Programming Language Convergence

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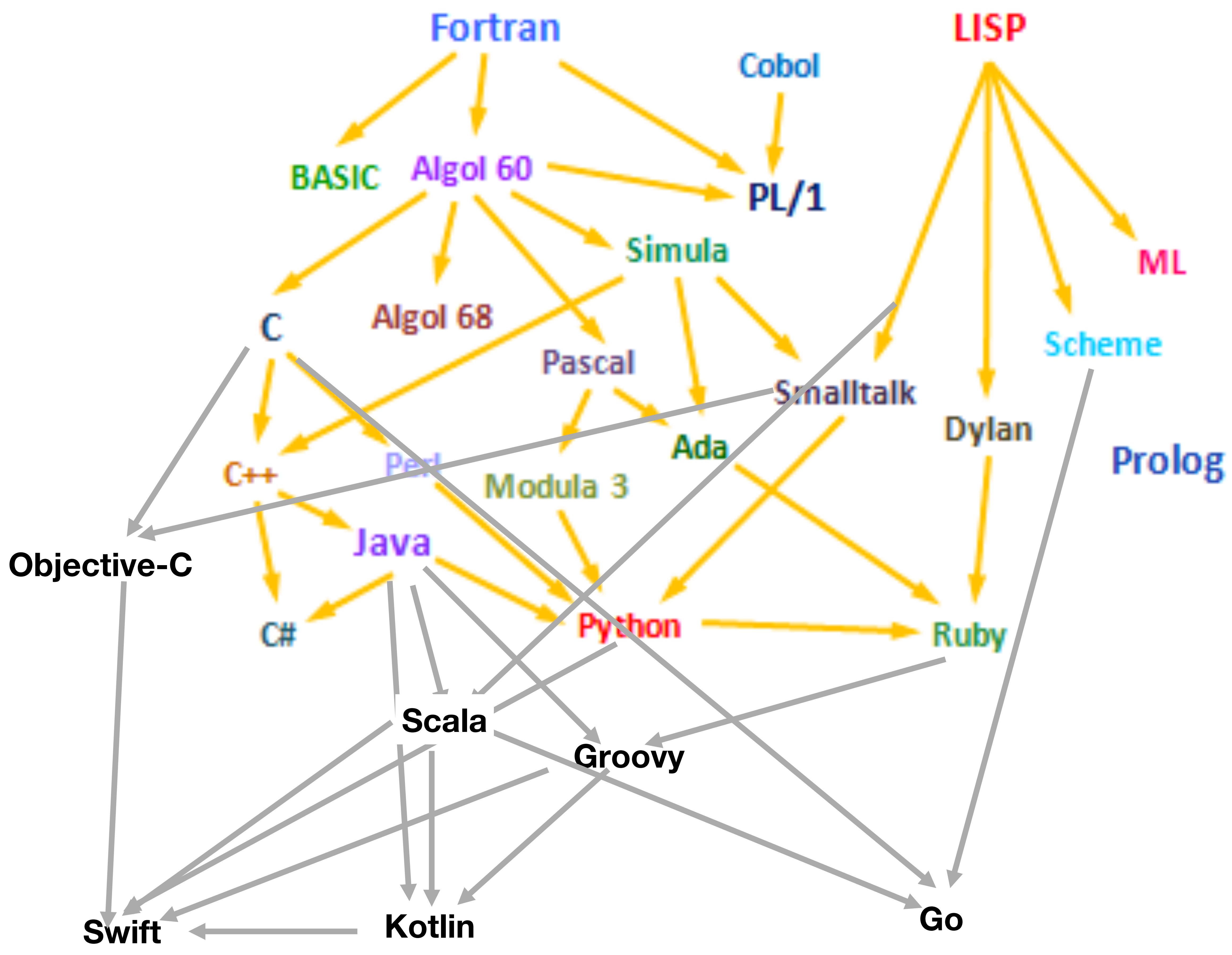

Fortran
LISP
Cobol
BASIC
Algol 60
PL/1
Simula
ML
C
Algol 68
Pascal
Scheme
Smalltalk
Dylan
Prolog
Ada
C++
Perl
Modula 3
Java
Objective-C
C#
Python
Ruby
Scala
Groovy
Swift
Kotlin
Go

