Exercise Session

Week 07

Adel Gavranović
agavranovic@student.ethz.ch

Overview

▸ polybox for session material ▸ Mail to TA

Today's Topics

Introduction

References

Characters

Repetition: Floating Point Numbers

The elephant in the room

That’s right: we’re online now!

The elephant in the room

That's right: we're online now!

- I want you to participate

The elephant in the room

That's right: we're online now!

- I want you to participate
- Turn on your camera (yes, all of you)

The elephant in the room

That’s right: we’re online now!

- I want you to participate
- Turn on your camera (yes, all of you)
- There’ll be more exercising and less recapping

The elephant in the room

That’s right: we’re online now!

- I want you to participate
- Turn on your camera (yes, all of you)
- There’ll be more exercising and less recapping
- I won’t record the sessions. I want to ensure that you come to the sessions instead of just watching it passively

The elephant in the room

That’s right: we’re online now!

- I want you to participate
- Turn on your camera (yes, all of you)
- There’ll be more exercising and less recapping
- I won’t record the sessions. I want to ensure that you come to the sessions instead of just watching it passively
- A lot might go wrong the first few times

The elephant in the room

That's right: we're online now!

- I want you to participate
- Turn on your camera (yes, all of you)
- There'll be more exercising and less recapping
- I won't record the sessions. I want to ensure that you come to the sessions instead of just watching it passively
- A lot might go wrong the first few times
- My internet connection is not the most stable one (send your complaints directly to SALT)

The elephant in the room

That’s right: we’re online now!

- I want you to participate
- Turn on your camera (yes, all of you)
- There’ll be more exercising and less recapping
- I won’t record the sessions. I want to ensure that you come to the sessions instead of just watching it passively
- A lot might go wrong the first few times
- My internet connection is not the most stable one (send your complaints directly to SALT)
- Not much will change on how the session will be held, except now you can see my whole face

The elephant in the room

That’s right: we’re online now!

- I want you to participate
- Turn on your camera (yes, all of you)
- There’ll be more exercising and less recapping
- I won’t record the sessions. I want to ensure that you come to the sessions instead of just watching it passively
- A lot might go wrong the first few times
- My internet connection is not the most stable one (send your complaints directly to SALT)
- Not much will change on how the session will be held, except now you can see my whole face
- I’m going to stick around for a while after each session for more specific questions

Questions from last Exercise Session

How will the exam look like?

Questions from last Exercise Session

How will the exam look like?

I honestly don't know myself, but it will deviate from the ones in the past.

Questions from last Exercise Session

How will the exam look like?

I honestly don’t know myself, but it will deviate from the ones in the past.

- Greater focus on actually programming stuff yourself (*practice!*)

Questions from last Exercise Session

How will the exam look like?

I honestly don’t know myself, but it will deviate from the ones in the past.

- Greater focus on actually programming stuff yourself (*practice!*)
- It will basically be entirely autograded

Questions from last Exercise Session

How will the exam look like?

I honestly don't know myself, but it will deviate from the ones in the past.

- Greater focus on actually programming stuff yourself (*practice!*)
- It will basically be entirely autograded
- The old exams are still a good source for ”testing” your knowledge on certain topics

Questions from last Exercise Session

How will the exam look like?

I honestly don’t know myself, but it will deviate from the ones in the past.

- Greater focus on actually programming stuff yourself (*practice!*)
- It will basically be entirely autograded
- The old exams are still a good source for ”testing” your knowledge on certain topics
- Exam-coding-questions from past semesters should be on the course website too

Comments on last [code]expert Exercises

- When using any ”fixed” value (like the error from the float-comparing exercise), make it into a `const` variable, i.e. `const double error = 0.0001`

Comments on last [code]expert Exercises

- When using any ”fixed” value (like the error from the float-comparing exercise), make it into a `const` variable, i.e. `const double error = 0.0001`
- Name everything *exactly* like the task description named it

Comments on last [code]expert Exercises

- When using any ”fixed” value (like the error from the float-comparing exercise), make it into a `const` variable, i.e. `const double error = 0.0001`
- Name everything *exactly* like the task description named it
- If you ever receive no feedback at all, it usually means your code is very good (or that I’m running late with corrections and have to hurry a bit)

Comments on last [code]expert Exercises

- When using any ”fixed” value (like the error from the float-comparing exercise), make it into a `const` variable, i.e. `const double error = 0.0001`
- Name everything *exactly* like the task description named it
- If you ever receive no feedback at all, it usually means your code is very good (or that I'm running late with corrections and have to hurry a bit)
- Having a good code structure is getting much more important now. If you want anyone to read and understand your code (*or correct it*), make sure to write it in a good style (i.e sensible variable naming, structure, consistent indentations, useful comments, const-ness)

Questions or Comments re: Exercises?

