Estruturas de Linguagem

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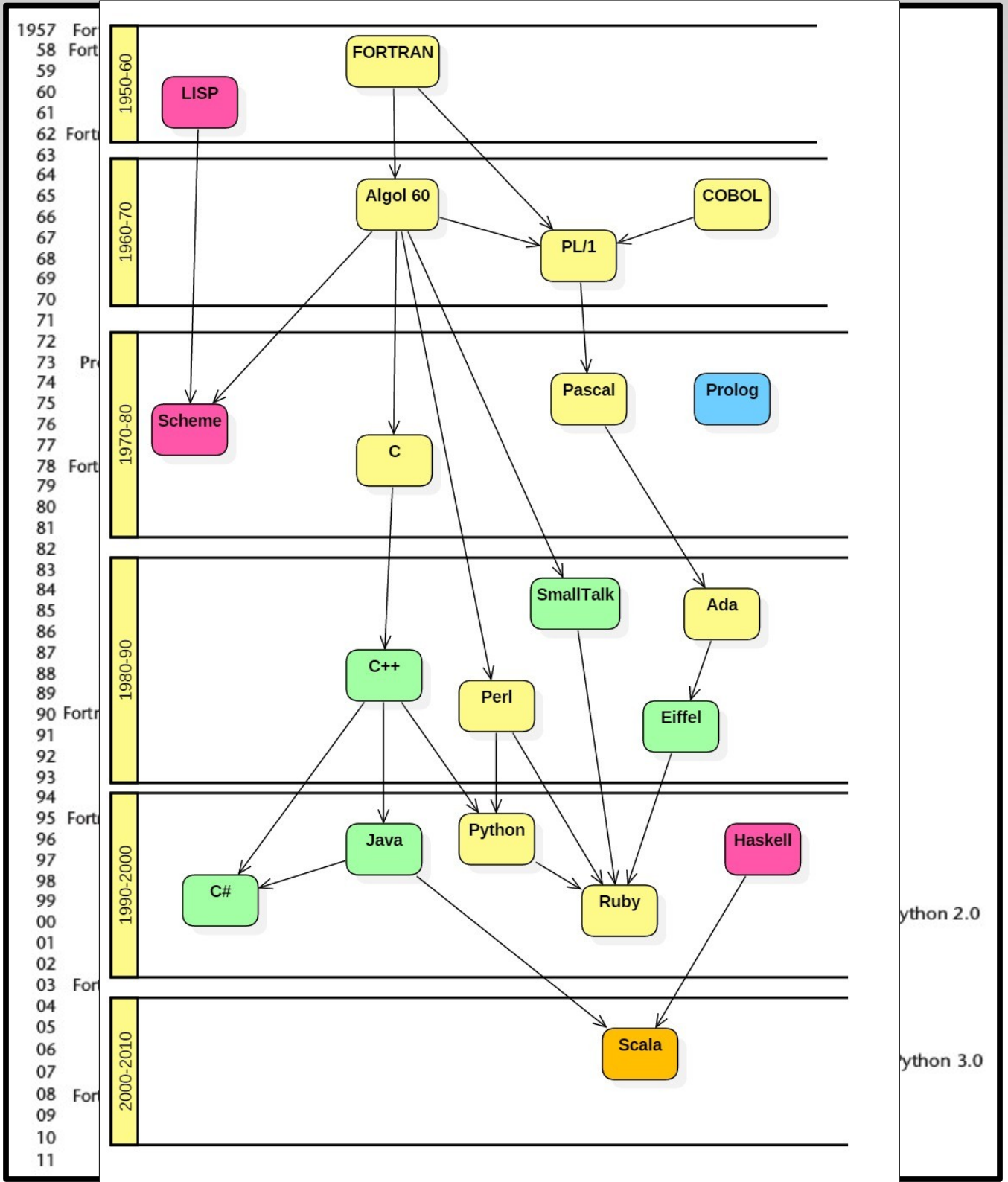
http://github.com/fsantanna-uerj/EDL



- Imperativa
- Funcional
- Lógica
- Orientada a Objetos

- Interpretada vs Compilada
- Dinâmica vs Estática

- Computação Científica
- Empresas e Negócios
- Inteligência Artificial
- Software Básico
- Servidores
- Internet / Web
  - front/back

Linguagens de “Baixo Nível”