Java Example

- Java algorithm to filter a list of strings
- Only printing those with 3 or less characters (in this test case).

```
import java.util.ArrayList;
import java.util.List;

class Erase{
  public static void main(String[] args)
  {
    List<String> names = new ArrayList<String>();
    names.add("Ted");
    names.add("Fred");
    names.add("Jed");
    names.add("Ned");
    System.out.println(names);
    Erase e = new Erase();
    List<String> short_names = e.filterLongerThan(names, 3);
    System.out.println(short_names.size());
    for (String s : short_names)
    {
      System.out.println(s);
    }
  }

  public List<String> filterLongerThan(List<String> strings,
                                                      int length)
  {
    List<String> result = new ArrayList<String>();
    for (String s : strings)
    {
      if (s.length() < length + 1)
      {
        result.add(s);
      }
    }
    return result;
  }
}
```

Groovy 1

- Also a valid Groovy program...

```
import java.util.ArrayList;
import java.util.List;

class Erase{
  public static void main(String[] args)
  {
    List<String> names = new ArrayList<String>();
    names.add("Ted");
    names.add("Fred");
    names.add("Jed");
    names.add("Ned");
    System.out.println(names);
    Erase e = new Erase();
    List<String> short_names = e.filterLongerThan(names, 3);
    System.out.println(short_names.size());
    for (String s : short_names)
    {
      System.out.println(s);
    }
  }

  public List<String> filterLongerThan(List<String> strings,
                                                     int length)
  {
    List<String> result = new ArrayList<String>();
    for (String s : strings)
    {
      if (s.length() < length + 1)
      {
        result.add(s);
      }
    }
    return result;
  }
}
```

Groovy 1

- Do we need generics?
- What about semicolons?
- Should standard libraries be imported?

```java
import java.util.ArrayList;
import java.util.List;

class Erase{
  public static void main(String[] args)
  {
    List<String> names = new ArrayList<String>();
    names.add("Ted");
    names.add("Fred");
    names.add("Jed");
    names.add("Ned");
    System.out.println(names);
    Erase e = new Erase();
    List<String> short_names = e.filterLongerThan(names, 3);
    System.out.println(short_names.size());
    for (String s : short_names)
    {
      System.out.println(s);
    }
  }

  public List<String> filterLongerThan(List<String> strings,
                                                        int length)
  {
    List<String> result = new ArrayList<String>();
    for (String s : strings)
    {
      if (s.length() < length + 1)
      {
        result.add(s);
      }
    }
    return result;
  }
}
```

https://dzone.com/articles/java-groovy-part-2-closures-an

Groovy 2

- *ArrayList not given a generic type.*
- *No need for semicolons.*
- *No need to import libraries.*

```
class Erase
{
  public static void main(String[] args)
  {
    List names = new ArrayList()
    names.add("Ted")
    names.add("Fred")
    names.add("Jed")
    names.add("Ned")
    System.out.println(names)
    Erase e = new Erase()
    List short_names = e.filterLongerThan(names, 3)
    System.out.println(short_names.size())
    for (String s : short_names)
    {
      System.out.println(s)
    }
  }

  public List filterLongerThan(List strings, int length)
  {
    List result = new ArrayList();
    for (String s : strings)
    {
      if (s.length() < length + 1)
      {
        result.add(s)
      }
    }
    return result
  }
}
```

Groovy 2

- Do we need the static types?
- Must we always have a main method and class definition?

```
class Erase
{
  public static void main(String[] args)
  {
    List names = new ArrayList()
    names.add("Ted")
    names.add("Fred")
    names.add("Jed")
    names.add("Ned")
    System.out.println(names)
    Erase e = new Erase()
    List short_names = e.filterLongerThan(names, 3)
    System.out.println(short_names.size())
    for (String s : short_names)
    {
      System.out.println(s)
    }
  }

  public List filterLongerThan(List strings, int length)
  {
    List result = new ArrayList();
    for (String s : strings)
    {
      if (s.length() < length + 1)
      {
        result.add(s)
      }
    }
    return result
  }
}
```

