The Language Stew

Robert C. Martin
Object Mentor Inc.

The Vacuum Catastrophe

The Hardware Catastrophe

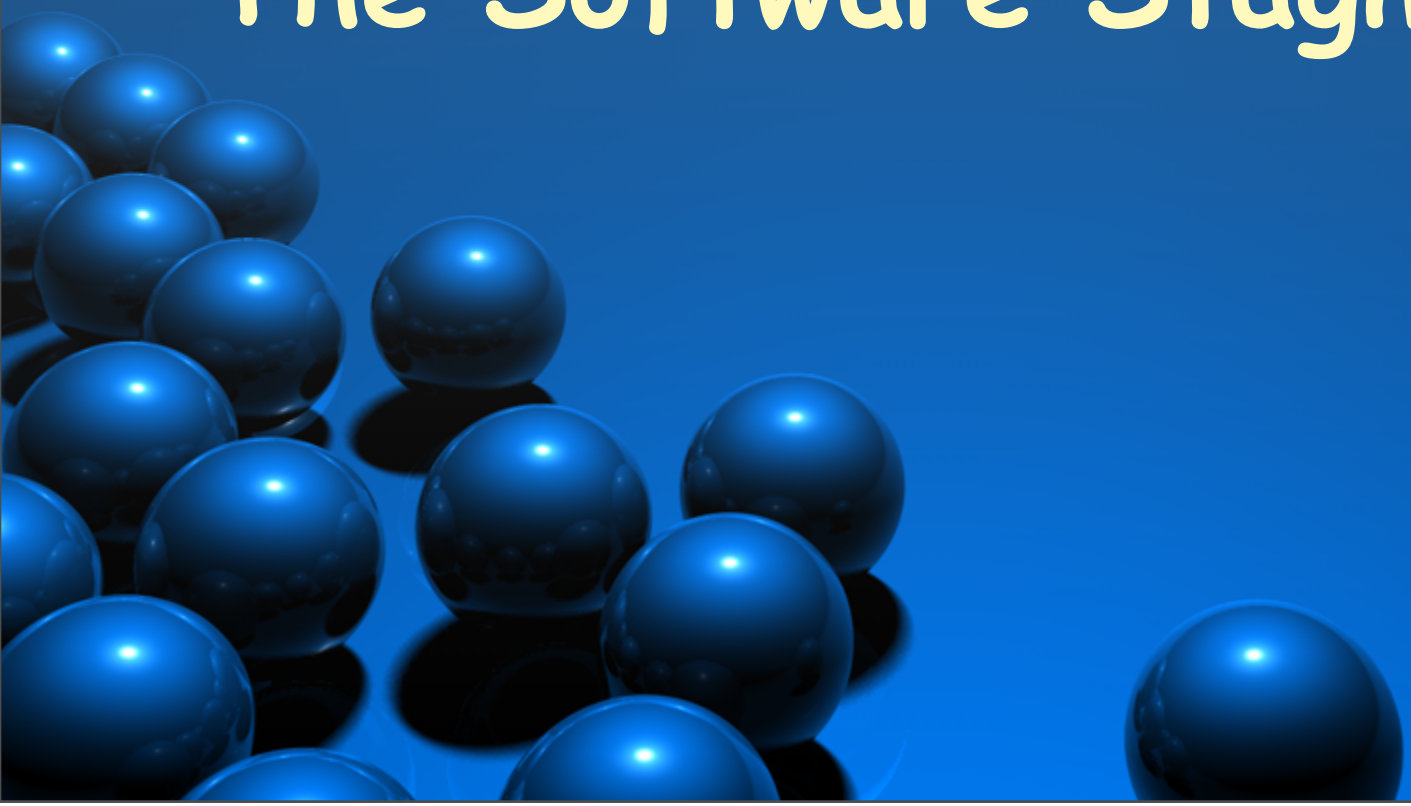
Count the orders of magnitude since PDP8

- 1e5 times faster
- 1e6 times more memory
- 1e7 times more storage
- 1e4 less cubic feet.
- 1e3 less power
- 1e2 less expensive

- **27** orders of magnitude

  - *And that doesn't count the internet.*

The Software Stagnation



The elements of our trade

- Sequence
  - `pay = e.calcPay(today);`
  - `e.deliverPay(pay);`
- Selection
  - `if (e.isPayDay(today)) e.pay(today);`
- Iteration
  - `for (e : employees) e.tryPay(today);`

Dot Counting in Java

```
public class DotCounter {
  public static int count(String s) {
    int dots = 0;
    for (int i=0; i<s.length(); i++)
      if (s.charAt(i) == '.')
        dots++;
    return dots;
  }
}
```

