


The Jump to Hyperspace

🌈 Light Speed, User Agency, & Moving Past the Cloud ☀️

The Jump to Hyperspace

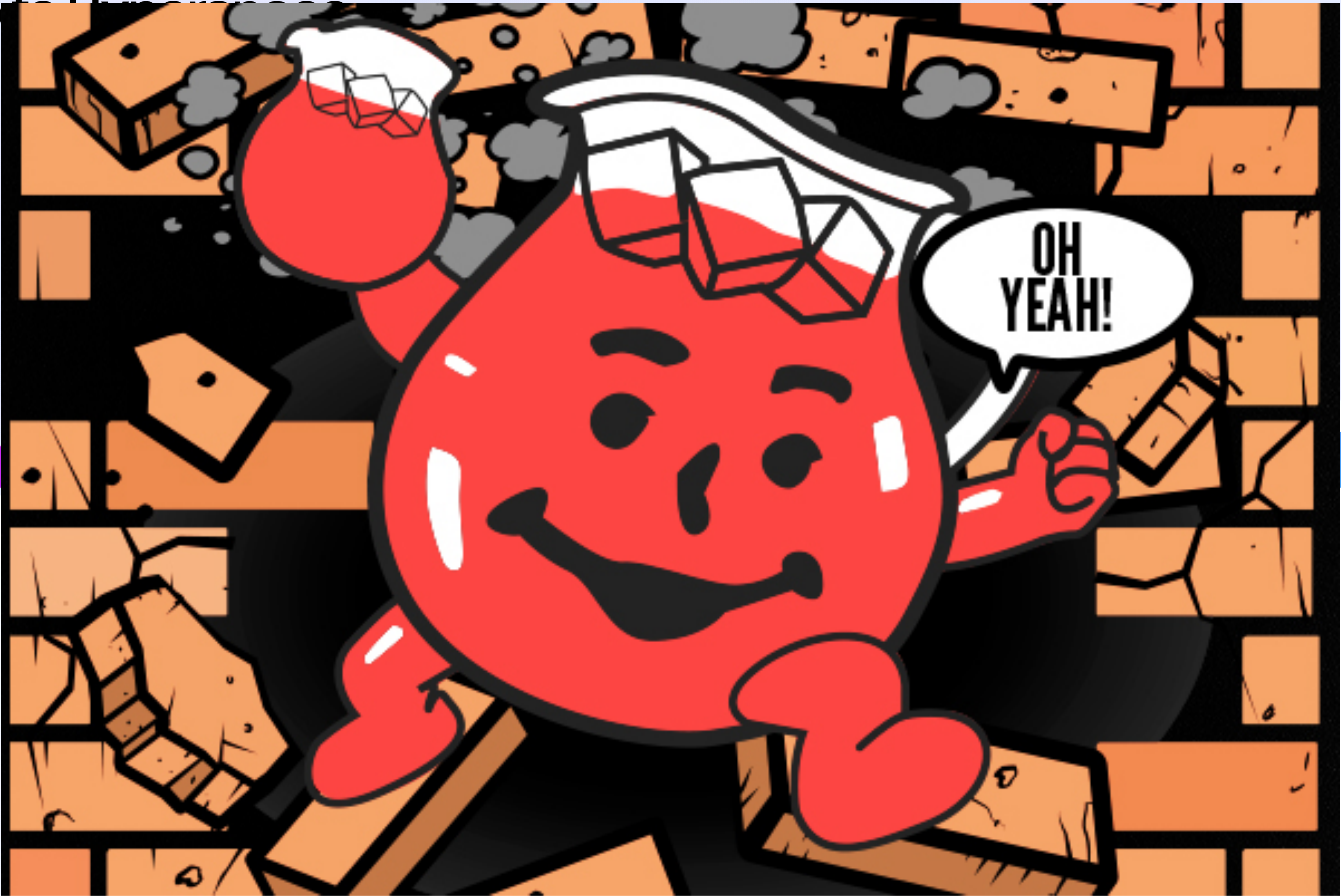
The background of the slide is an abstract composition of soft, flowing, wavy shapes. The upper portion is dominated by various shades of blue and purple, while the lower portion transitions into lighter, more ethereal tones of yellow and white. The overall effect is one of movement and depth, suggesting a vast, open space.

The Jump to Hyperspace

I suppose it is tempting,
if the only tool you have is a ***hammer***,
to treat everything as if it were a nail

– Abraham Maslow

The Jump to the ...



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The Jump to Hyperspace

Brooklyn Zelenka @expede

The Jump to Hyperspace

Brooklyn Zelenka @expede



github.com/expede
Vancouver 🇨🇦

The Jump to Hyperspace

Brooklyn Zelenka @expede

- ◆ Cofounder & CTO at Fission Codes 

- ◆ <https://fission.codes>


- ◆ <https://everywhere.computer>



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Vancouver 

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- ◆ PLs & DS are my jam 🙌



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- ◆ Come find me for Rust propaganda 🦀



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- ◆ PLs & DS are my jam 🙌

- ◆ Come find me for Rust propaganda 🦀

- ◆ Standards: UCAN, Multiformats, Skip Ratchet, Varsig, EIPs, etc



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From Dial-Up to Serverless

How We Got Here

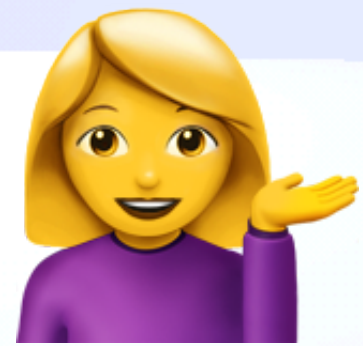


How We Got Here

One-to-One

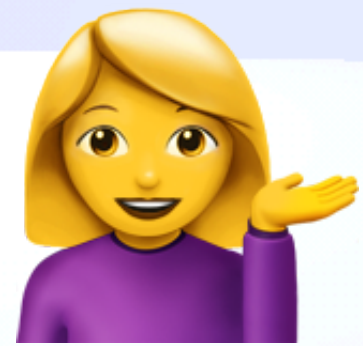
How We Got Here

One-to-One



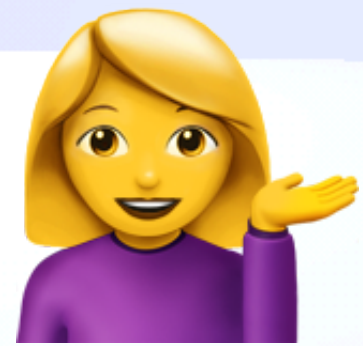
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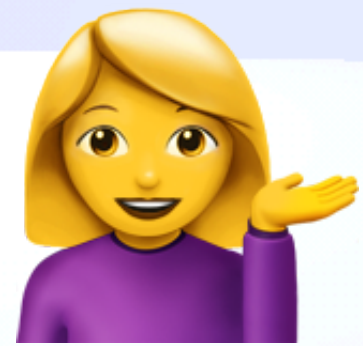
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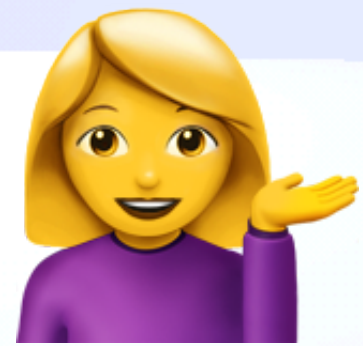
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One-to-One



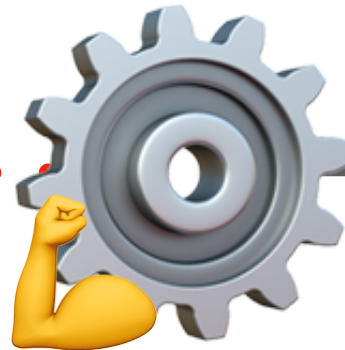
How We Got Here

One-to-One



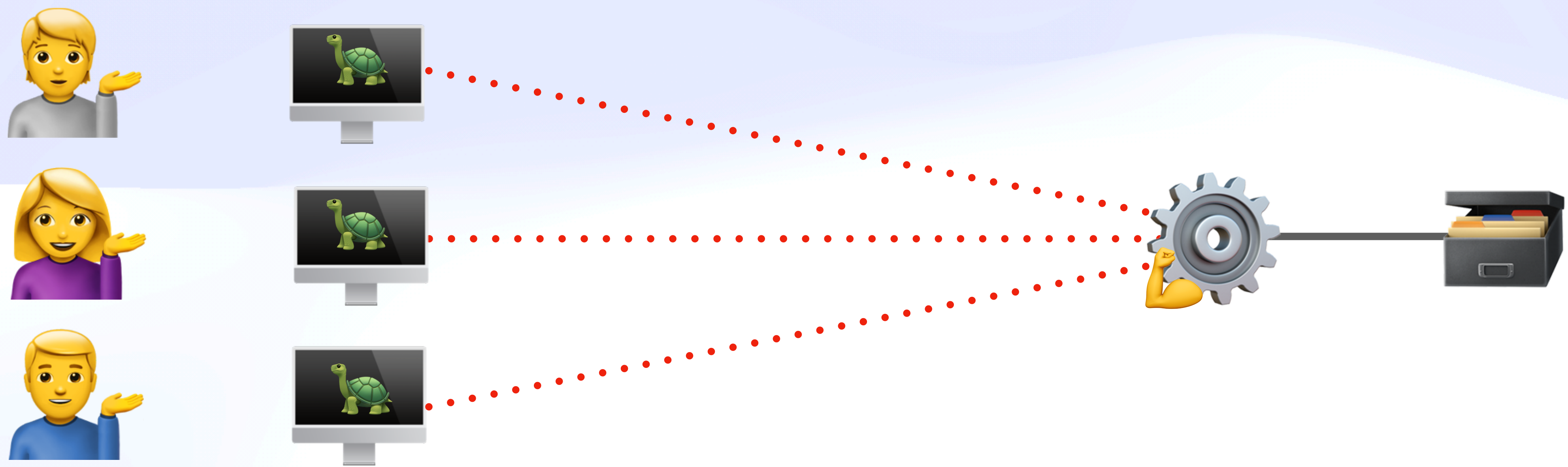
How We Got Here

One-to-One



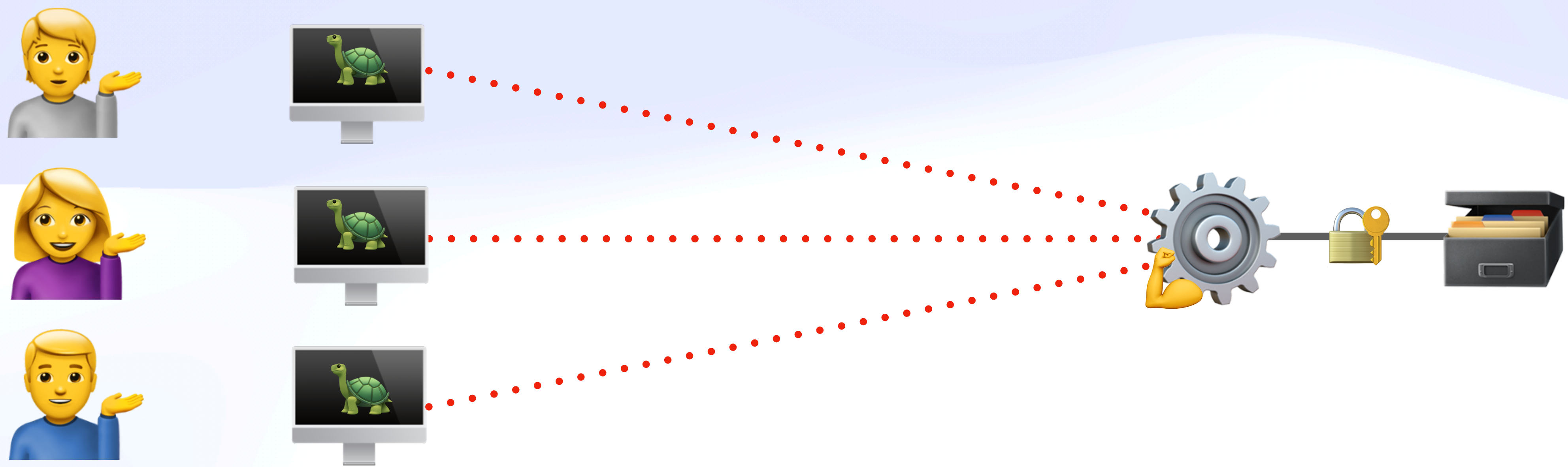
How We Got Here

One-to-One



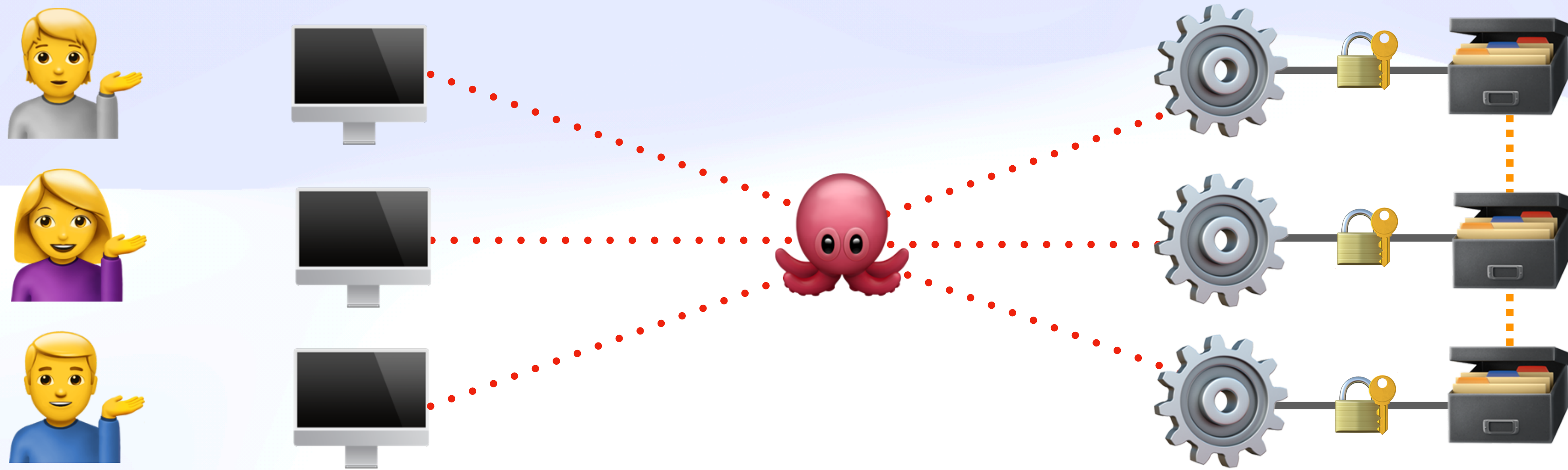
How We Got Here

One-to-One



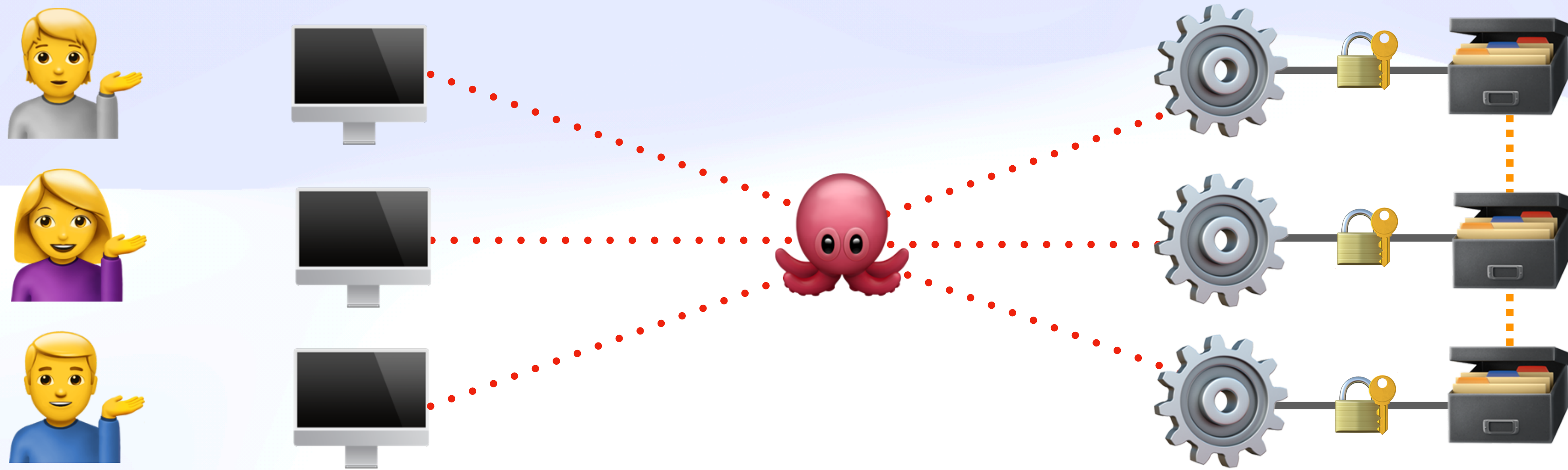
How We Got Here

Hidden Many-to-Many



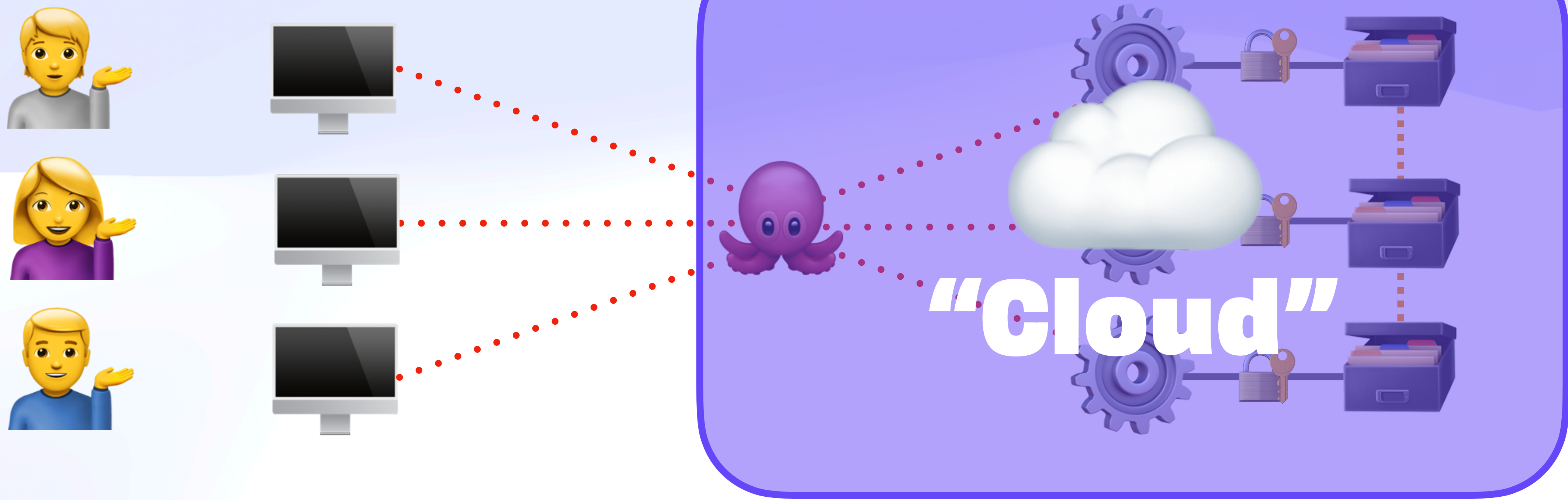
How We Got Here

Invisible Many-to-Many



How We Got Here

Invisible Many-to-Many



How We Got Here

Abstract Many-to-Many



How We Got Here

...and so it was for many years...

How We Got Here

...and so it was for many years...



How We Got Here

Consequences 🍂

How We Got Here

Consequences 🍂

- Single source of truth ("**the**" database)

How We Got Here

Consequences 🍂

- Single source of truth ("**the**" database)

- Server-centric



- "Full stack development"
- DevOps, Docker, k8s
- How to train enough engineers?

How We Got Here

Consequences 🍂

- Single source of truth ("**the**" database)
- Server-centric



- "Full stack development"
- DevOps, Docker, k8s
- How to train enough engineers?

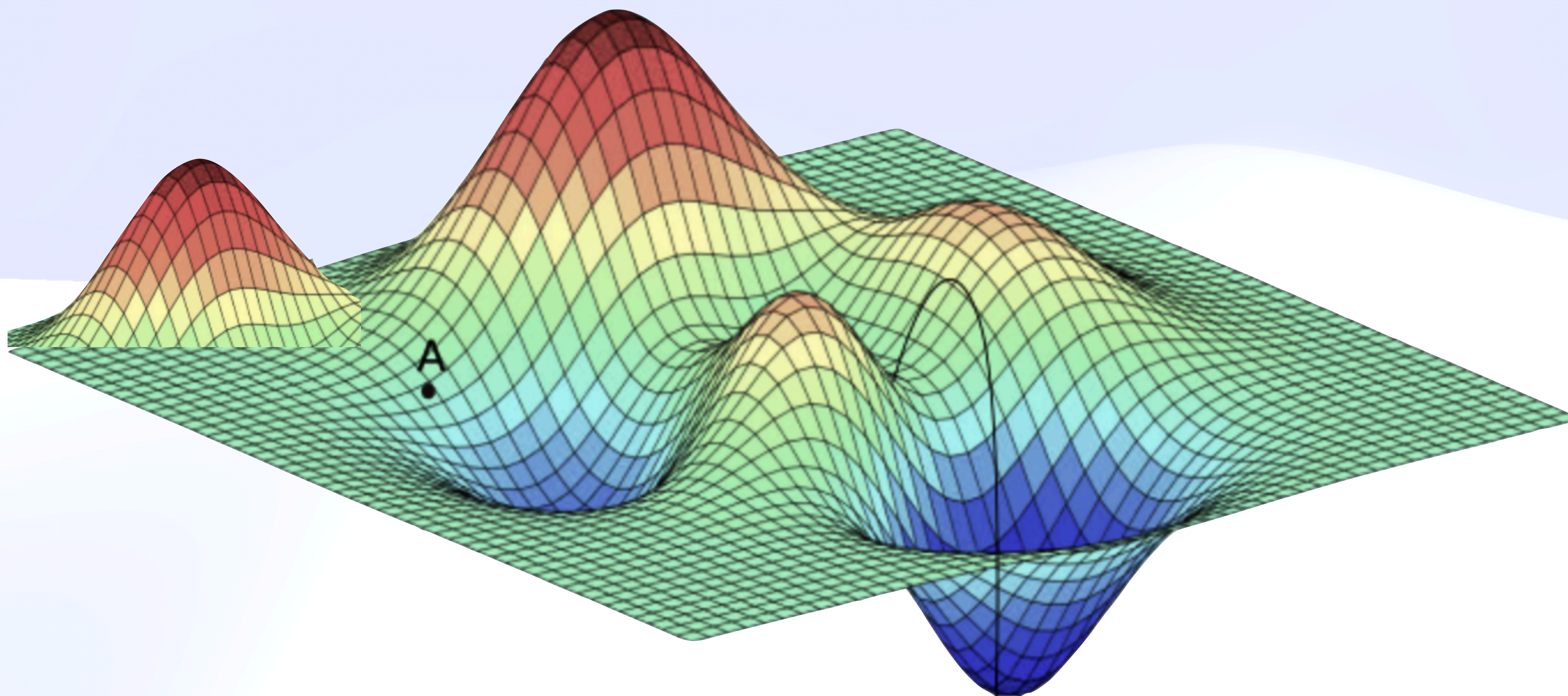


How We Got Here

Step Size

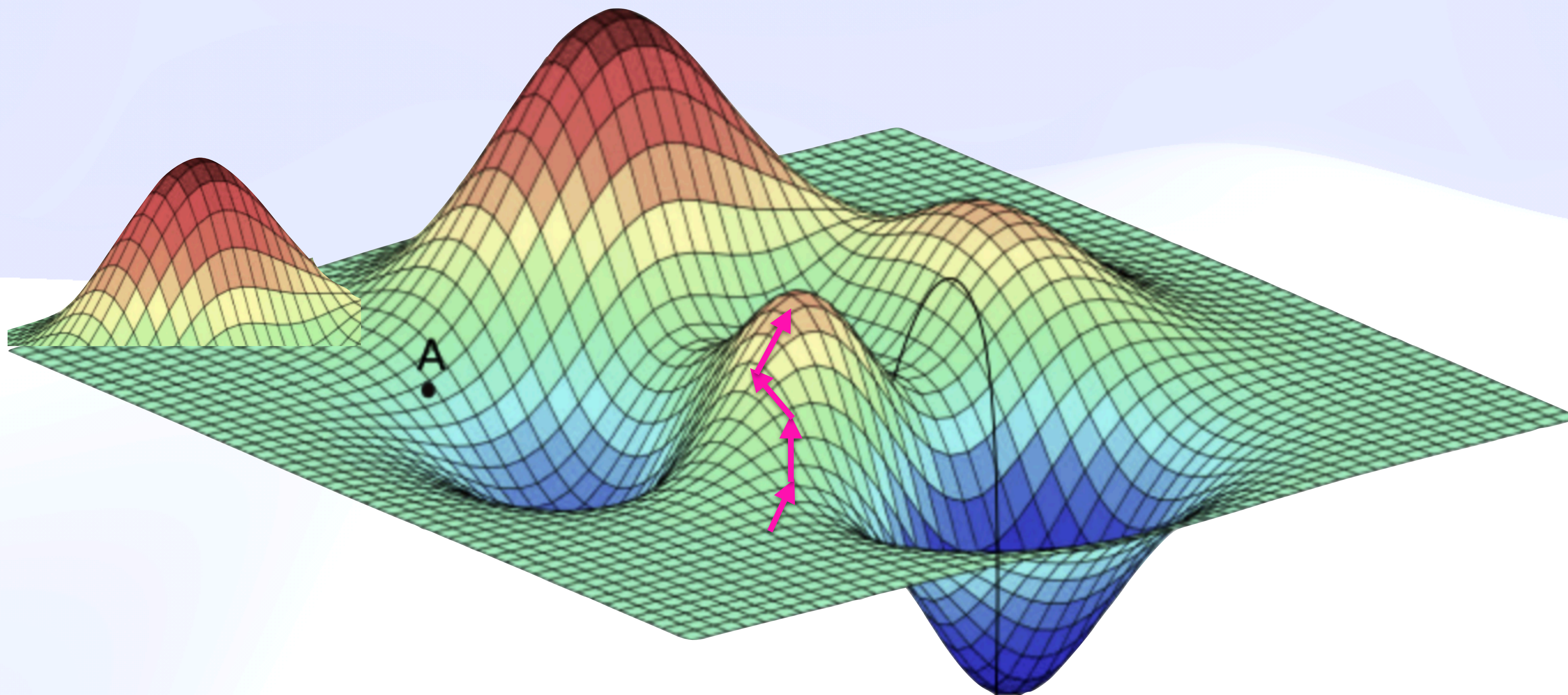
How We Got Here

Step Size



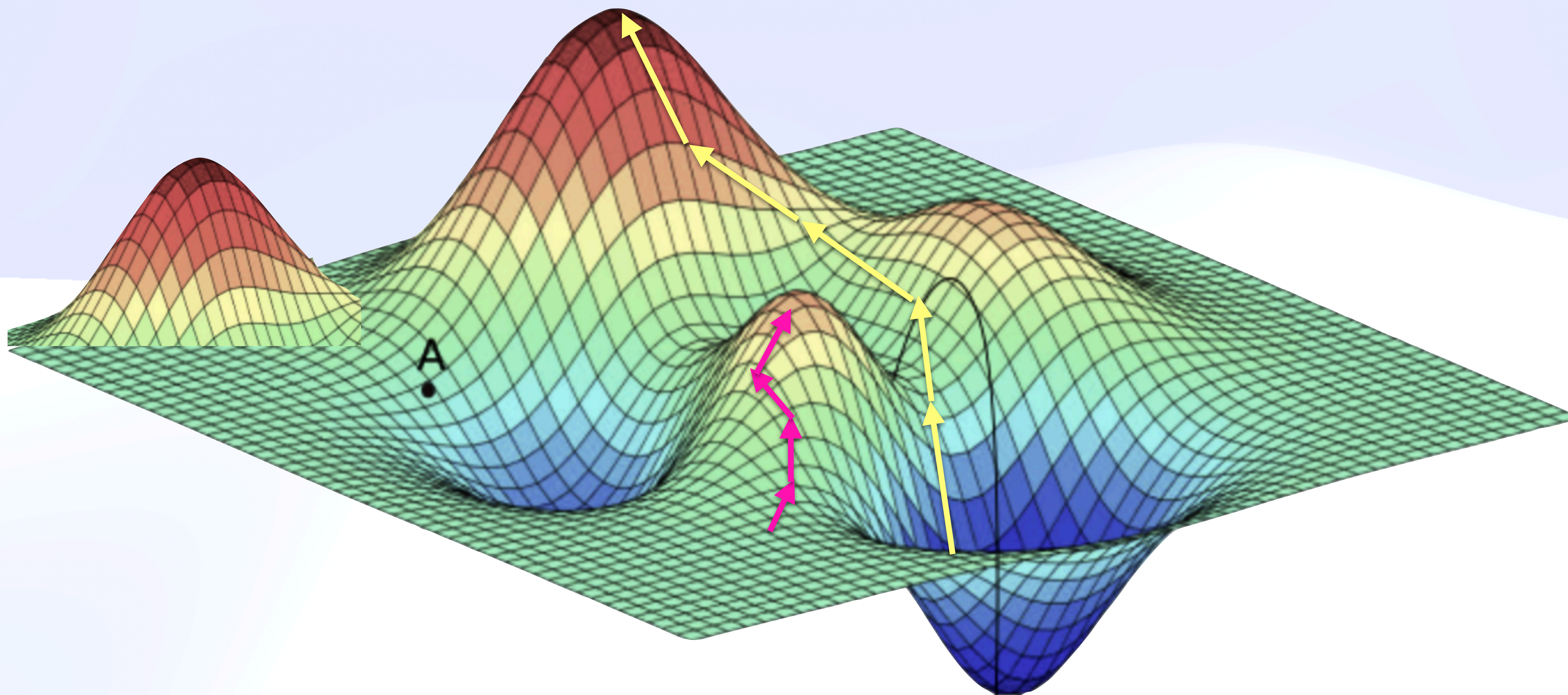
How We Got Here

Step Size



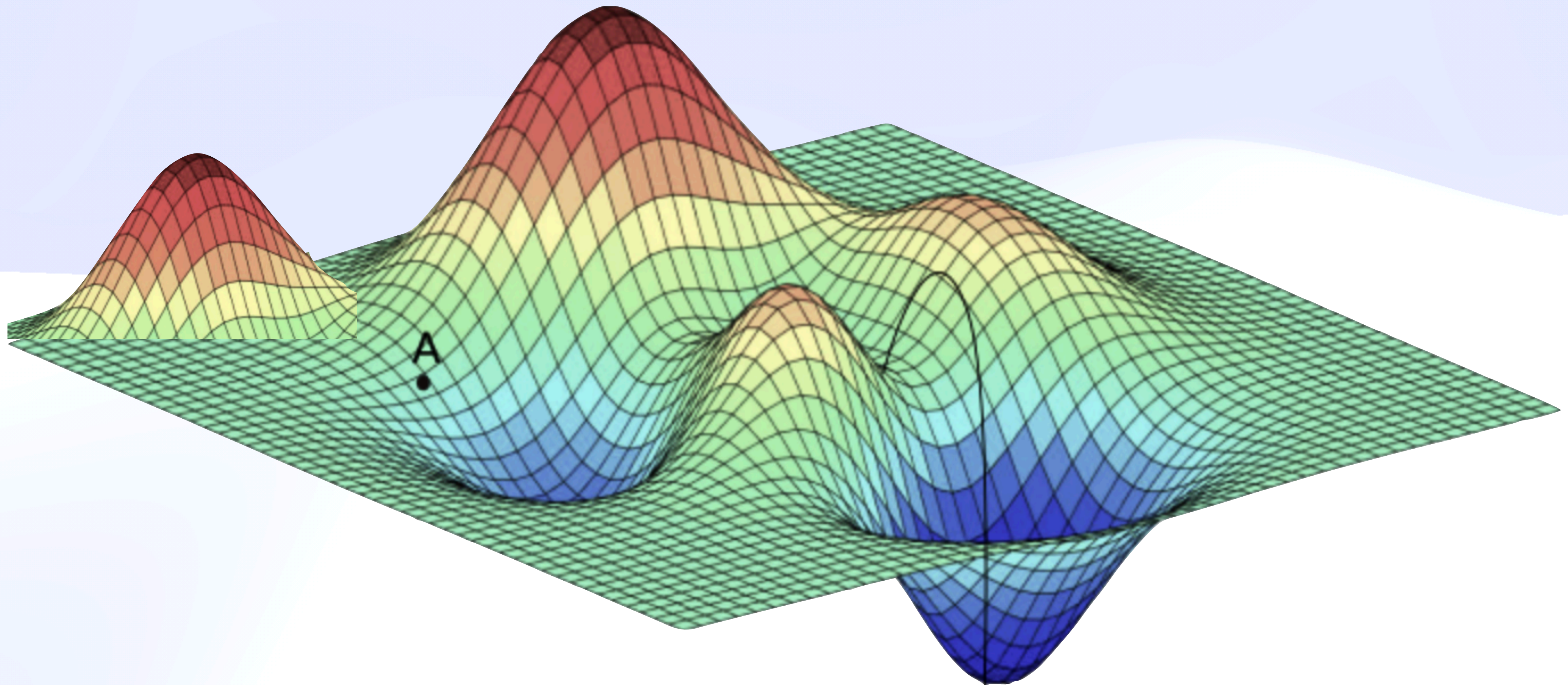
How We Got Here

Step Size



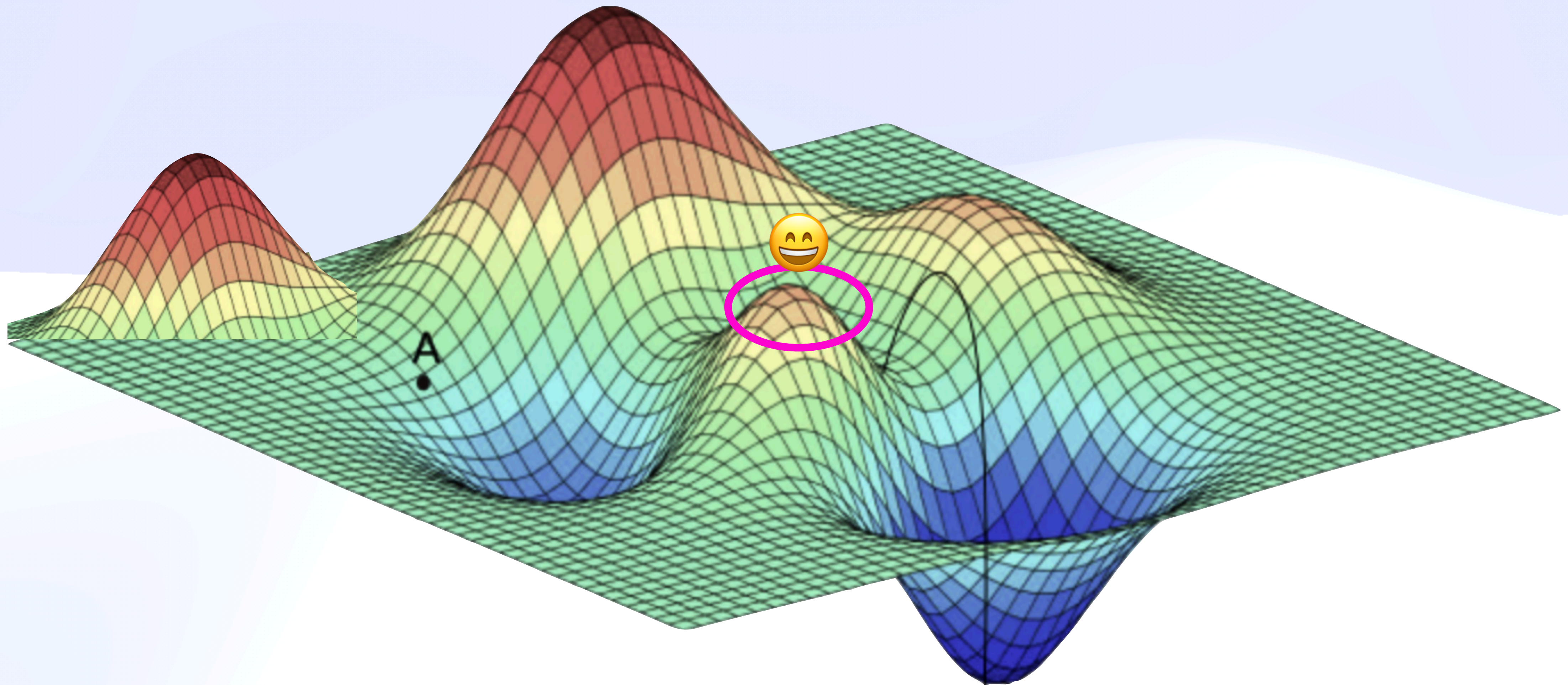
How We Got Here

Random Walk



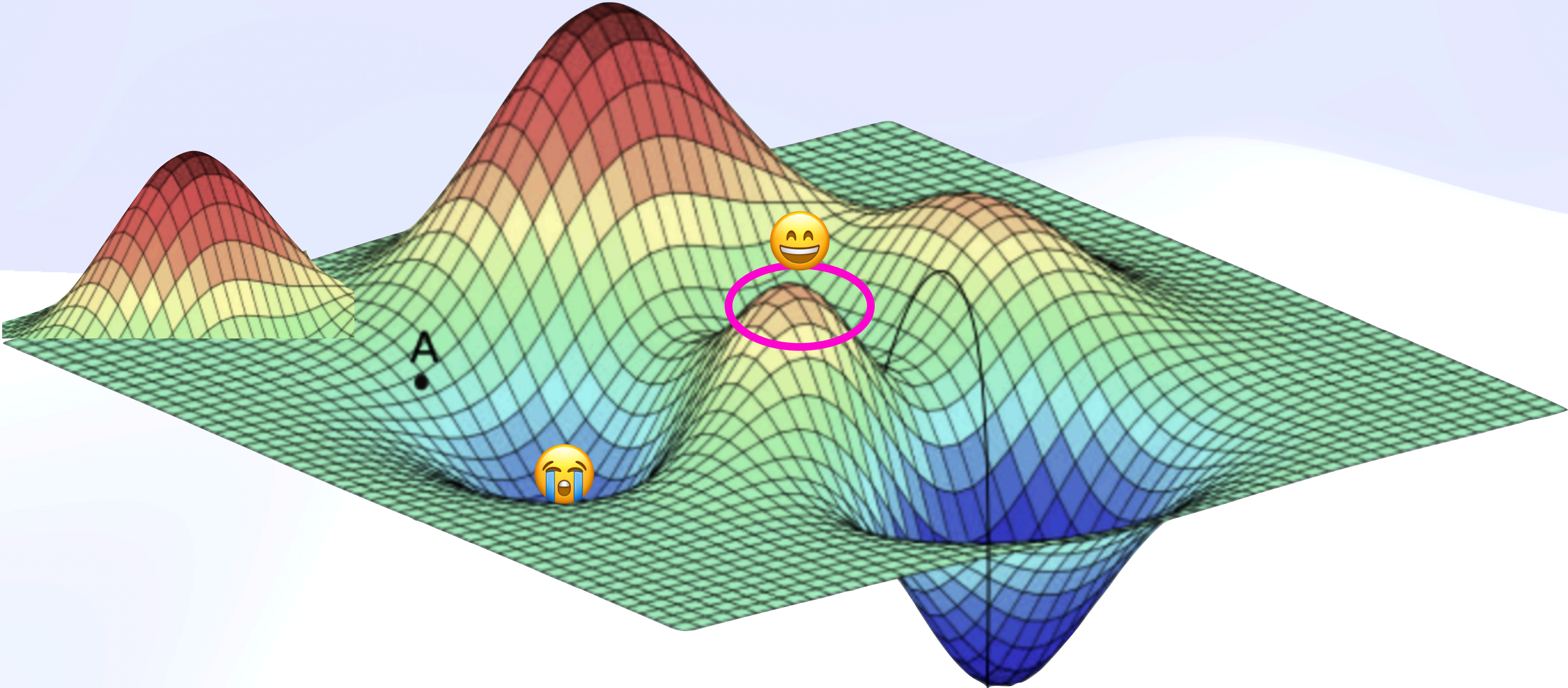
How We Got Here

Random Walk



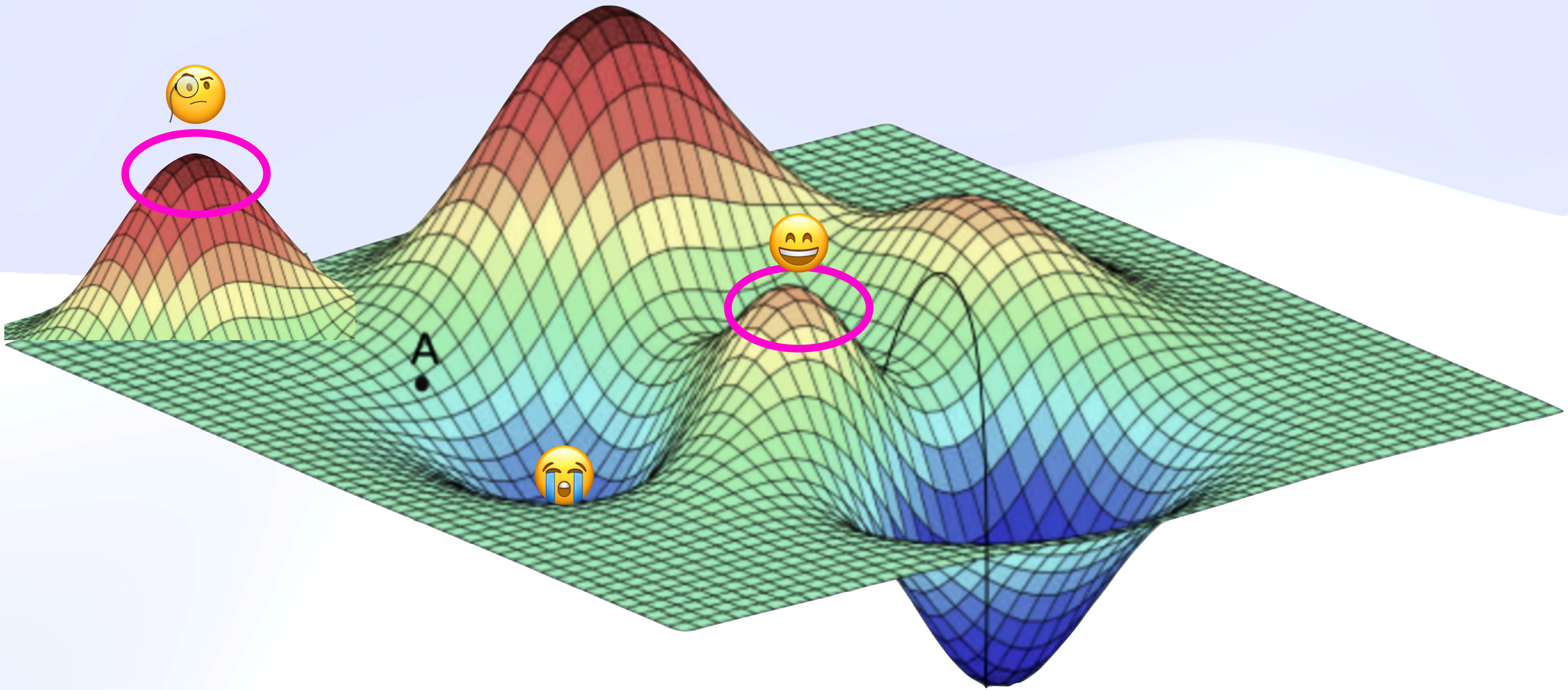
How We Got Here

Random Walk



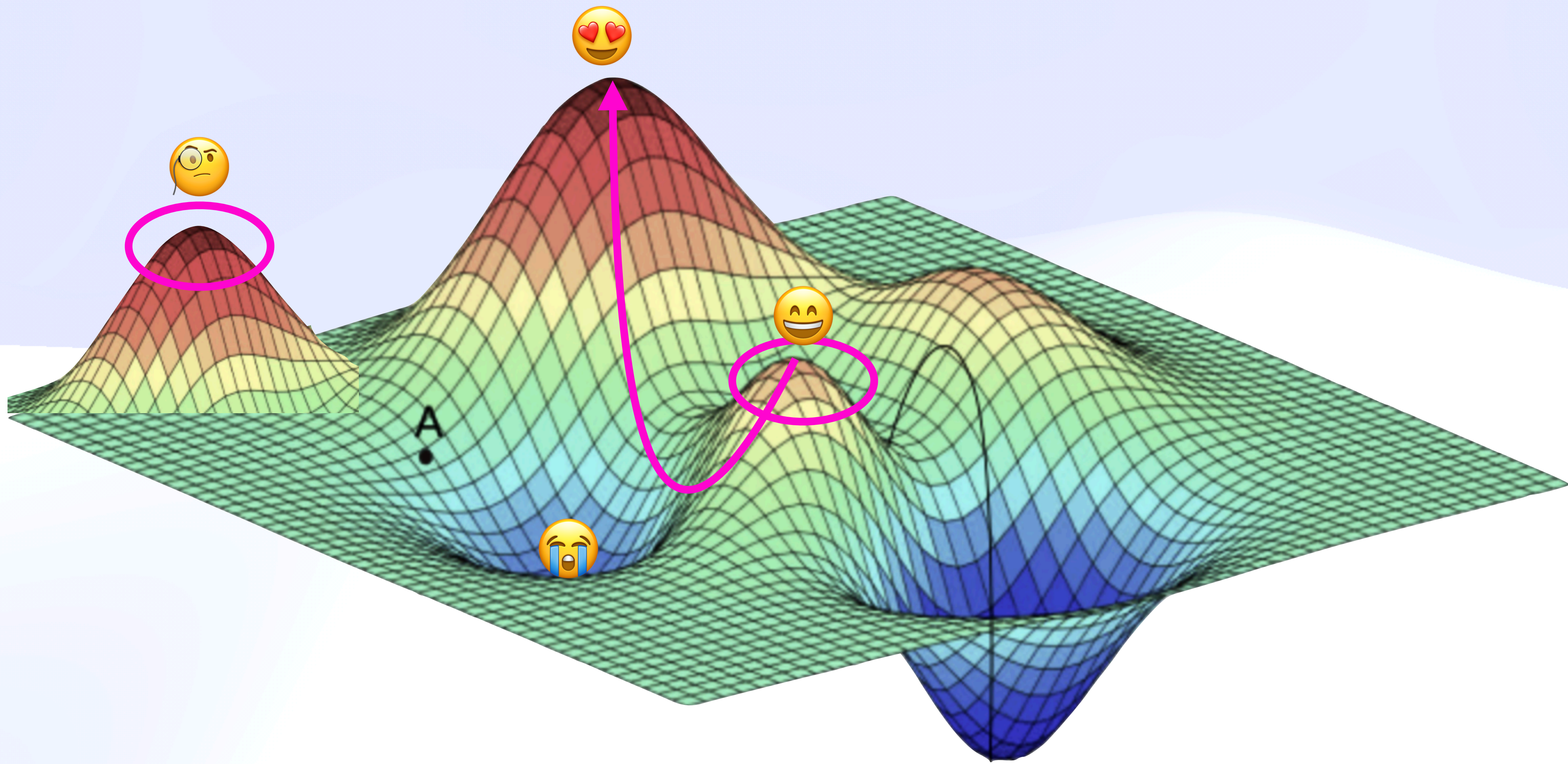
How We Got Here

Random Walk



How We Got Here

Random Walk



How We Got Here

"Industrial Strength"

How We Got Here

"Industrial Strength"



How We Got Here

"Industrial Strength"



How We Got Here

"Industrial Strength"



How We Got Here

Bike Scale

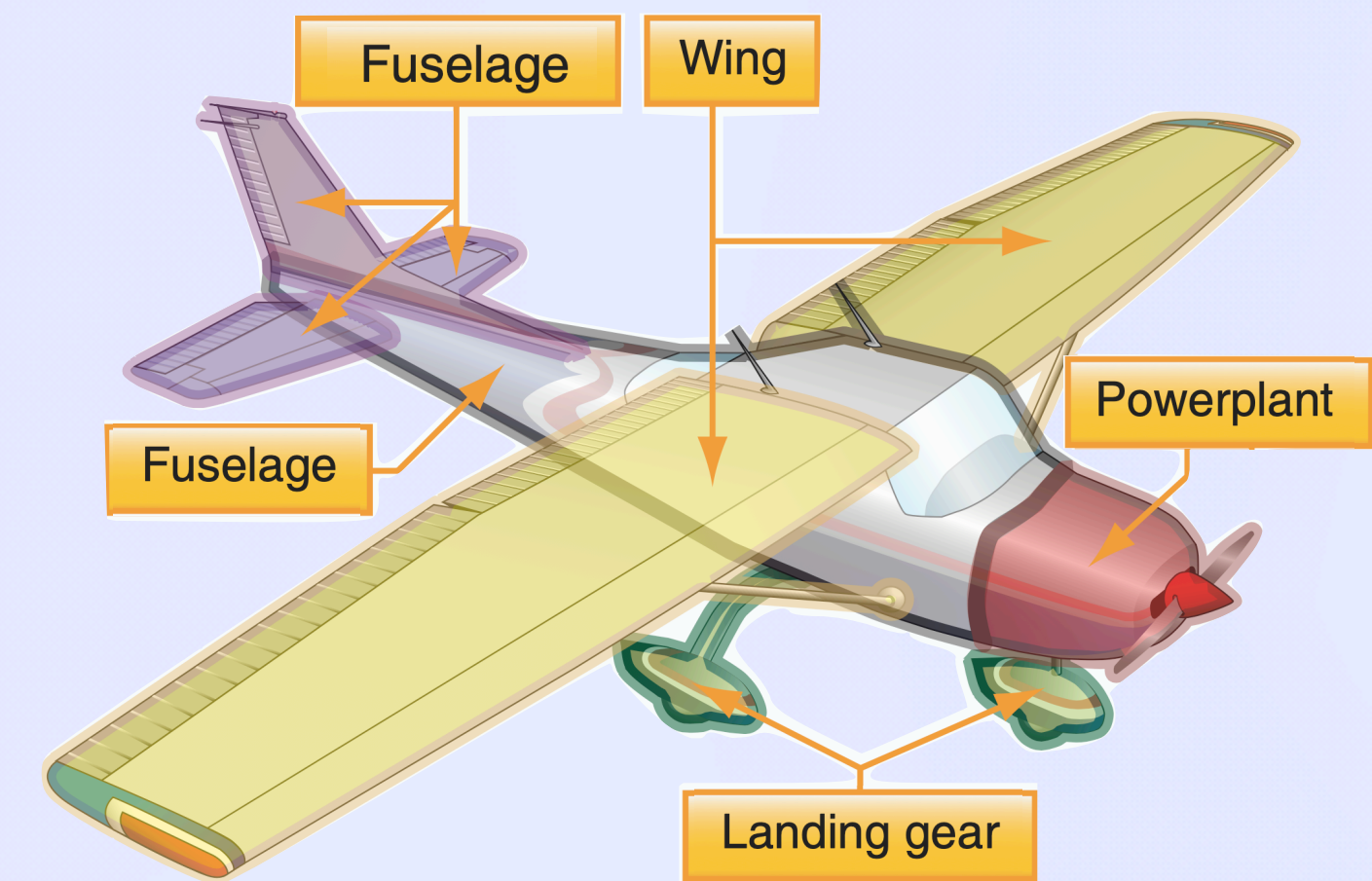


How We Got Here

Functional Fixedness

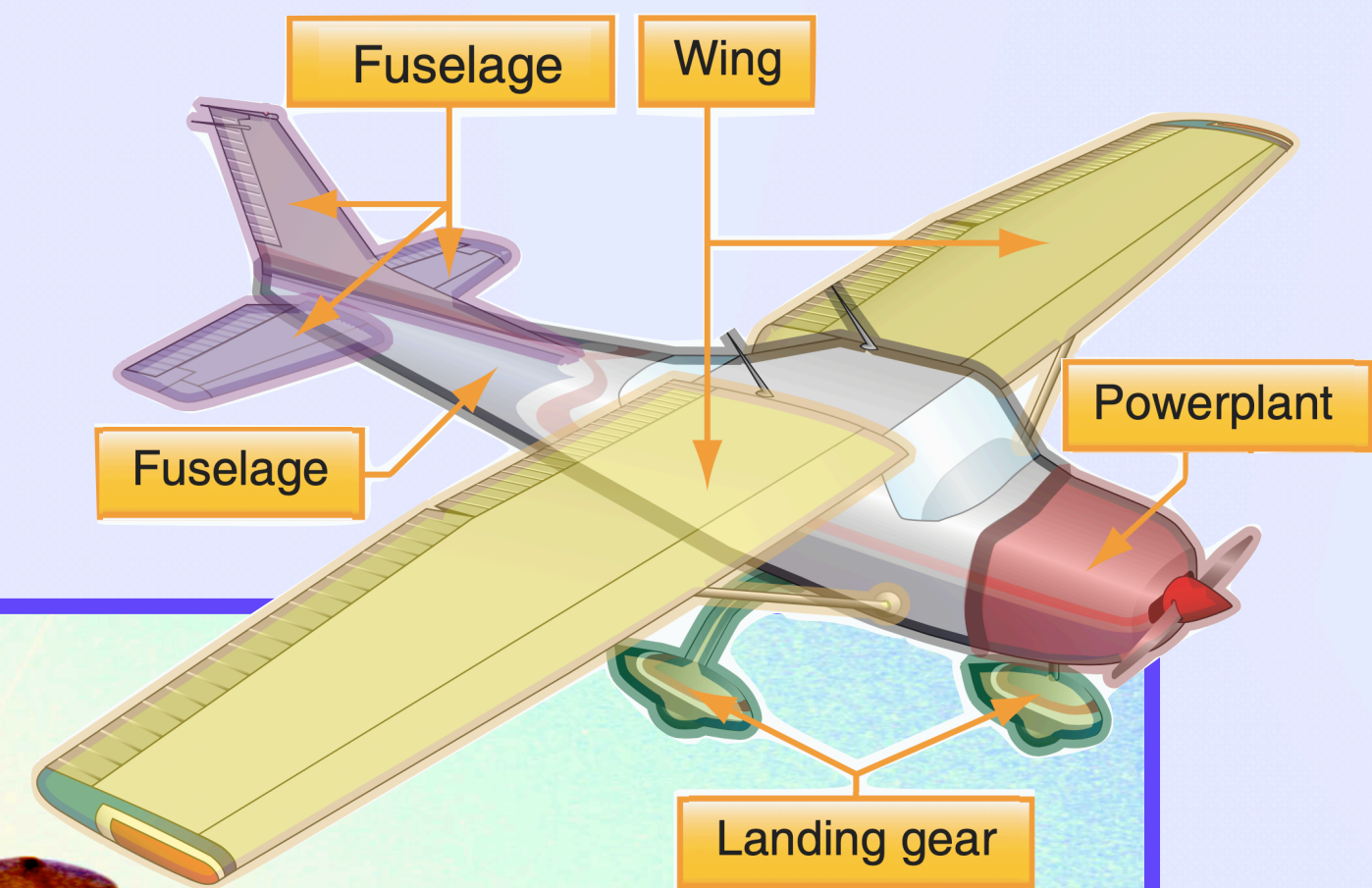
How We Got Here

Functional Fixedness



How We Got Here

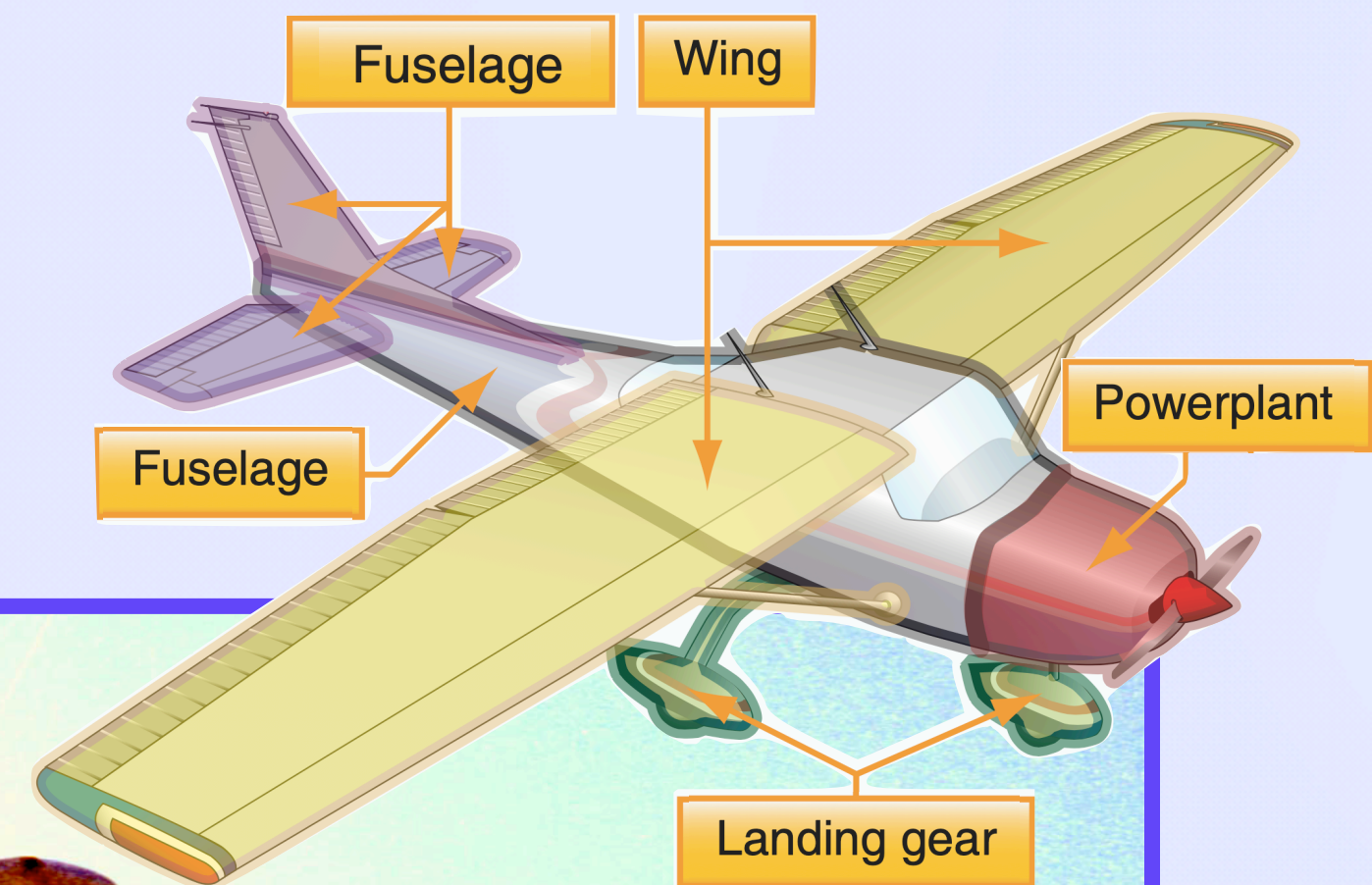
Functional Fixedness



How We Got Here

Functional Fixedness

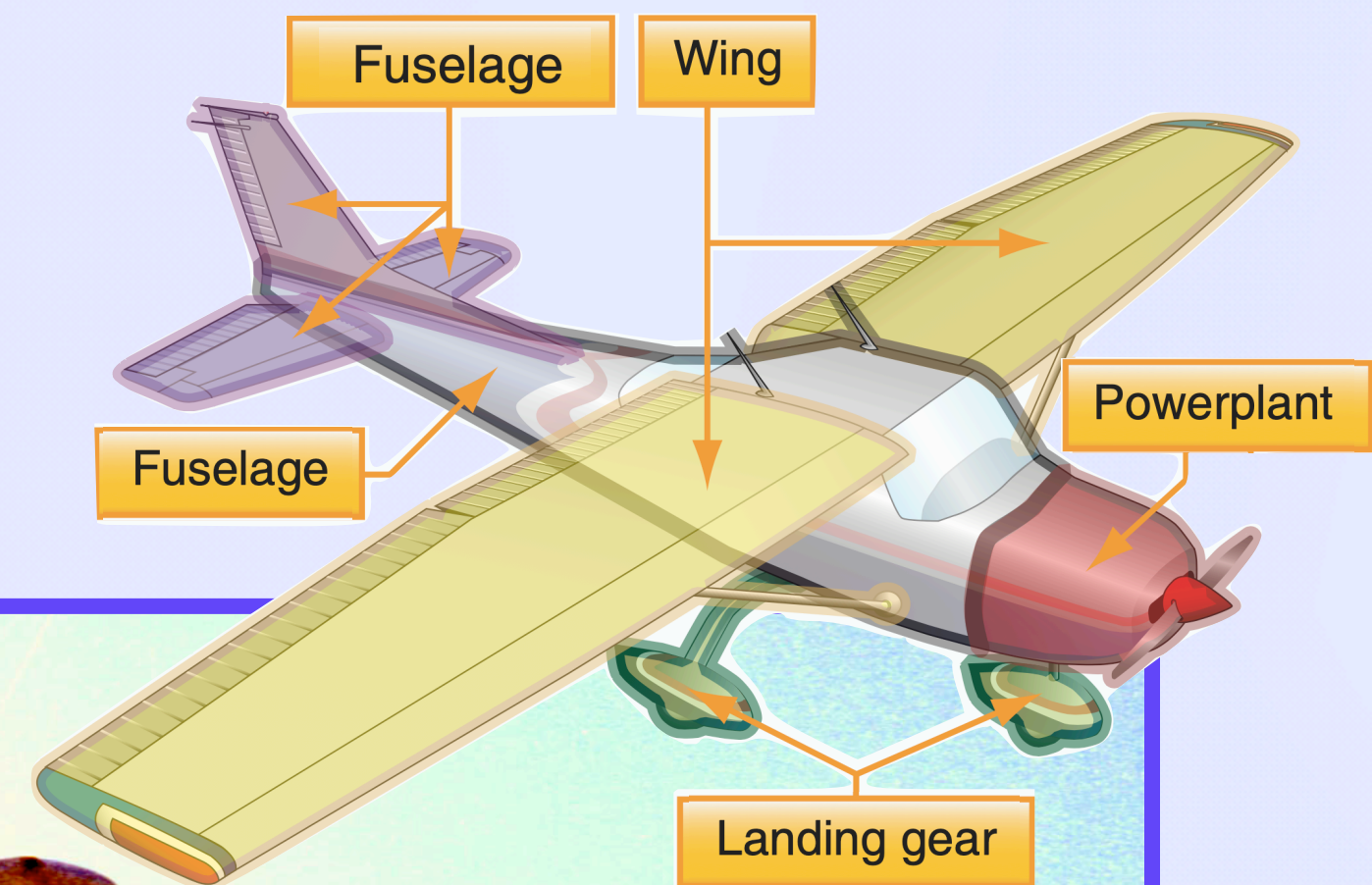
"Everyone else
was trying to
make an airplane.
We were trying to
do human
powered flight!"



