Do Machine Learning Models Produce TypeScript Types That Type Check?

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Type migration: JavaScript to TypeScript

- Incremental migration
- Static type checking
- Better documentation
- Editor integration

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```
function f(s) {
    return s.
}
```

abc f
abc s

```
function f(s: string) {
    return s.
}
```

Symbol interface Symbolvar
charAt
charCodeAt
codePointAt
concat

Machine learning for type prediction

Predict the most likely type annotation for the given code fragment

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```
function f(x) {
    return x + 1;
}
```

Type of x	Probability
`number`	0.4221
`any`	0.2611
`string`	0.2558
other	

Type of x	Probability
`string`	0.9512
`number`	0.0474
`Function`	0.0006
other	

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```
function f(x: _hole_) {
    return x + 1;
}
```

```
function f(x: number) {
    return x + 1;
}
```

TypeWeaver: type check the type annotations

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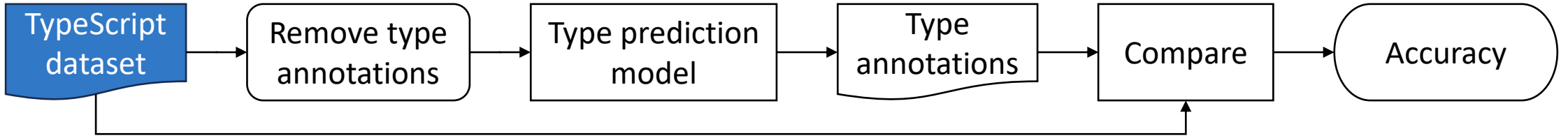
Prior work:

$$\text{Accuracy} = \frac{\text{correct predictions}}{\text{total predictions}}$$



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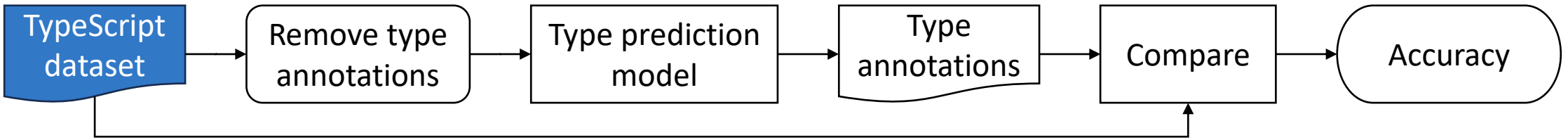
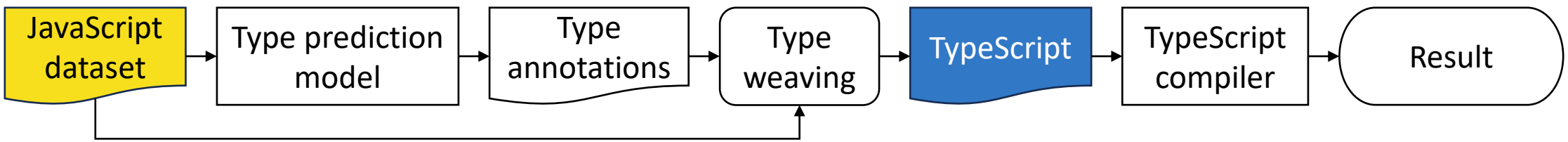


Our tool (TypeWeaver):



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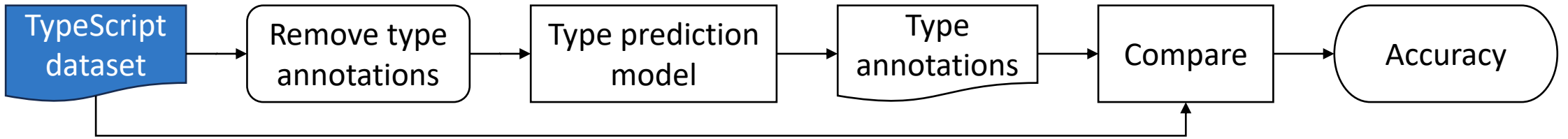

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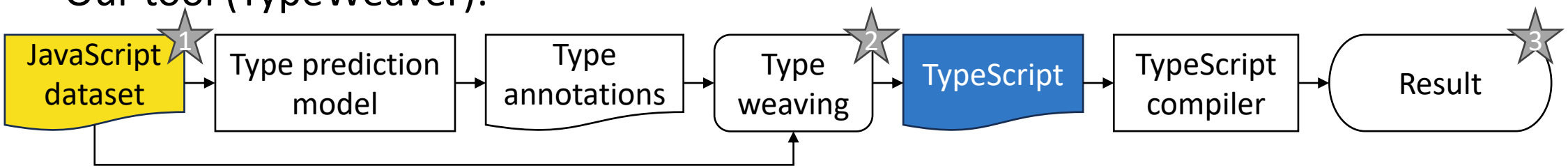

This talk

Constructing the JavaScript dataset

1. Top 1,000 most downloaded packages

2. Download source code

3. Filter and clean

4. Check dependencies

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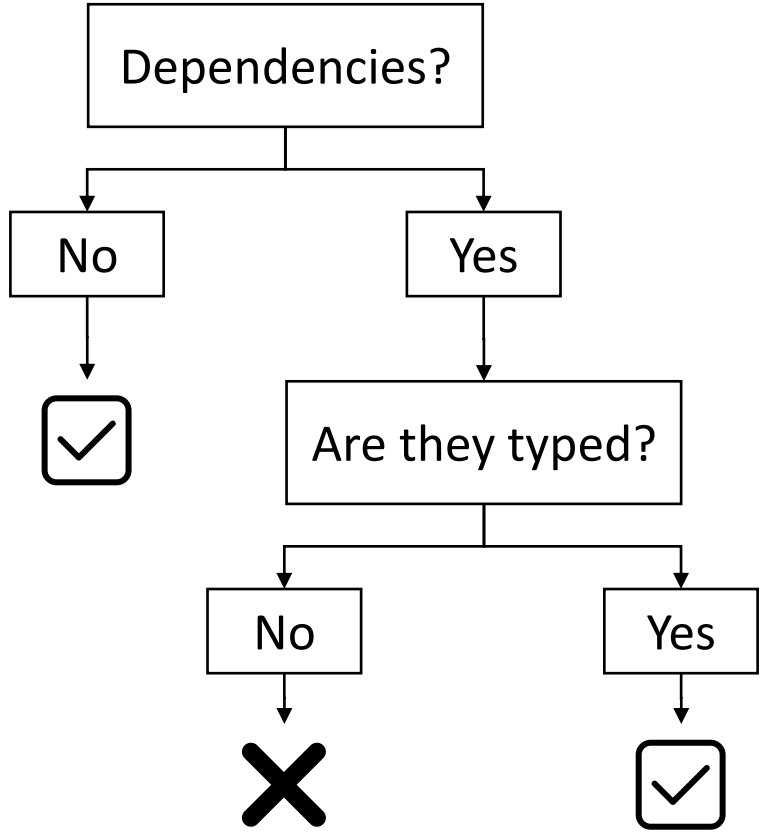

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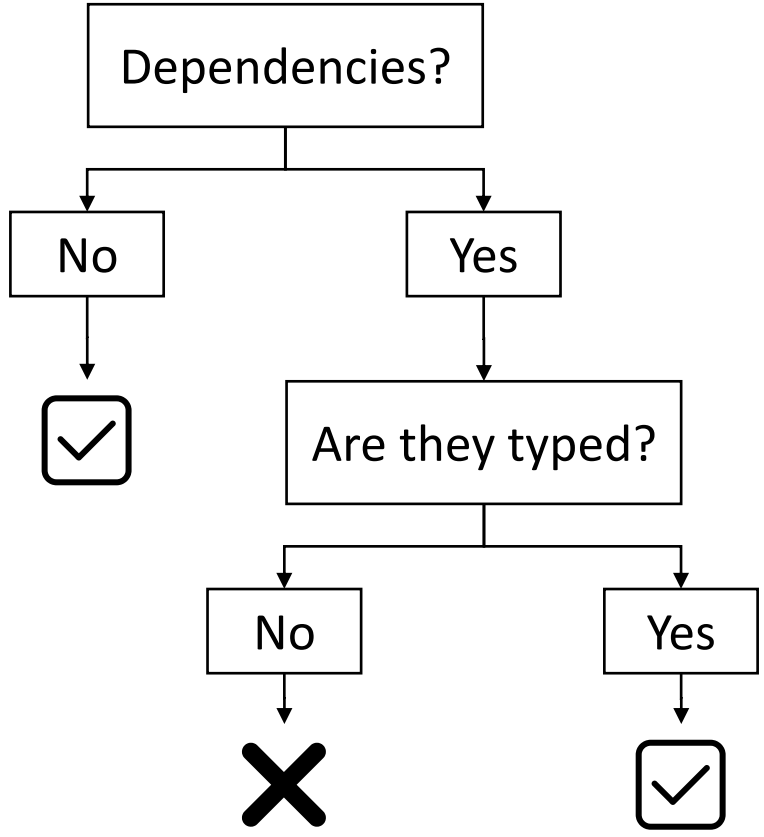

Result: 513 packages

Type weaving: JS + type annotations = TS

