Problem Solving Assignment 2

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Question 1)

Knapsack capacity = 800

| Item | Weight | Value |
|---|---|---|
| 1 | 600 | 36,000 |
| 2 | 400 | 23,200 |
| 3 | 400 | 23,200 |
| 4 | 160 | 7,200 |

**Strategy 1: Using highest value-to-weight best,**

Compute value-to-weight ratio and arrange items.

| Item | Weight | Value | Value-to-Weight |
|---|---|---|---|
| 1 | 600 | 36,000 | 60 |
| 2 | 400 | 23,200 | 58 |
| 3 | 400 | 23,200 | 58 |
| 4 | 160 | 7,200 | 45 |

Using greedy approach for this strategy,

1) Select item 1, total weight = 600
2) Skip item 2 as total weight = 600+400 = 1000 > 800
3) Skip item 3 as total weight = 600+400 = 1000 > 800
4) Select item 4, total weight = 600 + 160 =760

Using highest value-to-weight strategy, select item 1 and 4

Total weight = 600+160 = 760 which is within the knapsack capacity

**Strategy 2: Using Highest value best**

Using greedy approach for this strategy,

1) Select item 1, total weight = 600
2) Skip item 2 as total weight = 600+400 = 1000 > 800
3) Skip item 3 as total weight = 600+400 = 1000 > 800
4) Select item 4, total weight = 600 + 160 =760

Using highest value best strategy, select item 1 and 4

Total weight = 600+160 = 760 which is within the knapsack capacity

Since both strategies, give same results, the most suitable subset will be item 1 and 4.

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Question 2)

- Sort orders by profits in non-increasing order

| Order No. | 6 | 3 | 8 | 7 | 10 | 5 | 4 | 9 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| Profit | 100 | 90 | 80 | 70 | 60 | 50 | 40 | 30 | 20 | 10 |
| Deadline | 1 | 1 | 4 | 2 | 4 | 4 | 3 | 3 | 6 | 6 |

Next, consider Order No 6, since it is the first order considered, we fit in our schedule as latest as possible as follows:

| Order No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Profit | 6 | | | | | |
| Deadline | 100 | | | | | |

Next, consider Order No 3, but we cannot fit into the schedule.
Next, consider Order No 8 and fit in the schedule as latest as possible as follows:

| Order No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Profit | 6 | | | 8 | | |
| Deadline | 100 | | | 80 | | |

Next consider Order No 7 and fit in the schedule as latest as possible as follows:

| Order No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Profit | 6 | 7 | | 8 | | |
| Deadline | 100 | 70 | | 80 | | |

Next consider Order No 10 and fit in the schedule as latest as possible as follows:

| Order No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Profit | 6 | 7 | 10 | 8 | | |
| Deadline | 100 | 70 | 60 | 80 | | |

Next, consider Order No 5, but we cannot fit into the schedule.
Next, consider Order No 4, but we cannot fit into the schedule.
Next, consider Order No 9, but we cannot fit into the schedule.
Next consider Order No 2 and fit in the schedule as latest as possible as follows:

| Order No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Profit | 6 | 7 | 10 | 8 | | 2 |
| Deadline | 100 | 70 | 60 | 80 | | 20 |

Next consider Order No 1 and fit in the schedule as latest as possible as follows:

| Order No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Profit | 6 | 7 | 10 | 8 | 1 | 2 |
| Deadline | 100 | 70 | 60 | 80 | 10 | 20 |

The schedule is full now, we stop. Hence, the above table shows the accepted orders and the schedule.

The total profit can be achieved by the accepted orders = 100 + 70 + 60 + 80 + 10 + 20 = 340.

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Question 3)

| 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 128 | 242 | 202 | 150 | 172 | 134 |

| | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Step 1 | 242 | 128 | 202 | 150 | 172 | 134 |
| Step 2 | 242 | 202 | 128 | 150 | 172 | 134 |
| Step 3 | 242 | 202 | 172 | 150 | 128 | 134 |
| Step 4 | 242 | 202 | 172 | 150 | 128 | 134 |
| Step 5 | 242 | 202 | 172 | 172 | 134 | 128 |
| Step 6 | 242 | 202 | 172 | 172 | 134 | 128 |
| Final Result | 242 | 202 | 172 | 172 | 134 | 128 |

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Question 4)

Using Insertion sort,

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 19 | 17 | 15 | 11 | 13 |

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Step 1 | 19 | 17 | 15 | 11 | 13 |
| Step 2 | 19 | 17 | 15 | 11 | 13 |
| Step 3 | 19 | 17 | 15 | 13 | 11 |
| Step 4 | 19 | 17 | 15 | 13 | 11 |
| Final Result | 19 | 17 | 15 | 13 | 11 |

