data intelligence institute of Paris

PHD project

A data-driven complex network approach for Human Mobility problem

Abstract:

The analysis of complex networks is a very promising area of research, as evidenced by numerous research projects and works that focused on different areas. Very recently, these analyzes were generally focused on the in-depth characterization of only one aspect of the system. Therefore, a study that takes into account many informative axes and a network is lacking. In this PhD thesis, we propose to study a multimodal analysis capable of inspecting human mobility (complex network: Vehicles, Trains, Mobile applications, …,etc) in several important dimensions of a system. In order to achieve this goal, we will study the variation of the constitutive parameters of changes in the behavior of the network as a whole and extract solutions for example green mobility in the smart cities' context.

Context:

Over the recent years, cell phones have become ubiquitous thanks to major advancements in telecommunication technology. Cellular phones have turned out to be a great resource of data to analyze mobility behavior of people in metropolitan areas, as they overcome the limitations of other resources that fail to collect mobility data in a large scale. GPS, for example, provides accurate spatial data, but has two main disadvantages: device battery usage and the limitation of data collection for a certain group of people (e.g. drivers). The latter, in particular, makes the multimodal mobility study almost impossible. Cellular data on the other hand, appears to be a proper solution for the aforementioned drawbacks as it is inexpensive to collect for large-scale population with no excess of energy consumption of device. The problem with cellular phones compared to GPS is that they provide only coarse-grained mobility data at antenna level, with a varying localization error of hundred meters in densely populated cities, and within several kilometers in rural areas. In order to investigate the mobility behavior of users in choosing a transportation mode among different

alternatives or even a combination of modes, the first requirement is to infer the real trajectory of users from their cellular data. In this PhD thesis, we propose a solution to this problem by designing and developing an approach that exploits cellular data for multimodal mobility study.

Related work

The analysis of human mobility (trains, vehicles, ,etc.) is known as one of the main problems faced by cities. With the growth of urban areas and metropolitan cities, the demands the monitoring of the mobility of individuals continues to increase. As different transport systems are involved in metropolitan areas, researchers are motivated to work with transport network that does not just look for a single layer the entire transport system and the relationships between the layers. In order To study the multimodal mobility of individuals, it is extremely important to use realistic data, which is another challenge in mobility studies.

Thanks to the ubiquity of mobile phones everywhere, recently network operators have been providing large-scale datasets of mobility data in form of Call Data Records (CDRs) which are automatically generated for billing purpose. CDRs, despite being an invaluable resource to extract insights about human mobility, are temporally sparse. Therefore, CDRs cannot be treated as proper data for multimodal transportation studies in cities and metropolitan areas. There is a gap between studies and a comprehensive approach to study multimodal mobility using data in urban and metropolitan areas.

One of the objectives of this thesis is to bring together all the theoretical background and the studies related to the challenges discussed in the previous section. The state of the art in different aspects of human mobility studies, mobility data and mapping algorithms. The second step ends with a correlation studies the detected gaps and claims that in the literature, there is no mapping algorithm dealing with both multimodal transportation network and also with the scalability of using mobility data in urban and metropolitan areas.

Consequently, we elaborate on modeling and building the multimodal transportation network dataset containing road, train and metro lines. While realistically representing the deterministic aspects and non-deterministic aspects of human mobility stays a challenge, there is a certain need for increased research efforts in mobility modeling. Upcoming technologies as 5G and 6G can help more accurate understanding of human mobility and researchers can simulate many environments more realistically.

One of our goals is to grow attention to the field of human mobility modeling. This later involves the collection of real-life mobility data and filtering of the data as well as the modeling of the environment and the people's behavioral decisions. A mobility model can be verified with thorough analyses of both parts with various metrics and the model needs to be calibrated during this process. As the last main process, the implementation of a human mobility simulation generates synthetic mobility traces. The traces of the mobility simulation can be used for other simulations of networks, urban transportation planning, crowd management, disaster management, and many interesting applications for better quality of life.

The PhD objective is to propose an approach to infer multimodal trajectories of smartphone users from their sparse cellular data. Student is encouraged to look at these issues to be improved and develop new techniques and protocols for Multimodal analysis for Human Mobility problem. Potential research problems can be included as new.

The aim of this doctorate research work is to:

- Make a state of art and analyze the performance, complexity and applicability of existing methods in Multimodal analysis for Human Mobility problem.

- Identify, collect and evaluate the relevant parameters that have impacts on dynamic resources quality of scalable Human Mobility parameters.
- Design a mathematical model that can take into account the effects of all these parameters (based on Inference and learning algorithms: Bayesian networks, stochastic processes, neural networks …) and propose a comprehensive approach to study multimodal mobility using data in urban and metropolitan areas.

Partnership: Orange company and Telecom Paris Sud – Institut Polytechnique de Paris

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Combining Machine Learning/Data Analytics Techniques and Computational Argumentation for Explainable Automated Decision Making

Directeur: Pavlos MORAITIS (PROFESSEUR, LIPADE)

