Source-Level Dataflow-Based Fixes

Experiences from using IntraJ and MagpieBridge

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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)

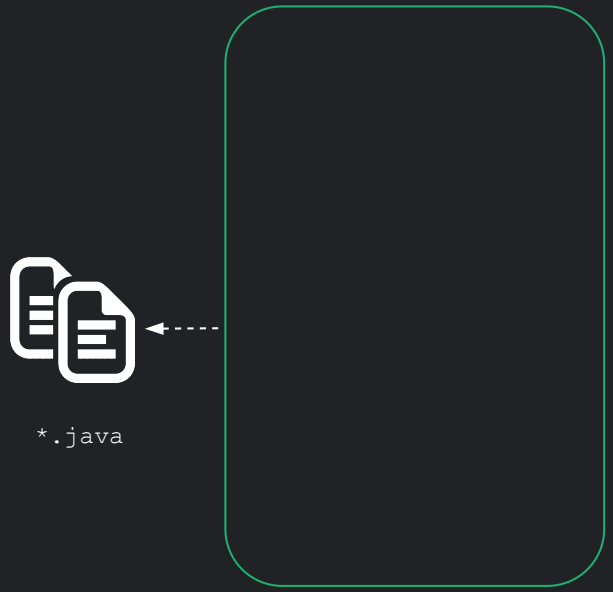
⚠ `Dead Assignment` at line 6. The value of `hash` is never read.

THE BIG PICTURE

`*.java`

Final User

THE BIG PICTURE



Final User

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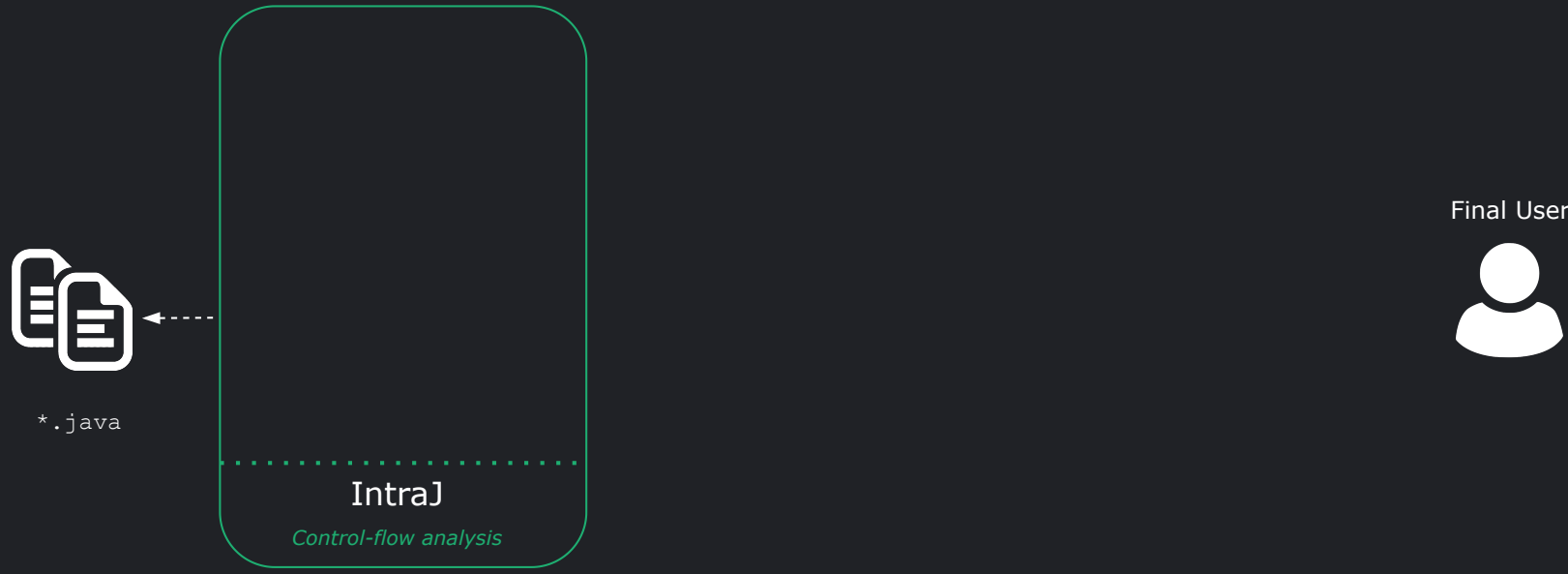

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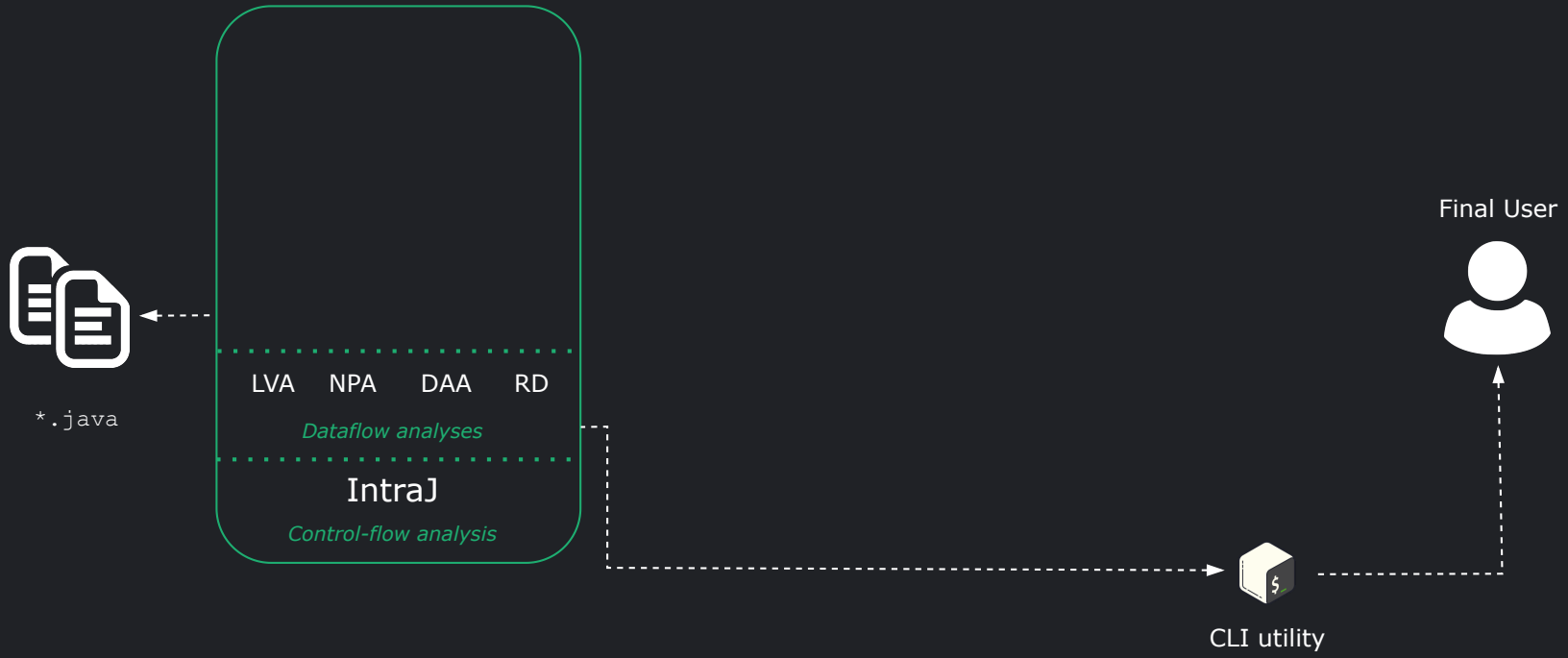

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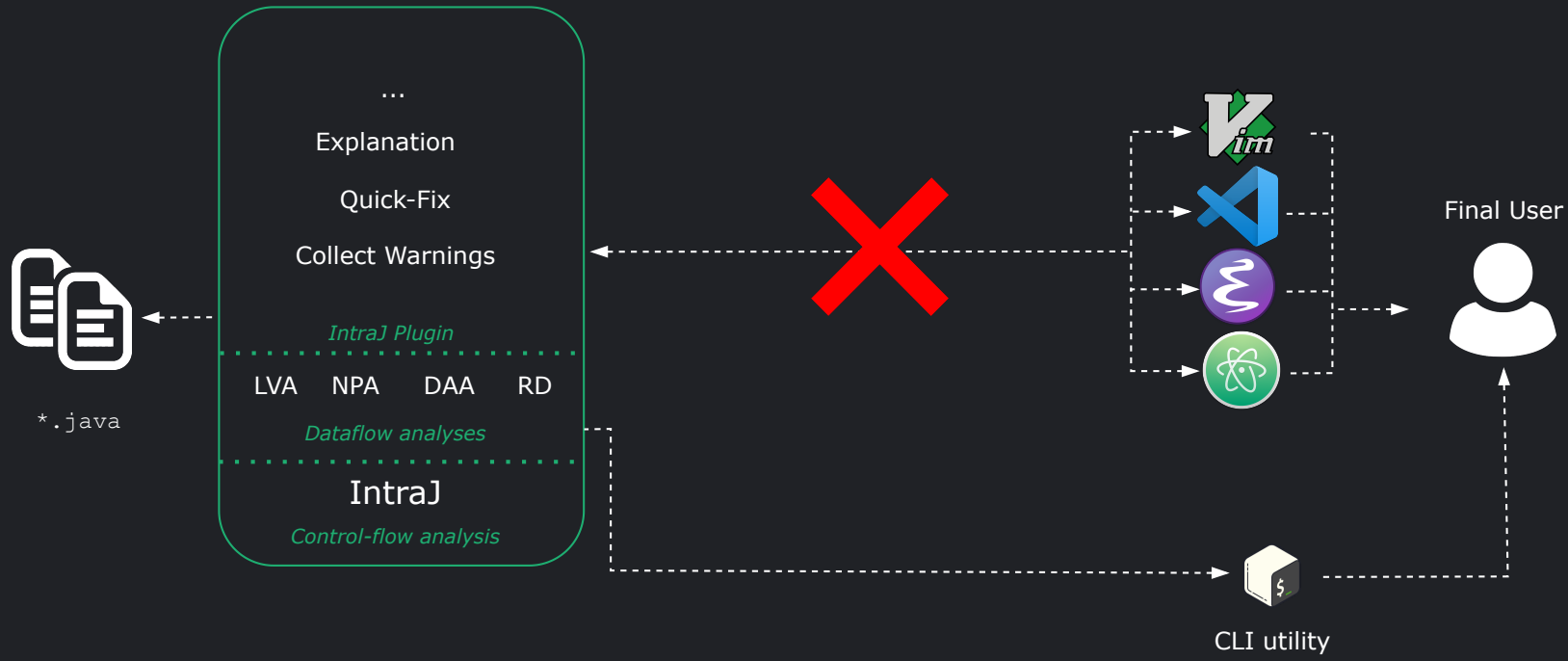

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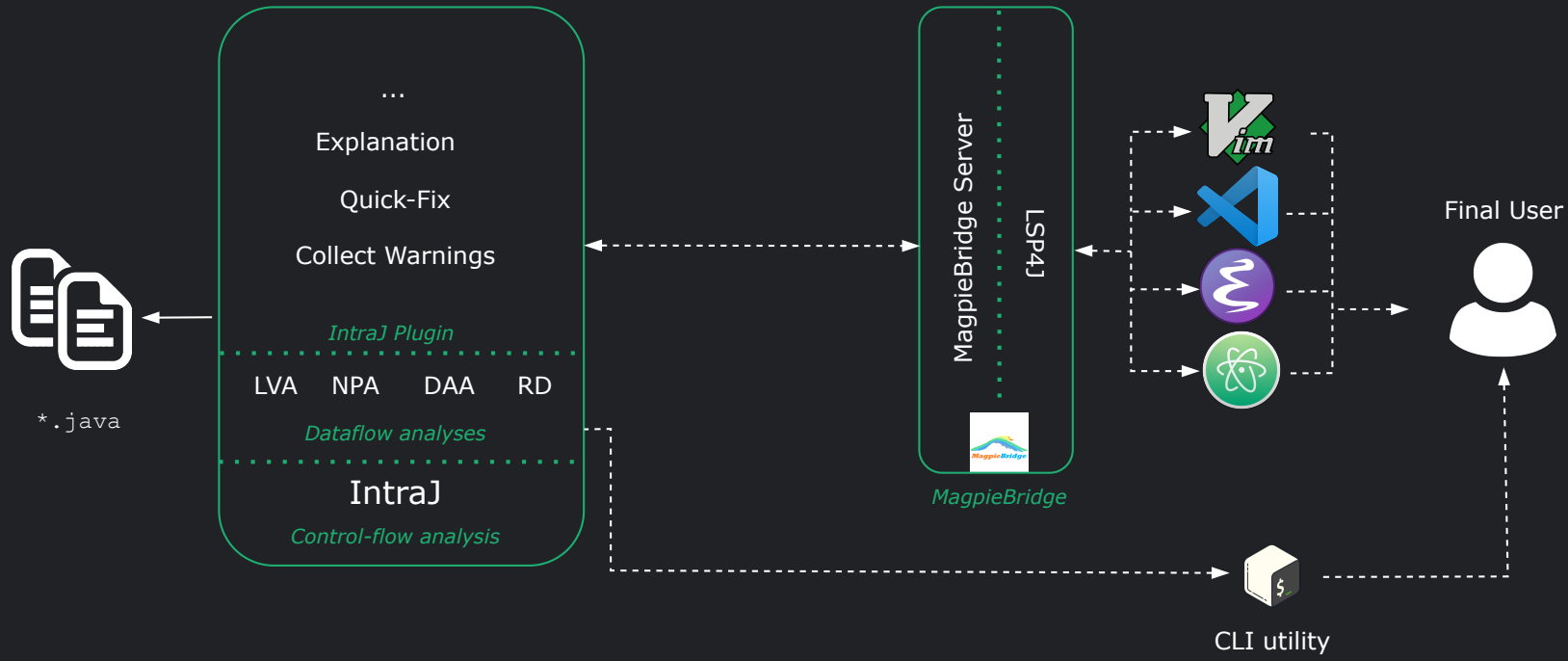

