EXTENDING AlDeSCo BY

Building a data flow graph for java

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Why even bother?

⊙ **AlDeSCo #83** 😄

Datenfluss wäre hilfreich gewesen

```
if(arr[i] > arr[j])
  // ...
```

What we want to check for

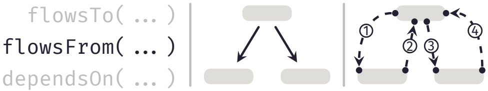
```
boolean needsToSwap = arr[i] > arr[j];
if(needsToSwap)
  // ...
```

What we got

Three steps to success

```java
class AlDeSCo {
  public int magic(int n, boolean b) {
    int x = 42;
    if(b)
      x = addFive(n);
    else
      x = n;
    return x;
  }
  private int addFive(int m) {
    return m + 5;
  }
}
```

How does `n` propagate through the program?



flowsTo(…)

flowsFrom(…)

dependsOn(…)

Select the Operation

```
  flowsTo( ... )
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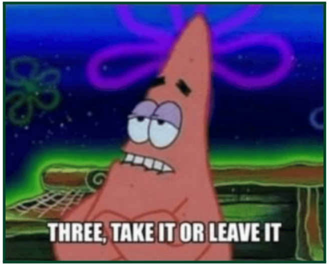
We can ask three different questions:



Select the Operation

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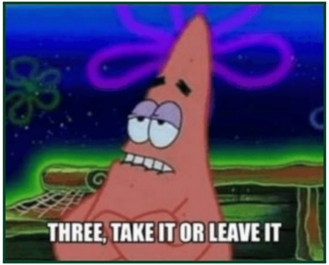
We can ask three different questions:

- Does `x` **depend on** `y`?



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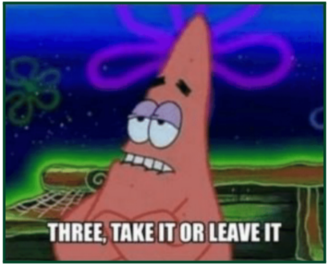
- Does x **depend on** y?
- What **flows from** x?



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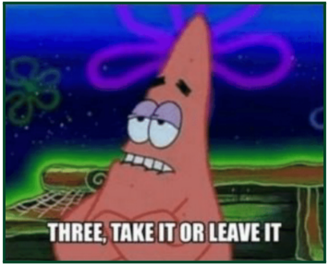
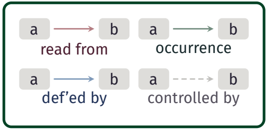
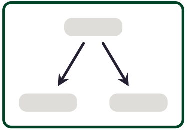


Build the dataflow graph





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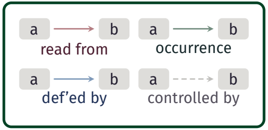

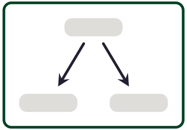

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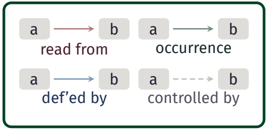
