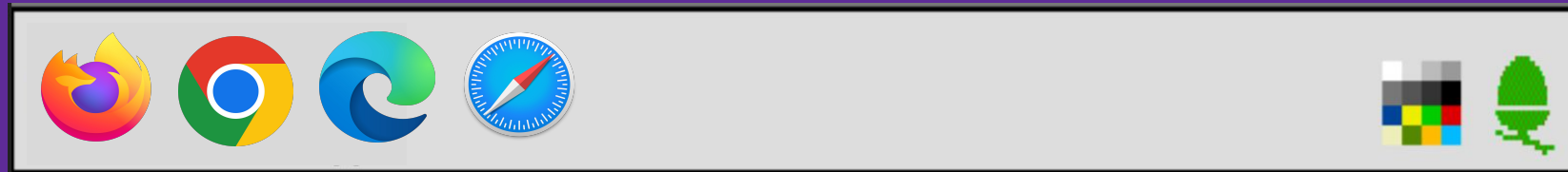


# Archimedes Live!

Bringing the Archimedes to your web browser



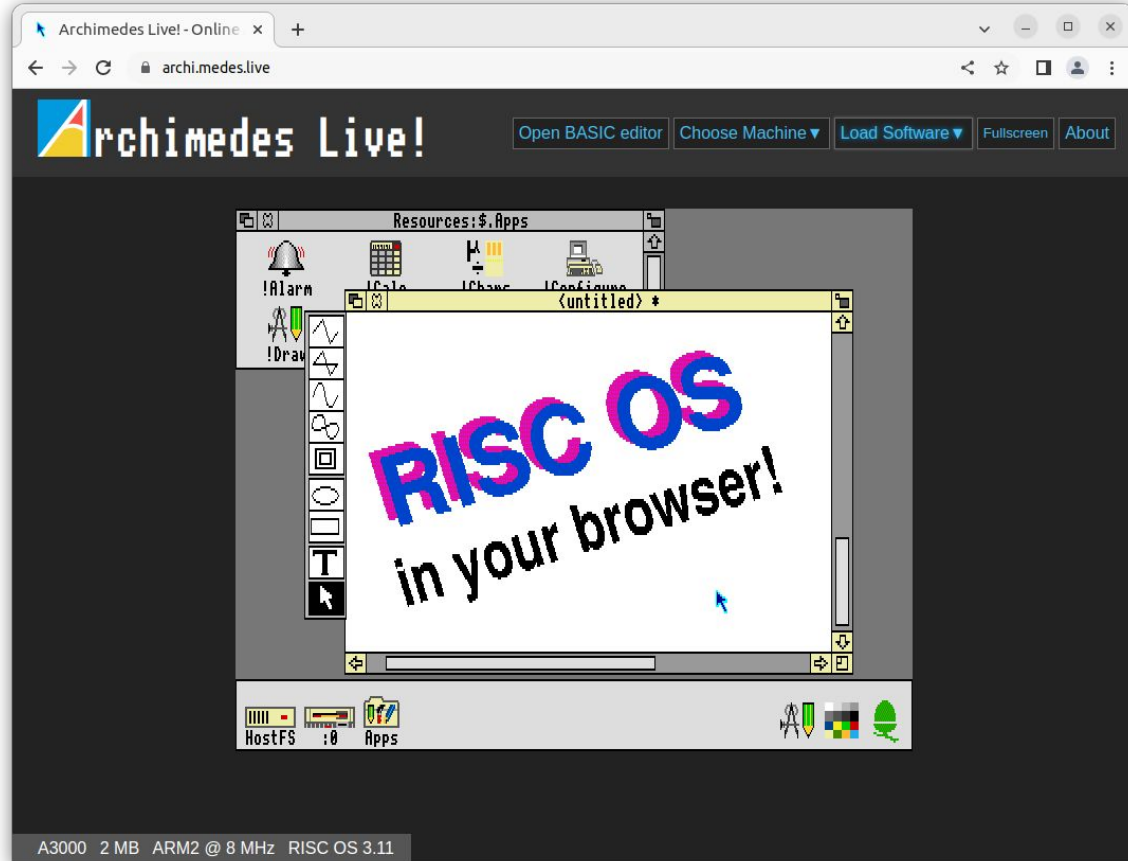
# About Me - Paul Stone

- Grew up with the BBC Micro
- Got an A5000 in 1992
- Learned BBC BASIC, a few SWIs
- Day job - Cybersecurity, vulnerability research
- Not an expert in RISC OS / Archimedes internals or emulation!



