Towards an Overture Code Generator

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Methods, Tools and Techniques for Modelling in VDM

Outline

Generating code from a model

1. Formal modeling helps understanding the system
2. Reducing the effort for transitioning to implementation
3. Costs of generating code
4. The code generator presented here is early work
   - It generates Java code from VDM++ models

Related work

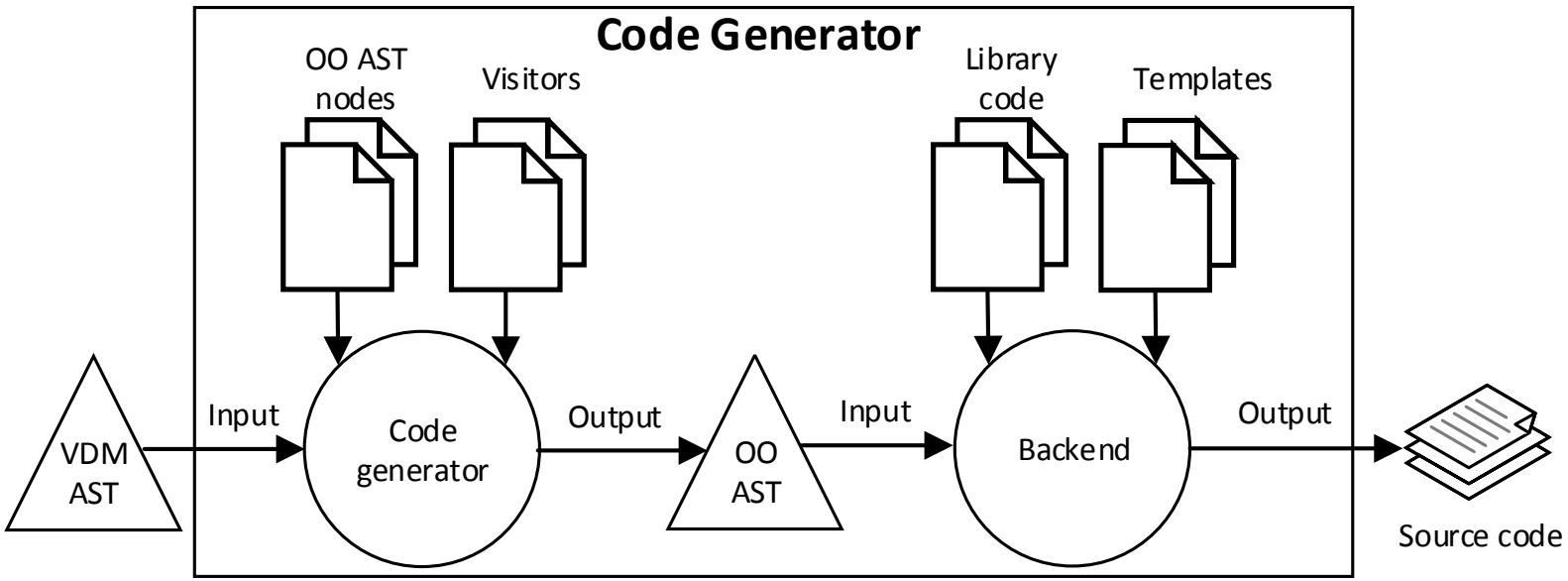
1. VDMTools CG development started in the 1990s
   - First CG support for Java was developed
   - Later support for VDM++ concurrency was made
2. An attempt was made inside the Overture project
   - It was not possible to extract type information
   - It did only work for trivial examples

CG and the new Abstract Syntax Tree (AST) (1/2)

1. The CG is implemented using visitors
2. The visitors construct a new intermediate *OO AST*
3. The OO AST serves two primary purposes
   - It gradually introduces the complexity of CG
   - It enables extending the CG with multiple OO languages

CG and the new AST (2/2)

