

Creating Javascript Playgrounds with the V8 Debugging Protocol

@ibare



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김경열 / Riiid

조승연 / Knowre

V8 Debugging Protocol로 Javascript Playgrounds 만들기

자바스크립트 디버깅을 위해 제공되는 V8 Debugging Protocol. 이를 이용하여 디버깅이 아닌 더 재미있고 흥미로운 것을 만들어가는 과정을 공유해본다. 과연 Swift Playgrounds 같은 것을 만들 수 있을까?

김민태 | 우아한형제들

사람들이 행복해하는 소프트웨어를 만드는 프로그래머가 되는 것을 목표로 살아가는 아들 바보 프로그래머

V8 Debugging Protocol로 Javascript
Playgrounds 만들기

실전 Bluemix Hands-on (2)

50 ~ 17:30

김민태 / 우아한형제들

홍정석 / IBM Korea Lab

JavaScript Playgrounds 만들기

는 V8 Debugging Protocol. 이를 이용하여 디버깅이 아닌 더 재미있는 해본다. 과연 Swift Playgrounds 같은 것을 만들 수 있을까?

만드는 프로그래머가 되는 것을 목표로 살아가는 아들 바보 프로

nds 만들기

ng Protocol. 이를 이용하여 디버깅이 아닌 더 재미있고 흥
Swift Playgrounds 같은 것을 만들 수 있을까?



래머가 되는 것을 목표로 살아가는 아들 바보 프로그래머

Swift Playgrounds

MyPlayground.playground > No Selection

```

1 // Playground - noun: a place
   where people can play
2
3 import Cocoa
4
5 // Constant declaration
6 let x = 10
7 let y = "10"
8
9 // Creating integer list
10 let list: Int[] = [2, 4, 6, 1,
11   3, 10, 9]
12
13 // Sorting a list
14 let sortedList = sort(list) {
15   $0 < $1 }
16
17 // Output sorted list
18 sortedList
19
20 // Function declaration
21 func doubleNum(a:Int) -> Int {
22   return (a * 2)
23 }
24
25 // Output list using for loop
26 for number in sortedList {
27   number
28   let value = doubleNum
29     (number)
30   value
31 }
32
33
34
35
36
37
38
39
40
41

```

10
"10"

[2, 4, 6, 1, 3, 10, 9]

(12 times)

[1, 2, 3, 4, 6, 9, 10]

(7 times)

(7 times)

(7 times)

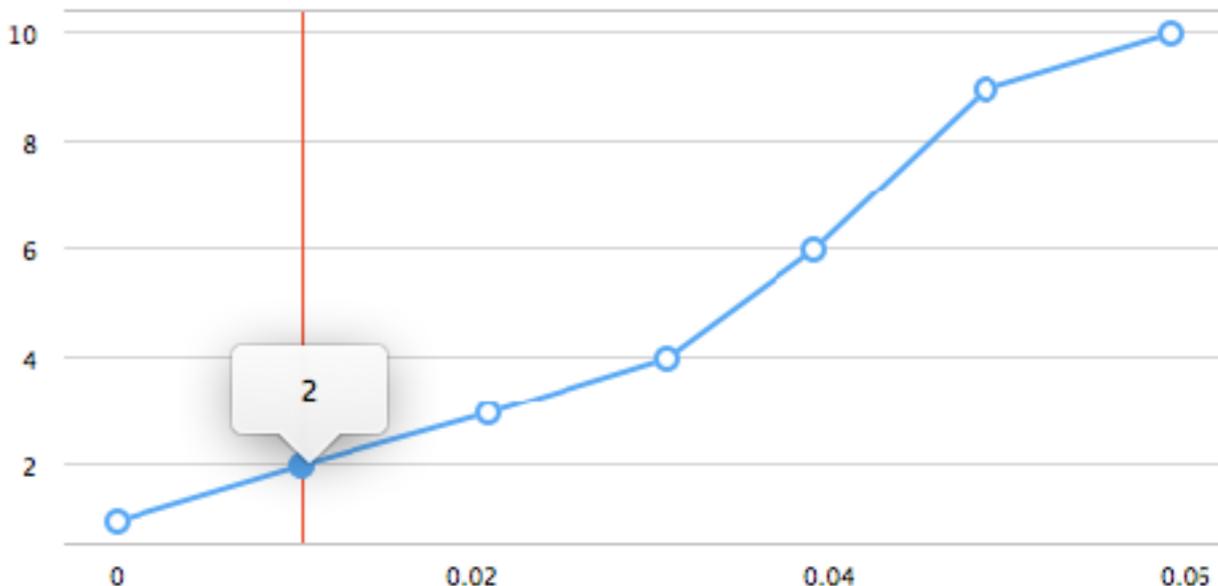
(7 times)

Timeline > MyPlayground.playground (Timeline)

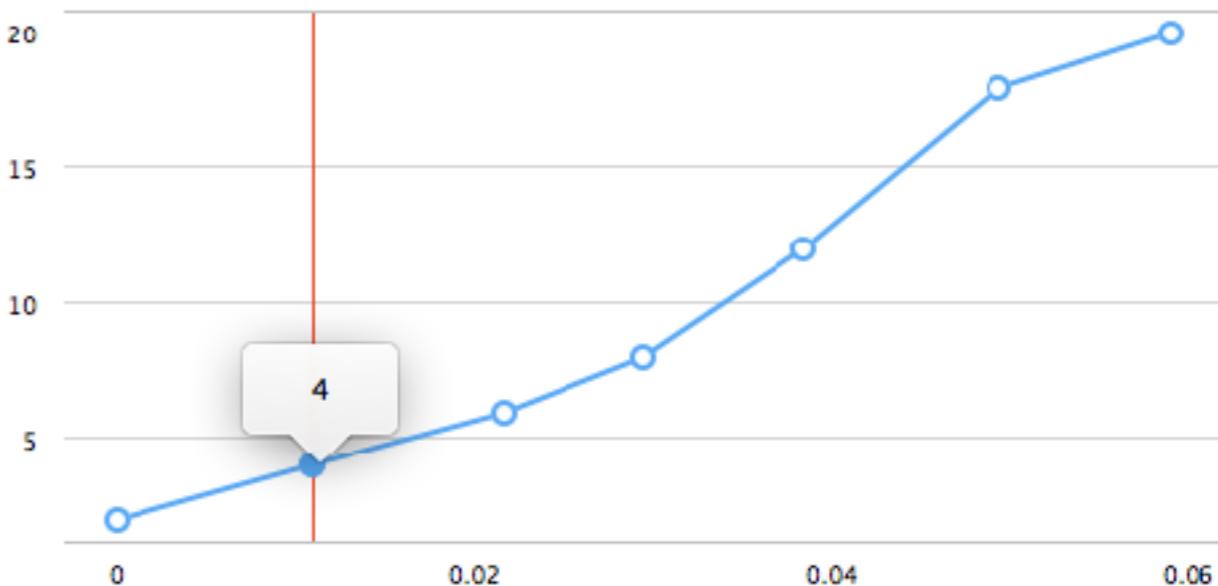
(no results)

Console Output

number



let value = doubleNum(number)





< Decision Tree >

+ ...

```
moveForward()  
turnRight()  
moveForward()  
moveForward()  
moveForward()  
turnRight()  
  
} else if isOnClosedSwitch {  
    toggleSwitch()  
    turnLeft()  
    moveForward()  
    collectGem()  
    turnAround()  
    moveForward()  
    turnLeft()  
  
}  
}  
  
for i in 1 ... 5 {  
    moveForward()  
    testSquare()  
}
```





Runtime
Context
Visualizer

AIATE

```
24
25     this.super();
26 },
27
28 viewWillMount(renderData) {
| 29     console.log('OP View: ', renderData);
30     return renderData;
31 },
32
33 viewDidMount($el) {
34     this.updateView('.header', Header, { title:
35
36     $(this.refs.shopList).selectric({
37         preventWindowScroll: false,
38         disableOnMobile: false
39     });
40 }
```

```
→ jsplay git:(master) ✘ node sort.js
1. stack.pop ~
   ↳ sort.js - 14
2. stack.pop +6ms
   ↳ sort.js - 14
3. stack.pop +2ms
   ↳ sort.js - 14
4. stack.pop +1ms
   ↳ sort.js - 14
5. empty stack length ~
   ↳ sort.js - 8
```