# What is it?

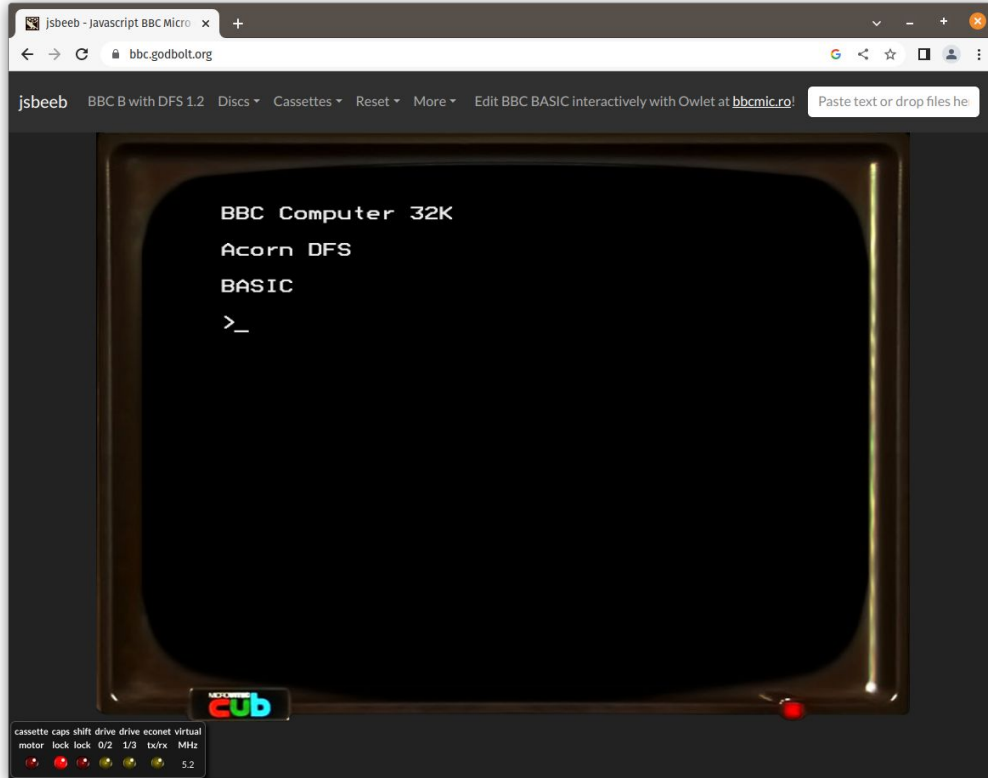
- A port of Sarah Walker's Arculator emulator to WebAssembly (WASM)
- An HTML / CSS / Javascript front-end to replace the Arculator GUI
- A small but growing catalogue of Archimedes software / games ready to play
- The least worst domain I could find: <https://archi.medes.live>
- Still in development!



**But Why?**



# Inspiration - jsbeeb

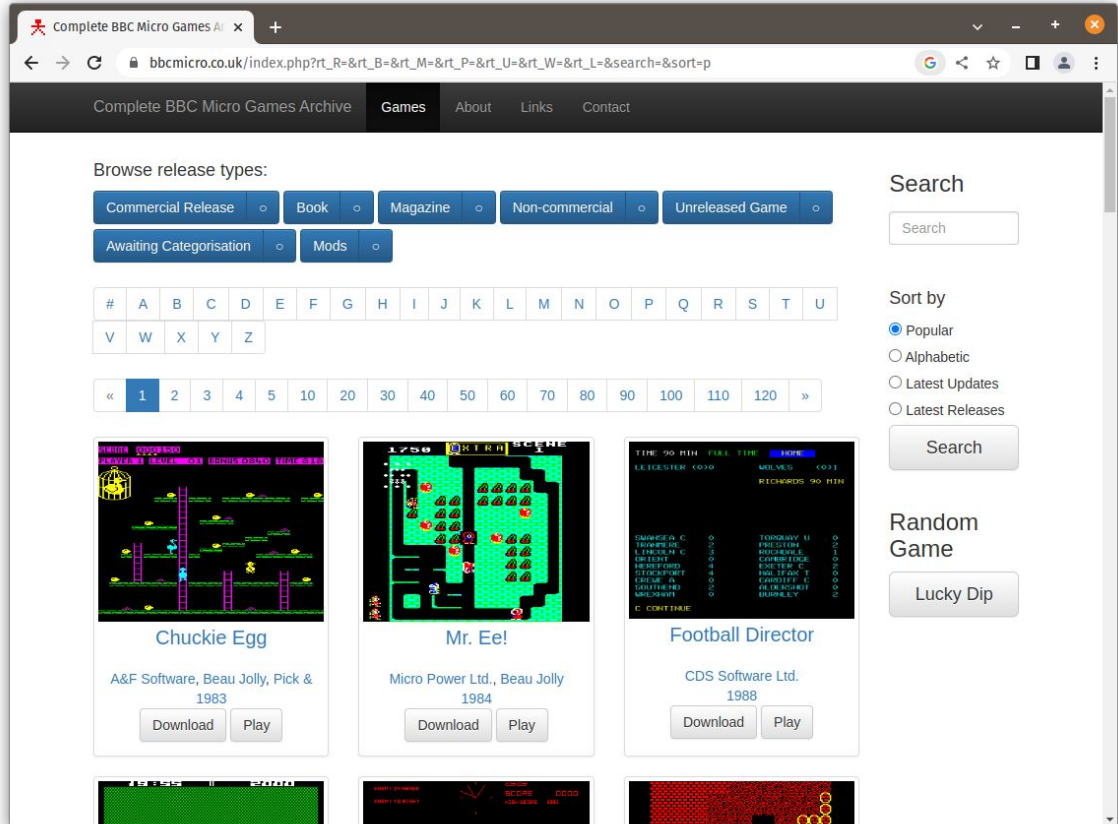


- Matt Godbolt's Javascript BBC Micro emulator
- Started in 2014
- Loads discs from STH archive or from local machine
- Can link straight to games e.g.:


<https://bbc.godbolt.org/?disc=|Superior/Exile.zip&autoboot>

# Inspiration - BBC Micro Games Archive

- Searchable / browsable catalogue of Beeb games
- Button to instantly launch games in JSBeeb




# Inspiration - BBC Micro Bot / Owlet Editor


 **bazzargh** @bazzargh@hachyderm.io Mar 25

bubbles [SHOW LESS](#)


#bbcmicrobot MODE2:VDU5  
REPEAT:X%=RND(1280):Y%=0:R%=8:REPEAT:I%=I%+1:GCOL0,I%  
MOD15+1::MOVEX%,Y%:PLOT&91,R%,0:X%=(X%+RND(60)-30)MOD1280:Y  
%=Y%+32+RND(16):R%=R%+RND(4):UNTILY%>1024:UNTILI%>500  
REPEATF=(F-INKEY10)MOD16:VDU19,(F+11)MOD15+1,0;0,19,(F+12)MOD15+1,4;  
0;19,(F+13)MOD15+1,6;0;19,(F+14)MOD15+1,7;0:UNTIL0




