Why and how to use generators for asynchronous programming

Benoit Viguier
@b_viguier

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Why and how to use generators for asynchronous programming

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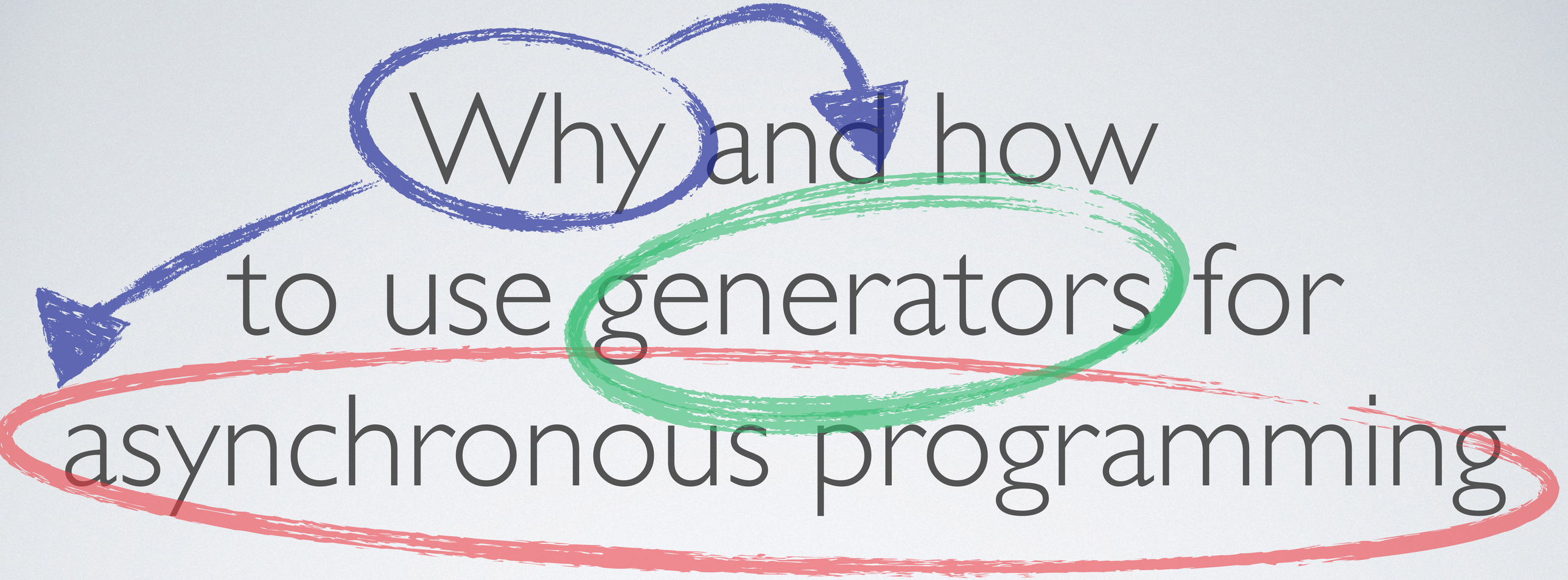

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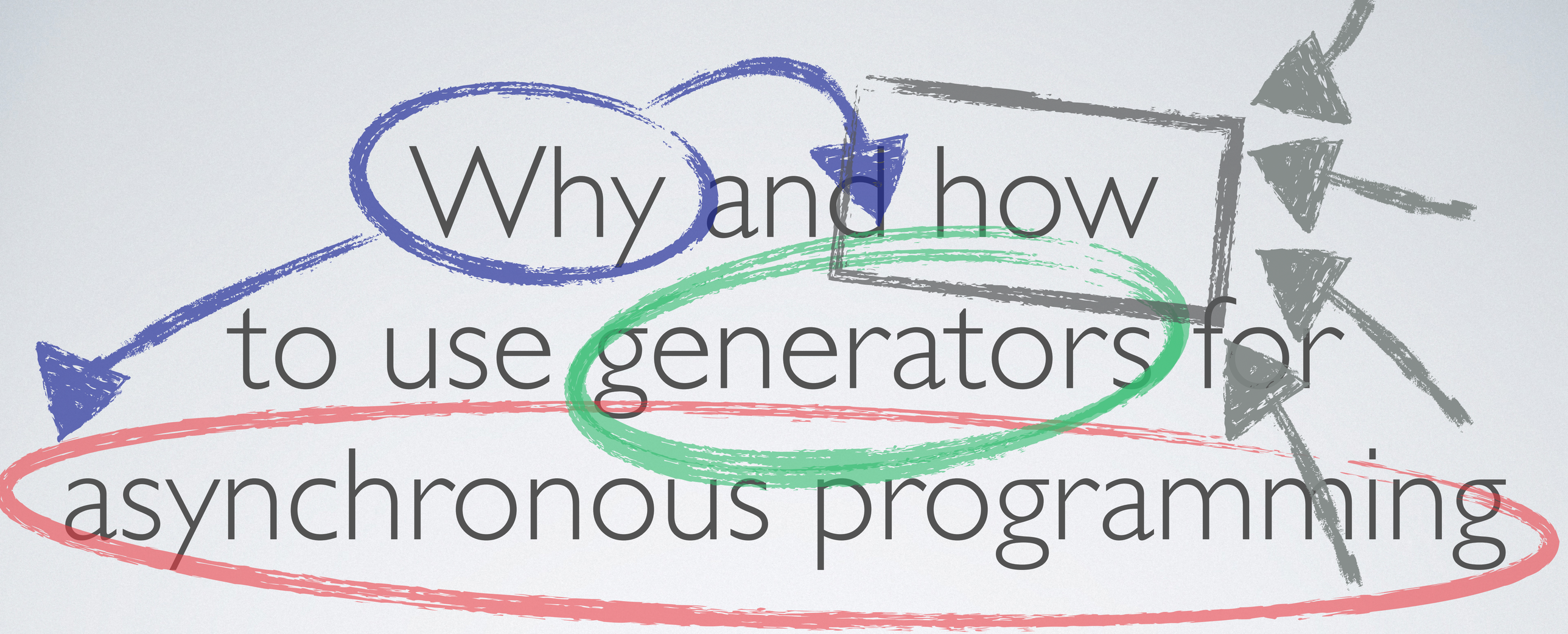

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GROUPE
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- GOLDEN NETWORK

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- W9
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- Ventadis — Vente à distance - Groupe M6
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funradio
etc.
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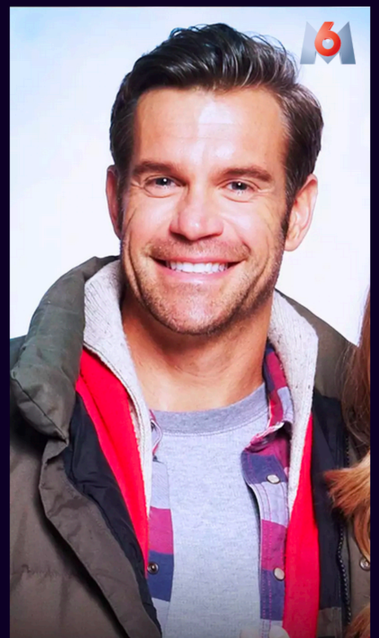
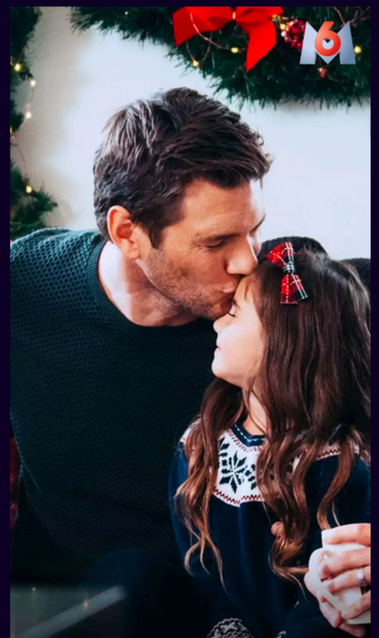
RTL TVI
club RTL
PLUG RTL
etc.
RTL most
RTL KLUB
RTL
etc.
RTL PLAY
RTL
2 RTL
Kockica
DIGITAL CHAPERS
etc.

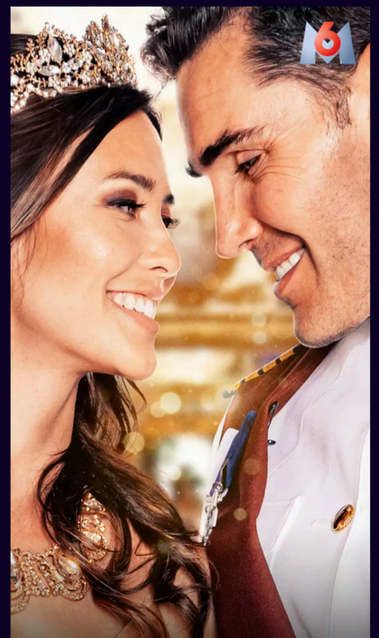

10 Million unique
users per month

Programmes par genre

Le Groupe M6 vous souhaite une bonne année !







One year of asynchronous PHP in production

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Tomorrow, 13:00

Asynchronous Programming

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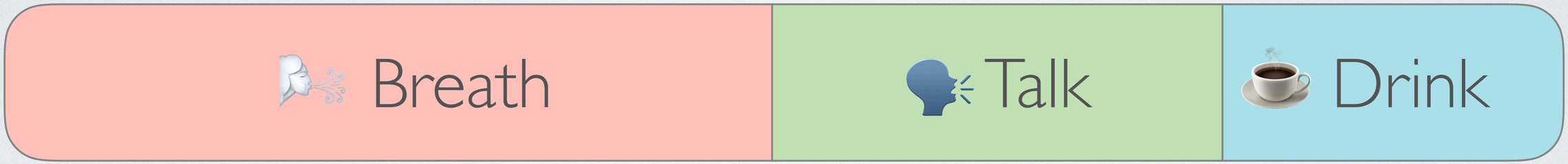
Tea for Two

An illustrated example

Tasks

-  **Drink** Tea
-  **Talk** with a friend
-  **Breath** just… to live

Synchronous

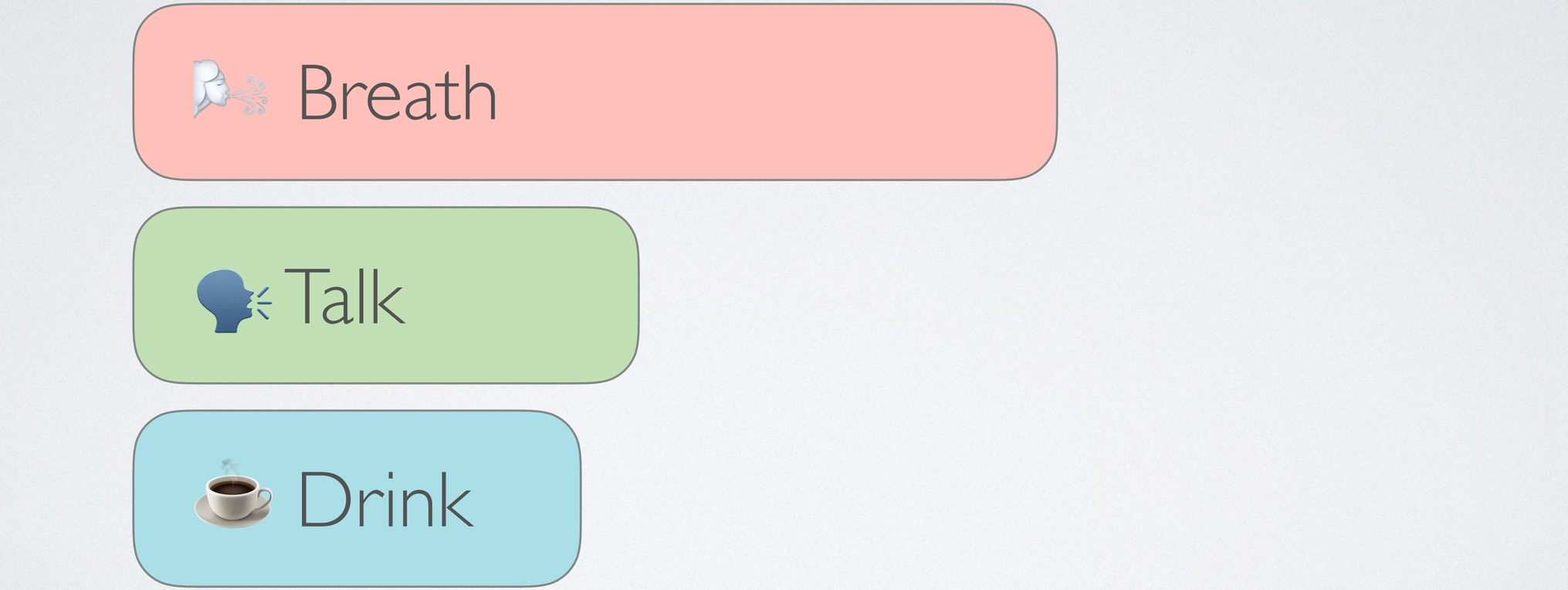


Time

Concurrency

Starting next task before the current one ends

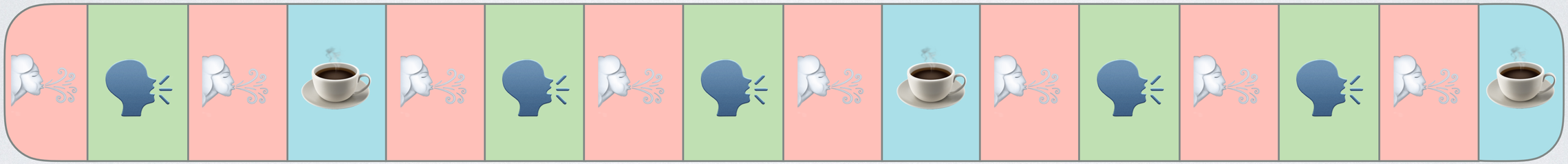
Parallel



Most languages are single threaded

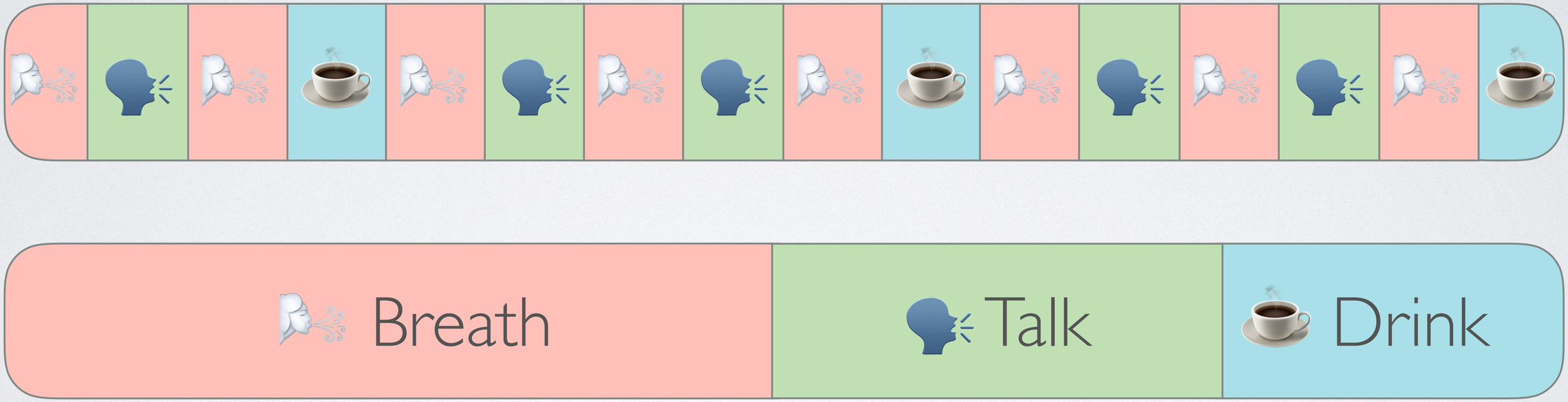
… by default

Asynchronous



Time

But… 🤔



Analyzing tasks

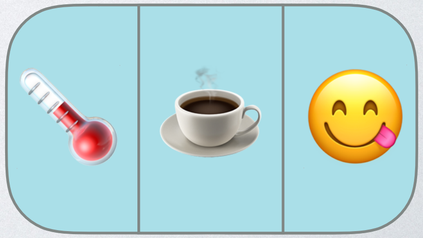
Internal/External operations

Drinking Tea

Waiting for the right temperature

Drinking (actually)

