goto; conference aarhus

ERLANG EVOLVES

FOR MULTI-CORE AND CLOUD ENVIRONMENTS

Torben Hoffmann

Erlang Solutions Ltd.

@LeHoff

http://musings-of-an-erlang-priest.blogspot.dk/

INTERNATIONAL SOFTWARE DEVELOPMENT CONFERENCE

gotocon.com

Agenda

- Erlang fundamentals

- Challenges

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2

Warning 1: The Truth

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I will do a few simplifications in order to get the main points across.

Warning 1: The Truth

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Warning 1: The Truth

Will you tell the truth?

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I will do a few simplifications in order to get the main points across.

Warning 1: The Truth

Will you tell the truth? Yes

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The whole truth?

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Warning 1: The Truth

Will you tell the truth?	Yes
The whole truth?	No

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Warning 1: The Truth

Will you tell the truth?	Yes
The whole truth?	No
So help you OTP?	

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Warning 1: The Truth

Will you tell the truth?	Yes
The whole truth?	No
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I will do a few simplifications in order to get the main points across.

Warning 2: Serious Love Ahead

I love Erlang!

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4

It was part of a major career shift and I have never looked back.
Apologies if I get too intense.

Realities Of Software Development

- Time-to-market pressure
- Utilisation of computing resources
- Scaling successes
- Maintenance burden

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What Could Be...

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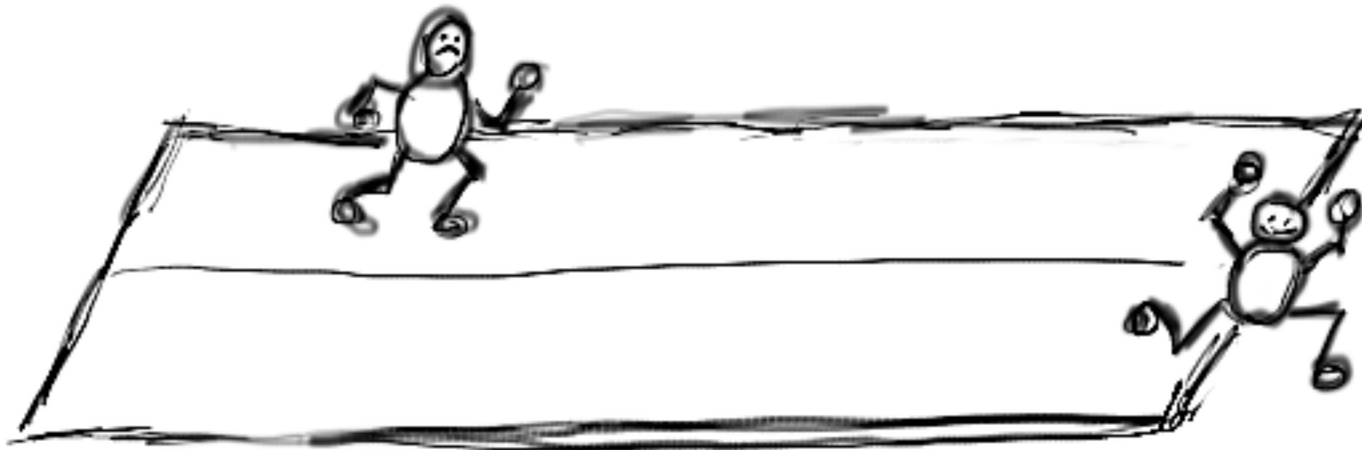
3x productivity over C++/Java
Seamless scaling on multicore
Scaling nicely over machines
Less code per feature
The future is here today – it's called Erlang!

What Could Be...



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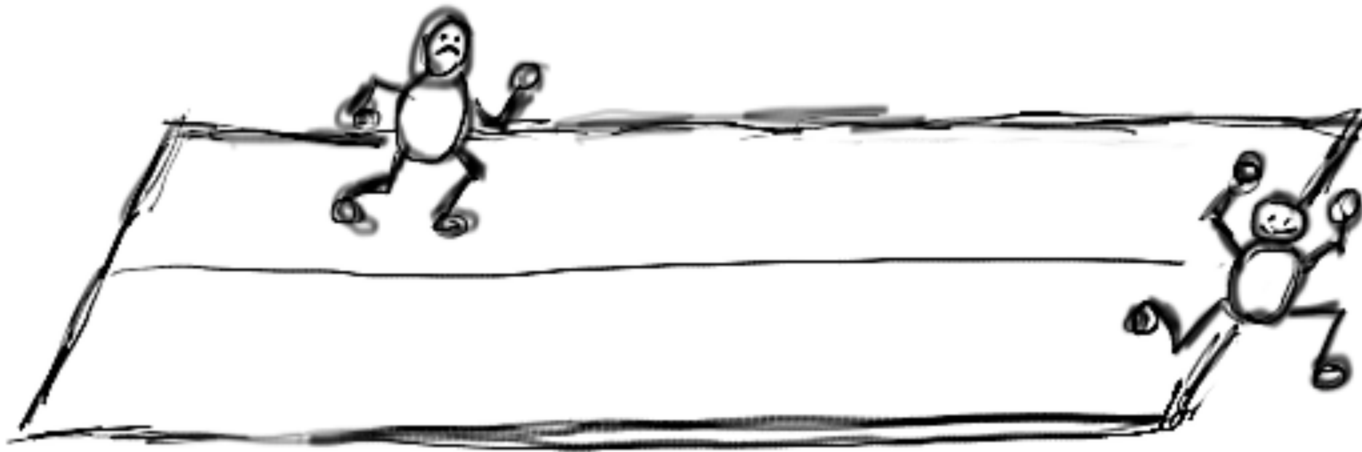

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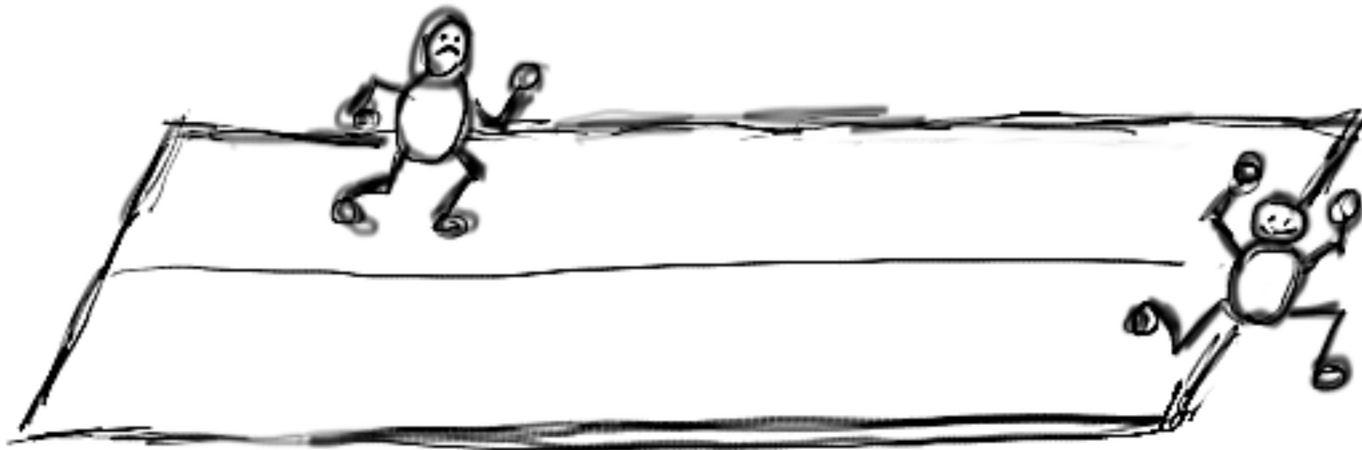

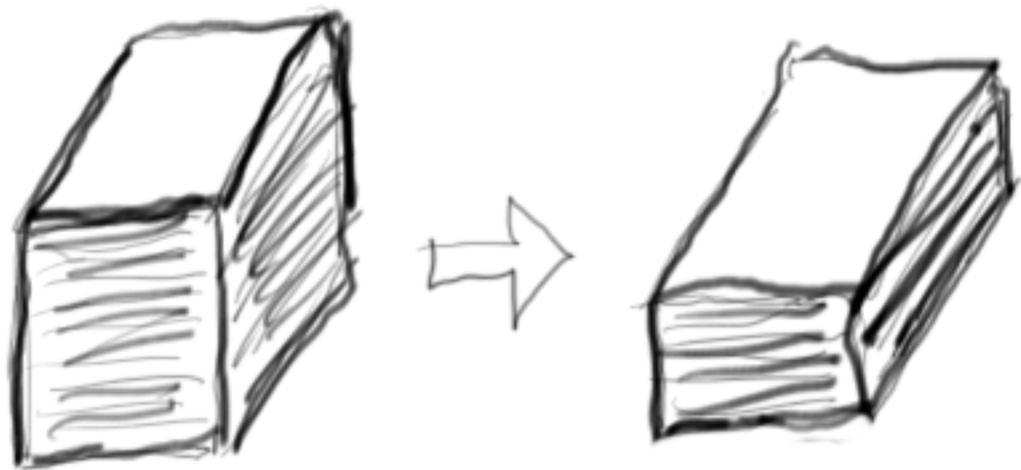

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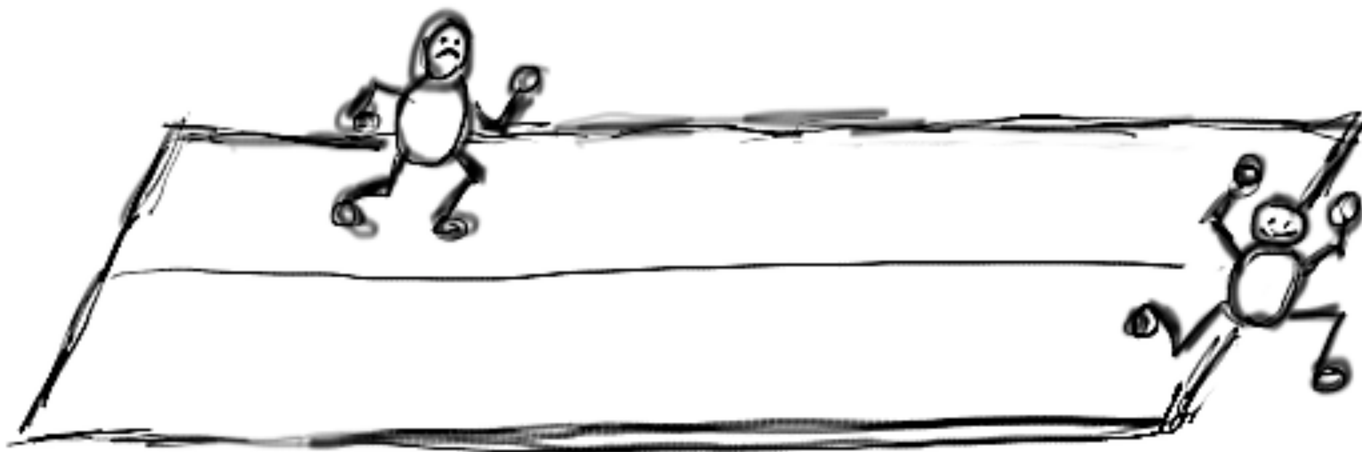

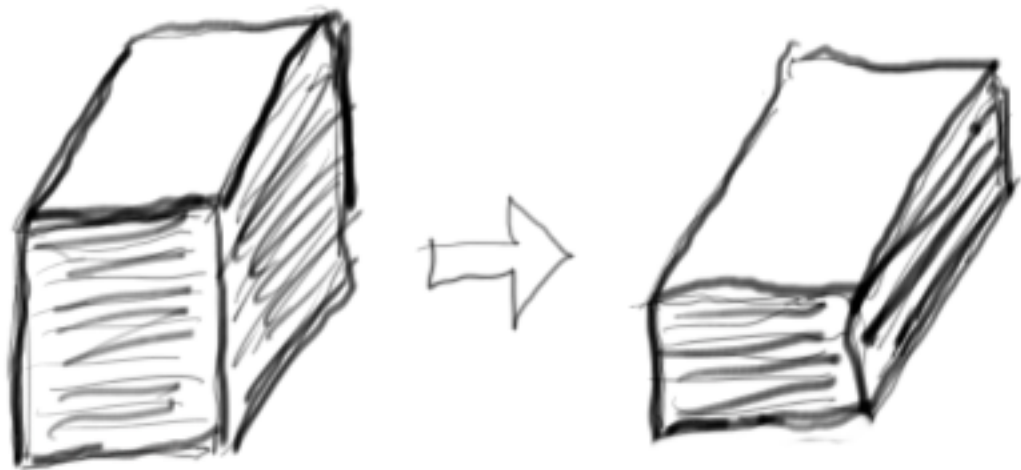

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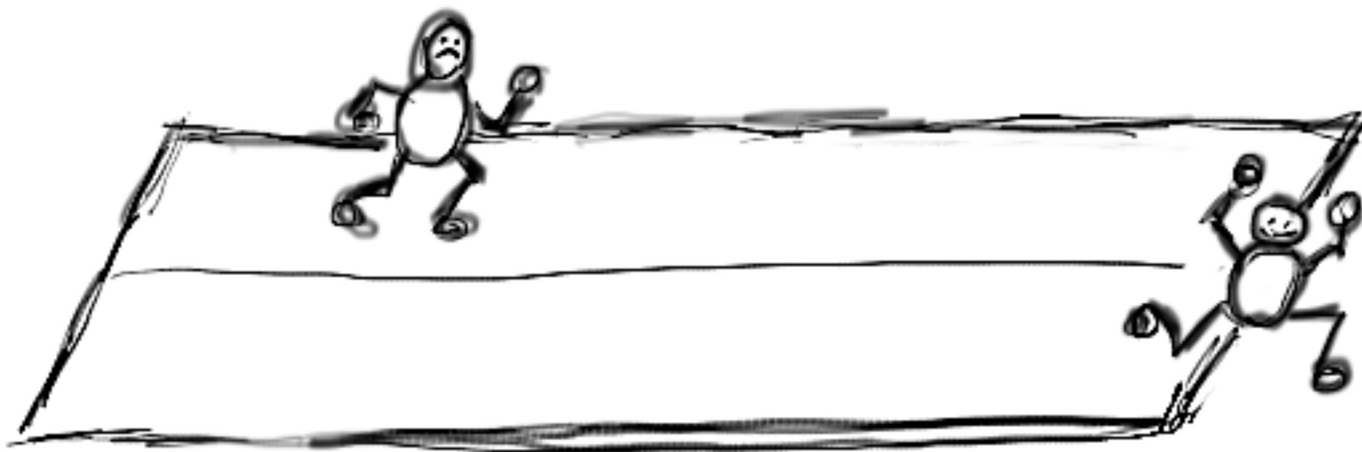

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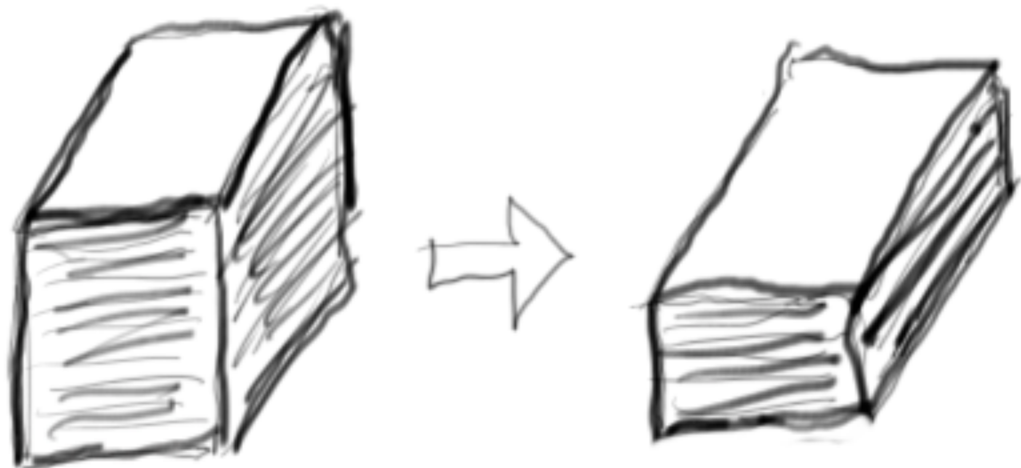

