Cute but Dangerous:

Learn Bad USB Hacking with the USB Nugget

Retia 2023

Who am I?

Hi! I’m Ash:

- Hacker

What we’re doing today

- Learning about HID / USB attacks
- Learning to flash a firmware to your USBNugget
- Writing your own CatScratch keystroke injection payloads
- Learning how to use the USB Nugget for security testing

What is the USB Nugget?

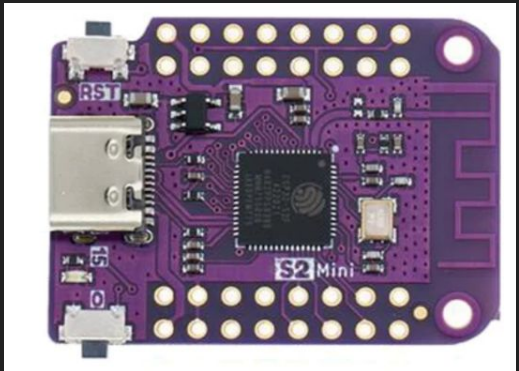
The USB Nugget is a hardware tool that makes it easy for beginners to learn **hacking techniques** and **hardware development**!

Features:

- Built-in screen
- RGB LED
- 4 D-Pad style buttons
- WiFi Microcontroller
- Plug-and-play expansion pins

What’s under the hood?

The USB Nugget is powered by the ESP32s2, a Wi-Fi enabled microcontroller



ESP32-S2 Features

ESP32-S2 is a highly integrated, low-power, single-core Wi-Fi Microcontroller SoC, designed to be secure and cost-effective, with a high performance and a rich set of IO capabilities.

Unparalleled Security for Your Connected Devices

- RSA-3072-based secure boot
- AES-128/192/256-XTS-based flash encryption
- Protected private key and device secrets from software access
- Cryptographic accelerators for enhanced performance
- Protection against physical fault injection attacks

Display, Touch Capabilities and Rich IO

ESP32-S2 integrates a rich set of peripherals, with 43 programmable GPIOs which can be flexibly configured to provide USB OTG, LCD interface, camera interface, SPI, I2S, UART, ADC, DAC and other common functionality. With LCD interface and 14 configurable capacitive touch GPIOs, ESP32-S2 provides the optimal HMI solution for touchscreen and touchpad-based devices.

Solid Wi-Fi Performance at Extreme Temperatures

ESP32-S2’s operating temperature ranges from -40 to +125 degrees Celsius, thus facilitating a variety of industrial, consumer and lighting applications.

What can the USB Nugget do?

- Run USB Attacks
- Teach programming
  - CircuitPython
  - Arduino
- Control Hardware / Sensors
- Run Community Projects
- Display cute animations!

What is the USB Nugget OS software?

The USB Nugget is a program that lets you run USB Attacks in seconds using the USB Nugget!

Current Features:

- CatScratch Compatible
- Built-in flash drive storage
- Quick Payload deployment
- WiFi Control

USB Attack Class

1 Hour

What are USB & HID Attacks?

- **USB attacks** pretend to be a trusted USB device like a keyboard or an ethernet adapter.
- **HID (Human Interface Device) attacks** pretend to be a keyboard or mouse since these are plug and play.
- Anything you can do behind a computer with a keyboard or mouse can be automated.
- You can spoof the hardware ID of a USB keyboard (or other HID), and use this to quickly type commands into a victim computer and steal files

What is Keystroke Injection?

- Keystroke injection emulates a USB keyboard
- Computers inherently trust keyboards & HID devices
- We can take advantage of this to type out preprogrammed commands and keypresses at fast speeds.

Common HID Attacks & Use Cases

Common HID attacks involve taking advantage of physical access to a device.

This could look like:

- Dropping malicious USB drives in a parking lot
- Running a payload on an unattended laptop by plugging in a USB Nugget
- Preventing a screen from locking by plugging in a device that jiggles the mouse

Do HID Attacks work?

- Yes! A study showed that 45% of USB drives left on a university campus were plugged in

(a) Unlabeled drive (b) Drive with keys (c) Drive with return label (d) Confidential drive (e) Exam solutions drive

Fig. 1: **Drive Appearances**—We dropped five different types of drives. We chose two appearances (keys and return label) to motivate altruism and two appearances (confidential and exam solutions) to motivate self-interest, as well as an unlabeled control.