Groovy 3

- *Types removed in method signature.*
- *main method and class definition removed.*

```
def filterLongerThan(strings, length)
{
  List result = new ArrayList();
  for (String s : strings)
  {
    if (s.length() < length + 1)
    {
      result.add(s)
    }
  }
  return result
}

List names = new ArrayList()
names.add("Ted")
names.add("Fred")
names.add("Jed")
names.add("Ned")
System.out.println(names)
List short_names = filterLongerThan(names, 3)
System.out.println(short_names.size())
for (String s : short_names)
{
  System.out.println(s)
}
```

Groovy 3

- Should we have a special notation for lists?
- And special facilities for list processing?

```
def filterLongerThan(strings, length)
{
  List result = new ArrayList();
  for (String s : strings)
  {
    if (s.length() < length + 1)
    {
      result.add(s)
    }
  }
  return result
}

List names = new ArrayList()
names.add("Ted")
names.add("Fred")
names.add("Jed")
names.add("Ned")
System.out.println(names)
List short_names = filterLongerThan(names, 3)
System.out.println(short_names.size())
for (String s : short_names)
{
  System.out.println(s)
}
```

Groovy 4

- *special notation for lists used*
- *list processing closures used.*

```
def filterLongerThan(strings, length)
{
  return strings.findAll {it.size() <= length}
}

names = ["Ted", "Fred", "Jed", "Ned"]
System.out.println(names)
List short_names = filterLongerThan(names, 3)
System.out.println(short_names.size())
short_names.each {System.out.println(it)}
```

Groovy 4

- Method needed any longer?
- Is there an easier way to use common methods (e.g. println)?
- Are brackets always needed?

```
def filterLongerThan(strings, length)
{
  return strings.findAll {it.size() <= length}
}

names = ["Ted", "Fred", "Jed", "Ned"]
System.out.println(names)
List short_names = filterLongerThan(names, 3)
System.out.println(short_names.size())
short_names.each {System.out.println(it)}
```

Groovy 5

- *Method removed*
- *Used common method notation*
- *Removed non necessary brackets.*

```
names = ["Ted", "Fred", "Jed", "Ned"]
println names
short_names = names.findAll{it.size() <= 3}
println short_names.size()
short_names.each {println it}
```

```java
import java.util.ArrayList;
import java.util.List;

class Erase{
  public static void main(String[] args)
  {
    List<String> names = new ArrayList<Str
    names.add("Ted");
    names.add("Fred");
    names.add("Jed");
    names.add("Ned");
    System.out.println(names);
    Erase e = new Erase();
    List<String> short_names = e.filterLongerThan(names, 3);
    System.out.println(short_names.size());
    for (String s : short_names)
    {
      System.out.println(s);
    }
  }

  public List<String> filterLongerThan(List<String> strings,
int length)
  {
    List<String> result = new ArrayList<String>();
    for (String s : strings)
    {
      if (s.length() < length + 1)
      {
        result.add(s);
      }
    }
    return result;
  }
}
```

```groovy
names = ["Ted", "Fred", "Jed", "Ned"]
println names
short_names = names.findAll{it.size() <= 3}
println short_names.size()
short_names.each {println it}
```

