Hopelessly Ambitious Reversing Talk

Applying Reverse Engineering to Web Security

about:matasano

- An Indie Security Firm: Founded Q1'05, Chicago and NYC.
- Research 2006:
  - endpoint agent vulnerabilities
  - hardware virtualized rootkits
  - a protocol debugger
  - windows vista (on contract to msft)
  - storage area networks (broke netapp)
  - 40+ pending advisories

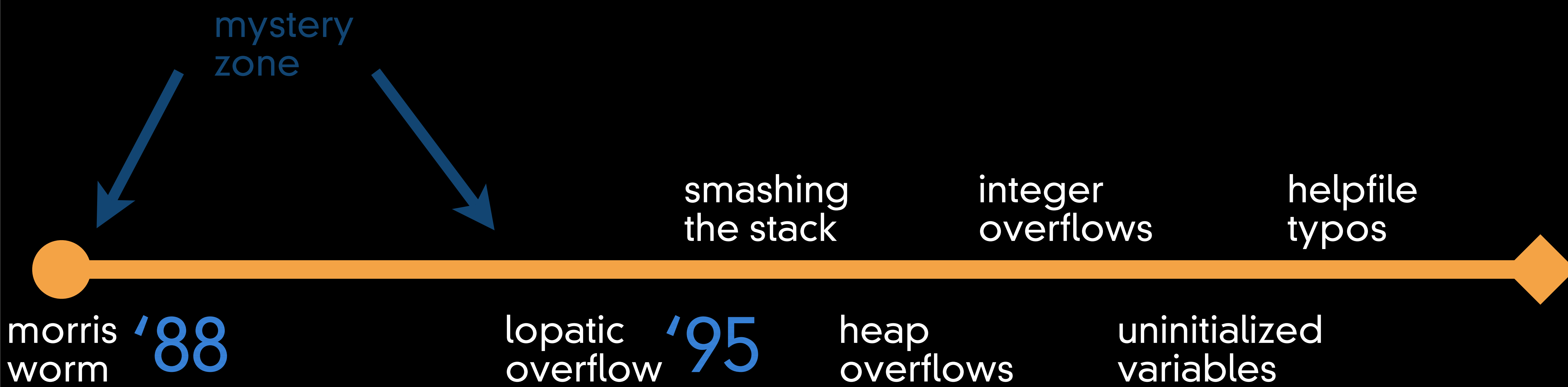
about:thomasptacek

- You may remember me from such research papers as: “Insertion, Evasion, Denial of Service”
- or such companies as: Secure Networks, Network Associates, Arbor Networks
- or such ISPs as: EnterAct
- or such high schools as: St. Ignatius
- etc, etc.

about:owasp_talk

- Reversing and Code-Assisted Pen Test
  - *add hours-not-days to projects, find 10x as many flaws*
- Binary Reversing
  - *all source is now open; C++, Java, .NET*
- Protocol Reversing
  - *busting secret protocols that hide in HTTP*