Users Really Do Plug in USB Drives They Find

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***Abstract*—We investigate the anecdotal belief that end users will pick up and plug in USB flash drives they find by completing a controlled experiment in which we drop 297 flash drives on a large university campus. We find that the attack is effective with an estimated success rate of 45–98% and expeditious with the first drive connected in less than six minutes. We analyze the types of drives users connected and survey those users to understand their motivation and security profile. We find that a drive's appearance does not increase attack success. Instead, users connect the drive with the altruistic intention of finding the owner. These individuals are not technically incompetent, but are rather typical community members who appear to take more recreational risks than their peers. We conclude with lessons learned and discussion on how social engineering attacks—while less technical—continue to be an effective attack vector that our community has yet to successfully address.**

I. Introduction

The security community has long held the belief that users can be socially engineered into picking up and plugging in seemingly lost USB flash drives they find. Unfortunately, whether driven by altruistic motives or human curiosity, the user unknowingly opens their organization to an internal attack when they connect the drive—a physical Trojan horse. Our community is filled with anecdotes of these attacks and pentesters have even boasted that they can *hack humans* by crafting labels that will pique an individual's curiosity [19]: "While in the bathroom, I place an envelope in one stall. On the cover of the envelope I put a sticker that says PRIVATE. Inside the 'private' envelope is a USB key with a malicious

median time to connection of 6.9 hours and the first connection occurring within six minutes from when the drive was dropped. Contrary to popular belief, the appearance of a drive does not increase the likelihood that someone will connect it to their computer. Instead, users connect all types of drives unless there are other means of locating the owner—suggesting that participants are altruistically motivated. However, while users initially connect the drive with altruistic intentions, nearly half are overcome with curiosity and open intriguing files—such as vacation photos—before trying to find the drive's owner.

To better understand users' motivations and rationale, we offered participants the opportunity to complete a short survey when they opened any of the files and read about the study. In this survey, we ask users why they connected the drive, the precautions they took, demographic information, as well as standard questions to measure their risk profile and computer expertise. We find that attack was effective against all sub-populations at Illinois. The majority of respondents connected a drive to locate its owner (68%) or out of curiosity (18%), although a handful also admitted they planned on keeping the drive for themselves.

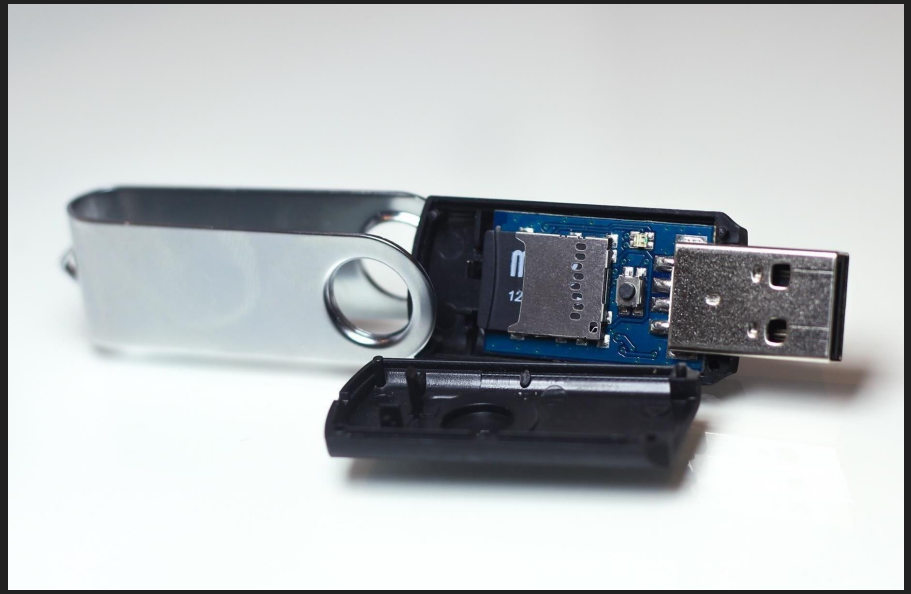
The students and staff that connected the drives were not computer nor security illiterate and were not significantly different than their peers at the University of Illinois on Egelman and Peer's Security Behavior Intentions Scale (SeBIS) [12]. While the users that connected the drive engaged in riskier behavior than their peers on the DOSPERT scale [4], they were more risk averse than the general population in every domain

Real Life Scenario: Fin7 USB Mailing Attack

Fin7 Cybercrime group suspected of mailing malicious USB drives to install ransomware onto targets' computers

What is the USB RubberDucky?

- First keystroke injection tool created by Darren Kitchen of Hak5
- Uses a simple scripting language to emulate a keyboard
- Exploded in popularity and was featured on shows like Mr Robot
- Simple device capable of supporting a single payload



What is DuckyScript?