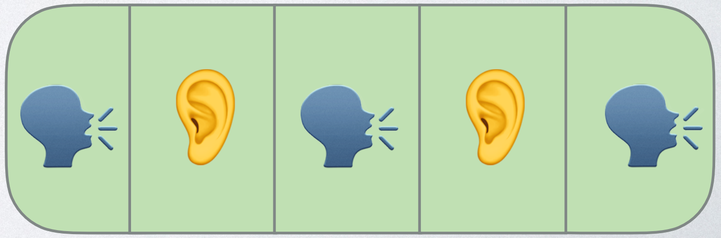
Enjoying



🗣️ **Talking** with a friend

🗣️ Speaking, asking something

👂 Listening

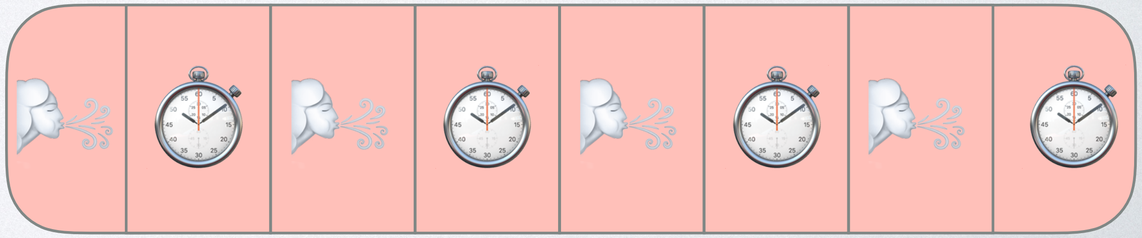


Breathing

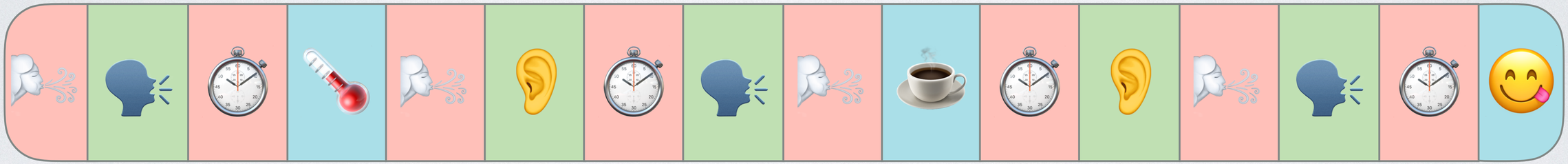
Breathing…

Waiting (a little)

