

Bread  
Body Lotion

## Body Lotion

Marg

Marg

## Washing Powder

## Washing Powder

Ice cream

Ice cream

Carrots

Carrots

Soap



Fruit n veg

Oranges

Grapes

Carrots

Dairy

Marg

Ice cream

Bread n bake

Flour

Bread rolls

Bread

Bathroom

Body Lotion

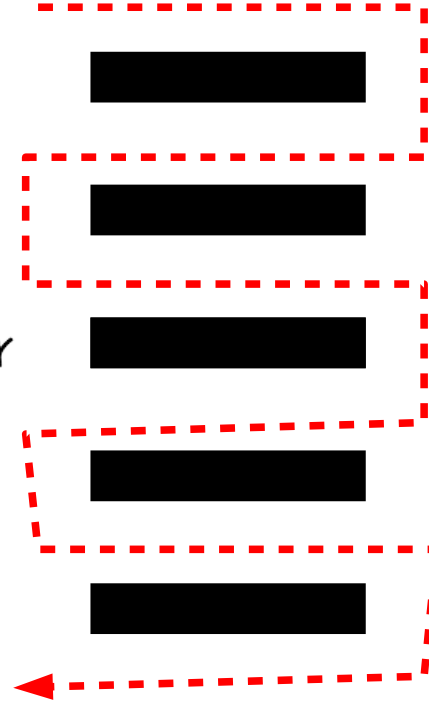
Kitchen

Washing Powder

Soap

Breakfast

Corn Flakes



Fruit n veg  
Oranges  
Grapes  
Carrots

Dairy  
Milk  
Ice cream

Bread n bake  
Flour  
Bread rolls  
Bread

Fruit n veg  
Oranges  
Grapes  
Carrots

Dairy  
Milk  
Ice cream

Bread n bake  
Flour  
Bread rolls  
Bread

Fruit n veg  
Oranges  
Grapes  
Carrots

Dairy  
Milk  
Ice cream

Bread n bake  
Flour  
Bread rolls  
Bread

Fruit n veg  
Oranges  
Grapes  
Carrots

Dairy  
Milk  
Ice cream

Bread n bake  
Flour  
Bread rolls  
Bread

Fruit n veg  
Oranges  
Grapes  
Carrots

Dairy  
Milk  
Ice cream

Bread n bake  
Flour  
Bread rolls  
Bread

Fruit n veg  
Oranges  
Grapes  
Carrots

Dairy  
Milk  
Ice cream

Bread n bake  
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Bread rolls  
Bread

Fruit n veg  
Oranges  
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Dairy  
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Ice cream

Bread n bake  
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Bread rolls  
Bread

Fruit n veg  
Oranges  
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Carrots

Dairy  
Milk  
Ice cream

Bread n bake  
Flour  
Bread rolls  
Bread

Fruit n veg  
Oranges  
Grapes  
Carrots

Dairy  
Milk  
Ice cream

Bread n bake  
Flour  
Bread rolls  
Bread

Fruit n veg  
Oranges  
Grapes  
Carrots

Dairy  
Milk  
Ice cream

Bread n bake  
Flour  
Bread rolls  
Bread

Fruit n veg  
Oranges  
Grapes  
Carrots

Dairy  
Milk  
Ice cream

Bread n bake  
Flour  
Bread rolls  
Bread



Body Lotion  
Washing Powder  
Soap  
Corn Flakes



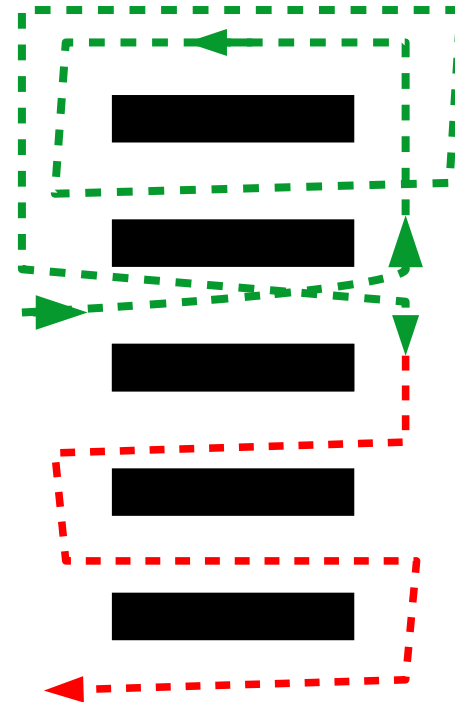
Body Lotion  
Washing Powder  
Soap  
Corn Flakes