Duckyscript is a simple language for scripting keyboard-based HID attacks

- Each DuckyScript command resides on a new line
- Commands are written in ALL CAPS
- Most commands invoke keystrokes, key-combos or strings of text
- Others commands create delays or pauses

Full Screen Windows 10 Update

```
1 DELAY 3000
2 GUI r
3 DELAY 100
4 STRING https://fakeupdate.net/win10ue/
5 ENTER
6 DELAY 3000
7 F11
```

Other DuckyScript tools: Bash Bunny

- Low-profile but a little more conspicuous
- Can emulate multiple types of USB devices like ethernet
- Can run 2 payloads
- Has a built-in filesystem & flash drive to easily exfiltrate victim files

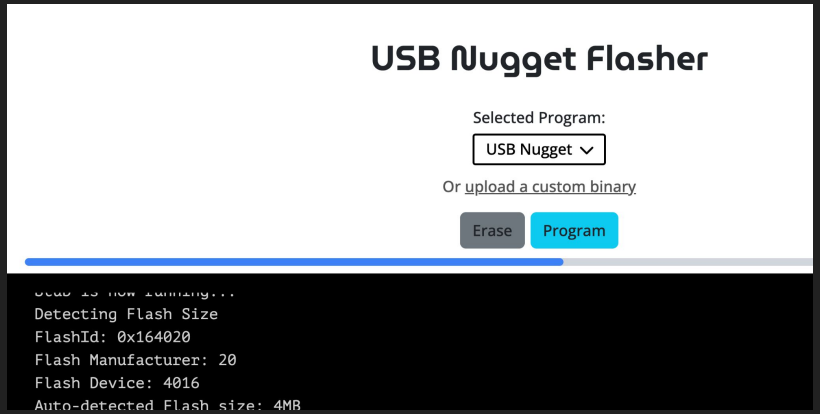
Other DuckyScript tools: OMG Cable

- Looks like a regular charging cable
- Comes in different USB types
- Built-in WiFi control
- Some versions record keystrokes
- Can perform HID attacks

Getting Started w/ the USB Nugget

Making your own payload

- Your USB Nugget comes flashed and ready to hack!
- You can always re-flash it if something goes wrong.
- Flashing is done through the Chrome browser
- Let’s go over how!



How to Flash your USB Nugget

Flashing your USB Nugget is easy!

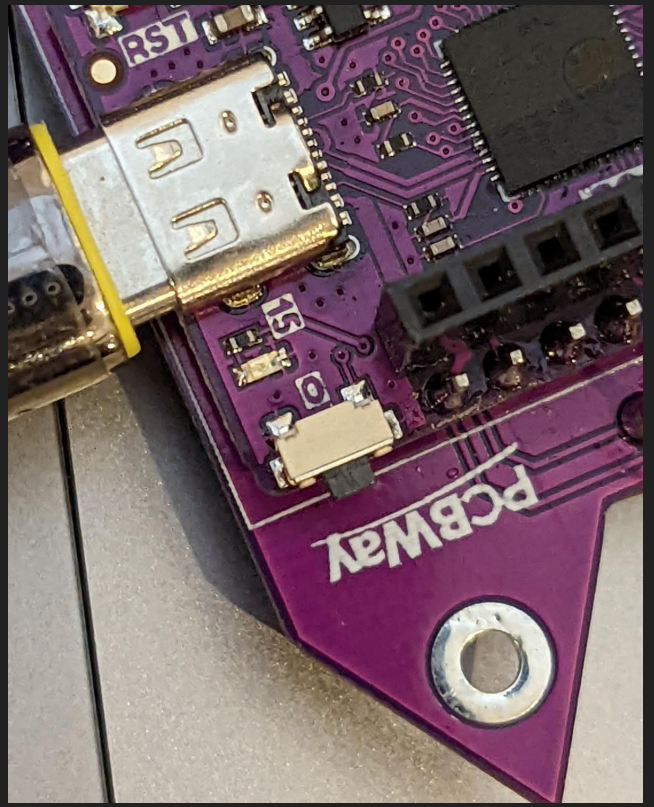
- Go to www.nugget.dev
- Click “Connect Your Nugget”

How to Flash your USB Nugget

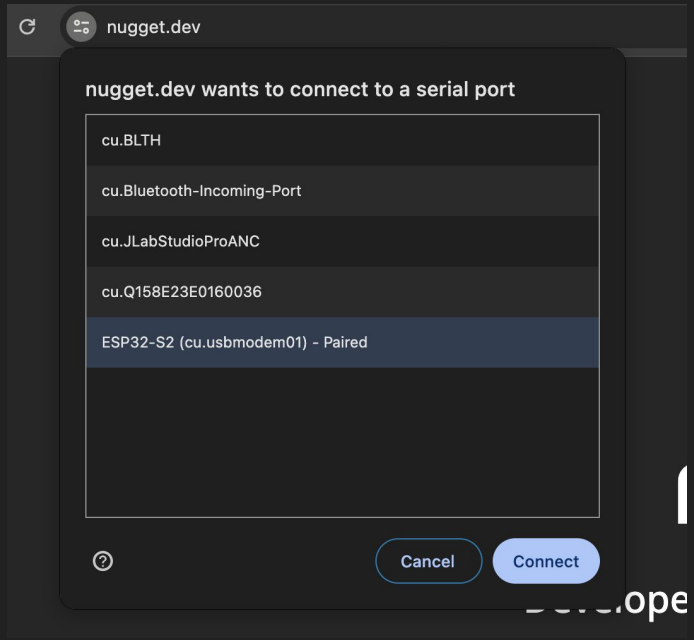
You may need to take off your case for this!

