

## UNIT -1

### 1.1 OVERVIEW OF LANGUAGE PROCESSING SYSTEM

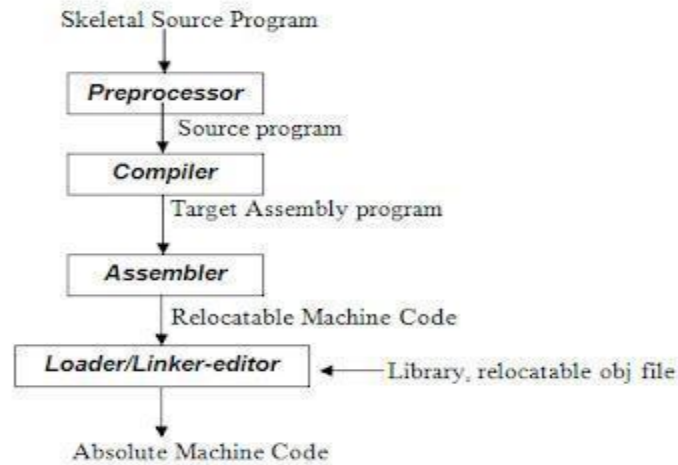


Fig 1.1 Language –processing System

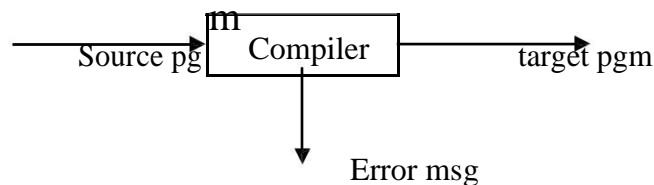
### 1.2 Preprocessor

A preprocessor produce input to compilers. They may perform the following functions.

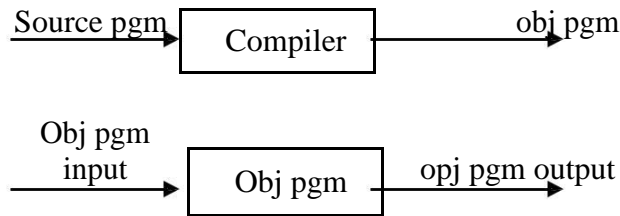
1. *Macro processing*: A preprocessor may allow a user to define macros that are short hands for longer constructs.
2. *File inclusion*: A preprocessor may include header files into the program text.
3. *Rational preprocessor*: these preprocessors augment older languages with more modern flow-of-control and data structuring facilities.
4. *Language Extensions*: These preprocessor attempts to add capabilities to the language by certain amounts to build-in macro

### 1.3 COMPILER

Compiler is a translator program that translates a program written in (HLL) the source program and translate it into an equivalent program in (MLL) the target program. As an important part of a compiler is error showing to the programmer.

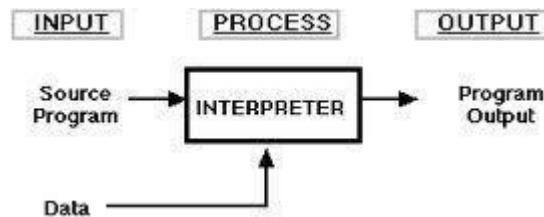


Executing a program written in HLL programming language is basically of two parts. The source program must first be compiled/translated into an object program. Then the resulting object program is loaded into memory and executed.



**1.4 ASSEMBLER:** programmers found it difficult to write or read programs in machine language. They begin to use a mnemonic (symbols) for each machine instruction, which they would subsequently translate into machine language. Such a mnemonic machine language is now called an assembly language. Programs known as assemblers were written to automate the translation of assembly language into machine language. The input to an assembler program is called source program, the output is a machine language translation (object program).

**1.5 INTERPRETER:** An interpreter is a program that appears to execute a source program as if it were machine language.



Languages such as BASIC, SNOBOL, LISP can be translated using interpreters. JAVA also uses interpreter. The process of interpretation can be carried out in following phases.

1. Lexical analysis
2. Syntax analysis
3. Semantic analysis
4. Direct Execution

**Advantages:**

- Modification of user program can be easily made and implemented as execution proceeds.
- Type of object that denotes a various may change dynamically.
- Debugging a program and finding errors is simplified task for a program used for interpretation.
- The interpreter for the language makes it machine independent.

**Disadvantages:**

- The execution of the program is *slower*.
- *Memory* consumption is more.

