Homework 20

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To prove that if an algorithm for one of Undirected Graph Isomorphism, Directed Graph Isomorphism, and Mixed Graph Isomorphism implies that they all do, the following reductions need to be made:

Directed Graph Isomorphism $\leq_p$ Mixed Graph Isomorphism

Assume there exists an algorithm for Mixed Graph Isomorphism called $MISO$. Then it is possible to construct a poly-time algorithm for Directed Graph Isomorphism called $DISO$ as follows:

$DISO(G, H):$
    return $MISO(G, H)$

A purely directed graph can be thought of as a special case of a mixed graph, so an algorithm for Mixed Graph Isomorphism works just as well on inputs that only have directed edges. Moreover, since $MISO$ is poly-time, and since $DISO$ makes no transformations from input to input or from output to output, then $DISO$ is also poly-time.

Undirected Graph Isomorphism $\leq_p$ Mixed Graph Isomorphism

Assume there exists an algorithm for Mixed Graph Isomorphism called $MISO$. Then it is possible to construct a poly-time algorithm for Undirected Graph Isomorphism called $UISO$ as follows:

$UISO(G, H):$
    return $MISO(G, H)$

A purely undirected graph can be thought of as a special case of a mixed graph, so an algorithm for Mixed Graph Isomorphism works just as well on inputs that only have directed edges. Moreover, since $MISO$ is poly-time, and since $UISO$ makes no transformations from input to input or from output to output, then $UISO$ is also poly-time.