ALGORITHMS A-3

Date

Group Member - 1 : HASNAIN SOMANI
19K - 0204
Group Member - 2 : ASHMAL ANIS
19K - 0305

(a) X = BACDB
Y = BDCB.

			B	A	C	D	B
	y \ x	0	1	2	3	4	5
	0	0	0	0	0	0	0
B	1	0	↖1	←1	←1	←1	↖1
D	2	0	↑1	↑←1	↑←1	↖2	←2
C	3	0	↑1	↑←1	↖2	↑←2	↑←2
B	4	0	↖1	↑←1	↑2	↑←2	↖3

Length of LCS = 3. → BCB, BDB.

			H	A	S	N	A	I	N
(b).	y \ x	0	1	2	3	4	5	6	7
	0	0	0	0	0	0	0	0	0
A	1	0	0	↖1	←1	←1	↖1	←1	←1
S	2	0	0	↑1	↖2	←2	←2	←2	←2
H	3	0	↖1	↑←1	↑2	↑←2	↑←2	↑←2	↑←2
M	4	0	↑1	↑←1	↑2	↑←2	↑←2	↑←2	↑←2
A	5	0	↑1	↖2	↑←2	↑←2	↖3	←3	←3
L	6	0	↑1	↑2	↑←2	↑←2	↑3	↑←3	↑←3

X = HASNAIN
Y = ASHMAL.

BC

No.

Date

Length of LCS = 3 → ASA

Shortest common supersequence:

HASNAIN ASA
ASHMAC

HASNHMATNI

(c) $S_1 = (4, \overset{(0,2)}{\cdot}, 20)$ (0204)

$S_2 = (5, 20)$ (0305)

		4	.	10	0	.	2
	5	0	0	0	0	0	0
	.	0	1	1	1	1	1
	2	0	1	1	1	1	2
	0	0	1	1	2	2	2

∴ Length = 2.

Part (a) ↓

Date

i \ j		E	X	E	C	U	T	I	O	N
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
I	1	①	2	3	4	5	6	6	7	8
N	2	2	②	3	4	5	6	7	7	7
T	3	3	3	③	4	5	5	6	7	8
E	4	4	3	4	④	5	6	6	7	8
N	5	5	4	4	4	⑤	6	7	7	7
T	6	6	5	5	5	5	⑤	6	7	8
I	7	7	6	6	6	6	6	⑤	6	7
O	8	8	7	7	7	7	7	6	⑤	6
N	9	9	8	8	8	8	8	7	6	⑤

No. of operations = 5.

Operations: I → E

N → X

T → E

E → C

N → U

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Date

(c).

	A_1	A_2	A_3	A_4	A_5
A_1	0	1	1	3	3
A_2		0	2	3	3
A_3			0	3	3
A_4				0	4
A_5					0

	A_1	A_2	A_3	A_4	A_5
A_1	0	150	246	173	2170
A_2		0	1200	123	25123
A_3			0	48	3048
A_4				0	16000
A_5					0

$m[1,2] = m[1,1] + m[2,2] + P_0P_1P_2 \rightarrow k=1$

$= 0 + 0 + 2(25)(3) = 150$

$m[2,3] = m[2,2] + m[3,3] + P_1P_2P_3 \rightarrow k=2$

$= (25)(3)(16) = 1200.$

$m[3,4] = m[3,3] + m[4,4] + P_2P_3P_4 \rightarrow k=3$

$= (3)(16)(1) + 0 = 48$

$m[4,5] = m[4,4] + m[5,5] + P_3P_4P_5 \rightarrow k=4.$

$= 0 + 0 + 16(1)(1000) = 16000$

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No.

