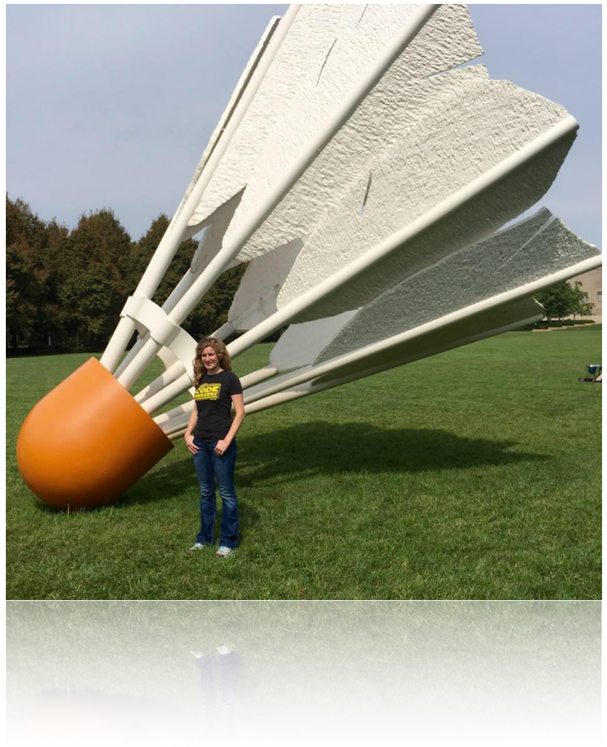
Framing Our Potential for Failure

Michelle Brush



Michelle Brush

Engineering Director, Cerner Corporation
Chapter Leader, Kansas City Girl Develop It
Conference Organizer, Midwest.io
@michellebrush

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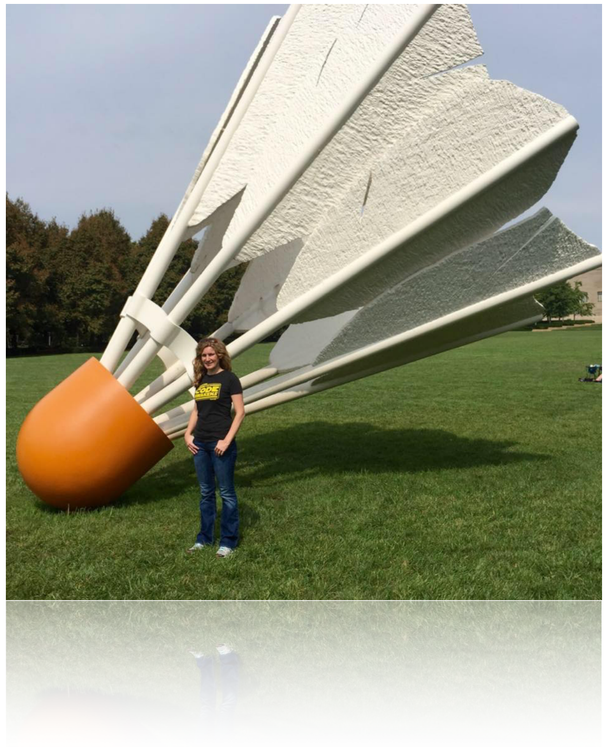
My Mom:

What is it that you do again?



Michelle Brush

Software Engineer, Various

Chapter Leader, Kansas City Girl Develop It

Conference Organizer, Midwest.io

@michellebrush

My Mom:

What is it that you do again?

Me:

I worry about failures and manage them.

Me:

Sometimes I fail.

Me:

usually due to people stuff

Me:

I, as a person, don’t scale well.

Me:

so I teach people to worry
about failure and manage it

Me:

redundancy

Me:

Sometimes that fails too.

Michelle Brush

Engineering Director, **Population Health**

6.3 **petabytes** of data

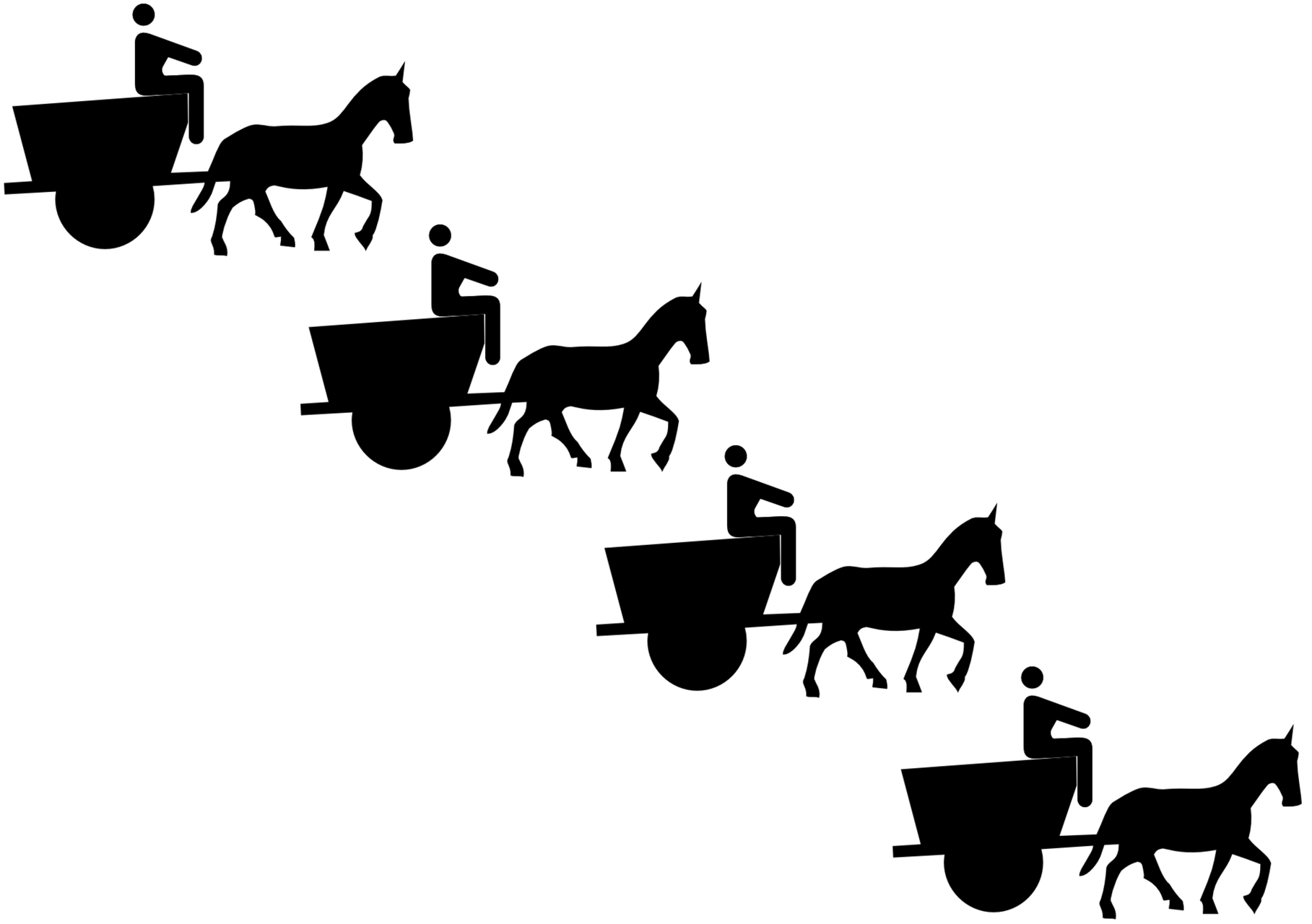
78.5 million **unique** lives

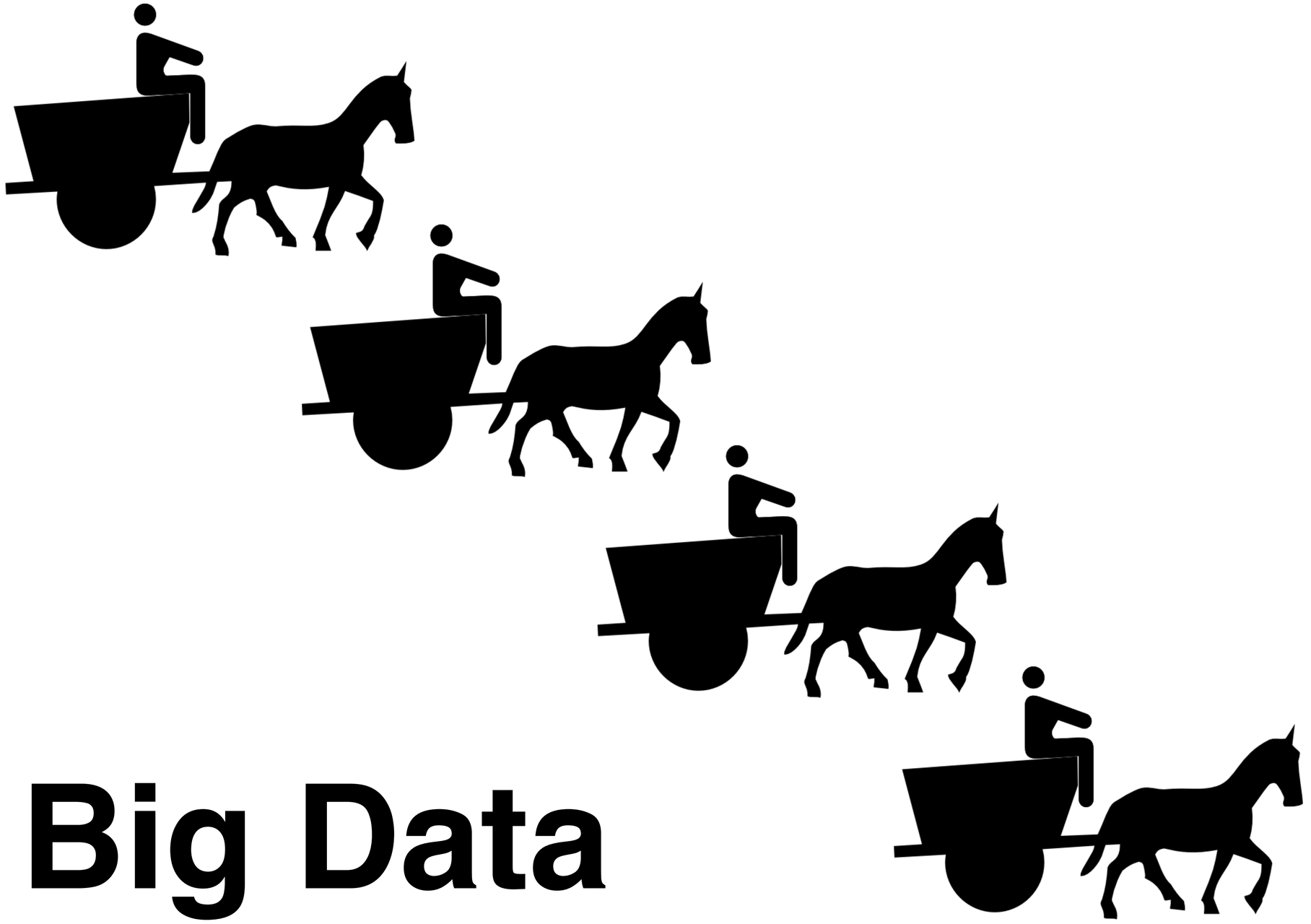
6.8 million **managed** lives

data

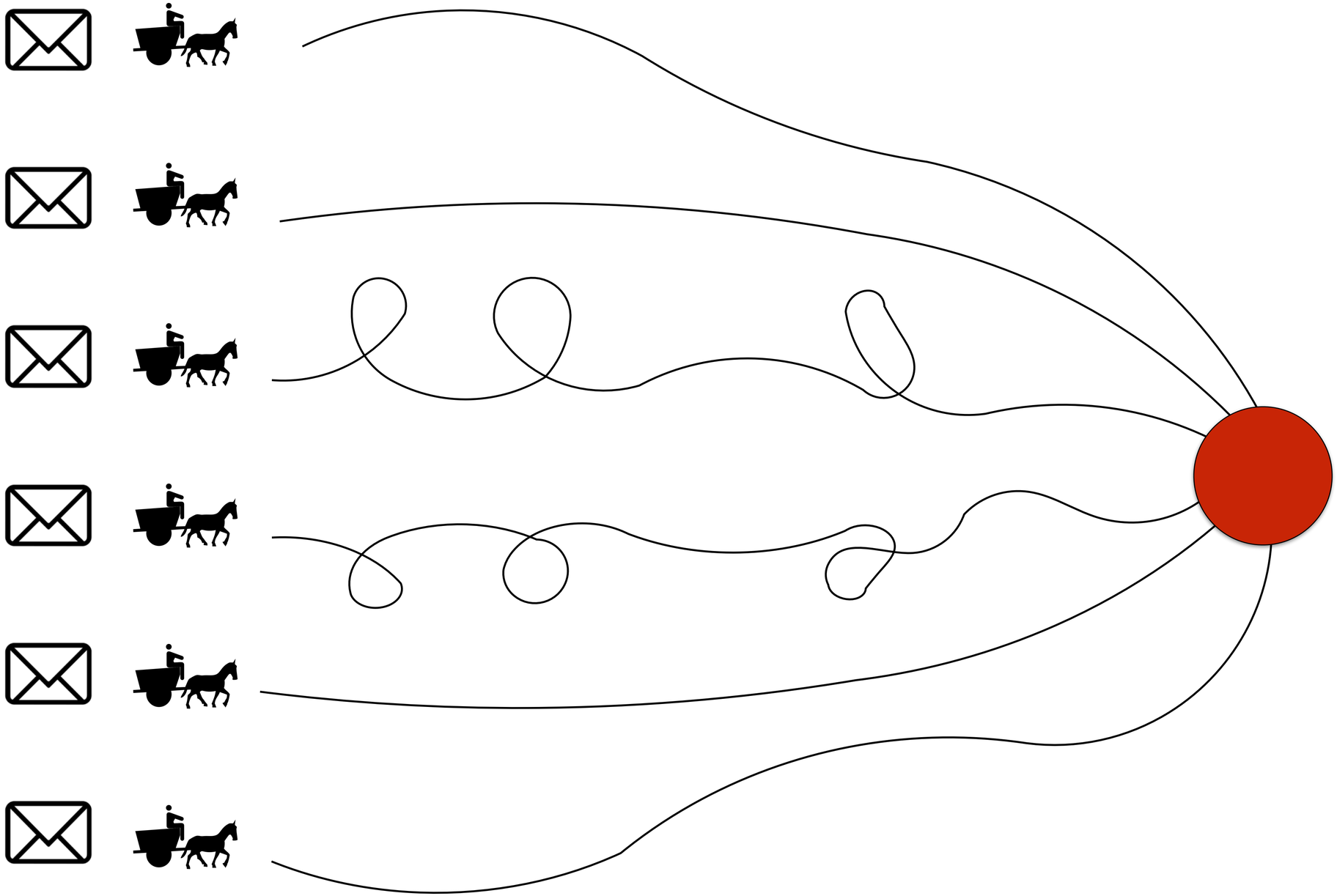
data

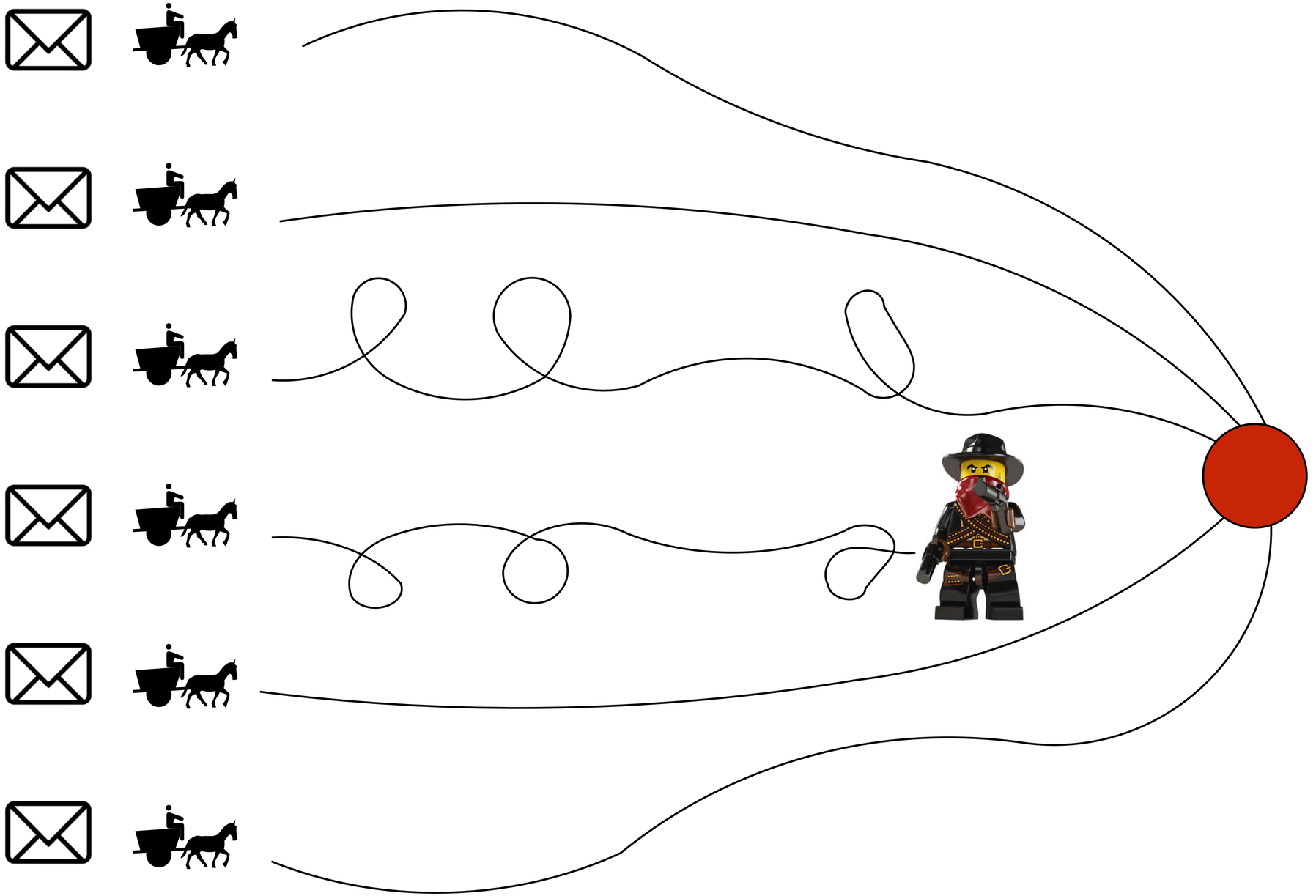
computer

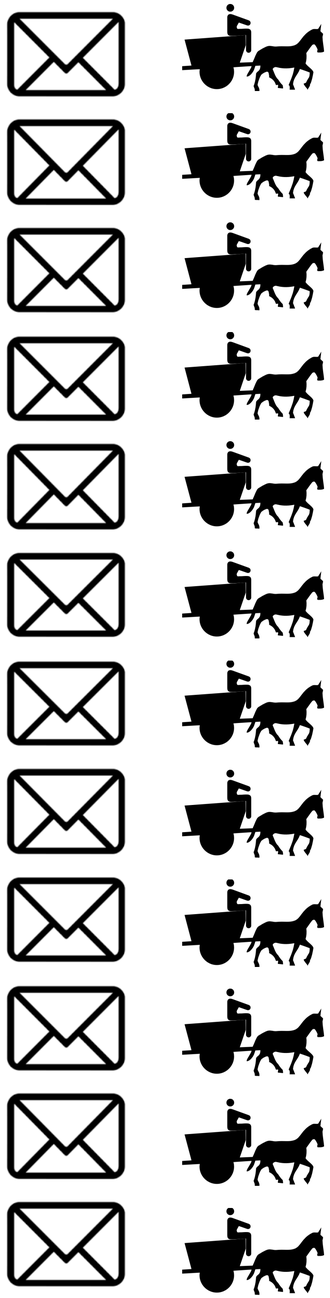




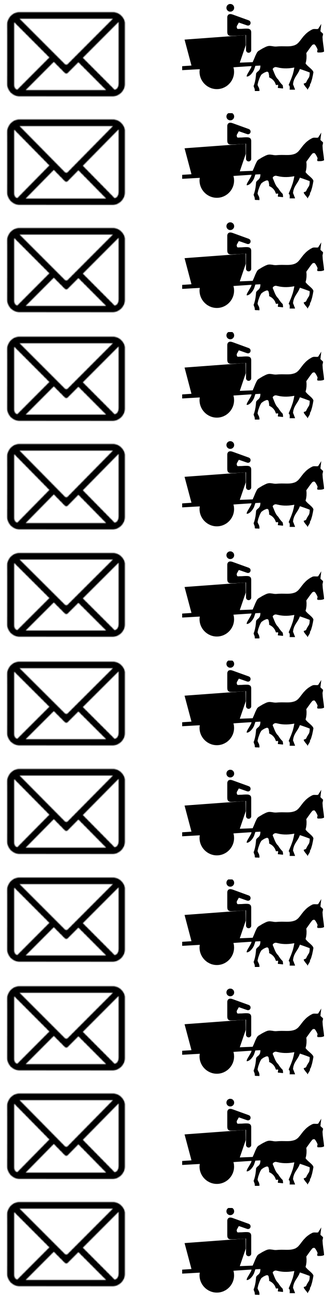
Big Data

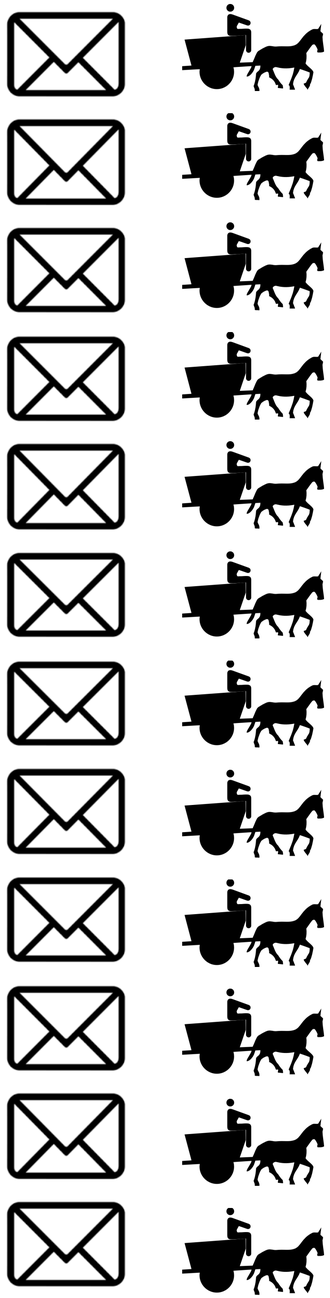




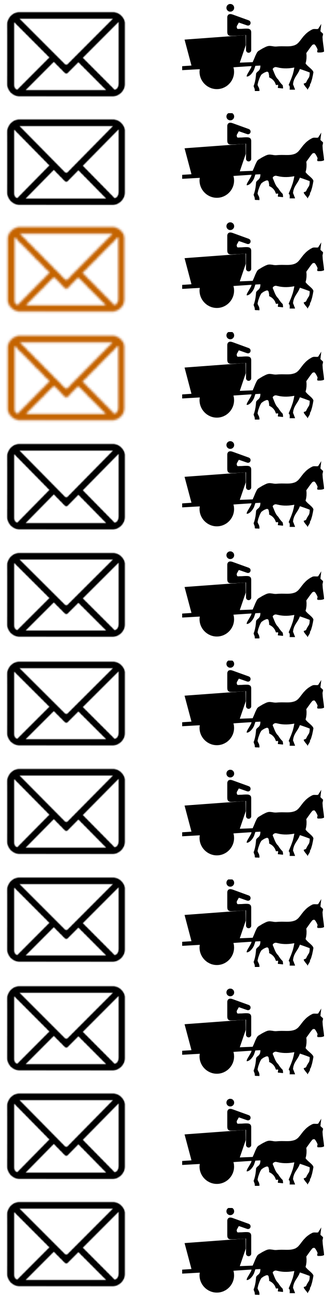


redundancy

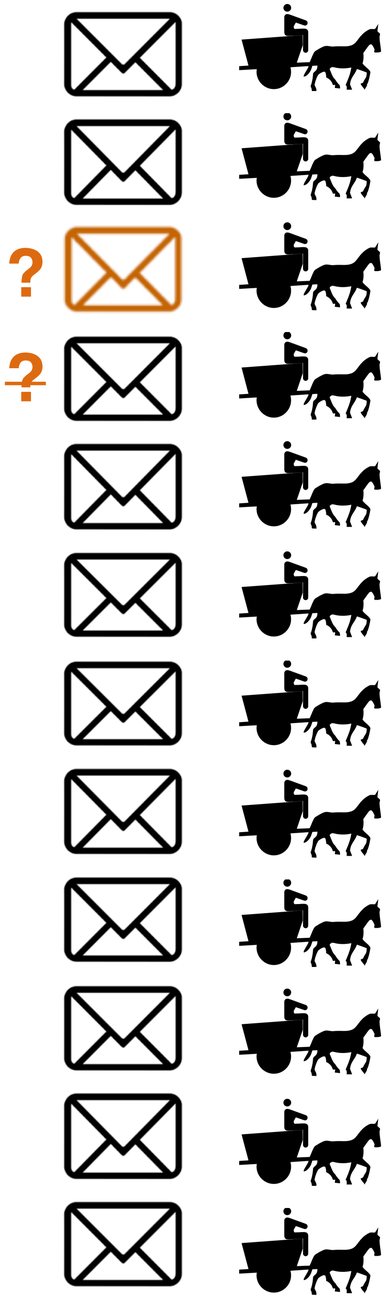




risk



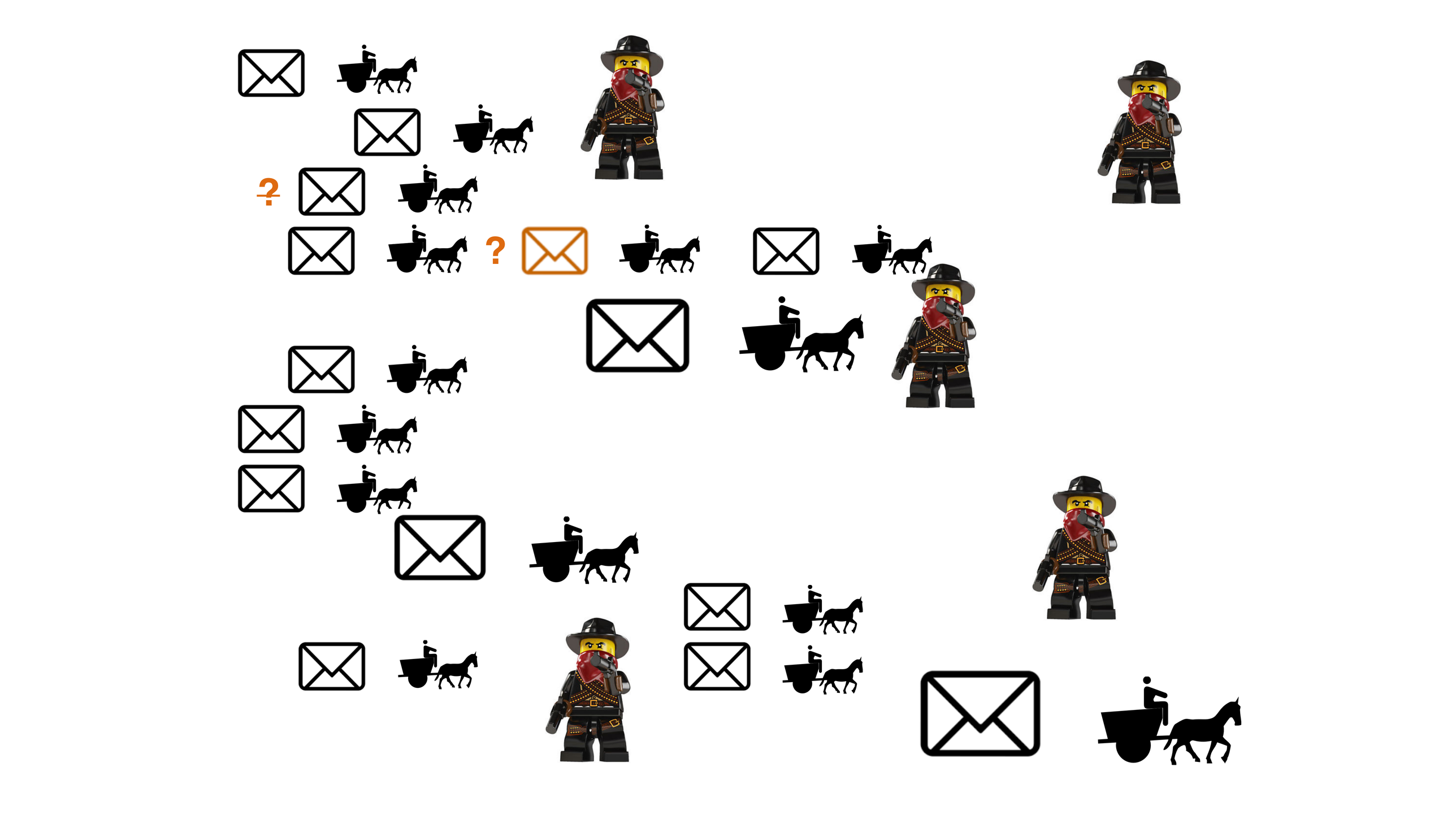
updates?

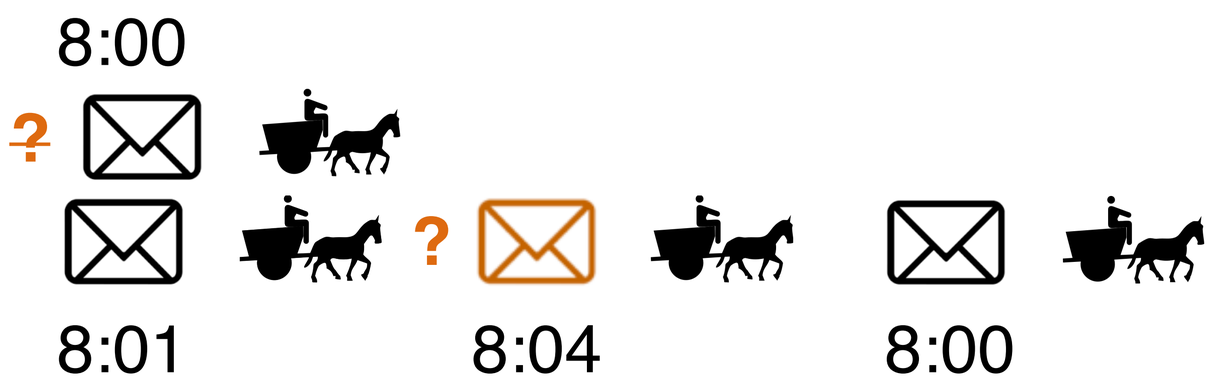


updates

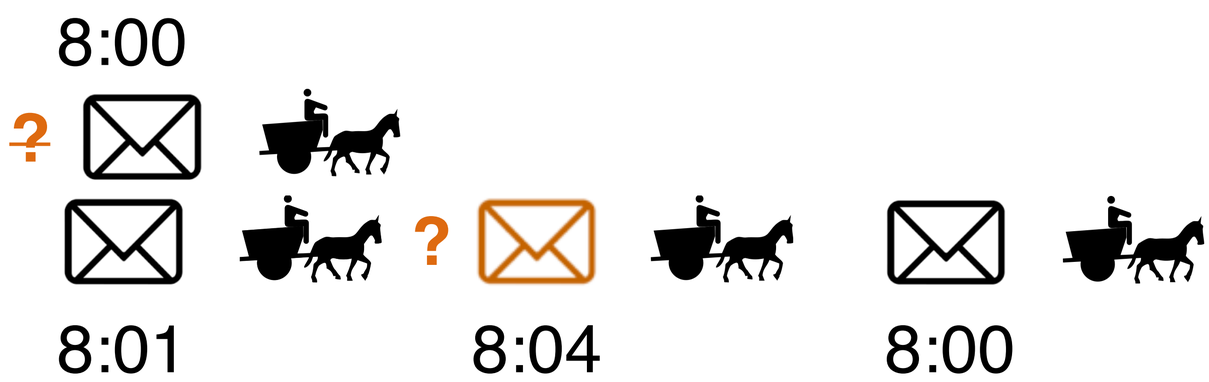
can fail.

It gets worse.

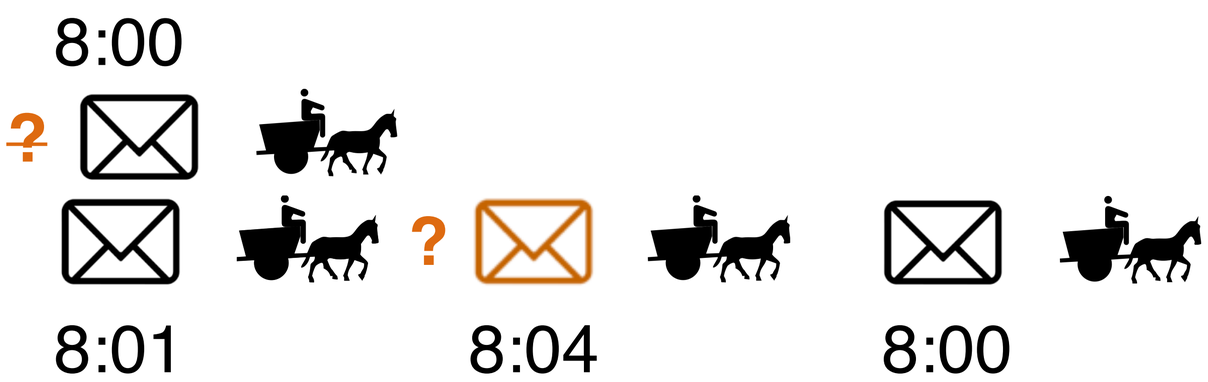




There's no guarantee that things arrive in order.

