PHP UK CONFERENCE

PHP GENERICS TODAY (ALMOST)

DAVE LIDDAMENT

Lamp Bristol

@daveliddament

Using generics can help us write more understandable, robust and reliable code.

Demonstrate how existing tools can (almost) give us the benefits of generics now.

IS THIS TALK FOR YOU?

```
function process(User $user): void { … }
```

```
function process(User $user): void { … }

process(“Bob”);
```

```
function process(User $user): void { … }

process(“Bob”);
```

```
/** @template T of Animal */
interface AnimalProcessor {
  /** @return class-string<T> */
  public function supports(): string;

  …
```

```
function process(User $user): void { … }

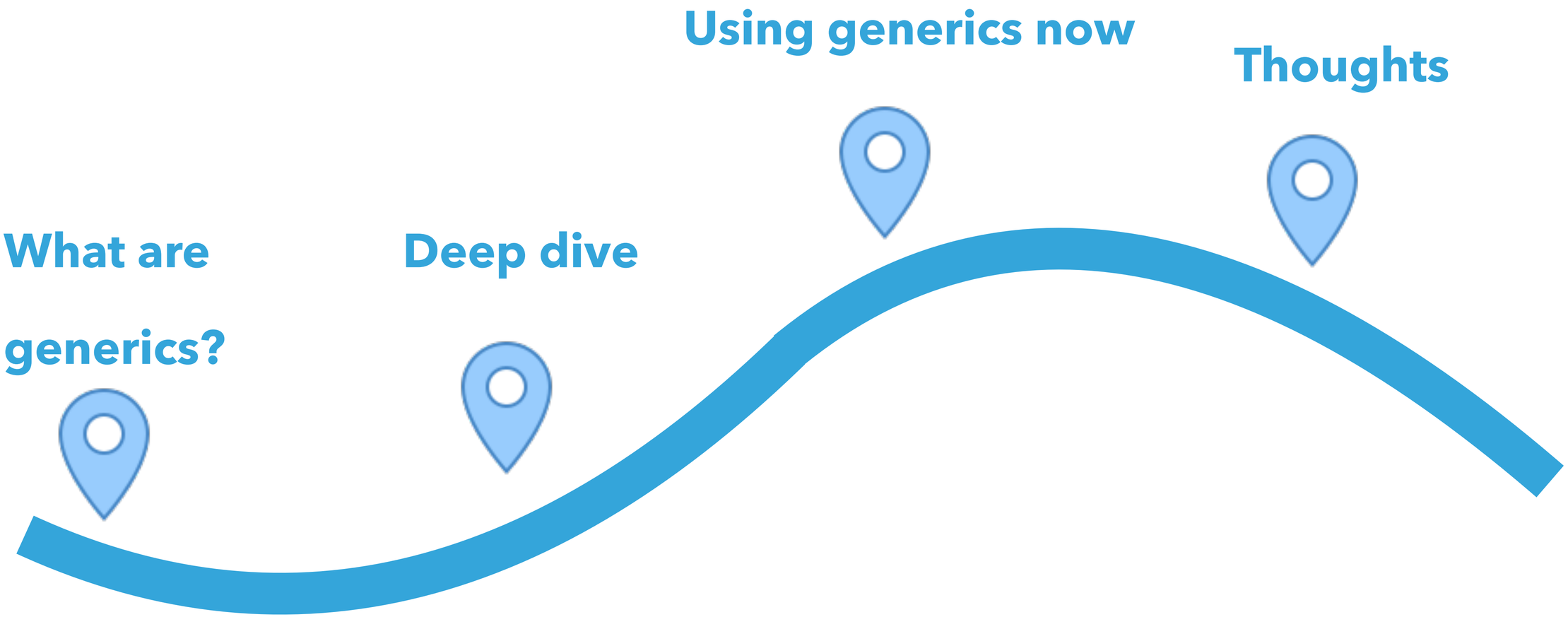
process(“Bob”);
```

```
/** @template T of Animal */
interface AnimalProcessor {
  /** @return class-string<T> */
  public function supports(): string;

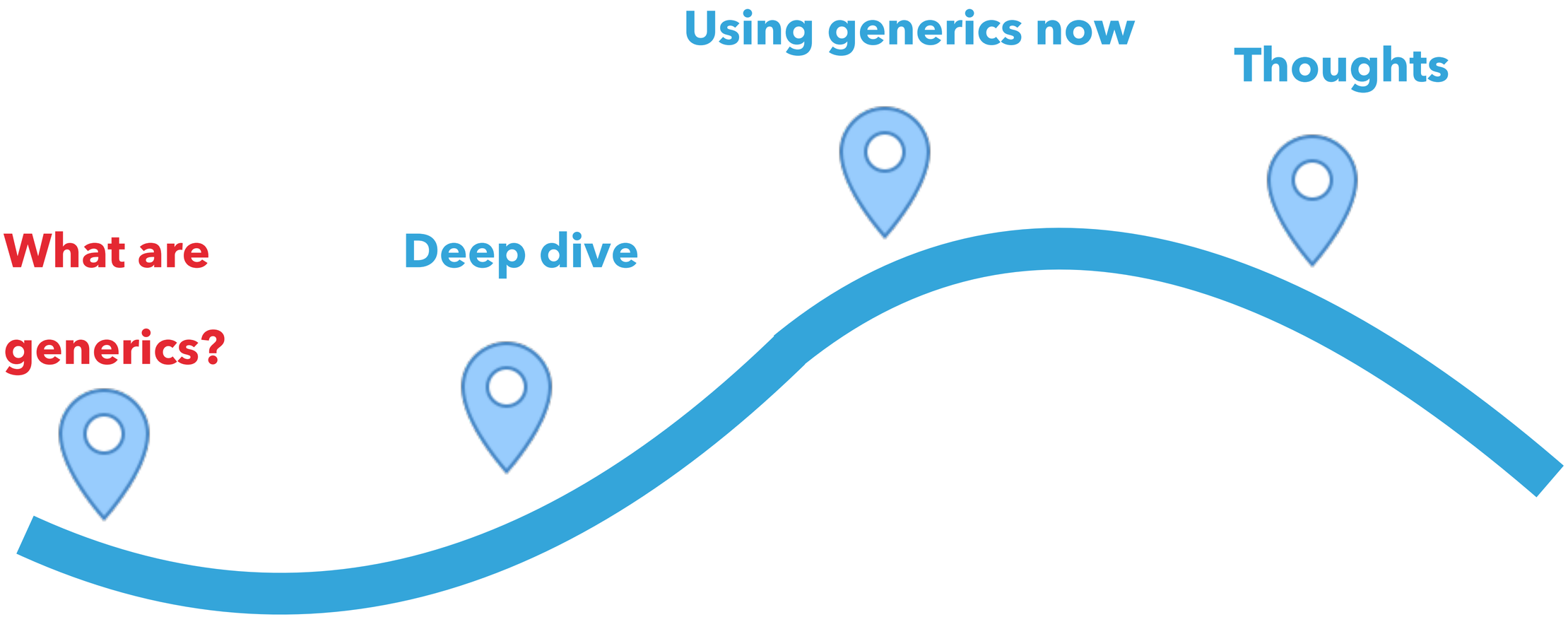
  …
```

Psalm

AGENDA



AGENDA



```
function process(User $user): void { … }

process(“Bob”);
```

```
function process(User $user): void { … }

process(“Bob”);
```

Clear, unambiguous type information

Run time check

Static analysis check

```
function process(User $user): void { … }

process(“Bob”);
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✅ **Clear, unambiguous type information**

Run time check

Static analysis check

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function process(User $user): void { … }

process(“Bob”);
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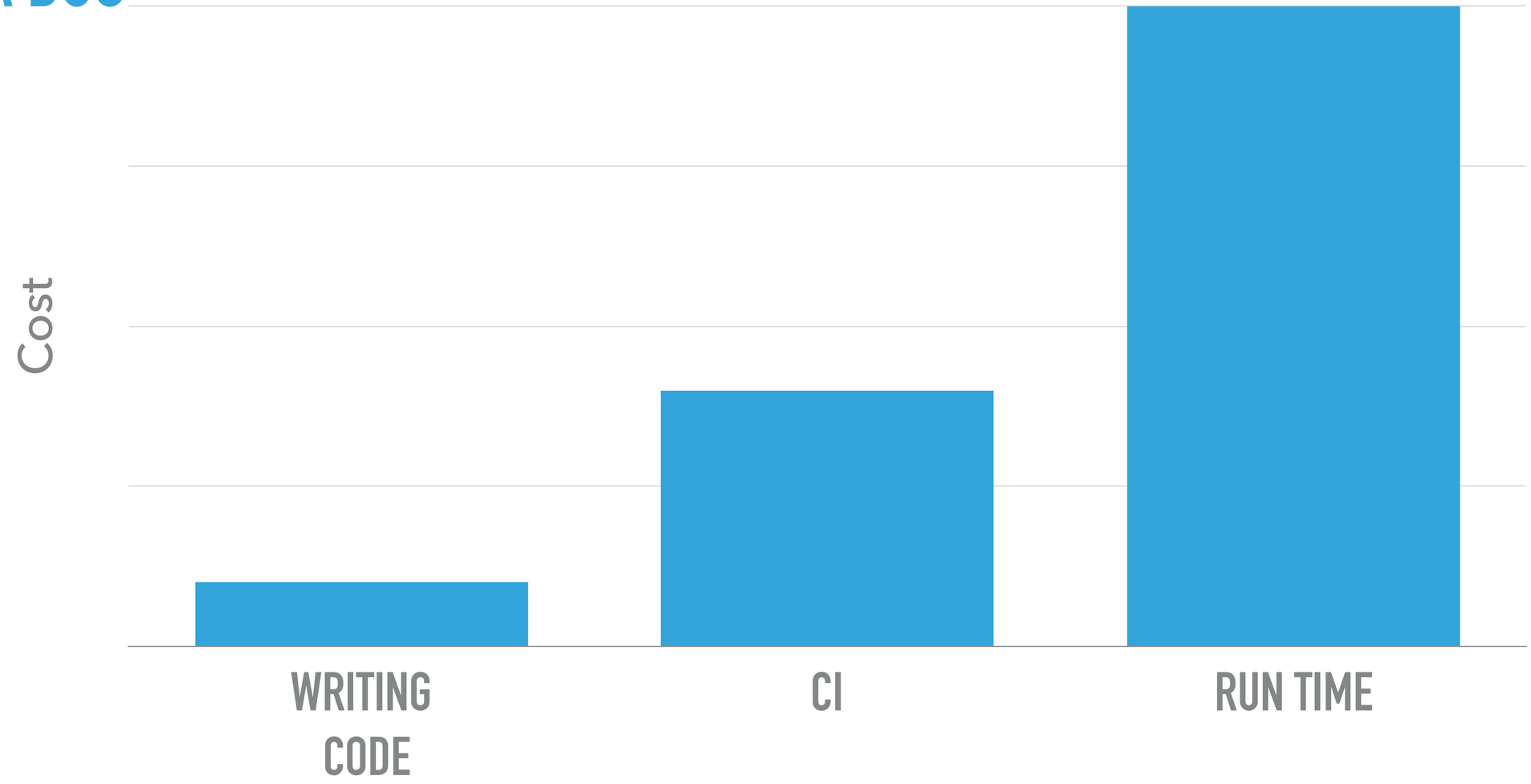
- ✅ **Clear, unambiguous type information**
- ✅ **Run time check**
- **Static analysis check**

