The study of network motif detection has shown promising results beneficial to many different fields. Network motifs are statistically overrepresented subgraphs that show up in a target network. These motifs have been linked to critical regulatory mechanisms. Most studies have been conducted on biological networks, but new research is showing that network motifs might highlight useful structures in various different networks such as communications, social, airline, and electronic.

There are many tools that search for network motifs. Several tools have been categorized and discussed in a 2011 publication entitled *Biological Network Motif Detection: Principles and Practice* by Elizabeth Wong and Brittany Baur. In the past 3 years, several new algorithms have been investigated and developed into tools of various states of completion. New data structures, such as G-tries, have shown great progress in run time. Though all tools have the same general purpose, their implementations and results are all different. Factors like network type, network size, motif size, and data resolution are all handled differently by the variety of tools. The goal of this project is to re-characterize existing tools based on an improved set of parameters, as well as incorporate newer tools. Another purpose is to give an accurate representation of the current state of the network motif detection field, and to comment on areas that could be benefited most by future work.

Most researchers who interact with these tools only care about the final result: the network motifs that are found. The only relevant characteristics of the algorithms employed are speed and accuracy. Certain aspects of the tools that may seem less important to developers—such as a usable interface—are much more important. With this in mind, we want to establish a judging profile that will appeal to the practical researcher who will use network motif detection tools sparingly. We propose the following parameters: (1) Practical limit of motif size, (2) User-friendliness, (3) I/O formats and information, (4) Network-specific performance, (5) Theoretical runtime, (6) Benchmark testing on specific networks. We believe all of these criteria to be helpful to someone who wants to find the best tool for their research.

We also want to cater towards developers who want to further the field of network motif detection. For these individuals, we are going to look for trends in current tools and evaluate their general effectiveness. Most tools devote their main focus to developing sophisticated algorithms that enumerate subgraphs and check them against the possible network. This is one important part of the NM-detection problem, but many tools overlook other parts that contribute towards accuracy. All tools generate random networks to run their algorithm on, creating meaningful context for significance measurements. If the randomization algorithms are not rigorous, all subsequent network motifs found may not be correct. The same can go for significance measurements. We want to investigate what randomization techniques and significance measurements are used by various tools. This, in tandem with an evaluation of which algorithms seem scalable to larger motifs, should present a good idea of the current limits of the network motif detection field.

Our research will appeal to both practical users of tools, as well as aspiring developers, and update the scientific community on the current state of network motif detection research. It will provide useful information for developers who want to work on future tools as well as the researchers who need to select a tool to use. This summary and comparison of existing network motif finding tools will greatly help interested people obtain a deeper understanding of the field.