Put your Nugget into flashing mode via one of two methods:

1. Hold down the “0” button on the back while connecting to your computer, then release the button.
2. Connect the Nugget to your computer, then hold the “0” button and tap the “RST” button, then release both buttons.



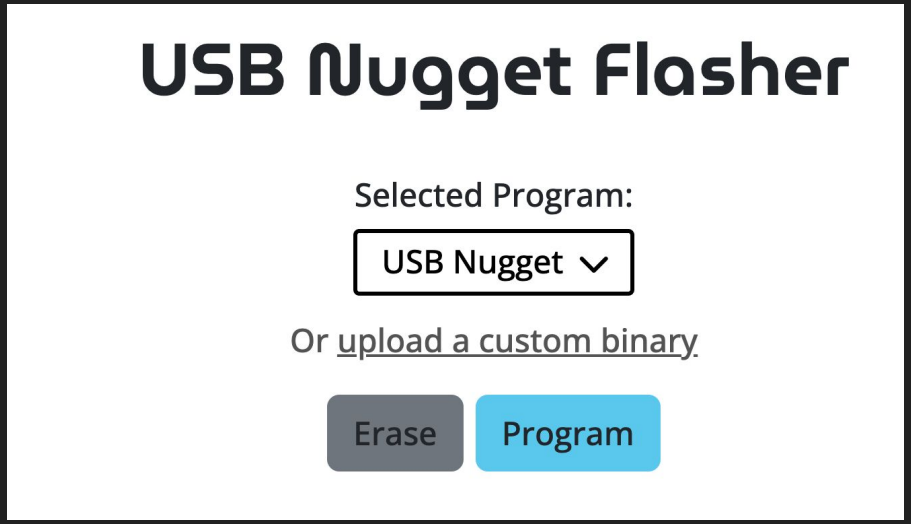
Your Nugget Should Appear!



- Select your Nugget and click Connect

How to Flash your USB Nugget

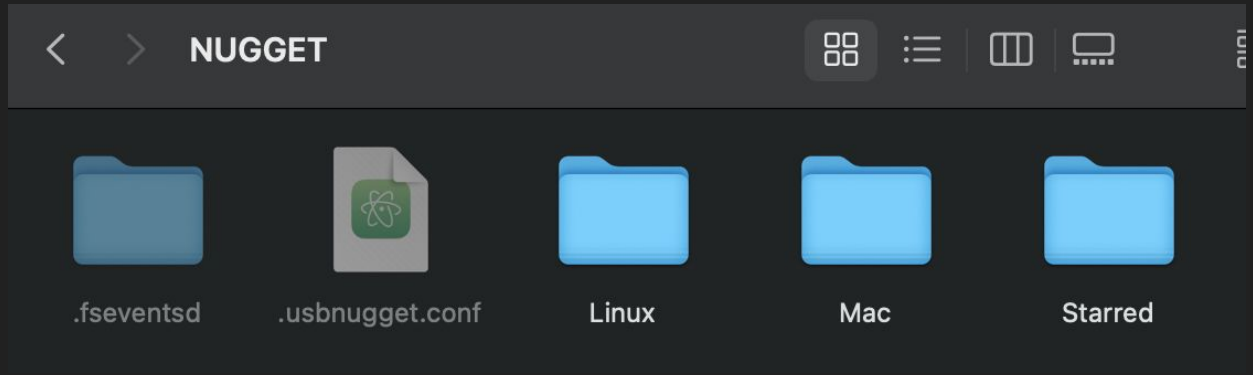
- Select the USB Nugget firmware
- Click Program to flash your Nugget!



You’re Done!

- Unplug your Nugget and plug it back in to run the new firmware

- Your Nugget should appear as a new USB drive. Open it and check out the sample scripts!



Break - Let’s Flash!

- Try flashing your Nugget!

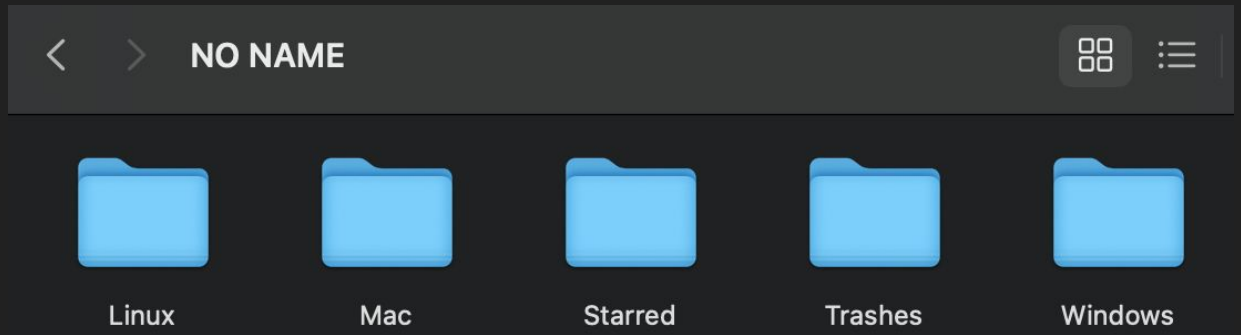
How Run Payloads On the USBNugget

To run a payload, use the buttons to select the target OS, payload type, and the payload to run

