Chapter 14

Input and Output

INTRODUCTION

Problems related to input-output are frequently asked questions in various graduate level competitive examinations. They are not very tough stuff but take a good deal of time to be solved or sometimes students do not take attempt to solve them because of time consuming impression of such type of questions. But proper understanding of the subject makes you believe that such problems are not as tough and time consuming as they seem.

CONCEPT OF INPUT-OUTPUT PROBLEMS

In such problems:

(a) It is imagined that there is some kind of computer/word processing machine.

(b) An input is given to the computer/ word processing machine

(c) The computer/word processing machine performs repeated operations as per a certain pattern to give different output in different steps.

TYPES OF PROBLEMS

(i) Problems of shifting

(ii) Problems of arrangement

(iii) Problems of mathematical operation

(iv) Miscellaneous.

PROBLEM OF SHIFTING

We know that in such type of problems, a word/number processing machine generate output through shifting. Shifting does mean an operation in which words or numbers of a given input give outputs in different steps through shifting their place to different place as per a fixed pattern.

Note : In shifting problems, the previous step of any step can possibly be determined, so we can move in backward or reverse order which is not possible in some of the other type of problems.

Methods to Solve

Lets take an example

Input : Blue Cat Good Other Have Cake
Step 1 : Blue Other Good Cat Have Cake
Step 2 : Blue Other Have Cat Good Cake
Step 3 : Cake Other Have Cat Good Blue
Step 4 : Cake Cat Have Other Good Blue
Step 5 : Cake Cat Good Other Have Blue
Step 6 : Blue Cat Good Other Have Cake

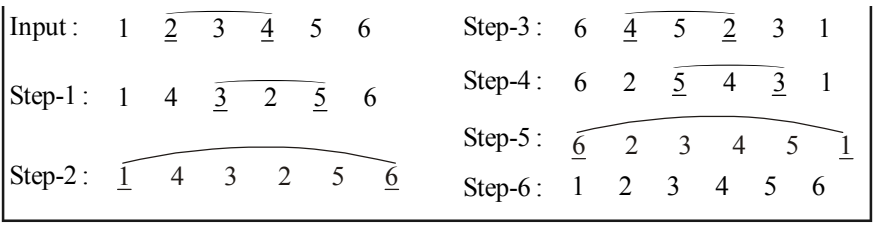
Shifting of element can easily be understood by making them equivalent to number like

Blue = 1, Cat = 2, Good = 3, Other = 4, Have = 5, Cake = 6

Input can be written as

1	2	3	4	5	6
Blue	Cat	Good	Other	Have	Cake

Step-1 : 2 and 4 interchanged
Step-2 : 3 and 5 interchanged
Step-3 : 1 and 6 interchanged
Step-4 : 1, 2 and 3 are repeated again.



PROBLEMS ON ARRANGEMENTS

1. Word Arrangement from Left Side:

EXAMPLE :

Input :	mango	tango	orange	banana	pear
Step I:	banana	mango	tango	orange	pear
Step II:	banana	mango	orange	tango	pear
Step III:	banana	mango	orange	pear	tango

Here, we start arrangement from the word that comes 1st in the dictionary; then comes the word coming 2nd in the dictionary, then comes the word coming 3rd in the dictionary and so on. In this case, the arrangement start from left side. This is the reason in step I banana comes 1st as it comes 1st in the dictionary. In the 2nd step, orange comes at 3rd place because after the arrangement of step I the next word coming in the dictionary is mango but it get arranged automatically and hence there is no need to arrange it in step II. This is the reason after arranging banana in step I, we directly come to the word orange (coming 3rd in the dictionary) in step II. In the 3rd step, we arrange the word 'pear' (coming 4th in the dictionary) and the word tango get arranged automatically.

