

# > **PROMPT**

## Courses for professionals in Software Engineering



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# Customised, free education for engineers and software developers

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Malin Rosqvist and Hans Hansson,  
project leaders for PROMPT at Mälardalen University.

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**Software is a business-critical resource** for large parts of Swedish and European industry. Software is also an important source of innovation and competitiveness. Therefore, the PROMPT initiative (Professional Master in Software Engineering) has been launched. PROMPT is a Swedish educational initiative in cooperation with several academic parties and a number of leading Swedish industrial companies and organizations. Together the parties develop advanced courses adapted for professional engineers and software developers.

The goal is to ensure supply of advanced software competencies and innovativeness to industry. For several of the traditional industries software is of crucial importance. Companies are facing tough international competition where strong measures are required to be able to maintain and develop their position.

The courses are developed to suit professionals who need to be able to combine work and studies. The courses combine conventional studies with web based learning.

The PROMPT project is led by the research direction Embedded Systems at Mälardalen University, and the courses are given in cooperation with Blekinge



Institute of Technology, Chalmers, the University of Gothenburg, Mälardalen University and RISE SICS. The project is funded by the Knowledge Foundation and by participating universities and companies. PROMPT is an open initiative which welcomes additional companies and universities.

# Future challenges are best tackled by cooperation

For Volvo Construction Equipment the PROMPT initiative is valuable for the company as well as for the Volvo employees

**Cooperation**, both over company boundaries and together with academia, is indispensable for Swedish industry's ability to be competitive. Therefore initiatives such as PROMPT are important. Embedded systems software development is an important area for the Swedish vehicle industry, among other things:

- Courses within the PROMPT initiative work a little bit like a watering hole, a partitioning off from our daily activities. The results of the studies will be directly applicable to our operations.

Peter Wallin is responsible for the external research portfolio at Volvo CE. Moreover he is Volvos representative on the PROMPT steering group and assistant supervisor of two industrial doctoral students at Mälardalen University (MDH).

## **Skilled staff most important**

External research and advanced level training has a high priority for Volvo CE, and Peter Wallin cannot stress its importance too much. This is one of the reasons that MDH has been AB Volvo's Academic Preferred Partner in embedded systems since 2013. For Volvo it also applies, in



addition to construction equipment, to trucks, buses and boat engines.

- MDH is well ahead in embedded systems and we have an established cooperation that has worked well for many years. The partnership excludes no-one else, but it gives us extra opportunities. You could say that it's the oil that lubricates the machinery, says Peter Wallin with a smile.

- Thanks to our knowing each other well we can have long-term plans together, we can share information and both we and MDH feel that we want to drive the cooperation forwards.

- MDH works as a neutral arena where we meet and discuss technology and research with other companies. We don't compete with any of the others, which facilitates open cooperation in which we learn from one another.

- Joint projects like these are important for us to be able to build broad skills from which to recruit in Sweden. If we are to be competitive we must cooperate over company boundaries, and here academia has an important part to play, says Peter Wallin. ■



Peter Wallin, manager of the company's external research portfolio.

Volvo Construction Equipment is a world-leading manufacturer of articulated haulers and wheel loaders, and one of the world's leading manufacturers of excavators, road machinery and compact equipment.



Volvo CE receives a lot of enquiries, but does not enter cooperation if the quality is not high.

*“We want it to be a quality stamp when Volvo CE is involved”*



# At Scania they develop their own employees



Industrial competitiveness requires cooperation with academia. For Scania, which is increasingly moving away from mechanics towards software, customised opportunities of developing employees' skills is of central importance. Beatrice Jonsson is Competence manager and in charge of the long-term skills supply of engineers at Scania.

**Industries steeped** in history cannot live on former merits; change is required for continued success. This applies not least to the skills of the employees, which must be developed in step with the times. This is the focus in PROMPT, the Master's study programmes in software

which have been developed in collaboration with several academic parties and a number of leading Swedish industrial companies.

– PROMPT is a fantastic initiative. I would have liked more people to have had this way of thinking, says Beatrice Jonsson, Competence

manager, in charge of the long-term skills supply of engineers at Scania.

Scania has a long tradition of further education. When the surrounding world changes people develop their own employees' skills according to the new conditions.



“*Our products and methods are complex, and our skilled employees have ensured that we have been world-leading for many decades. In a world where our business model is changing we have a lot to gain by developing*”

*Beatrice Jonsson, Competence manager*

“

*PROMPT is a fantastic opportunity to offer further education”*

– Our products and methods are complex, and our skilled employees have ensured that we have been world-leading for many decades. In a world where our business model is changing we have a lot to gain by developing, or even exchanging, skills to as great an extent as possible, says Beatrice Jonsson.

### Digitalisation of central importance

And the conditions within the transport sector are in a process of change. The increase in population and urbanisation are leading to increased needs for transport, which must not occur at the expense of the environment and resources. Technical development and digitalisation therefore play a very important role.

– We are going from being a traditional truck manufacturer to becoming a sustainable solution provider for transport of goods and people. In the future, the truck will only be a subset of our offering.

