Source-Level Dataflow-Based Fixes

Experiences from using IntraJ and MagpieBridge

Idriss Riouak - Lund University

EXAMPLE DATAFLOW-BASED ANALYSES

```
1  void foo(boolean b){
2    String x = null;
3    if(b) x = "Hello World";
4    x.toString();
5  }
```

Null pointer Analysis (NPA)

⚠ Possible `NullPointerException` at line 4

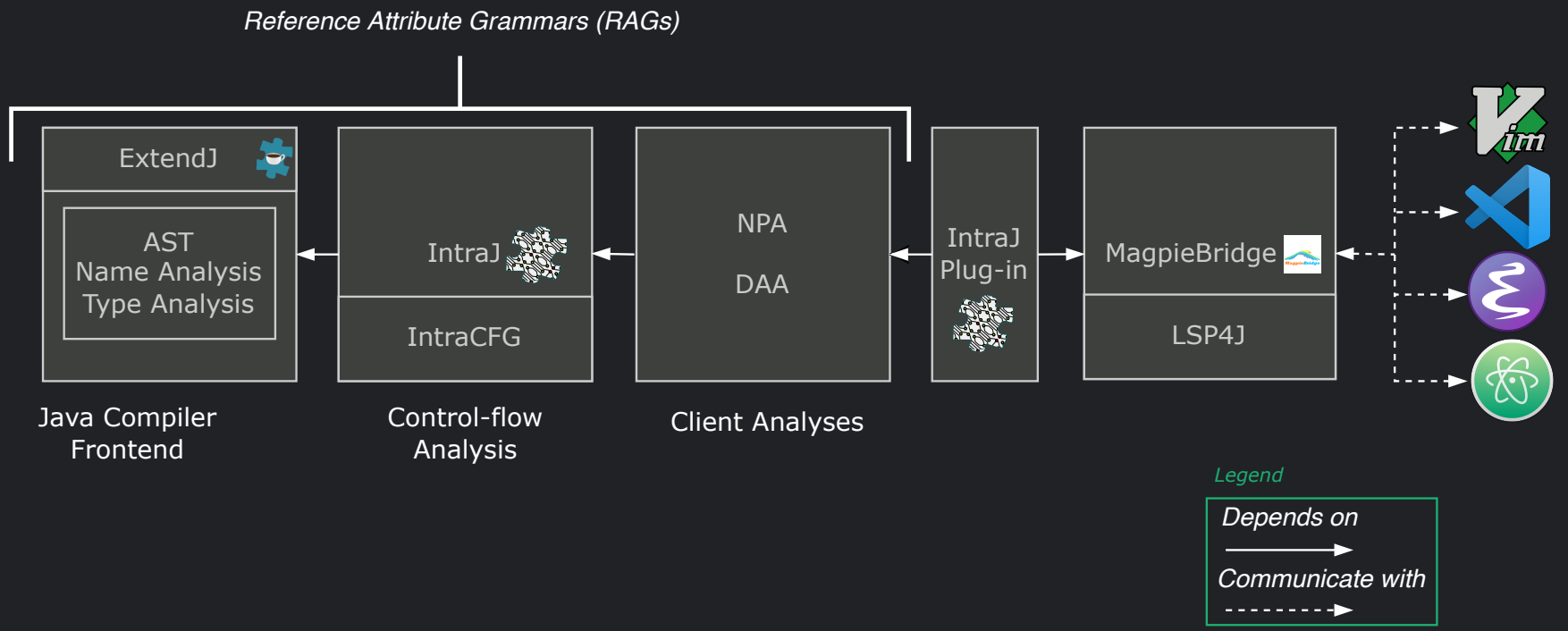
```
1  private int hash = 0;
2  int hashFunc(){
3    if(hash==0){
4      int hash = 10;
5      //Complex operations on  hash
6      hash += 10;
7    }
8    return hash;
9  }
```

Dead Assignment Analysis (DAA)

SIMPLIFIED EXAMPLE FROM APACHE FOP (90 KLOC)

⚠ `Dead Assignment` at line 6. The value of `hash` is never read.

THE BIG PICTURE



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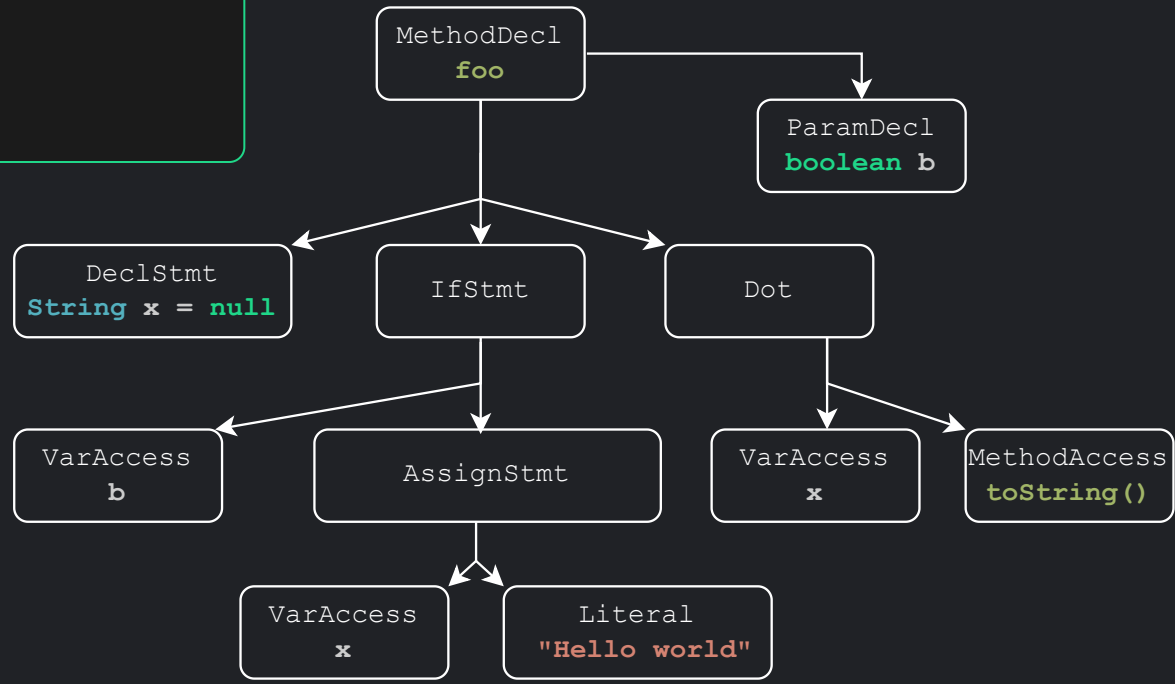

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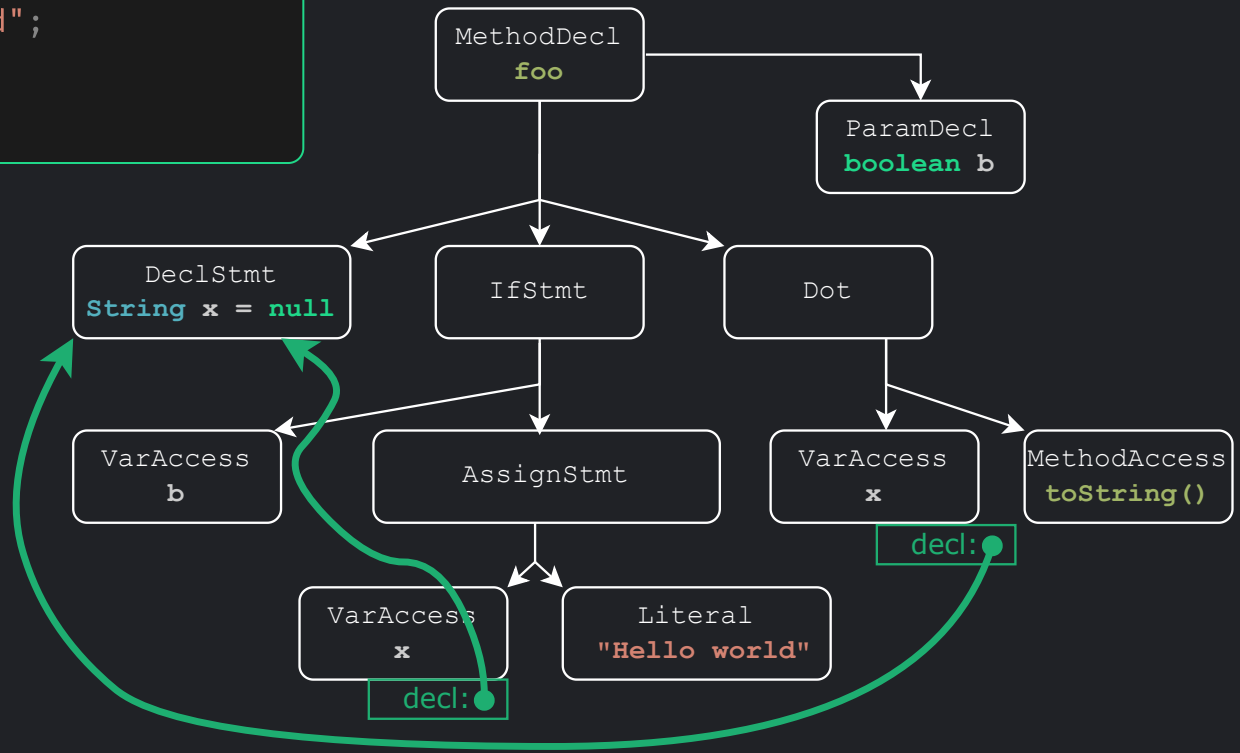