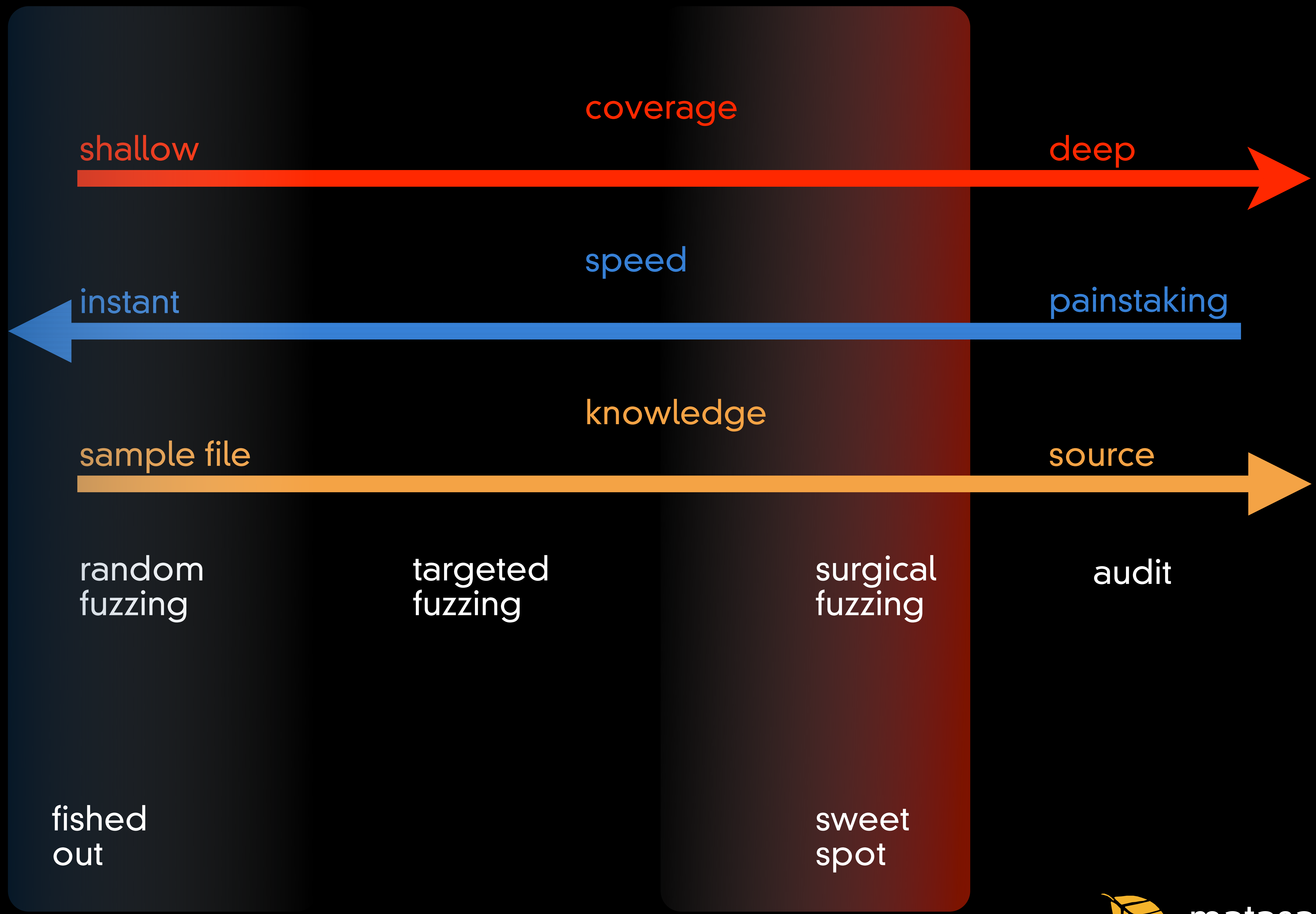
a question:



why did overflows take 7 years to break out?

why reversing matters (1)

- Reversing Will “Break Out” For Attackers
- 1994 Attacker: Shell Scripts, .rhosts
- 2006 Attacker: Assembly, Kernel Heap


coverage
shallow
deep
speed
instant
painstaking
knowledge
sample file
source
random fuzzing
targeted fuzzing
surgical fuzzing
audit
fished out
sweet spot
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why reversing matters (2)

- ★ The Easy Findings Are Drying Up
- ★ Pond Fished With Dynamite: Random Binary Fuzzing
- ★ Matters More For Attackers, But Professionals Must Follow

dueling methodologies:
pen test vs. code review

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pen test: fast, tactical

pen test: misses stuff

(unexposed form fields, hidden injection)

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pen test: limited range

(just CGI variables ala scarab, pantera)

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code review: *thorough*

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code review: slow

frequent effort/reward risk

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code review: need code

forget third-party dependencies

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middle ground

- ★ Code Assisted Penetration Test
  - use info about code to improve tests
  - test-driven, tactical
  - exploit source, but minimize effort