This means of course that software will become increasingly more important in Scania's products and solutions. Today Scania is developing, among other things, self-driving vehicles and modern user interfaces. They are working with online trucks that collect large amounts of data. For a classic heavy engineering company, this digitalisation implies major challenges in terms of skills. In their work with safeguarding skills supply, Beatrice Jonsson is looking 15 years ahead in time. Then she sees several alternative scenarios, which in turn imply various needs of skills.

– Altogether regardless of the scenario, digitalisation is going to be of central importance, and it

is likely that we will get a surplus of a certain type of engineer. We are going to need more software engineers, and that transfer must be done in dialogue with academia, says Beatrice Jonsson.

### Educate for future needs

There PROMPT can play an important role. The courses have been produced in consultation between academia and industry, and Scania is one of several companies that have participated in developing the course content so that it meets existing industrial needs.

– Since we need courses and study programmes of this kind we have a responsibility to participate and contribute. It's important that we make clear requirements and give the University input about what we need and prioritise. Moreover, for the University it will provide good input to other course activities, says Beatrice Jonsson.

She stresses that these courses and study programmes ought to be of benefit to more people. Scania is good at research cooperation, but Beatrice Jonsson calls for more cooperation in first-cycle education as well, and she hopes that the University will use both the industry's input and PROMPT courses in first-cycle education. Skill has a long delivery time, she says, and it is now that the right type of courses and study programmes can be created for those who are to develop the Scania products that will come out on the market in 2030.

– We want to support and participate in ensuring that people are educated for the needs that exist. Both we and the education system are a little sluggish and would benefit by a more closer dialogue. It's important that we find smart ways of getting flows in both directions.

– And I would like more teachers to come here on study visits



or placement, both for their own continuing professional development and because it would increase their understanding of what work tasks their students would have in the future.

### Fantastic opportunity

PROMPT is tailored for those who combine education with professional work. After Scania had informed their employees about PROMPT there have been a lot of people who have been in touch and shown interest. But Beatrice Jonsson hopes that still more will take the opportunity to take courses.

– PROMPT is a fantastic opportunity to offer further education, for example in case of a recess, or if

there is a change in people's work conditions. Moreover there are always employees who are keen on building on their skills or making a change in their skills. Many of those who studied more than 20 years ago now see the opportunities that are coming with connected vehicles and big data, for example.

– In the long run I hope that people may be able to do entire programmes in PROMPT. A dream scenario would be some form of bridging education, which would enable a mechanical engineer to become a software developer.

But sometimes a whole Master's programme is too much. Beatrice Jonsson believes that there can be a threshold for a working professional

to retrain and would therefore like to have shorter courses and study programmes as well, some form of "teasers" for non-software developers.

– I am a chemist myself, but I think that it's fun to work out how we can use all the data we get from our connected vehicles. But the step towards studying a programme that is tailored to "big data" feels too big. Just imagine if there were orientation courses in engineering that could give me guidance in what these "new" areas mean and to see which gaps I need to fill. Perhaps I won't need to supplement as much as I think. ■

Text: Lena Bergman. Photo: Jonas Bilberg



Malin Rosqvist from Mälardalen University with Beatrice Jonsson, Competence manager Scania.

# Competence development enhances competitiveness



Complex systems, competition from South-East Asia, technology that is quickly overtaken. Shall we give up? – No, considers Stefan Andersson, who is responsible for future aeronautical systems at Saab Aeronautics and Chair of the non-profit organisation Swedsoft. Instead he is urging the Swedish software industry to sharpen their claws.



**SAAB**



**SWEDSOFT**

– **We must be smarter** and faster than our competitors, Stefan Andersson states as he shows us around the Saab Aeronautics offices and factories in Linköping. In the elongated brick buildings from the 1940s, around a thousand engineers are working on the completion of the next generation of the fighter aircraft JAS Gripen. Development, simulation, production and flight testing – everything takes place at one and the same place – from decimetre-thick aluminium blocks to airworthy planes.

– This enables us who are working with development to get immediate feedback. We can fix some little thing and then check straight away whether it works. It's easy to study

test results and make analyses, he says, and considers that proximity is an important part of their success.

– We mustn't underestimate the value of communication. Even though they are hi-tech products we mustn't forget that they are built by people.

Stefan Andersson has been working at Saab Aeronautics since 1989 as a software engineer, systems engineer and line manager at different levels. Today he has a more overall responsibility and is the project manager for future aeronautical systems. He believes that short decision paths, a decentralised way of working and continual improvements form the basis of the most important success factors of all companies: motivation and skills.

– You should be able, and you should have the will, Stefan Andersson summarises.

## Skill is a moving target

At Saab Aeronautics in Linköping he feels that there are no problems with commitment and motivation. Difficult technological challenges, coupled with an exciting environment and clear feedback, guarantee this.

It is not as obvious with skills, he considers – not at Saab nor in the branch as a whole.

– Even though there is great knowledge in our companies, skill is a moving target; it's important not to become complacent. At Saab, as in other industries, software is becoming more and more a part

# “It’s not just about producing codes, but producing the right code in the right way”

Stefan Andersson, SAAB Aeronautics

of our products and our solutions. With us, and in Sweden generally, engineers need to further educate themselves or retrain. A lot of people working today with for example electronics or mechanics need to learn system modelling or software engineering instead.

