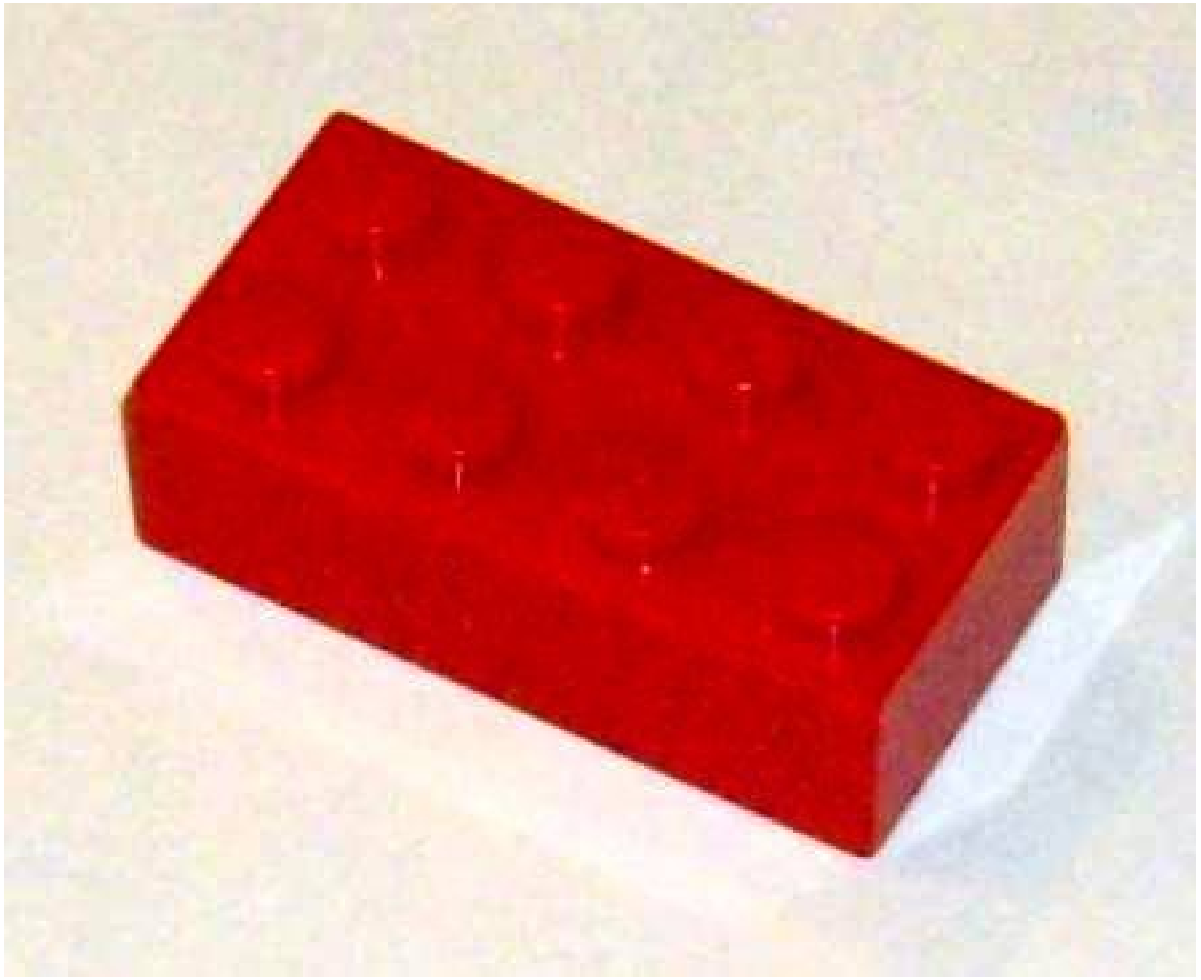
The D Programming Language

by Walter Bright
