

# Google Research Awards Proposal

## 1. Overview

Title: **Exploiting Open Data for Improving Spatial Keyword Query Applications**

Primary investigator: **Frederico Araújo Durão**

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## 2. Proposal

### Abstract

This proposal aims at proposing strategies to improve spatial-keywords queries results. First, we propose to exploit Linked Open Data (LOD) datasets (e.g., DBpedia and LinkedGeoData) to improve the points of interest (POI) description. Then, we aim at personalizing the query results to present the best POIs for the underlying user. By exploiting reviews on POIs, the system identifies the object which best satisfies the user and re-order the rank concerning for the user preference.

### Problem Statement and Research Goals

The problem this proposal aims at solving is the incapability of single spatial keyword querying to satisfy user needs by neglecting important and available information. Usually, these queries manipulate objects with short textual description, hindering the query capability to identify objects to satisfy the user need. Moreover, traditional keyword queries just consider the user information need depicted by query keywords, overlooking that users have personal preferences even when they type the same query keywords.

Tackling this problem, we propose a location-based solution that exploits the benefits of a LOD dataset to enhance the object's textual description. LOD enables applications to navigate along with links into related data sources. By navigating these links, the approach obtains an enhanced textual description for the objects. In addition, the query results are personalized to consider users unique preferences. A classifier exploits user reviews to define the user preference for each object in the query result.

### Work Description and Expected Outcomes

In order to improve spatial keyword queries, the solution combines query personalization with the object's description enhancement. This way, the best item for the user is presented first, improving the user experience with the system. We already built a search engine prototype able to apply the solution to the top-k Spatial Keyword Preference Query [2]. This query searches for points of interest based on other objects (features) in their spatial neighborhood.

Figure 1 describes an overview of our approach where the query result is improved automatically. Given a user query, the search engine first searches for features inside each point of interest's neighborhood. Then, it enhances the feature's textual description using LinkedGeodata and DBpedia (LOD datasets). A score function defines the relevance of each feature description based on the query keywords. Subsequently, the objects are ordered according to their scores and sent to the personalization algorithm. Finally, the personalization algorithm re-order the objects based on the user reviews and send the results to the user.

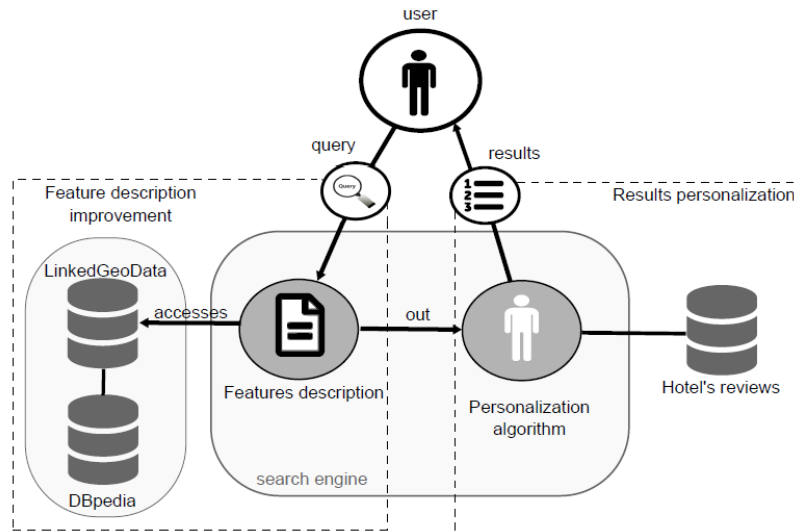


Figure 1. Overview of the approach to improve query results.

The LOD datasets will be accessed by their respective SPARQL endpoint to process the query. SPARQL is a query language that can be used to express queries across diverse LOD sources. A SPARQL endpoint is used to enable users to query a knowledge base via SPARQL. DBpedia and LinkedGeoData endpoints can be accessed at <http://dbpedia.org/sparql/> and <http://linkedgeodata.org/sparql>, respectively. Both DBpedia and LinkedGeoData have public access.

