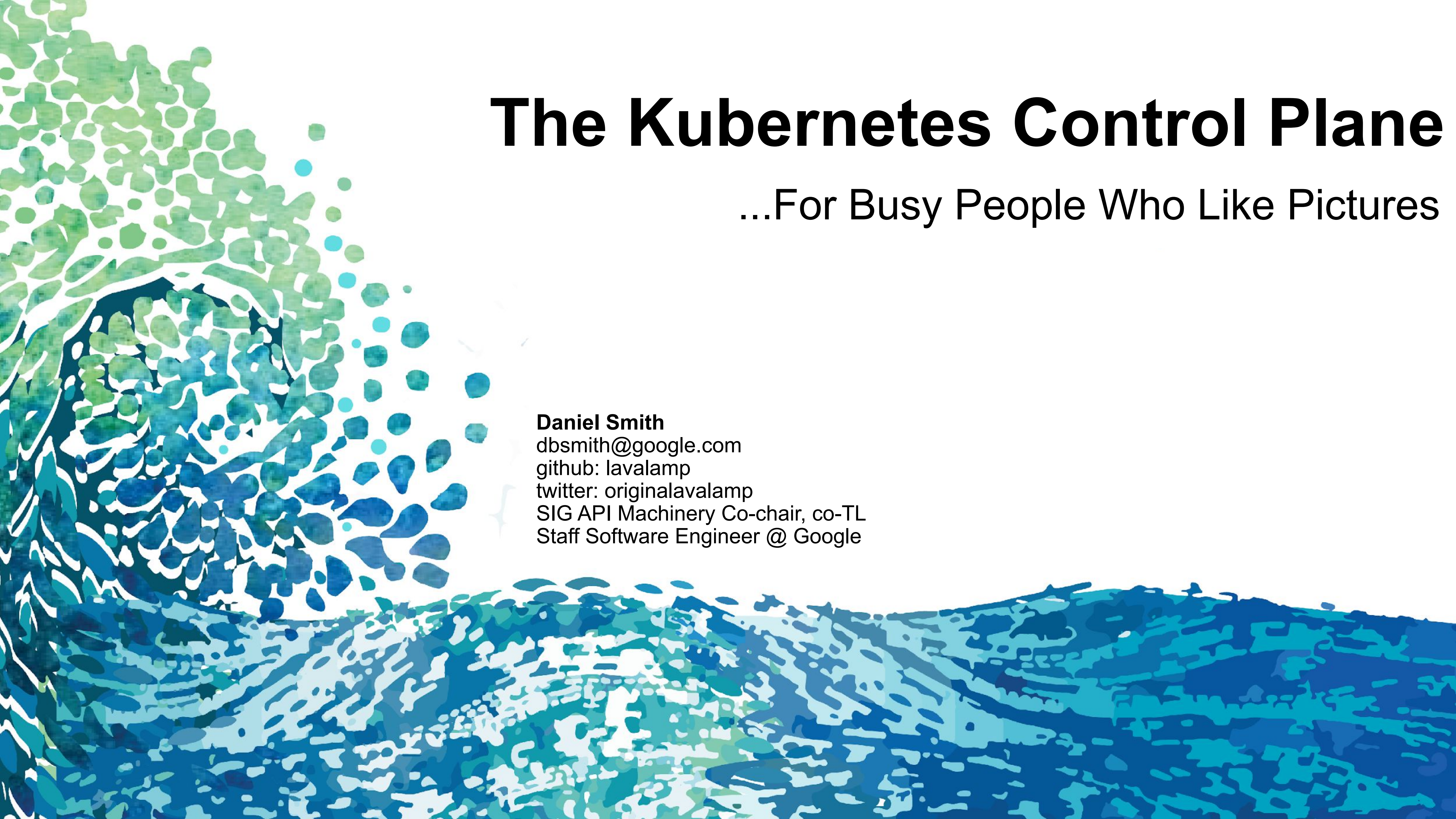
The Kubernetes Control Plane

...For Busy People Who Like Pictures



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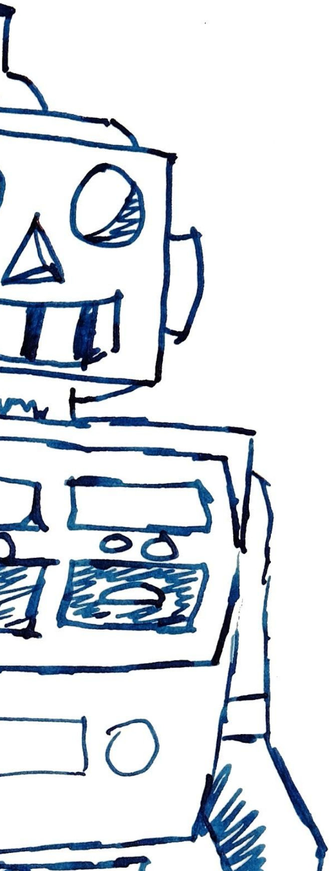
github: lavalamp
twitter: originalavalamp
SIG API Machinery Co-chair, co-TL
Staff Software Engineer @ Google

THE KUBERNETES CONTROL PLANE

FOR BUSY PEOPLE WHO LIKE PICTURES

THE KUBERNETES CONTROL PLANE

FOR BUSY PEOPLE WHO LIKE BAD PICTURES



DANIEL SMITH

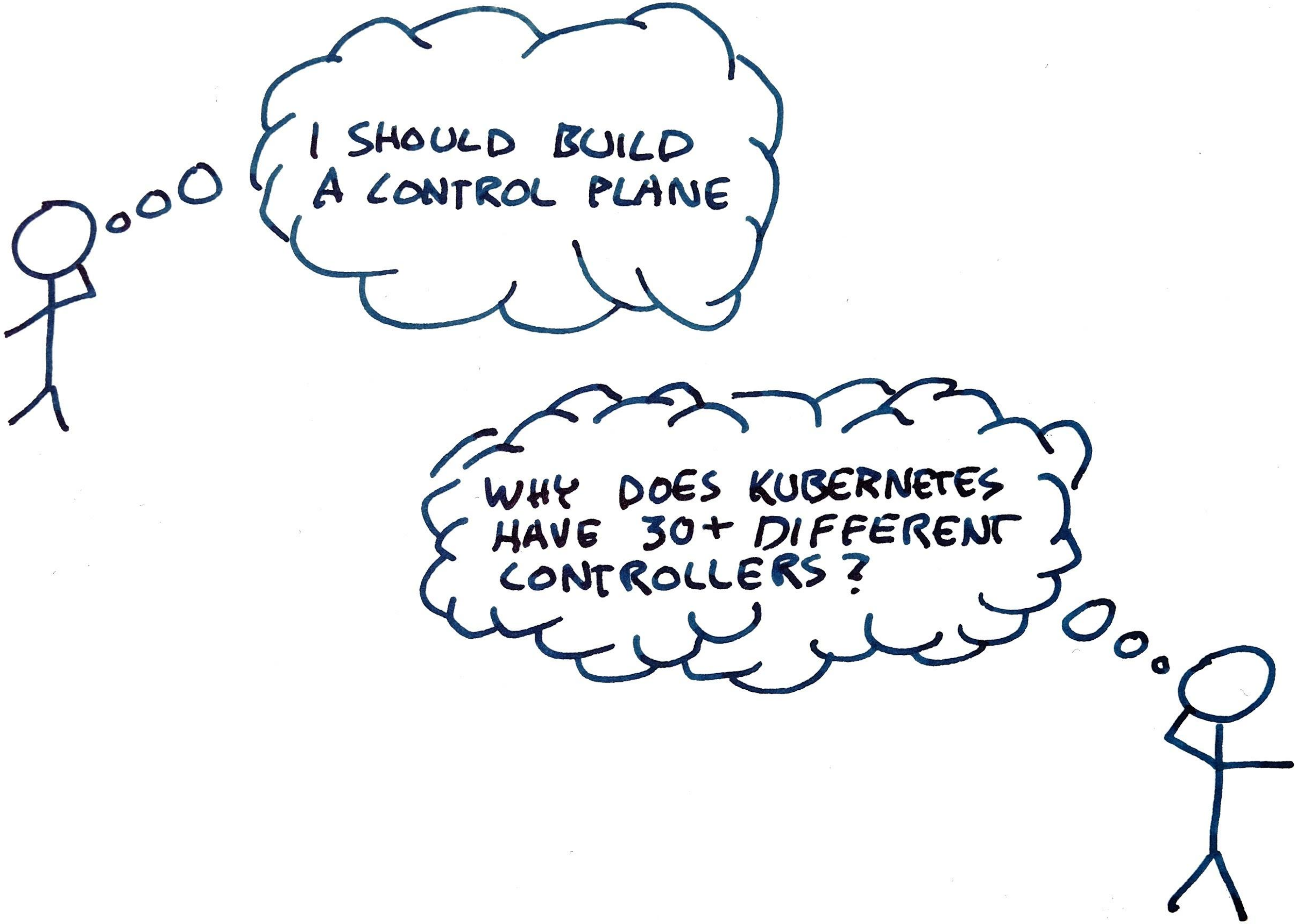
STAFF SOFTWARE ENGINER — GOOGLE

LAVALAMP — GITHUB

ORIGINALAVALAMP — TWITTER

SIG API MACHINERY

CO-CHAIR * CO-TL

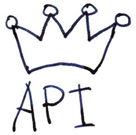

I SHOULD BUILD A CONTROL PLANE
WHY DOES KUBERNETES HAVE 30+ DIFFERENT CONTROLLERS?

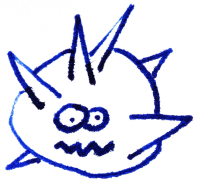
TRILOGY

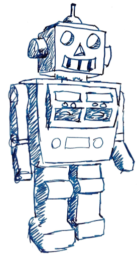
COPENHAGEN 2018: KUBERNETES-STYLE APIs OF THE FUTURE

SEATTLE 2018: A VISION FOR API MACHINERY

BARCELONA 2019: THE KUBERNETES CONTROL PLANE FOR BUSY PEOPLE WHO LIKE PICTURES







YOU ARE HERE

THE KUBERNETES API
IS ABOUT HUMANS AND
MACHINES WORKING TOGETHER.

THE KUBERNETES API IS ABOUT HUMANS AND MACHINES WORKING TOGETHER.

... YOU CAN'T DO THAT WITHOUT SOME MACHINES!!

CONTROLLERS: THE IN THE MACHINE

CONTROL THEORY!

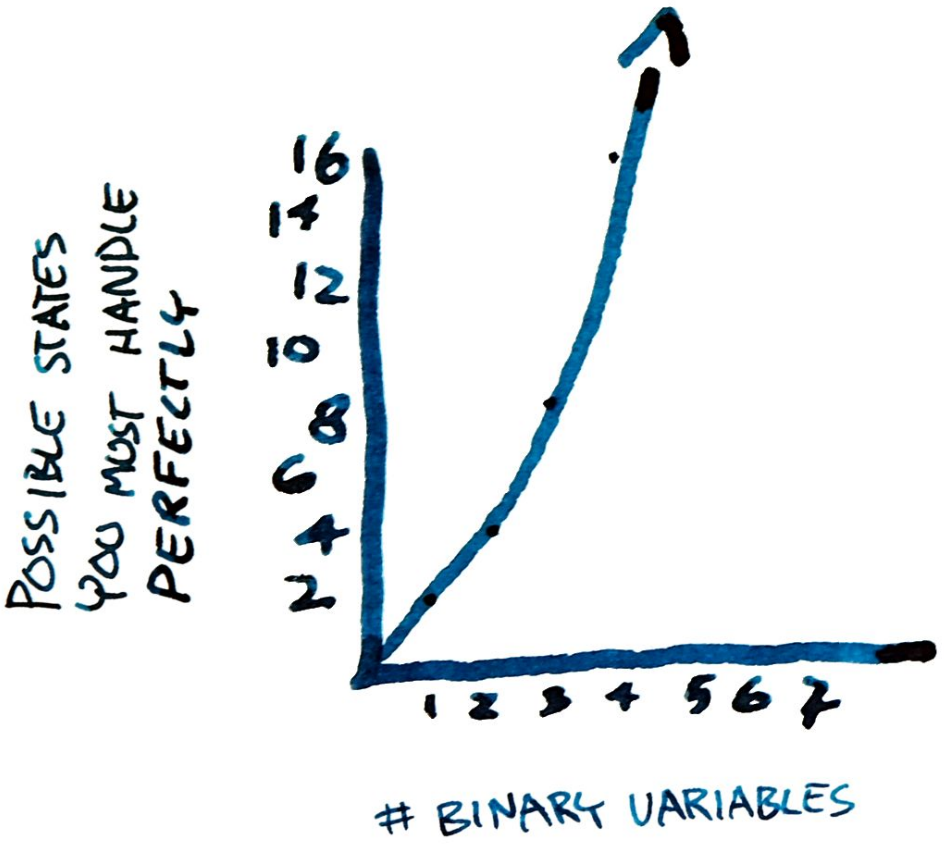
THE AGE-OLD DEBATE: ~~NATURE VS NURTURE~~

STATE MACHINE

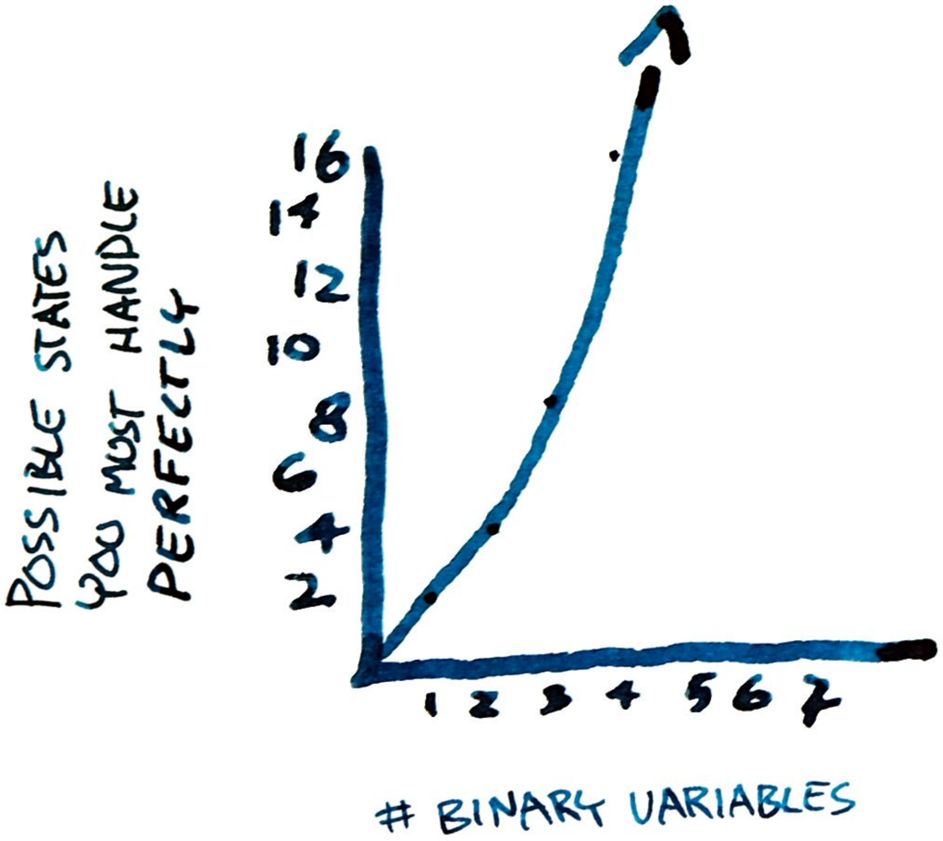
VS

CONTROL LOOP

STATE MACHINES

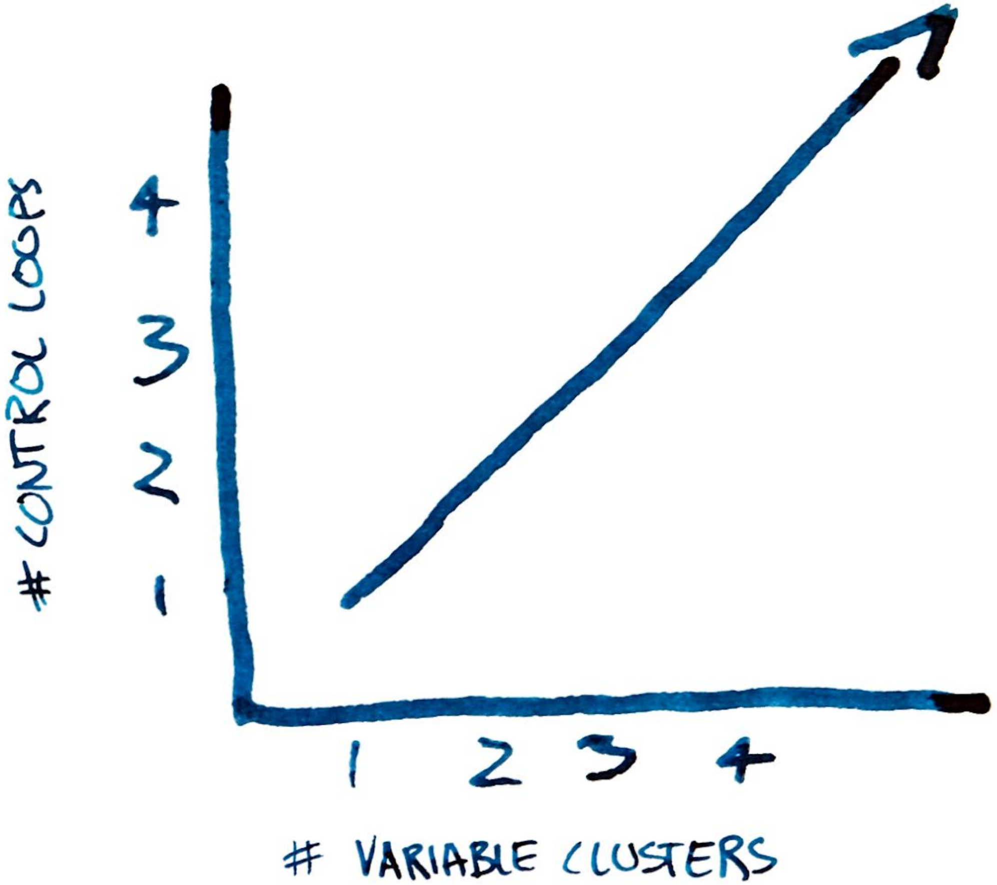


STATE MACHINES

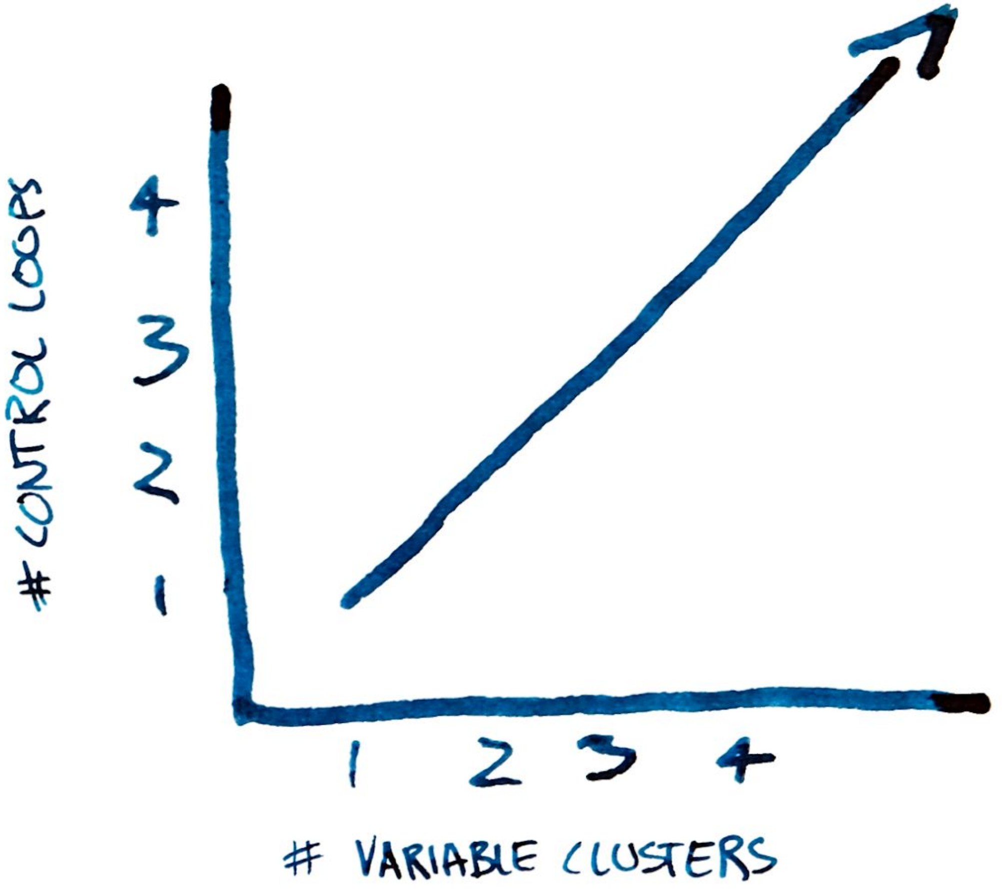


2^N ← TECHNICAL TERM: NOT GOOD ☹

CONTROLLERS

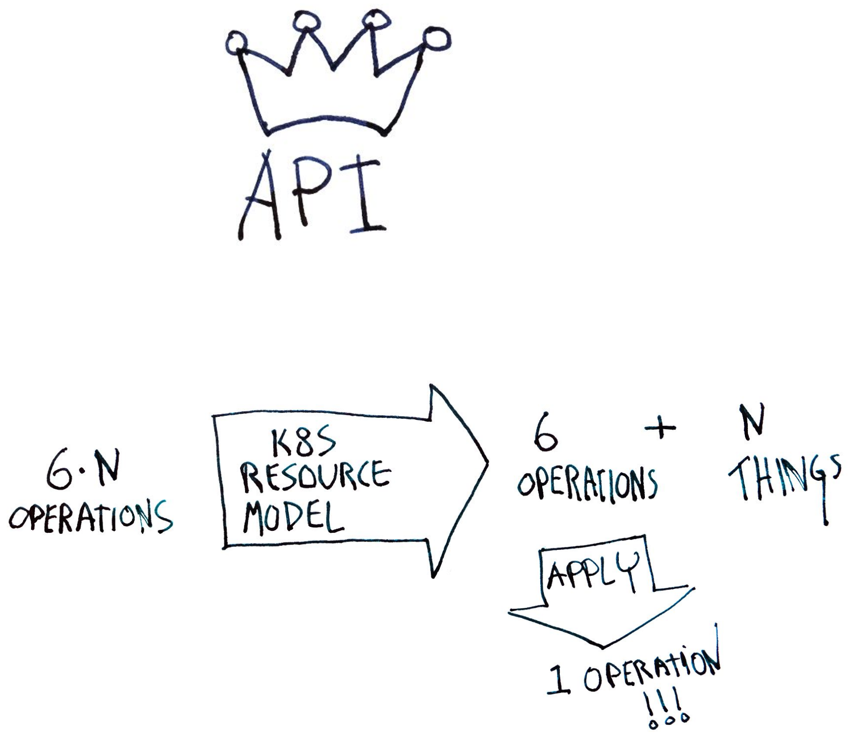


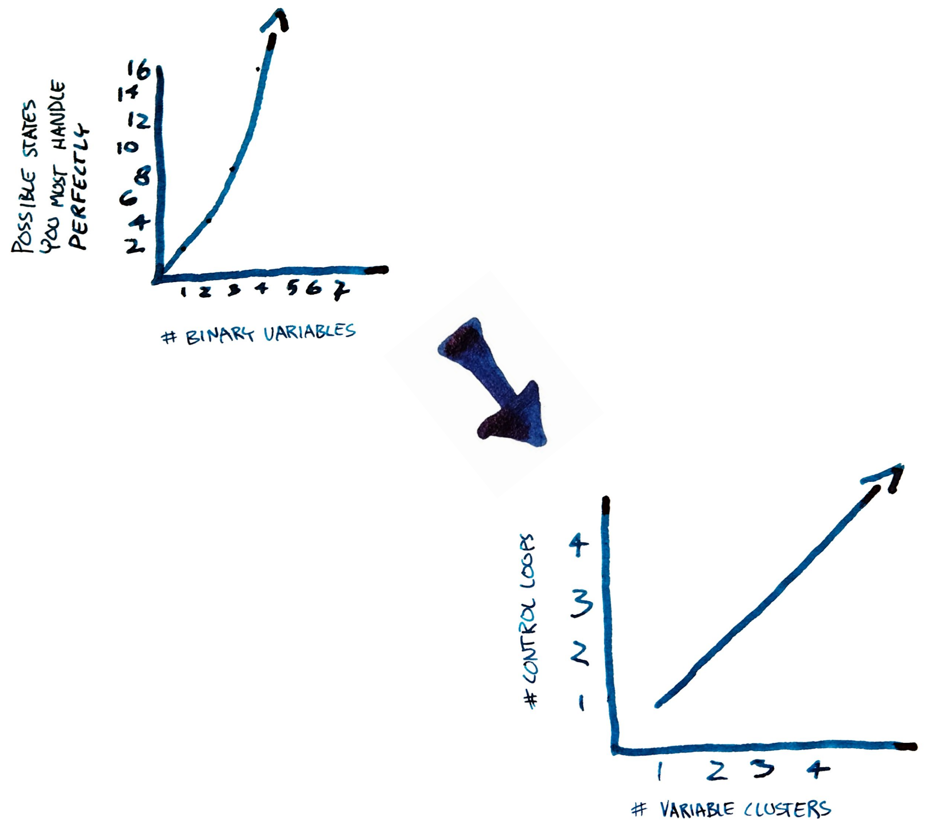
CONTROLLERS



N ← TECHNICAL TERM: PRETTY GOOD

☺





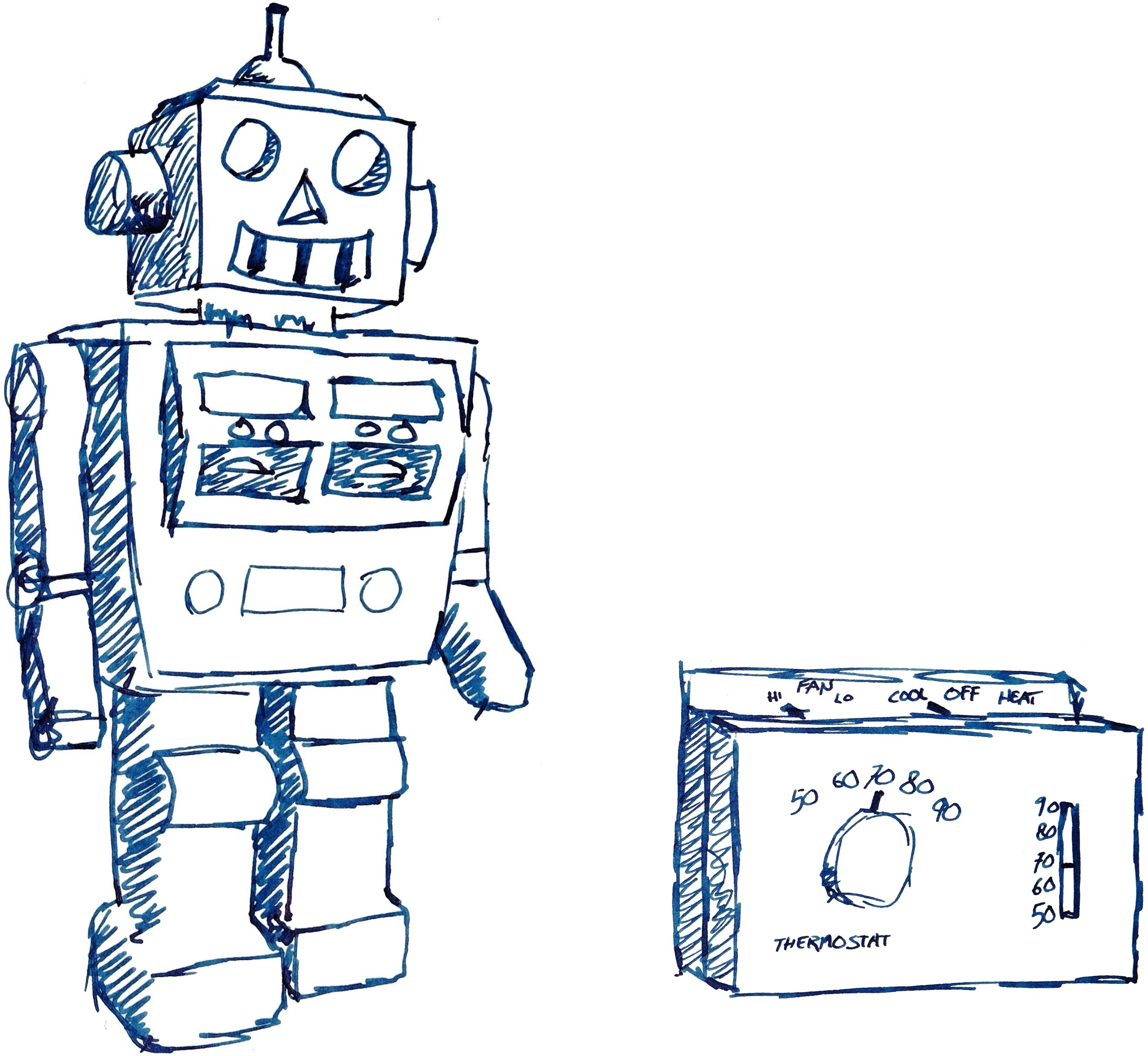
INTEGRATION COMPLEXITY VS IMPLEMENTATION COMPLEXITY