reverse engineering
is now practical

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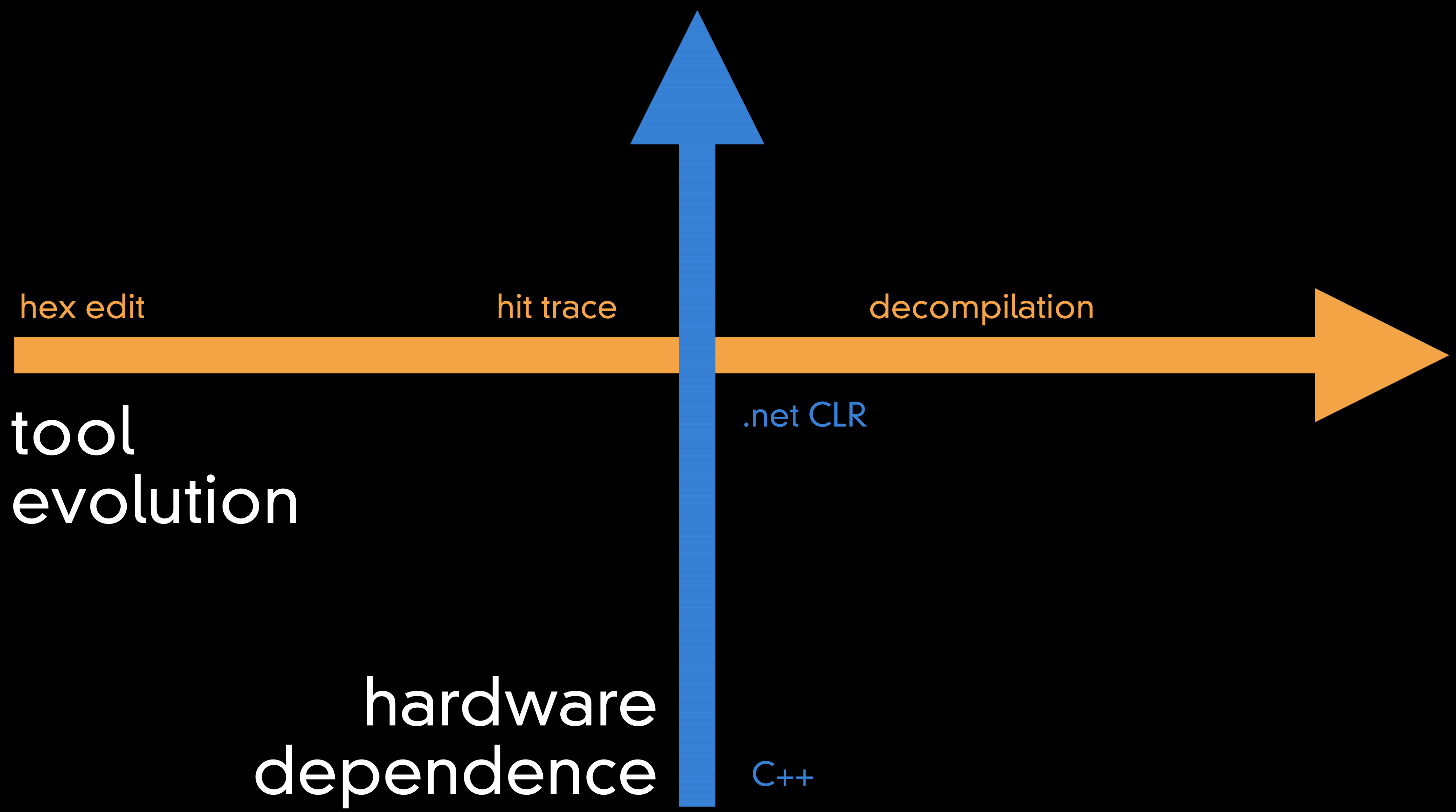
intersection



rce myth #1

- End results need to be compilable, nearly as good as the original source code!
  - No. Results just need to map out the inputs and operations. We'll never recompile. We don't need your algorithms.

rce myth #2

- All reversed source code needs to be read.
  - No. We're barely going to read any code. We isolate the few functions that matter, figure out their inputs, and test them.

rce myth #3

- If there are no symbols, reversing is impractical.
  - No. Real code is littered with giveaways about which functions are which. Stripping function names adds hours, not days.

rce myth #4

- The goal of reversing is to get back to the original source language.
  - No. All we need is “better than assembly”. We can “decompile” to a call graph, or a low-level language, and analyze that.

rce myth #5

- All decompilation is static, file-at-a-time.
  - No. We'll use debuggers, system call tracing, filesystems, logging, and single-stepping to help.