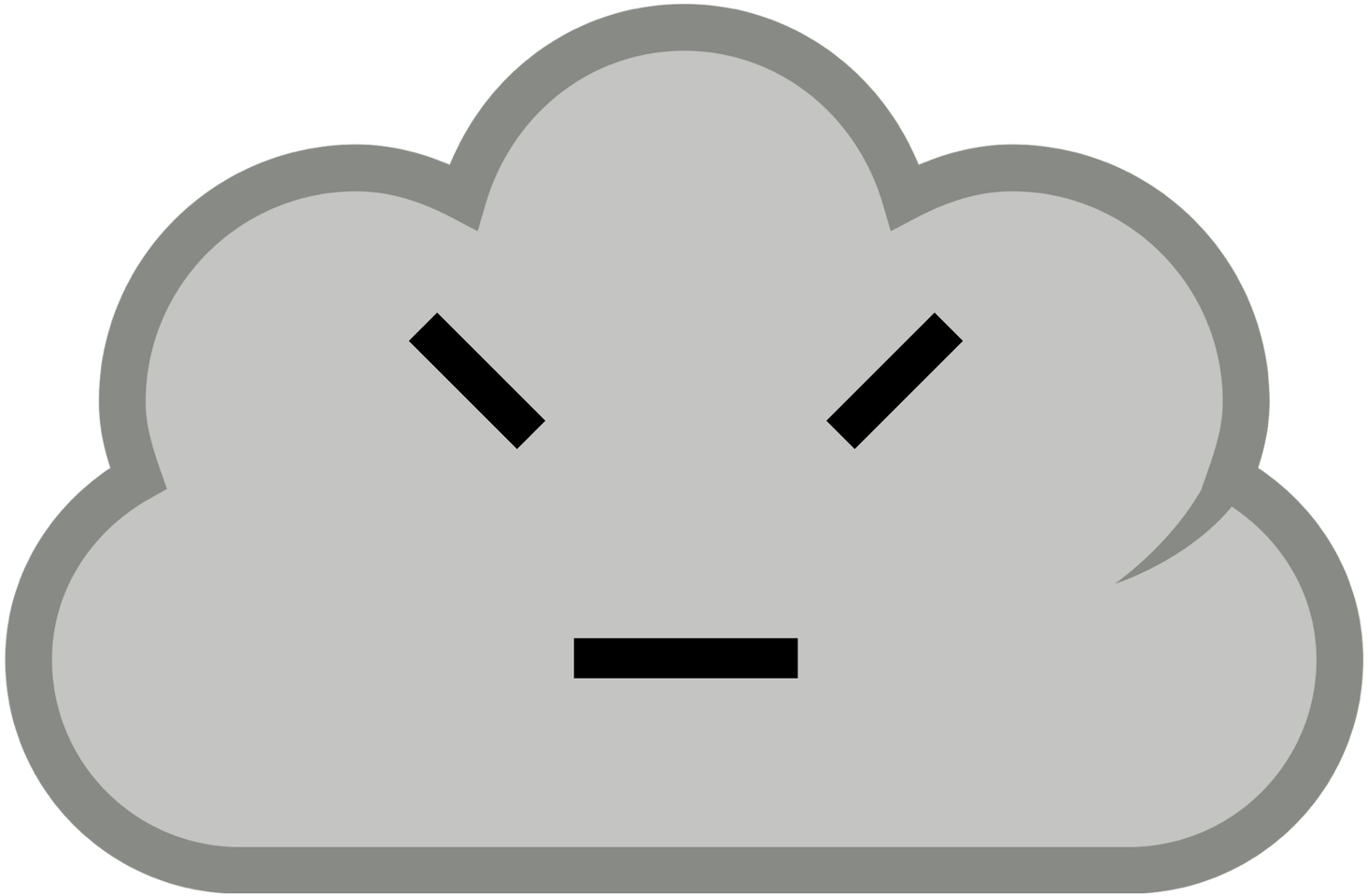


There's no guarantee that they arrive at all.



There are still more ways the system can be wrong, than we can possibly reason about.

Welcome to The Cloud.



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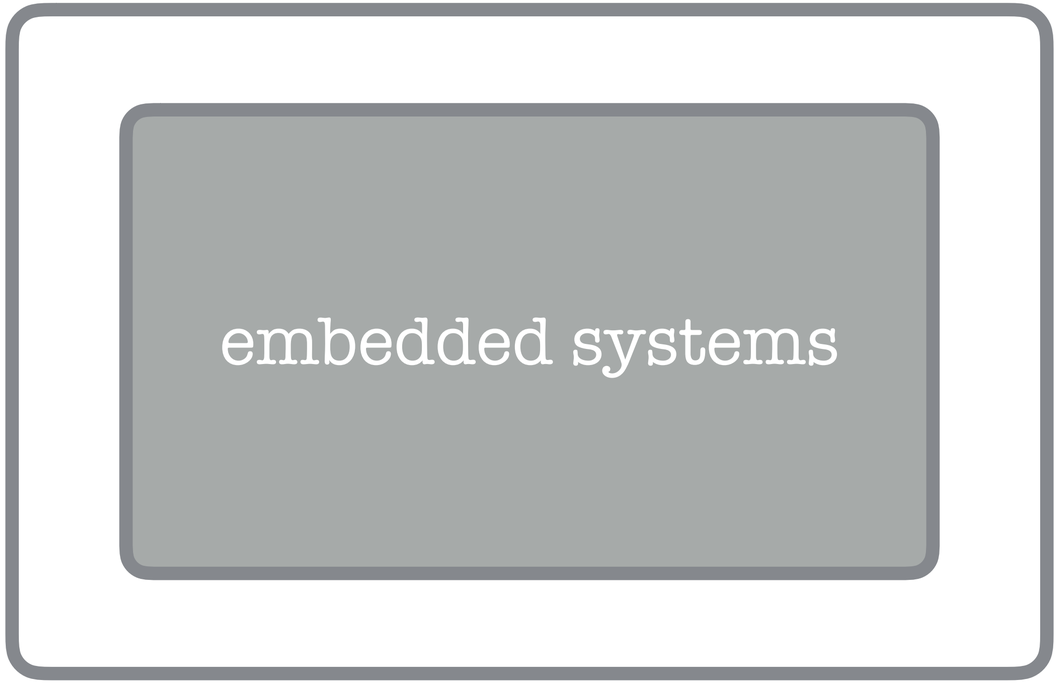
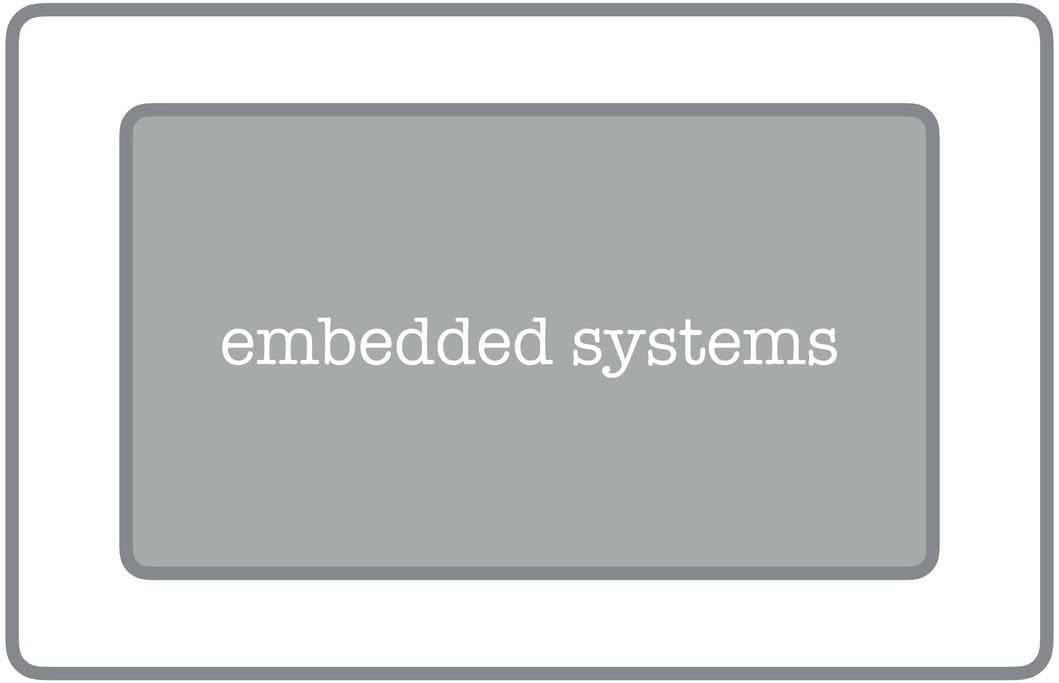

embedded systems



the tiny houses of engineering

200 sq. ft. of living space
Foundation optional

Emphasis on design to optimize reuse of space.

1 GB of hard disk
1 MB of main memory

CPU that's competitive with the average computer in the late 90's.

I can reuse my combined toilet/shower as my closet.

While the specific technologies we use
may be the means by which we fail,
they are not the cause.

You need technology to manage it, but if you don't even know how to worry about failure, you won’t know where to start.

I’m going to change the subject.

everyone’s favorite topic: **Software Estimation**

How many man-weeks/iterations/people will it take to do this project?

We’re typically wrong by 30%.

confidence.

What is the distance in light years to Alpha Centauri?

What year was helium discovered?

Quiz

Answer the following questions with a range of possible values. Ranges should be selected such that you would feel 90% confident that the true value falls in that range.

Question	Low	High
1. What is the distance in light years to Alpha Centauri?		
2. What is the circumference of the earth?		
3. What is the surface temperature of the sun?		
4. What is the number of pages on Wikipedia?		
5. What is the largest known prime?		
6. How many US Netflix streaming subscribers are there?		
7. What is Cerner's net worth?		
8. What year was helium discovered?		
9. What is the average cost of a wedding in the US?		
10. How many calories in a whole pepperoni pizza from Pizza Hut?		

lower and upper bounds with 90% confidence

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What is the distance in light years to Alpha Centauri?

10 - 1000

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10 - 1000

4.367

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What year was helium discovered?

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What year was helium discovered?

1850 - 1950

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What year was helium discovered?

1850 - 1950

1868

Quiz

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6 classes
32 people in each
192 people

best score: 7/10
1:32

overconfidence.

overoptimism.

bias.

structure beats bias.

eat your vegetables.

1. Develop system model.
2. Record known risk areas.
3. Publish model and risk areas.
4. Perform regular risk reviews. (Premortems)
5. Dissect and document missed risks.

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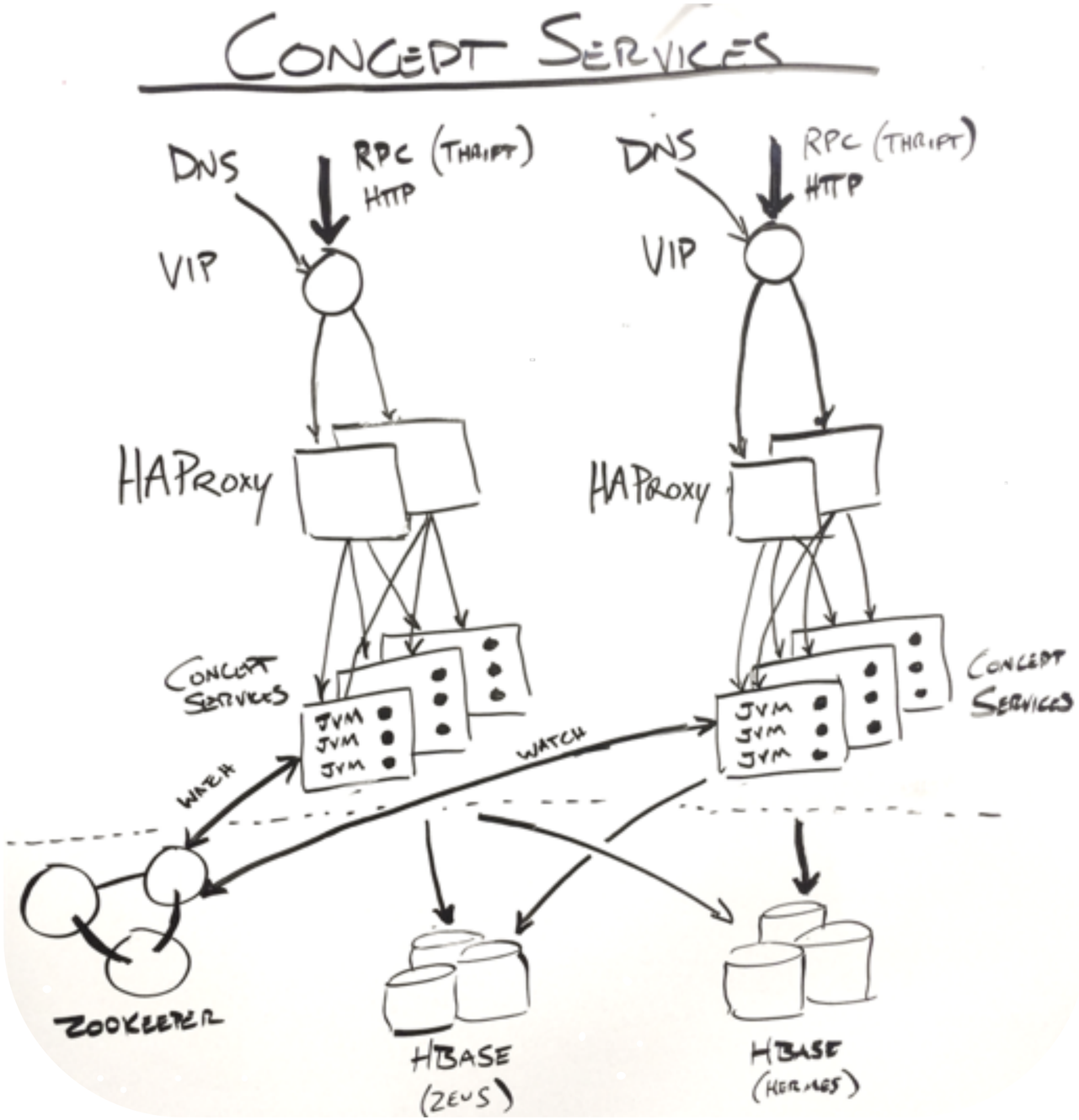

CONCEPT SERVICES
DNS
RPC (THRIFT)
HTTP
VIP
HAPROXY
DNS
RPC (THRIFT)
HTTP
VIP
HAPROXY
CONCEPT SERVICES
JVM
JVM
JVM
CONCEPT SERVICES
JVM
JVM
JVM
WATCH
WATCH
ZOOKEEPER
HBASE (ZEUS)
HBASE (HERMES)

nailed it!

The behavior of a system cannot be known just by knowing the elements of which the system is made.

“Accidents occur due to relationships not components.”

- Sidney Dekker

Drift Into Failure: From Hunting Broken Components to Understanding Complex Systems

We deal with a lot of relationships.

We deal with a lot of relationships.

temporal

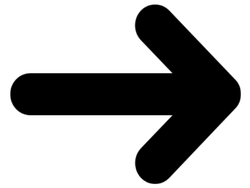
We deal with a lot of relationships.

temporal

spatial

We deal with a lot of relationships.

temporal

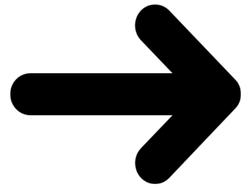


causal

spatial

We deal with a lot of relationships.

temporal



causal

spatial

familial

Paper published in IEEE Software 12 (6)
November 1995, pp. 42-50

Architectural Blueprints—The "4+1" View Model of Software Architecture

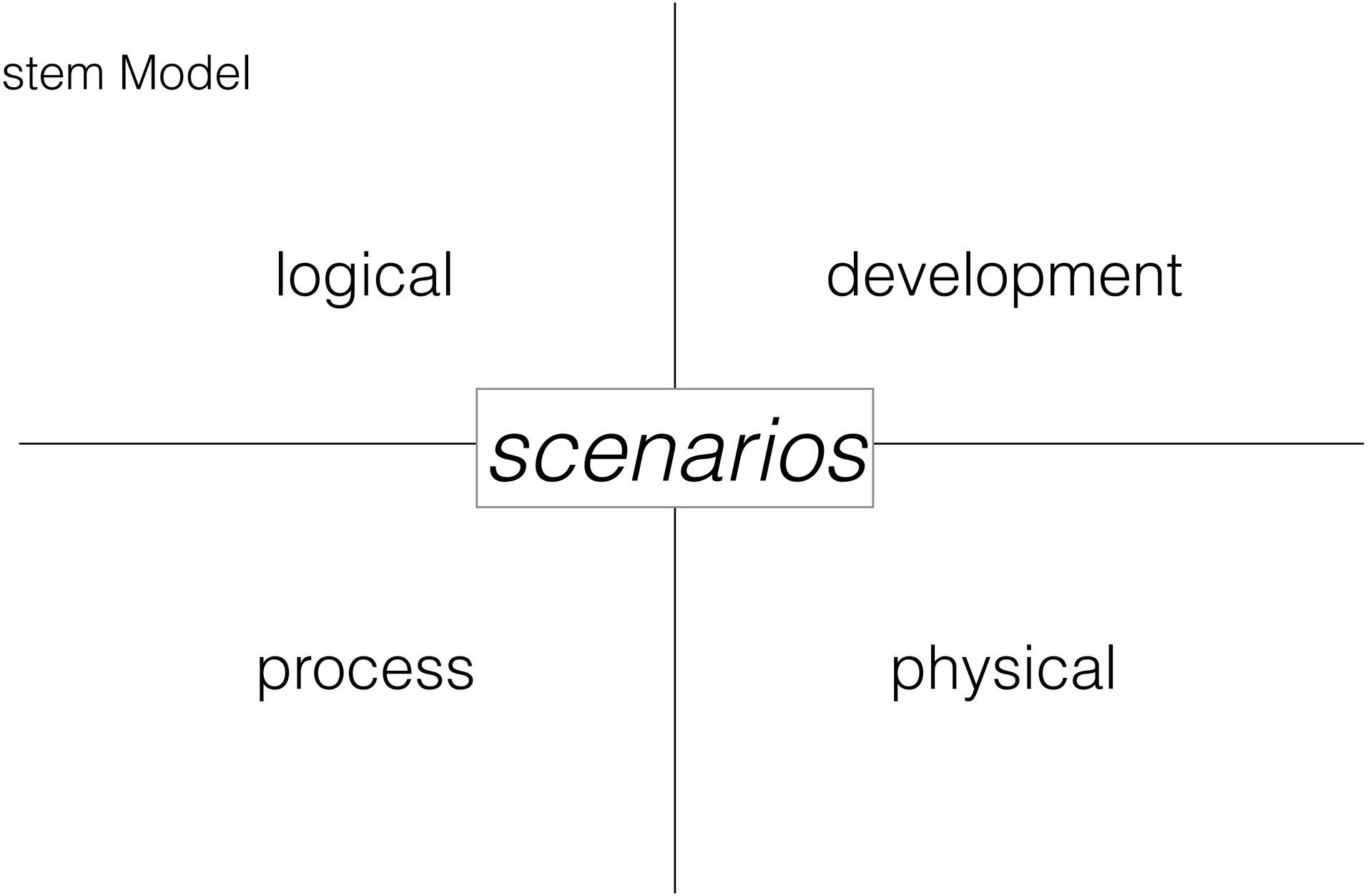
Philippe Kruchten
Rational Software Corp.

Abstract

This article presents a model for describing the architecture of software-intensive systems, based on the use of multiple, concurrent views. This use of multiple views allows to address separately the concerns of the various 'stakeholders' of the architecture: end-user, developers, systems engineers, project managers, etc., and to handle separately the functional and non functional requirements. Each of the five views is described, together with a notation to capture it. The views are designed using an architecture-centered, scenario-driven, iterative development process.

Keywords: software architecture, view, object-oriented design, software development process

System Model



logical

How would a user reason about the system?

development

How would the developer reason about the system?

development

What do I deploy?

How would a system engineer reason about the system?

physical

What's the hardware/ networking profile?

physical

How would the operating system reason about the system?

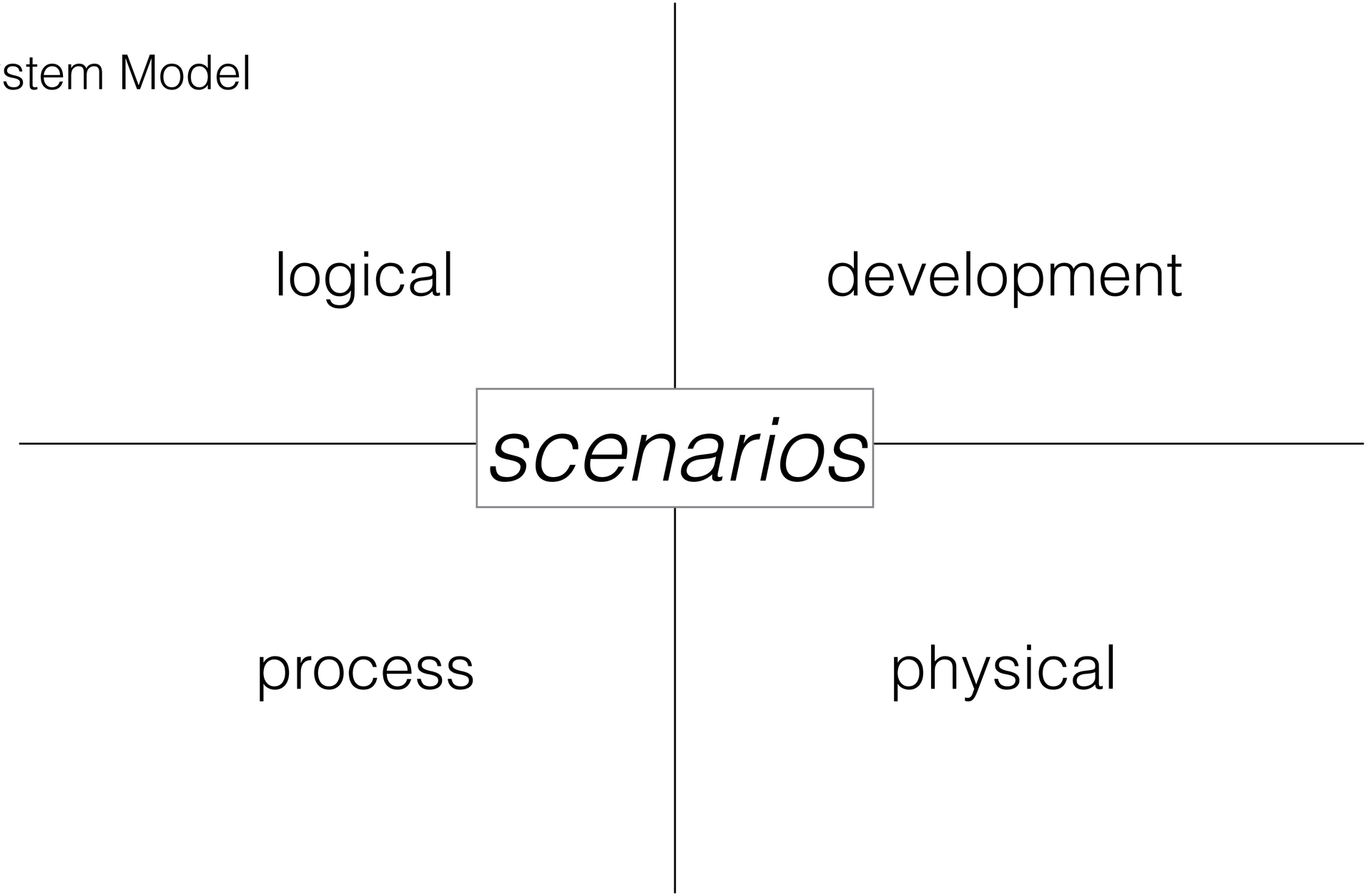
process

How are things communicating?

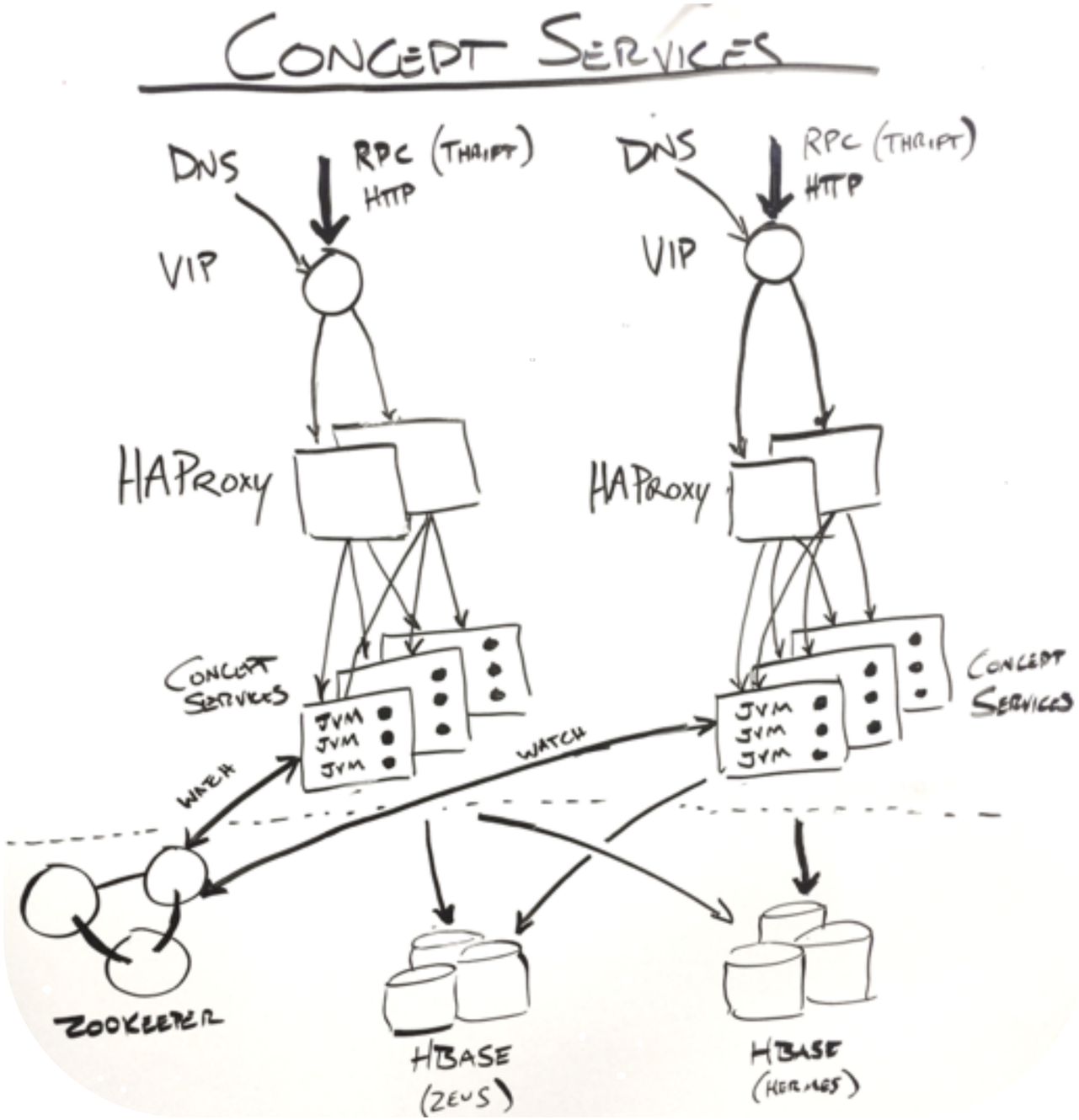
Are they doing things at the same time?

process

System Model



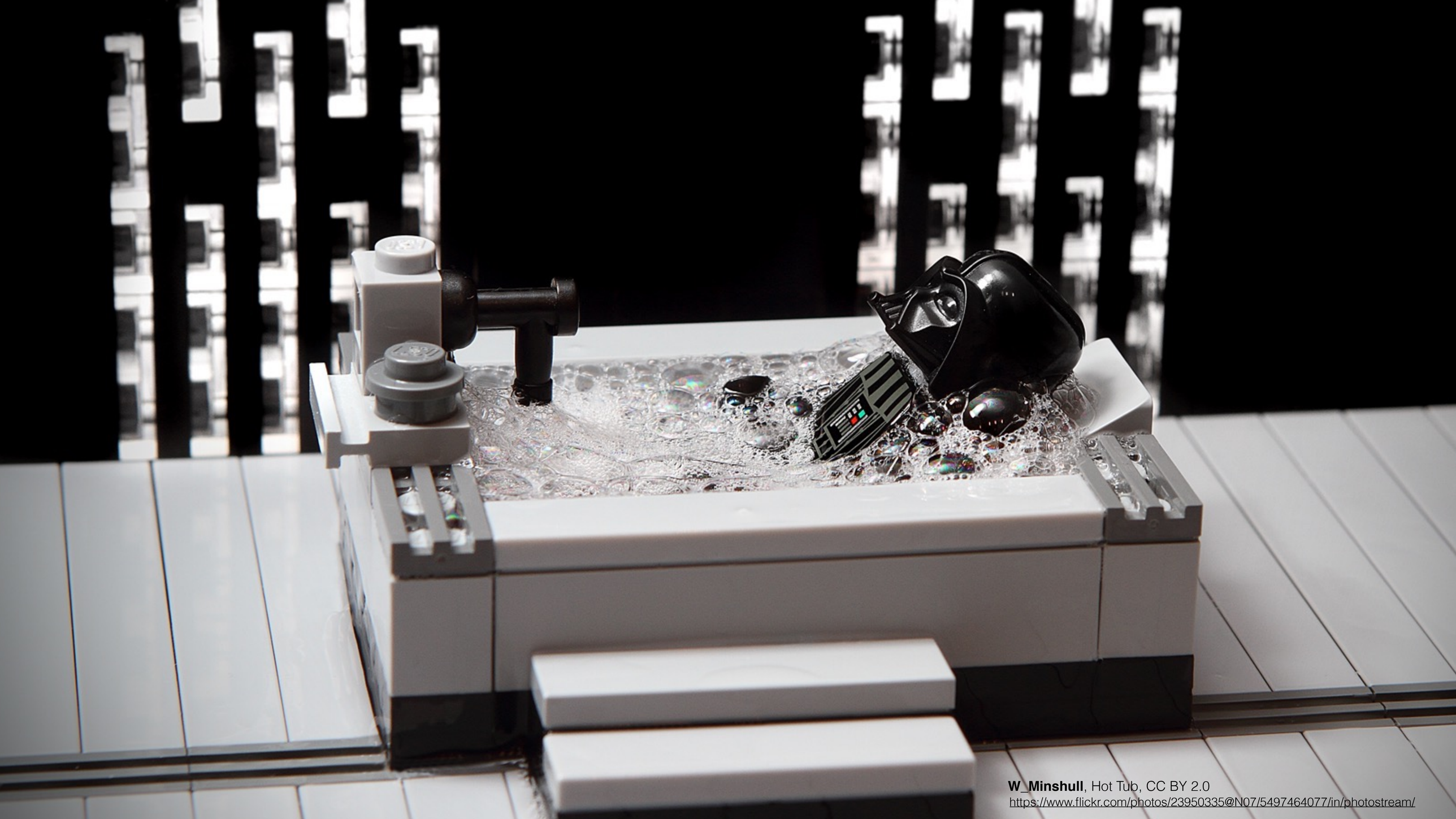
That seems like a lot of work.

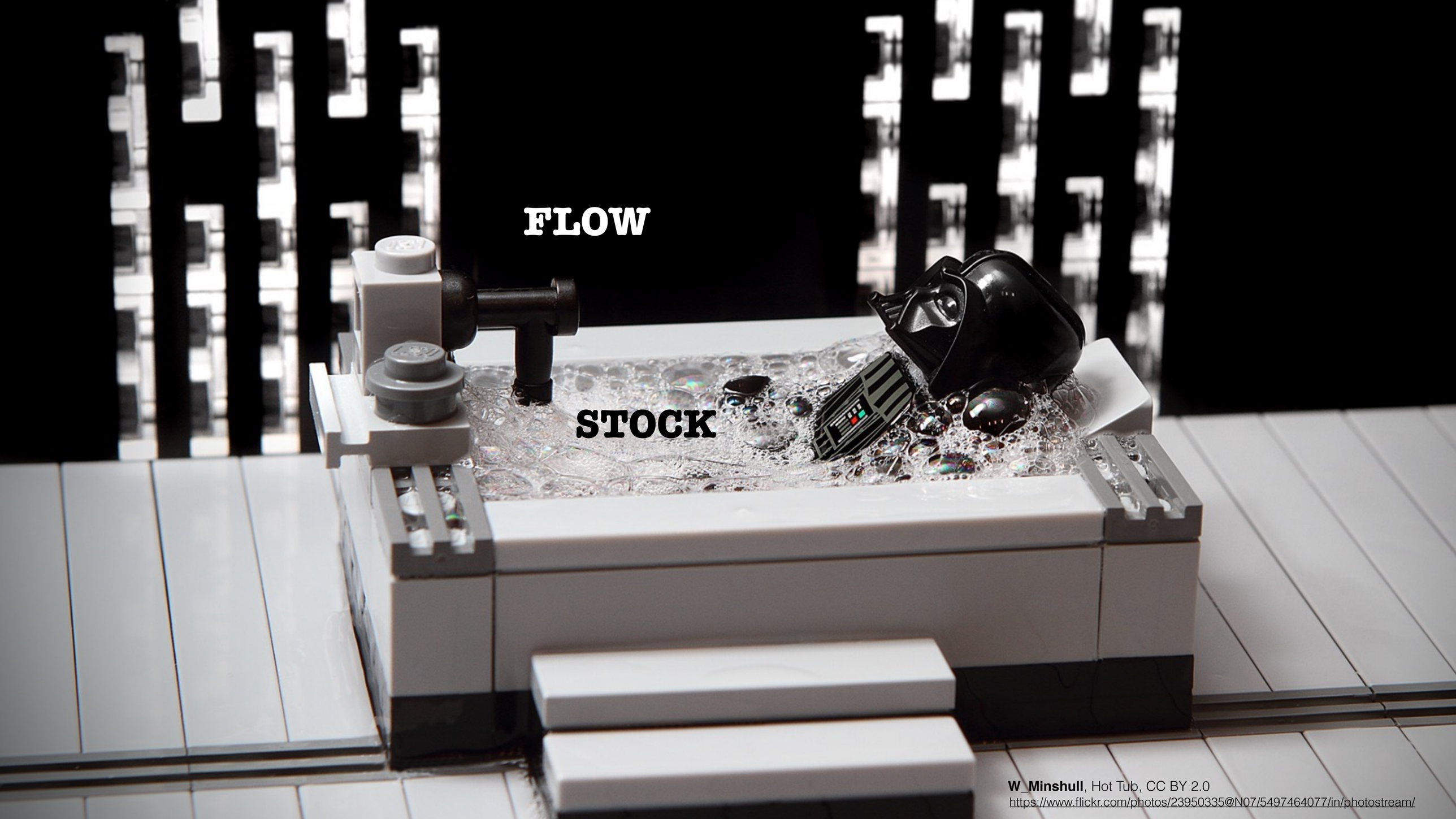


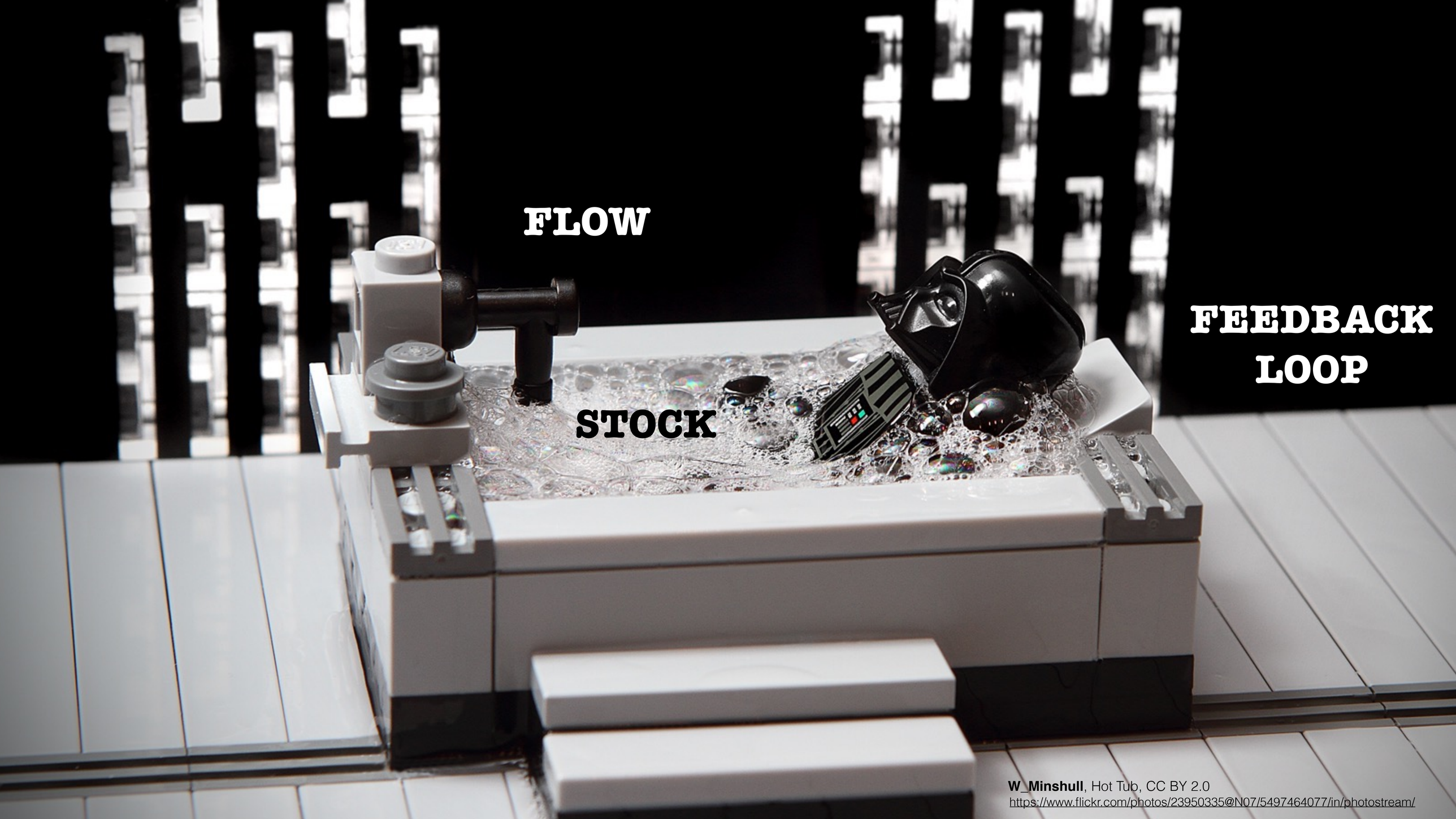
+

Stocks,
Flows, &
Feedback Loops

Systems Thinking







“creating mental models.”