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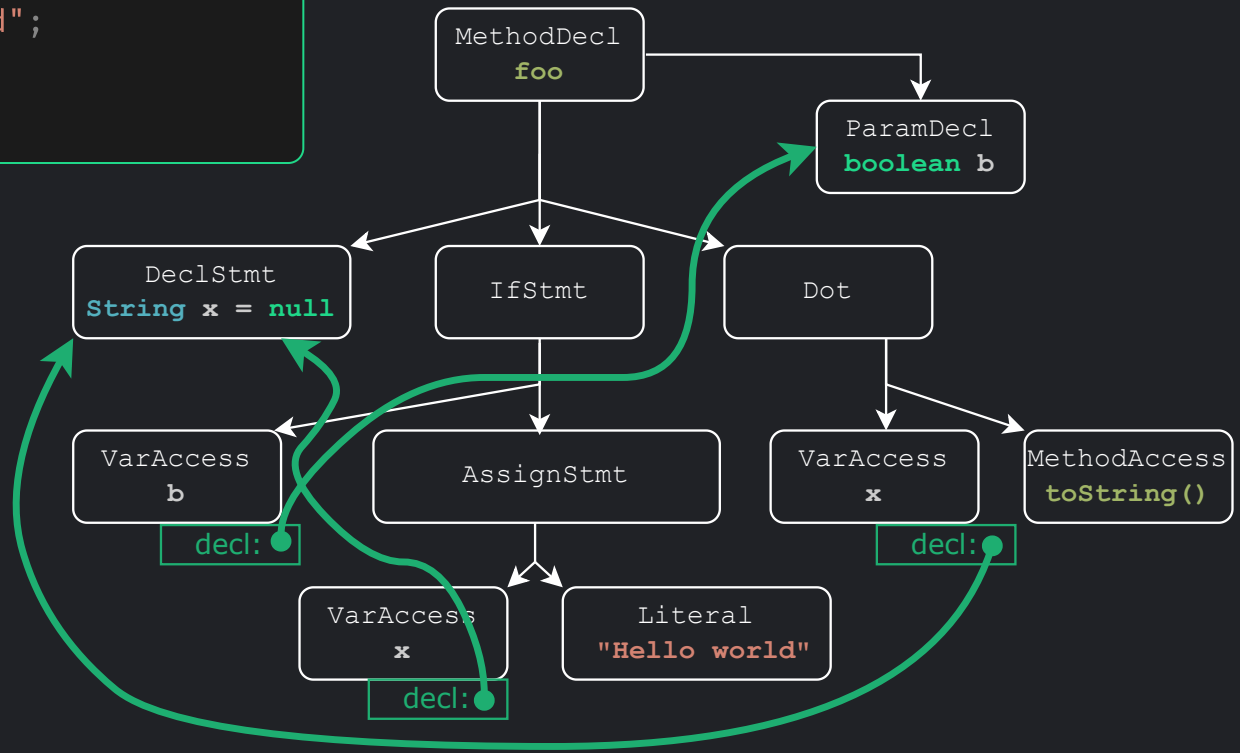

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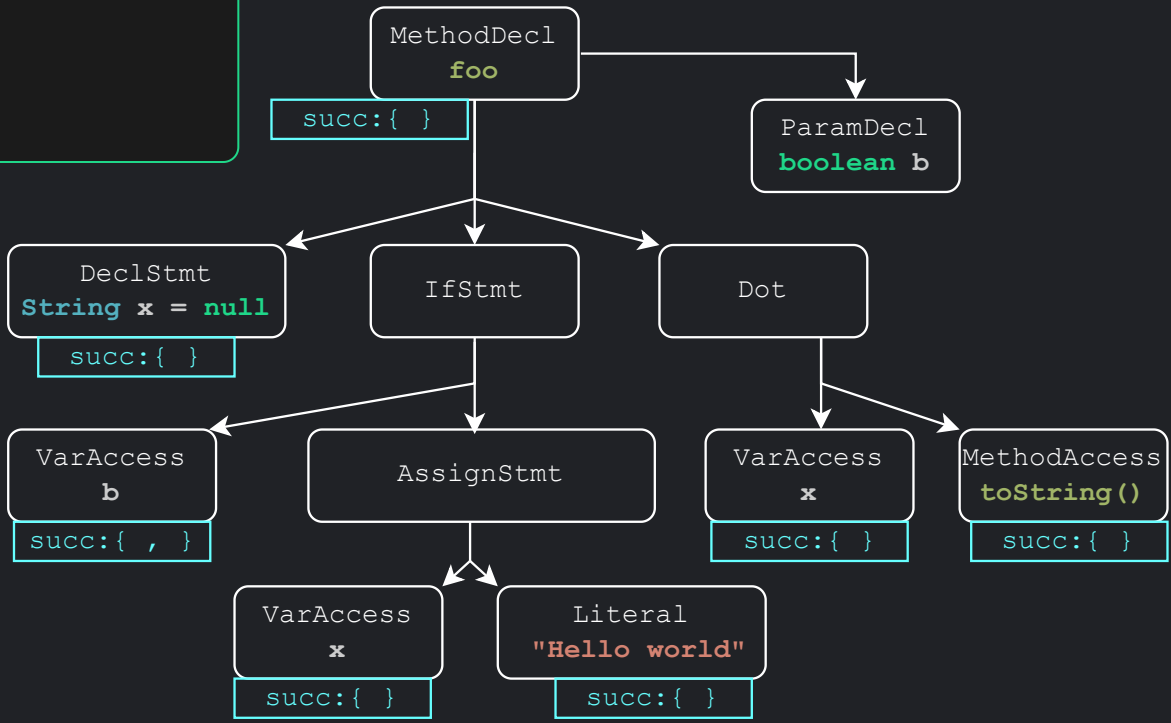

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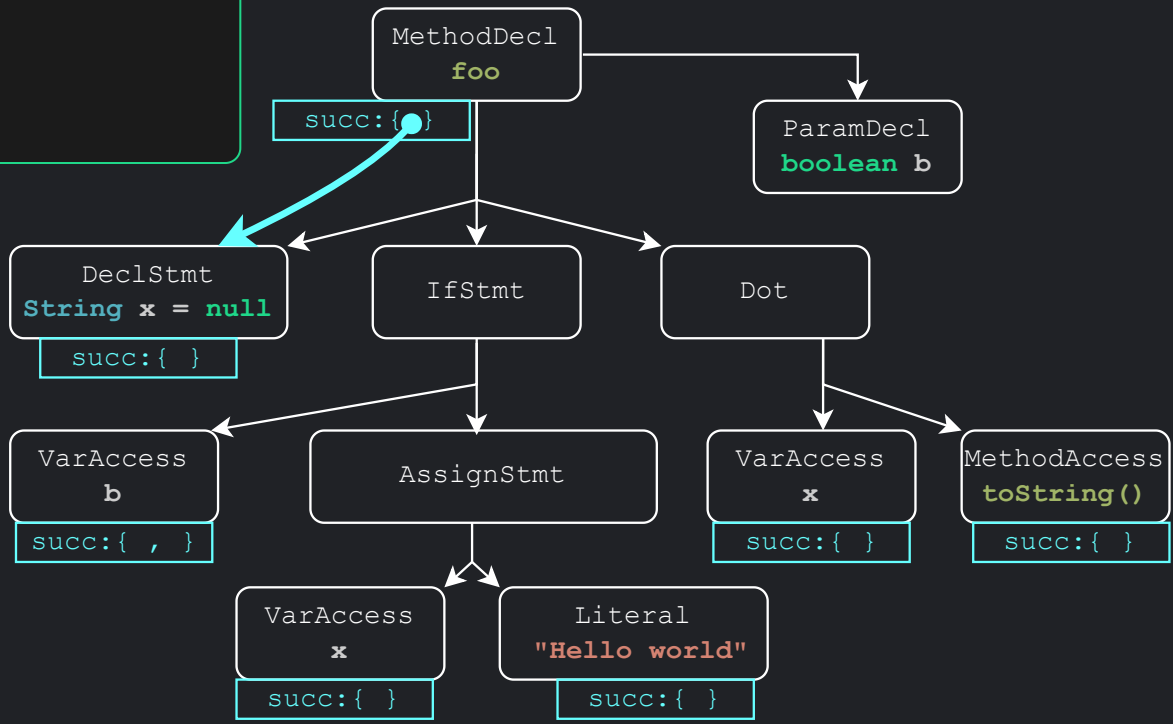

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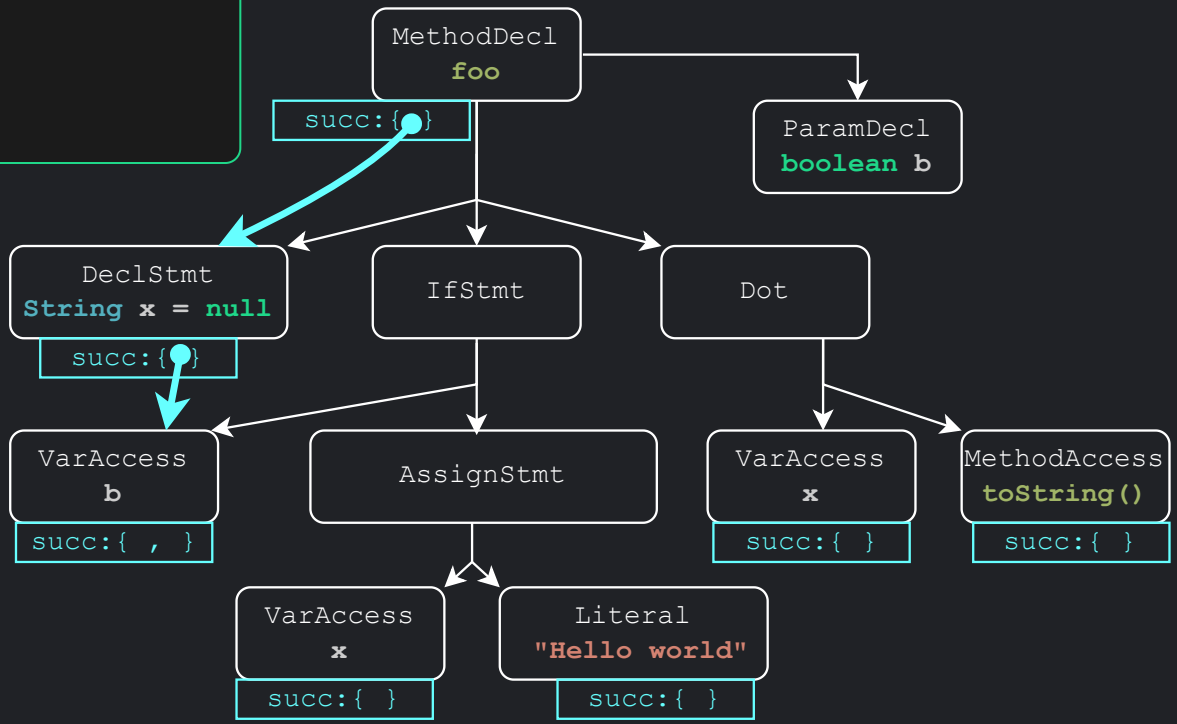

