2023-06588 - PhD Position F/M Non-parametric Bayesian mixture modeling applied to cell type deconvolution from bulk transcriptomic RNA-seq data

Contract type: Fixed-term contract
Level of qualifications required: Graduate degree or equivalent
Function: PhD Position

Context
The SISTM team is looking for a PhD student on the subject of non-parametric Bayesian mixture modeling applied to cell type deconvolution from bulk transcriptomic RNA-seq data. The SISTM team belongs to both the INSERM U1219 Bordeaux Population Health and the INRIA Bordeaux Sud-Ouest research centers. Its activity is focused around developing and applying high-dimensional statistical learning methods and mechanistic modeling for innovative vaccine trials.

Early phase vaccine trials are characterized by small sample sizes. Yet, they increasingly feature high-dimensional molecular data measurements, uncovering immunogenicity mechanisms and underlying cellular response determining vaccine effect. We set to develop new methods for (i) inferring cellular population abundance from bulk transcriptomics, (ii) predicting outcomes according to these correlated high dimensional data, and (iii) evaluate surrogacy for high-dimensional gene expression. Using the framework of adaptive classification, we wish to propose a novel adaptive supervised method for discriminant analysis of high-dimensional data while robust to the occurrence of classes not observed in the learning set. We will propose a new semi-parametric Bayesian mixture model for count data (RNA-seq data are often modelled with negative binomial distributions), using Dirichlet process prior with negative binomial kernels. This model assumes a potentially infinite mixture model (with a finite number of non-empty clusters), thus allowing the discovery of new mixture components. Variational estimation procedure will be used to tackle the high dimensionality of gene expression data. This new approach could be directly used to solve the current shortcomings in state-of-the-art methods for cell population proportion inference from gene expression. These new developments will be applied to Immunological sub-study embedded within COVERAGE (adaptive phase 3 randomized clinical trial evaluating several treatments strategies against COVID-19) and PREVACUP (a randomized clinical trial evaluating three different vaccine strategies against Ebola virus disease).

Contact:
Boris Hejblum
SISTM team
Inria BSG / Université de Bordeaux
boris.hejblum@inria.fr

Assignment
- Scientific surveillance of new methodological developments for cellular deconvolution from bulk transcriptomic data.
- Developing a new non-parametric Bayesian model for the deconvolution of bulk transcriptomic RNA-seq data to infer cell population abundance.
- Derive an efficient estimation procedure of the above model and implement it as an R package.
- Benchmark new developments and apply them to real data from vaccine trials.
- Communicate your results in international conferences and as scientific articles published in international peer-reviewed journal.

Main activities
- Follow-up of bibliographical activity concerning mechanistic model inference via deep learning approaches, which has been evolving rapidly in recent years.
- Coding and implementation of existing methods.
- Conceptual development of new approaches.
- Implementation of new approaches.
- Simulation and comparison of methods.
- Presentation of implemented methods both inside and outside the team, in the form of oral communications and/or scientific articles.

Skills
- A working knowledge of R programming and package development.
- A solid expertise in non-parametric Bayesian modeling.
- A marked interest for biomedical and immunological research and its development of scientific and entrepreneurial projects that have a worldwide impact.

Instruction to apply
Defence Security: This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PSPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PSPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy:
As part of its diversity policy, all Inria positions are open to women and men.

Warning: you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

About Inria
Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.
Applications

Benefits package

- 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

Positions are accessible to people with disabilities.