How We Got Here

Functional Fixedness

"Everyone else
was trying to
make **Google**.
We were trying to
do human
powered flight!"

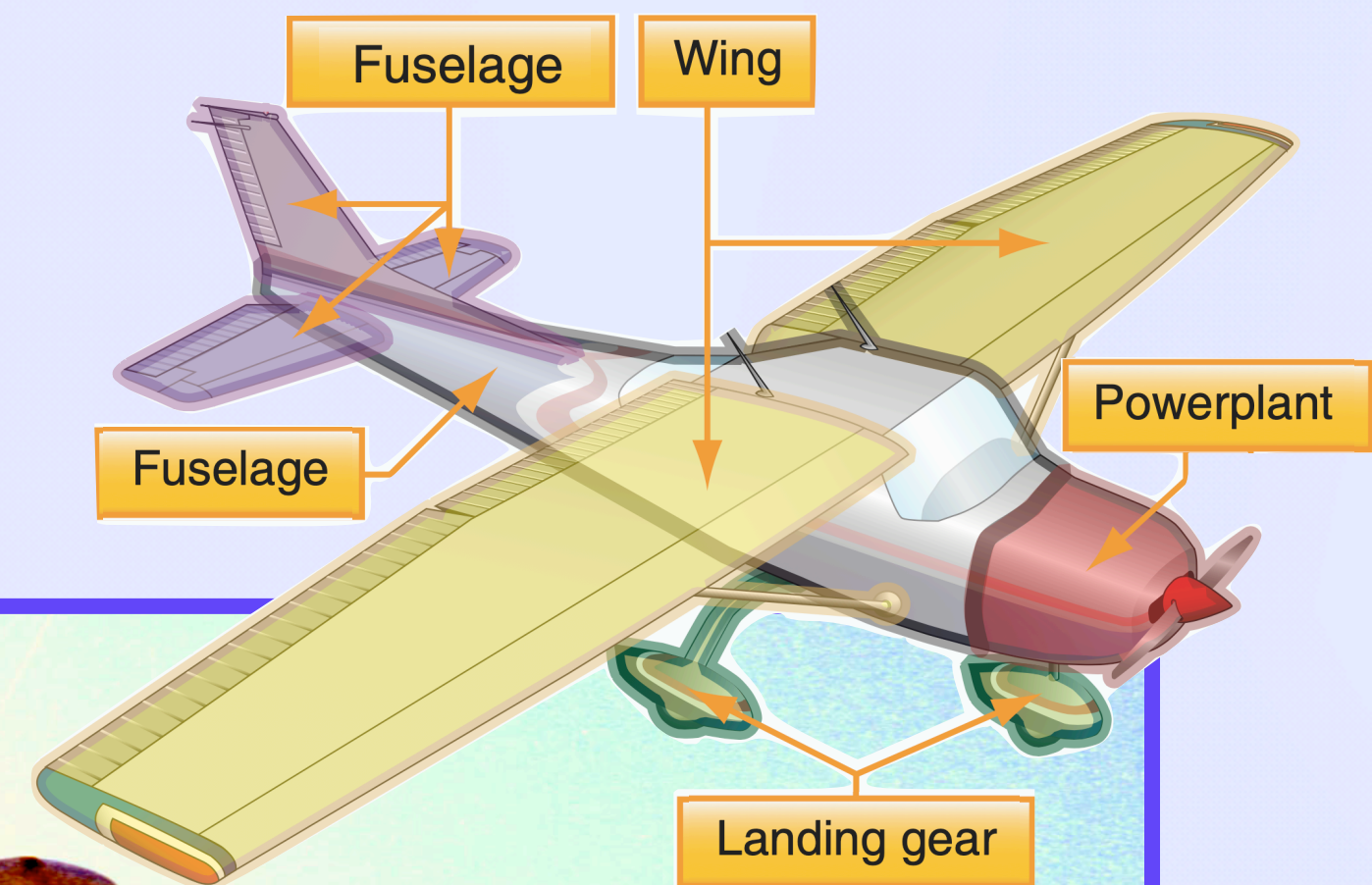


How We Got Here

Functional Fixedness

"Everyone else
was trying to
make Google .
We were trying to

build apps

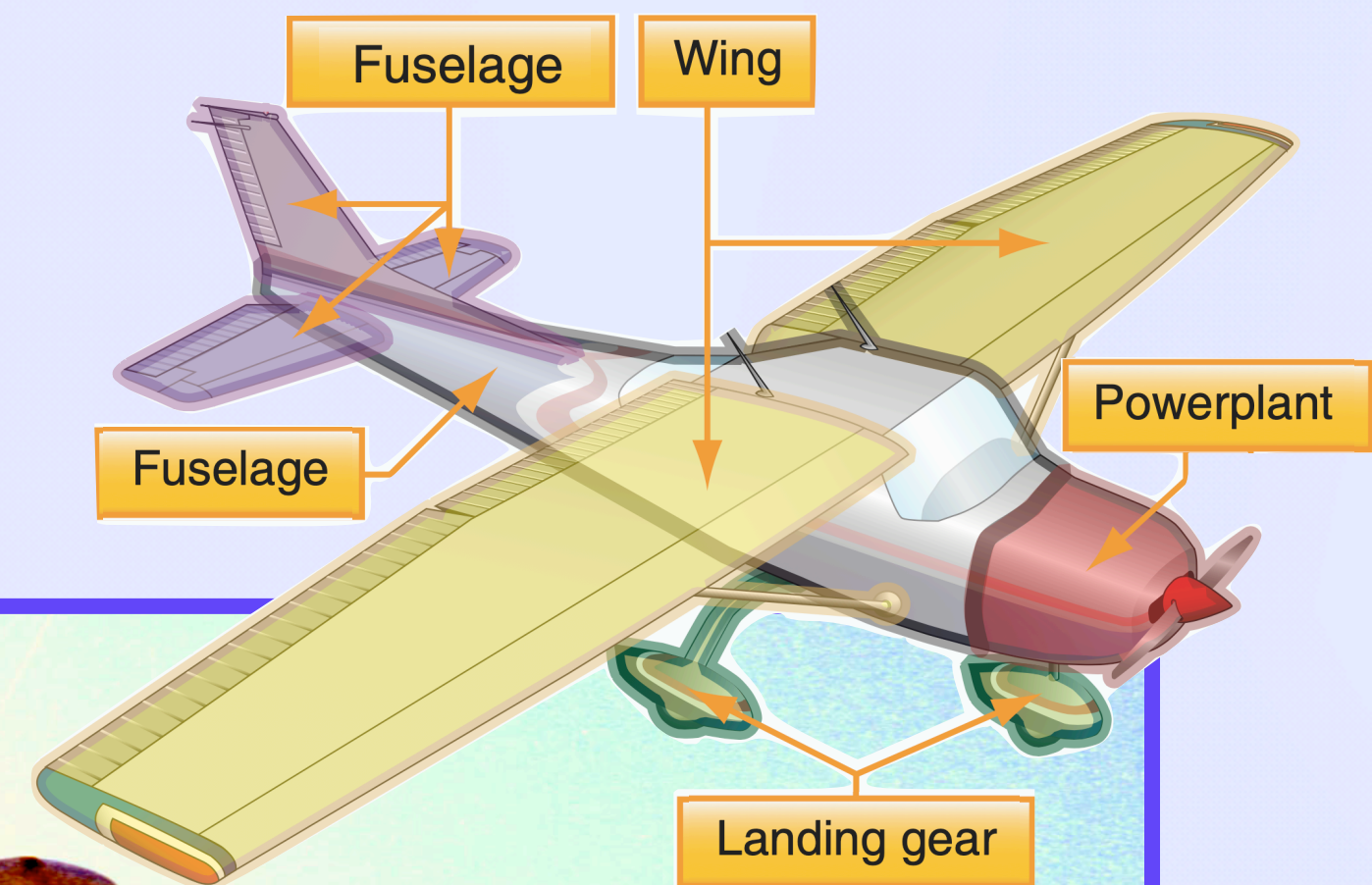


How We Got Here

Functional Fixedness

"Everyone else
was trying to
make **Google**.
We were trying to

**solve user
problems**!"



How We Got Here

Don't Make Me Think

How We Got Here

Don't Make Me Think



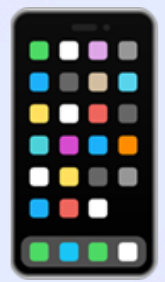
How We Got Here

Don't Make Me Think



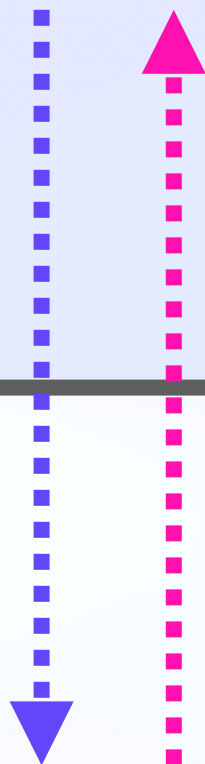
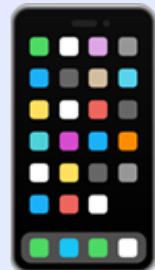
How We Got Here

Don't Make Me Think



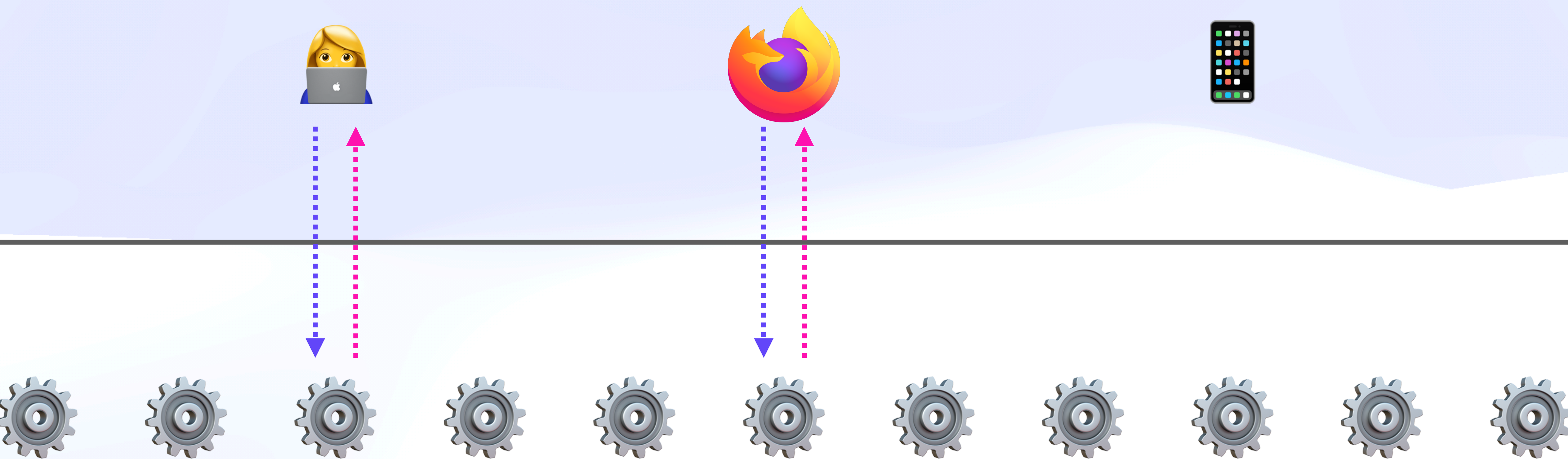
How We Got Here

Don't Make Me Think



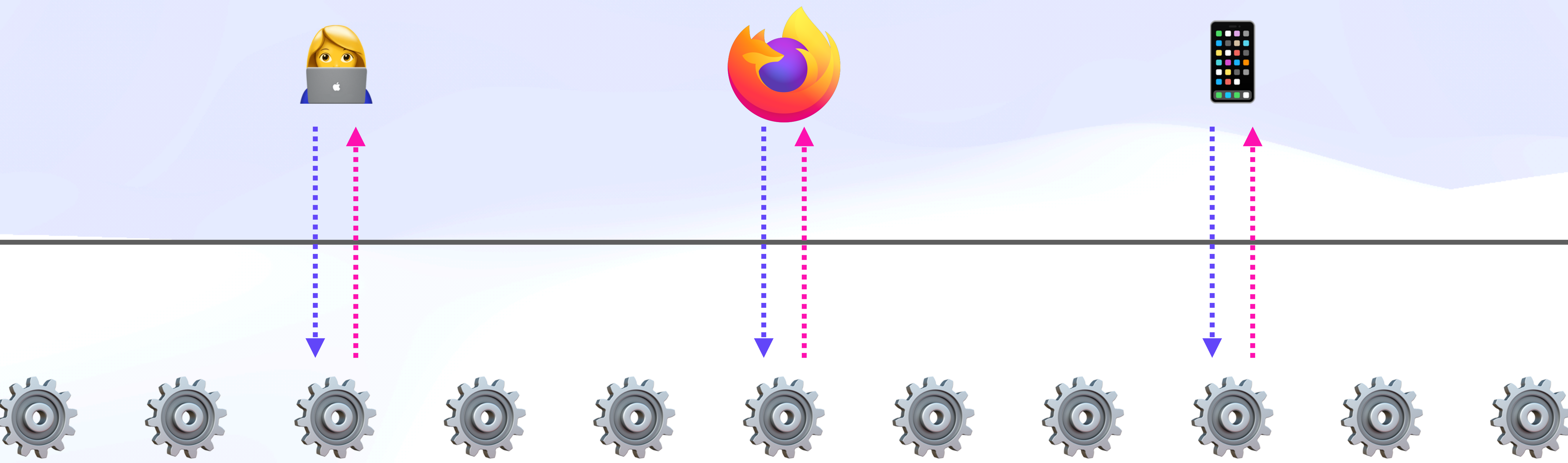
How We Got Here

Don't Make Me Think



How We Got Here

Don't Make Me Think



How We Got Here

Condensing The Stack

How We Got Here

Condensing The Stack

Users 🧑🏿 🧑🏻 🧑🏼 🧑🏾

Developer 🧑🏿💻

How We Got Here

Condensing The Stack

Users 🧑🧑🧑🧑

Browser 🖥️

REST / JSON-RPC / GraphQL ⬆️⬆️

Server ⚙️

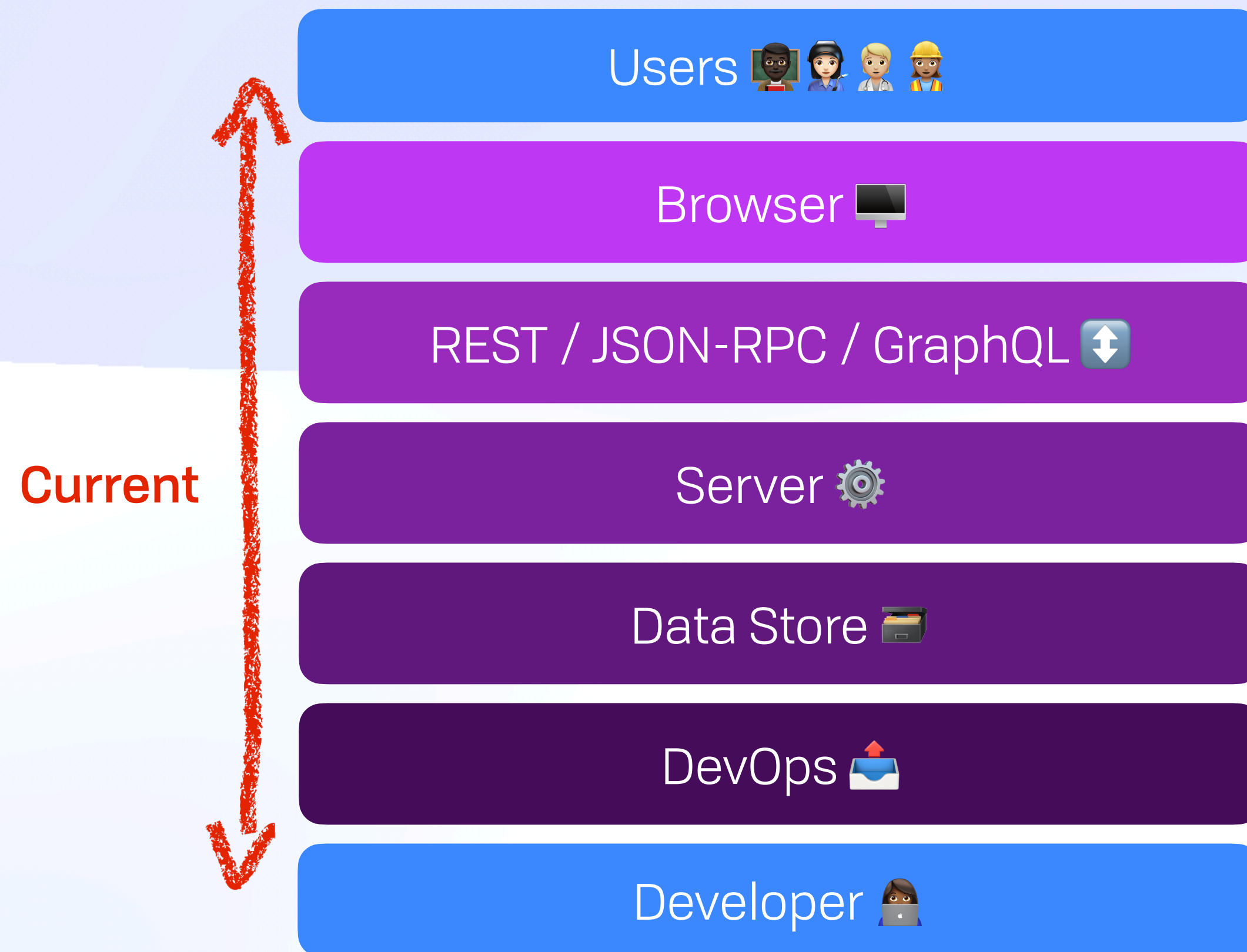
Data Store 🗄️

DevOps 📦

Developer 🧑💻

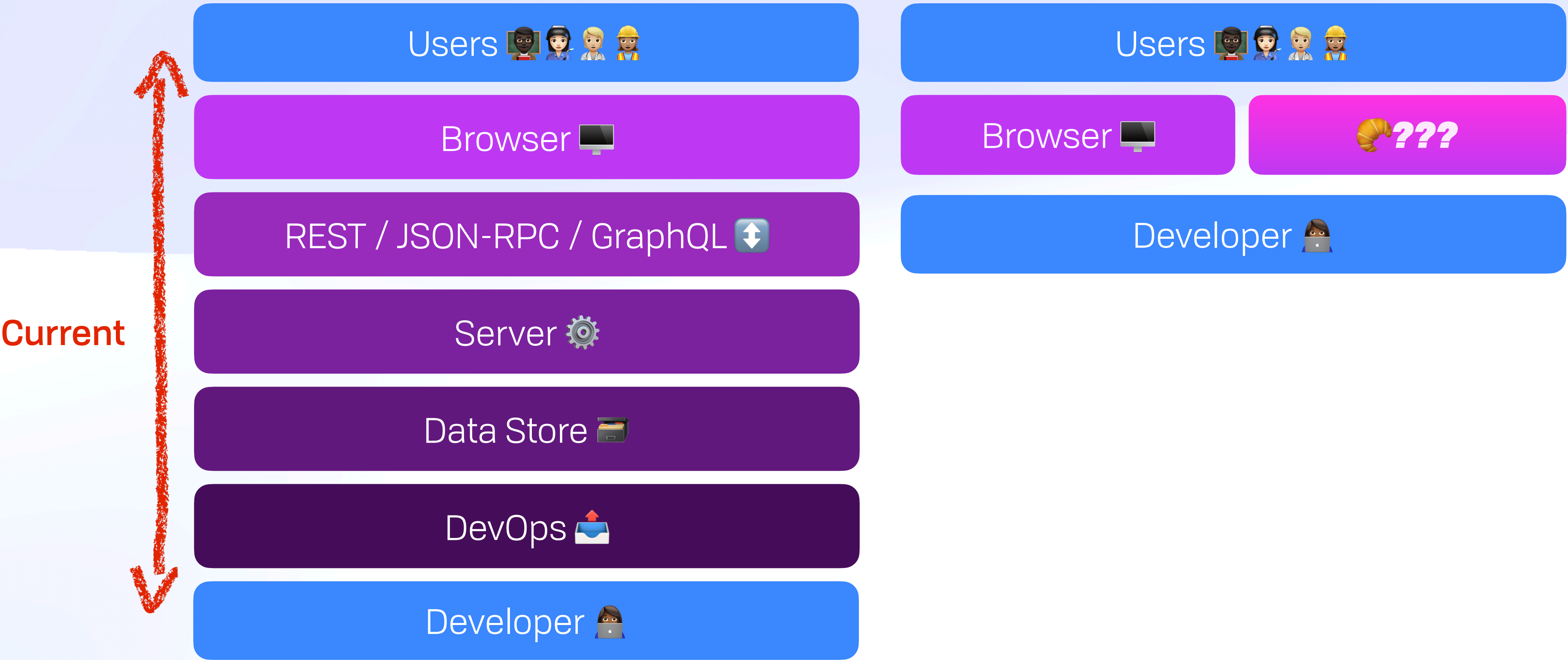
How We Got Here

Condensing The Stack



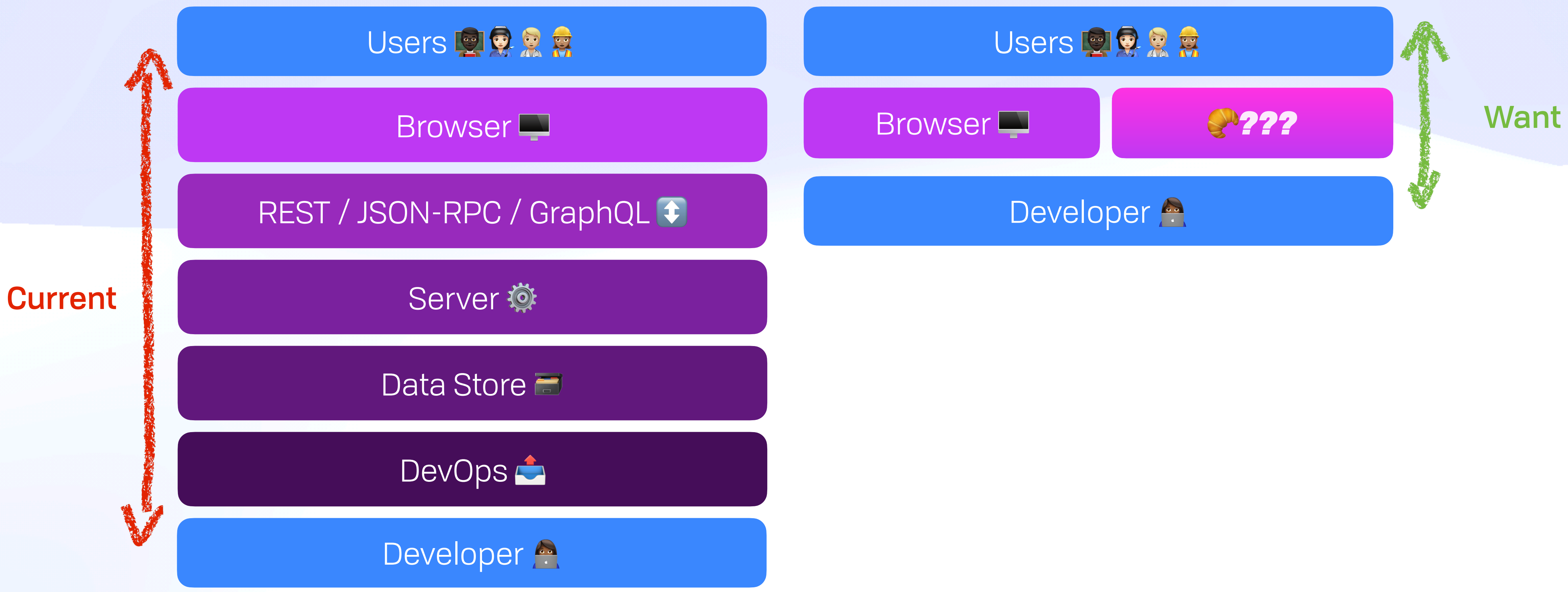
How We Got Here

Condensing The Stack



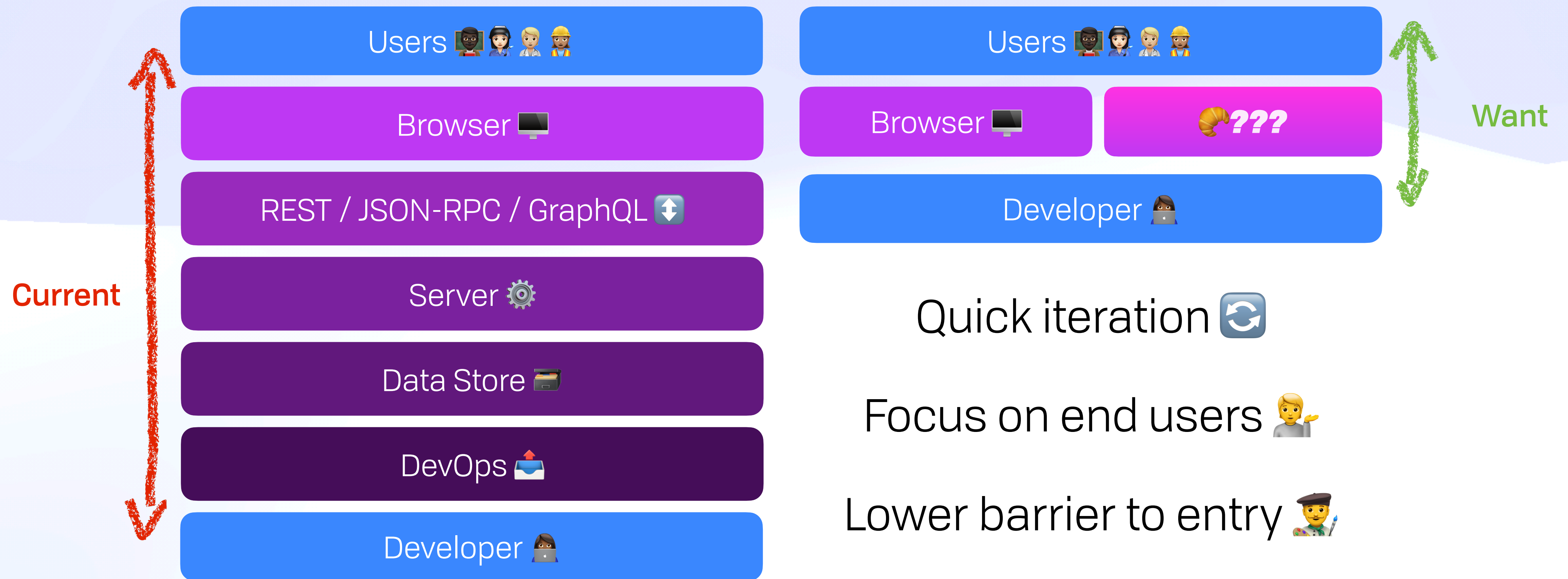
How We Got Here

Condensing The Stack



How We Got Here

Condensing The Stack



How We Got Here

There Is No ~~Spoon~~ Back End

How We Got Here

There Is No Spoon Back End



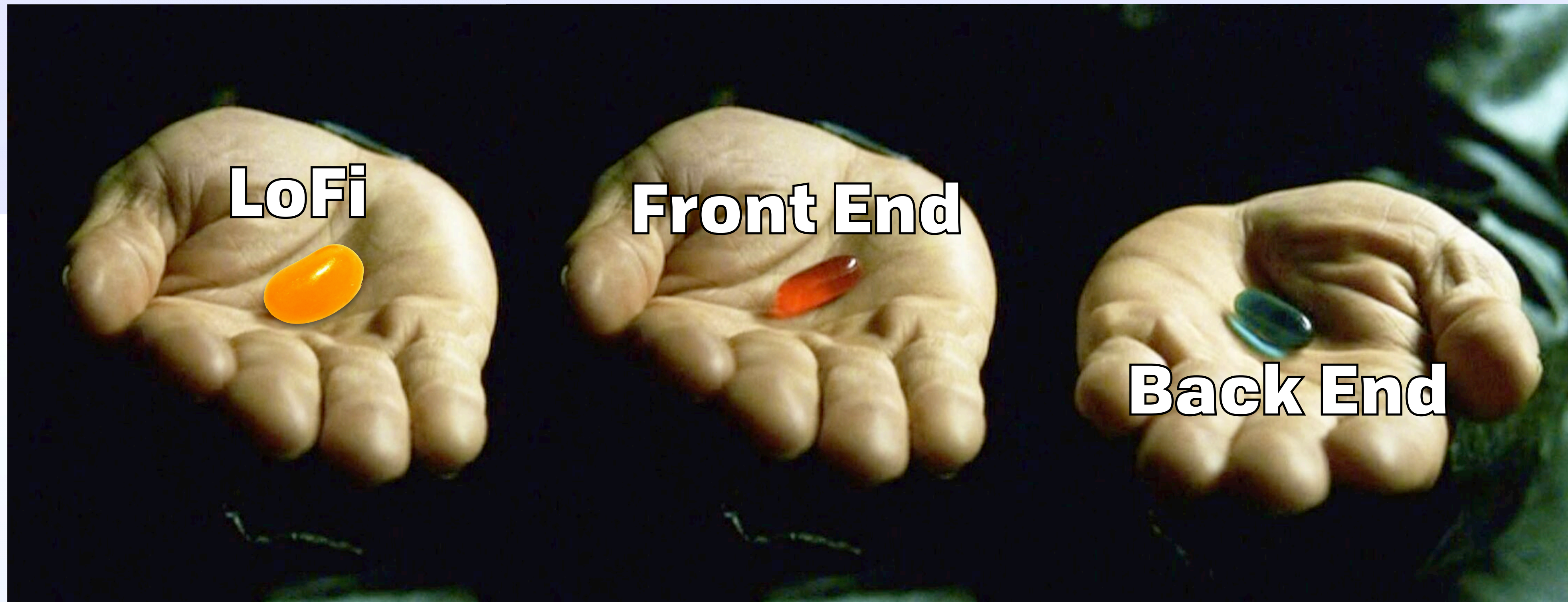
How We Got Here

There Is No ~~Spoon~~ Back End



How We Got Here

There Is No Spoon ***Back End***



Only Limited By Physics

Hard Constraints



Hard Constraints

The Long Way 'Round

Hard Constraints

The Long Way 'Round



Hard Constraints

The Long Way 'Round



Hard Constraints

The Long Way 'Round



Hard Constraints

The Long Way 'Round



Hard Constraints

The Long Way 'Round



Hard Constraints

The Long Way 'Round



Hard Constraints

The Long Way 'Round



Hard Constraints

The Long Way 'Round

Direct ≈ 490km



Hard Constraints

The Long Way 'Round



Direct \approx 490km
Actual \approx 4900km

Hard Constraints

The Long Way 'Round



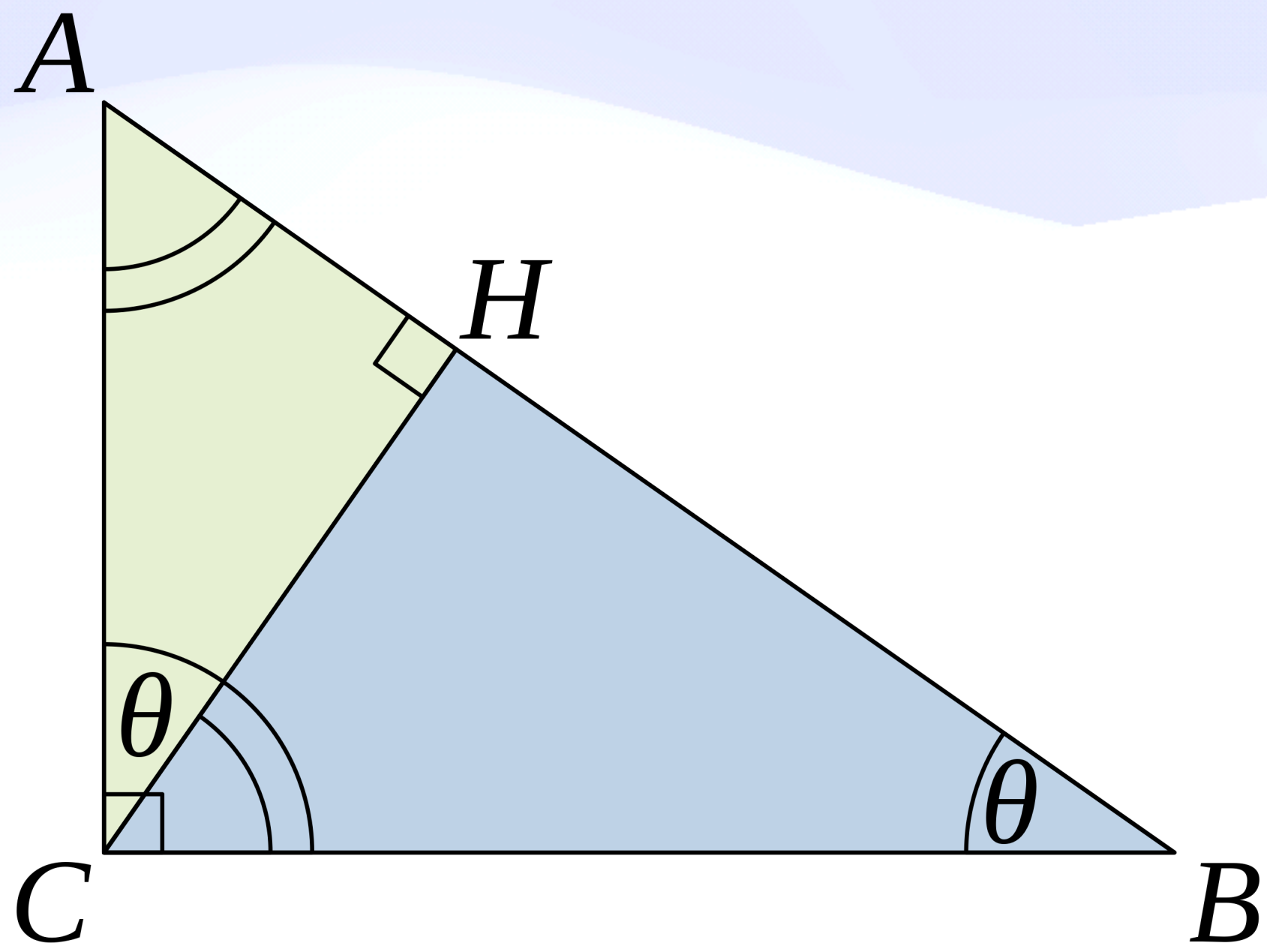
Direct \approx 490km
Actual \approx 4900km
 $\Delta \approx 10\times$

Hard Constraints

The Long Way 'Round



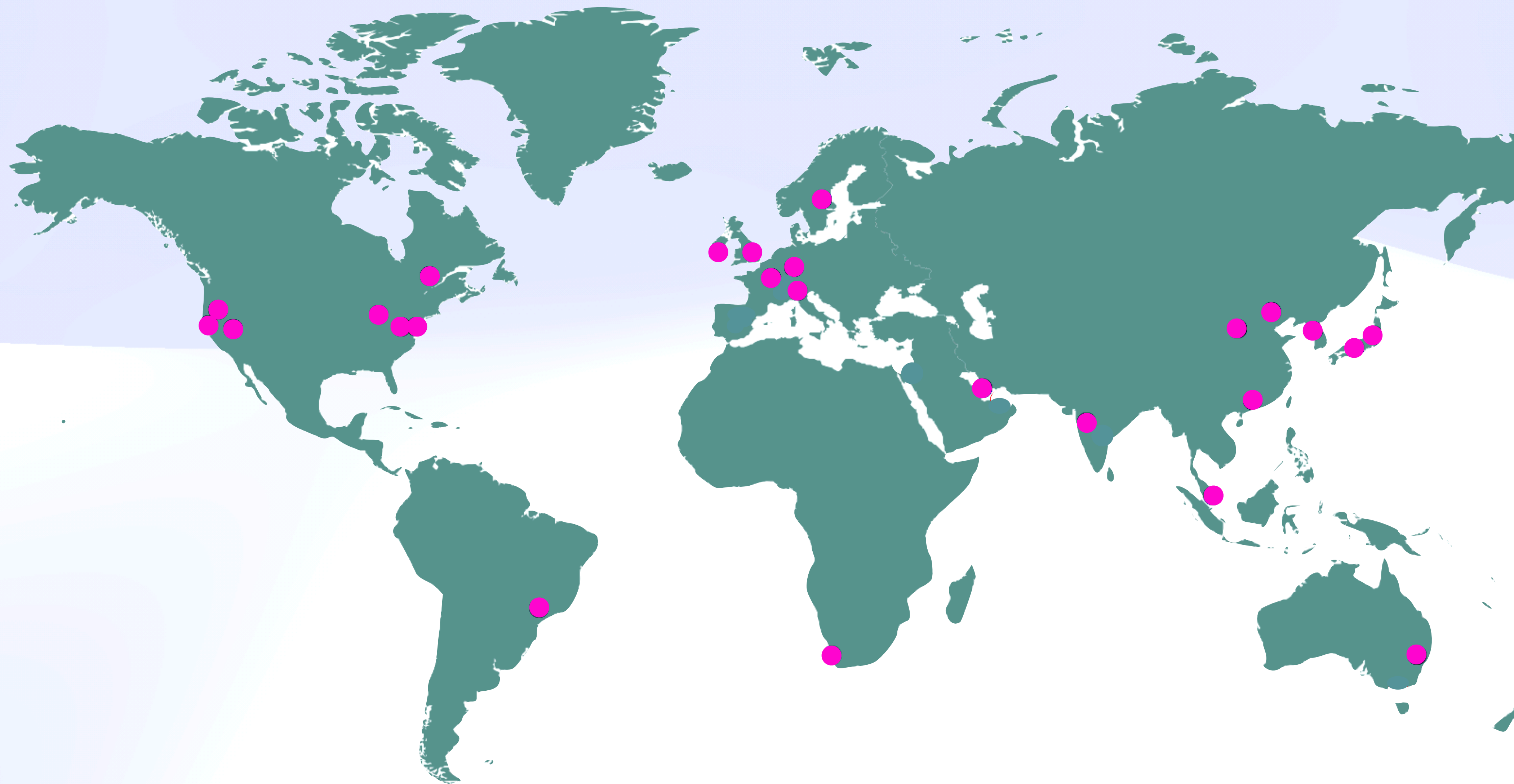
Direct \approx 490km
Actual \approx 4900km
 $\Delta \approx 10\times$



What if we could get 0ms?

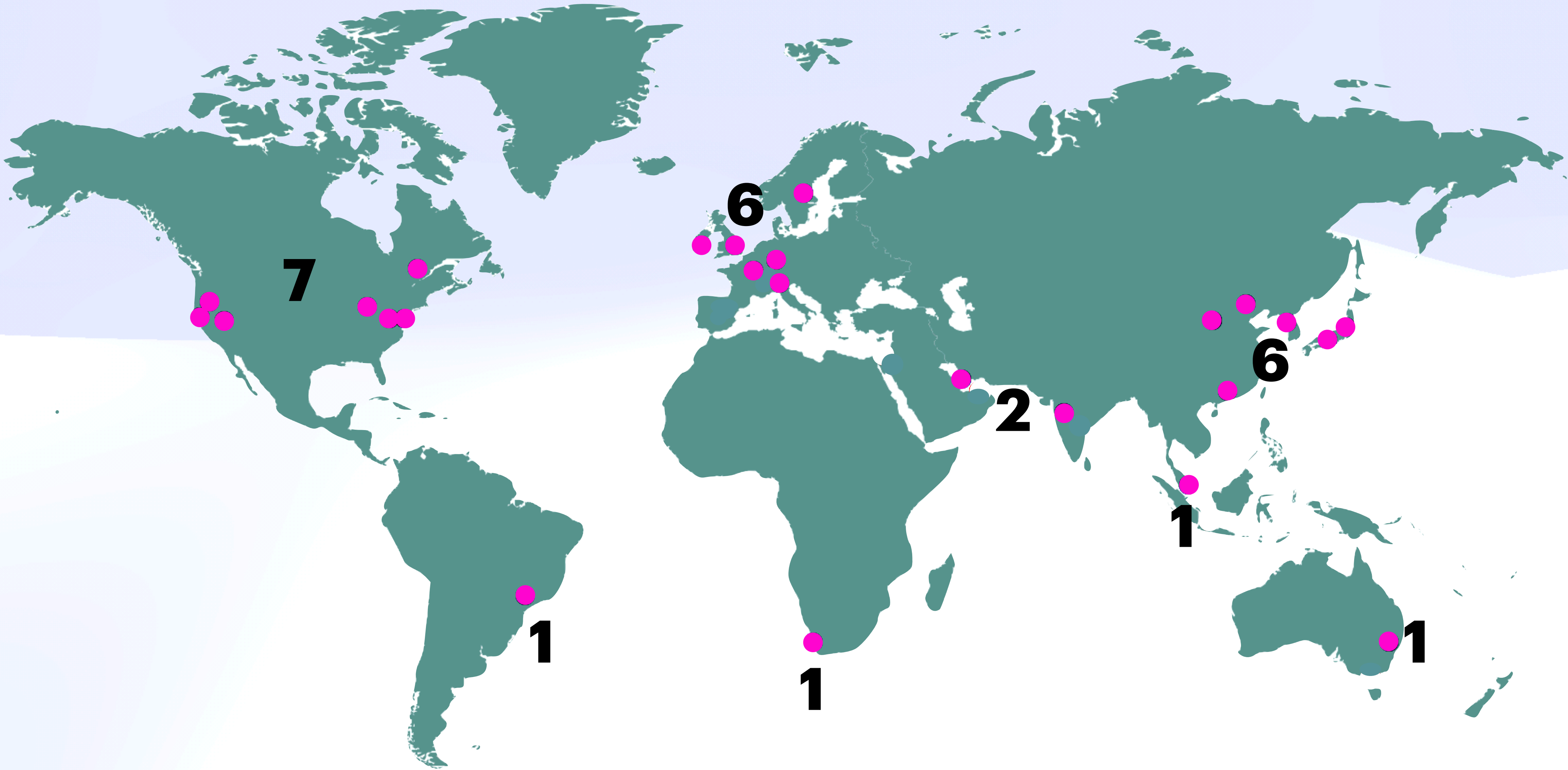
Hard Constraints

Users vs Cloud Infra



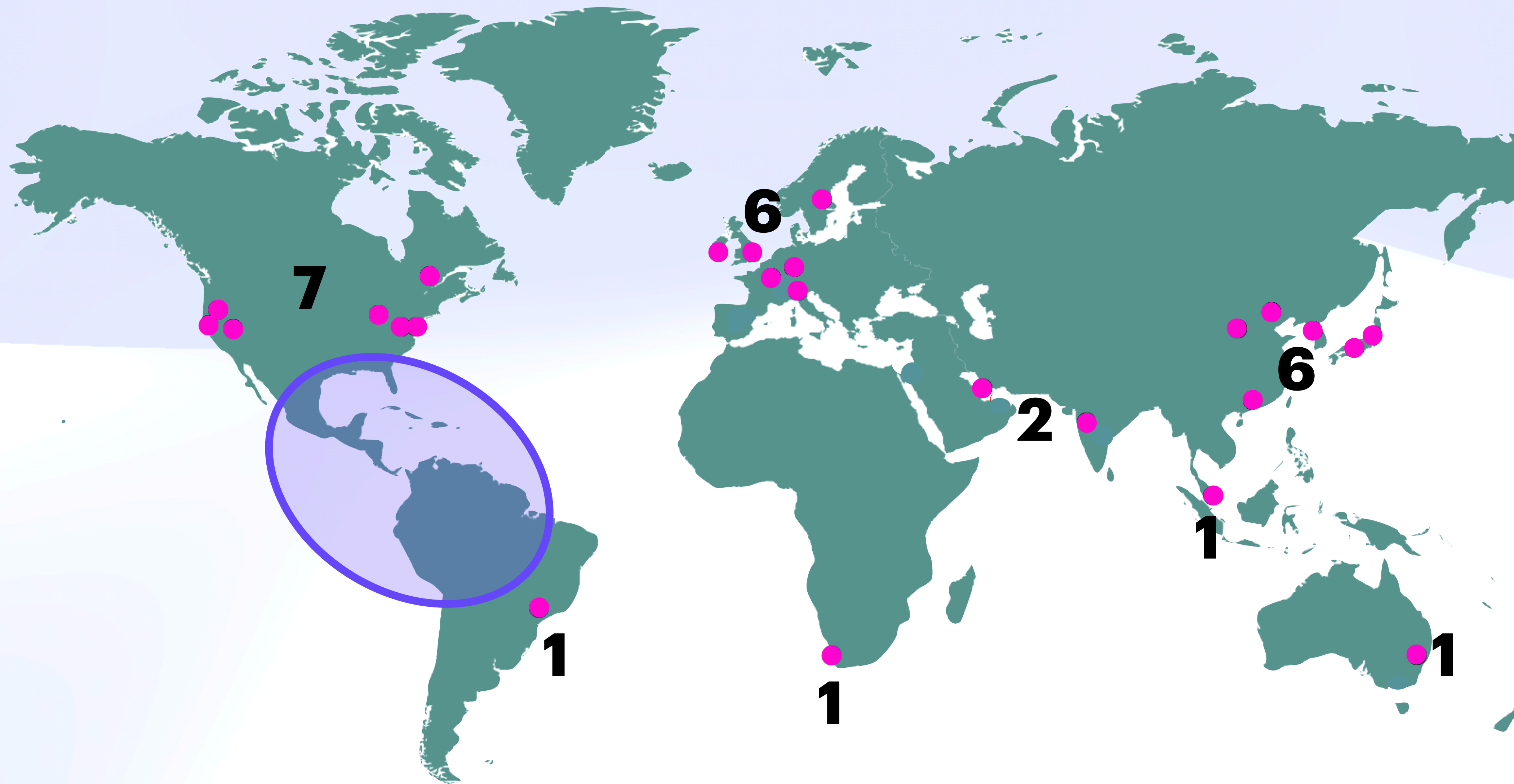
Hard Constraints

Users vs Cloud Infra



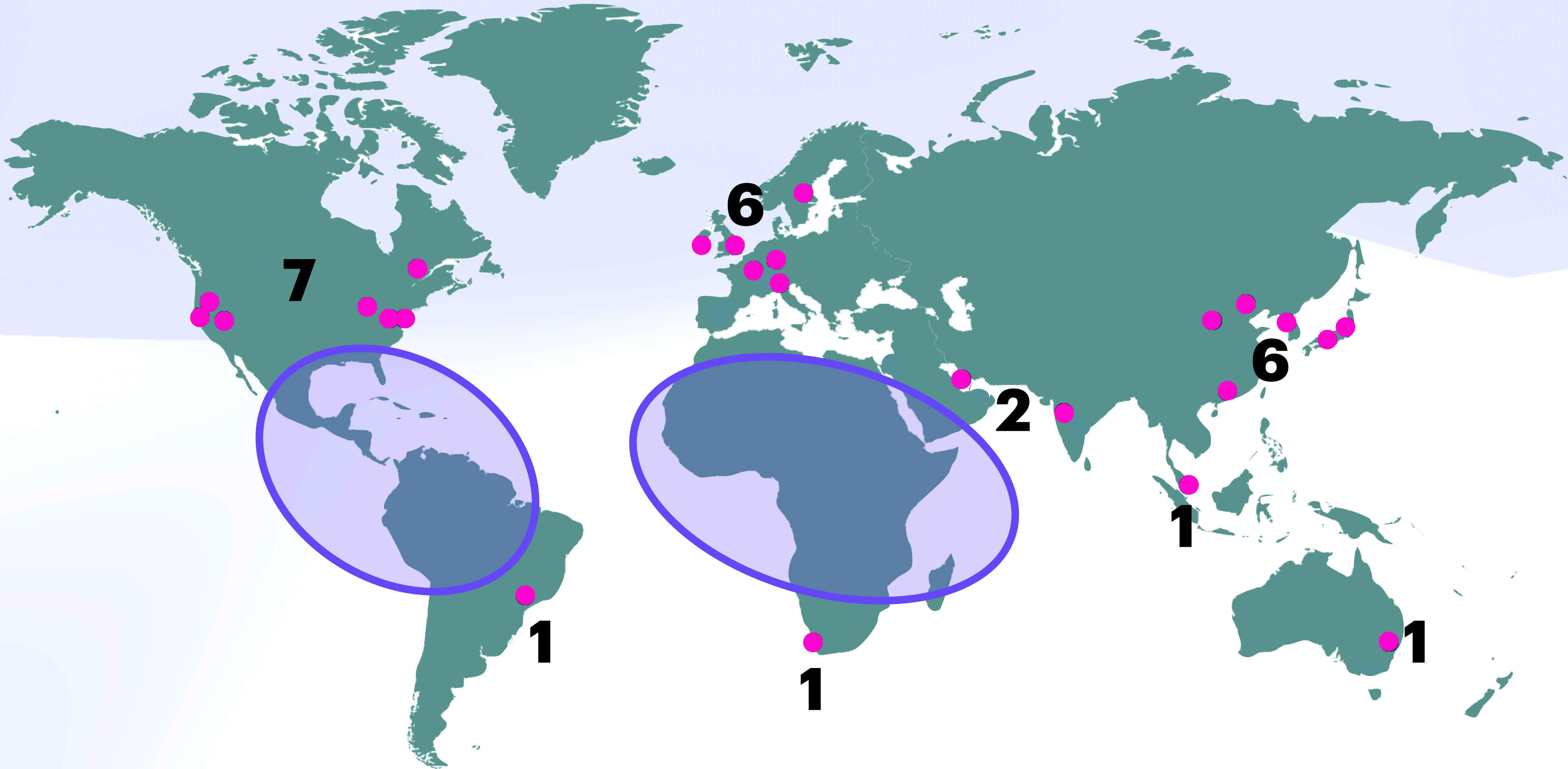
Hard Constraints

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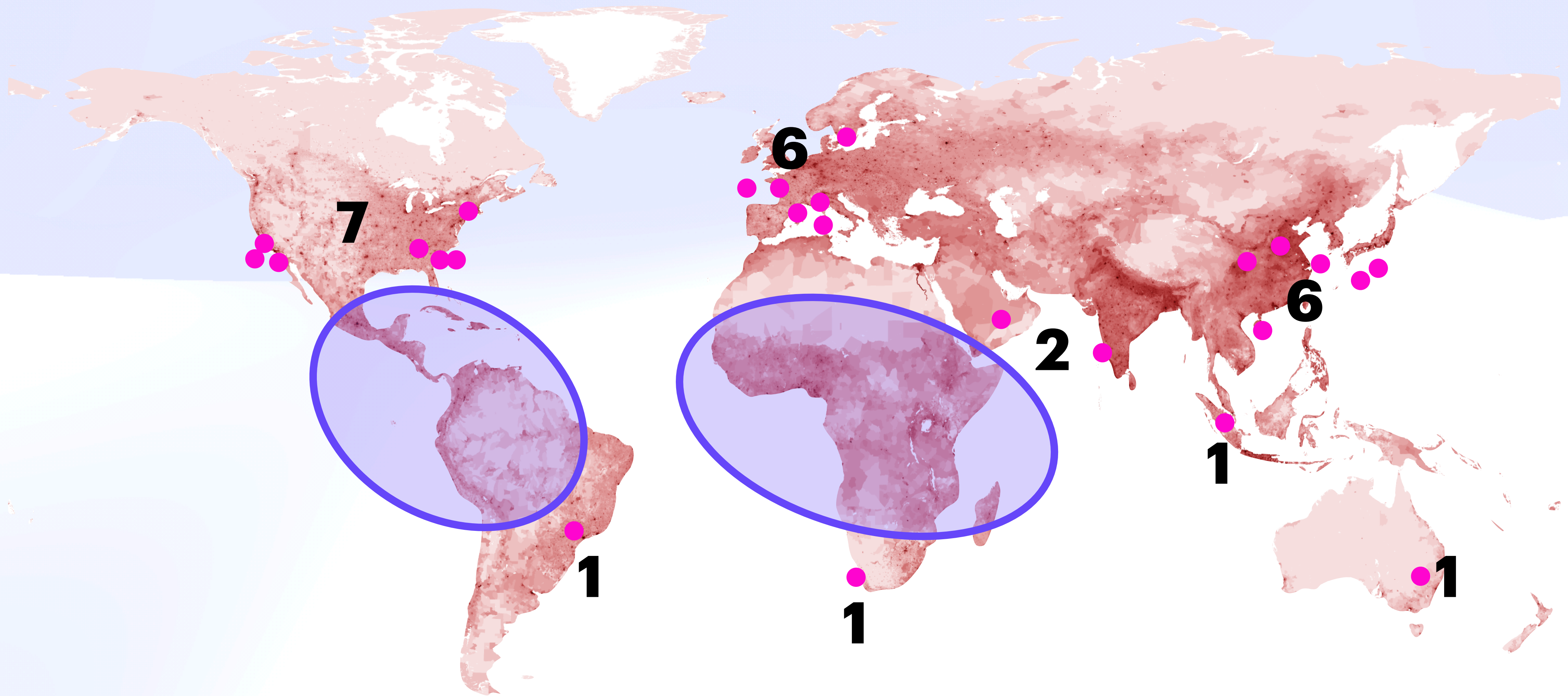
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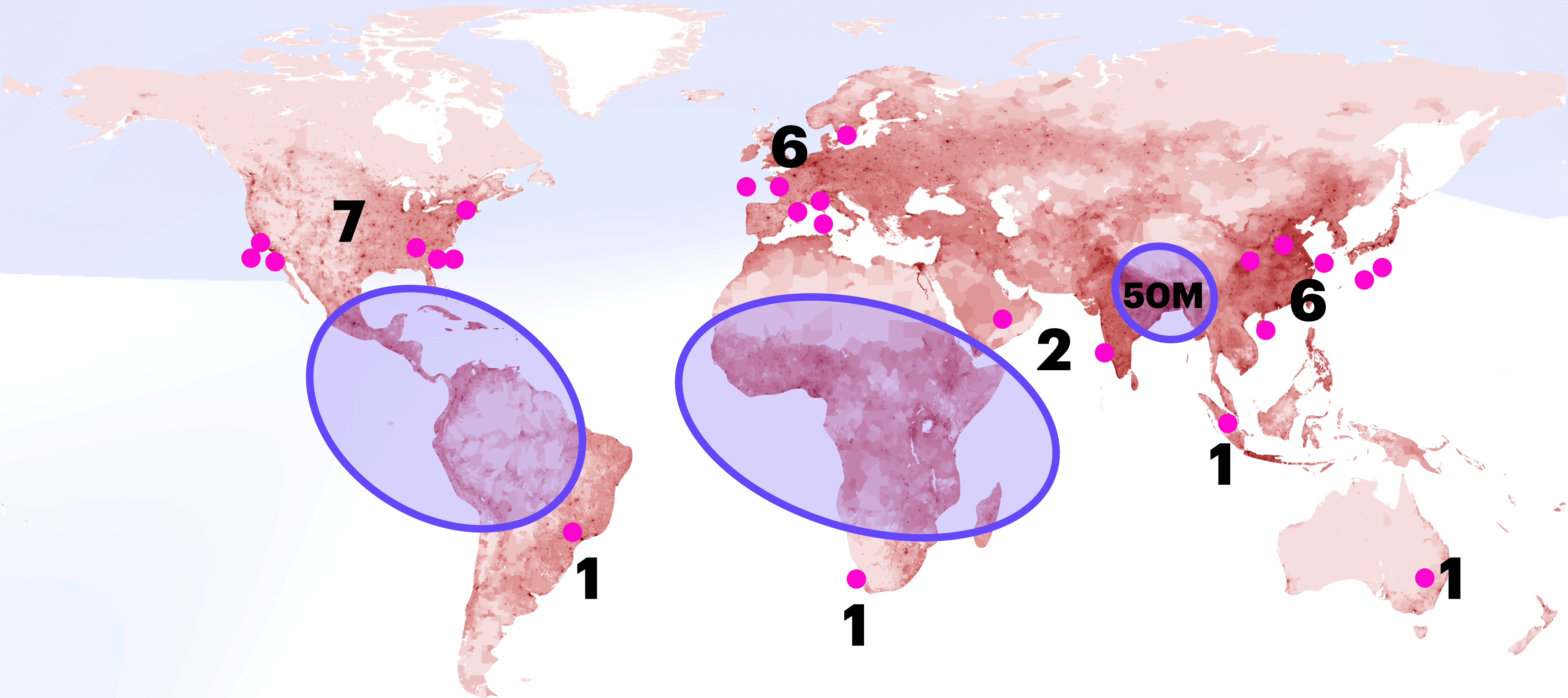
Hard Constraints