Breathing…

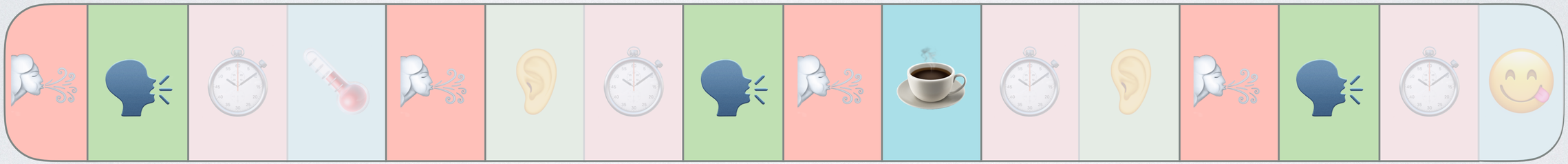


Asynchronous



Time

Internal operations



Time

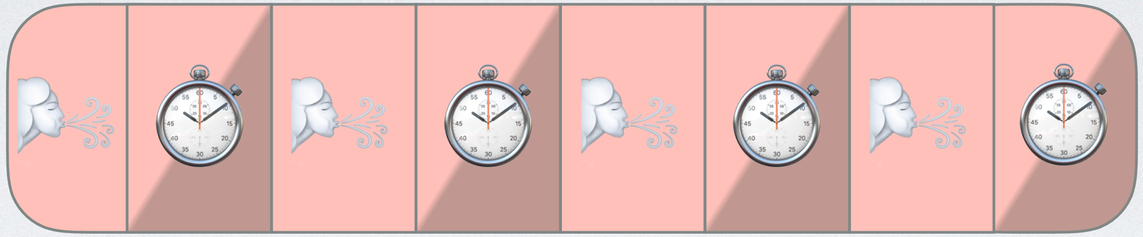
External operations

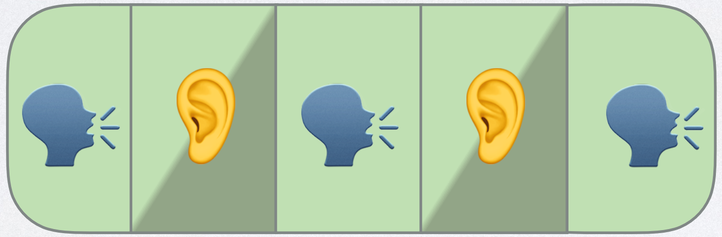
Time

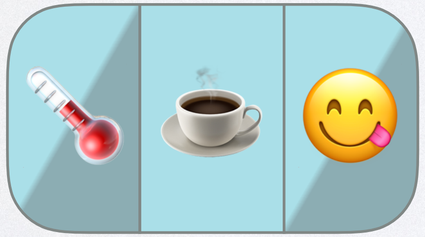
Dispatching execution

Event Loop

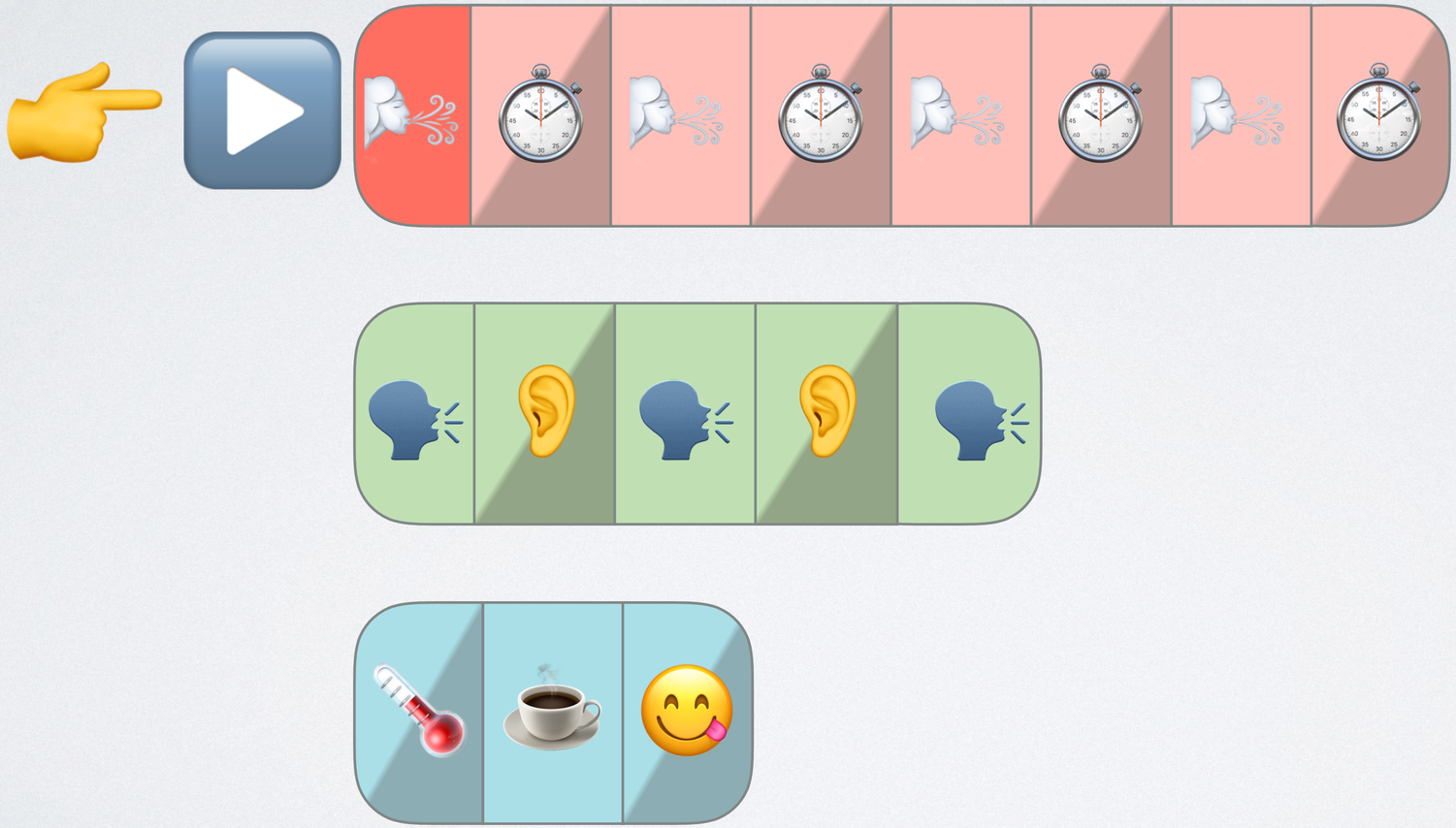
Event Loop



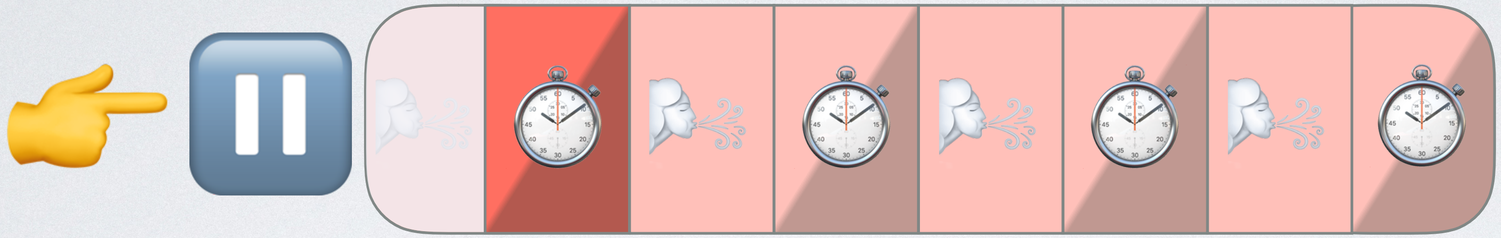


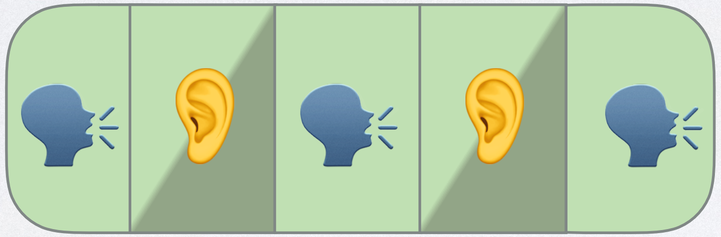


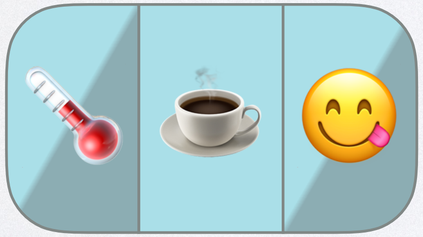
Event Loop



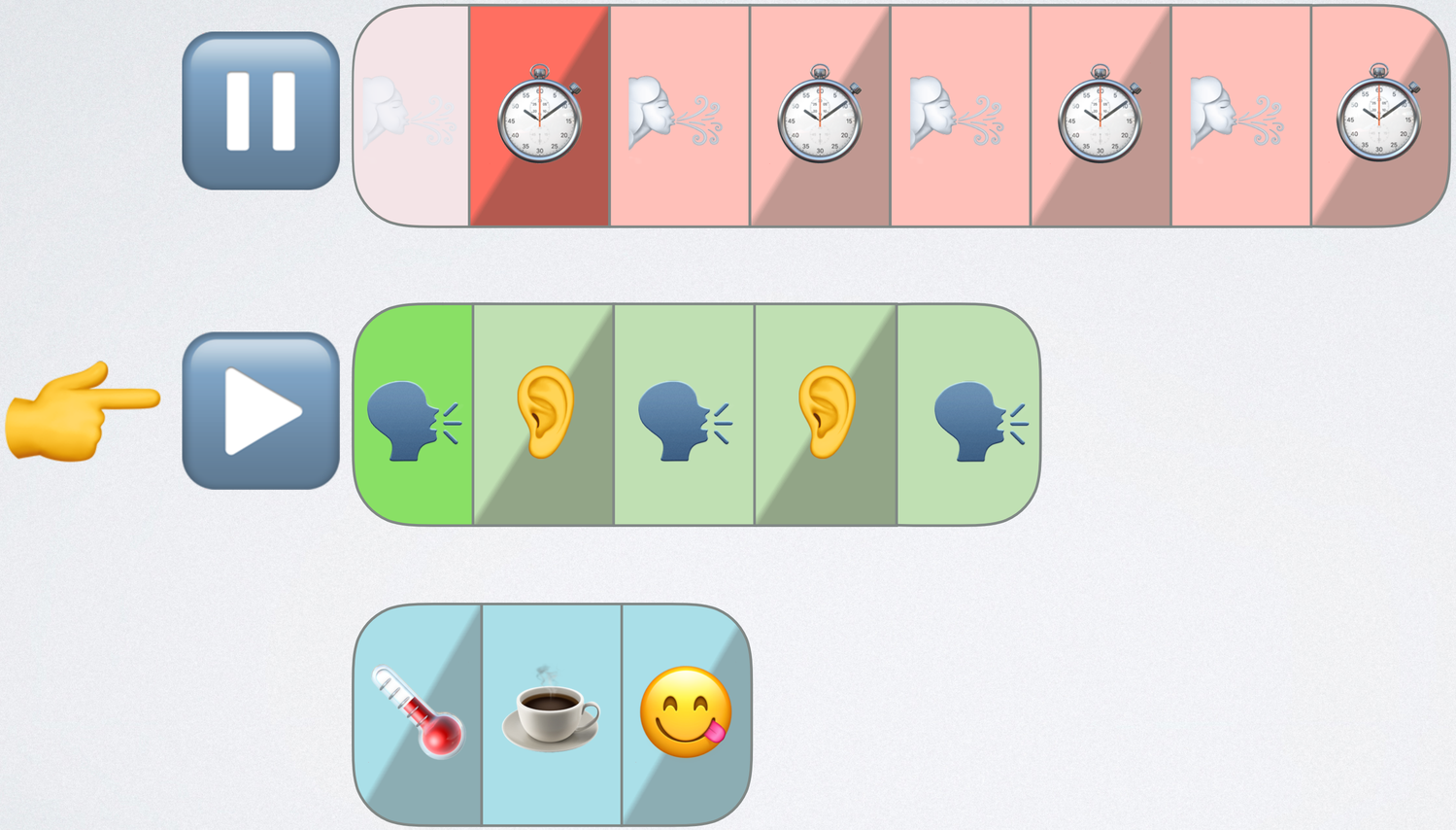
Event Loop







Event Loop

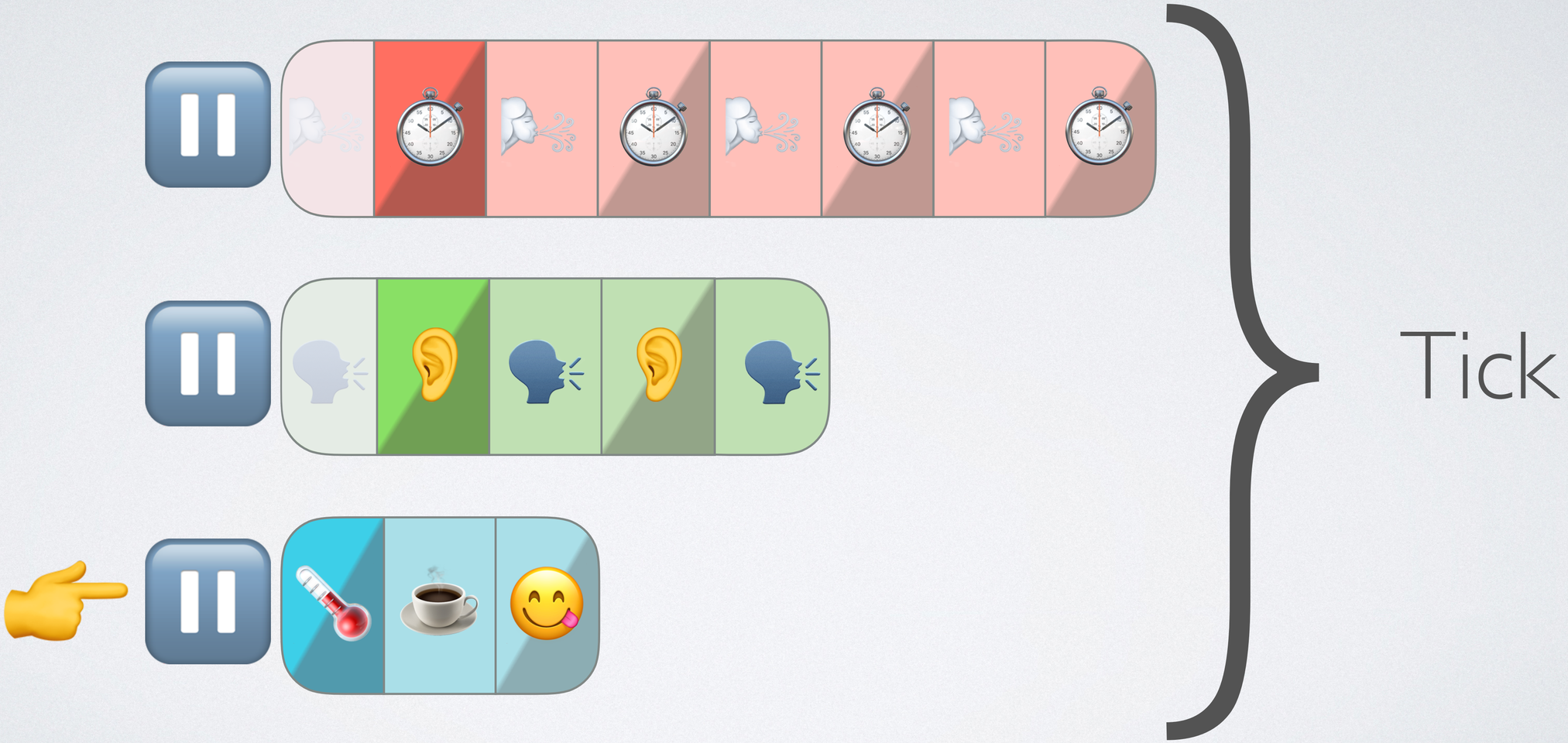


Event Loop

Event Loop

Event Loop

Event Loop



Event **Loop**

Event Loop

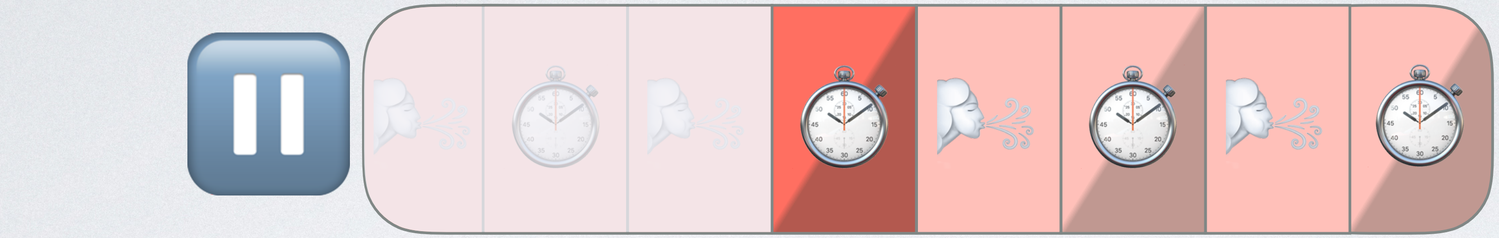
Event Loop

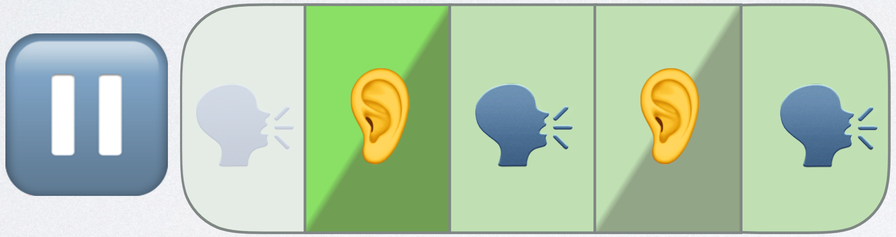
Event Loop

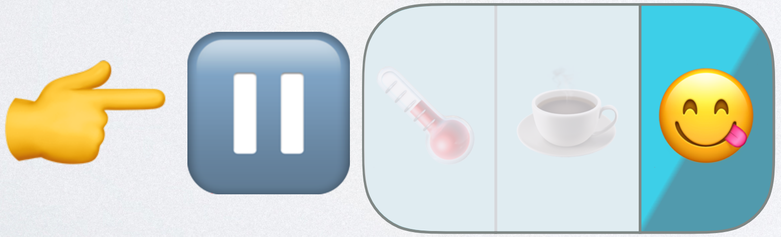
Event Loop

Event Loop

Event Loop







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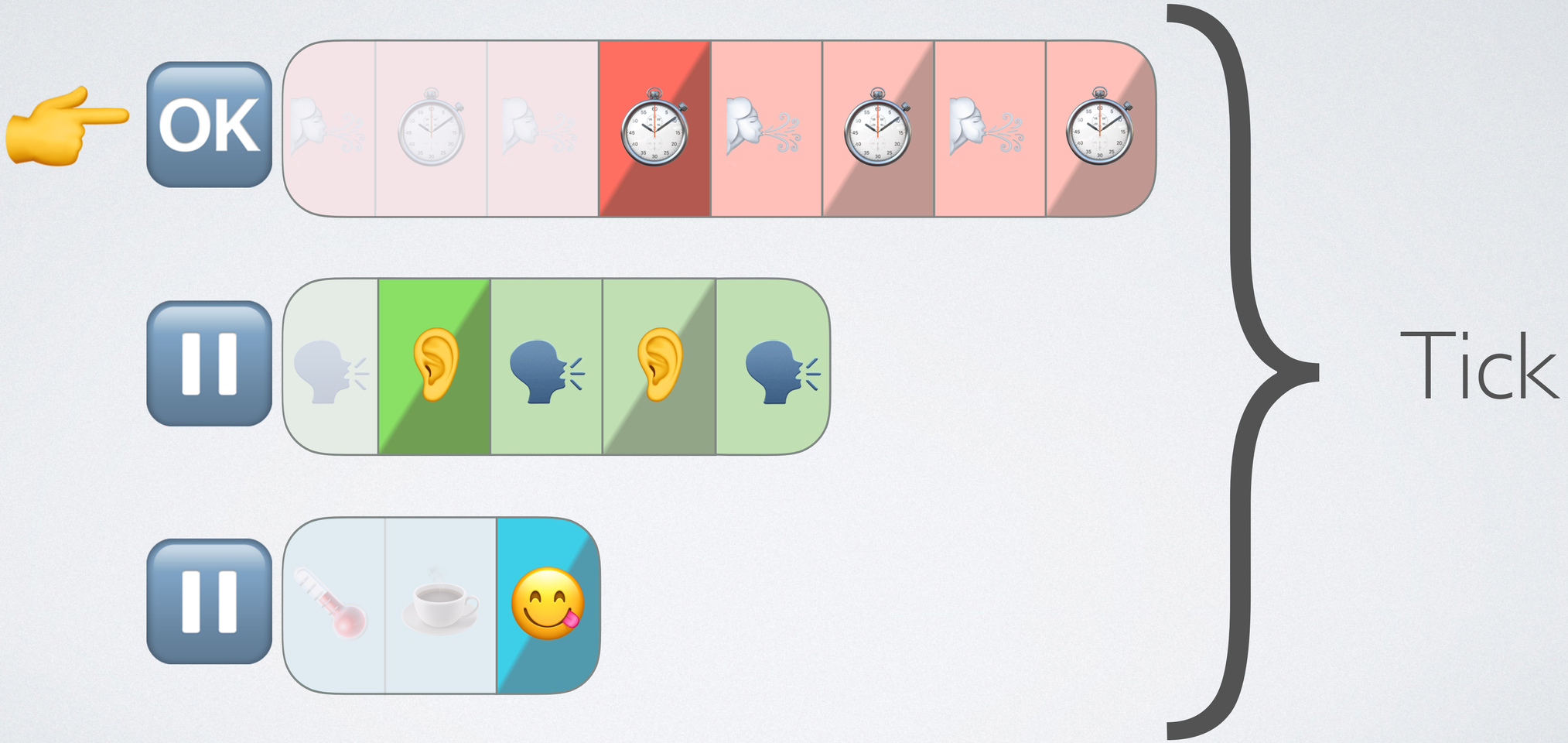

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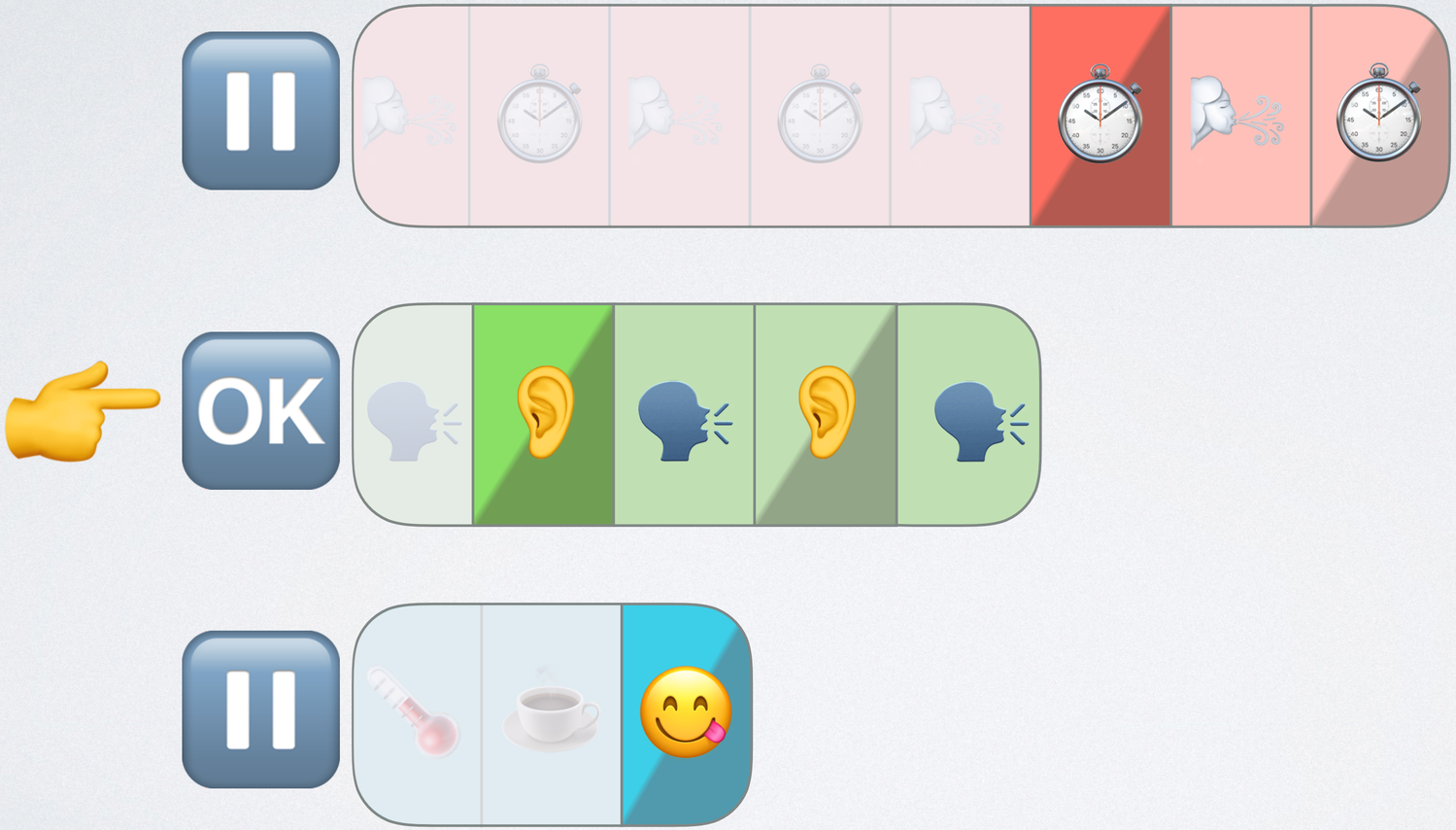

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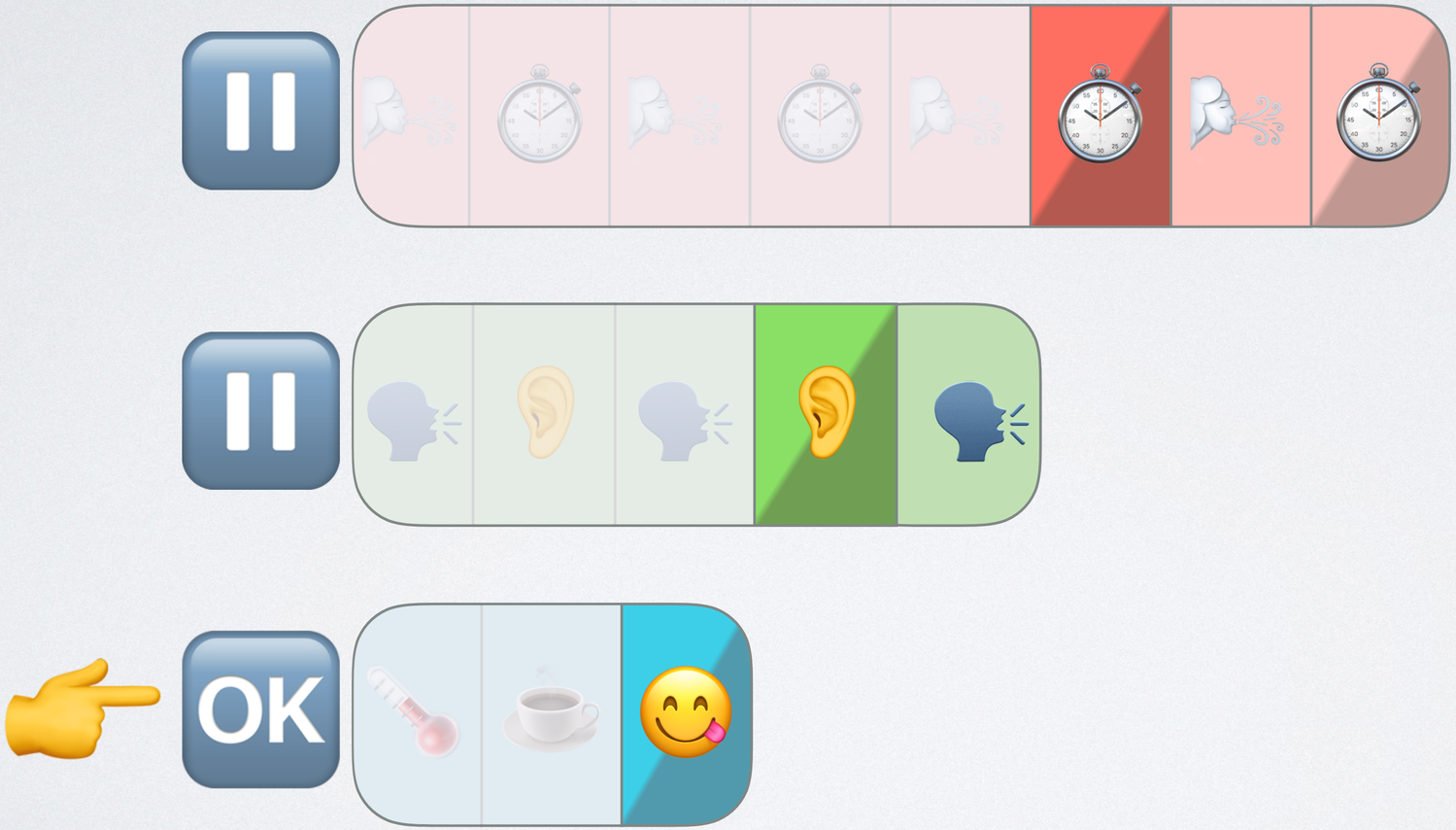