In the light of this he welcomes initiatives such as PROMPT, since there is a need for a national investment in skills that support the digitalisation that industry is facing.

## From words to action

– PROMPT is an exemplary initiative. They have gone from words to action in a situation where a lot of people just talk. Industry and academia have a lot to give each other. Industry can come with practical problems and lend products and

for innovation in software-intensive systems. As with PROMPT, Swedsoft is a collaboration between industry and the academic world, and Stefan Andersson gladly returns to how important it is that the various HEIs (higher education institutions) offer opportunities for CPD (continuing professional development) for professional engineers. Above all he requires education in three areas: ordinary conventional programming, software testing and system modelling.

– Here development progresses rapidly and undergraduate education will not hold over time, but there is a continual need for new knowledge, he says, but at the same time he underlines that spearhead knowledge is only one side of the coin. The other is breadth.

technology is being replaced by new, and it’s not possible to predict where in-depth skills need to be in five or ten years’ time.

## Joint forces needed

The fact that the academic sphere does not understand the needs of industry he considers to be a well-rehearsed myth. Research has knowledge and results that industry does not know about, and it is therefore often better equipped to define course content, but this does not exclude the importance of students using industrial problems in their project work.

– There is a need for a dialogue and a common platform for networking and learning – across the branch borders and between industry and academia.

# “Swedish industry’s tools for facing competition are to invest in skills and innovations based on software”

prototypes. In return they can get new approaches and solutions to their problems.

He explains that there are three perspectives of great benefit to one another – student, industry and researcher/expert – and he does not just speak of his experiences from Saab but also in his capacity as Chair of Swedsoft – a non-profit organisation that wants to promote Sweden as an international centre

– A lot of students feel very anxious: “Is what I’m reading relevant?”, “Am I learning the right things?” I would like to tone down this anxiety. We need good engineers with a basic understanding of science and an ability to solve problems. Specialist knowledge is good to top up with, but in a world of globalisation and rapid development we need an opportunity for continuing professional development. Established

The fact that PROMPT offers the opportunities to take academic credits he believes will guarantee a credibility that commercial educational alternatives cannot often offer.

– There is room for both. Sometimes a quick solution to a pragmatic problem is needed, and then a short course can be good, whereas academic courses emphasise more generic knowledge such as principles

Swedsoft is a non-profit organisation founded in 2007 in a joint venture between ABB, Ericsson, SAAB AB, Volvo AB and several universities in Sweden. The organisation wishes to make Sweden into an innovation centre for software-intensive systems, thereby increasing competitiveness in Swedish industry and strengthening Sweden's academic status internationally.



and thought patterns, and provide an overview that is more valuable in the long term.

### Competitive advantages

Sweden is a small country and it needs to make use of its resources to the full to measure up internationally. We can compete neither in number nor in price; we must instead find our strong points elsewhere.

– We are creative and mobile. We are good at changes and adaptations. Initiatives such as PROMPT show this. Instead of people with outdated skills becoming unemployed we make use of their potential by further educating them, says Stefan Andersson. A further development of PROMPT could be, for example, to give courses for immigrant engineers so that they quickly enter into working life, he considers. Another

one is to make a parallel career path and open up even more for practitioners to take credits and do research. Moreover he encourages other universities and university colleges to take up the challenge and design more courses and workshops with the sights set on lifelong learning. ■

Text and photo: Carina H Ahnstedt

# The fruit of cooperation

## PROMPT at Chalmers and University of Gothenburg

**World-leading research paired with experience and praxis from industry. PROMPT is the fruit of cooperation with four universities, one institute and a number of representatives from industry.**

**– We can offer an advanced education that has the advantages of distance work but also allows for close proximity, says Miroslaw Staron.**

**F**rom the balcony at Chalmers University of Technology at Lindholmen in Gothenburg you can see both Ericsson and Volvo – a proximity that guarantees a lot of cooperation.

– You just have to go right across the road and that's what we do as well, says Miroslaw Staron. He is Associate Professor at the Department of Software Development and is also on the steering committee of the PROMPT project.

– For us there are a lot of advantages of helping to run this programme. Even though Chalmers is a well-known name, it's up to us to keep up and take up the competition, Miroslaw Staron explains. Today big universities in the USA, for example MIT and Stanford, are offering online courses. Why then should students approach us in Sweden?, he asks and continues:

– PROMPT is a way of developing web-based learning, but it will not only be a distance course in the conventional sense, but we will be building an entire learning platform around PROMPT, where on-campus meetings are also included at different places around the country.

– There's a crying need for continuing professional development within the area, agrees Michel Chaudron, Professor of Software Development and Head of the Department of Software Engineering at Chalmers and the University of Gothenburg.

– As a university we naturally want to help to fulfil this need and also to learn more ourselves. Working practitioners are not a group that universities traditionally approach, but to strengthen Swedish competitiveness it's important to find forms for developing spearhead skills in the companies.

### Challenges in software

The challenges in the software area are great, and if Swedish industry is to retain its competitive ability and innovativeness we have to address these. Michel Chaudron identifies three areas in which the need of development is especially important: complexity, security and globality.

