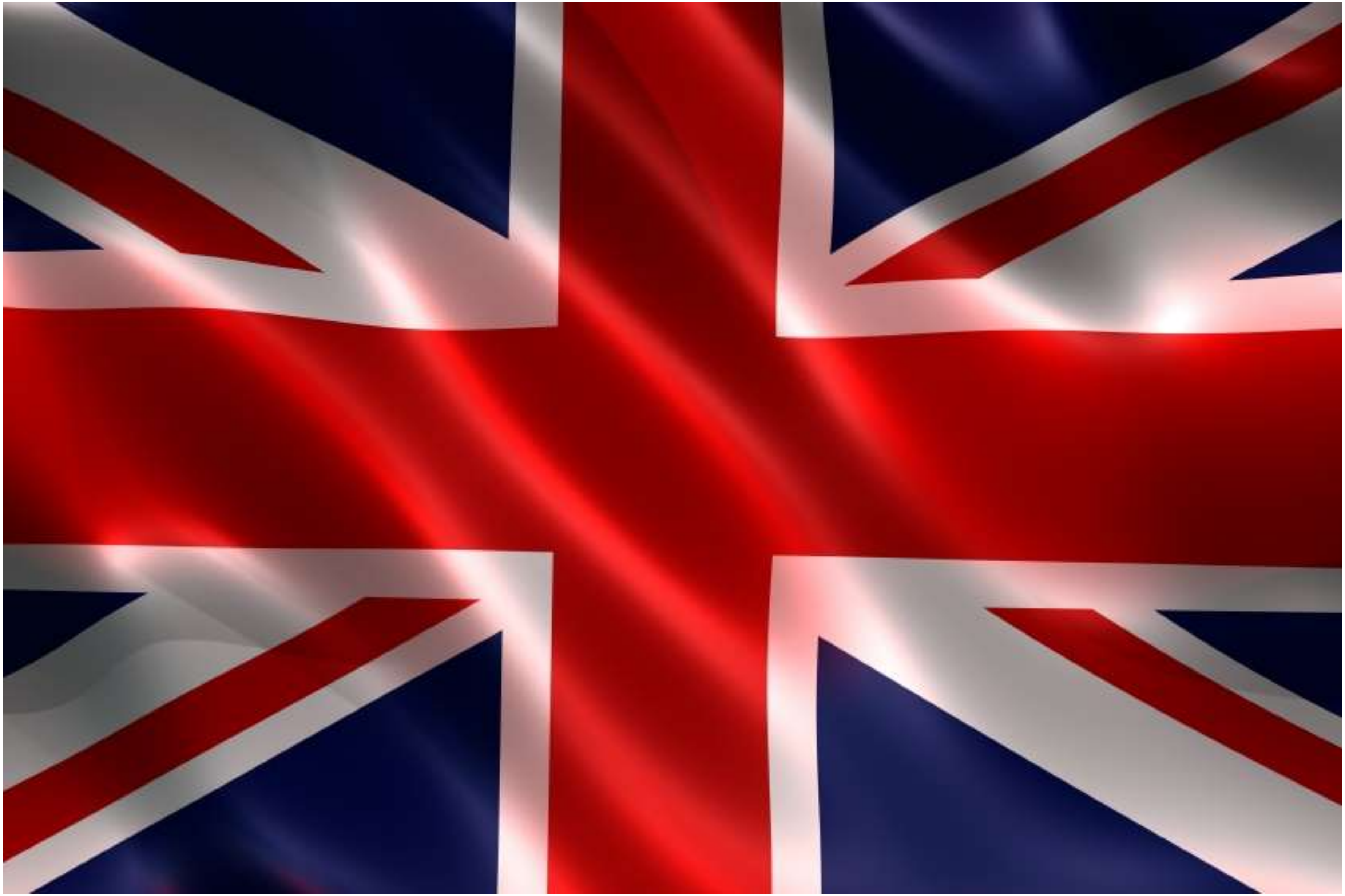
What application security tools vendors don’t want you to know and holes they will never find!

Mark Curphey
John Viega



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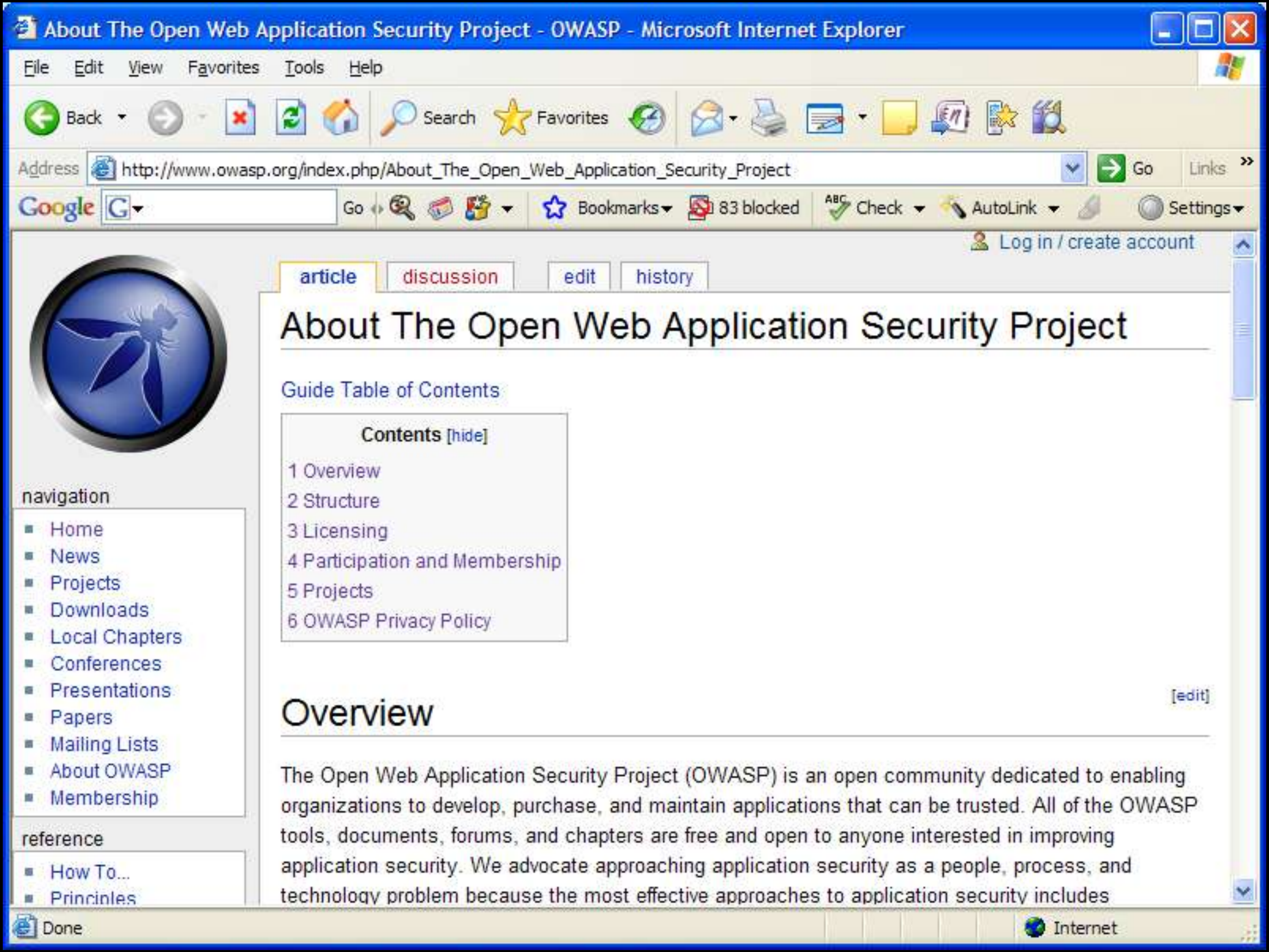
charles SCHWAB
NASDAQ



About The Open Web Application Security Project

Guide Table of Contents

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Overview

[edit]

The Open Web Application Security Project (OWASP) is an open community dedicated to enabling organizations to develop, purchase, and maintain applications that can be trusted. All of the OWASP tools, documents, forums, and chapters are free and open to anyone interested in improving application security. We advocate approaching application security as a people, process, and technology problem because the most effective approaches to application security includes

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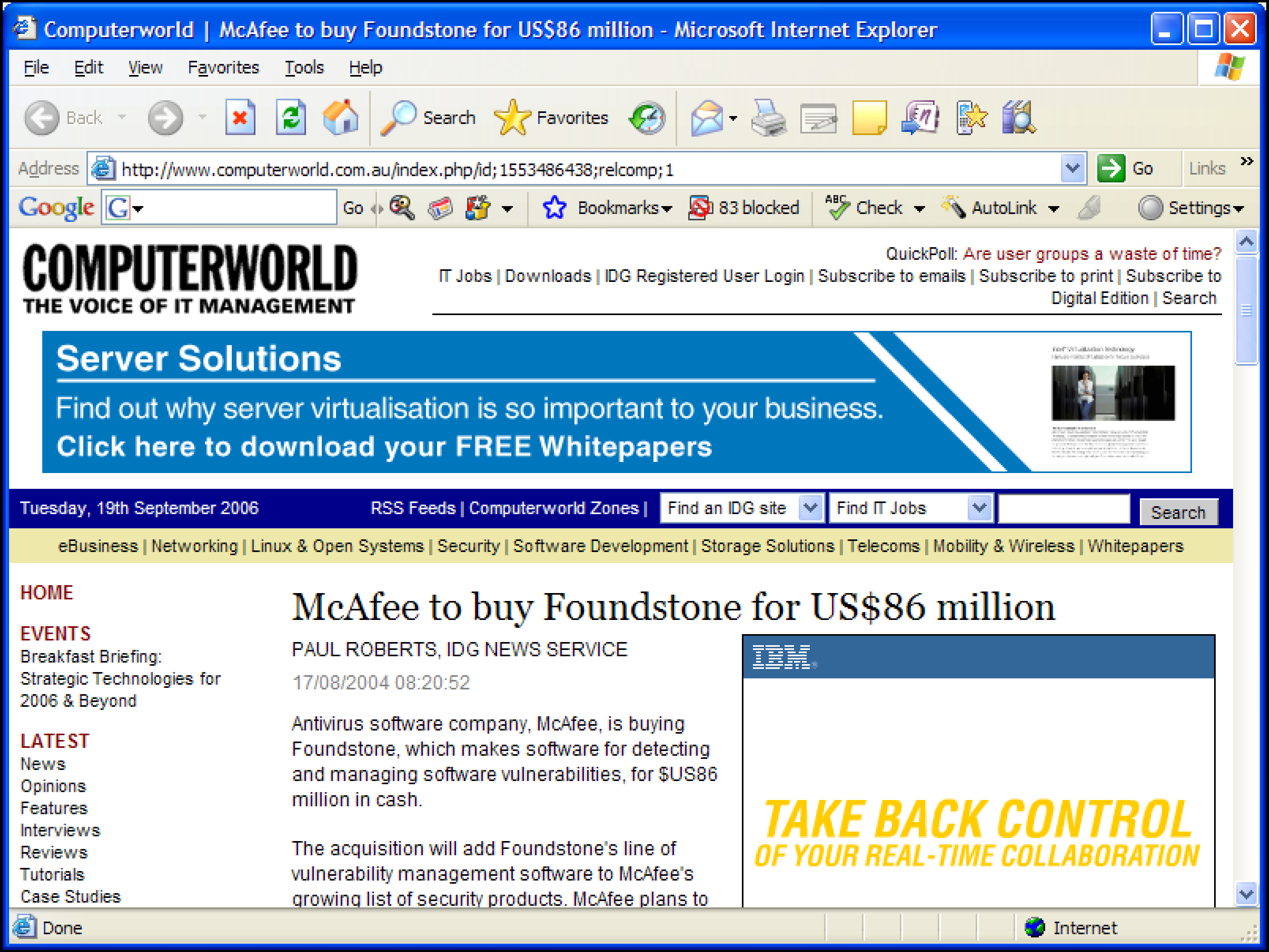
Computerworld | McAfee to buy Foundstone for US$86 million - Microsoft Internet Explorer
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83 blocked
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QuickPoll: Are user groups a waste of time?

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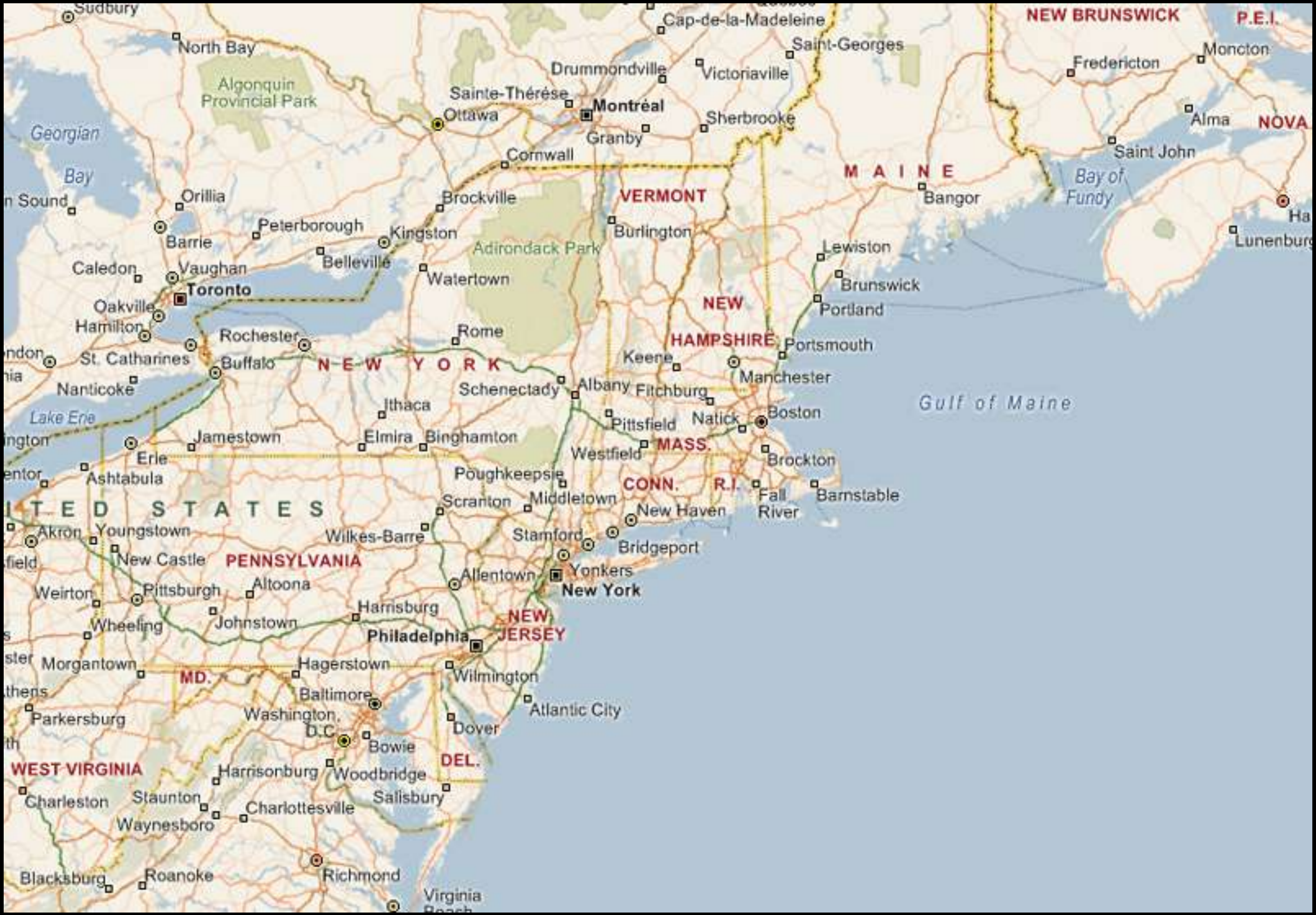
McAfee to buy Foundstone for US$86 million

PAUL ROBERTS, IDG NEWS SERVICE

17/08/2004 08:20:52

Antivirus software company, McAfee, is buying Foundstone, which makes software for detecting and managing software vulnerabilities, for $US86 million in cash.