2. Word Arrangement from Right:

EXAMPLE :

Input:	Name	Fame	Game	Shame	Jam
Step I:	Name	Game	Shame	Jam	Fame
Step II:	Name	Shame	Jame	Game	Fame
Step III:	Shame	Name	Jam	Game	Fame

In this case, the arrangement starts from right side. The word coming 1st in the dictionary comes at the 1st position from right. At the 2^{nd} position from right comes the word coming 2^{nd} in the dictionary and the process goes on till the arrangement gets completed. In the above given example, 'Fame' is the 1st word coming in the dictionary and hence it comes at the 1st position from right in the step I. In the step II, the 2nd word coming in the dictionary (Game) comes at the 2nd position from right. Point to be noted that the word coming

third in the dictionary will come at the 3rd position from right and this word is 'Jam'. But 'Jam' automatically get arranged as per the given pattern when we arrange the word 'Game' in II step. This is the reason why we don't arrange 'Jam' in the third step and jump directly to arrange the word. 'Name' that comes 4th in the dictionary. 'Name' occupies 4th position from right and the word 'Shame' automatically get arranged in the 3rd step. Hence, the word 'Shame' does not need to get arranged.

3. Word Arrangement from the Left-Right Alternate:

EXAMPLE :

Input:	Sachin	is	a	great	cricket	player
Step I:	a	Sachin	is	great	cricket	player
Step II:	a	is	great	cricket	player	Sachin
Step III:	a	cricket	is	great	player	Sachin
Step IV:	a	cricket	great	is	player	Sachin

Here, the arrangement is made by putting the first word at 1st place, then alphabetically last word at last place, then alphabetically second word at second place from left and the further arrangements goes on in the same manner. In the other words, are positioned from the left and from the right alternately. In the step I the word coming 1st in the dictionary is 'a' and it takes 1st position from left. In the step II, the last word coming alphabetically is Sachin and it takes last position (1st from right). In step III, the word coming 2nd in dictionary is 'cricket' that comes at 2nd position from left. In step IV, the word coming 3rd last in the dictionary takes the 3rd position from right. After the step IV, all the words get arranged in alphabetical order. Point to be noted that after step IV, there is no need to arrange the word 'great' as it get arranged automatically is step IV.

4. Arrangement in Increasing or Decreasing Order:

EXAMPLE :

Input:	25	17	18	58	100	35
Step I:	17	25	18	58	100	35
Step II:	17	18	25	58	100	35
Step III:	17	18	25	35	58	100

This arrangement gives a clear idea of arrangement of numbers in increasing order. In step I, the smallest number (17) comes at the 1st position from left pushing the remaining to the right. In step II, the 2nd smallest number (18) comes at 2nd position from left pushing the remaining number to the right. In step III, the 4th smallest number (35) takes 4th position from left and the other two numbers 58 and 100 get arranged automatically.

Now, let us see decreasing order arrangement:

Input:	25	17	18	58	100	35
Step I:	100	25	17	18	58	35
Step II:	100	58	25	17	18	35
Step III:	100	58	35	25	17	18
Step IV:	100	58	35	25	18	17

The same arrangement can take place from right side (or in the reverse order) as follow:

Input:	25	17	18	58	100	35
Step I:	25	18	58	100	35	17
Step II:	25	58	100	35	18	17
Step III:	58	100	35	25	18	17
Step IV:	100	58	35	25	18	17

5. Number Arrangment from Left-Right Alternate:

Like words left-right alternate arrangement, number arrangement also takes place. The process of this arrangement is exactly the same as the arrangement takes place in case of words. Just see the following cases:

Case I :

Input:	100	125	26	10	15	35
Step I:	10	100	125	26	15	35
Step II:	10	100	26	15	35	125
Step III:	10	15	100	26	35	125
Step IV:	10	15	26	35	100	125

Here, the smallest number (10) takes 1st position from left in step I. In step II the largest number takes the last (1st from right) position. Again in step III the 2nd smallest number (15) comes at the 2nd position from left. In the step IV, the 2nd largest number (100) comes at the 2nd position from right and the remaining number (26 and 35) get arranged automatically.

Case II :

Input:	100	125	26	10	15	35
Step I:	100	26	10	15	35	125
Step II:	10	100	26	15	35	125
Step III:	10	26	15	35	100	125
Step IV:	10	15	26	35	100	125

In case II, the arrangements take place in the same way as the arrangements take place in case I. But the difference here is that case I is a left-right

arrangement and case II is the right-left arrangement. In case II, the arrangement starts with the largest number (125) coming at the 1st position from right and this is step I. In step II, the smallest number (10) comes at the 1st position from left. In step III the 2nd largest number (100) comes at the 2nd position from right. In step III, the third largest number (35) automatically comes at the 3rd position from right. In 4th step, the 2nd smallest number (15) comes at the 2nd position from left and 26 get arranged automatically coming at 3rd position from left.