```
function process(User $user): void { … }

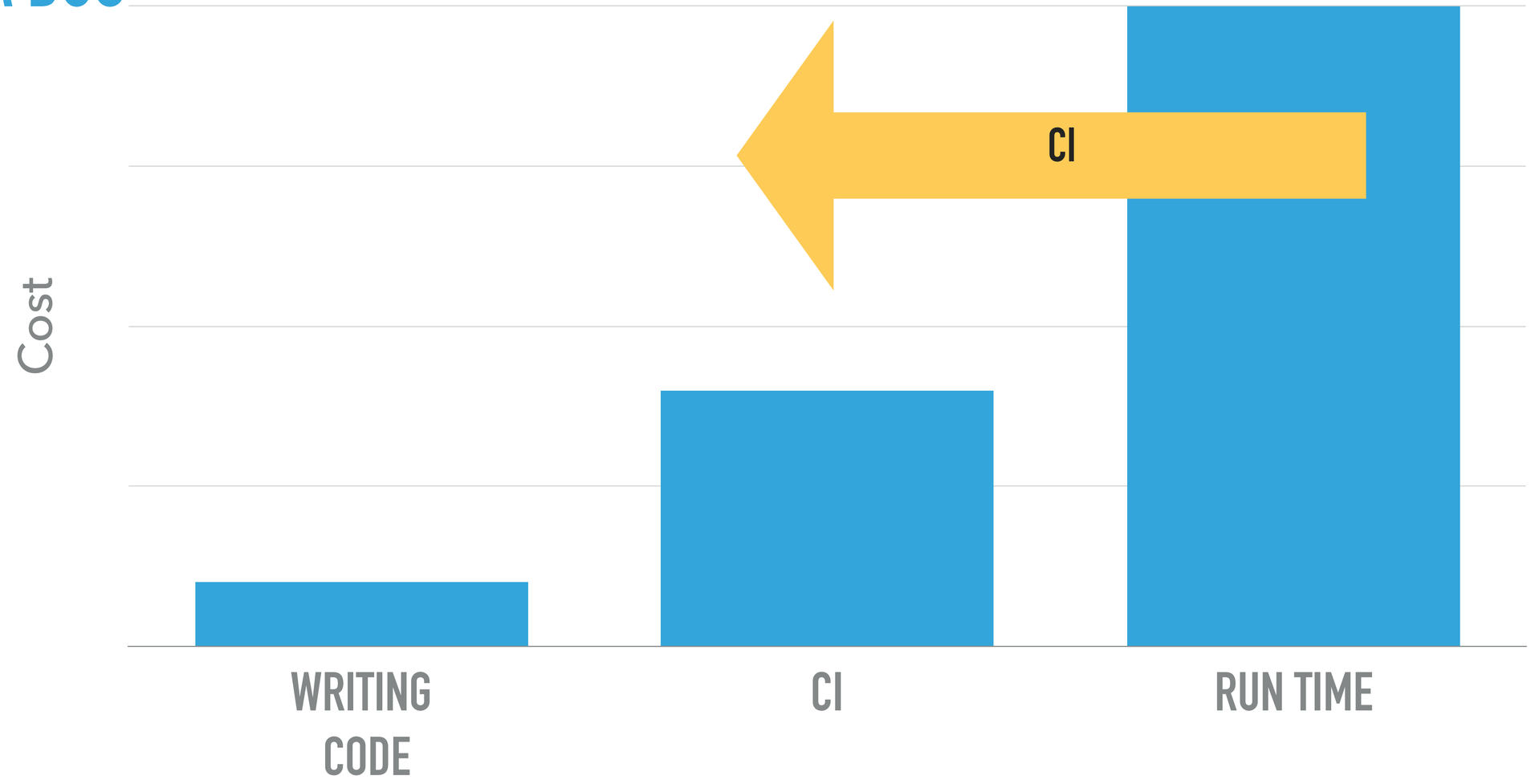
process(“Bob”);
```

- ✅ **Clear, unambiguous type information**
- ✅ **Run time check**
- ✅ **Static analysis check**

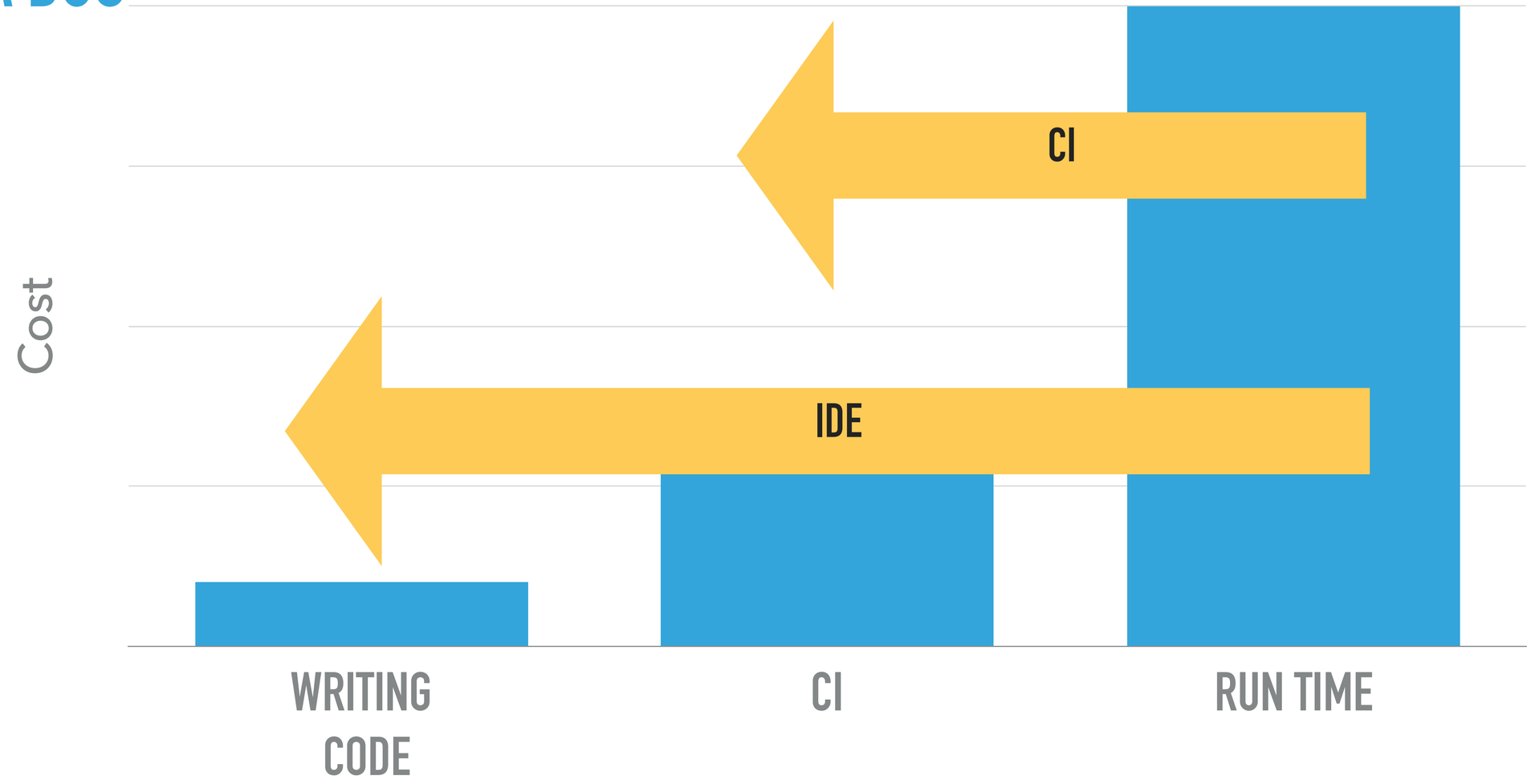
COST OF A BUG



COST OF A BUG



COST OF A BUG



```
class Queue {

  public function add(   $item): void {…}

  public function getNext()    {…}
}
```

```
class Queue {

  public function add(??? $item): void {…}

  public function getNext():??? {…}
}
```

```
function getQueue(): Queue { … }

$queue = getQueue();
```

```
function getQueue(): Queue { … }
$queue = getQueue();
```

Type of entities in the queue is known

Run time check

Static analysis check

```
function getQueue(): Queue { … }
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❌ **Type of entities in the queue is known**

❌ **Run time check**

Static analysis check

```
function getQueue(): Queue { … }
$queue = getQueue();
```

Type of entities in the queue is known

Run time check

Static analysis check

```
class TypedQueue {
 private string $type;
 private Queue $queue;

 public function __construct(string $type) {
   $this->type = $type;
   $this->queue = new Queue();
 }
```

```
class TypedQueue {
  private string $type;
  private Queue $queue;

  public function __construct(string $type) {
    $this->type = $type;
    $this->queue = new Queue();
  }
```

```
class TypedQueue {
 private string $type;
 private Queue $queue;

 public function __construct(string $type) {
  $this->type = $type;
   $this->queue = new Queue();
 }
```

```
class TypedQueue {
 private string $type;
 private Queue $queue;

 public function __construct(string $type) {
   $this->type = $type;
   $this->queue = new Queue();
 }
```

```
public function add($item) {
   if (!$item instanceof $this->type) {
     throw new TypeError();
   }
   $this->queue->add($item);
 }
public function getNext() {
   return $this->queue->getNext();
}
```

```
public function add($item) {
    if (!$item instanceof $this->type) {
      throw new TypeError();
    }
    $this->queue->add($item);
  }
public function getNext() {
    return $this->queue->getNext();
}
```

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public function add($item) {
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      throw new TypeError();
    }
    $this->queue->add($item);
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public function getNext() {
    return $this->queue->getNext();
}
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public function add($item) {
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      throw new TypeError();
    }
    $this->queue->add($item);
  }
public function getNext() {
    return $this->queue->getNext();
}
```

```
public function add($item) {
   if (!$item instanceof $this->type) {
     throw new TypeError();
   }
   $this->queue->add($item);
 }
public function getNext() {
   return $this->queue->getNext();
}
```

```
$userQueue = new TypedQueue(User::class);
```

```
$userQueue = new TypedQueue(User::class);

$userQueue->add(new User("Jane")); ✅
```

```
$userQueue = new TypedQueue(User::class);

$userQueue->add(new User("Jane")); ✅

$userQueue->add("bob");            ❌
```

```
$personQueue->add(new User("bob"));
```

Same code works for any type

Run time check

Static analysis check

```
$personQueue->add(new User("bob"));
```

✅ **Same code works for any type**

Run time check

Static analysis check

```
$personQueue->add(new User("bob"));
```

✅ **Same code works for any type**

✅ **Run time check**

Static analysis check

```
$personQueue->add(new User("bob"));
```

✅ Same code works for any type

✅ Run time check

❌ Static analysis check

```
class UserQueue {
 private Queue $queue; // Setup in constructor
 public function add(User $item): void {
  $this->queue->add($item);
 }
 public function getNext(): User {
   return $this->queue->getNext();
 }
}
```

```
class UserQueue {
 private Queue $queue; // Setup in constructor
 public function add(User $item): void {
  $this->queue->add($item);
 }
 public function getNext(): User {
   return $this->queue->getNext();
 }
}
```

```
class UserQueue {
 private Queue $queue; // Setup in constructor
 public function add(User $item): void {
  $this->queue->add($item);
 }
 public function getNext(): User {
    return $this->queue->getNext();
 }
}
```

```
class UserQueue {
 private Queue $queue; // Setup in constructor
 public function add(User $item): void {
  $this->queue->add($item);
 }
 public function getNext(): User {
   return $this->queue->getNext();
 }
}
```

```
class UserQueue {
 private Queue $queue; // Setup in constructor
 public function add(User $item): void {
  $this->queue->add($item);
 }
 public function getNext(): User {
   return $this->queue->getNext();
 }
}
```

```
$userQueue = new UserQueue();
```

```
$userQueue = new UserQueue();

$userQueue->add(new User("Jane")); ✅

$userQueue->add("bob");            ❌
```

```
$personQueue->add(new Person("bob"));
```

Same code works for any type

Run time check

Static analysis check

```
$personQueue->add(new Person("bob"));
```

Same code works for any type

Run time check

Static analysis check

```
$personQueue->add(new Person("bob"));
```

❌ **Same code works for any type**

✅ **Run time check**

Static analysis check

```
$personQueue->add(new Person("bob"));
```

❌ **Same code works for any type**

✅ **Run time check**

✅ **Static analysis check**

```
class Queue    {

  public function add(  $item): void {…}

  public function getNext()   {…}
}
```

```
class Queue <T> {

  public function add(  $item): void {…}

  public function getNext()   {…}
}
```

```
class Queue <T> {

  public function add(T $item): void {…}

  public function getNext()   {…}
}
```

```
class Queue <T> {

  public function add(T $item): void {…}

  public function getNext():T {…}
}
```

```
$userQueue = new Queue();
```

```
$userQueue = new Queue<User>();
```

```
$userQueue = new Queue<User>();

$userQueue->add(new User("Alice")); ✅

$userQueue->add("bob"); ❌
```

```
$personQueue->add(new Person("bob"));
```

Same code works for any type

Run time check

Static analysis check

```
$personQueue->add(new Person("bob"));
```

✅ **Same code works for any type**

Run time check

Static analysis check

```
$personQueue->add(new Person("bob"));
```

✅ **Same code works for any type**

✅ **Run time check**

Static analysis check

```
$personQueue->add(new Person("bob"));
```

- ✅ Same code works for any type
- ✅ Run time check
- ✅ Static analysis check

```
$userQueue = new TypedQueue(User::class);

$userQueue = new UserQueue();

$userQueue = new Queue<User>();
```

DEJA VU?

