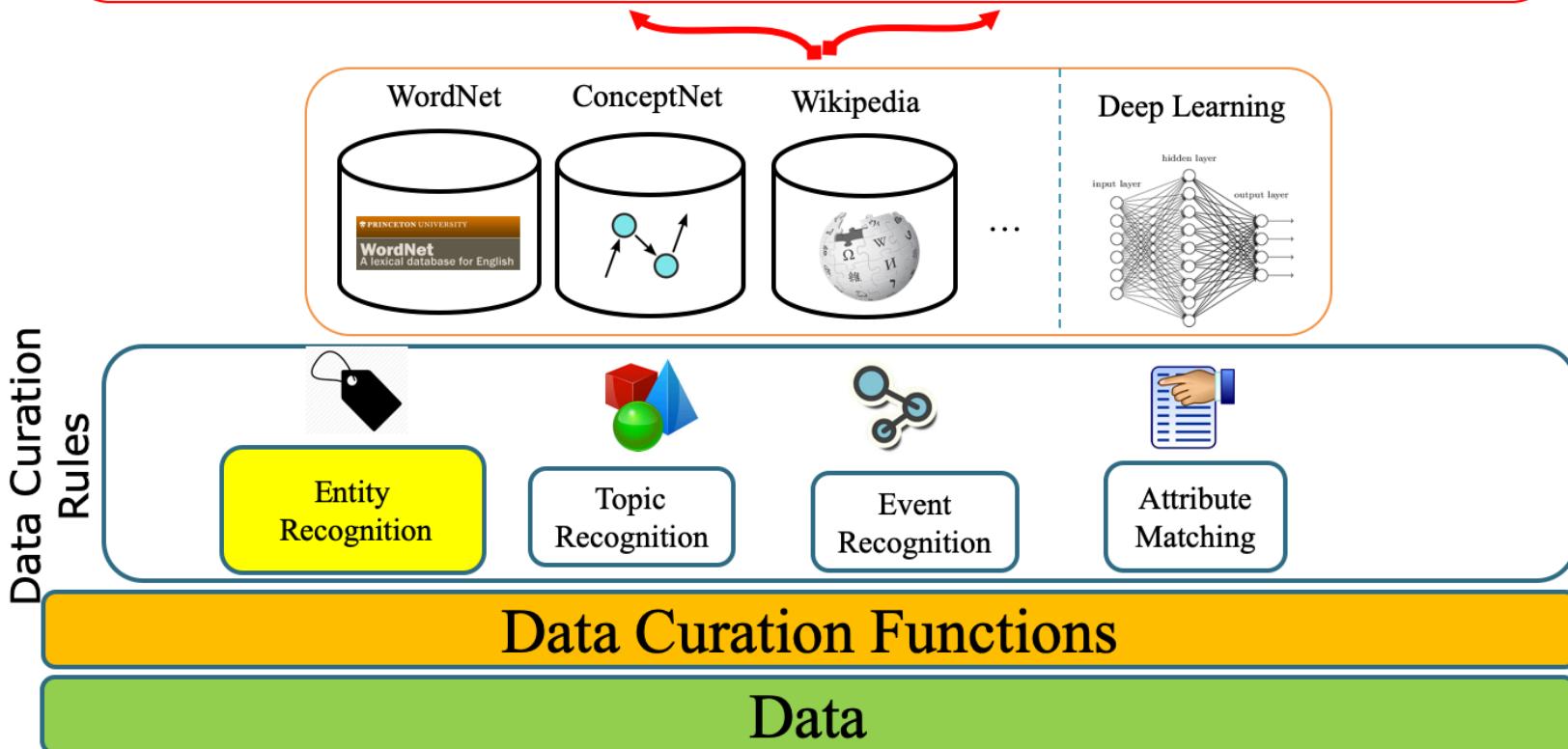
Data

# Tech Stack: Distance Supervision

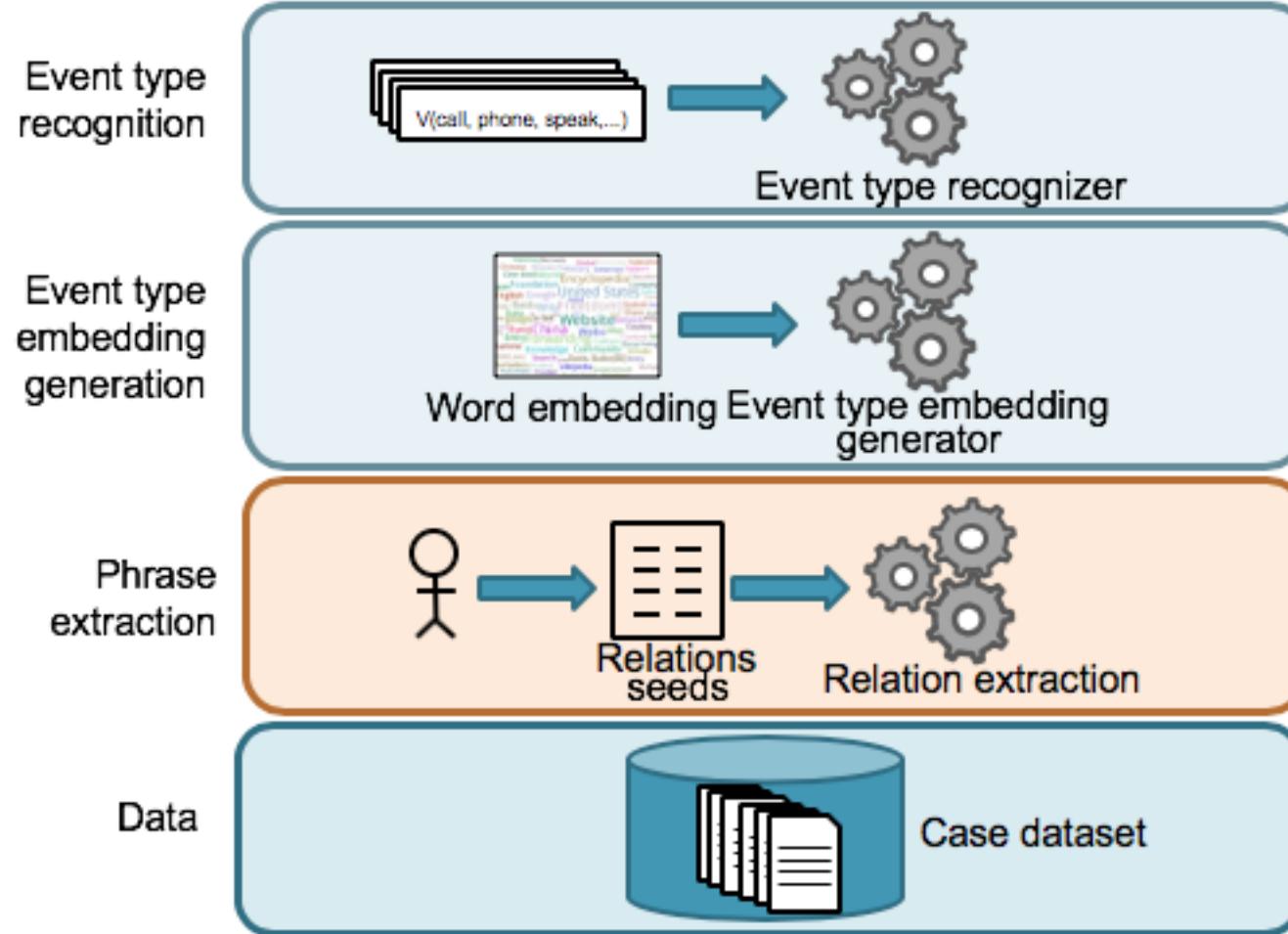


# Tech Stack: Embeddings | Models

Entity	Mentions
George Bush	President Bush, George W. Bush, Dubya, Shrub, Bush 2.0, Bush Jr, President George W. Bush, Bush 43, 43rd President of US, ...
Obama	Barack Hussein Obama II, Barack Obama, Barry, 44th President of US, First African American President of US, King Obama, ...