Users vs Cloud Infra



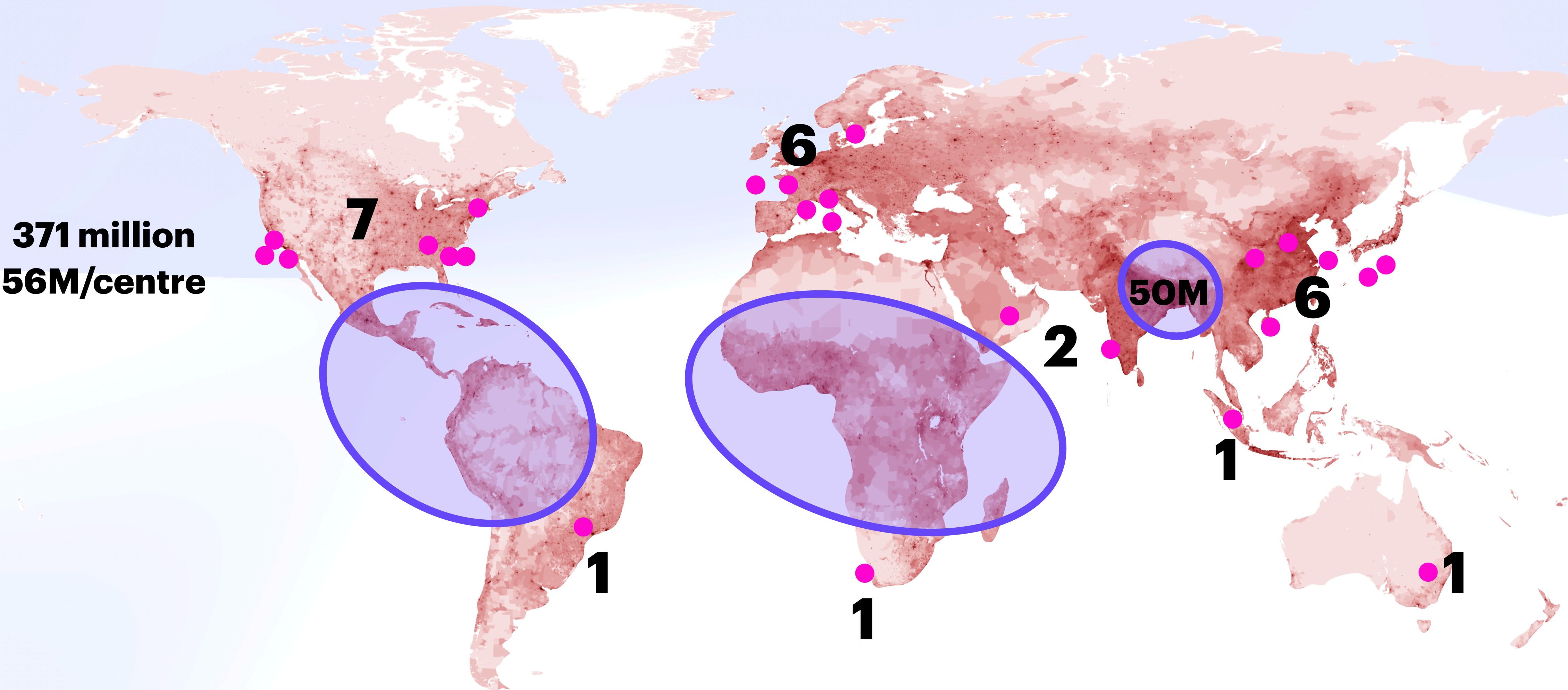
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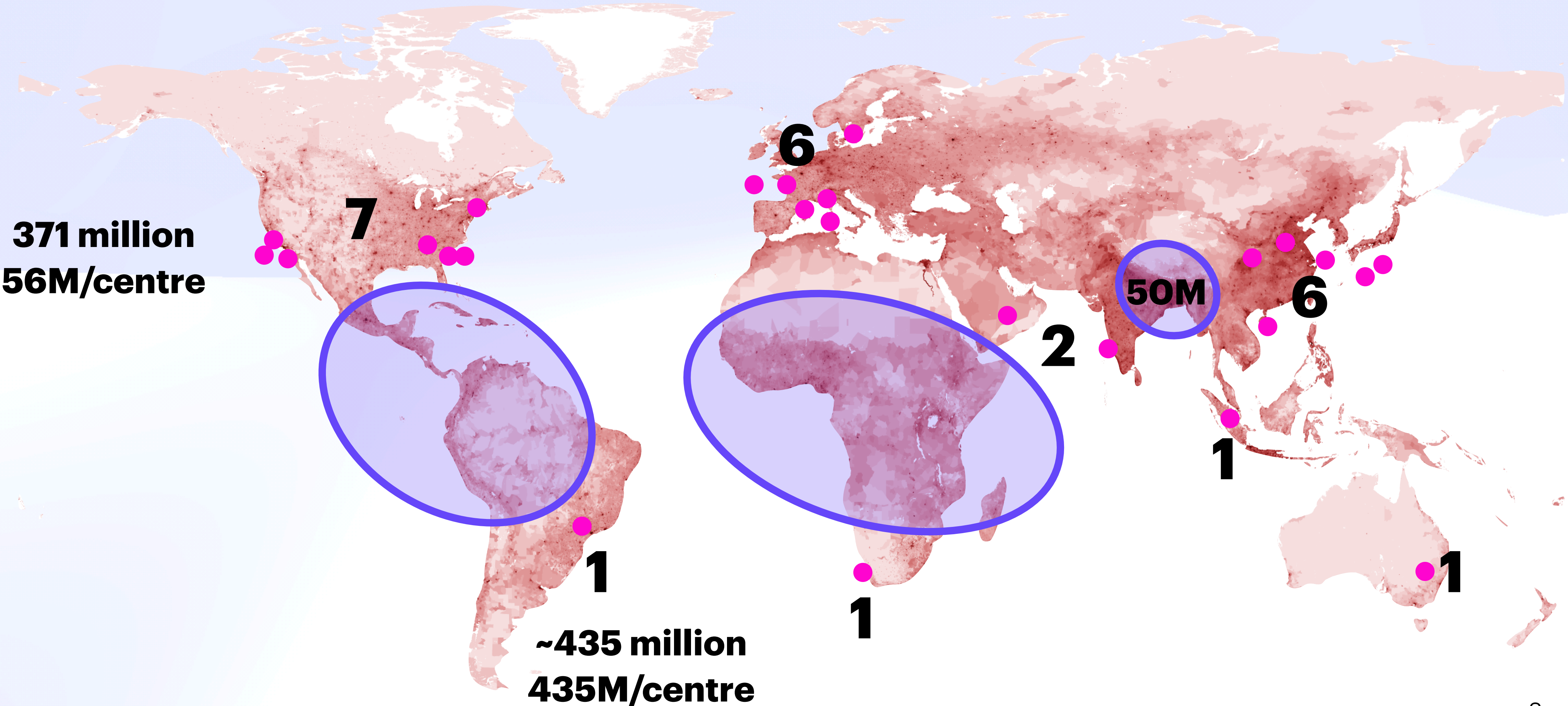
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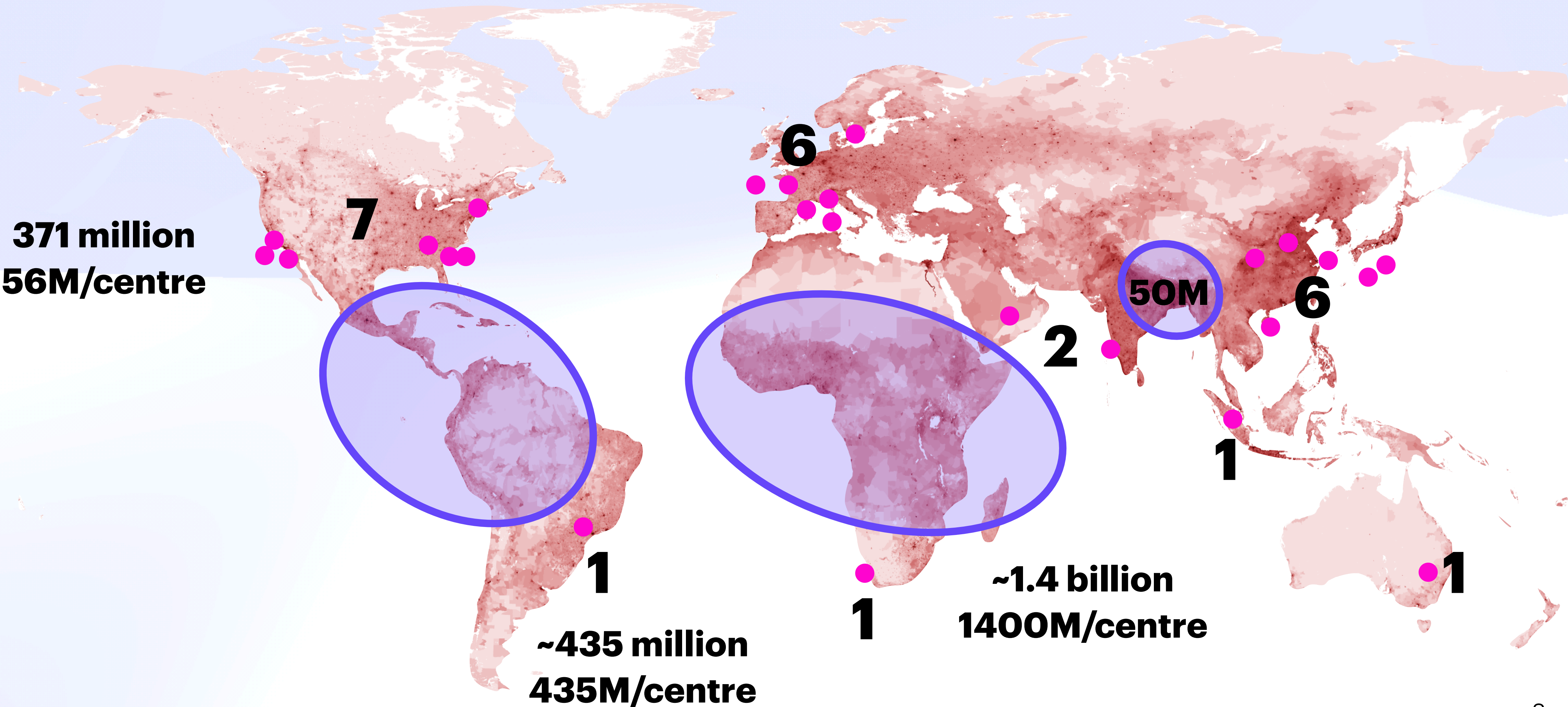
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Users vs Cloud Infra



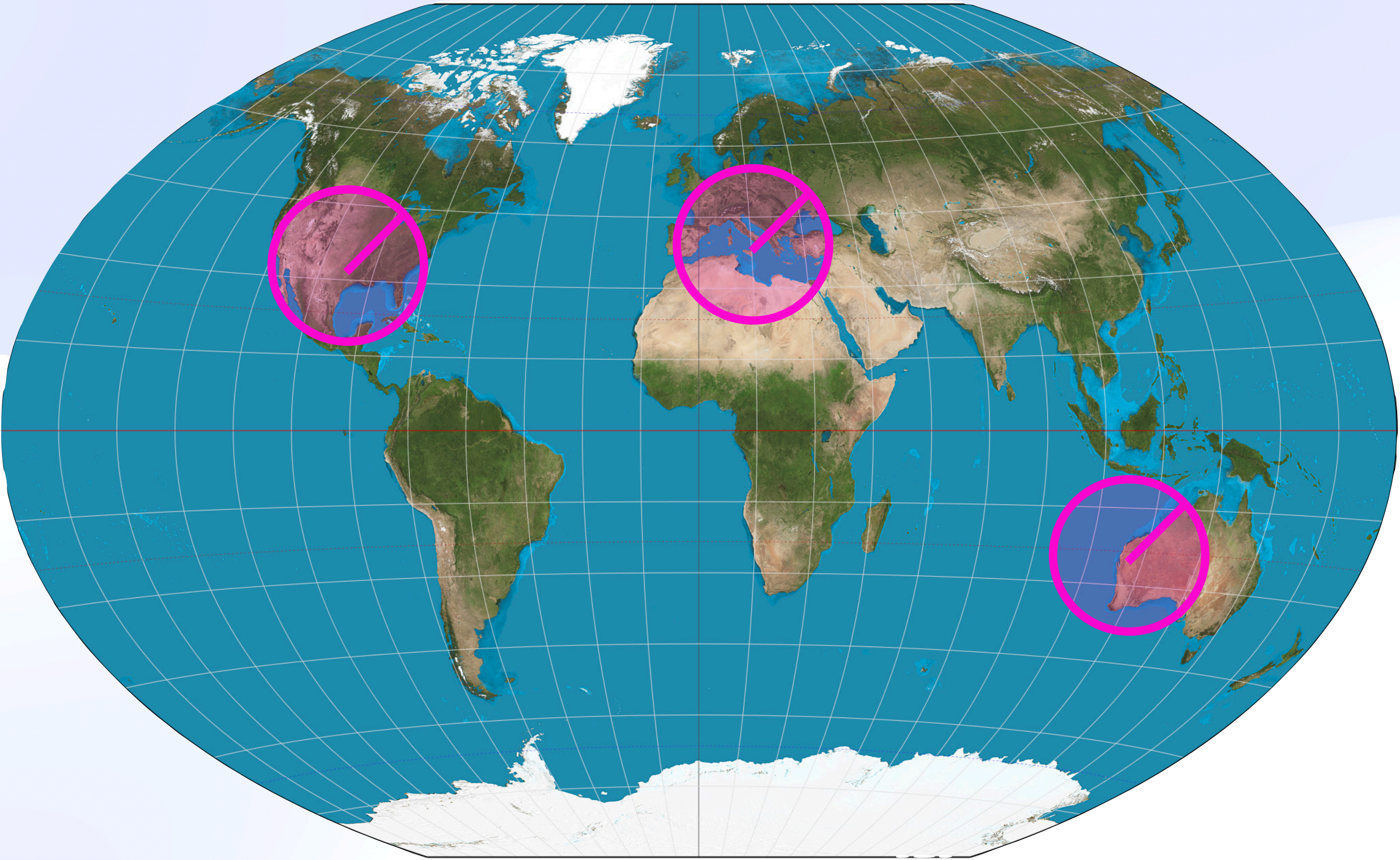
Hard Constraints

Users vs Cloud Infra



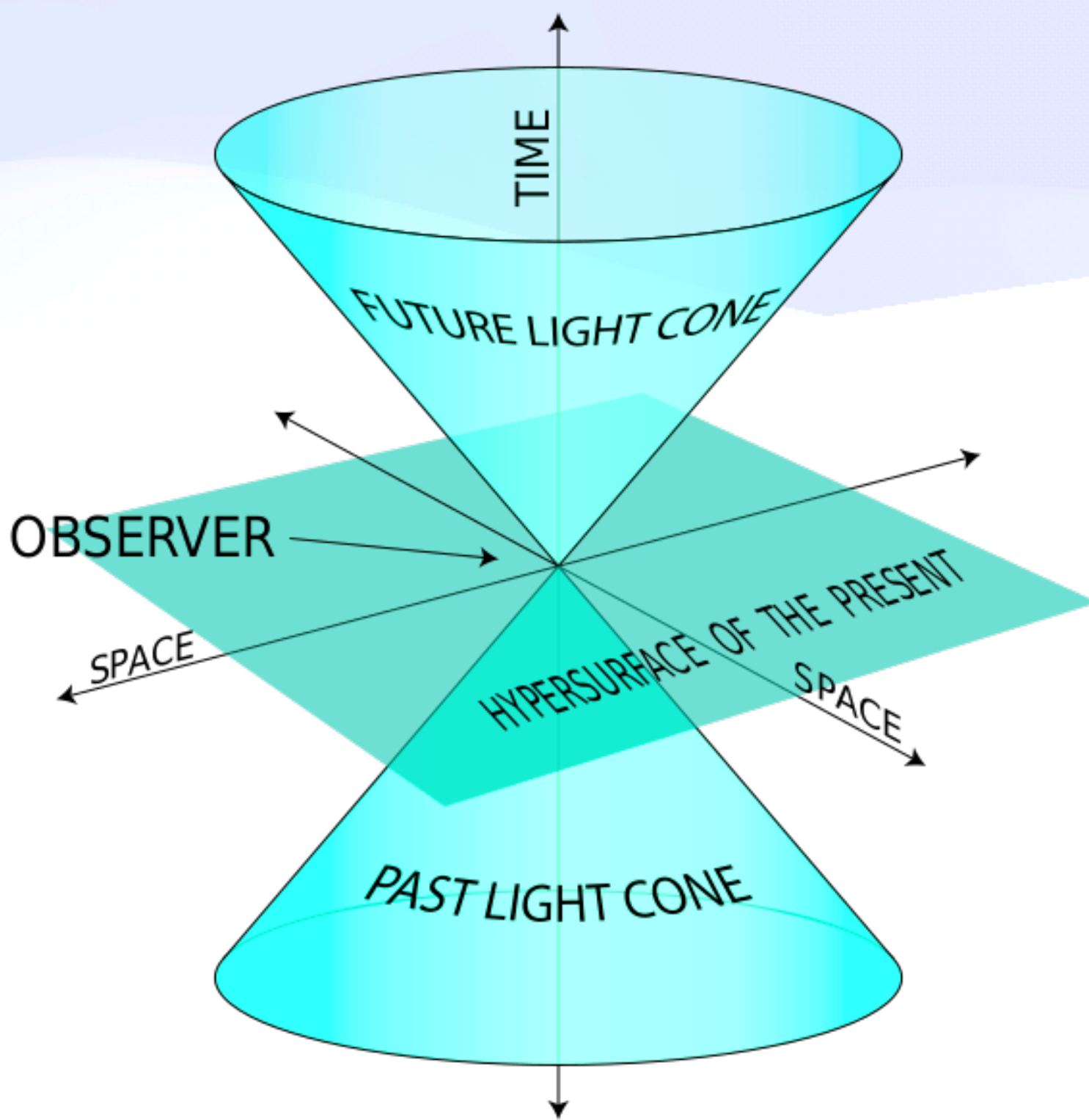
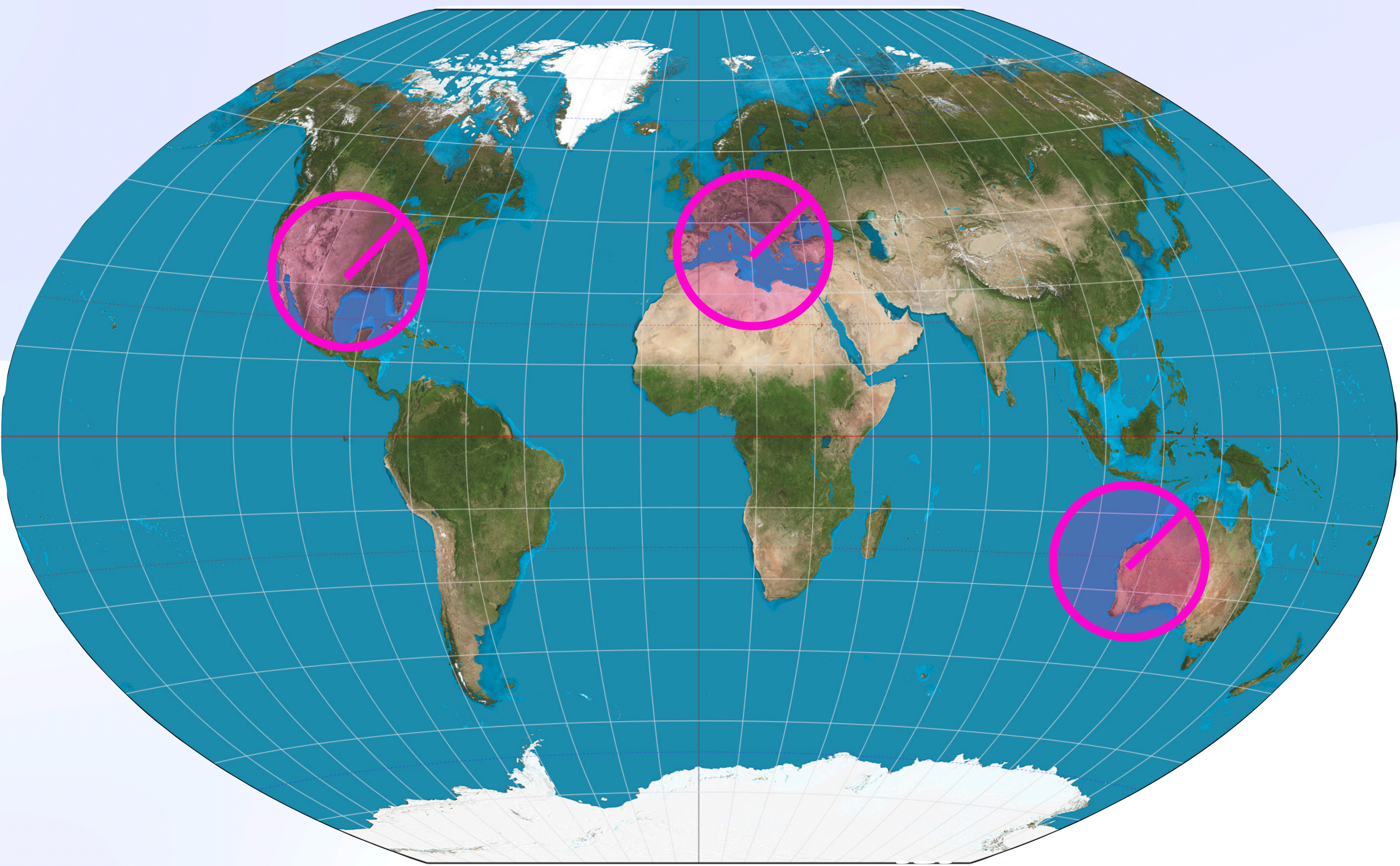
Hard Constraints

Causal Islands 🏖️ 🌴



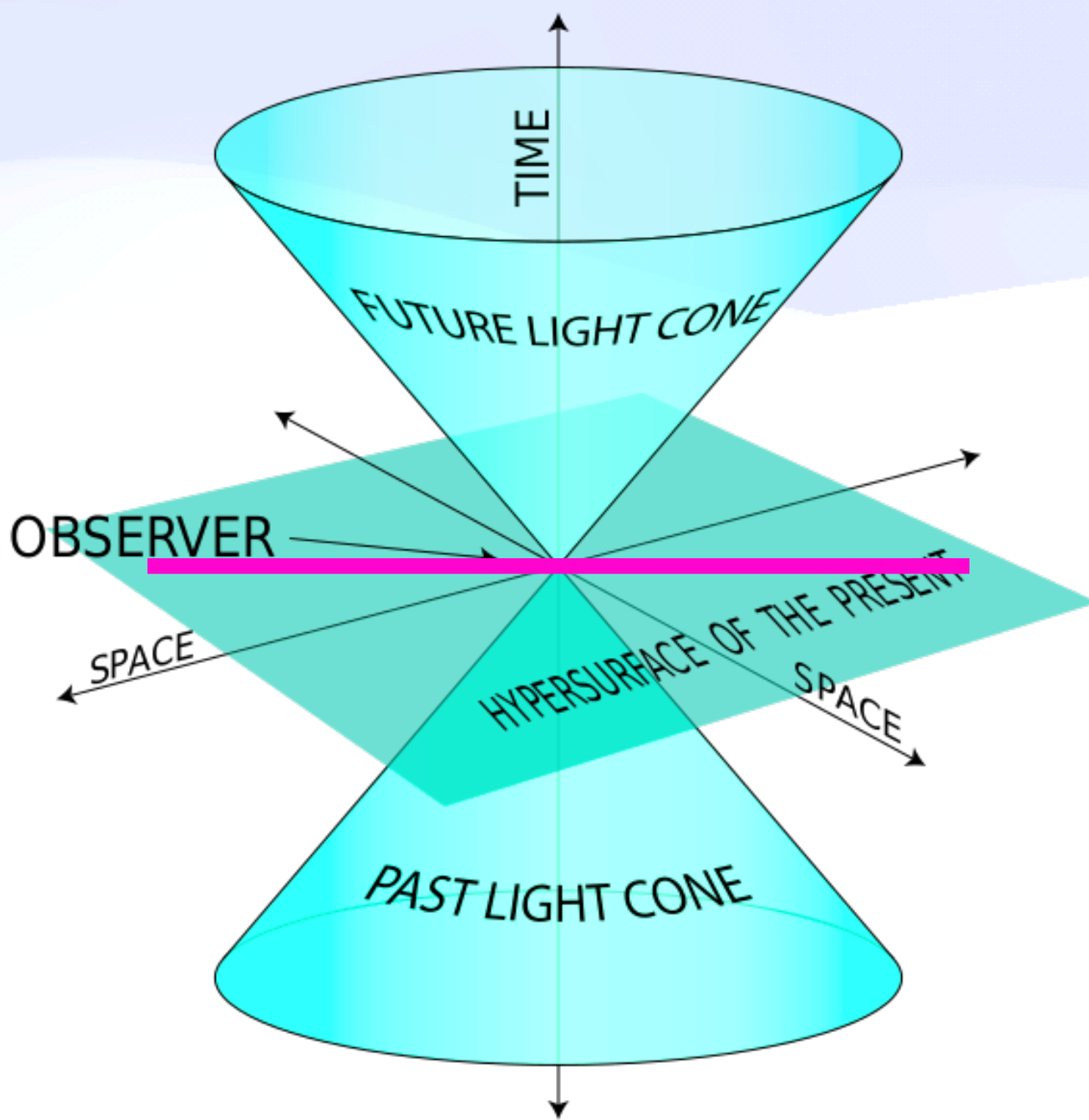
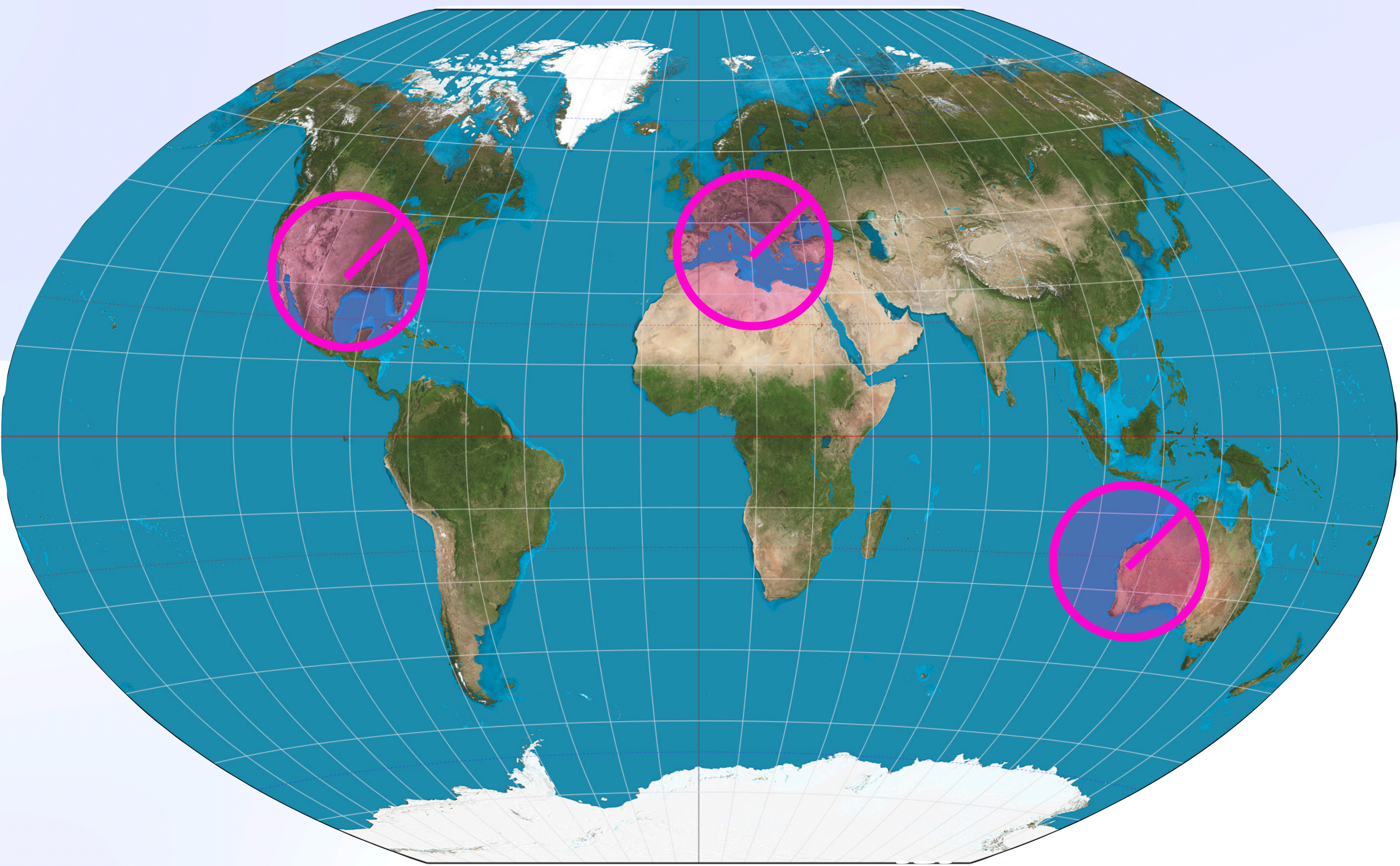
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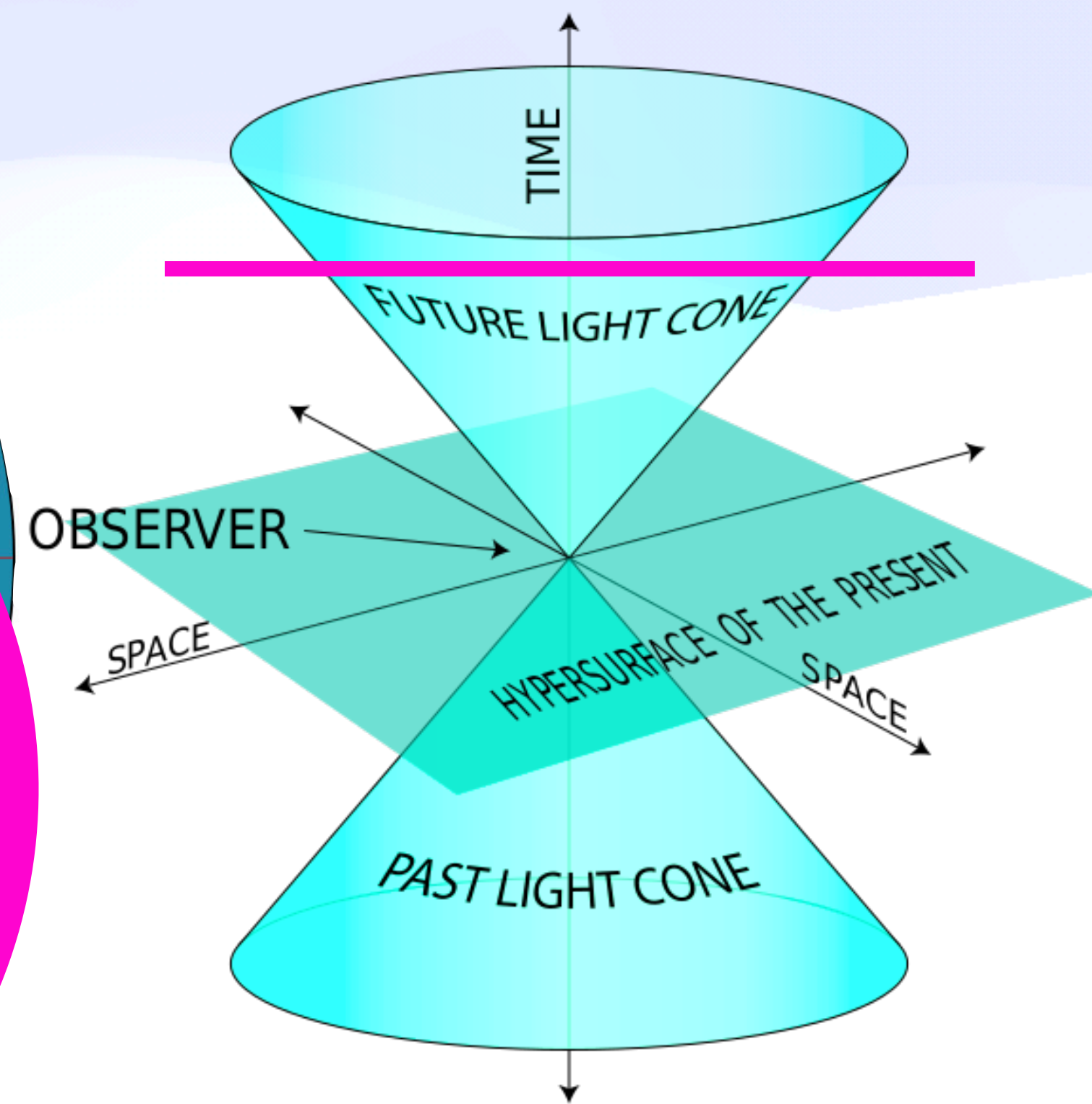
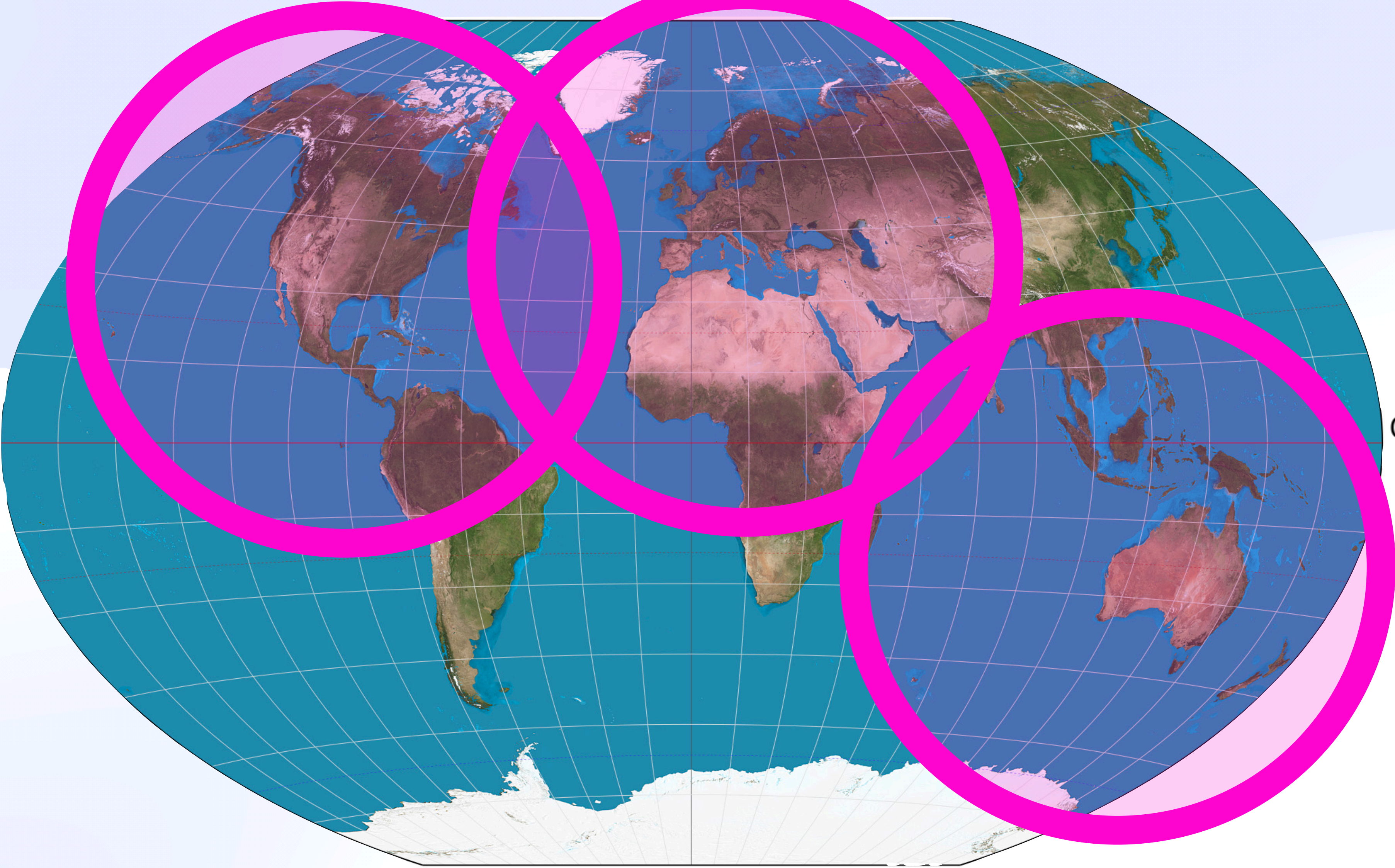
Hard Constraints

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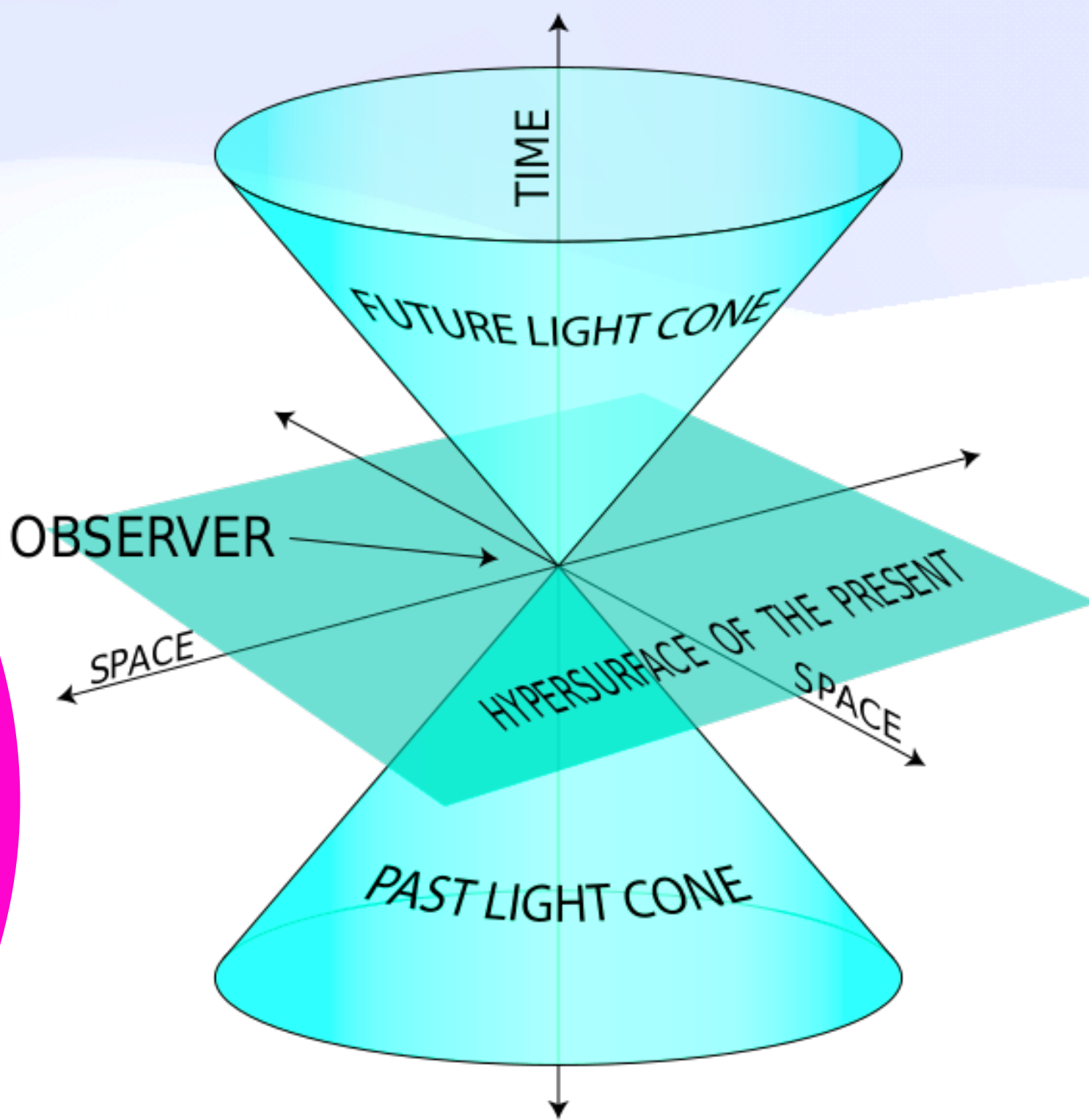
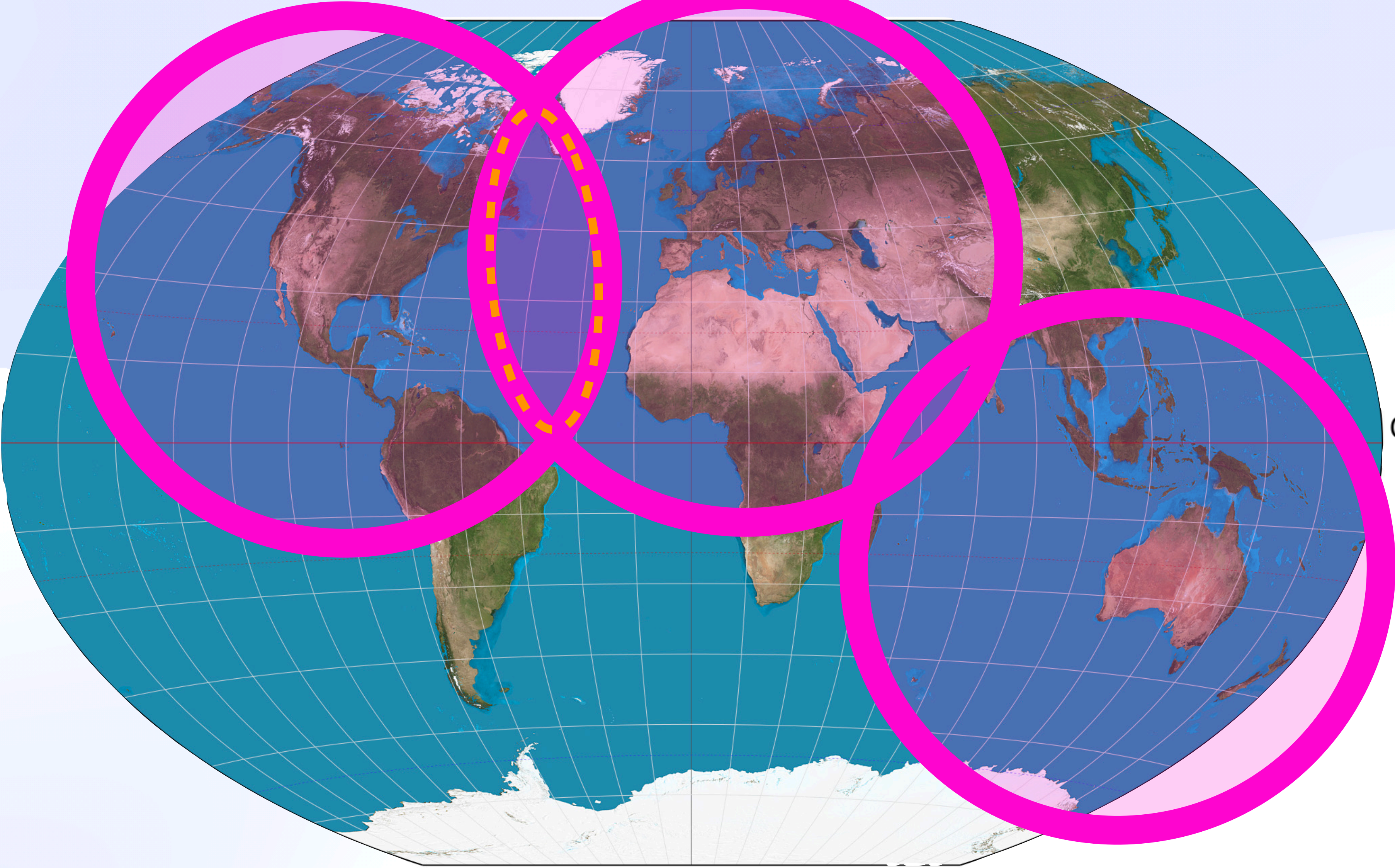
Hard Constraints

Causal Islands 🌴 🌴



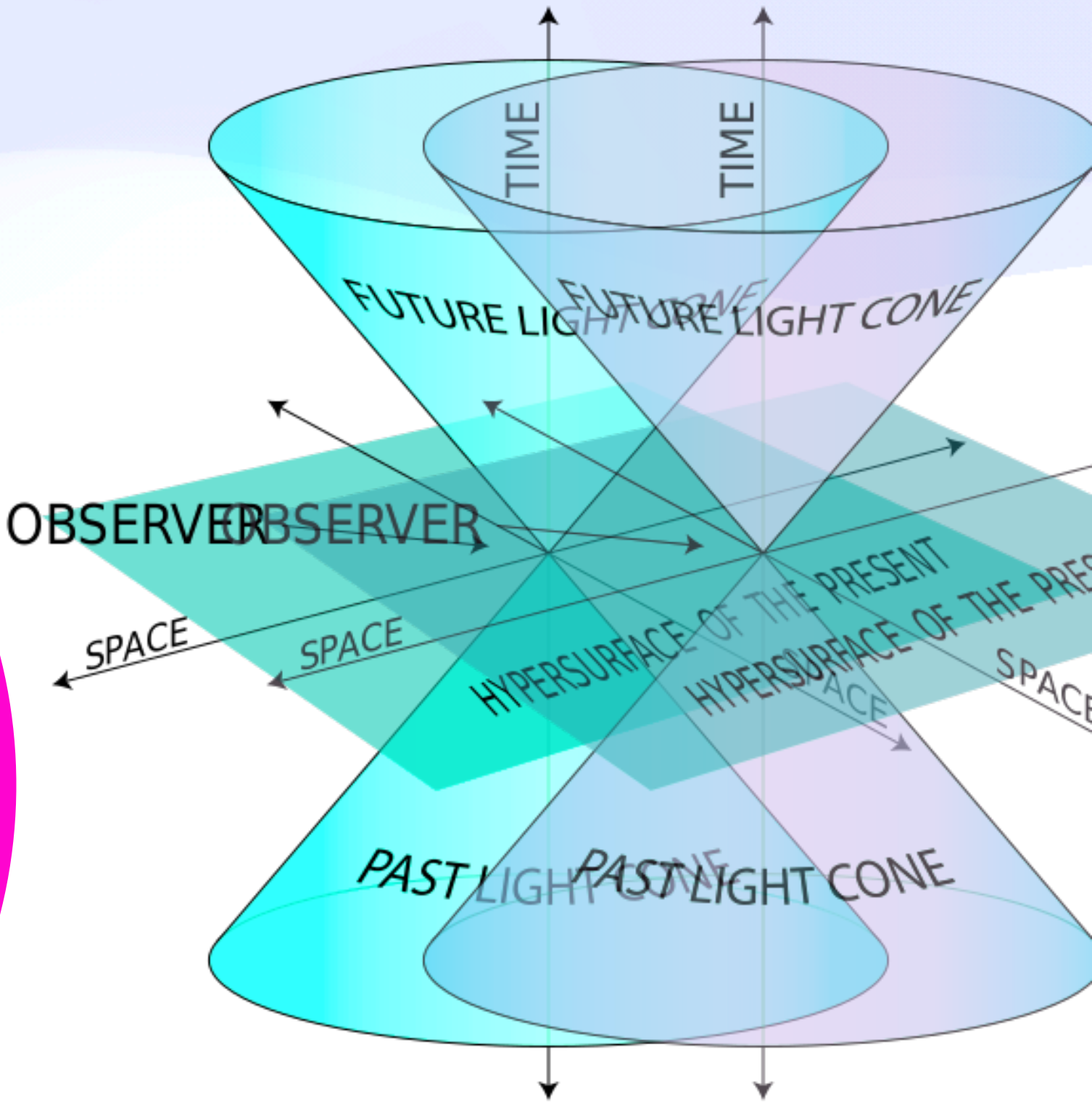
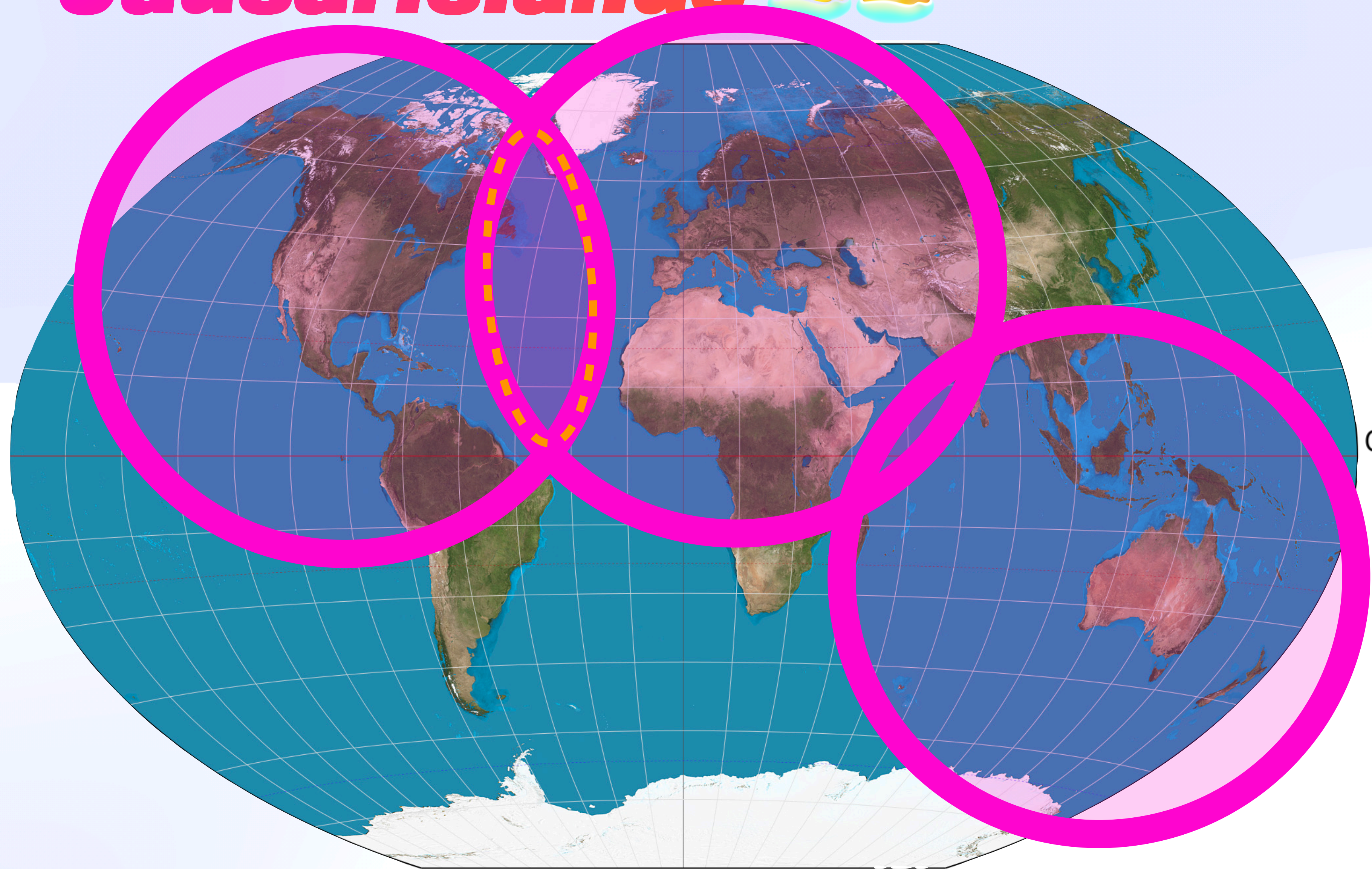
Hard Constraints

Causal Islands 🌴 🌴



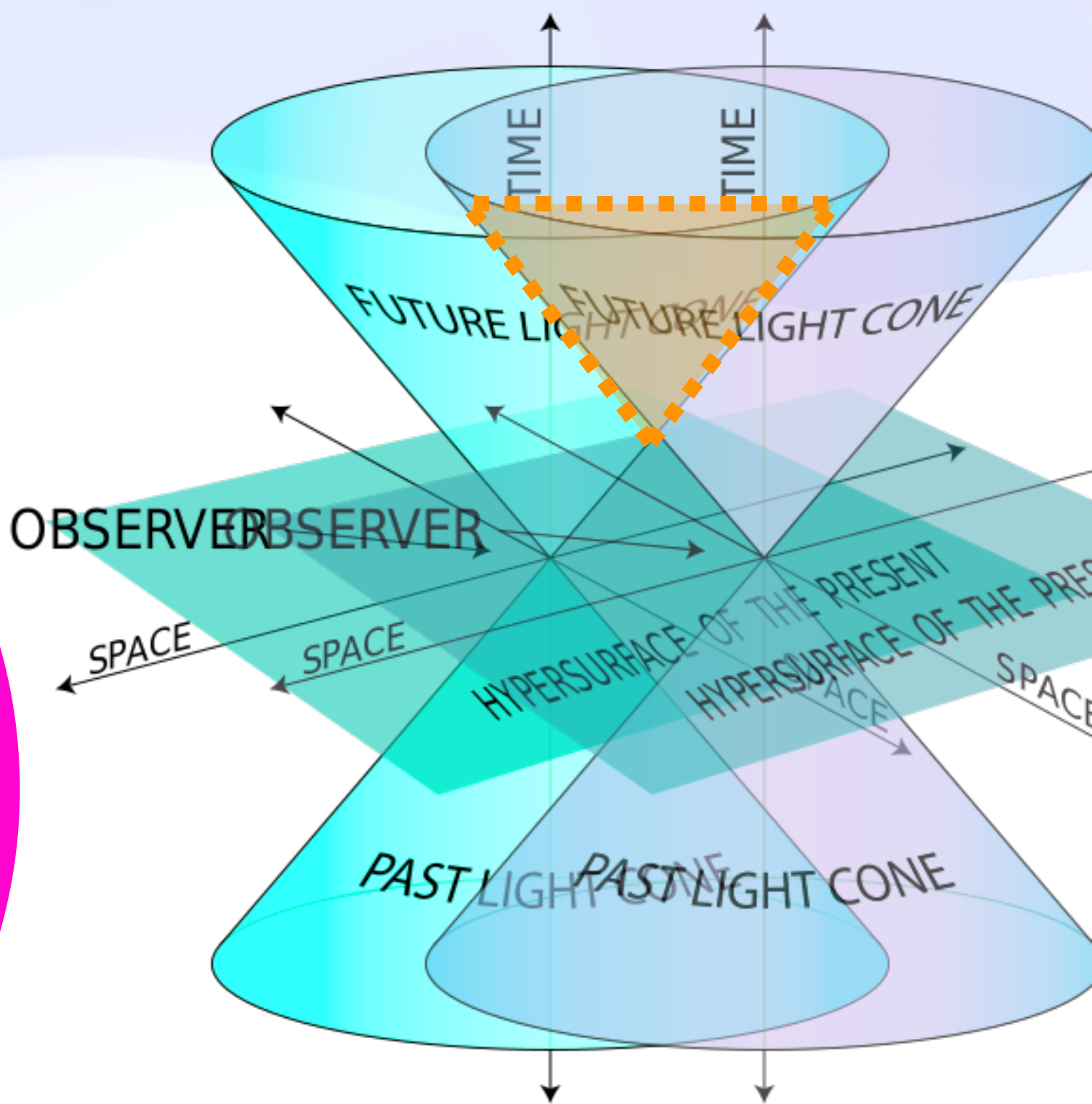
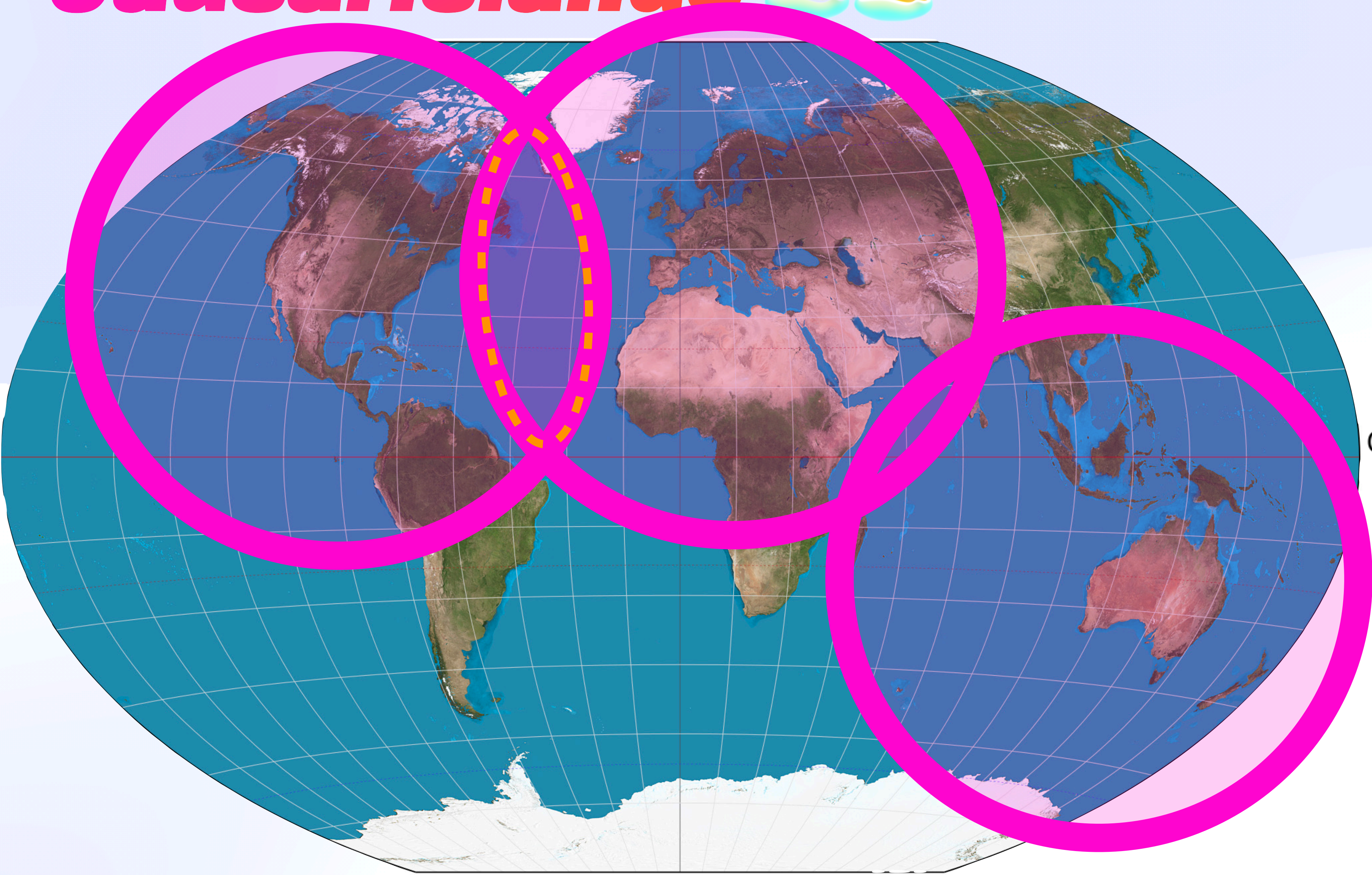
Hard Constraints

Causal Islands




Hard Constraints

Causal Islands 🌴 🌴



The Jump to Hyperspace

The background of the slide is an abstract composition of soft, flowing, wavy shapes. The top half is dominated by various shades of blue and purple, while the bottom half transitions into lighter, more ethereal tones of yellow and white. The overall effect is a sense of movement and depth, reminiscent of a cosmic or hyperspace environment.