 **BBC Micro Bot** @bbcmicrobot@mastodon.me.uk

I ran @bazzargh's program and got this.  
Source: [bbcmic.ro/?t=7t7EZ](https://bbcmic.ro/?t=7t7EZ) #bbcbasic

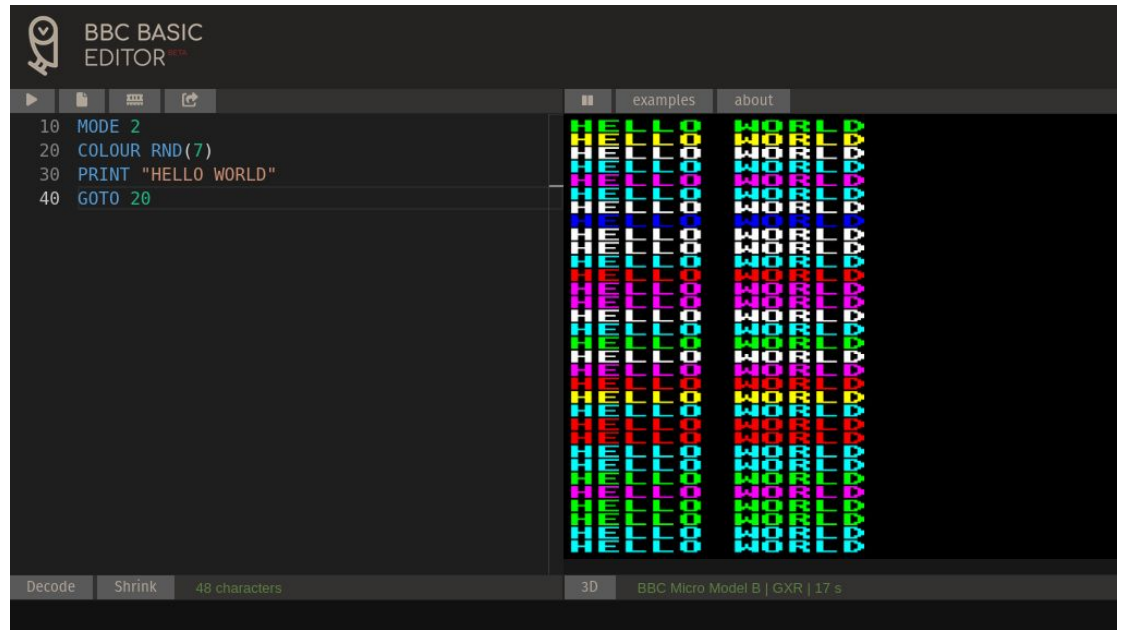


- Dominic Pajak's Mastodon (previously Twitter) bot and BBC BASIC editor
- Create / share / remix code

 **BBC BASIC EDITOR**

▶    examples about


```
10 MODE 2
20 COLOUR RND(7)
30 PRINT "HELLO WORLD"
40 GOTO 20
```



Decode Shrink 48 characters 3D BBC Micro Model B | GXR | 17 s

# Inspiration - ARM2bot


I want an Archimedes version of jsbeeb!

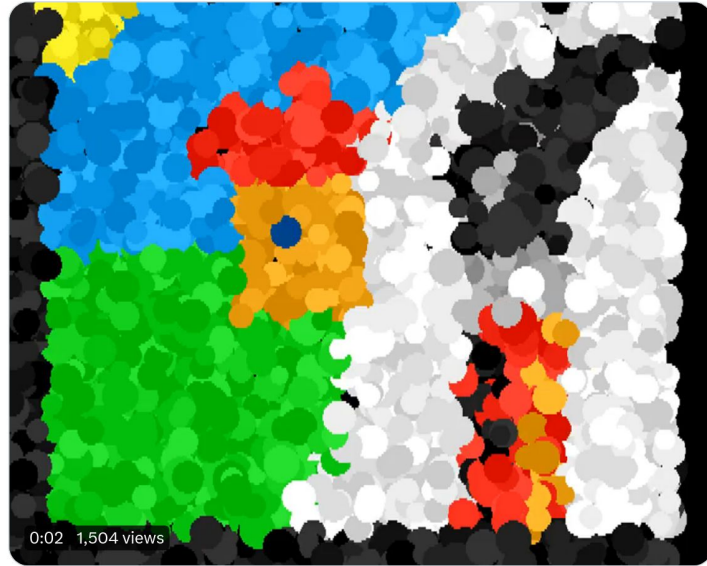
 **Paul Stone** @pdjstone · Oct 10, 2020

@bbcbasicbot  
10 MO.15:OFF  
20 DIMp%16:\$p%="bbMM88##"+"G2/&R,["  
30 U%=&3878d90:S%=U%+&1394  
40 REP.  
50 X%=RND(1216):Y%=RND(1024)  
60 I%=X%DIV38:J%=Y%DIV64  
70 SYS&2E,553,U%,S%,I%,J%TO,,,,c%  
80 GC.p%?c%-35TINTRND(4)<<6  
90 CIR. FI.X%,Y%,RND(16)+16  
100 UN.0

