A General Instruction for All Assignments: Please respect that all the assignments, except INL0, are group assignments. We do not have the possibility of marking individual assignments since it goes against the learning objectives of the course.

1 INL0: Plagiarism Risk Awareness Reading (0 ECTS)

Please listen and watch the videos at the following links:
`https://www.youtube.com/watch?v=2q0NlWcTq1Y`
`https://www.youtube.com/watch?v=rwOJvWhF_08`

And read the text at the following links:
`https://wts.indiana.edu/writing-guides/pdf/plagiarism.pdf`
`https://mdh.se/student/stod-studier/regler-rattigheter/regler-kring-fusk`

Once you have read, understood and watched the above text and videos, email: wasif.afzal@mdh.se saying so, by 07-September-2018, 23:59.

2 INL1: Formulation of Research Questions and Selection of a Research Method (1 ECTS)

The purpose of this assignment is to practice formulation of research questions and to select an appropriate research method. You are required to formulate research questions for given scenarios and to select a suitable research method. You are also required to provide a justification of your selection of a particular research method. This is a group assignment of two students.

For each scenario, report the following:

- Research questions: Formulate research questions or hypotheses for each of the given scenarios.
- Research methodology: Select an appropriate research methodology on the basis of your research questions or hypotheses.
- Justification: Provide arguments in favour of your selected research method. Also provide justification against other research methods that were not selected or any alternative research methods that could have been used.
- Assumptions (if any): For missing information in the scenario that is necessary for you to define an objective, answerable and focused research question, then please make reasonable assumptions and document them under this heading.

2.1 Scenarios

Following are the three scenarios:

2.1.1 Scenario 1

A development manager in a software development company has recently heard about the benefits of test-driven development (TDD). He thinks that writing test cases before implementation will improve the quality of the software they write. You (as a researcher) have been asked to evaluate whether TDD is better than the current way of working, i.e. test last development (TLD).

2.1.2 Scenario 2

Assume that investigation from Scenario 1 showed that TDD does indeed improve the quality of code significantly. Now the manager is additionally interested in knowing the preference of developers regarding TDD and TLD. Also, it will be significantly useful to know what are the major reservations regarding the new way of working. This would help to decide whether to adopt the change or not and how to facilitate the adoption.

2.1.3 Scenario 3

A manager in a company that you collaborate with is interested in investigating the performance of their current agile development process. Her aim is to understand the actual process (and not the prescribed process in the corporate guidelines), what are the main challenges and improvement opportunities with regard to the development process at the company. You are tasked to conduct this investigation using a scientifically rigorous approach.

2.2 Reading Instructions

- Chapter 3 of C. Robson's Real World Research, 3rd Edition or Chapter 3 of C. Roson & K. McCartan's Real World Research, 4th Edition.
- S. Easterbrook, J. Singer, M-A. Storey, and D. Damian. Selecting empirical methods for software engineering research. In Guide to advanced empirical software engineering, pages 285–311. Springer, 2008.
- Prof. Feldt's advice on formulating research questions: `http://robertfeldt.net/advice/guide_to_creating_research_questions.pdf`
- George Mason University's writing guide: `https://writingcenter.gmu.edu/guides/how-to-write-a-research-question`

3 INL2.1: Critical Appraisal of Assigned Research Papers According to Established Guidelines (1.5 ECTS)

In INL2.1, your task (in a group of two students) is to evaluate two studies for scientific rigor (according to established guidelines) and their conformance to ethical research guidelines.

The purpose of this assignment is to let you familiarize with guidelines for reporting and conducting experiments and case studies. Another purpose is to develop your skills in critical appraisal with the help of guidelines and checklists.

3.1 Reading instructions

Read the following guidelines for conducting/reporting/reviewing experiments and case study research, along with ethical considerations. Use the guidelines to thoroughly review the studies assigned to your group using the provided template.

- Experimentation
  - Jedlitschka, Andreas, Marcus Ciolkowski, and Dietmar Pfahl. Reporting experiments in software engineering. Guide to advanced empirical software engineering. Springer London, 2008. 201–228.
  - Chapter 2 and 6 of Wohlin et al. Experimentation in software engineering. Springer Science & Business Media, 2012.
- Case study research
  - Runeson, Per, and Martin Höst. Guidelines for conducting and reporting case study research in software engineering. Empirical software engineering 14.2 (2009): 131–164.
- Ethics
  - Chapter 2, Section 2.11 of Wohlin et al. Experimentation in software engineering. Springer Science & Business Media, 2012.
  - Section 3.3, Runeson, Per, and Martin Höst. Guidelines for conducting and reporting case study research in software engineering. Empirical software engineering14.2 (2009): 131–164.

4 INL2.2: Data Analysis (1.5 ECTS)

The purpose of this assignment is to exercise your data analysis skills. In a group of two students, you are required to analyze the given datasets of scenarios and answer the stated questions.