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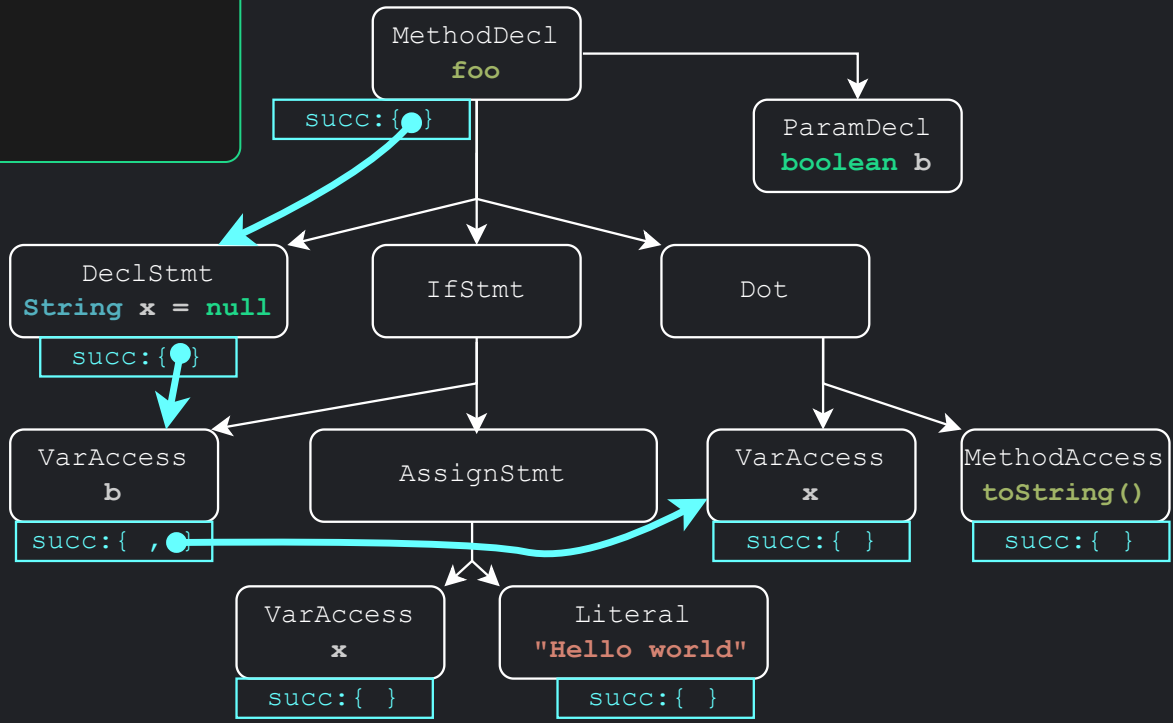

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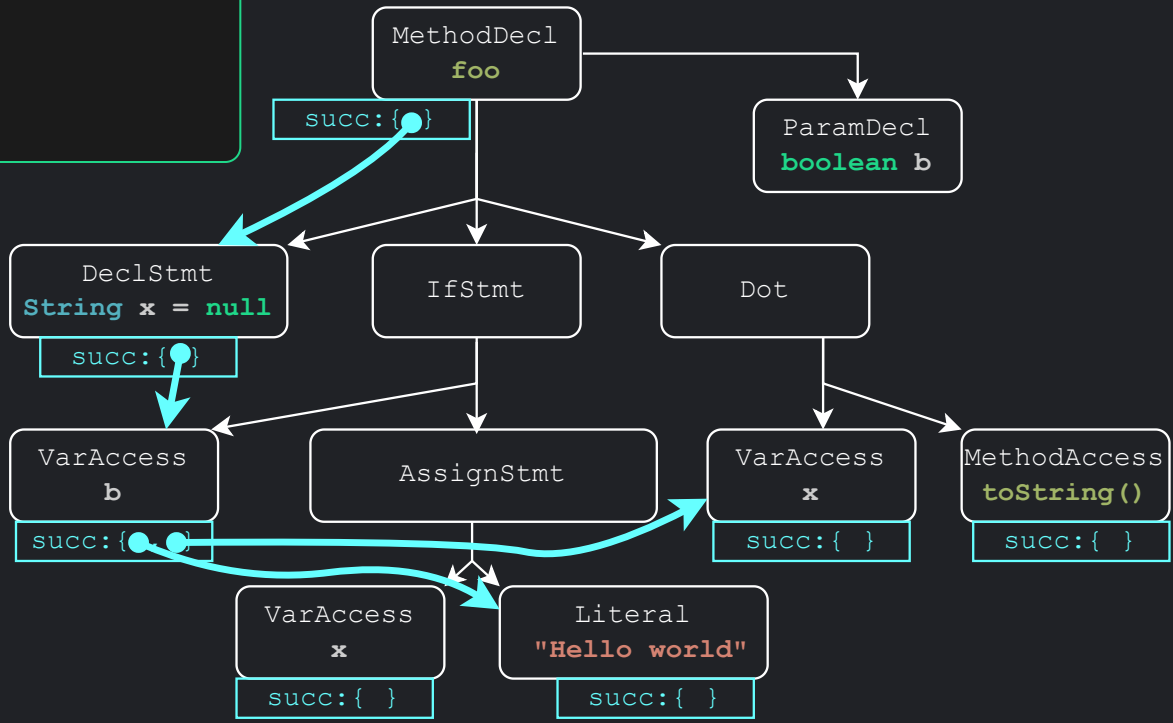

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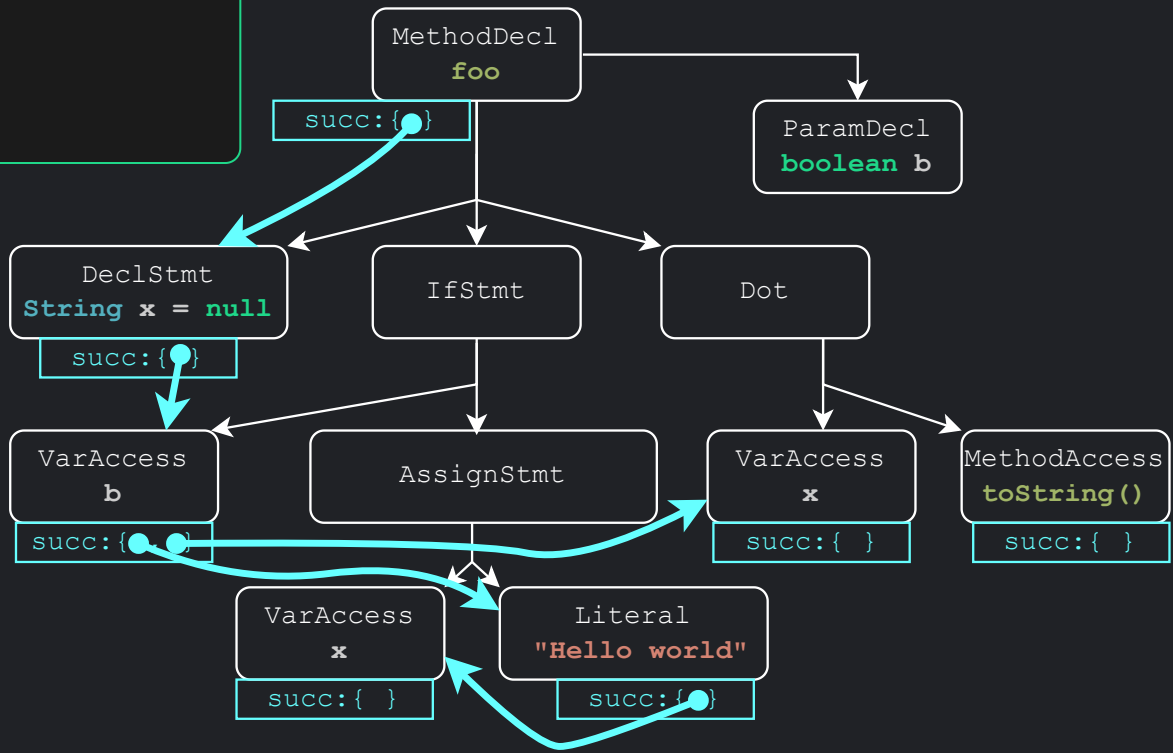

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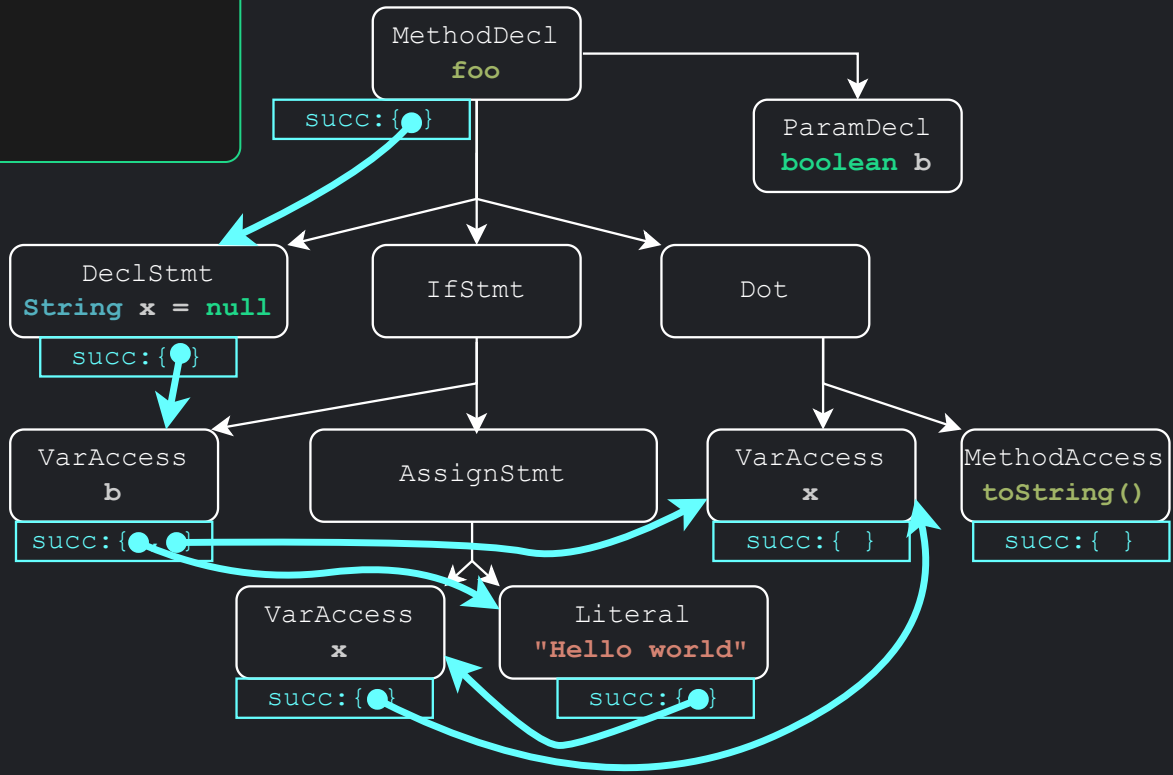