```
function f(x, y) {
    return x + y;
}
```

Token	Type	Probability
function		
f	string	0.6381
(		
x	string	0.4543
,		
y	number	0.4706
)		
{		
return		
x	number	0.3861
+		
y	number	0.5039
;		
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```
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  Parameter
    Identifier
  Parameter
    Identifier
  Block
    ReturnStatement
      …
```

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function f(x, y): string {
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function f(x: string, y): string {
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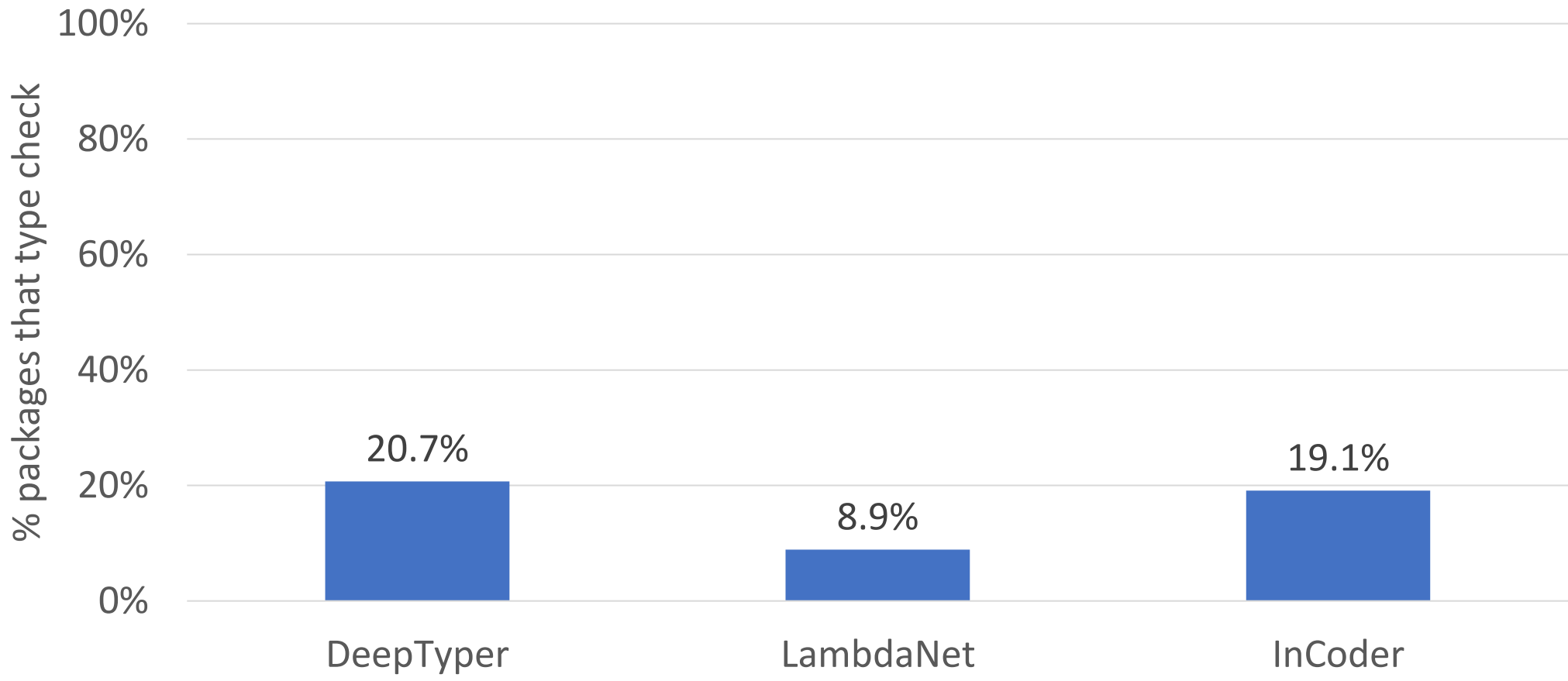
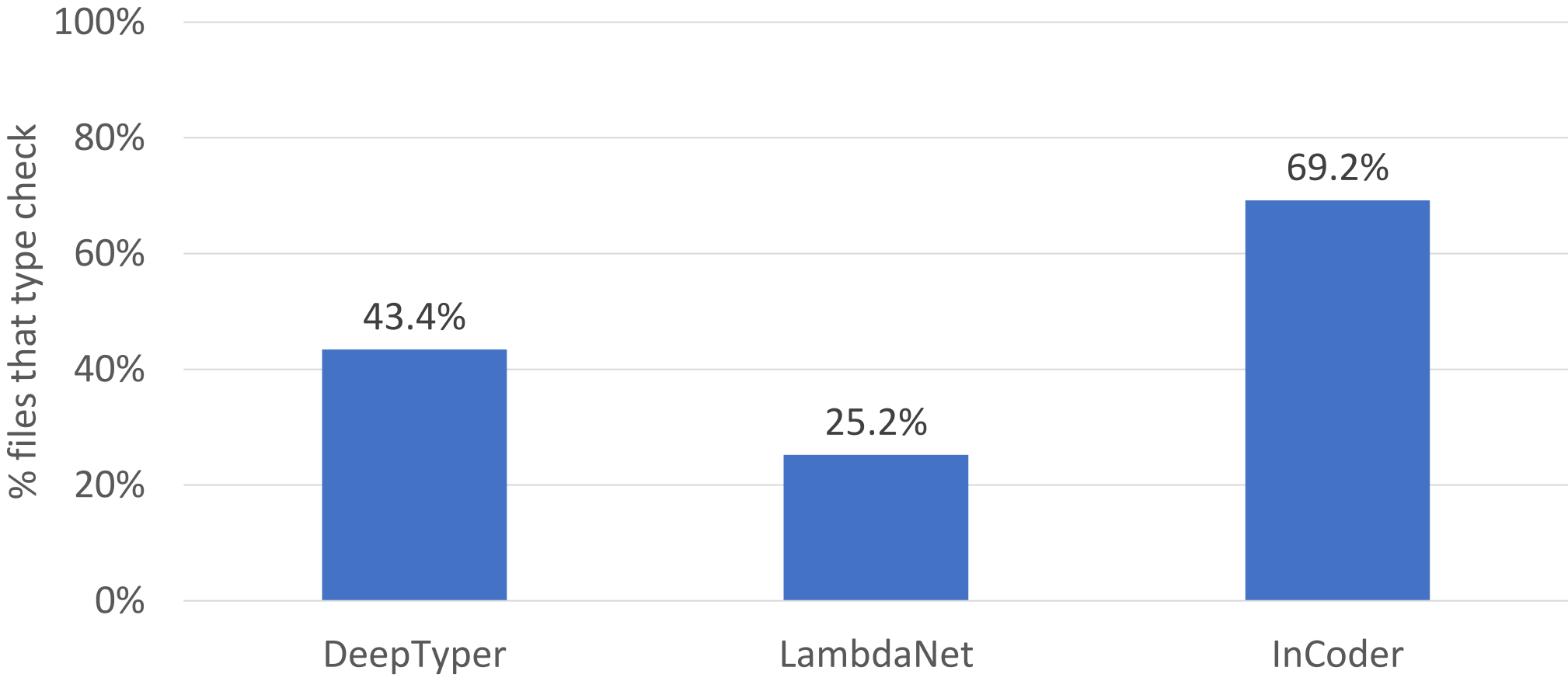
Do migrated packages type check?