- Charles Duhrigg

Smarter Faster Better

“Models help us choose where to direct our attention, so we can make decisions, rather than just react.”

- Charles Duhrigg

Smarter Faster Better

CLOSED LIST EXAMPLE

A*

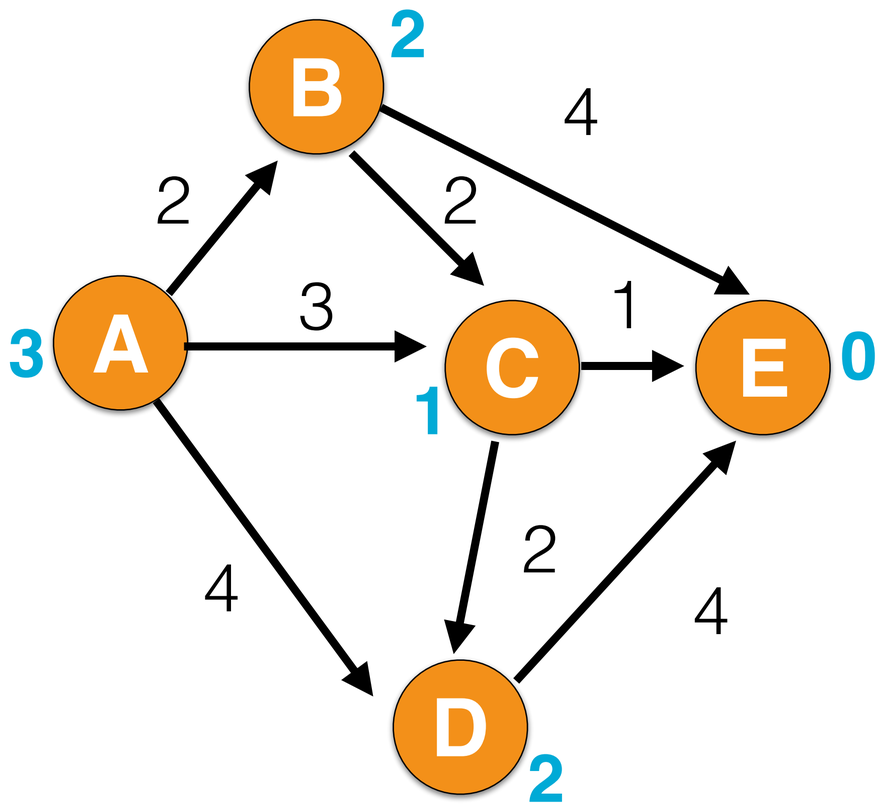
a graph search algorithm

graph: nodes and edges that need to be searched.

open list: a list of nodes that haven't been explored.

closed list: a list of nodes that have been explored.

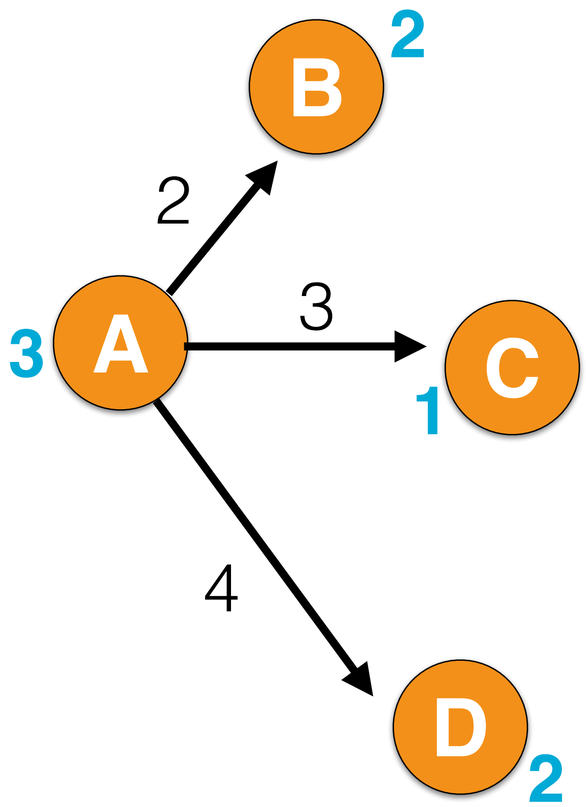
My Example Graph



Open List

Closed List

My Example Graph

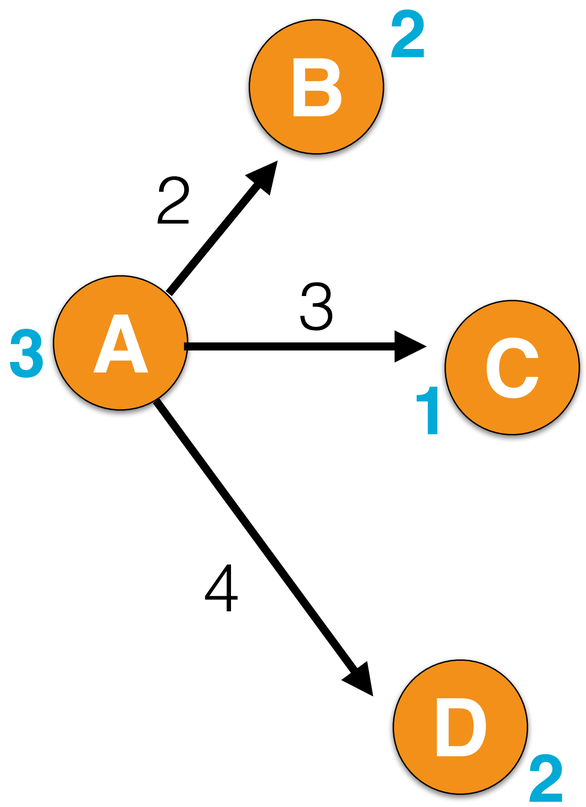


Open List

A	3

Closed List

My Example Graph



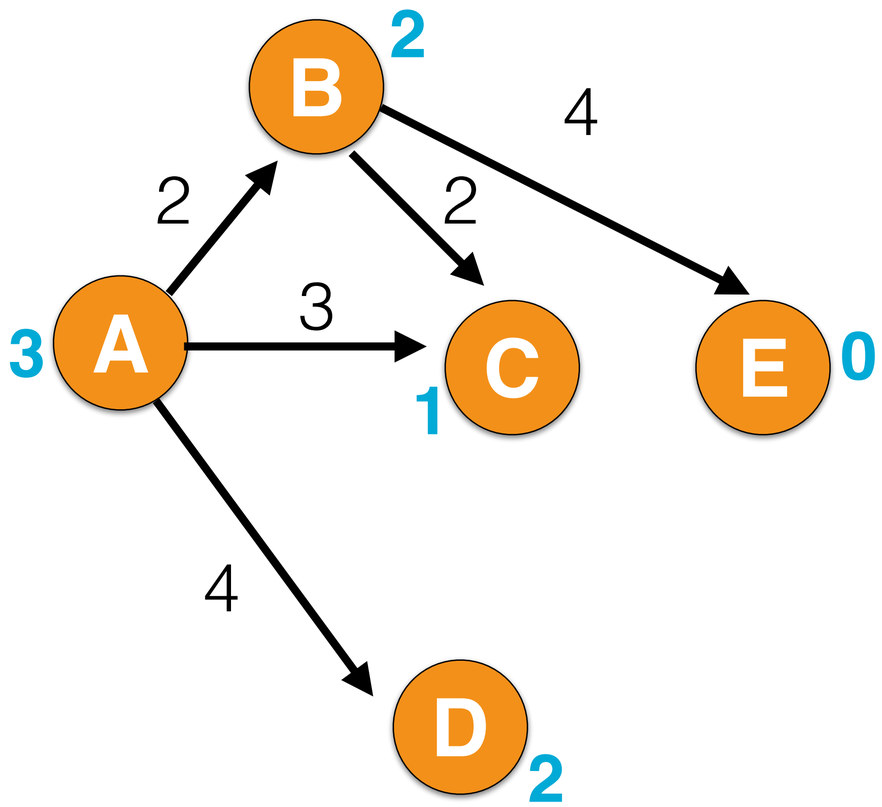
Open List

B	4
C	4
D	6

Closed List

A	3

My Example Graph



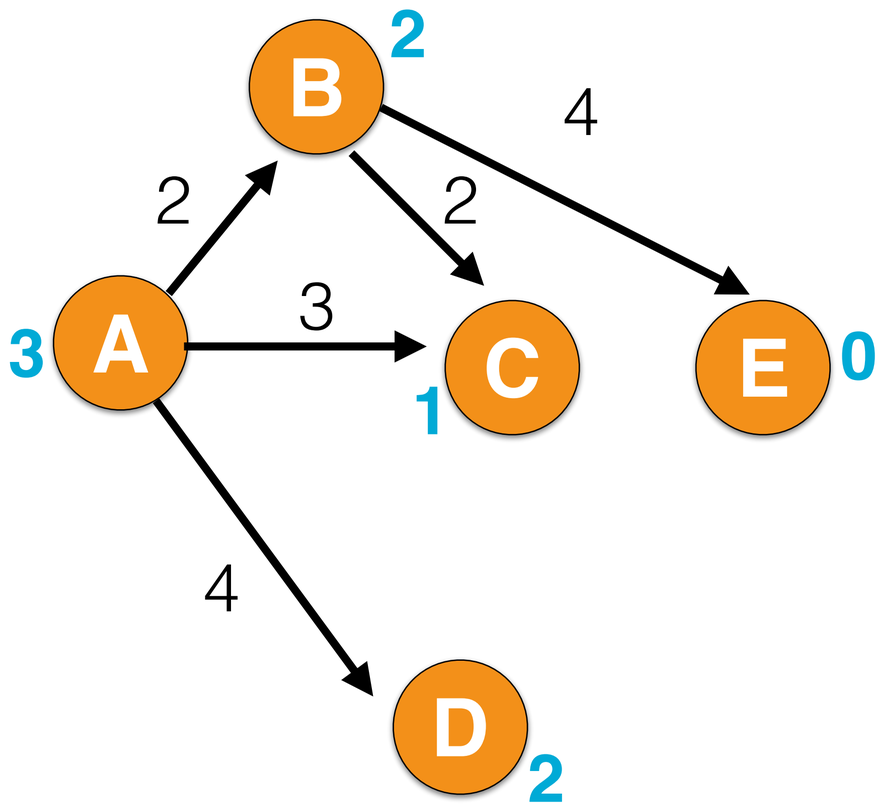
Open List

B	4
C	4
D	6

Closed List

A	3

My Example Graph



Open List

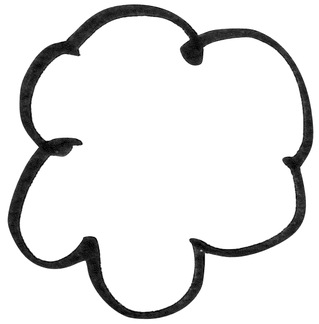
C	4
D	6
E	6

Closed List

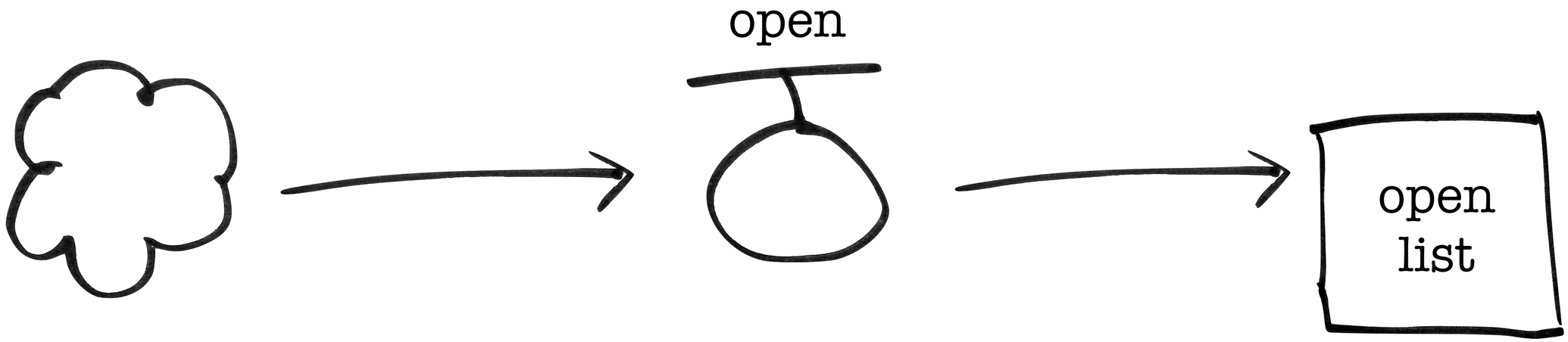
A	3
B	4

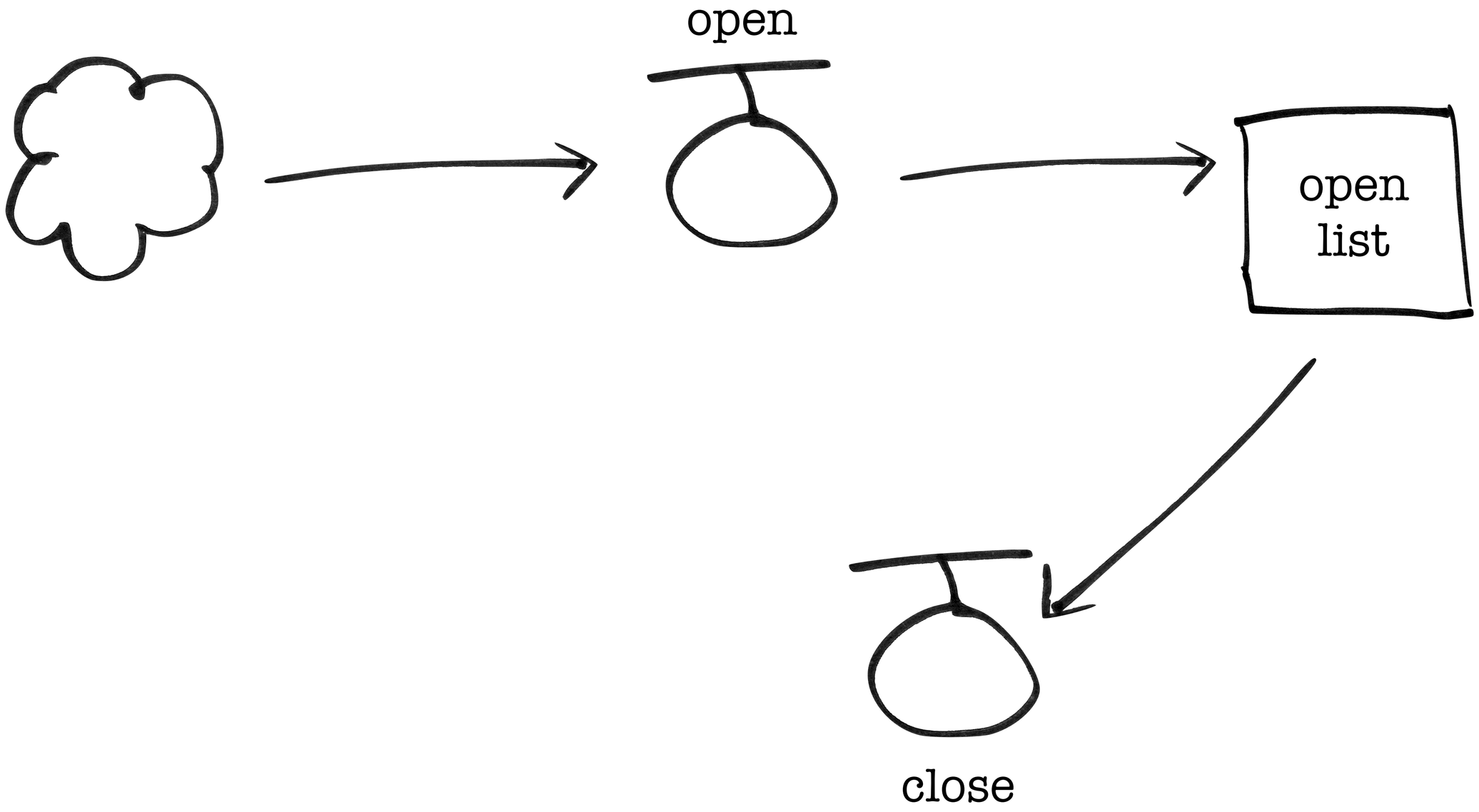
1 GB of hard disk
1 MB of main memory

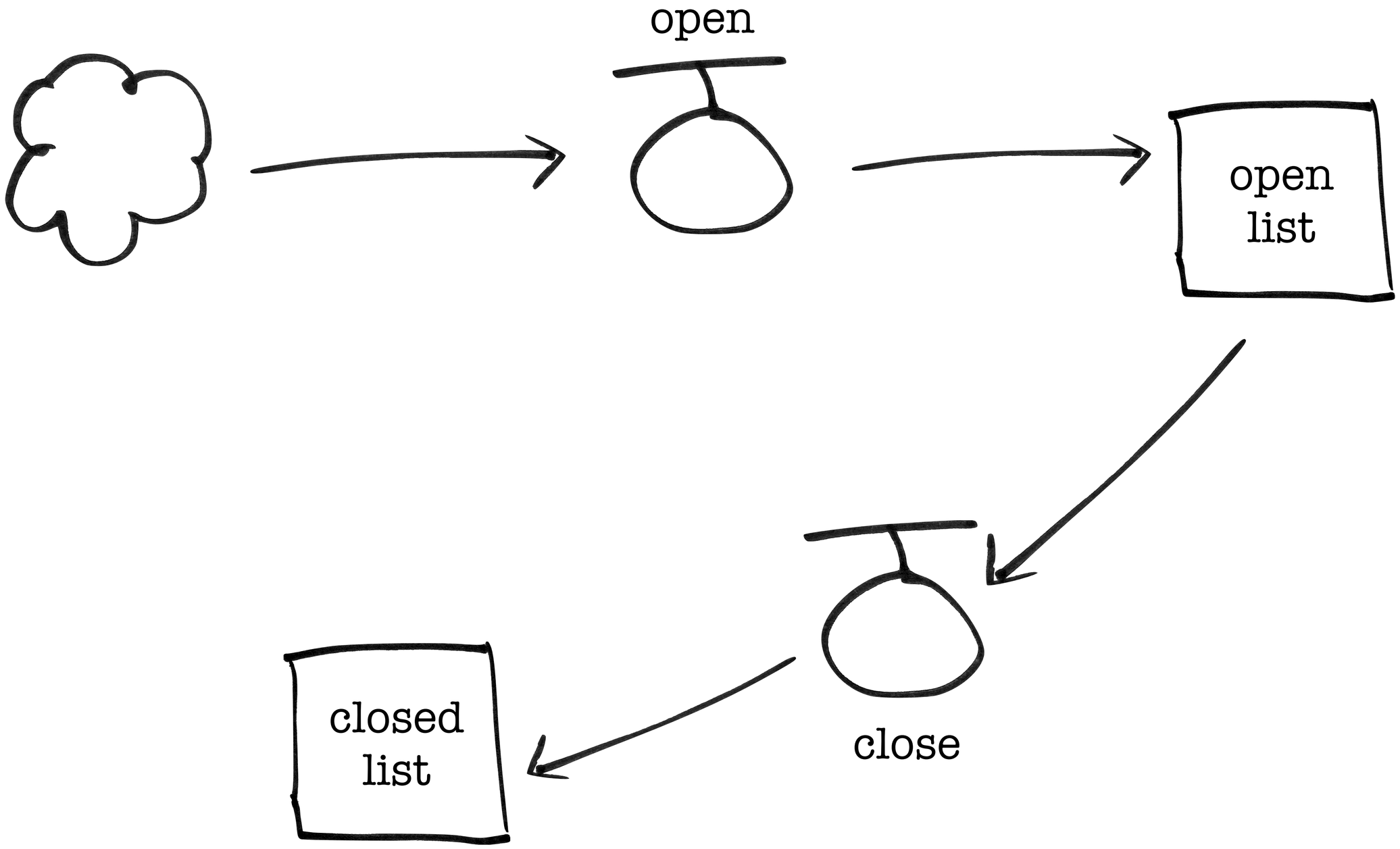
CPU that's competitive with the average computer in the late 90's.