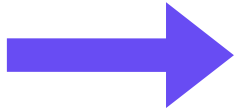
Body Lotion  
Washing Powder  
Soap  
Corn Flakes



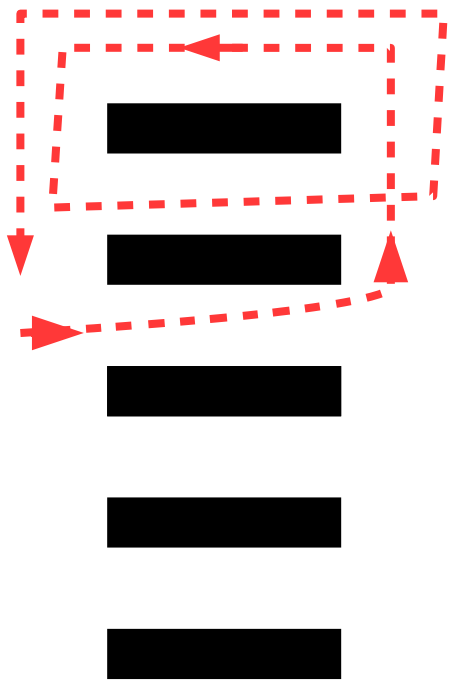
Body Lotion  
Washing Powder  
Soap  
Corn Flakes

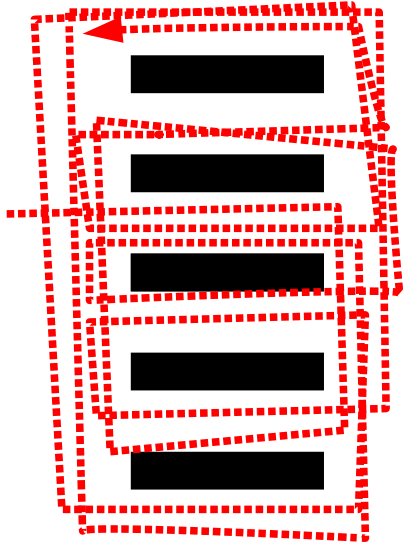


- Fruit n veg  
Oranges  
Grapes  
Carrots
- Dairy  
Marg  
Ice cream
- Bread n bake  
Flour  
Bread rolls  
Bread