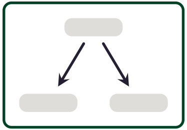


a → b read from

a → b occurrence

a → b def’ed by

a → b controlled by



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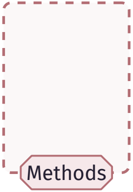

Methods

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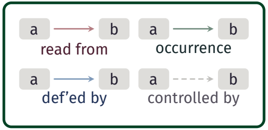

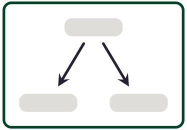

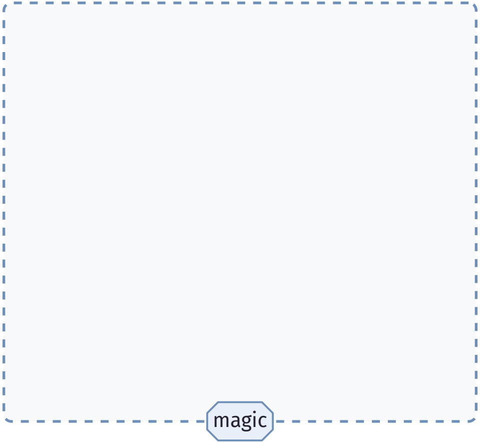

magic
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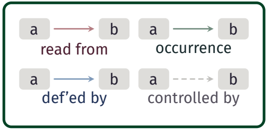

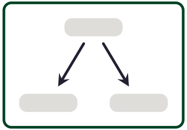

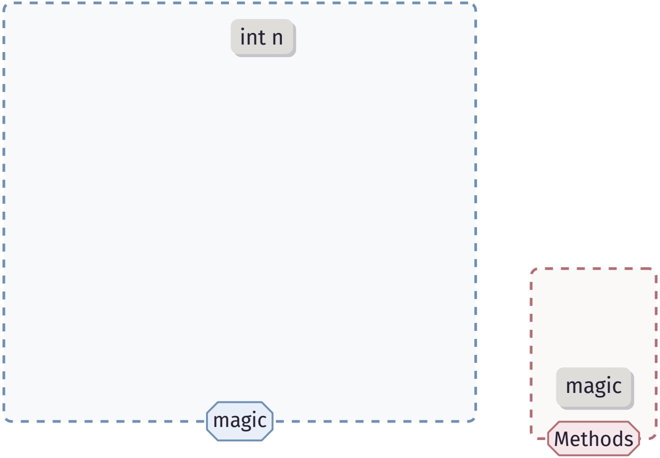

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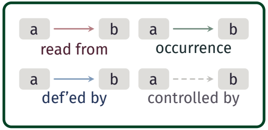

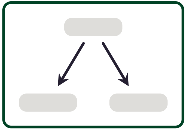

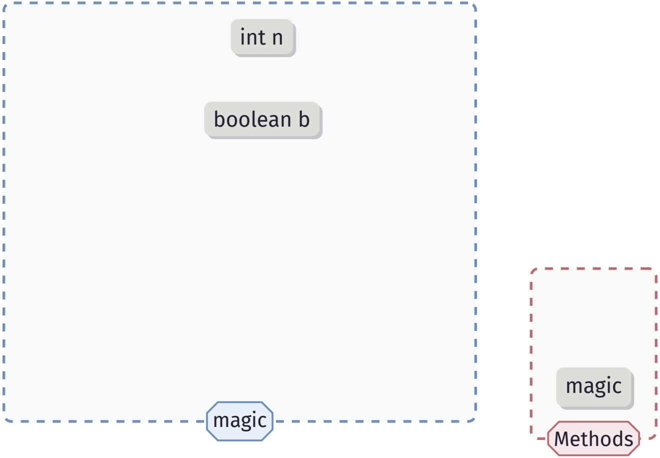

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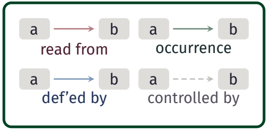

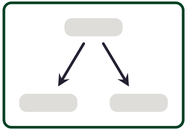

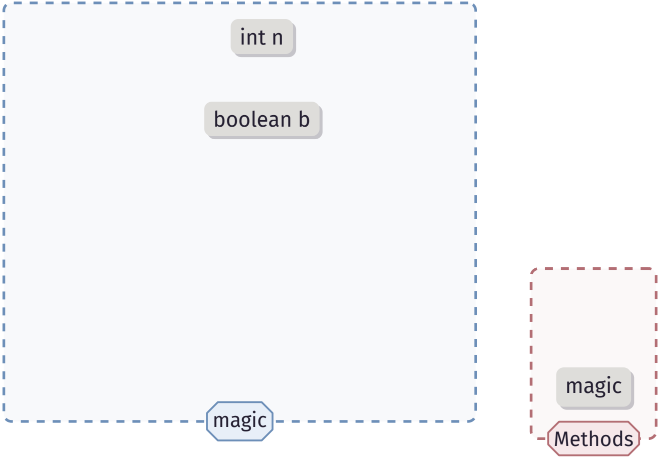

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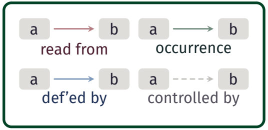

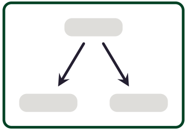

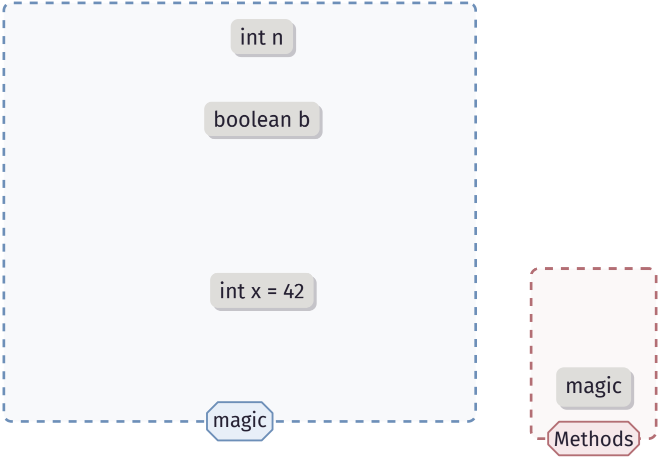

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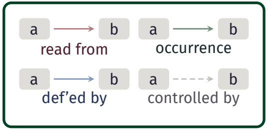

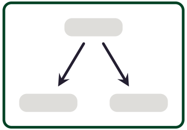

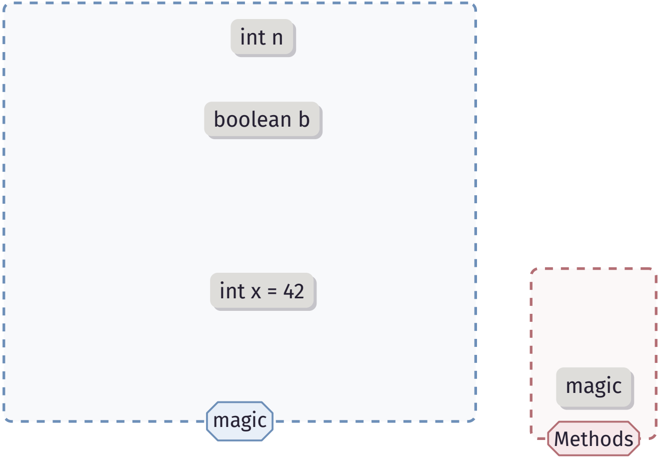

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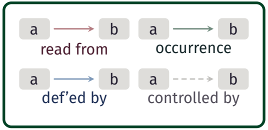

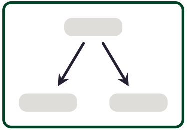

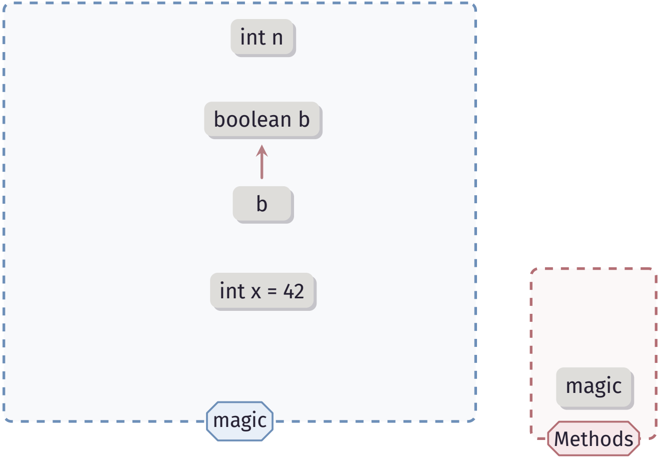

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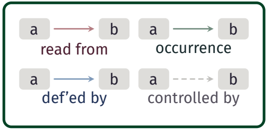

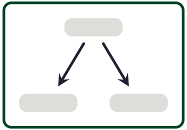

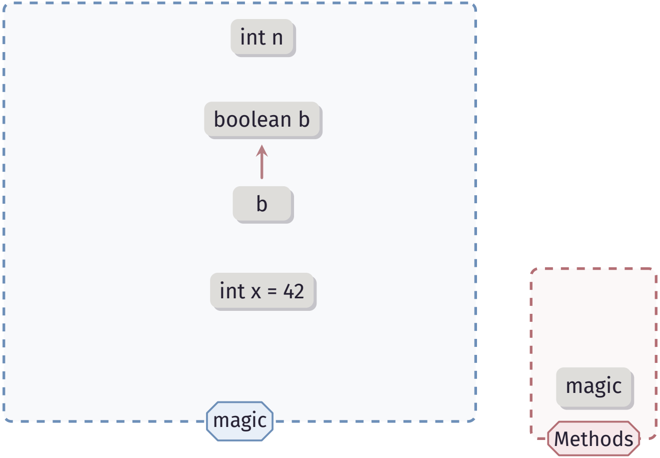

