Introduction to Java

Michelle Brush
Senior Software Architect
Cerner Corporation

Duke

Who I Am

- BS, Computer Science
- 13 years software development
  - Assembly, C, C++, C#, **Java**, JavaScript, Prolog, Python, Ruby, Scheme, SmallTalk, SQL
  - 2 years instruction, curriculum development
- cofounder, Kansas City **Girl Develop It**

Let's agree to some things.

We're all making an investment.

Class Commitments

Me

- No work
- No phone calls, texting, social networking
- Show patience
- Give feedback
- Help you find the answer

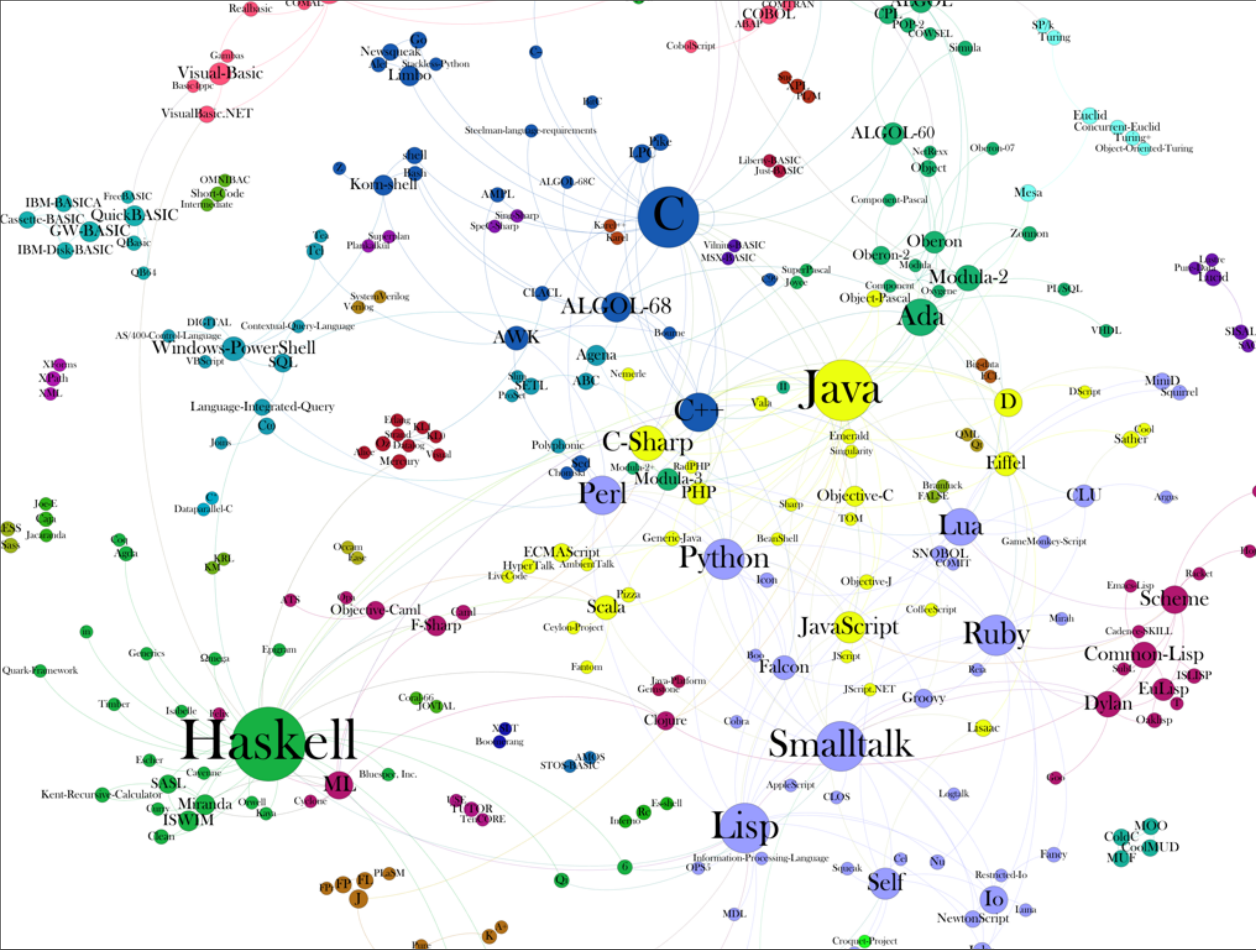
Class Commitments

You

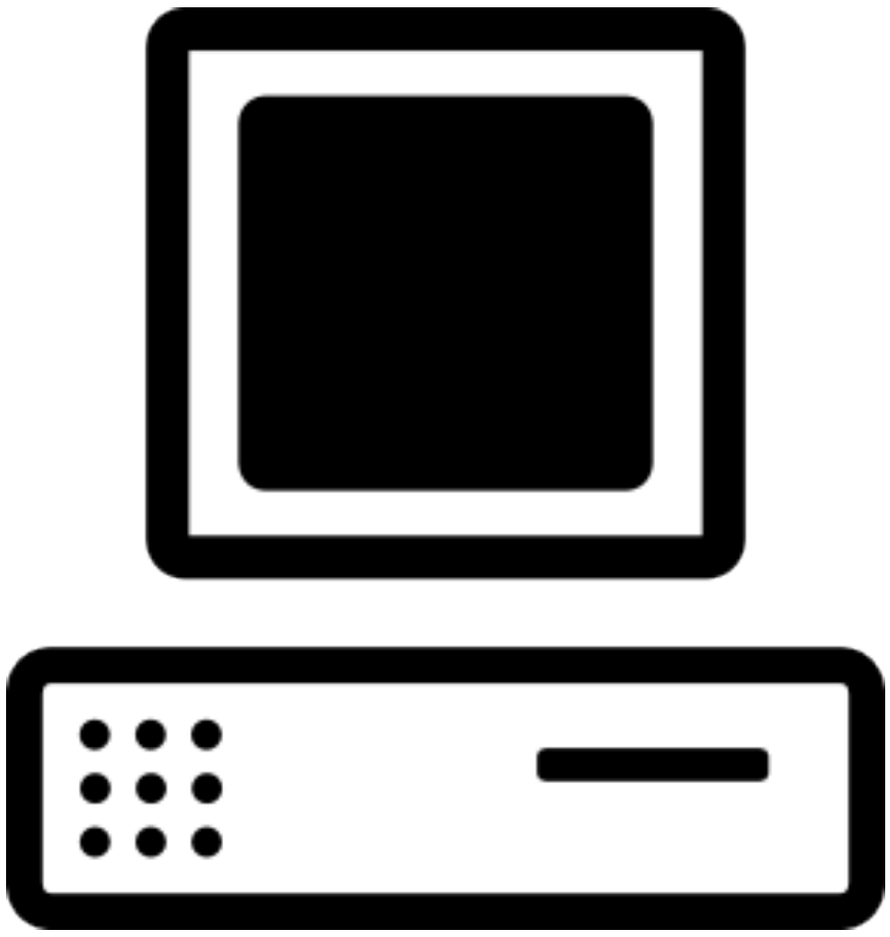
- No work
- No phone calls, texting, social networking
- No gurus
- Try it!
- Take feedback.

Different Skill Levels

I know nothing.	This will be some work.
I know a little programming.	Great.
I know one language well.	This will be easy.
I know a few languages well.	This will be very easy.
I know Java.	You're going to be bored.


Realbasic
COBOL
ABAP
CoboIScript
CPL
POP-2
COWSEL
Simula
SP/k
Turing
Gambas
Visual-Basic
Newsqueak
Go
Limbo
StacklessPython
VisualBasic.NET
Steelman-language-requirements
Euclid
Concurrent-Euclid
Turing+
Object-Oriented-Turing
ALGOL-60
NetRexx
Oberon-07
Object
shell
Bash
Korn-shell
Pike
LPC
Liberty-BASIC
Just-BASIC
OMNIBAC
Short-Code
Intermediate
FreeBASIC
IBM-BASICA
Cassette-BASIC
QuickBASIC
GW-BASIC
QBasic
IBM-Disk-BASIC
QB64
AMPL
ALGOL-68C
Sing-Sharp
Spec-Sharp
C
Karel++
Karel
Component-Pascal
Mesa
Oberon
Zonnon
Oberon-2
Modula
Modula-2
Vilnius-BASIC
MSX-BASIC
SuperPascal
Joyce
Component
Oxygene
Object-Pascal
Ada
PL/SQL
Tcl
Superplan
Plankalkul
SystemVerilog
Verilog
CLACL
ALGOL-68
DIGITAL
Contextual-Query-Language
AS/400-Control-Language
Windows-PowerShell
VBScript
SQL
AWK
Bourne
Agena
Nemerle
VHDL
SISAL
XForms
XPath
XML
SETL
ABC
Java
D
DScript
MiniD
Squirrel
Vala
C++
Language-Integrated-Query
Erlang
Oz
Mercury
Visual
C-Sharp
Polyphonic
Emerald
Singularity
QML
Eiffel
Cool
Sather
Modula-3
RadPHP
PHP
Perl
Objective-C
Brainfuck
FALSE
CLU
Argus
Data-parallel-C
Jacaranda
Occam
Generic-Java
BeanShell
TOM
Lua
ECMAScript
HyperTalk
AmbientTalk
LiveCode
Python
SNOBOL
COMIT
GameMonkey-Script
Icon
Objective-J
Racket
EmacsLisp
Scheme
Objective-Caml
Caml
F-Sharp
Pizza
Scala
Ceylon-Project
CoffeeScript
JavaScript
Ruby
Mirah
Cadence-SKILL
Common-Lisp
Generics
Omega
Epigram
Quark-Framework
Fantom
JScript
Falcon
Java-Platform
JScript.NET
Groovy
EuLisp
ISLISP
Dylan
Oaklisp
Timber
Isabelle
Coral66
JOVIAL
Haskell
Clojure
Cobra
Lisaac
Smalltalk
Boomerang
STOS-BASIC
AMOS
Escher
Cayenne
SASL
Bluespec, Inc.
Kent-Recursive-Calculator
Miranda
Orwell
ISWIM
Clean
ML
Cyclone
TUTOR
TenCORE
AppleScript
CLOS
Logtalk
Es-shell
Rc
Inferno
Lisp
MOO
ColdC
CoolMUD
MUF
Information-Processing-Language
OPS5
Squeak
Cel
Nu
Fancy
Self
Restricted-Io
Io
NewtonScript
PL-SM
FP
FL
J
Qi
MDL
K
Croquet-Project

