Little Languages

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Computer Language?

Overview

Definition of Little Language

Principles of Language Design

PIC – A little language to draw pictures

Key Take-Aways

Discussion

More Precise Definition

Computer Language:

> *A computer language enables a textual description of an object to be processed by a computer program*

Little Language?

Principles of Language Design

Design Goals

Simplicity

Fundamental Abstractions

Linguistic Structure

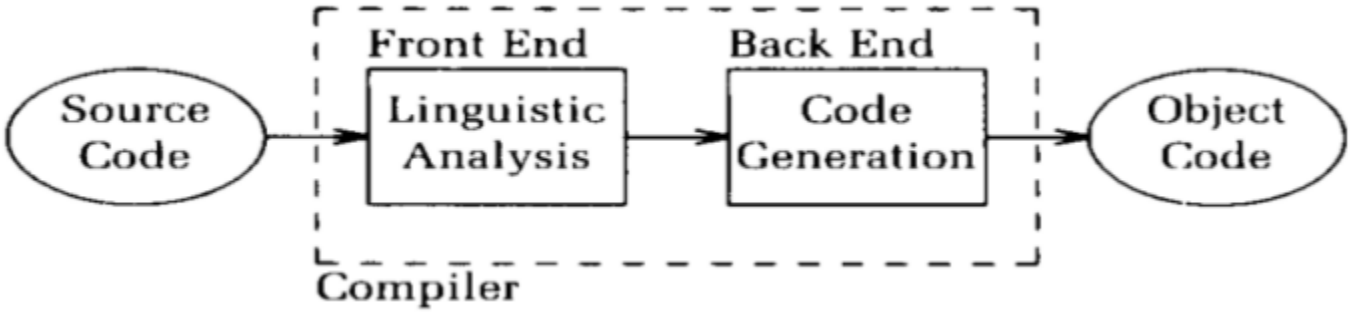
Principles of Language Design

Yardsticks of Language Design

- Orthogonality
- Generality
- Parsimony
- Completeness
- Similarity
- Extensibility
- Openness

Picture Drawing Program

PIC - A little language to draw pictures



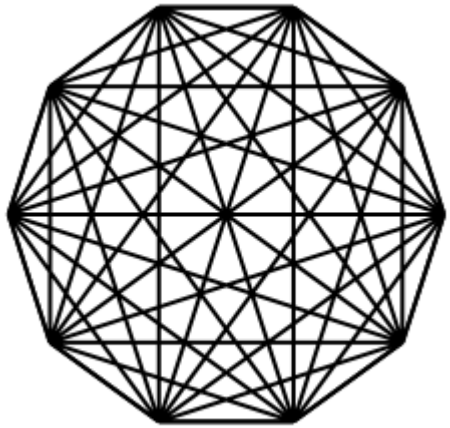
Picture Drawing Program

PICTURES – objects of interest

1. Interactive Program
2. Subroutine Library
3. Little Language

Picture Drawing Program

Interactive Program



Hard to implement

Painful to use

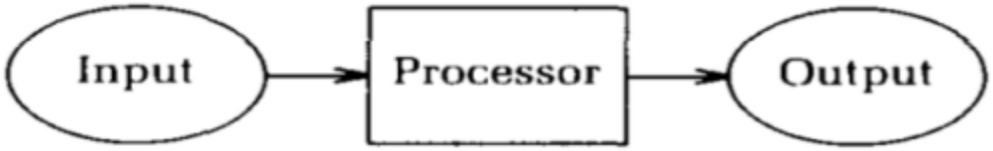
Difficult to extend to new problem domains

Least portable

Picture Drawing Program

Subroutine Library

line(x1, y1, x2, y2)




```
ellipse(0.3, 0, 0.6, 0.4)
text(0.3, 0, "Input")
arrow(0.75, 0, 0.3, 0)
box(1.2, 0, 0.6, 0.4)
text(1.2, 0, "Processor")
arrow(1.65, 0, 0.3, 0)
ellipse(2.1, 0, 0.6, 0.4)
text(2.1, 0, "Output")
```

Describing Pictures in PIC

A PIC program to draw a simple picture

```
ellipse "Source" "Code"
arrow
box "Compiler"
arrow
ellipse "Object" "Code"
```

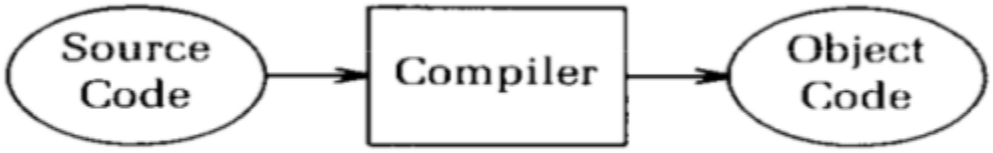
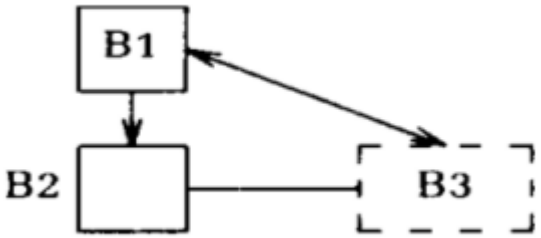


FIGURE 1. A Simple View of a Compiler

Describing Pictures in PIC




```
boxht = .25; boxwid = .25
down  # default direction
B1: box "B1"
arrow
B2: box
"B2 " at B2.w rjust
line right .4 from B2.e
B3: box dashed wid .4 "B3"
line <-> from B3.n to B1.e
```