Digital Mars

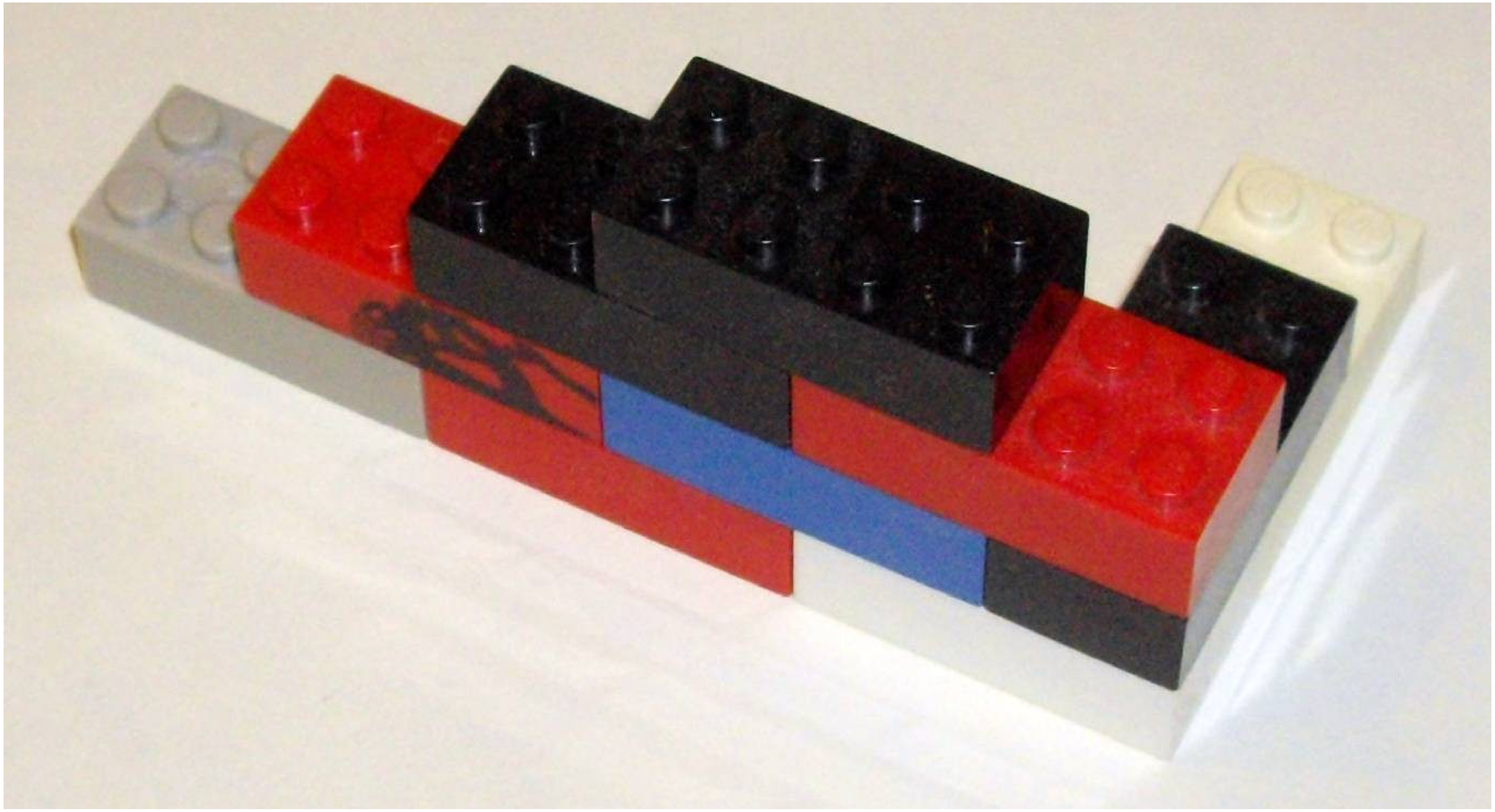
http://dlang.org/

Why?

Modeling Power?