```
/** @return User[] */
function getUsers(): array;


foreach(getUsers() as $user) {
  processUser($user);
}


function processUser(User $user): void {…}
```

```
/** @return User[] */
function getUsers(): array;


foreach(getUsers() as $user) {
  processUser($user);
}


function processUser(User $user): void {…}
```

```
/** @return User[] */
function getUsers(): array;

foreach(getUsers() as $user) {
  processUser($user);
}

function processUser(User $user): void {…}
```

```
/** @return User[] */
function getUsers(): array;

foreach(getUsers() as $user) {
  processUser($user);
}

function processUser(User $user): void {…}
```

```
/** @return User[] */
function getUsers(): array;
```

```
foreach(getUsers() as $user) {
  processUser($user);
}
```

```
function processUser(User $user): void {…}
```

```
/** @param User[] $users */
function processUsers(array $users): void {…}


processUsers([
  new User(“Jane”),
  “james”,
]);
```

```
/** @param User[] $users */
function processUsers(array $users): void {…}

processUsers([
  new User(“Jane”),
  “james”,
]);
```

```
/** @param User[] $users */
function processUsers(array $users): void {…}
```

```
processUsers([
  new User(“Jane”),
  “james”,
]);
```

```
/** @param User[] $users */
function processUsers(array $users): void {…}


processUsers([
    new User(“Jane”),
    “james”,
]);
```

Psalm

Phan,

Static Analyzer for PHP

PHPStan

Psalm

```php
<?php declare(strict_types = 1);

class User {
  public function __construct(string $name) {}
}

/** @param User[] $users */
function processUsers(array $users): void {
    var_export($users);
}

processUsers([
  new User('Jane'),
  'james',
]);
```

```
Psalm output (using commit 39a8227):

ERROR: InvalidArgument - 12:14 - Argument 1 of processUsers expects array<array-key, User>, array{0: User, 1: string(james)} provided
```

Psalm

```php
<?php declare(strict_types = 1);

class User {
  public function __construct(string $name) {}
}

/** @param User[] $users */
function processUsers(array $users): void {
    var_export($users);
}

processUsers([
  new User('Jane'),
  'james',
]);
```

```
Psalm output (using commit 39a8227):

ERROR: InvalidArgument - 12:14 - Argument 1 of processUsers expects array<array-key, User>, array{0: User, 1: string(james)} provided
```

```
11
12 processUsers([
13   new User('Jane'),
14   'james',
15 ]);
```

HOW DO WE TELL STATIC ANALYSERS ABOUT GENERICS?

```
class Queue<T>{

  public function add(T $item): void {…}

  public function getNext(): T{…}
}
```

```
/** @template T */
class Queue    {


  public function add(T $item): void {…}


  public function getNext(): T{…}
}
```

```
/** @template T */
class Queue    {

  /** @param T $item */
  public function add(  $item): void {…}


  public function getNext(): T{…}
}
```

```
/** @template T */
class Queue    {

  /** @param T $item */
  public function add(  $item): void {…}

  /** @return T */
  public function getNext()   {…}
}
```

```
/** @var Queue<User> $userQueue */
$userQueue = new Queue();
```

RECAP

```
class Queue() { … }
```

```
/** @template T */
class Queue() { … }
```

```
/** @template T */
class Queue() { … }


$userQueue = new Queue();
```

```
/** @template T */
class Queue() { … }

/** @var Queue<User> $userQueue */
$userQueue = new Queue();
```

```
/** @template T */
class Queue() { … }

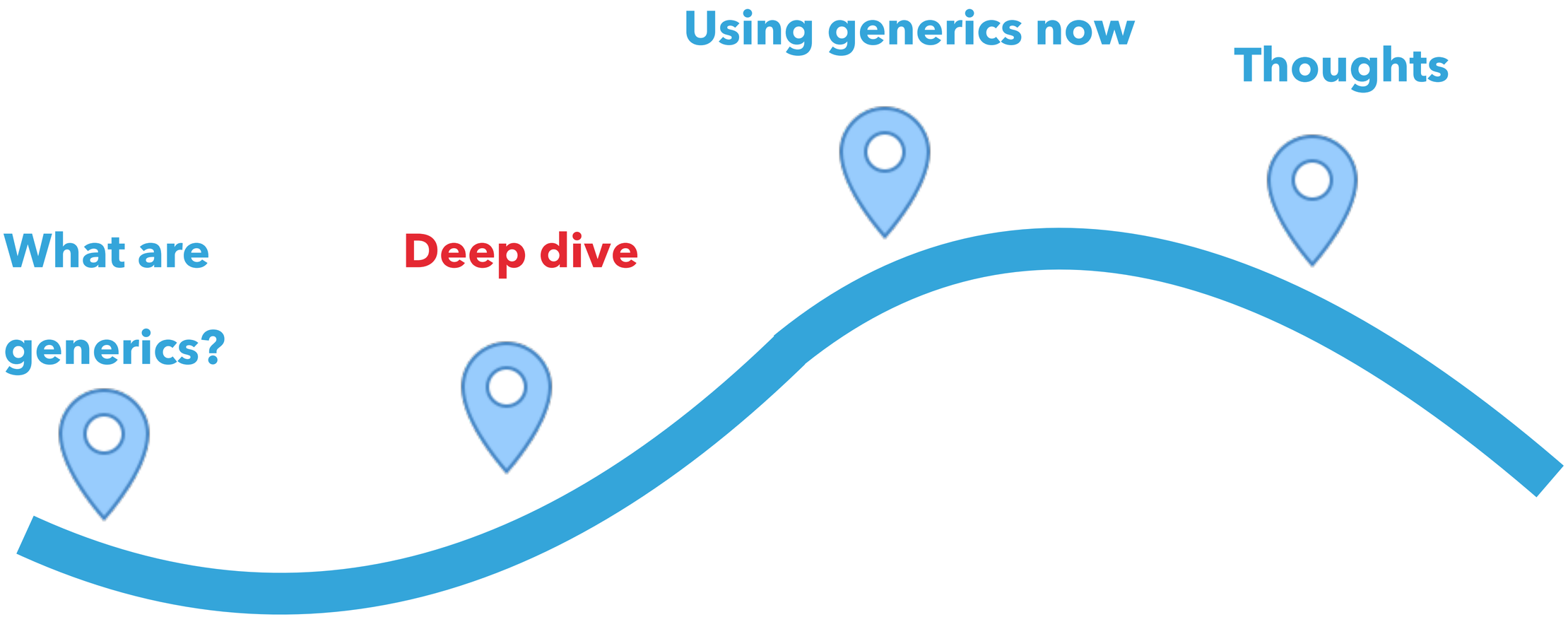
/** @var Queue<User> $userQueue */
$userQueue = new Queue();
```

```
/** @template T */
class Queue() { … }

/** @var Queue<User> $userQueue */
$userQueue = new Queue();
```

Psalm

AGENDA



COLLECTIONS

```
class Business {
    /** @return Employee[] */
    public function getEmployees(): array {…}
}
function promote(Employee $employee): void {…}
function welcome(string $name): void {…}

foreach($business->getEmployees() as $name => $employee) {
    welcome($name);
    promote($employee);
}
```

```
class Business {
    /** @return Employee[] */
    public function getEmployees(): array {…}
}
function promote(Employee $employee): void {…}
function welcome(string $name): void {…}

foreach($business->getEmployees() as $name => $employee) {
    welcome($name);
    promote($employee);
}
```

```
class Business {
    /** @return Employee[] */
    public function getEmployees(): array {…}
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function promote(Employee $employee): void {…}
function welcome(string $name): void {…}


foreach($business->getEmployees() as $name => $employee) {
    welcome($name);
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class Business {
    /** @return Employee[] */
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}
function promote(Employee $employee): void {…}
function welcome(string $name): void {…}

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    welcome($name);
    promote($employee);
}
```

```
class Business {
    /** @return Employee[] */
    public function getEmployees(): array {…}
}

function promote(Employee $employee): void {…}

function welcome(string $name): void {…}


foreach($business->getEmployees() as $name => $employee) {
    welcome($name);
    promote($employee);
}
```

```
class Business {
    /** @return Employee[] */
    public function getEmployees(): array {…}
}

function promote(Employee $employee): void {…}
function welcome(string $name): void {…}


foreach($business->getEmployees() as $name => $employee) {
    welcome($name);
    promote($employee);
}
```

```
19 foreach($business->getEmployees() as $name => $employee) {
20     promote($employee);
21     welcome($name);
22 }
```

```
Psalm output (using commit add7c14):

INFO: MixedArgument - 21:12 - Argument 1 of welcome cannot be mixed, expecting string
```

```
class Business {
    /** @return array<string,Employee> */
     public function getEmployees(): array {…}
}
function promote(Employee $employee): void {…}
function welcome(string $name): void {…}


foreach($business->getEmployees() as $name => $employee)
{
    welcome($name);
    promote($employee);
}
```

```
class Business {
    /** @return array<string,Employee> */
    public function getEmployees(): array {…}
}

function promote(Employee $employee): void {…}

function welcome(string $name): void {…}


foreach($business->getEmployees() as $name => $employee)
{
    welcome($name);
    promote($employee);
}
```

```
class Business {
    /** @return array<string,Employee> */
    public function getEmployees(): array {…}
}

function promote(Employee $employee): void {…}

function welcome(string $name): void {…}


foreach($business->getEmployees() as $name => $employee)
{
    welcome($name);
    promote($employee);
}
```

```
class Business {
    /** @return array<string,Employee> */
    public function getEmployees(): array {…}
}

function promote(Employee $employee): void {…}

function welcome(string $name): void {…}


foreach($business->getEmployees() as $name => $employee)
{
    welcome($name);
    promote($employee);
}
```

```
class Business {
    /** @return array<string,Employee> */
    public function getEmployees(): array {…}
}

function promote(Employee $employee): void {…}
function welcome(string $name): void {…}


foreach($business->getEmployees() as $name => $employee)
{
    welcome($name);
    promote($employee);
}
```

```
/** @var array<V> */
$people = [ … ];
```

```
/** @var array<K, V> */
$people = [ … ];
```

```
/** @var ArrayCollection<K, V> */
$people = new ArrayCollection();
```

FUNCTIONS

```
/**
 * @template T
 * @param T $value
 * @return T
 */
function mirror($value) { return $value; }
```

```
/**
 * @template T
 * @param T $value
 * @return T
 */
function mirror($value) { return $value; }
```

```
/**
 * @template T
 * @param T $value
 * @return T
 */
function mirror($value) { return $value; }
```

```
/**
 * @template T
 * @param T $value
 * @return T
 */
function mirror($value) { return $value; }
```

```
/**
 * @template T
 * @param T $value
 * @return T
 */
function mirror($value) { return $value; }
```

```
/**
 * @template T
 * @param T $input
 * @return T
 */
function mirror($input) { return $input; }
$value = mirror(5);
```

```
/**
 * @template T
 * @param T $input
 * @return T
 */
function mirror($input) { return $input; }
$value = mirror(5);
```

```
/**
 * @template T
 * @param T $input
 * @return T
 */
function mirror($input) { return $input; }
$value = mirror(5);
```

```
/**
 * @template T
 * @param T $input
 * @return T
 */
function mirror($input) { return $input; }
$value = mirror(5);
```

```
/**
 * @template T
 * @param T $input
 * @return T
 */
function mirror($input) { return $input; }
$value = mirror(5);
```

```
/**
 * @template T
 * @param T $input
 * @return T
 */
function mirror($input) { return $input; }
$value = mirror(5);
```

```
/**
 * @template T
 * @param T $value
 * @return array<T>
 */
function asArray($value) { return [$value]; }
$values = asArray(5);
```

```
/**
 * @template T
 * @param T $value
 * @return array<T>
 */
function asArray($value) { return [$value]; }
$values = asArray(5);
```

```
/**
 * @template T
 * @param T $value
 * @return array<T>
 */
function asArray($value) { return [$value]; }
$values = asArray(5);
```

CLASS STRING

```
App\Entities\Person
```

```
Person::class
```

```
class Person {…}

class DIContainer
{
 /**
  *
  * @param string $className
  * @return object
  */
 public function make(string $className): object {…}

}

$person = $this->diContainer->make(Person::class);
```

```
class Person {…}

class DIContainer
{
 /**
  *
  * @param string $className
  * @return object
  */
 public function make(string $className): object {…}

}

$person = $this->diContainer->make(Person::class);
```

```
class Person {…}

class DIContainer
{
    /**
     *
     * @param string $className
     * @return object
     */
    public function make(string $className): object {…}
}

$person = $this->diContainer->make(Person::class);
```

```
class Person {…}

class DIContainer
{
 /**
  *
  * @param string $className
  * @return object
  */
 public function make(string $className): object {…}

}
```

```
$person = $this->diContainer->make(Person::class);
```

```
class Person {…}

class DIContainer
{
 /**
  * @template T
  * @param class-string<T> $className
  * @return T
  */
 public function make(string $className): object {…}

}

$person = $this->diContainer->make(Person::class);
```

```
class Person {…}

class DIContainer
{
 /**
  * @template T
  * @param class-string<T> $className
  * @return T
  */
 public function make(string $className): object {…}

}

$person = $this->diContainer->make(Person::class);
```

```
class Person {…}

class DIContainer
{
 /**
  * @template T
  * @param class-string<T> $className
  * @return T
  */
 public function make(string $className): object {…}

}

$person = $this->diContainer->make(Person::class);
```

```
class Person {…}

class DIContainer
{
 /**
  * @template T
  * @param class-string<T> $className
  * @return T
  */
 public function make(string $className): object {…}

}

$person = $this->diContainer->make(Person::class);
```

```
class Person {…}

class DIContainer
{
 /**
  * @template T
  * @param class-string<T> $className
  * @return T
  */
 public function make(string $className): object {…}

}

$person = $this->diContainer->make(Person::class);
```

```
class Person {…}

class DIContainer
{
 /**
  * @template T
  * @param class-string<T> $className
  * @return T
  */
 public function make(string $className): object {…}

