TDT4200 Fall 2022 - Problem Set 0 (Main)
Introduction to C

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Deadline: September 6, 2022 by 22:00 in BlackBoard
Evaluation: Pass/Fail

- **This assignment is mandatory and will be evaluated as pass/fail.**

- **This assignment must be done individually and without help from anyone but the TDT4200 staff.** All sources found on the internet or elsewhere must be referenced. We encourage that you post clarification questions on the Forum in BB so all can benefit. However, make sure you do not post full or partial solutions on the BB Forum.

- **This assignment has two parts.** In the first part you will write a C program to calculate the Central Difference for finding the derivative of a function. In the second part you will answer two questions about your implementation.

- **Solution requirements** are stated in the Evaluation section.

- **Do not deliver any other files than those specified in the Delivery section.** Code should not use external dependencies aside from the ones already included in the handout code.

Difference approximation

In this assignment you will write a C program using Central Difference for finding the derivative of a function. The Central Difference is one part of solving the Shallow Water Equations that will be used in the next few assignments.

The Central difference equation

$$\frac{\delta}{\delta x} f \approx \frac{f(x + \Delta x) - f(x - \Delta x)}{2 \Delta x} \tag{1}$$

For this assignment you can set $\Delta x = 1$, so the expression simplifies to

$$\frac{\delta}{\delta x} f \approx \frac{f(x + 1) - f(x - 1)}{2} \tag{2}$$

1 Tasks

1. Create two heap-allocated arrays that hold N elements. One for the function values and one for the values for the derivative of the function.

2. Fill the function value array for the half-open range [0, N)* with
$f(x) = x^2$

3. Calculate the derivative values for the half-open range [1, N-1)** using the Central Difference and store it in the derivative array.

4. Note that $\frac{\delta}{\delta x} f(x) = 2x$. So the array should be filled with the values 2, 4, 6, 8, etc. if you've implemented the program correctly. Print the values to check that the program is correct.

2 Questions

- What happens if you dereference a pointer to an address that you do not own?

- What are the values of array A after this line if you were to print the elements?

```
int* A = (int*)malloc(32*sizeof(int));
```

Evaluation

The code should run error-free and produce correct output.

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*or equivalently the closed range [0, N-1]
**or equivalently the closed range [1, N-2]

Answer the questions with a couple of sentences. The purpose of the questions is for you to reflect on the work you have done.

Delivery

Deliver the file `central_diff.c` on BlackBoard. Answers to the questions should also be delivered on BlackBoard in a separate PDF file. Do **NOT** upload a ZIP file.