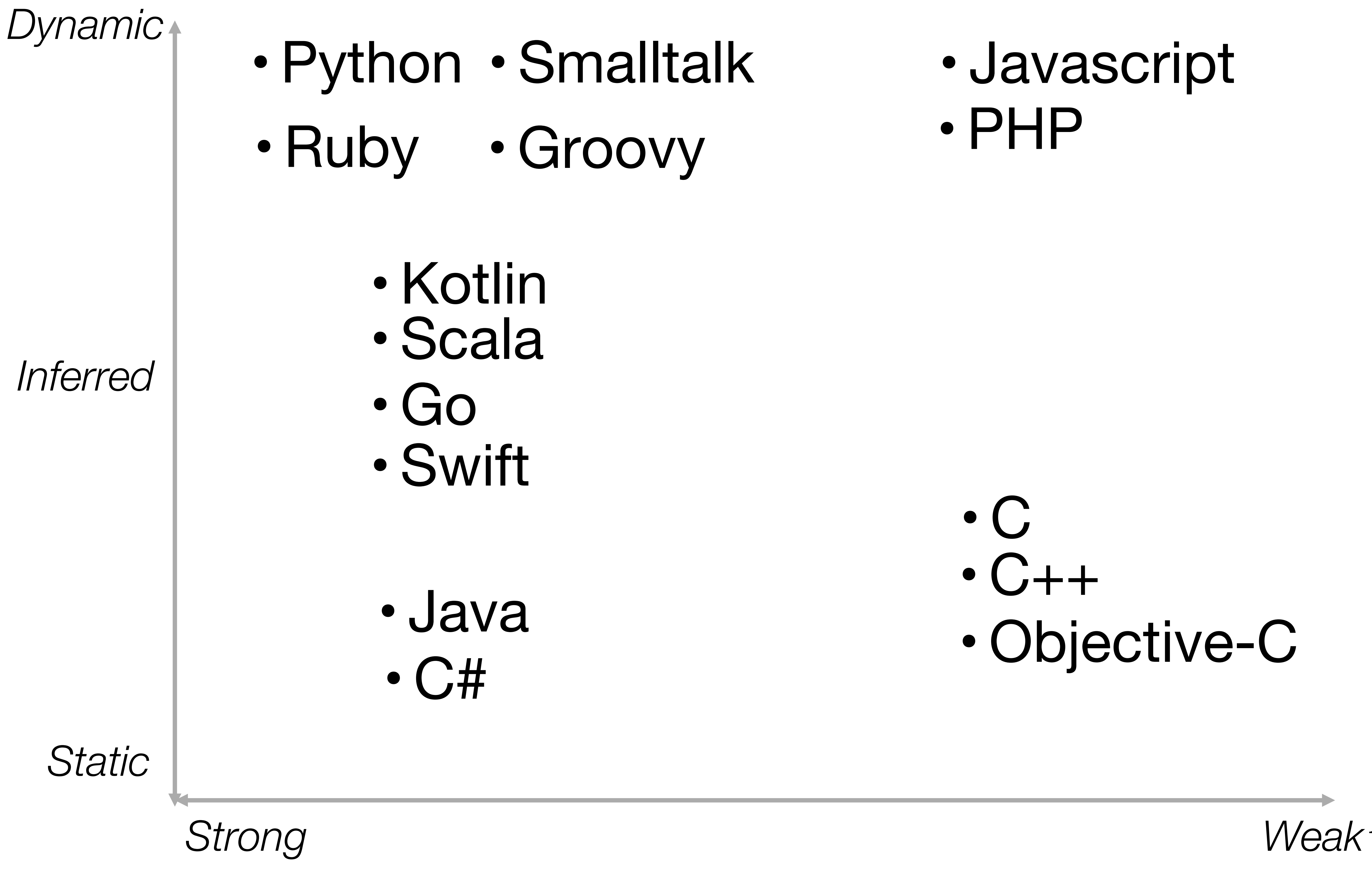
Java vs Groovy?

Another Approach to Types?

- *Type Inference* : the compiler draws conclusions about the types of variables based on how programmers use those variables.
  - Yields programs that have some of the conciseness of Dynamically Typed Languages
  - But - decision made at *compile time*, not at *run time*
  - More information for static analysis - refactoring tools, complexity analysis, bug checking etc...
- Haskell, Scala, **Kotlin** Java (from 7 onwards)

```
object InferenceTest1 extends Application {
  val x = 1 + 2 * 3         // the type of x is int
  val y = x.toString()      // the type of y is String
  def succ(x: int) = x + 1 // method succ returns int values
}
```

Typing Spectrum



Back to our Java Example

- Java algorithm to filter a list of strings
- Only printing those with 3 or less characters (in this test case).

```java
import java.util.ArrayList;
import java.util.List;

class Erase{
  public static void main(String[] args)
  {
    List<String> names = new ArrayList<String>();
    names.add("Ted");
    names.add("Fred");
    names.add("Jed");
    names.add("Ned");
    System.out.println(names);
    Erase e = new Erase();
    List<String> short_names = e.filterLongerThan(names, 3);
    System.out.println(short_names.size());
    for (String s : short_names)
    {
      System.out.println(s);
    }
  }

  public List<String> filterLongerThan(List<String> strings,
                                                     int length)
  {
    List<String> result = new ArrayList<String>();
    for (String s : strings)
    {
      if (s.length() < length + 1)
      {
        result.add(s);
      }
    }
    return result;
  }
}
```