}

$person = $this->diContainer->make(Person::class);
```

EXTENDING TEMPLATES

```
/** @template T */
abstract class Repository {

  /** @return array<T> */
  public function findAll(): array {…}

  /** @return T|null */
  public function findById(int $id) {…}
}
```

```
/** @template T */
abstract class Repository {

    /** @return array<T> */
    public function findAll(): array {…}

    /** @return T|null */
    public function findById(int $id) {…}
}
```

```
/** @template T */
abstract class Repository {

    /** @return array<T> */
    public function findAll(): array {…}

    /** @return T|null */
    public function findById(int $id) {…}
}
```

```
/** @template T */
abstract class Repository {

    /** @return array<T> */
    public function findAll(): array {…}

    /** @return T|null */
    public function findById(int $id) {…}
}
```

```
/** @template T */
abstract class Repository { … }

/** @extends Repository<User> */
class UserRepository extends Repository {…}

$user = $userRepository->findById(1);
```

```
/** @template T */
abstract class Repository { … }
```

```
/** @extends Repository<User> */
class UserRepository extends Repository {…}
```

```
$user = $userRepository->findById(1);
```

```
/** @template T */
abstract class Repository { … }

/** @extends Repository<User> */
class UserRepository extends Repository {…}

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/** @template T */
abstract class Repository { … }

/** @extends Repository<User> */
class UserRepository extends Repository {…}

$user = $userRepository->findById(1);
```

RESTRICTING TYPES

```
class Animal { … }

class Dog extends Animal {
  public function bark(): void {…}
}

class Cat extends Animal {
  public function meow(): void {…}
}
```

```
/** @template T */
interface AnimalGame {

  /** @param T $animal */
  public function play($animal): void;
}
```

```
/** @template T */
interface AnimalGame {

  /** @param T $animal */
  public function play($animal): void;
}
```

```
/** @template T */
interface AnimalGame {

    /** @param T $animal */
    public function play($animal): void;
}
```

```
/** @implements AnimalGame<Dog> */
class DogGame implements AnimalGame {

  public function play($animal): void {
    $animal->bark(); // We know $animal is a dog
  }
}
```

```
/** @implements AnimalGame<Dog> */
class DogGame implements AnimalGame {


  public function play($animal): void {
    $animal->bark(); // We know $animal is a dog
  }
}
```

```
/** @implements AnimalGame<Dog> */
class DogGame implements AnimalGame {

    public function play($animal): void {
        $animal->bark(); // We know $animal is a dog
    }
}
```

```
/** @implements AnimalGame<Dog> */
class DogGame implements AnimalGame {

    public function play($animal): void {
        $animal->bark(); // We know $animal is a dog
    }
}
```

```
/** @implements AnimalGame<Dog> */
class DogGame implements AnimalGame {

  public function play($animal): void {
    $animal->meow(); // Dogs can't meow
  }
}
```

```
/** @implements AnimalGame<Dog> */
class DogGame implements AnimalGame {

  public function play($animal): void {
    $animal->meow(); // Dogs can't meow
  }
}
```

```
/** @implements AnimalGame<Car> */
class Car implements AnimalGame { … }
```

```
/** @template T of Animal */
class AnimalGame { … }

/** @extends AnimalGame<Car> */
class CarGame extends AnimalGame { … }

/** @extends AnimalGame<Cat> */
class CatGame extends AnimalGame { … }
```

```
/** @template T of Animal */
class AnimalGame { … }

/** @extends AnimalGame<Car> */
class CarGame extends AnimalGame { … }

/** @extends AnimalGame<Cat> */
class CatGame extends AnimalGame { … }
```

```
/** @template T of Animal */
class AnimalGame { … }

/** @extends AnimalGame<Car> */
class CarGame extends AnimalGame { … }

/** @extends AnimalGame<Cat> */
class CatGame extends AnimalGame { … }
```

```
/** @template T of Animal */
class AnimalGame { … }

/** @extends AnimalGame<Car> */
class CarGame extends AnimalGame { … }

/** @extends AnimalGame<Cat> */
class CatGame extends AnimalGame { … }
```

❌

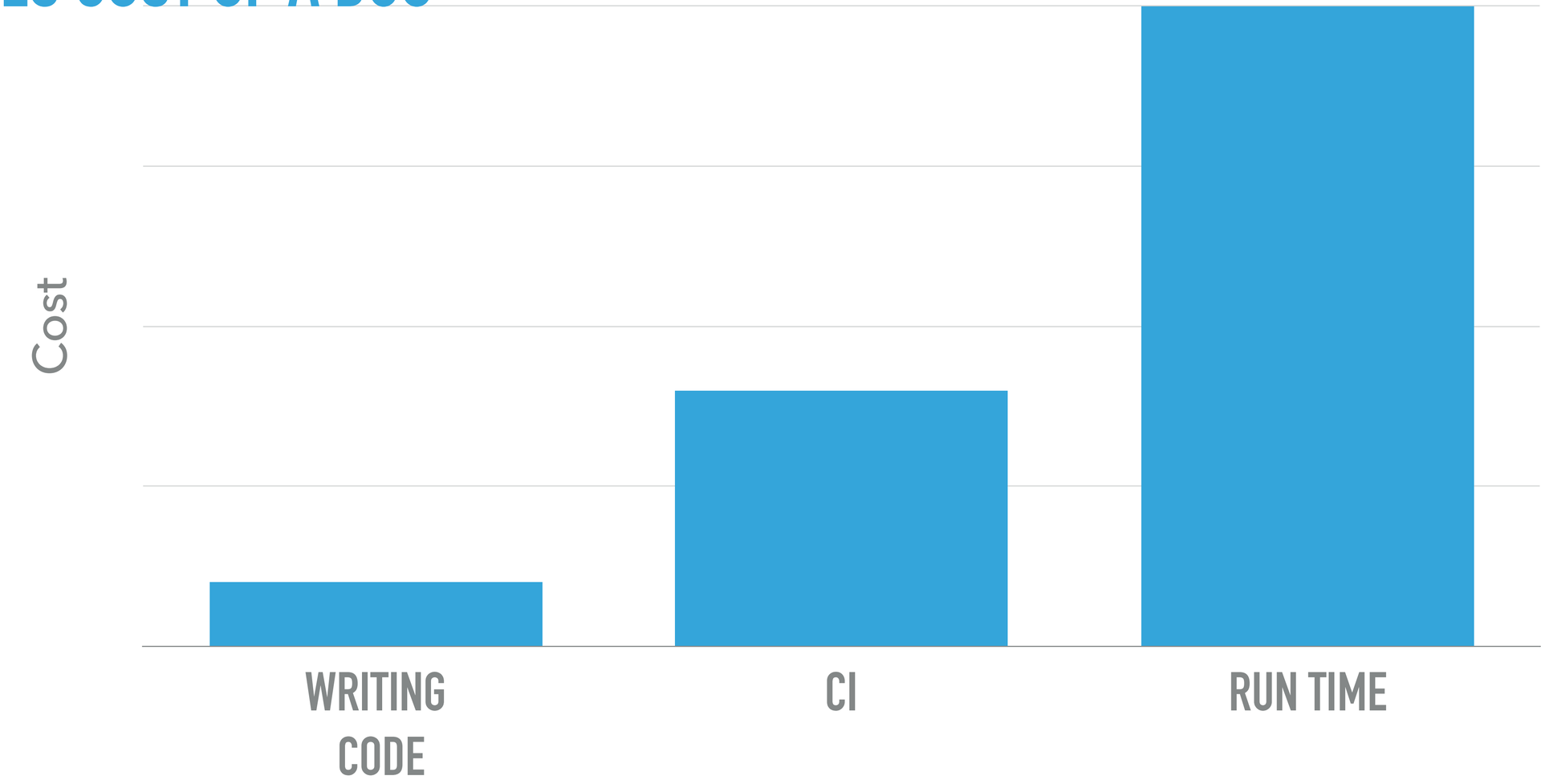
✅

HOW DOES THIS HELP US?

1. COMMUNICATES ADDITIONAL TYPE INFORMATION

