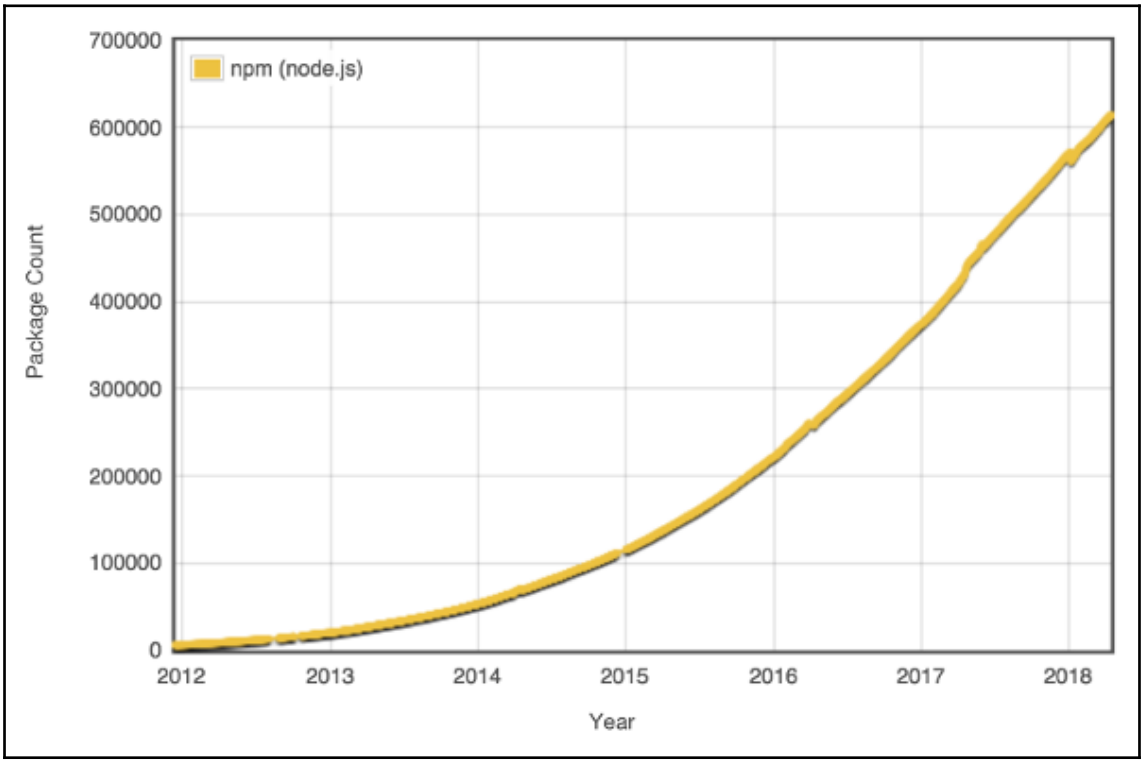
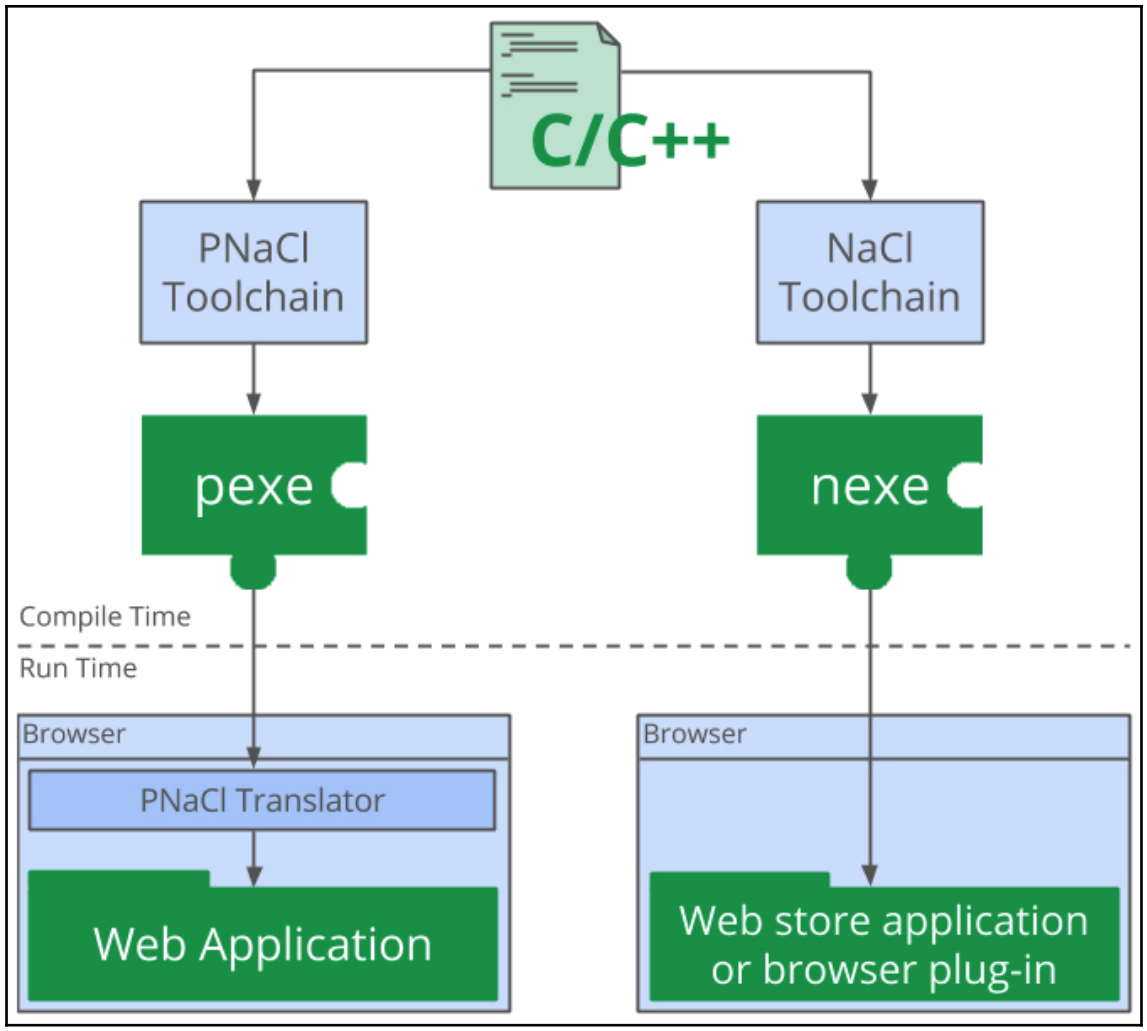
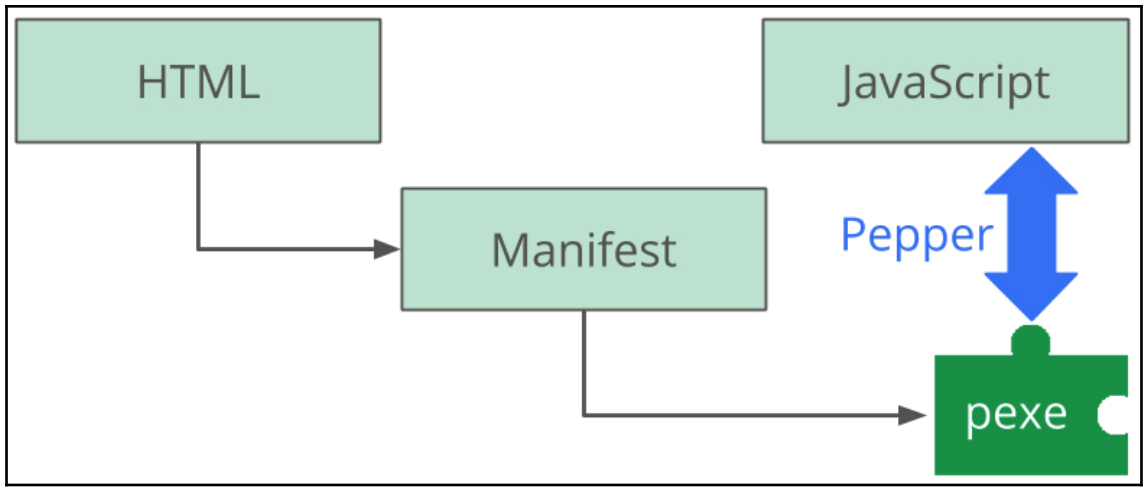
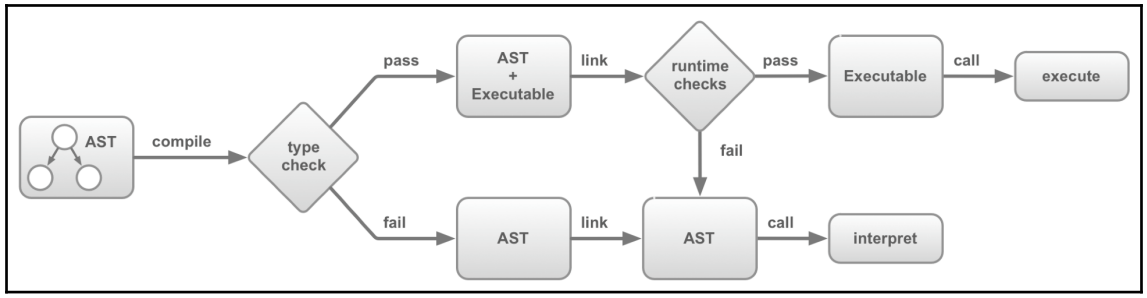
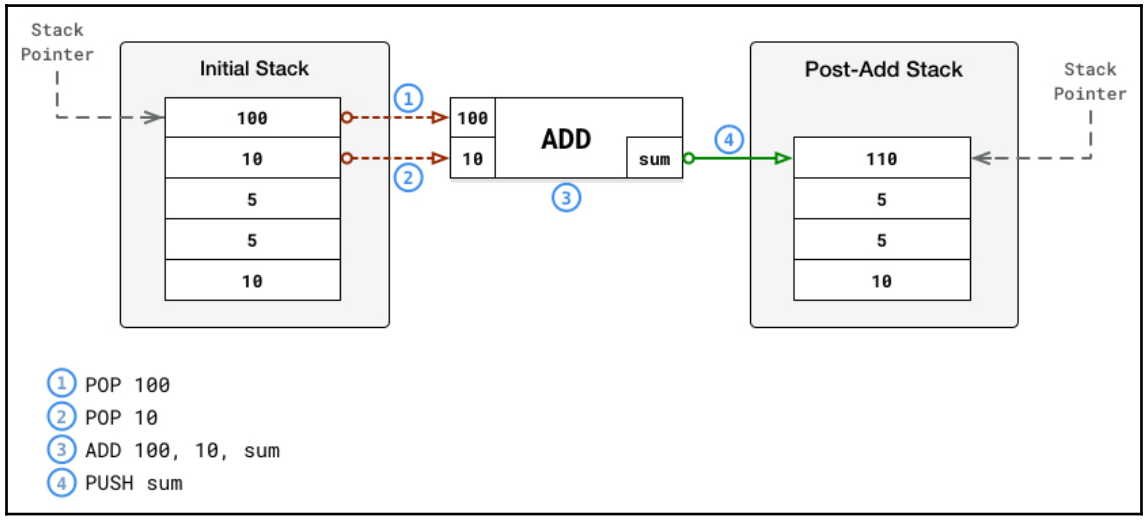
Chapter 1: What is WebAssembly?

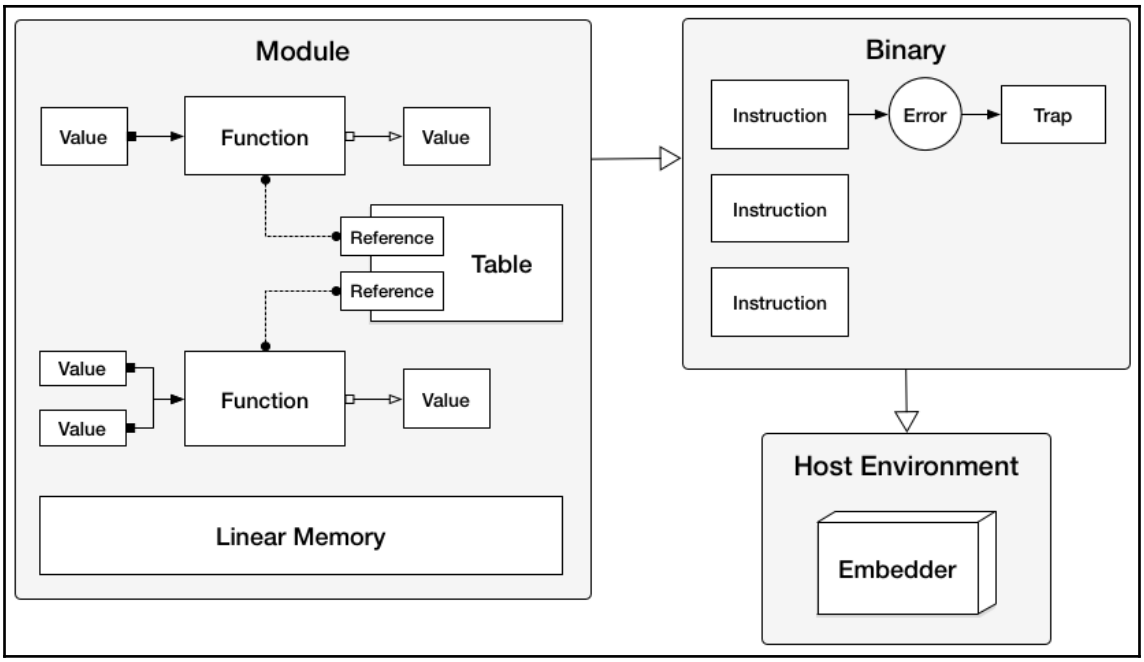


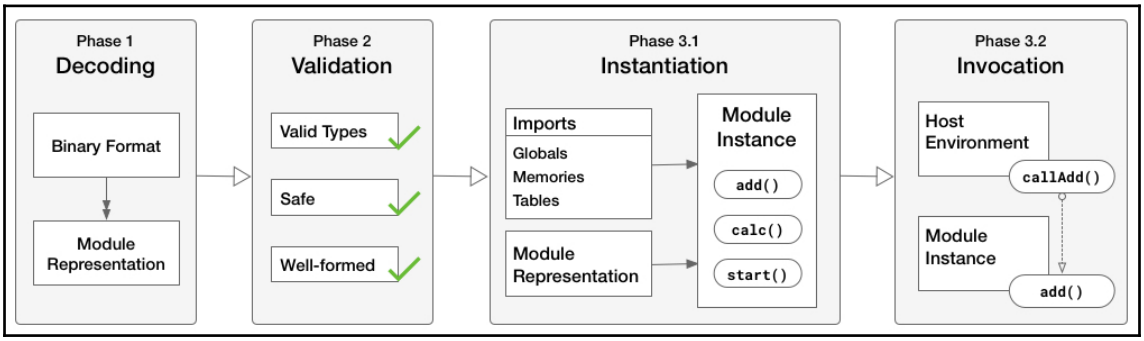

C/C++
PNaCl Toolchain
NaCl Toolchain
pexe
nexe
Compile Time
Run Time
Browser
PNaCl Translator
Web Application
Browser
Web store application or browser plug-in


HTML
JavaScript
Manifest
Pepper
pexe

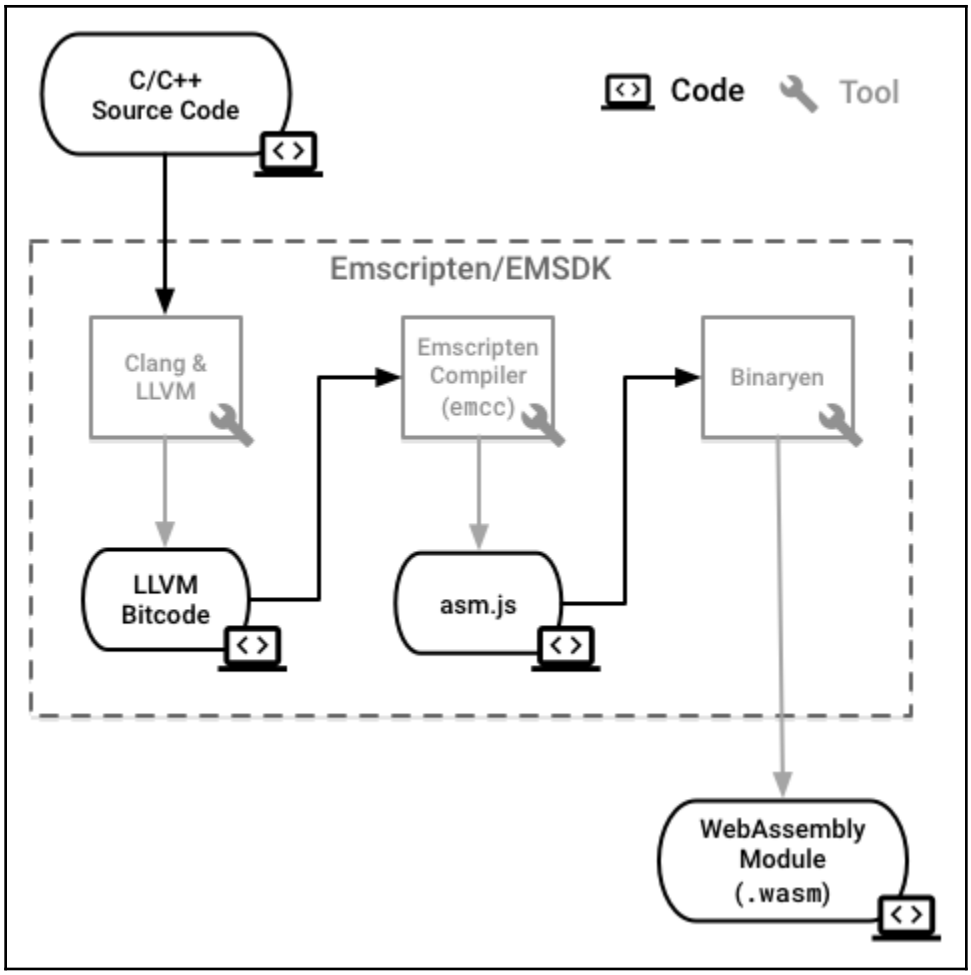

AST
compile
type check
pass
AST + Executable
link
runtime checks
pass
Executable
call
execute
fail
fail
AST
link
AST
call
interpret


Stack Pointer
Initial Stack
100
10
5
5
10
1
2
100
10
ADD
sum
3
4
Post-Add Stack
110
5
5
10
Stack Pointer
1 POP 100
2 POP 10
3 ADD 100, 10, sum
4 PUSH sum

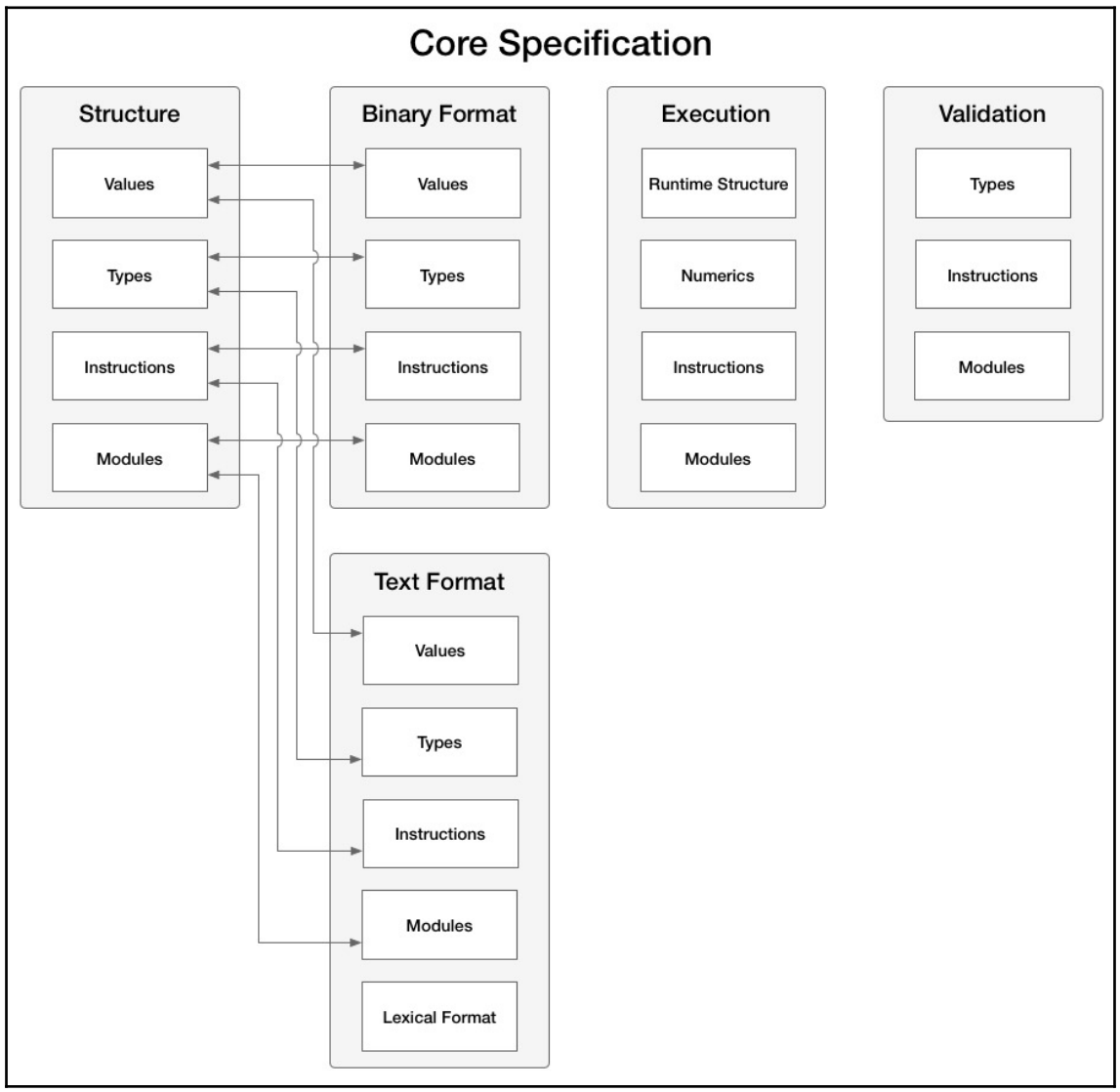

Module
Value
Function
Value
Reference
Reference
Table
Value
Value
Function
Value
Linear Memory
Binary
Instruction
Error
Trap
Instruction
Instruction
Host Environment
Embedder

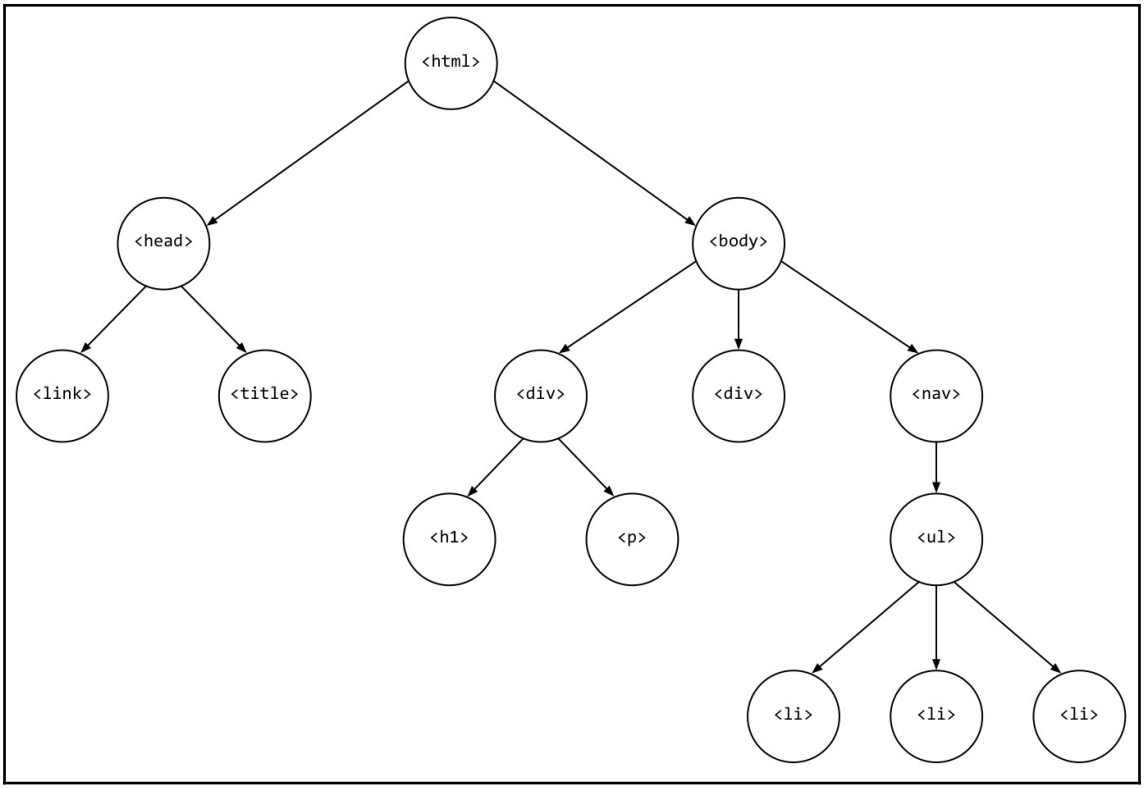

Phase 1
Decoding
Binary Format
Module Representation
Phase 2
Validation
Valid Types
Safe
Well-formed
Phase 3.1
Instantiation
Imports
Globals
Memories
Tables
Module Representation
Module Instance
add()
calc()
start()
Phase 3.2
Invocation
Host Environment
callAdd()
Module Instance
add()

Programming Language	2018	2013	2008	2003	1998	1993	1988
Java	1	2	1	1	16	-	-
C	2	1	2	2	1	1	1
C++	3	4	3	3	2	2	5
Python	4	7	6	12	24	19	-
C#	5	5	7	9	-	-	-
Visual Basic .NET	6	13	-	-	-	-	-
JavaScript	7	10	8	7	21	-	-
PHP	8	6	4	5	-	-	-
Ruby	9	9	9	19	-	-	-
Perl	10	8	5	4	3	11	-
Objective-C	18	3	44	50	-	-	-
Ada	30	16	17	14	6	6	2
Lisp	31	11	15	13	5	4	3
Pascal	143	14	18	97	11	3	13

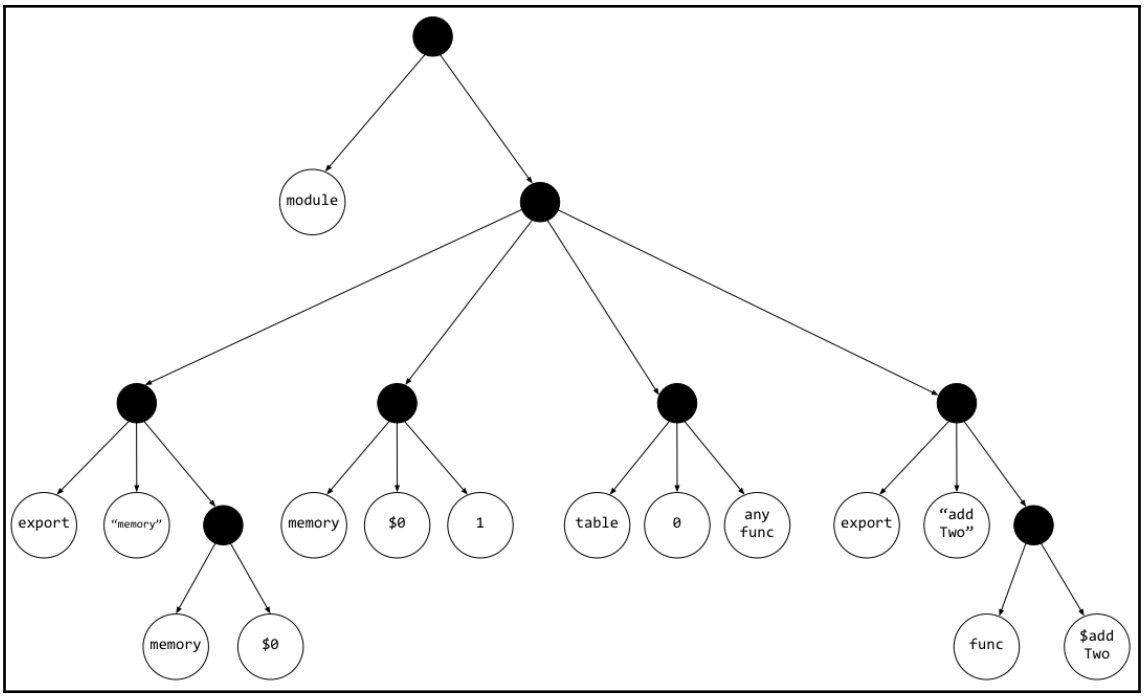

C/C++
Source Code
Code
Tool
Emscripten/EMSDK
Clang &
LLVM
Emscripten
Compiler
(emcc)
Binaryen
LLVM
Bitcode
asm.js
WebAssembly
Module
(.wasm)

Chapter 2: Elements of WebAssembly -Wat, Wasm, and the JavaScript API




<html>
<head>
<body>
<link>
<title>

<nav>
<h1>
<p>


module
export
"memory"
memory
$0
memory
$0
1
table
0
any
func
export
"add
Two"
func
$add
Two

Block Comments are surrounded with a `(;` and `;)`.

```
(;
  This is a block comment.
  It allows you to create a multi-line comment without having to
  use a double-semicolon in front of each line.
;)
(module
 (type $FUNCSIG$dd (func (param f64) (result f64)))
 (table 0 anyfunc)
 (memory $0 1)
 (data (i32.const 16) "Test\n\00")
 (data (i32.const 24) "\10\00\00\00")
 (export "memory" (memory $0))
 (export "getCharCountSqrt" (func $getCharCountSqrt))
 (func $getCharCountSqrt (; 0 ;) (param $0 i32) (result f32)
  (local $1 i32)
  (local $2 i32)
  (local $3 f64)
  ;; This is a line comment.
  (block $label$0
   (block $label$1
    (br_if $label$1
     (i32.eqz
      (i32.load8_u
       (get_local $0)
      )
     )
    )
    (set_local $0
     (i32.add
      (get_local $0)
      (i32.const 1)
     )
    )
```

`table` is a **Table Type**.