The Jump to Hyperspace

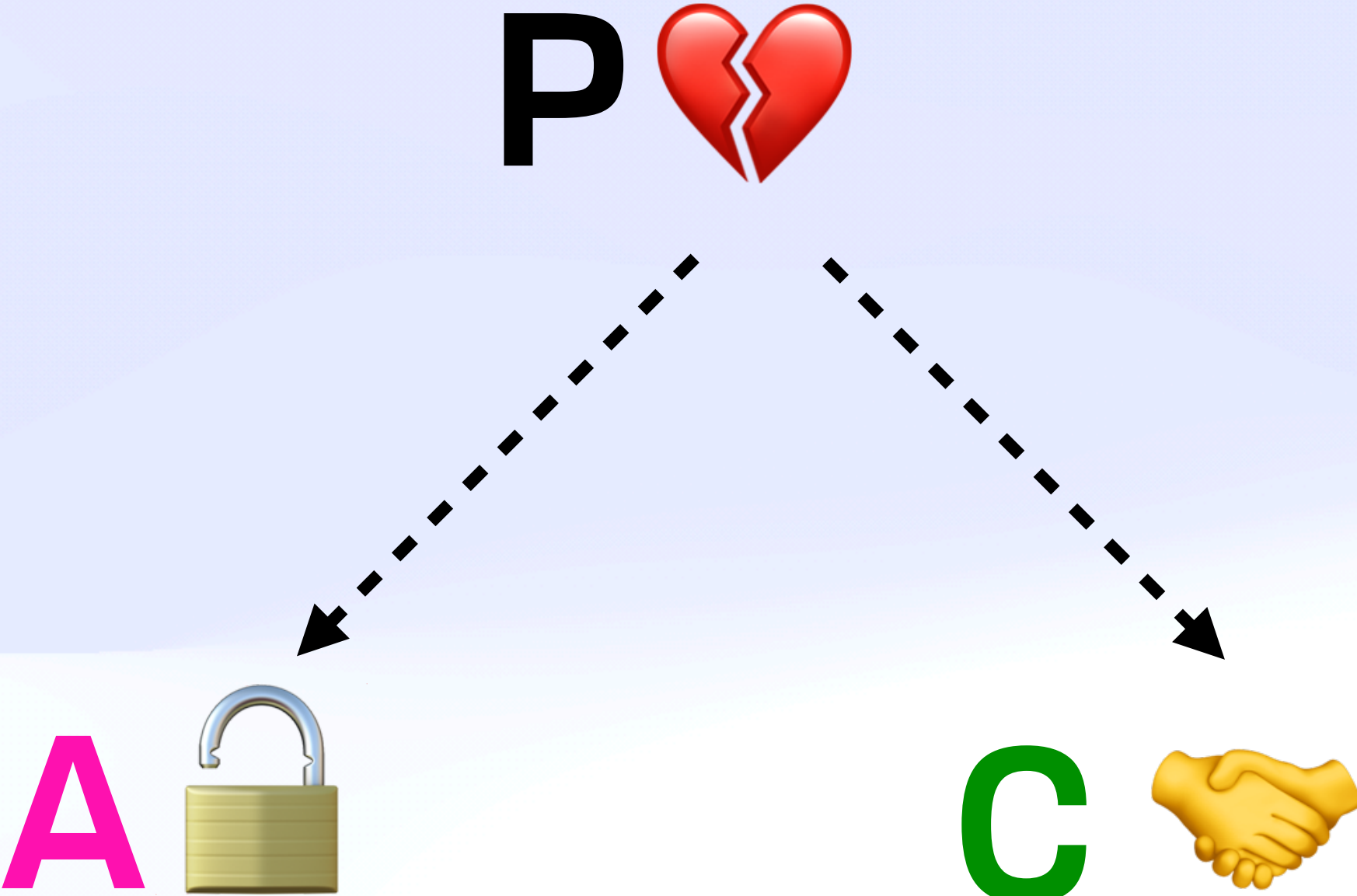
As we **continue to increase** the number of globally connected devices, [...] it is **completely impractical** that we can look at **a single, or a small number**, of globally distributed data centers

– **Meiklejohn**, A Certain Tendency Of The Database Community

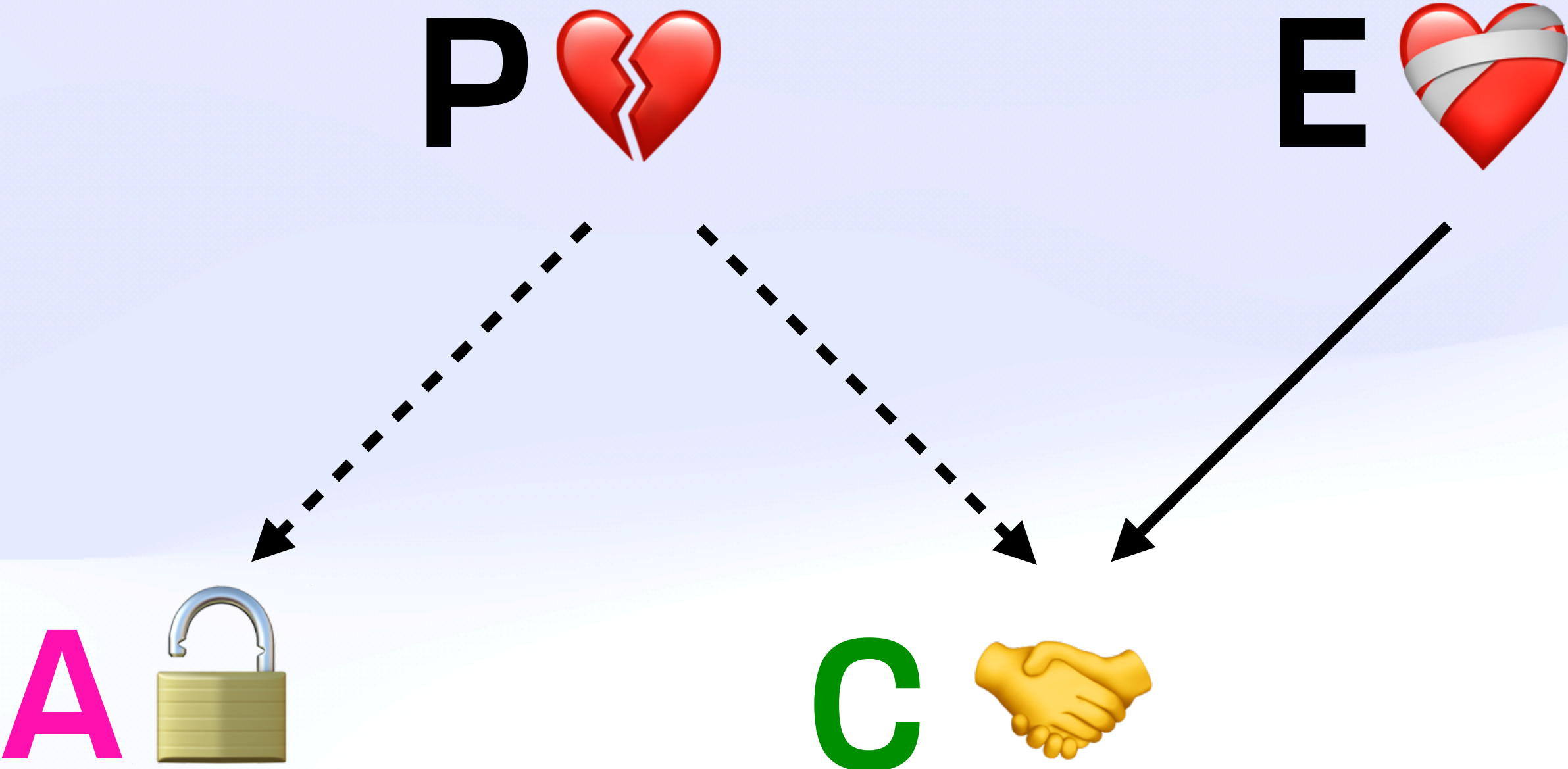
Disorderly Systems



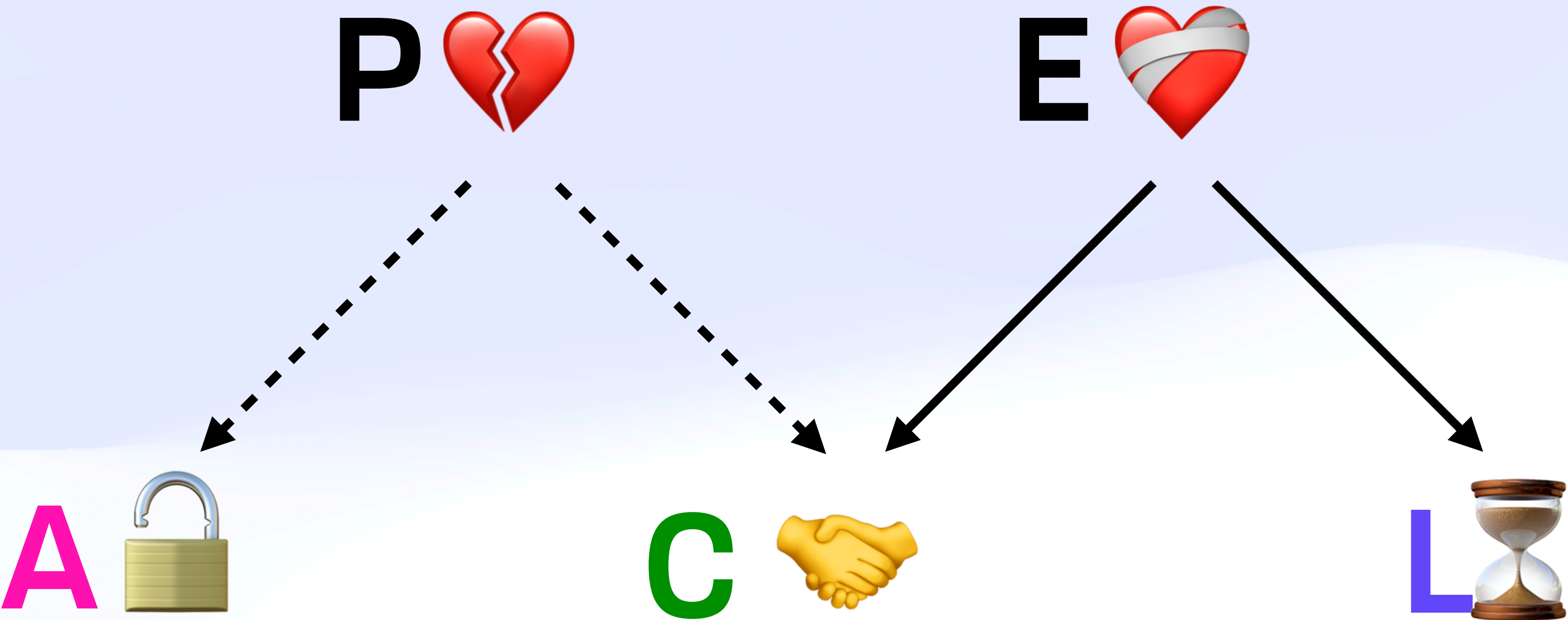
Disorderly Systems



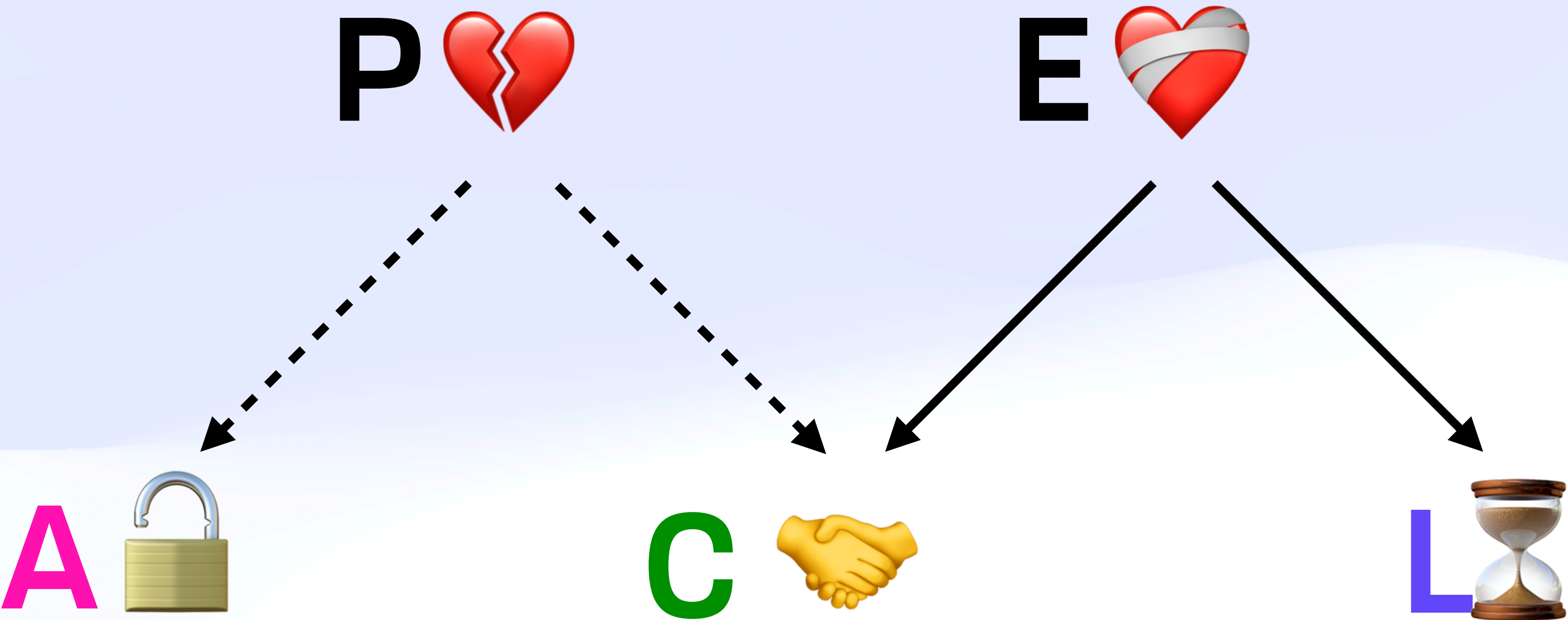
Disorderly Systems



Disorderly Systems



Disorderly Systems

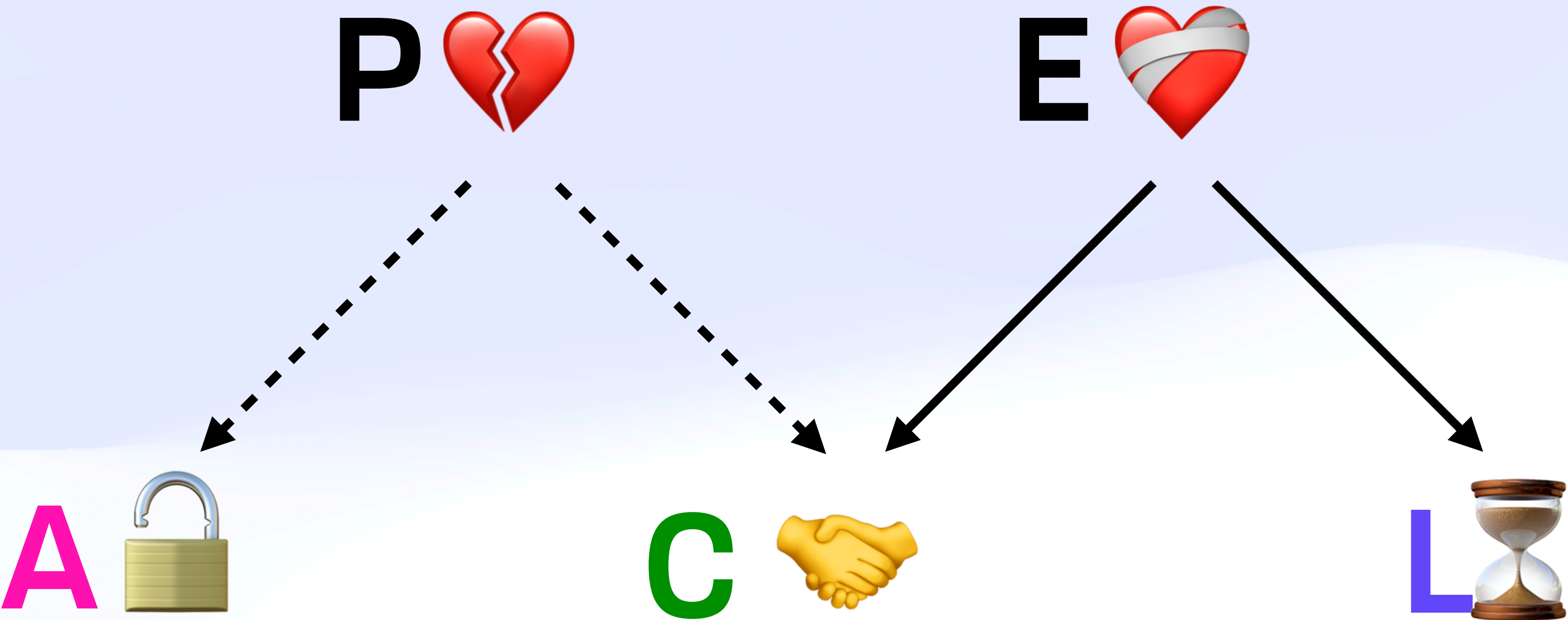


 Automerge

PA/EL



Disorderly Systems



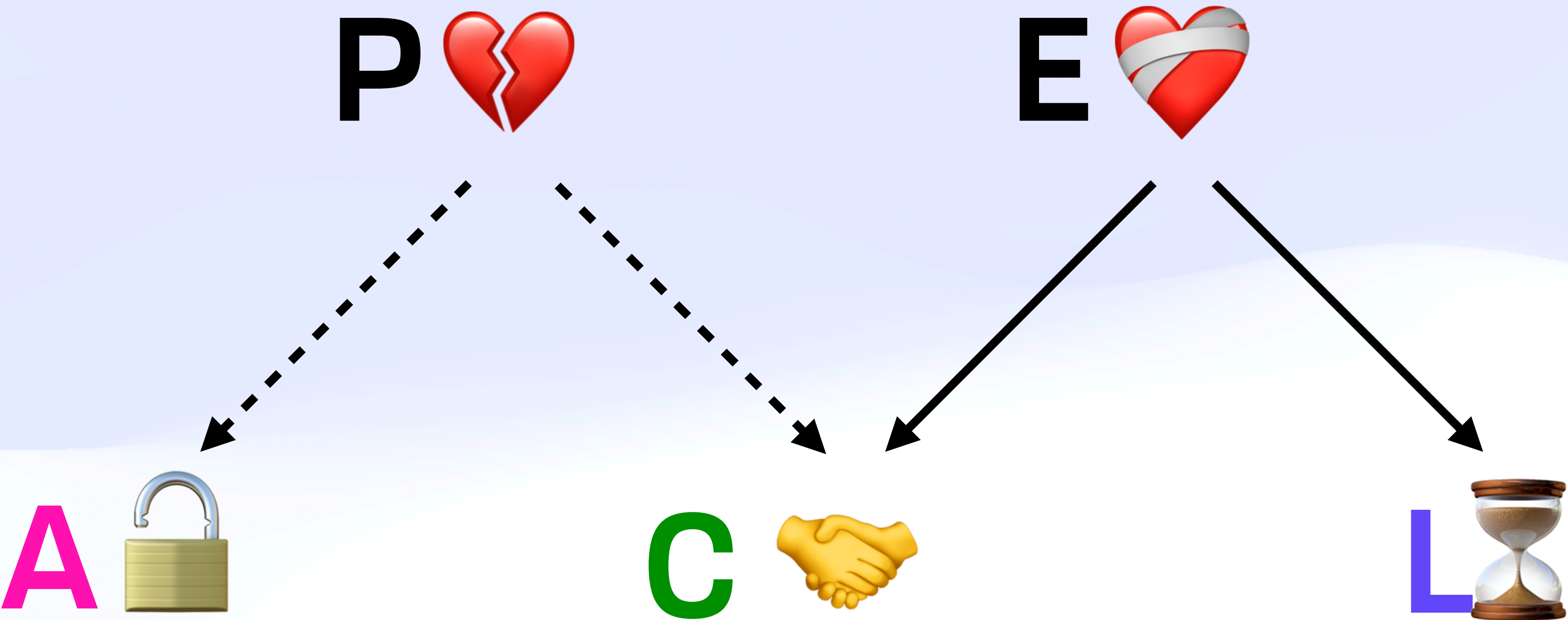
Automerge













PA/EL

electric

PA/EL

Disorderly Systems



| | | | | |
|---|-------|---|---|---|
|  Automerge | PA/EL |  |  |  |
|  electric | PA/EL |  |  |  |
|  | PA/EL |  |  |  |

Finally...

A New Hope



A New Hope

Early But Exciting

A New Hope

Early But Exciting



VIDEO: ARDHIRA PUTRA

GREGORY BARBER BACKCHANNEL AUG 3, 2023 6:00 AM

The Cloud Is a Prison. Can the Local-First Software Movement Set Us Free?

A New Hope

Early But Exciting



VIDEO: ARDHIRA PUTRA

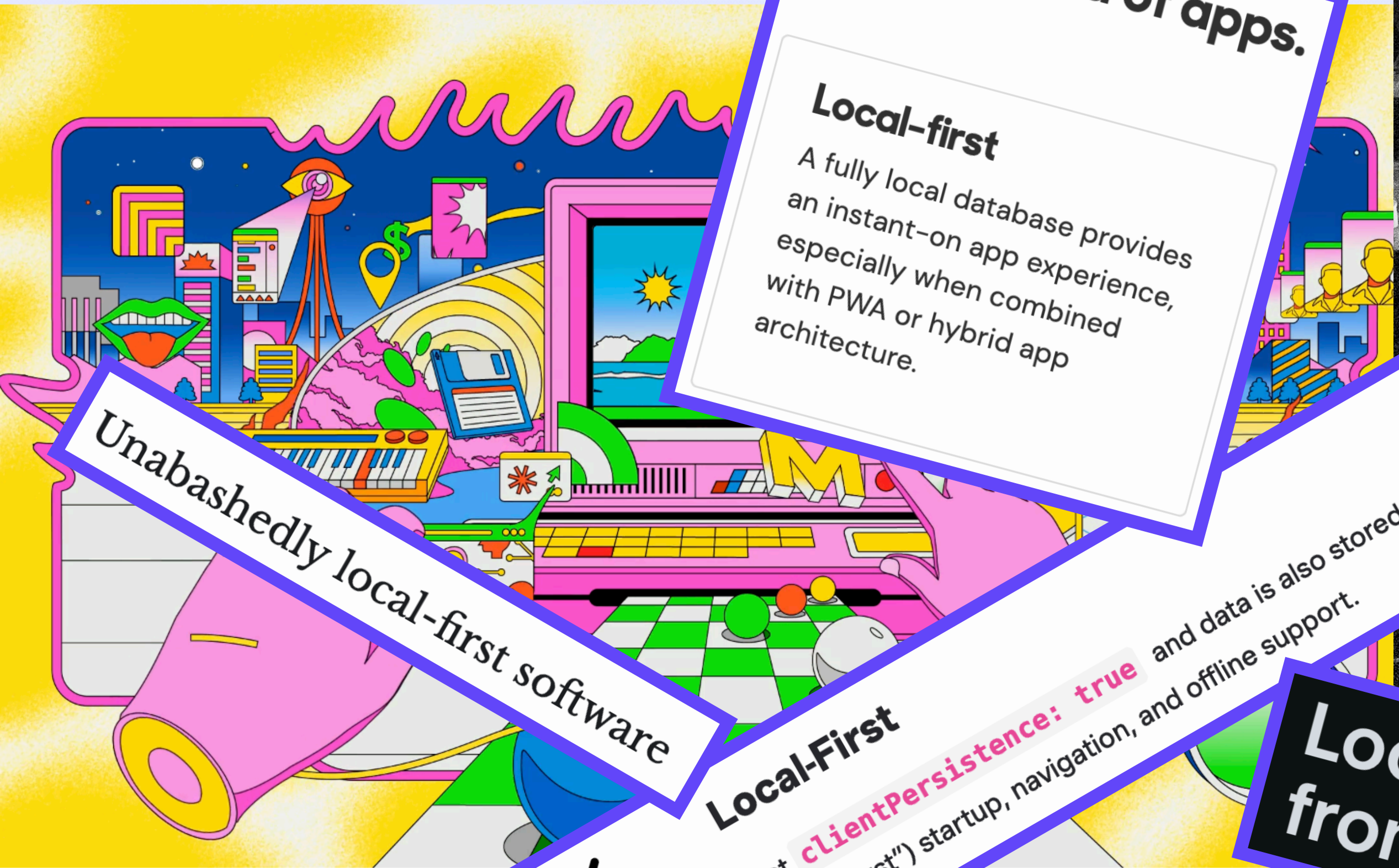
GREGORY BARBER BACKCHANNEL AUG 3, 2023 6:00 AM

The Cloud Is a Prison. Can the Local-First Software Movement Set Us Free?



A New Hope

Early But Exciting



A new breed of apps.

Local-first

A fully local database provides an instant-on app experience, especially when combined with PWA or hybrid app architecture.

Unabashedly local-first software

Local-First

Set `clientPersistence: true` and data is also stored on the client, providing instant ("local-first") startup, navigation, and offline support.



The best way to

local-first

Local-first sync for Postgres from the inventors of CRDTs

VIDEO: ARDHIRA PUTRA

GREGORY BARBER BACKCHANNEL AUG 3, 2023 6:00 AM

The Cloud Is a Prison. Can the Local-First Software Movement Set Us Free?



A New Hope

In the Wild



A New Hope

In the Wild 🦁



A New Hope

Slicing the Problem

Seven ideals for local-first software

1. No spinners: your work at your fingertips
2. Your work is not trapped on one device
3. The network is optional
4. Seamless collaboration with your colleagues
5. The Long Now
6. Security and privacy by default
7. You retain ultimate ownership and control

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A New Hope

Computing is Personal Again

A New Hope

Computing is Personal Again

Desktop: Personal Computing



Cloud: Impersonal Computing



LoFi: Interpersonal* Computing

*Or: Postmodern

A New Hope

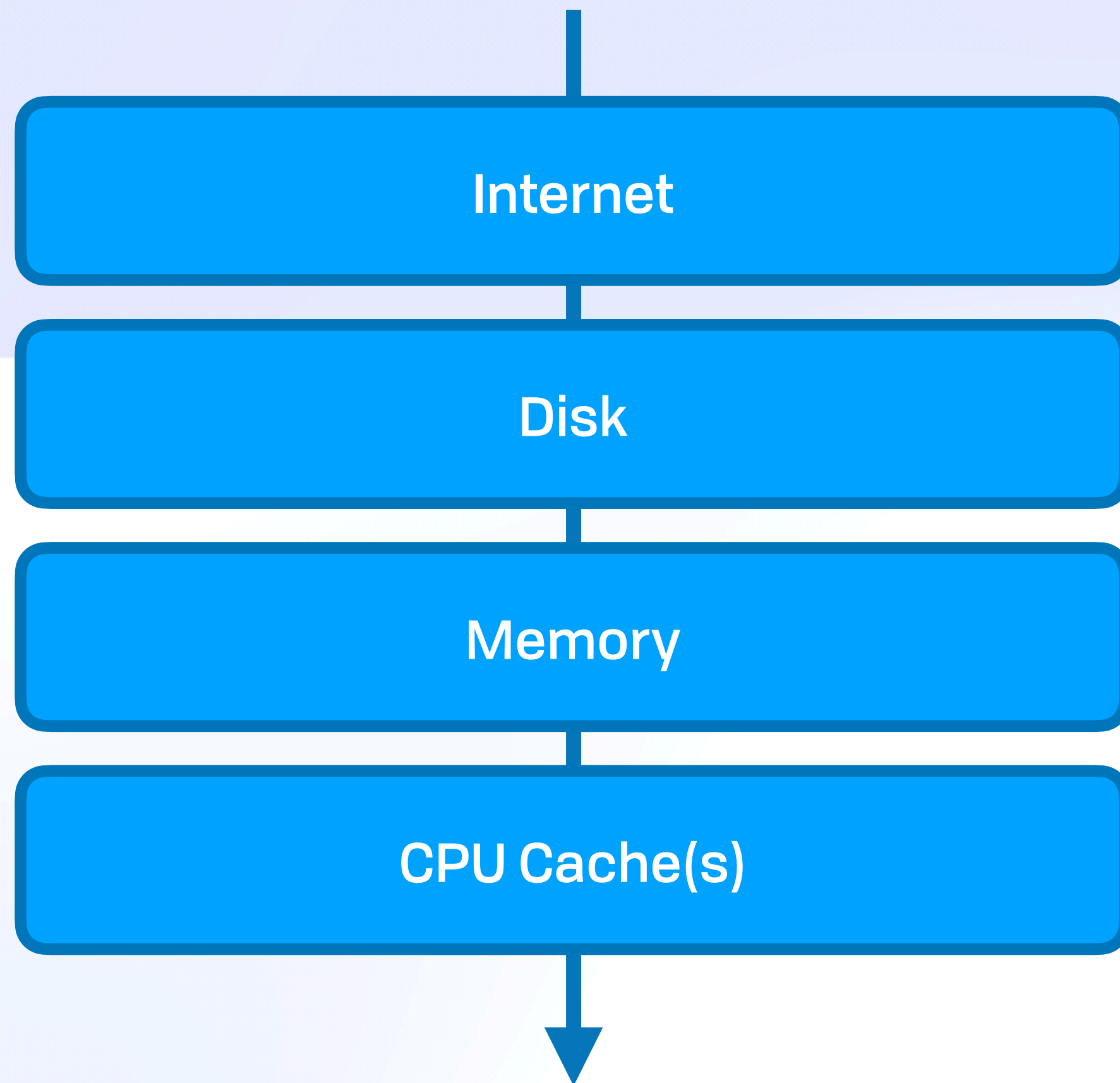
New Metaphors

Layered / "Cache for the Internet"

A New Hope

New Metaphors

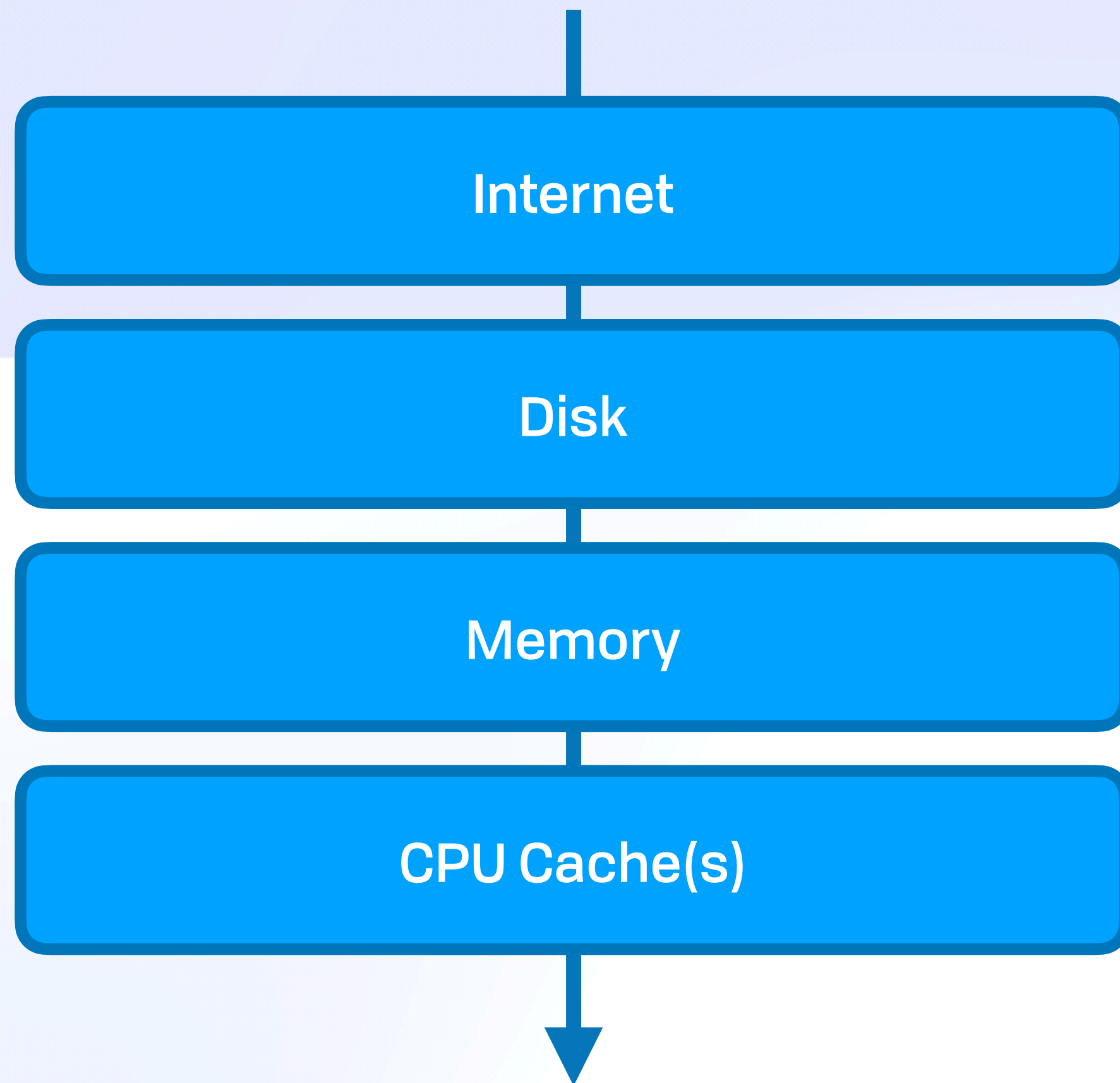
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A New Hope

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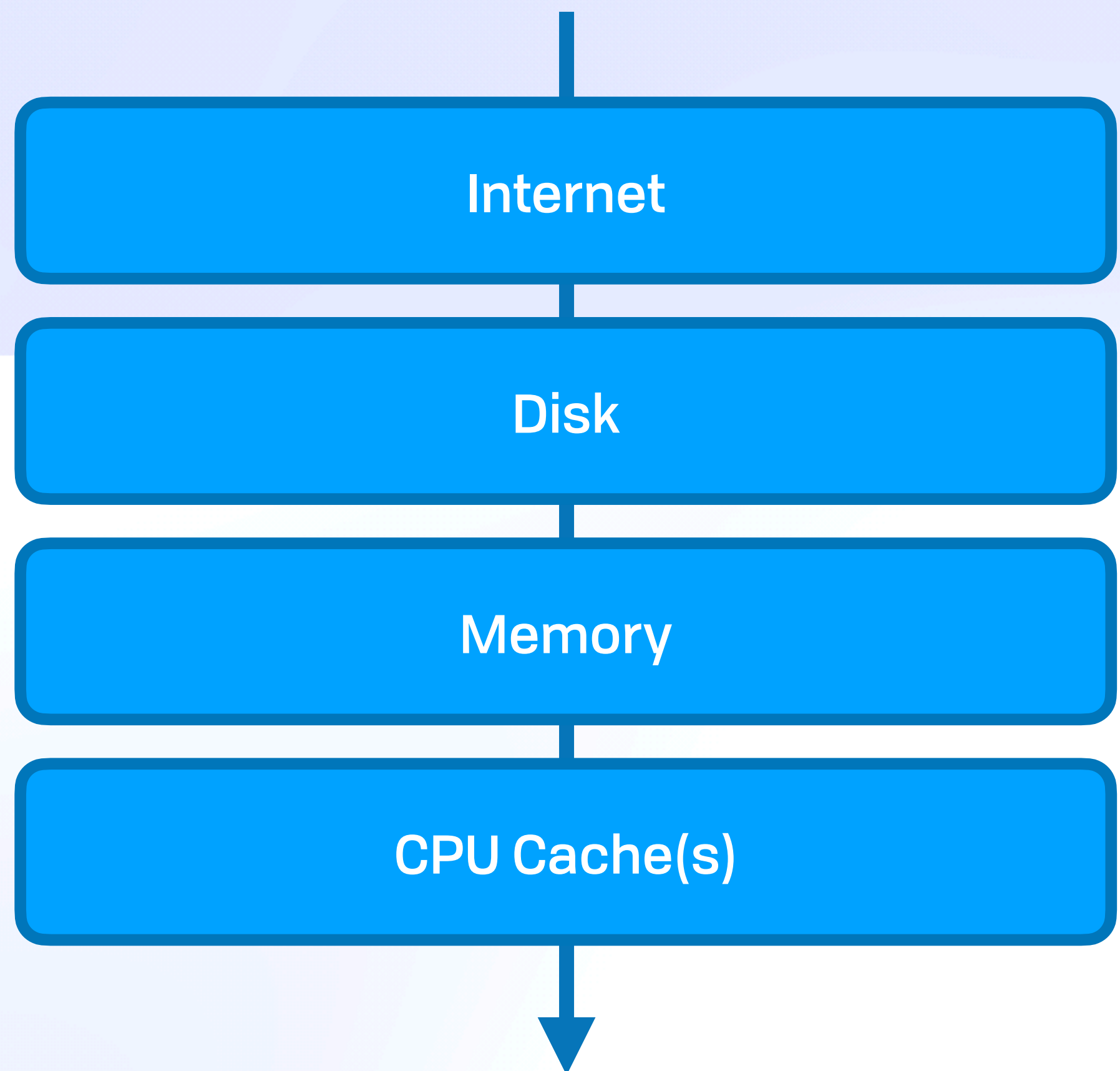


Cellular / P2P

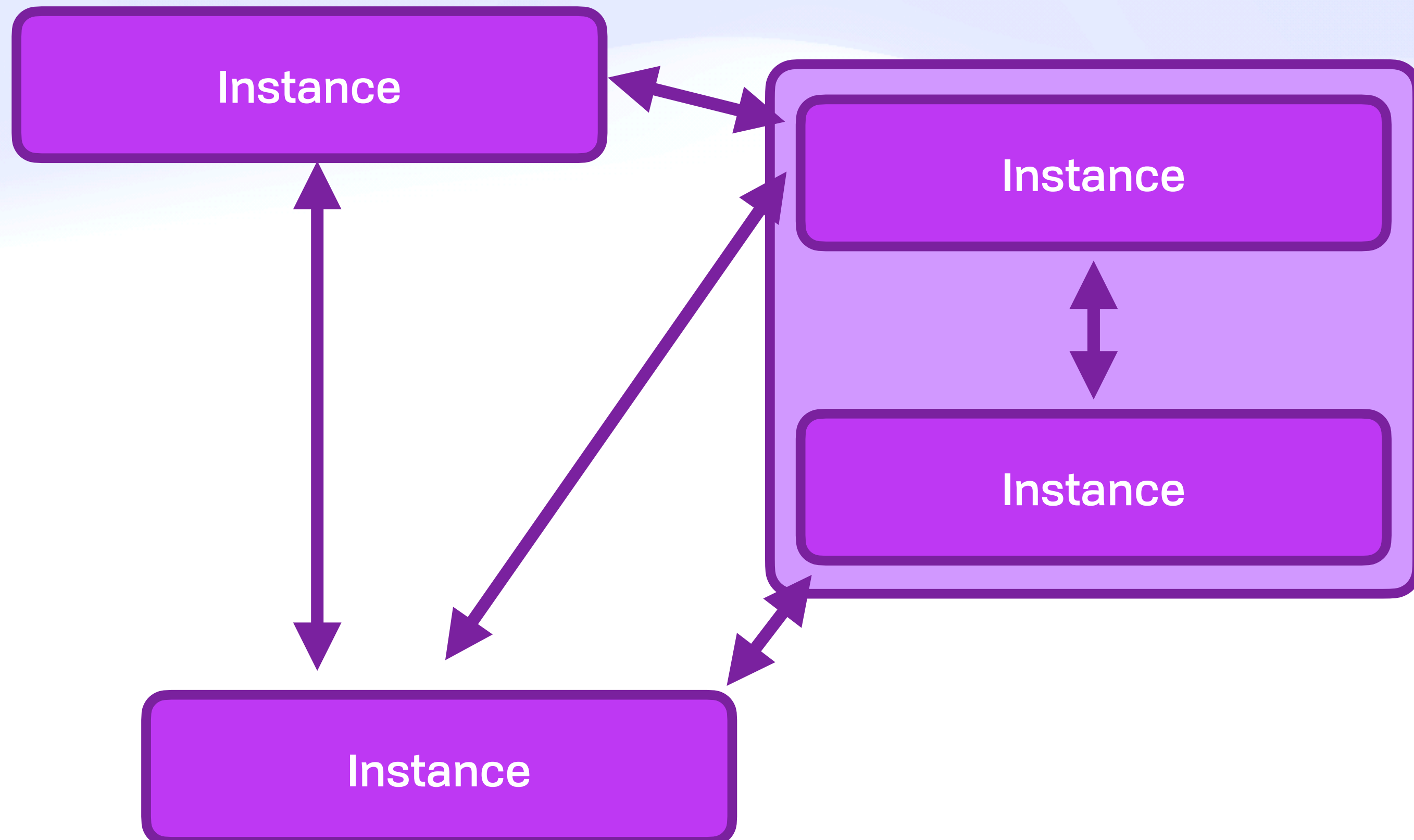
A New Hope

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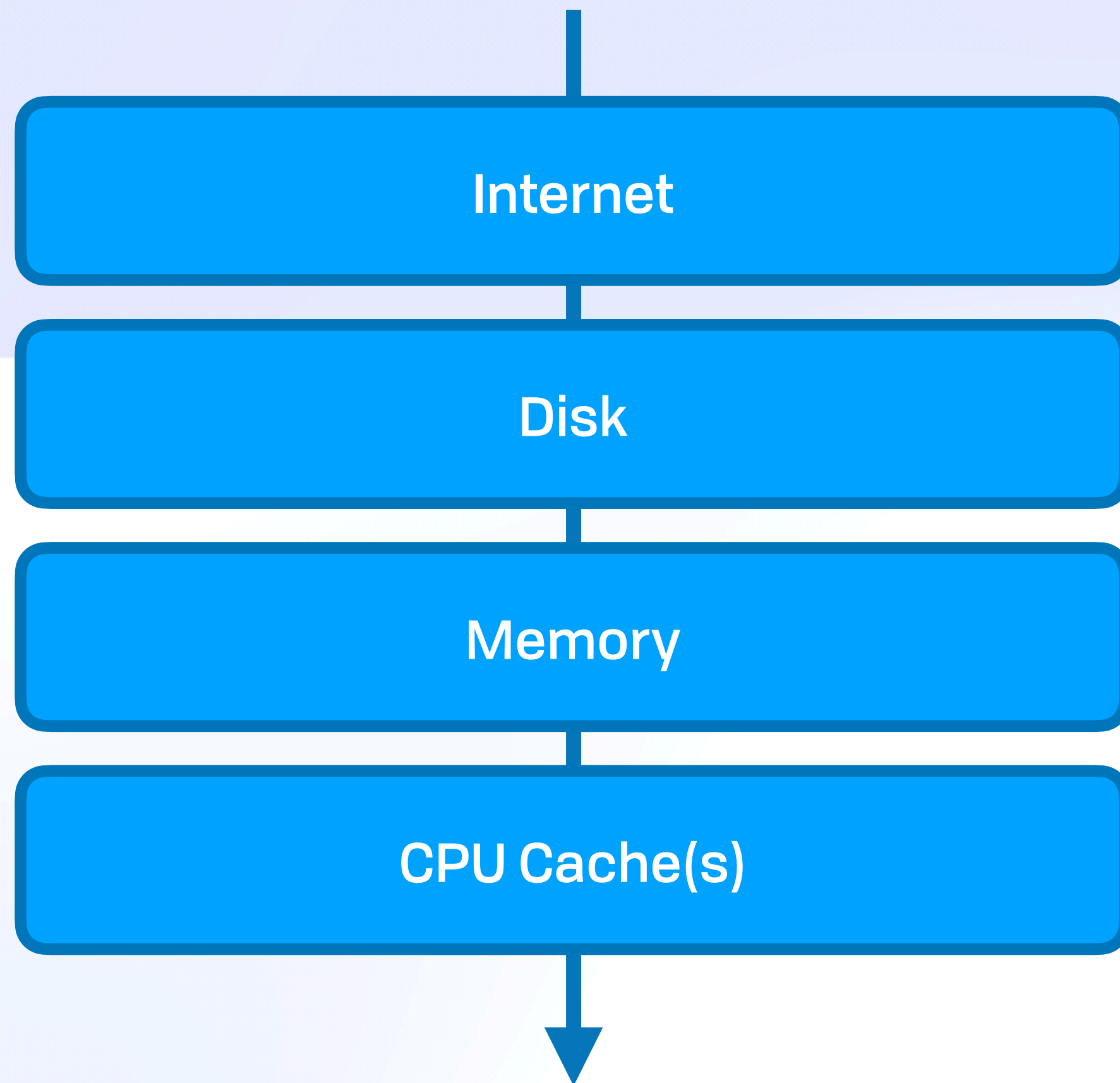
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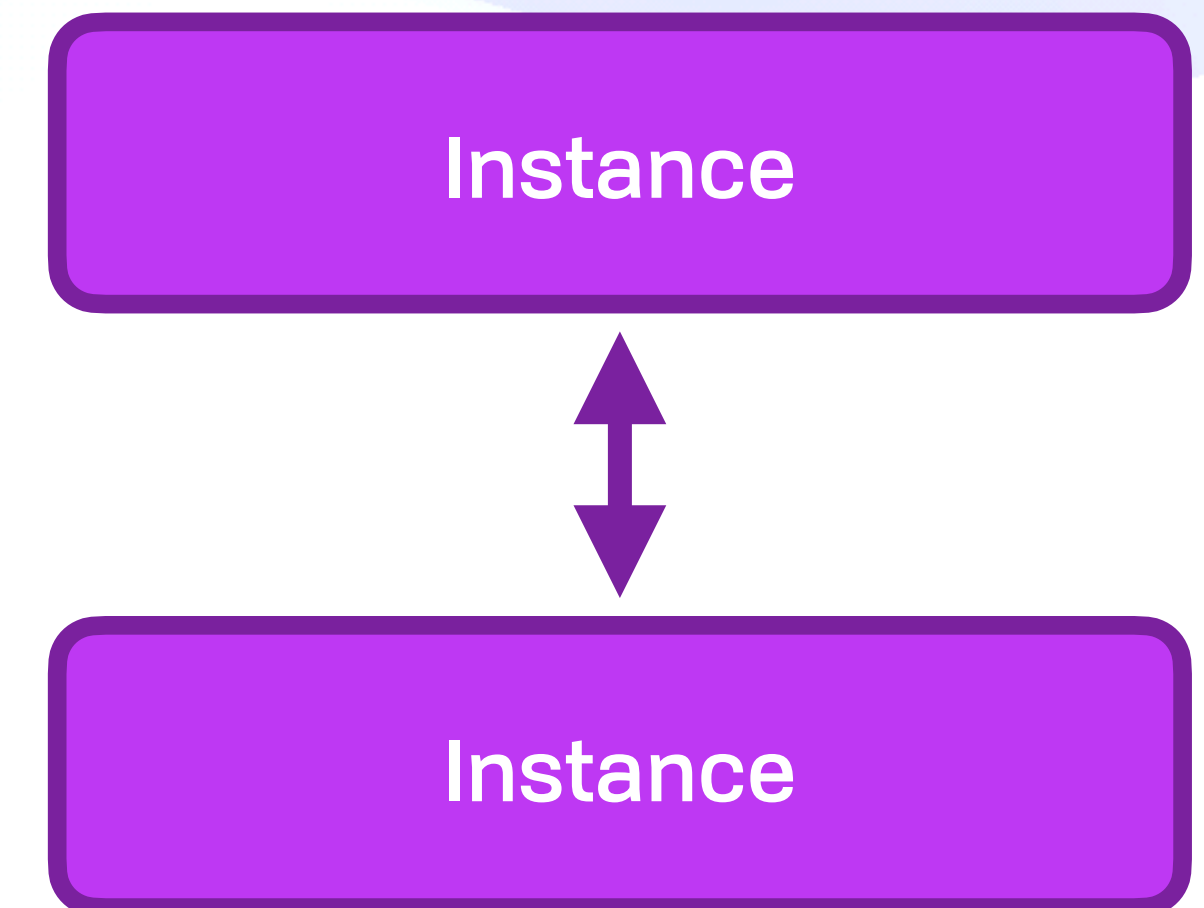
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New Metaphors

Layered / "Cache for the Internet"



Cellular / P2P



A New Hope

Back to Our Roots

A New Hope

Back to Our Roots

- 1. Decentralisation***
- 2. Non-discrimination***
- 3. Bottom-up Design***
- 4. Universality***
- 5. Consensus***

– **The Web Foundation**, History of the Web

A New Hope

Back to Our Roots

- 1. Decentralisation
- 2. Non-discrimination
- 3. Bottom-up Design
- 4. Universality
- 5. Consensus

| Layer | | | Protocol data unit (PDU) |
|--------------|---|--------------|--------------------------|
| Host layers | 7 | Application | Data |
| | 6 | Presentation | |
| | 5 | Session | |
| | 4 | Transport | Segment, Datagram |
| Media layers | 3 | Network | Packet |
| | 2 | Data link | Frame |
| | 1 | Physical | Bit, Symbol |

en.wikipedia.org/wiki/OSI_model

– The Web Foundation, History of the Web

A New Hope

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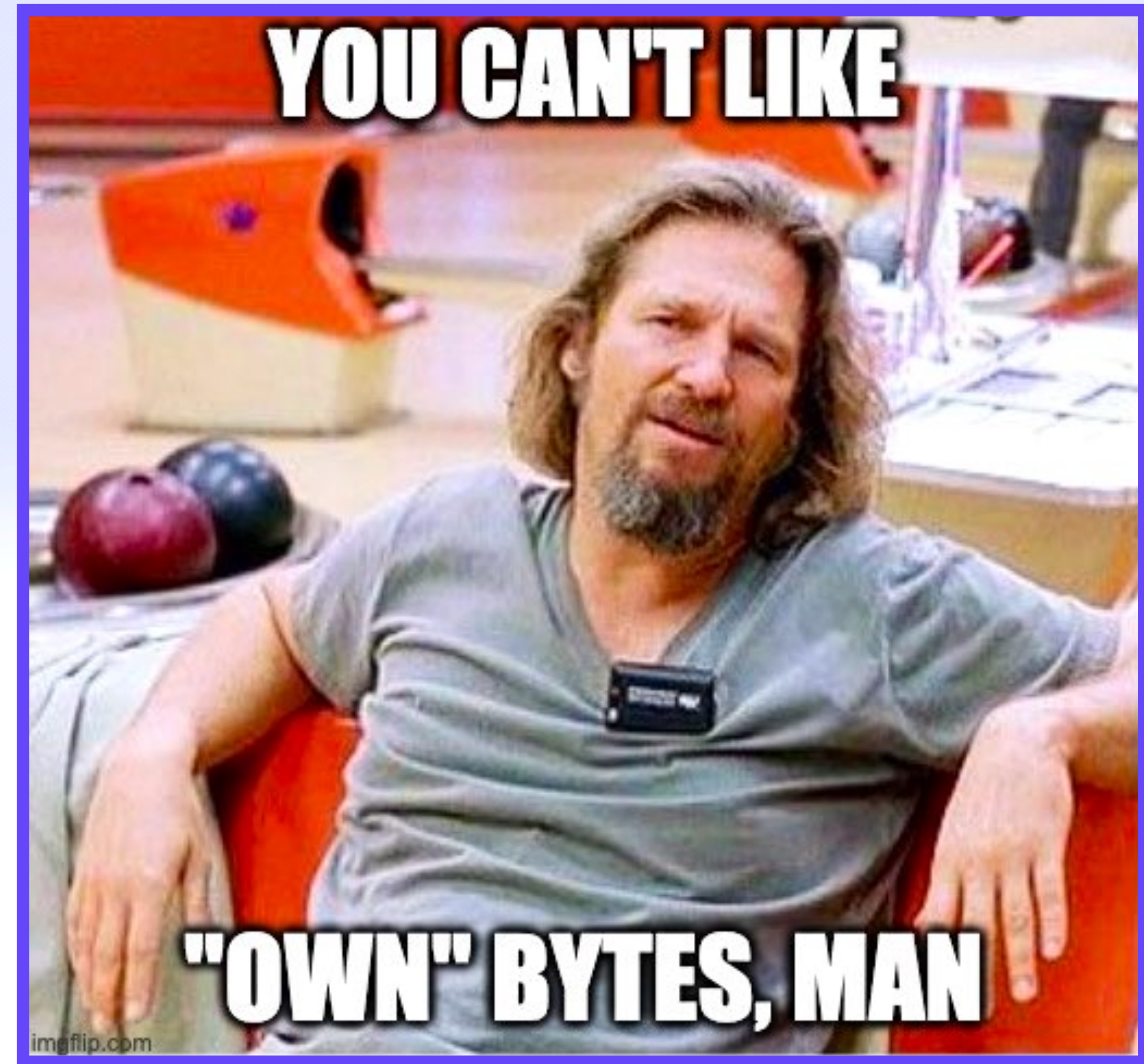
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– The Web Foundation, History of the Web

A New Hope

User Agency

- **Entry:** Empower users to participate
- **Exit:** Option to move or leave
- **Safety:** Control access to *your* data
- **Serve:** Provide capacity to others



A New Hope

Layers  ***Prior Understanding***

A New Hope

Layers ***Prior Understanding***

Data 

A New Hope

Layers 🧅 ***Prior Understanding***

Compute 🗑️

Data 💾

A New Hope

Layers 🧅 ***Prior Understanding***

Auth 🧑

Compute ⚙️

Data 💾

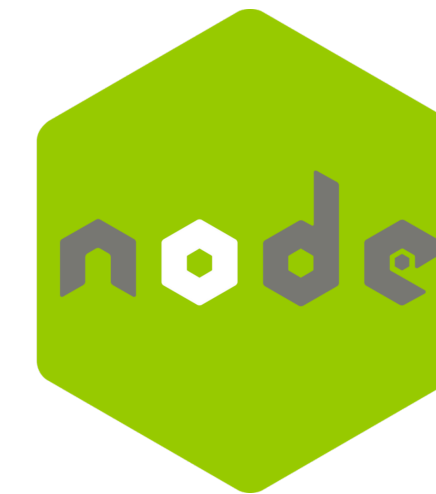
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Layers 🧅 *Prior Understanding*

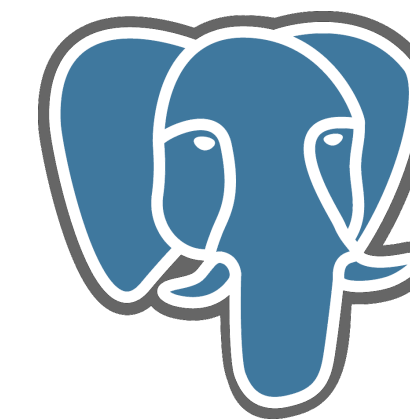
Auth 🧑



Compute ⚙️



Data 💾



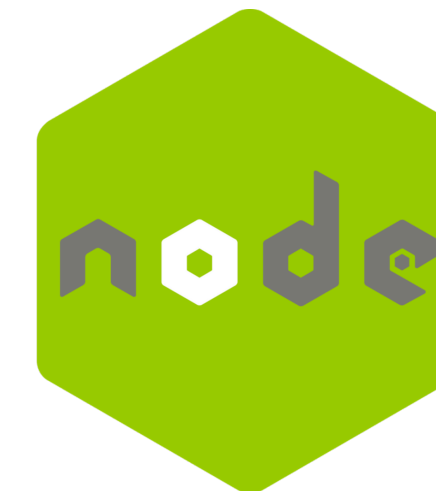
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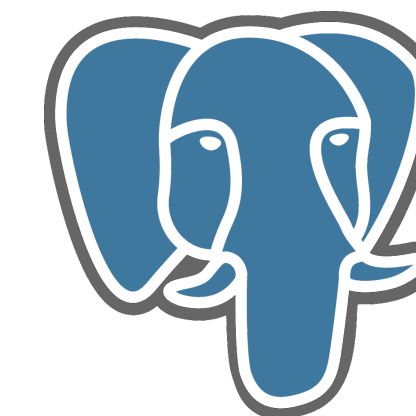
Auth



