Babel:
A refactoring tool

NICOLÒ RIBAUDO

Babel team

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https://opencollective.com/babel

@babeljs

https://babeljs.io

@babel

What is Babel?

What is Babel?

Babel is a JavaScript compiler

It’s a JavaScript to JavaScript compiler

```
player.level ??= 70_000;
```

```
(_player$level = player.level) != null
    ? _player$level
    : player.level = 70000;
```

What is Babel?

Babel is a JavaScript compiler

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1:18 / 59:40


HOLY JS
Москва
8-9 ноября, 2019
@babel/how-to
https://www.youtube.com/watch?v=UeVq_U5obnE
@NicoloRibaudo
5
СБЕРБАНК
innopolis
Альфа-Банк
semrush
ManyChat
Deutsche Bank
КОНТУР
Райффайзен БАНК
Ростелеком
1:18 / 59:40

What is Babel?

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Babel is a *customizable* JavaScript compiler

So... what can I do?

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- Compile modern ECMAScript syntax to older (and more supported) syntax
- Compile TypeScript, Flow and JSX to plain JavaScript

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- Perform static analysis on your code

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- Minify your code

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- Run one-time transforms and automate refactorings

So... what can I do?

- Run one-time transforms and automate refactorings

Codemods

One-time transforms and automate refactorings

Codemods

Codemods

Refactors… happen. 

Codemods

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Sometimes …

… they are self-contained, without impacting other parts or your program

And they take …

… a few hours

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... you need to introduce changes accross applications maintained by different teams

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Codemods

Refactors... happen. 

Sometimes ...

... they are self-contained, without impacting other parts or your program

... they affects your whole codebase

... you need to introduce changes accross applications maintained by different teams

... you maintain a popular library that is used by many users outside of your company

And they take ...

... a few hours

... a week

... many weeks, maybe months months

... ?

What can you use codemods for?

~~What can you use codemods for?~~

What did we use them for in Babel?

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What did we use them for in Babel?

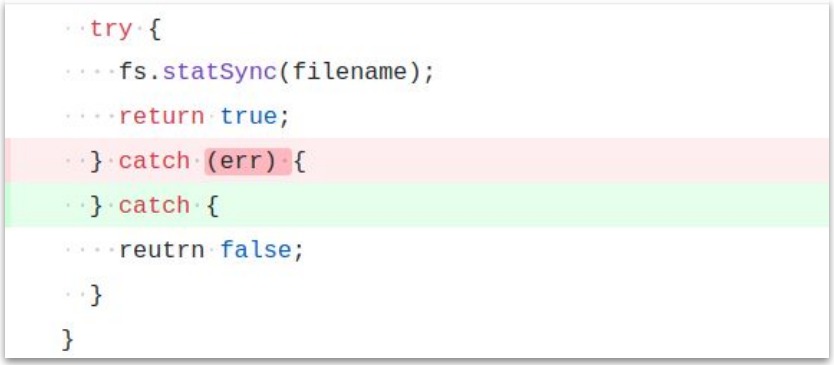
- Migrate our tests to Jest

```
  it("options", function() {
    const string = "original;";
    assert.deepEqual(
      newTransform(string).ast,
    expect(newTransform(string).ast).toEqual(
      babel.transform(string, { ast: true }).ast,
    );
    assert.equal(newTransform(string).code, string);
    expect(newTransform(string).code).toBe(string);
  });
```

~~What can you use codemods for?~~

What did we use them for in Babel?

- Migrate our tests to Jest
- Remove unused `catch` bindings



~~What can you use codemods for?~~

What did we use them for in Babel?

- Migrate our tests to Jest
- Remove unused `catch` bindings
- Remove the `resolve` dependency

```
import buildDebug from "debug";
import resolve from "resolve";
import path from "path";

@ -96,14 +95,18 @@ function resolveStandardizedName(

  try {
    return resolve.sync(standardizedName, { basedir: dirname });
    return require.resolve(standardizedName, {
      paths: [dirname],
    });
  } catch (e) {
```

~~What can you use codemods for?~~

What did we use them for in Babel?

- Migrate our tests to Jest
- Remove unused `catch` bindings
- Remove the `resolve` dependency
- Migrate from Flow to TypeScript

```
export type TemplateOpts = {|
  parser: ParserOpts,
  placeholderWhitelist: Set<string> | void,
  placeholderPattern: RegExp | false | void,
  preserveComments: boolean | void,
  syntacticPlaceholders: boolean | void,
|};
export type TemplateOpts = {
  parser: ParserOpts;
  placeholderWhitelist?: Set<string>;
  placeholderPattern?: RegExp | false;
  preserveComments?: boolean;
  syntacticPlaceholders?: boolean;
};
```

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What other companies use them for?

- Facebook publishes codemods to migrate away from legacy React versions 🔗
- Gatsby provides codemods to migrate to new versions 🔗🔗
- Next.js provides codemods to upgrade when a feature is deprecated 🔗

Compilers vs Codemods

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The usual Babel transforms are based on *strictly defined semantics*

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```
person?.address.city?.size
```

```
person == null
  ? void 0
  : (_tmp = person.address.city) == null
    ? void 0
    : _tmp.size
```

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```
person
  && person.address.city
  && person.address.city.size
```

```
person?.address.city?.size
```

Compilers vs Codemods

The usual Babel transforms are based on *strictly defined semantics*

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person?.address.city?.size
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```
person == null
  ? void 0
  : (_tmp = person.address.city) == null
    ? void 0
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```

Codemods are based on *assumptions* about your coding style

```
person
  && person.address.city
  && person.address.city.size
```

```
person?.address.city?.size
```

```
false?.address.city?.size
```

Compilers vs Codemods

The usual Babel transforms are based on *strictly defined semantics*

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They need to be precise and infallible.

Developers should be able to trust the compiler output without checking it every time.

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They need to work *in most cases*, but it's not necessary that they work *always*.

Compilers vs Codemods

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They need to be precise and infallible.

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Codemods are based on *assumptions* about your coding style

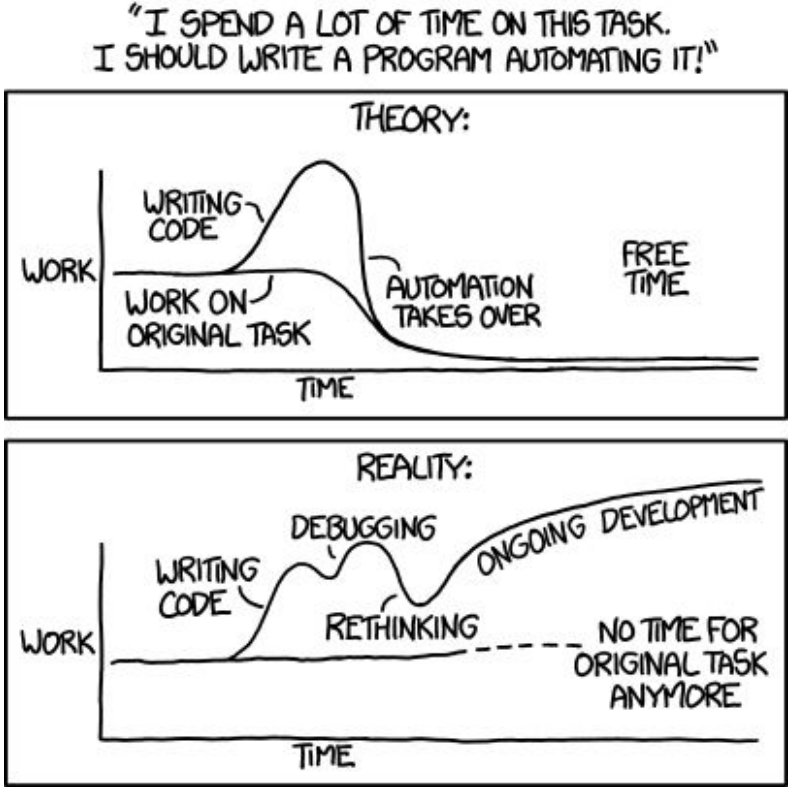
They need to work *in most cases*, but it's not necessary that they work *always*.

They rely on human intervention.

Human-assisted automated transforms

Why don't we just create the perfect codemod?

Human-assisted automated transforms



https://xkcd.com/1319/

Human-assisted automated transforms

```
const fs = require("fs");
const { join } = require("path");
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Human-assisted automated transforms

```
const fs = require("fs");
const { join } = require("path");

exports.readLocal = (file) => {
  return fs.readFileSync(
    join(__dirname, file)
  );
};
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import fs from "fs";
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export const readLocal = (file) => {
  return fs.readFileSync(
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Human-assisted automated transforms

```
const fs = require("fs");
const { join } = require("path");

exports.readLocal = (file) => {
  return fs.readFileSync(
    join(__dirname, file)
  );
};

// "writeLocal"
exports[`${fs.write.name}Local`] =
  (file, contents) => {
    return fs.writeFileSync(
      join(__dirname, file), contents
    );
  };
```

```
import fs from "fs";
import { join } from "path";

export const readLocal = (file) => {
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  );
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      join(__dirname, file), contents
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```

```
import fs from "fs";
import { join } from "path";

export const readLocal = (file) => {
  return fs.readFileSync(
    join(__dirname, file)
  );
}

// "writeLocal"
export const UNKNOWN =
  (file, contents) => {
    return fs.writeFileSync(
      join(__dirname, file), contents
    );
  };
```

Human-assisted automated transforms

```
const fs = require("fs");
const { join } = require("path");
import fs from "fs";
import { join } from "path";

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    join(__dirname, file)
  );
};
}

// "writeLocal"
exports[`${fs.write.name}Local`] =
export const UNKNOWN =
  (file, contents) => {
    return fs.writeFileSync(
      join(__dirname, file), contents
```

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Alternatives

Alternatives

`Regular Expressions`

Good for simple, self-contained refactors

Alternatives

`JSCodeshift`

The most popular tool to build JavaScript codemods

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- Provides a jQuery-like API to navigate the AST

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- Includes different tools (`@babel/parser` for parsing, `recast` for printing)

Alternatives

`JSCodeshift`

The most popular tool to build JavaScript codemods

- Provides a jQuery-like API to navigate the AST
- Includes different tools (`@babel/parser` for parsing, `recast` for printing)
- It can be used with any AST transform tool you like (Babel included!)

Alternatives

`JSCodeshift`

The most popular tool to build JavaScript codemods

So... why Babel?

Alternatives

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The most popular tool to build JavaScript codemods

So... why Babel?

- It provides a massive set of built-in utilities to analyze the AST and the Scope

Alternatives

`JSCodeshift`

The most popular tool to build JavaScript codemods

So... why Babel?

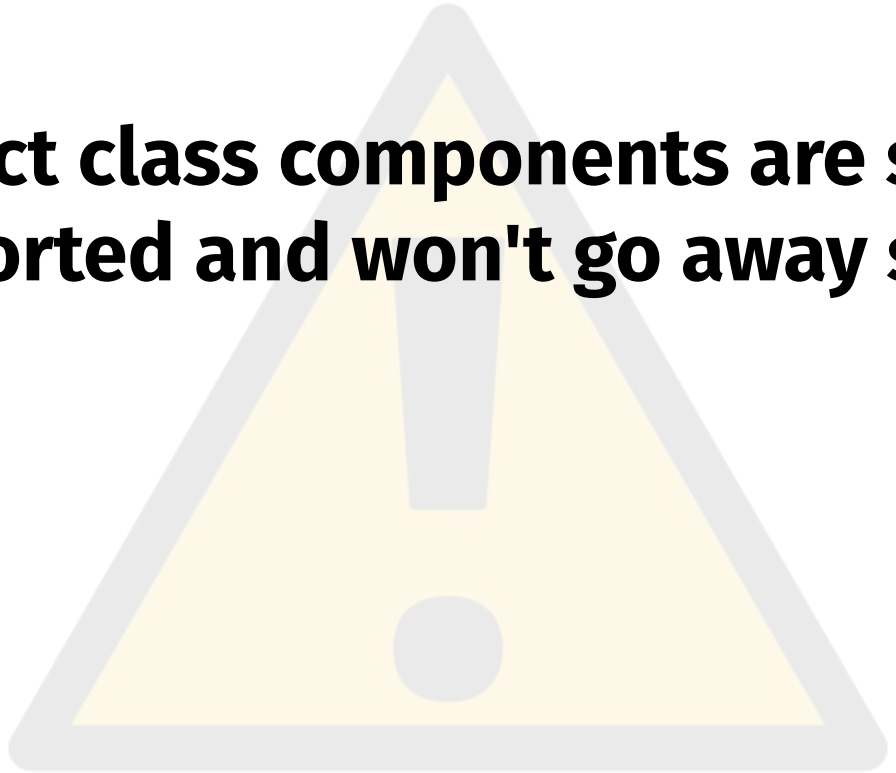
- It provides a massive set of built-in utilities to analyze the AST and the Scope
- You can re-use the same knowledge to modify your build process with custom plugins

A practical example

A practical example

Transforming React class components to functions with hooks

React class components are still supported and won't go away soon.



React class components are still supported and won't go away soon.

This codemod is for illustrative purposes, you don't actually need to do it!

