

Advanced Topics in Computer Science

Version 1.4 - April, 16th, 2019

Target skills and knowledge

The focus of this course is on *modeling, analysis, and enactment of business processes and the configuration and deployment of information systems to support these processes*. After taking the course, students are able to:

- model realistic business processes and systems;
- interpret the informal requirements and translate them into explicit models;
- analyze and improve processes (and the corresponding systems) via simulation and sensitivity analysis;
- configure and deploy a process-aware information system that runs in compliance with a process model.

Course unit contents

The ultimate goal of any information system is to support processes. Therefore, information systems need to be designed and analyzed such that in the end the processes are conforming to certain rules (e.g., auditing or legal requirements), response times and flow times are as short as possible, costs are reduced, and risks are minimized.

Process-aware information systems, such as Workflow Management (WFM) Systems, Enterprise Resource Planning (ERP) systems, Business Process Management (BPM) systems, Enterprise Information (EI) systems, Customer Relationship Management (CRM) systems, and Product Data Management (PDM) systems, are generic information systems that are configured on the basis of process models.

Some systems implement monolithic processes in isolation while in other systems various (web-) services are composed to complex processes.

In some systems, the process models are explicit and can be adapted (e.g., the control flow in a WFM/BPM system) while in other systems they are implicit (e.g., the reference models in the context of SAP).

However, it is clear that, in any enterprise, business processes and information systems are strongly intertwined. Therefore, it is important that students understand the relationship between systems and processes and are able to model complex systems involving processes, (web-) services, humans, and organizations.

This course will cover the entire life cycle of designing and deployment of process-aware information systems, namely:

1. to interpreting information process requirements and translate them into explicit, formal models;
2. to analyze the performance of the process, by simulating the respective formal models and performing sensitivity analysis;
3. to improve the process (and the respective model), by identifying, e.g., the bottlenecks, the over/underutilization of resources, reducing the service costs and time.

4. to configure and deploy a process-aware information system that is driven by the improved process model

The language used in this course to model processes is Petri net, in the two variants: Color Petri Nets and YAWL. Given informal process' descriptions, the students will model a number of processes in CPN Tools and perform analyses and simulations for their optimization.

The resulting improved model will be finally deployed in YAWL, an open-source process-aware information system, to validate the process.

Planned learning activities and teaching methods

The teaching activities will be composed of face-to-face classes where the theoretical concepts are introduced, which will be complemented by hands-on sessions where students can put the learnt concepts in practices.

Additional notes and suggested readings

In addition to the textbooks below, additional notes and materials are available on <http://cpntools.org/> on how to use CPN Tools and its programming language. On <http://www.yawlfoundation.org/>, it is possible to find a lot of relevant material and manuals to help deploy processes in YAWL.

Textbooks

For modelling, simulation and sensitivity analysis:

- Wil M.P. van der Aalst and Christian Stahl. *Modeling Business Processes A Petri Net-Oriented Approach*. The MIT press, 2011 (ISBN-13: 978-0-262-01538-7).

For the configuration and deployment of process-aware information systems:

- Arthur H.M. ter Hofstede, Wil M.P. van der Aalst, M. Adams, N. Russell. *Modern Business Process Automation: YAWL and its Support Environment*. Springer-Verlag Berlin Heidelberg, 2010 (ISBN-13: 978-3-642-03120-5).

Innovative teaching methods: Teaching and learning strategies

- Lecturing
- Tutorial
- Case study
- Working in group
- Problem solving

Innovative teaching methods: Software or applications used

- Moodle for sharing material
- CPN Tools (<http://cpntools.org/>) for modelling and simulation of business processes.
- YAWL (<http://www.yawlfoundation.org/>) as an example of process-aware information system

Examination methods

An assignment: The students are given a textual description of a realistic process and they need to model and optimize the process. Next, an information system is configured on the basis of such a model, so that it runs in compliance of the constraints described by the process itself.