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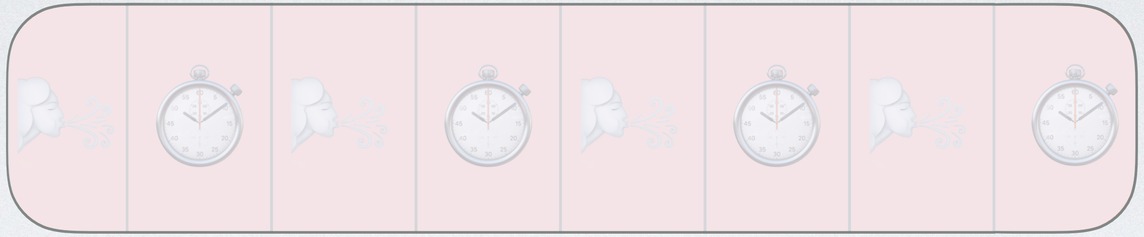
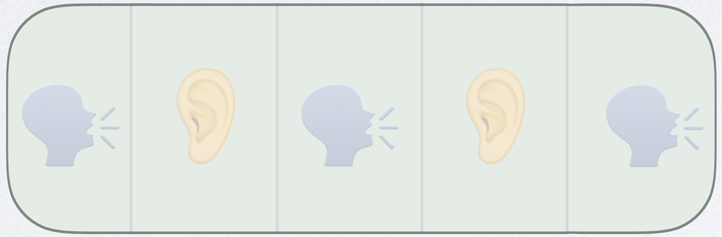
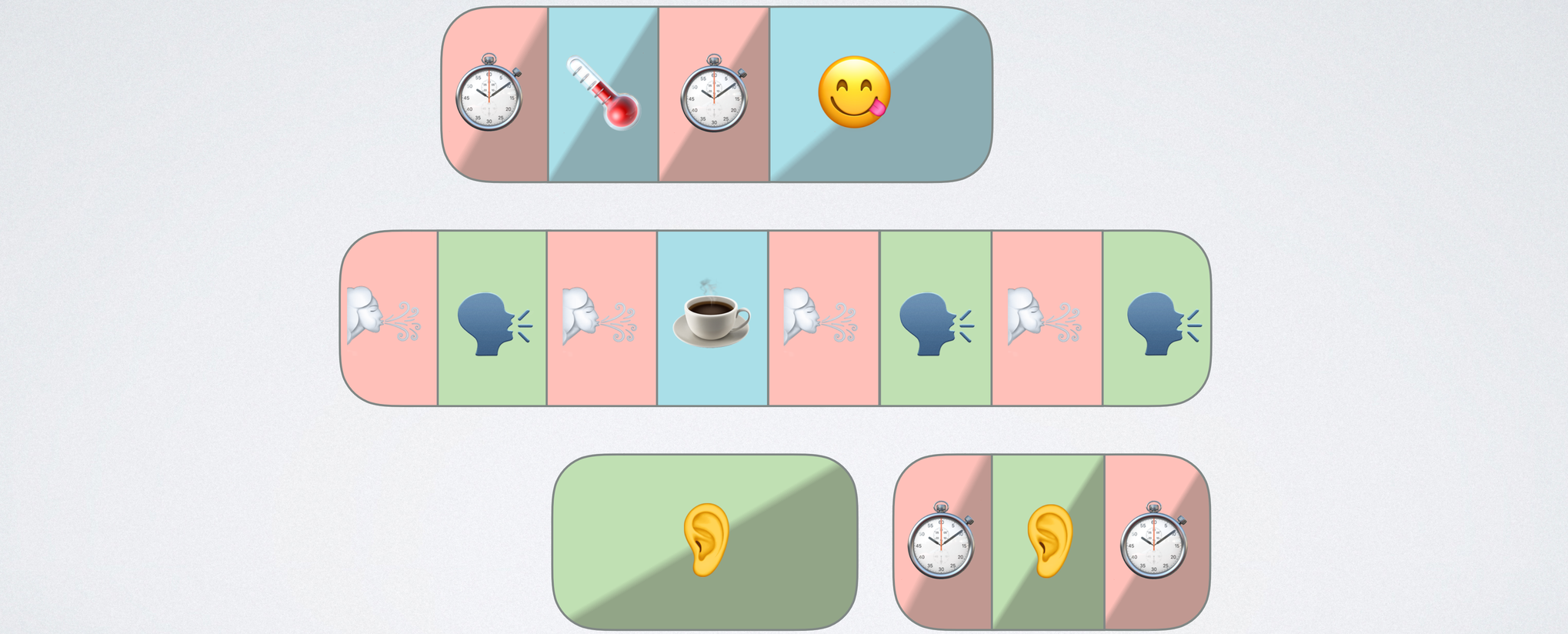


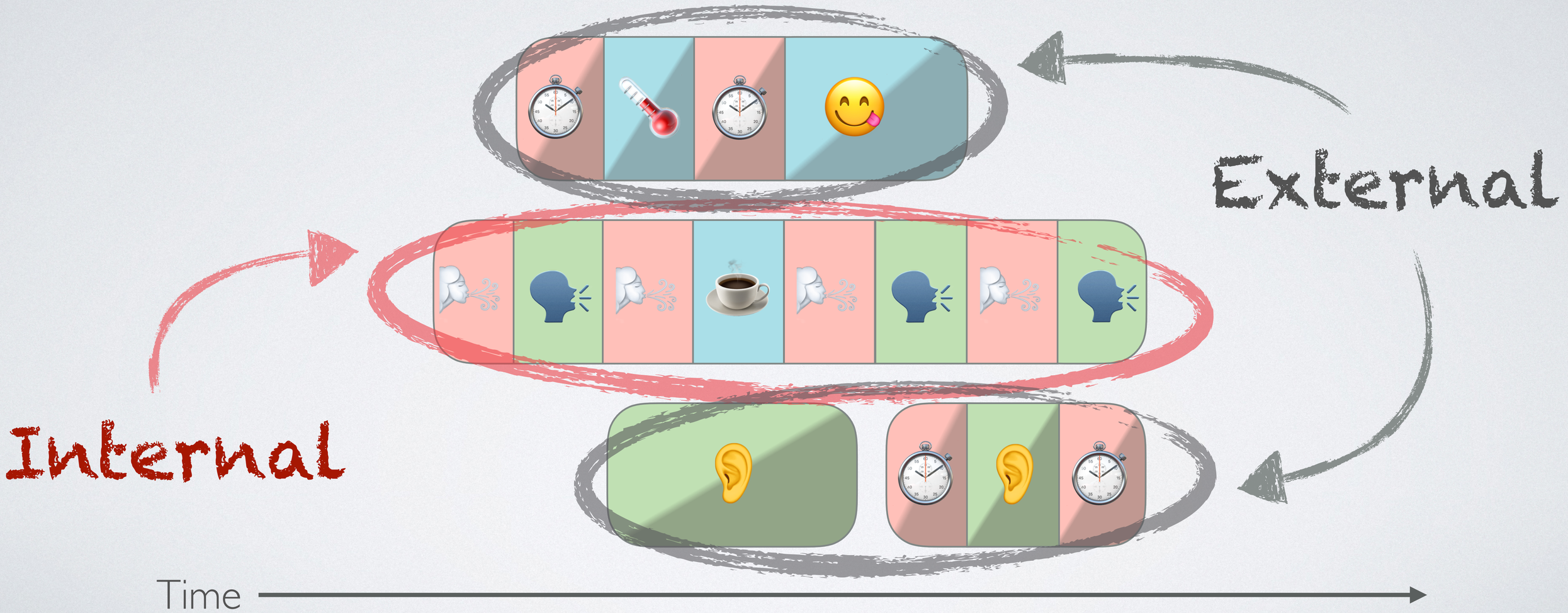


Asynchronous

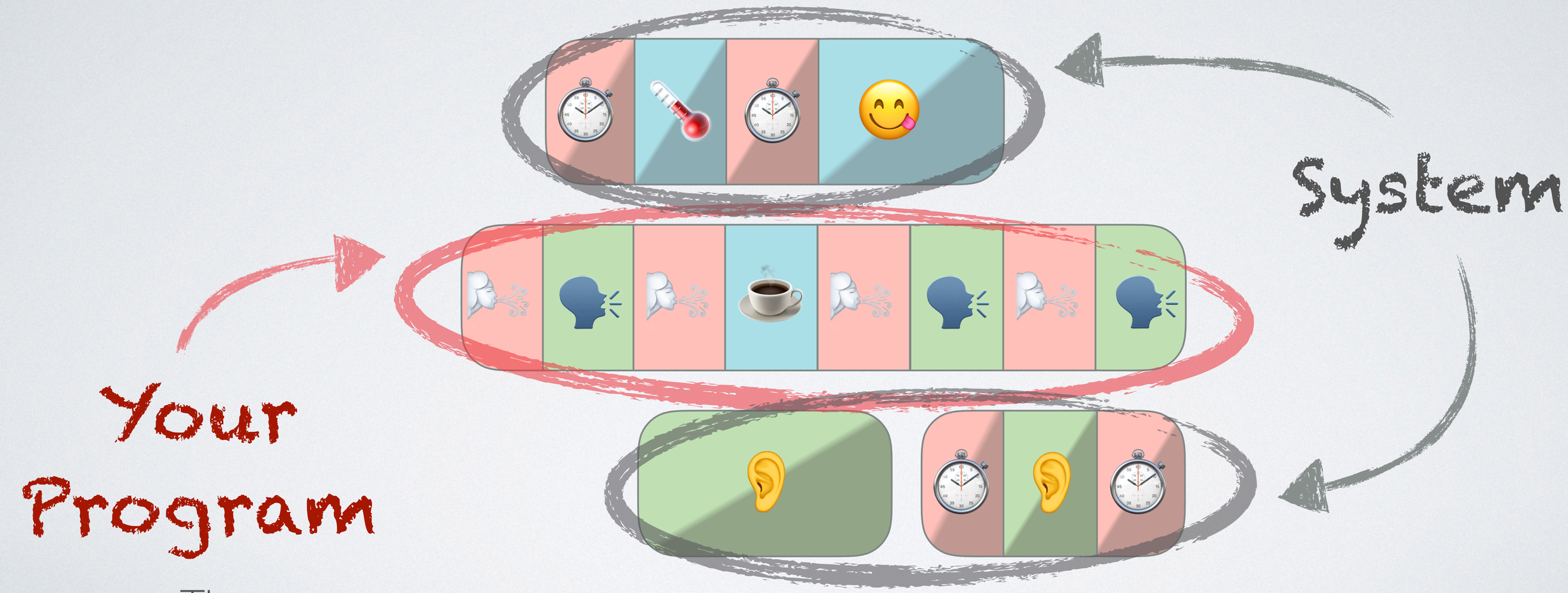


Time

Asynchronous



Asynchronous



How to dispatch code execution efficiently?

Generators

Subset of coroutines

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PARENTAL
ADVISORY
EXPLICIT PHP

Example

```php
function gen_one_two_three() {
    for ($i = 1; $i <= 3; $i++) {
        yield $i;
    }
}

$generator = gen_one_two_three();
foreach ($generator as $value) {
    echo "$value\n";
}
```

Starting with Generators

… by the weird part…

Creation

```
// ❌ Does NOT work
$generator = new \Generator;

// PHP Fatal error:  Uncaught Error:
// The "Generator" class is reserved
// for internal use
// and cannot be manually instantiated
```

Creation

```
function create(): \Generator
{
    yield;
}

$generator1 = create();
$generator2 = create();
```

Only `yield` matters

```php
function emptyGenerator(): \Generator
{
    return 1;
    yield; // Never reached…
}

$generator = emptyGenerator();
```

Execution

```php
function dyingGenerator(): \Generator
{
    die('hard');
    yield;
}
// The function is not executed…
$generator = dyingGenerator();
// Will die ‘hard’
$generator->valid();
```

```
final class Generator implements Iterator {

    function rewind() {}
    function valid(): bool {}
    function current() {}
    function key() {}
    function next() {}

    function send($value) {}
    function throw(Throwable $exception) {}
    function getReturn() {}
}
```

Outside

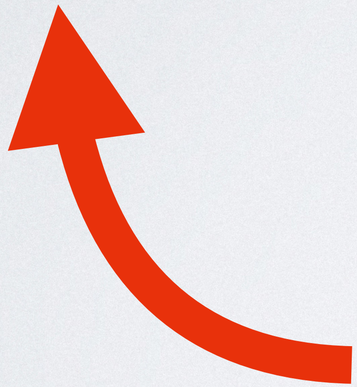
```php
$generator = createMyGenerator();
// Here, outside content
```

```php
function createMyGenerator():
\Generator
{
    // Here, inside content
}
```

Inside

Outside

```
$value = $generator->current();
$key = $generator->key();
```

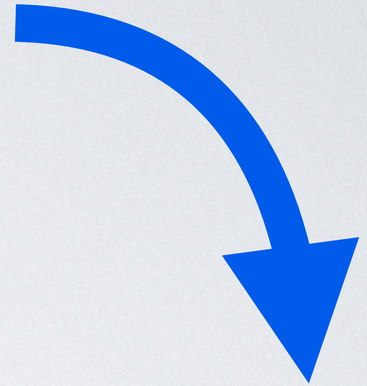


```
yield $key => $value;
```

Inside

Outside

```
$generator->send($value);
$generator->next();
```

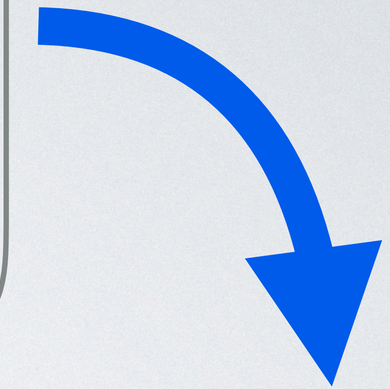


```
$value = yield;
$nullValue = yield;
```

Inside

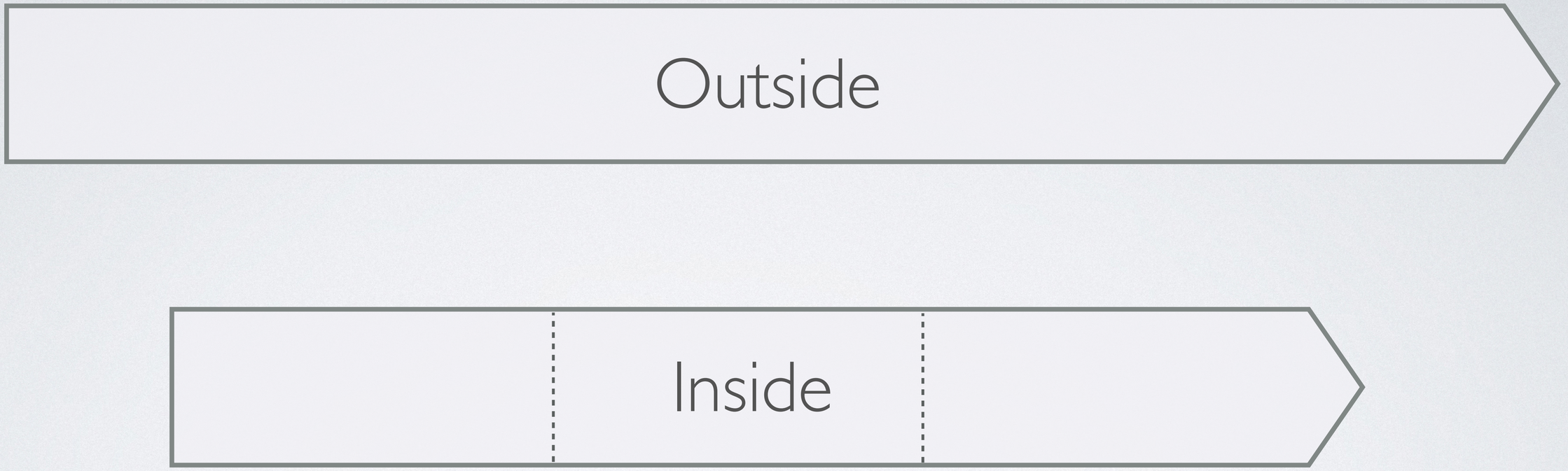
Outside

```
$v1 = $generator->current();
$v3 = $generator->send($v2);
```