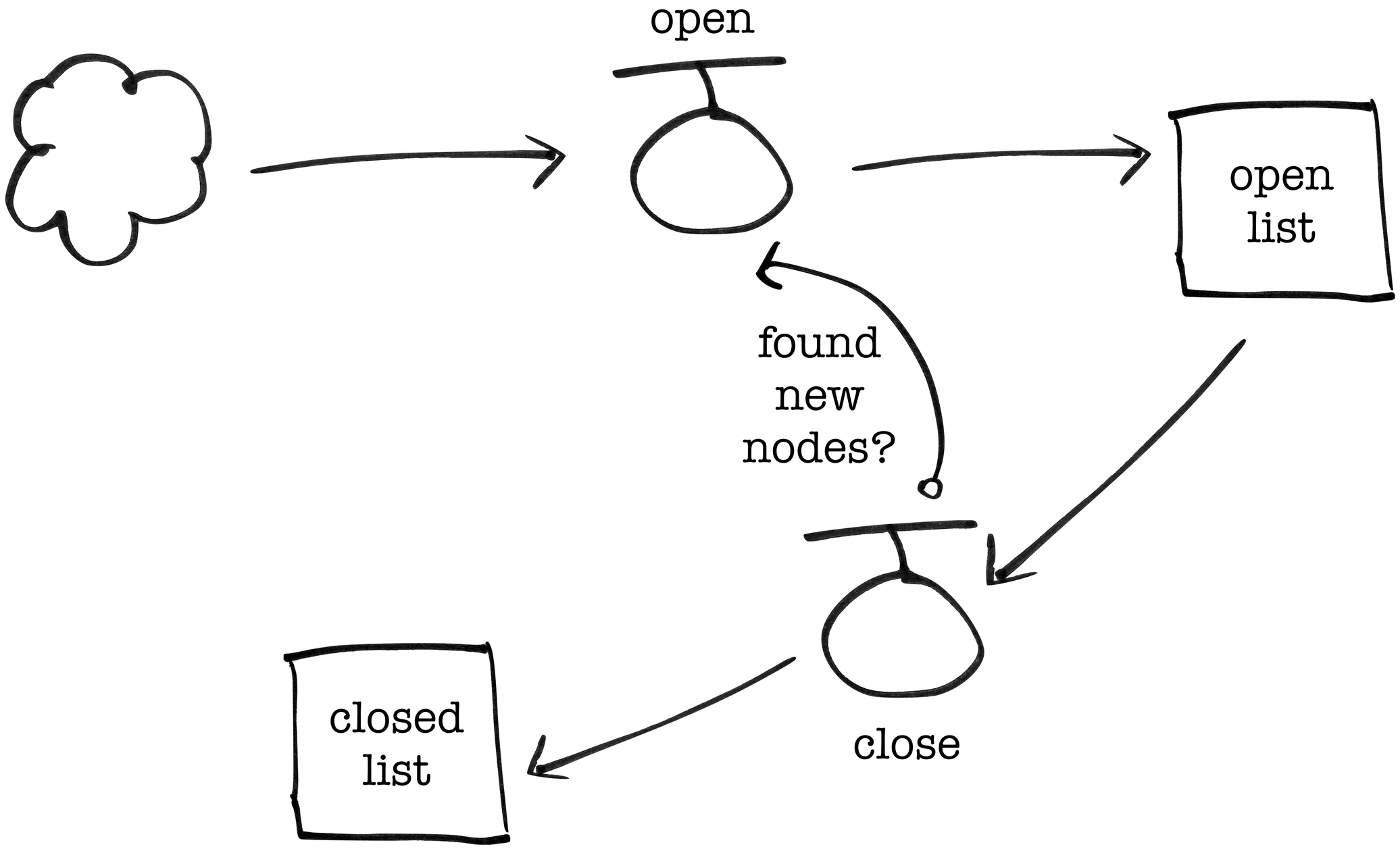


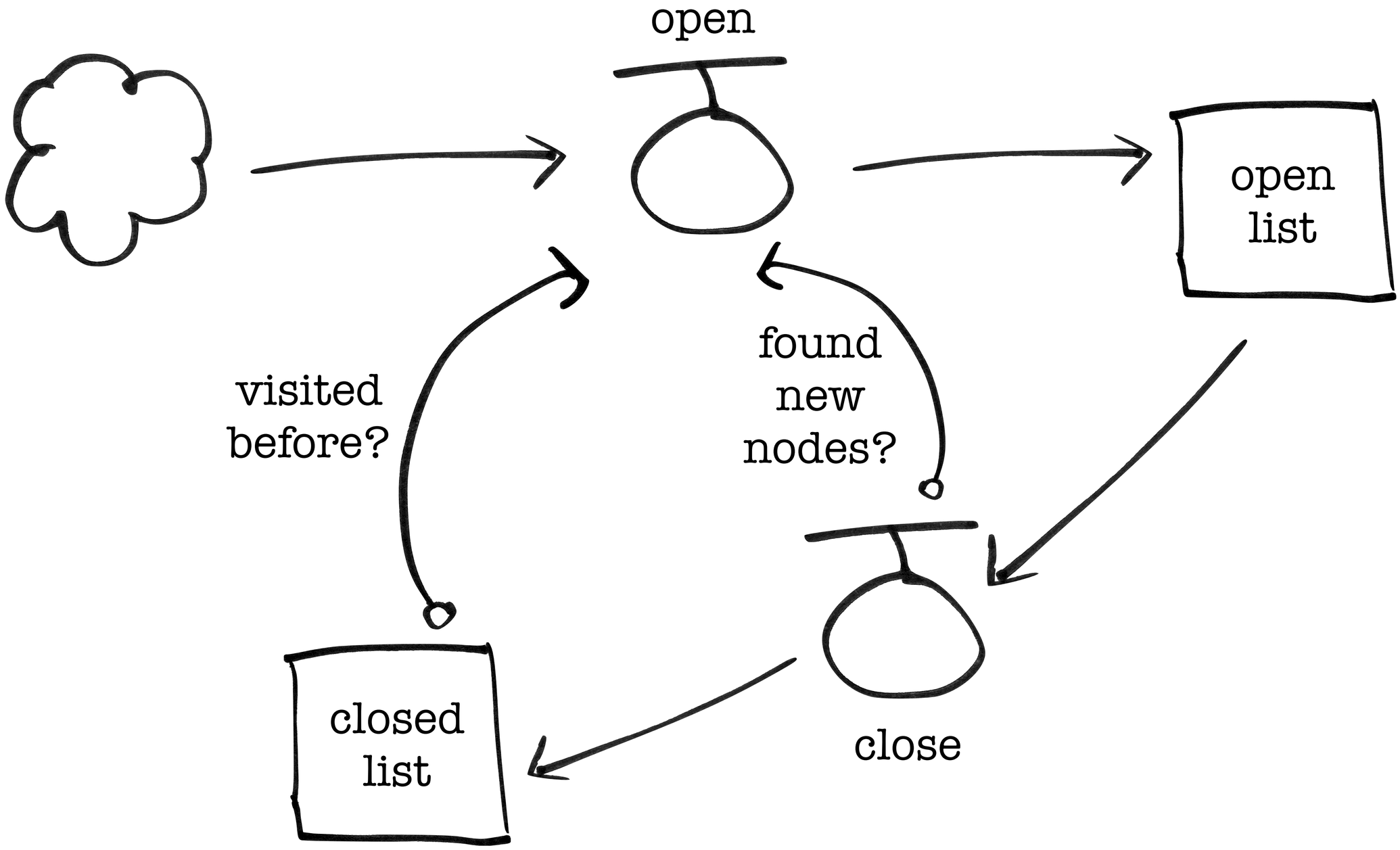

open

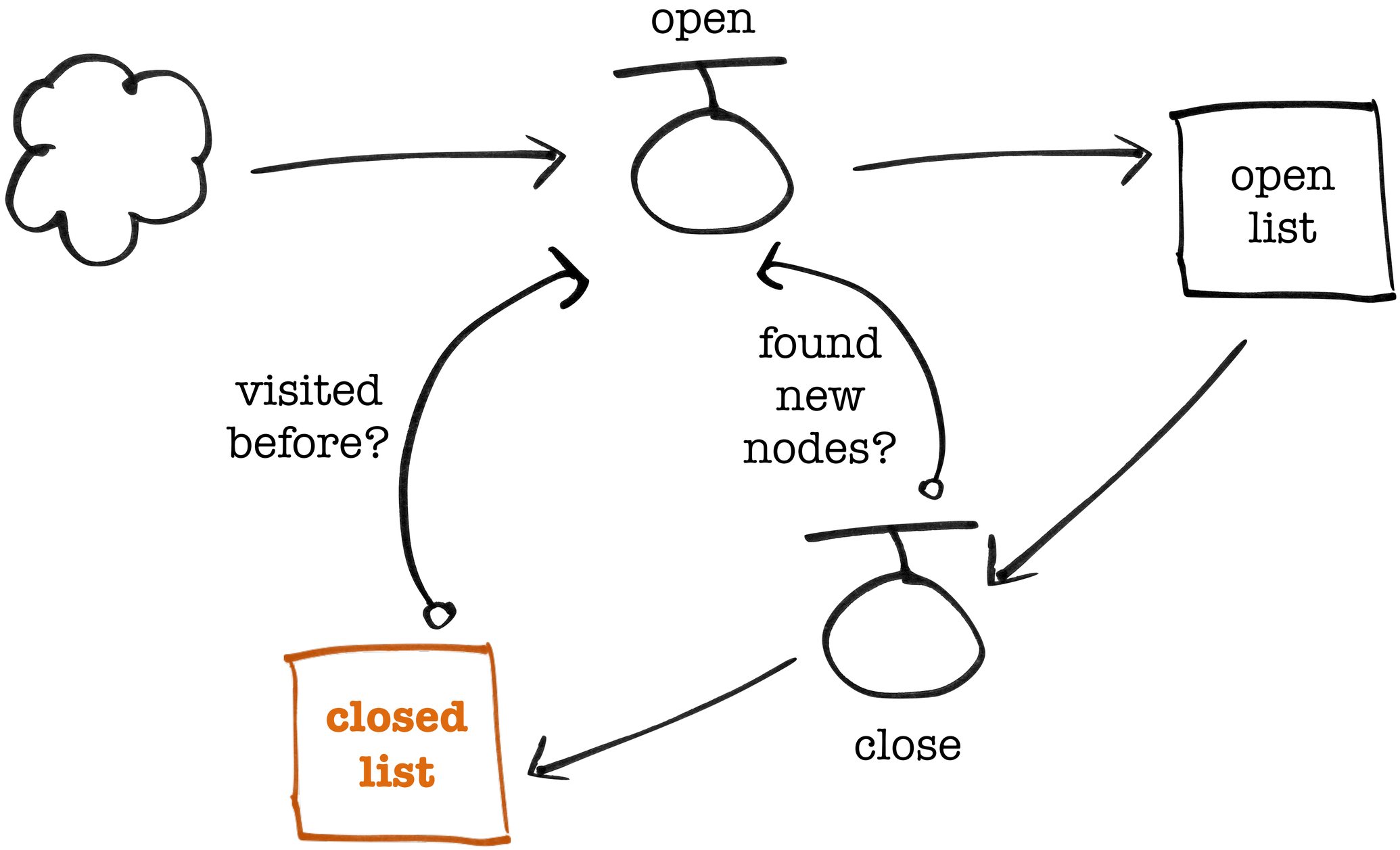

open
open
list


open
open
list
close


open
open
list
close
closed
list


open
open list
found new nodes?
close
closed list


open
open list
found new nodes?
visited before?
close
closed list

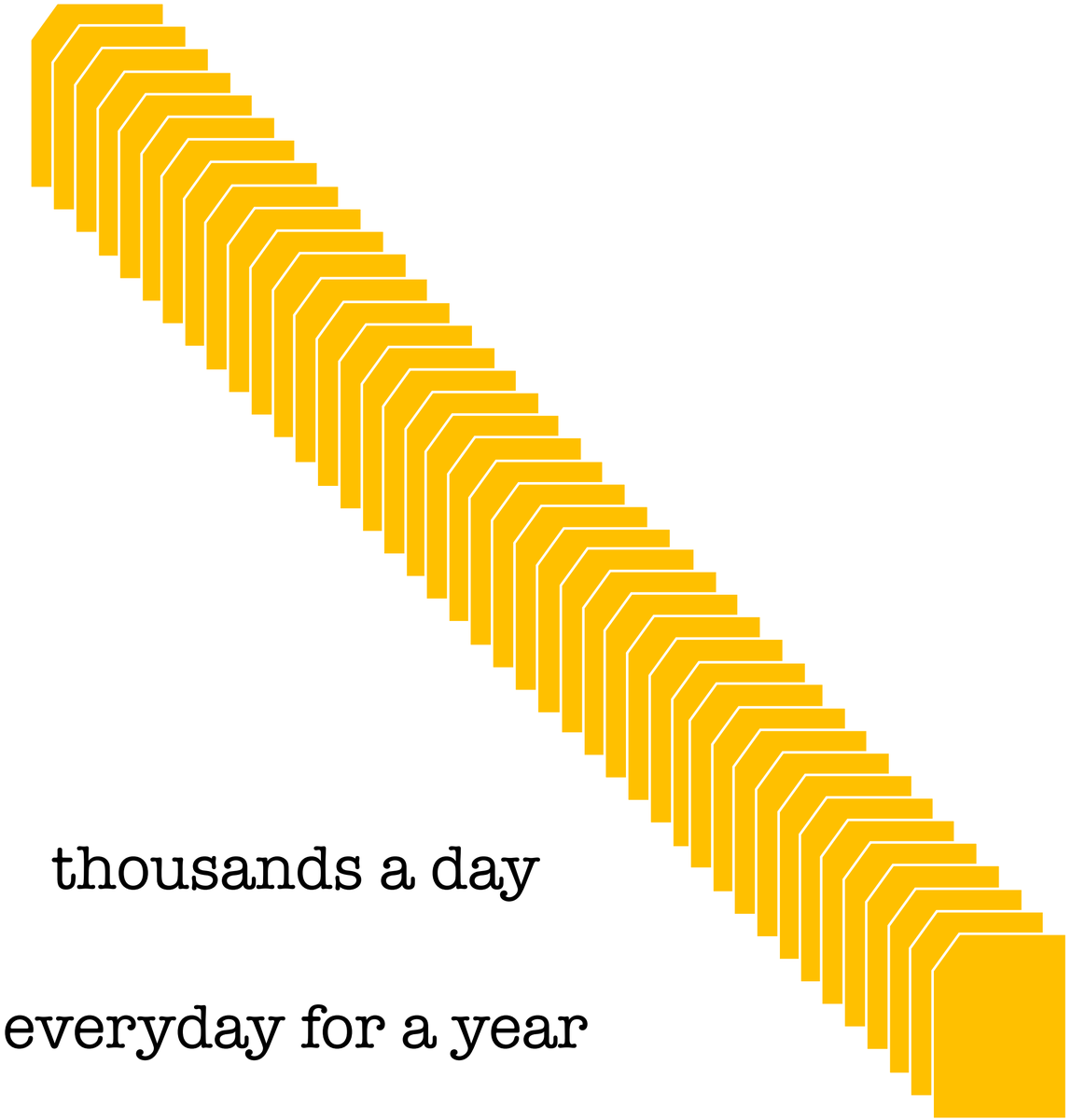

open
open list
found new nodes?
visited before?
closed list
close

SMALL FILES EXAMPLE

thousands a day

thousands a day

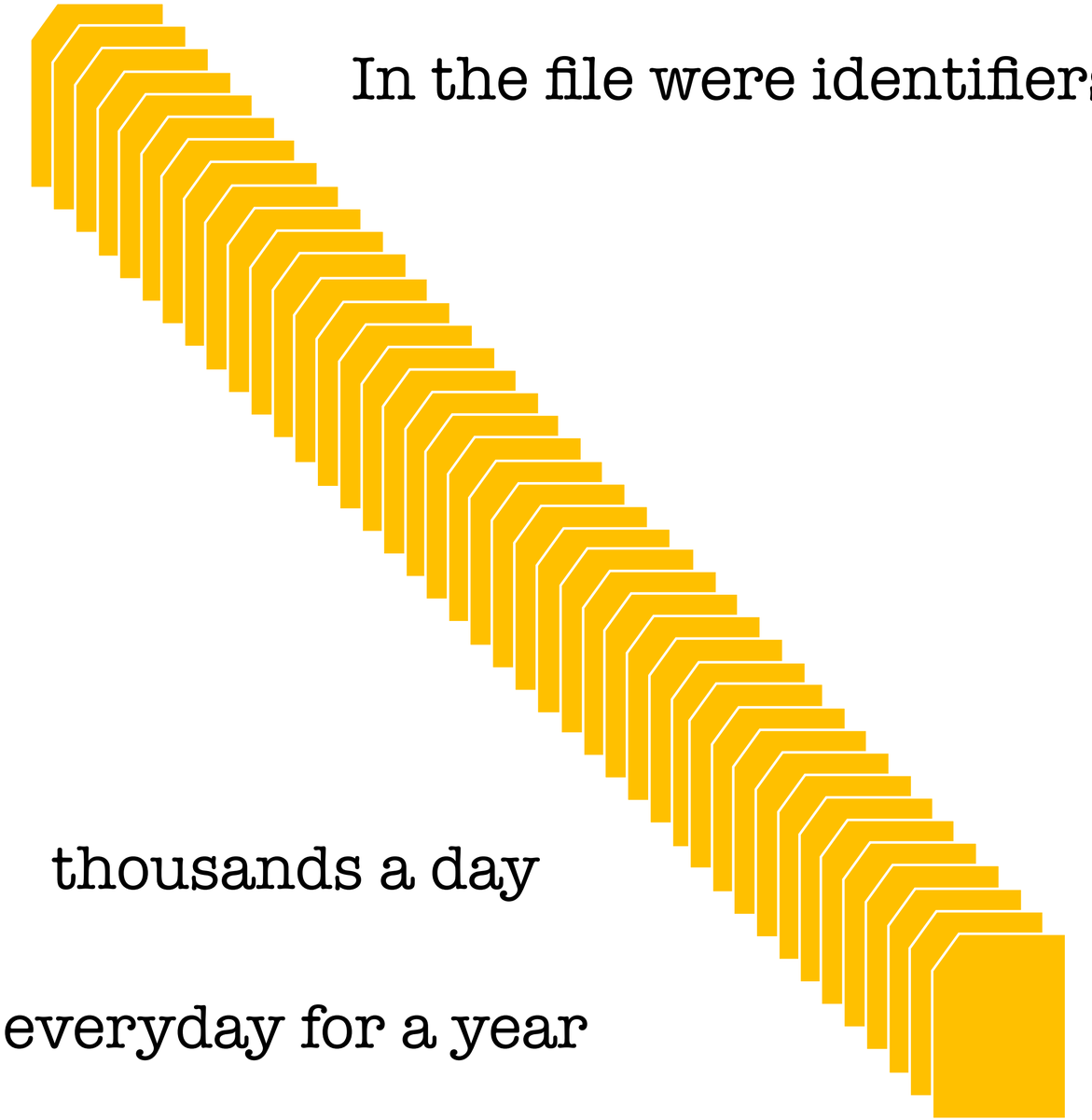
everyday for a year



thousands a day

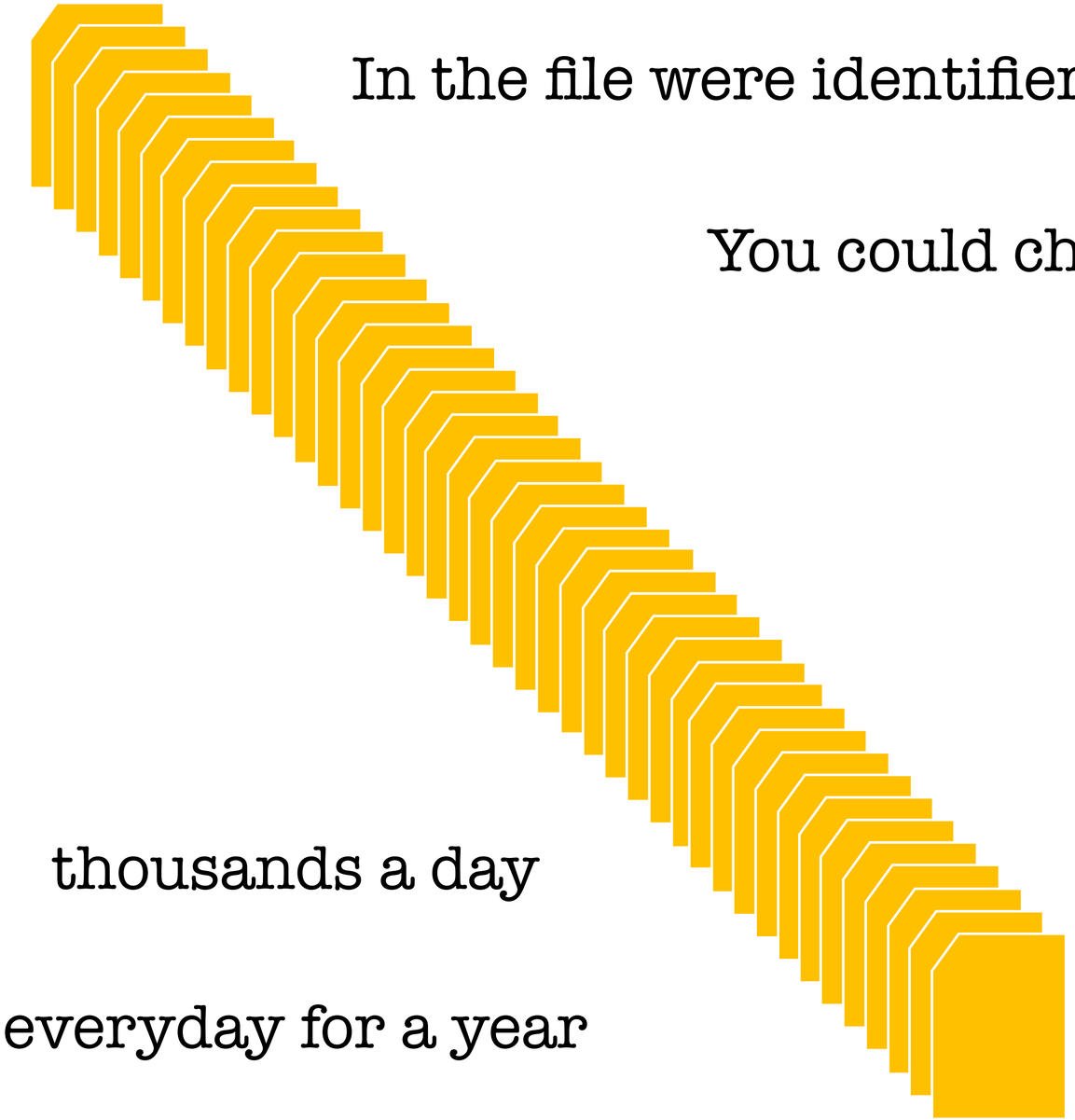
everyday for a year

In the file were identifiers that needed to be globally unique.



thousands a day

everyday for a year

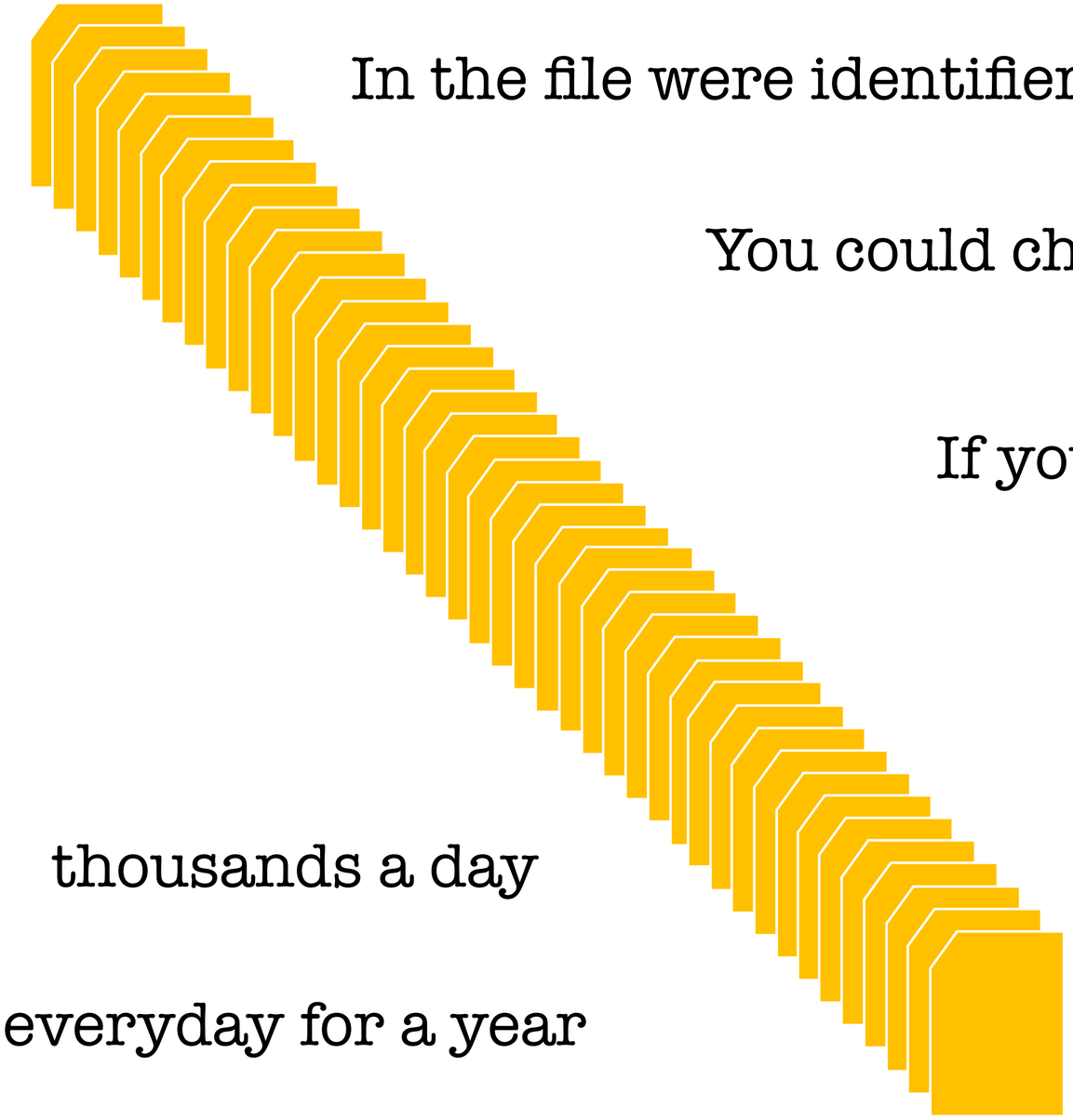


In the file were identifiers that needed to be globally unique.

You could change anything in the file passively -
except that identifier.

thousands a day

everyday for a year



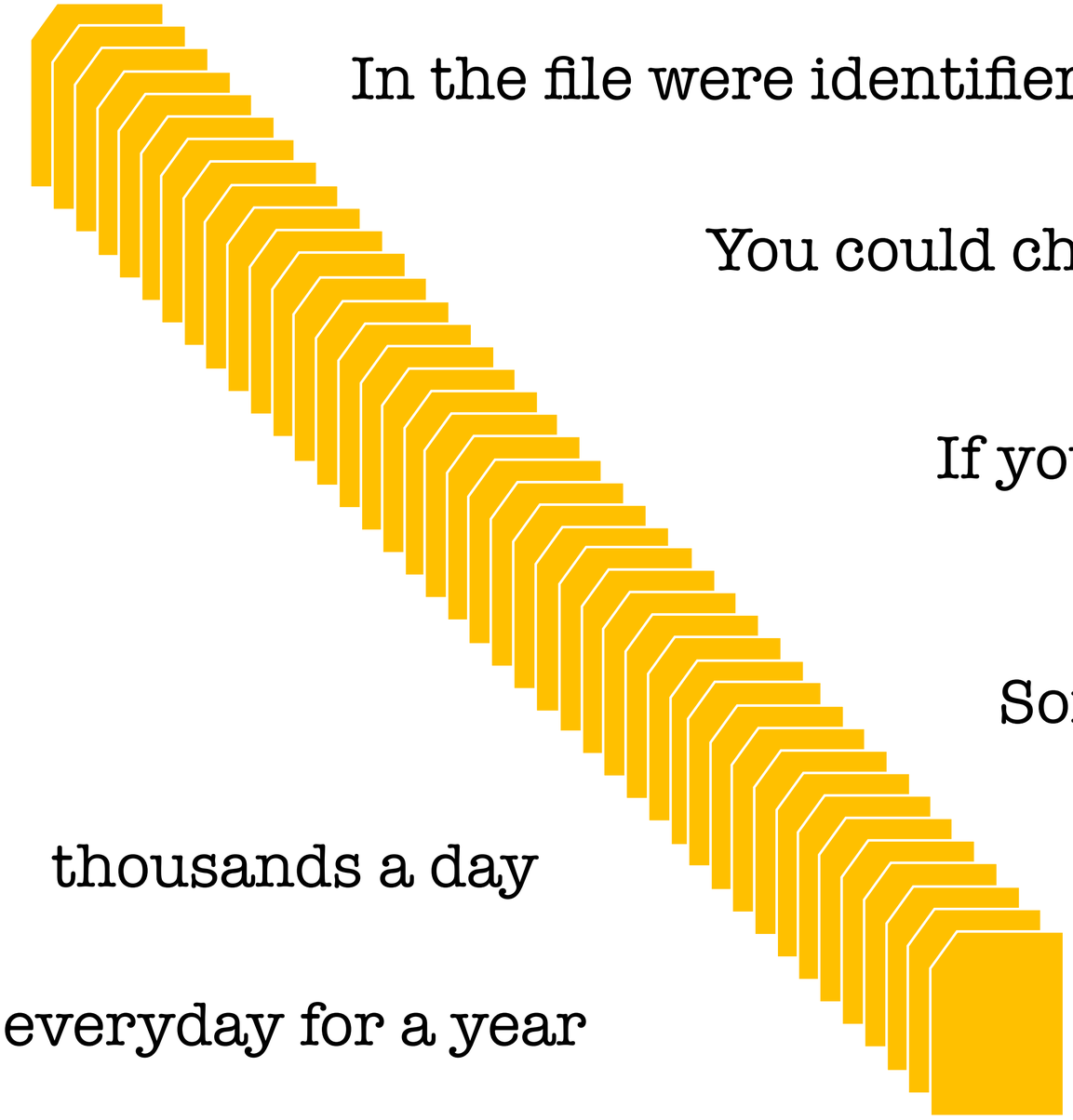
In the file were identifiers that needed to be globally unique.

You could change anything in the file passively - except that identifier.

If you change the identifier , you have to reprocess the file.

thousands a day

everyday for a year



In the file were identifiers that needed to be globally unique.

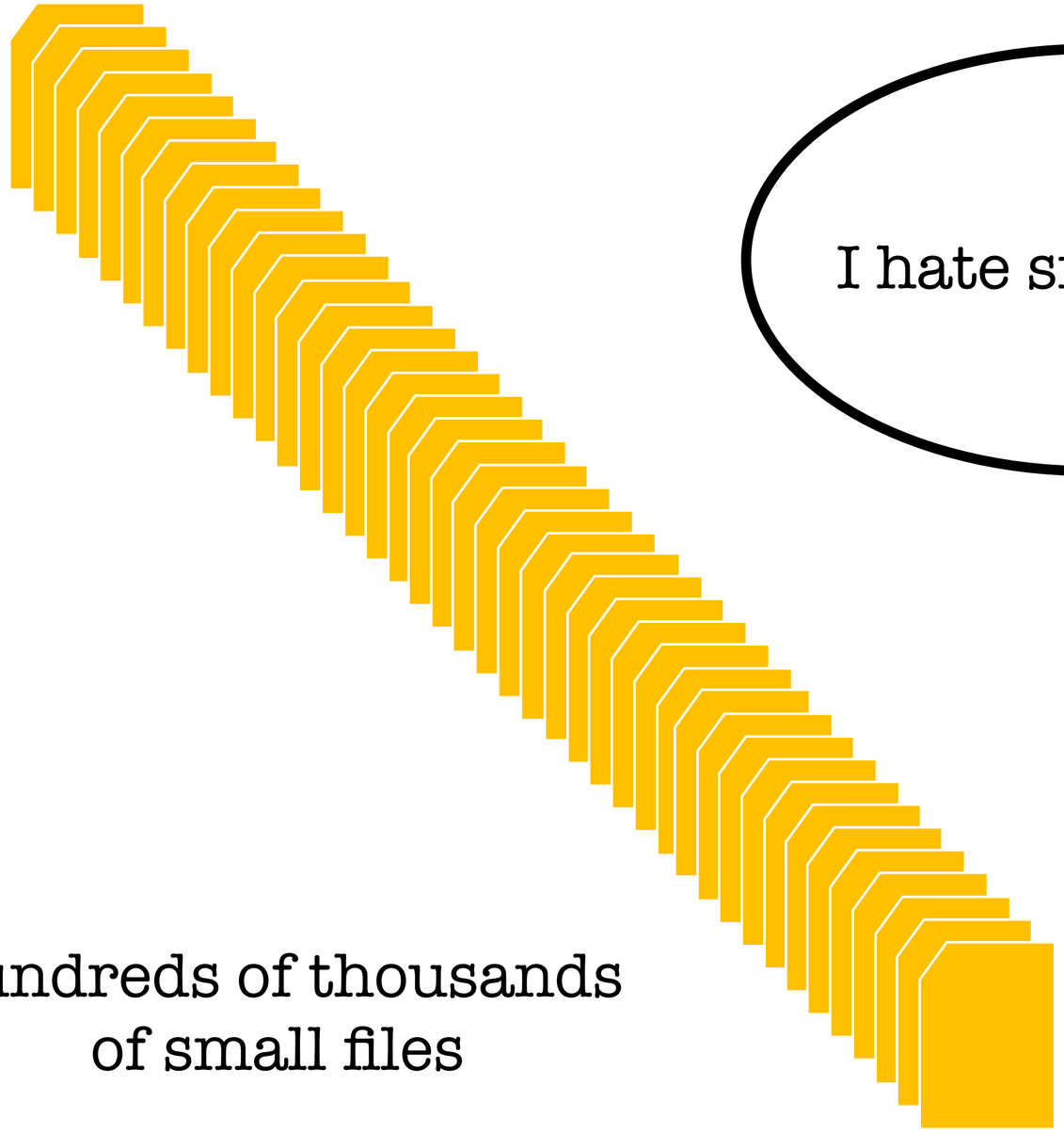
You could change anything in the file passively - except that identifier.

If you change the identifier , you have to reprocess the file.

Someone changed all of the identifiers.

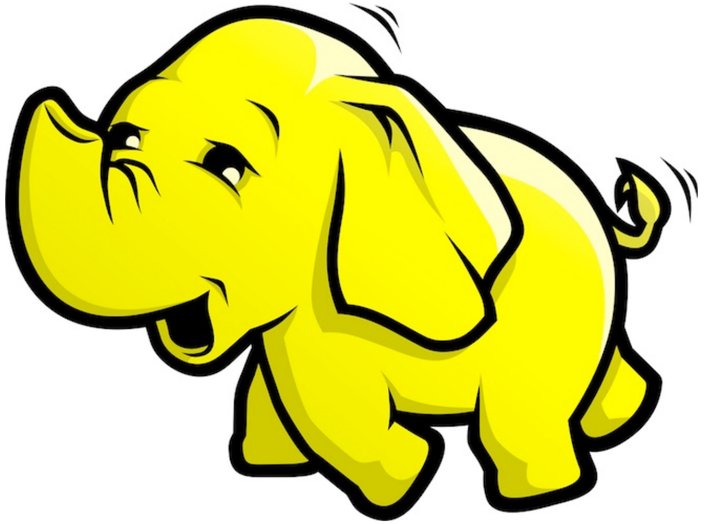
thousands a day

everyday for a year



hundreds of thousands
of small files

I hate small files.



cloudera

Cloudera Engineering Blog

Best practices, how-tos, use cases, and internals from Cloudera Engineering and the community

SEARCH

The Small Files Problem

February 2, 2009 | By Tom White | 32 Comments

Categories: General Hadoop

Small files are a big problem in Hadoop — or, at least, they are if the number of questions on the user list on this topic is anything to go by. In this post I'll look at the problem, and examine some common solutions.

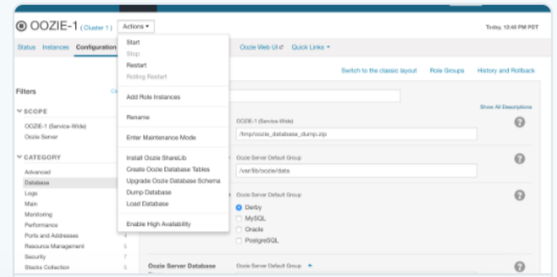
Problems with small files and HDFS

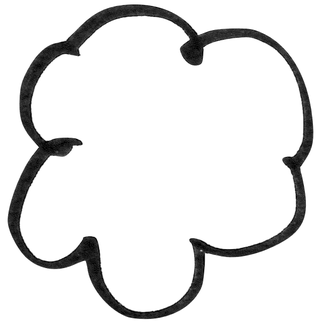
A small file is one which is significantly smaller than the HDFS block size (default 64MB). If you're storing small files, then you probably have lots of them (otherwise you wouldn't turn to Hadoop), and the problem is that HDFS can't handle lots of files.

Tweets by @ClouderaEng

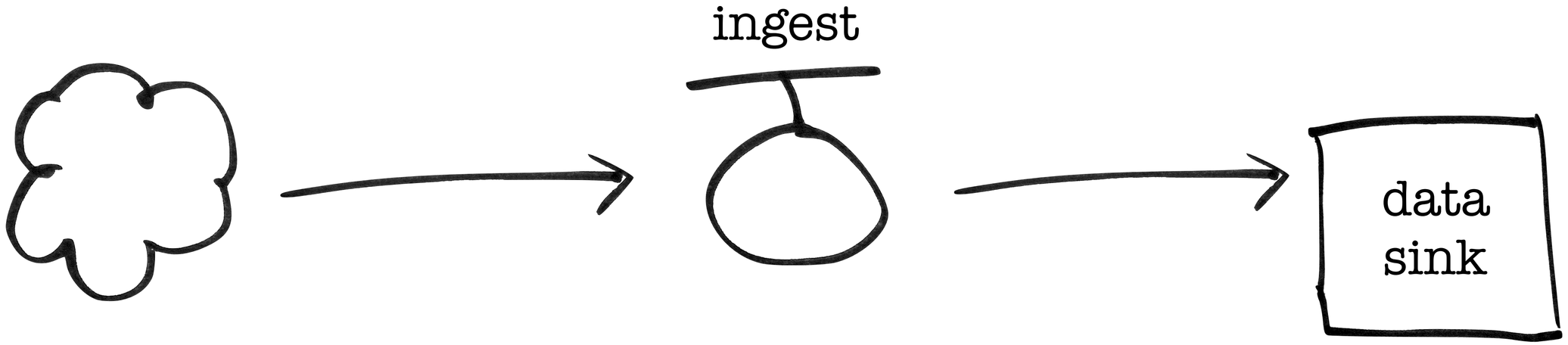
Cloudera Engineering
@ClouderaEng

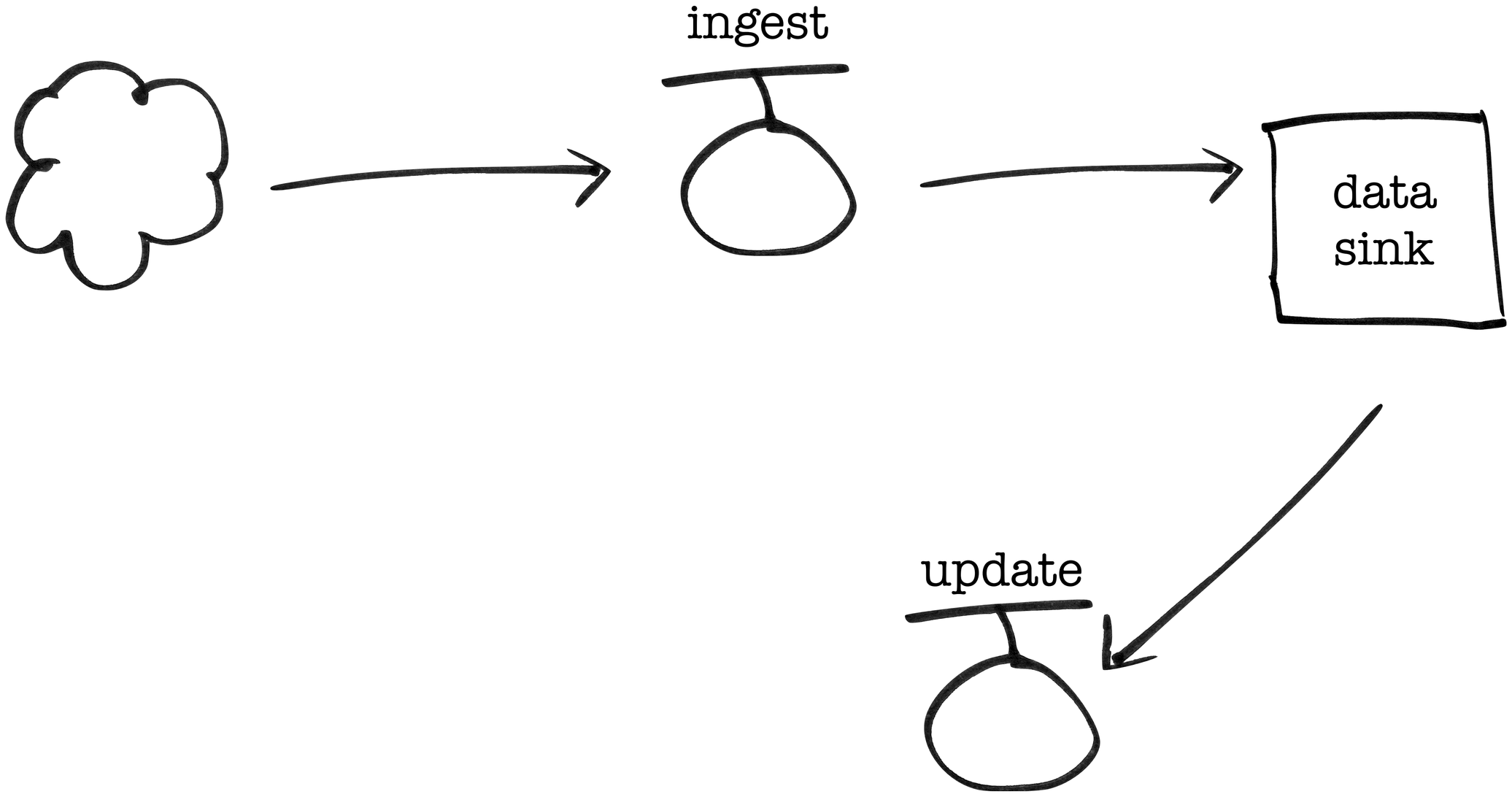
ICYMI: #HowTo: Use the New Apache Oozie Database Migration Tool via the @ClouderaEng blog j.mp/2fkPl0a