```
class Counter extends React.Component {
  state = { name: "Unknown", count: 0 };

  incrementCount = () => {
    this.setState((state) => ({ count: state.count - 1 }));
  };

  decrementCount = () => {
    this.setState((state) => ({ count: state.count - 1 }));
  };

  updateName = (e) => {
    this.setState({ name: e.target.value });
  };

  render() {
    return (
      <div>
        <label>
          ${this.props.label}:
          <input type="text" defaultValue={this.state.name}
                 onChange={this.updateName} />
        </label>

        <button onClick={this.decrementCount}>-1</button>
        <span>{this.state.count}</span>
        <button onClick={this.incrementCount}>+1</button>
      </div>
    );
  }
}
```

```
const Counter = (props) => {
  const [name, setName] = useState("Unknown");
  const [count, setCount] = useState(0);

  const incrementCount = () => {
    setCount((count) => count - 1);
  };

  const decrementCount = () => {
    setCount((count) => count - 1);
  };

  const updateName = (e) => {
    setName(e.target.value);
  };

  return (
    <div>
      <label>
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};
```

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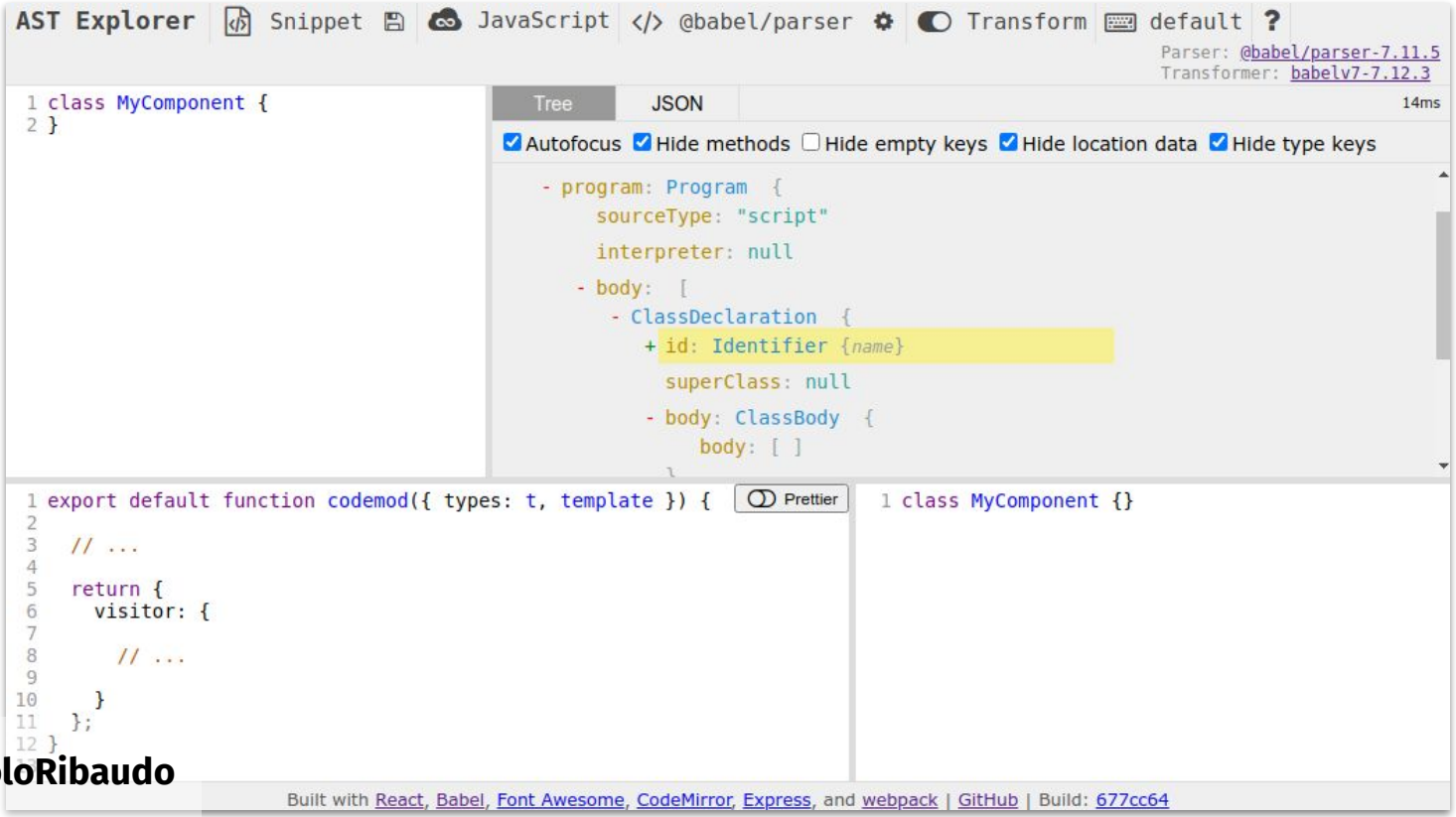
AST Explorer

A plugin development playground

AST Explorer: a plugin playground



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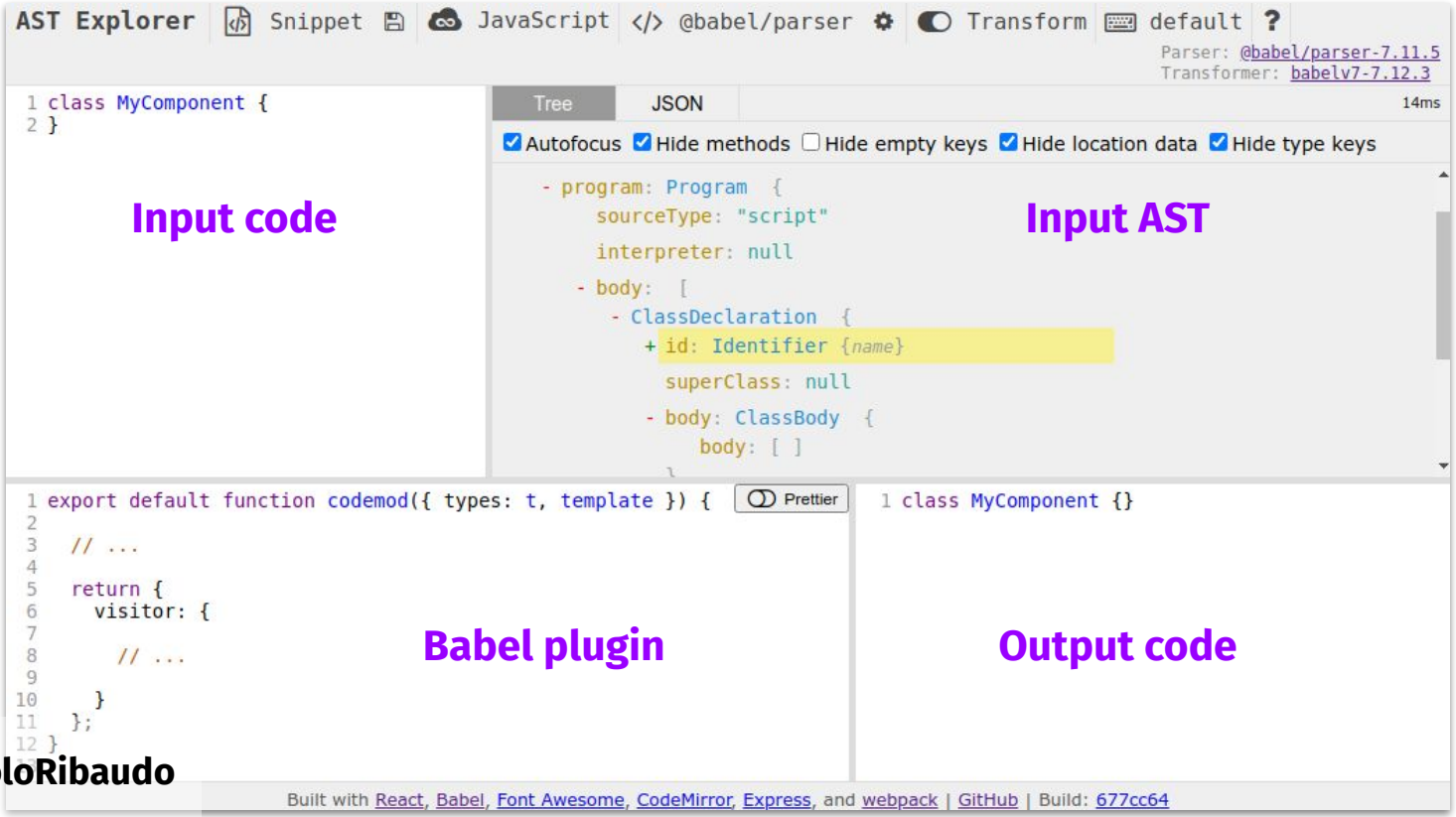
AST Explorer: a plugin playground



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Steps

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    a. *Not* adding support for complex state (with `useReducer()`)

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    b. Analytics: Should we support `defaultProps`?
5. Adding support for class fields
6. Injecting imports to hooks

The anatomy of a Babel plugin

```
function codemod({ types: t, template }) {

  // ...

  return {
    visitor: {

      // ...