1 4

Acorn Archimedes bot - OFFLINE Retweeted

 **Acorn Archimedes bot - OFFLINE**  
@ARM2bot





# The Web is Awesome!

## Instant

Click a link, run the emulator in seconds

## Accessible

Every computer has a web browser

Not everyone can download / install / configure an emulator

Lower barrier to entry to try out Archimedes / RISC OS

## Shareable

Share games / code with anyone, over social media

**But *How?***



# Porting Arculator to WebAssembly

- Emscripten compiles C / C++ to WASM

gcc → emcc, make → emmake

- Arculator is written in C
- Uses SDL for graphics / sound / input
- SDL has a Emscripten port



***emscripten***

**Emscripten is a complete compiler toolchain to WebAssembly, using LLVM, with a special focus on speed, size, and the Web platform.**

# Porting Arculator: Convert main loop

```
void main() {  
  while (1) {  
    int t1 = read_clock();  
    read_mouse_keyboard();  
  
    // emulate 10 ms of ARM CPU  
    arc_run();  
    draw_frame();  
  
    // ensure emulation runs in "real time"  
    int t2 = read_clock();  
    int time_taken = t2 - t1;  
    sleep(10 - time_taken);  
  }  
}
```

- No infinite loops in Javascript
- Can't "sleep" in Javascript
- Everything is event-driven using callbacks

# Porting Arculator: Convert main loop

```
int last_frame;

void main() {
    emscripten_set_main_loop(arcloop);
}

void arcloop() {
    int t = read_clock();
    read_mouse_keyboard();

    // vary emulated time to keep up with real time
    arc_run(t - last_frame);
    draw_frame();
    last_frame = t;
}
```

- Browsers aim for 60 fps / 16ms per frame
- arcloop is called by browser once per frame
- Gap between frames might be longer if OS / browser is busy
- Modified arc\_run to emulate variable amount of CPU time

# Success!



@pdjstone@mastodon.me.uk @pdjstone · Mar 24, 2022  
I compiled my favourite Archimedes emulator to WebAssembly and now it runs (just about) in a browser. Lots more to do



1 10 42

Working:

Graphics

Sound

Not working/Iffy:

Fullscreen

HostFS

Configuration

Mouse

# Porting Arculator: File system

- Emscripten has “MemFS” - files stored in browser memory
- Create / load files from Javascript
  - Load RISC OS ROMs
  - Load floppy disc image
  - Create emulator / machine config files
- How do we get user files onto HostFS?

```
getMachineConfigFile() {  
  let c = this.configParams;  
  let fpaEnabled = c['fpa_enabled'] ? 1 : 0;  
  let supportRom = c['support_rom'] ? 1 : 0;  
  return `  
machine = ${c['machine']}  
disc_name_0 = ${c['disc']}  
disc_name_1 =  
disc_name_2 =  
disc_name_3 =  
mem_size = ${c['mem_size']}  
cpu_type = ${c['cpu_type']}  
memc_type = ${c['memc_type']}  
fpa = ${fpaEnabled}  
fpu_type = ${c['fpa_type']}  
display_mode = 0  
double_scan = 1  
video_scale = 1  
video_fullscreen_scale = 0  
video_linear_filtering = 0  
fdc_type = ${c['fdc_type']}  
st506_support = 1
```

# Archimedes Live front-end

- Pre-configured Archimedes machines
- Drop-drop load disc images/archive files from local machine
- Automatically unpack ZIP/Spark/ArcFS archives onto HostFS
- Software / game library
- Create / run / share BBC BASIC snippets
- “Fast-forward” emulation to load games instantly
- Save screenshots



# Links! - <https://archi.medes.live#...>

- Launch a game - e.g. [#disc=lander&autoboot](#)
- Load 3rd party software -  
[#disc=https://bitshifters.github.io/content/bs-django02.zip](#)
- Boot preset machine - e.g. [#preset=a310-arthur](#) or [#preset=a5000](#)
- BASIC - e.g. [#basic=10%20MODE15...](#)
- Fast-forward (milliseconds) - e.g. [#preset=a3020&ff=14000](#)

**Is it fast?**



# Performance Goals

## Download size

Quick first load

Stay within the AWS Free tier

Cache as much as possible

## Speed / Frame rate

Run smoothly

No stuttering

Support slower/older PCs

## Latency

Make it “feel” snappy

No mouse/keyboard lag

Minimise time from input to output

# Performance - Download Size

Developer Tools — Archimedes Live! - Online Acorn Archimedes emulator — https://archi.medes.live/

Console Style Editor Inspector Debugger Memory Network Performance Storage

Filter URLs | Disable Cache | No Throttling

All HTML CSS JS XHR Fonts Images Media WS Other

Sta...	Me...	Domain	File	Initiator	Type	Transferred	Size	
200	GET	archi.medes.live	arculator.js?434e284-clean	script	js	24 kB	390.43 kB	0 ms
200	GET	archi.medes.live	System.Fixed.woff2	font	woff2	5.18 kB	4.08 kB	19 ms
200	GET	archi.medes.live	logo.svg	img	svg	1.90 kB	1.79 kB	17 ms
200	GET	archi.medes.live	nspark-helper.js?ca81491-clean	script	js	2.23 kB	3.26 kB	19 ms
200	GET	archi.medes.live	arculator.data?434e284-clean	arculator.data.j...	wasm	182.05 kB	213.86 kB	74 ms
200	GET	archi.medes.live	arculator.wasm?434e284-clean	arculator.js:996 ...	wasm	288.35 kB	1.05 MB	120 ms
200	GET	archi.medes.live	arlive.png	FaviconLoader.j...	png	5.41 kB	4.32 kB	17 ms
200	GET	files-archi.medes....	ros311	fsutil.js:48 (fetch)	wasm	1.16 MB	2.10 MB	197 ms
200	GET	files-archi.medes	arcrom_ext	fsutil.js:48 (fetch)	wasm	17.03 kB	65.54 kB	49 ms

