



The University of North Carolina at Chapel Hill

COMP 144 Programming Language Concepts
Spring 2002

Lecture 1: Introduction

Felix Hernandez-Campos

Jan 9

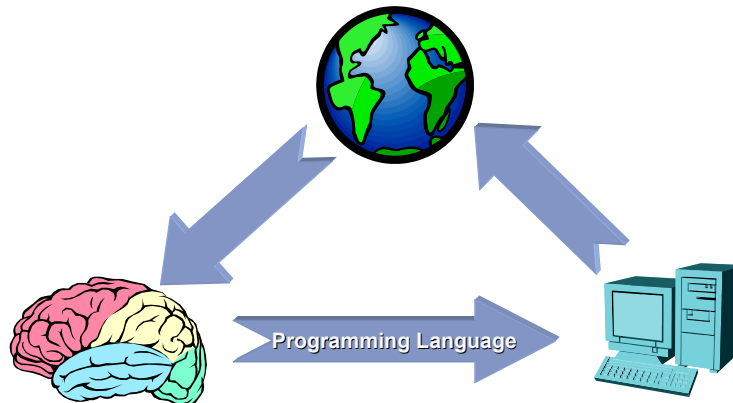
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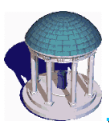
Programming Languages

- What is a programming language?



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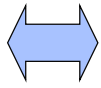
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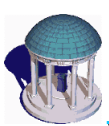
Programming Languages

- What is a programming language?
 - *Abstraction of virtual machine*

```
int sum(int[] x) {  
    int sum = 0;  
    n = 0;  
    while (n < x.length) {  
        sum += x[n];  
    }  
    return sum;  
}
```



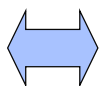
```
00101010101010  
10101011111010  
11101010101110  
00101010101010  
...
```



Programming Languages

- What is a programming language?
 - Donald Knuth:
 - » *Programming is the art of telling another human being what one wants the computer to do*

```
int sum(int[] x) {  
    int sum = 0;  
    n = 0;  
    while (n < x.length) {  
        sum += x[n];  
    }  
    return sum;  
}
```

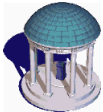


```
00101010101010  
10101011111010  
11101010101110  
00101010101010  
...
```



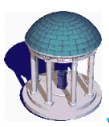
The Number of Programming Languages

- How many programming languages do you know?
 - This is a sample list...
 - » <http://dmoz.org/Computers/Programming/Languages/>
- Why is the number of programming languages so large?
 - Evolution
 - Special Purpose
 - Personal Preference



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Evolution: Genealogy

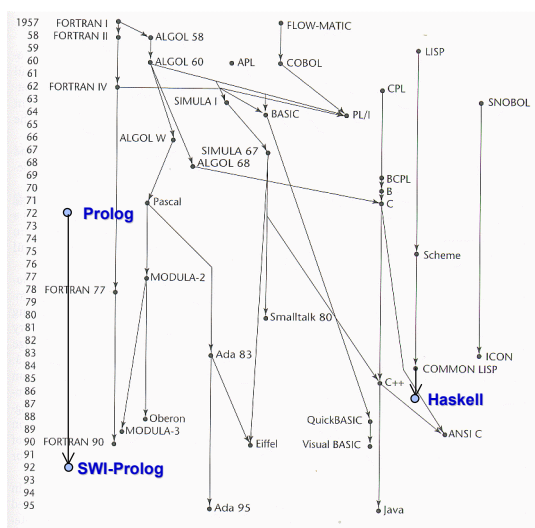
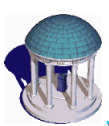


Figure 2.1
Genealogy of common high-level programming languages

From Sebesta's
Concepts of
Programming
Languages



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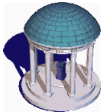


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The Number of Programming Languages

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- Why is the number of programming languages so large?
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 - Special Purpose
 - **Personal Preference**
- A programming language is a way of thinking
 - Different people think in a different way

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Quicksort in C

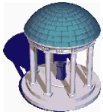
```
qsort( a, lo, hi ) int a[], hi, lo;
{
    int h, l, p, t;

    if (lo < hi) {
        l = lo;
        h = hi;
        p = a[hi];

        do {
            while ((l < h) && (a[l] <= p))
                l = l+1;
            while ((h > l) && (a[h] >= p))
                h = h-1;
            if (l < h) {
```

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Quicksort in C

```
        t = a[l];
        a[l] = a[h];
        a[h] = t;
    } while (l < h);

    t = a[l];
    a[l] = a[hi];
    a[hi] = t;

    qsort( a, lo, l-1 );
    qsort( a, l+1, hi );
}
}
```

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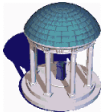


Quicksort in Haskell

```
qsort [] = []  
qsort (x:xs) = qsort lt_x ++ [x] ++ qsort ge_x  
  where  
    lt_x = [y | y <- xs, y < x]  
    ge_x = [y | y <- xs, y >= x]
```

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Successful Programming Languages

- Are all languages equally successful?
 - No!
- What makes a language successful?
 - Expressive power
 - Ease of use for the novice
 - Ease of implementation
 - Excellent compilers
 - Economics, patronage, and inertia

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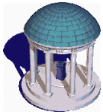


Why study programming languages?

- Use the most *appropriate* programming language for your task
 - E.g. Java is great for writing applications
 - E.g. C is great for systems programming
- Make it easier to learn new languages
 - Evolution => Similarities
- Make good better use of language features
 - Obscure features
 - Cost of features
 - Simulate useful features

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Classification of Programming Languages

- **Imperative languages**
 - What the computer is to do
- Von Neumann languages
 - » E.g. Fortran, Basic, C
- Object-oriented languages
 - » E.g. C++, Java

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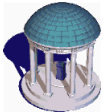


Classification of Programming Languages

- **Declarative languages**
 - How the computer should do it
- **Functional languages**
 - E.g. Lisp, ML, and Haskell
- **Dataflow languages**
 - E.g. Id and Val
- **Logic or constraint-based languages**
 - E.g. Prolog

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Summary

- **Programming languages:**
 - Set of abstractions => virtual machine
 - A way of thinking
- **COMP 144:**
 - Examine the fundamental principles of contemporary programming languages
 - » Design
 - » Implementation
 - Program in four completely different programming languages
 - » Practical experience

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