HUST

ĐẠI HỌC BÁCH KHOA HÀ NỘI

HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY

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Applied Algorithm Lab

Max-distance Sub-sequence

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Max-distance sub-sequence

- Given a sequence $a_1, \dots, a_N$
- Consider a subset of the sequence

    The distance of the subset is defined to be the minimum distance between two elements

- Find the subset of N given elements containing exactly C elements such that the distance is maximal.
- Example

stdin	stdout

1
5 3
1 2 8 4 9
	3

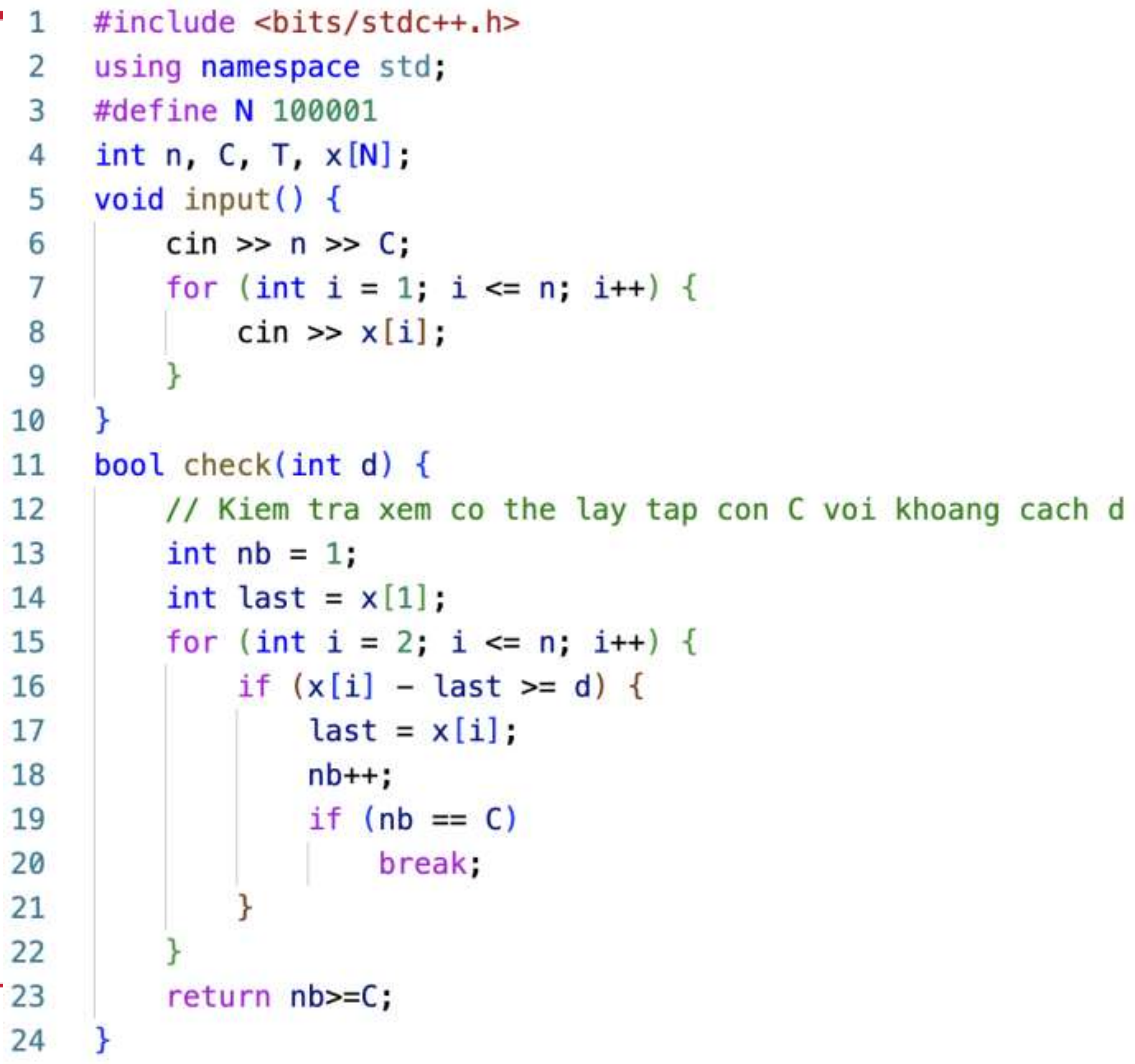
Max-distance sub-sequence

- Idea to solve: Sort $a_1, \ldots, a_N$ in increasing order
- The max-distance must be $\leq \frac{a_N - a_1}{c-1}$
- Find max-distance: traverse from $\mathrm{d} = \frac{a_N - a_1}{c-1}$ down to 1:
  - check(d): Check if we can find a sub-sequence with distance $\geq d$: Greedy
  - Add a1 into subsequence, use an auxiliary variable **last**
  - for i=2, i<=n; i++:
    - if a[i]-last ≥ d then we add a[i] to the subsequence and update **last**
    - otherwise continue
  - If the subsequence has C elements then d is max-distance. Print d
  - Complexity: O(n^2)

