

Estruturas de Linguagem

Francisco Sant'Anna

francisco@ime.uerj.br

<http://github.com/fsantanna-uerj/EDL>

Linguagens de “Baixo Nível”

- Código de Máquina

```
8B542408 83FA0077 06B80000 0000C383
FA027706 B8010000 00C353BB 01000000
C9010000 008D0419 83FA0376 078BD98B
B84AEBF1 5BC3
```

- Mapeamento 1:1 para CPU

- Máquina imperativa com espaço de endereçamento plano

- Binário vs Assembly

- Mnemônicos, Offsets, Endereços Simbólicos

- Não estamos interessados nelas

- São consequência direta da CPU

- Assembly

```
mov edx, [esp+8]
cmp edx, 0
ja @f
mov eax, 0
ret

@@:
cmp edx, 2
ja @f
mov eax, 1
ret

@@:
push ebx
mov ebx, 1
mov ecx, 1

@@:
lea eax, [ebx+ecx]
cmp edx, 3
jbe @f
mov ebx, ecx
mov ecx, eax
dec edx
jmp @b

@@:
pop ebx
ret
```

Linguagens de “Alto Nível”

- Portabilidade

- detalhes de arquitetura (registradores, alinhamento)
- sintaxe uniforme

- Produtividade

- abstrações de dados (tipos, registros, vetores, classes)
- abstrações de controle (loops, rotinas, continuações)
- concorrência, domínio, etc

- Performance?

- otimizações globais
- instruções específicas
- complexidade

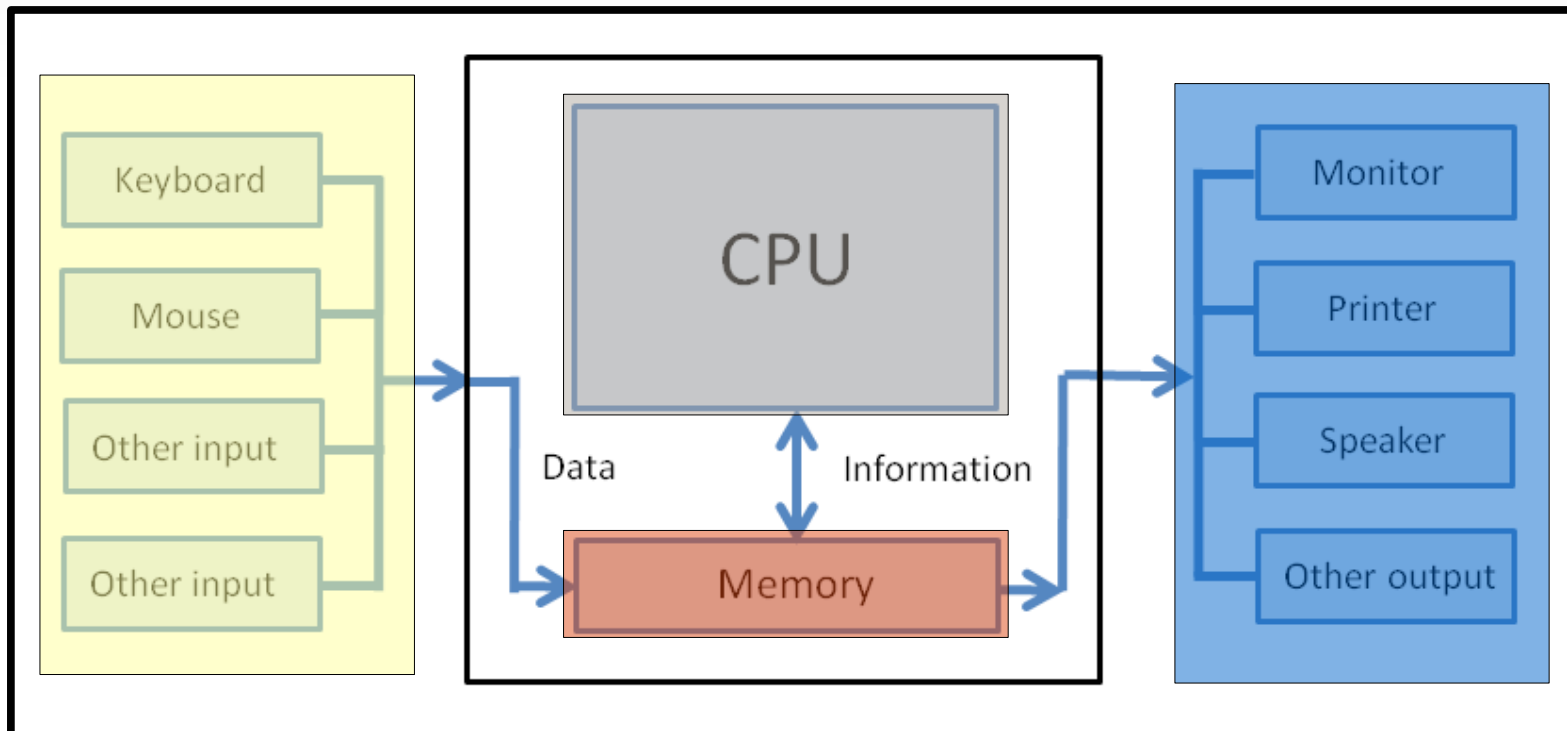
```
unsigned int f(unsigned int n)
{
    if (n <= 0)
        return 0;
    else if (n <= 2)
        return 1;
    else {
        unsigned int a,b,c;
        a = 1;
        b = 1;
        while (1) {
            c = a + b;
            if (n <= 3) return c;
            a = b;
            b = c;
            n--;
        }
    }
}
```