```
/** @param array<string,Translation> $translations */
function storeTranslations(array $translations): void;
```

2. REDUCES COST OF A BUG



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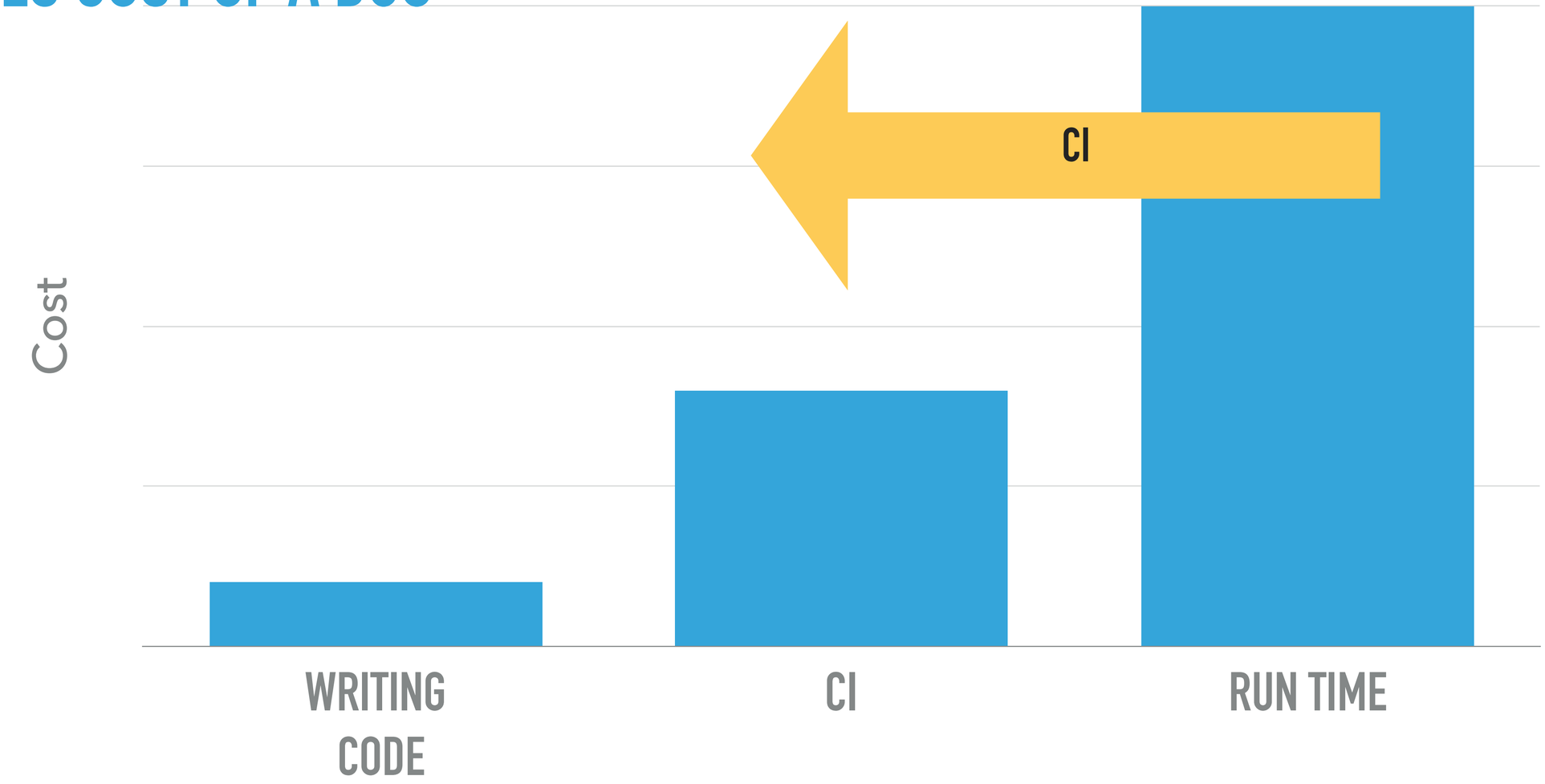

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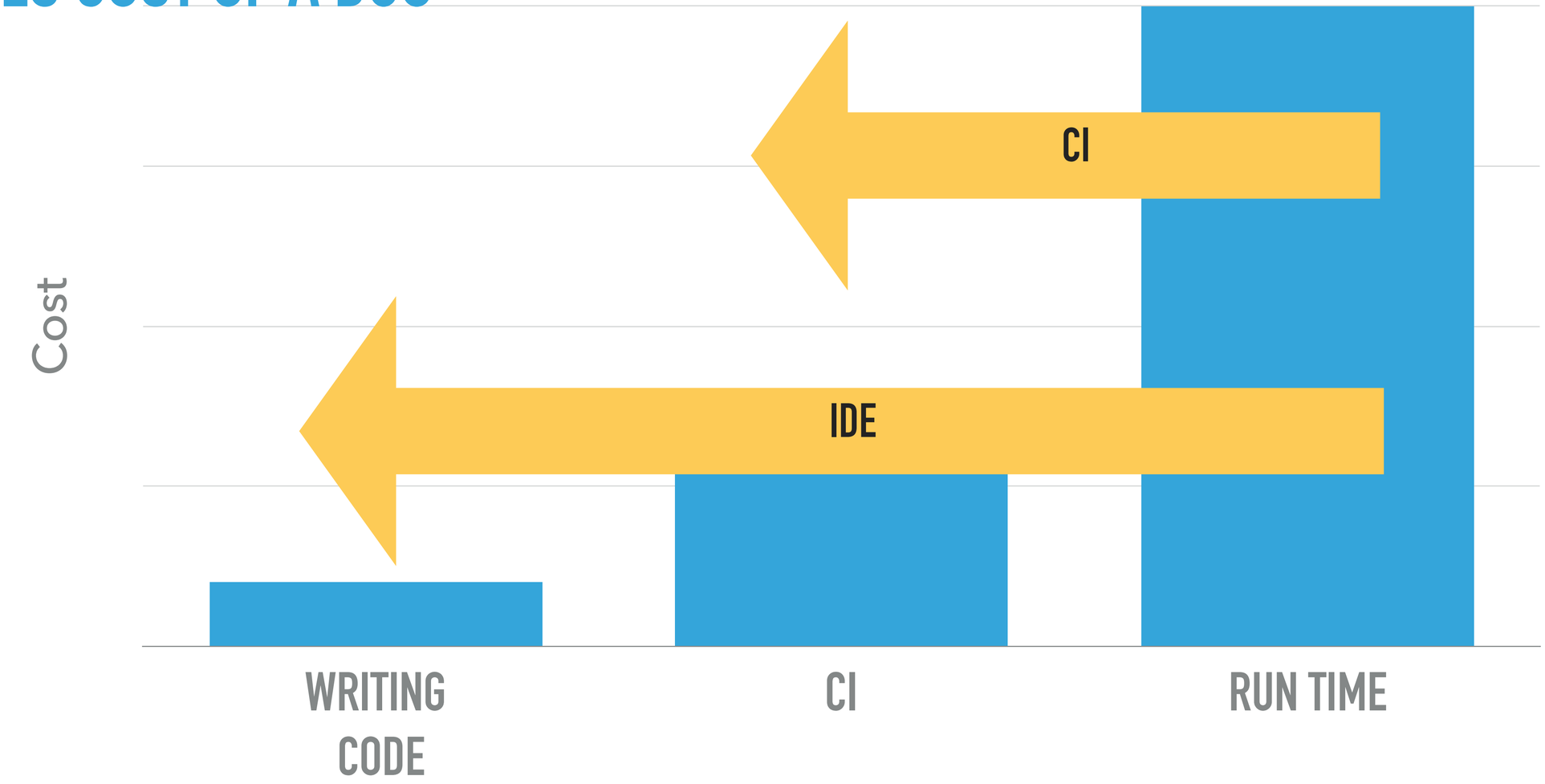
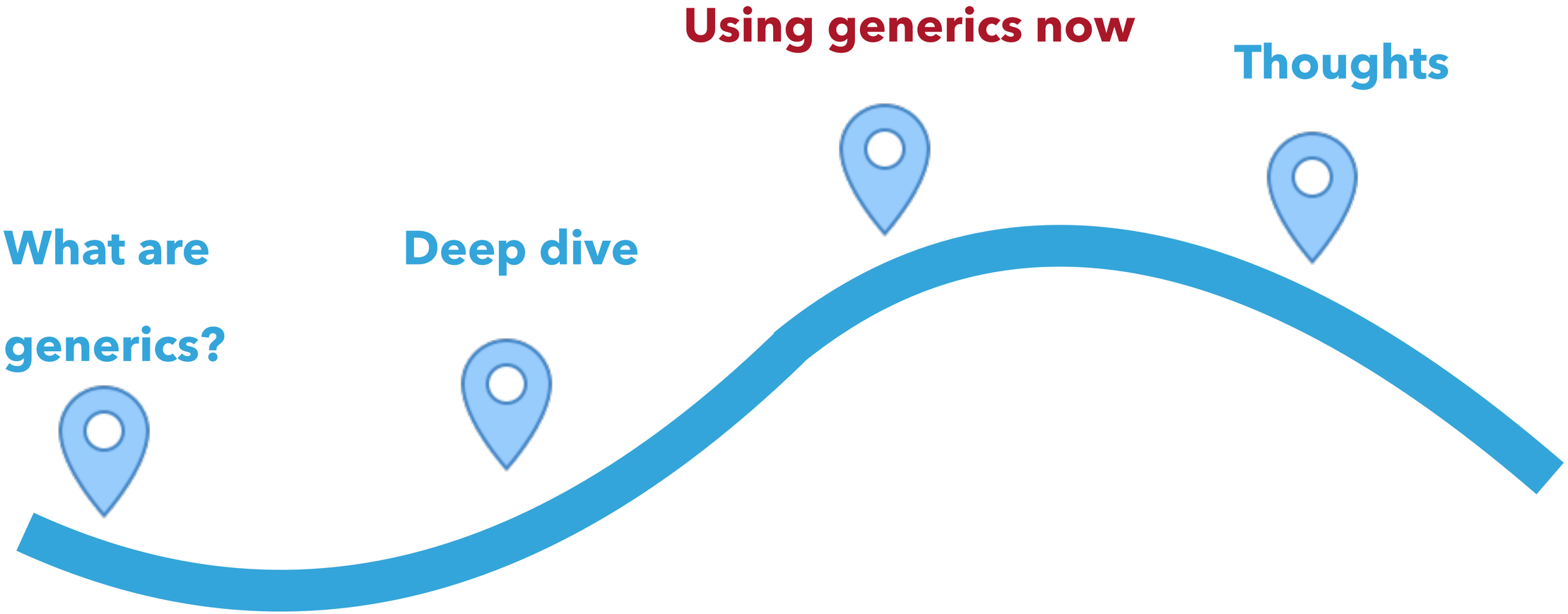


Using generics can help us write more understandable, robust and reliable code.

Demonstrate how existing tools can (almost) give us the benefits of generics now.

AGENDA



USING GENERICS NOW

USING GENERICS NOW

Provide type information for everything including generics

Psalm

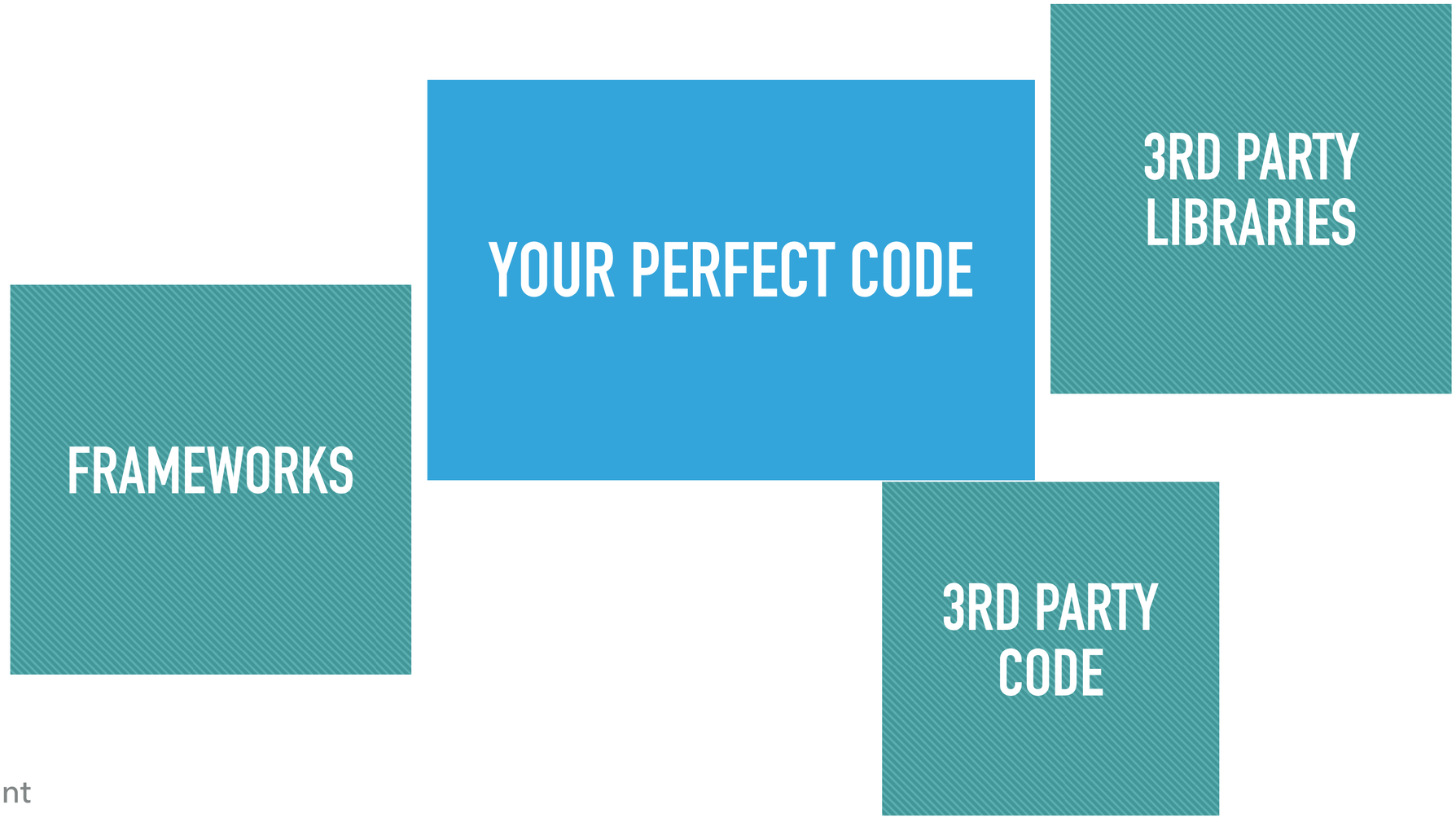
```
composer require —-dev vimeo/psalm

vendor/bin/psalm —i src 1

vendor/bin/psalm
```

YOUR PERFECT CODE

INTEGRATING WITH 3RD PARTY CODE



GET THIRD PARTY LIBRARIES ON BOARD

- E.g. Doctrine, PHPUnit, Webmozart Assertion
- Engage with maintainers
- 2 steps
  - Adding additional annotations
  - Introduce static analysers to build process

ADAPTORS FOR 3RD PARTY LIBRARIES: PROBLEM

```
interface Hasher {
    /**
     * @return string
     */
    public function encode();
}

$hash = $this->hasher->encode($id);
```

ADAPTORS FOR 3RD PARTY LIBRARIES: PROBLEM

```
interface Hasher {
    /**
     * @return string
     */
    public function encode();
}

$hash = $this->hasher->encode($id);
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ADAPTORS FOR 3RD PARTY LIBRARIES: PROBLEM

```
interface Hasher {
    /**
     * @return string
     */
    public function encode();
}

$hash = $this->hasher->encode($id);
```

```
class CleanHasher {

    /** @var Hasher $hasher */
    private $hasher; // Injected into constructor

    public function encode(int $id): string {
        return $this->hasher->encode($id);
    }
}


… in our code …
$hash = $this->cleanHasher->encode($id);
```

```
class CleanHasher {

    /** @var Hasher $hasher */
    private $hasher; // Injected into constructor

    public function encode(int $id): string {
        return $this->hasher->encode($id);
    }
}



… in our code …
$hash = $this->cleanHasher->encode($id);
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    /** @var Hasher $hasher */
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    }
}


… in our code …
$hash = $this->cleanHasher->encode($id);
```

USING STUBS

```
namespace ThirdParty\DI;

class DependencyInjection
{

 public function make(string $className): object
 {…}

}
```

Stubs/ThirdParty/DI.php

Stubs/ThirdParty/DI.php

```
namespace ThirdParty\DI;

class DependencyInjection
{
 /**
  * @template T
  * @param class-string<T> $className
  * @return T
  */
 public function make(string $className): object;
}
```

Stubs/ThirdParty/DI.php

```php
namespace ThirdParty\DI;

class DependencyInjection
{
 /**
  * @template T
  * @param class-string<T> $className
  * @return T
  */
 public function make(string $className): object;
}
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Stubs/ThirdParty/DI.php

