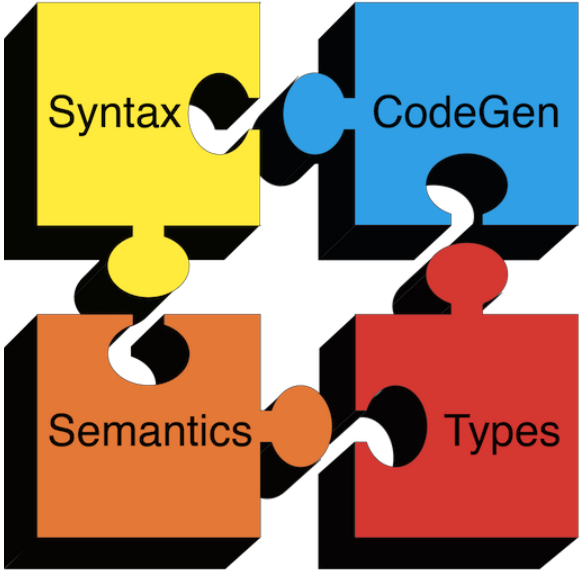


Compilers

Recursive Descent Algorithm

RD Algorithm

- Let TOKEN be the type of tokens
  - Special tokens INT, OPEN, CLOSE, PLUS, TIMES

- Let the global next point to the next input token

RD Algorithm

- Define boolean functions that check for a match of:
  - A given token terminal

    true / false

    bool term(TOKEN tok) { return *next++ == tok; }
  - The nth production of S:

    → bool S_n() { … }
  - Try all productions of S:

    → bool S() { … }

RD Algorithm

- For production E → T

```
bool E_1() { return T(); }
```

- For production E → T + E

```
bool E_2() { return T() && term(PLUS) && E(); }
```

- For all productions of E (with backtracking)

```
  bool E() {
    TOKEN *save = next;
    return   (next = save, E_1())
          || (next = save,  E_2());   }
```

RD Algorithm

- Functions for non-terminal T

```
bool T1() { return term(INT); }                              T → int
bool T2() { return term(INT) && term(TIMES) && T(); }        T → int * T
bool T3() { return term(OPEN) && E() && term(CLOSE); }       T → ( E )

bool T() {
   TOKEN *save = next;
   return    (next = save, T1())
          || (next = save, T2())
          || (next = save, T3()); }
```

RD Algorithm

- To start the parser
  - Initialize next to point to first token
  - Invoke E()

- Easy to implement by hand

RD Algorithm

E → T | T + E
T → int | int * T | (E)

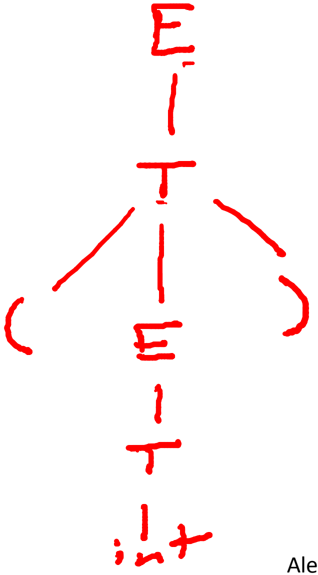
```
bool term(TOKEN tok) { return *next++ == tok; }

bool E1() { return T(); }
bool E2() { return T() && term(PLUS) && E(); }

bool E()  {TOKEN *save = next; return     (next = save, E1())
                                        || (next = save,  E2());   }

bool T1() { return term(INT); }
bool T2() { return term(INT) && term(TIMES) && T(); }
bool T3() { return term(OPEN) && E() && term(CLOSE); }

bool T() { TOKEN *save = next;  return    (next = save, T1())
                                        || (next = save,  T2())
                                        || (next = save,  T3()); }
```



RD Algorithm

Which lines are incorrect in the recursive descent implementation of this grammar?

$$E \to E' \mid E' + id$$
$$E' \to -E' \mid id \mid (E)$$

□ Line 3

□ Line 5

□ Line 6

□ Line 12

```
1  bool term(TOKEN tok) { return *next++ == tok; }

2  bool E_1() { return E'(); }
3  bool E_2() { return E'() && term(PLUS) && term(ID); }
4  bool E() {
5       TOKEN *save = next;
6       return (next = save, E_1()) && (next = save,  E_2());
7   }

8  bool E'_1() { return term(MINUS) && E'(); }
9  bool E'_2() { return term(ID); }
10 bool E'_3() { return term(OPEN) && E() && term(CLOSE); }
11 bool E'() {
12      TOKEN *next = save;  return (next = save, T_1())
13                                  || (next = save,  T_2())
14                                  || (next = save,  T_3());
15 }
```