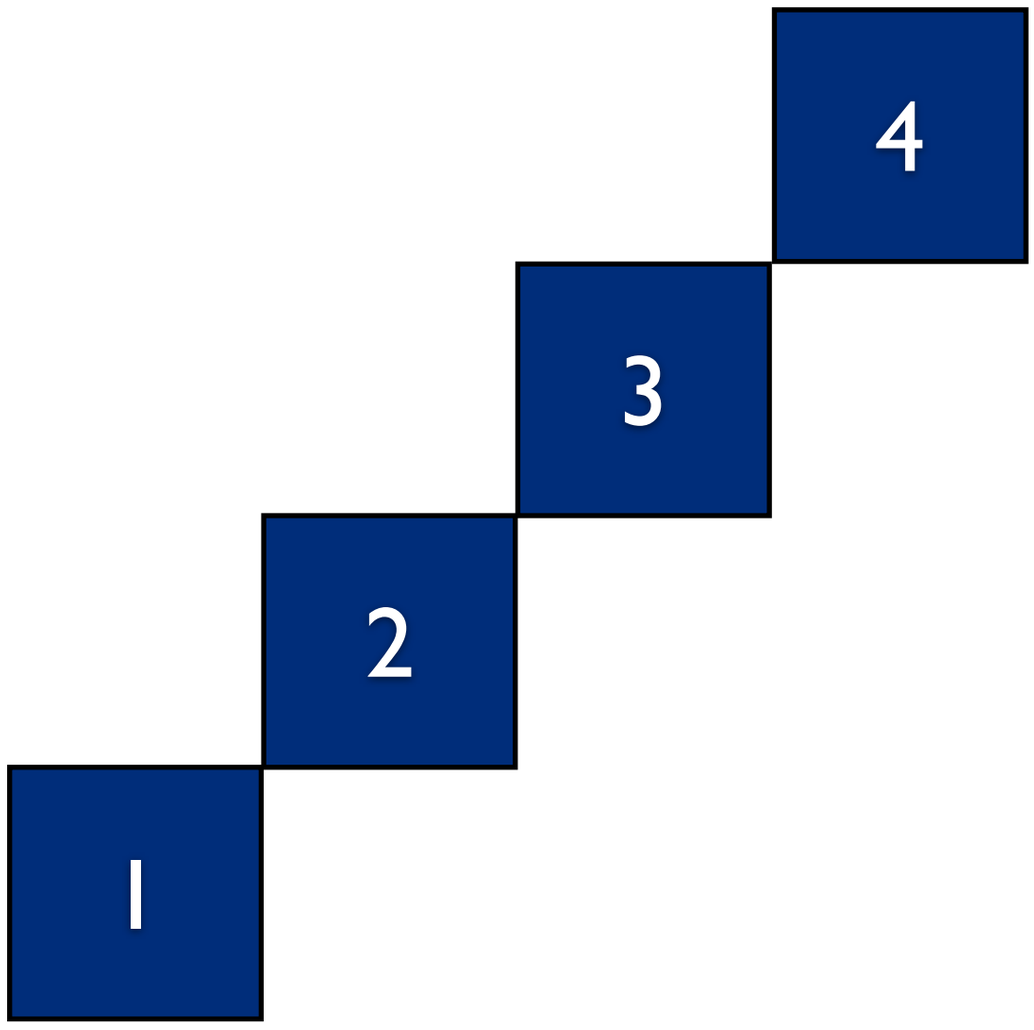
Programming



Change the way you think about things.

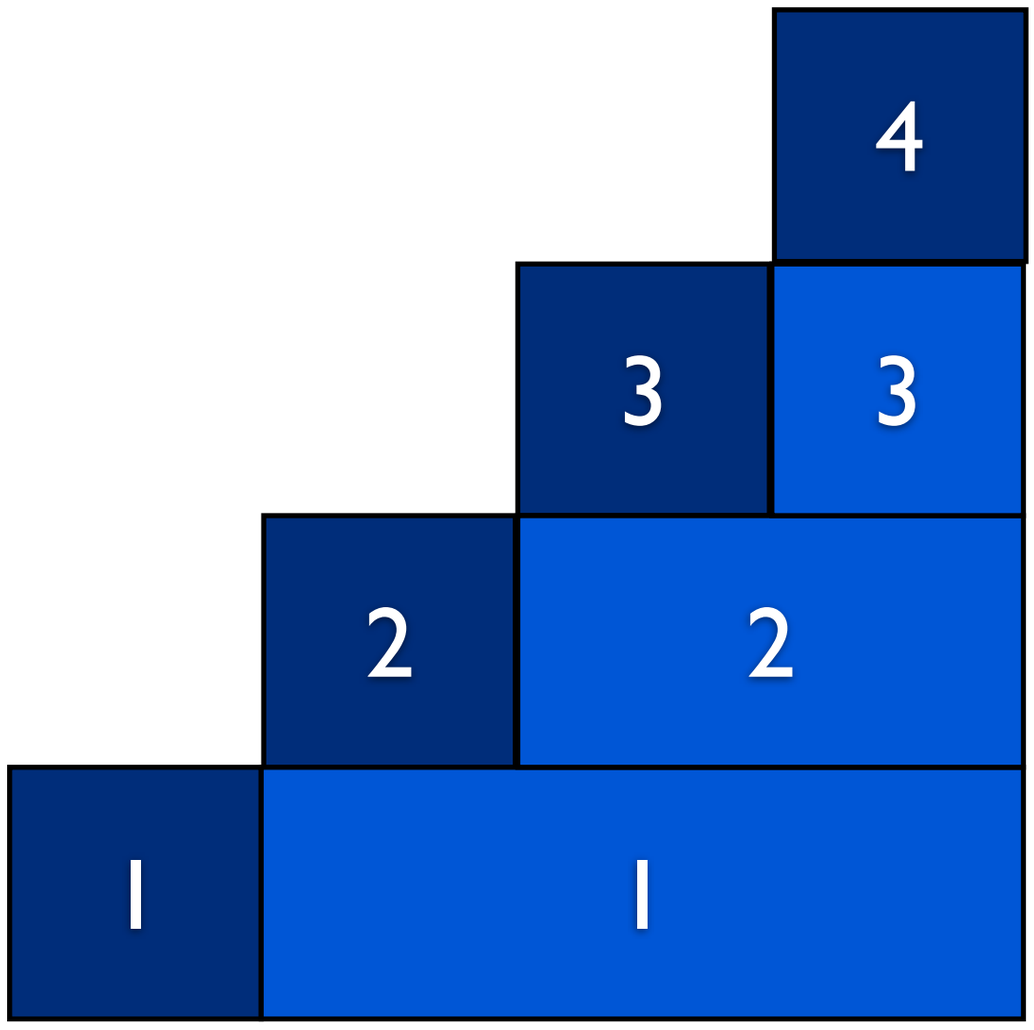
Think like a computer.

Let's talk about math.



1. Counting.
2. Numbers.
3. Comparison
4. Addition
5. Subtraction
6. ...

Let's talk about math.



1. Counting.
2. Numbers.
3. Comparison
4. Addition
5. Subtraction
6. ...

Let's talk about math.

Base Numbering Systems

1. **Counting**.
2. **Numbers**.
3. Comparison
4. Addition
5. Subtraction
6. ...

Base 10 Numbering

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, ?

10

1x10 + 0x1

11

1x10 + 1x1

296

2x100 + 9x10 + 6x1

Base 10 Numbering

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, ?

10

$$1x10^1 + 0x10^0$$

11

$$1x10^1 + 1x10^0$$

296

$$2x10^2 + 9x10^1 + 6x10^0$$

Memorization

Base 2 Numbering

0, 1, ?

10 = 2

$1x2^1 + 0x2^0$

11 = 3

$1x2^1 + 1x2^0$

111 = 7

$1x2^2 + 1x2^1 + 1x2^0$

Count to 15 in binary.

0 = 0

1 = 1

10 = 2

11 = 3

100 = 4

101 = 5

110 = 6

111 = 7

1000 = 8

1001 = 9

1010 = 10

1011 = 11

1100 = 12

1101 = 13

1110 = 14

1111 =15

Yay!

In the beginning, you are just going to have to roll with it.

As long as it's temporary.

;)

You can't learn to program without writing code.

Lots of it.

Class Structure

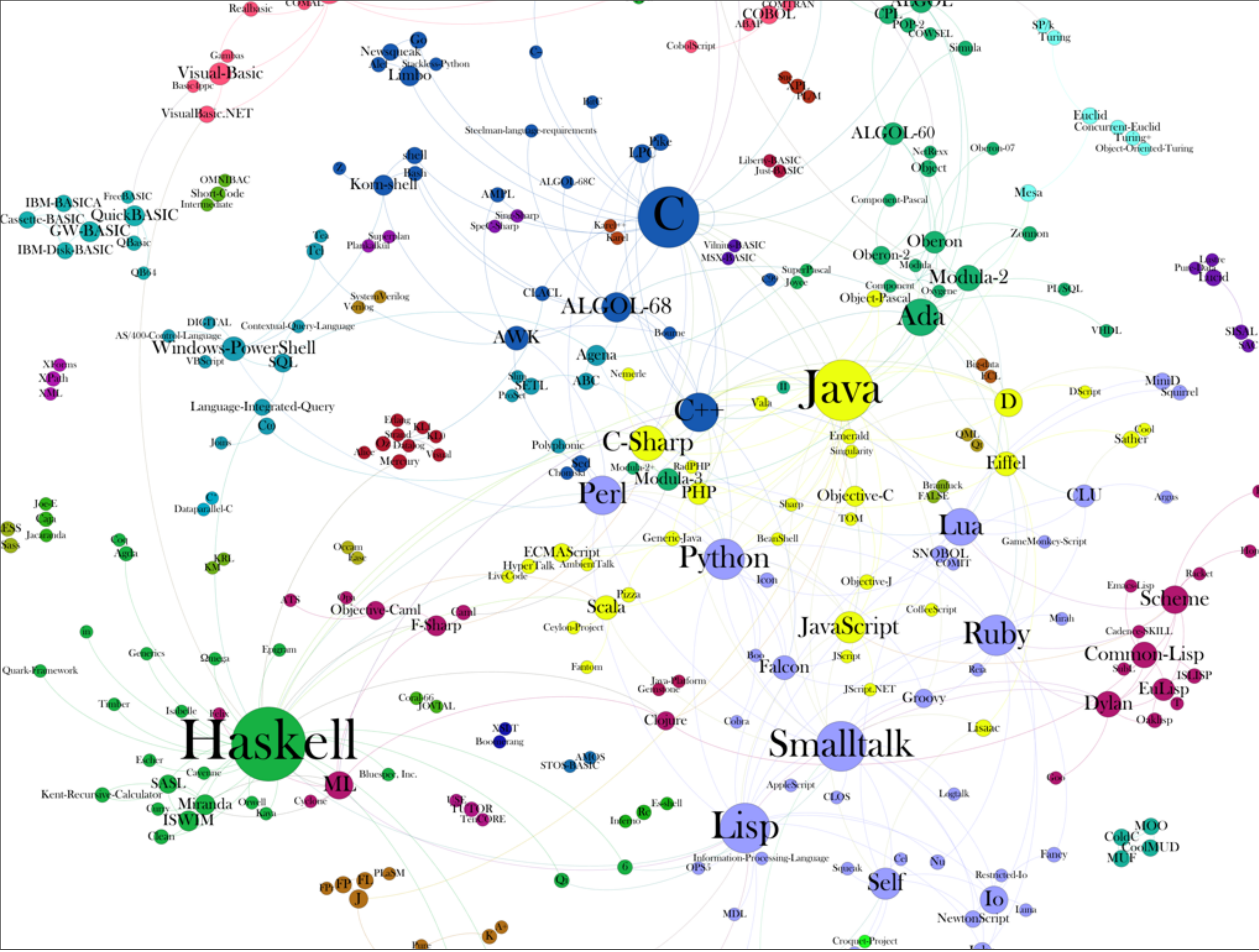
- The Why and What of Java
- Basic Logic
- Object-Oriented Programming
- When Things Go Wrong
- Common Java APIs
- JUnit
- Generics
- Putting It All Together I & II