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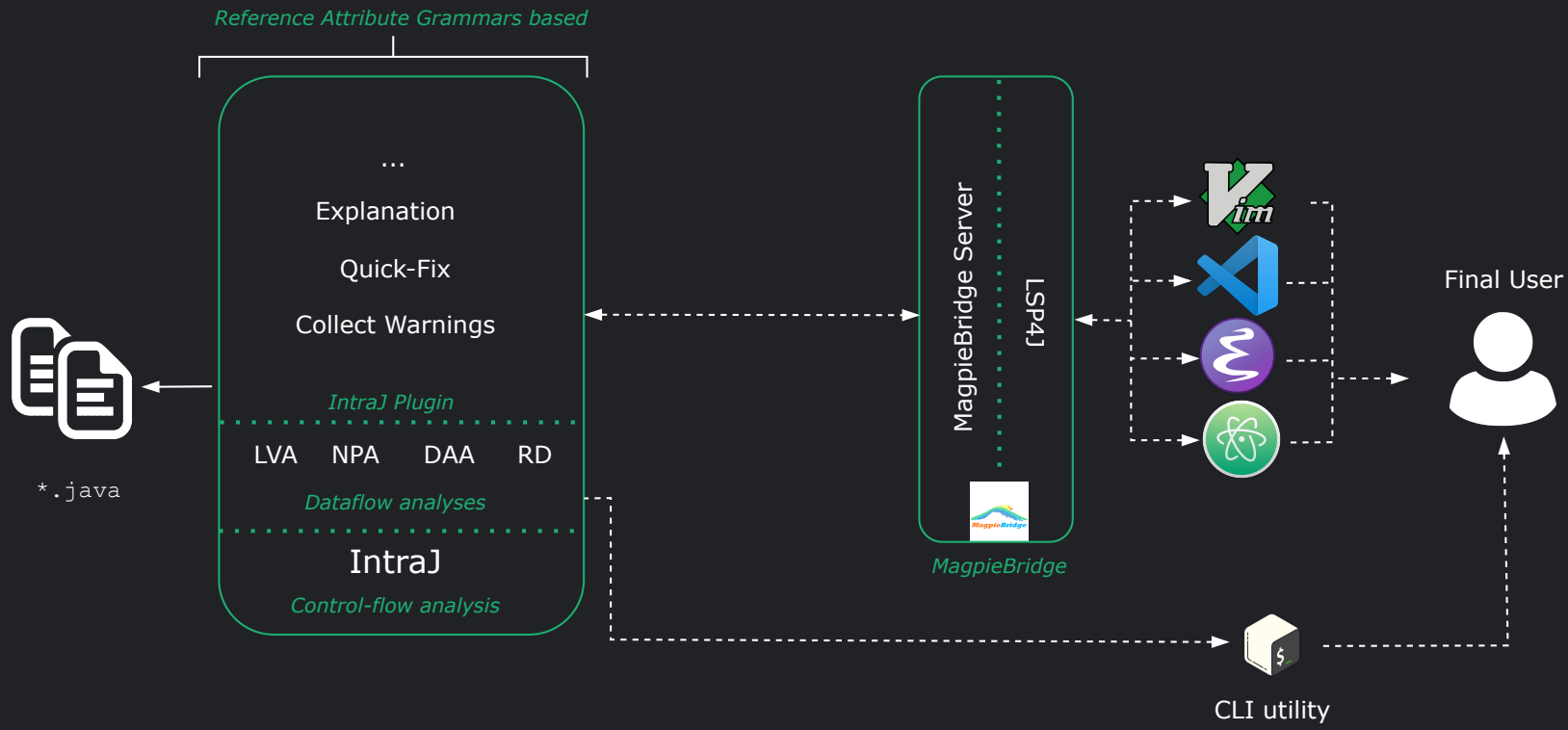

