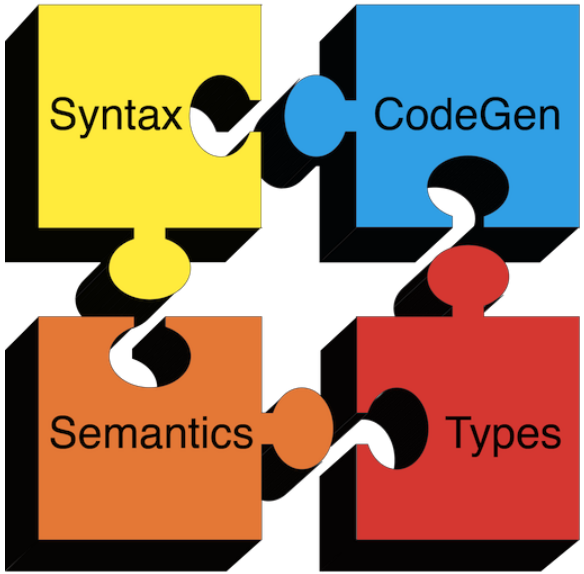


Compilers

Structure of a Compiler

Intro to Compilers

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

- First step: recognize words.
  - Smallest unit above letters

This is a sentence.

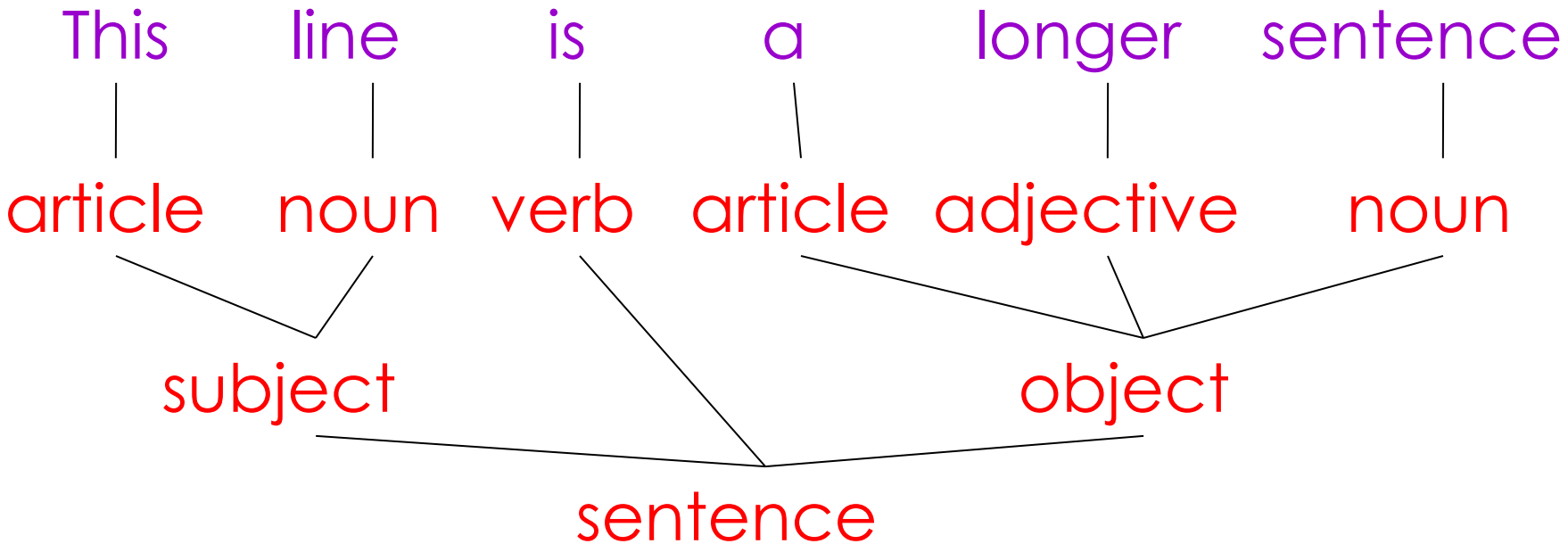
ist his ase nte nce

- Lexical analysis divides program text into “words” or “tokens”

