

Lab 8 – 14th March
Topics – Sets and Hashtables

Problem 1

Design and implement ADT SmallSet by treating a single *unsigned int* word as a bit vector and the positions as members of the universe:

- Let N be `sizeof(unsigned int)`. Then any subset of the universal set $U = \{ 0, 1, \dots, N-1 \}$ can be represented as a bit vector of size N (which in turn can be stored as an *int* word.)
- Given $S \subseteq U$, for any $j \in U$, $(j \in S)$ iff $(j^{\text{th}}$ bit (counting 0 as the LSB) of S is 1)
- Adding j to S can be implemented as setting j^{th} bit to 1; deleting as setting it to 0.

Obtaining j^{th} bit of an *int* in C can be achieved by masking the vector with a bit pattern and testing it: i.e. $(S \& B_j)$ iff $(j^{\text{th}}$ bit of S is 1) where B_j is all 0s except the j^{th} bit.

B_j can be obtained by left-shifting $((\text{unsigned int}) 1)$ j times.

Implement typical set operations *union*, *intersect*, and *difference* for this SmallSet ADT. You can use the following table for designing your functions.

| Key | Function | Input Format | Description |
|-----|--------------|---|--|
| 0 | readData | 0 N X Y A ₁ A ₂ A ₃ .. A _x B ₁ B ₂ B ₃ .. B _y | N represents the size of U (taken as input for convenience). X and Y represent the sizes of two sets of A & B respectively. You shall need to read two sets (A & B) of integers, separated by a new line. Each set contains values with space separation. Represent A and B in the form of SmallSet ADT described above. |
| 1 | Union | 1 | Perform union operation on A and B ($C = A \cup B$) and print C. |
| 2 | Intersection | 2 | Perform intersection operation on A and B ($C = A \cap B$) and print C. You may sort C in ascending order first before printing. |
| 3 | Difference | 3 | Perform difference operation on A and B ($C = A - B$) and print C. You may sort C in ascending order first before printing. |

Sample input and output

| Sample Input | Sample Output |
|--|---|
| 0 32 5 6 2 4 15 7 24 9 16 15 10 20 21 1 2 3 -1 | 2 4 7 9 10 15 16 20 21 24 15 2 4 7 24 |