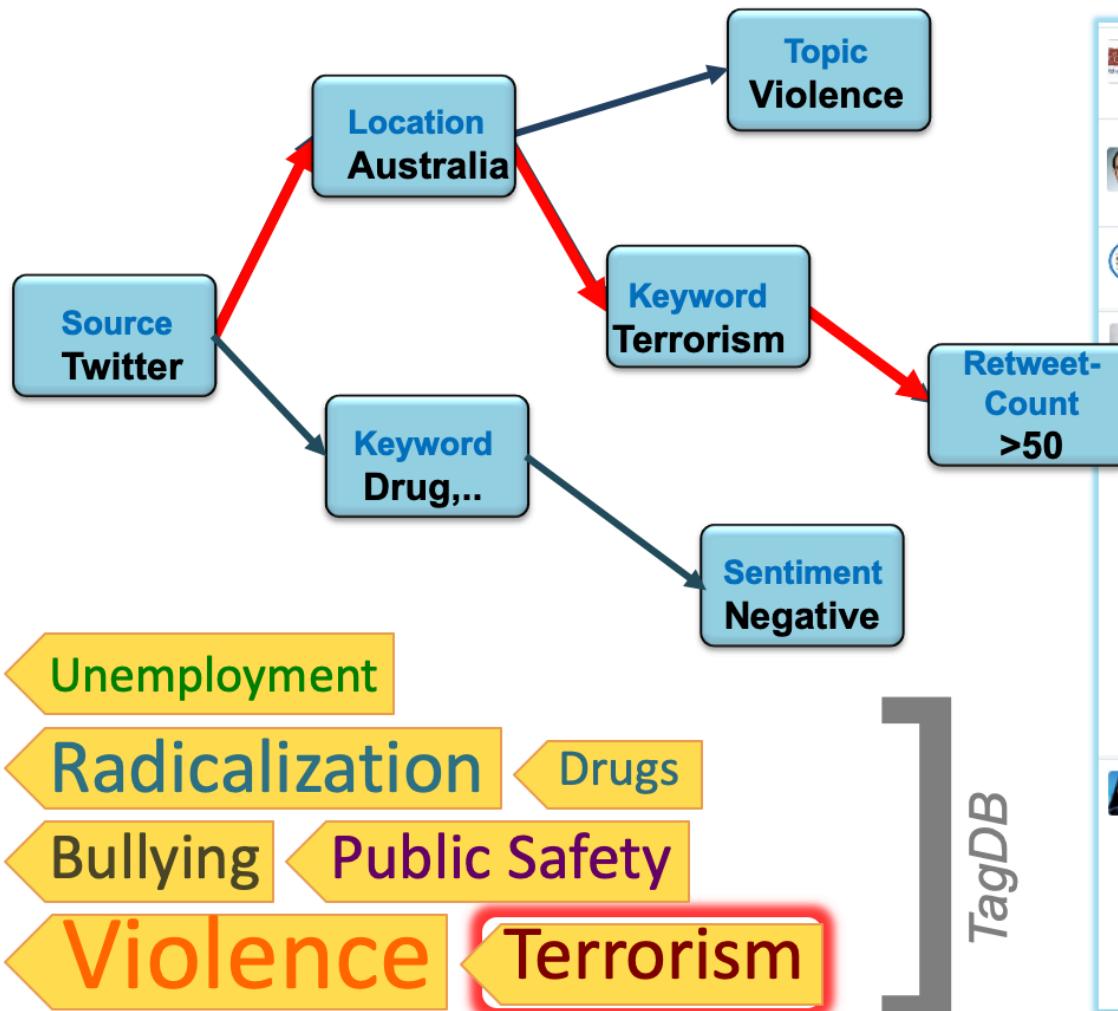


# Event type recognition using Vector Space Model

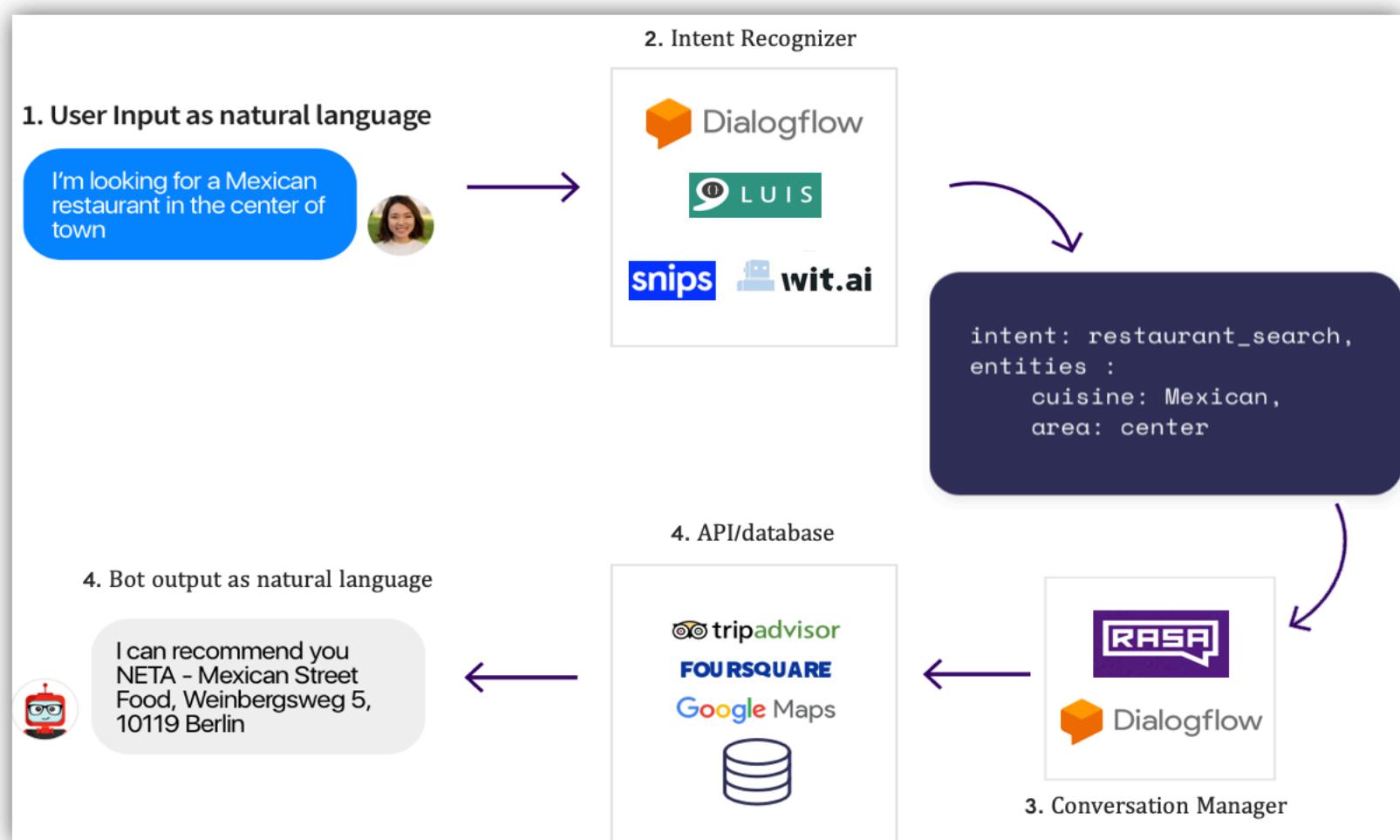


# Tech Stack: Algorithms | Expert Rules | Item

## Tagging | Tagging schemas

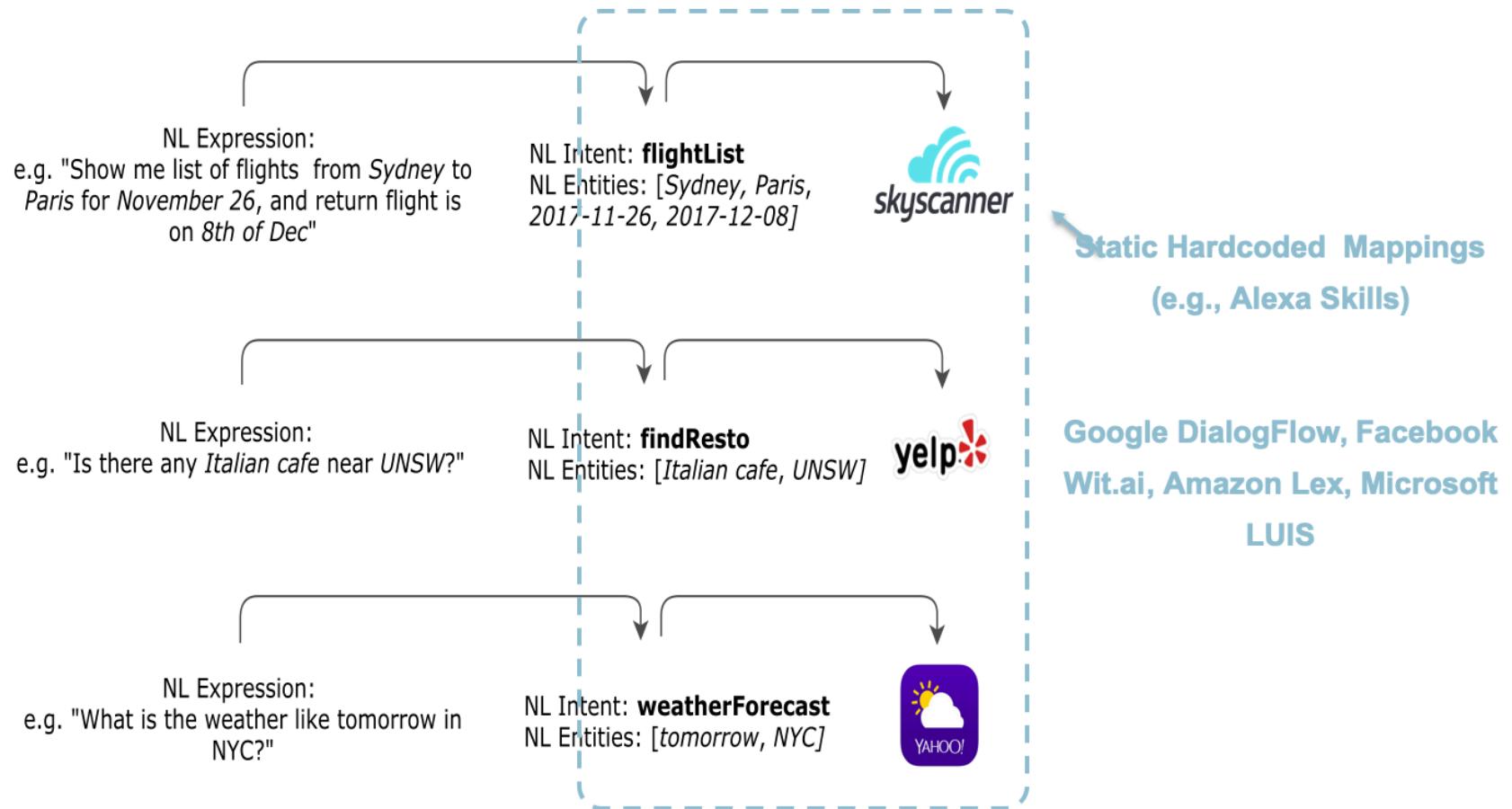


# Intents



Source: <https://www.techcrunch.com>

# Bot dev. Process: User Utterances | Intents | APIs



# Scale Hypothesis: APIs and their composition as Intents

- **Content:** apps for content sharing (e.g., Google, Facebook), media organizations, open data
- **Resources:** infrastructure (e.g., Amazon WSs), platforms (e.g., Heroku), SaaS (sales force), human cloud (crowd services)
- **Devices | Assets:** IoT (e.g., sensification – see, hear, touch), DVD players, cable TV boxes, game consoles)
- **Business services:** shared economy, banking, communication, health, e-commerce



# Back-end as service

- Unified interfaces to services (e.g., APIs for data, tasks, collaboration)
- Twilio: phone/messaging services
- Usergrid: data, users, events
- Expedia: travel services
- ***“...end users will provide the applications, and we will provide just the feed, the data, the callable APIs...” (D. Ferguson)***

# Natural Language Interfaces - Bots

- Conversational services: interact with users using ***natural language expressions, both voice and text***
- Designed to mimic human interaction
- Use ***software services*** to serve ***user services***
- Apple Siri, Microsoft Cortana, Google Assistant, Amazon Alexa



# Intents | Code | Integration

- User Expressions are **fuzzy** (Natural Language - NL)
- **Deterministic programming** (APIs, code) | **probabilistic programming** (Intents)
- API / code description: **limited knowledge, short NL description, low-level interfaces**
- **Mapping Intents to APIs requires more knowledge than API descriptions**

# User utterance to API Call

**“Recognizing intents and slots (method names and parameter values)”**

“Is there any Indian eatery here in Randwick?”

“Let me see if there is any Chinese cuisine around Kingsford”

“Can you give me list of Filipino resto in Bondi?”

