Aphorisms in Computer Science

Where you stand is where you sit
Requirements Engineering

• Requirements Engineering is more difficult now, because all systems that were easy to specify, have been built some time ago.

  • Tom DeMarco '01

• Requirements deficiencies are the primary source of project failures.

  • Robert Glass

• There are no wrong programs. Such a program is simply a different program

  • W. L. van der Poel
Modularization

• Every module is characterized by its knowledge of a design decision which it hides from all others. Its interface is chosen to reveal as little as possible about its inner workings.

• Only what is hidden can be changed without risk.

• David L. Parnas '72
• The *goto* statement as it stands is just too primitive; it is too much an invitation to make a mess of one's program

  • E. W. Dijkstra '68

• Testing can show the presence, but not the absence of errors

  • E.W. Dijkstra
We can conclude from experience that inspections increase productivity and improve final program quality.
• Users don't observe errors or faults. They observe execution failures.
  • H. Mills '90

• Smaller changes have a higher error density than larger ones.
  • Basili-Möller

• Error prevention is better than error removal.
  • Mays
Formal Methods

• Formal methods significantly reduce design errors, or eliminate them early.
  • Bauer-Zemanek

• Proving programs solves the problems of correctness, documentation and compatibility.
  • C. A. R. Hoare
The term *evolution* describes a process of progressive change in the attributes of entities. This may include:

- improvement in some sense,
- adaptation to a changing environment,
- loss of not-required or undesired properties, or,
- the emergence of new ones.

• M.M. Lehman '94
Software Evolution - 2

• A system that is used will be changed.

• An evolving system increases its complexity, unless work is done to reduce it.

• System evolution is determined by a feedback process.

• M. M. Lehman
• The software field is not a simple one and, if anything, it is getting more complex at a faster rate than we can put in order.
  • Barry W. Boehm '79

• Building software will always be hard. There is inherently no silver bullet.
  • F.P. Brooks, Jr '87
• Programmers are always surrounded by complexity; we cannot avoid it. Our applications are complex because we are ambitious to use our computers in ever more sophisticated ways.
  
  • C.A.R. Hoare '81

• Simple, elegant solutions are more effective, but they are much harder to find than complex ones
  
  • N. Wirth '85
• If you have a procedure with 10 parameters, you probably missed some.
  • Alan Perlis

• The software is done.
  We are just trying to get it to work.
  • Statement in Executive Program Review

• Good, fast, cheap. Pick any two.
  • Old software engineering aphorism
Work power

• The best engineers or scientists do not work for a company, a university or a laboratory; they really work for themselves.

• W. S. Humphrey '97
Software Architecture

- Software architecture involves the description of elements from which systems are built, interactions amongst those elements, patterns that guide their composition, and constraints on these patterns

- Architecture wins over technology

  - Mary Shaw '96
  - Morris-Ferguson
Performance

• The price/performance ratio of processors is halved every 18 months.
  • Moore

• The capacity of magnetic devices increases by a factor of ten every decade.
  • Hoagland

• Wireless bandwidth doubles every 2.5 years.
  • Cooper
Hello World
Hello World

from

the GNU archives
Hello world - 1

High School/Jr.High
10 PRINT "HELLO WORLD"
20 END

First year in College
program Hello(input, output)
begin
    writeln('Hello World')
end.

Senior year in College
(defun hello
    (print
        (cons 'Hello (list 'World))))
Hello World - 2

New professional

```c
#include <stdio.h>
void main(void) {
    char *message[] = {"Hello ", "World"};
    int i;
    for(i = 0; i < 2; ++i)
        printf("%s", message[i]);
    printf("\n");
}
```
Hello World - 3a