Array

```
6. [ 103, 234, 456, 654, 853 ] +3ms
   ↳ sort.js - 39
```

```
→ jsplay git:(master) ✘ █
```

L sort.js - 14

2. stack.pop +6ms

L sort.js - 14

3. stack.pop +2ms

L sort.js - 14

4. stack.pop +1ms

L sort.js - 14

5. empty stack length ~

L sort.js - 8

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4. stack.pop +1ms

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5. empty stack length ~

L sort.js - 8

at step3 (/Users/Kimmintae/Develop/ibare/jsplay/sample.js:10:18)
at step2 (/Users/Kimmintae/Develop/ibare/jsplay/sample.js:6:3)
at step1 (/Users/Kimmintae/Develop/ibare/jsplay/sample.js:2:3)
at Object.<anonymous> (/Users/Kimmintae/Documents/ibare/jsplay/sample.js:13:1)
at Module._compile (module.js:541:32)
at Object.Module._extensions..js (module.js:550:10)
at Module.load (module.js:458:32)
at tryModuleLoad (module.js:417:12)
at Function.Module._load (module.js:409:3)
at Module.runMain (module.js:575:10)

```
let stack = new Error().stack;
```

```
at step3 (/Users/Kimmintae/Develop/ibare/jsplay/sample.js:10:18)
at step2 (/Users/Kimmintae/Develop/ibare/jsplay/sample.js:6:3)
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at Module.runMain (module.js:575:10)
```

```
let stack = new Error().stack;
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at step3 (/Users/Kimmintae/Develop/ibare/jsplay/sample.js:10:18)
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```

2L+K



전체

이미지

동영상

뉴스

더보기 ▾

검색 도구

세이프서치 ▾



Learn Programming with Web Language

1 2 3 4 5

Overview
Expressions & statements
Function & Object

Event & Library
Storage & Network & SCWiget

무엇을 배울게 될까

크게 두 가지를 배웁니다

무엇을 배울게 될까

?

사진 찍는 것 좋아하세요?

잘 찍으시나요?

repl.it

JavaScript

Kim, min tae

Programmer & Photographer at insteon

AWS 기반 맥킨스 구축

간단하게 계산 방법은 정말 중요하란가?

프로그래밍이란?

“값”을 목적에 따라 처리하는 일련의 과정

“프로그래밍이란
매 순간순간 최선을
찾아 선택하는 행위”

식별자

이름 짓기 규칙에 따라
프로그래머가 만든 이름

연산자

산술, 논리 등 연산 수행 지점자

프로그램의 실행 흐름을
프로그래머가 예측할 수
없을 때 사용되는 패턴

“명심하세요”

문법에 지배당하지 않고
생각하는 방식을 탐구하기

문(文)

fibonacci.js × module.js ➞

```
1 (function (exports, require, modu
2
3 let n = 34;
4 let a = 0, b = 1, f = 1;
5
6 for(let i = 2; i <= n; i++) {
7     f = a + b;
8     a = b;
9     b = f;
10 }
11
12 console.log(f);
13
14 });
15 
```

Watch Expressions + ⌂

- f: 2

Call Stack Async

Scope Variables

- i: 3
- i: 2

Local

- dirname: "/Users/Kimmintae/D...
- filename: "/Users/Kimmintae/...
- a: 1
- b: 1
- exports: Object
- f: 2
- module: Module
- n: 34
- require: function require(path...
- this: Object

{ } Line 8, Column 9

```
1 // Load the http module to create an http server.  
2 var http = require('http');  
3  
4 // Configure our HTTP server to respond with Hello World to all requests.  
5 var server = http.createServer(function (request, response) {  
6     response.writeHead(200, {"Content-Type": "text/plain"});  
7     response.end("Hello World\n");  
8 });  
9  
10 // Listen on port 8000, IP defaults to 127.0.0.1  
11 server.listen(process.env.PORT);  
12     "8080"  
13 // Put a friendly message on the terminal  
14 console.log("Server running");
```

14:57 JavaScript Spaces: 2

```
javruben@ace:/home/ubuntu/workspace (performance) $ sudo apt-get install imagemagick
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
  libdjvu-libre-text libdjvu-libre21 libilmbase6 libmagickcore5-extra libnetpbm10
  libopenexr6 libwmf0.2-7 netpbm
Suggested packages:
  imagemagick-doc autotrace cups-bsd lpr lprng enscript ffmpeg gimp gnuplot grads hp2xx
  html2ps libwmf-bin mplayer povray radiance sane-utils transfig ufraw-batch
  libwmf0.2-7-gtk
0 upgraded, 9 newly installed, 0 to remove and 8 not upgraded.
Need to get 2649 kB of archives.
After this operation, 8851 kB of additional disk space will be used.
Do you want to continue? [Y/n] ■
```

Stop C Run Config N: Command: hello.js Runner: No... CWD Env...

Your code is running at <https://ace-c9-javruben.c9.io>.

Important: use `process.env.PORT` as the port and `process.env.IP` as the host in your scripts!

debugger listening on port 15454
Server running

▶ ⌂ ⌄ ↻ | ⌂ ⌁

▼ Call Stack

Function	Script	Ln	Col
anonymous(request, respo... /hello.js		6	12
EventEmitter.emit(type)	events.js	98	17
parser.onIncoming(req, sh... http.js		2108	12
parserOnHeadersComple... http.js		121	23
socket.ondata(d, start, end)	http.js	1966	22
onread(buffer, offset, len... net.js		527	27

▼ Scope Variables

Property	Value	Type
► ⚡ request	[Object]	object
► ⚡ response	[Object]	object
▼ ⚡ this	[Object]	object
⚡ _connectionKey	"4:0.0.0.0:8080"	string
⚡ _connections	1	number
► ⚡ _events	[Object]	object
► ⚡ _handle	[TCP]	object
⚡ _maxListeners	10	number
► ⚡ _slaves	[Array]	object
⚡ _usingSlaves	false	boolean
⚡ allowHalfOpen	true	boolean
⚡ connections	undefined	undefi...
⚡ domain	null	null
⚡ httpAllowHalfOpen	false	boolean
⚡ timeout	120000	number
► ⚡ Scope		global

▼ Breakpoints

 hello.js:6
response.writeHead(200, {"Content-Type": "te_

 Output Immediate

MyPlayground.playground > No Selection

