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**Algorithm** Simulated Annealing for the Knapsack Problem

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1: Define the total number of iterations  $N$ 
2: Initialize temperature  $T$ 
3: Define the cooling rate  $\alpha$ 

4: for  $iteration = 1$  to  $N$  do
5:   Record your current assortment of objects  $\xi_1$ .  $\xi = \{x_1, x_2, \dots, x_n\}$ ,
      $x_i \in \{0, 1\}$ 
6:   Pick an item at random with equal probability.
7:   Assess whether to add it to your backpack:
8:   if adding this new object into your bag exceeds the weight limit then
9:     Select an item at random from your bag or the one in your hand.
10:    Drop that item.
11:    Repeat until the objects in your bag are below the weight limit.
12:   else
13:     Add the item to your bag.
14:   end if

15:   Record the outcome as a trial assortment  $\xi'_1$ .
16:   Compare the value of the trial assortment with the original,  $V'_1$  and  $V_1$ 
     respectively.
17:   Calculate  $V(\xi) = \sum_{i=1}^n v_i x_i$ , for  $i = 1, 2, \dots, n$ .
18:   Determine the acceptance probability  $P$ :
19:   if  $V'_1 > V_1$  then
20:     Accept the new trial assortment as the new assortment  $\xi_2 = \xi'_1$ .
21:   else
22:     Calculate  $\Delta V = V'_1 - V_1$ .
23:     Calculate  $P = \min\{1, \exp(\Delta V/T)\}$ .
24:     Generate a random number  $r$  between 0 and 1.
25:     if  $r < P$  then
26:       Accept the new trial assortment as the new assortment  $\xi_2 = \xi'_1$ .
27:     else
28:       Discard the trial assortment and set the original assortment as
the new assortment  $\xi_2 = \xi_1$ .
29:     end if
30:   end if

31:   Update the temperature  $T = T \cdot (1 - \alpha)$  according to the cooling schedule.
32: end for
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