Dot Counting in C#

```
public class DotCounter {
  public static int Count(string s) {
    int dots = 0;
    for (int i=0; i<s.Length(); i++)
      if (s[i] == '.')
        dots++;
    return dots;
  }
}
```

C

```
int count_dots(char* s) {
   int count = 0;
   for (; *s; s++)
      if (*s == '.')
         count++;
   return count;
}
```

Ruby

```ruby
def count_dots(s)
  dots = 0
  s.each_char do |c|
    dots += 1 if c == '.'
  end
  dots
end
```

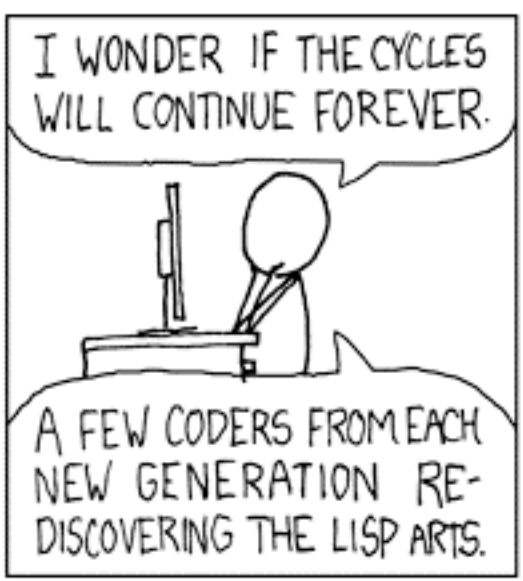
Scala

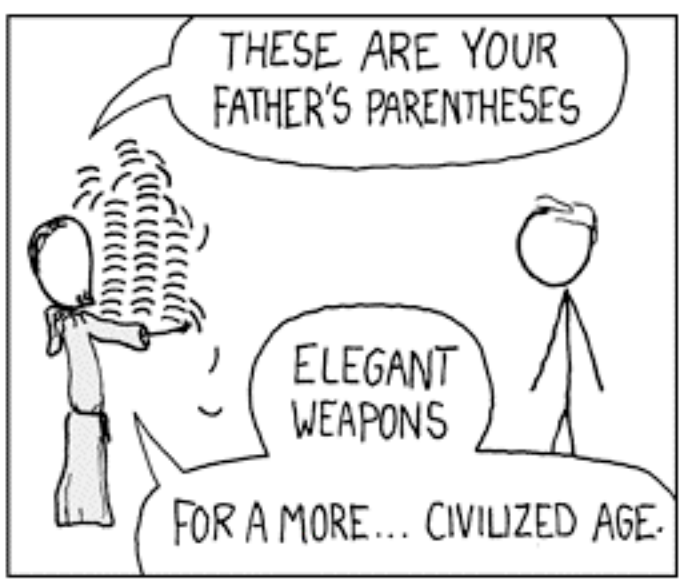
```
def dot_count(s: String): Int = {
  accumulate_dots(List.fromString(s), 0)
}

def accumulate_dots(s: List[Char],
                    dots: Int): Int = {
  if (s.length == 0)
    dots
  else
    accumulate_dots(s.tail,
                    if (s.head == '.')
                      dots + 1
                    else
                      dots)
}
```

Clojure

```
(defn count-dots [s]
  (if (empty? s)
    0
    (+
      (count-dots (rest s))
      (if (= \. (first s)) 1 0))))
```