Linguagem de Programação

- De quem pra quem?
 - tradutor
- Um programa que *reconhece* e executa programas
 - (compilador ou interpretador da linguagem)
- *Sintaxe (forma)* e Semântica (significado)
 - (a linguagem)
- Abstração sobre o computador

Linguagem como Abstração

```
frase = input()
print("----")
for i in range(1,5):
    print(i, frase)
```



Sintaxe vs Semântica

- *Forma, Símbolos* vs Significado, Execução
- Exemplo: Como é o comando **while** de C?
 - *Sintaxe:*
 - `While ::= while (Expression) Statement`
 - Formal, BNF
 - Semântica:

3.3.4 – Control Structures

The control structures **if**, **while**, and **repeat** have the usual meaning and familiar syntax:

```
stat ::= while exp do block end
stat ::= repeat block until exp
stat ::= if exp then block {elseif exp then block} [else block] end
```

Lua also has a **for** statement, in two flavors (see §3.3.5).

The condition expression of a control structure can return any value. Both **false** and **nil** are considered false. All values different from **nil** and **false** are considered true (in particular, the number 0 and the empty string are also true).

Sintaxe vs Semântica

Are semantics and s... x +

← stackoverflow.com/questions/209979/are-semantics-anc ↻ g Google 🔍 ☆ 📄 ⬇ 🏠 ☰


▲
65
▼
✓

Syntax is the grammar. It describes the way to construct a correct sentence. For example, *this water is triangular* is syntactically correct.

Semantics relates to the meaning. *this water is triangular* does not mean anything, though the grammar is ok.

share improve this answer

answered Oct 16 '08 at 19:57

 **Christian Lescuyer**
11.3k ● 2 ● 33 ● 37

Sintaxe vs Semântica

- *Sintaxe* diferente, Semântica igual

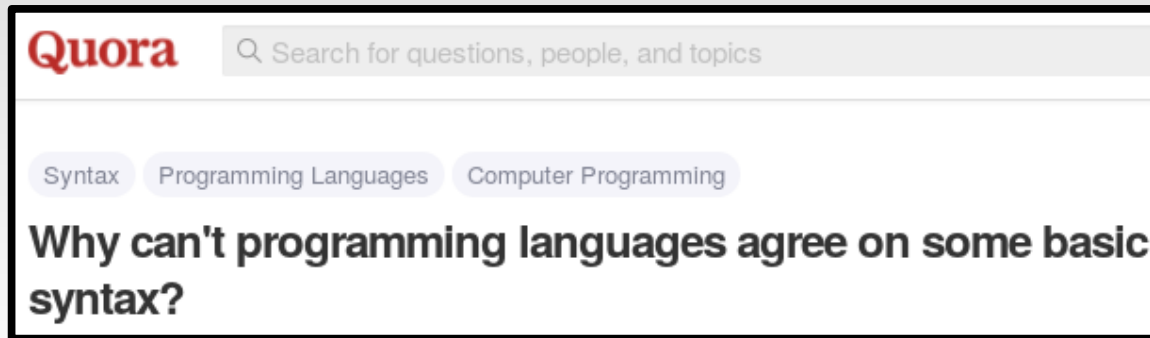
```
chico@note:~$ lua
Lua 5.1.5 Copyright (C) 1994-2012 Lua.org, PUC-Rio
> list = { 1, 2, 3 }
> print(#list)
3
> █

chico@note:~$ python3
Python 3.4.3 (default, Oct 14 2015, 20:28:29)
[GCC 4.8.4] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> list = [ 1, 2, 3 ]
>>> print(len(list))
3
>>> █
```