REFERENCE ATTRIBUTE GRAMMARS

```
1  void foo(boolean b){
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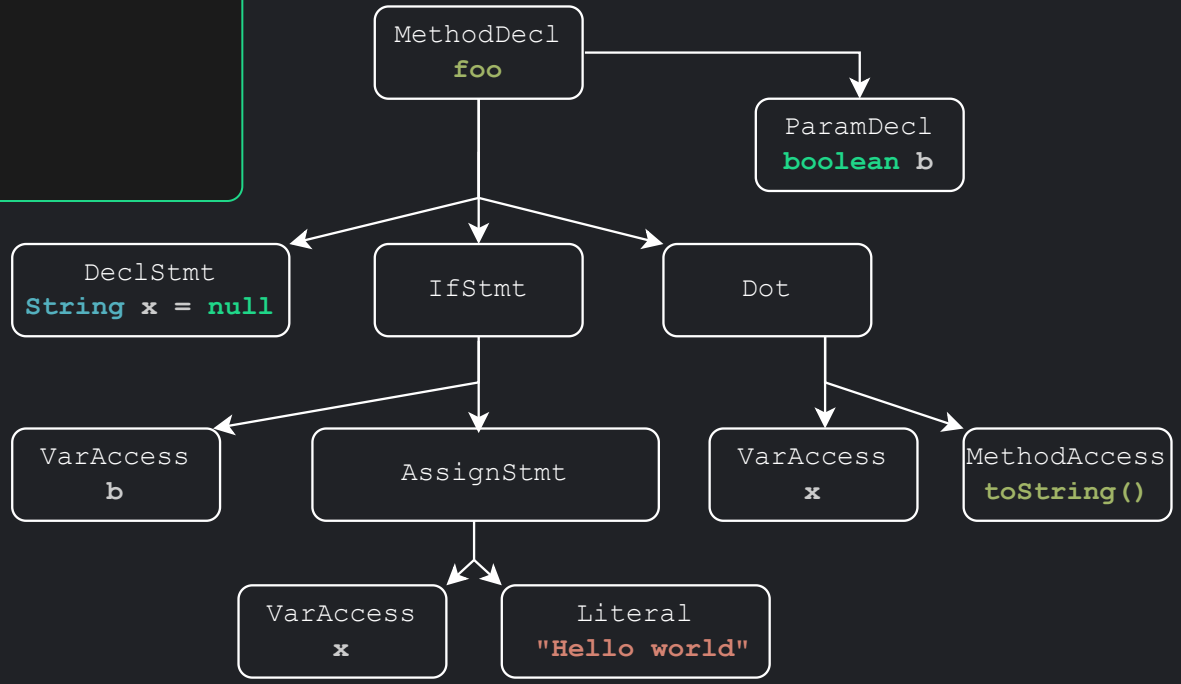

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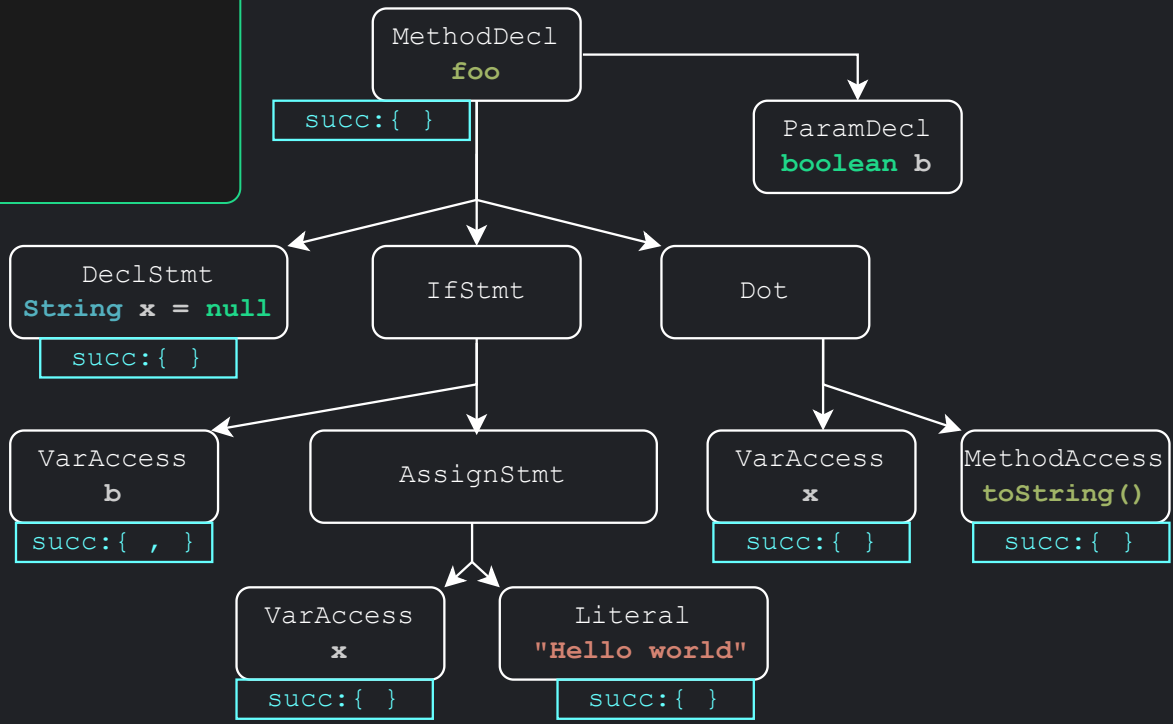

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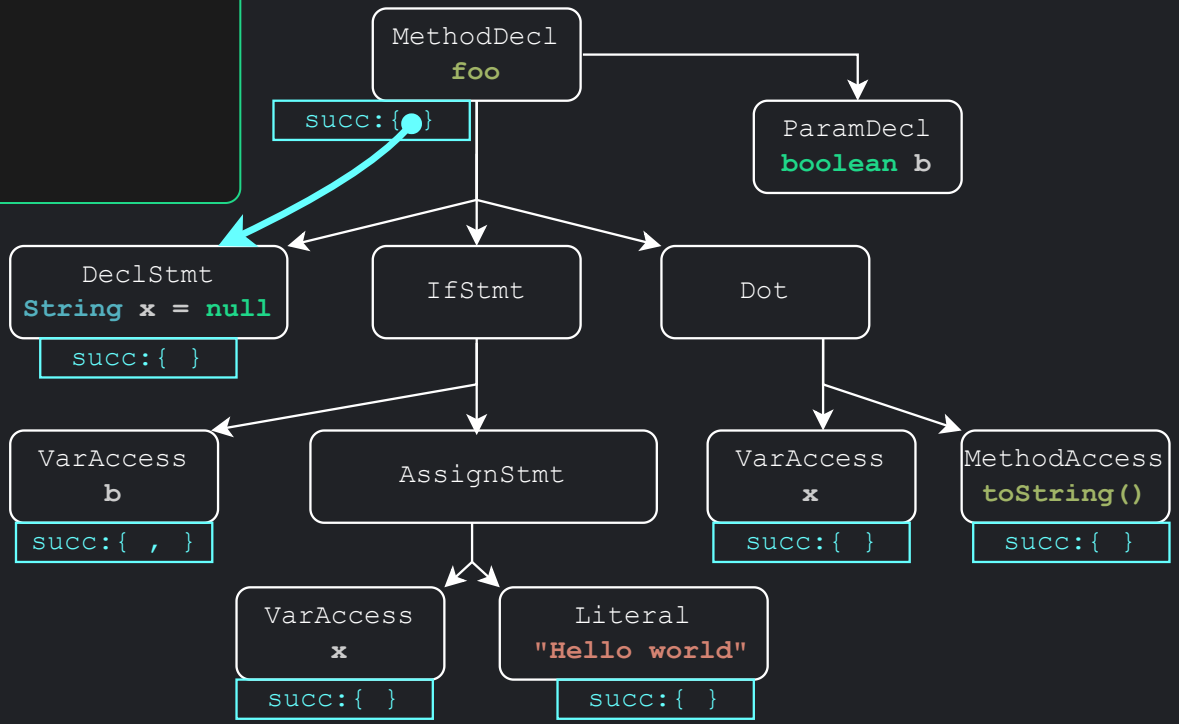

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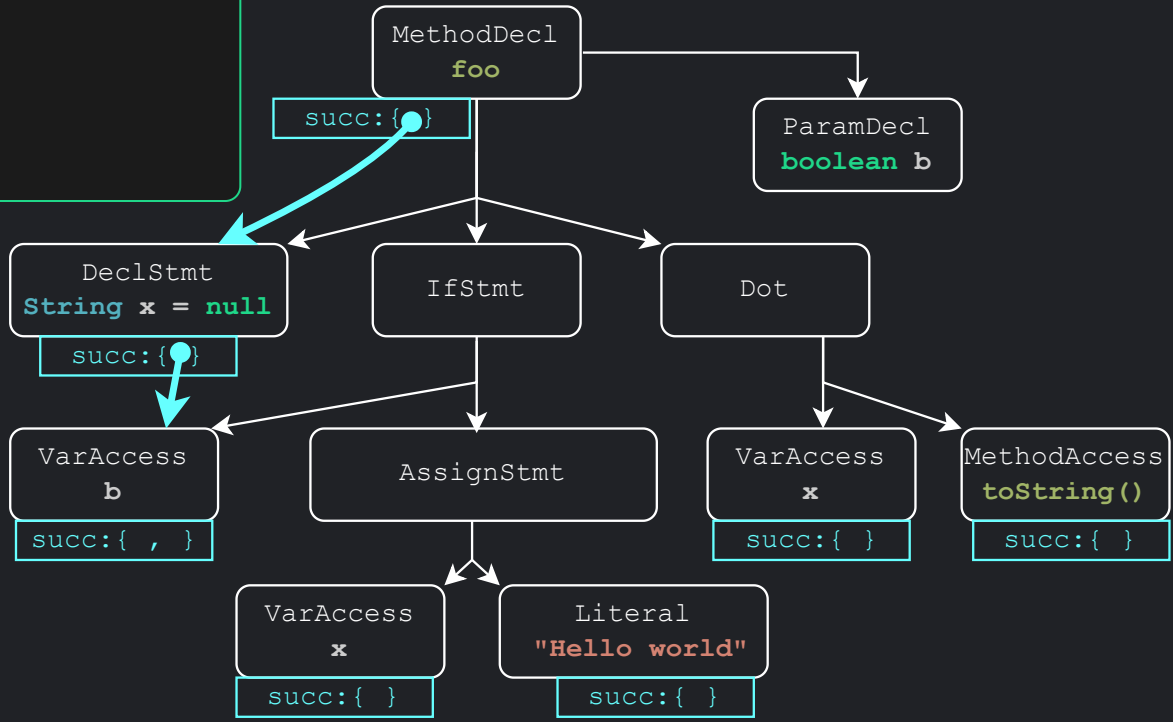

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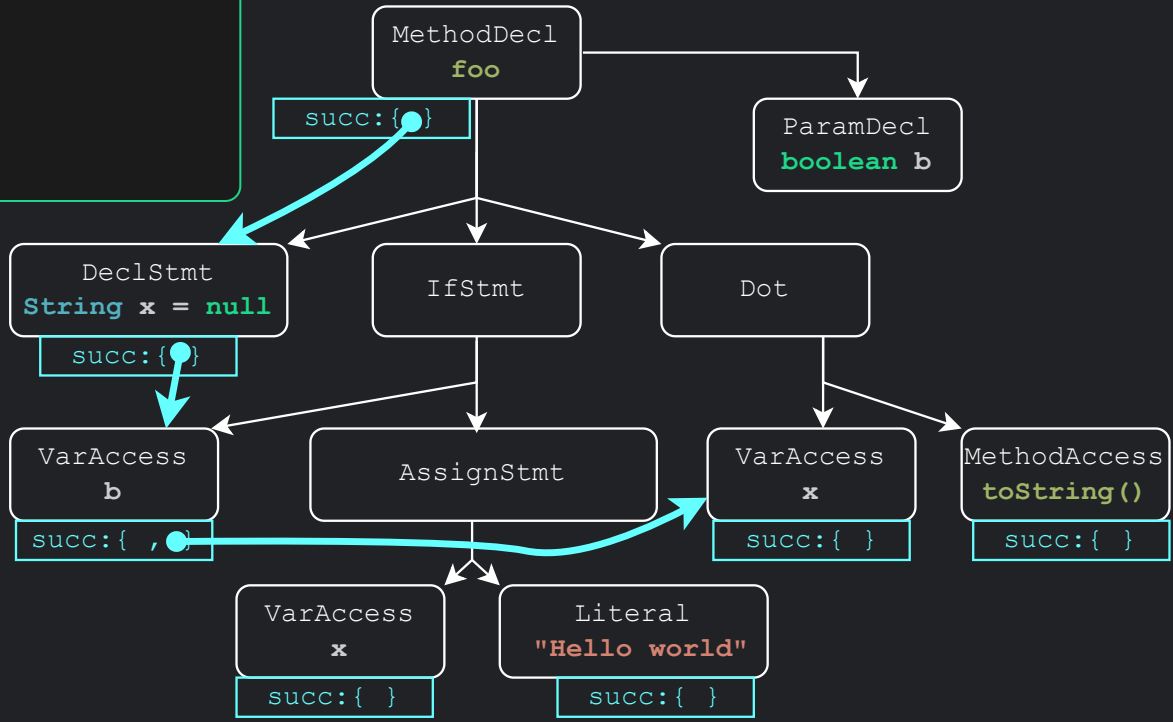

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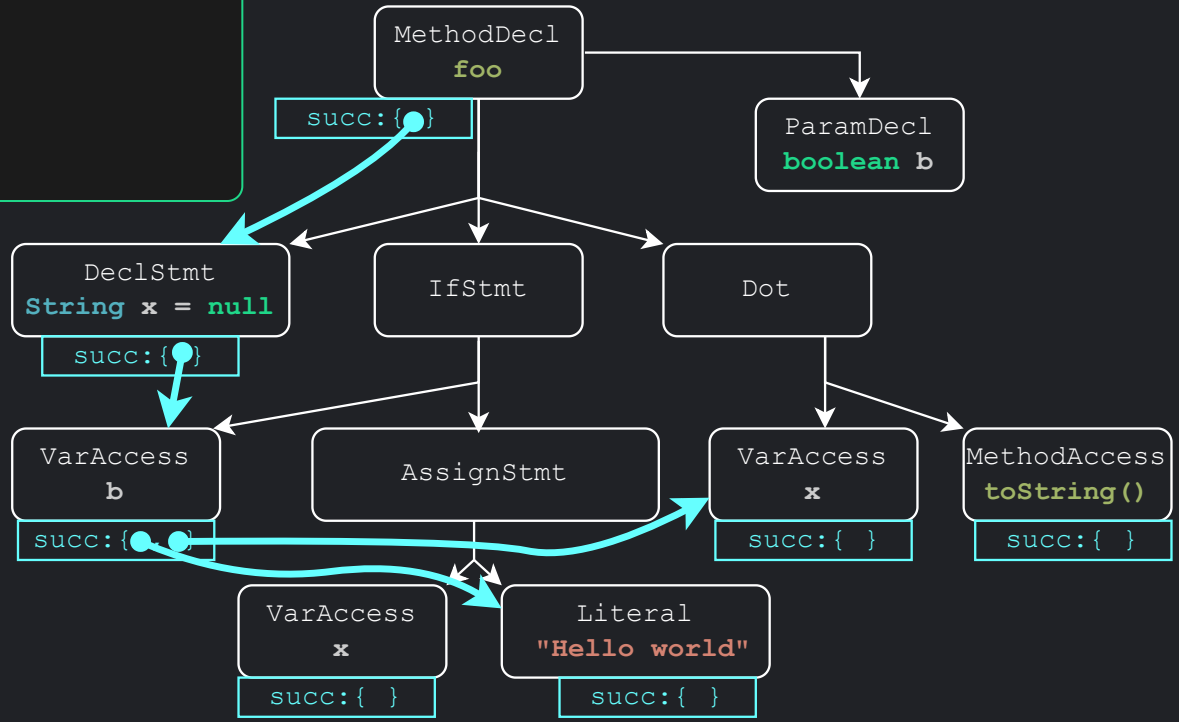

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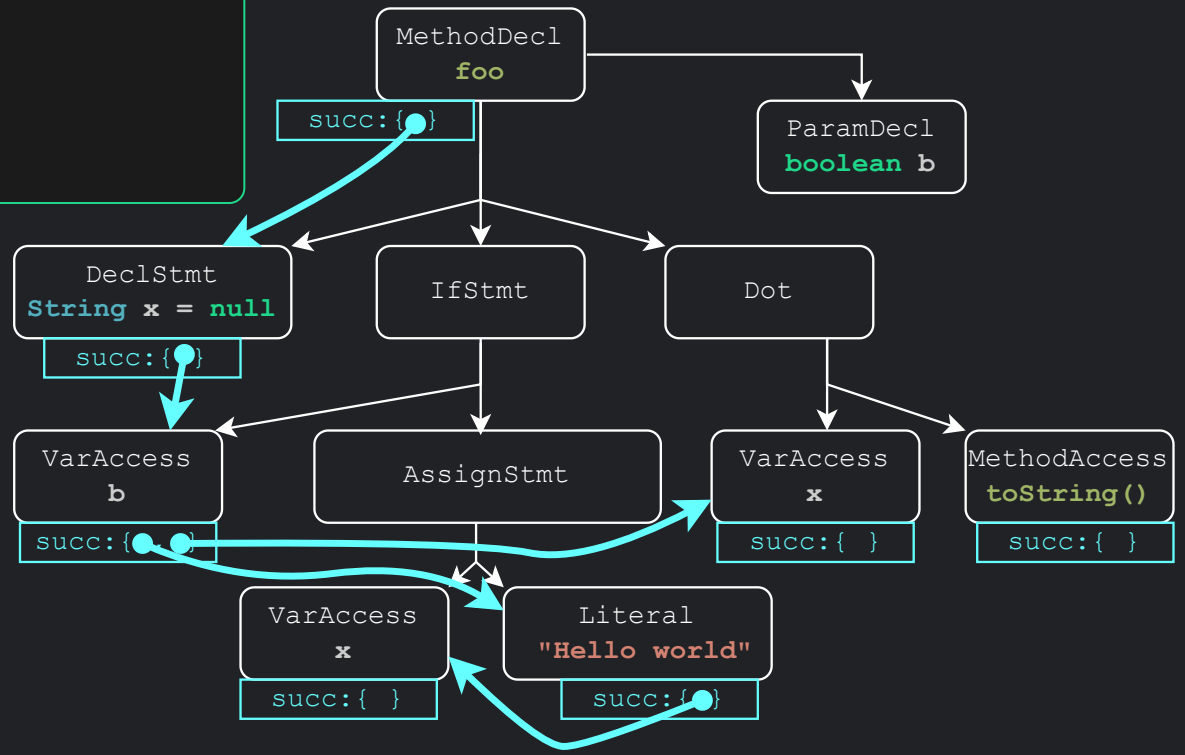

