

3 Degree Plans - Computer Science - Software and Data Engineering

Coordinated by: Department of Software Engineering

Study programme coordinator: Prof. Mgr. Martin Nečaský, Ph.D.

– Plan D - The joint double-degree study plan is organised in cooperation between the Faculty of Mathematics and Physics, Charles University, and the Faculty of Computer Science and Mathematics, University of Passau (further partners).

Plan D - Double-Degree Study Plan

This study plan of the study program “Computer Science - Software and Data Engineering“ is organised in cooperation between Charles University and the University of Passau (further partners). It offers students an opportunity to study in two academic environments and to obtain a prestigious double degree:

- Master of Science in Computer Science (University of Passau)
- Magistr (Mgr.) in Computer Science – Software and Data Engineering (Charles University)

The students acquire skills in software engineering, software development, Web engineering, database systems and Big Data processing, allowing them to work in a wide variety of fields of computer science in an international environment. The Program aims at expertise in the analysis, design and development of complex software solutions and systems focused on Big Data processing. The portfolio of courses provided covers several technological platforms, from classic, web-based to modern cloud and distributed solutions.

The students spend the first year at their home university and the second year at the host university.

Courses and credits

Students are required to earn ECTS credits by enrolling in the course units and seminars listed in the study plan and successfully passing the examinations. The ECTS credit requirements are described below.

The study plan includes compulsory courses as well as compulsory elective courses:

- Compulsory courses are courses each student must take, and they are not subject to election.
- Compulsory elective courses are courses each student must elect from the list and complete to fulfil the criteria for compulsory elective courses specified in the study plan.
- Other courses offered at the partner universities, not listed as compulsory or compulsory elective courses, are denoted as free courses.

The following tables show the compulsory courses with respective ECTS credits and possible interchangeability of courses. Interchangeable courses share more than 70% of the content and thus can be applied interchangeably (but the student can register for one of the interchangeable courses only).

3.1 Compulsory Courses

The following table lists compulsory courses taught at Charles University:

Code	Subject	Credits	Winter	Summer
NTIN090	Introduction to Complexity and Computability	4	2/1 C+Ex	—
NTIN066	Data Structures 1	6	—	2/2 C+Ex
NSZZ023	Diploma Thesis I	6	—	0/4 C
NSZZ024	Diploma Thesis II	9	0/6 C	—
NSZZ025	Diploma Thesis III	15	—	0/10 C

The following table lists compulsory courses taught at the University of Passau:

Code	Subject	Credits	Winter	Summer
NUPA037	Seminar	5	0/2 C	—
NUPA035	Presentation of the Master's Thesis	3	—	0/4 C
NUPA036	Master's Thesis in Computer Science	27	—	0/18 C

Courses with codes starting with NUPA, listed in the Charles University Student Information System, serve as ‘virtual mirrors’ of the corresponding courses at the University of Passau. These courses are taught only at the University of Passau.

Some of the courses or groups of courses offered at Charles University and the University of Passau are considered interchangeable. This means that students may take either of them to fulfil the respective study requirement (but cannot enrol for both).

Interchangeability of compulsory courses is as follows:

- The course Introduction to Complexity and Computability (NTIN090) is interchangeable with the course Computational Complexity Theory (NUPA038).
- The group of courses Diploma Thesis I (NSZZ023), Diploma Thesis II (NSZZ024), and Diploma Thesis III (NSZZ025) is interchangeable with the group of courses Presentation of the Master's Thesis (NUPA035) and Master's Thesis in Computer Science (NUPA036).

3.2 Compulsory Elective Courses - Team Project Courses

The student chooses one project course from four offered (International Research Project, Software Project, Research Project, Company Project). Given the other commitments, the recommended (but not mandatory) option is the one-semester course International Research Project (NPRG081).

Code	Subject	Credits	Winter	Summer
NPRG081	International research project	6	0/6 C	0/6 C
NPRG069	Software Project	12	0/8 C	0/8 C
NPRG070	Research Project	9	0/6 C	0/6 C
NPRG071	Company Project	6	0/4 C	0/4 C
NPRG072	Increased project scope	3	0/2 C	0/2 C

3.3 Compulsory Elective Courses - Profiling Courses

Courses at the University of Passau are organised into module groups. The joint double-degree program is related to two of them:

- ProgSoft (Programming Methods and Software Systems) – focuses on programming paradigms, compilers, program analysis, software engineering, software architectures, and verification methods.
- InfKomm (Information and Communication Systems) – covers databases, distributed systems, multimedia systems, cloud and IoT data processing, privacy and security, and data science.