PAL-8

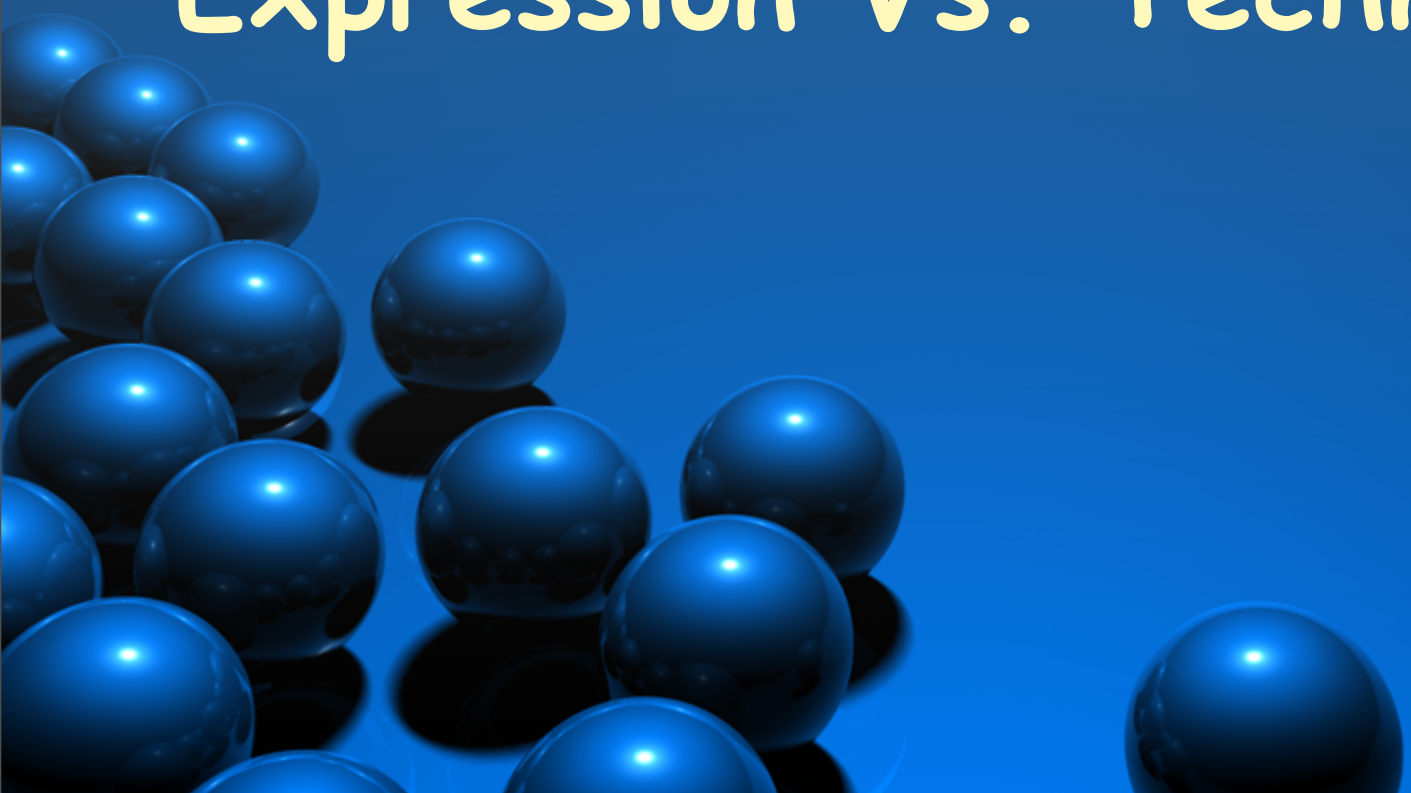
```
STR_PTR,      0
DOT,          '.'
DOTS,         0
COUNT_DOTS,   0
              DCA  STR_PTR
COUNT_NEXT,   TAD  I  STR_PTR
              SNZ
              JMP  DONE
              SUB  DOT
              SNZ
              ISZ  DOTS
              ISZ  STR_PTR
              JMP  COUNT_NEXT
DONE,         CLA
              TAD  DOTS
              JMP  I  COUNT_DOTS
```

Many different ways to say THE SAME THING

So is there no benefit to:

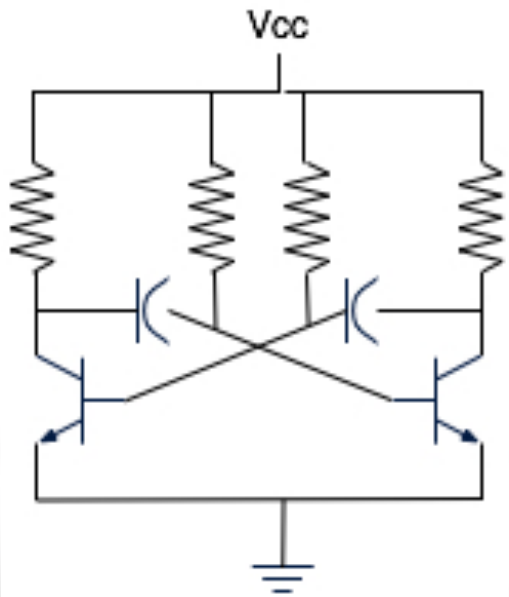
- Procedures?
- Objects?
- Functional?
- Information hiding
- Encapsulation
- Inheritance
- Design Patterns
- Monads
- etc?

Expression Vs. Technology



Why Doesn't MDA work?

- Because
  - Sequence
  - Selection
  - and Iteration
- Are not well captured in diagrams.



Procedural Programming

- Easy to add new functions.
- Hard to add new Data Structure.
- State is nearly global
  - Making threading very difficult.