    }
  };
}
```

The anatomy of a Babel plugin

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Get different utilities from Babel, ...

The anatomy of a Babel plugin

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Get different utilities from Babel, ...

... define helper functions to analyze and transform ...

The anatomy of a Babel plugin

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function codemod({ types: t, template }) {

  // ...

  return {
    visitor: {

      // ...

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```

Get different utilities from Babel, ...

... define helper functions to analyze and transform ...

... and intercept the AST nodes to handle.

1. Detecting React class components

```
class MyComponent extends React.Component {
  // ...
}
```

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class MyComponent extends React.Component {
  // ...
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```

```
- ClassDeclaration {
   + id: Identifier {name}
   - superClass: MemberExpression {
      - object: Identifier {
           name: "React"
        }
        computed: false
      - property: Identifier = $node {
           name: "Component"
        }
     }
   - body: ClassBody {
        body: [ ]
     }
  }
```

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      - property: Identifier  = $node {
           name: "Component"
        }
     }
   - body: ClassBody  {
        body: [ ]
     }
 }
```

1. Detecting React class components

```
return {
  visitor: {
    ClassDeclaration(path) {
      if (!isReactComponent(path.node)) {
        return;
      }

      alert("We have a React component!");
    }
  }
};
```

```
- ClassDeclaration  {
   + id: Identifier {name}
   - superClass: MemberExpression  {
      - object: Identifier  {
           name: "React"
        }
        computed: false
      - property: Identifier  = $node {
           name: "Component"
        }
    }
   - body: ClassBody  {
        body: [ ]
    }
 }
```

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1. Detecting React class components

```
function isReactComponent(node) {
  return t.matchesPattern(
    node.superClass,
    "React.Component"
  );
}
return {
  visitor: {
    ClassDeclaration(path) { /* ... */ }
  }
};
```

```
- ClassDeclaration {
  + id: Identifier {name}
  - superClass: MemberExpression {
    - object: Identifier {
        name: "React"
      }
      computed: false
    - property: Identifier = $node {
        name: "Component"
      }
    }
  - body: ClassBody {
      body: [ ]
    }
}
```

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2. Extracting the `render()` method

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class Counter extends Component {
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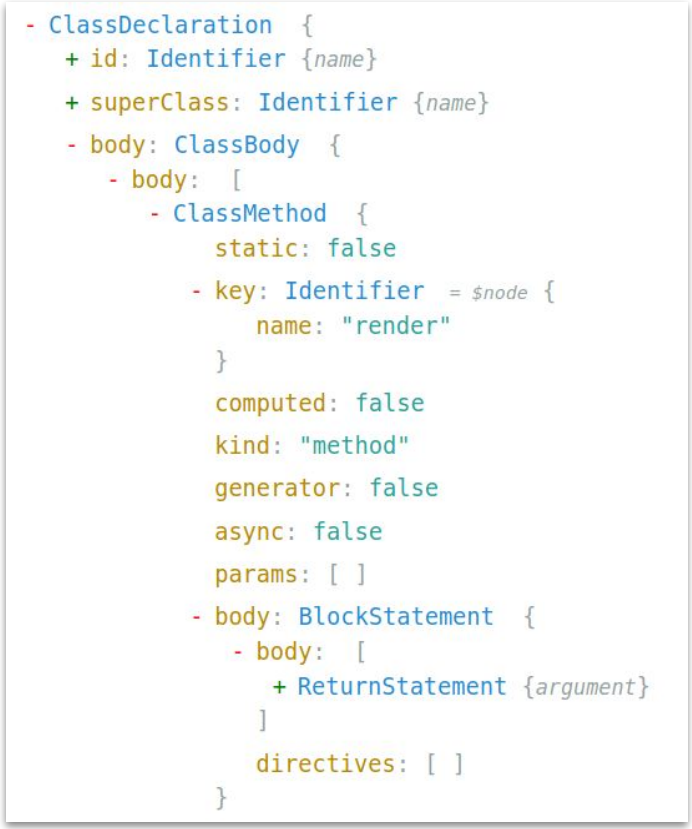


2. Extracting the `render()` method

```
function findMethod(node, name) {









}

findMethod(path.node, "render");
```

```
- ClassDeclaration {
  + id: Identifier {name}
  + superClass: Identifier {name}
  - body: ClassBody {
    - body: [
      - ClassMethod {
          static: false
        - key: Identifier = $node {
            name: "render"
          }
          computed: false
          kind: "method"
          generator: false
          async: false
          params: [ ]
        - body: BlockStatement {
          - body: [
            + ReturnStatement {argument}
            ]
            directives: [ ]
          }
```

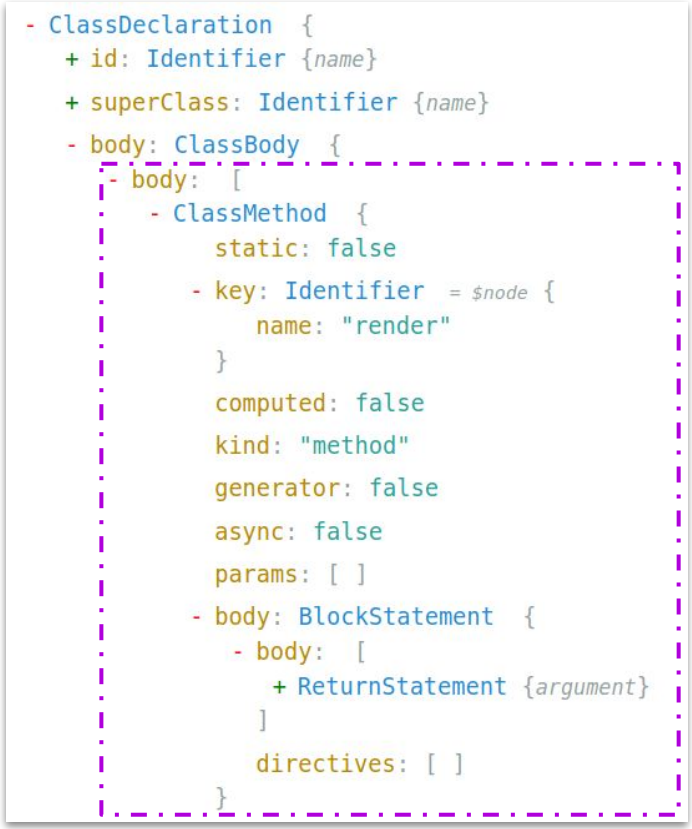
2. Extracting the `render( )` method

```
function findMethod(node, name) {
  const elem = node.body.body




}

findMethod(path.node, "render");
```



2. Extracting the `render()` method

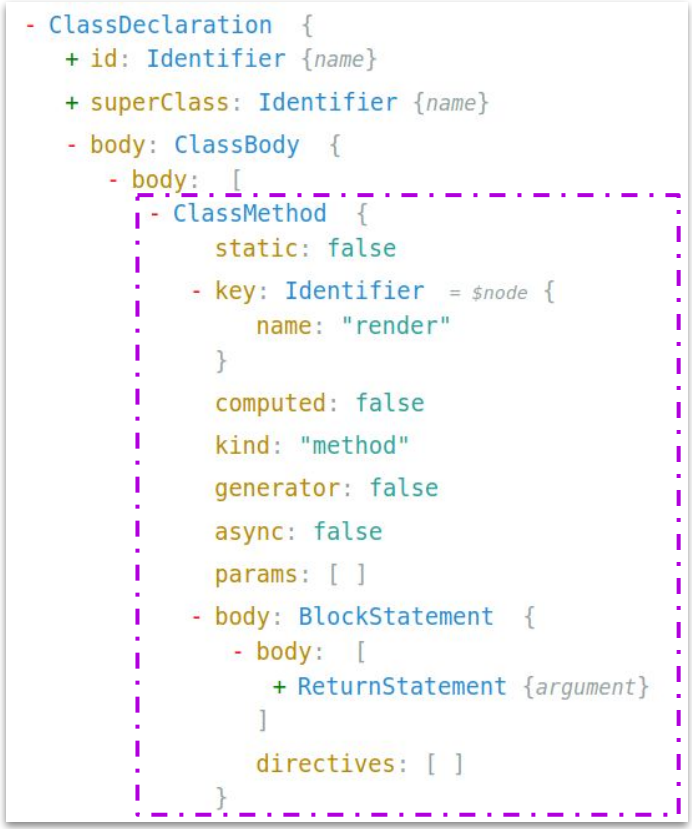
```
function findMethod(node, name) {
  const elem = node.body.body.find(el =>
    t.isClassMethod(el)



  );

}

findMethod(path.node, "render");
```



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2. Extracting the `render( )` method

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function findMethod(node, name) {
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    })

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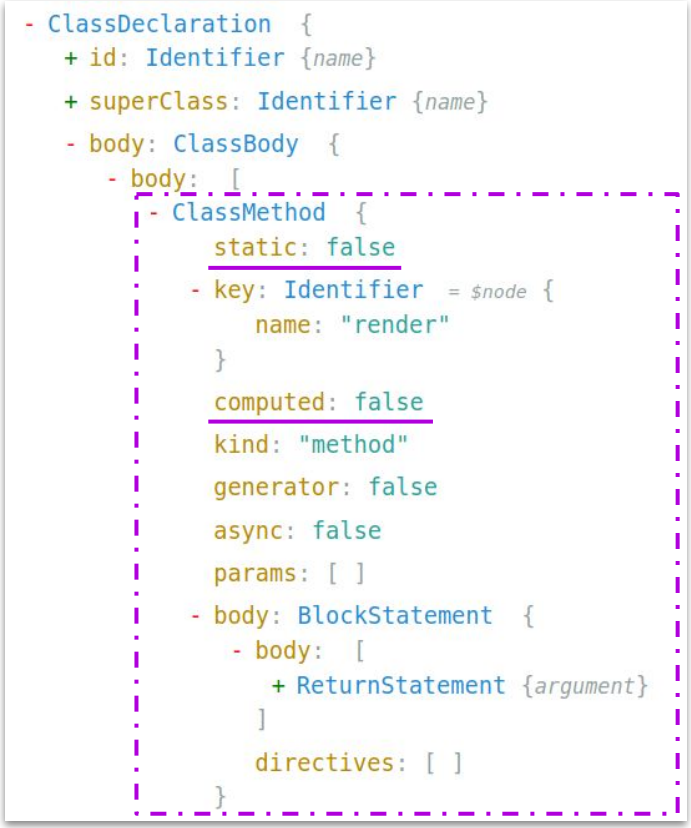
findMethod(path.node, "render");
```



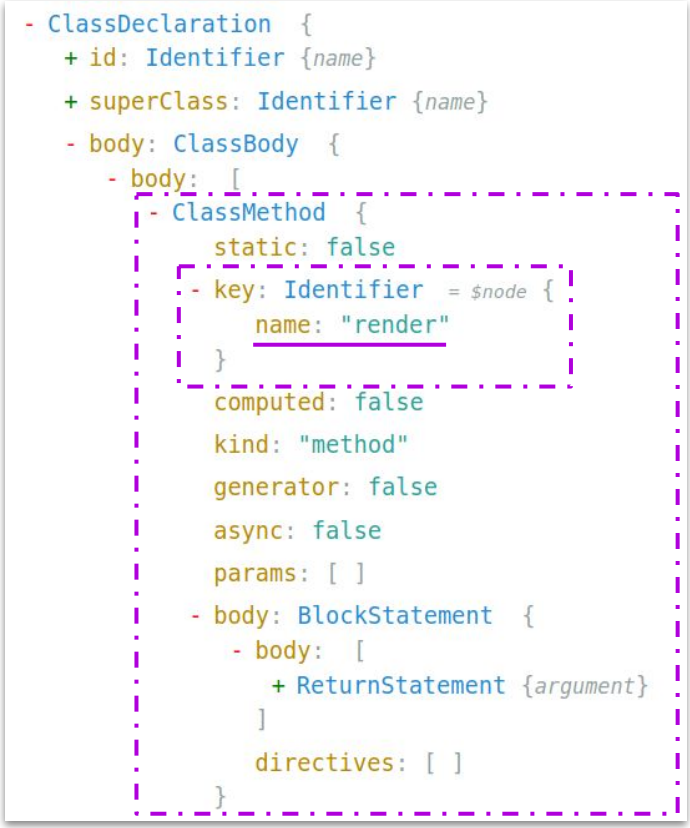
@NicoloRibaudo

2. Extracting the `render()` method

```
function findMethod(node, name) {
  const elem = node.body.body.find(el =>
    t.isClassMethod(el, {
      static: false, computed: false
    })
    && t.isIdentifier(el.key, { name })
  );