Swift

```swift
import Foundation

class Erase
{
  func main()
  {
    var names:String[] = String[]()
    names.append ("ted")
    names.append ("fred")
    names.append ("jed")
    names.append ("ned")
    println(names)
    var short_names:String[] = filterLongerThan(names, length:3)
    for name:String in short_names
    {
      println (name)
    }
  }
  func filterLongerThan (strings : String[], length : Int) -> String[]
  {
    var result:String[] = String[]()
    for s:String in strings
    {
      if countElements(s) < length + 1
      {
        result.append(s)
      }
    }
    return result
  }
}

var erase:Erase = Erase()
erase.main()
```

Swift

- Type Inference

```
import Foundation

class Erase
{
  func main()
  {
    var names = String[]()
    names.append ("ted")
    names.append ("fred")
    names.append ("jed")
    names.append ("ned")
    println(names)
    var short_names = filterLongerThan(names, length:3)
    for name in short_names
    {
      println (name)
    }
  }
  func filterLongerThan (strings : String[], length : Int) -> String[]
  {
    var result = String[]()
    for s in strings
    {
      if countElements(s) < length + 1
      {
        result.append(s)
      }
    }
    return result
  }
}

var erase = Erase()
erase.main()
```

Swift

- Literals

```
import Foundation

class Erase
{
  func main()
  {
    var names = ["ted", "fred", "jed", "ned"]
    var short_names = filterLongerThan(names, length:3)
    for name in short_names
    {
      println (name)
    }
  }

  func filterLongerThan (strings : String[], length : Int) -> String[]
  {
    var result = String[]()
    for s in strings
    {
      if countElements(s) < length + 1
      {
        result.append(s)
      }
    }
    return result
  }
}

var erase = Erase()
erase.main()
```

Swift

- Closures

```
import Foundation

class Erase
{
  func main()
  {
    var names = ["ted", "fred", "jed", "ned"]
    var short_names = names.filter { countElements($0) < 4 }
    for name in short_names
    {
      println (name)
    }
  }
}

var erase = Erase()
erase.main()
```

Swift

- Script

```
import Foundation

var names = ["ted", "fred", "jed", "ned"]
println(names)
var short_names = names.filter { countElements($0) < 4 }
println(short_names)
```

```
import java.util.ArrayList;
import java.util.List;

class Erase
{
  public static void main(String[] args)
  {
    List<String> names = new ArrayList<String>();
    names.add("Ted");
    names.add("Fred");
    names.add("Jed");
    names.add("Ned");
    System.out.println(names);
    Erase e = new Erase();
    List<String> short_names =
              e.filterLongerThan(names, 3);
    System.out.println(short_names.size());
    for (String s : short_names)
    {
      System.out.println(s);
    }
  }

  public List<String> filterLongerThan(
                   List<String> strings, int length)
  {
    List<String> result = new ArrayList<String>();
    for (String s : strings)
    {
      if (s.length() < length + 1)
      {
        result.add(s);
      }
    }
    return result;
  }
}
```

