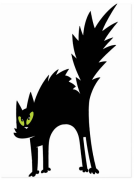
Number: _____ Name: _____

FCT/UNL Mestrado Integrado em Engenharia Informática

Linguagem de Modelação para Domínios Específicos
Domain Specific Modelling Languages
2020/2021



FRIDAY 13

November 2020

1º Test

Attention:

This test has a maximum duration of **13 x 9 + 3 minutes**.

Please do not unstaple this group of pages. There are **13 pages.** The last pages can be used for answering questions (identify which).

The questions in section A are **13 multiple choice questions (one answer)** to be answered in the Bubble sheet (given separately). To discourage lottery answering, wrong answers in the multiple choice questions will lead to a discount of ¼ of the grade of the corresponding questions in the final grade. Section B and C have together a total of **8 open box questions** (should be 13).

At the end of the test, you have to give back the test pages and the bubble sheet.

Please ensure that this and the bubble sheet pages are correctly identified. The professor is not held responsible for non-identified pages that are automatically discarded for the evaluation purposes.

When answering in the Bubble sheet, you can use a pencil. This way you can correct it if you make some mistake. Before finishing you have to write with a pen. **Section 2 and 3 can be answered using pencil.**

Please read carefully before answering. **Good Luck! You will need it ...**

Section 13 - A – (13 multiple choice questions)

1. A model is valid with respect to the language represented by a metamodel if:
   (Select the **sentence that is true**)
   A. the metamodel conforms to the model.
   B. each metamodel element is an instance of a model element.
   C. each model element is an instance of a metamodel element.
   D. the metamodel is a complete sentence.
   E. the model is defined in terms of itself.

2. Meta circularity in the context of the modelling stack is ?
(select the correct one):
   A. nonsense
   B. to use the Ecore language to define a new language conforming to the metamodel.
   C. when we extend model instances (e.g. Use Case Modelling Language) to conform to the metamodel.
   D. when the concepts available in the metamodel (e.g. Ecore) can be modelled using the language of the metamodel itself (e.g Ecore to define itself).
   E. When mode instances are associated with other model instances.

3. Which definition corresponds to the **reduction feature** according to Stackowiak?
(select the correct one):
   A. The model should be based on an original
   B. The model should be a selection of original's properties
   C. The model needs to be usable in place of an original with respect to some purpose
   D. The model should be easy to understand
   E. The model should be cheaper to produce than the original otherwise is worthless

4. Which statements about metamodels are not true?
(select the sentences that are false):
   A. metamodel is a model of another model or models
   B. a meta-metamodel at the second level of the OMG's 4 level layers standard (that start at M1 - the system layer)
   C. a token-model of a token-model is not a metamodel
   D. a type-model of a type-model is always a metamodel
   E. in order to create a linguistic metamodel we need a non-transitive relationship between type-models

5. What do you consider to be concrete syntax and abstract syntax in the following picture of a grammar of a toy textual language?

```
(* a simple program syntax in EBNF - Wikipedia *)
program = 'PROGRAM', white_space, identifier, white_space,
          'BEGIN', white_space,
          { assignment, ";", white_space },
          'END.' ;
identifier = alphabetic_character, { alphabetic_character | digit } ;
number = [ "-" ], digit, { digit } ;
string = '"' , { all_characters - '"' }, '"' ;
assignment = identifier , ":=" , ( number | identifier | string ) ;
alphabetic_character = "A" | "B" | "C" | "D" | "E" | "F" | "G"
                     | "H" | "I" | "J" | "K" | "L" | "M" | "N"
                     | "O" | "P" | "Q" | "R" | "S" | "T" | "U"
                     | "V" | "W" | "X" | "Y" | "Z" ;
digit = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9" ;
white_space = ? white_space characters ? ;
all_characters = ? all visible characters ? ;
```

   A. 'white_space', 'digit' are concrete syntax and 'A', 'B', '0' are abstract syntax, and '=' and '|' are metalanguage
   B. 'white_space', 'digit' are abstract syntax and 'A', 'B', '0' are concrete syntax, and '=' and '|' are metalanguage
   C. 'white_space', 'digit', 'A', 'B', '0' are abstract syntax, and '=' and '|' are concrete syntax
   D. 'white_space', 'digit', 'A', 'B', '0' are concrete syntax, and '=' and '|' are abstract syntax
   E. 'white_space', 'digit' are concrete syntax and 'A', 'B', '0','=' and '|' are abstract syntax