Max-distance sub-sequence

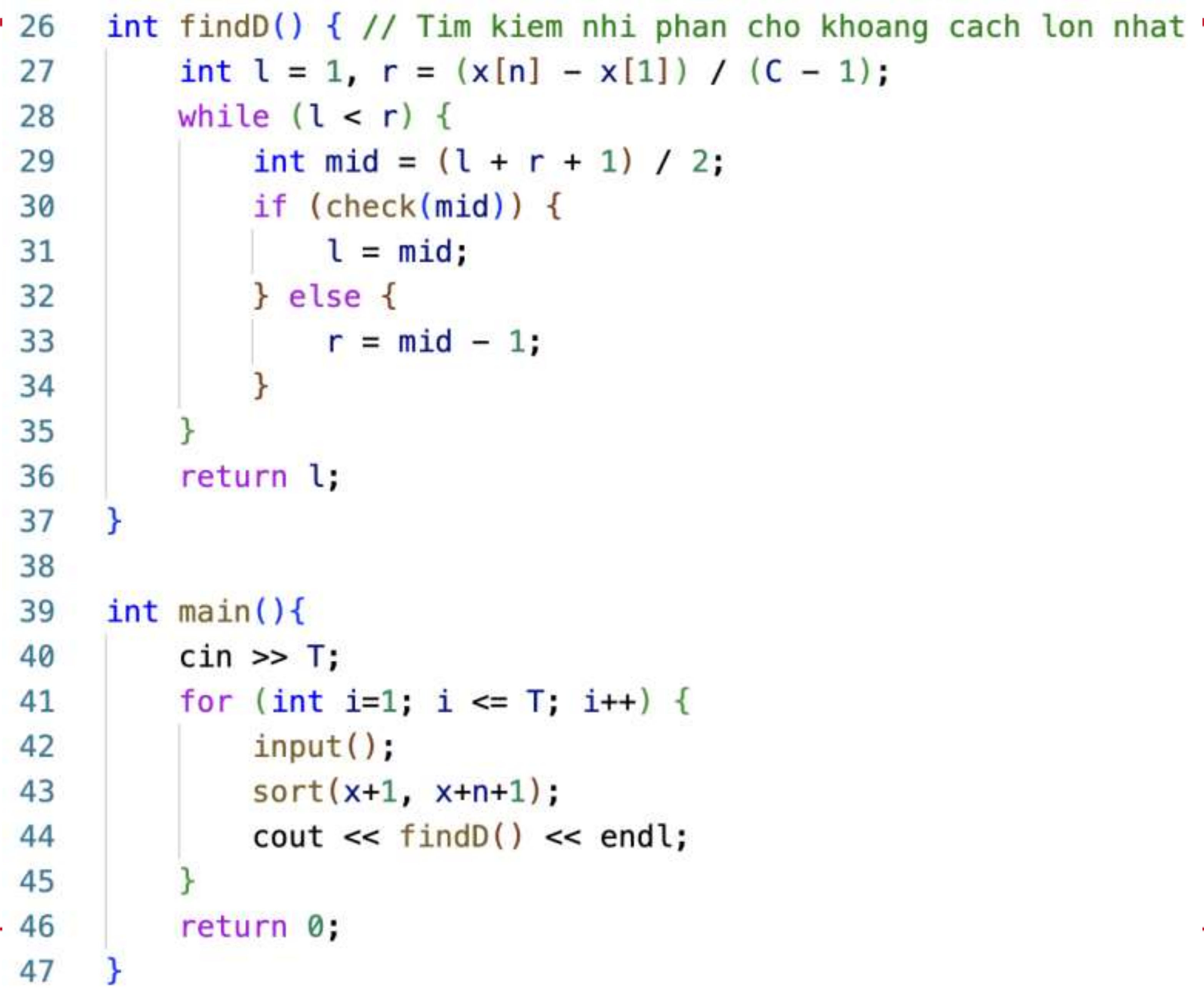
- Idea to solve: Sort $a_1,\ldots, a_N$ in increasing order
- The max-distance must be $\leq \frac{a_N - a_1}{c-1}$
- Find max-distance from $\mathrm{d} = \frac{a_N - a_1}{c-1}$ down to 1: this can be improved
  - Binary search for d
  - Complexity: O(n log n)

Max-distance sub-sequence - Implementation



```cpp
#include <bits/stdc++.h>
using namespace std;
#define N 100001
int n, C, T, x[N];
void input() {
    cin >> n >> C;
    for (int i = 1; i <= n; i++) {
        cin >> x[i];
    }
}
bool check(int d) {
    // Kiem tra xem co the lay tap con C voi khoang cach d
    int nb = 1;
    int last = x[1];
    for (int i = 2; i <= n; i++) {
        if (x[i] - last >= d) {
            last = x[i];
            nb++;
            if (nb == C)
                break;
        }
    }
    return nb>=C;
}
```

Max-distance sub-sequence - Implementation



```
int findD() { // Tim kiem nhi phan cho khoang cach lon nhat
    int l = 1, r = (x[n] - x[1]) / (C - 1);
    while (l < r) {
        int mid = (l + r + 1) / 2;
        if (check(mid)) {
            l = mid;
        } else {
            r = mid - 1;
        }
    }
    return l;
}

int main(){
    cin >> T;
    for (int i=1; i <= T; i++) {
        input();
        sort(x+1, x+n+1);
        cout << findD() << endl;
    }
    return 0;
}
```

THANK YOU !