The first of these – far too great complexity – is quite simply because the systems have grown too fast and too large.

– A lot of software systems are going on for thirty years old. Thirty years ago mobile phones didn't even exist. Today everything's connected. Therefore the systems are not adapted to the technology required. Instead people have built on and patched and mended the original systems, Miroslaw Staron explains.

– If you don't have a design that supports the function needed it results in what we call spaghetti code – a tangle where it's difficult to get an overview and which leads you the wrong way, says Michel Chaudron.

One important area within PROMPT is therefore to increase skills in architecture and design and thus to improve the structure, overview and function in the software.

### Operational reliability

Another area for improvement is operational reliability. Miroslaw Staron gives an example:

– Take a normal private car. Previously the software in every car was local for just that car. Today the system is connected to the web and to different cloud services. The systems are totally integrated and from a



Riccardo Scandariato, Michel Chaudron, Imed Hammouda and Miroslaw Staron make up the PROMPT team at Chalmers and University of Gothenburg.

security point of view it's necessary for them to function round the clock.

## Globalisation

The last big challenge is globalisation. The prerequisites for the companies to communicate have changed. Parts of the work group are perhaps on the other side of the globe, often in other time zones in countries such as China or in the USA.

– It's assumed that you, together with international colleagues, find solutions that are just as good as

those you arrive at with colleagues at the desk next to you. Then you need communication solutions that are smart, functional and secure, says Michel Chaudron.

## Exchange of knowledge

Apart from the unique cooperation between four universities, PROMPT is a result of collaboration with private enterprise and representatives from industry contribute towards course development. Companies from a variety of branches are involved since they are facing similar

challenges in the software area, regardless of industrial application.

– Greater integration implies that there are great advantages with the exchange of knowledge within different branches. Increasingly more areas may interact in the future, says Miroslaw Staron.

– Professional people have different demands than ordinary campus students, Miroslaw Staron states. One difference is that those who are a little older are not as used to web-based learning. They want to have the advantages of distance learning

*“We can offer an advanced education that has the advantages of distance work but also allows for close proximity”*

*Miroslaw Staron, Chalmers*



Chalmers campus Lindholmen is located close to industrial partners like Volvo and Ericsson.

but at the same time feel at home in the environment of perhaps ten to fifteen years ago. To attract that group we need to give them the opportunity to meet physically, but it should preferably be as near and simple for it to work for a full-time employed parent of small children to participate.

– Moreover there’s a lot to gain by students from different sectors of industry having the opportunity to get to know both us and one another to create networks, Miroslaw Staron adds.

### Feedback to academia

But PROMPT does not just offer an advanced learning platform for further education for the students. The close contact with industry also

gives quite a lot back to the different universities.

– With this feedback from industry it becomes clear to us what the problem really is so that we can develop our courses on the basis of that.

### Competition

On the education market there is a whole array of commercial courses and certifications for those who wish to improve their skills in software development. But neither Miroslaw Staron nor Michel Chaudron see these as any real competition. Their opinion is that PROMPT gives the companies unique access to world-leading research within the field that supports the companies’ development and innovation. Furthermore, a university education

gives them a quality assurance of the students’ knowledge, which differentiates it from commercial alternatives.

During the period 2015-2019 PROMPT will be expanding to comprise twenty or so courses, all produced in cooperation with and for industry.

– For us it’s valuable to establish a good network all over Sweden with other universities within the field, and that we can have an active discussion about both didactics and content. All the new technology and developments that we assimilate as educators in PROMPT will in the long term also be of benefit to our campus students in that we apply them to other courses. ■

Text: Carina H Ahnstedt. Photo: Pontus Johansson



Johan Haraldsson, specialist in embedded software at Volvo Group Trucks Technology, is pleased with the software testing course at Mälardalen University.

# Improving software testing at Volvo

How do you equip yourself for a future where software is hard currency? Since Johan Haraldsson graduated from Chalmers University of Technology as an Electronics Engineer 18 years ago the prerequisites for his work have changed several times. For this reason he has been particular about keeping himself updated and during his years in the profession he has participated in several different courses – both 50% part-time courses at Chalmers and commercial courses. He recently completed the PROMPT Software Testing course at Mälardalen University.

## – The advantage of PROMPT

is that the design is adapted for us who are working. When I have gone on more conventional courses previously it's been difficult to combine full-time work with group projects and daytime lectures, says Johan Haraldsson.

The courses in PROMPT are run as 25% part-time distance courses and are estimated to take about 200 hours per semester. It's a suitably sized workload to be able to have time for a full-time job, he thinks, adding that it also provides the opportunity for deeper reflection since the course dates are spread out over such a long time.

The teaching consists mainly of video lectures and group discussions on the net, but during the semester the participants have also had three physical whole-day meetings.

– They have been very rewarding. The lessons, where lecturers who are prominent within their fields meet participants with a lot of practical experience, give rise to a lot of interesting discussions.

Those of us who are working professionally get the chance to assimilate the new findings and place them in a corporate perspective.

## The value of research

The value of research is often governed by how it's interpreted,

in the opinion of Johan Haraldsson. To be able to learn about other people's interpretations in a group of qualified people is inspiring, and having met eye to eye makes it easier to continue communicating on the net.





