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Summer Term
2020

Exam in

Advanced Programming Techniques

August 28, 2020

Name: _____

Date of birth: _____

Matriculation number: _____

Course of studies: _____

Room, Seat Number: _____

Please do not fill out anything below this line!

Total number of points: _____ of 60

Grade: _____

Passed: ☐ Yes / ☐ No

Problem 1: Definitions and Terms (17 points)

(a) (7P) List the following:

One class from the chrono library: _____

_____

One associative containers: _____

_____

Two sequential container: _____

_____

Three C++ keywords for loops: _____

_____

(b) (3P) List three different classes implemented in the C++ standard library and in which header file they can be found.

_____

_____

_____

_____

_____

(c) (4P) Given is the function `fct` which takes a `float` and a constant reference to a `std::vector` as input and returns a `double`.
Using the `std::function` library type, define a variable `f` and initialize it with `fct`.

_____

_____

(d) (3P) Define a random number and state why one should not use `rand()` for this purpose anymore.

_____

_____

_____

Problem 2: Errors and Function Matching (12 points)

Fix all compiler or logical errors in the following incorrect C++ program.

```
#include <iostream>
#include <fstream>
#include <string>
#include <stdexcept>

void process(ifstream &is)
{
string s;
while (is << s)
   cout << s << endl;
}

int main(int argc, char* argv[])
{

for (double p = argv + 1; p != argv + argc; ++p) {
    ifstream input(*p);
    if (input) {
        process(input);
} else
        cerr << "couldn't open: " + string(*p);
}

auto p = argv + 1, end = argv + argc;

ifstream& input;
while (p != end) {
   input.open(*p);
    if (input) {
         process(input);
} else
cerr << "couldn't open: " + string(*p);
    input.close();
    ++*p;
}

return input;
}
```

Problem 3: Programming with the Standard Library (8 points)

Please note: The questions assume that all necessary header files from the Standard Library are included and an implicit `using namespace std;`. Likewise, you can safely assume the same for your code!

(a) (4P) Implement the function

```
template<typename KEY, typename VALUE>
void deleteValue(std::map<KEY, VALUE> & m, VALUE v)
```

- that removes the first key-value pair where the value is equal to `v`

Example usage:

```
map<char,int> m = {{'a',1},{'b',3},{'c',4}};
deleteValue(m,3);
cout << m << " ";
```

Expected output of the snippet above (if `operator<<` is overloaded):

```
a: 1
c: 4
```

(b) (4P) Implement the function

```
template<typename T>
int countUniques(std::vector<T> const & one, std::vector<T> const & two)
```

- that counts all elements that are in either `one` or `two`, but not in both
- use the STL alorithms library
- you can assume that there are no duplicates within one vector

Example usage:

```
std::vector<int> one {1,2,3,4,5,6};
std::vector<int> two {5,6,7,8,9};
cout << countUniques<int>(one,two) << endl;
```

Expected output of the snippet above:

```
7
```

since 1,2,3,4 are only in `one` and 7,8,9 are only in `two`

Problem 4: Classes (11 points)

Please note: The questions assume that all necessary header files from the Standard Library are included and an implicit `using namespace std;`*. Likewise, you can safely assume the same for your code!*

Write a class "IntList" such that following main function works:

```
IntList list1;
IntList list2(2);

list1 += 9;
list2 += 4;
list2 += 5;

std::cout << list1 << std::endl;
std::cout << list2 << std::endl;
std::cout << list2.elementSum() << std::endl;
```

and has the following output:

```
9,
2,4,5,
11
```

Make sure to not expose the internal data structure! Don't forget to implement the `operator<<` function given on the next page!

```
class IntList {
```

```
std::ostream & operator <<(std::ostream &os, const IntList & list){
```

Problem 5: Short Questions (12 points)

(a) (4P) Name at least two smart pointers provided by the standary library and explain their differences.

(b) (2P) What is a static member function?

(c) (2P) What is the difference between the static and dynamic type in C++?

(d) (2P) Name two options to allocate memory in C++.

(e) (2P) What means RAII?

Problem 6: Project (max. 12 bonus points)

(a) Which race did you implement in your group?

(b) What is your group's name?
