**DENSEST SUBGRAPH DISCOVERY ON THE GPU**

by

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**Abstract**

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(Abstract starts here)

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**Chapter 1**

**Introduction**

When it comes to analyzing large or complex groups of data, it is often useful to examine the connections and relationships shared between its subjects. Graphs can be used to model such relations. Graphs are composed of two components: vertices (which represent individual members of a data set) and edges (which represent the connections between these members). A graph is usually represented as *G = (V, E)*, where *V* is the set of vertices in the graph, and *E* is the set of edges in the graph. A couple of the major types of data that graphs can be used to model are social networks (e.g. Facebook, Twitter, etc.) and biological data (DNA, neural networks, etc.) [2]. It’s also worth noting that edges can be directed, as in a connection between two vertices specifically goes from one to another. A directed graph can be used to model other types of data sets, or specific types of relations, such as people following others in an online social network.

The analyzation of these graphs using various tools or techniques to find additional data and patterns is known as Graph Mining. While there are many studies and problems in graph mining, a fundamental one is known as the *densest subgraph discovery problem* (the DSD). The aim of the DSD is that given an undirected graph *G*, you must find a subgraph *S* such that it has the highest density of all subgraphs of *G*. The density of a graph is represented as *e/v* (where *e* is the number of edges in the graph and *v* is the number of vertices in the graph). The denser a graph is, the more connected the members of that graph are. And thus, in simple terms, the DSD aims to find the most connected group of vertices within a graph. Additionally, density can also be applied to network motifs, which are small structures of vertices and edges such as shapes or cliques. In this case, it would be the number of a given motif over the number of vertices, finding the most connected group of those motifs [3]. The densest subgraph (and thus solutions to the DSD) is a notable piece of information to have for a dataset and has plenty of notable applications in real data sets including finding and filtering out fake users or identifying echo chambers in social networks, or identification of regulatory motifs in DNA or gene annotation graphs in biological data [2].

Being such a notable problem, there are of course many solutions to the DSD. However, none so far have utilized parallel programming on the GPU to do so. (go into this)