**PROMPT courses gives the advantages of distance education in an environment where the students feel at home. They also get the opportunity to exchange experiences and to network in different places in the country.**

– We are alike but yet unlike, he states. The discussion between the branches is very interesting. When we from Volvo learn about experiences from Ericsson, ABB or Husqvarna it's noticeable that we often have the same problems but partly different views about their solutions. But is there no competition?

– The advantage is that we have primarily touched upon the development process and test methods. Most of us probably think that it's easier to share our experiences about the development of the product than about the product itself. At least I haven't felt that anyone has been holding back in the discussions but rather that there's been an open atmosphere.

### **Vital professional development**

The fact that both companies and the universities are investing in streamlining their software development he regards as being necessary for Swedish industry to be able to hold its own in international competition.

– Constant continuing professional development is vital for Swedish companies since software is such a big product. Sweden has of course traditionally been successful with innovations, but it's important to continue investing in a favourable development climate.

Today Johan Haraldsson is working as a specialist in embedded systems in trucks at Volvo Group

Trucks Technology in Gothenburg and he can testify to a development that requires tensed muscles.

– Our goal is to be ten times faster. The number of functions created with the help of software is increasing all the time and it's also in software development that the greatest opportunity for innovations exists.

– Vehicles will be more connected in the future and will need to communicate more to increase their safety, reduce energy consumption and improve comfort. There are great challenges in handling the complexity in all these systems, not least within the test area which has to meet the requirements where functional safety has the highest priority and the software has to be



continually updated, says Johan Haraldsson.

Now he would like to inspire more people in his work group to do the software test course, since this knowledge is exactly in line with what they are working with at the moment. He himself intends to continue educating himself in PROMPT during the next semester as well.

– There are several areas that interest me. I also hope that the range of courses increases. For example I would really like to go on a course with a specialisation in architecture and design. ■

Text: Carina H Ahnstedt



**The software testing team at Mälardalen University: Adnan Causevic, Daniel Sundmark and Eduard Enoiu.**

# Agile and lean with focus on customer needs

**Liselott Kronquist has many years of experience in the software industry. She has become more and more interested in agile processes and the PROMPT course Agile and Lean Development of Software-Intensive Products fits well into her plans for the future. Johanna Torstensson works with requirements analysis at Telenor. She has received concrete tools to streamline and further develop the development processes in which customer needs are always in focus.**

**L**iselott Kronquist is a consultant specializing in test automation. She uses part of what she learned at the PROMPT course “Agile and lean” in her current position at WirelessCar, part of Volvo IT. She also aims to eventually earn her Agile Practitioner certification.



**Liselott Kronquist**  
Test automation consultant

Liselott was on a leave of absence during the training and took four courses simultaneously. The concept of online learning suits her well.

– It is convenient to be able to be in control of how you use your time. The Agile and Lean course is well structured. The assignments were challenging but not impossible, says Liselott Kronquist.

The students use development processes from their workplaces and implement different agile methods. Liselott who was on a leave of absence used the processes she previously carried out, particularly at Volvo Trucks.

– It gave me insight into how we could have solved the problems instead and what the results would have been, says Liselott Kronquist.

Johanna Torstensson chose an ongoing development process in an agile team at Telenor.

– The colleagues were inspired by what I was able to add and the agile work was further developed. I had very useful exchanges with our course instructors, they were very experienced and competent, says Johanna Torstensson.

Both Liselott Kronquist and Johanna Torstensson appreciate the depth that a longer course provides compared to shorter ones.

– The literature and assignments gave insights in different ways and it was rewarding to process them on a deeper level, says Liselott Kronquist.

– The structure and content suited both me and Telenor. A great benefit was that I got to use my new knowledge in a known context. It provides a sustainable learning for me and is creating a learning at my workplace when I get the opportunity to share and reflect with my colleagues, says Johanna Torstensson.

Johanna Torstensson believes that the course is very timely. Every company needs to work smarter and more effectively.



**Johanna Torstensson**  
Requirements analyst at Telenor

– I have learned to visualize what is important and unnecessary steps in the development process, while ensuring high quality and measuring effectiveness in a good way, says Johanna Torstensson.



Blekinge Institute of Technology, campus in Karlskrona.

“We are working on solutions to make our customers’ digital life easier and more fun”

*Johanna Torstensson, Telenor*

The structure of the course is clearly tailored for working professionals. Each part deals with an agile method and the objective is such that each student can determine what needs to be done in collaboration with the instructor.

What both Liselott and Johanna think could be improved is the dialogue and exchange between students. The available web forum was not utilized to any significant extent.

– It would be good to have an introduction and put a face to the

names of the other students. Maybe it could lower the threshold and increase the networking in the forum. I would also have liked to have had guidelines for when each agile method is most appropriate and ideas for scalability. It would have been useful, says Johanna Torstensson.

Johanna Torstensson has great use for her new, in-depth knowledge in her daily work at Telenor. With agile development methods the development process retains the connection

with user needs and the solution becomes more customer centric.

