Fine-grained and Accurate Source Code Differencing

ASE 2014, Västerås

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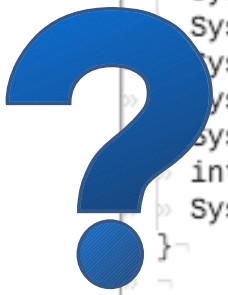
Context

```java
import java.util.Random;

public class Example {

  public void hello() {
    System.out.println("Hello everybody!");
    System.out.println("This code is a magnificent example");
    System.out.println("For the ASE 2014 conference");
    System.out.println("It draws a number at random");
    System.out.println("Adds 10");
    System.out.println("Multiplies by 10");
    System.out.println("And displays it");
    Random r = new Random();
    int i = r.nextInt();
    i += 10;
    i *= 10;
    System.out.println(i);
  }

}
```



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  public int random() {
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    return i;
  }

}
```

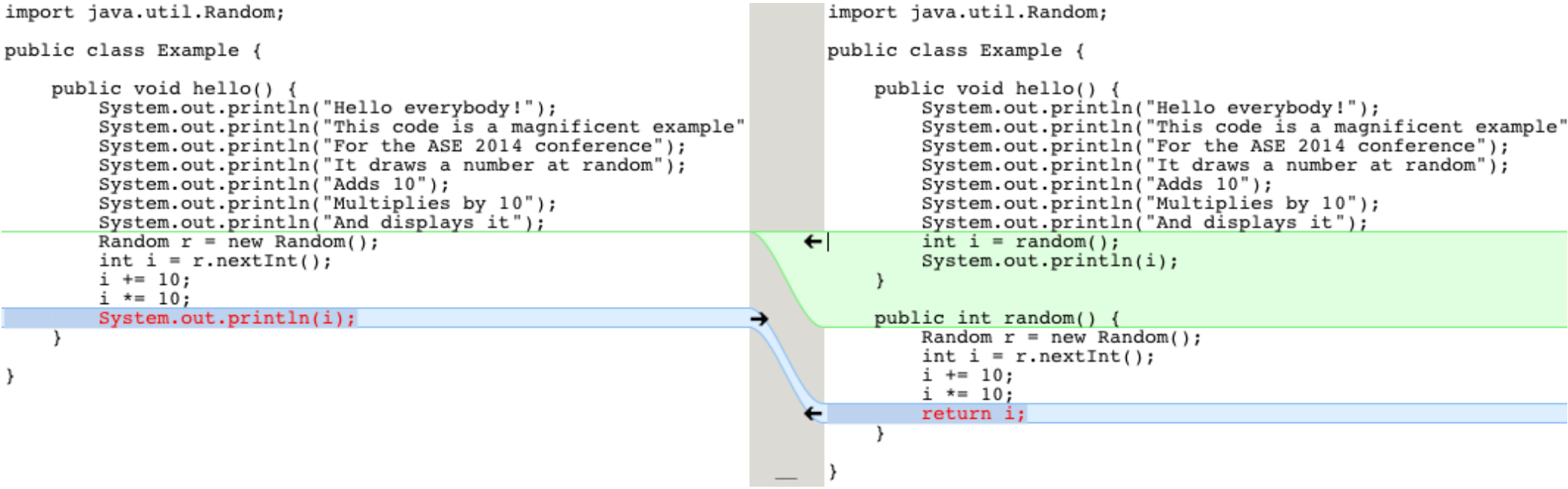
Previous version

Current version

Use cases

- Catch-up with code
- Code review
- Find buggy code
- ...

Current tool



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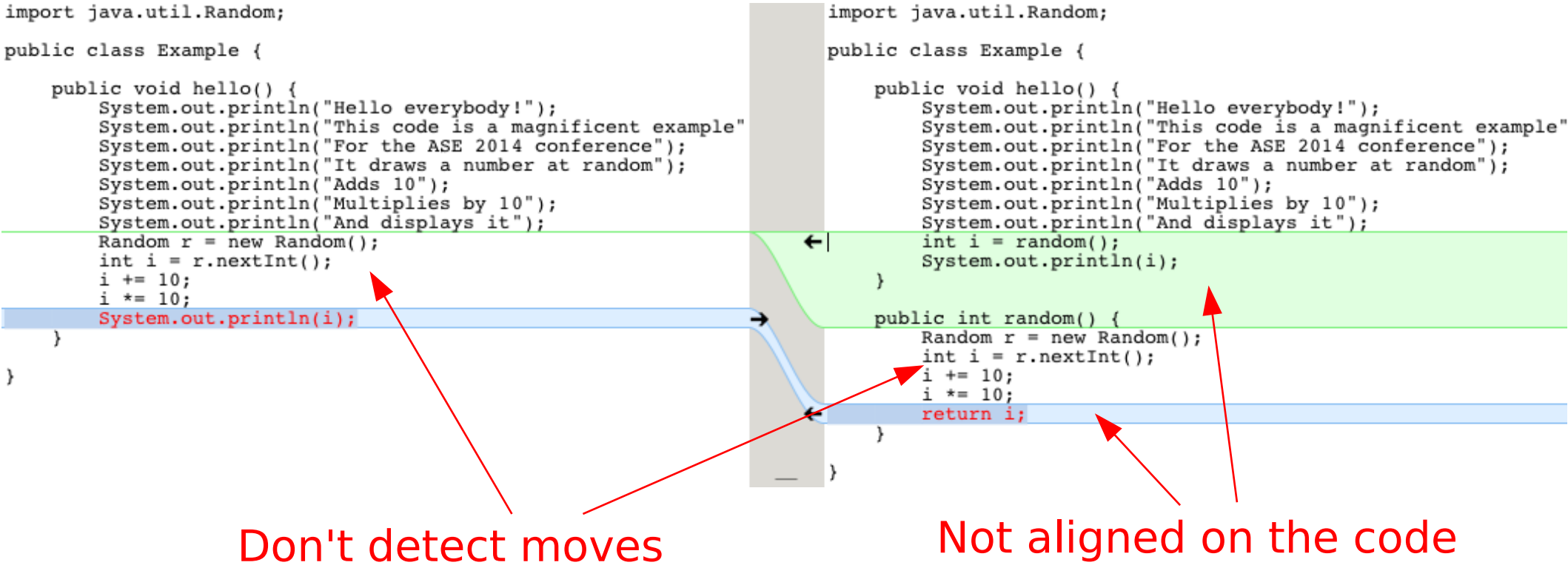
Meld v1.8

Current tool



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```

Don't detect moves

Not aligned on the code

Don't represent the developer intent

Our proposal

