Trolling with Math

```
base26_t YOU = 0x038C2767;
```

Trolling with Math

wat?

- frank^2
  - pronounced “frank 2” (the carat is ~flare~)
  - “that guy with the hat”
- DC949
- DC310

Trolling with Math

When we last left our heroes...

- "I have no idea what the fuck frank^2 is talking about, but its awesome."
- "More content, less bullshit."

Content

Trolling with Math

ya we pumpin

Trolling with Math

MATH!

- It's very possible your math teacher made this more complicated than it needs to be.
  - f(x) = x * 7
  - (lambda x: x * 7)
  - public static int multiplyBySevenAndReturn(Integer x) { return x * 7; }
- Mathematic functions can get even *more* complicated, but this is all we need for now.

Trolling with Math

ASSEMBLY!

- JMP and CALL instructions are not specific with immediate values. They're offsets.
- JMP 00401000 is more like JMP-A-FEW-BYTES-AHEAD. It's the same with CALL.
- ...except CALL sticks its dick in your stack.
- **Hot.**

Trolling with Math

ASSEMBLY!

- Oh, except for when you stick an address in a register. *Totally different.*
- When you stick an address in a register and then do something like CALL EAX, it specifically goes to whatever value is in EAX.
- Same goes for CALL [EAX] or JMP [EAX]--it just dereferences EAX and jumps to that address.

Trolling with Math

ASSEMBLY!

- Let's talk about JMP SHORT.
- This is essentially a jump within the range of -127 8==0==D 127.
- Regular JMP instructions are more like -2147483647 8=====0=====D 2147483647

Trolling with Math

ASSEMBLY!

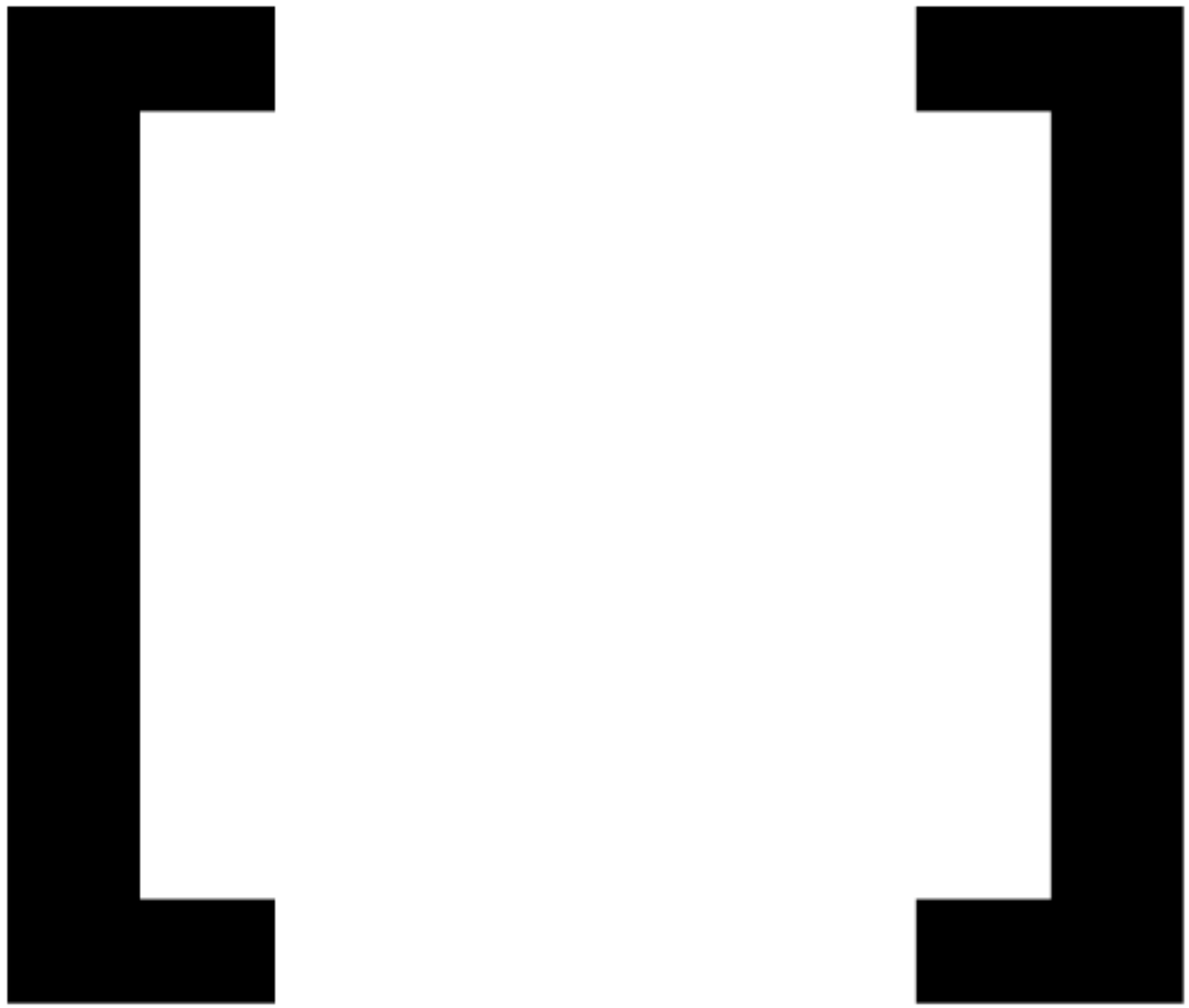
- There is no such thing as CALL SHORT.
  - I know, right?
  - What the *hell*.