```

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   where people can play
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4
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13 // Sorting a list
14 let sortedList = sort(list) {
15   $0 < $1 }
16
17 // Output sorted list
18 sortedList
19
20 // Function declaration
21 func doubleNum(a:Int) -> Int {
22   return (a * 2)
23 }
24
25 // Output list using for loop
26 for number in sortedList {
27   number
28   let value = doubleNum
29     (number)
30   value
31 }
32
33
34
35
36
37
38
39
40
41

```

10
"10"

[2, 4, 6, 1, 3, 10, 9]

(12 times)

[1, 2, 3, 4, 6, 9, 10]

(7 times)

(7 times)

(7 times)

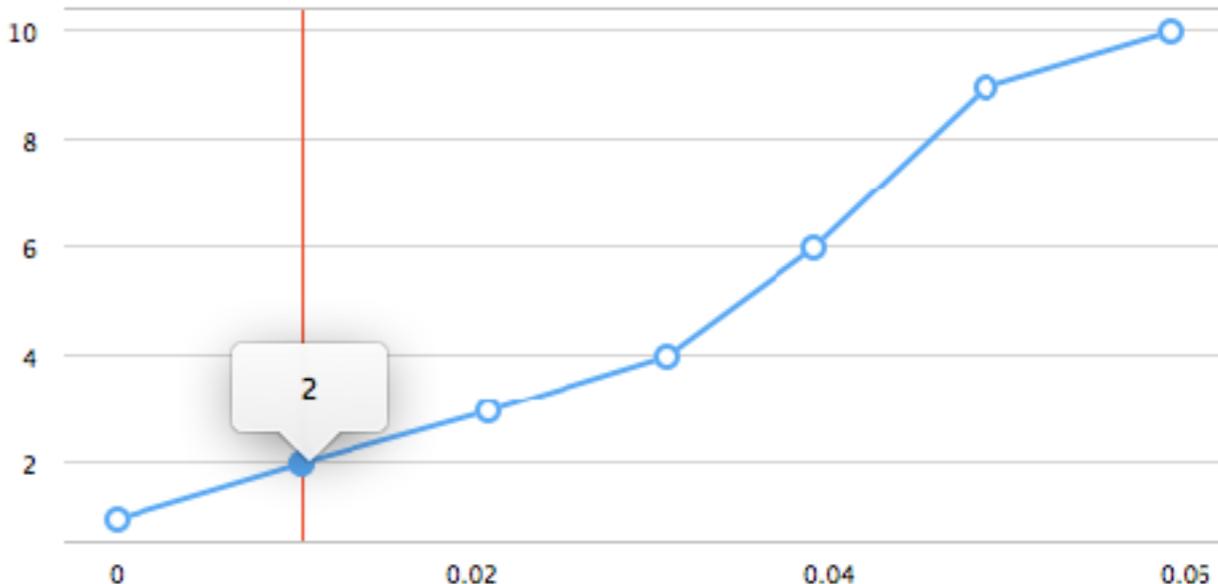
(7 times)

Timeline > MyPlayground.playground (Timeline)

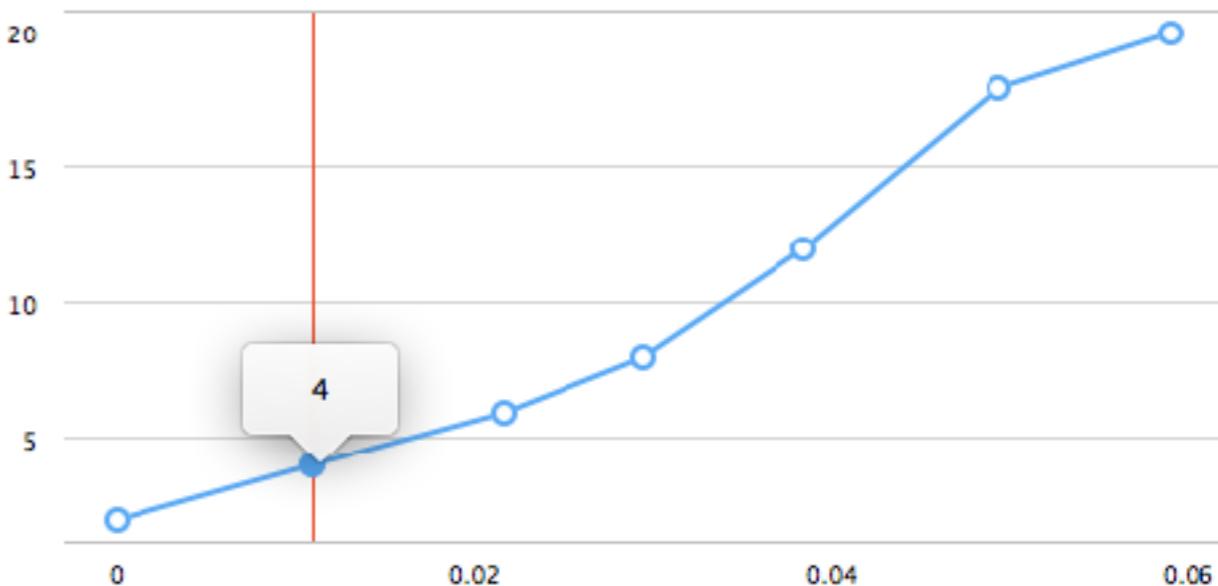
(no results)

Console Output

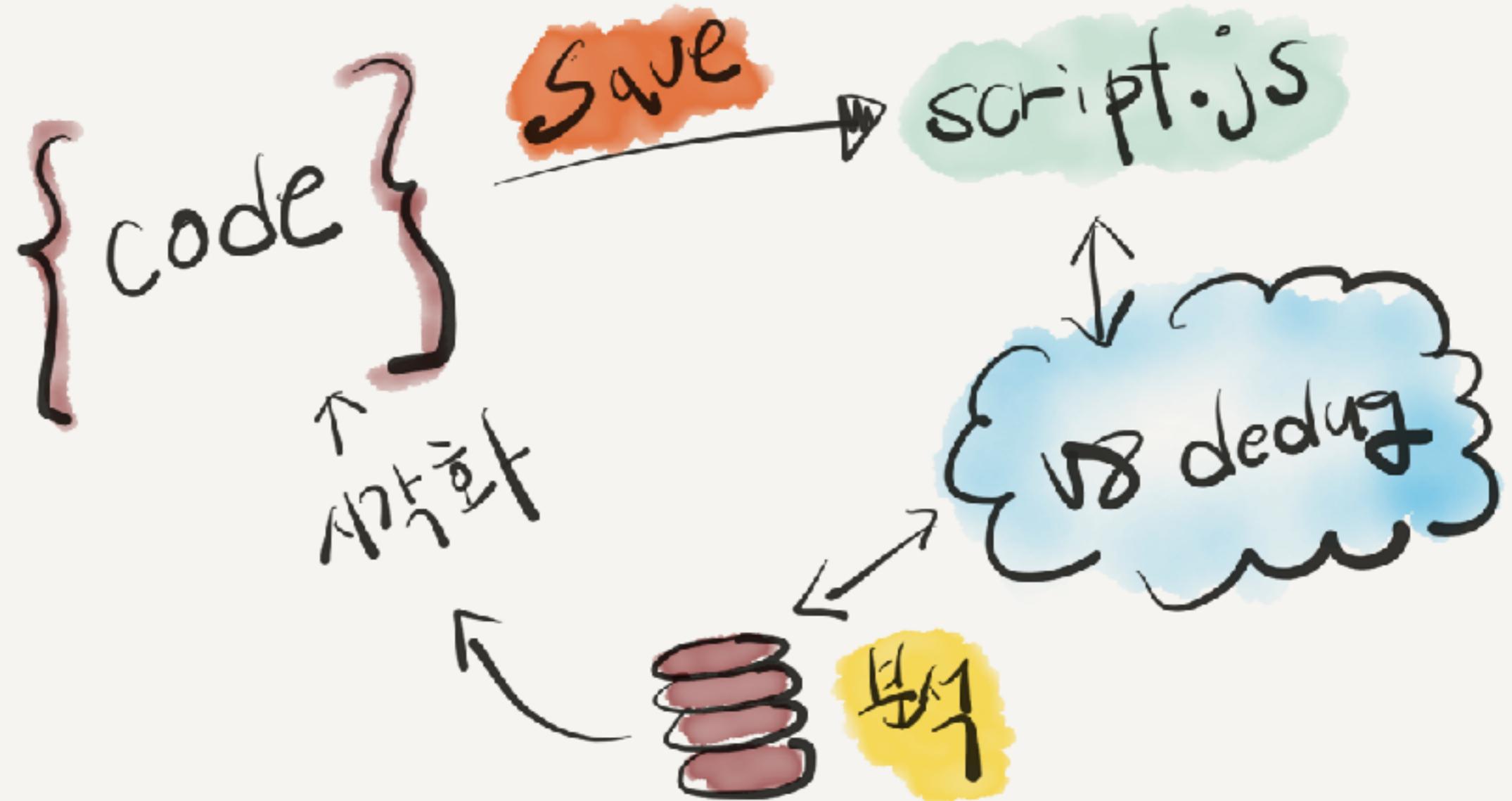
number



let value = doubleNum(number)



AI



An illustration of a white cat with a pink collar and a black outline. The cat is standing next to a red flower. The word "de" is written in black cursive script above the cat's head.

좀 더 간편한
방법은 있을까?

‘vm’ module

```
const util = require('util');
const vm = require('vm');

const sandbox = {
  animal: 'cat',
  count: 2
};

const script = new vm.Script('count += 1; name = "kitty";');

const context = new vm.createContext(sandbox);
for (var i = 0; i < 10; ++i) {
  script.runInContext(context);
}
```

```
const script = require('script');
const vm = require('vm');

const sandbox = {
  animal: 'cat',
  count: 2
};

const script = new vm.Script(`
```

```
};

const script = new vm.Scrip
const context = new vm.crea
for (var i = 0; i < 10; ++i
    script.runInContext(conte
}