open

```
int
main(int argc, char **argv) {
	printf("helu, world\n");
	exit(0);
}
```

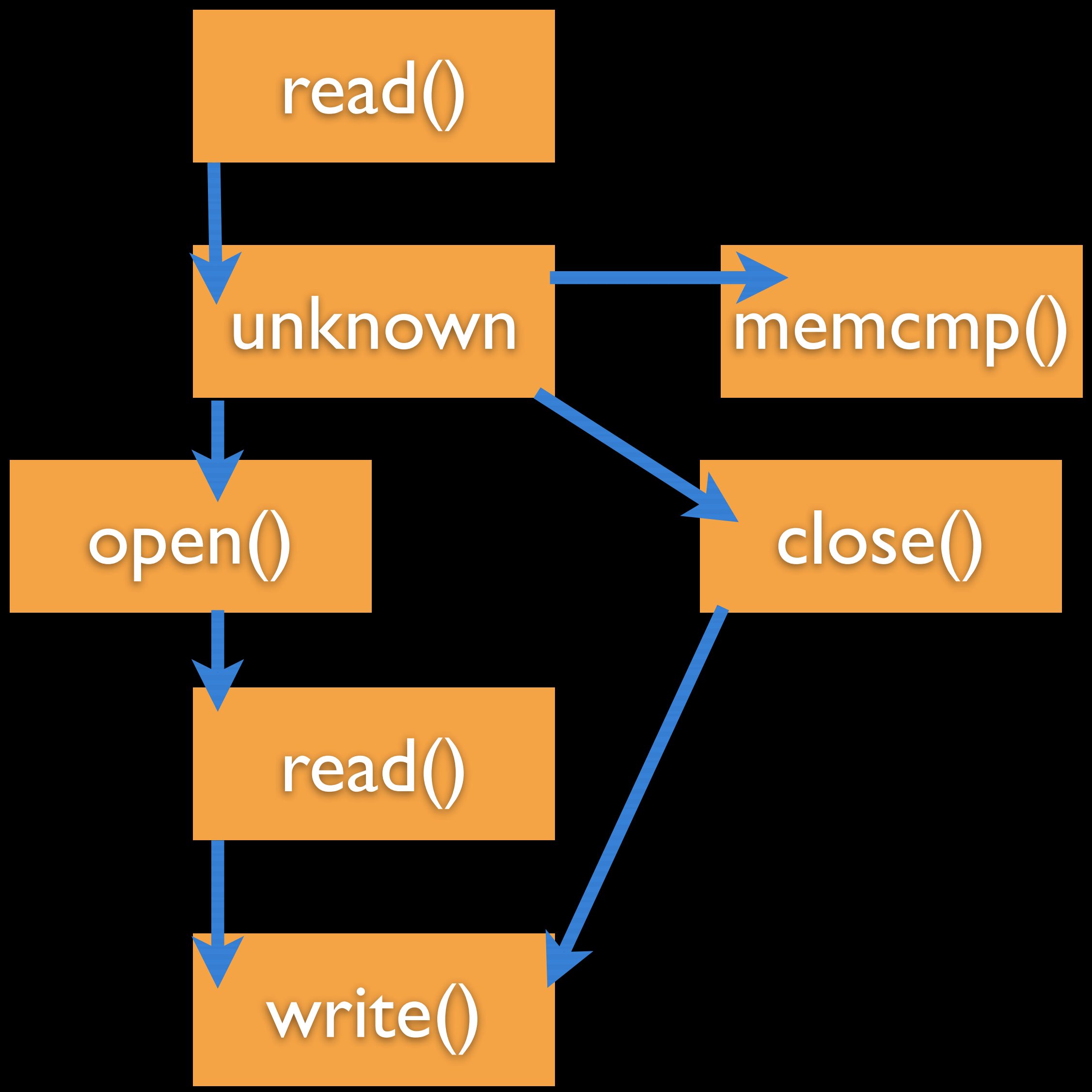
closed

```
000001c0  00 00 00 00 00 00 00 00  00 00 00 00 55 89 e5 53  |............U..S|
000001d0  83 ec 14 e8 f4 ff ff ff  8d 83 1a 00 00 00 89 04  |................|
000001e0  24 e8 1d 00 00 00 c7 04  24 01 00 00 00 e8 0c 00  |$.......$.......|
000001f0  00 00 68 65 6c 75 2c 20  77 6f 72 6c 64 00 f4 f4  |..helu, world...|
00000200  f4 f4 f4 f4 f4 f4 f4 f4  8b 1c 24 c3 22 00 00 00  |..........$."...|
00000210  03 00 00 05 16 00 00 00  03 00 00 05 0e 00 00 a4  |................|
00000220  26 00 00 00 00 00 00 a1  0c 00 00 00 08 00 00 00  |&...............|
```