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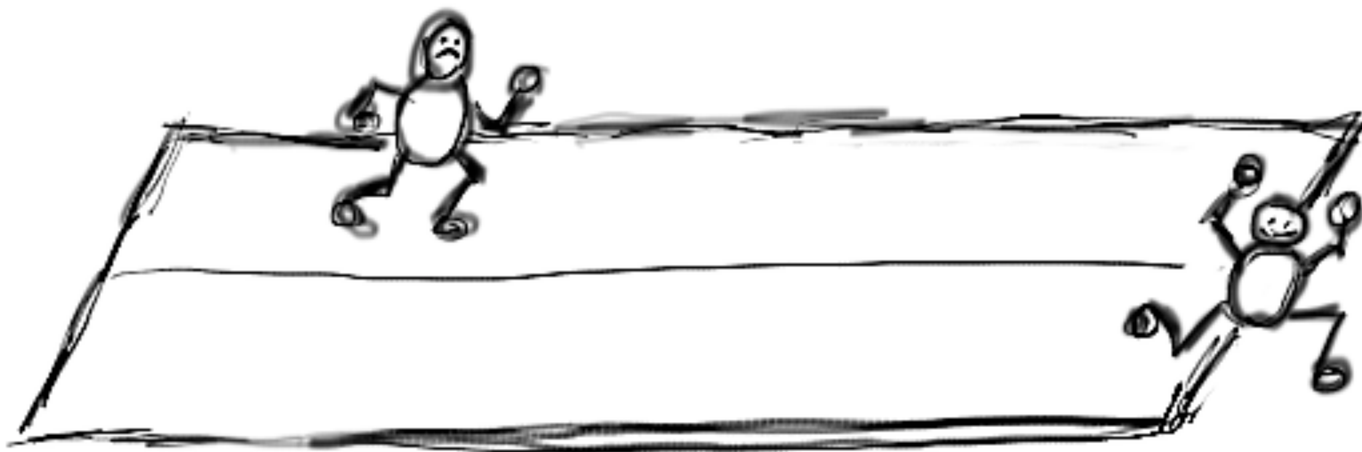

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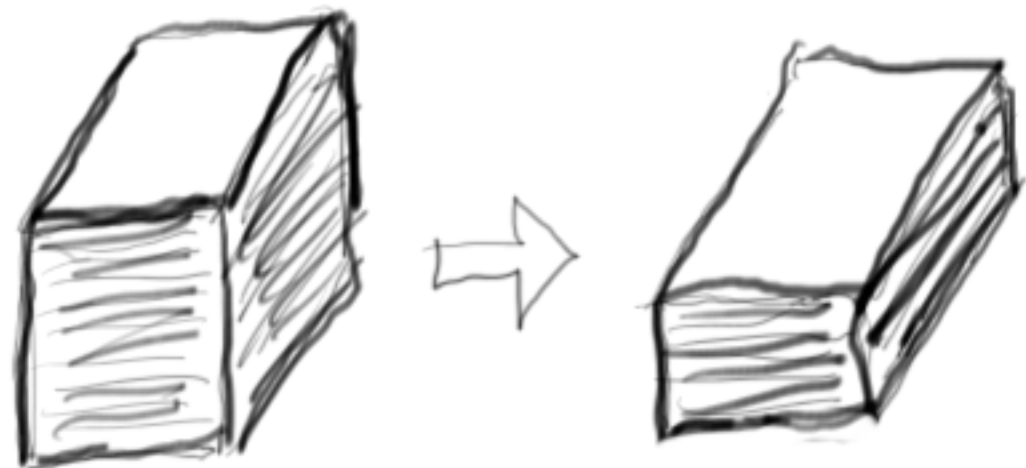

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Erlang's Original Requirements

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- Large scale concurrency

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- Soft real-time

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Sounds familiar?

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Sounds familiar?

Sounds good, right?

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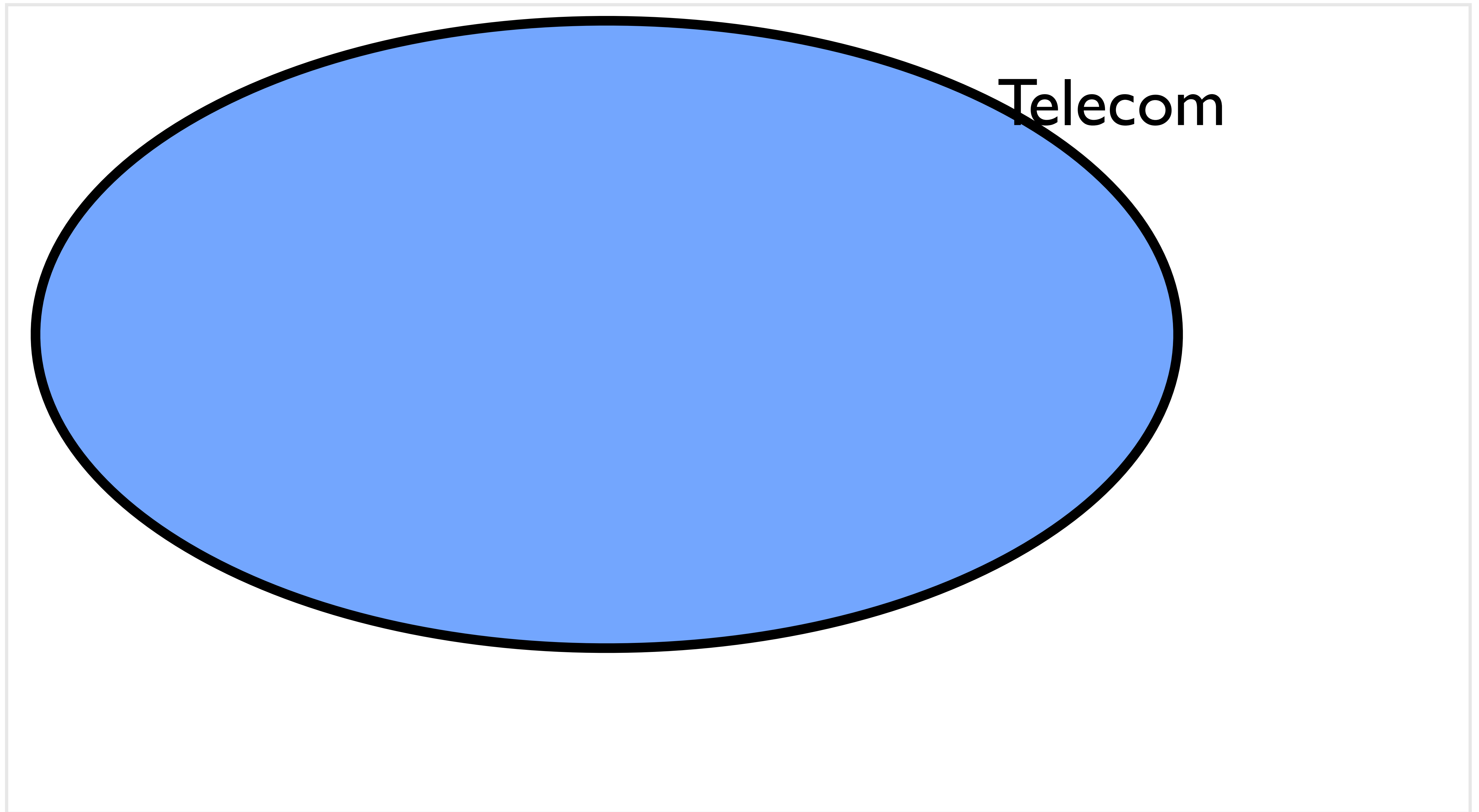
General vs Domain Specific



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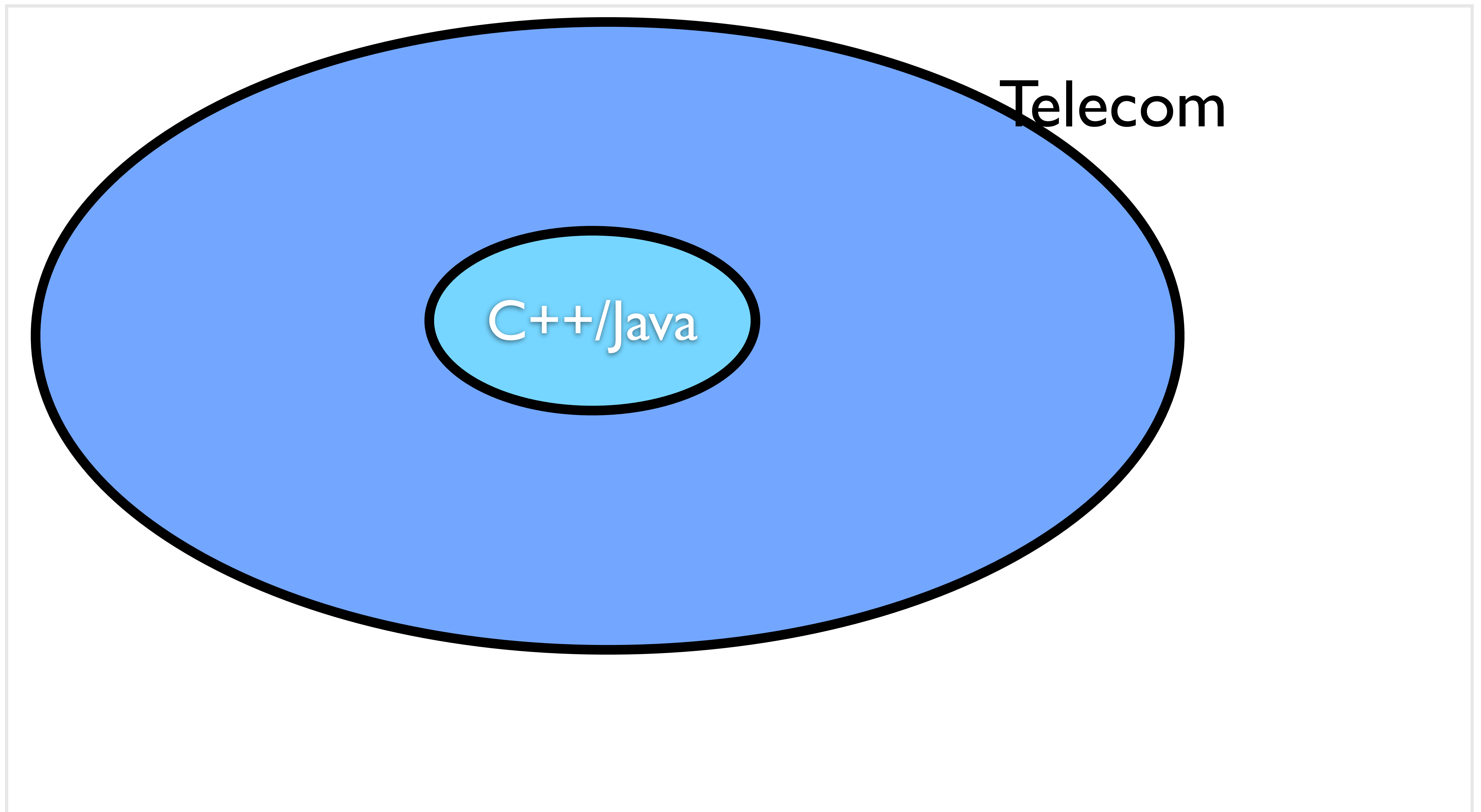

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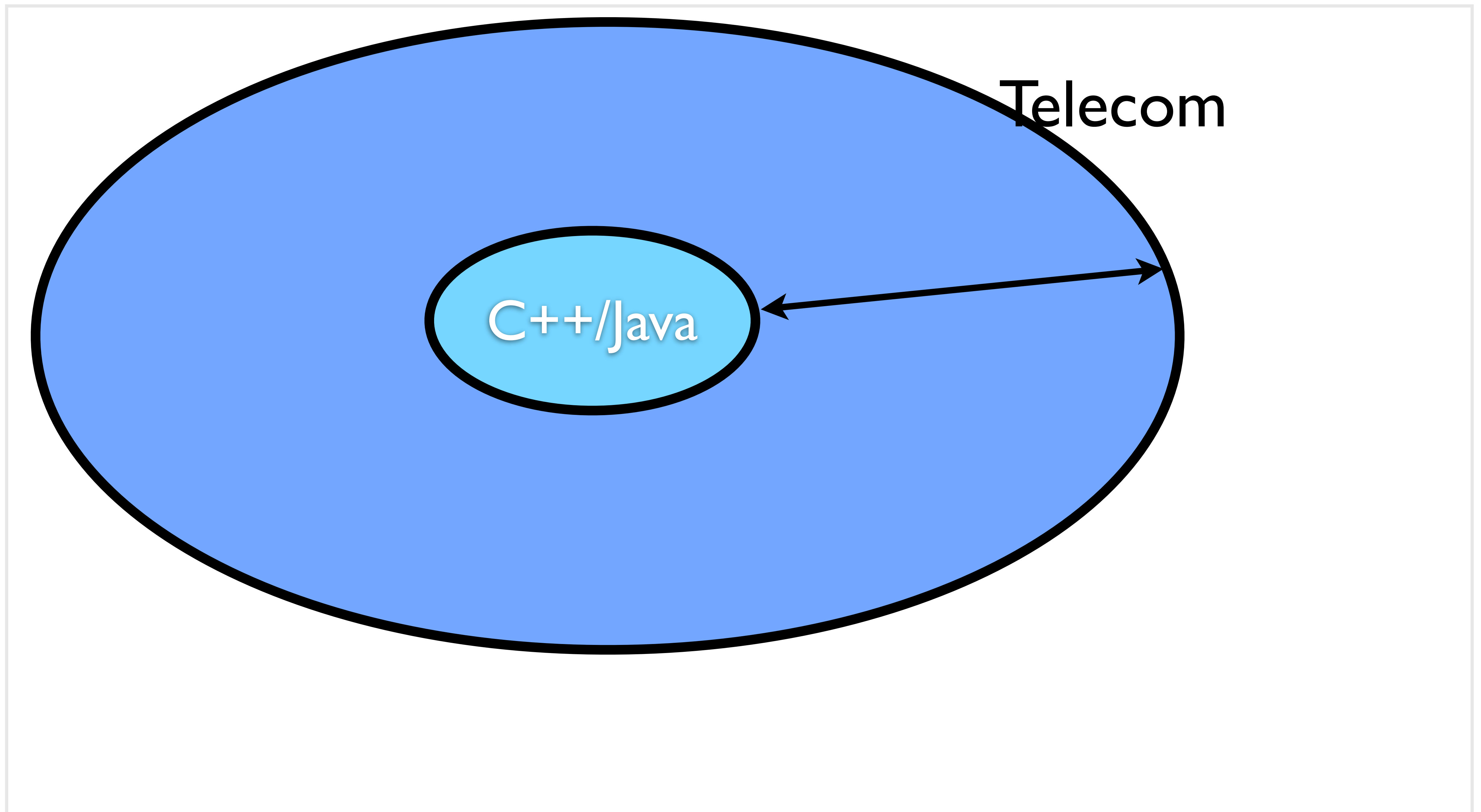

