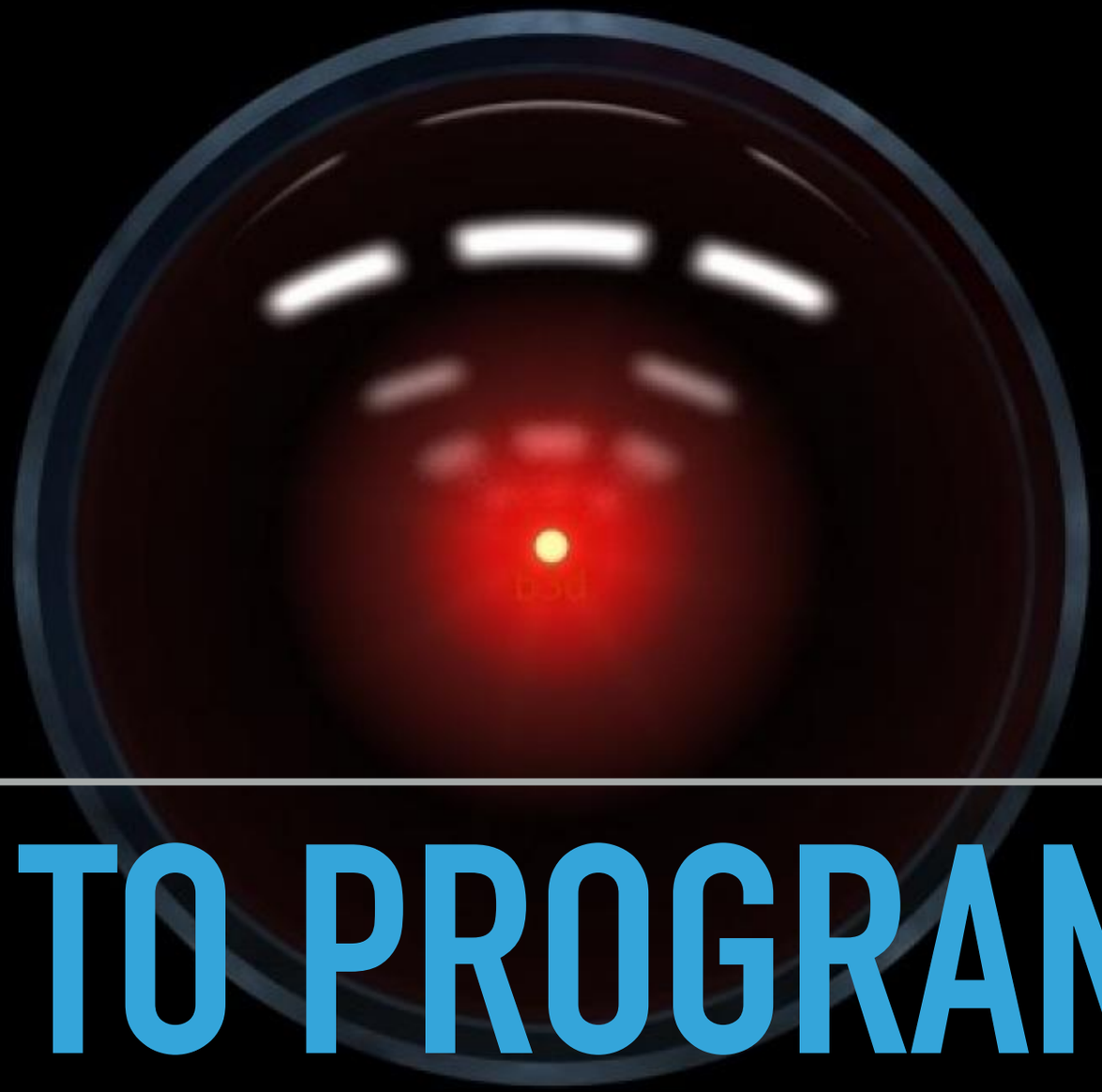
HTTP://WWW.SIMONWELLS.ORG

HTTP://ARG.NAPIER.AC.UK



DR SIMON WELLS

INTRO TO PROGRAMMING

WHY ARE WE HERE?

This is not meant to be an existential question

WHAT IS PROGRAMMING?

- Telling a computer what to do [solving problems]
  - Identifying parts of the solution [data]
  - Working out how to handle each part [algorithms]

- (*increasingly:*) Giving the machine the ability to find/learn the solution [AI]

- Telling others about your solution [communication/persuasion/teamwork]
  - Writing (Sorry [not sorry] ;)
  - Also: precision, accuracy, attention to detail

WHAT IS PROGRAMMING?

IF YOU CAN BAKE A CAKE/PREPARE A POT NOODLE/PUT UP A PICTURE/WIRE A PLUG/ FIX A PUNCTURE/LIGHT A FIRE – THEN YOU CAN PROBABLY WRITE A PROGRAM...

HOW DO I BECOME A (GREAT) PROGRAMMER?

- The programming genius
  - Just knows how to do it
  - Doesn’t exist, probably
  - Hollywood has a lot to answer for :(
- Can read/follow a book/article/tutorial & I’ll get it
  - Only part of the answer

HOW DO I BECOME A PROGRAMMER?

MYTHS

- Hard work & Effort
  - (but this can also be a lot of fun)
- Deliberate Practice (over time):

  Thinking -> Doing -> Reflecting

- There is no magic.

HOW DO I BECOME A (GREAT) PROGRAMMER?

THE TRUTH?

