

# *Exercises week 1*

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## **Exercise 1**

*Attain some familiarity with the way functions are selected from namespaces*

We used the following code,

## Exercise 2

*Learn why streams can be used to determine the truth values of conditions, but not to assign values to bool variables.*

Note: The code given in the exercise is incomplete, and therefore won't compile even without the intended mistake. So first of all we state the following code as a starting point:

header.ih

```
1 | #include <iostream>
2 | #include <string>
3 |
4 | using namespace std;
5 |
6 | bool promptGet(istream &in, string &str);
7 | void process(string const &str);
```

main.cc

```
1 | #include "header.ih"
2 |
3 | int main()
4 | {
5 |     string str;
6 |     while (promptGet(cin, str))
7 |         process(str);
8 | }
```

process.cc

```
1 | #include "header.ih"
2 |
3 | void process(string const &str)
4 | {
5 |     cout << "processed: " << str << '\n';
6 | }
```

```

                                promptget.cc
1 | #include "header.ih"
2 |
3 | bool promptGet(istream &in, string &str)
4 | {
5 |     cout << "Enter a line or ^D\n";      // ^D signals end-of-input
6 |
7 |     return getline(in, str);
8 | }

```

### 1.

This code doesn't work, because `getline(in, str)` cannot be returned as a `bool` in `promptGet`. This is because the class `istream` defines `explicit operator bool()` `const`. This allows the compiler to only perform a conversion to a `bool` when this is explicitly required (as in a `while` statement), but not implicitly (as in the `return` statement above).

### 2.

By changing `promptGet`'s body in the following way, the code does compile:

```

                                promptget.cc
1 | #include "header.ih"
2 |
3 | bool promptGet(istream &in, string &str)
4 | {
5 |     cout << "Enter a line or ^D\n";      // ^D signals end-of-input
6 |
7 |     return static_cast<bool>(getline(in, str));
8 | }

```

### 3.

By changing `promptGet` (and the declaration in the internal header) in the following way, the code does compile:

promptget.cc

```
1 | #include "header.ih"
2 |
3 | istream &promptGet(istream &in, string &str)
4 | {
5 |     cout << "Enter a line or ^D\n";      // ^D signals end-of-input
6 |
7 |     return getline(in, str);
8 | }
```

## Exercise 3

*Learn to implement index operators*

The Matrix class that is used here, is derived from the solutions of exercise 64.

We used the following code,

```
matrix/matrix.h
1  #ifndef INCLUDED_MATRIX_
2  #define INCLUDED_MATRIX_
3
4  #include <iosfwd>
5  #include <initializer_list>
6
7  class Matrix
8  {
9      size_t d_nRows = 0;
10     size_t d_nCols = 0;
11     double *d_data = 0;           // in fact R x C matrix
12
13     // exercise 5
14     // =====
15     std::istream &(Matrix::*d_extractMode)(
16         std::istream &in, Matrix const &matrix) const = &Matrix::extract
17
18     public:
19         typedef std::initializer_list<
20             std::initializer_list<double>> IniList;
21
22         Matrix() = default;
23         Matrix(size_t nRows, size_t nCols);           // 1
24         Matrix(Matrix const &other);                 // 2
25         Matrix(Matrix &&tmp);                         // 3
26         Matrix(IniList inilist);                     // 4
27
28         ~Matrix();
29
30         Matrix &operator=(Matrix const &rhs);
31         Matrix &operator=(Matrix &&tmp);
32
```

```

33     size_t nRows() const;
34     size_t nCols() const;
35     size_t size() const;           // nRows * nCols
36
37     static Matrix identity(size_t dim);
38
39     Matrix &tr();                   // transpose (must be square)
40     Matrix transpose() const;      // any dim.
41
42     void swap(Matrix &other);
43
44         // exercise 3
45         // =====
46     double *operator[](size_t index);
47     double *operator[](size_t index) const;
48
49         // exercise 4
50         // =====
51     friend Matrix operator+(Matrix const &lhs, Matrix const &rhs);
52     friend Matrix operator+(Matrix &&lhs, Matrix const &rhs);
53     Matrix &operator+=(Matrix const &other) &;           // 1
54     Matrix operator+=(Matrix const &other) &&;           // 2
55
56         // exercise 5
57         // =====
58     friend std::ostream &operator<<(
59         std::ostream &out, Matrix const &matrix);
60     friend std::istream &operator>>(
61         std::istream &in, Matrix const &matrix);
62
63     enum Mode
64     {
65         BY_ROWS,
66         BY_COLS
67     };
68
69     Matrix &operator()(size_t nRows, size_t nCols, Mode byCols = BY_ROWS)
70
71 private:
72     double &el(size_t row, size_t col) const;
73     void transpose(double *dest) const;