Class Structure

- **The Why and What of Java**
- Basic Logic
- Object-Oriented Programming
- When Things Go Wrong
- Common Java APIs
- JUnit
- Generics
- Putting It All Together I & II

The Why and What of Java

- Write Once, Run Anywhere
- Getting Setup
- Hello World
- Anatomy of the Program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XML
Language-Integrated-Query
Co
SETL
ProSet
ABC
C++
Vala
Java
D
DScript
MiniD
Squirrel
Erlang
KL1
Strand
KL0
Oz
Datalog
Alice
Visual
Mercury
Joins
Polyphonic
C-Sharp
Emerald
Singularity
QML
Qt
Cool
Sather
Chomski
Perl
Modula-2+
Modula-3
RadPHP
PHP
Brainfuck
FALSE
Eiffel
Dataparallel-C
Objective-C
Sharp
TOM
CLU
Argus
Lua
Jacaranda
Coq
Agda
KRL
KM
Occam
Generic-Java
BeanShell
ECMAScript
HyperTalk
AmbientTalk
LiveCode
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SNOBOL
COMIT
GameMonkey-Script
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EmacsLisp
Scheme
Racket
Objective-Caml
F-Sharp
Caml
Scala
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Clojure
Cobra
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Haskell
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Boomerang
Smalltalk
ML
Bluespec, Inc.
AMOS
STOS-BASIC
Escher
Cayenne
SASL
Kent-Recursive-Calculator
Miranda
Orwell
Cyclone
Clean
ISWIM
TUTOR
TenCORE
Inferno
Es-shell
AppleScript
CLOS
Logtalk
Lisp
MOO
ColdC
CoolMUD
MUF
Fancy
Information-Processing-Language
OPS5
Squeak
Cel
Nu
Restricted-Io
PL-SM
FP
FL
J
Self
Io
NewtonScript
Lama
MDL
Croquet-Project
K
A+

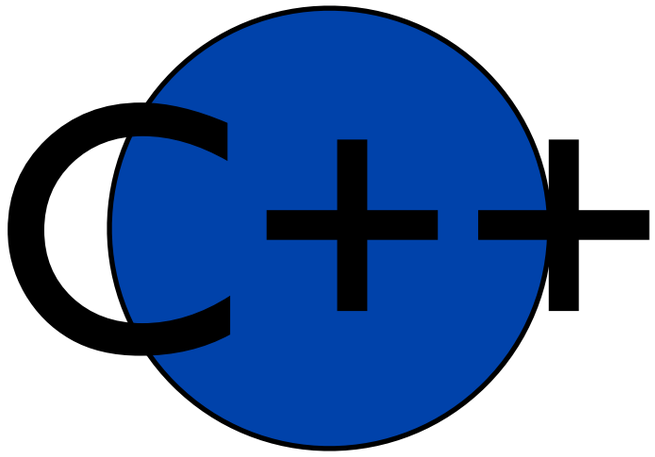
All programming languages are just tools to solve a problem.

What are we trying to solve with Java?

Originally: Write Once, Run Anywhere

James Gosling

01010100
01110010
01111001
00100000
01101001
01110100
00100001

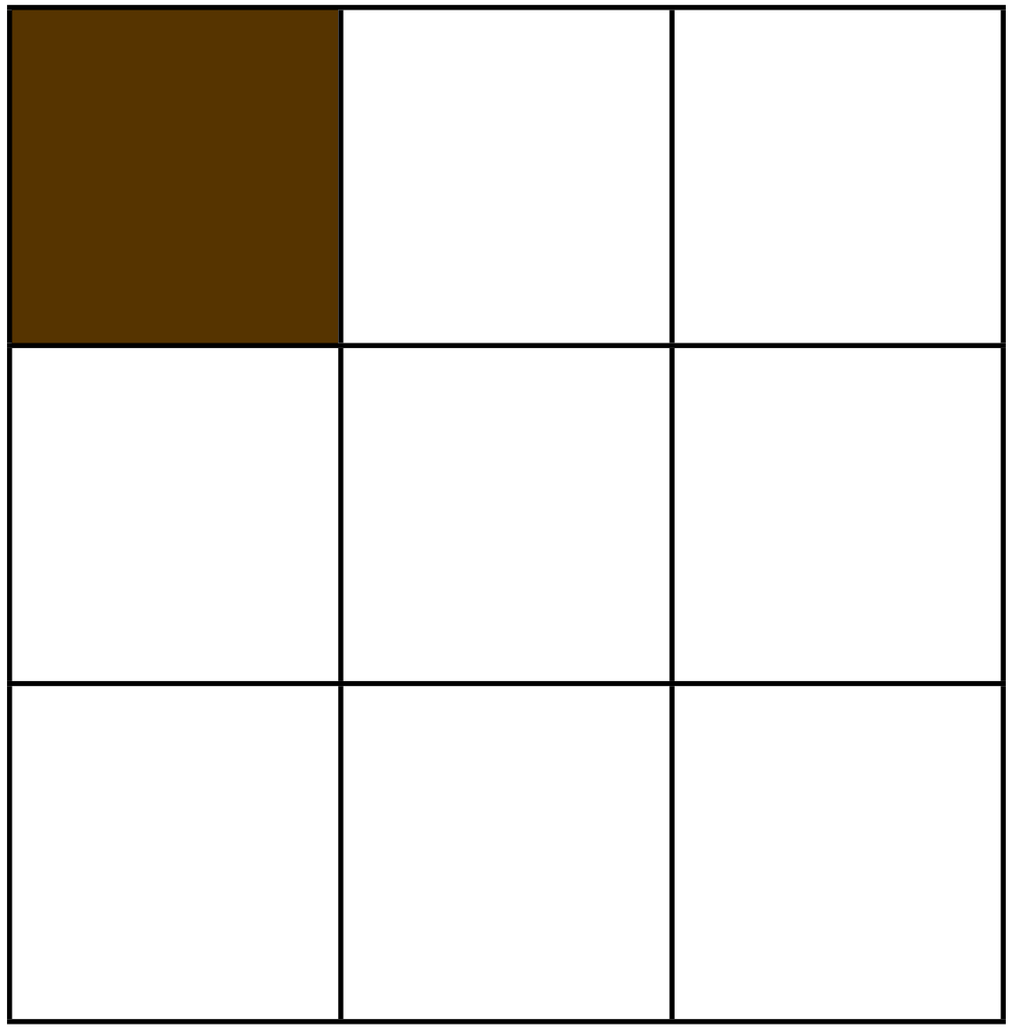


Memory Management

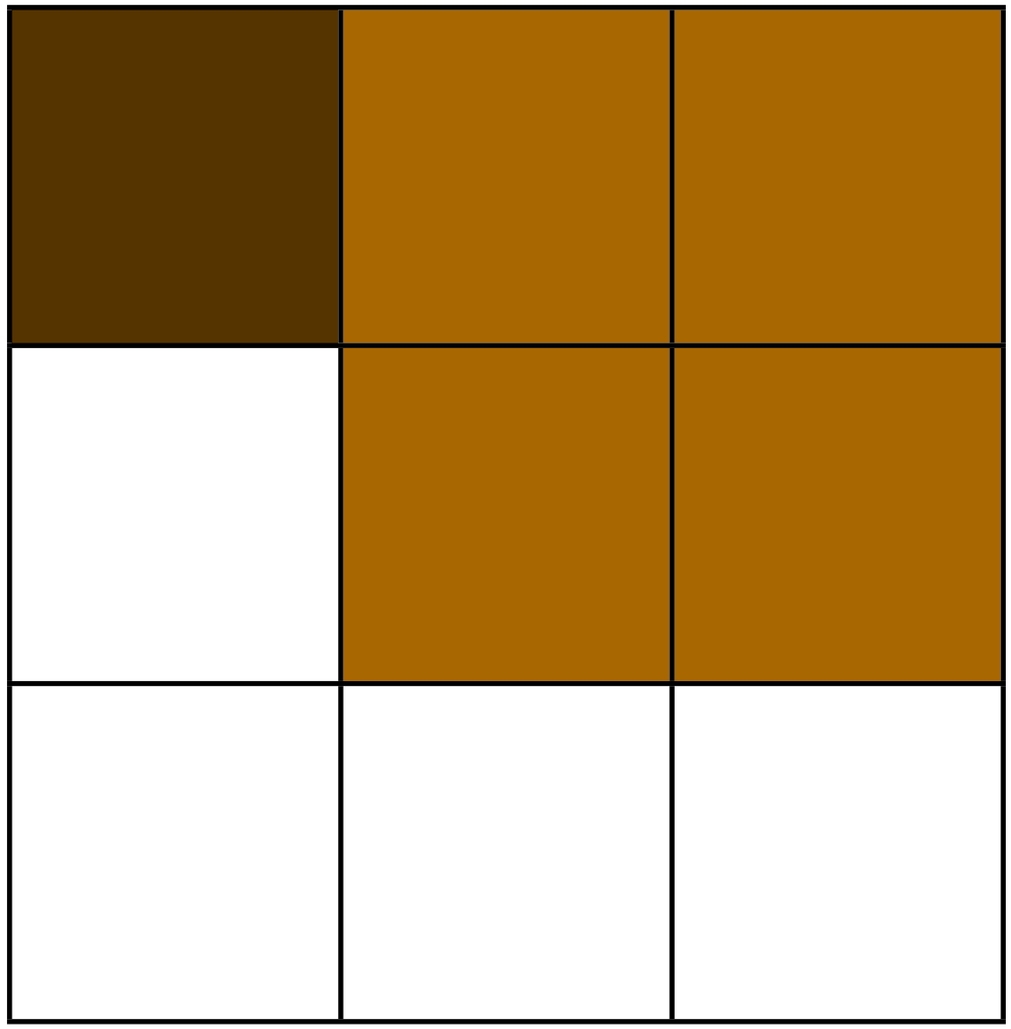
Memory means space.