PROGRAMMING IS A LIFESTYLE CHOICE

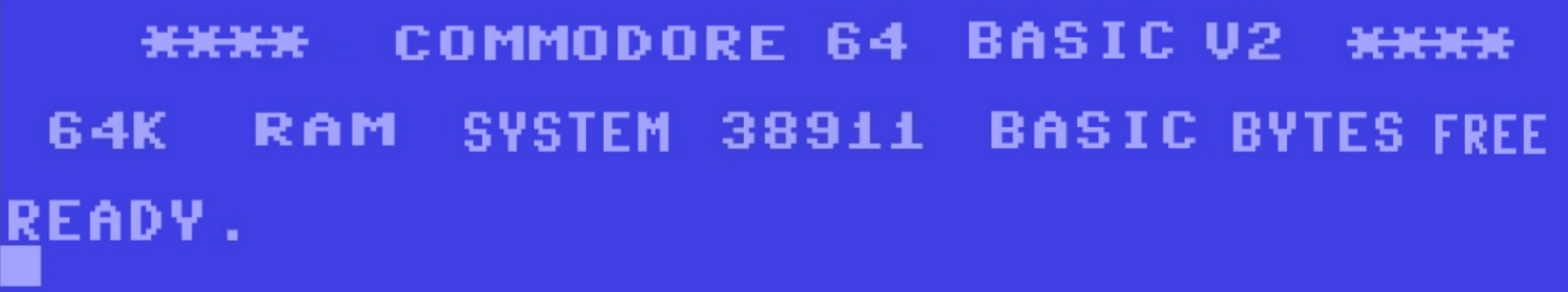
Write lots of programmes

BIO

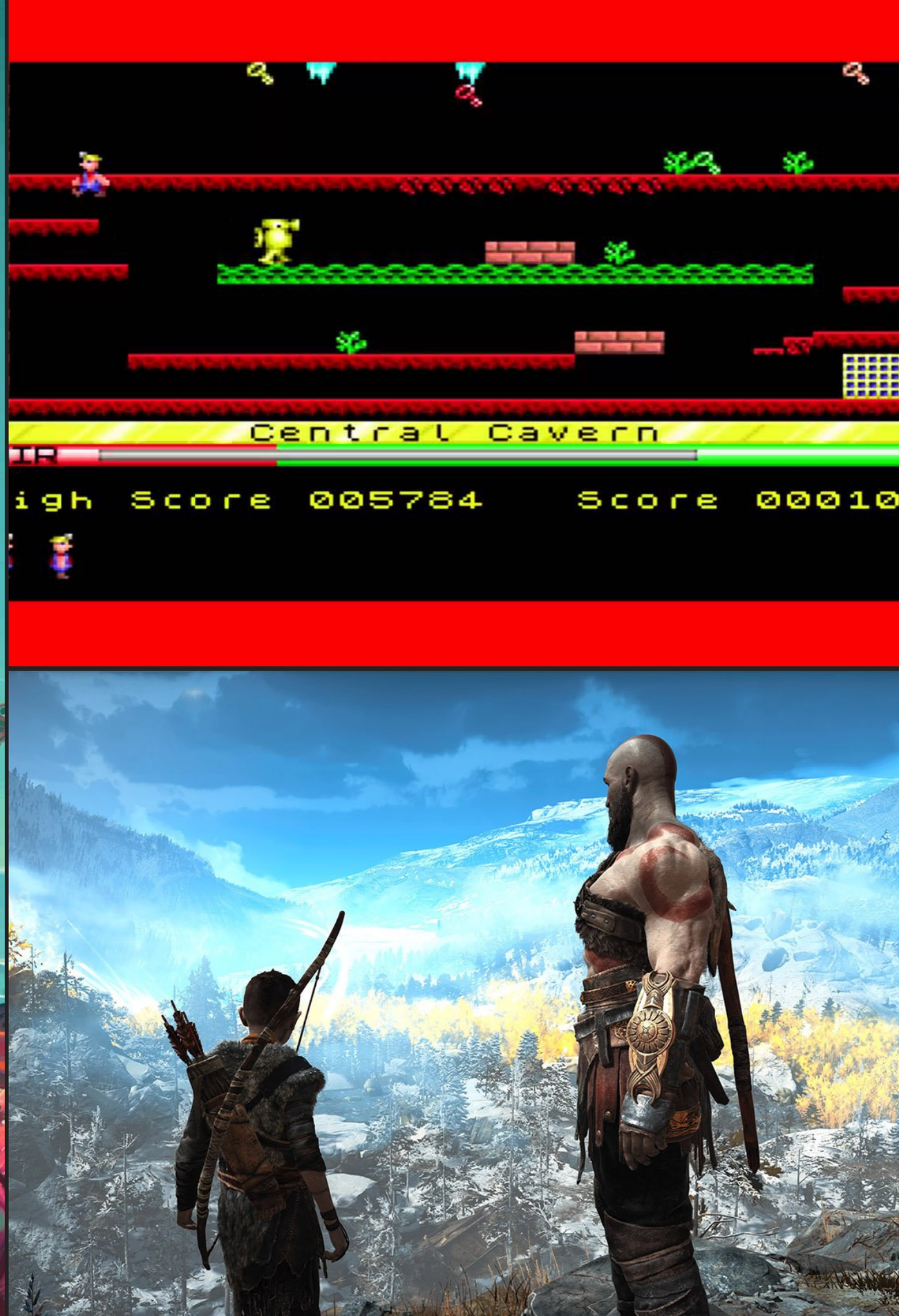
- First Computer (age 7)
- Wrote some programmes (often from magazines & books)
- No real programming experience until university
- Nobody else in immediate family with a degree
- Nobody else with a higher degree at all (yet)
- Interested in ***everything...***