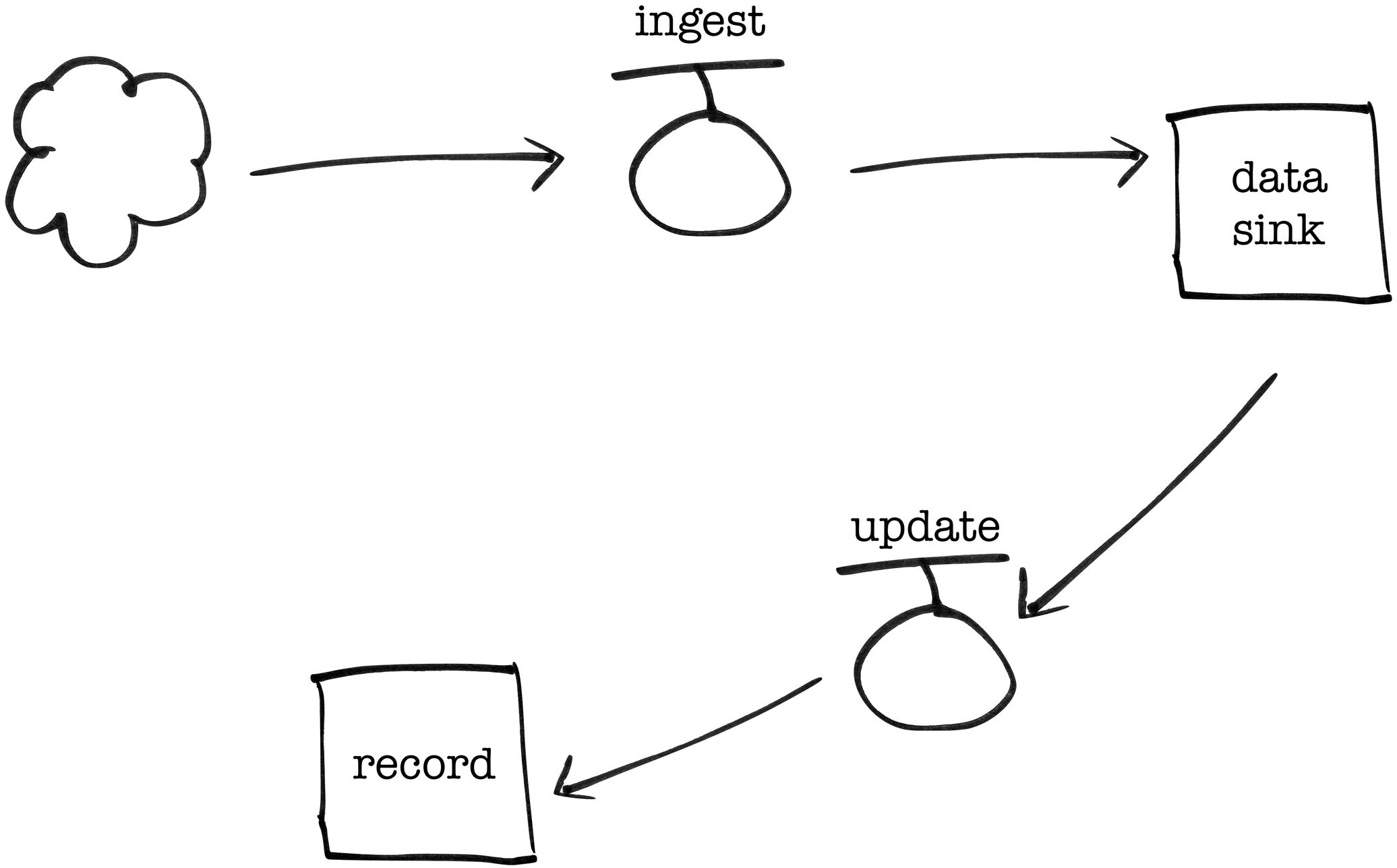


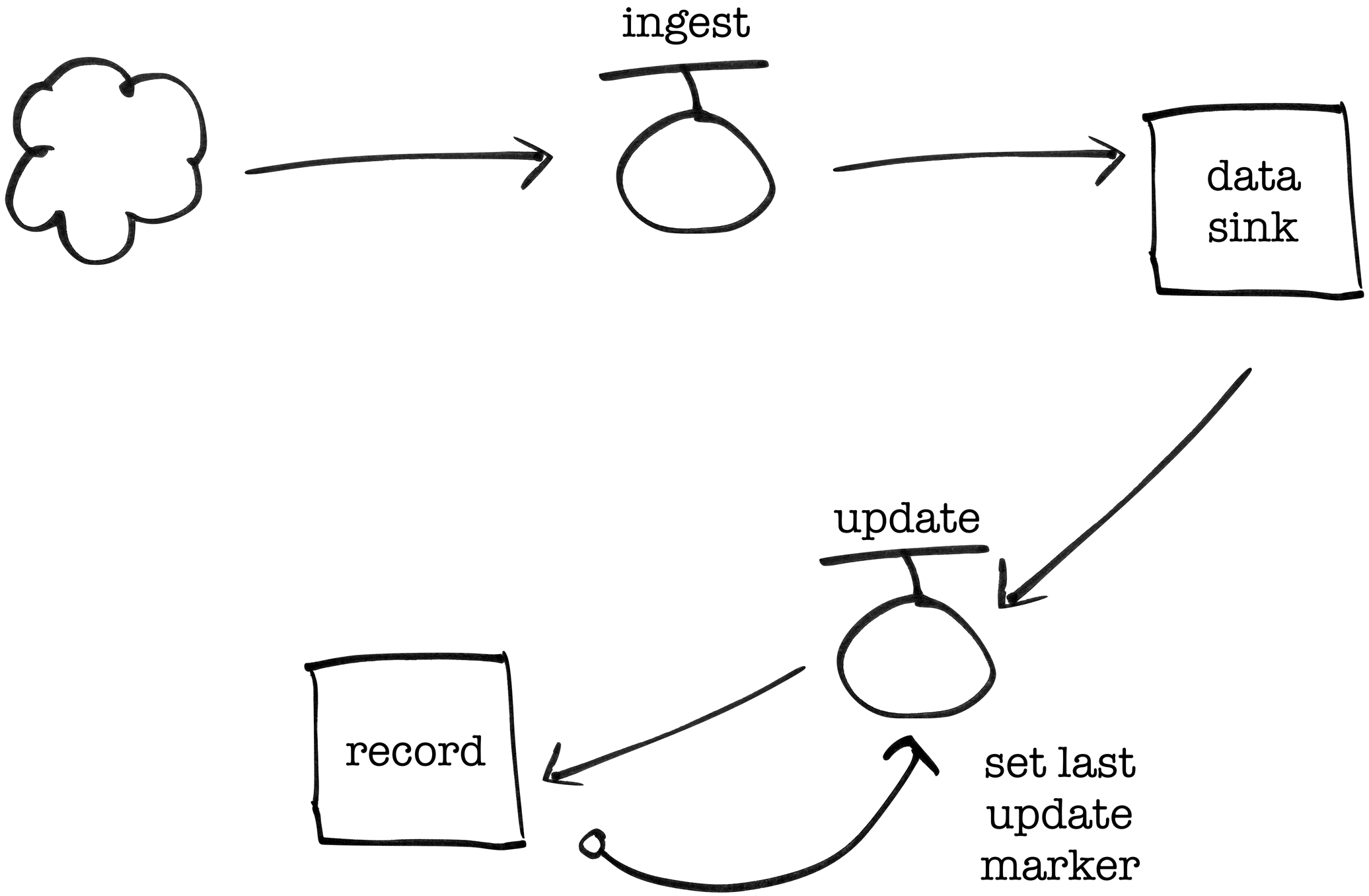


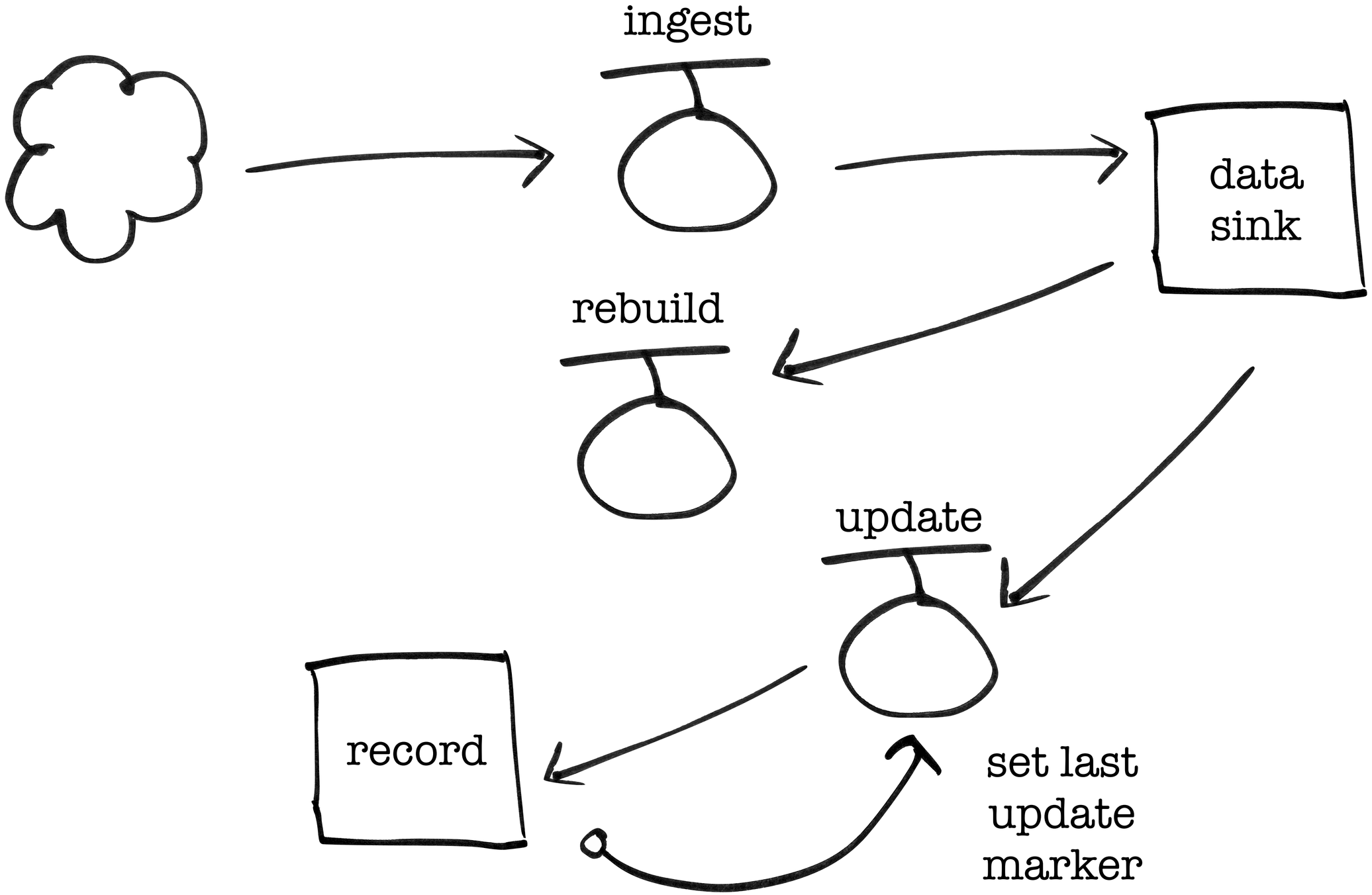

ingest

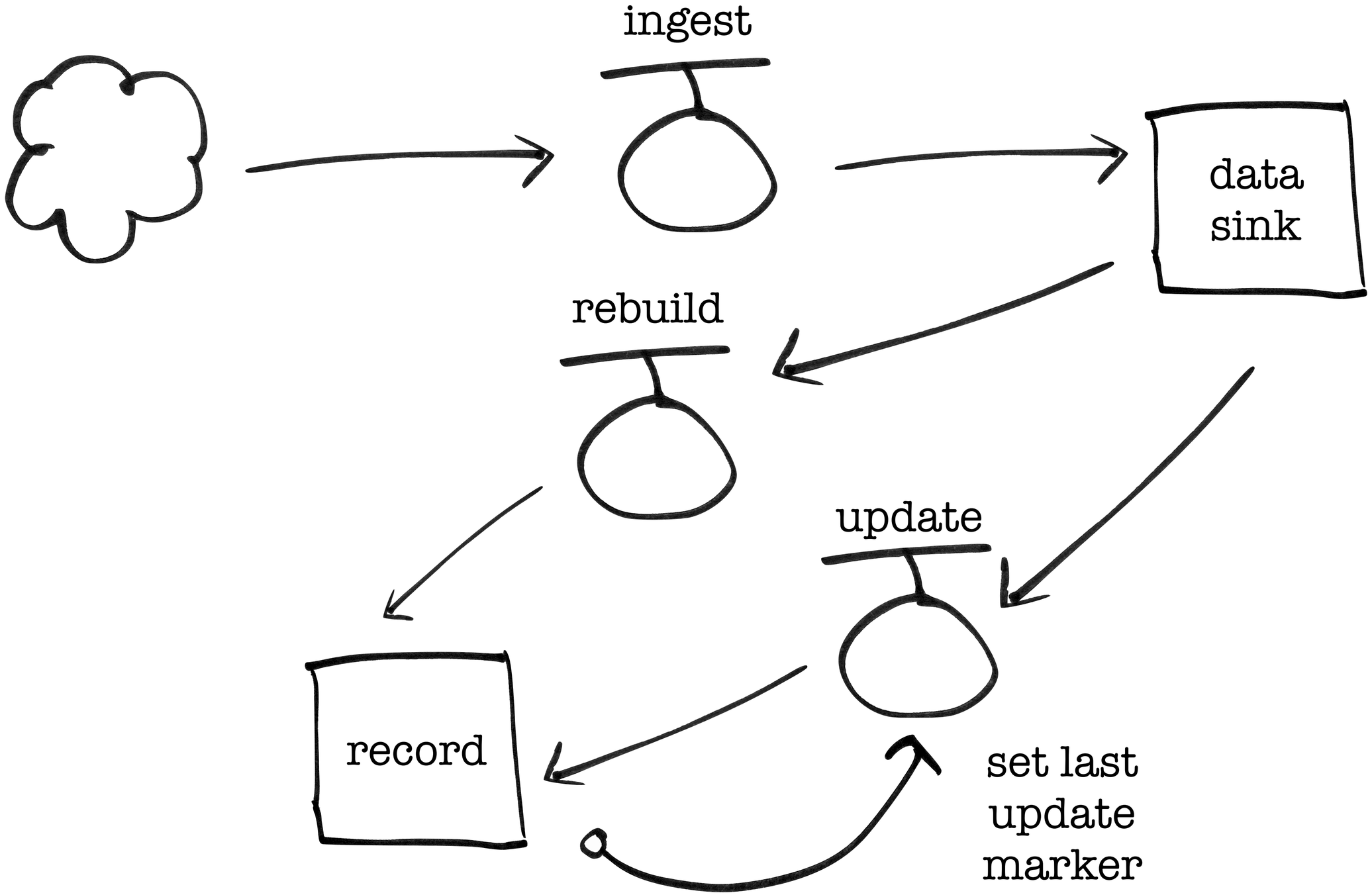

ingest
data
sink

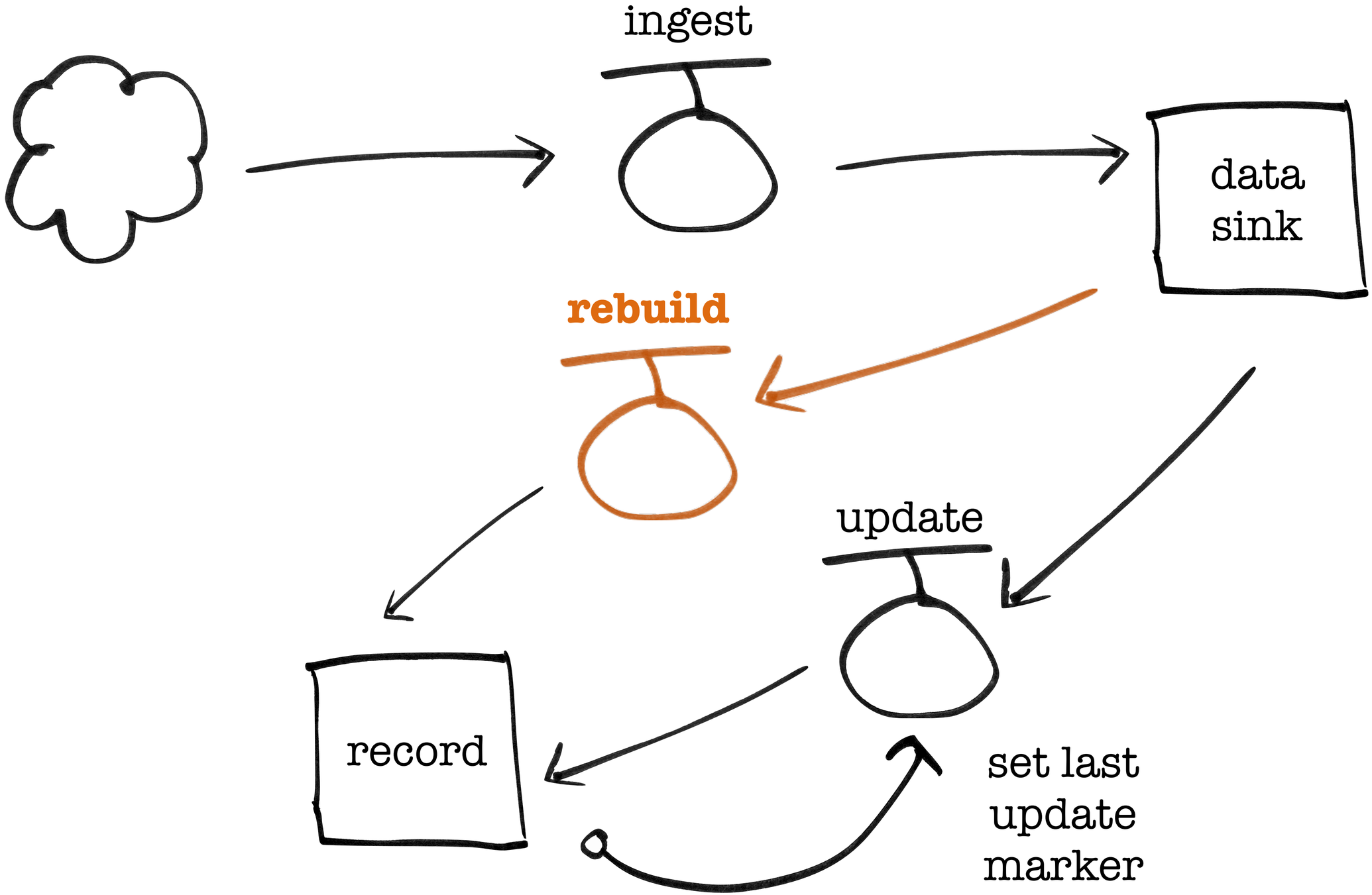

ingest
data
sink
update


ingest
data
sink
update
record


ingest
data
sink
update
record
set last
update
marker

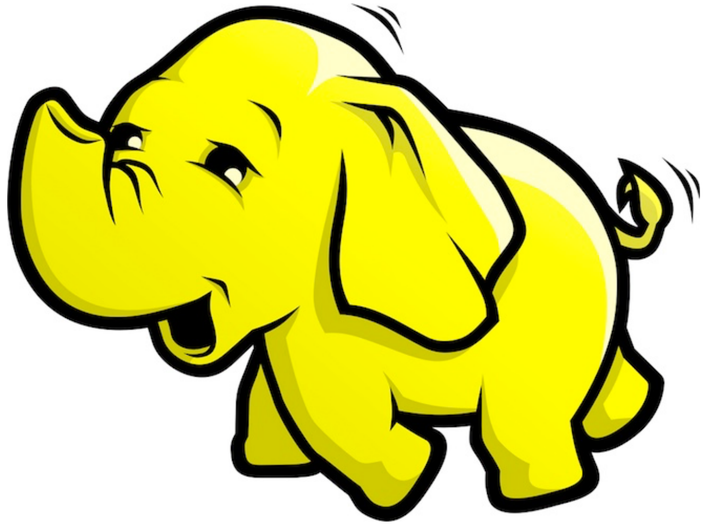

ingest
data
sink
rebuild
update
record
set last
update
marker


ingest
data
sink
rebuild
update
record
set last
update
marker

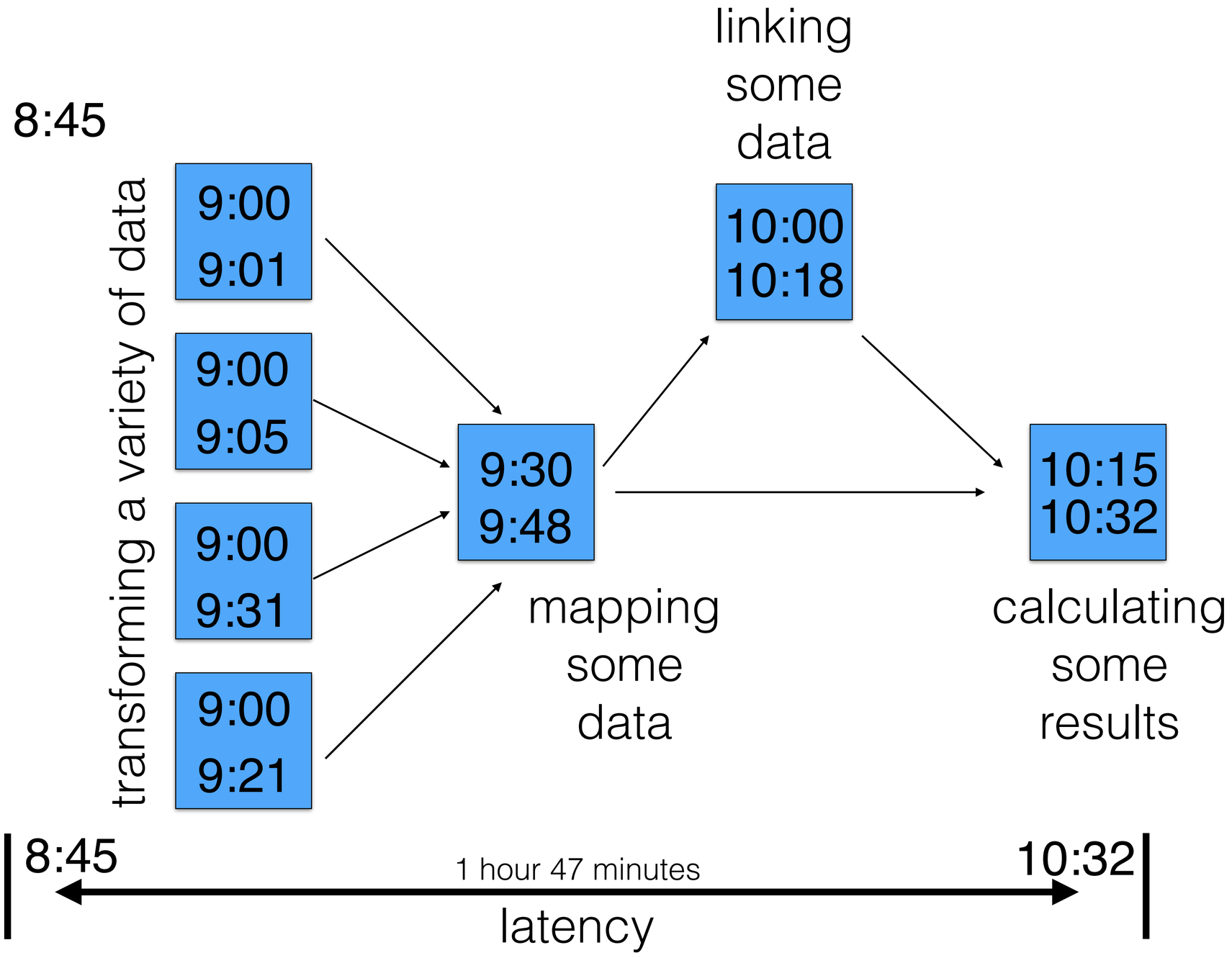

ingest
data
sink
rebuild
update
record
set last
update
marker

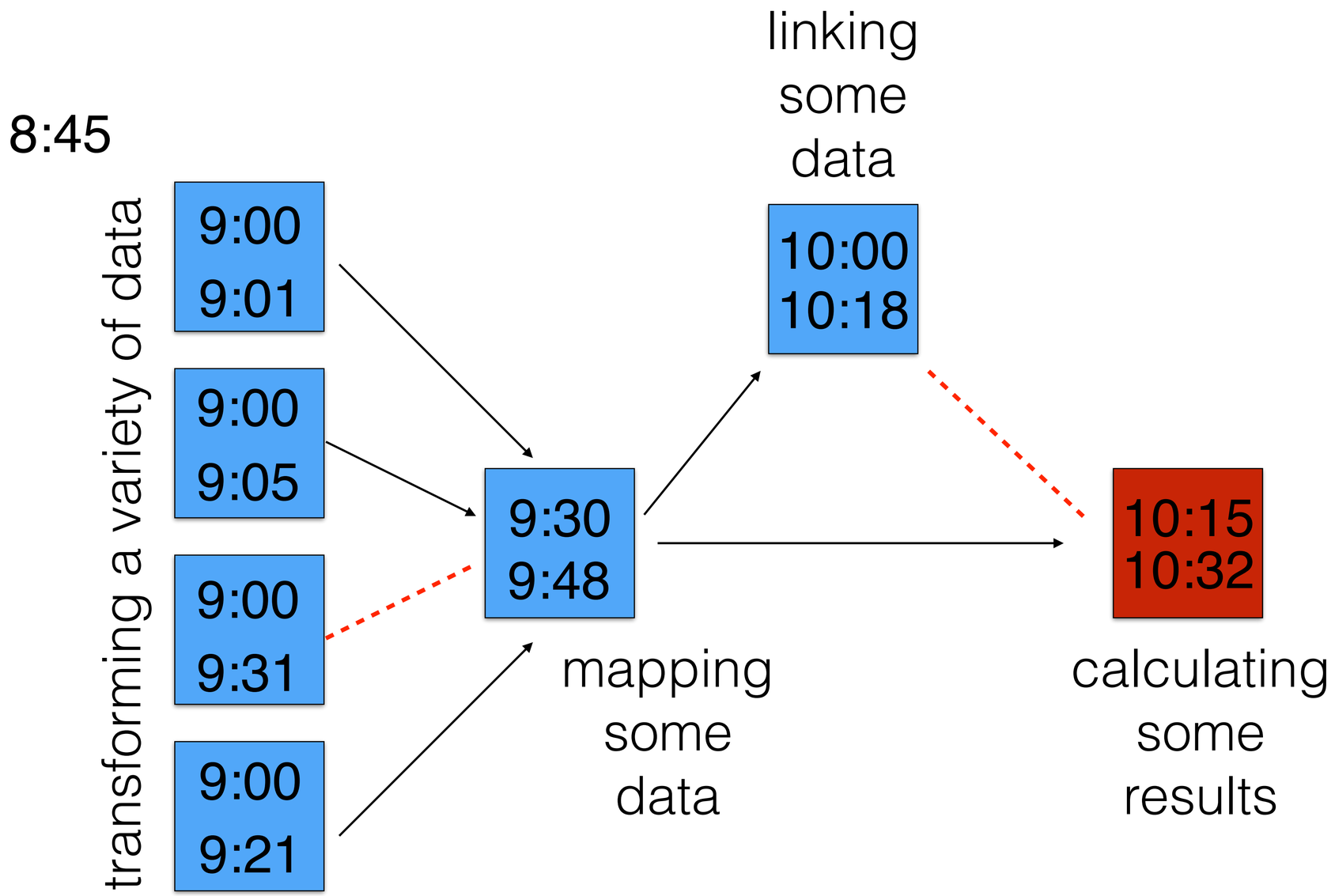
timing model

1. Ingest some data.
2. Transform it.
3. Map some attributes.
4. Link up some data.
5. Calculate the results.



Loosely scheduled map-reduce jobs.


8:45
transforming a variety of data
9:00
9:01
9:00
9:05
9:00
9:31
9:00
9:21
9:30
9:48
mapping
some
data
linking
some
data
10:00
10:18
10:15
10:32
calculating
some
results
8:45
1 hour 47 minutes
10:32
latency


8:45
transforming a variety of data
9:00
9:01
9:00
9:05
9:00
9:31
9:00
9:21
9:30
9:48
mapping
some
data
linking
some
data
10:00
10:18
10:15
10:32
calculating
some
results

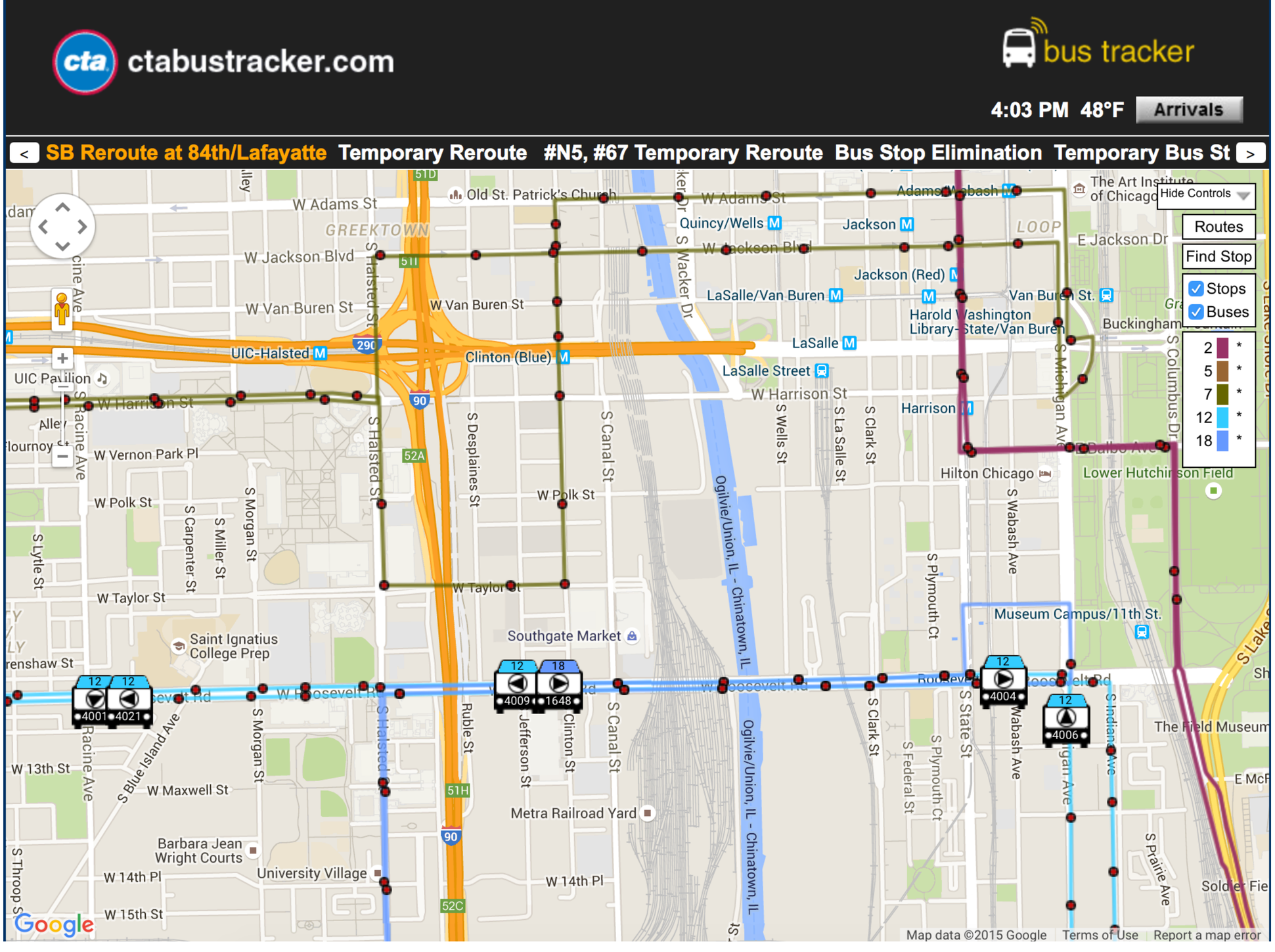
another big data transportation analogy

Main Street MAX Orange Line - *Saturday*

Effective: July 1, 2012 Updated: June 8, 2012

Southbound

	3rd & Grand Park-and-Ride	11th & Grand	Pershing & Main	31st & Main	39th & Main	47th & Nichols Pkwy.	63rd & Brookside	74th Terrace & Broadway
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
AM	- - - -	- - - -	4:50	4:54	5:00	5:04	5:11	5:15
	4:53	4:58	5:05	5:09	5:15	5:19	- - - -	- - - -
	5:08	5:13	5:20	5:24	5:30	5:34	5:41	5:45
	5:23	5:28	5:35	5:39	5:45	5:49	- - - -	- - - -
	5:38	5:43	5:50	5:54	6:00	6:04	6:11	6:15
	5:53	5:58	6:05	6:09	6:15	6:19	- - - -	- - - -
	6:08	6:13	6:20	6:24	6:30	6:34	6:41	6:45
	6:23	6:28	6:35	6:39	6:45	6:49	- - - -	- - - -
	6:38	6:43	6:50	6:54	7:00	7:04	7:11	7:15
	6:53	6:58	7:05	7:09	7:15	7:19	- - - -	- - - -
	7:08	7:13	7:20	7:24	7:30	7:35	7:43	7:47
	7:23	7:28	7:35	7:39	7:45	7:50	- - - -	- - - -


ctabustracker.com
bus tracker
4:03 PM 48°F
Arrivals
< SB Reroute at 84th/Lafayatte Temporary Reroute #N5, #67 Temporary Reroute Bus Stop Elimination Temporary Bus St >
Hide Controls
Routes
Find Stop
Stops
Buses
2
5
7
12
18
W Adams St
GREEKTOWN
Old St. Patrick's Church
Quincy/Wells
Jackson
LOOP
E Jackson Dr
W Jackson Blvd
Jackson (Red)
LaSalle/Van Buren
Van Buren St.
W Van Buren St
Harold Washington Library-State/Van Buren
Buckingham
UIC-Halsted
Clinton (Blue)
LaSalle
LaSalle Street
W Harrison St
Harrison
UIC Pavilion
W Vernon Park Pl
W Polk St
W Taylor St
Hilton Chicago
Lower Hutchinson Field
Museum Campus/11th St.
Southgate Market
Saint Ignatius College Prep
W 13th St
W Maxwell St
Metra Railroad Yard
Barbara Jean Wright Courts
University Village
W 14th Pl
W 15th St
The Field Museum
Soldier Fie
S Halsted St
S Racine Ave
S Morgan St
S Desplaines St
S Canal St
S Clinton St
S Jefferson St
S Ruble St
S Blue Island Ave
S Wells St
S La Salle St
S Clark St
S Plymouth Ct
S Federal St
S State St
S Wabash Ave
S Michigan Ave
S Columbus Dr
S Indiana Ave
S Prairie Ave
Ogilvie/Union, IL - Chinatown, IL
4001
4021
4009
1648
4004
4006
Google
Map data ©2015 Google
Terms of Use
Report a map error

A simpler metaphor for the nature of our complex systems helps identify the essential failure points.

It can provide a means to identify a solution.

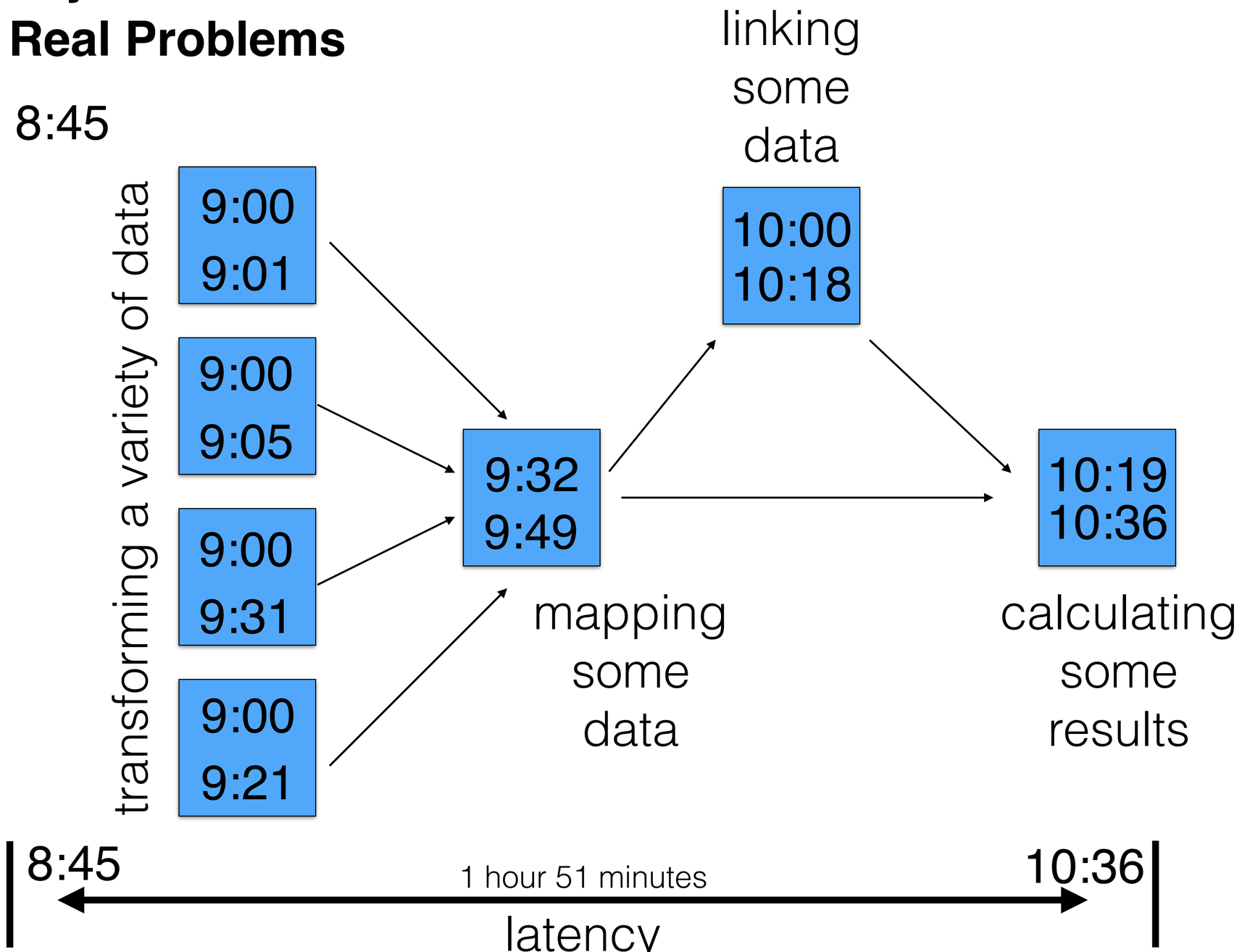
It can be better.

nominal time

“Show up at 8:45, but don’t leave until the bus is full.”