}

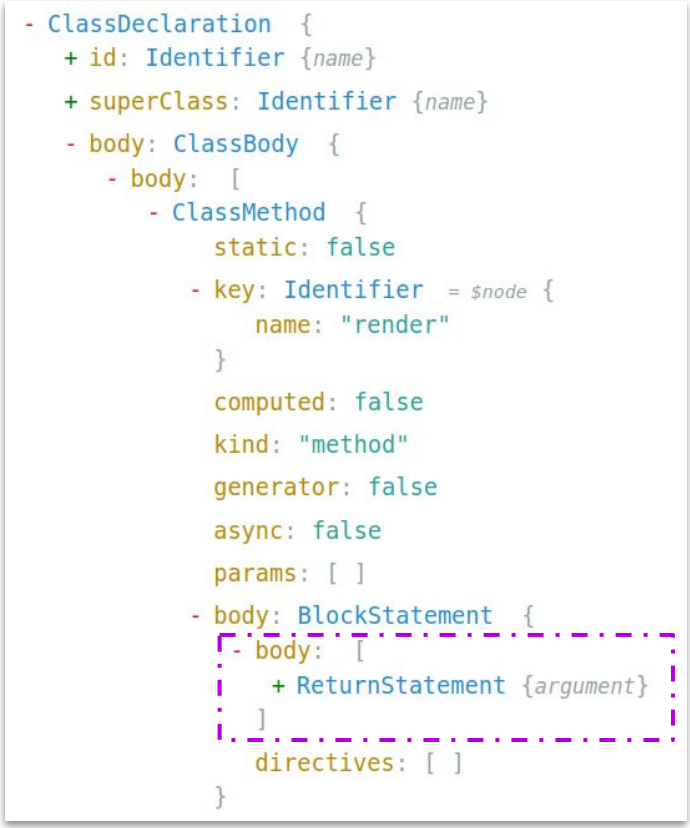
findMethod(path.node, "render");
```



2. Extracting the `render()` method

```
function findMethod(node, name) {
  const elem = node.body.body.find(el =>
    t.isClassMethod(el, {
      static: false, computed: false
    })
    && t.isIdentifier(el.key, { name })
  );
  if (elem) return elem.body.body;
}

findMethod(path.node, "render");
```

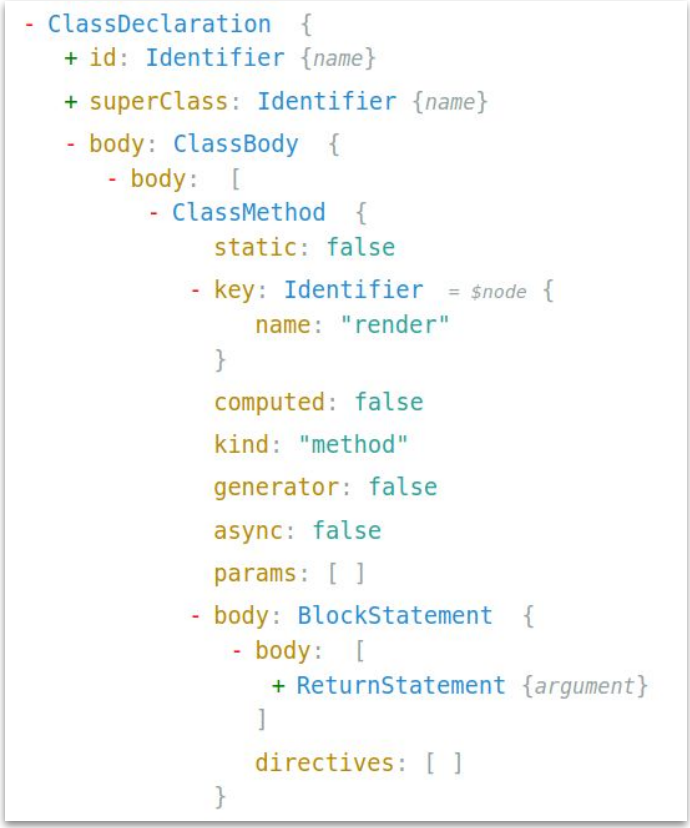


@NicoloRibaudo

2. Extracting the `render()` method

```
function findMethod(node, name) {
  const elem = node.body.body.find(el =>
    t.isClassMethod(el, {
      static: false, computed: false
    })
    && t.isIdentifier(el.key, { name })
  );
  if (elem) return elem.body.body;
}

findMethod(path.node, "render");
```



2. Extracting the `render()` method

```
visitor: {
  ClassDeclaration(path) {
    if (!isReactComponent(path.node)) return;

    path.replaceWith(template.ast`
      const ${path.node.id} = (props) => {
        ${findMethod(path.node, "render")};
      };
    `);
  },
},
```

2. Extracting the `render()` method

```
visitor: {
  ClassDeclaration(path) {
    if (!isReactComponent(path.node)) return;

    path.replaceWith(template.ast`
      const ${path.node.id} = (props) => {
        ${findMethod(path.node, "render")};
      };
    `);
  },
},
```

```
class Counter extends Component {
  render() {
    return <p>It works!</p>;
  }
}
```

2. Extracting the `render()` method

```
visitor: {
  ClassDeclaration(path) {
    if (!isReactComponent(path.node)) return;

    path.replaceWith(template.ast`
      const ${path.node.id} = (props) => {
        ${findMethod(path.node, "render")};
      };
    `);
  },
},
```

```
class Counter extends Component {
  render() {
    return <p>It works!</p>;
  }
}
```

```
const Counter = (props) => {
 return <p>It works!</p>;
};
```

3. Rewriting `this.props` usage

```
class Counter extends Component {
 render() {
   return <p>Hi, {this.props.name}!</p>
 }
}
```

3. Rewriting `this.props` usage

```
class Counter extends Component {
 render() {
   return <p>Hi, {this.props.name}!</p>
 }
}
```

3. Rewriting `this.props` usage

```
class Counter extends Component {
 render() {
   return <p>Hi, {this.props.name}!</p>
 }
}
```

3. Rewriting `this.props` usage

```
function rewritePropsUsage(path) {
```


```
}
```

@NicoloRibaudo

3. Rewriting `this.props` usage

```
function rewritePropsUsage(path) {
  path.traverse({
    MemberExpression(path) {




    },
  });
}
```

@NicoloRibaudo

3. Rewriting `this.props` usage

```
function rewritePropsUsage(path) {
  path.traverse({
    MemberExpression(path) {
      const { node } = path;
      if (
        !node.computed



      ) {

      }
    },
  });
}
```

```
- expression: MemberExpression  {
   - object: MemberExpression  {
        object: ThisExpression { }
        computed: false
     - property: Identifier  = $node {
          name: "props"
        }
    }
    computed: false
   - property: Identifier  {
        name: "name"
    }
 }
```

@NicoloRibaudo

3. Rewriting `this.props` usage

```
function rewritePropsUsage(path) {
  path.traverse({
    MemberExpression(path) {
      const { node } = path;
      if (
        !node.computed &&
        t.isThisExpression(node.object)

      ) {

      }
    },
  });
}
```

@NicoloRibaudo

3. Rewriting `this.props` usage

```
function rewritePropsUsage(path) {
  path.traverse({
    MemberExpression(path) {
      const { node } = path;
      if (
        !node.computed &&
        t.isThisExpression(node.object) &&
        t.isIdentifier(node.property, { name: "props" })
      ) {

      }
    },
  });
}
```

3. Rewriting `this.props` usage

```
function rewritePropsUsage(path) {
  path.traverse({
    MemberExpression(path) {
      const { node } = path;
      if (
        !node.computed &&
        t.isThisExpression(node.object) &&
        t.isIdentifier(node.property, { name: "props" })
      ) {
        path.replaceWith(t.identifier("props"));
      }
    },
  });
}
```

@NicoloRibaudo

3. Rewriting `this.props` usage

```
visitor: {
  ClassDeclaration(path) {
    if (!isReactComponent(path.node)) return;



    path.replaceWith(template.ast`
      const ${path.node.id} = (props) => {
        ${findMethod(path.node, "render")};
      };
    `);
  },
},
```

3. Rewriting `this.props` usage

```
visitor: {
  ClassDeclaration(path) {
    if (!isReactComponent(path.node)) return;

    rewritePropsUsage(path);

    path.replaceWith(template.ast`
      const ${path.node.id} = (props) => {
        ${findMethod(path.node, "render")};
      };
    `);
  },
},
```

@NicoloRibaudo

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    rewritePropsUsage(path);

    path.replaceWith(template.ast`
      const ${path.node.id} = (props) => {
        ${findMethod(path.node, "render")};
      };
    `);
  },
},
```

```
class Counter extends Component {
  render() {
    return <p>
      Hi, {this.props.name}!
    </p>;
  }
}
```

3. Rewriting `this.props` usage

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visitor: {
  ClassDeclaration(path) {
    if (!isReactComponent(path.node)) return;

    rewritePropsUsage(path);

    path.replaceWith(template.ast`
      const ${path.node.id} = (props) => {
        ${findMethod(path.node, "render")};
      };
    `);
  },
},
```

```
class Counter extends Component {
  render() {
    return <p>
      Hi, {this.props.name}!
    </p>;
  }
}
```

```
const Counter = (props) => {
 return <p>Hi, {props.name}!</p>;
};
```

4. Convert `state = {…}` to `useState()`

```
class Counter extends Component {
  state = { count: 0 };

  render() {
    return <p>
      Total: {this.state.count}
    </p>;
  }
}
```

4. Convert `state = {…}` to `useState()`

```
class Counter extends Component {
  state = { count: 0 };

  render() {
    return <p>
      Total: {this.state.count}
    </p>;
  }
}
```

4. Convert `state = {…}` to `useState()`

```
class Counter extends Component {
  state = { count: 0 };

  render() {
    return <p>
      Total: {this.state.count}
    </p>;
  }
}
```

4. Convert `state = {…}` to `useState()`

```
function findField(node, name) {
  const elem = node.body.body.find(el =>
    t.isClassProperty(el, {
      static: false, computed: false
    })
    && t.isIdentifier(el.key, { name })
  );
  if (elem) return elem.value;
}

findField(path.node, "state");
```

@NicoloRibaudo

4. Convert `state = {…}` to `useState()`

```
class Counter extends Component {
  state = { count: 0 };

  render() {
    return <p>
      Total: {this.state.count}
    </p>;
  }
}
```

```
count → get  : Identifier { "count" }
        set  : Identifier { "setCount" }
        init : NumericLiteral { 0 }

...
```

4. Convert `state = {…}` to `useState()`

4. Convert `state = {…}` to `useState()`

```
function findInitialState(node) {
  const stateNode = findField(node, "state");
  if (!stateNode) return;

}
```

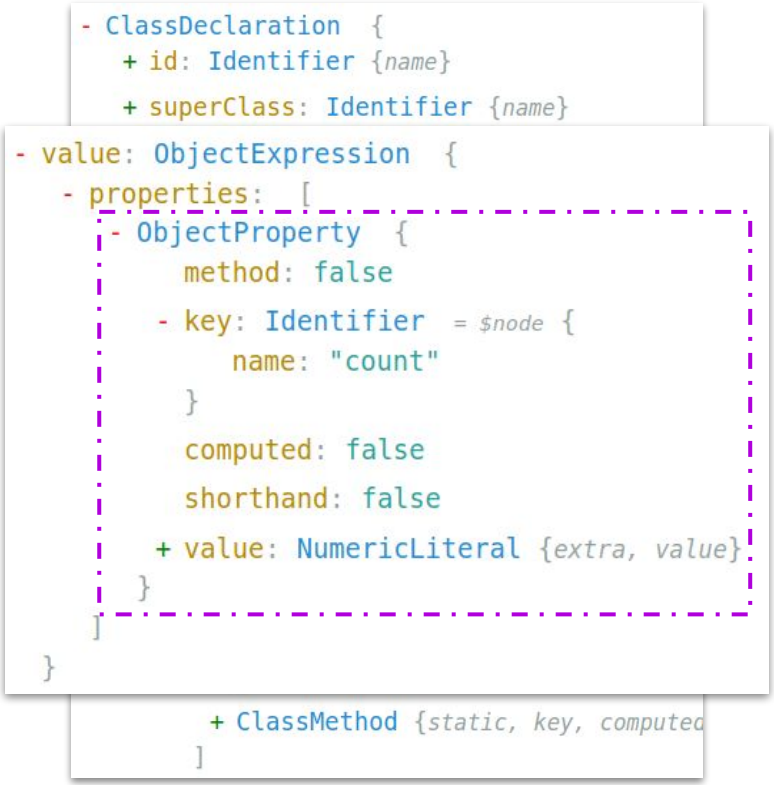
4. Convert `state = {…}` to `useState()`