IN SOME WAYS MY EXPERIENCE WAS EASIER

- Immediacy
- Lower expectations
- Work with less

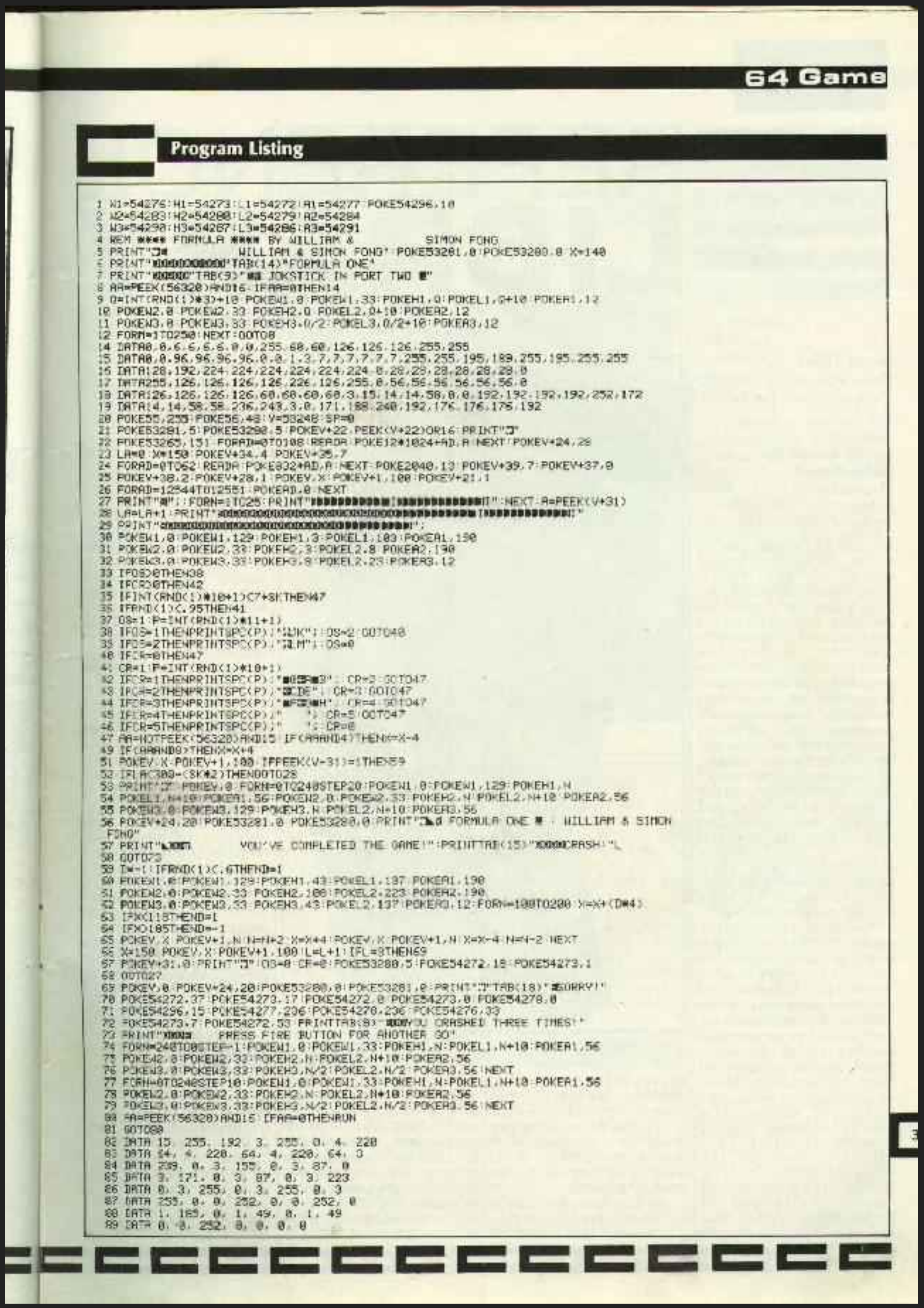


DOING ANYTHING WITH THIS MACHINE INVOLVED PROGRAMMING:
WE COULD GET STRAIGHT TO THE PROGRAMMING :D


Central Cavern
igh Score 005784
Score 00010

WORK WITH LESS

- A lot fewer programmers around
- Home computers were untrusted, unreliable, and just not a mainstream consideration (for kids, for games, for the future)
- No smart phones
- No Internet/Web (we did have bulletin boards & modems though & Magazines)