Allocate space.
Free space.
Keep track of space.

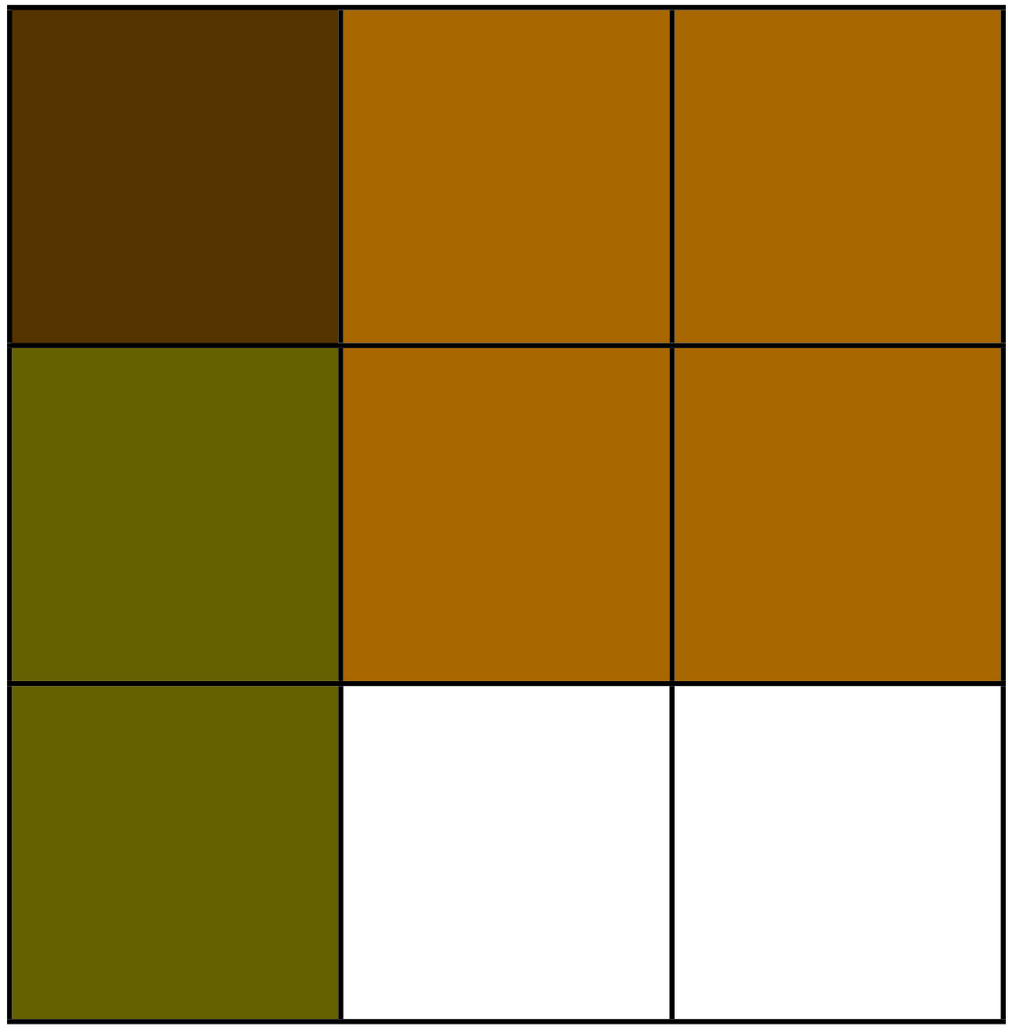
Analogy: Closet



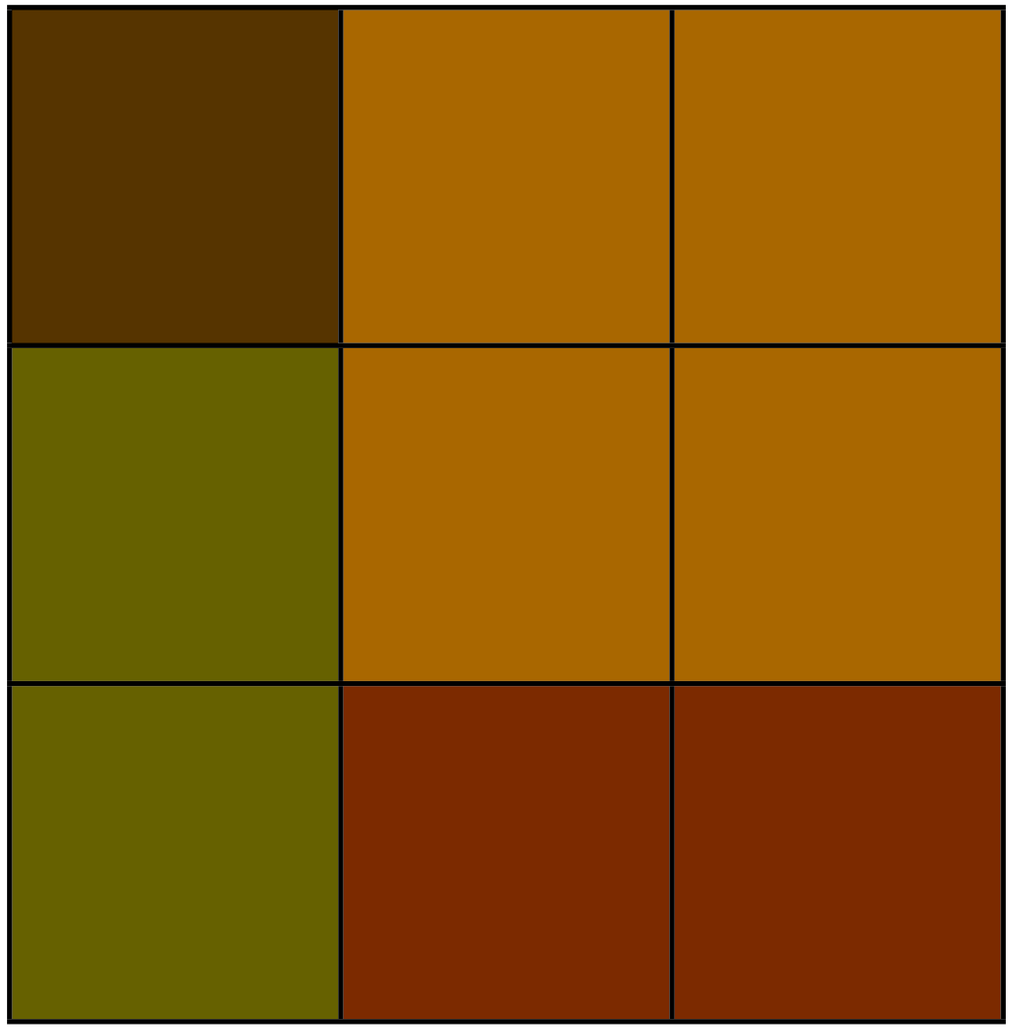
Analogy: Closet



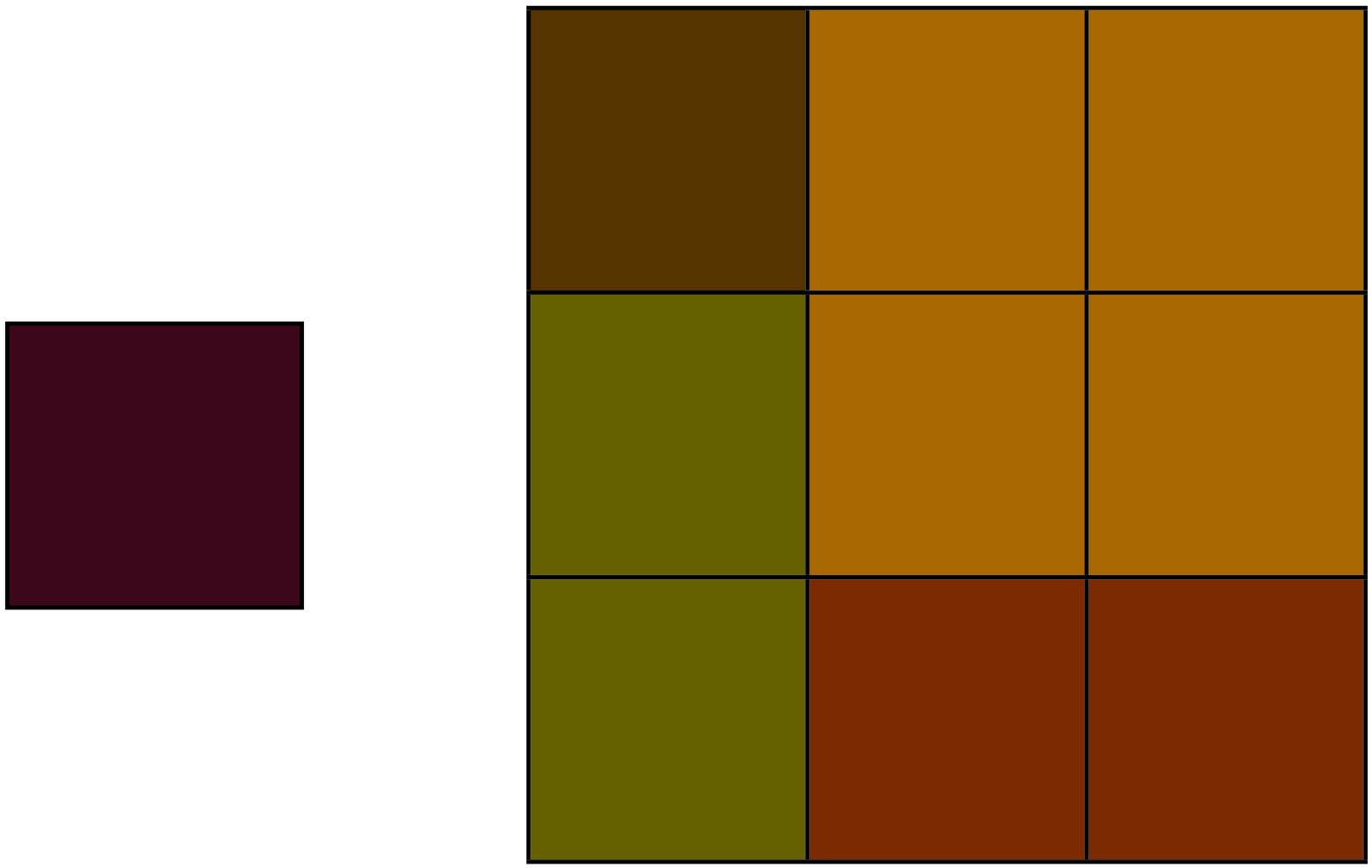
Analogy: Closet



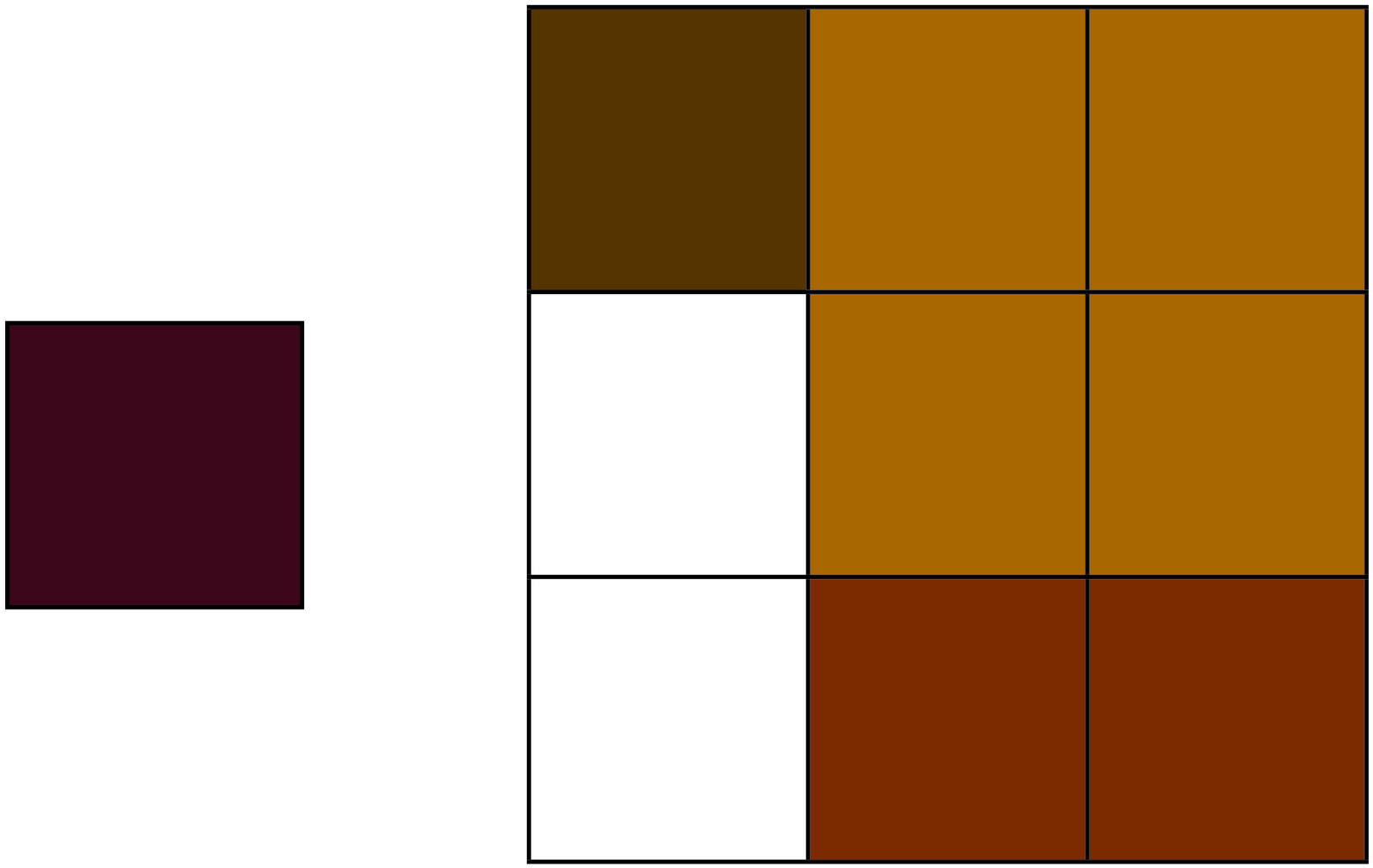
Analogy: Closet



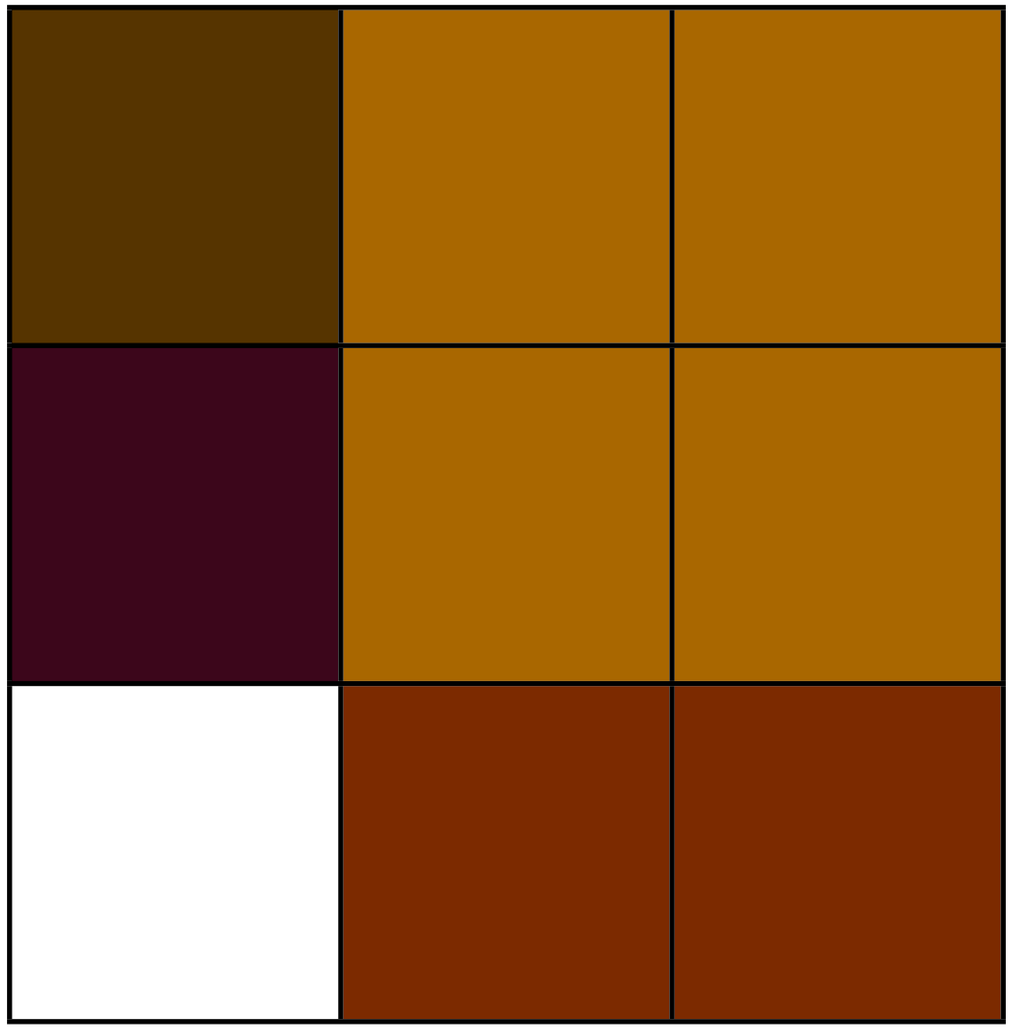
Analogy: Closet



Analogy: Closet



Analogy: Closet



I'd like the computer to manage all the space for me?

Garbage Collection

When you need it, the space is there.

When you don't, Java cleans it up - eventually.

