Stint
Language Reference Manual

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1. Introduction

The programming language Stint is a text-processing language, which contains a useful collection of built-in string manipulation functions. Stint provides efficient solutions for manipulations and conversions between the most common-used data types: string and int. When processing textual data and test file, Stint shows its advantages in several aspects:

✓ Intelligently distinguish between string and int.
✓ Provide a simple and direct way to do mathematic operations for numbers in string without extracting them and transferring data type.
✓ Define more effective text-manipulation via operators. Meanwhile, maintain traditional string features and functions.
✓ Make input and output functions more convenient.

2. Lexical Conventions

2.1 Identifiers
An identifier can only include 26 alphabets in lower or upper case (a-z, A-Z), digits (1-9), and underline (‘_’); the first character must be alphabets in lower case.

2.2 Comments
Double-slash (“//”) is the only comment sign, and it only works for single line.

//This is a comment
open “data.txt”; // can append to a statement

2.3 End-of-Statement
Semicolon (“;”) is used to indicate the end of one statement.

2.4 Keywords
The following identifiers are reserved as keywords/special function and may not be used otherwise:

```
int  string  boolean
if   else    return
while open close
false true std
eof  break void
```

2.5 Constants
In Stint, there are 3 types of constants: integer constant, string constant and boolean constant.

2.5.1 Integer Constants
An integer constant consists of a sequence of numbers without a decimal point.

```
int n = 100; // 100 is an integer constant
```

2.5.2 String Constants
A string constant is enclosed in double quote marks (“ “ ”).

```
// below are examples of string constants
string str = “This is a string”;
string title = “Product Name\tPrince\t\n”;
```
Stint also contains the following escape sequence as constants in order to represent some special characters such as new line, tab and backslash:

<table>
<thead>
<tr>
<th>Character Name</th>
<th>Escape Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newline</td>
<td>\n</td>
</tr>
<tr>
<td>Horizontal tab</td>
<td>\t</td>
</tr>
<tr>
<td>Double quotation marks</td>
<td>&quot;</td>
</tr>
<tr>
<td>Backslash</td>
<td>\</td>
</tr>
</tbody>
</table>

2.5.3 Boolean Constants
The reserved boolean constants are true and false.

```java
boolean a = true;
boolean b = false;
```

3. Data Type & Conversion

3.1 Data Types
There are three types of data in Stint – integer, string and boolean.

3.1.1 Integer
In Stint, the only supported integer type is int, which represents a sequence of digits. Integers are signed and with fixed size of 32 bits.

3.1.2 String
The string in Stint is defined as a sequence of ASCII characters enclosed in double quotes, e.g. “abc”. A string can have potentially unlimited length as long as the computing resource, e.g. memory, allows.

A string in Stint is a dynamic structure, which keeps a list of sub-strings or integers. Stint predefined some special operators in order to modify or search the sub-strings dynamically, e.g. “.< >” (extracting), “|” (splitting), “#” (highlighting), etc. (See details in Section 4.3)

3.1.3 Boolean
A boolean type can take either true or false as its value, which is used for condition determination.

Some main features of the three data types are illustrated in the table below.

<table>
<thead>
<tr>
<th>Primitive Types</th>
<th>Length</th>
<th>Range</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>int</td>
<td>32 bits</td>
<td>-2147483648 to 2147483647</td>
<td>0</td>
</tr>
<tr>
<td>string</td>
<td>&gt;= 8 bits</td>
<td>Any permutation of ASCII characters</td>
<td>”” (empty)</td>
</tr>
<tr>
<td>boolean</td>
<td>8 bits</td>
<td>true or false</td>
<td>false</td>
</tr>
</tbody>
</table>

3.2 Type Conversion
In Stint, there are two types of conversions, i.e. from integer to string and from boolean to string, both of which are done implicitly. No explicit conversion is allowed. All other invalid type conversions, e.g. from string to integer or from integer to boolean, will lead to a compilation error.
3.2.1 Integer-to-String
An integer can be converted to a string implicitly, but not vice versa. After casting, the new variable name cannot be the same as the original one; otherwise there will be a compilation error.

```java
int num = 12;
string snum = num;  // snum = "12" after conversion.
string snum = "12";
int num = snum;     // this assignment is invalid
```

Besides assigning, the implicit conversion can be done automatically as well when an integer is used in a string operation.

```java
int num = 12;
string snum = "abc" + num;  // snum = "abc12"
```

Even though a string cannot be converted into an integer directly, this conversion can be done by using a special operator defined in Stint, i.e. “.<<”. (See details in Section 4.3)

3.2.2 Boolean-to-String
A boolean value can be converted to a string, but not the other way around.

```java
boolean b = true;
string s = b;       // s = "true" when b is true
```

Trying to convert an integer or a string to a boolean will lead to a compilation error though it seems make sense.

```java
int n = 1;
boolean b = n;     // Compilation error.
```

### 4. Expressions & Operators

4.1 General Expression

4.1.1 Assignment: `destin = source`
Copy and assign the value of `source` to `destin`.

4.1.2 Parenthesis: `(expression)`
Expression in parenthesis will be assigned a higher precedence than those isn’t in.

4.1.3 Equality: `expr1 == expr2` `expr1 != expr2`
Check whether `expr1` and `expr2` have the same value.

4.1.4 Input Stream: `>> source expr`

4.1.5 Output Stream: `<< destin expr`
The subject of stream is indicated by `source/destin` that can be file name or std for standard I/O. Read a whole line from `source` to `expr` or write the content of `expr` to `destin`.

