Applied Static Analysis - Code Slicing

11.07.2019 – Patrick Müller

What is slicing?

- Reduction of program to relevant parts

- Goals:
  - Debugging
  - Reconstruct runtime values
  - Maintenance
  - Testing
  - Clone detection
  - Parallelization

- Here: only static backward slicing

Overview

- We want the **relevant** part of the program
  - Relevant for what?

=> We define a **slicing criterion (sc)**

In most cases: location and variable

- Slice consists of all code elements that may affect the value of the variable at the given location

- Can have several criteria

Example

```
def foo(input: Boolean) -> Unit {
  val test =  !input
  var a: Int
  var b: Int
  if (test) {
    a = 2
    b = 3
  } else {
    a = 10
    b = 20
  }
  b = 30
sc: println(a)
sc: println(b)
}
```

println(a);a

println(b);b

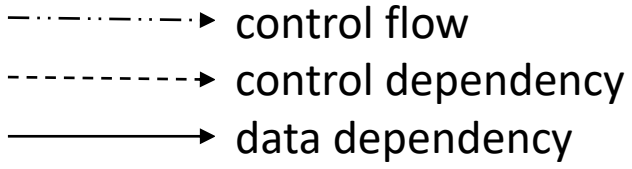
```
def foo(input: Boolean) -> Unit {
  val test =  !input
  var a: Int
  if (test) {
    a = 2
  } else {
    a = 10
  }
  println(a)
}
```

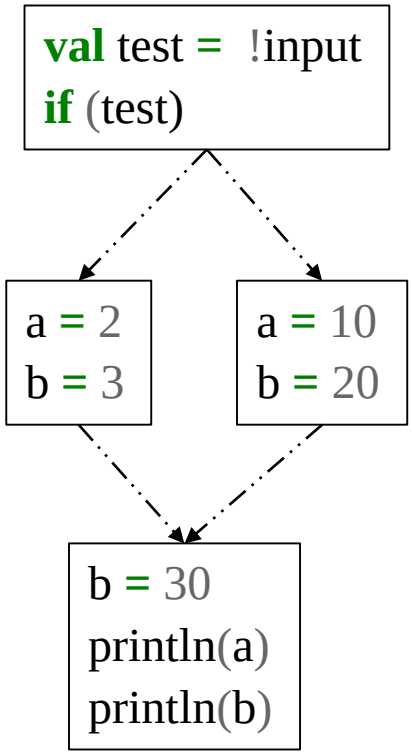
```
def foo() -> Unit {
  var b: Int
  b = 30
  println(b)
}
```

How to slice

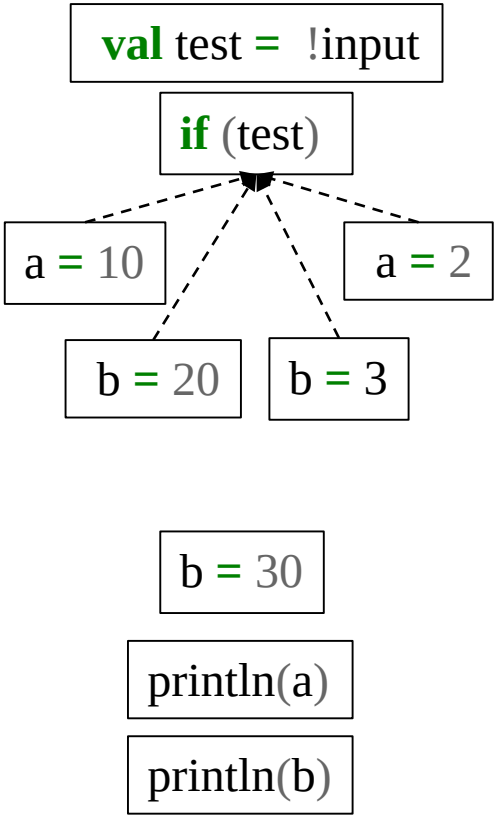
- We create a program dependence graph (pdg)
- Combination of
  - Control dependence graph
  - Data dependence graph
- Statements as vertices and 2 kinds of edges
  - Data dependency edges
  - Control dependency edges
- Slicing is backwards graph traversal from the slicing criterion