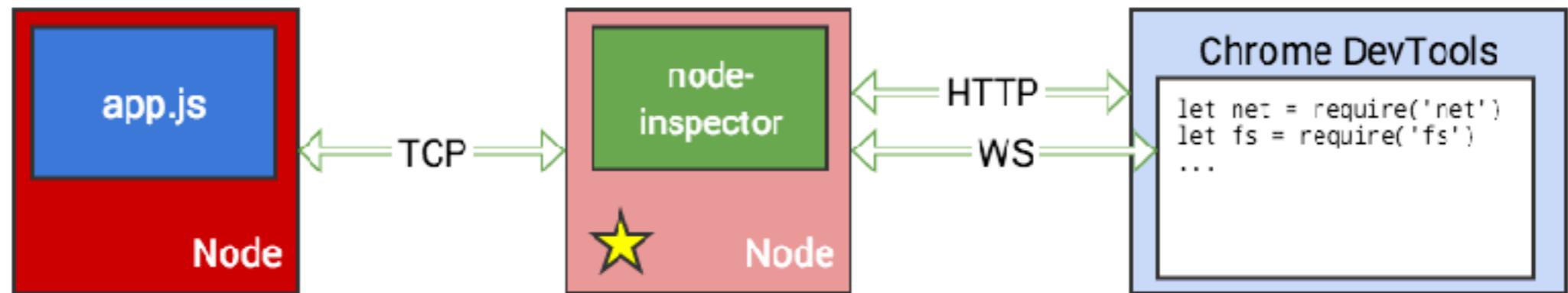
};
```

- runInContext
- runInNewContext
- runInThisContext
- runInDebugContext

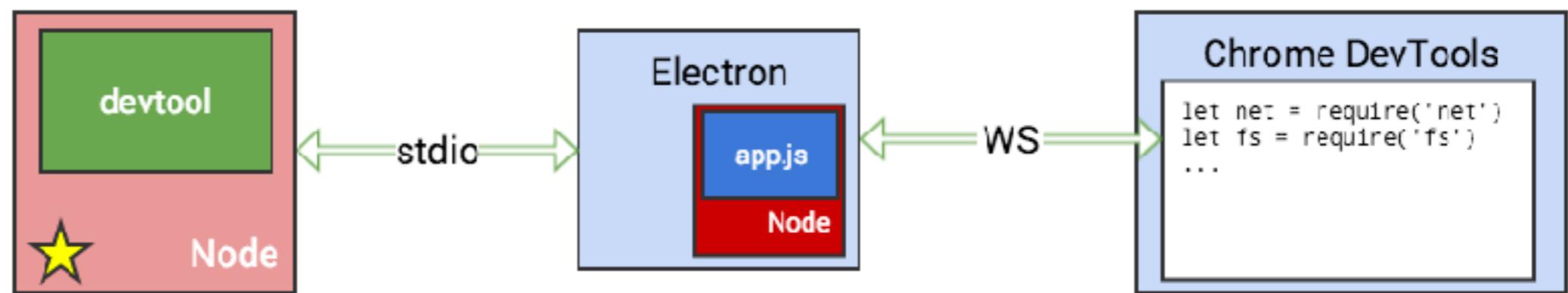
전역 공간망으로...

V8 기반
브라우저들은
어떻게 하나?