***Note*:** Left-right (or right-left) arrangement of numbers also take place in the same manner when numbers are arranged in decreasing order.

6. Arrangement of Words and Numbers Simultaneously:

Just see the following outputs produced by a word and number machine.

Case I

Input:	50	32	Vandana	Prerna	Aradhna	100
Step I:	32	50	Vandana	Prerna	Aradhna	100
Step II:	32	Aradhna	50	Vandana	Prerna	100
Step III:	32	Aradhna	50	Prerna	Vandana	100
Step IV:	32	Aradhna	50	Prerna	100	Vandana

In such case, numbers and words get arranged alternately. In step I, the smallest number (32) comes at the 1st position from left pushing the remaining members of input towards right. In the step II, the word coming 1st alphabetically (that is the word 'Aradhna') takes the 2nd position from left pushing the remaining member rightward. Point to be noted that the 2nd smallest number automatically comes at the third position from left while arranging the word 'Aradhna' and hence, there is no need to arrange the 2nd smallest number '50'. In step III, the word (Prerna) coming 2nd alphabetically comes at the 4th position from left pushing the other members to the right. In step IV, the largest number (100) occupies the 5th position from left and the word (Vandana) coming last alphabetically comes at last position automatically finishing the complete arrangement.

Let us see some other cases of this type:

Case II:

Input:	50	32	Vandana	Prerna	Aradhna	100
Step I:	100	50	32	Vandana	Prerna	Aradhna
Step II:	100	Vandana	50	32	Prerna	Aradhna
Step III:	100	Vandana	50	Prerna	32	Aradhan

In this case, largest number and the word coming last alphabetically get arranged alternately. Then the 2nd longest number and the word coming 2nd last alphabetically get arranged alternately and the process goes on till the arrangements of all the numbers and words get completed. In this case, arrangement completes in step III.

Case III:

Input:	50	32	Vandana	Prerna	Aradhna	100
Step I:	Aradhna	50	32	Vandana	Prerna	100
Step II:	Aradhna	32	50	Vandana	Prerna	100
Step III:	Aradhna	32	Prerna	50	Vandana	100

In this case, arrangement starts with the word coming 1st alphabetically and such word is 'Aradhna' that comes at the 1st position from left is step I. In step II, the smallest number (32) comes at the 2nd position from left. Then, in step III, the word coming 2nd alphabetically comes at the 3rd position from left and all the other members get arranged automatically.

Case IV:

Input:	50	32	Vandana	Prerna	Aradhna	100
Step I:	Vandana	50	32	Prerna	Aradhna	100
Step II:	Vandana	100	50	32	Prerna	Aradhna
Step III:	Vandana	100	Prerna	50	32	Aradhna
Step IV:	Vandana	100	Prerna	50	Aradhna	32

In this case, word coming last alphabetically comes 1st from left in step I and such word is 'Vandana'. In step II, the largest number (100) comes at the 2nd position from left. In step III, the word coming 2nd last alphabetically occupies the 3rd position from left, and such word is 'Prerna'. As the 2nd largest number (50) automatically get arranged as per the pattern going on and hence this is not needed to arranged in step IV. In step VI, the word coming Ist alphabetically comes at the 5th position from left and such word is 'Aradhna'. The smallest number (32) get arranged automatically coming at the last position from left in step IV. Thus, it is clear that in this case the word coming lst alphabetically and the greatest number get arranged alternately in 1st two steps; then 2nd last word alphabetically and 2nd largest number get arranged alternately finishing the whole arrangement in step IV.

Case V:

Input:	50	32	Vandana	Prerna	Aradhna	100
Step I:	32	50	Vandana	Prerna	Aradhna	100
Step II:	32	Vandana	50	Prerna	Aradhna	100
Step III:	32	Vandana	50	Prerna	100	Aradhna

In this case, the smallest number comes at the 1st position from left in step I and such number is 32. In step II, the word (Vandana) coming last alphabetically occupies the 2nd place from left. In the 2nd step, the 2nd smallest number (50) takes the 3rd position from left automatically and also the word coming 2nd last alphabatically takes the 4th position from left automatically. Hence, there is no need to arrange '50' and 'Prerna'. In the III step, the largest number (100) occupies the 5th position from left completing the whole arrangement.