**2 Loader and Link-editor:**

Once the assembler produces an object program, that program must be placed into memory and executed. The assembler could place the object program directly in memory and transfer control to it, thereby causing the machine language program to be executed. This would waste core by leaving the assembler in memory while the user's program was being executed. Also the programmer would have to retranslate his program with each execution, thus wasting translation time. To overcome these problems of wasted translation time and memory, system programmers developed another component called loader.

"A loader is a program that places programs into memory and prepares them for execution." It would be more efficient if subroutines could be translated into object form the loader could "relocate" directly behind the user's program. The task of adjusting programs so they may be placed in arbitrary core locations is called relocation. Relocation loaders perform four functions.

**1.6 TRANSLATOR**

A translator is a program that takes as input a program written in one language and produces as output a program in another language. Besides program translation, the translator performs another very important role, the error-detection. Any violation of the HLL specification would be detected and reported to the programmers. Important roles of translators are:

- 1 Translating the hll program input into an equivalent ml program.
- 2 Providing diagnostic messages wherever the programmer violates specification of the hll.

**1.7 TYPE OF TRANSLATORS:-**

INTERPRETOR  
 COMPILER  
 PREPROSESSOR

## 1.9 STRUCTURE OF THE COMPILER DESIGN

**Phases of a compiler:** A compiler operates in phases. A phase is a logically interrelated operation that takes source program in one representation and produces output in another representation. The phases of a compiler are shown in below There are two phases of

compilation.

- a. Analysis (Machine Independent/Language Dependent)
  - b. Synthesis(Machine Dependent/Language independent)
- Compilation process is partitioned into

### PHASES OF A COMPILER

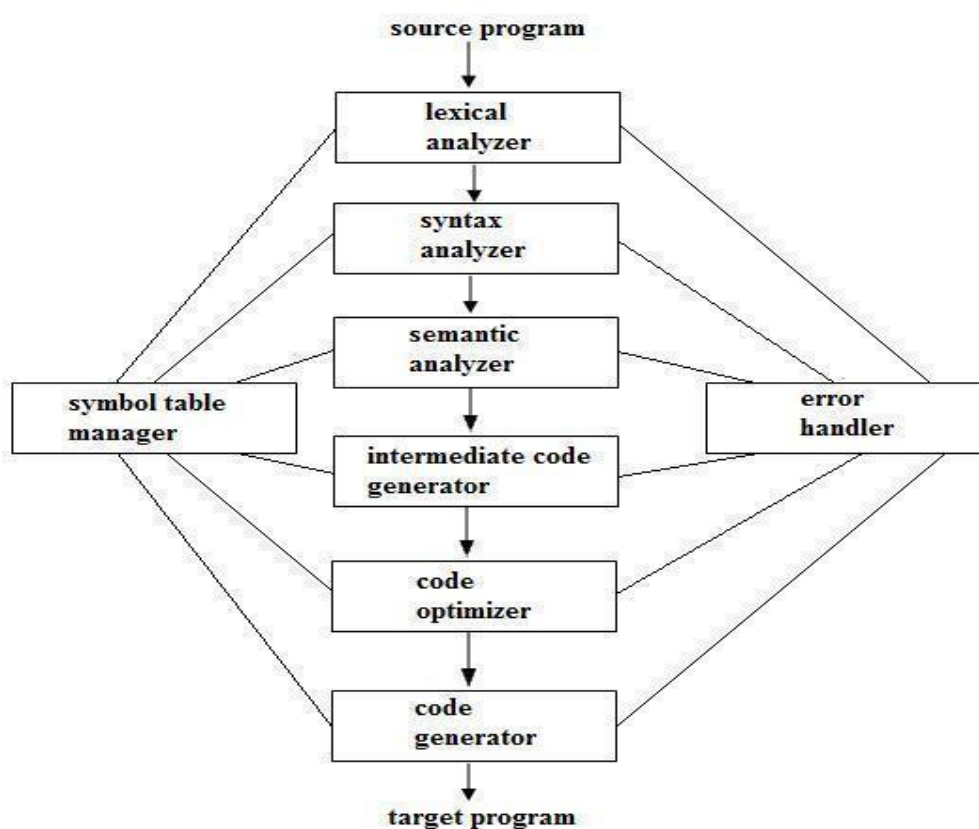


Fig 1.5 Phases of a compiler

No-of-sub processes called ‘**phases**’.

#### **Lexical Analysis:-**

LA or Scanners reads the source program one character at a time, carving the source program into a sequence of atomic units called **tokens**.

#### **Syntax Analysis:-**

The second stage of translation is called Syntax analysis or parsing. In this phase expressions, statements, declarations etc... are identified by using the results of lexical analysis. Syntax analysis is aided by using techniques based on formal grammar of the programming language.

