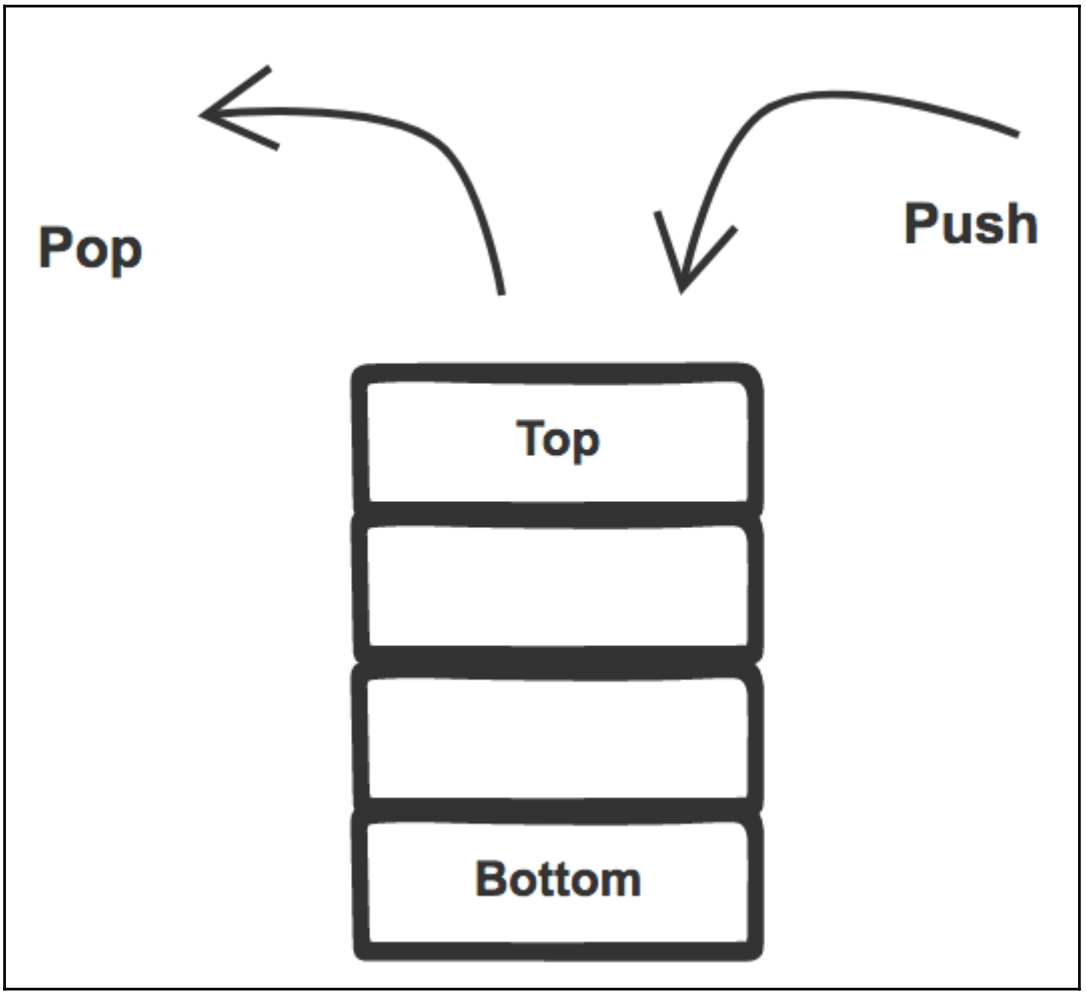
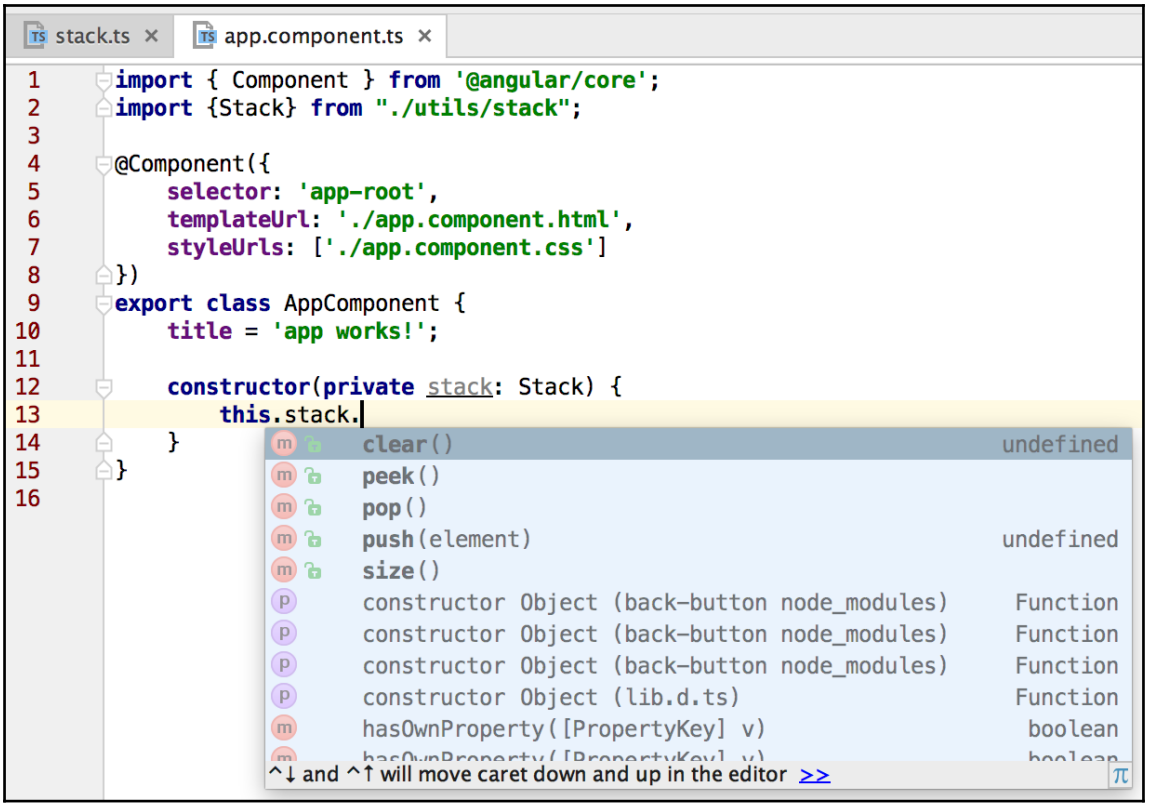
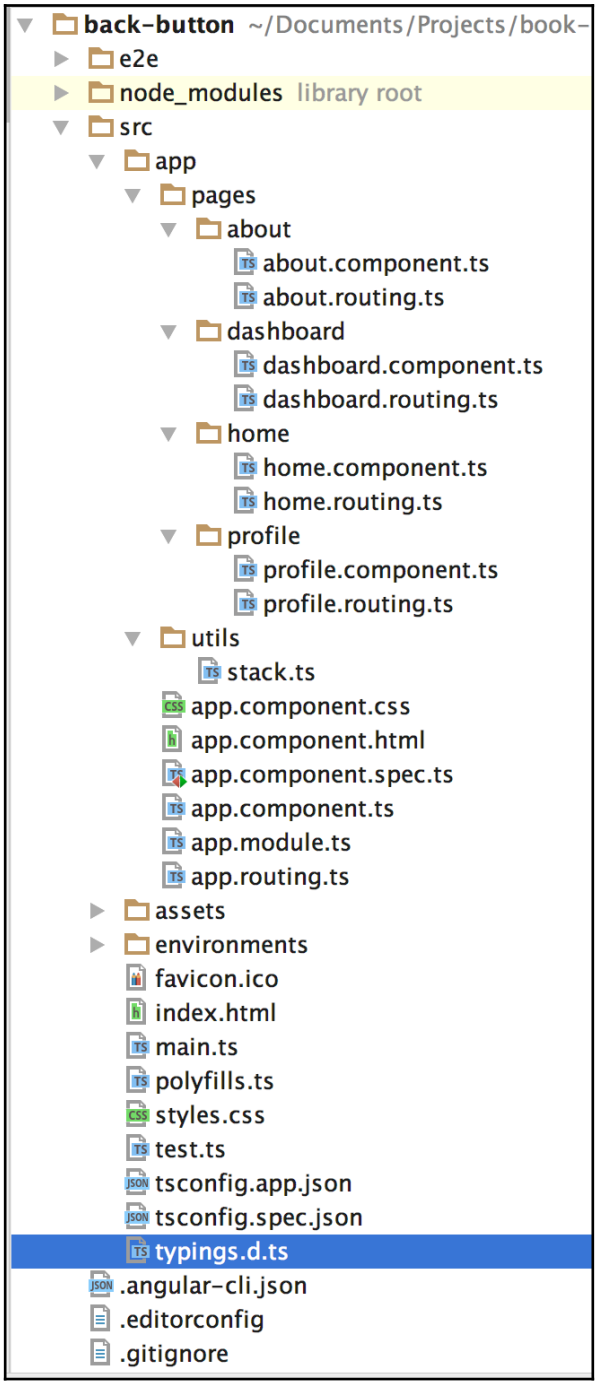
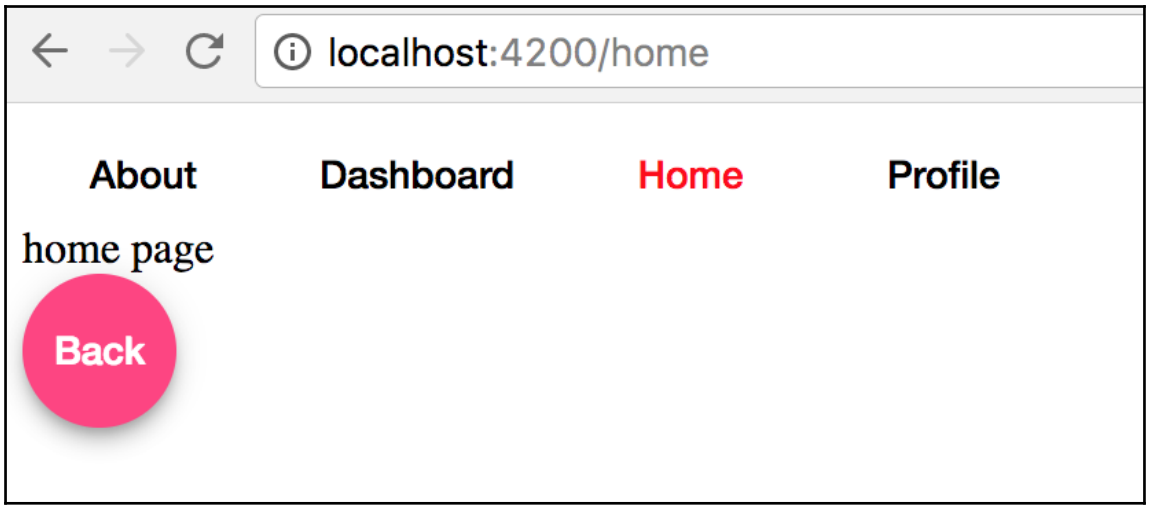
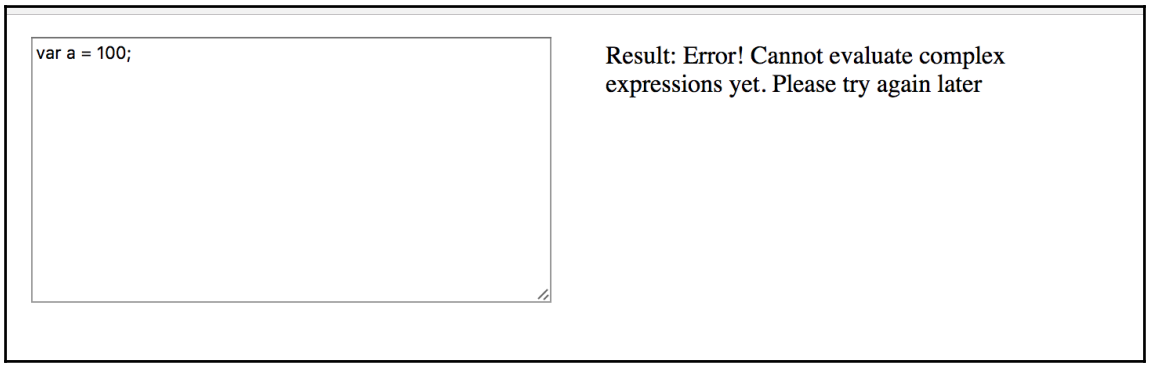
# Chapter 1: Building Stacks for Application State Management



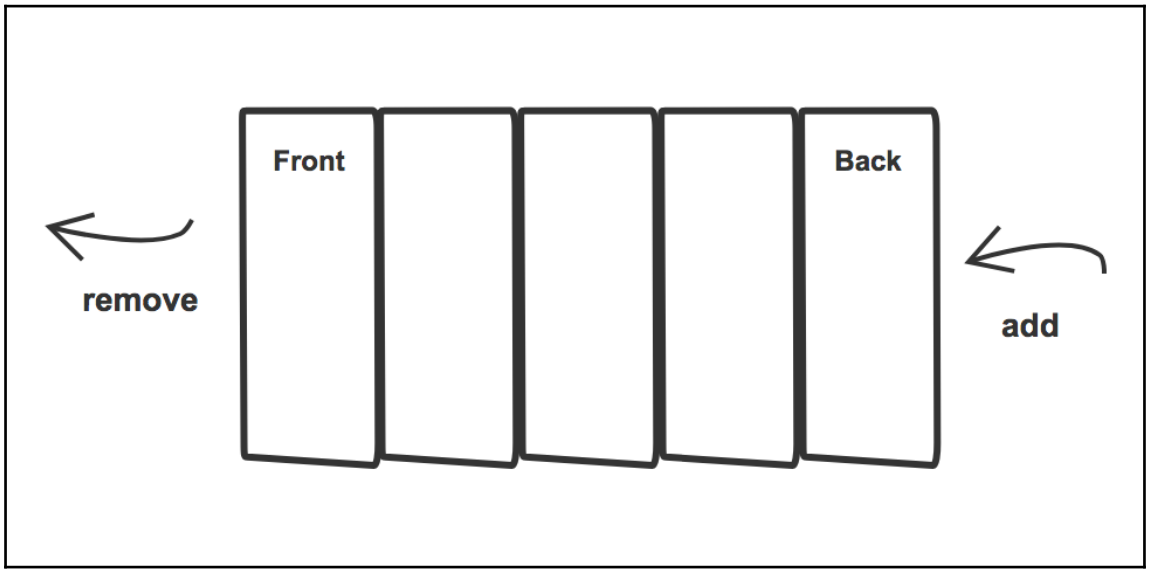

stack.ts
app.component.ts
import { Component } from '@angular/core';
import {Stack} from "./utils/stack";
@Component({
selector: 'app-root',
templateUrl: './app.component.html',
styleUrls: ['./app.component.css']
})
export class AppComponent {
title = 'app works!';
constructor(private stack: Stack) {
this.stack.
}
}
clear() undefined
peek()
pop()
push(element) undefined
size()
constructor Object (back-button node_modules) Function
constructor Object (back-button node_modules) Function
constructor Object (back-button node_modules) Function
constructor Object (lib.d.ts) Function
hasOwnProperty([PropertyKey] v) boolean
^↓ and ^↑ will move caret down and up in the editor >>

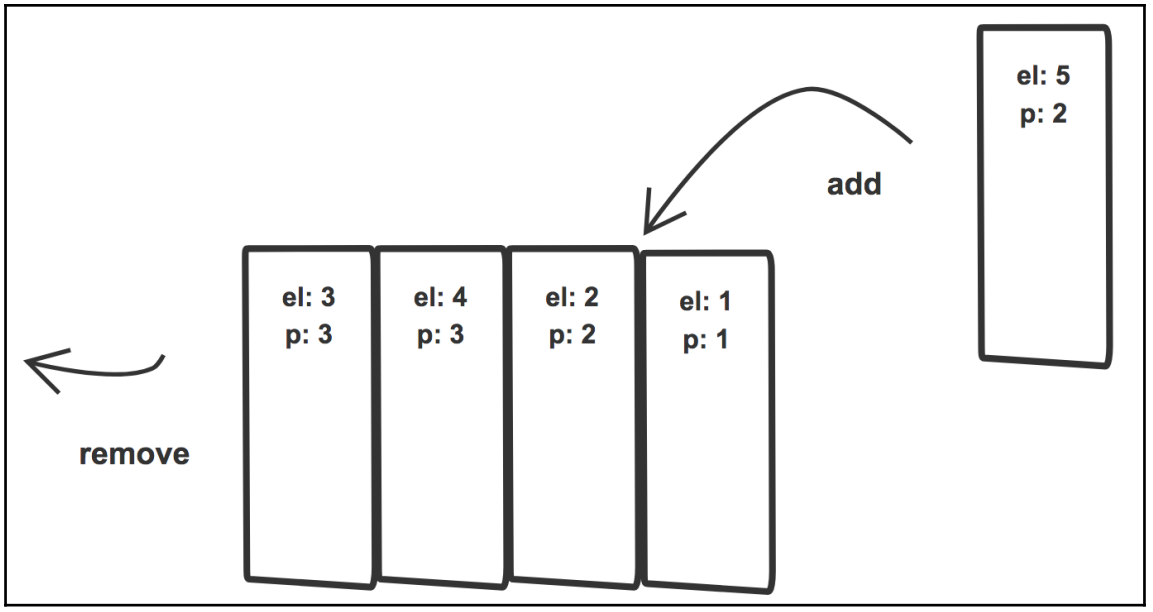

back-button ~/Documents/Projects/book-
e2e
node_modules library root
src
app
pages
about
about.component.ts
about.routing.ts
dashboard
dashboard.component.ts
dashboard.routing.ts
home
home.component.ts
home.routing.ts
profile
profile.component.ts
profile.routing.ts
utils
stack.ts
app.component.css
app.component.html
app.component.spec.ts
app.component.ts
app.module.ts
app.routing.ts
assets
environments
favicon.ico
index.html
main.ts
polyfills.ts
styles.css
test.ts
tsconfig.app.json
tsconfig.spec.json
typings.d.ts
.angular-cli.json
.editorconfig
.gitignore

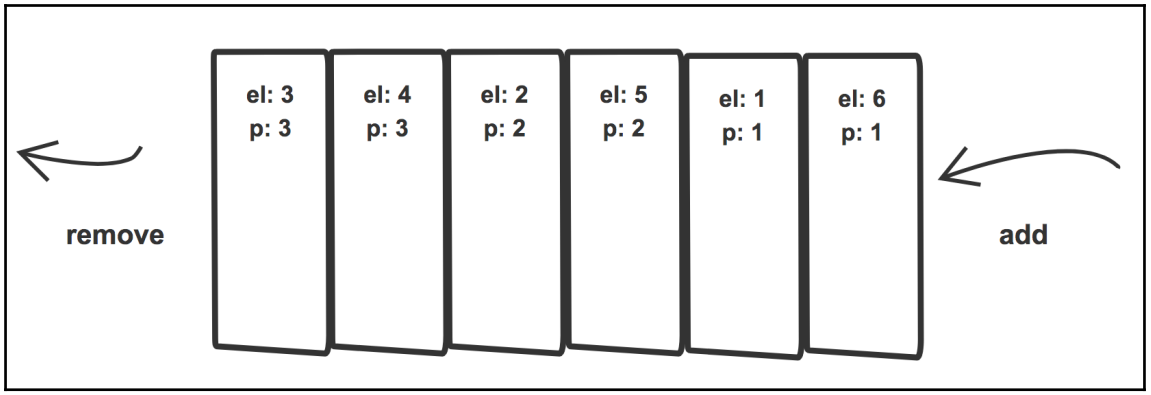

localhost:4200/home
About
Dashboard
Home
Profile
home page
Back


var a = 100;
Result: Error! Cannot evaluate complex expressions yet. Please try again later

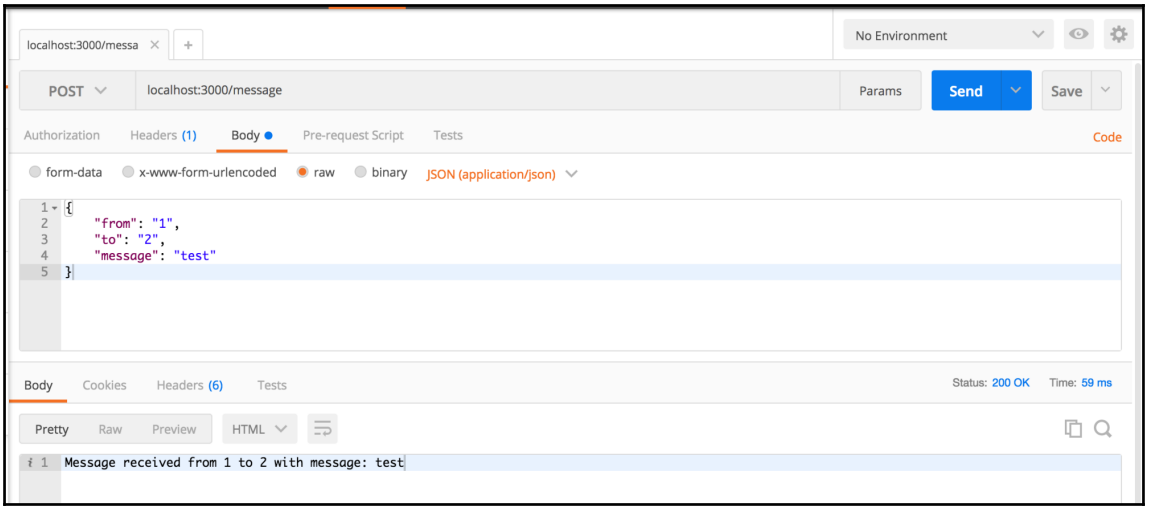
# Chapter 2: Creating Queues for In-Order Executions

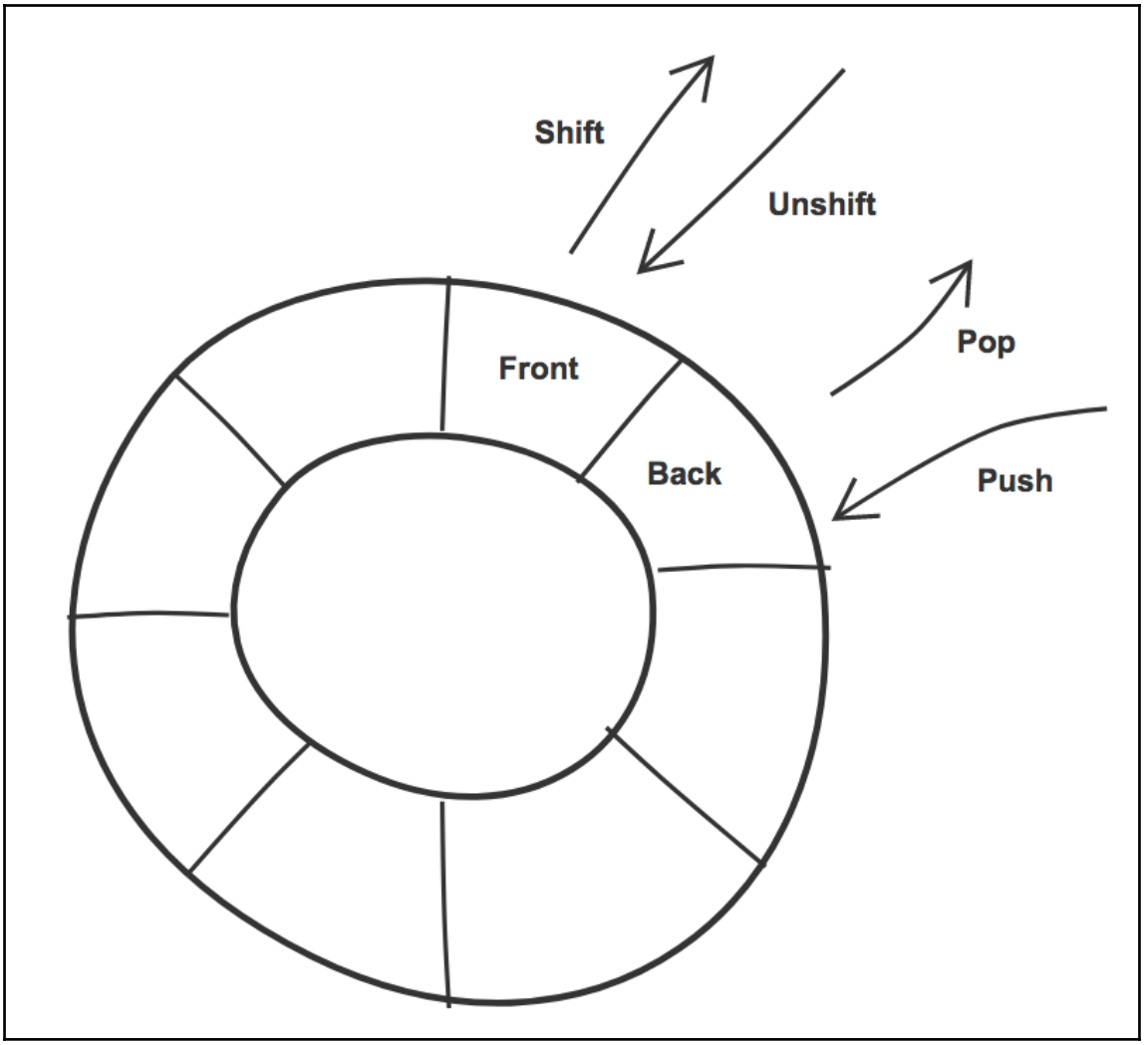





```
Kashyaps-MacBook-Pro:chat kashyapmukkamala$ npm init
This utility will walk you through creating a package.json file.
It only covers the most common items, and tries to guess sensible defaults.

See `npm help json` for definitive documentation on these fields
and exactly what they do.

Use `npm install <pkg> --save` afterwards to install a package and
save it as a dependency in the package.json file.

Press ^C at any time to quit.
name: (chat)
version: (1.0.0)
description: simple chat application
entry point: (index.js)
test command:
git repository:
keywords:
author:
license: (ISC)
About to write to /Users/kashyapmukkamala/Documents/Projects/book-examples/queues/chat/package.json:

{
  "name": "chat",
  "version": "1.0.0",
  "description": "simple chat application",
  "main": "index.js",
  "scripts": {
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "author": "",
  "license": "ISC"
}


Is this ok? (yes) yes
Kashyaps-MacBook-Pro:chat kashyapmukkamala$
```


localhost:3000/messa
No Environment
POST
localhost:3000/message
Params
Send
Save
Authorization
Headers (1)
Body
Pre-request Script
Tests
Code
form-data
x-www-form-urlencoded
raw
binary
JSON (application/json)
{
"from": "1",
"to": "2",
"message": "test"
}
Body
Cookies
Headers (6)
Tests
Status: 200 OK
Time: 59 ms
Pretty
Raw
Preview
HTML
Message received from 1 to 2 with message: test


Shift
Unshift
Pop
Front
Back
Push

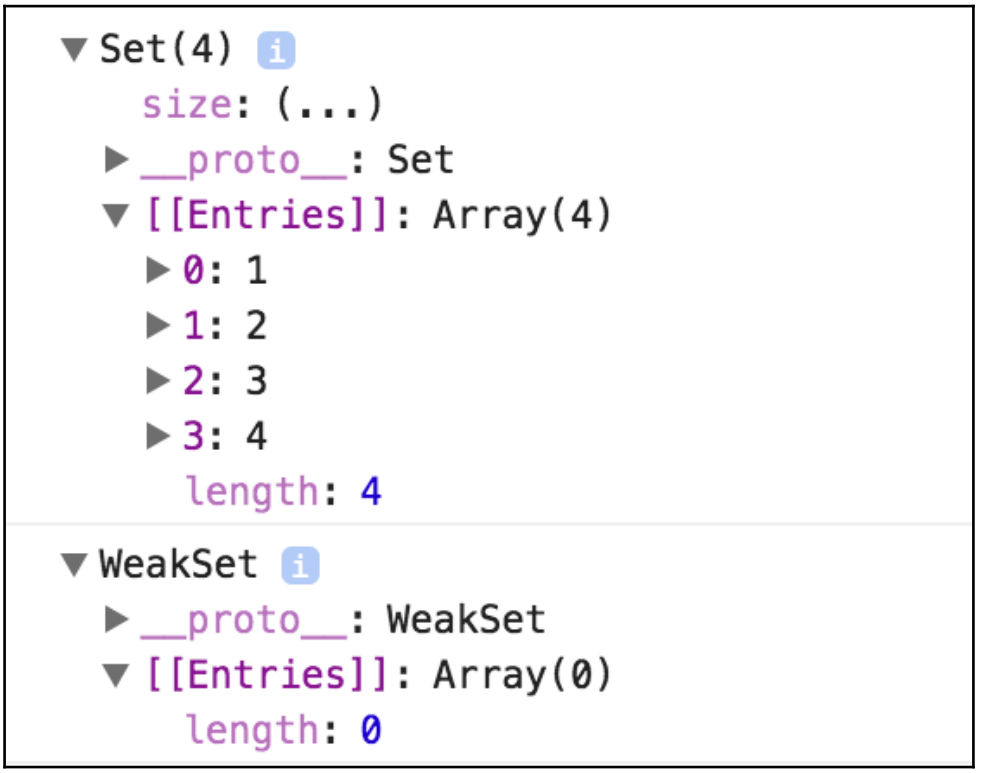
```
> node tests/benchmark.js

Running Fast Elements Array
circular-queue push x 49,093,818 ops/sec ±0.83% (90 runs sampled)
regular array push x 42,568,260 ops/sec ±0.93% (90 runs sampled)
circular-queue pop x 67,985,077 ops/sec ±0.87% (88 runs sampled)
regular array pop x 95,477,009 ops/sec ±1.04% (91 runs sampled)
circular-queue unshift x 45,205,363 ops/sec ±1.93% (87 runs sampled)
regular array unshift x 14,003,505 ops/sec ±2.07% (79 runs sampled)
circular-queue shift x 59,707,783 ops/sec ±2.28% (83 runs sampled)
regular array shift x 82,651,984 ops/sec ±2.09% (79 runs sampled)
```

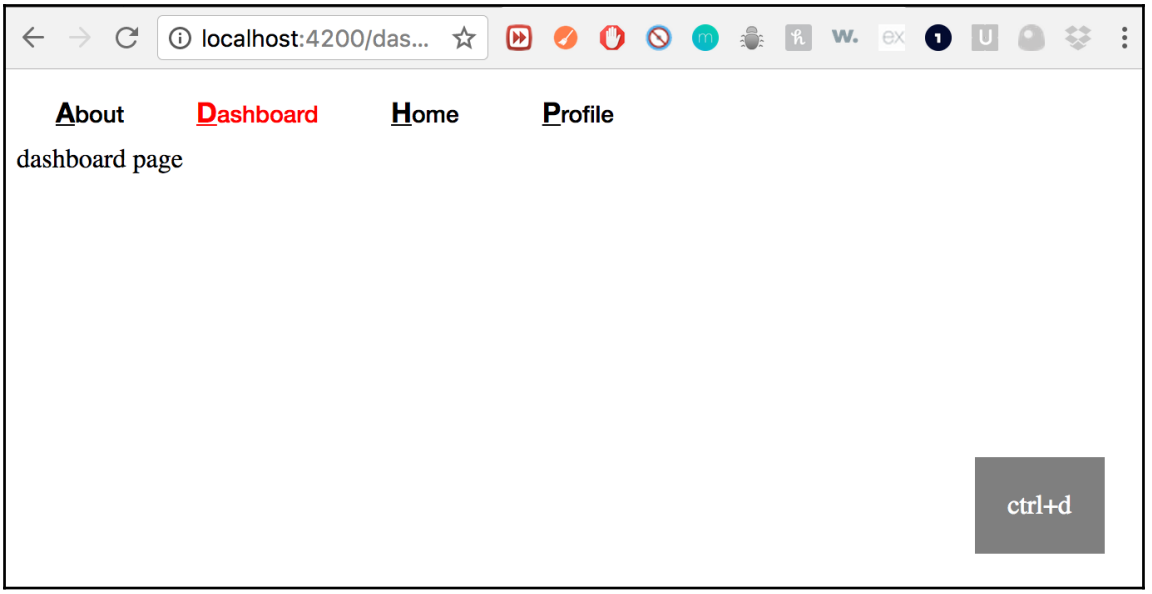
```
> node tests/benchmark.js

Running Dictionary Mode Array
circular-queue push x 48,317,225 ops/sec ±1.24% (86 runs sampled)
regular array push x 10,610,772 ops/sec ±1.49% (91 runs sampled)
circular-queue pop x 61,889,374 ops/sec ±1.97% (84 runs sampled)
regular array pop x 90,028,316 ops/sec ±1.70% (84 runs sampled)
circular-queue unshift x 45,178,523 ops/sec ±1.29% (83 runs sampled)
regular array unshift x 15,658,060 ops/sec ±1.55% (85 runs sampled)
circular-queue shift x 64,574,793 ops/sec ±1.29% (86 runs sampled)
regular array shift x 91,389,686 ops/sec ±1.36% (85 runs sampled)
```

```
> node tests/benchmark.js

regular array push x 42,192,977 ops/sec ±1.25% (89 runs sampled)
{ rss: 50614272,
  heapTotal: 33640448,
  heapUsed: 23483576,
  external: 8748 }
```

```
> node tests/benchmark.js

simple queue push x 10,422,721 ops/sec ±0.62% (91 runs sampled)
{ rss: 50716672,
  heapTotal: 33640448,
  heapUsed: 22201776,
  external: 8748 }
```

# Chapter 3: Using Sets and Maps for Faster Applications




localhost:4200/das...
About
Dashboard
Home
Profile
dashboard page
ctrl+d

Company Name

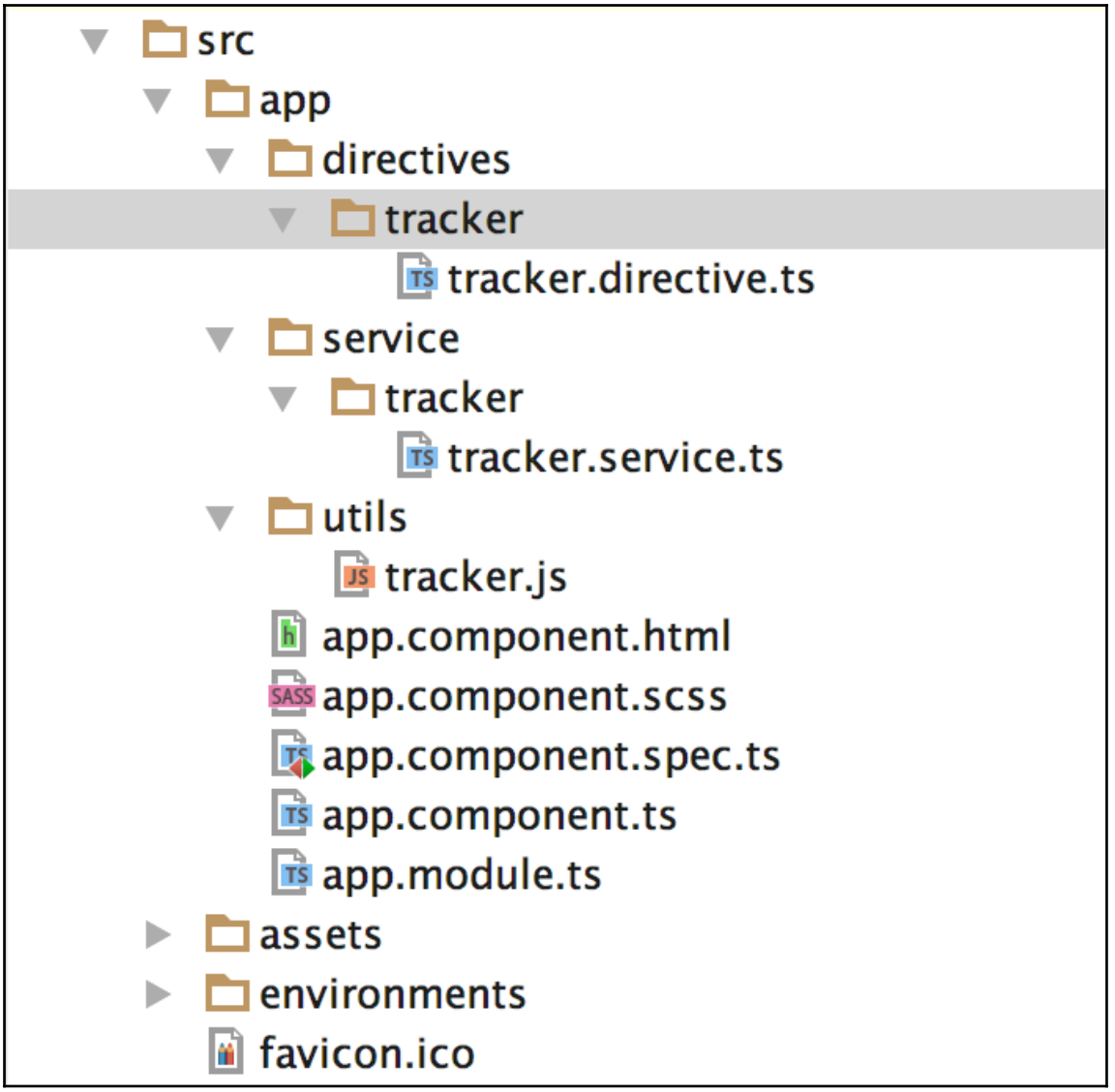
First Name Last Name

Address

Address 2

City State Postal Code

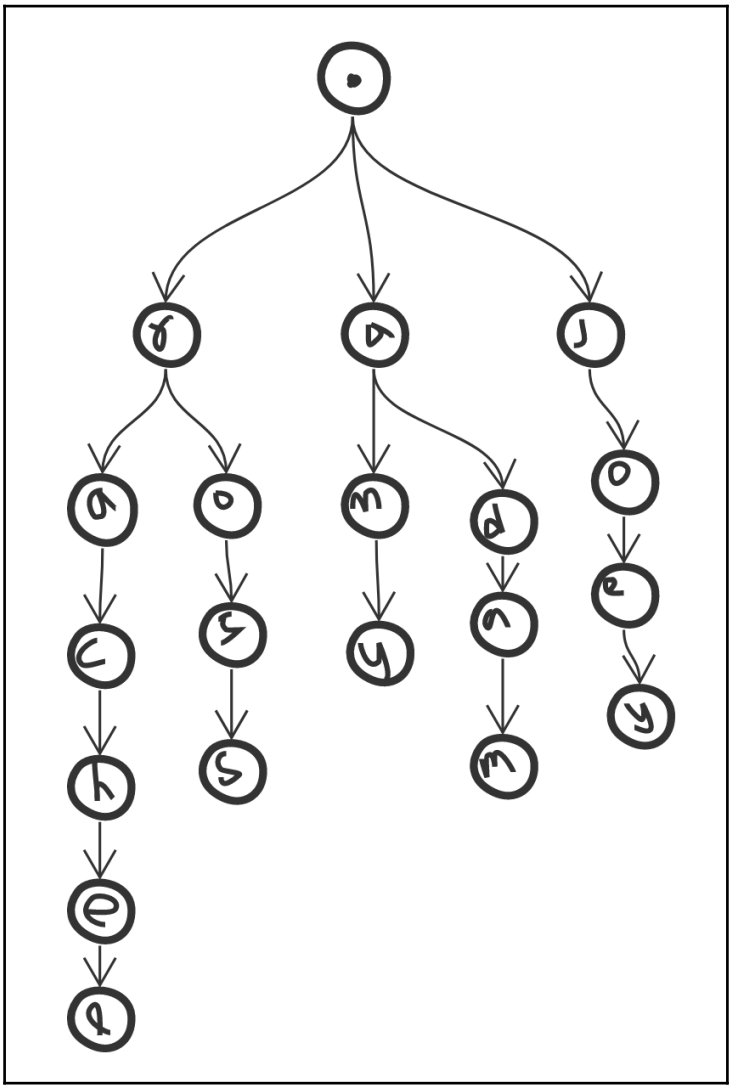
0 / 5

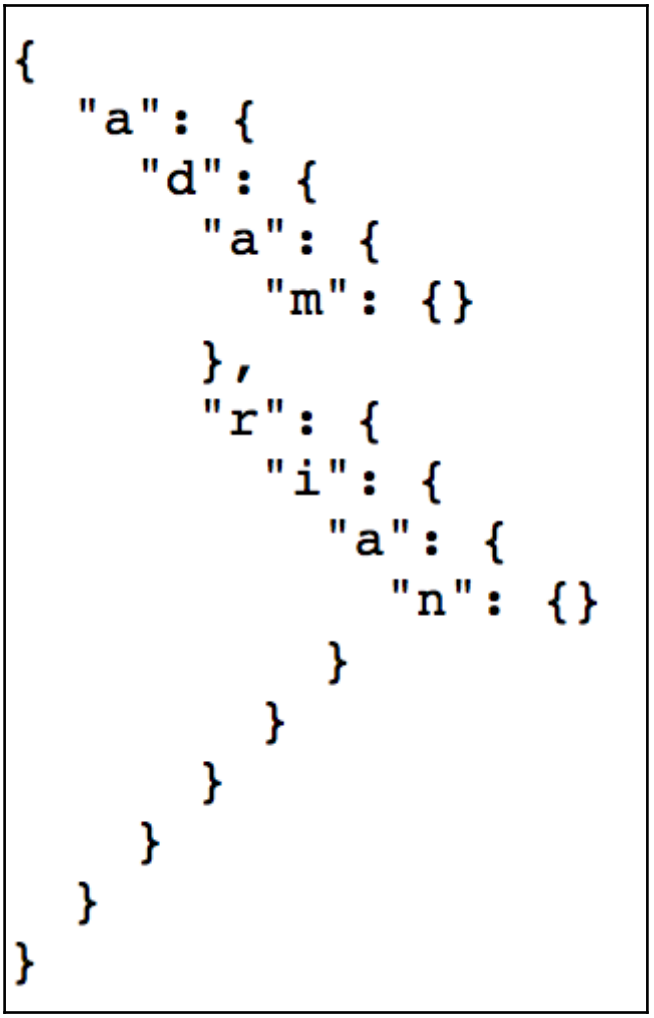

src
app
directives
tracker
tracker.directive.ts
service
tracker
tracker.service.ts
utils
tracker.js
app.component.html
app.component.scss
app.component.spec.ts
app.component.ts
app.module.ts
assets
environments
favicon.ico

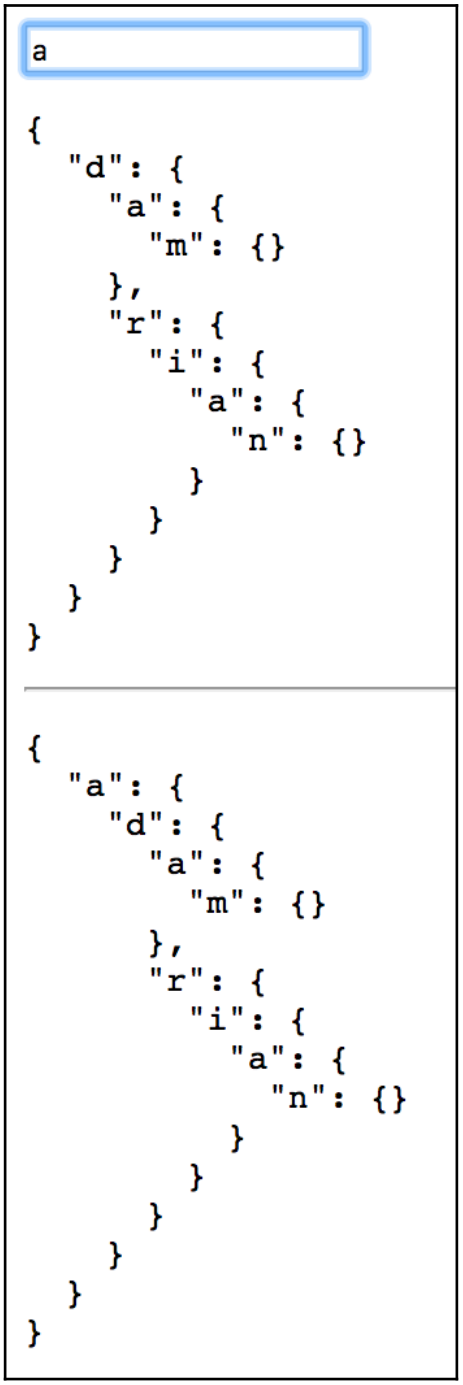
```
Kashyaps-MacBook-Pro:performance-sets-maps kashyapmukkamala$ node sets-arr.js
array #indexOf x 12,980,029 ops/sec ±0.85% (87 runs sampled)
set #has x 27,372,744 ops/sec ±0.95% (89 runs sampled)
array #splice x 9,994,447 ops/sec ±0.86% (92 runs sampled)
set #delete x 30,538,077 ops/sec ±1.27% (89 runs sampled)
array #length x 89,741,212 ops/sec ±1.55% (85 runs sampled)
set #size x 58,543,894 ops/sec ±1.32% (84 runs sampled)
Kashyaps-MacBook-Pro:performance-sets-maps kashyapmukkamala$
```

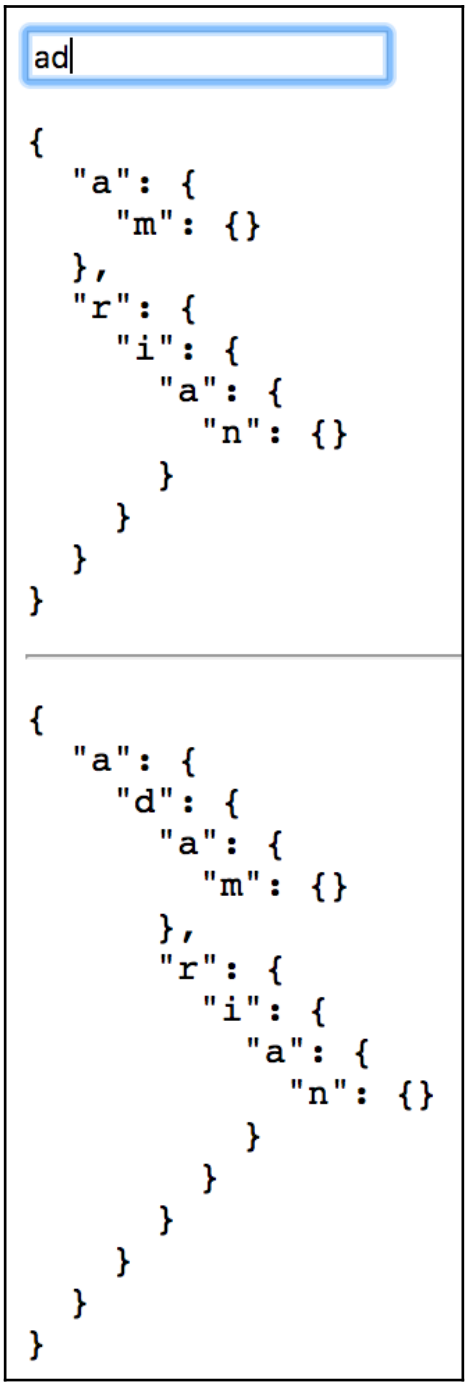
```
Kashyaps-MacBook-Pro:performance-sets-maps kashyapmukkamala$ node maps-obj.js
Object #get x 85,607,409 ops/sec ±1.57% (84 runs sampled)
Map #get x 6,452,224 ops/sec ±0.95% (87 runs sampled)
Object #delete x 19,291,361 ops/sec ±1.10% (86 runs sampled)
Map #delete x 6,353,435 ops/sec ±1.08% (86 runs sampled)
Object #length x 240,602 ops/sec ±1.06% (85 runs sampled)
Map #size x 55,984,048 ops/sec ±1.05% (87 runs sampled)
Kashyaps-MacBook-Pro:performance-sets-maps kashyapmukkamala$
```

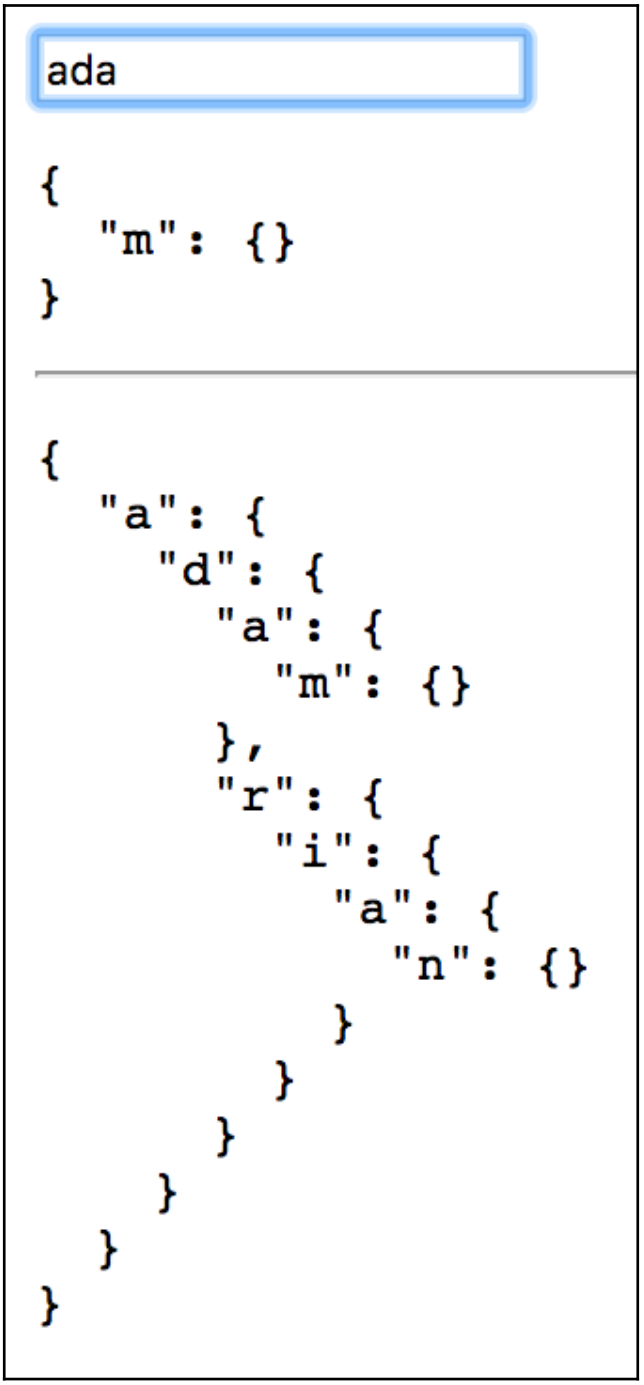
# Chapter 4: Using Trees for Faster Lookup and Modifications




{
"a": {
"d": {
"a": {
"m": {}
},
"r": {
"i": {
"a": {
"n": {}
}
}
}
}
}
}

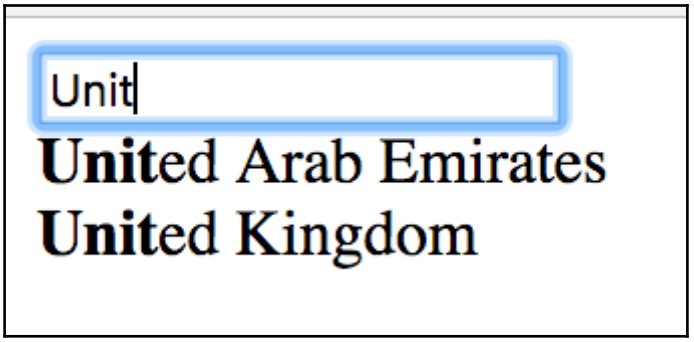

a
{
"d": {
"a": {
"m": {}
},
"r": {
"i": {
"a": {
"n": {}
}
}
}
}
}
{
"a": {
"d": {
"a": {
"m": {}
},
"r": {
"i": {
"a": {
"n": {}
}
}
}
}
}
}


ad
{
"a": {
"m": {}
},
"r": {
"i": {
"a": {
"n": {}
}
}
}
}
{
"a": {
"d": {
"a": {
"m": {}
},
"r": {
"i": {
"a": {
"n": {}
}
}
}
}
}
}


ada
{
"m": {}
}
{
"a": {
"d": {
"a": {
"m": {}
},
"r": {
"i": {
"a": {
"n": {}
}
}
}
}
}
}

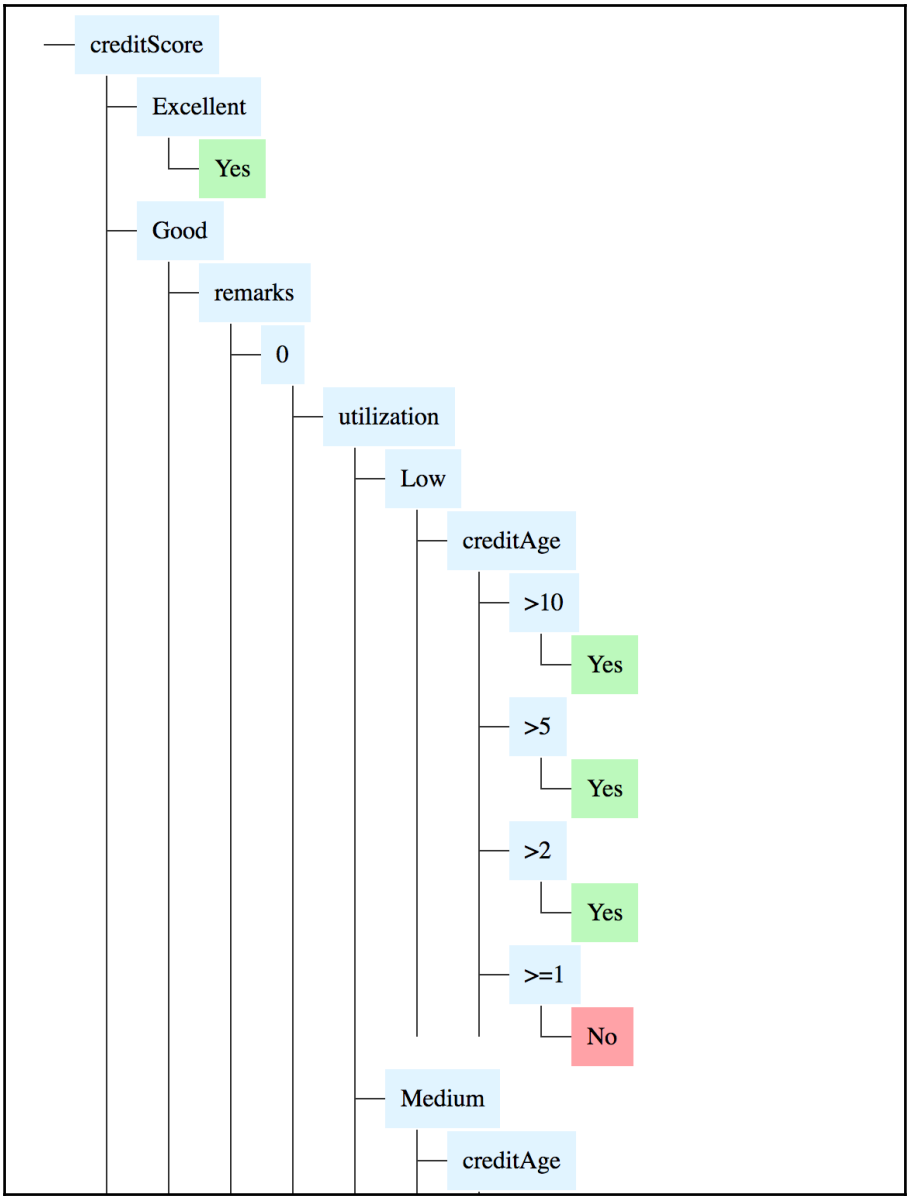
ad

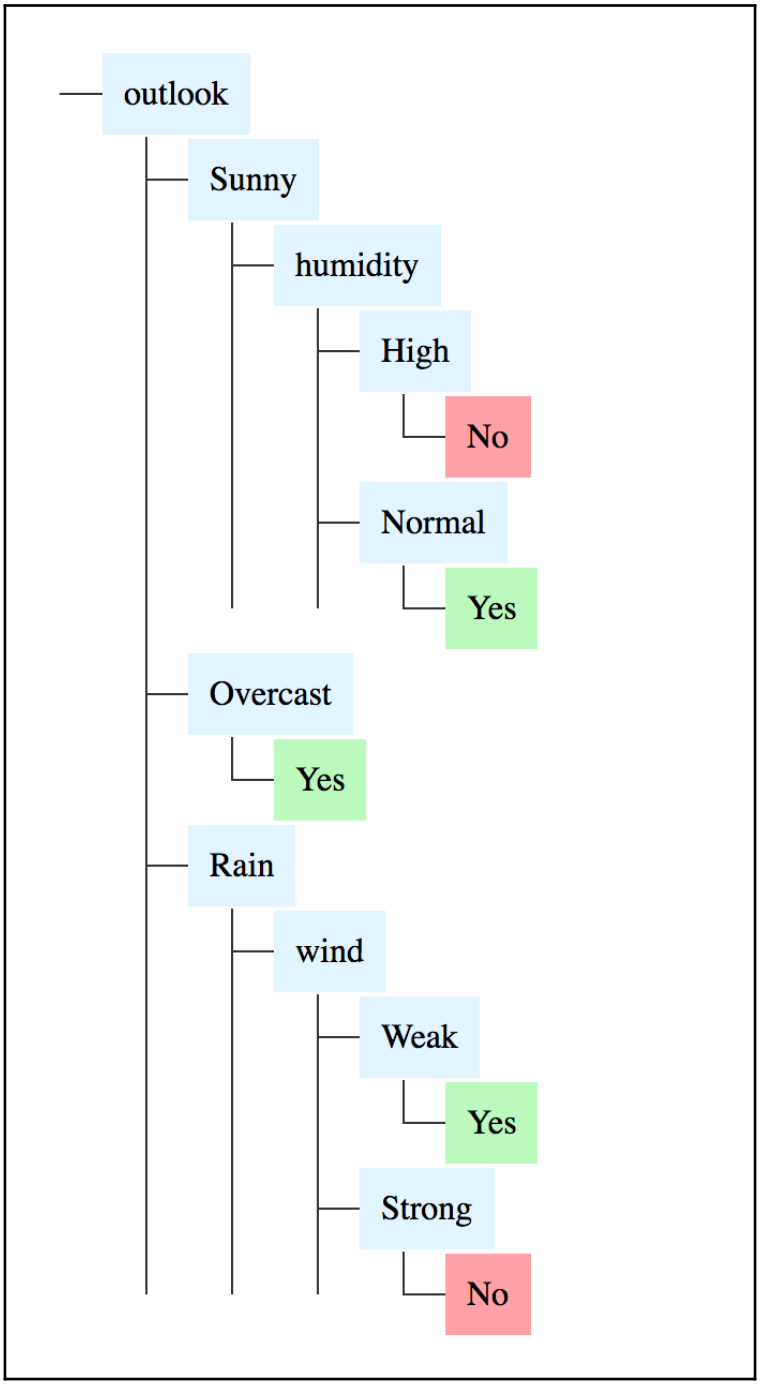

```
{
  "remainder": [
    "am",
    "rian"
  ],
  "a": {
    "remainder": [
      "m"
    ],
    "m": {
      "remainder": [
        ""
      ]
    }
  },
  "r": {
    "remainder": [
      "ian"
    ],
    "i": {
      "remainder": [
        "an"
      ],
      "a": {
        "remainder": [
          "n"
        ],
        "n": {
          "remainder": [
            ""
          ]
        }
      }
    }
  }
}
```

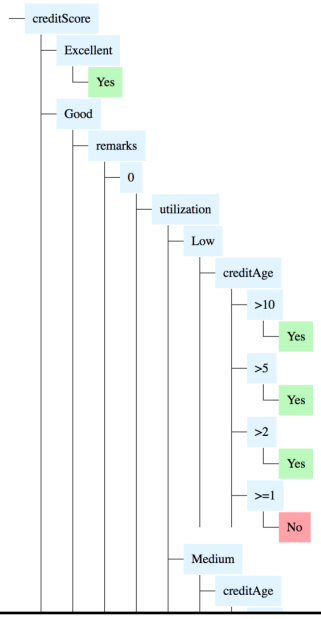



```
export class CreditCard {
    /*
    *
    * creditScore: Excellent, Good, Average, Poor
    * creditAge: 10, 5, 2, 1 (or above)
    * remarks: 0, 1, 2, 3 (or more)
    * utilization: Low, Medium, High
    * hardInquiries: 0, 1, 2, 3 (or more)
    *
    * */

    public static data = [{"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"Low","hardInquiries":"0",
  "approved":"Yes"},{"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"Low","hardInquiries":"2","approved":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"Medium","hardInquiries":"0","approved":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"Medium","hardInquiries":"2","approved":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"High","hardInquiries":"0","approved":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"High","hardInquiries":"2","approved":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"1","utilization":"Low","hardInquiries":"0","approved":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"1","utilization":"Low","hardInquiries":"2","approved":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"1","utilization":"Medium","hardInquiries":"0","approved":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"1","utilization":"Medium","hardInquiries":"2","approved":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"1","utilization":"High","hardInquiries":"0","approved":"Yes"},
```

```
import { Component, OnInit } from '@angular/core';
import {ID3} from "../utils/id3";
import {without, keys, filter} from "lodash";

@Component({
    selector: 'app-root',
    templateUrl: './app.component.html',
    styleUrls: ['./app.component.scss']
})
export class AppComponent implements OnInit {
    tests: any;

    constructor(private id3: ID3) {

    }

    ngOnInit() {
        this.tests = [{"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"Low","hardInquiries":"1","expected":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"Low","hardInquiries":">=3","expected":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"Medium","hardInquiries":"1","expected":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"Medium","hardInquiries":">=3","expected":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"High","hardInquiries":"1","expected":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"0","utilization":"High","hardInquiries":">=3","expected":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"1","utilization":"Low","hardInquiries":"1","expected":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"1","utilization":"Low","hardInquiries":">=3","expected":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"1","utilization":"Medium","hardInquiries":"1","expected":"Yes"},
  {"creditScore":"Excellent","creditAge":">10","remarks":"1","utilization":"Medium","hardInquiries":">=3","expected":"Yes"},
```

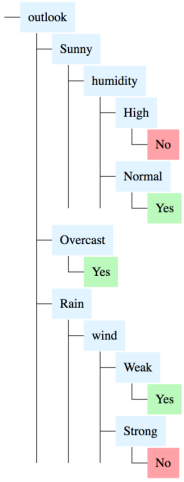

creditScore
Excellent
Yes
Good
remarks
0
utilization
Low
creditAge
>10
Yes
>5
Yes
>2
Yes
>=1
No
Medium
creditAge


outlook
Sunny
humidity
High
No
Normal
Yes
Overcast
Yes
Rain
wind
Weak
Yes
Strong
No




**Overall accuracy 95.833%**

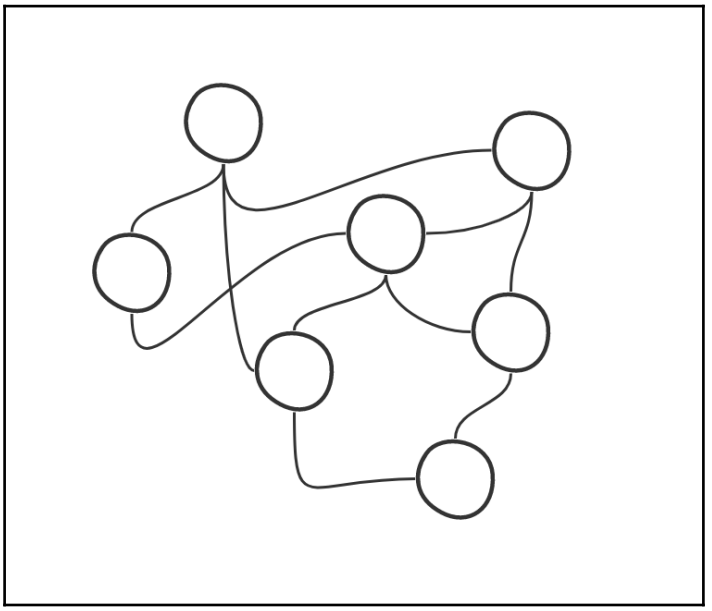
| Credit Score | Credit Age | Remarks | Utilization | Hard Inquiries | Expected | Actual | Accurate |
|---|---|---|---|---|---|---|---|
| Excellent | >10 | 0 | Low | 1 | Yes | Yes | true |
| Excellent | >10 | 0 | Low | >=3 | Yes | Yes | true |
| Excellent | >10 | 0 | Medium | 1 | Yes | Yes | true |
| Excellent | >10 | 0 | Medium | >=3 | Yes | Yes | true |
| Excellent | >10 | 0 | High | 1 | Yes | Yes | true |
| Excellent | >10 | 0 | High | >=3 | Yes | Yes | true |
| Excellent | >10 | 1 | Low | 1 | Yes | Yes | true |
| Excellent | >10 | 1 | Low | >=3 | Yes | Yes | true |
| Excellent | >10 | 1 | Medium | 1 | Yes | Yes | true |
| Excellent | >10 | 1 | Medium | >=3 | Yes | Yes | true |
| Excellent | >10 | 1 | High | 1 | Yes | Yes | true |
| Excellent | >10 | 1 | High | >=3 | Yes | Yes | true |
| Excellent | >10 | 2 | Low | 1 | Yes | Yes | true |
| Excellent | >10 | 2 | Low | >=3 | Yes | Yes | true |
| Excellent | >10 | 2 | Medium | 1 | Yes | Yes | true |
| Excellent | >10 | 2 | Medium | >=3 | Yes | Yes | true |
| Excellent | >10 | 2 | High | 1 | Yes | Yes | true |
| Excellent | >10 | 2 | High | >=3 | Yes | Yes | true |
| Excellent | >10 | >=3 | Low | 1 | Yes | Yes | true |
| Excellent | >10 | >=3 | Low | >=3 | Yes | Yes | true |
| Excellent | >10 | >=3 | Medium | 1 | Yes | Yes | true |
| Excellent | >10 | >=3 | Medium | >=3 | Yes | Yes | true |
| Excellent | >10 | >=3 | High | 1 | Yes | Yes | true |
| Excellent | >10 | >=3 | High | >=3 | Yes | Yes | true |
| Excellent | >5 | 0 | Low | 1 | Yes | Yes | true |
| Excellent | >5 | 0 | Low | >=3 | Yes | Yes | true |
| Excellent | >5 | 0 | Medium | 1 | Yes | Yes | true |
| Excellent | >5 | 0 | Medium | >=3 | Yes | Yes | true |
| Excellent | >5 | 0 | High | 1 | Yes | Yes | true |
| Excellent | >5 | 0 | High | >=3 | Yes | Yes | true |
| Excellent | >5 | 1 | Low | 1 | Yes | Yes | true |
| Excellent | >5 | 1 | Low | >=3 | Yes | Yes | true |

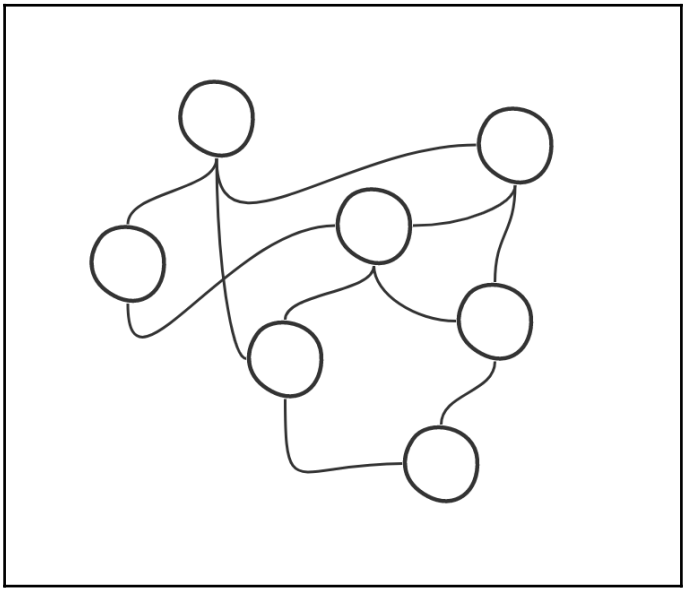


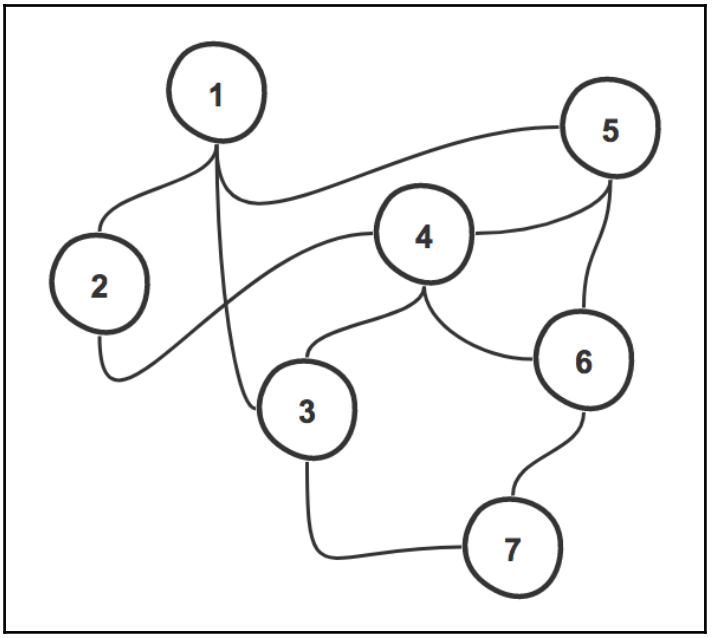

**Overall accuracy 100%**

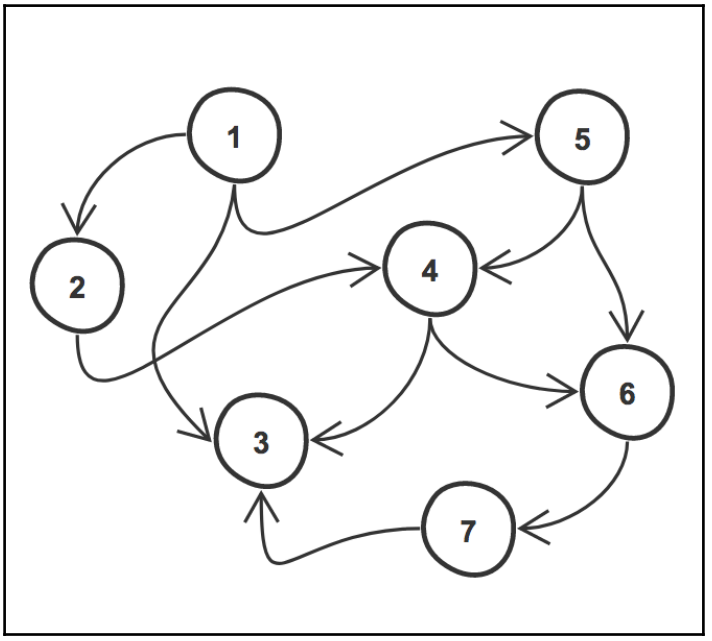
| Outlook | Wind | Humidity | Temperature | Expected | Actual | Accurate |
|---|---|---|---|---|---|---|
| Overcast | Strong | High | Mild | Yes | Yes | true |
| Rain | Strong | High | Mild | No | No | true |
| Sunny | Weak | Normal | Cool | Yes | Yes | true |

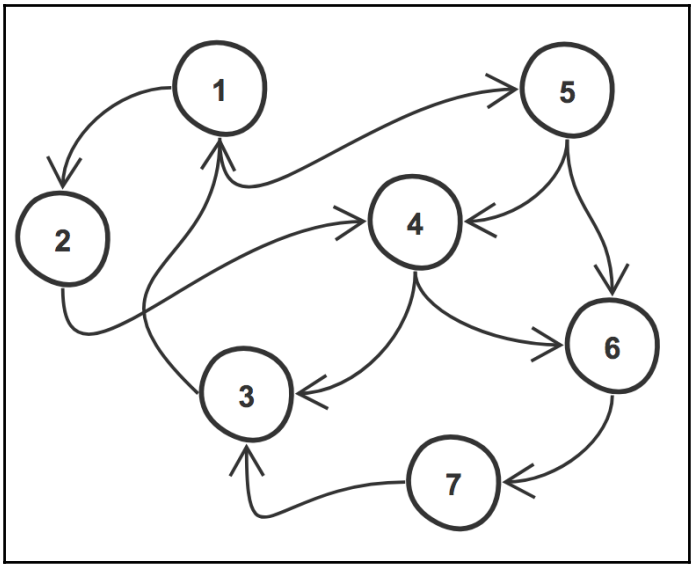
# Chapter 5: Simplify Complex Applications Using Graphs

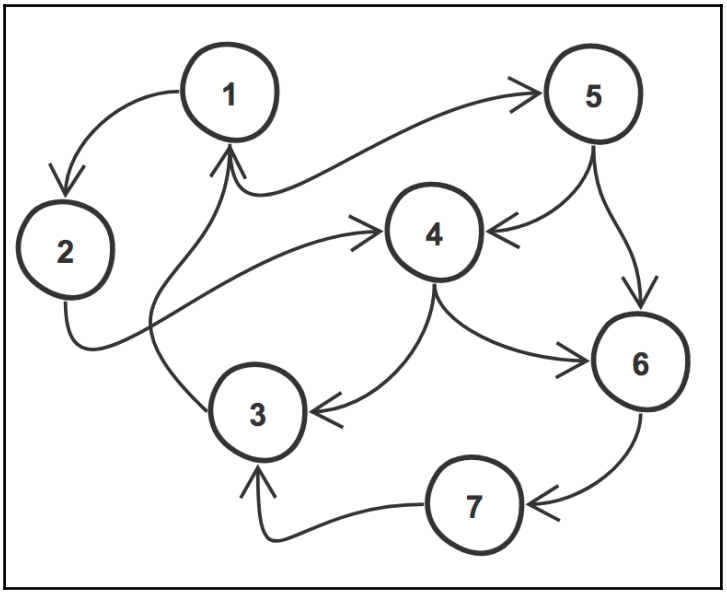


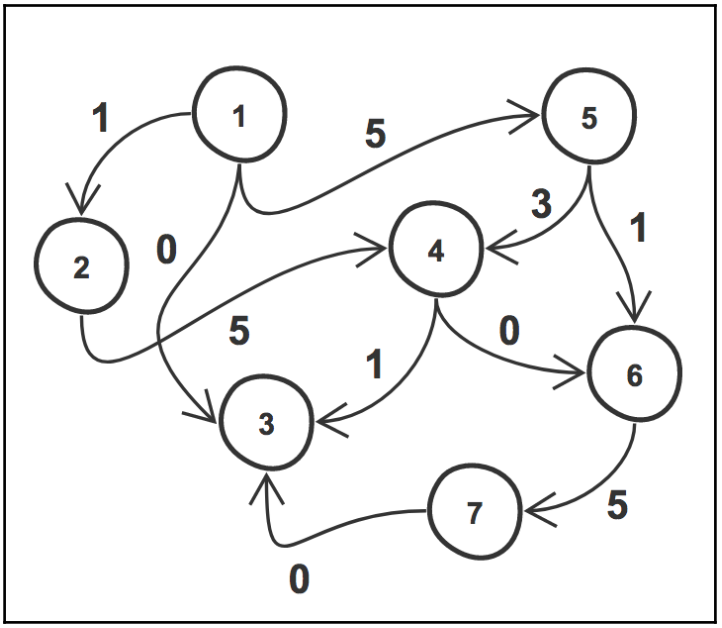


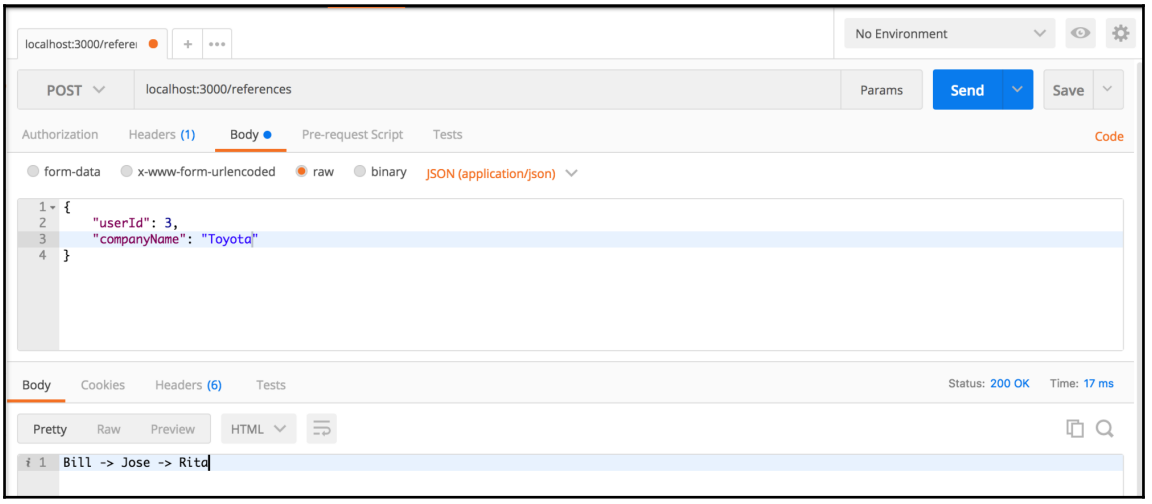

1
5
4
2
6
3
7

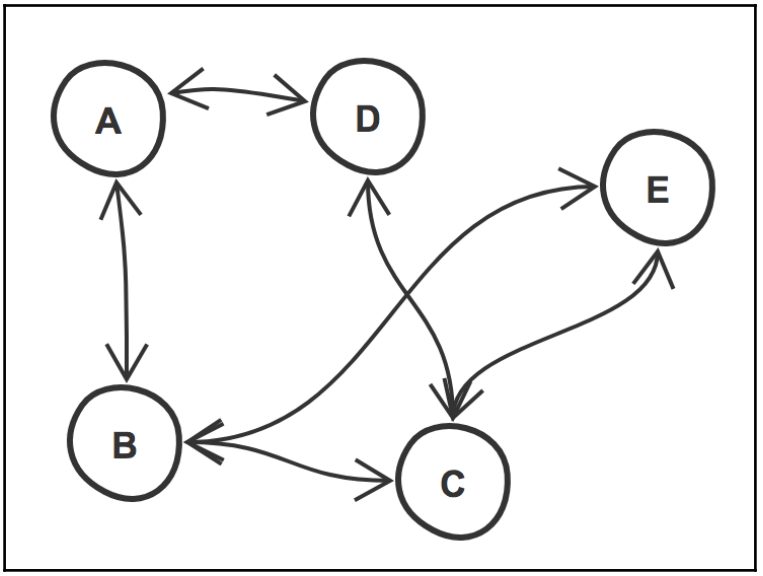

1
5
2
4
6
3
7


1
5
2
4
6
3
7


1
5
2
4
6
3
7


1
2
3
4
5
6
7
1
5
0
3
1
5
1
0
5
0


localhost:3000/referei
No Environment
POST
localhost:3000/references
Params
Send
Save
Authorization
Headers (1)
Body
Pre-request Script
Tests
Code
form-data
x-www-form-urlencoded
raw
binary
JSON (application/json)
{
"userId": 3,
"companyName": "Toyota"
}
Body
Cookies
Headers (6)
Tests
Status: 200 OK
Time: 17 ms
Pretty
Raw
Preview
HTML
Bill -> Jose -> Rita




GET localhost:3000/suggestions/A Params Send

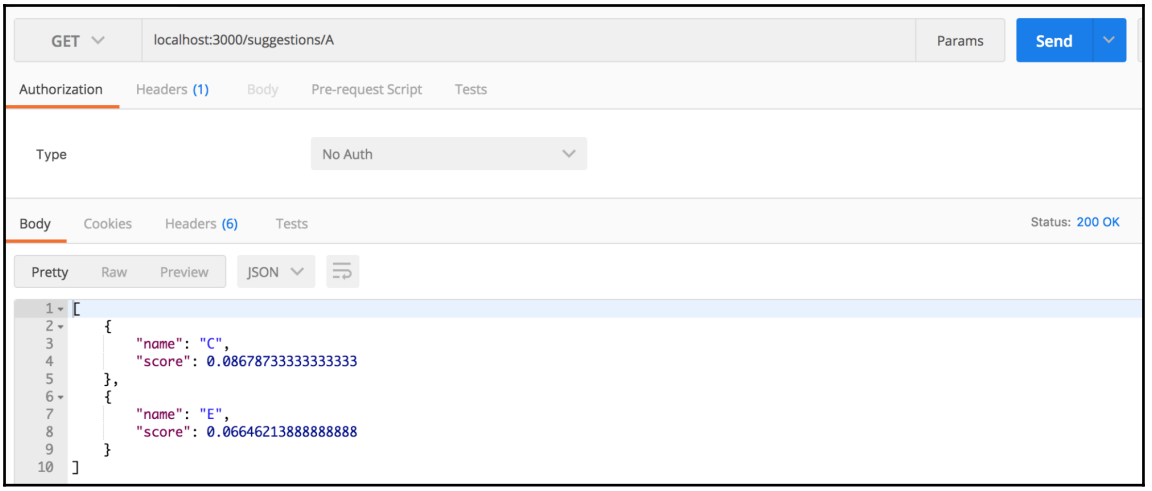
Authorization Headers (1) Body Pre-request Script Tests

Type No Auth

Body Cookies Headers (6) Tests Status: 200 OK

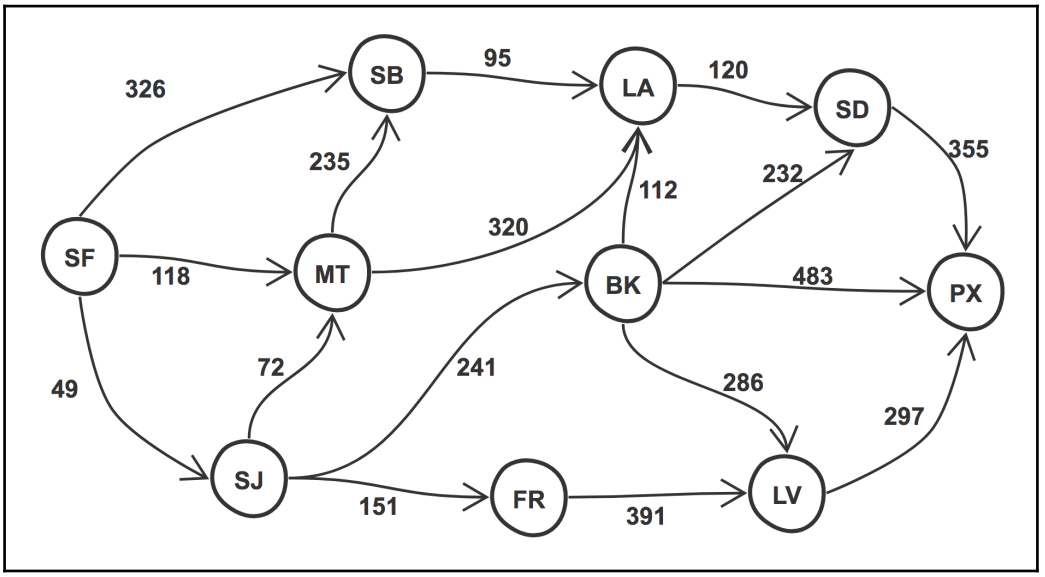
Pretty Raw Preview JSON

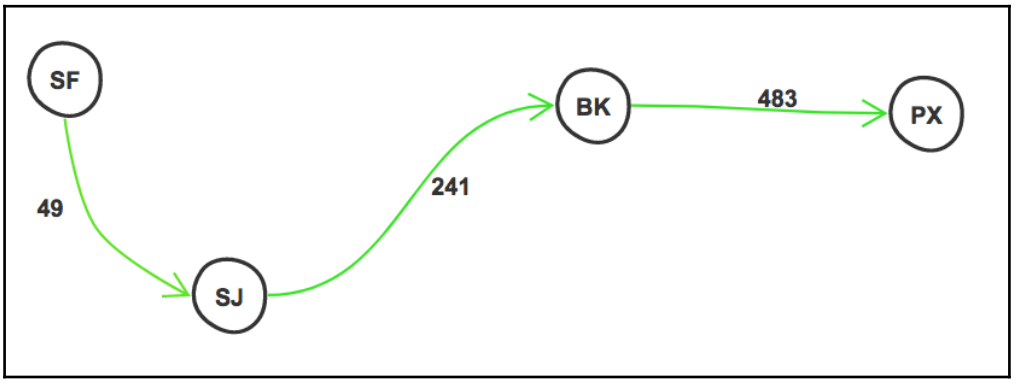

```
[
    {
        "name": "C",
        "score": 0.06249999999999999
    },
    {
        "name": "E",
        "score": 0.03819444444444444
    }
]
```

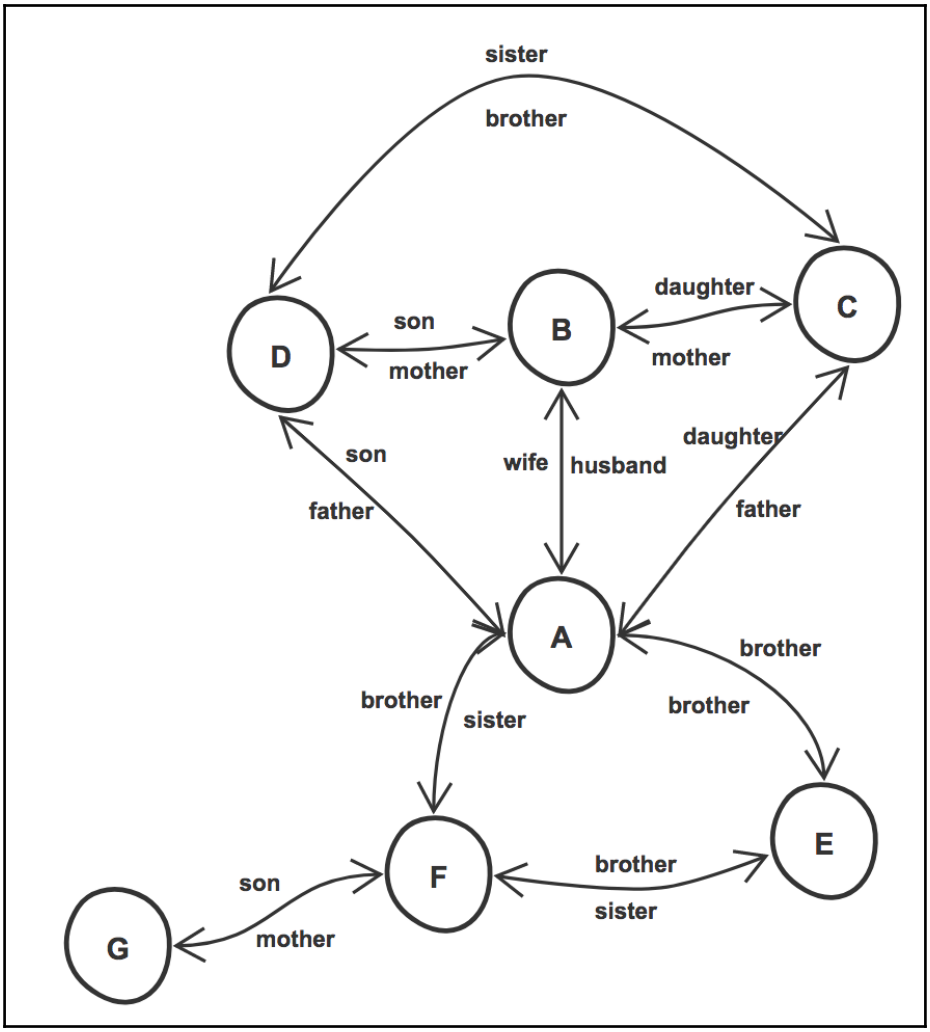


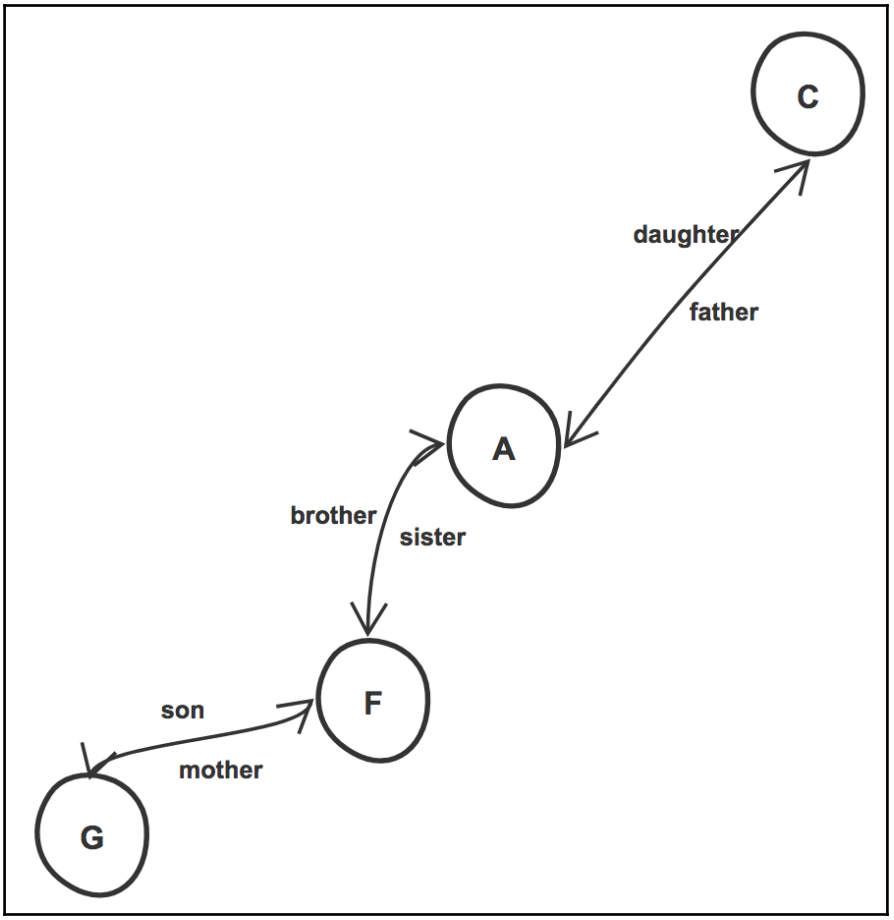

```
/Users/kashyapmukkamala/.nvm/versions/node/v6.10.0/bin/node index.js
Application listening on port 3000!
End of Iteration 1 : {"A":0.33,"B":0.33499999999999996,"D":0.33499999999999996}
End of Iteration 2 : {"A":0.5170416666666666,"B":0.11055,"D":0.11055,"C":0.18704166666666663,"E":0.07481666666666666}
End of Iteration 3 : {"A":0.39172375,"B":0.2400451805555552,"D":0.2149815972222218,"C":0.08678733333333333,"E":0.06646213888888888}
```

# Chapter 6: Exploring Types of Algorithms

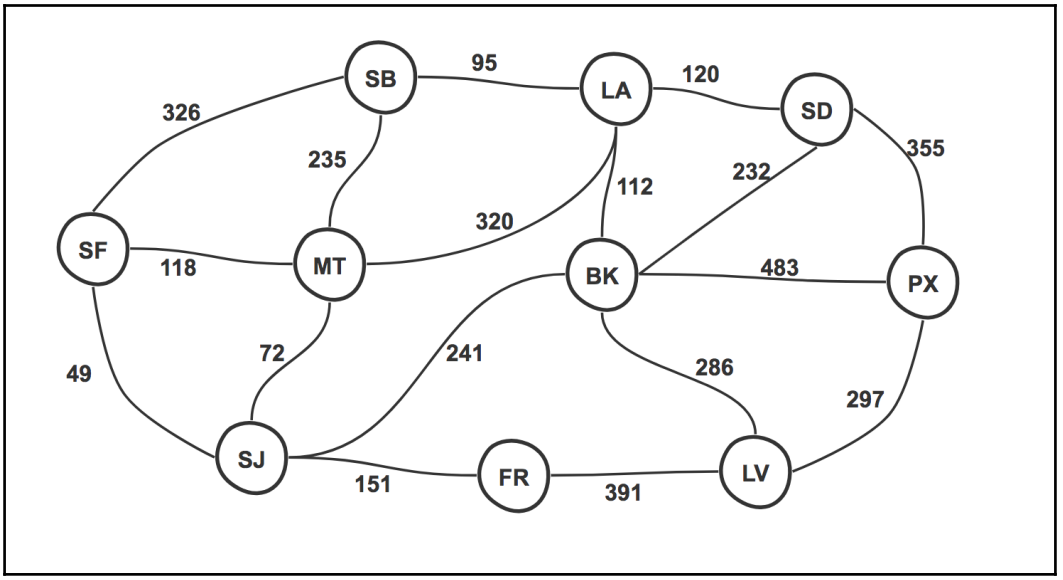


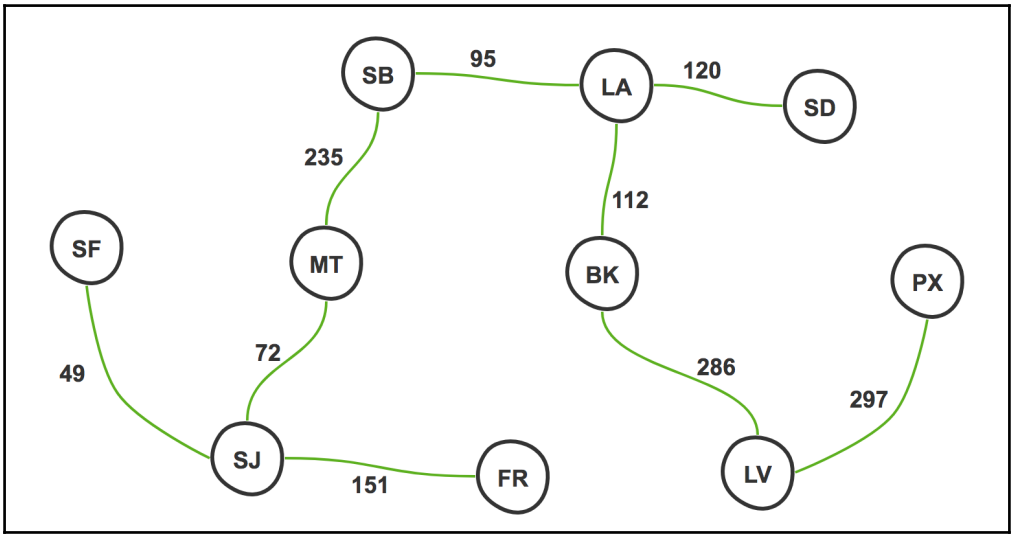




sister
brother
D
son
mother
B
daughter
mother
C
son
father
wife
husband
daughter
father
A
brother
brother
sister
brother
E
F
brother
sister
son
mother
G



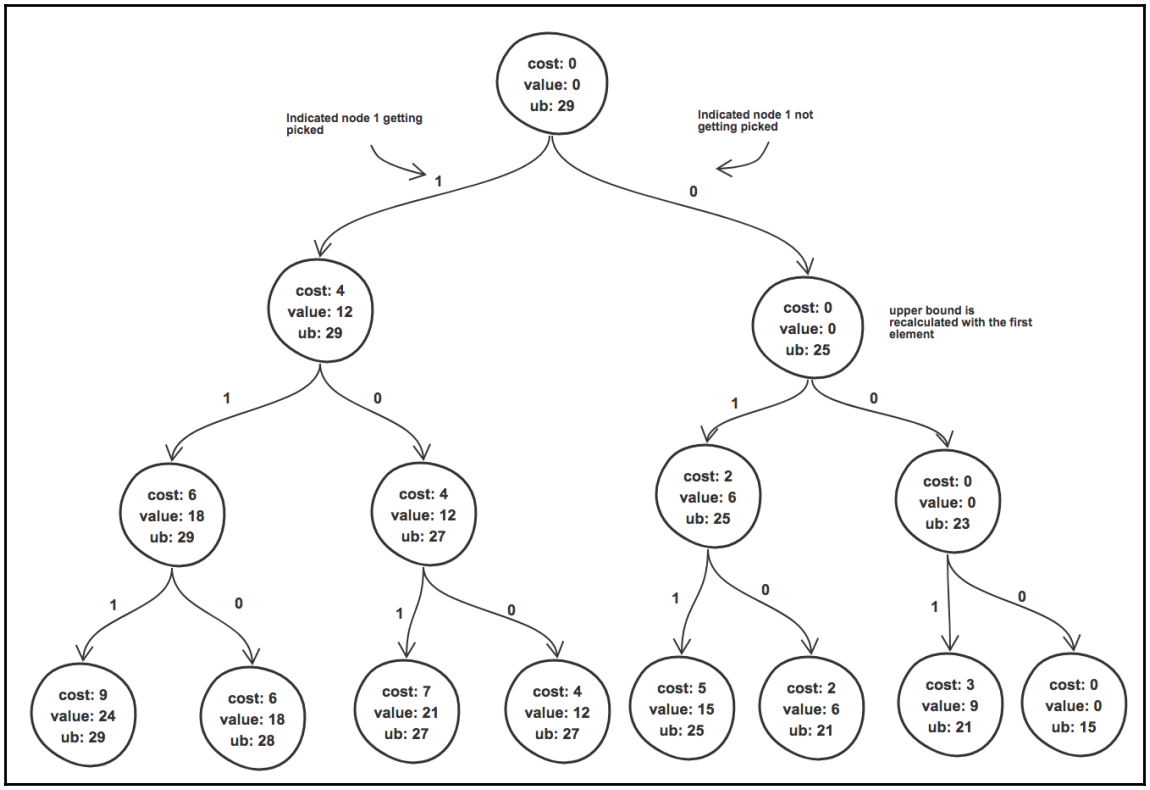

```
COST
        [   0     1      2       3     4       5    6       7      8     9       10       SUM
  5      [ true, false, false, false, false, true, false, false, false, false, false ],
  3      [ true, false, false, true,  false, true, false, false, true,  false, false ],
  2      [ true, false, true,  true,  false, true, false, true,  true,  false, true ],
  2      [ true, false, true,  true,  true,  true, false, true,  true,  true,  true ],
  5      [ true, false, true,  true,  true,  true, false, true,  true,  true,  true ]
        ]
```


SB
LA
SD
SF
MT
BK
PX
SJ
FR
LV
95
120
326
235
355
232
112
320
118
483
72
241
49
286
297
151
391

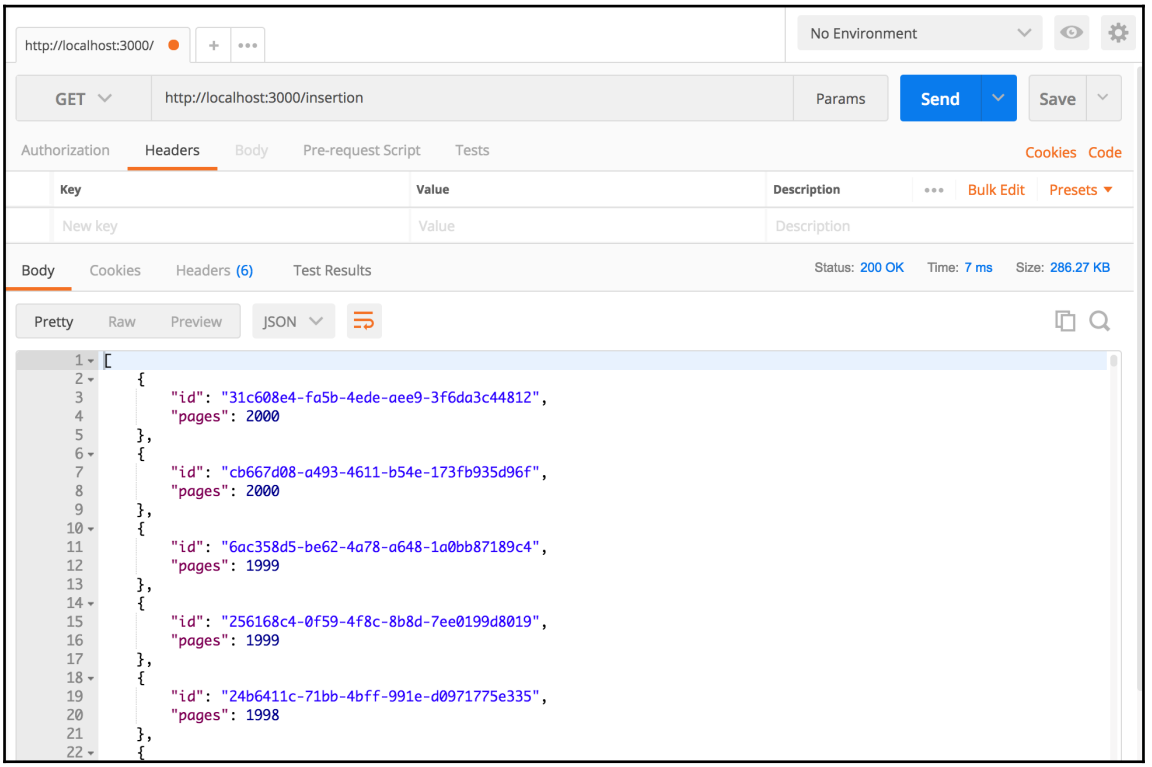

SB
LA
SD
SF
MT
BK
PX
SJ
FR
LV
95
120
235
112
49
72
286
297
151

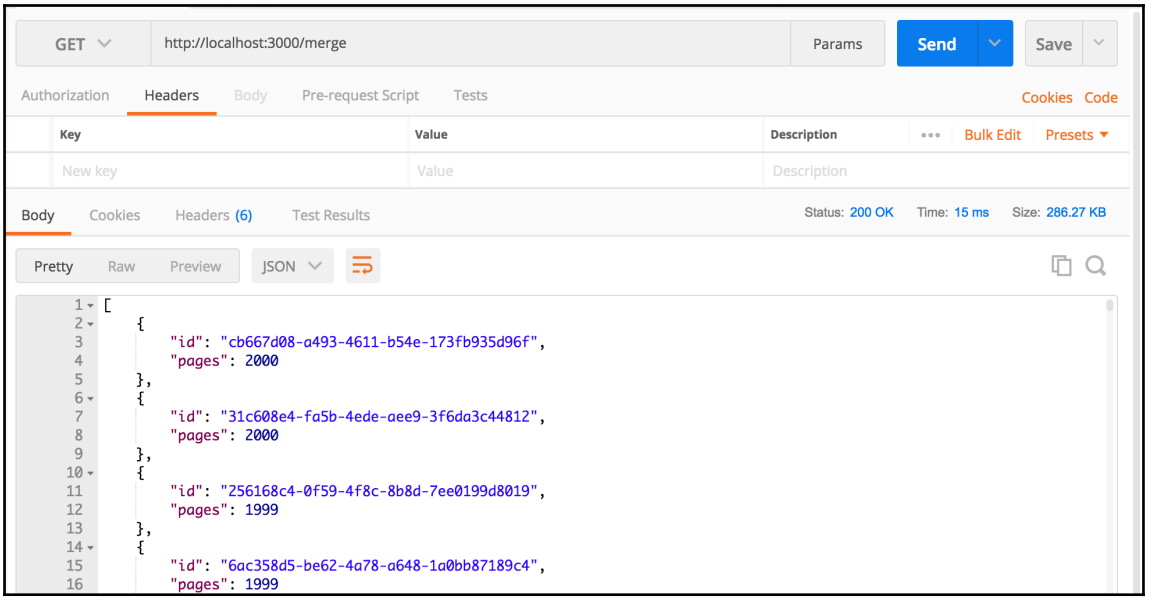
$$\sum_{0}^{n} eivi$$

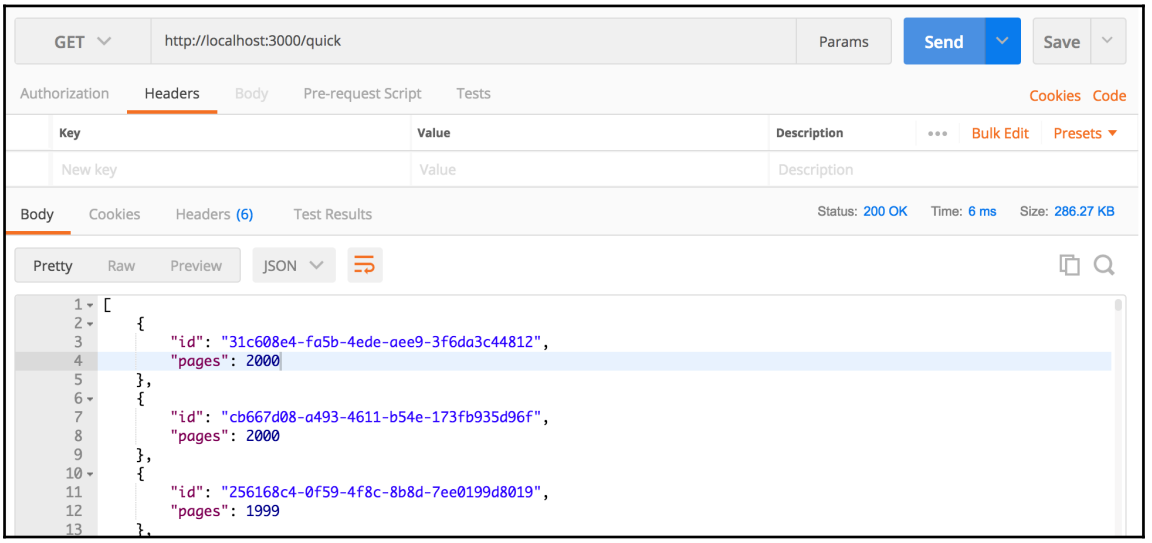
$$\sum_{0}^{n} eici < Total$$


cost: 0
value: 0
ub: 29
Indicated node 1 getting picked
Indicated node 1 not getting picked
1
0
cost: 4
value: 12
ub: 29
cost: 0
value: 0
ub: 25
upper bound is recalculated with the first element
1
0
1
0
cost: 6
value: 18
ub: 29
cost: 4
value: 12
ub: 27
cost: 2
value: 6
ub: 25
cost: 0
value: 0
ub: 23
1
0
1
0
1
0
cost: 9
value: 24
ub: 29
cost: 6
value: 18
ub: 28
cost: 7
value: 21
ub: 27
cost: 4
value: 12
ub: 27
cost: 5
value: 15
ub: 25
cost: 2
value: 6
ub: 21
cost: 3
value: 9
ub: 21
cost: 0
value: 0
ub: 15

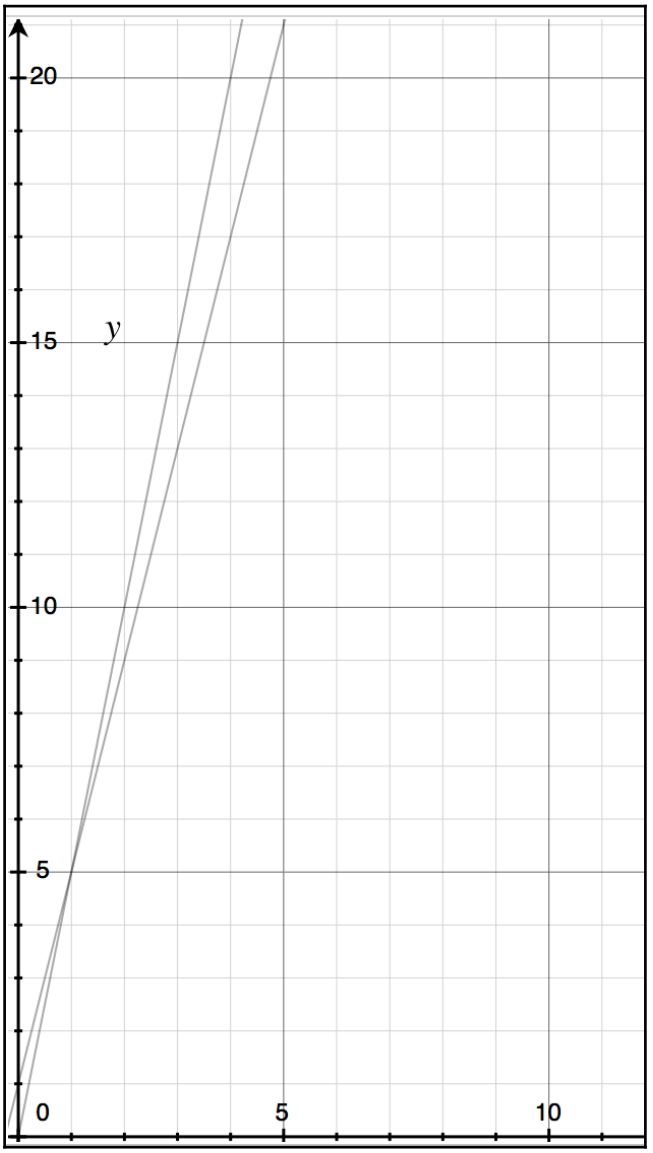
# Chapter 7: Sorting and Its Applications

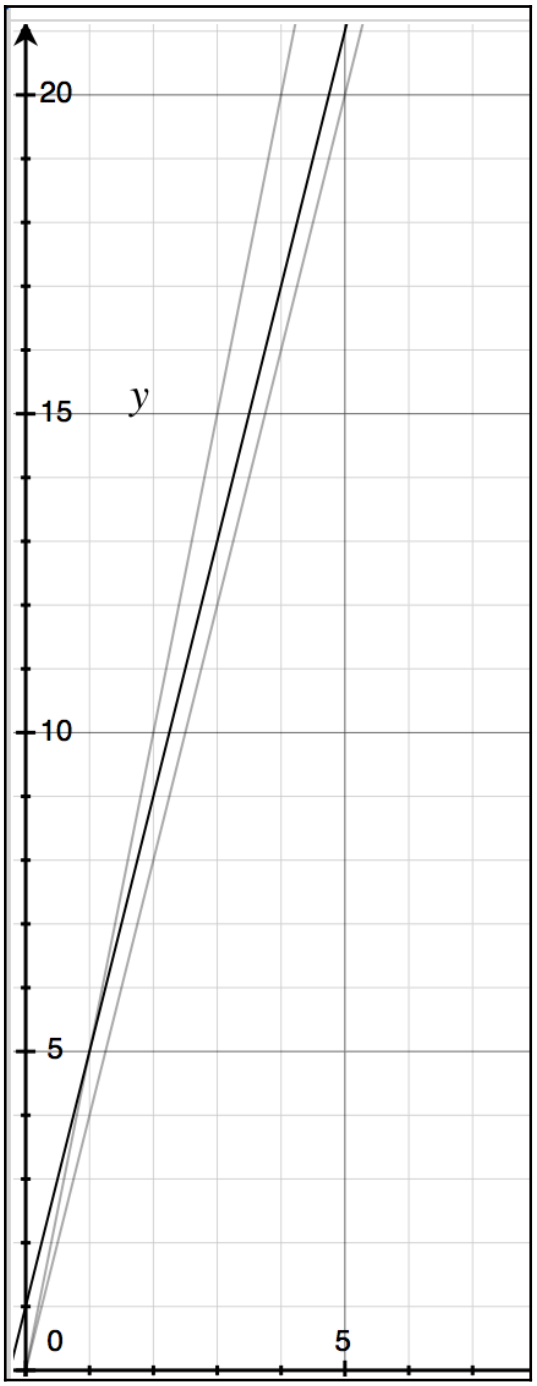



GET
http://localhost:3000/merge
Params
Send
Save
Authorization
Headers
Body
Pre-request Script
Tests
Cookies
Code
Key
Value
Description
Bulk Edit
Presets
New key
Value
Description
Body
Cookies
Headers (6)
Test Results
Status: 200 OK
Time: 15 ms
Size: 286.27 KB
Pretty
Raw
Preview
JSON
[
{
"id": "cb667d08-a493-4611-b54e-173fb935d96f",
"pages": 2000
},
{
"id": "31c608e4-fa5b-4ede-aee9-3f6da3c44812",
"pages": 2000
},
{
"id": "256168c4-0f59-4f8c-8b8d-7ee0199d8019",
"pages": 1999
},
{
"id": "6ac358d5-be62-4a78-a648-1a0bb87189c4",
"pages": 1999

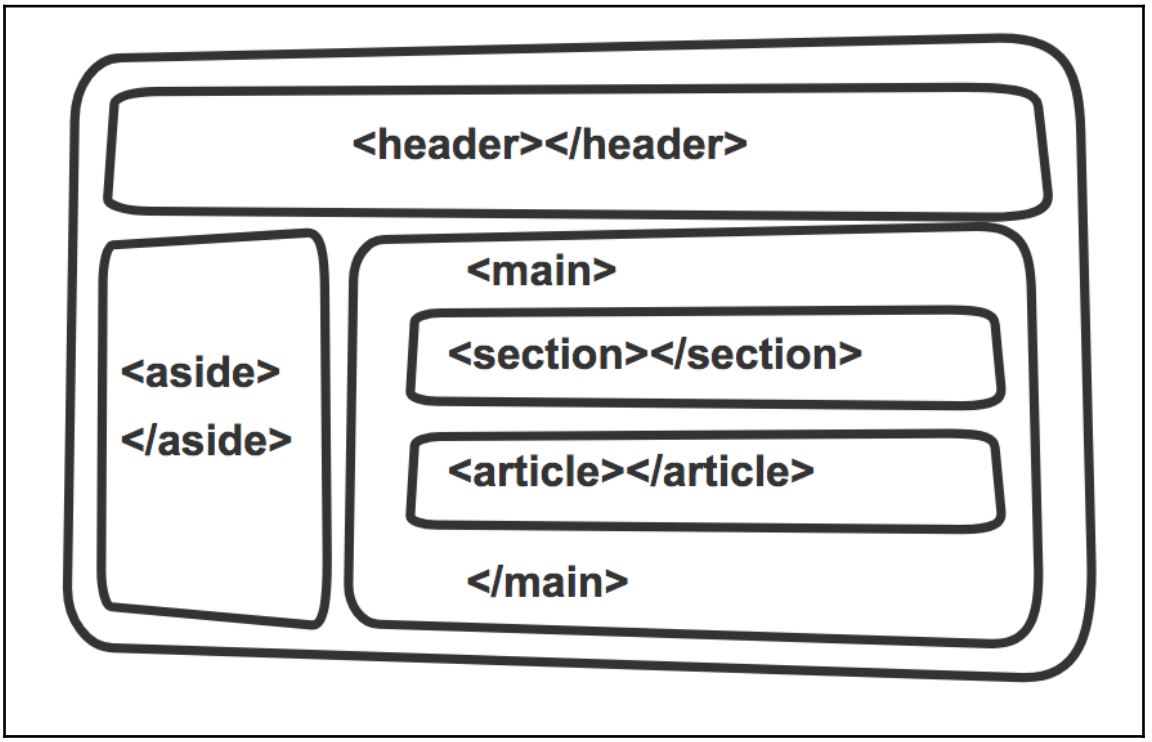

GET
http://localhost:3000/quick
Params
Send
Save
Authorization
Headers
Body
Pre-request Script
Tests
Cookies
Code
Key
Value
Description
Bulk Edit
Presets
New key
Value
Description
Body
Cookies
Headers (6)
Test Results
Status: 200 OK
Time: 6 ms
Size: 286.27 KB
Pretty
Raw
Preview
JSON
[
{
"id": "31c608e4-fa5b-4ede-aee9-3f6da3c44812",
"pages": 2000
},
{
"id": "cb667d08-a493-4611-b54e-173fb935d96f",
"pages": 2000
},
{
"id": "256168c4-0f59-4f8c-8b8d-7ee0199d8019",
"pages": 1999
},

# Chapter 8: Big O Notation, Space, and Time Complexity

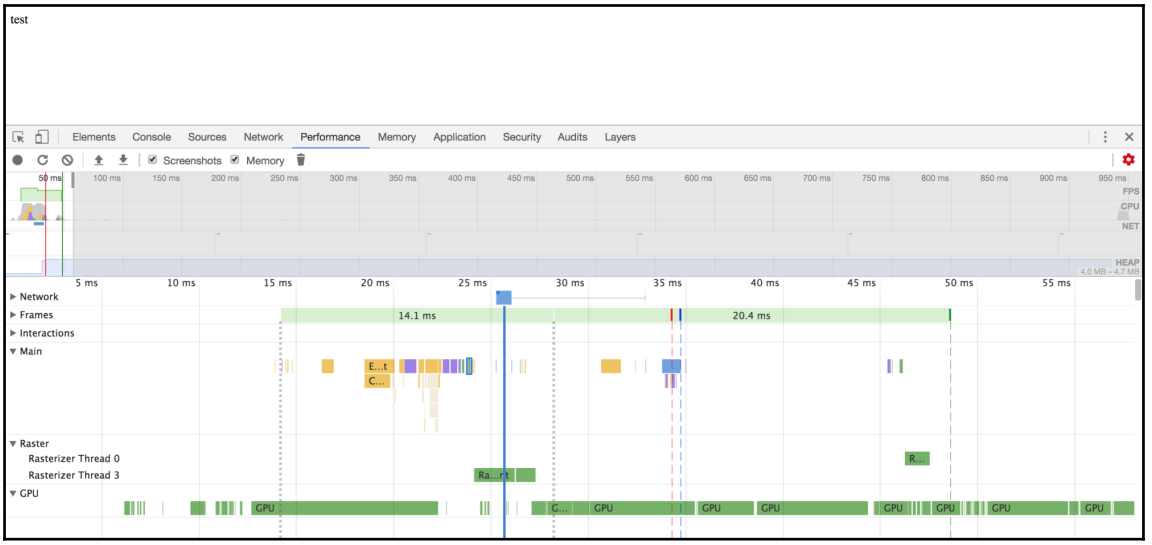


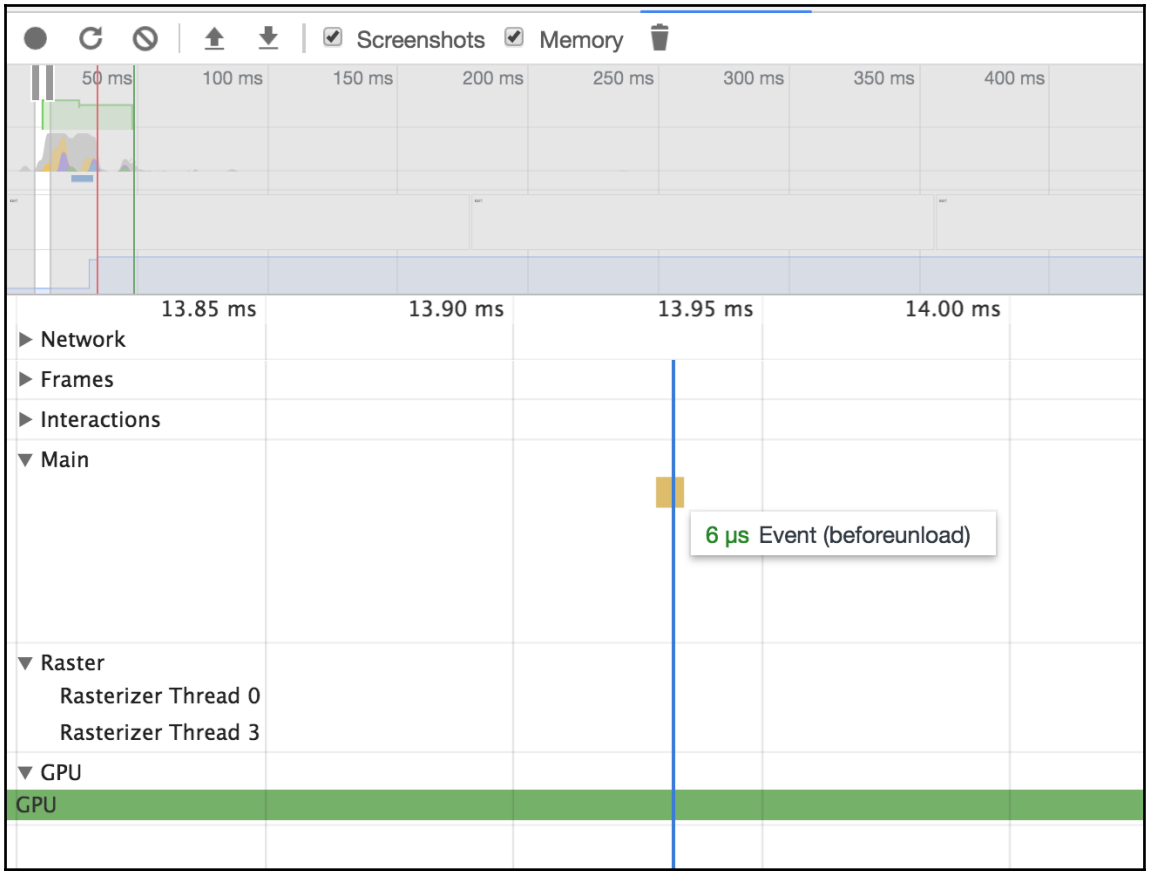

20
15
y
10
5
0
5

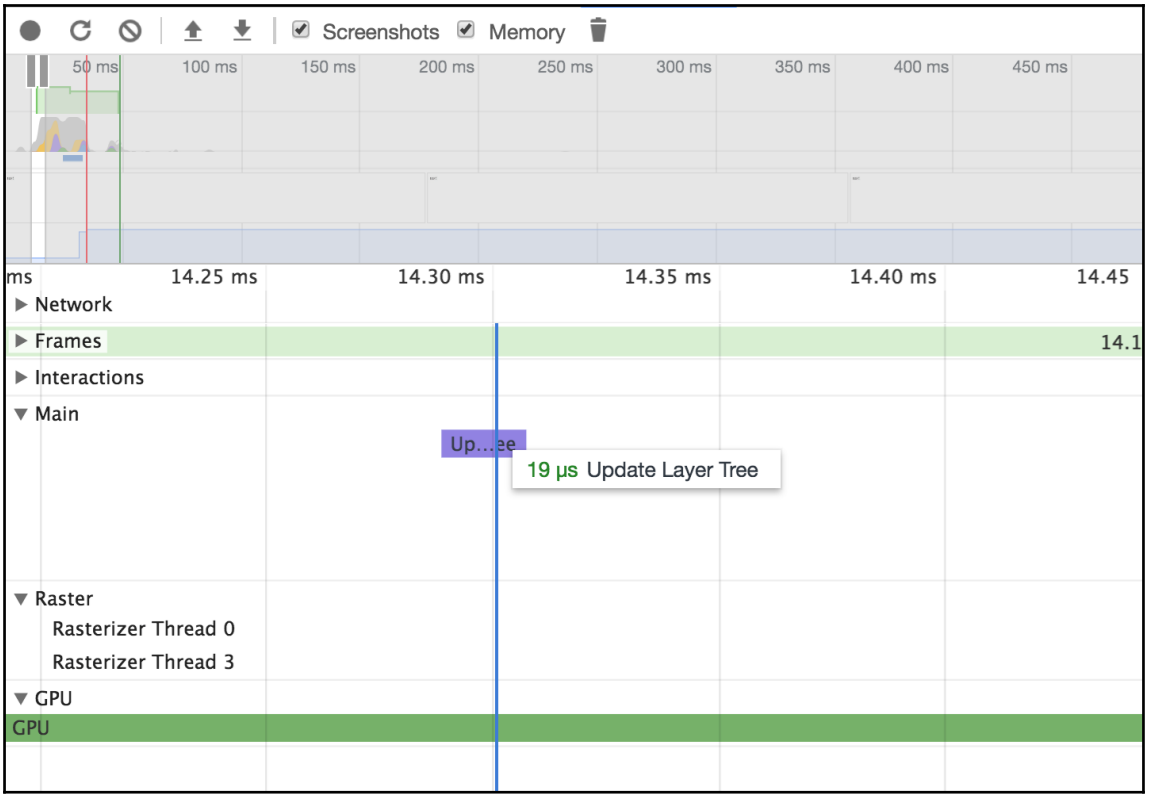
# Chapter 9: Micro-Optimizations and Memory Management

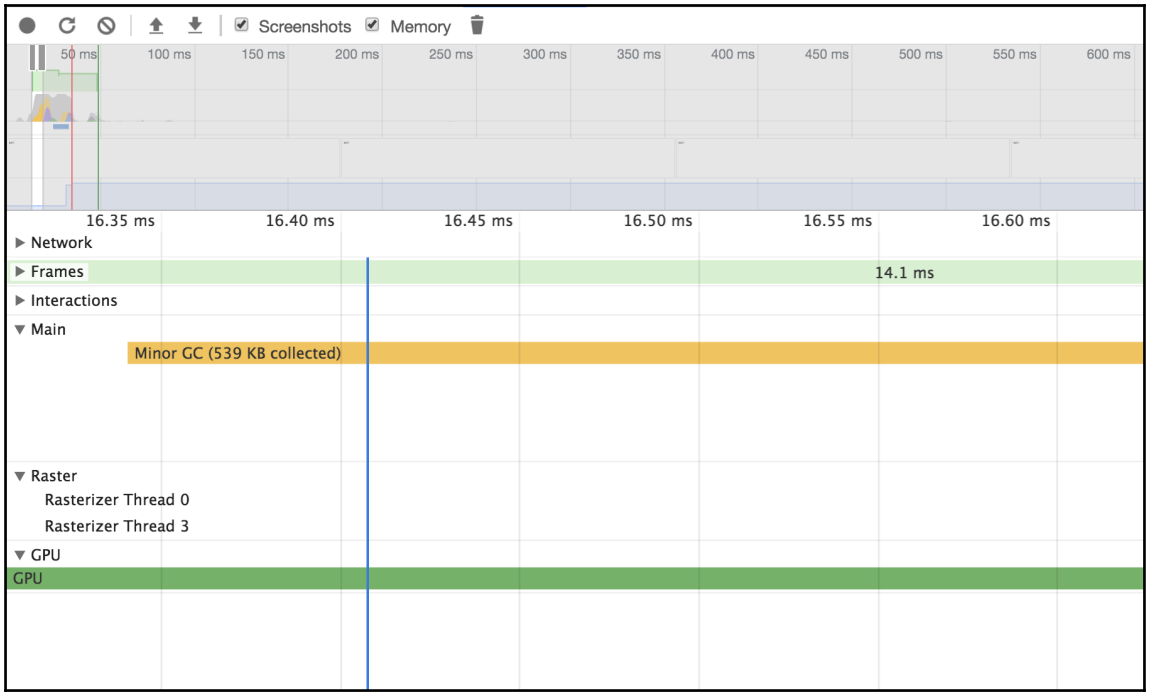


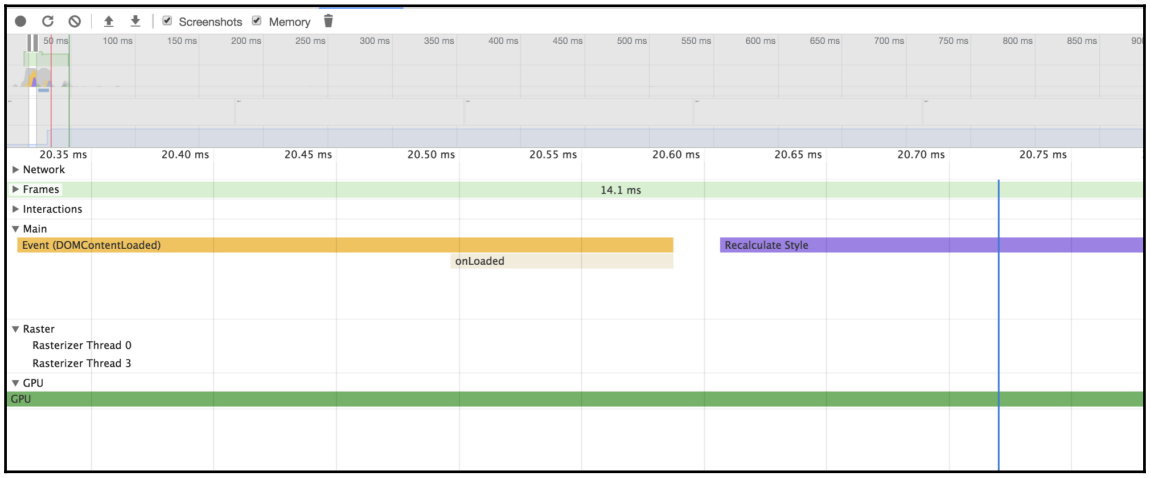

| Name | Method | Status | Type | Initiator | Size | Time | Waterfall |
|---|---|---|---|---|---|---|---|
| prefetch.html?_ijt=5c5be16e8vp5e0t6och47pctie | GET | 200 | document | Other | 834 B | 70 ms | |
| Haegefjell_Jan_2013_Large.jpg | GET | 200 | jpeg | prefetch.html?… | 13.2 MB | 4.20 s | |
| Haegefjell_Jan_2013_Large.jpg | GET | 200 | jpeg | prefetch.html?… | (from disk cache) | 58 ms | |

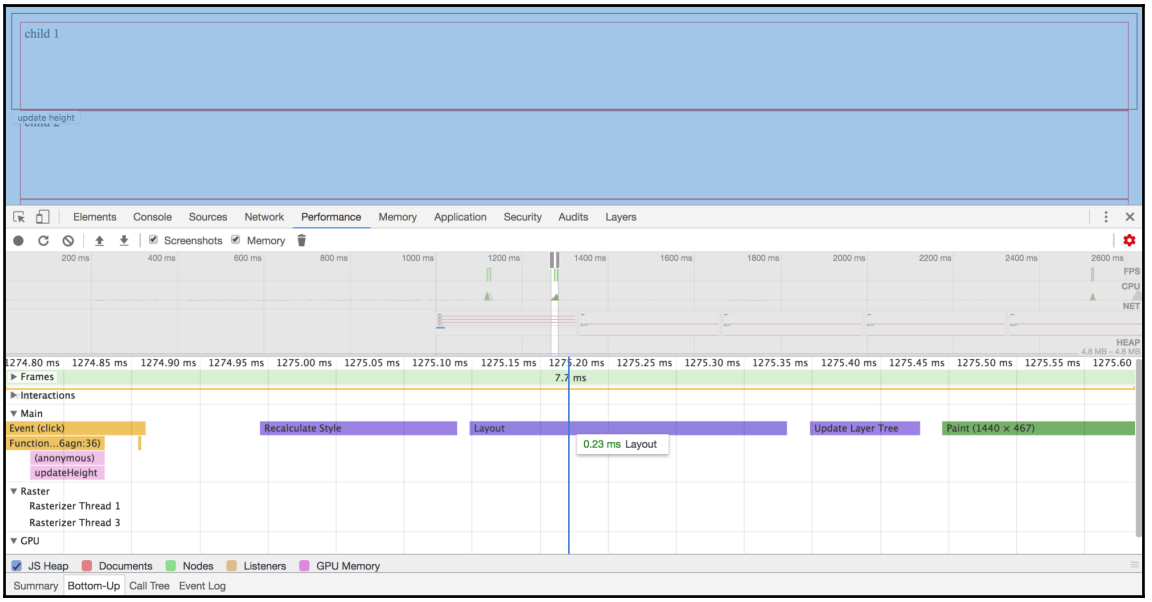

test
Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Layers
Screenshots
Memory
FPS
CPU
NET
HEAP
Network
Frames
14.1 ms
20.4 ms
Interactions
Main
Raster
Rasterizer Thread 0
Rasterizer Thread 3
GPU

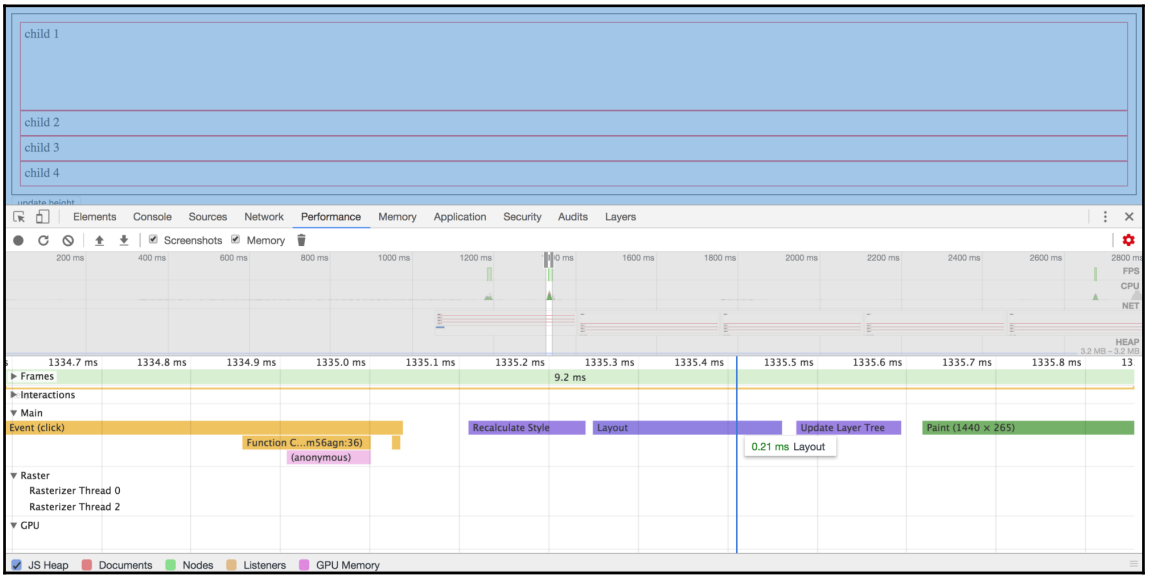

Screenshots
Memory
50 ms
100 ms
150 ms
200 ms
250 ms
300 ms
350 ms
400 ms
13.85 ms
13.90 ms
13.95 ms
14.00 ms
Network
Frames
Interactions
Main
6 µs Event (beforeunload)
Raster
Rasterizer Thread 0
Rasterizer Thread 3
GPU
GPU

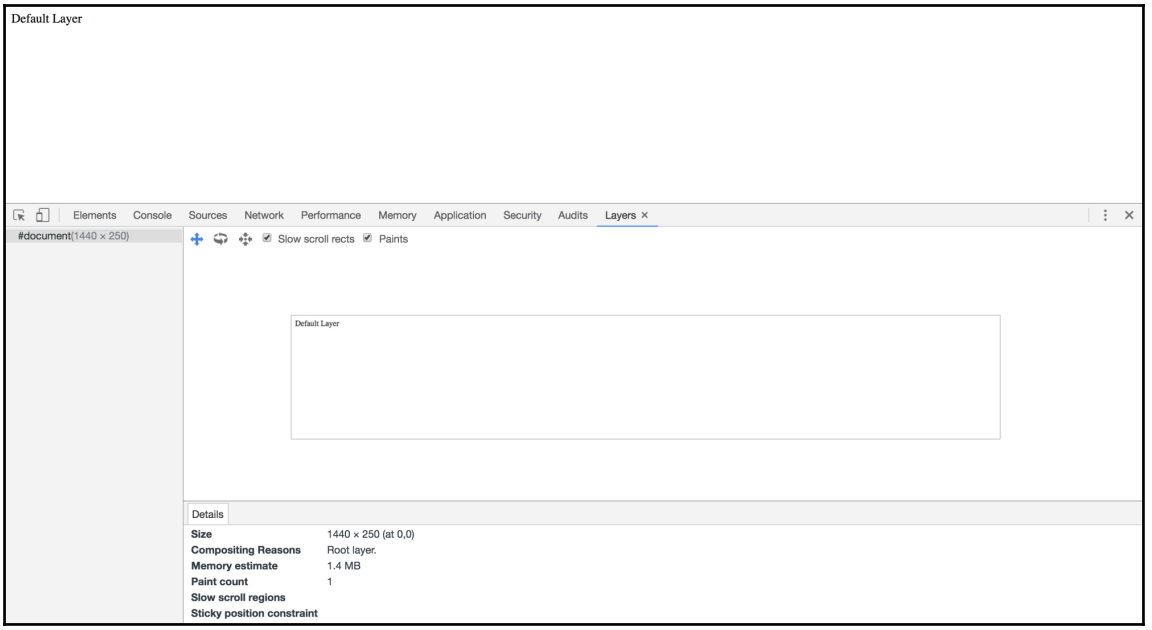

Screenshots
Memory
50 ms
100 ms
150 ms
200 ms
250 ms
300 ms
350 ms
400 ms
450 ms
ms
14.25 ms
14.30 ms
14.35 ms
14.40 ms
14.45
Network
Frames
14.1
Interactions
Main
Up…ee
19 µs Update Layer Tree
Raster
Rasterizer Thread 0
Rasterizer Thread 3
GPU
GPU

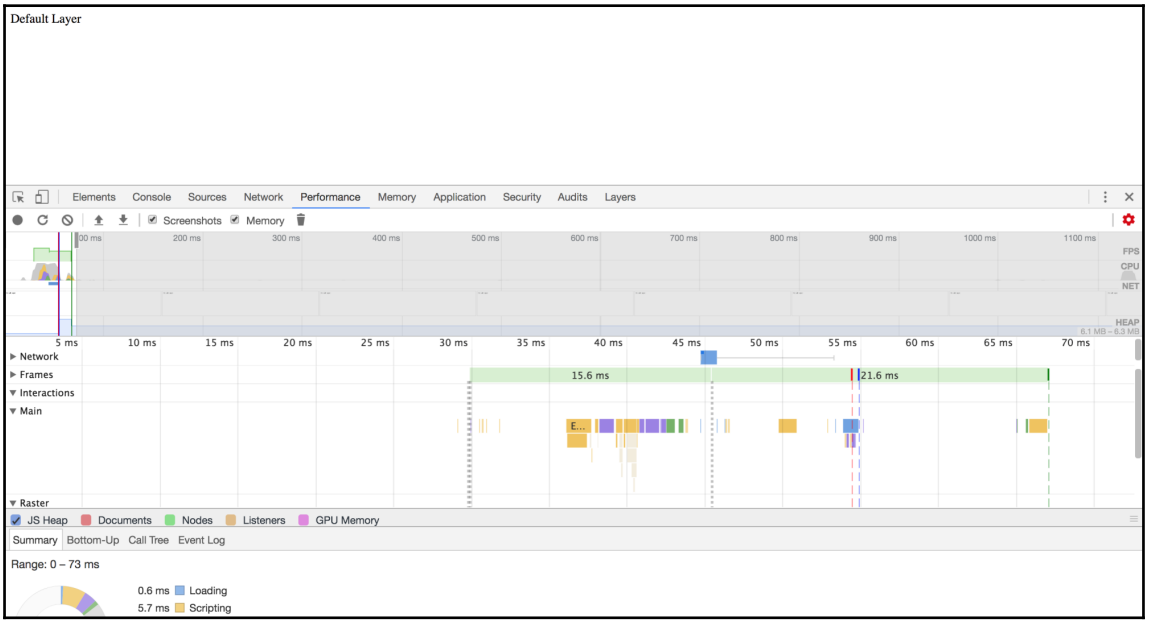

Screenshots
Memory
50 ms
100 ms
150 ms
200 ms
250 ms
300 ms
350 ms
400 ms
450 ms
500 ms
550 ms
600 ms
16.35 ms
16.40 ms
16.45 ms
16.50 ms
16.55 ms
16.60 ms
Network
Frames
14.1 ms
Interactions
Main
Minor GC (539 KB collected)
Raster
Rasterizer Thread 0
Rasterizer Thread 3
GPU
GPU

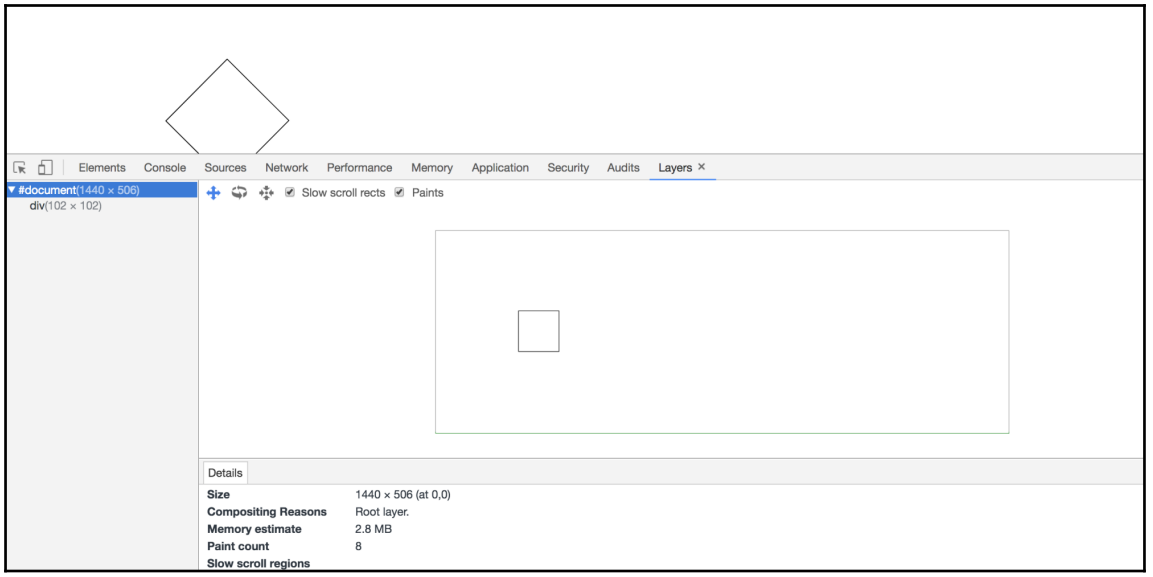

Screenshots
Memory
20.35 ms
20.40 ms
20.45 ms
20.50 ms
20.55 ms
20.60 ms
20.65 ms
20.70 ms
20.75 ms
Network
Frames
14.1 ms
Interactions
Main
Event (DOMContentLoaded)
onLoaded
Recalculate Style
Raster
Rasterizer Thread 0
Rasterizer Thread 3
GPU
GPU

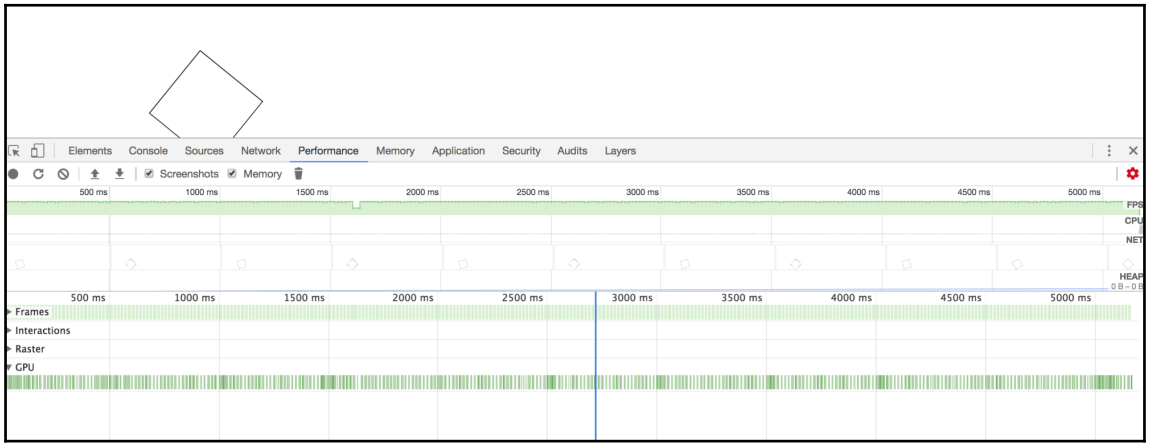

child 1
update height
Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Layers
Screenshots
Memory
FPS
CPU
NET
HEAP
Frames
Interactions
Main
Event (click)
Recalculate Style
Layout
Update Layer Tree
Paint (1440 × 467)
Function...6agn:36)
(anonymous)
updateHeight
0.23 ms Layout
Raster
Rasterizer Thread 1
Rasterizer Thread 3
GPU
JS Heap
Documents
Nodes
Listeners
GPU Memory
Summary
Bottom-Up
Call Tree
Event Log


child 1
child 2
child 3
child 4
Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Layers
Screenshots
Memory
FPS
CPU
NET
HEAP
Frames
9.2 ms
Interactions
Main
Event (click)
Recalculate Style
Layout
Update Layer Tree
Paint (1440 × 265)
Function C...m56agn:36)
(anonymous)
0.21 ms Layout
Raster
Rasterizer Thread 0
Rasterizer Thread 2
GPU
JS Heap
Documents
Nodes
Listeners
GPU Memory

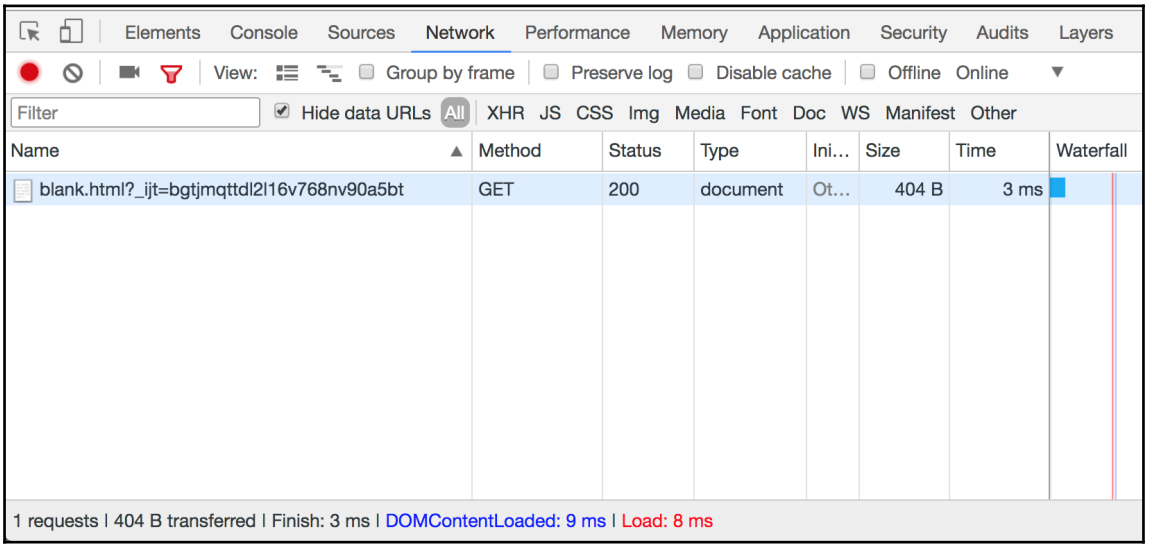

Default Layer
Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Layers ×
#document(1440 × 250)
Slow scroll rects
Paints
Default Layer
Details
Size
1440 × 250 (at 0,0)
Compositing Reasons
Root layer.
Memory estimate
1.4 MB
Paint count
1
Slow scroll regions
Sticky position constraint

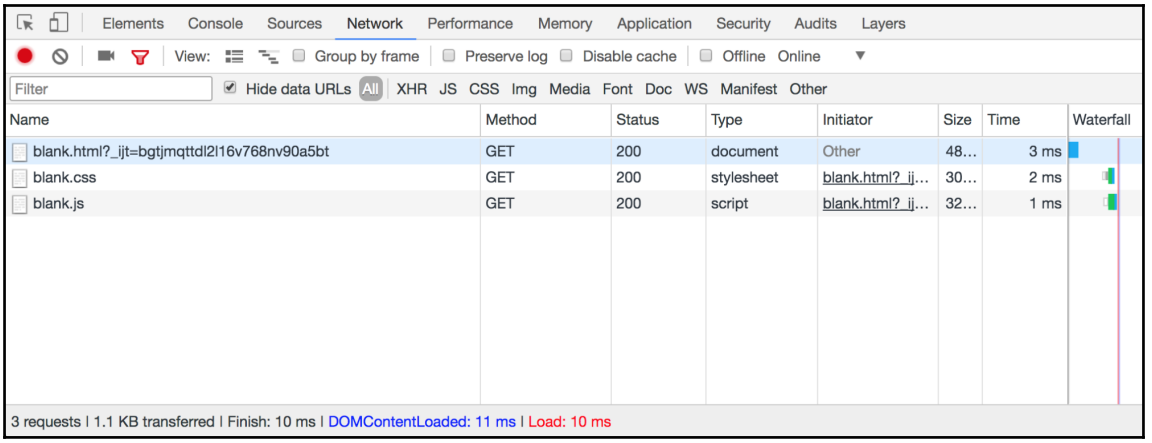

Default Layer
Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Layers
Screenshots
Memory
FPS
CPU
NET
HEAP
Network
Frames
Interactions
Main
Raster
15.6 ms
21.6 ms
JS Heap
Documents
Nodes
Listeners
GPU Memory
Summary
Bottom-Up
Call Tree
Event Log
Range: 0 – 73 ms
0.6 ms Loading
5.7 ms Scripting

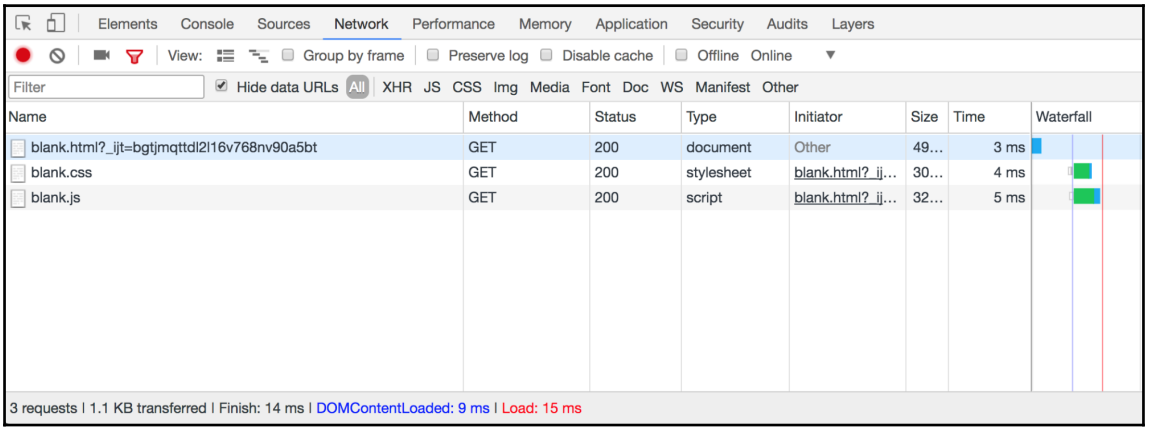

Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Layers
#document(1440 × 506)
div(102 × 102)
Slow scroll rects
Paints
Details
Size
1440 × 506 (at 0,0)
Compositing Reasons
Root layer.
Memory estimate
2.8 MB
Paint count
8
Slow scroll regions


Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Layers
Screenshots
Memory
500 ms
1000 ms
1500 ms
2000 ms
2500 ms
3000 ms
3500 ms
4000 ms
4500 ms
5000 ms
FPS
CPU
NET
HEAP
Frames
Interactions
Raster
GPU


<!DOCTYPE html>
<html>
<head>
</head>
<body>
<div style="
color: rgba(255, 0, 0, 0.3);
">Color me red == $0
</body>
</html>
Styles
Computed
Event Listeners
DOM
Filter
element.style {
color: #ff00004d;
}
div {
display: block;
}


Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Layers
View:
Group by frame
Preserve log
Disable cache
Offline
Online
Filter
Hide data URLs
All
XHR
JS
CSS
Img
Media
Font
Doc
WS
Manifest
Other
Name
Method
Status
Type
Ini…
Size
Time
Waterfall
blank.html?_ijt=bgtjmqttdl2l16v768nv90a5bt
GET
200
document
Ot…
404 B
3 ms
1 requests | 404 B transferred | Finish: 3 ms | DOMContentLoaded: 9 ms | Load: 8 ms


Elements Console Sources Network Performance Memory Application Security Audits Layers
View: Group by frame Preserve log Disable cache Offline Online
Filter Hide data URLs All XHR JS CSS Img Media Font Doc WS Manifest Other
Name Method Status Type Initiator Size Time Waterfall
blank.html?_ijt=bgtjmqttdl2l16v768nv90a5bt GET 200 document Other 48… 3 ms
blank.css GET 200 stylesheet blank.html?_ij… 30… 2 ms
blank.js GET 200 script blank.html?_ij… 32… 1 ms
3 requests | 1.1 KB transferred | Finish: 10 ms | DOMContentLoaded: 11 ms | Load: 10 ms

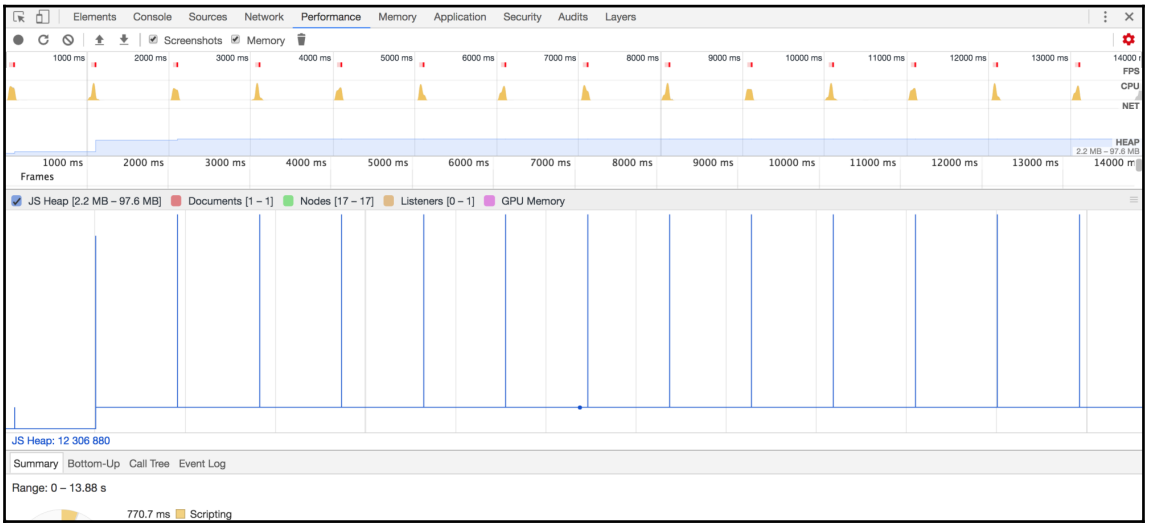

Elements Console Sources Network Performance Memory Application Security Audits Layers
View: Group by frame Preserve log Disable cache Offline Online
Filter Hide data URLs All XHR JS CSS Img Media Font Doc WS Manifest Other
Name Method Status Type Initiator Size Time Waterfall
blank.html?_ijt=bgtjmqttdl2l16v768nv90a5bt GET 200 document Other 49… 3 ms
blank.css GET 200 stylesheet blank.html?_ij… 30… 4 ms
blank.js GET 200 script blank.html?_ij… 32… 5 ms
3 requests | 1.1 KB transferred | Finish: 14 ms | DOMContentLoaded: 9 ms | Load: 15 ms

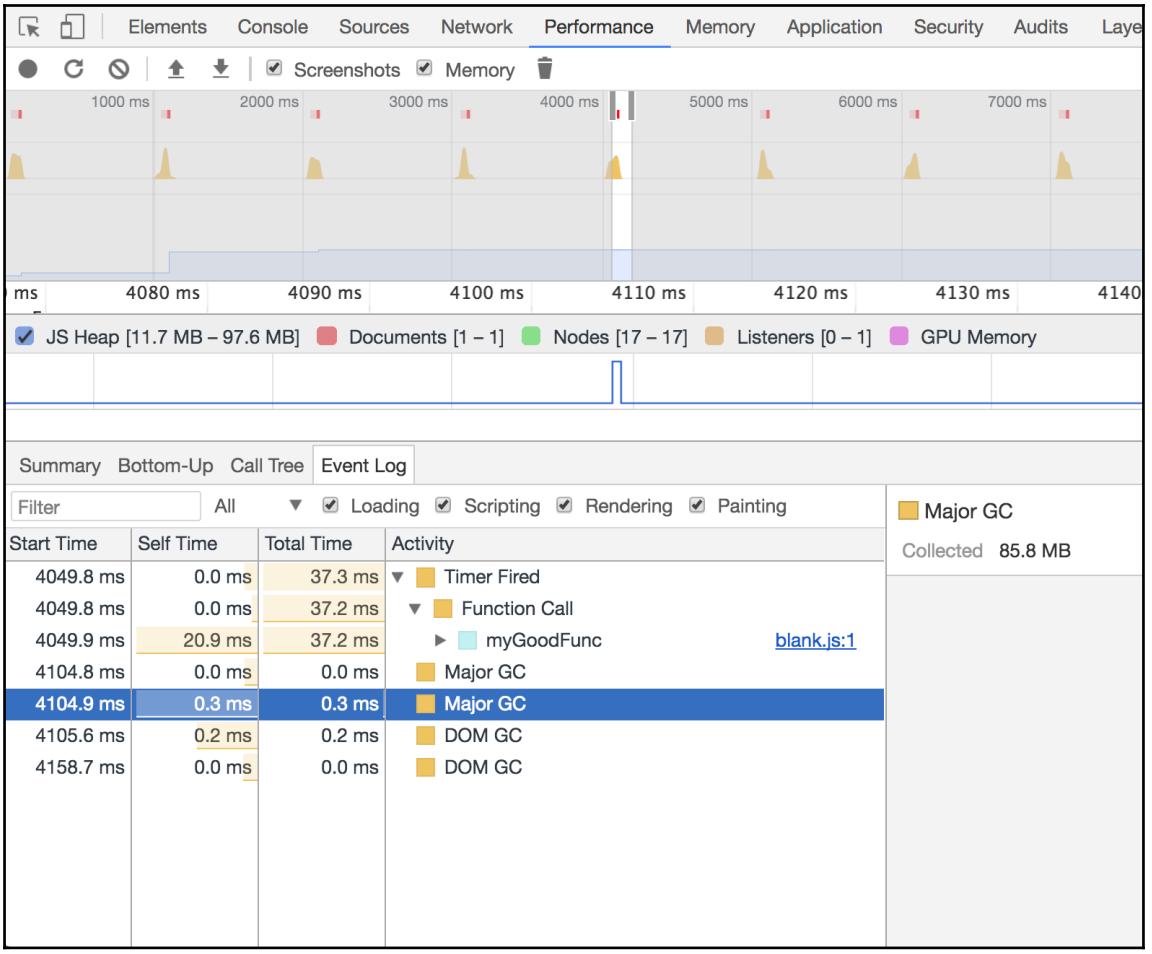
## 9.2 ToBoolean

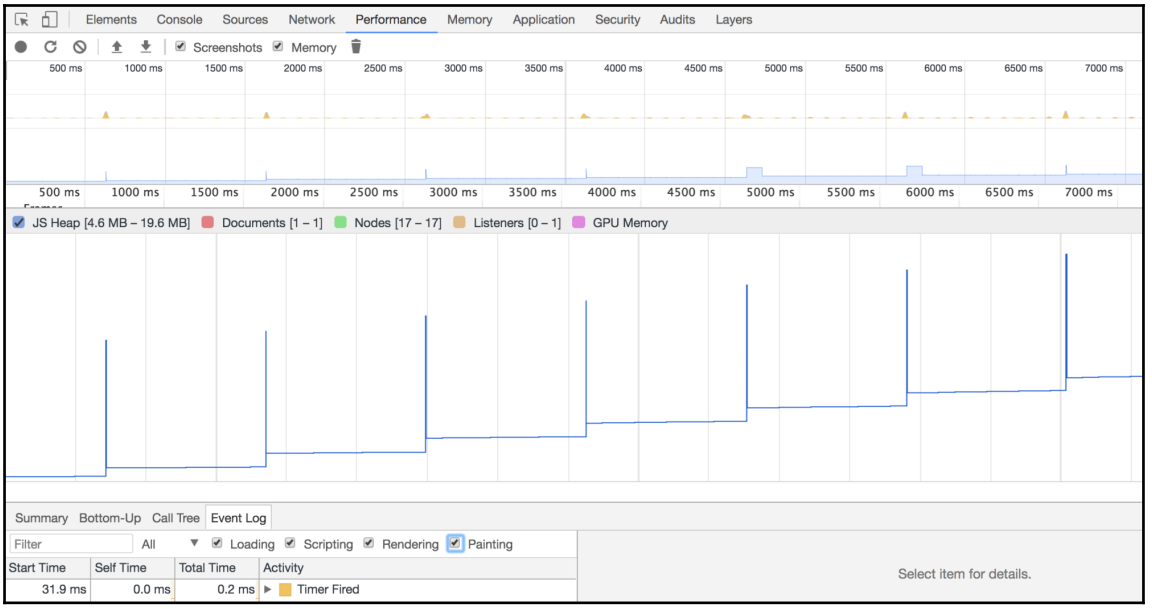
The abstract operation ToBoolean converts its argument to a value of type Boolean according to Table 11:

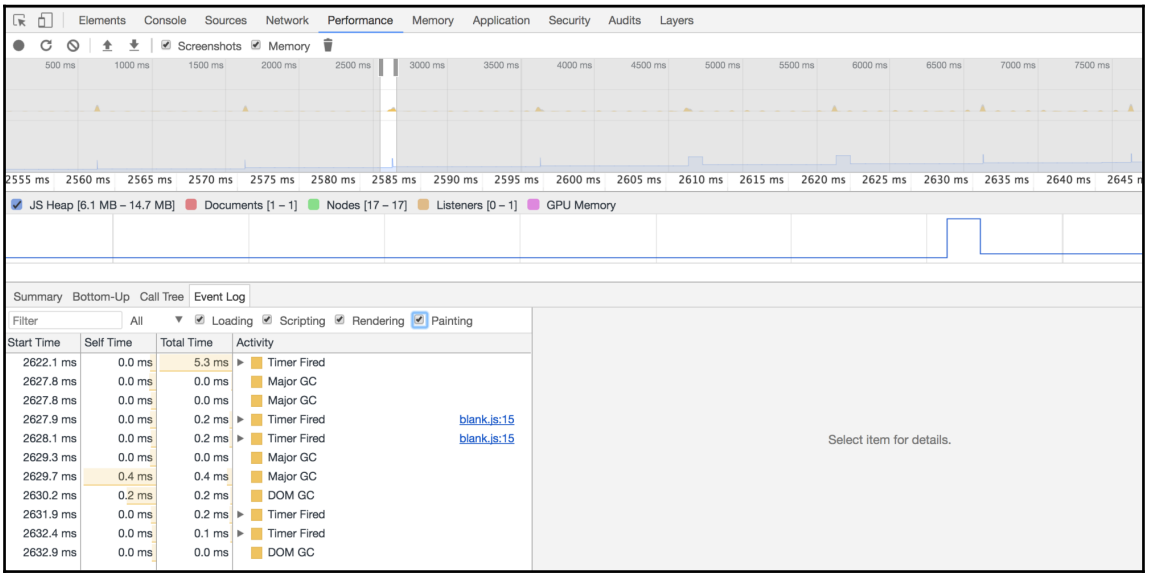
**Table 11 — ToBoolean Conversions**

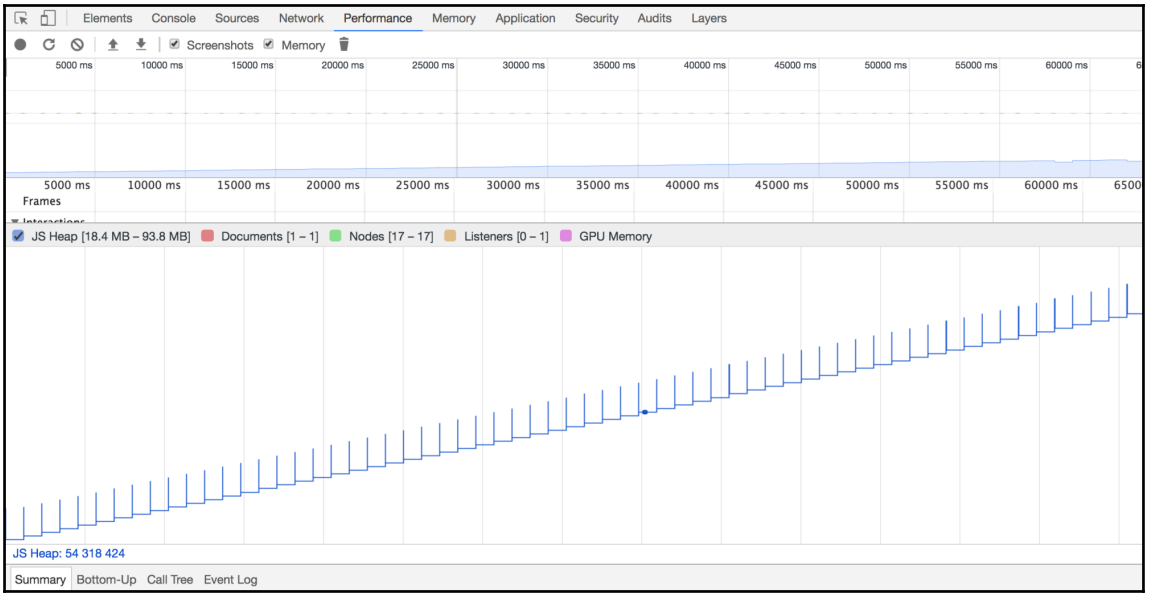
| Argument Type | Result |
|---|---|
| Undefined | **false** |
| Null | **false** |
| Boolean | The result equals the input argument (no conversion). |
| Number | The result is **false** if the argument is **+0**, **−0**, or **NaN**; otherwise the result is **true**. |
| String | The result is **false** if the argument is the empty String (its length is zero); otherwise the result is **true**. |
| Object | **true** |

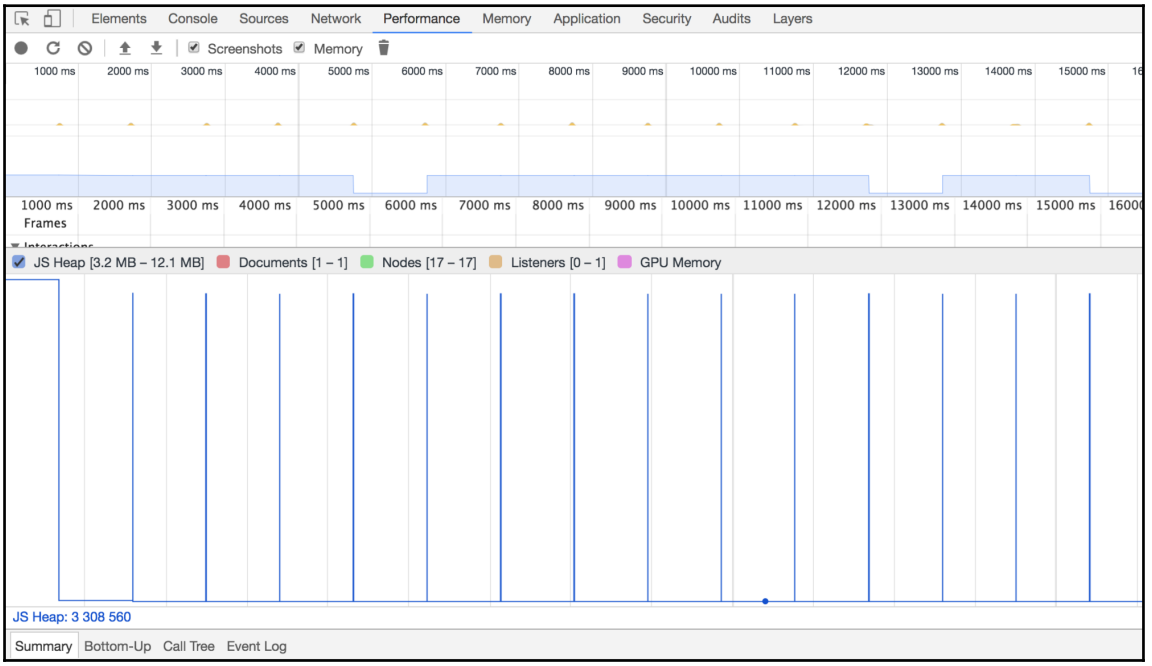



Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Screenshots
Memory
1000 ms
2000 ms
3000 ms
4000 ms
5000 ms
6000 ms
7000 ms
ms
4080 ms
4090 ms
4100 ms
4110 ms
4120 ms
4130 ms
4140
JS Heap [11.7 MB – 97.6 MB]
Documents [1 – 1]
Nodes [17 – 17]
Listeners [0 – 1]
GPU Memory
Summary
Bottom-Up
Call Tree
Event Log
Filter
All
Loading
Scripting
Rendering
Painting
Start Time
Self Time
Total Time
Activity
4049.8 ms 0.0 ms 37.3 ms Timer Fired
4049.8 ms 0.0 ms 37.2 ms Function Call
4049.9 ms 20.9 ms 37.2 ms myGoodFunc blank.js:1
4104.8 ms 0.0 ms 0.0 ms Major GC
4104.9 ms 0.3 ms 0.3 ms Major GC
4105.6 ms 0.2 ms 0.2 ms DOM GC
4158.7 ms 0.0 ms 0.0 ms DOM GC
Major GC
Collected 85.8 MB


Elements Console Sources Network Performance Memory Application Security Audits Layers
Screenshots Memory
500 ms 1000 ms 1500 ms 2000 ms 2500 ms 3000 ms 3500 ms 4000 ms 4500 ms 5000 ms 5500 ms 6000 ms 6500 ms 7000 ms
JS Heap [4.6 MB – 19.6 MB] Documents [1 – 1] Nodes [17 – 17] Listeners [0 – 1] GPU Memory
Summary Bottom-Up Call Tree Event Log
Filter All Loading Scripting Rendering Painting
Start Time Self Time Total Time Activity
31.9 ms 0.0 ms 0.2 ms Timer Fired
Select item for details.


Elements Console Sources Network Performance Memory Application Security Audits Layers
Screenshots Memory
500 ms 1000 ms 1500 ms 2000 ms 2500 ms 3000 ms 3500 ms 4000 ms 4500 ms 5000 ms 5500 ms 6000 ms 6500 ms 7000 ms 7500 ms
2555 ms 2560 ms 2565 ms 2570 ms 2575 ms 2580 ms 2585 ms 2590 ms 2595 ms 2600 ms 2605 ms 2610 ms 2615 ms 2620 ms 2625 ms 2630 ms 2635 ms 2640 ms 2645 ms
JS Heap [6.1 MB – 14.7 MB] Documents [1 – 1] Nodes [17 – 17] Listeners [0 – 1] GPU Memory
Summary Bottom-Up Call Tree Event Log
Filter All Loading Scripting Rendering Painting
Start Time Self Time Total Time Activity
2622.1 ms 0.0 ms 5.3 ms Timer Fired
2627.8 ms 0.0 ms 0.0 ms Major GC
2627.8 ms 0.0 ms 0.0 ms Major GC
2627.9 ms 0.0 ms 0.2 ms Timer Fired blank.js:15
2628.1 ms 0.0 ms 0.2 ms Timer Fired blank.js:15
2629.3 ms 0.0 ms 0.0 ms Major GC
2629.7 ms 0.4 ms 0.4 ms Major GC
2630.2 ms 0.2 ms 0.2 ms DOM GC
2631.9 ms 0.0 ms 0.2 ms Timer Fired
2632.4 ms 0.0 ms 0.1 ms Timer Fired
2632.9 ms 0.0 ms 0.0 ms DOM GC
Select item for details.


Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Layers
Screenshots
Memory
5000 ms
10000 ms
15000 ms
20000 ms
25000 ms
30000 ms
35000 ms
40000 ms
45000 ms
50000 ms
55000 ms
60000 ms
Frames
JS Heap [18.4 MB – 93.8 MB]
Documents [1 – 1]
Nodes [17 – 17]
Listeners [0 – 1]
GPU Memory
JS Heap: 54 318 424
Summary
Bottom-Up
Call Tree
Event Log


Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
Layers
Screenshots
Memory
1000 ms
2000 ms
3000 ms
4000 ms
5000 ms
6000 ms
7000 ms
8000 ms
9000 ms
10000 ms
11000 ms
12000 ms
13000 ms
14000 ms
15000 ms
Frames
JS Heap [3.2 MB – 12.1 MB]
Documents [1 – 1]
Nodes [17 – 17]
Listeners [0 – 1]
GPU Memory
JS Heap: 3 308 560
Summary
Bottom-Up
Call Tree
Event Log