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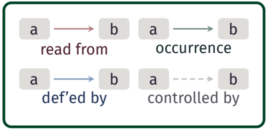

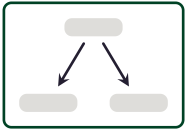

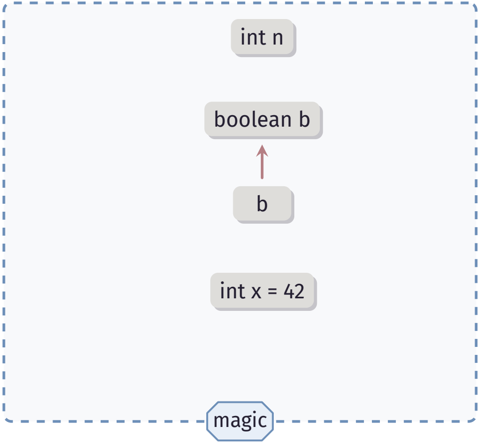

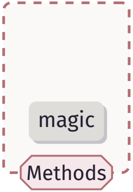

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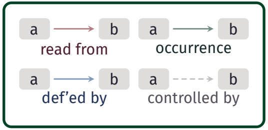

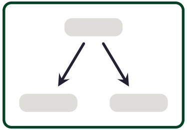

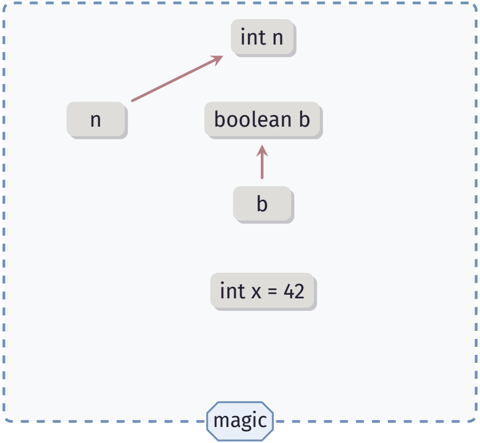

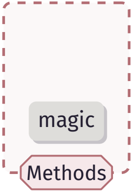

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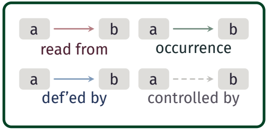

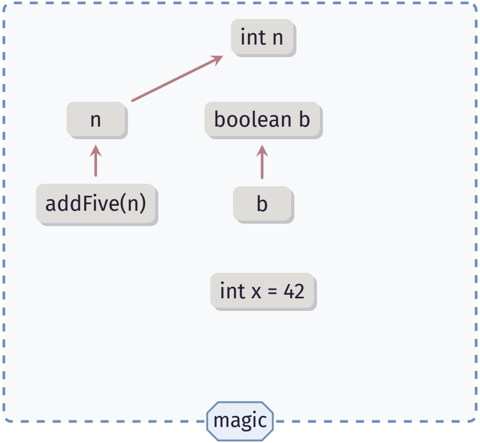

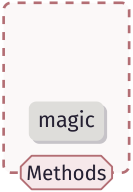

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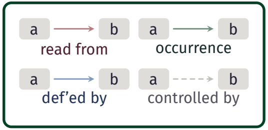

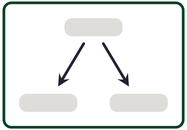

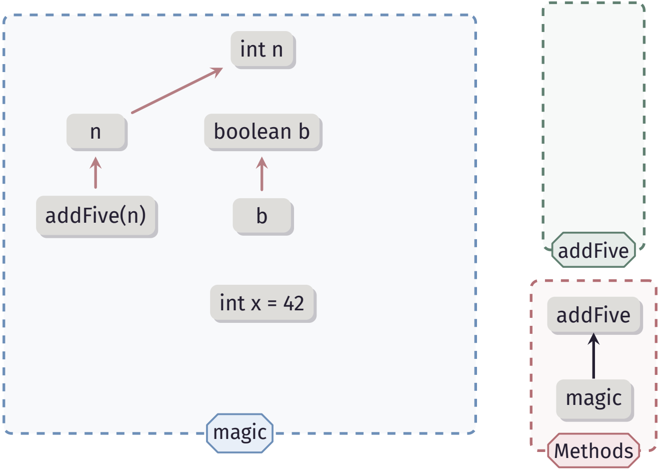

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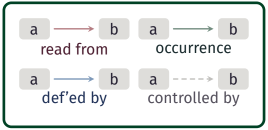

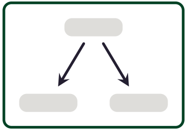

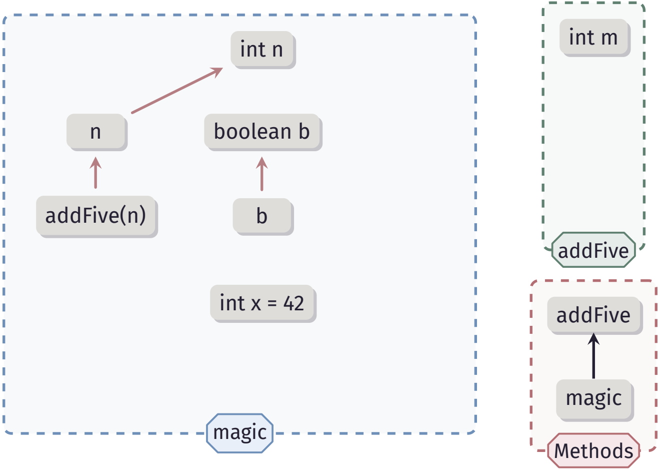

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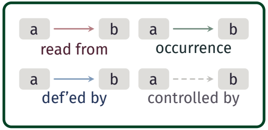

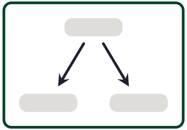

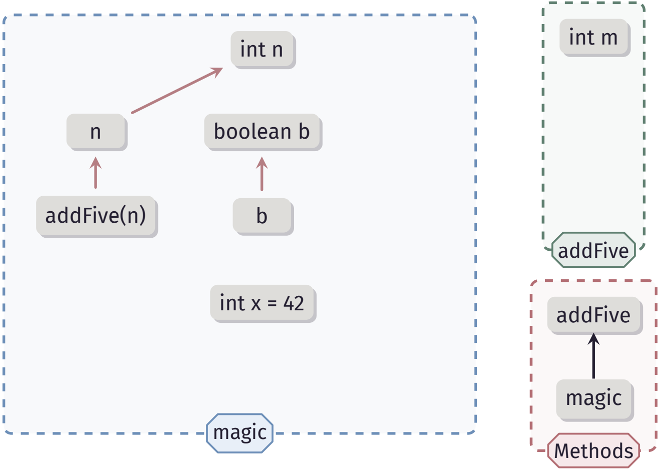

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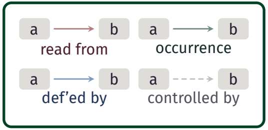
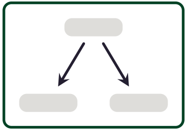
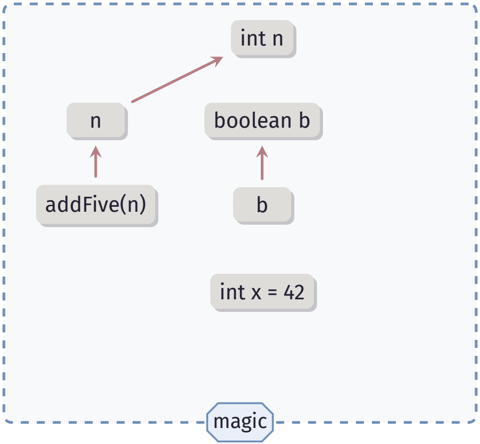
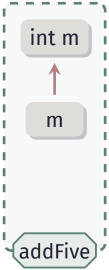
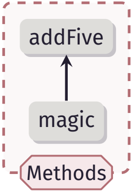
Build the dataflow graph











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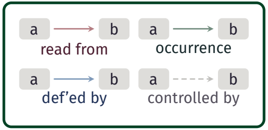

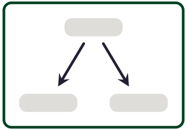

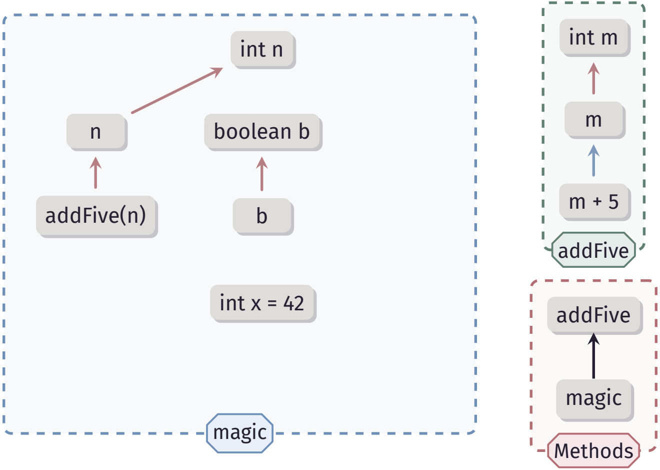