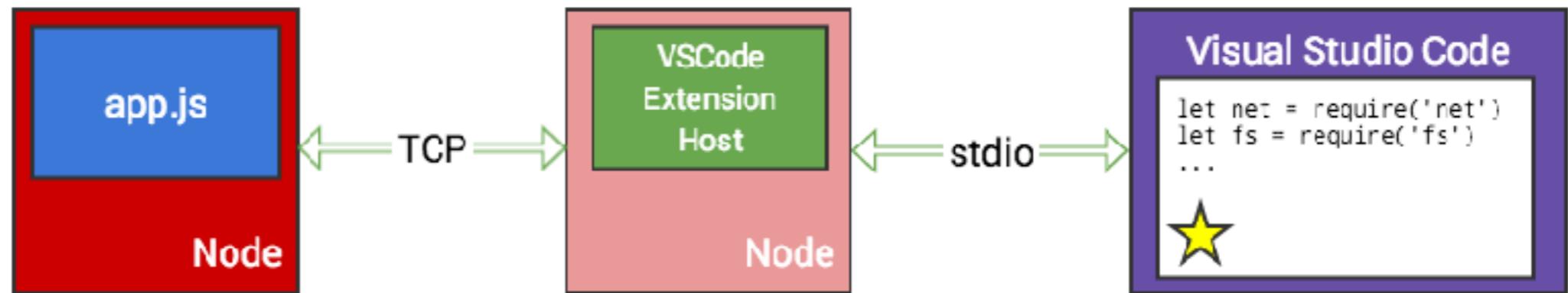
node-inspector

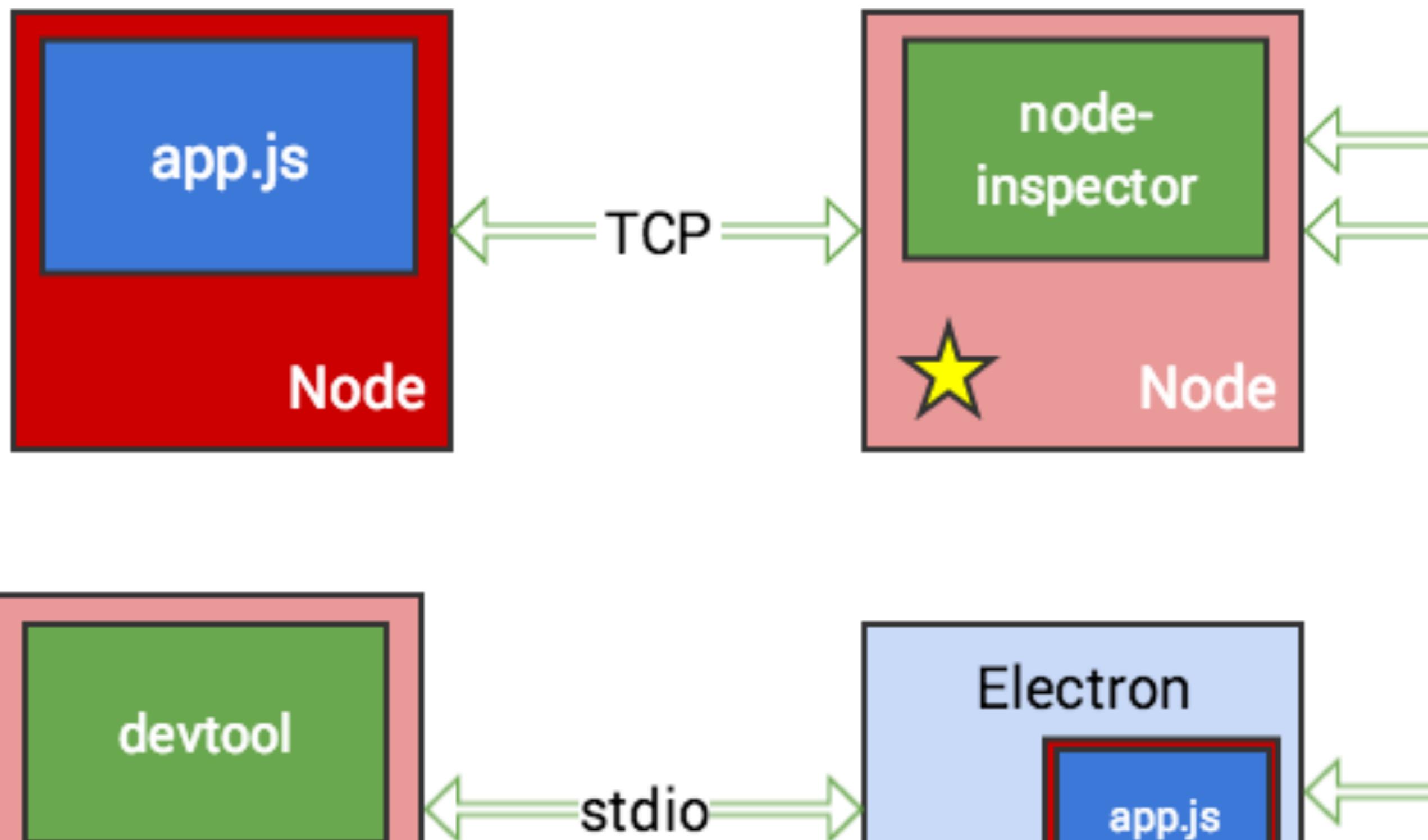


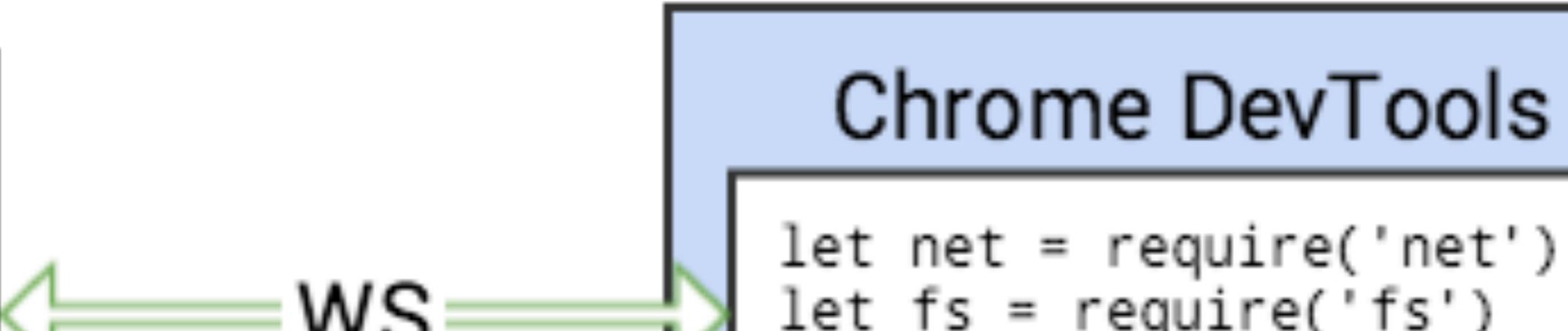
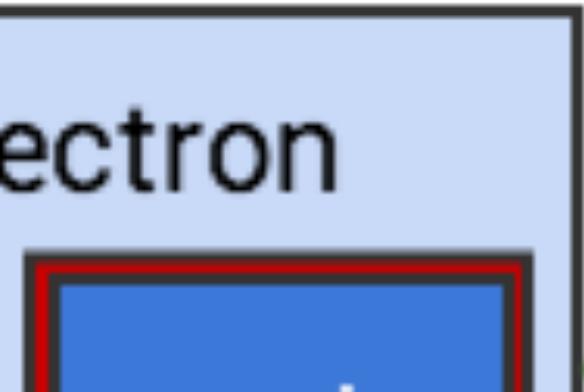
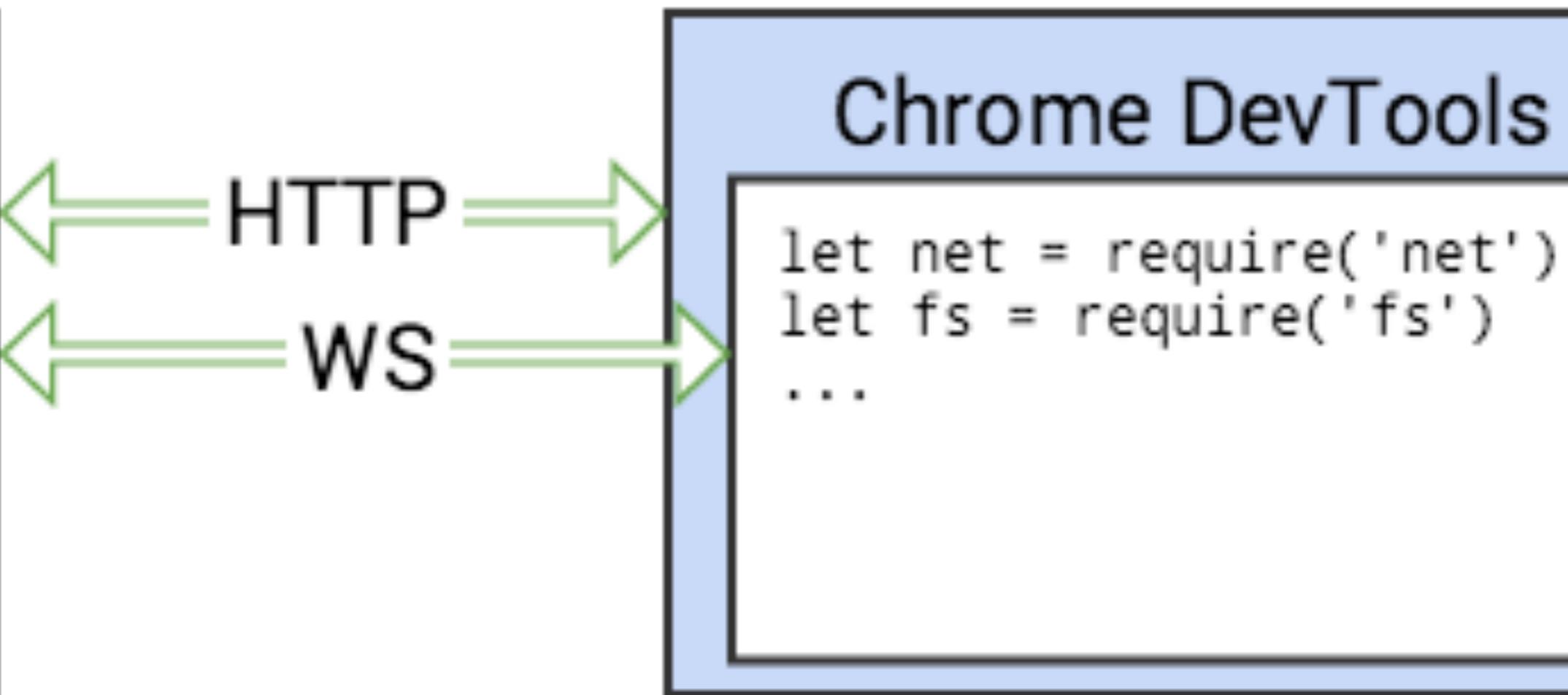