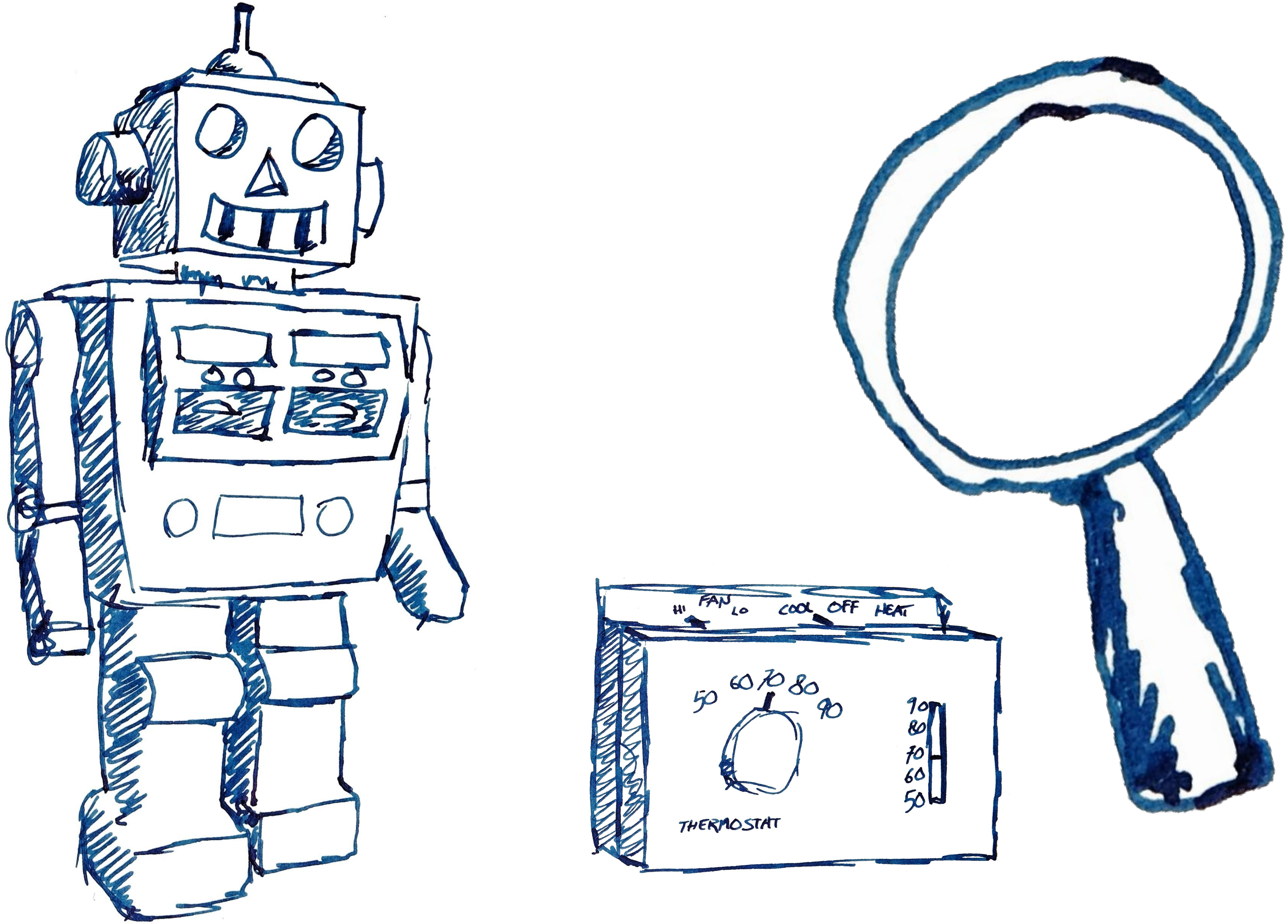
GLOBALLY EASIER
LOCALLY HARDER

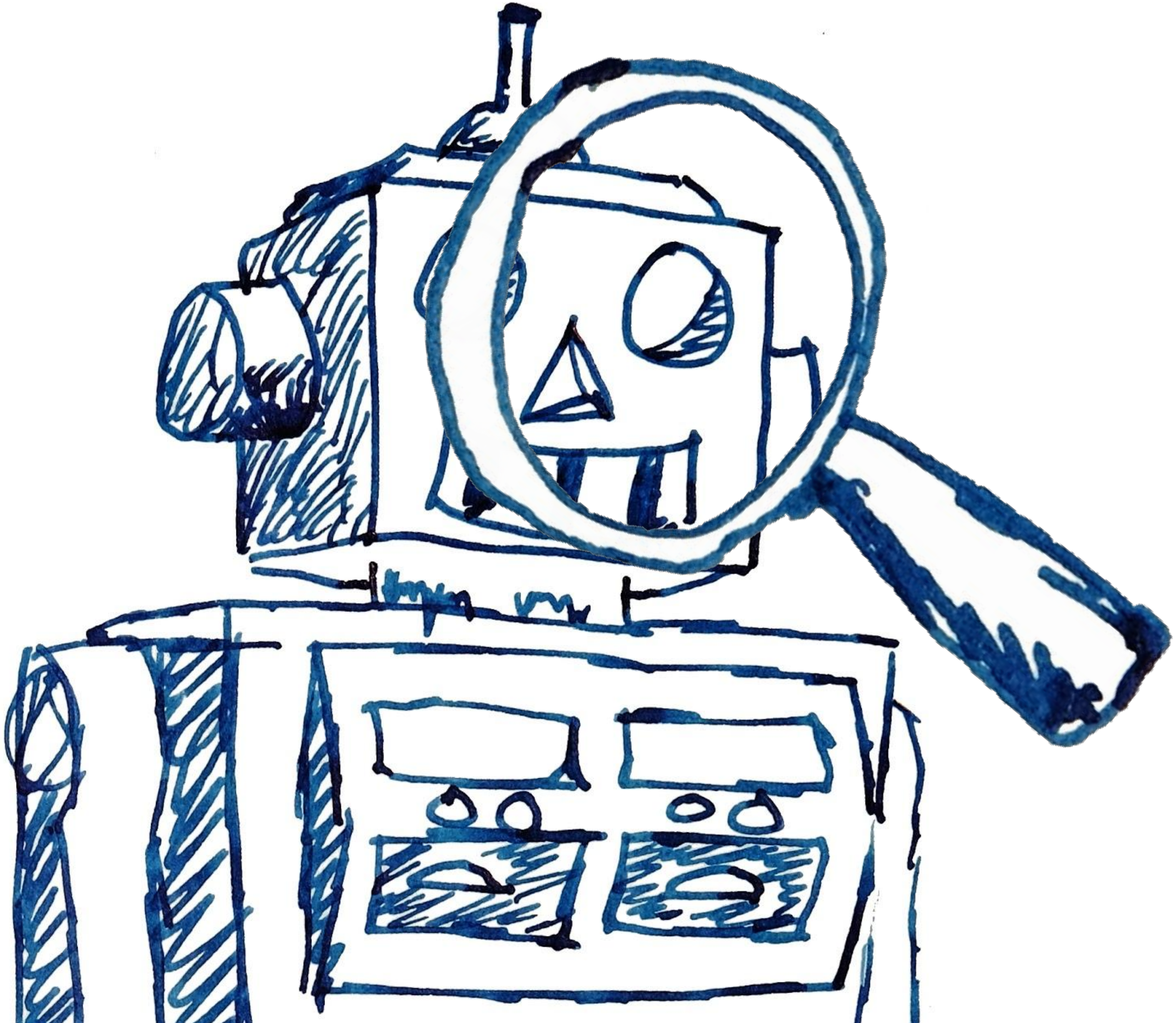
AN IDEAL KRM CONTROLLER

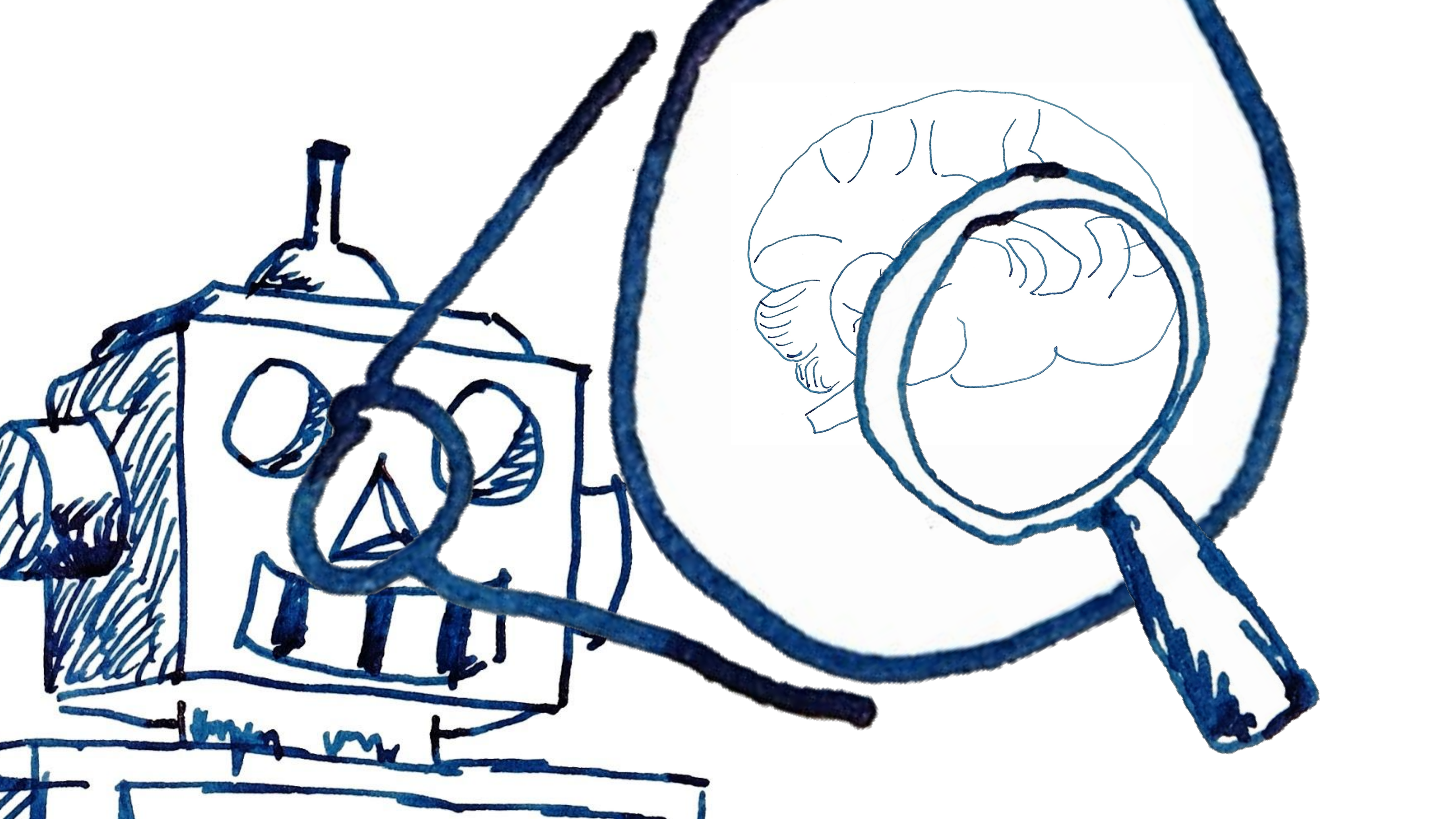
AN **IDEAL KRM CONTROLLER** SHOULD:

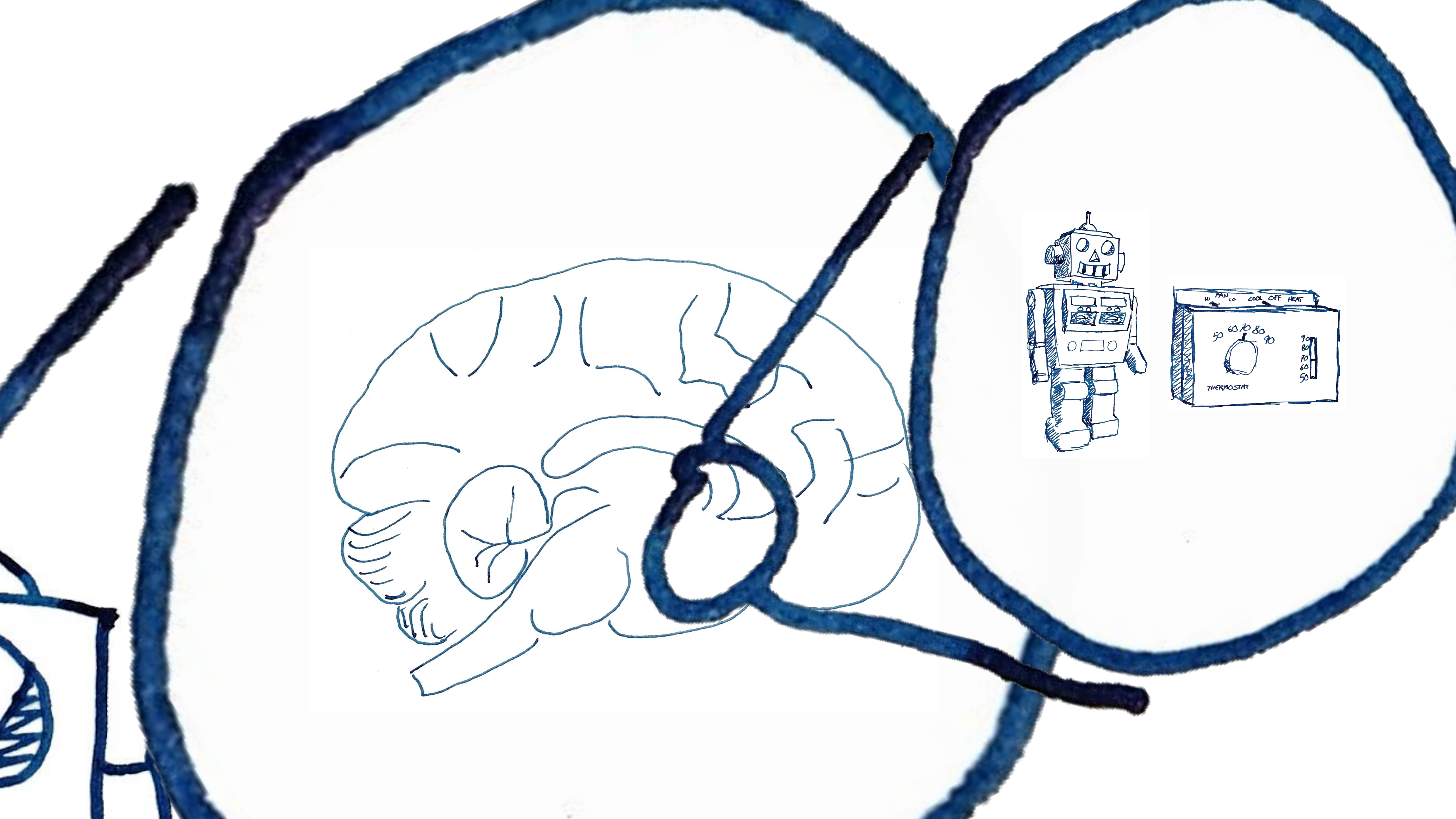
* ONLY DO **ONE** THING
* HAVE AN **INPUT** SOURCE
* HAVE A PLACE TO WRITE **STATUS**
* HAVE AN **OUTPUT** LOCATION
* **ANTICIPATE ITS OWN EFFECTS** ON THE REST OF THE SYSTEM
* BREAK THINGS **EXACTLY** A LITTLE BIT ON FAILURE


HI
FAN
LO
COOL
OFF
HEAT
50
60
70
80
90
90
80
70
60
50
THERMOSTAT


HI FAN LO
COOL OFF HEAT
50 60 70 80 90
90 80 70 60 50
THERMOSTAT






HI FAN LO
COOL OFF HEAT
50 60 70 80 90
90
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THERMOSTAT

HI
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50 60 70 80 90
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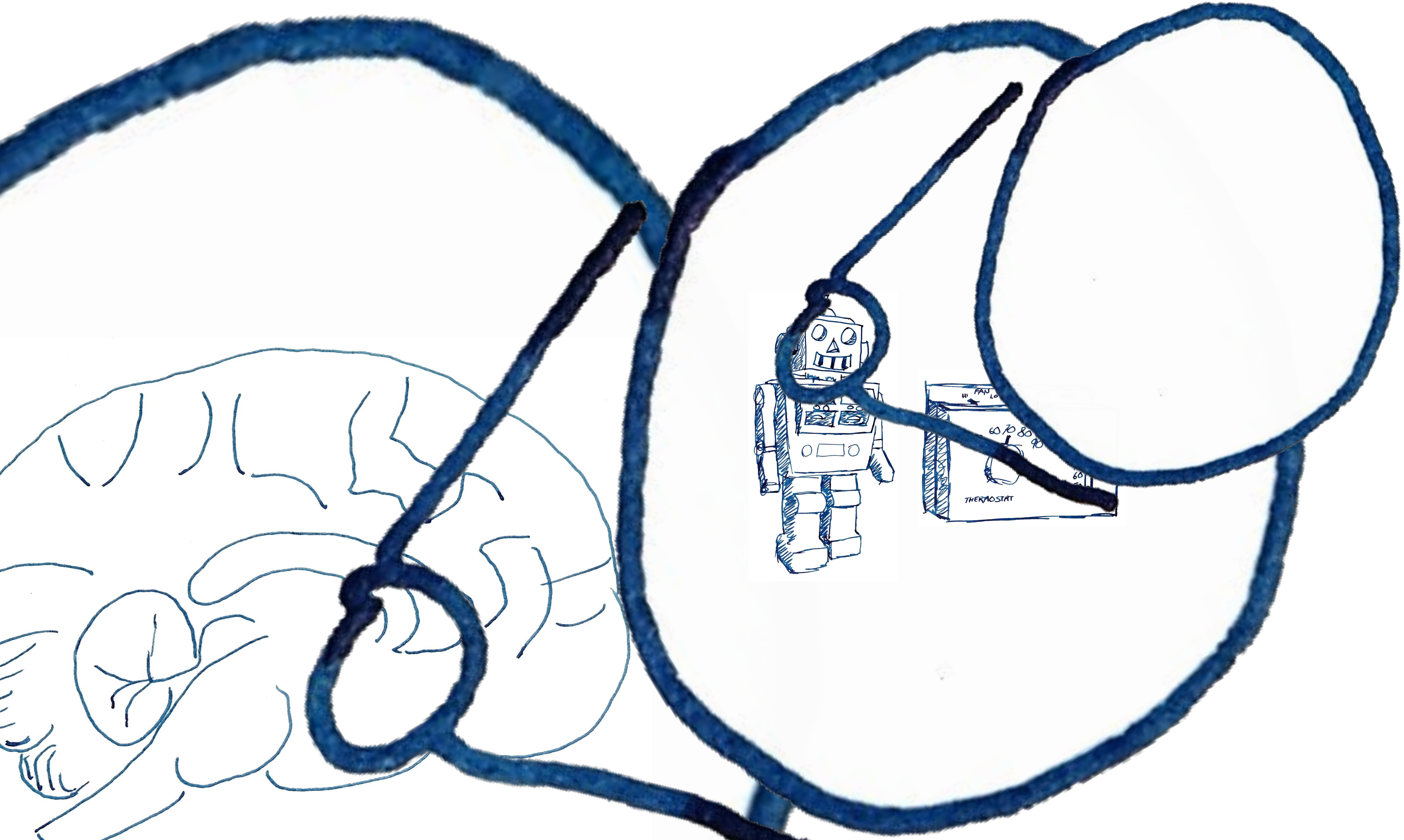
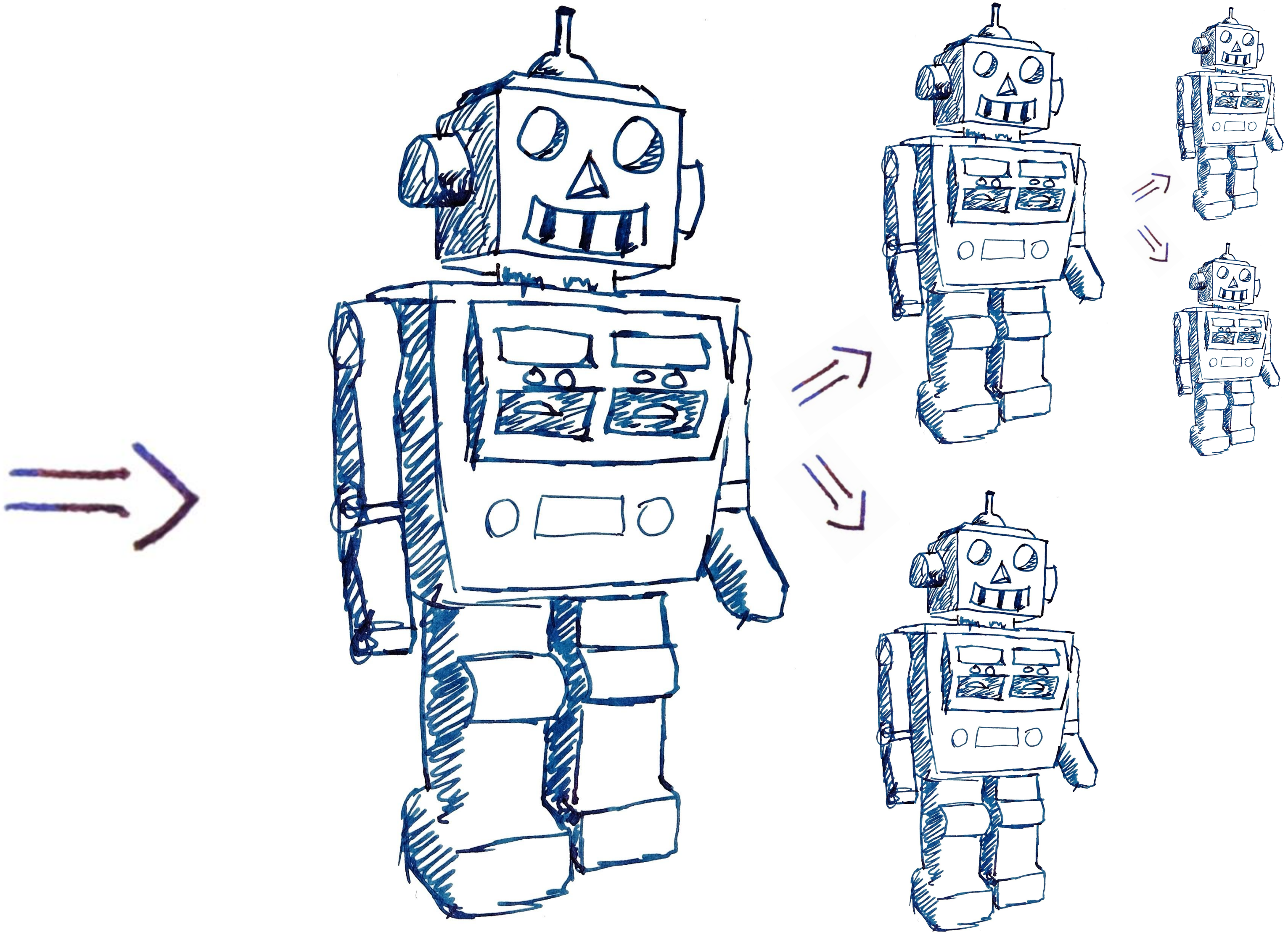
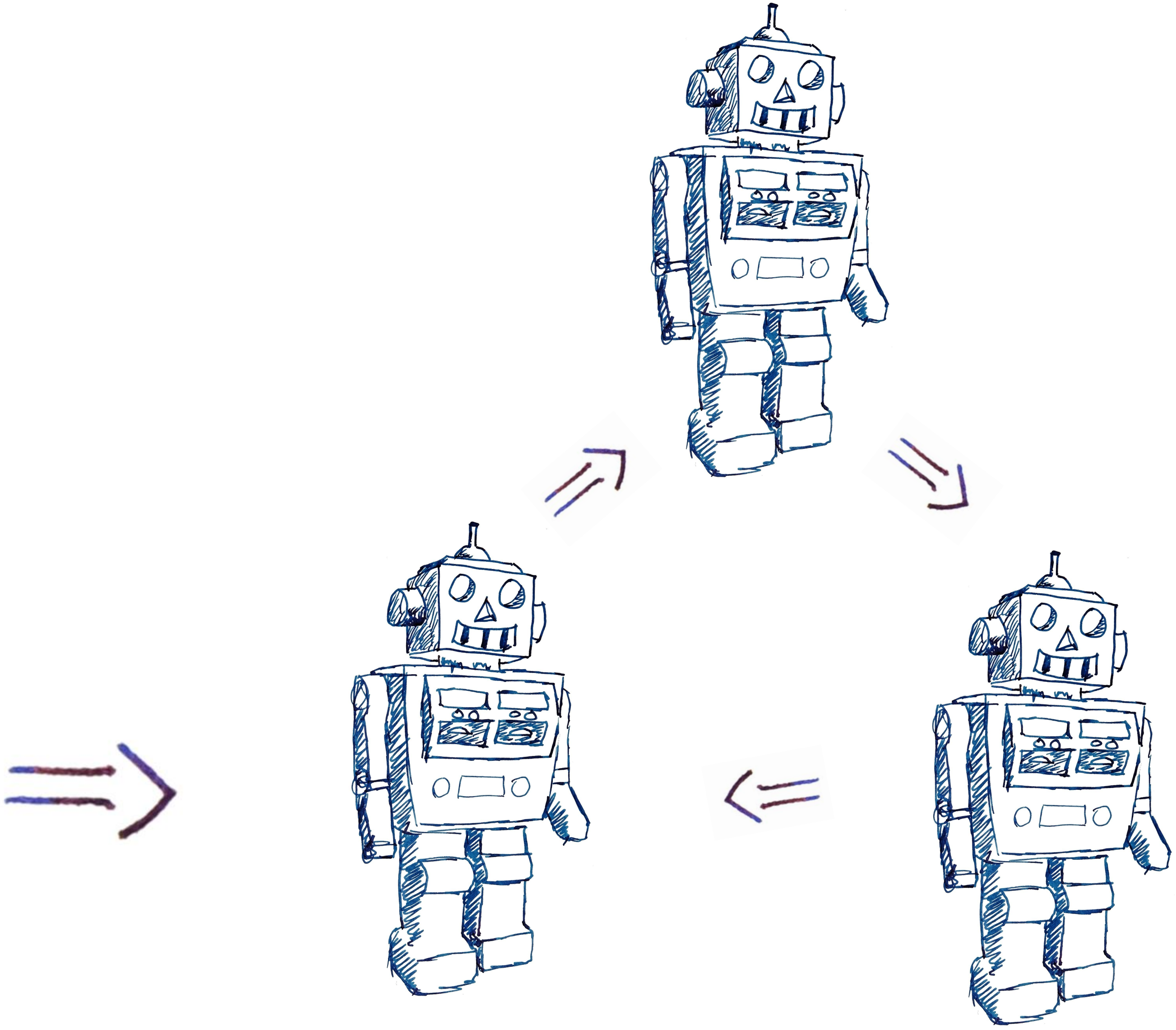
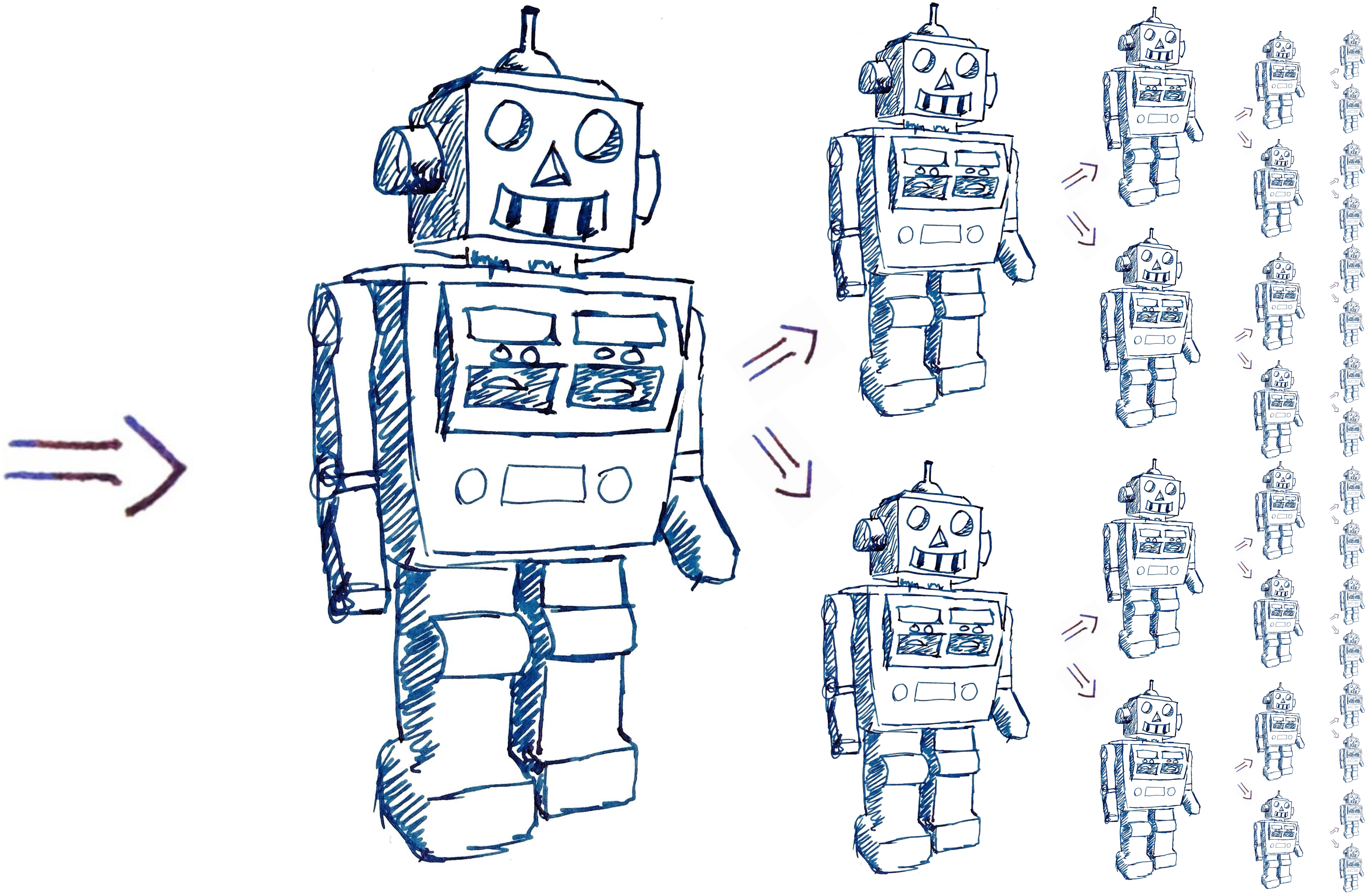
RMOSTAT


