

01 - Introduction and Math Preliminaries

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Outline

- 1 Introduction to Compilers
- 2 S-Algol
- 3 Math Preliminaries

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What is a compiler?

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A compiler ...

- verifies the validity of the source program.
- translate a source program into an object program.
- translates a source program without changing its semantic meaning.

Program Stages

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- Compile Time

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 - Lexicographical Properties of the Program

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 - Program Execution
 - Dynamic Behavior of the Program

Phases of Compilation

1 Lexical Analysis

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- 2 Syntax Analysis

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- `DO 1 I=1,12`

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Consider the following Fortran:

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- DO 1 I=1.12

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- Results in a **parse tree** representation of the program.

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- generates object code as it descends the tree.
- optimizes object code.

Recursive Descent Compiling

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- Errors are detected as the recognizers execute.
- Limited in scope to $LL(1)$ languages.

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Language Properties

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- Procedures
- Designed as a Teaching Language
- Powerful Enough for Systems Programming

Variable Declarations

<code>let x := 1</code>	<code>!has type int i.e. integer</code>
<code>let y := 2.7</code>	<code>!has type real</code>
<code>let switch := x<pi</code>	<code>!has type bool i.e. boolean</code>
<code>let name := "Bill"</code>	<code>!has type string</code>
<code>let e=2.71828</code>	<code>!real constant</code>
<code>let lbl := "here"</code>	<code>!has type cstring</code>

Structures

```
structre identifier(cstring name ;real val)  
let var := identifier("x", 2.14)
```


Procedures

```
procedure count(cint s,e)
begin
  let x := s
  while x <= e do
  begin
    write x
    x := x + 1
  end
end
```

```
procedure convert(cint L,S,D->real)
  L+S/20+D/240
```

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- We often speak of closure of grammars, languages, and sets.
- Computing closures reveal vital information about a language.
- We will get more formal with closures later.

Alphabets and Languages

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- Expanding the above language yields:

$$L = \{aa, ab, ac, ba, bb, bc, ca, cb, cc\}$$

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- A^0 is the empty string, we often give it the special symbol λ

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- A^* is the language consisting of every possible string over the alphabet A .

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- This is called the Transitive Closure of A

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- Hence A^* is the reflexive transitive closure of A under the operation of concatenation.
- Also, A^+ is the transitive closure of A under the operation of concatenation.

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$\forall s \in A^*$:

- 1 Decides $s \stackrel{?}{\in} L$
- 2 Computes the function $L \mapsto L'$ on s