Seasoned professional

```cpp
#include <iostream.h>
#include <string.h>
class string
{
    private:
        int size;
        char *ptr;
    public:
        string() : size(0), ptr(new char(\0')) { }
```
Seasoned professional (continued)

```cpp
string(const string &s) : size(s.size)
{
    ptr = new char[size + 1];
    strcpy(ptr, s.ptr);
}
~string() { delete [] ptr; }

friend
    ostream &operator <<(ostream &s, const string &s);
    string &operator=(const char *str);
};
```
Seasoned professional - continued(2)

```cpp
ostream &operator<<(ostream &stream, const string &s)
{   return(stream << s.ptr); }

string &string::operator=(const char *chrs)
{ if (this != &chrs)
{ delete [] ptr;
    size = strlen(chrs);
    ptr = new char[size + 1];
    strcpy(ptr, chrs);
}
    return(*this);
}
```
string &string::operator=(const char *chrs)
{ if (this != &chrs)
{ delete [] ptr;
    size = strlen(chrs);
    ptr = new char[size + 1];
    strcpy(ptr, chrs);
}
return(*this);
}
Seasoned professional - continued(4)

```c
int main()
{
    string str;
    str = "Hello World";
    cout << str << endl;
    return(0);
}
```
Hello World - 4

System Administrator

```
#include <stdio.h>
#include <stdlib.h>
main() {
    char *tmp; int i=0; /* on y va bourin */
tmp=(char *)malloc(1024*sizeof(char));
while (tmp[i]="Hello Wolrd"[i++]);
/* Ooopps y'a une infusion ! */
i=(int)tmp[8];
tmp[8]=tmp[9];
tmp[9]=(char)i;
printf("%s\n",tmp);
}```
#!/usr/local/bin/perl
$msg="Hello, world.
";
if ($#ARGV >= 0) {
  while(defined($arg=shift(@ARGV))) {
    $outfilename = $arg;
    open(FILE, "">" . $outfilename) || die "Can't write $arg: $!
";
    print (FILE $msg);
    close(FILE) || die "Can't close $arg: $!
";
  }
} else {
  print ($msg);
}
1;
Hello World - 6

**Experienced Hacker**

```c
#include <stdio.h>
#include <string.h>
#define S "Hello, World\n" main()
    {exit(printf(S) == strlen(S) ? 0 : 1);} 
```

**Seasoned Hacker**

```bash
% cc -o a.out ~/src/misc/hw/hw.c % a.out Hello, world.
```

**Guru Hacker**

```bash
% cat Hello, world.
```
Hello World - 7

**New Manager (do you remember?)**

```
10 PRINT "HELLO WORLD"
20 END
```

**Middle Manager**

mail -s "Hello, world." bob@b12
Bob, could you please write me a program that prints "Hello, world."? I need it by tomorrow.
^D

**Senior Manager**

% zmail jim I need a "Hello, world." program by this afternoon.
Hello World - 8

Chief Executive

% letter
letter: Command not found.
% mail To: ^X ^F ^C
% help mail help: Command not found.
% damn!
!: Event unrecognized
% logout
Hello World - 9

Research Scientist

PROGRAM HELLO
PRINT *, 'Hello World'
END

Older research Scientist

WRITE (6, 100)
100 FORMAT (1H ,11HHELLO WORLD)
CALL EXIT
END
package examples.hello;
import java.rmi.Naming;
import java.rmi.RemoteException;
import java.rmi.RMISecurityManager;
import java.rmi.server.UnicastRemoteObject;
public class HelloImpl extends UnicastRemoteObject implements Hello {
    public HelloImpl() throws RemoteException {
        super();
    }
    public String sayHello() {
        return "Hello World!";
    }
}
public static void main(String args[]) {
// Create and install a security manager
if (System.getSecurityManager() == null) {
    System.setSecurityManager(new RMISecurityManager());
}
try {
    HelloImpl obj = new HelloImpl();
    // Bind this object instance to the name "HelloServer"
    Naming.rebind("//myhost/HelloServer", obj);
    System.out.println("HelloServer bound in registry");
}
catch (Exception e) {
    System.out.println("HelloImpl err: " + e.getMessage());
e.printStackTrace();
}
public void init() {
    try {
        obj = (Hello)Naming.lookup("//" + getCodeBase().getHost() + "/HelloServer");
        message = obj.sayHello();
    } catch (Exception e) {
        System.out.println("HelloApplet exception:" + e.getMessage());
        e.printStackTrace();
    }
}

public void paint(Graphics g) {
    g.drawString(message, 25, 50);
}
package examples.hello; // Applet code
import java.applet.Applet;
import java.awt.Graphics;
import java.rmi.Naming;
import java.rmi.RemoteException;
public class HelloApplet extends Applet {
    String message = "blank";
    // "obj" is the identifier that we'll use to refer
    // to the remote object that implements the "Hello" interface
    Hello obj = null;
    public void init() { // see next slide
        // see next slide
    }
}
hello, world

in various languages
Algol Family

**Algol-60**

`'BEGIN' 'COMMENT' Hello World in Algol 60; OUTPUT(4,'("Hello World!")');'END`

**Algol-68**

(`# Hello World in Algol 68 # print("Hello World!",newline)`)
; Hello World for Intel Assembler (MSDOS)

mov ax, cs
mov ds, ax
mov ah, 9
mov dx, offset Hello
int 21h
xor ax, ax
int 21h
Hello: db "Hello World!", 13, 10, "$"
Hello World for the nasm Assembler (Linux)