□ cheat sheets?
(exam)

Learning Objectives Checklist

Now I...

□ can do *Program Tracing*

Learning Objectives Checklist

Now I...

- □ can do *Program Tracing*
- □ understand what vectors are and how they work conceptually

Learning Objectives Checklist

Now I...

- □ can do *Program Tracing*
- □ understand what vectors are and how they work conceptually
- □ can create, modify and iterate over `std::vectors`

Learning Objectives Checklist

Now I...

- □ can do *Program Tracing*
- □ understand what vectors are and how they work conceptually
- □ can create, modify and iterate over `std::vectors`
- □ know how to write a program that can modify ASCII characters

Learning Objectives Checklist

Now I...

- □ can do *Program Tracing*
- □ understand what vectors are and how they work conceptually
- □ can create, modify and iterate over `std::vectors`
- □ know how to write a program that can modify ASCII characters
- □ I can *trace* the aforementioned ASCII program

Code Example with Program Tracing I

```
int a = 3;
int& b = a;

b = 2;

std::cout << a;
```

Code Example with Program Tracing I

```
int a = 3;
int& b = a;

b = 2;

std::cout << a;
```

```
// output "2"
```

Code Example with Program Tracing II

```
void foo(int i){
   i = 5;
}

int main(){
   int i = 4;
   foo(i);
   std::cout << i << std::endl;
}
```

Code Example with Program Tracing II

```
void foo(int i){
   i = 5;
}

int main(){
   int i = 4;
   foo(i);
   std::cout << i << std::endl;
}
```

```
// output: "4", but why?
```

Code Example with Program Tracing II

```
void foo(int i){
   i = 5;
}

int main(){
   int i = 4;
   foo(i);
   std::cout << i << std::endl;
}
```

```
// output: "4", but why?
```

References are usually used as function parameters or return values (we'll see an example of this later). If the parameters of a function are not of the reference type, we say that we *"pass them to the function by value"*, which is what we did in all of our functions so far (and in this one). In this case the function makes its own copies of the values, and uses these copies to do something in the function body.

Code Example with Program Tracing III

```
void foo(int& i){
   i = 5;
}

int main(){
   int i = 4;
   foo(i);
   std::cout << i << std::endl;
}
```

Code Example with Program Tracing III

```
void foo(int& i){
   i = 5;
}

int main(){
   int i = 4;
   foo(i);
   std::cout << i << std::endl;
}
```

```
// output: "5", but why?
```

Code Example with Program Tracing III

```
void foo(int& i){
   i = 5;
}

int main(){
   int i = 4;
   foo(i);
   std::cout << i << std::endl;
}
```

```
// output: "5", but why?
```

If a parameter of a function is of the reference type (&), hence will become an alias of the call argument, we say that we "*pass the argument by a reference*".

Exercises

Q: Why do we need references? Aren't the types we say before enough?

A: Multiple reasons:

- save space
- change variables directly

Exercises

Q: Why do we need references? Aren't the types we say before enough?

A: Multiple reasons: void

- You can return (or rather modify) multiple results from a function
- We avoid copying parameters, which improves performance: sometimes we pass *huge* vectors to a function, and we don't want to waste performance copying the whole thing. A reference tells the function where that parameter (int, double, vector, whatever) is stored, this way the function can operate on the parameter directly
- Sometimes copying just won't work (std::cout for example, but don't worry about that for now)

Extensive Program Tracing Guide

▸ Link to an Extensive Guide on Program Tracing

Questions?

References as Return Types

We’ve seen function parameters being of a reference type, but references can also be used for the return type of a function:

References as Return Types

We've seen function parameters being of a reference type, but references can also be used for the return type of a function:

```
int& increment(int& m){
   return ++m;
}

int main(){
   int n = 3;

   increment(increment(n));

   std::cout << n << std::endl;
}
```

++n;

n= 3

References as Return Types

We've seen function parameters being of a reference type, but references can also be used for the return type of a function:

```
int& increment(int& m){
   return ++m;
}

int main(){
   int n = 3;

   increment(increment(n));

   std::cout << n <<;
}
```

```
// output: "5", but why?
```

Questions?

Exercises

Task

Solve the exercises in the following PDF with *Program Tracing*

:: open week_7_exercises.pdf now ::

Exercise

a m
A m

x('a'-'A')

(x - X)

vector<char>

A	d	e	l	g	a	u

Task

Think about how to solve the [code]expert exercise "Converting Input to UPPER CASE" with pen and paper.