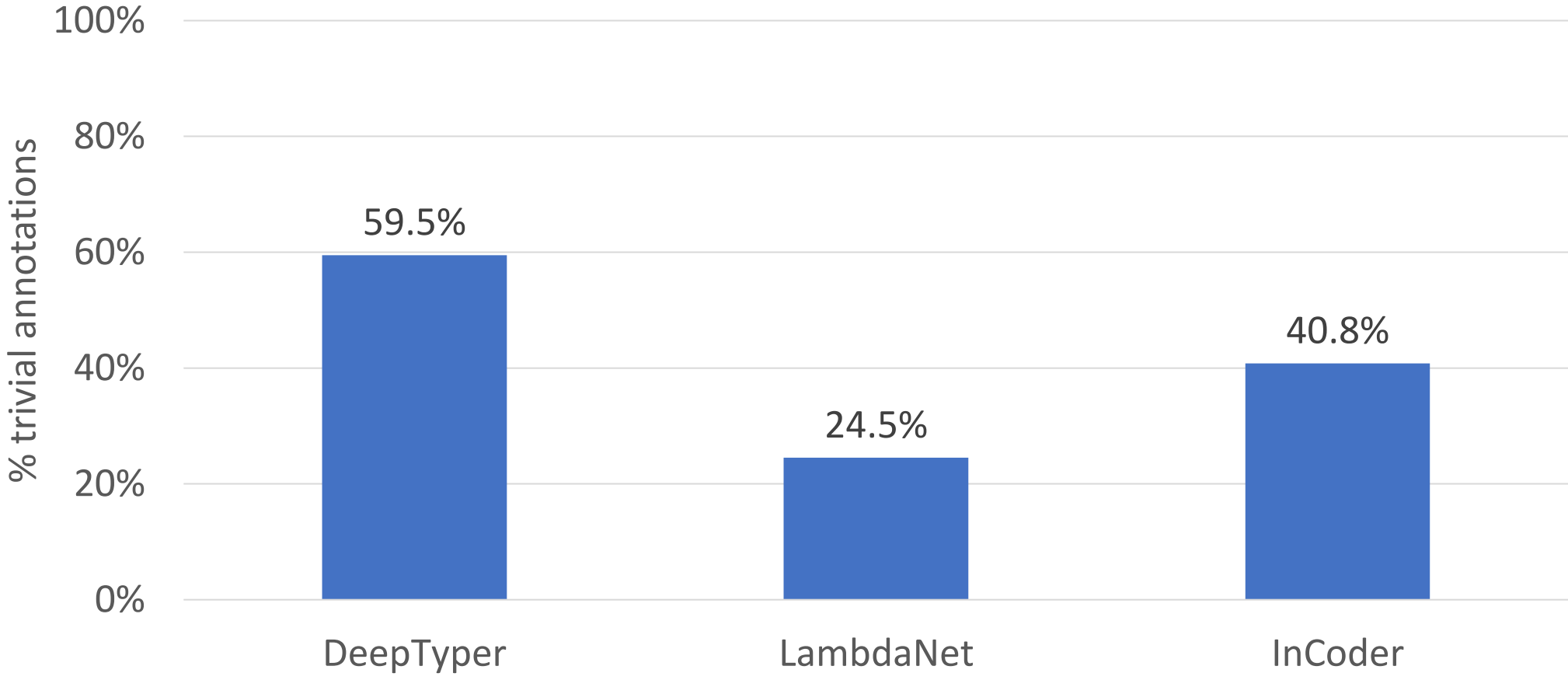


Do migrated files type check?

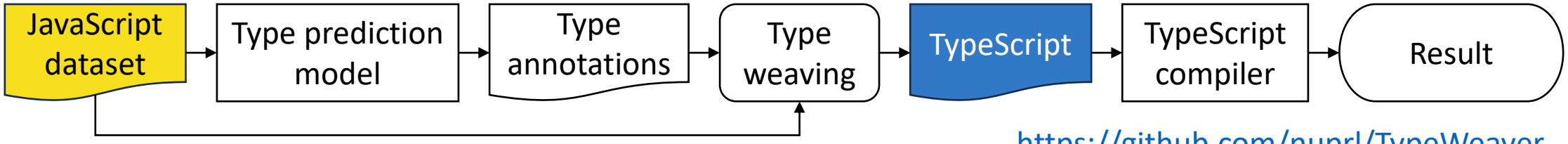


How many type annotations are trivial?

