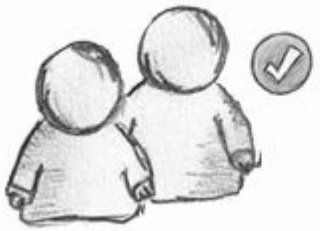
Clafer

Lightweight Modeling Language



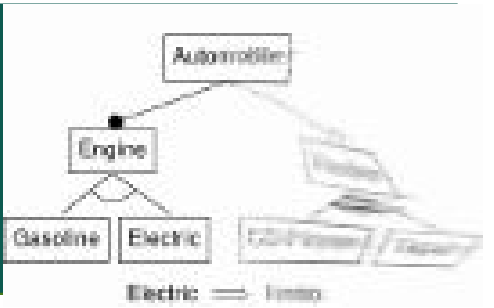
Designed with
usability in mind

Implementation Part

Presenter: Athanasios Koutoulas

Model Driven Engineering Academic Year 2013 - 2014

THE CONCEPT



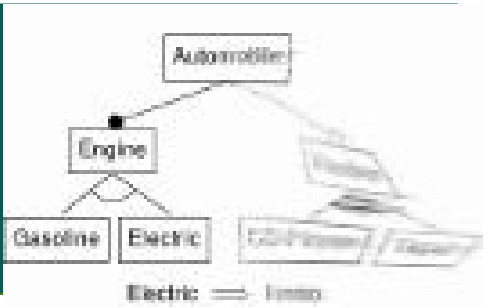
- ING Bank Loans Modeling

- Based on:
  - ING Bank official website
  - loans e-brochure
  - on-line simulators

- Purpose:

  How a complex concept can be modeled by Clafer

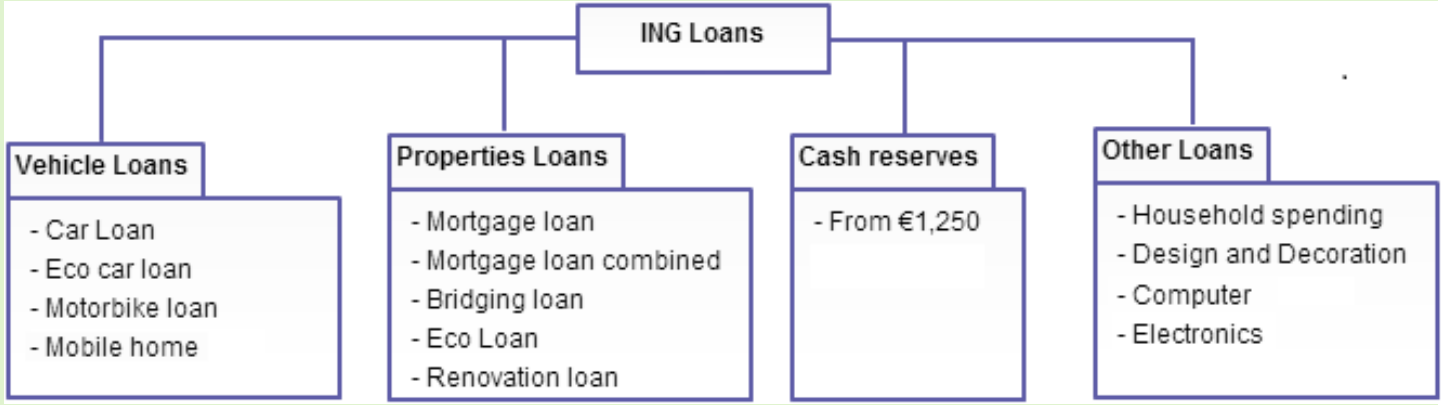
INITIAL ANALYSIS I



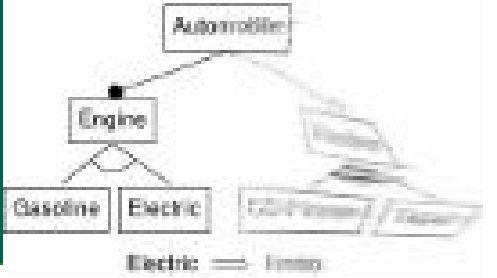
- Reading the source, taking notes, organizing.