How to Add Payloads to the USB Nugget

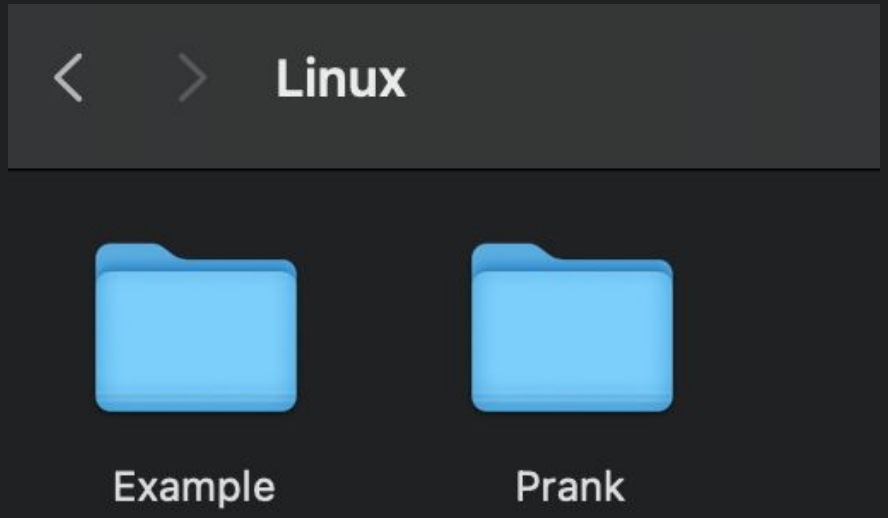
Plug in your Nugget and look for a USB drive to appear.

You'll see folders to keep payloads for different operating systems.



How to Add Payloads to the USBNugget

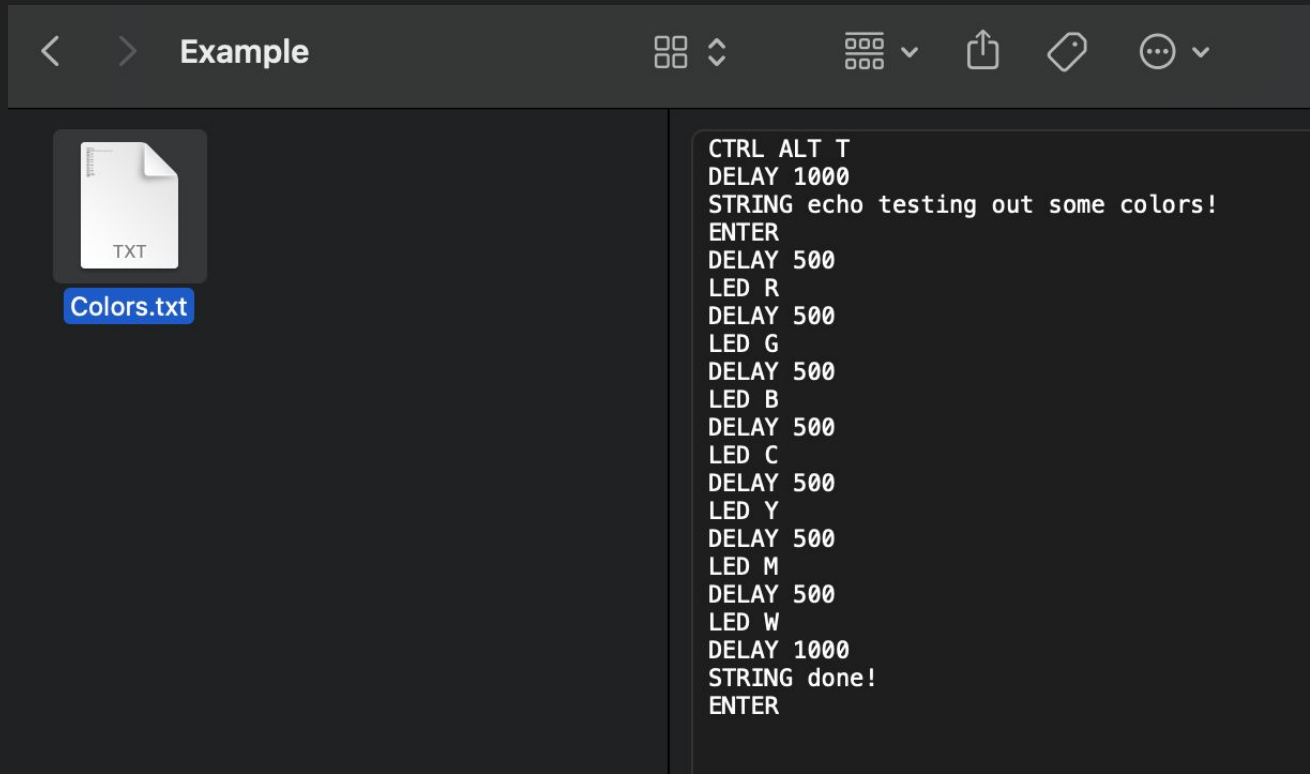
Inside each OS folder you'll see a folder for types of payloads. The default is examples and pranks, but you can add more.