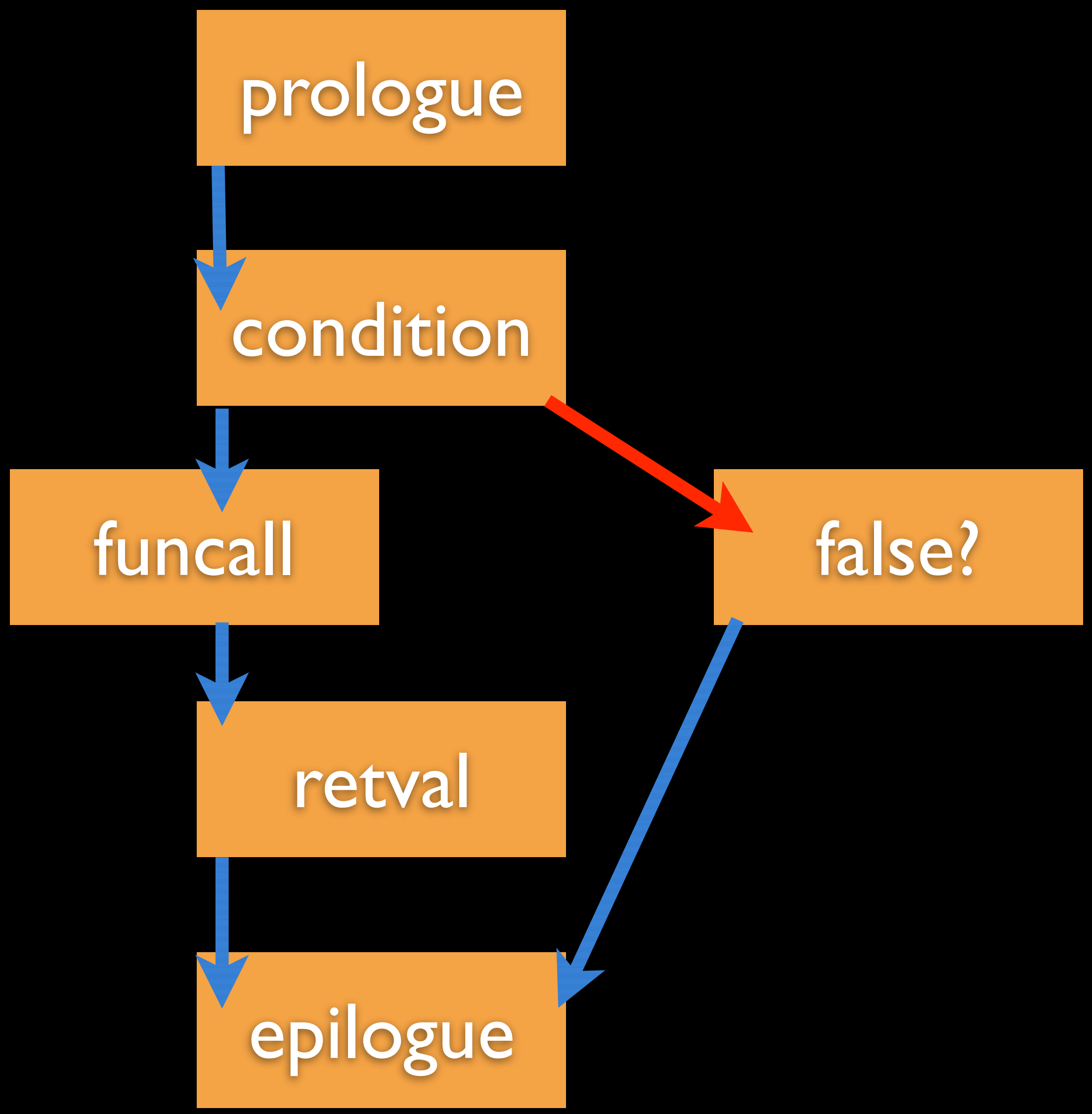
disassembled

```
push   %ebp
mov    %esp,%ebp
push   %ebx
sub    $0x14,%esp
call   0 <LC_SEGMENT.__TEXT.__text>
lea    0x1a(%ebx),%eax
mov    %eax,(%esp)
call   37 <___i686.get_pc_thunk.bx-0x5>
movl   $0x1,(%esp)
call   32 <___i686.get_pc_thunk.bx-0xa>
```

