Watson

WatsonPaths

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Complex system seminar
January 22, 2015
IBM research report
WatsonPaths: Scenario-based Question Answering and Inference over Unstructured Information
Overview

- Background of Watson
- WatsonPaths
- Architecture of scenario-based QA
- Learning
- Result and future
IBM’s Watson

● Supercomputer created by IBM
● Artificially intelligent computer system
● Created as a QA-machine
● First focus Jeopardy
● Natural language compatible
Watson inside

● **Software**
  ○ DeepQA software and Apache UIMA framework

● **Hardware**
  ○ Cluster of ninety IBM Power 750 servers, each uses a 3.5 GHz POWER7 eight core processor, with four threads per core. In total, the system has 2,880 POWER7 processor cores and has 16 terabytes of RAM

● **Data**
  ○ DBPedia, Wordnet and YAGO
Watson at Jeopardy

- No internet connection
- 200 million pages of structured and unstructured content consuming four terabytes of disk storage
- Brad Rutter and Ken Jennings
WatsonPaths, next step for Watson

- More natural interaction with humans
- Assist human cognition
- Learn and improve from the interaction
WatsonPaths

- Focus on the medical domain
- Patient scenario analysis: Diagnosis or treatment recommendation
- From monolithic question view to exploring multiple facts of the scenario in parallel and reason towards the conclusion
Scenario analysis

- Identify possibly important factors
  - Syntactic parsing
  - Terms are mapped to identify concepts and semantic types
  - Identify important relations
- Machine learned
- An assertion graph is created
Assertion Graph

- Core data structure
- Statements and unstructured statements
- Relations between statements (usually indicative)
- Node = statement
  Edge = relation
- Confidence values
A 63-year-old patient is sent to the neurologist with ... resting tremor ... What part of his nervous system is most likely affected?
Relation generation step

A 63-year old patient is sent to the neurologist with a clinical picture of resting tremor that began 2 years ago.

At first it was only the left hand, but now it compromises the whole arm.

At physical exam, the patient has an unexpressive face and difficulty in walking, and...

- resting tremor that began 2 years ago
- compromises the whole arm
- unexpressive face
- difficulty in walking

- Parkinson disease
- Cerebellar diseases
- Progressive supranuclear palsy
- Huntington’s disease

- Parkinson’s disease
- Diffuse lewy body disease

- Substantia Nigra
- Cerebellum
- Lenticular Nuclei
- Pons
- Caudate Nucleus
Confidence and Belief

- Belief engine
  - Probabilistic inference over the assertion graph
- Method created to perceive the most valid path to find a hypothesis.
Input Scenario

Scenario Analysis

Node Prioritization

Relation (Edge) Generation (may ask questions to Watson)

Estimate Confidences In Nodes ("Belief Engine")

Hypothesis Identification

Hypothesis Confidence Refinement (learned model)

Assertion Graph

Repeat until "completion" (which may be defined in different ways)

Final Confidences in Hypotheses
Learning over Assertion Graphs

- Supervised machine learning
  - Scenario question training data
    - Complete scenarios
    - Questions about those scenarios
    - Answers to the questions
  - Subquestion training data
    - Atomic questions
    - Answers to the questions
Collaborative Learning Application

- Inspiration for the solving model came from medical students
- Dual learning
- Feedback for good or bad
Cognitive Computing Application

- Facilitate human reasoning
- Communicate in a natural way
- Learn and improve
Evalulation of the WatsonPath

● Medical test preparation questions
● 2190 questions
  ○ 1000 training
  ○ 690 development set
  ○ 500 blind test
Results

<table>
<thead>
<tr>
<th></th>
<th>Full</th>
<th>Diagnosis</th>
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<tbody>
<tr>
<td><strong>Accuracy</strong></td>
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<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>42.0%</td>
<td>53.8%</td>
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<tr>
<td>WatsonPaths</td>
<td><strong>48.0%</strong></td>
<td><strong>64.1%</strong></td>
</tr>
<tr>
<td><strong>Confidence</strong></td>
<td></td>
<td></td>
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<tr>
<td>Baseline</td>
<td>59.8%</td>
<td>75.3%</td>
</tr>
<tr>
<td>WatsonPaths</td>
<td><strong>67.5%</strong></td>
<td><strong>81.8%</strong></td>
</tr>
</tbody>
</table>

- Accuracy
- Confidence Weighted Score

\[ \text{CWS} = \frac{1}{n} \sum_{i=1}^{n} \frac{\text{number correct in first } i \text{ ranks}}{i} \]
Conclusions and future work

● The WatsonPaths is a scenario based question answering system
● Collaborative decision support tool

● More focus on collaborative user application
● Expand WatsonPaths beyond the medical field
Thank you for your time!