Case VI:

Input:	50	32	Vandana	Prerna	Aradhna	100
Step I:	100	50	32	Vandana	Prerna	Aradhna
Step II:	100	Aradhna	50	32	Vandana	Prerna
Step III:	100	Aradhna	50	Prerna	32	Vandana

In this case, the logic is that the greatest number (100) comes at the 1st position from left in step I. In step II the word coming 1st alphabetically takes the 2nd position from left and the 2nd largest number (50) gets arranged automatically. Hence, in step III, we direct arrange the word coming 2nd last alphabetically (that word is 'Prerna') occupies the 4th position from left and the other two members (32 and 'Vandana') get arranged automatically finishing the whole arrangement.

7. Arrangement Based on the Number of Letters in Words:

Just have a look at the following patterns:

Case I :

Input:	let	pattern	love	fried	be	mature
Step I:	be	let	pattern	love	fried	mature
Step II:	be	let	love	pattern	fried	mature
Step III:	be	let	love	fried	pattern	mature
Step IV:	be	let	love	fried	mature	pattern

Here, the words get arranged as per increasing number of letters. In other words, the word having least number of letters comes 1st from left in step I and such word is 'be'. The word 'let' is bigger than 'be' and smaller than other words letterwise and hence, it takes 2nd position from left but it gets arranged automatically when the word 'be' is arranged in step I. In 2nd step, the word 'love' comes at the 3rd position from left as it is bigger than word 'let' letterwise. In step III, the letterwise bigger word (fried) than love comes at the fourth position from left. Similarly, mature comes at the 5th position from left and pattern comes at the last position automatically while arranging the word 'mature'.

Case II :

Input:	let	pattern	love	fried	be	mature
Step I:	pattern	let	love	fried	be	mature
Step II:	pattern	mature	let	love	fried	be
Step III:	pattern	mature	fried	let	love	be
Step IV:	pattern	mature	fried	love	let	be

In this case, the words get arranged in decreasing order in terms of letters. In other words, the word having the largest number of letters comes 1st from left, then comes the word having 2nd largest number of letters, then comes the word having 3rd largest number of letters and the process goes on till the word having the least number of letters occupies the last position from left.

Case III:

Input:	let	pattern	gate	a	set	be	hope
Step I:	a	let	pattern	gate	set	be	hope
Step II:	a	be	let	pattern	gate	set	hope
Step III:	a	be	let	set	pattern	gate	hope
Step IV:	a	be	let	set	gate	pattern	hope
Step V:	a	be	let	set	gate	hope	pattern

Have you noticed something here? Here, the words get arranged in increasing order of litters. But when it comes to the case of two or more words having equal number of letters the priority is given alphabetically. It does mean that the word coming 1st as per the alphabet will be put before the word coming 2nd. Similarly, the word coming 2nd alphabetically will be put before the word coming third. This is the reason why 'let' has been put before 'set' and 'gate' has been put before 'hope'.

Case IV:

Input:	let	pattern	gate	a	set	be	hope
Step I:	pattern	let	gate	a	set	be	hope
Step II:	pattern	hope	let	gate	a	set	be
Step III:	pattern	hope	gate	let	a	set	be
Step IV:	pattern	hope	gate	set	let	a	be
Step V:	pattern	hope	gate	set	let	be	a

In this case, the words get arranged in decreasing order of letters. But when it comes to the case of two or more words having equal number of letters the priority is given to the word that comes later alphabetically. It does mean that the word coming 1st alphabetically will be put after the word coming 2nd and the word coming 2nd will be put after the word coming 3rd. This is the reason why 'hope' has been put before 'gate' and 'set' has been put before 'let'.