`16` is an **Integer Value**.

`"Test\n\00"` "Test\n\00" is a **String Value**.

"memory" is an **Name Value**.

`$0` is an **Identifier Value**.

`func`, `param`, and `result` are **Function Types**.

`i32` is a **Value Type**.

Line Comments start with a `;;`.

`block` is a **Block Control Instruction**.

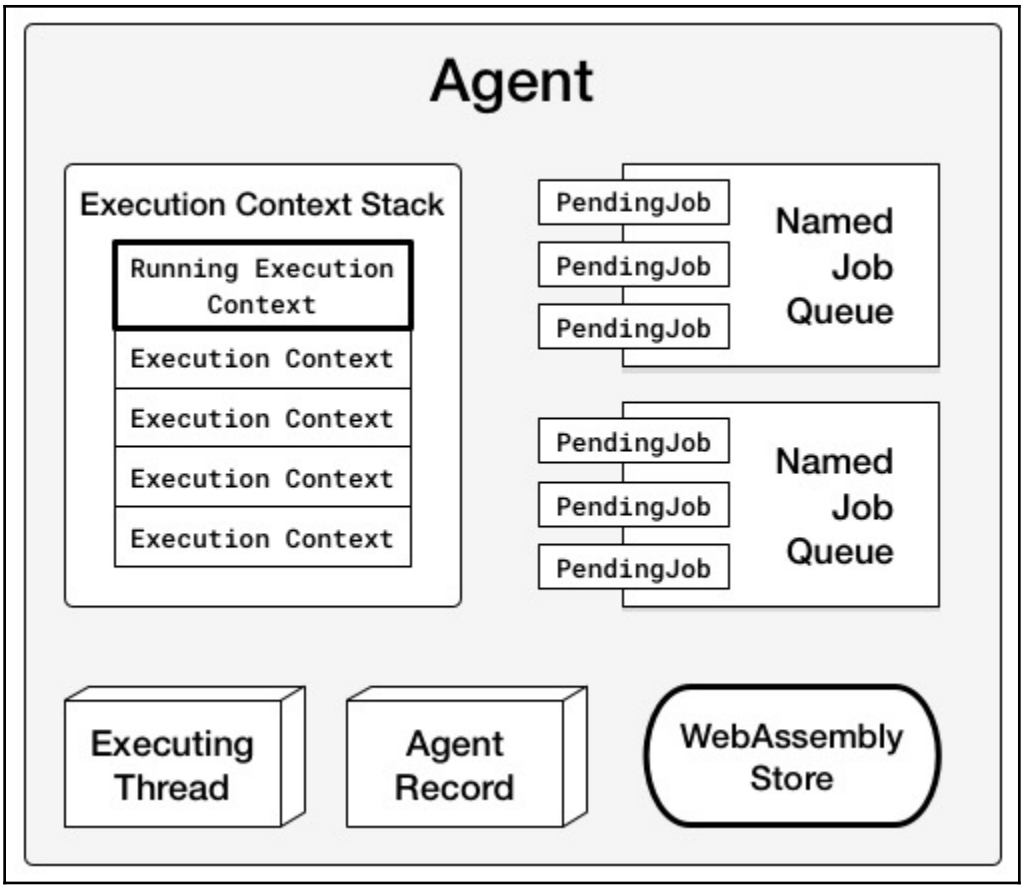
`$label$1` is a **Label Identifier**.

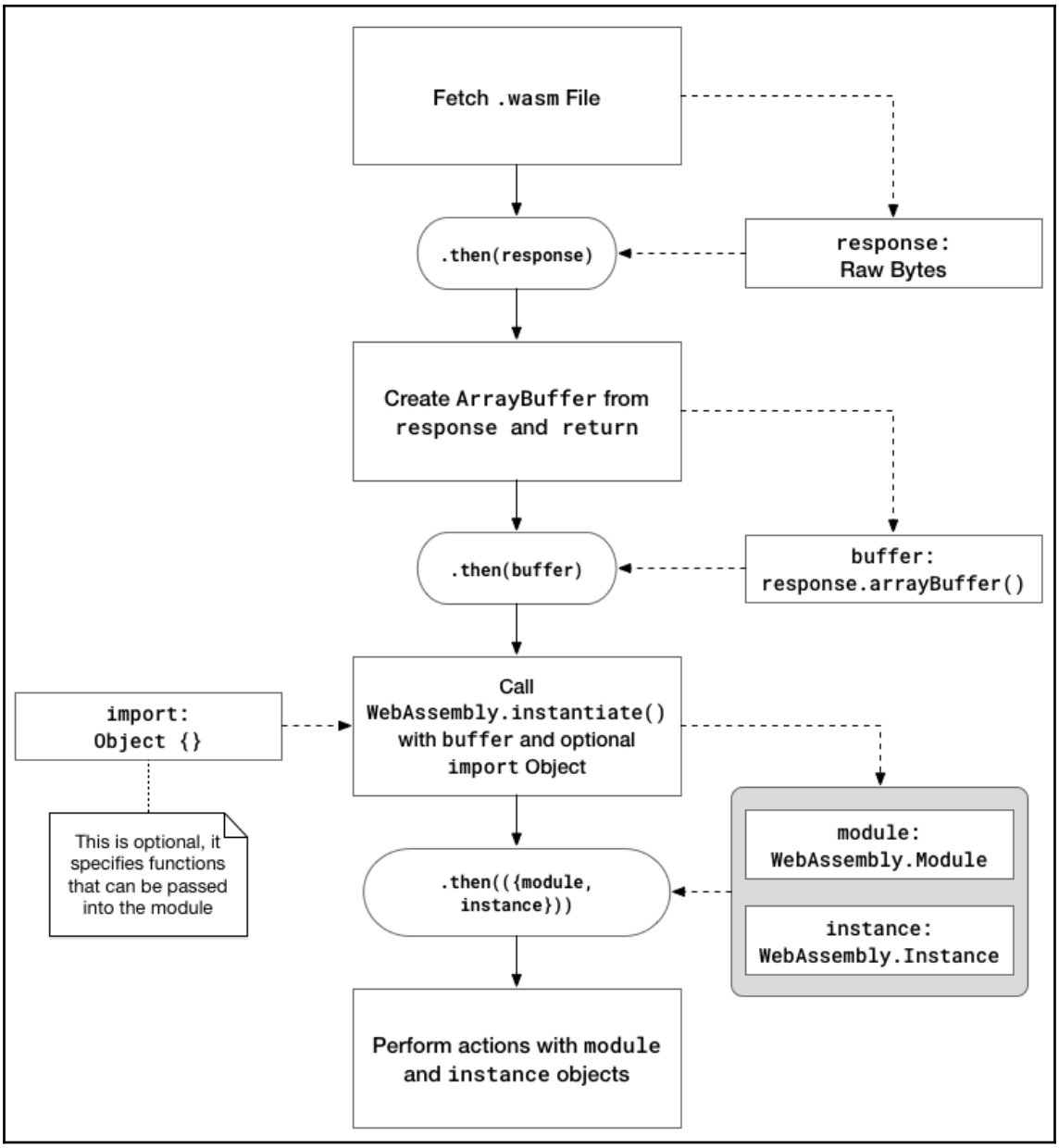
`br_if` is a **Plain Control Instruction**.

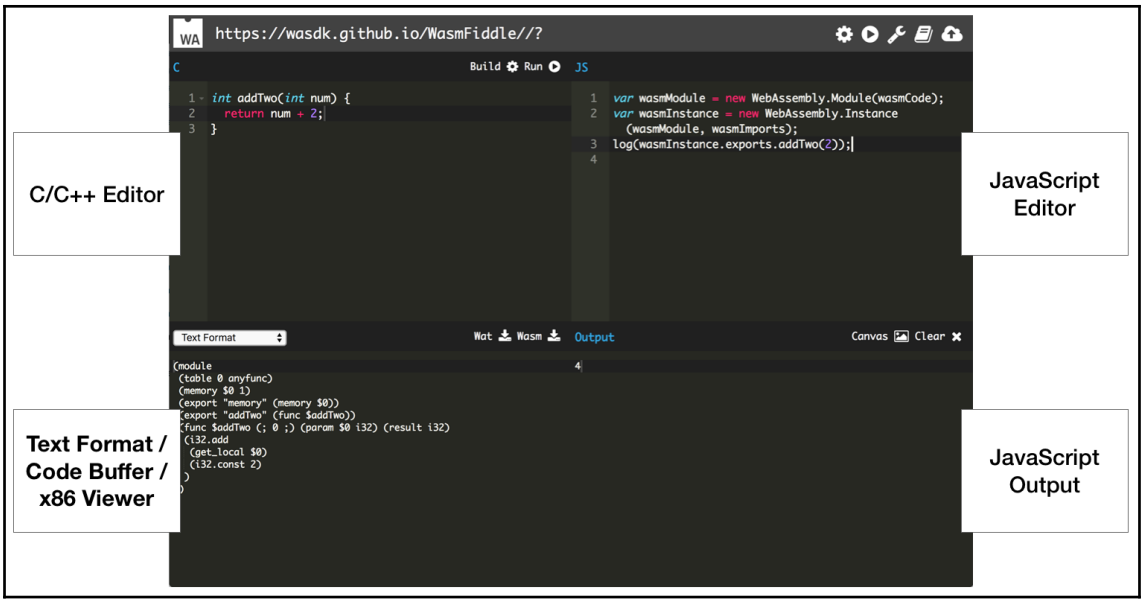
`load8_u` is a **Memory Instruction**.

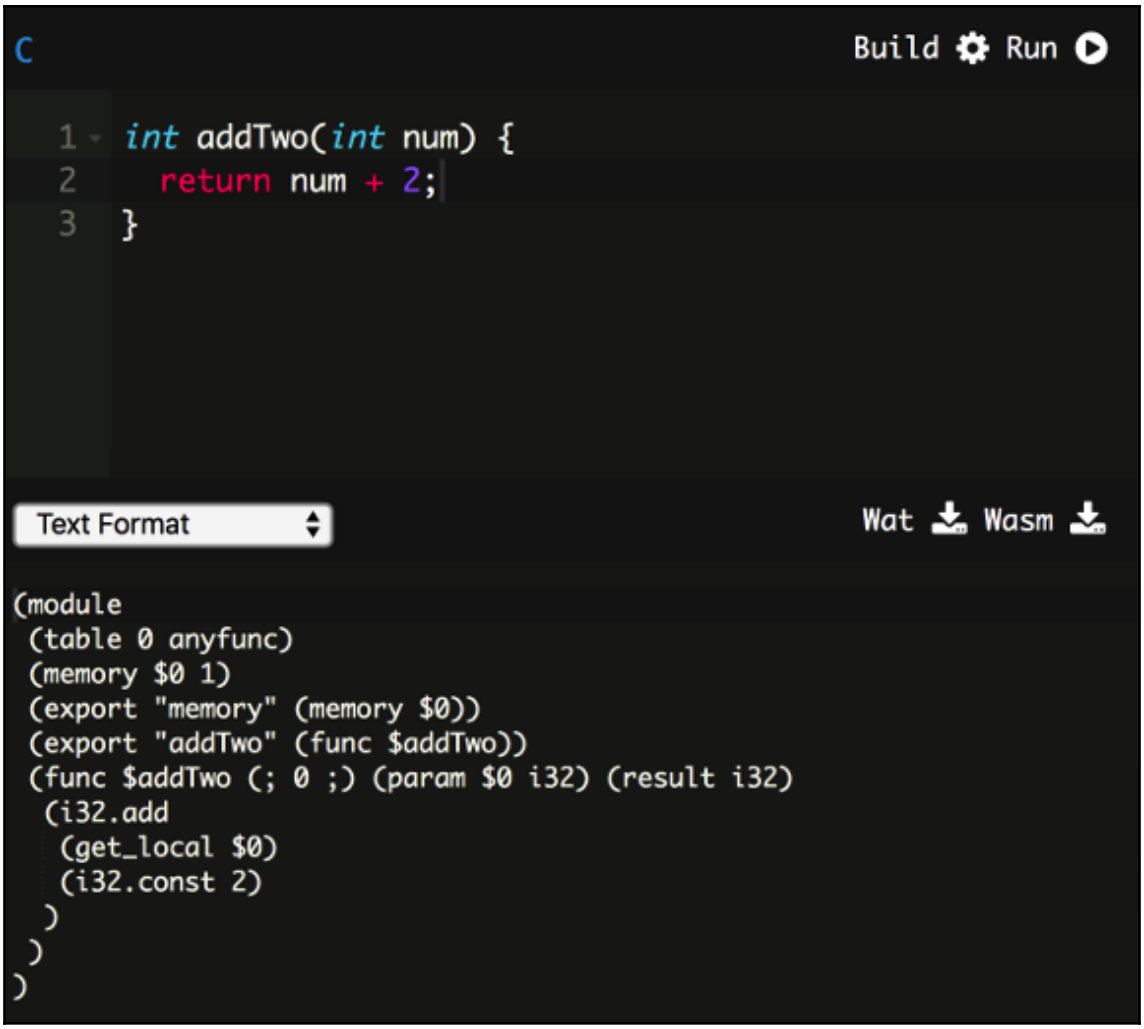
`get_local` is a **Variable Instruction**.

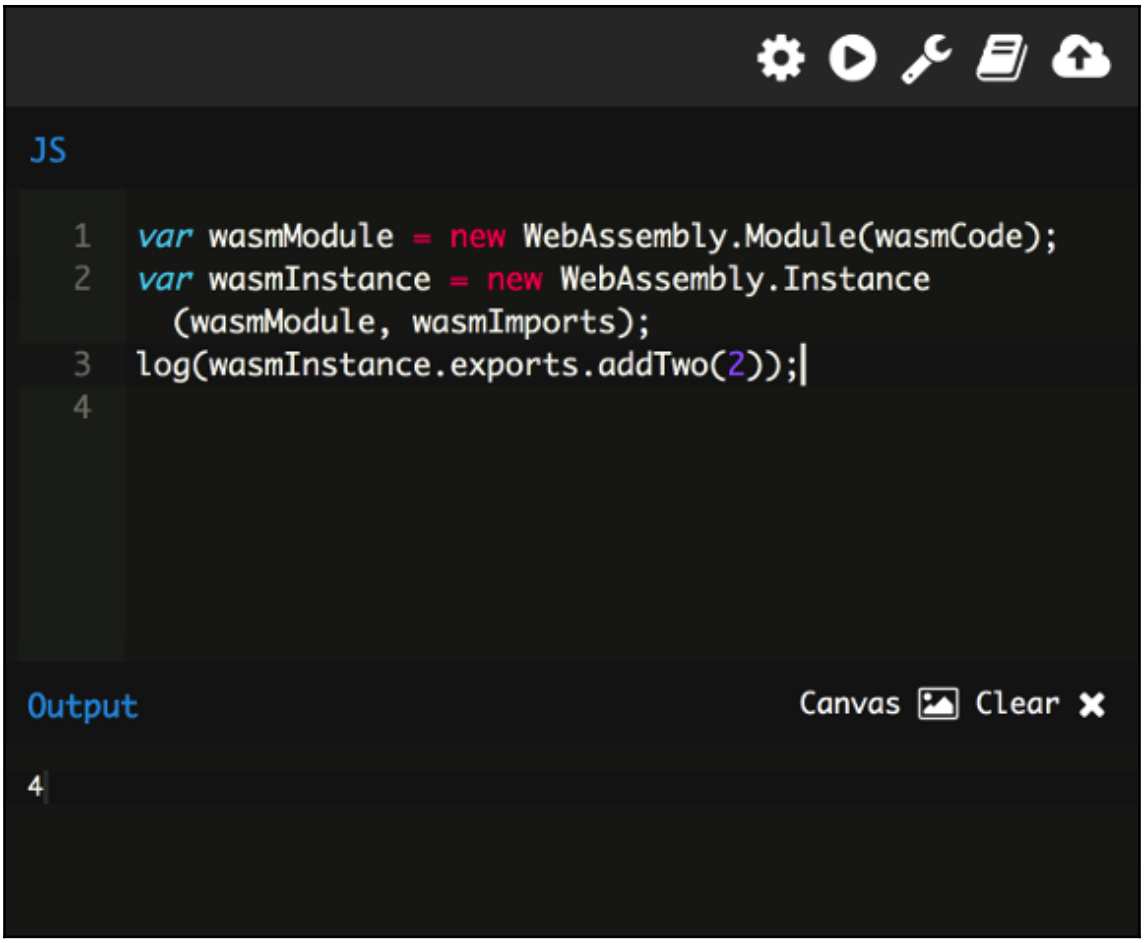
`i32.const` is a **Numeric Instruction**.


Agent
Execution Context Stack
Running Execution Context
Execution Context
Execution Context
Execution Context
Execution Context
PendingJob
PendingJob
PendingJob
Named Job Queue
PendingJob
PendingJob
PendingJob
Named Job Queue
Executing Thread
Agent Record
WebAssembly Store

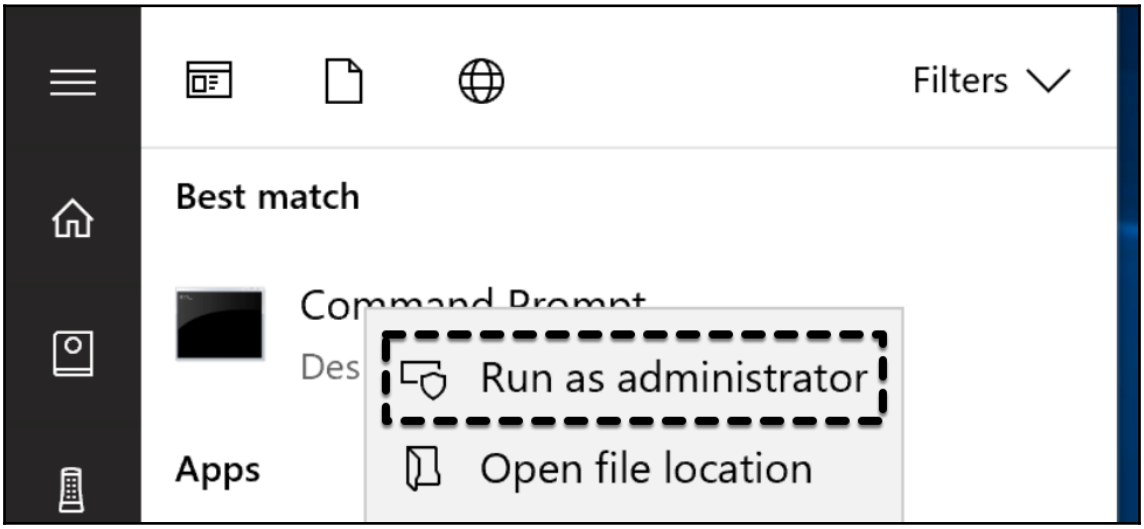

Fetch .wasm File
.then(response)
response:
Raw Bytes
Create ArrayBuffer from
response and return
.then(buffer)
buffer:
response.arrayBuffer()
import:
Object {}
This is optional, it specifies functions that can be passed into the module
Call
WebAssembly.instantiate()
with buffer and optional
import Object
module:
WebAssembly.Module
instance:
WebAssembly.Instance
.then(({module,
instance}))
Perform actions with module
and instance objects

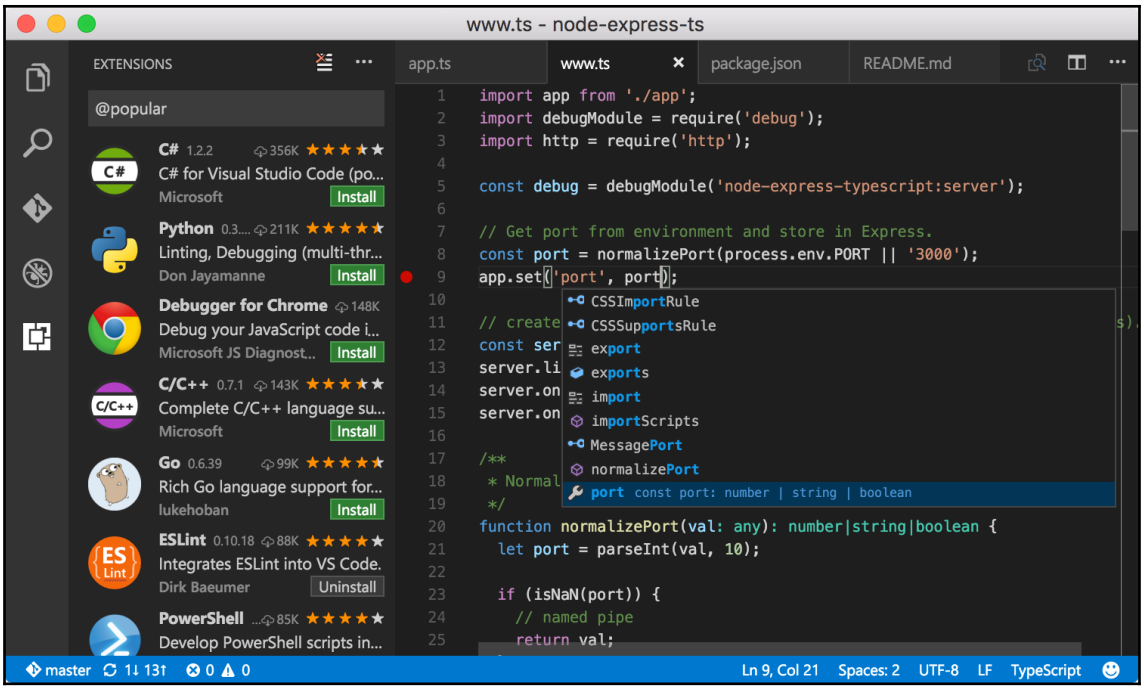

C/C++ Editor
JavaScript Editor
Text Format / Code Buffer / x86 Viewer
JavaScript Output
https://wasdk.github.io/WasmFiddle//?
Build
Run
int addTwo(int num) {
return num + 2;
}
var wasmModule = new WebAssembly.Module(wasmCode);
var wasmInstance = new WebAssembly.Instance
(wasmModule, wasmImports);
log(wasmInstance.exports.addTwo(2));
Text Format
Wat
Wasm
Output
Canvas
Clear
(module
(table 0 anyfunc)
(memory $0 1)
(export "memory" (memory $0))
(export "addTwo" (func $addTwo))
(func $addTwo (; 0 ;) (param $0 i32) (result i32)
(i32.add
(get_local $0)
(i32.const 2)
)
)
4

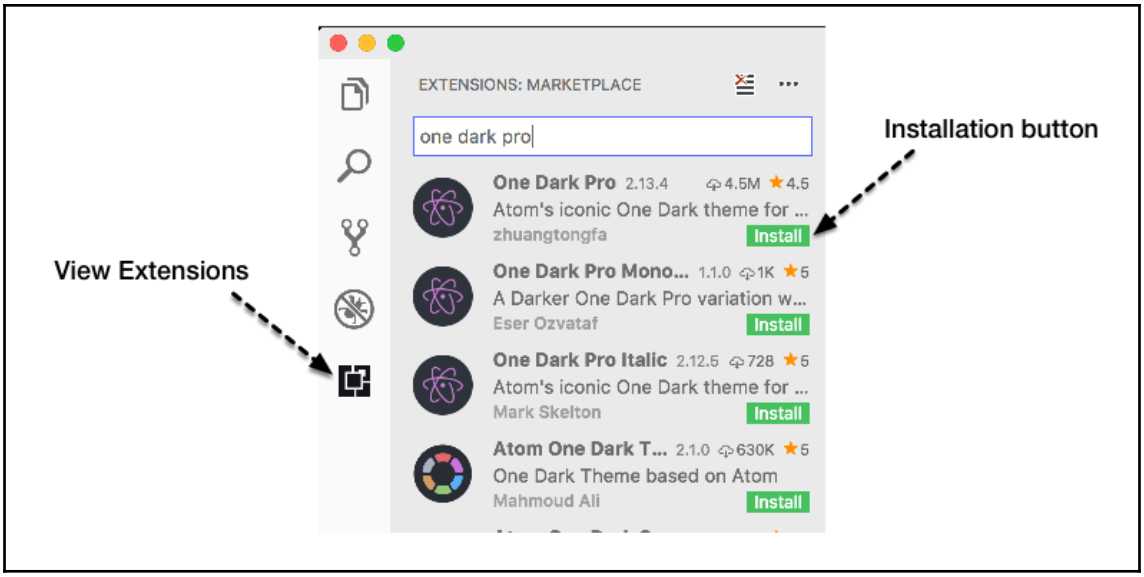

C
Build
Run
1 int addTwo(int num) {
2 return num + 2;
3 }
Text Format
Wat
Wasm
(module
(table 0 anyfunc)
(memory $0 1)
(export "memory" (memory $0))
(export "addTwo" (func $addTwo))
(func $addTwo (; 0 ;) (param $0 i32) (result i32)
(i32.add
(get_local $0)
(i32.const 2)
)
)
)