FAN
HI
LO
60 70 80 90
60
THERMOSTAT







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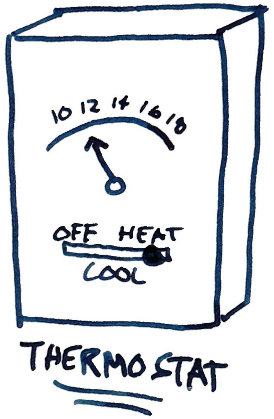
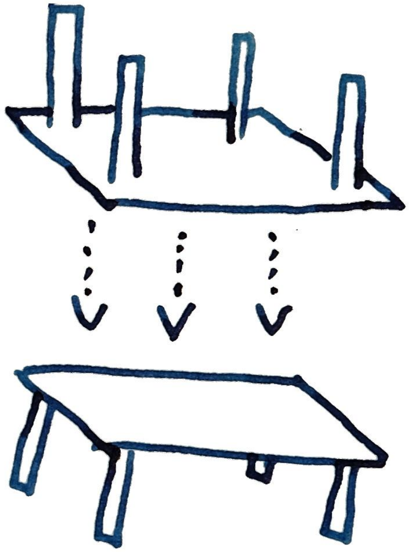
CONTROL ~~THEORY~~ PRACTICE!

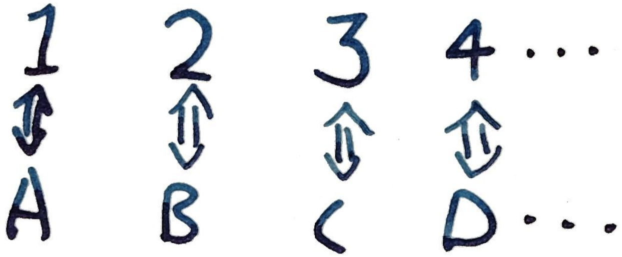
CONTROLLER CATEGORIES

- THE "CLASSIC" CONTROLLERS
- STANDING QUERY / "TABLE JOIN"
- IN- OR BIJECTION ENFORCERS



THERMOSTAT





DISCLAIMERS!

→ MANY CONTROLLERS WRITE EVENTS: NOT SHOWN!

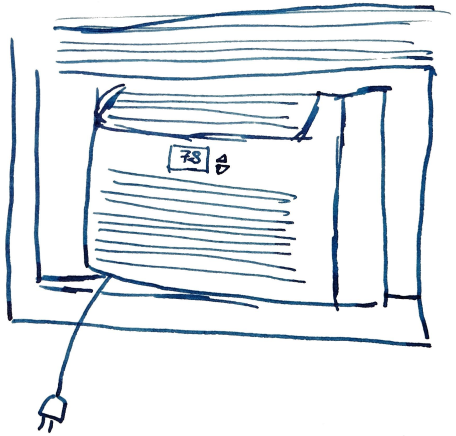
→ NOT ALL "STATUS" PATHS SHOWN!

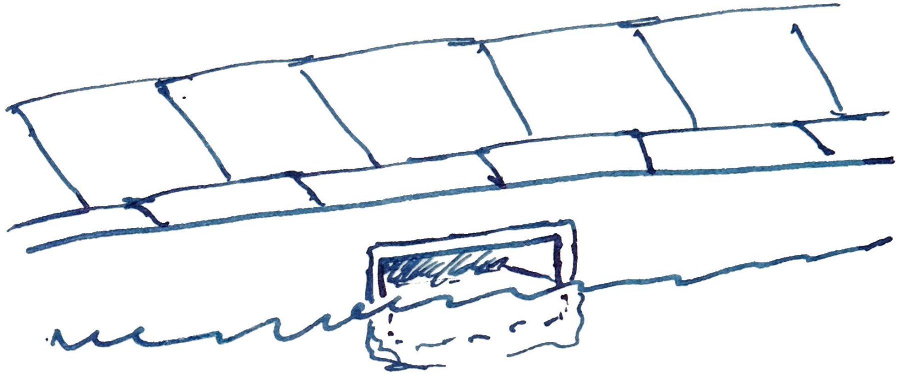
→ WE'LL GO FAST ON SOME OF THESE!

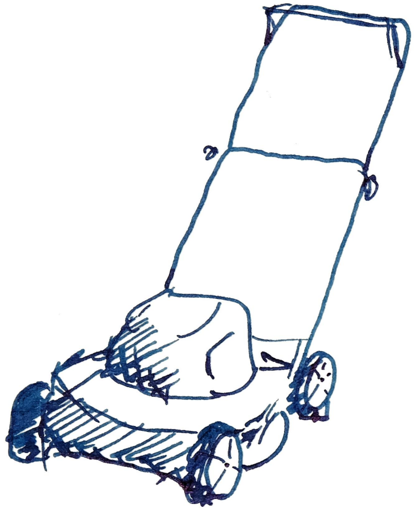
CLASSIC CONTROLLER

FIRST UP:

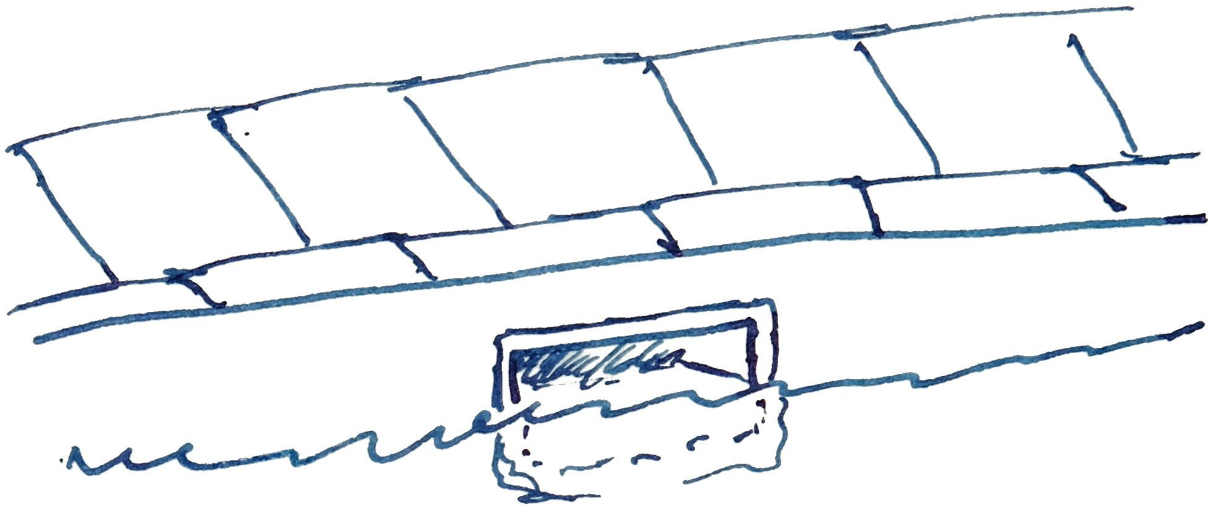
GARBAGE COLLECTORS!