Example II

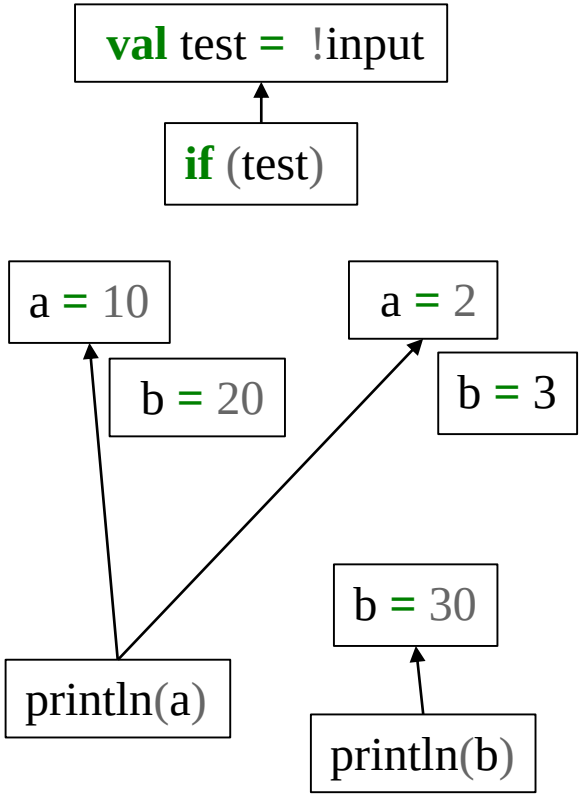




control flow graph

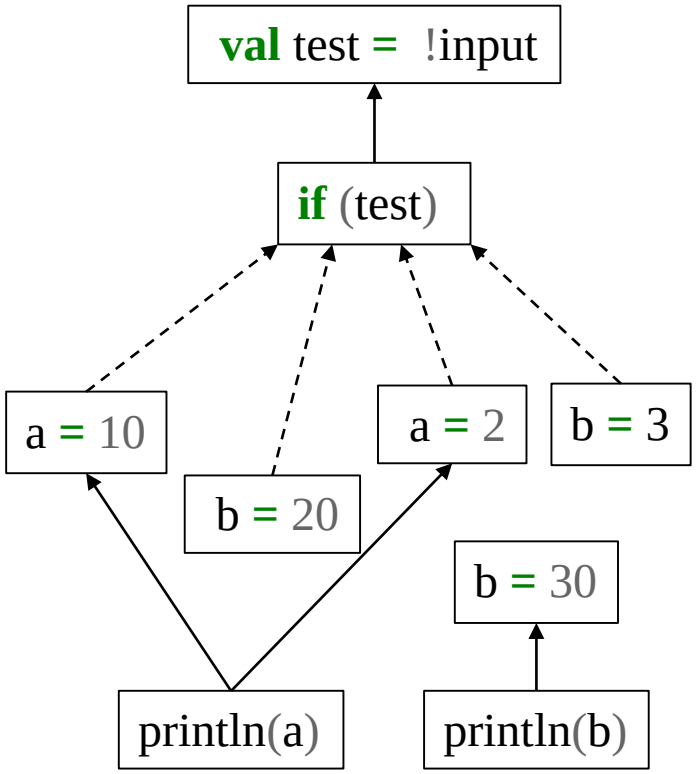


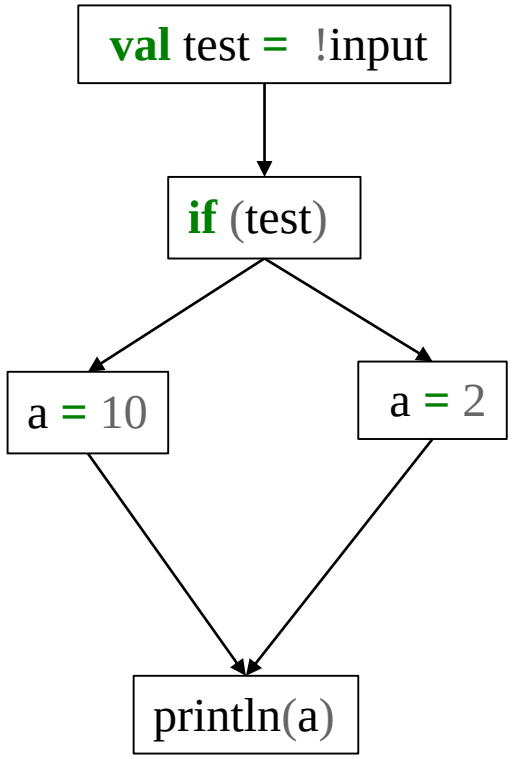
control dependence graph



data dependence graph

Program Dependence Graph





Program Dependence Graph II

- Only intraprocedural
- No handling of object orientation

Reminder:

new Object()