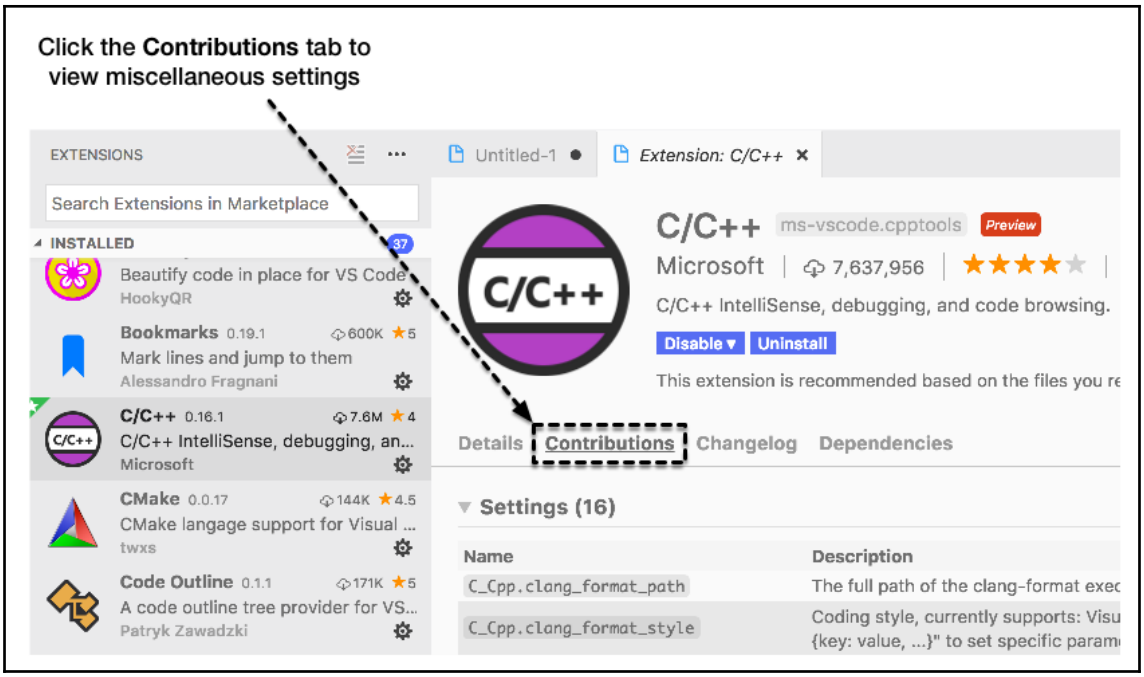

JS
1 var wasmModule = new WebAssembly.Module(wasmCode);
2 var wasmInstance = new WebAssembly.Instance
(wasmModule, wasmImports);
3 log(wasmInstance.exports.addTwo(2));
4
Output
Canvas
Clear
4

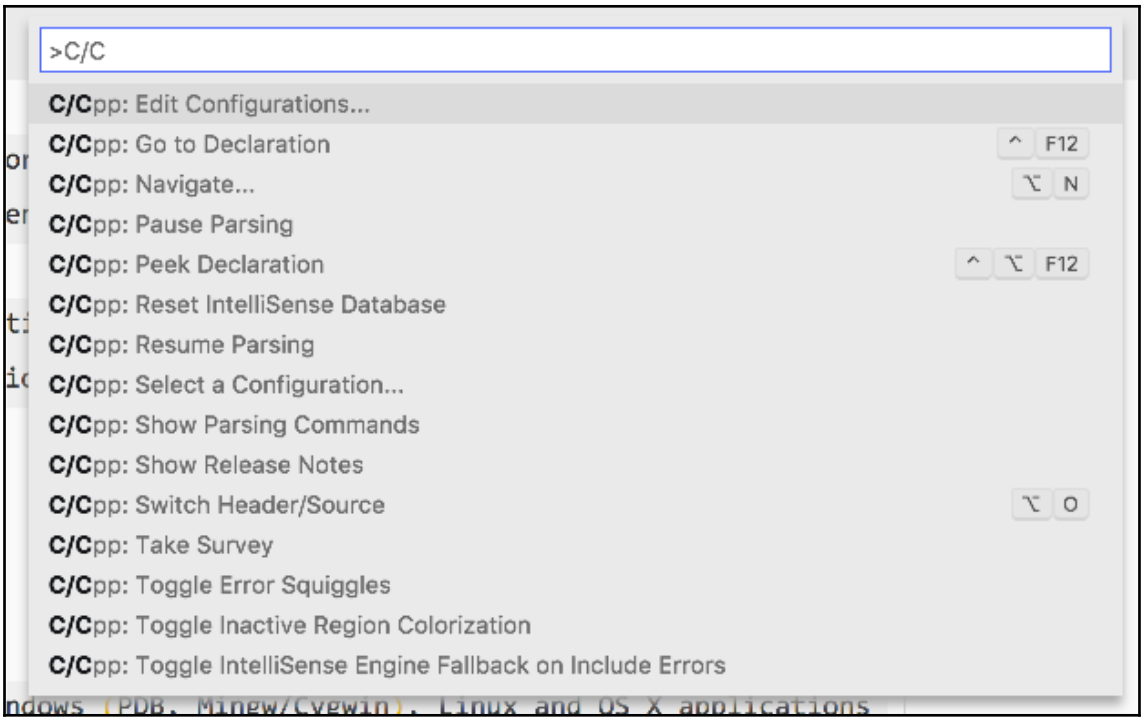
CHapter 3: Setting Up a Development Environment

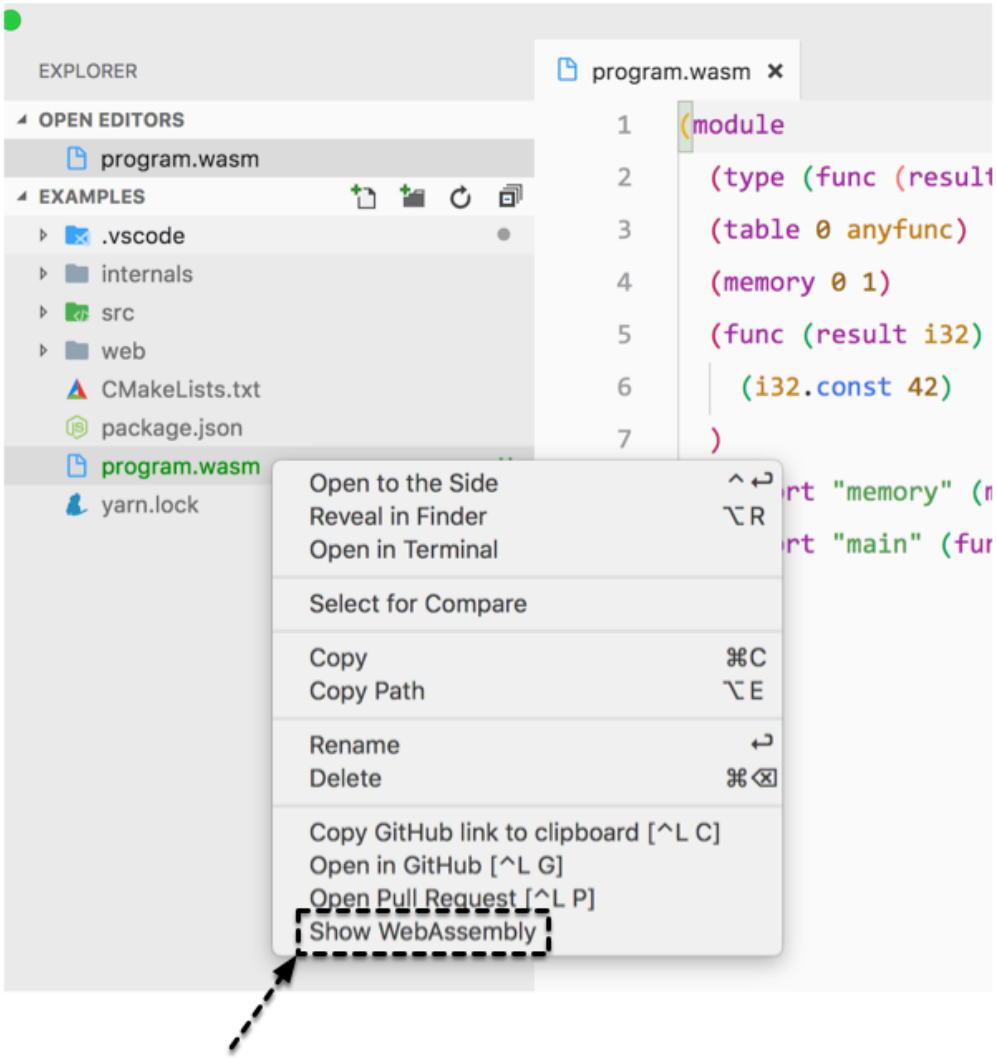



www.ts - node-express-ts
EXTENSIONS
@popular
C# 1.2.2 356K
C# for Visual Studio Code (po...
Microsoft
Install
Python 0.3.... 211K
Linting, Debugging (multi-thr...
Don Jayamanne
Install
Debugger for Chrome 148K
Debug your JavaScript code i...
Microsoft JS Diagnost...
Install
C/C++ 0.7.1 143K
Complete C/C++ language su...
Microsoft
Install
Go 0.6.39 99K
Rich Go language support for...
lukehoban
Install
ESLint 0.10.18 88K
Integrates ESLint into VS Code.
Dirk Baeumer
Uninstall
PowerShell ...85K
Develop PowerShell scripts in...
app.ts
www.ts
package.json
README.md
import app from './app';
import debugModule = require('debug');
import http = require('http');
const debug = debugModule('node-express-typescript:server');
// Get port from environment and store in Express.
const port = normalizePort(process.env.PORT || '3000');
app.set('port', port);
CSSImportRule
CSSSupportsRule
export
exports
import
importScripts
MessagePort
normalizePort
port const port: number | string | boolean
function normalizePort(val: any): number|string|boolean {
let port = parseInt(val, 10);
if (isNaN(port)) {
// named pipe
return val;
master
Ln 9, Col 21
Spaces: 2
UTF-8
LF
TypeScript

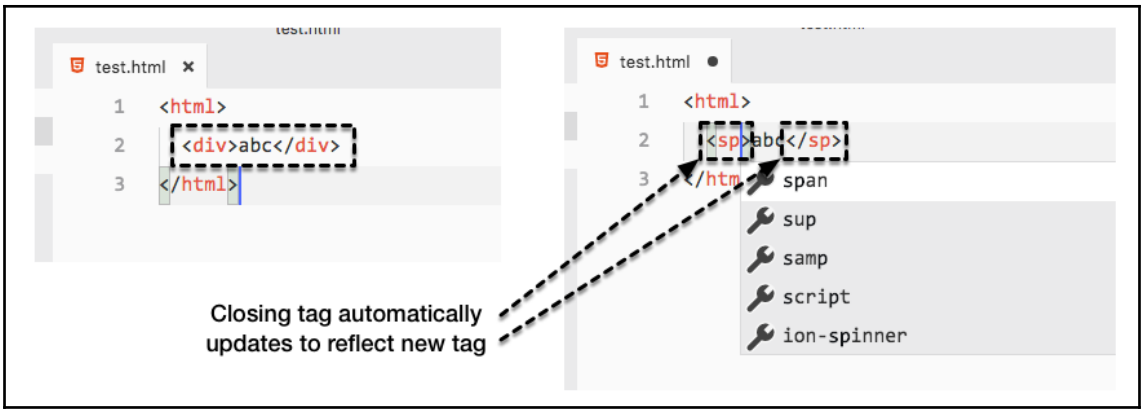

EXTENSIONS: MARKETPLACE
one dark pro
Installation button
View Extensions
One Dark Pro 2.13.4 4.5M 4.5
Atom's iconic One Dark theme for ...
zhuangtongfa
Install
One Dark Pro Mono... 1.1.0 1K 5
A Darker One Dark Pro variation w...
Eser Ozvataf
Install
One Dark Pro Italic 2.12.5 728 5
Atom's iconic One Dark theme for ...
Mark Skelton
Install
Atom One Dark T... 2.1.0 630K 5
One Dark Theme based on Atom
Mahmoud Ali
Install

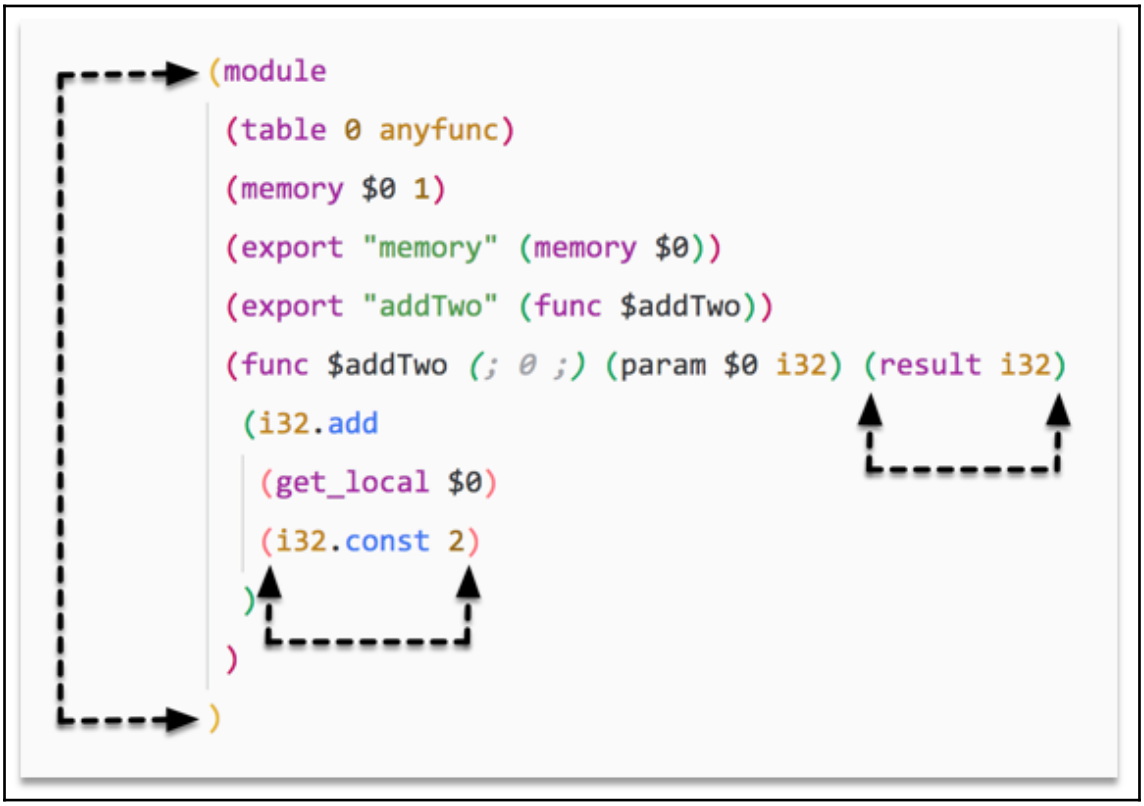

Click the Contributions tab to view miscellaneous settings
EXTENSIONS
Search Extensions in Marketplace
INSTALLED
37
Beautify code in place for VS Code
HookyQR
Bookmarks 0.19.1
600K ★5
Mark lines and jump to them
Alessandro Fragnani
C/C++ 0.16.1
7.6M ★4
C/C++ IntelliSense, debugging, an...
Microsoft
CMake 0.0.17
144K ★4.5
CMake langage support for Visual ...
twxs
Code Outline 0.1.1
171K ★5
A code outline tree provider for VS...
Patryk Zawadzki
Untitled-1
Extension: C/C++
C/C++
ms-vscode.cpptools
Preview
Microsoft
7,637,956
C/C++ IntelliSense, debugging, and code browsing.
Disable ▾
Uninstall
This extension is recommended based on the files you re
Details
Contributions
Changelog
Dependencies
Settings (16)
Name
Description
C_Cpp.clang_format_path
The full path of the clang-format exec
C_Cpp.clang_format_style
Coding style, currently supports: Visu
{key: value, ...}" to set specific param

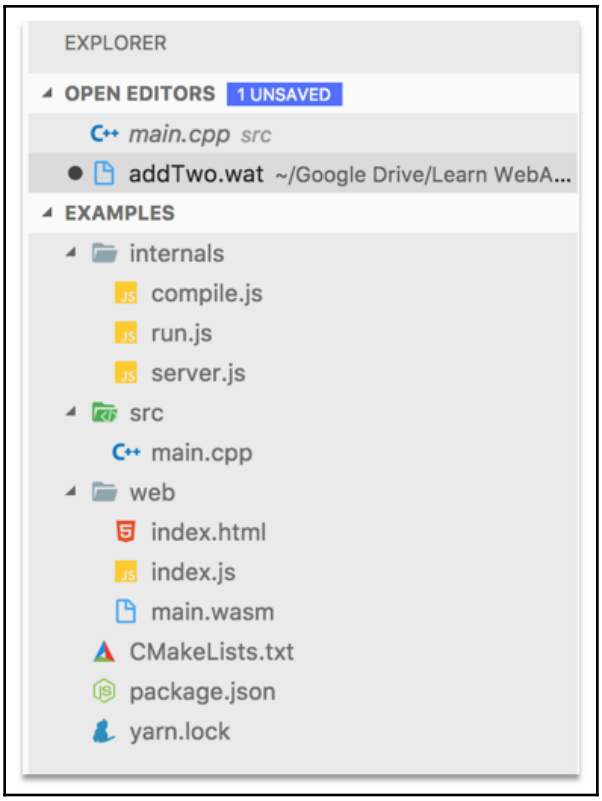

>C/C
C/Cpp: Edit Configurations...
C/Cpp: Go to Declaration ^ F12
C/Cpp: Navigate... ⌥ N
C/Cpp: Pause Parsing
C/Cpp: Peek Declaration ^ ⌥ F12
C/Cpp: Reset IntelliSense Database
C/Cpp: Resume Parsing
C/Cpp: Select a Configuration...
C/Cpp: Show Parsing Commands
C/Cpp: Show Release Notes
C/Cpp: Switch Header/Source ⌥ O
C/Cpp: Take Survey
C/Cpp: Toggle Error Squiggles
C/Cpp: Toggle Inactive Region Colorization
C/Cpp: Toggle IntelliSense Engine Fallback on Include Errors

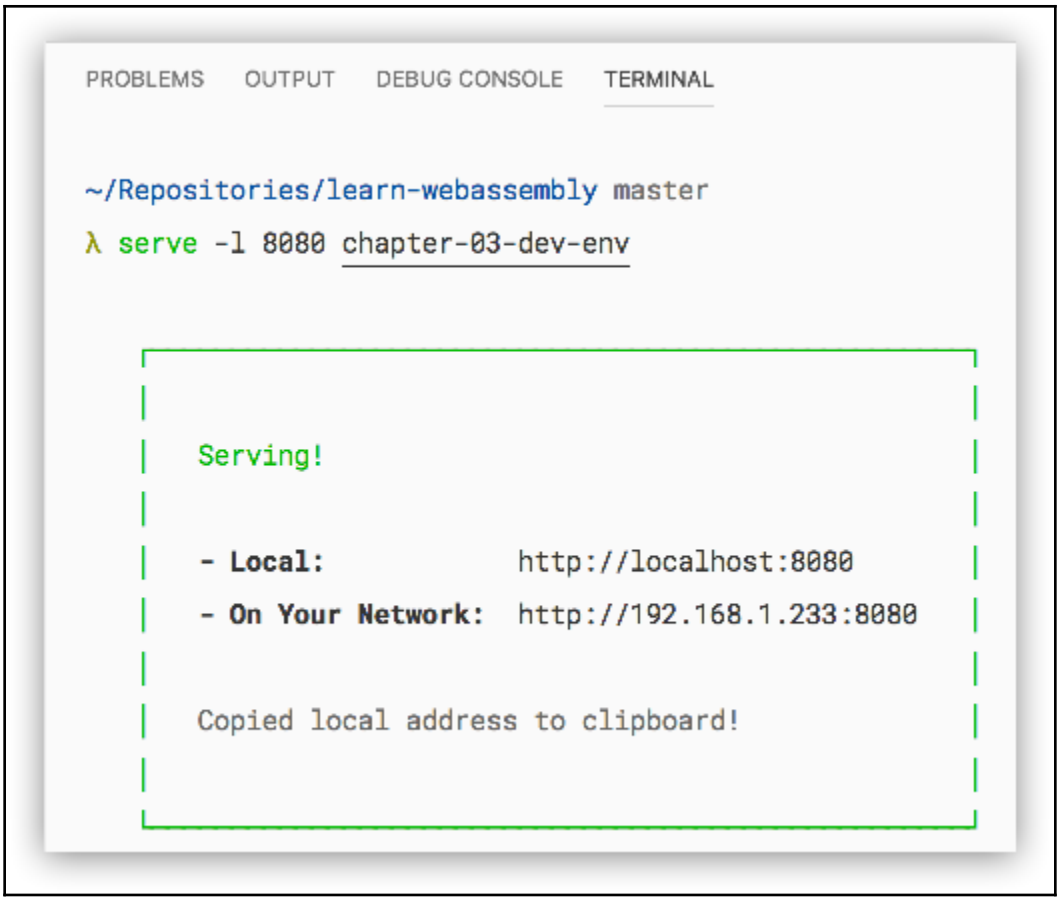


Selecting this option for a `.wasm` file shows the corresponding Wat in an editor tab

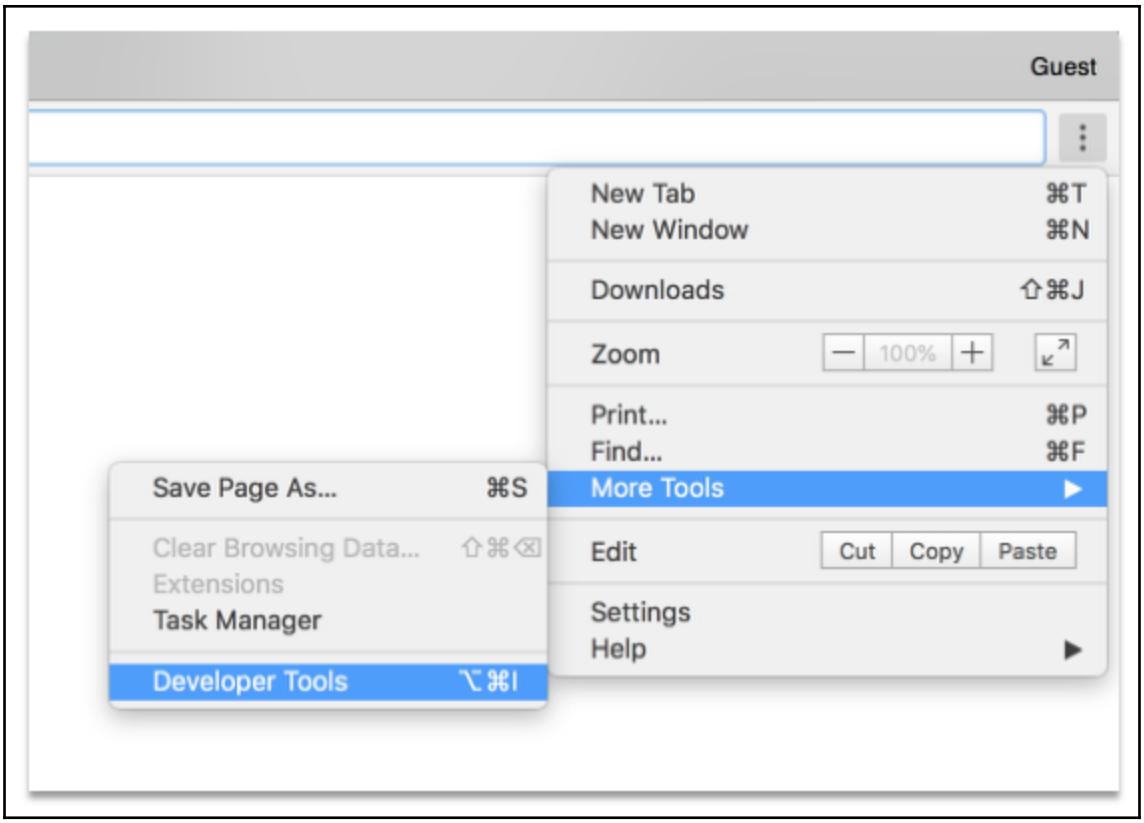

test.html
1 <html>
2 abc
3 </html>
test.html
1 <html>
2 <sp>abc</sp>
3 </htm
span
sup
samp
script
ion-spinner
Closing tag automatically
updates to reflect new tag

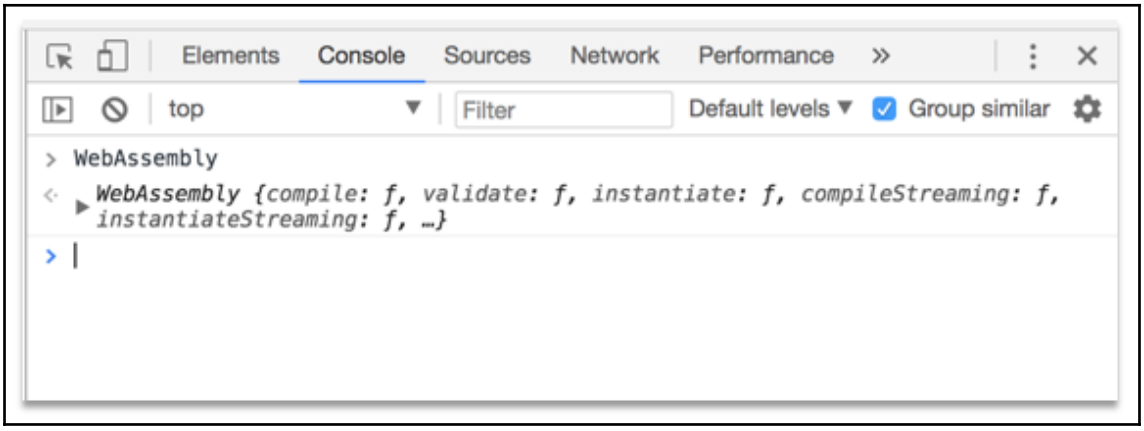

(module
(table 0 anyfunc)
(memory $0 1)
(export "memory" (memory $0))
(export "addTwo" (func $addTwo))
(func $addTwo (; 0 ;) (param $0 i32) (result i32)
(i32.add
(get_local $0)
(i32.const 2)
)
)
)

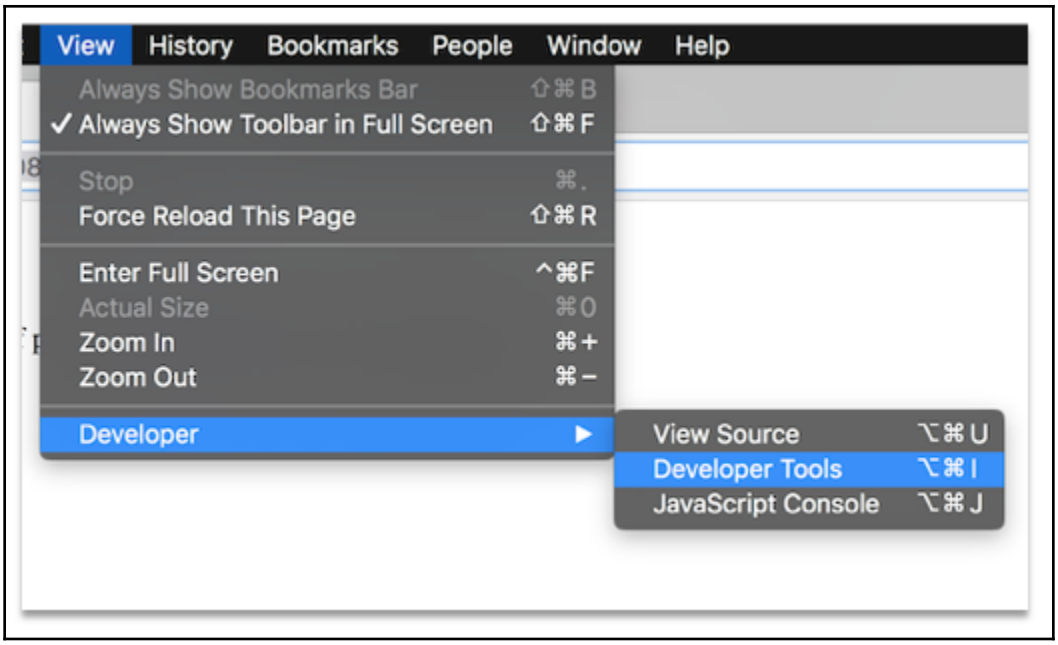

EXPLORER
OPEN EDITORS
1 UNSAVED
main.cpp src
addTwo.wat ~/Google Drive/Learn WebA...
EXAMPLES
internals
compile.js
run.js
server.js
src
main.cpp
web
index.html
index.js
main.wasm
CMakeLists.txt
package.json
yarn.lock