Date

$m[1,3] \rightarrow k=1 \rightarrow m[1,1] + m[2,3] + p_0 p_1 p_3$

$= 0 + 1200 + 2(25)(16) = 2000.$

$k=2 \rightarrow m[1,2] + m[3,3] + p_0 p_2 p_3$

$= 150 + (2)(3)(16) = 246$

$m[2,4] \rightarrow k=2 \rightarrow m[2,2] + m[3,4] + p_1 p_2 p_4$

$= 0 + 48 + 25(3) = 123$

$k=3 \rightarrow m[2,3] + m[4,4] + p_1 p_3 p_4$

$= 1200 + 0 + 25(16) = 1600.$

$m[3,5] \rightarrow k=3 \rightarrow m[3,3] + m[4,5] + p_2 p_3 p_5$

$= 0 + 1600 + 3(16)(1000) = 64000$

$k=4 \rightarrow m[3,4] + m[5,5] + p_2 p_4 p_5$

$= 48 + 3(1)(1000) = 3048$

$m[1,4] \rightarrow k=1 \rightarrow m[1,1] + m[2,4] + p_0 p_1 p_4$

$= 0 + 123 + 2(25)(1) = 173$

$k=2 \rightarrow m[1,2] + m[3,4] + p_0 p_2 p_4$

$= 150 + 48 + 2(3) = 204.$

$k=3 \rightarrow m[1,3] + m[4,4] + p_0 p_3 p_4$

$= 246 + 0 + 2(16) = 278.$

Date

m[2,5] → k=2 → m[2,2] + m[3,5] + $P_1P_2P_5$

= 3048 + 25(3)(1000) = 78048.

k=3 → m[2,3] + m[4,5] + $P_1P_3P_5$

= 1200 + 16000 + 25(16)(1000) = 417200.

k=4 → m[2,4] + m[5,5] + $P_1P_4P_5$

= 123 + 25(1000) = 25123.

m[1,5] → k=1 → m[1,1] + m[2,5] + $P_0P_1P_5$

= 25123 + 2(25)(1000) = 75125.

k=2 → m[1,2] + m[3,5] + $P_0P_2P_5$

= 150 + 3048 + 2(3)(1000) = 9198

k=3 → m[1,3] + m[4,5] + $P_0P_3P_5$

= 246 + 16000 + 2(16)(1000) = 48246

k=4 → m[1,4] + m[5,5] + $P_0P_4P_5$

= 170 + 2(1000) = 2170.

Matrix : $A_1 A_2 A_3 A_4 A_5$

→ $(A_1 A_2 A_3 A_4)(A_5)$

→ $[(A_1)(A_2 A_3 A_4))(A_5)$

→ $(((A_1)((A_2)(A_3 A_4)))A_5)$ Ans.

Question #4 Knapsack

value = [2,3,1,4] weight = [3,4,6,5] w = 8

max (V[i-1,w], V[i-1, w-wi] + vi)

vi	wi	0	1	2	3	4	5	6	7	8
		0	0	0	0	0	0	0	0	0
2	3	1	0	0	0	2	2	2	2	2
3	4	2	0	0	0	2	3	3	3	5
4	5	3	0	0	0	2	3	4	4	5
1	6	4	0	0	0	2	3	4	4	5

i=1:

max(V[0,0], 2+V[0,-3]) = max(0,0) = 0
max(V[0,1], 2+V[0,-2]) = max(0,0) = 0
max(V[0,2], 2+V[0,-1]) = max(0,0) = 0
max(V[0,3], 2+V[0,0]) = max(0,0) = 0
max(V[0,4], 2+V[0,1]) = max(0,2+0) = 2
max(V[0,5], 2+V[0,2]) = max(0,2+0) = 2
max(V[0,6], 2+V[0,3]) = max(0,2+0) = 2
max(V[0,7], 2+V[0,4]) = max(0,2+0) = 2
max(V[0,8], 2+V[0,5]) = max(0,2+0) = 2

i=2: doing for only when w ≥ wi

max(V[1,4], 3+V[1,0]) = max(2,3+0) = 3
max(V[1,5], 3+V[1,1]) = max(2,3+0) 3
max(V[1,6], 3+V[1,2]) = max(2,3+0) 3
max(V[1,7], 3+V[1,3]) = max(2,3+2) 5
max(V[1,8], 3+V[1,4]) = max(2,3+2) 5