(within the files that type check)



Conclusion: TypeWeaver



https://github.com/nuprl/TypeWeaver

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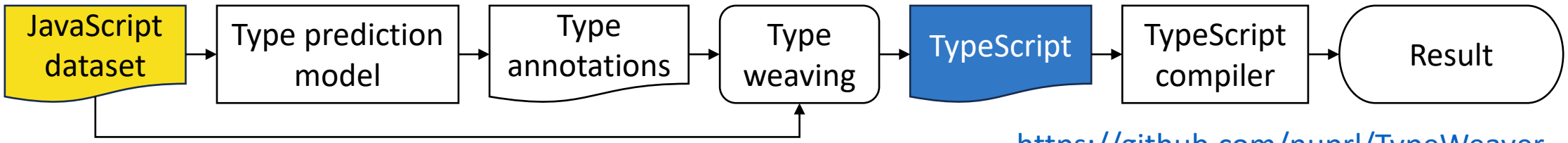

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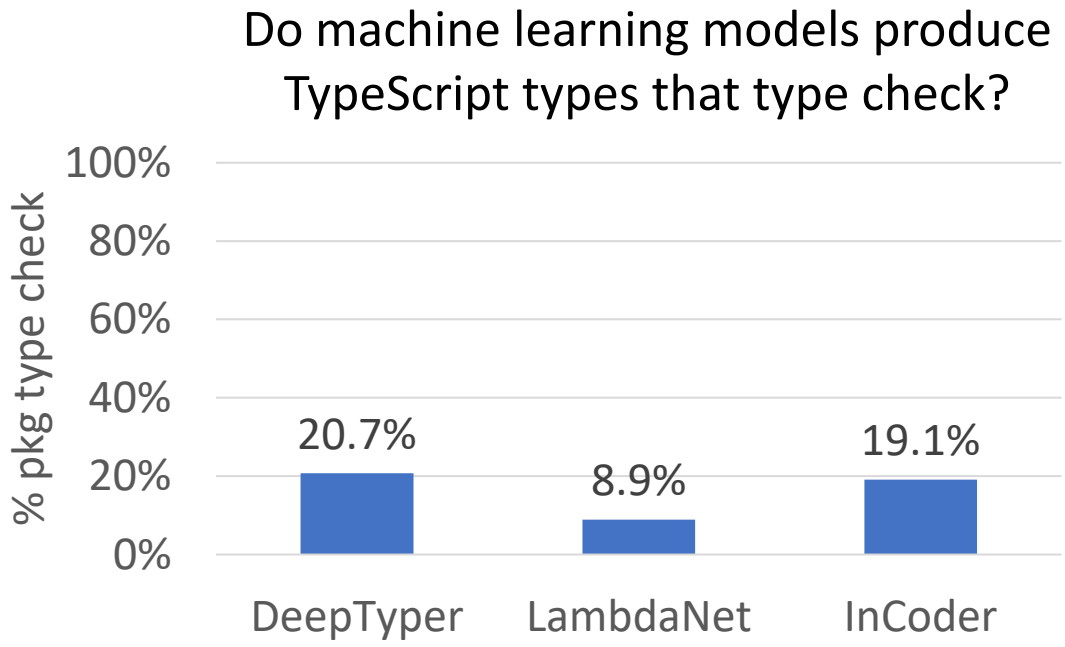

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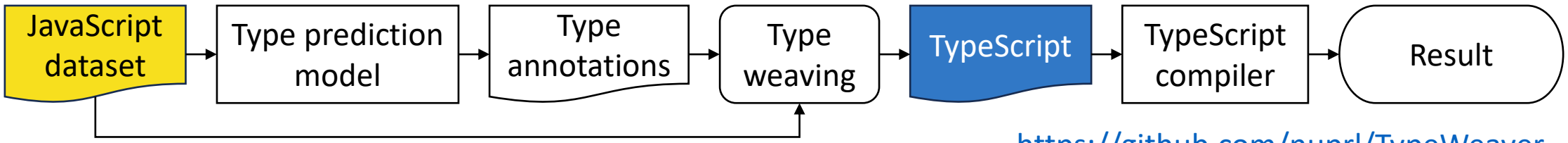