The acquisition will add Foundstone's line of vulnerability management software to McAfee's growing list of security products. McAfee plans to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Algonquin Provincial Park
Cap-de-la-Madeleine
Saint-Georges
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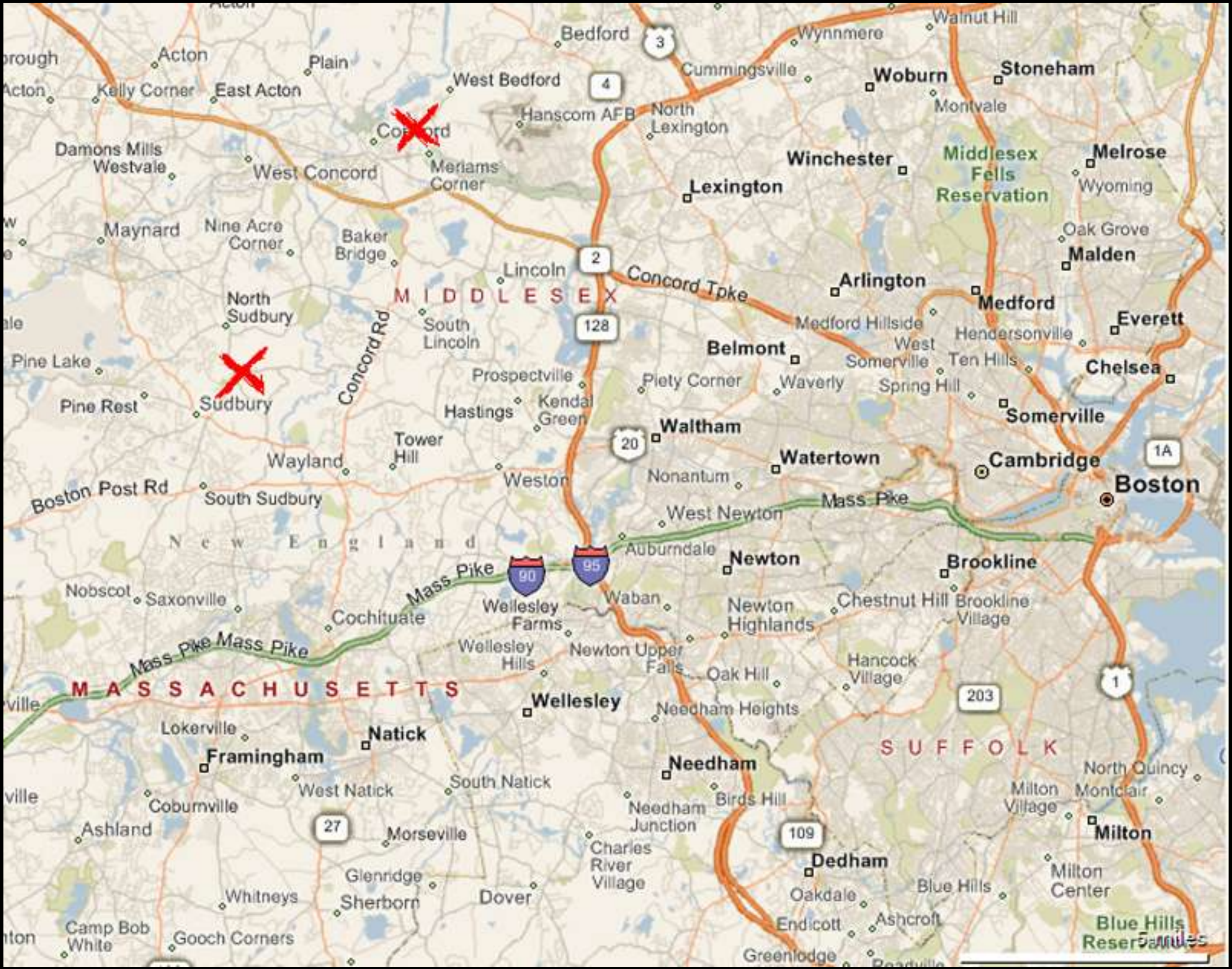
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Stoneham
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North Lexington
Montvale
Concord
Merriams Corner
Winchester
Middlesex Fells Reservation
Melrose
Damons Mills
Westvale
West Concord
Lexington
Wyoming
Maynard
Nine Acre Corner
Baker Bridge
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Oak Grove
Malden
Lincoln
Concord Tpke
Arlington
North Sudbury
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Medford
South Lincoln
Medford Hillside
Hendersonville
Everett
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Concord Rd
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Brookline Village
Mass Pike
Mass Pike
Wellesley Hills
Newton Upper Falls
Hancock Village
Oak Hill
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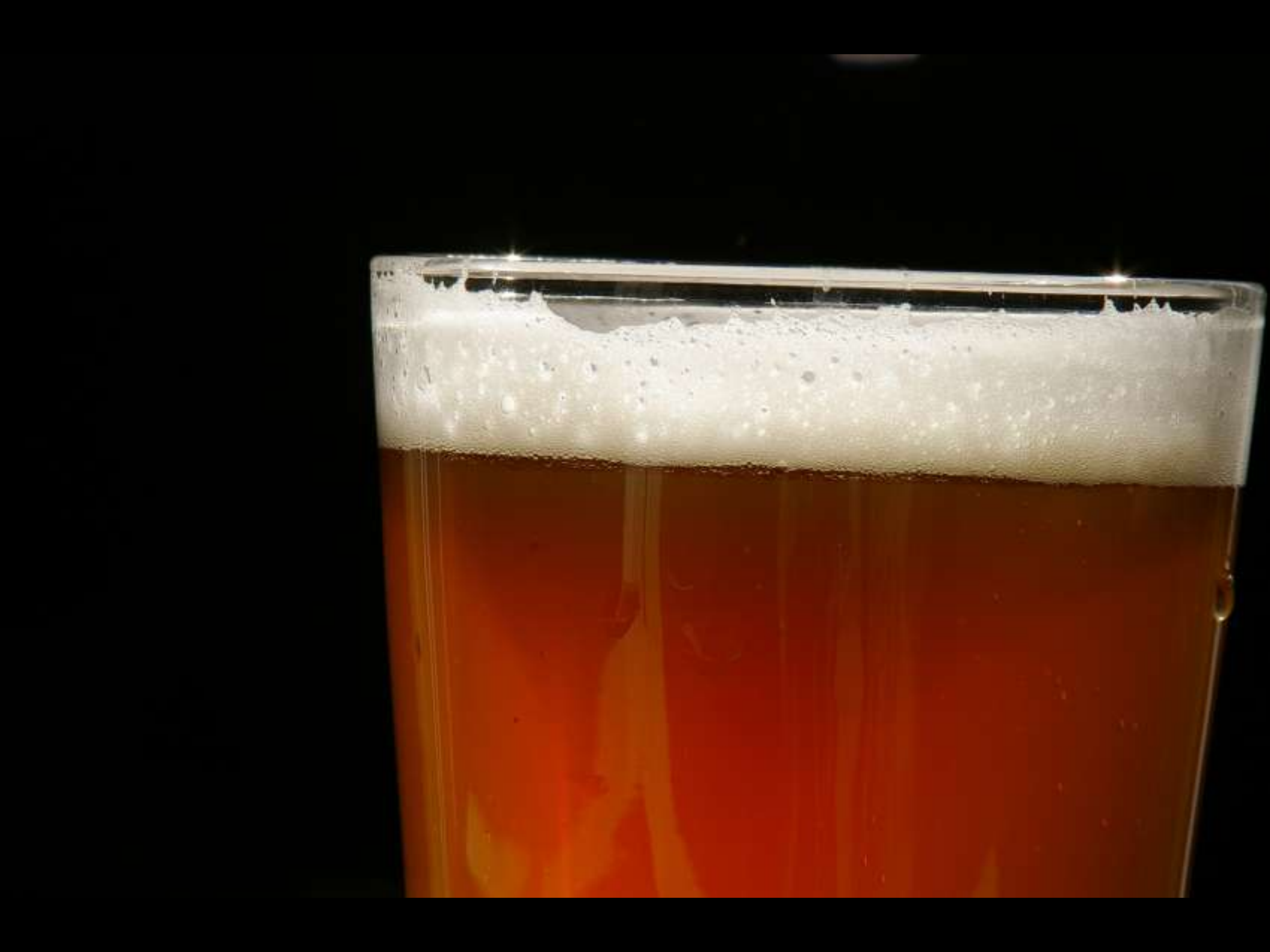
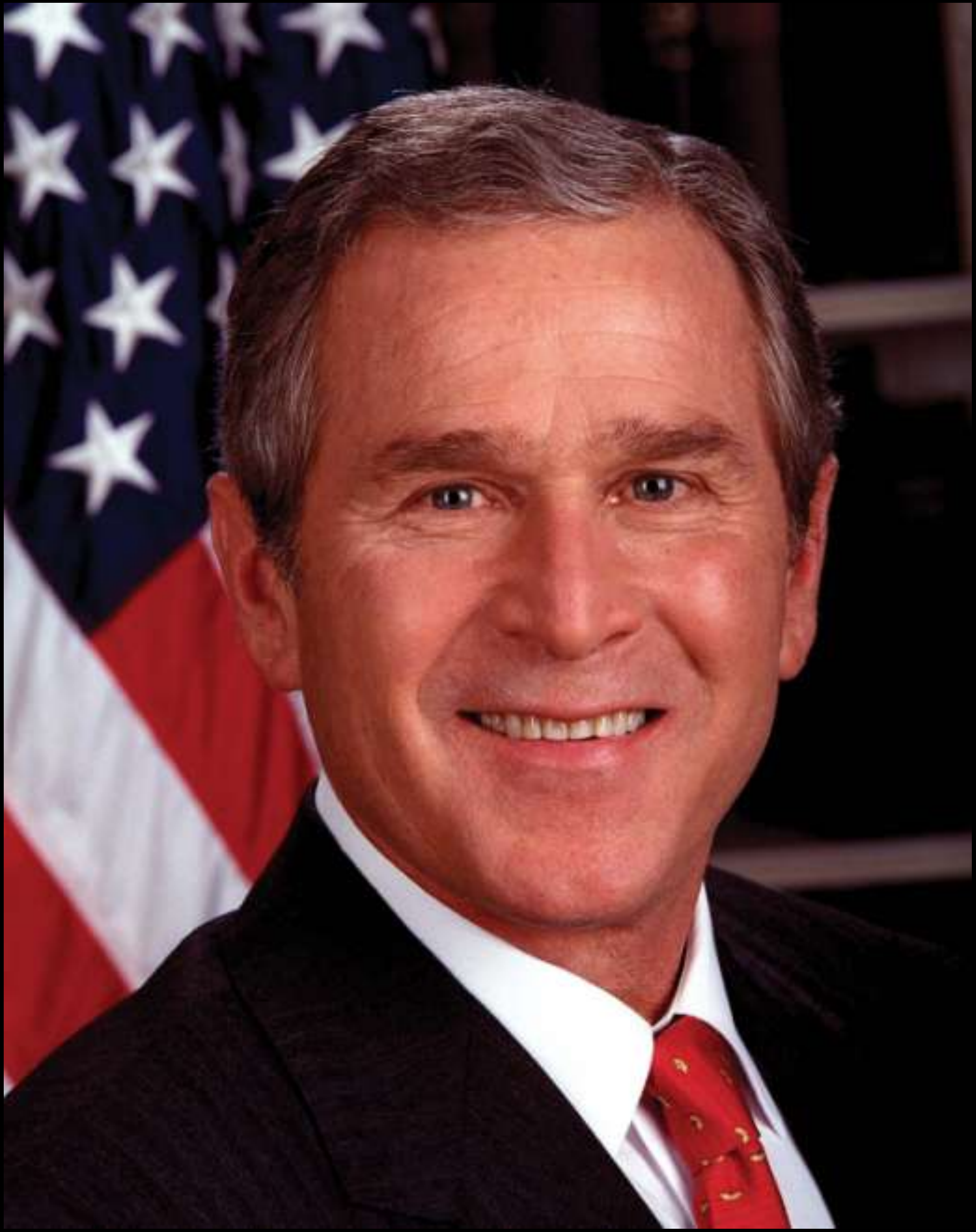
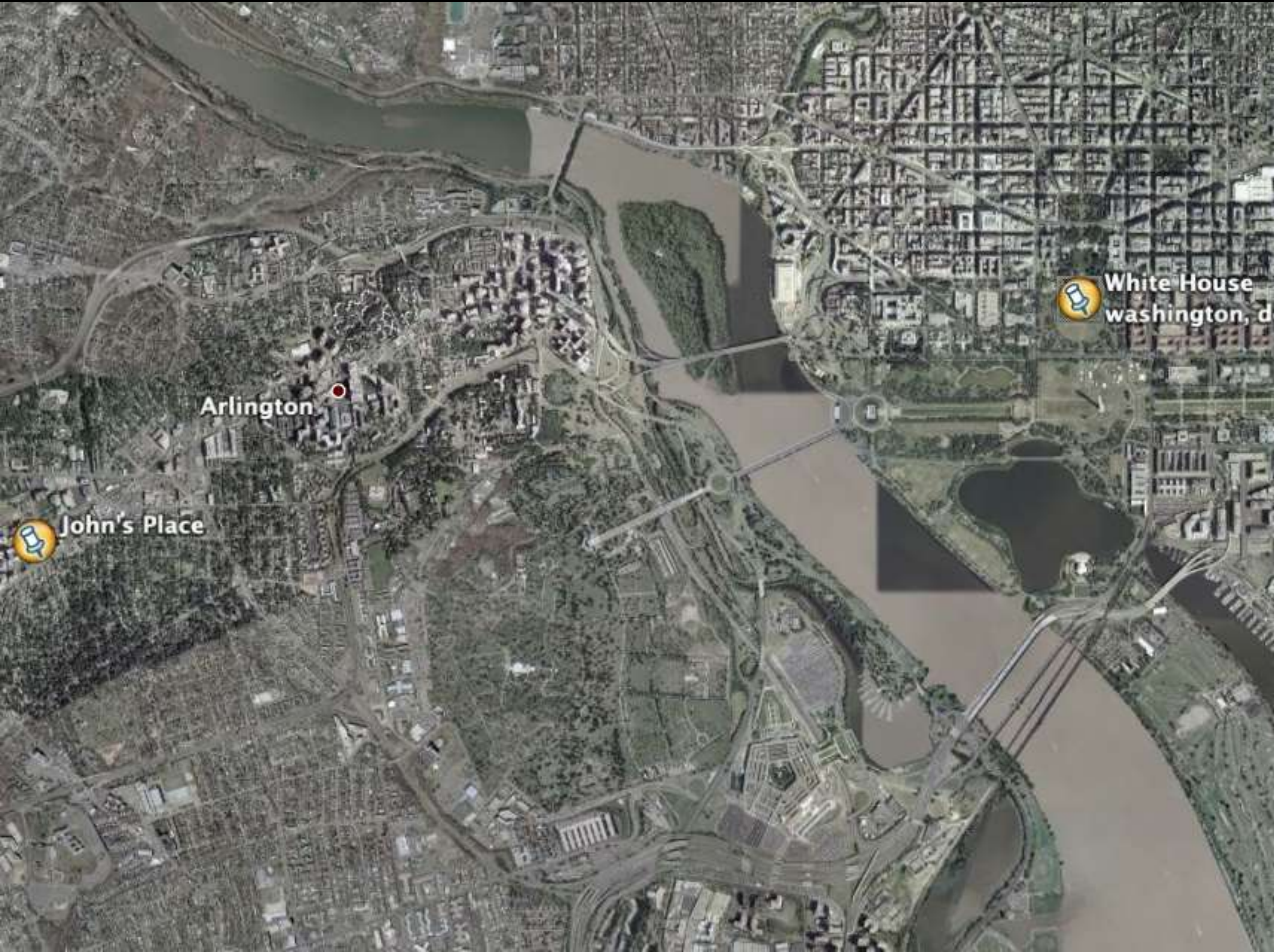
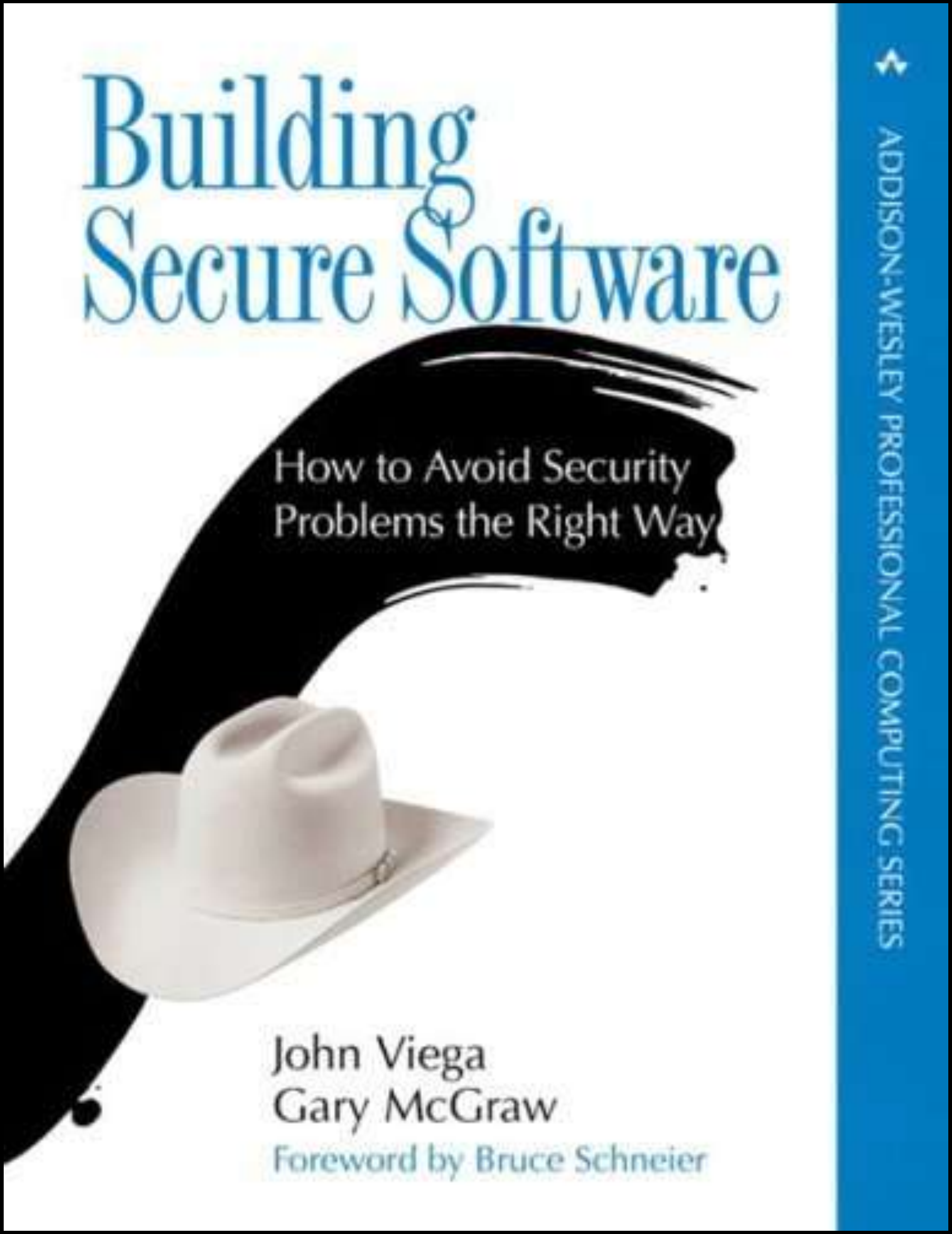
Lokerville
Natick
SUFFOLK
Framingham
Needham
North Quincy
West Natick
South Natick
Milton Village
Montclair
Coburnville
Needham Junction
Birds Hill
27
Ashland
Morseville
109
Milton
Charles River Village
Dedham
Glenridge
Milton Center
Whitneys
Sherborn
Dover
Oakdale
Blue Hills
Camp Bob White
Gooch Corners
Endicott
Ashcroft
Blue Hills Reservation
Greenlodge
5 miles






White House
washington, d
Arlington
John's Place



Building Secure Software

How to Avoid Security Problems the Right Way

John Viega
Gary McGraw
Foreword by Bruce Schneier

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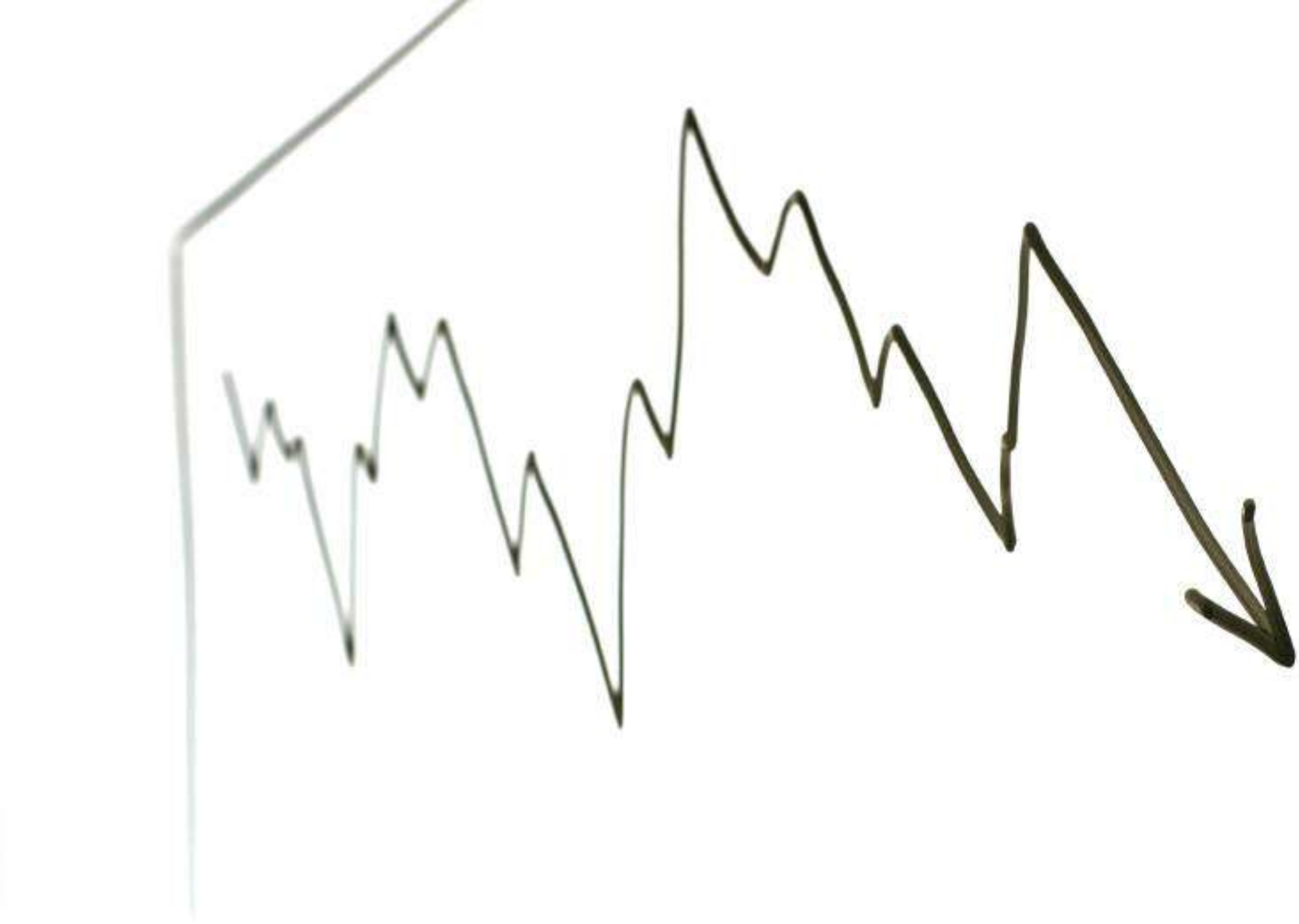
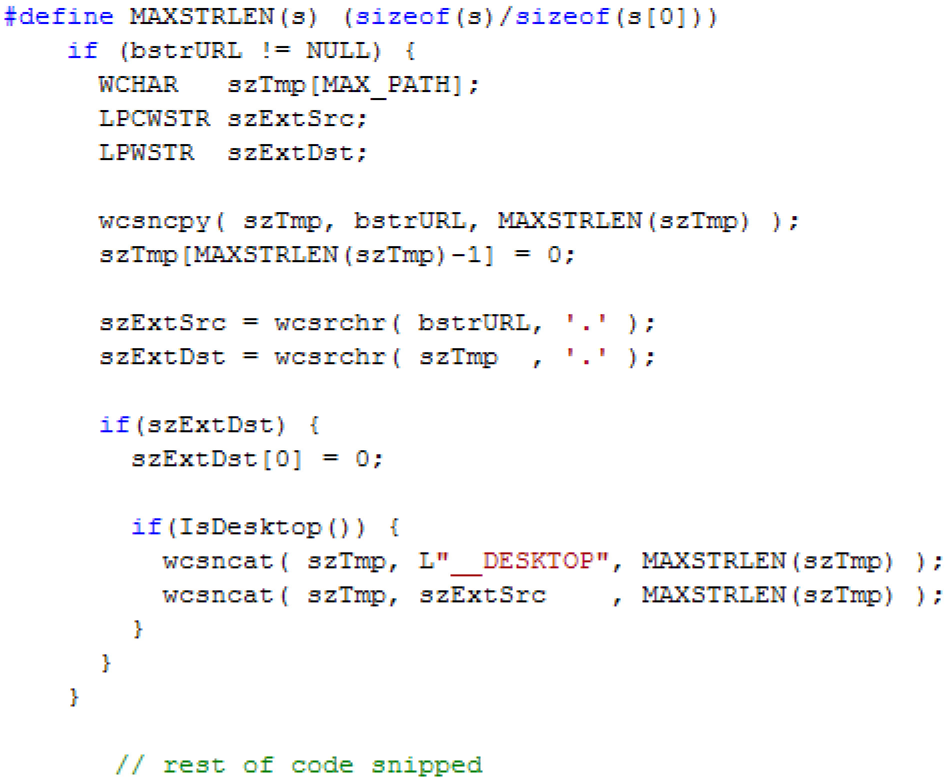


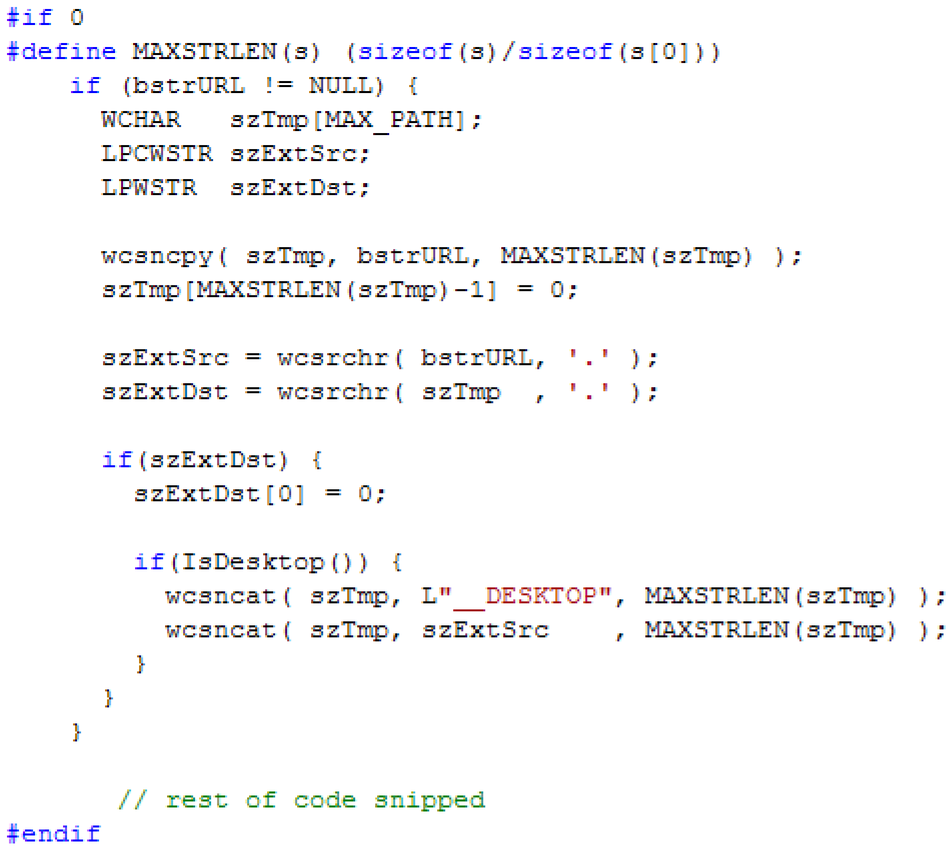
HOTEL
QUES
CABLE CAR HOTEL

function deleteRegister
$oRegisterAssistance
$bResult = $oRegisterAssistance
if($bResult) {
$oStructure
function
startDataAssistance
mUserPercentage
$oDataAssistance = new
DataAssistance(
Percentage
return $oDataAssistance
}
function
$oDataAssistance
return
function
$oDataAssistance
$vObject
return
function
return
function
return

How Important is Context?



```
#define MAXSTRLEN(s) (sizeof(s)/sizeof(s[0]))
    if (bstrURL != NULL) {
      WCHAR   szTmp[MAX_PATH];
      LPCWSTR szExtSrc;
      LPWSTR  szExtDst;

      wcsncpy( szTmp, bstrURL, MAXSTRLEN(szTmp) );
      szTmp[MAXSTRLEN(szTmp)-1] = 0;

      szExtSrc = wcsrchr( bstrURL, '.' );
      szExtDst = wcsrchr( szTmp  , '.' );

      if(szExtDst) {
        szExtDst[0] = 0;

        if(IsDesktop()) {
          wcsncat( szTmp, L"__DESKTOP", MAXSTRLEN(szTmp) );
          wcsncat( szTmp, szExtSrc    , MAXSTRLEN(szTmp) );
        }
      }
    }

       // rest of code snipped
```



```
#if 0
#define MAXSTRLEN(s) (sizeof(s)/sizeof(s[0]))
    if (bstrURL != NULL) {
      WCHAR   szTmp[MAX_PATH];
      LPCWSTR szExtSrc;
      LPWSTR  szExtDst;

      wcsncpy( szTmp, bstrURL, MAXSTRLEN(szTmp) );
      szTmp[MAXSTRLEN(szTmp)-1] = 0;

      szExtSrc = wcsrchr( bstrURL, '.' );
      szExtDst = wcsrchr( szTmp  , '.' );

      if(szExtDst) {
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        if(IsDesktop()) {
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          wcsncat( szTmp, szExtSrc    , MAXSTRLEN(szTmp) );
        }
      }
    }

       // rest of code snipped
#endif
```

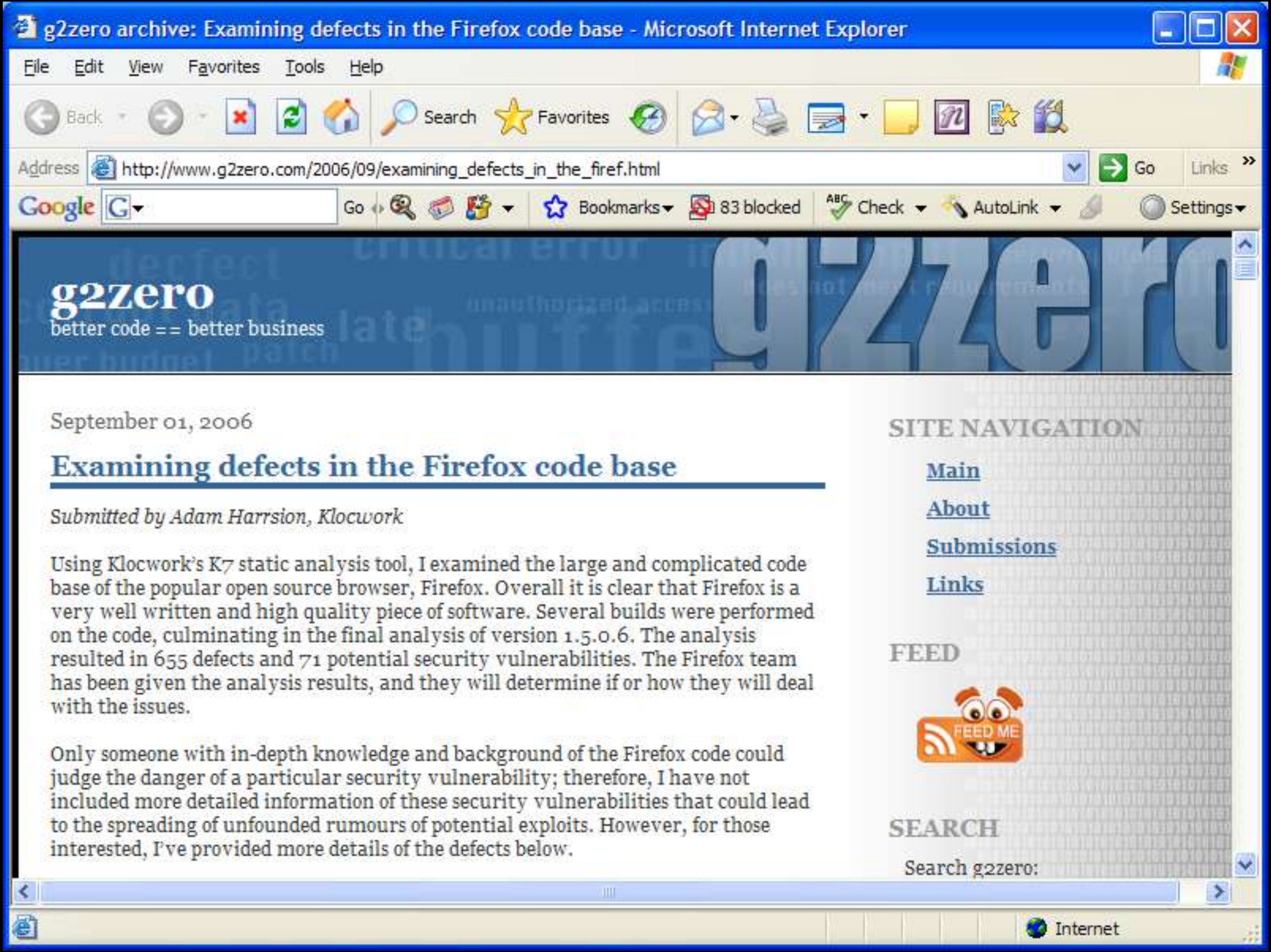
g2zero archive: Examining defects in the Firefox code base - Microsoft Internet Explorer
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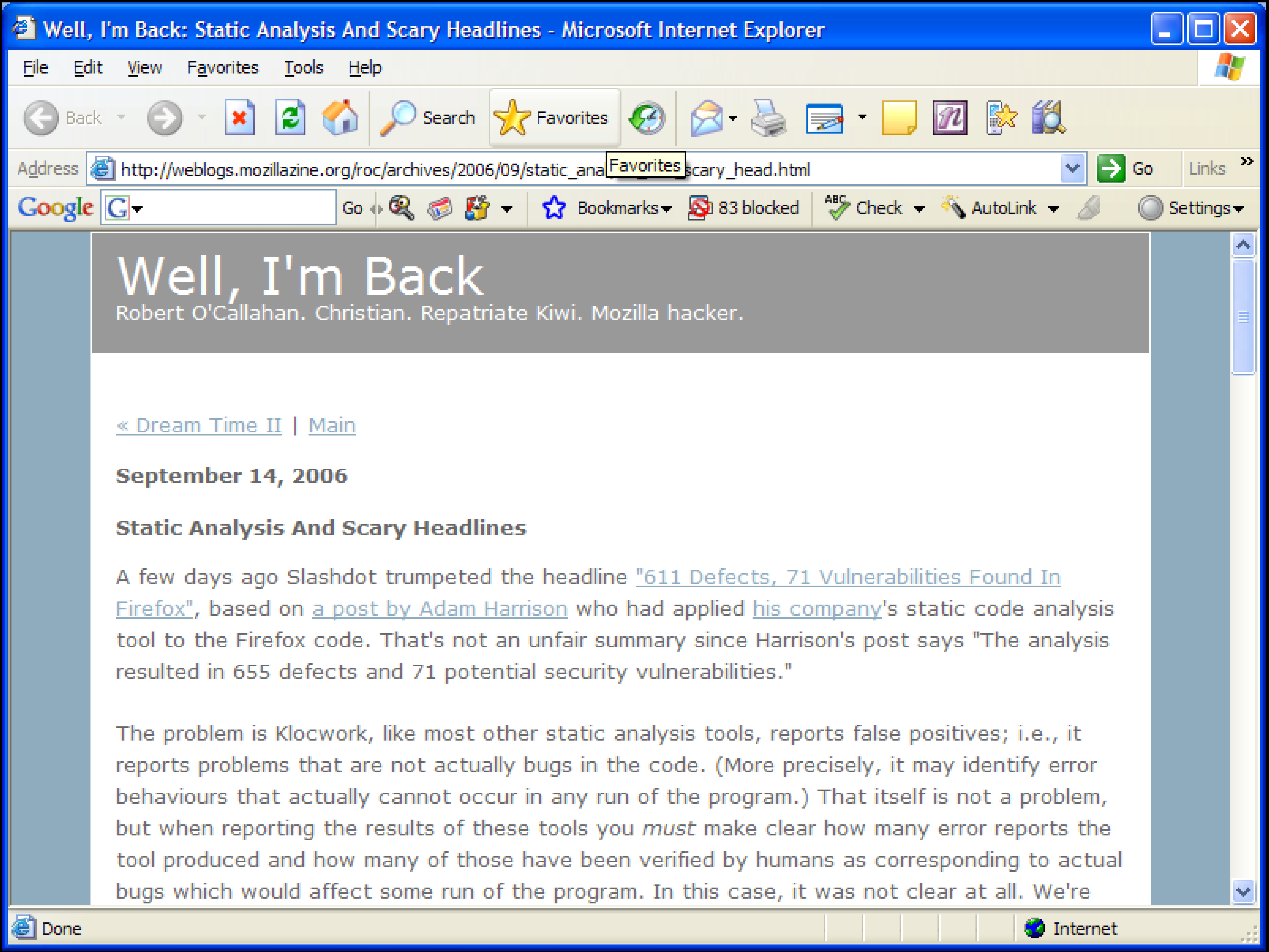
September 01, 2006

