UTS:QCIS
QUANTUM COMPUTATION & INTELLIGENT SYSTEMS

Centre for
Quantum Computation & Intelligent Systems

University of Technology, Sydney, Australia

Predicting Treatment Outcomes with Genetics

The Scientific Basis of Personalised Medicine

The Vision

During pharmaceutical drug trials we apply new techniques in data mining to develop deep predictive models of treatment outcomes based on the patient's gene activity and genetic variation. This leads naturally to the clinician who then takes account of a patient's genetic code when prescribing a treatment program. This is the scientific basis of personalized medicine.

Existing IP

Data mining genetic data is very hard due to the high dimensions of the data.

Our team, comprising data miners from UTS and biomedical domain experts from The Children's Hospital at Westmead, has developed new data mining techniques to construct these predictive models and to visualise similarities and differences between patients.

Our approach differs markedly from the standard reductionist paradigm where biologists search for a biosignature consisting of a small number of genes. We embrace the complexity of genomic data by taking a constructionist approach using sense making, data integration and systems biology to capture not just the similarities between individuals in a cohort, but the differences between them, enabling individualization of patients.

Limits to the current technology

Our results indicate that our constructionist approaches can improve the understanding of biomarkers in paediatric cancer, can identify new biomarkers and can allow us to visualise patients by their systems biology. The next step is to address the limits to the current technology so that we can move towards a personalised treatment approach.

Contribution to our work has so far been limited to biologists and data miners, but achieving personalized medicine will require bringing clinicians into the process to elicit their specific needs. Furthermore, the robustness of our methods must be assessed systematically and thoroughly by validating in other diseases, drug protocols and patient cohorts.

Buy in and championing by clinicians will promote the use of personalised medicine in hospitals and lead to clinical trials. Stronger evidence of the robustness of our approach will further convince clinicians and others of the efficacy of our approach.

The Plan

We propose a research program over three years with two streams.

Stream 1 enhances the engagement of clinicians by eliciting their requirements and by further developing our approaches to visualising cohorts of patients. These approaches based on dimensionality reduction methods and visual analytics will be evaluated on datasets and clinicians recruited from the CHW and other hospitals.

Stream 2 assesses the robustness of our approaches by applying them to pediatric cancer datasets from other hospitals and to other complex diseases where gene activity and variation data is available. We plan to compare our approaches to other state-of-the-art methods.

Budget

Funding is sought from an Industry Partner possibly in association with the Australian Research Council. Total funding is estimated at $180,000 p.a. for three years. For example this could be achieved with an ARC contribution of $80,000 p.a. and an industry cash contribution of $100,000 p.a.

The Risk

The two main areas of risk are:

1. We are unable to find interested clinicians. This risk is small due to growing recognition of the need for personalised medicine from bodies such as the American Society of Clinical Oncology (see http://www.asco.org/ASCOv2/Research+Resources/Research+Blueprint).
2. Our models are not robust when assessed in the context of additional datasets and/or diseases. However, we have already addressed this by analysing data from several sources.

Within twelve months we are confident we can assess the robustness of our models in the following ways:

1. For the ALL data from The Children's Hospital at Westmead, we will be able to compare robustness of classification models using combinations of gene activity data, gene variation data and clinical data.
2. For the same data, we will examine the effect of adding patients one by one into the similarity spaces to evaluate their robustness.
3. We will be able to do some biological interpretation of the genes highlighted as important from the models using gene enrichment analysis (Gene Ontology, KEGG, and others).

The Opportunity

This project offers you the opportunity to be an active part of the personalisation of medicine. It will enable you to correlate the effectiveness of drug treatments against each patient's individual genetic profile. This analysis opens opportunities for developing and marketing focussed treatments that are effective for particular genetic patterns but that would have otherwise been seen to be ineffective in the context of the general population.

You may wish to become actively involved in the direction of the project and to bring the IP into line with your commercial interests. Involvement of this kind would focus the work and would be a win-win for researchers and investors alike. You may wish to allocate a member of your research staff to come and work with us on this research.

You may be interested in securing exclusive rights to the IP produced or may be interested in sharing both the IP and the cost with a funding body such as the Australian Research Council, or with another organisation.

We are completely open to discuss how this work may progress. We believe that the risk is low and that the potential payoff to the marketing and prescription of pharmaceuticals as well as the effective treatment of complex diseases is enormous.

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QUANTUM COMPUTATION & INTELLIGENT SYSTEMS

The Centre for Quantum Computation and Intelligent Systems (QCIS) is a Research Centre within the University of Technology, Sydney's Priority Investment Research Program.The QCIS Centre's mission is to be acknowledged by research centres throughout the world as a pre-eminent research centre in quantum computation and intelligent systems, and to be acknowledged by Australian industry and government as a leading source of knowledge and expertise in quantum computation and intelligent systems.

The Centre's vision is to develop theoretical foundations in, and innovative technologies for, quantum computation and intelligent systems. Technology created by the Centre's research is providing next-generation enterprise intelligent information systems. The Centre's vision is to develop theoretical foundations in, and innovative technologies for, quantum computation and intelligent systems. Technology created by the Centre's research is providing next-generation enterprise intelligent information systems. This technology will result in next-generation enterprise intelligent information systems.

The Centre's five major research programs cover quantum computation, knowledge discovery, decision support, innovation, and infrastructure enhancement. Together, these programs develop a set of innovative and practical methodologies and techniques for intelligent information processing and system building for a broad range of businesses in the finance, marketing, security, health, telecommunications, government, IT and e-services, and engineering sectors.

The five QCIS state-of-the-art research laboratories, listed in alphabetical order, are:

- Data Sciences and Knowledge Discovery Laboratory
- Decision Systems and e-Service Intelligence Laboratory
- Innovation and Enterprise Research Laboratory
- Knowledge Infrastructure Laboratory
- Quantum Computation Laboratory

The Centre is staffed by over thirty scientists and more than seventy research students. It is located in The University of Technology, Sydney, Building 10, on Jones Street at Broadway (Sydney). For more information, contact QCIS at UTS on (02) 9514 2000, by email at: qcis-centre@uts.edu.au, or visit the QCIS website at: www.qcis.uts.edu.au.

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