Compute ⚙️



Data 💾



A New Hope

Layers 🧅 ***Prior Understanding***

Auth

Compute ⚙️

Data 💾

A New Hope

Static Layers 🍰 ***Upside Down Cake***

Compute ⚙️

Data 💾

Auth

A New Hope

Static Layers 🍰 ***Upside Down Cake***

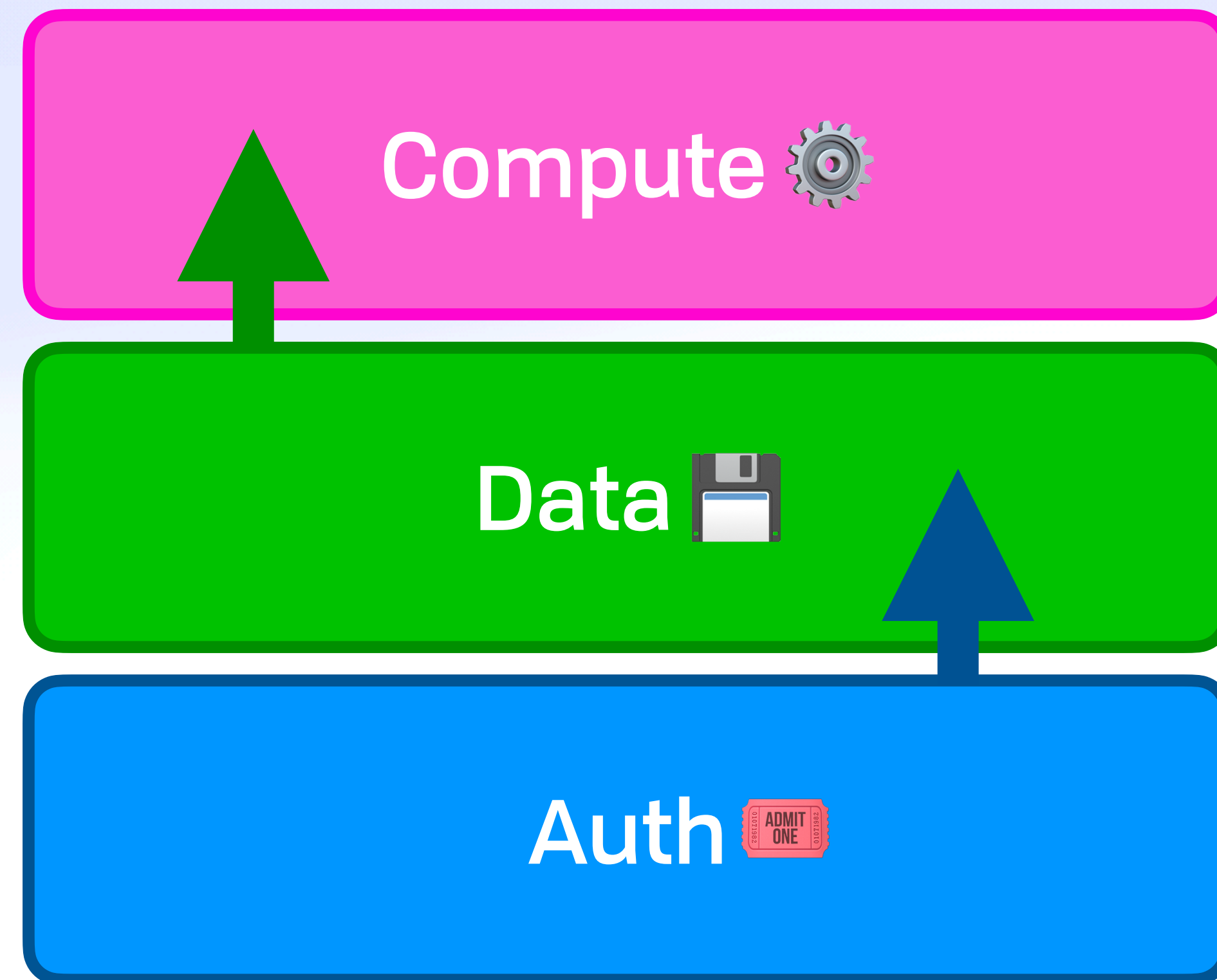
Compute ⚙️

Data 💾

Auth 🎫

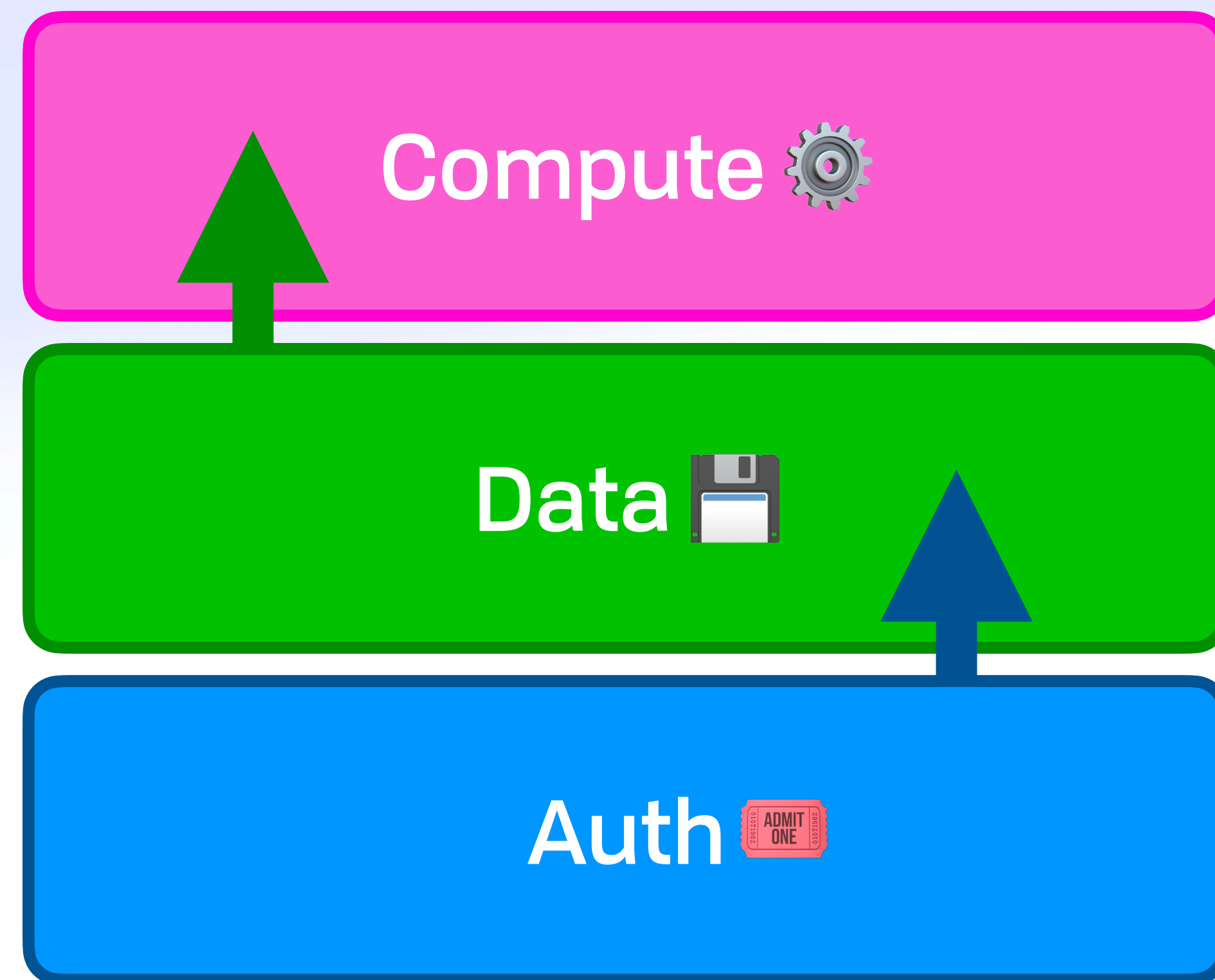
A New Hope

Static Layers 🍰 ***Upside Down Cake***



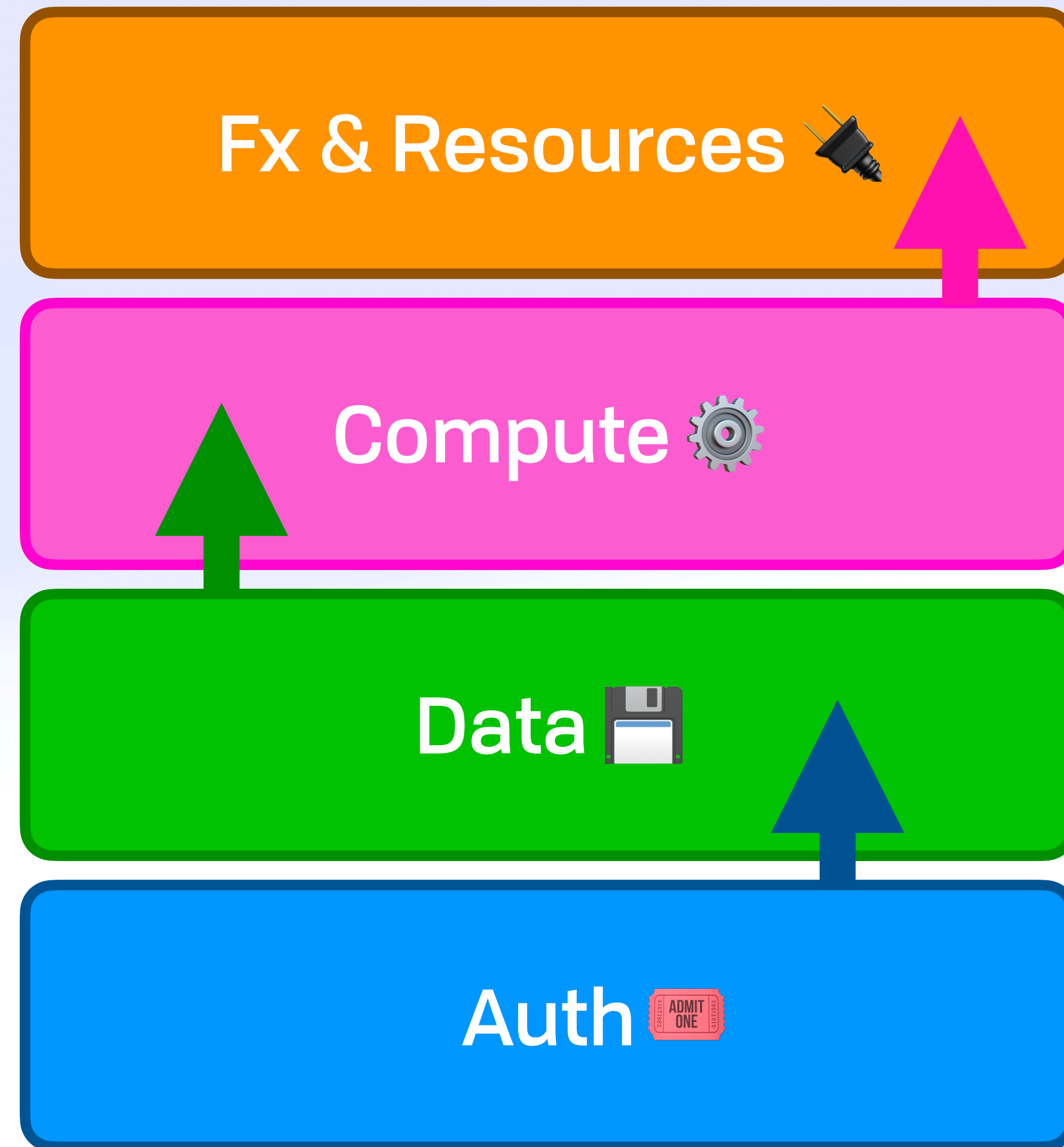
A New Hope

Layers 🙄



A New Hope

Layers 🙄



Welcome to the Jungle

Distributed Systems



Welcome to the Jungle

Systems



Welcome to the Jungle

Disorderly Systems



The Jump to Hyperspace

The Jump to Hyperspace

Much of the ***pain*** in traditional distributed programming comes from this mismatch: programmers are expected to ***bridge from an ordered programming model into a disordered reality*** that executes their code.

— The Bloom Language Website

Disorderly Systems



Disorderly Systems



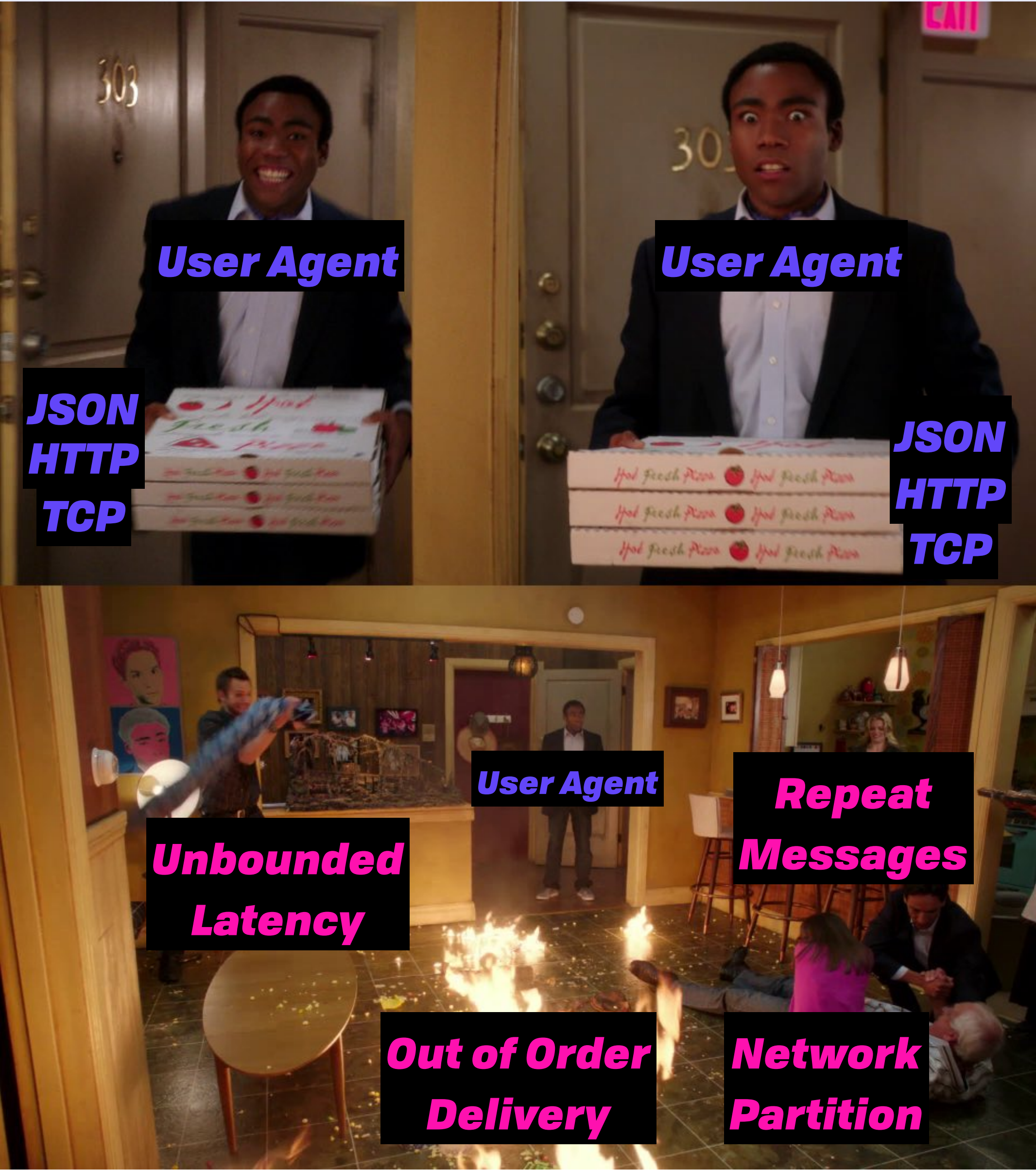
Disorderly Systems



Disorderly Systems



Disorderly Systems



Disorderly Systems

Solving Lamport's Problem

Disorderly Systems

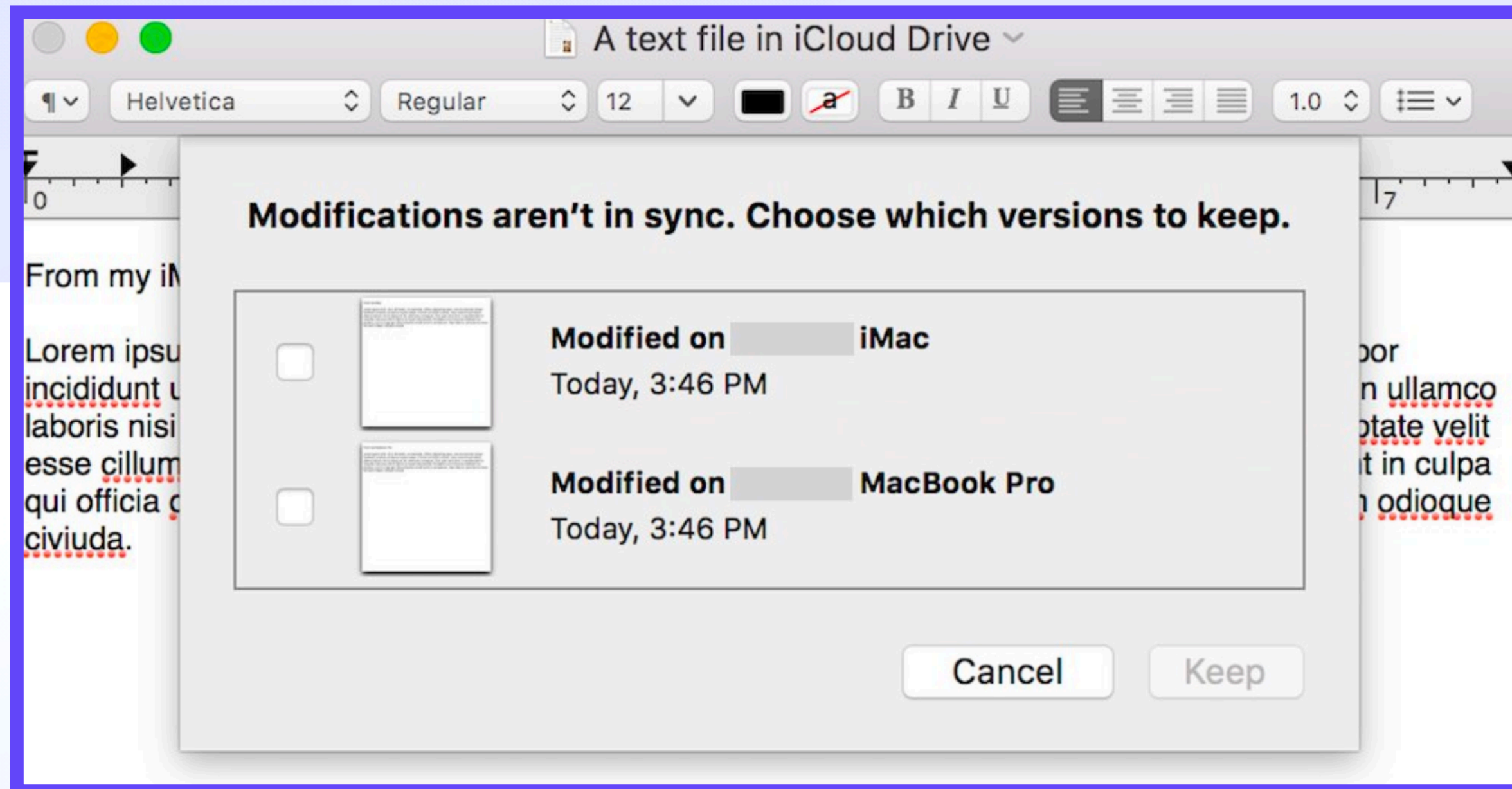
Solving Lamport's Problem

A ***distributed system*** is one in which the ***failure*** of a computer ***you didn't even know existed*** can render ***your own computer unusable***

— Leslie Lamport

Disorderly Systems

Partition Troubles



<<<<<<< HEAD

Option A

=====

Option B

>>>>>>> some-branch

Disorderly Systems

Keeping CALM 🧘

A problem has a ***consistent, coordination-free*** distributed implementation if and only if it is ***monotonic***.

The CALM Theorem

Disorderly Systems

Monotonicity

Disorderly Systems

Monotonicity

$\max(a, b)$

Disorderly Systems

Monotonicity

$\max(a, b)$

$\max(1, \underline{2})$

Disorderly Systems

Monotonicity

$\max(a, b)$

$\max(1, \underline{2})$

$\max(2, \underline{42})$

Disorderly Systems

Monotonicity

$\max(a, b)$

$\max(1, \underline{2})$

$\max(2, \underline{42})$

$\max(\underline{42}, 10)$

Disorderly Systems

Monotonicity

$\max(a, b)$

$\max(1, \underline{2})$

$\max(2, \underline{42})$

$\max(\underline{42}, 10)$

$\max(\underline{42}, 11)$

Disorderly Systems

Monotonicity

$\max(a, b)$

$\max(1, \underline{2})$

$\max(2, \underline{42})$

$\max(\underline{42}, 10)$

$\max(\underline{42}, 11)$

42

Disorderly Systems

Monotonicity

`max(a, b)`

`max(1, 2)`

`max(2, 42)`

`max(42, 10)`

`max(42, 11)`

42

`set.add(item)`

Disorderly Systems

Monotonicity

`max(a, b)`

`max(1, 2)`

`max(2, 42)`

`max(42, 10)`

`max(42, 11)`

42

`set.add(item)`

`{ }.add(1)`

Disorderly Systems

Monotonicity

`max(a, b)`

`max(1, 2)`

`max(2, 42)`

`max(42, 10)`

`max(42, 11)`

42

`set.add(item)`

`{ }.add(1)`

`{1}.add(9)`

Disorderly Systems

Monotonicity

`max(a, b)`

`max(1, 2)`

`max(2, 42)`

`max(42, 10)`

`max(42, 11)`

42

`set.add(item)`

`{ }.add(1)`

`{1}.add(9)`

`{1, 9}.add(4)`

Disorderly Systems

Monotonicity

`max(a, b)`

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`max(2, 42)`

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`set.add(item)`

`{ }.add(1)`

`{1}.add(9)`

`{1, 9}.add(4)`

`{1, 4, 9}.add(9)`

Disorderly Systems

Monotonicity

`max(a, b)`

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`set.add(item)`

`{ }.add(1)`

`{1}.add(9)`

`{1, 9}.add(4)`

`{1, 4, 9}.add(9)`

{1, 4, 9}

Disorderly Systems

Unafraid of Change 🤨

Disorderly Systems

Unafraid of Change 🤨



Automerge

Disorderly Systems

Unafraid of Change 🤨

```
automerge.change(doc, tx => {
```



Automerge

Disorderly Systems

Unafraid of Change 🤨

```
automerge.change(doc, tx => {  
  automerge.splice(tx, ["text"], 0, 0, "Hello ")  
})
```



Automerge

Disorderly Systems

Unafraid of Change 🤨

```
automerge.change(doc, tx => {  
  automerge.splice(tx, ["text"], 0, 0, "Hello ")  
  tx.counter.increment(20)  
})
```



Automerge

Disorderly Systems

Unafraid of Change 🤨

```
automerge.change(doc, tx => {  
  automerge.splice(tx, ["text"], 0, 0, "Hello ")  
  tx.counter.increment(20)  
  tx.map.key = "new value"  
  tx.map.nested_map.key = "new nested value"  
})
```



Automerge

Disorderly Systems

Unafraid of Change 🤨

```
automerge.change(doc, tx => {  
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  tx.counter.increment(20)  
  tx.map.key = "new value"  
  tx.map.nested_map.key = "new nested value"  
  tx.list[0] = "A"  
  tx.list.insertAt(0, "Z")  
  tx.list[4].nested = "MAP"  
  tx.list[5][0] = "NESTED LIST"  
})
```



Automerge

Fixing The Leaky Pipes... Statically

Access Control



Access Control

Access Control

Cryptography is a tool for turning
lots of different problems into
key management problems

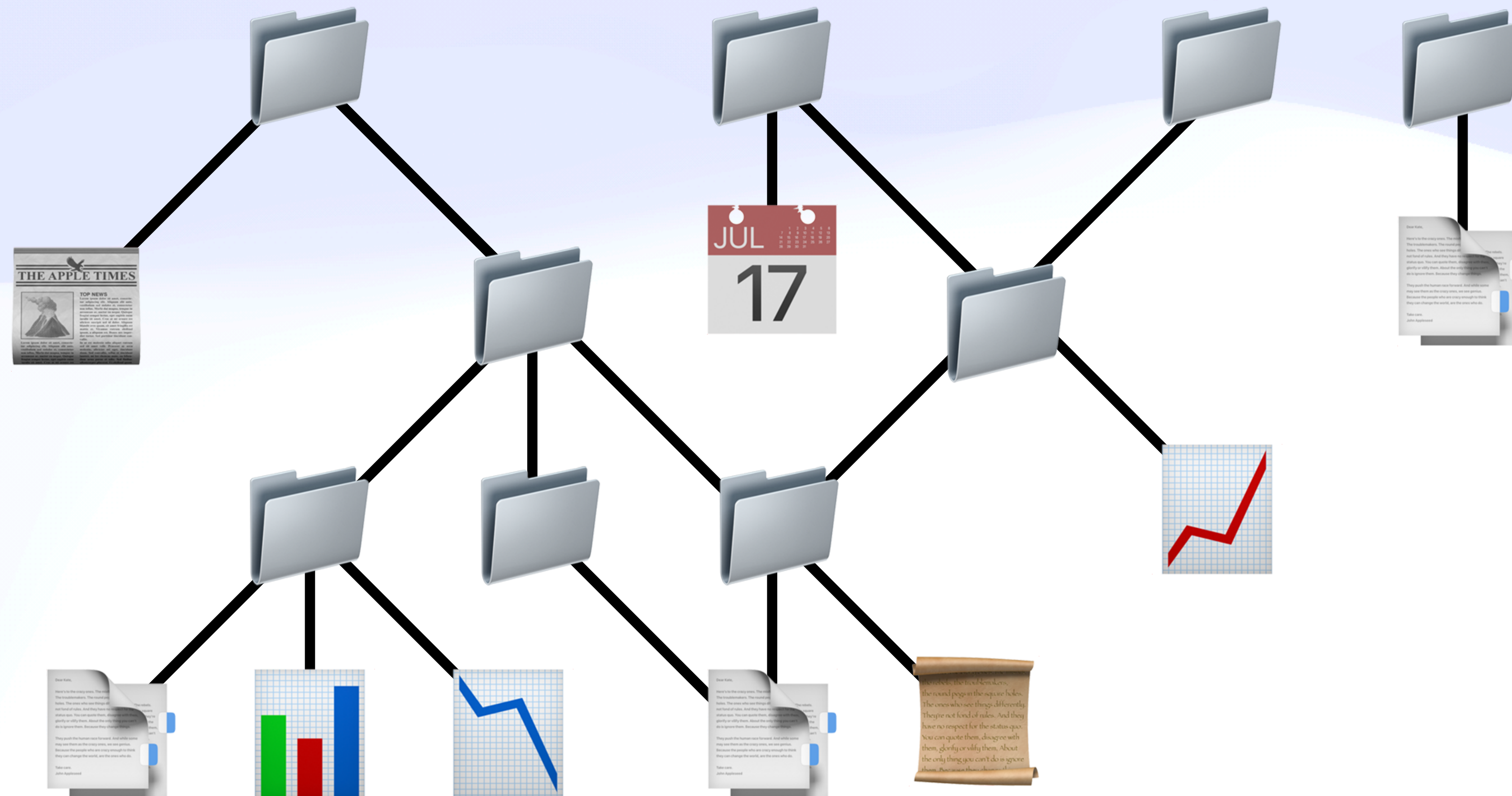
Dr. Lea Kissner, Global Lead of Privacy Technologies at Google

Access Control

Universal Read Control

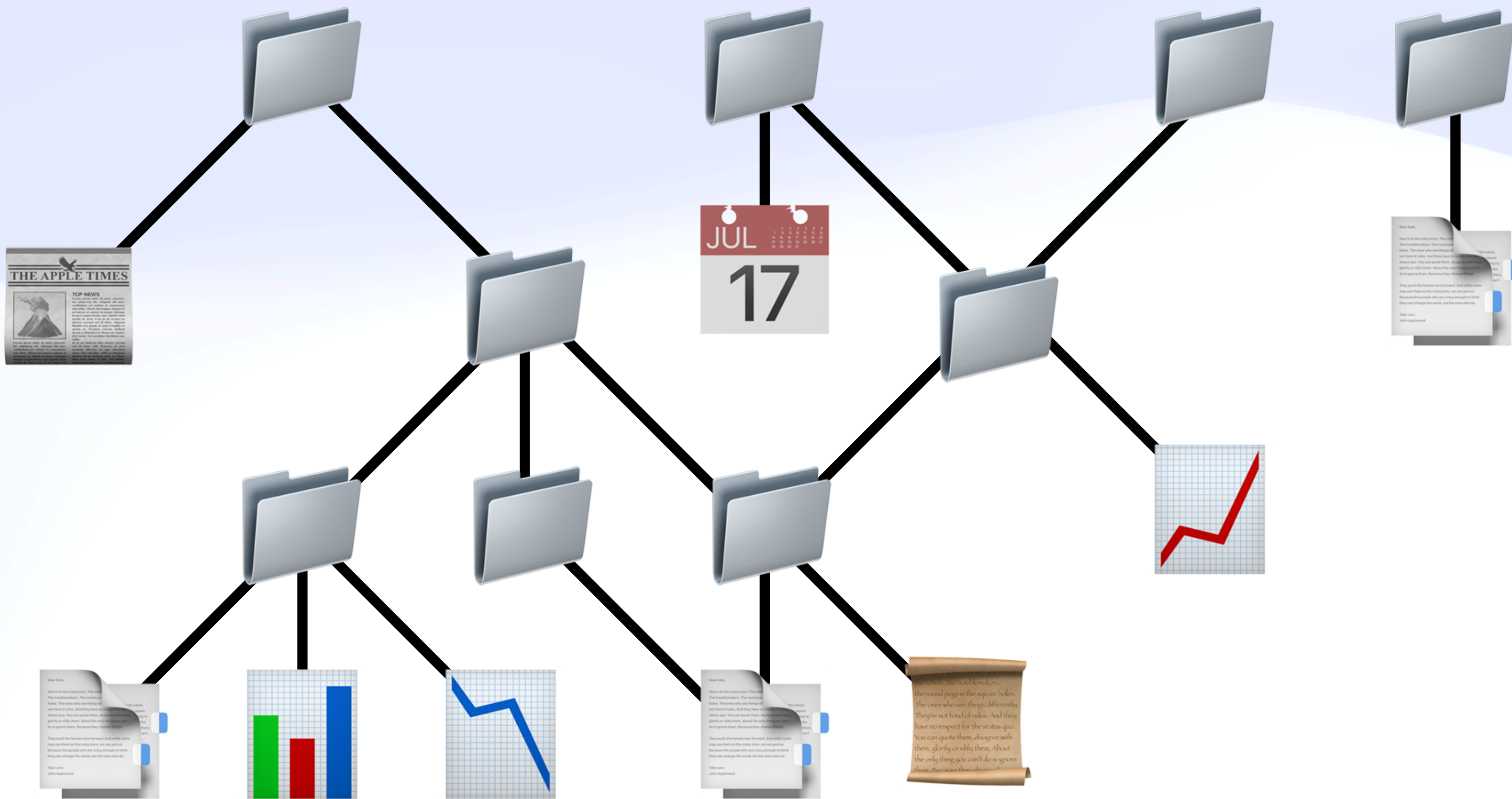
Access Control

Universal Read Control

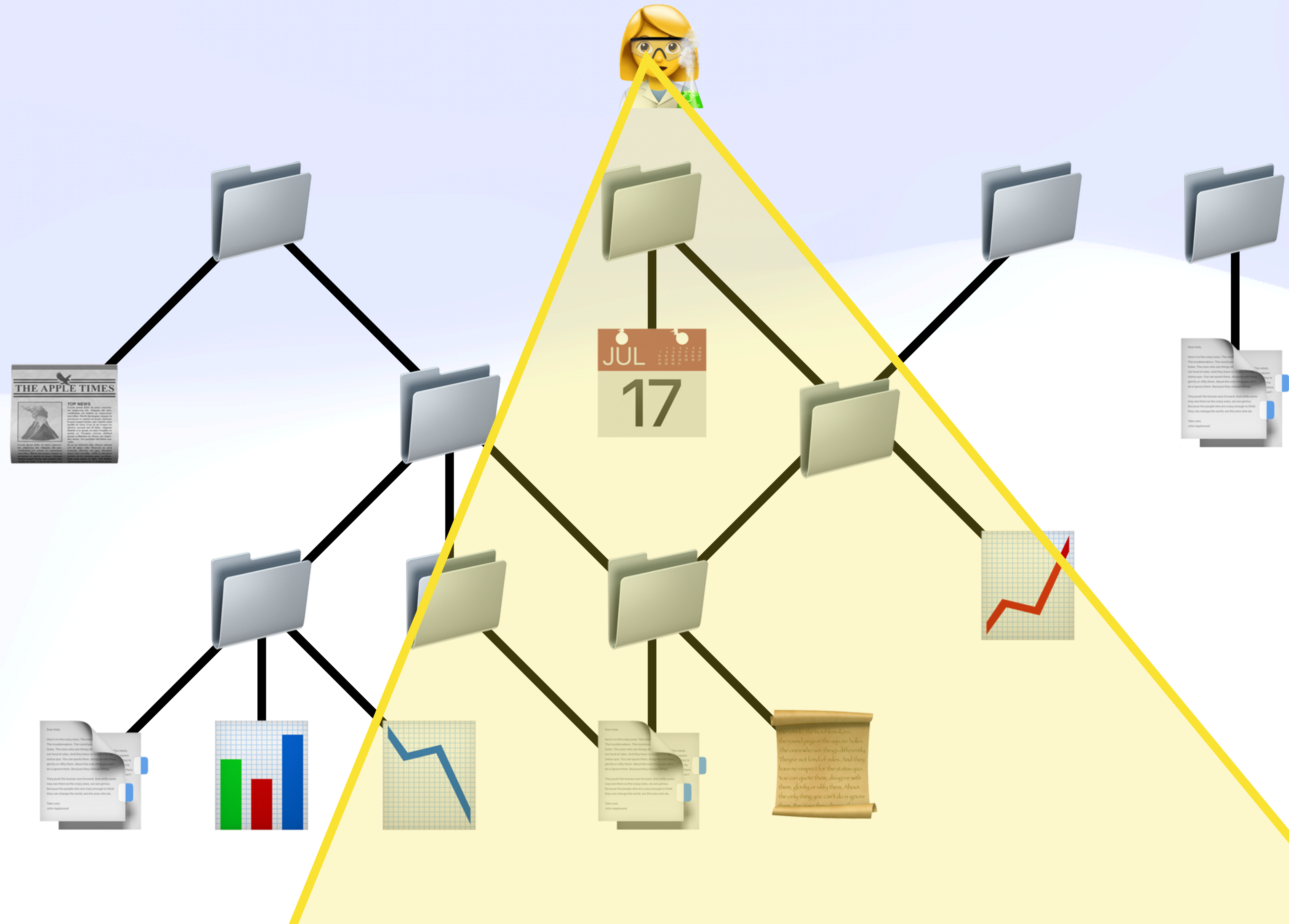


Access Control

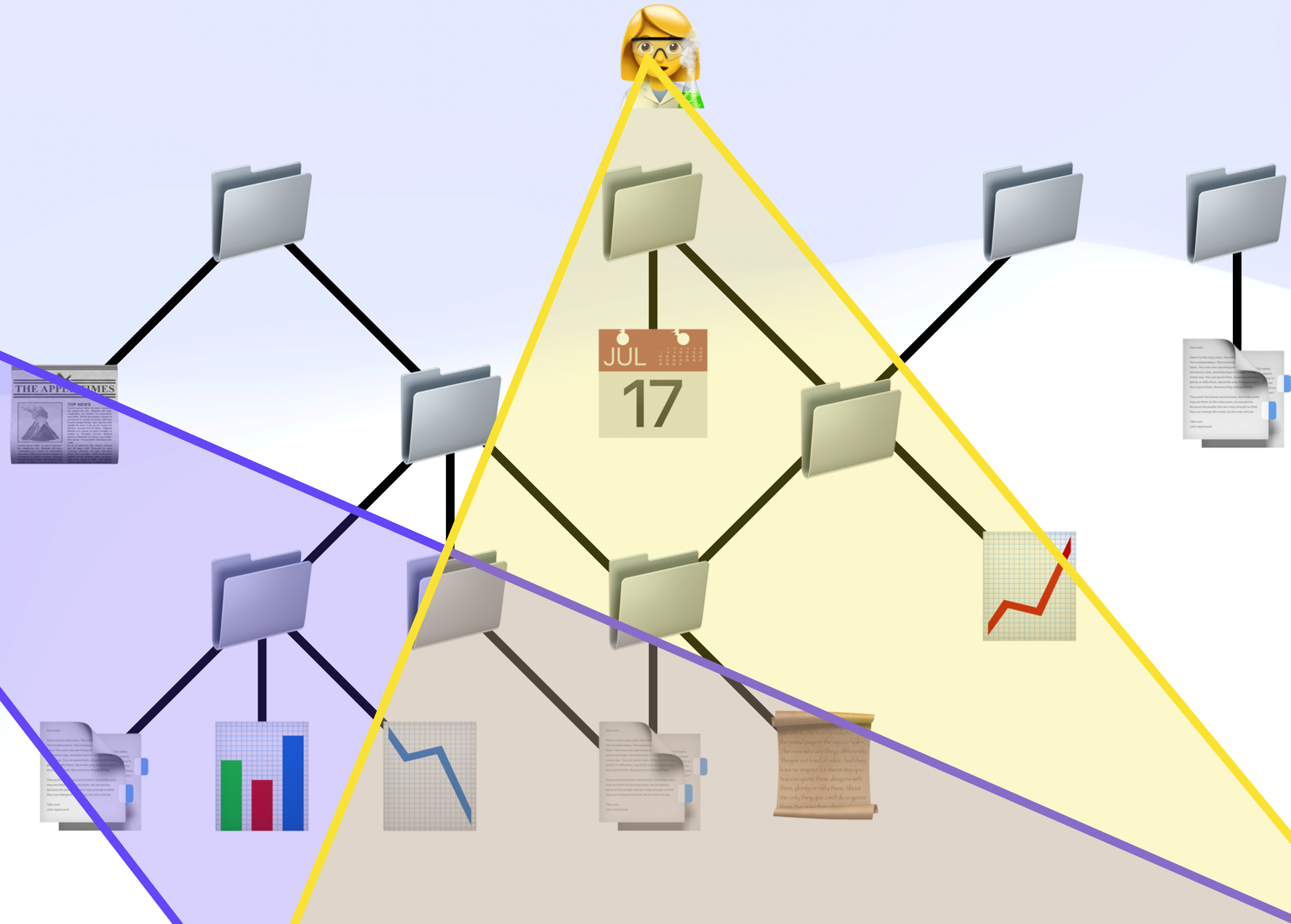
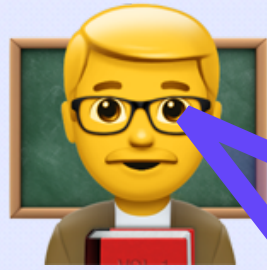
Universal Read Control



Universal Read Control

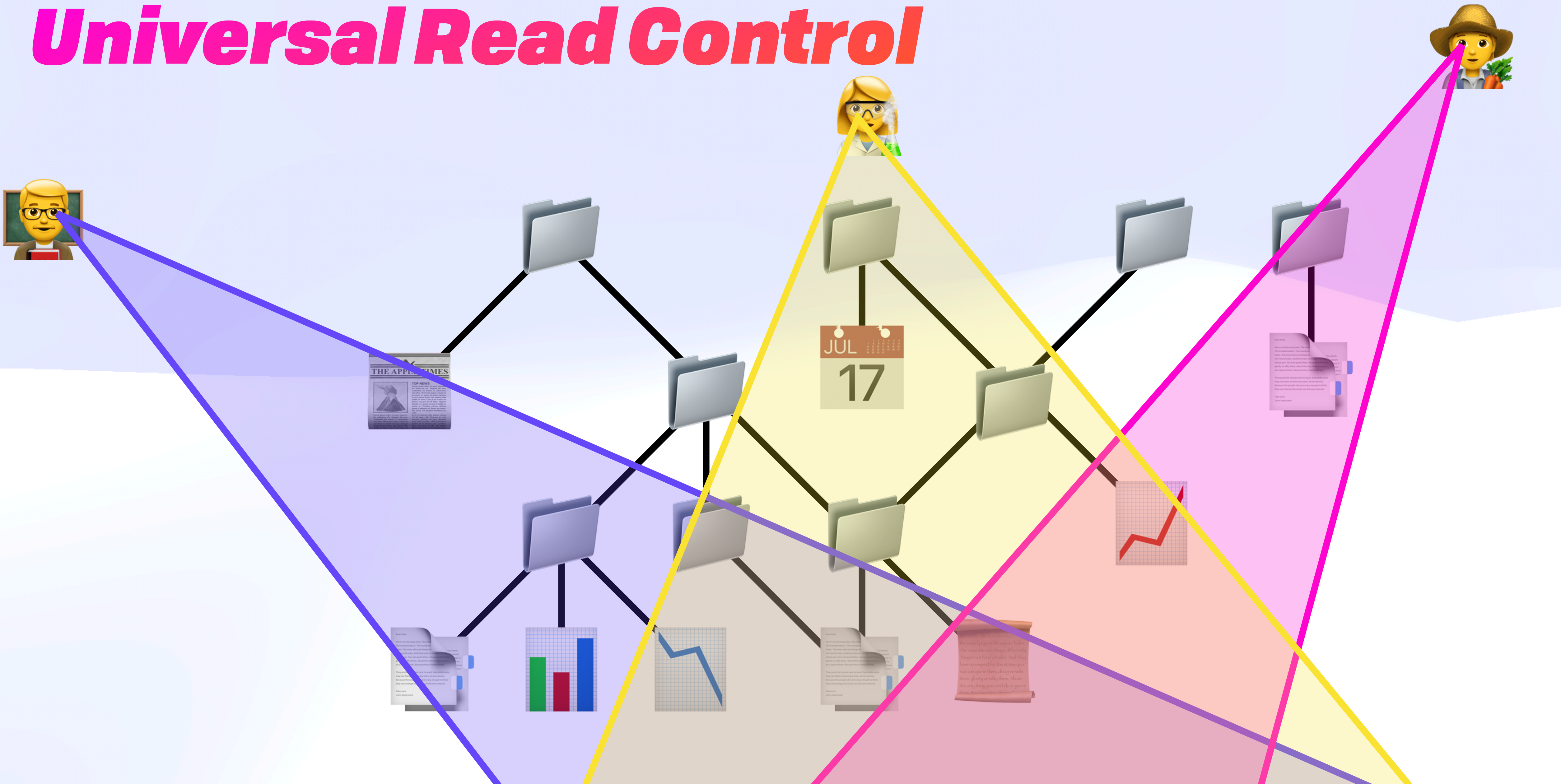


Universal Read Control



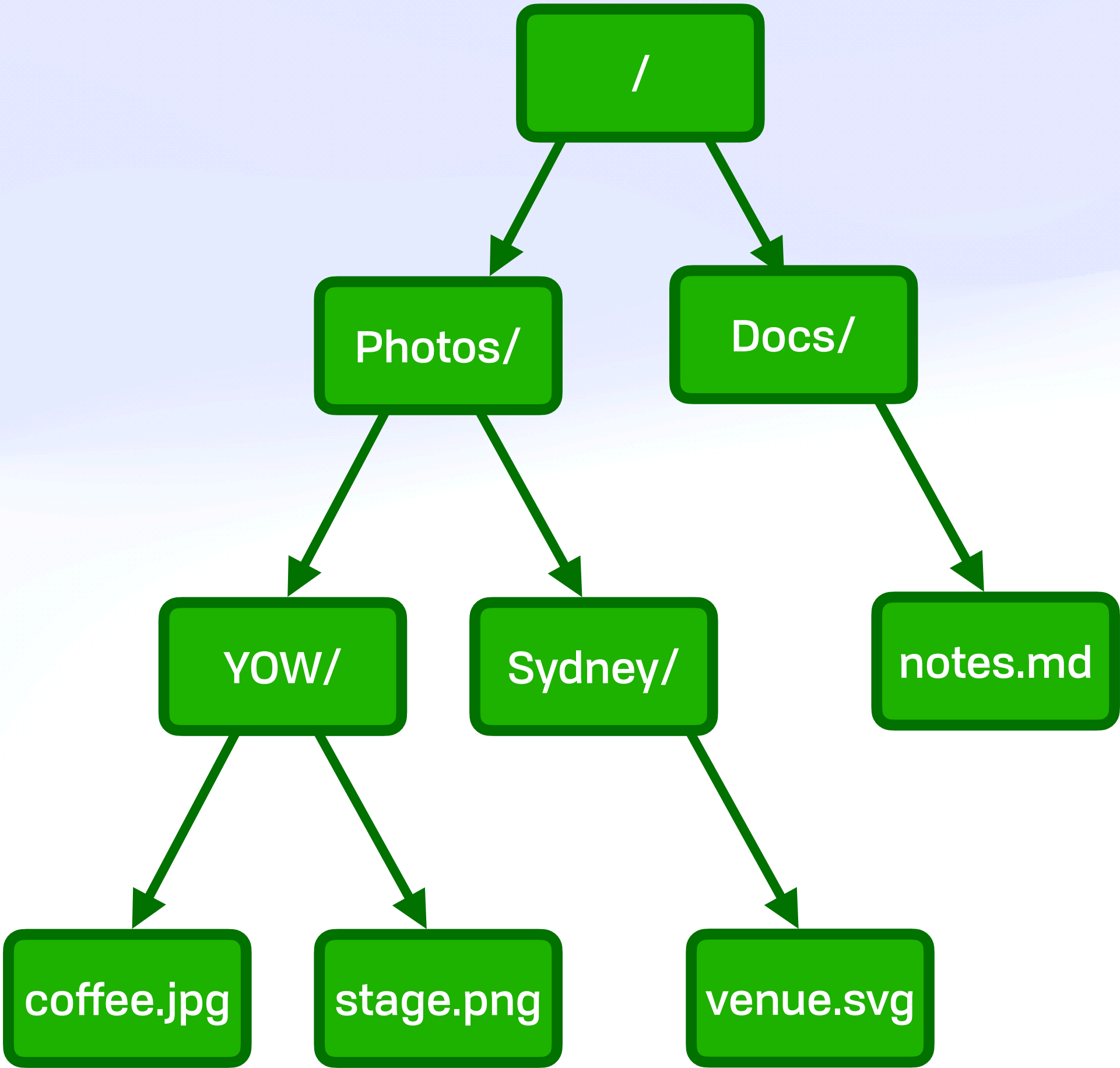
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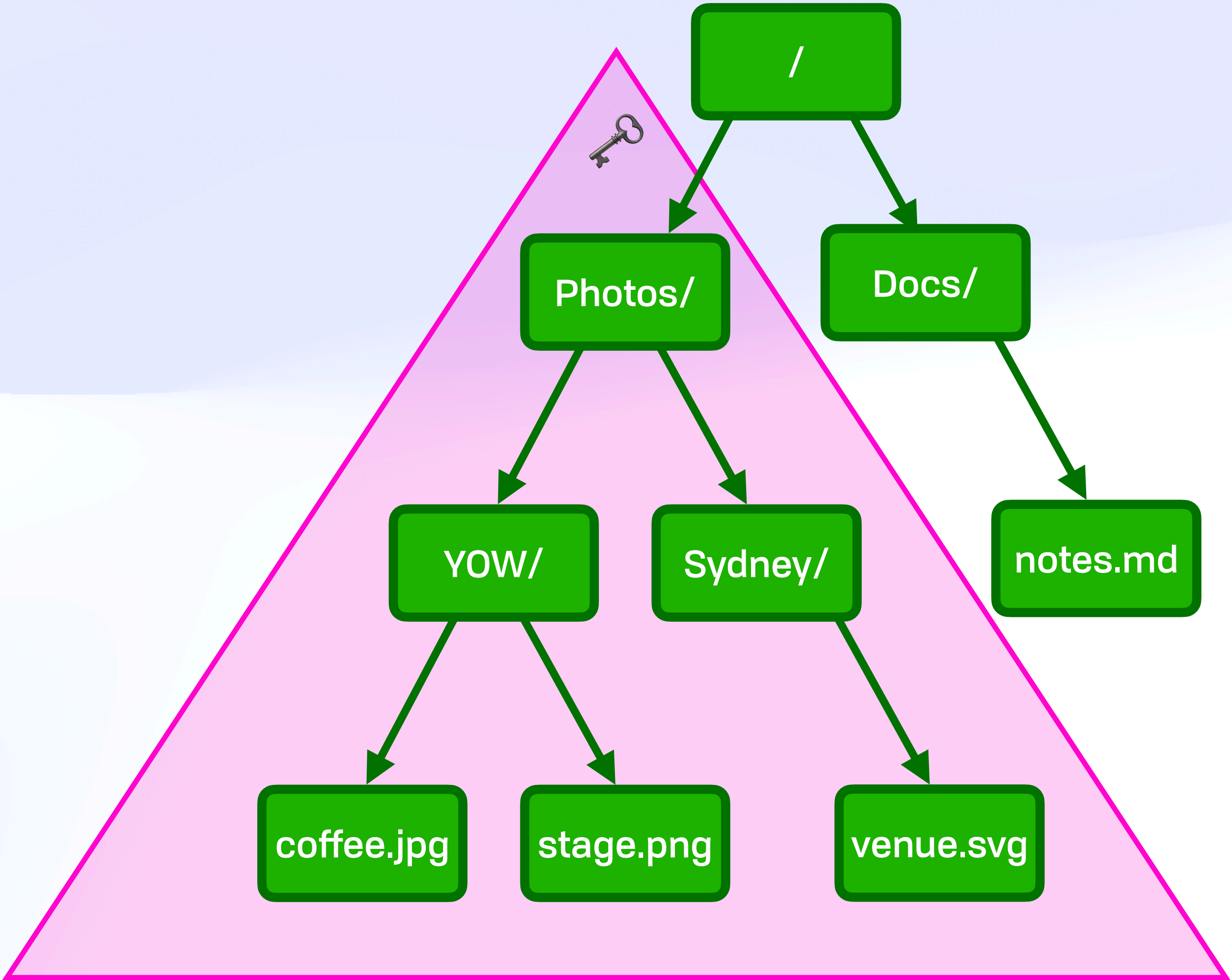
Access Control

Offline Read Control



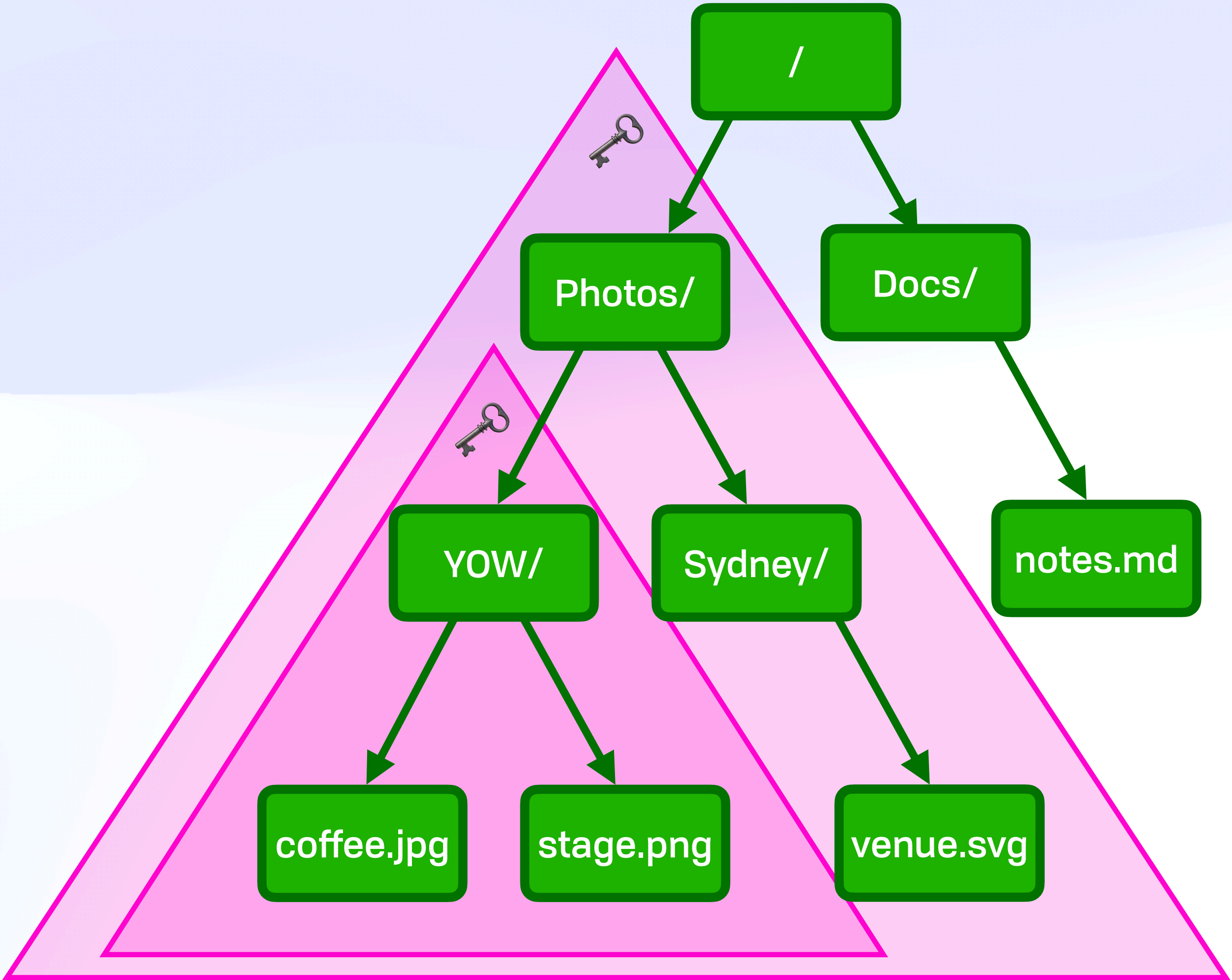
Access Control

Offline Read Control



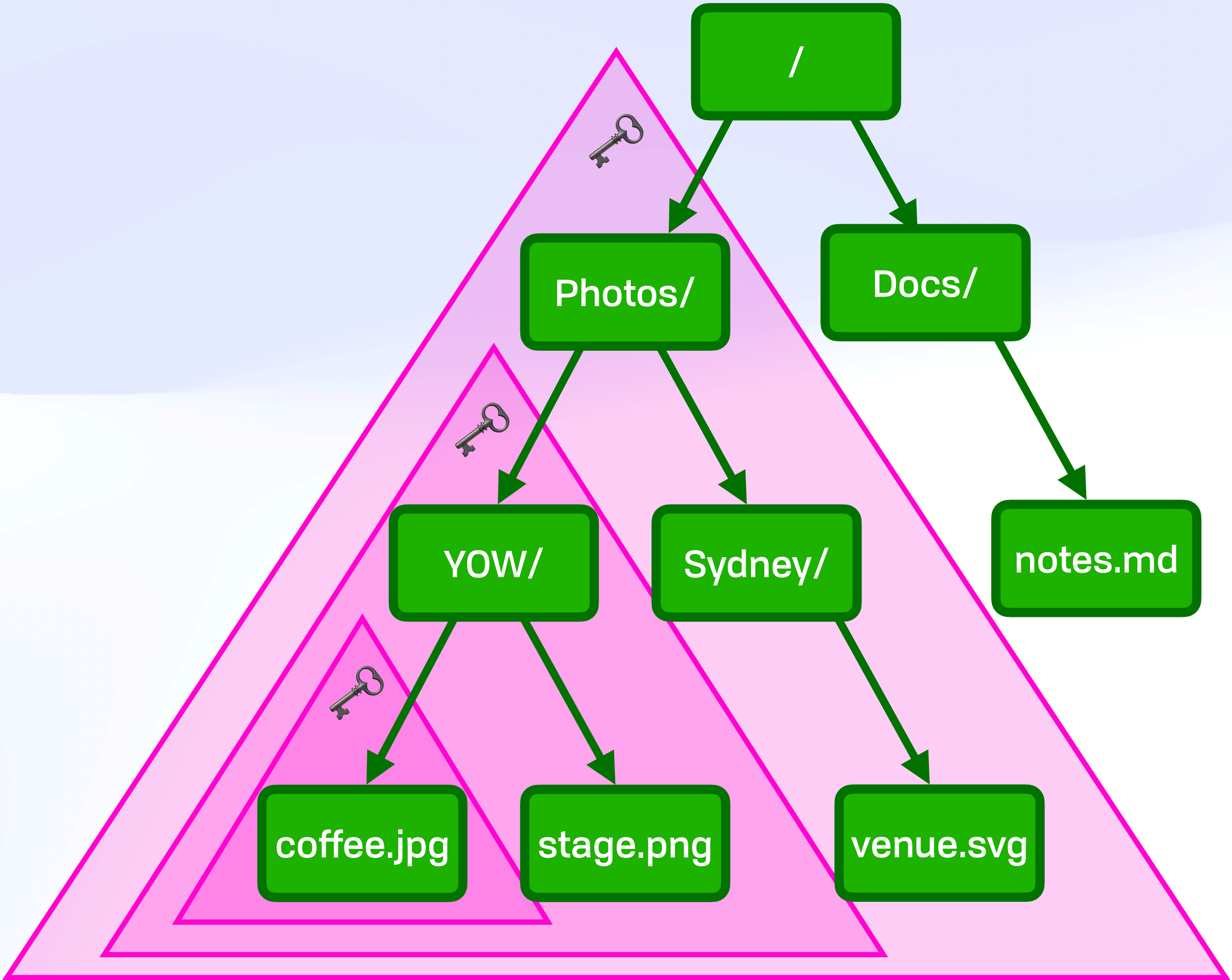
Access Control

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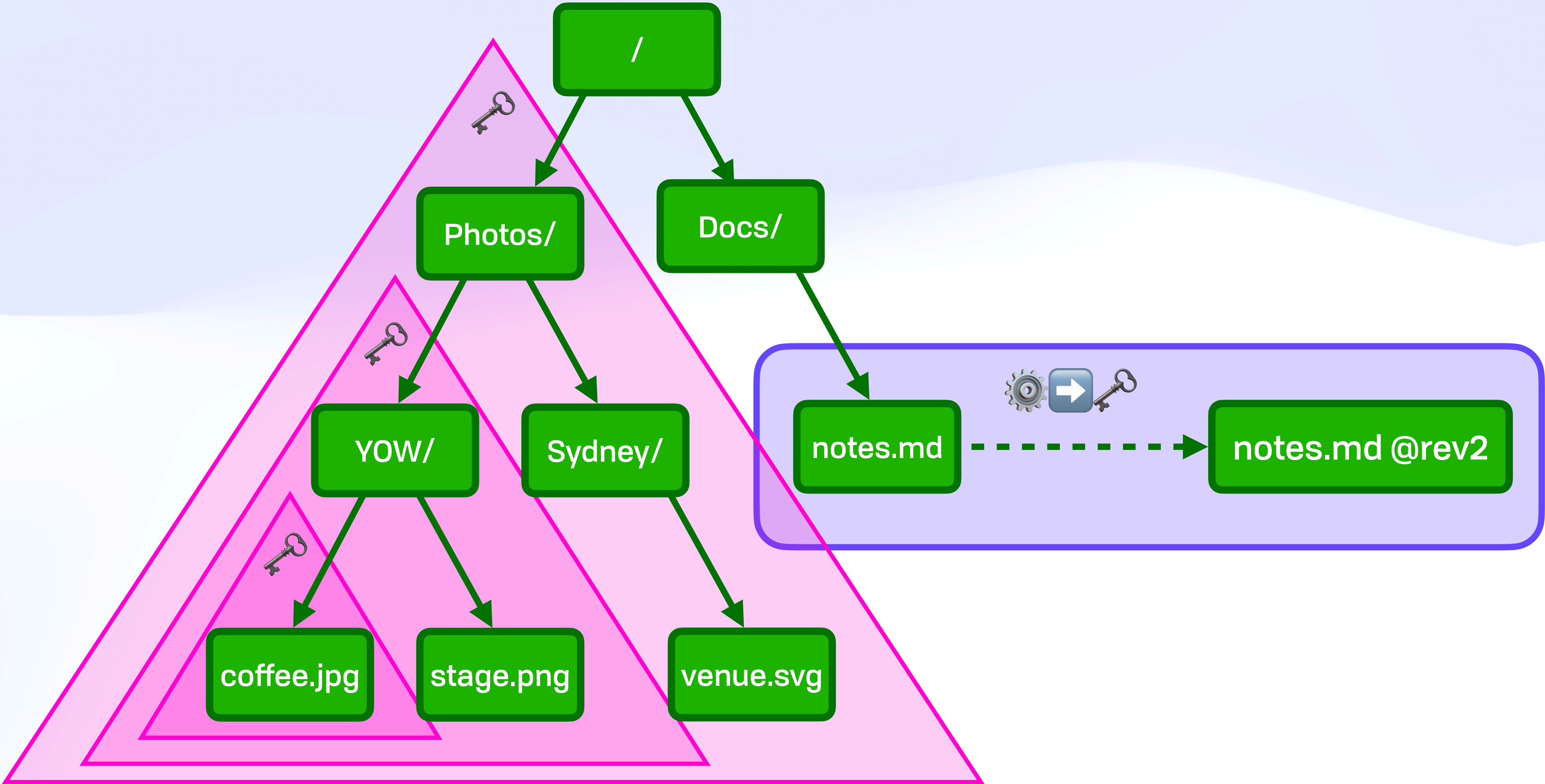
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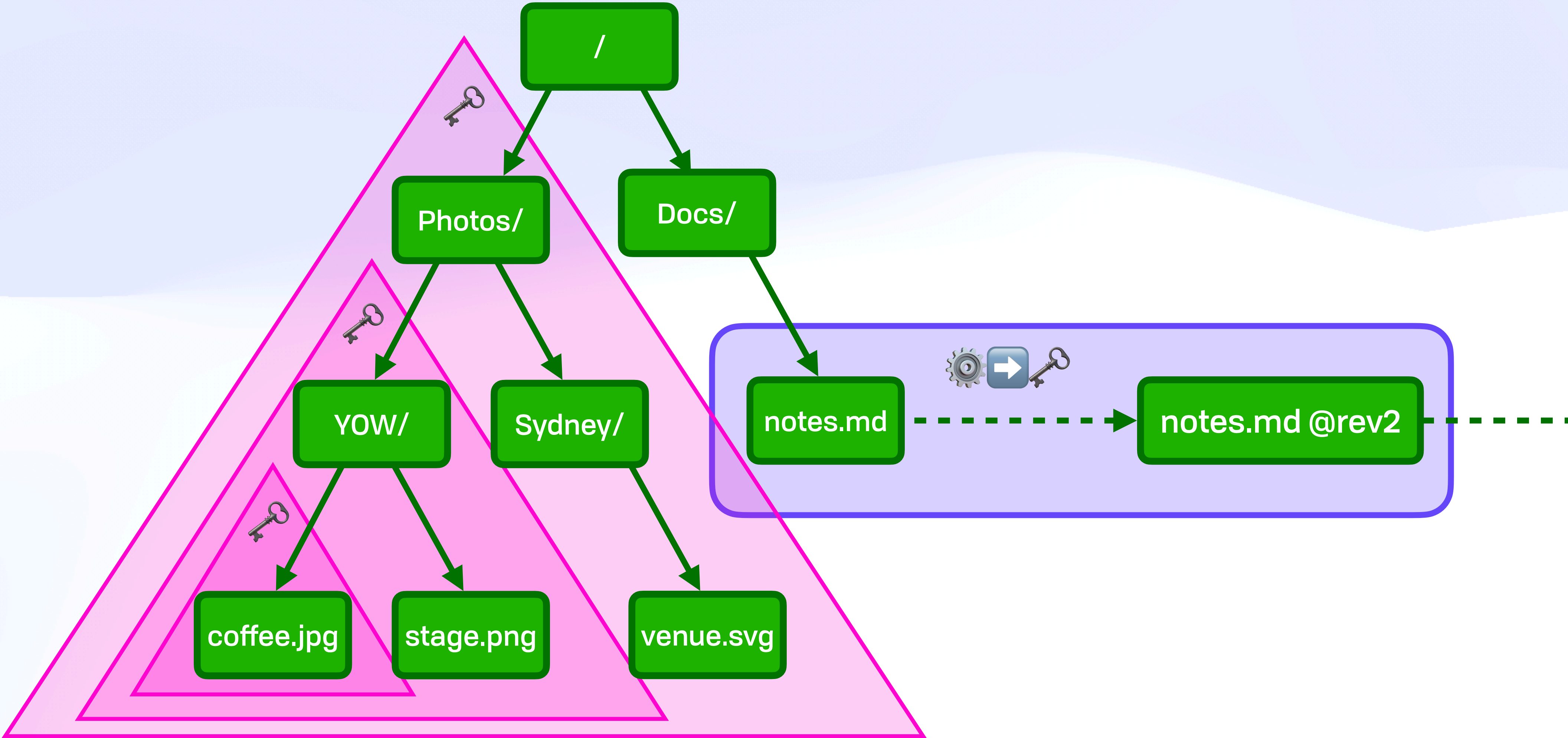
Access Control

