Tiny Programming Language Compiler

Compiler for the TINY Programming Language described in Language Description.

TINY Programming Language

> A program in TINY consists of a set of functions (any number of functions and ends with a main function), each function is a sequence of statements including (declaration, assignment, write, read, if, repeat, function, comment, …) each statement consists of (number, string, identifier, expression, condition, …).

Language Description

- Number: any sequence of digits and maybe floats (e.g. 123 | 554 | 205 | 0.23 | …)
- String: starts with double quotes followed by any combination of characters and digits then ends with double quotes (e.g. “Hello” | “2nd + 3rd” | …)
- Reserved_Keywords: int | float | string | read | write | repeat | until | if | elseif | else | then | return | endl
- Comment_Statement: starts with /* followed by any combination of characters and digits then ends with *_/ (e.g. /_this is a comment*/ | …)
- Identifiers: starts with letter then any combination of letters and digits. (e.g. x | val | counter1 | str1 | s2 | …)
- Function_Call: starts with Identifier then left bracket “(“ followed by zero or more Identifier separated by “,” and ends with right bracket “)”. (e.g. sum(a,b) | factorial(c) | rand() | …)
- Term: maybe Number or Identifier or function call. (e.g. 441 | var1 | sum(a,b) | …)
- Arithmetic_Operator: any arithmetic operation (+ | - | * | /)
- Equation: starts with Term or left bracket “(“ followed by one or more Arithmetic_Operator and Term. with right bracket “)” for each left bracket (e.g. 3+5 | x +1 | (2+3)*10 | …)
- Expression: may be a String, Term or Equation (e.g. “hi” | counter | 404 | 2+3 | …)
- Assignment_Statement: starts with Identifier then assignment operator “:=” followed by Expression (e.g. x := 1 | y:= 2+3 | z := 2+3*2+(2-3)/1 | …)
- Datatype: set of reserved keywords (int, float, string)
- Declaration_Statement: starts with Datatype then one or more identifiers (assignment statement might exist) separated by coma and ends with semi-colon. (e.g. int x; | float x1,x2:=1,xy:=3; | …)
- Write_Statement: starts with reserved keyword “write” followed by an Expression or endl and ends with semi-colon (e.g. write x; | write 5; | write 3+5; | write “Hello World”; | …)
- Read_Statement: starts with reserved keyword “read” followed by an Identifier and ends with semi-colon (e.g. read x; | …)

- Return_Statement: starts with reserved keyword “return” followed by Expression then ends with semi-colon (e.g. return a+b; | return 5; | return “Hi”; | …)
- Condition_Operator: (less than “<” | greater than “>” | is equal “=” | not equal “<>”)
- Condition: starts with Identifier then Condition_Operator then Term (e.g. z1 <> 10)
- Boolean_Operator: AND operator “&&” and OR operator “||”
- Condition_Statement: starts with Condition followed by zero or more Boolean_Operator and Condition (e.g. x < 5 && x > 1)
- If_Statement: starts with reserved keyword “if” followed by Condition_Statement then reserved keyword “then” followed by set of Statements (i.e. any type of statement: write, read, assignment, declaration, …) then Else_If_Statment or Else_Statment or reserved keyword “end”
- Else_If_Statement: same as if statement but starts with reserved keyword “elseif”
- Else_Statement: starts with reserved keyword “else” followed by a set of Statements then ends with reserved keyword “end”
- Repeat_Statement: starts with reserved keyword “repeat” followed by a set of Statements then reserved keyword “until” followed by Condition_Statement
- FunctionName: same as Identifier
- Parameter: starts with Datatype followed by Identifier (e.g. int x)
- Function_Declaration: starts with Datatype followed by FunctionName followed by “(“ then zero or more Parameter separated by “,” then “)” (e.g. int sum(int a, int b) | …)
- Function_Body: starts with curly bracket “{” then a set of Statements followed by Return_Statement and ends with “}”
- Function_Statement: starts with Function_Declaration followed by Function_Body
- Main_Function: starts with Datatype followed by reserved keyword “main” then “()” followed by Function_Body
- Program: has zero or more Function_Statement followed by Main_Function

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TINY Language Regular Expressions

digit ::= 0|1|2|3|4……|9

letter ::= [a-z][A-Z]

Number ::= digit.*?digit*

String ::= "(letter|digit)*"

Reserved_Keywords ::= int | float | string | read | write |
repeat | until | if | elseif | else | then | return | endl