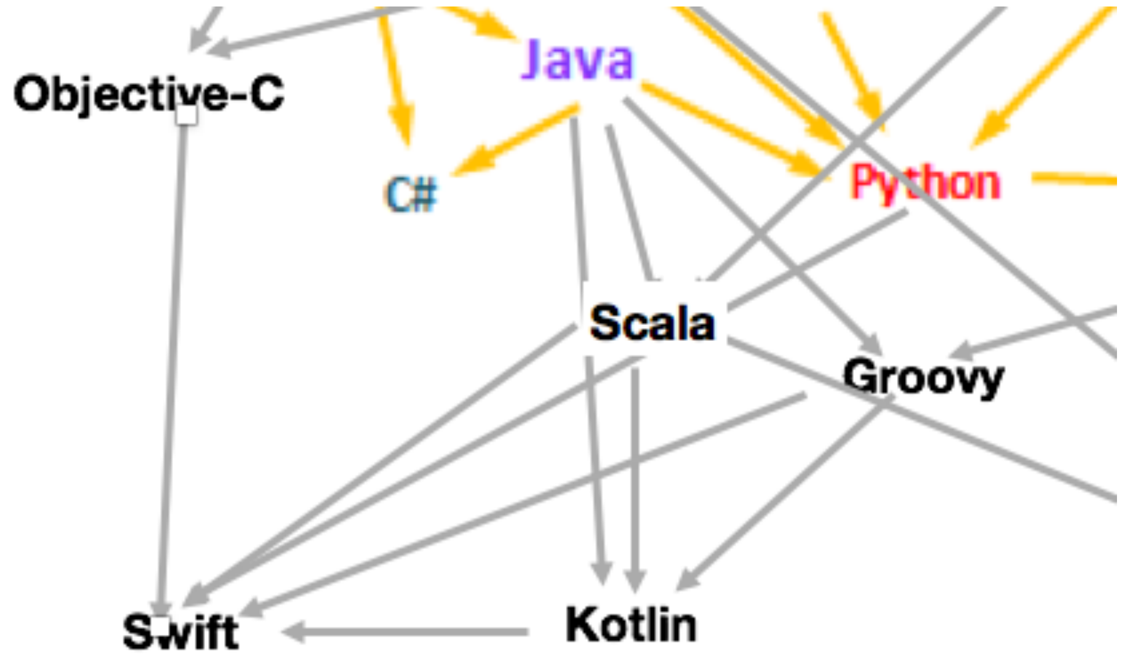
Java

```
names = ["Ted", "Fred", "Jed", "Ned"]
println names
short_names = names.findAll{it.size() <= 3}
short_names.each {println it}
```

Groovy

```
var names = ["ted", "fred", "jed", "ned"]
println(names)
var short_names = names.filter { countElements($0) < 4 }
println(short_names)
```

Swift



Kotlin 1

```kotlin
package wordfilter
import java.util.ArrayList;

fun main(args: Array<String>) {
  val names: MutableList<String> = ArrayList<String>();
  names.add("Ted");
  names.add("Fred");
  names.add("Jed");
  names.add("Ned");
  System.out.println(names);
  val e = Erase();
  val short_names = e.filterLongerThan(names, 3);
  System.out.println(short_names.size);
  for (s: String in short_names) {
    System.out.println(s);
  }
}

class Erase {
  fun filterLongerThan(strings: MutableList<String>, length: Int): MutableList<String> {
    val result: MutableList<String> = ArrayList<String>();
    for (s: String in strings) {
      if (s.length < length + 1) {
        result.add(s)
      }
    }
    return result
  }
}
```

```
package wordfilter
import java.util.ArrayList;

fun main(args: Array<String>) {
  val names: MutableList<String> = ArrayList<String>();
  names.add("Ted");
  names.add("Fred");
  names.add("Jed");
  names.add("Ned");
  System.out.println(names);
  val e = Erase();
  val short_names = e.filterLongerThan(names, 3);
  System.out.println(short_names.size);
  for (s: String in short_names) {
    System.out.println(s);
  }
}

fun filterLongerThan(strings: MutableList<String>, length: Int): MutableList<String> {
  val result: MutableList<String> = ArrayList<String>();
  for (s: String in strings) {
    if (s.length < length + 1) {
      result.add(s)
    }
  }
  return result
}
```

Kotlin 3

```
package wordfilter
import java.util.ArrayList;

fun main(args: Array<String>) {
  val names: MutableList<String> = mutableListOf("Ted", "Fred", "Jed", "Ned");
  println(names);
  val e = Erase();
  val short_names = e.filterLongerThan(names, 3)
  println(short_names.size)
  for (s: String in short_names) {
    println(s);
  }
}

fun filterLongerThan1(strings: MutableList<String>, length: Int): List<String> {
  val result: List<String> = strings.filter { it.length < length + 1 }
  return result
}
```

Kotlin 4

```
package wordfilter
import java.util.ArrayList;

fun main(args: Array<String>) {
  val names: MutableList<String> = mutableListOf("Ted", "Fred", "Jed", "Ned");
  println(names);
  val short_names: List<String> = names.filter { it.length < 4 }
  println(short_names.size)
  println(short_names)
}
```