“Please show me some cafes near George street”

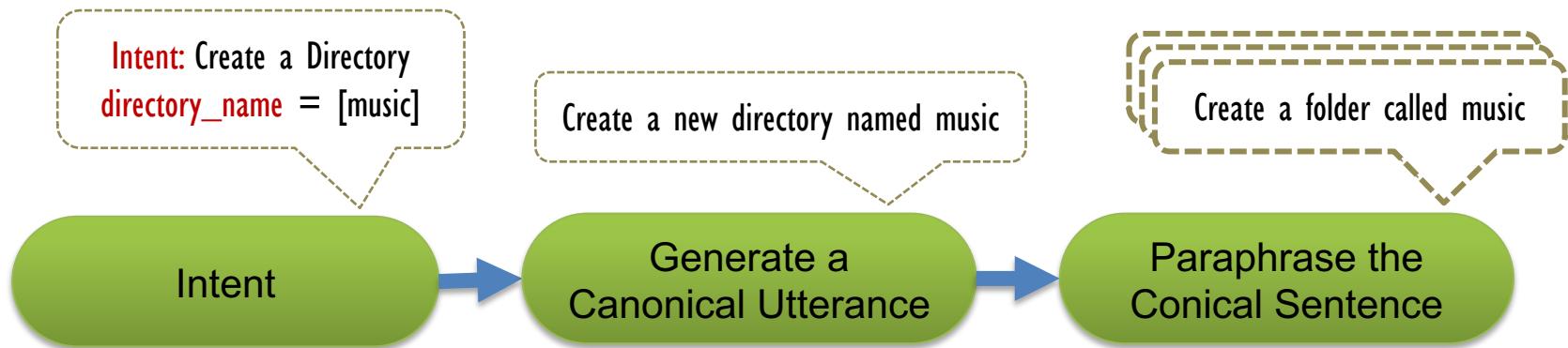


`SearchBusiness (term = Italian restaurant, location = Kensington)`

# API Latent Knowledge - What Knowledge?

- **API Description**
  - e.g. “OpenWeatherMap is an online service that provides weather data, including current weather data, forecasts, and historical data.”
  - Meaning: Keywords, Topics/Domains, Keywords
- **API Methods**
  - Name: e.g. *WeatherForecast*
  - Meaning: Intents, Verbs (e.g. *get*, *show*), Utterances (e.g. “*What is the weather like in New York?*”)
- **API Parameters**
  - Meaning: Attributes, Types (e.g. *location*), Possible Values (e.g. *New York*), Value Mentions (e.g. “*NYC*”, “*NY*”, “*City That Never Sleeps*”, “*The Big Apple*”)

# Intent training process



# Training Data Acquisition Methods

- Expert-based training
- Acquisition via a Prototype (e.g. *Evorus*, *Analyza*)
- Crowdsourcing (e.g. *Almond*, *NL2API*, *API-KG*)
- Automated Data Acquisition
  - Automatic Canonical Sentence Generation (DSL, generative grammars)
  - Automatic Paraphrasing
- Other (Transfer learning, Reinforcement Learning, Weak Supervision)

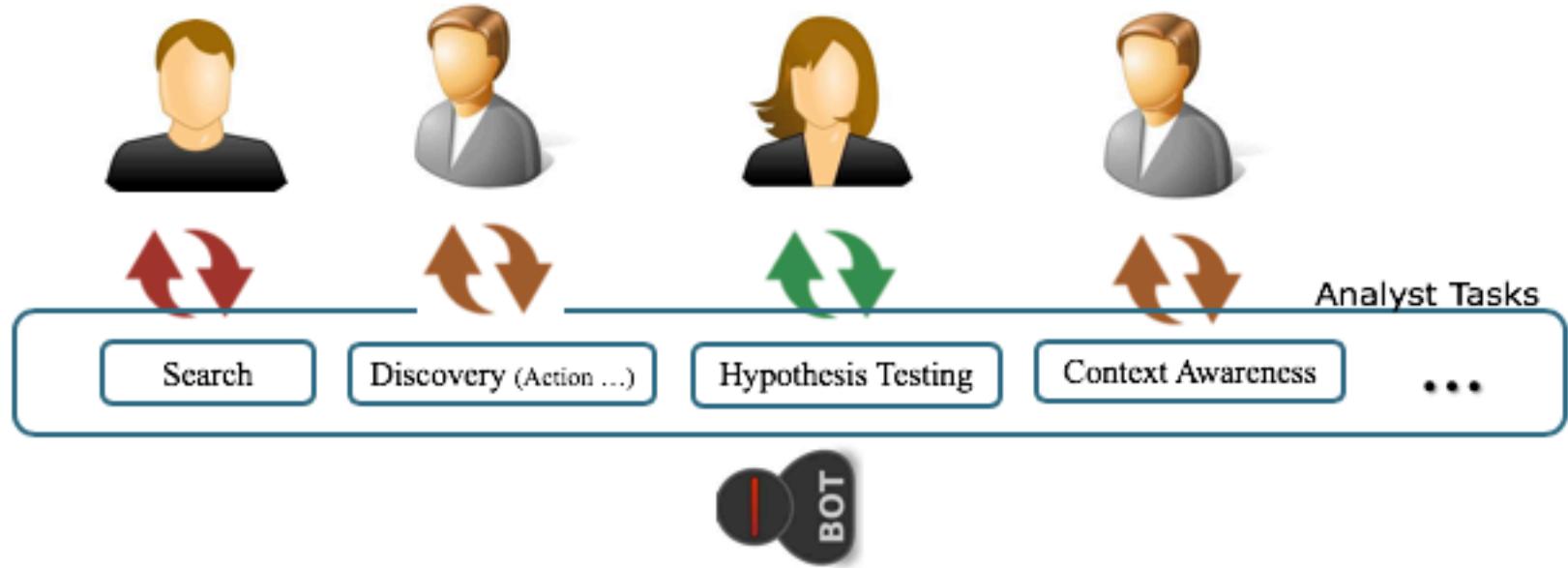
# A Taxonomy of Quality Issues

- **Spelling Errors**
- **Linguistic Errors**
- **Sematic Errors**
  - Unintentionally generated paraphrases which are not equivalent to the given initial utterance  
(e.g., “is the alarm working?” → “is the bell working”)
- **Cheating**
  - Semantic Errors happening intentionally (e.g., “where is the alarm”)
- **Task Misunderstanding (Translation and Answering)**
  - Translation: Translating instead of paraphrasing (e.g. “alarm çalışıyor mu?”)
  - Answering: Answering to question (e.g. “I don’t know if it is working”)