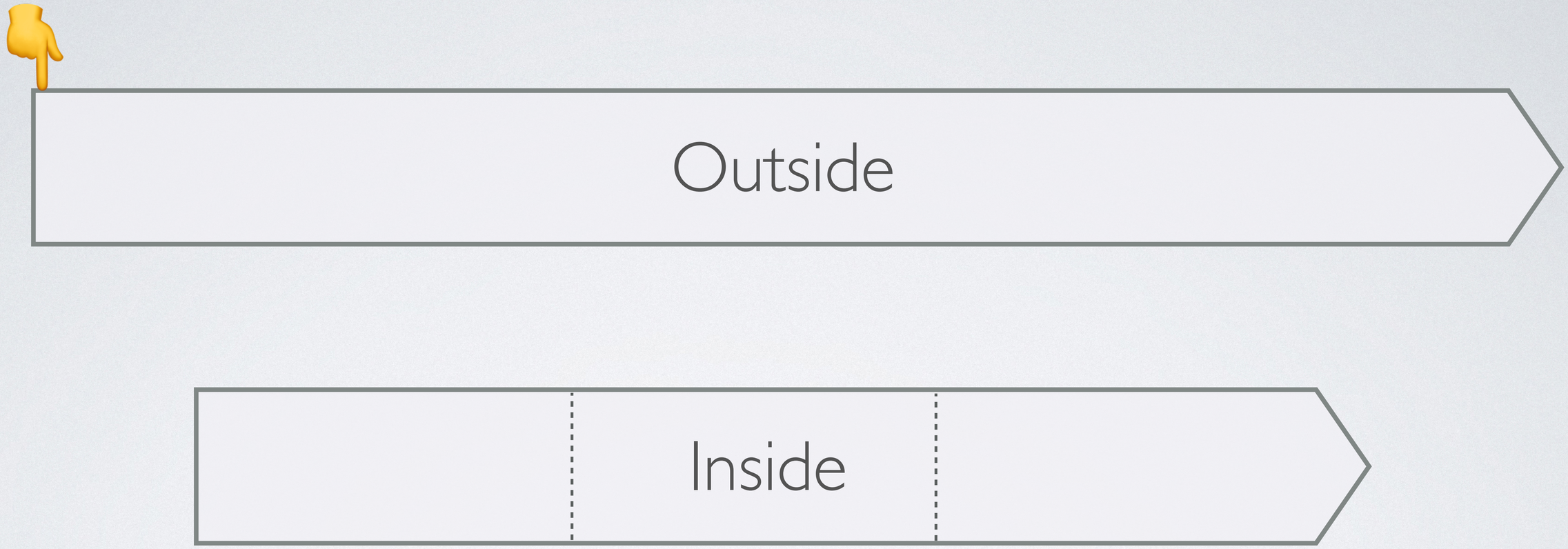


```
$v2 = yield $v1;
yield $v3;
```

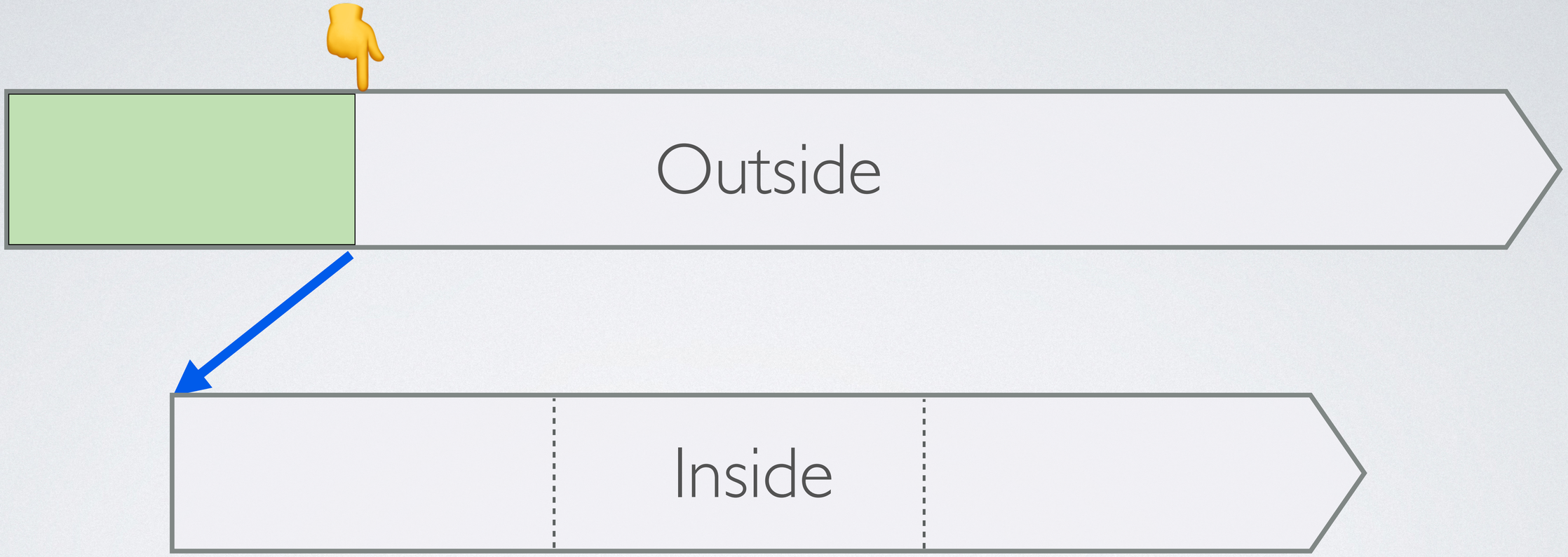
Inside


Outside
Inside

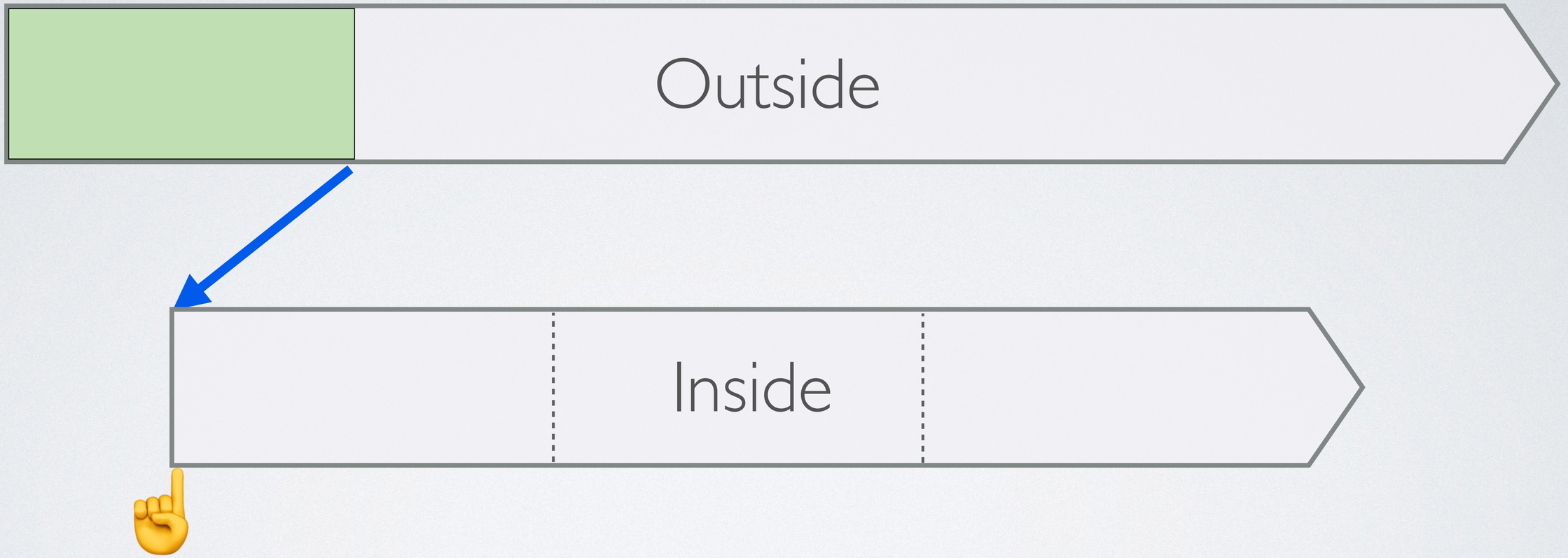
```
$generator = createMyGenerator()
```



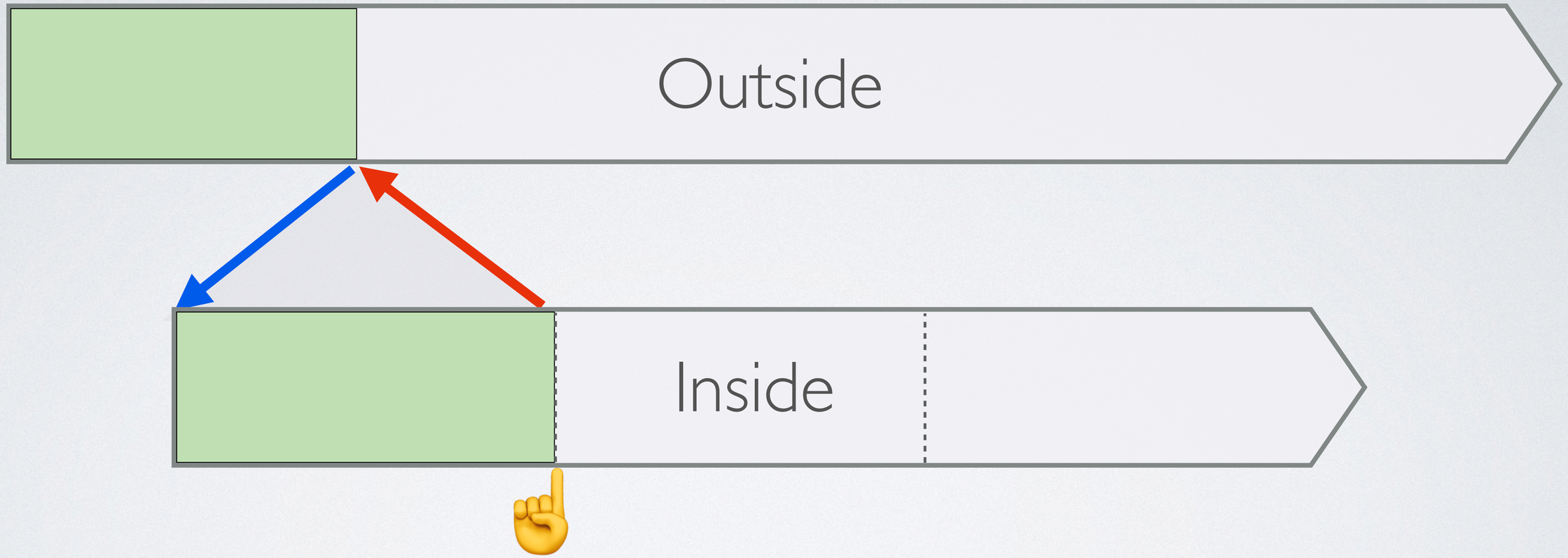
```
$v1 = $generator->current()
```



```
$v1 = $generator->current()
```

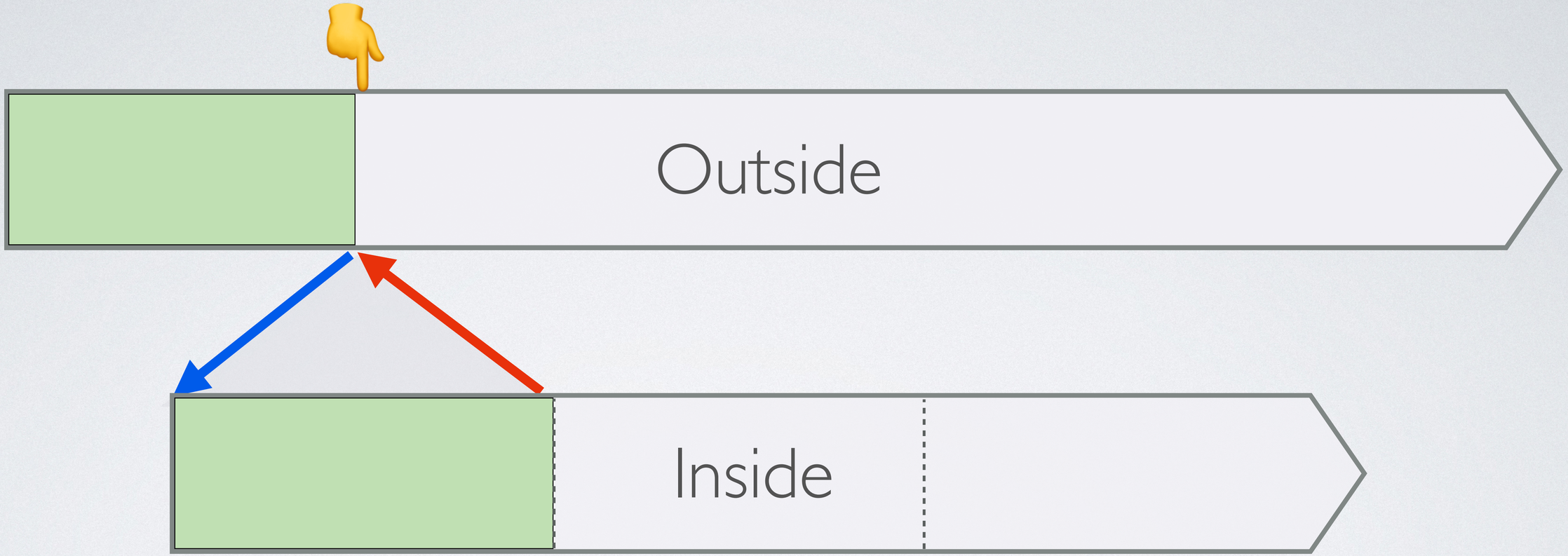


```
$v1 = $generator->current()
```



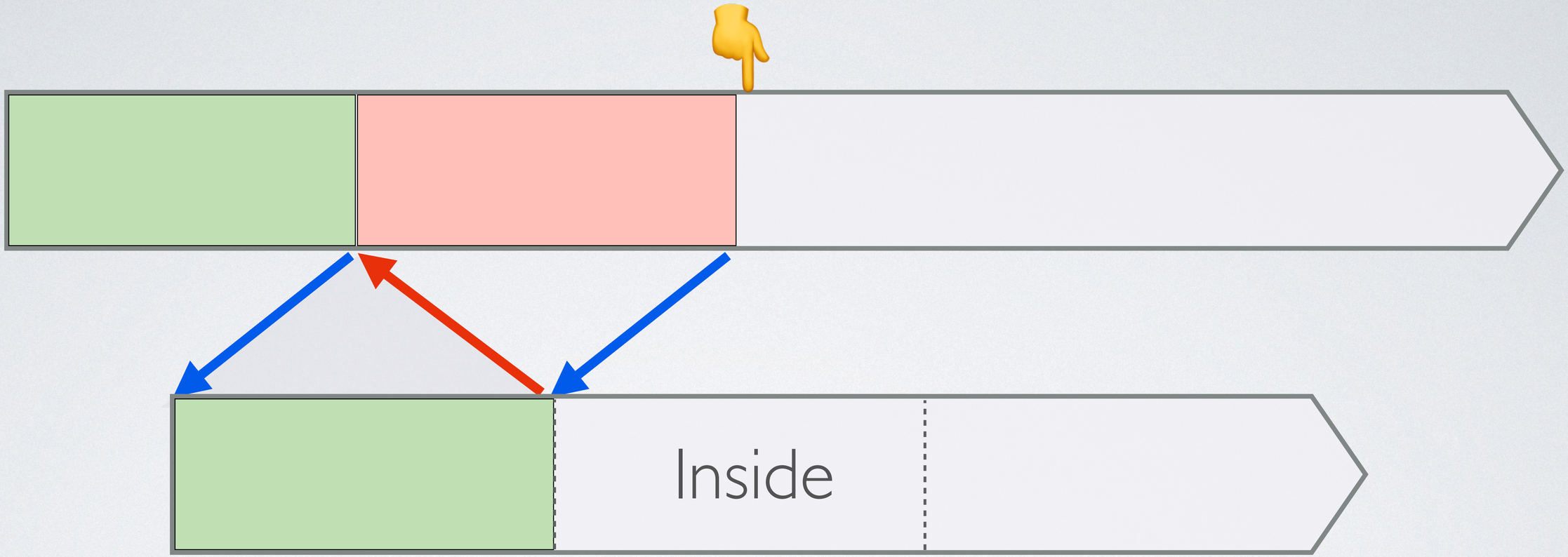

```
$v2 = yield $v1
```

```
$v1 = $generator->current()
```