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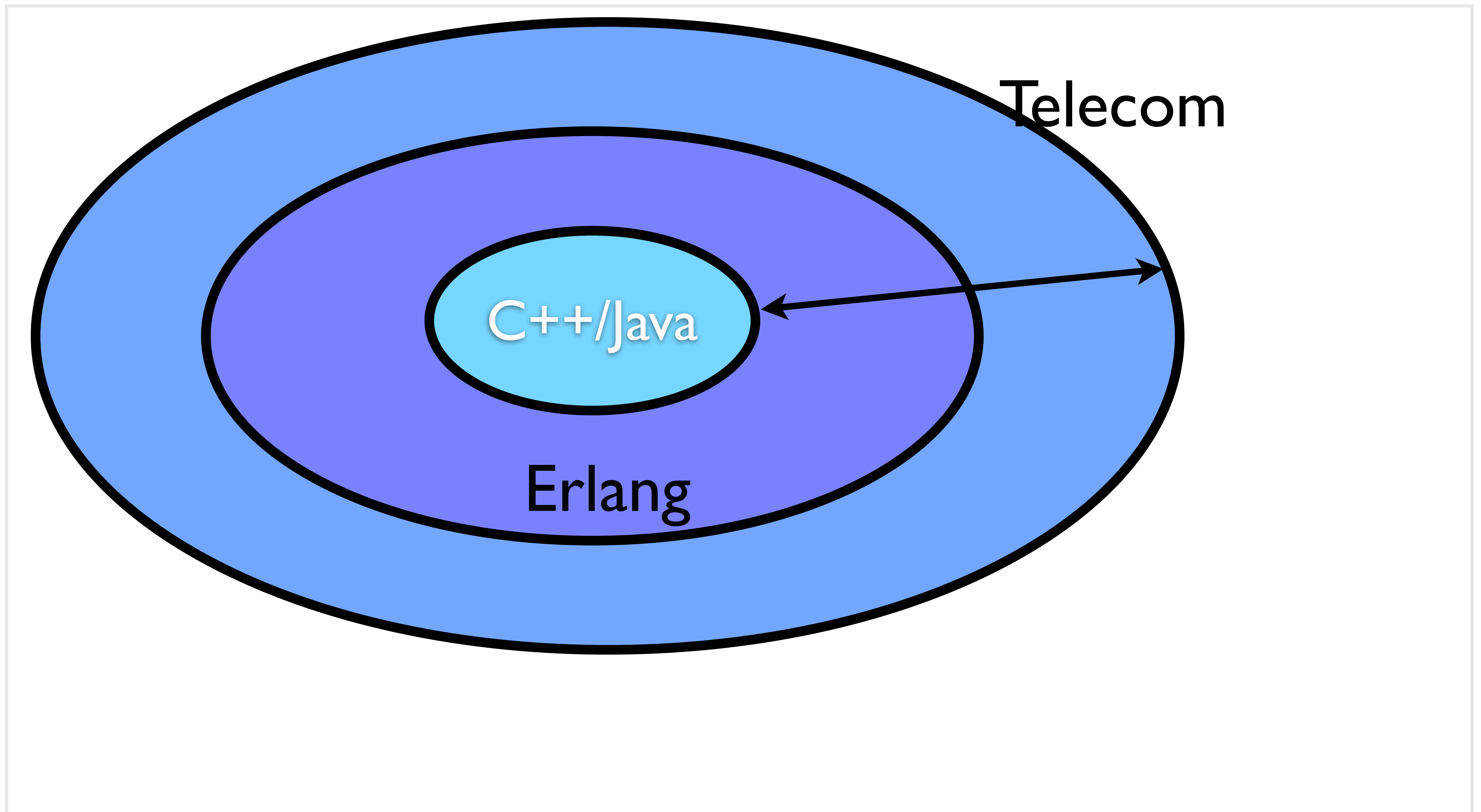

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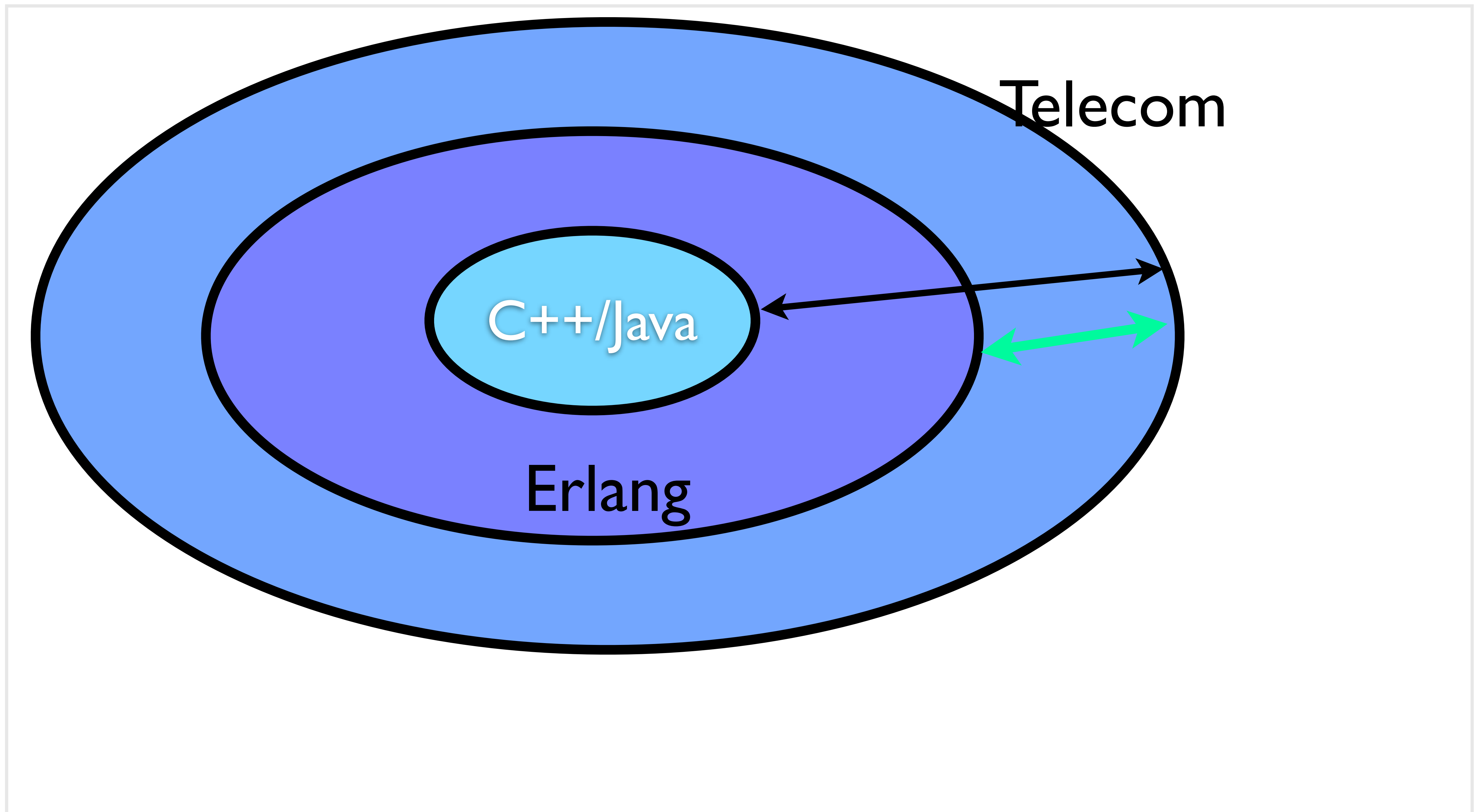

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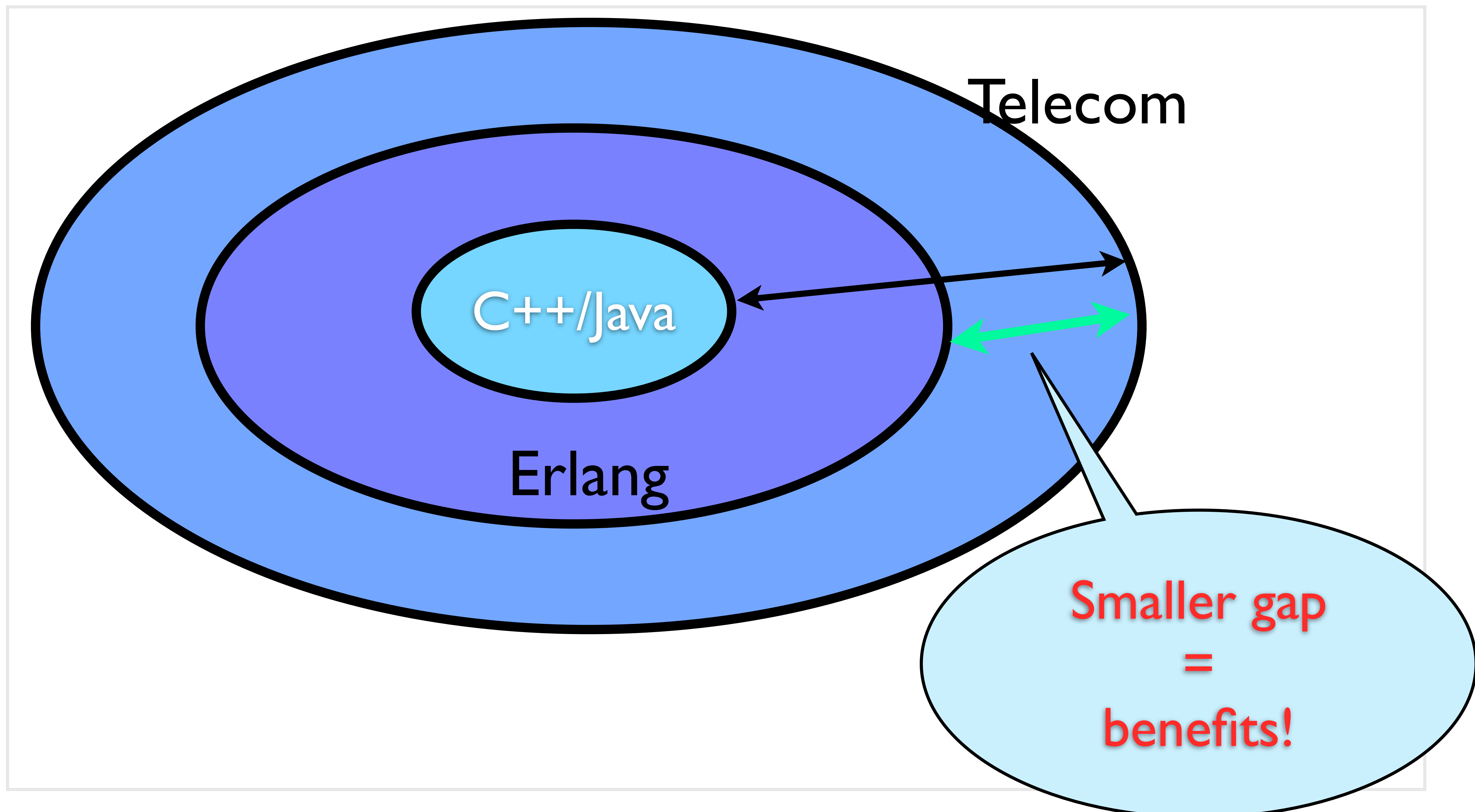

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Erlang's Sweet Spot

GUI

Erlang

Middleware
Coordination
Control

Drivers

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Erlang was intended to deal with the control plane in telecom, which is all about orchestration of what goes on.
GUI and low-level things are not what Erlang was created for - hence Erlang has good support for integration with other languages.
Read the wonderful doctor thesis by Bjarne Däcker if you want to learn more: http://

Other Erlang Domains

- Messaging - XMPP et al
  - ejabberd, MongooseIM
- Webservers
  - Yaws, Chicago Boss
- Payment switches & soft switches
  - Vocalink, OpenFlow/LINC
- Distributed Databases
  - Riak, CouchDB, Scalaris

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If the tool fits,
you must select!
Tech Mesh Conference
4-5 December
London

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To Share Or Not To Share

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11

Death propagates in shared memory unless you do a ton of defensive programming.
Due to the actor model with no shared memory it is custom in Erlang to do fail-fast programming.
No shared memory allows you to fail fast when suitable.
Erlang uses message passing between processes to exchange information.

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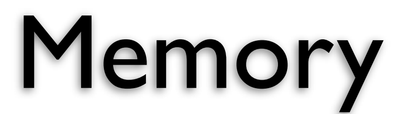

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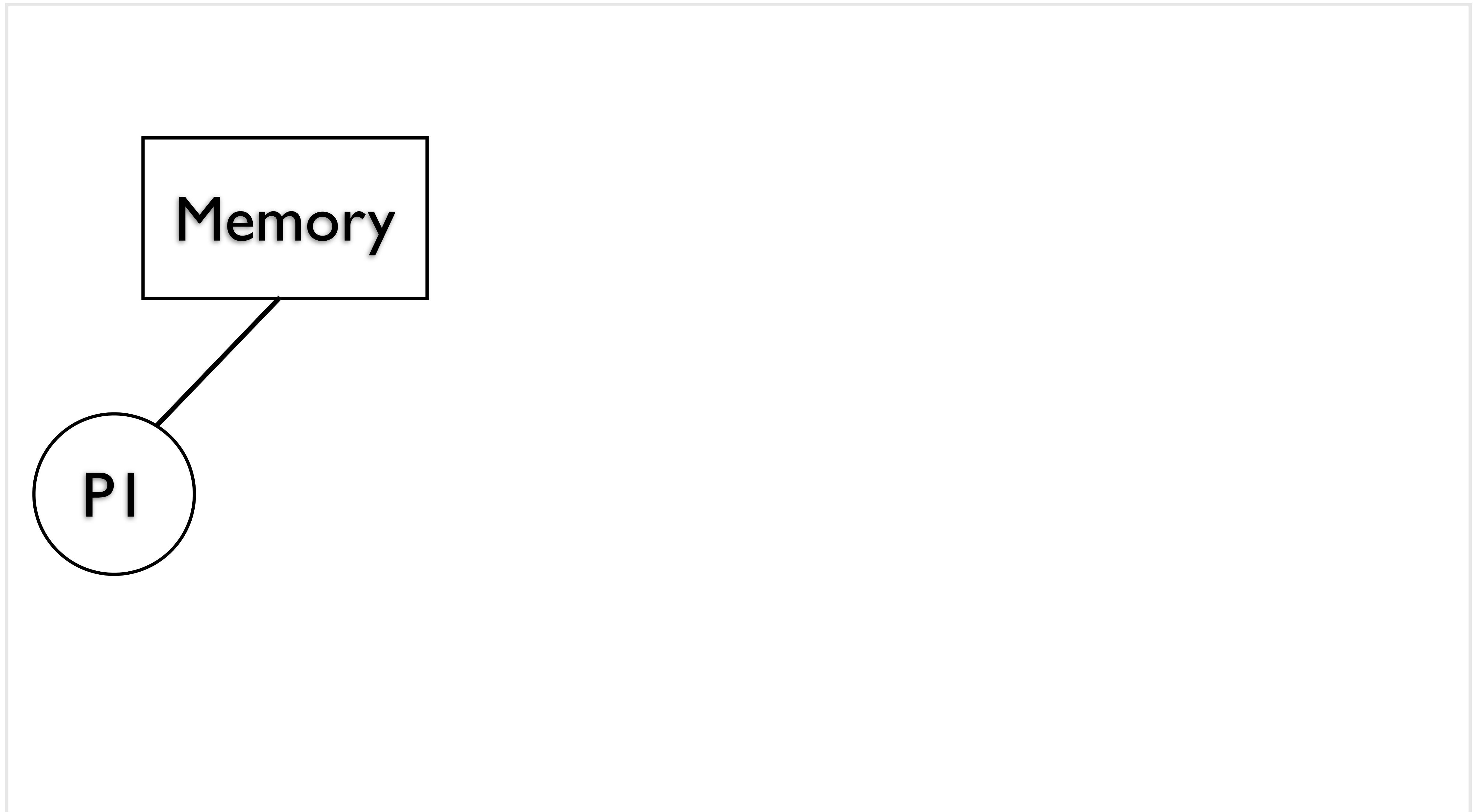

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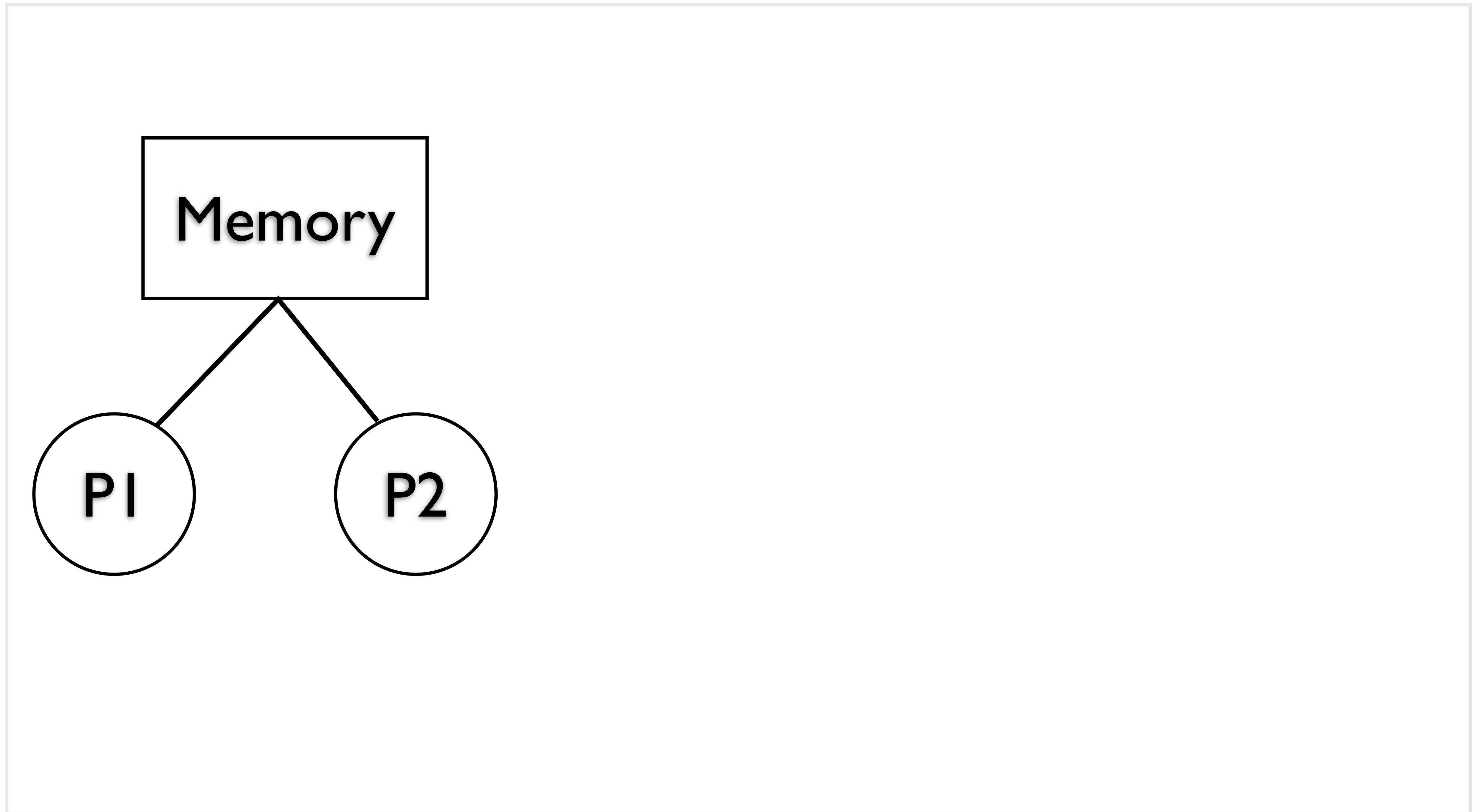