– We are working on solutions to make our customers’ digital life easier and more fun. The course has given me tools to maintain focus on customer requirements throughout the development process, which in turn allows us to offer services that truly creates value for the customer, says Johanna Torstensson. ■

Text: Gunnel E Vidén

**On the PROMPT website you will find more information about the courses and contact information to teachers.**

#### **Prerequisites**

PROMPT courses are developed to suit professionals. The courses require professional experience of software development, either as an entry requirement or to get priority in the selection process. You state this by sending in a proof of your professional experience together with your academic merits when applying for a course. You find more information on the website **[promptedu.se](http://promptedu.se)**.

#### **Application and more information**

All courses are not given all semesters, please visit the website **[promptedu.se](http://promptedu.se)** for more information about the courses and up-dates on course instances. Apply to the courses [antagning.se](http://antagning.se).

#### **About credits**

1.5 credit corresponds to 40 hours of studies. A course of 7.5 credits corresponds to 200 hours of studies. PROMPT courses are normally run at a pace of 25%, which means that a course of 7.5 credits or 200 hours is run over a full semester.

# Professional Master in Software Engineering

## Courses

|  |       |
|--|-------|
| <b>Processes and methods for development of software intensive systems</b> .....                   | 22-23 |
| Agile and lean development of software intensive products, 7.5 credits .....                       | 22    |
| Evidence-based process improvement, 7.5 credits .....  | 22    |
| Continuous requirements engineering and product management, 7.5 credits.....                       | 22    |
| Distributed development and outsourcing, 2.5 credits .....   | 23    |
| Behavioral Software Engineering, 5 credits.....  | 23    |
| Model-based development: Theory and practice (MBD-TP), 7.5 credits.....                            | 23    |
| <b>Software test</b> .....   | 24-25 |
| Quality assurance – The applied science of software testing, 7.5 credits.....                      | 24    |
| Adaptive lean software testing, 7.5 credits.....   | 24    |
| Large-scale software testing, 2.5 credits .....  | 24    |
| Quality assurance – Regression testing and fault prediction, 2.5 credits.....                      | 25    |
| Quality assurance – Catching bugs by formal verification, 7.5 credits.....                         | 25    |
| Quality assurance – Model based testing in practice, 2.5 credits .....                             | 25    |
| <b>Dependable software</b> .....   | 26-27 |
| Quality assurance – Certification of safety-critical (software) systems, 7.5 credits .....         | 26    |
| Safety critical software, 6 credits .....  | 26    |
| Design of dependable and fault-tolerant embedded systems, 7.5 credits .....                        | 27    |
| Applied cybersecurity, 5 credits .....   | 27    |
| <b>Architecture and design</b> .....   | 28    |
| Advanced software architecture, 7.5 credits .....  | 28    |
| Usability and user experience, 7.5 credits.....  | 28    |
| <b>Big Data</b> .....  | 29    |
| Applied Cloud Computing and Big Data, 7.5 credits.....   | 29    |
| Machine Learning With Big Data, 7.5 credits.....   | 29    |
| <b>Project courses</b> .....   | 30    |
| Science, research methods and scientific papers, with focus on computer science, 7.5 credits ..... | 30    |
| Industrial Software Development, 7.5 credits .....   | 30    |



Torbjörn  
Fridensköld

### Agile and lean development of software intensive products, 7.5 credits

The course gives an overall perspective of agile and lean development in a software-developing organization. Agile methods in project organisations constitute only one step towards the realization of an adaptable, quick and efficient product development organization. By adapting lean principles (the origin of agile methods) in the entire product development chain, from product management and requirements engineering to delivery and support, true flexibility and efficiency can be achieved without sub-optimization.

**Responsible for the course:** Torbjörn Fridensköld, Blekinge Institute of Technology.

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Nauman Ghazi

### Evidence-based process improvement, 7.5 credits

The purpose of the course is to provide an evidence-based perspective on change management in the industry with a focus on processes and quality in software development organizations. The course provides knowledge about quality work at the organizational level as well as insight into the typical barriers to improvement work at a technical and non-technical level. The course introducing methods and tools for measuring, evaluation and feedback processes and process improvements.

**Responsible for the course:** Nauman Ghazi, Blekinge Institute of Technology.

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Richard Berntsson  
Svensson

### Continuous requirements engineering and product management, 7.5 credits

The course focuses on the problems that arise when managing requirements in a changing and cost sensitive reality. The course discusses challenges related to large scale requirements engineering and market-driven requirements engineering. Areas such as continuous requirements engineering, requirements engineering process improvement, quality requirements, value, and technical product management are discussed and related to industry practice.

**Responsible for the course:** Richard Berntsson Svensson, Blekinge Institute of Technology.



## Processes and methods for development of software intensive systems



Darja Smite

### Distributed development and outsourcing, 2.5 credits

This course focuses on distributed projects and work in distributed teams, in which software development activities are carried out in multiple locations, and often in different countries. The overall goal of this course is to equip software professionals taking the course with the knowledge of fundamental differences of distributed projects, including outsourcing, in comparison with collocated development and skills necessary to overcome the associated challenges. The course will highlight state-of-the-art knowledge in the area and focus on industrial case studies as a source for reflection and learning.