The aim of this thesis is to propose a combination of data analytics (DA)/machine learning (ML) and symbolic AI techniques, and more particularly computational argumentation, for explainable automated decision making. There is indeed a lot of application domains of automated decision making for critical situations (e.g. military decision-making taking place in a variety of complex domains such as defense, security, cyber, etc., risk management, automated support of judicial decisions, automated management of regulatory compliance, automated support for medical diagnosis, etc.) where the capability of the AI systems to explain the trace of their reasoning and the data on which the reasoning (and therefore their decisions) is made, is mandatory. More particularly our goal is to combine the Logic Programming with Priorities (LPP) structured argumentation framework [Kakas and Moraitis, AAMAS03] with DA/ML techniques (e.g. deep learning) for extracting/building/learning arguments and making preference elicitation from data and texts. LPP proposes a powerful argumentative and abductive reasoning mechanism through its associated system GORGIAS that allows the modelling and automation of complex and difficult decision-making, in a changing environment and in the presence of incomplete and contradictory information. Currently the knowledge of the developed AI systems is acquired from experts. Nevertheless, there are situations where experts are not available or the volume of the expertise and the necessary data are very huge which makes the use of experts prohibitive. The techniques we want to develop, should allow the recognition and extraction/building/learning (of structures) of arguments from texts (e.g. law texts) and/or accumulated data (e.g. in medical diagnosis results). The possibility to explain the reasoning trace and the used data by the developed systems (thanks to LPP framework), will put in evidence the knowledge and the data from which the arguments have been extracted/built/learned and therefore enhance the used DA/ML techniques with explainability feature. We plan to validate our theoretical work in two different application domains namely medical diagnosis and legal reasoning. For the medical diagnosis domain, we will use medical data in ophthalmology provided by a public hospital while for the legal reasoning we will use law texts and past cases/jurisprudences (e.g. in divorces or labor domain) available in public repositories.

References

Kakas A., Moraitis P., **"Argumentation Based Decision Making for Autonomous Agents",** in *Proc. 2nd International Joint Conference on Autonomous Agents and Multi-Agent Systems (AAMAS'03),* pp. 883-890, Melbourne, Australia, 2003

An approach based on temporal knowledge graphs to detect the spread and decontextualization of fake news

Problem statement and Context

The impact of manipulative online content on society cannot be underestimated. Social media enables users to get exposed to a myriad of misinformation and disinformation, including fake news, i.e., news stories with intentionally false information. For example, a report estimated that over 1 million tweets were related to the fake news story “Pizzagate” by the end of 2016 presidential election. Such widespread fake news has detrimental societal effects. While considerable effort has been invested by the journalistic community, followed by R&D activities, prior approaches have focused mainly on automatic content verification (identifying “fake news”), which has been proven a very complex and still unsolved task. In fact, while professional fact checkers provide high-quality analytics, their effort is very time-consuming. For example, reaching out to a third party for an expert comment might take several days. In addition, they do not have human resources for constantly monitoring the web, relying on user input to launch the fact-checking process. Non-transparent content, on the contrary, appears constantly and spreads very quickly. Early intervention is essential for thwarting misinformation.

Moreover, most of the existing propagation-based fake news detection methods focus on *static* networks and assume the whole information propagation network structure is accessible before performing learning algorithms. However, in real-world information diffusion networks, new nodes and edges constantly emerge. Hence, the time aspect is crucial for fake news propagation [1]. In fact, the manipulation by decontextualization or truncation is important. The information which is largely distorted information, constructed from segments of real information but disseminated in another context. It may be rewritten information, a truncated image, an old video captioned with false information. For instance a video displaying the president of Russia with the French president around the table laughing dated 2015, it is used today again where the date has been changed and states that both presidents came up to an agreement which is not true.

Recently, heterogeneous graphs have been examined, such as exploiting social context information news articles, and its metadata to build heterogeneous information networks [2] [3]. Although the existing deep learning approaches have shown great success to detect fake news based on the high-level feature representations of news contents, they ignore the *external knowledge* by which people usually judge the authenticity of the news. News content is highly condensed and consists of a large number of entity mentions. A named entity could possibly denote different entity mentions because a named entity may have multiple textual forms, for instance “Mr A.Einstein” or “ Albert Einstein” are the same

person. These connections between entities can be done through a structure namely knowledge graph (KG).

In this thesis, we focus on the detection of fake news based on the propagation of decontextualized news over time [4], which could fuse structure, content semantics, and temporal information. We will exploit a KG-based framework for detecting fake news articles, a specific category of misinformation that are reused and decontextualized over the time for a new context.

Thesis goal

This PhD thesis aims to propose an intelligent framework to detect the reusability of past news for fake news propagation taking into account the time dimension, in particular, the work will handle the following contributions:

- Propose an approach to fusion the entities with their entity context in a knowledge graph for fake news detection
- Propose an approach to detect the inconsistency in the decontextualized news for fake news detection using temporal semantic reasoning combined with machine learning methods.
- Implementation of the proposed approach.

Required Skills: Data management, symbolic IA, machine learning, probabilistic modeling

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References

[1] Chenguang Song, Kai Shu, Bin Wu: Temporally evolving graph neural network for fake news detection. Inf. Process. Manag. 58(6): 102712 (2021)

[2] Van-Hoang Nguyen, Kazunari Sugiyama, Preslav Nakov, Min-Yen Kan: FANG: Leveraging Social Context for Fake News Detection Using Graph Representation. CIKM 2020: 1165-1174

[3] Yaqian Dun, Kefei Tu, Chen Chen, Chunyan Hou, Xiaojie Yuan: KAN: Knowledge-aware Attention Network for Fake News Detection. AAAI 2021: 81-89.

[4] S. Tahrat, S.Benbernou, M.Ouziri: Temporal ABox Cleaning in TDL-Lite. Description Logics 2021.

