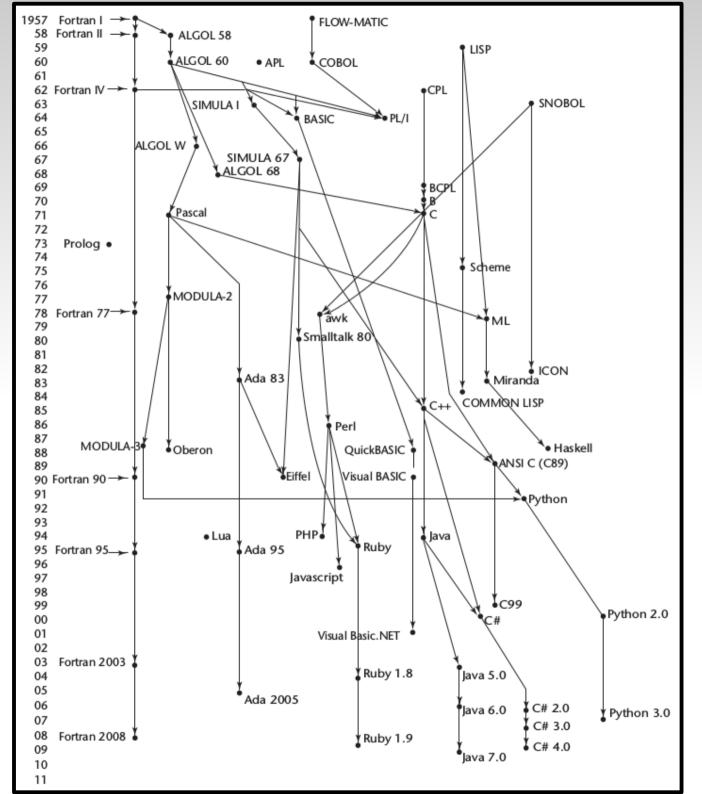
Estruturas de Linguagem

Francisco Sant'Anna

francisco@ime.uerj.br

http://github.com/fsantanna/EDL



- Imperativa
- Funcional
- Lógica
- Orientada a Objetos
- Interpretada vs Compilada
- Estática vs Dinâmica
- Computação Científica
- Empresas e Negócios
- Inteligência Artificial
- Software Básico
- Servidores
- Aplicações Web
 - front/back

Linguagens de "Baixo Nível"

Código de Máquina

Assembly

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

```
mov edx, [esp+8]
cmp edx, 0
ia @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
@a:
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

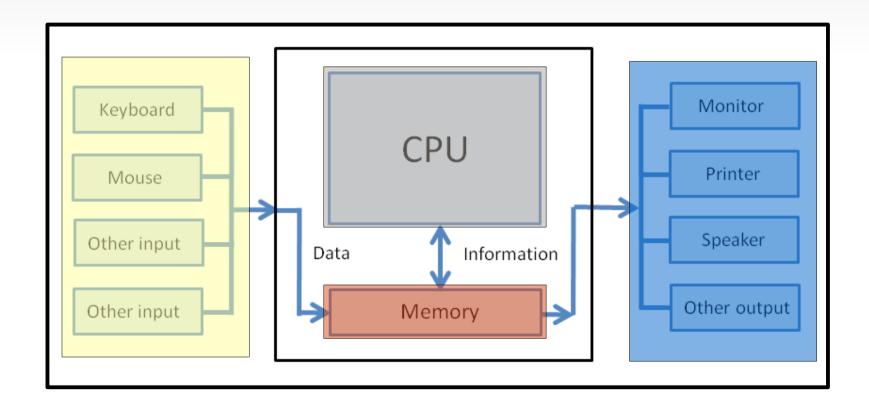
```
unsigned int fib (unsigned int n)
{
    if (n <= 0)
        return 0;
    else if (n <= 2)
        return 1;
    else {
        unsigned int a,b,c;
        a = 1;
        b = 1;
        while (1) {
            c = a + b;
            if (n <= 3) return c;
            a = b;
            b = c;
   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