**Responsible for the course:** Darja Smite, Blekinge Institute of Technology.

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Fabian Fagerholm

### Behavioral Software Engineering, 5 credits

Behavioural Software Engineering aims to provide understanding and knowledge that it is the people involved in software development who are key to ensuring the success of a project. People are not always rational, but rather imperfect. They act in group and organisational environments in which group norms, personal motivation, subconscious biases, emotions, and politics affect choices and actions. Better understanding of human nature contributes to the organisation so it can help individuals to better fulfil needs, utilise strengths, improve experience at work, foster creativity, and increase chances of success with the development work.

**Responsible for the course:** Fabian Fagerholm, Blekinge Institute of Technology.

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Antonio Cicchetti

### Model-based development: Theory and practice (MBD-TP), 7.5 credits

The purpose of the course is to provide participants with the principles behind model-driven development of software systems and the application of such a methodology in practice. Modelling is an effective solution to reduce problem complexity and, as a consequence, to enhance time-to-market and properties of the final product.

**Responsible for the course:** Antonio Cicchetti, Mälardalen University.



Adnan Causevic

### Quality assurance – The applied science of software testing, 7.5 credits

This course provides an understanding of the fundamental problems in software testing, as well as solid foundation in the practical methods and tools for a systematic state-of-the-art approach to testing of software. After the course, the participants are expected to understand the fundamental goals, challenges and limitations of software testing, and its relation to other software engineering activities, such as requirements engineering, design and implementation.

**Responsible for the course:** Adnan Causevic, Mälardalen University.

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Emil Alégroth

### Adaptive lean software testing, 7.5 credits

The course provides practical experience of industry relevant and modern software testing techniques and tools. It will give a thorough understanding how testing must be handled to be an integrated part of the organization's software engineering processes, to deliver a high quality software and to eliminate unnecessary waste in an efficient way.

**Responsible for the course:** Emil Alégroth, Blekinge Institute of Technology.

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Emil Alégroth

### Large-scale software testing, 2.5 credits

Modern software systems are often large scale, and therefore challenging to test. The scale can have different forms: the size, complexity and the amount of configurations of the software that shall be tested; the amount of hardware platforms on which the software shall be tested; or the magnitude of the testing which increases in different environments, for example when the test process have been distributed to a larger system to deliver quality in an effective way. This course gives practical methods and knowledge to address these challenges and to increase the quality for large scale software.

**Responsible for the course:** Emil Alégroth, Blekinge Institute of Technology.



## Software test



Wasif Afzal

### Quality assurance – Regression testing and fault prediction, 2.5 credits

Changes to software under test are unavoidable. Such changes and their side effects must be well tested, without re-running all tests. Moreover, in general, testing cost is well known, therefore faults must be detected early by focusing testing efforts on fault-prone parts. The participants in the course will learn about regression test selection and software fault prediction techniques. Effective regression test selection techniques will reduce cost of implementing modifications to software under test. Software fault prediction part of the course is about focusing test efforts on more fault-prone parts of the software where maximum return on investing test resources can be achieved. Overall, this course is about using techniques that make software testing more efficient and effective.

**Responsible for the course:** Wasif Afzal, Mälardalen University.

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Cristina Seceleanu

### Quality assurance – Catching bugs by formal verification, 7.5 credits

The aim of the course is to introduce the participants into methods and tools for verifying systems that need to react to external stimuli. The methods use system models with precise formal semantics and will span model-checking as well as deductive verification. A set of simple examples as well as real-world applications will be used throughout the course to illustrate the methods and their tool support. The objective of the course is to understand the underpinning theories of formal verification, and learn how to apply tool support in order to verify system models.

**Responsible for the course:** Cristina Seceleanu, Mälardalen University.

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Eduard Enoiu



Daniel Sundmark

### Quality assurance – Model based testing in practice, 2.5 credits

Model-based testing is a systematic method to automatically generate test cases from models of system requirements. It allows you to evaluate requirements, create a model and generate automatically test cases. After this course you should be able to have knowledge about writing requirements and use these to create models for software testing. You will develop practical skills and abilities on applying model-based testing in industrial practice. You will learn how to use different kinds of modeling techniques. You will be able to use this new knowledge to design requirement models and automate test cases during unit and integration testing. In addition, as a test practitioner you will learn how to design test cases using models at system level.

**Responsible for the course:** Eduard Enoiu, Daniel Sundmark, Mälardalen University.



Barbara Gallina

### Quality assurance – Certification of safety-critical (software) systems, 7.5 credits

The aim of this course is to give students insight about certification and about what it means to certify/self-assess safety-critical systems with focus on software system and to create a safety case, including a multi-concern perspective when needed and reuse opportunities, when appropriate.

**Responsible for the course:** Barbara Gallina, Mälardalen University.



Kaj Hänninen



Kristina Lundqvist

### Safety critical software, 6 credits

Software is nowadays used to realize advanced functionality in different types of systems. One of the main issues that industries face today is to develop advanced software-based systems and to assure that the systems are safe to use. In this course the students will be introduced to functional safety. The course will give an overview of selected methods for safety assurance of critical software focusing on activities related to safety analysis, architectures, verification and validation. After course completion the students will be well aware of key issues and methods used for development of safety-critical software. Students will also have acquired an ability to adopt the scientific advances within the areas. Basic knowledge of functional safety will make the student more attractive on the global job market.