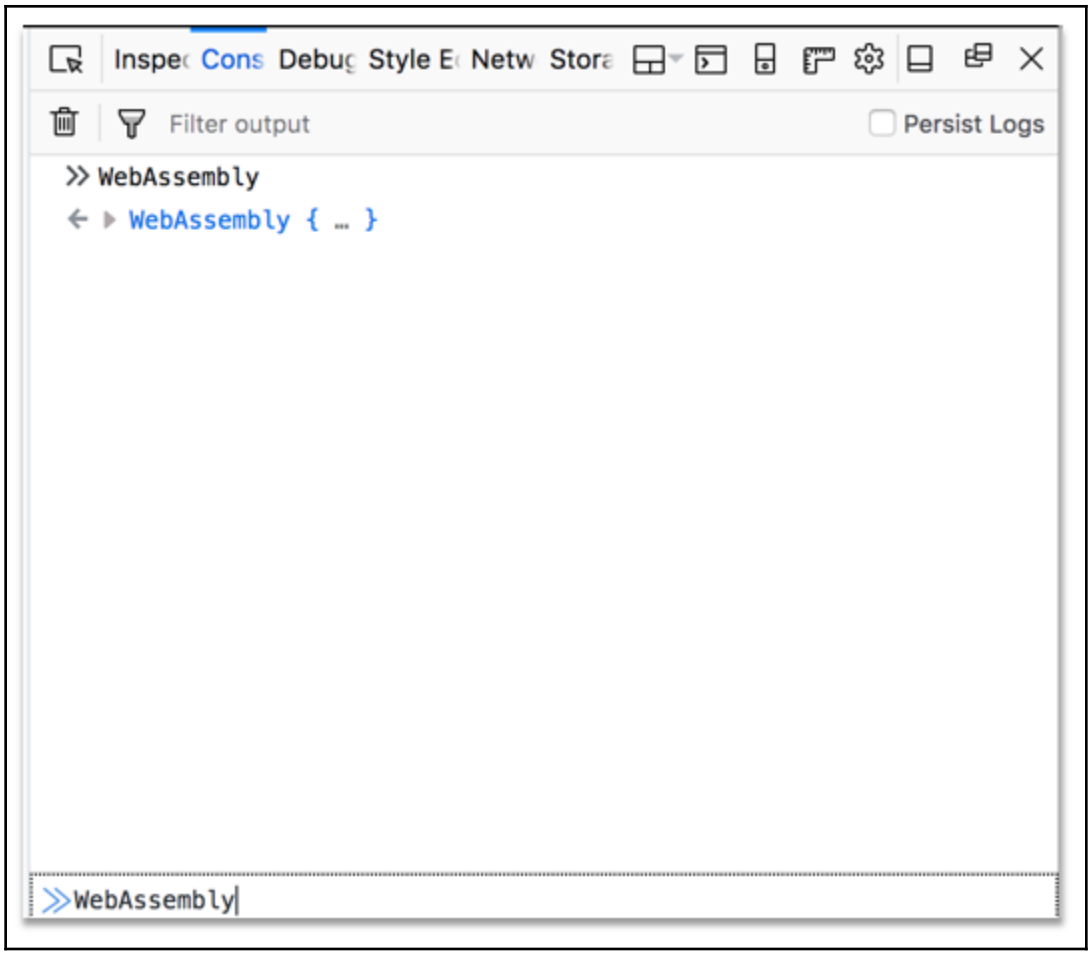

PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
~/Repositories/learn-webassembly master
λ serve -l 8080 chapter-03-dev-env
Serving!
- Local: http://localhost:8080
- On Your Network: http://192.168.1.233:8080
Copied local address to clipboard!

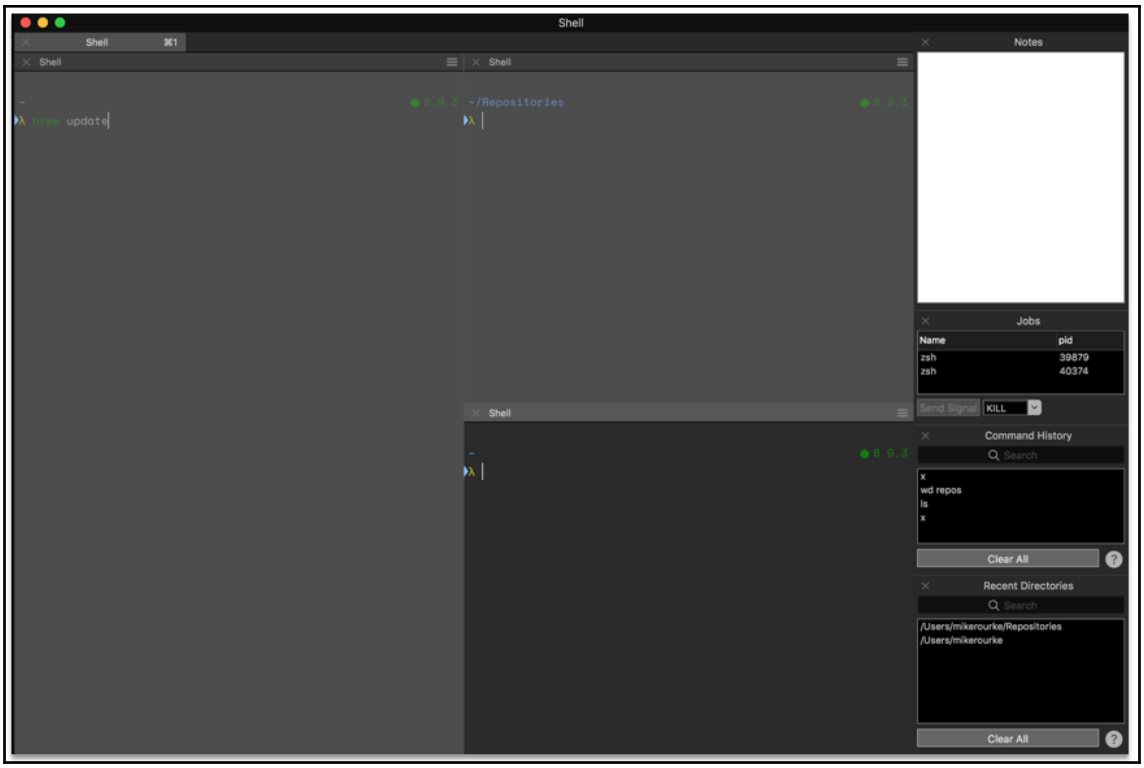

Test Server
127.0.0.1:8080
Test
This is some text on the main page. Click here to check out the stuff page.

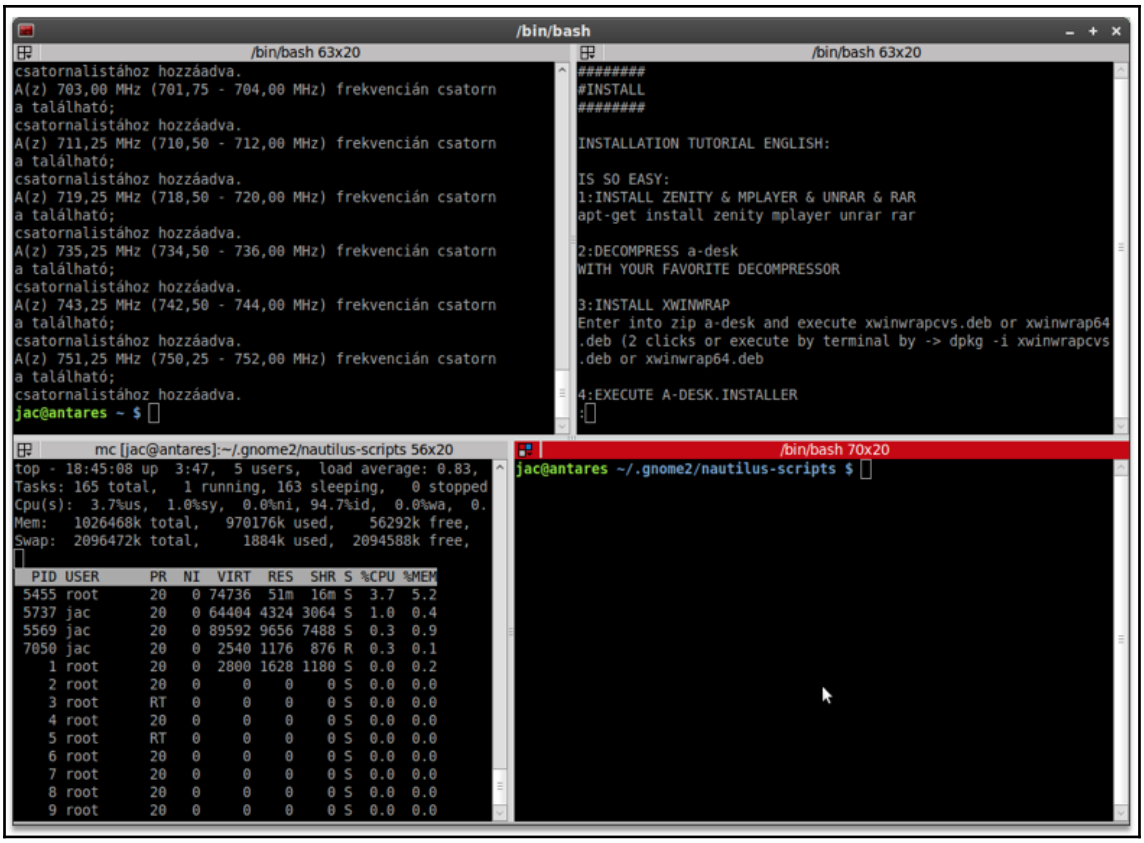

Guest
New Tab ⌘T
New Window ⌘N
Downloads ⇧⌘J
Zoom — 100% +
Print... ⌘P
Find... ⌘F
More Tools
Edit Cut Copy Paste
Settings
Help
Save Page As... ⌘S
Clear Browsing Data... ⇧⌘⌫
Extensions
Task Manager
Developer Tools ⌥⌘I

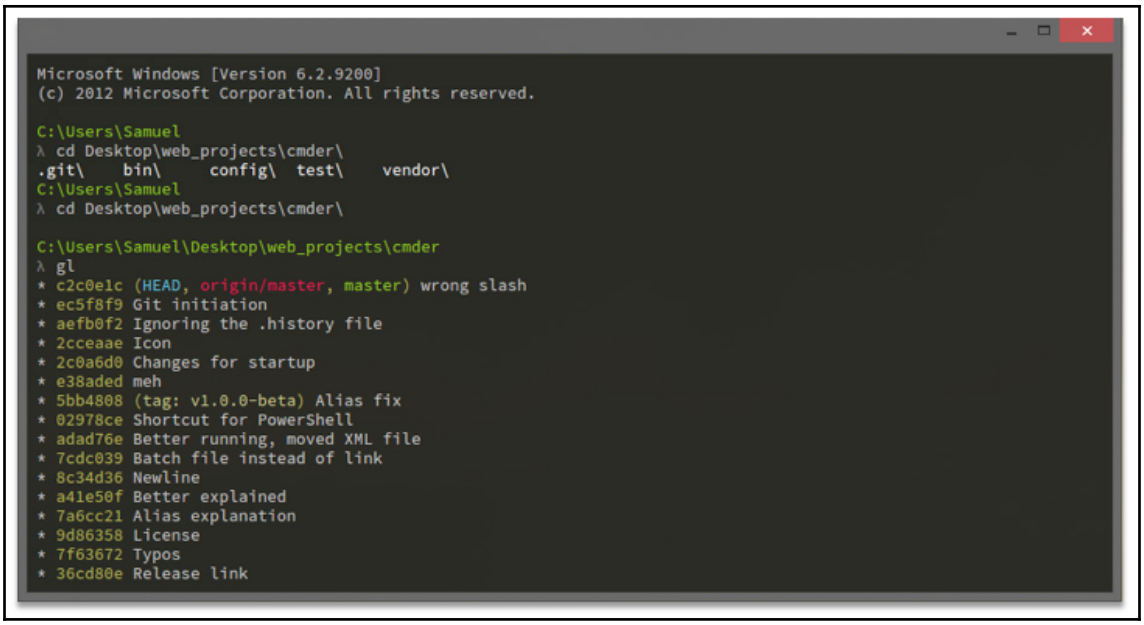

Elements
Console
Sources
Network
Performance
top
Filter
Default levels
Group similar
> WebAssembly
WebAssembly {compile: f, validate: f, instantiate: f, compileStreaming: f, instantiateStreaming: f, …}


View
History
Bookmarks
People
Window
Help
Always Show Bookmarks Bar ⇧⌘B
✓ Always Show Toolbar in Full Screen ⇧⌘F
Stop ⌘.
Force Reload This Page ⇧⌘R
Enter Full Screen ^⌘F
Actual Size ⌘0
Zoom In ⌘+
Zoom Out ⌘−
Developer ▶
View Source ⌥⌘U
Developer Tools ⌥⌘I
JavaScript Console ⌥⌘J

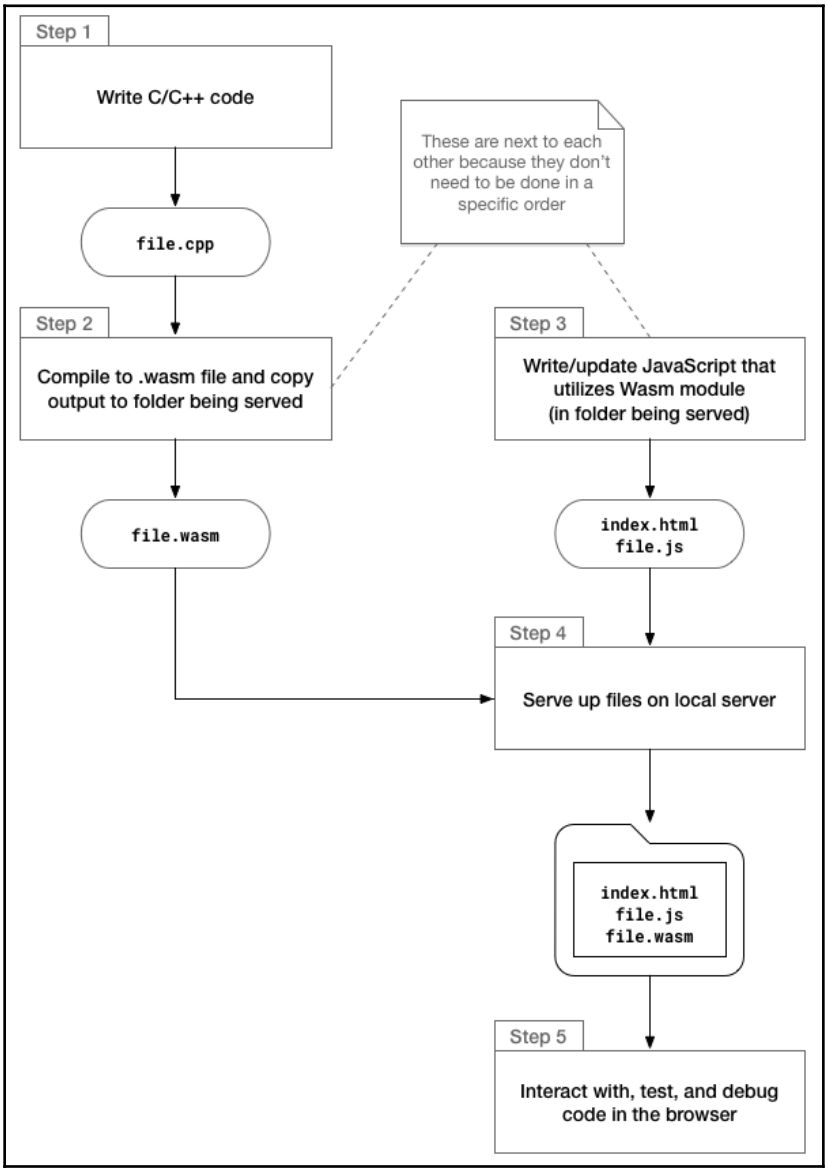

Inspe Cons Debug Style E Netw Stora
Filter output
Persist Logs
WebAssembly
WebAssembly { … }
WebAssembly

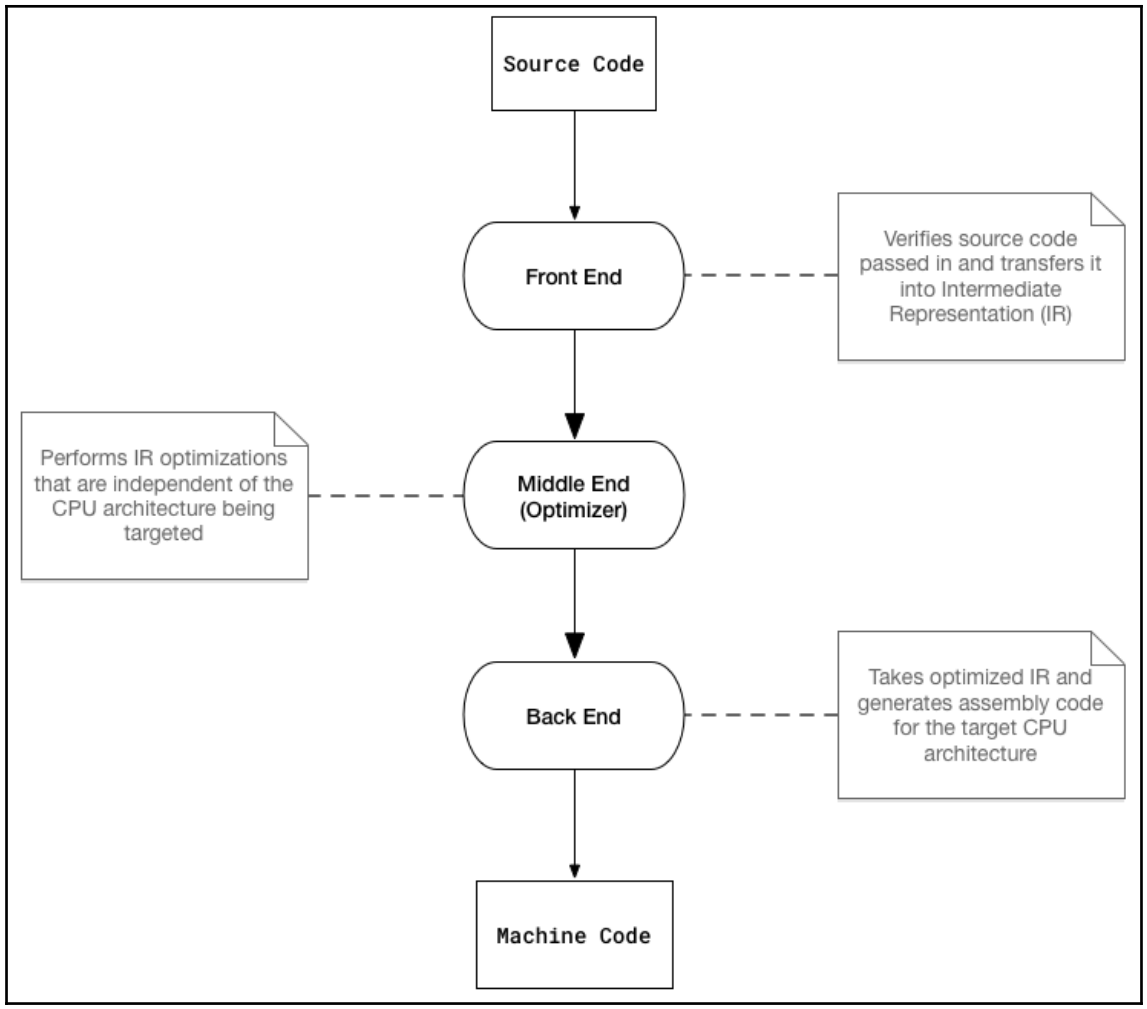

Shell
Shell ⌘1
Shell
~
brew update
Shell
~/Repositories
Shell
Notes
Jobs
Name
pid
zsh
39879
zsh
40374
Send Signal
KILL
Command History
Search
x
wd repos
ls
x
Clear All
Recent Directories
Search
/Users/mikerourke/Repositories
/Users/mikerourke
Clear All

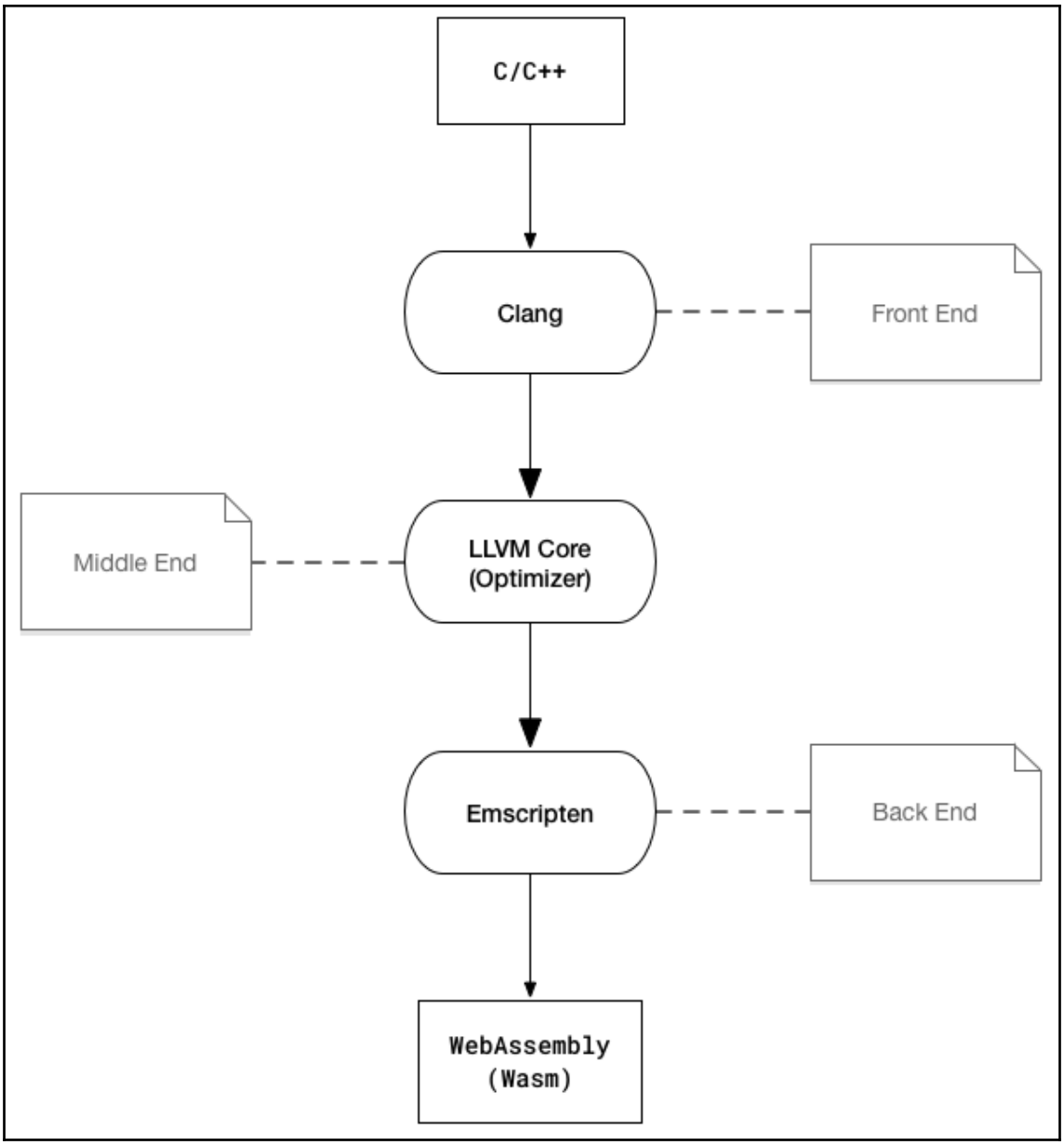

/bin/bash
/bin/bash 63x20
csatornalistához hozzáadva.
A(z) 703,00 MHz (701,75 - 704,00 MHz) frekvencián csatorn
a található;
csatornalistához hozzáadva.
A(z) 711,25 MHz (710,50 - 712,00 MHz) frekvencián csatorn
a található;
csatornalistához hozzáadva.
A(z) 719,25 MHz (718,50 - 720,00 MHz) frekvencián csatorn
a található;
csatornalistához hozzáadva.
A(z) 735,25 MHz (734,50 - 736,00 MHz) frekvencián csatorn
a található;
csatornalistához hozzáadva.
A(z) 743,25 MHz (742,50 - 744,00 MHz) frekvencián csatorn
a található;
csatornalistához hozzáadva.
A(z) 751,25 MHz (750,25 - 752,00 MHz) frekvencián csatorn
a található;
csatornalistához hozzáadva.
jac@antares ~ $
/bin/bash 63x20
########
#INSTALL
########
INSTALLATION TUTORIAL ENGLISH:
IS SO EASY:
1:INSTALL ZENITY & MPLAYER & UNRAR & RAR
apt-get install zenity mplayer unrar rar
2:DECOMPRESS a-desk
WITH YOUR FAVORITE DECOMPRESSOR
3:INSTALL XWINWRAP
Enter into zip a-desk and execute xwinwrapcvs.deb or xwinwrap64
.deb (2 clicks or execute by terminal by -> dpkg -i xwinwrapcvs
.deb or xwinwrap64.deb
4:EXECUTE A-DESK.INSTALLER
mc [jac@antares]:~/.gnome2/nautilus-scripts 56x20
top - 18:45:08 up 3:47, 5 users, load average: 0.83,
Tasks: 165 total, 1 running, 163 sleeping, 0 stopped
Cpu(s): 3.7%us, 1.0%sy, 0.0%ni, 94.7%id, 0.0%wa, 0.
Mem: 1026468k total, 970176k used, 56292k free,
Swap: 2096472k total, 1884k used, 2094588k free,
PID USER PR NI VIRT RES SHR S %CPU %MEM
5455 root 20 0 74736 51m 16m S 3.7 5.2
5737 jac 20 0 64404 4324 3064 S 1.0 0.4
5569 jac 20 0 89592 9656 7488 S 0.3 0.9
7050 jac 20 0 2540 1176 876 R 0.3 0.1
1 root 20 0 2800 1628 1180 S 0.0 0.2
2 root 20 0 0 0 0 S 0.0 0.0
3 root RT 0 0 0 0 S 0.0 0.0
4 root 20 0 0 0 0 S 0.0 0.0
5 root RT 0 0 0 0 S 0.0 0.0
6 root 20 0 0 0 0 S 0.0 0.0
7 root 20 0 0 0 0 S 0.0 0.0
8 root 20 0 0 0 0 S 0.0 0.0
9 root 20 0 0 0 0 S 0.0 0.0
/bin/bash 70x20
jac@antares ~/.gnome2/nautilus-scripts $