```
function findInitialState(node) {
  const stateNode = findField(node, "state");
  if (!stateNode) return;

  const state = new Map();
  for (const prop of stateNode.properties) {




  }
  return state;
}
```



4. Convert `state = {…}` to `useState()`

```
function findInitialState(node) {
  const stateNode = findField(node, "state");
  if (!stateNode) return;

  const state = new Map();
  for (const prop of stateNode.properties) {
    state.set(prop.key.name, {
      get: t.identifier(prop.key.name),
      set: t.identifier(`set${upper(prop.key.name)}`),
      init: prop.value,
    });
  }
  return state;
}
```

4. Convert `state = {…}` to `useState()`

```
get  : Identifier { … }
set  : Identifier { … }
init : NumericLiteral { … }

...
```

```
path.replaceWith(template.ast`
  const ${componentId} = (props) => {

    ${findMethod(path, "render")};
  };
`);
```

4. Convert `state = {…}` to `useState()`

```
const state = findInitialState(path.node);
```

```
get  : Identifier { … }
set  : Identifier { … }
init : NumericLiteral { … }
```

```
...
```

```
path.replaceWith(template.ast`
  const ${componentId} = (props) => {

    ${findMethod(path, "render")};
  };
`);
```

4. Convert `state = {…}` to `useState()`

```
const state = findInitialState(path.node);
const useStateCalls = [];
for (let { get, set, init } of state.values())
  useStateCalls.push(template.ast`
    const [${get}, ${set}] = useState(${init})
  `);

path.replaceWith(template.ast`
  const ${componentId} = (props) => {

    ${findMethod(path, "render")};
  };
`);
```

```
get  : Identifier { … }
set  : Identifier { … }
init : NumericLiteral { … }

...
```

4. Convert `state = {…}` to `useState()`

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  useStateCalls.push(template.ast`
    const [${get}, ${set}] = useState(${init})
  `);

path.replaceWith(template.ast`
  const ${componentId} = (props) => {
    ${useStateCalls};
    ${findMethod(path, "render")};
  };
`);
```

```
get  : Identifier { … }
set  : Identifier { … }
init : NumericLiteral { … }

...
```

4. Convert `state = {…}` to `useState()`

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const useStateCalls = [];
for (let { get, set, init } of state.values())
  useStateCalls.push(template.ast`
    const [${get}, ${set}] = useState(${init})
  `);

path.replaceWith(template.ast`
  const ${componentId} = (props) => {
    ${useStateCalls};
    ${findMethod(path, "render")};
  };
`);
```

```
class Counter extends Component {
  state = { count: 0 };
  render() {
    return /* ... */;
  }
}
```

4. Convert `state = {…}` to `useState()`

```
const state = findInitialState(path.node);
const useStateCalls = [];
for (let { get, set, init } of state.values())
  useStateCalls.push(template.ast`
    const [${get}, ${set}] = useState(${init})
  `);

path.replaceWith(template.ast`
  const ${componentId} = (props) => {
    ${useStateCalls};
    ${findMethod(path, "render")};
  };
`);
```

```
class Counter extends Component {
  state = { count: 0 };
  render() {
    return /* ... */;
  }
}
```

```
const Counter = (props) => {
 const [count, setCount] = useState(0);
 return /* ... */;
};
```

4. Convert `this.state.count` to `count`

```
class Counter extends Component {
  state = { count: 0 };
  render() {
    return <p>Total: {this.state.count}</p>;
  }
}
```

```
const Counter = (props) => {
  const [count, setCount] = useState(0);
  return <p>Total: {count}</p>;
};
```

4. Convert `this.setState` to `setCount`

```
render() {
  const inc = () => this.setState(prev => ({
    count: prev.count + 1
  }));
  return <p onClick={inc}>Total: {this.state.count}</p>;
}
```

```
const Counter = (props) => {
  const [count, setCount] = useState(0);
  const inc = () => setCount(count => count + 1);
  return <p onClick={inc}>Total: {count}</p>;
};
```

Does our codemod cover every case?

🔍 Ignoring unsupported patterns

🔍 Ignoring unsupported patterns

Complex state initialization

🔍 Complex state initialization

```
class Counter extends Component {
  state = { count: 0, label: "Likes" };
  render() {
    return <p>
      {this.state.label}: {this.state.count}
    </p>;
  }
}
```

🔍 Complex state initialization

```
class Counter extends Component {
  state = { count: 0, label: "Likes" };
  render() {
    return <p>
      {this.state.label}: {this.state.count}
    </p>;
  }
}
```

```
const Counter = (props) => {
   const [count, setCount] = useState(0);
   const [label, setLabel] = useState("Likes");

   return <p>{label}: {count}</p>;
};
```

🔍 Complex state initialization

```
class Counter extends Component {
  state = getInitialState();
  render() {
    return <p>
      {this.state.label}: {this.state.count}
    </p>;
  }
}
```

```
const Counter = (props) => {
   const [count, setCount] = ??????;
   const [label, setLabel] = ??????;

   return <p>{label}: {count}</p>;
};
```

🔍 Complex state initialization

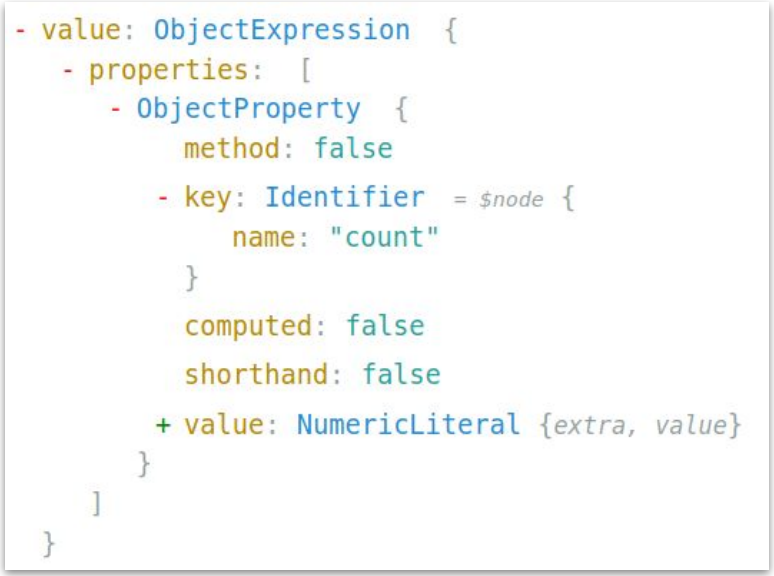
```
function findInitialState(node) {
  const stateNode = findField(node, "state");
  if (!stateNode) return;

  const state = new Map();
  for (const prop of stateNode.properties) {
    /* ... */
  }
  return state;
}
```

🔍 Complex state initialization

```
function findInitialState(node) {
  const stateNode = findField(node, "state");
  if (!stateNode) return;

  const state = new Map();
  for (const prop of stateNode.properties) {
    /* ... */
  }
  return state;
}
```



🔍 Complex state initialization

```
function findInitialState(node) {
  const stateNode = findField(node, "state");
  if (!stateNode) return;

  if (!t.isObjectExpression(stateNode)) {




    return;
  }

  const state = new Map();
  for (const prop of stateNode.properties) {
    /* ... */
```

```
- value: ObjectExpression  {
   - properties:  [
      - ObjectProperty  {
           method: false
         - key: Identifier  = $node {
              name: "count"
           }
           computed: false
           shorthand: false
         + value: NumericLiteral {extra, value}
        }
     ]
  }
```

🔍 Complex state initialization

```
function findInitialState(node) {
  const stateNode = findField(node, "state");
  if (!stateNode) return;

  if (!t.isObjectExpression(stateNode)) {
    t.addComment(
      stateNode.node, "leading", " @warning: Unable to refactor complex state initialization ",
    );
    return;
  }

  const state = new Map();
  for (const prop of stateNode.properties) {
    /* ... */
```

🔍 Complex state initialization

```
class Counter extends Component {
  state = getInisialState();
  render() {
    return <p>
      {this.state.label}: {this.state.count}
    </p>;
  }
}
```

🔍 Complex state initialization

```
class Counter extends Component {
  state
  rende
    ret
      {
    </p
  }
}
```

```
class Counter extends Component {
  state =
    /* @warning: Unable to refactor complex state initialization */
    getInisialState();

  render() {
    return <p>
      {this.state.label}: {this.state.count}
    </p>;
  }
}
```

🔍 Analyzing a pattern's frequency

🔍 Analyzing a pattern's frequency

Is it worth to implement support for `defaultProps`?

```
class Counter extends Component {
  static defaultProps = { name: "Nicolò" };

  render() {
    return <p>Hi, {this.props.name}!</p>;
  }
}
```

🔍 Analyzing a pattern's frequency

```
class Person {
 constructor(name) {
   this.name = name;
 }
}
```

```
class Btn extends Component {
  render() {
    return <button />
  }
```

```
class Btn extends Component {
 static defaultProps = {
   name: "Test",
 };

 render() {
   return <button />
 }
}
```

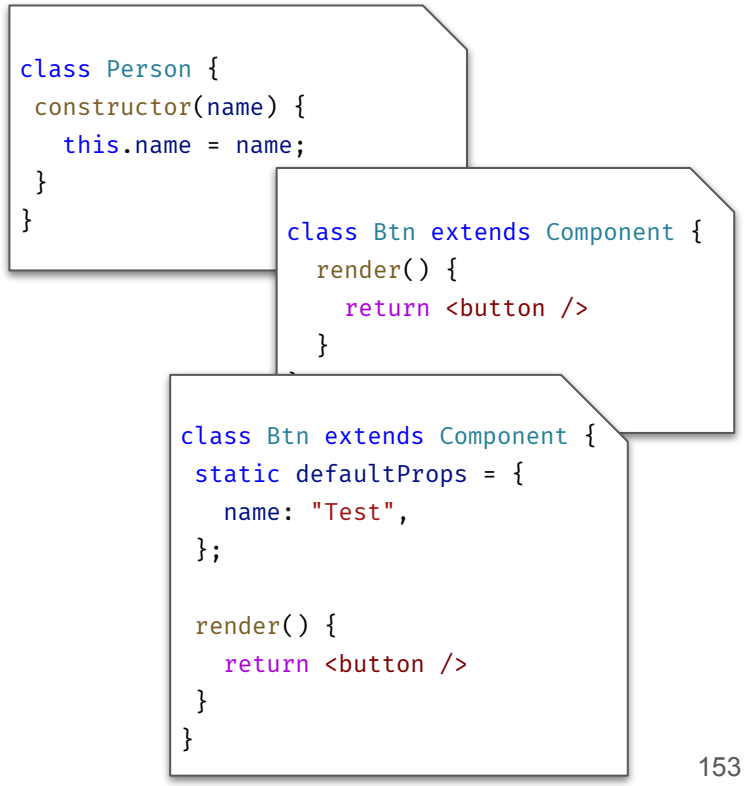
🔍 Analyzing a pattern's frequency

```
let reactClasses = 0, defaultProps = 0;

function defaultPropsAnalysis({ types: t }) {
  return {
    visitor: {


        // ...


