STRUIXLANG

1.0 Release Candidate 1

A stack-based Programming language implemented in Python.

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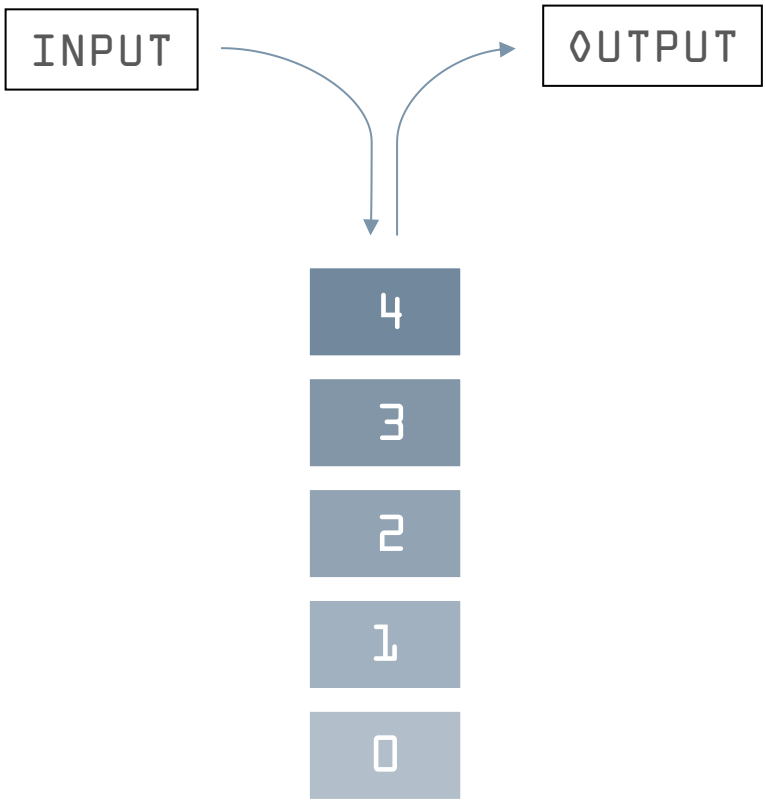
About struixLang

A stack-based programming language implemented in Python3.

struixLang implements a **stack**, which is a list of objects which the program operates on.

Also, a **dictionary** is present, containing **words** *(functions/subroutines)* which may be executed in a program.

Several primitive *(read: built-in)* words are pre-defined and mechanisms to define new *user-defined* words within struixLang itself are in place.



Stack = Struix

Based on Felix Pleşoianu's scratch-lang.

Use Cases

The most potential use case for struixLang is as an **embedded domain specific scripting language**.

Being so compact, struixLang can be easily adapted to the specifics of the host language and of the intended task. Not to mention its inherent simplicity should ensure acceptable performance even on top of another interpreted language (like this implementation).

Usage

To run the default shell for struixLang, run the `repl.py` file under Python 3.

The interpreter can also be imported from within other Python programs.

```
import struixTerp
```

However, the interpreter by itself does not form the language. To import the primitives do:

```
import struixPrimitives
```

Then create a new instance of the interpreter:

```
terp = struixTerp.Terp()
```

Add the primitives to it:

```
struixPrimitives.AddWords(terp)
```

And give the interpreter a string of struixLang code to run:

```
terp.run("""
         var a
         a 10 store
         "Hello, World!"
         a fetch
         [ print ] 2 times
         """)
```

However, some potentially dangerous operations are enabled only on passing `terp.ENABLE_UNSAFE_OPERATIONS` to `struixPrimitives.AddWords()`:

```
struixPrimitives.AddWords(terp, terp.ENABLE_UNSAFE_OPERATIONS)
```

Data Model

struixLang supports the following data types:

- Integers,
- Floats,
- Strings,
- Boolean,
- Lists, and
- Words.

However, the current implementation can utilize words which put or use values of any type supported in Python 3.

Also note that as struixLang is a *Homoiconic Language*, it can treat code as data and data as code, hence **words** are included in the list above.