Selected courses from Charles University’s standard study plan have also been assigned to these groups to simplify the ECTS credit requirements described below.

The following table lists the courses from Charles University that are assigned to the InfKomm group:

Code	Subject	Credits	Winter	Summer
NSWI144	Data on the Web	5	—	2/1 C+Ex
NDBI034	Multimedia Retrieval	4	2/1 C+Ex	—
NDBI040	Modern Database Systems	5	—	2/2 C+Ex
NDBI042	Data Visualization Techniques	4	—	2/1 C+Ex
NPFL138	Deep Learning	8	—	3/4 C+Ex
NDBI023	Data Mining	5	—	2/2 C+Ex
NDBI049	Query Languages	3	2/0 Ex	—
NDBI021	User preferences and advanced recommending methods	4	2/1 C+Ex	—
NSWI080	Middleware	4	—	2/1 MC
NSWI101	System Behaviour Models and Verification	5	2/2 C+Ex	—
NSWI131	Performance Evaluation of Computer Systems	4	—	2/1 C+Ex
NSWI166	Introduction to recommender systems and user preferences	4	—	2/1 C+Ex

The following table lists the courses from Charles University that are assigned to the ProgSoft group:

Code	Subject	Credits	Winter	Summer
NPRG014	Concepts of Modern Programming Languages	4	0/3 C	—
NSWI126	Advanced Tools for Software Development and Monitoring	2	0/2 C	—
NPRG058	Advanced Programming in Parallel Environment	6	2/2 C+Ex	—
NSWI153	Advanced Web Applications Development	5	—	2/2 C+Ex
NSWI130	Software System Architectures	5	2/2 C+Ex	—

NTIN043	Formal Foundations of Software Engineering	5	2/2 C+Ex	—
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The following table lists the courses from the University of Passau that are assigned to the InfKomm group:

Code	Subject	Credits	Winter	Summer
NUPA023	Foundations of Energy Systems	6	2/2 Ex	—
NUPA024	Safety and Security of Critical Infrastructures	6	—	2/2 Ex
NUPA025	Methodological Foundations of Distributed Systems	6	—	2/2 Ex
NUPA026	Multimedia Databases	7	—	3/2 Ex
NUPA027	Data Modelling and Data Processing in the Internet of Things	5	—	2/1 Ex
NUPA028	Privacy-Preservation Technologies in Information Systems	5	2/1 Ex	—
NUPA029	Data Science Lab	6	0/4 Ex	—
NUPA030	Advanced Topics in Data Science	5	2/1 Ex	—
NUPA001	Scaling Database Systems	6	2/2 Ex	—
NUPA031	Reproducibility Engineering	6	2/2 Ex	—
NUPA032	Introduction to Deep Learning	6	2/2 Ex	—
NUPA033	Applied Artificial Intelligence Lab	6	0/4 Ex	—
NUPA034	Computational Linguistics	6	—	2/2 Ex
NUPA022	Research Seminar for the Focus InfKomm	5	0/2 C	0/2 C

The following table lists the courses from the University of Passau that are assigned to the ProgSoft group:

Code	Subject	Credits	Winter	Summer
NUPA002	Practical Parallel Programming	7	—	3/2 Ex
NUPA003	Dependence Analysis	6	—	2/2 Ex
NUPA004	Loop Parallelisation	6	—	2/2 Ex
NUPA005	Functional Programming	6	—	2/2 Ex
NUPA006	Virtual Machines and Runtime Systems	6	2/2 Ex	—
NUPA007	Domain-Specific Languages	6	—	2/2 Ex
NUPA008	Software Analysis	6	—	2/2 Ex
NUPA009	Advanced Software Product Development	10	2/4 Ex	—
NUPA010	Search-Based Software Engineering	6	2/2 Ex	—
NUPA011	Mobile Security	6	—	2/2 Ex
NUPA012	Program Repair	6	—	2/2 Ex
NUPA013	Secure Information Flow	6	—	2/2 Ex
NUPA014	Engineering Dependable Software	6	—	2/2 Ex
NUPA015	Object-Oriented Programming with C++	6	—	2/2 Ex

NUPA016	Compiler Construction	9	—	4/2 Ex
NUPA017	Reverse and Reengineering	6	2/2 Ex	—
NUPA018	Software-Projektmanagement	7	—	3/1 Ex
NUPA019	Principles of AI Engineering	6	2/2 Ex	2/2 Ex
NUPA020	Requirements Engineering	6	2/2 Ex	—
NUPA021	Research Seminar for the Focus ProgSoft	5	0/2 C	0/2 C

Interchangeability of compulsory elective courses is as follows:

- Course Program Analysis and Code Verification (NSWI132) is interchangeable with the course Software Analysis (NUPA008).
- Course Programming in C++ (NPRG041) is interchangeable with the course Object-Oriented Programming with C++ (NUPA015).
- Course Compiler Principles (NSWI098) is interchangeable with the course Compiler Construction (NUPA016).
- Course Data Science (NDBI048) is interchangeable with the course Data Science Lab (NUPA029).
- Course Deep Learning (NPFL114) is interchangeable with the course Introduction to Deep Learning (NUPA032).