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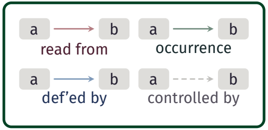

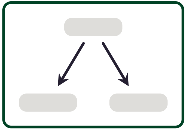

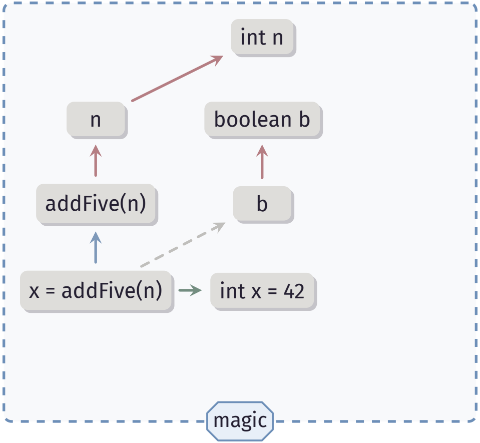

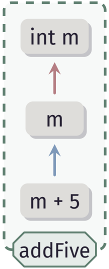

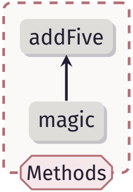

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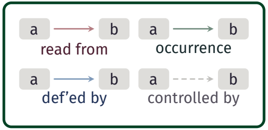

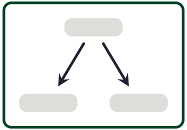

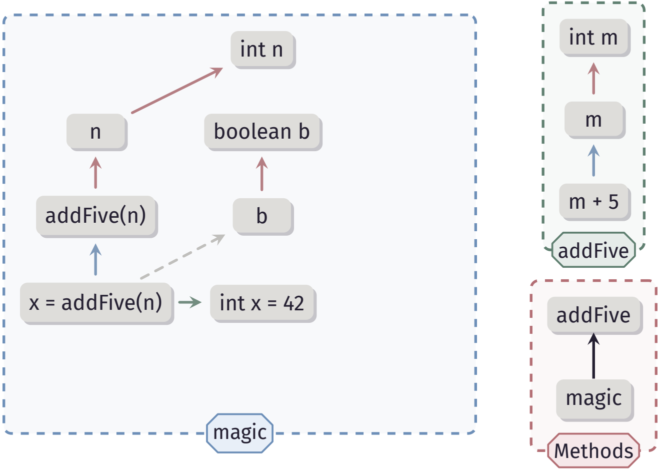

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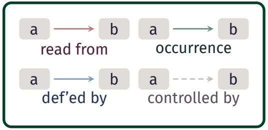

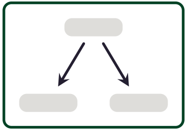

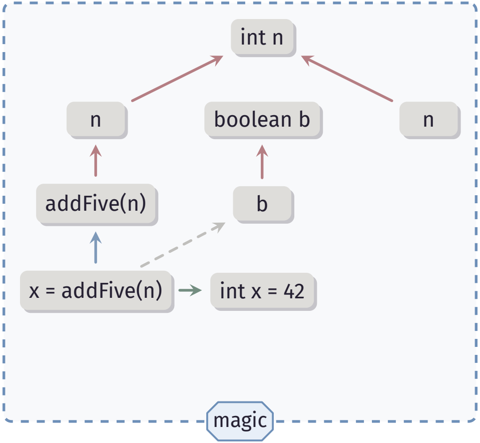

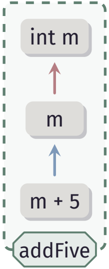

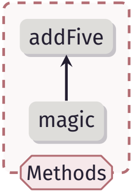

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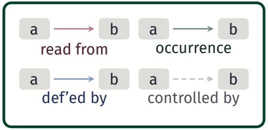

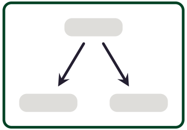

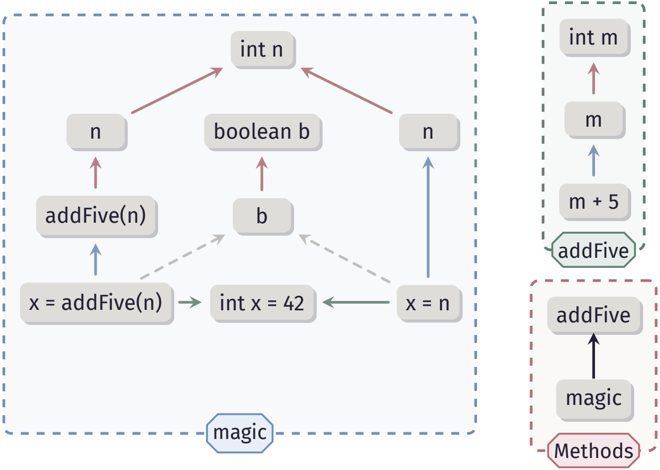

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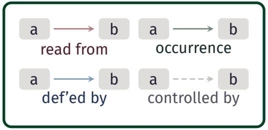

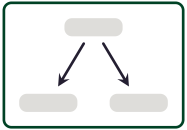

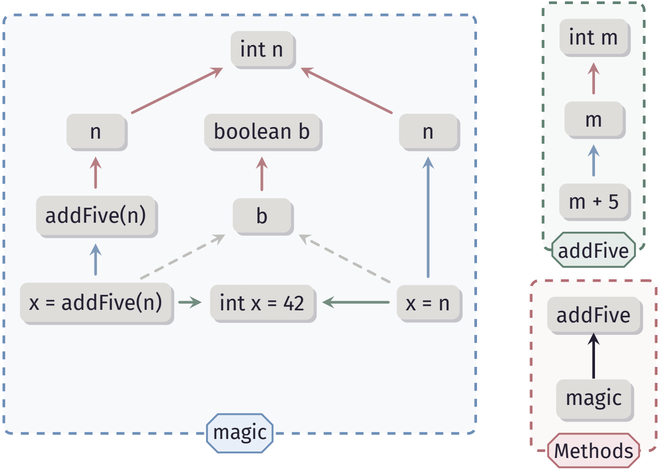

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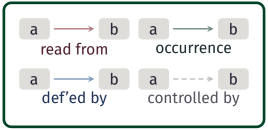

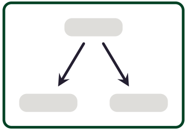

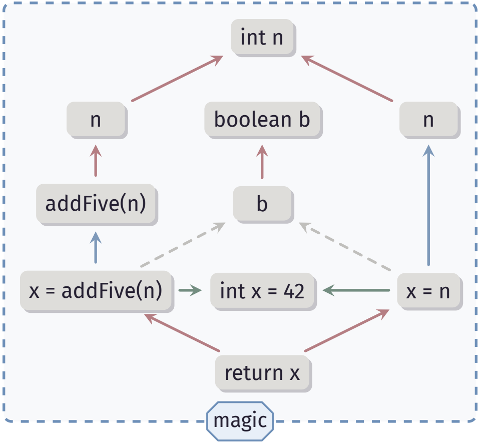

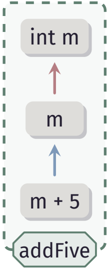

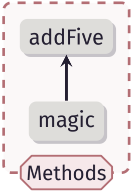

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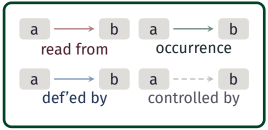
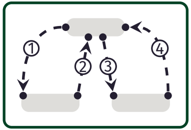
TRAVERSE THE DATAFLOW GRAPH





`flowsTo(a)`

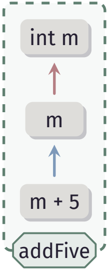
Traverse all paths that lead to a.

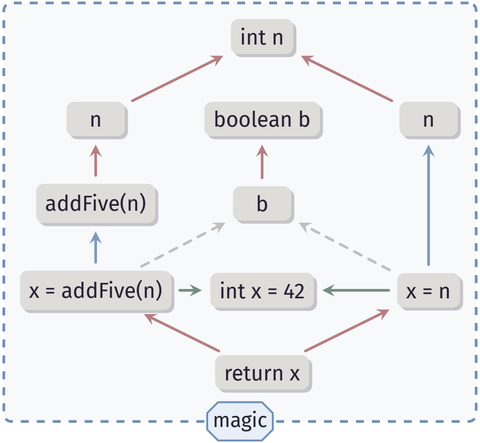
`flowsFrom(a)`