Offline Read Control



Access Control

Offline Read Control



Access Control

ACL Redux

Access Control

ACL Redux



Access Control

ACL Redux



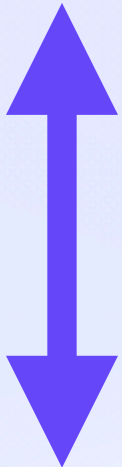
Access Control

ACL Redux



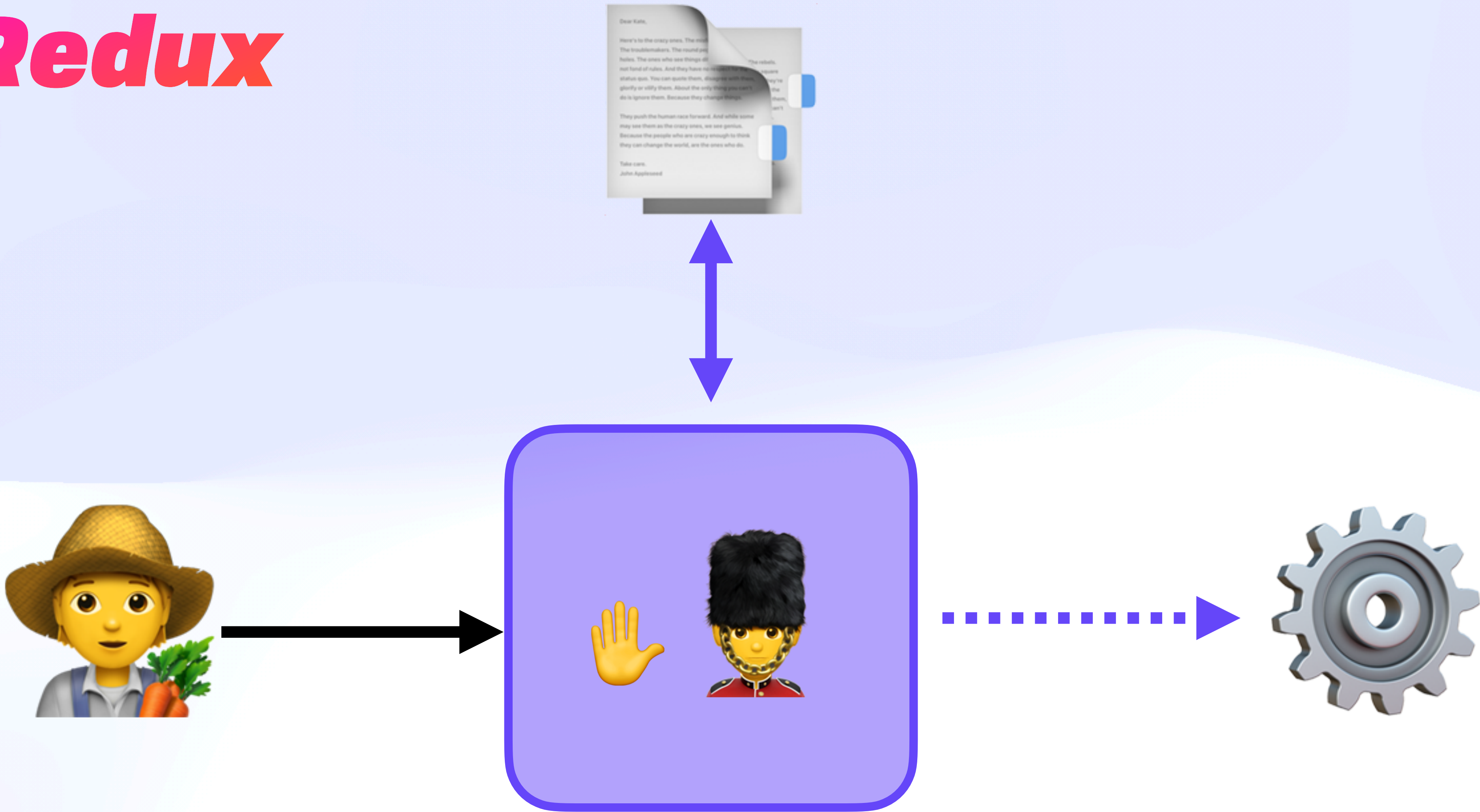
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ACL Redux



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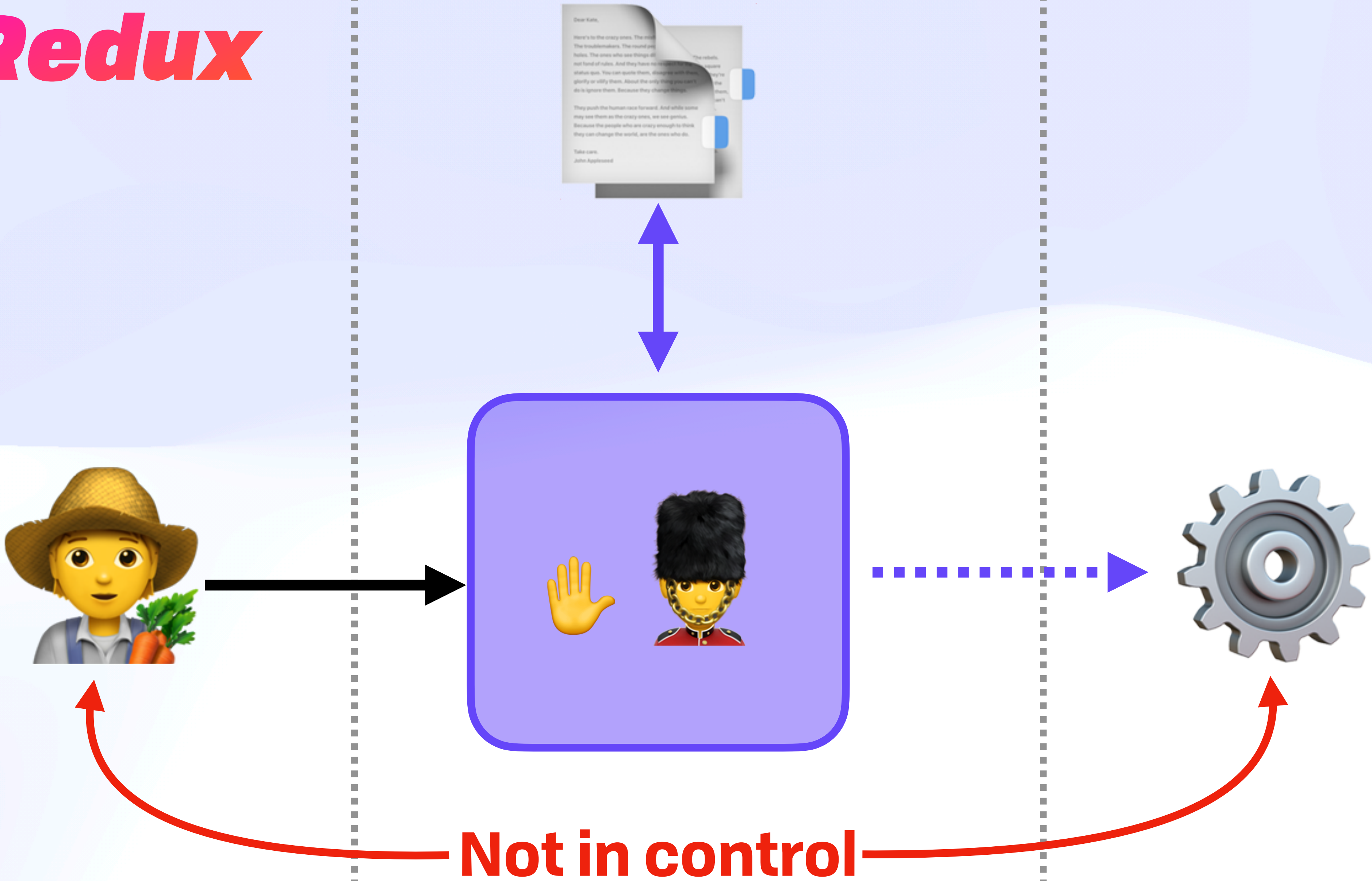
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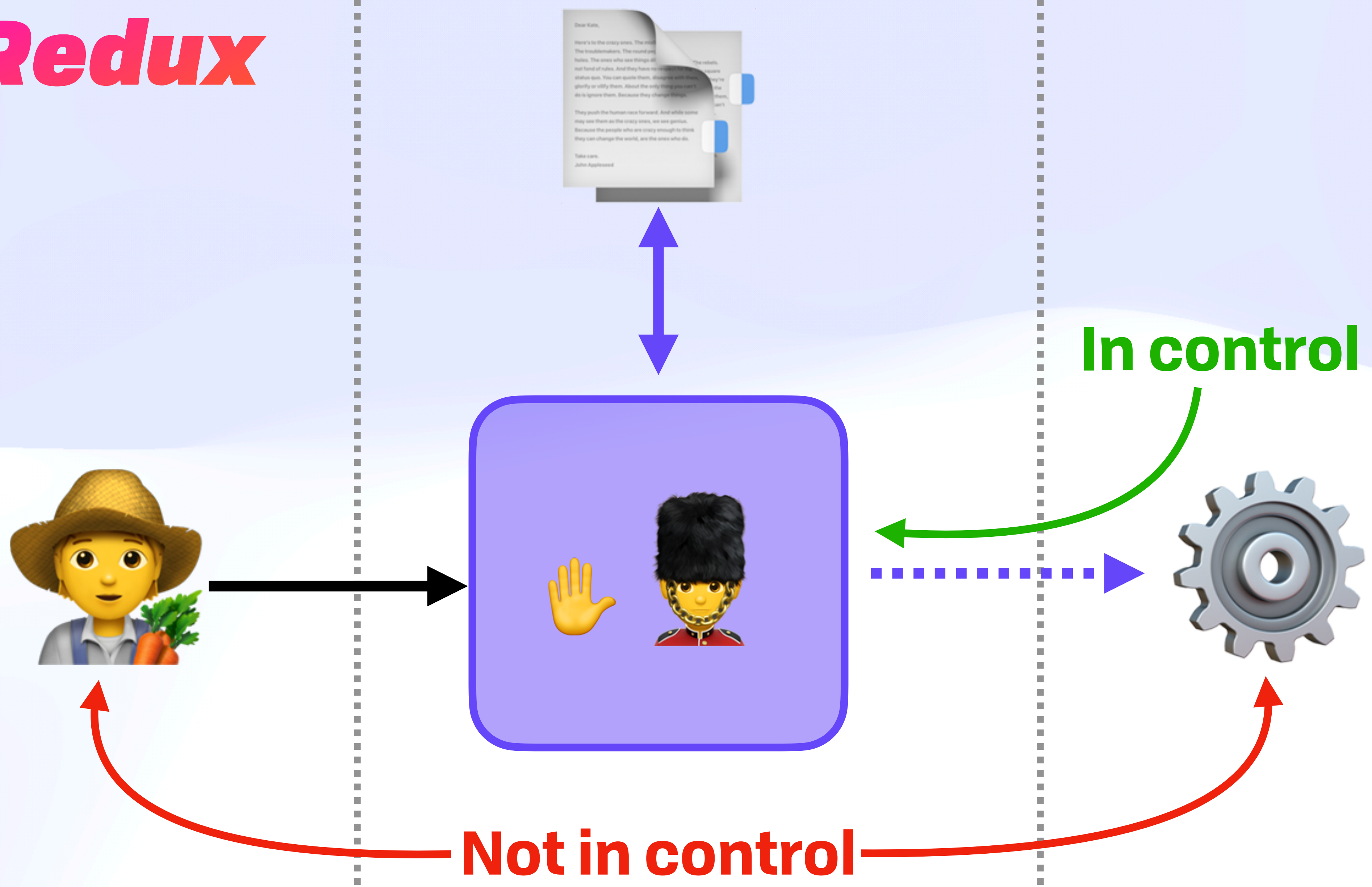
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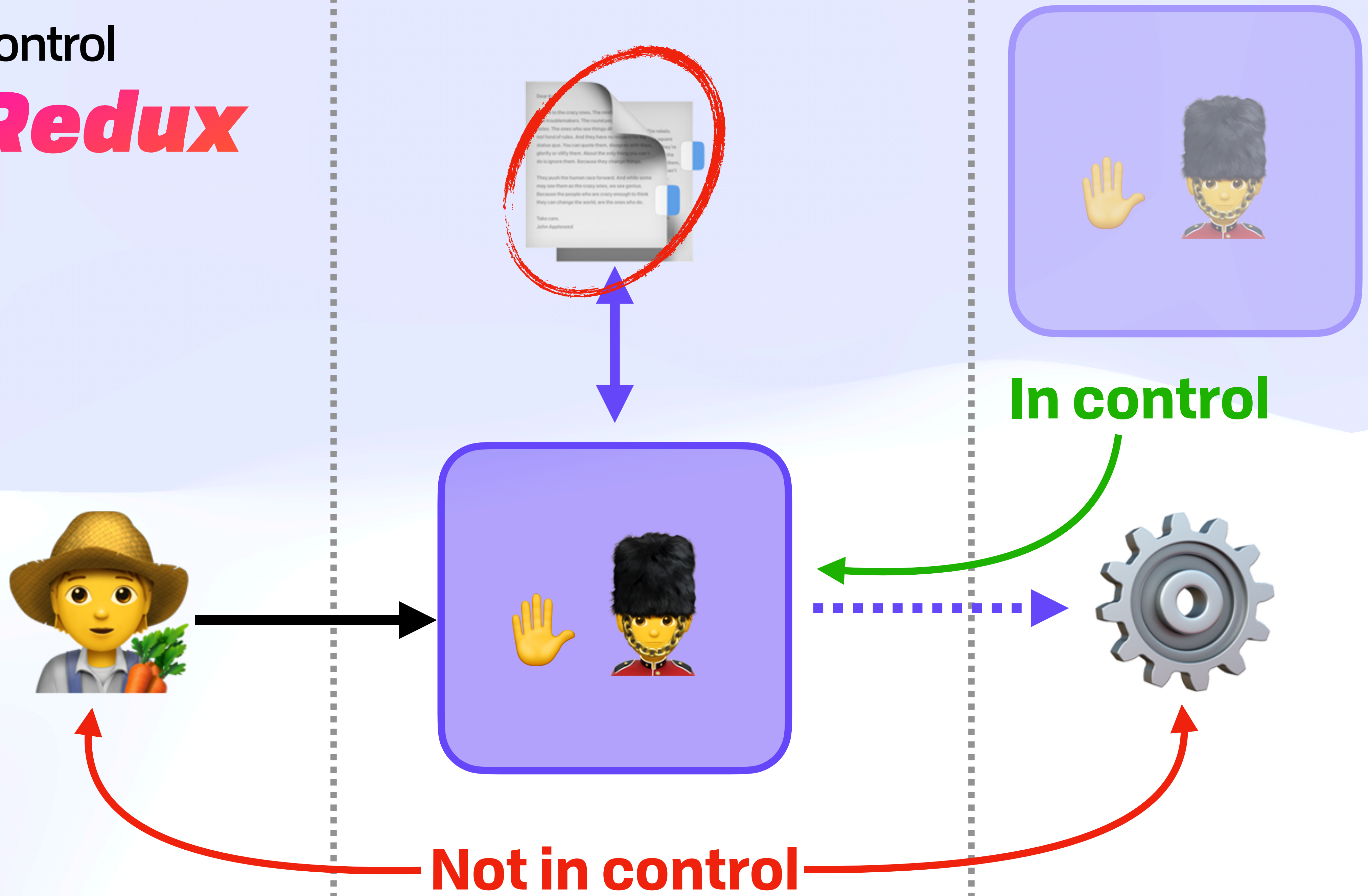
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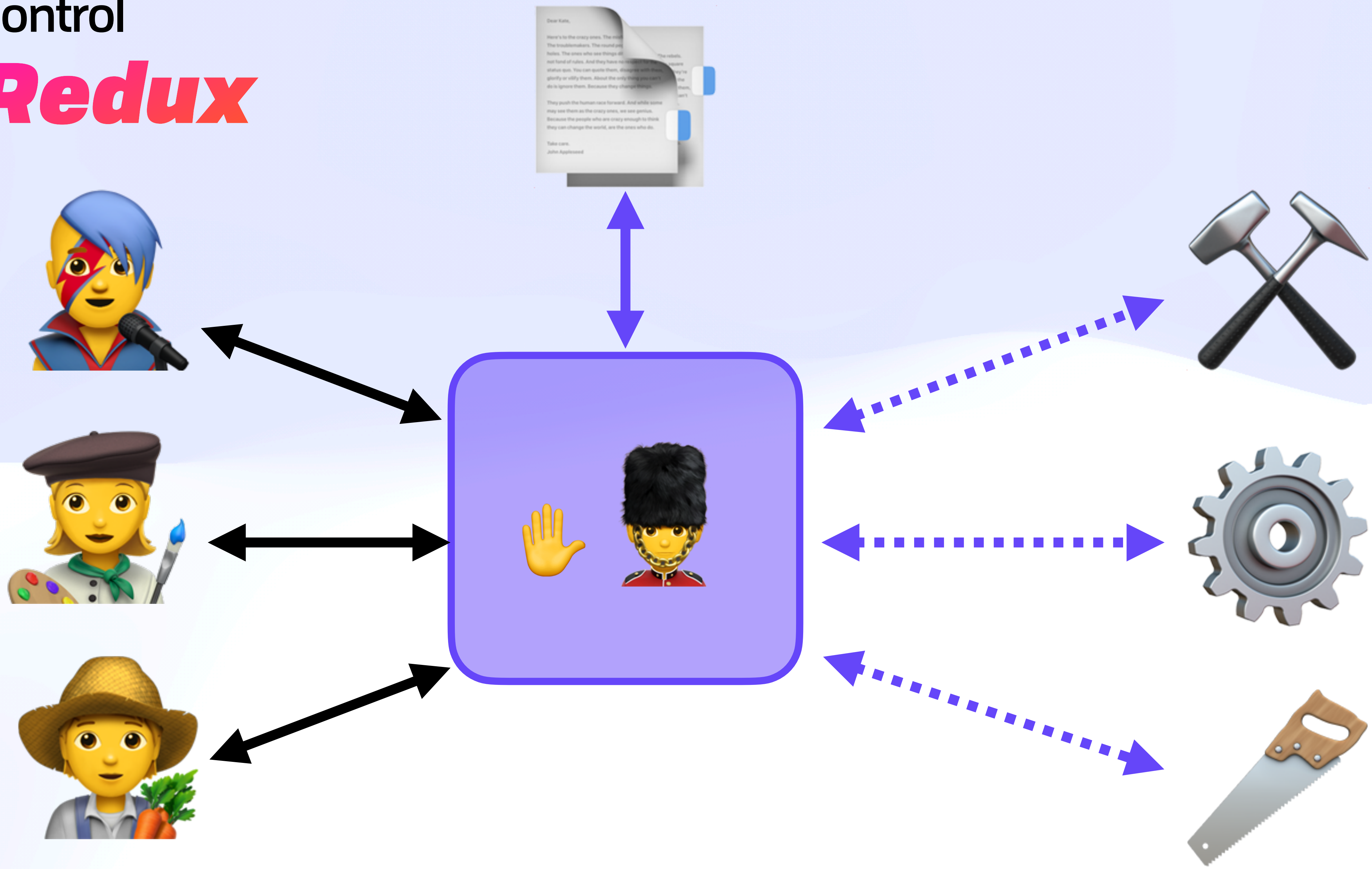
Access Control

ACL Redux



Access Control

ACL Redux



Access Control

Capabilities

Access Control

Capabilities



Access Control

Capabilities



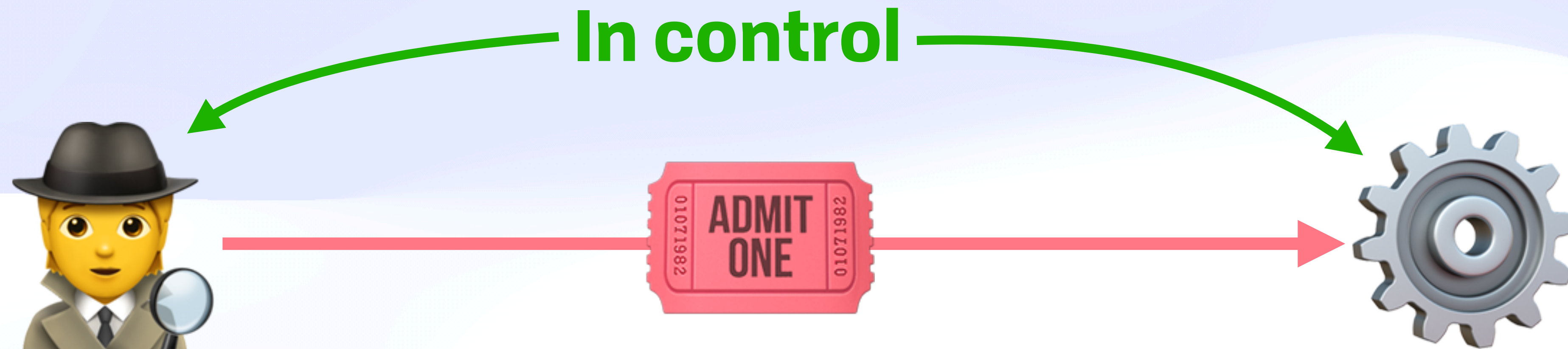
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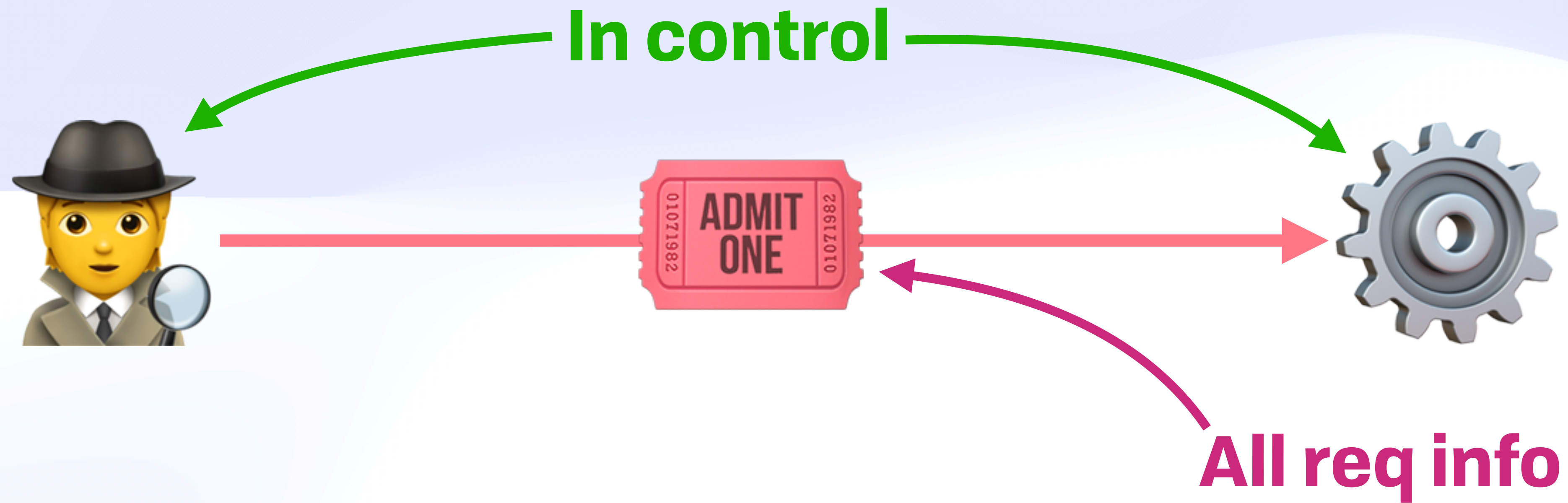
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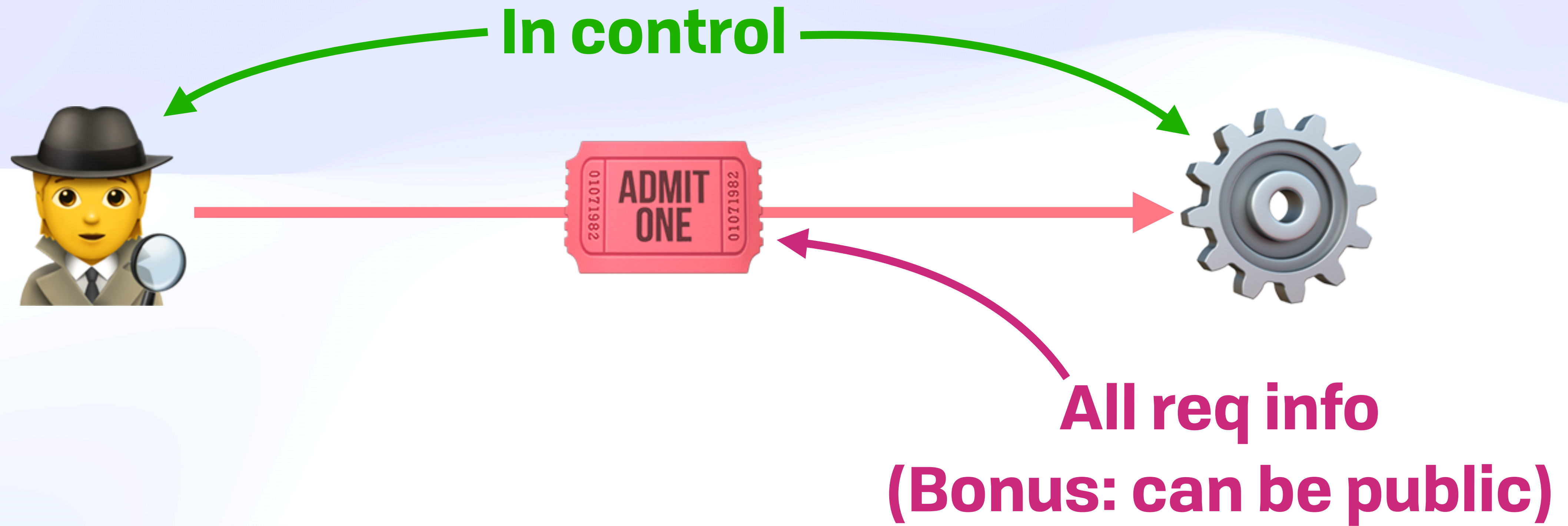
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Access Control

Capabilities



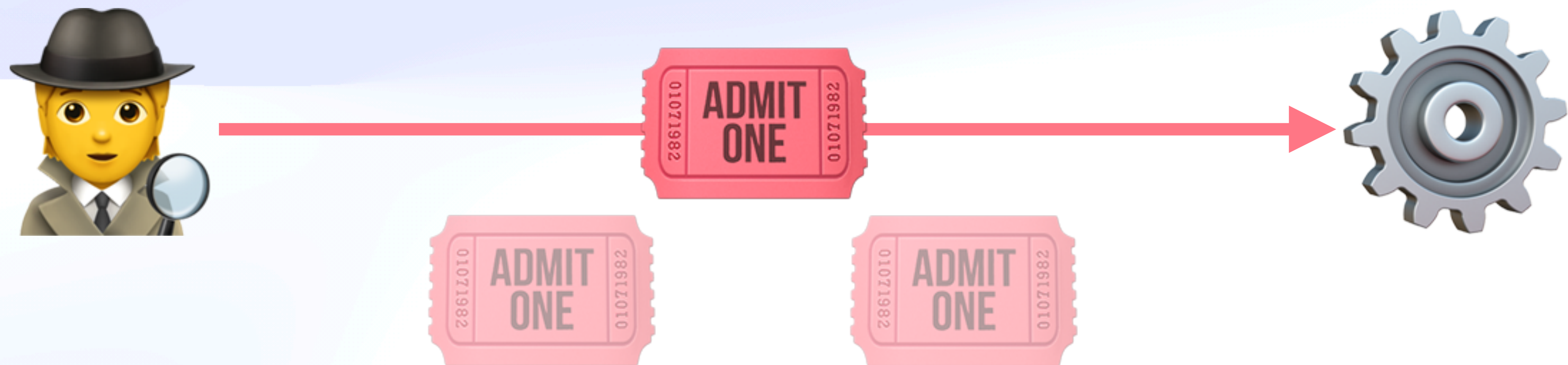
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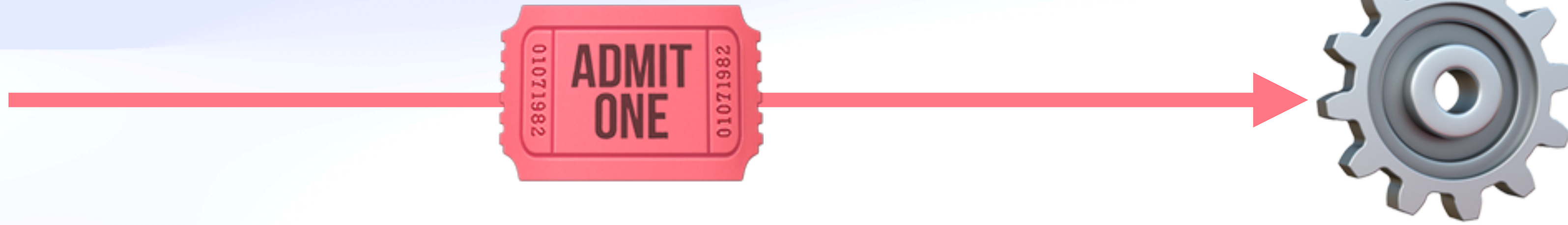
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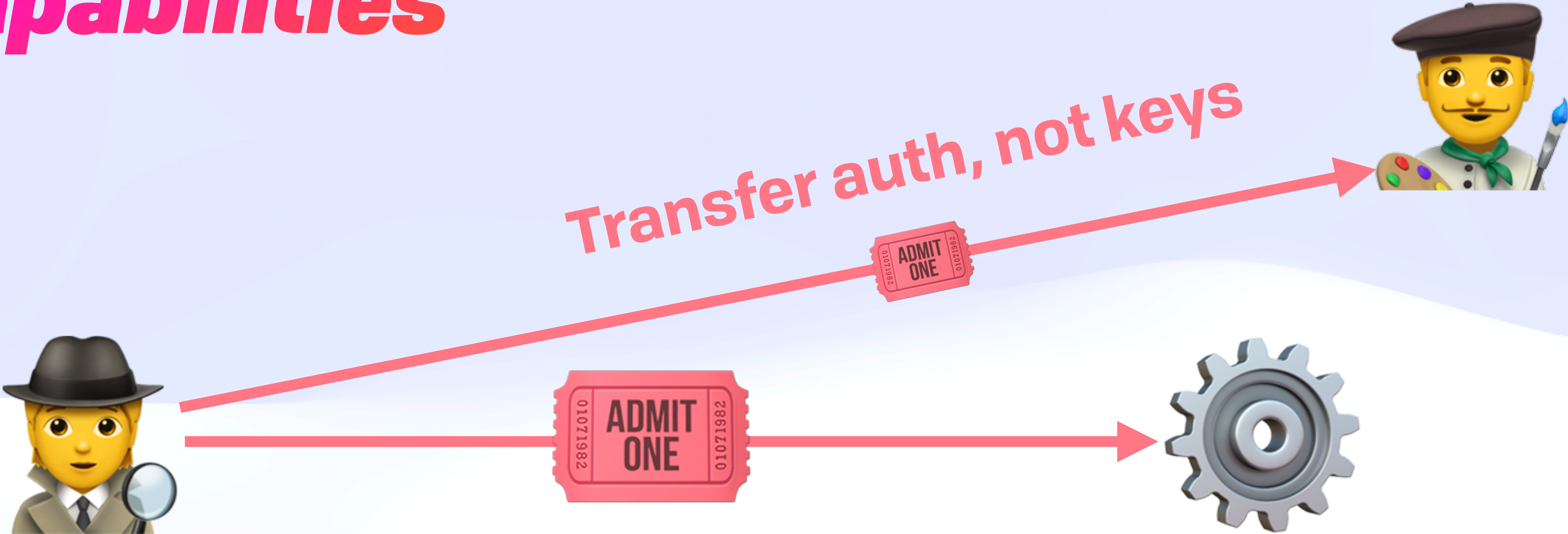
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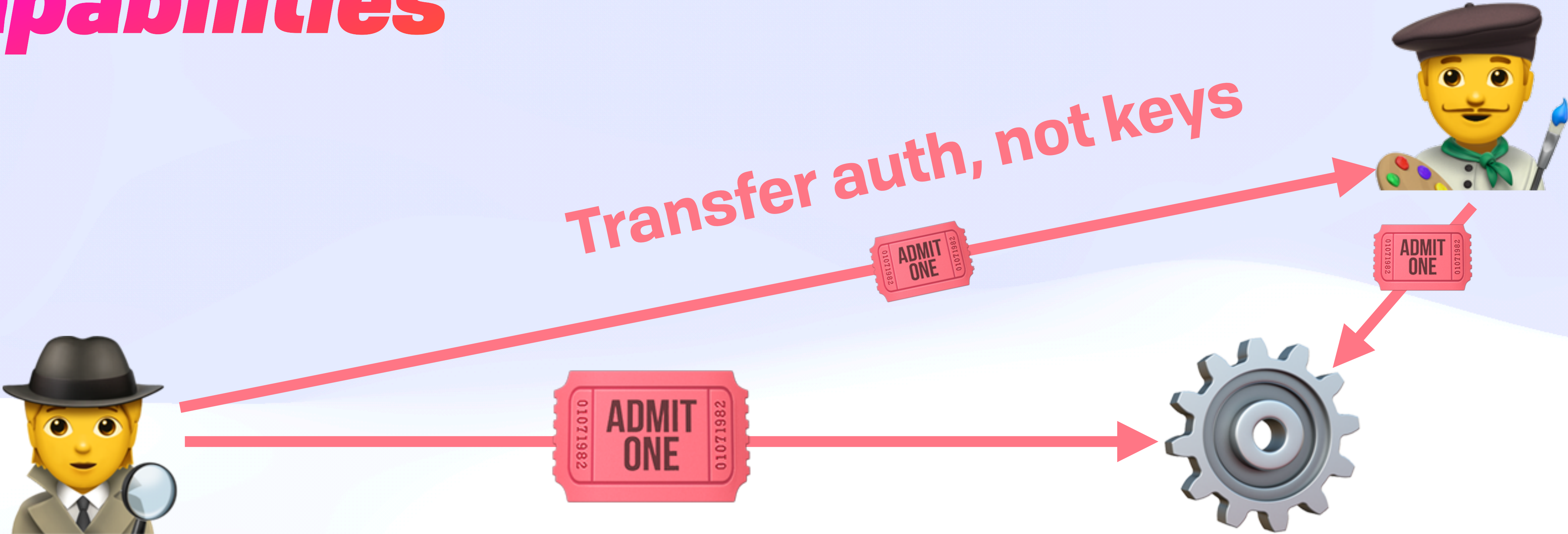
Access Control

Capabilities



Access Control

Capabilities



Access Control

JWT++

```
{
  "aud": "did:key:zStEZpzSMtTt9k2vszgvCwF4fLQQSyA15W5AQ4z3AR6Bx4eFJ5crJFbuGxKmbma4",
  "iss": "did:key:z5C4fuP2DDJChhMBCwAkpYUMuJZdNWWH5NeYjUyY8btYfzDh3aHwT5picHr9Ttjq",

  "nbf": 1611204719,
  "exp": 1611300000,

  "fct": [
    {
      "sha256": "B94D27B9934D3E08A52E52D7DA7DABFAC484EFE37A5380EE9088F7ACE2EFCDE9",
      "msg": "hello world"
    }
  ]

  "att": [
    {
      "wnfs": "boris.fission.name/public/photos/",
      "cap": "OVERWRITE"
    },
    {
      "email": "boris@fission.codes",
      "cap": "SEND"
    }
  ],

  "prf": [
    "eyJhbGciOiJSUzI1NiIsInR5cCI6IkpXVCIsInVhdDI6IjAuMS4wIn0.eyJhdWQiOiJkaWQ6a2V5Onp"
  ]
}
```


Access Control

JWT++

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  "iss": "did:key:z5C4fuP2DDJChhMBCwAkpYUMuJZdNWWH5NeYjUyY8btYfzDh3aHwT5picHr9Ttjq",

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    }
  ],

  "prf": [
    "eyJhbGciOiJSUzI1NiIsInR5cCI6IkpXVCIsInVhdDI6IjAuMS4wIn0.eyJhdWQiOiJkaWQ6a2V5Onpj"
  ]
}
```


Access Control

JWT++

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  "iss": "did:key:z5C4fuP2DDJChhMBCwAkpYUMuJZdNWWH5NeYjUyY8btYfzDh3aHwT5picHr9Ttjq",

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  ],

  "prf": [
    "eyJhbGciOiJSUzI1NiIsInR5cCI6IkpXVCIsInVhdDI6IjAuMS4wIn0.eyJhdWQiOiJkaWQ6a2V5Onpj"
  ]
}
```


Access Control

JWT++

```
{
  "aud": "did:key:zStEZpzSMtTt9k2vszgvCwF4fLQ0SvA15W5AQ4z3AR6Bx4eFJ5crJFbuGxKmbma4",
  "iss": "did:key:z5C4fuP2DDJChhMBCwAkpYUMuJZdNWWH5NeYjUyY8btYfzDh3aHwT5picHr9Ttjq",

  "nbf": 1611204719,
  "exp": 1611300000,

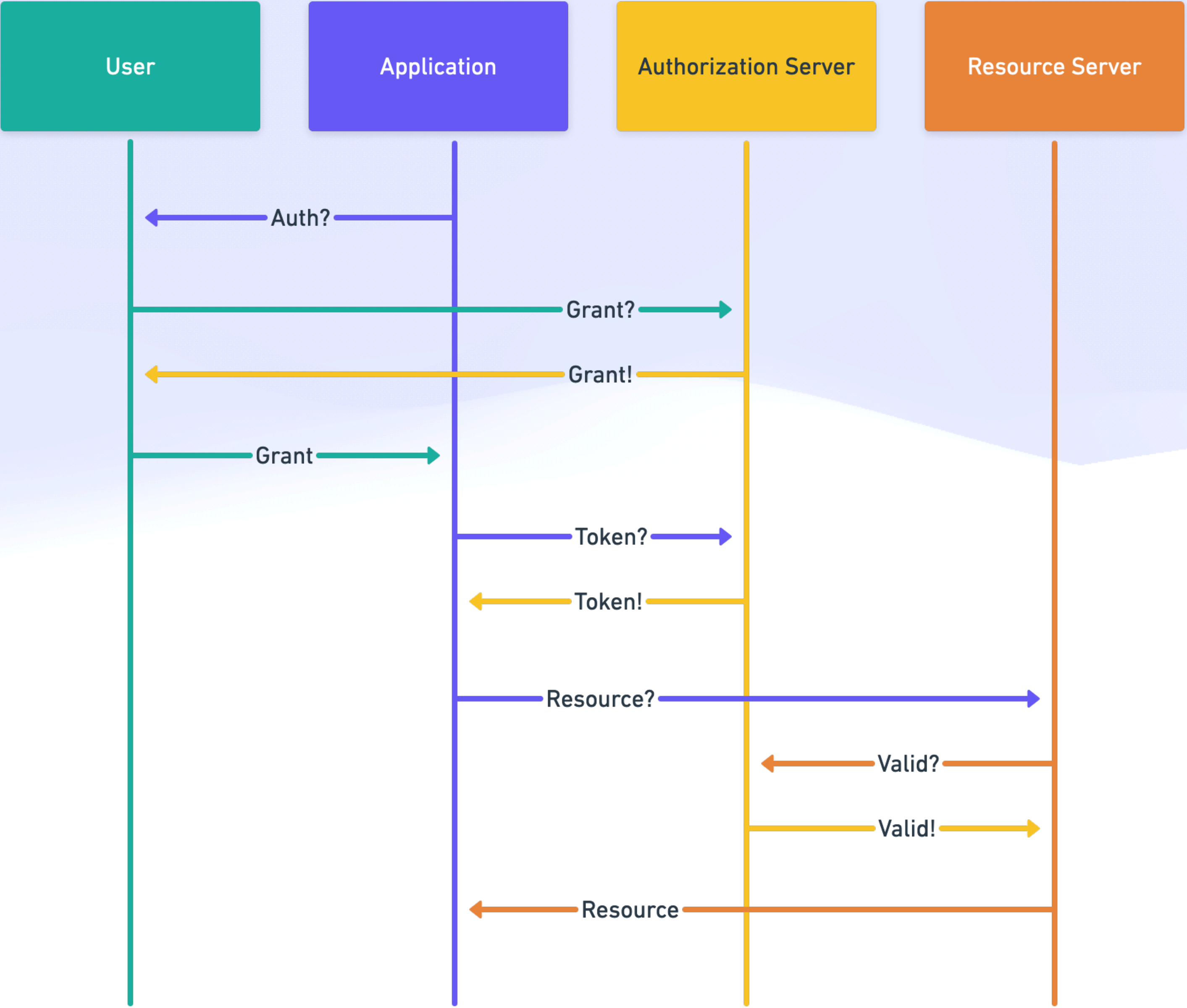
  "fct": [
    {
      "sha256": "B94D27B9934D3E08A52E52D7DA7DABFAC484EFE37A5380EE9088F7ACE2EFCDE9",
      "msg": "hello world"
    }
  ]

  "att": [
    {
      "wnfs": "boris.fission.name/public/photos/",
      "cap": "OVERWRITE"
    },
    {
      "email": "boris@fission.codes",
      "cap": "SEND"
    }
  ],

  "prf": [
    "eyJhbGciOiJSUzI1NiIsInR5cCI6IkpXVCIsInVhdDI6IjAuMS4wIn0.eyJhdWQiOiJkaWQ6a2V5Onp"
  ]
}
```