Proposition de Sujet de Doctorat – Ecole Doctorale EDITE

Recherche de cas pathologiques similaires dans des bases d'images radiologiques

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Directeur de l'Unité de Recherches (Prénom, NOM): Pr Themis Palpanas

Description du projet :

Mots-clés: Analyse / traitement d'images médicales, Images multi-paramétriques ou multi-modales, recherche d'images similaires dans une base de données, Retour de pertinence, informations sémantiques, PACS, fusion d'informations, Apprentissage supervisé, Deep Learning

Contexte scientifique: Les méthodes automatiques de recherche d'images fournissent un moyen d'aide à la décision dans de nombreux domaines d'application. Dans le domaine de la radiologie, elles permettent d'assister les radiologues lors de leur travail d'interprétation d'images (aide au diagnostic) en identifiant des cas similaires au sein de bases de données patients, comme les PACS, déplaçant ainsi le problème du diagnostic dans le domaine des Big Data Un cas typique d'utilisation est la recherche par l'exemple où l'on souhaite retrouver des images visuellement similaires à un exemple donné en requête d'image issue d'un nouvel examen médical d'un patient. Pour ce faire les images sont décrites par leurs caractéristiques visuelles (niveaux de gris, texture) déduites directement de leurs pixels et/ou de régions d'intérêt délimitées dans les images (lésion, organe). Une mesure de distance est utilisée pour rechercher des images similaires dans l'espace des caractéristiques. Cependant, face à la complexité et la multiplicité des nouvelles générations d'images médicales, les processus de recherche d'images basés sur le contenu peuvent s'avérer insuffisants. En particulier, ces systèmes sont très limités pour la recherche de cas similaires issus d'examens impliquant des imageries multi-modales (par exemple PET-CT) ou multi-paramétriques (IRM avec différents protocoles d'acquisition ou séquences).

Dans ce contexte, des recherches sont menées par le LIPADE et le service de radiologie de l'HEGP, pour proposer différentes approches permettant d'améliorer ces systèmes de recherche d'images. La première est l'intégration de descripteurs d'images de plus haut-niveau comme des annotations/termes sémantiques dans ces processus [DEP2014, KUR2014]. Ces termes peuvent être utilisés pour décrire un nombre important d'informations relatives au contenu visuel des images et sont directement liés à la compréhension haut-niveau du contenu de ces dernières. Certains termes sémantiques peuvent être également automatiquement prédits à partir du contenu visuel de l'image ou de régions d'intérêt.

La deuxième approche consiste à intégrer des mécanismes de retour de pertinence [LU2003, KUR2015], approches qui permettent de prendre en compte le point de vue des radiologues sur les images retrouvées par le système. L'idée repose sur le fait que

l'utilisateur dispose de connaissances de haut-niveau sur les images qu'il recherche et qu'il est donc le plus à même de juger de la pertinence des images retournées par la recherche.

Finalement, la troisième approche est d'intégrer des stratégies de recherche de cas similaires permettant aux systèmes de recherche d'images de ne pas être limités à une recherche « image par image » mais à retrouver des cas similaires, en prenant en compte plusieurs séquences complémentaires d'images comme en IRM multiparamétrique(T1, T2, T1 fatSat …,) comme illustré sur la figure 1, ou des images issues de modalités différentes (CT, PET, IRM, US).

Objectifs de la thèse: Le sujet de doctorat proposé fait suite à plusieurs travaux préliminaires concernant respectivement le développement logiciel en Java de la plate-forme iCBMIR destinée à la recherche automatique d'images radiologiques, à l'intégration au sein de cette plate-forme de premiers mécanismes de retour de pertinence et, à leurs applications à des bases d'images radiographiques des tumeurs osseuses [KUR2015]. Ces premiers travaux ont été suivis d'une adaptation des algorithmes de recherche d'images similaires à la recherche de cas similaires dans le cadre d'images d'IRM multi-paramétriques.
Encouragés par ces résultats prometteurs, les objectifs de ce doctorat portent sur l'étude de la fusion d'informations extraites des images des différentes séquences IRM ou de modalités d'acquisition différentes, mais aussi d'informations textuelles provenant de compte-rendus radiologiques par exemple. En effet il est important d'étudier les modalités de fusion, les poids affectés à chaque source d'information (descripteurs ou termes sémantiques extraits des images multiparamétriques ou multimodales, termes sémantiques extrait de rapports). Ces poids peuvent être modulés en fonction de la connaissance extraite après des experts, mais il est également important d'étudier les possibilités d'apprendre ces différents poids, notamment à l'aide de méthodes d'apprentissage supervisées, et notamment des méthodes de *Deep Learning* qui s'avèrent très performantes dans de nombreuses tâches de reconnaissance aussi bien dans le domaine de l'image que dans le domaine textuel.
Cependant elles laissent encore actuellement un nombre de questions scientifiques ouvertes concernant l'obtention d'un nombre suffisant d'images étiquetées permettant un bon apprentissage, la possibilité d'appendre des représentations visuelles et textuelles [ZHE2020] et enfin la difficulté à donner une explication argumentée sur le résultat de obtenu. Ces problématiques de *data augmentation*, de *transfer learning* à partir de bases d'images non spécifiques [KRI2012], [RUS2015], et d'interprétabilité [RIB2016] du résultat seront au cœur du travail de recherche développé, de manière à obtenir un système interprétable et le plus générique possible dans le cadre de l'imagerie médicale, qui soit utilisable même en présence de cas pathologiques rares.
Ces mécanismes d'apprentissage des poids pourront également être introduits dans le développement de nouvelles approches de retour de pertinence basées sur un « effet mémoire » pour déterminer automatiquement les poids affectés aux différentes séquences IRM (ou différentes modalités d'imagerie) lors de la recherche de cas similaires.