- Purpose:
  - collect all possible loans
  - group their attributes
  - apply constraints

- Clafer model:
  - well-organised
  - direct
  - flexible

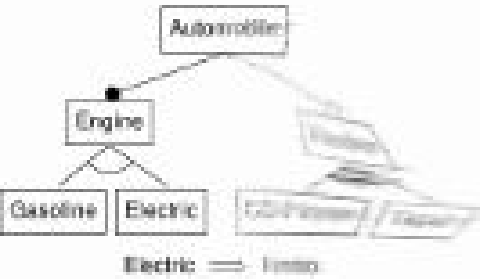


INITIAL ANALYSIS II

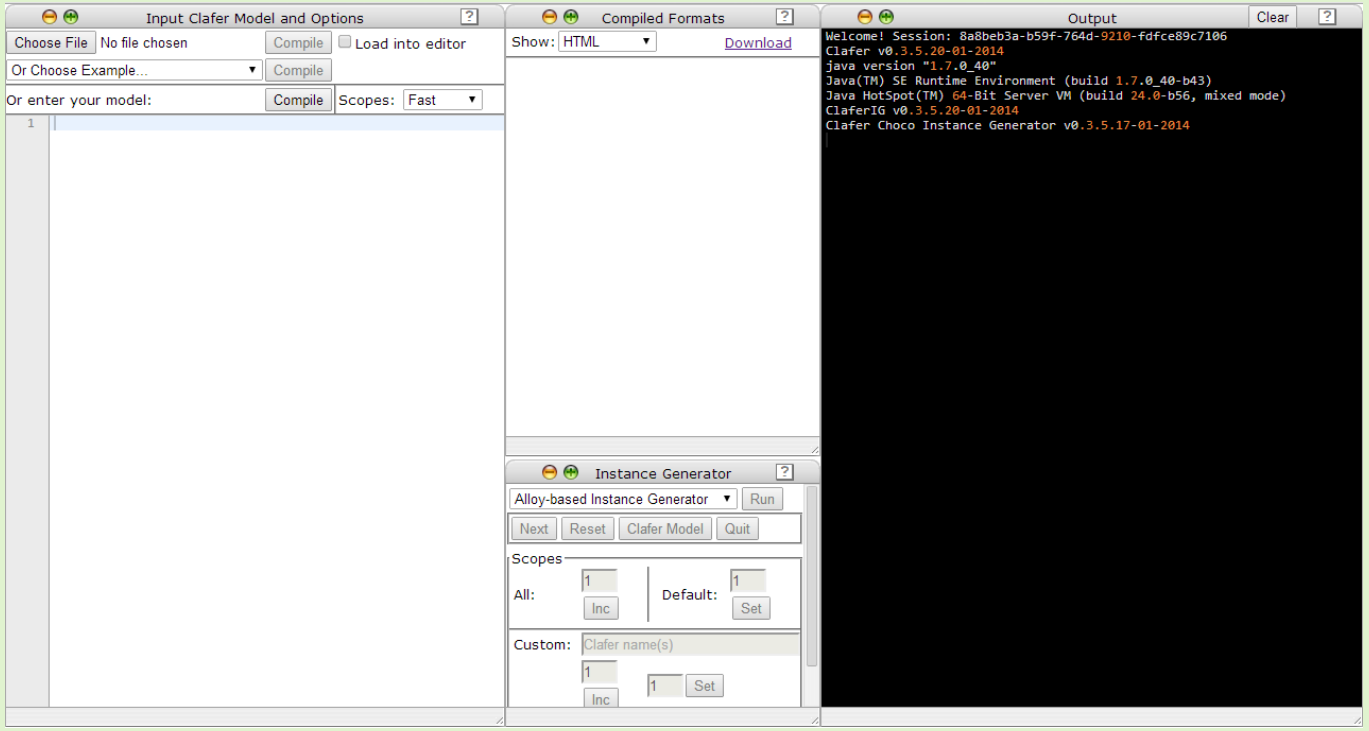


Vehicle Loans	
Attributes	Description
Proposal	String value. It represents the proposal of each loan.
Repayment Period	Integer value. Specifies the permissible boundaries of the duration of each repayment period. It depends on the loan.
Chronology	It specifies the age of the vehicle. According to the value of different rules are applied. There are 3 acceptable values: - New vehicle - Second-hand vehicle less than 2 years old - Second-hand vehicle more than 2 years old
Vehicle type	It specifies the type of the vehicle. There are different rules in the loans for each vehicle. There are 4 acceptable values: Car, Motorbike, Eco Car and Mobile home.
Amount to borrow	Integer value. It represents the minimum and maximum amount to be borrowed. This amount belongs to the range of [2000, 125000] euros.
Fees	String value. This attribute refers to additional fees of the loan. In the case of the Vehicle loans it has two values/attributes: Management fees and Service fees.
Interest Rate	This attribute varies regarding to the Repayment Period of the loan and the age (Chronology) of the vehicle. The interest rates for all cases can be found on the website of ING Bank and can be

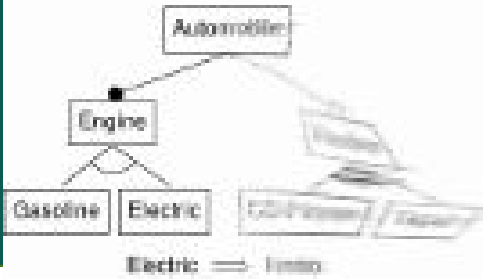
CLAFER IDE



- Text editor
- Compiler
  - error detection
