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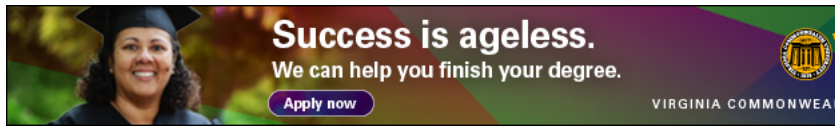
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## Question: STUDY PROBLEM 5 In coin change problem, the goal is findin...

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### STUDY PROBLEM 5

In coin change problem, the goal is finding the smallest number of coins that will sum up a change. While there is a greedy algorithm (i.e., continuously selecting the largest coin less than remaining change) for the coins in U.S., there could be a set of coin values in another country for which the greedy algorithm does not always give the smallest number of coins. Give a set of such coins first (and explain why greedy does not work) and define a dynamic programming solution for it?

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### Expert Answer



anonymous answered this  
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Set of coins where the greedy algorithm fails:

Consider there are coins of 1, 3, and 4

Now, you need to get the sum 6.

By greedy algorithm gives 3 coins needed i.e.  $4 + 1 + 1$

But we can get the sum with only two coins of 3.  $3 + 3 = 6$

Let we want to get the sum  $N$  with possible coin denominations in coins list with size  $M$ .

Let  $dp[i]$  denotes the minimum no. of sum of to a change of  $i$ .

Note that  $\infty$  indicates that sum not possible.

I am providing the algorithm in pseudocode. It can be converted to many programming languages easily

Algorithm\_minimum\_coins( $N$ , coins,  $M$ )

```
// initializing dp array to  $\infty$ 
```

```
for i= 1 to N
```

```
    dp[i]= $\infty$ 
```

```
// Base case: requires only one coin for the change that equals to some coin
```

```
for i = 1 to M
```

```
    dp[coins[i]]= 1
```

```
// filling the remaining values
```

```
for i= 1 to N
```

```
{
```

```
    for j= 1 to M
```

```
    {
```

```
        // checking if coin is not greater than coin
```

```
        if( $i > \text{coins}[j]$ )
```

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```
}  
}  
}  
// returning the minimum no. of coins required to get given change N  
returning dp[N]  
}
```

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Q: Andy is trying to put together a holiday gift knapsack (with  $W=8$ ) for Sarah. He has  $n$  items to choose from, each with infinitely many copies (aka. knapsack with repetitions). Item  $i$  has weight  $w_i$ , and value  $v_i$ . Andy wants to pick some items (possibility with duplicates) so their total weight is exactly  $W$ , while minimizing the total value of the items picked. If  $OPT[w]$  denotes the...

A: See answer

Q: Part 1: The bottom-up dynamic programming approach fo the Unbounded 0/1 Knapsack Problem given in class (Lecture 23, slide 10) is:  $\text{int UnboundedBinaryKnapsack}(\text{int weights}[1,...,n], \text{float values}[1,...,n], \text{int } W, \text{int } n) \{ z = \text{new int}[0,...,W] \}$   $z[0] = 0$  for  $(w=1; w \leq W; w++) \{ z[w]=0$  for  $(i=1; i \leq n; i++)$  if  $(\text{weights}[i] \leq w) \{ z[w] = \max( z[w], z[ w - \text{weights}[i] ] + \text{values}[i]...$

A: See answer

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