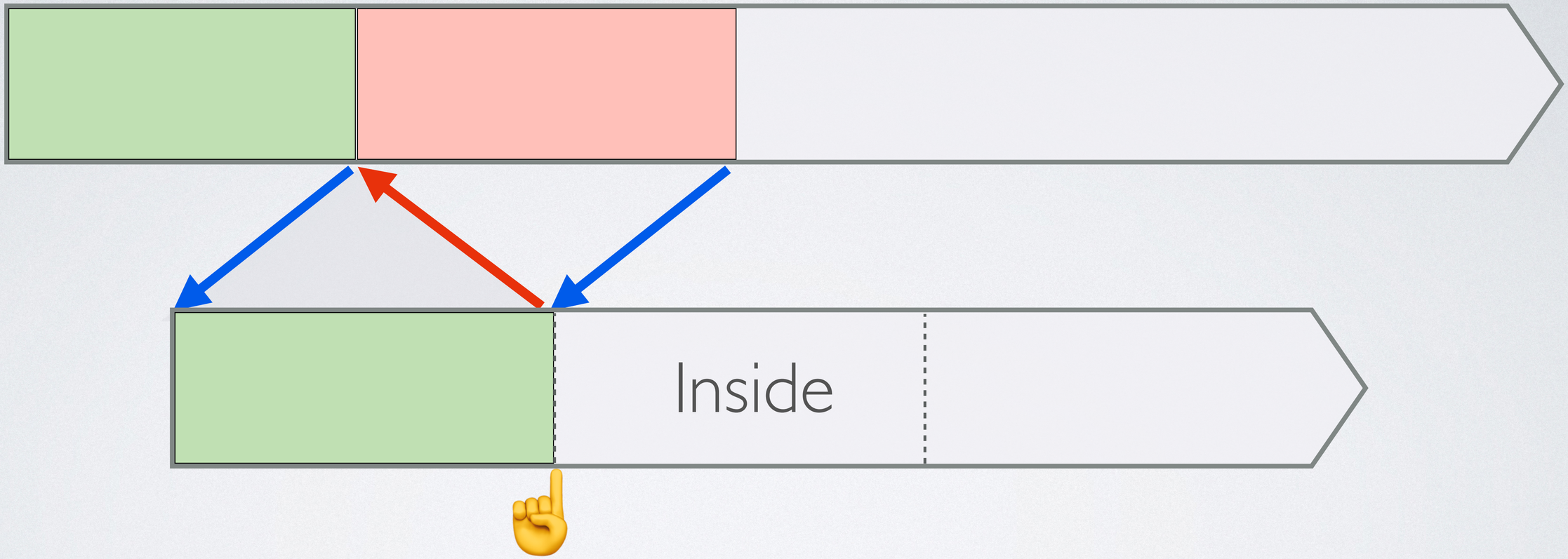

```
$v2 = yield $v1
```

```
$v3 = $generator->send($v2)
```



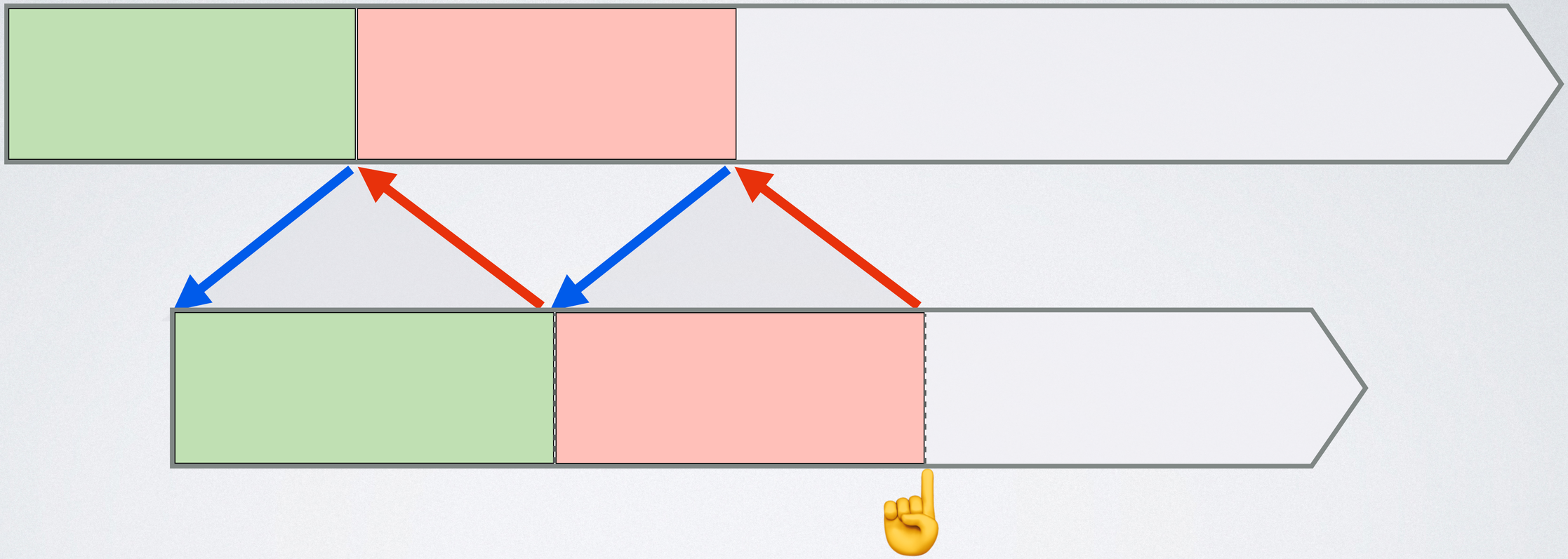

```
$v2 = yield $v1
```

```
$v3 = $generator->send($v2)
```



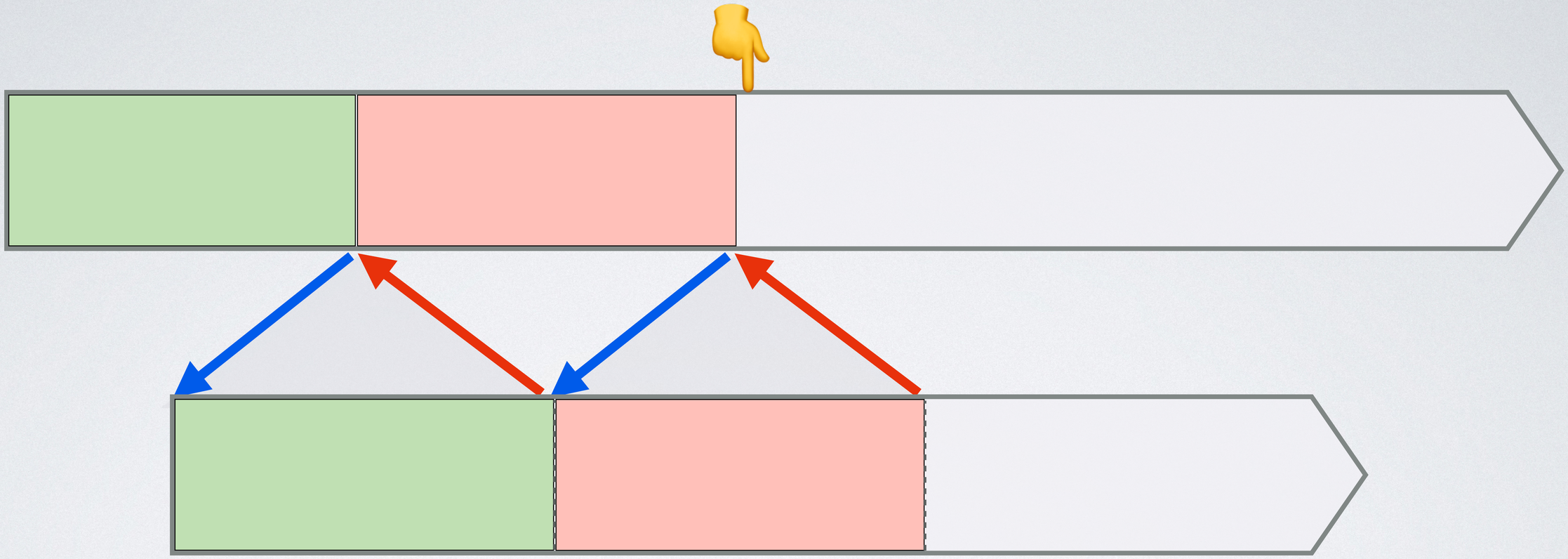

```
$v2 = yield $v1
```

```
$v3 = $generator->send($v2)
```



```
yield $v3
```

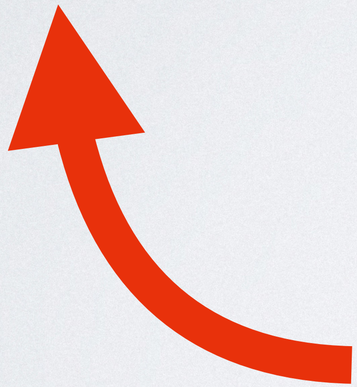
```
$v3 = $generator->send($v2)
```



```
yield $v3
```

Outside

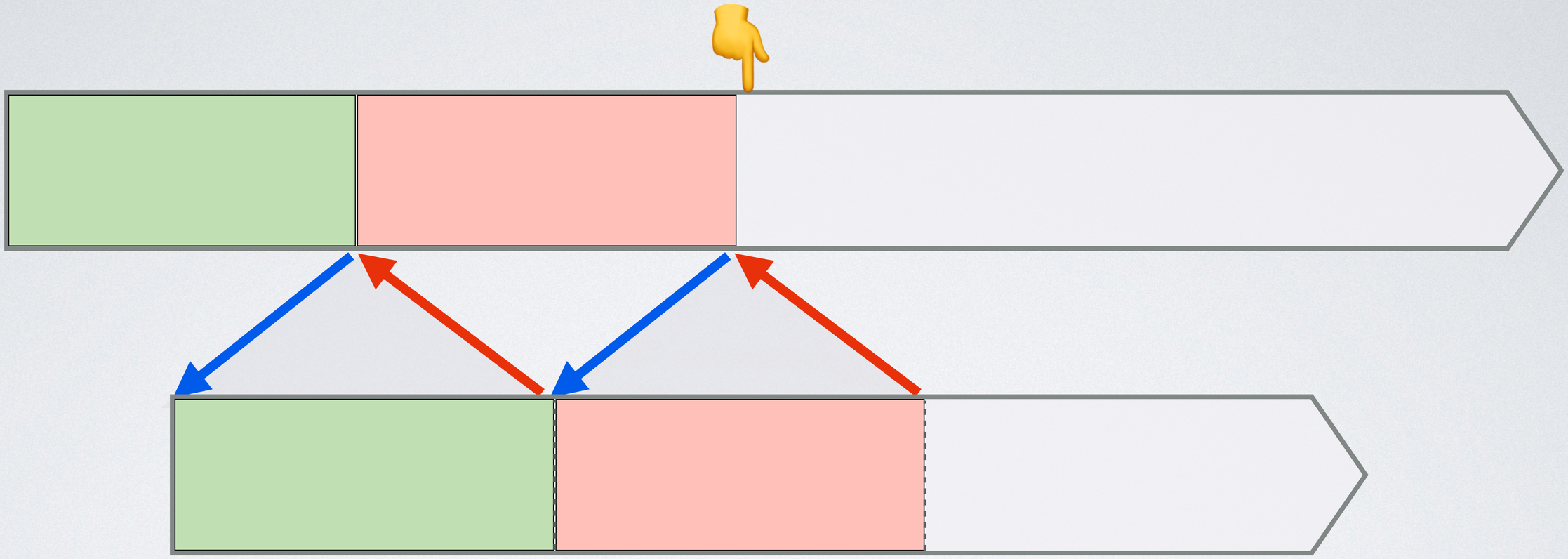
```php
if (!$generator->valid()) {
    $value = $generator->getReturn();
}
```



```php
return $value;
```

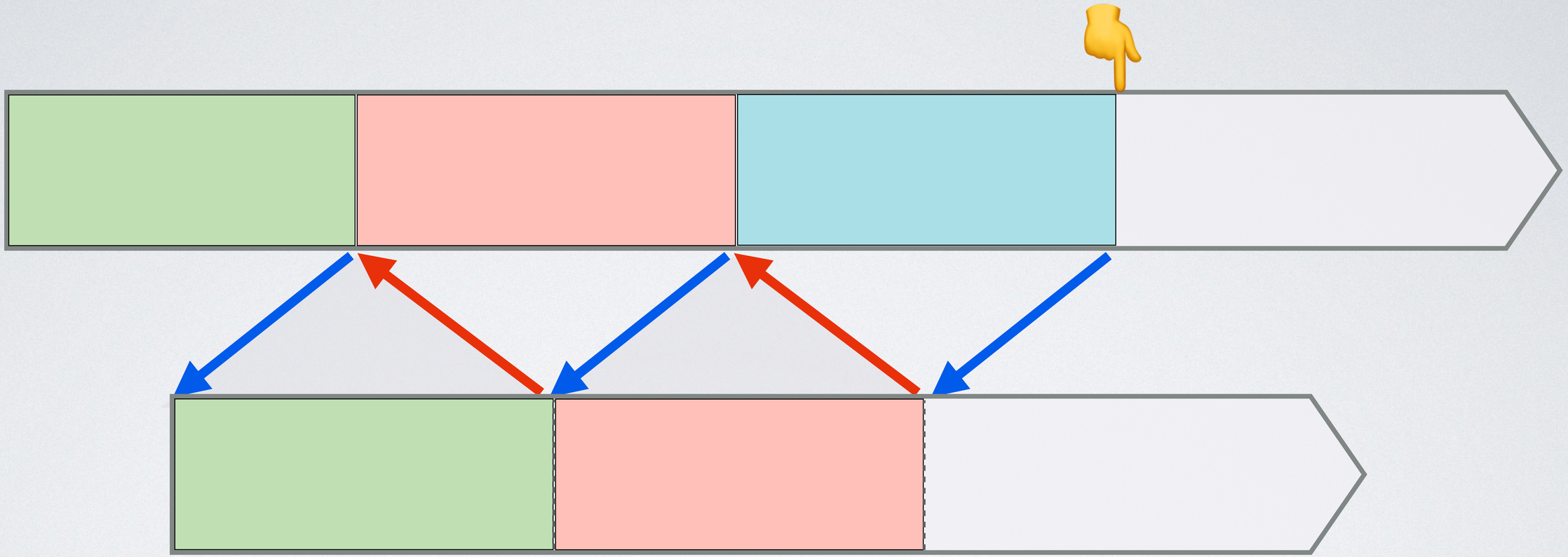
Inside

```
$v3 = $generator->send($v2)
```