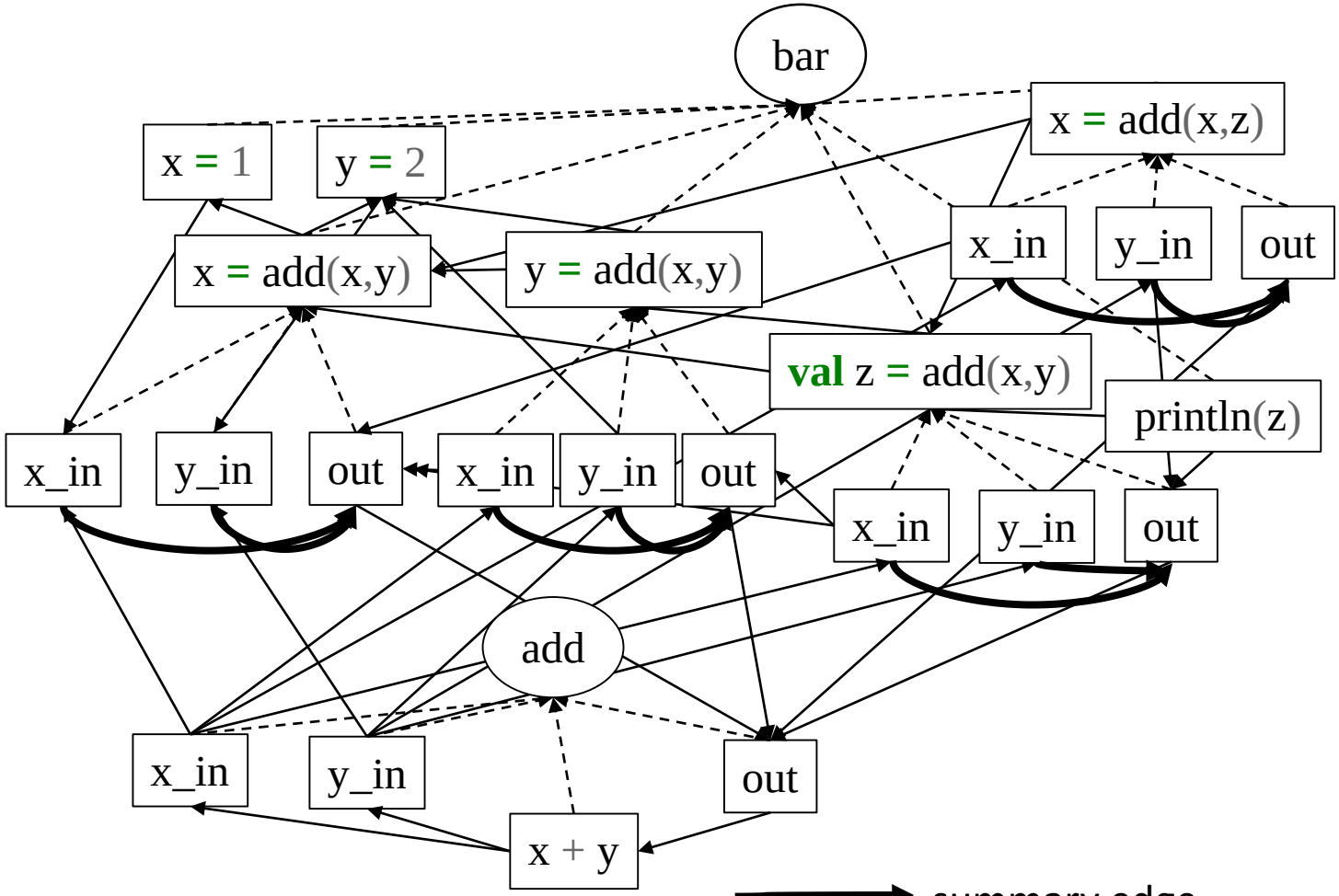
NEW Object
DUP
INVOKESPECIAL java/lang/**Object**.init()

Creating System Dependence Graph

- Augment PDG with functions and callsites
- For each callsite add explicit vertices for parameters
- Split graph traversal in two phases:
  - Upwards in the call stack
  - Downwards in the call stack