```
namespace ThirdParty\DI;

class DependencyInjection
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 /**
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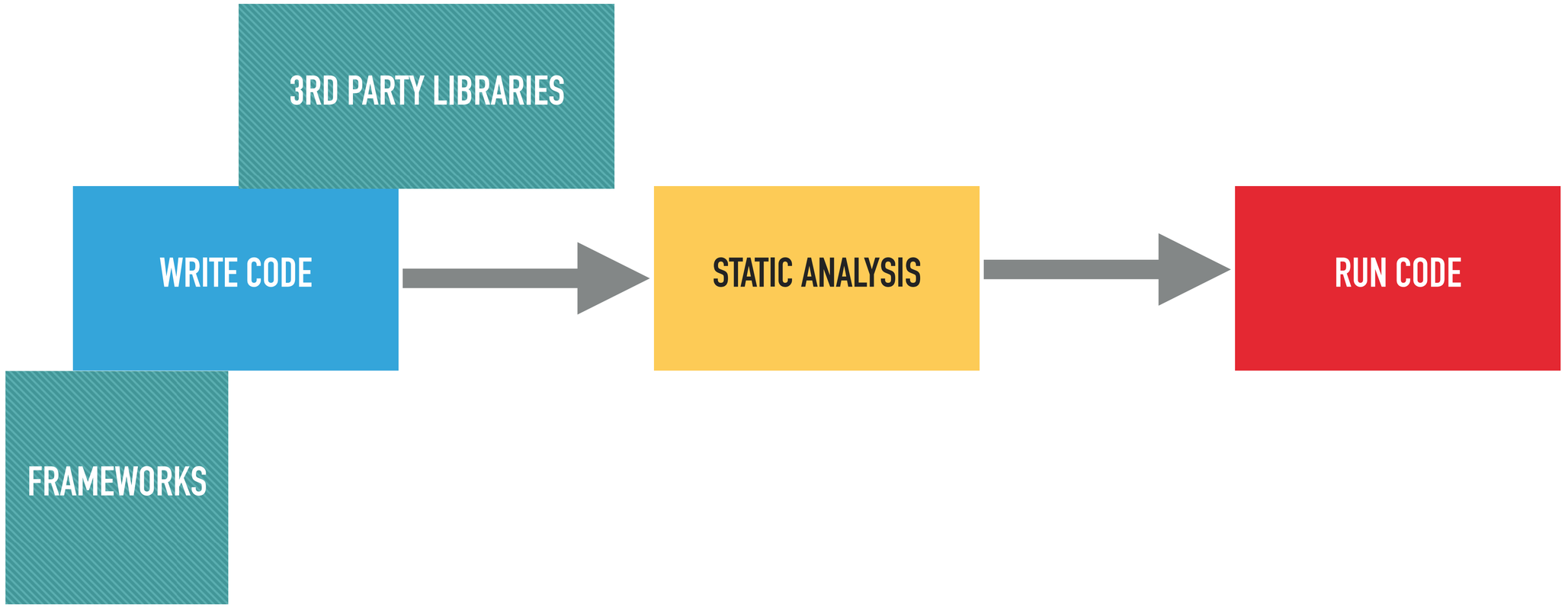
  * @param class-string<T> $className
  * @return T
  */
 public function make(string $className): object;
}
```

STATIC ANALYSER PLUGINS

- Needed where lots of “magic” is going on
- Specific to static analysis tool
- Hard to write

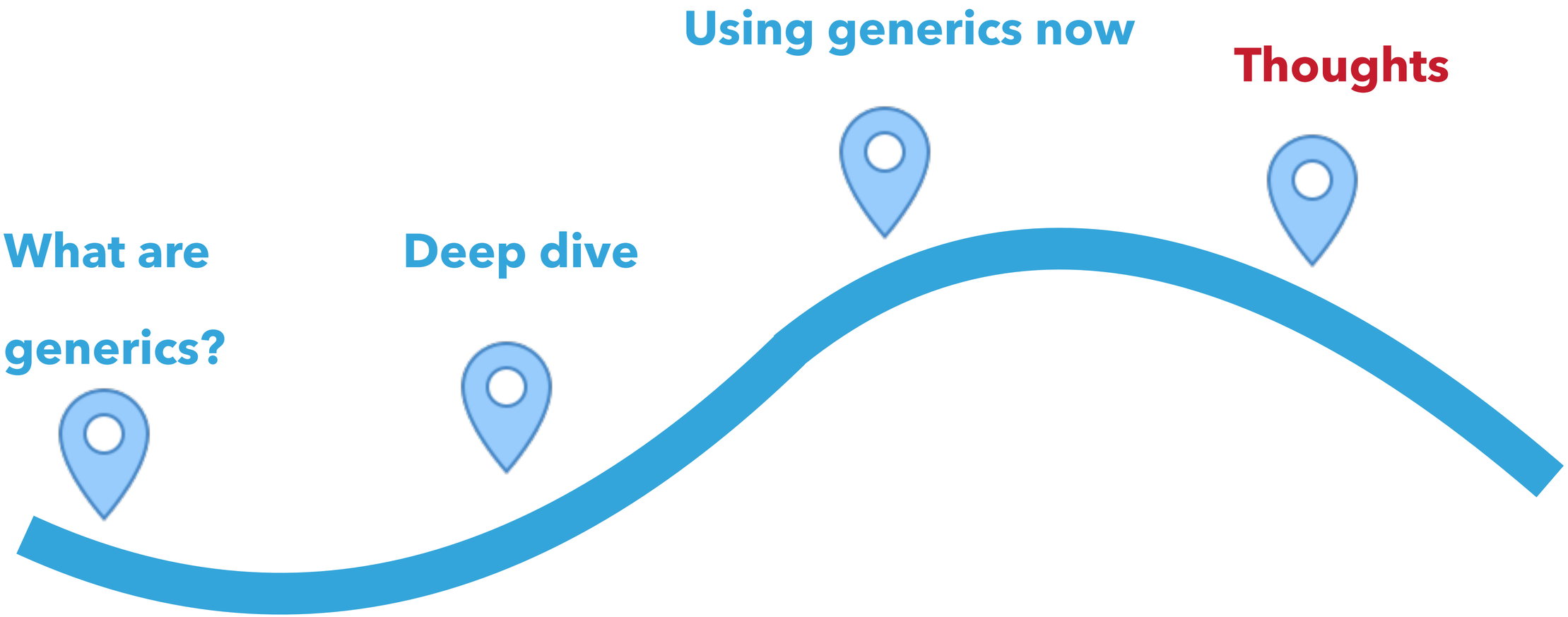
USING GENERICS NOW

Static analyser needs to know the types of everything



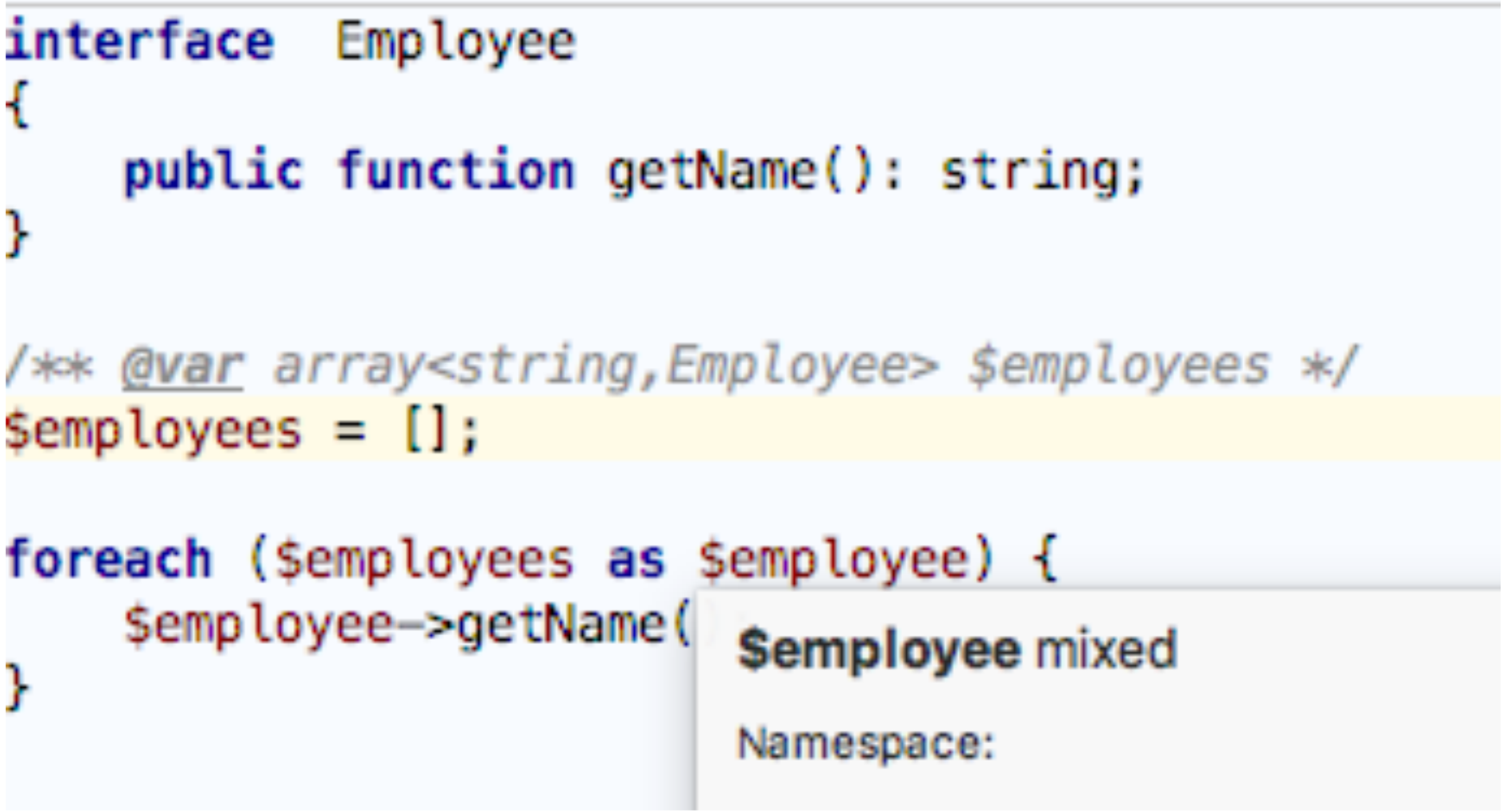
Static analyser needs to know the types of everything

AGENDA

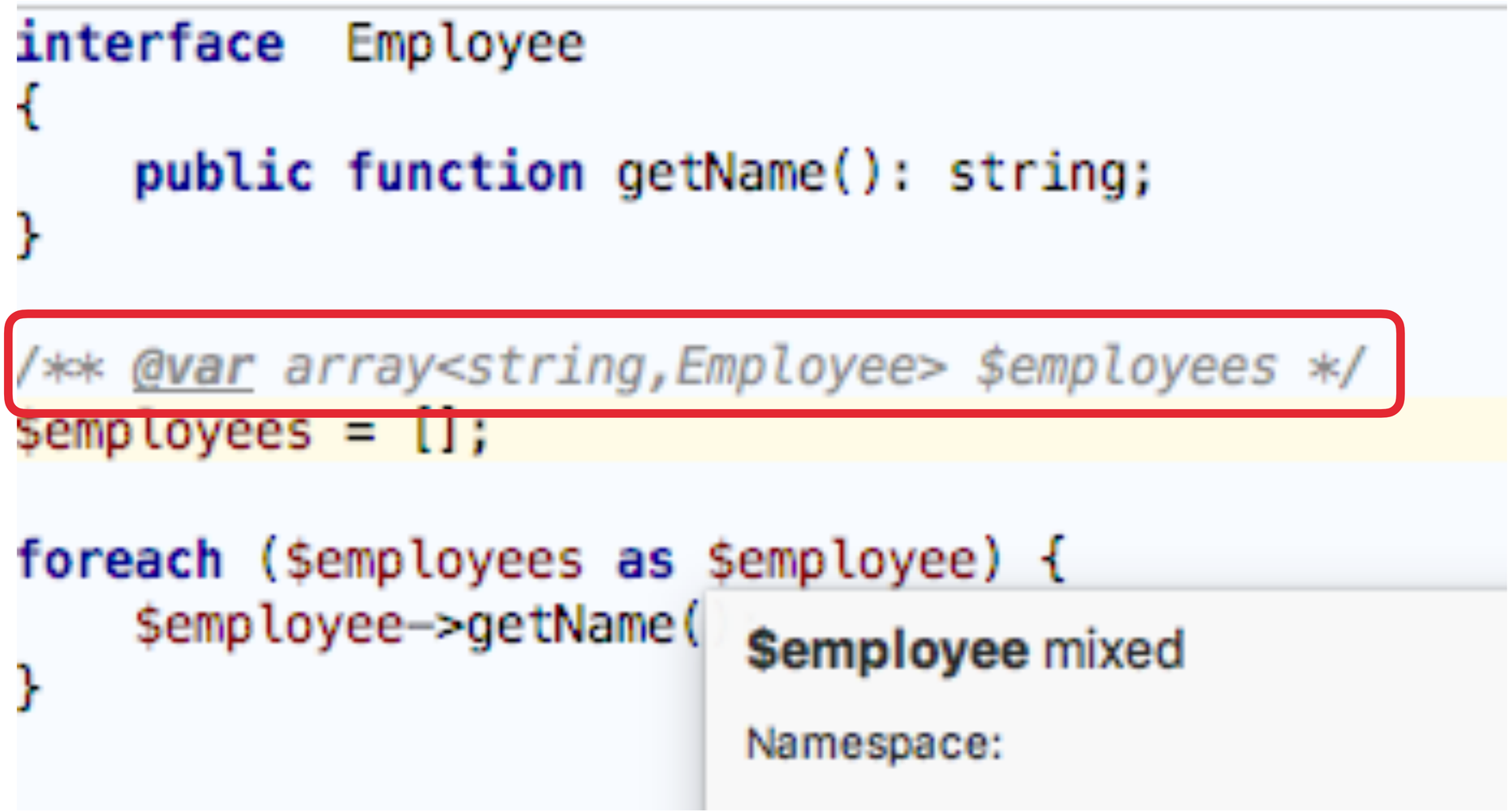


PHP GENERICS NOW (ALMOST)

IDE SUPPORT?


interface Employee
{
public function getName(): string;
}
/** @var array<string,Employee> $employees */
$employees = [];
foreach ($employees as $employee) {
$employee->getName(
}
$employee mixed
Namespace:

IDE SUPPORT?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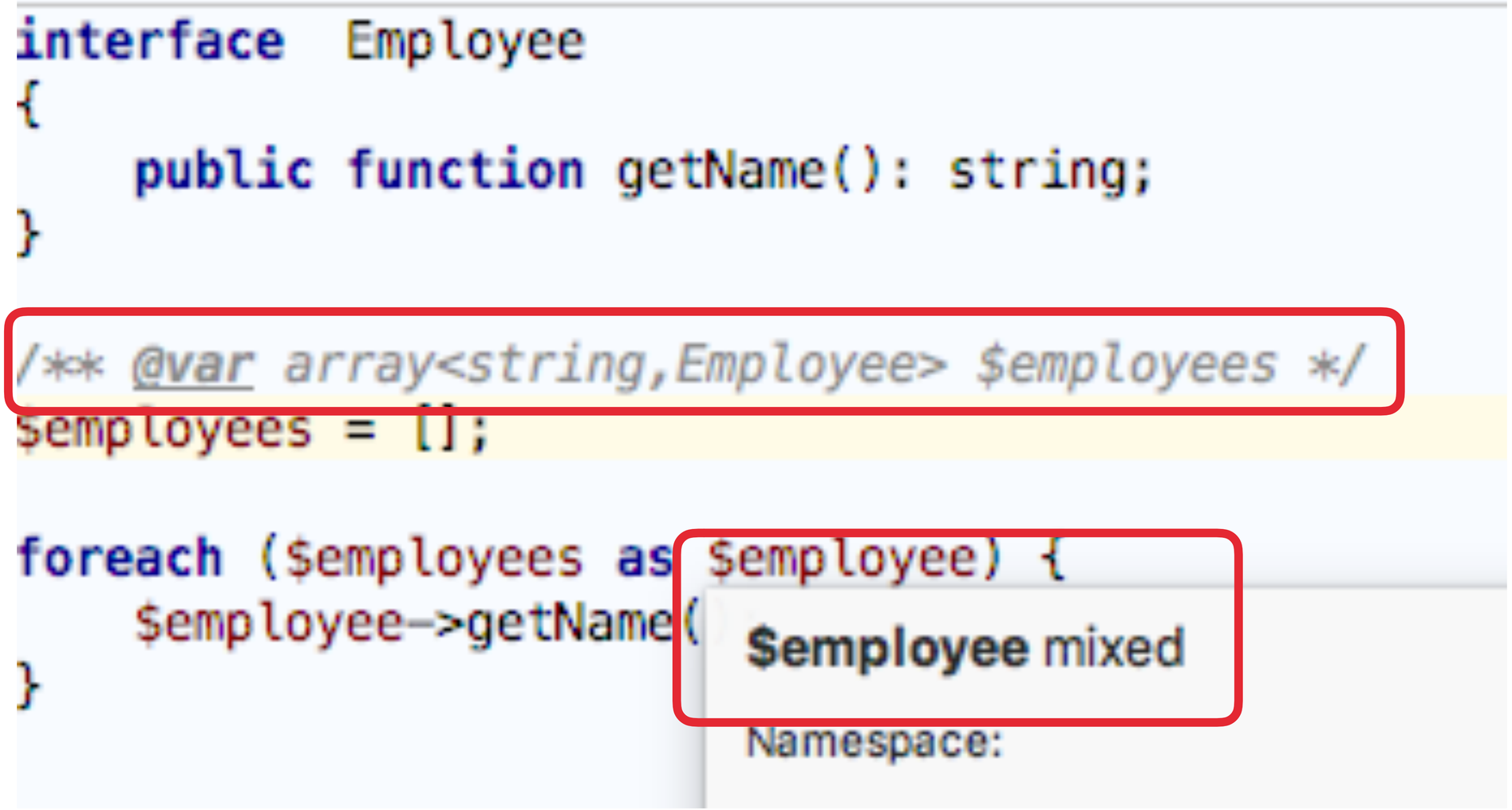
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{
public function getName(): string;
}
/** @var array<string,Employee> $employees */
$employees = [];
foreach ($employees as $employee) {
$employee->getName(
}
$employee mixed
Namespace:

