

## Syllabus

### 1. Information regarding the programme

1.1 Higher education institution	<b>Babeş-Bolyai University</b>
1.2 Faculty	<b>Faculty of Mathematics and Computer Science</b>
1.3 Department	<b>Department of Computer Science</b>
1.4 Field of study	<b>Mathematics</b>
1.5 Study cycle	<b>Bachelor</b>
1.6 Study programme / Qualification	<b>Mathematics and Computer Science</b>

### 2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)	<b>Object Oriented Programming</b> <b>Programare orientată obiect</b>						
2.2 Course coordinator	<b>Lect. PhD Diana Laura Borza</b>						
2.3 Seminar coordinator	<b>Lect. PhD Diana Laura Borza</b>						
2.4. Year of study	<b>1</b>	2.5 Semester	<b>2</b>	2.6. Type of evaluation	<b>E</b>	2.7 Type of discipline	<b>Compulsory</b>
2.8 Code of the discipline	<b>MLE5006</b>						

### 3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	5	Of which: 3.2 course	2	3.3 seminar/laboratory	1 sem 2 lab
3.4 Total hours in the curriculum	70	Of which: 3.5 course	28	3.6 seminar/laboratory	42
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					24
Additional documentation (in libraries, on electronic platforms, field documentation)					15
Preparation for seminars/labs, homework, papers, portfolios and essays					19
Tutorship					9
Evaluations					13
Other activities: .....					
3.7 Total individual study hours	80				
3.8 Total hours per semester	150				
3.9 Number of ECTS credits	6				

### 4. Prerequisites (if necessary)

4.1. curriculum	· Fundamentals of programming
4.2. competencies	· Average programming skills in a high-level programming language

## 5. Conditions (if necessary)

5.1. for the course	· Class room with projector
5.2. for the seminar /lab activities	· Laboratory with computers, having a C++ compiler, a C++ IDE (preferably Visual Studio) and Qt library installed

## 6. Specific competencies acquired

<b>Professional competencies</b>	<ul style="list-style-type: none"> <li>· C1.1 Description of programming paradigms and of language specific mechanisms, as well as identification of syntactic and semantic differences.</li> <li>· C1.2 Explanation of existing software applications, on different levels of abstraction (architecture, classes, methods) using adequate basic knowledge.</li> <li>· C1.3 Elaboration of adequate source codes and testing of components in a given programming language, based on some given specifications.</li> <li>· C1.4 Testing applications based on testing plans.</li> <li>· C1.5 Developing units of programs and corresponding documentations.</li> </ul>
<b>Transversal competencies</b>	<ul style="list-style-type: none"> <li>· CT1 Application of efficient and rigorous working rules, manifest responsible attitudes towards the scientific and didactic fields, respecting the professional and ethical principles.</li> <li>· CT2 Use of efficient methods and techniques for learning, information, research and development of abilities for knowledge exploitation, for adapting to the needs of a dynamic society and for communication in Romanian as well as in a widely used foreign language.</li> </ul>

## 7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	<ul style="list-style-type: none"> <li>· To understand the concepts of the object-oriented programming paradigm and to design object-oriented solutions of small/medium scale problems, using C++ and Qt.</li> </ul>
7.2 Specific objective of the discipline	<ul style="list-style-type: none"> <li>· To demonstrate the differences between traditional imperative design and object-oriented design.</li> <li>· To explain class structures as fundamental, modular building blocks.</li> <li>· To understand the role of inheritance, polymorphism, dynamic binding and generic structures in building reusable code.</li> <li>· To explain and to use defensive programming strategies, employing formal assertions and exception handling.</li> <li>· To design user- interfaces and write small/medium scale C++ programs using Qt.</li> <li>· To use classes written by other programmers and third-party libraries when constructing their systems.</li> </ul>