22 requests | 4.54 MB / 1.96 MB transferred | Finish: 1.01 s | DOMContentLoaded: 272 ms | load: 385 ms

# Performance - Download Size

Developer Tools — Archimedes Live! - Online Acorn Archimedes emulator — https://archi.medes.live/

Console Style Editor Inspector Debugger Memory Network Performance Storage

Filter URLs | Disable Cache | No Throttling

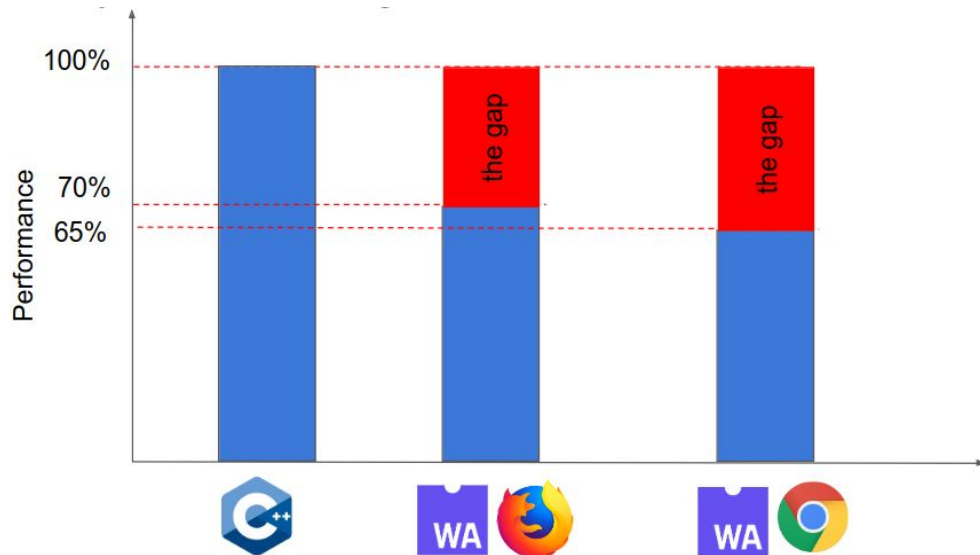
All HTML CSS JS XHR Fonts Images Media WS Other

Sta...	Me...	Domain	File	Initiator	Type	Transferred	Size		
200	GET	archi.medes.live	arculator.js:434e204-clean	script	js	74 kB	370.43 kB		
<b>22 requests   4.54 MB / 1.96 MB transferred   Finish: 1.01 s   DOMContentLoaded: 272 ms   load: 385 ms</b>									
200	GET	archi.medes.live	nspark-helper.js?ca81491-clean	script	js	2.23 kB	3.26 kB		19 ms
200	GET	archi.medes.live	arculator.data?434e284-clean	arculator.data?...	wasm	182.05 kB	213.86 kB		74 ms
200	GET	archi.medes.live	arculator.wasm?434e284-clean	arculator.js:996 ...	wasm	288.35 kB	1.05 MB		120 ms
200	GET	archi.medes.live	arclive.png	FaviconLoader.j...	png	5.41 kB	4.32 kB		17 ms
200	GET	files-archi.medes...	ros311	fsutil.js:48 (fetch)	wasm	1.16 MB	2.10 MB		197 ms
200	GET	files-archi.medes...	arcrom_ext	fsutil.js:48 (fetch)	wasm	17.03 kB	65.54 kB		49 ms
<b>22 requests   4.54 MB / 1.96 MB transferred   Finish: 1.01 s   DOMContentLoaded: 272 ms   load: 385 ms</b>									

# Performance - Speed

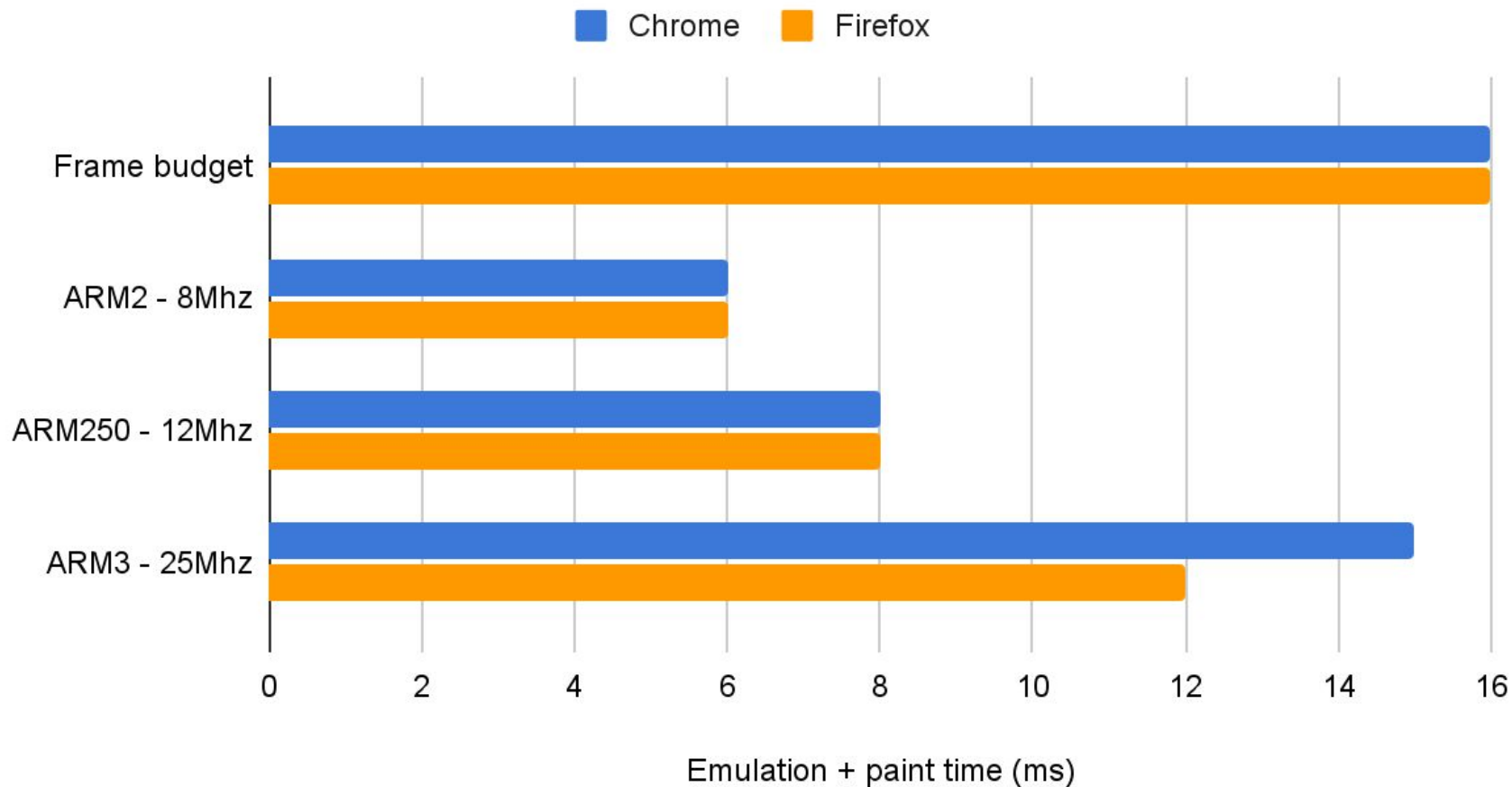
“...we find a substantial performance gap: applications compiled to WebAssembly run slower by an average of 45% (Firefox) to 55% (Chrome)”