```
class Business {
    /**
     * @return Employee[]
     * @psalm-return array<string,Employee>
     */
     public function getEmployees(): array {…}
}
```

```
class Business {
    /**
     * @return Employee[]
     * @psalm-return array<string,Employee>
     */
     public function getEmployees(): array {…}
}
```

```
class Business {
    /**
     * @return Employee[]
     * @psalm-return array<string,Employee>
     */
     public function getEmployees(): array {…}
}
```

WE NEED A STANDARD

WE NEED A STANDARD

WE NEED A STANDARD

IMPLEMENTING A STANDARD

IMPLEMENTING A STANDARD

- Full language support

IMPLEMENTING A STANDARD

- Full language support
- PSR

IMPLEMENTING A STANDARD – GENERICS INTO THE AST

IMPLEMENTING A STANDARD – GENERICS INTO THE AST

- Real annotations

```
[@template T]
class Queue {…}
```

IMPLEMENTING A STANDARD – GENERICS INTO THE AST

- Real annotations

```
[@template T]
class Queue {…}
```

- Add to language syntax

```
class Queue<T> {…}
```

IMPLEMENTING A STANDARD – GENERICS INTO THE AST

- Real annotations

```
[@template T]
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- Add to language syntax

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class Queue<T> {…}
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PHP CODE

IMPLEMENTING A STANDARD - GENERICS INTO THE AST

- Real annotations

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- Add to language syntax

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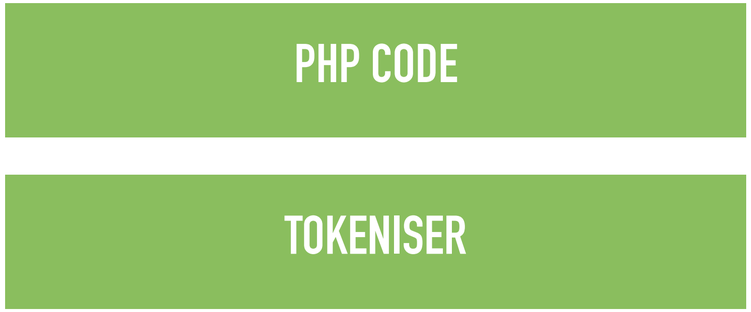

IMPLEMENTING A STANDARD – GENERICS INTO THE AST

- Real annotations

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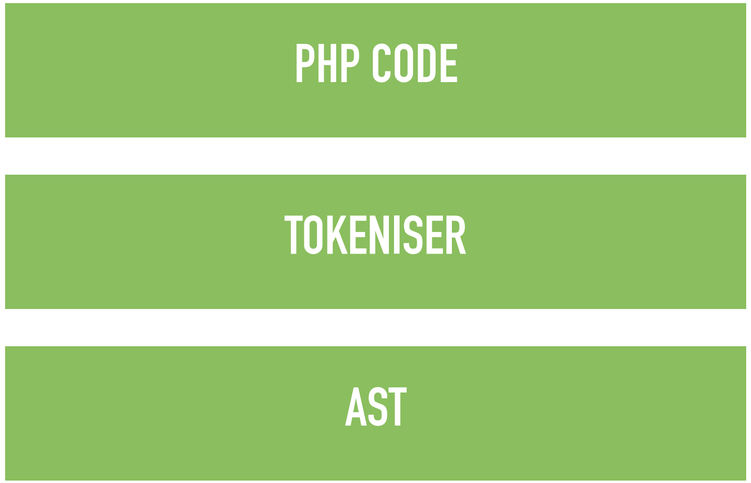
[@template T]
class Queue {…}
```

- Add to language syntax

```
class Queue<T> {…}
```



IMPLEMENTING A STANDARD – GENERICS INTO THE AST

- Real annotations

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[@template T]
class Queue {…}
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```

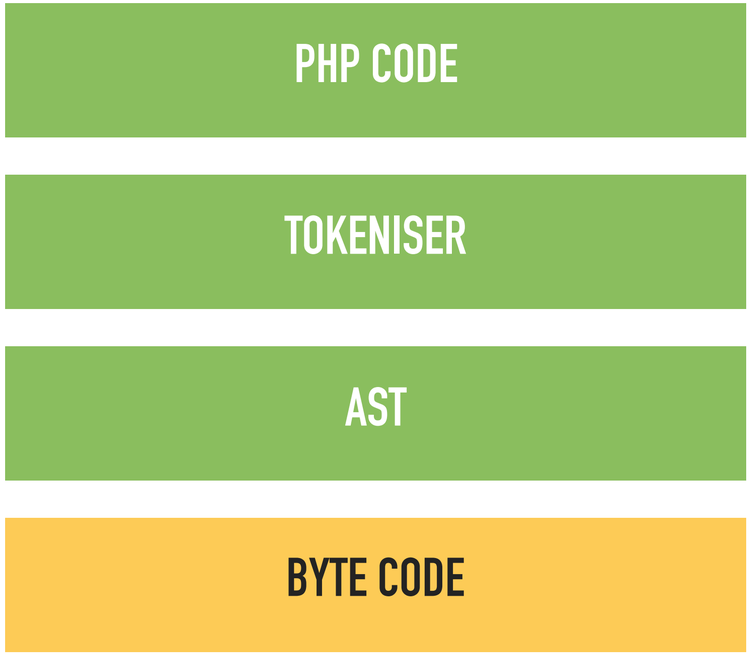

IMPLEMENTING A STANDARD - GENERICS INTO THE AST

- Real annotations

```
[@template T]
class Queue {…}
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- Add to language syntax

```
class Queue<T> {…}
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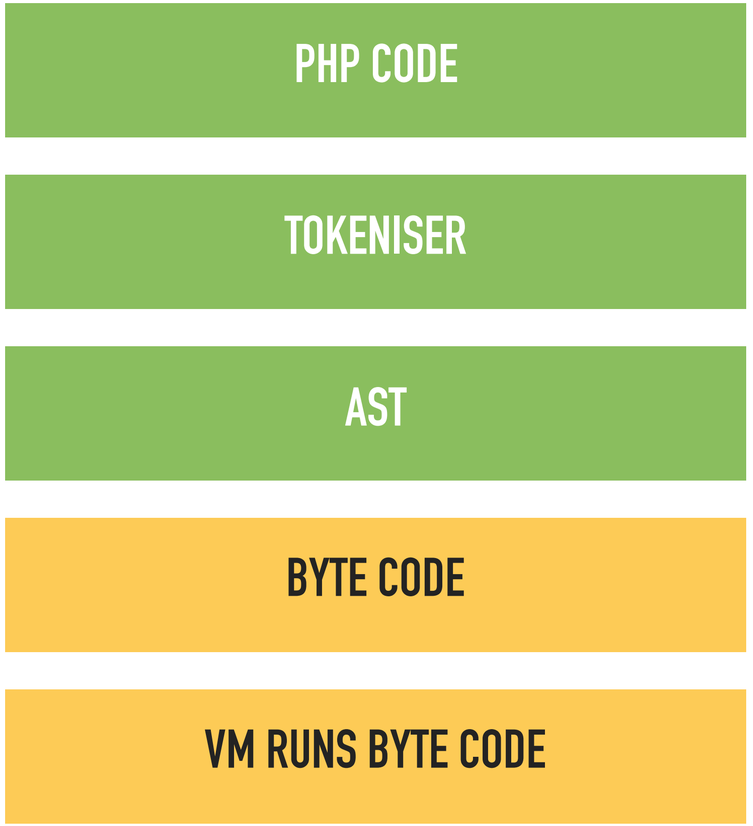


```
/** @template T */
class Queue    {

  /** @param T $item */
  public function add(    $item): void {…}

  /** @return T */
  public function getNext()   {…}
}
```

NEED TO TRUST TOOLS: NO RUN TIME CHECKS