6. The model transformation from Class Diagram Models (input) to Java Source Code (output) can be classified as :
(select the correct one)
   A. Restrictive Query
   B. Abstraction
   C. Synthesis
   D. Migration
   E. Refinement

7. When we map concepts of a model in a source language to concepts of another target language, we call it:
   (select the correct one)
   A. Model Matching (weaving)
   B. Model Merging
   C. Model Synchronization
   D. Model Translation
   E. Model Synthesis

8. Model Migration is a kind of model transformation:
   (select the correct one)
   A. Horizontal and Endogenous
   B. Horizontal and Exogenous
   C. Vertical and Endogenous
   D. Vertical and Exogenous
   E. Vertical and can be either Endogenous or Exogenous

9. To refactor a Class Diagram Model (simultaneously input and output):
   (select the correct one)
   A. Is an endogenous and in-place Transformation
   B. Is an endogenous and out-place Transformation
   C. Is an exogenous and in-place Transformation
   D. Is an exogenous and out-place Transformation
   E. Either exogenous or endogenous Transformation

10. When we design the language metamodel in Ecore:
    (select the statements that are true)
    A. We are defining the language's concrete syntax.
    B. We can no longer derive an EBNF grammar from it for a textual DSL (and the opposite).
    C. It can be used as a source for the language of the input models for a model transformation to another language.
    D. We are defining the semantics of the language.
    E. If we need to define extra constraints for well-formedness we can complement with EVL.

11. When at the design phase of the language we are faced with the decision of implementing either a Textual or a Graphical language, the focus of the decision is a matter of:
    (choose the correct answer)
    A. Deciding its concrete syntax
    B. Deciding its abstract syntax
    C. Deciding its semantic domain
    D. Deciding its semantic mapping
    E. Deciding if it is General Purpose or Domain Specific

12. To completely define a language we need to define the following:
    (choose the most complete answer)
    A. the Metamodel
    B. the Notation and metamodel
    C. the Grammar
    D. the Syntax, Semantics and Pragmatics
    E. the Model transformations or mapping to semantics

Number: _____ Name: _____

13. What Language is this code?
(select the correct answer)

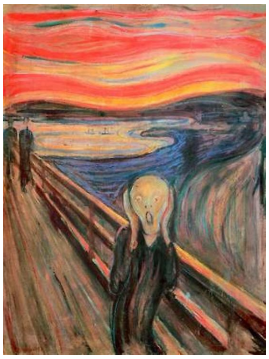
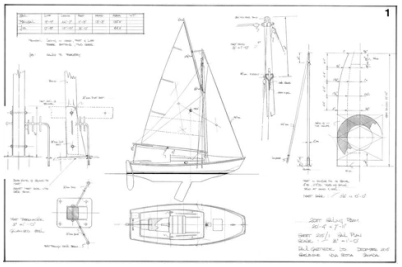
```
pre {
  var numMovies = Movie.all.size();
  var numActors = Person.all.size();
  var apm = numActors / numMovies;
}

context Movie {

  constraint ValidActors {
    guard : self.persons.size() > apm
    check : self.persons.forAll(p | p.satisfies("HasValidName"))
  }
}

context Person {

  @lazy
  constraint HasValidName {
    check : self.name.isPlain()
  }

  constraint ValidMovieYears {
    check : self.movies.forAll(m |  m.year + 1 > self.birthYear)
  }
}

operation String isPlain() : Boolean {
  return self.matches("[A-Za-z\\s]+");
}

post {
  ("Actors per Movie="+apm).println();
  ("# Movies="+numMovies).println();
  ("# Actors="+numActors).println();
}
```