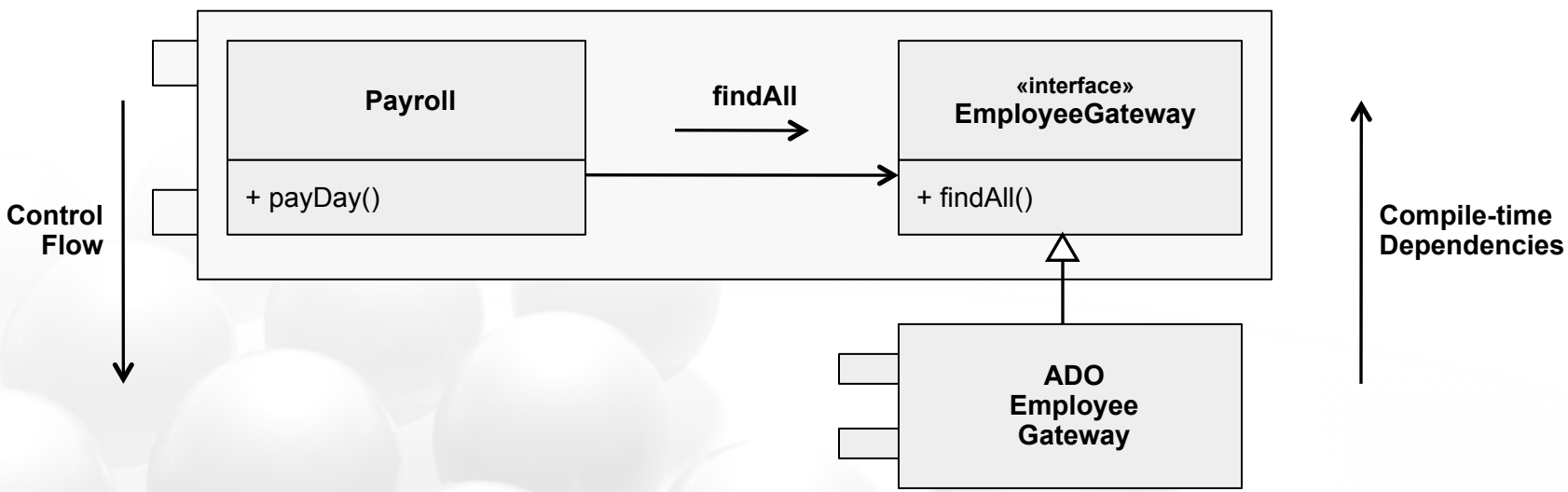
```
void drawAllShapes(struct Shape* list) {
   for (struct Shape* s = list; s; s=s->next) {
      switch (s->type) {
      case square:
         drawSquare(s);
         break;

      case circle:
         drawCircle(s);
         break;
      }
   }
}
```

Object-Oriented Programming

- Control flow and compile-time dependencies are opposed.
  - Making it easy to add new data structures
  - But hard to add new functions.
- *Some* locality of state

```
public class Payroll {
  private EmployeeGateway employeeGateway;
  public void payDay(Date payDate) {
    foreach (Employee employee in employeeGateway.findAll())
      employee.calculatePay(payDate);
  }
}
```



Definitions

- Structured Programming:
  - discipline imposed upon direct transfer of control.
- Object-Oriented Programming:
  - discipline imposed upon *indirect* transfer of control.

Functional Programming

- State is local
- Better protection from Threads.
- Source code dependencies align with Control Flow
  - Making it easy to add new functions
  - But hard to add new datatypes.
- Functions are first class elements.
  - Source Code Dependencies oppose Control Flow
  - Not best of both worlds, but workable.
- State is extremely local
  - Making multiprocessing easier.

Definition

- Functional Programming:
  - Discipline imposed upon mutable state.
    - Nahhhhh.

Static vs Dynamic

- Decades of war has left a ruined landscape.
  - C vs. Pascal
  - C++ to the Rescue.
  - C++ vs Smalltalk
  - Smalltalk's untimely demise.
  - The ascendency of static typing.
  - TDD!
    - and the revolution begins.
  - Python, Ruby, Rails!

Java, C#, C++

- Urgh.
- OO -ish.
- Statically typed.
- Source code dependencies can oppose flow of control.
- Componentizable.
- Wordy and constrained.

```
public boolean equals(Object obj) {
  if (obj == null)
    return false;
  if (!(obj.getClass() == getClass()))
    return false;
  MediaCopy that = (MediaCopy) obj;
  return this.id.equals(that.id) &&
    this.media.equals(that.media);
}
```

Ruby

- OO
- Dynamically Typed.
- Compondentizable
- Monkey-patch-able!
  - “I reject your reality and substitute my own.”
- Elegant, and yet...