```

```

74
75         // exercise 3
76         // =====// private backdoor
77         double *operatorIndex(size_t index) const;
78
79         // exercise 4
80         // =====
81         void add(Matrix const &rhs);
82
83         // exercise 5
84         // =====
85         std::istream &extractRows(
86             std::istream &in, Matrix const &matrix) const;
87         std::istream &extractCols(
88             std::istream &in, Matrix const &matrix) const;
89     };
90
91     inline size_t Matrix::nCols() const
92     {
93         return d_nCols;
94     }
95
96     inline size_t Matrix::nRows() const
97     {
98         return d_nRows;
99     }
100
101     inline size_t Matrix::size() const
102     {
103         return d_nRows * d_nCols;
104     }
105
106     inline double &Matrix::el(size_t row, size_t col) const
107     {
108         return d_data[row * d_nCols + col];
109     }
110
111         // exercise 3
112         // =====
113     inline double *Matrix::operatorIndex(size_t index) const
114     {

```

```

115     return d_data + index * d_nCols;
116 }
117
118 inline double *Matrix::operator[](size_t index)
119 {
120     return operatorIndex(index);
121 }
122
123 inline double *Matrix::operator[](size_t index) const
124 {
125     return operatorIndex(index);
126 }
127
128     // exercise 4
129     // =====
130 Matrix operator+(Matrix const &lhs, Matrix const &rhs);           // 1
131 Matrix operator+(Matrix &&lhs, Matrix const &rhs);                 // 2
132
133     // exercise 5
134     // =====
135 std::ostream &operator<<(std::ostream &out, Matrix const &matrix);
136 std::istream &operator>>(std::istream &in, Matrix const &matrix);
137
138 #endif

```



## Exercise 4

*Learn to implement and spot opportunities for overloaded operators*

The header is shown in exercise 3, the implementations of the added functions are shown below:

```
matrix/add.cc
1 | #include "matrix.ih"
2 |
3 | void Matrix::add(Matrix const &rhs)
4 | {
5 |     if (rhs.d_nCols != d_nCols or rhs.d_nRows != d_nRows)
6 |     {
7 |         cerr << "Warning: Matrices have differnt size, "
8 |                 "so cannot be added!\n";
9 |         exit(1);
10 |    }
11 |
12 |    for (size_t idx = size(); idx--> 0; )
13 |        d_data[idx] += rhs.d_data[idx];
14 | }
```

```
matrix/operatoradd.cc
1 | #include "matrix.ih"
2 |
3 | Matrix operator+(Matrix const &lhs, Matrix const &rhs)
4 | {
5 |     Matrix tmp{ lhs };
6 |     tmp.add(rhs);
7 |     return tmp;
8 | }
```

```
matrix/operatoradd2.cc
1 | #include "matrix.ih"
2 |
```

```

3 | Matrix operator+(Matrix &&lhs, Matrix const &rhs)
4 | {
5 |     lhs.add(rhs);
6 |     return move(lhs);
7 | }

```

matrix/operatorcompadd1.cc

```

1 | #include "matrix.ih"
2 |
3 | Matrix &Matrix::operator+=(Matrix const &other) &
4 | {
5 |     Matrix tmp{ *this };
6 |     tmp.add(other);
7 |     swap(tmp);
8 |     return *this;
9 | }

```

matrix/operatorcompadd2.cc

```

1 | #include "matrix.ih"
2 |
3 | Matrix Matrix::operator+=(Matrix const &other) &&
4 | {
5 |     add(other);
6 |     return move(*this);
7 | }

```

## Exercise 5

## Exercise 6

## Exercise 7

## Exercise 8

## Exercise 9

## Exercise 10