64 Game

Program Listing

```
1 W1=54276:H1=54273:L1=54272:A1=54277:POKE54296,10
2 W2=54283:H2=54280:L2=54279:A2=54284
3 W3=54290:H3=54287:L3=54286:A3=54291
4 REM **** FORMULA **** BY WILLIAM &          SIMON FONG
5 PRINT"]*         WILLIAM & SIMON FONG":POKE53281,0:POKE53280,0:X=140
6 PRINT"XXXXXXXXXX"TAB(14)"FORMULA ONE"
7 PRINT"XXXXX"TAB(9)"** JOKSTICK IN PORT TWO *"
8 AA=PEEK(56320)AND16:IFAA=0THEN14
9 Q=INT(RND(1)*3)+10:POKEW1,0:POKEW1,33:POKEH1,Q:POKEL1,Q+10:POKEA1,12
10 POKEW2,0:POKEW2,33:POKEH2,Q:POKEL2,Q+10:POKEA2,12
11 POKEW3,0:POKEW3,33:POKEH3,Q/2:POKEL3,Q/2+10:POKEA3,12
12 FORM=1TO250:NEXT:GOTO8
14 DATA0,0,6,6,6,6,0,0,255,60,60,126,126,126,255,255
15 DATA0,0,96,96,96,96,0,0,1,3,7,7,7,7,7,7,255,255,195,189,255,195,255,255
16 DATA128,192,224,224,224,224,224,224,0,28,28,28,28,28,28,0
17 DATA255,126,126,126,126,226,126,255,0,56,56,56,56,56,56,0
18 DATA126,126,126,126,60,60,60,60,3,15,14,14,58,0,0,192,192,192,192,252,172
19 DATA14,14,58,58,236,243,3,0,171,188,240,192,176,176,176,192
20 POKE55,255:POKE56,48:V=53248:SP=0
21 POKE53281,5:POKE53280,5:POKEV+22,PEEK(V+22)OR16:PRINT"]"
22 POKE53265,151:FORAD=0TO108:READA:POKE12*1024+AD,A:NEXT:POKEV+24,28
23 LA=0:X=150:POKEV+34,4:POKEV+35,7
24 FORAD=0TO62:READA:POKE832+AD,A:NEXT:POKE2040,13:POKEV+39,7:POKEV+37,0
25 POKEV+38,2:POKEV+28,1:POKEV,X:POKEV+1,100:POKEV+21,1
26 FORAD=12544TO12551:POKEAD,0:NEXT
27 PRINT"*";:FORN=1TO25:PRINT"**********[************I":NEXT:A=PEEK(V+31)
28 LA=LA+1:PRINT"******************************[***********!"
29 PRINT"*******************************!";
30 POKEW1,0:POKEW1,129:POKEH1,3:POKEL1,103:POKEA1,150
31 POKEW2,0:POKEW2,33:POKEH2,3:POKEL2,8:POKEA2,190
32 POKEW3,0:POKEW3,33:POKEH3,8:POKEL2,23:POKEA3,12
33 IFOS>0THEN38
34 IFCR>0THEN42
35 IFINT(RND(1)*10+1)<7+SKTHEN47
36 IFRND(1)<.95THEN41
37 OS=1:P=INT(RND(1)*11+1)
38 IFOS=1THENPRINTSPC(P);"JK";:OS=2:GOTO40
39 IFOS=2THENPRINTSPC(P);"LM";:OS=0
40 IFCR=0THEN47
41 CR=1:P=INT(RND(1)*10+1)
42 IFCR=1THENPRINTSPC(P);"*AB*C";:CR=2:GOTO47
43 IFCR=2THENPRINTSPC(P);"*DE";:CR=3:GOTO47
44 IFCR=3THENPRINTSPC(P);"*FG*H";:CR=4:GOTO47
45 IFCR=4THENPRINTSPC(P);"    ";:CR=5:GOTO47
46 IFCR=5THENPRINTSPC(P);"    ";:CR=0
47 AA=NOTPEEK(56320)AND15:IF(AAAND4)THENX=X-4
49 IF(AAAND8)THENX=X+4
51 POKEV,X:POKEV+1,100:IFPEEK(V+31)=1THEN59
52 IFLA<300-(SK*2)THENGOTO28
53 PRINT"]":POKEV,0:FORN=0TO240STEP20:POKEW1,0:POKEW1,129:POKEH1,N
54 POKEL1,N+10:POKEA1,56:POKEW2,0:POKEW2,33:POKEH2,N:POKEL2,N+10:POKEA2,56
55 POKEW3,0:POKEW3,129:POKEH3,N:POKEL2,N+10:POKEA3,56
56 POKEV+24,20:POKE53281,0:POKE53280,0:PRINT"]*0 FORMULA ONE * : WILLIAM & SIMON
 FONG"
57 PRINT"*XXX       YOU'VE COMPLETED THE GAME!":PRINTTAB(15)"XXXXCRASH!"L
58 GOTO73
59 D=-1:IFRND(1)<.6THEND=1
60 POKEW1,0:POKEW1,129:POKEH1,43:POKEL1,137:POKEA1,190
61 POKEW2,0:POKEW2,33:POKEH2,100:POKEL2,223:POKEA2,190
62 POKEW3,0:POKEW3,33:POKEH3,43:POKEL2,137:POKEA3,12:FORN=100TO200:X=X+(D*4)
63 IFX<118THEND=1
64 IFX>185THEND=-1
65 POKEV,X:POKEV+1,N:N=N+2:X=X+4:POKEV,X:POKEV+1,N:X=X-4:N=N-2:NEXT
66 X=150:POKEV,X:POKEV+1,100:L=L+1:IFL=3THEN69
67 POKEV+31,0:PRINT"]":OS=0:CR=0:POKE53280,5:POKE54272,18:POKE54273,1
68 GOTO27
69 POKEV,0:POKEV+24,20:POKE53280,0:POKE53281,0:PRINT"]"TAB(18)"*SORRY!"
70 POKE54272,37:POKE54273,17:POKE54272,0:POKE54273,0:POKE54278,0
71 POKE54296,15:POKE54277,236:POKE54278,236:POKE54276,33
72 POKE54273,7:POKE54272,53:PRINTTAB(8)"XXXYOU CRASHED THREE TIMES!"
73 PRINT"XXXX     PRESS FIRE BUTTON FOR ANOTHER GO"
74 FORN=240TO0STEP-1:POKEW1,0:POKEW1,33:POKEH1,N:POKEL1,N+10:POKEA1,56
75 POKEW2,0:POKEW2,33:POKEH2,N:POKEL2,N+10:POKEA2,56
76 POKEW3,0:POKEW3,33:POKEH3,N/2:POKEL2,N/2:POKEA3,56:NEXT
77 FORN=0TO240STEP10:POKEW1,0:POKEW1,33:POKEH1,N:POKEL1,N+10:POKEA1,56
78 POKEW2,0:POKEW2,33:POKEH2,N:POKEL2,N+10:POKEA2,56
79 POKEW3,0:POKEW3,33:POKEH3,N/2:POKEL2,N/2:POKEA3,56:NEXT
80 AA=PEEK(56320)AND15:IFAA=0THENRUN
81 GOTO80
82 DATA 15, 255, 192, 3, 255, 0, 4, 220
83 DATA 64, 4, 220, 64, 4, 220, 64, 3
84 DATA 239, 0, 3, 155, 0, 3, 87, 0
85 DATA 3, 171, 0, 3, 87, 0, 3, 223
86 DATA 0, 3, 255, 0, 3, 255, 0, 3
87 DATA 255, 0, 0, 252, 0, 0, 252, 0
88 DATA 1, 165, 0, 1, 49, 0, 1, 49
89 DATA 0, 0, 252, 0, 0, 0, 0
```

MODERN PROGRAMMING

- Getting into programming nowadays is easy:
  - Books, Web pages, Tutorials
  - Compilers, interpreters, IDEs
  - Nearly always have at least one computer on our person
- However:
  - Most computer experience is now point & click (or swipe)
  - We see lots of really cool stuff but don't know how to get there from here
  - **Bootstrapping is hard**:
    - there's lots of other stuff to do before you can start hacking away
  - Also:
    - **What should I programme?**

- Modern computers aren't really set up to make programming accessible out-of-the-box
- Some hoop jumping: need to install programming language tools (compiler, interpreter, IDE, editor)
  - NB. Some computers already have these installed by default (Mac OS & Linux), e.g. python, ruby
- Not as straightforward as powering up the machine & getting dumped straight into a programming interface

