Notice of the Final Oral Examination
for the Degree of Master of Science

of

NICOLE CROTEAU

BSc (University of Victoria, 2013)

"High-Dimensional Classification for Brain Decoding"

Department of Mathematics and Statistics

Friday August 14, 2015
1:30 P.M.
David Turpin Building
Room A136

Supervisory Committee:
Dr. Farouk Nathoo, Department of Mathematics and Statistics, UVic (Supervisor)
Dr. Ryan Budney, Department of Mathematics and Statistics, UVic (Member)
Dr. Julie Zhou, Department of Mathematics and Statistics, UVic (Member)

External Examiner:
Dr. Linglong Kong, Department of Mathematical and Statistical Sciences, University of Alberta

Chair of Oral Examination:
Dr. Mike Masson, Department of Psychology, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Brain decoding involves the determination of a subject's cognitive state or an associated stimulus from functional neuroimaging data measuring brain activity. In this setting the cognitive state is typically characterized by an element of a finite set, and the neuroimaging data comprise voluminous amounts of spatiotemporal data measuring some aspect of the neural signal. The associated statistical problem is one of classification from high-dimensional data. We explore the use of functional principal component analysis, mutual information networks, and persistent homology for examining the data through exploratory analysis and for constructing features characterizing the neural signal for brain decoding. We review each approach from this perspective, and we incorporate the features into a classifier based on symmetric multinomial logistic regression with elastic net regularization. The approaches are illustrated in an application where the task is to infer from brain activity measured with magnetoencephalography (MEG) the type of video stimulus shown to a subject.