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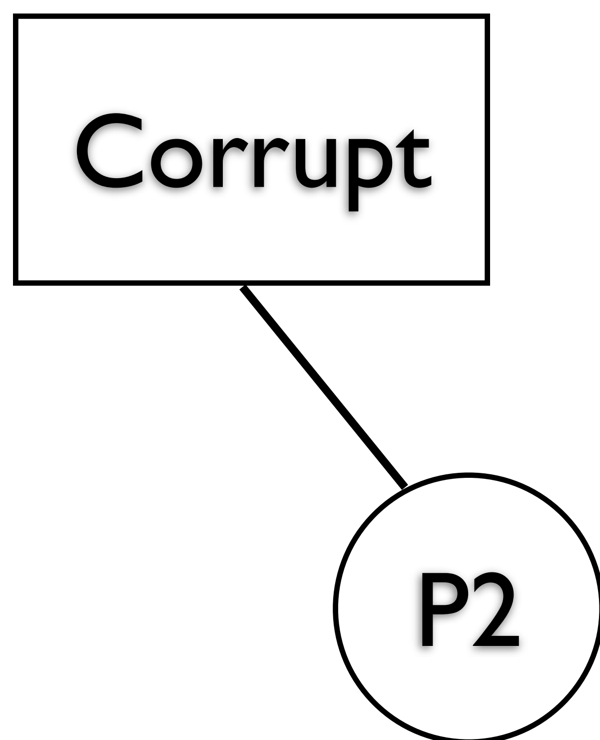

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To Share Or Not To Share

Corrupt

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To Share Or Not To Share

Corrupt

Memory

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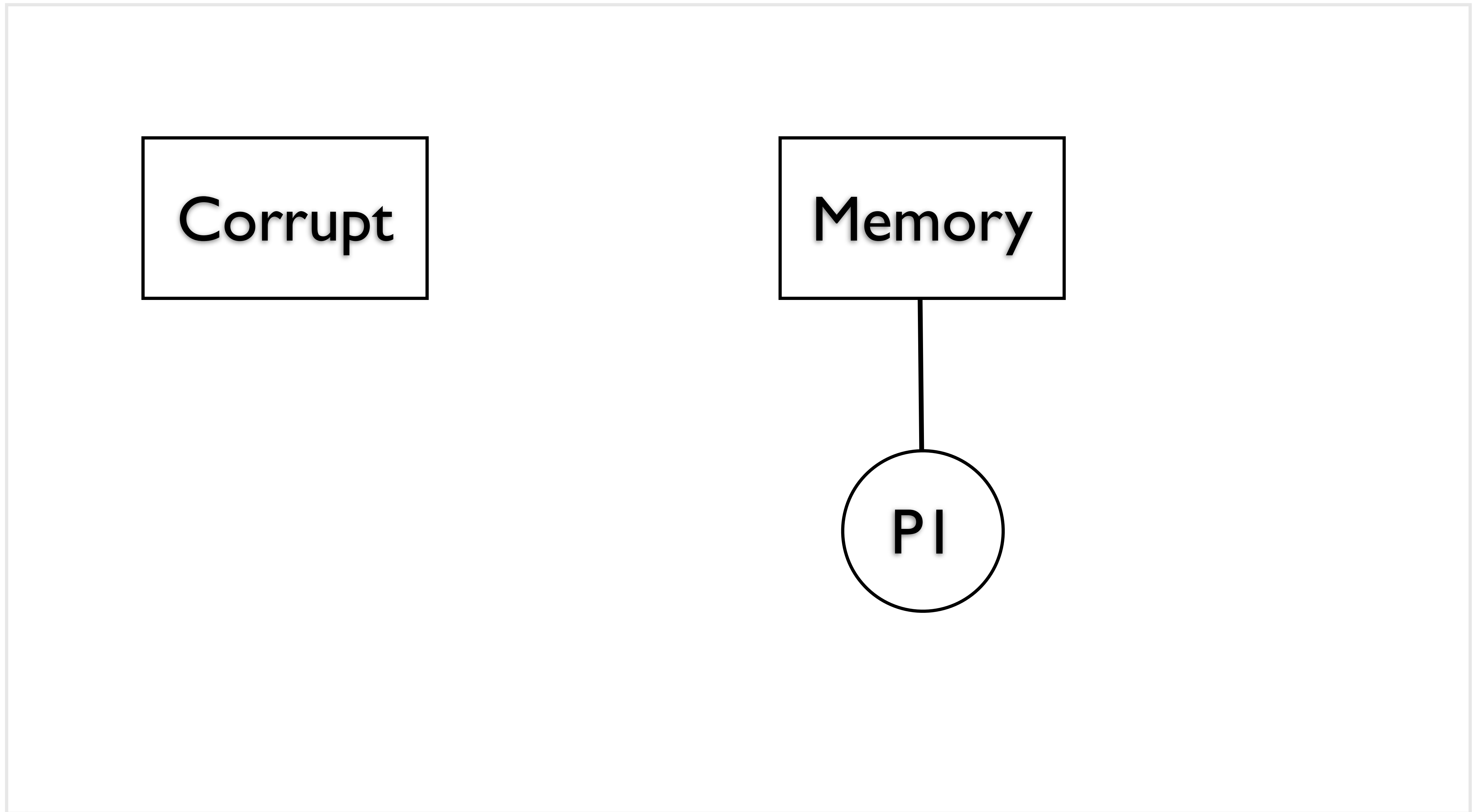

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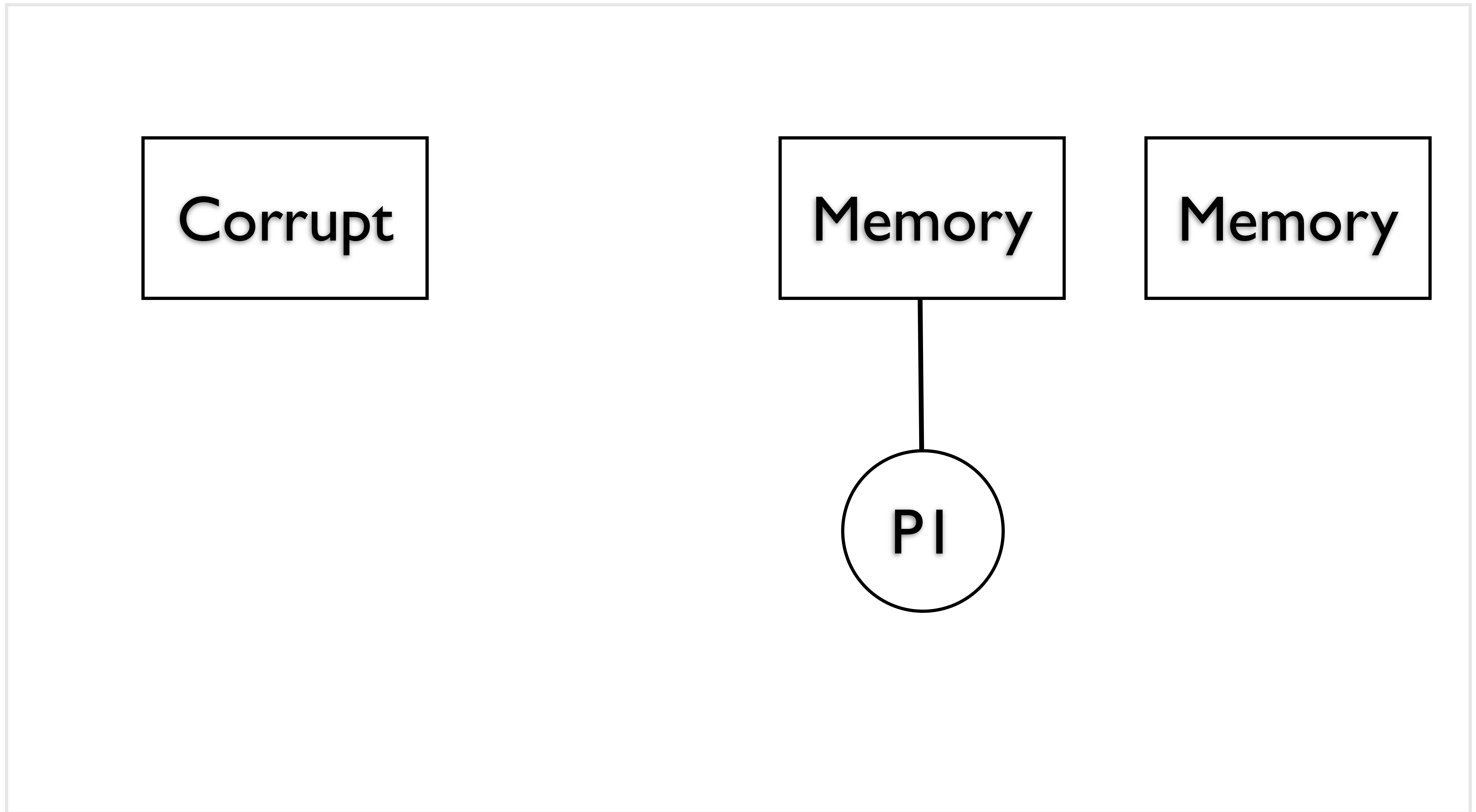

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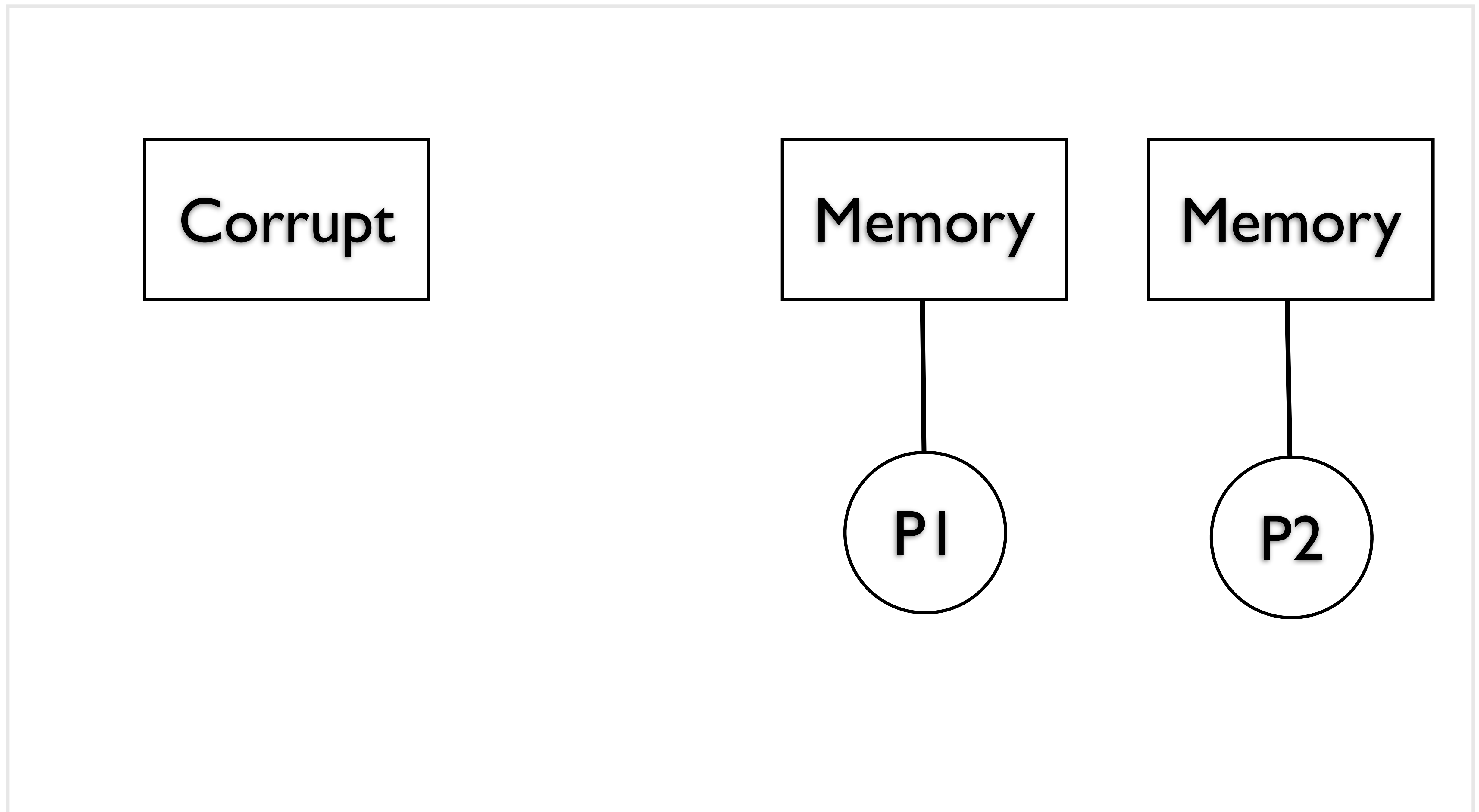

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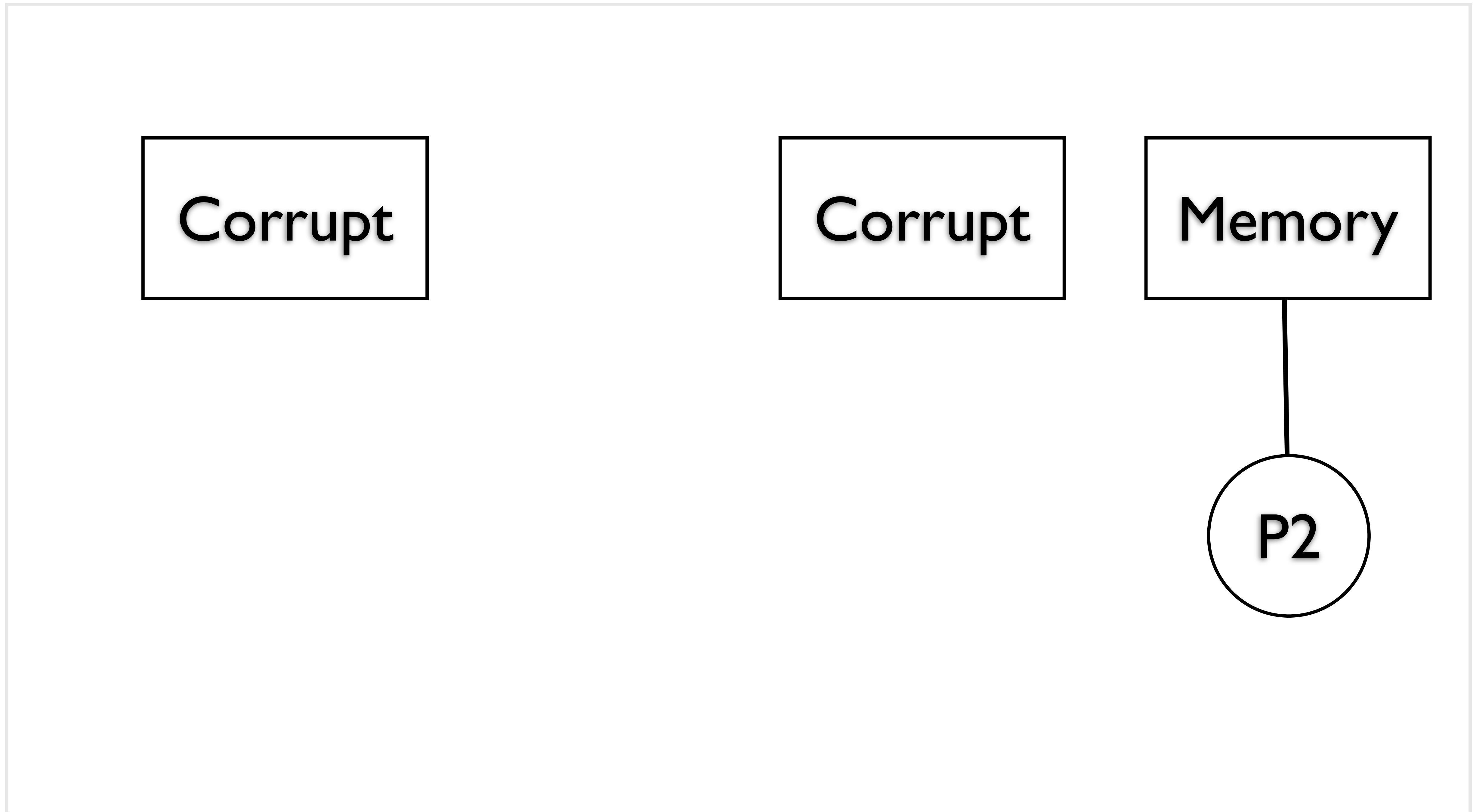