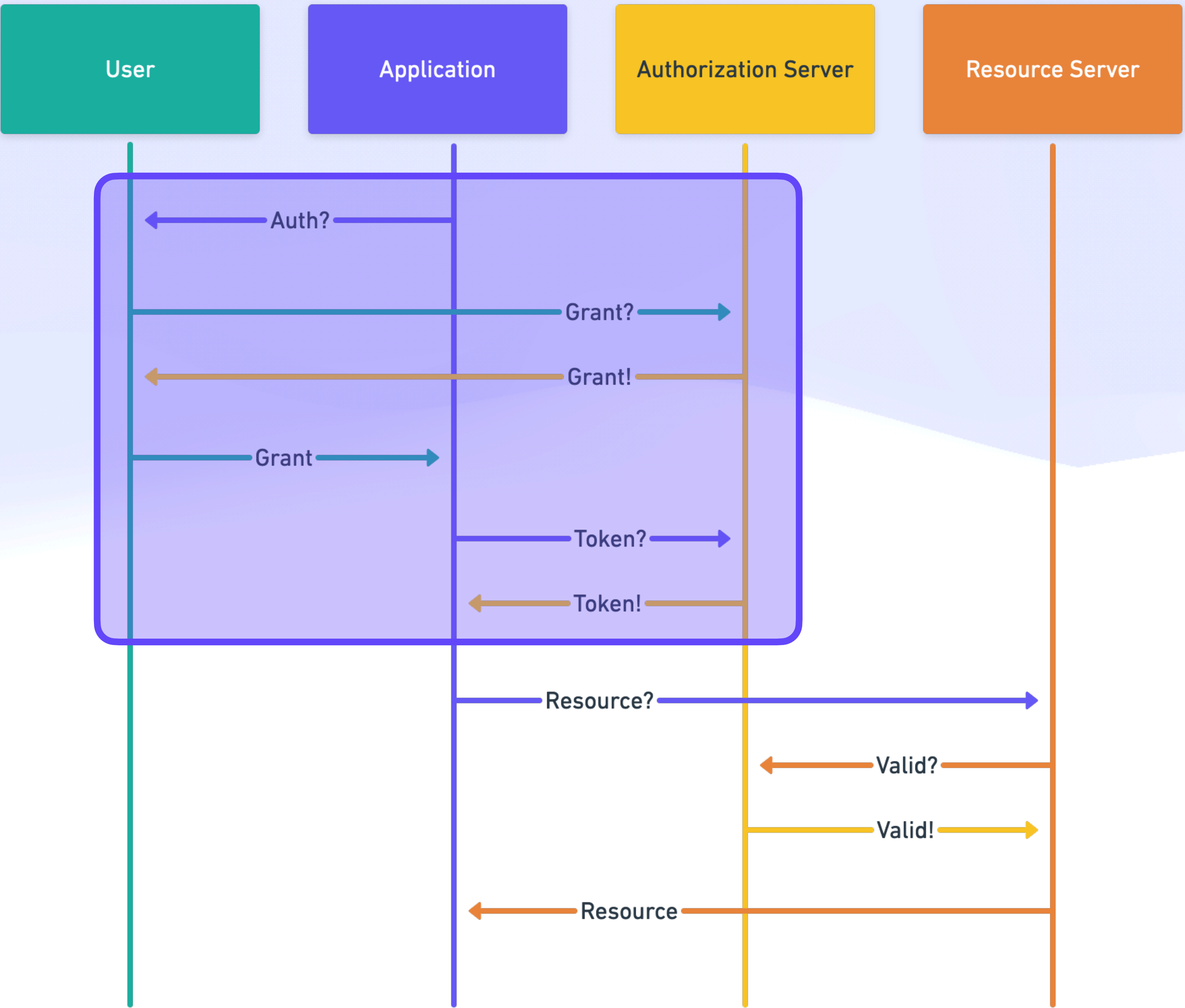

Access Control

OAuth Sequence



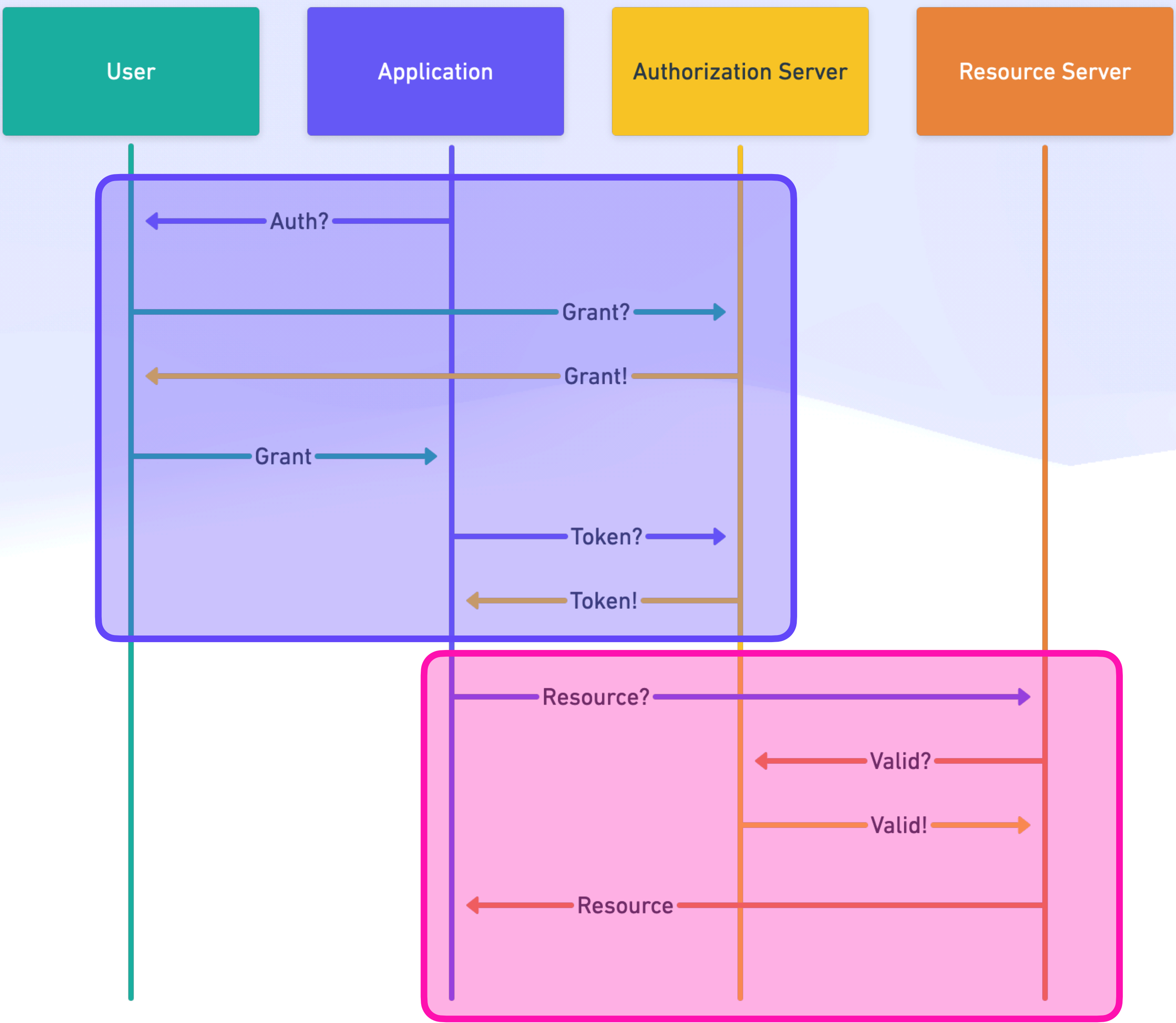
Access Control

OAuth Sequence



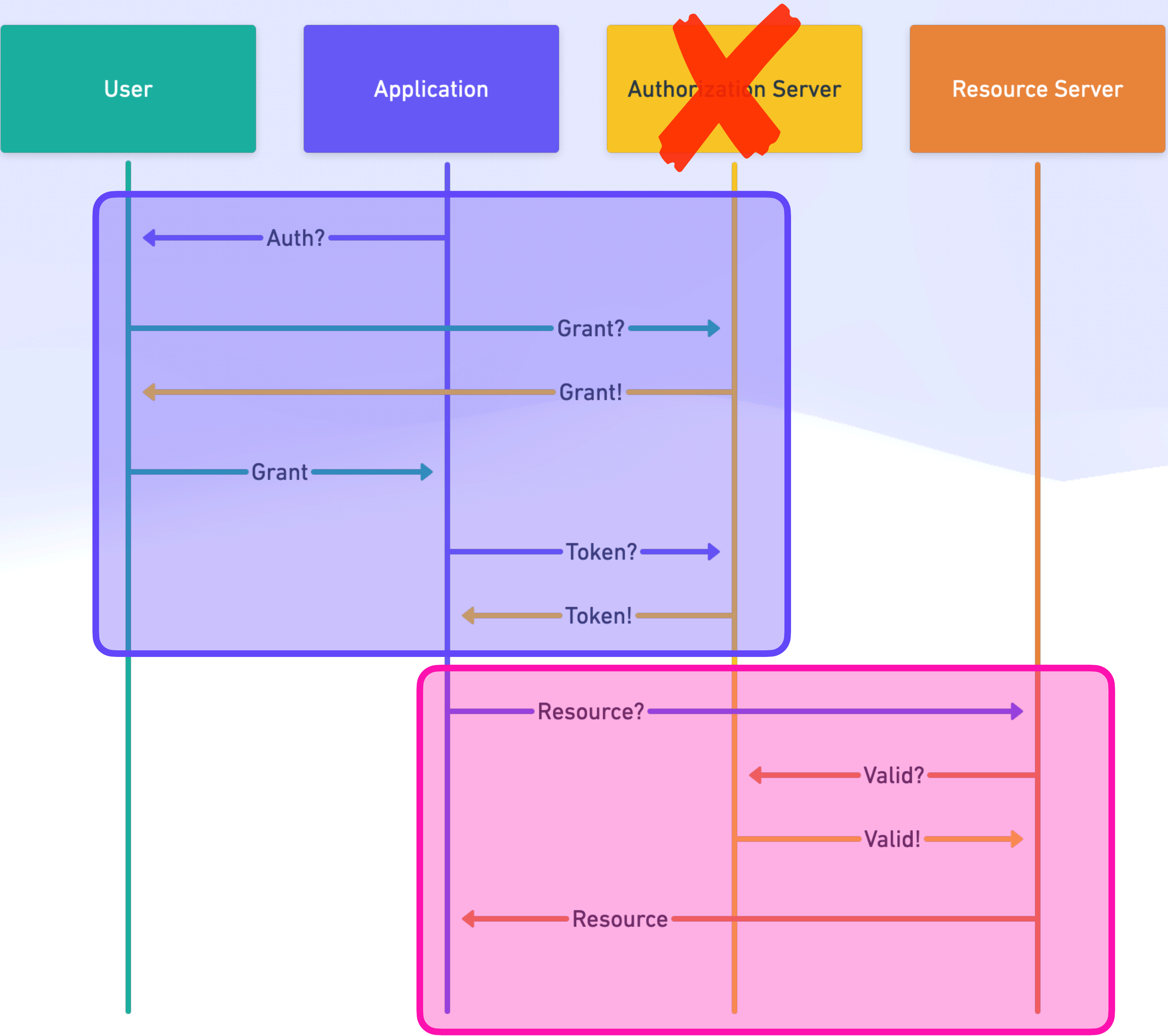
Access Control

OAuth Sequence



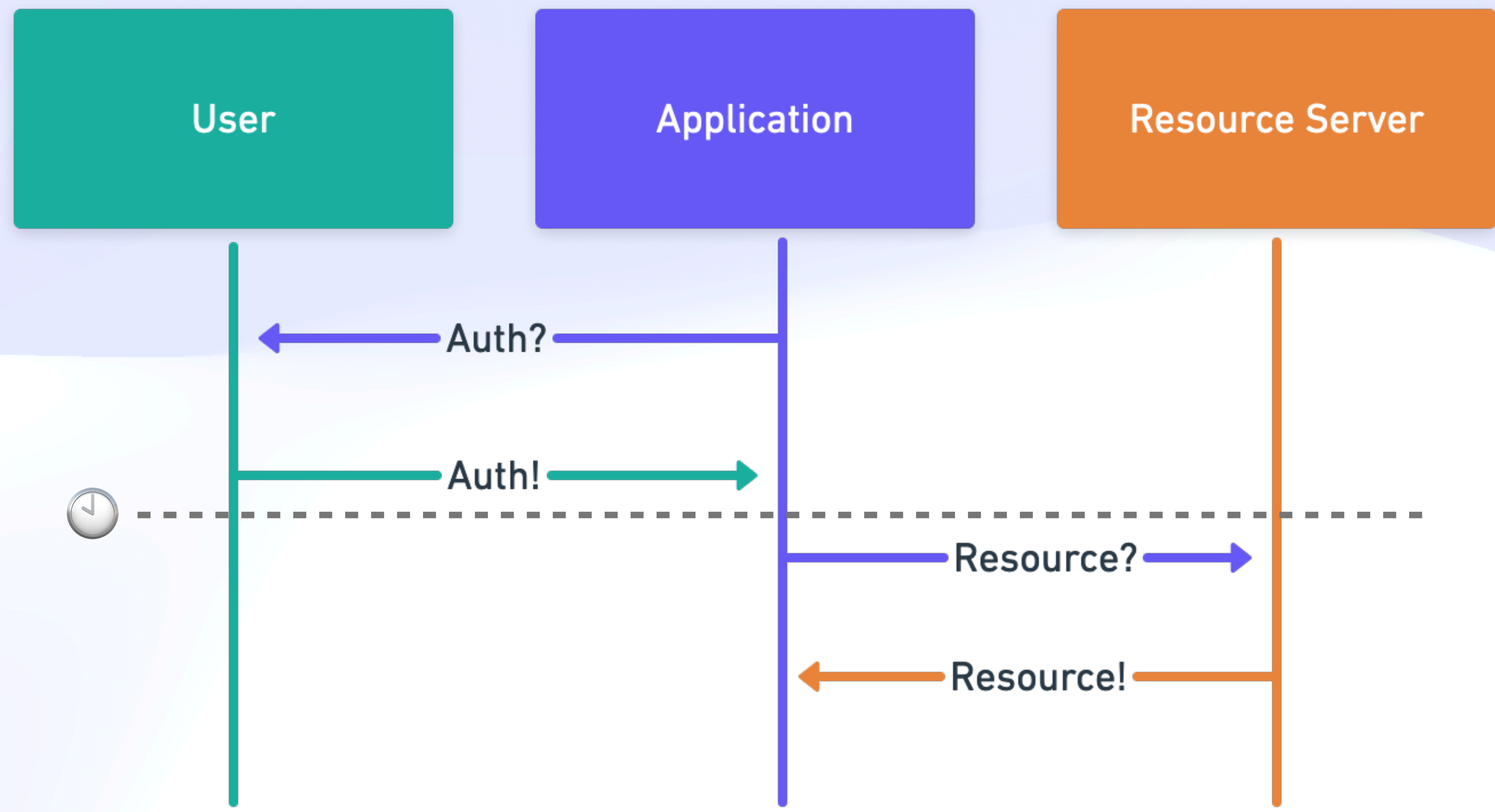
Access Control

OAuth Sequence



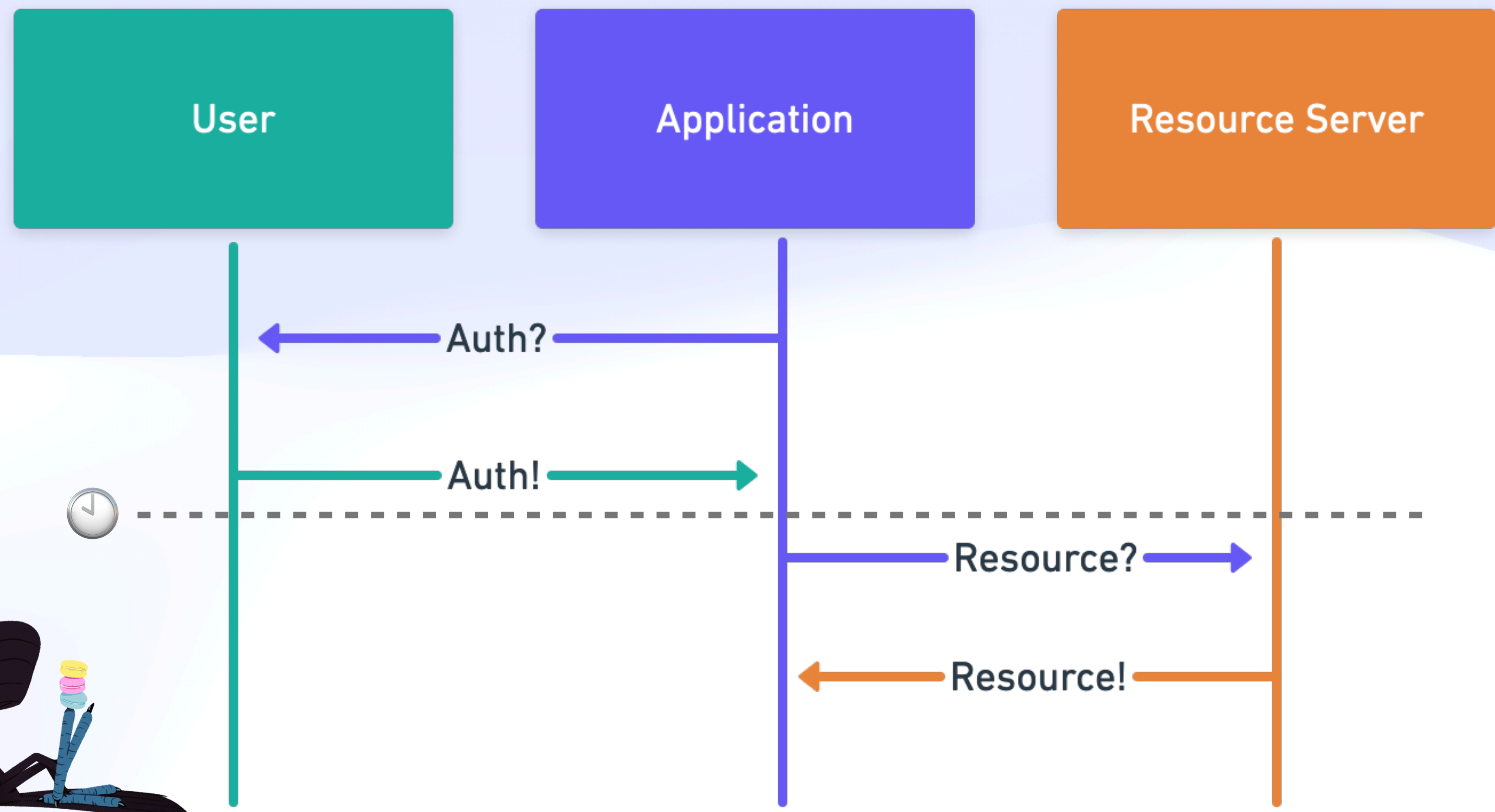
Access Control

UCAN Sequence



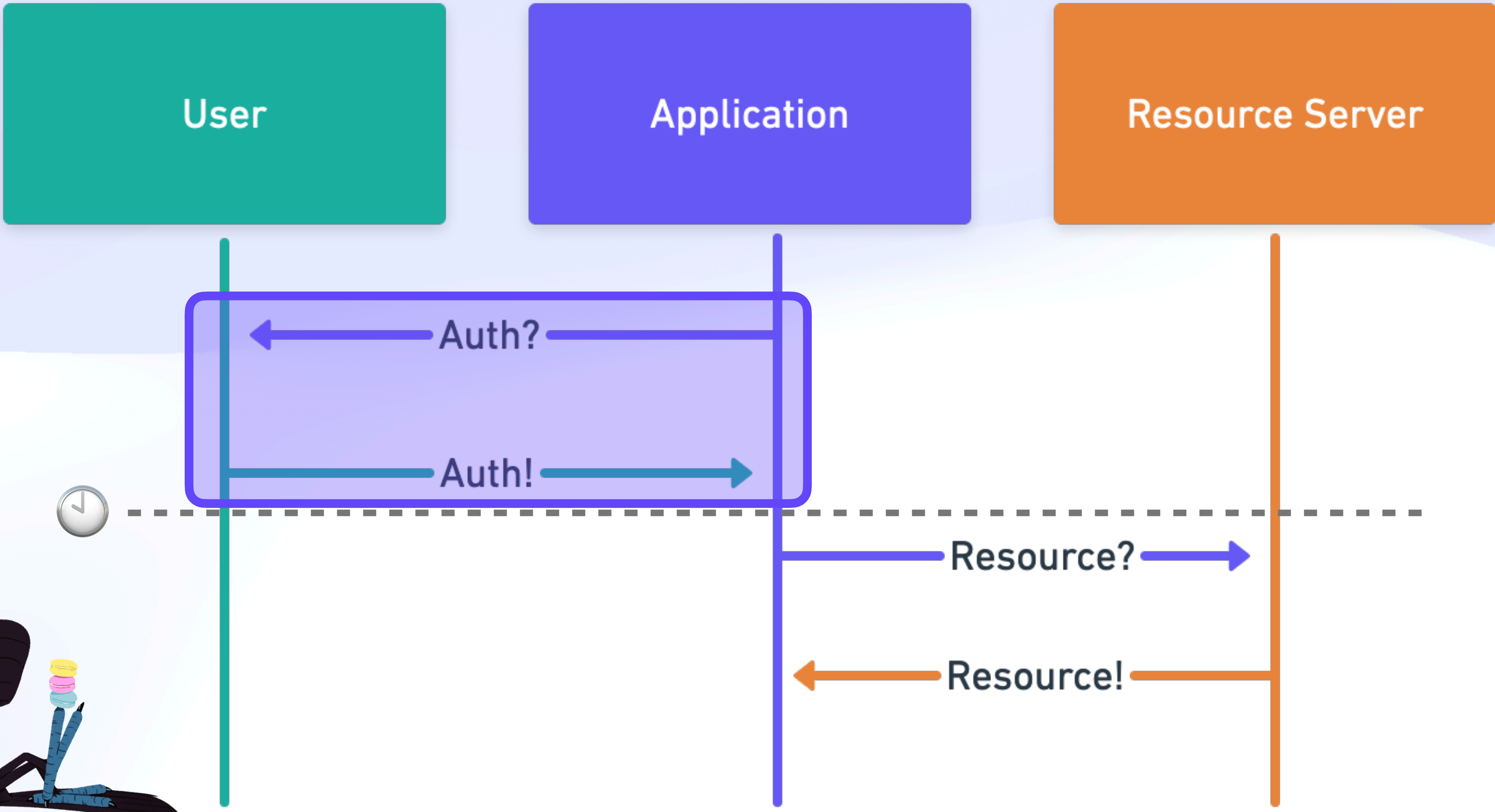
Access Control

UCAN Sequence



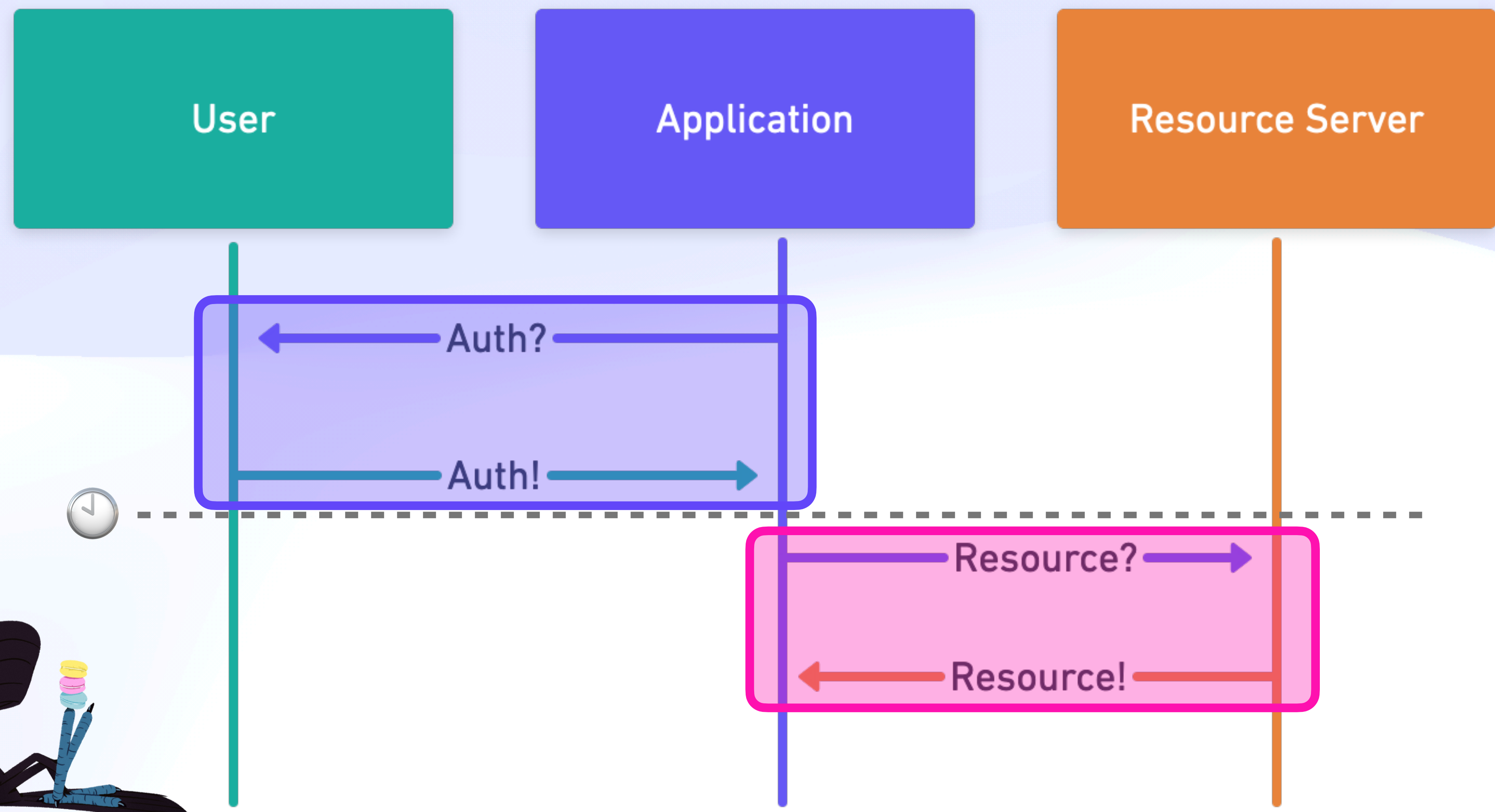
Access Control

UCAN Sequence



Access Control

UCAN Sequence



Access Control

Auth Accidents Will Happen

Access Control

Auth Accidents Will Happen

Byzantine Agent



Access Control

Auth Accidents Will Happen

Byzantine Agent



Revocation (non-monotone)



Goodbye Cloud, Hello Crowd

Universal Compute

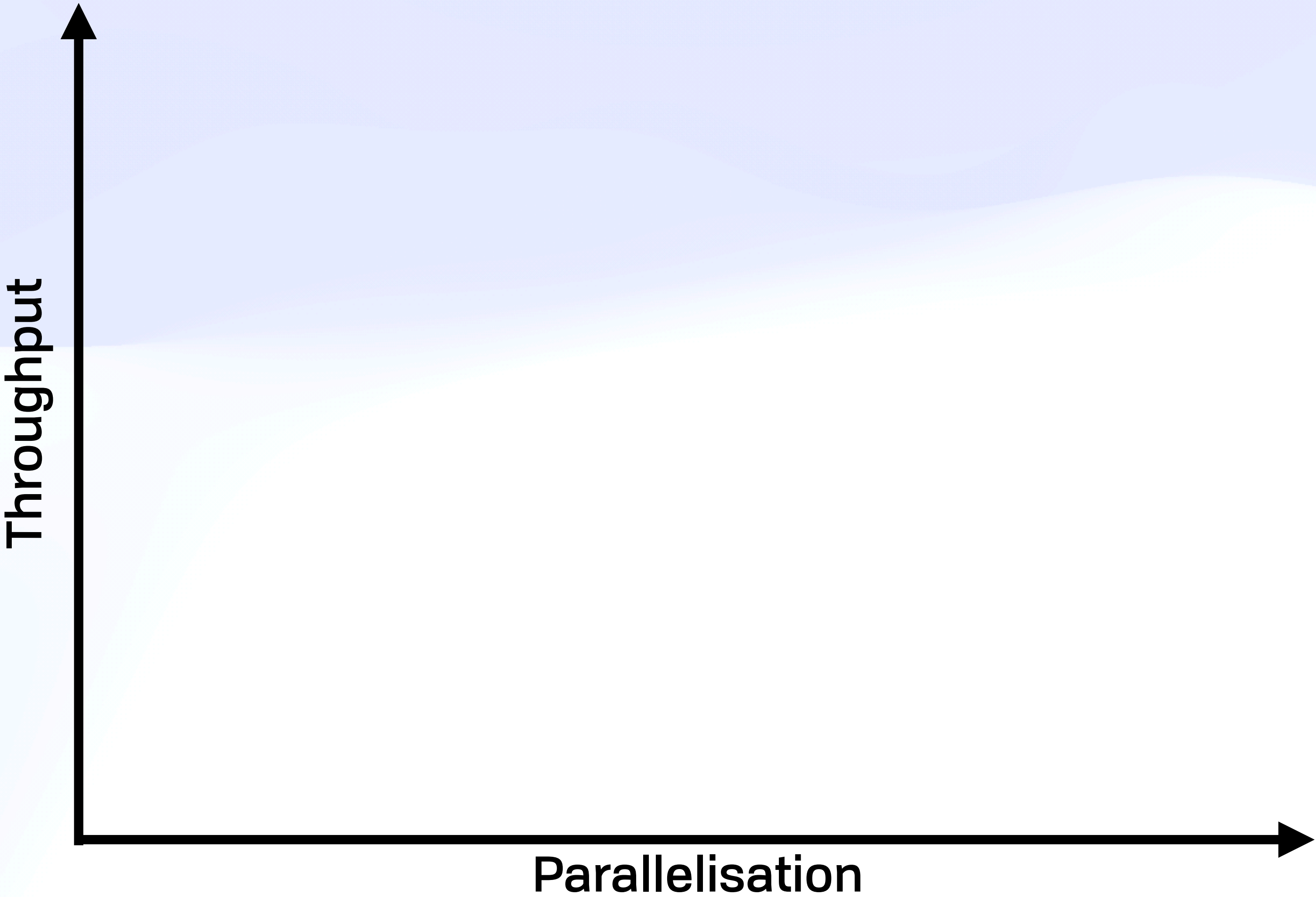


Compute Substrate

With a Little Help From My Friends

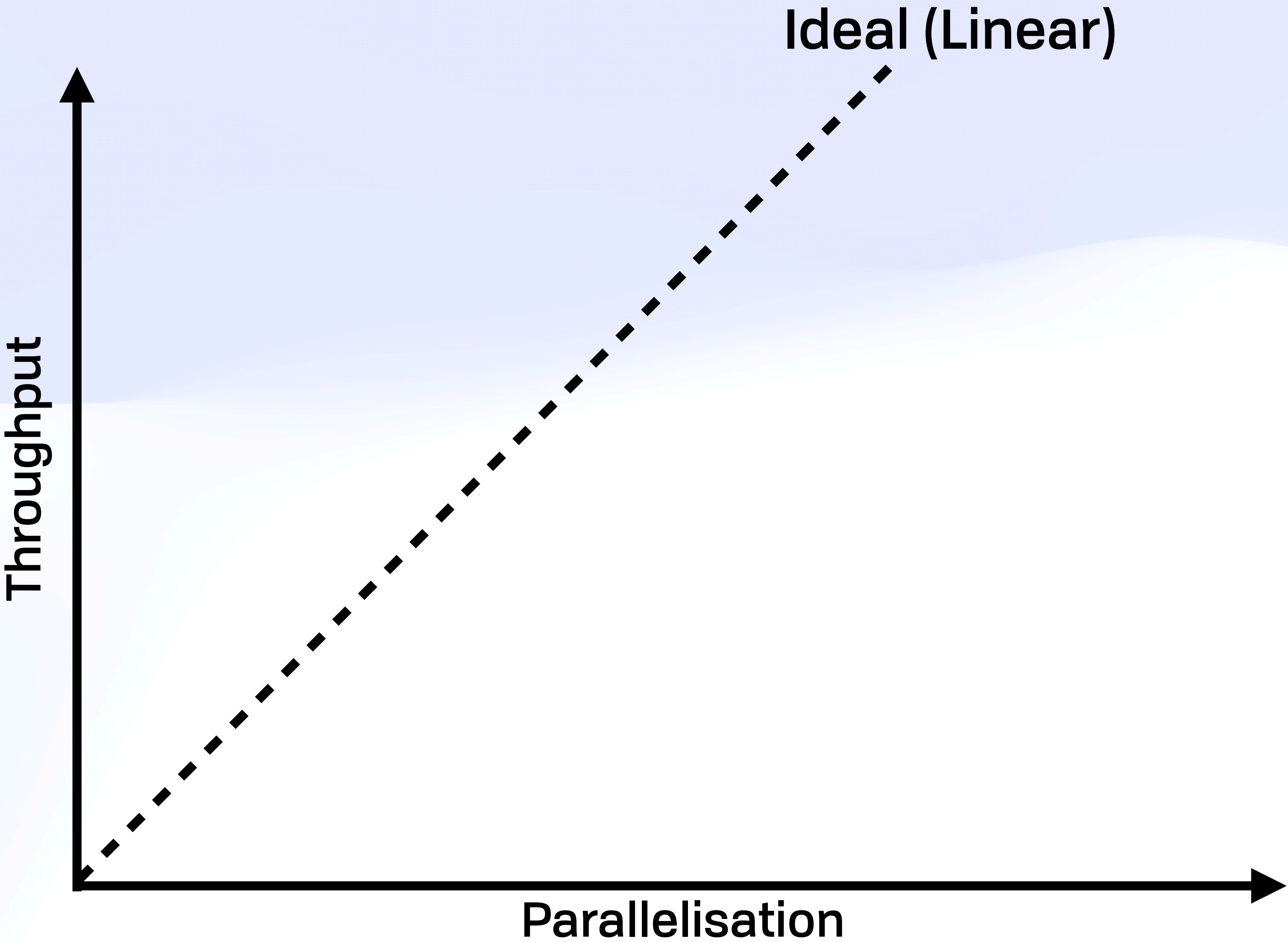
Compute Substrate

With a Little Help From My Friends



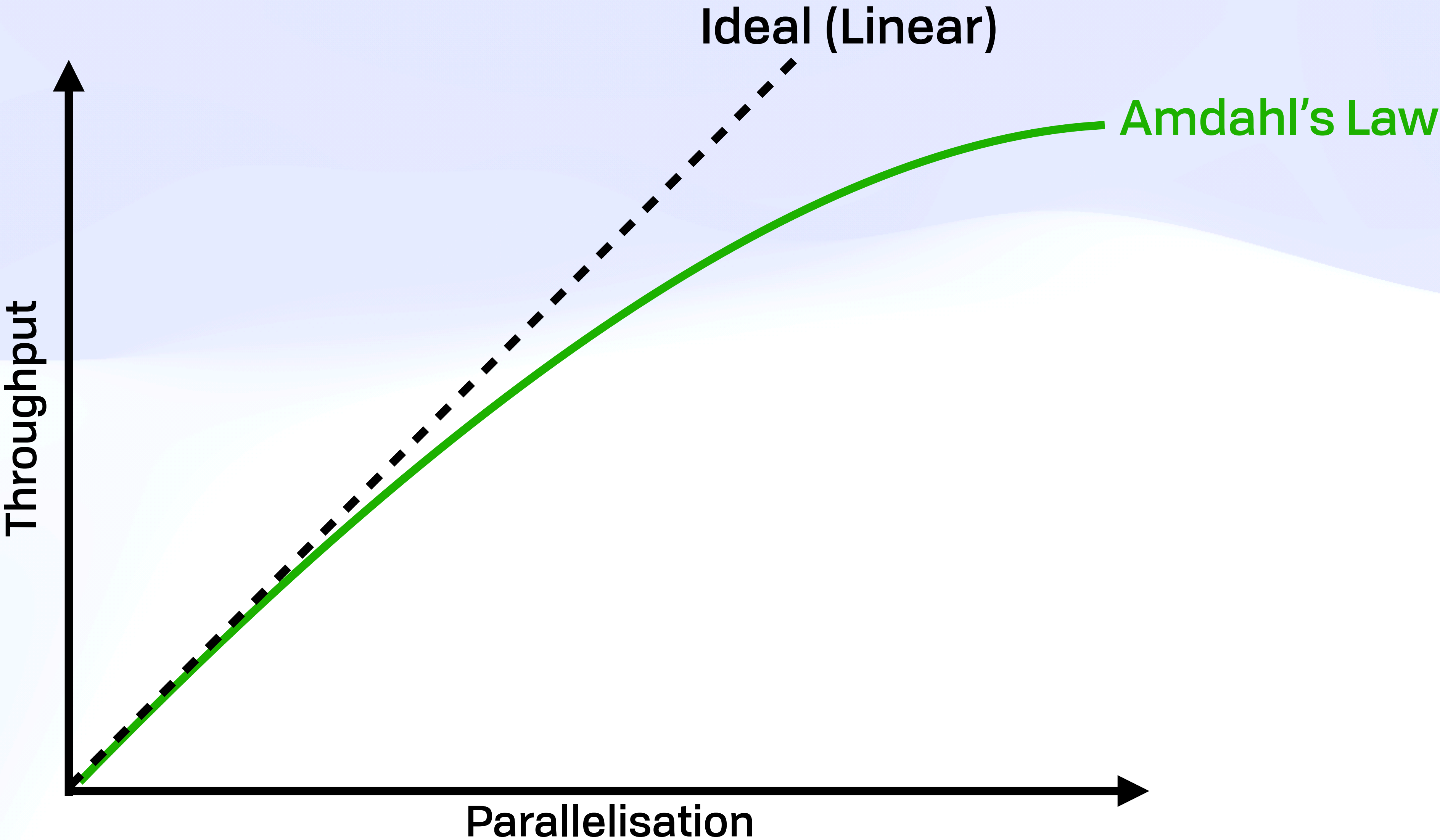
Compute Substrate

With a Little Help From My Friends



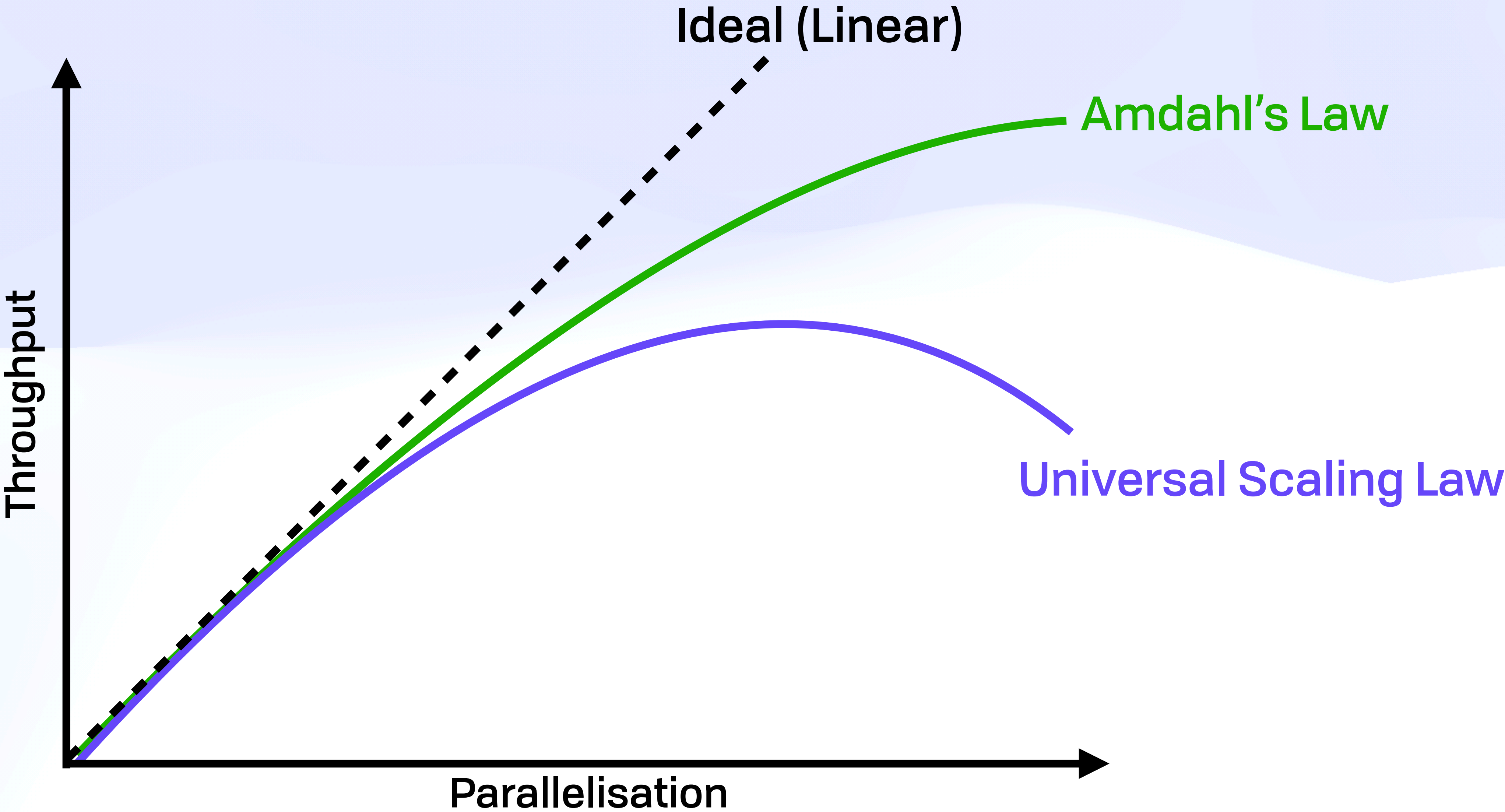
Compute Substrate

With a Little Help From My Friends



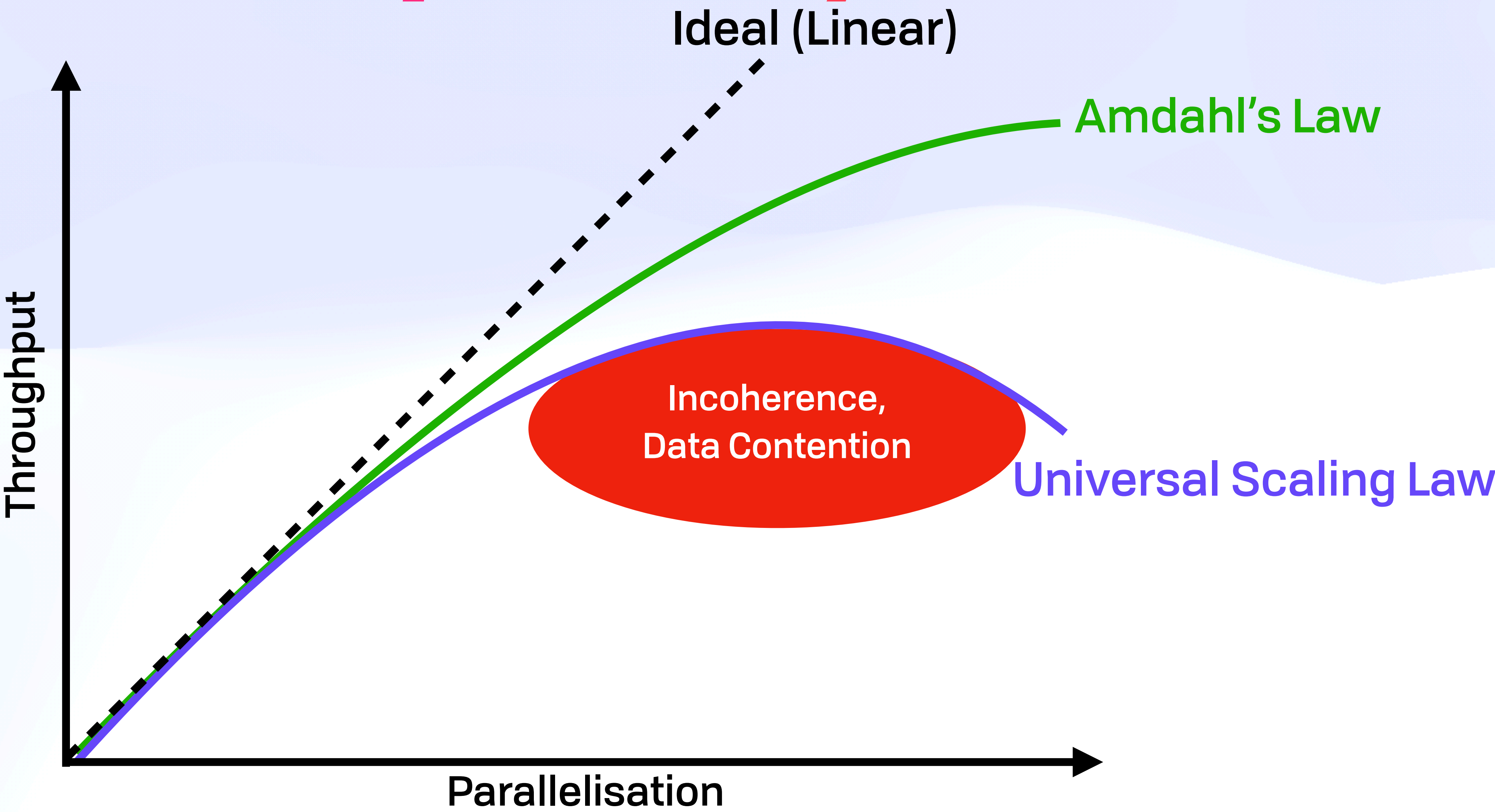
Compute Substrate

With a Little Help From My Friends



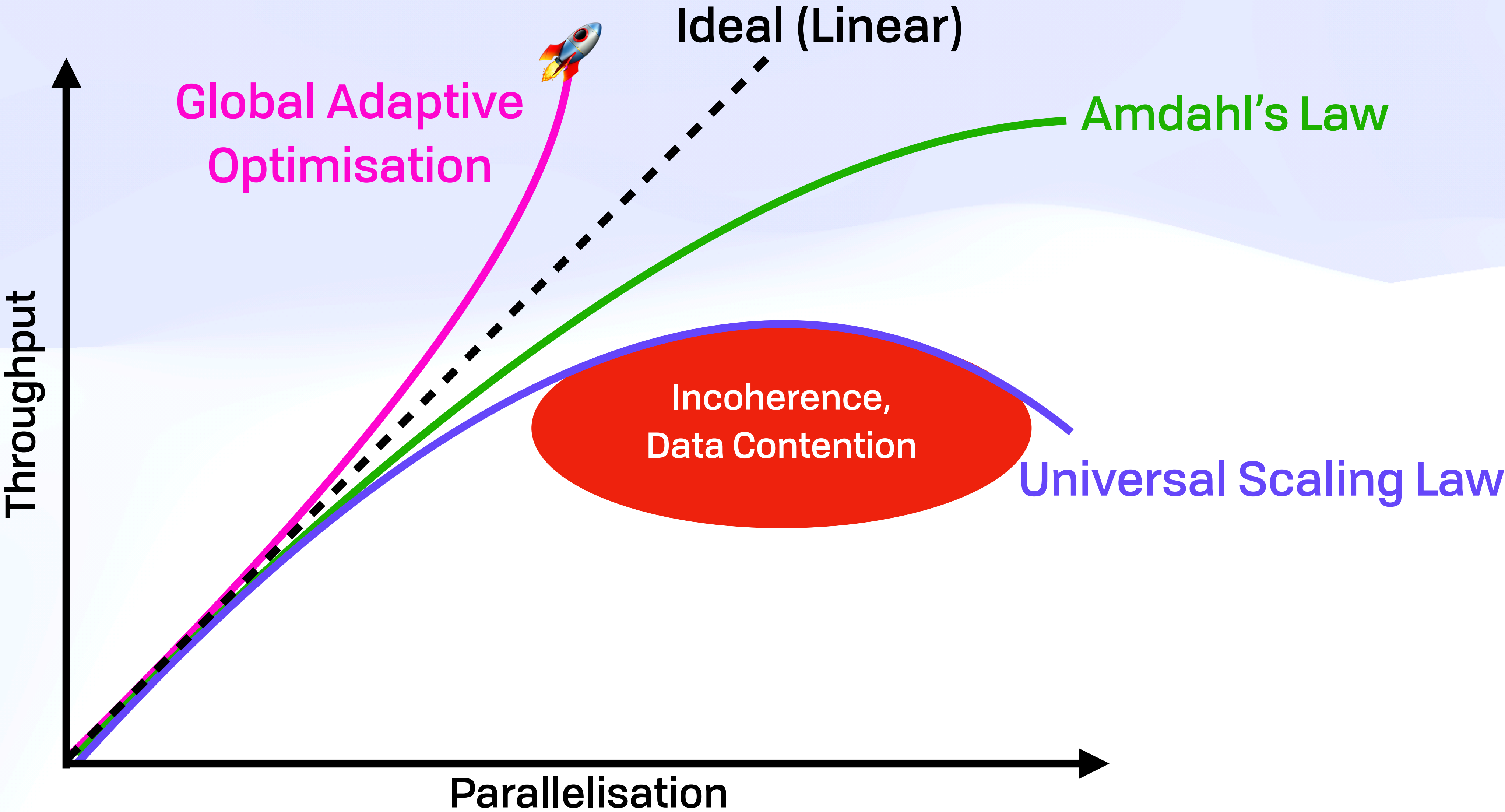
Compute Substrate

With a Little Help From My Friends



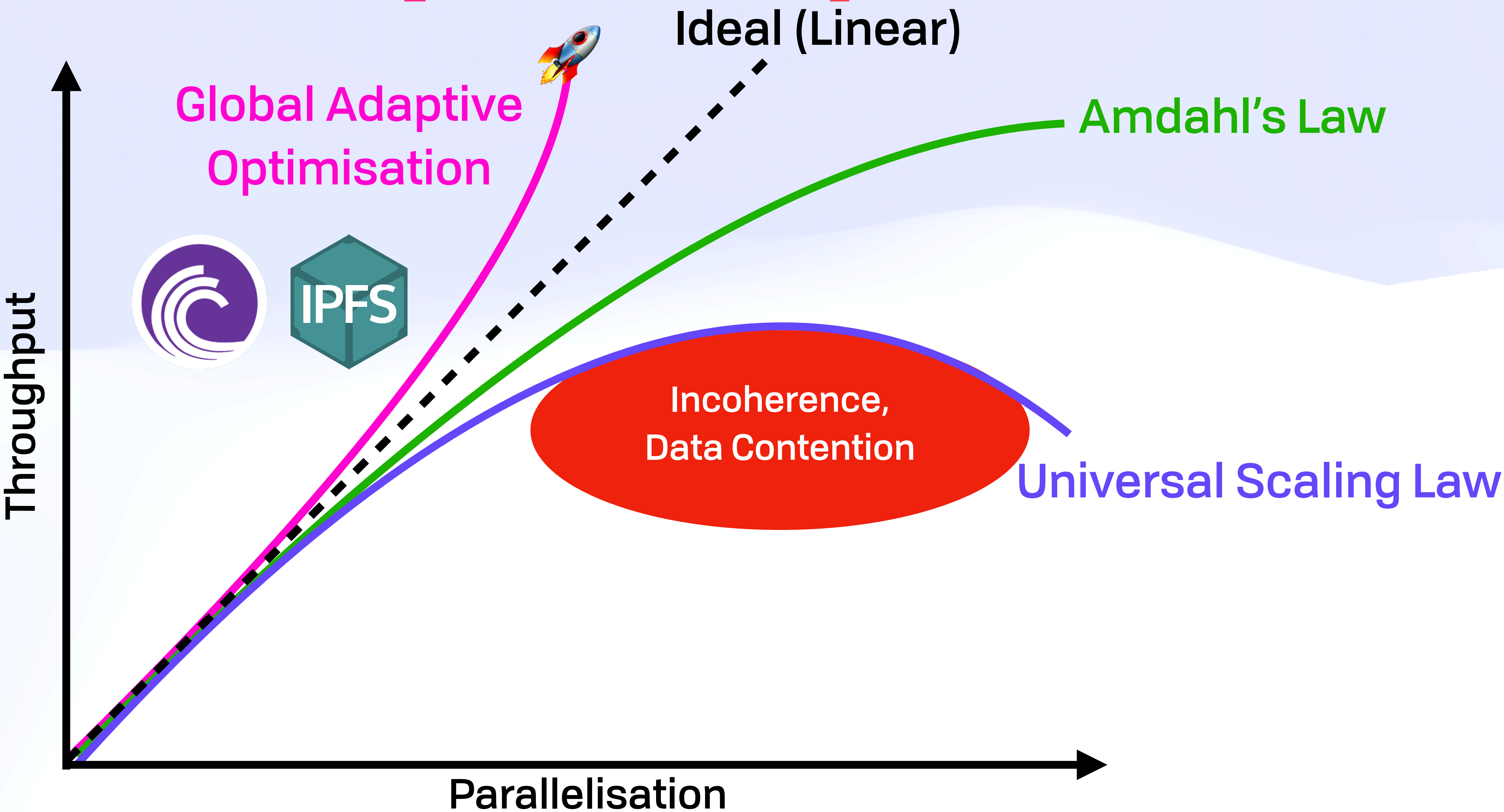
Compute Substrate

With a Little Help From My Friends



Compute Substrate

With a Little Help From My Friends



Compute Substrate

Code-as-Data

Compute Substrate

Code-as-Data

Arguments

WA

Compute Substrate

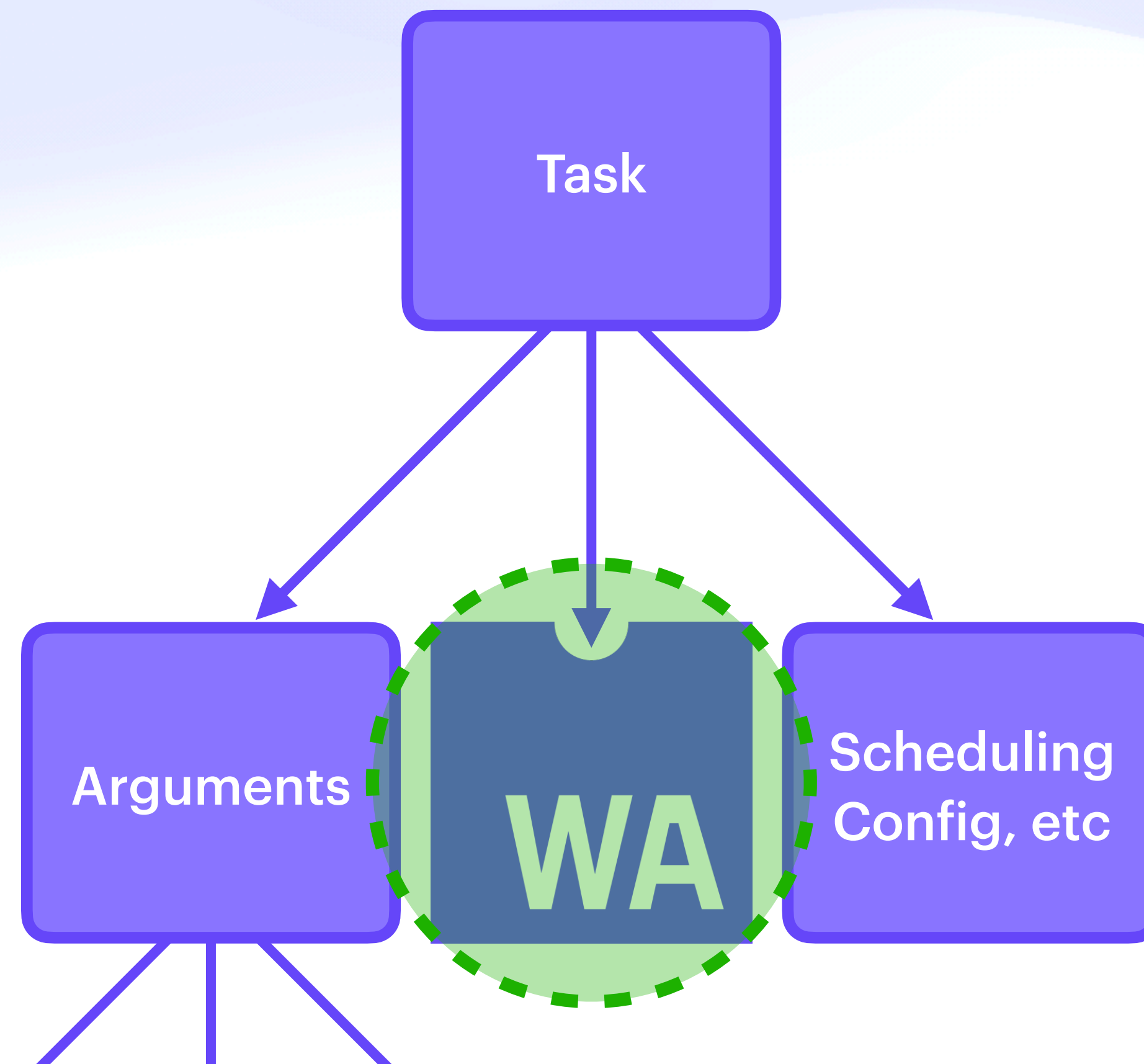
Code-as-Data

Arguments

WA

Compute Substrate

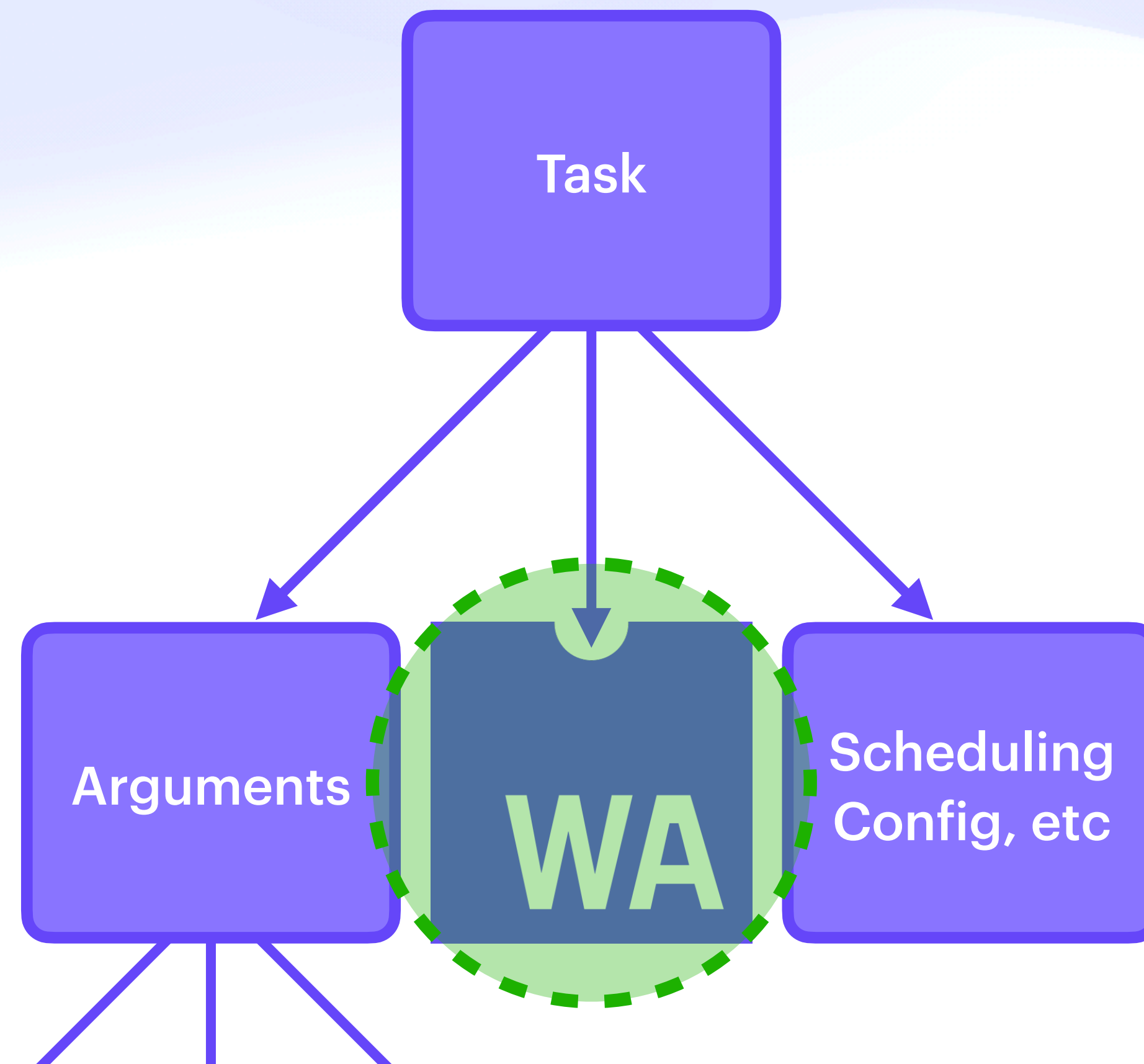
Code-as-Data



Compute Substrate

Code-as-Data

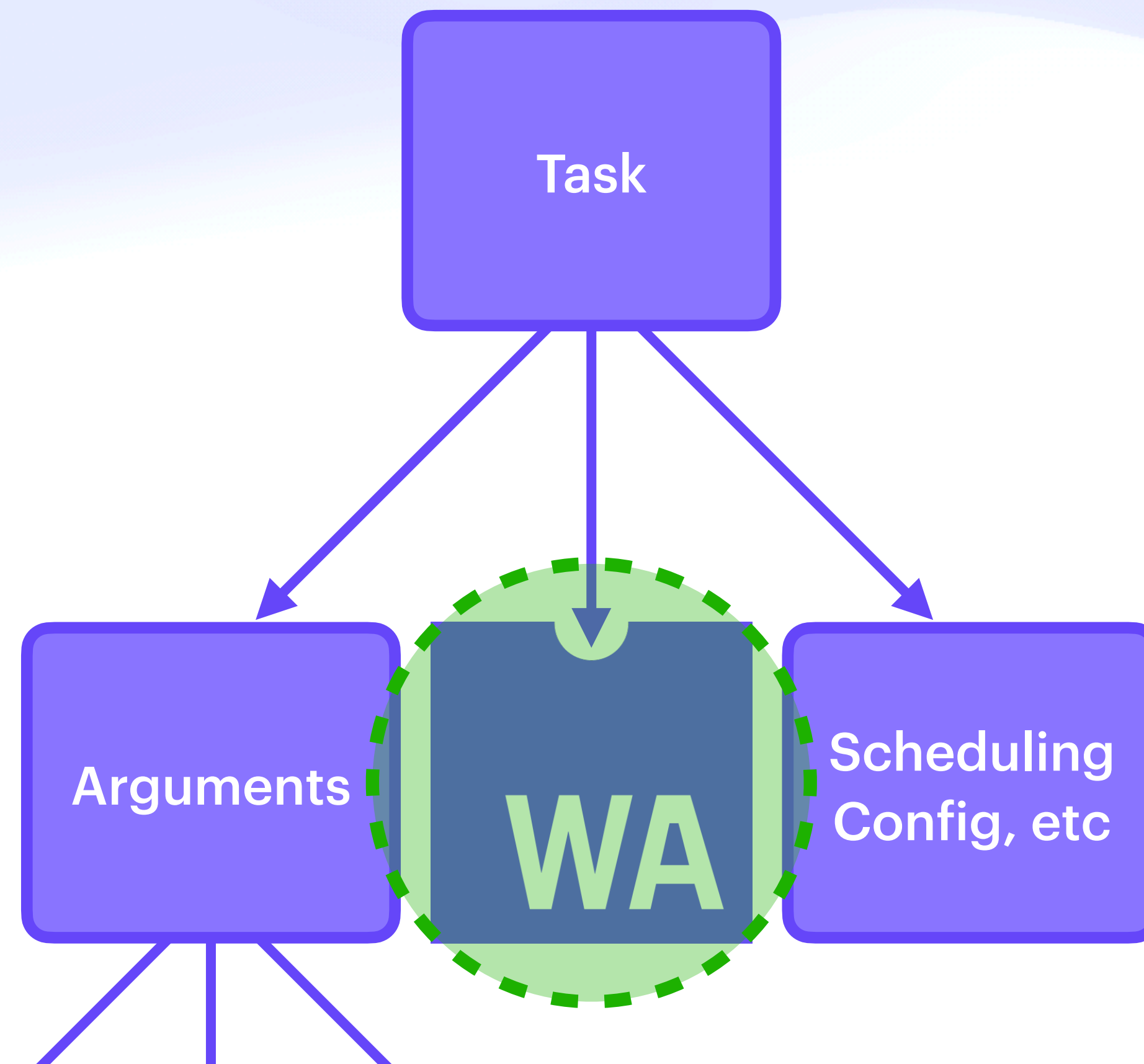
```
const message = () ⇒ alert("hello world")
```



Compute Substrate

Code-as-Data

```
const message = () ⇒ alert("hello world")  
message // Nothing happens
```



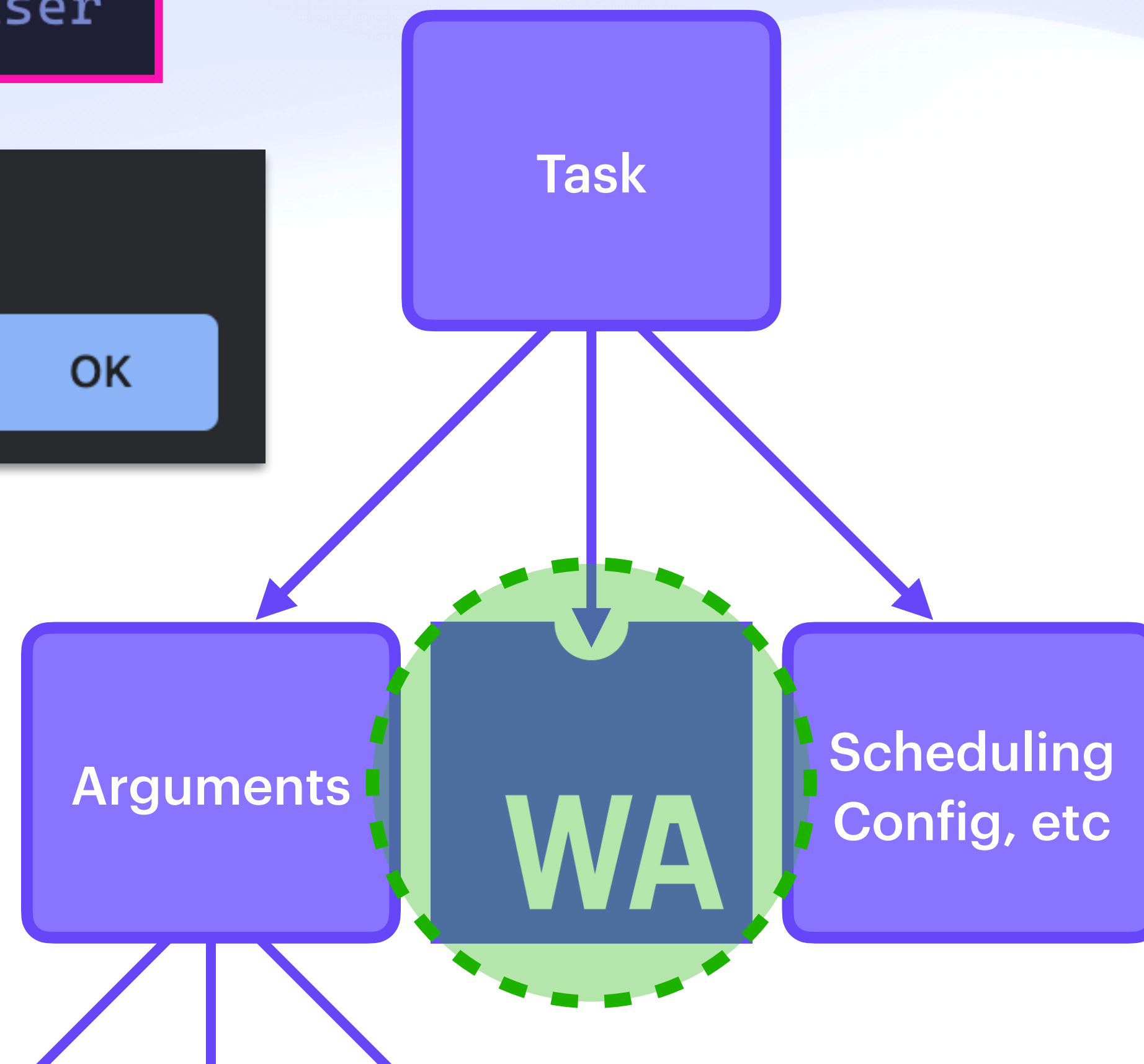
Compute Substrate

Code-as-Data

```
const message = () ⇒ alert("hello world")  
  
message // Nothing happens  
  
message() // A message interrupts the user
```

hello world

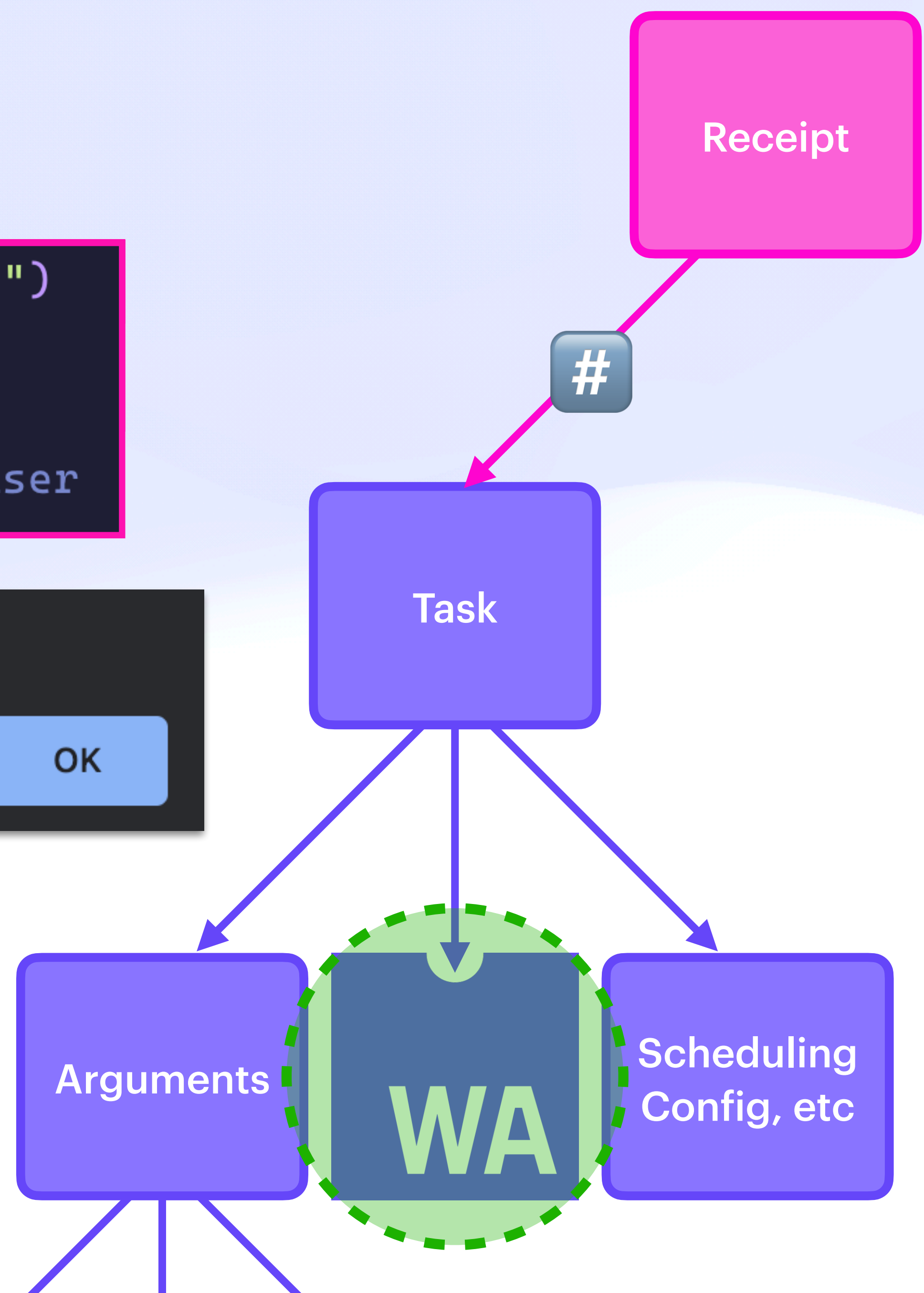
OK



Compute Substrate

Code-as-Data

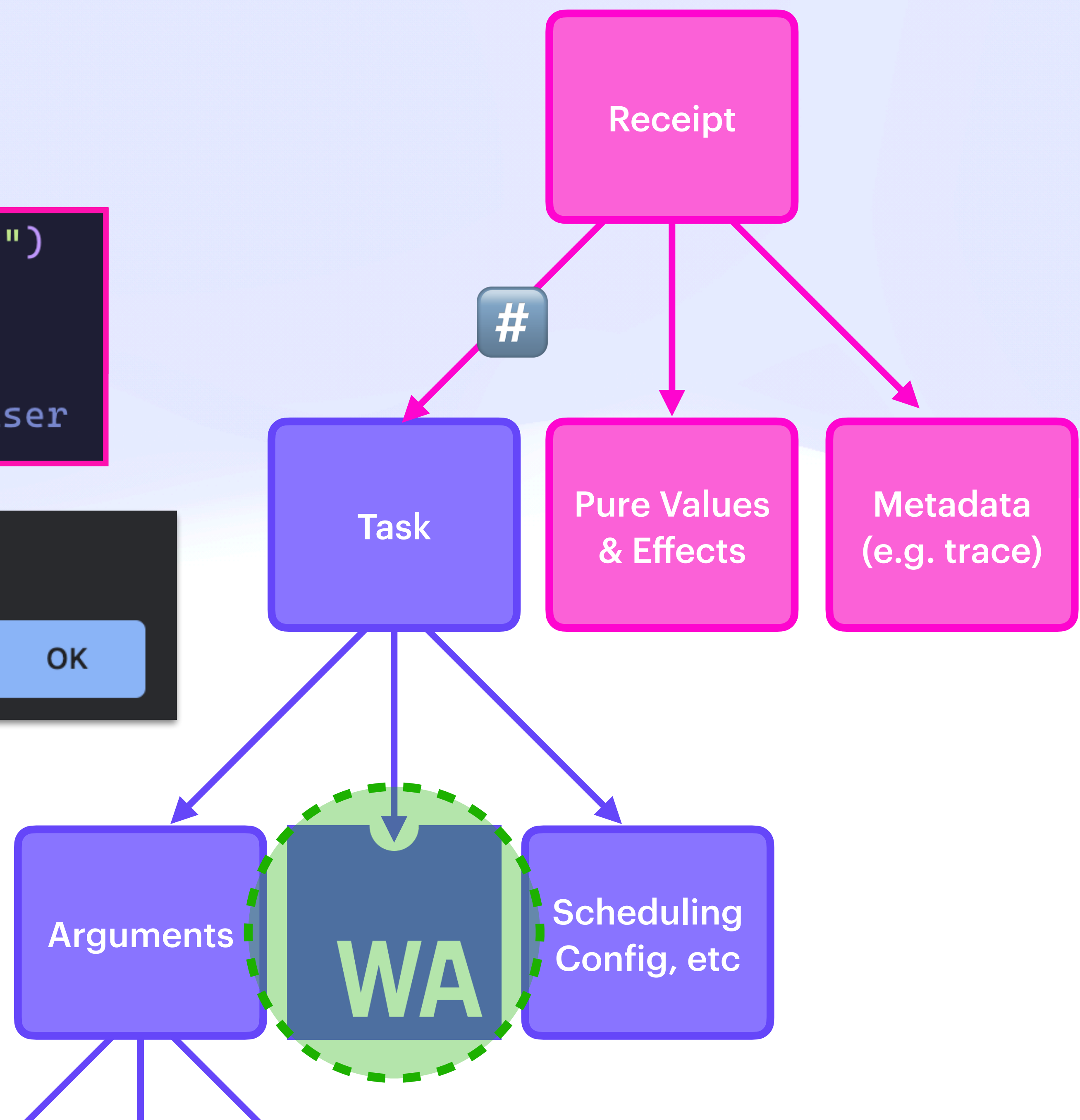
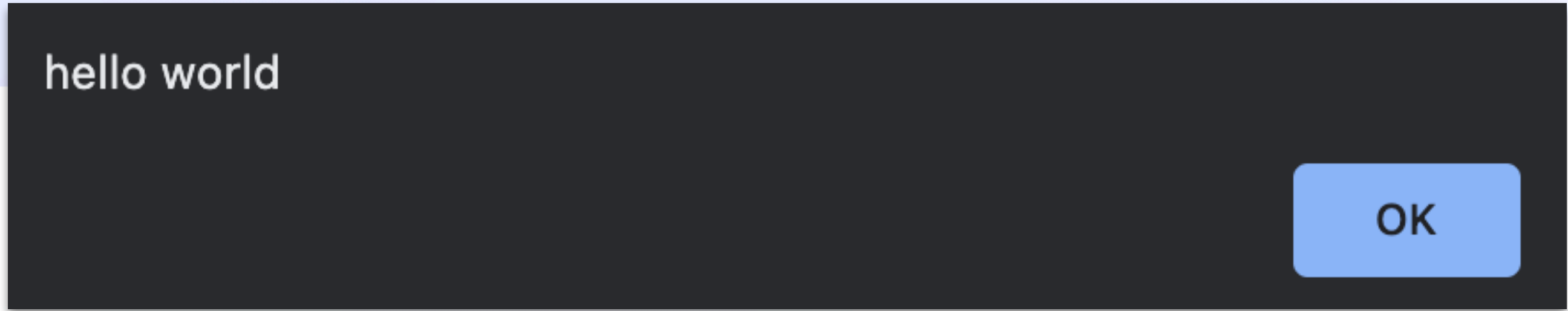
```
const message = () => alert("hello world")  
message // Nothing happens  
message() // A message interrupts the user
```



