Developing A Cognitive Assistant For Audit Plan Brainstorming Sessions

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Agenda

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- Introduction
- Research Problem
- Proposed Solution
- Methodology
- Experiment and Demo
- Limitation and Future

Introduction

Brainstorming Session:

Mandated in two auditing standards:

- SAS No. 99
- SAS No. 109 *(Landis 2008, Hammersley et al. 2010, Carpenter 2007, Hoffman and Zimbelman 2009, Bellovary and Johnstone 2007, Hunton and Gold 2010, Lynch et al. 2009)*

Purpose:

- **Discuss** the susceptibility of the entity's financial statements to material misstatement due to fraud
- **Emphasize** professional skepticism *(Landis 2008, Hammersley et al. 2010, Beasley and Jenkins 2003)*

Common procedure:

- Checklist
- Open-ended form *(Bellovary and Johnstone 2007)*

Introduction

Importance of Brainstorming Session to Auditing:

- **Affect auditors' subsequent performance of audit** *(Hammersley et al. 2010, Carpenter 2007).*

- **Generate more high-quality ideas** on fraud risks as a team *(Landis 2008, Beasley and Jenkins 2003, Carpenter 2007, Hoffman and Zimbelman 2009)*
  - Consider the identified risks more troublesome
  - Discuss past cases and their effects
  - Senior auditors share experience and expertise, juniors share recent first-hand knowledge *(Beasley and Jenkins 2003)*

- **Provide evidence** with documented fraud risks *(Hammersley et al. 2010, Nelson 2009)*

Inefficiencies and distractions will muddy fraud risks identification and hinder key audit decisions *(Beasley and Jenkins 2003)*

Introduction

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Current Issues of Brainstorming Sessions:

Issues summarized based on literature and interviews with eight audit firms:

- **Limitations with Checklist**
  - **Limit** auditors' idea in identifying new risks
  - **Miss** important topics
  - **No** enough attention to listed risks *(Landis 2008)*
  - **No** decision support at all
- **Ineffective new ideas generation:** memory recall and documents search
- **Uncollected experience and expertise from seniors**
- **Unreached additional external information**

Audit Cognitive Assistant

Cognitive Assistant (Intelligent Personal Assistant)

Speech-enabled technologies that uses inputs such as the user's voice, vision (images), and contextual information to provide assistance by answering questions in natural language, making recommendations, and performing actions *(Canbek and Mutlu 2016, Hauswald et al. 2015, Myers et al. 2007, Garrido et al. 2010, Chen, 2015)*

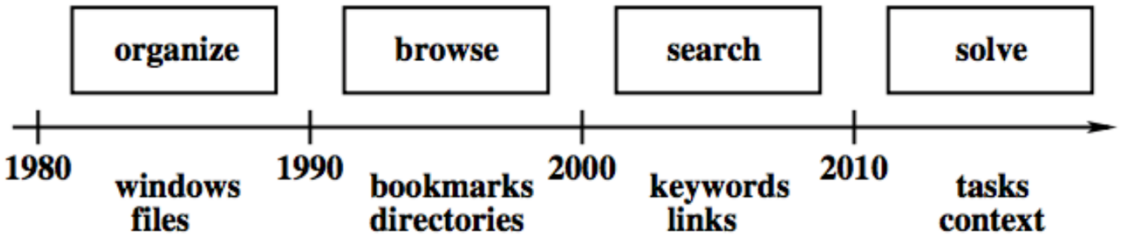
Commercial personal assistants *(Mehrez, 2013)*:

- Apple Siri
- Google Now
- Microsoft's Cortana
- Amazon's Echo/Alexa
- IBM Watson

From left to right: Cortana, Siri, Google Now (Litchfield, 2015)

Cognitive Assistant (Intelligent Personal Assistant)

- Next natural stage in the evolution of the user interface *(Bellegarda 2013)*



Natural Stages in the Evolution of the User Interface *(Bellegarda 2013)*

- **Features:**
  - Combining spoken dialogue system and AI
  - Adaptive learning capability *(Myers et al., 2007).*
  - Provide simple tasks assistance as well as cognitive decision making support *(Canbek and Mutlu 2016, Ebling 2016)*

Cognitive Assistant (Intelligent Personal Assistant)

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Cognitive Computing

Cognitive computing refers to systems that learn at scale, reason with purpose and interact with humans naturally *(IBM 2016)*

- Learn and improve "knowledge" through human interactions *(IBM 2016)*
- Mimic human brain and help improve human decision-making *(Wang, 2009d, Wang et al., 2009, Terdiman 2014, Knight 2011, Hamill 2013, Denning, 2014, Ludwig 2013)*
- Involve technologies:
  - Data mining
  - Pattern recognition
  - Natural language processing

