PhD Position F/M [Campagne DOC BMI-NF-GRA-2024]
Modelling cultural knowledge evolution with dynamic epistemic logics and belief revision

Contexte et atouts du poste

Cultural knowledge evolution considers how agents can evolve their knowledge through communicating and adapting it. Knowledge adaptation may be modelled as belief revision operators.

Cultural knowledge evolution deals with the evolution of knowledge representation in a group of agents. For that purpose, cooperating agents interact with their environment and other agents. When these agents find their behaviour inadequate, which can be detected by failing to understand others, they use operators to adapt their beliefs. This framework, originating from social sciences [Mesoudi, 2011], has been considered in the context of evolving natural languages [Steels, 2012]. We have applied it to ontology alignment repair, i.e. the improvement of incorrect alignments [Euzenat, 2017] and ontology evolution [Bourahla et al., 2021]. We have shown that it converges towards successful communication through improving the intrinsic knowledge quality.

This can be thought of as agents revising their beliefs when something tells them that they may not be correct. Belief revision operators have been designed for that purpose [Fermé and Hansson, 2018]. Multi-agent dynamic epistemic-doxastic logics (DEL for short) are dedicated to describe agent knowledge and beliefs and modelling agent actions, such as communicating, through dynamic modal operators [van Ditmarsch et al., 2007]. Belief upgrade modalities available in dynamic epistemic logics enable them to revise beliefs in the face of new information and can be thought of as belief revision [Baltag and Smets, 2006; van Benthem, 2007].

This Phd position aims at investigating deeper the relationships between cultural knowledge evolution on the one hand and dynamic epistemic logics and belief revision, on the other hand. There are, at least, two possible distinct starting points for that purpose.

First, dynamic epistemic logics have been used, in a bottom-up fashion, to model specific cultural knowledge evolution experiments and to prove the properties of adaptation operators [van den Berg, 2021]. This also raised new questions about the adequacy of dynamic epistemic logics in this context.

It would be useful to take a top-down approach to understand how far the parallel between belief upgrade and belief revision can be pursued and if this is sufficient to model more elaborate cultural knowledge evolution experiments. Indeed, although dynamic epistemic logics offer belief revision, it is hidden within the semantics of communication actions instead of being independent belief revision operators. It is thus unclear that they can really be seen as pro bono revision operators, nor that they would be sufficient in all cases. For instance, agents may perform indirectly observable actions from which other agents may induce knowledge.

Some questions that arise in relation to this problem are:

- Are the mechanisms used in dynamic epistemic logic sufficient for all kinds of adaptation
operators?
- Can they be expressed in a generic way through 'event models' used to express DEL's semantics?
- What other types of revision operators can be included within dynamic epistemic logics?

Second, modal logics, such as multi-agent dynamic epistemic logics, consider the knowledge of all agents globally, but very little the connections between agent knowledge, beside epistemic-doxastic modalities (e.g. the fact that an agent knows what another agent believes). Another way to consider belief revision in the context of cultural knowledge evolution is to consider that agents cooperatively revise common knowledge, instead of revising independently their own particular knowledge and beliefs.

Relations between agent knowledge can be expressed in the form of alignments between their knowledge. These are syntactic devices that relate terms of the theories, instead of formulas. Revision of networks of ontologies made of ontologies and alignments have already been studied [Euzenat, 2015]. It would be worth considering these in the context of dynamic epistemic logics with the alignments affecting communicative actions (queries, announcements, etc.), e.g. query answers being evaluated modulo alignments or announcements being only effective if corresponding alignments exist. In complement, the outcome of communicative actions may be belief or alignment revision. This would loosely model how knowledge and communication are dependent. Hence, it would be worth understanding how communication, enabled by alignments, influences revision and how revision influences communication.

More generally, these two research directions may contribute reconnecting multi-agent dynamic epistemic logics and distributed approaches to belief revision.

References:
[Fermé and Hansson, 2018] Edoardo Fermé, Sven Olof Hansson, Belief change: introduction and overview, Springer, Cham (CH), 2018

Links:
- MIAI Knowledge communication and evolution: https://moex.inria.fr/cooperation/miai/
- moEx web site: https://moex.inria.fr
- Lazy lavender: https://gitlab.inria.fr/moex/lazylav

See also this link: https://moex.inria.fr/joinus/2023-Th-cebr.html

Principales activités

Main activities:
- Analyse the state of the art
- Problem formalization
- Software development
- Propose & design experiments
- Write scientific reports & articles

Compétences

Qualification: Master or equivalent in computer science.

Researched skills:
Curiosity and openness.
Interaction with other researchers.
Autonomous researcher.
Solid logic background.
Knowledge of dynamic epistemic logics and/or belief revision would be a plus.
Innovative.

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (90 days / year) and flexible organization of working hours (except for internship)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage under conditions

Rémunération

1st and 2nd year: 2 100 euros gross salary / month
3rd year: 2 190 euros gross salary / month

Informations générales

- Thème/Domaine : Représentation et traitement des données et des connaissances
- Ville : Montbonnot
- Centre Inria : Centre Inria de l'Université Grenoble Alpes
- Date de prise de fonction souhaitée : 2024-10-01
- Durée de contrat : 3 ans
- Date limite pour postuler : 2024-04-30

Contacts

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- Directeur de thèse :
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A propos d'Inria

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Attention : Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

Consignes pour postuler

CV, cover letter, Master's grades, a letter of recommendation from the Master's course supervisor (or equivalent), possibly a letter of recommendation from the master's supervisor.

Sécurité défense : Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

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