The assignment is divided in three parts:

Part 1. Modelling (deadline 7 April at 11pm). **40% of the grade**

Part 2. Optimization (deadline 5 May at 11pm). **20% of the grade**

Part 3. Configuration and Deployment of a Process-aware Information-System. **40% of the grade**

Part 3 can be delivered in two dates:

1. **June, 14th at 11pm.** In this case, students are called to discuss the different parts of the assignment on June, 19th at 2pm in room 1BC45.
2. **July, 1st at 11pm.** In this case, students are called to discuss the different parts of the assignment on July, 5th at 10am in room 2BC30.

Three later dates will follow.

On the day of the discussion, the grade will be finalized (“verbalizzazione”). Depending on the quality of the discussion, the grade can slightly modify with respect to the sum of the grade of the three parts. Students are requested to register for the exam session.

It is possible to improve the grade in a later exam session, by extending the assignments with additional parts. If any student is willing to do so, (s)he would contact the teacher to discuss how to extend the assignments.

Part I and Part III will be each given a grade between 0 and 40; Part II will be given a grade between 0 and 20. The maximum sum will be 100, which will be later multiplied by 0.3 to scale between 0 and 30 and rounded to the closest integer. If the sum is greater than 99 (i.e. the average is greater than 29.7), this will lead to “cum laude”.

This assignment is to be solved **in a group composed by two students**. While it is encouraged to discuss with students of other groups, the solutions have to be **original**. Solutions of the two or more groups that are almost identical will be considered as plagiarism (“copiato”), all those groups will be just given 0 points, with no possibility to repeat the assignment.

Assessment criteria

The assignment assesses the actual development of the student’s skills to model and optimize business process and to accordingly configure process-aware information systems.

Class Schedule and Class Topics

The classes will take place in Torre Archimede in room 1BC50 on:

- Wednesdays, 14.30h – 16.15h
- Fridays, 12.30h – 14.15h

The contact hours are of three types:

- Normal class hours in which the concepts are introduced
- Instructions (Tutoraggio) in which students will work on exercises provided by the teacher. The instructions marked with star (that is *Instruction (*)*) will require the use of a laptop.
- Walk-in Session in which students can work on the assignment in the class room, and the teacher is available to support and answer questions.

The schedule of the course is as follows, where instructions and walk-in sessions are marked in *Italic*.

Week	Wednesday 14.30h – 16.15h	Friday 12.30h – 14.15h	Sunday at 23.00h
25/2 – 03 /3	Introduction to the course and to Petri Nets	Petri Nets for Business Process Modelling	
04/3 – 10/3	<i>Instruction (Petri Nets)</i>	Colour Petri Nets (Part I)	
11/3 – 17/3	Colour Petri Nets (Part II)	<i>(No class)</i>	
18/3 – 24/3	<i>Instruction (Colour Petri Nets)</i>	Functions and Hierarchy	
25/3 – 31/3	<u><i>Instruction (Colour Petri Nets)*</i></u>	<i>(No class)</i>	
01/4 – 07/4	<i>Walk-in Session (Assignment)</i>	<i>(No class)</i>	Deadline Part 1 of the Assignment
08/4 – 14/4	Simulation	<i>(No class)</i>	
15/4 – 21/4	Modelling and Simulation of Logistic Processes	<i>(No class)</i>	
22/4 – 28/4	<i>(No class)</i>	<i>(No class)</i>	
29/4 – 05/5	<i>(No class)</i>	Soundness	Deadline Part 2 of the Assignment
06/5 – 12/5	Introduction to Process Management Systems and YAWL: Part 1	<u><i>Instruction (YAWL) *</i></u>	
13/5 – 19/5	Introduction to Process Management Systems and YAWL: Part 2	<u><i>Instruction (YAWL) *</i></u>	
20/5 – 26/5	<u><i>Instruction (YAWL) *</i></u>	<i>Walk-in Session (Assignment)</i>	
27/5 – 02/6	<i>(No class)</i>	<i>(No class)</i>	
03/6 – 09/6	<i>Walk-in Session (Assignment)</i>	Conclusion: What is happening before and after Modelling, Simulation and Deployment?	
10/6 – 14/6	<i>Walk-in Session (Assignment)</i>	<i>(No class)</i>	First deadline Part 3 of the Assignment