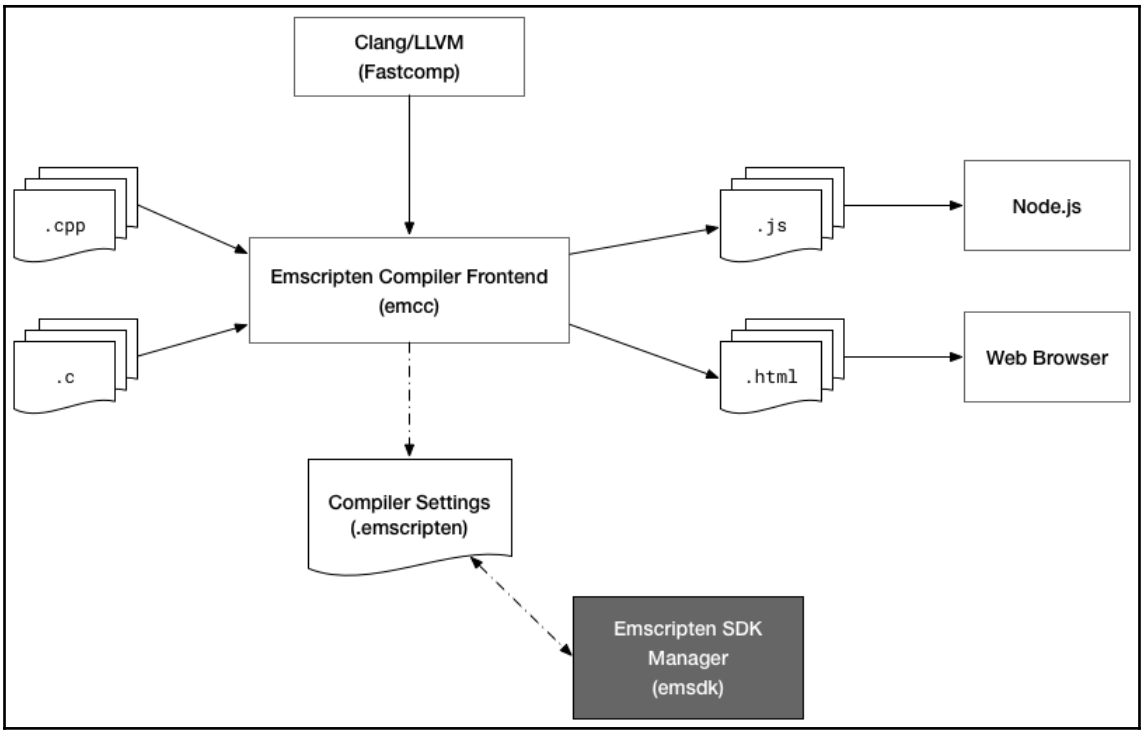

Microsoft Windows [Version 6.2.9200]
(c) 2012 Microsoft Corporation. All rights reserved.
C:\Users\Samuel
λ cd Desktop\web_projects\cmder\
.git\ bin\ config\ test\ vendor\
C:\Users\Samuel
λ cd Desktop\web_projects\cmder\
C:\Users\Samuel\Desktop\web_projects\cmder
λ gl
* c2c0e1c (HEAD, origin/master, master) wrong slash
* ec5f8f9 Git initiation
* aefb0f2 Ignoring the .history file
* 2cceaae Icon
* 2c0a6d0 Changes for startup
* e38aded meh
* 5bb4808 (tag: v1.0.0-beta) Alias fix
* 02978ce Shortcut for PowerShell
* adad76e Better running, moved XML file
* 7cdc039 Batch file instead of link
* 8c34d36 Newline
* a41e50f Better explained
* 7a6cc21 Alias explanation
* 9d86358 License
* 7f63672 Typos
* 36cd80e Release link

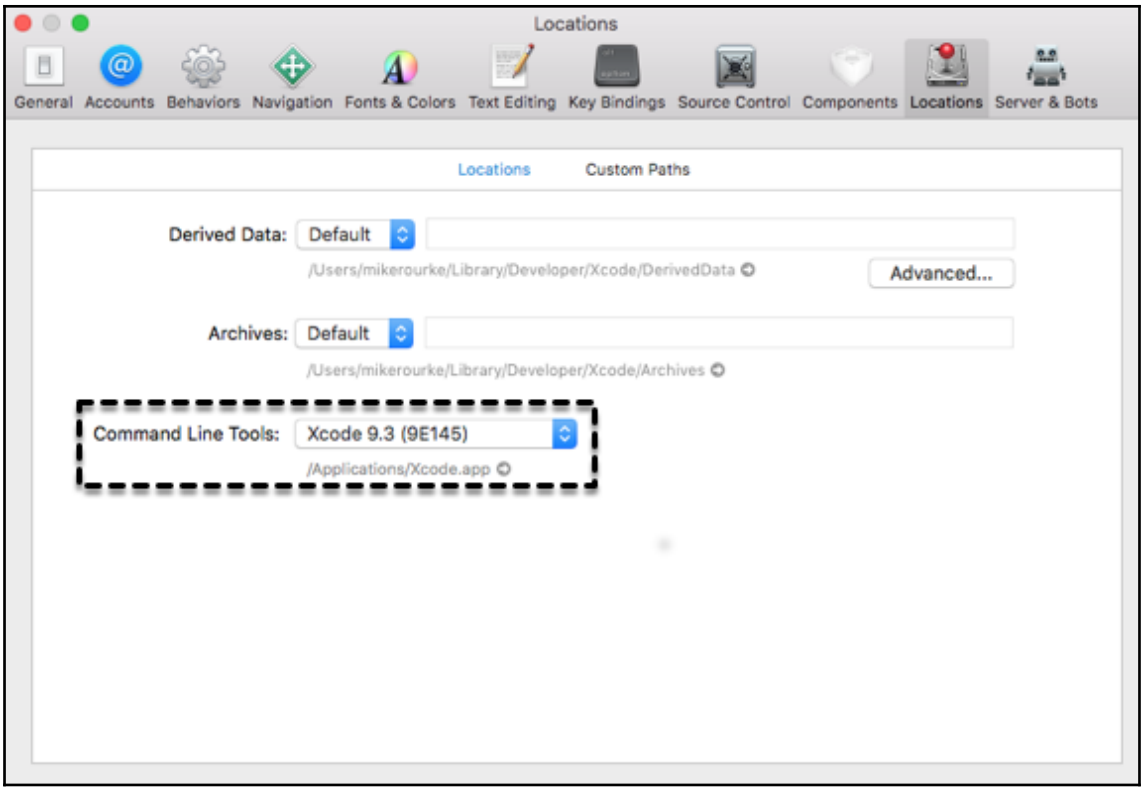
Chapter 4: Installing the Required Dependencies



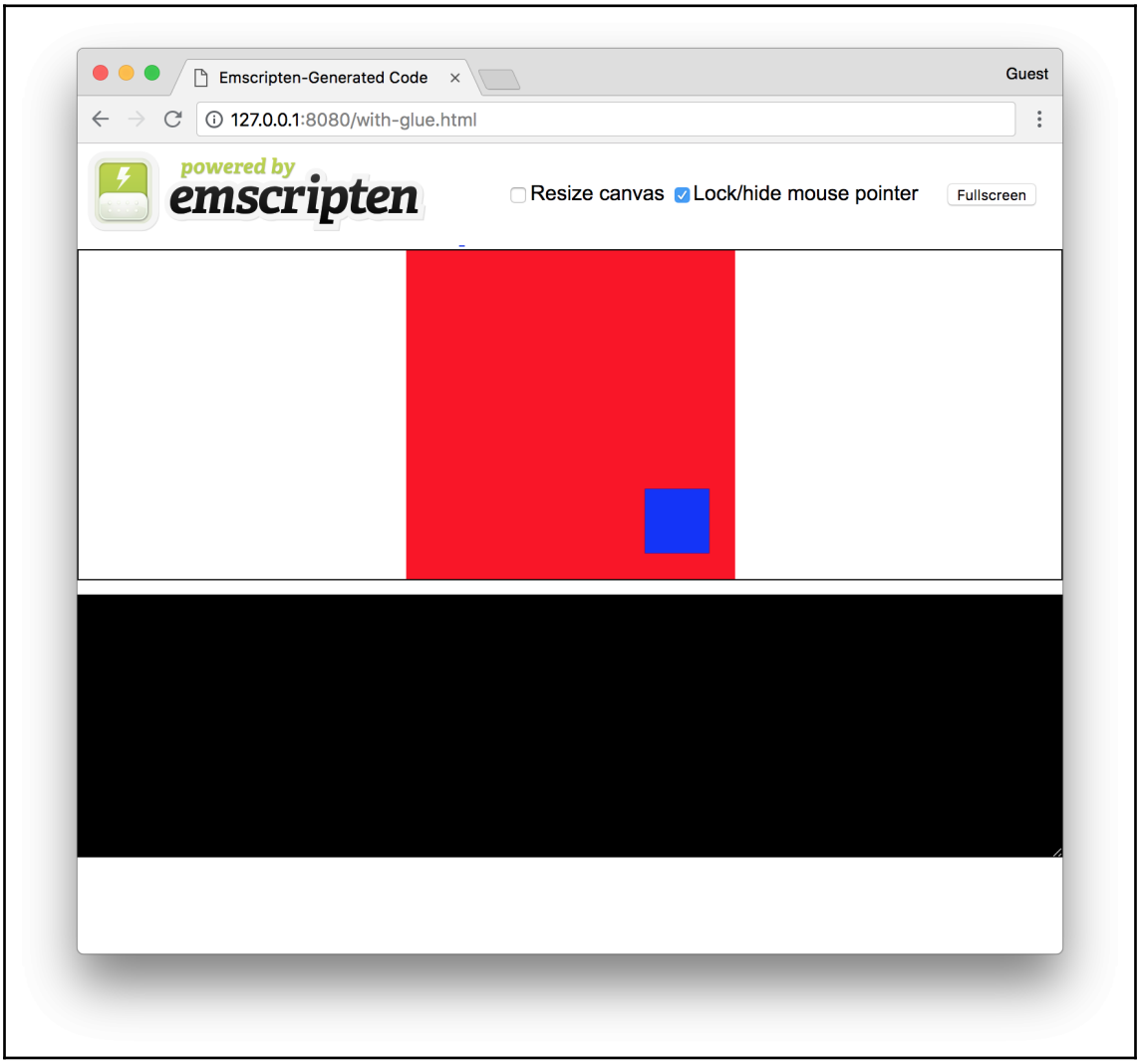

Source Code
Front End
Verifies source code passed in and transfers it into Intermediate Representation (IR)
Performs IR optimizations that are independent of the CPU architecture being targeted
Middle End (Optimizer)
Back End
Takes optimized IR and generates assembly code for the target CPU architecture
Machine Code

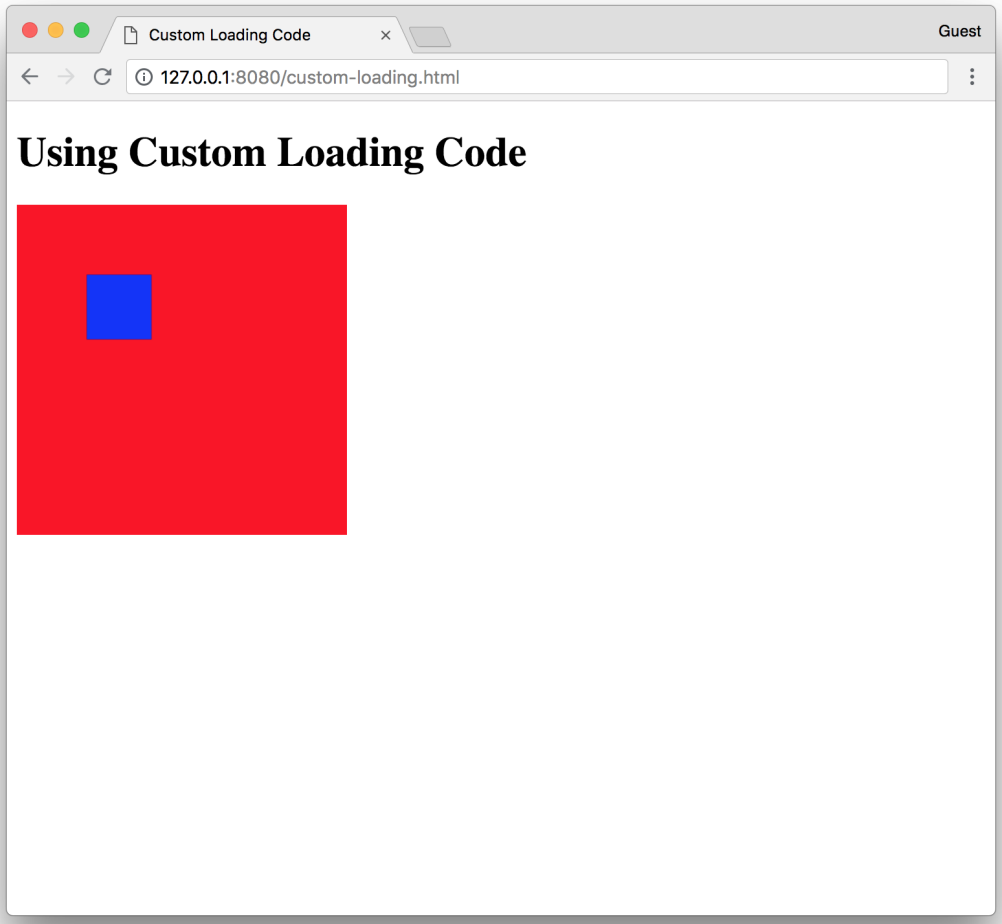

C/C++
Clang
Front End
Middle End
LLVM Core
(Optimizer)
Emscripten
Back End
WebAssembly
(Wasm)

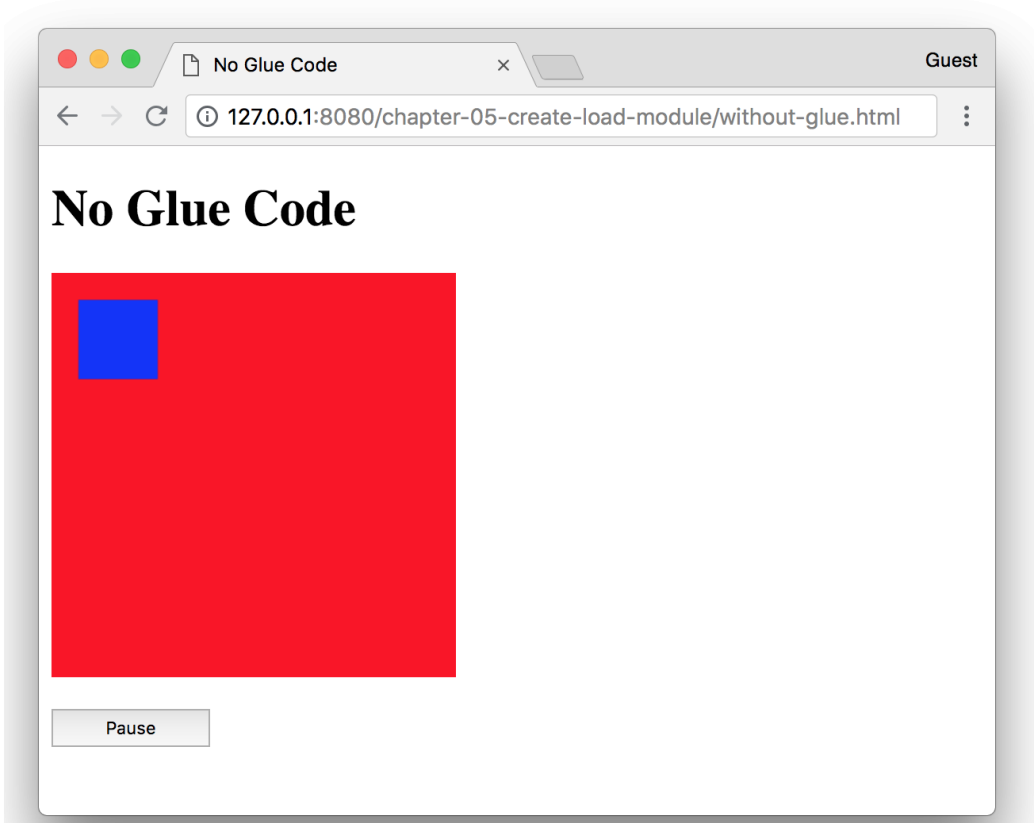

Clang/LLVM
(Fastcomp)
.cpp
.c
Emscripten Compiler Frontend
(emcc)
.js
.html
Node.js
Web Browser
Compiler Settings
(.emscripten)
Emscripten SDK
Manager
(emsdk)


Locations
General
Accounts
Behaviors
Navigation
Fonts & Colors
Text Editing
Key Bindings
Source Control
Components
Locations
Server & Bots
Locations
Custom Paths
Derived Data:
Default
/Users/mikerourke/Library/Developer/Xcode/DerivedData
Advanced...
Archives:
Default
/Users/mikerourke/Library/Developer/Xcode/Archives
Command Line Tools:
Xcode 9.3 (9E145)
/Applications/Xcode.app

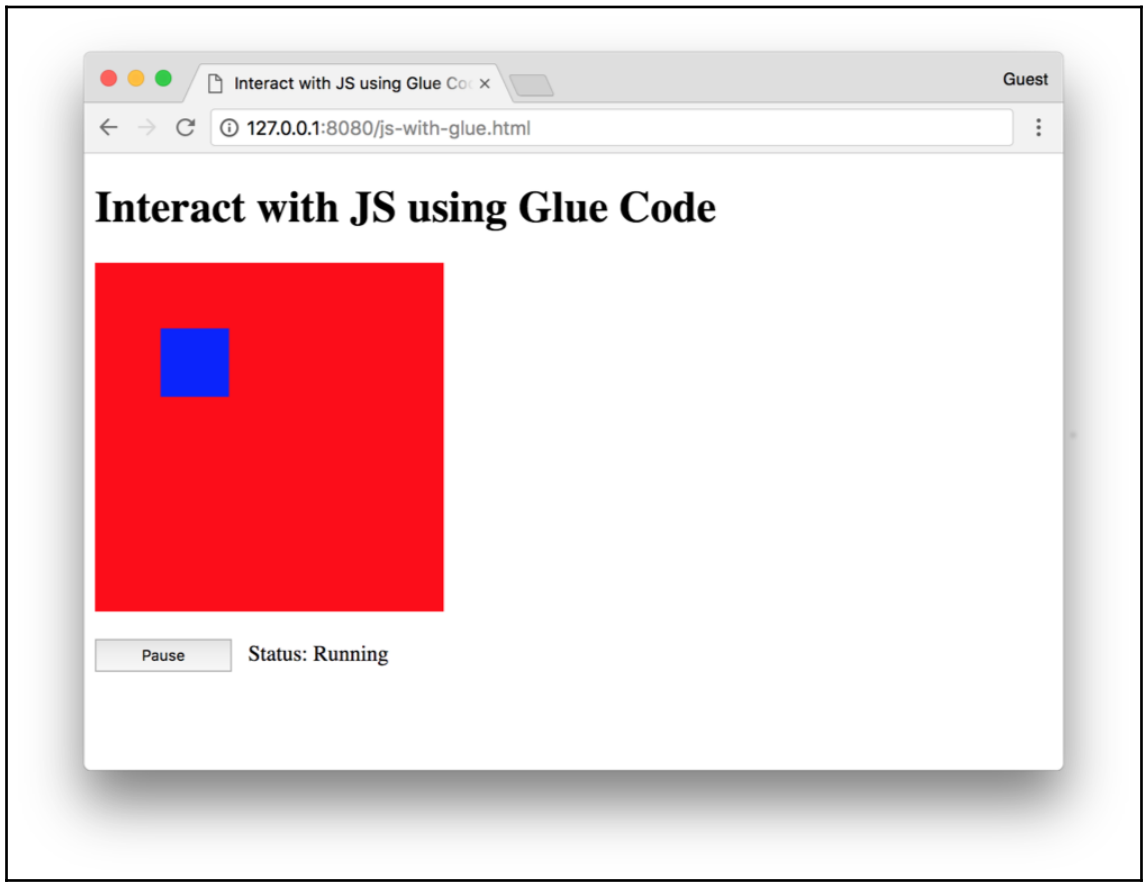
Chapter 5: Creating and Loading a WebAssembly Module

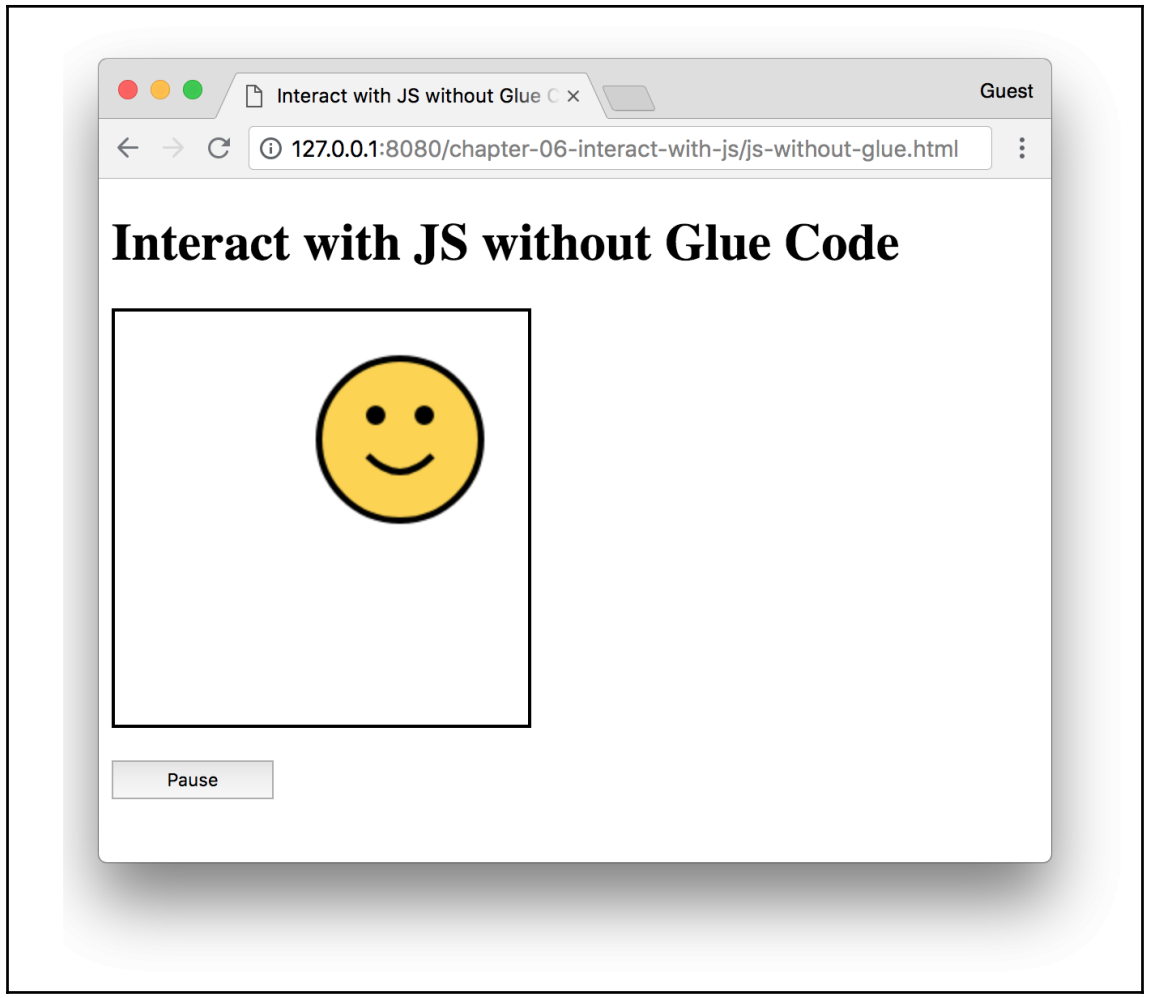


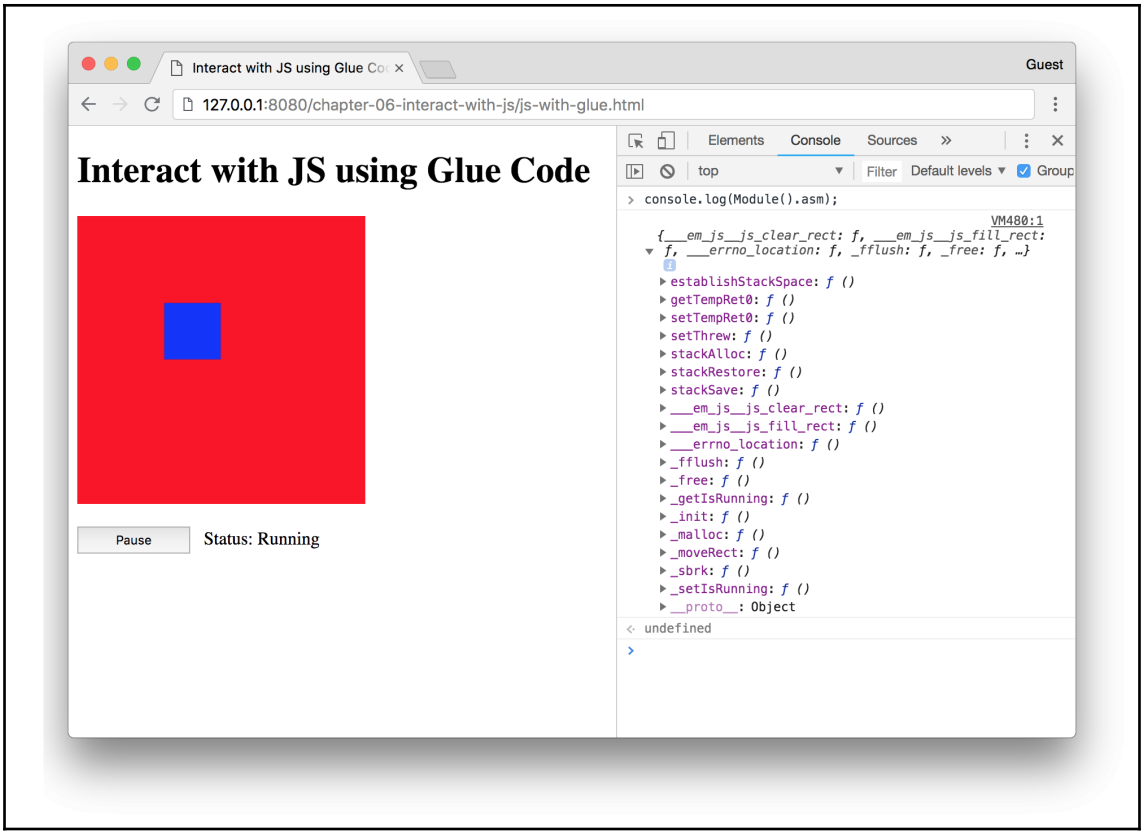

Custom Loading Code
Guest
127.0.0.1:8080/custom-loading.html
Using Custom Loading Code