*Not So Fast: Analyzing the Performance of WebAssembly vs. Native Code (USENIX 2019)*



<https://www.usenix.org/conference/atc19/presentation/jangda>

# Windows, AMD Ryzen 7 4700U, 2Ghz (2020)



# Performance - Latency

Improve latency by one frame (16ms)

```
void arc_run()  
{  
    LOG_EVENT_LOOP("arc_run()\n");  
-   execarm((speed_mhz * 1000000) / 100);  
    joystick_poll_host();  
    mouse_poll_host();  
    keyboard_poll_host();  
    if (mousehack) doosmouse();  
  
    frameco++;  
    ddnoise_frames++;  
}
```

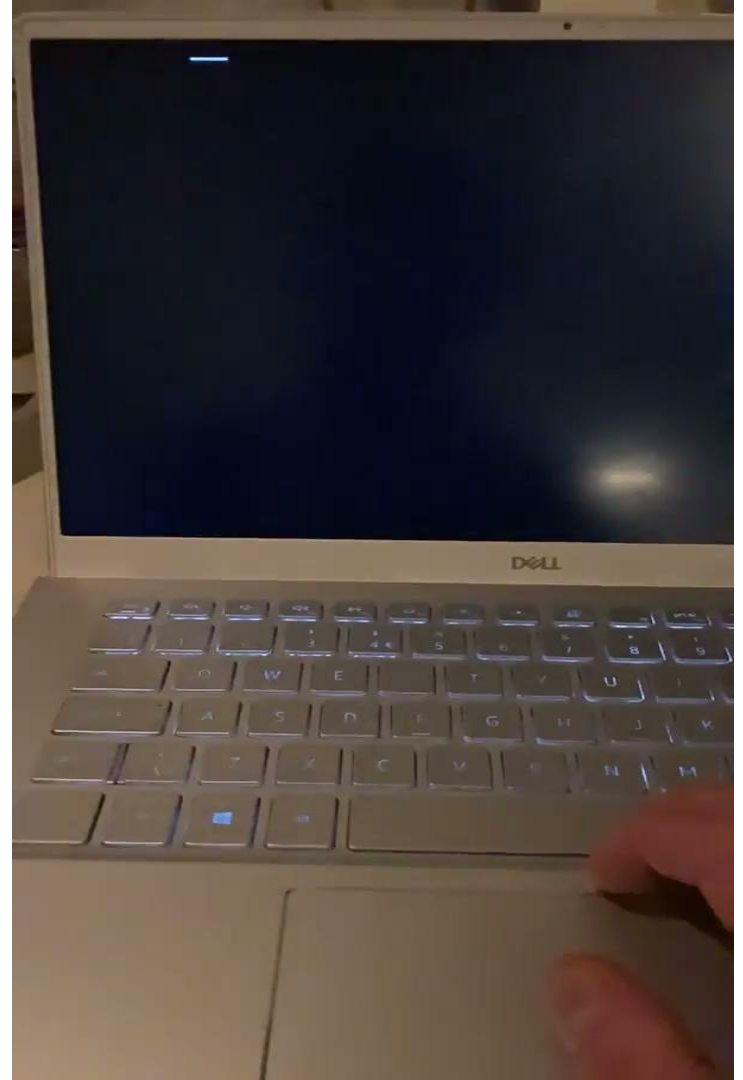
```
328 void arc_run()  
329 {  
330     LOG_EVENT_LOOP("arc_run()\n");  
  
331     joystick_poll_host();  
332     mouse_poll_host();  
333     keyboard_poll_host();  
334     if (mousehack) doosmouse();  
335 +   execarm((speed_mhz * 1000000) / 100);  
336     frameco++;  
337     ddnoise_frames++;  
}
```