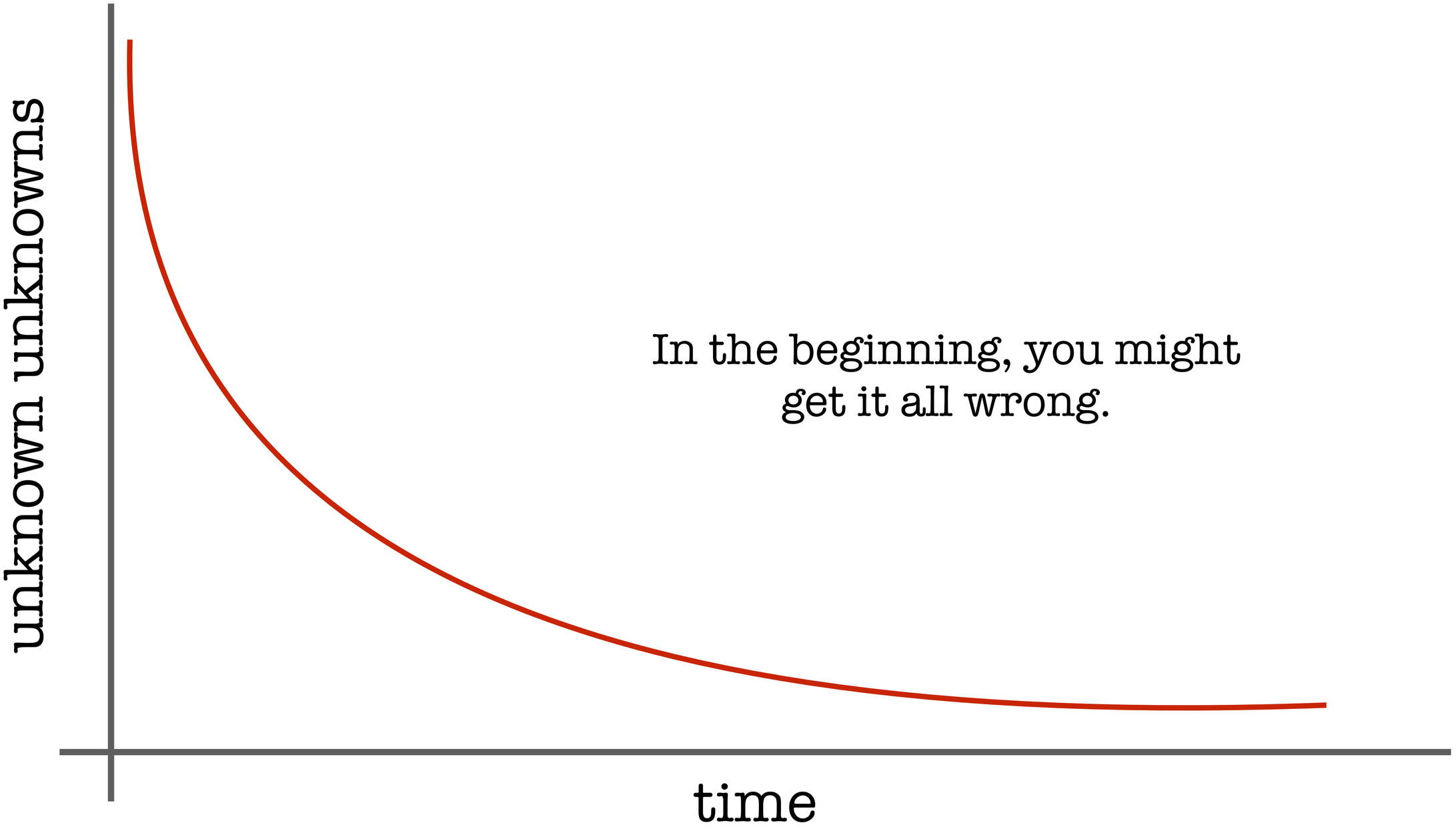
Real Systems

Real Problems



Pick the model(s) that work for you.

1. Develop system model.
2. Record known risk areas.
3. Publish model and risk areas.
4. Perform regular risk reviews. (Premortems)
5. Dissect and document missed risks.


unknown unknowns
time
In the beginning, you might
get it all wrong.

1. Develop system model.
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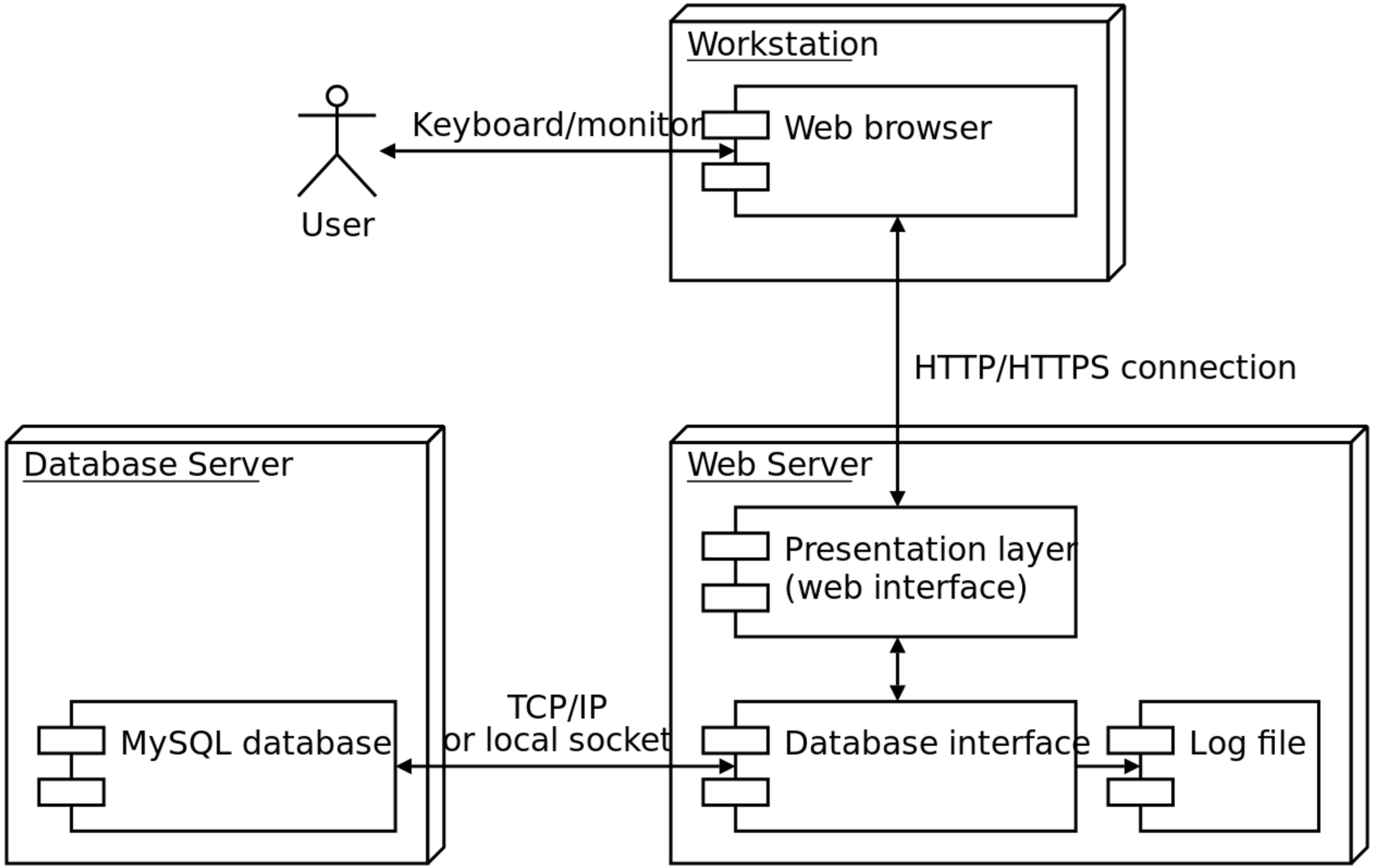
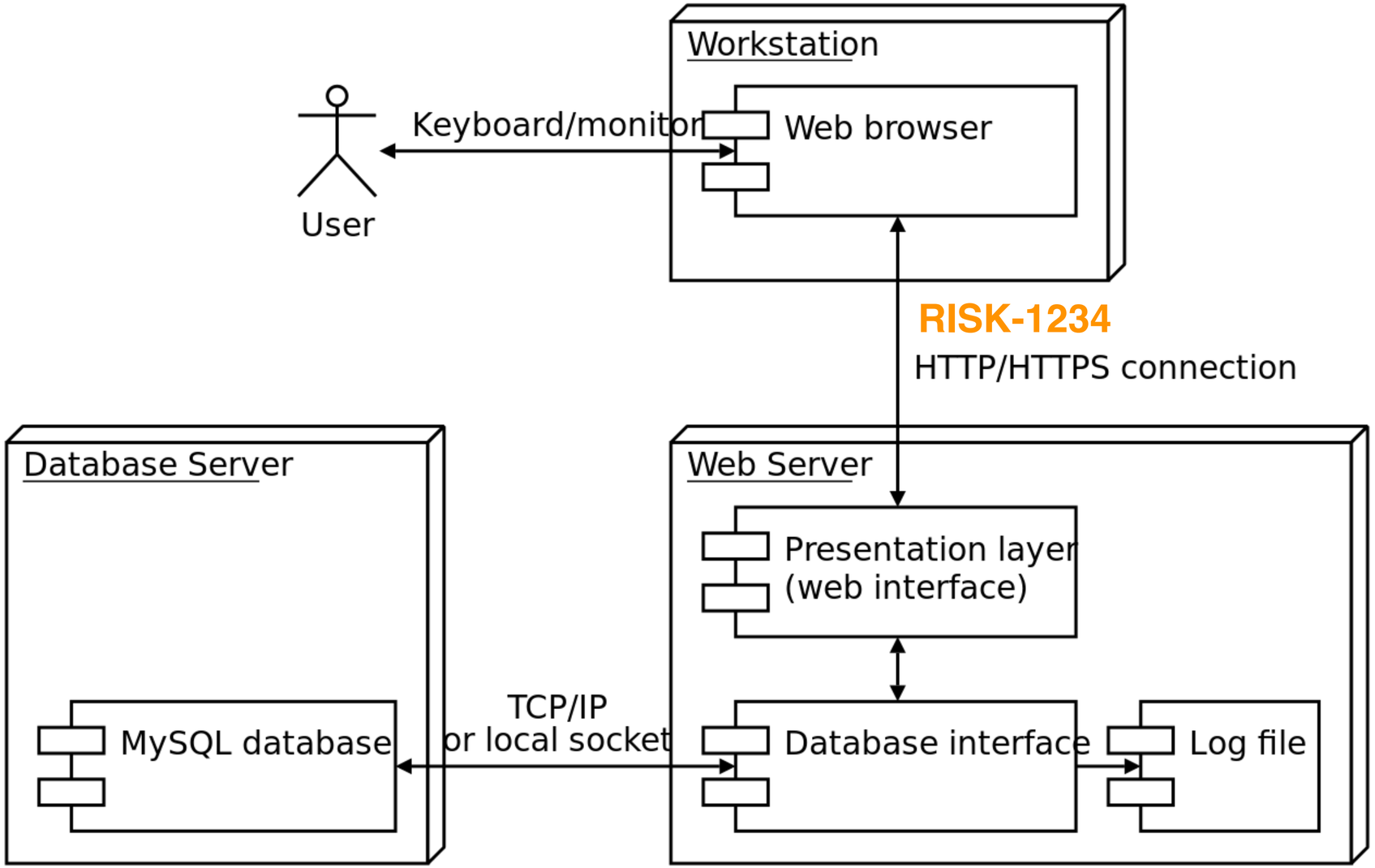
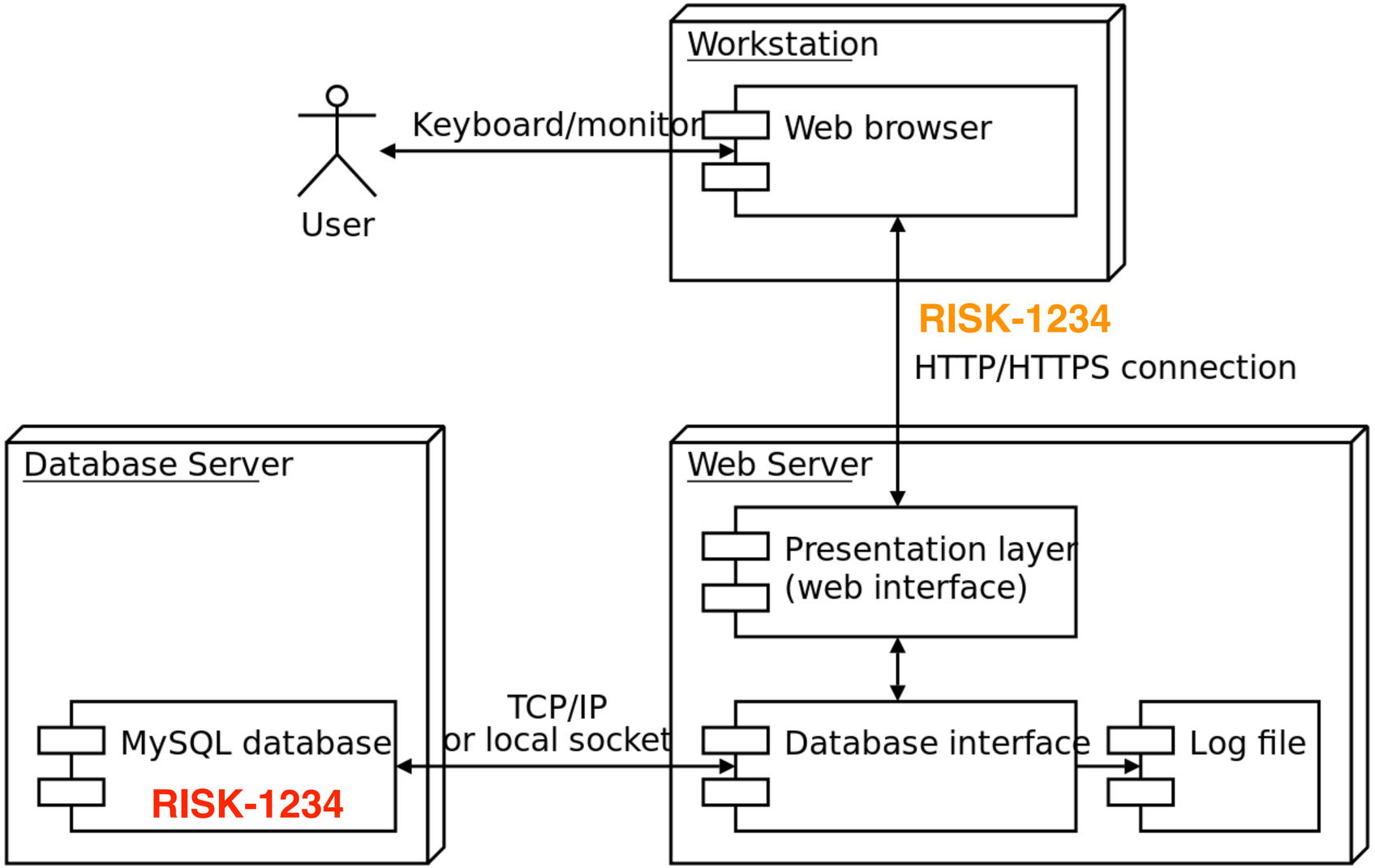
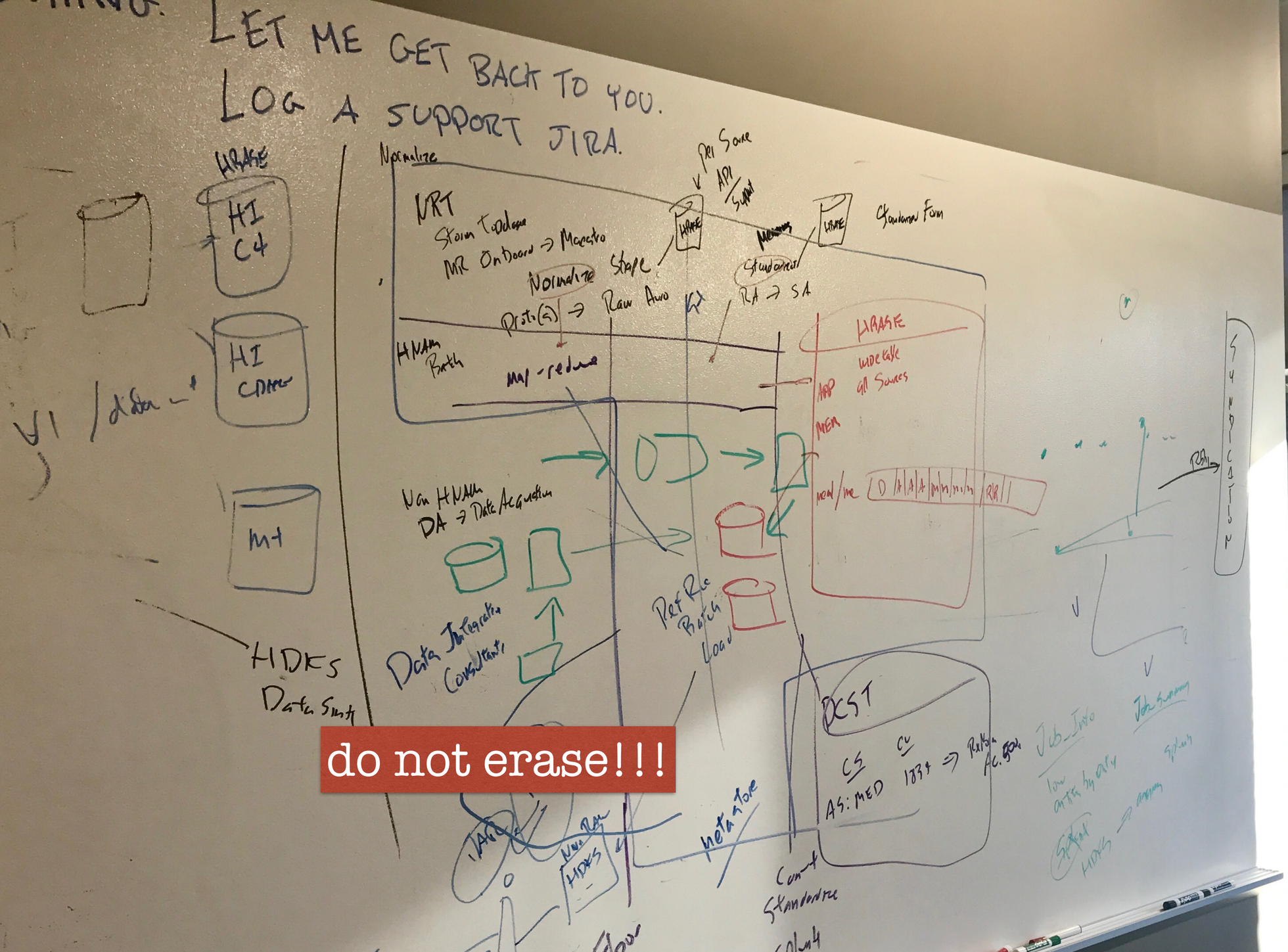

Workstation
Web browser
Keyboard/monitor
User
HTTP/HTTPS connection
Database Server
Web Server
Presentation layer
(web interface)
TCP/IP
or local socket
MySQL database
Database interface
Log file

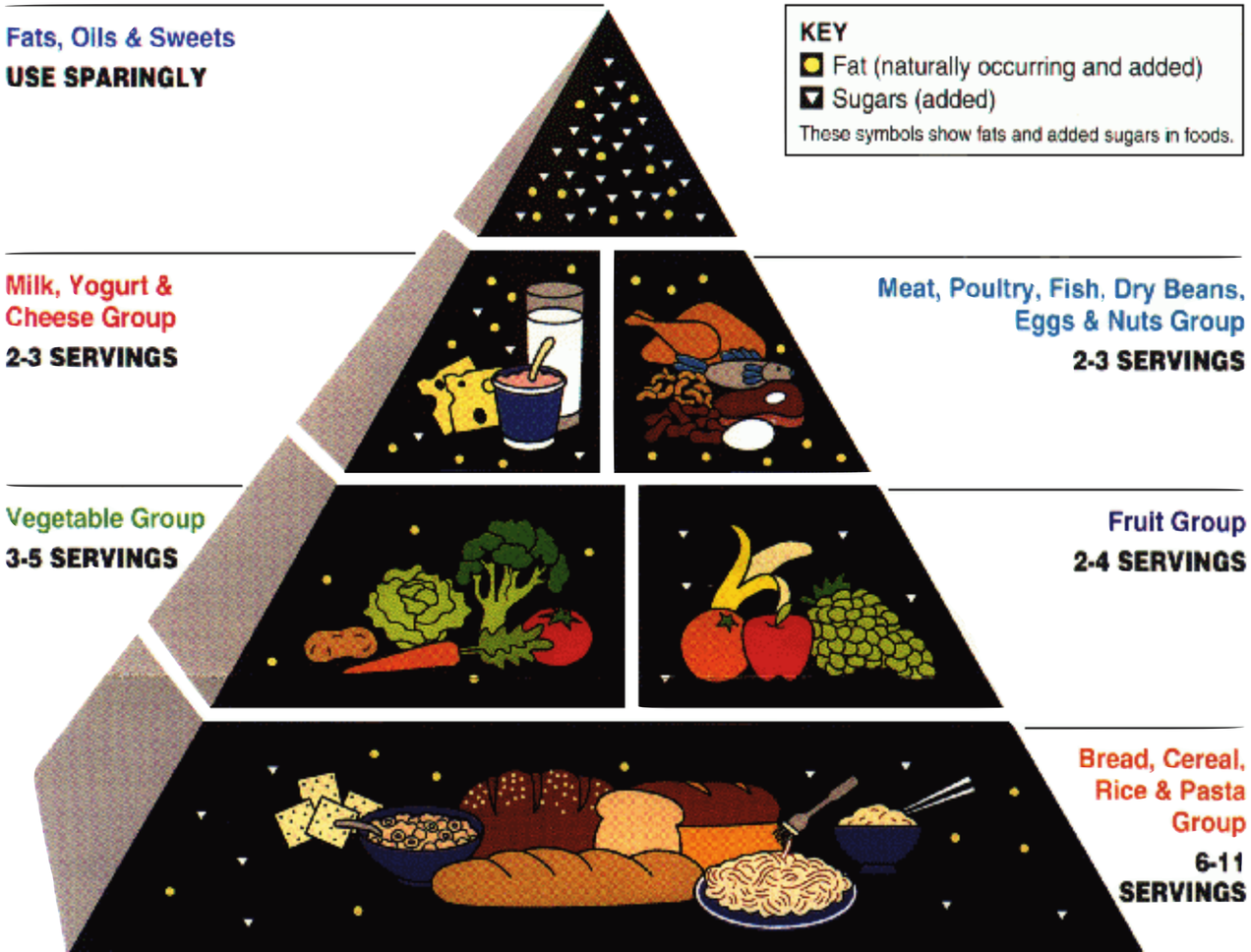

Workstation
Web browser
Keyboard/monitor
User
RISK-1234
HTTP/HTTPS connection
Database Server
Web Server
Presentation layer
(web interface)
MySQL database
TCP/IP
or local socket
Database interface
Log file


Workstation
Web browser
Keyboard/monitor
User
RISK-1234
HTTP/HTTPS connection
Database Server
Web Server
Presentation layer
(web interface)
TCP/IP
or local socket
MySQL database
RISK-1234
Database interface
Log file


LET ME GET BACK TO YOU.
LOG A SUPPORT JIRA.
do not erase!!!

If you want your people to make good decisions,they need context to more than just their piece of the system.

Big, visible diagrams are effective learning aides.



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4. Perform regular risk reviews. (Premortems)
5. Dissect and document missed risks.

Premortems

1. Inform everyone the system has failed.
2. Ask the group to identify most likely causes.
3. Adjust the plan to account for those risks.

Risk Reviews

1. List **ALL** changes going in the release.
2. Review each change in terms of the risk matrix.
3. If it's **RED**, it doesn't go. (Pull the cord.)
4. If it's **ORANGE**, we need a monitoring & mitigation plan.
5. If it's **YELLOW**, we need at least a mitigation.

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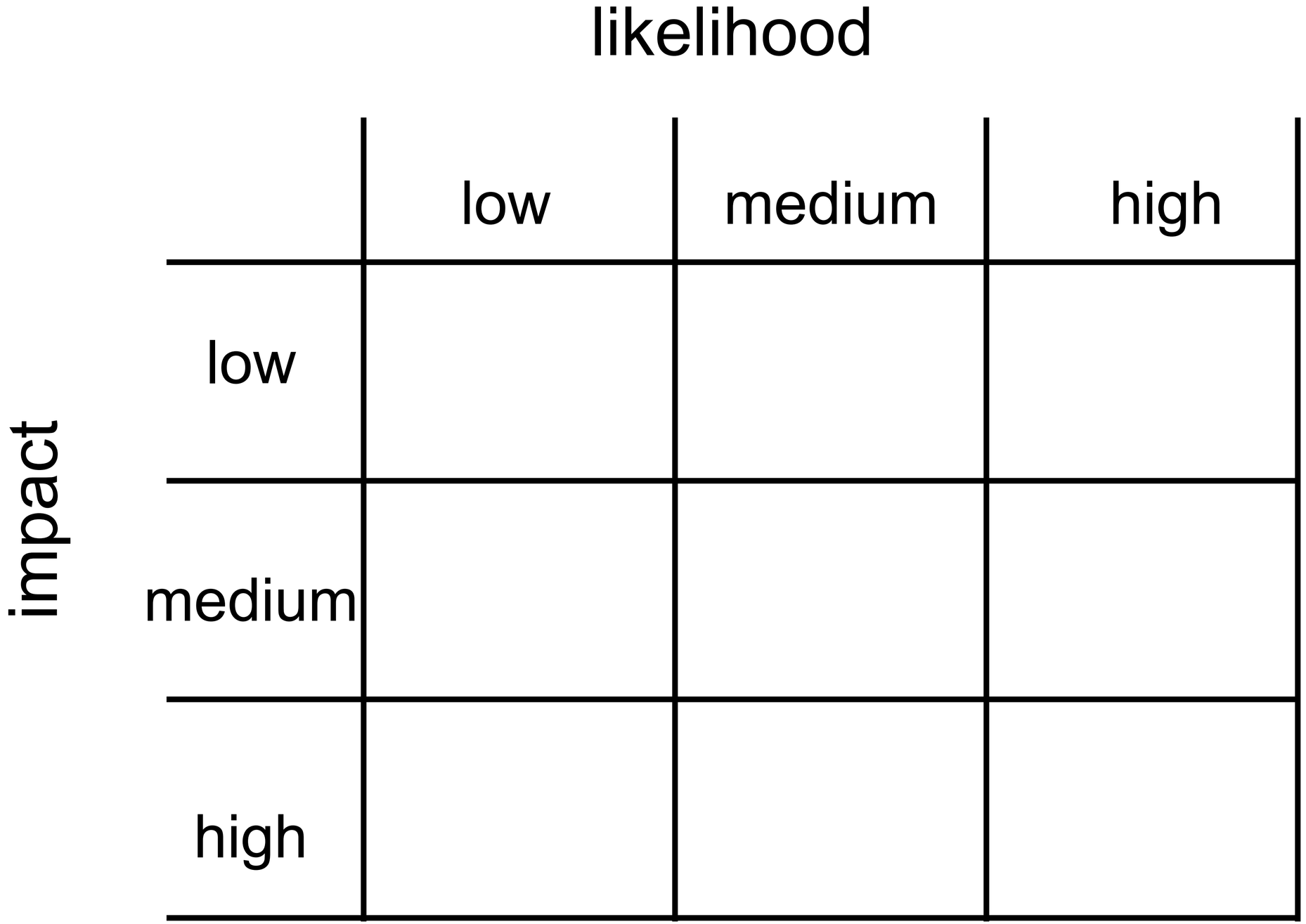
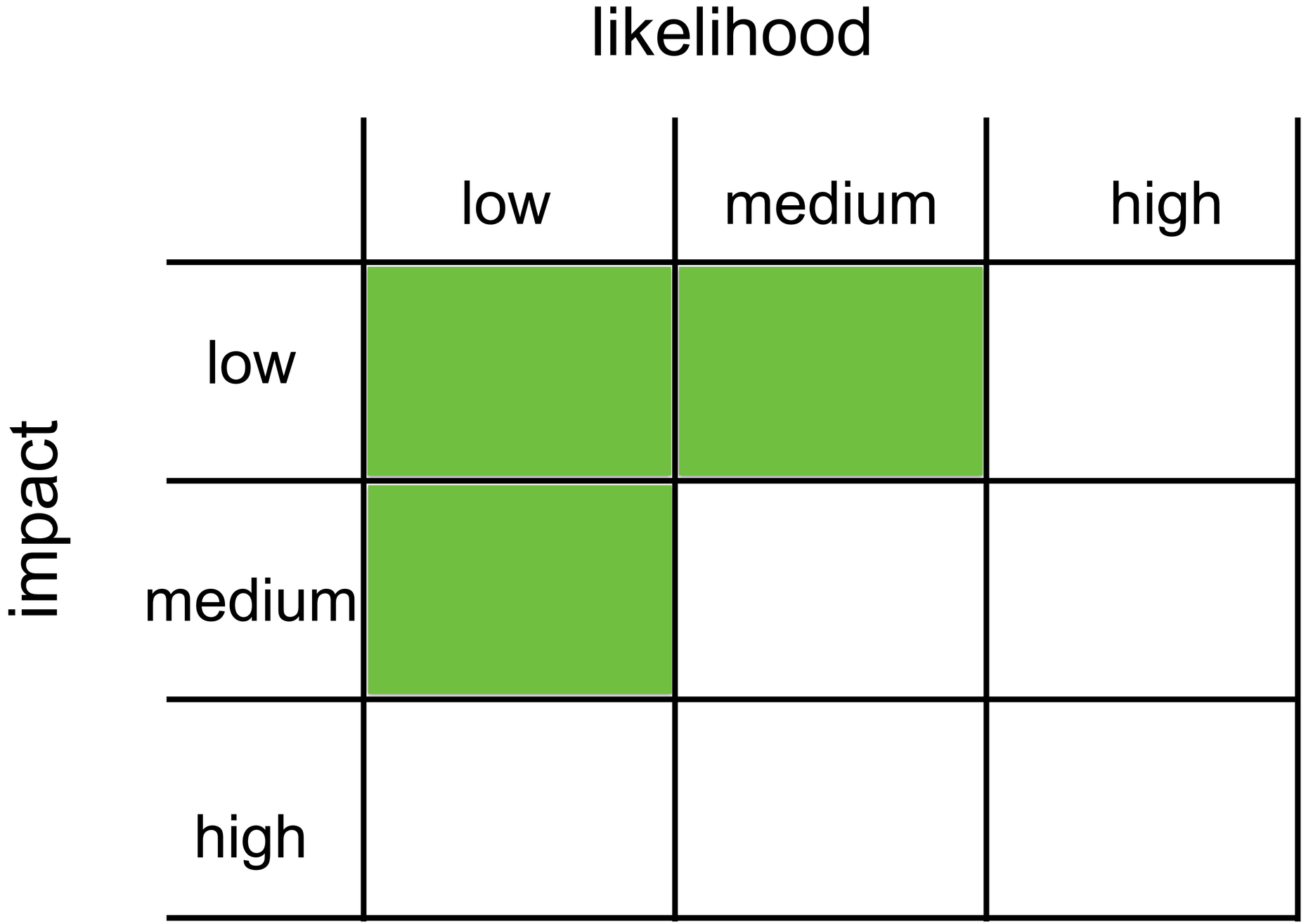

likelihood
low
medium
high
impact
low
medium
high

How do you measure likelihood & impact?