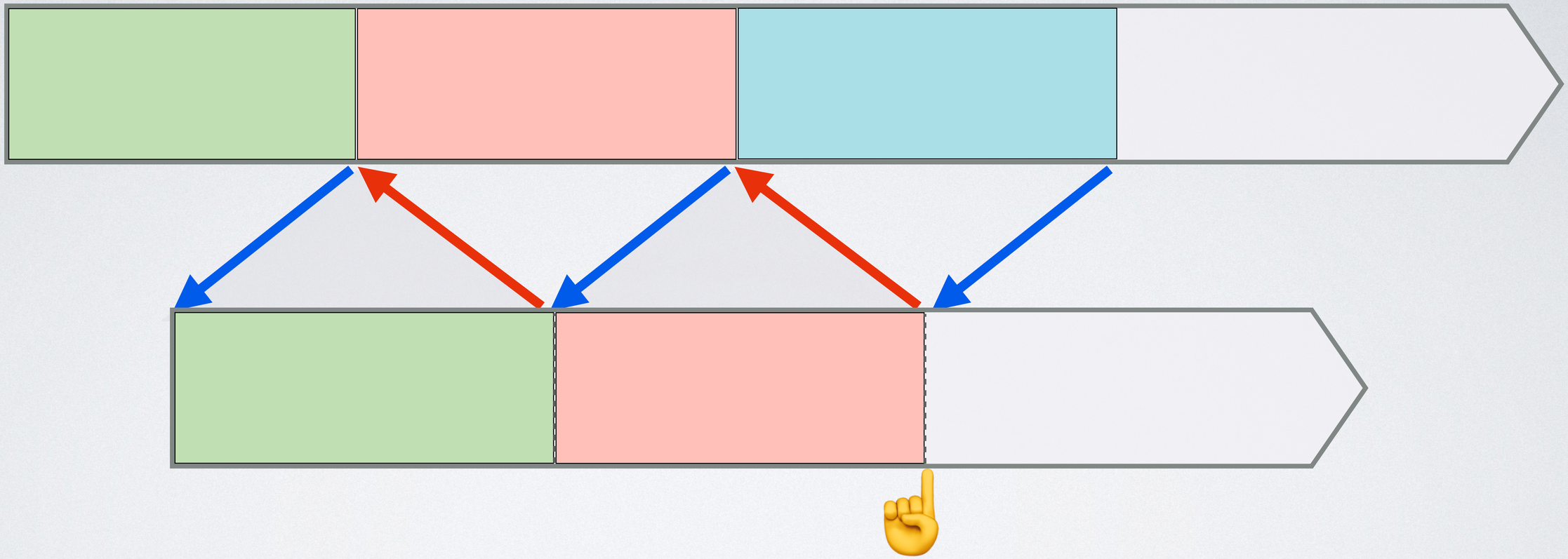
```
yield $v3
```

```
$generator->next()
```



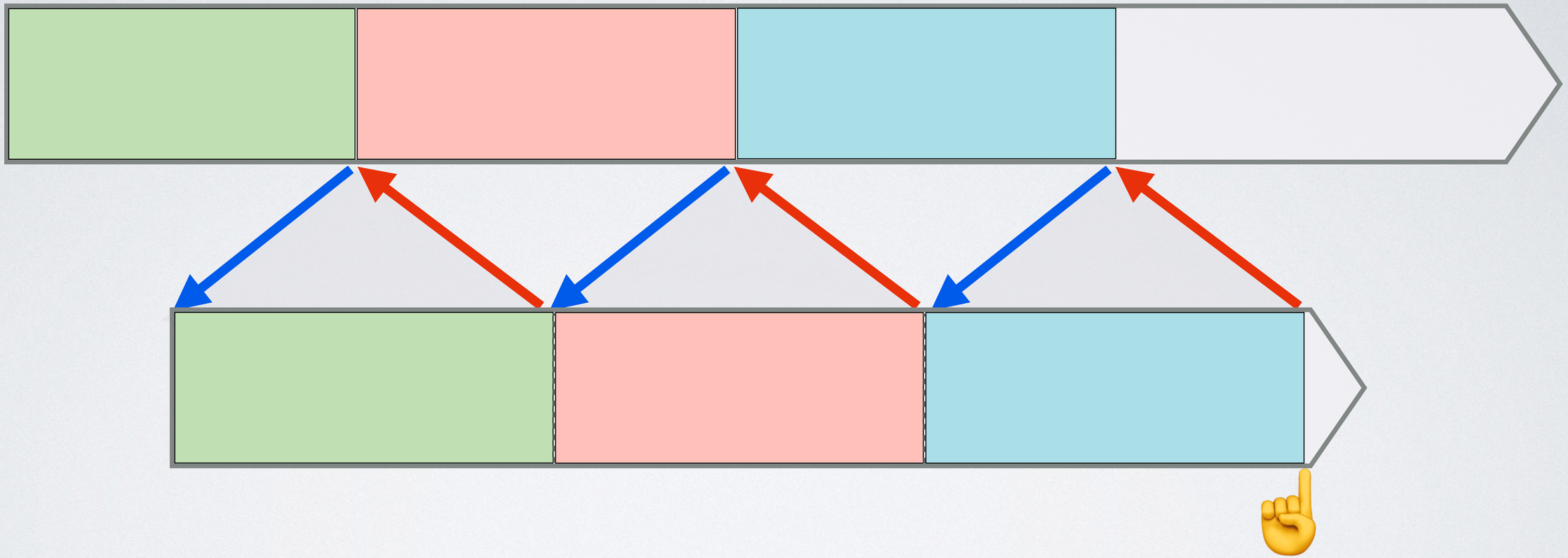
```
yield $v3
```

$generator->next()



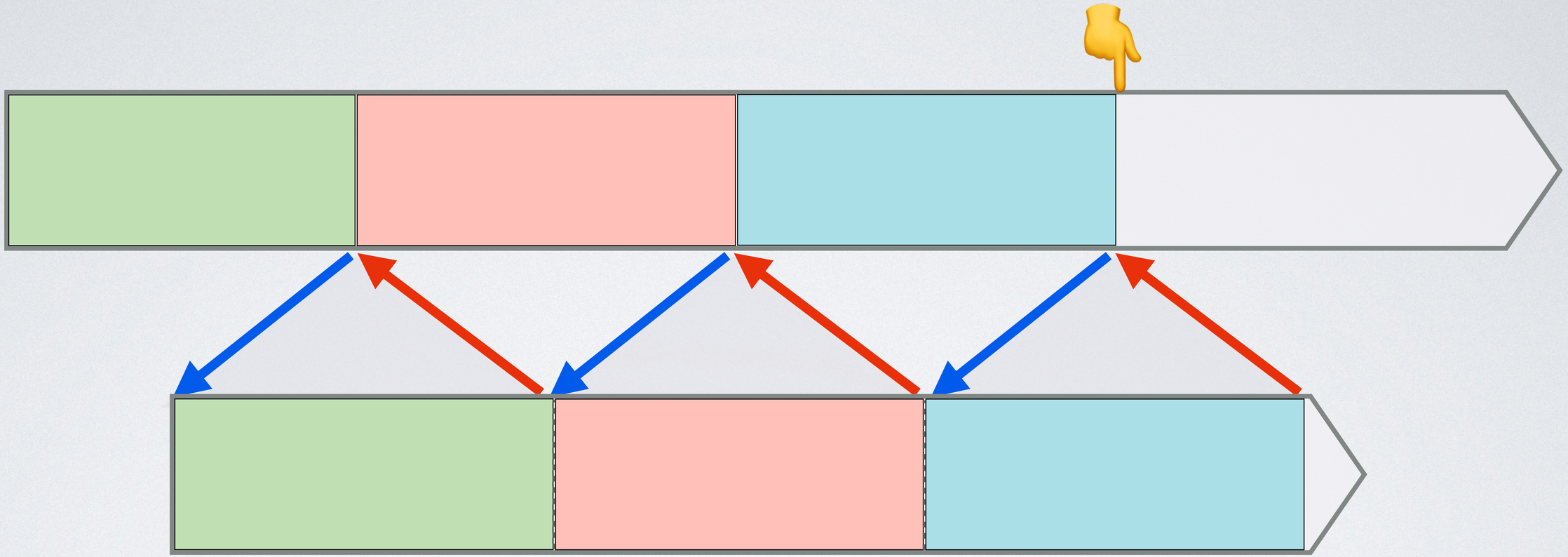
yield $v3

```
$generator->next()
```



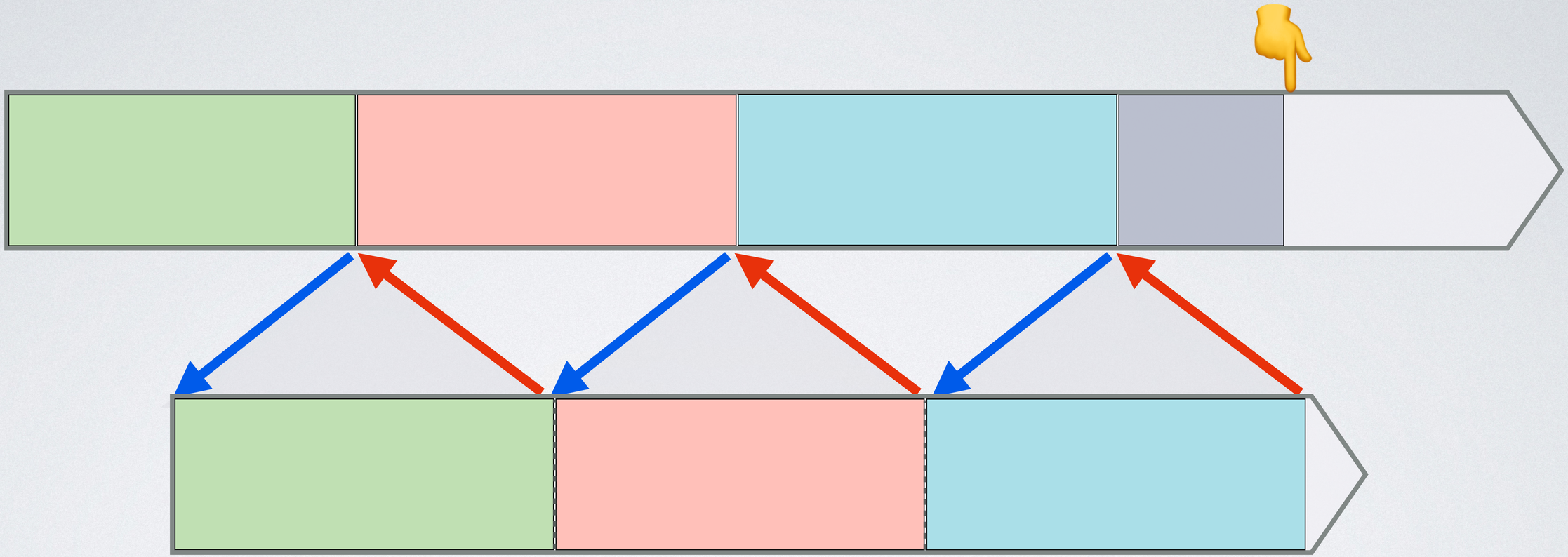
```
return $value;
```

```
$generator->next()
```



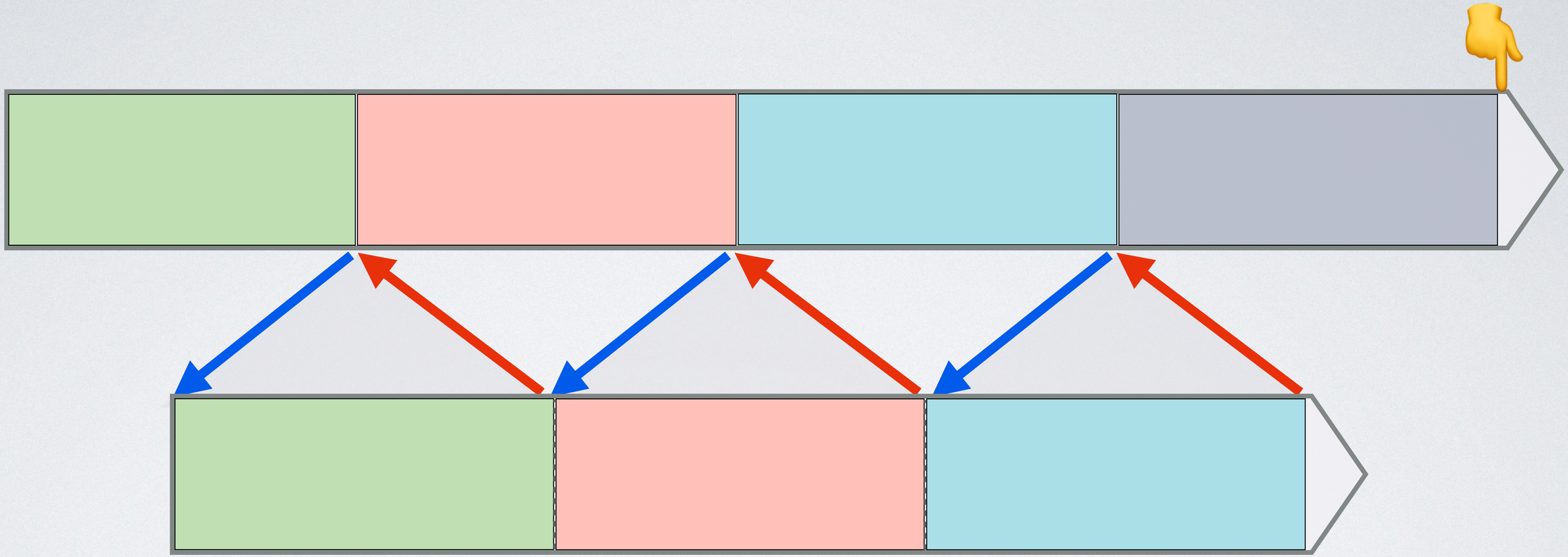
```
return $value;
```

```
!$generator->valid()
```



```
return $value;
```

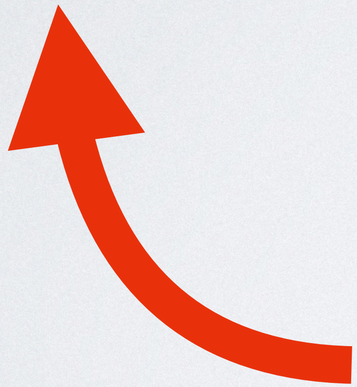
```
$value = $generator->getReturn()
```



```
return $value;
```

Outside

```php
try {
    $generator->next();
} catch (\Exception $exception)
{}
```

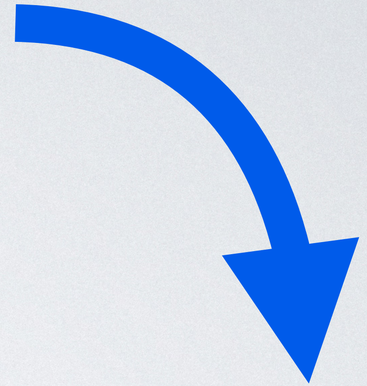


```php
yield;
throw new \Exception();
```

Inside

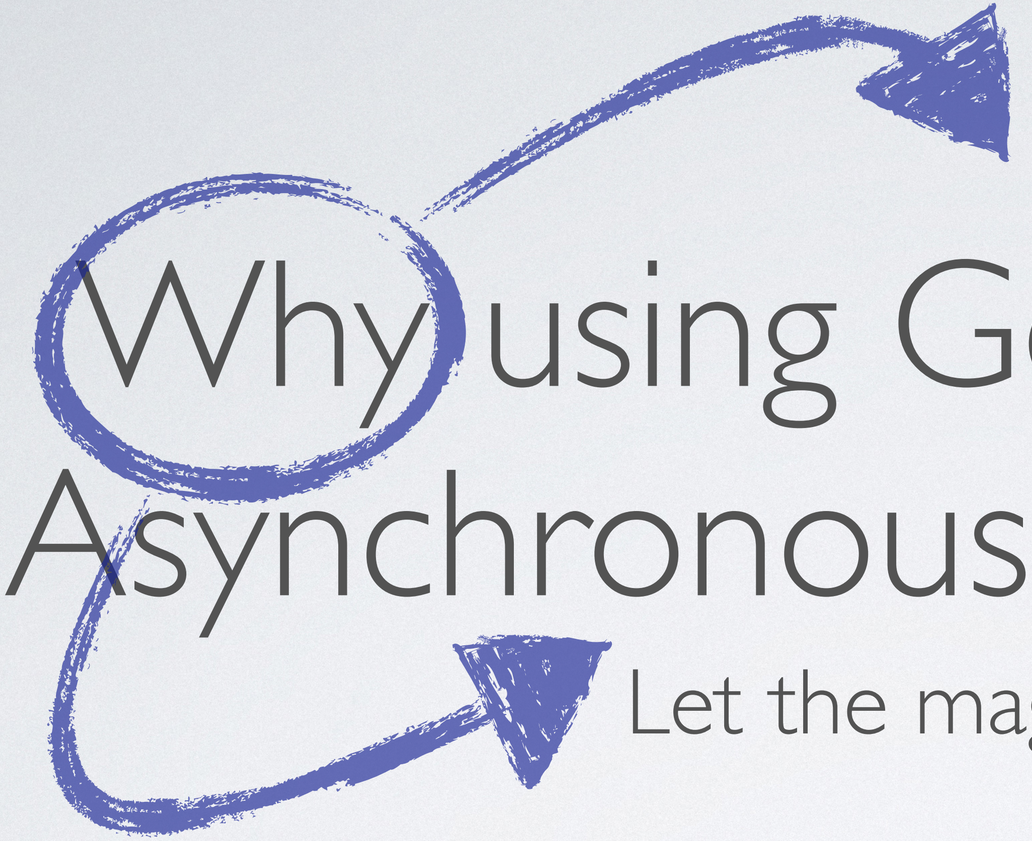
Outside

```
$generator->throw($exception);
```