```
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}
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GumTree

- Differencing algorithm
  - Work on syntax trees
  - Detect code moves
- Tool
  - Efficient
  - Empirically validated
  - Freely available

State of the art

- On text
  - Never aligned on the code structure
- On syntax trees
  - Optimal without moves: *O(n^3)* [27]
  - Optimal with moves: *NP-hard* [4]
  - Very few existing heuristics (ex: [6, 13])
  - **GumTree heuristic: *O(n^2)***

GumTree process

1. Parse code files to code agnostic tree structure
2. **Find mappings between nodes**
   - *Like developers manually proceed*
3. Deduce code edition actions (as in [6])
4. Output code differences

Finding mappings

1. Top-down
   - Find biggest chunks of unmodified code
2. Bottom-up
   - Propagate mappings to the containers of these chunks (functions, classes, ...)
   - Extend mappings in the left-over code of these containers

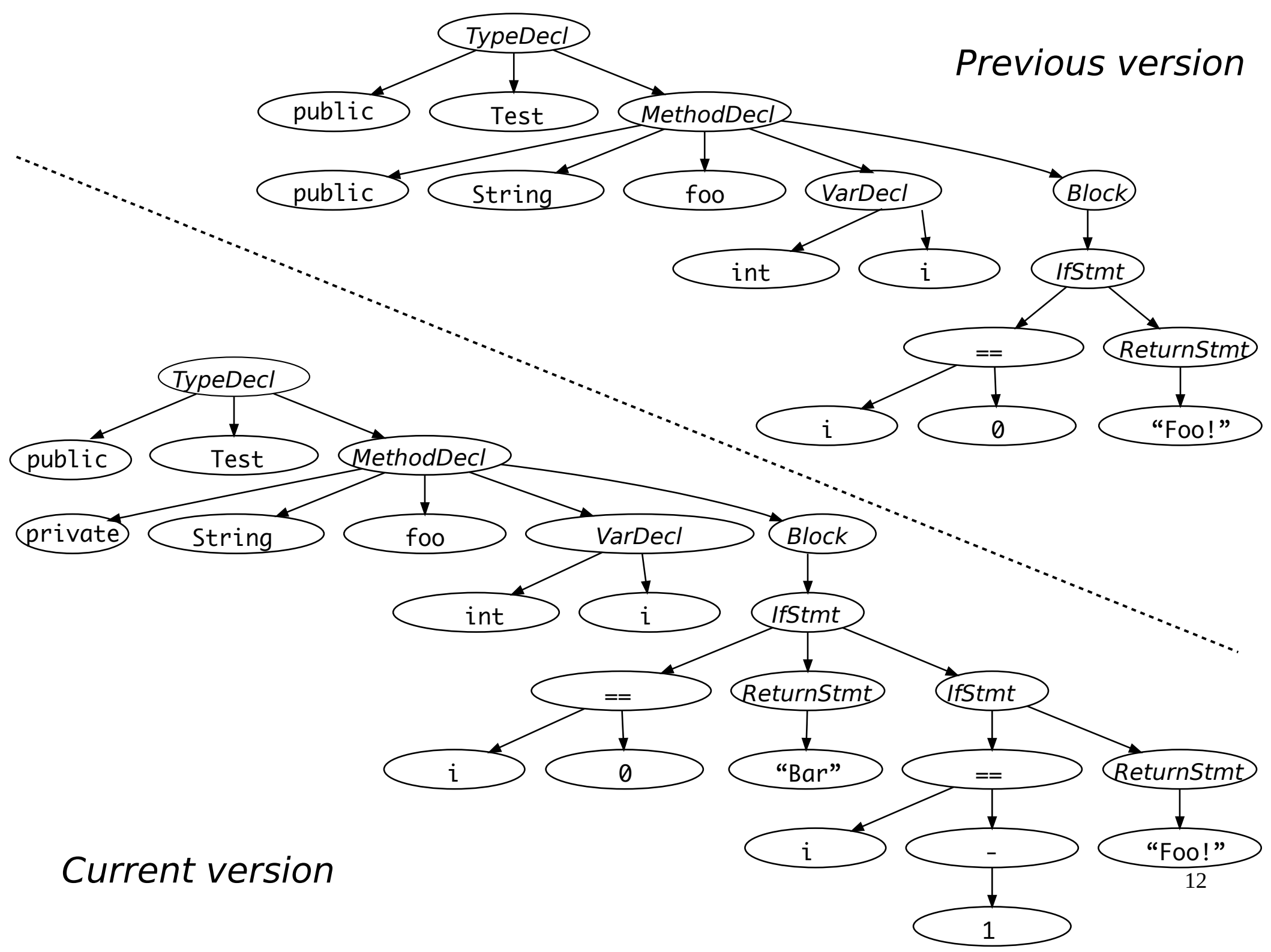
Example

```
public class Test {
  public String foo(int i) {
    if (i == 0)
      return "Foo!";
  }
}
```

Previous version

```
public class Test {
  private String foo(int i) {
    if (i == 0)
      return "Bar";
    else if (i == -1)
      return "Foo!";
  }
}
```