Trolling with Math

ASSEMBLY!

- Here's some computer science witchcraft.
- *Technically* you can define the space between each instruction as...

Trolling with Math



nullspacelabs

Trolling with Math

ASSEMBLY!

- Each instruction is executed one after another.
- This can be interpreted as an unconditional jump to the next instruction.
- This gives us space between each assembly instruction so long as each instruction is subsequently linked by an unconditional jump.

Trolling with Math

ASSEMBLY!

```
MOV   EAX,5355434B
MOV   EBX,20412044
XOR   EAX,EBX
CALL  49434B20
MOV   EDX,EAX
SUB   AL,46
XOR   EAX,41545459
```

Trolling with Math

ASSEMBLY!

```
MOV   EAX,5355434B
JMP 0
MOV   EBX,20412044
JMP 0
XOR   EAX,EBX
JMP 0
CALL 49434B20
JMP 0
MOV   EDX,EAX
JMP 0
SUB   AL,46
JMP 0
XOR   EAX,41545459
JMP 0
```

Trolling with Math

ASSEMBLY!

- It is therefore possible to place every single assembly instruction in an arbitrary location in memory *if and only if* each singular instruction is followed by an accompanying unconditional jump to the next instruction.

Trolling with Math

ASSEMBLY!

- A one-dimensional array can technically be interpreted as a two-dimensional array as well. It just requires a little math.
- This gives us the ability to interpret a location in memory as an X/Y grid.
- Coupled with interpreting null space between instructions as unconditional jumps, we can literally draw instructions.
- This is **awesome.**

Trolling with Math

Let's do this

- Disassemble each instruction.
- Allocate space in memory significantly larger than the collection of instructions.
- For each instruction, determine *f(x)*
- Place each instruction at the corresponding (x,y) location in memory.
- Join the instruction with an unconditional jump.
- Mark memory executable and run.

Bullshit

Trolling with Math

FUCK!

- Like gravity, that shit only works in theory.
- In practice, we're fucked.
- Totally and utterly fucked.

Trolling with Math

FUCK!

- All of your JMP instructions? Fucked.
- All of your CALL instructions? Fucked.
- Any self-referential code? Fucked.
- Self-modifying code that relies on iteration? You better BELIEVE it's fucked.

Trolling with Math

FUCK!

- Let's start with JMP instructions.
- Since JMPs are offsets, when placed in an arbitrary location, they no longer point to where you think they're pointing at.
- Short JMPs are in a similar situation. When arbitrarily placed by your *f(x)* function, they will very likely not point to where you think they will.
- Short JMPs are easily fixed. Long JMPs? Not so much.

Trolling with Math

FUCK!

- Dealing with register-based JMPs are going to be an issue as well.
- Since they require hard offsets and may be calculated at run-time, there is no easy way to determine where they're going.
- So unless you want to do some extra work to get this working... you may as well ignore it.

Trolling with Math

FUCK!

- *f(x)* formulas aren't nearly as elegant in code as they are on paper.
- This requires all sorts of strange voodoo magic if we want to use arbitrary formulas-- function pointers, class pointers, the whole shebang.

DEAL WITH IT

Trolling with Math

he;lp

- At disassembly, convert all your JMP SHORTs to JMP PANTS before storing them away.
- Simple enough!

Trolling with Math

he;lp

- The actual offset data though? *Hoo.*
- All instructions which you've detected have offsets that will move when the code is moved need to be recalculated.
- This means you need to:
  - Keep track of the instructions.
  - Keep track of the targets.
- See the source for an example of how I accomplished this.

Trolling with Math

he;lp

- After all the instructions are placed, replace the old offsets with the new offsets.
- Assuming you didn't fuck up the offsets, those problems are now solved.