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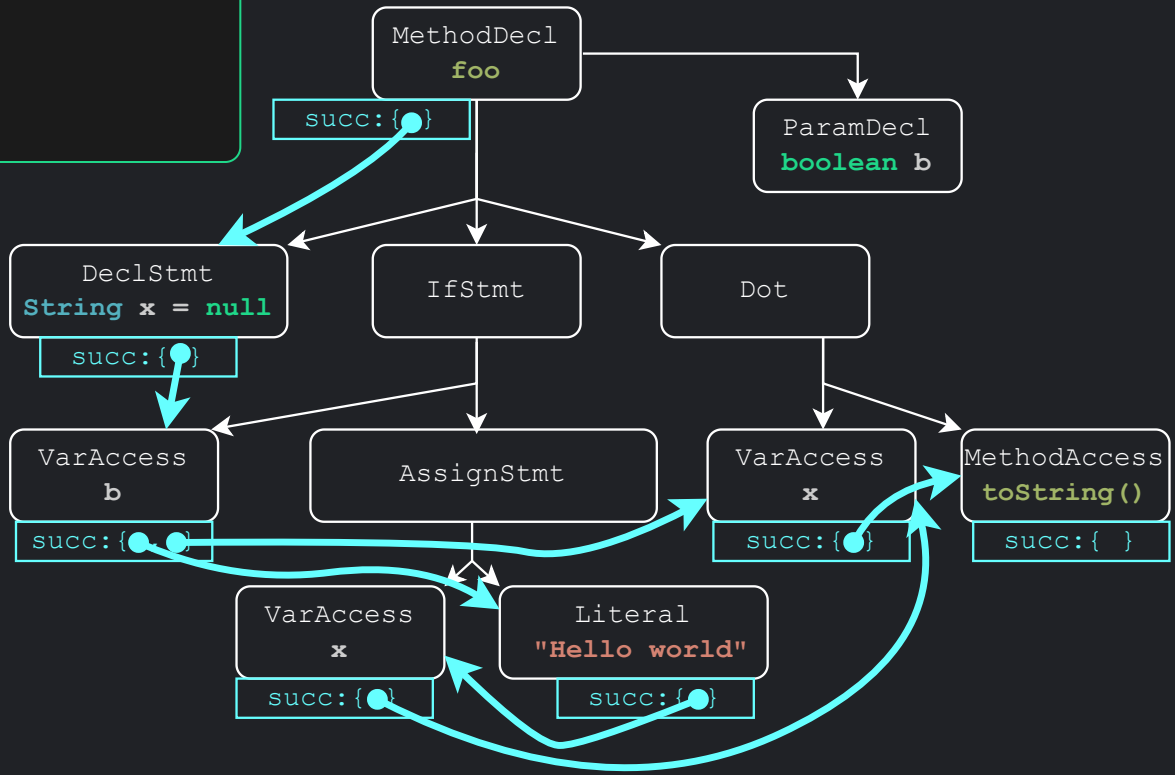

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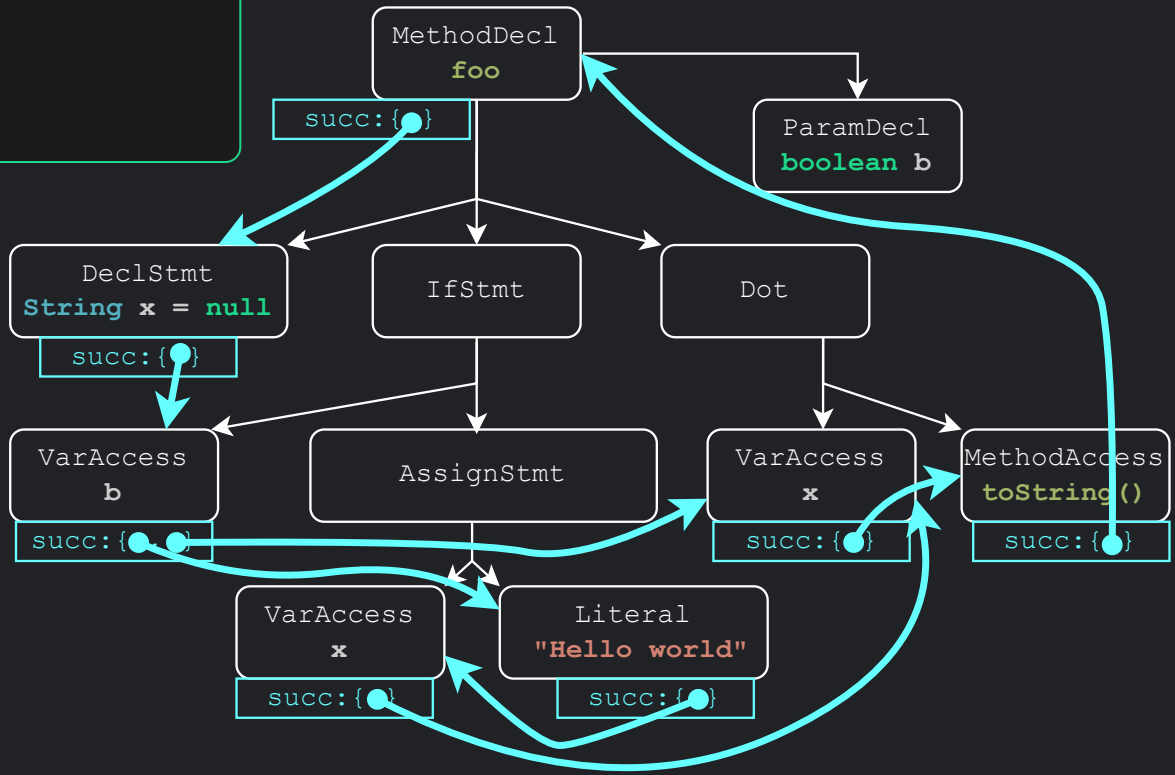

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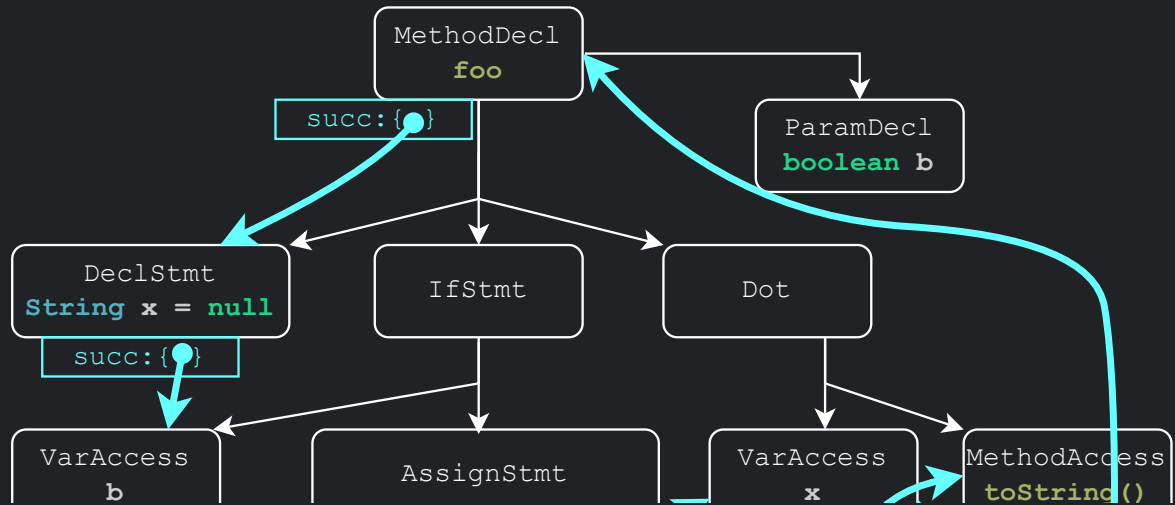
- JastAdd ecosystem
  - Ondemand evaluation
  - Mutually dependent properties
  - Add subtree to the AST

jastadd



INTRAJ

- Builds the CFGs on the AST
- Handles implicit control-flows
- Analyses competitive with existing tools e.g., ***SonarQube***

If you want to know more ...