Application of AI and Cognitive Computing in Accounting and Auditing

- **Undergoing AI projects in accounting firms** *(Kokina and Davenport 2017, Deniz et al. 2017, Agnew 2016)*
  - KPMG: collaborate with IBM Watson *(Lee 2016)*
  - Deloitte: assemble and integrate cognitive capabilities to audit *(Raphael 2016)*
  - PwC and EY: audit platforms and predictive analytics *(Kokina and Davenport 2017)*

- **Current focus:**
  - Not much productivity improvement *(Kokina and Davenport 2017)*
  - Focus on the automation of labor-intensive tasks, such as document review *(Rapoport 2016, Greenman 2017)*

- **Future potential:**
  - Focus on massive data analysis and innovative learning capabilities
  - Apply in audit, tax, advisory and other services *(IBM 2017)*

Research Motivation

Advantages of cognitive assistant

1. **Technically feasible**
   - Advanced AI technologies
   - Big data support
2. **Solution to a success of brainstorming sessions**
   - **Knowledge collection and organization (knowledge base)**
     - Auditors' experience and domain knowledge
     - Unstructured audit data sources
   - **Audit information retrieval and decision making support (cognitive computing)**
   - **Recommendation on discussion procedure and topics (learning capability)**
   - **Audit applications / program connection (invoking apps)**
3. **Improve efficiency in group discussion (spoken interface)**

Research Motivation

Who will benefit from the proposed audit cognitive assistant?

- Whole audit team
  - Partner
  - Manager
  - Seniors
  - Juniors
- Engagement of different size
  - Large team
  - Small team

Challenges

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Challenges of developing cognitive assistant for auditing and accounting

- General challenges for cognitive assistant
- Knowledge from auditor experts
- Heterogeneous information integration

Proposed Method

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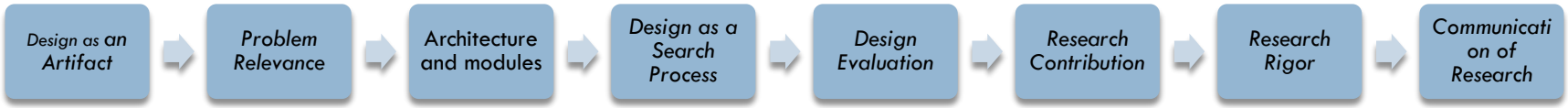
AI based audit cognitive assistant - Luca

Design Science *(Gregor and Hevner 2013; Hevner et al. 2004):*



Technical support:

Piggybacking on existing modules

- Modules from Cognitive Assistant such as Apple's Siri, IBM Watson

Information support:

- Knowledge learned from experimental audit brainstorming cases
- Verbal protocol analysis (VPA) method is used in conversation convertion

