

Exercises for the Lecture Series
“Object-Oriented Programming for Scientific Computing”

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EXERCISE 1 EXCEPTIONS AND DESTRUCTORS

What happens when a destructor throws an exception? Let's look at the program to the right.

- Augment the example with the definition of the class `my_exception`, which is derived from `std::exception`. The class `my_exception` should receive an error message in a `std::string` in its constructor. The virtual method `what()` should return this error message.
- What do you observe when executing the program?
- Try to explain the behavior.
- Section 15.2, point 3 of the C++ standard:

```
#include <iostream>
#include <string>
#include <exception>

// class Foo throws in the destructor
class Foo {
public:
    ~Foo () {
        throw my_exception("Foo exception");
    }
};

// class Bar throws in the constructor
class Bar {
public:
    Bar () {
        throw my_exception("Bar exception");
    }
};

int main()
try {
    Foo f;
    Bar b;
}
catch (const std::exception & e){
    std::cout << "ERROR:" << e.what() << std::endl;
}
```

- 3 The process of calling destructors for automatic objects constructed on the path from a try block to a throw-expression is called “stack *unwinding*.” [Note: If a destructor called during stack unwinding exits with an exception, terminate is called (15.5.1). So destructors should generally catch exceptions and not let them propagate out of the destructor. —end note]

Why is the behavior detailed in the *note* sensible?

Further reading: a collection of the possible options when destructors and exceptions meet can be found under <http://www.kolpackov.net/projects/c++/eh/dtor-1.xhtml> 8 Points

EXERCISE 2 EXCEPTIONS AND SANITY CHECKS

The class `NumVector` on the last exercise sheet did not do bounds checking, i.e. it was possible to access indices smaller than zero or larger than the largest index. Modify the method `operator []`, so that erroneous access results in an exception being thrown (comparable to the behavior of the method `std::vector<T>::at` instead of `std::vector<T>::operator []`).

Also implement a method `operator *` that calculates the scalar product of two vectors. Exceptions that may result from incompatible lengths should be caught and a new, more detailed exception should be thrown.

The exceptions should be classes written by you and have distinct types. Write a program that tests both exceptions and prints a detailed error message in the case of errors without terminating the program. 8 Points

EXERCISE 3 FATHER AND SON

What do you think the Java code on the right will do? Translate it into equivalent C++ code (extends corresponds to `public` inheritance and `Throwable` to an exception).

Comment your program and write down in which order the lines are executed. Is this a valid C++ program? If yes, what does it do?

Source: Randall Munroe (xkcd.com)

```
CLASS BALL EXTENDS THROWABLE {}
CLASS P {
  P TARGET;
  P(P TARGET) {
    THIS.TARGET = TARGET;
  }
  VOID AIM(BALL BALL) {
    TRY {
      THROW BALL;
    }
    CATCH (BALL B) {
      TARGET.AIM(B);
    }
  }
}
PUBLIC STATIC VOID MAIN (STRING[] ARGS) {
  P PARENT = NEW P(NULL);
  P CHILD = NEW P(PARENT);
  PARENT.TARGET = CHILD;
  PARENT.AIM(NEW BALL());
}
}
```

4 Points