How to Add Payloads to the USB Nugget

Finally, you'll see a payload .TXT file.

You can open and edit it in your favorite text editor to change a payload!

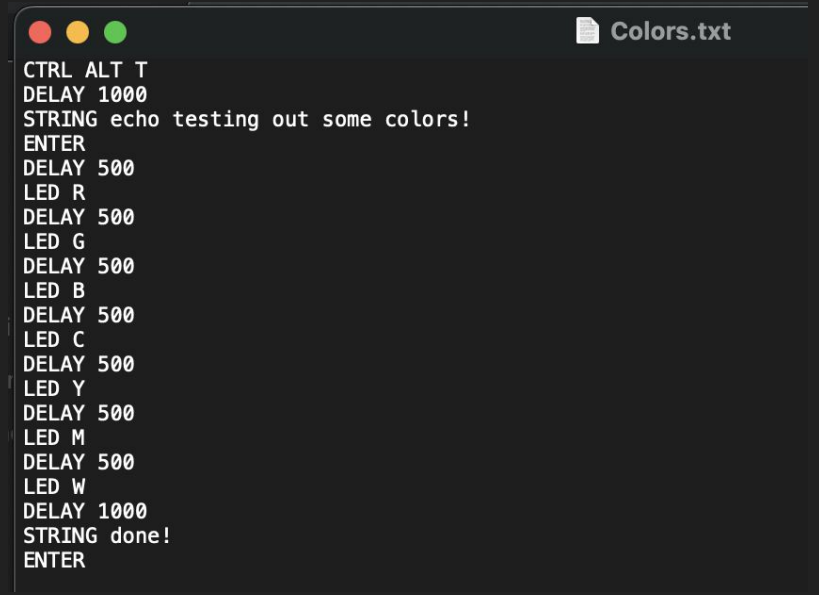


Coding your first CatScratch payload

There are example scripts preloaded on your USB Nugget!

Open any in a text editor, and make a change.

Save the script, and when your Nugget re-loads, press the button for the script you edited to see it run!



CatScratch Payloads

Get Started Creating Payloads!

Go here for examples:

https://usbnugget.dev/docs/guides/write-first-payload

Methodology: Working Backwards

To write code for the Rubber Nugget, we need to work backwards from what we want to do. We'll be creating some basic scripts based on how you do simple actions on your computer.

To design your first script, think about something you do all the time on your computer that you could accomplish with only a keyboard.

Break down the steps into a list of things you need to do to accomplish the task. In general, getting to the command line is the fastest way to take advantage of the Rubber Nugget's speed.

Basic CatScratch Commands

Modifier Keys

Keys like SHIFT, ALT, and the WINDOWS or GUI key can be useful for accessing hotkey combinations, are are frequently used in combination key presses.

Key
`CTRL` or `CONTROL`
`SHIFT`
`ALT`
`WINDOWS` `CMD` or `GUI`

Example	Result
SHIFT C	Type the Shift key and then the c key
SHIFT C	Press the Shift key and the c key at the same time
TYPE Hello	Types out “Hello”

Built-in Commands

Now that we have the basics down, let’s take a look at supported commands:

Command	Example	Description
`//`	`// Some comment`	This is used to leave comments, and is not executed in the script
`DEFAULTWAIT` or `DEFAULT_WAIT`	`DEFAULTWAIT 200`	This sets the default time in ms between each command
`WAIT`	`WAIT 1000`	Sets a one-time delay in ms
`TYPE`	`TYPE Hello World!`	Types whatever string follows the command
`LED`	`LED R`	Changes the color of the LED. Current Options: R = red, G = green, B = blue, C = cyan, Y = yellow, M = magenta, W = white
`SCREEN`	`SCREEN Hello`	Displays the string after the command on the USB Nugget’s screen

Delays and timing

Delays make one-way scripts possible.