# Performance - Is It Snappy?

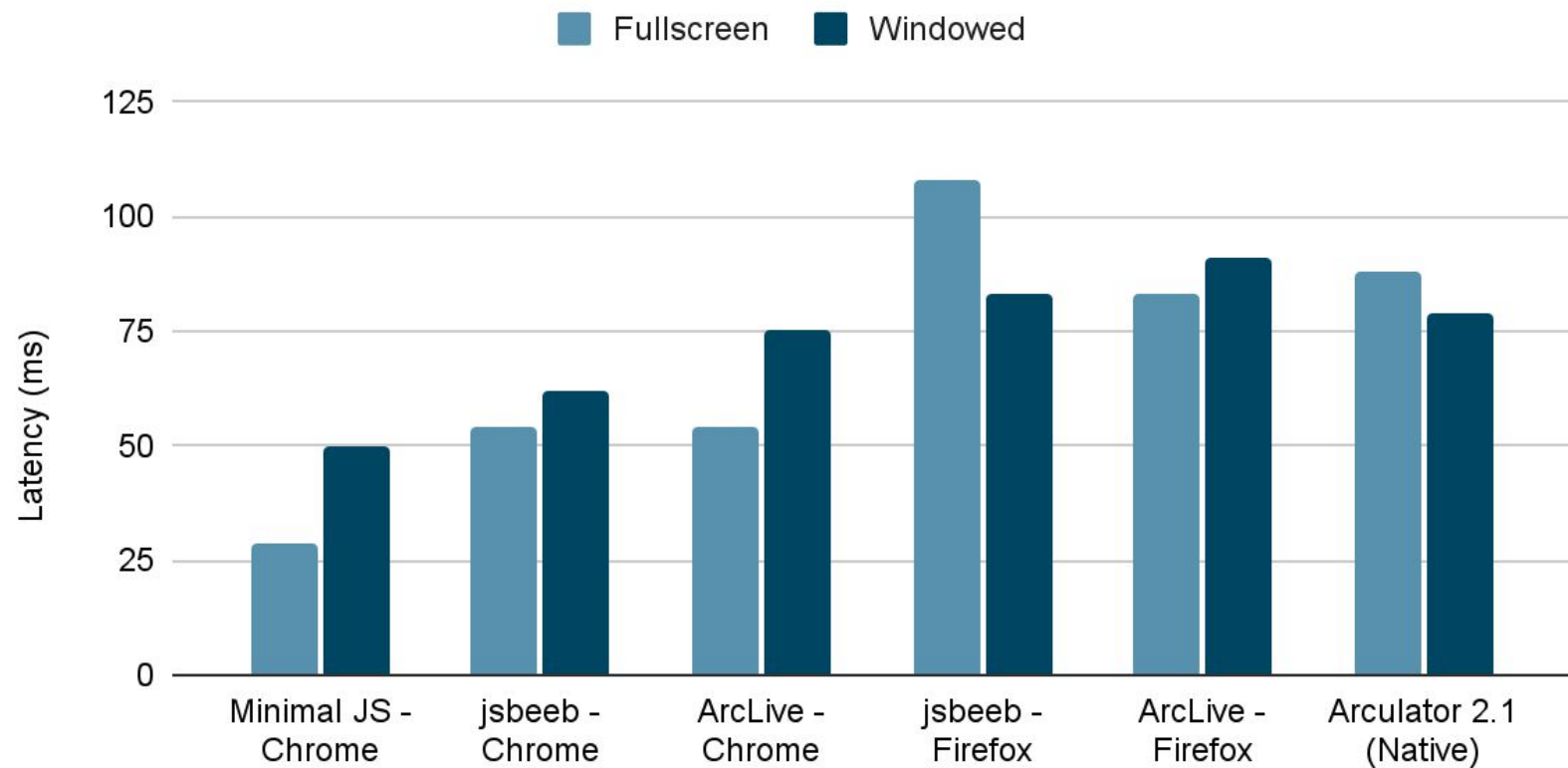
Use iPhone app to record at 240fps (4ms resolution)

Hit key → Screen colour changes



# Keypress Latency - Windows 10

(lower is better)



Next release of Arculator should have better latency!

# Performance - Future Enhancements

- Do audio filtering and output using WebAudio
- Replace SDL input layer
- Use WebGL directly for display instead of SDL
- Run emulation in background thread

# Open Source!

- Keep in-sync with upstream Arculator
- nspark to unpack Spark/ArcFS archives
- ADFSlib Python library (ported to Python 3, used to compile software catalogue)
- Thanks to Matthew Bloch for improving the build system!

<https://github.com/pdjstone/archimedes-live>

<https://github.com/pdjstone/arculator-wasm>

<https://github.com/pdjstone/arclive-software>

<https://github.com/pdjstone/nspace-wasm>

Please file issues if you have problems!