**Intermediate Code Generations:-**

An intermediate representation of the final machine language code is produced. This phase bridges the analysis and synthesis phases of translation.

**Code Optimization :-**

This is optional phase described to improve the intermediate code so that the output runs faster and takes less space.

**Code Generation:-**

The last phase of translation is code generation. A number of optimizations to **reduce the length of machine language program** are carried out during this phase. The output of the code generator is the machine language program of the specified computer.

**Table Management (or) Book-keeping:-**

This is the portion to **keep the names** used by the program and records essential information about each. The data structure used to record this information called a „Symbol Table“.

**Error Handlers:-**

It is invoked when a flaw error in the source program is detected.

The output of LA is a stream of tokens, which is passed to the next phase, the syntax analyzer or parser. The SA groups the tokens together into syntactic structure called as **expression**. Expression may further be combined to form statements. The syntactic structure can be regarded as a tree whose leaves are the token called as parse trees.

**The parser has two functions.** It checks if the tokens from lexical analyzer, occur in pattern that are permitted by the specification for the source language. It also imposes on tokens a tree-like structure that is used by the sub-subsequent phases of the compiler.

**Example**, if a program contains the expression **A+/B** after lexical analysis this expression might appear to the syntax analyzer as the token sequence **id+/id**. On seeing the /, the syntax analyzer should detect an error situation, because the presence of these two adjacent binary operators violates the formulations rule of an expression.

Syntax analysis is to make explicit the hierarchical structure of the incoming token stream by **identifying which parts of the token stream should be grouped**.

**Example**, (A/B\*C has two possible interpretations.)

- 1, divide A by B and then multiply by C or
- 2, multiply B by C and then use the result to divide A.

each of these two interpretations can be represented in terms of a parse tree.

**Intermediate Code Generation:-**

The intermediate code generation uses the structure produced by the syntax analyzer to create a stream of simple instructions. Many styles of intermediate code are possible. One common style uses instruction with one operator and a small number of operands.

The output of the syntax analyzer is some representation of a parse tree. the intermediate code generation phase transforms this parse tree into an intermediate language representation of the source program.

## Code Optimization

This is optional phase described to improve the intermediate code so that the output runs faster and takes less space. Its output is another intermediate code program that does the some job as the original, but in a way that saves time and / or spaces.

### 1, Local Optimization:-

There are local transformations that can be applied to a program to make an improvement. For example,

```
If A > B goto L2
      Goto L3
```

**L2 :**

This can be replaced by a single statement

```
If A < B goto L3
```

Another important local optimization is the elimination of common sub-expressions

```
A := B + C + D
E := B + C + F
```

Might be evaluated as

```
T1 := B + C
```

```
A := T1 + D
```

```
E := T1 + F
```

Take this advantage of the common sub-expressions **B + C**.

### 2, Loop Optimization:-

Another important source of optimization concerns about **increasing the speed of loops**. A typical loop improvement is to move a computation that produces the same result each time around the loop to a point, in the program just before the loop is entered.

## Code generator :-

Cg produces the object code by deciding on the memory locations for data, selecting code to access each datum and selecting the registers in which each computation is to be done. Many computers have only a few high speed registers in which computations can be performed quickly. A good code generator would attempt to utilize registers as efficiently as possible.