- Body Lotion  
Washing Powder  
Soap  
Corn Flakes

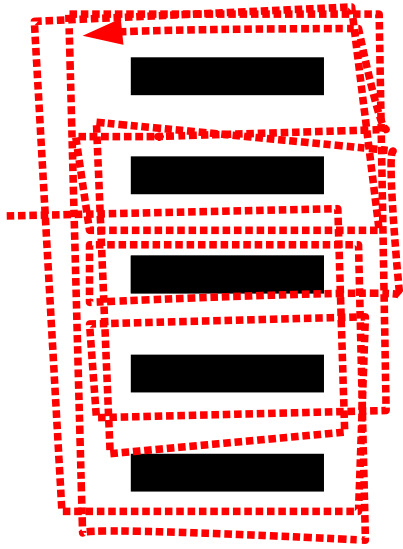




## **Interpreter**

Immediately  
runs

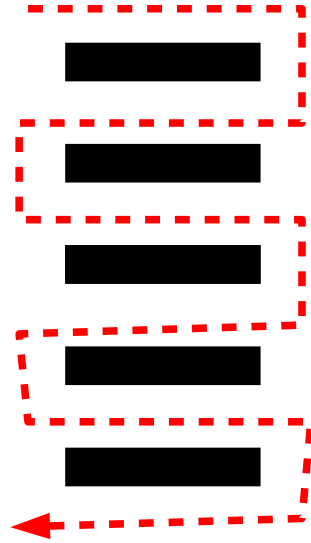
Not efficient;  
can run slow



## **Interpreter**

Immediately  
runs

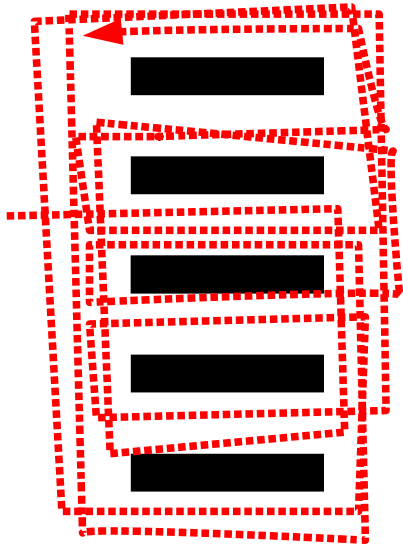
Not efficient;  
can run slow



## **Compiler**

Delay before  
running

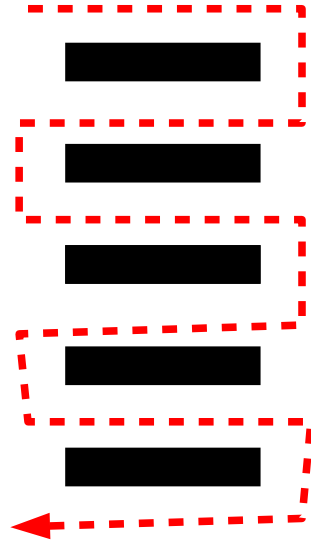
Runs efficiently



## **Interpreter**

Immediately  
runs

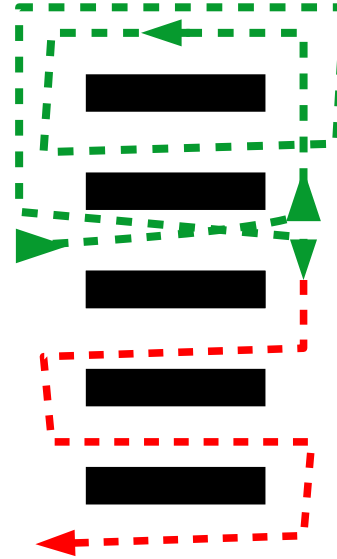
Not efficient;  
can run slow



## **Compiler**

Delay before  
running

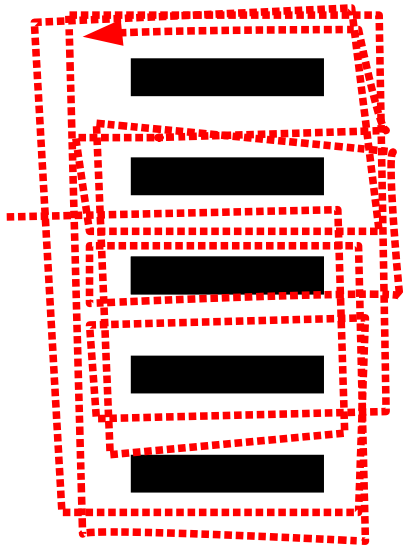
Runs efficiently



## **Just-in-time**

Immediately  
runs

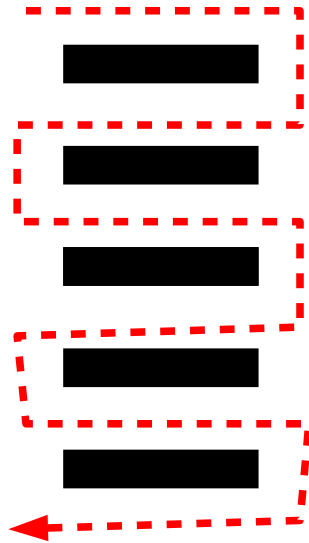
Runs quite  
efficiently  
(2008)



