C&PE 778 Homework 08 William Powers 2025

Write a psuedocode to implement the Tabu Seach Algorithm for the following multiobjective knapsack problem:

The multiobjective knapsack problem: A hiker is heading out for a seven-day trip through the wilderness. She has a large backpack, and is deciding which of a large set of items to bring along. Assume that there are 50 ***possible items, each with a value*** $V(i)$ ***and a weight*** $W(i)$***. Assuming she only wants no more than one of each item, find a set of pareto-optimal solutions which maximize the value while minimizing the weight to be carried.***

As given in the problem statement, define the value and weight of each item i as v_i and w_i respectivelly. Because the hiker is undertaking a long trek with a large but space-limited backpack, the task reduces to minimizing the weight of the items carried while maximizing their overall value. Denoting the binary choice of choosing each item as $x \in \{0, 1\}$, the objective is writtena as

$$\min_x \sum_{i=1}^{50} \frac{\lambda(w_i x_i)}{(1-\lambda)(v_i x_i)}$$

where $\lambda \in (0, 1)$ is a pareto weighting factor that can be tuned to emphasize minimizing weight over maximizing value, or vice versa. Being that x_i is a binary decision variable, the problem is characterized as a mixed integer linear program (MILP) and can is choosen here to be solved via the TABU Search Algorithm with psuedo code shown below.

```
1. Initialize problem to only taking the single most valued item (assuming it can be
carried).

2. Initialize paretor weight λ for weight vrs. value emphasis.

3. Initialize length M TABU list to hold best solutions.

4. For N iterations...

4.1 Compute a random set of items to bring. Through out non-feasible solutions.

4.2 Move in direction with smallest objective and not on TABU list (using line search).

4.3 Check for convergence (step tolerance or solution tolerance).

4.4 Add solution to TABU list and move to next iteration.


** Can add adaptability to make larger random moves if local solutions are not promising.
```