Le(la) candidat(e) recruté(e) participera également au développement logiciel de la plate-forme iCBMIR destinée à la recherche automatique d'images radiologiques et programmée via le langage Java. Les images seront extraites du PACS de l'HEGP après anonymisation et enrichissement contextuel.

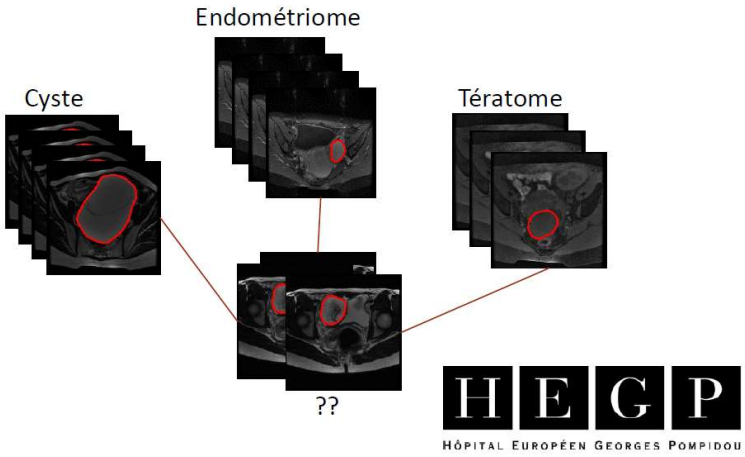

Figure 1 : exemple de recherche de cas similaires dans le cadre de l'aide au diagnostic de masses ovariennes à partir d'images d'IRM multiparamétriques

Description de la structure d'accueil: LIPADE (Laboratoire Informatique Paris Descartes – Université Paris Descartes)

L'équipe Systèmes Intelligents de Perception (SIP), dirigée par Laurent Wendling, est située au sein de l'UFR Mathématiques et Informatique de l'Université Paris Descartes. Née en Janvier 1990, rattachée depuis 1998 au Laboratoire d'Informatique de Paris Descartes (LIPADE), son action thématique s'oriente essentiellement vers le domaine de la Perception Visuelle accompagné de quelques éléments d'Intelligence Artificielle tels que le filtrage sémantique, l'utilisation du contexte ou encore le contrôle intelligent. L'équipe a développé un axe prioritaire "Analyse et Interprétation d'images". L'objectif étant de développer des méthodes issues de la reconnaissance des formes, de l'analyse d'images et de l'intelligence artificielle pour apporter des solutions fonctionnelles et originales à différentes problématiques.

Ce doctorat s'inscrit dans le cadre d'une collaboration entre le laboratoire d'Informatique de Paris Descartes (LIPADE) et l'équipe du service de radiologie de l'HEGP, reliée au Laboratoire de Recherche en Imagerie du PARCC, équipe 2 de l'UMR970 INSERM-Paris Descartes. Un des axes thématiques du laboratoire est centré sur l'imagerie fonctionnelle des tumeurs, afin d'améliorer le diagnostic, le bilan et l'évaluation des traitements des cancers. L'appartenance des encadrants à la fois au Laboratoire et au service de Radiologie permet de favoriser la translation des techniques développées chez le petit animal aux patients. En recherche clinique, des travaux sur la lecture et les comptes rendus standardisés des examens, ainsi que l'annotation sémantique sont en cours, afin de favoriser la constitution au fil de l'eau d'une base de données permettant les études rétrospectives sur des cohortes de patients et des banques de données pour l'enseignement.

Profil recherché pour le/la candidat/e:
Nous recherchons un(e) étudiant(e) ayant un Master 2, Informatique ou Analyse d'images, ayant des compétences en traitement d'images, fouilles de données, Informatique bio-médicale et ayant un goût prononcé pour le développement logiciel, notamment avec le langage Java, et l'évolution dans un contexte interdisciplinaire. Des bonnes compétences en Anglais sont également nécessaires. Pour toute candidature envoyer un CV + lettre de motivation a :

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Références

[DEP2014] Depeursinge, A., Kurtz, C., Napel, S., Beaulieu, C. & Rubin, D (2014) Predicting Visual Semantic Descriptive Terms from Radiological Image Data: Preliminary Results with Liver Lesions in CT, IEEE Transactions on Medical Imaging, 33(8):1669-1676, IEEE Signal Processing Society.

[KRI2012] A. Krizhevsky , I. Sutskever , G.E. Hinton , Imagenet classification with deep convolutional neural networks, in: Advances in Neural Information Processing Sys- tems, 2012, pp. 1097–1105 .

[KUR2014] Kurtz, C., Depeursinge, A., Napel, S., Beaulieu, C. & Rubin, D (2014) On combining image-based and ontological semantic dissimilarities for medical image retrieval applications, Medical Image Analysis, 18(7):1082-1100, Elsevier.

[KUR2015] Kurtz, C., Idoux, P., Thangali, A., Cloppet, F., Beaulieu, C. & Rubin, D. (2015) Semantic retrieval of radiological images with relevance feedback, In Proceedings of the Multimodal Retrieval in the Medical Domain workshop -- MRMD 2015, 9059, Springer. Vienna (Austria)

[LU2003] Lu, Y., Zhang, H., Wenyin, L., & Hu, C. (2003) Joint semantics and feature basedimage retrieval using relevance feedback. IEEE Transactions on Multimedia, 5(3), 339-347.

[RIB2016] Ribeiro, M. T., Singh, S., & Guestrin, C. (2016, August). Why should i trust you? Explaining the predictions of any classier. In Proceedings ACM SIGKDD International Conference on Knowledge Discovery and Data mining (pp. 1135-1144).