Compute Substrate

Code-as-Data

```
const message = () => alert("hello world")  
message // Nothing happens  
message() // A message interrupts the user
```



Compute Substrate

Invocation & Distributed Promises

Compute Substrate

Invocation & Distributed Promises

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [42]
  }
}
```


Compute Substrate

Invocation & Distributed Promises

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [42]
  }
}
```

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [{"await/ok": {"/": "bafkreiauharffox63dv2iakndymassol3ryznr32tqii6ijw6ter3ksleu"}}]
  }
}
```


Compute Substrate

Invocation & Distributed Promises

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [42]
  }
}
```

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [{"await/ok"} {"":"/": "bafkreiauharffox63dv2iakndymassol3ryznr32tqii6ijw6ter3ksleu"}}]
  }
}
```


Compute Substrate

Invocation & Distributed Promises

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [42]
  }
}
```

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [{"await/ok"} {"":"/": "bafkreiauharffox63dv2iakndymassol3ryznr32tqii6ijw6ter3ksleu"}}]
  }
}
```


Compute Substrate

Distributed Invocation

Compute Substrate

Distributed Invocation

```
dns:example.com/TYPE=TXT  
crud/update
```


Compute Substrate

Distributed Invocation

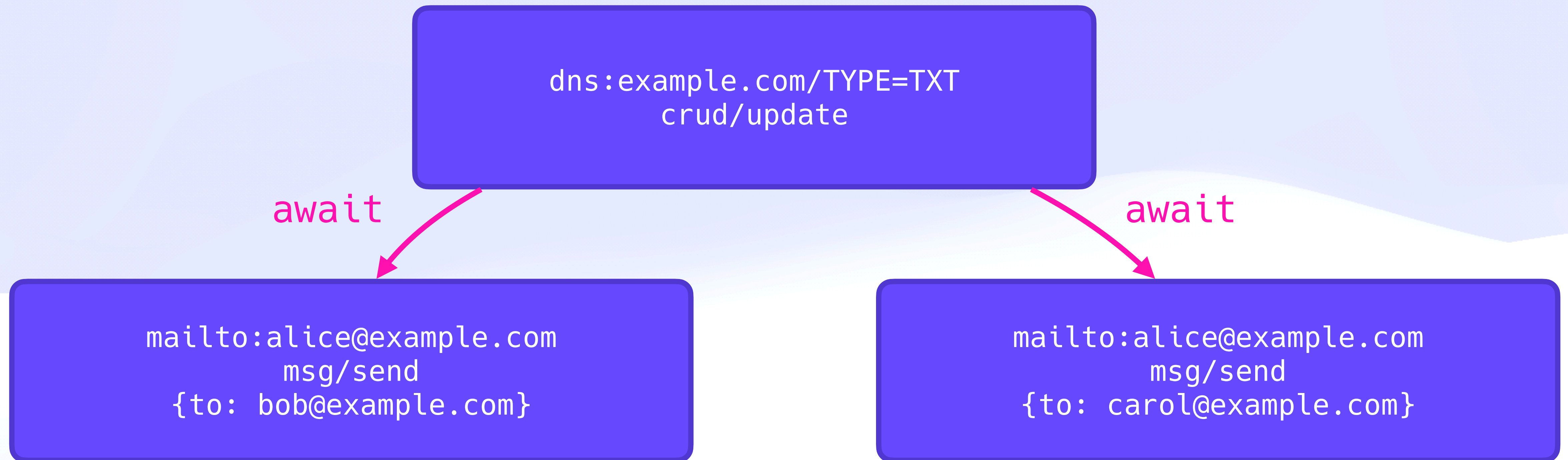
dns:example.com/TYPE=TXT
crud/update

await

mailto:alice@example.com
msg/send
{to: bob@example.com}

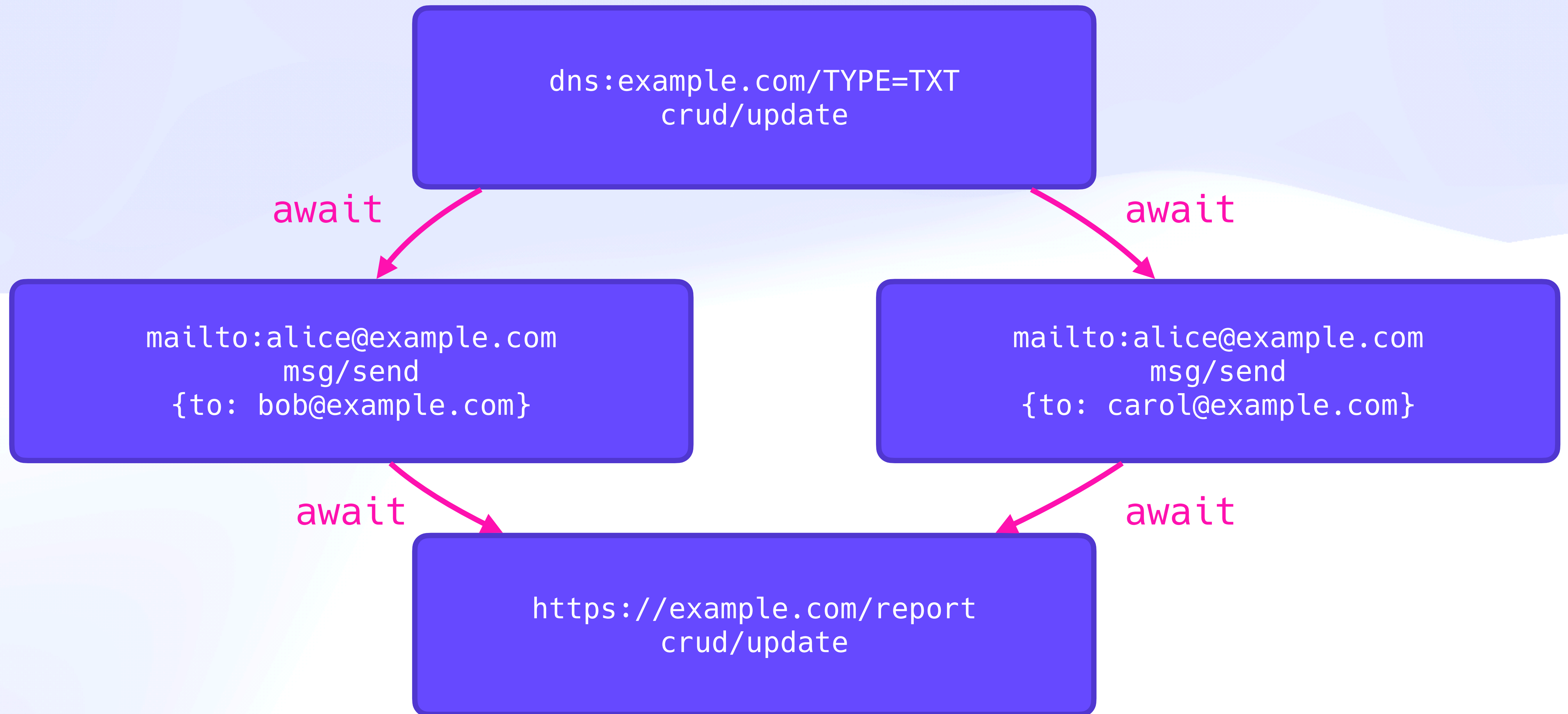
Compute Substrate

Distributed Invocation



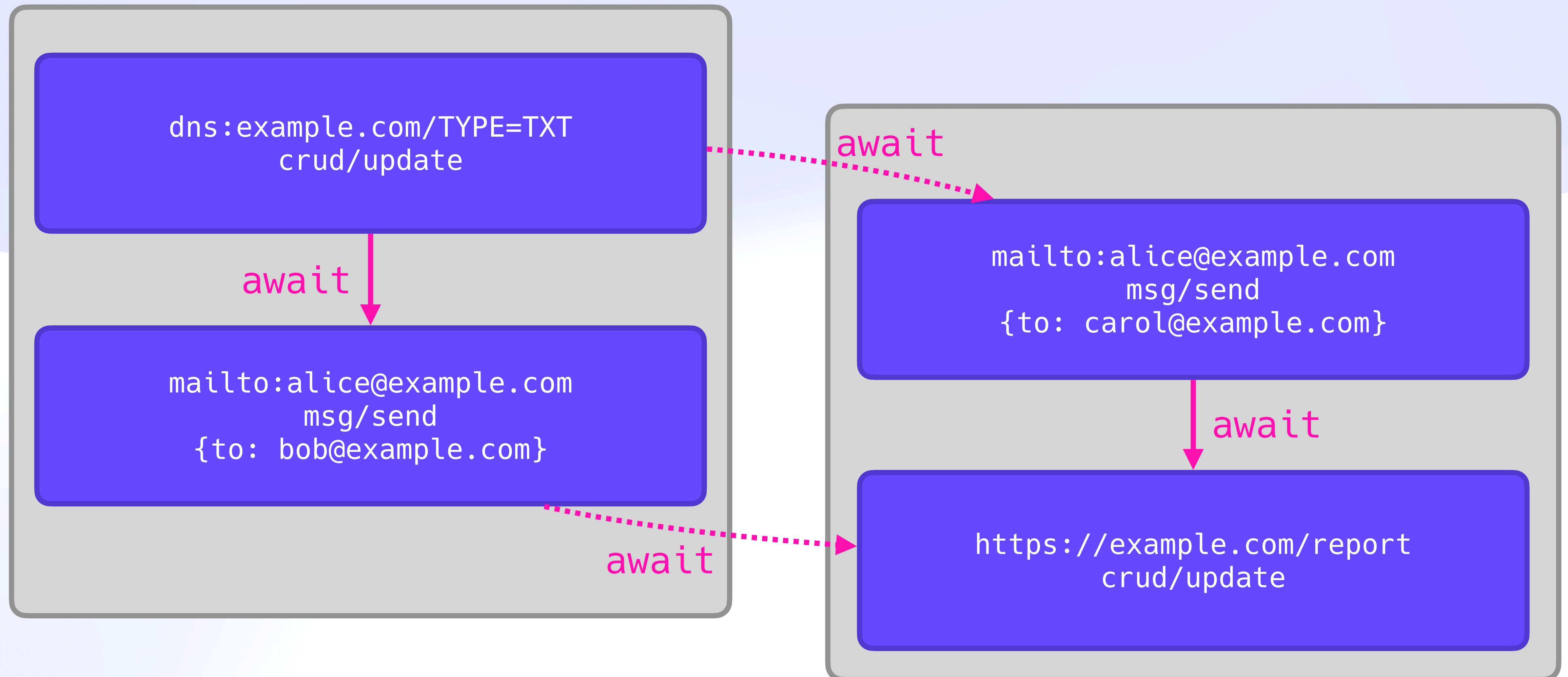
Compute Substrate

Distributed Invocation



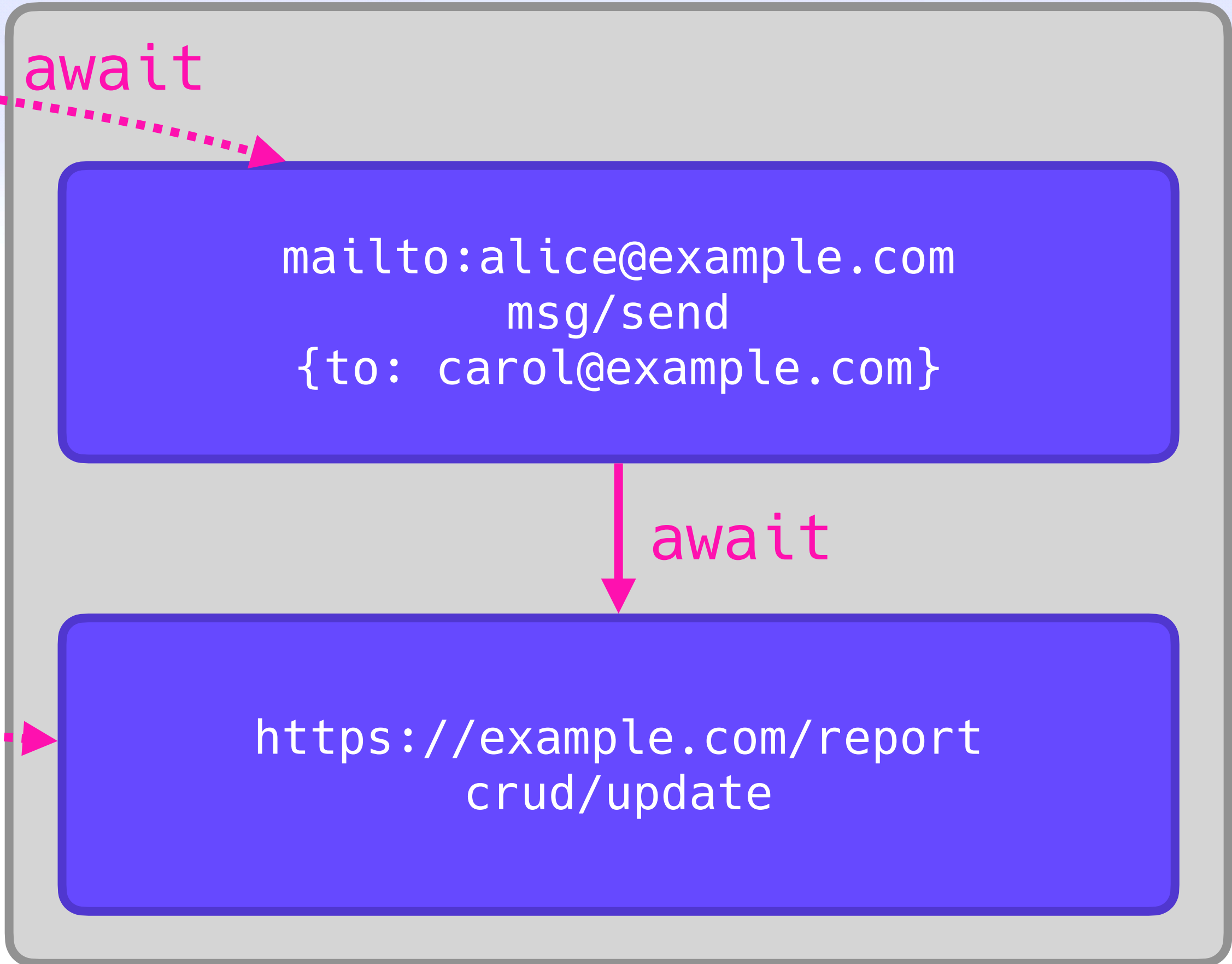
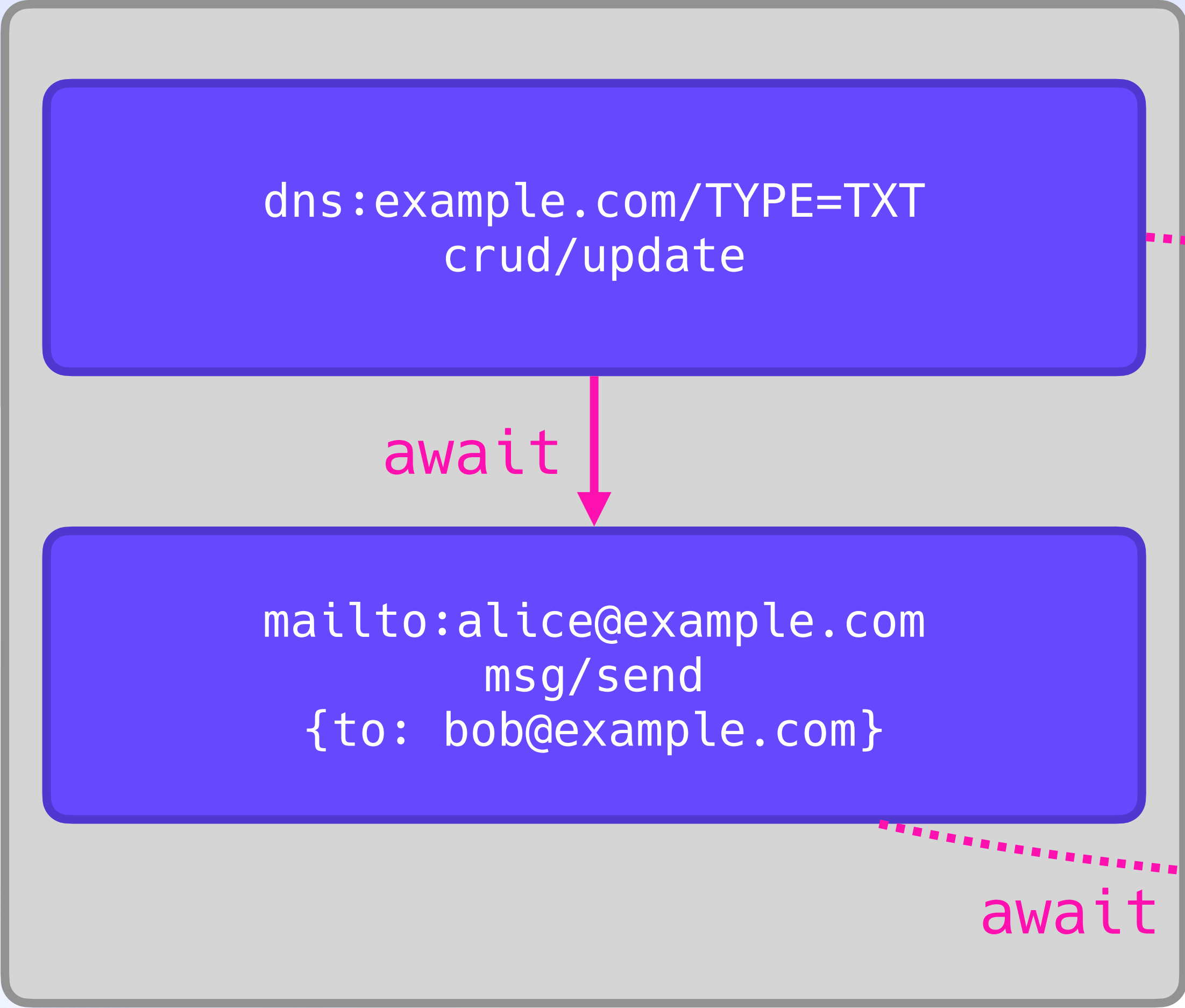
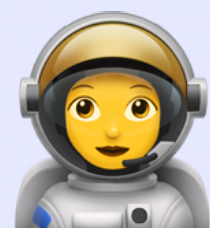
Compute Substrate

Distributed Invocation



Compute Substrate

Distributed Invocation

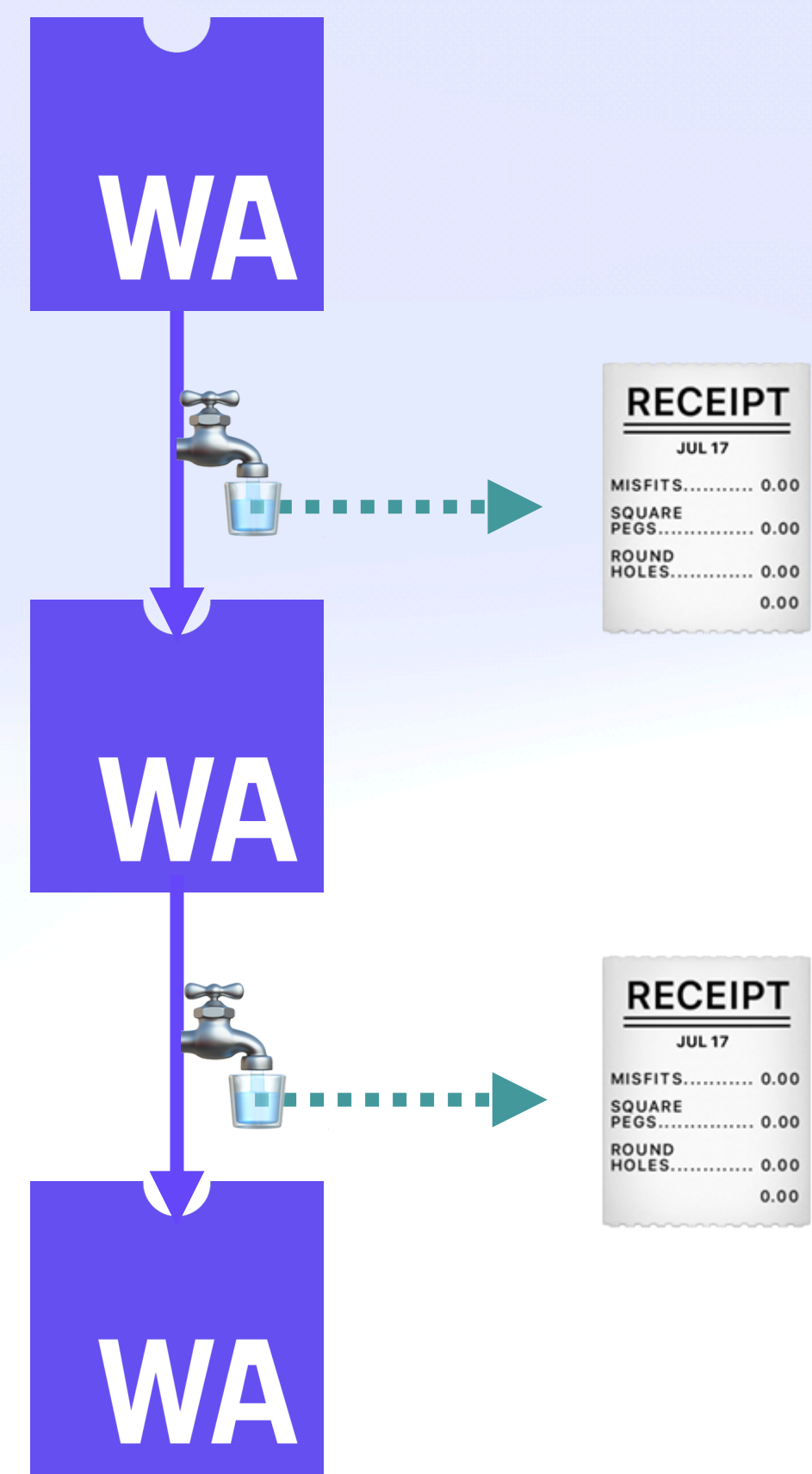


Compute Substrate

Cache, Suspend, Move, Verify

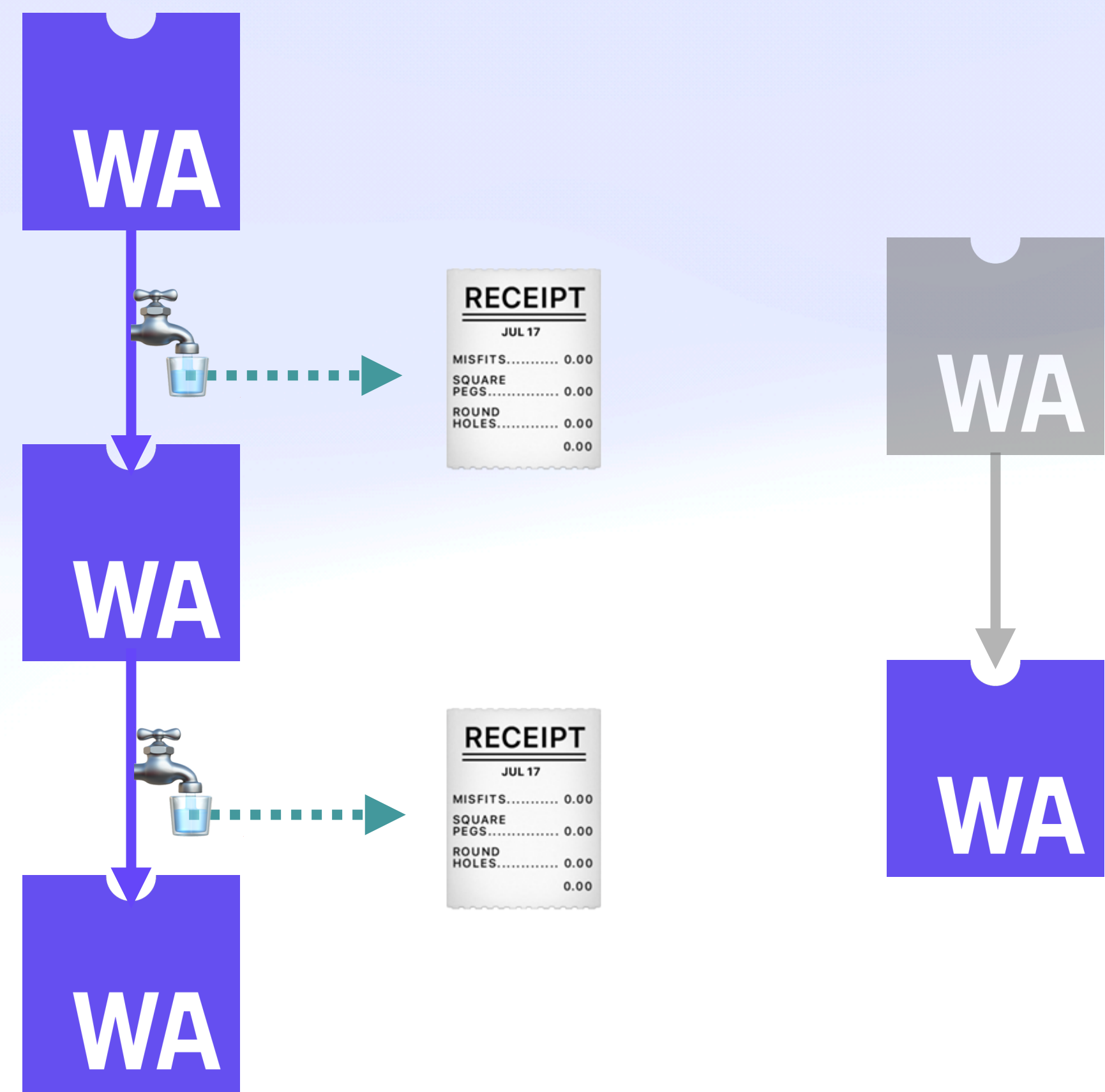
Compute Substrate

Cache, Suspend, Move, Verify



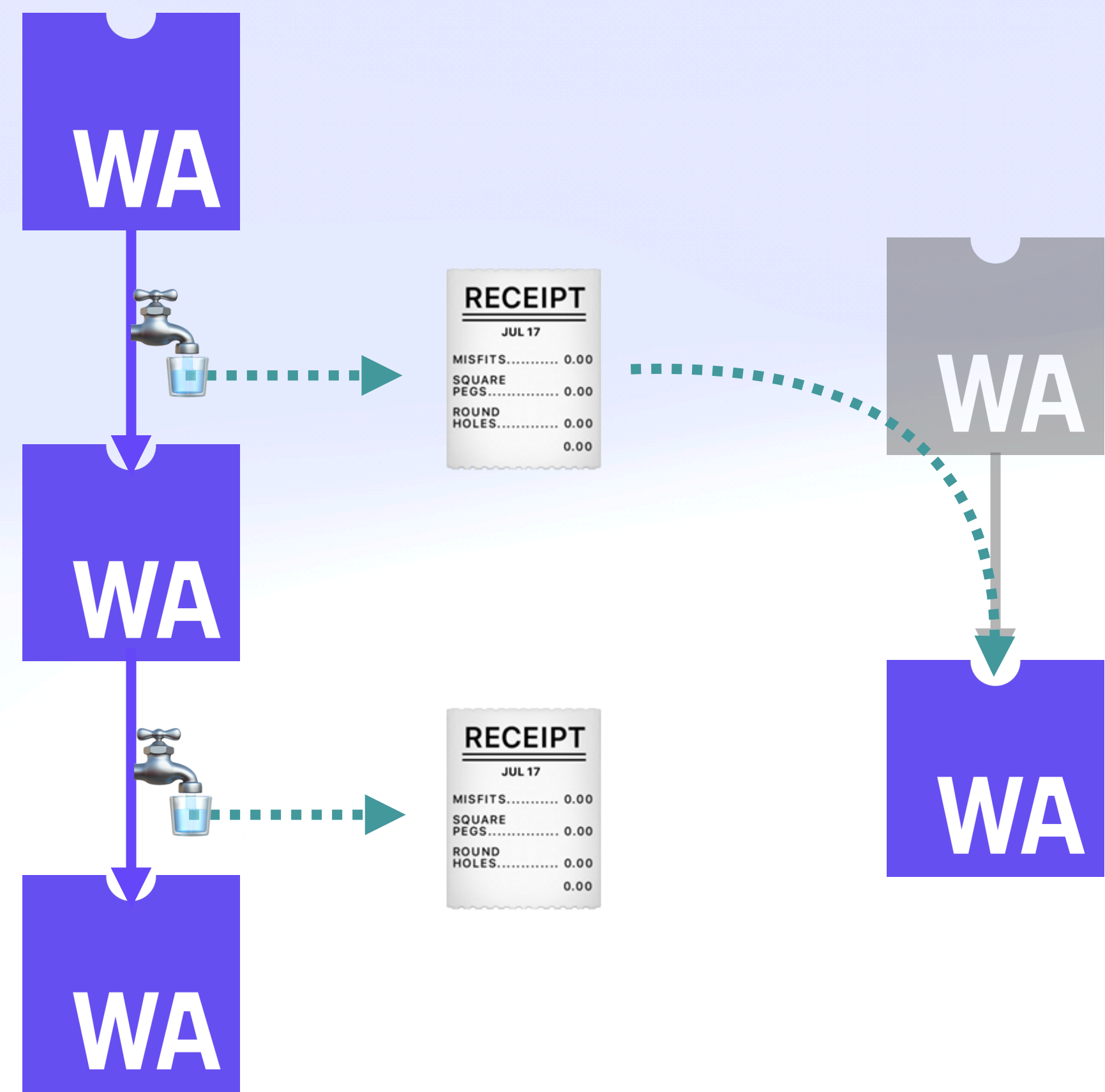
Compute Substrate

Cache, Suspend, Move, Verify



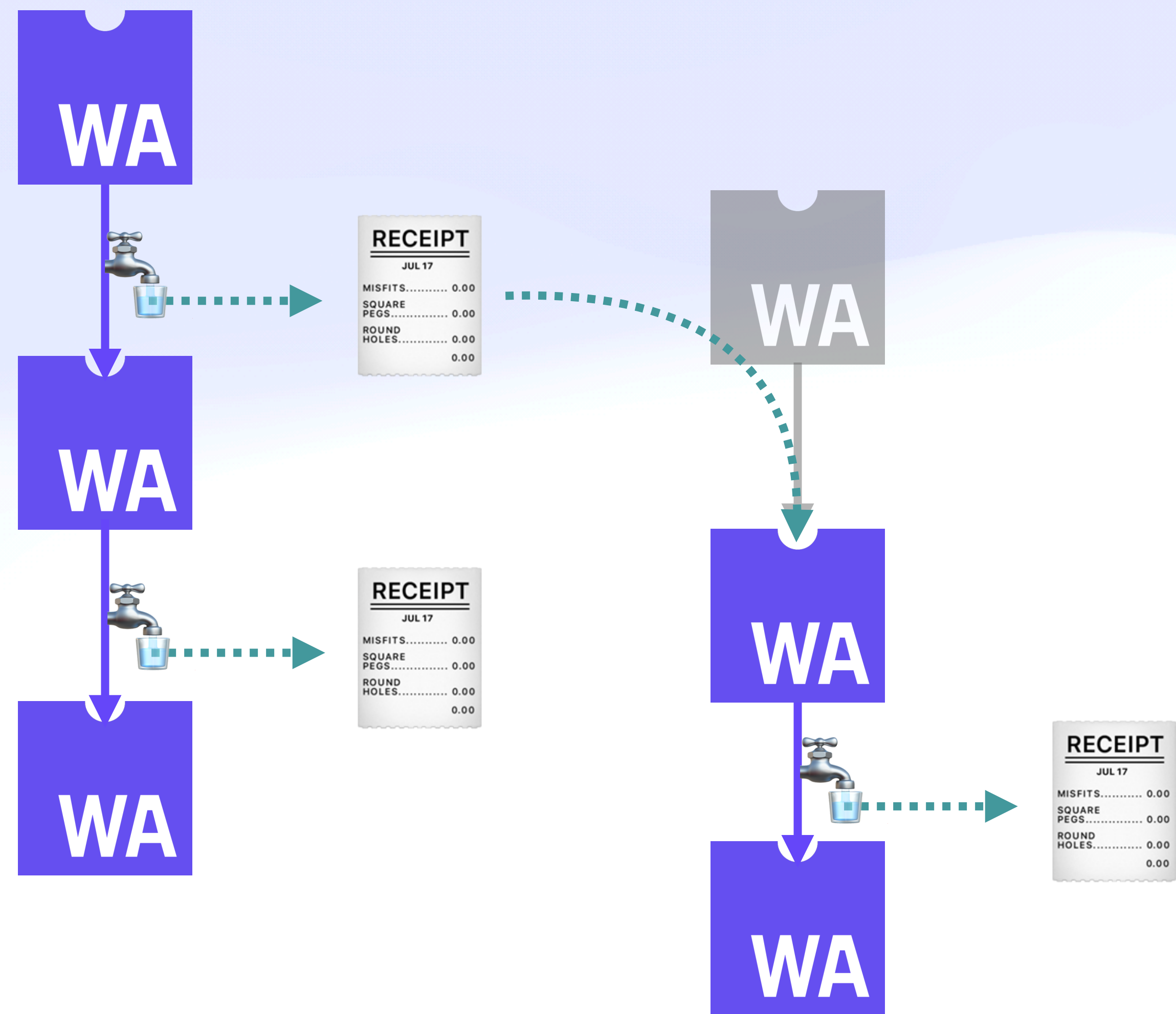
Compute Substrate

Cache, Suspend, Move, Verify



Compute Substrate

Cache, Suspend, Move, Verify



Compute Substrate

Run Once, And Never Again



Compute Substrate

Run Once, And Never Again



◆ **Input Hash → Cached Output**

Compute Substrate

Run Once, And Never Again



- ◆ **Input Hash → Cached Output**
- ◆ "Instant" AI

Compute Substrate

Run Once, And Never Again



- ◆ **Input Hash → Cached Output**
- ◆ "Instant" AI
 - ◆ e.g. moderation, tagging

Compute Substrate

Run Once, And Never Again



- ◆ **Input Hash → Cached Output**
 - ◆ "Instant" AI
 - ◆ e.g. moderation, tagging
 - ◆ Cryptography

Compute Substrate

Run Once, And Never Again



- ◆ **Input Hash → Cached Output**
 - ◆ "Instant" AI
 - ◆ e.g. moderation, tagging
 - ◆ Cryptography
 - ◆ EigenTrust

Compute Substrate

Run Once, And Never Again



- ◆ **Input Hash → Cached Output**
 - ◆ "Instant" AI
 - ◆ e.g. moderation, tagging
 - ◆ Cryptography
 - ◆ EigenTrust
 - ◆ Resizing, thumbs, cropping

IPVM Homestar Demo



Workflow One



☐ Crop



☐ Rotate90



☐ Blur



Workflow Two



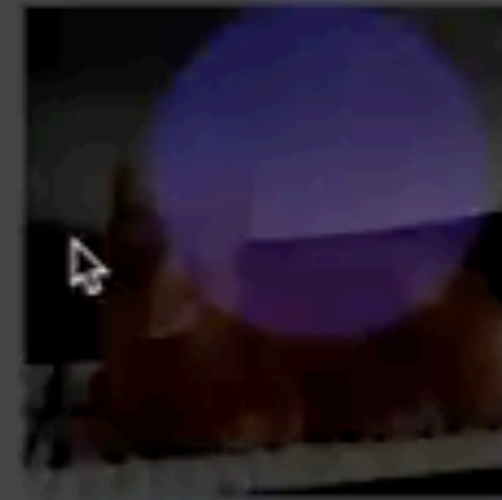
☐ Crop



☐ Rotate90



☐ Grayscale



0:00



Loom - Screen Recorder & Screen Capture is sharing your screen.

Stop sharing

[Hide](#)

IPVM Homestar Demo



Workflow One



☐ Crop



☐ Rotate90



☐ Blur



Workflow Two



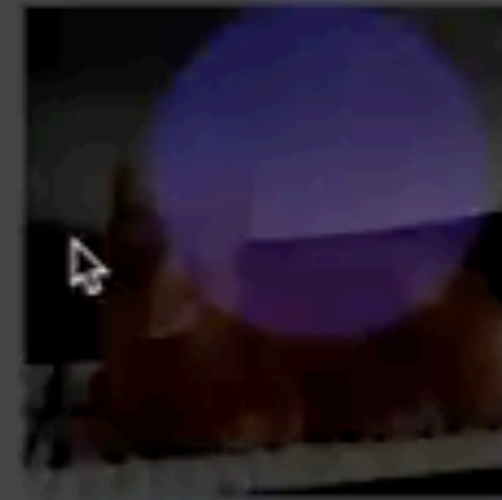
☐ Crop



☐ Rotate90



☐ Grayscale



0:00



Loom – Screen Recorder & Screen Capture is sharing your screen.

Stop sharing

[Hide](#)

Wrapping Up

Where Do We Go From Here?



Where Do We Go From Here?

Better Living Through Science 

Where Do We Go From Here?

Better Living Through Science 

- Reason from 1st principles!

Where Do We Go From Here?

Better Living Through Science

- Reason from 1st principles!
- Works today!

Where Do We Go From Here?

Better Living Through Science

- Reason from 1st principles!
- Works today!
- +Scale, +user agency, +simplicity

Where Do We Go From Here?

Better Living Through Science

- Reason from 1st principles!
- Works today!
- +Scale, +user agency, +simplicity
- -Early days (but lots of opportunity for innovators)

Where Do We Go From Here?

New Constrains = New Design Space

Where Do We Go From Here?

New Constrains = New Design Space



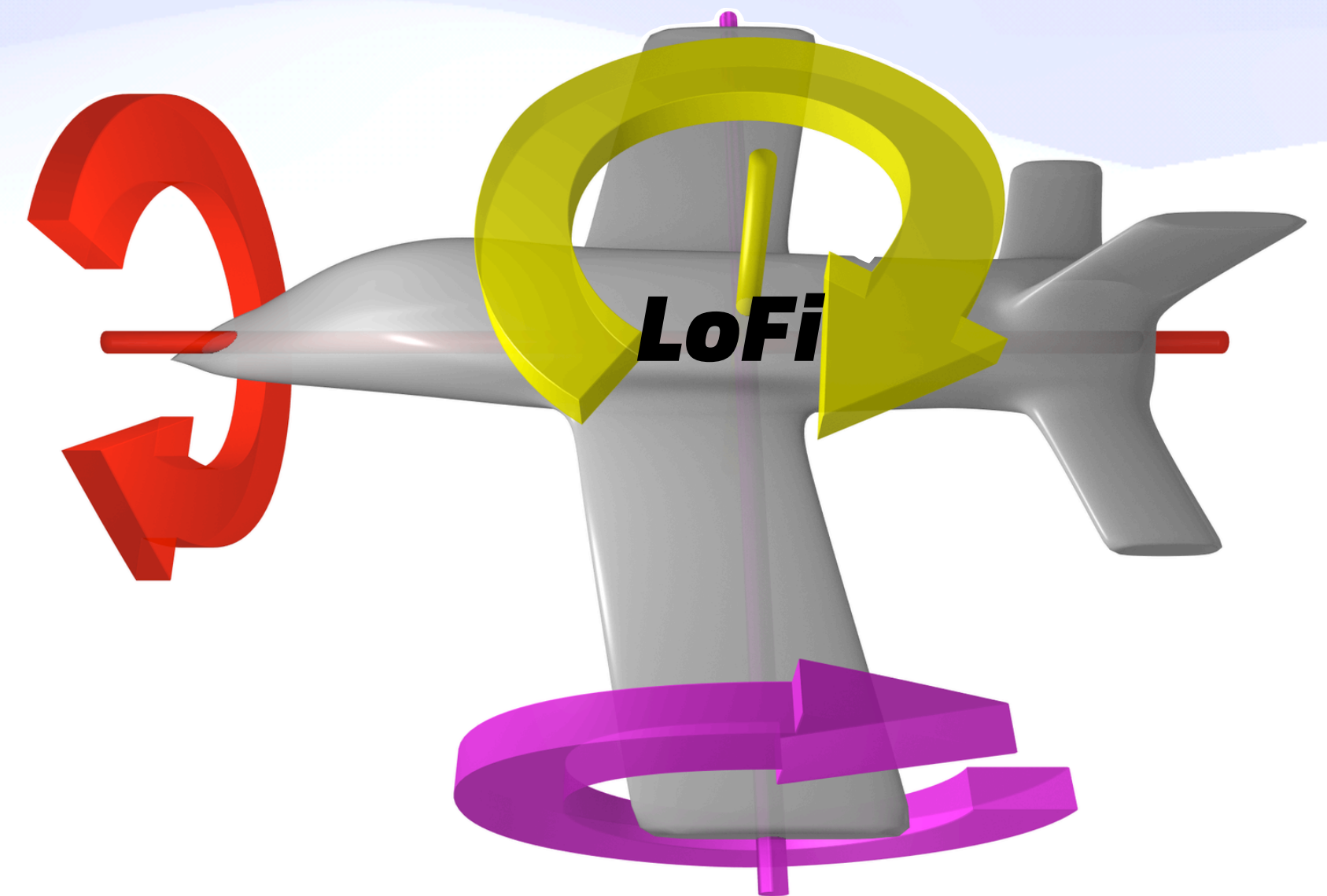
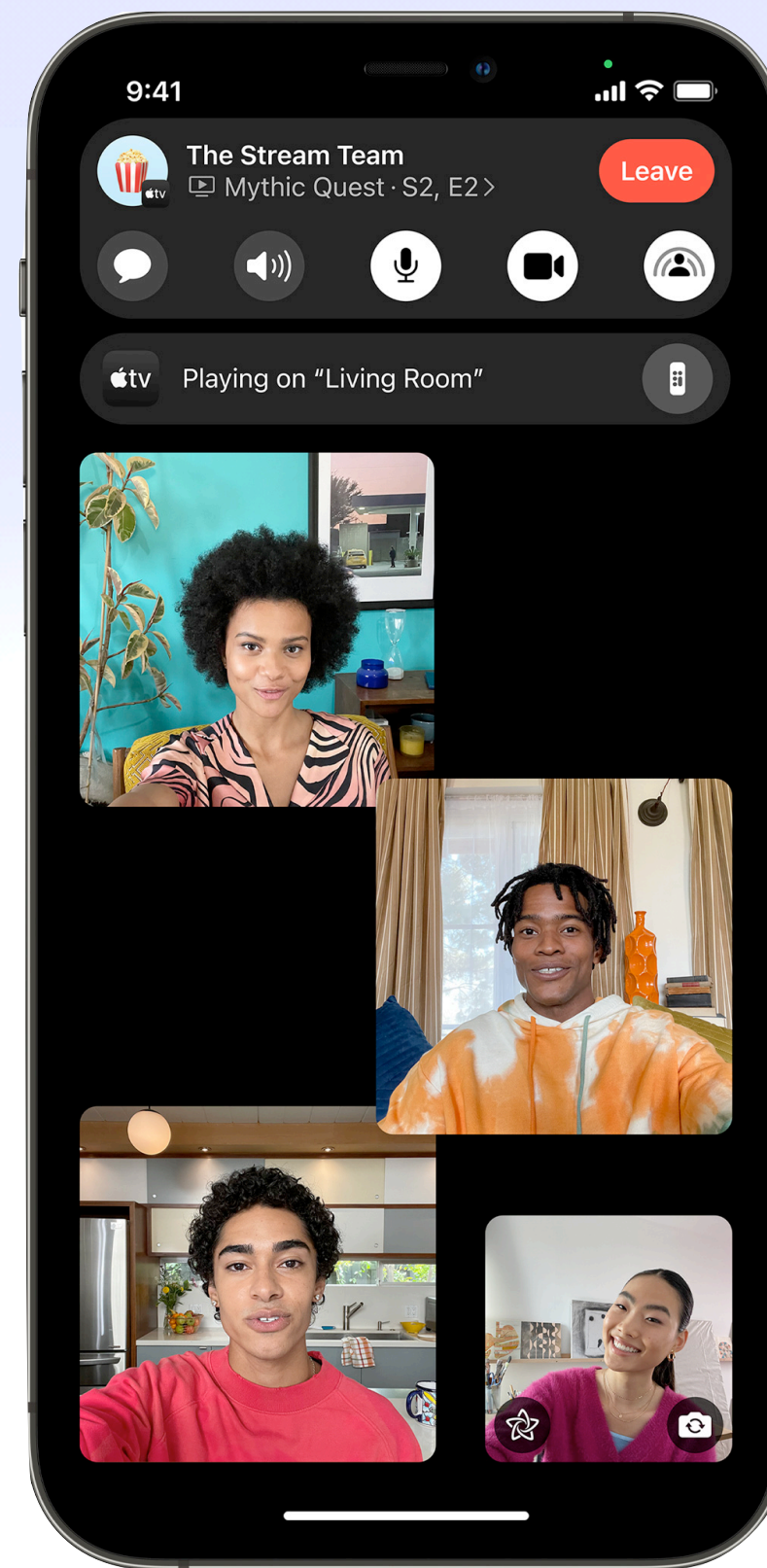
Where Do We Go From Here?

New Constrains = New Design Space

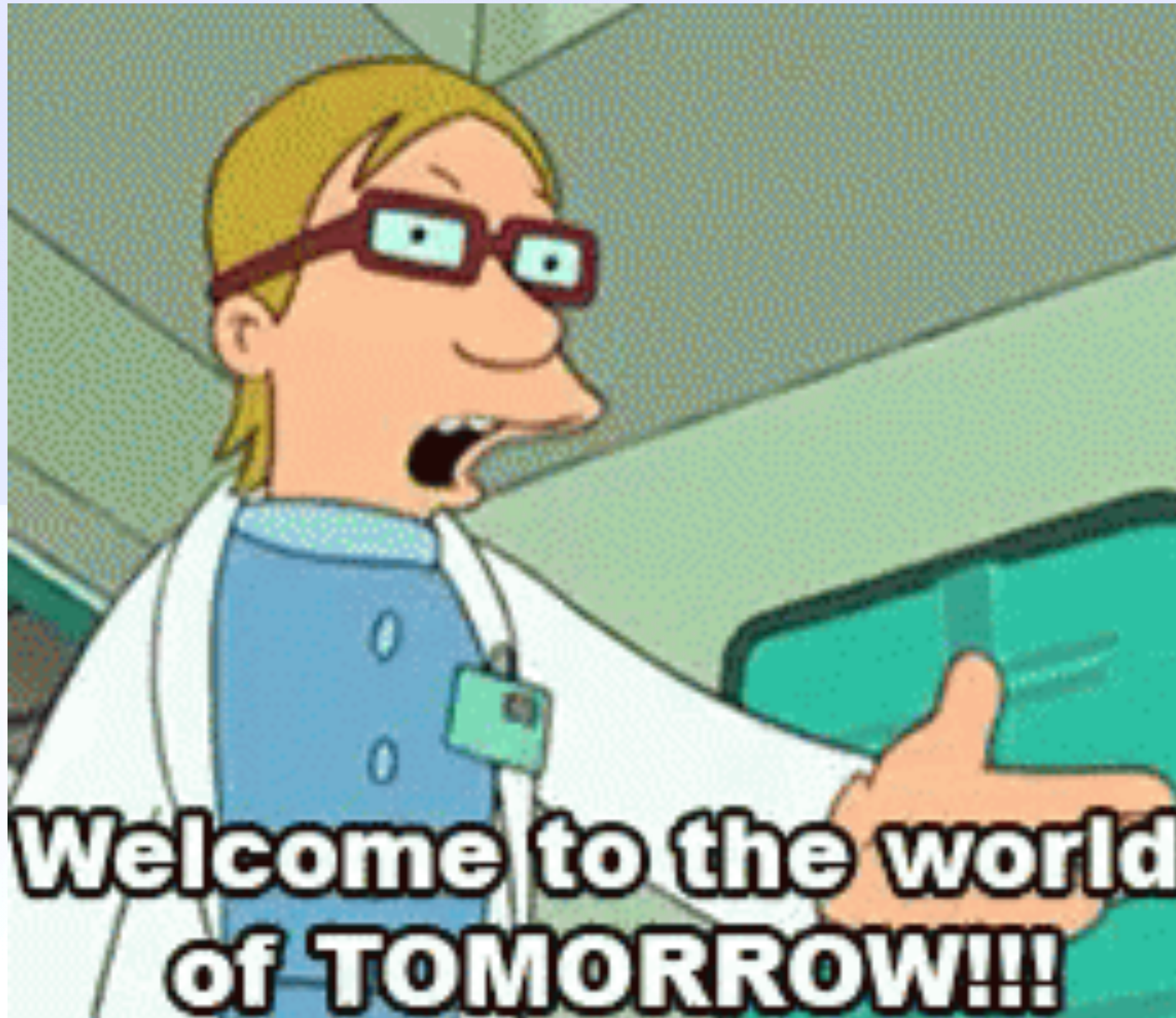


Where Do We Go From Here?

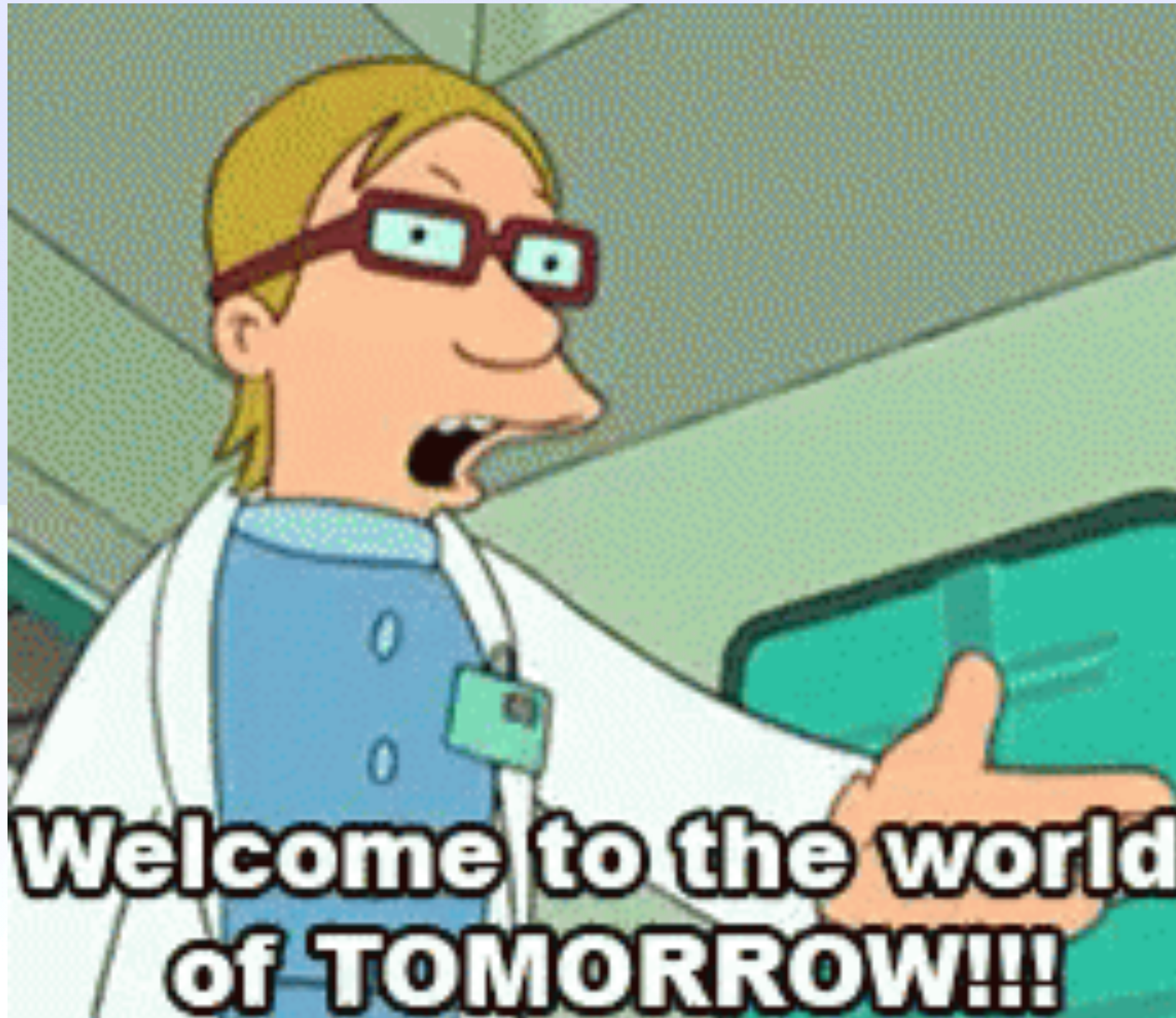
New Constrains = New Design Space



The Jump to Hyperspace



The Jump to Hyperspace



github.com/ucan-wg
github.com/ipvm-wg



Thank You, Australia



<https://fission.codes>



brooklyn@fission.codes



[@expede@octodon.social](#)



bsky.app/profile/expede.wtf