Current version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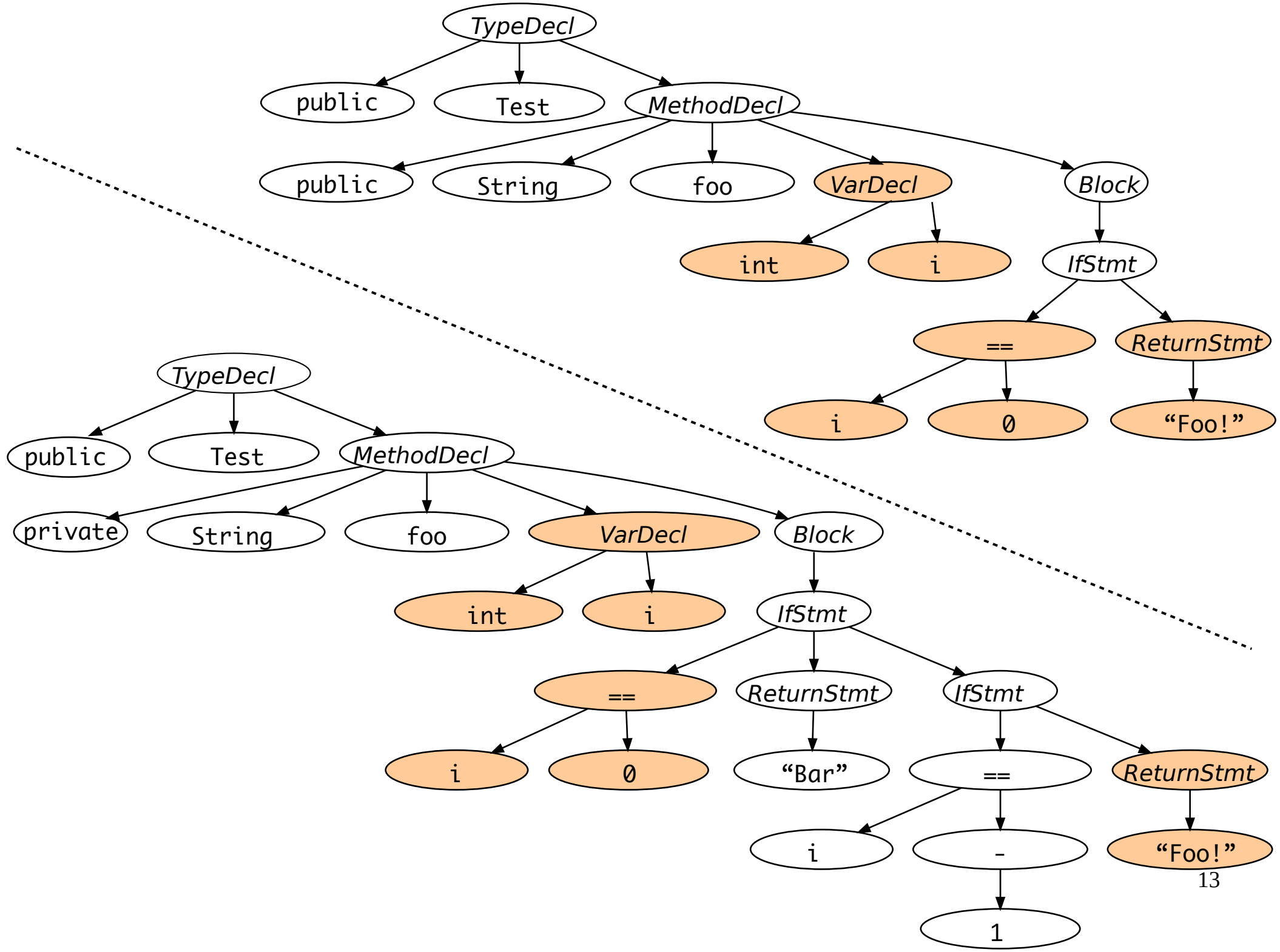
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