# Software Catalogue

```
[swiv]
title="S.W.I.V."
tags="game,ex-commercial"
year=1992
publisher="Krysalis Software"
description="Fast-paced vertical 2D shooter"
disc="http://acorn.revivalteam.de/Download/Images/SWIV.zip"
```

```
[mr-doo]
title="Mr. Doo"
tags="game,ex-commercial"
year=1992
publisher="Image Systems"
archive="mr-doo.zip"
app-path="!MrDoo"
ff-ms=17000
```

# Software Catalogue

## Load Software

Category: All ▼

Search

- RISC OS 2  
Application Disc 2
- RISC OS 3  
Application disc 1  
(1992)
- S.W.I.V. (1992)
- Signals (2022)
- Spheres of Chaos  
(1993)**
- Tipsy Cube (2022)
- Twinworld (1991)

### Spheres of Chaos

Author: Iain McLeod  
Year: 1993

Fast-moving psychedelic take the classic asteroids formula

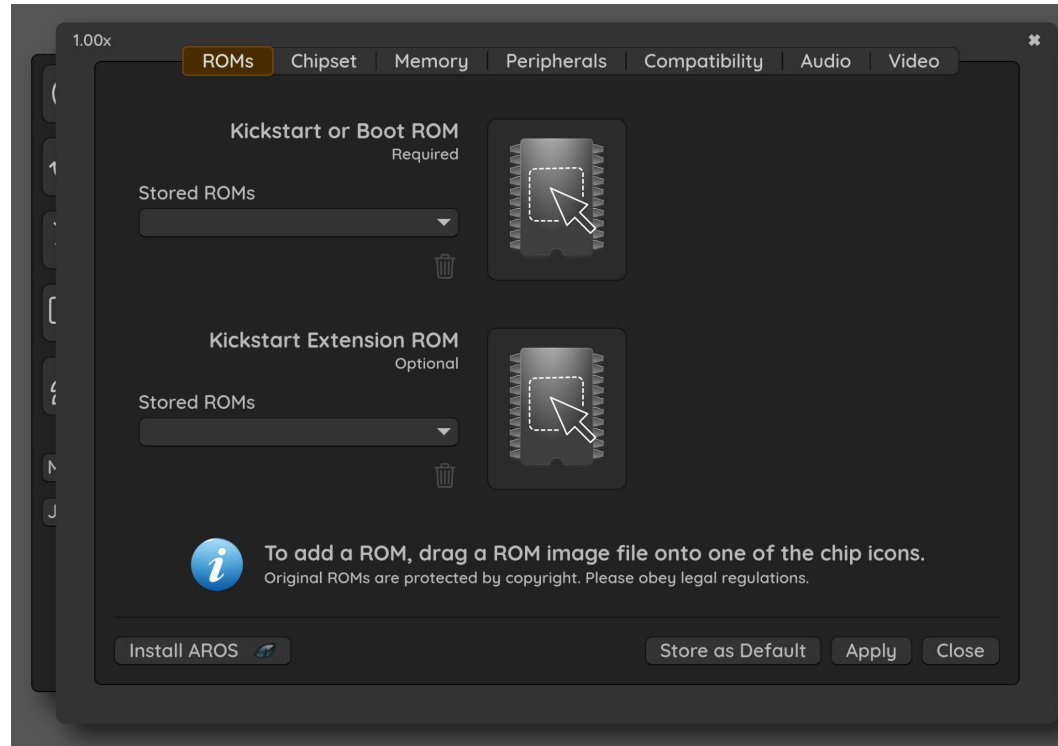
[▶ Launch](#)

Auto-boot

Upload a disc image or RISC OS archive:  No file selected.

You can also drag a disc image or archive file onto the emulator to load it.

# The Competition - vAmiga



<https://www.neoartcr.com/vamiga/index.htm>

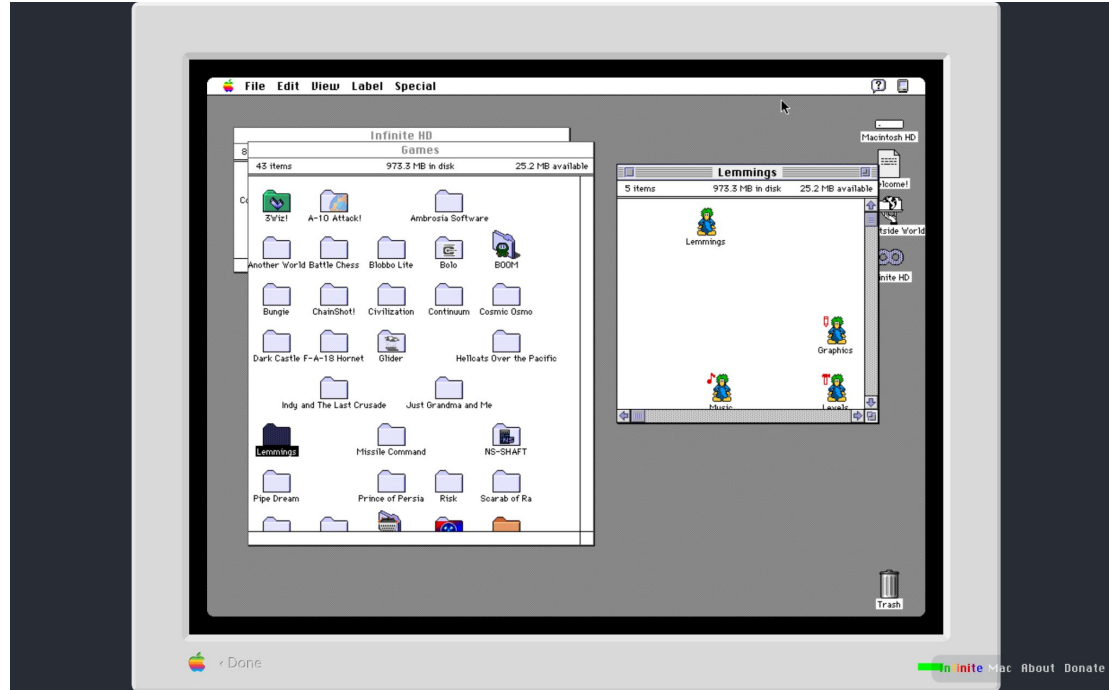
# The Competition - OSZX Amiga Emulator



<https://amiga.oszx.co/>



# The Competition - Infinite Mac



<https://initemac.org/1991/System 7.1>

**Demo Time!**

