CSE 2320 - Homework 6 NAME: Matthew Fritz

Total points: 65 Topics: Greedy and Dynamic Programming for Knapsack problem variations (unbounded, 0/1, fractional)

P1 (4 pts) Given this solution information, for the **unbounded** Knapsack problem below, recover the choices that gave the optimal answer for knapsack capacity 19. Show your work (highlight or circle cells).

$$
B > A,\ 2A > B : 2A \text{ is greater than } 1\ B.
$$

$$
C > B,\ C > A
$$

```
Item   |  A|  B|  C|  D|
Weight |  3|  4|  7|  8|
Value  | the item values are hidden as they should not be used in recovering the solution.
```

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
picked				A	B	B	A	C	D	D	A	B	B	A	C	C	D	A	B	B

Items picked for capacity 19: B + C + D

P2 (61 pts) Given the item types below, answer the bullet questions and show your work there. Then, for a centralized picture of everything, copy just the answers (the amount of money and picked items) in this summary table.

Item:	A	B	C	D
Weight:	3	4	6	7
Value:	4	7	10	12

Knapsack version / Algorithm	Unbounded, Not fractional	0/1 (one of each item), Not fractional	0/1 (one of each item), Fractional
Dynamic Programming	$$: 24 Items: [redacted] C B B	$$: 23 Items: D B A	
Greedy	$$: 21 Items: B B B	$$: 23 Items: B D A	$$: 24 Items: B D + ½ C

a) (20 pts) Using DP fill in the table below. Assume there is an unlimited amount of each item, and you CANNOT take fractions of an item (**unbounded, and NOT fractional** Knapsack). Recover the items in the solution and show how you did that (e.g. highlight or circle cells). Show your work as done in class. When finished, copy the answer in the summary table above.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sol	0	0	0	4	7	7	10	12	14	14	17	19	21	22	24
picked				A	B	B	C	D	B	A	B	B	B	C	B
A, 3, 4				0,4	1,4	2,4	3,8	4,11	5,11	6,14	7,16	8,18	9,18	10,21	11,23
B, 4, 7					0,7	1,7	2,7	3,11	4,14	5,14	6,17	7,19	8,21	9,21	10,24
C, 6, 10							0,10	1,10	2,10	3,14	4,17	5,17	6,20	7,22	8,24
D, 7, 12								0,12	1,12	2,12	3,16	4,19	5,19	6,22	7,24

ITEMS PICKED: B, B, C

b) (20 pts) Using DP, fill in the table below. Assume there is ONLY ONE of each item, and you CANNOT take fractions of an item (**0/1, and NOT fractional** Knapsack). Use a star to show if the current item was used or not in the solution. Recover the items in the solution and show how you did that (e.g. highlight or circle cells). Show your work as done in class. When finished, copy the answer in the summary table above.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
picked				A				B							D
NOi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A, 3, 4	0	0	0	4	4	4	4	4	4	4	4	4	4	4	4
B, 4, 7	0	0	0	4	7	7	7	11	11	11	11	11	11	11	11
C, 6, 10	0	0	0	4	7	7	10	10	10	14	17	17	17	21	21
D, 7, 12	0	0	0	4	7	7	10	12	12	12	16	19	19	22	23

ITEMS PICKED: D, B, A

can't choose

D=7
14-7=7, 13=4
7-4=3, A=3
3-3=0
2

c) (8 pts) What items will a Greedy algorithm based on the **ratio value to weight**, choose for a problem of size W=14? Assume there are unlimited of each item, and you CANNOT take fractions of an item (**unbounded, not fractional** Knapsack). Show your work. When finished, copy the answer in the summary table above.

	ratio value to weight
A	4/3 ≈ 1.33
B	7/4 = 1.75
C	10/6 ≈ 1.66
D	12/7 ≈ 1.71

14
- 4 - 1 of B 3×7 = 21
10
- 4 - 2 of B
6
- 4 - 3 of B
2

d) (8 pts) What items will a Greedy algorithm based on the **ratio value to weight**, choose for a problem of size W=14? Assume you have ONLY ONE of each item and you CANNOT take a fraction of an item (**0/1, not fractional** Knapsack). Show your work. When finished, copy the answer in the summary table above.

reference table in previous question...

14
- 4 - B
10
- 7 - D, next highest v:w
3
- 3 - A, only one that can fit
0

B D A
7 + 12 + 4 = 23

e) (5 pts) What items will a Greedy algorithm based on the **ratio value to weight**, choose for a problem of size W=14? Assume you have ONLY ONE of each item and you can take a fraction of each item (**0/1, fractional** Knapsack). Show your work.

14
- 4 - Same, B
10
- 7 - Same as d, D
3
- 3 - ½ of C
0

When weight is 3 (½)
value of A = 4
value of C ≈ 3/6 = ½ · 10 = 5
½ C > A
use C

B D C
7 + 12 + (½)10
7 + 12 + 5 = 12 + 12 = 24

Write your answers in this document or a new document called **2320_H6.pdf** and submit it in Canvas. It can be hand-written and scanned, but it must be uploaded electronically. Remember to include your name at the top.