    },
  };
```



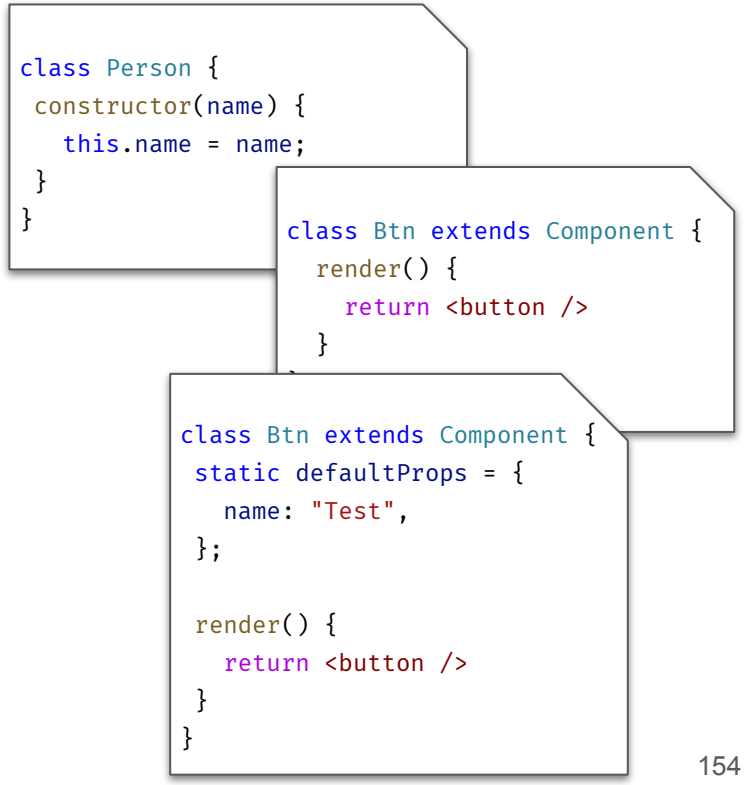
🔍 Analyzing a pattern's frequency

```
let reactClasses = 0, defaultProps = 0;

function defaultPropsAnalysis({ types: t }) {
  return {
    visitor: {
      ClassDeclaration(path) {


        // ...

      }
    },
  };
```

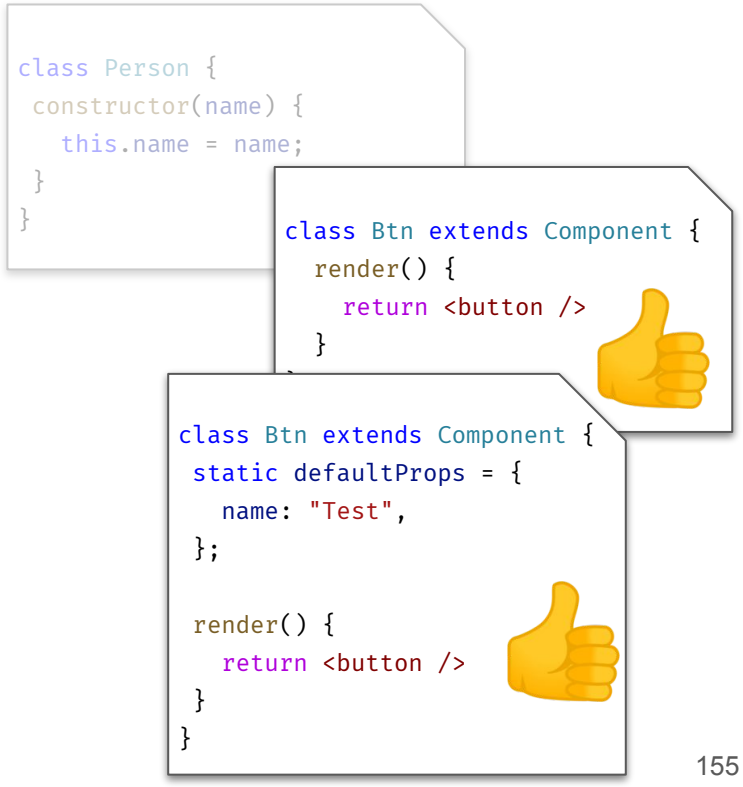


🔍 Analyzing a pattern's frequency

```
let reactClasses = 2, defaultProps = 0;

function defaultPropsAnalysis({ types: t }) {
  return {
    visitor: {
      ClassDeclaration(path) {
        if (!isReactComponent(path.node)) return;
        reactClasses++;
        // ...

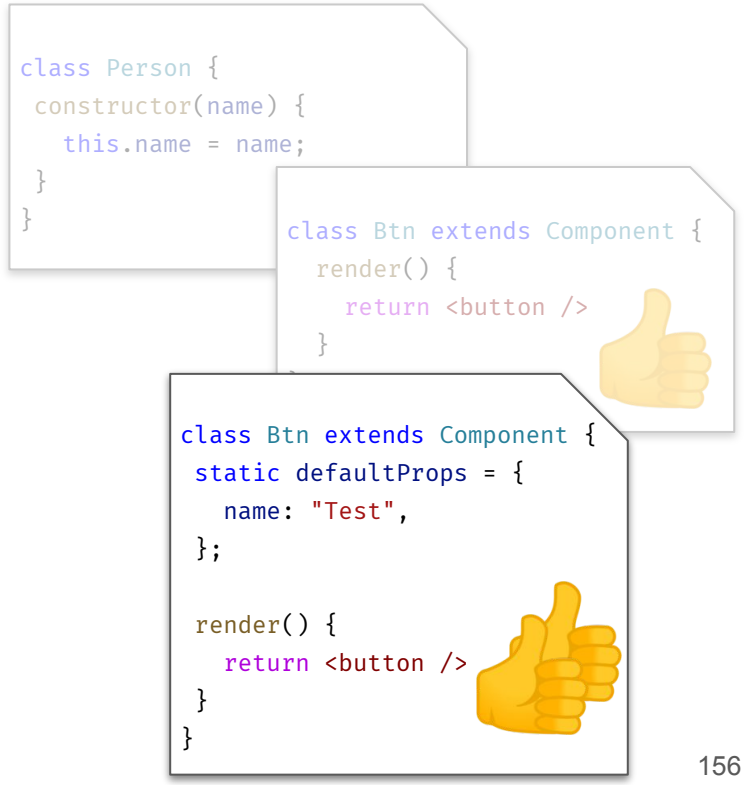
      }
    },
  };
```



🔍 Analyzing a pattern's frequency

```
let reactClasses = 2, defaultProps = 1;

function defaultPropsAnalysis({ types: t }) {
  return {
    visitor: {
      ClassDeclaration(path) {
        if (!isReactComponent(path.node)) return;
        reactClasses++;
        if (findField(path.node, "defaultProps"))
          defaultProps++;
      }
    },
  };
```



🔍 Analyzing a pattern's frequency

```
glob("src/**/*.jsx").forEach(filename => {



});
```

```
class Person {
 constructor(name) {
   this.name = name;
 }
}
```

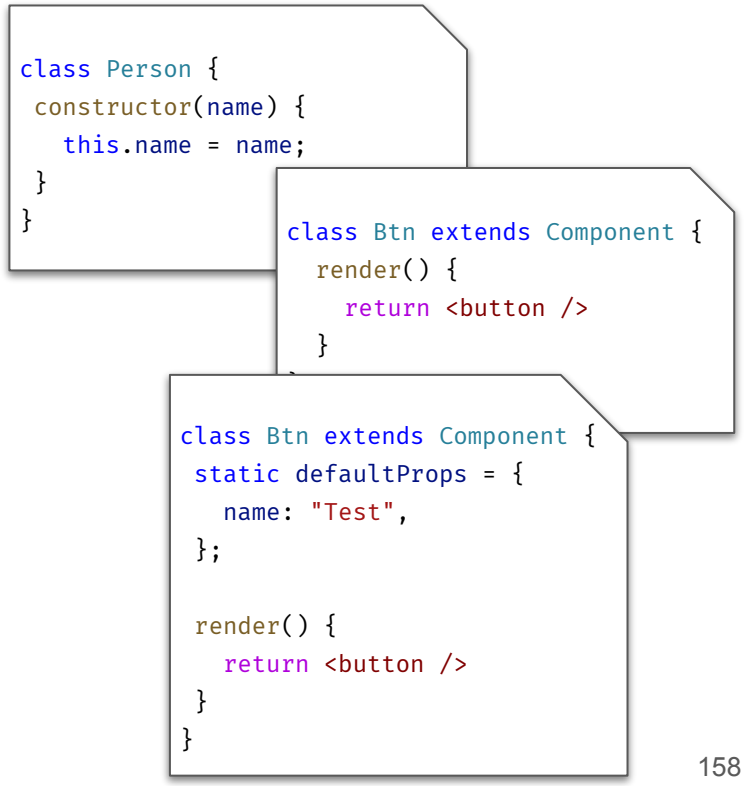
```
class Btn extends Component {
  render() {
    return <button />
  }
```

```
class Btn extends Component {
 static defaultProps = {
   name: "Test",
 };

 render() {
   return <button />
 }
}
```

🔍 Analyzing a pattern's frequency

```
glob("src/**/*.jsx").forEach(filename => {
    babel.transformFileSync(filename, {
        plugins: [defaultPropsAnalysis]
    });
});
```



🔍 Analyzing a pattern's frequency

```
glob("src/**/*.jsx").forEach(filename => {
    babel.transformFileSync(filename, {
        plugins: [defaultPropsAnalysis]
    });
});

console.log(`
Number of React classes: ${reactClasses}
Number ot classes using defaultProps: ${defaultProps}
(${(defaultProps / reactClasses)})
`);
```

```
class Person {
 constructor(name) {
   this.name = name;
 }
}
```

```
class Btn extends Component {
  render() {
    return <button />
  }
```

```
class Btn extends Component {
 static defaultProps = {
   name: "Test",
 };

 render() {
   return <button />
 }
}
```

🔍 Analyzing a pattern's frequency

```
glob("src/**/*.jsx").forEach(filename => {
    babel.transformFileSync(filename, {
        plugins: [defaultPropsAnalysis]
    });
});

console.log(`
  Number of React classes: 150
  Number ot classes using defaultProps: 5
  (0.03333333333333333)
`);
```

```
class Person {
 constructor(name) {
   this.name = name;
 }
}
```

```
class Btn extends Component {
  render() {
    return <button />
  }
}
```

```
class Btn extends Component {
 static defaultProps = {
   name: "Test",
 };

 render() {
   return <button />
 }
}
```

Back to our codemod ...

Back to our codemod ...

... assuming that we run some analysis and discovered that we almost only use arrow functions instead of class methods

5. Convert class fields to variables