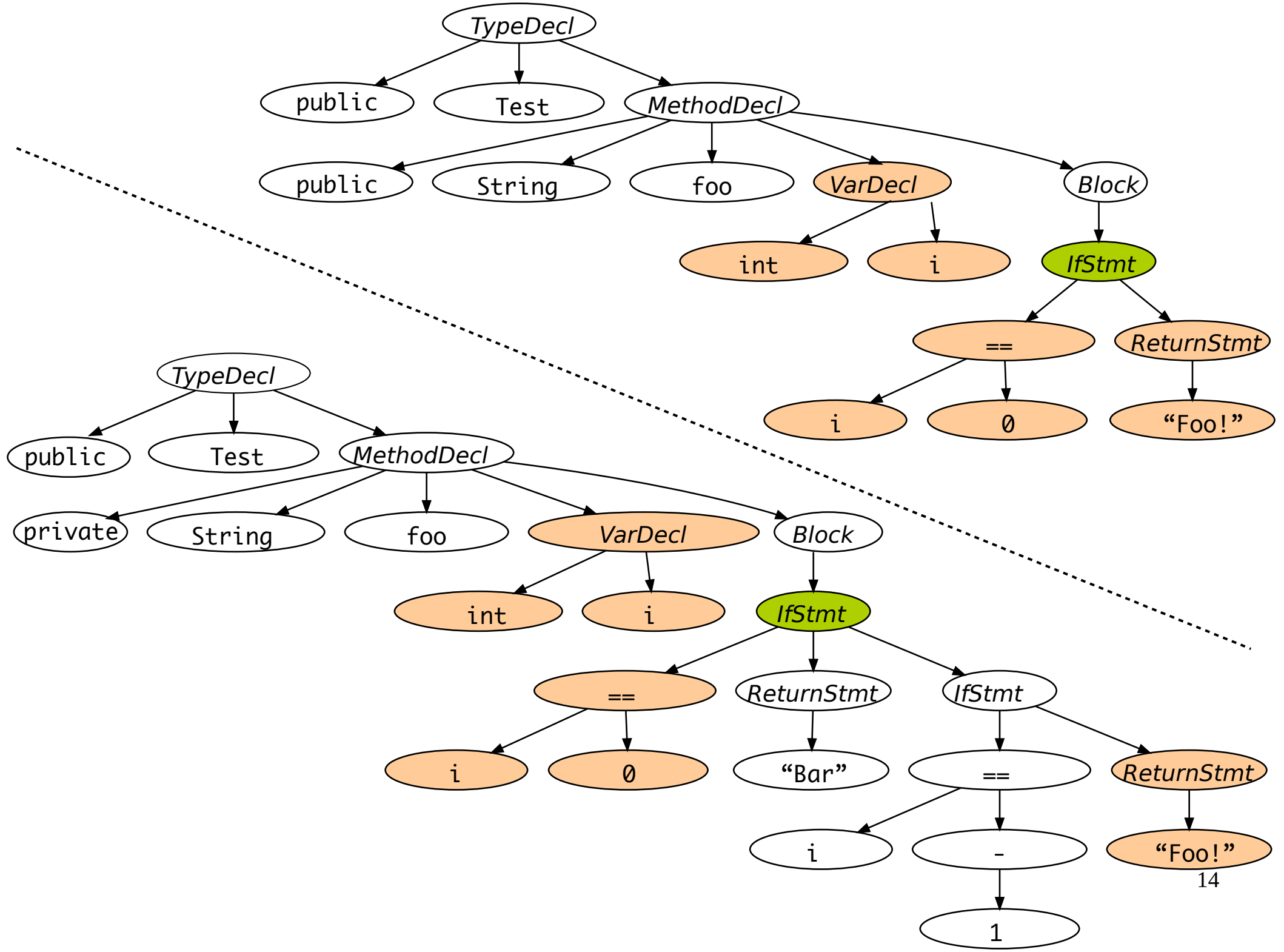
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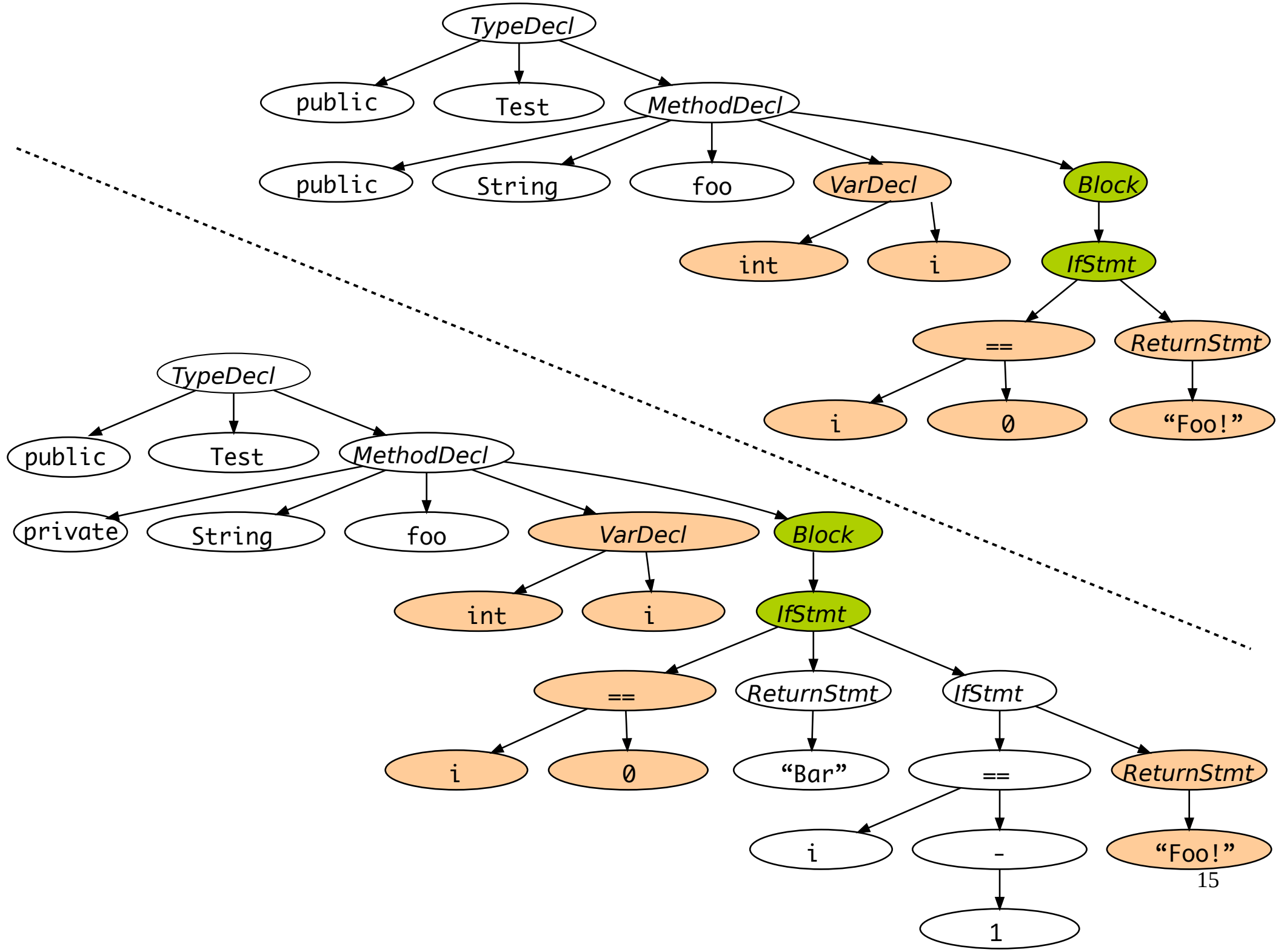