4.1.6 Function Call: `func-name (arg1, arg2, ...)`

4.2 Numeric Operator

4.2.1 Arithmetic Operator: `expr1 + expr2` `expr1 - expr2`
`expr1 * expr2` `expr1 / expr2`
Basic arithmetic operation for integer: add, subtraction, multiplication, and division.
4.2.2 Relational Operator: \( expr1 > expr2 \quad expr1 >= expr2 \)
\( expr1 < expr2 \quad expr1 <= expr2 \)

Compare expr1 and expr2 with above relations. Return a Boolean value.

4.3 String Operator

4.3.1 Position Indicator: \( @ \) position
Indicate specific position where the operation will be done. Use with string operator “+” and “-” (See examples in 4.3.2/4.3.3).

4.3.2 Append (Insert): \( expr1 + expr2 \quad expr1 + expr2 @ pos \)
Append expr2 to the end of expr1. When using “@”, append expr2 after the character indicated by pos of expr1 (use as insert).
Use a number smaller than the lowest index (negative number) or larger than the highest index will put expr2 at the head/tail of expr1.

\[
\begin{align*}
str &= \text{“ab”} + \text{“c”}; \quad // \text{str = “abc”} \\
str &= \text{“ab”} + \text{“c”} @ 0; \quad // \text{str = “acb”}
\end{align*}
\]

4.3.3 Delete: \( expr1 – expr2 \quad expr1 – expr2 @ pos \)
Delete the first expr2 in expr1. When using “@”, delete the first expr2 occurring after the character indicated by pos in expr1 (not include this character). The operator will give expr1 back if no matching of expr2 found in expr1.

\[
\begin{align*}
str &= \text{“cabc”} – \text{“c”}; \quad // \text{str = “abc”} \\
str &= \text{“cabc”} – \text{“c”} @ 1; \quad // \text{str = “cab”}
\end{align*}
\]

4.3.4 Sub-string Extractor: \[ index \]
\[ index, length \]
Get the sub-string of a single character at index, or starting from index of length.

\[
\begin{align*}
str &= \text{“abcd”}; \text{str} = \text{str}[0]; \quad // \text{str = “a”} \\
str &= \text{“abcd”}; \text{str} = \text{str}[1, 2]; \quad // \text{str = “bc”}
\end{align*}
\]

4.3.5 Integer Set Extractor: \:< \text{index}>
Get the set of integer with index.

\[
\begin{align*}
\text{string} \text{ str} &= \text{“a12b56c”}; \\
\text{int} \text{ integer} &= \text{str.<0>}; \quad // \text{integer = 12}
\end{align*}
\]

4.3.6 String Set Extractor: \:< \text{index}>
Get the set of string with index. Set of string may vary with user’s setting (see detail in 4.37/4.38).

4.3.7 String Splitter: \text{string} | \text{sep}
Change the set of string as sub-strings separated by sep. Return the amount of sets having been split.

\[
\begin{align*}
\text{string} \text{ str} &= \text{“this is a sentence in string”}; \\
\text{int} \text{ num} &= \text{str | “ “}; \quad // \text{num = 6} \\
\text{string} \text{ temp} &= \text{str<0>}; \quad // \text{temp = “this”} \\
\text{temp} &= \text{str<4>}; \quad // \text{temp = “sentence”}
\end{align*}
\]
4.3.8 String Finder: \( \text{string} \# \text{ substr} \)
Change the set of string as all sub-strings equaling substr. Return the number of substr in string.

```java
string str = "this is his thesis";
int num = str "is"; // num = 4
str<2> = "er"; // str = "this is her thesis"
```

4.3.9 String Remover: \(~ \text{ expression} \)
Remove expression from the string it belongs to.

```java
string str = "a12b56c";
~str.<0>; // str = "ab56c"
~str[0, 3]; // str = "6c"
```

4.4 Boolean Operator
4.4.1 And: \( \text{expr1} \&\& \text{expr2} \)
4.4.2 Or: \( \text{expr1} || \text{expr2} \)
4.4.3 Not: \( ! \text{ expression} \)

4.5 Precedence
The precedence of above operators is typically in the following order from high to low. All three boolean operators are in the same order, so they are not included in the table below.

