The main objective of this thesis is to unify existing results obtained independently in the fields of within the foundations of game theory and artificial intelligence. The treatment of the acquisition of information as well as information processing is studied by mathematicians and engineers within the framework of information theory. Alternatively, decision-making processes are studying within the foundations of game theory and control theory. Surprisingly, the progress toward a unified mathematical theory including the processing are studied by mathematicians and engineers within the framework of information theory, game theory, and artificial intelligence. The starting date of the PhD is September 2019.

**Contexte et atouts du poste**

**About INRIA**

Established in 1967, INRIA is the only public research body fully dedicated to computer sciences and applied mathematics in France. In close cooperation with leading international universities and the main players in public and private research in France and abroad, INRIA’s 3,400 researchers strive to invent the digital technologies of the future. INRIA hosts basic research and applied research groups spanning all domains in computer science and applied mathematics within eight research centers across France and several international research centers in Asia, South and North America. One of the main roles of INRIA is to foster the transfer between its research centers and innovative companies developing products and services around the globe.

One of the laboratories hosting Inria staff in Lyon is the Laboratoire CITI. The CITI is a joint laboratory between INRIA, the Université de Lyon and the Institut National de Sciences Appliquées (INSA) de Lyon.

**About The University of Sheffield**

With almost 25,000 of the brightest students from around 120 countries, learning alongside over 1200 of the best academics from across the globe, the University of Sheffield is one of the world’s leading universities. A member of the UK’s prestigious Russell Group of leading research-led institutions, Sheffield offers world-class teaching and research excellence across a wide range of disciplines. Sheffield has five Nobel Prize winners among former staff and students and its alumni go on to hold positions of great responsibility and influence all over the world, making significant contributions in their chosen fields. The Department of Automatic Control and Systems Engineering is one of the largest departments devoted to the subject in Europe, with 28 academic staff, 43 research staff, 29 professional and support staff and nearly 400 taught and research students. It is a world-leading research department, as evidenced by the results of the 2014 Research Excellence Framework (REF2014) exercise - out of 62 UK institutions specialising in multi-disciplinary and inter-disciplinary engineering, the Department was ranked first for quality of research publications.

**Mission confiée**

This PhD position is opened within the collaboration between INRIA and the University of Sheffield (TUOS) in the areas of information Sciences and Systems. The PhD student is fully funded by INRIA and hosted in France by the Laboratoire CITI in the scientific campus of Lyon. The PhD student will be supervised by Prof. Iñaki Esnaola (Sheffield) and Prof. Samir M. Perlaza (INRIA). The research topic lies in the broad intersection of information theory, game theory, and artificial intelligence. The starting date of the PhD is September 2019.

**Principales activités**

Most daily-life activities of both humans and machines depend upon a simple yet central set of capacities inherent to humans and recently granted to machines: acquisition of information, information processing, and decision making. The acquisition of information as well as information processing are studied by mathematicians and engineers within the framework of information theory. Alternatively, decision-making processes are studying within the foundations of game theory and control theory. Surprisingly, the progress toward a unified mathematical theory including the advances in information theory, game theory and control theory are relatively minor. Most of the current literature is developed under the assumption that decision makers possess complete information in order to make decisions and interact with each other. The most comprehensive developments suggest Bayesian approaches to model via priors the lack of information. Nonetheless, within the current Bayesian approach, the impact of perturbations to the state of knowledge either because of loss or acquisition of additional data is difficult to quantify.

The main objective of this thesis is to unify existing results obtained independently in the fields of...
mathematics and engineering for the study of the behavior of humans and machines under the assumption that information is not perfect but rather acquired through systems with limited acquisition capabilities such as biological sensors, e.g., eyes, ears, skin, etc, and electronic sensors, e.g., cameras, communication systems, data collectors, etc. Essentially, this thesis seeks to quantify the notion of incomplete information using information measures such that decision-making processes can be quantitatively studied and, for instance, the probability of making mistakes or making decisions that may harm individual interests can be precisely estimated as a function of the distortion on the random variables describing the environment. Hence, the findings of this thesis would lead to clear answers to questions of the form: Given the available information about the random variables describing the environment, what is the probability of making a decision that might induce a regret to the decision maker? Given the rate at which information about the environment is received, what is the minimum time interval that minimizes the probability of regret?

Compétences
Candidates are expected to have a strong background in mathematics.
Abilities in algorithm design and computer programming are also essential.
Previous knowledge on information theory, game theory and signal processing is desirable.
The candidate must have a provable level of written and spoken english. Skills in french language are not required.

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 (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération