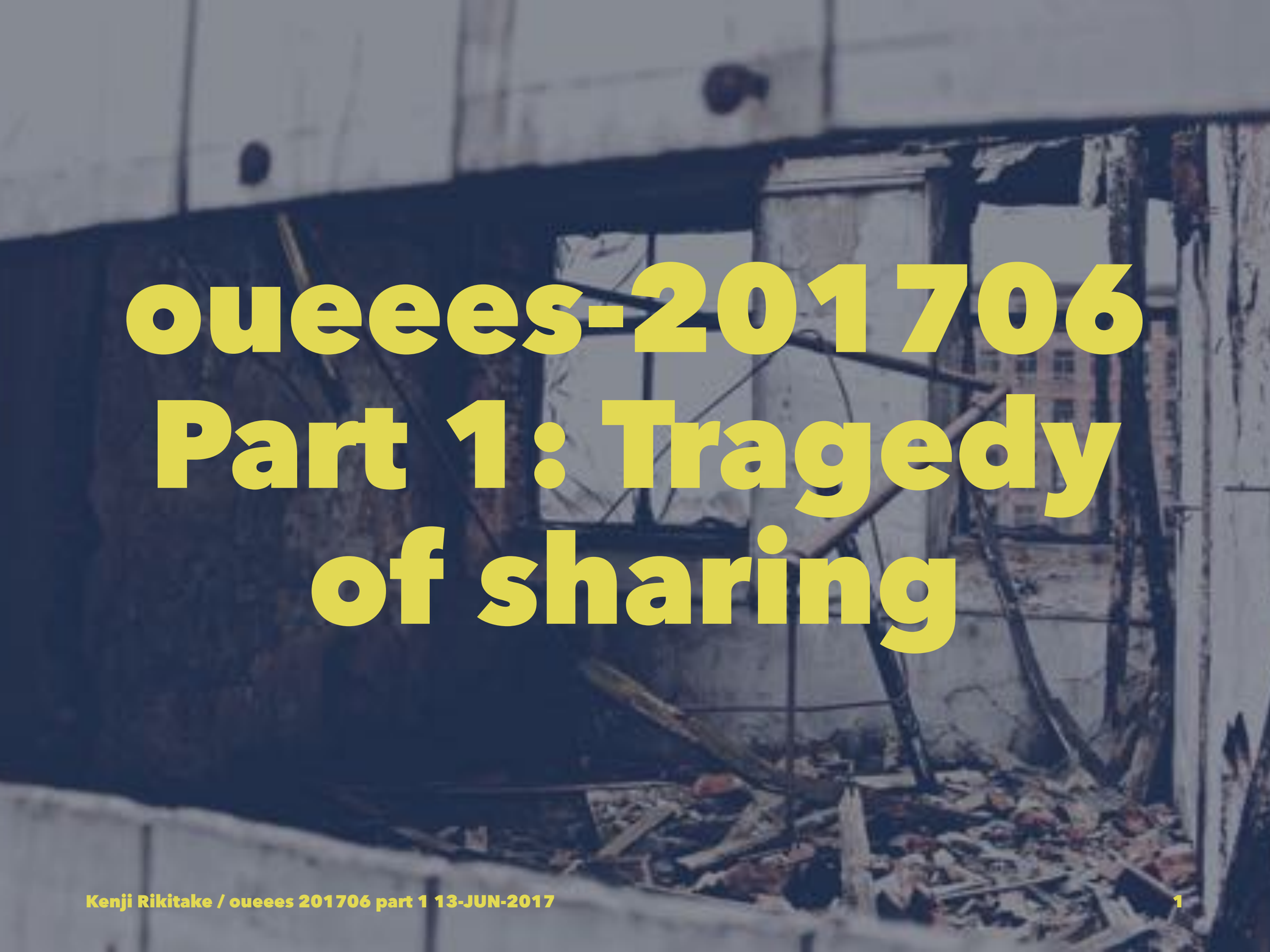

oueees-201706 Part 1: Tragedy of sharing

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Lecture notes on GitHub

- https://github.com/jj1bdx/oueees-201706-public/
- Don't forget to *check out the issues*!

Sharing

Share (v.)[1]

Have/give a portion of (something) with another or others

Use, occupy, or enjoy (something) jointly with another or others

Possess (a view or quality) in common with others

[1] New Oxford American Dictionary, macOS 10.12.5

More on share (v.)[2]

Tell someone about (something), *especially something personal*

Post or repost (something) on a social media website or application

[2] New Oxford American Dictionary, macOS 10.12.5, emphasis by Kenji Rikitake

Purposes of sharing: Showing off and Saving resources

Showing off

- **Publicly bragging**
- **Addiction for Approval**
- **「私かわいい」**
- … and various other psychological reasons
- **Creating a lot of social problems**
- **To be discussed in Part 3**

Sharing on programming

Historical background on computing resources

- CPU speed
- Memory
- Storage
- Network bandwidth
- ...All always on shortage

Sharing, programming and memory

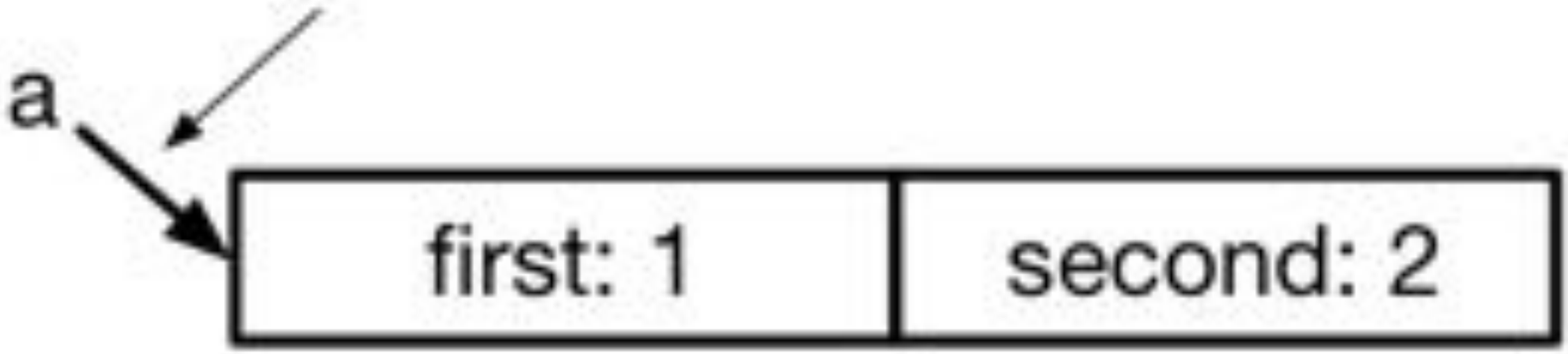
- Memory is expensive: *explicit* allocation required
- Variables are *mutable*
- Internal state is *commonly shared* and accessible between multiple functions and modules
- Use *memory pointers* to minimize the number of copying, inherently suggesting: *share as much as you can*

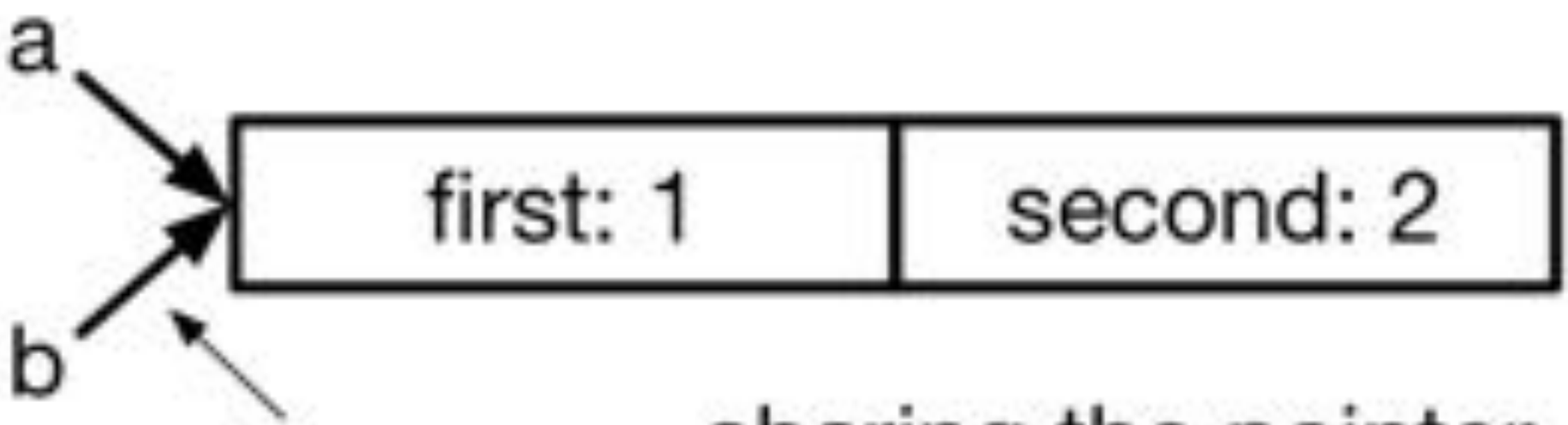
Question: is sharing *intuitive?*

In JavaScript (node.js)

```
var a = {first: 1, second: 2}
b = a // only share pointer
-> { first: 1, second: 2 }
a.second = 3
-> 3
b // element is shared
-> { first: 1, second: 3 }
b == { first: 1, second: 3 }
-> false // WHY?
```

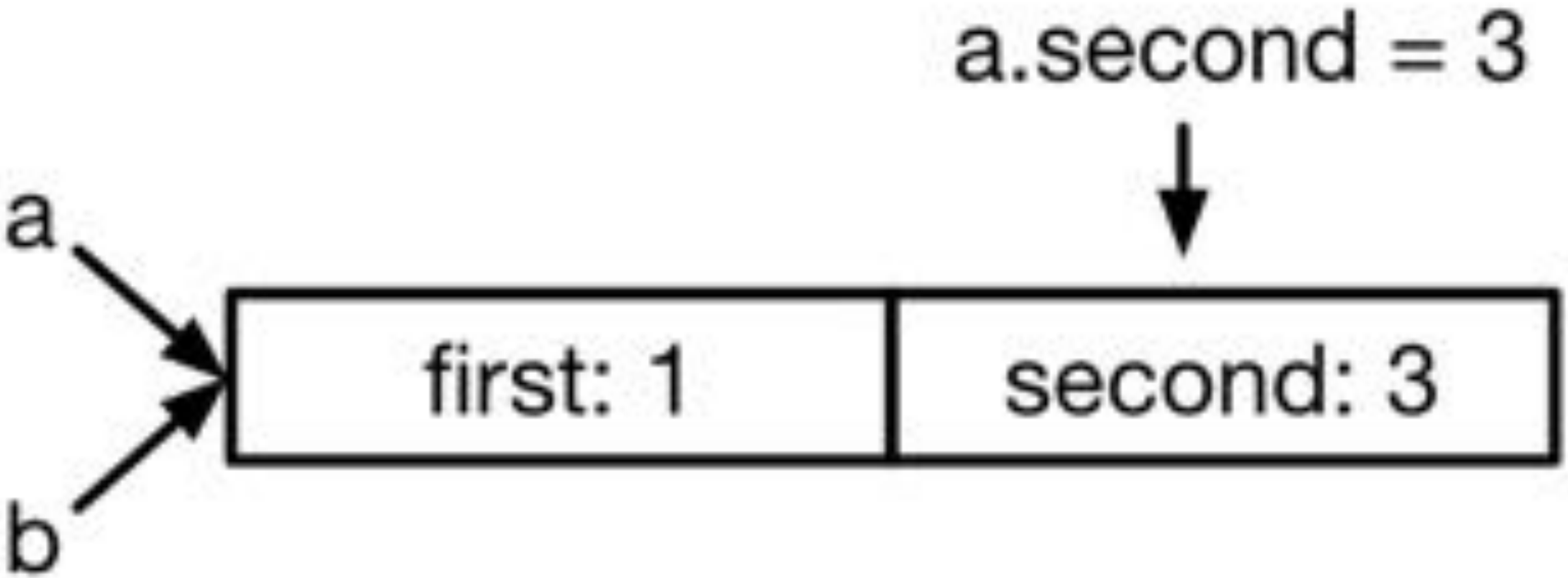
var a = {first: 1, second: 2}

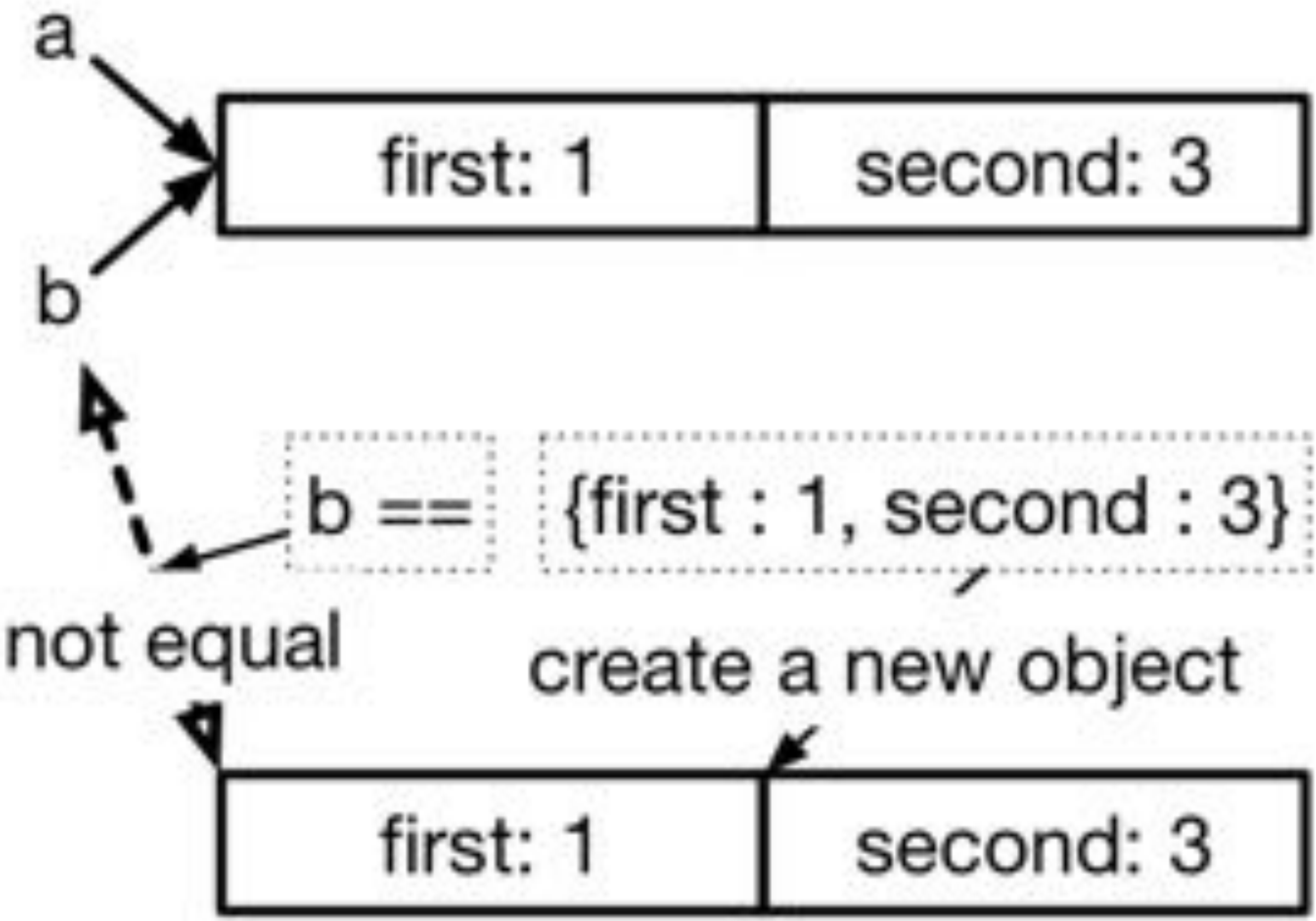




b = a

sharing the pointer *only*

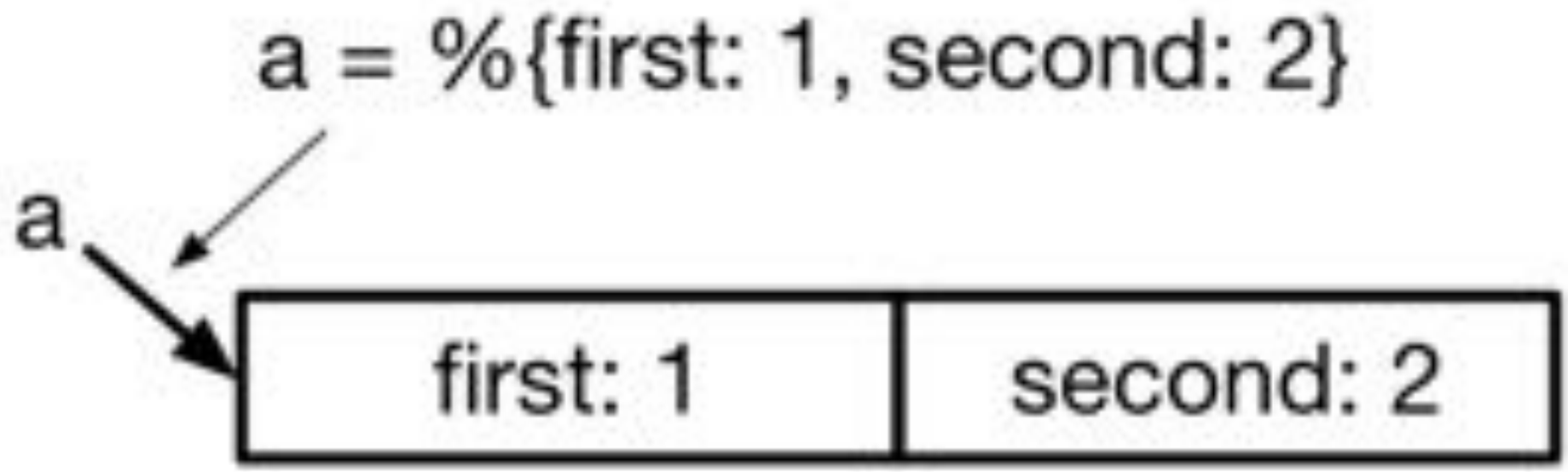

a.second = 3
a
b
first: 1
second: 3

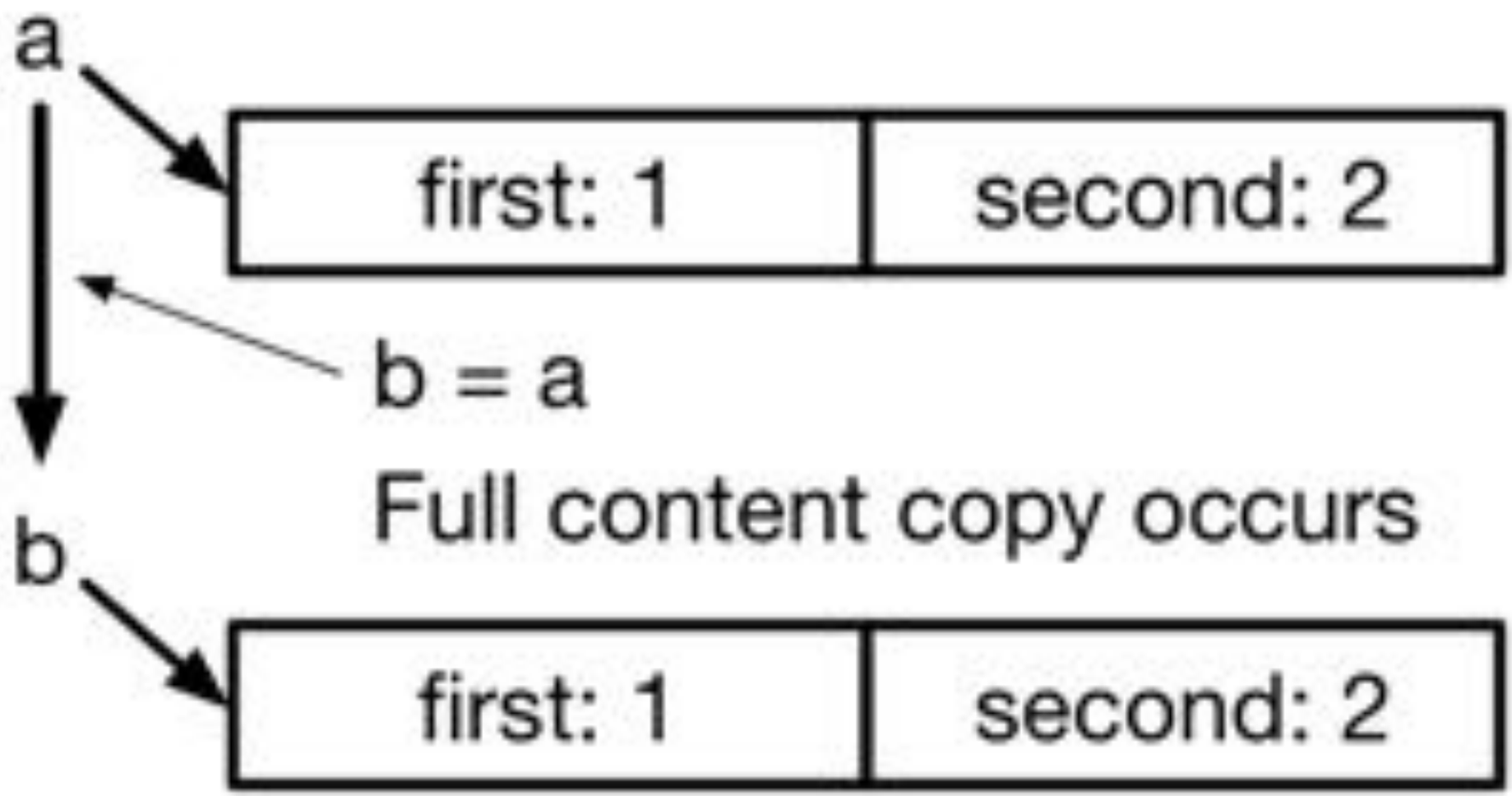

a
b
first: 1
second: 3
b ==
{first : 1, second : 3}
not equal
create a new object
first: 1
second: 3

Copying by default, not sharing, can solve this issue

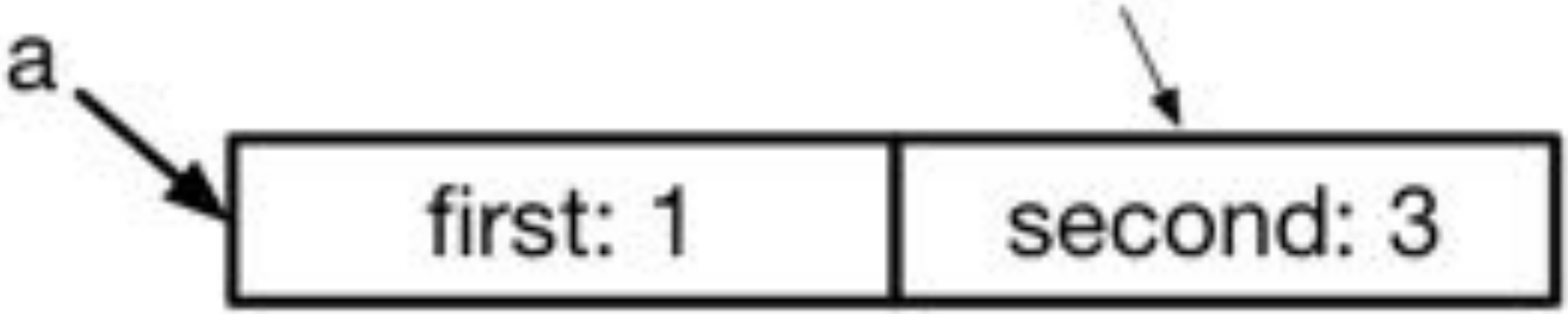
In Elixir (v1.4.4)

```
iex(1)> a = %{first: 1, second: 2}
%{first: 1, second: 2}
iex(2)> b = a # copying the map
%{first: 1, second: 2}
iex(3)> a = %{a | second: 3}
%{first: 1, second: 3} # member modified
iex(4)> b # not shared with a
%{first: 1, second: 2}
iex(5)> b == %{first: 1, second: 2}
true # intuitive!
```

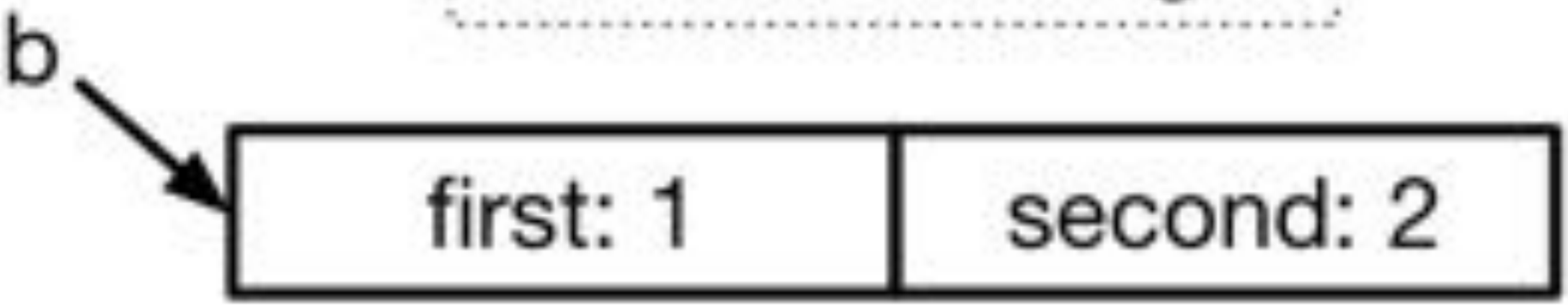

a = %{first: 1, second: 2}
a
first: 1
second: 2


a
first: 1
second: 2
b = a
Full content copy occurs
b
first: 1
second: 2

a = %{a | second: 3}



b is left unchanged



(b == %{first:1, second:2}) is true

Thought: sharing *is not necessarily intuitive*

Issues of sharing-based programming languages

- Access violation between multiple programs
- Zombie memory area without ownership
- Need for explicit copying cause bugs
- Mutable states are difficult to debug
- Semantically sharing is a *shortcut* and breaks many logical assumptions

Then why programming languages are still sharing based?

For resource conservation

- Reduce memory allocation attempts
- Reduce allocated memory size
- Reduce time for copying and communication

Sad news: most languages work like JavaScript (or C++, C#, Java) - so be careful!

False assumptions on sharing over networks

1-4 of Eight Fallacies of Distributed Computing[3]

- **The network is reliable**
- **Latency is zero**
- **Bandwidth is infinite**
- The network is secure

[3] https://blog.fogcreek.com/eight-fallacies-of-distributed-computing-tech-talk/

5-8 of Eight Fallacies of Distributed Computing[4]

- Topology doesn't change
- There is one administrator
- Transport cost is zero
- The network is homogeneous

[4] https://blog.fogcreek.com/eight-fallacies-of-distributed-computing-tech-talk/

The network is *not* reliable

- Somebody breaks the link (cut the line/fiber)
- Error rate of wireless/radio communication is far higher than the wired communication
- Data over the network *may* be altered without being discovered

Latency is *not* zero

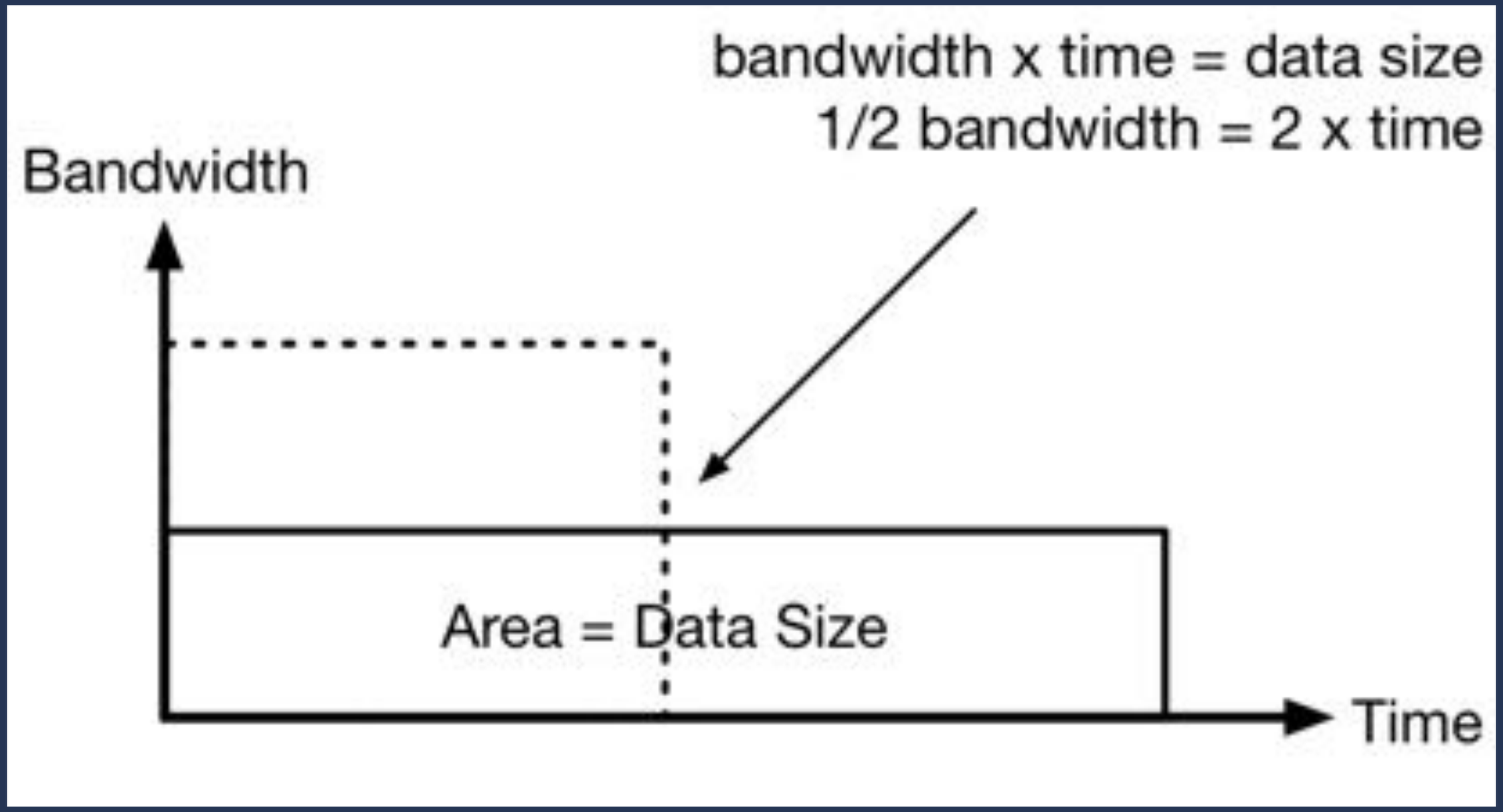
- Speed of light: ~300,000km/s
- = only **~30cm/ns**, **~300km/ms**
- Even slower on the optic fiber (**~x0.7**)[5]
- Japan-US West Coast: **~0.1s** for round-trip
- **Light is SLOW**

[5] https://physics.stackexchange.com/questions/80043/how-fast-does-light-travel-through-a-fibre-optic-cable

Bandwidth is *limited*

- 1Gbps on Ethernet: ~100Mbytes/sec
- **32Gbytes takes 32 seconds** on Ethernet
- **32Gbytes takes ~54 minutes** on ~1Mbytes/sec link
- **Replication of pictures and videos takes minutes or even hours**

Bandwidth and latency



Implications

- What you think you have successfully shared over the network **might be delivered corrupted** or **would not be delivered at all**
- **Sharing might not be completed as you expect**, especially regarding network errors
- **Data delivery delays**

Themes on part 2: Distributed systems

Concurrency

Consistency .vs availability

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- Sad news: Ben White
- False assumptions on sharing over networks: Fré Sonneveld
- Themes on part 2: Redd Angelo