Trolling with Math

he;lp

- Now that we have the caveats out of the way, we have a path to a potential higher-level implementation.
- It goes like this:

Trolling with Math

Implementation

- Disassemble instructions.
- Prepare buffer.
- Initialize *f(x)* function constants.
- Iterate over *f(x)* values and determine data pointers by which your code will be written to while tracking fucked instructions.
- Write the instructions to the corresponding pointers.

Trolling with Math

Implementation

- Repair all your conditional jumps.
- Mark the new section of memory as executable.
- *RUN!*


COOL STORY, BRO

Trolling with Math

Who cares?

- The isolation of assembly instructions and numerical steps to calculate *f(x)* allows us to place assembly instructions anywhere in the buffer we want to with little to no interaction from the user.
- In order to obfuscate the clarity of the codepath, all you have to do is write a function and point the MATHEMACHINAE at some assembly.

Trolling with Math

Who cares?

- This makes accomplishing various polymorphic techniques a little bit simpler as well.
- Instead of writing code that manipulates your code in a specific way each time, you can write a series of functions which randomly determine the location of your code, then select *those* functions at random, etc.

Trolling with Math

Who cares?

- Anti-reversing isn't about how cool and fresh your anti-debug techniques are.
- Anti-reversing isn't about how much of a boner you get from breaking out of IDA and spawning Last Measure all over a reverser's desktop (but it **is** pretty goddamn funny).
- Anti-reversing is about **being a dick.**

Trolling with Math

Who cares?

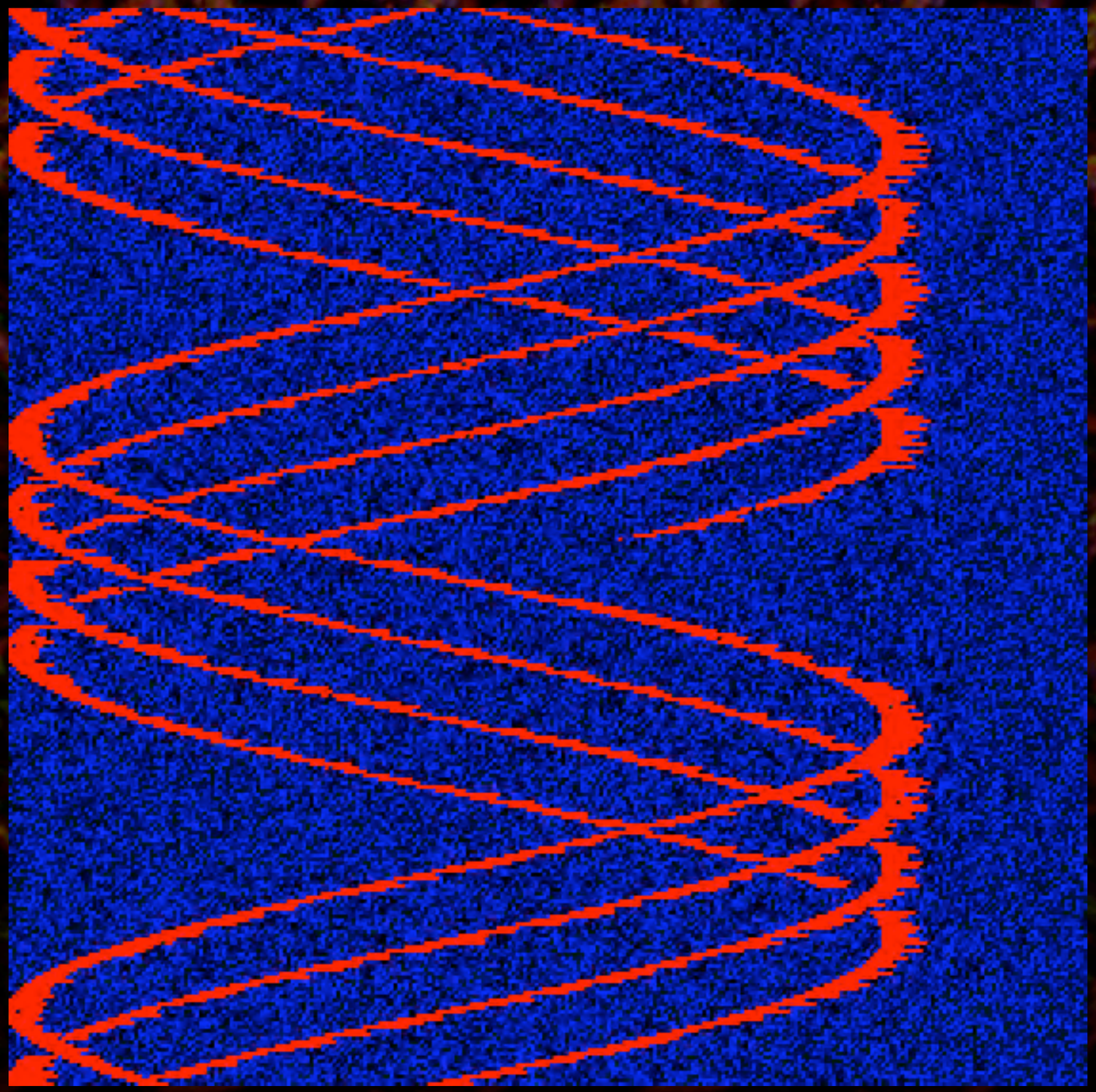
- Everyone knows where to Google for anti-debug techniques.
- You can't Google for creativity, though.
- The most creative anti-reversing assholes among you will be the direct result of broken fingers and fist-sized holes in plastered walls.
- And that's something to be proud of!