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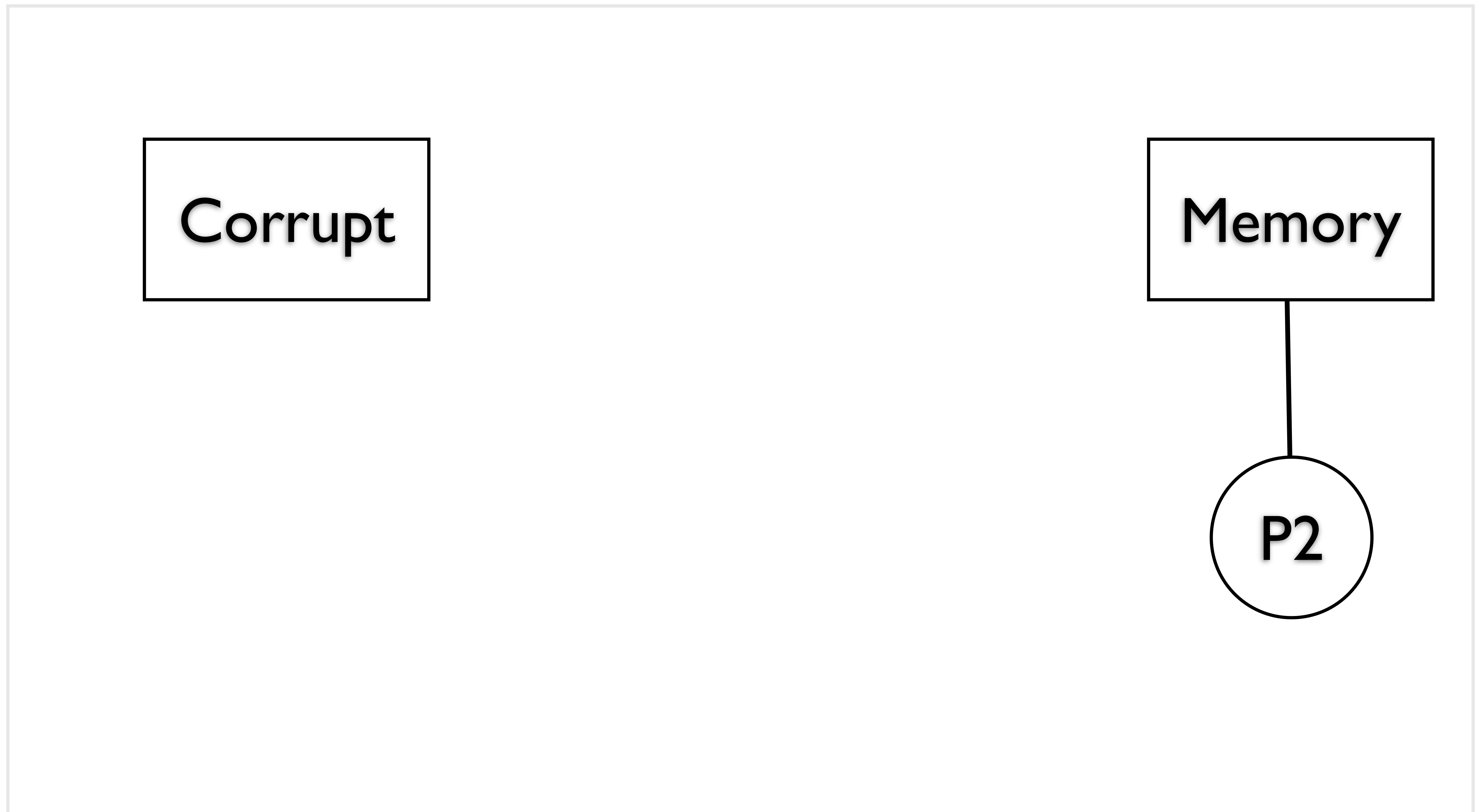

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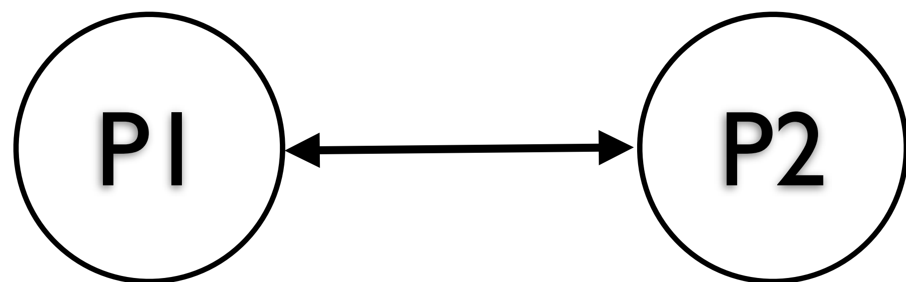
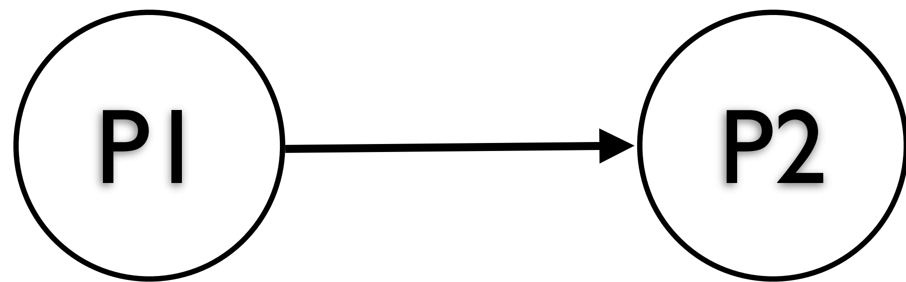
Dealing With Failures



link =
die together



monitor =
notification
of death

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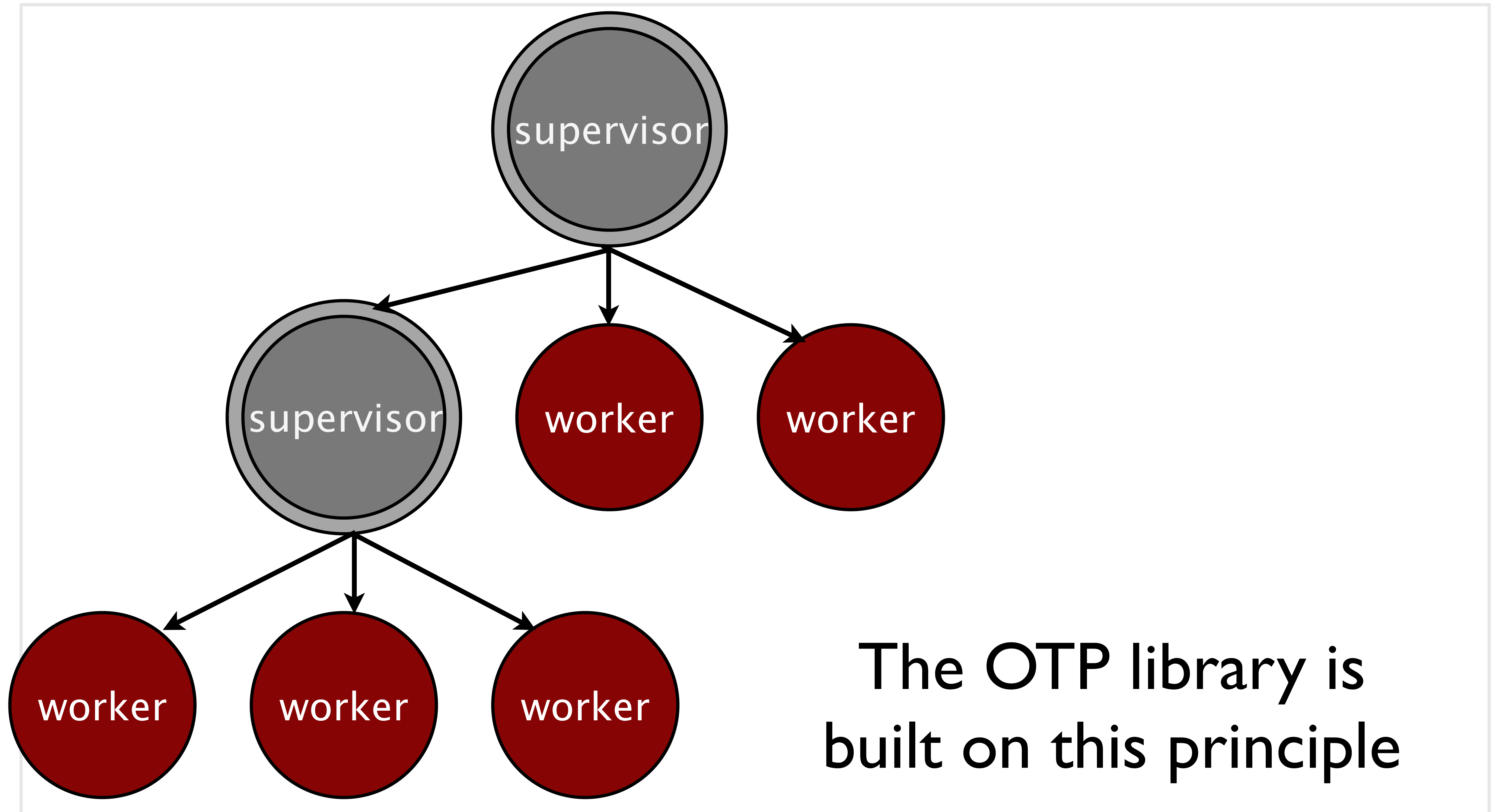
The ability to link processes and monitor them is the key to adopting fail-fast fully.
Link & monitor works across machines!

Supervision Trees



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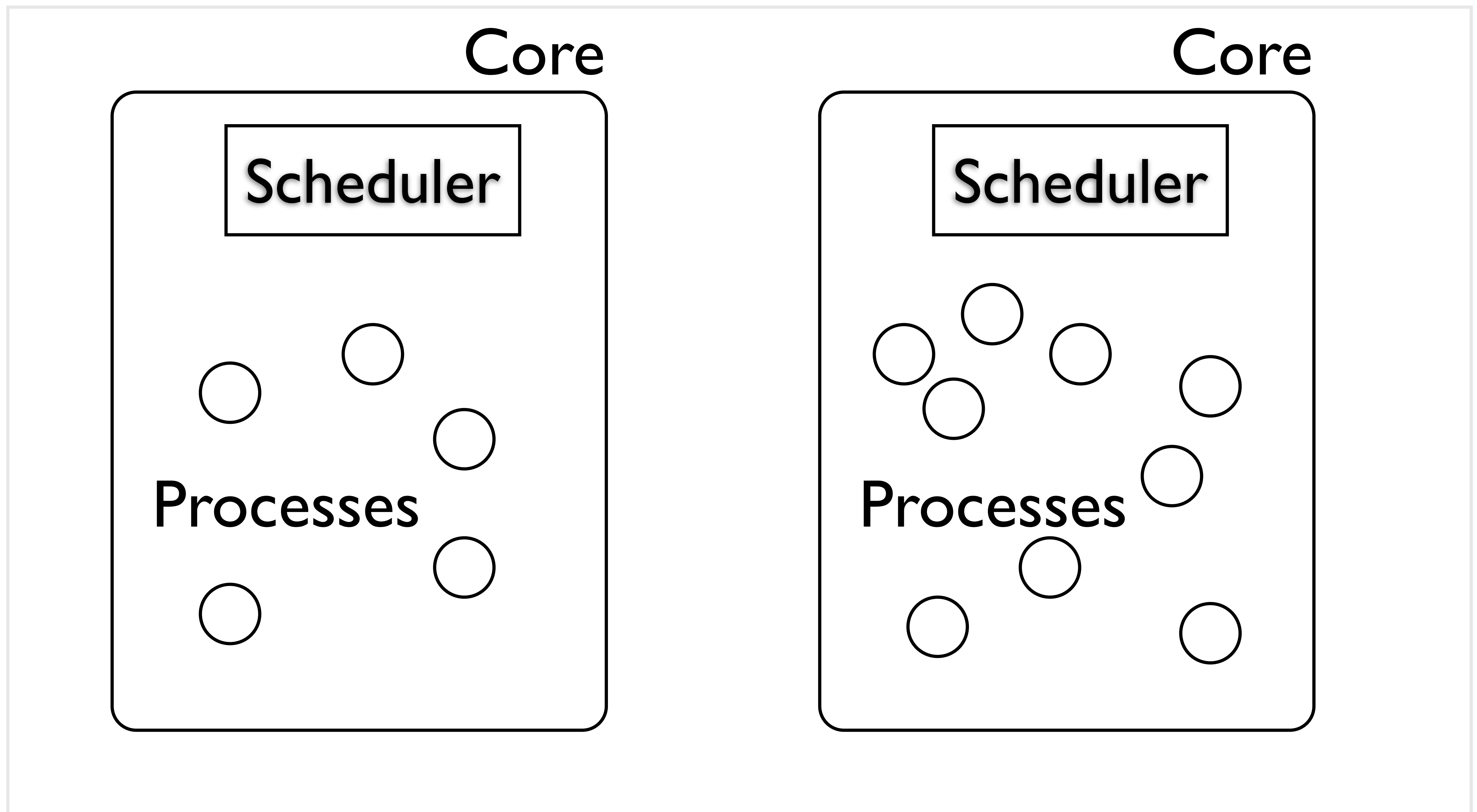
Robust systems does not happen by accident – even in Erlang!
You have to think about the consequences of a worker process that fails and let the supervisor take appropriate actions.
Using the OTP library's components makes it straightforward to implement the supervision tree, which has the added benefit that all things are started in the right order.

Distribution Over Cores



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There is 1 scheduler per core.
The VM tries to load balance across the available cores.
Scales extremely well with the addition of extra cores – WITHOUT changing the programs!