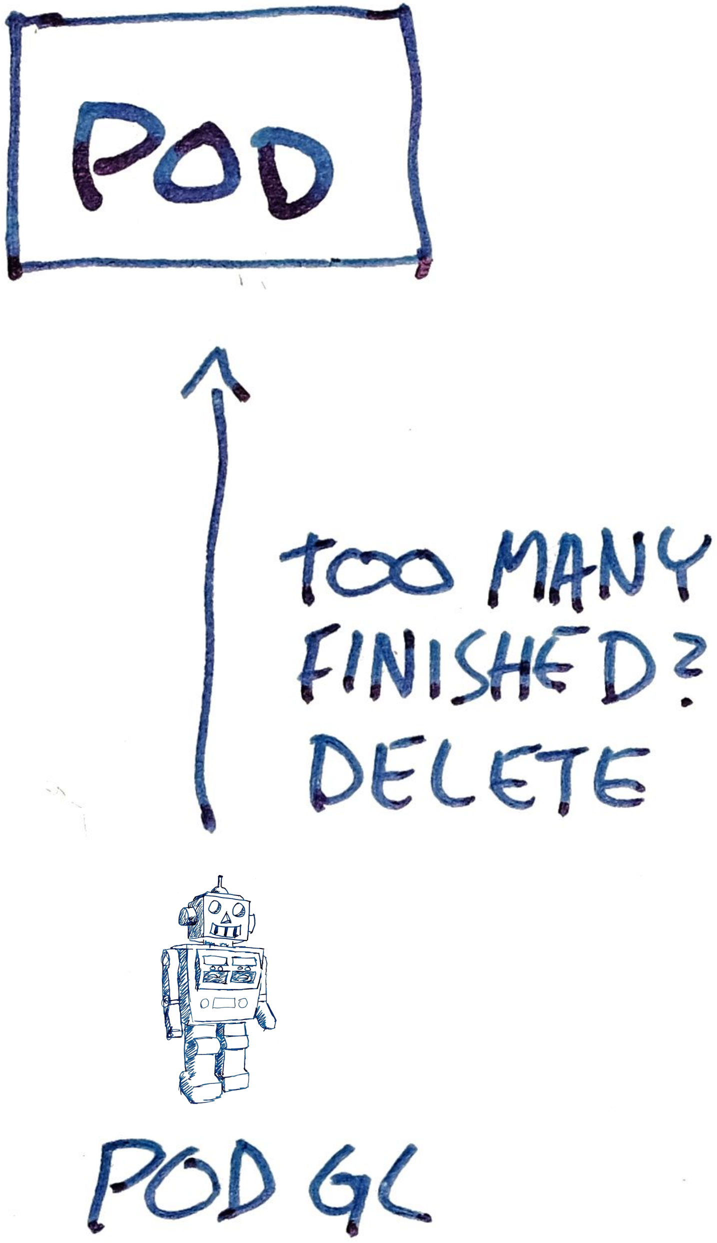


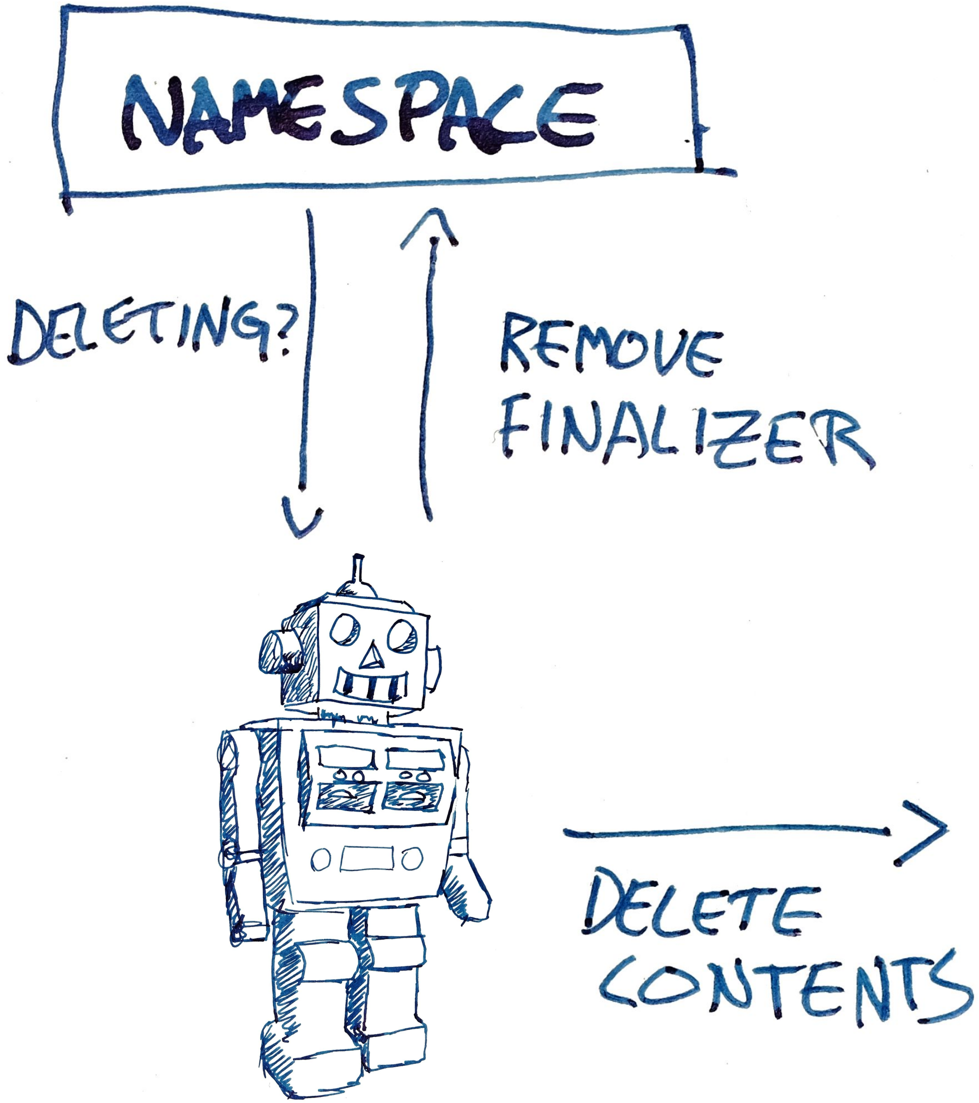




CLASSIC CONTROLLER

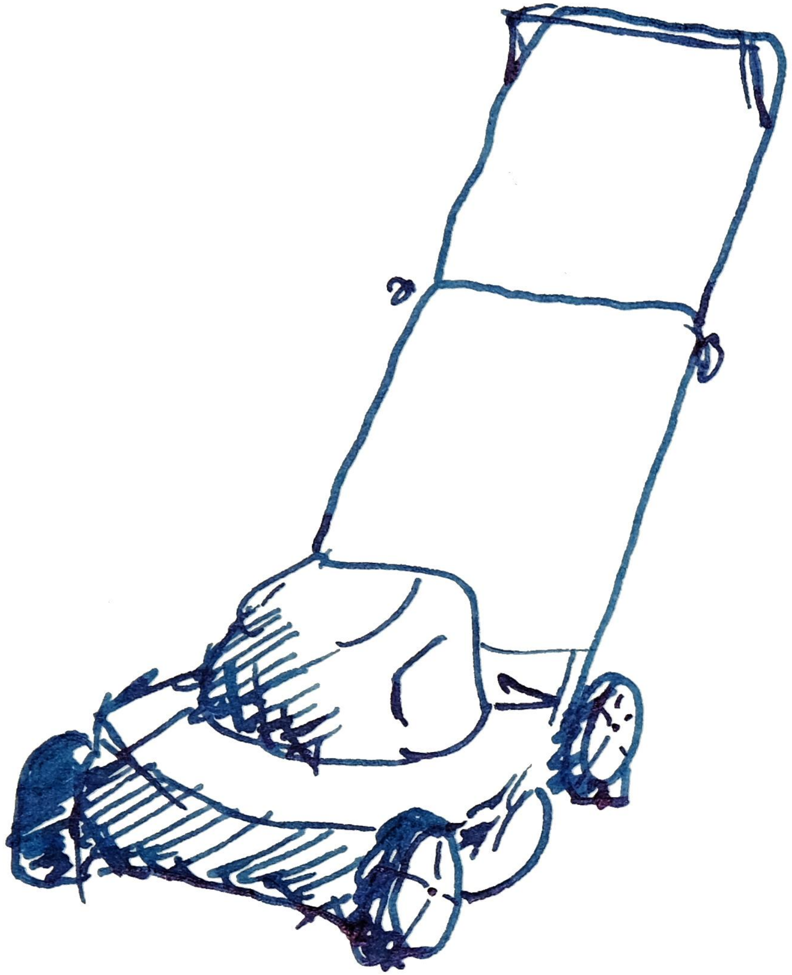




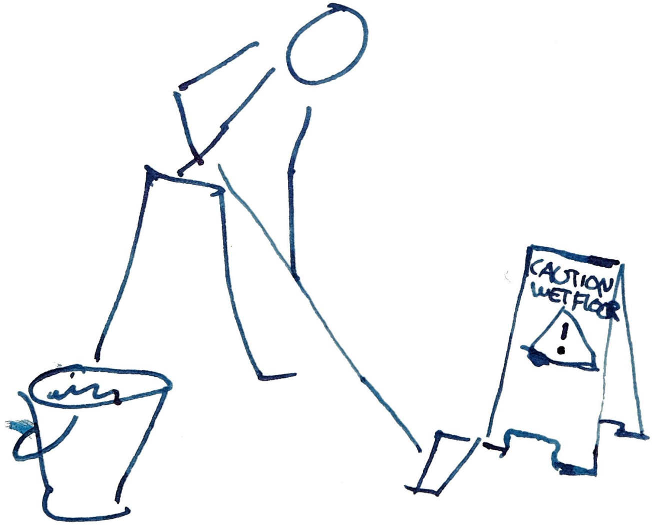


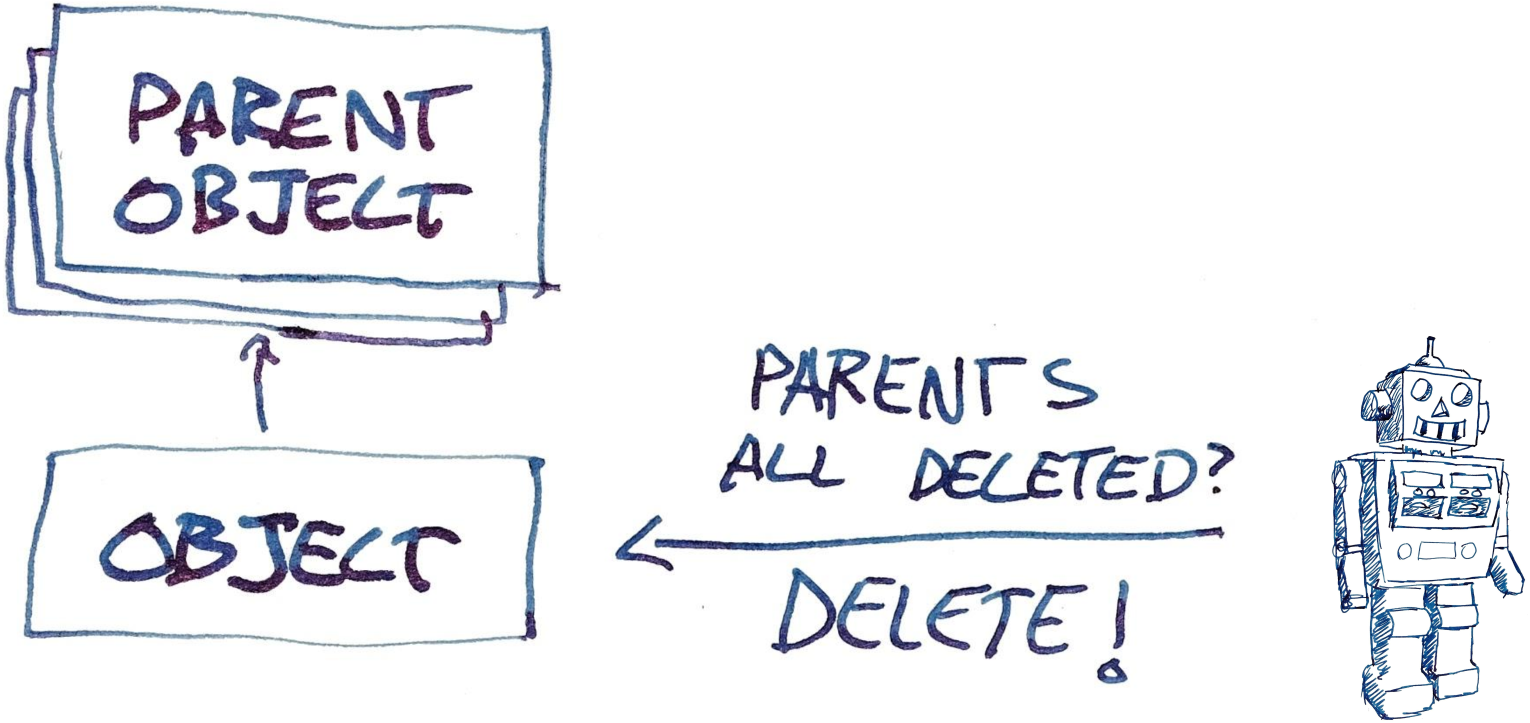
NAMESPACE LIFECYCLE

CLASSIC CONTROLLER



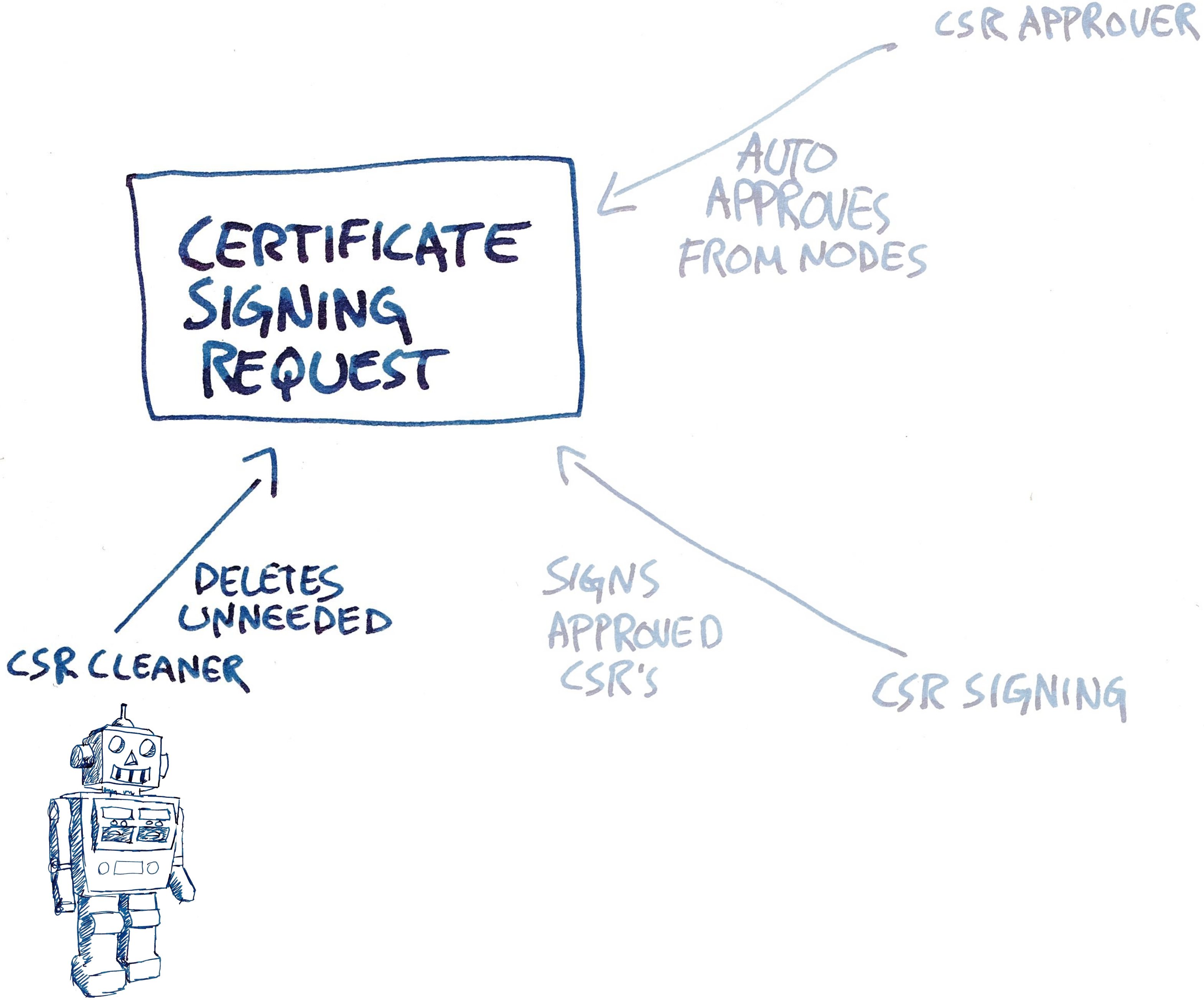
CLASSIC CONTROLLER



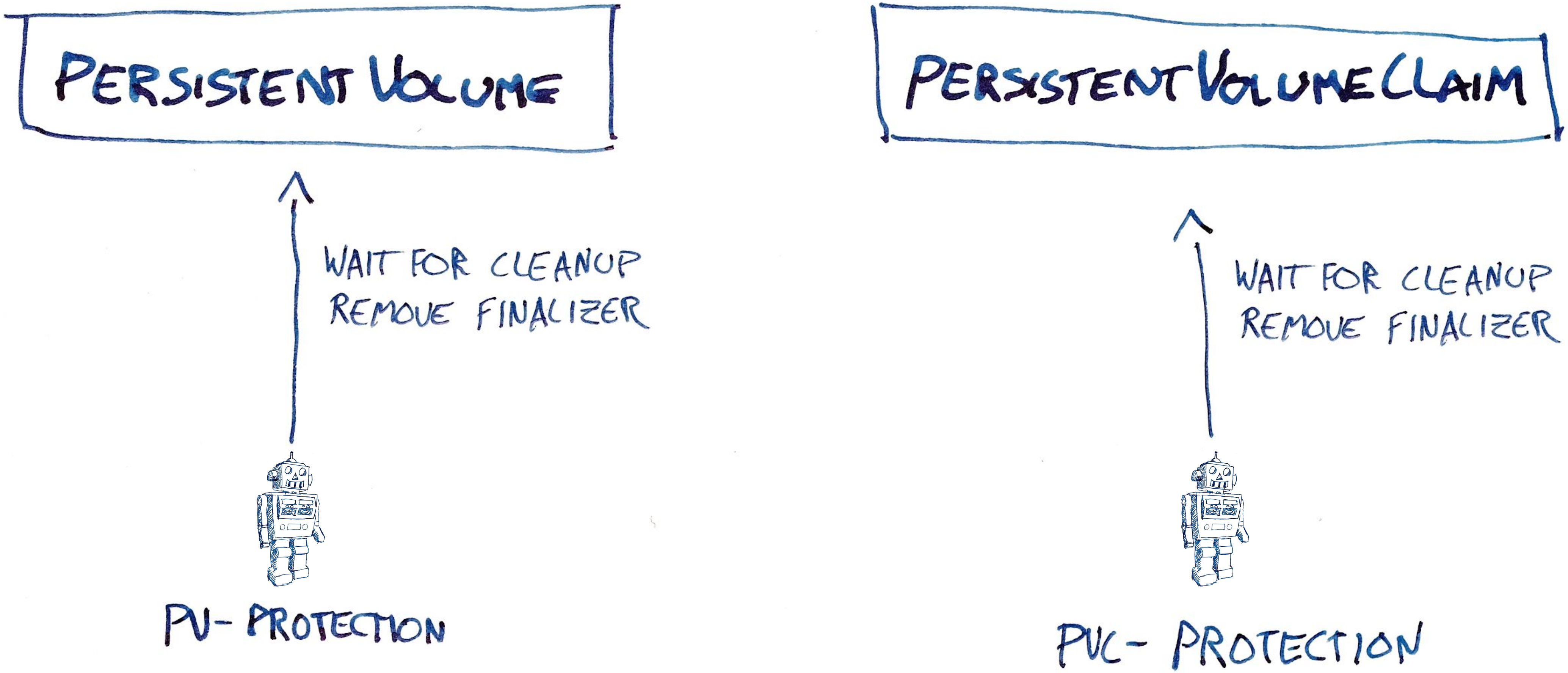


GARBAGE COLLECTOR

CLASSIC CONTROLLER



CLASSIC CONTROLLER


PERSISTENT VOLUME

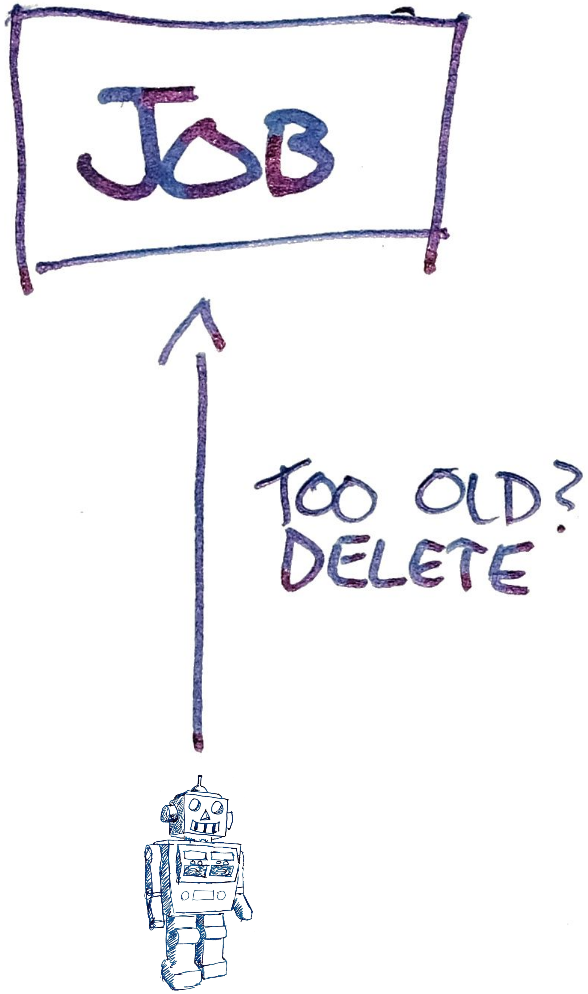
WAIT FOR CLEANUP
REMOVE FINALIZER

PV- PROTECTION

PERSISTENT VOLUME CLAIM

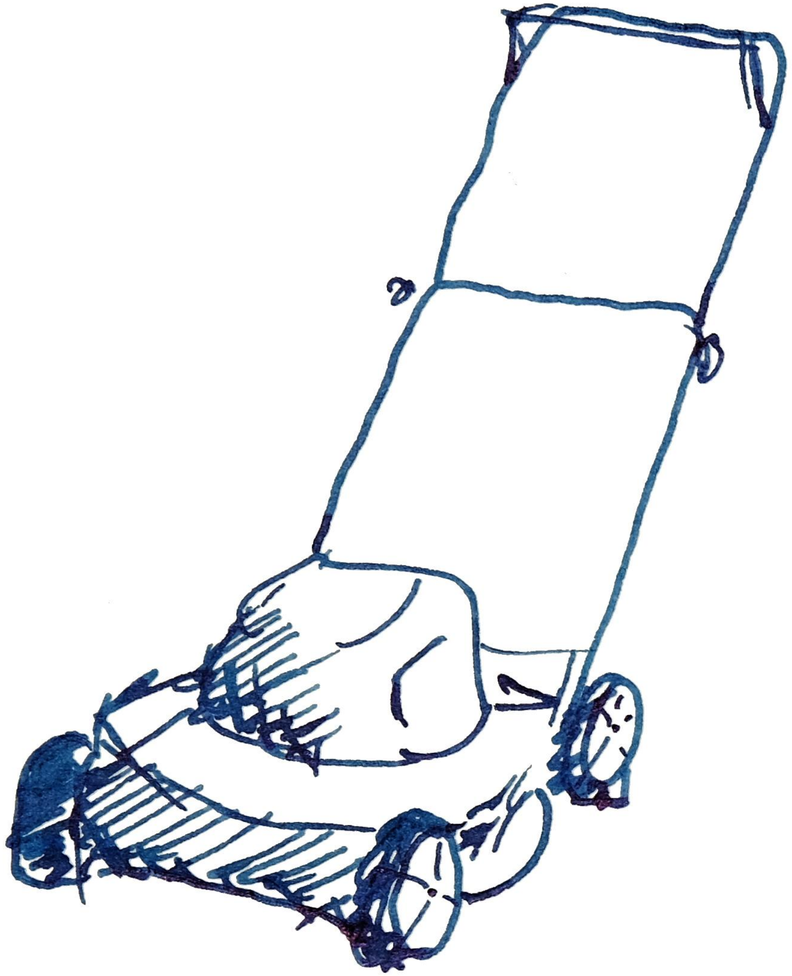
WAIT FOR CLEANUP
REMOVE FINALIZER

PVC- PROTECTION

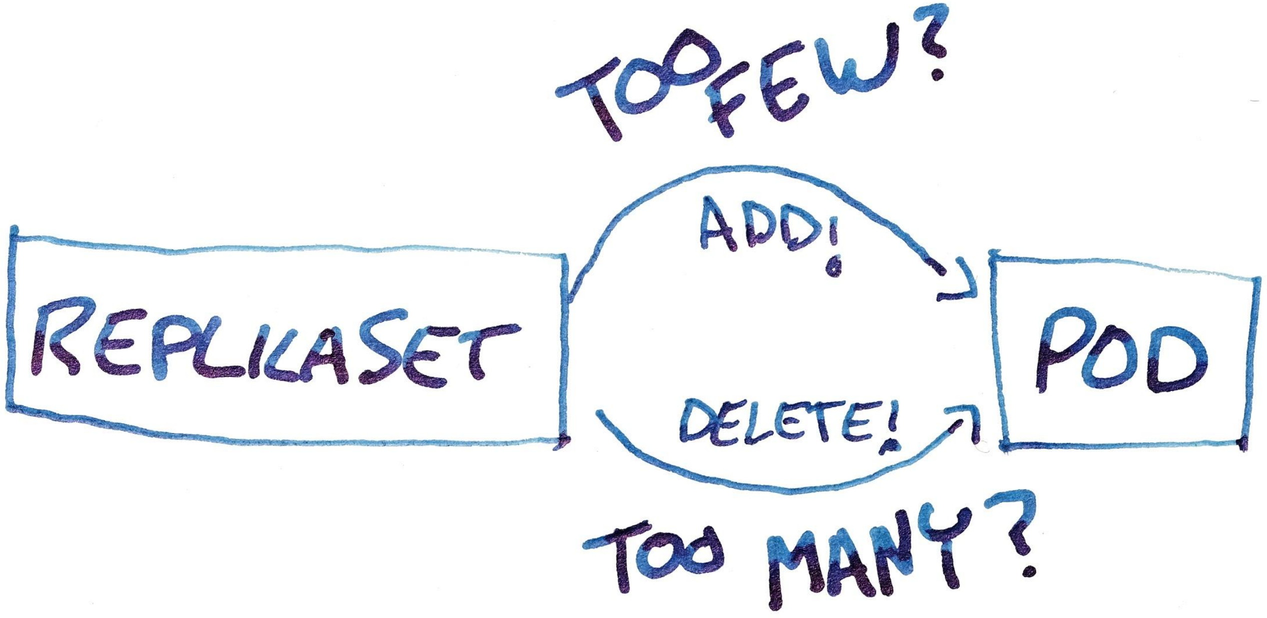


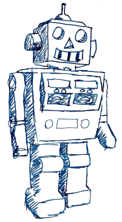
TTL-AFTER-FINISHED

CLASSIC CONTROLLER



CLASSIC CONTROLLER





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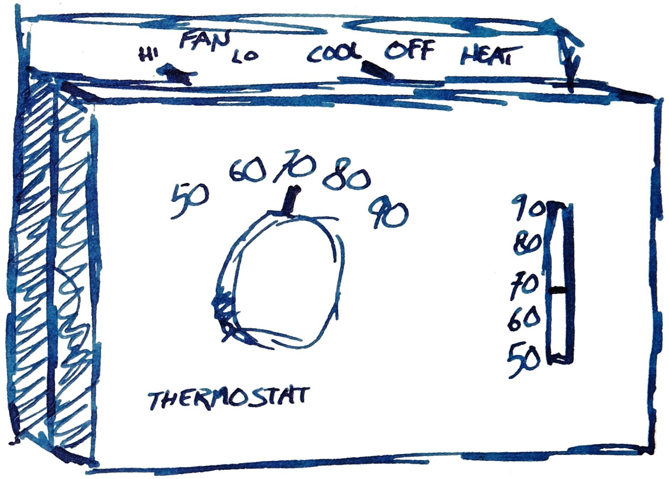
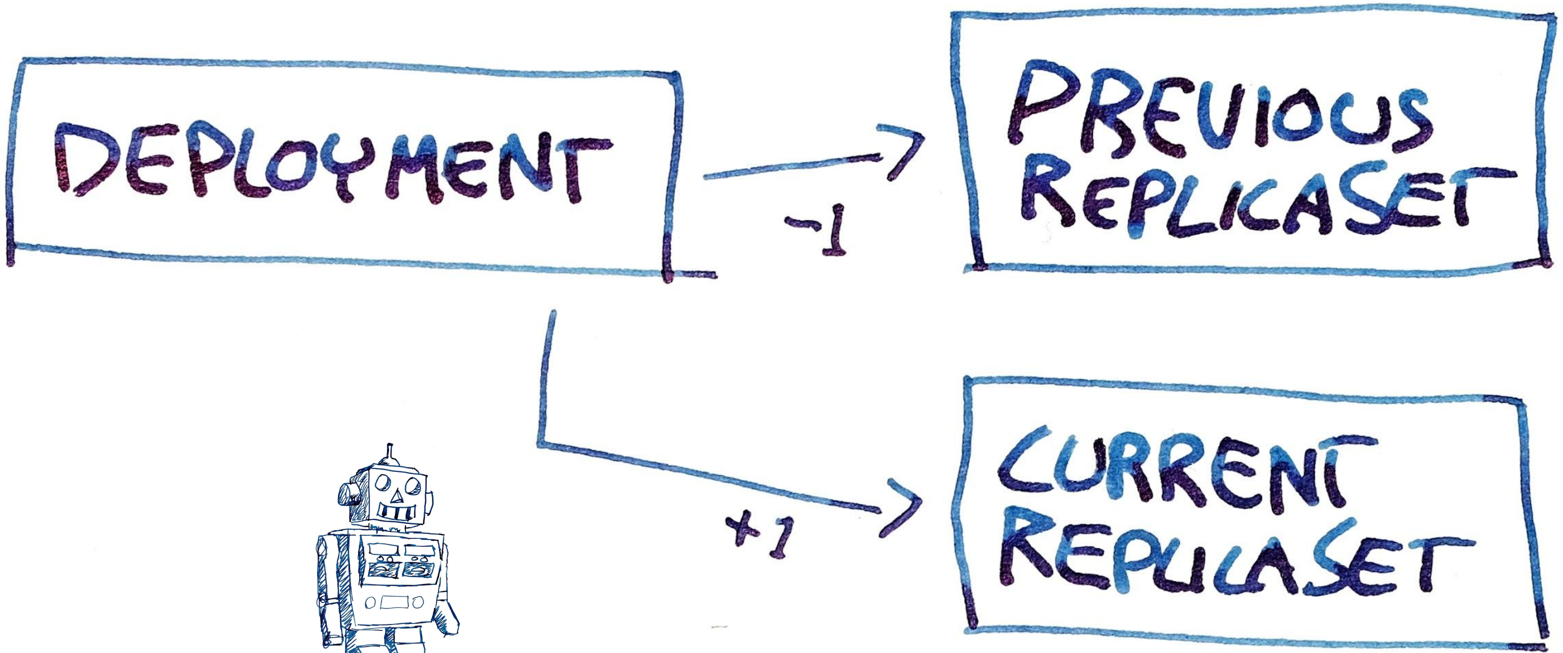
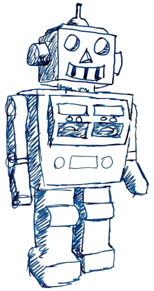
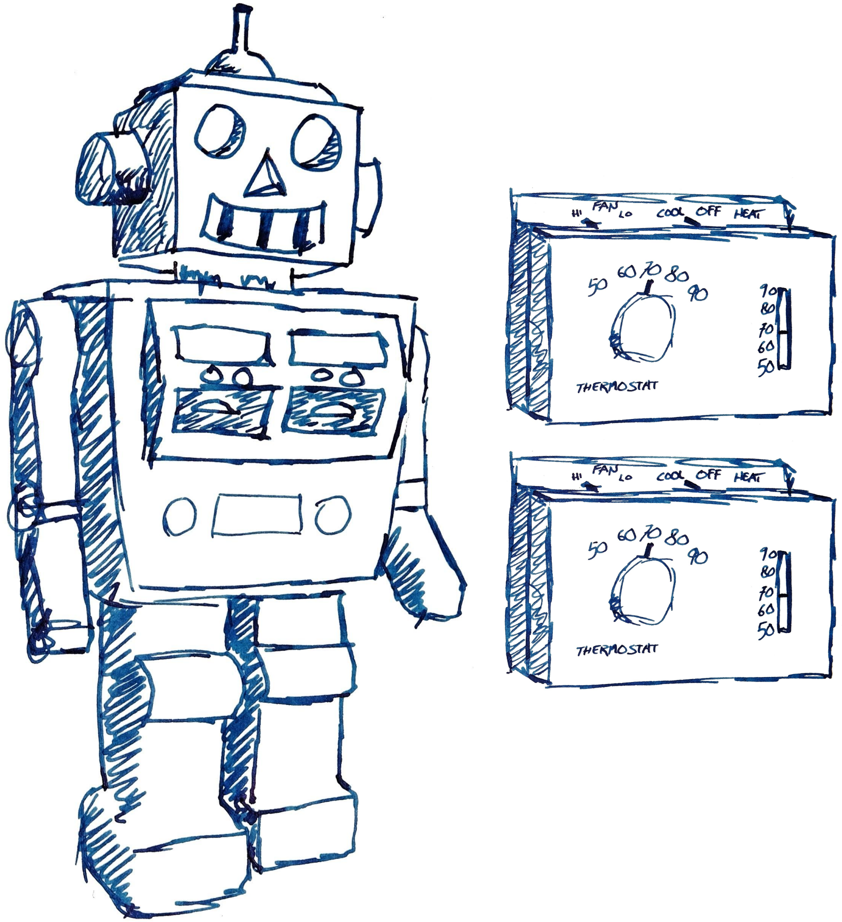


CLASSIC CONTROLLER





DEPLOYMENT



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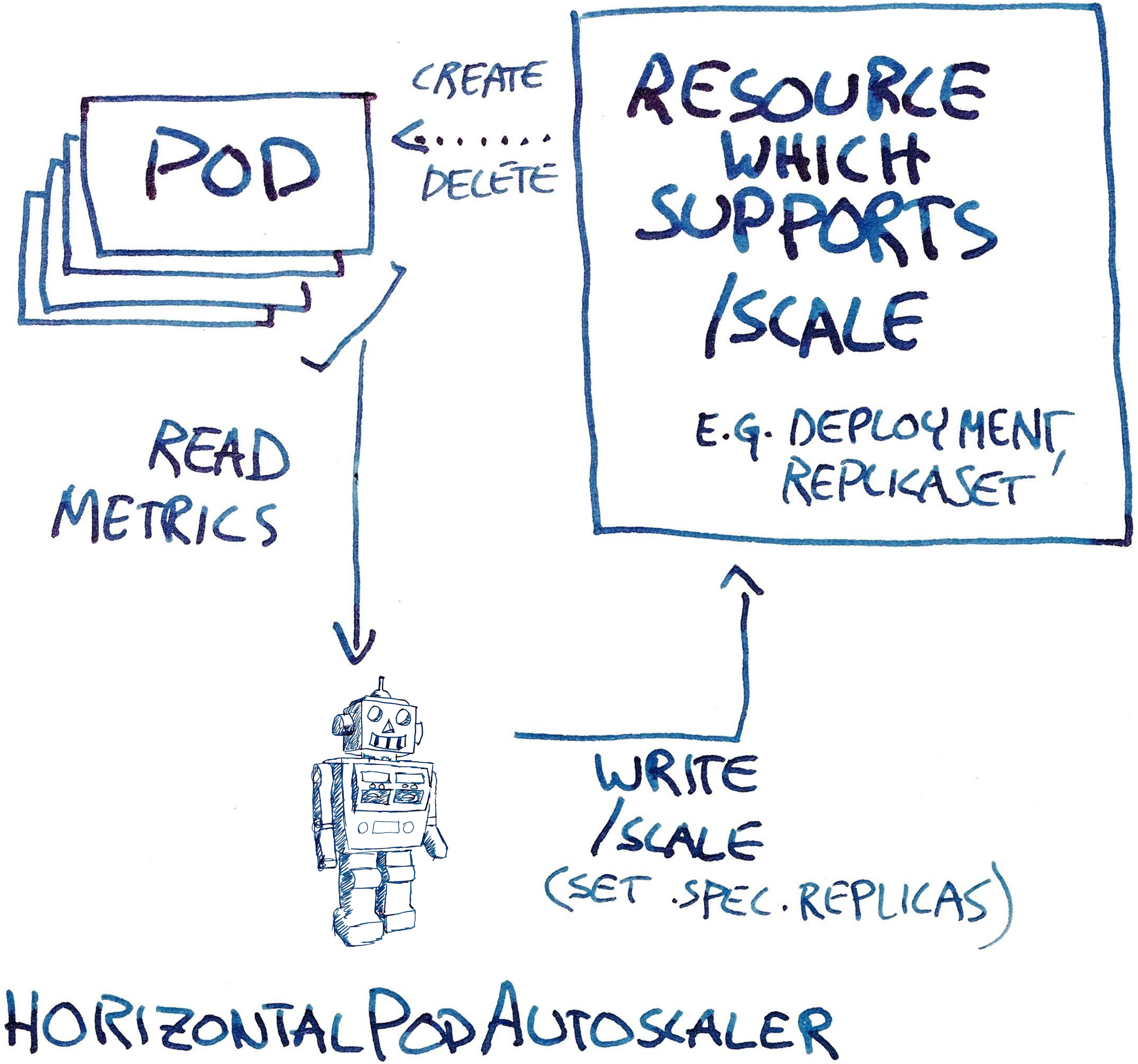

