

TypePlug -- Practical, Pluggable Types

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Types?

Static typing is Good!

- > Programs with failures are rejected
 - Reduces errors detected at runtime
- > Documentation
- > Minor inconvenience, major payoff

Static typing is Evil!

- > Exactly all cool programs are rejected
 - Reflection?!
- > Inconvenience is not at all “minor”
 - Typed programs hard to change + evolve
- > Only the most trivial errors are detected
 - False sense of security

Pluggable Types

- > Optional: does not change the semantics
- > Pluggable: many different ones
 - Especially exotic type-systems
- > “Type-Systems as Tools”

Gilad Bracha, OOPSLA 04:
Pluggable Type-Systems

The Problem

- > Large, untyped code-base
- > Overhead for using pluggable types is high
 - Existing code needs to be annotated with type information

TypePlug

- > Pluggable types for Squeak

- > Based on sub-method reflection framework
(Demo on Wednesday!)

- > Case-Studies:
 - Non-Nil Types
 - Class Based Types
 - Confined Types

Non-Nil Type-System

- > Declare variables to never be nil

```
Object subclass: #Line
  typedInstanceVariables: 'startPoint endPoint <:nonNil:>'
  typedClassVariables: ''
  poolDictionaries: ''
  category: 'Demo'
```

DEMO

Non-Nil Type-System

```
moveHorizontally: anInteger
```

```
    startPoint := self movePoint: startPoint  
                horizontally: anInteger.
```

```
    endPoint:=self movePoint: endPoint  
              horizontally: anInteger
```

Non-Nil Type-System

```
moveHorizontally: anInteger
```

```
startPoint := self movePoint: startPoint  
              horizontally: anInteger.
```

```
endPoint:=self movePoint: endPoint  
              horizontally: anInteger <- type 'TopType' of  
expression is not compatible with type 'nonNil' of variable  
'endPoint'.
```

Non-Nil Type-System

`movePoint: aPoint horizontally: anInteger`

`↑ (aPoint addX: anInteger y: 0) <:nonNil :>`

The Problem (again)

- > Large, untyped code-base
- > Overhead for using pluggable types is high
 - Existing code needs to be annotated with type information

Solution

- > Only type-check annotated code
- > Use type-inference to infer types of non-annotated code
- > Explicit type-casts
- > Allow external annotations for foreign code

External Type Annotations

- > We need to annotate existing code
 - Especially libraries and frameworks
 - Example: `Object>>#hash` is `<: nonNil` :>

- > We do not want to change the program code!

- > Solution: External Type Annotations
 - Added and modified in the TypesBrowser
 - Do not change the source
 - External representation: Type Packages

Browser

The screenshot shows a browser window titled "TPNilTypeSystem Browser: InterestingPoint". The window is divided into several panes:

- Left Pane:** Shows the class name "InterestingPoint" in red. Below it are buttons for "instance", "?", and "class".
- Middle-Left Pane:** Labeled "-- all --", it lists methods: "moving" (in red), "accessing", and "initializing".
- Middle-Right Pane:** Labeled "addX:", it shows the method signature "addX:y:" (in red).
- Right Pane:** Labeled "addX:", it shows the method body: "y: <nonNil :>" followed by an upward arrow "↑".

Below the panes is a navigation bar with buttons: "browse", "variables", "hierarchy", "inheritance", "senders", "implementors", "versions", and "errors".

The bottom pane displays the source code for the "addX" method:

```

addX: anInteger y: anotherInteger
  self addX: anInteger<- in message 'addX:' of class 'InterestingPoint' is argument 'TopType' not
  compatible with expected type 'nonNil'.
  self addY: anotherInteger.
  
```

Future Work

- > Improve Type-Inference
 - Better algorithms
 - Explore heuristical type inference (Roeltyper)

- > Type Checking and Reflection
 - Use pluggable types to check reflective change

Conclusion

- > TypePlug: Pragmatic framework for Pluggable Types
 - Only type-check annotated code
 - Use type-inference
 - Explicit type-casts
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Questions?