The common ECTS credit requirements are as follows:

- At least 120 ECTS credits in total.
- At least 45 ECTS credits are required to advance to the second year.
- At least 30 ECTS credits (excluding the ECTS credits for the Diploma thesis) from courses of each partner.

The ECTS credit requirements checked at the University of Passau are as follows:

- At least 40 ECTS credits for ProgSoft courses and at least 30 ECTS credits for courses outside ProgSoft (excluding the ECTS credits for the Diploma thesis), OR
- at least 40 ECTS credits for InfKomm courses and at least 30 ECTS credits for courses outside InfKomm (excluding the ECTS credits for the Diploma thesis).

The ECTS credit requirement checked at Charles University is as follows:

- At least 50 ECTS credits for the compulsory elective courses (i.e., ProgSoft and InfKomm courses).

3.2 Recommended Course of Study

Since students spend exactly one winter semester and one summer semester at each of the two universities, they primarily enrol in the compulsory courses offered at the respective university in that semester and choose from its compulsory elective courses. They may also supplement their course selection with free courses.

Charles University: 1st year - Winter Semester

Code	Subject	Credits	Winter	Summer
NTIN090	Introduction to Complexity and Computability	4	2/1 C+Ex	—
NDBI034	Multimedia Retrieval	4	2/1 C+Ex	—

NDBI049	Query Languages	3	2/0 Ex	—
NSWI101	System Behaviour Models and Verification	5	2/2 C+Ex	—
NDBI021	User preferences and advanced recommending methods	4	2/1 C+Ex	—
NPRG014	Concepts of Modern Programming Languages	4	0/3 C	—
NPRG058	Advanced Programming in Parallel Environment	6	2/2 C+Ex	—
NSWI130	Software System Architectures	5	2/2 C+Ex	—
NTIN043	Formal Foundations of Software Engineering	5	2/2 C+Ex	—

Charles University: 1st year - Summer Semester

Code	Subject	Credits	Winter	Summer
NTIN066	Data Structures 1	6	—	2/2 C+Ex
NPRG081	International research project	6	—	0/6 C
NSWI144	Data on the Web	5	—	2/1 C+Ex
NDBI040	Modern Database Systems	5	—	2/2 C+Ex
NDBI042	Data Visualization Techniques	4	—	2/1 C+Ex
NPFL138	Deep Learning	8	—	3/4 C+Ex
NDBI023	Data Mining	5	—	2/2 C+Ex
NSWI166	Introduction to recommender systems and user preferences	4	—	2/1 C+Ex
NSWI080	Middleware	4	—	2/1 MC
NSWI131	Performance Evaluation of Computer Systems	4	—	2/1 C+Ex
NSWI126	Advanced Tools for Software Development and Monitoring	2	0/2 C	—
NSWI153	Advanced Web Applications Development	5	—	2/2 C+Ex

University of Passau: 2nd year - Winter Semester

Code	Subject	Credits	Winter	Summer
NUPA037	Seminar	5	0/2 C	—
NUPA001	Scaling Database Systems	6	2/2 Ex	—
NUPA006	Virtual Machines and Runtime Systems	6	2/2 Ex	—
NUPA009	Advanced Software Product Development	10	2/4 Ex	—
NUPA010	Search-Based Software Engineering	6	2/2 Ex	—
NUPA017	Reverse and Reengineering	6	2/2 Ex	—
NUPA019	Principles of AI Engineering	6	2/2 Ex	2/2 Ex
NUPA020	Requirements Engineering	6	2/2 Ex	—
NUPA023	Foundations of Energy Systems	6	2/2 Ex	—

NUPA028	Privacy-Preservation Technologies in Information Systems	5	2/1 Ex	—
NUPA029	Data Science Lab	6	0/4 Ex	—
NUPA030	Advanced Topics in Data Science	5	2/1 Ex	—
NUPA031	Reproducibility Engineering	6	2/2 Ex	—
NUPA032	Introduction to Deep Learning	6	2/2 Ex	—
NUPA033	Applied Artificial Intelligence Lab	6	0/4 Ex	—