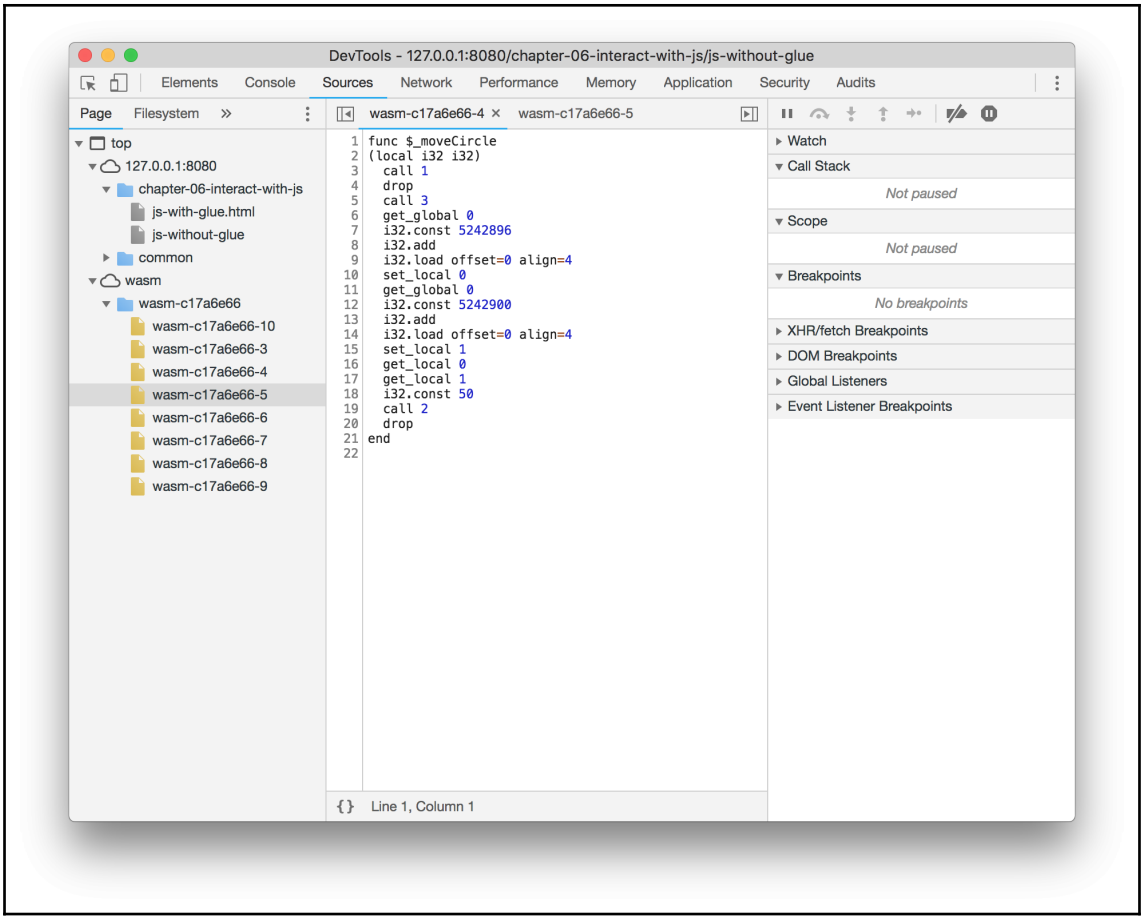

No Glue Code
Guest
127.0.0.1:8080/chapter-05-create-load-module/without-glue.html
No Glue Code
Pause

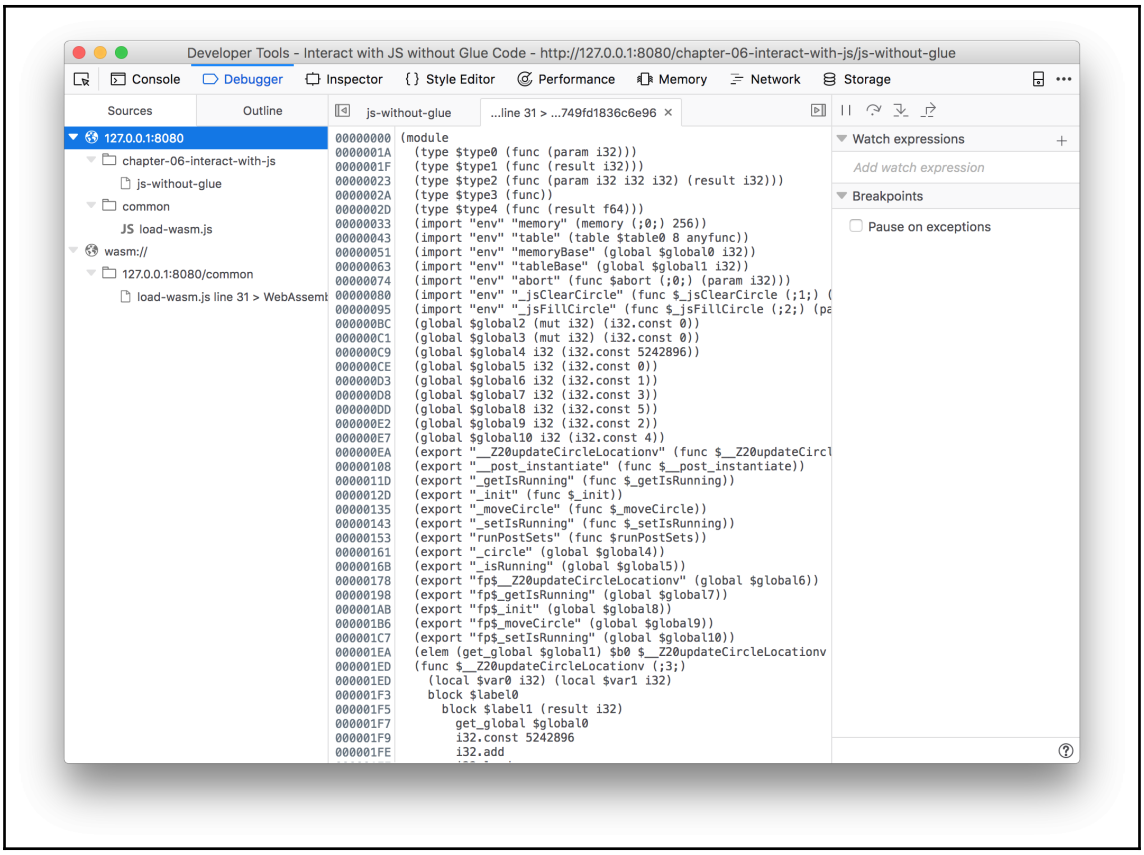
Chapter 6: Interacting with JavaScript and Debugging



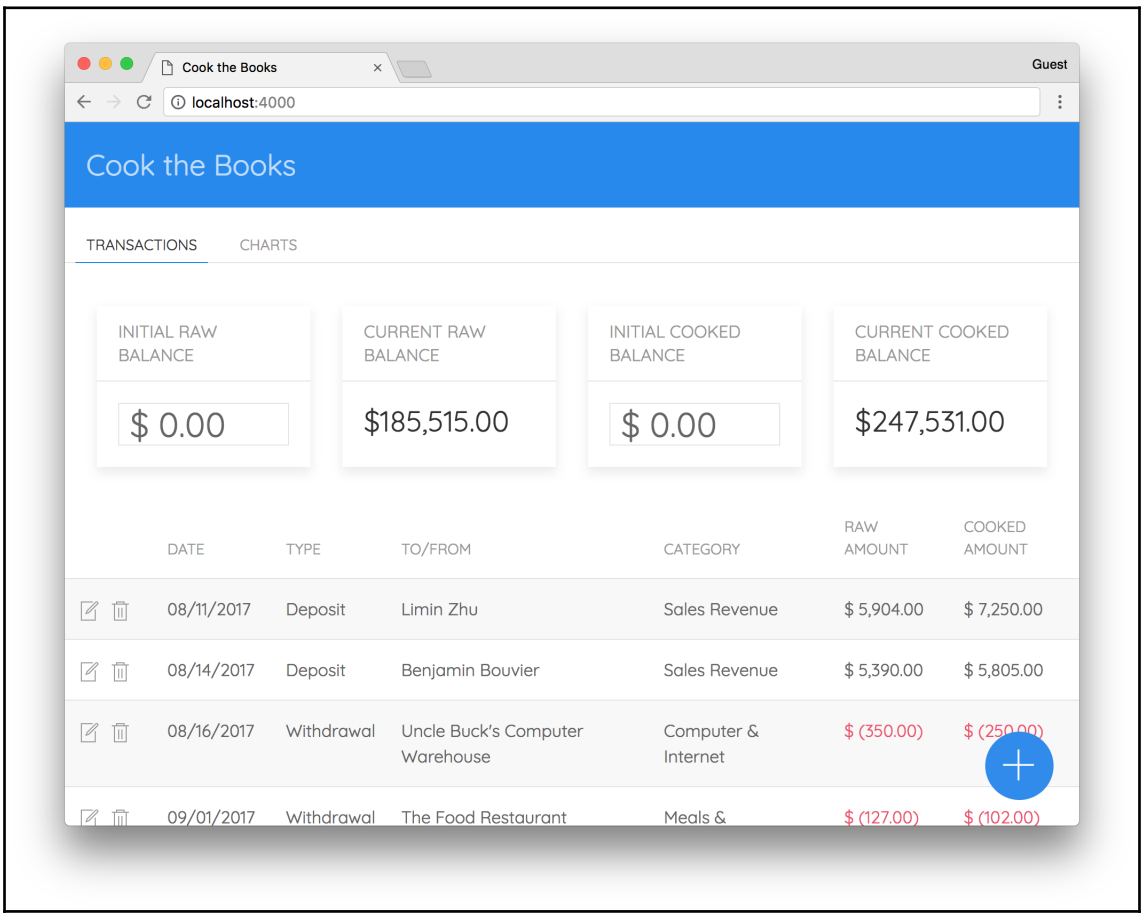

Interact with JS without Glue
Guest
127.0.0.1:8080/chapter-06-interact-with-js/js-without-glue.html
Interact with JS without Glue Code
Pause

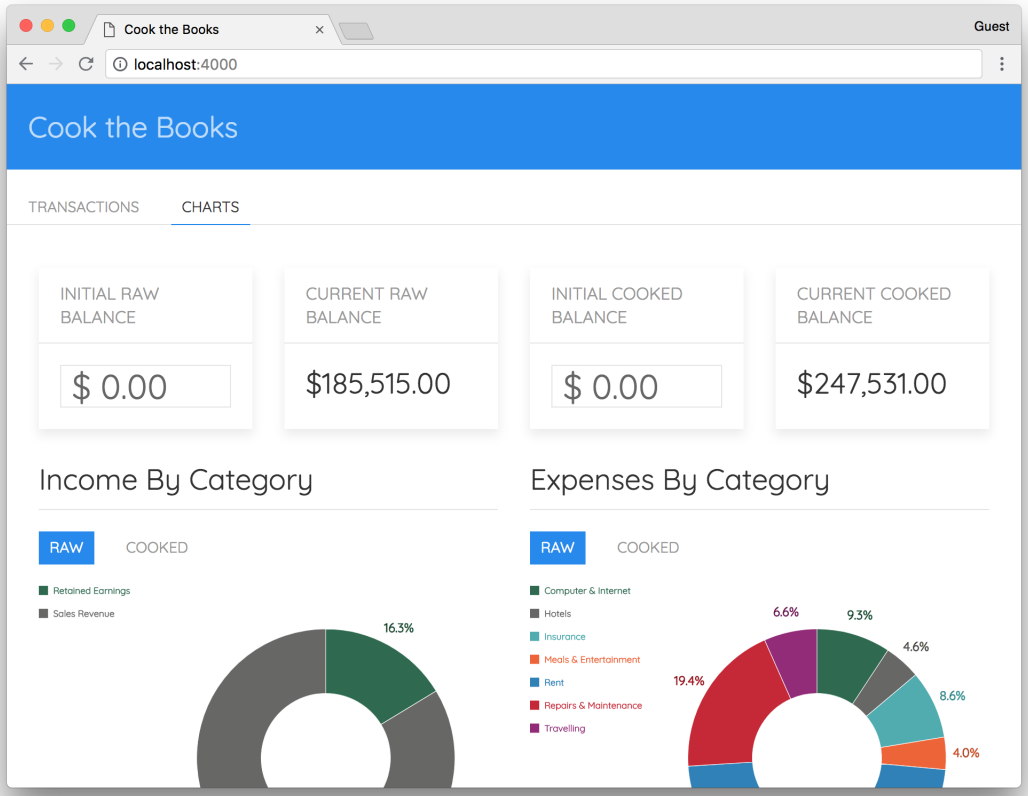

Interact with JS using Glue Co
Guest
127.0.0.1:8080/chapter-06-interact-with-js/js-with-glue.html
Interact with JS using Glue Code
Pause
Status: Running
Elements
Console
Sources
top
Filter
Default levels
Group
console.log(Module().asm);
VM480:1
{___em_js__js_clear_rect: ƒ, ___em_js__js_fill_rect: ƒ, ___errno_location: ƒ, _fflush: ƒ, _free: ƒ, …}
establishStackSpace: ƒ ()
getTempRet0: ƒ ()
setTempRet0: ƒ ()
setThrew: ƒ ()
stackAlloc: ƒ ()
stackRestore: ƒ ()
stackSave: ƒ ()
___em_js__js_clear_rect: ƒ ()
___em_js__js_fill_rect: ƒ ()
___errno_location: ƒ ()
_fflush: ƒ ()
_free: ƒ ()
_getIsRunning: ƒ ()
_init: ƒ ()
_malloc: ƒ ()
_moveRect: ƒ ()
_sbrk: ƒ ()
_setIsRunning: ƒ ()
__proto__: Object
undefined

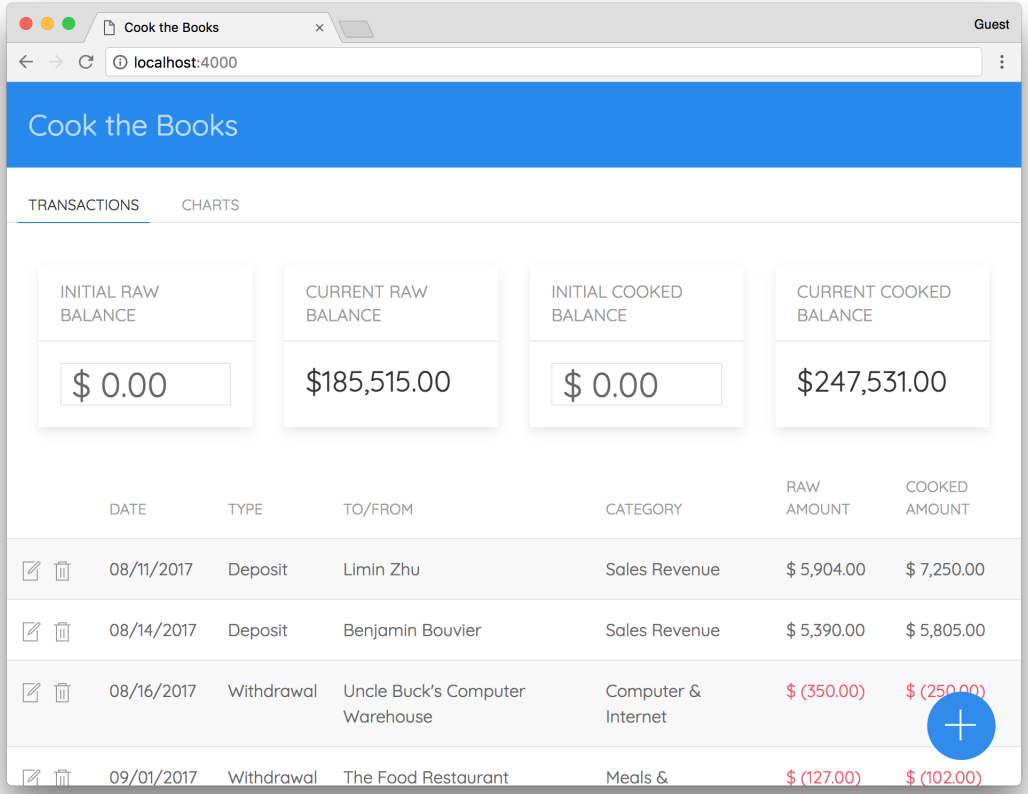

DevTools - 127.0.0.1:8080/chapter-06-interact-with-js/js-without-glue
Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Page
Filesystem
top
127.0.0.1:8080
chapter-06-interact-with-js
js-with-glue.html
js-without-glue
common
wasm
wasm-c17a6e66
wasm-c17a6e66-10
wasm-c17a6e66-3
wasm-c17a6e66-4
wasm-c17a6e66-5
wasm-c17a6e66-6
wasm-c17a6e66-7
wasm-c17a6e66-8
wasm-c17a6e66-9
wasm-c17a6e66-4
wasm-c17a6e66-5
1 func $_moveCircle
2 (local i32 i32)
3 call 1
4 drop
5 call 3
6 get_global 0
7 i32.const 5242896
8 i32.add
9 i32.load offset=0 align=4
10 set_local 0
11 get_global 0
12 i32.const 5242900
13 i32.add
14 i32.load offset=0 align=4
15 set_local 1
16 get_local 0
17 get_local 1
18 i32.const 50
19 call 2
20 drop
21 end
22
{}
Line 1, Column 1
Watch
Call Stack
Not paused
Scope
Not paused
Breakpoints
No breakpoints
XHR/fetch Breakpoints
DOM Breakpoints
Global Listeners
Event Listener Breakpoints

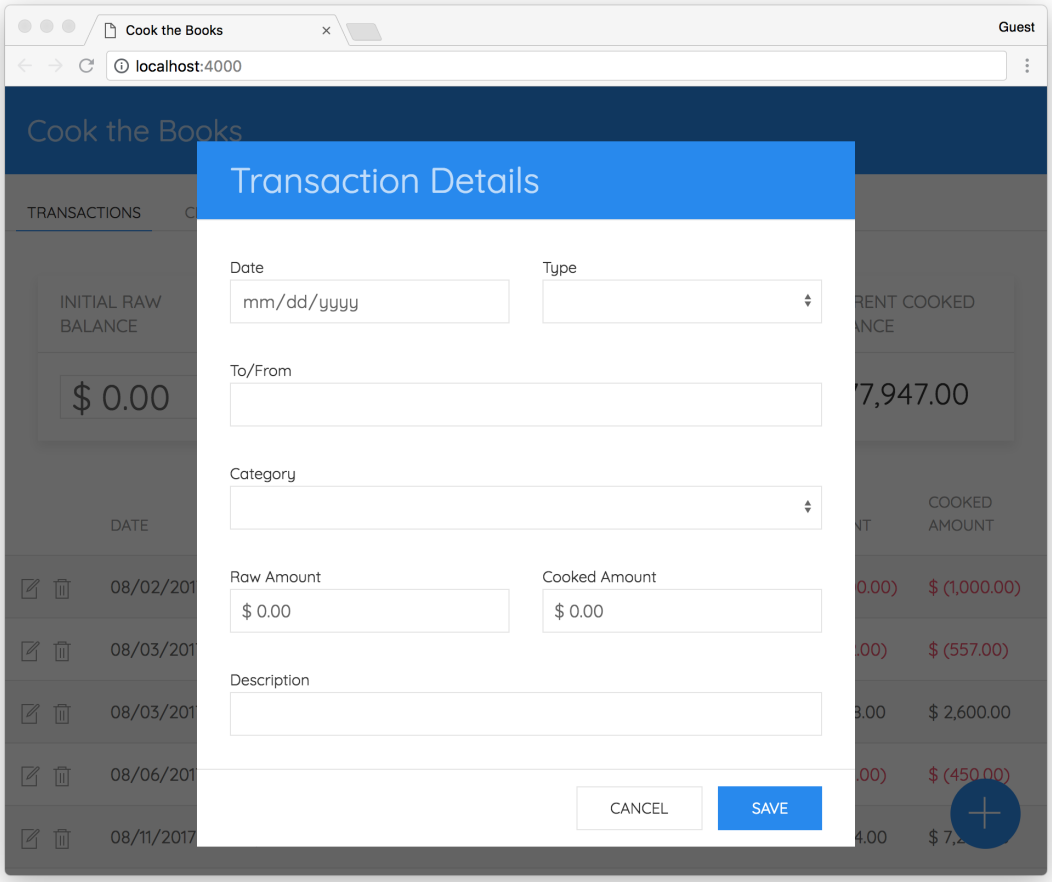

Developer Tools - Interact with JS without Glue Code - http://127.0.0.1:8080/chapter-06-interact-with-js/js-without-glue
Console
Debugger
Inspector
Style Editor
Performance
Memory
Network
Storage
Sources
Outline
127.0.0.1:8080
chapter-06-interact-with-js
js-without-glue
common
load-wasm.js
wasm://
127.0.0.1:8080/common
load-wasm.js line 31 > WebAssemb
js-without-glue
...line 31 > ...749fd1836c6e96
00000000 (module
0000001A (type $type0 (func (param i32)))
0000001F (type $type1 (func (result i32)))
00000023 (type $type2 (func (param i32 i32 i32) (result i32)))
0000002A (type $type3 (func))
0000002D (type $type4 (func (result f64)))
00000033 (import "env" "memory" (memory (;0;) 256))
00000043 (import "env" "table" (table $table0 8 anyfunc))
00000051 (import "env" "memoryBase" (global $global0 i32))
00000063 (import "env" "tableBase" (global $global1 i32))
00000074 (import "env" "abort" (func $abort (;0;) (param i32)))
00000080 (import "env" "_jsClearCircle" (func $_jsClearCircle (;1;) (
00000095 (import "env" "_jsFillCircle" (func $_jsFillCircle (;2;) (pa
000000BC (global $global2 (mut i32) (i32.const 0))
000000C1 (global $global3 (mut i32) (i32.const 0))
000000C9 (global $global4 i32 (i32.const 5242896))
000000CE (global $global5 i32 (i32.const 0))
000000D3 (global $global6 i32 (i32.const 1))
000000D8 (global $global7 i32 (i32.const 3))
000000DD (global $global8 i32 (i32.const 5))
000000E2 (global $global9 i32 (i32.const 2))
000000E7 (global $global10 i32 (i32.const 4))
000000EA (export "__Z20updateCircleLocationv" (func $__Z20updateCircl
00000108 (export "__post_instantiate" (func $__post_instantiate))
0000011D (export "_getIsRunning" (func $_getIsRunning))
0000012D (export "_init" (func $_init))
00000135 (export "_moveCircle" (func $_moveCircle))
00000143 (export "_setIsRunning" (func $_setIsRunning))
00000153 (export "runPostSets" (func $runPostSets))
00000161 (export "_circle" (global $global4))
0000016B (export "_isRunning" (global $global5))
00000178 (export "fp$__Z20updateCircleLocationv" (global $global6))
00000198 (export "fp$_getIsRunning" (global $global7))
000001AB (export "fp$_init" (global $global8))
000001B6 (export "fp$_moveCircle" (global $global9))
000001C7 (export "fp$_setIsRunning" (global $global10))
000001EA (elem (get_global $global1) $b0 $__Z20updateCircleLocationv
000001ED (func $__Z20updateCircleLocationv (;3;)
000001ED (local $var0 i32) (local $var1 i32)
000001F3 block $label0
000001F5 block $label1 (result i32)
000001F7 get_global $global0
000001F9 i32.const 5242896
000001FE i32.add
Watch expressions
Add watch expression
Breakpoints
Pause on exceptions

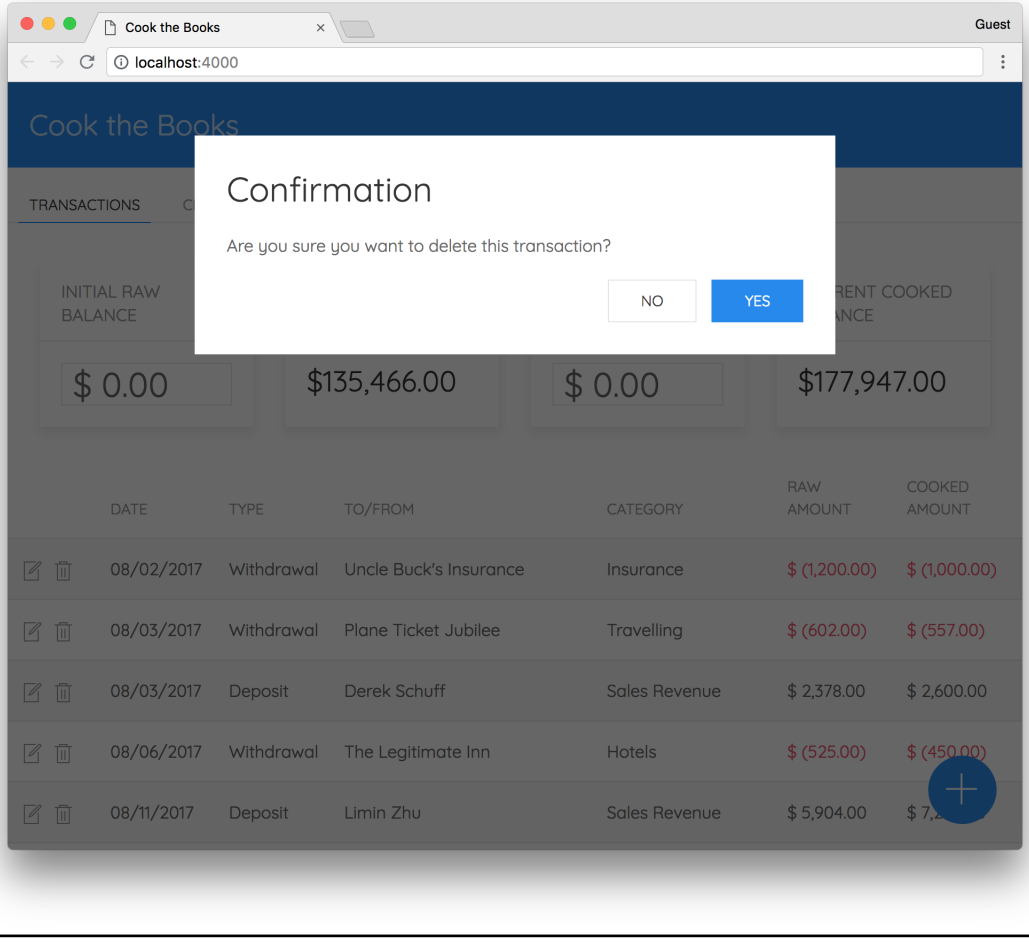
Chapter 7: Creating an Application from Scratch

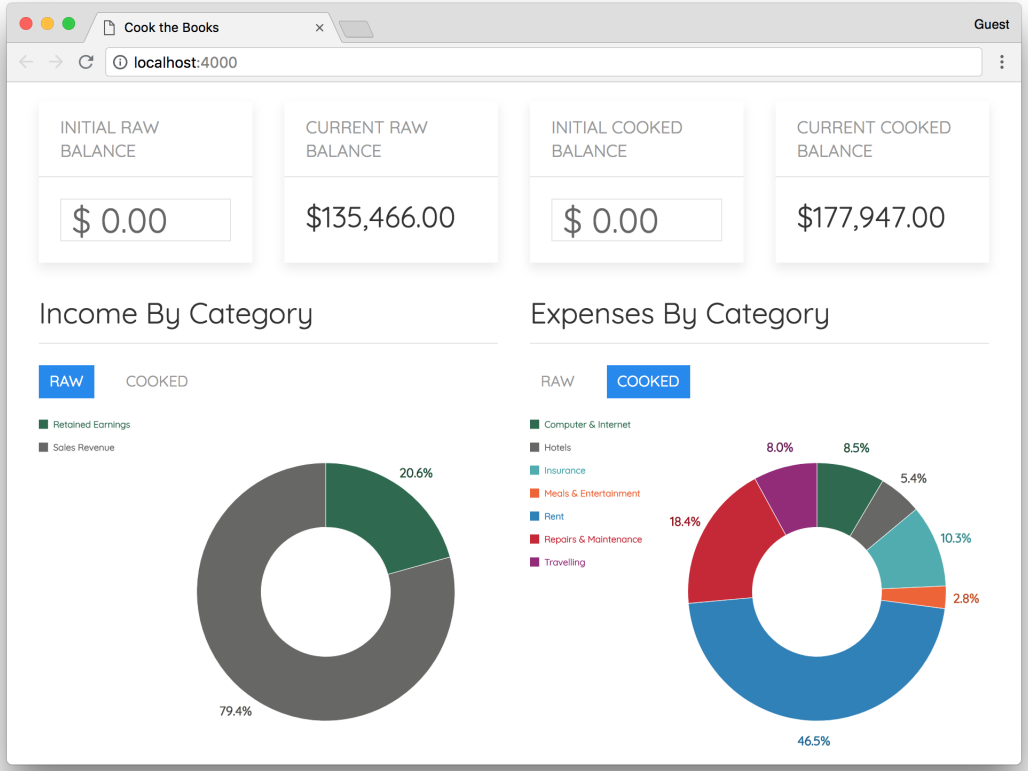



Cook the Books
Guest
localhost:4000
Cook the Books
TRANSACTIONS
CHARTS
INITIAL RAW BALANCE
$ 0.00
CURRENT RAW BALANCE
$185,515.00
INITIAL COOKED BALANCE
$ 0.00
CURRENT COOKED BALANCE
$247,531.00
Income By Category
RAW
COOKED
Retained Earnings
Sales Revenue
16.3%
Expenses By Category
RAW
COOKED
Computer & Internet
Hotels
Insurance
Meals & Entertainment
Rent
Repairs & Maintenance
Travelling
6.6%
9.3%
4.6%
8.6%
4.0%
19.4%

