CS 3113 Fall 2025 – Project 4 – Bonus (No late submission accepted)
Due Friday, December 5th at 11:59 PM

Project 4 is a bonus project.
You need to simulate the least recently used (LRU) page replacement algorithm.
Below is the sample input1.txt

```
Frames 3
7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1
```

Input explanation:

- `Frames 3` means each process is allocated maximum 3 frames.
- `7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1` is a reference string representing the page being referenced as each time step.

The output should look as follows:

```
7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1
Page replacement using LRU
time step 0: 7
time step 1: 7 0
time step 2: 7 0 1
time step 3: 2 0 1
time step 4: 2 0 1
time step 5: 2 0 3
time step 6: 2 0 3
time step 7: 4 0 3
time step 8: 4 0 2
time step 9: 4 3 2
time step 10: 0 3 2
time step 11: 0 3 2
time step 12: 0 3 2
time step 13: 1 3 2
time step 14: 1 3 2
time step 15: 1 0 2
time step 16: 1 0 2
time step 17: 1 0 7
time step 18: 1 0 7
time step 19: 1 0 7
total number of page faults = 12
```

Other Input – Output examples:

Input 2

```
Frames 3
1 2 3 4 2 3 4 1 2 1 1 3 1 4
```

Output 2

```
1 2 3 4 2 3 4 1 2 1 1 3 1 4
Page replacement using LRU
time step 0: 1
time step 1: 1 2
time step 2: 1 2 3
time step 3: 4 2 3
time step 4: 4 2 3
time step 5: 4 2 3
time step 6: 4 2 3
time step 7: 4 1 3
time step 8: 4 1 2
time step 9: 4 1 2
time step 10: 4 1 2
time step 11: 3 1 2
time step 12: 3 1 2
time step 13: 3 1 4
total number of page faults = 8
```

Input 3

```
Frames 4
3 1 4 2 5 4 1 3 5 2 0 1 1 0 2 3 4 5 0 1
```

Output 3

```
3 1 4 2 5 4 1 3 5 2 0 1 1 0 2 3 4 5 0 1
Page replacement using LRU
time step 0: 3
time step 1: 3 1
time step 2: 3 1 4
time step 3: 3 1 4 2
time step 4: 5 1 4 2
time step 5: 5 1 4 2
time step 6: 5 1 4 2
time step 7: 5 1 4 3
time step 8: 5 1 4 3
time step 9: 5 1 2 3
time step 10: 5 0 2 3
time step 11: 5 0 2 1
time step 12: 5 0 2 1
time step 13: 5 0 2 1
time step 14: 5 0 2 1
time step 15: 3 0 2 1
time step 16: 3 0 2 4
time step 17: 3 5 2 4
time step 18: 3 5 0 4
time step 19: 1 5 0 4
total number of page faults = 14
```

TODO

- Write the LRU page replacement algorithm in a file called project4.cpp.
- Assume that the input is read via redirection
- Compile and run project4.cpp. Make sure you keep the input file (e.g input.txt) in the same directory where your program is located.
- Submit project4.cpp to GradeScope.

Linux User
Open terminal and execute the following commands:

g++ -std=c++11 project4.cpp -o project4
./project4 < input.txt

MacOS User
Open terminal and execute the following commands:

clang++ -std=c++11 project4.cpp -o project4
./project4 < input.txt

If you do not have clang++ in your MacOS, it means you first need to install XCode by running the following command on the terminal:

xcode-select --install

Windows User
If you have installed VSCode for the Data Structure class, you can use its terminal to run the same command as in Linux.

If you do not have C, C++ compiler installed in your Windows machine, you can try installing it using one of the following options:

- https://code.visualstudio.com/docs/cpp/config-mingw

Rules and Submission Policy

All projects in this course are **individual assignments** and are not to be completed as group work. Collaboration with others or the use of outside third parties to complete this project is strictly prohibited. Submissions must be made through **GradeScope**, where automated grading will be conducted. Additionally, manual grading may be performed to ensure correctness and adherence to requirements.

Several input files will be used to evaluate your program. While a subset of these input files will be provided to you for testing, additional files not shared beforehand will also be used during grading. Your score on this project will depend on producing correct results for all input files, including the undisclosed ones used in GradeScope evaluation.

All programs must be written in **C or C++** and must compile successfully using the **GCC** or **GNU C++ compiler**. It is your responsibility to ensure that your program adheres to these requirements.
The course syllabus provides more details on the late and submission policy. You should also go through that.