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Question 5)

Using bubble sort,

| 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 14 | 71 | 51 | 25 | 36 | 17 |

1st Comparison sequence

| | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1st Comp | 71 | 14 | 51 | 25 | 36 | 17 |
| 2nd Comp | 71 | 51 | 14 | 25 | 36 | 17 |
| 3rd Comp | 71 | 51 | 25 | 14 | 36 | 17 |
| 4th Comp | 71 | 51 | 25 | 36 | 14 | 17 |
| 5th Comp | 71 | 51 | 25 | 36 | 17 | 14 |

End of Pass 1

| | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Pass 1 | 71 | 51 | 25 | 36 | 17 | 14 |

2nd Comparison

| | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1st Comp | 71 | 51 | 25 | 36 | 17 | 14 |
| 2nd Comp | 71 | 51 | 25 | 36 | 17 | 14 |
| 3rd Comp | 71 | 51 | 36 | 25 | 17 | 14 |
| 4th Comp | | | | | | |
| 5th Comp | | | | | | |

End of Pass 2

| | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Pass 1 | 71 | 51 | 25 | 36 | 17 | 14 |
| Pass 2 | 71 | 51 | 36 | 25 | 17 | 14 |
| Final result | 71 | 51 | 36 | 25 | 17 | 14 |

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Question 6)

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Step 1: | 200 | 100 | 250 | 150 | 300 | 50 | **350** | 400 |
| Step 2: | 150 | 100 | 50 | **200** | 300 | 250 | **350** | 400 |
| Step 3: | 50 | 100 | **150** | **200** | 300 | 250 | **350** | 400 |
| Step 4: | **50** | 100 | **150** | **200** | 300 | 250 | **350** | 400 |
| Step 5: | **50** | **100** | **150** | **200** | 300 | 250 | **350** | 400 |
| Step 6: | **50** | **100** | **150** | **200** | 250 | **300** | **350** | 400 |
| Step 7: | **50** | **100** | **150** | **200** | **250** | **300** | **350** | 400 |
| Step 8: | **50** | **100** | **150** | **200** | **250** | **300** | **350** | **400** |
| Final Result | **50** | **100** | **150** | **200** | **250** | **300** | **350** | **400** |

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Question 7)

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 4 | 7 | 9 | 11 | 17 | 23 | 27 | 30 | 34 | 38 | 43 |

(a)

Let T be sequence.

Let f = first

Let l = last

Target number: 38

**Step 1:**

f = 0, l = 12

mid = (0+12)/2 = 6

As target 38 > T(6) = 17, hence, f of step 2 = 6+1 = 7, and l of step 2 = 12

**Step 2:**

f = 7, l = 12

mid = (7+12)/2 = 9.5 = 9 (Floor function)

As target 38 > T(9) = 30, hence f of step 3 = 9+1 = 10, and l of step 3 = 12

**Step 3:**

f = 10, l = 12

mid = (10+12)/2 = 11

As target 38 = T(11) = 38, target has been found, its index is 11.

(b)

Target number: 25

**Step 1:**

f = 0, l = 12

mid = (0+12)/2 = 6

As target 25 > T(6) = 17, hence, f of step 2 = 6+1 = 7, and l of step 2 = 12

**Step 2:**

f = 7, l = 12

mid = (7+12)/2 = 9.5 = 9 (Floor function)

As target 25 < T(9) = 30, hence, f of step 3 = 7, l of step 3 = 9-1 = 8

**Step 3:**

f = 7, l = 8

mid = (7+8)/2 = 7.5 = 7 (Floor function)

As target 25 >T(7) = 23, f of step 4 = 7 + 1 = 8, and l = 8

**Step 4:**

f = 8, l = 8

mid = (8+8)/2 = 8

As target 25 < T(8) = 27 , hence, f od step 5 = 8 and l of step 5 = 8-1 = 7

**Step 5:**

f = 8, l = 7

As f > l, there is no such subsequence.

Hence, 25 (target) cannot be found.

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Question 8)

8)

```
largest_index_position(A, f, l) {
// Input: A portion of sequence A between indices f and l (f ≤ l)
// Output: The index of the largest element in the above portion

    if f = l
        return l
    else {
        temp1 = largest_index_position(A, f, [(f+l)/2])
        temp2 = largest_index_position(A, [(f+l)/2] + 1, l)
    }
    if A[temp1] ≥ A[temp2]
        return temp1
    else
        return temp2
}
```