Architecture of the Proposed Audit Cognitive Assistant

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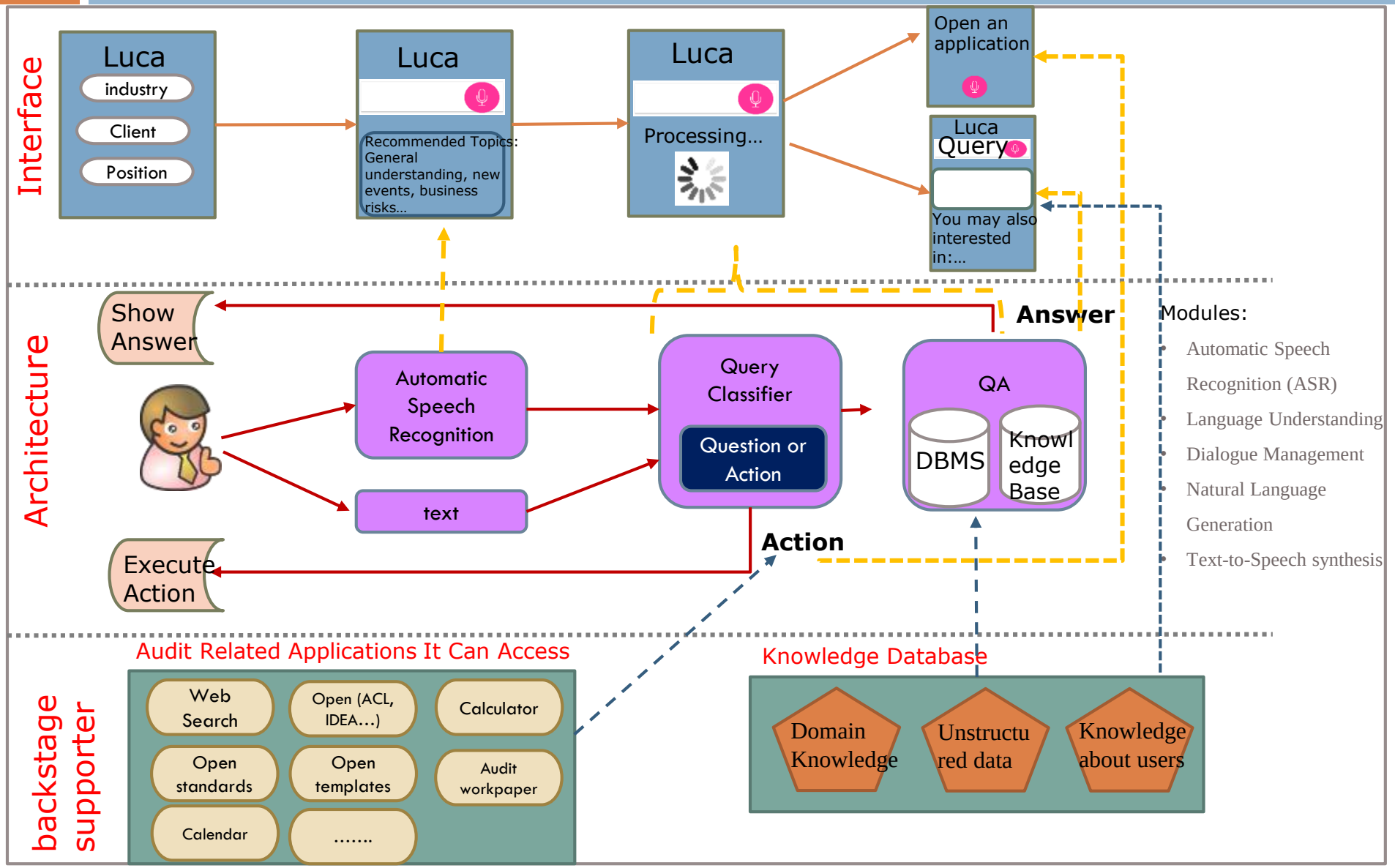

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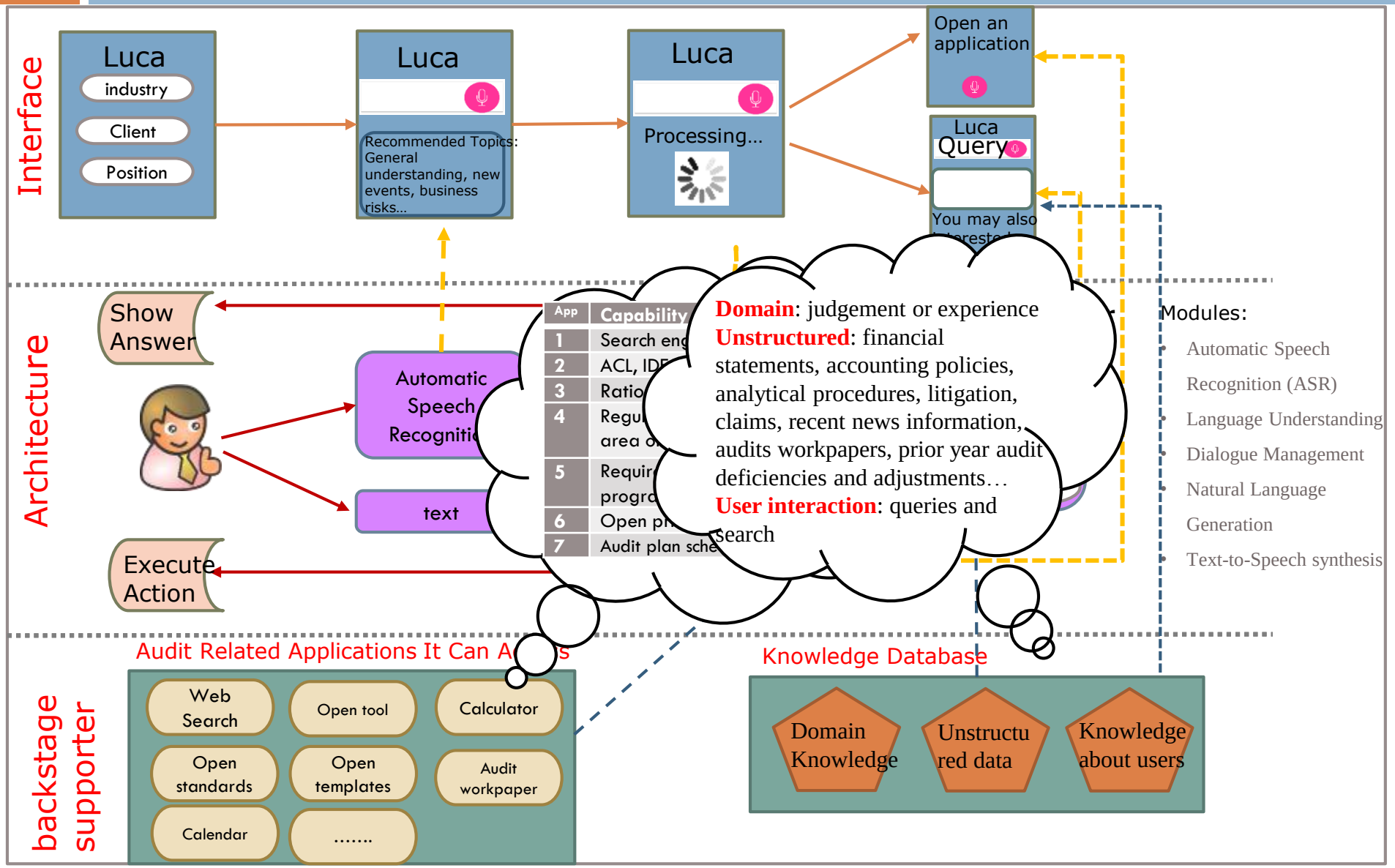