  - HTML
  - XML
  - javascript
  - Alloy
  - Graph
- Instance generator
  - Alloy-based



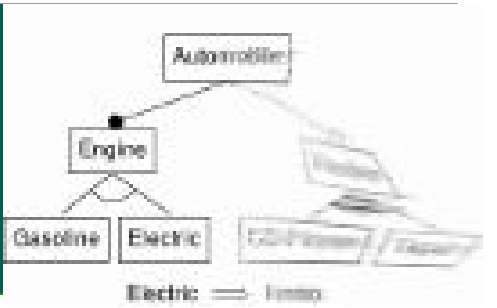
TRANSLATION TO CLAFER LANGUAGE I




```
abstract Fees

    Management_fees : string

        [Management_fees = "no management fees"]

    Service_fees :  string

        [Service_fees = "no service fees"]

abstract xor Repayment_Method : Fees

    Monthly_Repayment

    Quartely_Repayment

    Semester_Repayment

    Yearly_Repayment

abstract Proposal : Repayment_Method

    Description : string

abstract Amount_Vehicles : Proposal

    Amount_to_borow_in_thousands : integer

        [(2 <= Amount_to_borow_in_thousands)
        && (Amount_to_borow_in_thousands <= 125)]

abstract Repayment

    Repayment_Period_in_months: integer
```

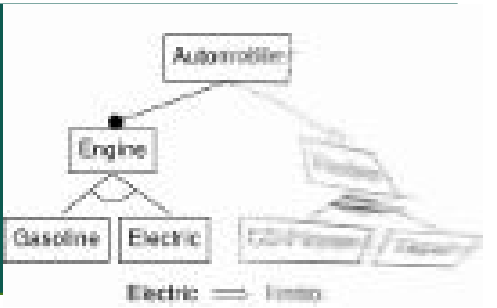
```
abstract xor Chronology : Repayment

    New_vehicle

    Second_hand_less_than_2years

    Second_hand_more_than_2years

abstract xor Interest_Car : Chronology

    Interest_225

        [((12 <= Repayment_Period_in_months) && (Repayment_Period_in_months <= 60)) &&
        ((Chronology => New_vehicle) || (Chronology => Second_hand_less_than_2years))]

    Interest_275

        [((61 <= Repayment_Period_in_months) && (Repayment_Period_in_months <= 84)) &&
        ((Chronology => New_vehicle) || (Chronology => Second_hand_less_than_2years))]

    Interest_750

        [((12 <= Repayment_Period_in_months) && (Repayment_Period_in_months <= 84)) &&
        (Chronology => Second_hand_more_than_2years)]
```