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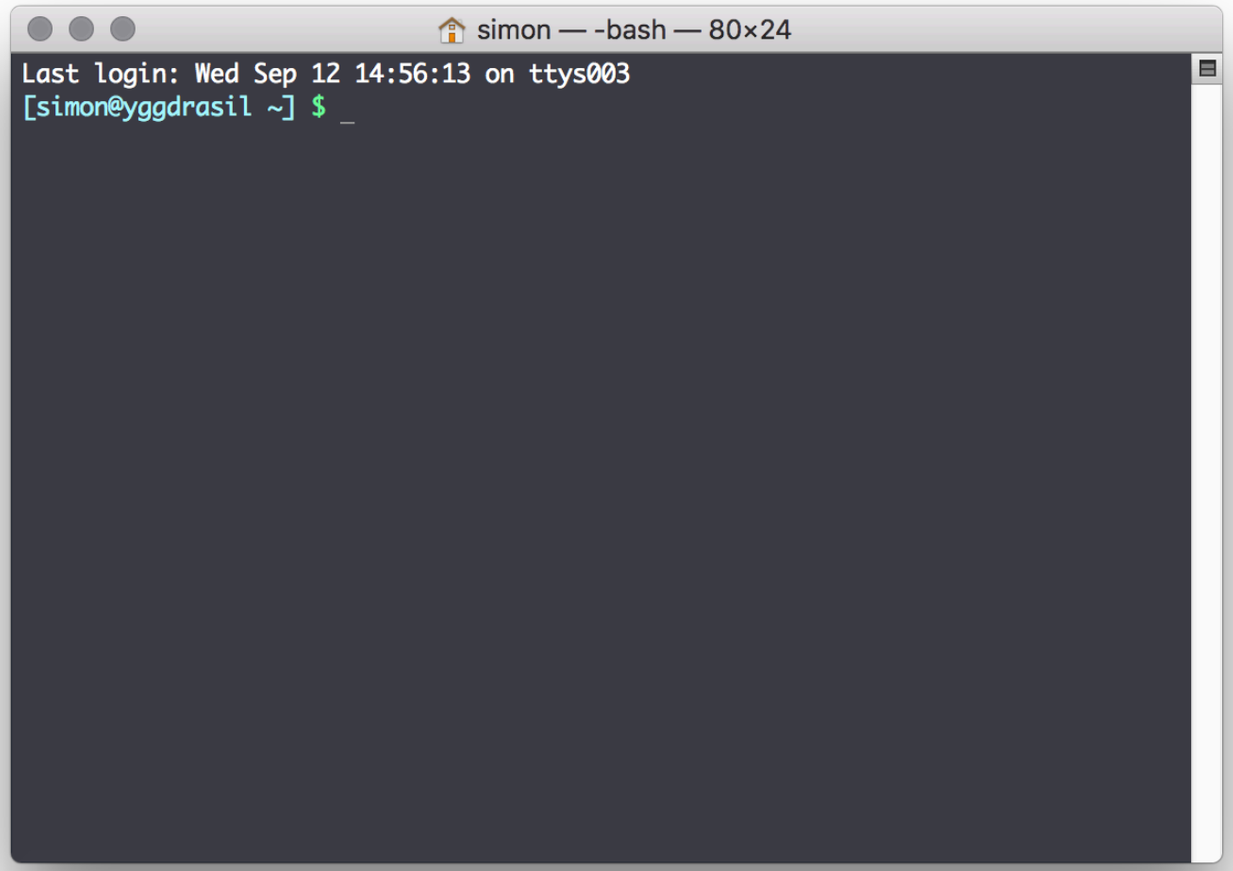
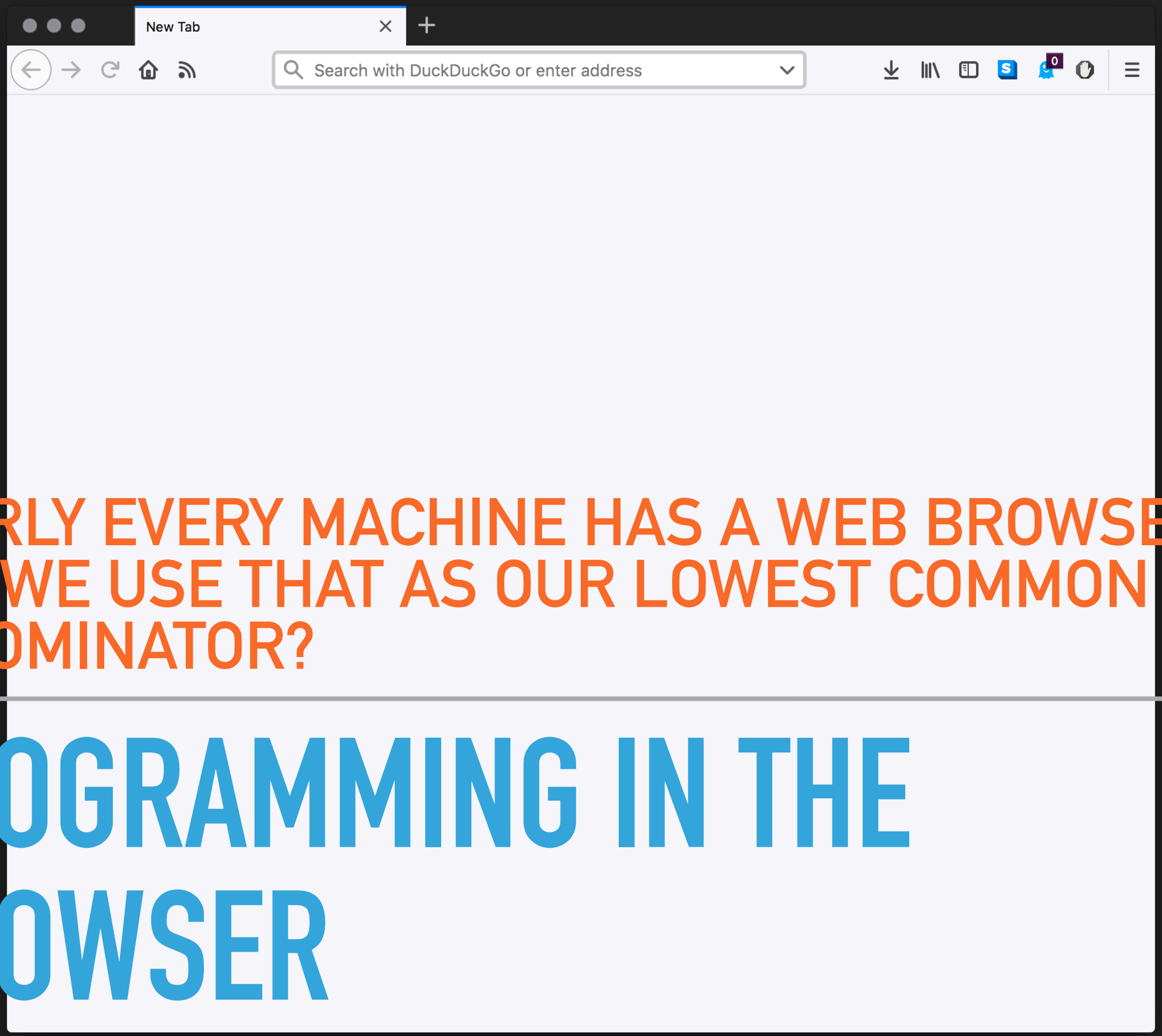
BOOTSTRAPPING IS HARD