## 8. Content

8.1 Course	Teaching methods	Remarks
1. <b>C/C++ introduction</b> (basic elements of C/C++ programming language, data types, constant variables, scope and lifetime of the variables, statements, functions: declaration and definition, overloading functions).	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
2. <b>Modular programming in C/C++</b> (functions, formal and actual parameters, pointers and memory management, the stack	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> </ul>	

and the help, pointers to functions, header files, modular programming, libraries).	<ul style="list-style-type: none"> <li>· Didactical demonstration</li> </ul>	
<b>3. Object oriented programming in C++</b> (introduction to object oriented programming, object oriented programming features, abstraction, encapsulation, classes and objects, access modifiers, object creation and destruction, operator overloading, static and friend elements).	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
<b>4. Inheritance and polymorphism</b> (base and derived classes, Liskov substitution principle, method overriding, inheritance and polymorphism).	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
<b>5. Polymorphism</b> (static and dynamic binding, virtual methods, multiple inheritance, upcasting and downcasting, abstract classes, UML class diagrams and relations).	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
<b>6. Templates in C++. The C++ Standard Template Library</b> (function templates, class templates, containers in STL: array, vector, list, stack, heap, map, set), iterators, STL algorithms, lambda functions.	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
<b>7. Streams and exception handling</b> (input output streams, insertion and extraction operators, overloading insertion and extraction operators, formatting, manipulators, flags, text files, exception handling, exception safe code).	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
<b>8. Resource management and RAII</b> (Resource Acquisition Is Initialization (RAII), smart pointers, move semantics, smart pointers in STL: <code>std::unique_ptr</code> , <code>std::shared_ptr</code> , <code>std::weak_ptr</code> )	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
<b>9. Graphical User Interfaces</b> (Qt Toolkit: installation, Qt modules and instruments, Qt GUI components, Layout management, design interfaces using Qt Designer).	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
<b>10. Event driven programming I</b> (callbacks, events, signals and slots in Qt).	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
<b>11. Event driven programming II</b> (Model View Controller, Models and Views in Qt, using	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> </ul>	

predefined models, implementing custom models).	<ul style="list-style-type: none"> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
<b>12. Design patterns I</b> (creational, structural, behavioral patterns, examples, singleton, factory method, adapter pattern).	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
<b>13. Design patterns II</b> (façade pattern, observer pattern, strategy pattern, case study application and examples).	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	
<b>14. Revision</b> (revision of the most important topics covered by the course, examination guide).	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> <li>· Examples</li> <li>· Didactical demonstration</li> </ul>	

### Bibliography

1. B. Stroustrup. *The C++ Programming Language*, Addison Wesley, 1998.
2. Bruce Eckel. *Thinking in C++*, Prentice Hall, 1995.
3. A. Alexandrescu. *Programarea moderna in C++: Programare generica si modele de proiectare aplicate*, Editura Teora, 2002.
4. S. Meyers. *Effective C++: 55 Specific Ways to Improve Your Programs and Designs (3rd Edition)*, Addison-Wesley, 2005.
5. S. Meyers. *More effective C++: 35 New Ways to Improve Your Programs and Designs*, Addison-Wesley, 1995.
6. B. Stroustrup. *A Tour of C++*, Addison-Wesley, 2013.
7. C++ reference (<http://en.cppreference.com/w/>).
8. Qt Documentation (<http://doc.qt.io/qt-5/>).
9. E. Gamma, R. Helm, R. Johnson, J. Vlissides. *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison-Wesley Longman Publishing, 1995.

8.2 Seminar	Teaching methods	Remarks
1. Simple problems in C. Functions. Structures, enums and arrays.	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> </ul>	The seminar is structured as a 2 hour class, every 2 weeks.
2. Modular programming.	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> </ul>	
3. Classes. Operator overloading. User-defined objects as class data members.	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> </ul>	
4. Inheritance. Polymorphism. Templates.	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> </ul>	
5. Files, exceptions. STL containers, iterators, algorithms.	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> </ul>	

6. Graphical User Interfaces.	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> </ul>	
7. Implementation based on UML diagrams. Design patterns.	<ul style="list-style-type: none"> <li>· Interactive exposure</li> <li>· Explanation</li> <li>· Conversation</li> </ul>	