4.1 Scenario 1 (Quantitative data)

Use of Integrated Development Environments (IDE) is known to improve the efficiency of developers. We are interested to investigate which of the two famous IDEs (*IDE-A* or *IDE-B*) improves efficiency of programmers. We have designed an experiment to evaluate the two alternatives. As shown in Tables 1 & 2, we have assigned 10 developers to independently develop programs Prog-1 and Prog-2 using *IDE-A* or *IDE-B*.

Table 1: Experiment design, assigning treatments, objects and subjects

Programmers	Using IDE-A	Using IDE-B
1	Prog-1	Prog-2
2	Prog-2	Prog-1
3	Prog-1	Prog-2
4	Prog-1	Prog-2
5	Prog-2	Prog-1
6	Prog-2	Prog-1
7	Prog-1	Prog-2
8	Prog-2	Prog-1
9	Prog-1	Prog-2
10	Prog-2	Prog-1

Table 2: Data from the experiment

Programmer	Time (in minutes) to develop Prog-1	Time (in minutes) to develop Prog-2
1	104	71.3
2	102	110
3	159	178
4	168	153
5	150	120
6	151	174
7	111	94.9
8	105	86.1
9	137	115
10	124	175

4.1.1 Questions on Scenario 1

Answer the following questions:

1. What are the objects, subjects, treatment and factors in this experiment?
2. How would you describe this in terms of a standard design type e.g. one factor, two treatments?
3. In Table 2, why are five programmers using IDE-A to develop program Prog-1 first and then developing Prog-2 using IDE-B, while the remaining five programmers will use IDE-A to develop program Prog-2 first and then use IDE-B to program Prog-1? i.e. what is the benefit of this design?
4. Why is it important to assume that Prog-1 and Prog-2 are different, but still equally complex/hard to develop? What are the implications on the design and conclusions of the study if this is not true?

Answer the following questions related to analysis:

1. State the null and alternative hypothesis for this investigation.
2. Use descriptive statistics and visualize the data in Table 2 (use e.g. box plot, histograms and scatter plot). Which visualization tool helped you develop some insights into the data? What were the insights e.g. interesting patterns or trends in the data, a clear difference in efficiency between two IDEs, outliers. How will you group the data for these visualizations?
3. Choose and justify your choice of a parametric/non-parametric choice for analyzing the given data (document the steps you undertook and the results).
4. Run the statistical method and report if you can reject the null hypothesis? Please interpret your results, what does this imply for the objective of the study?
5. Based on the results would you be confident to recommend an IDE either IDE-A or IDE-B for use in your company. Why or why not?

4.2 Scenario 2 (Qualitative data)

We are about to engage in our first research collaboration with a company. Therefore, we want to learn from the experience of other researchers who have collaborated with industry. For this purpose, we have identified the following three papers reporting experience and lessons learned regarding collaboration with industry.

- Runeson, Per. It Takes Two to Tango An Experience Report on Industry-Academia Collaboration. 2012 IEEE Fifth International Conference on Software Testing, Verification and Validation. IEEE, 2012.

- Martinez-Fernandez, Silverio, and Helena Martins Marques. Practical experiences in designing and conducting empirical studies in industry-academia collaboration. Proceedings of the 2nd International Workshop on Conducting Empirical Studies in Industry. ACM, 2014.
- Gorschek, Tony, et al. A model for technology transfer in practice. IEEE software 23.6 (2006): 88–95.

Now we want to analyze these individual reports and aggregate the findings related to the following:

1. Challenges/impediments in industry-academia collaboration
2. Patterns (best practices) that lead to successful industry-academia collaboration
3. Anti-patterns (practices to avoid) that should be avoided in industry-academia collaboration

4.2.1 Questions on Scenario 2

- Describe the approach that you will follow to analyze the given data (i.e. the three papers). Please read Chapter 18 of the reference book [1] or chapter 17 of the reference book [2] to make an informed decision about your approach and the steps you take. For example, the analysis approach you will use (a. Quasi-statistical approach, b. thematic coding approach or c. grounded theory approach). Also describe your mechanism for coding the data. Also explain why you chose the approach over other alternatives.
- Please describe the coding procedure that you followed. For each step, please provide an example of how you coded the information in the papers.
- Answer the following questions by citing examples from your analysis of the three studies:
    1. Which challenges or impediments for industry-academia collaborations have been raised by the papers?
    2. What patterns have been proposed for industry-academia collaborations?
    3. What should be avoided during industry-academia collaborations?

5 INL3: Research Proposal and Study Design (3.5 ECTS)

The purpose of this assignment is to let you experience the initiation, planning and design phases of a research project (such as your final year thesis project). In this assignment, you (as a group of four students) will pick a topic/area of your interest, justify why the topic is worthy of a scientific investigation, define and further refine the scope of the study by finding relevant research on the topic. You have to refine your research questions and develop a project plan with the scope and time-line of a *masters thesis* in mind. The following are the main tasks in this assignment:

1. Choose and justify a topic for research
2. Formulate research questions
3. Review the related work
4. Identify the gaps in existing work and revise your research questions
5. Highlight what will be your research contribution with reference to identified gaps
6. Choose and justify your choice of research methods to answer your research questions
7. Prepare a study design to operationalize your chosen research, data collection and analysis method.
8. Prepare a project plan for the study
9. Document the above activities in a research proposal

Your research proposal should have the following sections:

5.1 Introduction, aims, objectives, research questions/hypotheses

- What is the problem/ theoretical aspect that you want to investigate?
- Who are the stakeholders?
- What is the context of the problem?
- Why is the problem urgent and relevant to address?
- Describe the aim and purpose of this research study.
- Describe the likely implications of the investigation from a research, industrial and/or societal perspective.
- Broadly describe the actions that will be taken to achieve the objectives of the study.