- Código de Máquina

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

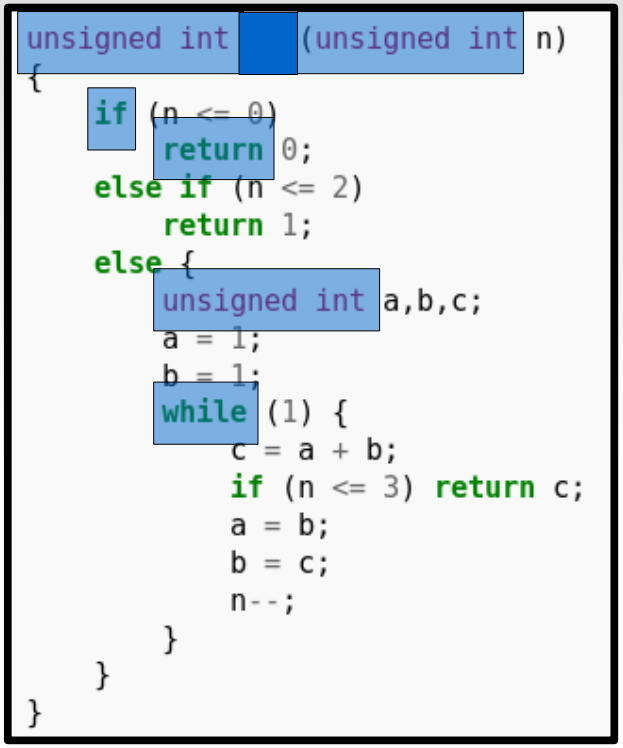
- Assembly

```
    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
```