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1. B. Stroustrup. *The C++ Programming Language*, Addison Wesley, 1998.
2. Bruce Eckel. *Thinking in C++*, Prentice Hall, 1995.
3. A. Alexandrescu. *Programarea moderna in C++: Programare generica si modele de proiectare aplicate*, Editura Teora, 2002.
4. S. Meyers. *Effective C++: 55 Specific Ways to Improve Your Programs and Designs (3rd Edition)*, Addison-Wesley, 2005.
5. S. Meyers. *More effective C++: 35 New Ways to Improve Your Programs and Designs*, Addison-Wesley, 1995.
6. B. Stroustrup. *A Tour of C++*, Addison-Wesley, 2013.
7. C++ reference (<http://en.cppreference.com/w/>).
8. Qt Documentation (<http://doc.qt.io/qt-5/>).
9. E. Gamma, R. Helm, R. Johnson, J. Vlissides. *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison-Wesley Longman Publishing, 1995.

8.3 Laboratory	Teaching methods	Remarks
1. Environment setup (installing a C++ compiler and an IDE). C/C++ basics.	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	The laboratory is structured as weekly 2 hour classes.
2. Introductory problems (in C).	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	
3. Feature-driven software development process. Layered architecture. Test driven development. Modular programming	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	
4. Classes and objects in C++. Copy constructors, assignment operators, destructors.	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	
5. Inheritance. Method overriding.	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	
6. Inheritance and polymorphism. Virtual methods.	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	
7. Laboratory test.	Practical test	
8. STL containers, iterators and algorithms.	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	
9. Streams, overloading the insertion and extraction operators, persistence.	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	
10. Exception handling. Testing.	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	
11. Qt Graphical User Interfaces I.	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	
12. Qt Graphical User Interfaces II. Signals and slots in Qt.	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	
13. Design patterns.	<ul style="list-style-type: none"> <li>· Explanation</li> <li>· Conversation</li> </ul>	
14. Laboratory test.	Practical test	

## Bibliography

1. B. Stroustrup. *The C++ Programming Language*, Addison Wesley, 1998.
2. R. Gilberg. *C++ Programming: An Object-Oriented Approach*, McGraw-Hill Education, 2019
3. A. Alexandrescu. *Programarea moderna in C++: Programare generica si modele de proiectare aplicate*, Editura Teora, 2002.
4. S. Meyers. *Effective C++: 55 Specific Ways to Improve Your Programs and Designs (3rd Edition)*, Addison-Wesley, 2005.
6. B. Stroustrup. *A Tour of C++*, Addison-Wesley, 2013.
7. C++ reference (<http://en.cppreference.com/w/>).
8. Qt Documentation (<http://doc.qt.io/qt-5/>).
9. E. Gamma, R. Helm, R. Johnson, J. Vlissides. *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison-Wesley Longman Publishing, 1995.
10. Bruce Eckel. *Thinking in C++*, Prentice Hall, 1995.

## 9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The course respects the ACM Curricula Recommendations for Computer Science studies.
- The course exists in the studying program of all major universities in Romania and abroad.
- The content of the course is considered by the software companies as important for average object-oriented programming skills.

## 10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	The correctness and completeness of the accumulated knowledge and the capacity to design and implement correct C++ programs.	Written examination (regular session).	<b>60%</b>
10.5 Seminar/lab activities	Ability to design, implement, test and debug a C++ program with a graphical user interface.	Practical evaluation. Two tests during the semester.	<b>20%</b>
	Project.	Design, implementation and testing of a small-medium application that uses a 3-tier architecture. Documentation	<b>20%</b>
10.6 Minimum performance standards			
<ul style="list-style-type: none"><li>□ Students must prove that they acquired an acceptable level of knowledge and understanding of the core concepts taught in the class, that they are capable of using this knowledge in a coherent form, that they have the ability to establish certain connections and to use the knowledge in solving small/medium scale problems using object-oriented programming in C++.</li><li>□ Successfully passing the examination is conditioned by a minimum grade of 5 (no rounding) for the laboratory practical test, the laboratory assignment and written examination.</li><li>□ Attendance is mandatory for 5 seminar sessions and 12 laboratory sessions.</li></ul>			

Date

02.10.2024

Signature of course coordinator

Lect. PhD. Diana Laura Borza

Signature of seminar coordinator

Lect. PhD. Diana Laura Borza

Date of approval

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Signature of the head of department

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