Traverse all paths that start at a.

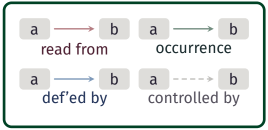
`dependsOn(a, b)`

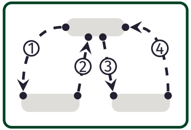
Is there a path between a and b?





Traverse the Dataflow Graph





flowsTo(a)

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flowsFrom(int n)

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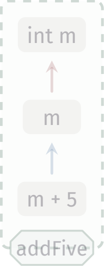
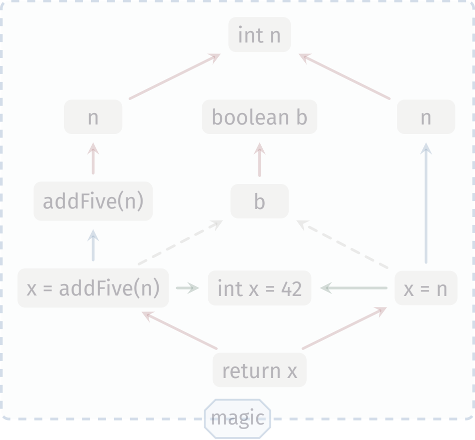
dependsOn(a, b)

Is there a path between a and b?





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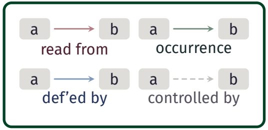

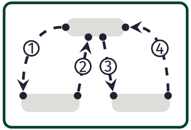

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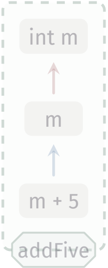

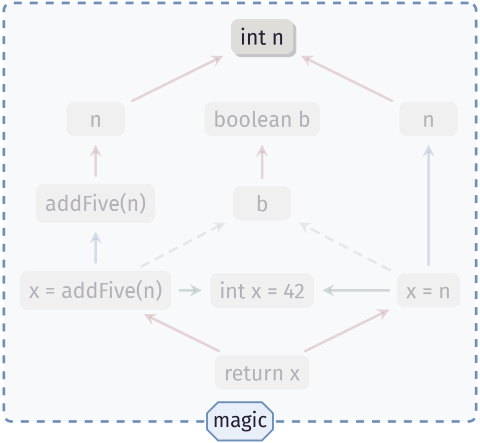

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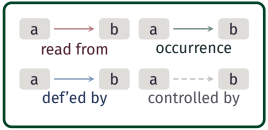

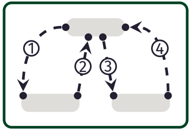

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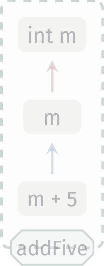

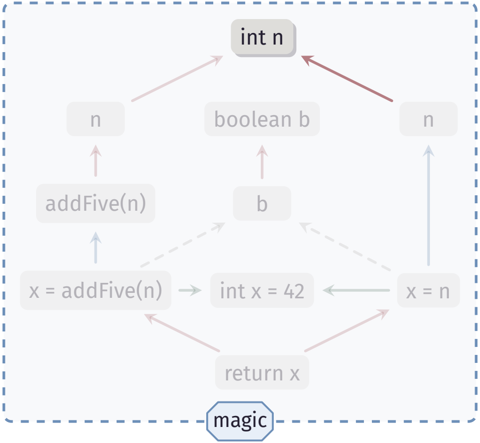

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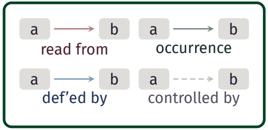

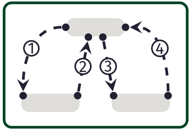

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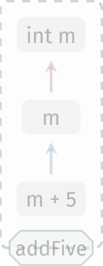

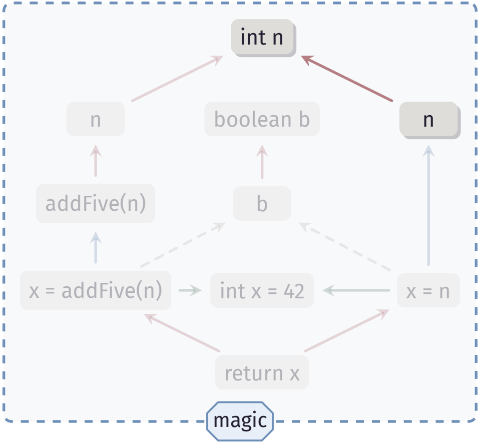

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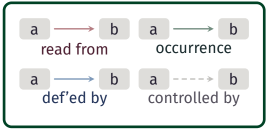

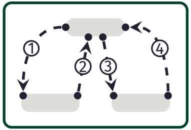

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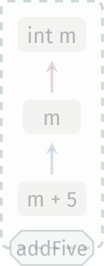

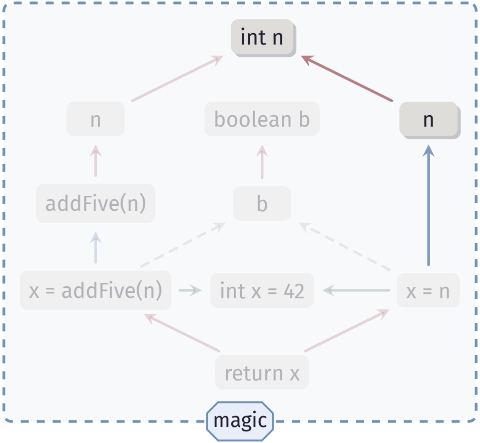

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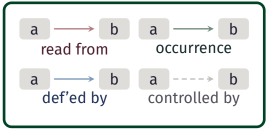

