1. In the *sum-of-subsets problem* you are given as input:
- a set of n positive integers (weights) $\{w_1, w_2, w_3, \ldots, w_n\}$, and
- a target sum, W

with the task of finding all subsets that sum to the target sum, W.

Consider an instance of the sum-of-subsets problem: For the weights of { 5, 6, 10, 11, 16 }, find all the subsets adding to 21.

To solve a problem using backtracking, you need to answer the following questions:

a) What should the state-space tree look like? (i.e.,What would the "for each child c" loop iterate over?)

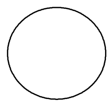
b) What state information is needed at each node?

Global Problem-Instance Information

	1	2	3	4	5
weights:	5	6	10	11	16

n: 5 W: 21

Starting Node - original call to start recursive backtracking function



c) Any alternate state-space tree which might be better for exploring subsets?

d) Without some pruning criteria (check for "promising" child node), how many nodes are in both of the above state-space trees?

e) What criteria can be used to determine if a child node (c) is NOT promising?

f) What information is needed by our promising function?

2. Consider customizing the Backtrack template for the sum-of-subsets problem. Use a single, “global”, current-node state which is updated before we go down to the child (via a recursive call) and undone when we backtrack to the parent.

```
Backtrack( recursionTreeNode p ) {

    treeNode c;
    for each child c of p do                          # each c represents a possible choice
        if promising(c) then                          # c is "promising" if it could lead to a better solution
            if c is a solution that's better than best then   # check if this is the best solution found so far
                best = c                              # remember the best solution
            else
                Backtrack(c)                          # follow a branch down the tree
            end if
        end if
    end for
} // end Backtrack
```

3. In the 0-1 *Knapsack problem*:

> A thief breaks into a jewelry store carrying a knapsack that will break if its weight limit (*W*) is exceeded. The thief wants to maximize the total value in the knapsack without exceeding its weight limit *W*.

Consider the following 0-1 Knapsack problem with four items and a knapsack weight limit of *W*=10 oz.

Item, *i*	**Weight, w_i**	**Profit , p_i**	**Profit/Weight**
1	4 oz.	$40	$10/oz.
2	7 oz.	$63	$9/oz.
3	5 oz.	$25	$5/oz.
4	3 oz.	$12	$4/oz.

To solve a problem using backtracking, you need to answer the following questions:

a) What should the state-space tree look like? (i.e.,What would the "for each child c" loop iterate over?) (Hint: consider alternate state-space tree which might be better for exploring subsets)

Global Problem-Instance Information

	1	2	3	4
(weights) w:	4	7	5	3
(profits) p:	40	63	25	12

n: 4 W: 10

Starting Node - original call to start recursive backtracking

b) What state information is needed at each node?

c) What criteria can be used to determine if a parent node (p) is NOT promising?

d) What information is needed by our promising function?

e) Since any subset is potentially the best solution, consider customizing the backtracking optimization template "checknode" (p. 228) for the 0-1 Knapsack problem. Use a single, "global", current-node state which is updated before we go down to the child (via a recursive call) and undone when we backtrack to the parent.

```
checknode( treeNode p ) {
    treeNode c;
    if  p is better than best solution
            best = p                          # remember as the best solution
    end if
    if promising(p) then                      # p is "promising" if it could lead to a better solution
            for each child c of p do          # each c represents a possible choice
                checknode(c)                  # follow a branch down the tree
            end for
    end if
} // end checknode
```