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On some reconstruction problems

Richard Taylor

This thesis is devoted to the study of a major unsolved problem in graph theory, namely the Reconstruction Conjecture.

In Chapter 1 we give a survey of the partial results that have been obtained on the conjecture. Also included in this chapter is a short section giving some preliminary results which are required later in the thesis.

Much of Chapter 2 is concerned with a conjecture of F. Harary and B. Manvel, which is closely related to the Reconstruction Conjecture. Answering a problem raised by them, we show that the Reconstruction Conjecture implies their conjecture. We also prove a strong form of this conjecture for trees, as well as proving the equivalence of the problems of reconstructing graphs, with the problems of reconstructing certain classes of coloured graphs.

In Chapter 3 we consider the problem of reconstructing the numbers of certain spanning subgraphs of a graph. Using a counting identity due to W.L. Kocay, we construct formulae for the numbers of certain subgraphs in a graph. These formulae may be used in turn to reconstruct the numbers of the subgraphs concerned. We give such formulae for subgraphs which are

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spanning trees, hamiltonian cycles, hamiltonian paths, as well as disconnected subgraphs, and subgraphs with disconnected complements. Also, let H^* be obtained from a graph H by appending a pendant edge to each vertex of H. Then by constructing an appropriate formula we reconstruct the number of spanning subgraphs of a graph, which are isomorphic to H^*.

The results of Chapter 4 are concerned with the extent to which the Reconstruction Conjecture may be strengthened in terms of multiple vertex deletions. We consider this problem in the context of general graphs as well as trees, and supply both theoretical results and computational data.

Finally, in Chapter 5 we consider the problem of determining conditions whereby a collection of graphs correspond to the deck of some graph. We present a new necessary condition, and analyse its effectiveness.

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