Examining defects in the Firefox code base

Submitted by Adam Harrsion, Klocwork

Using Klocwork's K7 static analysis tool, I examined the large and complicated code base of the popular open source browser, Firefox. Overall it is clear that Firefox is a very well written and high quality piece of software. Several builds were performed on the code, culminating in the final analysis of version 1.5.0.6. The analysis resulted in 655 defects and 71 potential security vulnerabilities. The Firefox team has been given the analysis results, and they will determine if or how they will deal with the issues.

Only someone with in-depth knowledge and background of the Firefox code could judge the danger of a particular security vulnerability; therefore, I have not included more detailed information of these security vulnerabilities that could lead to the spreading of unfounded rumours of potential exploits. However, for those interested, I've provided more details of the defects below.



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Well, I'm Back

Robert O'Callahan. Christian. Repatriate Kiwi. Mozilla hacker.

« Dream Time II | Main

September 14, 2006

Static Analysis And Scary Headlines

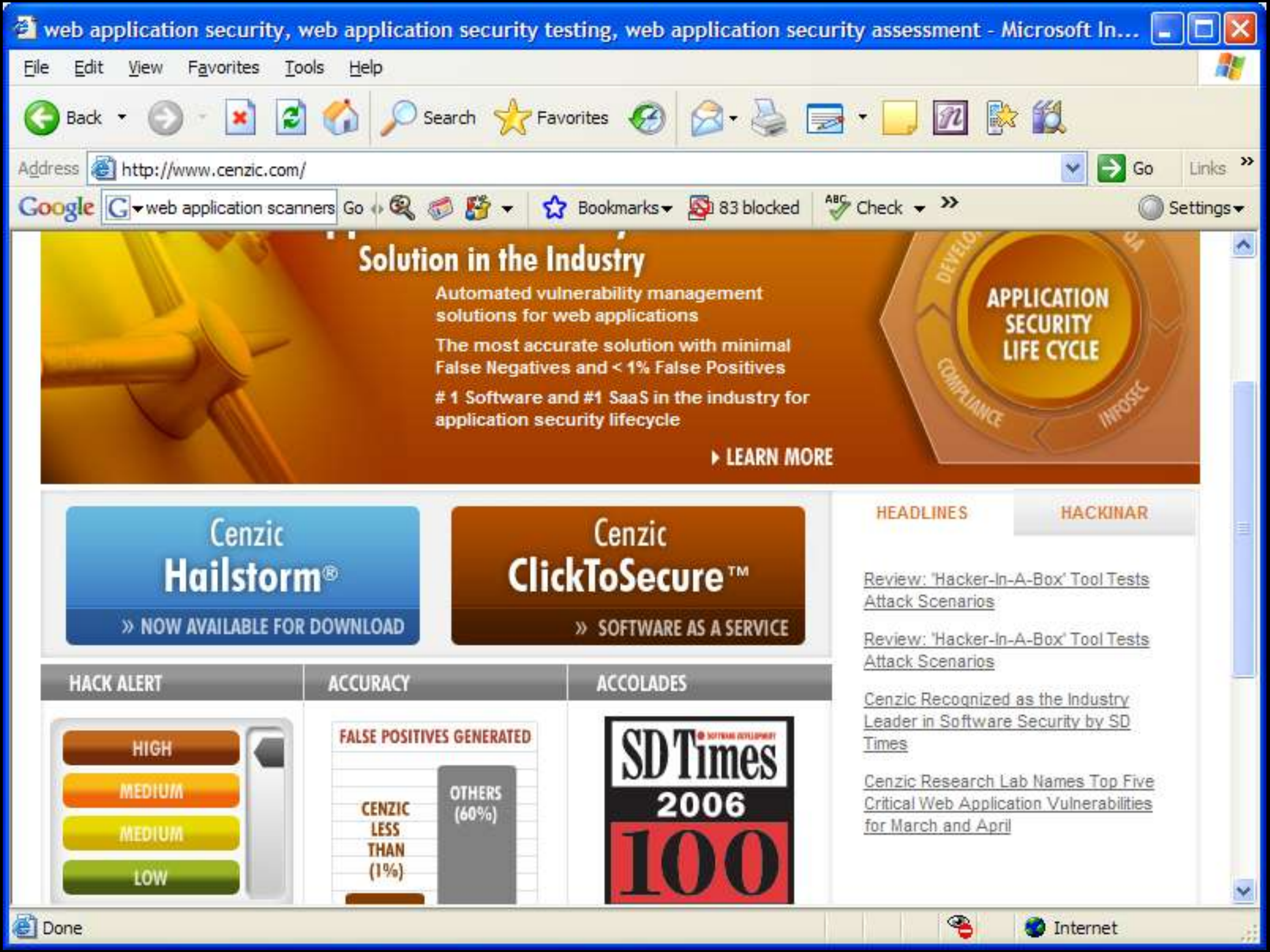
A few days ago Slashdot trumpeted the headline "611 Defects, 71 Vulnerabilities Found In Firefox", based on a post by Adam Harrison who had applied his company's static code analysis tool to the Firefox code. That's not an unfair summary since Harrison's post says "The analysis resulted in 655 defects and 71 potential security vulnerabilities."

The problem is Klocwork, like most other static analysis tools, reports false positives; i.e., it reports problems that are not actually bugs in the code. (More precisely, it may identify error behaviours that actually cannot occur in any run of the program.) That itself is not a problem, but when reporting the results of these tools you *must* make clear how many error reports the tool produced and how many of those have been verified by humans as corresponding to actual bugs which would affect some run of the program. In this case, it was not clear at all. We're

Mozilla vs. Klocwork
611 “defects”
72 “vulnerabilities”

3 verified bugs

99.5% useless?



web application security, web application security testing, web application security assessment - Microsoft In...

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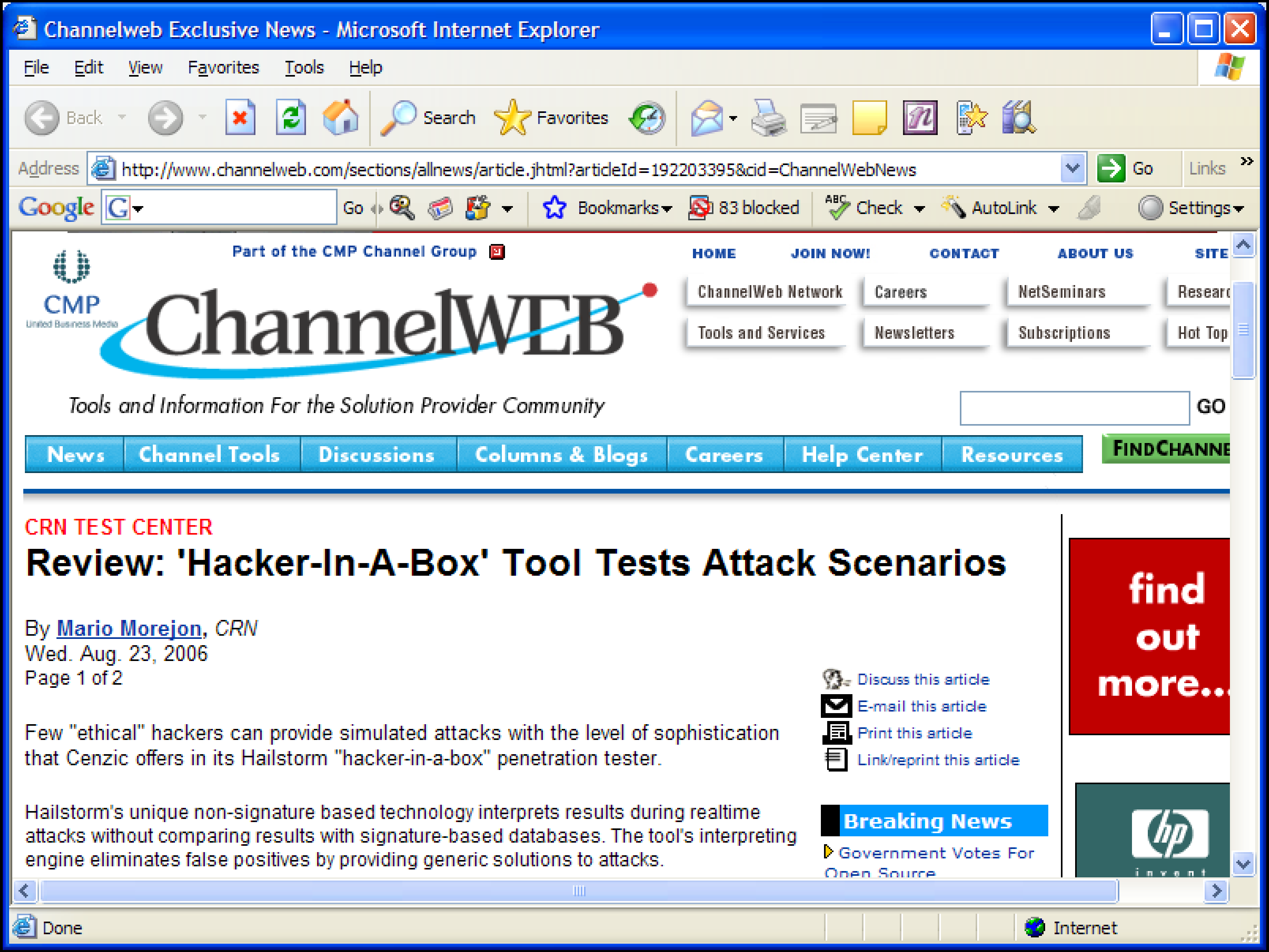
Review: 'Hacker-In-A-Box' Tool Tests Attack Scenarios

Review: 'Hacker-In-A-Box' Tool Tests Attack Scenarios

Cenzic Recognized as the Industry Leader in Software Security by SD Times

Cenzic Research Lab Names Top Five Critical Web Application Vulnerabilities for March and April

HACK ALERT ACCURACY ACCOLADES



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hp invent
Done
Internet

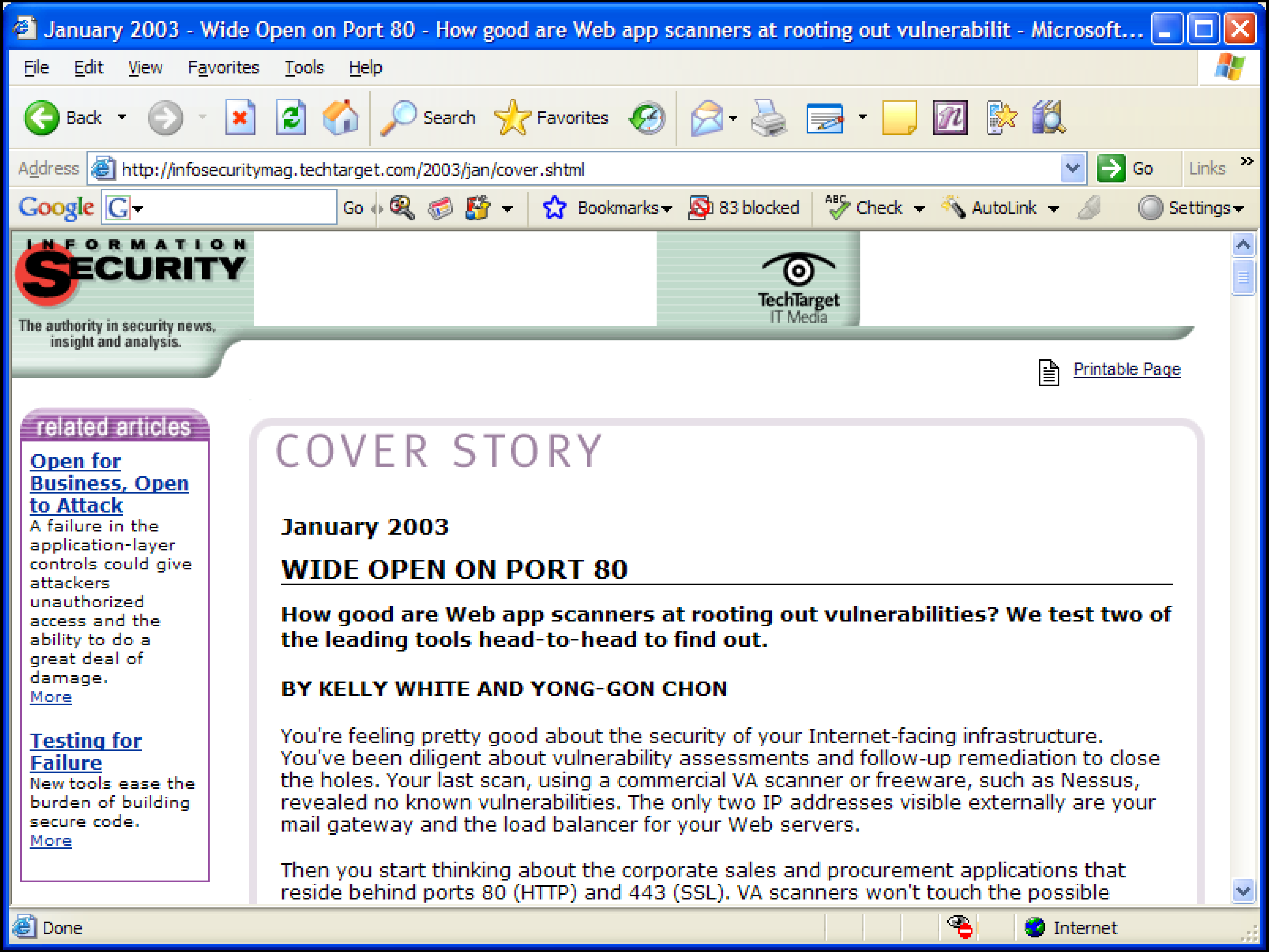
CRN TEST CENTER

Review: 'Hacker-In-A-Box' Tool Tests Attack Scenarios

By Mario Morejon, *CRN*
Wed. Aug. 23, 2006
Page 1 of 2

Few "ethical" hackers can provide simulated attacks with the level of sophistication that Cenzic offers in its Hailstorm "hacker-in-a-box" penetration tester.

Hailstorm's unique non-signature based technology interprets results during realtime attacks without comparing results with signature-based databases. The tool's interpreting engine eliminates false positives by providing generic solutions to attacks.


January 2003 - Wide Open on Port 80 - How good are Web app scanners at rooting out vulnerabilit - Microsoft...
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Open for Business, Open to Attack
A failure in the application-layer controls could give attackers unauthorized access and the ability to do a great deal of damage.
More

Testing for Failure
New tools ease the burden of building secure code.
More

COVER STORY

January 2003

WIDE OPEN ON PORT 80

How good are Web app scanners at rooting out vulnerabilities? We test two of the leading tools head-to-head to find out.

BY KELLY WHITE AND YONG-GON CHON

You're feeling pretty good about the security of your Internet-facing infrastructure. You've been diligent about vulnerability assessments and follow-up remediation to close the holes. Your last scan, using a commercial VA scanner or freeware, such as Nessus, revealed no known vulnerabilities. The only two IP addresses visible externally are your mail gateway and the load balancer for your Web servers.

Then you start thinking about the corporate sales and procurement applications that reside behind ports 80 (HTTP) and 443 (SSL). VA scanners won't touch the possible

What kind of talk is this?

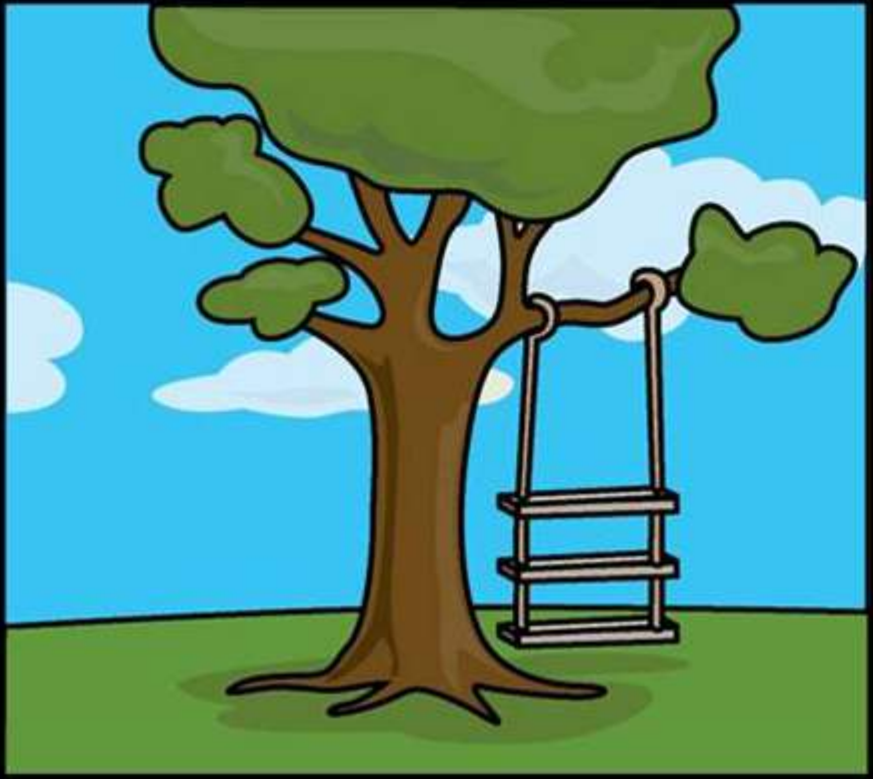
Tools that try to find security holes in software

Way for us to understand and rationalize why they are so bad and unlikely to get much better soon

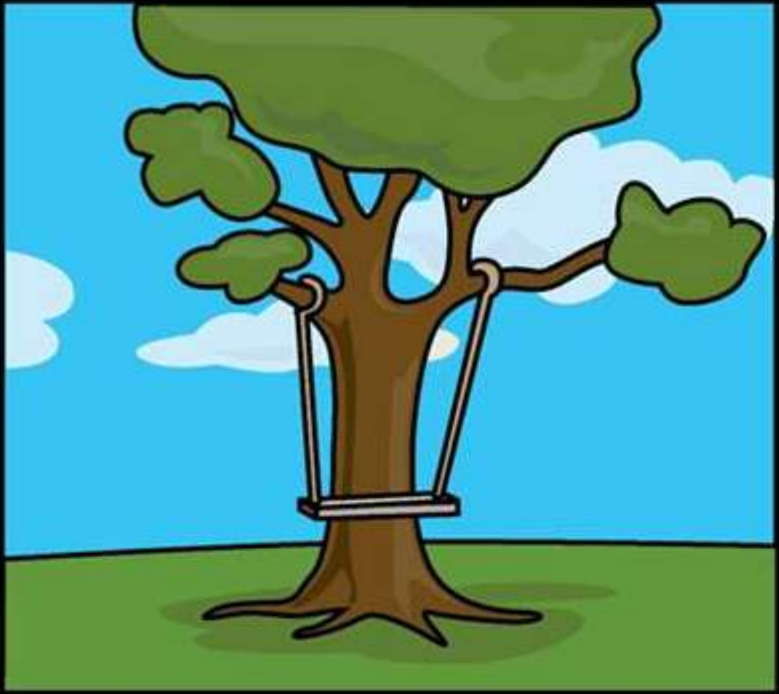
It is a realistic state of the union about the current state of application security technology and how it is being marketed and applied

Dr. Holger Peine
http://fhgonline.fraunhofer.de/server?suche-publica&num=048.06/D&iese
(N.B. about overly generous quote to Cenzic)

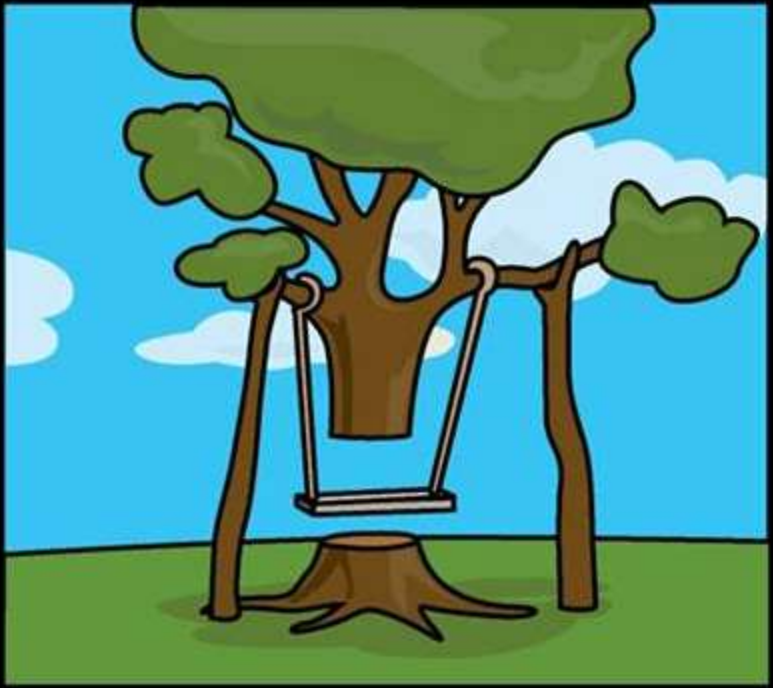
Arian Evans
http://www.owasp.org/index.php/Image:AppSec2005DC-Arian_Evans_Tools-Taxonomy.ppt