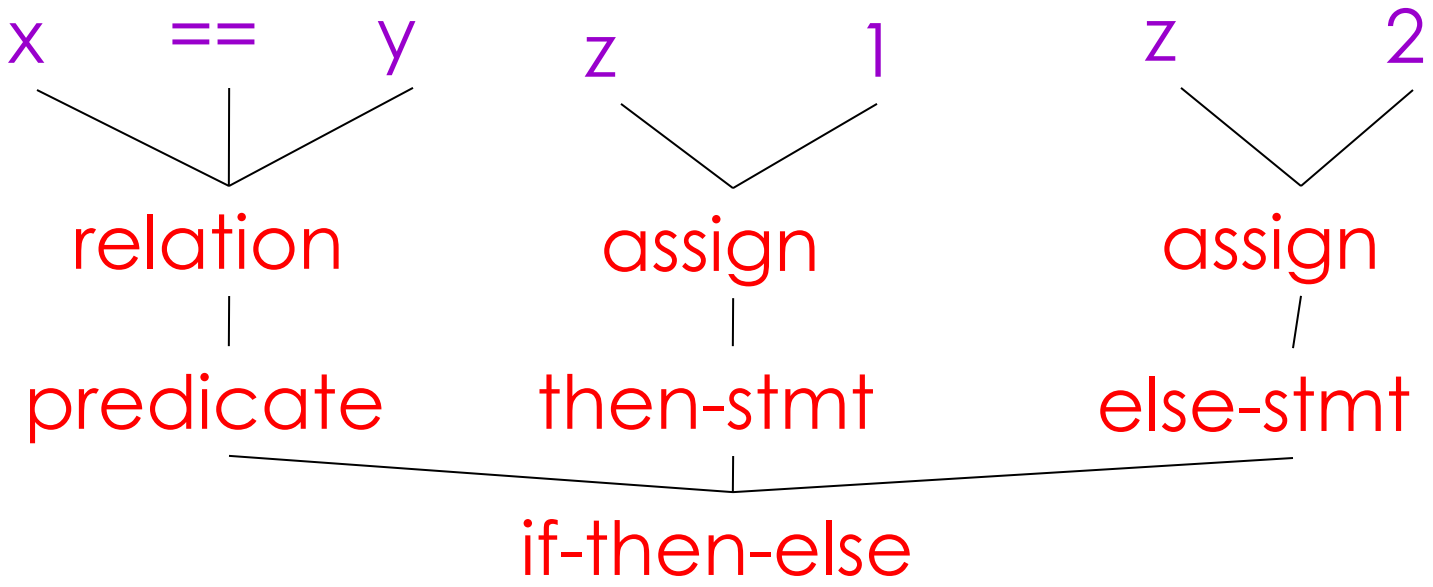
```
if x == y then z = 1; else z = 2;
```

- Once words are understood, the next step is to understand sentence structure

- Parsing = Diagramming Sentences
  - The diagram is a tree


This
line
is
a
longer
sentence
article
noun
verb
article
adjective
noun
subject
object
sentence

if x == y then z = 1; else z = 2;



- Once sentence structure is understood, we can try to understand “meaning”
  - This is hard!

- Compilers perform limited semantic analysis to catch inconsistencies

- Example:

  Jack said Jerry left his assignment at home.

- Even worse:

  Jack said Jack left his assignment at home?

- Programming languages define strict rules to avoid such ambiguities

```
{
    int Jack = 3;
    {
        int Jack = 4;
        cout << Jack;
    }
}
```

- Compilers perform many semantic checks besides variable bindings

- Example:

  Jack left her homework at home.

- A “type mismatch” between her and Jack; we know they are different people

- Optimization has no strong counterpart in English
  - But a little bit like editing

- Automatically modify programs so that they
  - Run faster
  - Use less memory

X = Y * 0 is the same as X = 0

- Produces assembly code (usually)

- A translation into another language
  - Analogous to human translation

- The overall structure of almost every compiler adheres to our outline

- The proportions have changed since FORTRAN