Great For Bricklike Models



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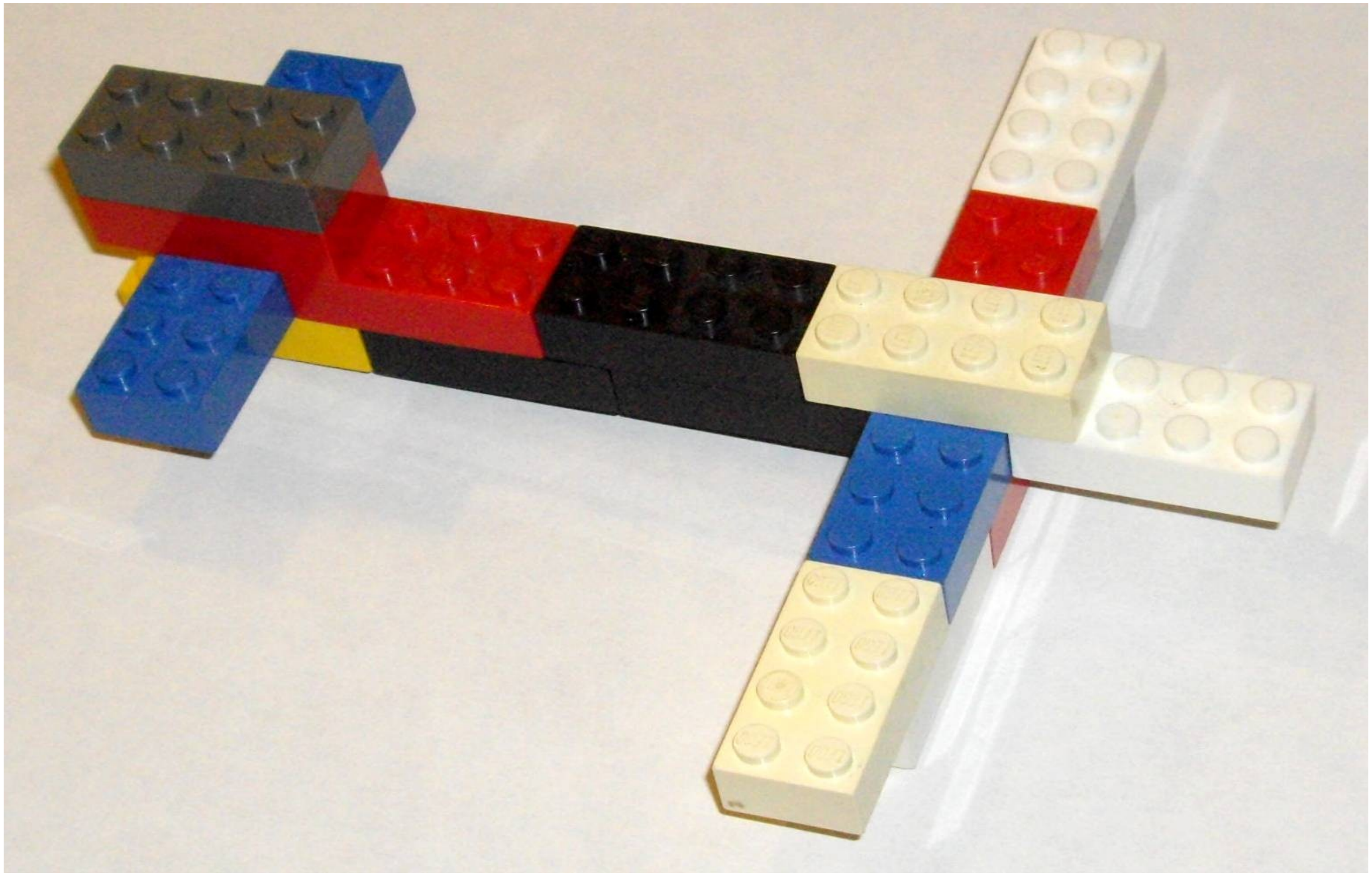
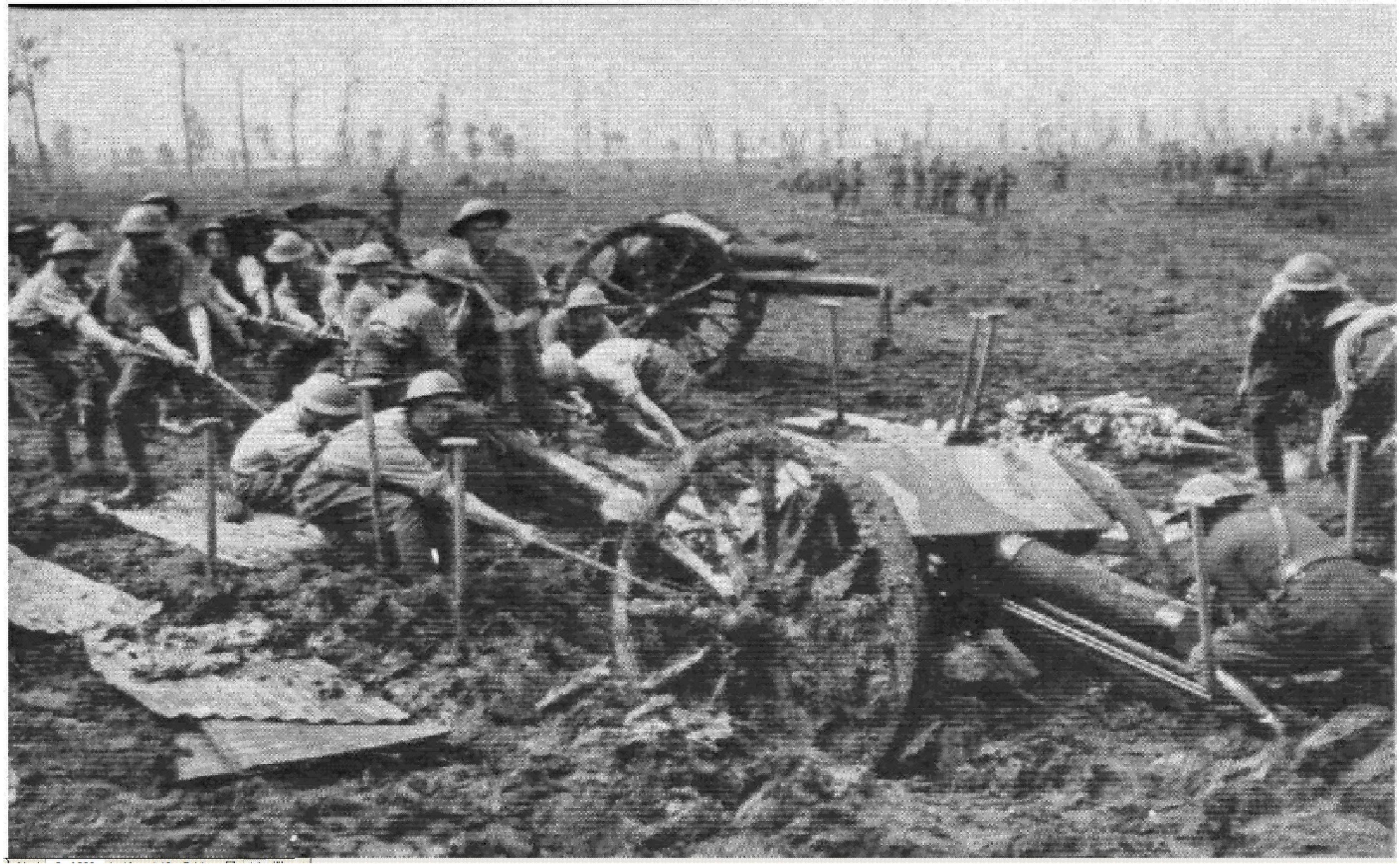