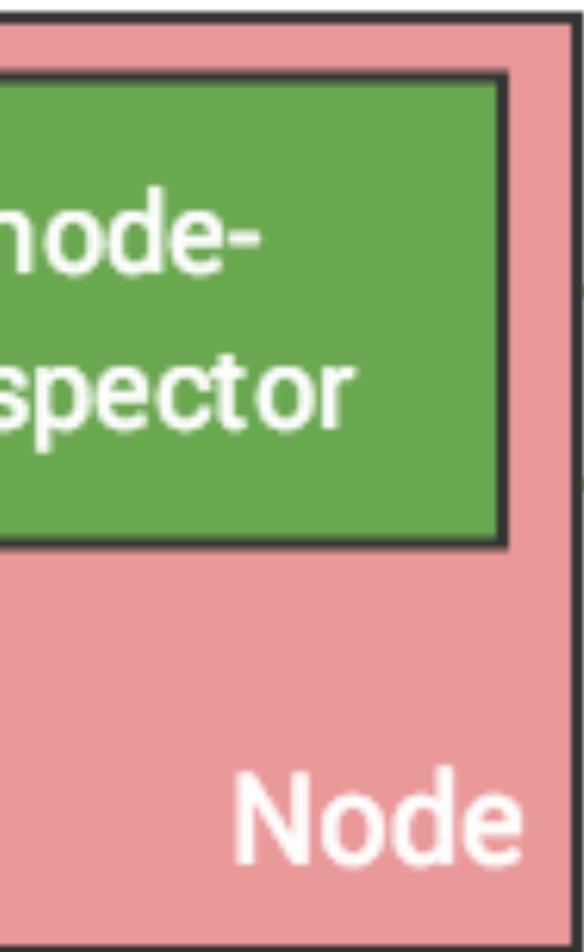
devtool



vsCode







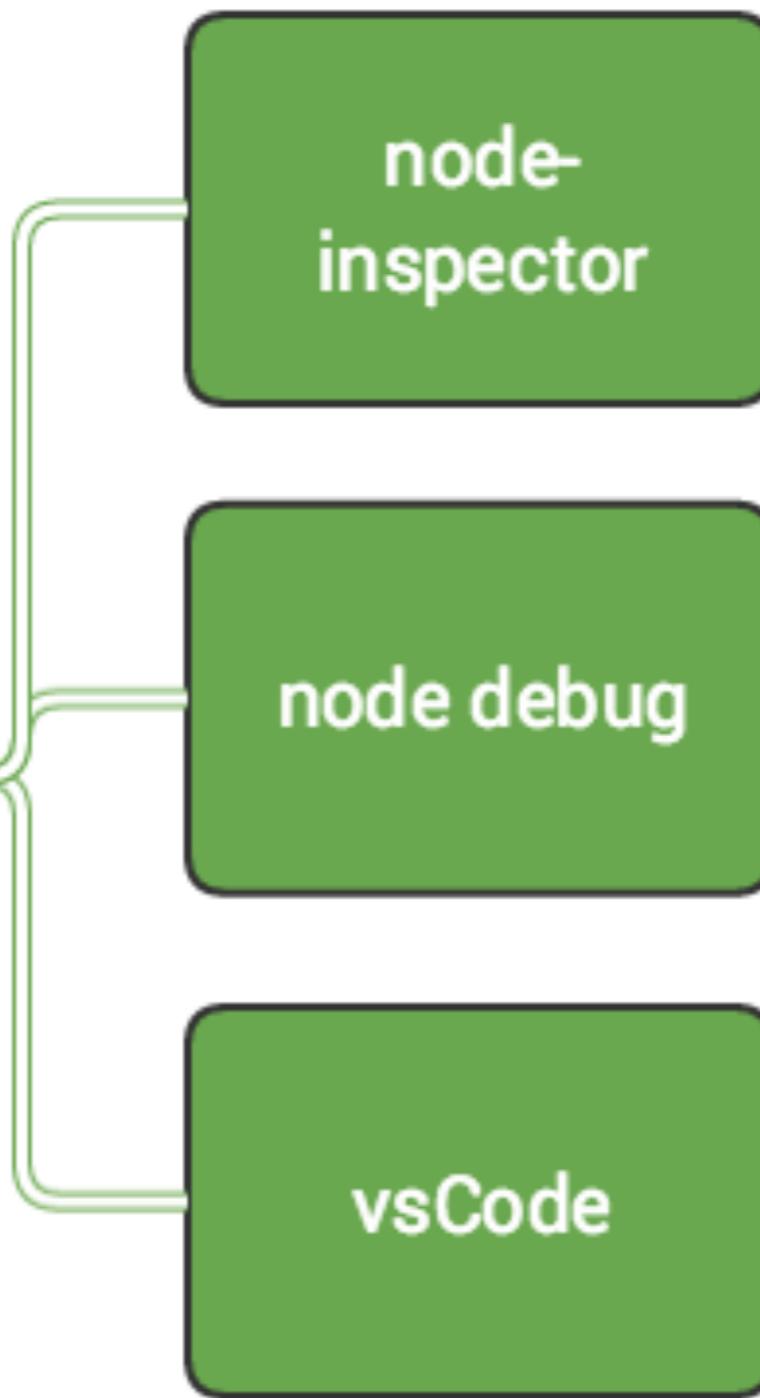
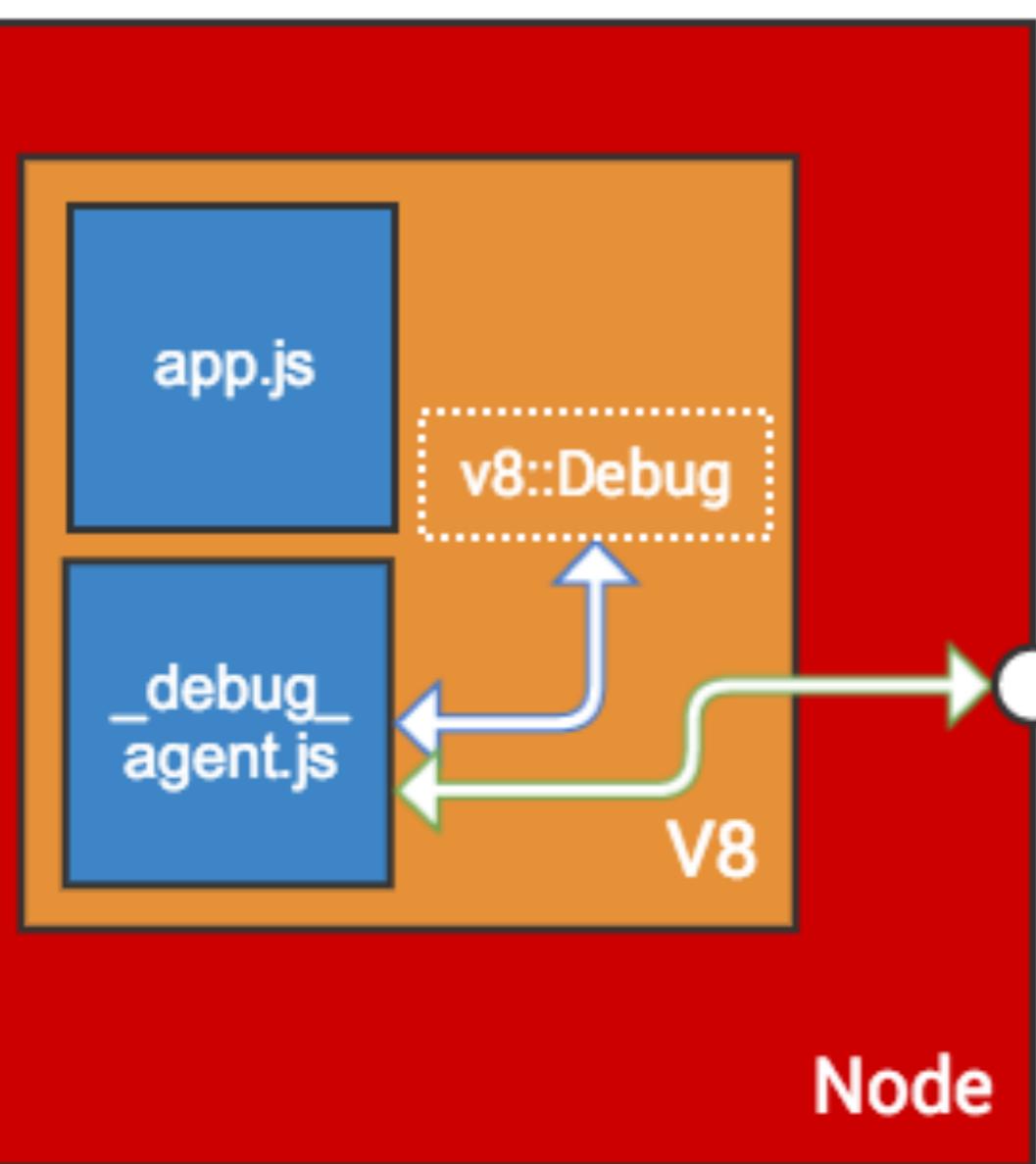
node-inspector

node-inspector