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)
```



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

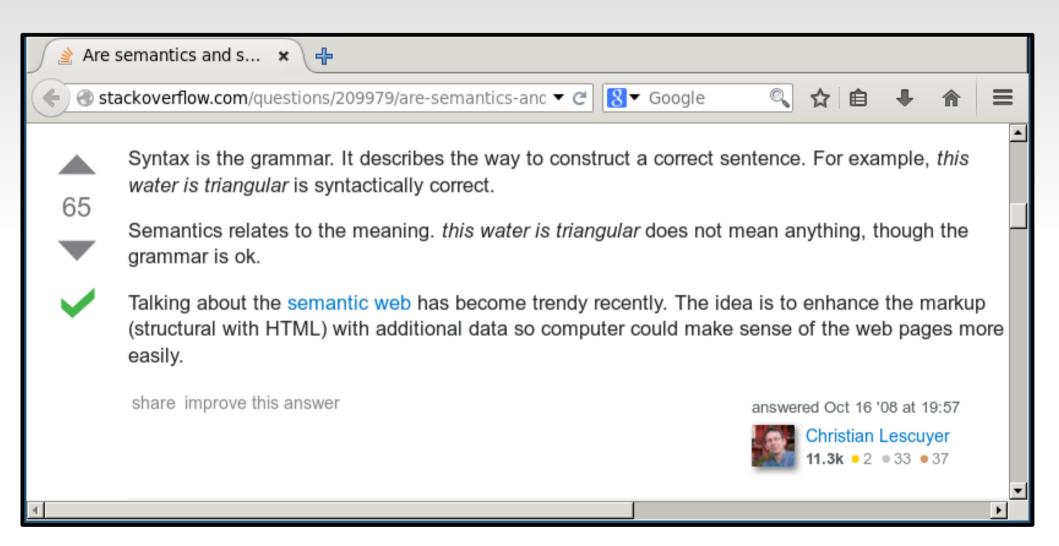
3.3.4 - Control Structures

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).

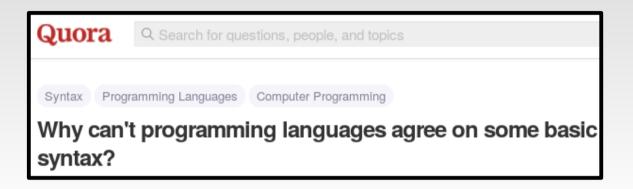
The condition expression of a control structure can return any value. Both **false** and **nil** are considered false. All values different from **nil** and **false** are considered true (in particular, the number 0 and the empty string are also true).



• Sintaxe diferente, Semântica igual

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
```



Decisões de design:

- indentação obrigatória em Python
- comentários aninhados

Semântica influencia a Sintaxe

- S-expressions de LISP
- Lambdas em linguagens funcionais

• O curso aborda, principalmente, <u>semântica</u> de linguagens.

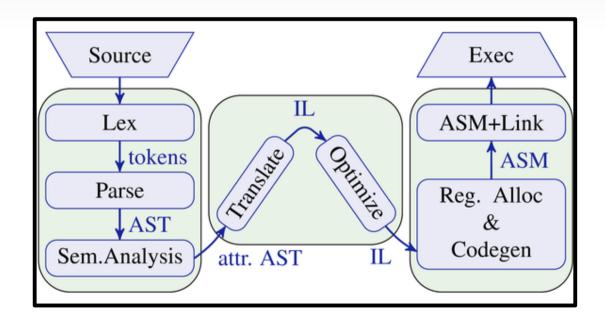
Wadler's Law states that:

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.

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

Compiladores

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



Avaliando Linguages



External Evaluation Criteria

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

Rapid development

Programmers are more expensive than machines, make fast progress. (We should consider both the lin making this evaluation.)

Easy maintenance

Maintenance is expensive.

Reliability and safety

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

Portability

I'd like my program to run on many different platfo Efficiency

The compiler should be fast. The code itself should Low training time (learnability)

The language should be easy to learn. Training is e Reusability

Writing software components once is cheaper than Pedagogical value

The language should support and enforce the cond

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.

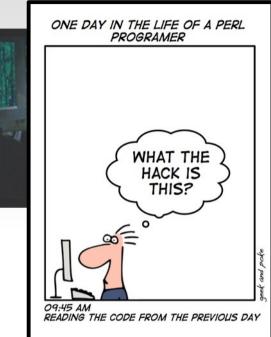
We will generally make use of these and other internal evaluation criteria when comparing languages.



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$
chico@note:/data/UERJ/EDL/code$
```



```
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.