Research internship (Master)

Title: Dealing with inconsistencies in biological networks

Topic: Bioinformatics / Logic
Lab: LRI/INRIA Saclay Ile-de-France (University Paris Sud, CNRS and INRIA)
City: Orsay
Team: INRIA AMIB and LRI Bioinfo
Advisor: Christine Froidevaux, Christine.Froidevaux@lri.fr
Head of the laboratory: Nozha Boujemaa (INRIA) and Philippe Dague (LRI)

General presentation of the topic

This internship is done in the context of a current collaboration between INRA (Tours) and INRIA which aims to help the understanding of signalling pathways involving G protein-coupled receptors which are excellent targets in pharmacogenomics. Building signalling networks is a particularly challenging task in bioinformatics. Exploiting the very numerous and heterogeneous data available is crucial in this context. We have proposed a method that mimics the scientist's reasoning, modelling it by means of logical rules. We have thus developed a Knowledge-Base using the SOLAR solver (collaboration with NII) to automatically construct signalling pathways (represented as networks) by deduction from the data.

Objective of the internship

Networks may change over time because new data may become available. Exploiting the very numerous and various data available in a consistent way is crucial in this context. Causes of inconsistencies are various: they can involve noisy data coming from poorly conducted experiences or conflicting data provided by different labs. They may appear after updating the knowledge base with new information (new experiment or new logical rule) due to evolution of the knowledge or constraints given by the dynamic network.

Identification of all the minimal causes of inconsistencies will be performed. Also partition-based detection of inconsistencies will be investigated by suggesting several decompositions of the networks (distributed reasoning).

The second step of this internship consists in determining a strategy to repair the knowledge base. Criteria for admissible repairs will be specified, considering both biological relevance and need for computational efficiency. Then repairs operations will be proposed and implemented to modify facts and logical rules to get rid of inconsistencies. The impact of each modification on the whole networks will be evaluated.

Bibliographic references

Hidetomo Nabeshima, Koji Iwanuma, Katsumi Inoue and Oliver Ray, SOLAR: An automated deduction system for consequence finding, AI Communications 23, 183–203, 2010.

Domitille Heitzler, Pascale Crépieux, Anne Poupon, Frédérique Clément, François Fages and Eric Reiter, Towards a systems biology approach of G protein-coupled receptor signalling: challenges and expectations, C R Biologies 332(11):947-57, 2009.

Marie Agier, Christine Froidevaux, Jean-Marc Petit, Yoan Renaud, Jef Wijsen, On Armstrong-compliant logical query languages, 4th. Int. Workshop on Logic in Databases (LID 2011), Co-located with EDBT & ICDT 2011, Uppsala.

Expected ability of the student

Skills in theorem-proving are expected. An interest in biological systems will be appreciated.