Important Note: *The case of arrangement discussed so far are the cases of push. In all the cases a new word jumps from its place in every step, occupies its new and due place and gives the remaining words and push either towards left or right as per the requirement of the pattern. But in some cases of arrangement interchange does take place and that format is given below*:

8. Arrangement with Interchange:

EXAMPLE

Input:	the	most	beautiful	girl	is	Vandana
Step I:	beautiful	most	the	girl	is	Vandana
Step II:	beautiful	girl	the	most	is	Vandana
Step III:	beautiful	girl	is	most	the	Vandana

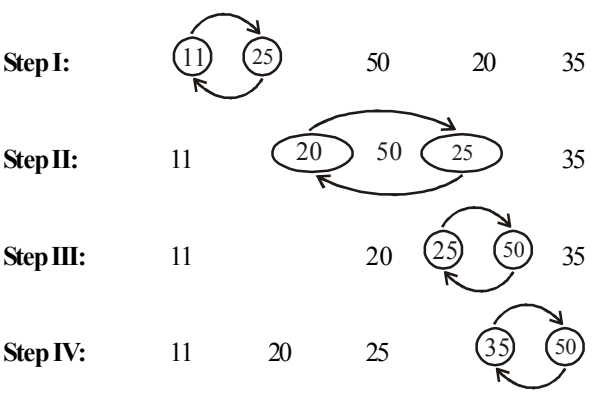
In this case, the word (beautiful) coming 1st in alphabetical order comes at the 1st position from left interchanging its place with the word 'the' and this is step I. In step II, the word (girl) coming 2nd in alphabetical order occupies the 2nd position from left interchanging with the word 'most'. In step III, the word coming 3rd (is) comes at the third position from left interchanging with the word 'the' and finishing the complete arrangement in alphabetical order.

This type of cases can also be seen in number arrangements and in the arrangements of numbers and words simultaneously. The examples of these type of arrangements are given below:

EXAMPLE **(Increasing order number arrangement)**

Input:	25	11	50	20	35
Step I:	11	25	50	20	35
Step II:	11	20	50	25	35
Step III:	11	20	25	50	35
Step IV:	11	20	25	35	50

Presentation :

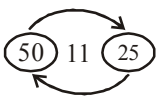


The presentation gives you the clear idea of how interchange takes place in every step.

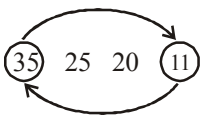
EXAMPLE **(Decreasing order number arrangement)**

Input:	25	11	50	20	35
Step I:	50	11	25	20	35
Step II:	50	35	25	20	11

Presentation:

Step I: 

20 35

Step II: 50 

PROBLEMS OF MATHEMATICAL OPERATION—

In this type of problems, the input has some numbers. Different steps are obtained by taking the numbers of the input and different arithmetic operations are performed after that.

EXAMPLE

Input :	44	35	18	67	22	28	36
Step I :	36	27	10	59	14	20	28
Step II :	16	15	8	42	4	16	18
Step III :	132	105	54	201	66	84	108
Step IV :	50	41	24	73	28	34	42
Step V :	8	8	9	4	4	1	9
Step VI :	64	64	81	169	16	100	81
Step VII :	20	19	12	46	8	20	22

In this case, in step I (each number of the input – 8). In step II, product of the digits of each number of the input. In step III, each number of the input is multiplied by 3. In step IV, each number of the input is added by 6. In step V, keep adding the digits of each number of the input till they are converted into single digit. In step VI, (digit sum of each number of input)^2. In step VII, each number of step II is added by 4.

MISCELLANEOUS PROBLEMS

In this type of problems, there is no fixed pattern of questions coming under this category. Infact, questions under this category comes before you as a real surprise.

EXAMPLE

Input :	every	now	and	then	same
Step I :	every	ow	nd	hen	ame
Step II :	ever	no	an	the	sam
Step III :	vry	nw	nd	thn	sm
Step IV :	ee	o	a	e	ae
Step V :	ery	w	d	en	me

In this case, in step I, first letter disappear. In step II, last letter disappear. In step III, vowels disappear. In step IV, consonants disappear. In step V, first two letters disappear.

❑ Shortcut Approach

1. First of all, observe the given input line of words or numbers and the last step of rearrangement, so that candidate may get an idea about the changes effected in various steps of rearrangement.
2. In order to know what changes have been made in each step, observe two consecutive steps carefully.
3. Now, correlate the input, the last step and anyone of the middle steps. This will enable you to identify the rule of arrangement.
4. In shifting problems, it is possible to determine the previous/earlier steps including input. We can proceed/move backward or in reverse direction in shifting problems.
5. In shifting problems for convenience, we assign numeric value to given words.

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