Recommender System of the Proposed Cognitive Assistant

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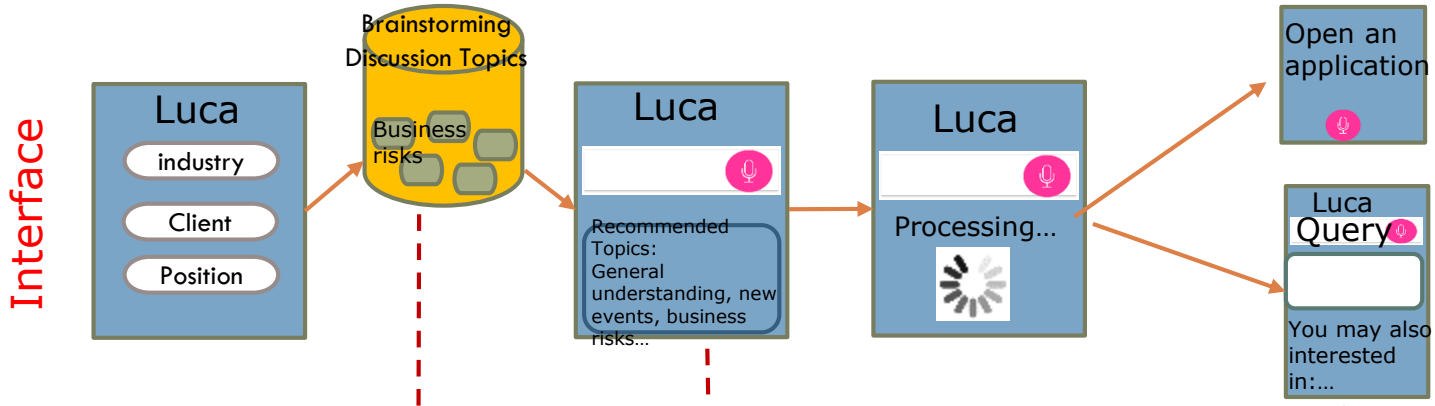

Recommendation System

Risk Assessment Areas

- General understanding
- New events/ areas
- Significant accounts
- Business Risks
- Financial statement level risks
- Fraud Risks
- Going Concern
- Accounting policies
- IT controls
- Related Parties
- Internal Control
- Professional skepticism
- Materiality …

Recommended Risk Assessment Areas Based on Industry and Client

General understanding
New events/ areas
Significant accounts
Business Risks
Fraud Risks
……

Examples of Recommended Sub-topics

General understanding

You may be interested in…

- ☐ Company information
- ☐ Management
- ☐ Business strategy
- ☐ Industry environment
- ☐ Market competition
- ☐ Economic factors

New areas/events

You may be interested in…

- ☐ foreign operations
- ☐ joint ventures
- ☐ new agreements with covenants
- ☐ new acquisitions
- ☐ new stores in other countries (branches)
- ☐ new general counsel
- ☐ Cyber security

Significant Accounts

You may be interested in…

Recommender System of the Proposed Cognitive Assistant

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Significant Accounts General