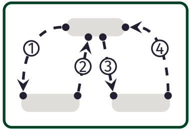

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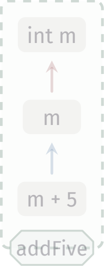

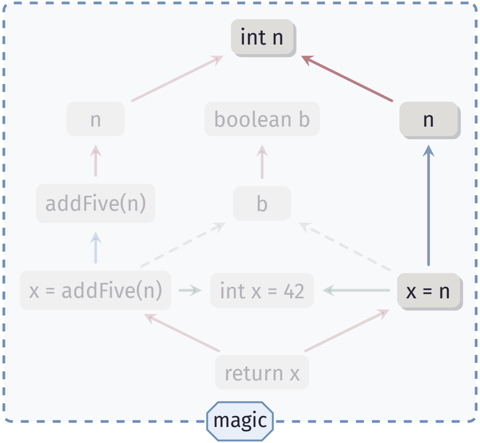

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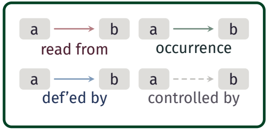
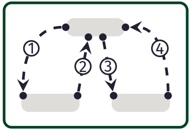


a → b read from

a → b occurrence

a → b def'ed by

a ⇢ b controlled by



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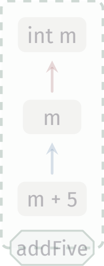
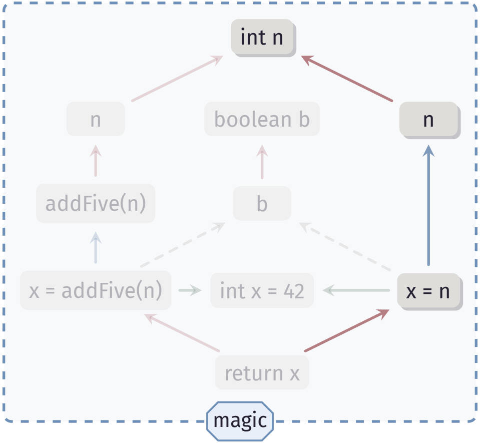


int m

m

m + 5

addFive



int n

n

boolean b

n

addFive(n)

b

x = addFive(n)

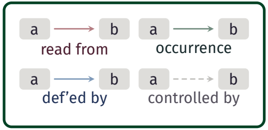
int x = 42

x = n

return x

magic

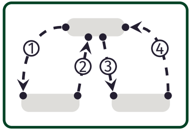
Traverse the Dataflow Graph


a → b read from

a → b occurrence

a → b def'ed by

a → b controlled by



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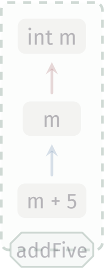
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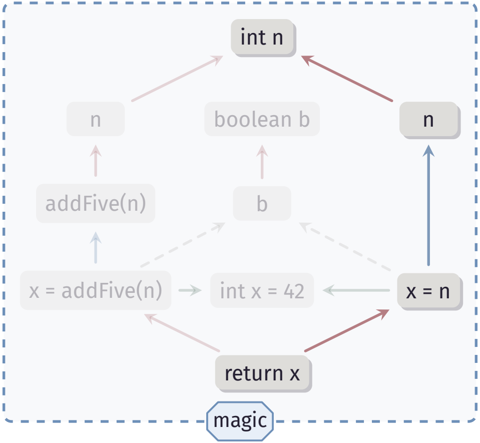
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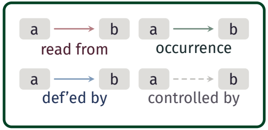

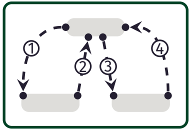

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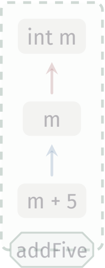

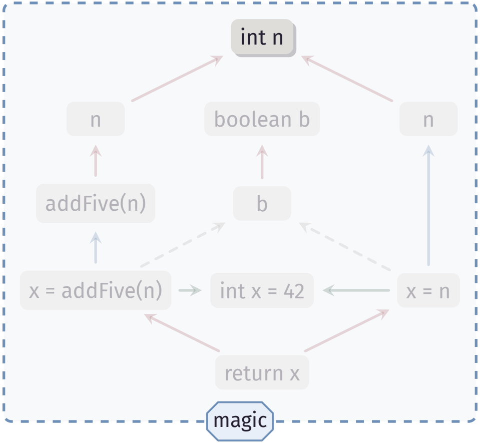

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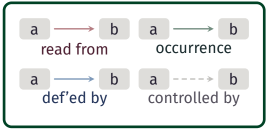

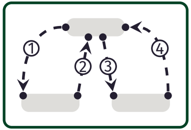

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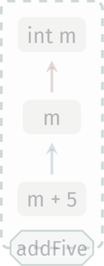

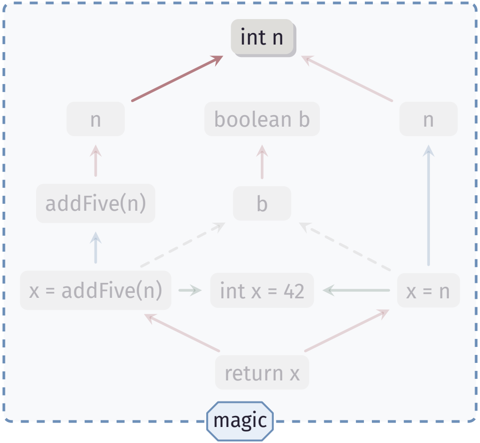

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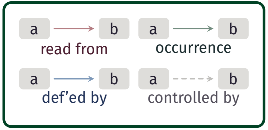