GitHub

Paper

NULL POINTER ANALYSIS

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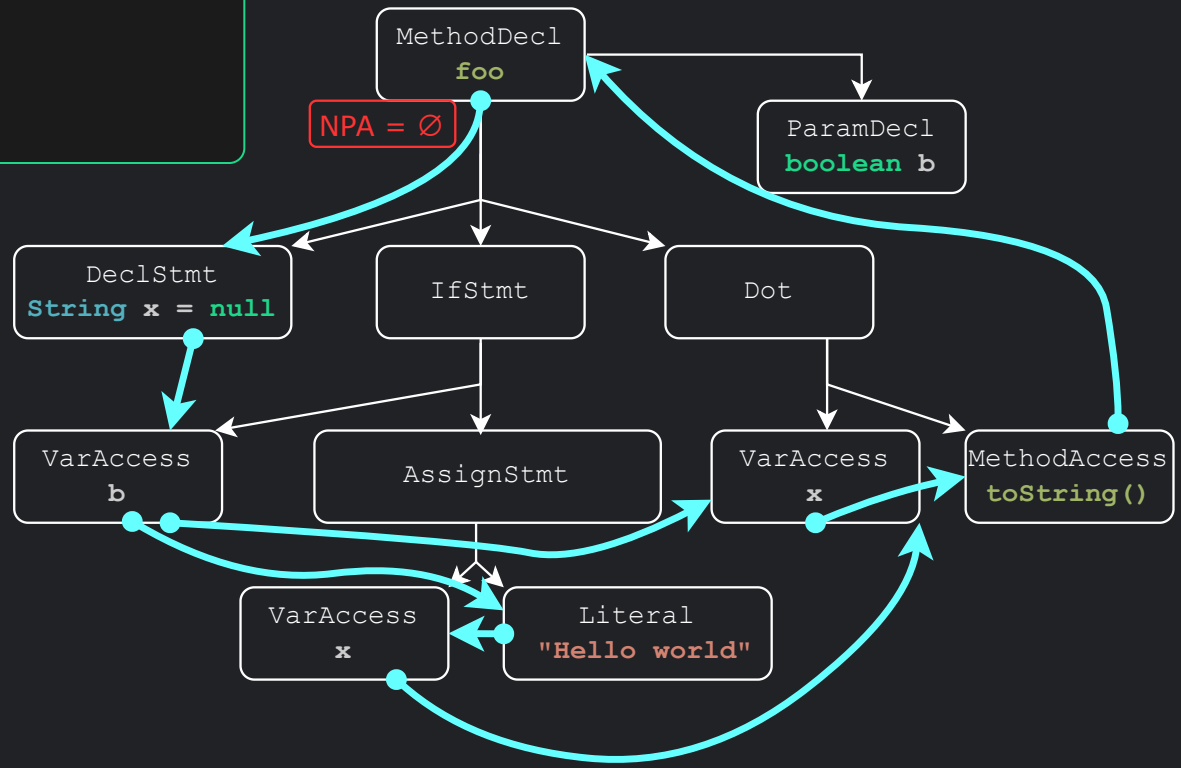

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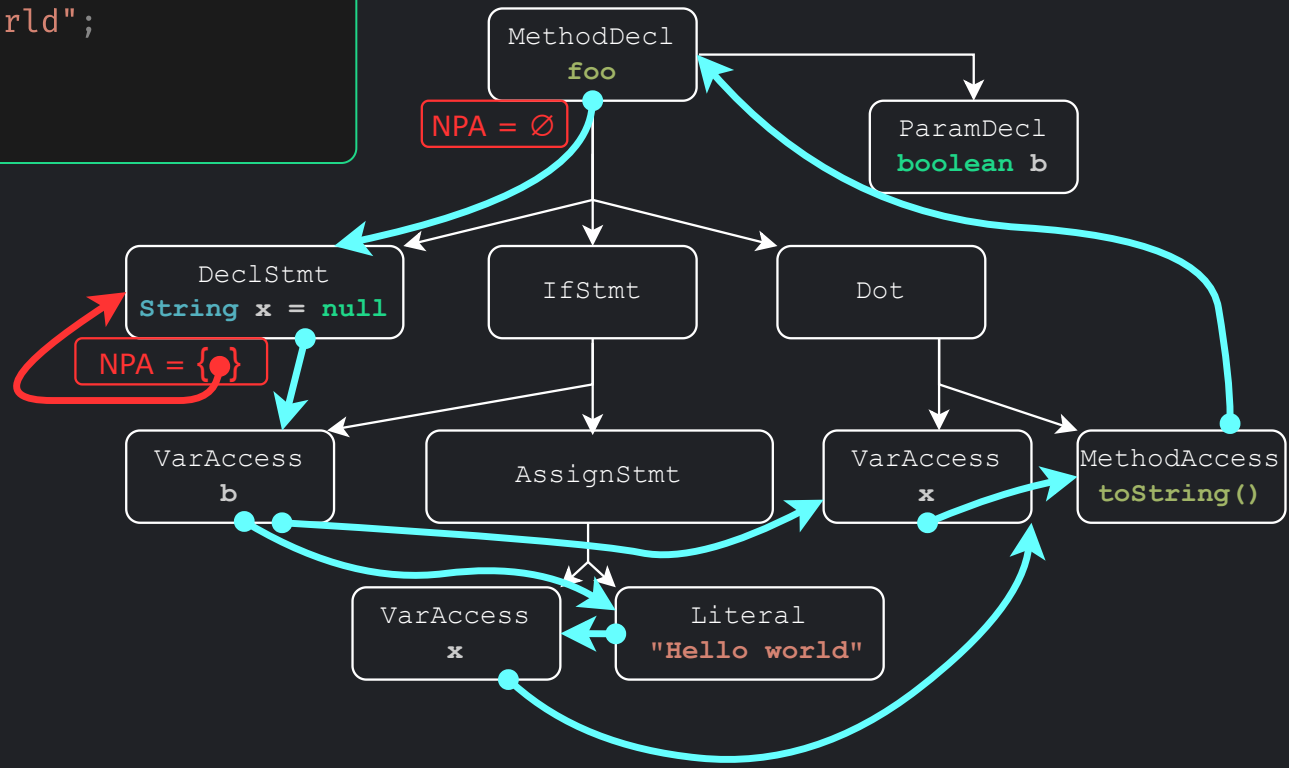

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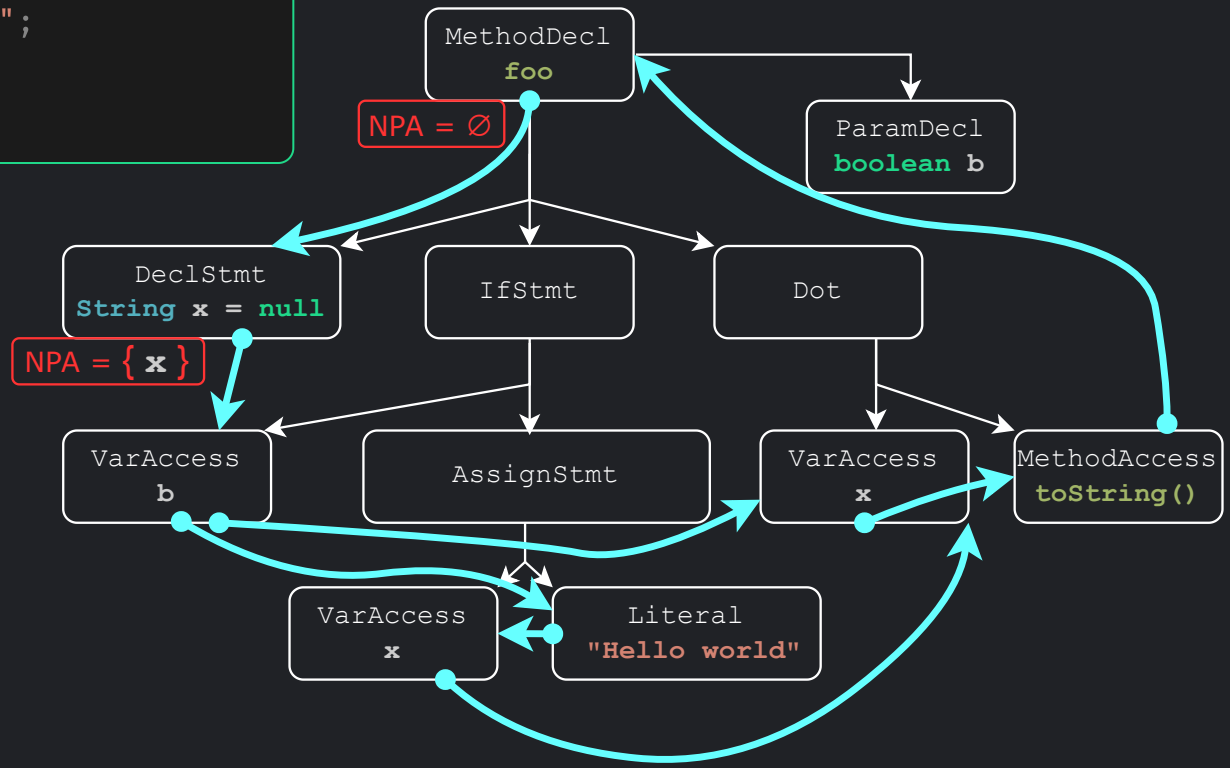

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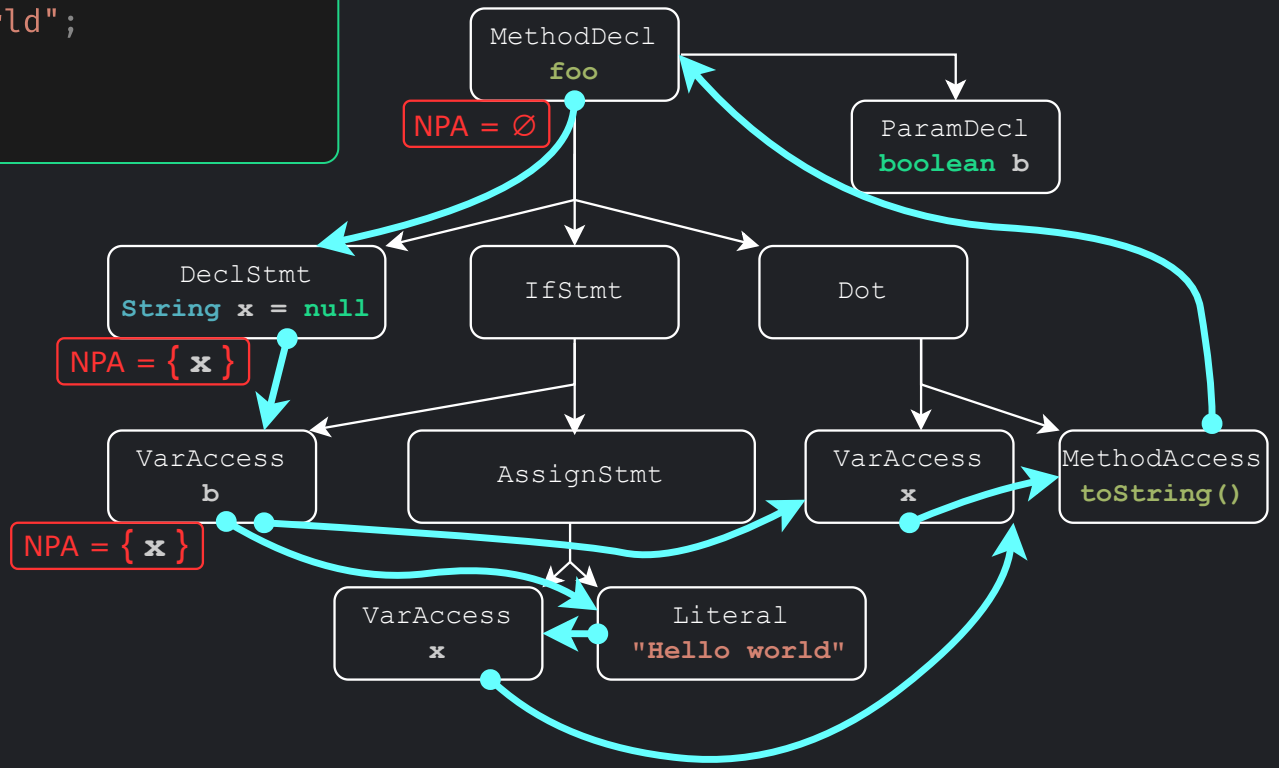