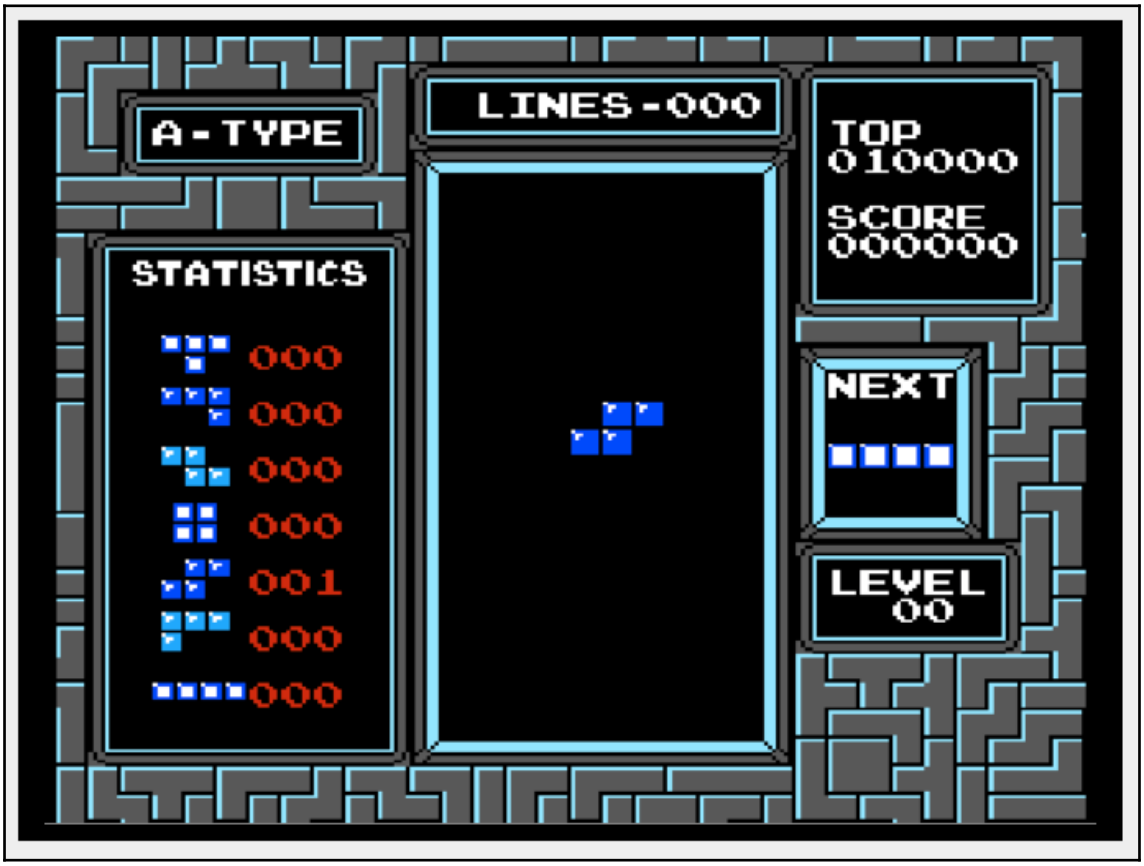

Cook the Books
Guest
localhost:4000
Cook the Books
TRANSACTIONS
CHARTS
INITIAL RAW BALANCE
$ 0.00
CURRENT RAW BALANCE
$185,515.00
INITIAL COOKED BALANCE
$ 0.00
CURRENT COOKED BALANCE
$247,531.00
DATE
TYPE
TO/FROM
CATEGORY
RAW AMOUNT
COOKED AMOUNT
08/11/2017
Deposit
Limin Zhu
Sales Revenue
$ 5,904.00
$ 7,250.00
08/14/2017
Deposit
Benjamin Bouvier
Sales Revenue
$ 5,390.00
$ 5,805.00
08/16/2017
Withdrawal
Uncle Buck's Computer Warehouse
Computer & Internet
$ (350.00)
$ (250.00)
09/01/2017
Withdrawal
The Food Restaurant
Meals &
$ (127.00)
$ (102.00)

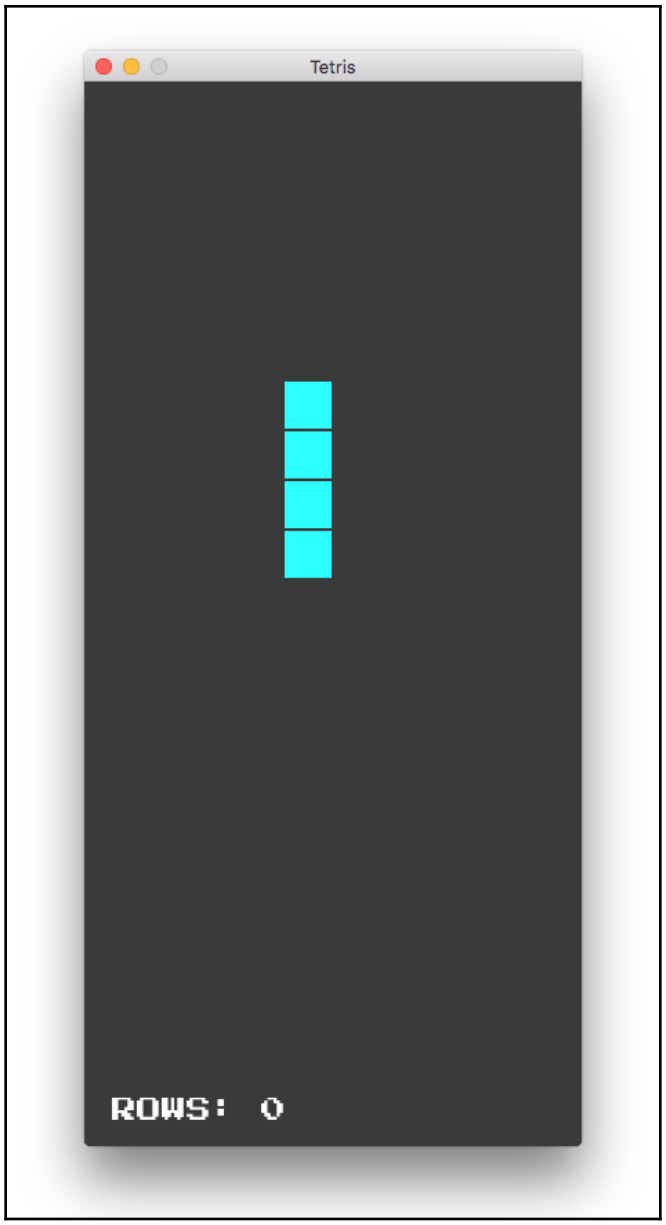

Cook the Books
Guest
localhost:4000
Cook the Books
TRANSACTIONS
INITIAL RAW BALANCE
$ 0.00
DATE
COOKED AMOUNT
$ (1,000.00)
$ (557.00)
$ 2,600.00
$ (450.00)
Transaction Details
Date
mm/dd/yyyy
Type
To/From
Category
Raw Amount
$ 0.00
Cooked Amount
$ 0.00
Description
CANCEL
SAVE

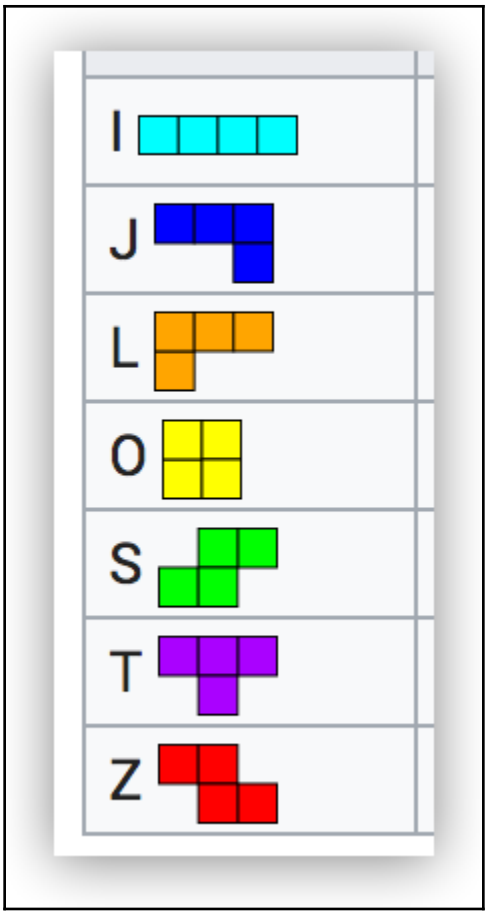

Cook the Books
Guest
localhost:4000
Cook the Books
TRANSACTIONS
Confirmation
Are you sure you want to delete this transaction?
NO
YES
INITIAL RAW BALANCE
$ 0.00
$135,466.00
$ 0.00
$177,947.00
DATE
TYPE
TO/FROM
CATEGORY
RAW AMOUNT
COOKED AMOUNT
08/02/2017 Withdrawal Uncle Buck's Insurance Insurance $ (1,200.00) $ (1,000.00)
08/03/2017 Withdrawal Plane Ticket Jubilee Travelling $ (602.00) $ (557.00)
08/03/2017 Deposit Derek Schuff Sales Revenue $ 2,378.00 $ 2,600.00
08/06/2017 Withdrawal The Legitimate Inn Hotels $ (525.00) $ (450.00)
08/11/2017 Deposit Limin Zhu Sales Revenue $ 5,904.00

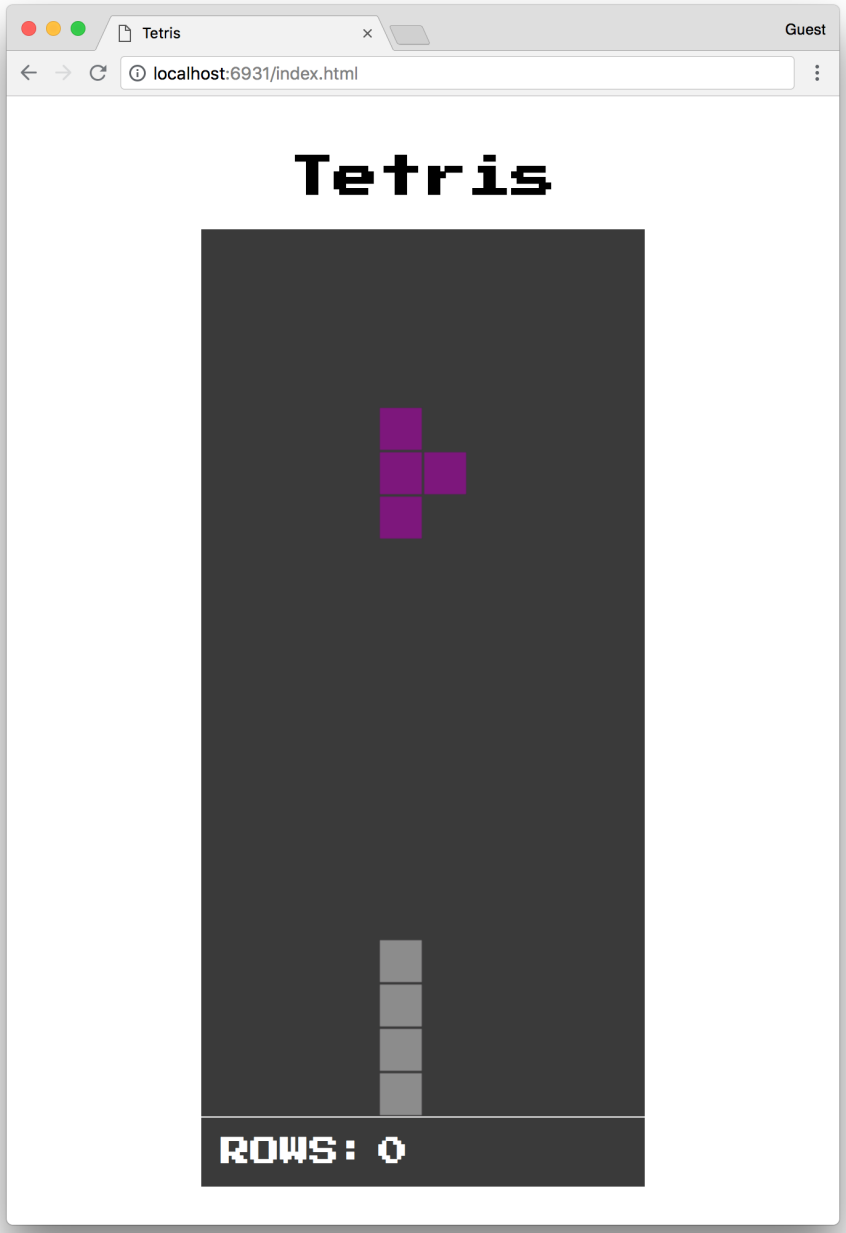

Cook the Books
Guest
localhost:4000
INITIAL RAW BALANCE
$ 0.00
CURRENT RAW BALANCE
$135,466.00
INITIAL COOKED BALANCE
$ 0.00
CURRENT COOKED BALANCE
$177,947.00
Income By Category
RAW
COOKED
Retained Earnings
Sales Revenue
20.6%
79.4%
Expenses By Category
RAW
COOKED
Computer & Internet
Hotels
Insurance
Meals & Entertainment
Rent
Repairs & Maintenance
Travelling
8.0%
8.5%
5.4%
10.3%
2.8%
18.4%
46.5%