Write a program that reads a sequence of characters delimited by the new-line character ("/n") and then outputs the sequence with all lower-case letters changed to UPPER-CASE letters. Please put the code that converts the entire sequence to upper-case and a single character to upper-case into separate functions (you should have at least three functions).

Hints: As you've seen in the lecture, variables of type char can be treated as numbers. Store the words in a `std::vector`.

ints

How to `std::vector`

- Don't forget to `#include <vector>`

How to `std::vector`

std::vector<char>
int double

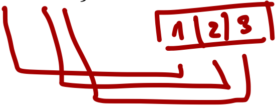
- Don’t forget to `#include <vector>`
- Think of vectors as a series of slots, each containing a value of the type you’ve specified

How to `std::vector`

- Don’t forget to `#include <vector>`
- Think of vectors as a series of slots, each containing a value of the type you’ve specified
- You can basically treat `std::vector` as just another type

How to `std::vector`

- Don't forget to `#include <vector>`
- Think of vectors as a series of slots, each containing a value of the type you've specified
- You can basically treat `std::vector` as just another type
- `std::vector<int> myvector{1,2,3};` to initialize a vector

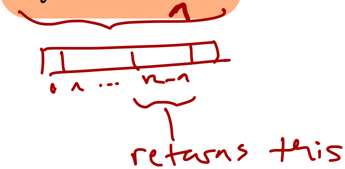


How to `std::vector`

- Don't forget to `#include <vector>`
- Think of vectors as a series of slots, each containing a value of the type you've specified
- You can basically treat `std::vector` as just another type
- `std::vector<int> myvector{1,2,3};` to initialize a vector
- there are multiple ways to initialize a vector, check out the summary or search online for more

How to `std::vector`

- Don’t forget to `#include <vector>`
- Think of vectors as a series of slots, each containing a value of the type you’ve specified
- You can basically treat `std::vector` as just another type
- `std::vector<int> myvector{1,2,3};` to initialize a vector
- there are multiple ways to initialize a vector, check out the summary or search online for more
- `myvector[n-1]` to look at the n’th entry in a vector

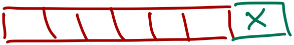


1

How to `std::vector`

- Don't forget to `#include <vector>`
- Think of vectors as a series of slots, each containing a value of the type you've specified
- You can basically treat `std::vector` as just another type
- `std::vector<int> myvector{1,2,3};` to initialize a vector
- there are multiple ways to initialize a vector, check out the summary or search online for more
- `myvector[n-1]` to look at the n'th entry in a vector
- use `myvector.push_back(x)` to append `x` to the vector (be careful with the type)

! imp.



Exercise

Task

Try to solve the [code]expert exercise ”Converting Input to UPPER CASE” in the [code]expert IDE.
Optional: do it in small groups (breakout rooms)

Solution ”Converting Input to UPPER CASE”

```
#include <iostream>
#include <vector>
#include <ios>

// POST: Converts the letter to upper case.
void char_to_upper(char& letter){
   if(’a’ <= letter && letter <= ’z’){
      letter -= ’a’ - ’A’; // ’a’ > ’A’
   }
}

// POST: Converts all letters to upper-case.
void to_upper(std::vector<char>& letters){
   for(unsigned int i = 0; i < letters.size(); ++i){
      char_to_upper(letters.at(i));
   }
}
```

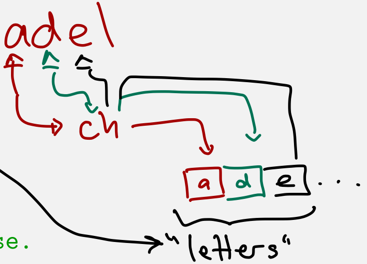
Solution "Converting Input to UPPER CASE"

```
std::cin >> std::noskipws;

std::vector<char> letters;
char ch;

// Step 1: Read input.
do{
   std::cin >> ch;
   letters.push_back(ch);
}while(ch != '\n');
```

"enter"



```
// Step 2: Convert to upper-case.
to_upper(letters);

// Step 3: Output.
for(unsigned int i = 0; i < letters.size(); ++i){
   std::cout << letters.at(i);
}
```

print(...);

Questions?

Normalized Floating Point Number Systems

Normalized Floating Point Number Systems

Task

Ask questions on stuff related to NFPNS that you didn't understand yet. I will try my best to answer them.

- numbers start with $1.\underbrace{\ldots}_{P}$

1 2 3 4 5 6 7 0: round down

1.0011011

p = 5 1.0011

p=7 1.001110

Guided Exercise

::open NFPN_TASK.pdf::

Task

Try to solve the task (as a group).
I'll guide you when I think it's necessairy.