Distribution Over Machines

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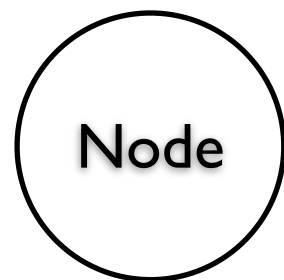
Each instance of the Erlang runtime is called a node.
There can be several nodes on one machine if you fancy that.
Nodes detect when other nodes are not around any more - the programmer can then decide what to do.
If you have the PID (Process Identifier) of a process you do not care which node it is on. You

Distribution Over Machines



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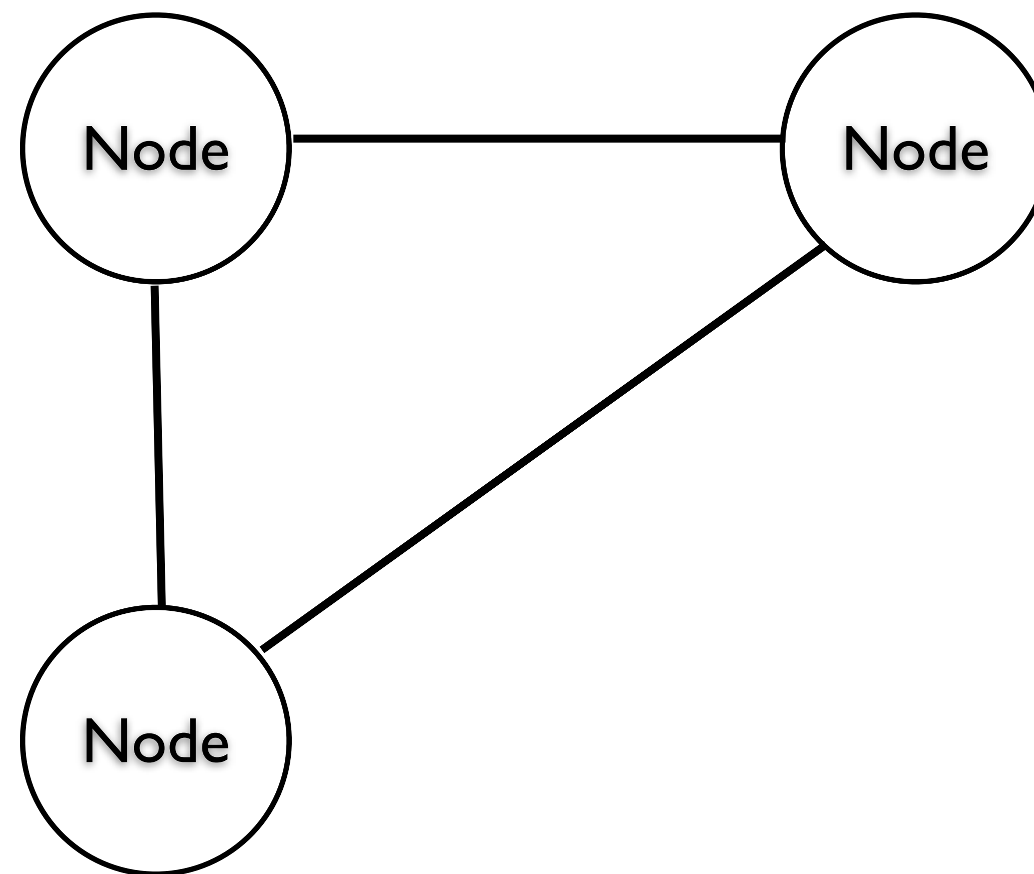

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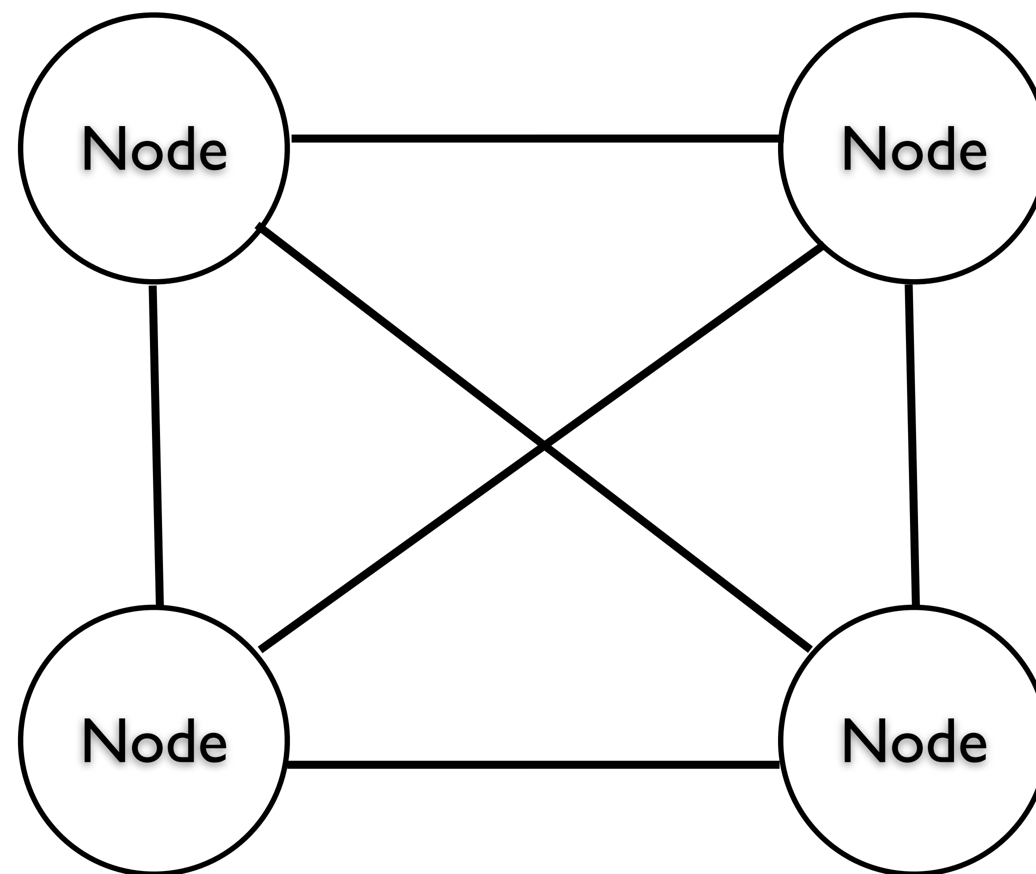

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Staying Alive...

Learn New Moves!

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As style changed a new group entered the top of the hip scale.
For most it meant a serious restart or a stop altogether.

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Staying Alive Erlang Style

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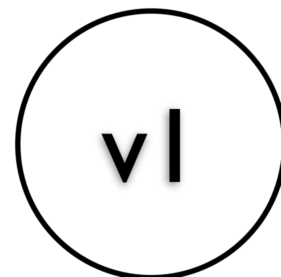
With Erlang you can survive upgrades without loosing service.
Along with the code change signal you specify how the internal state of the process should be updated before continuing.

Staying Alive Erlang Style

Process running



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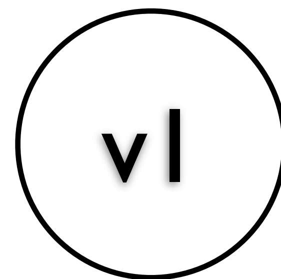

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Staying Alive Erlang Style

Process running

Code loaded: v2

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Staying Alive Erlang Style

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Code loaded: v2

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Challenges

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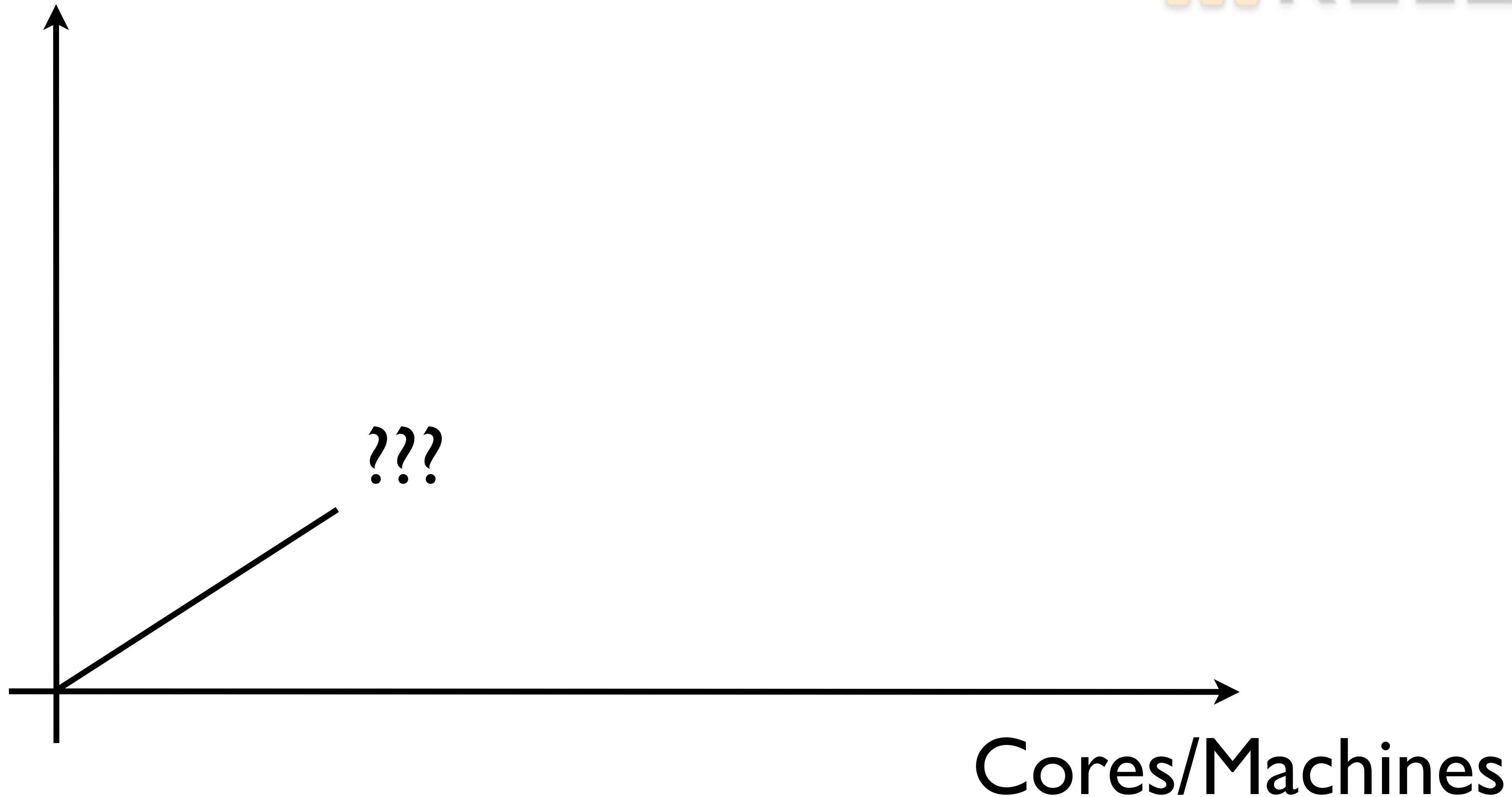
18

How Will I Know If It Really Scales?



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A Scalability Benchmark Suite for Erlang/OTP.
http://www.softlab.ntua.gr/release/bencherl/index.html
A number of synthetic benchmarks plus real-world (dialyzer and scalaris).
Extendable to test your own application.

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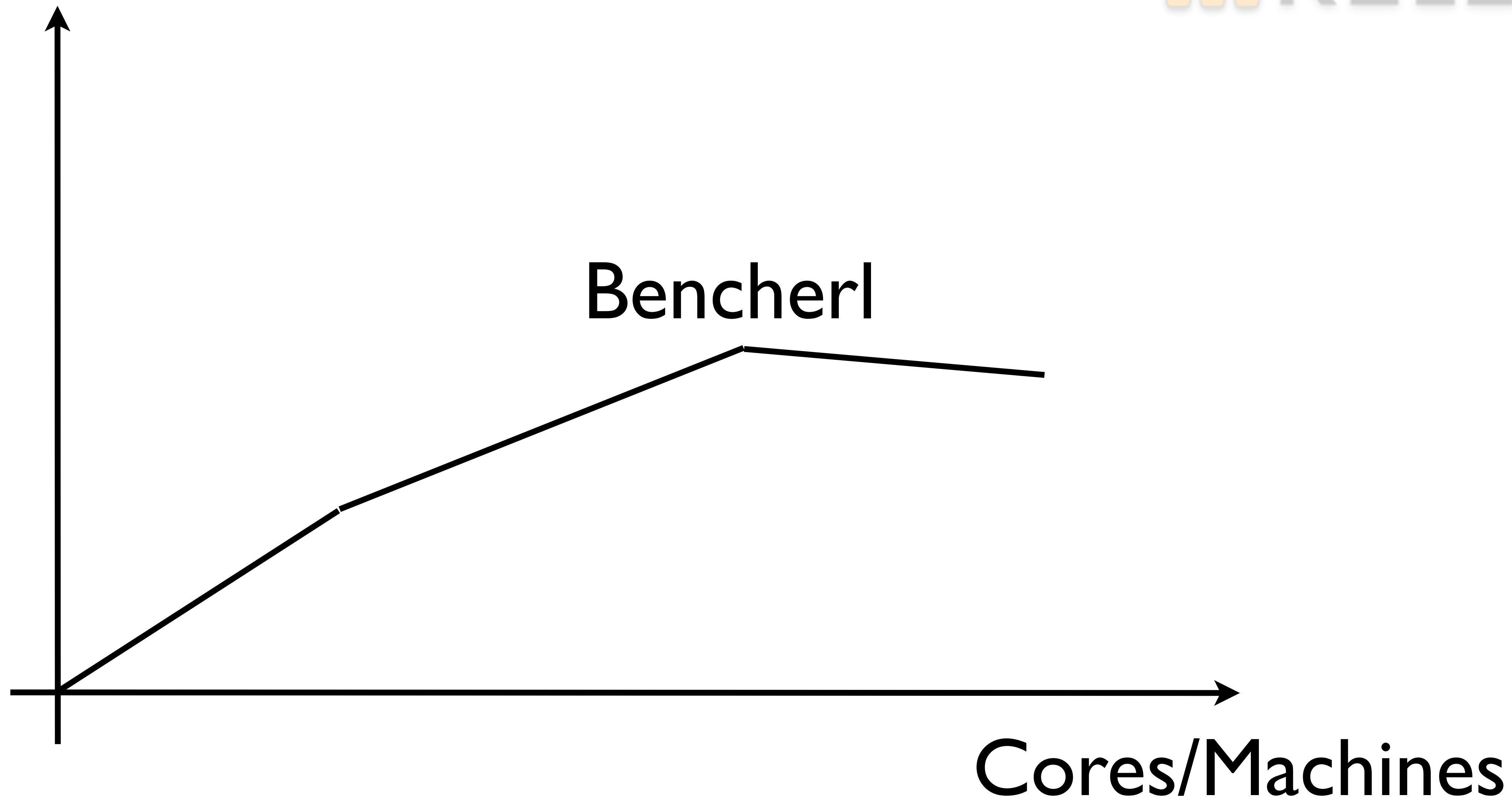

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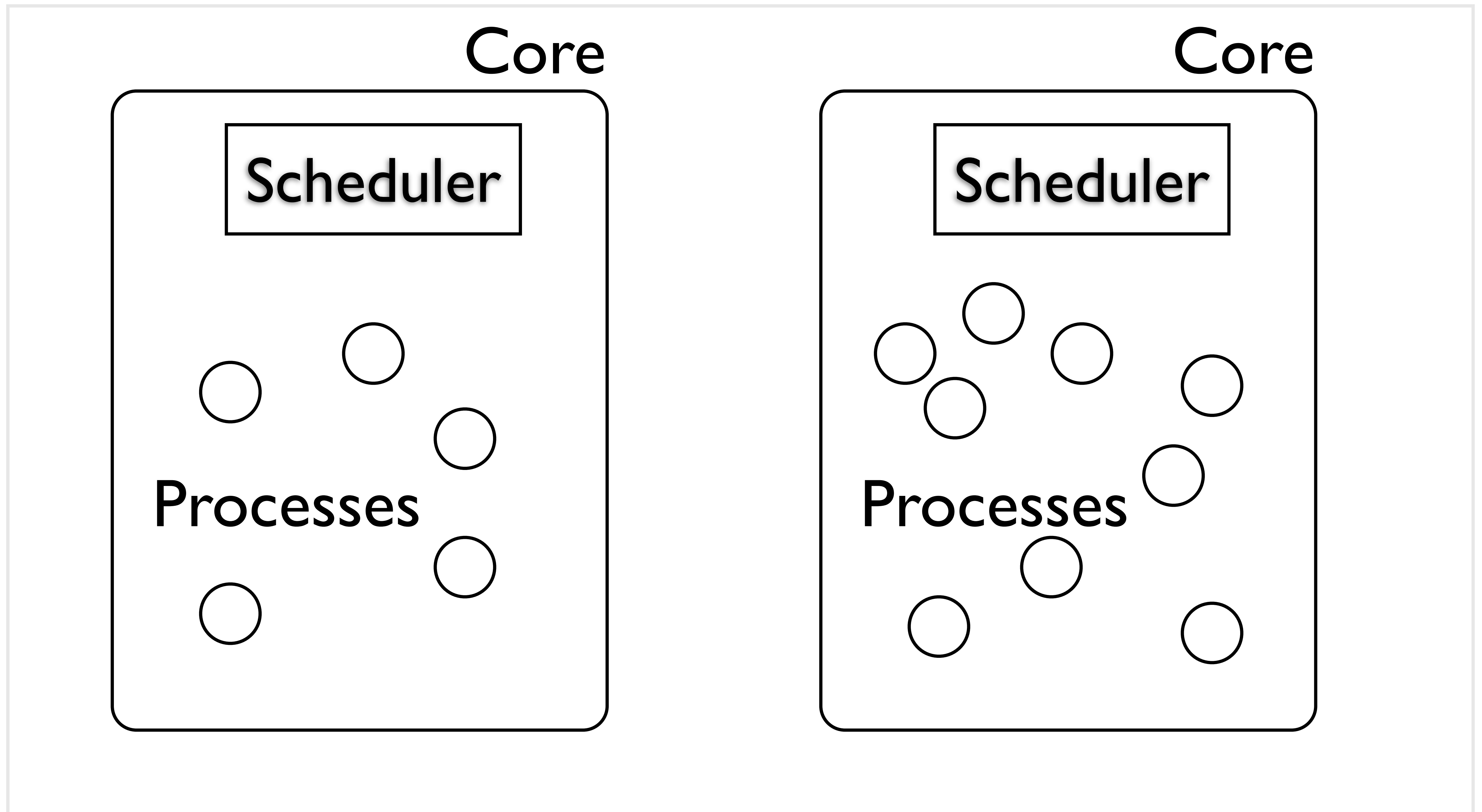
Who Is Doing What?