<table>
<thead>
<tr>
<th>Precedence</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (highest)</td>
<td>( )</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>[ ], &lt;&gt;,,&lt;&gt;</td>
</tr>
<tr>
<td>4</td>
<td>*, /</td>
</tr>
<tr>
<td>5</td>
<td>+,-</td>
</tr>
<tr>
<td>6</td>
<td>&gt;, &gt;=, &lt;, &lt;=, ==, !=</td>
</tr>
<tr>
<td>7 (lowest)</td>
<td>=, &lt;&lt;,&gt;&gt;</td>
</tr>
</tbody>
</table>

5. Declarations
5.1 Variable Declaration
Variables must be declared before they are used in the program. A variable declaration has the following form:

```java
var_type var_name;
```

The var_type can be int, boolean or string. The var_name can be any valid identifier. If a variable is declared, in the following assignment, value assigned to the variable must have exactly the same type as declared. Otherwise, it’s a syntax error. A single semicolon must be followed by the declaration.

Variables can also be initialized during the declaration. A declaration with initialization has the following form:

```java
var_type var_name = expression;
```
The expression must have exactly the same type as var_type. Otherwise, it’s a syntax error.

5.2 Function Declaration
A function declaration has the following form:

\[ \text{return-type function-name (type parameter1, type parameter2, \ldots)} \]

The detail of this part is talk in section 7.1.

6. Statements

6.1 Expression Statement
An expression statement is composed of primary expressions separated by a single semicolon at the end of each expression.

6.2 If Statement
If statement consists of keywords if and else. It has the following two varieties:

\[
\text{if ( expression ) }
\begin{cases}
\text{statement} \\
\text{else}
\end{cases}
\text{if ( expression ) }
\begin{cases}
\text{statement1} \\
\text{else}
\end{cases}
\]

The expression must be of boolean. Statements must be surrounded by open and closed curly bracket. In the first case, if the expression is evaluated to true, then statement is executed. Otherwise statements after the if statement is executed. In the second case, if the expression is evaluated to true, then statement1 is executed, otherwise statement2 is executed.

6.3 While Statement
While statements consists of keyword while and it allows a statement to be executed for any number of times. It has the following format:

\[
\text{while ( expression ) }
\begin{cases}
\text{statement} \\
\end{cases}
\]

The expression must be boolean. Statements must be surrounded by open and closed curly bracket. The expression is evaluated before the execution of the statement and statement will be executed until the expression is evaluated to false.

6.4 Break Statement
Break statement consists of keyword break. It’s used to jump out of the while loop. It’s followed by a single semicolon. The following is an example of using break statement:

\[
\text{while ( true ) }
\begin{cases}
\text{break;}
\end{cases}
\]
6.5 Open Statement
Open statement consists of keyword **open**. It’s used to open a file. It takes a string as the file name. It has the following format:

```
open filename
```

6.5 Close Statement
Close statement consists of keyword **close**. It’s used to close a file. It takes a string as the file name. It has the following format:

```
close filename
```

6.7 Return Statement
Return statement consists of keyword **return**. A function must have a return statement to return its value to its caller. It can return an expression that is evaluated to type **int**, **bool** or **string**, or it can return nothing when the function uses **void** as its return type.

```
return expression;
return;
```

The return statement must be followed by a single semicolon.

7. Functions

7.1 Function Definition
A function in Stint is typically the same as a function in C or a method in Java. It takes a series of parameters and returns a value after execution of the code within the function.

The signature of a function is as follows:

```
return-type function-name ( type parameter1, type parameter2 .... )
{
    statements
    ......     
    return value;
}
```

All functions have global scope within the program it was create. And the names of functions are unique among all the functions and variables.

The return type must be one among **void**, **int**, **string**, and **boolean**. We suggest to use **boolean** as the return type to replace **void, true** indicating execution success, otherwise **false**.

The body of a function must be included in a “ { } ” just like C and Java do. The variables defined within the body of a function have local scope. That’s to say, all variables have the same local scope. We don’t recommend creating variables in the body of a function except for temporary variables. If a function with variable definitions within its body gets called multiple times, these variables will be reinitiated.

All program will start from **boolean main()** function. Return **true** means program terminates successfully.
7.2 Build-in Functions

- **string** `ReadFile(string filename)`
  This function is used to get a line of content from a file certain opened. A pointer variable will add itself every time after this function is executed. If it has reached the end of a file, the return value became **eof**.

- **boolean** `PrintFile(string s, string filename)`
  This function is used to print String s to the end of a text file. It can be a file that hasn’t been opened yet, the function will automatically do the rest of work.

- **string** `toUpperCase(string s)`
  The return string will be the same as input screen but in all upper case.

- **string** `toLowerCase(string s)`
  Similar as `toUpperCase()`, this one return string s with all characters in lower case.

- **boolean** `replaceAll(string dest, string s)`
  This function is used to replace all the matched sections in dest to s.

8. Scope

In **Stint**, the scope is defined as the region within a program in which a certain identifier/function can be accessed.

All identifiers are of local scope, i.e. they can only be accessed within the function body in which it is declared. The local scope is confined by the nearest pair of curly brackets. Identifiers/variables cannot be accessed until declared.

Functions are of global scope from the position they are defined till the end of code. Function calls are possible as long as the target function has been defined before the current position.