- *Sintaxe* igual, Semântica diferente

```
chico@note:~$ python2
Python 2.7.6 (default, Mar 22 2014, 22:59:56)
[GCC 4.8.2] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> 1/2
0
>>>
chico@note:~$
chico@note:~$
chico@note:~$ python3
Python 3.4.3 (default, Oct 14 2015, 20:28:29)
[GCC 4.8.4] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> 1/2
0.5
>>> █
```

Sintaxe vs Semântica



- Decisões de design:
 - indentação obrigatória em Python
 - comentários aninhados
- Semântica influencia a *Sintaxe*
 - S-expressions de LISP
 - Lambdas em linguagens funcionais

Sintaxe vs Semântica

- O curso aborda, principalmente, semântica de linguagens.

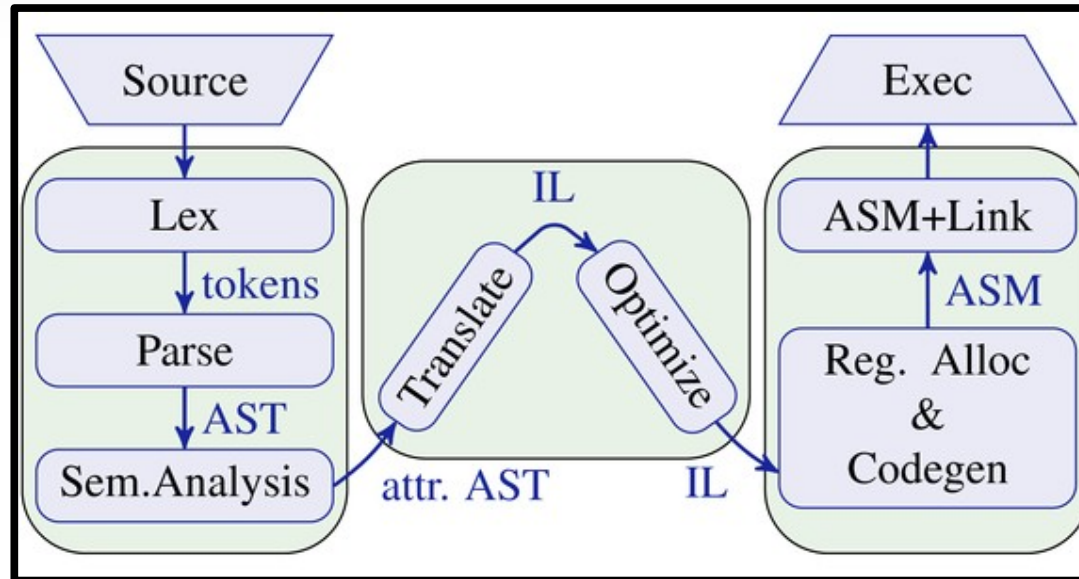
Wadler's Law states that:

In any language design, the total time spent discussing a feature in this list is proportional to two raised to the power of its position.

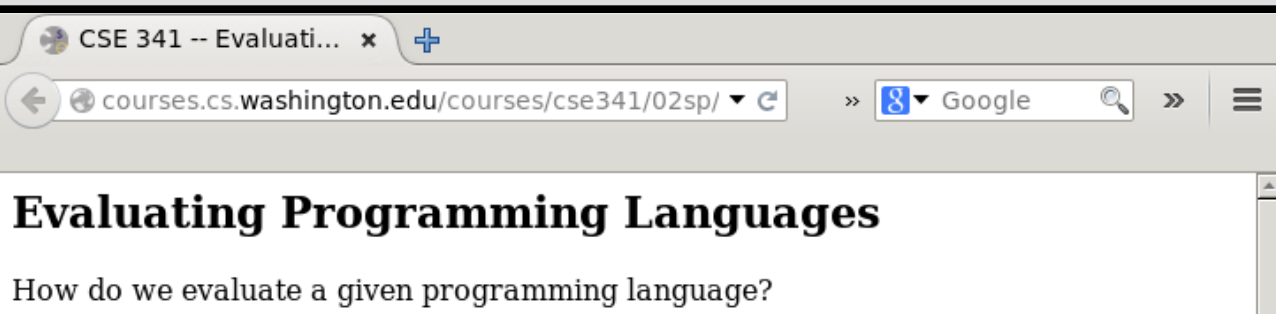
0. Semantics
1. Syntax
2. Lexical syntax
3. Lexical syntax of comments

Compiladores

- Não é um curso de compiladores.
 - Implementação vs Design



Avaliando Languages



External Evaluation Criteria

The actual users of languages (businesses, engineers, secretaries, etc.) have certain demands on the language. To evaluate languages is to ask whether a given language meets the demands of its user community.

