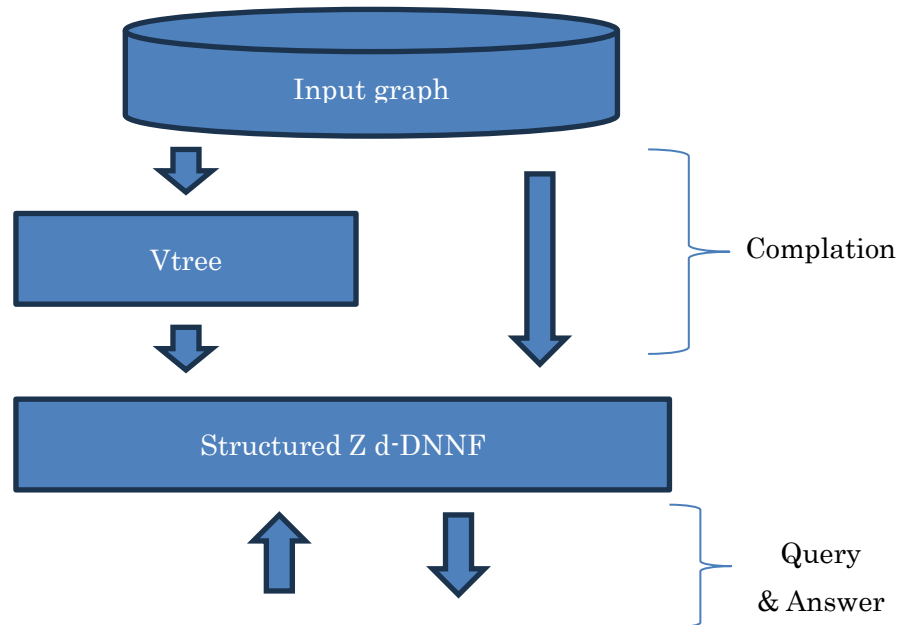Team name: Cypher

Team member: Teruji Sugaya

Our algorithm is It can be classified as a kind of **knowledge compilation**.

Knowledge compilation is a method to transform the input to a succinct data structure that supports various queries to know various properties of the input graph. Here, this transformation is called **compilation**. Out data structure is called **Structured Z d-DNNF** [1]. It supports some queries that are necessary to know the answer of this contest, i.e., the cardinality of paths between the predetermined terminals under the path length constraint. Our compilation is consisted of two steps: 1st, construct a data structure called **vtree** from the input graph, then 2nd, compile a structured Z d-DNNF from the input graph and the vtree. Vtree is a kind of data structure based on a tree structure.

As a well-known data structures of knowledge compilation, there exist those called Binary Decision Diagrams (BDD), or Zero-suppressed Binary Decision Diagrams (ZDD). BDD and ZDD are compiled based on a linear order. As result, BDD and ZDD's size and/or the time of compilation is bounded by the path width of the input graph. On the other hand, our data structure is based on a tree. Therefore, the size and/or the time of compilation is bounded by branch width of the input graph, that is known to be smaller than path width.

[1] T. Sugaya et al.,Fast compilation of graph substructures for counting and enumeration," *Behaviormetrika, Vol* 45, No.2, p. 423, 2018.