Trolling with Math

Yo dawg, I heard this joke was played out...

Trolling with Math

...but it's contextual, so fuck the haters



Trolling with Math

At least I didn't use memegenerator

Trolling with Math

AW FUCK

Trolling with Math

Shit sucks

- But the example code only uses unconditional jumps.
- Unconditional jumps only go in one goddamn direction.
- Conditional jumps go in *two*.
- That makes them *better*.

Trolling with Math

wait wh

- If we require conditional jumps yet need to use unconditional jumps... what the fuck?
- Opaque predicates save the day!
- But why stop there?

Trolling with Math

Hardening

- Consider the null-space expansion posited earlier.
- If a set of instructions has an unconditional jump between each instruction, it also follows that a series of assembly instructions which do not have direct affect on the result of our desired instructions can precede or proceed a single instruction.
- This is **even more awesome.**

Trolling with Math

Hardening

pre-amble

assembly data

post-script

Trolling with Math

Hardening

- The pre-amble section can be used for two things:
  - Repairing the after-effects of the previous pre-amble's opaque predicate.
  - Anti-debug code chunks.

Trolling with Math

Hardening

- The post-script is a whole lot more fun.
- This section can be used for:
  - Opaque predicates and obfuscated jumps
  - Anti-debug and general control-flow obfuscation
  - Encryption/decryption of various chunks of code within the program

Trolling with Math

Hardening

```
CALL  IsDebuggerPresent
CMP   EAX,1
JE    FuckYouNeighbor
MOV   EAX,5355434B
PUSH  EAX
XOR   EAX,EAX
JZ    nextBlock
```

```
POP   EAX
MOV   EBX,20412044
CLC
JNC   nextBlock
```

Trolling with Math

Hardening

- This obviously introduces a whole lot more issues than our baseline does, such as after-effects and a complication of generating all the different sets of instructions.
- So throw your Shmooballs if you got ‘em, I’m about to be That Guy:

COMING SOON
(AKA READ MY SHITTY BLOG)

Trolling with Math

Hardening

- Our *f(x)* formulas don't necessarily need to be calculated iteratively, e.g. *f(*1*)*, *f(*2*)*, ... *f(n)*
- There's nothing to stop us from randomly calculating them as well!

Trolling with Math

Hardening

- If our code is generated from a predictable formula, then it follows the entry point is predictable, i.e. it can be calculated at runtime.
- Oh, hi mister Debugger! What's that? You want to ride the snake?
- **NOT WORTHY**

Drawbacks

Trolling with Math

Drawbacks

- This technique assumes sanely compiled code.
- This means if you're trying to obfuscate assembly that would make the Conficker gang say "bravo!", you're screwed.

Trolling with Math

Drawbacks

- Massive memory footprint.
- You are likely going to be dealing with a HUGE dataset when you're done.
- This gets significantly larger when you obfuscate more than just one functions.
- I sure hope your FuDG3p4Ck3R v6.66 is efficient!

Trolling with Math

Drawbacks

- You think your function pointers are so clever? Yeah? Fuck you, *they're broken.*
- Wise-guy thought he might be smart by using C++ and the STL to get by and make his code more efficient? *Fuck* your OOP paradigm.

Trolling with Math

Drawbacks

- The more clever you get with generating obfuscation pairs and manipulating the assembly, the more complicated it gets to repair.
- It's a slippery-slope from "oh, hey, neat, I can just stick a JMP or two in here" to "HOW THE FUCK DO I MEMORIZE THE DRAGONBOOK IN AS SHORT AMOUNT OF TIME AS POSSIBLE?!"

Trolling with Math

End!

- @franksquared
- http://argolithmic.blogspot.com
- http://argolith.ms