Kotlin 5

```kotlin
val names = mutableListOf("Ted", "Fred", "Jed", "Ned");
println(names);
val short_names = names.filter { it.length < 4 }
println(short_names)
```

```java
import java.util.ArrayList;
import java.util.List;

class Erase
{
  public static void main(String[] args)
  {
    List<String> names = new ArrayList<String>();
    names.add("Ted");
    names.add("Fred");
    names.add("Jed");
    names.add("Ned");
    System.out.println(names);
    Erase e = new Erase();
    List<String> short_names =
              e.filterLongerThan(names, 3);
    System.out.println(short_names.size());
    for (String s : short_names)
    {
      System.out.println(s);
    }
  }

  public List<String> filterLongerThan(
                  List<String> strings, int length)
  {
    List<String> result = new ArrayList<String>();
    for (String s : strings)
    {
      if (s.length() < length + 1)
      {
        result.add(s);
      }
    }
    return result;
  }
}
```

Java

```groovy
names = ["Ted", "Fred", "Jed", "Ned"]
println names
short_names = names.findAll{ it.size() < 4 }
short_names.each {println it}
```

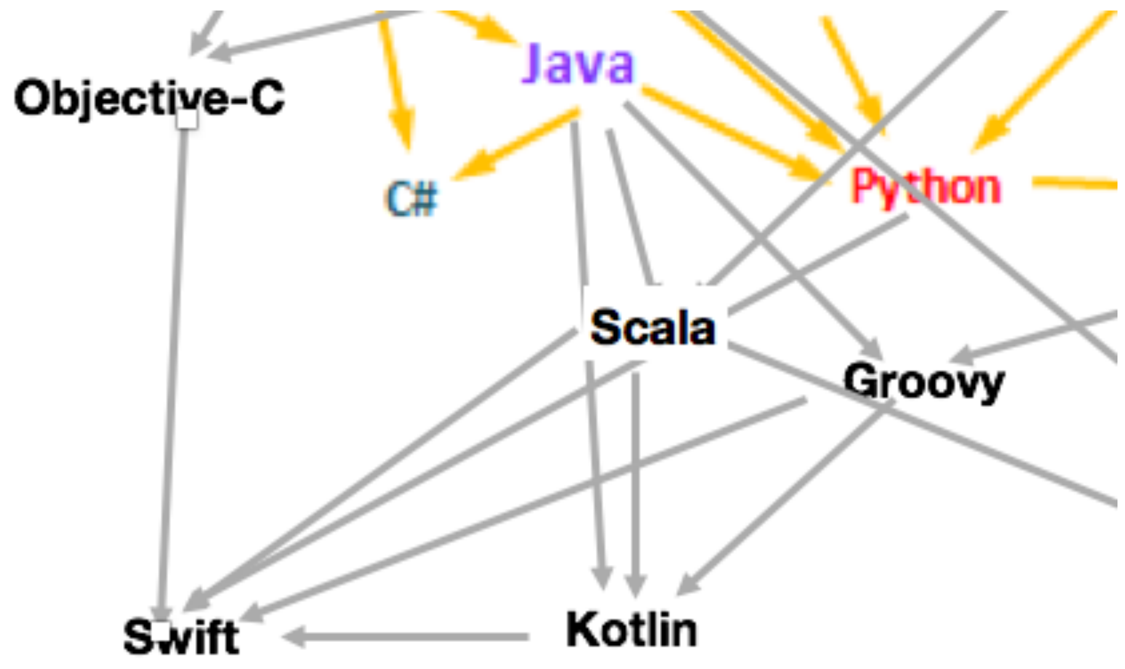
Groovy

```swift
let names = ["ted", "fred", "jed", "ned"]
println(names)
let short_names = names.filter { countElements($0) < 4 }
println(short_names)
```

Swift

```kotlin
val names = mutableListOf("Ted", "Fred", "Jed", "Ned");
println(names);
val short_names = names.filter { it.length < 4 }
println(short_names)
```

Kotlin


Objective-C
Java
C#
Python
Scala
Groovy
Swift
Kotlin