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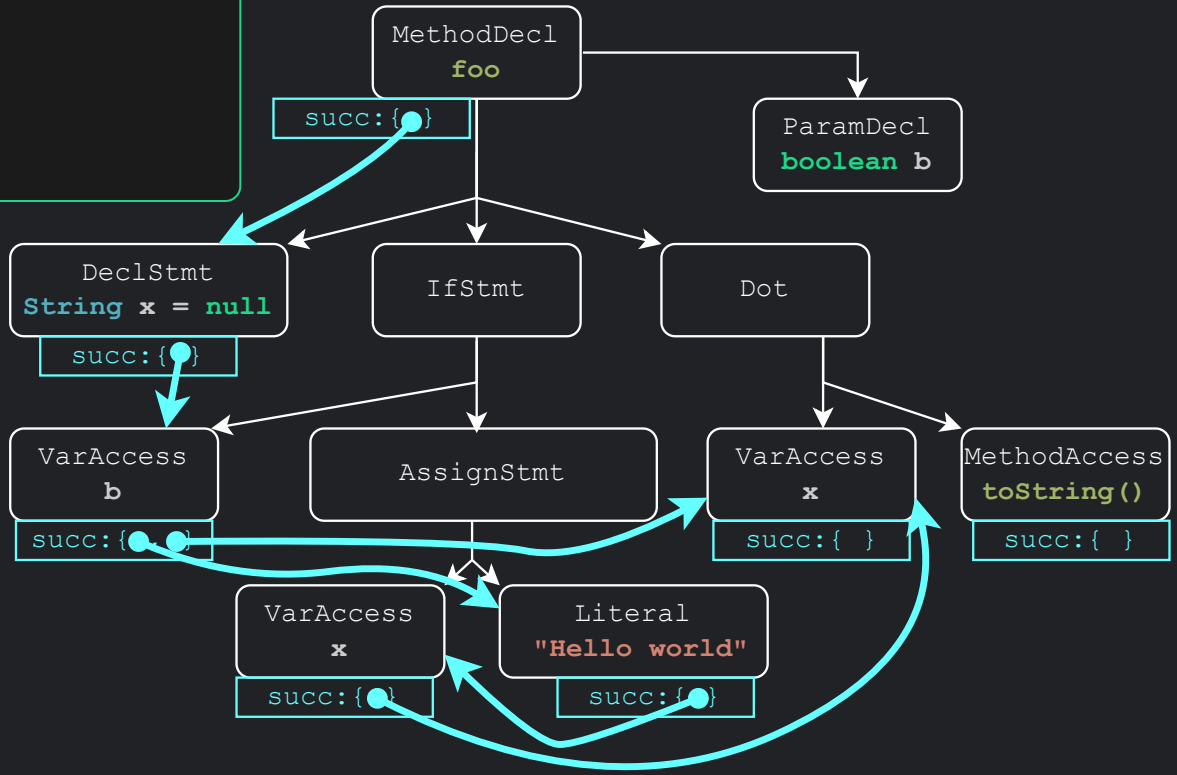

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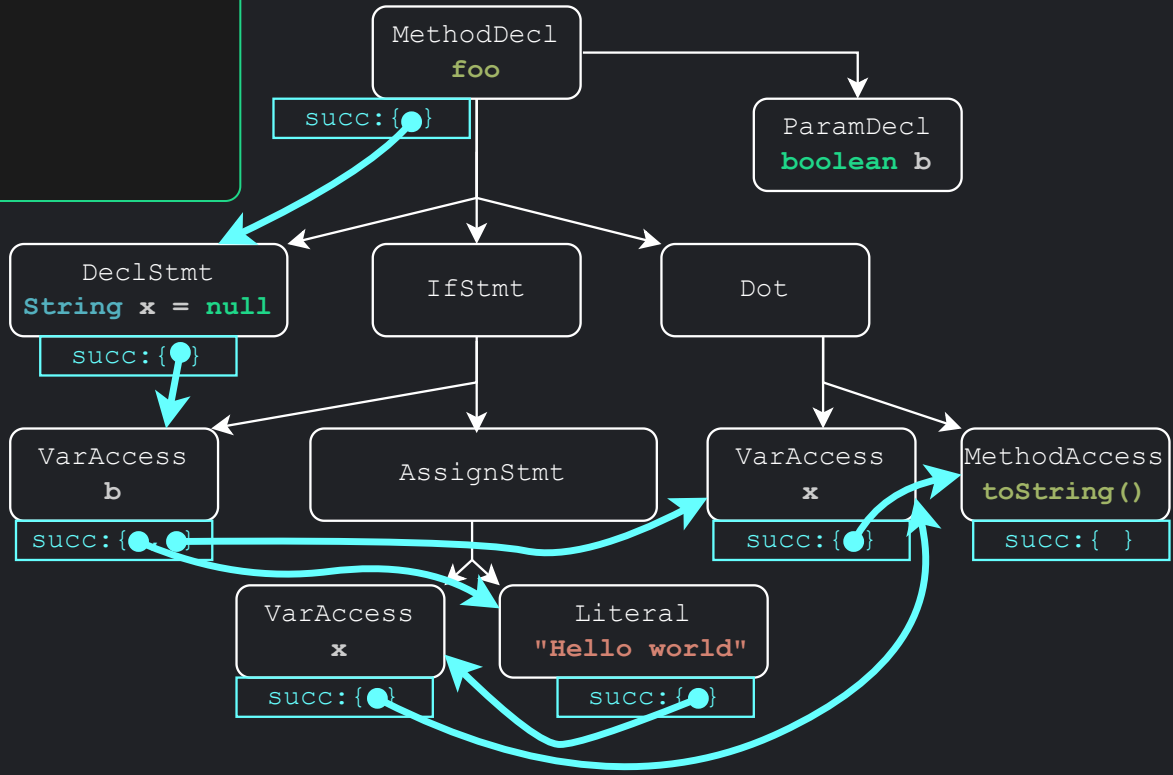

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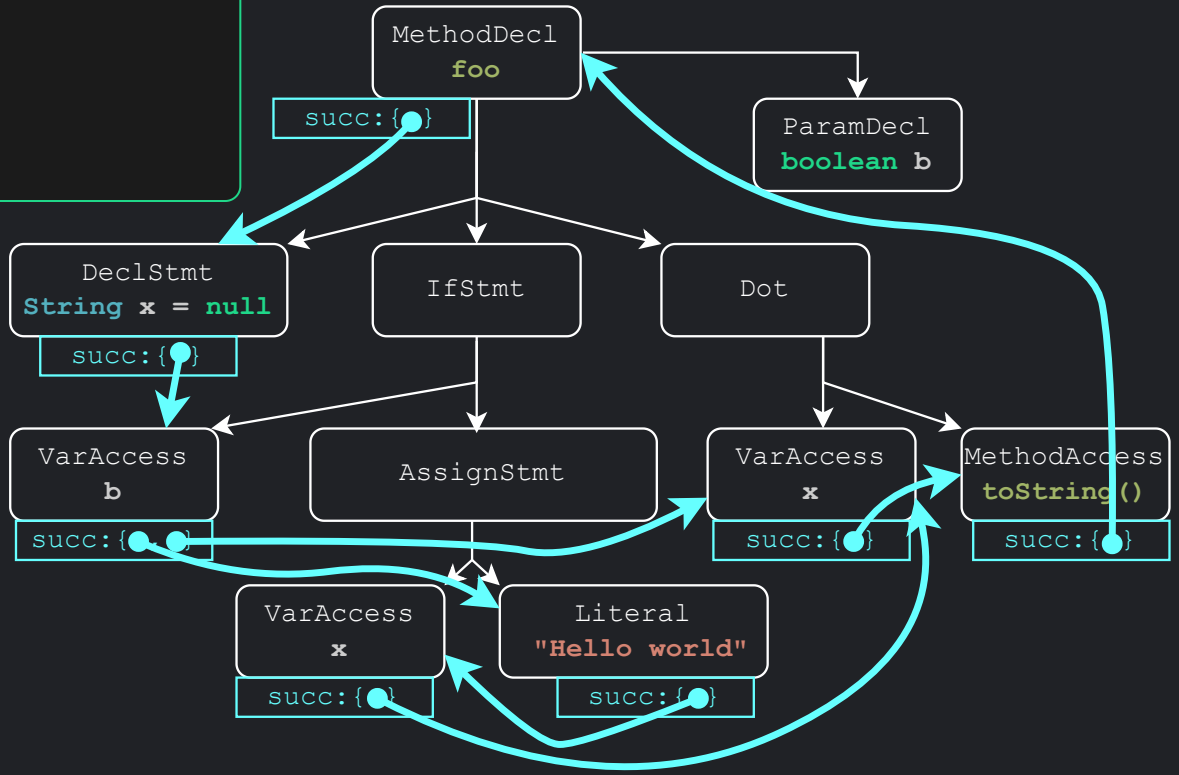

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```
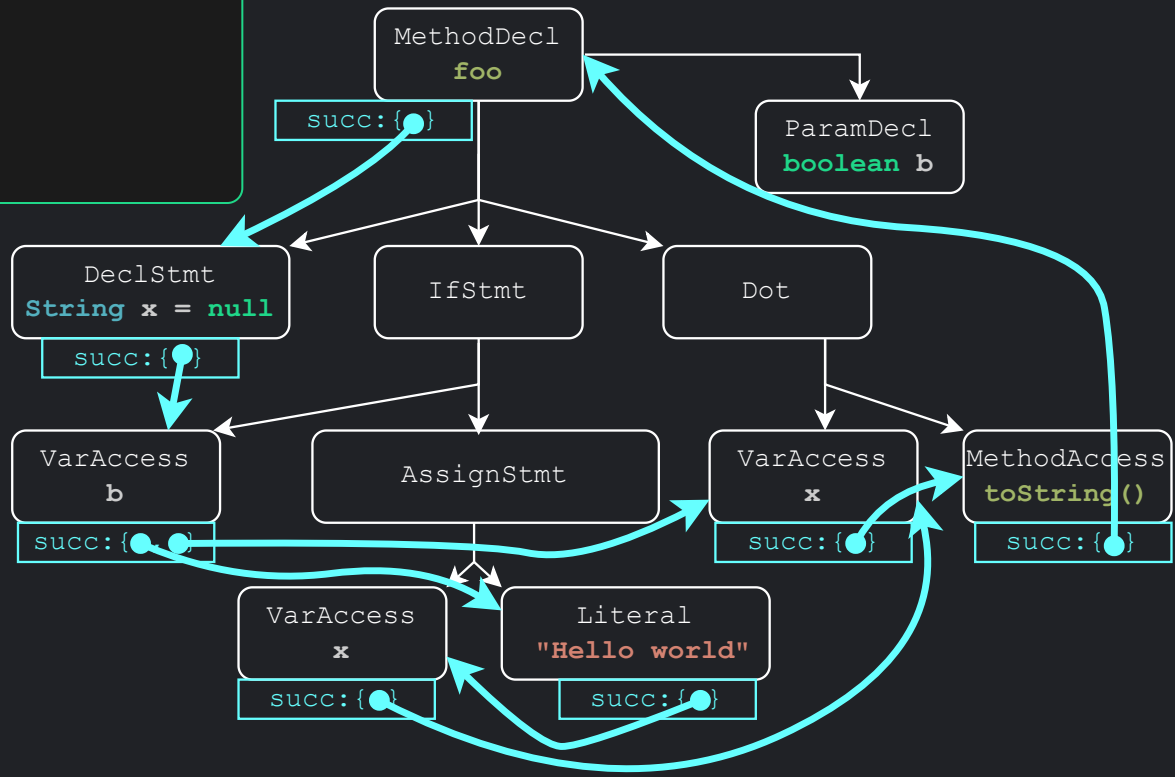

- JastAdd ecosystem
  - On-demand evaluation
  - Fix point computation
  - Higher-Order Attibutes

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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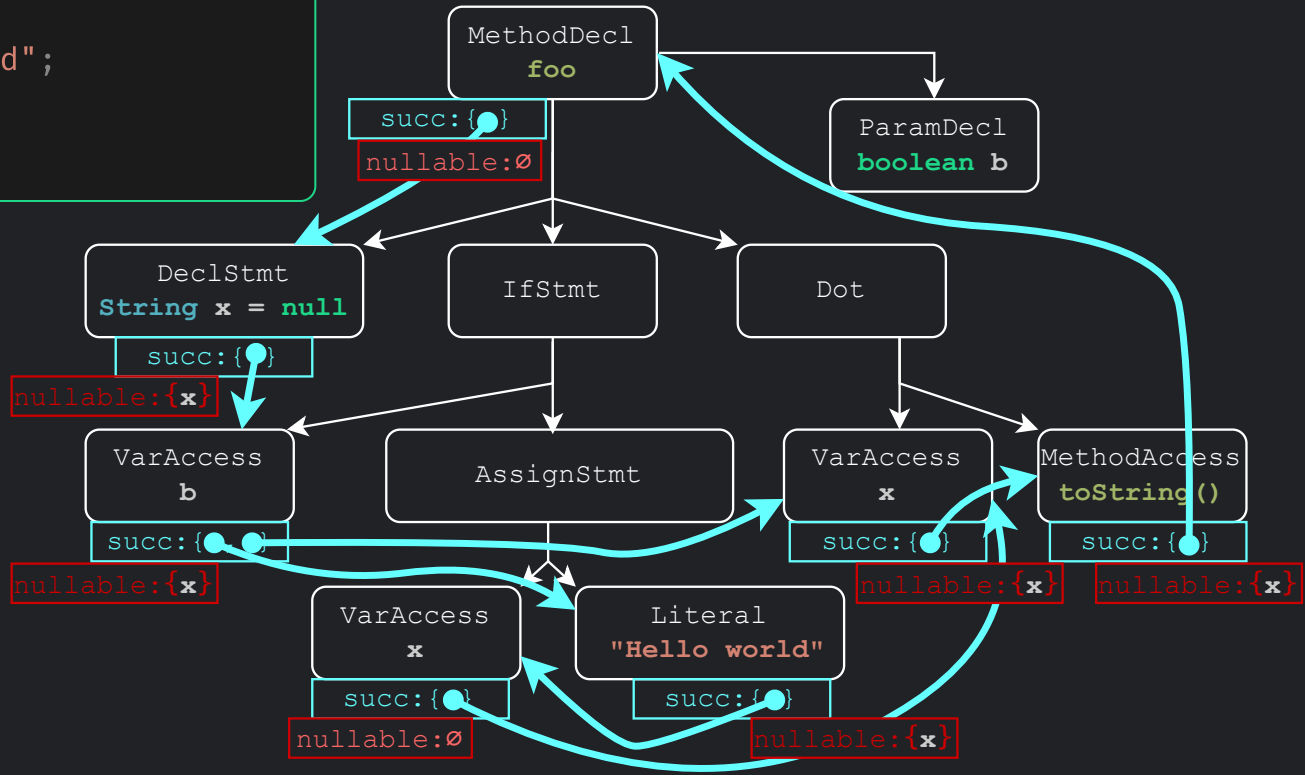

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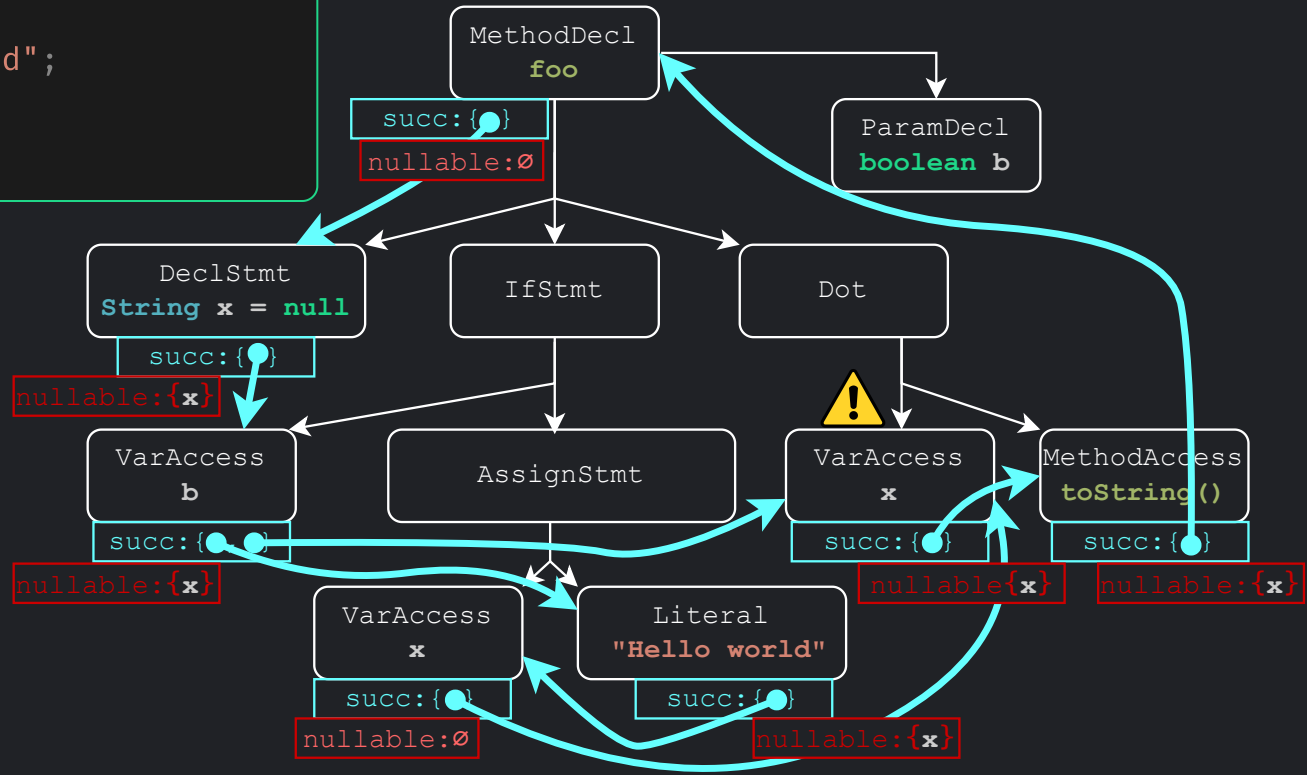
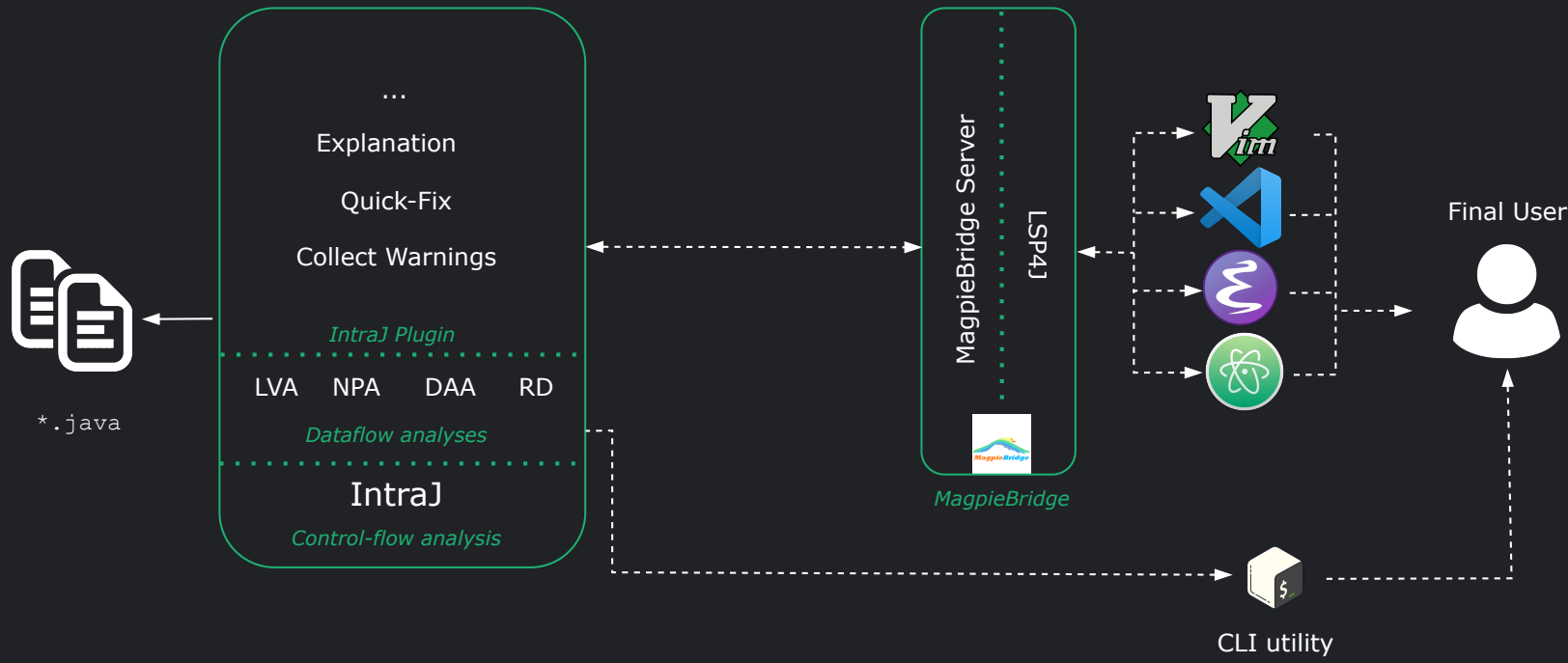
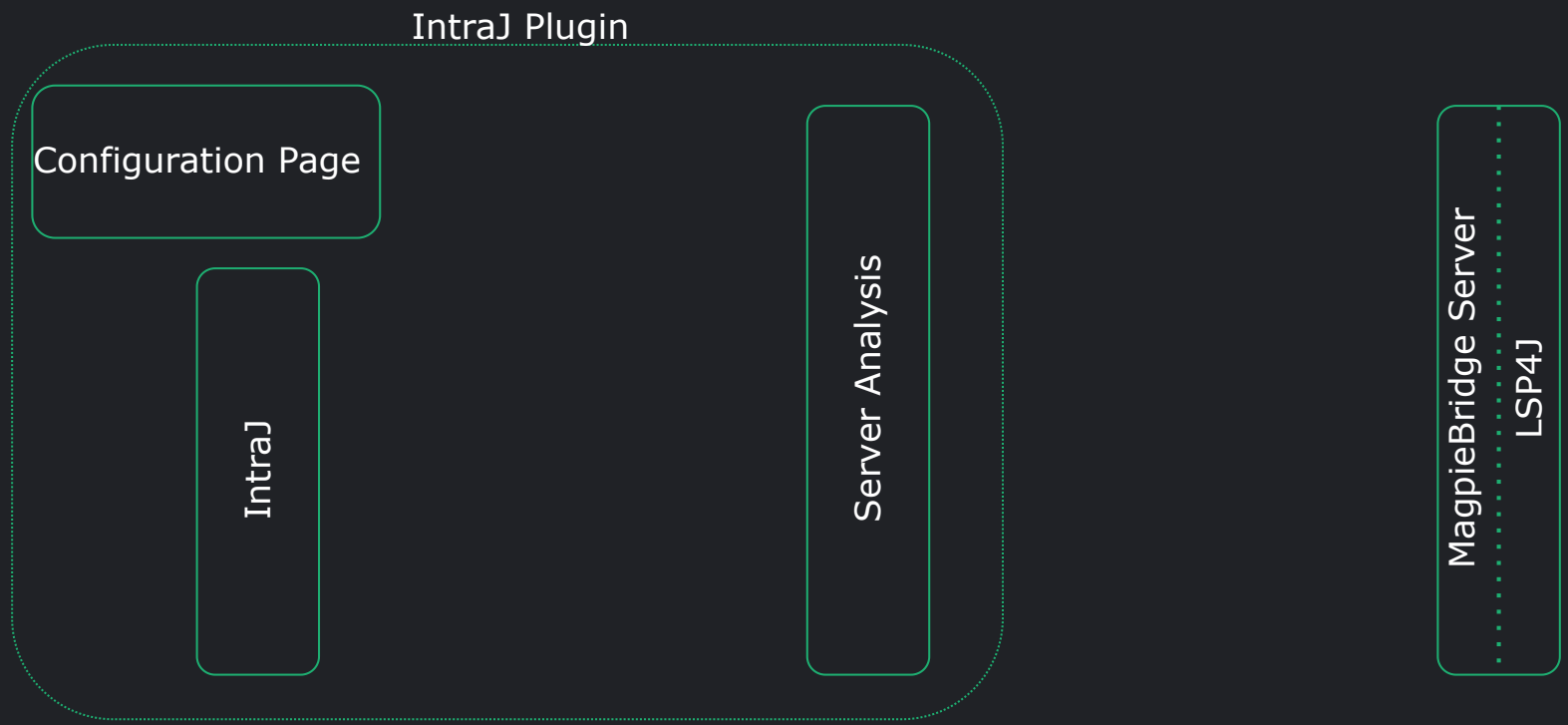