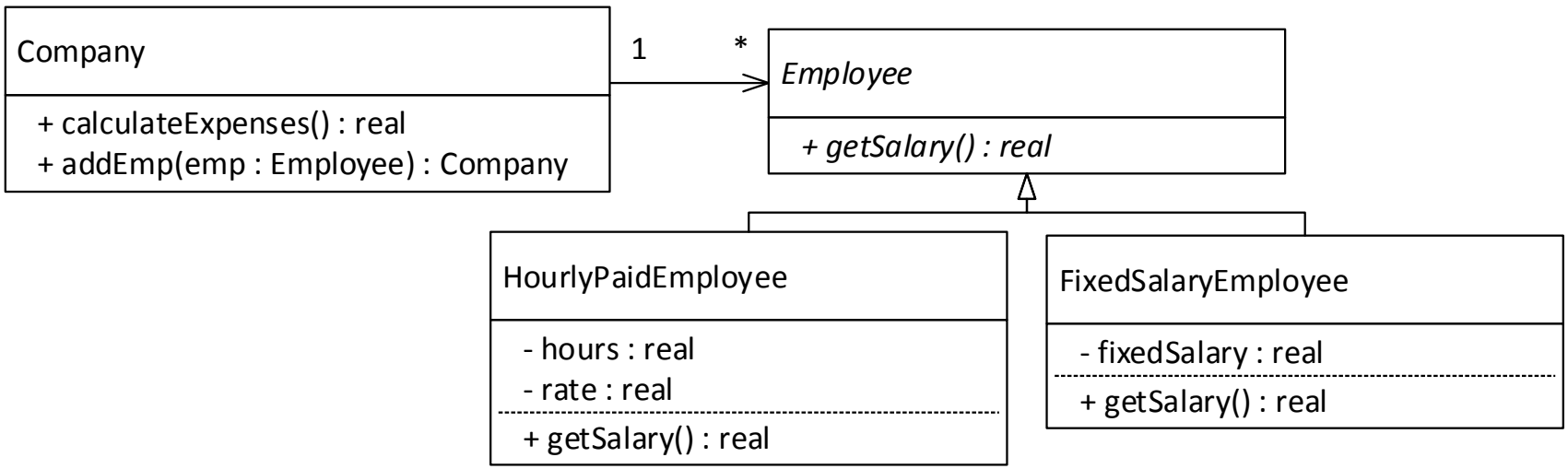
1. Backend: A configurable part producing the actual code
2. Library code: Utility code specific to a target language
3. Templates: Mappings of VDM nodes to a target language



The case study

UML description of the case study VDM model

A system for handling company salary expenses



The Company VDM class

VDM

```
class Company
instance variables
  private employees : seq of Employee;
operations
  ...
  public calculateExpenses: () ==> real
  calculateExpenses() == ...

  public addEmp : Employee ==> Company
  addEmp (emp) == ...
functions
  private start_calc: seq of Employee -> real
  start_calc(emps) == ...
end Company
```

The Company Java class

Java

```
...
public class Company {

 private List<Employee> employees;
 ...
 public double calculateExpenses() {...}

 public Company addEmp(Employee emp) {...}

 private double start_calc(List<Employee> emps) {...}

}
```

Adding employees to a company

VDM

```
public addEmp : Employee ==> Company
addEmp (emp) ==
(
 employees := employees ^ [emp];
 return self;
);
```

Java

```
public Company addEmp(Employee emp) {

  employees = Utils.seqConc(employees, Utils.seq(emp));
  return this;
}
```

Calculation of salary expenses (1/2)

VDM

```
private start_calc: seq of Employee -> real
start_calc(emps) ==
 if emps = []
  then 0
 else
  (hd emps).getSalary() + start_calc(tl emps);
```

Calculation of salary expenses (2/2)

Java

```
private double start_calc(List<Employee> emps) {

 if (emps.isEmpty())
 {
   return 0;
 }
 else
 {
    return emps.get(0).getSalary()
           + start_calc(emps.subList(1, emps.size()));
 }
}
```

Future plans

1. CG for a distributed hardware platform
2. Investigating extensibility of the CG
3. Mapping of union types
   - Difficult to generate but they easily appear in a model

```
--Type seq1 of (char) | nat1
if true then "one" else 2
--Type seq1 of (FixedSalaryEmployee | HourlyPaidEmployee)
[new FixedSalaryEmployee(), new HourlyPaidEmployee()]
```