- Revenue
- Cash flow
- Account receivables
- Liabilities/loans
- Rent
- Inventory
- Fixed assets/intangibles
- Investment
- Expenses
- Payroll
- tax

Business risk

- Litigation
- Reputation
- Consolidation
- Acquisitions and Consolidation
- Global environment
- Business strategy
- Business complexity
- Data protection and data security
- Quality of IT system

Fraud risk

- Revenue
- Financial reporting
- Misappropriation of assets
- Gift card - deferred revenue
- Consolidation

Revenue

- Sources, amounts (month, quarter, year)
- Manual or automated collection/adjustment
- New customer contracts
- New suppliers
- Changes in standards
- Comparison with prior years (growth, drop)
- International operation & sales (centralized vs decentralized)
- Control effectiveness (any tools)
- Seasonal routine revenue pattern
- Materiality
- Specialist involvement
- Common fraud risk
- Test

Architecture of the Proposed Audit Cognitive Assistant

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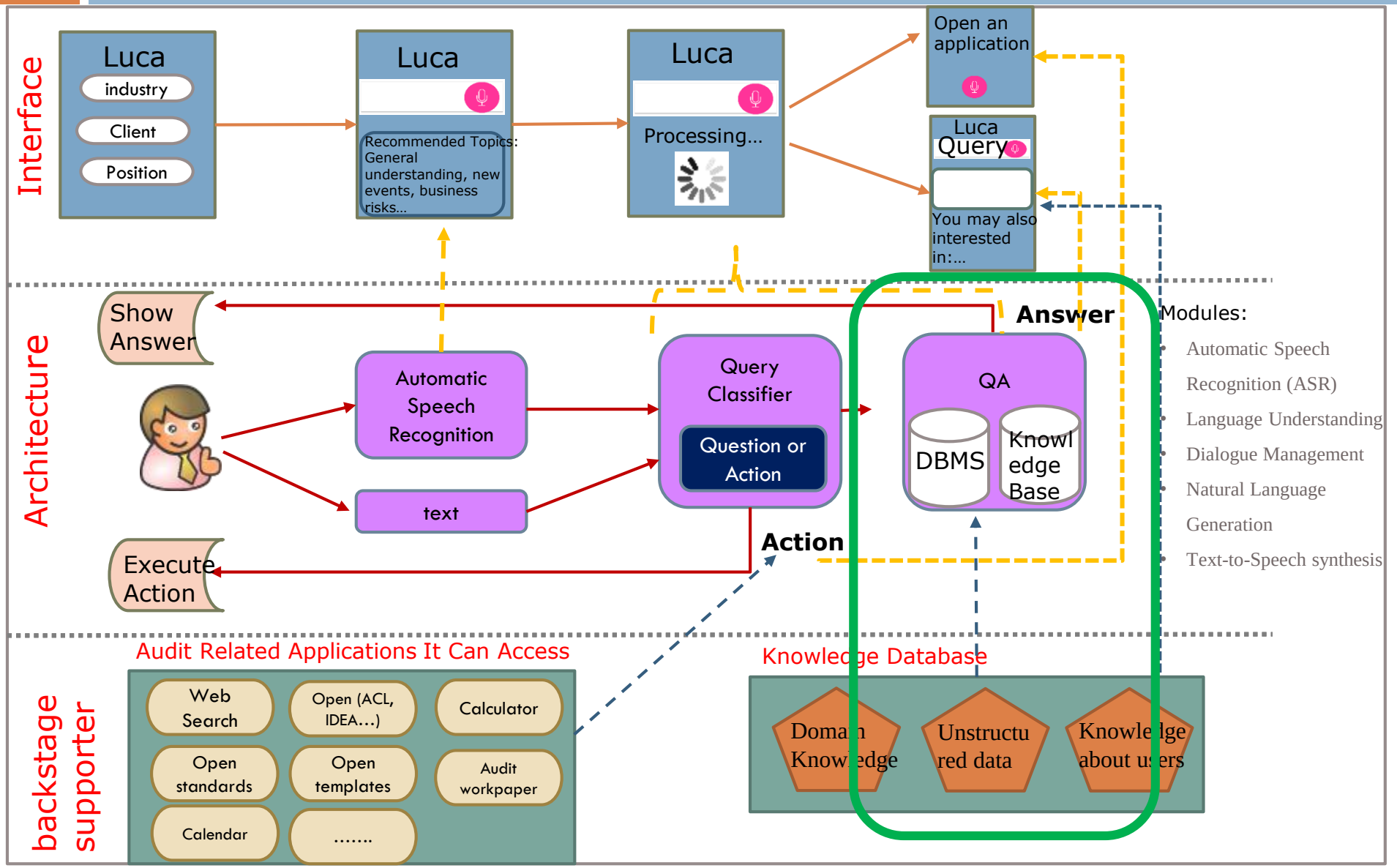