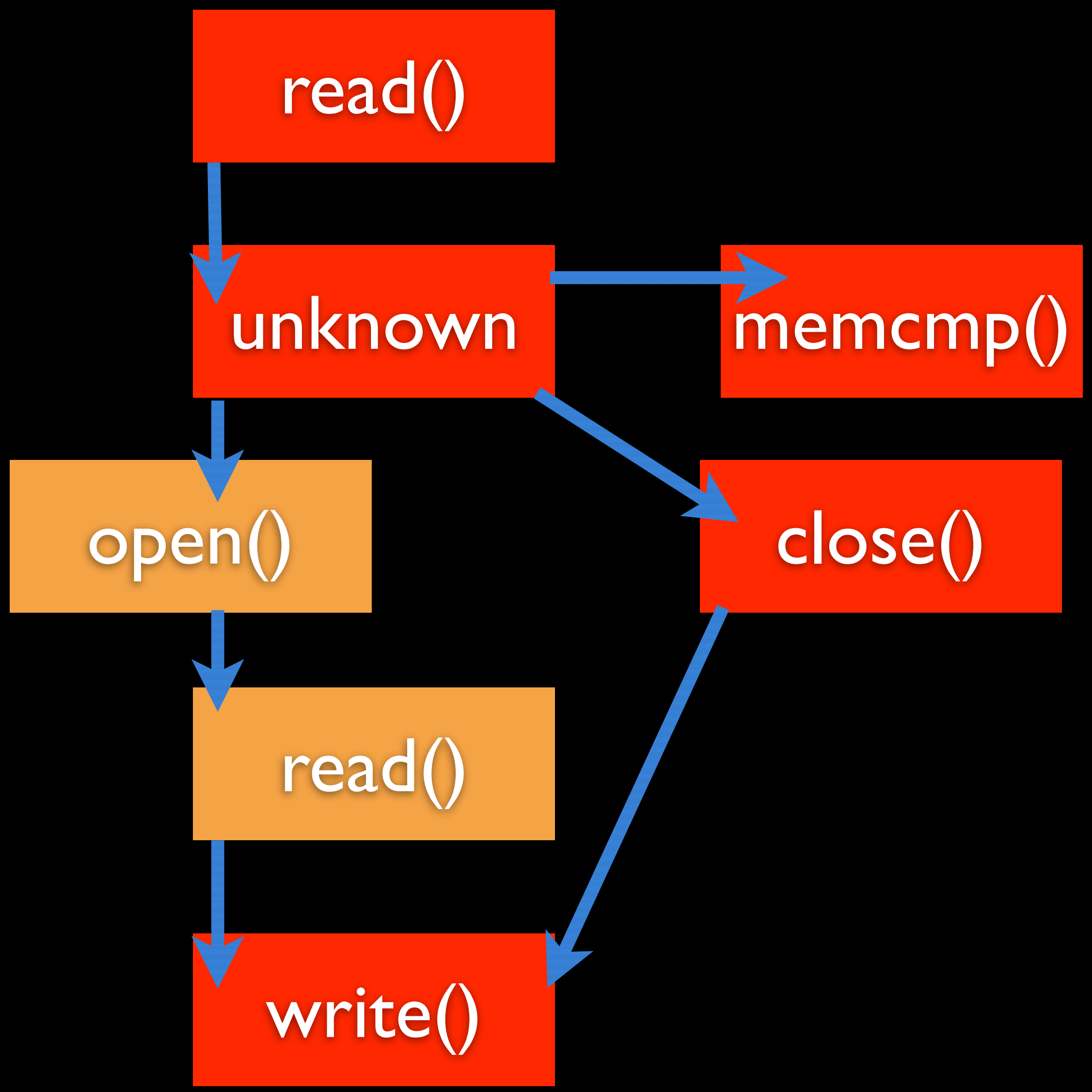
call graphed



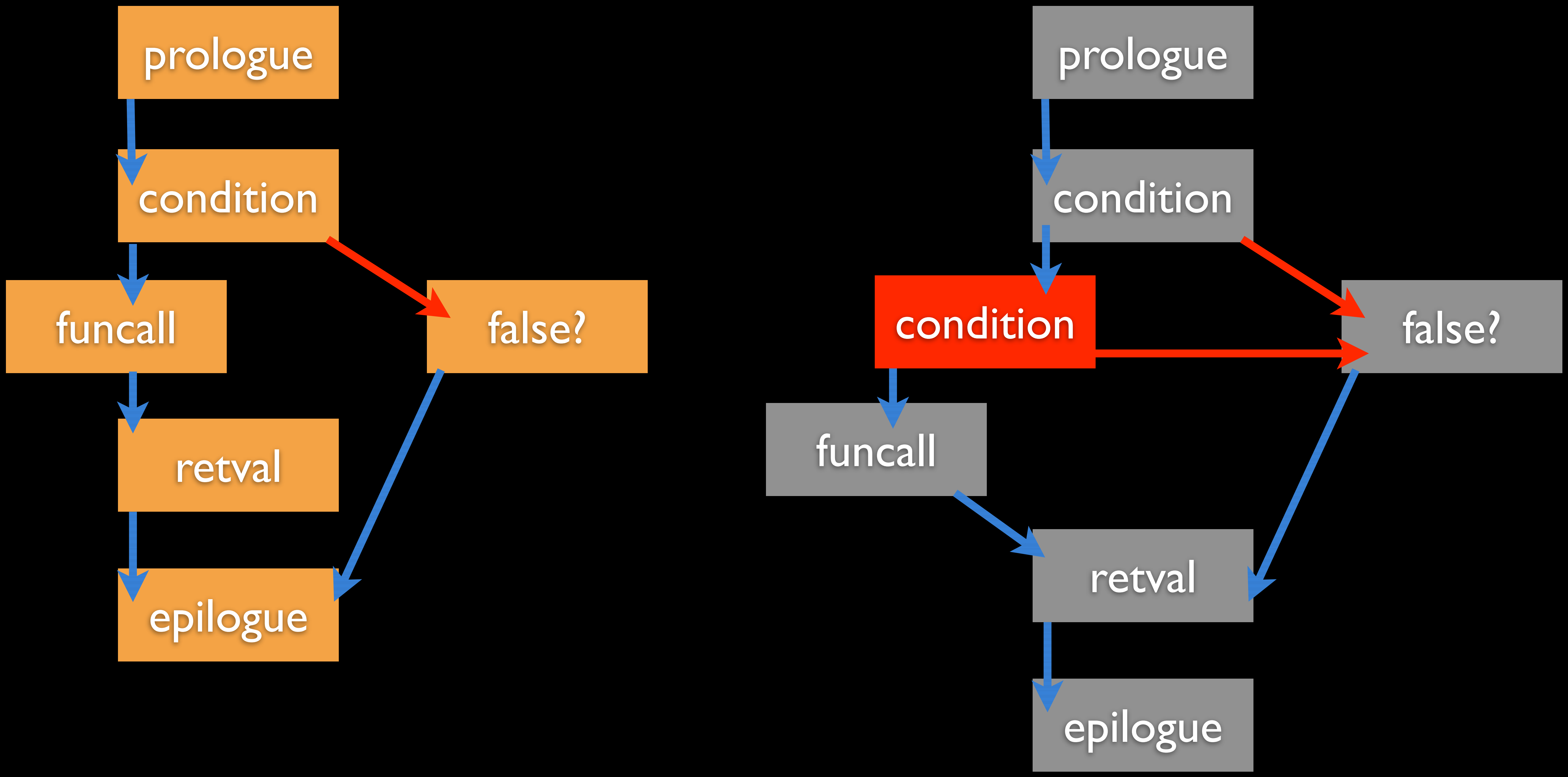
bblock graphed



hit traced



bblock diffed patch



open java

```
class Program {
   public static void main(String args[]) {
      System.out.println(“helu, world”);
   }
}
```

closed java

```
class Program {
   public static void main(String args[]) {
      System.out.println(“helu, world”);
   }
}
```