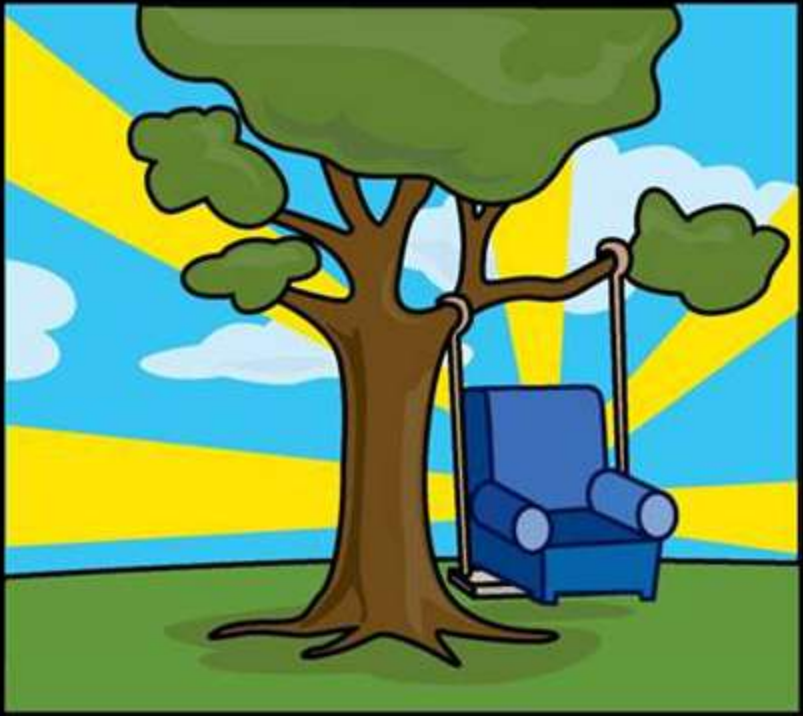
1. What the customer described



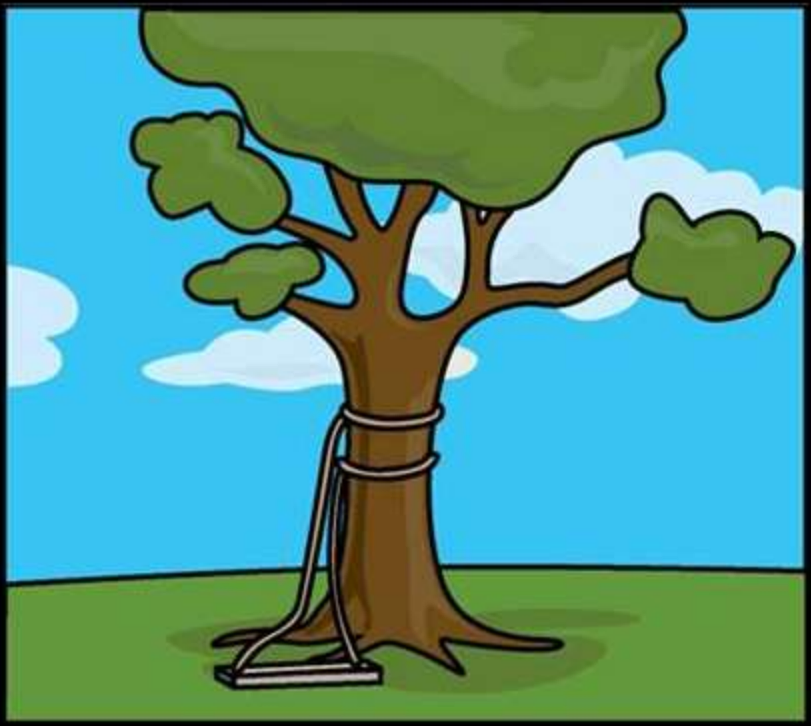
2. How the project manager interpreted it



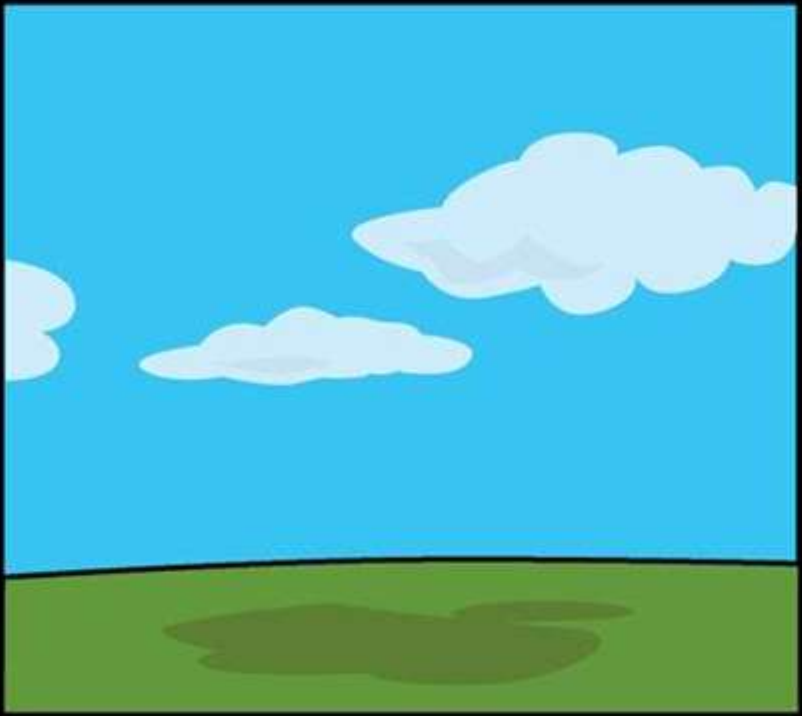
3. How the business analyst interpreted it



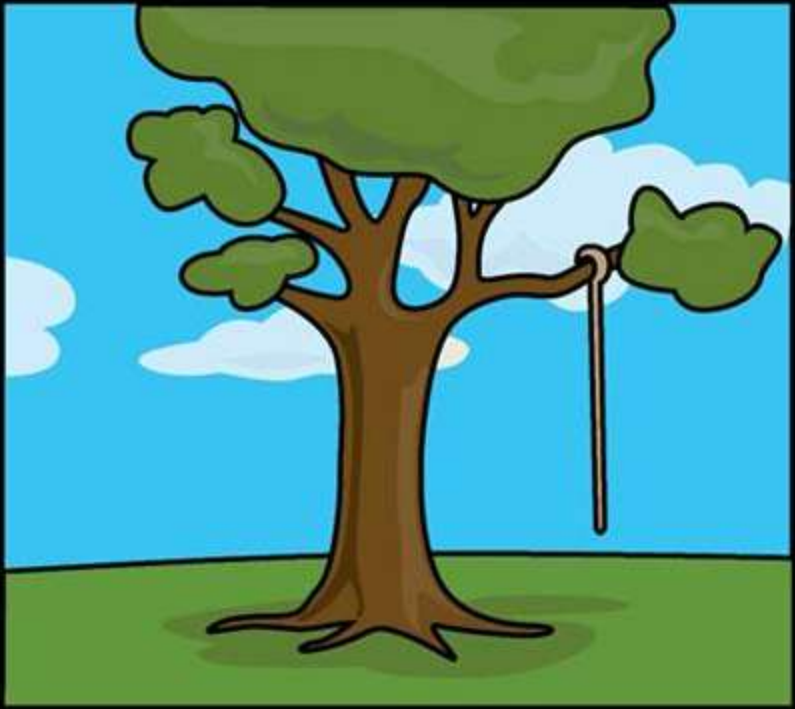
4. How the (expensive) business consultant saw it



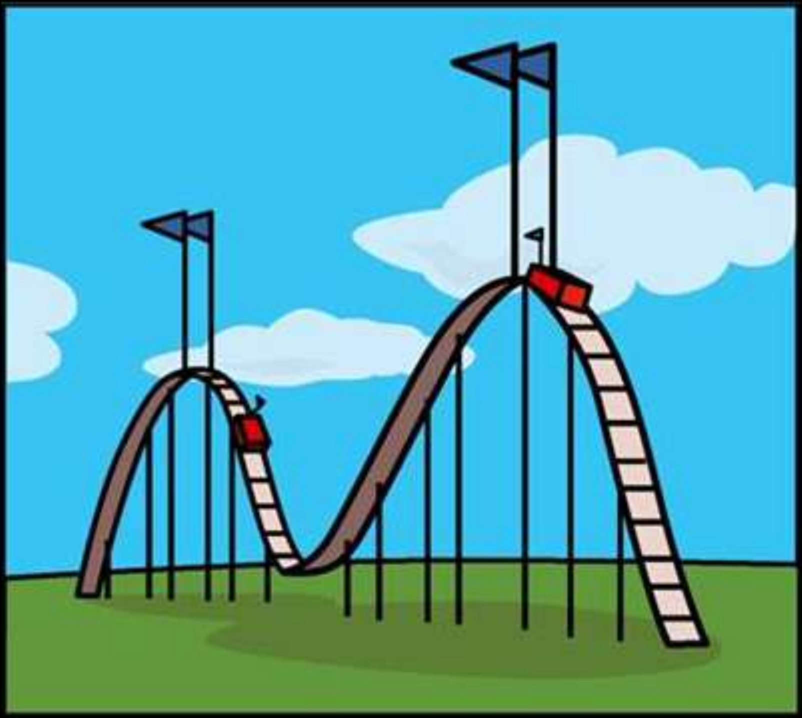
5. How the developer wrote it



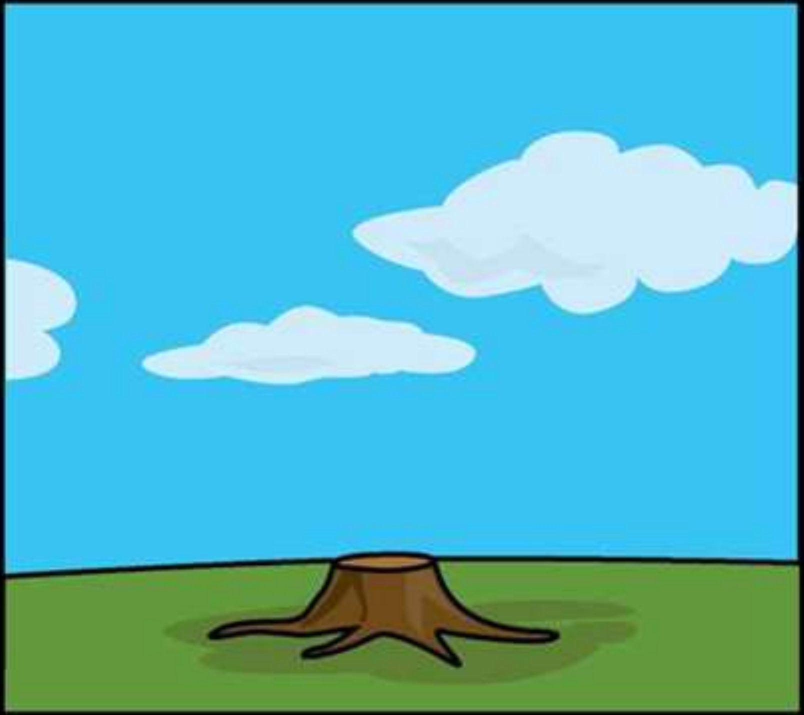
6. How the project was documented



7. What operations installed



8. How the consultants billed the project



9. How it was supported

10. What the customer really wanted

Implementation Bugs

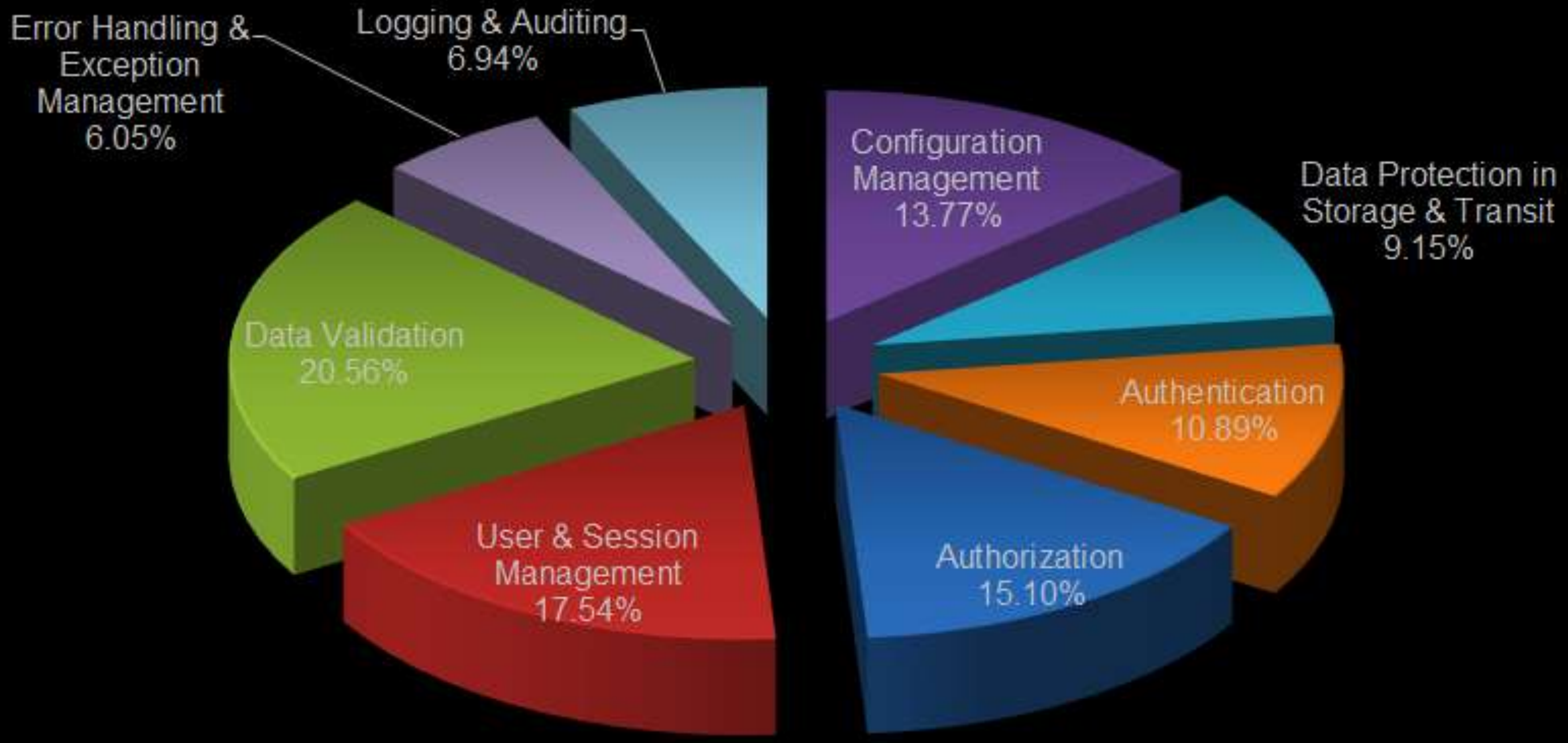
vs.

Design Flaws

Security Frame of Reference

Name	Description
Configuration Management	Configs, security managers, web server settings etc.
Authentication	Knowing users and entities are who they claim to be
Authorization	Who can do what to whom, TOCTOU etc.
Data Protection (Transit & Storage)	Encrypted passwords, on-wire protection, channel sinks, encrypted configuration files etc.
Data Validation	Valid, well formed, free of malicious payloads etc.
Auditing and Logging	Knowing who does what to whom etc.
Error & Exception Handling	What happens when the pooh hits the fan etc.
User Management	Password reset, registration, licensing etc.

2005-2006 Client Vulnerability Breakdown by Foundstone SecurityFrame®



Scorecard

🟩 - stands reasonable chance of finding issues
🟨 - “could” find some issues
🟥 - unlikely to find issues with confidence

Security Reference Frame	**Effectiveness of Assessment Tools**					
	Web App Scanners		Static Code Analysis		Binary Analysis	
	Bug	Flaw	Bug	Flaw	Bug	Flaw
Configuration Management	🟨	🟨	🟥	🟨	*	*
Authentication	🟨	🟥	🟨	🟨	*	*
Authorization	🟨	🟥	🟨	🟥	*	*
Data Protection (Transit & Storage)	🟥	🟥	🟨	🟨	*	*
Data Validation	🟨	🟥	🟨	🟨	*	*
Auditing and Logging	🟥	🟥	🟨	🟥	*	*
Error & Exception Handling	🟨	🟥	🟨	🟥	*	*
User Management	🟨	🟥	🟨	🟥	*	*

* unscientific, based on experience

Web App Scanners

Configuration Management

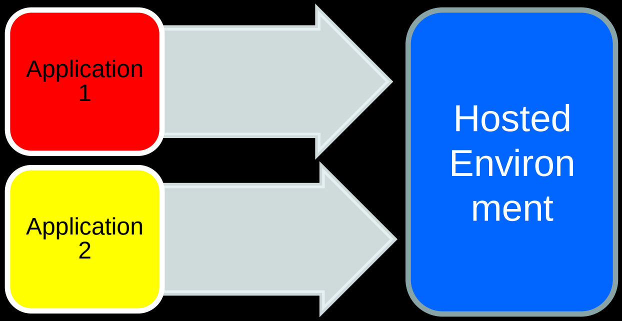
Implementation Bug

Hard coded connection string
in configuration files

Use of common crypto keys across
Implemntations

Design Flaw

ASP.NET application running in
partial trust



Revert.ToSelf();

* good at many web server config issues

Web App Scanners

Data Validation

Implementation Bug

Stored cross site scripting
(even basic XSS in some cases)

SQL injection (non ‘)

Buffer overflows NOT HTTP 500’s!

Design Flaw

Canonicalization

Internationalization

* Their strongest category

Data protection

Implementation Bug

Weak random number generators

Secure memory management issues

Design Flaw

Clear text passwords stored in database

Weak algorithms *

Reusing keys with stream ciphers

User Management

Implementation Bug

Password generation on reset

Weak session ID’s

Design Flaw

Clear text passwords in the database

Password expiry

Password reset sent in clear

Grep: Lack of Context

```
…
strcpy(dst, src);  // Generally a “high severity” error
…
strncpy(dst, src); // Generally a filtered out “low sev”
…
```

Grep: Lack of Context

```
…
// Generally a “high severity” error
strcpy(dst, src);  // Generally a “high severity” error
…

// Generally “low severity”, filtered out by default
strncpy(dst, src, n);
…
```

Grep: Lack of Context

```
void copy_20(char *src) {
  char dst[20];
  int  n;

  if (strlen(src) > 19) {
     return 0;
  }
  strcpy(dst, src);
  return strdup(dst);
}
```

Grep: Lack of Context

```
void copy(char *dst, char *src) {
  int  n = strlen(src);

  strncpy(dst, src, n);
  return strdup(dst);
}


…

char d[20];
copy(d, arbitrary_user_input);
```

Grep-style

- Cons:
  - 95%+ false positives for most apps
  - False negatives when rules ignore API
  - while(i<n) buf[i++] = getc();
  - Reports: char crlf[]="\r\n"; strcat("foo", crlf);
- Pros:
  - Gives manual auditor a starting point
  - Easy to support new languages
  - Immediate results on any code base

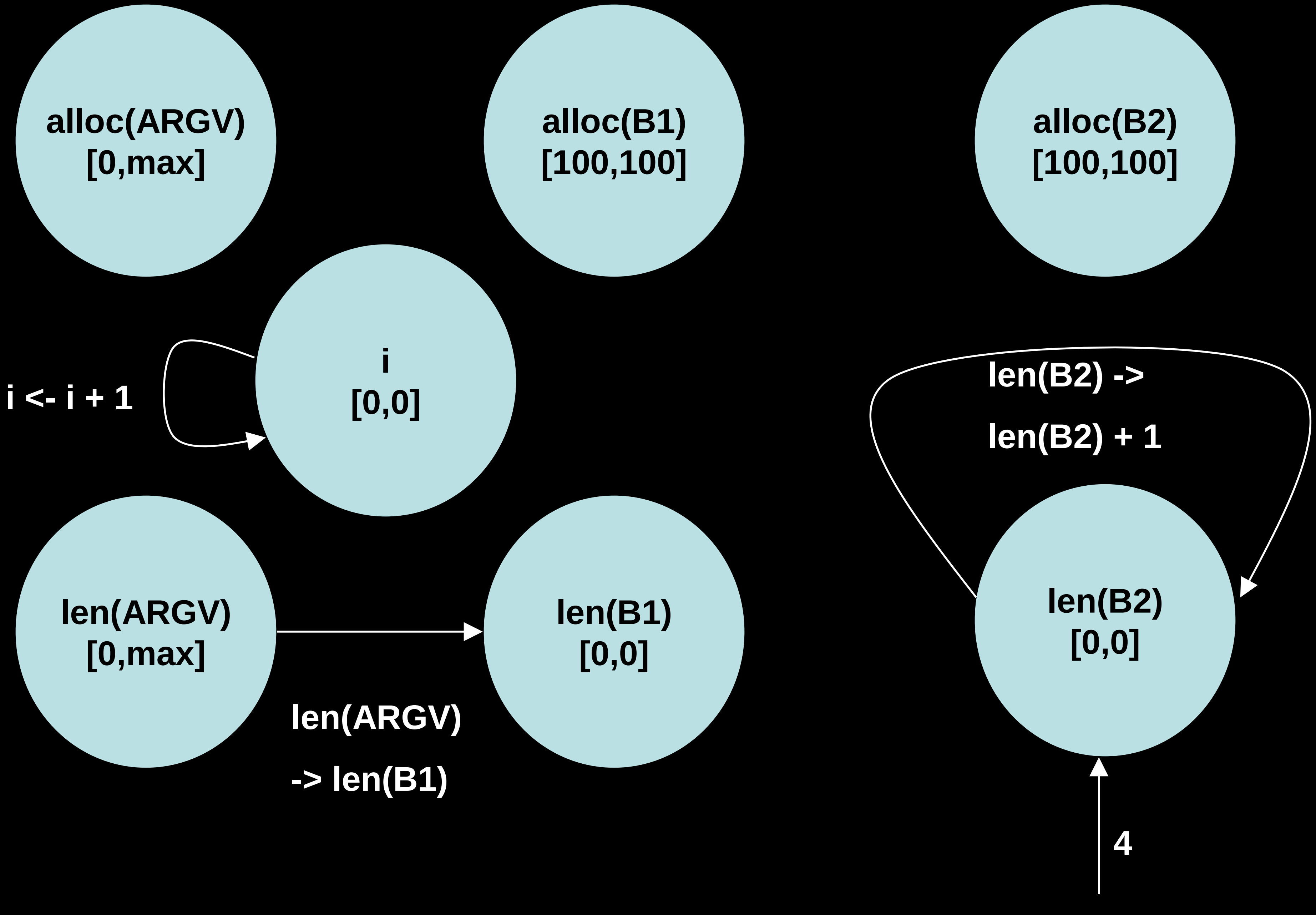
Let’s try to do better with “real” static analysis!