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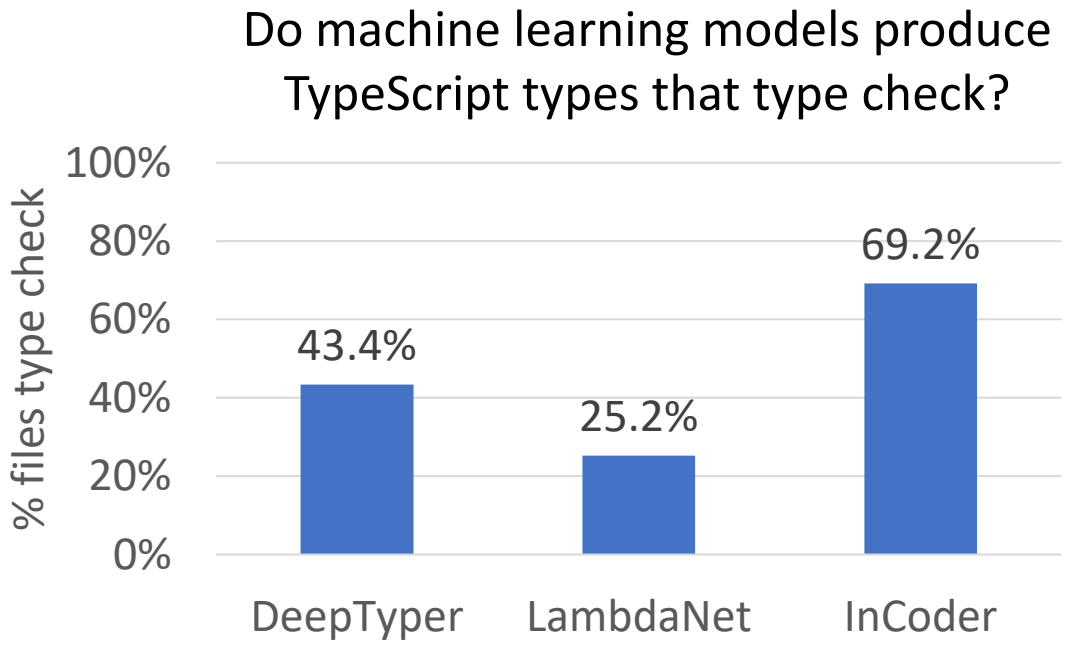

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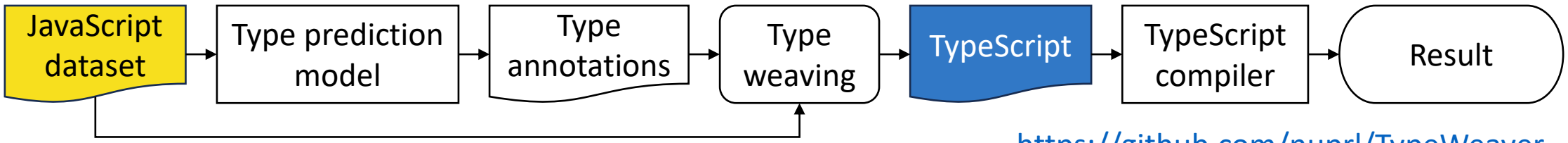