```
DEBUG=* node-debug app.js
```

node v6.3.1

```
\n\nmodule.exports = new V8Debug();\n\n});", "sourceLength":9051, "scriptType":2, "compilationType":0, "context":{"ref":163}, "text":"/Users/Kimmintae/.nvm/versions/node/v6.3.1/lib/node_modules/v8-debug/v8-debug.js (lines: 278)"}], {"handle":89, "type":"context", "text": "#<ContextMirror>"}, {"handle":100, "type":"context", "text": "#<ContextMirror>"}, {"handle":351, "type":"context", "text": "#<ContextMirror>"}, {"handle":353, "type":"context", "text": "#<ContextMirror>"}, {"handle":355, "type":"context", "text": "#<ContextMirror>"}, {"handle":356, "type":"context", "text": "#<ContextMirror>"}, {"handle":359, "type":"context", "text": "#<ContextMirror>"}, {"handle":361, "type":"context", "text": "#<ContextMirror>"}, {"handle":363, "type":"context", "text": "#<ContextMirror>"}, {"handle":365, "type":"context", "text": "#<ContextMirror>"}, {"handle":367, "type":"context", "text": "#<ContextMirror>"}, {"handle":369, "type":"context", "text": "#<ContextMirror>"}, {"handle":373, "type":"context", "text": "#<ContextMirror>"}], "running":false}\nnode-inspector:protocol:v8-debug request: {"seq":5, "type":"request", "command": "evaluate", "arguments": {"global":true, "expression": "Object.getOwnPropertyDescriptor(global,-1)"} } +5s\nnode-inspector:protocol:devtools frontend: {"id":19, "method": "Profiler.setSamplingInterval", "params": {"interval":1000}} +2ms\nnode-inspector:protocol:devtools backend: {"id":19} +0ms\nnode-inspector:protocol:devtools frontend: {"id":20, "method": "IndexedDB.enable"} +2ms\nnode-inspector:protocol:devtools backend: {"id":20} +0ms\nnode-inspector:protocol:devtools frontend: {"id":21, "method": "HeapProfiler.enable"} +1ms\nnode-inspector:protocol:devtools backend: {"id":21} +0ms\nnode-inspector:protocol:devtools frontend: {"id":22, "method": "Worker.setAutoconnectToWorkers", "params": {"value":true}} +2ms\nnode-inspector:protocol:devtools backend: {"id":22} +1ms\nnode-inspector:protocol:v8-debug response: {"seq":202, "request_seq":5, "type": "response", "command": "evaluate", "success":true, "body": {"handle":326, "type": "function", "class": {"ref":91}, "protoObject": {"ref":34}, "prototypeObject": {"ref":327}, "name": "", "inferredName": "Object.defineProperty.get", "resolved":true, "source": "function () {\n};\n", "script": {"ref":104}, "scriptId":34, "position":7844, "line":238, "column":19, "scopes": [{"type":3, "index":0}, {"type":6, "index":1}, {"type":0, "index":2}], "propertyType":3, "ref":15}, {"name": "name", "attributes":3, "propertyType":3, "ref":328}, {"name": "prototype", "attributes":6, "propertyType":3, "ref":327}], "text": "function () {\n    console.log('Hello, and welcome to hacking node.js!\\n\\n// This file is invoked by node::Lo', 'sourceOffset':0, "lineCount":469, "sourceStart": "// Hello, and welcome to hacking node.js!\n// This file is invoked by node::Lo", "sourceLength":14273, "scriptType":2, "command": "bootstrap_node.js (lines: 469)"}, {"handle":15, "type": "number", "value":0, "text": "0"}, {"handle":328, "type": "string", "value": "", "length":0, "text": ""}], "running":false}\nnode-inspector:protocol:v8-debug request: {"seq":6, "type": "request", "command": "scope", "arguments": {"functionHandle":326, "maxStringLength": -1}} } +42ms\nnode-inspector:protocol:devtools frontend: {"id":23, "method": "Inspector.enable"} +1ms\nnode-inspector:protocol:devtools backend: {"id":23} +1ms\nnode-inspector:protocol:devtools frontend: {"id":24, "method": "Page.setShowViewportSizeOnResize", "params": {"show":true, "showGrid":false}} +0ms\nnode-inspector:protocol:devtools backend: {"id":24} +0ms\nnode-inspector:protocol:v8-debug response: {"seq":203, "request_seq":6, "type": "response", "command": "scope", "success":true, "body": {"type":3, "index":0, "object": {"ref":-20}, "handle":-20, "type": "object", "className": "Object", "constructorFunction": {"ref":52}, "protoObject": {"ref":53}, "prototypeObject": {"ref":3}, "properties": [{"name": "process", "propertyType":2, "ref":338}, {"name": "setupGlobalVariables", "propertyType":2, "ref":339}, {"name": "setupGlobalTimeouts", "propertyType":2, "ref":340}, {"name": "setupProcessFatal", "propertyType":2, "ref":342}, {"name": "tryGetCwd", "propertyType":2, "ref":343}, {"name": "evalScript", "propertyType":2, "ref":344}, {"name": "runInThisContextifyScript", "propertyType":2, "ref":348}, {"name": "runInThisContext", "propertyType":2, "ref":350}], "text": "#<Object>"}], "running":false} +1ms\nnode-inspector:protocol:v8-debug request: {"seq":7, "type": "request", "command": "evaluate", "arguments": {"expression": "(function (NM) {NM.require(\"module\").load(\"/Users/Kimmintae/.nvm/versions/node/v6.3.1/lib/node_modules/node-inspector/lib/InjectorServer.js\")({\"v8-debug\": \"/Users/Kimmintae/.nvm/versions/node/v6.3.1/lib/node_modules/node-inspector/lib/convert.js\"}})(NM)", "global":true, "additional_context": [{"name": "NM", "handle":350}], "maxStringLength": -1}} } +9ms\nnode-inspector:protocol:v8-debug response: {"seq":204, "request_seq":7, "type": "response", "command": "evaluate", "success":true, "body": {"handle":3, "type": "undefined", "text": ""}}, +1ms\nnode-inspector:protocol:v8-debug request: {"seq":8, "type": "request", "command": "evaluate", "arguments": {"expression": "(function (require, debug, options) {\n    require(\"./lib/InjectorServer.js\");\n    require(\"./lib/Injection\");\n    process._debugObject = {\"injection\": \"/Users/Kimmintae/.nvm/versions/node/v6.3.1/lib/node_modules/node-inspector/lib/Injections/ConsoleLength\":-1}}) +0ms\nnode-inspector:protocol:v8-debug request: {"seq":9, "type": "request", "command": "evaluate", "arguments": {"expression": "(function (require, debug, options) {\n    require(\"./lib/Injection\");\n    process._debugObject = {\"injection\": \"/Users/Kimmintae/.nvm/versions/node/v6.3.1/lib/node_modules/node-inspector/lib/Injections/NetworkLength\":-1}}) +1ms\nnode-inspector:protocol:v8-debug request: {"seq":10, "type": "request", "command": "evaluate", "arguments": {"expression": "(function (require, debug, options) {\n    require(\"./lib/Profile\");\n    require(\"./lib/v8-profiler\");\n    Kimmintae/.nvm/versions/node/v6.3.1/lib/node_modules/node-inspector/node_modules/v8-profiler/v8-profiler.js\")", "global":true, "maxStringLength": -1}}) +1ms
```

devtools은
필요 있는데...

node debug mode

```
$ node --debug --debug-port=5859 --debug-brk app.js
```

```
Debugger listening on [::]:5859
```

v8 debugging protocol

“very simple text-based
protocol”

Header-A: Some-Value\r\nContent-Length: 9\r\n\r\n{"seq":1}

Frame body

seq
type

Frame body

seq
type request
 response
 event

e body

seq
type request
 response
 event

command
arguments

Command

- continue
- backtrace
- frame
- setVariableValue
- lookup
- break
- setbreakpoint
- setexceptionbreak
- changebreakpoint
- clearbreakpoint
- clearbreakpointgroup
- listbreakpoints
- disconnect
- restartframe
- scopes
- scope
- evaluate
- references
- source
- scripts
- threads
- suspend
- version
- changelive
- flags
- gc

Command

- continue
- backtrace
- frame
- setVariableValue
- lookup
- break
- setbreakpoint
- setexceptionbreak
- changebreakpoint
- clearbreakpoint
- clearbreakpointgroup
- listbreakpoints
- disconnect
- restartframe
- scopes
- scope
- evaluate
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- source
- scripts
- threads
- suspend
- version
- changelive
- flags
- gc

Command

- continue
- backtrace
- frame
- setVariableValue
- lookup

Command

- continue
- backtrace
- frame
- setVariableValue
- lookup

- next
- in
- out
- min



step count
1 ~ 3 ~

Command

- continue
- backtrace
- frame
- setVariableValue
- lookup

Command

- continue
- backtrace
- **frame**
- setVariableValue
- lookup

Command

- continue
- backtrace
- frame
- setVariableValue
- lookup

Command

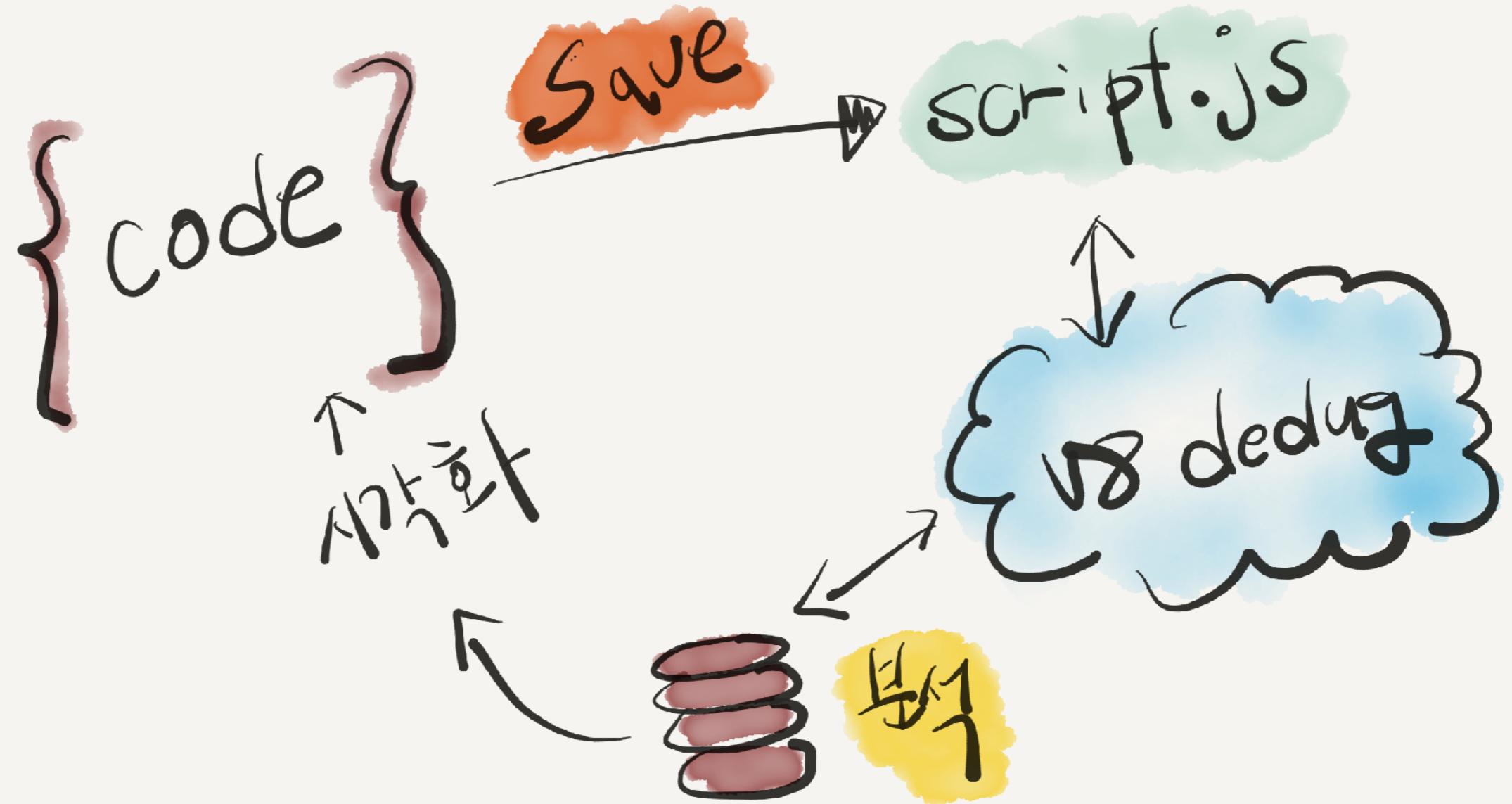
- continue
- backtrace
- frame
- setVariableValue
- **lookup**

Debugger listening on [::]:5859

