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Efficient Recognition Algorithm of Interval Bigraphs

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Many problems handled by computers are modeled in graph structures. Graph theory and algorithm theory are important to solve these problems efficiently. The recognition problem of graphs is one of the basic problems that is relating deeply to the algorithm theory and the graph theory. The recognition problem of a graph class C is the decision problem whether a graph belongs to the graph class C . The hardness of the recognition problem is independent to the inclusion between the graph classes. There are many known recognition algorithms that on the interval graphs, circular arc graphs, etc.

An interval graph is the intersection graph of a multiset of intervals on the real line. It has one vertex for each interval in the set, and an edge between every pair of vertices corresponding to intervals that intersect. Interval graphs can model various problems by thinking of an interval as time, a temperature, etc. In bioinformatics, it is possible to think of the fragment of DNA as an interval. In this case, huge information is given by not the graph representation but the interval representation.

Interval graphs and interval bigraphs have the common feature. An interval bigraph is the intersection graph of two families of intervals on the real line such that vertices are adjacent if and only if their corresponding intervals belong to distinct families and intersect. Interval bigraphs were introduced in the 1980's by Harary, Kabell, and McMorris. However, the

characterization of interval bigraphs in this paper is not correct, that was pointed out in 1997. In addition, recognition algorithm for interval bigraphs was proposed in polynomial time. The time complexity of this recognition algorithm was $O(nm^6(n+m)\log n)$. However, this algorithm also has bugs, and the fixed algorithm is published on the Web. The time complexity of the correct recognition algorithm is $O(n^5m^6\log n)$.

Recently, a very simple characterization of an interval bigraph was given by Hell and Huang. The characterization is as follows. If a graph is an interval bigraph, complement of the graph is a circular arc graph.

This characterization is a very excellent idea. However, there is not an algorithm that is based on this characterization. From the viewpoint of the graph algorithm, it is not well investigated about interval bigraph.

In this paper, we propose a recognition algorithm for proper interval bigraphs by using this characterization. Proper interval bigraphs form a subclass of interval bigraphs. A proper interval bigraph is an interval bigraph that has a many good characterization. Proper interval bigraphs have a useful feature addition to the interval bigraphs. Therefore, the development of the recognition algorithm of proper interval bigraphs is a good step to that of interval bigraphs.

There are linear time recognition algorithms of proper interval bigraphs using the other characterizations.

For example, there is a linear time algorithm using the LexBFS algorithm. Moreover, proper interval bigraphs are equivalent to bipartite permutation graphs, and there is the algorithm using the characterizations as bipartite permutation graphs, too. However, it is difficult to extend those algorithms to general interval bigraphs. Hell and Huang show another characterization using a complement of a proper interval bigraph. We propose a polynomial time recognition algorithm for proper interval bigraphs by using this characterization.