List of Primitive Words in this Implementation

1. PRINT – Pops and displays the last item put in the stack
2. PSTACK – Displays all items of the stack in Last-In-First-Out (LIFO) order.
3. RAISE – Raises
4. EXIT – Stops the execution of the struixLang code.
5. Operators from CALCGEN:
    a. + - Adds last 2 numbers from stack or concatenates
    b. – - Subtracts last 2 numbers from stack.
    c. * - Multiplies last 2 numbers form stack.
    d. ** - Raises 2nd last number to the power of last number.
    e. / - Divides last 2 numbers.
    f. // - Divides last 2 numbers and removes decimal part to produce an integer.
    g. % - Gives the remainder of division of last 2 numbers.
    h. @
    i. <<
    j. >>
    k. %
    l. |
    m. ^
    n. ~
    o. < - Relational operator LESS THAN.
    p. > - Relational operator GREATER THAN.
    q. <= - Relational operator LESS THAN OR EQUAL TO.
    r. >= - Relational operator GREATER THAN OR EQUAL TO.
    s. == - Relational operator EQUAL TO.
    t. != - Relational operator NOT EQUAL TO.
    u. IN – Check if 2nd last item is present within last item (string, list, etc).
    v. IS – Checks if the 2nd last item is the same item (same instance of same class) as last item.
    w. OR – Logical or Boolean OR.
    x. AND – Logical or Boolean AND.
6. DUP – Duplicates last item in stack.

7. DROP – Removes last item from stack.
8. SWAP – Swaps last item with 2nd last item.
9. OVER – Duplicates and pushes 2nd last item to stack.
10. ROT – Duplicates and pushes 3rd last item to stack.
11. VAR – Creates a variable with following name.
12. CONST – Creates constant with following name and value.
13. STORE – Stores a value to a variable.
14. FETCH – Retrieves value from variable.
15. # (also COMMENT) – Flags a line for no execution.
16. PYEVAL – Evaluates a Python expression.
17. PYEXEC – Executes a Python statement.
18. PYLITEVAL – Evaluates a Python expression safely.
19. DEF – Starts creation of a user-defined new word.
20. END – Ends a new user-defined word definition.
21. [- Starts a list.
22. LENGTH (also LEN) – Finds the length of a list or a string.
23. ITEM – Returns an item from a list
24. NOT – Logical or Boolean NOT.
25. TRUE – Logical or Boolean value TRUE, HIGH, or 1.
26. FALSE – Logical or Boolean value FALSE, LOW, or 0.
27. RUN – Runs a list containing struixLang code.
28. TIMES – Runs a list a number of times.
29. IFTRUE – Runs a list on receiving TRUE.
30. IFFALSE – Runs a list on receiving FALSE.
31. IFELSE – Runs one of two lists on receiving either TRUE or FALSE.
32. WHILE – Runs a list while another list yields TRUE.
33. DOWHILE – Exit-Control Loop similar to WHILE.

struixLang 101

EXECUTION PROCESS

1. Any integer, float or string goes to the stack.
2. Any comments are ignored.
3. Anything else is interpreted.

SYNTAX AND OTHER STUFF

a. Parts of code are separated only by whitespace.
`“Enter 2 Numbers:” print [ input ] 2 times + print` is same as
```
“Enter 2 Numbers:” print
[ input ] 2 times
+
print
```
b. Integers are numbers with no decimal points.
c. Floats are numbers with decimal points
d. Strings start with either `‘` or `“`.
e. Comments start with either `#` or `COMMENT` followed by a space.
f. struixLang is case-insensitive (except for strings; this can be easily changed with minor modifications to the interpreter code).
g. Infinity (`inf`) is a float.

Basics of struixLang

INPUT AND OUTPUT

Keeping the above rules in mind, specifically Rule 1, the following should put the integer 10 on the stack:

```
>>> 10
```

To verify, type the following and press enter:

```
>>> pstack
10
```

Let's try again:

```
>>> 11.5
>>> pstack
```

Surprise, the output will not be just `11` but the following:

```
11.5
10
```

`pstack` is the word (command/function) which is used for displaying the entire stack (working memory) in Last-In-First-Out (LIFO) order.