Obsolete Technology



Waiting?

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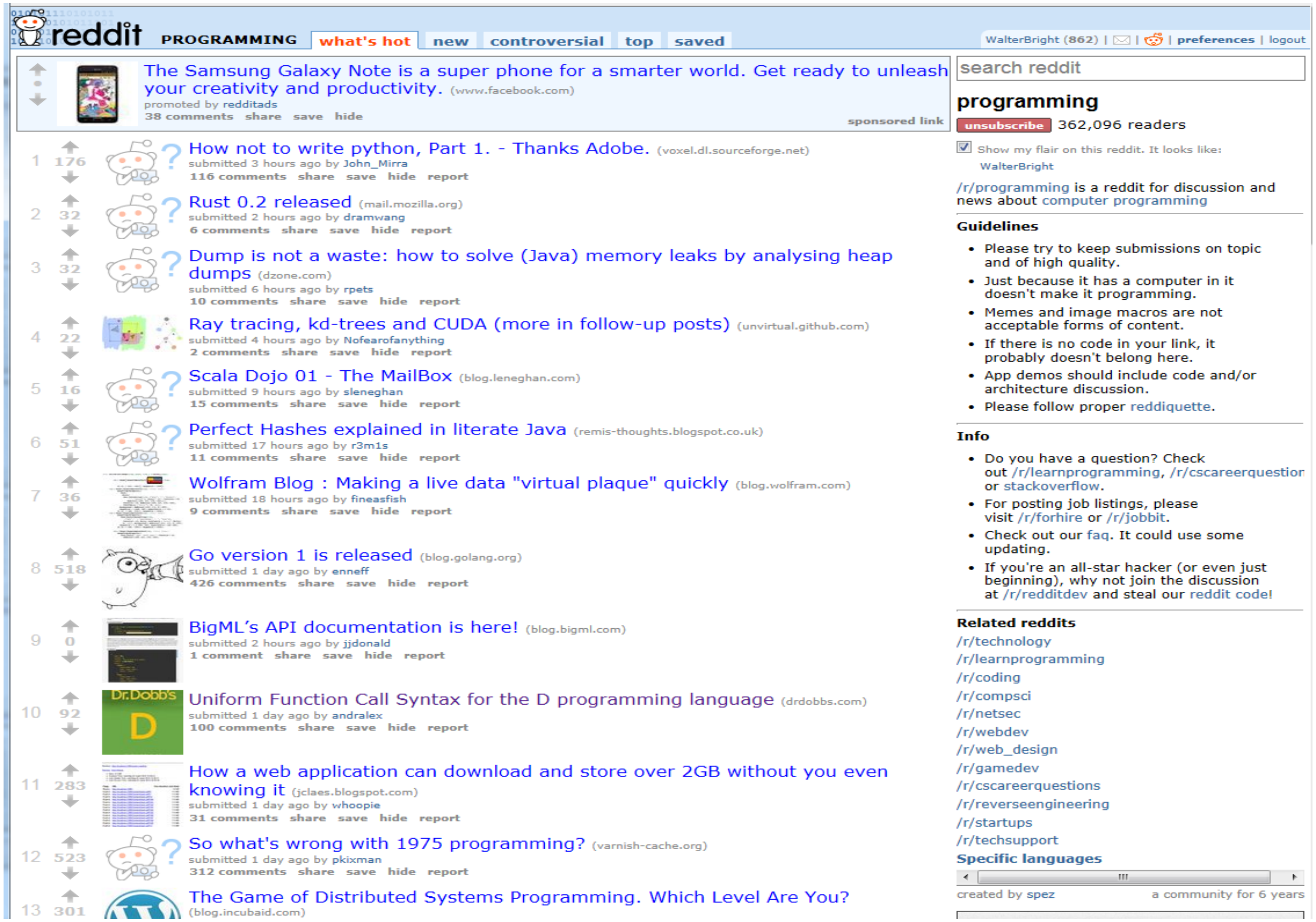

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Specific languages

created by spez a community for 6 years

Solutions exist in other languages,
but are not combined.