01010100
01110010
01111001
00100000
01101001
01110100
00100001

I

0

Base 2 Numbering

0, 1, ?

10

$1x2^1 + 0x2^0$

11

$1x2^1 + 1x2^0$

111

$1x2^2 + 1x2^1 + 1x2^0$

01010100
01110010
01111001
00100000
01101001
01110100
00100001

```
push    %ebp
mov     %esp, %ebp

mov     8(%ebp), %eax
mov     12(%ebp), %ecx
push    %edx
```

ASSEMBLY

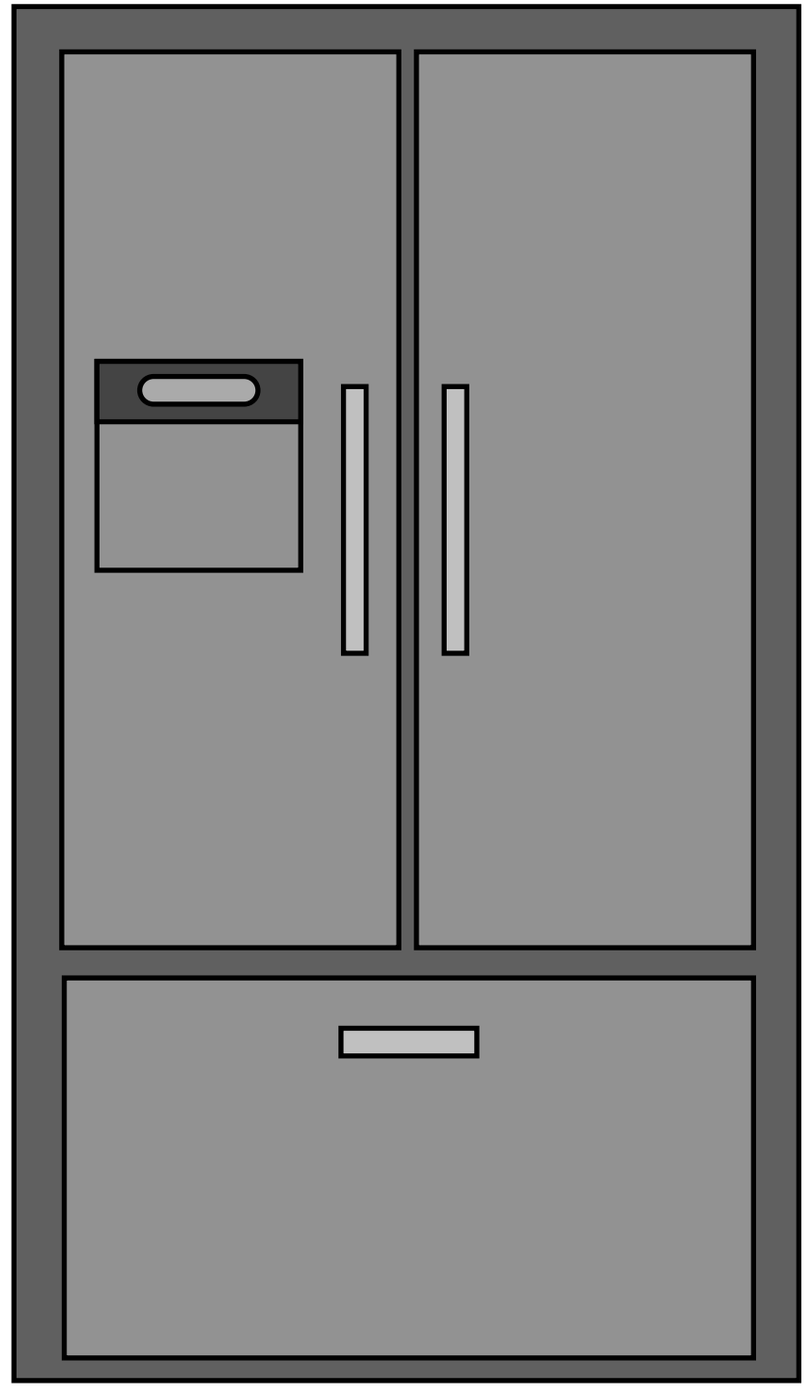
```
C++
cout << "Hello World.";

Python
print 'Hello World.'

Ruby
puts "Hello World."

Java
print("Hello World.");
```