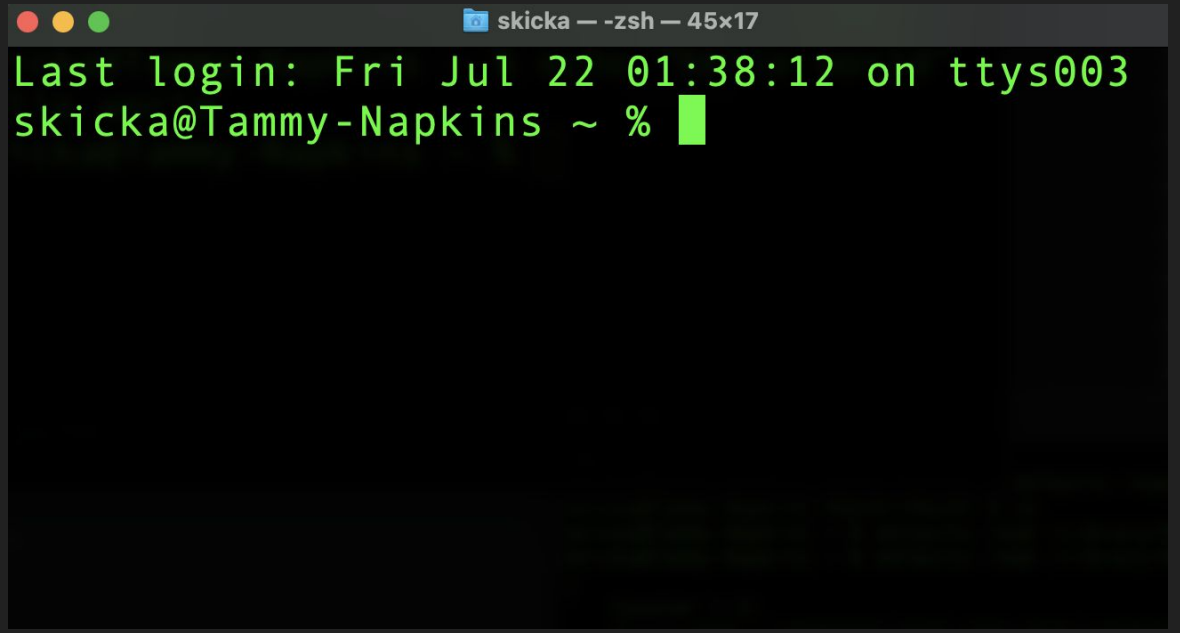
Because microcontrollers work so quickly, many of the commands would not work without adding time for commands to finish.

In testing, we should start out with generous delays and move into a more optimized design that works quickly without breaking anything.

Strategy: Race to the Terminal

The fastest way to do bad things on a computer is opening a terminal or powershell window.

What's the fastest way to open a terminal window?



Terminal Shortcuts

Quickest way to open a terminal on different operating systems.

Linux: CTRL ALT T

Mac: Cmd SPACE

Windows:

- GUI R - opens run dialog
- cmd - types a program
- ENTER - opens command prompt

Using Keyboard Shortcuts

Windows 10 Keyboard Shortcuts: https://www.windowscentral.com/best-windows-10-keyboard-shortcuts

Linux Keyboard Shortcuts (Debian): www.computerhope.com/ushort.htm

MacOS Keyboard Shortcuts: https://support.apple.com/en-us/HT201236

Raspberry Pi OS Shortcuts:

https://defkey.com/raspbian-raspberry-pi-shortcuts https://defkey.com/raspbian-raspberry-pi-shortcuts

Example Payload 1: RickRoll

Payload Breakdown:

- Open a terminal window
- Launch browser of choice (Chrome or Firefox)
- Open a custom url (like a Youtube Video)
- Play video and open fullscreen

STRING

DELAY

ENTER

F11 - fullscreen

Example Payload 1: PseudoCode

- **Press a key combo** to open a terminal window
- **Wait** for Terminal to open
- **Type** in a command to launch chrome / firefox
- **Wait** for browser to open
- **Type** in the url
- **Press enter**
- **Wait** for url to load
- **Press a function key** for full screen

Hint:

“start firefox” or “firefox” can be used to launch firefox from a terminal. You can also launch a url with this command.

Example Payload 2: Ransom Message

- Open a terminal window
- Use volume keys or a command to turn up the volume
- Use “say” or “espeak” to demand a dogecoin ransom to be paid
- Open a full screen browser window to a fake ransomware window:
  - https://www.cryptoprank.com/#/crypto

Hint: function keys can be used to raise the volume.

Example Payload 3: Advanced Ransom

Add-on the following objectives to the previous payload:

- Create a text file on the user's desktop that contains the dogecoin ransom text
- After letting the website run for 10 seconds, lock the user's computer

Hint: Use a keyboard shortcut to lock the computer. Creating a text file via command line is the fastest method, but you can also manually open notepad or another text editor.

Example Payload 4: Data Exfiltration

Finally, lets try out a data exfiltration payload!

Setup

- Generate a **web url bug** Canary Token at: canarytokens.org
- Copy the token link

Payload

- Open a terminal and get the MAC address (hardware address)
- Using the Curl tool, create a web request to the Canary Token that exfiltrates the MAC address in the user-agent field.