Primitive Objects & Operations

26 page manual
Implemented within a week
4000 lines of C code

Natural expression
Implicit direction
Suggestive

Not Included:
Declarations
While and Case
Separate compilation

Extensibility and Openness

PIC Preprocessors

UNIX SHELL program


```
scatter infile | pic | troff >outfile
```

PIC Preprocessors

SCATTER

A tiny language that makes scatter plots from x, y data.

```
size x 1.8
size y 1.2
range x 1870 1990
range y 35 240
label x Year
label y Population
ticks x 1880 1930 1980
ticks y 50 100 150 200
file pop.d
```

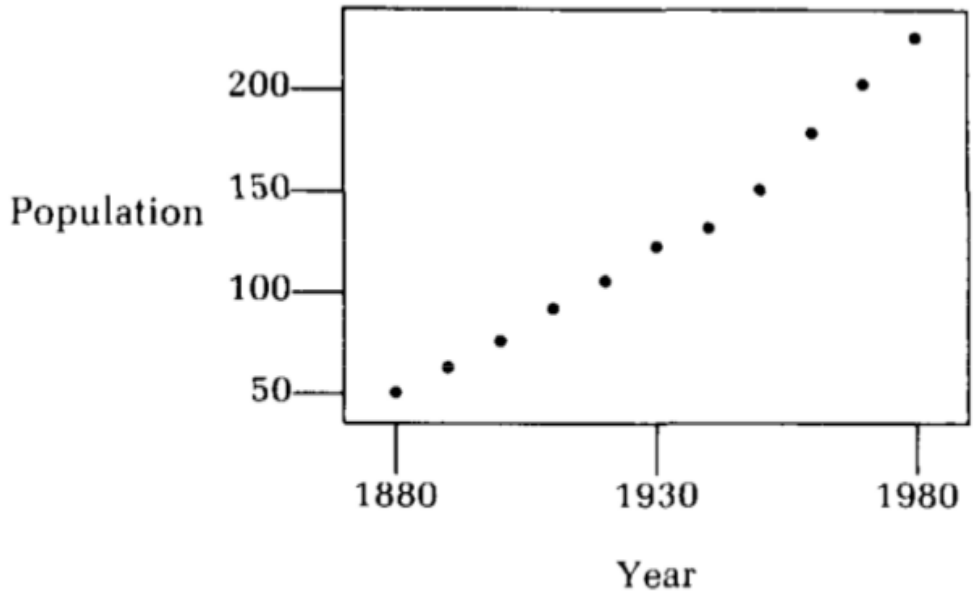


FIGURE 4. Population of the United States

Building PIC

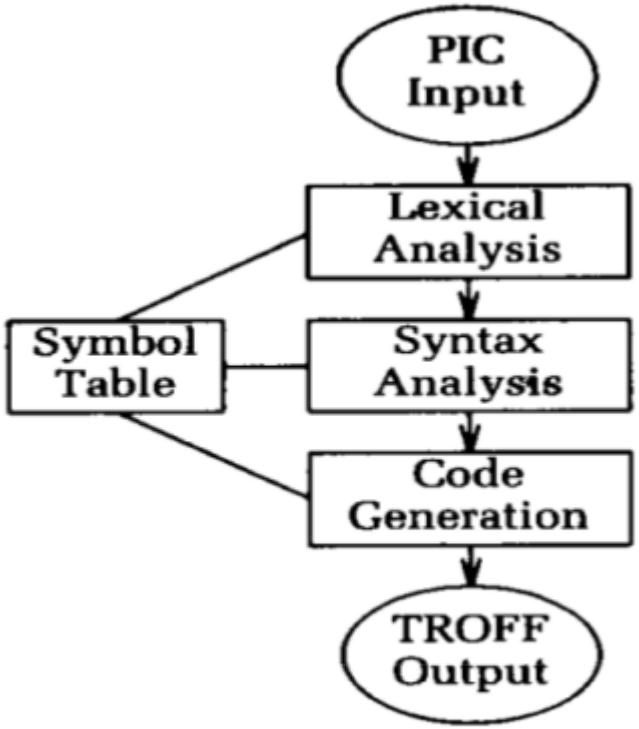


FIGURE 6. A Detailed View of PIC

Lexical Analyzer

- LEX *by Mike Lesk*

```
">"                 return(GT);
"<"                 return(LT);
">="                return(GE);
"<="                return(LE);
"<-"                return(HEAD1);
"->"                return(HEAD2);
"<->"               return(HEAD12);
"."(s|south)        return(SOUTH);
"."(b|bot|bottom)   return(SOUTH);
```

```
line down from B1.s
```

Typical output of a lexer

```
LINE
DOWN
FROM
SYMBOL: B1
SOUTH
```

Syntax Analyzer

YACC *by Steve Johnson*

A little language for describing languages.

```
primitive:
    BOX attrlist       { boxgen($1); }
  | CIRCLE attrlist    { elgen($1); }
  | ELLIPSE attrlist   { elgen($1); }
  | ARC attrlist       { arcgen($1); }
  | LINE attrlist      { linegen($1); }
    ...
  ;
```

Part of PIC's definition of primitive geometric objects

Conclusion

The Design Process

Insights from Compiler Building

Linguistic Insights

Little Languages

PIC, SCATTER, TROFF, UNIX SHELL, LEX, YAAC

Microscopic Languages

Floating-point number, Regular Expressions

Discussion

Top-down vs. Bottom-up Approach to problem solving

Use of Little Language approach in MBSE

Arguments for and against the idea of single language for all programming domains.