- 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

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



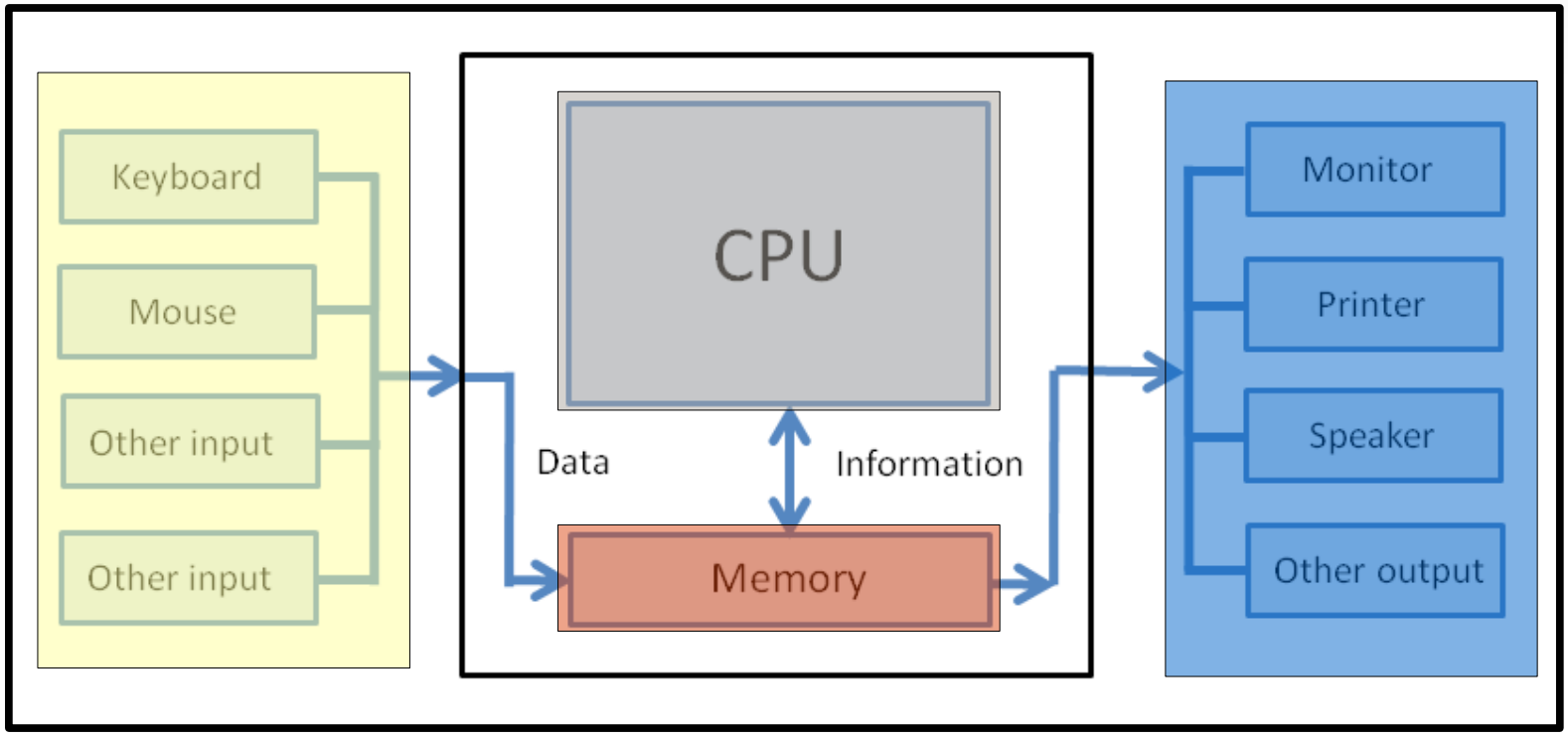
```
unsigned int [redacted](unsigned int n)
{
    if (n <= 0)
        return 0;
    else if (n <= 2)
        return 1;
    else {
        unsigned int a,b,c;
        a = 1;
        b = 1;
        while (1) {
            c = a + b;
            if (n <= 3) return c;
            a = b;
            b = c;
            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:
    - Informal, RTFM!

3.3.4 – Control Structures

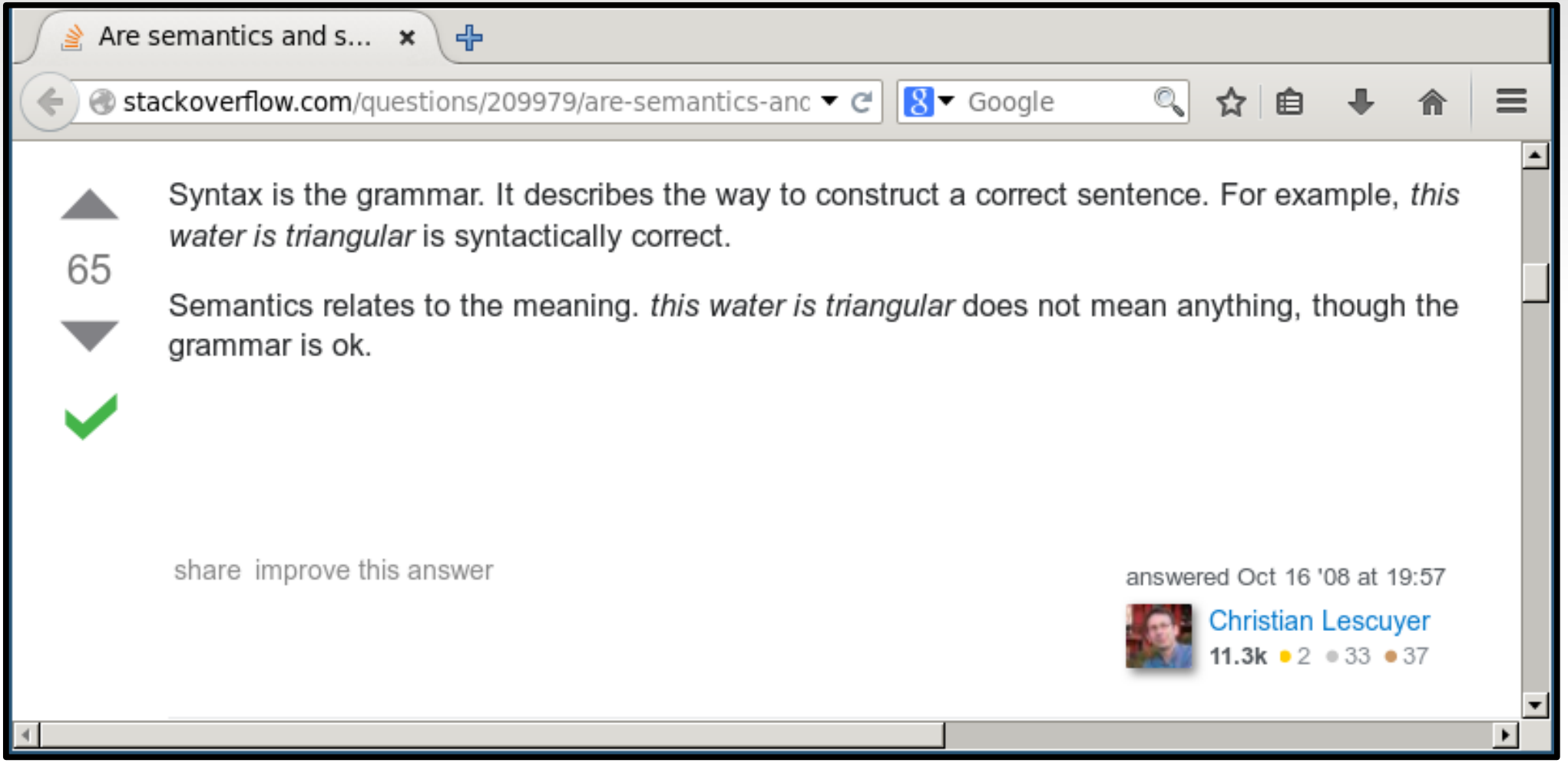
The control structures **if**, **while**, and **repeat** have the usual meaning and familiar syntax:

```
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



Sintaxe vs Semântica

- *Sintaxe* diferente, Semântica igual

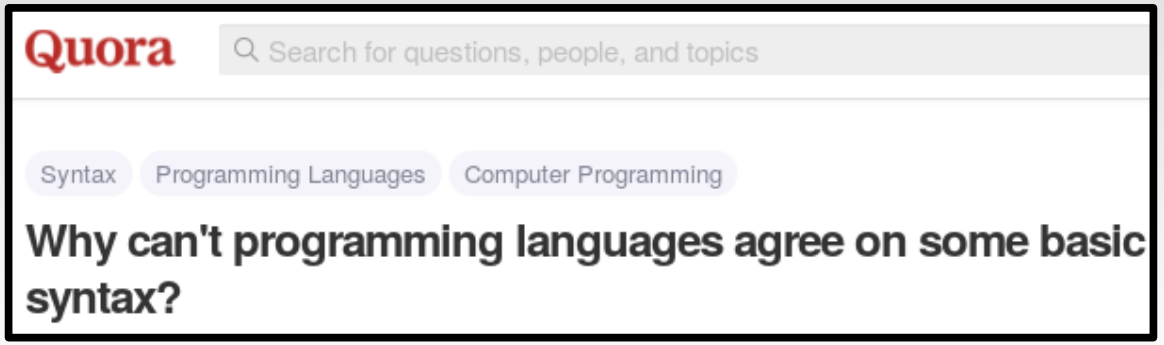
```
chico@note:~$ lua
Lua 5.1.5  Copyright (C) 1994-2012 Lua.org, PUC-Rio
> list = { 1, 2, 3 }
> print(#list)
3
>
```

```
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

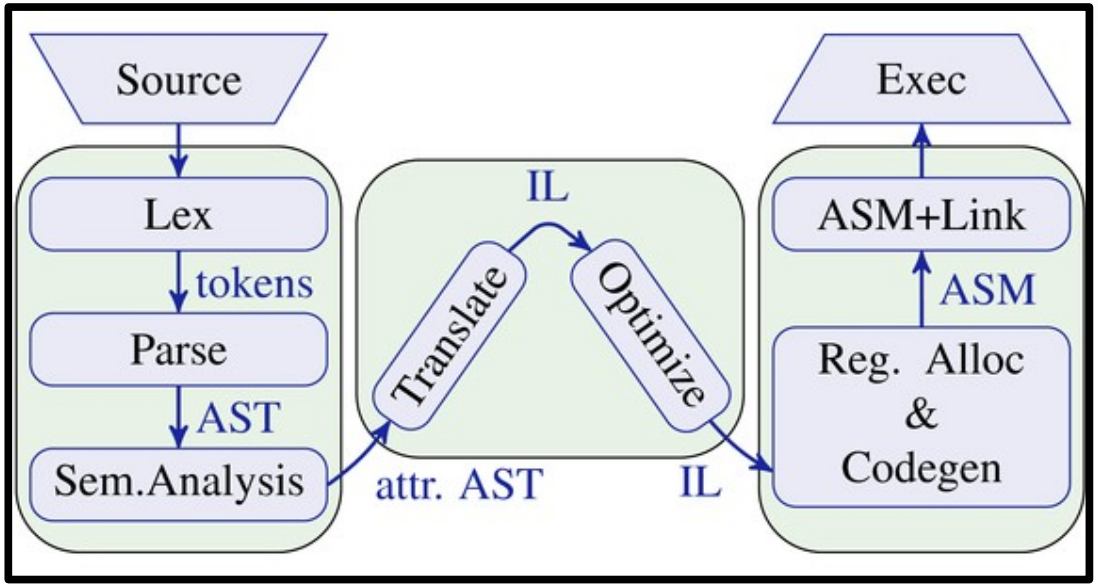
- O curso aborda, principalmente, semântica de linguagens.

Wadler's Law states that:

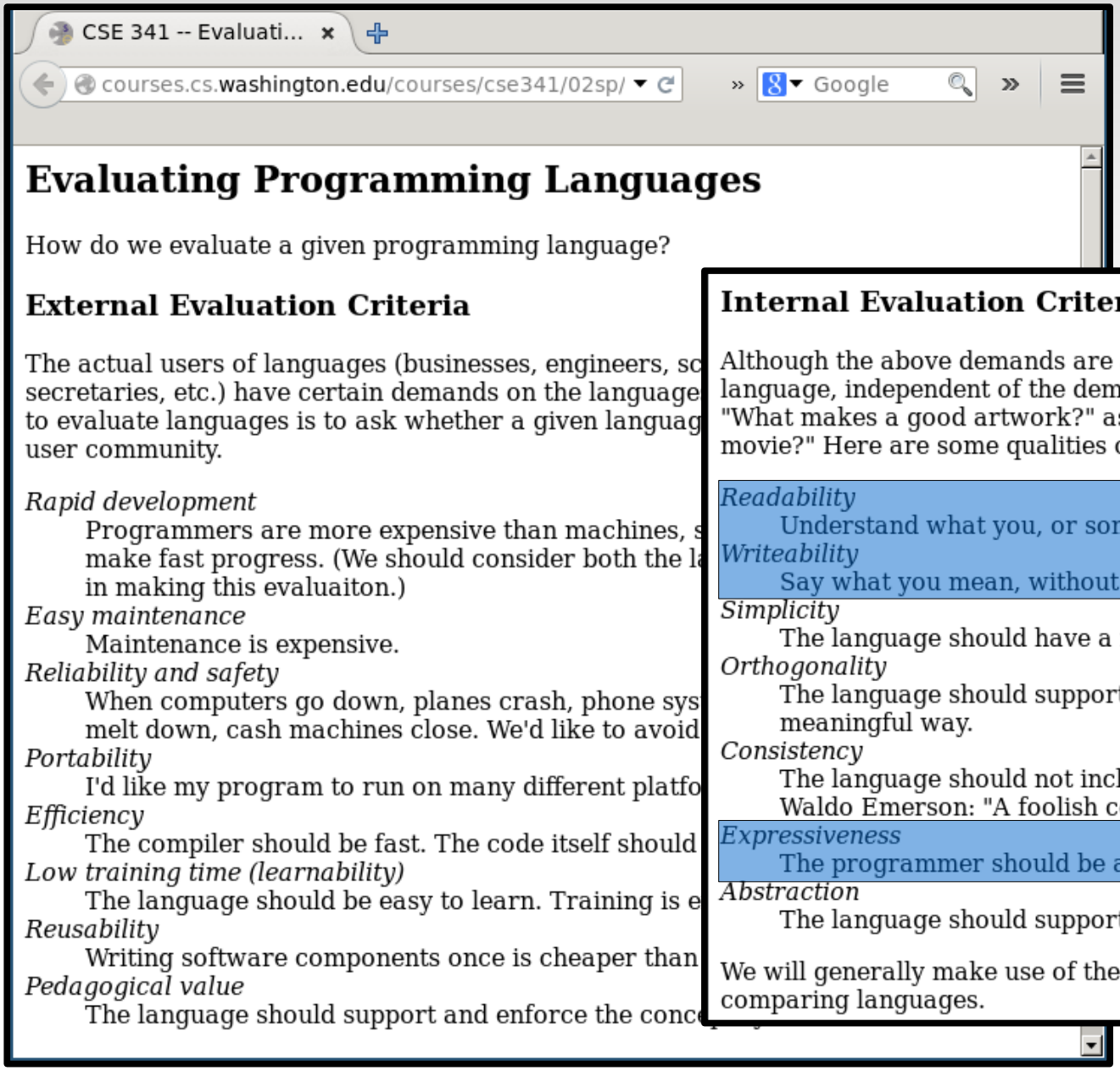
```