Payload Repository

For more payloads, check out the Hak5 Payload Repository:

https://hak5.org/blogs/payloads/

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Links to USB Rubber Ducky Payloads

- Payload - Non-Malicious Auto Defacer
- Payload - Lock Your Computer Message
- Payload - Ducky Downloader
- Payload - Ducky Phisher
- Payload - FTP Download / Upload
- Payload - Restart Prank
- Payload - Silly Mouse, Windows is for Kids
- Payload - Windows Screen rotation hack
- Payload - Powershell Wget + Execute
- Payload - mimikatz payload
- Payload - MobileTabs
- Payload - Ugly Rolled Prank
- Payload - XMAS
- Payload - Pineapple Assocation (VERY FAST)
- Payload - Remotely Possible
- Payload - Batch Wiper/Drive Eraser
- Payload - Generic Batch
- Payload - Paint Hack
- Payload - Local DNS Poisoning
- Payload - Deny Net Access
- Payload - RunEXE from SD
- Payload - Run Java from SD
- Payload - Download mimikatz, grab passwords and email them via gmail
- Payload - Hotdog Wallpaper
- Payload - Android 5.x Lockscreen
- Payload - Chrome Password Stealer
- Payload - Website Lock
- Payload - Windows 10 : Download & Change Wallpaper
- Payload - Windows 10 : Download & Change Wallpaper another version
- Payload - Windows 10 : Download and execute file with Powershell
- Payload - Windows 10 : Disable windows defender
- Payload - Windows 10 : Disable Windows Defender through powershell
- Payload - Windows 10 : Wifi, Chrome Dump & email results
- Payload - Windows 7 : Logoff Prank
- Payload - Netcat Reverse Shell
- Payload - Fake Update screen
- Payload - Rickroll
- Payload - Fast Meterpreter
- Payload - Data-Exfiltration / Backdoor
- Payload - Fake Update screen
- Payload - OSX Sudo Passwords Grabber
- Payload - OSX Root Backdoor
- Payload - OSX User Backdoor
- Payload - OSX Local DNS Poisoning
- Payload - OSX Youtube Blaster
- Payload - OSX Photo Booth Prank
- Payload - OSX Internet Protocol Slurp
- Payload - OSX Ascii Prank
- Payload - OSX iMessage Capture
- Payload - OS X Wget and Execute
- Payload - OSX Passwordless SSH access (ssh keys)
- Payload - OSX Bella RAT Installation
- Payload - OSX Sudo for all users without password
- Payload - MrGray's Rubber Hacks
- Payload - Copy File to Desktop
- Payload - Youtube Roll
- Payload - Disable AVG 2012
- Payload - Disable AVG 2013
- Payload - EICAR AV test

CTF: Attack a Raspberry Pi

30 Min.

Example Actions

- Steal a file
- Delete a file
- Write a file with a message in it
- Steal a hash
- Corrupt a hash
- Kill the computer
- Plant a keylogger
- Rickroll
- Join rogue Wi-Fi network
- Team ASCII banner
- Grabify link tracker
- Cron task
- Netcat backdoor
- Change background
- Auto-restart computer
- Auto-quit programs

Pseudocode: Inject Payload Into Raspberry Pi

What are the steps we need to write code for?

Delay for the keyboard to be recognized
Open the run menu by pressing ALT and F2 at the same time
Wait for it to open
Type “lxterminal” to search for the Terminal application
A brief delay to finish typing
Press enter
Wait about 5 seconds for the window to open
Write whatever string we want
Wait to finish typing
Press enter
A short delay before the final line
Pressing Control and D at the same time closes the Terminal window

Final Break - Try some scripts!

Take a break, after this, we'll be trying out our new skills in a team CTF!

CTF: Design the Highest Scoring Payload

In our last section, we'll be working together to write payloads to win a prize!

Our target is a Raspberry Pi computer running Raspbian. Your goal is to work as a team to make a payload that does the most number of bad things.

CTF Challenge: Attack The Raspberry Pi

For our final challenge, we'll be dividing into teams and working on HID attack scripts to achieve a number of specific goals.

Each team will get time to write their script, and then 90 seconds to plug in and run their script.

The team to earn the most number of points wins a prize! Points are awarded when a team achieves the actions below:

Points	File Operations	Flags	Destruction	Advanced (x 2 points)
10	Create a text file with a message	Display a message demanding bitcoins	Reboot or shut down the computer	Create a Cron Task
20	Delete a file	Change the Wallpaper	Kill the network connection	Download & execute a bash or Python file
30	Download a file to the desktop	Get a Grabify link hit from the target computer	Kill the computer (No boot)	Steal data via Grabify
40	Create a fork bomb	RickRoll in a browser window	Create startup task that shuts down computer	Join an (evil) Wi-Fi network
50	Steal a file off the computer	Change RPI's SSH MOTD Banner to your team name	Encrypt files or the file system (ransomware)	Netcat backdoor (remote access)