Closure conversion

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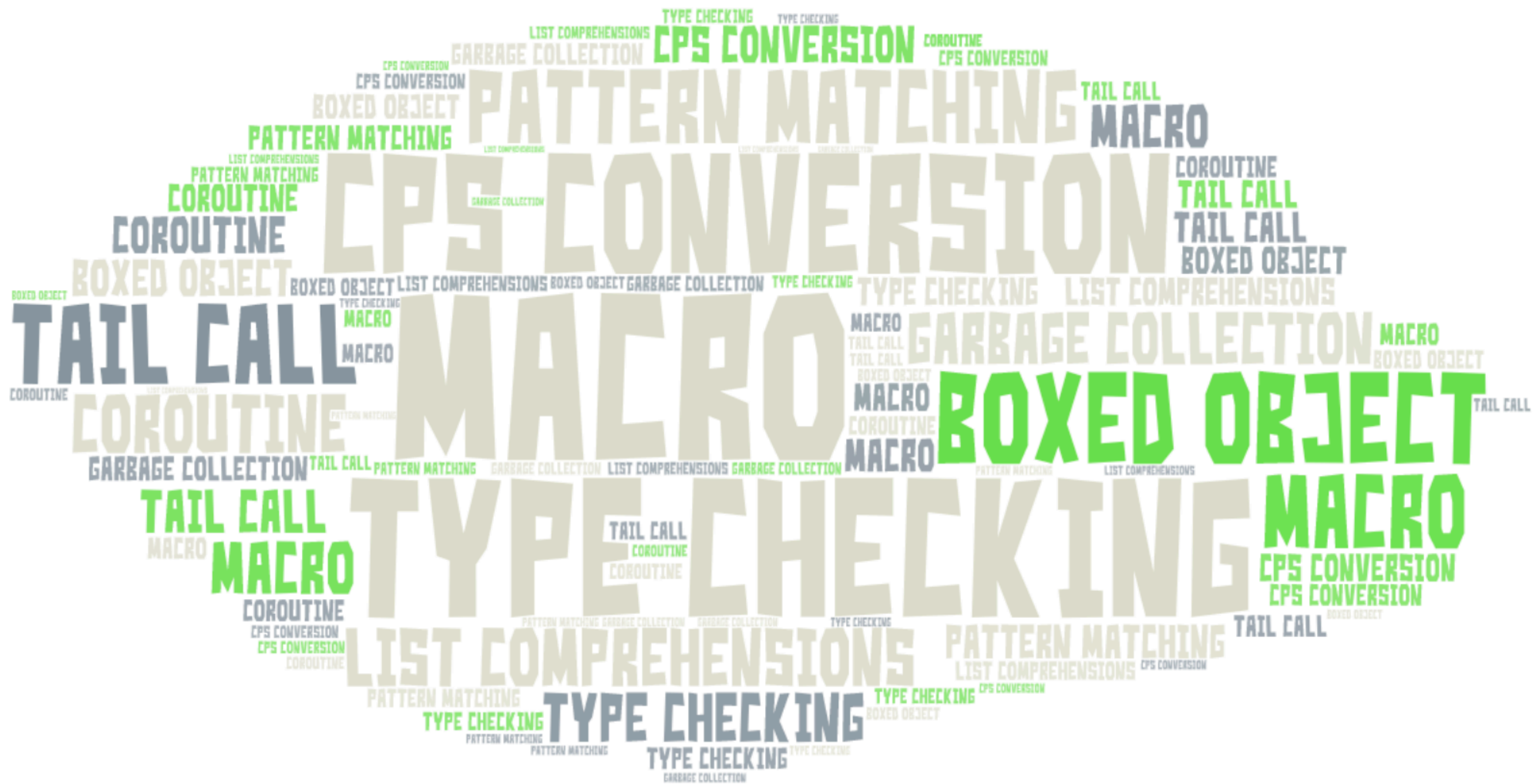
Dannypsnl & 2022/07/31


TYPE CHECKING
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COROUTINE
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Common thing?

Function as Value

```
let makeAdder = (n) => (m) => (n + m)

makeAdder(2)(3) // 5
```

C?

```c
int adder(int m) {
  return n + m;
}

typedef int (*adder_t)(int);
adder_t make_adder(int n) {
  return &adder;
}
```

Not just syntax

Pseudo C: address of n

```c
typedef int (*adder_t)(int);
adder_t make_adder(int n) {
  int adder(int m) {
    return n + m;
  }
  return &adder;
}
```

Not just syntax

Store in Global variable

```
int n1;
int adder(int m) {
  return n1 + m;
}
adder_t make_adder(int n) {
  n1 = n;
  return &adder;
}
```

Not just syntax

Store in Global variable

```
int main() {
  adder_t add1 = make_adder(1);
  add1(2); // 3
  adder_t add2 = make_adder(2);
  add2(2); // 4
}
```

Not just syntax

Store in Global variable

```
int main() {
  adder_t add1 = make_adder(1);
  adder_t add2 = make_adder(2);
  add1(2); // 4
  add2(2); // 4
}
```

Not just syntax

Store in Global variable

```
int n1;
int adder(int m) {
  return n1 + m;
}
adder_t make_adder(int n) {
  n1 = n;
  return &adder;
}
```

Closure Encoding

```
typedef struct {
  uint64_t func_ptr;
  expr_t *env;
} closure_t;
```

pseudo code: call conversion

```
closure_t make_adder(int n) {
  return make_closure(adder, n);
}
int main() {
  closure_t add1 = make_adder(1);
  closure_t add2 = make_adder(2);
  add1.func_ptr(2, add1.env);
  add2.func_ptr(2, add2.env);
}
```

Transformation

Free variables

```
let makeAdder = (n) => (m) => (n + m)
```

```
(n) => (m) => (n + m)
```

```
(m) => (n + m)
```

Transform to

```
[(m, env) => (env[0] + m), [n]]
```

```
(n) => [(m, env) => (env[0] + m), [n]]
```

Transform to

```
[(n, env) => [(m, env) => (env[0] + m), [n]], []]
```

Result

```
let makeAdder =
  [(n, env) =>
    [(m, env) => (env[0] + m)
     , [n]]
   , []]

let clos = makeAdder
let clos1 = clos[0](2, clos[1])
clos1[0](3, clos1[1]) // 5
```

Today’s target

JS to Scheme

```javascript
let makeAdder = (n) => (m) => (n + m)
makeAdder(2)(3)
```

```scheme
(begin
  (define make-adder
    (lambda (n)
      (lambda (m) (+ n m))))
  ((make-adder 2) 3))
```

JS to Scheme

```
let makeAdder = (n) => (m) => (n + m)
makeAdder(2)(3)
```

```
(begin
  (define make-adder
    (lambda (n)
      (lambda (m) (+ n m))))
  ((make-adder 2) 3))
```

JS to Scheme

```
let makeAdder = (n) => (m) => (n + m)
makeAdder(2)(3)
```

```
(begin
  (define make-adder
    (lambda (n)
      (lambda (m) (+ n m))))
  ((make-adder 2) 3))
```

```scheme
(define make-adder
  (lambda (n)
    (lambda (m) (+ n m))))
```

Shorthand

```scheme
(define (make-adder n)
  (lambda (m) (+ n m)))
```

Final

```
(begin
  (define (make-adder n)
    (lambda (m) (+ n m)))
  ((make-adder 2) 3))
```

Happy coding time

Me