```
/** @template T */
class Queue    {

  /** @param T $item */
  public function add(  $item): void {…}

  /** @return T */
  public function getNext()   {…}
}
```

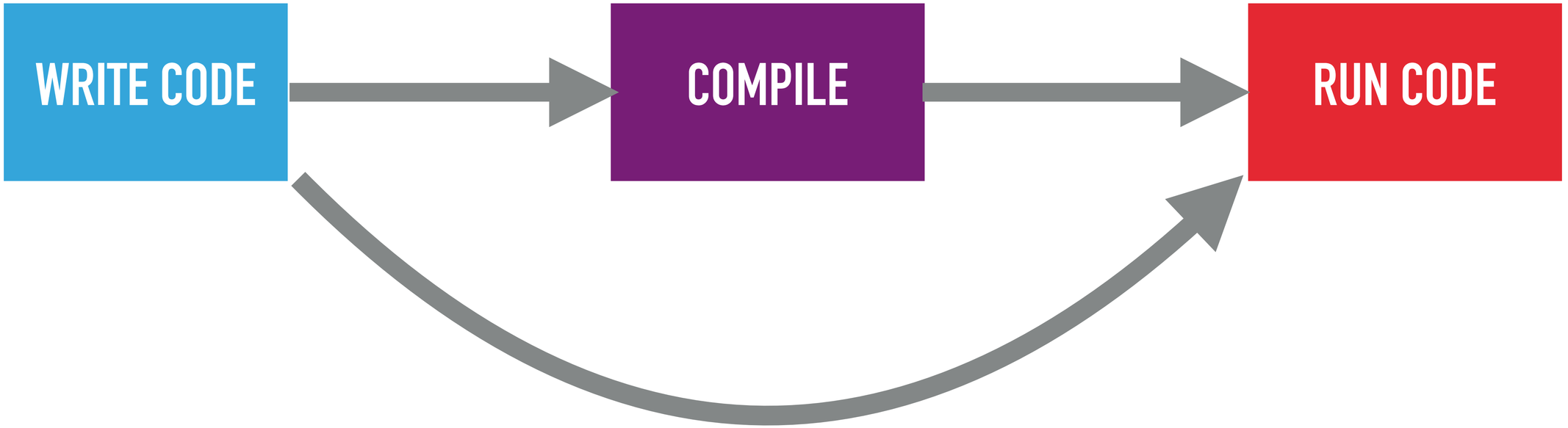
```
/** @template T */
class Queue    {

  /** @param T $item */
  public function add(    $item): void {…}

  /** @return T */
  public function getNext()    {…}
}
```

All bets are off if there is any missing or incorrect type information

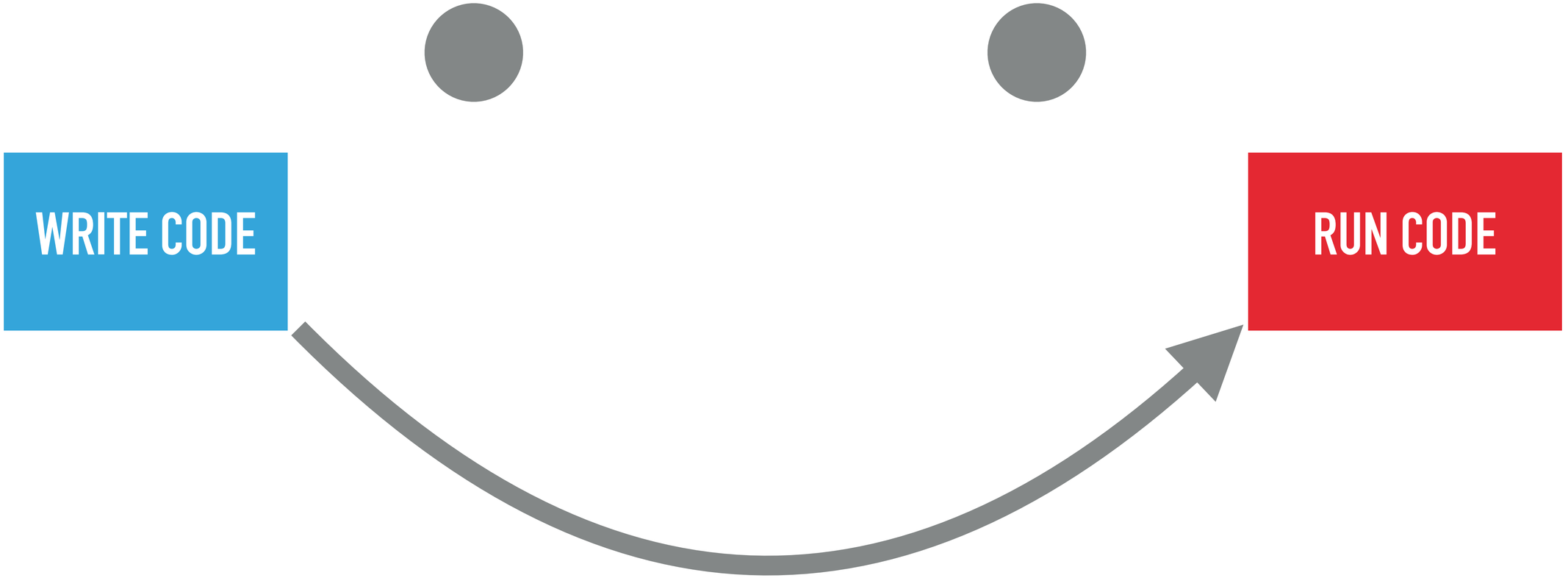
THE END OF RUN TIME CHECKS?

WHY NOT JUST USE JAVA?

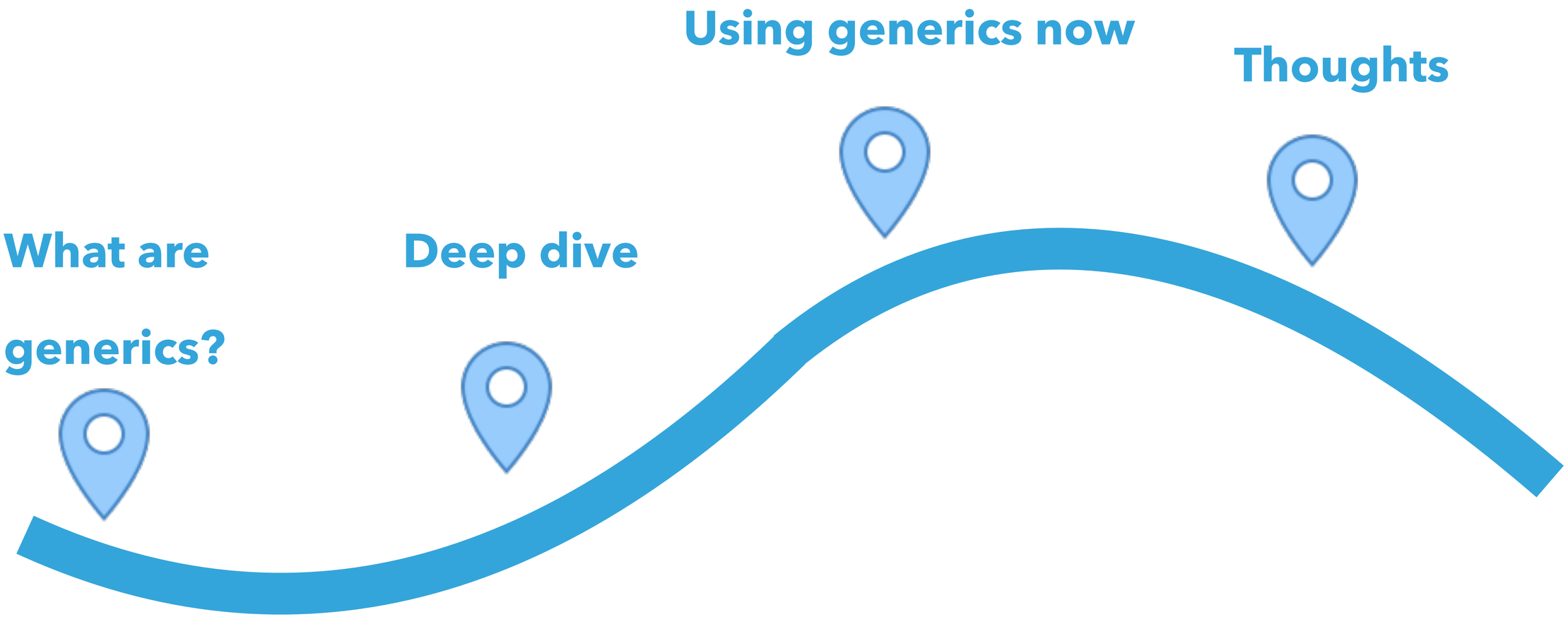
WHY NOT JUST USE JAVA?



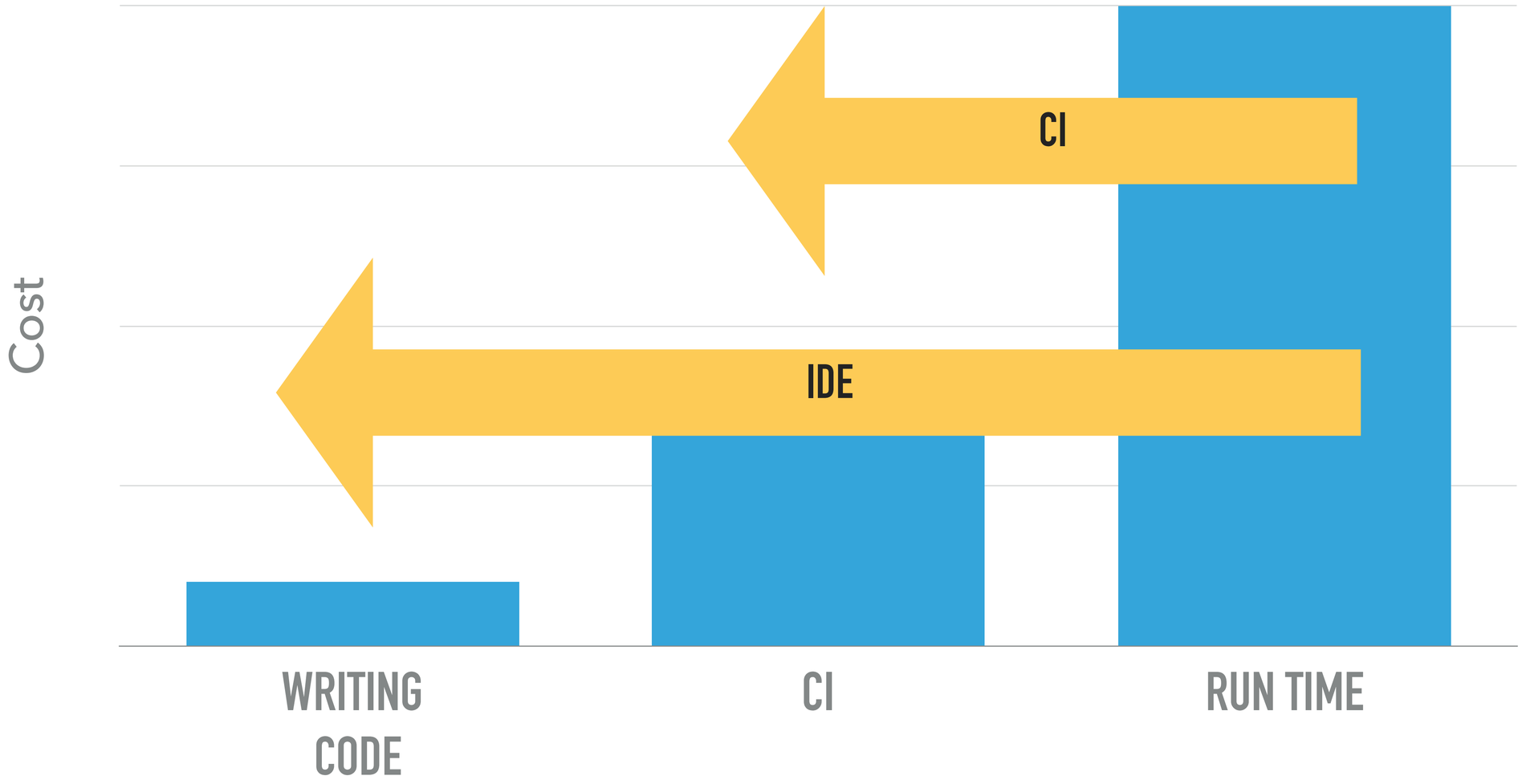
WHY NOT JUST USE JAVA?



AGENDA



ADD CLARITY TO CODE. FIND SOME BUGS EARLIER.



USING GENERICS NOW

Psalm

STANDARDS

Dave Liddament

Lamp Bristol

Organise PHP-SW and Bristol PHP Training

Author of Static Analysis Results Baseliner (SARB)

18 years of writing software (C, Java, Python, PHP)

@daveliddament

Dave Liddament

Lamp Bristol

Thank you for listening

Organise PHP-SW and Bristol PHP Training

Author of Static Analysis Results Baseliner (SARB)

18 years of writing software (C, Java, Python, PHP)

@daveliddament

QUESTIONS

FURTHER READING

- Feedback: https://joind.in/talk/911ad
- Slides: https://www.daveliddament.co.uk/talks/php-generics-today-almost
- Code: https://github.com/DaveLiddament/php-generics-today-almost
- Static Analysers:
  - Psalm: https://psalm.dev
  - PHPStan: https://phpstan.org
- RFC and notes:
  - https://wiki.php.net/rfc/generics
  - https://github.com/PHPGenerics/php-generics-rfc/issues/45
  - https://wiki.php.net/rfc/annotations_v2