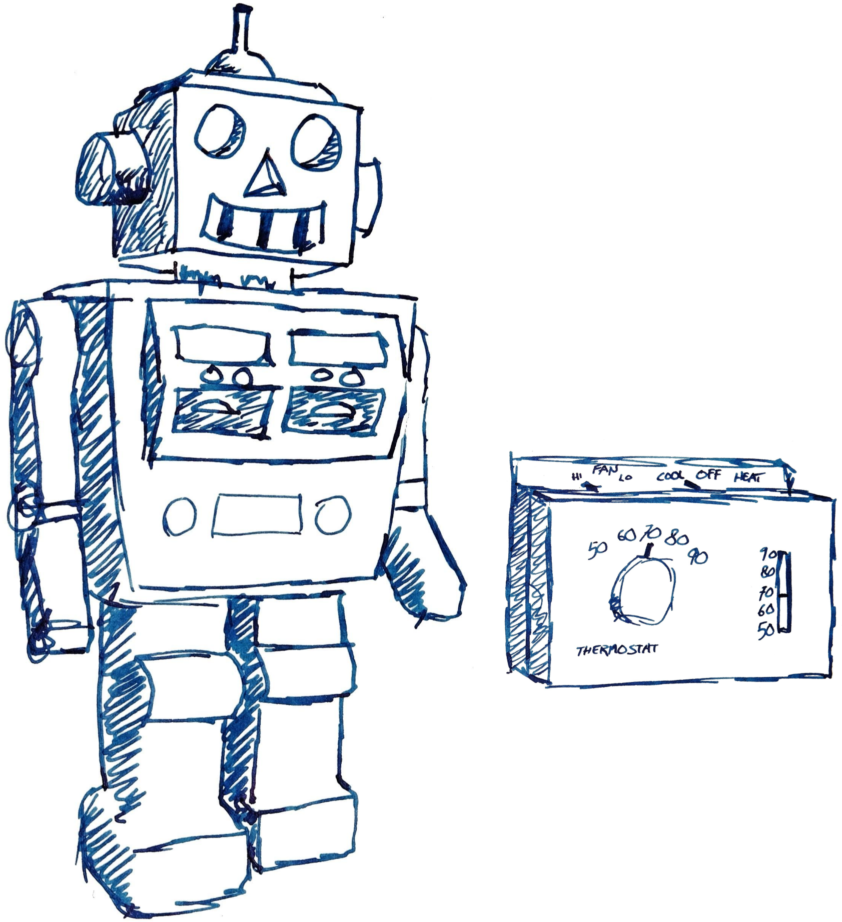

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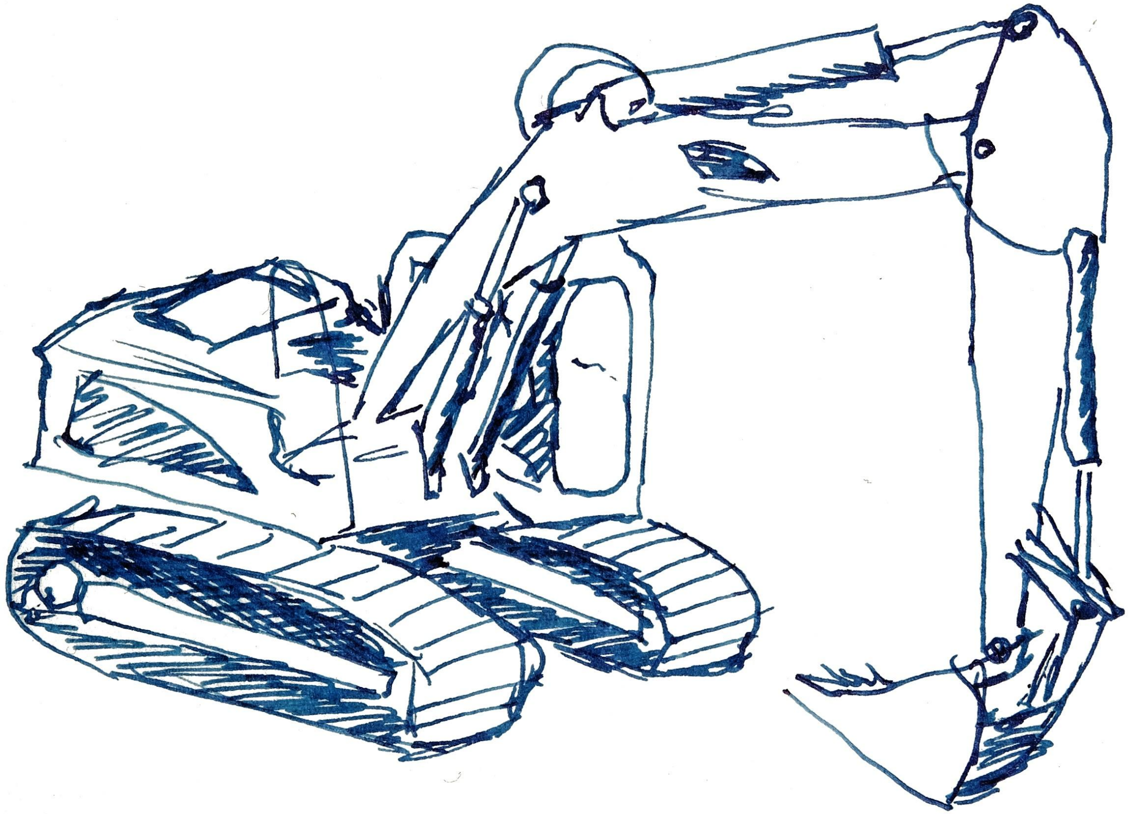
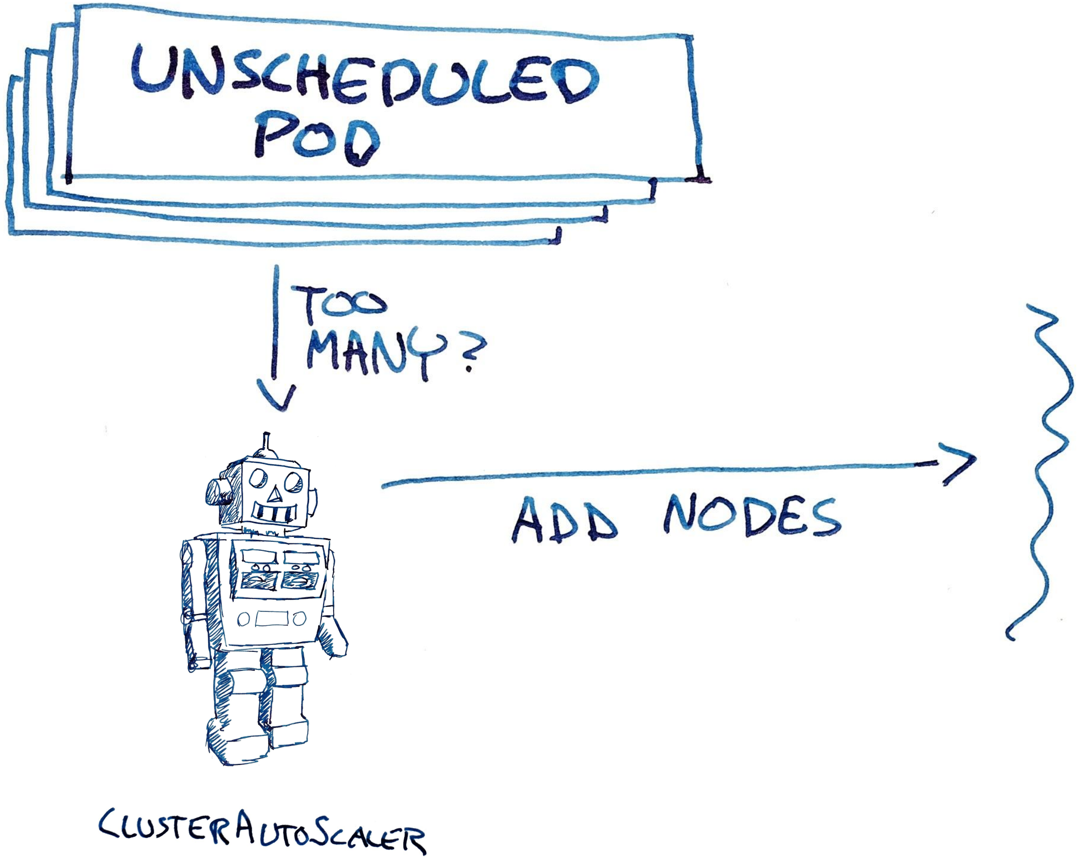
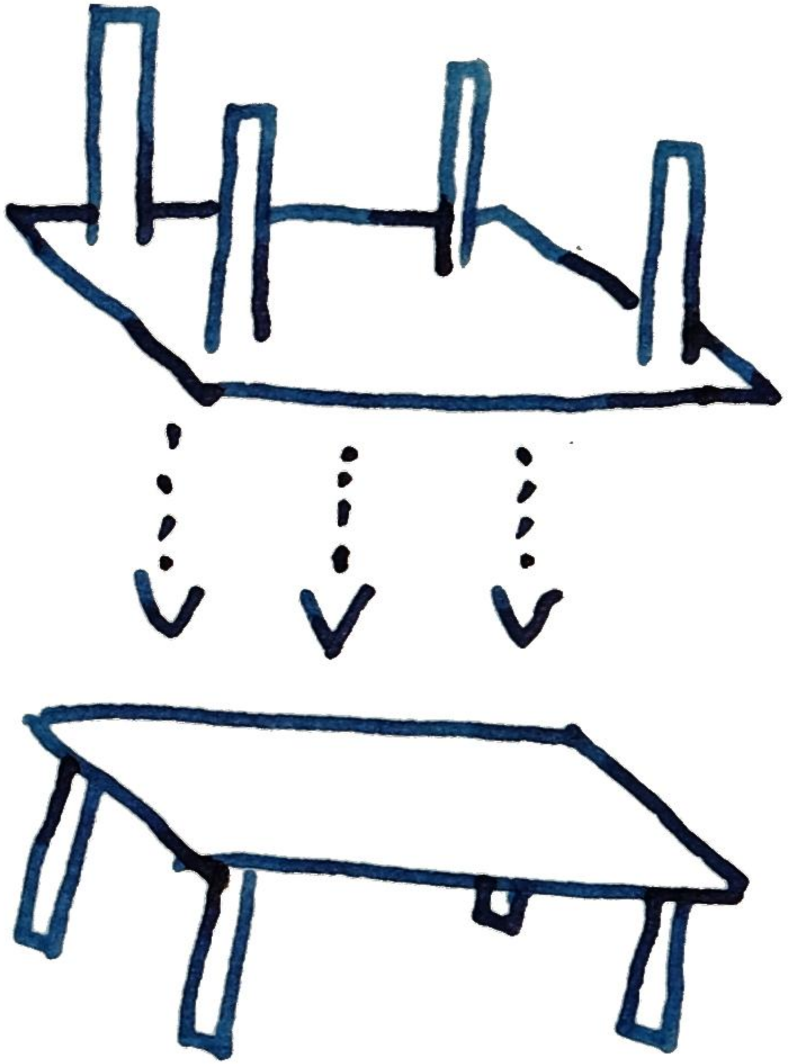


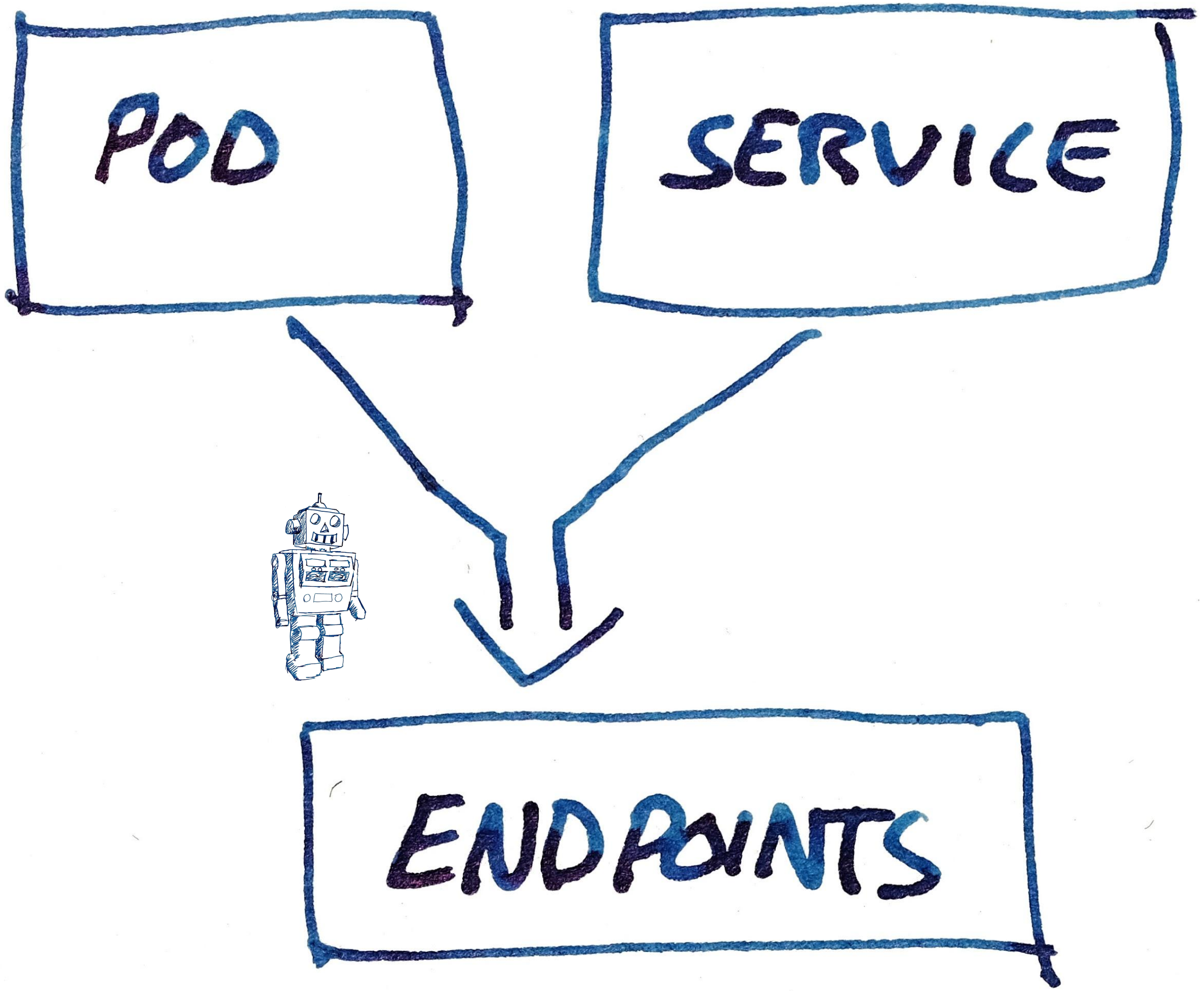


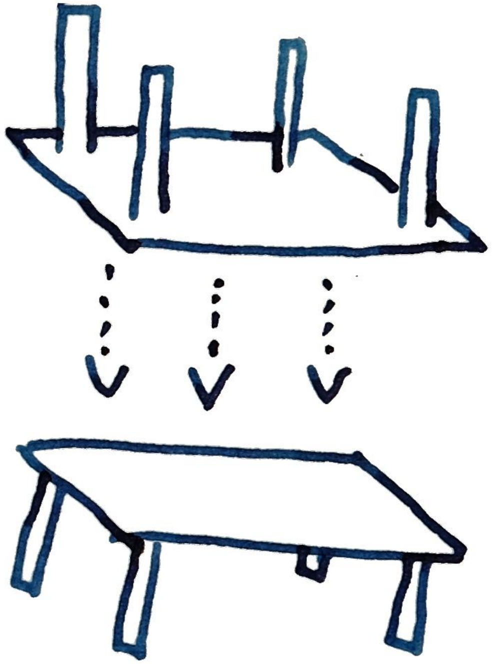
CLOUD PROVIDER

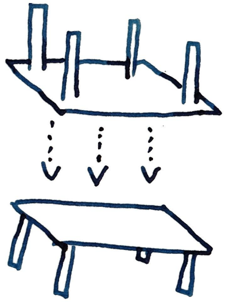
STANDING QUERY TABLE JOIN



STANDING QUERY
TABLE JOIN







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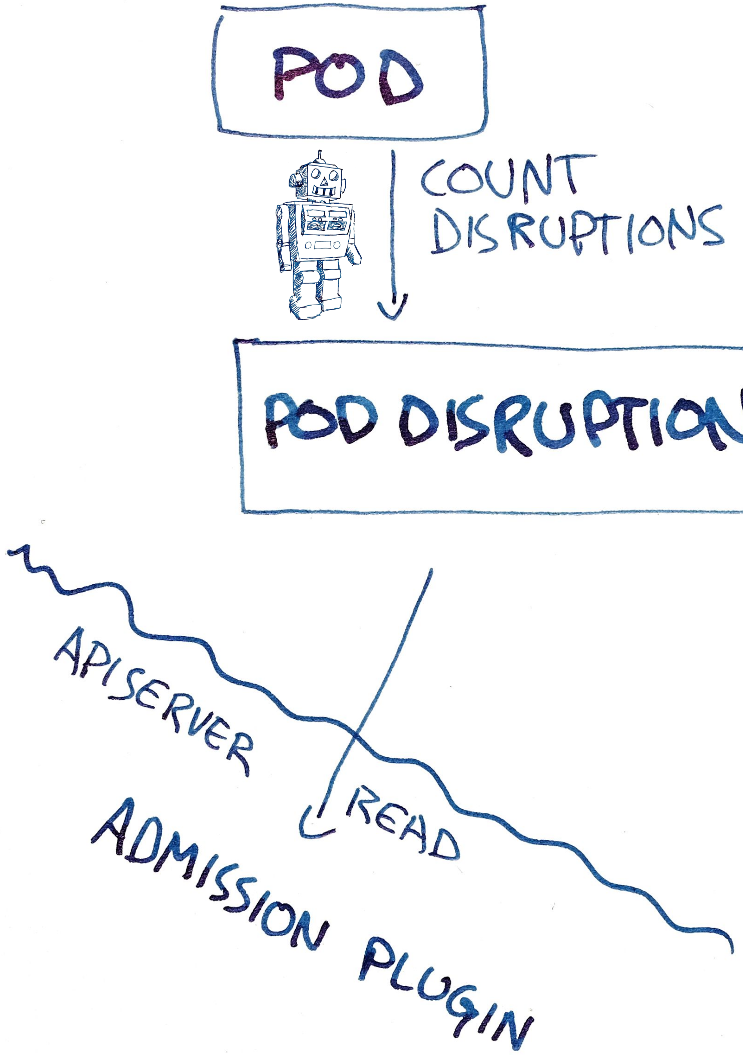

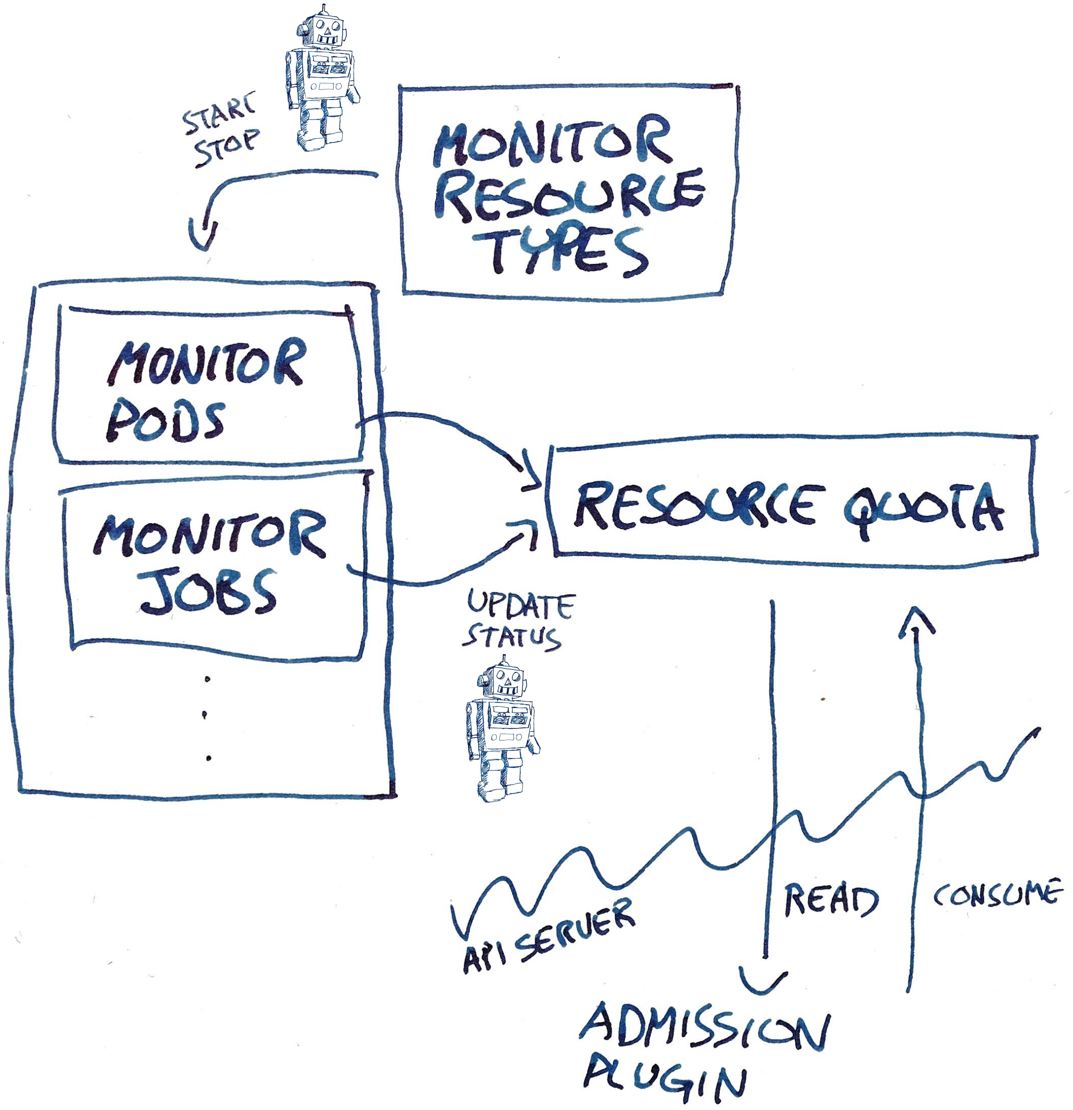

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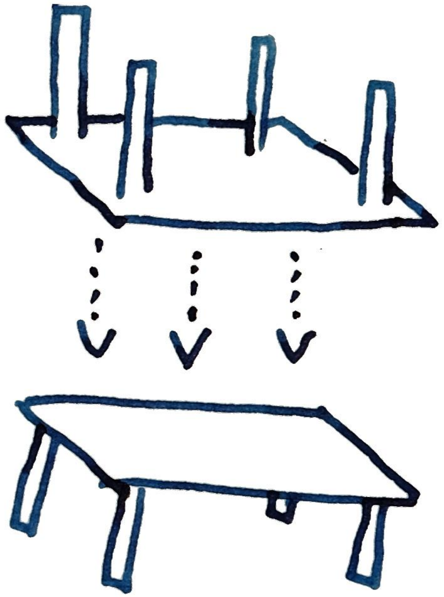

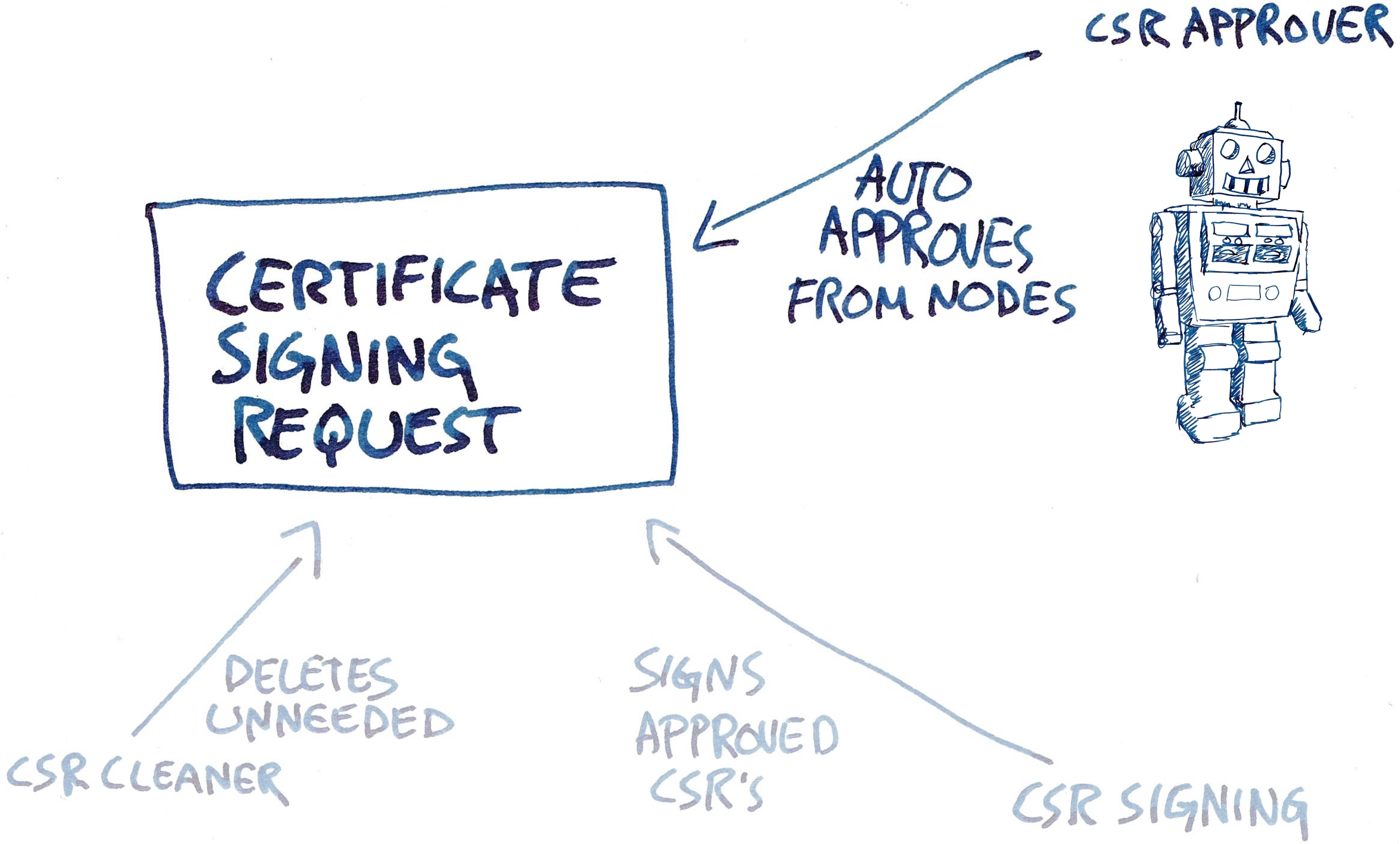

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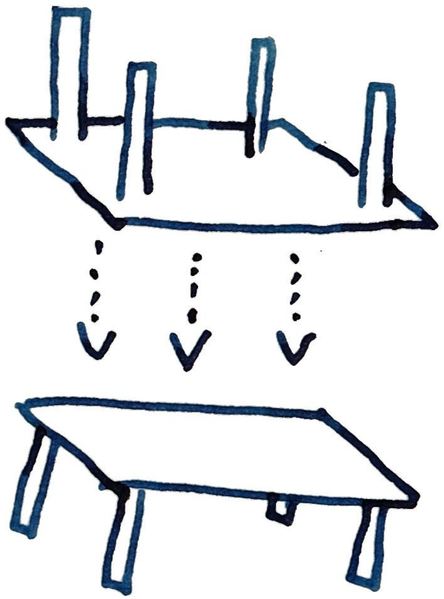
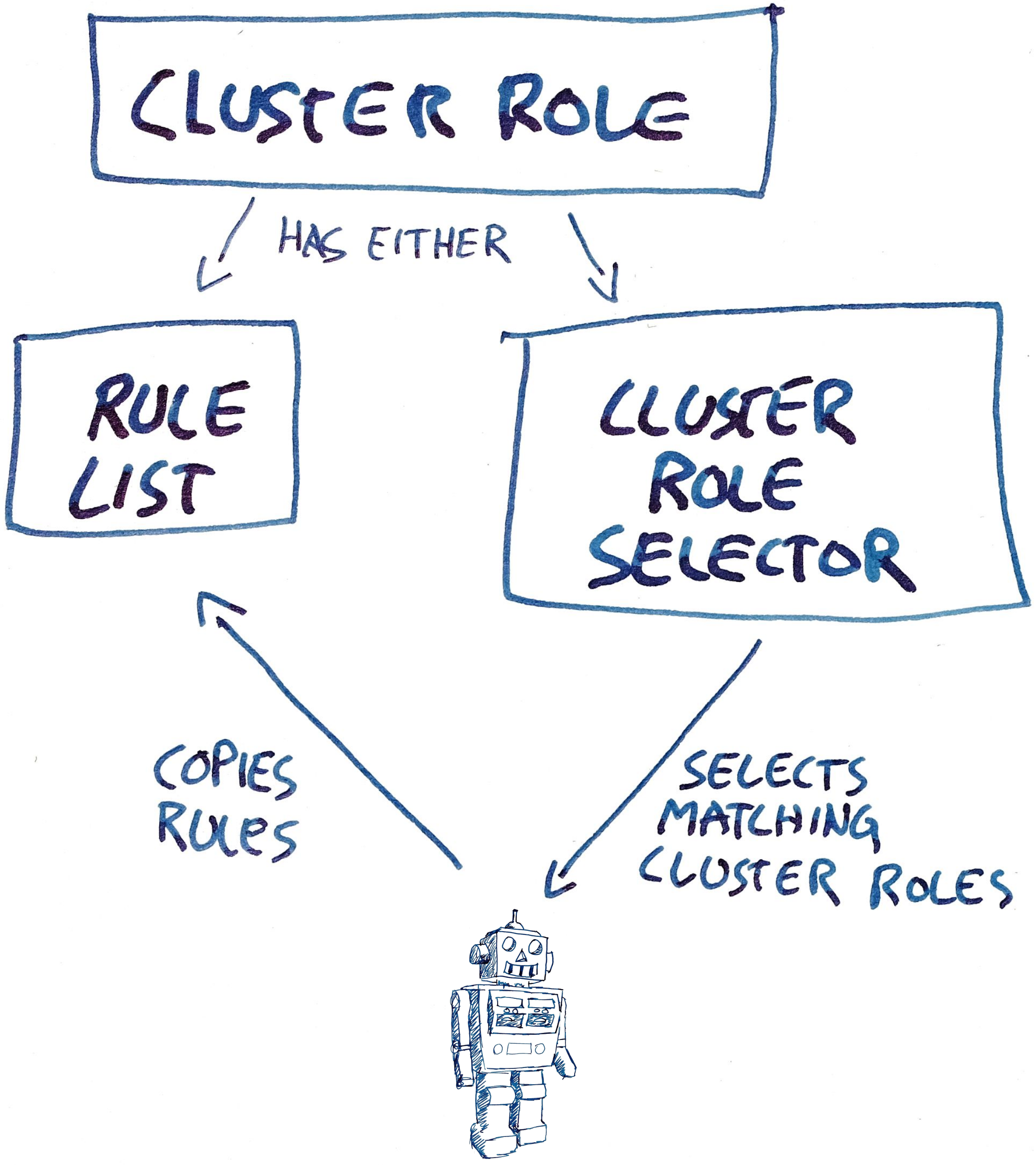


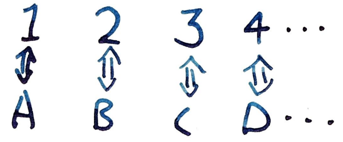


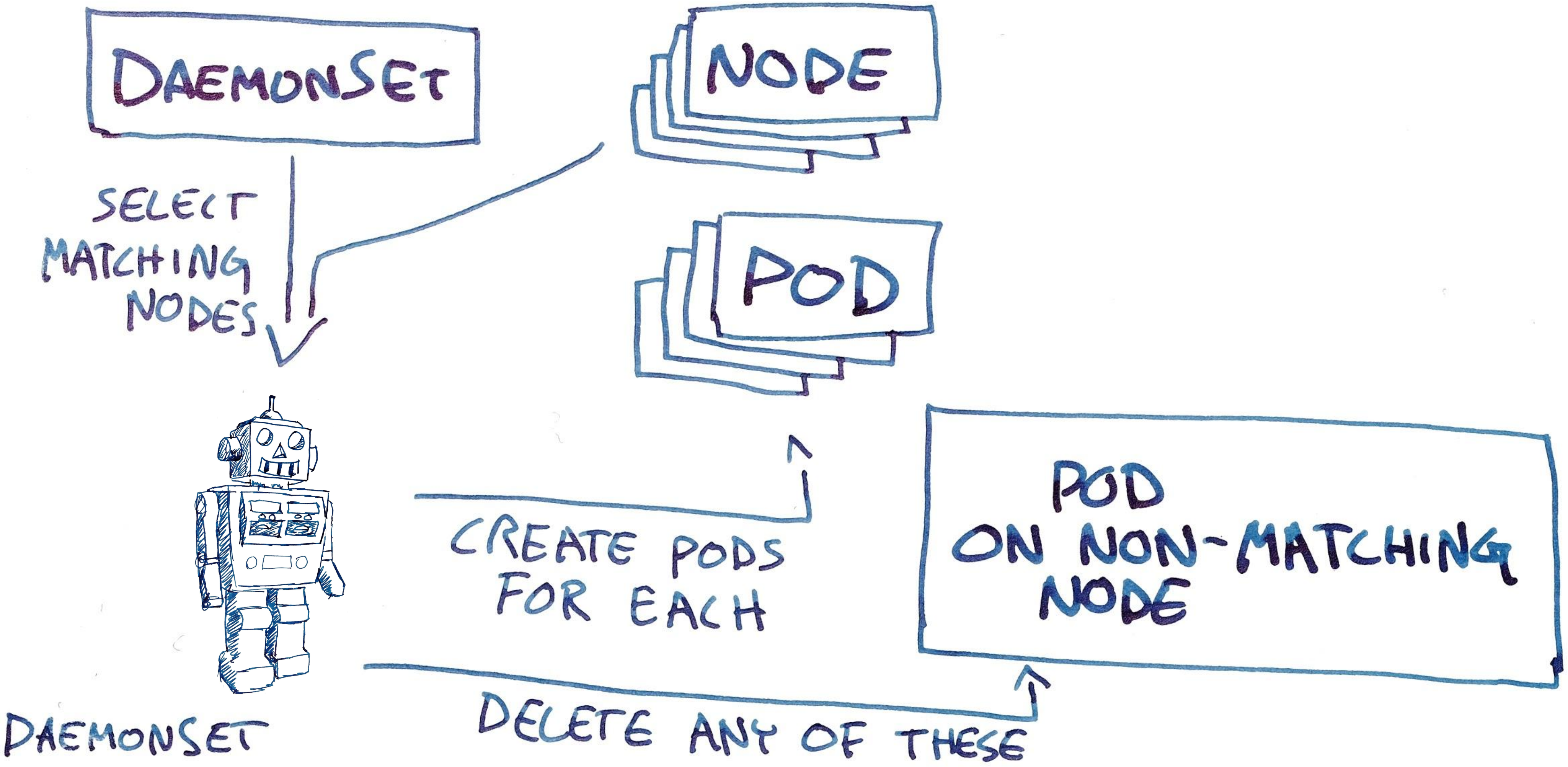
CLUSTER ROLE - AGGREGATION

$\overset{\text{IN}}{\text{BI}}$JECTION ENFORCER

$$\begin{tikzcd}
1 \arrow[d, leftrightarrow] & 2 \arrow[d, Leftrightarrow] & 3 \arrow[d, Leftrightarrow] & 4 \arrow[d, Leftrightarrow] & \cdots \\
A & B & C & D & \cdots
\end{tikzcd}$$

$\overset{\text{IN}}{\text{BI}}$JECTION ENFORCER

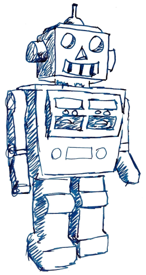




$^{\text{IN}}_{\text{BI}}$JECTION ENFORCER

1	2	3	4 ...
↕	⇕	⇕	⇕
A	B	C	D ...