THE BIG PICTURE, AGAIN



ZOOM-IN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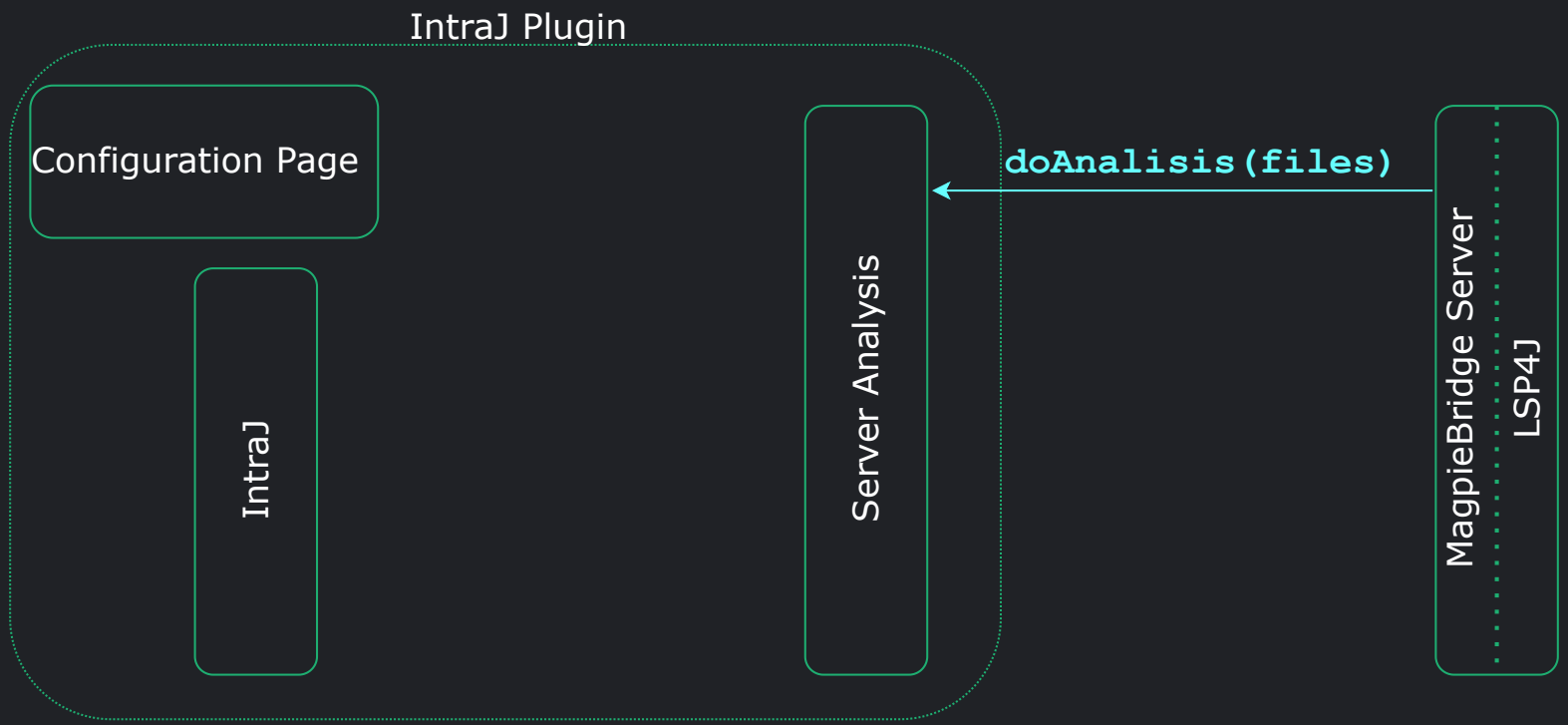
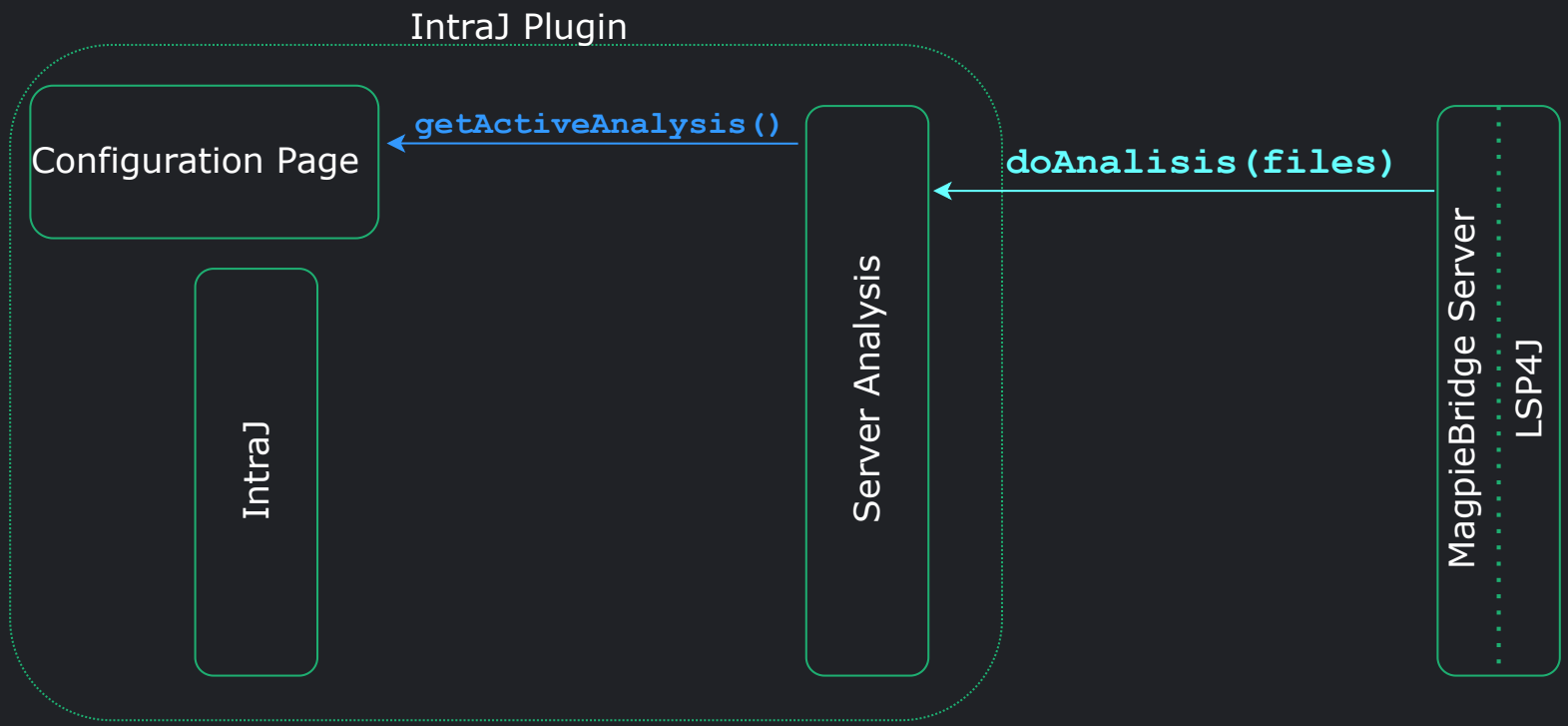
Configuration Page
IntraJ
Server Analysis
MagpieBridge Server
LSP4J

ZOOM-IN


IntraJ Plugin
Configuration Page
IntraJ
Server Analysis
doAnalisis(files)
MagpieBridge Server
LSP4J

ZOOM-IN


IntraJ Plugin
Configuration Page
getActiveAnalysis()
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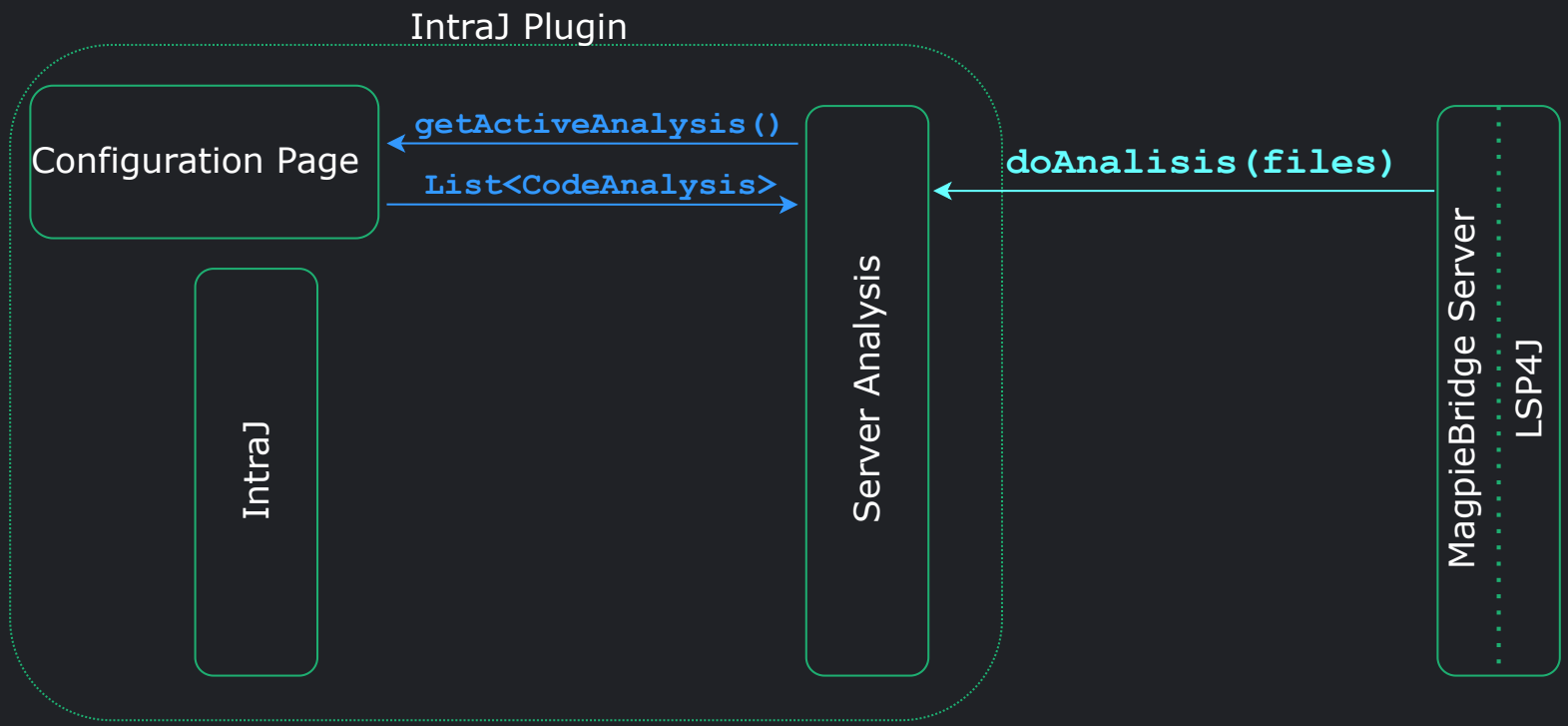
ZOOM-IN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getActiveAnalysis()
List<CodeAnalysis>
IntraJ
Server Analysis
doAnalisis(files)
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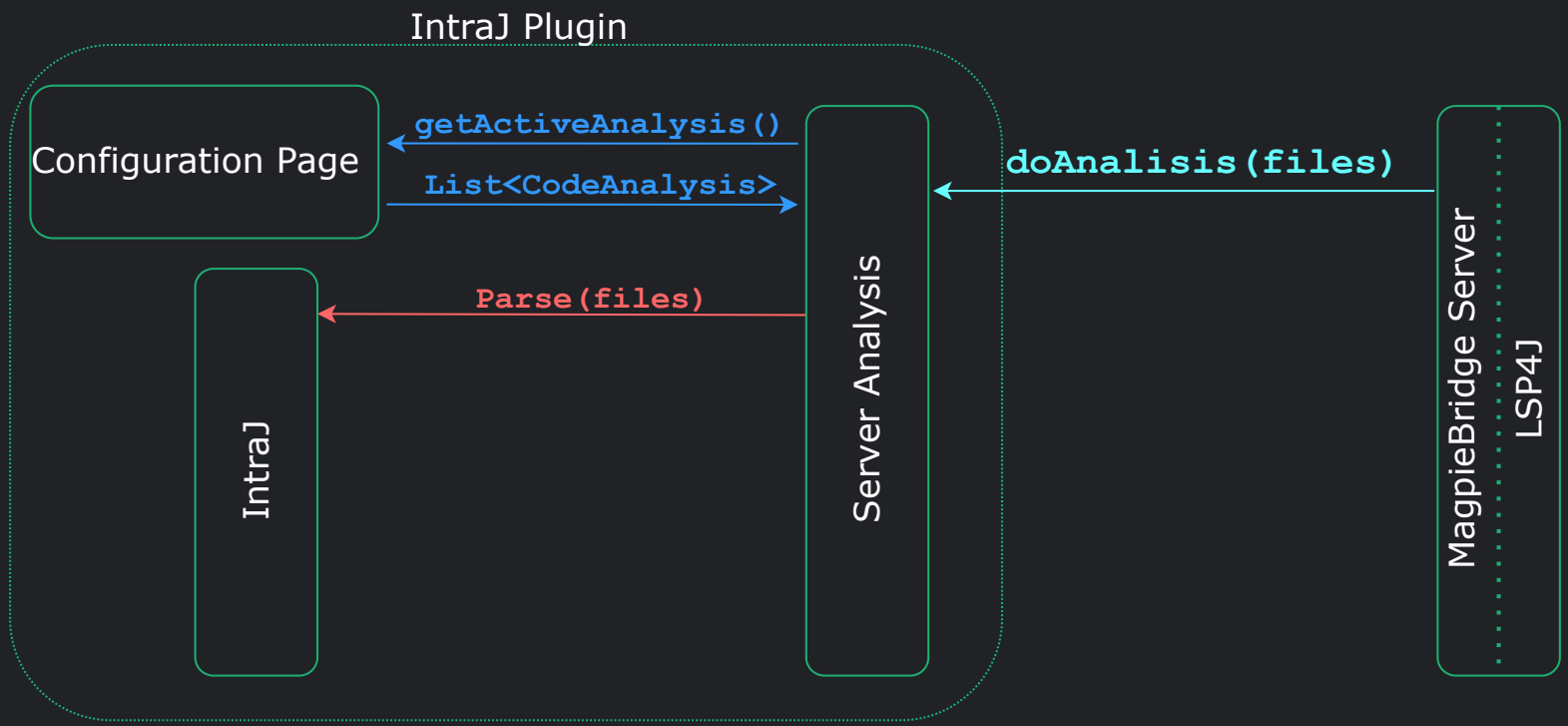
ZOOM-IN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Configuration Page