High Level Languages

James Gosling

01110010
01111001
00100000
01101001
01110100
00100001

01010000
01111110
01111001
11101111
01100001
00101101



01010100
01110010
01111001
00100000
01110100
00100001

01010100
01110010
0
01010000
1
01111110
0
01111001
11
01
00

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01101001
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High Level Languages

Compiler

Compiler

```
01010101010
01010010010
10000011111
```

```
11110001001
01010010010
10000011111
```

```
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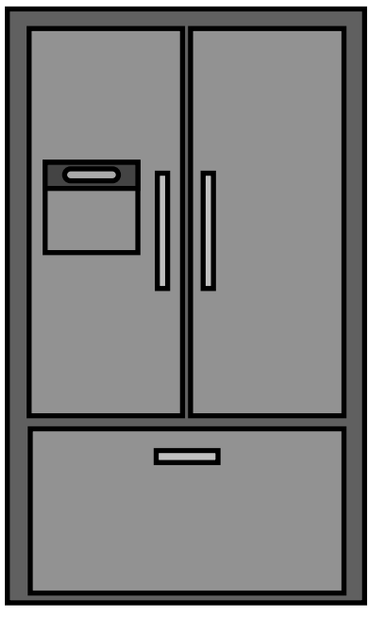


Compiler

```
Java
print “Hello World.";
```

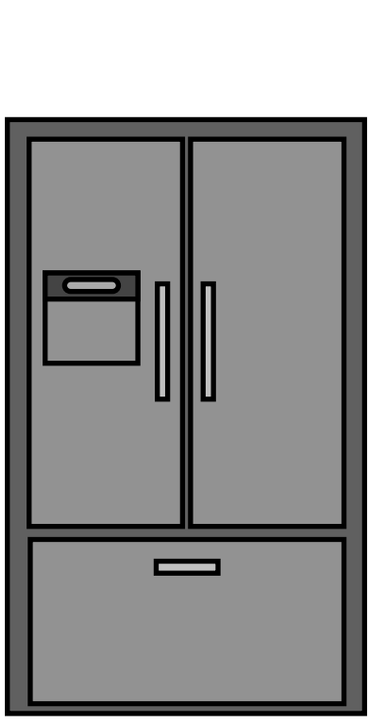
```
aload_0
invokespecial #1
```

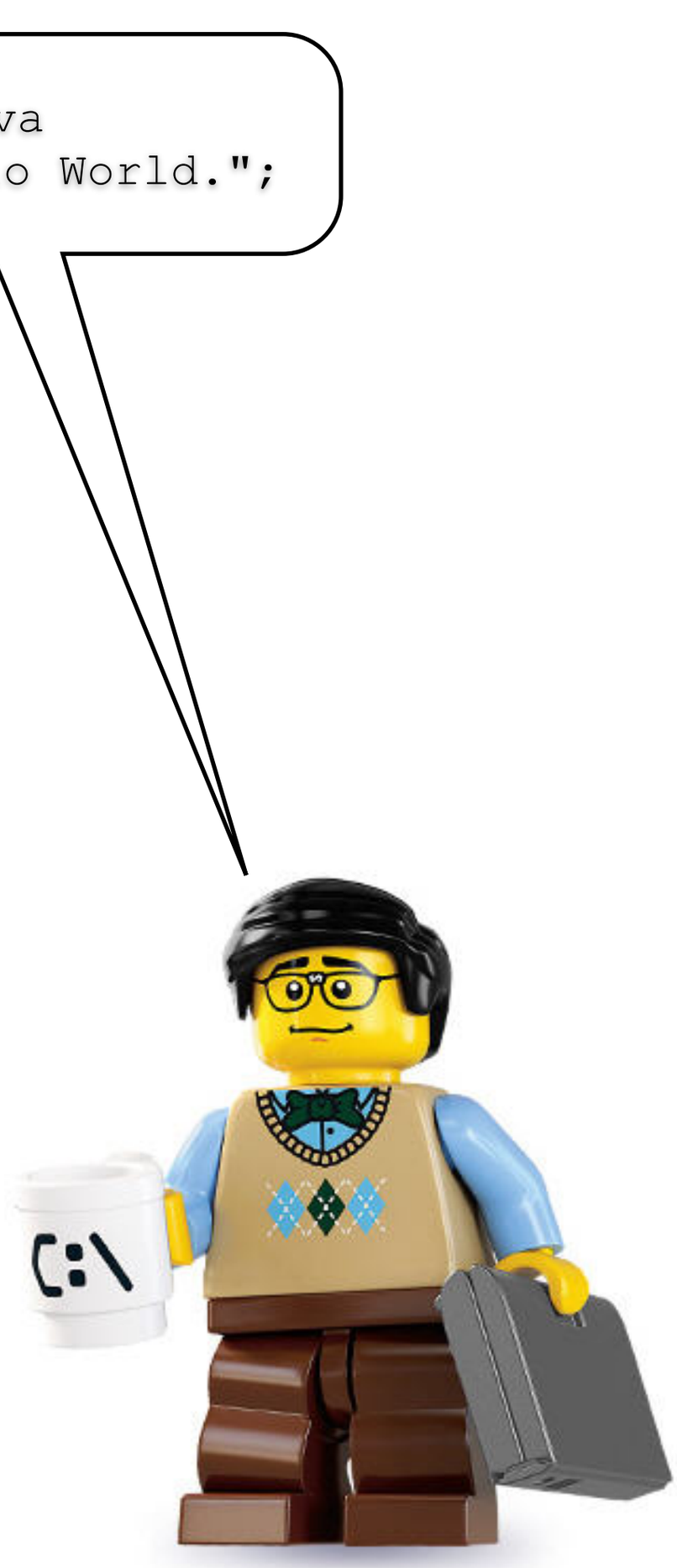
Runtime Environment