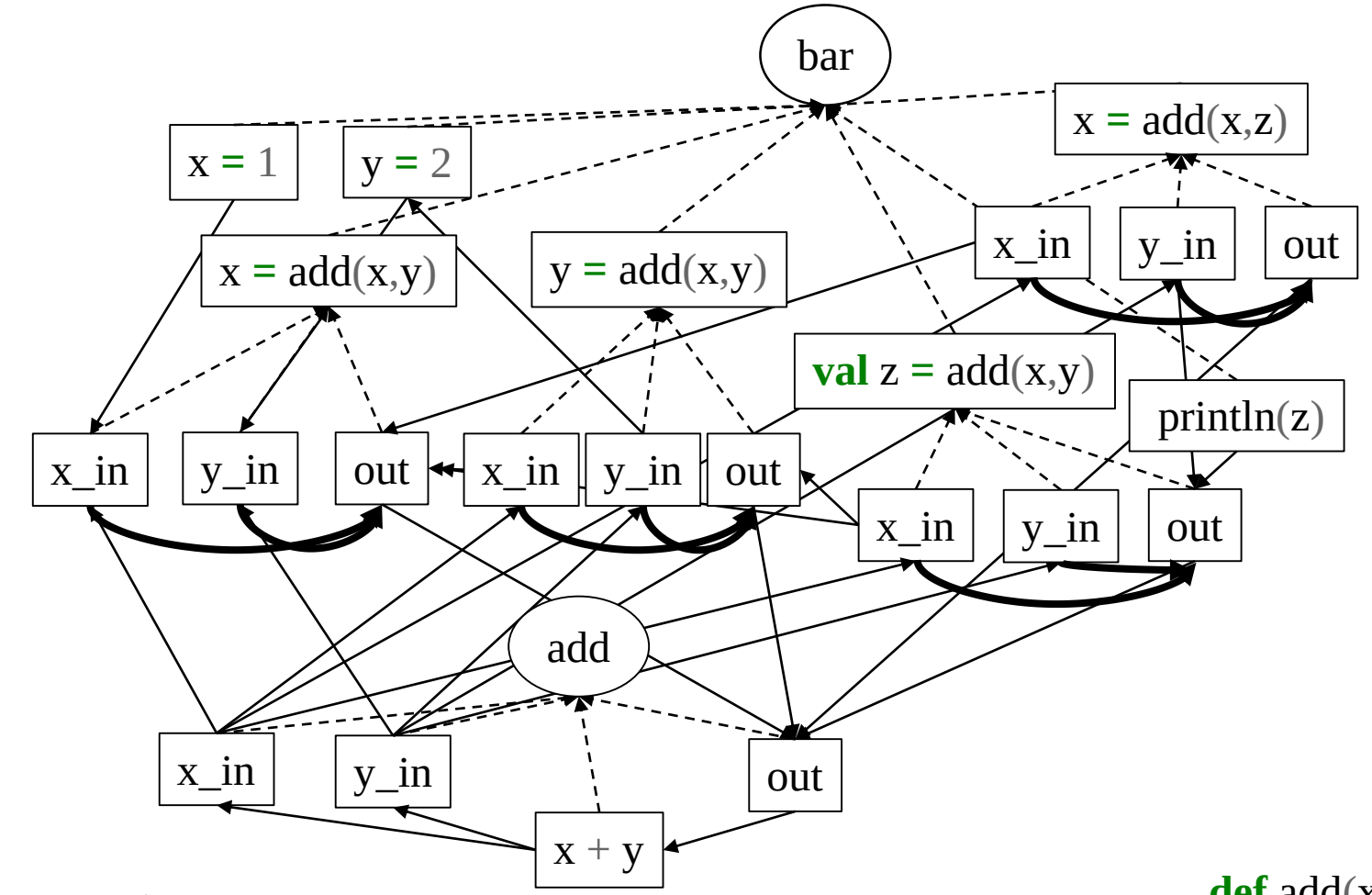
Example System Dependence Graph

```
def bar() {
  var x = 1
  var y = 2
  x = add(x,y)
  y = add(x,y)
  val z = add(x,y)
  x = add(x,z)
  println(z)
}
```




```
def add(x: Int, y: Int): Int =
  x + y
```