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List<CodeAnalysis>
Parse(files)
IntraJ
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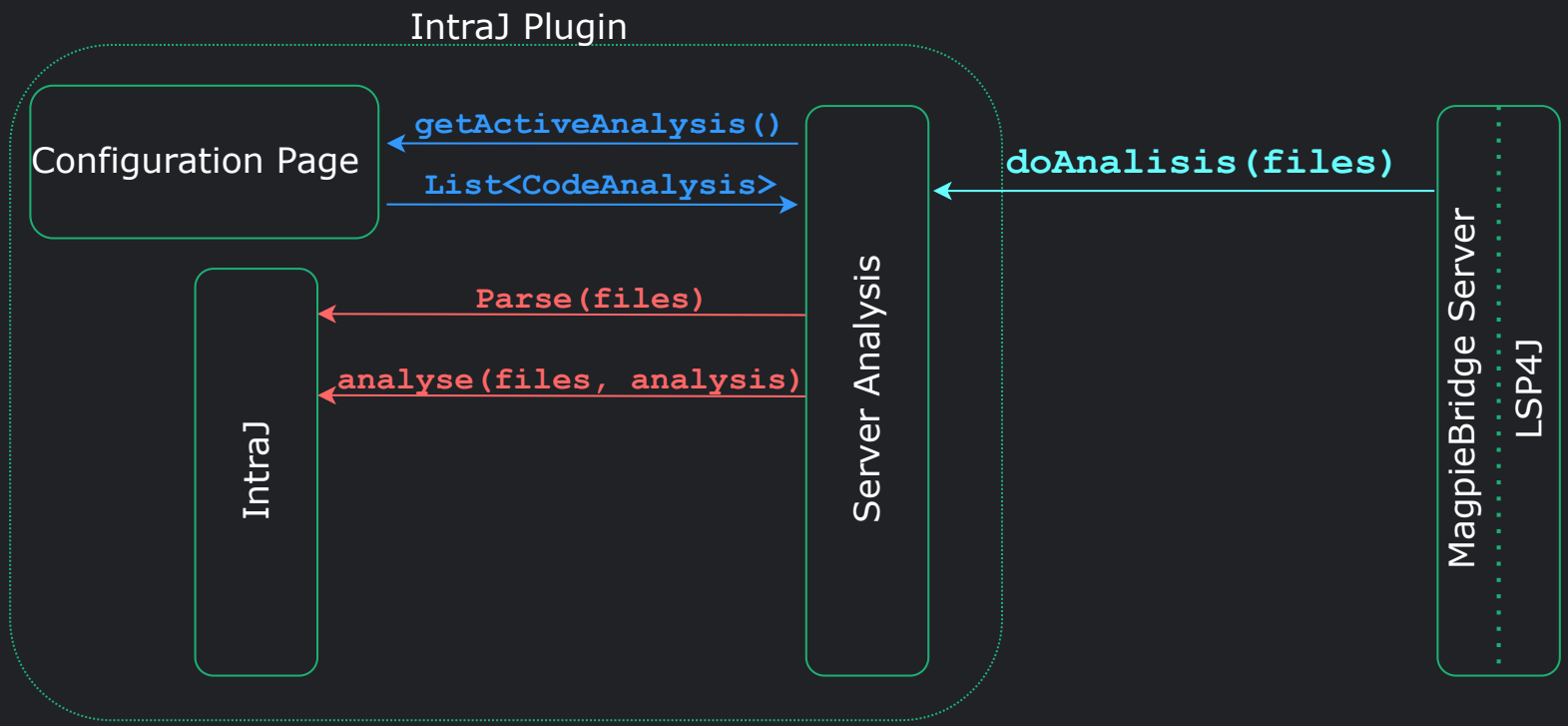
ZOOM-IN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getActiveAnalysis()
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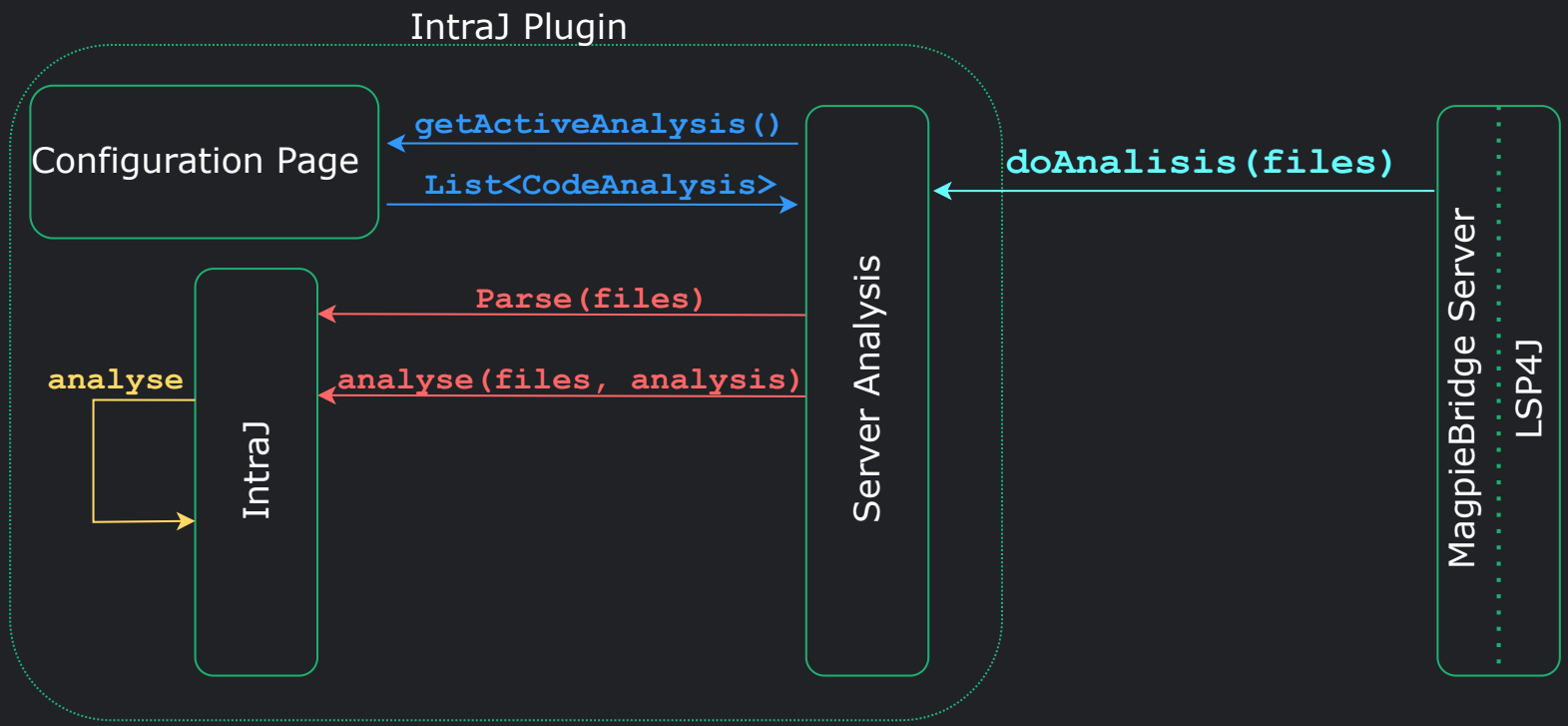
IntraJ
Server Analysis
doAnalisis(files)
MagpieBridge Server
LSP4J

ZOOM-IN


IntraJ Plugin
Configuration Page
getActiveAnalysis()
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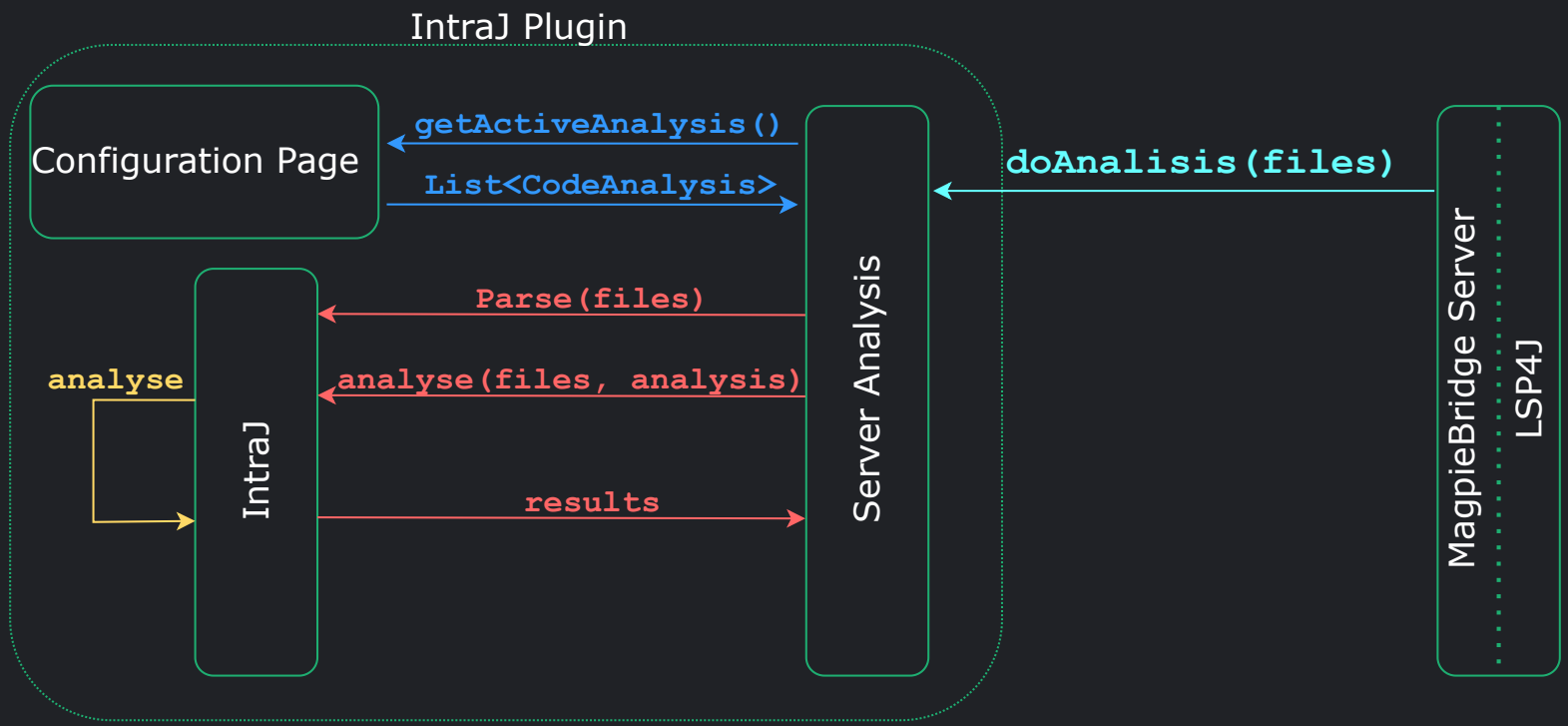
ZOOM-IN


IntraJ Plugin
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getActiveAnalysis()
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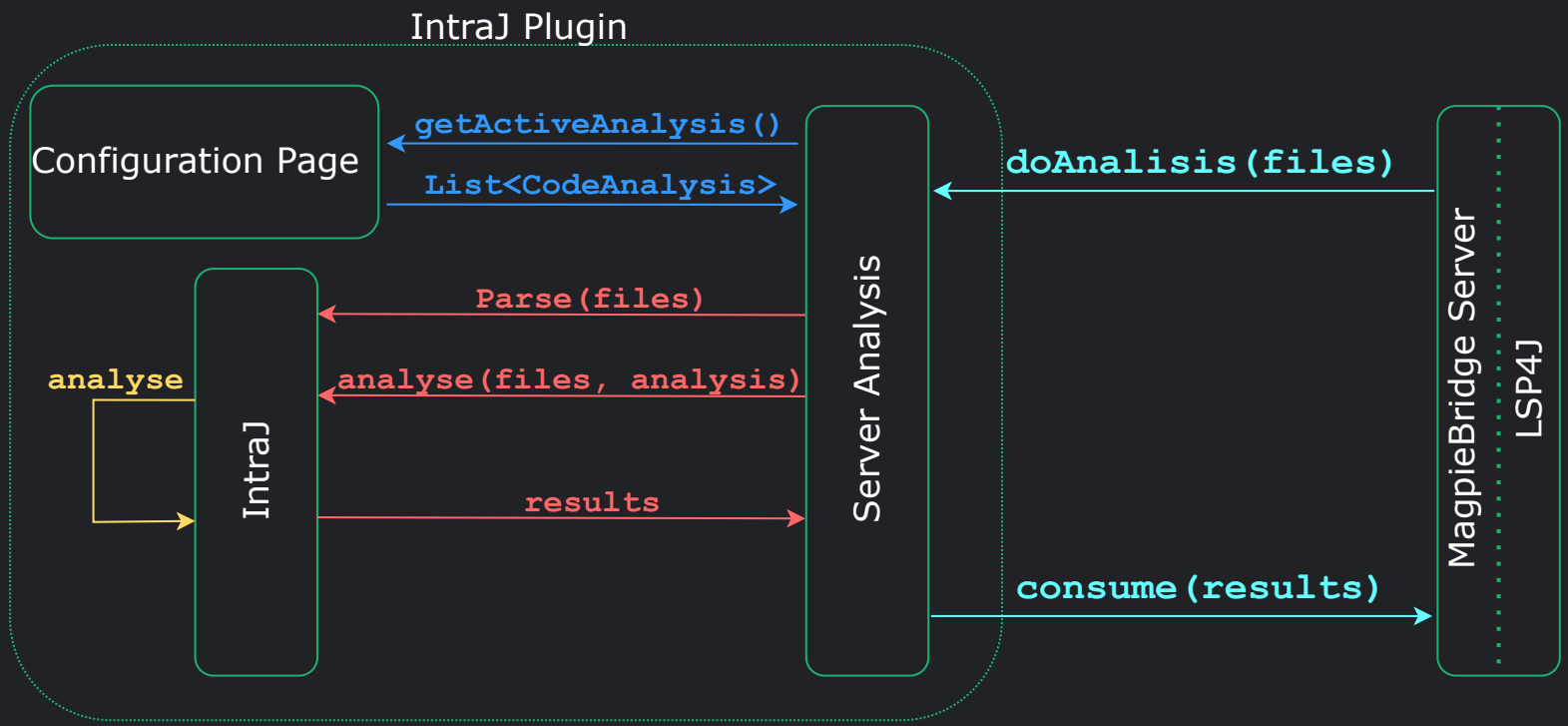