Question Answering System of the Proposed Cognitive Assistant

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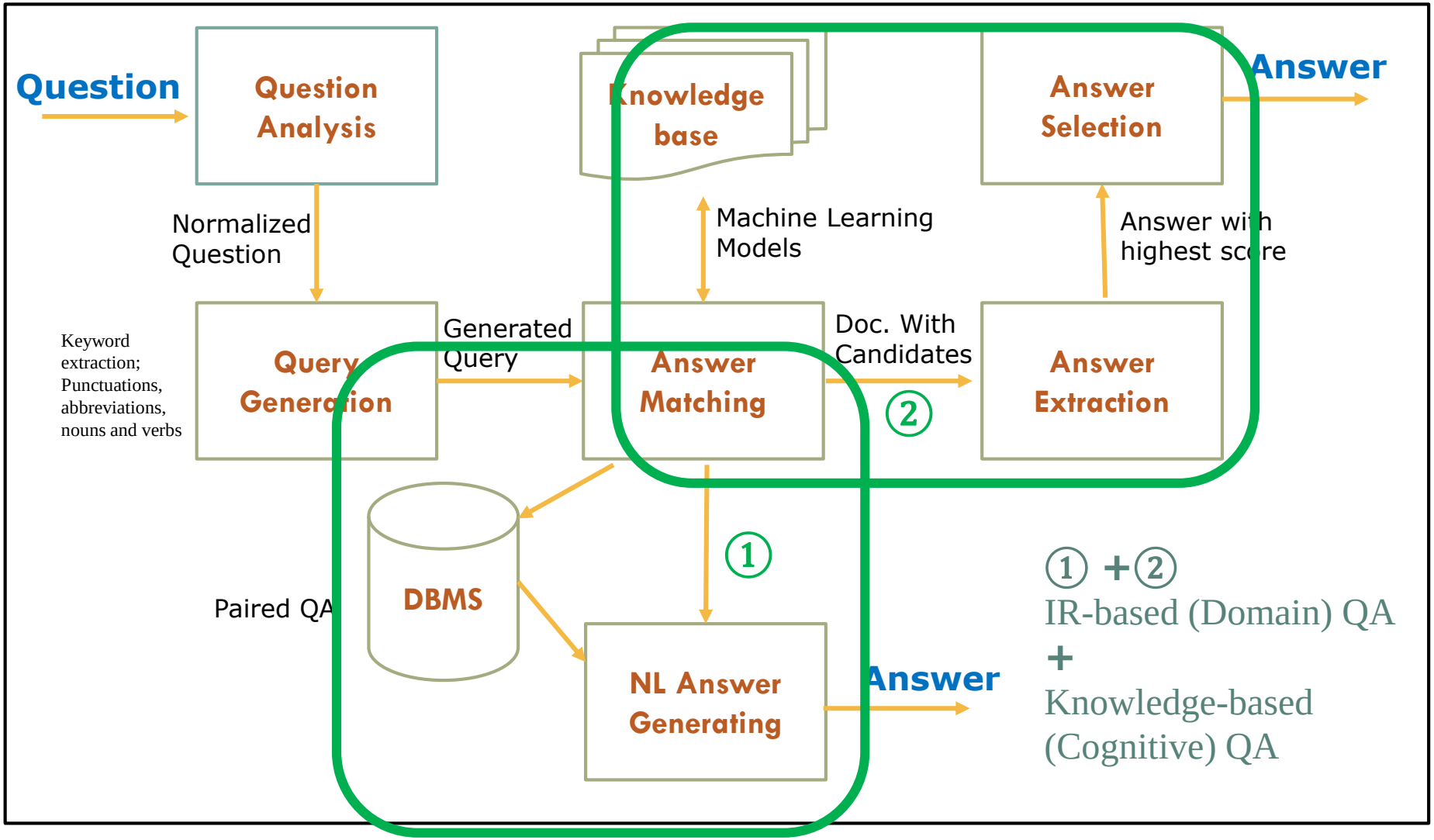