All In One Language:

Modeling Power

Modern Convenience

Native Efficiency

"You want to go forward, what do you do? You put it in D."

http://voices.washingtonpost.com/44/2010/08/obamas-latest-joke-republicans.html

D Has The Modeling Power

Mega Bloks P-51

The Right Modeling Paradigm for the Job

Polymorphism
Value semantics
Functional

Generics
Generative
Contract

Polymorphism

```
interface Shape {
  void Draw();
}
class Square : Shape {
  this(int xpos, int ypos, int width) {
    x = xpos; y = ypos;
    w = width;
  }
  void Draw() {
    writefln("Drawing Square at (%s,%s), width %s\n", x, y, width);
  }
  private int x, y, width;
}
```

Structs Have Value Semantics

```
struct BigNum {

    // construction
    this(int a) { … }

    // intercept copying
    this(this) { ... }

    // destructor
    ~this() { ... }
}
```

Functional

- Data immutability

```
immutable int[] a = [1, 2, 4, 6];
```

- Pure functions

```
pure int square(int x) { return x * x; }
```

- Lambda functions

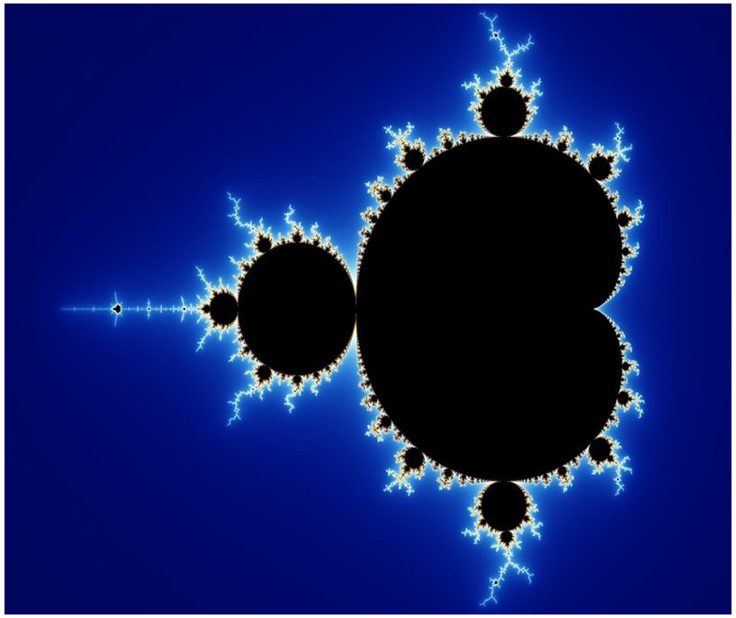
```
a.sort( (x,y) => x < y );
```

Generics

```
size_t levenshteinDistance
(alias equals = (a,b) => a == b, Range1, Range2)
(Range1 s, Range2 t)
if (isForwardRange!(Range1) &&
isForwardRange!(Range2))
{
    ...
}
```

Generative

```
struct A {
  int a;
  mixin(bitfields!(
    uint, "x", 2,
    int, "y", 3,
    uint, "z", 2,
    bool, "flag", 1));
}
A obj;
obj.x = 2;
obj.z = obj.x;
```



http://commons.wikimedia.org/wiki/File:Mandel_zoom_00_mandelbrot_set.jpg

Contract

```
// Interfaces and classes
interface Printable {
   void print(uint level)
   in { assert(level > 0); } // contract is part of the interface
}

// Interface implementation
class Widget : Printable {
   void print(uint level) { ... }
}

// Single inheritance of state
class ExtendedWidget : Widget {
   override void print(uint level)
   in { /* weakening precondition is okay */  }
   body {
       ... level may be 0 here ...
   }
}
```

Modern Convenience

Convenience

- Associative Arrays
- Static Typing With Inference
- Resource Management
- Slices and Ranges
- Immutability and Sharing is Typed
- System and Safe Code

Associative Arrays

```
// Symbol table
int[string] keywords = ["loop":3, "exit":4];
...
string abc;
...
if (keywords[abc] == 3)
  ...

// Sparse array of longs
long[int] sa;
sa[1] = 3;
sa[1000] = 16;
foreach (v; sa)
  writeln(v);
```