```
01010101010
01010010010
10000011111
```

Runtime Environment

```
11110001001
01010010010
10000011111
```





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Runtime Environment

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```
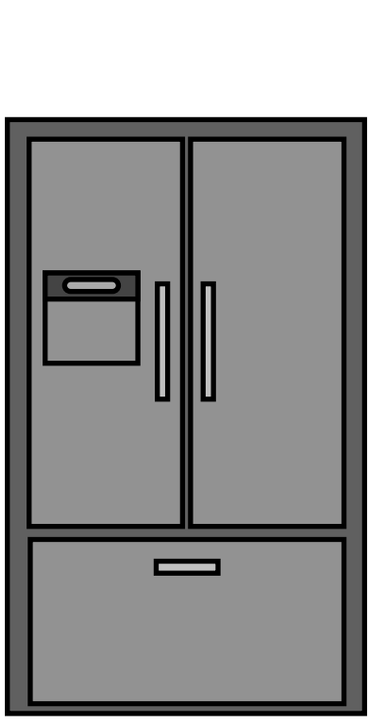
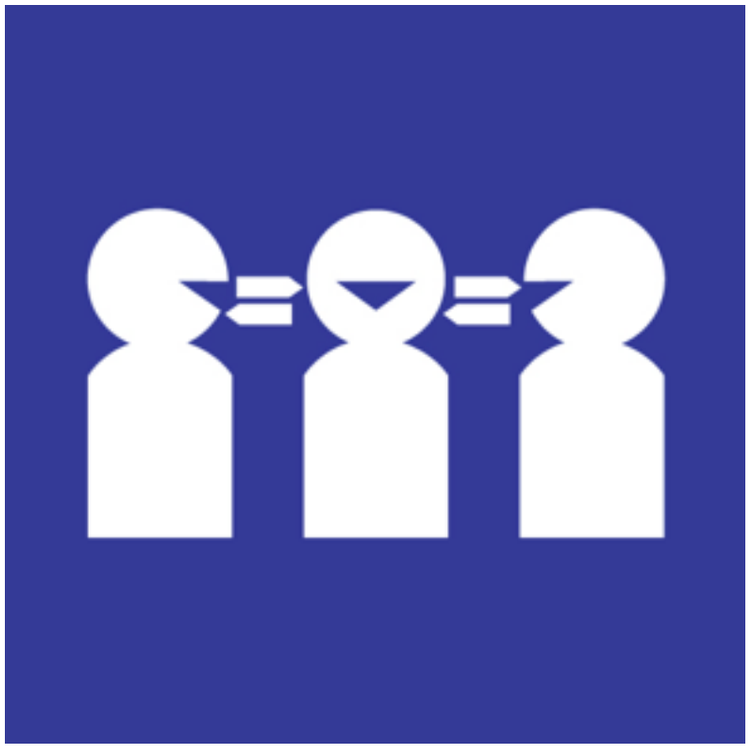
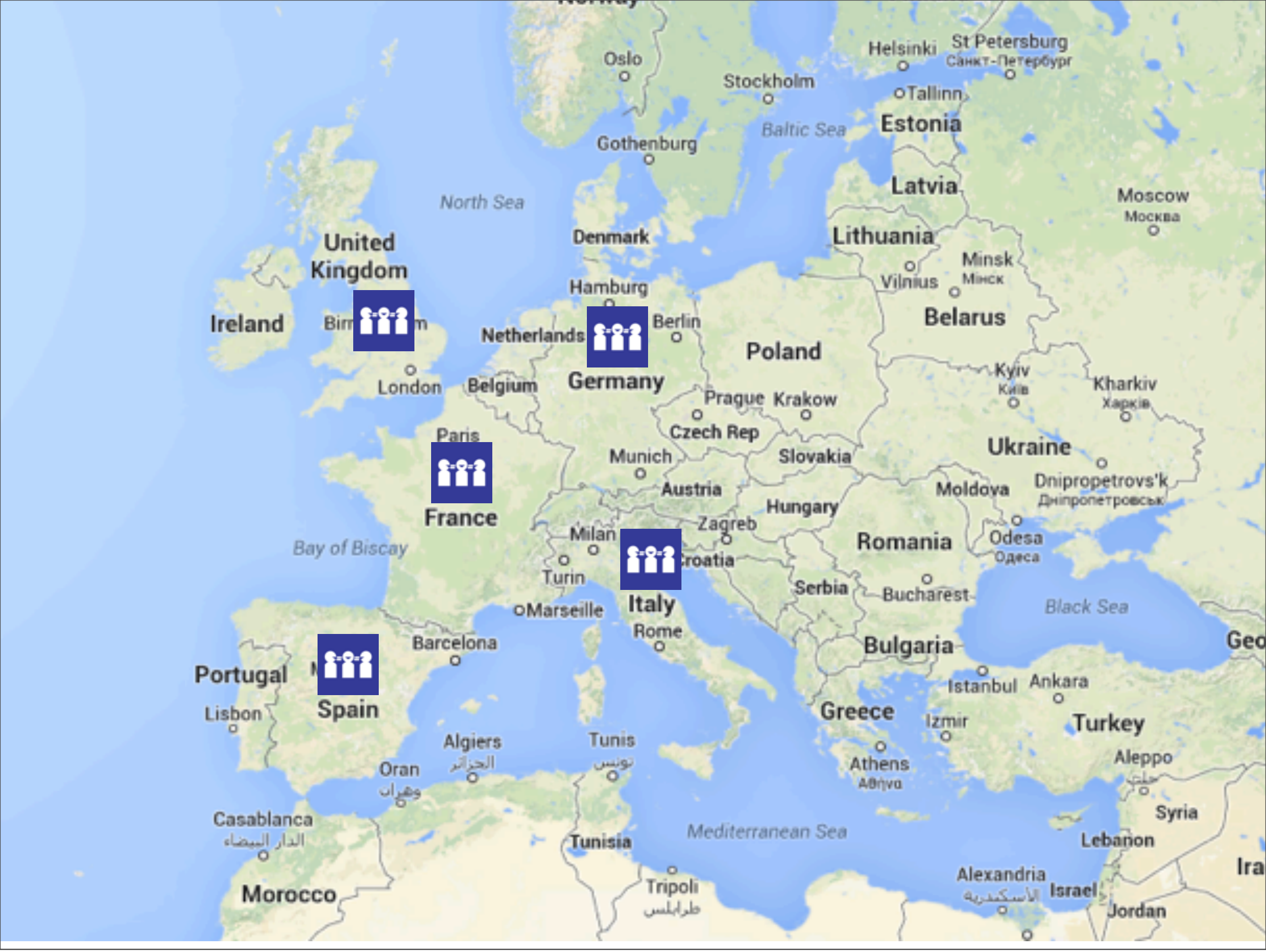



Wow! That's more complicated!



Interpreter


Oslo
Helsinki
St Petersburg
Санкт-Петербург
Stockholm
Tallinn
Estonia
Baltic Sea
Gothenburg
Latvia
North Sea
Moscow
Москва
United Kingdom
Denmark
Lithuania
Minsk
Мінск
Vilnius
Hamburg
Belarus
Ireland
Berlin
Netherlands
Poland
Germany
Kyiv
Київ
Kharkiv
Харків
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Belgium
Prague
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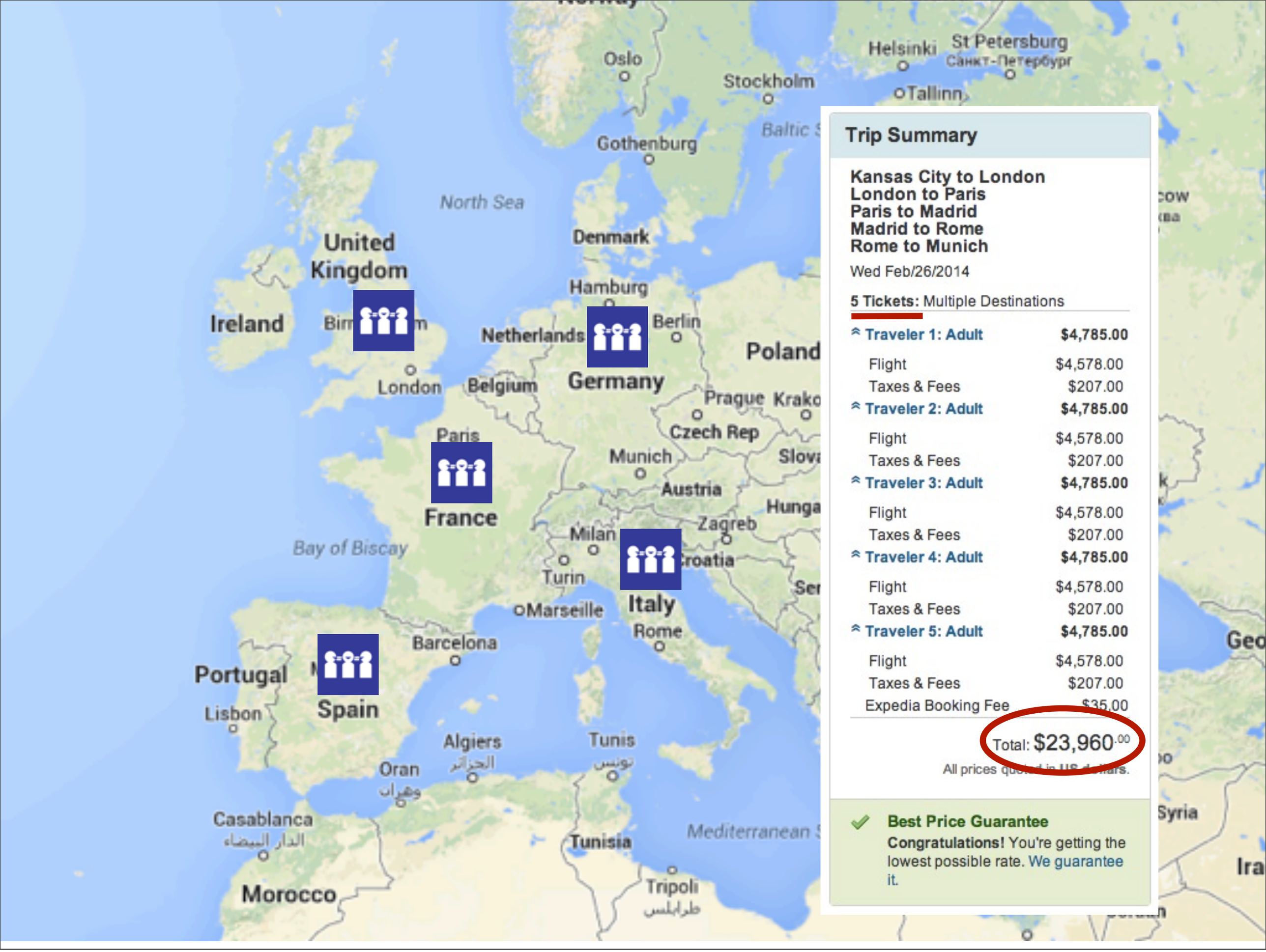
Paris
Ukraine
Munich
Slovakia
Austria
Moldova
Dnipropetrovs'k
Дніпропетровськ
Hungary
France
Zagreb
Odesa
Одеса
Milan
Romania
Croatia
Bay of Biscay
Turin
Serbia
Bucharest
Black Sea
Marseille
Italy
Rome
Barcelona
Bulgaria
Portugal
Istanbul
Ankara
Spain
Greece
Izmir
Turkey
Lisbon
Algiers
الجزائر
Tunis
تونس
Athens
Αθήνα
Aleppo
حلب
Oran
وهران
Syria
Casablanca
الدار البيضاء
Mediterranean Sea
Lebanon
Tunisia
Alexandria
الأسكندرية
Israel
Tripoli
طرابلس
Morocco
Jordan



Trip Summary

Kansas City to London
London to Paris
Paris to Madrid
Madrid to Rome
Rome to Munich

Wed Feb/26/2014

5 Tickets: Multiple Destinations

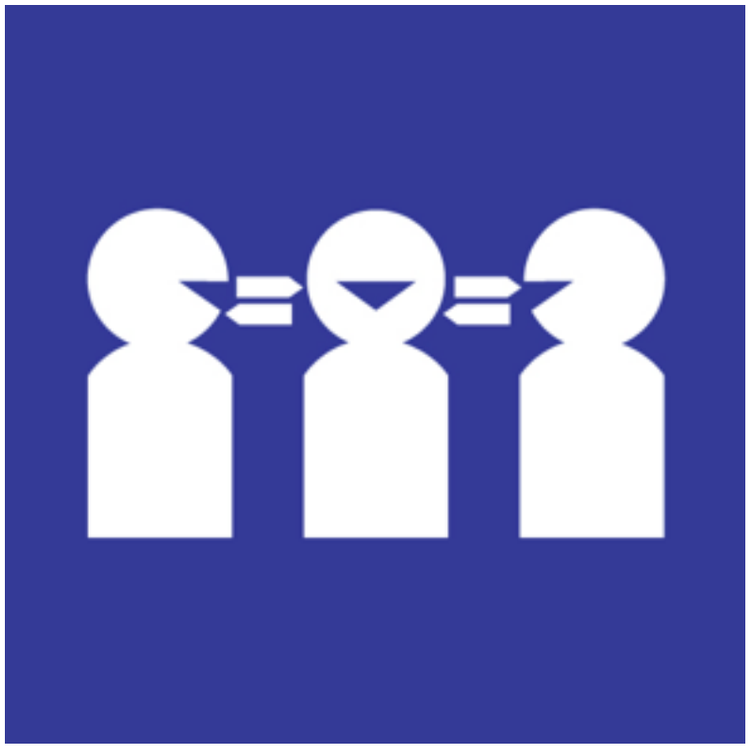
Traveler 1: Adult	**$4,785.00**
Flight	$4,578.00
Taxes & Fees	$207.00
Traveler 2: Adult	**$4,785.00**
Flight	$4,578.00
Taxes & Fees	$207.00
Traveler 3: Adult	**$4,785.00**
Flight	$4,578.00
Taxes & Fees	$207.00
Traveler 4: Adult	**$4,785.00**
Flight	$4,578.00
Taxes & Fees	$207.00
Traveler 5: Adult	**$4,785.00**
Flight	$4,578.00
Taxes & Fees	$207.00
Expedia Booking Fee	$35.00

Total: $23,960.00

All prices quoted in US dollars.

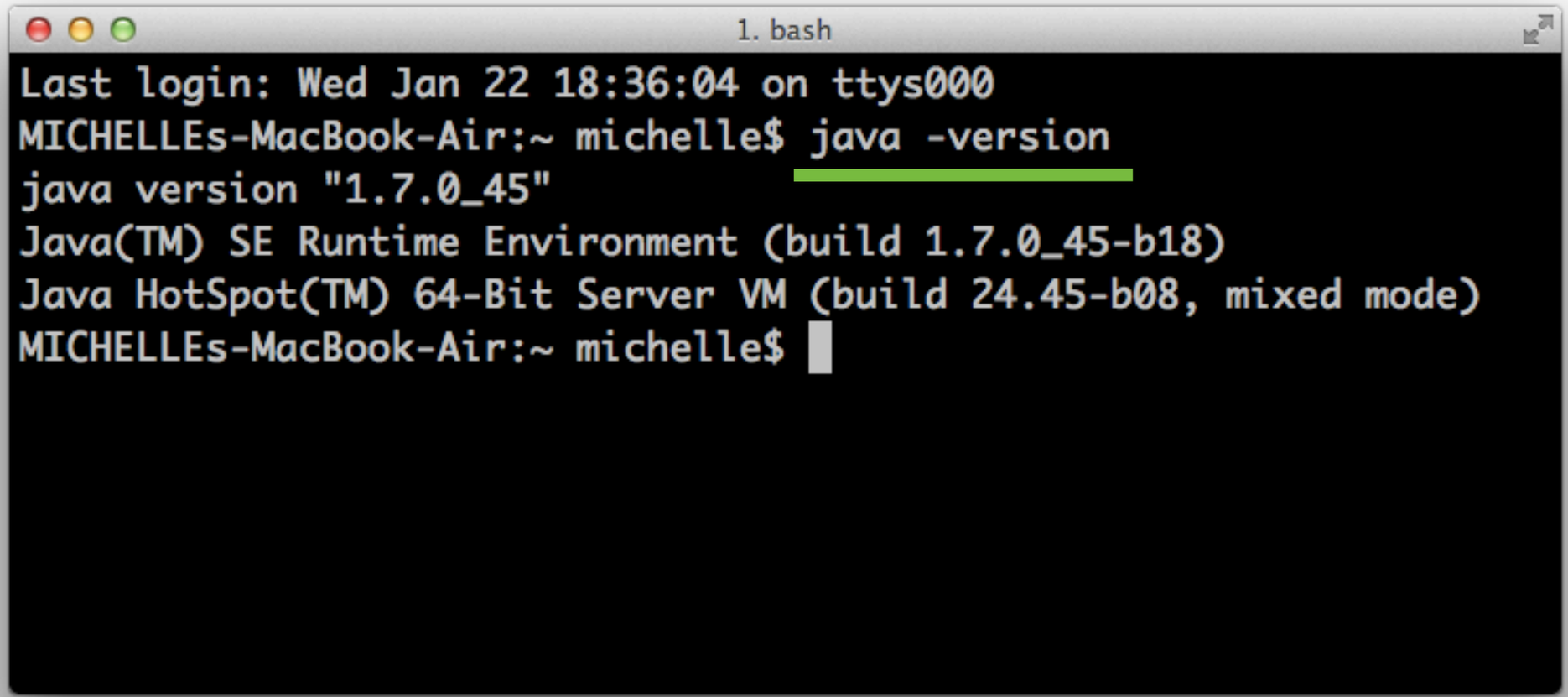
Best Price Guarantee
Congratulations! You're getting the lowest possible rate. We guarantee it.

WANTED: Spanish interpreter



Runtime Environment
Virtual Machine

finding the runtime environment



Why do you want to learn Java?

Why is Java popular?

Community

Support
Libraries
Best Practices
Resources
Conferences
Tools

like IDEs...

IDE

- **I**nteractive
- **D**evelopment
- **E**nvironment

Let's get you setup.

- JDK
- IntelliJ IDEA
- Project Skeleton

Downloads

- JDK 7
  - http://www.oracle.com/technetwork/java/javase/downloads/jdk7-downloads-1880260.html
- Interactive Development Environment: IntelliJ IDEA
  - http://www.jetbrains.com/idea/download/

Java JDK & JRE

DEMO

java

javac

javap

Hello World

In a file called *hello.java*