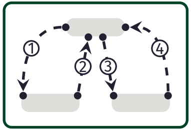

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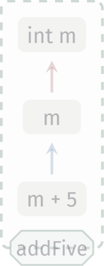

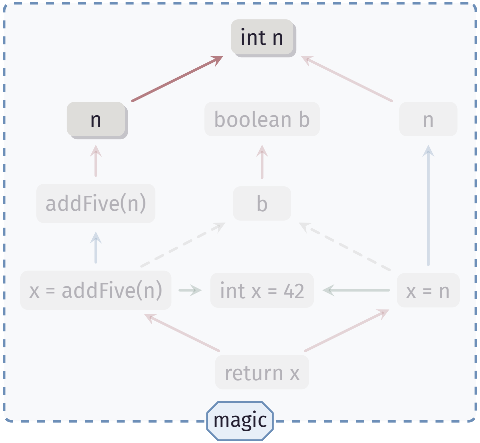

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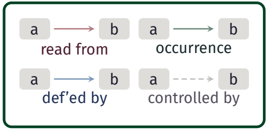

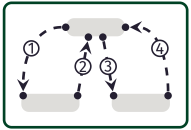

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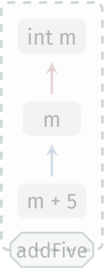

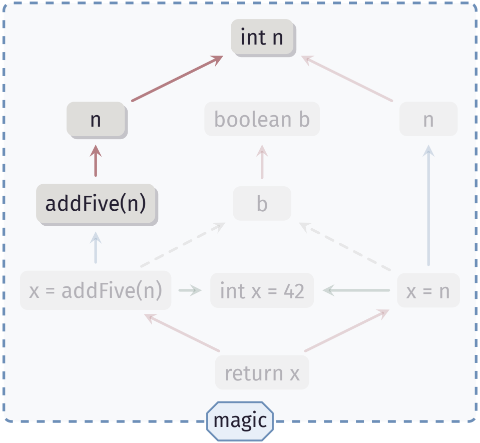

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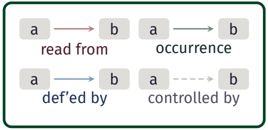

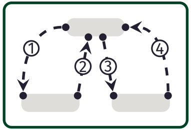

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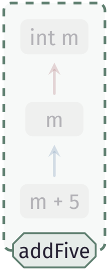

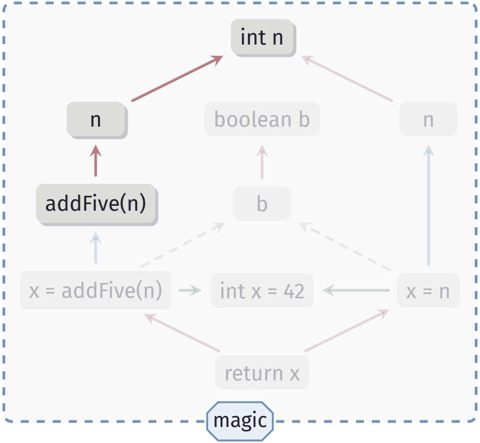

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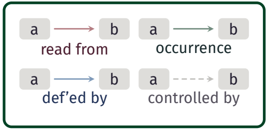

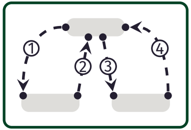

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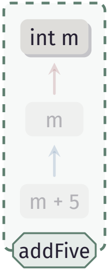

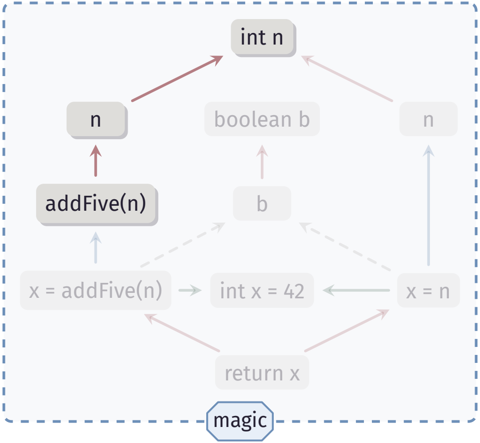

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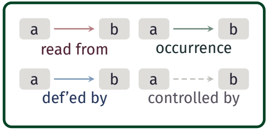

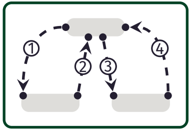

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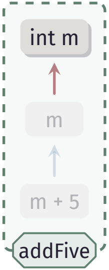

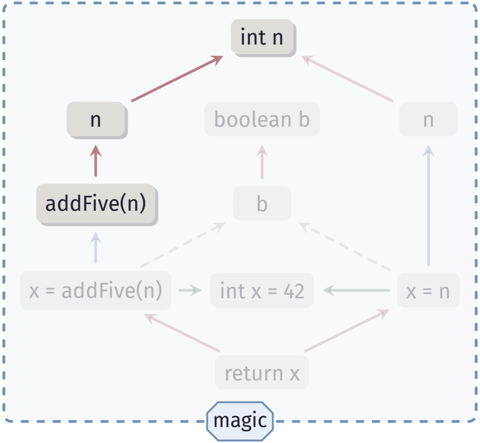

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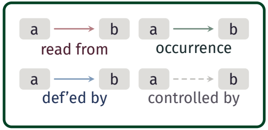

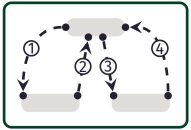

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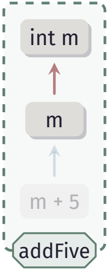

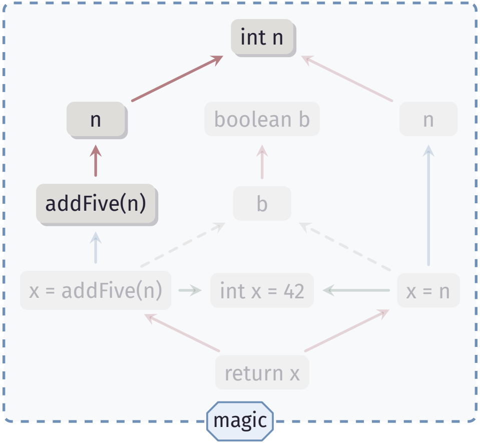

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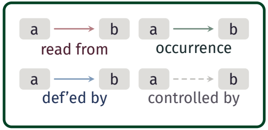