A. Ecore
B. pure EOL
C. EVL
D. ETL
E. EGL

Number: _____ Name: _____

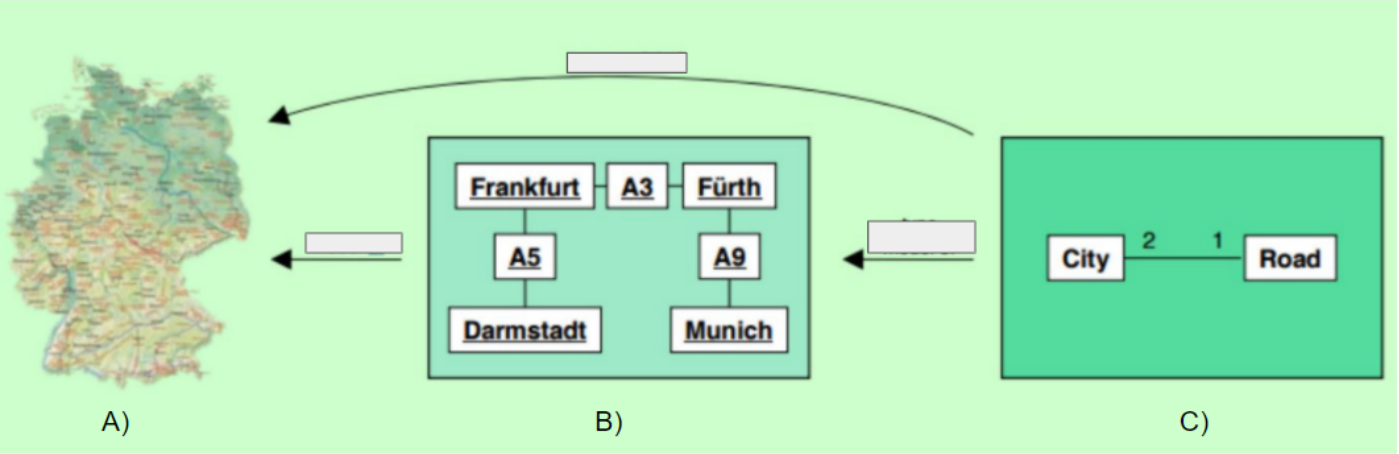
Section 13 - B

1. According to the definition of properties of a model discussed in class can we consider the following cases a model? Define a model and discuss one-by-one to justify your opinion for each case based on the properties.

		
A) Painting	B) Sailing boat plan	C) Globe
		
D) Hotel in Brussels	E) Solar System educational toy	

2. What is the language mechanism stack? Please describe what it means and draw its schematics.

3. Consider the following situation about locations presented in class:



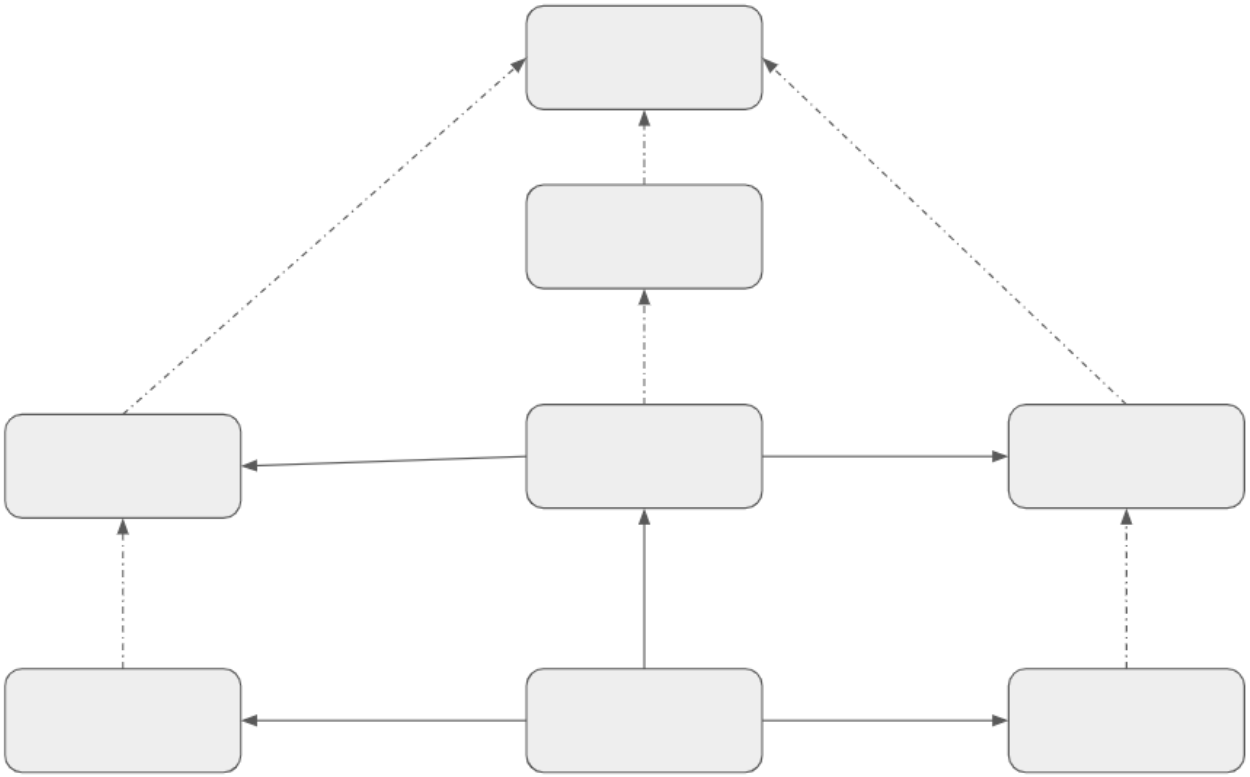
Can we consider B) and C) to be a metamodel? a type model? or a token model? How do they relate to each other? Please justify your answer and define metamodel. (**Answer in the next page**)

