

Exam *Generic Language Thechnology* (2IS15) 1st of February 2013, 14:00-17:00.

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This exam consists of 3 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) Why is Eclipse in combination with the EMF extension useful for generic language technology applications? Give at least one example.
- (b) Which of these languages  $L_0 = \{a^k b^l c^m \mid k, l, m > 0\}$ ,  $L_1 = \{a^k b^l c^k \mid k, l > 0\}$ , and  $L_2 = \{a^k b^k c^k \mid k > 0\}$  is context-free? Give a grammar for that can be used to recognize the context-free language(s).
- (c) Describe the steps needed to translate a regular expression into a minimal DFA. You may use an example for illustration.
- (d) What is meant by the lexical disambiguation rule "prefer keywords"? Give two alternatives for implementing this rule.
- (e) What is leftmost/rightmost derivation? Give a context-free grammar that produces exactly the same left and right most derivation.
- (f) Give the LL(1) property. Is the following grammar LL(1) or SLR(1)?  
 $S \rightarrow A \text{ "a" } A \text{ "b" } \mid B \text{ "b" } B \text{ "a"}$   
 $A \rightarrow \epsilon$   
 $B \rightarrow \epsilon$   
Motivate your answer.
- (g) Why is the closure computation needed when constructing (S)LR table?
- (h) What is a graph structured stack?

2. Grammar and syntax

- (a) Why is EMF more powerful with respect to defining the abstract syntax of a (programming) language than a signature based approach? Illustrate this by means of an example.
- (b) Does it make sense to have a metametameta-model? Motivate your answer.

- (c) Xtext and EMFText are both based on ANTLR. What are the consequences for both tools? Describe two aspects where Xtext and EMFText fundamentally differ?
- (d) What are the consequences of having a generalized parser for the formalism in which you write your context-free grammar? Use SDF as a source of inspiration.
- (e) What is the relation between the nonterminal in the left hand side and the nonterminals occurring in the right hand side in an Xtext production rule and the corresponding meta-model? Illustrate this by an example.
- (f) How do you deal with lists, for instance a list of Statements, in Xtext?

### 3. Semantics

- (a) Why is a block a syntactical notion and a scope a semantical notion? Illustrate this by means of an example.
- (b) What are the requirements for a DSL in order to ensure type checking at compile time?
- (c) Functions and procedures encapsulate operations, but have different effects. If you have to design a DSL would you include functions or procedures or both? Give a good motivation for your decision.
- (d) Why makes overloading the identification phase more complicated? Illustrate this by a concrete example.
- (e) Why is it necessary to have a precise definition of the dynamic semantics of a language? How can the dynamic semantics be defined?

### Grading of exercises

1	<i>a</i>	10		2	<i>a</i>	10		3	<i>a</i>	10	
	<i>b</i>	10			<i>b</i>	10			<i>b</i>	10	
	<i>c</i>	10			<i>c</i>	10			<i>c</i>	10	
	<i>d</i>	10			<i>d</i>	10			<i>d</i>	10	
	<i>e</i>	10			<i>e</i>	10			<i>e</i>	10	
	<i>f</i>	10			<i>f</i>	10					
	<i>g</i>	10									
	<i>h</i>	10									

The final mark for the exam is:  $(10 + score)/20$ .