To display the last element put in the stack, use print:

```
>>> print
11.5
>>> pstack
10
```

THE IMPORTANT-LOOKING NOTE: `print` *and most other words* remove the item which it prints *or operates on* from the stack.

Strings can be put in the stack is a similar way:

```
>>> “Hello, World!” print
Hello, World!
>>> ‘Hello Again!’ print
Hello Again!
```

The input word comes to your rescue when you want to accept a value from the user:

```
>>> “Enter a number:” print input
Enter a number:
_
```

The last line is a prompt for the user to type something. Whatever the user enters is pushed (appended) to the stack.

The following number accepts a number, squares it and displays it.

```
>>> “Enter a number:” print input 2 ** print
Enter a number:
10
100
```

VARIABLES AND CONSTANTS

Sometimes a value needs to be stored for easy reference. Variables are used for that. A variable can be created with the `VAR` word:

```
>>> var a
```

To store values in it, the `STORE` word is used:

```
>>> a 10 store
```

Values are retrieved using the FETCH word:

```
>>> a fetch print
10
```

But for some instances a permanent value need be assigned a name, a value which is not supposed to change after it has been assigned. The `CONST` word is what's needed:

```
>>> const a “Constant String”
>>> a pstack
“Constant String”
```

NOTE: Constants don't need a `FETCH` word to get its value, it is accessed directly.

MATHEMATICAL OPERATIONS

In almost all programming languages, and in books, the operator is almost always placed in between the operands like `1 + 2`. This is called infix notation.

struixLang is a stack-based language and before an operator can work, the operands need to be on the stack. Hence, to reduce the complexity of the interpreter, mathematical (and most other) operations are expressed in postfix notation.

```
1 + 2           →   1 2 +
(34 + 78) * 8   →   34 78 + 8 *
```

Let's try them out:

```
>>> "Enter a number:" print    const n input    n 2 + n *    print
Enter a number:
10
120
```

What happens:

1. A message is displayed.
2. The input (10) is set as constant.
3. `n 2 + n *  = (n + 2) n *` [∵ `n 2 +` → `n + 2`]
   `= (n + 2) * n`
4. `= (10 + 2) * 10` [Putting value of n]
5. The result (120) is displayed.

NOTE about Division: `5 2 /` will produce `2.5` while `5 2 //` will produce `2`.

STACK OPERATIONS

One of the most important parts of a stack-based language, stack operations are necessary for almost everything more complex than adding 2 numbers and displaying them.

ToS – Top of Stack; last element put in stack.

2oS – 2nd Item on Stack; below ToS.

3oS – 3rd Item on Stack, and so on…

DUP – Duplicate ToS

```
>>> 10 pstack
10
>>> dup pstack
10
10
```

DROP – Remove ToS

```
>>> 10 11 12 pstack
12
11
10
>>> drop pstack
11
10
```

SWAP – Swap ToS and 2oS

```
>>> 10 11 pstack
11
10
>>> swap pstack
10
11
```

OVER – Copy 20S on top of ToS

```
>>> 10 11 pstack
11
10
>>> over pstack
10
11
10
```

ROT – Move 3oS on top of ToS

```
>>> 10 11 12 pstack
12
11
10
>>> rot pstack
10
12
11
```

COMMENTS

```
>>> 10 11 + print # This is a comment.

21
```

Note that a space is needed after the `#` for the comment to work.

LIST

Lists are like miniature versions of the stack†; they can store anything the stack can store.

Lists start with the `[` symbol and items in it are separated by spaces. Its end is marked by a `]`.

```
>>> [ 1 2 3 ] pstack
[1, 2, 3]
```

Nested Lists

Lists can store anything the stack can store, and the stack can store lists. When a list is stored in a list the structure is known as nested lists.

```
>>> [ 1 2 3 [ 'a' 'b' 'c' ] ] pstack
[1, 2, 3, ['a', 'b', 'c']]
```

† The stack is actually a list.