## Interpreter

Immediately  
runs

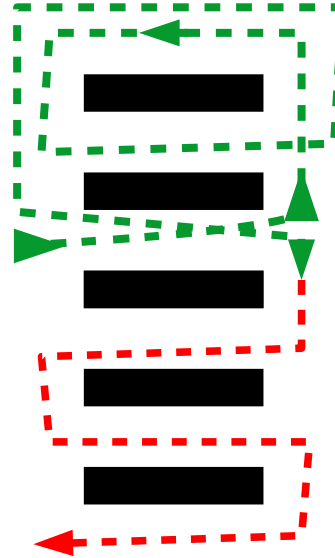
Not efficient;  
can run slow



## Compiler

Delay before  
running

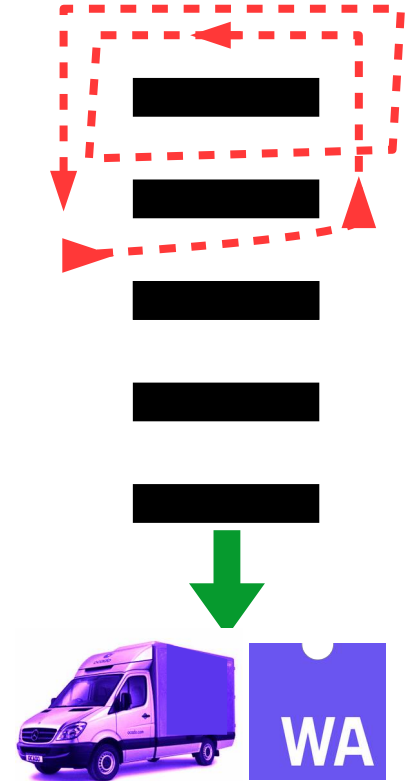
Runs efficiently



## Just-in-time

Immediately  
runs

Runs quite  
efficiently  
(2008)



## WebAssembly

Immediately  
runs highly efficiently  
(MVP 2017)



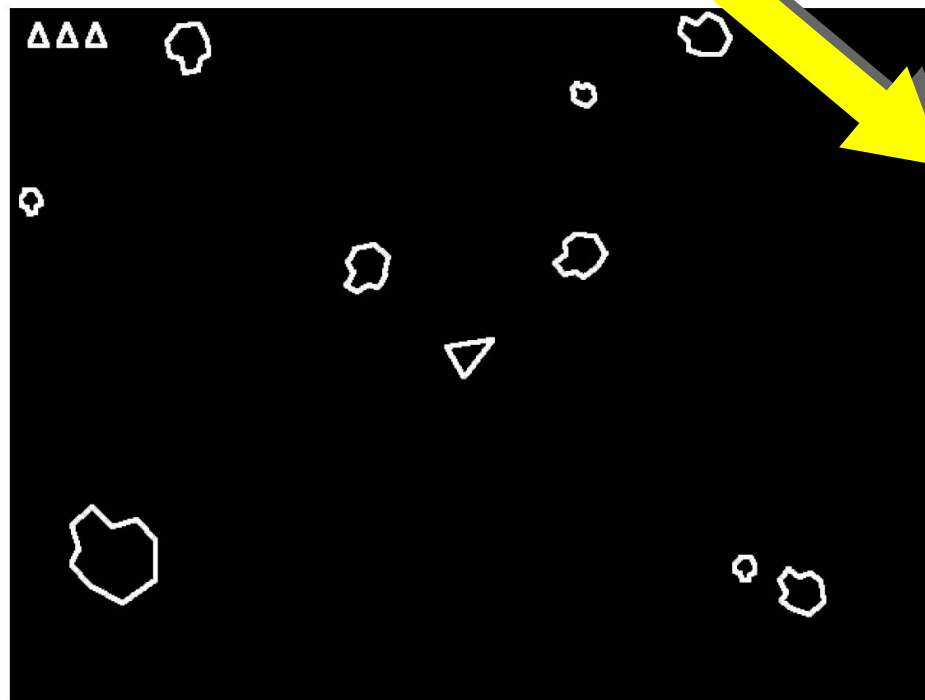
# What is WebAssembly

Asteroids in WebAssembly

[Code on GitHub](#)

An [Asteroids](#) game ported from C to WebAssembly.

(Arrows to move; Spacebar to shoot)



**Written in  
C NOT  
JavaScript**

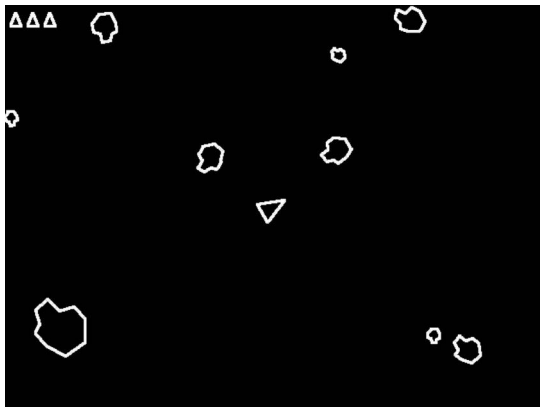
[levelupwasm.com  
/apps/asteroids](https://levelupwasm.com/apps/asteroids)

# What is WebAssembly

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Want to learn how to port games like this one to the web? Check out my book [Level Up with WebAssembly](#).