4. What is Model-Driven Engineering? Why is it different from traditional system development?

Number: _____ Name: _____

5. What is the difference between a programming language and modelling language?

6. Please define model transformation and complete the following schematics:



Number: _____ Name: _____

Section 13 - C

Imagine that you are a software language Engineer (SLE) hired to design a language for the game designer of the next Role Playing Game (RPG) for smartphones named “Friday 13th - bad things will happen”, and sequels for the next five years.

With this new language, the game developer will be able, from the same game engine, to model a different game product of the same kind with a different name (e.g. ““Friday 13th - the return of the black cat”), and from that everything will be generated by model transformations. Consider for the sake of simplicity that this game is only one level in a typical game. The great advantage, besides fast/automated generation, is that from the model of the game setup, the developer can check if the game can be ever finished and if a certain score for the player can be obtained. So from the same model the designer can generate the code for the mobile app for Android and iOS, and also to a model (metamoded in ecore) for a simulator (to test several situations) and for a model checker (to check for deadlock properties).

Every game has a different world map or mazze. This map has a name (e.g. “house of the broken mirror”), which is the environment where the game takes place. The world map is composed of many different rooms, which are connected, and the hero agent can move across. A room contains a two-dimensional map of cells. The hero and the monster can not stay in the same cell. The monster has individual damage points. However, keys can be in the same cell as the agent as he has he can pick them. each key unlocks a specific door. The agents can move between cells if they are unoccupied. In the map there exist objects or artifacts to be picked up, traps that cause the agents to lose health points, switches that, when activated, and doors that allow the passage of agents to other rooms. Each room has at most one monster in the initial setup (but can change along the game). There can also be other artefacts in the room like spells (for temporary immunity, speed) or goodies like treasures that give more points. There is only one goal in the map, which is meant for ending the game once the hero gets there. The hero also has an initial position where the game starts.

The following picture is a mockup of a possible game setup. There are the moving tiles in red (small cells for the hero and the monster NPC to move around). Here we can see the initial positions of both monsters and heroes when the game starts. There are keys for certain doors that can be setup initially to be open or closed. There are traps.

Number: _____ Name: _____

1. Propose a metamodel and well formedness rules for this RPG setup language using the ecore diagrams notation and OCL/ETL like code (when referring to transformations classify them as vertical/ horizontal/ inplace/ outplace/ endogenous/ exogenous):

Answer…

2. How would you use the EMF tools Epsilon (and languages) in Eclipse (which languages?) to implement this RPG language?

Answer…

Number: _____ Name: _____

Extra page (use for whatever)…

Extra page (use for whatever)…