I don’t.


likelihood
low
medium
high
impact
low
medium
high

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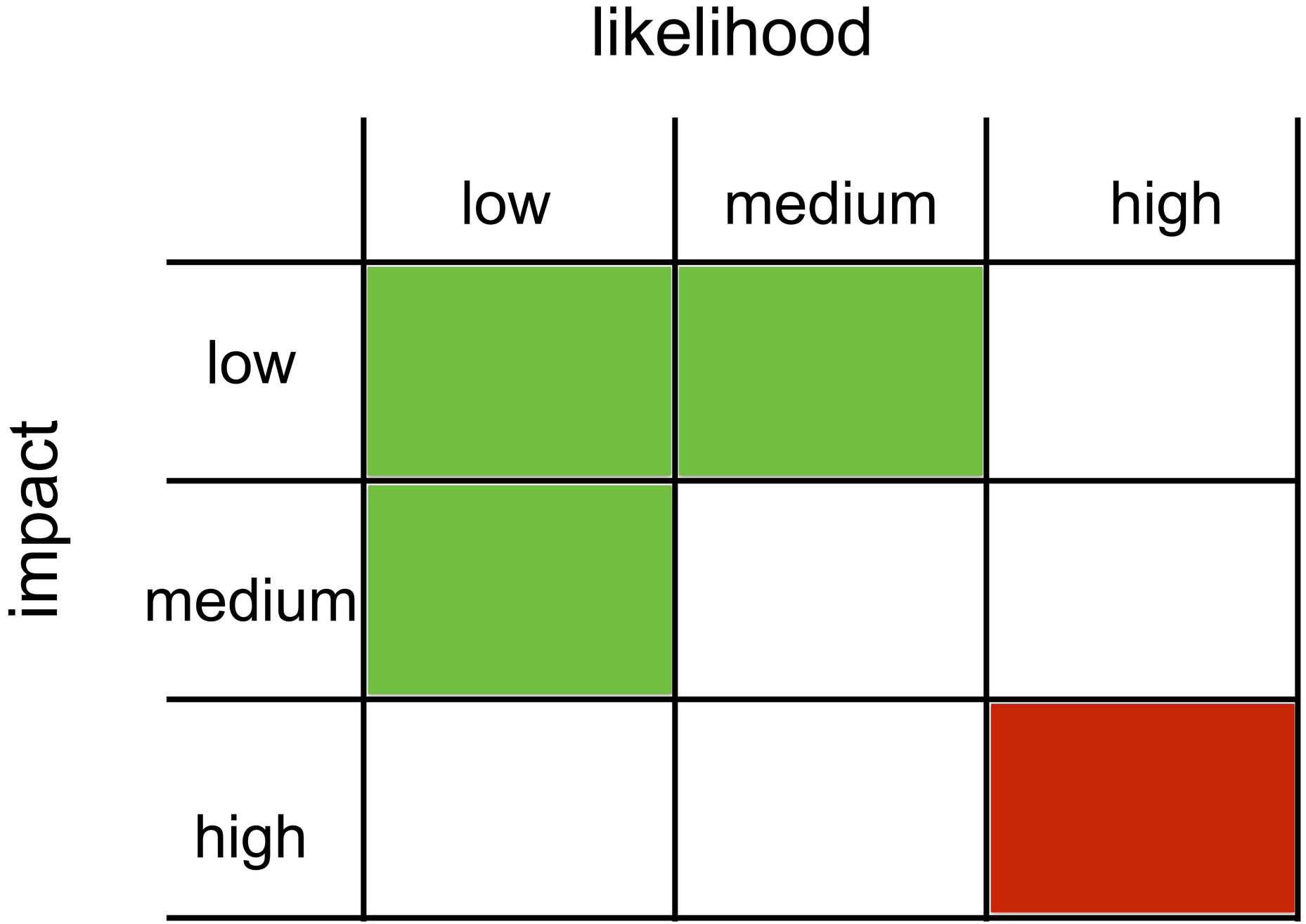
likelihood
low
medium
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impact
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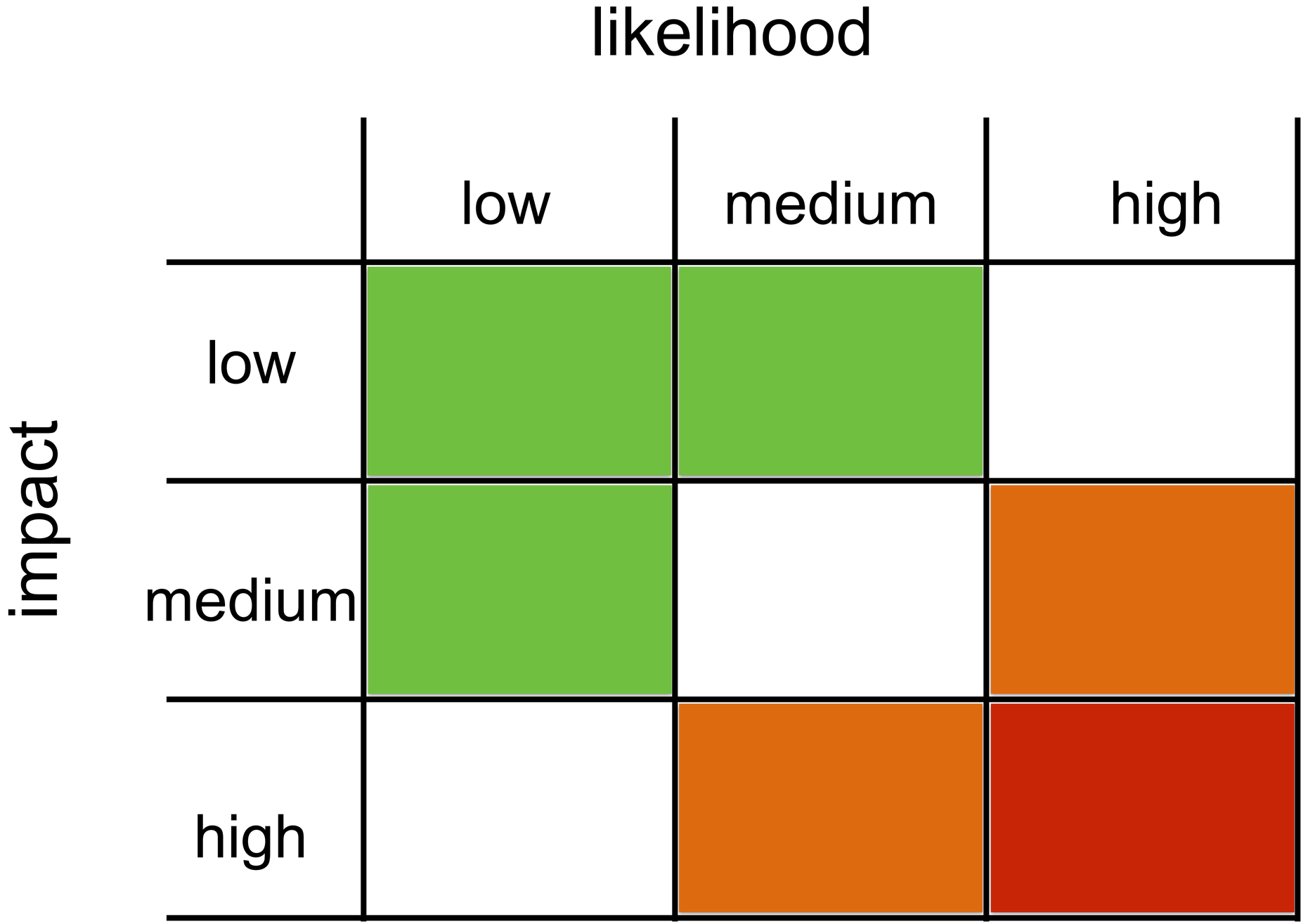
likelihood
low
medium
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impact
low
medium
high

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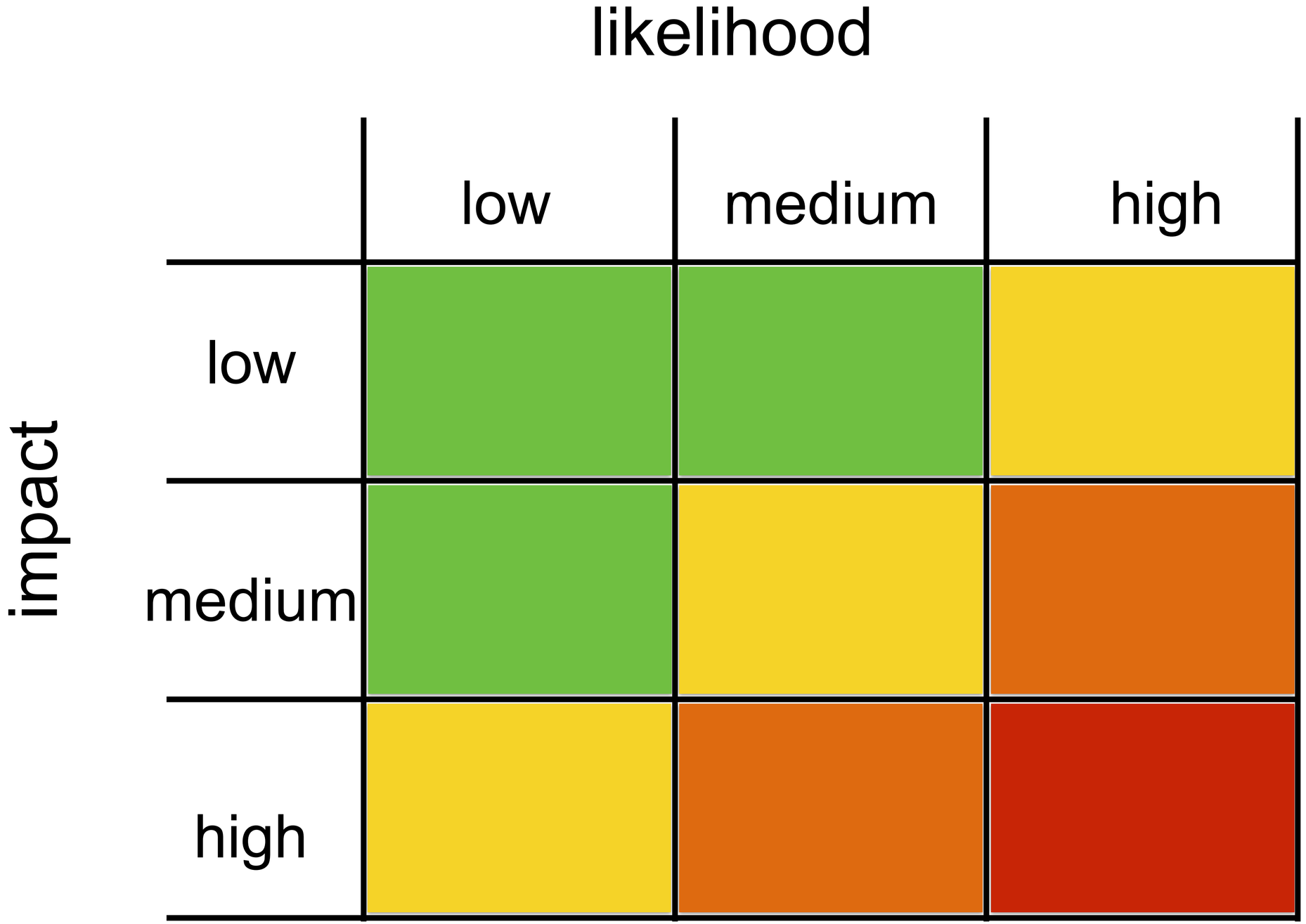
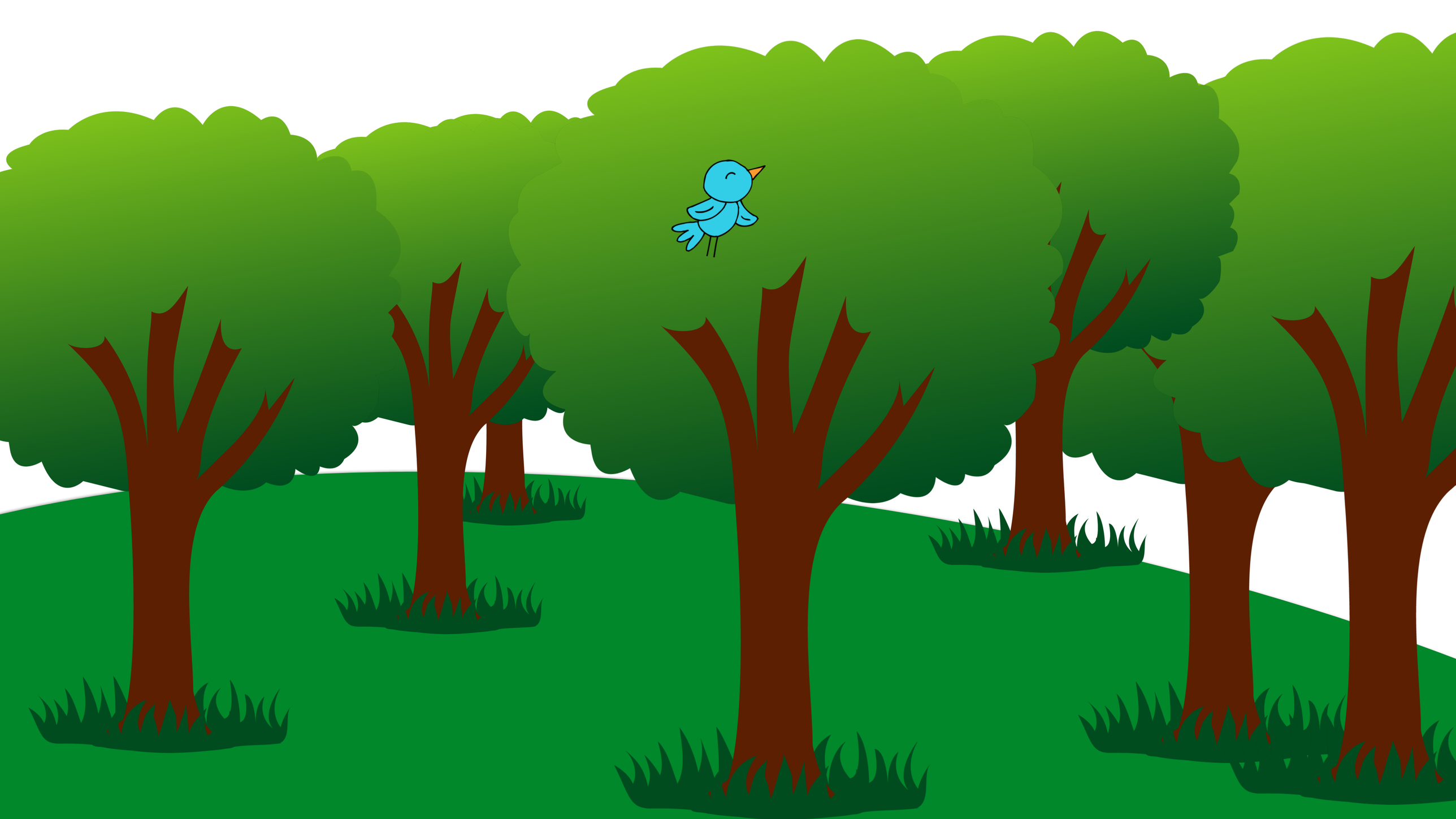

likelihood
low
medium
high
impact
low
medium
high

What if we get this wrong too?



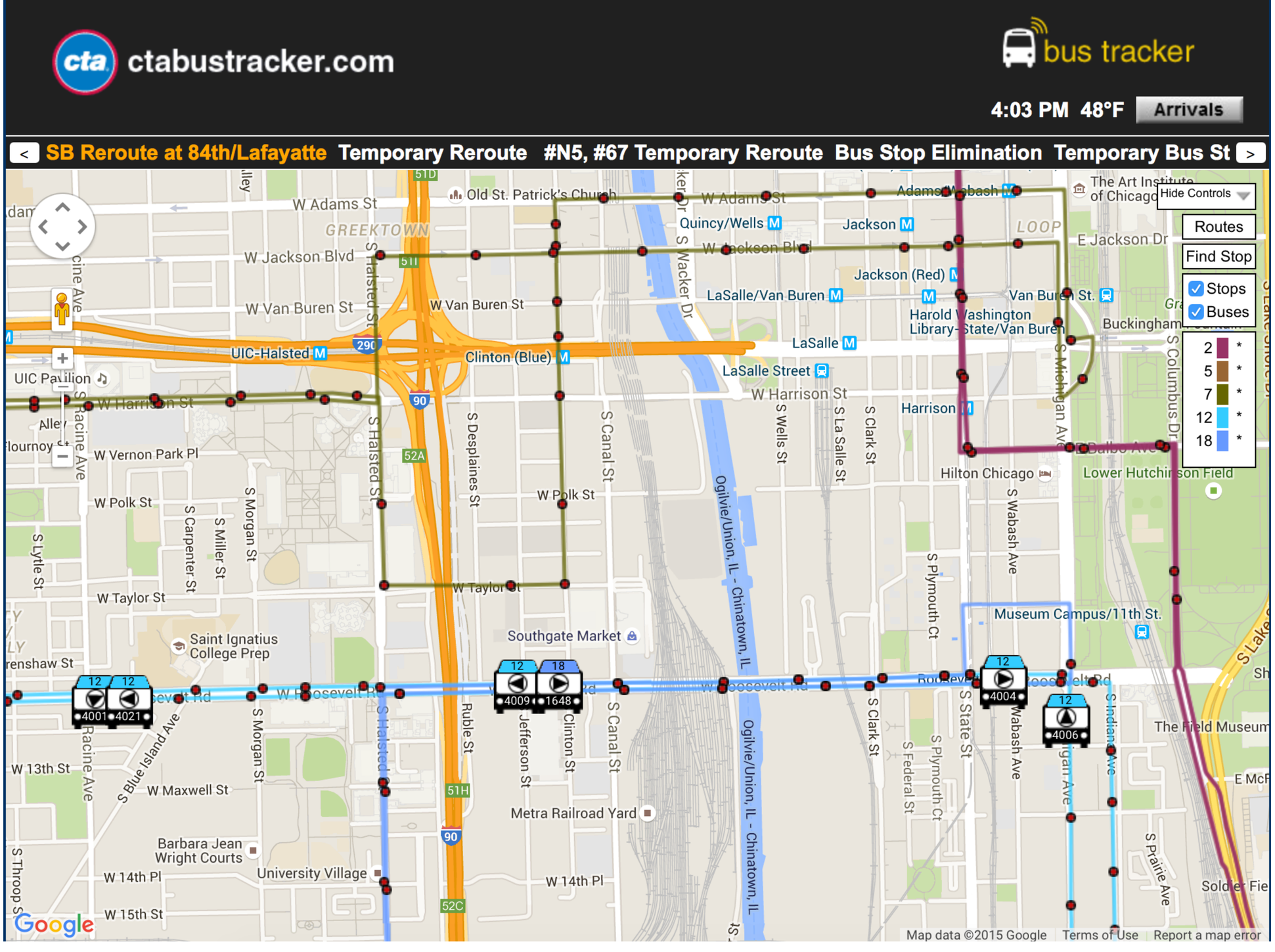
systems thinking:

return to a well-understood model

“Models help us choose where to direct our attention, so we can make decisions, rather than just react.”

- Charles Duhrigg

Smarter Faster Better


ctabustracker.com
bus tracker
4:03 PM 48°F
Arrivals
< SB Reroute at 84th/Lafayatte Temporary Reroute #N5, #67 Temporary Reroute Bus Stop Elimination Temporary Bus St >
Hide Controls
Routes
Find Stop
Stops
Buses
2
5
7
12
18
W Adams St
GREEKTOWN
Old St. Patrick's Church
Quincy/Wells
Jackson
LOOP
E Jackson Dr
W Jackson Blvd
Jackson (Red)
LaSalle/Van Buren
Van Buren St.
W Van Buren St
Harold Washington Library-State/Van Buren
Buckingham
UIC-Halsted
Clinton (Blue)
LaSalle
LaSalle Street
W Harrison St
Harrison
UIC Pavilion
W Vernon Park Pl
W Polk St
W Taylor St
Hilton Chicago
Lower Hutchinson Field
Museum Campus/11th St.
Southgate Market
Saint Ignatius College Prep
W 13th St
W Maxwell St
Metra Railroad Yard
Barbara Jean Wright Courts
University Village
W 14th Pl
W 15th St
The Field Museum
Soldier Fie
S Halsted St
S Racine Ave
S Morgan St
S Desplaines St
S Canal St
S Clinton St
S Jefferson St
S Ruble St
S Blue Island Ave
S Wells St
S La Salle St
S Clark St
S Plymouth Ct
S Federal St
S State St
S Wabash Ave
S Michigan Ave
S Columbus Dr
S Indiana Ave
S Prairie Ave
Ogilvie/Union, IL - Chinatown, IL
4001
4021
4009
1648
4004
4006
Google
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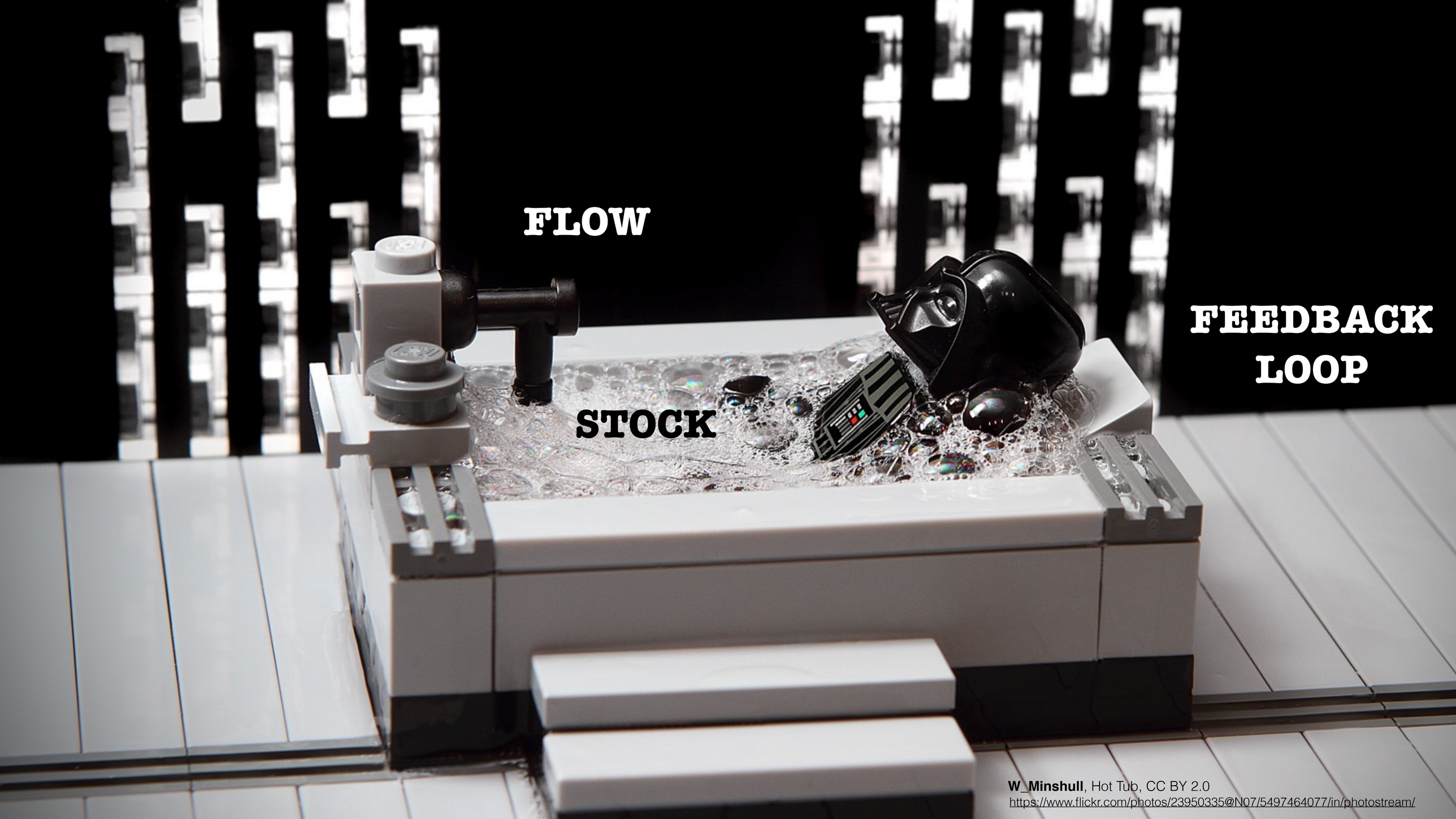
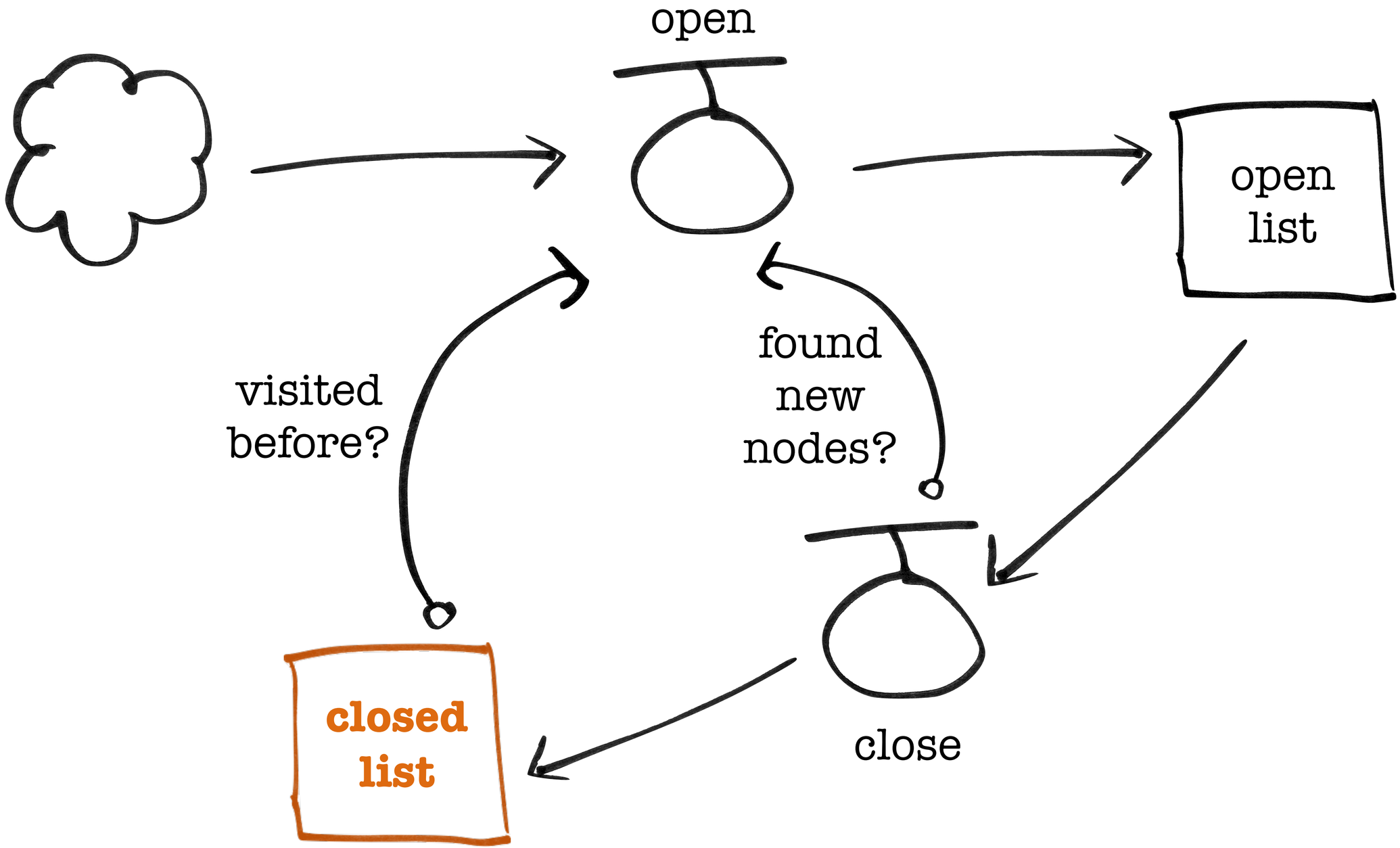
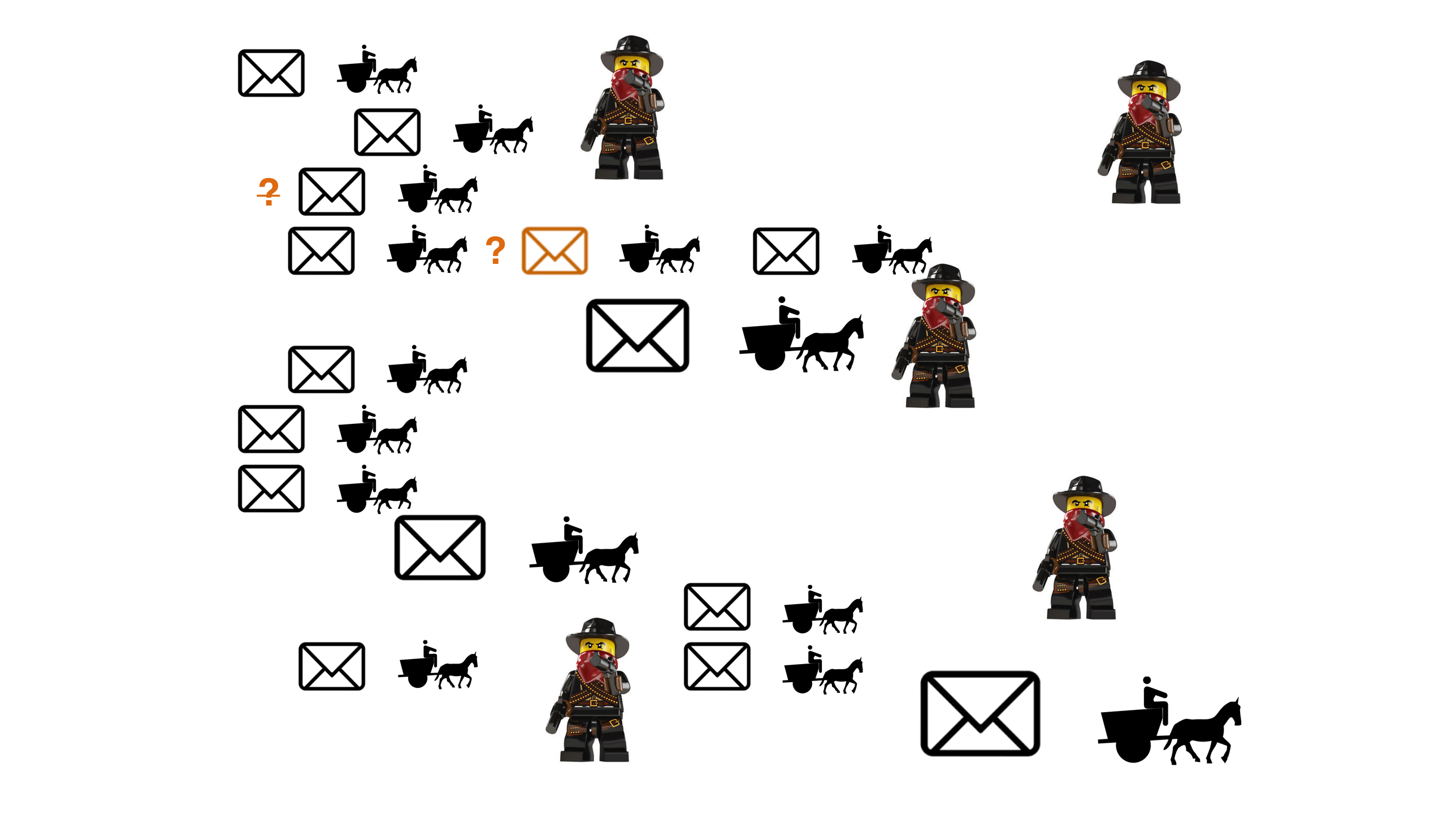
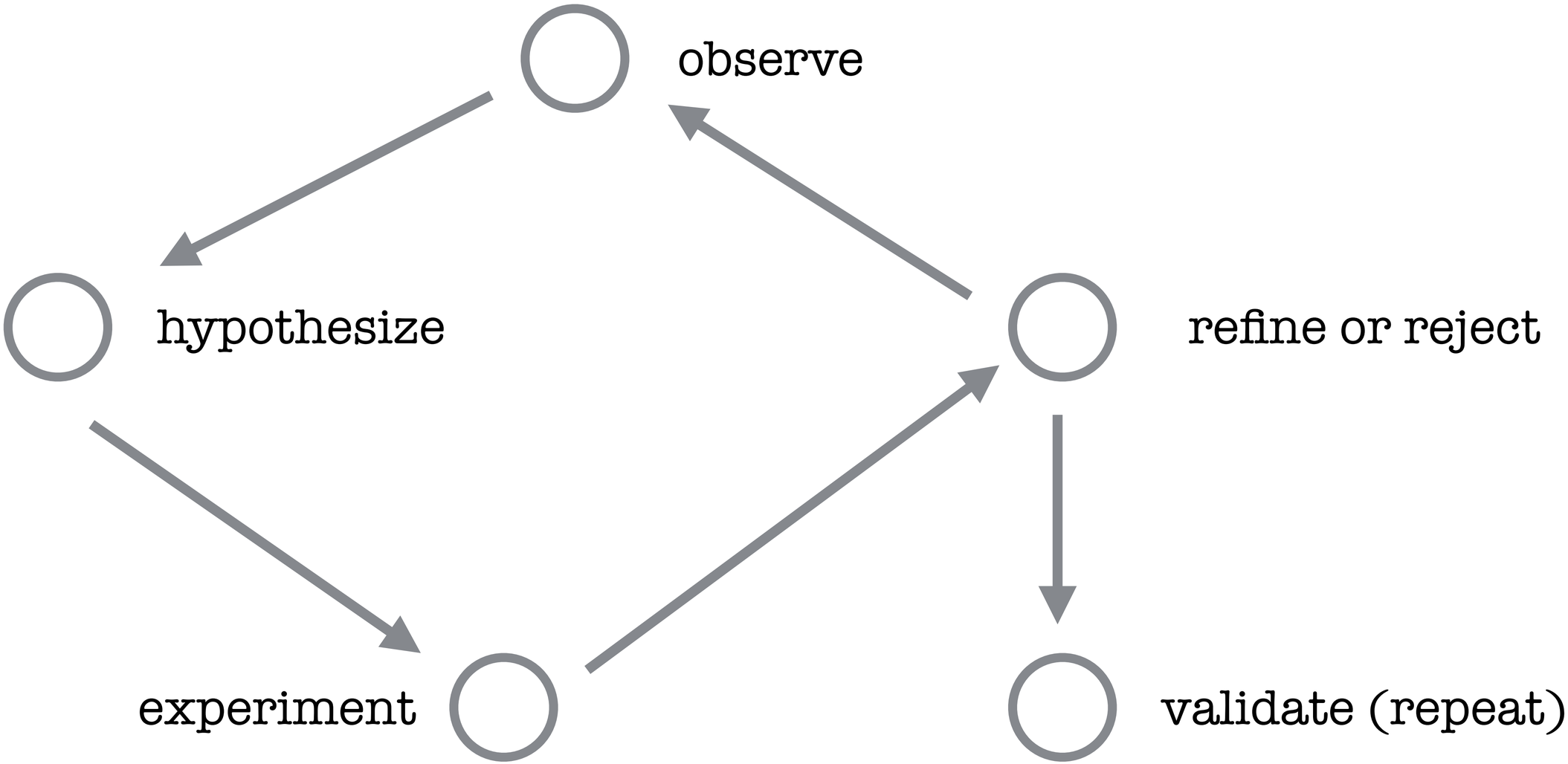
Report a map error



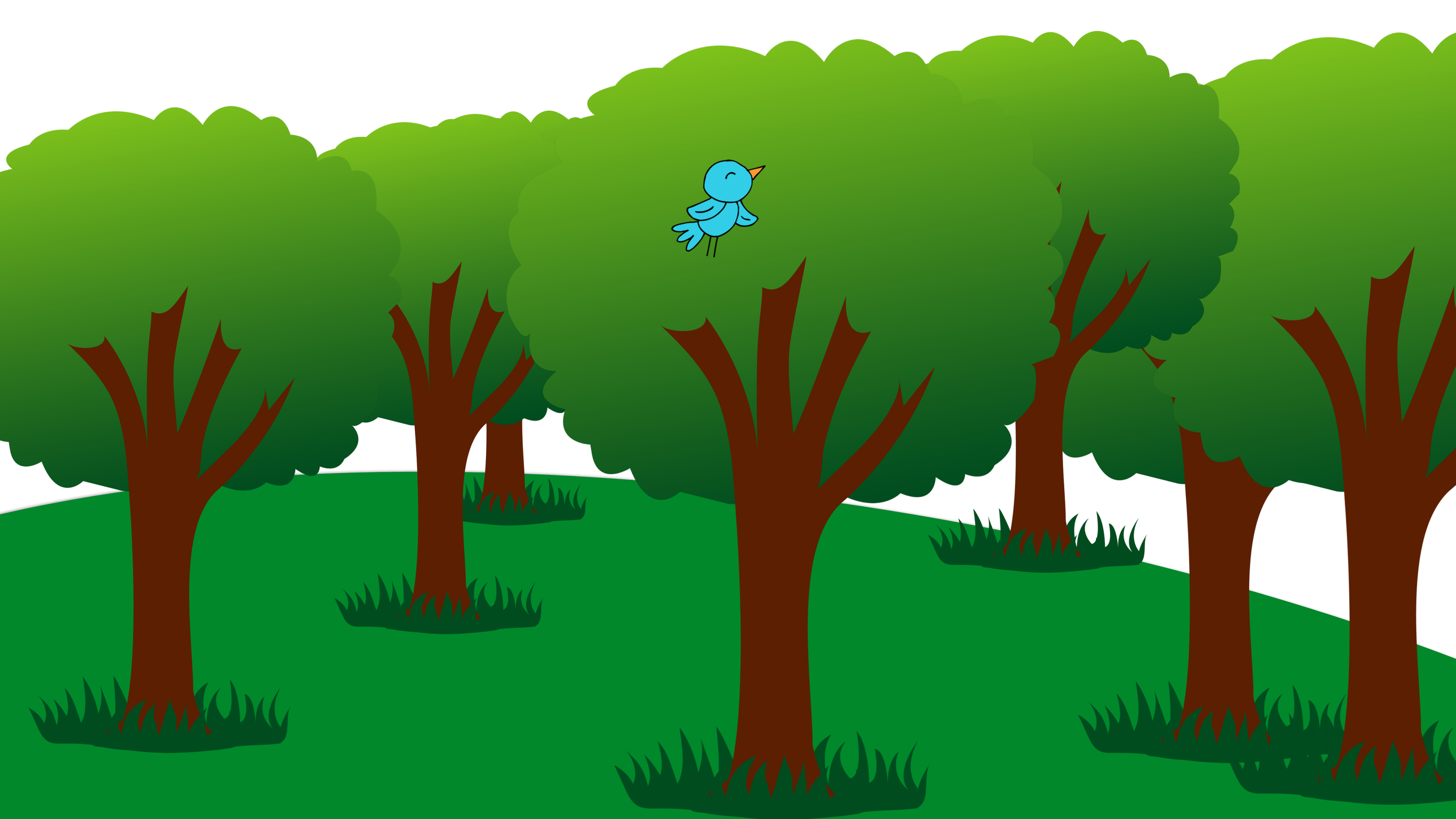

open
open list
found new nodes?
visited before?
close
closed list




observe
hypothesize
refine or reject
experiment
validate (repeat)