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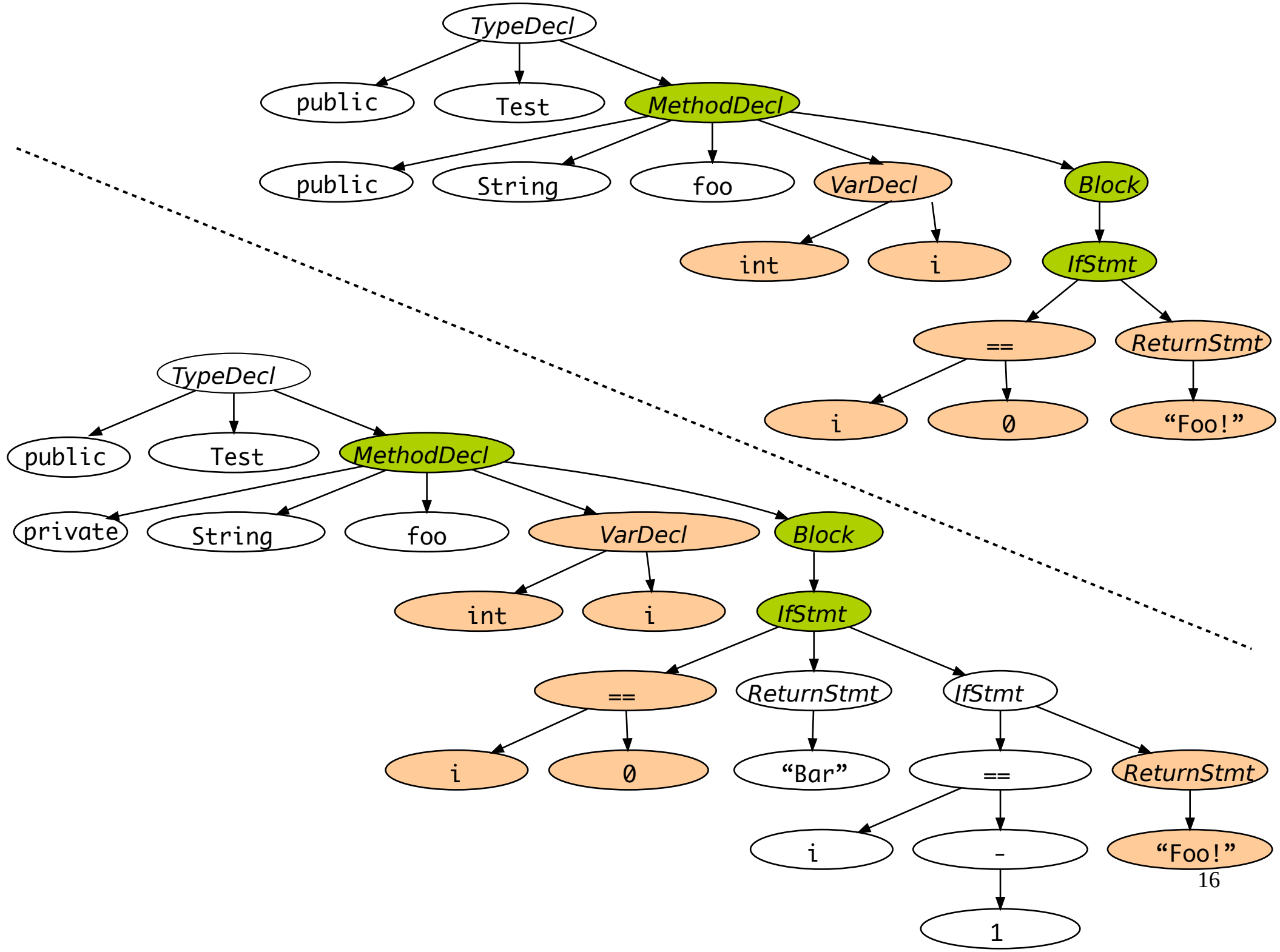
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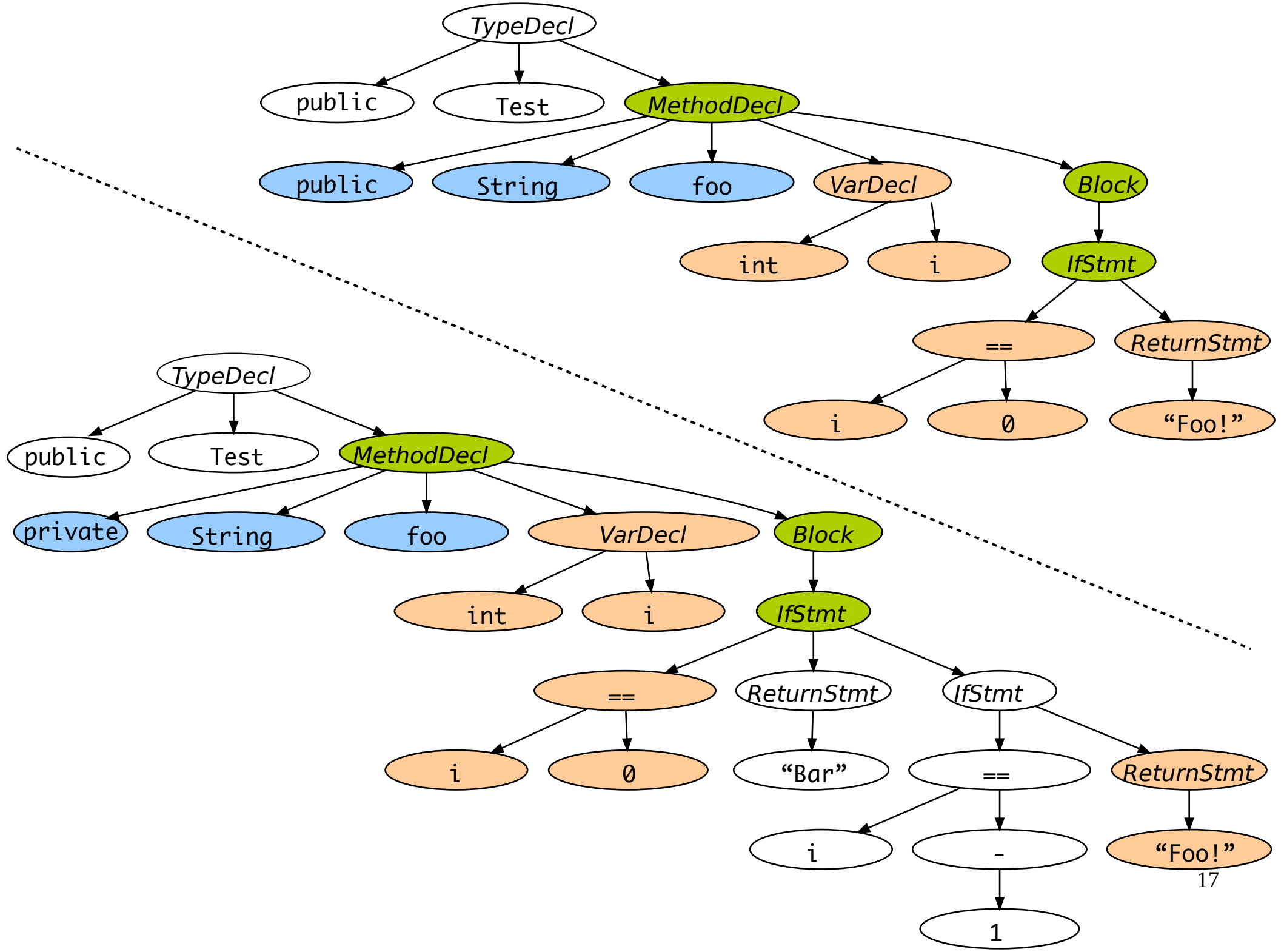