Question Answering System of the Proposed Cognitive Assistant

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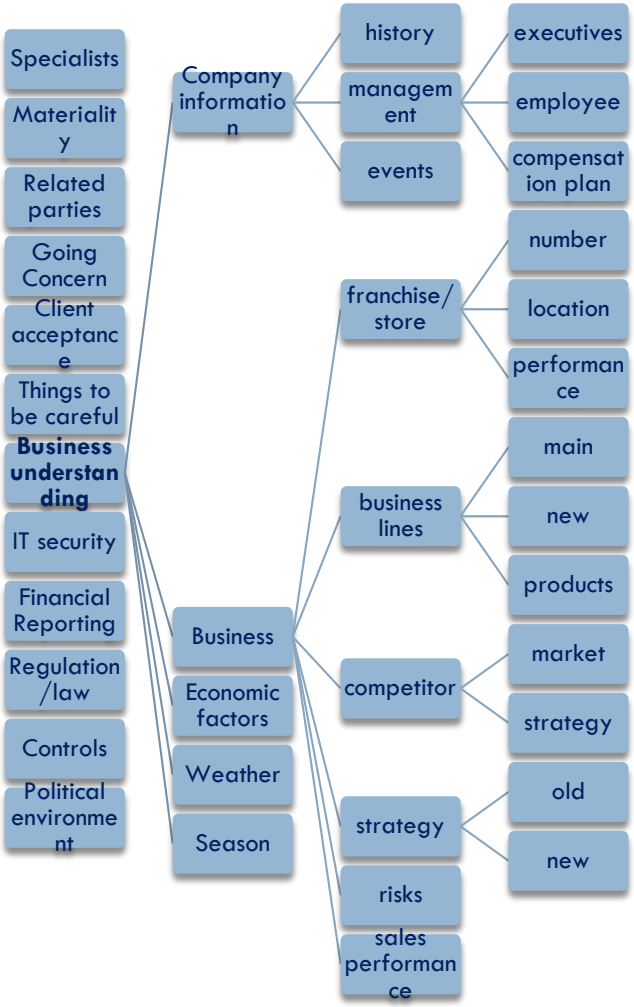
Proposed Questions and Answers Categories



Example: IT security

Q	A
Do they have any security issue before?	Customer's credit card information leakage issue
What IT controls do they have?	New head of IT, control over POS systems in the stores; control from store POS system to servers at IT center

Experiment

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Experiment Objective:

- Develop knowledge base for the proposed cognitive assistant

System supporting data:

- Recordings of four typical brainstorming discussions conducted in a big audit firm
- Additional cases can be integrated into the system

	(Brian H. manager)
53	And you mentioned that they're still trying to figure out the right strategy there
54	the document also talks about a new strategy
55	and transforming the business
56	and I think they are trying to go from maybe a perception of a little bit more upscale,
57	to more of the bar and grill.
	(Brian F.Partner)
58	It is interesting
59	because when they started they were clearly a bar and grill restaurant

Experiment

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Data:

Participants	Client Industry	Time to Complete	Notes
Partner and Manager	**Electronics/Publicly held**	**120 minutes**	• Utilized the firm' brainstorming checklist • Information: publicly available sources (e.g., 10K) and partner's knowledge of the company
Partner and Manager	**Retail-Home/Publicly held**	**60 minutes**	• Utilized the firm' brainstorming checklist • Information: publicly available sources (e.g., 10K) and partner's knowledge of the company
Partner and Manager	**Equipment rental company based in Canada/Owned by small private equity firm**	**60 minutes**	• Utilized the checklist, but the discussion flowed more based on the partner's lead • Information: workpapers and partner's knowledge of the company
Partner and Manager	**Restaurant/Publicly held**	**60 minutes**	• The manager referred to the checklist, but the discussion was more based on the partner's response to manager's questions. • Information: publicly available sources (e.g., 10K) and partner's knowledge of the company