# Case Workers | Digital Assistants

- Natural Language search | conversations
- Situational and context awareness | proactive information preparation
- In-context search and task enablement

# Case Workers | Digital Assistants



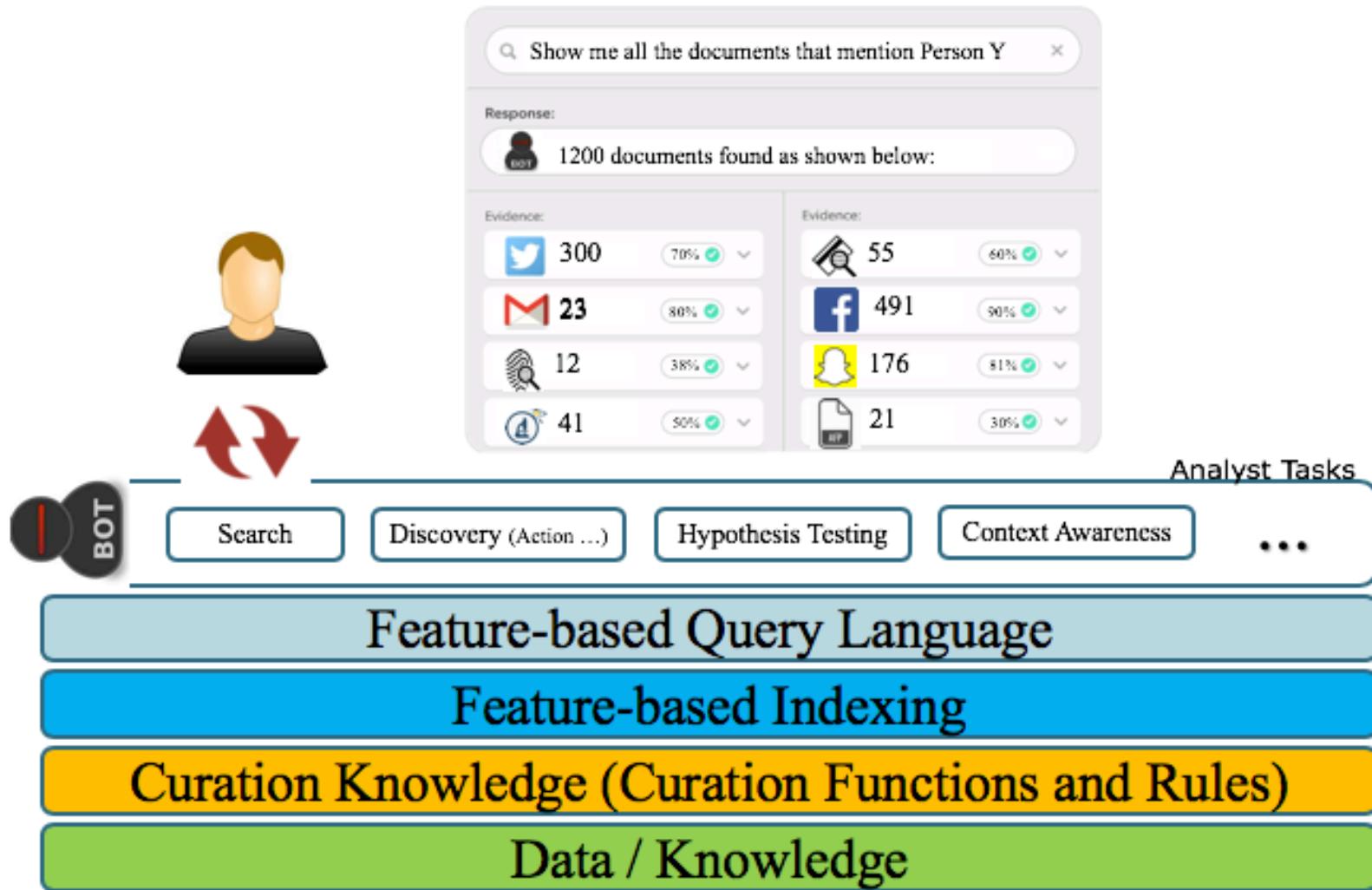
Entity-based Query Language

Entity-based Indexing

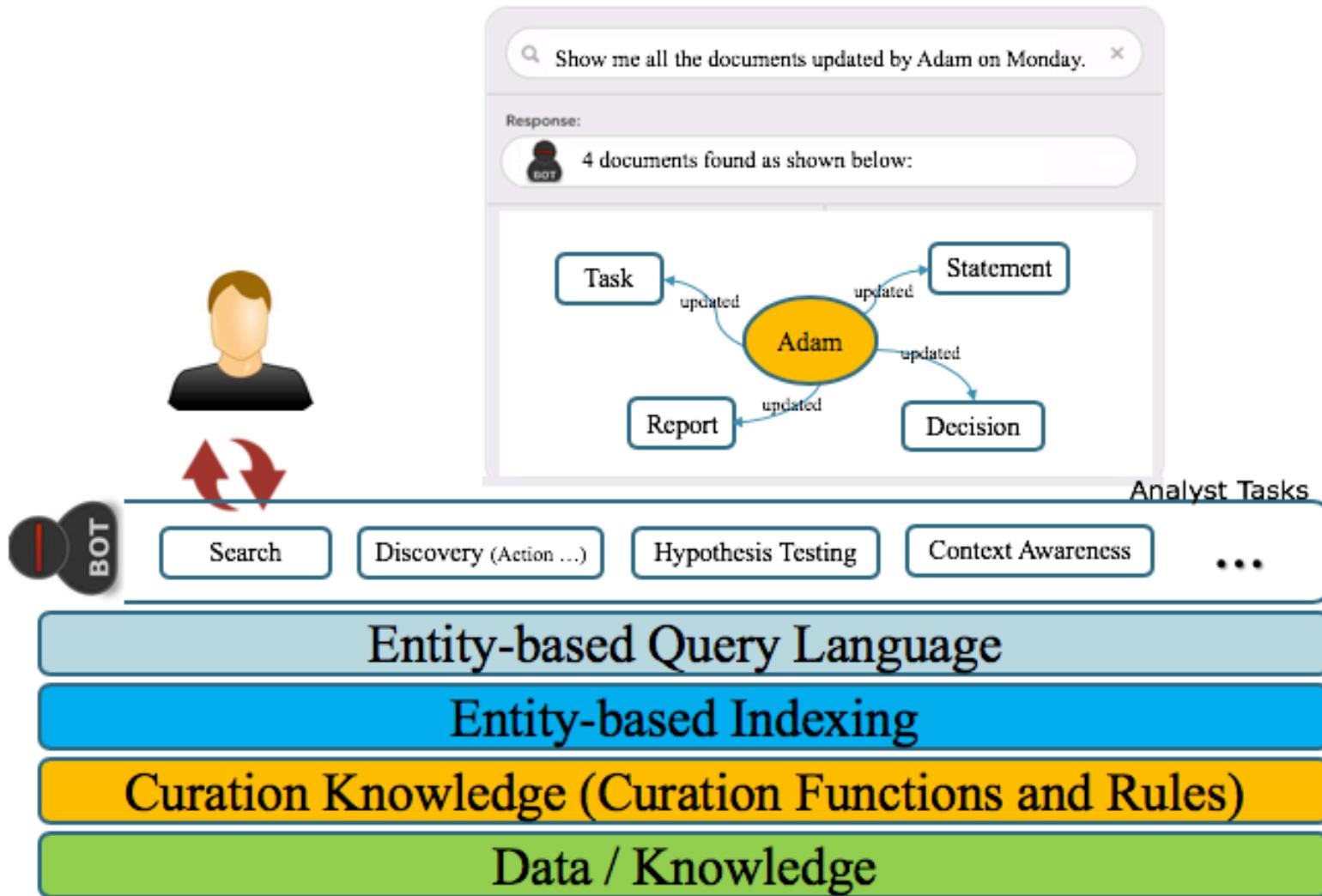
Curation Knowledge (Curation Functions and Rules)

Data / Knowledge

# NL search / Entity mentions



# NL search / Relation mentions



# NL search / Hypothesis checking

The screenshot shows a digital investigation interface. At the top, a search bar contains the query: "Person Y was involved in a Terrorist attack." Below the search bar, a response section indicates "43 documents found as shown below:". The interface is divided into two main columns: "Evidence:".