In any language design, the total time spent discussing
a feature in this list is proportional to two raised to
the power of its position.
     0. Semantics
     1. Syntax
     2. Lexical syntax
     3. Lexical syntax of comments
```

Compiladores

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



Avaliando Linguages



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.

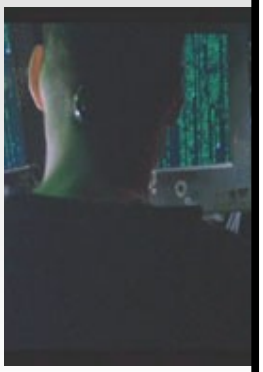
Manutenção

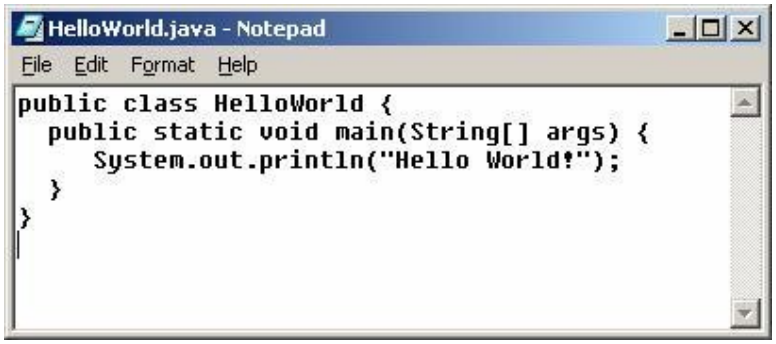
Prototipação

Readability vs Writability