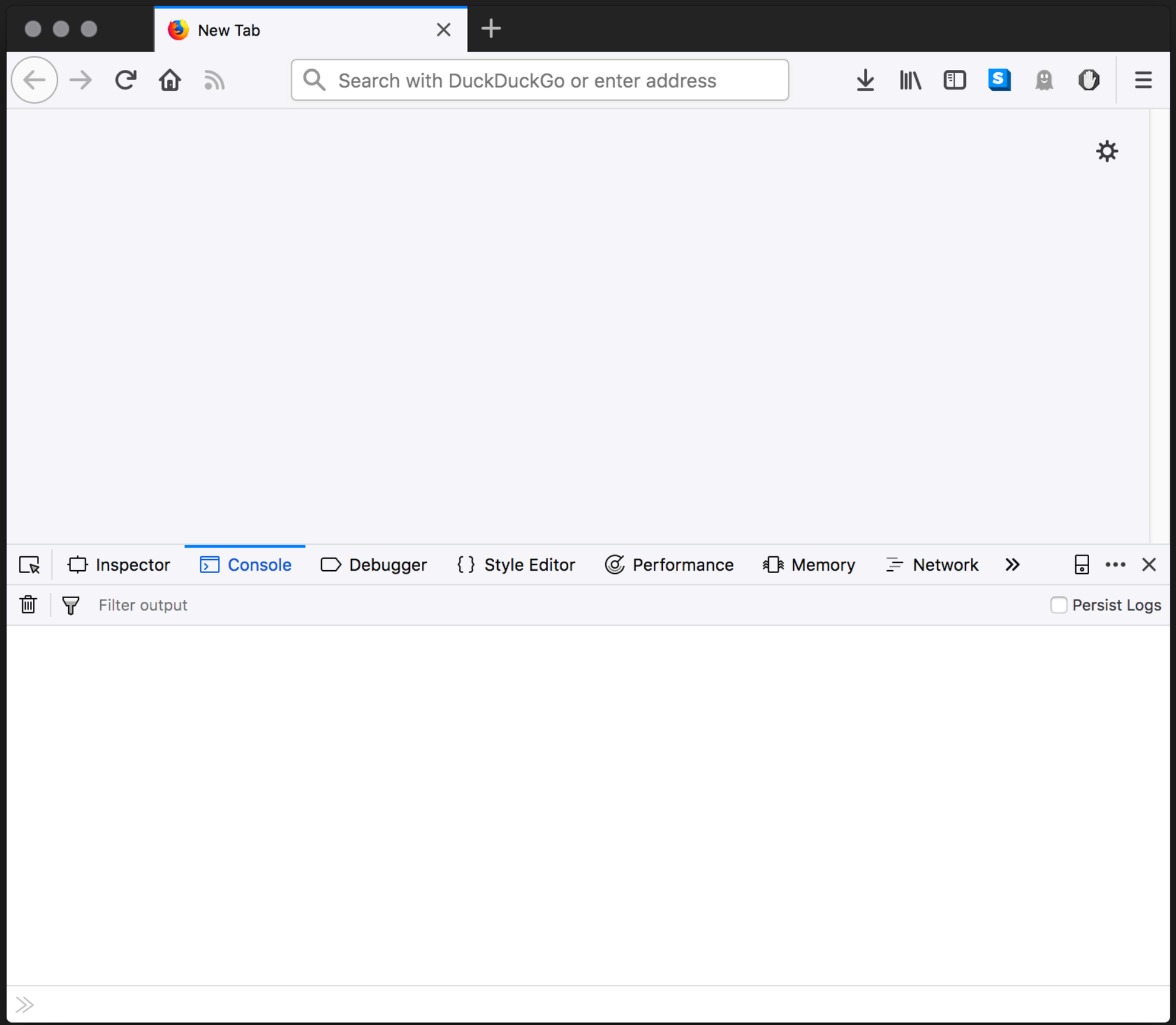
- Programming is a literate practise
  - If you only mouse around the GUI then life as a programmer is slightly more difficult
- CLI gives you the best, most fine-grained control of your computer
- Neal Stephenson “In the beginning was the command line”

TIP: LEARN TO LOVE THE COMMAND LINE :)



NEARLY EVERY MACHINE HAS A WEB BROWSER - CAN WE USE THAT AS OUR LOWEST COMMON DENOMINATOR?