TRANSLATION TO CLAFER LANGUAGE II




```
103 //-------------CONCRETE CLAFERS FOR INSTANCE GENERATION------------//
104
105 xor Vehicle_Loans : Amount_Vehicles
106
107         [Description = "The ING Car Loan is an instalment loan
108         for buying a new or second-hand vehicle. This could be
109         a car, an Eco car, a motorcycle or a mobile home"]
110
111     Car : Interest_Car
112
113     Motorbike : Interest_Motorbike
114
115     Eco_Car : Interest_Eco_Car
116
117     Mobile_Home : Interest_Mobile_Home
```

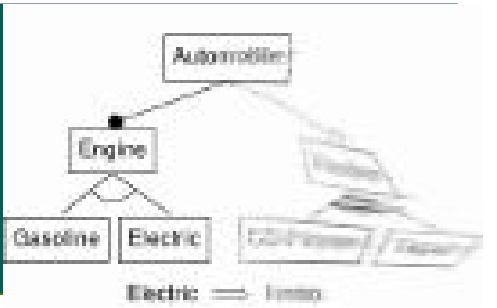
INSTANCE GENERATION



- Successful compilation
- Clafer to Alloy translator
- Clafer Instance generator

```
ClaferIDE> Running the chosen instance generator...
Loan_Type
  Vehicle_Loans
    Car
      Interest_275
      Second_hand_less_than_2years
      Repayment_Period_in_months = 84
    Amount_to_borow_in_thousands = 9
    Description = "The ING Car Loan is an instalment loan
        for buying a new or second-hand vehicle. This could be
        a car, an Eco car, a motorcycle or a mobile home"
    Semester_Repayment
    Management_fees = "no management fees"
    Service_fees = "no service fees"

claferIG> claferIG>
```

INSTANCE VERIFICATION



- Consistency of instances
- Violation remarking
- Correction

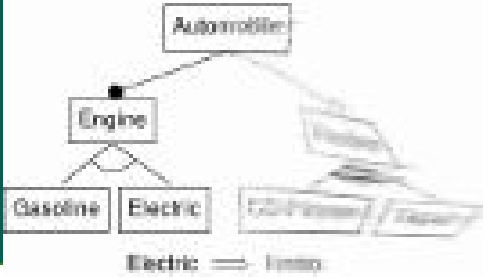
```
Vehicle_Loans : Amount_Vehicles

    [Description = "The ING Car Loan is an instalment loan
    for buying a new or second-hand vehicle. This could be
    a car, an Eco car, a motorcycle or a mobile home"]
    Instance_Car_Loan : Interest_Car
    [Amount_to_borow_in_thousands=5]
    [Repayment_Period_in_months = 10]
    [Chronology => Second_hand_more_than_2years]
```

```
The following set of constraints cannot be satisfied in the current scope.
(Hint: use the setUnsatCoreMinimization command to minimize the set of constraints below)
  1) Repayment_Period_in_months = 10 (line 96, column 6)
Altering the following constraints produced the following near-miss example:
  1) removed Repayment_Period_in_months = 10
```

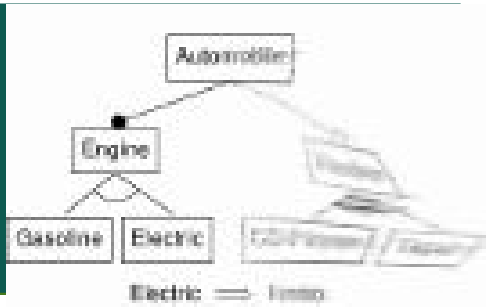
EVALUATION & CONCLUSIONS

- Powerful modeling language
- Suitable for complex concepts modeling
- Easy to learn, simple syntax
- Improving the understanding of a concept
- Suitable for instance generation & verification

GUIDES



- 1. Clafer homepage: http://www.clafer.org
- 2. Attributed Feature Models in Clafer, Kacper Bak, Generative Software Development Lab, University of Waterloo, Canada.
- 3. Clafer: a Unified Language for Class and Feature Modeling, Kacper Bak Generative Software Development Lab ,University of Waterloo, Canada
- 4. Domain Concept Modeling Using Clafer, A Tutorial By Michal Antkiewicz Version 9.2, Mar 20, 2012
- 5. Example-Driven Modeling Using Clafer, Michal Antkiewicz, Kacper Bak, Krzysztof Czarnecki, Zinovy Diskin, Dina Zayan & Andrzej Wasowski.



Thank you for your attention!

Questions?