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⋮

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loading.gif

asteroids.js

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▼ www.levelupwasm.com

▼ apps/asteroids

index.html

asteroids.js

loading.gif

▶ stackpath.bootstrapcdn.com

▶ wasm

1 <!doctype html>

2 <html lang="en">

3 <head>

4 <meta charset="utf-8">

5 <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no">

6 <meta name="description" content="Asteroids game ported from C to WebAssembly">

7 <meta name="author" content="Robert Aboukhalil">

8 <title>Asteroids Game in WebAssembly</title>

9

10 <!-- Bootstrap core CSS -->

11 <link href="https://stackpath.bootstrapcdn.com/bootstrap/4.3.1/css/bootstrap.min.css" rel="stylesheet">

12

13 <style>

14 body { padding-top: 5rem; }

15 .starter-template { text-align: center; }

16 canvas { display: block; margin: 0 auto; }

17 </style>

18 </head>

19 <body>

20 <nav class="navbar navbar-expand-md navbar-dark bg-dark fixed-top">

21 <a class="navbar-brand" href="#">Asteroids in WebAssembly</a>

22 <button class="navbar-toggler" type="button" data-toggle="collapse" data-target="#navbarCollapse">

23 <span class="navbar-toggler-icon"></span>

24 </button>

25

26 <div class="collapse navbar-collapse" id="navbarCollapse">

27 <ul class="navbar-nav mr-auto"></ul>

28 <div>

29 <a style="color: #ccc;" class="nav-link" href="https://github.com/levelupwasm/asteroids">GitHub</a>

30 </div>

31 </div>

32 </nav>

33

34 <div class="starter-template">

35 <p class="lead">

36 An <a href="https://github.com/flightcrank/asteroids">Asteroids</a> game ported from C to WebAssembly.

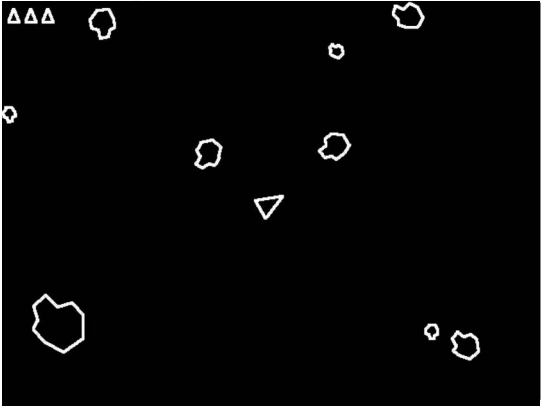
37 <small>(Arrows to move, Spacebar to shoot)</small>

# What is WebAssembly

Asteroids in WebAssembly

Code on GitHub

An [Asteroids](#) game ported from C to WebAssembly.  
(Arrows to move; Spacebar to shoot)



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Elements Console Sources Network Performance Memory Application Security Audits

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  - www.levelupwasm.com
  - stackpath.bootstrapcdn.com
  - wasm
    - wasm-0053561a
      - 0600
        - wasm-0053561a-693
        - wasm-0053561a-694
        - wasm-0053561a-695
        - wasm-0053561a-696
        - wasm-0053561a-697
        - wasm-0053561a-698
        - wasm-0053561a-699
      - 0700
      - 0800
      - 0900
      - 1000
      - 1100
      - 1200
      - 1300
      - 1400
      - 1500
      - 1600
      - 1700

wasm-0053561a-694    wasm-0053561a-696    **wasm-0053561a-698** x >>

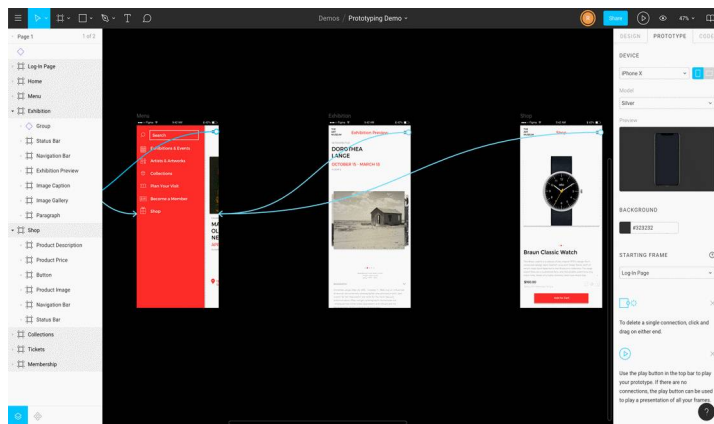
```
1 func (param i32 i32)
2 (local i32 i32 i32 i32 i32 i32 i32 i32 i32 i32 i32 i32 i32 i32 i32 i32
3   global.get 18
4   local.set 58
5   global.get 18
6   i32.const 32
7   i32.add
8   global.set 18
9   global.get 18
10  global.get 19
11  i32.get_s
12  if
13    i32.const 32
14    call 1
15  end
16  local.get 58
17  i32.const 8
18  i32.add
19  local.set 53
20  local.get 58
21  local.set 54
22  local.get 0
23  local.set 12
24  local.get 1
25  local.set 23
26  i32.const 0
27  local.set 34
28  i32.const 0
29  local.set 45
30  local.get 53
31  i32.const 23368
32  i64.load offset=0 align=4
33  i64.store offset=0 align=4
34  i32.const 0
35  local.set 34
36  loop
37    block
38      local.get 34
39      local.set 55
40      local.get 23
```