Slicing using a System Dependence Graph



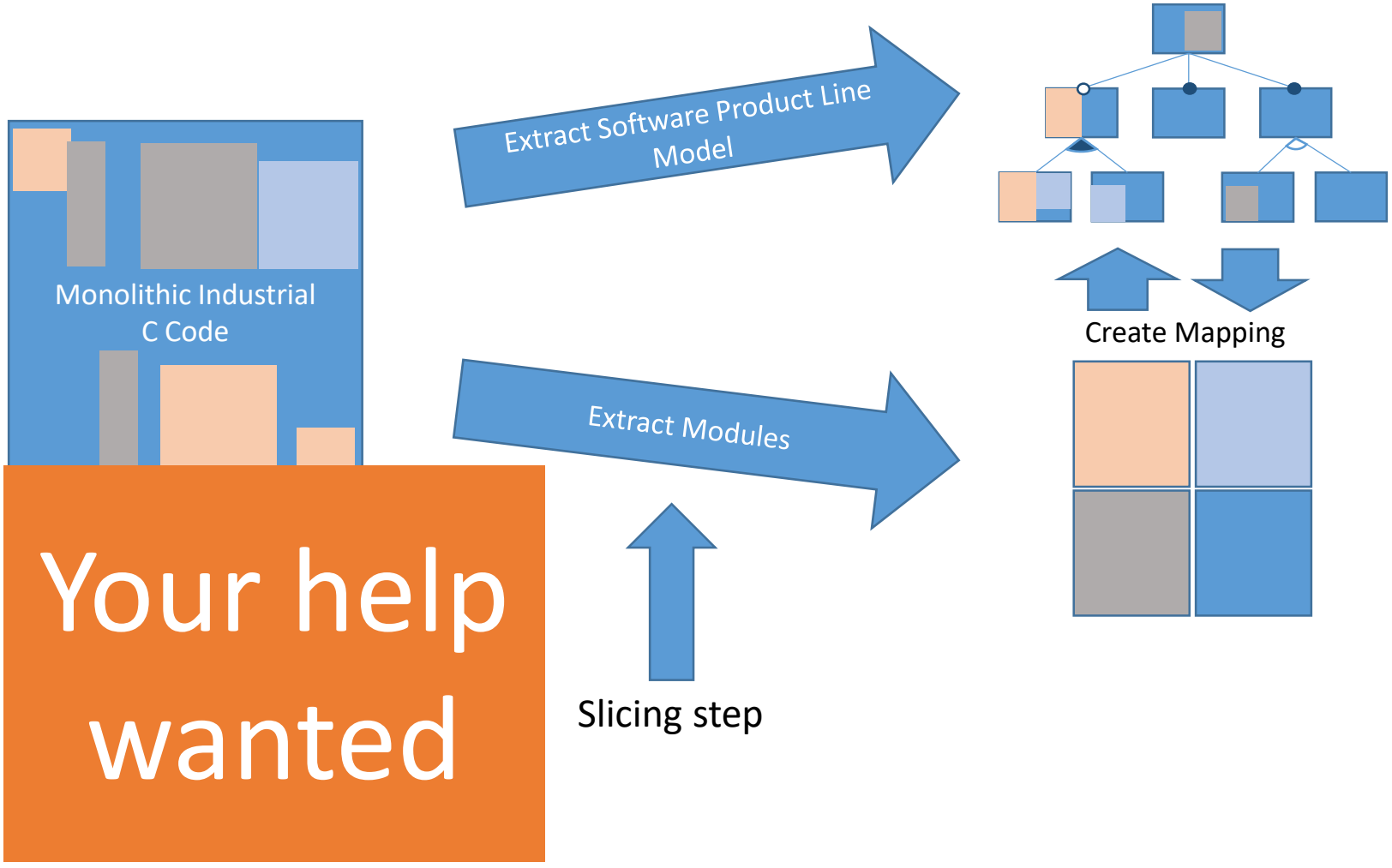

```
def bar() {
  var x = 1
  var y = 2
  x = add(x,y)
  y = add(x,y)
  val z = add(x,y)
  println(z)
}
```

```
def add(x: Int, y: Int): Int =
  x + y
```

Object Oriented Slicing

- Add nodes for classes to be able to represent dependency
- Add in/out vertices at callsites for fields and global variables
- Callsites can be polymorphic – use callgraph for candidate methods

Research Project - Software Factory 4.0



Sources

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