```
class Counter extends Component {
  state = { count: 0 };

  inc = () =>
    this.setState(state => ({
      count: state.count + this.props.step,
    }));

  render() {
    return <p onClick={this.inc}>
      Total: {this.state.count}
    </p>;
  }
}
```

@NicoloRibaudo

5. Convert class fields to variables

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      count: state.count + this.props.step,
    }));

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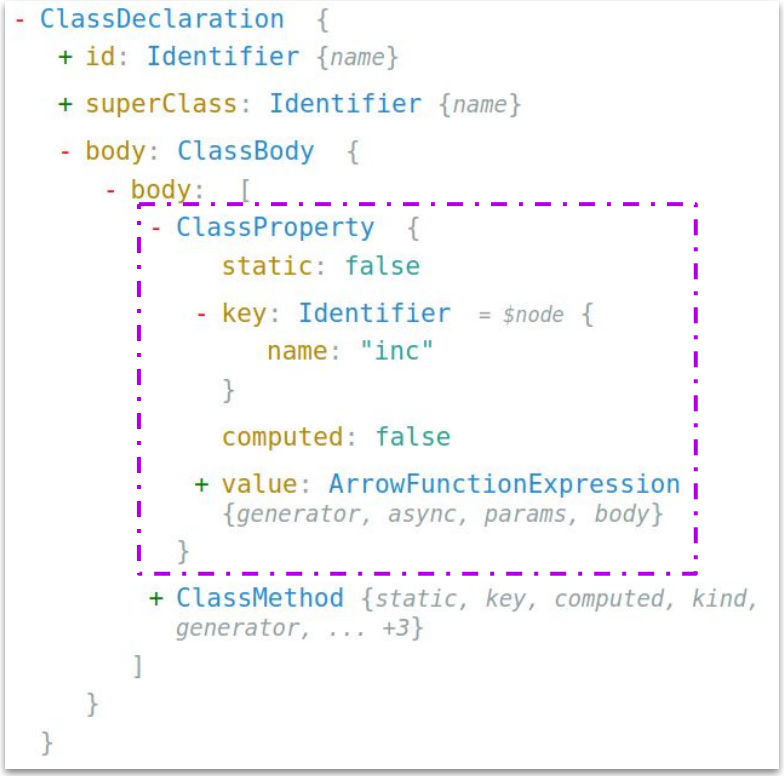
    return <p onClick={this.inc}>
      Total: {this.state.count}
    </p>;
  }
}
```



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5. Convert class fields to variables

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    this.setState(state => ({
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    }));

  render() {
    return <p onClick={this.inc}>
      Total: {this.state.count}
    </p>;
  }
}
```

```
state ⟶ init : ObjectLiteral { ... }

inc   ⟶ init : ArrowFunctionExpression {}

...
```

5. Convert class fields to variables

```
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    this.setState(state => ({
      count: state.count + this.props.step,
    }));

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    return <p onClick={this.inc}>
      Total: {this.state.count}
    </p>;
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```
inc    ⟶ init : ArrowFunctionExpression {}
...
```

5. Convert class fields to variables

```
function findClassProperties(node) {
  const properties = new Map();

  return properties;
}
```

5. Convert class fields to variables

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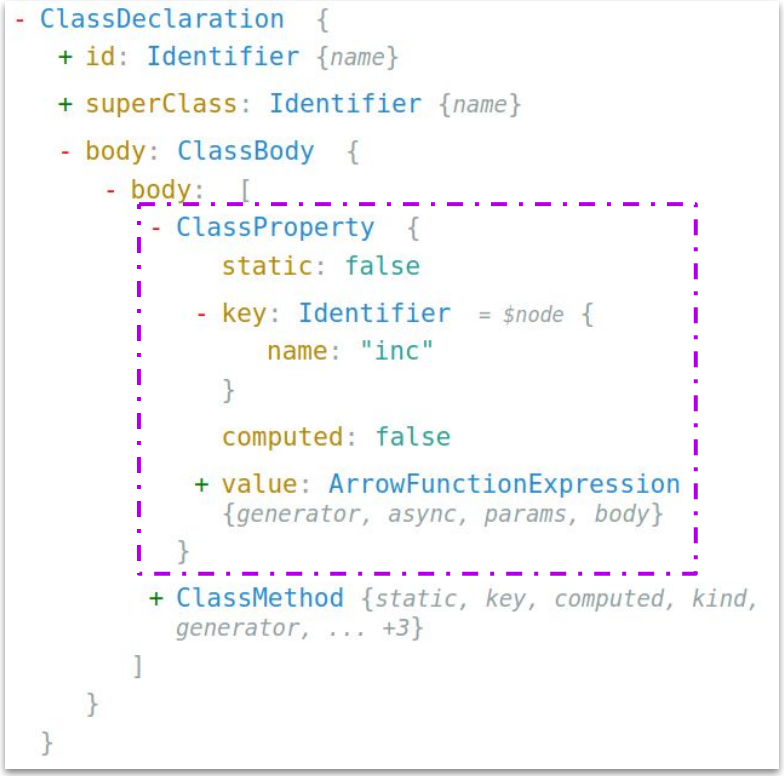
function findClassProperties(node) {
  const properties = new Map();
  for (const elem of node.body.body) {

  }
  return properties;
}
```



@NicoloRibaudo

5. Convert class fields to variables

```
function findClassProperties(node) {
  const properties = new Map();
  for (const elem of node.body.body) {
    if (
      !t.isClassProperty(elem, {
        computed: false, static: false,
      })
    ) continue;









  }
  return properties;
}
```

@NicoloRibaudo

5. Convert class fields to variables

```
function findClassProperties(node) {
  const properties = new Map();
  for (const elem of node.body.body) {
    if (
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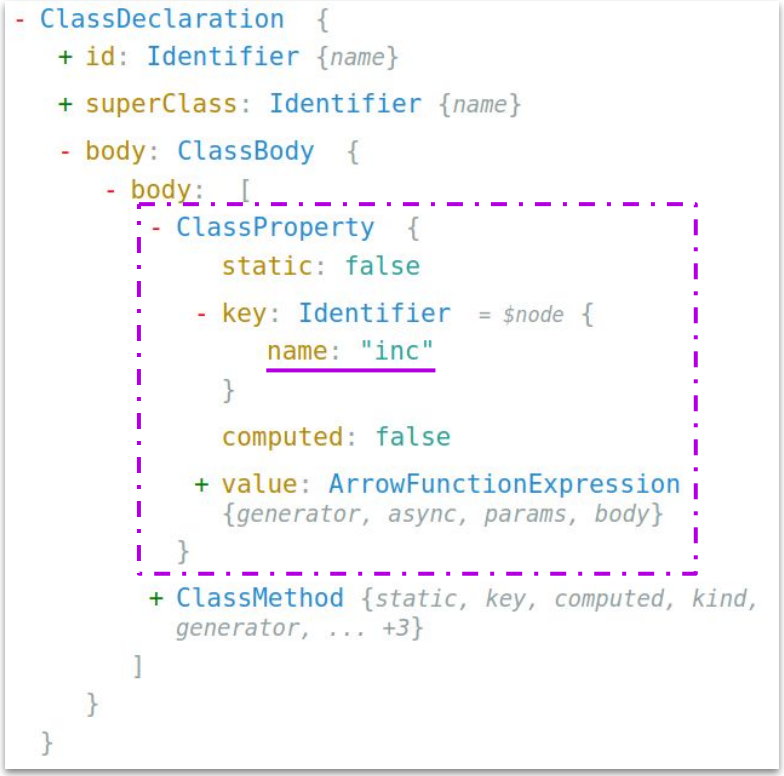
      })
    ) continue;

    if (elem.key.name === "state") continue;



  }
  return properties;
}
```



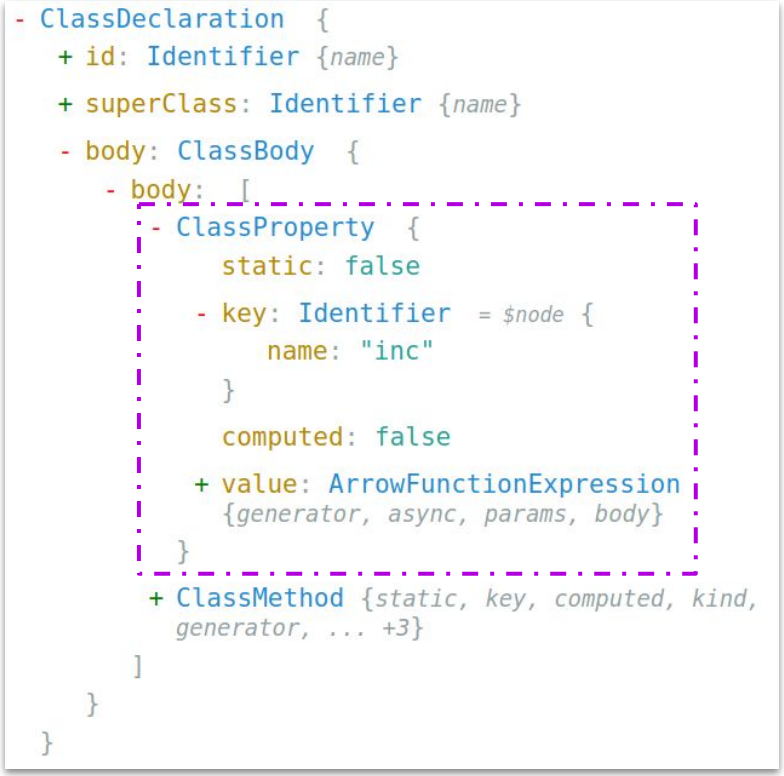
@NicoloRibaudo

5. Convert class fields to variables

```
function findClassProperties(node) {
  const properties = new Map();
  for (const elem of node.body.body) {
    if (
      !t.isClassProperty(elem, {
        computed: false, static: false,
      })
    ) continue;

    if (elem.key.name === "state") continue;

    properties.set(elem.key.name, elem.value);
  }
  return properties;
}
```



5. Convert class fields to variables

```
visotor: {
  ClassDeclaration(path) {

    // ...

    path.replaceWith(template.ast`
      const ${componentId} = (props) => {
        ${useStateCalls};

        ${findMethod(path, "render")};
      };
    `);
  }
}
```

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5. Convert class fields to variables

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visotor: {
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    // ...

    path.replaceWith(template.ast`
      const ${componentId} = (props) => {
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        ${findMethod(path, "render")};
      };
    `);
  }
}
```

```
inc ⟶ init : ArrowFunctionExpression {}

...
```

5. Convert class fields to variables

```
// ...
```

```
inc ⟶ init : ArrowFunctionExpression {}

...
```

```
path.replaceWith(template.ast`
  const ${componentId} = (props) => {
    ${useStateCalls};

    ${findMethod(path, "render")};
  };
`);
```

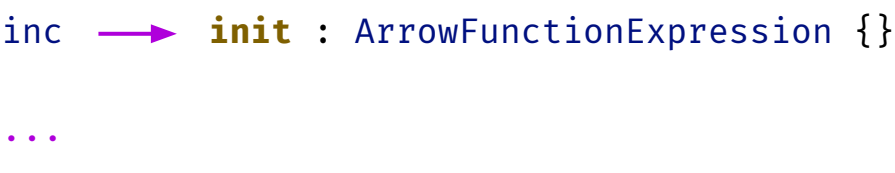
5. Convert class fields to variables

```
const vars = findClassProperties(path.node);

// ...


path.replaceWith(template.ast`
  const ${componentId} = (props) => {
    ${useStateCalls};

    ${findMethod(path, "render")};
  };
`);
```



5. Convert class fields to variables

```
const vars = findClassProperties(path.node);
const varsDeclarations = [];
for (const [name, init] of vars)
  varsDeclarations.push(template.ast`
    const ${t.identifier(name)} = ${init};
  `);

path.replaceWith(template.ast`
  const ${componentId} = (props) => {
    ${useStateCalls};

    ${findMethod(path, "render")};
  };
`);
```

```
inc ⟶ init : ArrowFunctionExpression {}

...
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    const ${t.identifier(name)} = ${init};
  `);

path.replaceWith(template.ast`
  const ${componentId} = (props) => {
    ${useStateCalls};
    ${varsDeclarations};
    ${findMethod(path, "render")};
  };
`);
```

```
inc ⟶ init : ArrowFunctionExpression {}

...
```

5. Convert class fields to variables

```
class Counter extends Component {
  state = { count: 0 };

  inc = () => this.setState(state => ({
    count: state.count + this.props.step,
  }));

  render() {
    return <p onClick={this.inc}>
      Total: {this.state.count}
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```
const Counter = props => {
  const [count, setCount] = useState(0);