## WebAssembly code (Wasam)

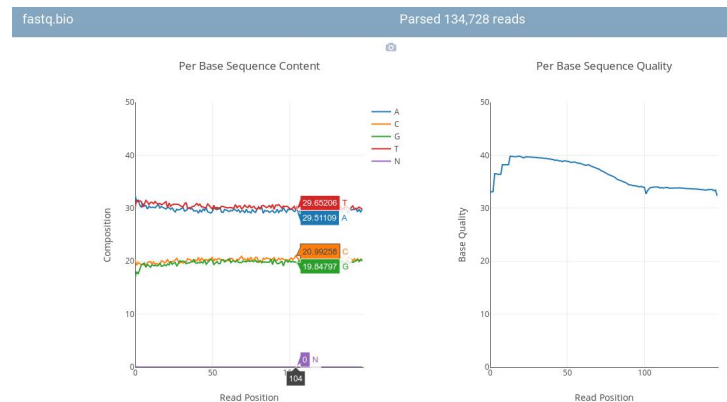
Compiled  
(converted) from C  
to WebAssembly to  
run directly in the  
browser

# Why is WebAssembly important?

*Faster than  
JavaScript*



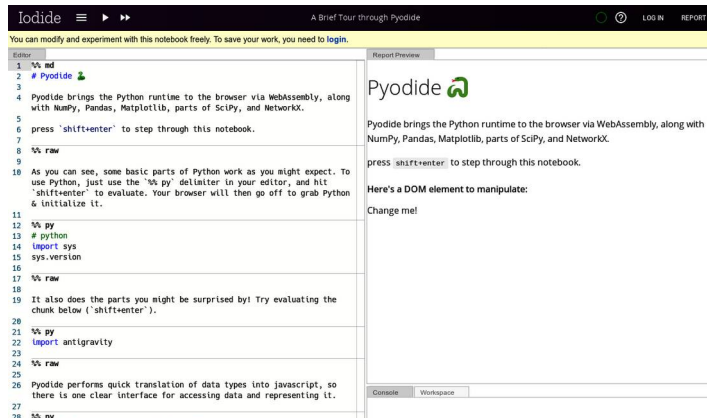
*Figma 3X faster*



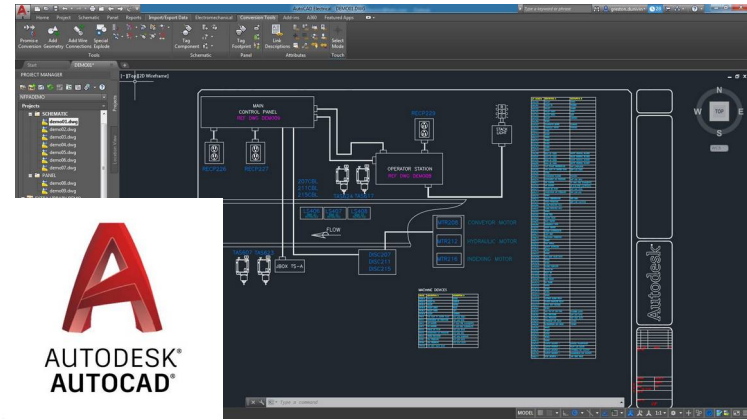
*fastq.bio DNA  
sequencer 20X faster*

# Why is WebAssembly important?

*Run established codebase*



***Pyodide is Python running on the browser via webAssembly for scientific and AI***



***AutoCAD web version uses identical codebase as desktop - C***

# TL;DR

**WebAssembly Code is 'shipped in'**  
**via a binary blob**

**Allows faster execution than**  
**JavaScript**

**Allows established non JavaScript**  
**code via compiler to run on the web**

