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Designing toxicogenomics to support decision making in environmental toxicology

Oral Defence by PhD Candidate Jessica Ewald

Natural Resource Sciences

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Abstract

Traditional toxicity testing methods that rely on live animal exposures are costly, time consuming, and ethically concerning. Rising public pressure and changes in policy to reduce animal testing have prompted an international effort to develop new approach methods, for example *in vitro* exposures that use detailed molecular data to predict potential risk in live animals. However, traditional bioinformatics approaches for analyzing this type of data (called toxicogenomics data) do not produce results that are easily integrated into regulatory decision-making processes, particularly for non-mammalian and ecologically relevant species that lack comprehensive genomics resources. In this thesis, I address this problem by designing new statistical methods and corresponding software for analyzing and visualizing toxicogenomics data in the context of environmental toxicology. Chapters 3 – 6 present five different web-based tools (EcoOmicsAnalyst, ExpressAnalyst, EcoOmicsDB, FastBMD, and EcoToxXplorer) and custom gene sets (EcoToxModules) for raw RNA-seq data processing, analysis, and visualization. The software focus on supporting data from non-mammalian and ecologically relevant species and do not require any computer programming to use. The results and visualizations have been carefully designed to make them easier to communicate to non-bioinformatician audiences in the field of environmental toxicology. Throughout the thesis, a design-thinking framework was used to continuously obtain and incorporate feedback from a large group of stakeholders and potential end-users from academia, government, and industry.



About the Candidate

Jessica Ewald holds a BSc in Environmental Sciences and Engineering from Harvard University. Throughout her doctoral research, Jessica has engaged in multiple collaborations with various groups from government, industry, and academia. Her research has benefitted from internal and external awards, including NSERC CGS-D and from the Canadian Federation for University Women. Outside of academic research, Jessica enjoys reading and hiking with her dog.