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Question 1

1.1

The 5^{th} bit (A[5]) is the one missing.

1.2

Normally, if no bits are missing, A[10] should be 1. Since A[10] = 0, the missing bit must be the 10^{th} bit or a bit before the 10^{th} bit. Therefore, the missing bit lies between 1 and 10 inclusive.

1.3

If there is no bit missing prior, every even index should contain a 1. Therefore, if the current n is even, check if the n/2 bit is 1. If n is odd, check if the (n – 1)/2 bit is 1.

If the bit is 1, the missing bit is in the last half of the bits.

If the bit is 0, the missing bit is in the first half of the bits (including the checked bit).

Recurse on the half containing the missing bit.

Once n = 1 and the remaining bit is 1, the missing bit is the one before the current index.

If the remaining bit is 0, the missing bit is the one after the current index.

Since we are halving the amount n at each step, we only complete O(1) checking processes at most O(logn) times. Therefore, the above algorithm runs in O(logn) time.