Question Answering System of the Proposed Cognitive Assistant

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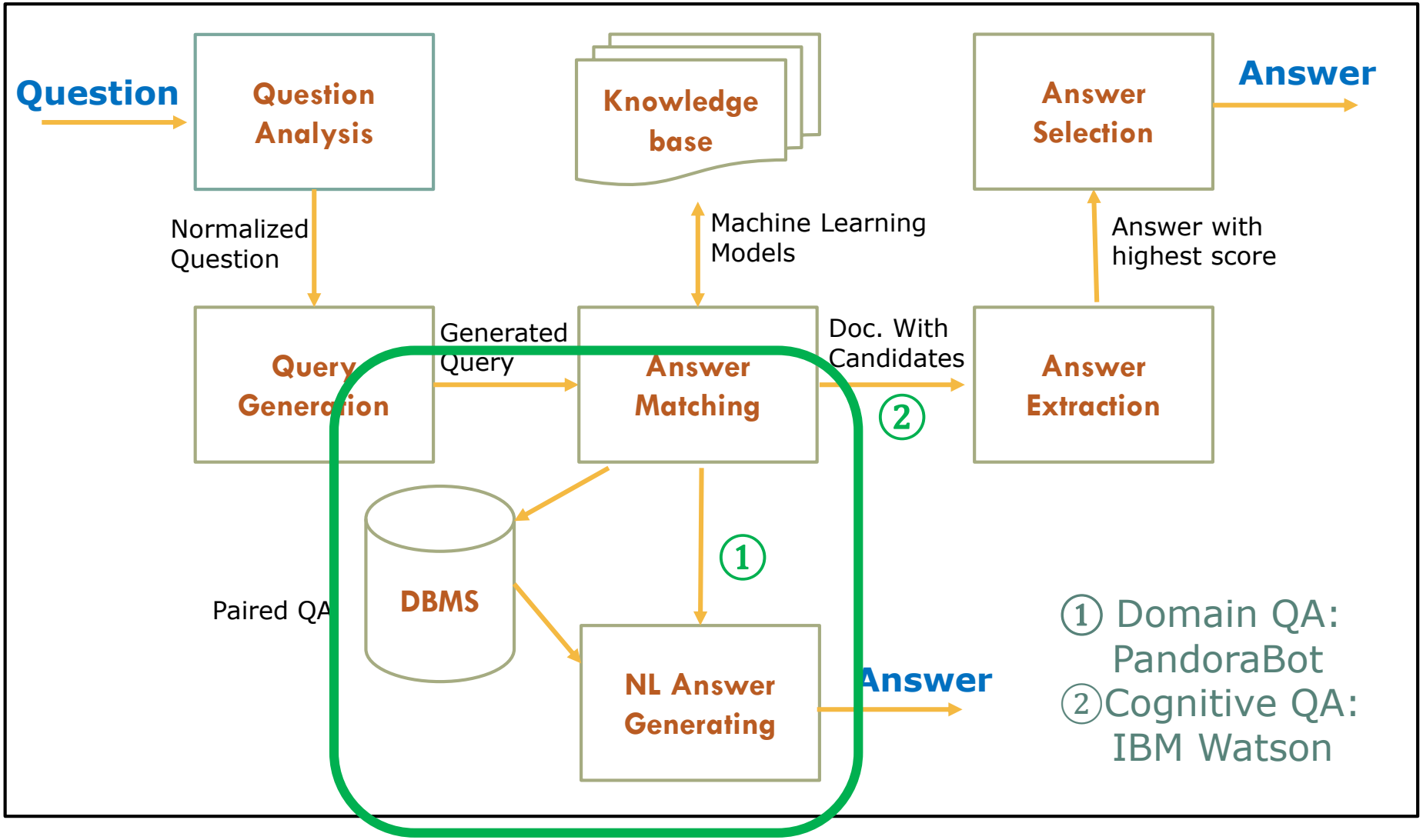

System Testing

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- Testing input: question asked by user
- Testing output: generated answer

Sample Q	A
what is the number of stores and franchise	700 stores: 650 company-owned franchise and 50 franchises
what are the main businesses	Main businesses include bar and grill, and Mexican restaurants.

Using developed QA pairs to build Domain QA part:

- Examples from Pandorabot (written with AIML):

Human:

what are the core products

Ask

Human: what are the core products

Matched: what are the core products (*category defined in test.aiml*)

qiao: beers and burgers

Human:

any identified store level risk

Ask

Human: any identified store level risk

Matched: any identified store level risk (*category defined in test.aiml*)

qiao: 1. a lot of temporary employees 2. high employee ternover rate (less motivateion to work), this may lead to informationn security issue

Contribution

- Fill research gap in solutions for brainstorming session inefficiencies
- First work to bring Cognitive Assistant technology into auditing domain
- Propose a new method in audit knowledge organization
  - Integrate various audit data resources
  - Collect numerous auditors' knowledge and experience
- Develop a method for customized audit plan decision support

Limitation and Future Work

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- Limitation
  - Need large number of brainstorming meeting cases
- Continue Work
  - Develop industry based recommendation system
  - Develop audit knowledge QA system
  - Design an “Audit Watson” for predictive audit risk assessment: case of medical industry

Future Research Opportunities

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Applying AI in Accounting and Auditing:

- How AI can improve tax, advisory and other services?
- What other audit stages can cognitive computing be used ?
- How AI understand nonverbal language such as emotions from voice tone and facial expressions and gestures (Ebling 2016, Hu et al 2017)
- Audit automation possibility
- How AI can help the assessment of exogenous financial information?

Future Research Plan

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- Audit data analytics
- Open data analysis
- Application of AI in accounting and auditing

Thank You !