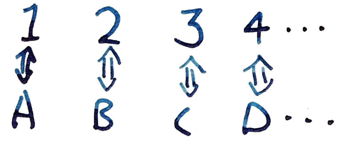
SERVICE ACCOUNT

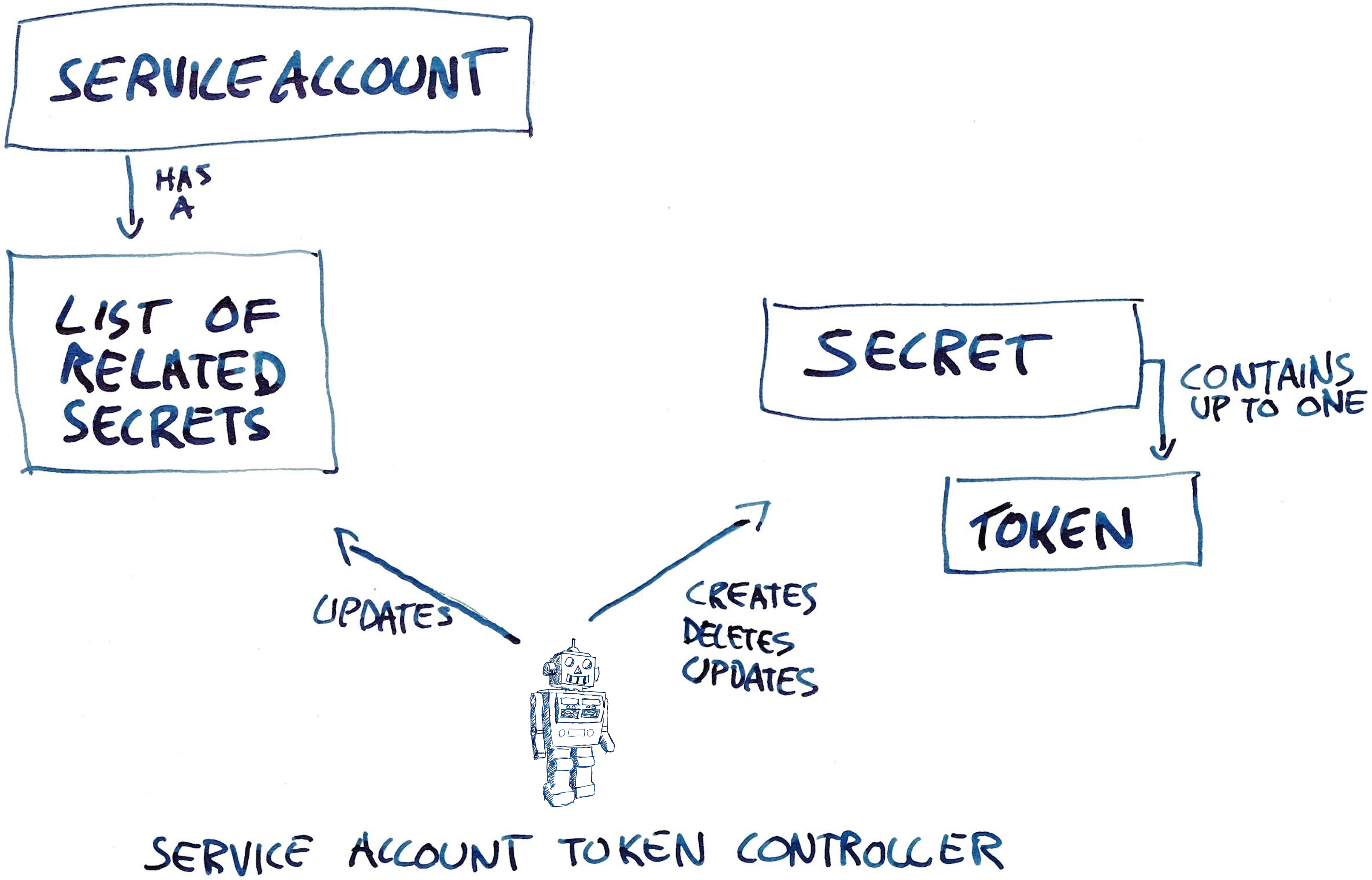


MAKE DEFAULT ← FROM CONFIG? NO! "DEFAULT"

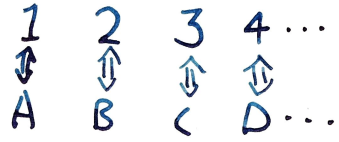
NAMESPACE → SERVICE ACCOUNT

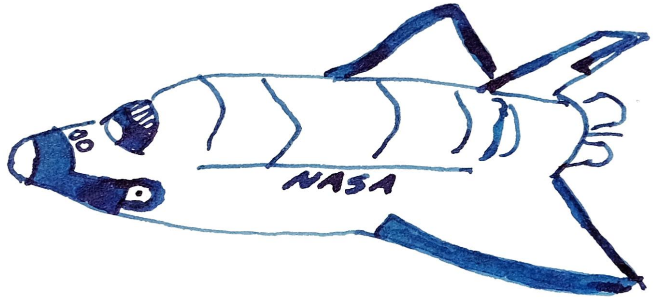
IN BIJECTION ENFORCER



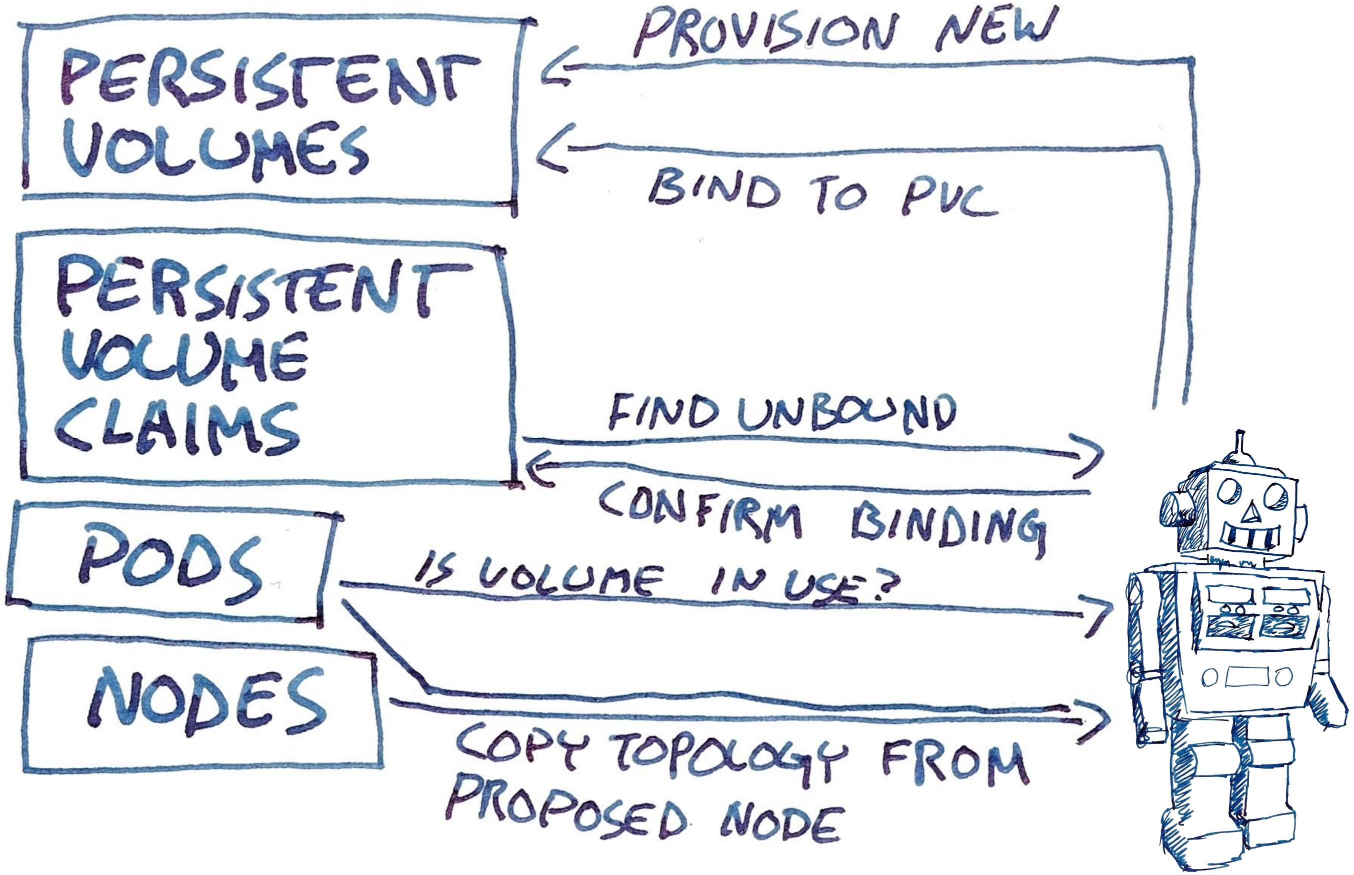


$^{\text{IN}}_{\text{BI}}$JECTION ENFORCER





// KEEP THE SPACE SHUTTLE FLYING

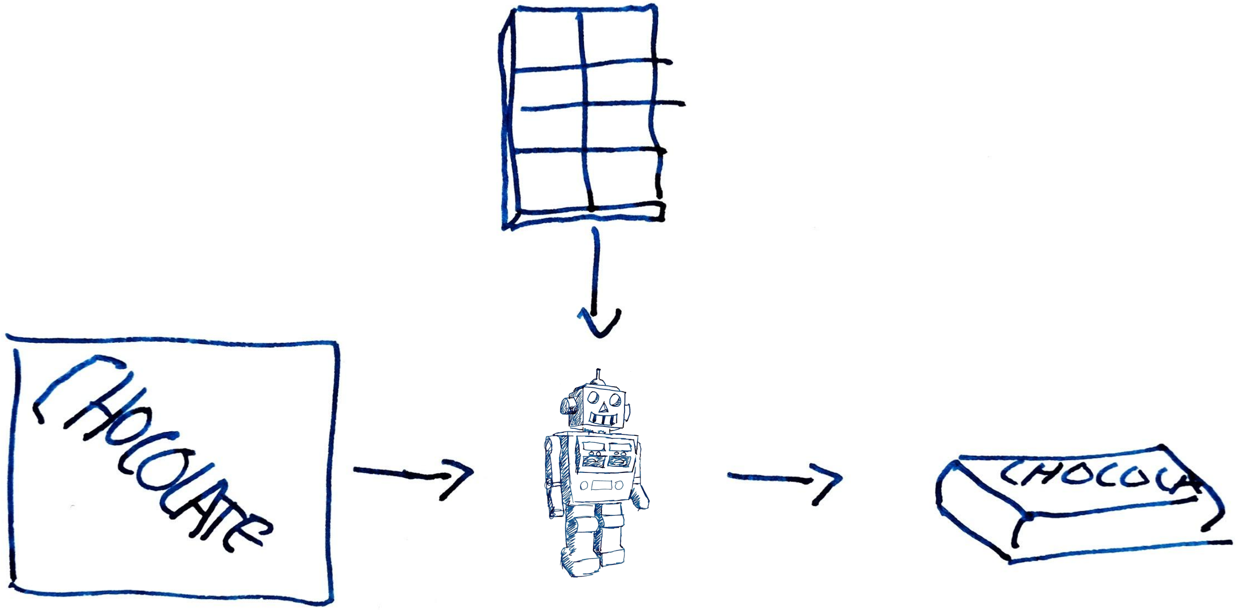


PERSISTENTVOLUME-BINDER

IN

BIJECTION ENFORCER

$$\begin{array}{cccc} 1 & 2 & 3 & 4\cdots \\ \updownarrow & \Updownarrow & \Updownarrow & \Updownarrow \\ A & B & C & D\cdots \end{array}$$



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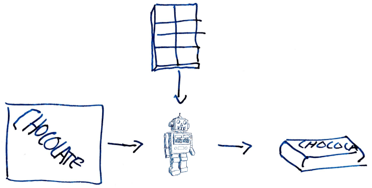

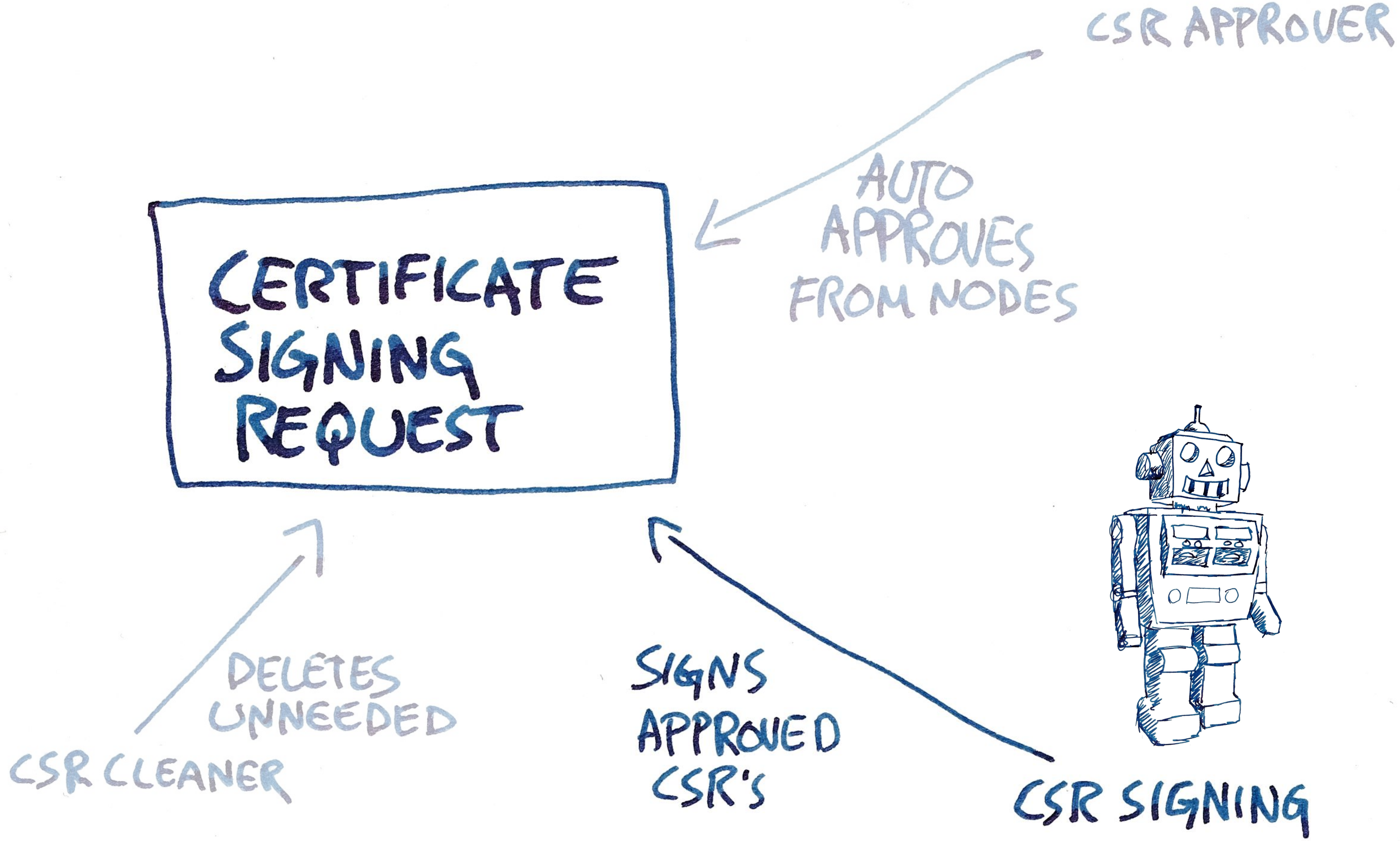

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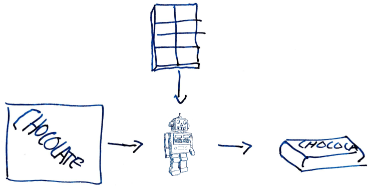
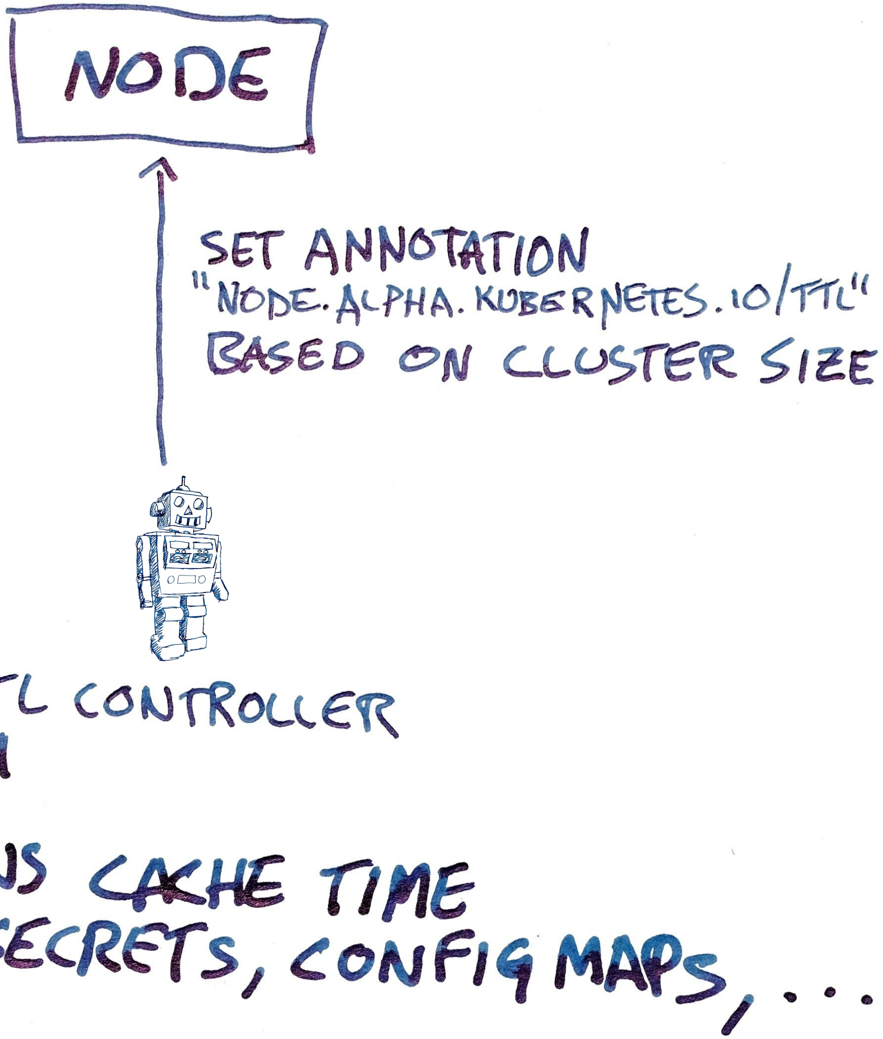


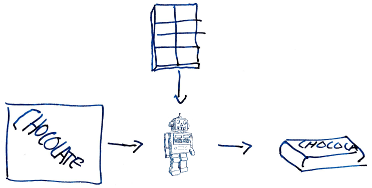

NODE

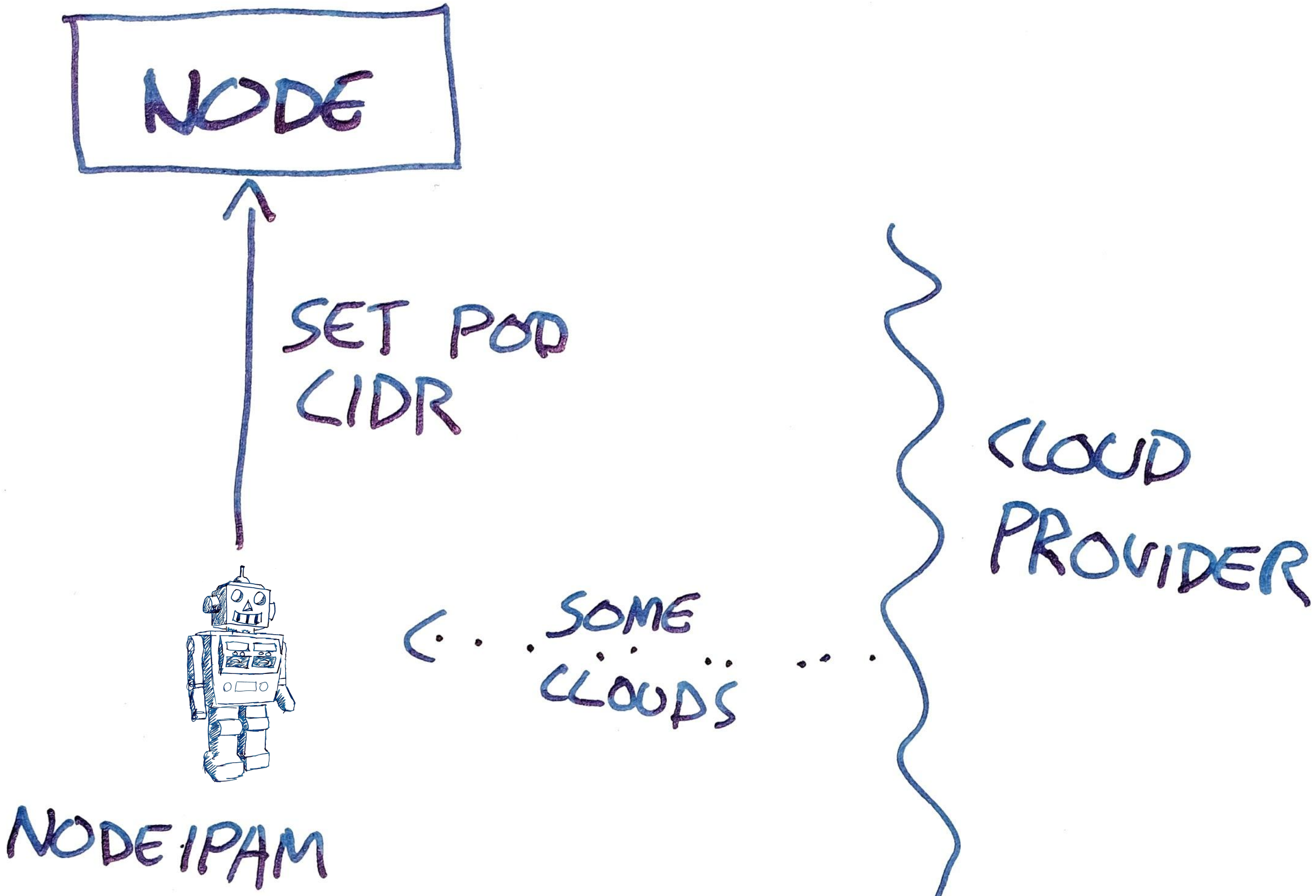
SET ANNOTATION
"NODE.ALPHA.KUBERNETES.IO/TTL"
BASED ON CLUSTER SIZE

TTL CONTROLLER

MEANS CACHE TIME
FOR SECRETS, CONFIG MAPS, ...