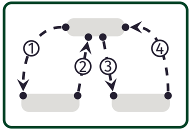

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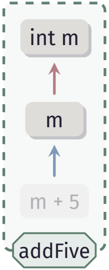

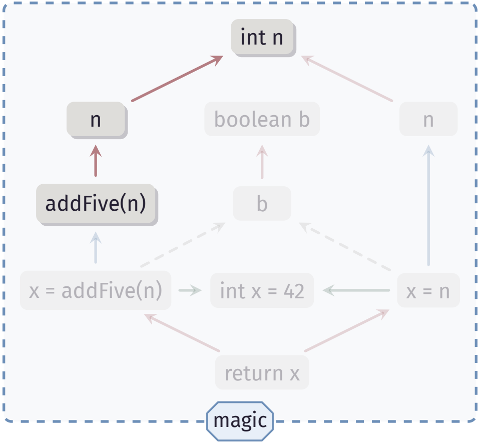

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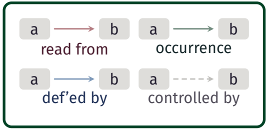

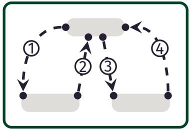

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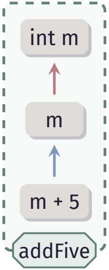

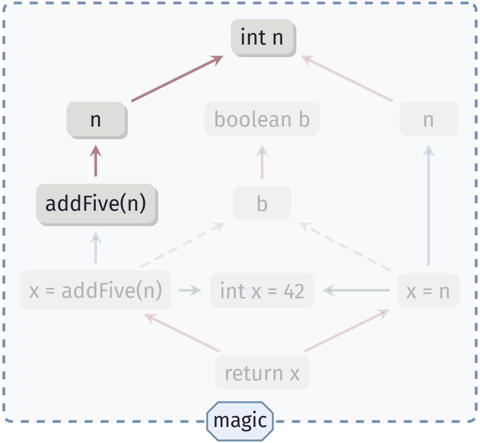

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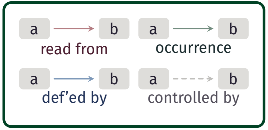

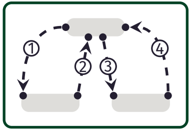

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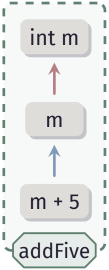

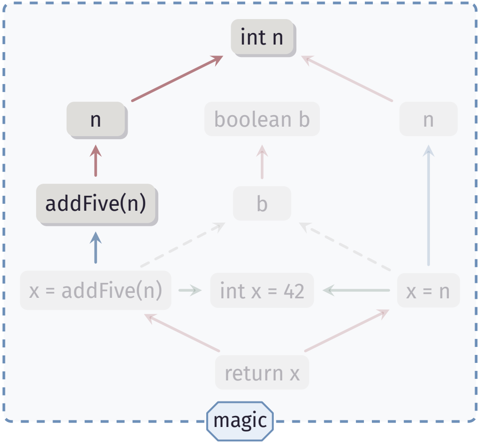

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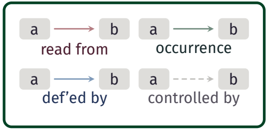

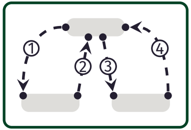

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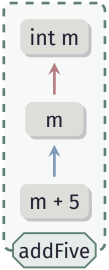

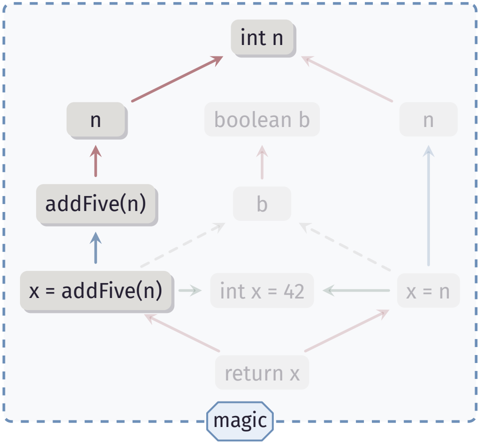

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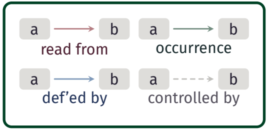

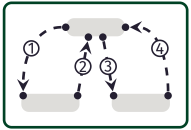

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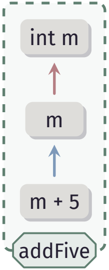

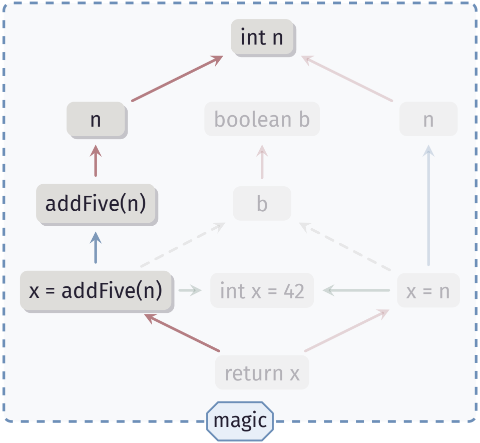

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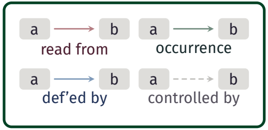

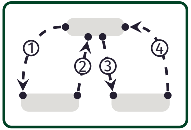

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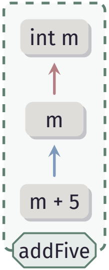

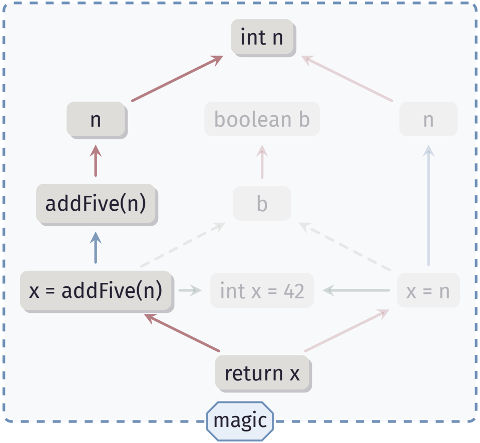

Lukas Pietzschmann

Ulm, 10/29/2023

lukas.pietzschmann@uni-ulm.de