- Left Column (Evidence from Gmail):** Shows 16 results. A preview of the first result is visible, containing text about a meeting at 7:45 and travel info. The list includes names like Robert (Perry), Michael, Ross, James, Julian, Geoffrey, John, Manning, James, Jeremy, James, and others.
- Right Column (Evidence from Twitter and Facebook):** Shows 300 results from Twitter and 491 results from Facebook. Both sections include a dropdown menu icon.

Below the evidence sections, there is a user icon with a double-headed arrow below it, labeled "Analyst Tasks".

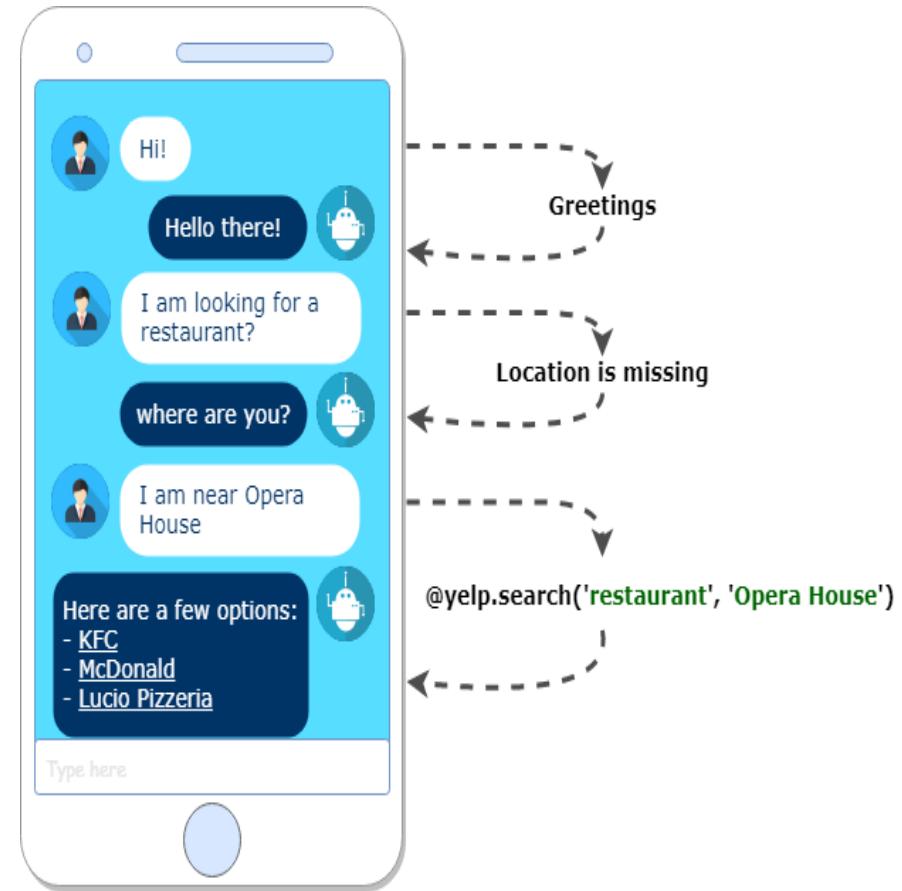
At the bottom, a navigation bar features a "BOT" icon with a vertical bar and a red dot, followed by buttons for "Search", "Discovery (Action ...)", "Hypothesis Testing", "Context Awareness", and "...".