**Responsible for the course:** Kaj Hänninen, Kristina Lundqvist, Mälardalen University.



## Dependable software



Guillermo  
Rodriguez-Navas

### Design of dependable and fault-tolerant embedded systems, 7.5 credits

The purpose of the course is to provide participants with the fundamental principles of dependability and fault tolerance, as well as with the main practical methods and strategies for design of fault-tolerant embedded systems. After the course students will be able to develop fault-tolerant software according to current methodologies and have knowledge about existing fault-tolerant architectures

**Responsible for the course:** Guillermo Rodriguez-Navas, Mälardalen University.



Daniel Hedin

### Applied cybersecurity, 5 credits

The web is emerging as a powerful application platform. While bringing unparalleled possibilities for collaboration unhampered by physical location or device choice, the distributed, always-online nature of a web application leaves it open for attack. Using the most common web application and web service vulnerabilities as the setting, this course teaches how to identify, analyze and protect against attacks. Many of the attacks discussed in the course are instances of universal attack classes, where other instances have similar attack vectors and protection mechanisms.

**Responsible for the course:** Daniel Hedin, Mälardalen University.



**Riccardo  
Scandariato**

### Advanced software architecture, 7.5 credits

The purpose of the course is to present the most industry-relevant techniques in the area of architectural design and provide the means to document software architectures with standards like UML. The course also provides the participants with the necessary knowledge to reduce the technical debt in the software development projects they work on. Moreover, the course has a hands-on approach, which translates into actionable know-how that is relevant to the professional practice of software design.

**Responsible for the course:** Riccardo Scandariato, Chalmers and University of Gothenburg.



**Rikard Lindell**

### Usability and user experience, 7.5 credits

The course provides an opportunity to develop skill in experience design and design thinking as well as techniques and methods to design digital artifacts with desirable experiential qualities. This course focuses on the design process, design theory, and techniques and methods to design and produce digital artifacts with desirable experiential qualities.

**Responsible for the course:** Rikard Lindell, Jarmo Laaksolahti, Mälardalen University and RISE SICS.



**Jarmo Laaksolahti**



Mikael Svahnberg

## Applied Cloud Computing and Big Data, 7.5 credits

In today's mobile and connected world large amounts of data are created that need to be managed, analysed, and linked. This is done on a large number of servers in the so called Cloud. The development, deployment, and management of these servers is called Cloud Computing. The purpose of this course is to give a broad background about the design, development, deployment, testing, and the monitoring of a cloud solution with a specific focus on large sets of data.

**Responsible for the course:** Mikael Svahnberg, Blekinge Institute of Technology.



Shahina Begum

## Machine Learning With Big Data, 7.5 credits

The rapid development of digital technologies and advances in communications have led to gigantic amounts of data with complex structures called 'Big data' being produced every day at exponential growth. The course addresses fundamental concepts of machine learning with big data as well as recent research trends in the domain. It gives an understanding of problems and industrial challenges through domain-based case studies and provides basic knowledge to use tools to develop systems using machine-learning algorithms.

**Responsible:** Shahina Begum, Mälardalen University.



## Project courses



Jan Gustafsson

### Science, research methods and scientific papers, with focus on computer science, 7.5 credits

The purpose of the course is to raise the students' scientific awareness and knowledge of methods used in computer science research. The course introduces students to basic concepts in the philosophy of science, and gives an overview of different research methods in science and technology, especially those in computer science. A central part of the course handles scientific writing. Important skills like searching for sources, writing, reviewing, presenting, and opposing scientific papers are trained. Students will write an own paper, connecting their everyday work with relevant issues in science and research, thereby improving their scientific awareness, knowledge and skill.

**Responsible for the course:** Jan Gustafsson, Mälardalen University.



Petra Edoff

### Industrial Software Development, 7.5 credits

The purpose of the course is that students will develop and expand their knowledge of processes, methods and techniques in computer science. The course will provide knowledge of how to plan, carry out and present an independent improvement work related to their own company's problem and project model in software engineering. This course is suitable for people working in the development of complex technical systems where software plays a key role and are interested in learning more on how to run change projects in their organization.

**Responsible for the course:** Petra Edoff, Mehrdad Saadatmand, Mälardalen University and RISE SICS.



Mehrdad  
Saadatmand

# >PROMPT Steering Committee



Hans Hansson, professor Mälardalen University • Sverker Jansson, Director, computer systems laboratory, RISE SICS • Sigrid Eldh, Senior Specialist in Software Test Technology at Ericsson • Claes Wohlin, Professor, Blekinge Institute of Technology • Fredrik Ågren, Manager Software Engineering, SAAB Electronic Defence Systems • Magnus Billgren, CEO, Tolpagorni • Andreas Hjertström, Chief Project Manager, Advanced Engineering Planning, Funding and Project Management, Volvo Construction Equipment • Peter Gustafsson, Pro-Dean for education at Mälardalen University • Miroslaw Staron, Chalmers and University of Gothenburg



## Joint forces for competence development:



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