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    count => count + props.step
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    Total: {count}
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      Total: {this.state.count}
    </p>;
  }
}
```

```
- expression: MemberExpression  {
    start: 191
    end: 199
  + loc: {start, end}
  - object: ThisExpression  {
      start: 191
      end: 195
    + loc: {start, end}
    }
    computed: false
  - property: Identifier  = $node {
      start: 196
      end: 199
    + loc: {start, end, identifierName}
      name: "inc"
    }
}
```

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5. Convert class fields *usage* to variables

```
function rewriteVarsUsage(path, props) {




}
```

5. Convert class fields *usage* to variables

```
function rewriteVarsUsage(path, props) {
  path.traverse({
    MemberExpression(path) {
      }
  });
}
```

5. Convert class fields *usage* to variables

```
function rewriteVarsUsage(path, props) {
  path.traverse({
    MemberExpression(path) {
      const { node } = path;
      if (!t.isThisExpression(node.object)) return;
      if (node.computed) return;









    }
  });
}
```

```
- expression: MemberExpression  {
    start: 191
    end: 199
  + loc: {start, end}
  - object: ThisExpression  {
      start: 191
      end: 195
    + loc: {start, end}
    }
    computed: false
  - property: Identifier  = $node {
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}
```

5. Convert class fields *usage* to variables

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function rewriteVarsUsage(path, props) {
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      const { node } = path;
      if (!t.isThisExpression(node.object)) return;
      if (node.computed) return;

      const { name } = node.property;
      if (!props.has(name)) return;



    }
  });
}
```

```
- expression: MemberExpression  {
    start: 191
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```

5. Convert class fields *usage* to variables

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function rewriteVarsUsage(path, props) {
  path.traverse({
    MemberExpression(path) {
      const { node } = path;
      if (!t.isThisExpression(node.object)) return;
      if (node.computed) return;

      const { name } = node.property;
      if (!props.has(name)) return;

      path.replaceWith(t.identifier(name));
    }
  });
}
```

```
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    start: 191
    end: 199
  + loc: {start, end}
  - object: ThisExpression  {
      start: 191
      end: 195
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}
```

5. Convert class fields *usage* to variables

```
class Counter extends Component {
  state = { count: 0 };

  inc = () => this.setState(state => ({
    count: state.count + this.props.step,
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      Total: {this.state.count}
    </p>;
  }
}
```

```
const Counter = props => {
  const [count, setCount] = useState(0);

  const inc = () => setCount(
    count => count + props.step
  );

  return <p onClick={inc}>
    Total: {count}
  </p>;
};
```

6. Inject `imports` for used hooks

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So far we only implemented local transforms, modifying a self-contained AST node:

`ClassDeclaration`

6. Inject `imports` for used hooks

So far we only implemented local transforms, modifying a self-contained AST node:

`ClassDeclaration`

We can use Babel's scope analysis and AST utilities to modify unrelated parts of the AST.

6. Inject `imports` for used hooks

```
class Counter extends Component {
  state = { count: 0 };
  render() {
    return <p>Total: {this.state.count}</p>;
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}
```

```
const Counter = (props) => {
 const [count, setCount] = useState(0);
 return <p>Total: {count}</p>;
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```

6. Inject `imports` for used hooks

```
class Counter extends Component {
  state = { count: 0 };
  render() {
    return <p>Total: {this.state.count}</p>;
  }
}
```

ReferenceError: useState is not defined

```
const Counter = (props) => {
 const [count, setCount] = useState(0);
 return <p>Total: {count}</p>;
};
```

6. Inject `imports` for used hooks

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  state = { count: 0 };
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const Counter = (props) => {
 const [count, setCount] = useState(0);
 return <p>Total: {count}</p>;
};
```

6. Inject `imports` for used hooks

```
class Counter extends Component {
  state = { count: 0 };
  render() {
    return <p>Total: {this.state.count}</p>;
  }
}
```

```
import { useState } from "react";
const Counter = (props) => {
 const [count, setCount] = useState(0);
 return <p>Total: {count}</p>;
};
```

6. Inject `imports` for used hooks

```
function findReactImport(path) {




}
```

```
import * as _ from "lodash";
import React, { Component } from "react";

export function buildBtn(color) {
  class Btn extends Component {
    state = { x: 0 };

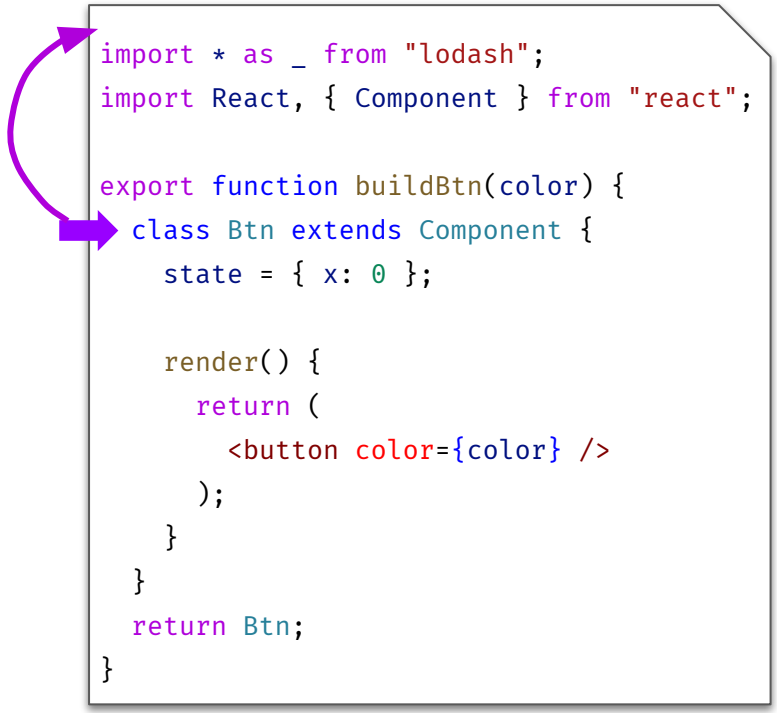
    render() {
      return (
        <button color={color} />
      );
    }
  }
  return Btn;
}
```

6. Inject `imports` for used hooks

```
function findReactImport(path) {
  const program = path.findParent((p) => p.isProgram());




}
```



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    }
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```

6. Inject `imports` for used hooks

```
function findReactImport(path) {
  const program = path.findParent((p) => p.isProgram());
  let importPath = program.get("body")
    .filter(({ node }) => t.isImportDeclaration(node))









}
```

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import * as _ from "lodash";
import React, { Component } from "react";

export function buildBtn(color) {
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  if (importPath) return importPath;

  program.unshiftContainer(
    "body", template.ast`import "react"`
  );

}
```

```
import "react";
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export function buildBtn(color) {
  class Btn extends Component {
    state = { x: 0 };

    render() {
      return (
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    "body", template.ast`import "react"`
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    "body", template.ast`import "react"`
  );
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}
```

We are always working with *paths*, not with *nodes*.

6. Inject `imports` for used hooks

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function findReactImport(path) {
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We are always working with *paths*, not with *nodes*.

AST nodes are ergonomic for reading the AST, but when mutating it we must use *NodePaths* to let Babel track updates.

6. Inject `imports` for used hooks

```
visotor: {
  ClassDeclaration(path) {
    /* ... */









  }
}
```

```
import "react";
import * as _ from "lodash";

export function buildBtn(color) {
  class Btn extends Component {
    state = { x: 0 };

    render() {
      return (
        <button color={color} />
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    }
  }
  return Btn;
}
```

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```

```
import "react";
import * as _ from "lodash";

export function buildBtn(color) {
  const Btn = props => {
    const [x, setX] = useState(0);

    return (
      <button color={color} />
    );
  }


  return Btn;
}
```

6. Inject `imports` for used hooks

```
visotor: {
  ClassDeclaration(path) {
    /* ... */
    if (
       useStateCalls.length > 0

    ) {









    }
  }
}
```

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import "react";
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}
```

```
import { useState } from "react";
```

```
- ImportDeclaration  {
    start: 6
    end: 39
  + loc: {start, end}
    importKind: "value"
  - specifiers:  [
     + ImportSpecifier {start, end, loc, imported, local}
    ]
  + source: StringLiteral {start, end, loc, extra, value}
 }
```

6. Inject `imports` for used hooks

```
visotor: {
  ClassDeclaration(path) {
    /* ... */
    if (
       useStateCalls.length > 0

    ) {
      findReactImport(path)









    }
  }
}
```

```
import { useState } from "react";
```

```
- ImportSpecifier {
    start: 15
    end: 23
  + loc: {start, end}
  - imported: Identifier = $node {
      start: 15
      end: 23
    + loc: {start, end, identifierName}
      name: "useState"
    }
  - local: Identifier {
      start: 15
      end: 23
    + loc: {start, end, identifierName}
      name: "useState"
    }
  }
```

6. Inject `imports` for used hooks

```
visotor: {
  ClassDeclaration(path) {
    /* ... */
    if (
       useStateCalls.length > 0

    ) {
      findReactImport(path)









    }
  }
}
```

```
import { useState as useState } from "react";
```

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6. Inject `imports` for used hooks

```
visotor: {
  ClassDeclaration(path) {
    /* ... */
    if (
       useStateCalls.length > 0

    ) {
      findReactImport(path)




    }
  }
}
```

```
import "react";
import * as _ from "lodash";

export function buildBtn(color) {
  const Btn = props => {
    const [x, setX] = useState(0);

    return (
      <button color={color} />
    );
  }


  return Btn;
}
```

6. Inject `imports` for used hooks

```
visotor: {
  ClassDeclaration(path) {
    /* ... */
    if (
       useStateCalls.length > 0

    ) {
      findReactImport(path).pushContainer(
        "specifiers",
        t.importSpecifier(t.identifier("useState"),
                          t.identifier("useState"))
      );
    }
  }
}
```

```
import "react";
import * as _ from "lodash";

export function buildBtn(color) {
  const Btn = props => {
    const [x, setX] = useState(0);

    return (
      <button color={color} />
    );
  }


  return Btn;
}
```

6. Inject `imports` for used hooks

```
visotor: {
  ClassDeclaration(path) {
    /* ... */
    if (
       useStateCalls.length > 0 &&
       !path.scope.hasBinding("useState")
    ) {
      findReactImport(path).pushContainer(
        "specifiers",
        t.importSpecifier(t.identifier("useState"),
                          t.identifier("useState"))
      );
    }
  }
}
```

```
import "react";
import * as _ from "lodash";

export function buildBtn(color) {
  const Btn = props => {
    const [x, setX] = useState(0);

    return (
      <button color={color} />
    );
  }


  return Btn;
}
```

@NicoloRibaudo

6. Inject `imports` for used hooks

```
class Counter extends Component {
  state = { count: 0 };
  render() {
    return <p>Total: {this.state.count}</p>;
  }
}
```

```
import { useState } from "react";
const Counter = (props) => {
 const [count, setCount] = useState(0);
 return <p>Total: {count}</p>;
};
```

</Example>

Complementary tools

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Babel is great at doing two things:

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- Parsing JavaScript, proposals or language extensions

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- Providing tools to transform the code's AST

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JSCodeshift's CLI

Codemods also need:

- A way to print the resulting AST, keeping the original formatting
- A way to run the Babel plugin on the different files

Complementary tools

recast

JSCodeshift's CLI

A manual for loop that iterates over the files

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- A way to print the resulting AST, keeping the original formatting
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Demo!

https://github.com/nicolo-ribaudo/conf-holyjs-moscow-2020

Babel:
A refactoring tool

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