In order to personalize the query, we will build user profiles and choose the suitable classifier to work with these profiles. The user profile will be composed of the user's past reviews and a label indicating whether the review is positive or negative. The Google Places API can be used to extract the user reviews and ratings required to build the user profile. A classifier, trained with the user profile, classifies each POI review in the query result as good or bad to the query user. In fact, the classifier compares the query user review with the ones in the database. Whether the POI review is similar to the query user review, it receives a value of 1 (good); otherwise, it receives 0 (bad).

At the end of this project, we expect to build a search engine capable of improving spatial-keyword query results automatically. Leastwise, the described approaches may improve the Spatial Keyword Preference query results, but we hope to build a generic search model able to improve any spatial-keyword query. Moreover, the search engine will be used to build a prototype Web service that, given a set of keywords, and a city of interest, generates a list of POIs that satisfy the user need in that city.

## Relation to Prior Work

Several studies employ LOD datasets to improve textual descriptions of spatial objects. [5] describe an augmented reality browser that uses LOD to enhance the description of objects. Similarly, [6] employ LOD to improve POIs description, but they use voluntary users to generate, update and revise the POI's description. On the other hand, [2] discuss a detailed approach on how to improve a POI description automatically, using LOD.

Personalizing services offer relevant information tailored to user preferences and behavior. Some approaches deal with personalization of spatial query results employing methods based on the user's current location and schedule [7], or user weights on POIs [4], or user formulary describing her preferences [3].

## References

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- [2] ALMEIDA, J. P. D de; ROCHA-JUNIOR, J. B. Top-k Spatial Keyword Preference Query. Journal of Information and Data Management - JIDM, v. 6, n. 3, p. 162-177, 2016.
- [3] BOUHANA, A. et al. An Ontology-based CBR Approach for Personalized Itinerary Search Systems for Sustainable Urban Freight Transport. Expert Systems with Applications. Elsevier, v. 42, n. 7, p. 3724-3741, 2015.
- [4] DAI, J. et al. On Personalized and Sequenced Route Planning. World Wide Web, Springer, v. 19, n. 4, p. 679-705, 2016.
- [5] HEDGE, V. et al. Utilising Linked Data for Personalized Recommendation of POI's. International AR Standards Meeting, Barcelona, Spain. [S.l.: s.n.], 2011.
- [6] KARAM, R.; MELCHIORI, M. Improving geo-spatial linked data with the wisdom of the crowds. ACM. Proceedings of the joint EDBT/ICDT 2013 workshops. [S.l.], p. 68-74, 2013.
- [7] KWON, O.; SHIN, M. K. Laco: A Location-aware Cooperative Query System for Securely Personalized Services. Expert Systems with Applications, Elsevier, v. 34, n. 4, p. 2966-2975, 2008.

## 3. Proposal Context

João Paulo is currently a PhD candidate under a Brazilian Postgraduate scholarship (FAPESB). This grant proposal is related to João Paulo's PhD thesis topic on the Semantic Web, contributing with a personalization method to improve spatial-keyword queries, providing a Web Service prototype to search for points of interest, and datasets for other researchers evaluate and compare systems which employ spatial-keyword queries.

## 4. Budget

We request the value to support one PhD student for one year (US\$ 1,200 monthly), as well as a modest conference travel support for the student (US\$ 3,000).

## 5. Data Policy

All developed code and data sets will be made available at GitHub or another appropriate public repository. All papers derived from this work will be published preferentially in open-access journals.

# Primary Investigator – Frederico Durão

## About me

Frederico Durão was a postdoctoral researcher at Insight Centre for Data Analysis, University College Cork, Ireland in 2016/2017. Before Frederico Durão was a technical coordinator of the USTO.RE project that aims at developing a P2P platform for data storage in the cloud. In 2012, he obtained his PhD in Computer Science from the University of Aalborg, Denmark. Before, Frederico earned his BS in Computer Science in the Faculty Ruy Barbosa in 2004 and his Masters in Computer Science at the Federal University of Pernambuco in 2008. From 2005 until 2008 he worked as scientist at the Center for Advanced Studies and Systems of Recife (CESAR), where he participated in several industrial projects geared to both the scientific community as well as for industry. In 2008, Frederico Durão became a member of the Intelligent Web and Information Systems (IWIS) at the Department of Informatics at Aalborg University, where he researched strategies and algorithms for personalized Web. Frederico Durão revised and published several articles in conferences and journals relevant to the areas of Information Systems and Social Web. Currently, Frederico Durão is a member of the WISER Research Group and a professor at the Federal University of Bahia where he teaches and researches the areas of Social Web and Information Retrieval. In particular, I am Open Access enthusiast - believing in free access to knowledge for everybody. Besides I acknowledge the necessity of migrating towards better research practices and criticize narrow-minded methods for evaluating research excellence.