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```
def discountedPrice(bag)
  minPrice = nil
  minAllocation = nil
  forEachDiscountAllocation(bag) do |allocation|
    price = allocation.calculateDiscount(self)
    if (minPrice == nil || price < minPrice)
      minPrice = price
      minAllocation = allocation.dup
    end
  end
  undiscountedBooks = (bag.dup)
  undiscountedBooks.remove(minAllocation.books)
  minPrice + grossPriceOf(undiscountedBooks.books)
end
```

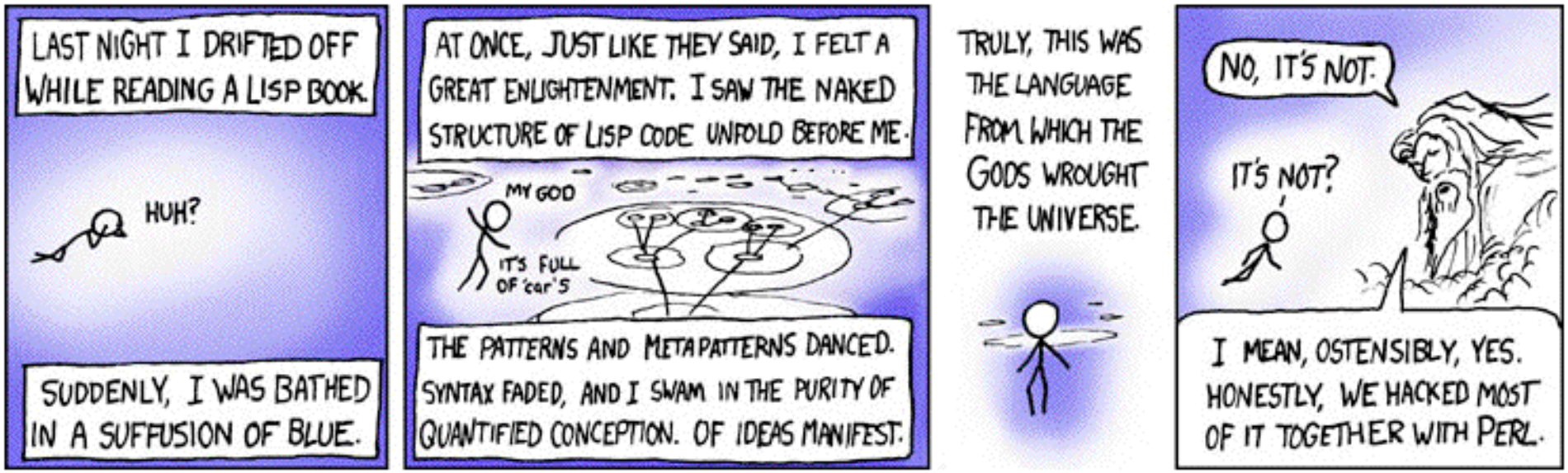
Scala / F#

- Hybrid languages.
  - Can be procedural.
  - Can be OO.
  - Can be functional.
  - Statically typed.
  - Warty like C++
  -

```
trait Ord {
  def <(that: Any): Boolean
  def <=(that: Any): Boolean = (this < that) || (this == that)
  def >(that: Any): Boolean = !(this <= that)
  def >=(that: Any): Boolean = !(this < that)
}
```

Clojure

- Functional
- Java Stack
- Very disciplined State/Identity/Value model. STM!
  - Atoms
  - Agents
  - Refs in transactions.
- Lots of Insidious Sequential Parenthesis.



STM

- Refs

```
(def current-track (ref "Venus, the Bringer of Peace"))
(def current-composer (ref "Holst"))
(dosync (ref-set current-track "Credo")
        (ref-set current-composer "Byrd"))
```

- Atoms

```
(def current-track (atom {:title "Credo" :composer "Byrd"}))
(reset! current-track {:title "Spem in Alium" :composer "Tallis"})
(swap! current-track assoc :title "Sancte Deus")
```

- Agents

```
(def counter (agent 0))
(send counter inc)
```

- Dereference

```
@counter
```

Moore's Law is Dead.

Well, at least for processor speed.

- Individual cycle times aren't going to get faster.
- Multiple cores are the clear solution.
- And that means:

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Concurrency

Concurrency Antidote

- Extreme Localized Scope
- Disciplined model of State/Value/Identity
- Functional Language
- Java Stack

- I vote for Clojure.

But can mere mortals...

fin

- unclebob @ objectmentor.com
- fitnesse.org
- cleancodeproject.com