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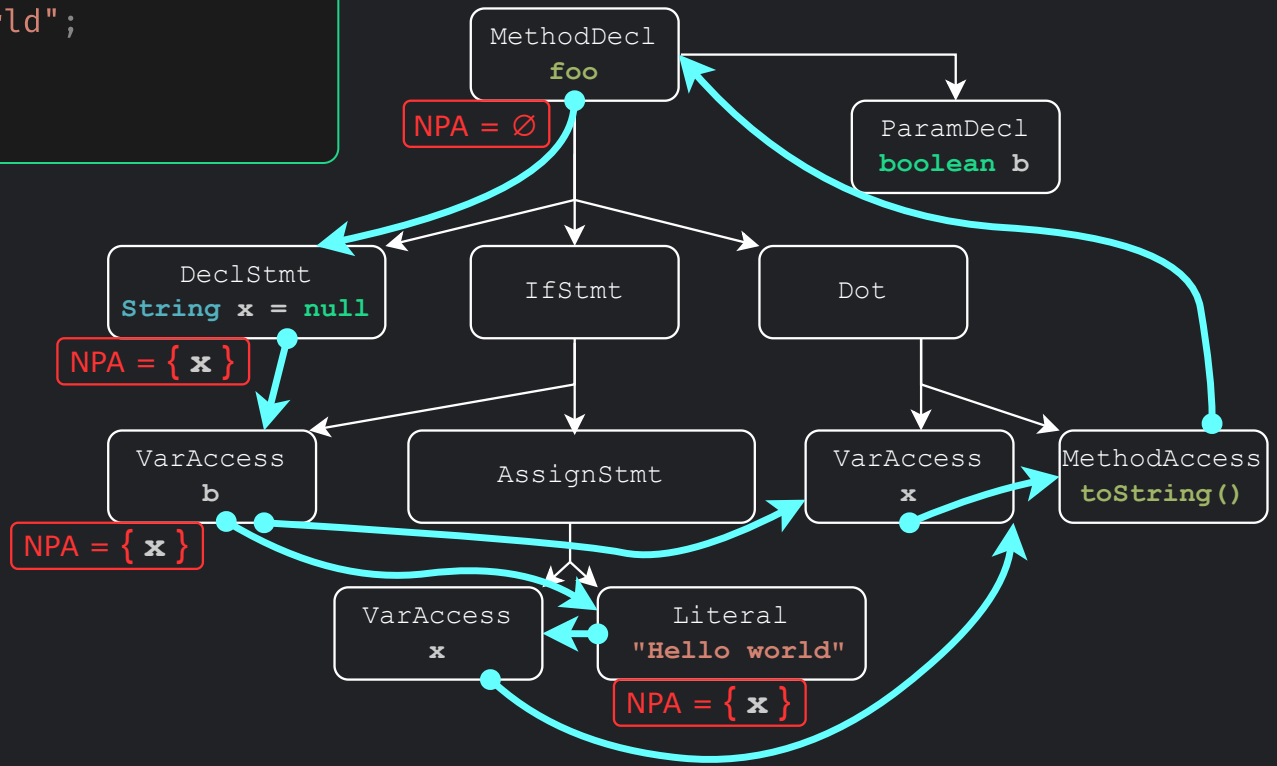

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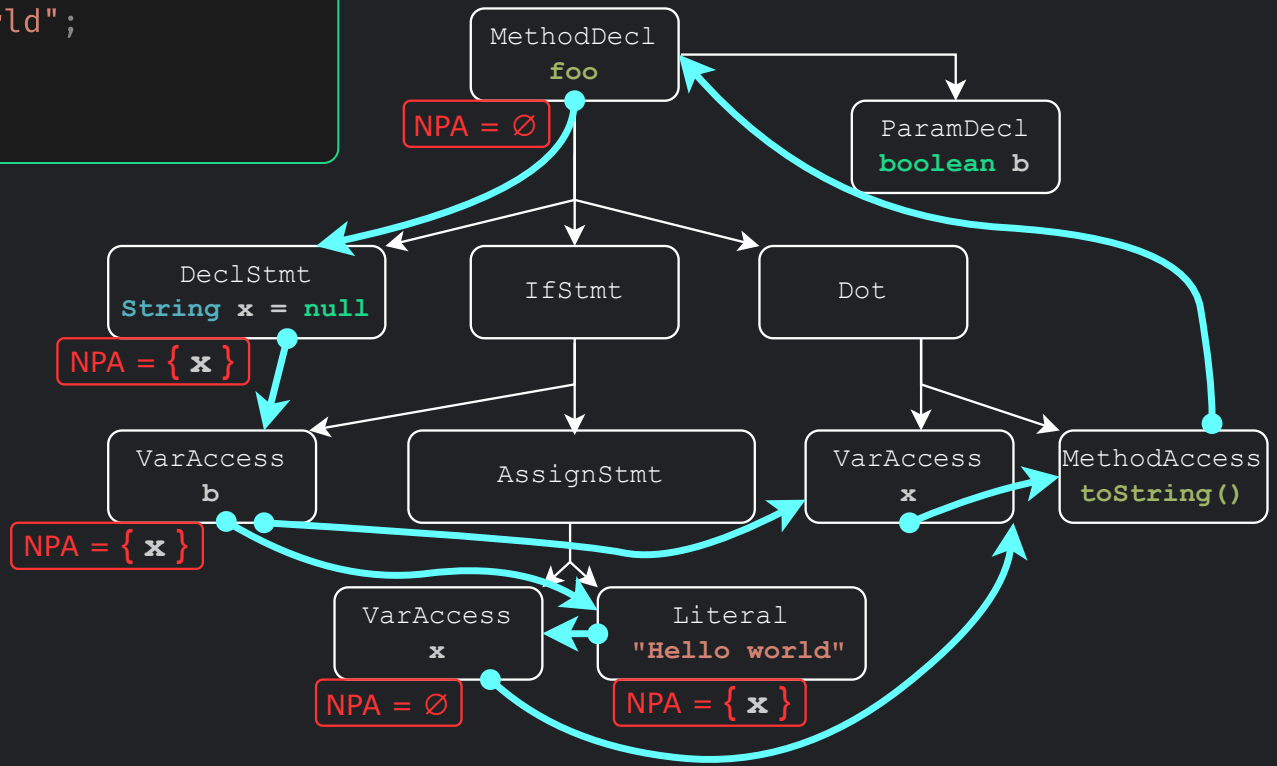

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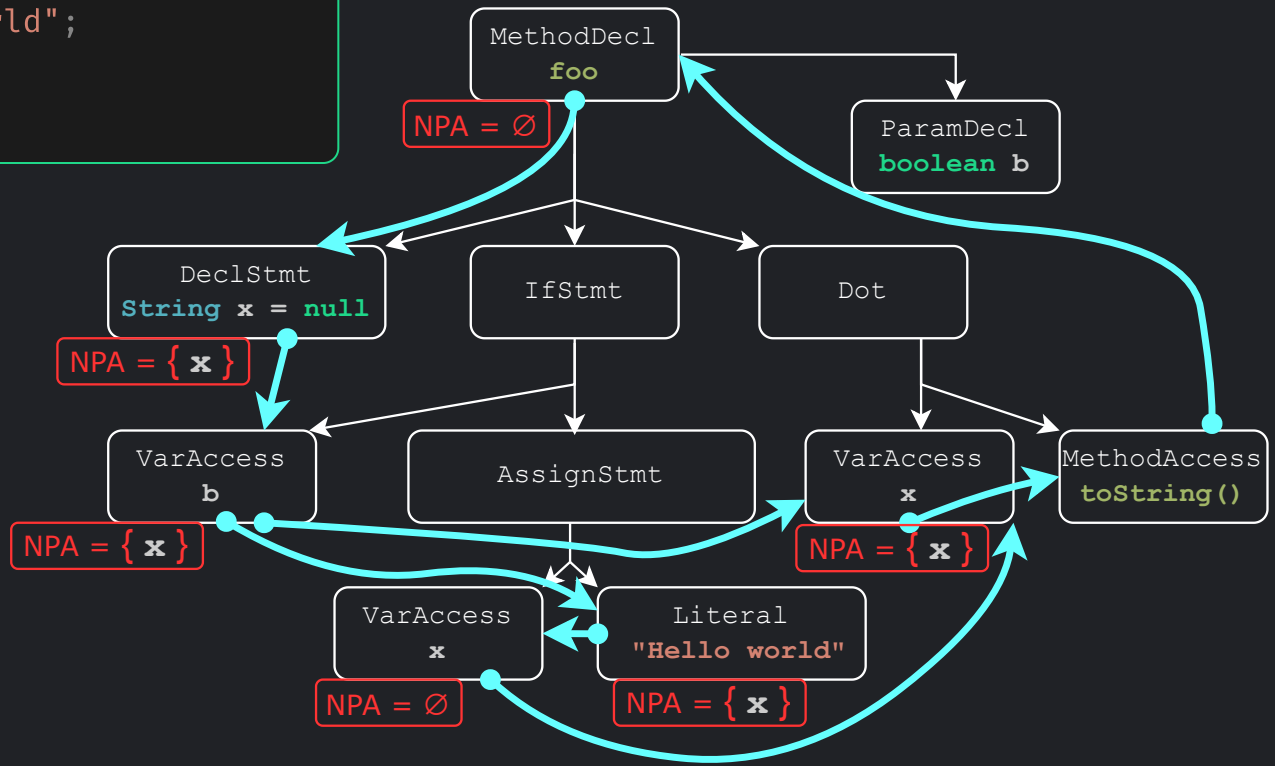