```
Header-A: Some-Value\r\nContent-Length: 26\r\n\r\n{ "seq": 1, "type": "request" }
```

@node/lib/_debugger.js

npm install v8-debugger





```
1 let a = [34, 203, 3, 746, 200, 984, 198, 764, 9];
2
3 function bubbleSort(a)
4 {
5   let swapped;
6
7   do {
8     swapped = false;
9     for (var i=0; i < a.length-1; i++) {
10       if (a[i] > a[i+1]) {
11         var temp = a[i];
12         a[i] = a[i+1];
13         a[i+1] = temp;
14         swapped = true;
15       }
16     }
17   } while (swapped);
18 }
19
20 bubbleSort(a);
21
```

```
let jsFile = 'run.js';
let code = req.body.code;

fs.writeFile(jsFile, req.body.code);

let scprocess = spawn('node',
  ['--debug', '--debug-brk', executeScript]);

let v8 = require('v8-debugger').createClient({ port: 5858 });

v8.protocol.onResponse = v8MessageListener;

while (this._isFinish) {
  v8.reqStep('next', 1, commonHandler);
}
```

```
let jsFile = 'run.js';
let code = req.body.code;

fs.writeFile(jsFile, req.body.code, function(err) {
  if (err) {
    res.status(500).send('Error writing file');
  } else {
    execFile(jsFile, {}, function(error, stdout, stderr) {
      if (error) {
        res.status(500).send(`Error executing file: ${error}`);
      } else {
        res.send(stdout);
      }
    });
  }
});
```

```
let jsFile = 'run.js';
let code = req.body.code;

fs.writeFile(jsFile, req.body.code);

let scprocess = spawn('node',
['--debug', '--debug-brk', execPath,
  { limit: 1024 * 1024 * 1024 }]);

scprocess.stdout.on('data', (data) => {
  console.log(`[${scprocess.pid}] ${data}`);
});

scprocess.stderr.on('data', (data) => {
  console.error(`[${scprocess.pid}] ${data}`);
});

scprocess.on('error', (err) => {
  console.error(`[${scprocess.pid}] ${err}`);
});

let v8 = require('v8-debugger');

v8.setBreakpoint(scprocess.pid, 'Object.create');
```

```
file(jsFile, req.body.code);

process = spawn('node',
  'debug', '--debug-brk', executeScript));

require('v8-debugger').createClient({});

col.onResponse = v8MessageListener;

this._isFinish) {
  step('next', 1, commonHandler);
}
```

```
let v8 = require('v8-debugger').cr

v8.protocol.onResponse = v8Message

while (this._isFinish) {
  v8.reqStep('next', 1, commonHand
}

}
```

```
, '--debug-brk', executeScript]);  
  
uire('v8-debugger').createClient({  
  
onResponse = v8MessageListener;  
  
_isFinish) {  
('next', 1, commonHandler);
```

21st...

반복문인가?

단순 식인가?

함수 호출인가?

...

코드의 의미
파악이 선행되어야 한다

Javascript Parser

```
esprima.parse(req.body.code)
```

```
[  
  VariableDeclaration {  
    type: 'VariableDeclaration',  
    declarations: [Object],  
    kind: 'let'  
  },  
  FunctionDeclaration {  
    type: 'FunctionDeclaration',  
    id: [Object],  
    params: [Object],  
    body: [Object],  
    generator: false,  
    expression: false  
  },  
  ExpressionStatement {  
    type: 'ExpressionStatement',  
    expression: [Object]  
}  
]
```



```
1 let a = [34, 203, 3, 746, 200, 984, 198, 764, 9];
2
3 function bubbleSort(a)
4 {
5   let swapped;
6
7   do {
8     swapped = false;
9     for (var i=0; i < a.length-1; i++) {
10       if (a[i] > a[i+1]) {
11         var temp = a[i];
12         a[i] = a[i+1];
13         a[i+1] = temp;
14         swapped = true;
15       }
16     }
17   } while (swapped);
18 }
19
20 bubbleSort(a);
21
```



```
1 let a = [34, 203, 3, 746, 200, 984, 198, 764, 9];
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13         a[i+1] = temp;
14         swapped = true;
15       }
16     }
17   } while (swapped);
18 }
19
20 bubbleSort(a);
21
```

Variable Declaration



```
1 let a = [34, 203, 3, 746, 200, 984, 198, 764, 9];
2
3 function bubbleSort(a)
4 {
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6
7   do {
8     swapped = false;
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11         var temp = a[i];
12         a[i] = a[i+1];
13         a[i+1] = temp;
14         swapped = true;
15       }
16     }
17   } while (swapped);
18 }
19
20 bubbleSort(a);
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```

Function Declaration



```
1 let a = [34, 203, 3, 746, 200, 984, 198, 764, 9];
2
3 function bubbleSort(a)
4 {
5   let swapped;
6
7   do {
8     swapped = false;
9     for (var i=0; i < a.length-1; i++) {
10       if (a[i] > a[i+1]) {
11         var temp = a[i];
12         a[i] = a[i+1];
13         a[i+1] = temp;
14         swapped = true;
15       }
16     }
17   } while (swapped);
18 }
19
20 bubbleSort(a);
21
```

Expression Statement

泫 Runtime Context Visualizer ≡?

<https://github.com/ibare/jsplay>



MY APPS



CO-WORK



DATA

MY APPS +

Golmoo guide project_ver.5 20130228

Title

W 320

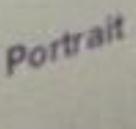
H 1900

Device

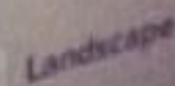
Flexible

Unlimited

Orientation



Portrait



Landscape

On br
Your br
Change

use "git

\$ git

0228

On branch level 2

Your branch is up-to-date with 'origin/ncsoft@ibare'.
Changes not staged for commit

modified: <http://www.slideshare.net/ibare/dvcs-git>

└ Learn DVCS for beginner

use "git add" and/or "git commit -a -m 'Learn level 2'"