IN BIJECTION ENFORCER





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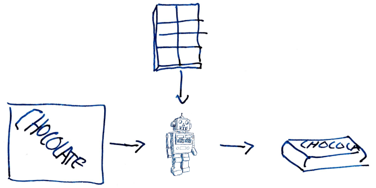
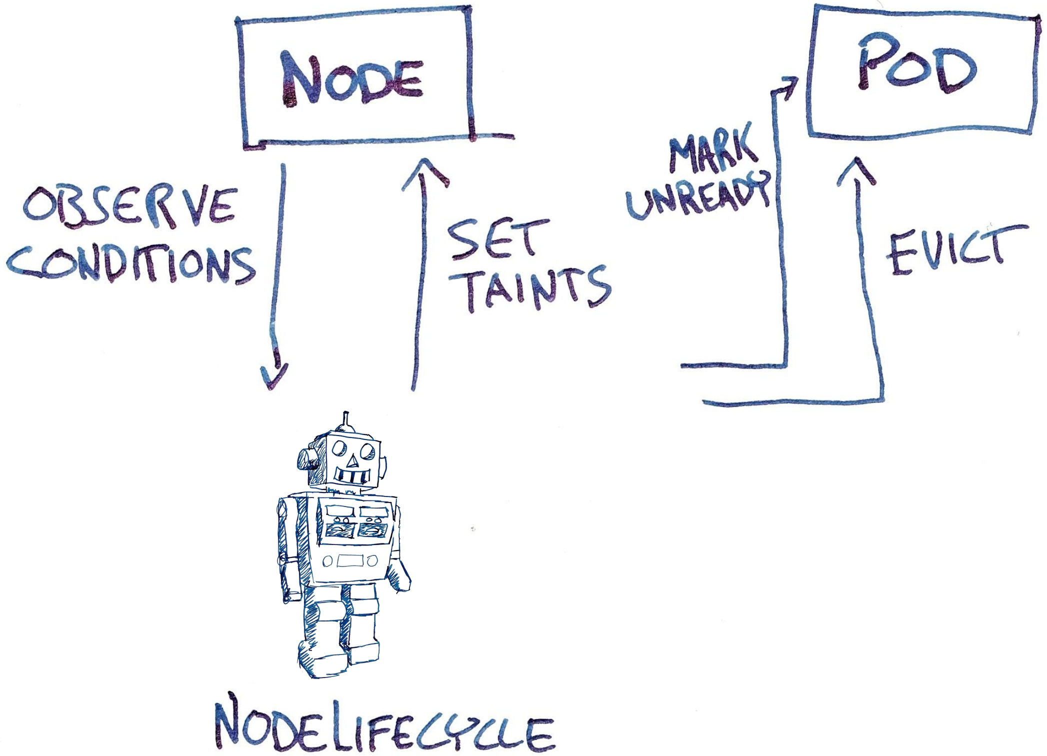
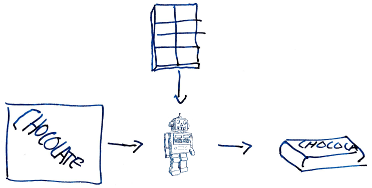
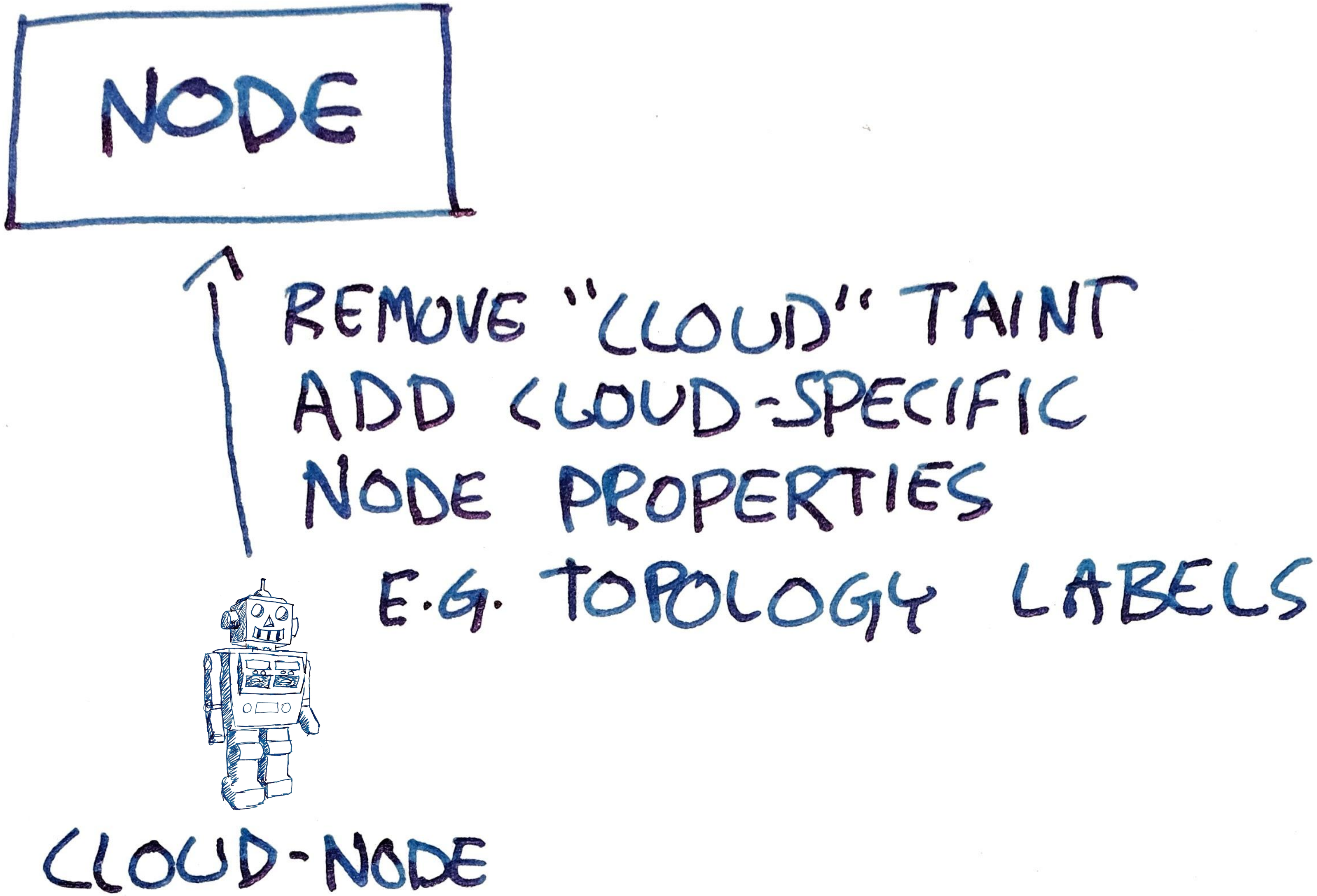




TAKE CHARGE OF THE K8S RESOURCES IF SOMETHING HAPPENS TO KUBELET

IN BIJECTION ENFORCER





NODE

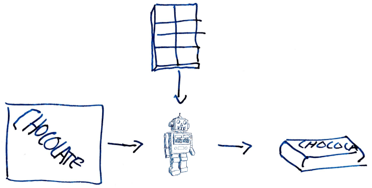
REMOVE "CLOUD" TAINT

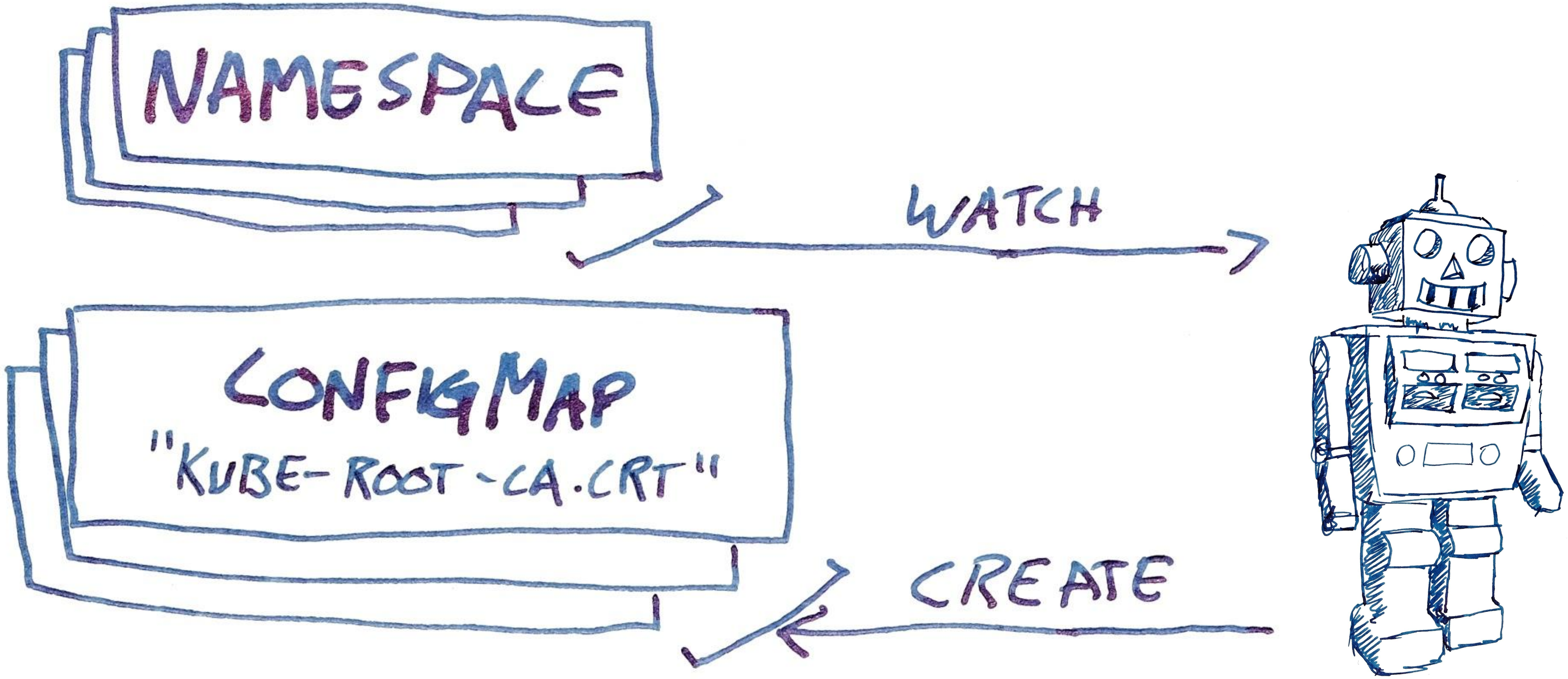
ADD CLOUD-SPECIFIC NODE PROPERTIES

E.G. TOPOLOGY LABELS

CLOUD-NODE

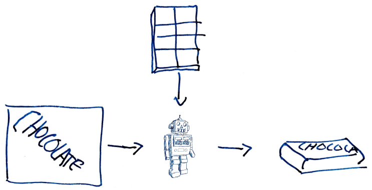
IN BIJECTION ENFORCER

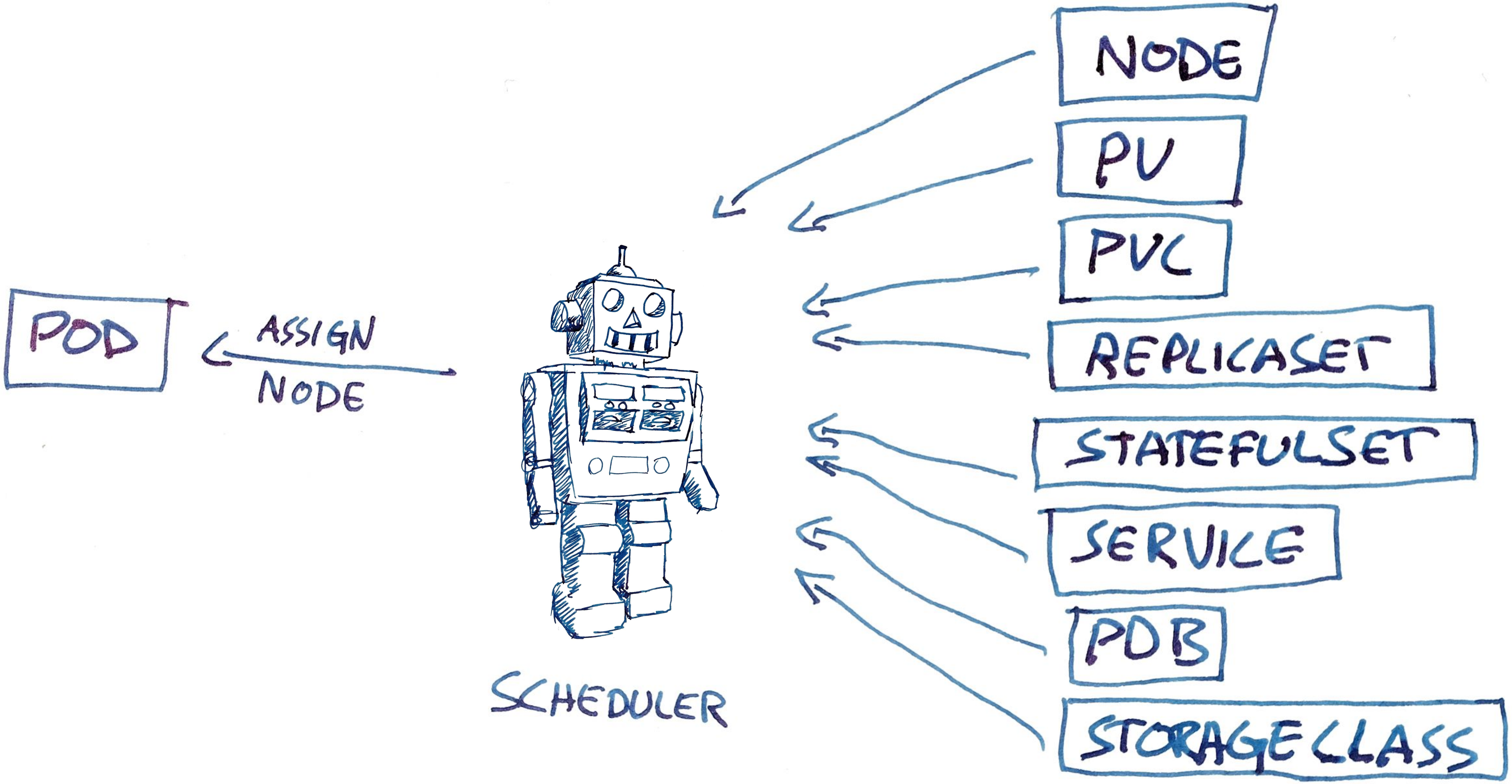




ROOT-CA-CERT-PUBLISHER

IN BIJECTION ENFORCER





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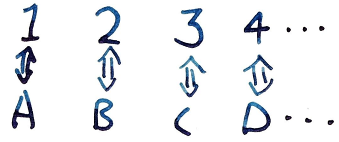

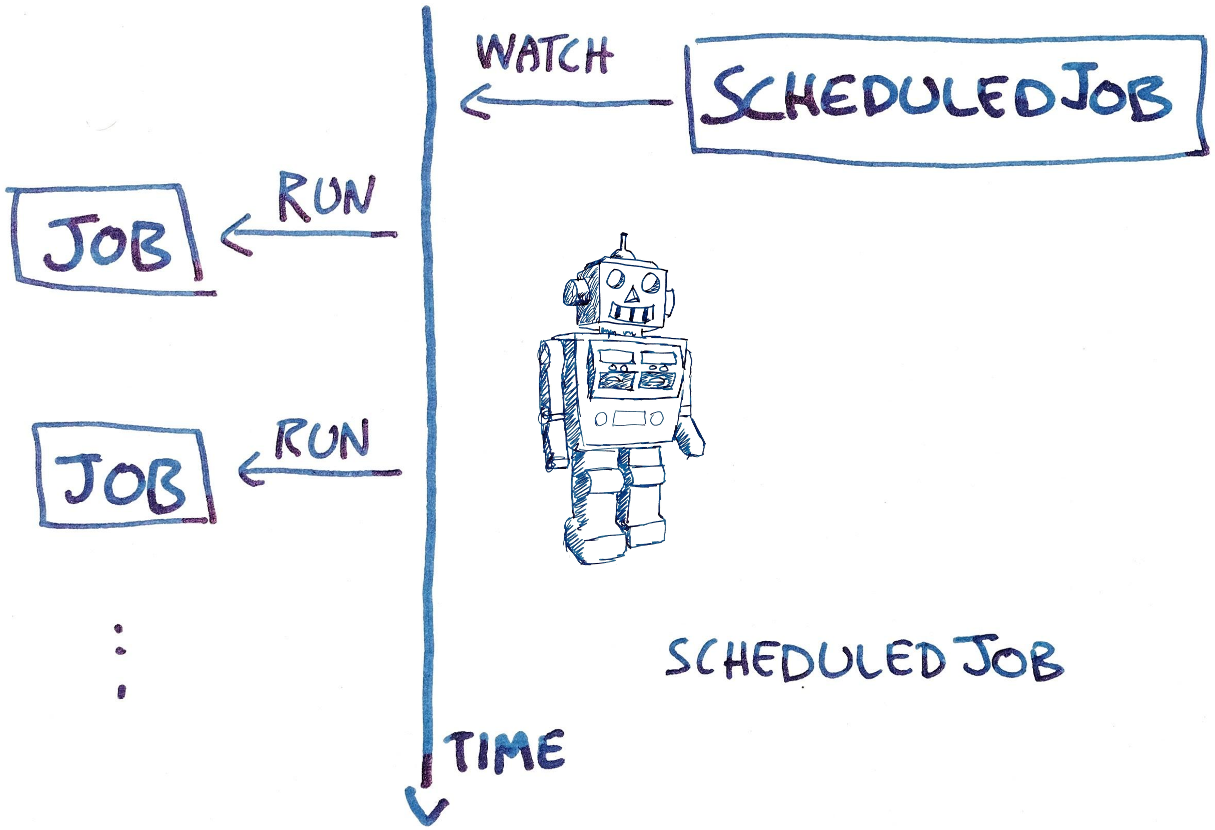

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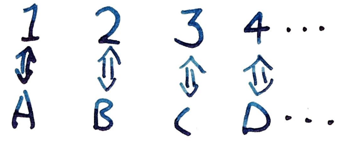
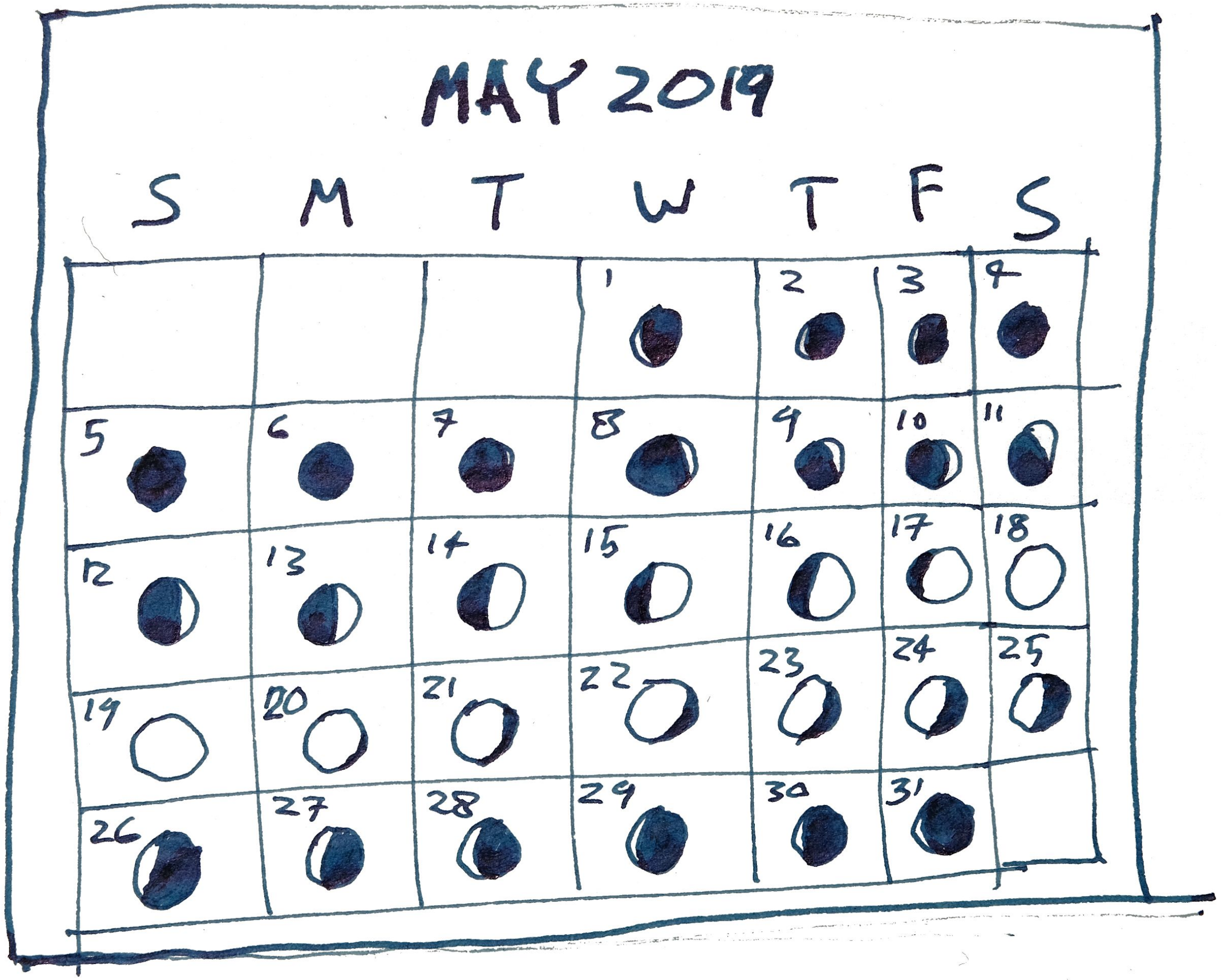
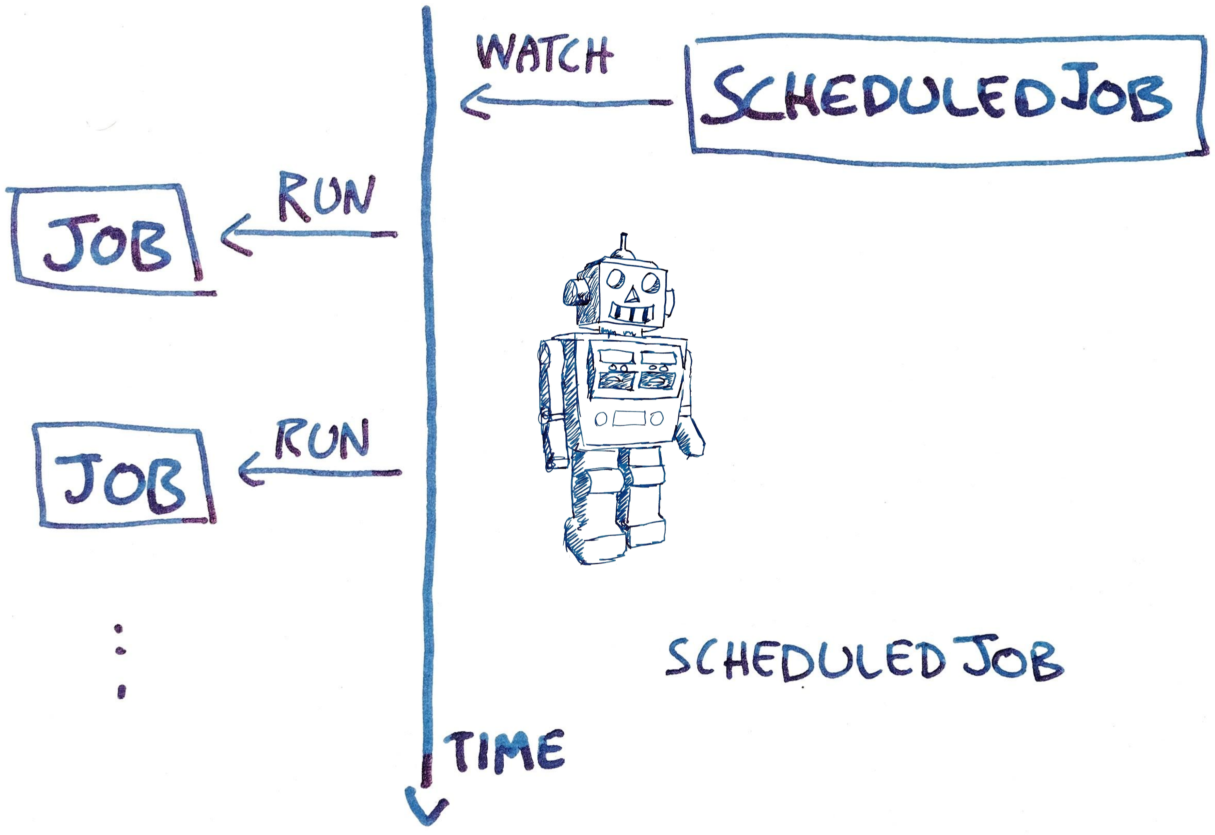




MAY 2019

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	



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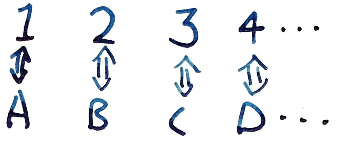
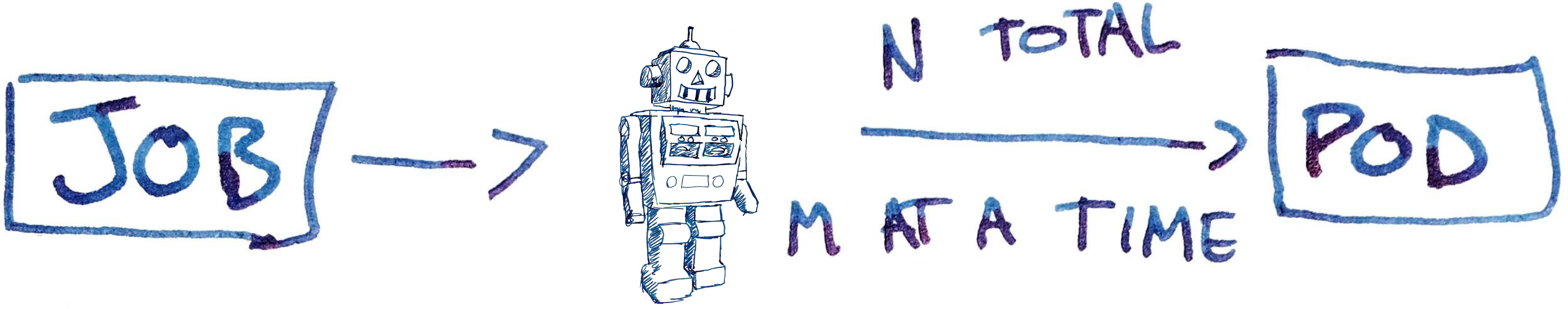
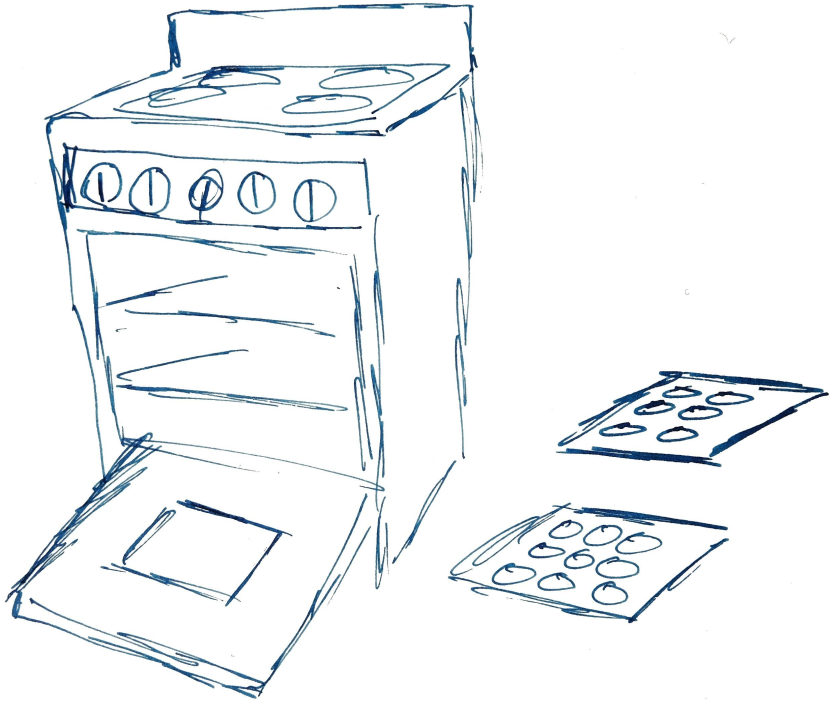