PROGRAMMING IN THE BROWSER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Inspector
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Debugger
Style Editor
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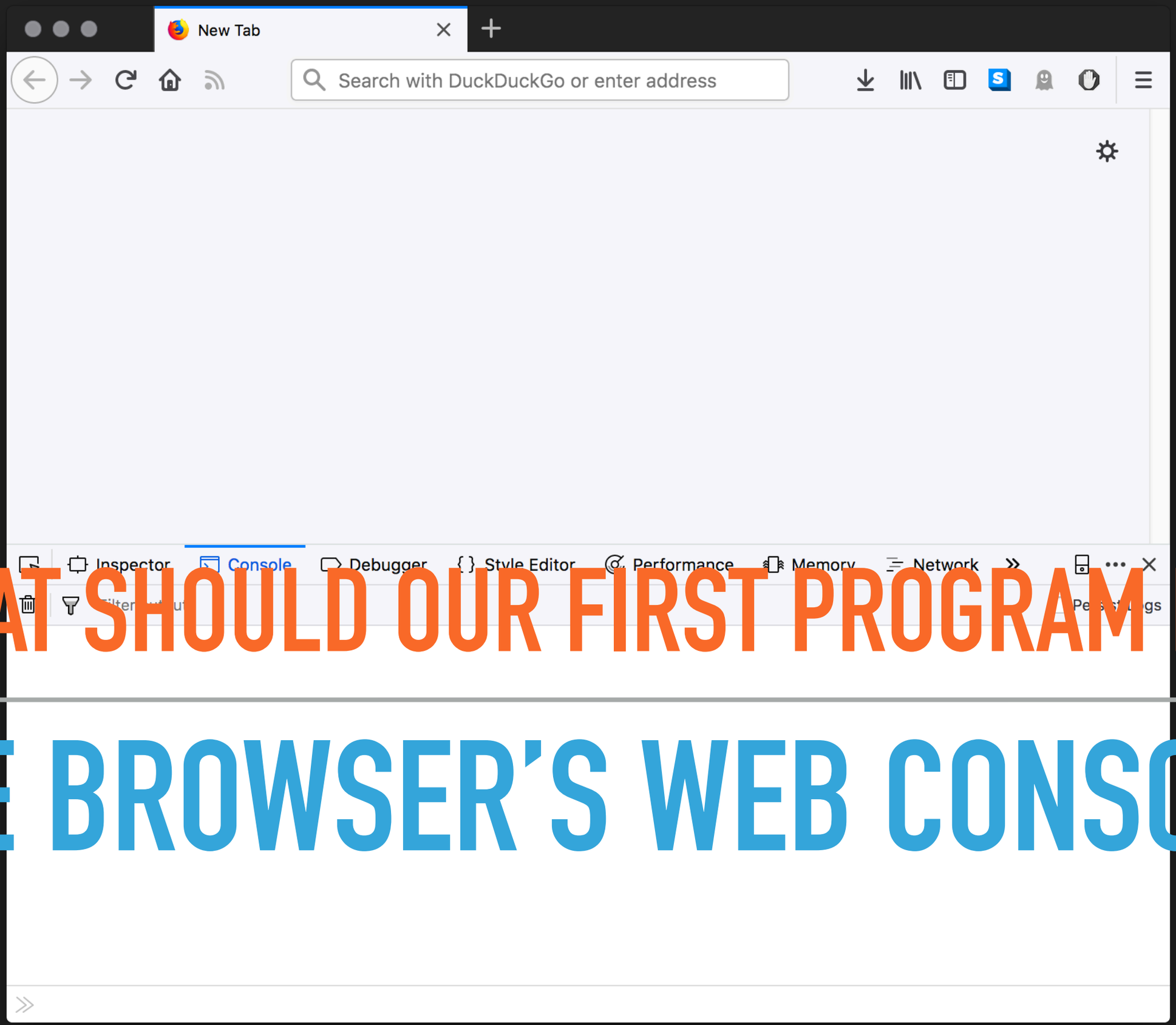
Persist Logs



WHAT SHOULD OUR FIRST PROGRAM BE?

THE BROWSER'S WEB CONSOLE

#1

HELLO NAPIER

New Tab

Search with DuckDuckGo or enter address

Inspector | Console | Debugger | Style Editor | Performance | Memory | Network

Filter output

Persist Logs

```
>> console.log('hello napier!!!')
   hello napier!!!                                   debugger eval code:1:1
<- undefined
```

#2

INTERACT WITH THE WEB PAGE/SCREEN

New Tab

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Inspector | Console | Debugger | Style Editor | Performance | Memory | Network

Filter output

Persist Logs

```
document.body.style.backgroundColor = "lightgreen";
"lightgreen"
```

#3

USE STANDARD JAVASCRIPT FUNCTIONS

New Tab

Search with DuckDuckGo or enter address

Today's date is Thu Sep 13 2018 16:10:26 GMT+0100 (BST)

Inspector | Console | Debugger | Style Editor | Performance | Memory | Network

Filter output

Persist Logs

```
let d = new Date();
undefined
document.body.innerHTML = "<h1>Today's date is " + d + "</h1>"
"<h1>Today's date is Thu Sep 13 2018 16:10:26 GMT+0100 (BST)</h1>"
```

#4

CONSTRUCT A WEB PAGE

New Tab

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Hello Napier!!!

Inspector | Console | Debugger | Style Editor | Performance | Memory | Network

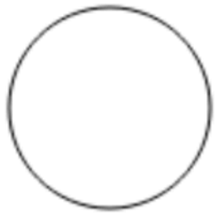
Filter output | Persist Logs

```
let p = document.createElement("P");
let t = document.createTextNode("Hello Napier!!!");
p.appendChild(t);
document.body.replaceWith(p);
```

undefined

#5

GRAPHICS



```
let c = document.createElement("canvas");
var ctx = c.getContext("2d");
ctx.beginPath();
ctx.arc(95,50,40,0,2*Math.PI);
ctx.stroke();
document.body.replaceWith(c);
```

```
undefined
```

#6

SOUND - BEEPS, BOOPS, CHIPTUNES

New Tab

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Inspector | Console | Debugger | Network | Style Editor | Performance | Memory | Storage | Accessibility

Filter Output | Errors | Warnings | Logs | Info | Debug | CSS | XHR | Requests

```
var context = new (window.AudioContext || window.webkit.AudioContext)();
var freq = {
    'a4'    :440.00,
    'a4#'   :466.16,
    'b4'    :493.92,
    'c5'    :523.28,
    'c5#'   :554.40,
    'd5'    :587.36,
    'd5#'   :622.24,
    'e5'    :659.28,
    'f5'    :698.48,
    'f5#'   :740.00,
    'g5'    :784.00,
    'g5#'   :830.64,
    'a5'    :880.0000
}

for (i in D = ['e5',, 'e5',, 'e5',, 'c5',, 'e5',, 'g5',, 'g5']) {
    console.log(i);
    var oscillator = context.createOscillator();
    if (D[i]) {

        onended = function() { console.log('Note has stopped playing'); }

        oscillator.connect(context.destination);
        note = D[i]
        oscillator.frequency.setValueAtTime(freq[note], context.currentTime);
        oscillator.type = 'square';
        oscillator.start(i * .1);
        oscillator.stop(i * .1 + .1);
    }
}
```

#7

SOUND - MUSIC (AFTER A FASHION)

New Tab

Search with DuckDuckGo or enter address

Inspector | Console | Debugger | Network | Style Editor | Performance | Memory | Storage | Accessibility