Why Java Decompiles

- Simple instructions: fits on a Wikipedia page
- Embedded types: everything's an object, objects have names.
- Storage model: arguments, locals, instance variables all predictable, along with stack frames
- Verified code: can't jump to the middle of an instruction.
- Minimal indirection: no computed function pointers

demo: ida

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demo: paimei minesweeper

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demo: binnavi eye candy

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demo: jad

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demo: xcode java

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demo: .net reflector

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the 8 steps

1. Configure the Application: *set up a working lab.*
2. Sniff Test: *see if it survives silly stuff.*
3. Capture Traffic: *get data to work with.*
4. Decode and Frame: *break up messages.*
5. Establish Replayability: *start talking to target.*
6. Establish Variability: *start attacking target.*
7. Establish Generation: *build fuzzing framework.*
8. Write Test Cases: *test for coverage.*

(1) configure

- ★ Get the product working in its normal state.
  - Consider disabling security features for now.
- ★ We lose more time here than anywhere else.
- ★ Objective: A VMware "just-add-water" lab.

(2) sniff test

- Is there any authentication?
- Can I crash it with random data?
- Objective: Qualify the target.
  - *don't waste time with totally broken apps.*

(3) capture

- ★ I use tcpdump to figure out what ports an application uses.
- ★ I use a simple socket-based plugboard for everything else.
- ★ Objective: files for each side of connection
  - *inspect in hexdump*

(4) frame

- ★ The hardest step.
  - but usually much simpler for web apps
- ★ Take one capture file.
- ★ Objective: files for each protocol message.

(5) replay

- ★ Cat message files back at the server
  - (in the right order)
- ★ Objective #1: successful responses
- ★ Objective #2: see what varies

(6) vary

- ★ Now we have examples of protocol messages.
- ★ Objective: fuzzing templates
  - Change strings
  - Change length
  - Change things at random

(7) generate

- ★ Now we have a good idea of how the protocol works.
- ★ Objective: code to generate from scratch
  - I've used C, Python, Ruby, and Bash
  - I actually prefer Bash.

(8) test cases

- Start finding flaws.
- You should be minutes-not-hours for each new test case now.

protocol decoder ring

web	RPC	corba
HTTP	transport	IIOP
POST	pdu	Message
Apache	server	ORB
Page	service	Object
URL	request	IOR
DNS	resolver	CosNaming
&action=	action	Method
Cookie	session	SvcContext
POST Args	data	MessageBody

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predictable sessions

web	RPC	corba
Cookie	session	SvcContext

proprietary session cookies are almost always monotonically increasing 32 bit integers.

forced browsing

web	*RPC*	*corba*
Page	service	Object
URL	request	IOR
&action=	action	Method
Cookie	session	SvcContext

often, every service/action is left to fend for itself to verify the caller: requests with no session are honored.

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memory corruption

web	*RPC*	*corba*
HTTP	transport	IIOP
POST	pdu	Message
POST Args	data	MessageBody

most web apps are built in Java/.NET.
most custom protocols are C/C++.

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injection

web	*RPC*	*corba*
POST	pdu	Message
POST Args	data	MessageBody

requests usually still hit an SQL database, but there's no off-the-shelf validator code to use. don't forget '90s shell metacharacters and UNC paths!

cross-site-scripting

web	RPC	corba
POST Args	data	MessageBody

almost all of these apps have a web front-end somewhere; "submarine" XSS lets us inject javascript into backend database.

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conclusion

it seems vanishingly unlikely I'll make it to this slide.

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chisec:

third thursday, every other month,
houlihan’s on wacker.

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