

Exam *Generic Language Thechnology* (2IS15) 20th of January 2014, 14:00-17:00.

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This exam consists of 4 questions.

*You are allowed to use all distributed material, slides, books, papers, and laptop.*

*You need to give a concise motivation for all the answers.*

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## 1. Basic technology

- (a) Eclipse can be considered as a syntax-based language workbench. What is meant by a "syntax-based" language workbench? What is meant by a "semantics-based" language workbench? Does Epsilon provide sufficient ingredients to transform a "syntax-based" language workbench into a "semantics-based" language workbench? Motivate your answer.
- (b) Give an example of a "computer science" domain-specific language and a "non-computer science" domain-specific language. Is the latter "non-computer science" because it can not be executed? Motivate your answer.
- (c) What happens when a DFA is minimized? Is the resulting DFA more efficient with respect to scanning the input?
- (d) When is it necessary to transform an ambiguous grammar into a non-ambiguous grammar? What kind of technique can you use to transform the ambiguous grammar into a non-ambiguous one?
- (e) Given the following grammar  $G$

$S ::= A a A b$

$S ::= B b B a$

$A ::=$

$B ::=$

Calculate the first and follow sets for grammar  $G$ . Is this grammar LL(1)? Is this grammar SLR(1)? Please motivate your answer.

## 2. Grammar and syntax

- (a) Libraries, for instance the Java Swing library, may be considered as a very basic form of DSLs, why? Motivate your answer. What is needed to promote a library to an embedded DSL?

(b) A meta-model can be expressed in a metameta-model in *modelware*, what is the equivalent mechanism in *grammarware*? Illustrate this.

(c) Give the Xtext grammar for the following grammar:

```
E ::= E + E |  
    - E |  
    ( E ) |  
    N
```

Please indicate explicitly what the priorities of these operators (the priorities should all be different) and associativity you assume.

(d) What is the relationship between a model and a meta-model? A meta-model is more powerful/expressive than a signature, in what respect? Illustrate by means of an example.

(e) SDF and LEX both allow the definition of lexical syntax. Give an example of, for instance, the definition of identifiers in both formalisms. In which aspects do both formalisms differ with respect to the definition of lexical syntax?

### 3. Transformations

(a) Give an Ecore meta-model to represent two-dimensional coordinates. Give an example of an endogenous model transformation for this meta-model.

(b) Give the collection types of EOL. Which of these types of EOL would you use to represent a list of two-dimensional coordinates? Motivate your answer.

(c) Suppose that for generating code for the LegoMind robots speed is relevant. Write a simple ETL transformation that reads the speed, as user input, and checks whether the speed is non-zero.

(d) What is the shortcoming of a declarative transformation language? How is this solved in ETL?

### 4. Semantics

(a) What may be the consequence of not having an explicit type checker when developing a domain specific language?

(b) What is the advantage of having nested blocks in a domain specific language?

(c) What is meant by context-independent overloading? Why do you need overloading if you have inheritance?

(d) If you develop a code generator for a domain specific language to some general purpose language, for instance Java, you write down the dynamic semantics in a transformational way. Why may it not be sufficient to give a precise dynamic semantics for a domain specific language? Give two reasons.

### Grading of exercises

1	$a$	30	2	$a$	10	3	$a$	10	4	$a$	10
	$b$	30		$b$	20		$b$	10		$b$	10
	$c$	20		$c$	20		$c$	20		$c$	20
	$d$	20		$d$	20		$d$	10		$d$	20
	$e$	30		$e$	20						

The total score is 330 points, this will be divided by 33 to obtain the final mark for this exam. This final mark counts for 70% and the practical exercises count for 30%, both with a minimum of 5.5, for the total final mark of GLT.