

SPSIL
Language Specification
Version 1.0

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1 Introduction

SPSIL or *System Programmer's Simple Integer Language* is an untyped programming language designed for implementation of an operating system on ESIM (*Extended Simple Integer Machine*) architecture. The language is minimilistic and consists of only basic constructs required for the implementation. Programming using SPSIL requires a basic understanding of the underlying ESIM architecture and operating system concepts.

2 Lexical Elements

2.1 Comments and White Spaces

SPSIL allows only line comments. Line comments start with the character sequence `//` and stop at the end of the line. White spaces in the program including tabs, newline and horizontal spaces are ignored.

2.2 Keywords

The following are the reserved words in SPSIL and it cannot be used as names of constans.

| | | | | |
|---------------------|-----------------------|----------------------|--------------------|---------------------|
| <code>alias</code> | <code>else</code> | <code>if</code> | <code>read</code> | <code>while</code> |
| <code>define</code> | <code>endif</code> | <code>ireturn</code> | <code>store</code> | <code>strcmp</code> |
| <code>do</code> | <code>endwhile</code> | <code>load</code> | <code>then</code> | |

2.3 Operators and Delimiters

The following are the operators and delimiters in SPSIL

| | | | | | | | | | |
|-------------------|-------------------|--------------------|--------------------|-----------------|-----------------|----------------|-------------------------|-----------------|----------------|
| <code>(</code> | <code>)</code> | <code>;</code> | <code>[</code> | <code>]</code> | <code>/</code> | <code>*</code> | <code>+</code> | <code>-</code> | <code>%</code> |
| <code>></code> | <code><</code> | <code>>=</code> | <code><=</code> | <code>!=</code> | <code>==</code> | <code>=</code> | <code>&&</code> | <code> </code> | <code>!</code> |

2.4 Registers

SPSIL allow the use of 19 registers for various operations.(R0-R15, BP, SP, IP)

2.5 Identifiers

Identifiers are used for defining names for constants as well as aliasing registers in the register set. Identifiers should start with an alphabet but may

contain both alphabets, digits and/or underscore (_). No other special characters are allowed in identifiers.

2.6 Literals

There are integer literals and string literals in SPSIL. An integer literal is a sequence of digits representing an integer. Negative integers are represented with a negative sign preceding the sequence of digits. Any sequence of characters enclosed within double quotes (") are considered as string literals. However SPSIL restricts string literals to size of atmost 16 characters including the '\0' character which is implicitly appended at the end of a string value.

3 Register Set

SPSIL doesn't allow the use of declared variables. Instead a fixed set of registers is provided. The register set in SPSIL contains 19 registers. There is a direct mapping between the registers to the machine registers in ESIM.

| | |
|--------|---------------------|
| R0-R7 | Program Registers |
| R8-R15 | Kernel Registers |
| BP | Base Pointer |
| SP | Stack Pointer |
| IP | Instruction Pointer |

3.1 Aliasing

Registers in the register can be referred to by using a different name. A name is assigned to a particular register using the **alias** keyword. Each register can be assigned to only one alias at any particular point of time. However, a particular register can be assigned to a different alias at a later point. No two registers can have the same alias name simulatneously.

4 Named Constants

Symbolic names can be assigned to constants using the **define** keyword. Unlike aliasing, two or more symbolic names can be assigned to the same constant.

4.1 Predefined Constants

SPSIL provides a set of predefined named constants. These predefined names can also be reassigned to different constants explicitly by the user. The predefined set of constants are mostly the starting addresses in memory for various OS components..

The predefined set of constants provided in SPSIL are

| Name | Default Value |
|------------|---------------|
| SCRATCHPAD | 256 |
| PAGE_TABLE | 512 |
| MEM_LIST | 576 |
| FILE_TABLE | 640 |
| READY_LIST | 736 |
| PROC_TABLE | 767 |
| FAT | 1024 |
| DISK_LIST | 1536 |
| USER_PROG | 1792 |
| INTERRUPT | 13824 |

5 Addresses

The memory of the machine can be directly accessed. A word in the memory is accessed by specifying the word number within []. A number, a register, or a constant can be used to specify the word number in the memory.

Examples of addressing : [1024], [R9], [FILE_TABLE], [CONSTANT]

6 Expressions

An expression specifies the computation of a value by applying operators and functions to operands. SPSIL supports arithmetic and logical expressions.

6.1 Arithmetic Expressions

Registers, constants, and 2 or more arithmetic operations connected using arithmetic operators are categorized as arithmetic expressions. SPSIL provides five arithmetic operators, viz., +, -, *, / (Integer Division) and % (Modulo operator) through which arithmetic expressions may be combined. Expression syntax and semantics are similar to standard practice in

programming languages and normal rules of precedence, associativity and paranthesization hold.

6.2 Logical Expressions

Logical expressions may be formed by combining arithmetic expressions using relational operators. The relational operators supported by SPSIL are

<, >, <=, >=, ==, !=

Standard meanings apply to these operators. A relational operator will take in two arguments and return 1 if the relation is valid and 0 otherwise. Logical expressions themselves may be combined using logical operators, && (logical and) , || (logical or) and ! (not).

6.3 String Comparison

The only operation that can be performed on strings stored in memory is string comparison. **strcmp** is used to compare two strings whose address is stored in the registers that are given as operands.

e.g. *strcmp(R9,R10);*

7 Addressing

SPSIL allows the use of directly addressing memory words of ESIM. A word in the memory is accessed by specifying the word number within []. An arithmetic expression can be used to specify the word number. This will correspond to the value stored in the given address (word number). An expression can be assigned to an address. But an addressing element cannot be used in an arithmetic expression.

Examples of addressing: [1024], [R9], [R10+R11+128], [FAT] etc.

8 Statements

Statements control the execution of the program. All statements in SPSIL are terminated with a semicolon ;

8.1 Define Statement

Define statement is used to define a symbolic name for a constant. Define statements should be the first block of an SPSIL program. The keyword **define** is used to associate a constant integer value to a name.

***define** constant_name value;*

8.2 Alias Statement

An **alias** is used to refer to any register in the register set using a different name. **Alias** statements can be used anywhere in the program. Only the latest alias for any particular register can be used.

***alias** alias_name register_name*

8.3 Assignment Statement

The SPSIL assignment statement assigns the value of an expression to a register or a memory address. **textbf=** is known as the assignment operator. The operand on the right hand side of the operator is assigned to the left hand side. The general syntax is as follows

Register / [Address] = Expression / [Address]

8.4 If Statement

If statements specify the conditional execution of two branches according to the value of a logical expression. If the expression evaluates to 1, the **if** branch is executed, otherwise the **else** branch is executed if it exists. The **else** part is optional. The general syntax is as follows

***if** (logical expression) **then**
 statements;
else
 statements;
endif;*

8.5 While Statement

While statement iteratively executes a set of statements based on the value of a logical expressions. The statements are iteratively executed as long as the logical expression evaluates to 1.

```
while (logical expression) do  
    statements;  
endwhile;
```

8.6 ireturn Statement

ireturn statement is used to pass control from kernel mode to user mode. The **ireturn** is used at the end of an interrupt code.

```
ireturn;
```

8.7 Read/Write Statements

The standard input and output statements in SPSIL are **read** and **write** respectively. The read statement reads an integer value into any register in the register set. The write statement outputs an integer, a string literal, the value inside a register, or a constant.

```
read variable_name;  
write expression;
```