ZOOM-IN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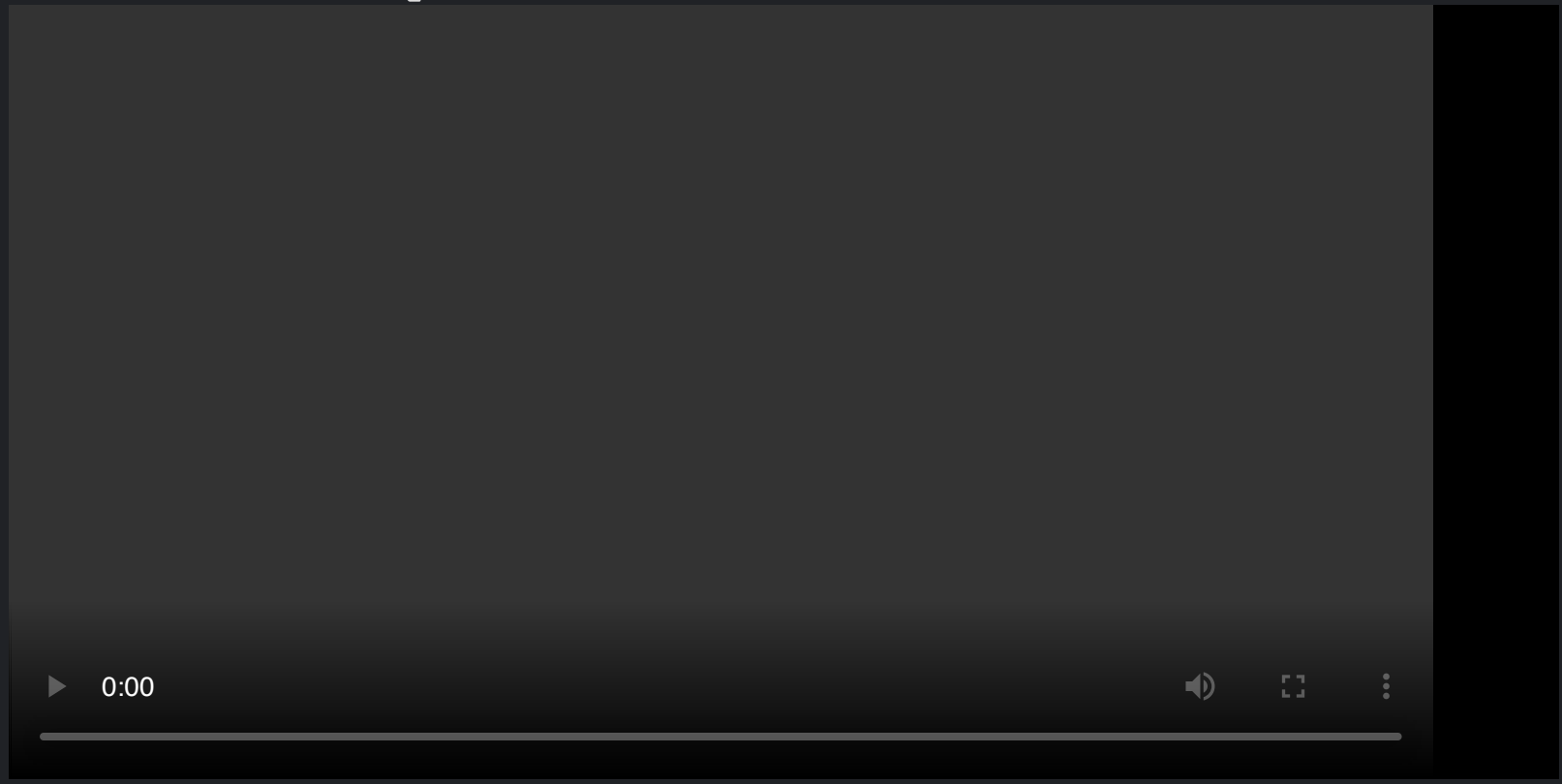
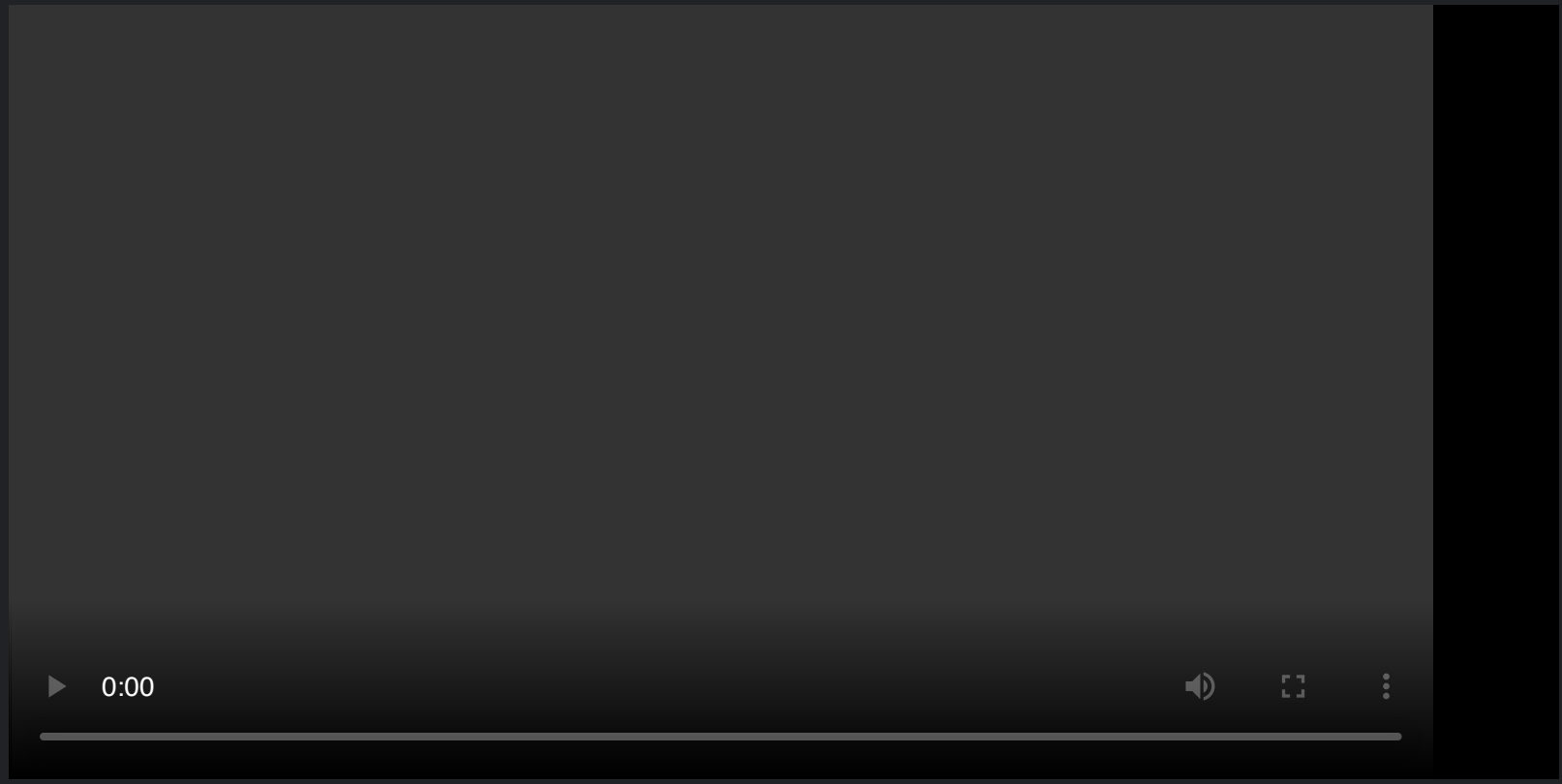
results
consume(results)

EXAMPLE: QUICK FIX



EXAMPLE: BUG EXPLANATION



TIP OF THE ICEBERG

OVERALL EXPERIENCE

- Intuitive and easy to use
- Concise specification of the server
- Well documented
- With the scaffolding we provide, adding support for a new analysis is trivial:

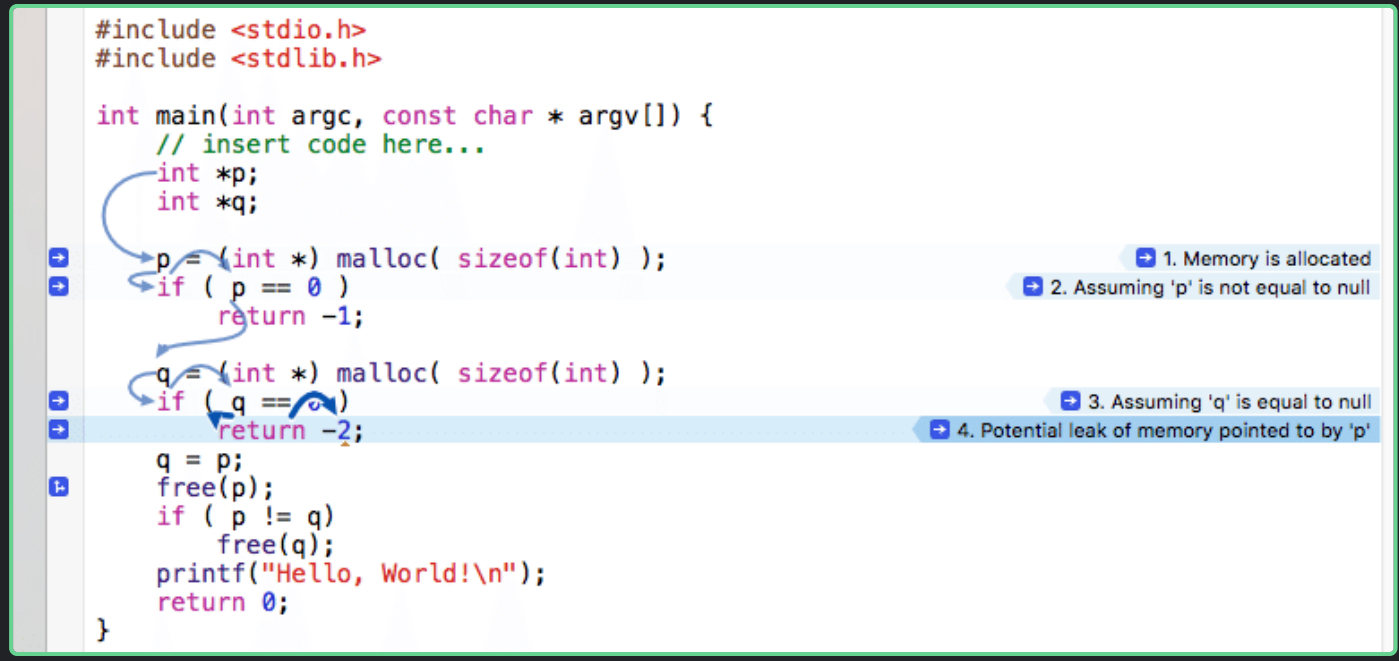
```
1  public class YourAnalysis extends CodeAnalysis {
2    public String getName() { return "YourAnalysis"; }
3    protected Set<Warning> getWarnings(CompilationUnit cu)
4      { return cu.yourAnalysis(); }  //⟵  Property triggered by the analysis
5  }
```