Filter Output | Errors | Warnings | Logs | Info | Debug | CSS | XHR | Requests

```
var context = new (window.AudioContext || window.webkitAudioContext)();
var oscillator = context.createOscillator();
var volume = context.createGain();
var active = false;

volume.gain.setValueAtTime(0, context.currentTime);

oscillator.connect(volume).connect(context.destination);
oscillator.start(0);

document.addEventListener('mousedown',function(e){on(e)})
document.addEventListener('mousemove',function(e){play(e)})
document.addEventListener('mouseup',function(e){off(e)})

function on(e){
    active = true;
    e.preventDefault()
    oscillator.frequency.setValueAtTime(~~(1000*(1-((e.clientY)/window.innerHeight))), context.currentTime);
    volume.gain.setValueAtTime(~~(e.clientX/window.innerWidth*100)/100, context.currentTime);
}

function play(e){
    e.preventDefault()
    if(active){
        oscillator.frequency.setValueAtTime(~~(1000*(1-((e.clientY)/window.innerHeight))), context.currentTime);
        volume.gain.setValueAtTime(~~(e.clientX/window.innerWidth*100)/100, context.currentTime);
    }
}

function off(e){
    active = false;
    volume.gain.setValueAtTime(0, context.currentTime);
}
```

- Nearly every computer has a browser so we can programme “old school” style almost anywhere at any time
- More likely to run against our own limitations right now than those of the the browser/JS
- Can build simple hackery into our daily programming habits

WHERE ARE WE?

WHAT SHOULD I PROGRAMME?

- Good Question!
- I’ve shown some simple things to get started
- What are you interested in?
- Key is to start small (remember the limitations & lower expectations I mentioned earlier)
- We want to make small increments without biting off more than we can chew.

WHAT SHOULD I PROGRAMME?

- Codes & Ciphers
  - This is actually an assignment in my second year web tech class (so I won't spoil it here)
- Chaos, Fractals, Artificial Life, & Cellular Automata
- Procedural Generation
- Simple Games (text-based dungeon crawlers)

WHERE DID SIMON START?

- A grid of cells that can be on or off

Take a starting generation

Some cells on & the rest off

Calculate the next *generation* according to some simple rules & repeat

- Can lead to very complex, sometime chaotic, behaviours
  - The CompSci bit: Some CA have been proven to be able to calculate anything that a regular computer can calculate

---

CELLULAR AUTOMATA

#8

1D CELLULAR AUTOMATA

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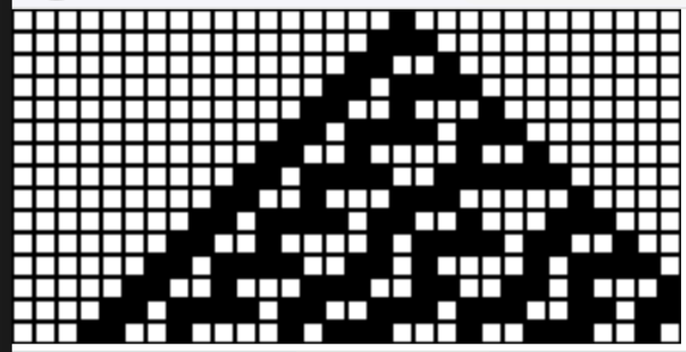

Inspector | Console | Debugger | Style Editor | Performance | Memory | Network

Filter output | Persist Logs

```
function draw(generation, population){
        for (var i=0; i<population.length; i++)         {
        ctx.rect(i*dimension, generation*dimension, dimension, dimension)
        if(population[i] === 1)
        { ctx.fillRect(i*dimension, generation*dimension, dimension, dimension) }
            ctx.stroke();
        }
}
function next_gen(old) {
  var old = [0].concat(old, [0]);
  var state = []; // The new state.

  for (var i=1; i<old.length-1; i++) {
           if (old[i-1] === 1 && old[i] === 1 && old[i+1] === 1) { state[i-1] = 0; }
      else if (old[i-1] === 1 && old[i] === 1 && old[i+1] === 0) { state[i-1] = 0; }
      else if (old[i-1] === 1 && old[i] === 0 && old[i+1] === 1) { state[i-1] = 0; }
      else if (old[i-1] === 1 && old[i] === 0 && old[i+1] === 0) { state[i-1] = 1; }
      else if (old[i-1] === 0 && old[i] === 1 && old[i+1] === 1) { state[i-1] = 1; }
      else if (old[i-1] === 0 && old[i] === 1 && old[i+1] === 0) { state[i-1] = 1; }
      else if (old[i-1] === 0 && old[i] === 0 && old[i+1] === 1) { state[i-1] = 1; }
      else if (old[i-1] === 0 && old[i] === 0 && old[i+1] === 0) { state[i-1] = 0; }

  }
  return state;
}
var c = document.createElement("canvas");
var ctx = c.getContext("2d");
var dimension = 10
var current = [0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0];
var next = [];
var j =60;
for (var i = 0; i < j; i++) {
    draw(i, current);
    current = next_gen(current);
}
document.body.replaceWith(c);
```

← undefined

RULE 30

current pattern	111	110	101	100	011	010	001	000
new state for center cell	0	0	0	1	1	1	1	0

SIMULATING THE WORLD....

- There are some places that collect programming problems & issue challenges:
  - Project Euler
  - Stack Exchange Code Golf
  - Code kata
  - Reddit Daily Programmer
  - Programming Praxis
  - Rosetta Code
  - International Collegiate Programming Contest Problems Index
  - Algorithmist

I DON'T LIKE ANY OF THAT CRAP, WHAT SHOULD I DO?

WHAT ELSE ARE YOU INTO?

YOU CAN FIND COMPUTATION/ PROGRAMMING PROBLEMS IN LOTS OF PLACES…

IN SUMMARY

- Think small (until it’s time to think big)
- Follow your interests
- If you don’t have any interests then:
  - look around you | read more | steal from others
- Become a daily programmer
- Write LOTS of code
- Have fun

WE ARE ALL SMART HERE. DISTINGUISH YOURSELF BY BEING KIND.

RESOURCES

- Website for this talk:

https://siwells.github.io/READY/

- Code for all of the examples (& more) is available here:

https://github.com/siwells/READY/tree/master

- If you want to find out more, these books are a good starting place for learning JavaScript:
  - “JavaScript: The Good Parts” by Douglas Crockford
  - “Eloquent JavaScript” by Marijn Haverbeke
  - “The “You don’t know JS” series by Kyle Simpson
- The MDN web docs site:

https://developer.mozilla.org/en-US/