11.1-2.

A ***bit vector*** is simply an array of bits (0s and 1s). A bit vector of length m takes much less space than an array of m pointers. Describe how to use a bit vector to represent a dynamic set of distinct elements with no satellite data. Dictionary operarions should run in $O(1)$ time.

Answer.

Using the bit vector data structure, we can represent keys less than m by a string of m bits, denoted by $V[0...m-1]$, in which each position that occupied by the bit 1, corresponds to a key in the set S. If the set contains no element with key k, then $V[k]=0$. For instance, we can store the set $\{2,4,6,10,16\}$ in a bit vector of length 20:

```
0 0 1 0 1 0 1 0 0 0 1 0 0 0 0 0 1 0 0 0 0
```

The dictionary operations are trivial to implement:

```
BITMAP-SEARCH(V, k)
1   if V[k] ≠ 0
2       return k
3   else return NIL

BITMAP-INSERT(V, x)
1   V[x] = 1

BITMAP-DELETE(V, x)
1   V[x] = 0
```

Each of these operations takes only $O(1)$ time.

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