Sample program

```
void main(int argc, char **argv) {
  char b1[100] = {0,}; // alloc(B1) <- 100
  char b2[100] = {0,}; // alloc(B2) <- 100
  char b3[100] = {0,}; // alloc(B3) <- 100

  strcpy(b2, b1); // len(B2)<-len(B1)<- 100; No error.
  if (argc > 1) {
     // len(B3) <- max(len(argv), 400)
     strncpy(b3, argv[1], 400); // alloc(B3) == 100.
                                // len > alloc: ERROR!
  }
```

Another program

```
// alloc(ARGV) <- len(ARGV) <- [0,MAX]
void main(int argc, char **argv) {
  char *b1 = malloc(100);  // alloc(B1) <- [100,100]
  char *b2 = malloc(100);  // alloc(B2) <- [100,100]
  int  i;

  strcpy(b2, “foo”); // len(B2) <- 4
  if (argc > 1 && strlen(argv[1]) < 100)
    strcpy(b1, argv[1]);  // len(B1) <- len(ARGV)
  for (i=0;i<3;i++)   // i <- i + 1
    strcat(b2, “.”);  // len(B2) <- len(B2) + 1
}
```



alloc(ARGV)
[0,max]

alloc(B1)
[100,100]

alloc(B2)
[100,100]

i <- i + 1

i
[0,0]

len(B2) ->

len(B2) + 1

len(ARGV)
[0,max]

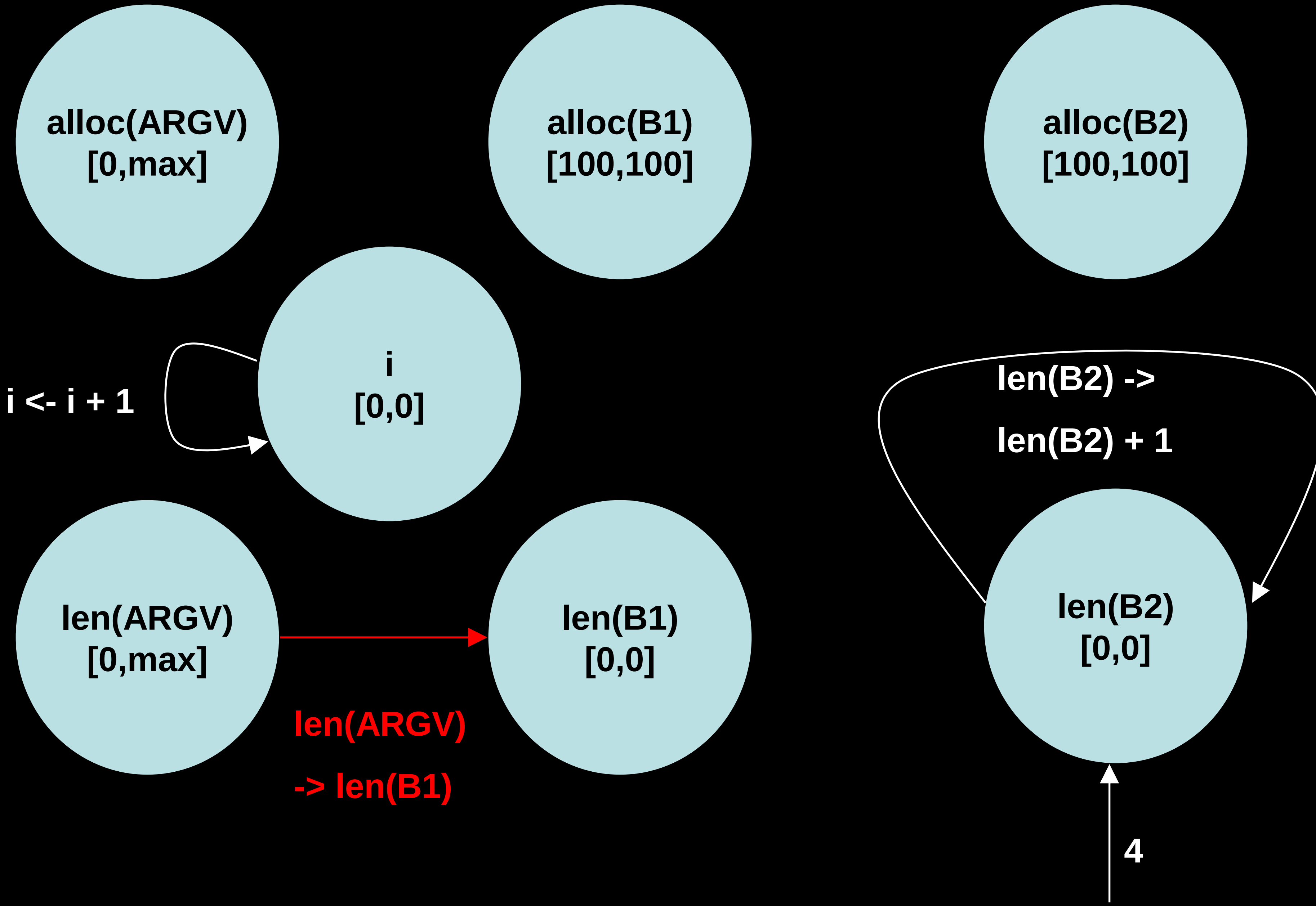
len(B1)
[0,0]

len(B2)
[0,0]

len(ARGV)

-> len(B1)

4



alloc(ARGV)
[0,max]

alloc(B1)
[100,100]

alloc(B2)
[100,100]

i <- i + 1

i
[0,0]

len(B2) ->

len(B2) + 1

len(ARGV)
[0,max]

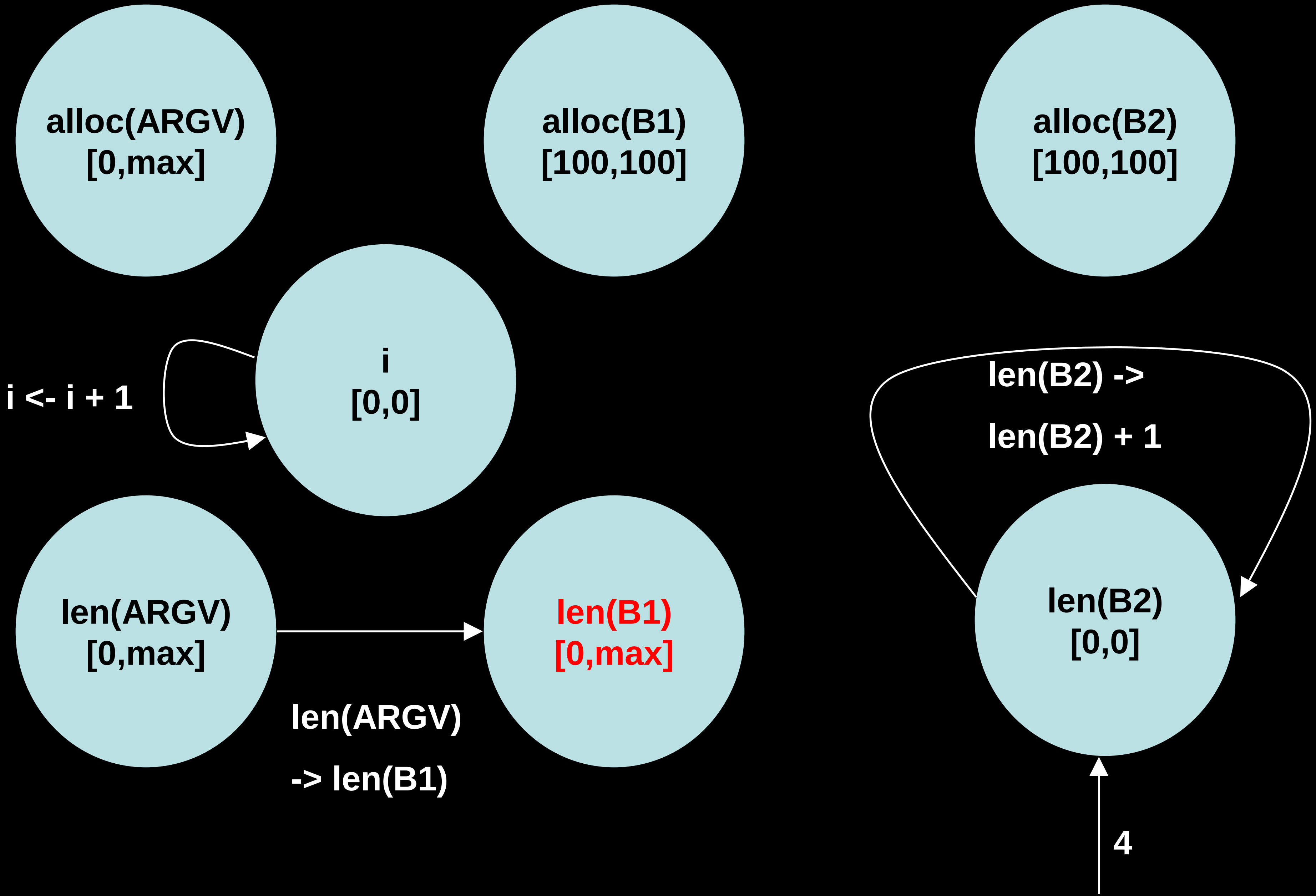
len(B1)
[0,0]

len(B2)
[0,0]

len(ARGV)

-> len(B1)

4



alloc(ARGV)
[0,max]

alloc(B1)
[100,100]

alloc(B2)
[100,100]

i <- i + 1

i
[0,0]

len(B2) ->

len(B2) + 1

len(ARGV)
[0,max]

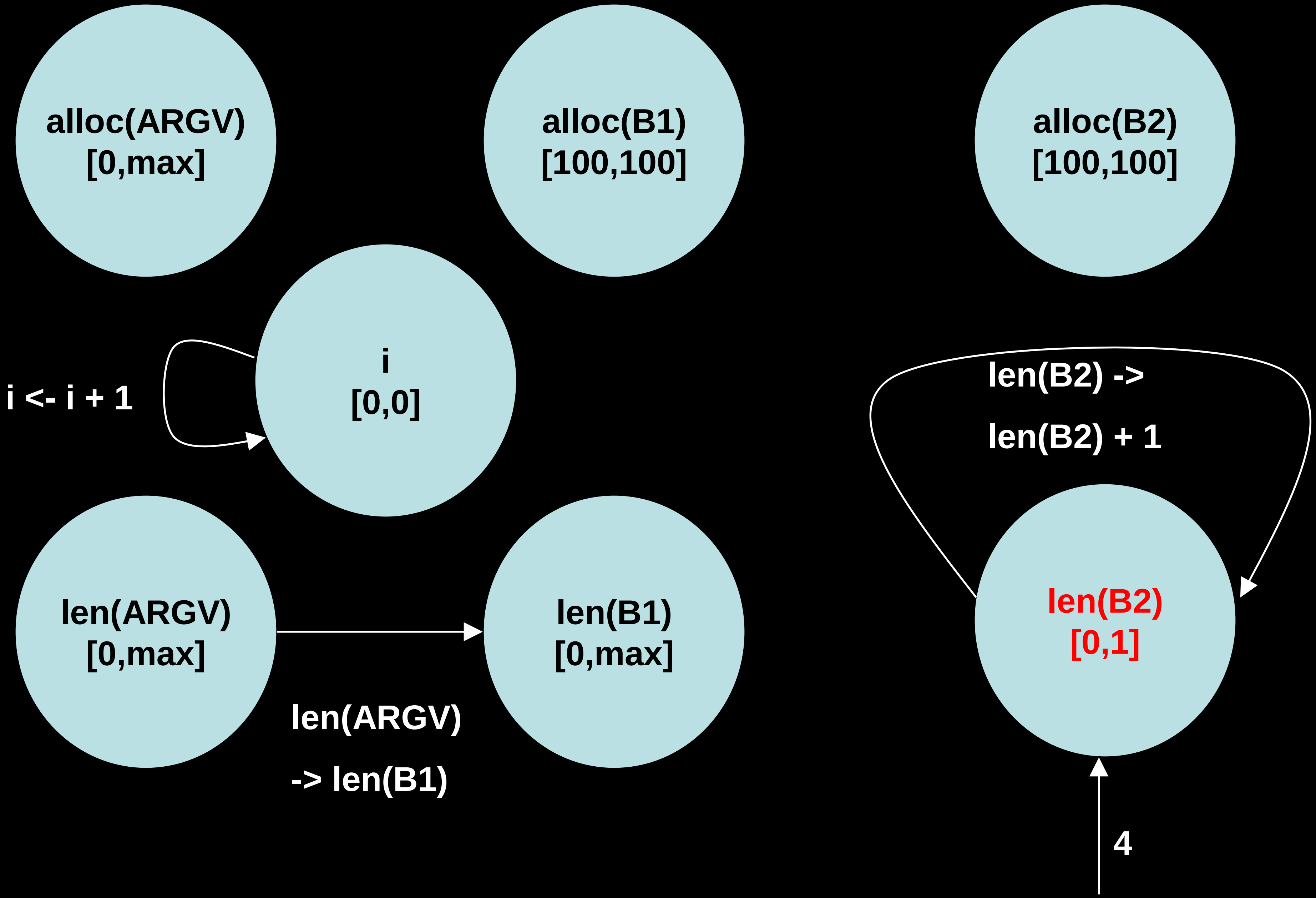
len(B1)
[0,max]

len(B2)
[0,0]

len(ARGV)

-> len(B1)

4



alloc(ARGV)
[0,max]

alloc(B1)
[100,100]

alloc(B2)
[100,100]

i <- i + 1

i
[0,0]

len(B2) ->

len(B2) + 1

len(ARGV)
[0,max]

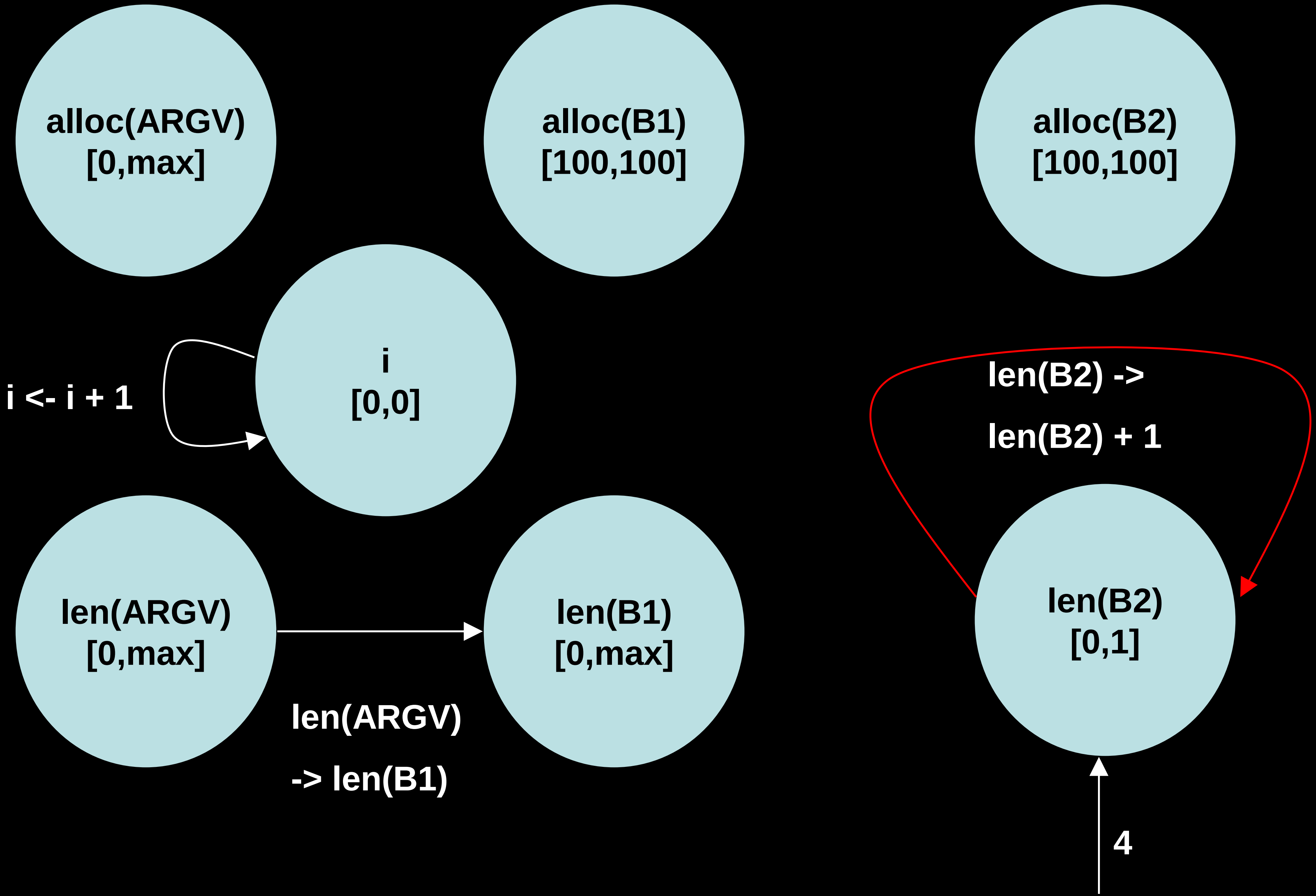
len(B1)
[0,max]

len(B2)
[0,1]

len(ARGV)

-> len(B1)

4



alloc(ARGV)
[0,max]

alloc(B1)
[100,100]

alloc(B2)
[100,100]

i <- i + 1

i
[0,0]

len(B2) ->

len(B2) + 1

len(ARGV)
[0,max]

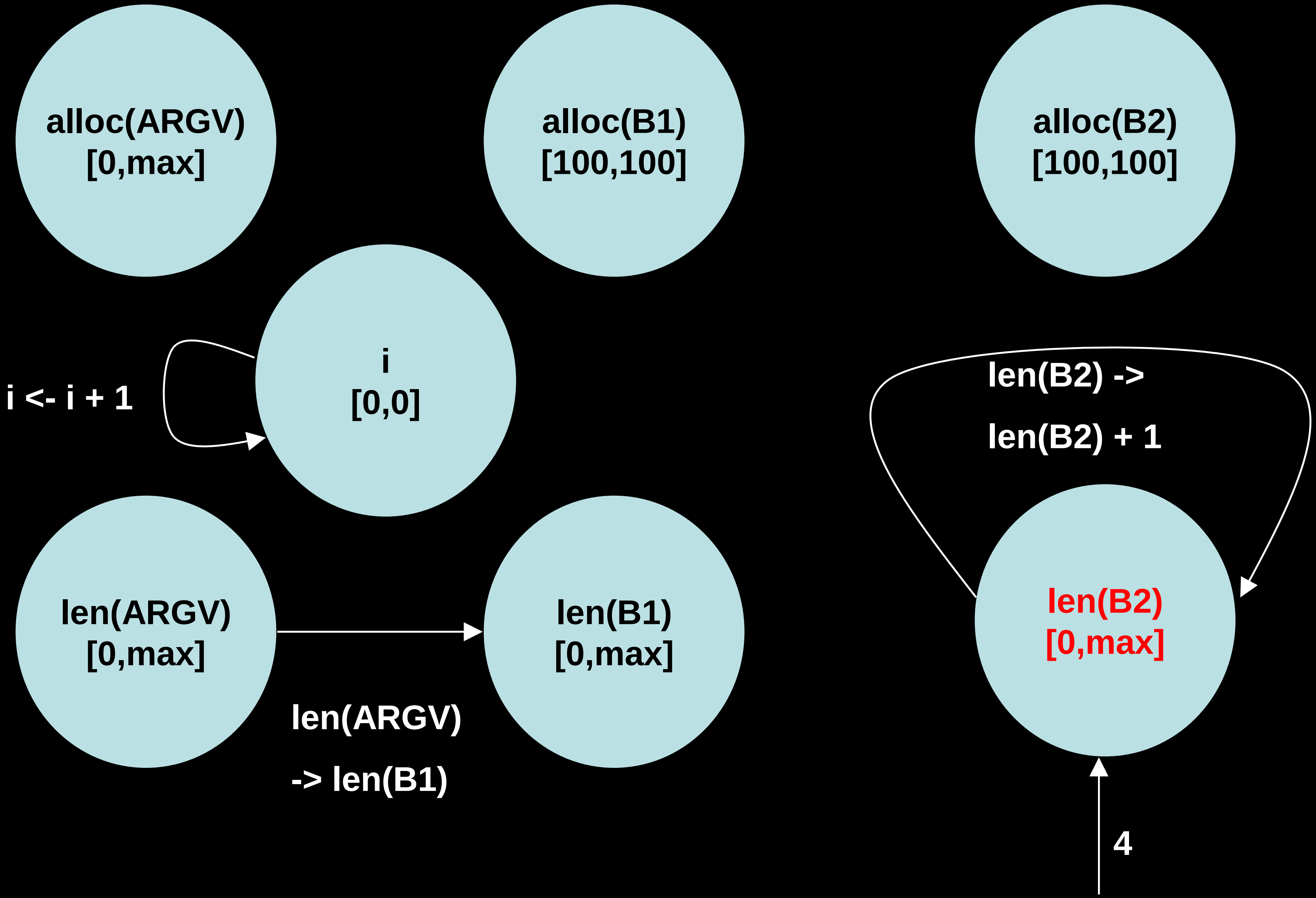
len(B1)
[0,max]

len(B2)
[0,1]

len(ARGV)

-> len(B1)

4



alloc(ARGV)
[0,max]

alloc(B1)
[100,100]

alloc(B2)
[100,100]

i <- i + 1

i
[0,0]

len(B2) ->
len(B2) + 1

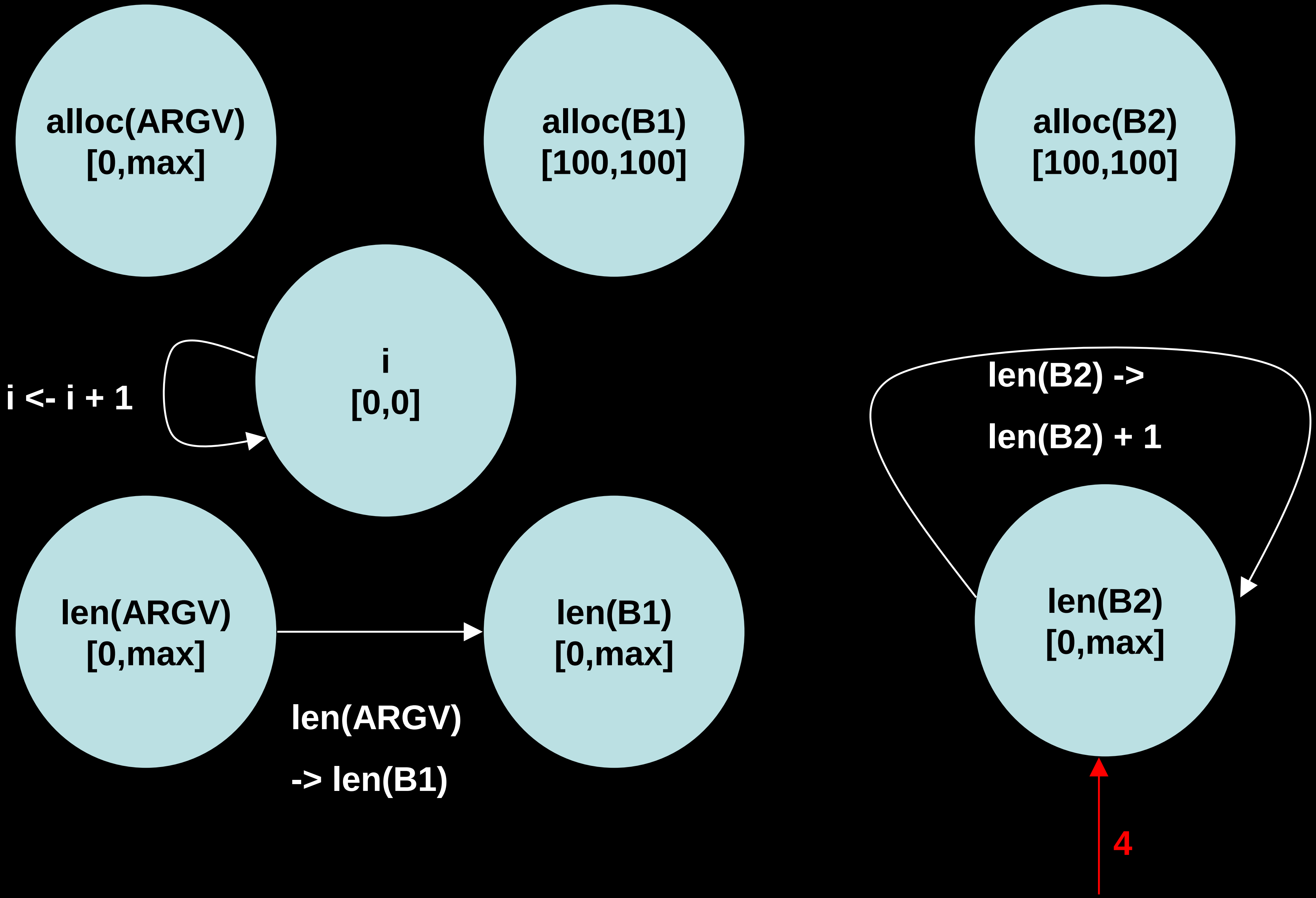
len(ARGV)
[0,max]

len(B1)
[0,max]

len(B2)
[0,max]

len(ARGV)
-> len(B1)

4



alloc(ARGV)
[0,max]

alloc(B1)
[100,100]

alloc(B2)
[100,100]

i <- i + 1

i
[0,0]

len(B2) ->

len(B2) + 1

len(ARGV)
[0,max]

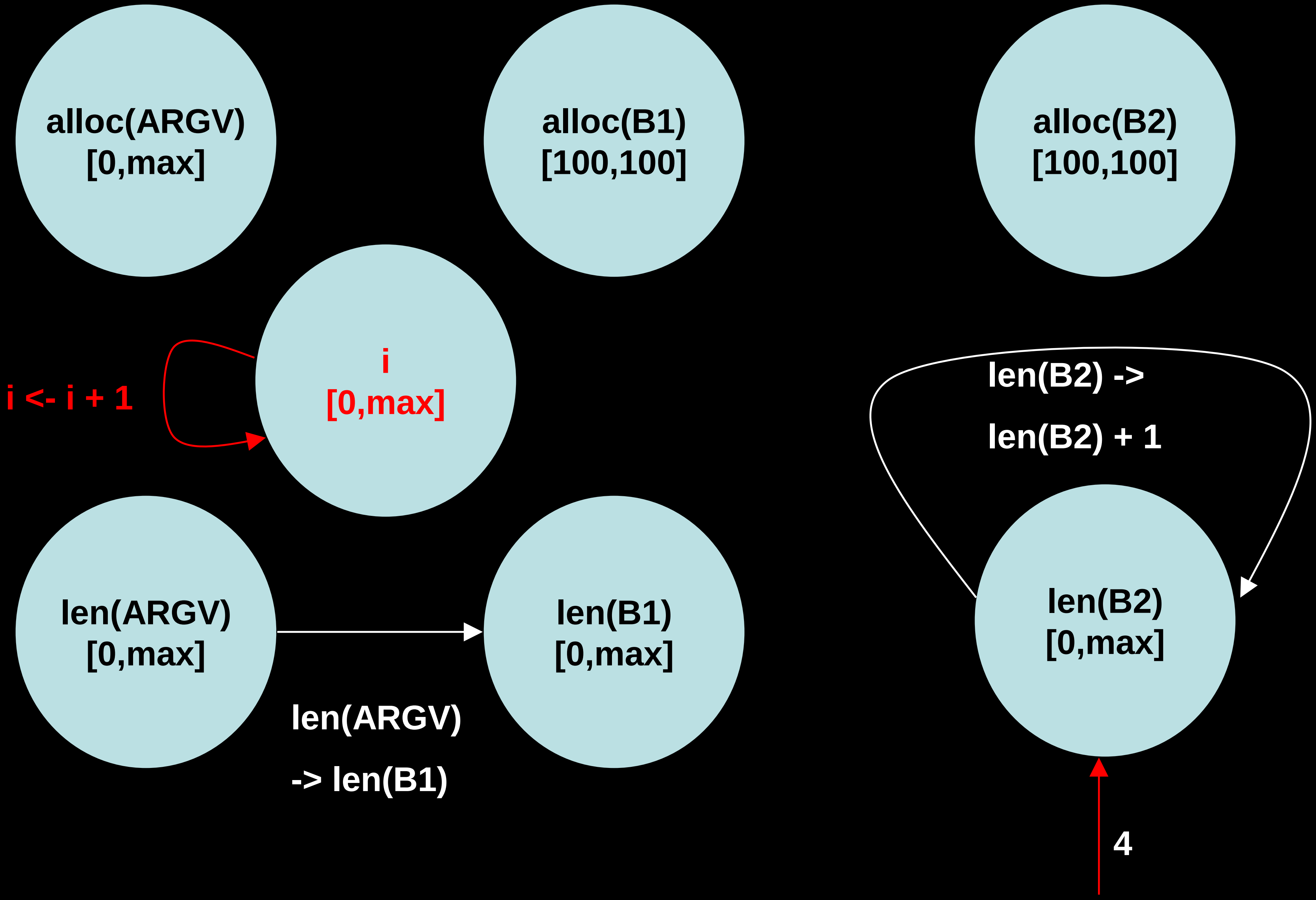
len(B1)
[0,max]

len(B2)
[0,max]

len(ARGV)