i=3

max(V[3,5], 4 + V[2,0]) = max(3, 4+0) = 4
max(V[2,6], 4 + V[2,1]) = max(3, 4+0) = 4
max(V[2,7], 4 + V[2,2]) = max(5, 4+0) = 5
max(V[2,8], 4 + V[2,3]) = max(5, 4+2) = 6

i=4

max(V[3,6], 1 + V[3,0]) = max(4, 1+0) = 4
max(V[3,7], 1 + V[3,1]) = max(5, 1+0) = 5
max(V[3,8], 1 + V[3,2]) = max(6, 1+0) = 6

6-4=2 value=4, weight=5
2-2=0 value=2 weight=3
item (1,4)

~~Question#9~~: group number 1 ASHMAL
2 = HASNAIN

S={1,19,8,8,1,19}
sum= 56 which is even so partition exists

56/2=28

we just need to find elements that adds upto sum/2 and we will find the second sum automatically.

as we cant solve it from the table in 28 different columns, we will solve it by directly.

The recurrance relation:

```
if(j< S[i-1])
    m[i][j]=m[i-1][j]
else
    m[i][j]= m[i-1][j] or m[i][j-S[i-1]]
```

To find a sum 28 we can see that we can easily form it by adding 19, 1, 8 so the other subset will also be same.

S1 {19,1,8} S2 {19,1,8}

Question 4) length[7] = {1, 2, 3, 4, 5, 6, 7, 8}

price[] = {1, 5, 8, 9, 10, 17, 17, 20}

Rod length = 6

	len	1	2	3	4	5	6	7	8
v(i)	price	1	5	8	9	10	17	17	20
c(i)		1	5	8	10	13	17	18	22

$$c(i) = \max_{1 \le k \le i} \{v_k + c(i-k)\} \quad \therefore c(1) = 1$$

$$c(2) = \max \begin{cases} v_1 + c(1) = 1+1 = 2 \\ v_2 = 5 \end{cases} = \max(2, 5) = 5$$

$$c(3) = \max \begin{cases} v_1 + c(2) = 1+5 = 6 \\ v_2 + c(1) = 5+1 = 6 \\ v_3 = 8 \end{cases} = \max(6, 6, 8) = 8$$

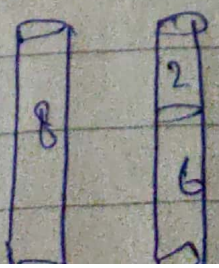
$$c(4) = \max \begin{cases} v_1 + c(3) = 1+8 = 9 \\ v_2 + c(2) = 5+5 = 10 \\ v_3 + c(1) = 8+1 = 9 \\ v_4 = 9 \end{cases} = \max(9, 10, 9, 9) = 10$$

$$c(5) = \max \begin{cases} v_1 + c(4) = 1+10 = 11 \\ v_2 + c(3) = 5+8 = 13 \\ v_3 + c(2) = 8+5 = 13 \\ v_4 + c(1) = 9+1 = 10 \\ v_5 = 10 \end{cases} = \max(11, 13, 13, 10, 10) = 13$$

$C(6) = \max \begin{cases} v_1 + C(5) = 1+13 = 14 \\ v_2 + C(4) = 5+10 = 15 \\ v_3 + C(3) = 8+8 = 16 \\ v_4 + C(2) = 9+5 = 14 \\ v_5 + C(1) = 10+1 = 11 \\ v_6 = 17 \end{cases} = \max(14, 15, 16, 14, 11, 17) = 17$

$C(7) = \max \begin{cases} v_1 + C(6) = 18 \\ v_2 + C(5) = 18 \\ v_3 + C(4) = 18 \\ v_4 + C(3) = 17 \\ v_5 + C(2) = 15 \\ v_6 + C(1) = 18 \\ v_7 = 17 \end{cases} = \max(18, 18, 18, 17, 15, 18) = 18$