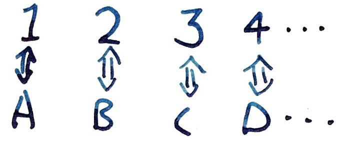


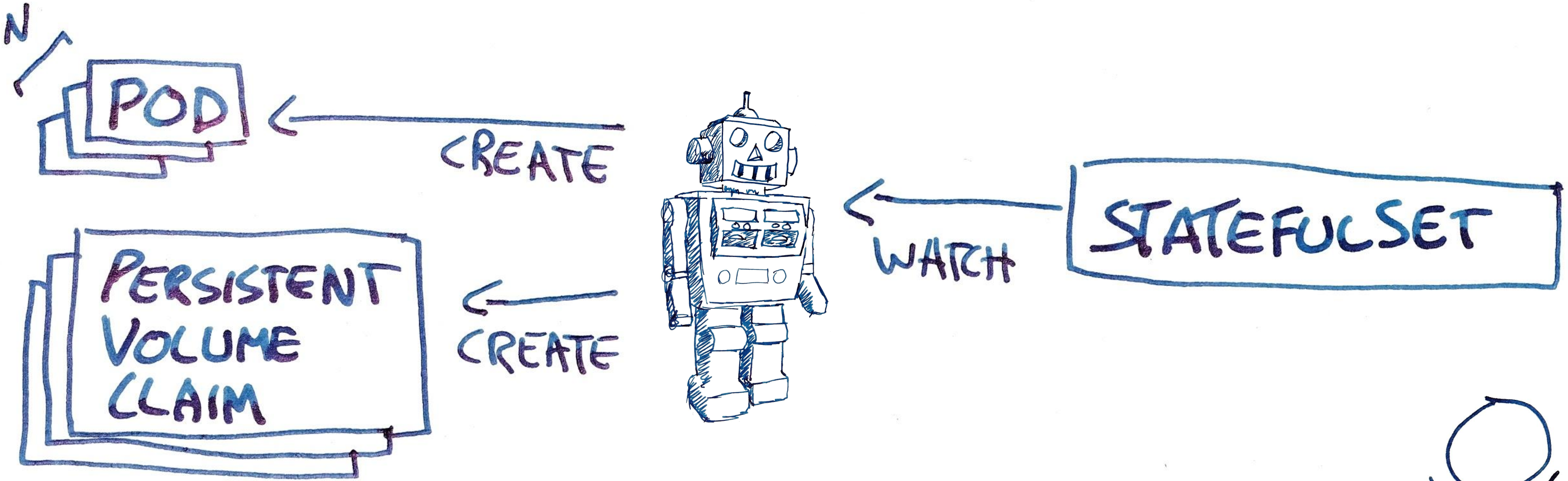
JOB



"COMPLEX INJECTION WITH A THING"

IN/BIJECTION ENFORCER

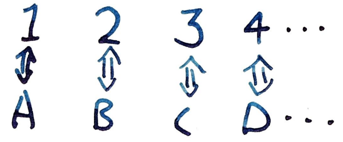


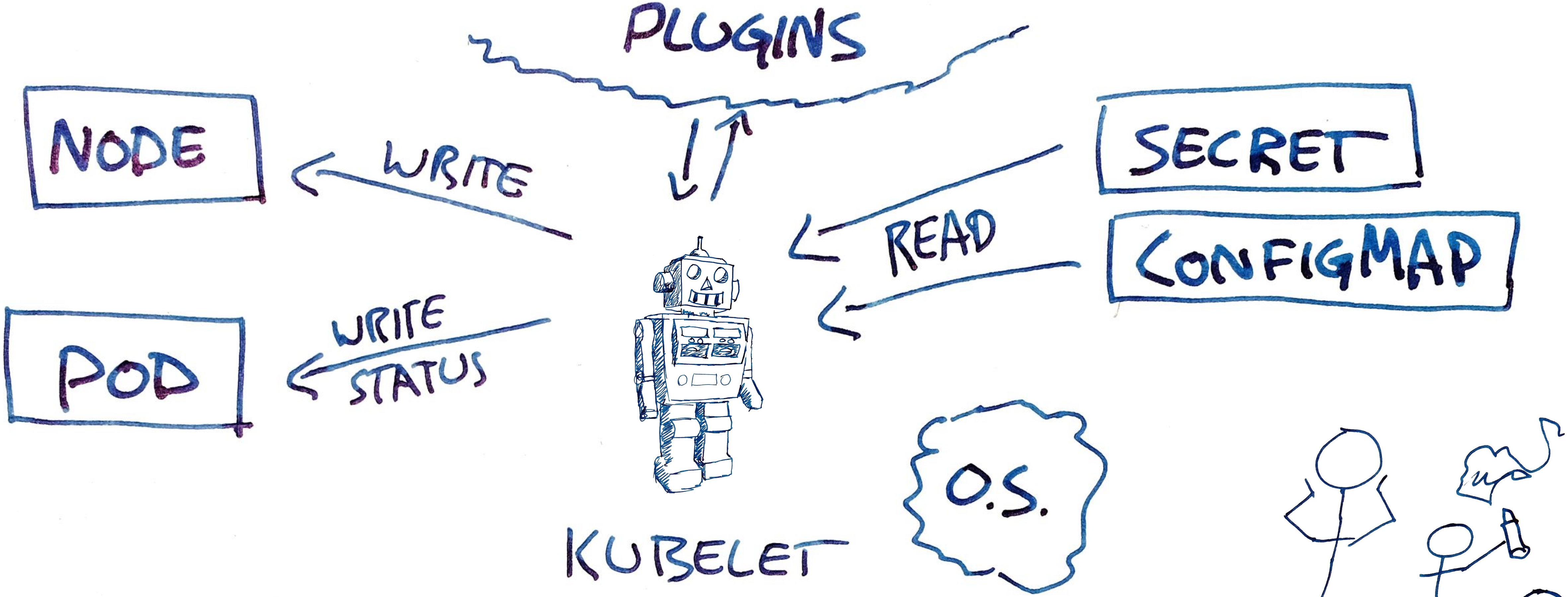


STATEFULSET

"INJECTION WITH A COMPLEX THING"

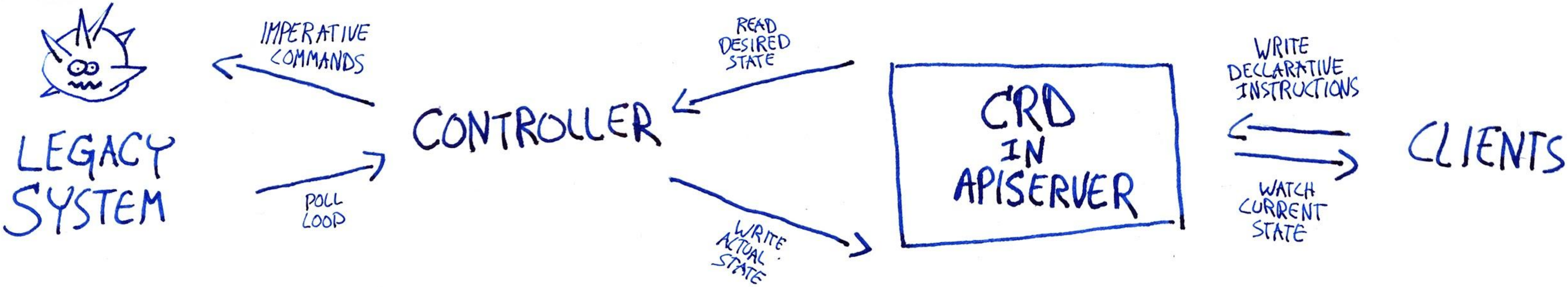
$^{\text{IN}}_{\text{BI}}$JECTION ENFORCER





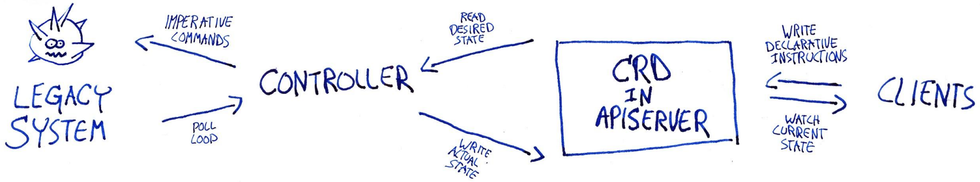
"INJECTION WITH A COMPLEX THING"

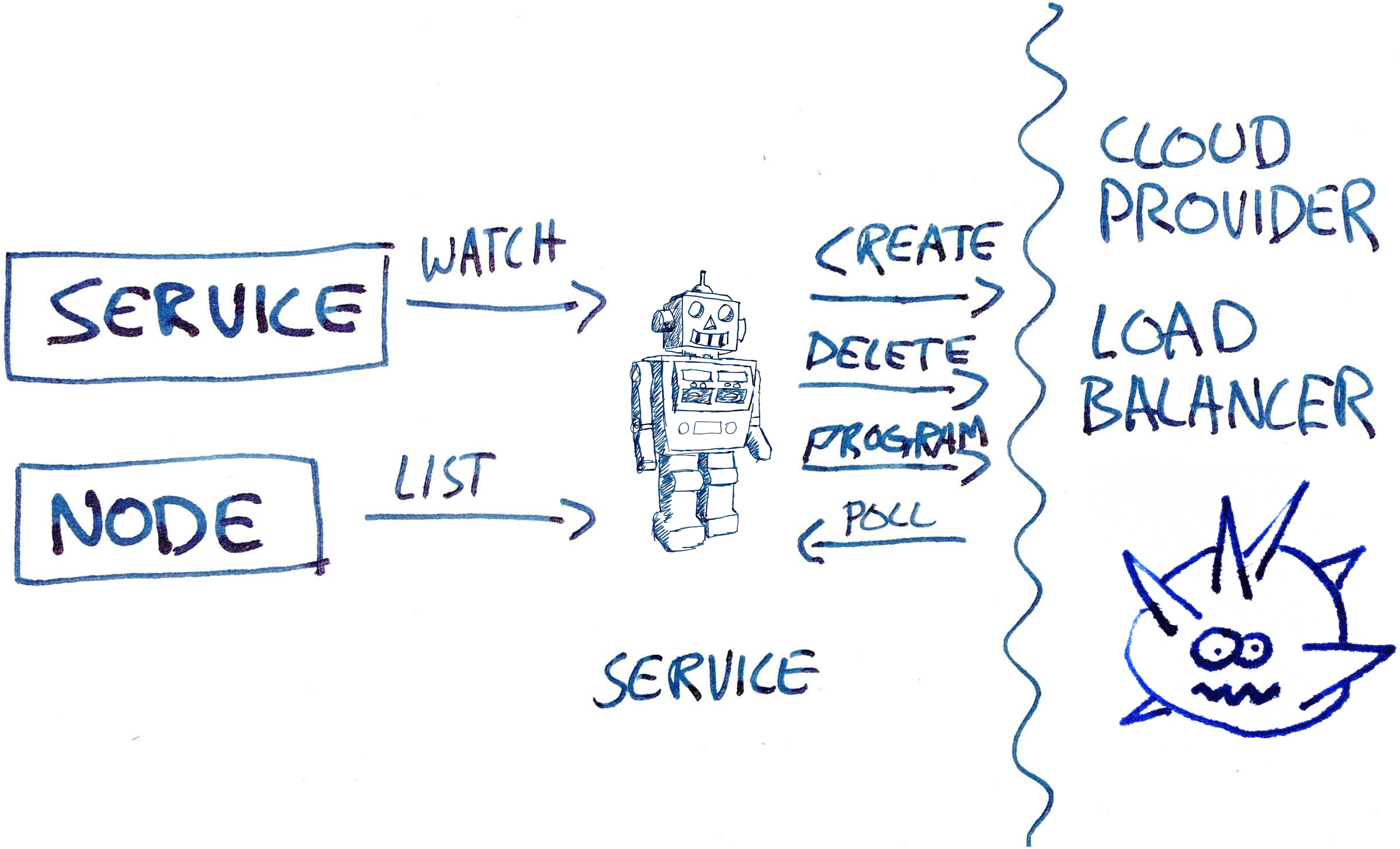
IN BIJECTION ENFORCER



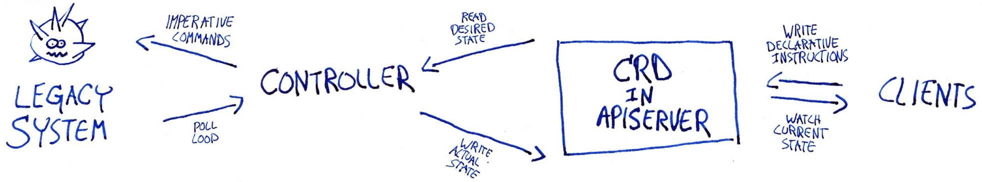
OPERATOR PATTERN!

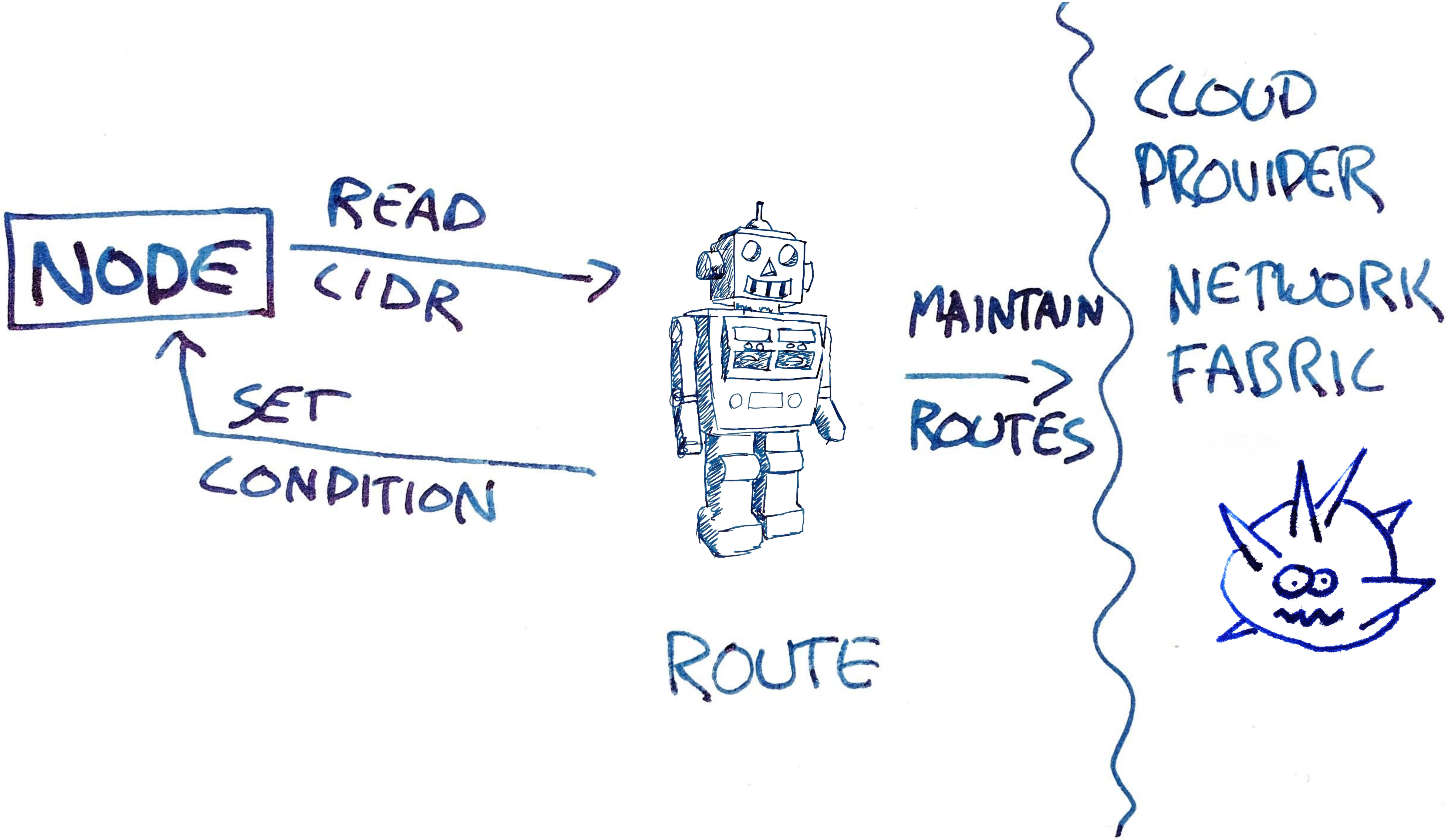
IN BIJECTION ENFORCER





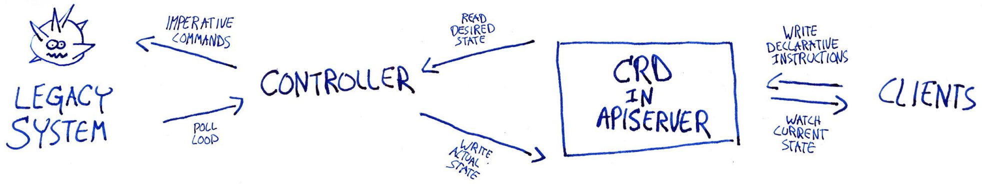
${}^{\text{IN}}_{\text{BI}}$JECTION ENFORCER

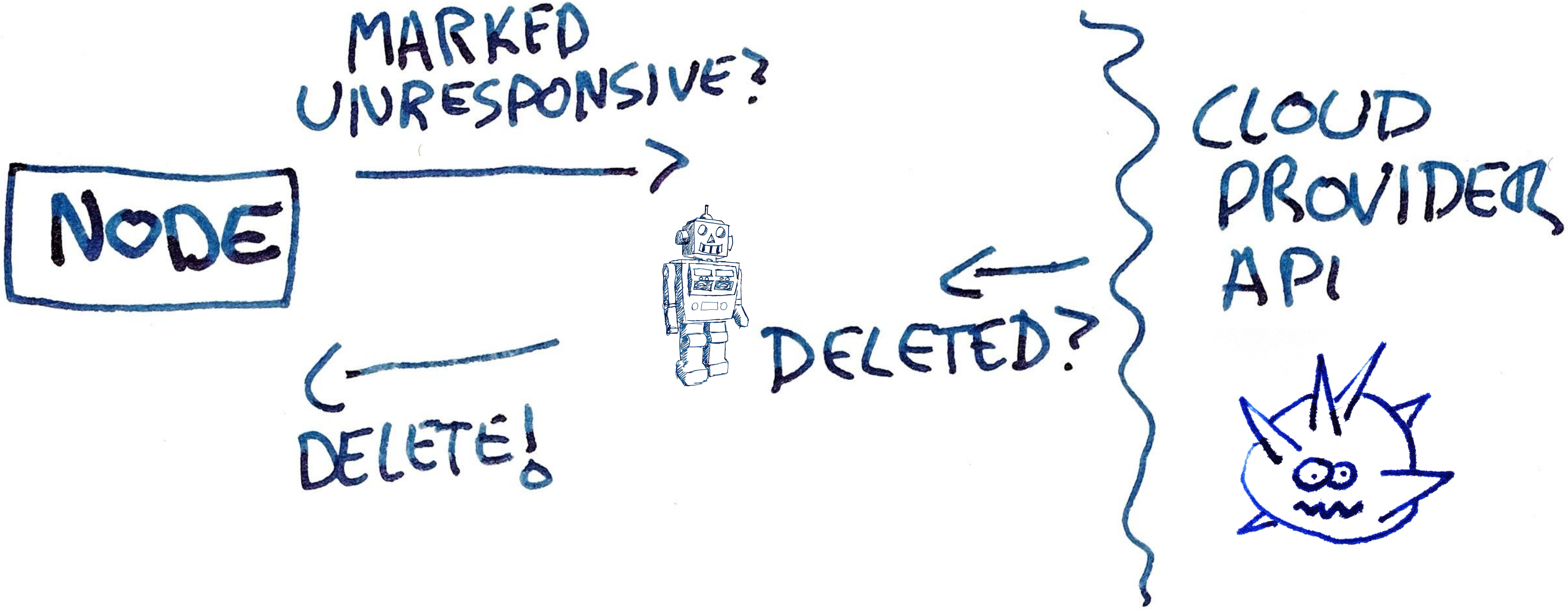




IN

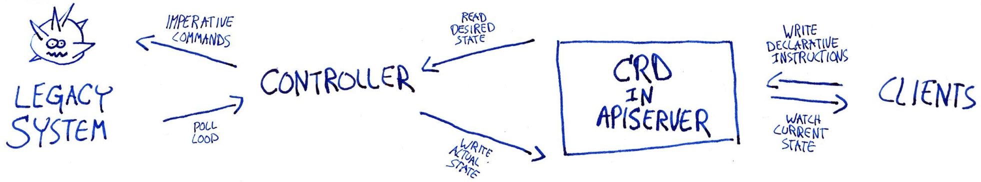
BIJECTION ENFORCER

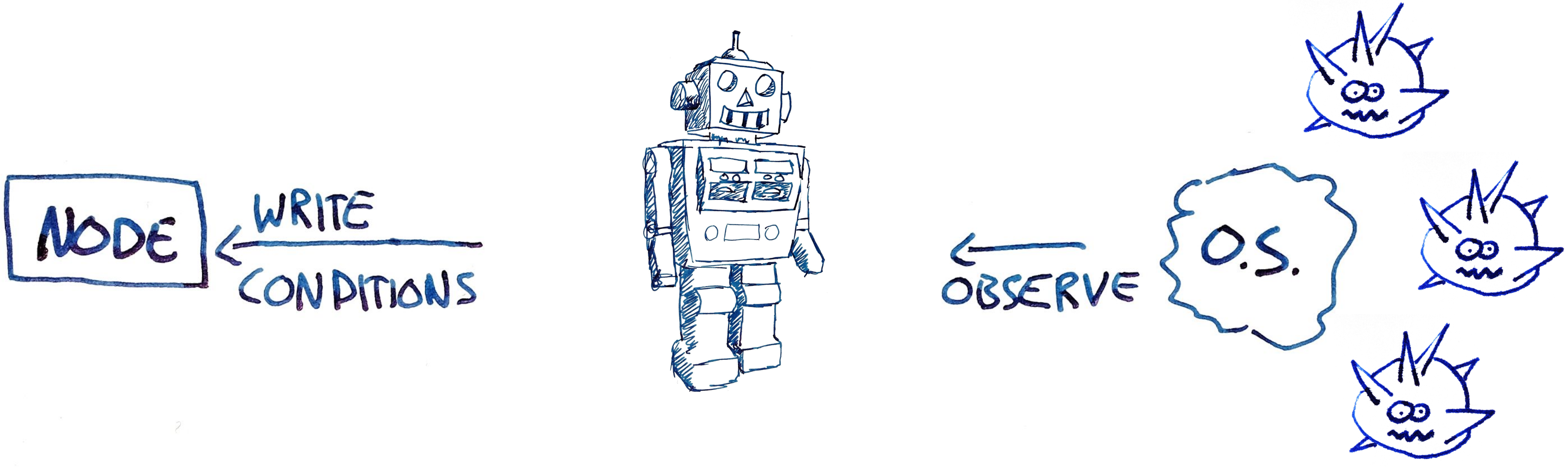




CLOUD-NODE-LIFECYCLE

IN BIJECTION ENFORCER





NODE PROBLEM DETECTOR

THAT'S ALL* OF THEM!

READY TO
WRITE
YOUR OWN??

*MOST

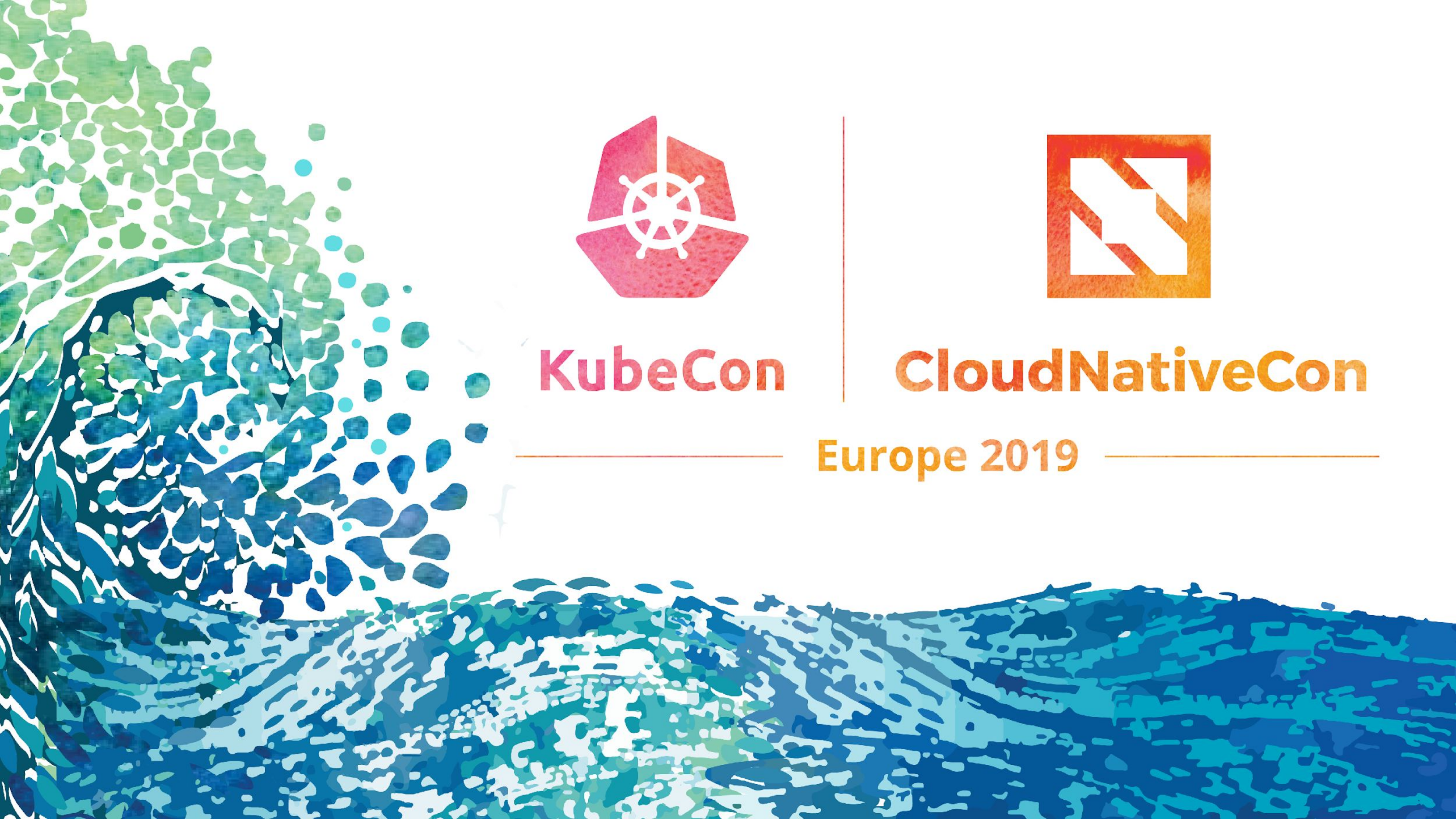
SOUND LIKE A FUN
PROBLEM SPACE?

GET INVOLVED!!!

→ SIG API MACHINERY

→ SIG APPS

→ SIG ARCHITECTURE



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