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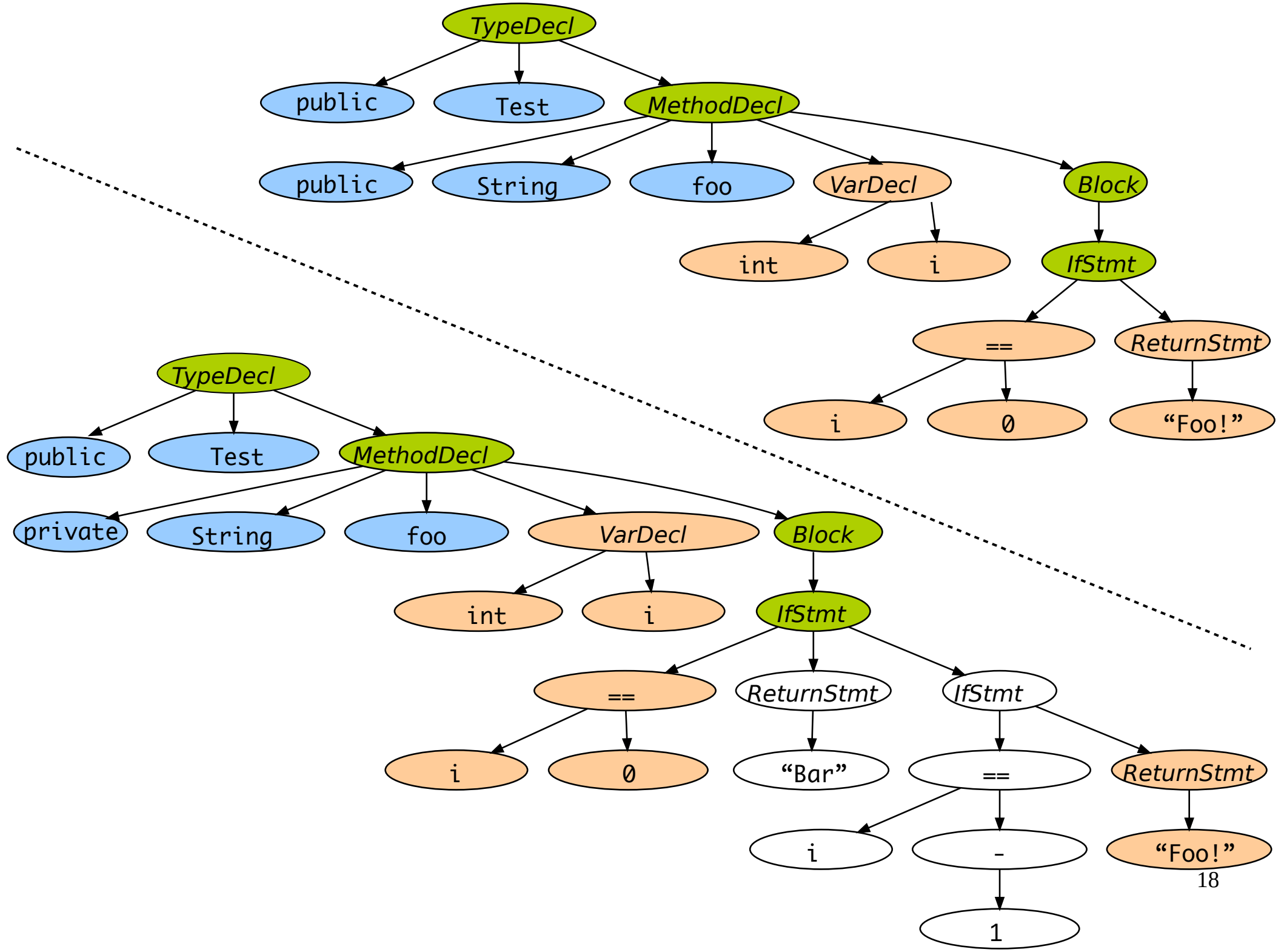
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Output