Static Typing With Inference

```
void main() {
    // Define an array of numbers, double[]. Compiler recognizes
    // common type of all initializers.
    auto arr = [ 1, 2, 3.14, 5.1, 6 ];
    // Dictionary that maps string to int, type is spelled int[string]
    auto dictionary = [ "one" : 1, "two" : 2, "three" : 3 ];
    // Calls the min function defined below
    auto x = min(arr[0], dictionary["two"]);
}

// Type deduction works for function results. Important for
// generic functions, such as min below, which works correctly
// for all comparable types.
auto min(T1, T2)(T1 lhs, T2 rhs) {
    return rhs < lhs ? rhs : lhs;
}
```

Resource Management

```
import std.stdio, core.stdc.stdlib;

class Widget { ... }

void main() {
    auto w = new Widget;  // automatic

    // Code is executed in any case upon scope exit
    scope(exit) { writeln("Exiting main."); }

    // RAII: File is closed deterministically at scope's end
    foreach (line; File("text.txt").byLine()) {
        writeln(line);
    }

    auto p = malloc(10);   // explicit C-style
    if (p) free(p);
}
```

Slices

```
auto filename = “etc/c/zip.d”;
auto path = filename[0..6];  // “etc/c/”
auto name = filename[6..9]; // “zip”
auto ext = filename[10..11]; // “d”
```

Safe, efficient, fast memory reuse

Ranges

```
#!/usr/bin/rdmd
import std.range, std.stdio;

// Compute average line length for stdin
void main() {
    ulong lines = 0, sumLength = 0;
    foreach (line; stdin.byLine()) {
        ++lines;
        sumLength += line.length;
    }
    writeln("Average line length: ",
        lines ? cast(double) sumLength / lines : 0.0);
}
```

Old Style

$$\int_{x_1}^{x_2} f(x)\, dx$$

```
double integrate(double x1, double x2,
  double delegate(double dx) f) {

  double sum = 0;
  double dx = 0.001;
  for (double x = x1; x < x2; x += dx)
    sum += f(x) * dx;
  return sum;
}

double parabola(double x, double c) {
  return integrate(0,x, (x => c * x * x));
}
```

Ranges and Algorithms

```d
import std.range : iota;
import std.algorithm : reduce;

auto integrate(alias f, T)(T x1, T x2) {
  auto dx = 0.001;
  return reduce!((a,x)=>a+f(x)*dx) (0.0, iota(x1, x2, dx));
}

auto parabola(double x, double c) {
  return integrate!(x => c * x * x)(0.0, x);
}
```

Immutability and Sharing is Typed

```
// Immutable data shared across threads
immutable string programName = "demo";

// Mutable data is thread-local
int perThread = 42;

// Explicitly shared data
shared int perApp = 5;
```

System and Safe Code

```
extern ( C ) @system void* calloc(size_t, size_t);

@trusted T[] callocArray(T)(size_t length) {
    T* p = cast(T*)calloc(length, T.sizeof);
    return p[0 .. length];
}

@safe int[] odds() {
    auto a = callocArray!int(3);
    a[0] = 1; a[1] = 3; a[2] = 5;
    return a;
}
```

Native Efficiency

Compiles to Native Code

- Fast program loads
- Predictable behavior
- Testing and QA is under your control
- You control the performance, not the VM vendor

Direct Access To C

```
void livingDangerously() {

    // Access to C's malloc and free primitives
    auto buf = malloc(1024 * 1024);
    scope(exit) free(buf); // free automatically upon scope exit

    // Interprets memory as an array of floats
    auto floats = cast(float[]) buf[0 .. 1024 * 1024];

    // Even stack allocation is possible
    auto moreBuf = alloca(4096 * 100);
    ...
}
```

Inline Assembler

```
uint checked_multiply(uint x, uint y) {
    uint result;
    version (D_InlineAsm_X86) {
        // Inline assembler "sees" D variables.
        asm {
            mov     EAX,x         ;
            mul     EAX,y         ;
            mov     result,EAX    ;
            jc      Loverflow     ;
        }
        return result;
    } else {
        result = x * y;
        if (!y || x <= uint.max / y)
           return result;
   }
Loverflow:
   throw new Exception("multiply overflow");
}
```

D Combines:

Modeling Power

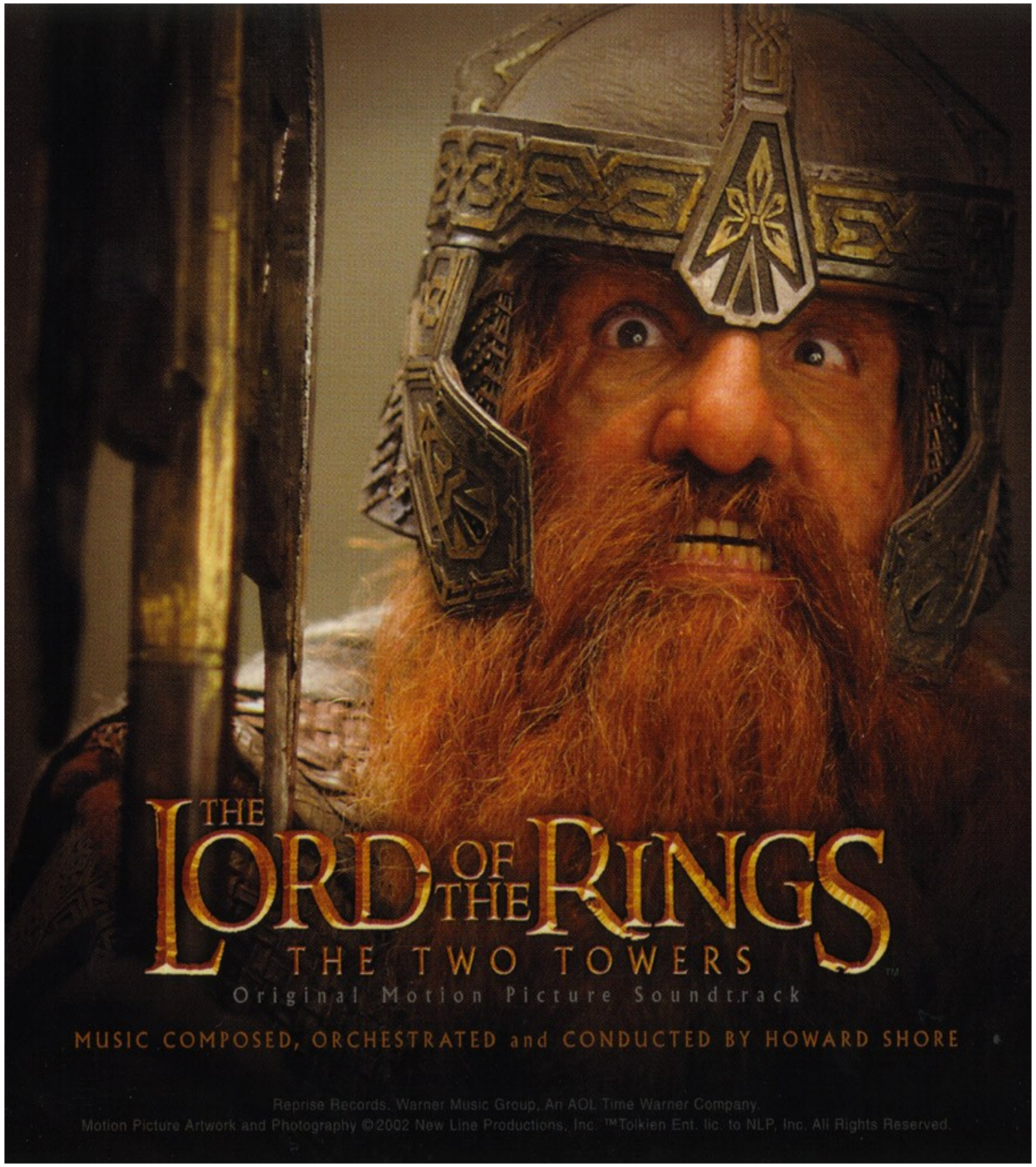
Modern Convenience

Native Efficiency

Can D go Mainstream?

Certainty of death

Very small chance of success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Web site:

dlang.org

Community:

forum.dlang.org

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https://www.github.com/D-Programming-Language

D Conference Sept. 26-29 2012

astoriaseminar.com