Comment ::= /*String*\/

Identifier ::= letter (letter | digit)*

Term ::= Number | Identifier | Function_Call

Arithmatic_Operator ::= + | - | * | /

Equation ::= (Term (Arithmatic_Operator (Equation | Term))+) | ((Term Arithmatic_Operator (Equation | Term))) (Arithmatic_Operator (Term | Equation))*

Expression ::= String | Term | Equation

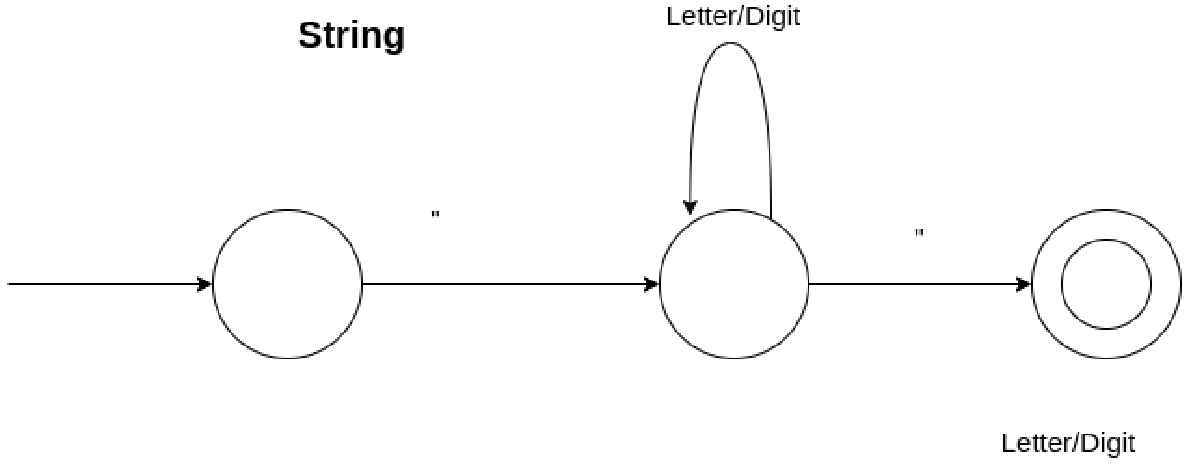
Datatype ::= int | float | string

Condition_Operator ::= < | > | = | <>

Boolean_Operator ::= && | ||

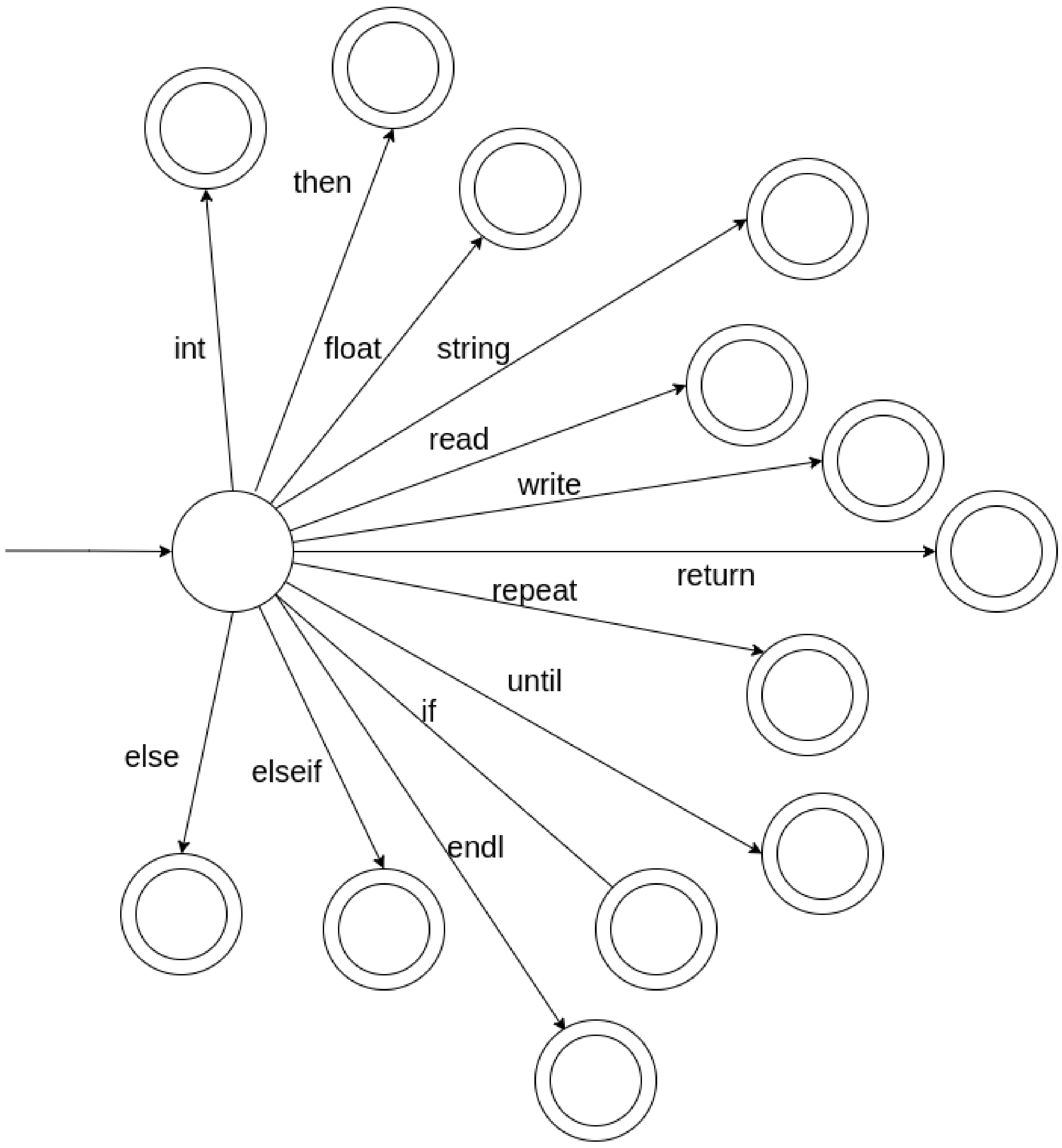
TINY Language Deterministic Finite Automaton DFA