[RUS2015] Russakovsky, O., Deng, J., Su, H., Krause, J., Satheesh, S., Ma, S., & Berg, A. C. (2015). Imagenet large scale visual recognition challenge. International Journal of Computer Vision, 115(3), 211-252.

[ZHE2020] Zhedong Zheng, Liang Zheng, Michael Garrett, Yi Yang, Mingliang Xu, and Yi-Dong Shen. 2020. Dual-path Convolutional Image-Text Embeddings with Instance Loss. ACM Trans. Multimedia Comput. Commun. Appl. 16, 2, Article 51 (June 2020), 23 pages. DOI:https://doi.org/10.1145/3383184

Title: Proactive Mobility, Naming and Caching in Next Network Generation based Mobile service

Abstract

Forthcoming 5G and 6G networks raise an important research issue of seamless mobility management of cellular and non-cellular networks. Adopting Information Centric Networking (ICN) architecture as common mobility management is promising because existing mobility management mechanisms are complicated and incur large signaling overhead. ICN architectures target to substitute present host-centric IP network by an information-centric vision for effective, reliable, and secure information dissemination. It is based on various prominent principles like publish/subscribe model, named content, innetwork caching, and security over atomic information objects. These features allow a data chunk to be cached and retrieved from multiple nodes in the network, and can be validated without building a connection with its host. Though these tenets simplify the mobility problem in ICN, seamless mobility for real-time applications still demands a control plane. It remains to expand the futur complex network architecture capable of conveying this IoT traffic while ensuring that of the other types of traffic in a cost-effective manner and with a sufficient quality of service and Experience. To overcome the aforementioned drawbacks, one alternative solution could be the usage of proactive framework for caching and naming to forecast both user's content request allocation and mobility pattern though having only restricted information on the user's and network's status. Especially in fast changing scenarios where objects/nodes/users' positions are varying due to the mobility. On other hand one of the objectives of this thesis is to expand a mathematical framework to optimize and construe prospective complex systems typified via their wide dimensions, their stochastic aspects, and their being self-organized, like small cell telecommunication networks and/or smart grids.

Description of the main thesis activities:

The objective of the thesis is to develop an architecture and expand a mathematical framework to optimize and construe prospective complex tools to ensure a new proactive naming and caching framework that can accurately predict both the content demand distribution and mobility template of every consumer and, thereafter, cache the best appropriate contents while minimizing resources supporting IoT slices within ICN/SDN distributed controllers.

The candidate will work on three main contributions:

- Distributed implementation of an optimized caching and naming decentralized controller architecture to help with registration and resolution of name/locator mappings

- Proactive resource and mobility prediction and dynamic optimization of ICN over IoT for 5G networks.

  • facilitate mobility in ICN/CCN through the concept of AI/NI Split

  • Seamless mobility is achieved based proactive renew of mobility states to facilitate with re-routing benefit

- Realizing ICN service as numerous interacting virtual slices – Base Mobility, Network, Service slice

Firstly, the candidate will work on the definition of distributed framework optimized caching and naming decentralized controller to dynamically allocate resources to different slices. We will also study the optimal placement algorithms of controllers that permit performance optimization criterion such as minimizing Energy, latency between the controller and switches, maximizing controller connectivity based the proactive mobility plane and so on. As most popular scenarios

– Smart Transportation: Very short Response time Ad-hoc + Infrastructure communication with mobility, secure data collection and exchange

– Smart Healthcare: Security/Privacy/Trust, High Reliability, short-communication latency

Required skills

- A Master's degree or an engineer Computer Science and /or Applied Mathematics or assimilable.

- Good understanding of the fundamental of and network science in general

- Knowledge in optimization theory, machine learning theory, graph theory, stochastic processes, Bayesian networks and/or Game theory are highly desirable.

- Programming potential in various languages (Python, C/C ++,Matlab, Java,...etc).

- A good level of English, sufficient to publish in International journals.

- A strong curiosity in research interdisciplinarity.

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Description

Date depot: 11 avril 2022
Titre: Fusion multi-niveaux pour la réponse automatique à des questions visuelles sur des images de télédétection
Directeur de thèse: Laurent WENDLING (LIPADE)
Encadrant : Sylvain LOBRY (LIPADE)
Domaine scientifique: Sciences et technologies de l'information et de la communication
Thématique CNRS : Images et vision

Resumé: De grandes quantités d'images de télédétections sont aujourd'hui facilement accessibles grâce aux efforts venant des secteurs public et privé. Un exemple fort sont les satellites Sentinel lancés depuis 2014 dans le cadre du programme Copernicus de l'Union Européenne. Cette mission offre un accès libre à des images de natures différentes (multi-spectral et radar notamment) avec une grande couverture spatiale et un temps de revisite court. Cependant, il peut être difficile d'extraire de l'information des images de télédétection. Cette interpretation est généralement faite par des experts, et implique souvent un travail manuel, qui devient un facteur limitant avec l'augmentation de la quantité de données produites. Ainsi, des méthodes automatiques ont été développées pour des applications d'intérêt général (par exemple: le suivi des feux de forêts) ou présentant un intérêt financier. Cependant, les informations contenues dans ces images peuvent être d'intérêt pour un publique bien plus large. Par exemple, les journalistes pourraient suivre d'une manière indépendante les guerres ou les effets du déréglement climatique. Les administrations locales pourraient utiliser cette information dans la prise de décision. Enfin, les citoyens sont aussi intéressés par leur environnement, comme le montre le succès d'initiatives telles que OpenStreetMap ou Google StreetView. Alors que les données sont là, le grand public n'a pas la compétence pour en extraire une information utile. Notre objectif est donc de permettre l'extraction d'information via des modèles permettant de répondre automatiquement à des questions posées (en langage naturel) à propos d'un ensemble d'images de télédétection (de différentes modalités). Cette tâche de visual question answering (VQA) a été récemment proposée dans la communauté de la vision par ordinateur [1] et pour la télédétection [2]. Dans cette thèse nous nous intéresserons aux opérations permettant la fusion des caractéristiques extraites de la question, et celles des images de différentes modalités. L'objectif sera de proposer de nouvelles méthodes permettant de prendre en compte les différents niveaux d'information contenus dans les différentes modalités en lien avec la requête en langage naturel. L'encadrement se fera conjointement avec Sylvain Lobry (LIPADE – Équipe SIP) et pourra faire l'objet de collaborations et de visites avec d'autres équipes de recherche à l'internationale travaillant sur ce sujet.