Inside

```
try {
    yield;
} catch (\Exception $exception)
{}
```



Why using Generators for Asynchronous Programming

Let the magic happen

BEDROCK

Benoit Viguier

@b_viguier

ConFoo.CA

DEVELOPER CONFERENCE

Promises

Synchronous

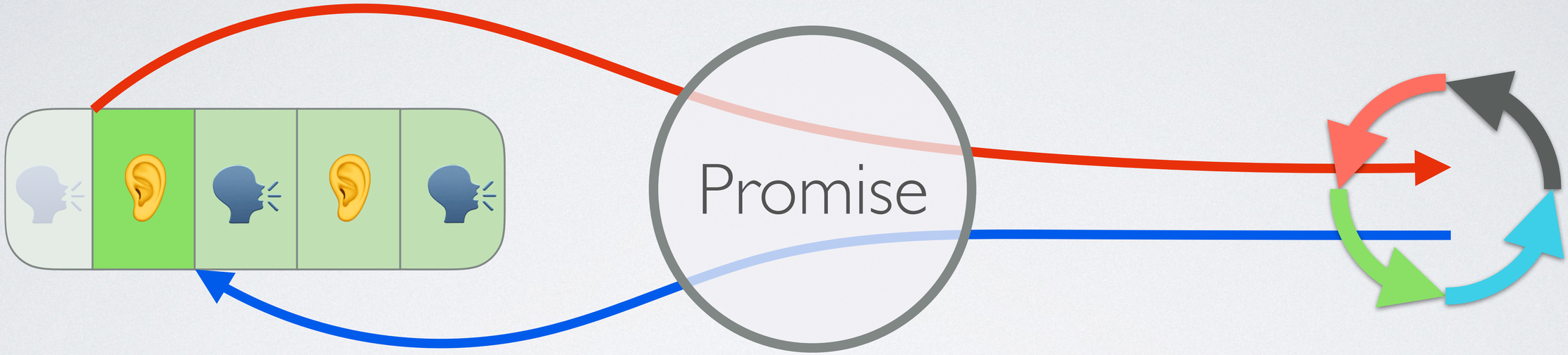
```php
function talk(string $question1, string $question2)
{
    /** @var string $response */
    $response = askQuestion($question1);
    echo $response;

    /** @var string $response */
    $response = askQuestion($question2);
    echo $response;
}
```

Synchronous

```
function askQuestion(string $question): string
{
    // …
}
```

Waiting for a result…



Here your result!

Asynchronous

```
function askQuestion(string $question): Promise
{
    // …
}
```

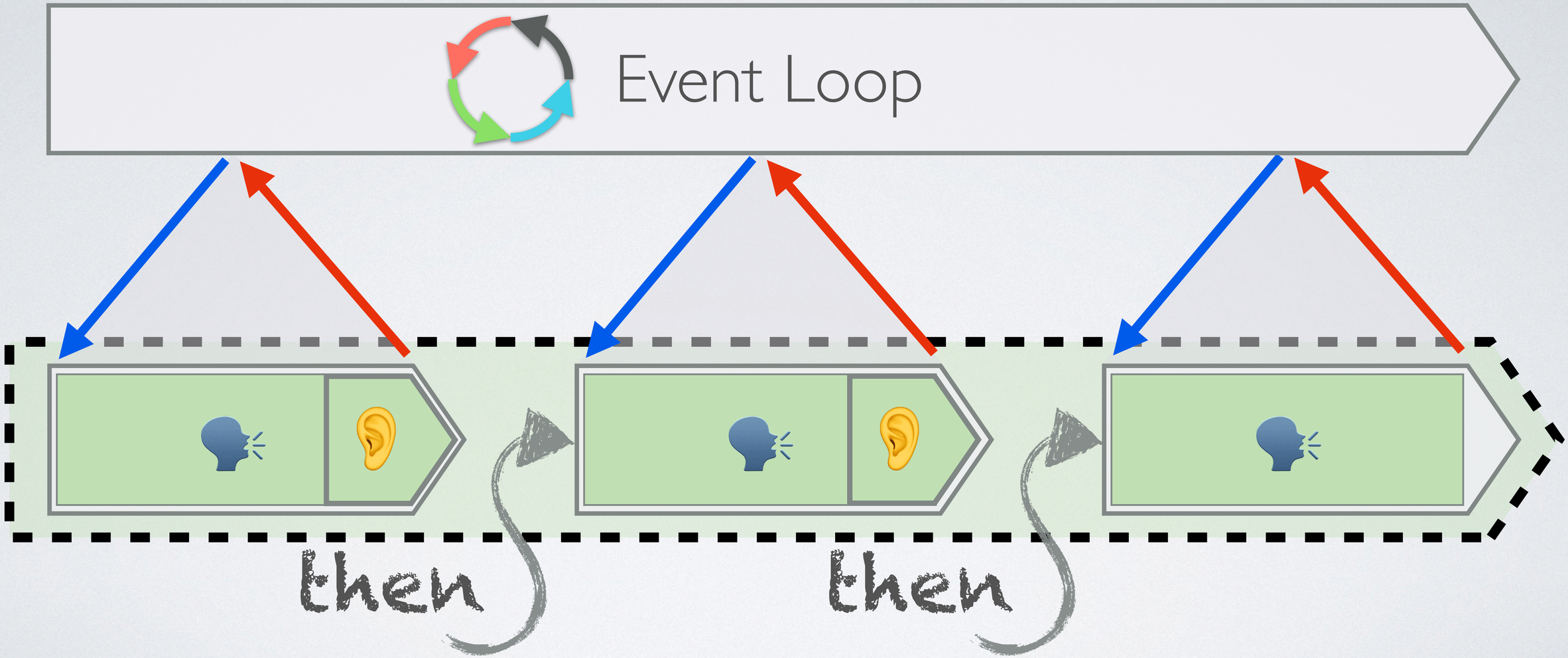
Asynchronous

```
function talk(string $question1, string $question2)
{
    /** @var Promise $promise */
    $promise = askQuestion($question1);
    // !? echo $response;

    /** @var Promise $promise */
    $promise = askQuestion($question2);
    // !? echo $response;
}
```

Promises A+

Thenable Promises


Event Loop
then
then

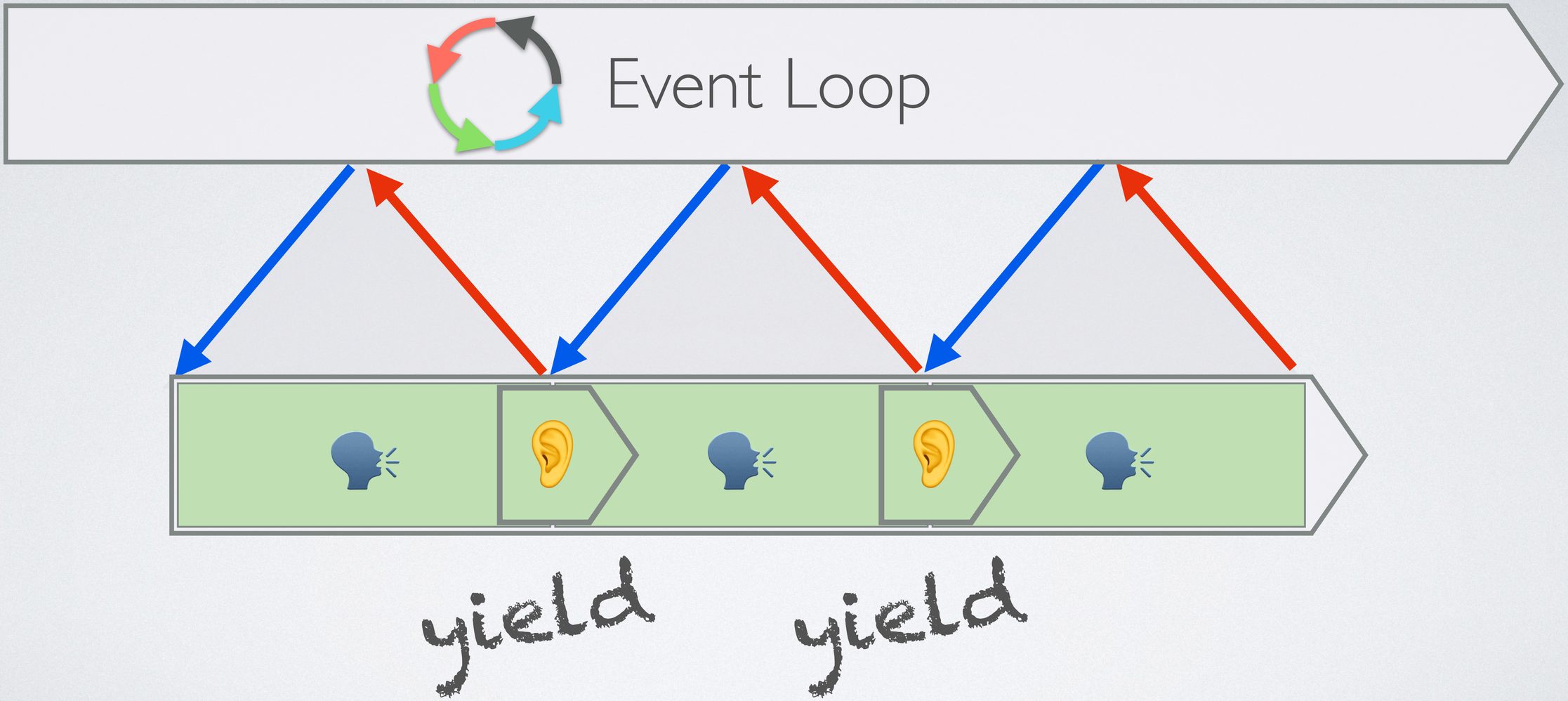
```php
function talk(string $question1, string $question2)
{
    $promise = askQuestion($question1);
    $promise->then(
        function(string $response) use($question2) {
            echo $response;

            return askQuestion($question2);
        }
    )->then(
        function(string $response) {
            echo $response;
        }
    );
}
```

🔥Callback Hell🔥

```
$promise
    ->then(function ($x) {
        return $x + 1;
    })
    ->then(function ($x) {
        throw new \Exception($x + 1);
    })
    ->otherwise(function (\Exception $x) {
        return $x->getMessage() + 1;
    })
    ->then(function ($x) {
        echo 'Mixed '.$x;
    });
```

Generator Promises


Event Loop
yield
yield

Synchronous

```php
function talk(string $question1, string $question2)
{

    /** @var string $response */
    $response = askQuestion($question1);
    echo $response;



    /** @var string $response */
    $response = askQuestion($question2);
    echo $response;
}
```

Asynchronous

```
function talk(string $question1, string $question2)
{

    /** @var string $response */
    $response = yield askQuestion($question1);
    echo $response;



    /** @var string $response */
    $response = yield askQuestion($question2);
    echo $response;
}
```

Asynchronous

```
function talk(string $question1, string $question2)
{
    $promise = askQuestion($question1);
    /** @var string $response */
    $response = yield $promise;
    echo $response;

    $promise = askQuestion($question2);
    /** @var string $response */
    $response = yield $promise;
    echo $response;
}
```

To asynchronously *wait*
the value of a **promise**,
use **`yield`**.

Asynchronous Function:

a **generator**

yielding only *promises*.

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Choose your Event Loop

reactphp/react

👍 Community

😩 *Thenable* Promises

amphp/amp

👍 Generators

🤔 Coupling ?

m6web/tornado

👍 Generators

😘 Interfaces / Adapters

🤔 M6Web

Tea for Two

Let's code it!

Discussing with a friend

```php
function talk(string $question1, string $question2)
: \Generator
{
    /** @var string $response */
    $response = yield askQuestion($question1);
    echo $response;

    /** @var string $response */
    $response = yield askQuestion($question2);
    echo $response;
}
```

Breathing

```
function breath(EventLoop $eventLoop, int $count)
: \Generator
{
    while (--$count >= 0) {
        echo "Breathing\n";
        yield $eventLoop->idle();
    }
}
```

Drinking Tea

```
function tMax(EventLoop $eventLoop, int $maximum)
: \Generator
{
    do {
        yield $eventLoop->idle();
        $current = rand(20, 40);
    } while ($current > $maximum);

    return $current;
}
```

Drinking Tea

```
function drink(EventLoop $eventLoop): \Generator
{
    $generator = tMax($eventLoop, 35);
    $promise = $eventLoop->async($generator);
    $temperature = yield $promise;

    echo "Drinking [$temperature °]\n";

    yield $eventLoop->delay(1000/*ms*/);
}
```

Drinking Tea

```
function drink(EventLoop $eventLoop): \Generator
{
    $generator = tMax($eventLoop, 35);
    $promise = $eventLoop->async($generator);
    $temperature = yield $promise;

    echo "Drinking [$temperature °]\n";

    yield $eventLoop->delay(1000/*ms*/);
}
```

Drinking Tea

```
function drink(EventLoop $eventLoop): \Generator
{
    $generator = tMax($eventLoop, 35);
    $promise = $eventLoop->async($generator);
    $temperature = yield $promise;

    echo "Drinking [$temperature °]\n";

    yield $eventLoop->delay(1000/*ms*/);
}
```

Drinking Tea

```
function drink(EventLoop $eventLoop): \Generator
{
    $generator = tMax($eventLoop, 35);
    $promise = $eventLoop->async($generator);
    $temperature = yield $promise;

    echo "Drinking [$temperature °]\n";

    yield $eventLoop->delay(1000/*ms*/);
}
```

Wait for it…

```
$concurrentPromise = $eventLoop->promiseAll(

    $eventLoop->async( breath($eventLoop, 10)       ),
    $eventLoop->async( discuss('Where?', ‘What?') ),
    $eventLoop->async( drink($eventLoop)            )

);

$eventLoop->wait($concurrentPromise);
```

Wait for it…

```
$concurrentPromise = $eventLoop->promiseAll(

    $eventLoop->async( breath($eventLoop, 10)       ),
    $eventLoop->async( discuss('Where?', ‘What?') ),
    $eventLoop->async( drink($eventLoop)            )

);

$eventLoop->wait($concurrentPromise);
```

Wait for it…

```
$concurrentPromise = $eventLoop->promiseAll(

    $eventLoop->async( breath($eventLoop, 10)       ),
    $eventLoop->async( discuss('Where?', ‘What?') ),
    $eventLoop->async( drink($eventLoop)            )

);

$eventLoop->wait($concurrentPromise);
```

So...

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Benoit Viguier

@b_viguier

Asynchronous Programming **doesn't** require…

~~Http Server~~


Threads


JavaScript™

Asynchronous Programming **requires**…


Event Loop

Interruptible Tasks

Generators:
Powerful tool for
Asynchronous Programming


PRACTICE

One year of asynchronous PHP in production

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Tomorrow, 13:00

Why and how to use generators for asynchronous programming

Benoit Viguier
@b_viguier

Thanks !

```
$answer = yield $you->ask($me);
```

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Benoit Viguier
@b_viguier

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