The interface is organized into colored horizontal bars:

- Light Blue Bar:** Entity-based Query Language
- Blue Bar:** Entity-based Data Summaries
- Yellow Bar:** Curation Knowledge (Curation Functions and Rules)
- Green Bar:** Data / Knowledge

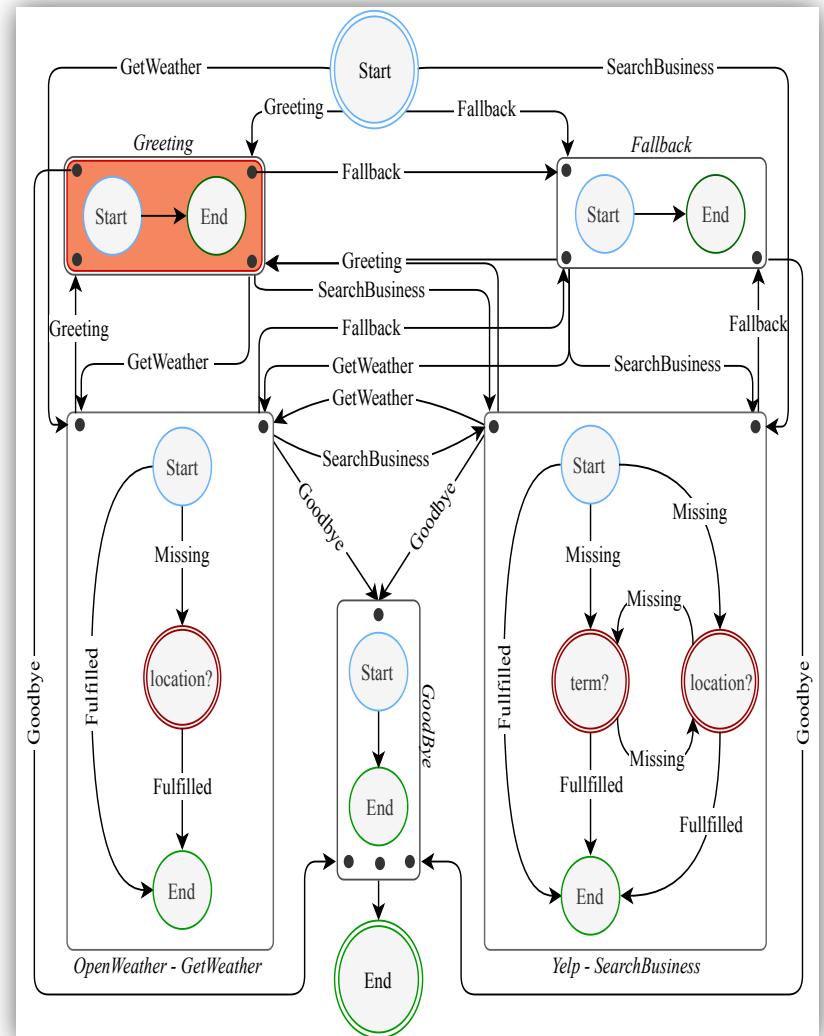
# Conversations – user – intents - APIs

- Single-turn query/command
  - find a Chinese restaurant nearby
  - turn on the TV
- Conversational
  - Find a Chinese restaurant  
Where are you?  
Near Opera house



# Conversations | Interaction Patterns | Speech Acts

- **Multiple intents** (e.g. greeting, booking)
- **Conversation Acts**: asking for clarification, providing missing information, rejecting offer, correcting information, etc.
- **Nested conversations** (compositions)
- **Operations**: auto-filling from conversation memory, context, generating answers, invoking APIs, state transitions



# Technology stack

- Entity | event | intent extraction
- NLP
- Entity | concept- based indexing and search
- Distant supervision (e.g. knowledge graphs for entity mentions, relationship mentions, offences, event mentions)
- Human | programmatic | domain expert-rule tagging
- Information items linking (semantic items, matching)
- Re-enforcement learning | deep learning
- Summarization | narrative generation rules
- Conversational AI

# Summary

- Machine reading, automated tagging
- Structure embeddings | entity based indexing
- APIs latent knowledge (API/intent embeddings, RL)
- Conversational AI | Natural language processing
- Applications: investigations, SENG automation, research / SLR / coding, security / reports / people

# Thanks

- Thanks to all contributors:  
Research students/staff, collaborators, sponsors  
(D2D CRC)