Résumé dans une autre langue: Large amounts of remote sensing images are now readily available thanks to efforts coming from the public and private sectors. A strong example are the Sentinel satellites launched since 2014 as part of the European Union's Copernicus program. This mission offers free access to images of different natures (multi-spectral and radar in particular) with a large spatial coverage and a short revisit time. However, it can be difficult to extract information from remote sensing images. This interpretation is usually done by experts, and often involves manual processing, which becomes a limiting factor as the amount of data produced increases. Thus, automatic methods have been developed for applications of general interest (e.g. monitoring forest fires) or of financial interest. However, the information contained in these images can be of interest to a much wider audience. For example, journalists could independently monitor wars or the effects of climate change. Local governments could use this information in decision making. Finally, citizens are also interested in their environment, as shown by the success of initiatives such as OpenStreetMap or Google StreetView. While the data is there, the general public does not have the skills to extract useful information from it. Our goal is therefore to enable information extraction via models that automatically answer questions asked (in natural language) about a set of remote sensing images (of different modalities). This visual question answering (VQA) task has been recently proposed in the computer vision community and for remote sensing. In this thesis, we will focus on operations allowing the fusion of features extracted from the question, and those from images of different modalities. The objective will be to propose new methods to take into account the different levels of information contained in the different modalities in relation to the natural language query. The supervision will be done jointly with Sylvain Lobry (LIPADE - SIP team) and may involve collaborations and visits with other international research teams working on this topic.

Voir le PDF descriptif

 Version 1.32

Description

Date depot: 6 avril 2021
Titre: Modélisation et apprentissage profond de relations spatiales quantitatives pour l'interprétation sémantique de scènes
Directeur de thèse: Laurent WENDLING (LIPADE)
Encadrant : Camille KURTZ (LIPADE)
Domaine scientifique: Sciences et technologies de l'information et de la communication
Thématique CNRS : Images et vision

Resumé: L'équipe Systèmes Intelligents de Perception (SIP) du LIPADE est spécialisée dans l'analyse d'images fortement sémantiques, pour la résolution de problèmes autour du bio-médical, de la télédétection et de l'analyse de documents. Retrouver la structure sous-jacente de ces images par le biais d'indices (pouvant être complexes) et modéliser les éventuelles interactions entre ceux-ci est fondamental pour extraire les connaissances en vue d'une interprétation. Les principaux travaux s'articulent essentiellement autour de trois axes de recherche allant de l'analyse et la description de l'image aux modèles de représentation vers l'intégration de connaissances. Dans de nombreux domaines, les quantités d'images et de vidéos acquises deviennent de plus en plus importantes, formant de véritables masses de données. Face à la grande complexité de ces dernières, les approches automatiques de traitement et d'analyse d'images, purement fondées sur des caractéristiques bas-niveaux extraites du contenu des images, montrent leurs limites et peuvent produire des résultats qui parfois ne sont pas suffisamment pertinents pour les besoins applicatifs de l'utilisateur. De nombreuses méthodes de reconnaissance des formes sont fondées, par exemple, sur le calcul de descripteurs de formes sur des régions extraites à partir d'une phase de segmentation issue ou non d'un apprentissage. Si les approches classiques, maintenant largement fondées sur des caractéristiques convolutionnelles apprises via une architecture neuronale, permettent d'obtenir des résultats satisfaisants dans de nombreuses situations, elles négligent la structure spatiale et son évolution temporelle, décrite par les objets de la scène. Il existe en particulier des familles d'approches globales qui associent à la forme un vecteur de caractéristiques mais elles ne prennent généralement pas en compte les disparités de cette dernière. Ceci permet d'intégrer plus facilement l'aspect spatial mais les approches sont souvent sensibles au bruit et requièrent des simplifications grossières et/ou une phase d'appariement coûteuse en temps lors de la mise en correspondance. Dans le contexte de ce projet de thèse (voir descriptif détaillé) de doctorat en Informatique, nous proposons d'explorer et de définir de nouvelles représentations composites qui intègrent des familles de descriptions spatiales complexes entre couples de régions (et interne à chaque région) et d'étudier la possibilité d'intégrer celles-ci dans des approches fondées sur les Graph-CNN pour garantir une représentation plus fine des scènes considérées. L'encadrement se fera conjointement avec Camille Kurtz et Sylvain Lobry (LIPADE - équipe SIP).

