Digit Queries (CSES)

Problem Statement

Consider an infinite string that consists of all positive integers in increasing order:
12345678910111213141516171819202122232425...

Your task is to process q queries of the form: what is the digit at position k in the string? Input The first input line has an integer q: the number of queries. After this, there are q lines that describe the queries. Each line has an integer k: a 1-indexed position in the string. Output For each query, print the corresponding digit.

Solution

To solve this problem we first have to find how many digits the number at position k has. To do that we will calculate powers of 10. Then we can easily check between which powers of 10 number k is.

Next we will perform binary search on the range of our powers of 10. The key here is the formula for the start of number at position k. For a given number i we can check at which position it starts by substracting the previous power of 10 from it and then multiplying the result by the number of digits and we also need to add previous number position.