RELEASE



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Who Is Doing What?

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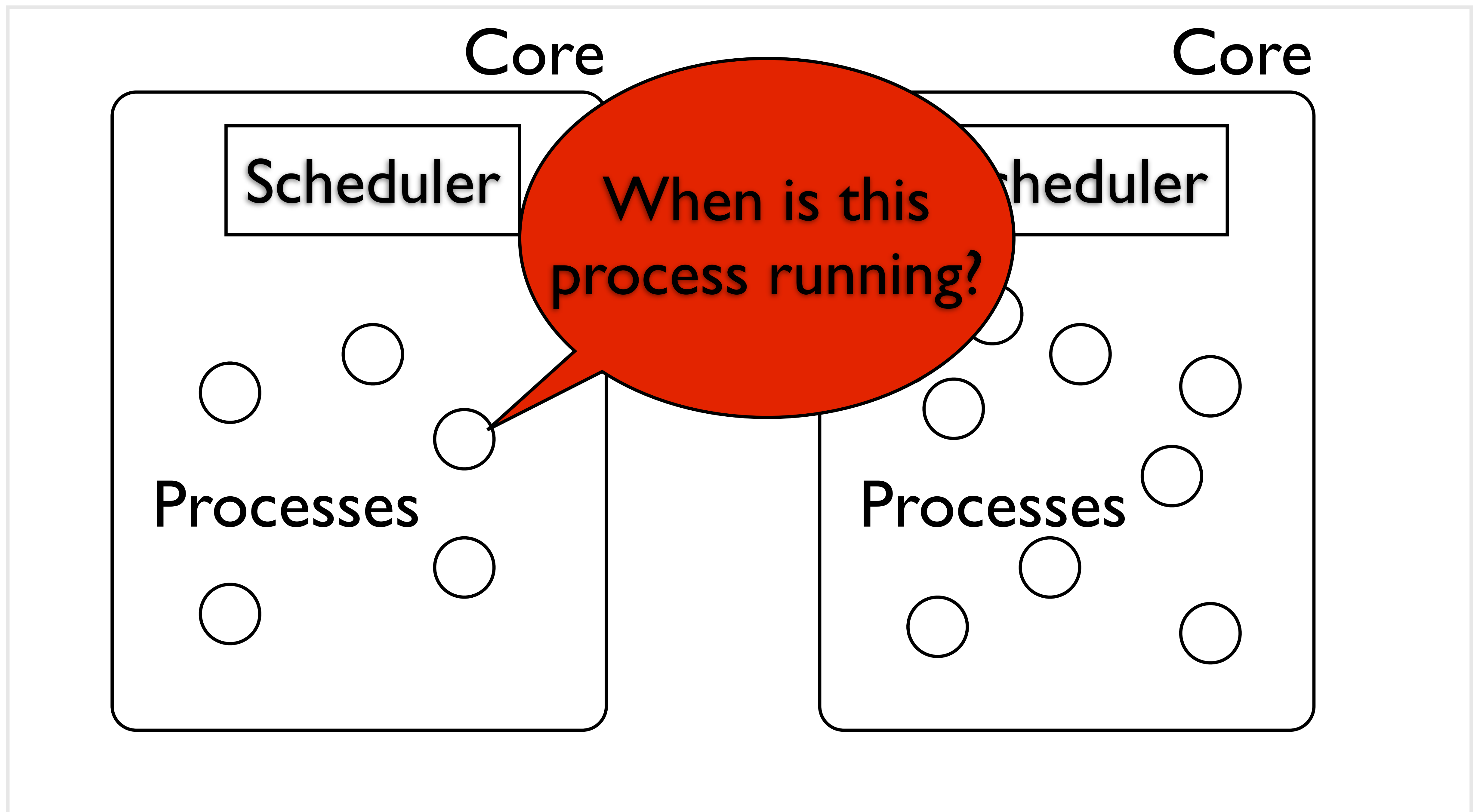

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Who Is Doing What?

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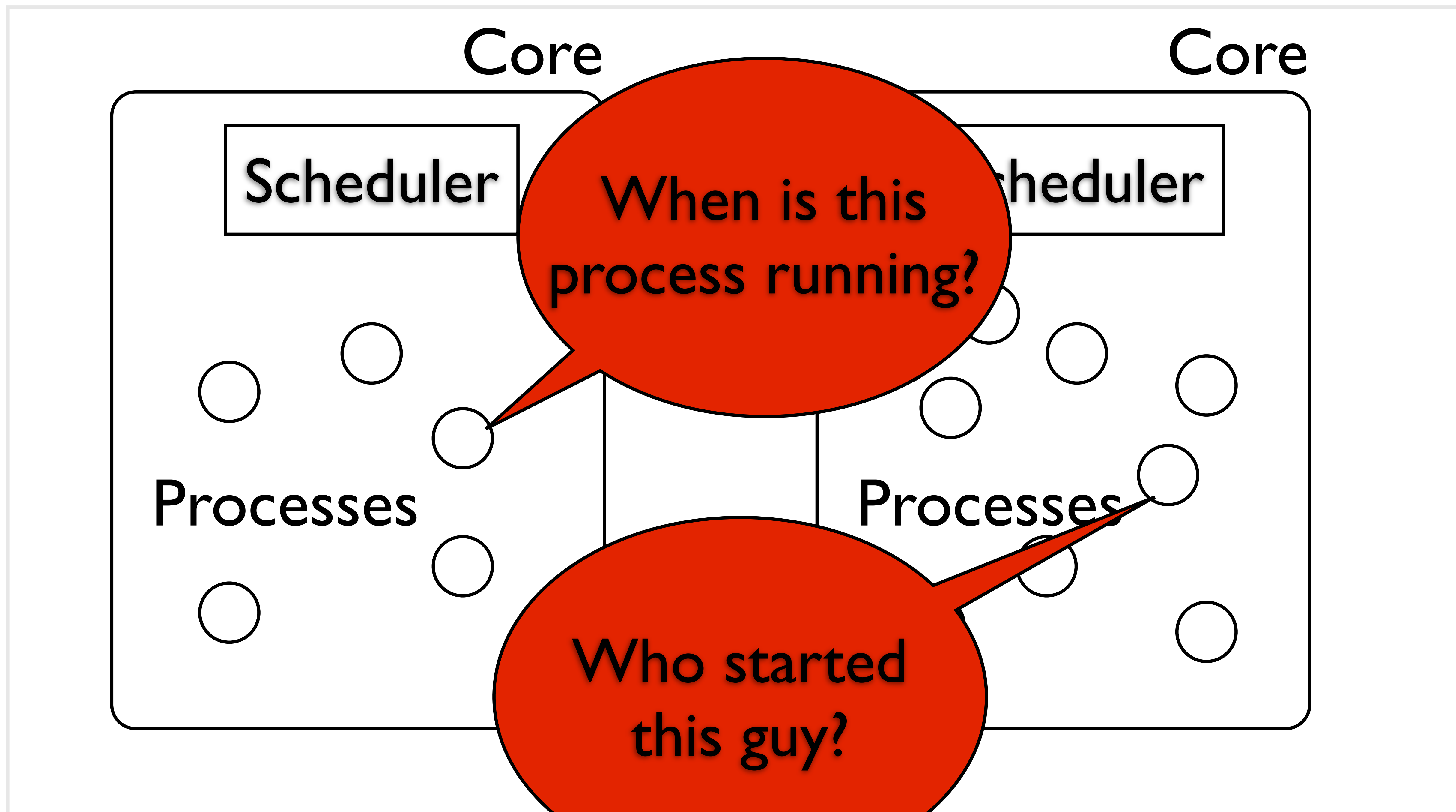

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Percept2 To The Rescue

Active functions

overview | processes | ports | function activities | inter-node messaging

pid	module:function/arity	activity	function start/end secs	monitor start/end secs
<0.36.0>	{sim_code,sim_code_detection,8}		{1.0e-6,2.854873}	{0.419,1.1255}
<0.36.0>	{sim_code,sim_code_detection,4}		{0.016239,2.839082}	{0.419,1.1255}
<0.36.0>	{sim_code,sim_code_detection_1,6}		{0.016253,2.607782}	{0.419,1.1255}
<0.36.0>	{sim_code,generalise_and_hash_ast,6}		{0.016274,2.607782}	{0.419,1.1255}
<0.36.0>	{sim_code,pforeach,2}		{0.016275,2.607782}	{0.419,1.1255}
<0.775.0>	{sim_code,pforeach_1,3}		{0.016385,2.607765}	{0.419,1.1255}
<0.775.0>	{sim_code,'-generalise_and_hash_ast/6-fun-0-',6}		{0.016386,2.607761}	{0.419,1.1255}
<0.775.0>	{sim_code,generalise_and_hash_file_ast_1,7}		{0.016387,2.607761}	{0.419,1.1255}
<0.775.0>	{sim_code,pforeach,2}		{1.107858,2.607761}	{0.419,1.1255}
<0.776.0>	{sim_code,pforeach_1,3}		{0.016393,0.454145}	{0.419,1.1255}
<0.776.0>	{sim_code,'-generalise_and_hash_ast/6-fun-0-',6}		{0.016394,0.454131}	{0.419,1.1255}
<0.776.0>	{sim_code,generalise_and_hash_file_ast_1,7}		{0.016395,0.454131}	{0.419,1.1255}
<0.776.0>	{sim_code,pforeach,2}		{0.265244,0.454131}	{0.419,1.1255}
<0.780.0>	{sim_code,pforeach_1,3}		{0.016425,0.454381}	{0.419,1.1255}
<0.780.0>	{sim_code,'-generalise_and_hash_ast/6-fun-0-',6}		{0.016426,0.454377}	{0.419,1.1255}
<0.780.0>	{sim_code,generalise_and_hash_file_ast_1,7}		{0.016427,0.454377}	{0.419,1.1255}
<0.780.0>	{sim_code,pforeach,2}		{0.32833,0.454377}	{0.419,1.1255}
<0.891.0>	{sim_code,pforeach_0,3}		{0.26539,0.454128}	{0.419,1.1255}
<0.891.0>	{sim_code,pforeach_wait,2}		{0.265718,0.454116}	{0.419,1.1255}
<0.891.0>	{sim_code,pforeach_wait,2}		{0.265979,0.454116}	{0.419,1.1255}
<0.893.0>	{sim_code,pforeach_1,3}		{0.265735,0.454025}	{0.419,1.1255}
<0.893.0>	{sim_code,'-generalise_and_hash_file_ast_1/7-fun-1-',2}		{0.265736,0.45402}	{0.419,1.1255}
<0.893.0>	{sim_code,'-generalise_and_hash_file_ast_1/7-fun-0-',6}		{0.265737,0.45402}	{0.419,1.1255}
<0.893.0>	{sim_code,generalise_and_hash_function_ast,6}		{0.265738,0.45402}	{0.419,1.1255}

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Percept: Erlang Concurrency Profiling Tool, utilizes trace informations and profiler events to form a picture of the processes's and ports runnability.
Percept2 is an extension of Percept (part of the OTP release).
Extensions: # of schedulers active, active functions, process migration, message passing stats, inter-node communication

Memory Alloc Previously

R12B-1

Thread 1 ... Thread N

Scheduler 1 | Scheduler 2 | ... | Scheduler N

sl_alloc
eheap_alloc
binary_alloc

sl_alloc
eheap_alloc
binary_alloc

...

sl_alloc
eheap_alloc
binary_alloc

ets_alloc | ets_alloc | ets_alloc

mseg_alloc

RELEASE

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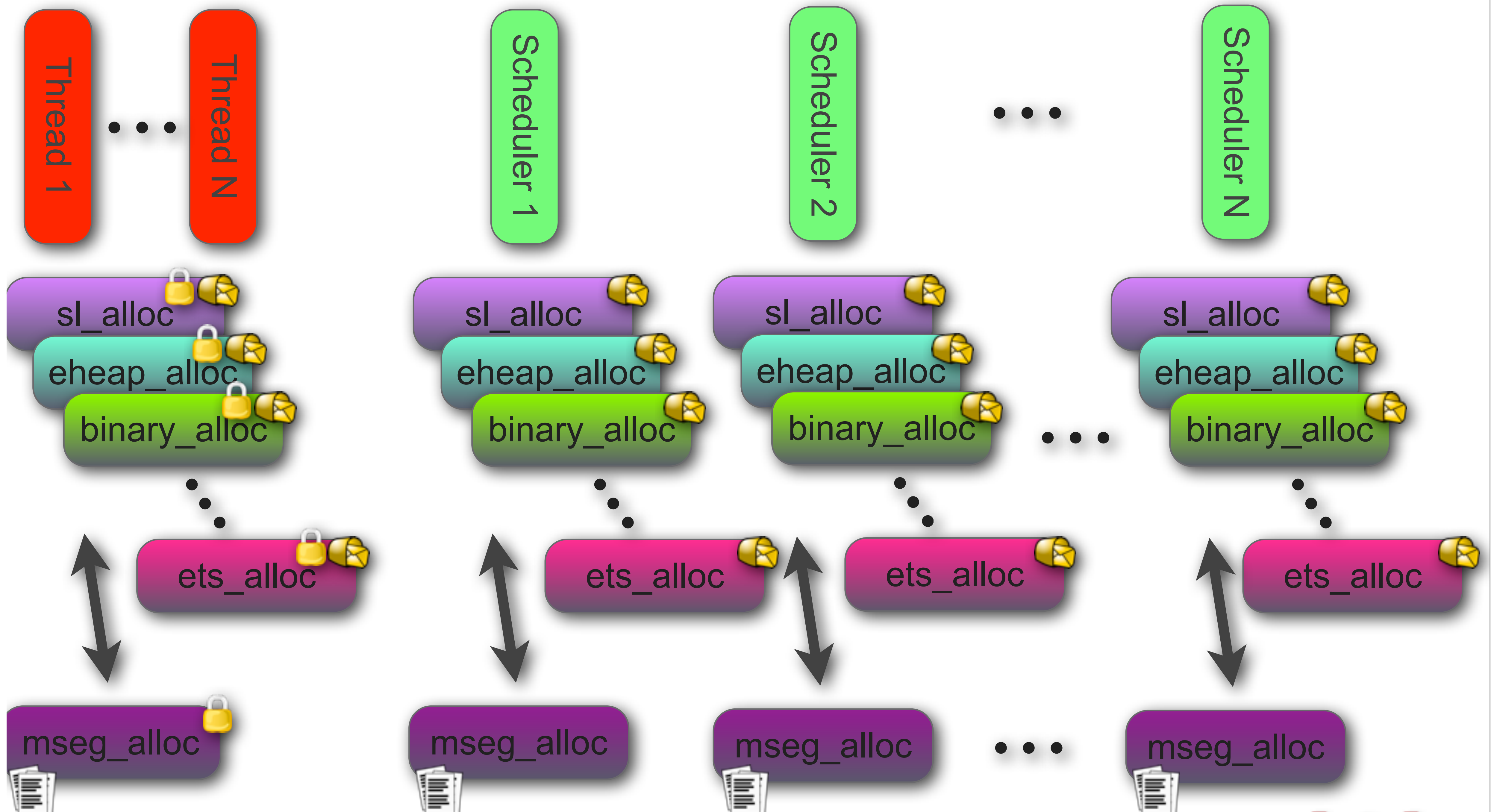
One central memory allocator for all schedulers on the same machine