- Strings



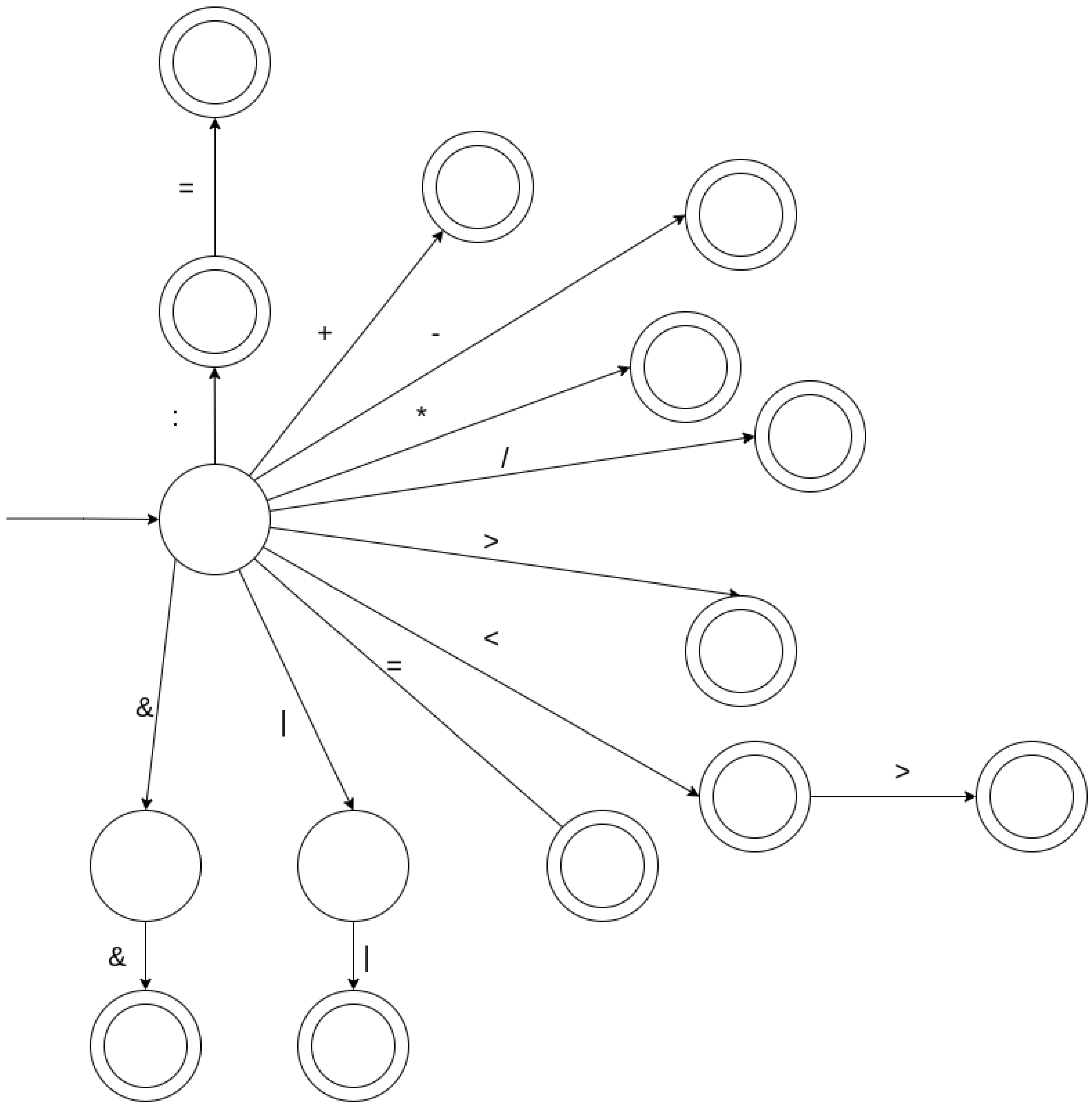
- Reserved Words

Reserved Words



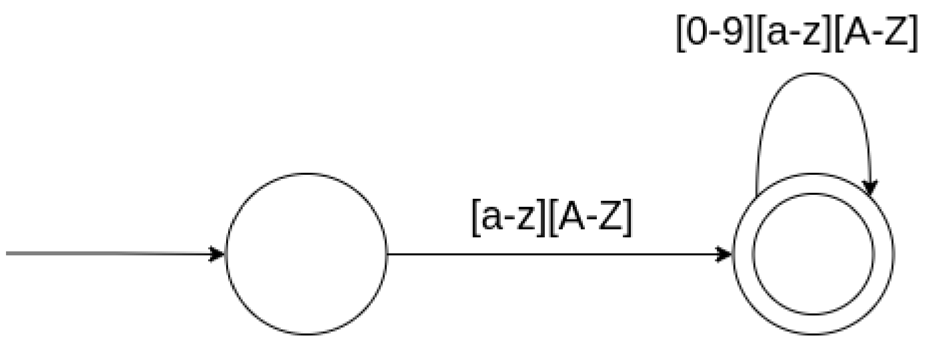
- Operators

Operators

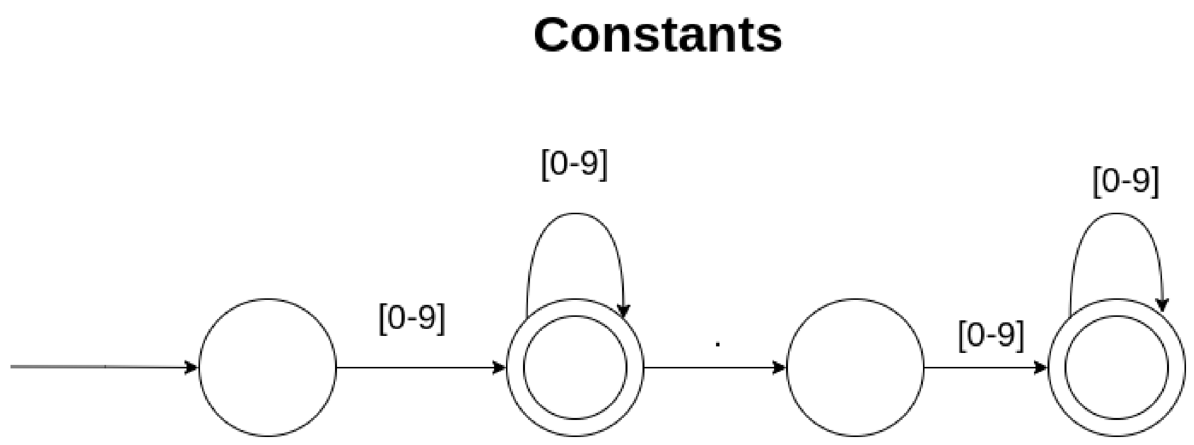


- Identifiers

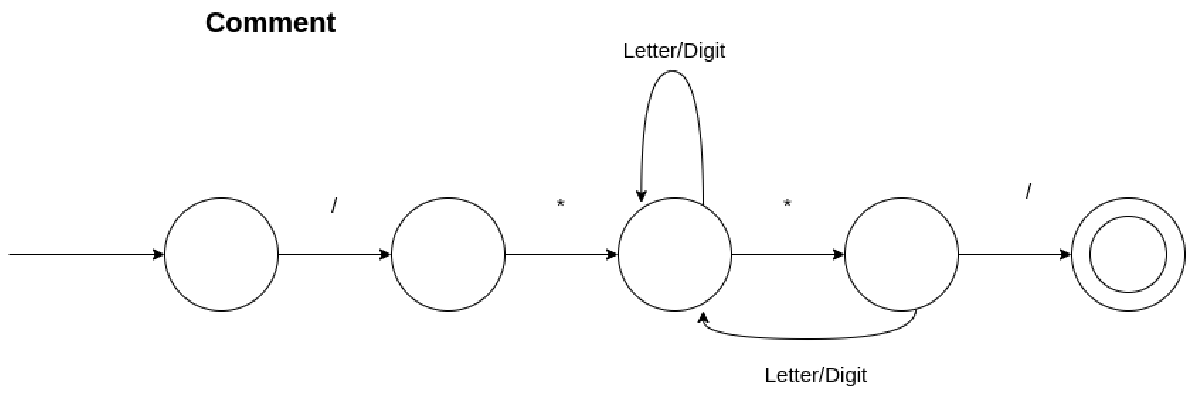
Identifiers



- Constants



- Comments



TINY Language Context Free Grammar CFG

- Program → Program_Function_Statement Main_Function
- Main_Function → Data_Type main ( ) Function_Body
- Program_Function_Statement → Function_Statement Program_Function_Statement | ε
  - Function_Statement → Function_Declaration Function_Body
  - Function_Declaration → Data_Type Function_Name (Function_Parameters)
  - Datatype → int | float | string
  - Function_Name → identifier
  - Function_Parameters → Data_Type Identifier More_Parameters | ε
  - More_Function_Parameters → , Data_Type Identifier More_Function_Parameters | ε
  - Function_Body → { Statements Return_Statement }
- Statements → State Statements | ε
  - Statement → Function_Call | Assignment_Statement | Declaration_Statement | Write_Statement | Read_Statement | If_Statement | Repeat_Statement
- Function_Call → Identifier (Parameters) ;
  - Parameters → Expression More_Parameters | ε
