

## Exam in

## Advanced Programming Techniques

July 24, 2018

Name:		
Date of birth:		
Student number:	:	
Pleas	e do not fill out anyth	ing below this line!
	Total number of points:	of 100
	Grade:	
	Passed:	$\square$ Yes $/$ $\square$ No

(a)	(4P) List the following:
	Two standard library types:
	Two sequential containers:
	Two C++11 or 14 features:
	Two C++ keywords for access labels:
(b)	(3P) List two different kinds of smart pointers from the standard library and explain why they should be used instead of plain pointers.
(c)	(3P) Given is the function fct which takes a constant pointer to a double and a reference to a constant std::list as input and returns no value.  Using the std::function library type, define the variable f and initialize it with fct.
(d)	(3P) List three different parts of the standard library by specifying the corresponding header file.

Given is the following incorrect C++ program that should call the correct doit() function and output 2 as a string:

```
#include <iostream>
struct Foo {
    Foo(const Foo&) { n = 1; }
    virtual int doit() { return n; }
    virtual char doit() { return 1; }
  private:
    int n;
};
class Bar : Foo {
    Bar() { n=2;}
    void doit() { return n; }
};
void main() {
    Bar& f;
    Foo& fooref = &f;
    std::string s = fooref.doit();
    std::cout << s;</pre>
}
```

List all errors in the code and state how one can change the program such that the correct output is printed.

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!

Your task is to implement the function

```
template<typename T>
list<T> eraseDuplicates(const list<T> & input)
```

- this function should return a list consisting only of unique elements of the passed list input
- preserving the order of the input list is not important
- you can assume that instances of T can be compared for equality

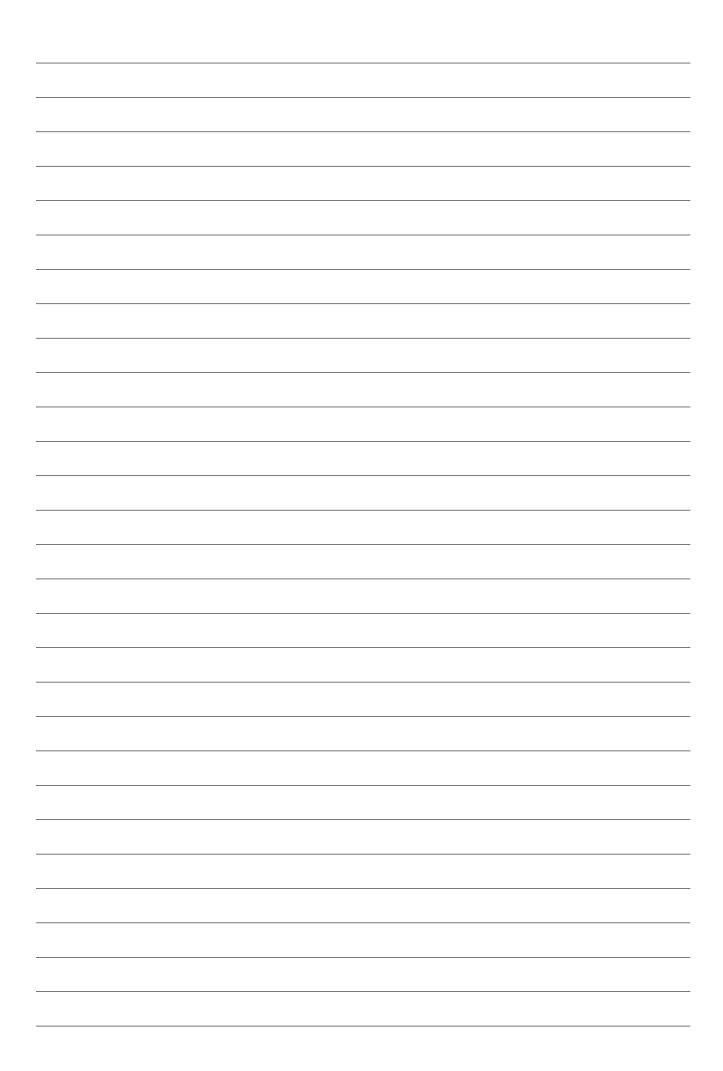
Example usage:

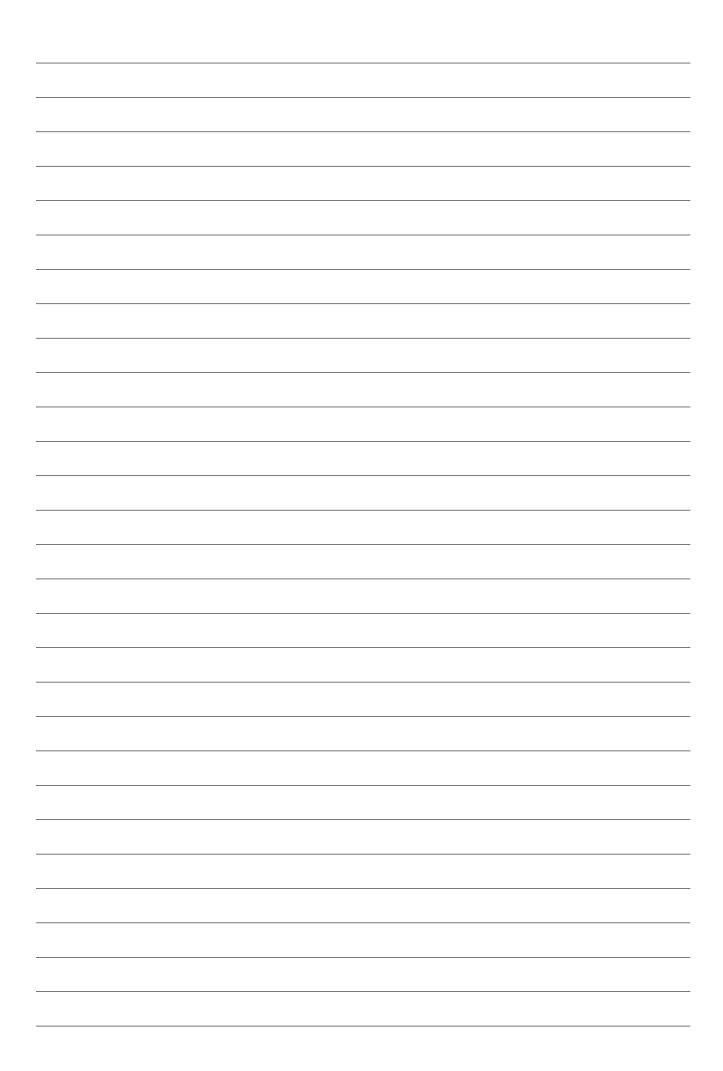
a b c



Problem 4: Classes (12 points)

Write a class "Integer" such that following main function works and outputs "2343".
<pre>int main(){   Integer i(1);   Integer j(2);   Integer k(3);</pre>
<pre>std::cout &lt;&lt; j; j = 3; std::cout &lt;&lt; j;</pre>
<pre>k = i + j; std::cout &lt;&lt; k;</pre>
<pre>std::cout &lt;&lt; Integer::amount(); return 0; }</pre>





You are required to reference your project code in this task (*not* the assignment code) where indicated. Please provide line numbers as well as the file you are referring to.

(a) (4P) In the assignments, you implemented multiple variants of a Matrix class. One key differences was the specification of the matrix dimensions, either via constructor arguments or via template arguments:

```
template<typename T>
class Matrix {
  Matrix(size_t rows, size_t cols);
 /* ... */
};
template<typename T, size_t rows, size_t cols>
class Matrix {
 Matrix() {}
 /* ... */
};
Give two advantages and two disadvantages of the second approach (template arguments).
```

(b)	(4P) Give two examples where you made use of $C++11$ , $C++14$ or $C++17$ features is your project code. If you didn't use any such features give two examples where they $cou$ be used.					
	Discuss how this improved (would improve) code quality, e.g. by allowing a more concistormulation.					

(4P)								
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Please make sure that you submit your project code with the exam paper such that we are able to check it! In case two groups submit the same code none of them will obtain any points for it.

(a)	Which race did you implement in your group?
(b)	What is your group's name?
(c)	Did you pass the forward simulation task?
(d)	$\Box$ Yes / $\Box$ No $\Box$ Did you pass the optimization task? $\Box$ Yes / $\Box$ No
(e)	Did you pass the push challenge?  □ Yes / □ No
(f)	Did you pass the rush challenge? $\square \ {\rm Yes} \ / \ \square \ {\rm No}$