```perl
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$
```





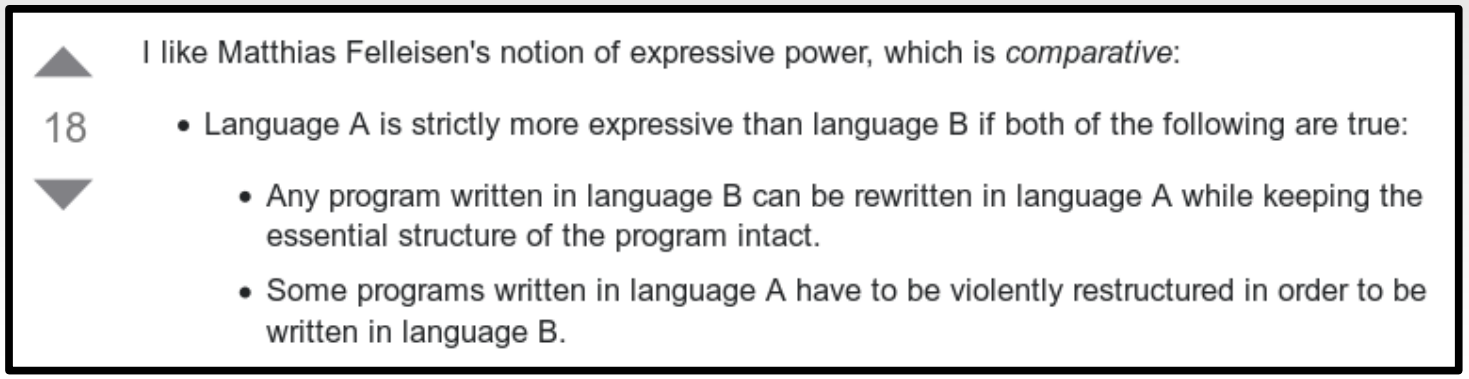
Readability vs *Writability*

```c
// C

int timeOut = 1;

<...>

timeOut = 0;
```

```java
// Java

boolean timeOut = true;

<...>

timeOut = false;
```

Tarefa 1

Poder de Expressividade



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

- 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.

- Exemplo Python vs C
- Python é estritamente mais expressiva que C se as duas condições forem verdadeiras:
  - Qualquer programa em C pode ser reescrito em Python mantendo a **estrutura essencial do programa** intacta.
  - Alguns programas em Python precisam ser violentamente reestruturados para serem escritos em C.

Poder de Expressividade

- Exemplos em Lua
  - Closures: `counter/*, fun/closures-02`
  - Co-rotinas: `iter/*`