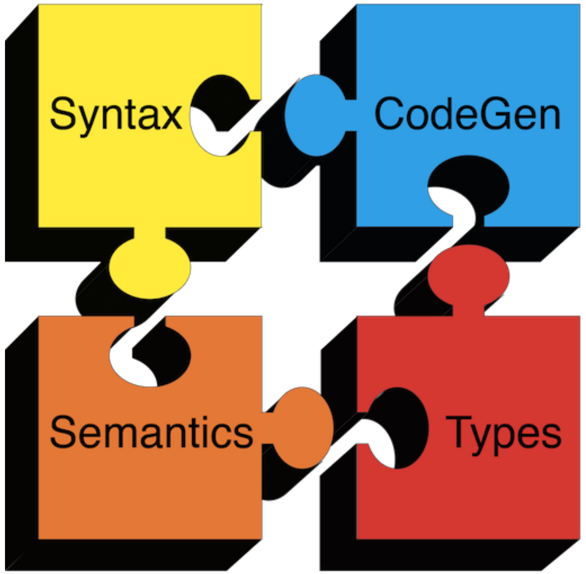


Compilers

Lexical Analysis

Alex Aiken

1. Lexical Analysis
2. Parsing
3. Semantic Analysis
4. Optimization
5. Code Generation

Lexical Analysis

```
if (i == j)
    Z = 0;
else
    Z = 1;
```

```
\tif (i == j)\n\t\tz = 0;\n\telse\n\t\tz = 1;
```

Lexical Analysis

- Token Class (or Class)
  - In English:

    Noun, verb, adjective, ...

  - In a programming language:

    Identifier, Keywords, '(', ')', Numbers, ...

Lexical Analysis

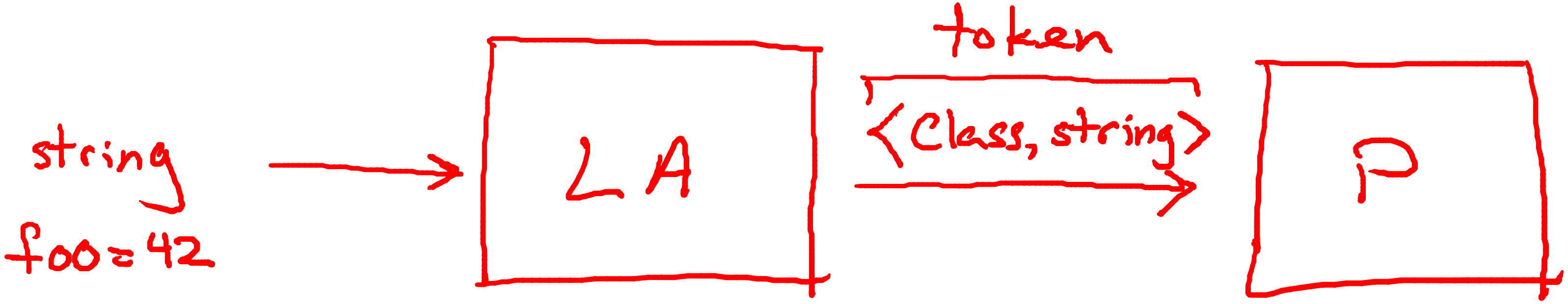
- Token classes correspond to sets of strings.

- Identifier:
  - *strings of letters or digits, starting with a letter*
- Integer: $\underline{A}1$ $\underline{F}oo$ $\underline{B}17$
  - *a non-empty string of digits* 0 12 001 00
- Keyword:
  - *"$\underline{\text{else}}$" or "$\underline{\text{if}}$" or "$\underline{\text{begin}}$" or …*
- Whitespace:
  - *a non-empty sequence of blanks, newlines, and tabs*

if $\underbrace{\_\ \_\ \_}$ ($\rightarrow$ whitespace

Lexical Analysis

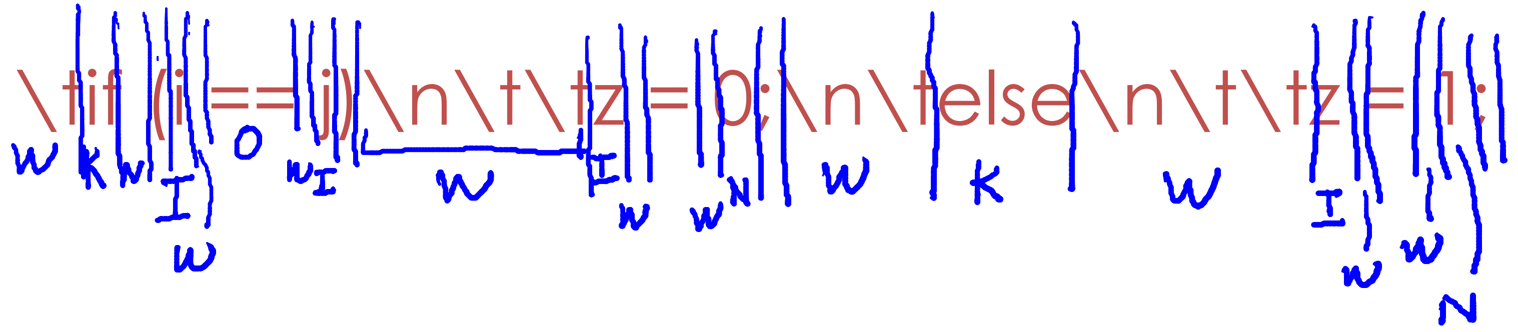
- Classify program substrings according to role
  token class
- Communicate tokens to the parser



<Id, "foo"> <Op, "="> , <Int, "42">

Lexical Analysis

```
\tif (i == j)\n\t\tz = 0;\n\telse\n\t\tz = 1;
```



Operator
Whitespace
Keywords
Identifiers
Numbers

(
)
;
=

Lexical Analysis

For the code fragment below,
choose the correct number of tokens in
each class that appear in the code fragment

```
x = 0;\n\twhile (x < 10) {\n\tx++;\n}
```

- ○ W = 9; K = 1; I = 3; N = 2; O = 9
- ○ W = 11; K = 4; I = 0; N = 2; O = 9
- ○ W = 9; K = 4; I = 0; N = 3; O = 9
- ○ W = 11; K = 1; I = 3; N = 3; O = 9

W: Whitespace
K: Keyword
I: Identifier
N: Number
O: Other Tokens:
{ } ( ) < ++ ; =

Lexical Analysis

- An implementation must do two things:

1. Recognize substrings corresponding to tokens
    - The *lexemes*

2. Identify the token class of each lexeme

$$\underbrace{\langle \text{token class, lexeme} \rangle}_{\text{token}}$$