Presentation of the semantic technologies for searching of information

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- Avignon University, Avignon, France, 2020-2021

- INRAE (French National Institute of Agricultural Research), France 2019-2021

- Technical University- Sofia, Bulgaria, 2010-2019
Research projects

- European Reform University Alliance
- Action research mental health
- Distributed knowledge graphs
- Des Données aux Connaissances en Agronomie et Biodiversité
- INSYLVA France infrastructure for management of forest resources
- Multi-agent system for searching of medical information in internet
- Large Scale Industrial Structural Optimisation for Advanced Applications
- The development of a simulation model of administrative services and procedures in order to develop e-services and e-management

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Mariya Evtimova- Gardair, Evangelos Pallis. Intelligent agents system for medical information. Intelligent Wireless Communications, Chapter 5, IET, 2021

Evtimova-Gardair M., ”Multi-agent searching system for medical information”, WSEAS Transactions on information science and applications, E-ISSN: 2224-3402, vol.16,2019, pp.140-145


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Web search engines

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The Problem???

Increase the quality of the returned results

- short and vague requests
- increase the volume of the data

- Semantic technologies
- Agent technologies
- Personalization

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Objective of the project

Development of a model of the system

- BIG DATA from vague and uncertain information
- Use technologies for personalization, semantic ontologies, intelligent agents, and fuzzy and probability theory

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Tasks

- Investigation of the problems in the reasoners
- To propose a model of a reasoner and ontology
- To integrate mobile agent for extraction of information from uncomplete and contradictory information environment from internet sources
- To create a model of user profile
Tasks

- To create new conceptual model of personalized semantic searched system
- To create a program- partial realization of separate modules
- Evaluation of the results
Ontology technologies include:

- Reasoners
- Instruments for annotation
- Ontology based robots
- Instruments for extraction of information
Knowledge graphs and ontologies

KGs can represent complex structured information about entities, their properties and their relationships with other entities.

1. CovidGraph (https://covidgraph.org/)
2. KGTK COVID-19 KnowledgeGraph (Hope, Portenoy, Vasan et al., 2020)
3. Blender Lab COVID-KG (Wang, Li, Wang et al., 2020)
4. COVID-19 KnowledgeGraph (Wise et al., 2020)
5. COVID-KOP (Korn, Bobrowski, Li et al., 2020)

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2 part. Conclusion

- User profile
- Using mobile agent
- A reasoner for Big Data, uncertain and vague query
- Ontology - fuzzy and probability logic for BIG DATA
3 Part- Modeling of semantic search system

Semantic search system:
- big volume of data
- requested vague and uncertain information
Personalized semantic searched system

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Personalized user profile
Hybrid ontology

- Fuzzy logic
- Probability logic
- Case and rule based ontology
What is fuzzy logic?

- Many-valued logic
- Truth value $[0,1]$ 
- Fuzzy set theory
- Membership function

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What is probability theory?

- Probability measure $[0,1]$
New model of reasoner

1. Algorithm for Big Data reasoning from vague and uncertain request
   • Define the distribution of the data

2. Algorithm for reasoning for big data from standard ontology and measurement of semantic similarities
   • Separate the data into groups

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1. Algorithm

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4 part- Partial realization of the system. Experimental evaluation of the results

- Description of the created prototype of the system
- Evaluation and the results of the system
Usage of software

- jColibri- ALADIN
- JADE
- Protege
Architecture of the personalized searching system
Functional diagram – with static agent
Creation of ontology

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Fuzzy function of BMI

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Expand the ontology to work with uncertain and Vague information and with Big Data

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Experimental results

<table>
<thead>
<tr>
<th>Category symptoms</th>
<th>Total Queries</th>
<th>Diagnosed by the system</th>
<th>Diagnosed by an expert</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>Precision</th>
<th>Recall</th>
<th>F-measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal &amp; Digestive symptom</td>
<td>35</td>
<td>34</td>
<td>36</td>
<td>31</td>
<td>1</td>
<td>3</td>
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<td>0.911764706</td>
<td>0.933939339</td>
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<tr>
<td>Cardiovascular system symptom</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>20</td>
<td>0</td>
<td>2</td>
<td>0.909030909</td>
<td>0.9523808952</td>
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<tr>
<td>Head and neck symptom</td>
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<td>19</td>
<td>19</td>
<td>18</td>
<td>0</td>
<td>1</td>
<td>0.947368421</td>
<td>0.972972973</td>
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<tr>
<td>Hemic and immune system</td>
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<td>9</td>
<td>8</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0.888888889</td>
<td>1</td>
<td>0.941176471</td>
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<tr>
<td>Musculoskeletal system symptom</td>
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<td>10</td>
<td>8</td>
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<td>0</td>
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<tr>
<td>Nervous system symptom</td>
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<td>26</td>
<td>27</td>
<td>25</td>
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<td>2</td>
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<td>0.961538462</td>
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<tr>
<td>Nutrition, metabolism and development symptom</td>
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<td>32</td>
<td>30</td>
<td>28</td>
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<td>1</td>
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<tr>
<td>Reproductive system symptom</td>
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<td>20</td>
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<td>2</td>
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<td>0.9</td>
<td>0.923076923</td>
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<tr>
<td>Respiratory system and chest symptom</td>
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<td>32</td>
<td>33</td>
<td>31</td>
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<td>1</td>
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<tr>
<td>Skin and integumentary tissue symptom</td>
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<td>12</td>
<td>13</td>
<td>12</td>
<td>0</td>
<td>1</td>
<td>0.923076923</td>
<td>0.96</td>
<td>0.96</td>
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<tr>
<td>Urinary system symptom</td>
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<td>9</td>
<td>9</td>
<td>8</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>225</strong></td>
<td><strong>225</strong></td>
<td><strong>225</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>0.98</strong></td>
<td><strong>0.94003482</strong></td>
<td><strong>0.96</strong></td>
</tr>
</tbody>
</table>

**Legend:**
- A1: The system and the expert decide the same
- A2: The system and the expert have different opinions, experts believe that the disease is in another category
- A3: Expert decide that is in this category, but the system not
Heartbeat pain in the chest

Disease
Cardiovascular system disease

Treatment
Aspirin; Nitroglycerin; Call doctor

Description
Discomfort, pressure, heaviness, or pain in the chest, arm, or below the breastbone. Discomfort radiating to the back, jaw, throat, or arm. Fullness, indigestion, or choking feeling (may feel like heartburn). Sweating, nausea, vomiting, or dizziness; Extreme weakness, anxiety, or shortness of breath.
Description

Holiday Type: Skiing
Number of persons: 2
Region: Allgäu
Transportation: Car
Duration: 7
Season: January
Accommodation: FiveStars

Solution

Price: 1868
Hotel: Hofgut Kuernach, Allgäu
Adaptation

- Direct proportion between "Number of Persons" and "Price"
- Direct proportion between "Duration" and "Price"

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Motivation

CBR is:
- Successful AI subfield
- Mature & established

Building CBR applications requires:
- Formalization
- Methodologies
- Implementation assistance
Main features of jCOLIBRI

- Extensible
- Reusable
- Different types of users and different purposes:
  - Development, Research and/or Teaching
- Compatible with commercial applications and suitable for developing large scale applications
- Supporting different types of CBR systems
- It is just a .jar file → Suitable for web applications
Extensions

- Textual CBR
- Knowledge Intensive CBR
- Distributed CBR
- Data Intensive CBR
- Recommender Systems

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