- Formulate research questions with the following in mind:

    1. The scope of the investigation should be practical, given the duration of a Master thesis project i.e. approx 17 weeks for conducting and reporting research.
    2. The effort required to undertake the research project should also be something within the scope of a master thesis i.e. 30 ECTS.

5.2 Related work

Present an overview of current research in the field (properly reference cited papers), identify a knowledge gap (such that you need to undertake a primary study.

5.3 Research Methodology

You shall select a suitable research methodology, describe how it will be used in this specific case, and present an argument why this research methodology is suitable for your research project. Compare your chosen method to at least one other relevant research method.

Detailed study design: Depending on the chosen research method, use appropriate guidelines to help you in designing and documenting critical aspects of study design.

- Experimentation
    - Chap. 8 titled: Reporting experiments in software engineering [3].
    - Chapters 2 and 6 [4].
- Case study research
    - Guidelines for conducting and reporting case study research [5]. Use in particular their checklist to reflect on your design.
- Simulation
    - de Franca and Travassos's planning and reporting guidelines [6].
- Surveys
    - Section 8.4 of Wohlin et al.'s experimentation book [4].
    - Chap. 11 titled Surveys and questionnaires in [1] or chap. 10 titled surveys and questionnaires in [2].
    - Chap. 3 titled Personal Opinion Surveys [3].

For ethical considerations,

- Chap. 2, Section 2.11 [4].

- Section 3.3 of Runeson et al.'s guidelines [5].
- Chap. 10, titled Ethical and political considerations in [1] or chap. 09, titled Ethical and political considerations in [2].

For example, the design for an experiment would include objects, subjects, treatments, assignment of treatments, objects and subjects.

Describe the objects their attributes of interest. What motivated the choice of these objects?

For surveys, whether you will use online questionnaires, structured/semi-structured/unstructured inter- views. Why? Also develop the questions in your survey and map them to the research questions?

What are the dependent and independent variables? What attributes and measures will be used?

Describe the population for your study.

Sampling strategy for selecting participants/subjects: why is the chosen approach most appropriate for your study?

You shall define how you expect to analyse the results of your research project. You shall present a clear argument why this analysis method is the most suitable for your particular research project and research methodology. Present the steps that will be taken to analyze the data. Create tables with mock data to illustrate your approach. Within this section, you shall also describe validity threats, and what you intend to do to mitigate the threats.

5.4 Expected outcomes

The expected results/ outcomes that are relevant and potential stakeholders that could be interested in those need to be indicated.

5.5 Time and activity plan

Realistic WBS, schedule, and expectations about required resources. Identify the most relevant and important risks. Ignores irrelevant risks. Meaningful impact analysis and mitigation strategy/plan.

5.6 Risk Management

Make sure to think about non-trivial risks. For example, what if you do not get enough respondents in the survey. Ignore irrelevant risks. Meaningful impact analysis and mitigation strategy/plan.

5.7 References

Properly reference and document all sources used in the proposal, please use consistent formatting throughout the reference list.

6 Deadlines and re-examinations

Regular submission dates for mandatory assignments:

- INL0: 23:59, 07-09-2018
- INL1: 23:59, 17-09-2018
- INL2.1: 23:59, 10-10-2018
- INL2.2: 23:59, 15-10-2018
- INL3: 23:59, 01-11-2018

  First resubmissions (for assignments INL1, 2.1, 2.2 & 3): 23:59, 06-11-2018
  Second resubmissions: 23:59, 15-12-2018

References

[1] C. Robson and K. McCartan, *Real World Research*, 4th ed. Wiley, 2015.

[2] C. Robson, *Real World Research*, 3rd ed. Wiley, 2013.

[3] F. Shull, J. Singer, and D. I. Sjøberg, *Guide to Advanced Empirical Software Engineering*. Secaucus, NJ, USA: Springer-Verlag New York, Inc., 2007.

[4] C. Wohlin, P. Runeson, M. Hst, M. C. Ohlsson, B. Regnell, and A. Wessln, *Experimentation in Software Engineering*. Springer Publishing Company, Incorporated, 2012.

[5] P. Runeson and M. Höst, "Guidelines for conducting and reporting case study research in software engineering," *Empirical Software Engineering*, vol. 14, no. 2, p. 131, 2008.

[6] B. B. França and G. H. Travassos, "Experimentation with dynamic simulation models in software engineering: Planning and reporting guidelines," *Empirical Softw. Engg.*, vol. 21, no. 3, pp. 1302–1345, Jun. 2016. [Online]. Available: http://dx.doi.org/10.1007/s10664-015-9386-4