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

of

OMER WASIM

BEng (The University of Hong Kong, 2018)

“Preserving Large Cuts in Fully Dynamic Graphs”

Department of Computer Science

Monday, April 27, 2020
1:30 P.M.
Remote Defence

Supervisory Committee:
Dr. Valerie King, Department of Computer Science, University of Victoria (Supervisor)
Dr. Brue Kapron, Department of Computer Science, UVic (Member)

External Examiner:
Dr. Jing Huang, Department of Mathematics and Statistics, UVic

Chair of Oral Examination:
Dr. David Goluskin, Department of Mathematics and Statistics, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

This thesis initiates the study of the MAX-CUT problem in fully dynamic graphs. Given a graph $G = (V, E)$, we obtain the first fully dynamic algorithms to maintain a $\frac{1}{2}$-approximate cut in sublinear update time under edge insertions and deletions to $G$. Our results include the following deterministic algorithms: i) an $O(\Delta)$ worst-case update time algorithm, where $\Delta$ denotes the maximum degree $G$ and ii) an $O(m^{1/2})$ amortized update time algorithm where $m$ denotes the number of edges in $G$.

We also obtain the following randomized algorithms when edge updates come from an oblivious adversary: i) a $\tilde{O}(n^{2/3})$ update time algorithm to maintain a $\frac{1}{2}$-approximate cut, and ii) a $O(n^c)$ worst case update time algorithm for graphs on $m = n^{1+\epsilon}$ edges where $c > 1 - \frac{\epsilon}{2}$. The latter algorithm relies on a new fully dynamic sparsification routine which maintains a sparse subgraph having sublinear (in $n$) maximum degree and approximates all large cuts in $G$ under edge updates in constant update time.