## Table Management OR Book-keeping :-

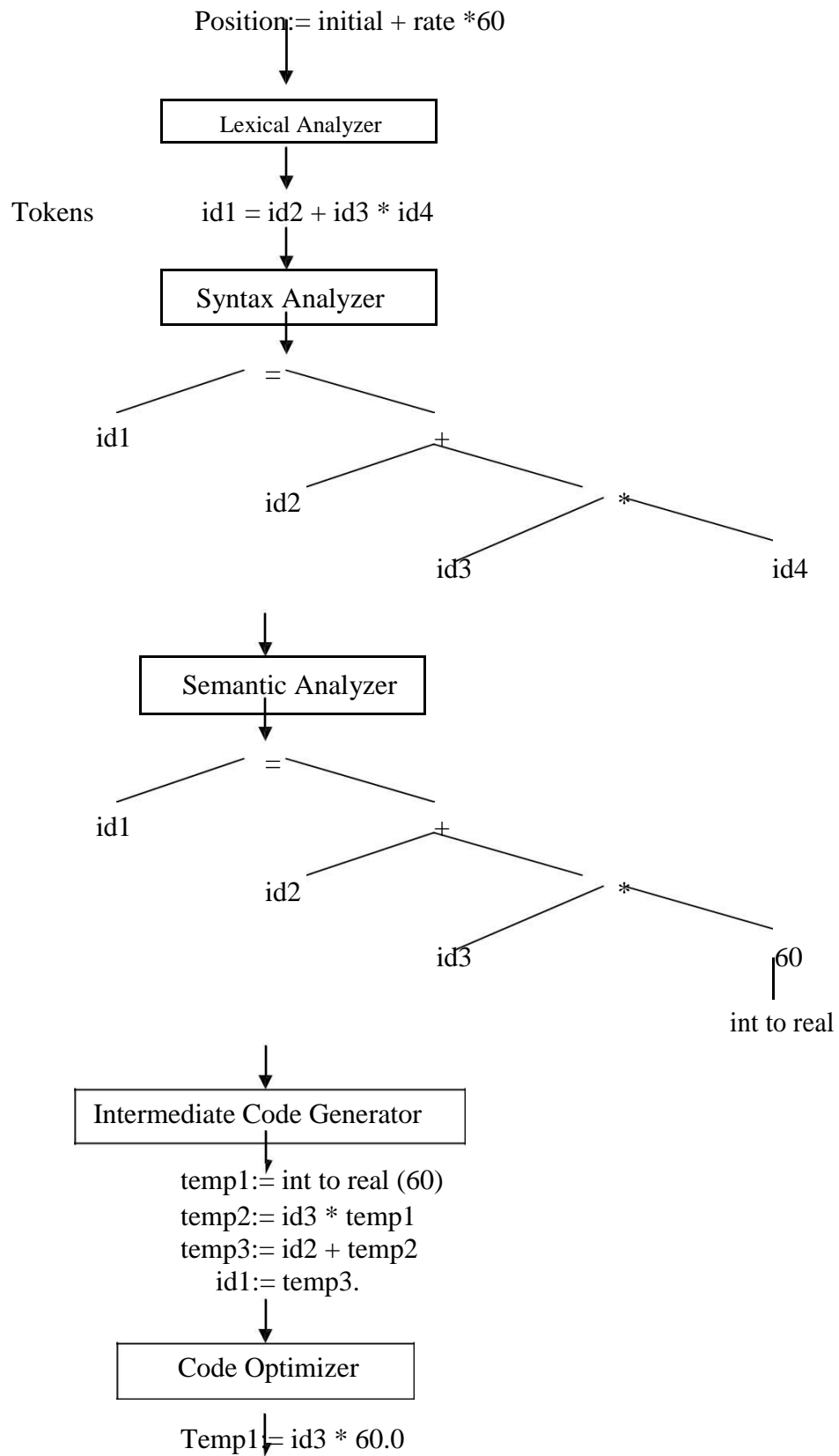
A compiler needs to collect information about all the data objects that appear in the source program. The information about data objects is collected by the early phases of the compiler-lexical and syntactic analyzers. The data structure used to record this information is called as Symbol Table.

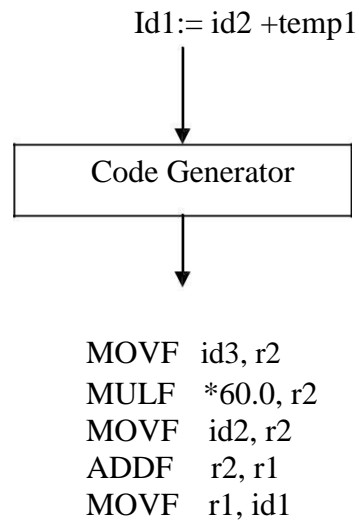
## Error Handling :-

One of the most important functions of a compiler is the detection and reporting of errors in the source program. The error message should allow the programmer to determine exactly where the errors have occurred. Errors may occur in all or the phases of a compiler.

Whenever a phase of the compiler discovers an error, it must report the error to the error handler, which issues an appropriate diagnostic msg. Both of the table-management and error-Handling routines interact with all phases of the compiler.

Example:





### 1.10 TOKEN

LA reads the source program one character at a time, carving the source program into a sequence of automatic units called „Tokens“.

- 1, Type of the token.
- 2, Value of the token.

Type : variable, operator, keyword, constant

Value : N1ame of variable, current variable (or) pointer to symbol table.

**If the symbols given in the standard format the LA accepts and produces token as output.** Each token is a sub-string of the program that is to be treated as a single unit. Token are two types.

- 1, Specific strings such as IF (or) semicolon.
- 2, Classes of string such as identifiers, label, constants.