Chapter 8: Porting a Game with Emscripten

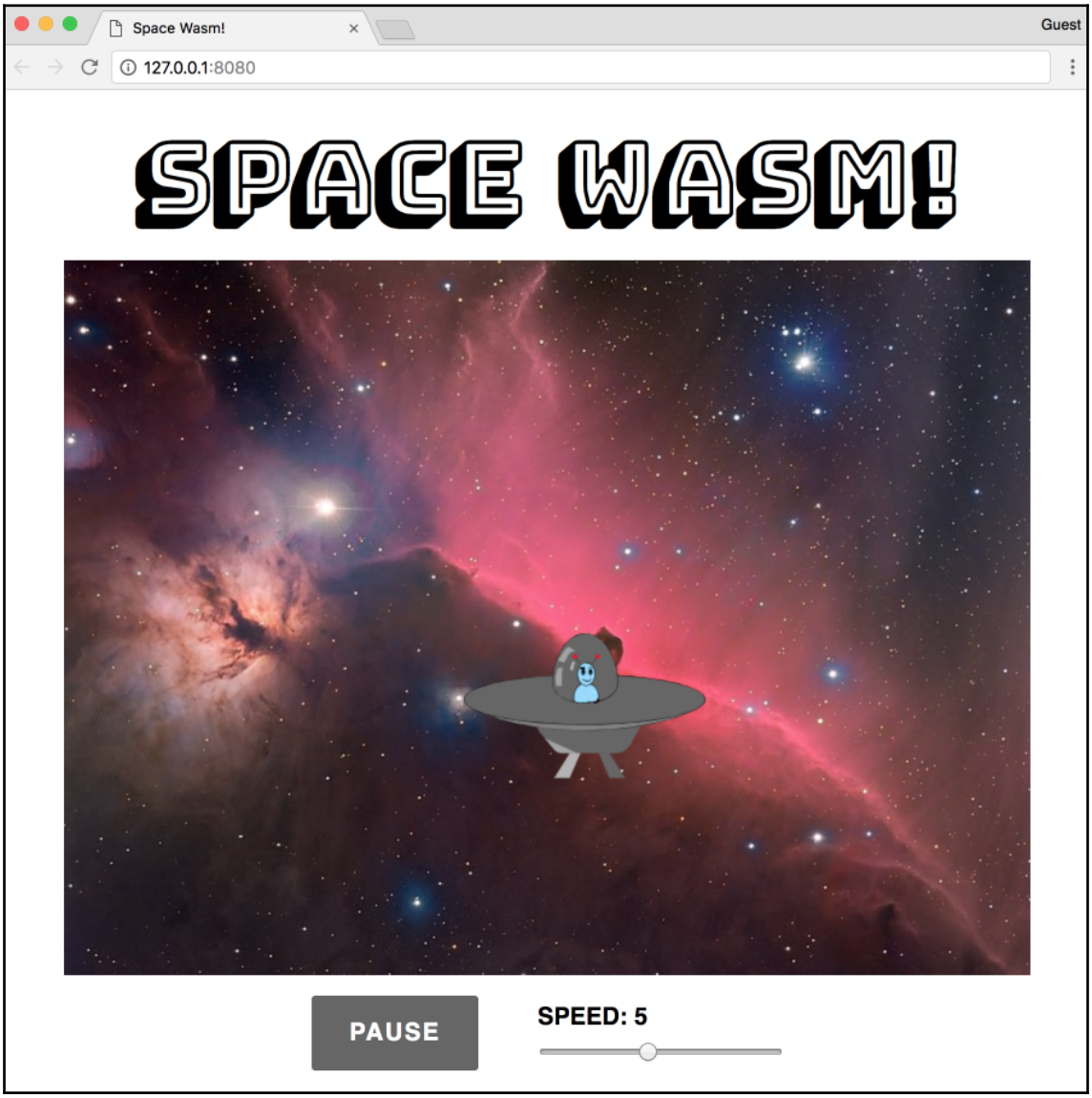



Tetris
ROWS: 0

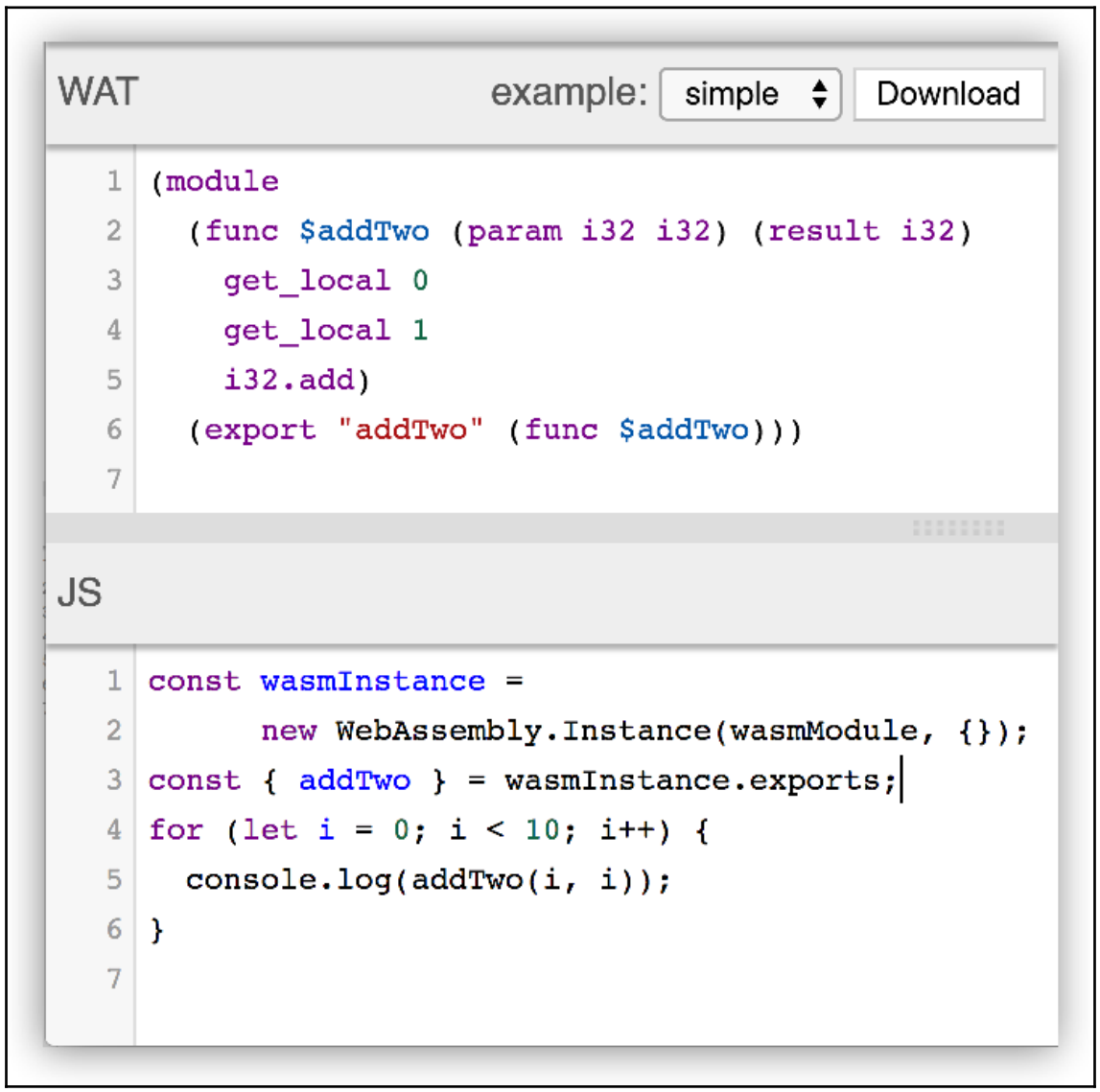

I
J
L
O
S
T
Z

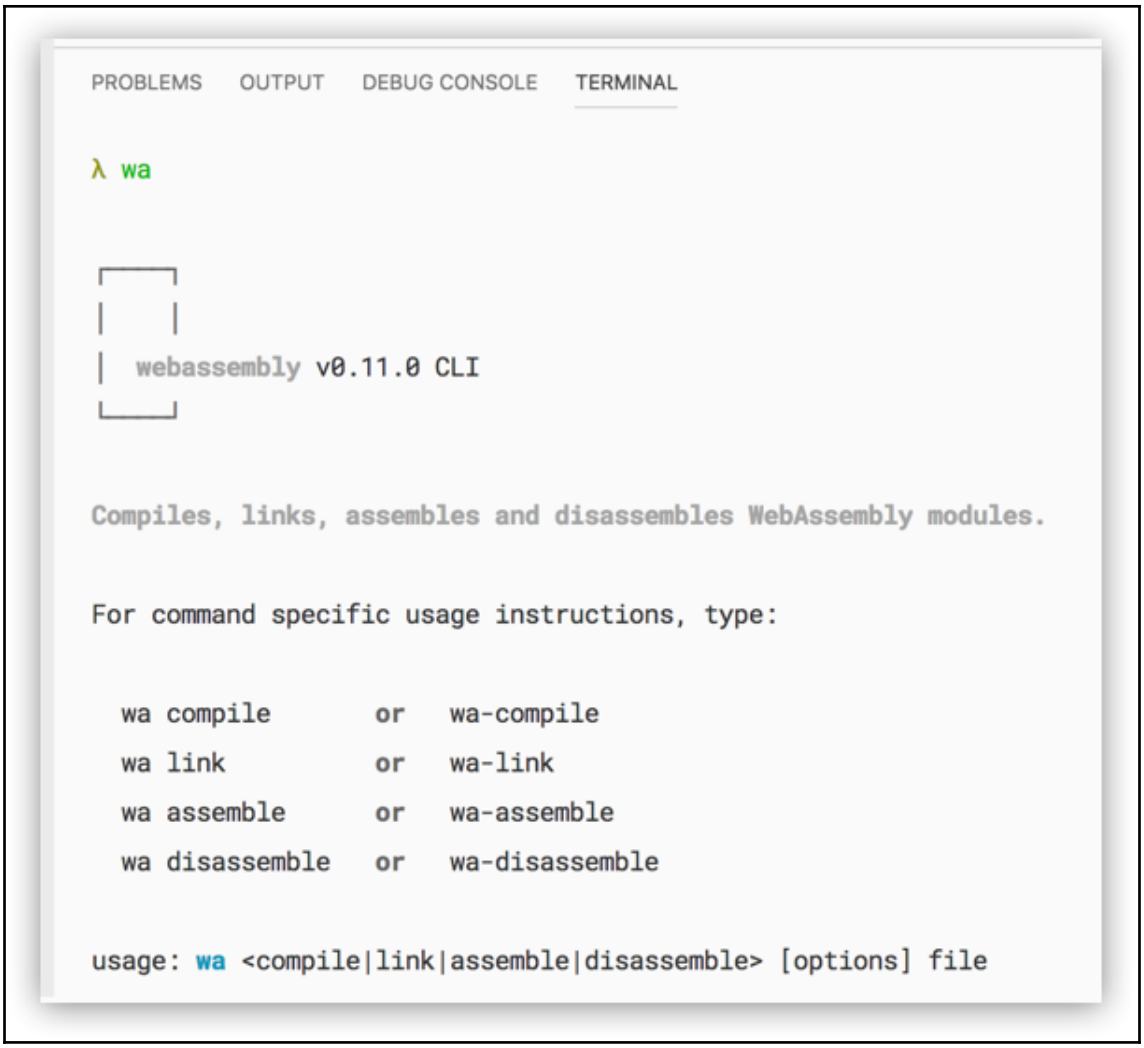

Tetris
Guest
localhost:6931/index.html
Tetris
ROWS: 0

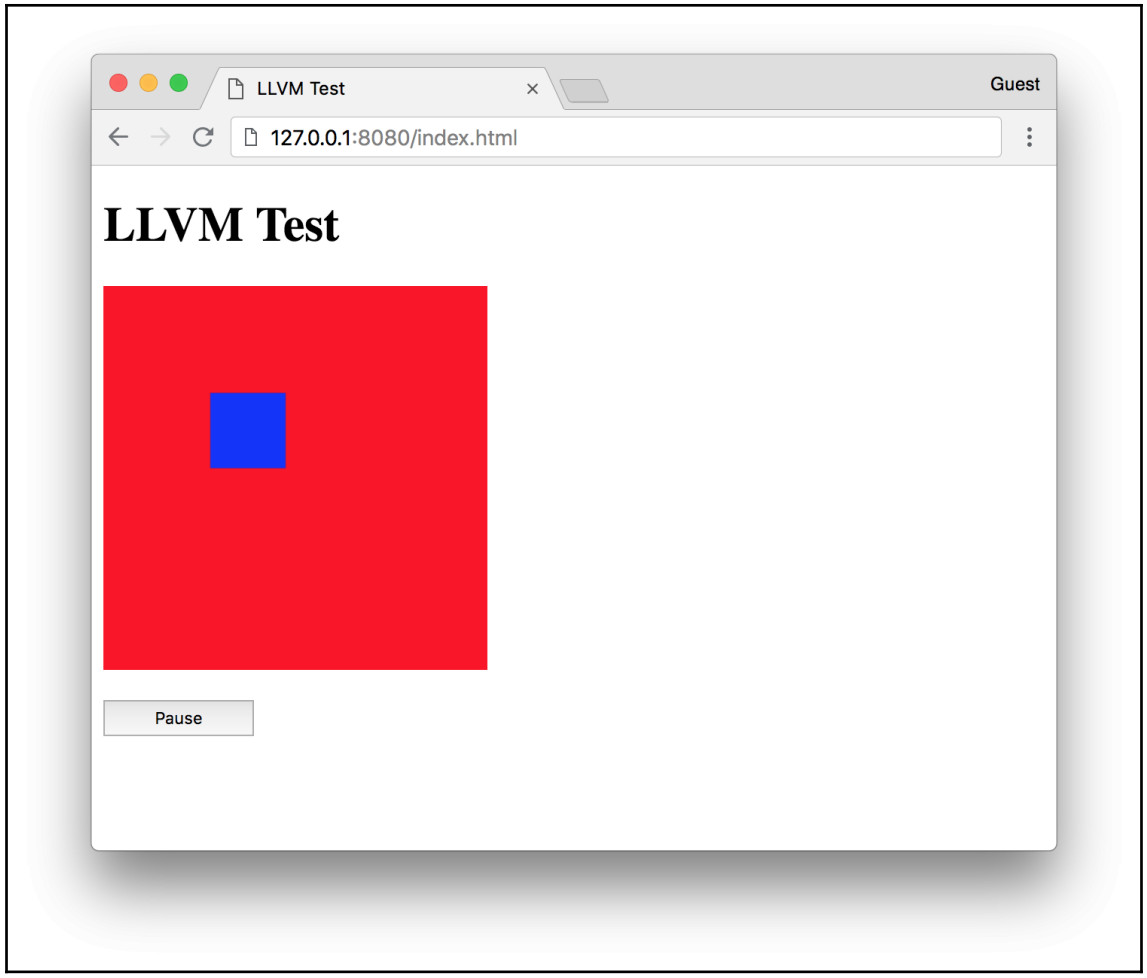
Chapter 9: Integrating with Node.js

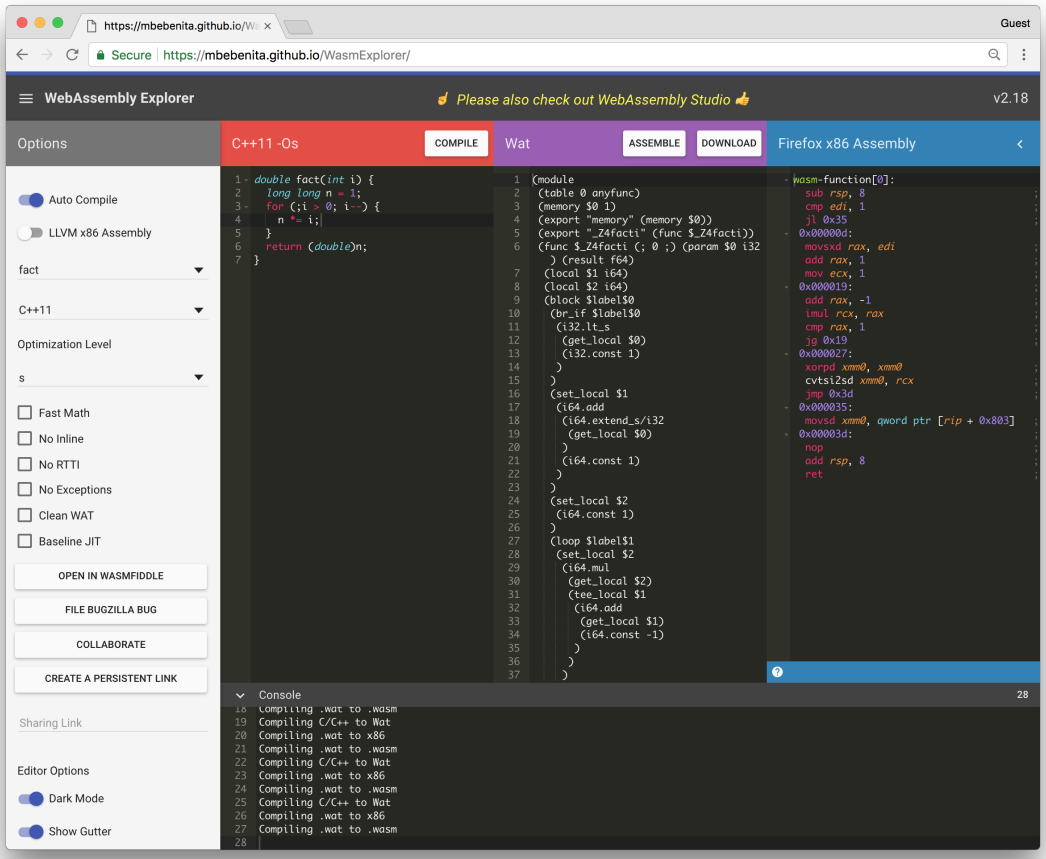


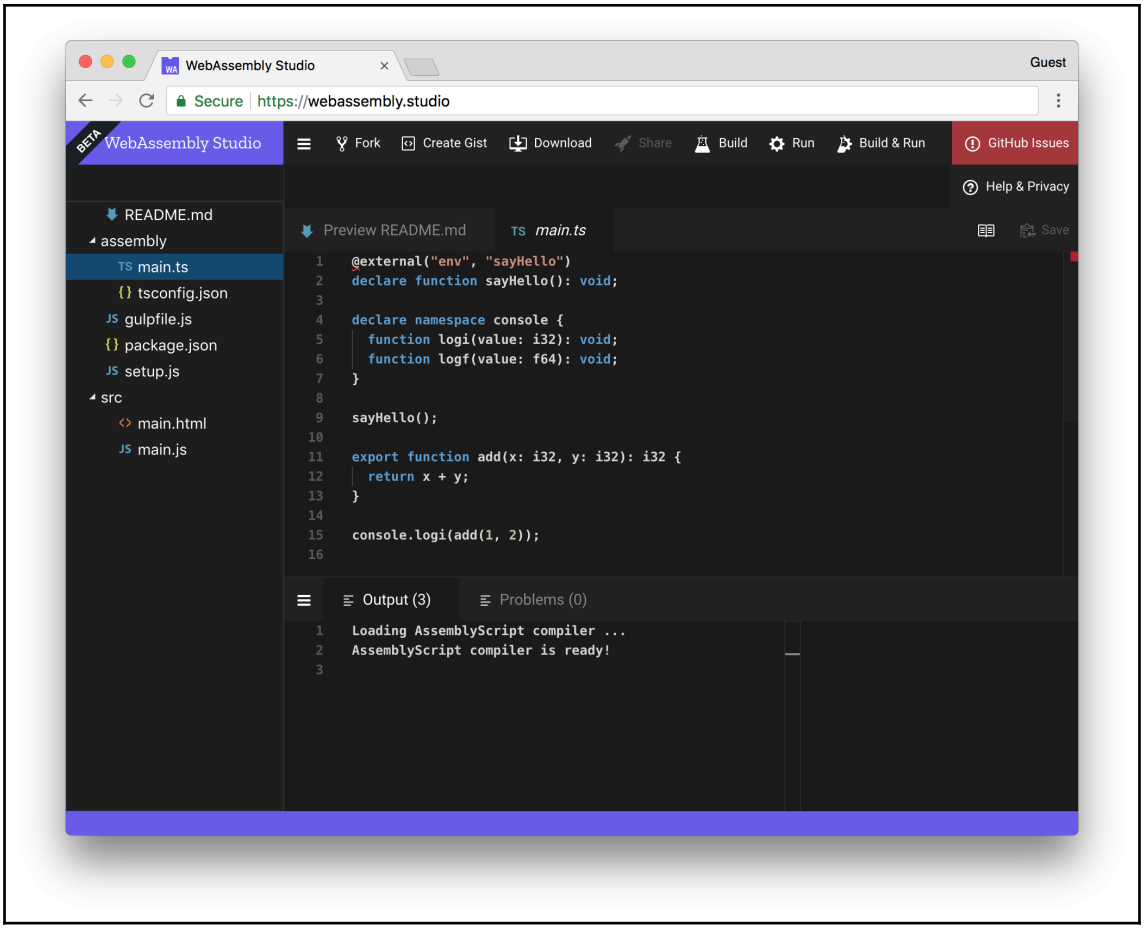
Chapter 10: Advanced Tools and Upcoming Features

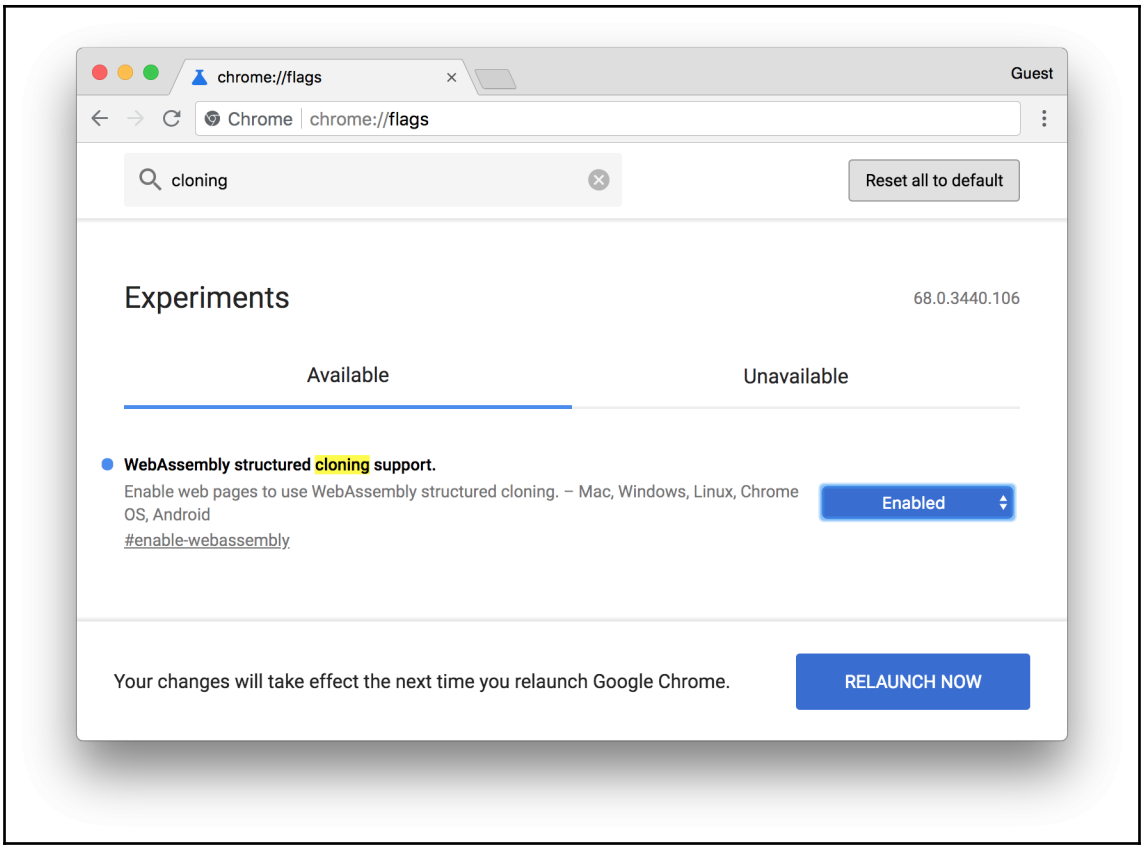


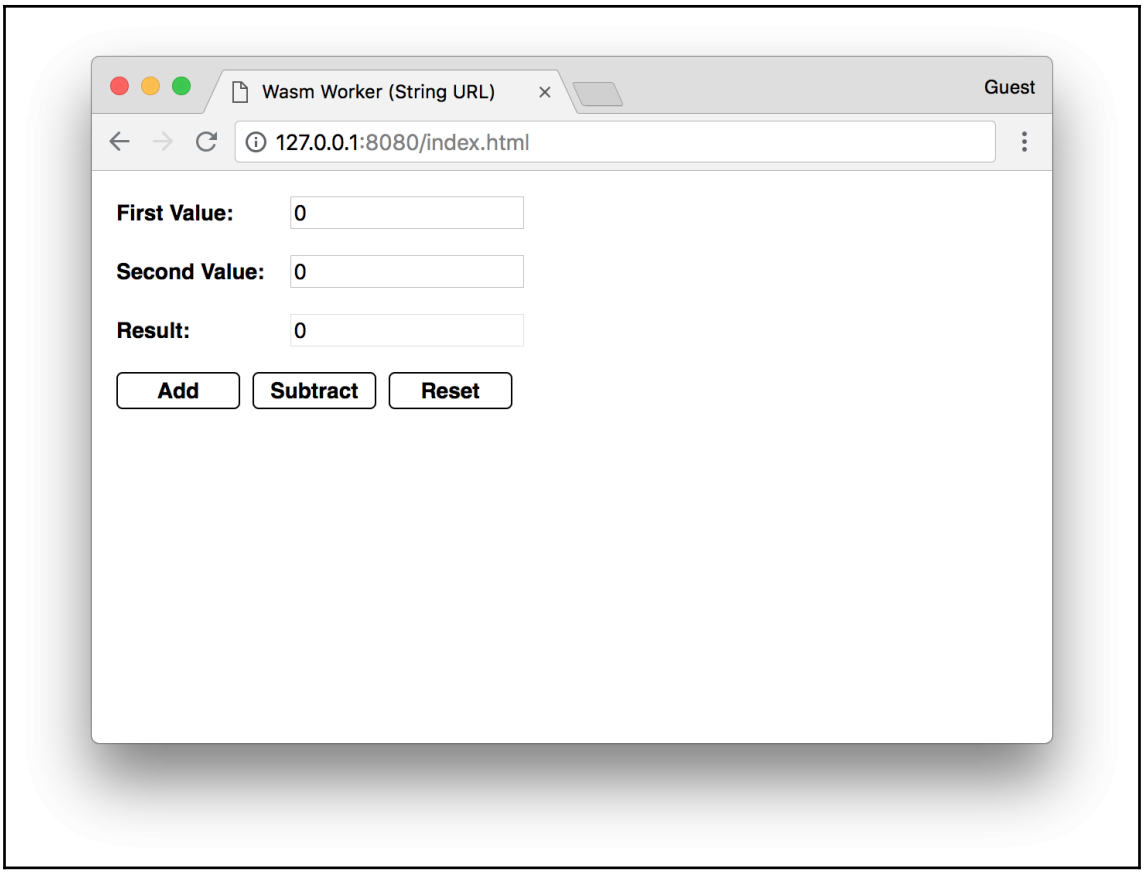

PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
λ wa
webassembly v0.11.0 CLI
Compiles, links, assembles and disassembles WebAssembly modules.
For command specific usage instructions, type:
wa compile or wa-compile
wa link or wa-link
wa assemble or wa-assemble
wa disassemble or wa-disassemble
usage: wa <compile|link|assemble|disassemble> [options] file

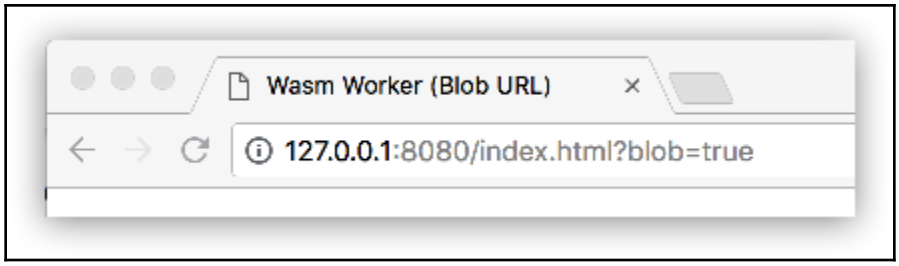

LLVM Test
Guest
127.0.0.1:8080/index.html
LLVM Test
Pause

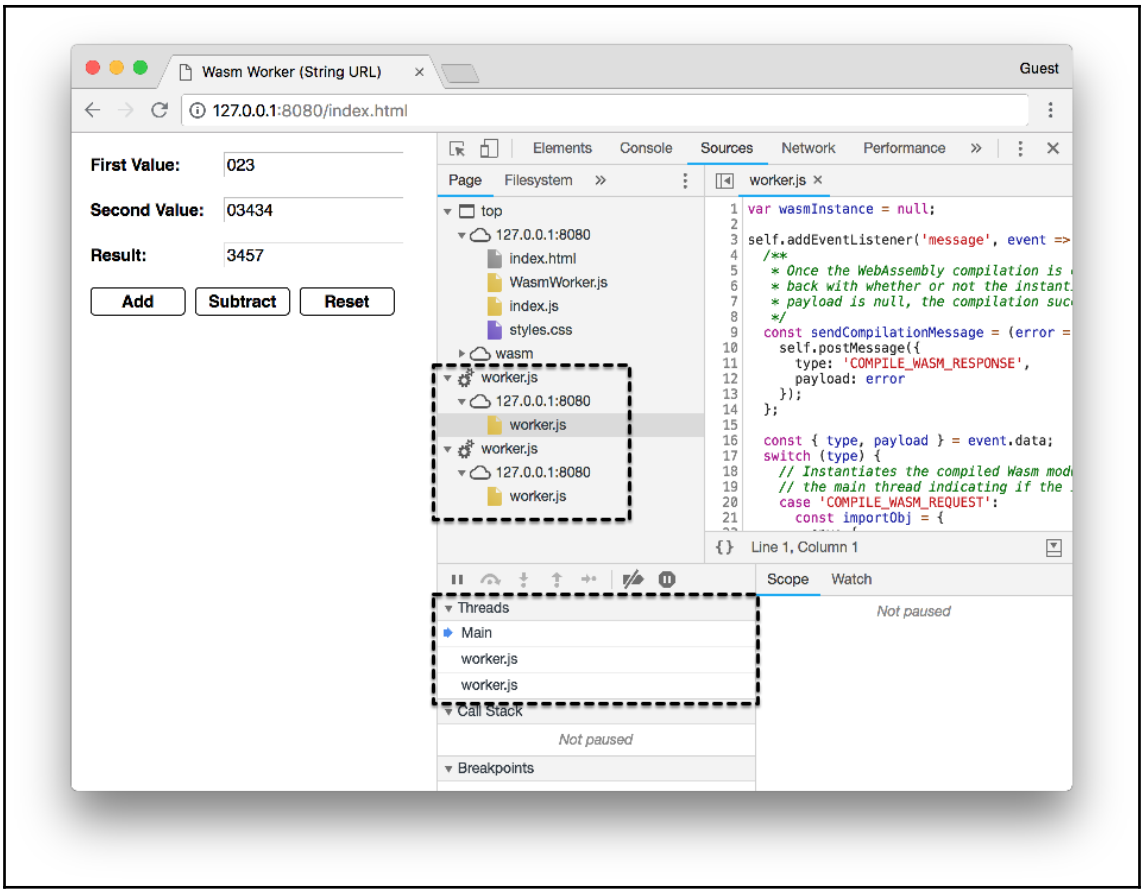

https://mbebenita.github.io/W
Guest
Secure | https://mbebenita.github.io/WasmExplorer/
WebAssembly Explorer
Please also check out WebAssembly Studio
v2.18
Options
C++11 -Os
COMPILE
Wat
ASSEMBLE
DOWNLOAD
Firefox x86 Assembly
Auto Compile
LLVM x86 Assembly
fact
C++11
Optimization Level
s
Fast Math
No Inline
No RTTI
No Exceptions
Clean WAT
Baseline JIT
OPEN IN WASMFIDDLE
FILE BUGZILLA BUG
COLLABORATE
CREATE A PERSISTENT LINK
Sharing Link
Editor Options
Dark Mode
Show Gutter
double fact(int i) {
long long n = 1;
for (;i > 0; i--) {
n *= i;
}
return (double)n;
}
(module
(table 0 anyfunc)
(memory $0 1)
(export "memory" (memory $0))
(export "_Z4factii" (func $_Z4factii))
(func $_Z4factii (; 0 ;) (param $0 i32
) (result f64)
(local $1 i64)
(local $2 i64)
(block $label$0
(br_if $label$0
(i32.lt_s
(get_local $0)
(i32.const 1)
)
)
(set_local $1
(i64.add
(i64.extend_s/i32
(get_local $0)
)
(i64.const 1)
)
)
(set_local $2
(i64.const 1)
)
(loop $label$1
(set_local $2
(i64.mul
(get_local $2)
(tee_local $1
(i64.add
(get_local $1)
(i64.const -1)
)
)
)
)
wasm-function[0]:
sub rsp, 8
cmp edi, 1
jl 0x35
0x00000d:
movsxd rax, edi
add rax, 1
mov ecx, 1
0x000019:
add rax, -1
imul rcx, rax
cmp rax, 1
jg 0x19
0x000027:
xorpd xmm0, xmm0
cvtsi2sd xmm0, rcx
jmp 0x3d
0x000035:
movsd xmm0, qword ptr [rip + 0x803]
0x00003d:
nop
add rsp, 8
ret
Console
28
Compiling .wat to .wasm
Compiling C/C++ to Wat
Compiling .wat to x86
Compiling .wat to .wasm
Compiling C/C++ to Wat
Compiling .wat to x86
Compiling .wat to .wasm
Compiling C/C++ to Wat
Compiling .wat to x86
Compiling .wat to .wasm

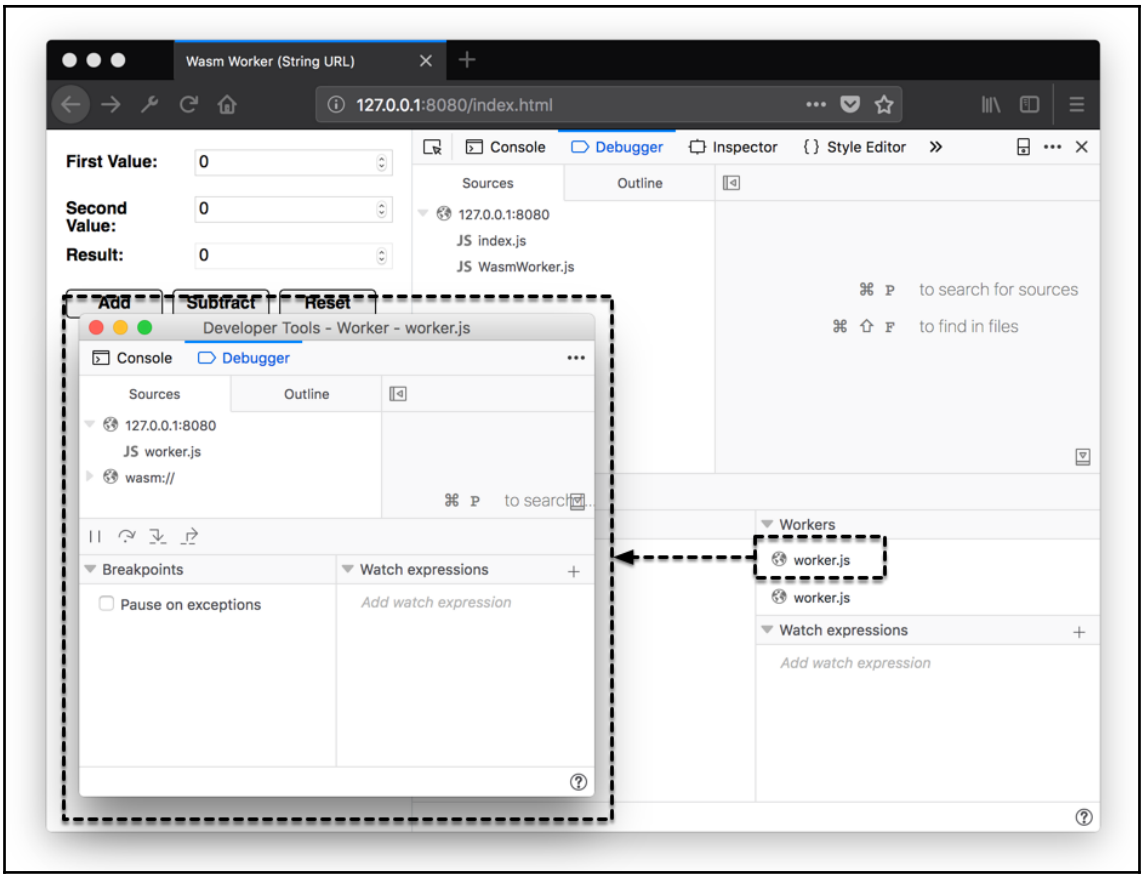

WebAssembly Studio
Guest
Secure https://webassembly.studio
BETA
WebAssembly Studio
Fork
Create Gist
Download
Share
Build
Run
Build & Run
GitHub Issues
Help & Privacy
README.md
assembly
main.ts
tsconfig.json
gulpfile.js
package.json
setup.js
src
main.html
main.js
Preview README.md
main.ts
Save
@external("env", "sayHello")
declare function sayHello(): void;
declare namespace console {
function logi(value: i32): void;
function logf(value: f64): void;
}
sayHello();
export function add(x: i32, y: i32): i32 {
return x + y;
}
console.logi(add(1, 2));
Output (3)
Problems (0)
Loading AssemblyScript compiler ...
AssemblyScript compiler is ready!


chrome://flags
Guest
Chrome | chrome://flags
cloning
Reset all to default
Experiments
68.0.3440.106
Available
Unavailable
WebAssembly structured cloning support.
Enable web pages to use WebAssembly structured cloning. – Mac, Windows, Linux, Chrome OS, Android
#enable-webassembly
Enabled
Your changes will take effect the next time you relaunch Google Chrome.
RELAUNCH NOW


Wasm Worker (String URL)
Guest
127.0.0.1:8080/index.html
First Value:
0
Second Value:
0
Result:
0
Add
Subtract
Reset


Wasm Worker (Blob URL)
127.0.0.1:8080/index.html?blob=true


Wasm Worker (String URL)
Guest
127.0.0.1:8080/index.html
First Value:
023
Second Value:
03434
Result:
3457
Add
Subtract
Reset
Elements
Console
Sources
Network
Performance
Page
Filesystem
worker.js
top
127.0.0.1:8080
index.html
WasmWorker.js
index.js
styles.css
wasm
worker.js
127.0.0.1:8080
worker.js
worker.js
127.0.0.1:8080
worker.js
var wasmInstance = null;
self.addEventListener('message', event =>
/**
* Once the WebAssembly compilation is
* back with whether or not the instant
* payload is null, the compilation suc
*/
const sendCompilationMessage = (error =
self.postMessage({
type: 'COMPILE_WASM_RESPONSE',
payload: error
});
};
const { type, payload } = event.data;
switch (type) {
// Instantiates the compiled Wasm mod
// the main thread indicating if the
case 'COMPILE_WASM_REQUEST':
const importObj = {
{}
Line 1, Column 1
Scope
Watch
Not paused
Threads
Main
worker.js
worker.js
Call Stack
Not paused
Breakpoints


Wasm Worker (String URL)
127.0.0.1:8080/index.html
First Value:
0
Second Value:
0
Result:
0
Add
Subtract
Reset
Console
Debugger
Inspector
Style Editor
Sources
Outline
127.0.0.1:8080
index.js
WasmWorker.js
⌘ P to search for sources
⌘ ⇧ F to find in files
Developer Tools - Worker - worker.js
Console
Debugger
Sources
Outline
127.0.0.1:8080
worker.js
wasm://
⌘ P to search
Breakpoints
Pause on exceptions
Watch expressions
Add watch expression
Workers
worker.js
worker.js
Watch expressions
Add watch expression