Résumé dans une autre langue: The Intelligent Perception Systems (SIP-LIPADE) team develops a priority axis on image analysis and interpretation with a specific focus on visual perception for computer around three main themes: biomedical, remote sensing and document analysis. The goal is to develop methods from pattern recognition, image analysis and artificial intelligence theory to provide functional and original solutions to different problems related to visual perception. By using a large amount of data, automatic approaches to image processing and analysis, which rely mainly on low-level features extracted from the content of images, show their limits and can produce results that are sometimes inconsistent and non-interpretable. Many pattern recognition methods are based, for example, on the calculation of pattern descriptors on regions extracted from a segmentation phase achieved or not from a learning step. Although the classical approaches, now largely based on convolutional features learned thanks to the neuronal architecture, allow to obtain satisfactory results in many situations, they fail to efficient handle the spatial structure and its temporal evolution, described by the objects of the scene. There are in particular families of global approaches which associate a vector of features with the shape, but they generally do not take into account their disparities. This facilitates the handling of the spatial description, but the approaches are often sensitive to noise and require rough simplifications during the matching step. In the context of this doctoral thesis project (see detailed description) in Computer Science, we propose to explore and define new composite representations that integrate families of complex spatial descriptions between pairs of regions (and internal to each region) and to study the possibility of integrating these into approaches based on Graph-CNN to guarantee a finer representation of the scenes considered. The supervision will be done jointly with Camille Kurtz and Sylvain Lobry (LIPADE - SIP team).

Voir le PDF descriptif

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Description

Date depot: 12 avril 2022
Titre: Explainable and Trustable Automated Negotiations
Directeur de thèse: Pavlos MORAITIS (LIPADE)
Encadrant : Jean-Guy MAILLY (LIPADE)
Domaine scientifique: Sciences et technologies de l'information et de la communication
Thématique CNRS : Intelligence artificielle

Resumé: In the coming 15 years artificial intelligence will have to participate in the digital transformation of the society by including new domains that are not currently accessible by the recent developments of (especially statistical) AI. These domains are related to different aspects of people's personal, social and professional life that generate conflicts which are time and money consuming for solving them. Such conflicts arise in divorces, road accidents, layoffs, business contracts, etc. Therefore, the aim of the forthcoming artificial intelligence research directions should be to facilitate people's personal and professional life by saving time and money. A research direction that may provide trustable solutions for conflicts resolution is automated negotiation. Apart the business domain where automated business negotiations should allow increasing profitability by saving time and resources as they could allow negotiating thousands of deals in parallel, we do believe that automated negotiation could also revolutionize other aspects of people's personal and social life by dealing for example with divorces, road accidents and layoffs. We call these negotiations legal negotiations. Indeed, the common characteristic of these three situations is that conflicts resolution is based on the strict application of a dedicated legislation that doesn't need a human judge's law subjective interpretation and sometimes personal intimate conviction as it is the case in other situations as for example homicides. Therefore, automating conflicts resolution involved in everyday people’s personal, social and professional life through automated negotiation will have an important social impact. However automated legal and business negotiations have to be explainable and trustable in order to be adopted by governments and people. That means that the agreements that will be proposed to the litigants (in the situations involving personal and professional people's life) have to be accompanied with explanations that present the laws (and the law cases) that have been applied, in order to create trust and allow acceptability. To the same way, the success and trust on automated business negotiations is based on the possibility of the negotiating parts to defend their offers (and counter offers) by explaining the reasons why an offer is proposed rather than another. Our aim in this thesis will be to propose a platform for automated legal and business negotiations based on computational argumentation [1] that allows to deal with the requirements presented above. This platform will allow automated argumentation-based legal negotiations for conflicts whose resolution is based on application of law (i.e. divorces, road accidents, layoffs) and automated argumentation-based business negotiations where conflicts resolution is based on the search of mutually accepted agreements. For realizing this work, we will extend the frameworks proposed in [2,3]. Indeed, the above frameworks are based on abstract argumentation and the challenge in this thesis will be to adapt them for structured argumentation as we will have to represent application specific knowledge for which the claims and the supporting evidence/information of the arguments must be explicitly described. For validating the theoretical work, we will be developing a proof of concept (POC) of the proposed platform. References [1] Y. Dimopoulos, P. Moraitis. Advances in Argumentation-based Negotiation, Chapter 4, in Negotiation and Argumentation in Multi-Agent Systems: Fundamentals, Theories, Systems and Applications, pp. 82-125, F. Lopes and H. Coelho (Eds.), Bentham Science Publishers, 2014 [2] Y. Dimopoulos, JG. Mailly, P. Moraitis. Arguing and Negotiating using Incomplete Negotiators Profiles, Autonomous Agents and Multi-Agent Systems, 35, 18 (2021) [3] Y. Dimopoulos, JG. Mailly, P. Moraitis. Argumentation-based Negotiation with Incomplete Opponent Profiles, in AAMAS'19, pp. 1252-1260, Montreal, Canada, 2019