```
class hello {
    public static void main(String[] args) {
        System.out.println("Hello World.");
    }
}
```

Hello World

Very Important

```
class hello {
    public static void main(String[] args) {
        System.out.println("Hello World.");
    }
}
```

Hello World

Object-Oriented

```
class hello {
    public static void main(String[] args) {
        System.out.println("Hello World.");
    }
}
```

Hello World

Sees the world as a bunch of objects that do things.

```
class hello {
    public static void main(String[] args) {
        System.out.println("Hello World.");
    }
}
```

Hello World

Objects that all do the same things are described by their category. It has a name.

```
class hello {
   public static void main(String[] args) {
      System.out.println("Hello World.");
   }
}
```

Hello World

Function or Method

```
class hello {

    public static void main(String[] args)
    {
        System.out.println("Hello World.");
    }
}
```

Hello World

Behavior we've named.

```
class hello {

    public static void main(String[] args)
    {
        System.out.println("Hello World.");
    }
}
```

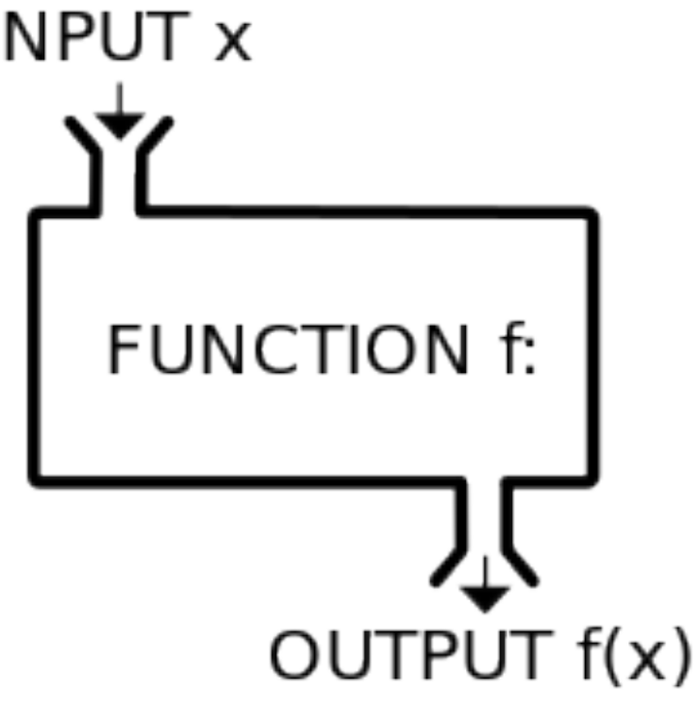
Algebra

$f(x) = x + 1$

$f(x) = x^2$

$f(x,y) = x + y$

$f(x,y) = x^2 + y^2$



Hello World

Function or Method

```
class hello {

    public static void f(String[] x)
    {
        System.out.println("Hello World.");
    }
}
```

Hello World

return type

```
class hello {
    public static void main(String[] args)
{
        System.out.println("Hello World.");
    }
}
```

Hello World

What type of data are we giving back?

```
class hello {

    public static void main(String[] args)
{
        System.out.println("Hello World.");
    }
}
```

Hello World

Scope

```
class hello {
    public static void main(String[] args)
{
        System.out.println("Hello World.");
    }
}
```

Hello World

lifetime or visibility

```
class hello {
    public static void main(String[] args)
{
        System.out.println("Hello World.");
    }
}
```

Hello World

visibility: everyone can see this.

```
class hello {
    public static void main(String[] args)
{
        System.out.println("Hello World.");
    }
}
```

Visibility

What keyword do you think I'd use if I wanted to hide something?

Private

Hello World

Scope

```
class hello {
    public static void main(String[] args)
{
        System.out.println("Hello World.");
    }
}
```

Hello World

lifetime: this exists forever

```
class hello {

    public static void main(String[] args)
{
        System.out.println("Hello World.");
    }
}
```

Hello World

arguments or parameters

```
class hello {
    public static void main(String[]
args) {
        System.out.println("Hello World.");
    }
}
```

Hello World

data you provide a function

```
class hello {
    public static void main(String[]
args) {
        System.out.println("Hello World.");
    }
}
```

Hello World

Type

```
class hello {
   public static void main(String[]
args) {
      System.out.println("Hello World.");
   }
}
```

What's a String?

- It's a type.
- It's also a class.
- It's a sequence of characters.
- It is enclosed in quotes: "".

"Happy"

"Monkey!"

"This is a String."

"&@#! is a String."

"A"

""

Hello World

What "type" of thing is this?

```
class hello {
   public static void main(String[] args) {
      System.out.println("Hello World.");
   }
}
```

Hello World

```
class hello {

    public static void main(String[] args)
{
        System.out.println("Hello World.");
    }
}
```

name

I have a **function**, that **everyone can see**, that **lives as long as this class** lives, that **doesn't return anything**, whose **name is main,** and **it takes some sequences of characters** as input and **calls them "args".**

```
class hello {

    public static void main(String[]  args) {
        System.out.println("Hello World.");
    }
}
```

Hello World

function or method invocation

```
class hello {
    public static void main(String[] args) {
        System.out.println("Hello
World.");
    }
}
```

Hello World

We're calling a function.

```
class hello {
    public static void main(String[] args) {
        System.out.println("Hello
World.");
    }
}
```

Hello World

Parameter value.

```
class hello {
    public static void main(String[] args) {
        System.out.println("Hello
World.");
    }
}
```

Hello World

We're sending data to the println function.

```
class hello {
    public static void main(String[] args) {
        System.out.println("Hello World.");
    }
}
```

Hello World

Let's change it and see what happens.

```
class hello {
   public static void main(String[] args) {
      System.out.println("Java!");
   }
}
```

Hello World

What about all the { } ?

```
class hello {
   public static void main(String[] args) {
      System.out.println("Java!");
   }
}
```

Hello World

```
{
    ...
}
```

Block:
An encapsulated section of code.

Hello World

```
class hello {
   public static void main(String[] args) {
      System.out.println("Java!");
   }
}
```

What about the ; ?

Terms - Activity

Pair Programming

- 2 people
- 1 problem
- 1 computer

TO DO:

1. Set up your computer.
2. Find your partner.
3. Write Hello World.

In a file called *hello.java*

```
class hello {
   public static void main(String[] args) {
      System.out.println("Hello World.");
   }
}
```

Ongoing Project

Restaurant System

What do we need?

project skeleton
set of user stories