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public class Test {
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Previous state

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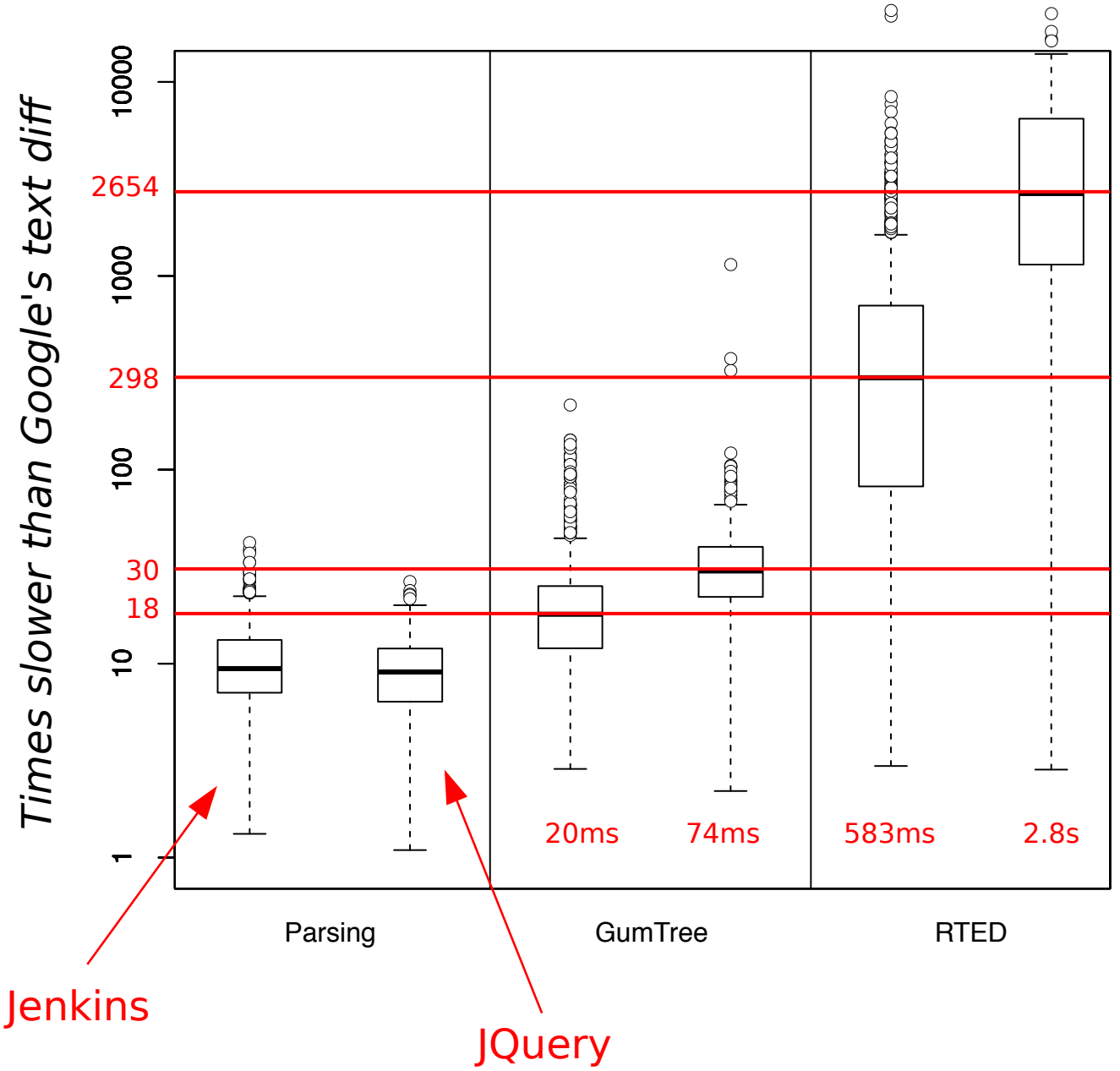
Current state

