The Bin Packing problem is the problem of finding the smallest number of containers needed to hold a set of items. More formally: given a set of $n$ items, each with a size, $s_i$, and set of bins, $B$, where each bin has a fixed capacity, $c$, find the minimum number of bins needed to pack all items.

One strategy for solving the bin packing problem is to do a first fit heuristic. Here you pack the items one at a time into the first bin that the item will fit into. If it doesn’t fit into any of the current bins, you start a new bin. Formally state this as an algorithm and show that it is always within 2 times the optimal solution. (Be sure to draw examples with different sized items.)

The Bin Packing problem is what is called an optimization problem. Here we want to optimize (in this case minimize) the number of bins used. It is not in NP because it is not a decision problem. It is, however, NP-hard and each NP-hard optimization problem has a corresponding decision problem which is NP-complete. Formally rephrase the bin packing problem as a decision problem, and specify it as a set.