$C(8) = \max \begin{cases} v_1 + C(7) = 1+18 = 19 \\ v_2 + C(6) = 5+17 = 22 \\ v_3 + C(5) = 8+13 = 21 \\ v_4 + C(4) = 9+10 = 19 \\ v_5 + C(3) = 10+8 = 18 \\ v_6 + C(2) = 17+5 = 22 \\ v_7 + C(1) = 17+1 = 18 \\ v_8 = 20 \end{cases} = \max(19, 22, 21, 19, 18, 22, 18, 20) = 22$



= Optimal way to cut a rod of length 8.

Question #i) Coin-change-making-problem

S = {1,5,6,8} change = 11

i \ j	0	1	2	3	4	5	6	7	8	9	10	11
1	0	1	2	3	4	5	6	7	8	9	10	11
5	0	1	2	3	4	1	2	3	4	5	2	3
6	0	1	2	3	4	1	1	2	3	4	2	2
8	0	1	2	3	4	1	1	2	1	2	2	2

↑

formula ⇒ min(mn, 1 + arr[j − w[i]])

input ⇒ S = {1,5,6,8}

output ⇒ The minimum number of coins needed to make this desired changed is equal to 2.

Thus {min. no of coins needed : 2

Denomination of 2 coins = {5,6} = 11

Question #j)

	0	1	2	3	4	5	6	7	8	9	10
0	T	F	F	F	T	F	F	F	F	F	T
1		F	F	F	T	F	F	F	F	F	T
2			T	F	F	F	F	F	F	F	F
3				F	F	F	F	F	F	F	F
4					F	F	F	F	F	F	F
5						F	F	F	F	F	F
6							F	F	F	F	F
7								F	T	F	F
8									T	F	F
9										F	F
10											F

when letter length l=1.

word (0,0) = T

w(1,1) = l

w(2,2) = i

w(3,3) = k

w(4,4) = e

w(5,5) = m

w(6,6) = o

w(7,7) = b

w(8,8) = i

w(9,9) = l

w(10,10) = e

when letter length l=2

w(0,1) = Il f

w(1,2) = Li f

w(3,4) = iK f

w(5,6) = ke f

w(6,7) = em f

w(7,8) = mo f

w(8,9) = ob f

w(9,10) = bl f

w(1,3,10) = le f

when length = 3:

w(0,1) = Ili F
w(1,3) = lik F
w(2,4) = ike F
w(3,5) = kem F
w(4,7) = emo F
w(6,8) = mob F
w(7,9) = obi F
w(8,10) = ile F

when letter length = 4

w(0,3) = Ilik F
w(1,4) = like T
w(2,5) = ikem F
w(3,6) = kemo F
w(4,7) = emob F
w(5,8) = mobi F
w(6,9) = obil F
w(7,10) = bile F

when letter length = 5

w(0,4) = Ilike T
w(1,5) = likem F
w(2,6) = ikemo F
w(3,7) = kemob F
w(4,8) = emobi F
w(5,9) = mobil F
w(6,10) = obile F

Now letter length = 6

w(0,5) = Likem F
w(1,6) = ikemo F
w(2,7) = kemob F
w(3,8) = kemobi F
w(4,9) = emobil F
w(5,10) = mobile T

word length = 7

w(0,6) = Ilikemo (F)
w(1,7) = likemob (F)
w(2,8) = ikemobi (F)
w(3,9) = kemobil (F)
w(4,10) = emobile (F)

letter length = 8

w(0,7) = Ilikemob F
w(1,8) = likemobi F
w(2,9) = ikemobil F
w(3,10) = kemobile F

letter length = 9

w(0,8) = Ilikemobi F

w(1,9) = likemobil F

w(2,10) = ikemobile F

length word = 10

w(0,9) = Ilikemobil

w(1,10) = likemobile T