Performance evaluation

- Four distinct tools
  - *Google's text diff*
  - Code parsing
  - Code parsing + GumTree
  - Code parsing + RTED (optimal tree-diff algorithm)
- Every file modification of a complete release of
  - Jenkins (Java) → Eclipse JDT Parser
  - JQuery (JavaScript) → Mozilla Rhino Parser
- Report slowdown compared to Google's text diff

Slowdown vs. text diff

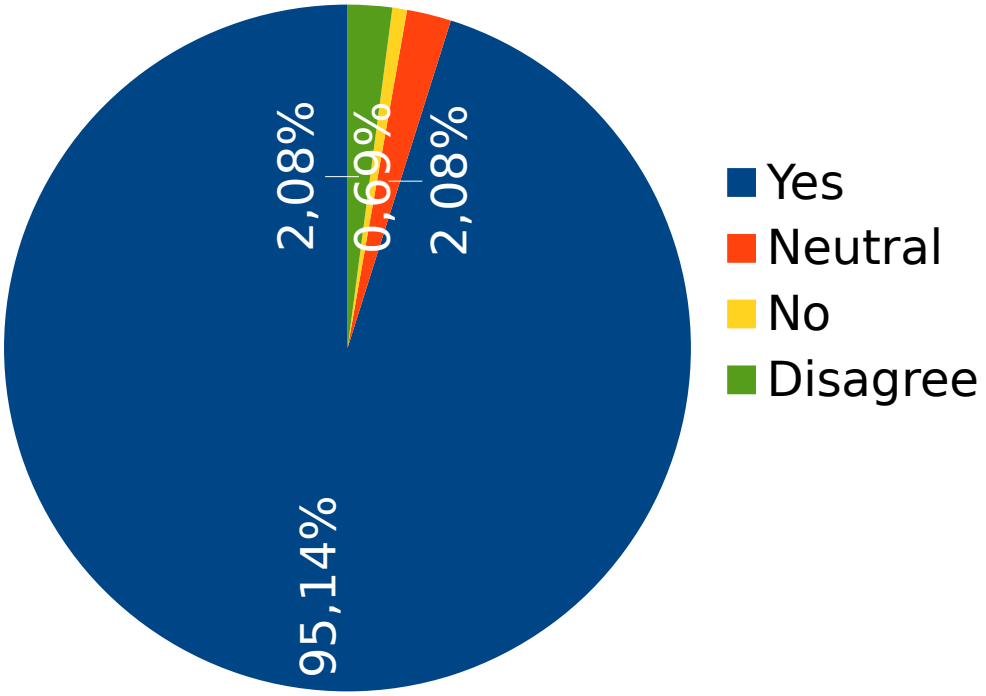


Human evaluation

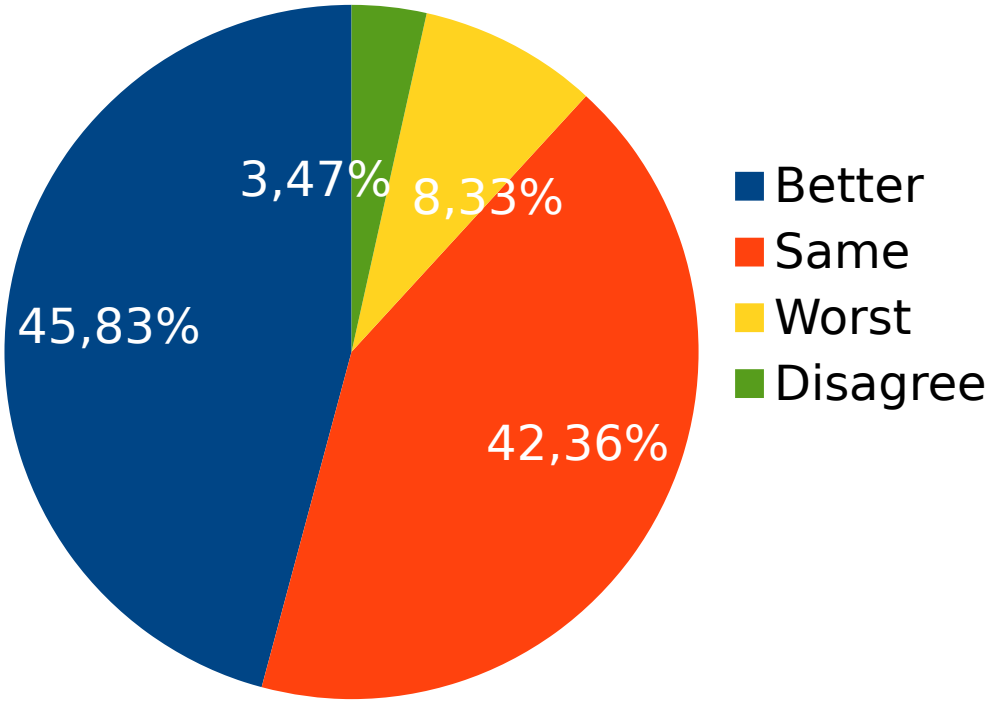
- 144 file modifications from 16 Java projects
- Two tools
  - GumTree
  - A visual text diff tool
- Two questions
  - GumTree does a good job? (*Yes, Neutral or No*)
  - GumTree is better than text diff? (*Yes*, *No* or *Same*)
- Three raters
- Report opinion of the majority

Results

GumTree does a good job?



GumTree vs text diff?

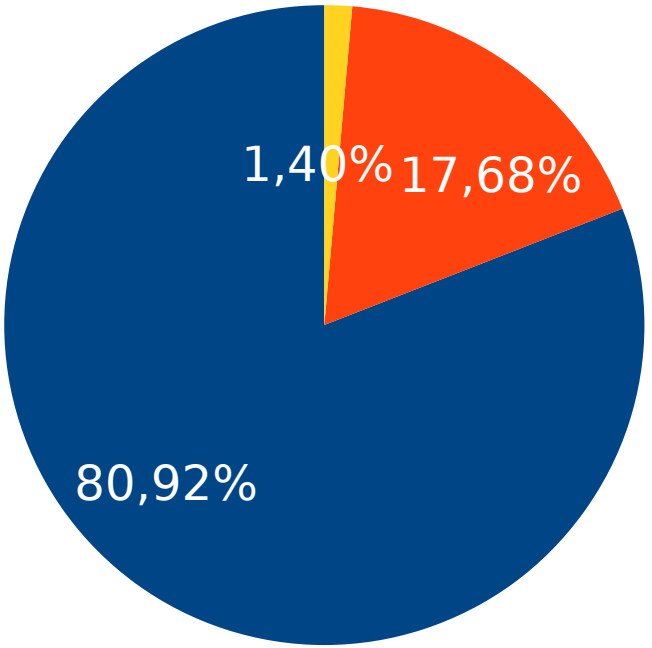


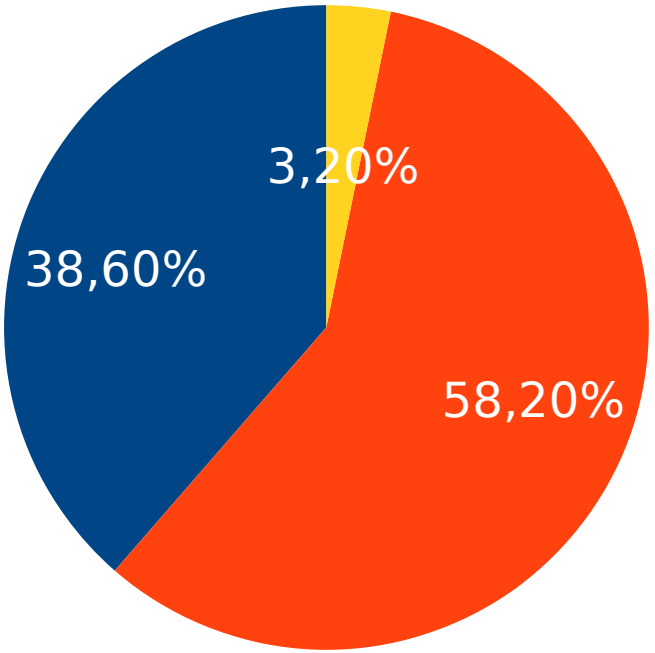
Automatic evaluation

- 1000 file modifications from 16 Java projects
- Two tools
  - GumTree
  - ChangeDistiller (our implementation)
- Two Java parsers
  - Eclipse JDT (fine grained)
  - ChangeDistiller (coarse grained)
- Report number of edit actions

Results

Number of edit actions of GumTree vs. ChangeDistiller





Eclipse JDT Parser

ChangeDistiller Parser

Conclusion

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  - Work on syntax trees
- Tool
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  - Empirically validated
  - Freely available

https://github.com/GumTreeDiff/gumtree