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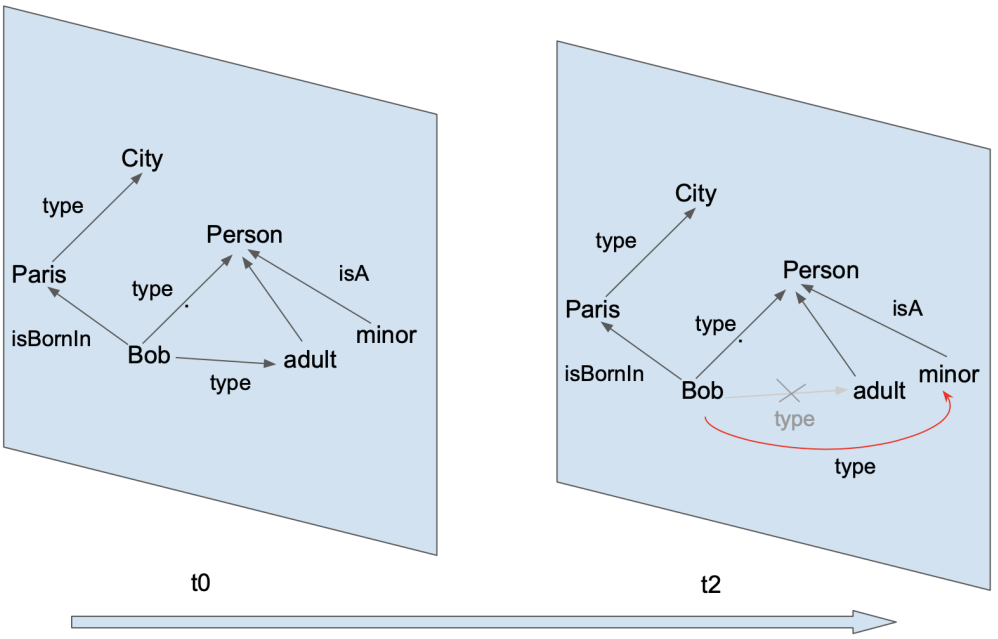
Temporal Reasoning for Web Data Cleaning in a World Evolving

Problem statement and Context

With the increasing availability of web data, we are witnessing the proliferation of businesses engaged in automatic data extraction from thousands of web sources with the goal of cleaning useful information and intelligence about people, companies, countries, products, and organizations [1]. However, the data cannot be used as-is because of errors with inconsistency and uncertainty that are in the sources themselves (which can be knowledge bases, databases etc) as well as those due to the automatic extraction.

As an example, considering the DBpedia knowledge graph which is a (human and automatic) extraction from Wikipedia, there are 1761 disjointness inconsistencies between the only entities *Place* and *Person* in DBpedia according to the results of [8]. That is, the same resource is typed at the same time as *Person* and *Place*. Another example is represented as a knowledge graph and depicted in the following figure: at time t_0 Bob is considered as an adult and at time t_{0+2} is considered as minor. The evolution of the resource/person *Bob* from adult to minor is not possible. This is a time-based inconsistency (red edge) that we aim to detect and repair. Some other inconsistencies may be hidden and couldn't be detected using traditional query languages such as SPARQL. They need to be handled using more intelligent system based on combined symbolic AI (logics) and statistical AI (machine learning).



In fact, time is crucial in information processing because events occur at specific points in time and also the relationships among objects exist over time. Many data sets contain

temporal records which span a long period of time; each record has semantic attributes associated (explicitly or implicitly) with a timestamp and describes some aspects of a real world entity at a particular time (eg., author information in DBLP) [2][3]. The ability to model this temporal dimension is therefore necessary in real-world applications such as banking, medical records and geographical information systems, sentiment analysis in political domain etc. Traditional ontology languages generally reflect static information and do not support full access to temporal data and all reasoning tasks such as satisfiability problems, query answering etc. A major challenge in this task of dealing with temporal information comes from the combined need of modeling it and being able to handle the inefficiency of data, especially when this latter one is inconsistent, i.e, in contradiction with the domain of interest which could also be dynamic [4][5]. The aim of the thesis is to study the automation of temporal reasoning over temporal ontologies and knowledge bases to identify the error and the inconsistency in order to repair [6] those data for better predictions in decision making based on a clean world.

Thesis goal

This PhD thesis aims to propose an intelligent framework to enhance quality of of knowledge base taking into account the time dimension, in particular, the work will handle the following contributions:

- Propose an approach on how to detect the inconsistency in expressive knowledge bases
- Propose a formal approach to repair the temporal errors using probabilistic techniques to find the best semantic repair
- Propose a summarization/abstract approach in order to handle the scalability
- Implementation of the proposed approach.

Required Skills: Data management, symbolic IA, machine learning, probabilistic modeling

References

[1] S. Trouvé. A white Paper on temporal analytics www.recordfuture.com/assets/RF-white-paper.pdf

[2] Ziawasch Abedjan, Cuneyt Gurcan Akcora, Mourad Ouzzani, Paolo Papotti, Michael Stonebraker:Temporal Rules Discovery for Web Data Cleaning**.** Proc. VLDB Endow. 9(4): 336-347 (2015).

[3] F. Li, M. Lee, W. Hsu, and W. Tan. Linking temporal records for profiling entities. In SIGMOD, pages 593–605, 2015.

[4] Jiaoyan Chen, Xi Chen, Ian Horrocks, Erik B. Myklebust, Ernesto Jiménez-Ruiz: Correcting Knowledge Base Assertions. WWW 2020: 1537-1547

[5] Meghyn Bienvenu, Camille Bourgaux, François Goasdoué: Explaining Inconsistency-Tolerant Query Answering over Description Logic Knowledge Bases. AAAI 2016: 900-906

[6] S. Tahrat, S.Benbernou, M.Ouziri: Temporal ABox Cleaning in TDL-Lite. Description Logics 2021.

[7] Amrapali Zaveri, Dimitris Kontokostas, Mohamed A Sherif, Lorenz Bu¨hmann, Mo- hamed Morsey, So ¨ren Auer, and Jens Lehmann. User-driven quality evaluation of dbpedia. In Proceedings of the 9th International Conference on Semantic Systems, pages 97–104. ACM, 2013.

[8] Daniel Caminhas, Daniel Cones, Natalie Hervieux, Denilson Barbosa: Detecting and Correcting Typing Errors in DBpedia. DI2KG@KDD 2019

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