```
SECTION .data
    msg db "Hello, world!",0xa ;
    len equ $ - msg

SECTION .text
    global main
main:  mov eax,4     ; write system call
           mov ebx,1     ; file (stdout)
           mov ecx,msg   ; string
           mov edx,len   ; strlen
           int 0x80      ; call kernel
    mov eax,1     ; exit system call
           mov ebx,0
           int 0x80      ; call kernel
```
# Hello World in awk

BEGIN {
    print "Hello World!"
    exit
}

Hello World in BrainF***. No comment character exists.

+++++++++++++[>++++++++>++++++++++++>++++<<<-]
>++.++++++++ ..+++>+++.<<++++++++++++++.>.+++.-
-------------.-+.
C-ANSI

/* Hello World in C, Ansi-style */

#include <stdio.h>
#include <stdlib.h>

int main(void) {
    puts("Hello World!");
    return EXIT_SUCCESS;
}

// Hello World in Microsoft C# ("C-Sharp")

using System;

class HelloWorld
{
    public static int Main(String[] args)
    {
        Console.WriteLine("Hello, World!");
        return 0;
    }
}

// Hello World in C++ (pre-ISO)
#include <iostream.h> main()
{
    cout << "Hello World!" << endl;
    return 0;
}

// Hello World in ISO C++
#include <iostream>
#include <ostream>
int main()
{
    std::cout << "Hello World!" << std::endl;
}
;; Hello World in Fjölnir (Icelandic programming language)

"hello" < main
{
    main -> stef();
    stofn skrifastreng(;'Halló Veröld!'),
    stofnlok
}

* 

"GRUNNUR"
;
LaTeX

% Hello World! in LaTeX
\documentclass{article}
\begin{document}
Hello World!
\end{document}

TeX

% Hello World in plain \TeX
\immediate\write16{Hello World!}
\end
## Hello World as a Turing machine.

<table>
<thead>
<tr>
<th>State</th>
<th>Read</th>
<th>Write</th>
<th>Step</th>
<th>Next state</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>empty</td>
<td>H</td>
<td>&gt;</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>empty</td>
<td>e</td>
<td>&gt;</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>empty</td>
<td>l</td>
<td>&gt;</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>empty</td>
<td>l</td>
<td>&gt;</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>empty</td>
<td>o</td>
<td>&gt;</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>empty</td>
<td>blank</td>
<td>&gt;</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>empty</td>
<td>W</td>
<td>&gt;</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>empty</td>
<td>o</td>
<td>&gt;</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>empty</td>
<td>r</td>
<td>&gt;</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>empty</td>
<td>l</td>
<td>&gt;</td>
<td>11</td>
</tr>
<tr>
<td>11</td>
<td>empty</td>
<td>d</td>
<td>&gt;</td>
<td>12</td>
</tr>
<tr>
<td>12</td>
<td>empty</td>
<td>!</td>
<td>&gt;</td>
<td>STOP</td>
</tr>
</tbody>
</table>
* Hello World in Cobol

IDENTIFICATION DIVISION.
PROGRAM-ID. HELLO.
ENVIRONMENT DIVISION.
DATA DIVISION.
PROCEDURE DIVISION.
MAIN SECTION.
DISPLAY "Hello World!" STOP RUN.

***************************************************************************
Hello World in Ook. No comments possible.
"Piet" is an esoteric programming language invented by David Morgan-Mar (www.dangermouse.net/esoteric/piet.html). He writes: "Piet is a programming language in which programs look like abstract paintings. The language is named after Piet Mondrian, who pioneered the field of geometric abstract art."