```
1  activeAnalyses.put(new YourAnalysis(), true); //Register the analysis
```

- Plugin V 0.0.1 made by Charlie Mrad (Master Student @ LU)

LOOKING FORWARD FOR ...

Not only warnings



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

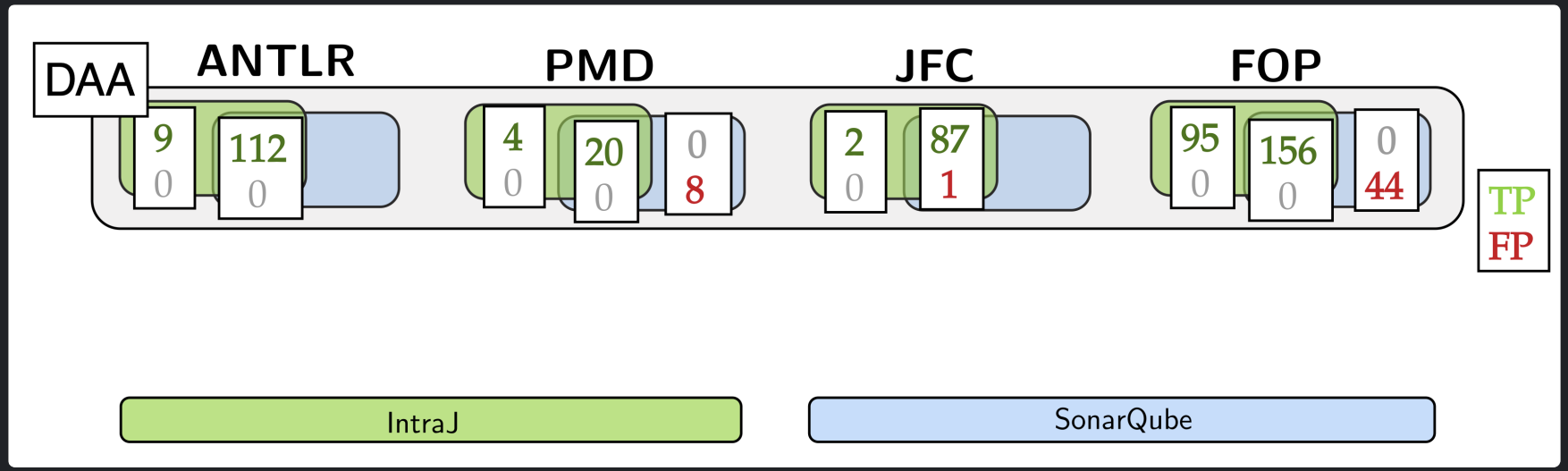
1. Error are directly linked to the source code
2. Works with broken code
3. Easier integration with IDEs

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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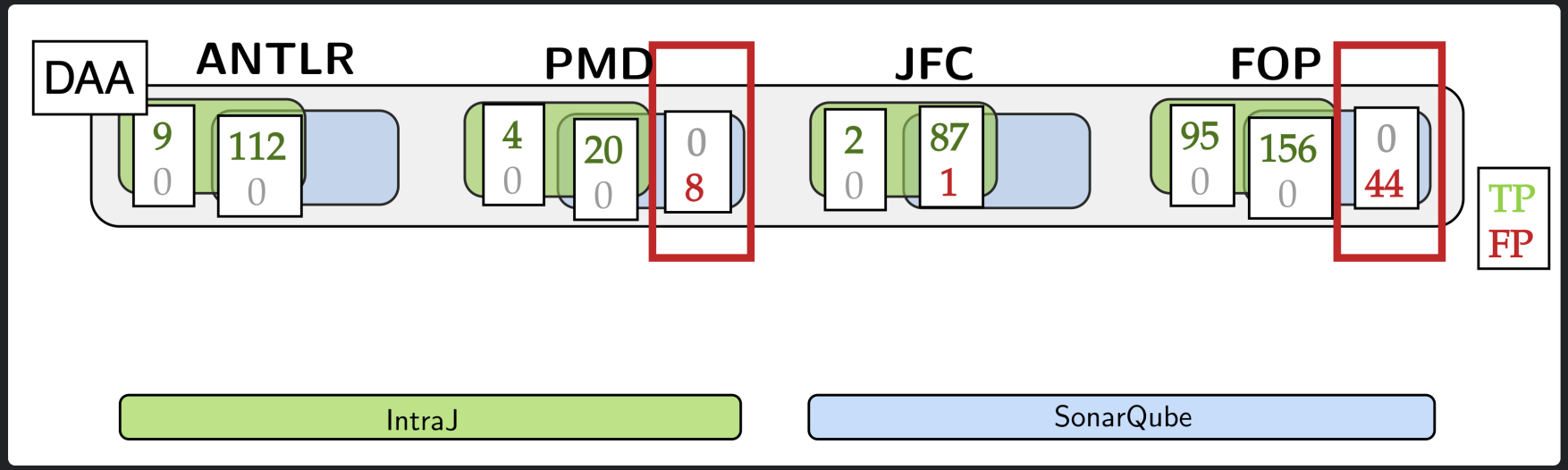

DeadAssignmentAnalysis: IntraJ detects everything that SonarQube detects

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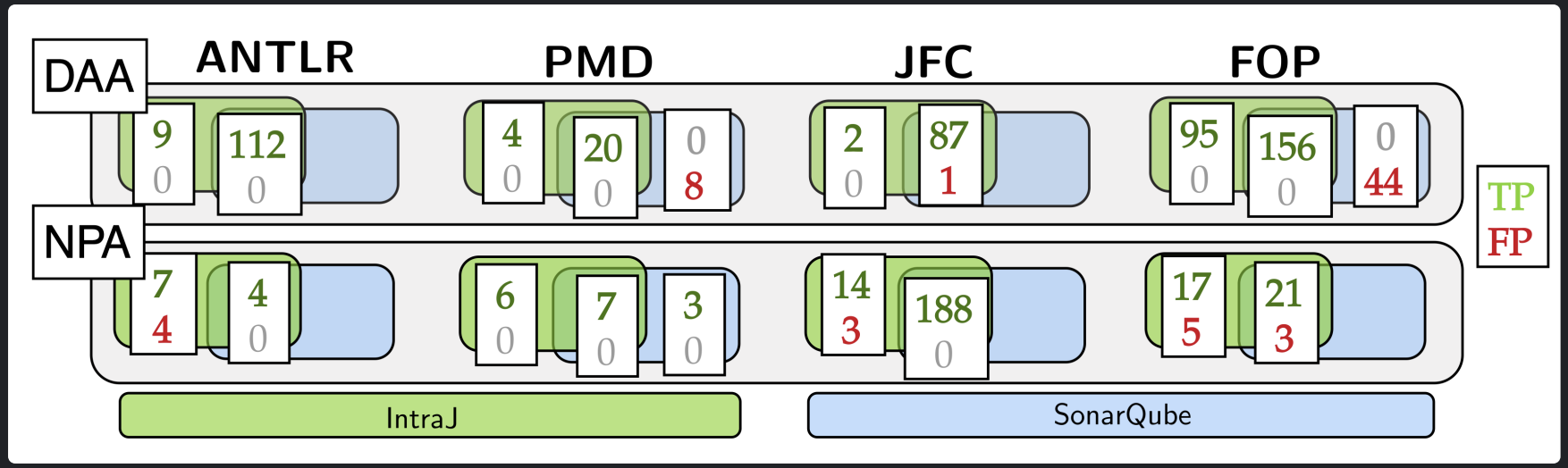
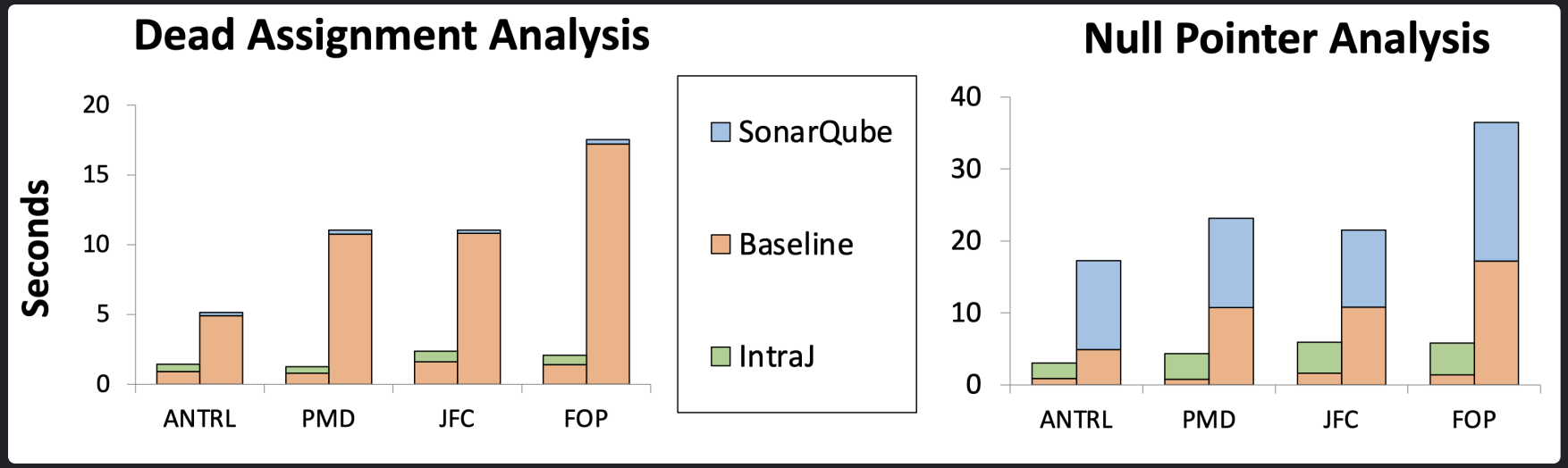


DeadAssignmentAnalysis: IntraJ detects everything that SonarQube detects

NullPointerAnalysis: SonarQube is more precise but IntraJ remains competitive

PERFORMACE

1. No dealy in the previous demo



INTRAJ - A USE CASE