

## Lesson 9. The Self-Sufficient Marine

**Example 1. Self-sufficiency** is the ability to carry out a mission without external support or aid, which is critical for operations in environments with limited infrastructure and logistical support. Such scenarios are common in expeditionary missions for the Marines. Perhaps the most fundamental question of self-sufficiency for these missions is whether a squad can be successful with the items that the Marines are able to carry.

Suppose you have a list of the items that a Marine may carry for a particular mission. In addition, suppose you have for each item:

- the **weight** of the item, in units of 0.1 lbs
- the **value** of carrying one unit of the item for the mission, on a scale from 0 to 10
- **lower and upper bounds** on how many of the item needs to be carried
- whether the item is **partially shared**: that is, if the item can be shared among a few Marines if needed (e.g. binoculars)
- whether the item is **shared**: that is, if an item should be used by an entire squad (e.g. metal detector)

Assume that a Marine can carry 65 lbs, at most 2 types of partially shared items, and 0 shared items. The objective is to determine how many of each item a Marine should carry in order to maximize the total value of the items.

Formulate this problem as a dynamic program by giving its shortest/longest path representation.