Algorithms
Homework 1 Specifications

Note

Skeleton code is available in four different programming languages: C, C++, Java, Python. You may choose any one of them to complete the assignment. If you wish to use a language other than the four provided, please contact the TA (`ta@theory.snu.ac.kr`).

Selection Algorithm

Input format. The first line contains two integers: $n \leq 1,000,000$ and $idx \leq n$. The second line contains n integers separated by spaces. Duplicate elements may exist.
e.g.

```
5 2
1 3 2 5 4
```

Implementation. The skeleton code already includes input parsing and timing functionality. You need to implement the following three functions in `src/hw1.xx`: `randomized_select`, `deterministic_select`, and `check_selection`. To make your implementation easier, skeletons of helper functions such as `swap` and `insertion_sort` are also provided and can be used freely. Please refer to the skeleton code for the input and output specifications of each function.

Compilation and Execution. For all languages, you can compile the code using `make`, and run the program using `make run` in command line. (For Python, compilation is not required.) If you want to check the specific commands used, please refer to the provided `Makefile` for each language.

Output. If all functions are correctly implemented according to the specifications, running the program should produce output similar to the following:

```
Randomized: correct
Elapsed Time: 0.001000
Deterministic: correct
Elapsed Time: 0.001000
```

Grading

For each instance, your program may use up to 1 second for C/C++ (5 seconds for Python and Java) and 1 GB of memory. **You are not allowed to use any non-standard libraries or built-in libraries that provide sorting or similar functionality. If you are unsure whether a library is allowed, please contact the TA.**

Environment. We suggest using one of C, C++, Java or Python. If it is difficult for you to use one of the languages mentioned above, please contact the TA (`ta@theory.snu.ac.kr`). The compilers/interpreters and compilation commands that will be used for grading are as follows:

- C: gcc (Debian 12.2.0-14) 12.2.0
  ```
  gcc -O2 -std=gnu99 -Iinclude src/main.c src/hw1.c -o main
  ```
- C++: g++ (Debian 12.2.0-14) 12.2.0
  ```
  g++ -O2 -std=gnu++17 -Iinclude src/main.cpp src/hw1.cpp -o main
  ```
- Python: Python 3.11.5
- Java: javac (OpenJDK-23)
  ```
  mkdir -p bin
  javac -d bin Main.java src/HW1.java
  ```

Submission. Please compress your submission as `AG_HW1_[student ID].zip` (e.g., `AG_HW1_2025-12345.zip`). Your submission should include exactly 4 files:

- Source code for the problem (Choose one from `hw1.c`, `hw1.cpp`, `hw1.py`, `HW1.java`)
- Report (`report.pdf`)
- Two additional examples (`2.in`, `3.in`)

Hand in your submission to eTL. Please make sure that the submission files are placed at the top level of the compression and that submission file names are the same as above. **Please follow the rules for submission file names.**