## Education

- 2016 - 2017** Postdoctorate.  
University College Cork, UCC, Ireland.
- 2012 - 2013** Postdoctorate.  
Centro de Estudos e Sistemas Avançados do Recife, CESAR, Brazil.  
*Grantee of:* Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES.
- 2012 - 2012** Postdoctorate.  
Recife Center for Advanced Studies and Systems, CESAR, Brazil.  
*Grantee of:* Conselho Nacional de Desenvolvimento Científico e Tecnológico, CNPq.
- 2008 - 2012** Ph.D. in Systems Personalization.  
Aalborg University, Denmark. *Year of degree:* 2012.  
*Advisor:* Peter Dolog.  
*Keywords:* Semantic Web; Ontology; Information; Wiki; Personalization.
- 2006 - 2008** Master's in Computer Science  
Federal University of Pernambuco, UFPE, Brazil. *Year of degree:* 2008.  
*Advisor:* Eduardo Santana de Almeida e Silvio Romero de Lemos Meira.  
*Keywords:* Semantic Web; Ontology; re-use; Search Engine.
- 2000 - 2004** Graduation in Computer Science.  
Faculdade Ruy Barbosa, Brasil.  
*Advisor:* Trícia Santos e José Maria N. David.

## Professional Experience

2013 - Federal University of Bahia, Brazil, Professor.  
2012 - 2014 - Pernambuco State Science and Technology Support Foundation, FACEPE, Brazil.  
2012 - 2013 - IKEWAI, Brazil, Researcher.  
2012 - 2012 - Federal University of Pernambuco, Researcher.  
2008 - 2012 - Aalborg University, Denmark.  
2005 - 2008 - Recife Center for Advanced Studies and Systems, CESAR, Brazil, Researcher.  
2003 - 2005 - UFBA Data Center, CPD, Brazil, System Analyst.

## Main Publications

DURÃO, F. A.; BAYYAPU, K. R.; XU, G.; LAGES, R.; DOLOG, P. **Expanding user's query with tag-neighbors for effective medical information retrieval**. Multimedia Tools and Applications, v. 71, p. 905-929, 2014.

DURAO, FREDERICO; CARVALHO, JOSE FERNANDO S.; FONSEKA, ANDERSON.; GARCIA, VINICIUS CARDOSO. **A systematic review on cloud computing**. Journal of Supercomputing, v. 67, p. 3-28, 2014.

DURÃO, F. A.; LAGES, R.; DOLOG, P.; COSKUN, N. **A Multi-Factor Tag-Based Personalized Search**. In: Springer Berlin Heidelberg. (Org.). Lecture Notes in Business Information Processing. 1ed. Berlin: Springer Berlin Heidelberg, 2012, v. 101, p. 192-206.

DOLOG, P.; DURÃO, F. A.; LIN, Y.; JAHN, K.; PEITERSEN, D. K. **Recommending Open Linked Data in Creativity Sessions using Web Portals with Collaborative Real Time Environment**. Journal of Universal Computer Science (Online), v. 33, p. 34-39, 2010.

DURÃO, F. A.; DOLOG, P. **Extending a hybrid tag-based recommender system with personalization**. In: ACM Symposium on Applied Computing (SAC), 2010, Sierre, Suica. ACM Symposium on Applied Computing (SAC), 2010.

DURÃO, F. A.; DOLOG, P. **Social and Behavioral Aspects of a Tag-based Recommender System**. In: International Conference on Intelligent Systems Design and Applications (ISDA), 2009, Pisa, Italy. International Conference on Intelligent Systems Design and Applications (ISDA), 2009.

DURÃO, F. A.; DOLOG, P. **A Personalized Tag-Based Recommendation in Social Web Systems**. In: International Workshop on Adaptation and Personalization for Web 2.0, 2009, Trento, Italy. International Workshop on Adaptation and Personalization for Web 2.0, 2009.

## Languages

Portuguese, English, Danish