-> len(B1)

4



alloc(ARGV)
[0,max]

alloc(B1)
[100,100]

alloc(B2)
[100,100]

i <- i + 1

i
[0,max]

len(B2) ->

len(B2) + 1

len(ARGV)
[0,max]

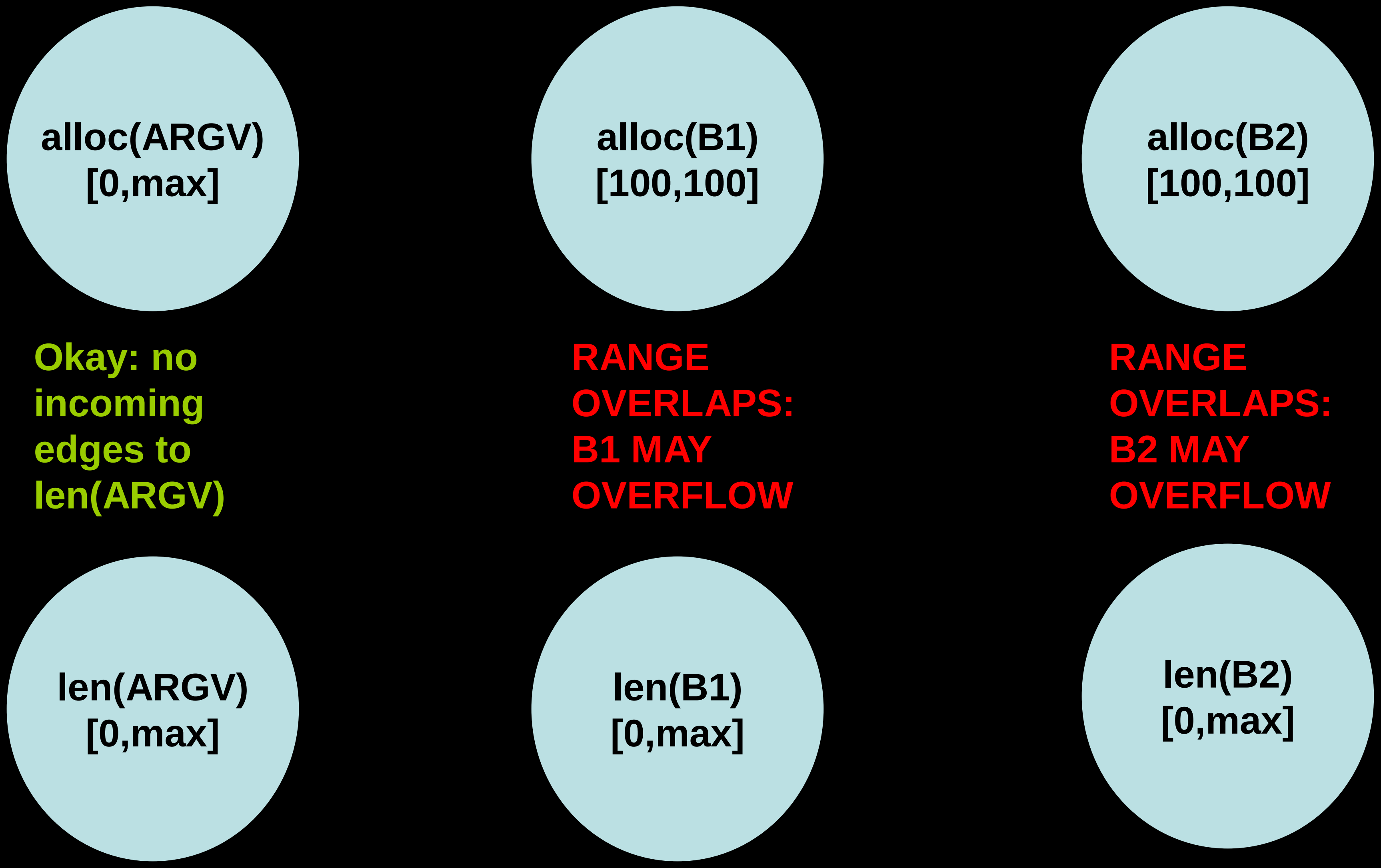
len(B1)
[0,max]

len(B2)
[0,max]

len(ARGV)

-> len(B1)

4



alloc(ARGV)
[0,max]

alloc(B1)
[100,100]

alloc(B2)
[100,100]

Okay: no incoming edges to len(ARGV)

RANGE OVERLAPS: B1 MAY OVERFLOW

RANGE OVERLAPS: B2 MAY OVERFLOW

len(ARGV)
[0,max]

len(B1)
[0,max]

len(B2)
[0,max]

The Program Again

```
void main(int argc, char **argv) {
 char *b1 = malloc(100);
 char *b2 = malloc(100);
 int  i;

 strcpy(b2, “foo”);
if (argc > 1 && strlen(argv[1]) < 100)
  strcpy(b1, argv[1]);
 for (i=0;i<3;i++)
  strcat(b2, “.”);
}
```

Is this the b2 vuln?

The Program Again

```
void main(int argc, char **argv) {
  char *b1 = malloc(100);
  char *b2 = malloc(100);
  int  i;

  strcpy(b2, “foo”);
if (argc > 1 && strlen(argv[1]) < 100)
    strcpy(b1, argv[1]);
  for (i=0;i<3;i++)
    strcat(b2, “.”);
}
```

Or is this?

The Program Again

```
void main(int argc, char **argv) {
  char *b1 = malloc(100);
  char *b2 = malloc(100);
  int  i;

  strcpy(b2, “foo”);
// b1 will never be less than 100.
if (argc > 1 && strlen(argv[1]) < 100)
    strcpy(b1, argv[1]);
  for (i=0;i<3;i++)
    strcat(b2, “.”);
}
```

A good analysis requires some understanding of control flow!

Many analyses aren’t worth it!

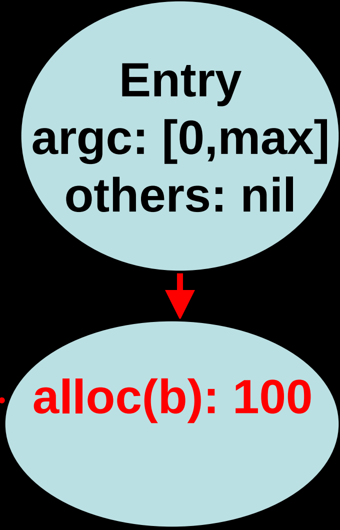
- Over Grep:
  - No great improvement in false positives
  - Parsing code well is extremely complex
    - Perl, anyone?
- In general:
  - Capturing semantics is never-ending
  - Specify 3rd-party libraries, etc?

Control Flow

Entry
argc: [0,max]
others: nil

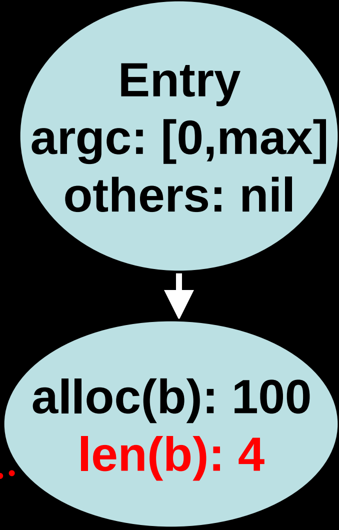
```
#define len(x) strlen(x)
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```

Control Flow



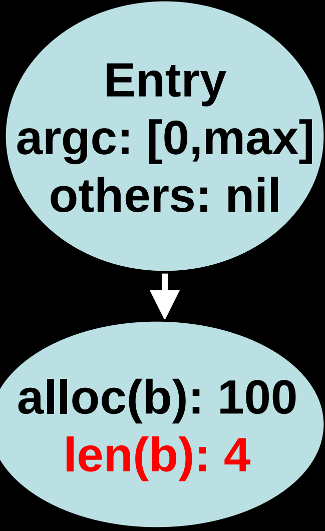
```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```

Control Flow



```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```

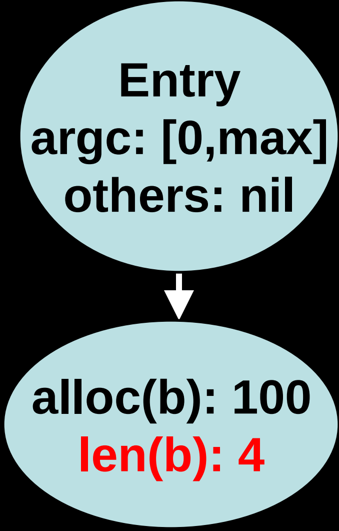
Control Flow



Write to B. Does it overflow?

```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```

Control Flow



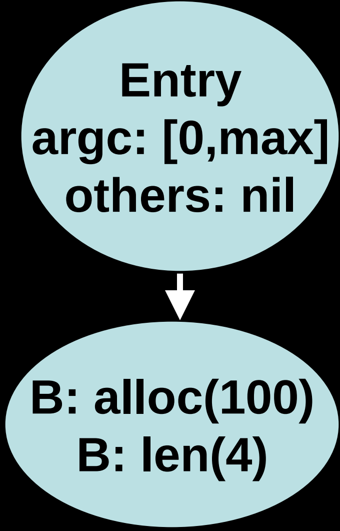
Entry
argc: [0,max]
others: nil

alloc(b): 100
len(b): 4

```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```

No. At this node, B is alloc’d to 100, actual len of 4.

Control Flow

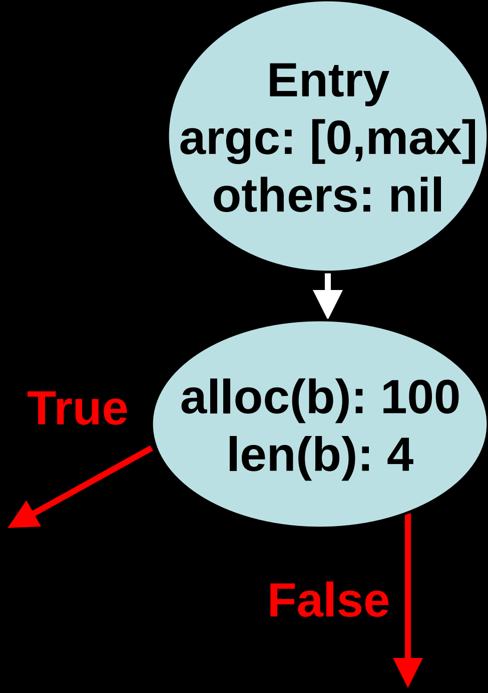


Entry
argc: [0,max]
others: nil

B: alloc(100)
B: len(4)

```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```

Control Flow



Entry
argc: [0,max]
others: nil

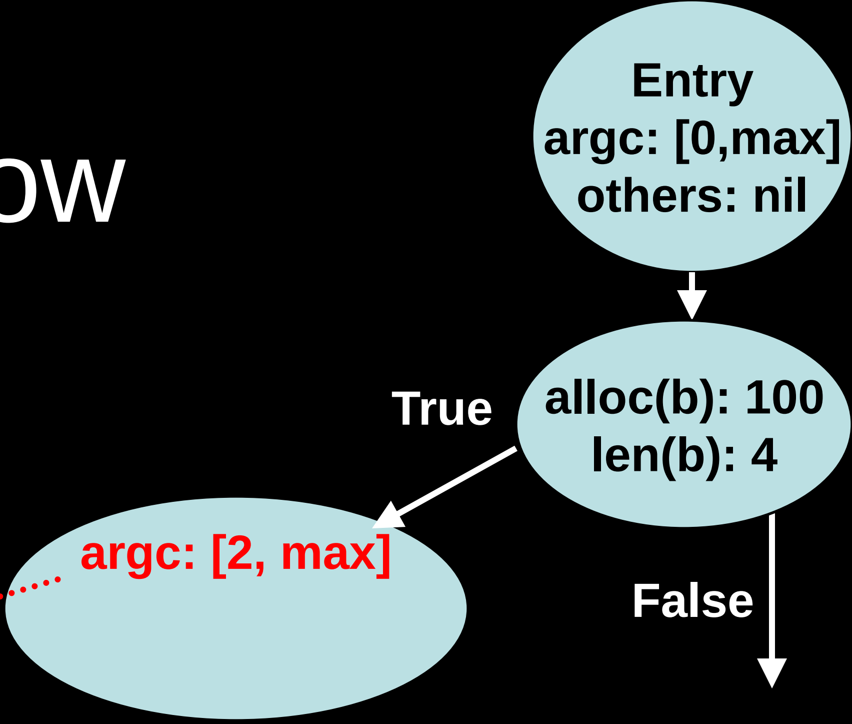
alloc(b): 100
len(b): 4

True

False

```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```

Control Flow



Entry
argc: [0,max]
others: nil

alloc(b): 100
len(b): 4

True

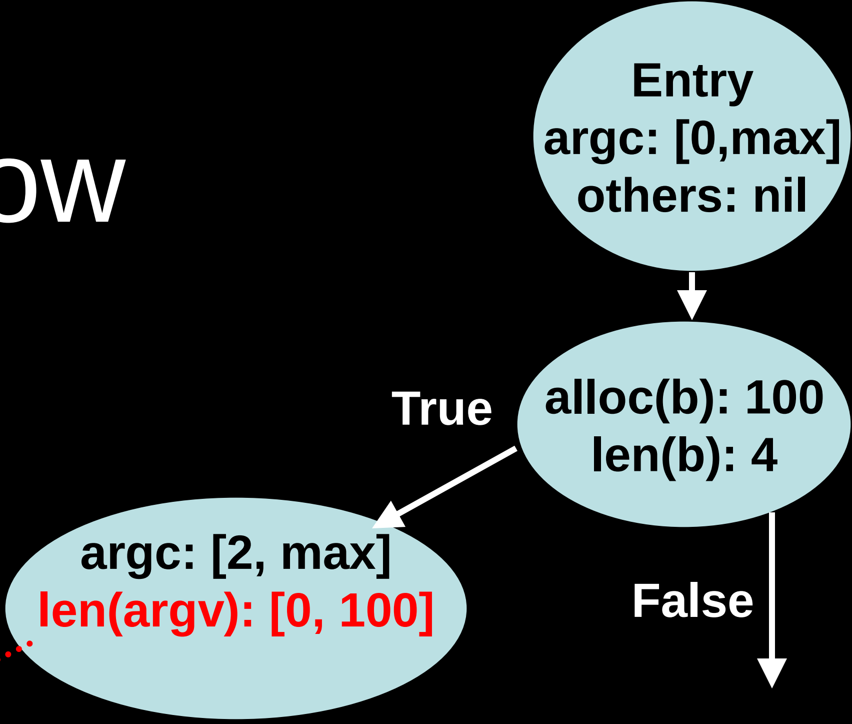
argc: [2, max]

False

```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```

Control Flow

```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```



Entry
argc: [0,max]
others: nil

alloc(b): 100
len(b): 4

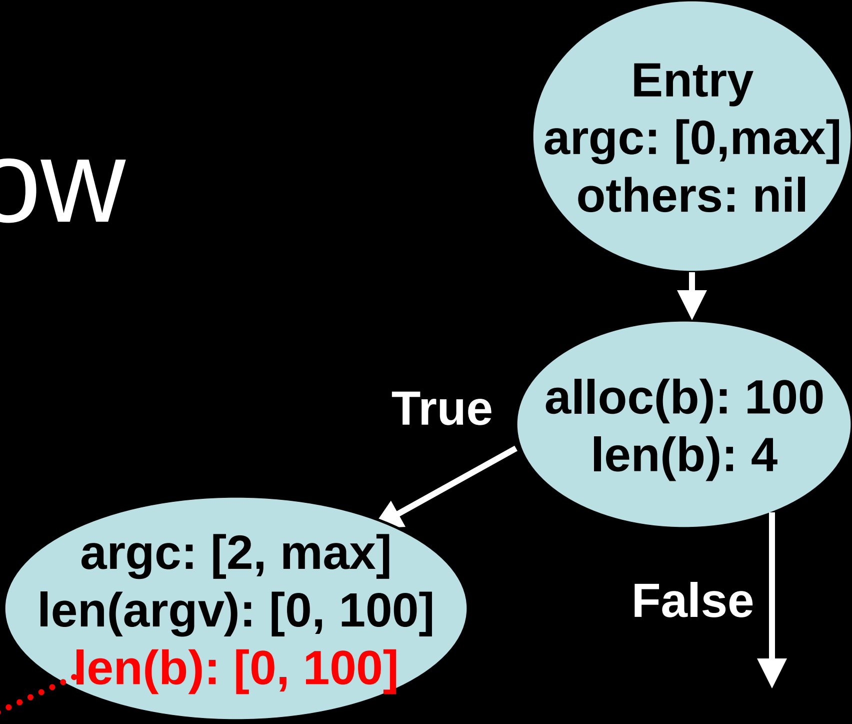
True

argc: [2, max]
len(argv): [0, 100]

False

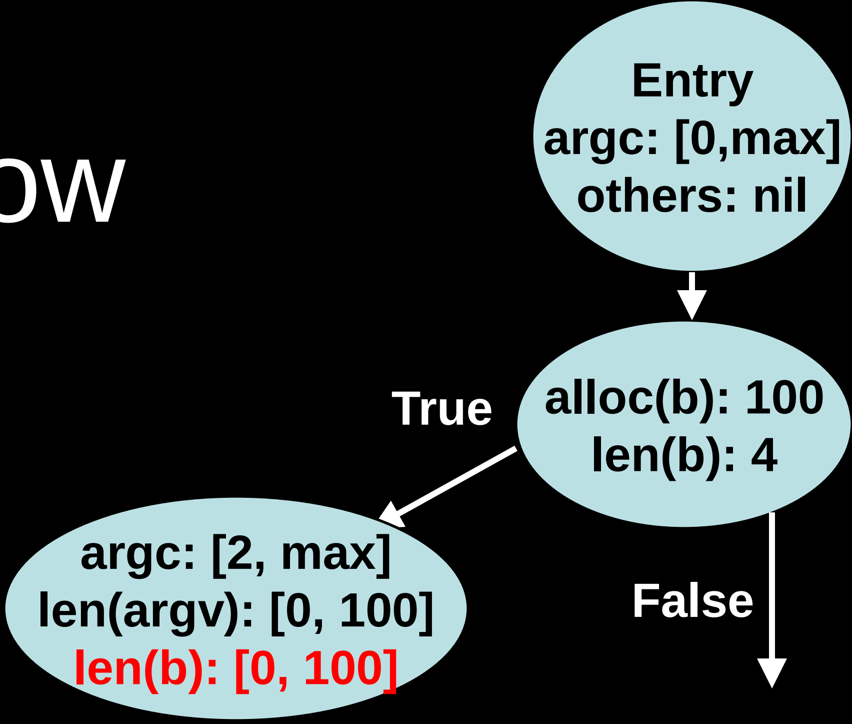
Control Flow

```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```



Control Flow

```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```



Entry
argc: [0,max]
others: nil

alloc(b): 100
len(b): 4

True

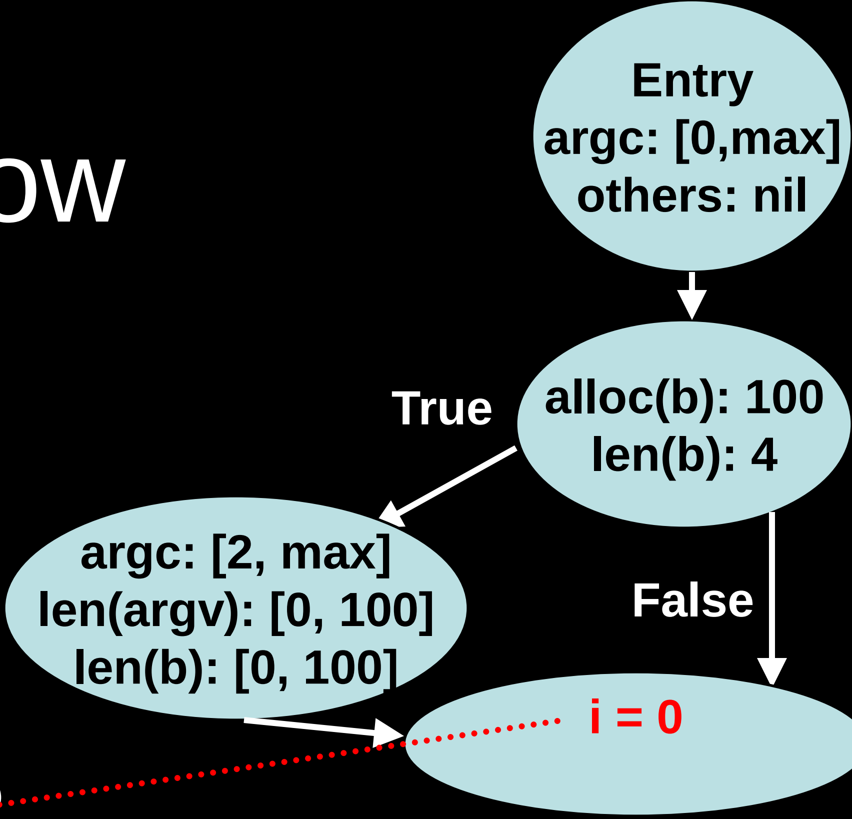
argc: [2, max]
len(argv): [0, 100]
len(b): [0, 100]

False

No overflow. b is alloc'd to 100, len can be no more than 100 after null is added.

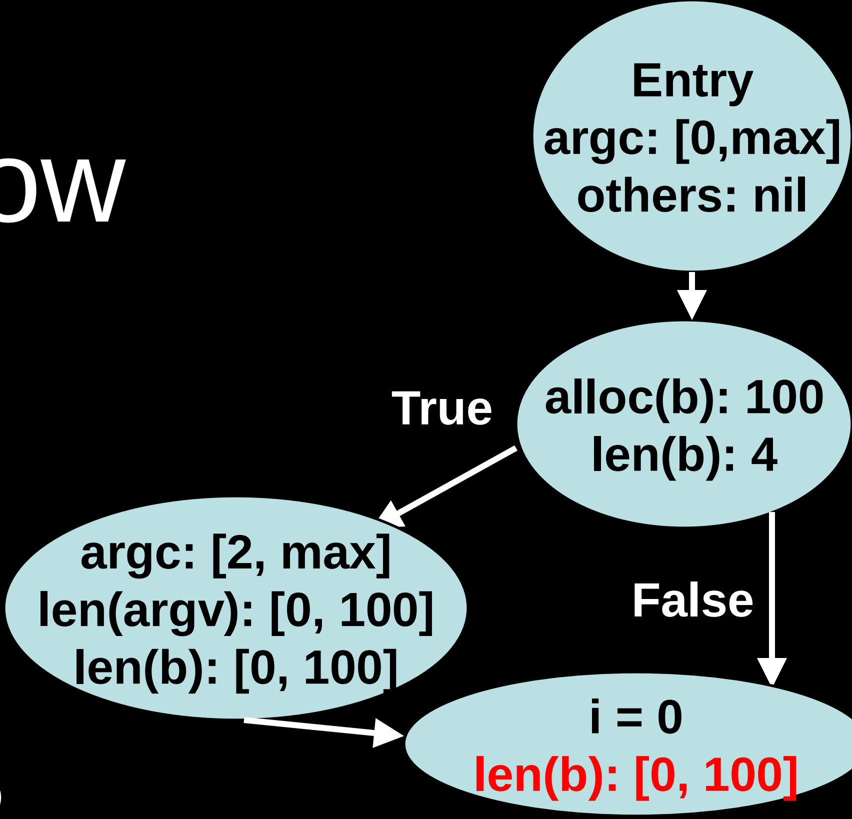
Control Flow