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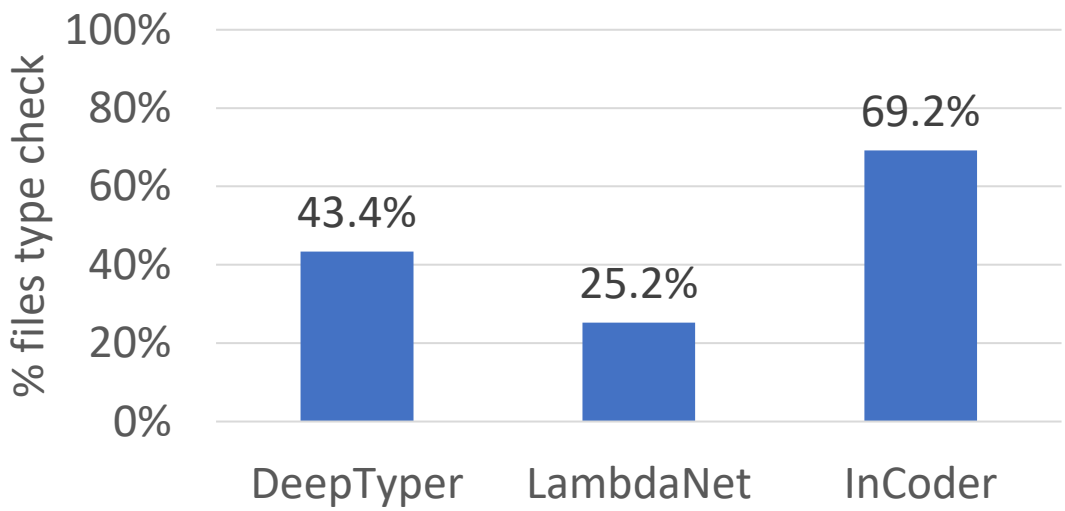
Do machine learning models produce TypeScript types that type check?

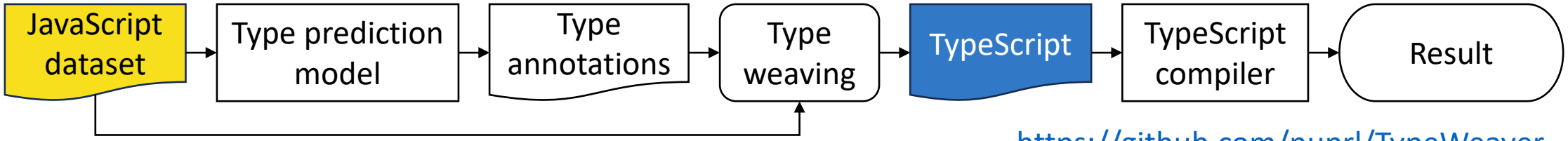


Open questions:

- How should we evaluate type prediction models?
- Can slightly wrong annotations be useful?

Conclusion: TypeWeaver

Thank you!



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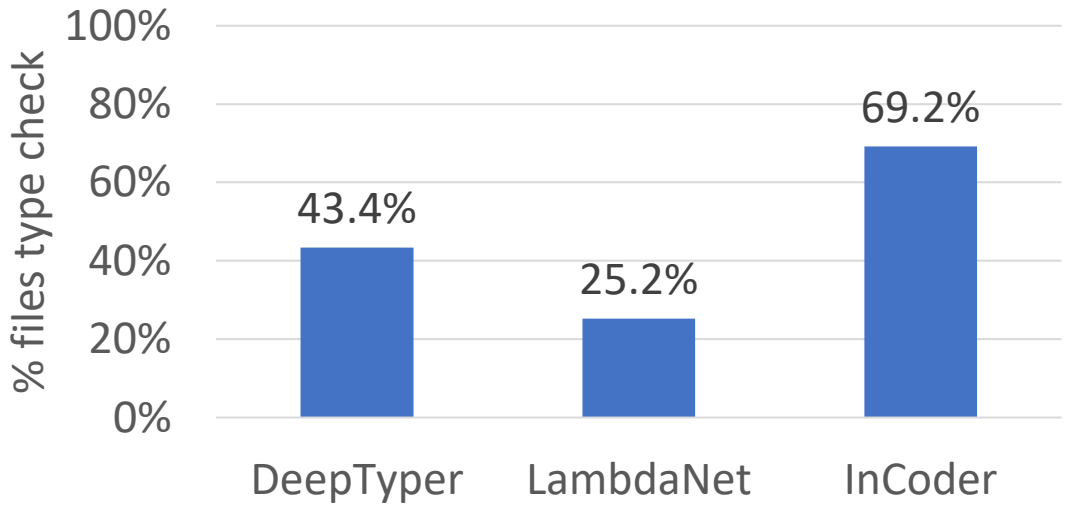

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