Rapid development

Programmers are more expensive than machines, so we want to make fast progress. (We should consider both the time and the cost in making this evaluation.)

Easy maintenance

Maintenance is expensive.

Reliability and safety

When computers go down, planes crash, phone systems melt down, cash machines close. We'd like to avoid this.

Portability

I'd like my program to run on many different platforms.

Efficiency

The compiler should be fast. The code itself should be efficient.

Low training time (learnability)

The language should be easy to learn. Training is expensive.

Reusability

Writing software components once is cheaper than writing them many times.

Pedagogical value

The language should support and enforce the concepts of good programming.

Internal Evaluation Criteria

Although the above demands are all important, we should still ask what makes a *good* language, independent of the demands of its users. This is a little like the question "What makes a good artwork?" as opposed to "What makes a good Hollywood movie?" Here are some qualities of a good language.

Readability

Understand what you, or someone else has written.

Writeability

Say what you mean, without excessive verbiage.

Simplicity

The language should have a minimal number of primitive concepts/features.

Orthogonality

The language should support the combination of its concepts/features in a meaningful way.

Consistency

The language should not include needless inconsistencies. (But remember Ralph Waldo Emerson: "A foolish consistency is the hobgoblin of small minds.")

Expressiveness

The programmer should be able to express their algorithm naturally.

Abstraction

The language should support a high level of data and control abstraction.

We will generally make use of these and other internal evaluation criteria when comparing languages.

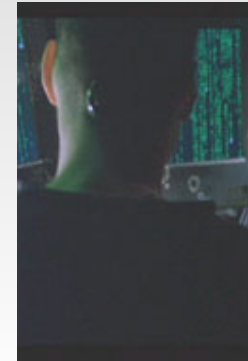
Manutenção

Prototipação

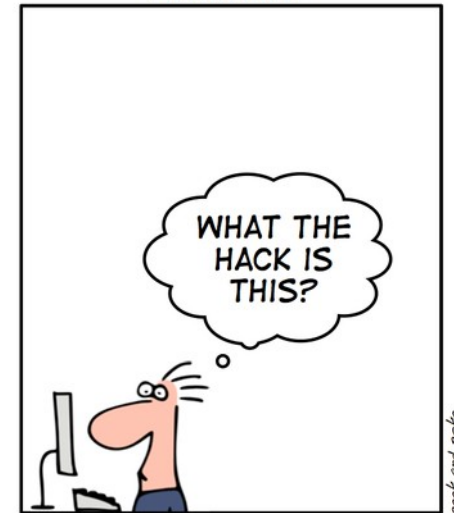
Readability vs Writability

```
while(<>) {  
    split;  
    print "$_[1], $_[0]\n";  
}
```

```
chico@note:/data/UERJ/EDL/code$ cat names.txt  
Francisco Sant'Anna  
João Silva  
chico@note:/data/UERJ/EDL/code$ cat names.txt | perl names.pl  
Sant'Anna, Francisco  
Silva, João  
chico@note:/data/UERJ/EDL/code$  
chico@note:/data/UERJ/EDL/code$
```



ONE DAY IN THE LIFE OF A PERL PROGRAMMER



09:45 AM
READING THE CODE FROM THE PREVIOUS DAY

geek and poke

```
HelloWorld.java - Notepad  
File Edit Format Help  
public class HelloWorld {  
    public static void main(String[] args) {  
        System.out.println("Hello World!");  
    }  
}
```



Readability vs Writability

```
// C
```

```
int timeOut = 1;
```

```
<...>
```

```
timeOut = 0;
```

```
// Java
```

```
boolean timeOut = true;
```

```
<...>
```

```
timeOut = false;
```


Poder de Expressividade



I like Matthias Felleisen's notion of expressive power, which is *comparative*:

18



- Language A is strictly more expressive than language B if both of the following are true:
 - Any program written in language B can be rewritten in language A while keeping the essential structure of the program intact.
 - Some programs written in language A have to be violently restructured in order to be written in language B.

```
die ("found no solutions") unless length(solutions) > 0;
```

instead of

```
if (length(solutions) == 0) { die("found no solutions"); }
```

So you have to establish whether you're asking about expressive power of surface syntax or deeper structure.

Poder de Expressividade

- Exemplos em Lua
 - Closures: `counter/*`
 - Co-rotinas: `iter/*`