```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```



Control Flow

```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```



Entry
argc: [0,max]
others: nil

alloc(b): 100
len(b): 4

True

argc: [2, max]
len(argv): [0, 100]
len(b): [0, 100]

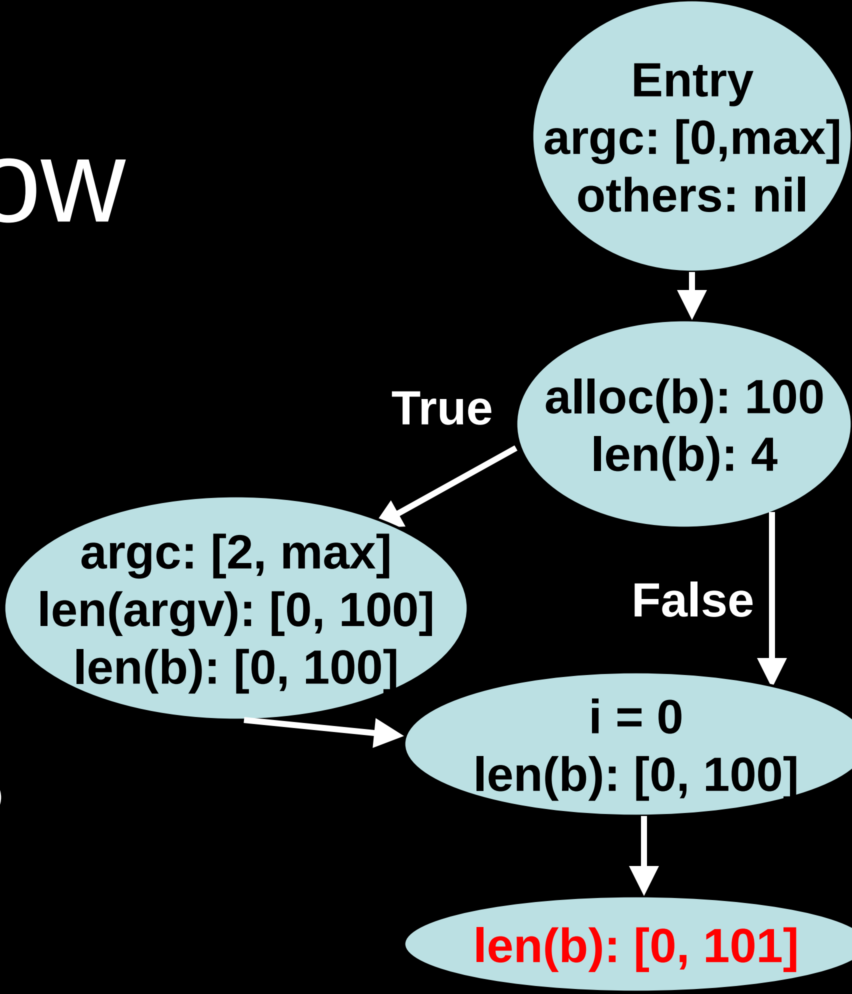
False

i = 0
len(b): [0, 100]

Use the worst case assumption for the length of b.

Control Flow

```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```



Entry
argc: [0,max]
others: nil

alloc(b): 100
len(b): 4

True

argc: [2, max]
len(argv): [0, 100]
len(b): [0, 100]

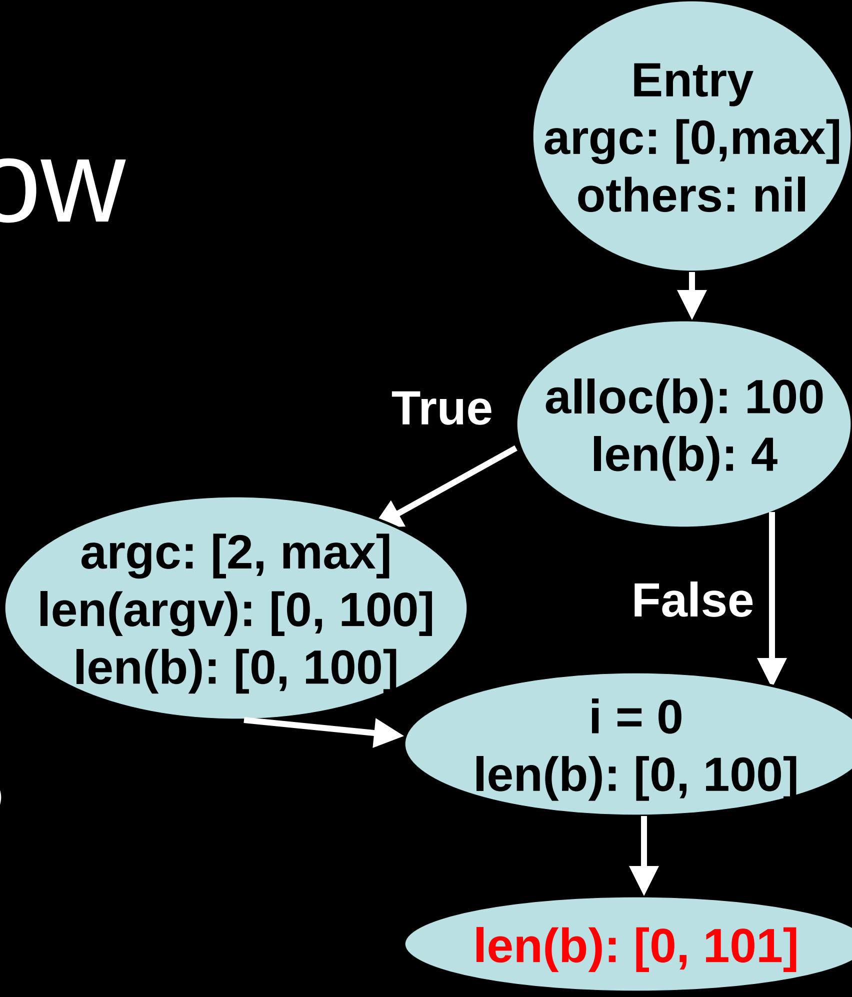
False

i = 0
len(b): [0, 100]

len(b): [0, 101]

Control Flow

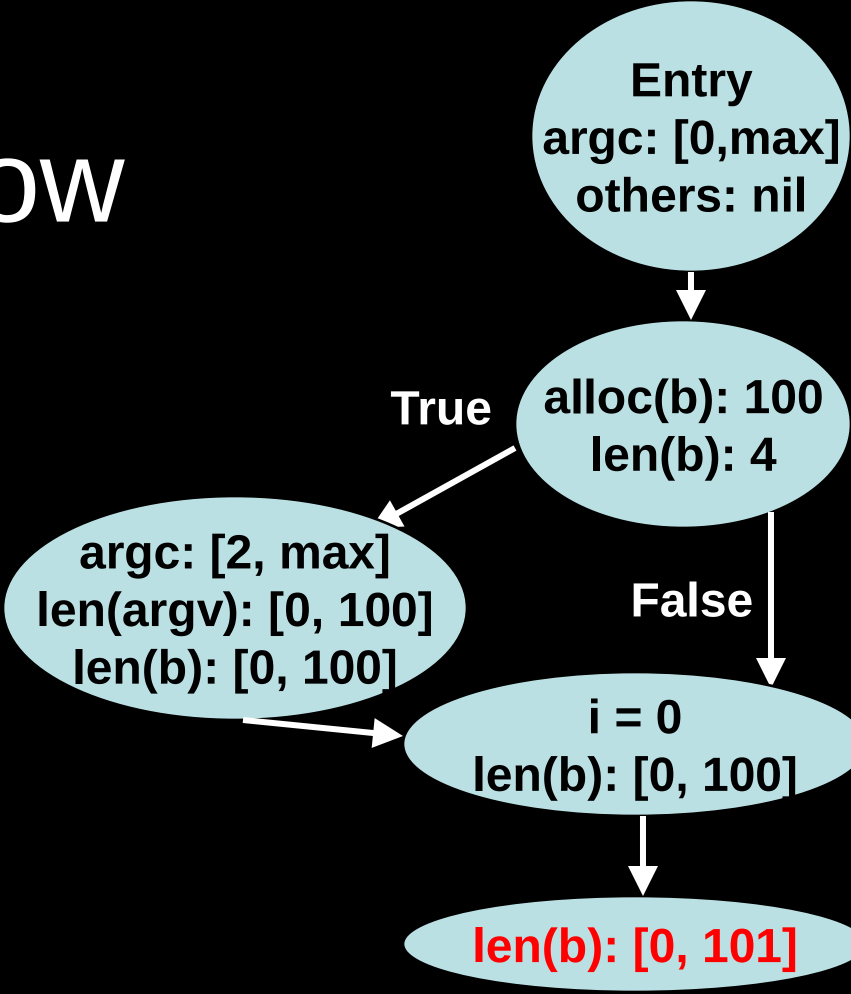
```
void main(int argc, char **argv) {
  char *b = malloc(100);
  int  i;

  strcpy(b, “foo”);
  if(argc > 1 && len(argv[1]) < 100)
    strcpy(b, argv[1]);
  for (i=0;i<3;i++)
    strcat(b, “.”);
}
```



ERROR: len(b) > alloc(b)!!!

Control Flow

Could show you the graph to help you debug…



Entry
argc: [0,max]
others: nil

alloc(b): 100
len(b): 4

True

False

argc: [2, max]
len(argv): [0, 100]
len(b): [0, 100]

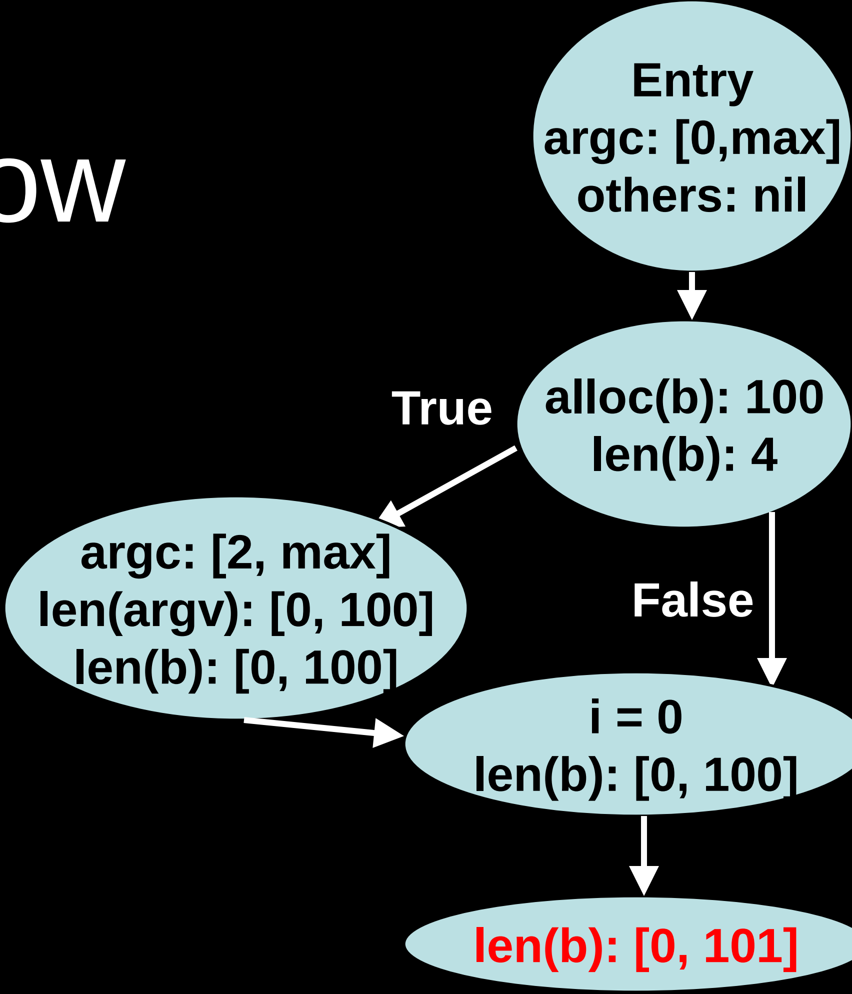
i = 0
len(b): [0, 100]

len(b): [0, 101]

Control Flow

If you're a rocket scientist ☹

(graphs get big and complex in real programs)



Entry
argc: [0,max]
others: nil

alloc(b): 100
len(b): 4

True

argc: [2, max]
len(argv): [0, 100]
len(b): [0, 100]

False

i = 0
len(b): [0, 100]

len(b): [0, 101]

Control Flow

```
foo.c:2412: example(): Possible buffer overflow of
  variable dst
Stack trace:
   foo.c:1733: process_data()
   network.c:432: read_from_socket()
   main.c:94: main_loop()
   main.c:32: main()
```

Though, we could show you (one possible) "stack trace" instead… (far better than dynamic analysis tools!)

Control Flow

```
foo.c:2412: example(): Possible buffer overflow of
  variable dst
Data trace:
   foo.c:1733: process_data()
   network.c:432: read_from_socket()
      |
      |->  Data received from external socket
```

Or, we could show where the data came from

Not just memory stuff…

```
SQL Injection error: WebGoat/src/lessons/
  lessons.ChallengeScreen.doStage2 line 183
Source argument: query
Potential unsafe contents: *;’&\
Input source: Network Data:
  lessons.ChallengeScreen.doStage2 line 178
```

Issue 1

```
void main(int argc, char **argv) {
  char *b = malloc(100000);
  int  n = argc;

  for  (i=0;i<n;i++)
    strcat(b, “.”);
}
```

Issue 1

```
void main(int argc, char **argv) {
  char *b = malloc(100000);
  int  n = argc;

  for (i=0;i<n;i++)
    strcat(b, ".");
}
```

In a more complex example, would we really have to "run" the loop MAX_INT times?

Issue 1

```
void main(int argc, char **argv) {
  char *b = malloc(100000);
  int  n = argc;

  for (i=0;i<n;i++)
    strcat(b, “.”);
}
```

In this case, we could multiply the effect by the maximum value of n.

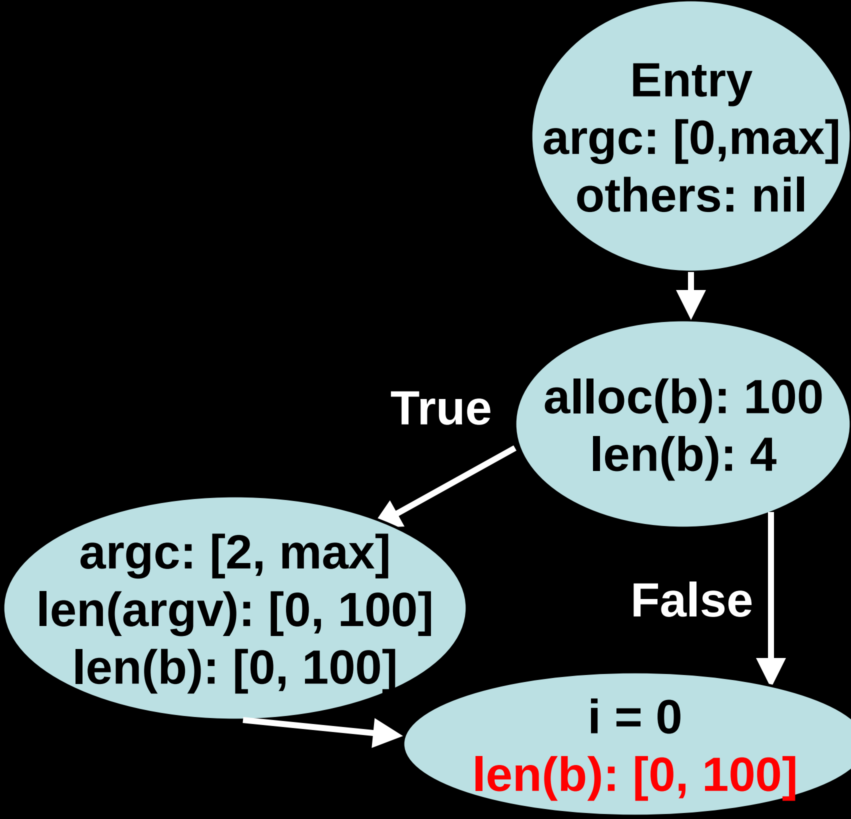
Issue 1

```
void main(int argc, char **argv) {
  char *b = malloc(100000);
  int  n = argc;

  for (i=0;i<n;i++)
    strcat(b, “.”);
}
```

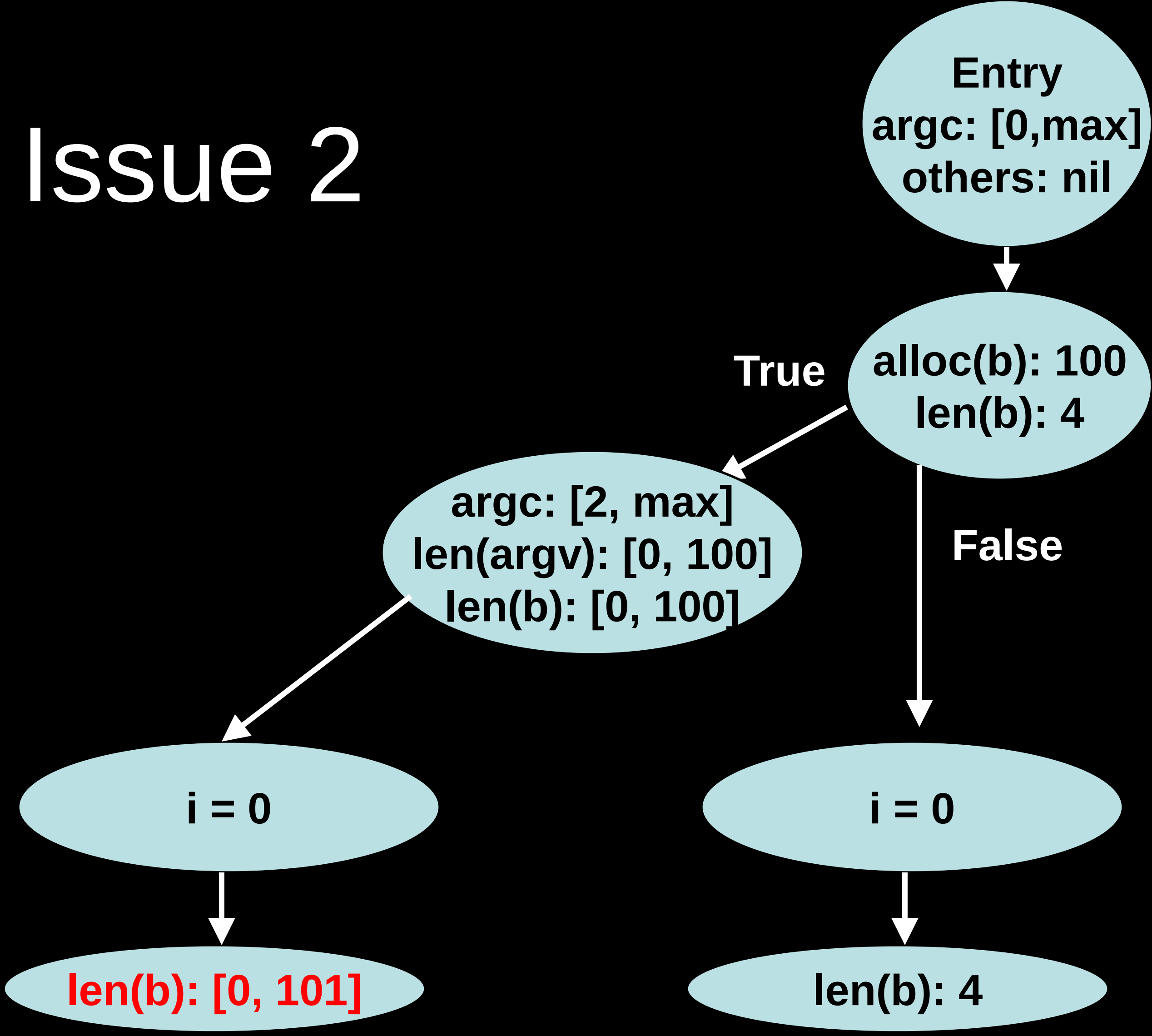
More complex cases aren't that easy, and require approximations!

Issue 2

We lost accuracy when we merged.



Issue 2



Entry
argc: [0,max]
others: nil

alloc(b): 100
len(b): 4

True

argc: [2, max]
len(argv): [0, 100]
len(b): [0, 100]

False

i = 0

i = 0

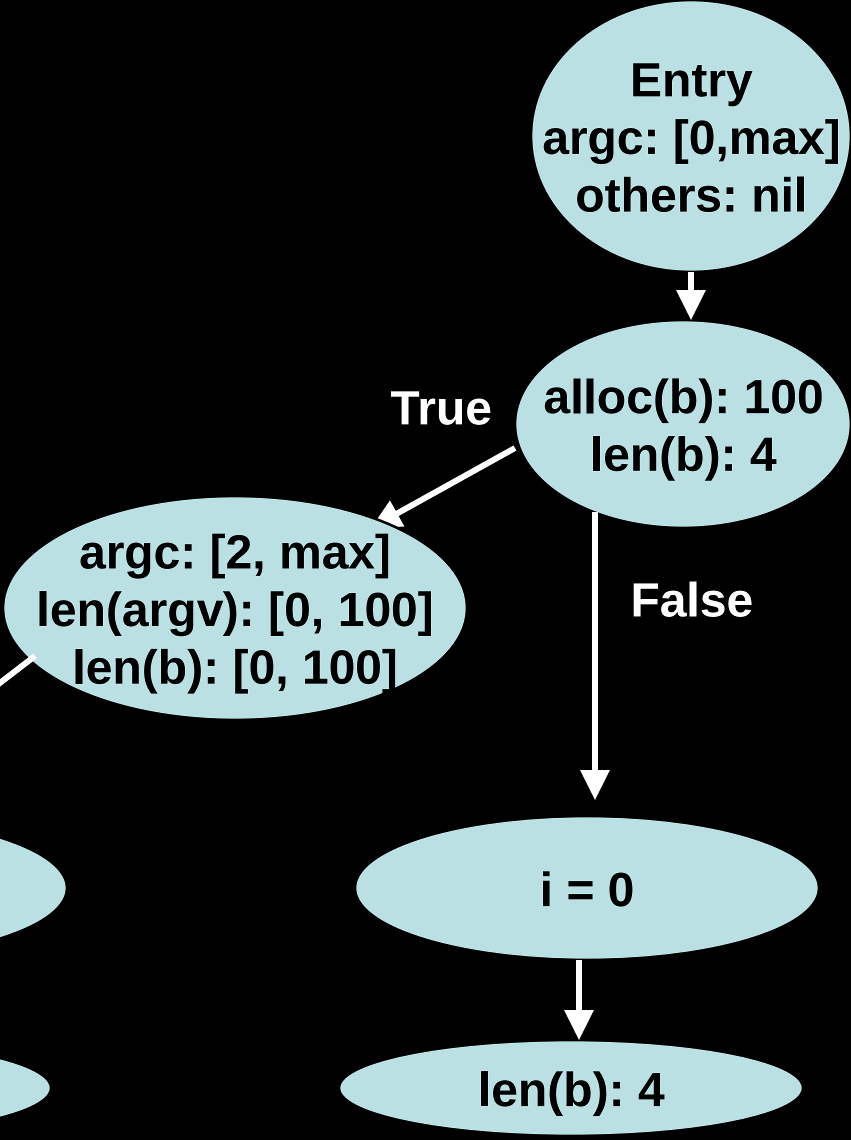
len(b): [0, 101]

len(b): 4

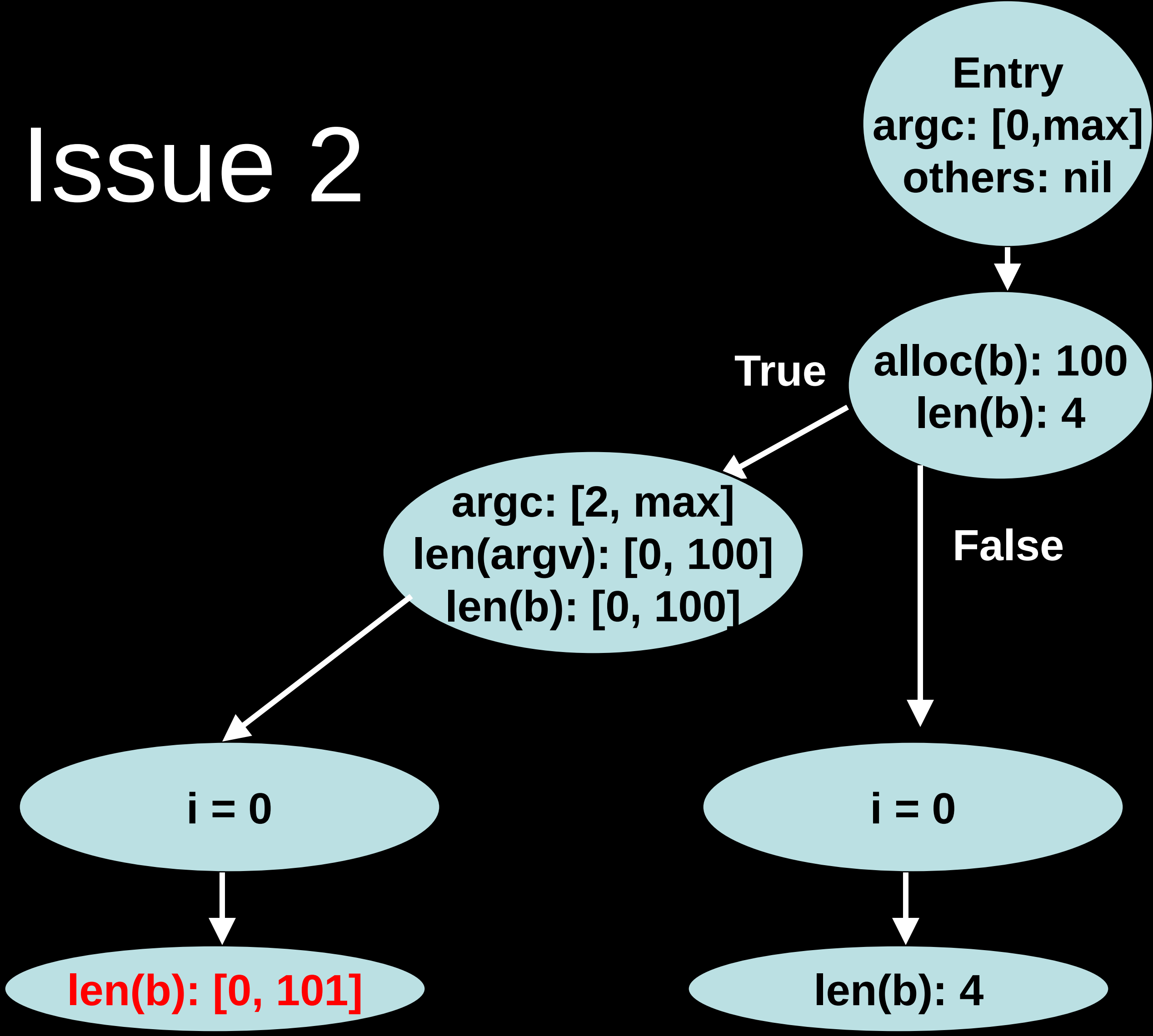
Issue 2

We can show which path is bad!