University of Passau: 2nd year - Summer Semester

Code	Subject	Credits	Winter	Summer
NUPA035	Presentation of the Master's Thesis	3	—	0/4 C
NUPA036	Master's Thesis in Computer Science	27	—	0/18 C
NUPA002	Practical Parallel Programming	7	—	3/2 Ex
NUPA003	Dependence Analysis	6	—	2/2 Ex
NUPA004	Loop Parallelisation	6	—	2/2 Ex
NUPA005	Functional Programming	6	—	2/2 Ex
NUPA007	Domain-Specific Languages	6	—	2/2 Ex
NUPA008	Software Analysis	6	—	2/2 Ex
NUPA011	Mobile Security	6	—	2/2 Ex
NUPA012	Program Repair	6	—	2/2 Ex
NUPA013	Secure Information Flow	6	—	2/2 Ex
NUPA014	Engineering Dependable Software	6	—	2/2 Ex
NUPA015	Object-Oriented Programming with C++	6	—	2/2 Ex
NUPA016	Compiler Construction	9	—	4/2 Ex
NUPA018	Software-Projektmanagement	7	—	3/1 Ex
NUPA024	Safety and Security of Critical Infrastructures	6	—	2/2 Ex
NUPA025	Methodological Foundations of Distributed Systems	6	—	2/2 Ex
NUPA026	Multimedia Databases	7	—	3/2 Ex
NUPA027	Data Modelling and Data Processing in the Internet of Things	5	—	2/1 Ex
NUPA034	Computational Linguistics	6	—	2/2 Ex

Thesis

The student selects the thesis topic, preferably (but not mandatorily) in the second year at the host university, in accordance with its regulations. The thesis is written in English and carried out under the joint supervision of a supervisor and a consultant from both partner universities.

The thesis should demonstrate the student's ability to conduct independent scientific work and to apply appropriate research methods to a defined topic. It must be submitted and defended in line with the regulations of the university where it is

officially registered. The supervisor and the consultant jointly ensure that the thesis meets the academic standards and requirements of both institutions.

Final (State) Examination

The studies are successfully completed by passing the final (state) examination. The final (state) examination is performed in front of a committee consisting of members proposed jointly by the partners and approved in accordance with the relevant rules and regulations of both partners. The examination will consist of a Diploma thesis defence and an oral examination. Both parts will be held in the order indicated, i.e. first the defence, then the oral part. The student must successfully pass both parts to finish the studies. The oral examination will take place immediately after the successful defence of the Diploma thesis. It will be implemented in the form of an expert discussion on topics closely related to the topic of the presented thesis.

A student may register for the final (state) examination after completing at least 90 ECTS credits, fulfilling the minimum requirements for ECTS credits stated above (except for the total number of 120 ECTS credits), and successfully submitting his/her Diploma thesis. The remaining ECTS credits for the Diploma thesis will be given after the successful defence of the thesis, prior to the oral examination.

A student is entitled to one regular attempt and a maximum of two retake attempts of the final (state) examination. The quality of the thesis and the correctness of the answers to the committee's questions are graded independently. A comprehensive final grade is awarded on the basis of the two partial grades.

Grade conversion

- A (ECTS) = "Výborně" (in Czech) = "Excellent" = 1,3 (University of Passau)
- B (ECTS) = "Výborně" (in Czech) = "Excellent" = 1,7 (University of Passau)
- B (ECTS) = "Velmi dobře" (in Czech) = "Very good" = 2,0 (University of Passau)
- C (ECTS) = "Velmi dobře" (in Czech) = "Very good" = 2,3 (University of Passau)
- C (ECTS) = "Velmi dobře" (in Czech) = "Very good" = 2,7 (University of Passau)
- D (ECTS) = "Dobře" (in Czech) = "Good" = 3,0 (University of Passau)
- D (ECTS) = "Dobře" (in Czech) = "Good" = 3,3 (University of Passau)
- E (ECTS) = "Dobře" (in Czech) = "Good" = 3,7 (University of Passau)
- E (ECTS) = "Dobře" (in Czech) = "Good" = 4,0 (University of Passau)
- F (ECTS) = "Nedostatečný" (in Czech) = "Fail" = 4,3 (University of Passau)
- F (ECTS) = "Nedostatečný" (in Czech) = "Fail" = 4,7 (University of Passau)
- F (ECTS) = "Nedostatečný" (in Czech) = "Fail" = 5,0 (University of Passau)