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CSCE686 – Dr. Lamont

Project Proposal

A real world problem that incorporates two different NP-Complete problem models is a airlift scheduling program for Air Mobility Command. While there are certainly many other considerations in the actual application of such a program, it can be simplified to a combination of the Knapsack problem and the Vehicle Routing problem. For example, the knapsack problem can be used to determine how to load the planes, maximizing the value of cargo that can fit in each aircraft, and the vehicle routing problem can be used to determine the order in which to drop off the cargo.

The Knapsack Problem can be defined as:

Let *S* be a set of *n* items, each with a weight *wi* and a value *vi*, and paired with a maximum cargo weight *W*. Constraints: . Objective: maximize value.

The Vehicle Routing Problem can be defined as:

Let *G* = (*V*, *A*) be a graph where *V* = {1, …, *n*} is a set of vertices representing air drop locations with the airfield located at vertex 1, and *A* is the set of arcs. With every arc (*i, j*) *i* =/=*j* is associated a non-negative cost matrix *C* = (*cij*). Constraints: (i) each air drop in *V*\{1} is visited exactly once by exactly one plane; (ii) all flight plans start and end at the airfield. Objective: minimize cost.

These problems can be combined in this context as:

Let *G* = (*V*, *A*) be a graph where *V* = {1, …, *n*} is a set of vertices representing air drop locations with the airfield located at vertex 1, and *A* is the set of arcs between them. Every arc (*i, j*) *i* =/=*j* is associated a non-negative cost matrix *C* = (*cij*). Let each vertex be assigned a set *S*,of *n* items, each with a weight *wi* and a value *vi*. Let P be a set of planes, each with a maximum cargo weight *Wi*. Constraints: (i) each air drop in *V*\{1} is visited exactly once by exactly one plane; (ii) all flight plans start and end at the airfield; (iii) . Objective: maximize total value and minimize total cost across all flight plans.