Memory Alloc Now



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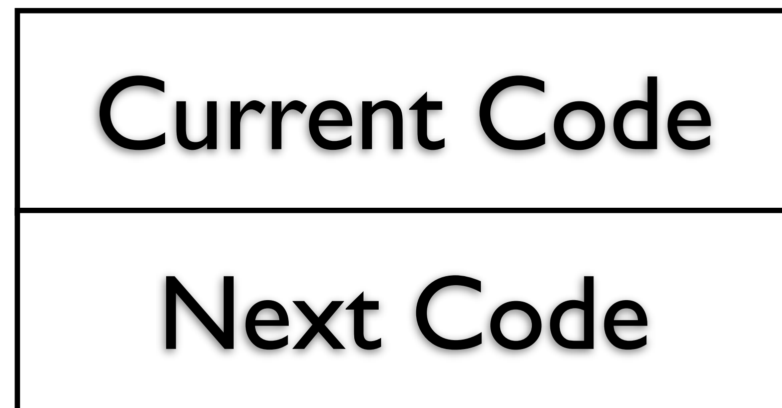
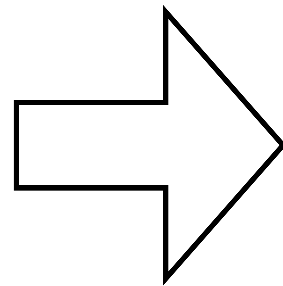
One central memory allocator for all schedulers on the same machien

Upgrading Blocks



Load code  All schedulers blocked

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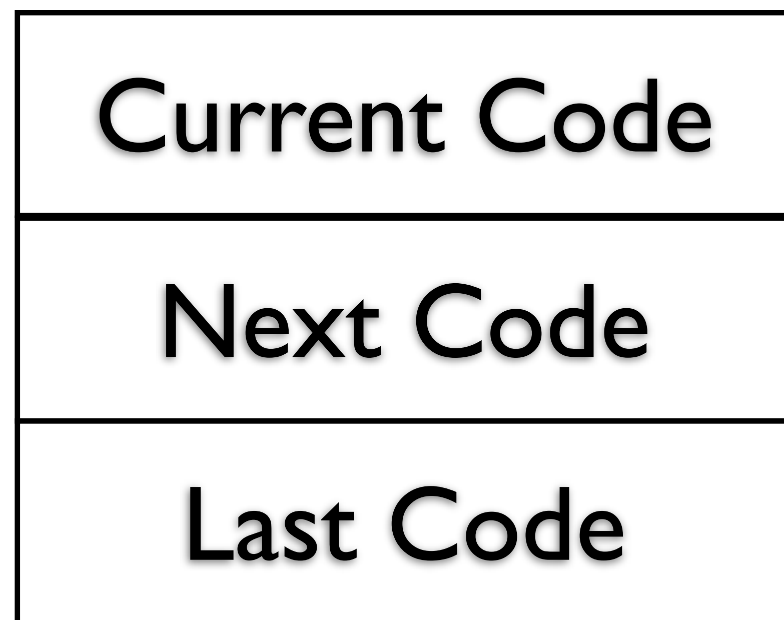
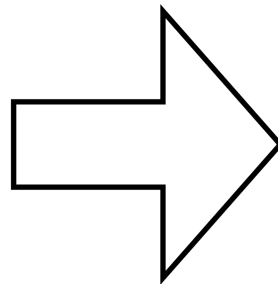
Upgrade Without Blocking



Load code



Each scheduler does it when needed

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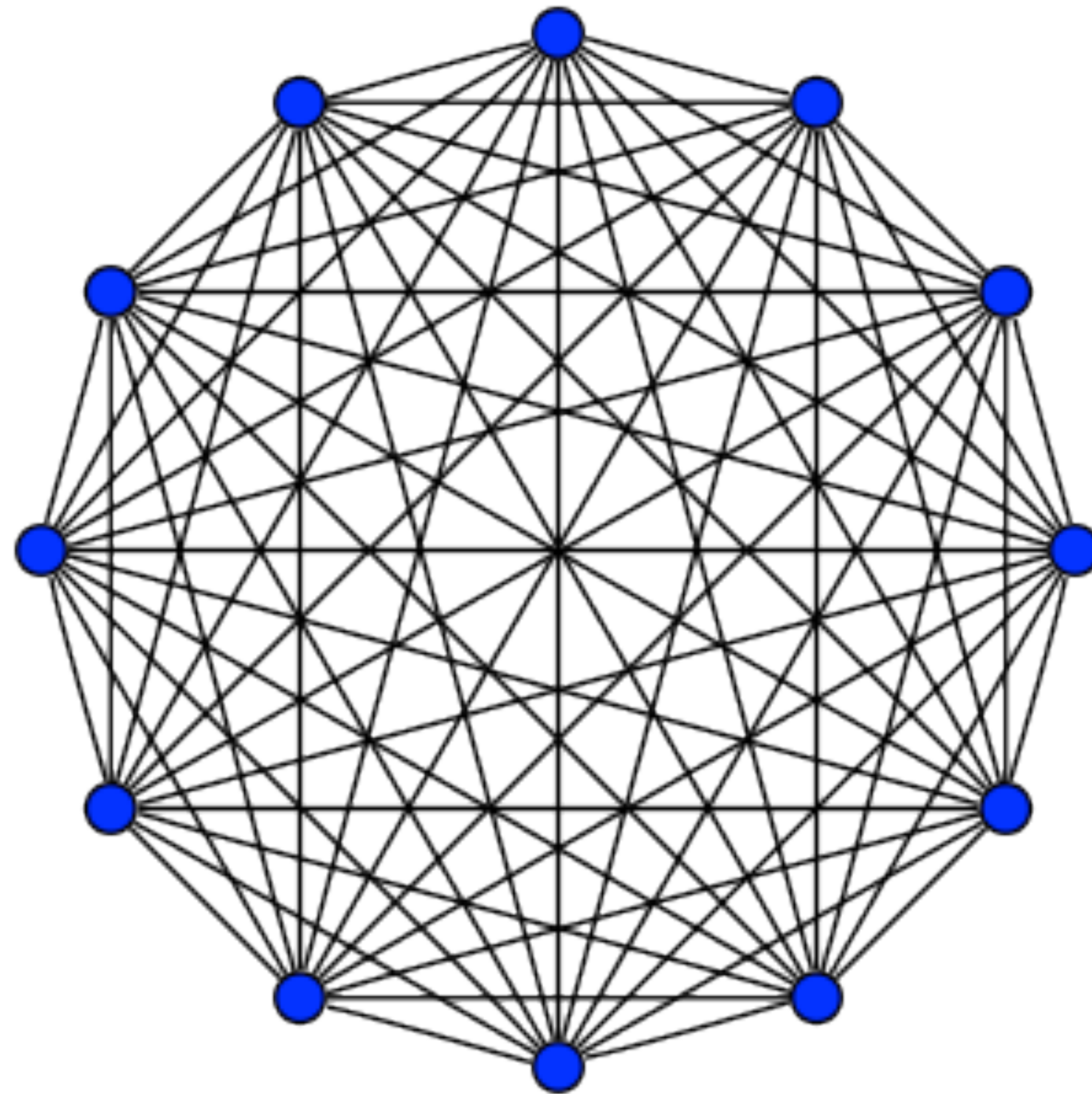
Coming in R16!

Fully Connected



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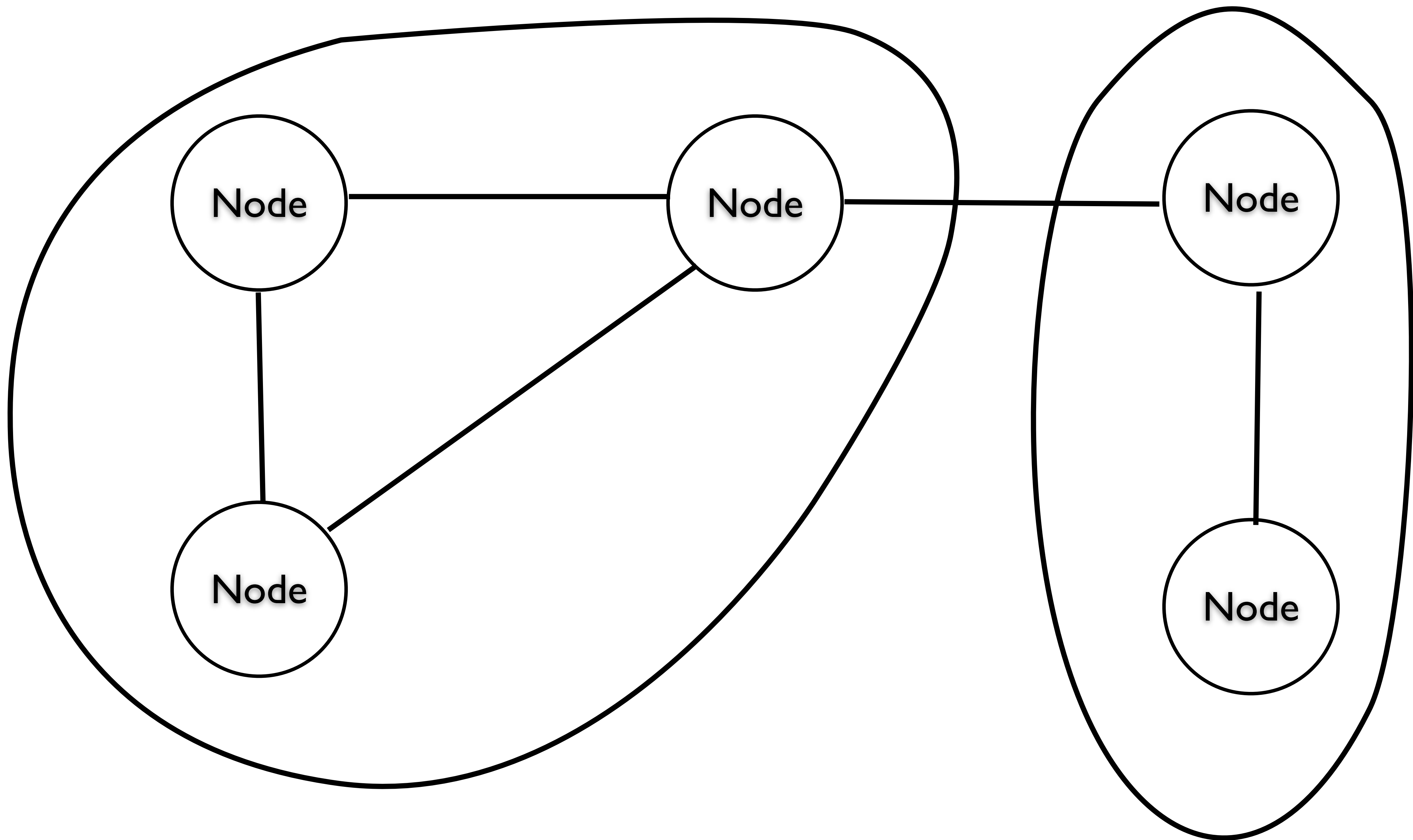
26

Erlang connects all nodes fully.
So you get a lot of connections.

Scaling Over Machines

RELEASE



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A fully connected system might not be right for every problem.
s_groups allows you to create clusters of nodes.
Nodes inside a cluster are fully connected.
Connections between clusters can be arbitrary.

Managing Erlang Systems

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Basic Erlang has the ability to go in and monitor what is going on in any node you can attach yourself to.
But no tool exists to manage a big number of nodes in a coherent fashion.
This is no different from any other language/technology!

Managing Erlang Systems

- Provision machines

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28

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Memory usage
CPU load
Process hierarchy

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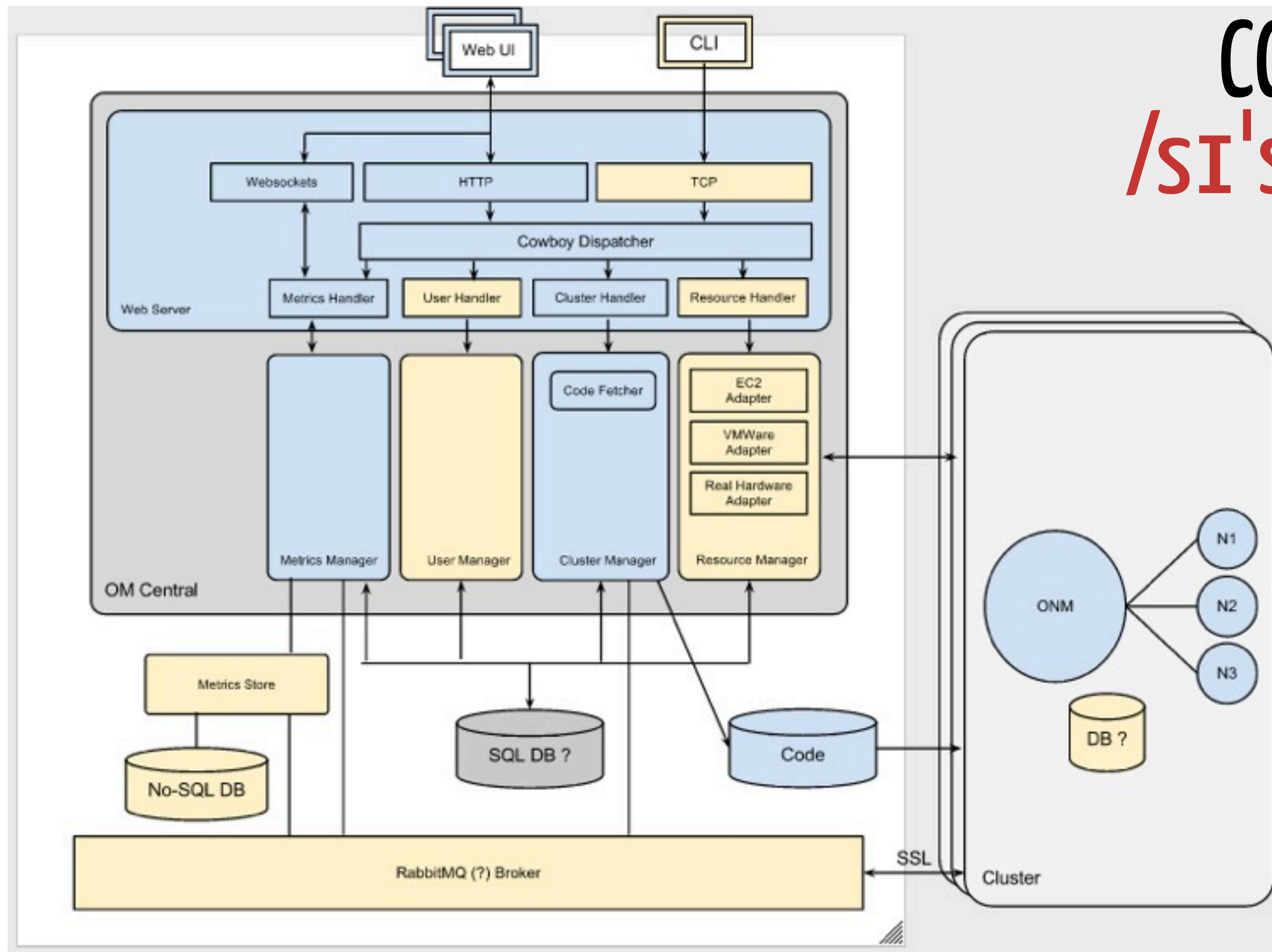
Managing Big Systems

RELEASE



CCL
/sɪˈsɪlɪ/

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Erlang Solutions are building a tool as part of the RELEASE project to manage and operate big Erlang systems.
CCL = Cloud Computing Lace or Cloud Cuckoo Land depending on your mood.

Erlang And Parallelism

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Erlang And Parallelism

- Created for

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Erlang And Parallelism

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  - explicit concurrency

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  - ray tracing

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Erlang And Parallelism

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  - highly concurrent systems
- No direct support for
  - matrix multiplication
  - ray tracing
  - coarse grained parallel problems

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Intensional Parallelism

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We are taking the good things from what has been learnt in the Haskell & Data-flow language communities and building a DSL which helps us leverage these types of parallel optimisations"

Intensional Parallelism

- Lucid like: demand-driven data computation
- Find short comings in the Erlang VM
- Variables are infinite streams of values

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```
running_avg
  where
     sum = first(input) fby sum + next(input);
     n = 1 fby n + 1;
     running_avg = sum / n;
  end;
```

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Black magic

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Going Forward

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Going Forward

- Consider Erlang when the problem fits

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Going Forward

- Consider Erlang when the problem fits
- More focus on right tool for the job

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