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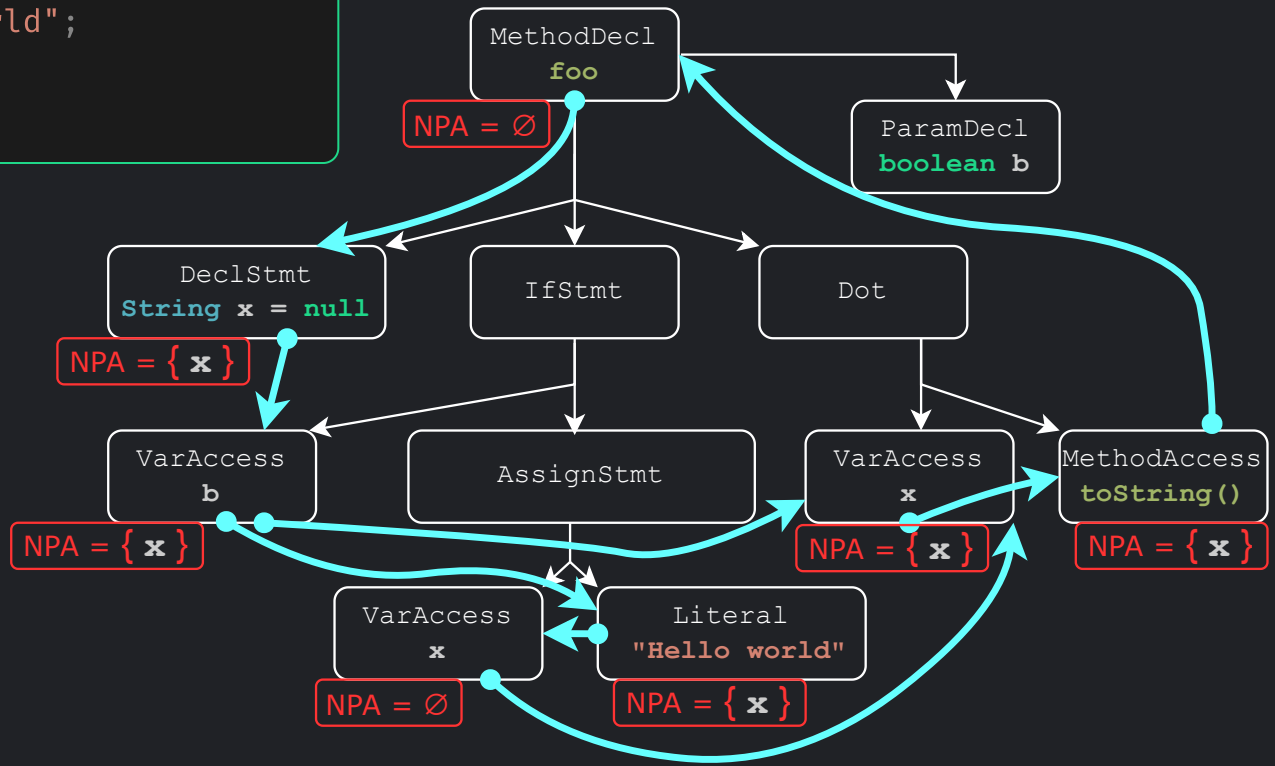

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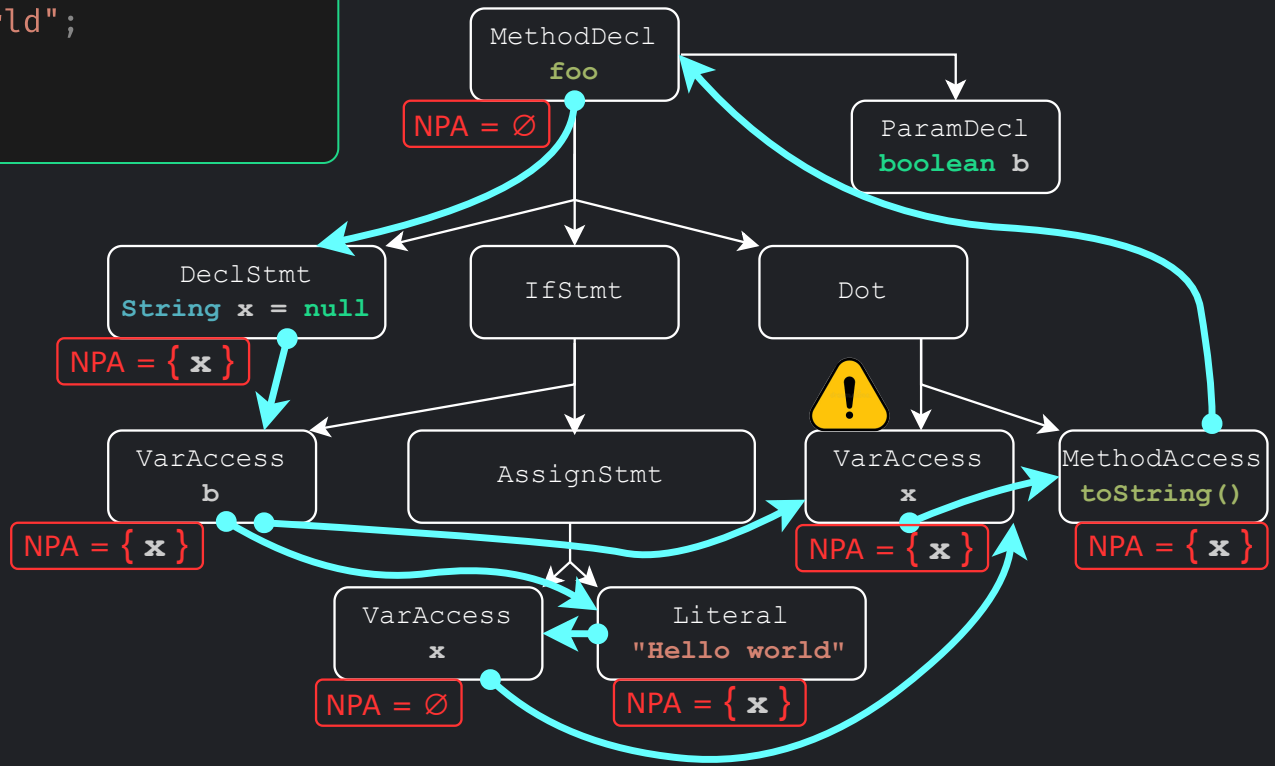
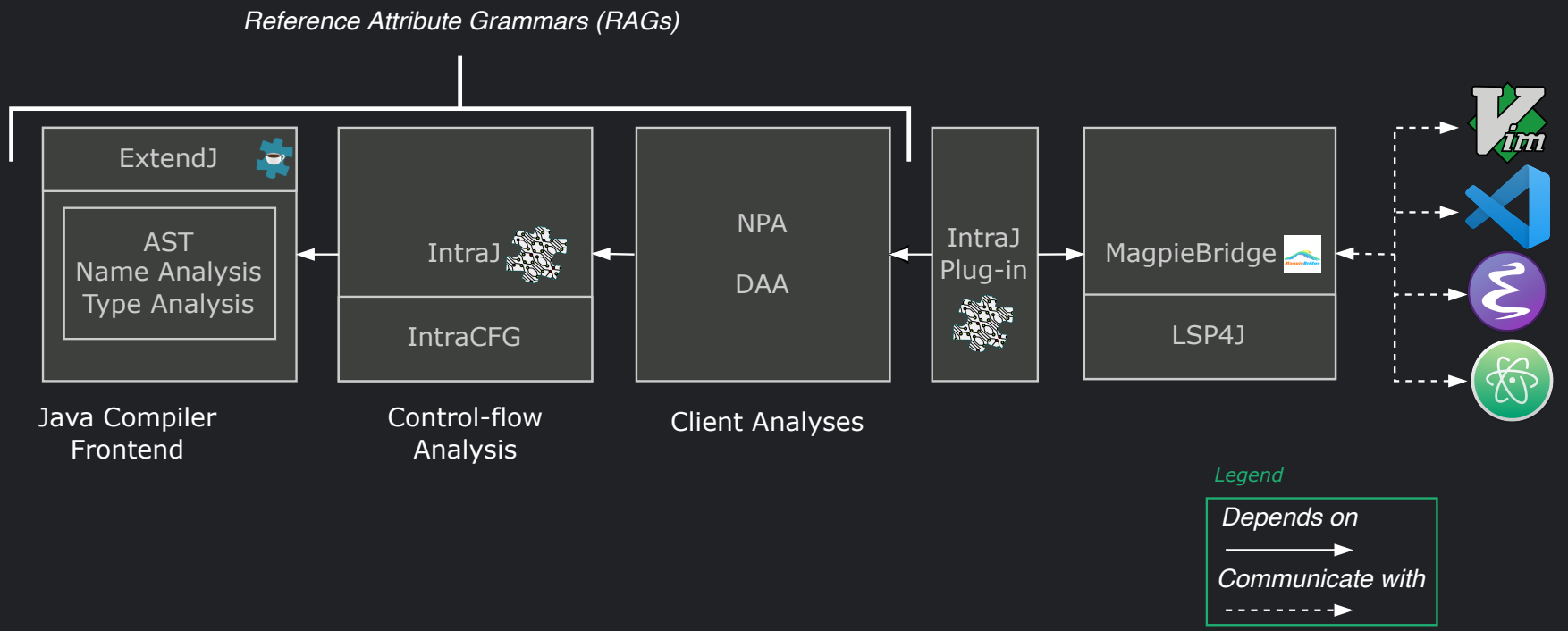


THE BIG PICTURE



INTRAJ PLUGIN

- Credits:
  - Plugin V 0.1 made by Charlie Mrad (Master Student @ LU)
- Live demo:
  - Null Pointer Analysis
  - Dead Assignment Analysis
- The role of MagpieBridge:
  - Integration with VSCode
  - Extension settings

TIP OF THE ICEBERG

THANK YOU FOR YOUR ATTENTION !