  - More_Parameters → , Expression More_Parameters | ε
- Assignment_Statement → Identifier := Expression
- Expression → String | Term | Equation
- Term → number | identifier | Function_Call
- Equation → Term Operator_Equation | (Equation) Operator_Equation
- Operator_Equation → Arthematic_Operator Equation Operator_Equation | ε

    - Arthematic_Operator → plus | minus | divide | multiply
- Declaration_Statement → Data_Type Identifier Declare_Rest1 Declare_Rest2 ;
    - Declare_Rest1 → , identifier Declare_Rest1 | ε
    - Declare_Rest2 → Assignment_Statement | ε
- Write_Statement → write Write_Rest ;
    - Write_Rest → Expression | endl
- Read_Statement → read identifier ;
- If_Statement → if Condition_Statement then Statements Other_Conditions
    - Condition_statement → Condition
    - Condition → identifier Condition_Operator Term More_Conditions
    - Condition_Operator → less_than | greater_than | not_equal | equal
    - More_Conditions → and Condition | or Condition| ε
    - Other_Conditions → Else_if_Statement | Else_statement | end
- Else_if_Statement → elseif Condition_statement then Statements Other_Conditions
- Else_statement → else Statements end
- Repeat_Statement → repeat Statements untill Condition_statement
- Return_Statement → return Expression ;

TINY Code Samples

Sample program includes all 30 rules

```
int sum(int a, int b)
{
    return a + b;
}
int main()
{
    int val, counter;
    read val;

    counter := 0;

    repeat

        val := val - 1;
        write "Iteration number [";
        write counter;
        write "] the value of x = ";
        write val;
        write endl;
        counter := counter+1;

    until val = 1

    write endl;

    string s := "number of Iterations = ";
    write s;

    counter := counter-1;
    write counter;

    /* complicated equation */
    float z1 := 3*2*(2+1)/2-5.3;
    z1 := z1 + sum(a,y);

    if  z1 > 5 || z1 < counter && z1 = 1
    then
        write z1;
    elseif z1 < 5
    then
        z1 := 5;
    else
        z1 := counter;
    end

    return 0;
}
```

Sample program in Tiny language – computes factorial

```
/* Sample program in Tiny language – computes factorial*/
int main()
{
    int x;
    read x; /*input an integer*/
    if x > 0 /*don’t compute if x <= 0 */
    then
        int fact := 1;

        repeat
            fact := fact * x;
            x := x – 1;
        until x = 0

        write fact; /*output factorial of x*/
    end
    return 0;
}
```