

EXAMINATIONS – 2016
TRIMESTER 1

SWEN 423
OBJECT-ORIENTED
PARADIGMS

Time Allowed: THREE HOURS

OPEN BOOK

Permitted materials: Any materials except electronic devices may be brought into the examination.

Instructions:

Answer all questions

This examination will be marked out of **180** marks.

Read each question carefully before attempting it.

You may answer the questions in any order. Make sure you clearly identify the question you are answering.

Many of the questions require you to discuss an issue, or to express and justify an opinion. Be careful in how you answer: it is important to both show that you *understand* the topic but also that you can *explain* it properly *using accurate terminology*. Your answers need only refer to the topic discussed in the course, but you may refer to other topics if you wish.

Question	Topic	Marks
1.	Frameworks	45
2.	Mirrors	20
3.	Strong exception safety	25
4.	Pure object orientation	45
5.	This	45
Total		180

Question 1. Frameworks

[45 marks]

- (a) [15 marks] What is the the difference between frameworks (like, for example, Swing) and other libraries (like, for example, `java.lang.Math`).
- (b) [15 marks] Explain how subtyping supports frameworks, and write a 5 to 20 line code example showing the usefulness of subtyping in frameworks.
- (c) [15 marks] Explain how subclassing/inheritance support frameworks and write a 5 to 20 line code example showing the usefulness of subclassing/inheritance in frameworks.

Question 2. Mirrors

[20 marks]

With respect to the paper “Mirrors”:

- (a) [5 marks] What is the difference between the mirror design described in the paper and the Java approach to the same problem?
- (b) [10 marks] Write a 2 to 20 line code example in Java/pseudocode showing the original Java approach, and a 2 to 20 line code example in pseudocode showing the Mirrors approach.
- (c) [5 marks] Discuss the differences.

Question 3. Strong exception safety

[25 marks]

With respect to the paper “Strong exception safety”:

- (a) [20 marks] What is this approach aiming to avoid? Describe informally how the type system can prevent it.
- (b) [5 marks] Inspired by the paper “Strong exception safety”, can you suggest other kinds of typical programming errors that can be prevented by type systems?

Question 4. Pure object orientation

[45 marks]

- (a) [15 marks] Explain the concept of closures in Smalltalk, Newspeak and JavaScript. Write a short 5-20 line code example showing how closures are useful in real programming.
- (b) [15 marks] Smalltalk/Newspeak define Booleans and conditionals (if-then-else) in the language. Write an implementation of True, False, ifThen and ifThenElse in a pseudocode of your choice. Hint: I would suggest pseudo-JavaScript.
- (c) [15 marks] HARD: Discuss the most important differences between Newspeak and Smalltalk.

Question 5. This

[45 marks]

- (a) [10 marks] Explain the **this** typing problem and how it forces subclassing/inheritance to include subtyping in many OO languages like Java/C++/C#.
- (b) [20 marks] We have seen many approaches trying to solve this problem: to allow inheritance without subtyping. For each of the approaches that you can recall, write their name, a short description of how they solve this problem, and a 5 to 20 line code example showing how they deal with **this** typing.
- (c) [15 marks] HARD: Draw a connection between the **this** typing problem and family polymorphism typing problems.

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