GitHub

Paper

Extension

MOTIVATIONS: SOURCE-LEVEL

```
1  void foo(boolean b){
2    String x = null;
3    if(b) x = "Hello World";
4    x.toString();
5  }
```

Advantages

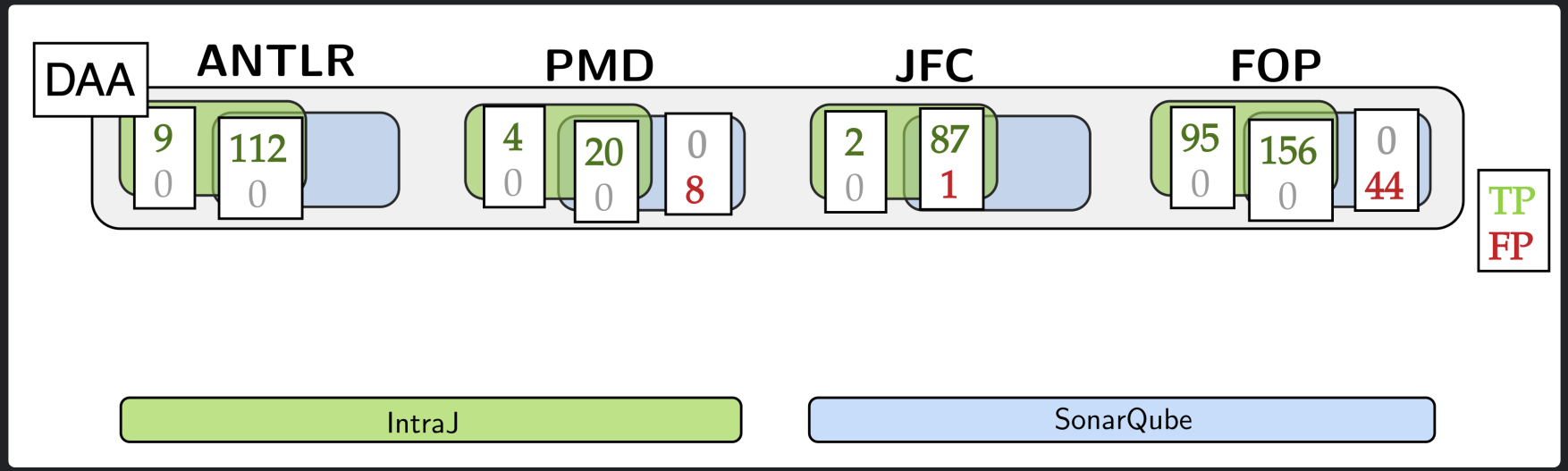
1. Error are directly linked to the source code
2. Works with broken code
3. Easier integration with IDEs

Disadvantages

1. Bigger language
2. Source-code contains implicit facts

```
1   void foo(java.lang.boolean);
2     Code:
3        0: aconst_null
4        1: astore_2
5        2: aload_1
6        3: invokevirtual #2
7        6: ifeq          12
8        9: ldc           #3
9       11: astore_2
10      12: aload_2
11      13: invokevirtual #4
12      16: pop
13      17: return
```

PRECISION: NUMBERS



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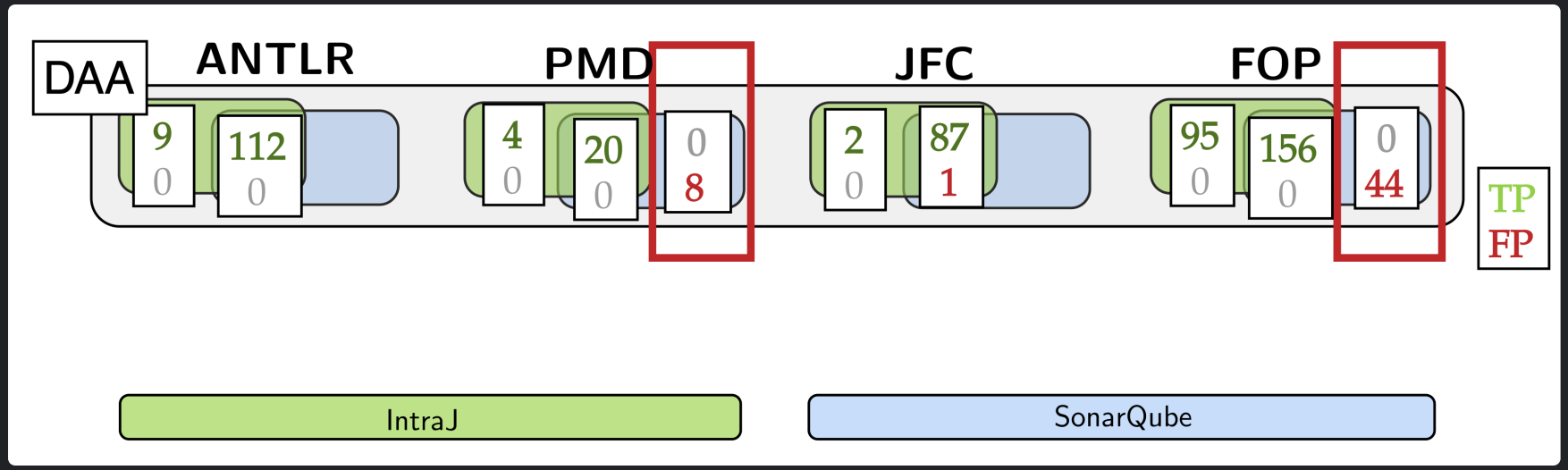

DeadAssignmentAnalysis: IntraJ detects everything that SonarQube detects

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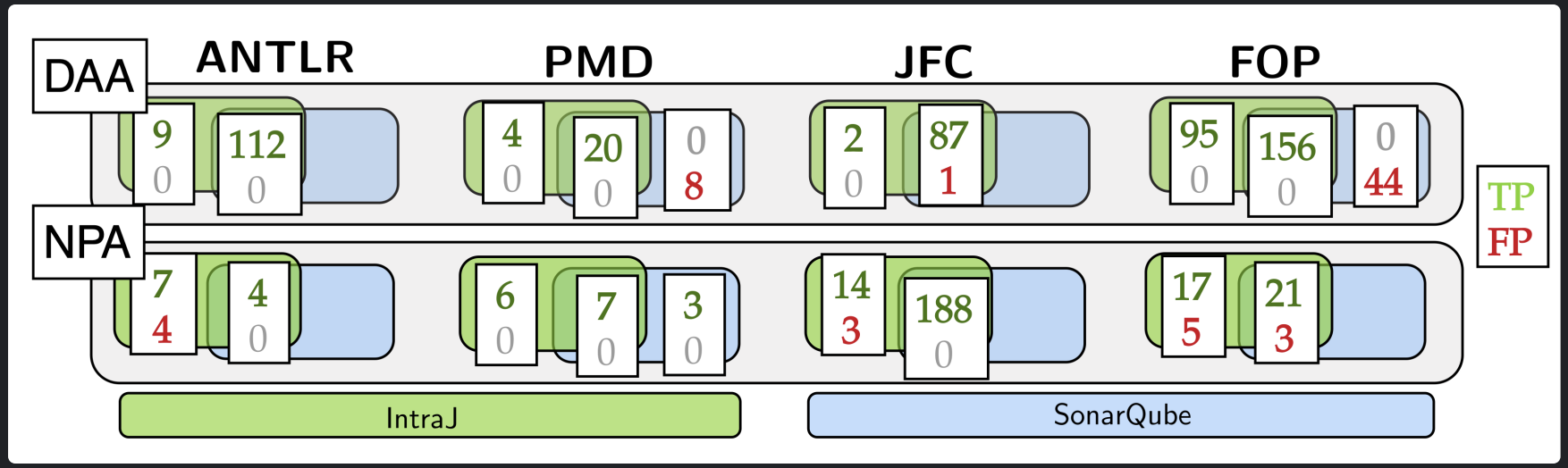
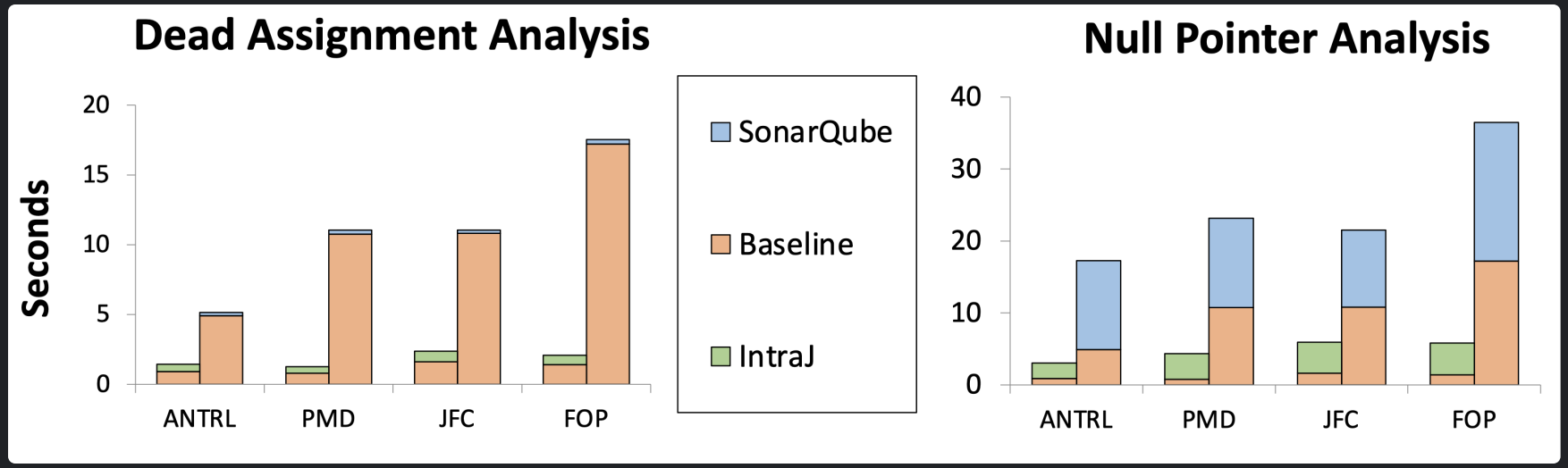


DeadAssignmentAnalysis: IntraJ detects everything that SonarQube detects

NullPointerAnalysis: SonarQube is more precise but IntraJ remains competitive

PERFORMACE

1. No dealy in the previous demo



INTRAJ - A USE CASE

```
1  // Hello World!
2  class Foo {
3    static void main(String[] args) {
4      System.out.println("Hello World!");
5    }
6  }
7
```