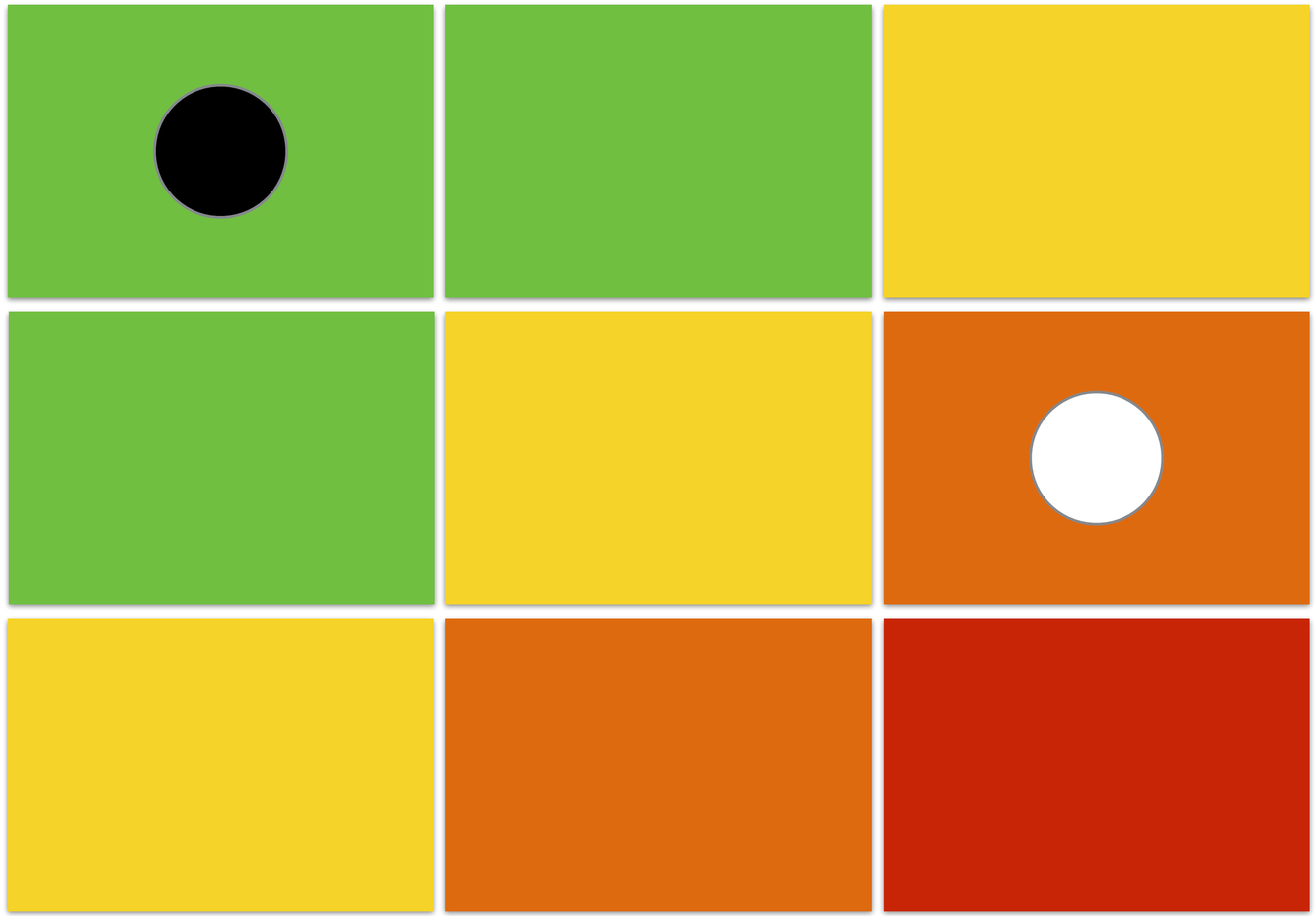
Let’s write down what we know to be true.

(again)

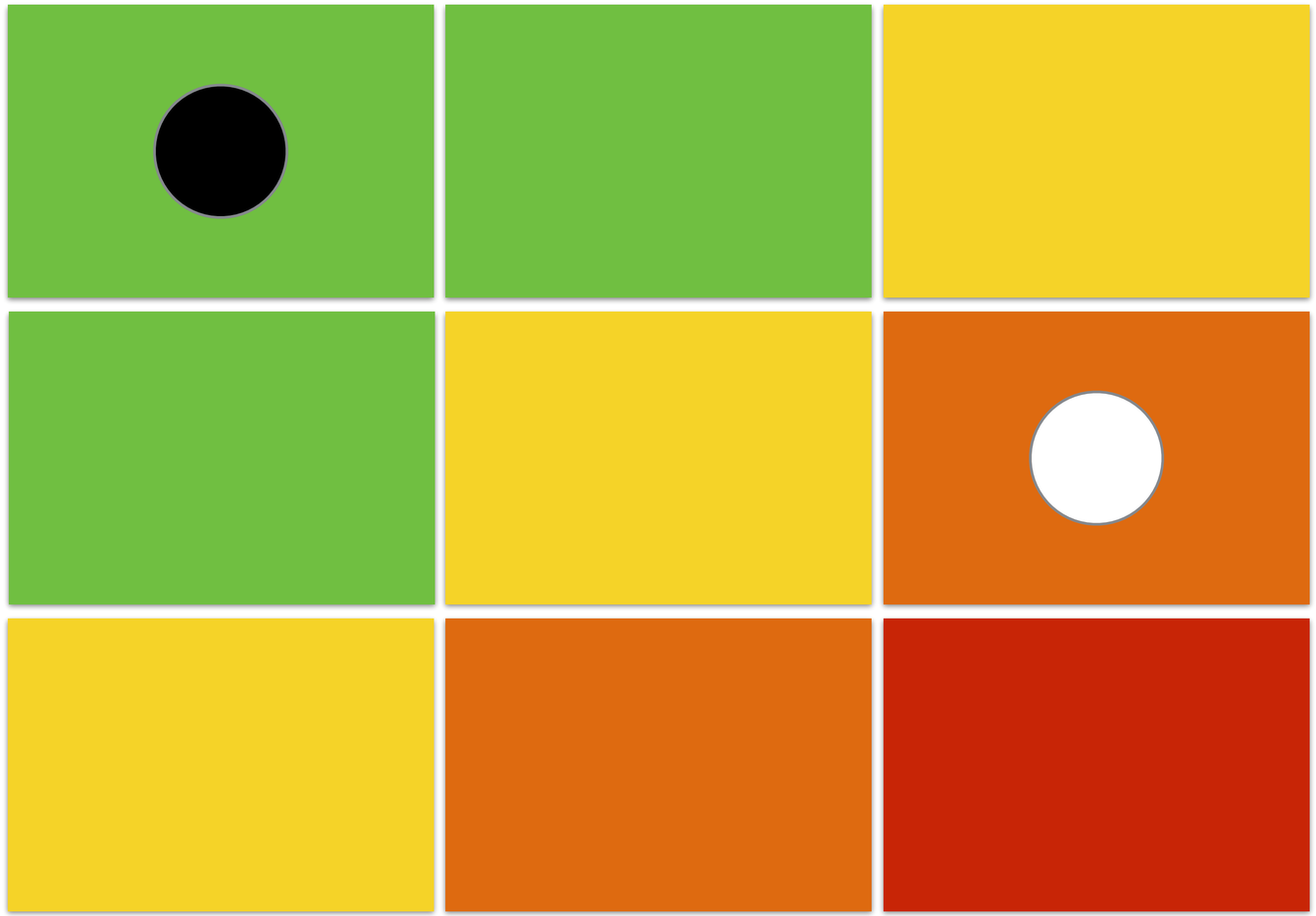


1. Develop system model.
2. Record known risk areas.
3. Publish model and risk areas.
4. Perform regular risk reviews. (Premortems)
5. Dissect and document missed risks.

post-incident retrospective



not just the technology stuff



It's really, really hard to pull the cord.

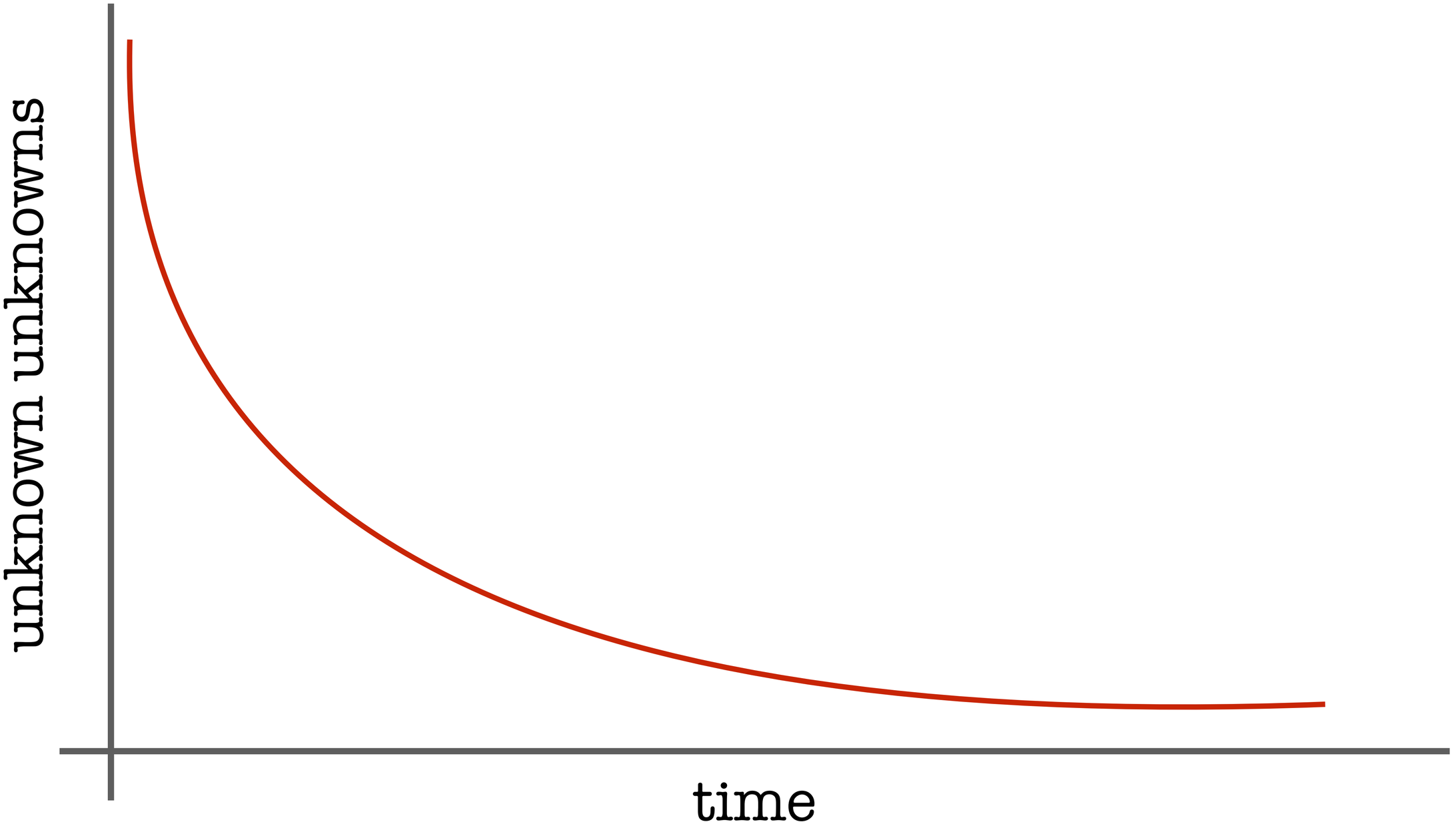
1. List **ALL** changes going in the release.
2. Review each change in terms of the risk matrix.
3. If it's **RED**, it doesn't go. (Pull the cord.)
4. If it's **ORANGE**, we need a monitoring & mitigation plan.
5. If it's **YELLOW**, we need at least define a mitigation.

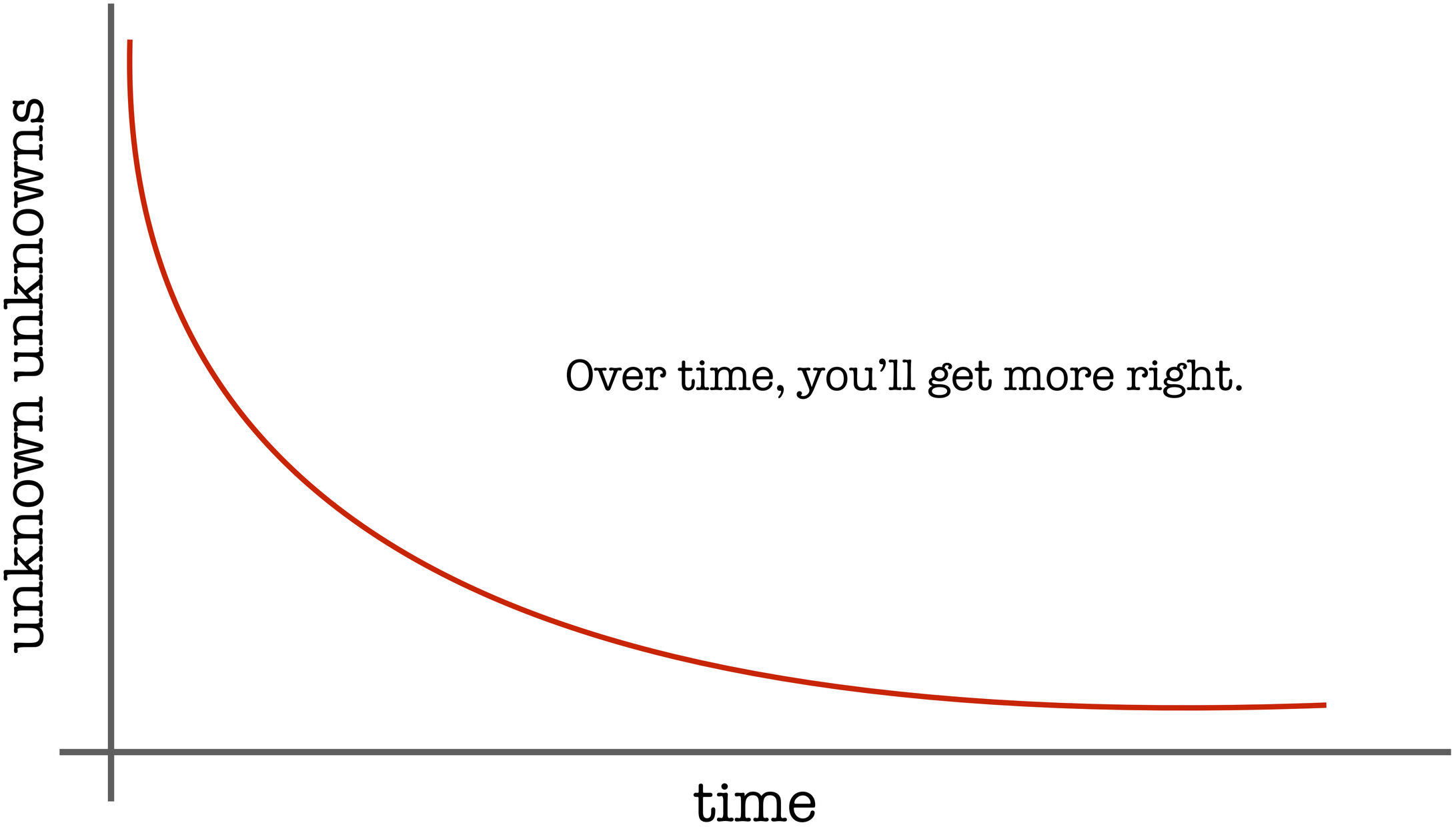
“I think we’re not ready, and I already told leadership we’re going to be late, should I go tell them I’m wrong?”

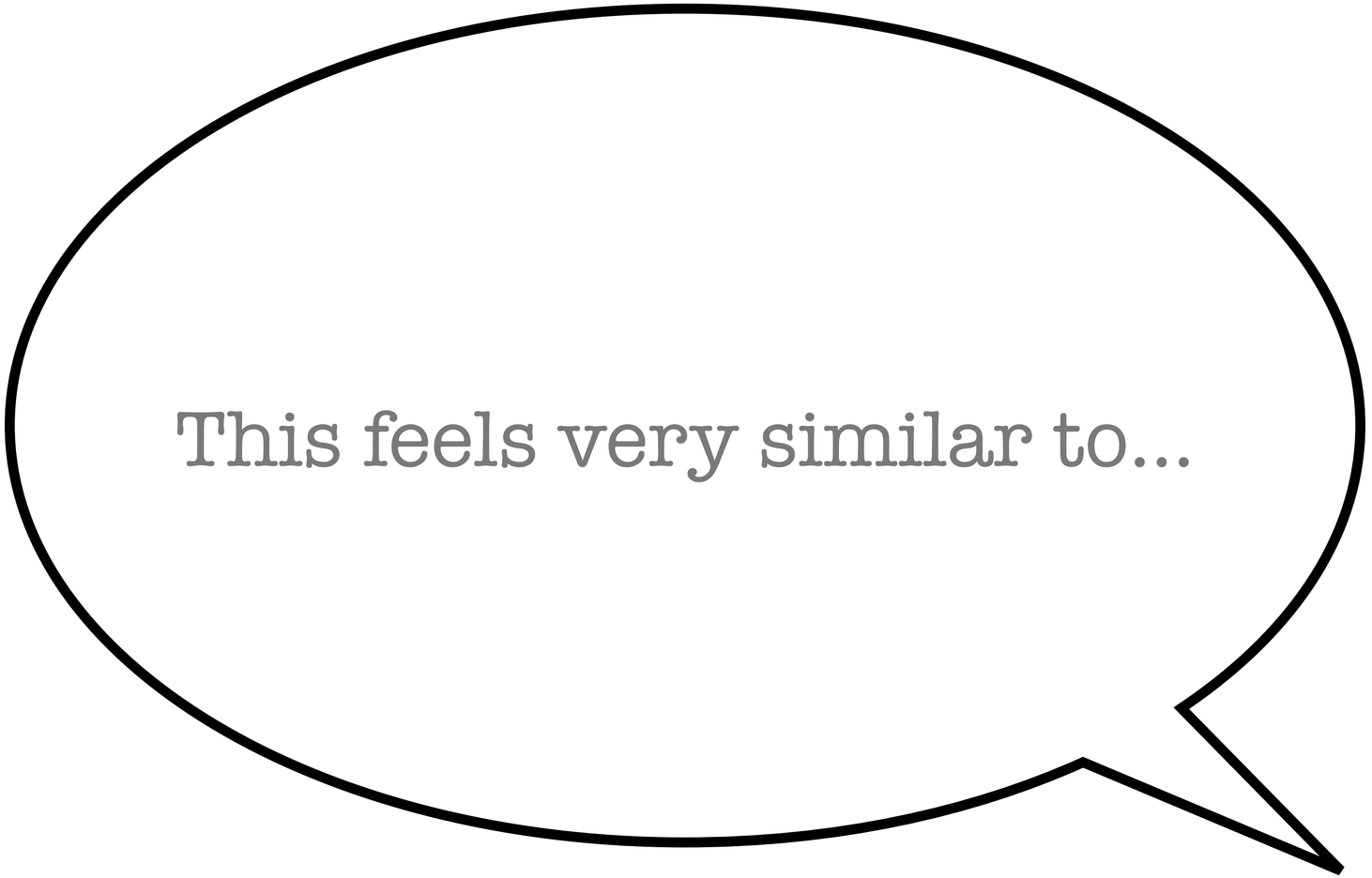
Leaders need to be aware that framing matters.

As you go through this process...

1. Develop system model.
2. Record known risk areas.
3. Publish model and risk areas.
4. Perform regular risk reviews. (Premortems)
5. Dissect and document missed risks.


unknown unknowns
time

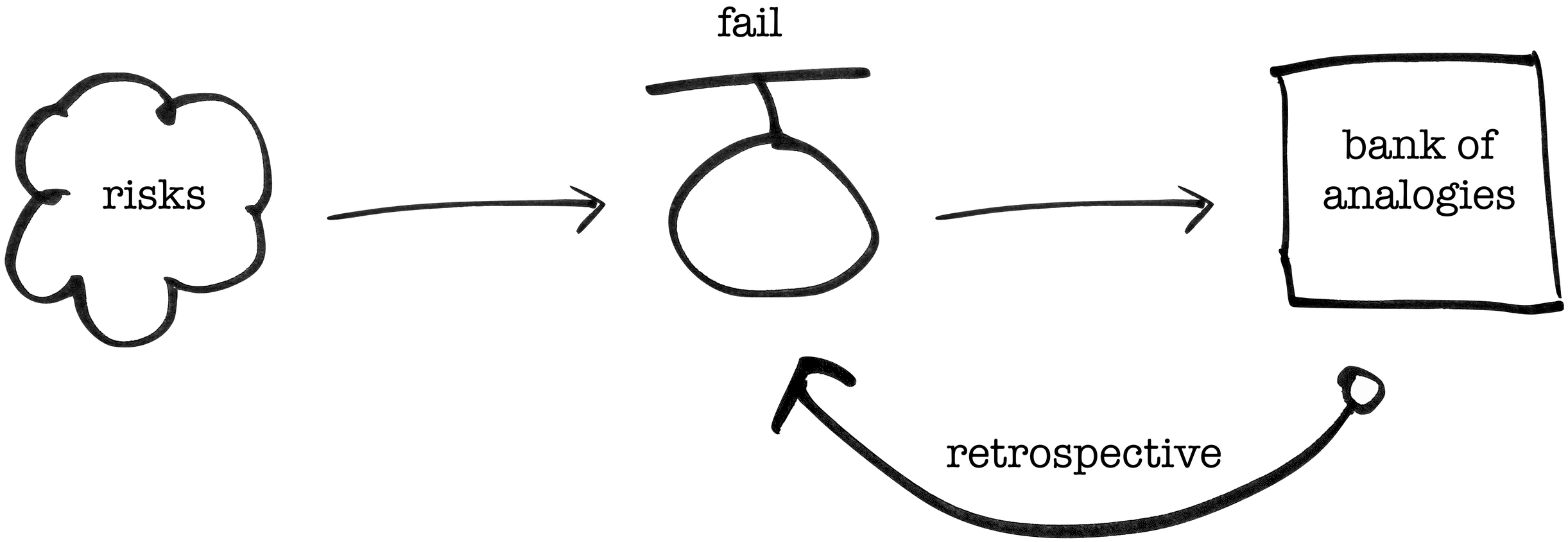

unknown unknowns
time
Over time, you'll get more right.


This feels very similar to...

analogy-based risk assessment

analogy-based assessment

leveraging a collection of previous experiences to reflect on how a new situation might play out


fail
risks
bank of
analogies
retrospective

analogy-based assessment

This is what experience gives us.

Process

1. Develop system model.
2. Record known risk areas.
3. Publish model and risk areas.
4. Perform regular risk reviews. (Premortems)
5. Dissect and document missed risks.

Process externalizes the things
great engineers have internalized.

It’s a way of thinking out loud.

Thinking out loud is a great coaching tool.

Me:

redundancy

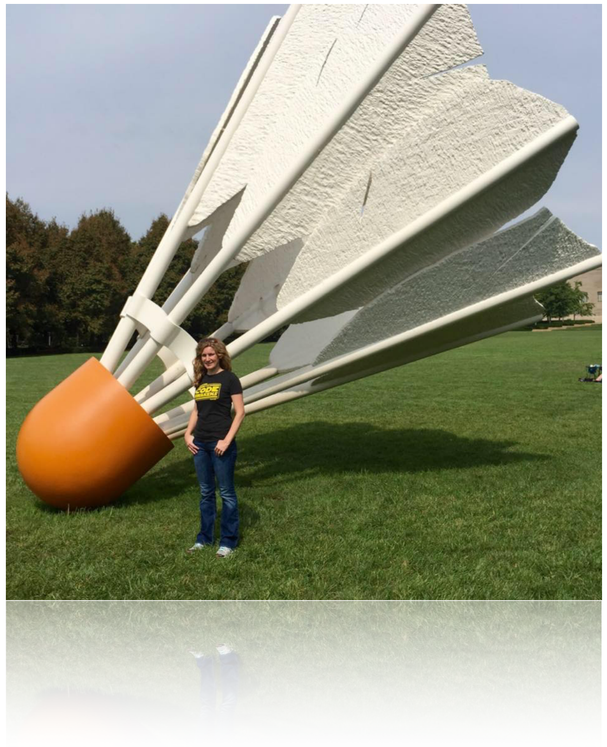
Me:

I teach people to worry about failure and manage it

My mom is a very extroverted person.

She thinks out loud.

I learned to think like her.



Michelle Brush

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Chapter Leader, Kansas City Girl Develop It
Conference Organizer, Midwest.io
@michellebrush

Thank you for letting me think out loud.

References

Paper published in IEEE Software 12 (6)
November 1995, pp. 42-50

Architectural Blueprints—The "4+1" View Model of Software Architecture

Philippe Kruchten
Rational Software Corp.

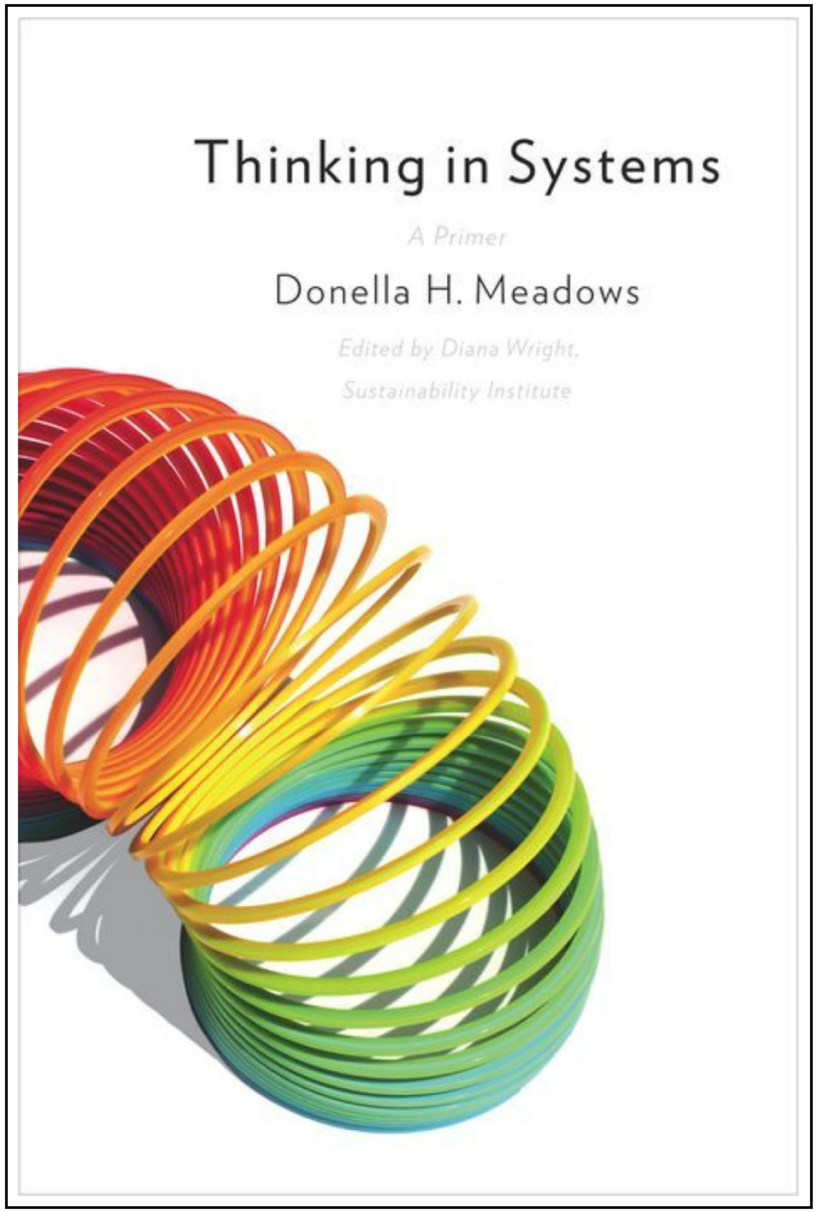
Abstract

This article presents a model for describing the architecture of software-intensive systems, based on the use of multiple, concurrent views. This use of multiple views allows to address separately the concerns of the various 'stakeholders' of the architecture: end-user, developers, systems engineers, project managers, etc., and to handle separately the functional and non functional requirements. Each of the five views is described, together with a notation to capture it. The views are designed using an architecture-centered, scenario-driven, iterative development process.

Keywords: software architecture, view, object-oriented design, software development process

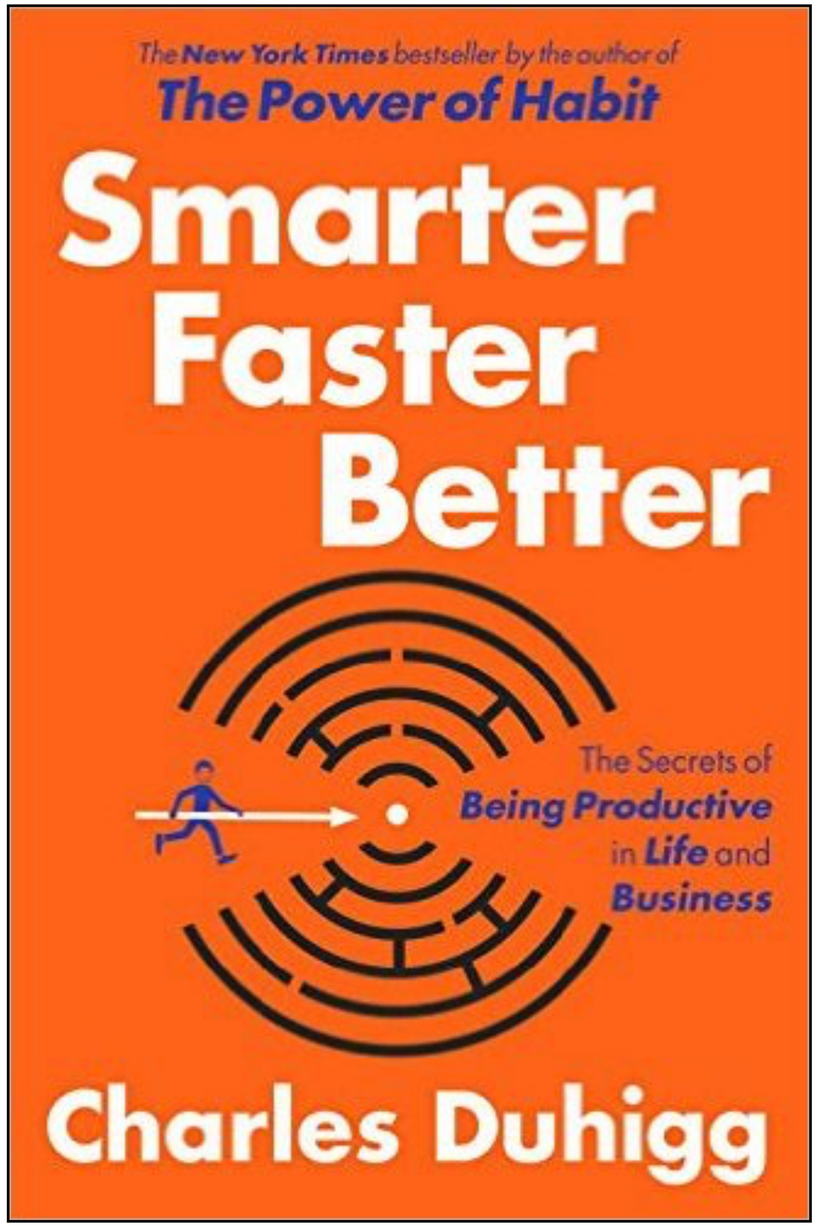
Introduction

We all have seen many books and articles where one diagram attempts to capture the gist of the architecture



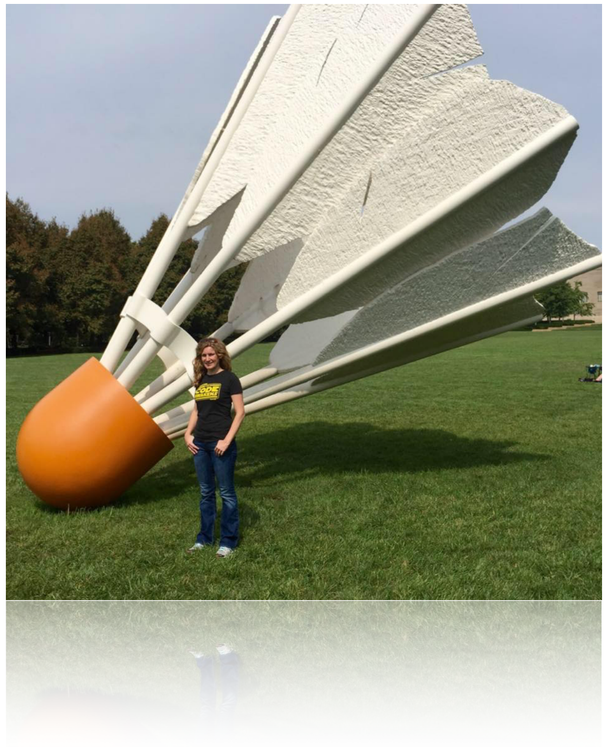
Thinking in Systems

Donella H. Meadows



Smarter Faster Better

Charles Duhigg



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Thank you, again.