RED GRAMMER

HELLO WORLD!
Haikus instead of error messages

Three things are certain:
Death, taxes, and lost data.
Guess which has occurred.

Everything is gone;
Your life's work has been destroyed.
Squeeze trigger (yes/no)?

-- David Dixon

-- David Carlson
I'm sorry, there's -- um -- insufficient -- what's-it-called? The term eludes me ...

Windows NT crashed. I am the Blue Screen of Death. No one hears your screams.

-- Owen Mathews

-- Peter Rothman
Seeing my great fault
Through darkening blue windows
I begin again

The code was willing,
It considered your request,
But the chips were weak.

-- Chris Walsh

-- Barry L. Brumitt
Printer not ready.
Could be a fatal error.
Have a pen handy?

A file that big?
It might be very useful.
But now it is gone.

-- Pat Davis

-- David J. Liszewski
Errors have occurred.
We won't tell you where or why.
Lazy programmers.

Server's poor response
Not quick enough for browser.
Timed out, plum blossom.

---

-- Charlie Gibbs
---

-- Rik Jespersen
---
Chaos reigns within.
Reflect, repent, and reboot.
Order shall return.

Login incorrect.
Only perfect spellers may enter this system.

-- Suzie Wagner

-- Jason Axley
This site has been moved.
We'd tell you where, but then we'd have to delete you.

wind catches lily
scatt'ring petals to the wind:
segmentation fault

-- Charles Matthews

-- Nick Sweeney
ABORTED effort:
Close all that you have.
You ask way too much.

First snow, then silence.
This thousand dollar screen dies so beautifully.
With searching comes loss
and the presence of absence:
"My Novel" not found.

The Tao that is seen
Is not the true Tao, until
You bring fresh toner.

-- Howard Korder

-- Bill Torcaso
The Web site you seek cannot be located but endless others exist

Stay the patient course Of little worth is your ire The network is down

-- Joy Rothke

-- David Ansel
A crash reduces your expensive computer to a simple stone.

There is a chasm of carbon and silicon the software can't bridge.

-- James Lopez

-- Rahul Sonnad
Yesterday it worked
Today it is not working
Windows is like that

To have no errors
Would be life without meaning
No struggle, no joy

-- Margaret Segall

-- Brian M. Porter
You step in the stream,
but the water has moved on.
This page is not here.

No keyboard present
Hit F1 to continue
Zen engineering?

-- Cass Whittington

-- Jim Griffith
Hal, open the file
Hal, open the damn file, Hal
open the, please Hal

Out of memory.
We wish to hold the whole sky,
But we never will.

-- Jennifer Jo Lane

-- Francis Heaney
Having been erased,
The document you're seeking
Must now be retyped.

The ten thousand things
How long do any persist?
Netscape, too, has gone.

-- Judy Birmingham

-- Jason Willoughby
Rather than a beep
Or a rude error message,
These words: "File not found."

Serious error.
All shortcuts have disappeared.
Screen. Mind. Both are blank.
Self reproducing programs

A program that generates a copy of its own source text as its complete output.
Sources:

The Quine Page:

http://www.nyx.net/~gthompson/quine.htm
http://www.wvquine.org/

The Theory:
The oldest Quine:

Lisp or Scheme:

```plaintext
((lambda (x)
    (list x (list (quote quote) x)))
(quote
    (lambda (x)
        (list x (list (quote quote) x)))))
```
Classic Quine in 'C'

/* newlines may be removed for "better" understanding*/

char*f="char*f=%c%s%c;main()
{printf(f,34,f,34,10);}%c";
main(){printf(f,34,f,34,10);}
Quine in Java

Author: Dario Dariol

```java
import java.text.*;
class a{
public static void main(String x[]){
    char b[]={34};
    char c[]={123};
    String s[]=new String[3];
    s[0]="import java.text.*;
    class a{2} public static void main(String x[]){2}char b[]={2}34};
    char c[]={2}123}; String s[]=new String[3];s[0]={1}{0}{1};
    s[1]=new String(b);s[2]=new String(c);
    System.out.println(MessageFormat.format(s[0],s));}}";
    s[1]=new String(b);s[2]= new String(c);
    System.out.println(MessageFormat.format(s[0],s));}}
```
Quine in Forth

Author: Elko Tchernev (etchernev@acm.org) Note: On some ANS Forths the following self-displaying word will work; I'm not sure if this is cheating or not. (Probably is). :

ME S" SEE ME" EVALUATE ;
Quine in Perl

Author: Christoph Durr

$b='\$b=\%c%s%c;printf$b,39,\$b,39;\';printf$b,39,\$b,39;

Author: Markus Holzer

#!/usr/local/bin/perl
$a='#!/usr/local/bin/perl\%c\$a=\%c%s%c;
printf($a,10,39,$a,39,10);\%c';printf($a,10,39,$a,39,10);

Author: Robin Houston Note: Last line is blank
print<<\"x2,"\nprint<<\"x2,"\n
Author: Kiriakos Georgiou
printf($x,39,$x='printf($x,39,$x=\%c%s%c,39);\',39);
Quine in Perl

Author: Frank Stajano (fstajano@orl.co.uk)

$l='l=%s;print l%%%\l``;print l%%%l``

Author: Greg Stein (gstein@microsoft.com)

$x='x=%s\012print x%%%`x`` print x%%%x``

Author: Terry Reedy (tjreedy@udel.edu)

Note: works as an interactive string input. The double quotes could theoretically be removed.

"x='x=%s;x%%%`x``;x%%%x``"
Quine in Scheme

Language: Scheme  Author: Tanaka Tomoyuki  (tanaka@ucdavis.edu)  Note: (Chez Scheme Version 5.0b)

(call/cc
  (lambda (c) (c ((lambda (c) `(call/cc (lambda (c) (c ,c ',c))))
    '(lambda (c) `(call/cc (lambda (c) (c ,c ',c)))))))))

Author: Tanaka Tomoyuki (tanaka@ucdavis.edu)
Note: (Chez Scheme Version 5.0b)

((lambda (q qq) ((lambda (x) `((lambda (q qq) ,(q x)) . ,(q qq)))
  '(lambda (x) `((lambda (q qq) ,(q x)) . ,(q qq)))))
  (lambda (q) `(,q ',q))
  '(lambda (q) `(,q ',q))
  (lambda (q) `(,q ',q))
  '(lambda (q) `(,q ',q))))
Quine in Unix shell

Author: Brian A.E. Meekings (baem@mink.mt.att.com)
Note: sh, ksh

b=\;bb=$b$b$b$b;b;q=';x='echo
   "b=$bb;bb=$b$b$b$b;q=$b$q;x=$q$x$q";echo $x'
echo "b=$bb;bb=$b$b$b$b;q=$b$q;x=$q$x$q";echo $x

Author: Matt Corks njaharve@waterloo.ca
Note: works for bash, ksh, zsh

#!/xhbin/bash read foo<<'EOF';eval $foo
echo '#!/bin/bash';echo 'read foo<<"'"EOF""';eval$foo';
   echo $foo;echo EOF
EOF
This museum

- The 'vitrinemuseum' shows early computer hardware as used for various labs at Delft University of Technology.

- Have a look at http://vitrinemuseum.ewi.tudelft.nl