And, future calculations become much more accurate.



Issue 2

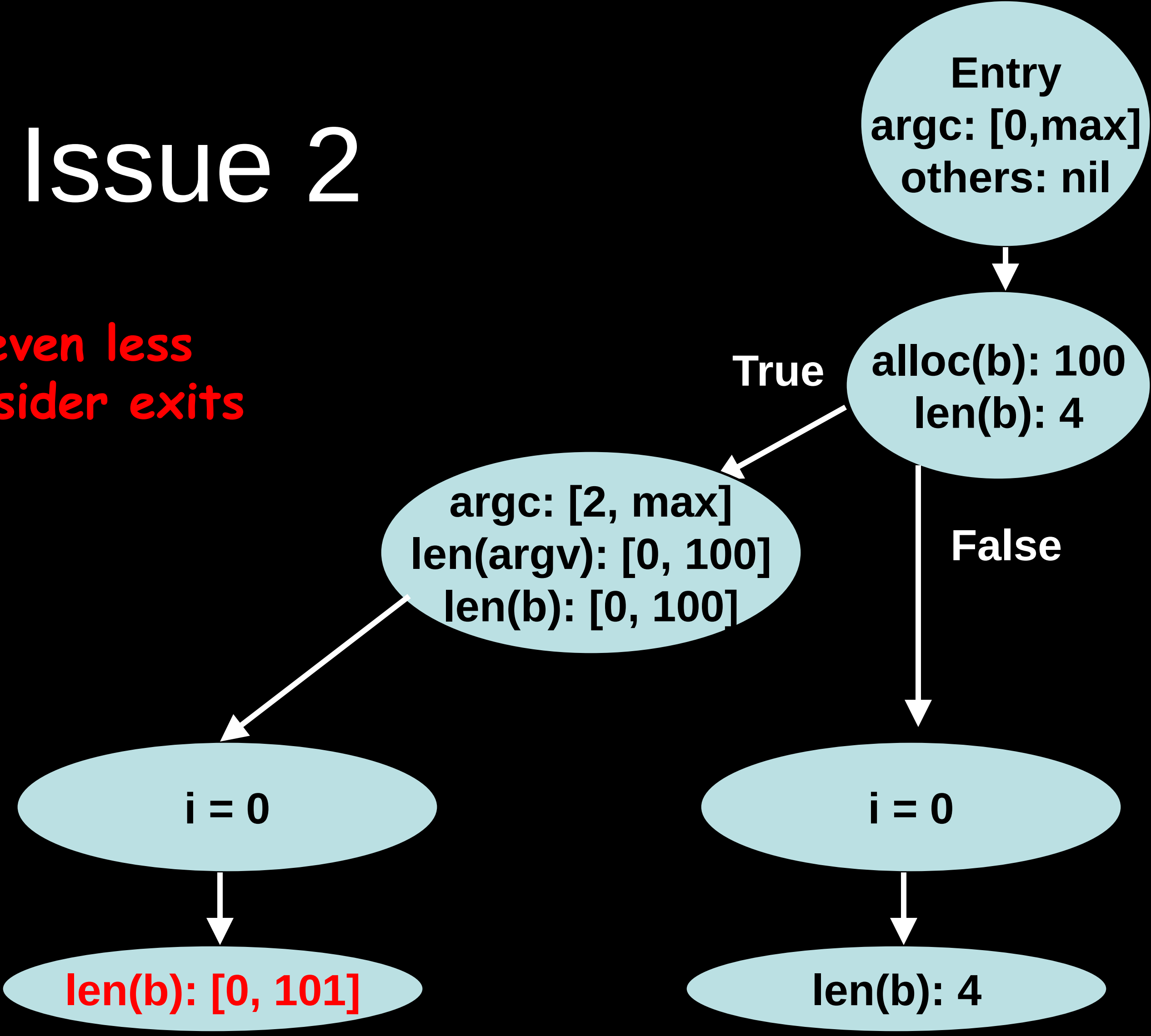


An exponential explosion of nodes

Only feasible for single functions (intraprocedural analysis)

Issue 2

Full path analysis is even less feasible when we consider exits from complex loops



The problem with intraprocedural

```
char *magic_function(char *a, char *b) {
      char *p1 = a;
      char *p2 = b;

      while (*p2)
        *p1++ = *p2++;
  return a;
}
```

The problem with intraprocedural

```
char *magic_function(char *a, char *b) {
      char *p1 = a;
      char *p2 = b;

      while (*p2)
        *p1++ = *p2++;
  return a;
}
```

No matter how accurate we get inside the procedure, we are in a catch-22 (spam vs. ignore)

The problem with intraprocedural

```
char *magic_function(char *a, char *b) {
      char *p1 = a;
      char *p2 = b;

      while (*p2)
        *p1++ = *p2++;
  return a;
}
```

Instead of erroring, we can “summarize” the generic properties.

The problem with intraprocedural

```
char *magic_function(char *a, char *b) {
      char *p1 = a;
      char *p2 = b;

      while (*p2)
        *p1++ = *p2++;
  return a;
}
```

e.g., len(a) <- len(b)

The problem with intraprocedural

```
char *magic_function(char *a, char *b) {
      char *p1 = a;
      char *p2 = b;

      while (*p2)
        *p1++ = *p2++;
  return a;
}
```

Scaling algorithms to an entire program can greatly improve accuracy… and decrease efficiency!

Using environmental knowledge

- Socket vs. file
- Consider data from config files / registry
- Analyze two communicating programs together

There will always be falses

- For some things, even false negatives
  - e.g., anything in C
- Lots of things need to be approximated and are tough to approximate well
  - Arrays and pointers
  - Dynamic dispatch
  - Built in containers
- Okay, it’s an overflow, but is it exploitable?
  - Do you care?

Building good tools is hard!

- Good analysis takes years
  - Most companies haven’t bothered to try!
- Tool should handle all dev environments
  - efficiency + checkins?
- Tools should be easy enough for my mom
- Binary analysis is far, far harder!
- Few people do even a reasonable job.

Everybody gets this right… for the wrong reasons

```
secureConnect (host, port):
      s = sslConnect(gethostbyaddr(host), port)
      cert = get_cert(s)
      if ! certSignedByTrustedRoot(cert):
            raise “SSLError”
      if  cert.DN <> host:
            raise “SSLError”
      if ! subjAltNameMatches(cert, host):
            raise “SSLError”
      if certRevoked(cert):
            raise “SSLError”
      return s
```

If you’re not an auditor, it probably isn’t cost effective!

Notes on Buying Automated Tools

Trials are limited for a reason (as are the EULA’s)

Make sure you test them on your own site / code

Basic Conclusion

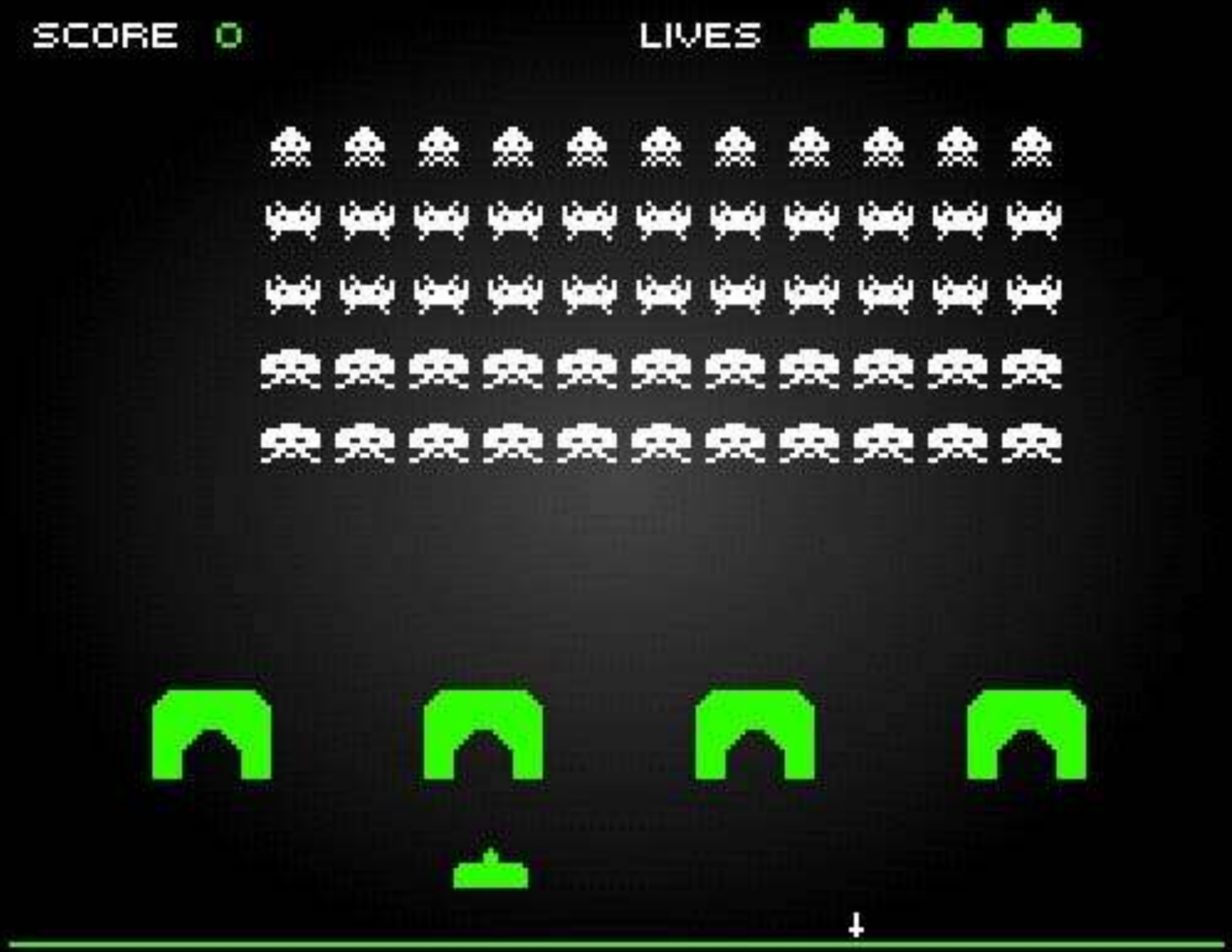
“The height of mediocrity is still low”

Basic Conclusion

Accuracy on basic software today is mediocre at best

It is really easy to write an application that can’t be automatically scanned

It is really hard to write an automated scanner than can effectively analyze software


SCORE 0
LIVES

PCI Data Security Standards

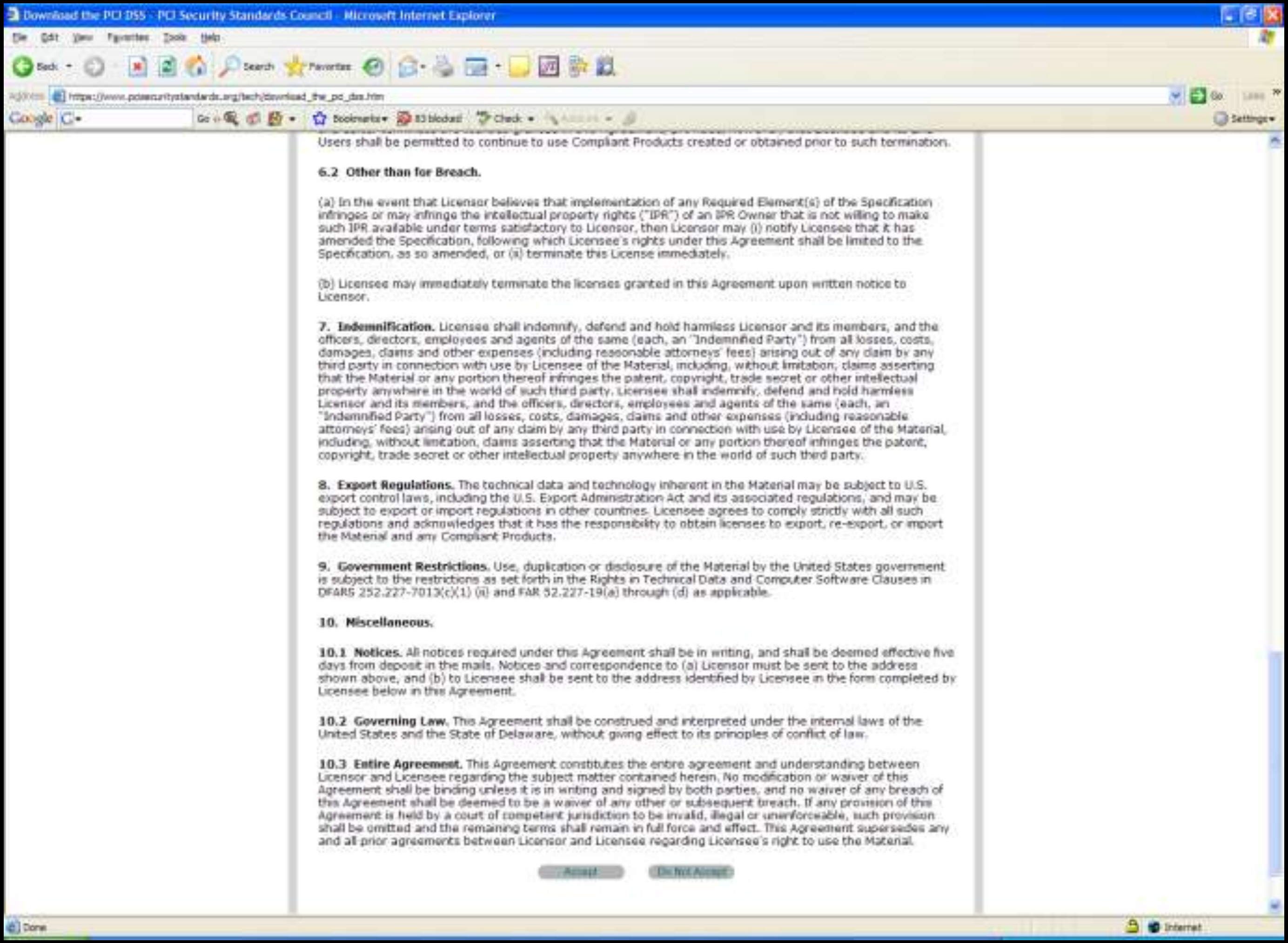
6.6 Ensure that all web-facing applications are protected against known attacks by applying either of the following methods:

- **Having all custom application code reviewed for common vulnerabilities by an organization that specializes in application security**

- **Installing an application layer firewall in front of web-facing applications.**

Note: This method is considered a best practice until June 30, 2008, after which it becomes a requirement.

Full document at
https://www.pcisecuritystandards.org/tech/download_the_pci_dss.htm
PCI-DSS is now managed by an industry consortium at
www.pcisecuritystandards.org


Download the PCI DSS - PCI Security Standards Council - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
https://www.pcisecuritystandards.org/tech/download_the_pci_dss.htm
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Bookmarks 83 blocked Check Settings
Done
Internet

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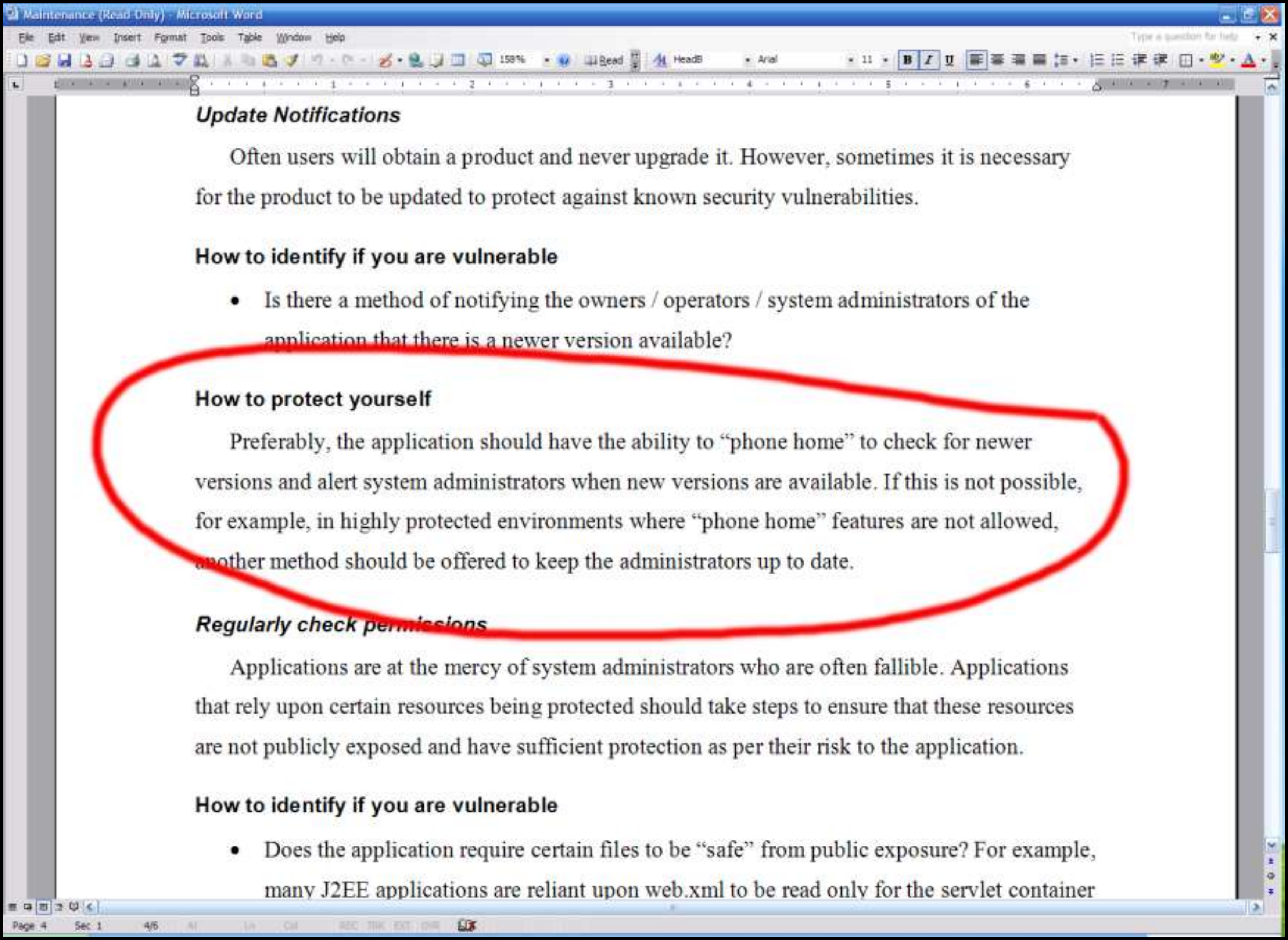
10.2 Governing Law. This Agreement shall be construed and interpreted under the internal laws of the United States and the State of Delaware, without giving effect to its principles of conflict of law.

10.3 Entire Agreement. This Agreement constitutes the entire agreement and understanding between Licensor and Licensee regarding the subject matter contained herein. No modification or waiver of this Agreement shall be binding unless it is in writing and signed by both parties, and no waiver of any breach of this Agreement shall be deemed to be a waiver of any other or subsequent breach. If any provision of this Agreement is held by a court of competent jurisdiction to be invalid, illegal or unenforceable, such provision shall be omitted and the remaining terms shall remain in full force and effect. This Agreement supersedes any and all prior agreements between Licensor and Licensee regarding Licensee's right to use the Material.

……or go straight to the document here!

https://www.pcisecuritystandards.org/pdfs/pci_dss_v1-1.pdf


Maintenance (Read Only) - Microsoft Word
File Edit View Insert Format Tools Table Window Help
Type a question for help
159%
Read
HeadB
Arial
11
Page 4 Sec 1 4/6

Update Notifications

Often users will obtain a product and never upgrade it. However, sometimes it is necessary for the product to be updated to protect against known security vulnerabilities.

How to identify if you are vulnerable

- Is there a method of notifying the owners / operators / system administrators of the application that there is a newer version available?

How to protect yourself

Preferably, the application should have the ability to "phone home" to check for newer versions and alert system administrators when new versions are available. If this is not possible, for example, in highly protected environments where "phone home" features are not allowed, another method should be offered to keep the administrators up to date.

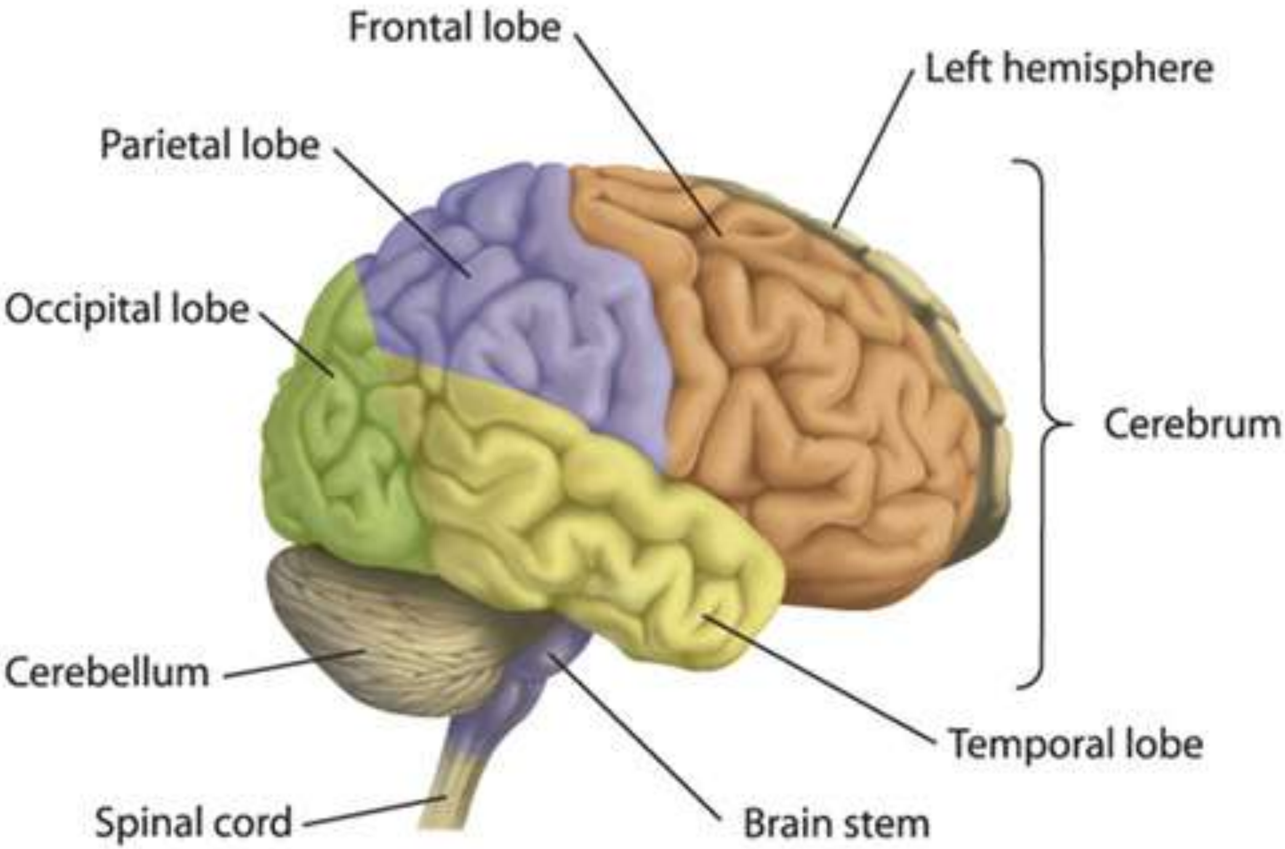
Regularly check permissions

Applications are at the mercy of system administrators who are often fallible. Applications that rely upon certain resources being protected should take steps to ensure that these resources are not publicly exposed and have sufficient protection as per their risk to the application.

How to identify if you are vulnerable

- Does the application require certain files to be "safe" from public exposure? For example, many J2EE applications are reliant upon web.xml to be read only for the servlet container

Introducing the only tool in the world that really works effectively today……


Frontal lobe
Left hemisphere
Parietal lobe
Occipital lobe
Cerebrum
Cerebellum
Temporal lobe
Spinal cord
Brain stem

News for people who run tools

A fool with a tool

….is still a fool

China!

China!

China!

People

Process

Technology

Fair and Balance

Automated tools aren’t totally “useless” today

(* but the marketing departments cards are marked)

What sort of tool do we want?

Testing framework / toolkit that combines

- Binary
- Run-time
- Code
- Pen

AI (or human driven)

Extensible

Community driven rules

That’s all folks!