Perl 6 Roles In Depth

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YAPC::Europe 2009


Hi!
Hola!
Hej hej!
Ahoj!
Salut!
OH HAI
Olá!
Ciao!
Привет!

Perl 6 Roles In Depth

.WHO?

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Me

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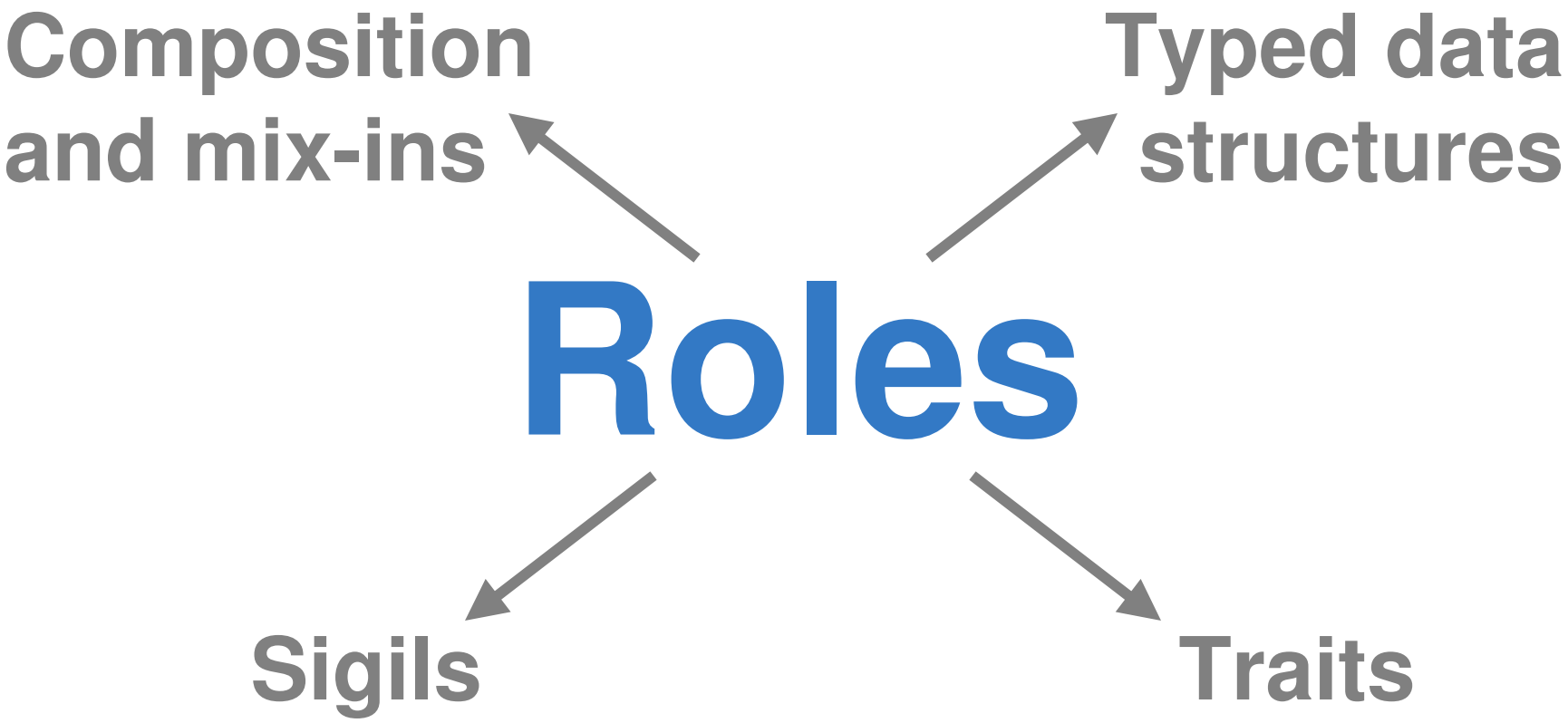
- LOL

Roles

Roles

Right at the heart of Perl 6

Perl 6 Roles In Depth



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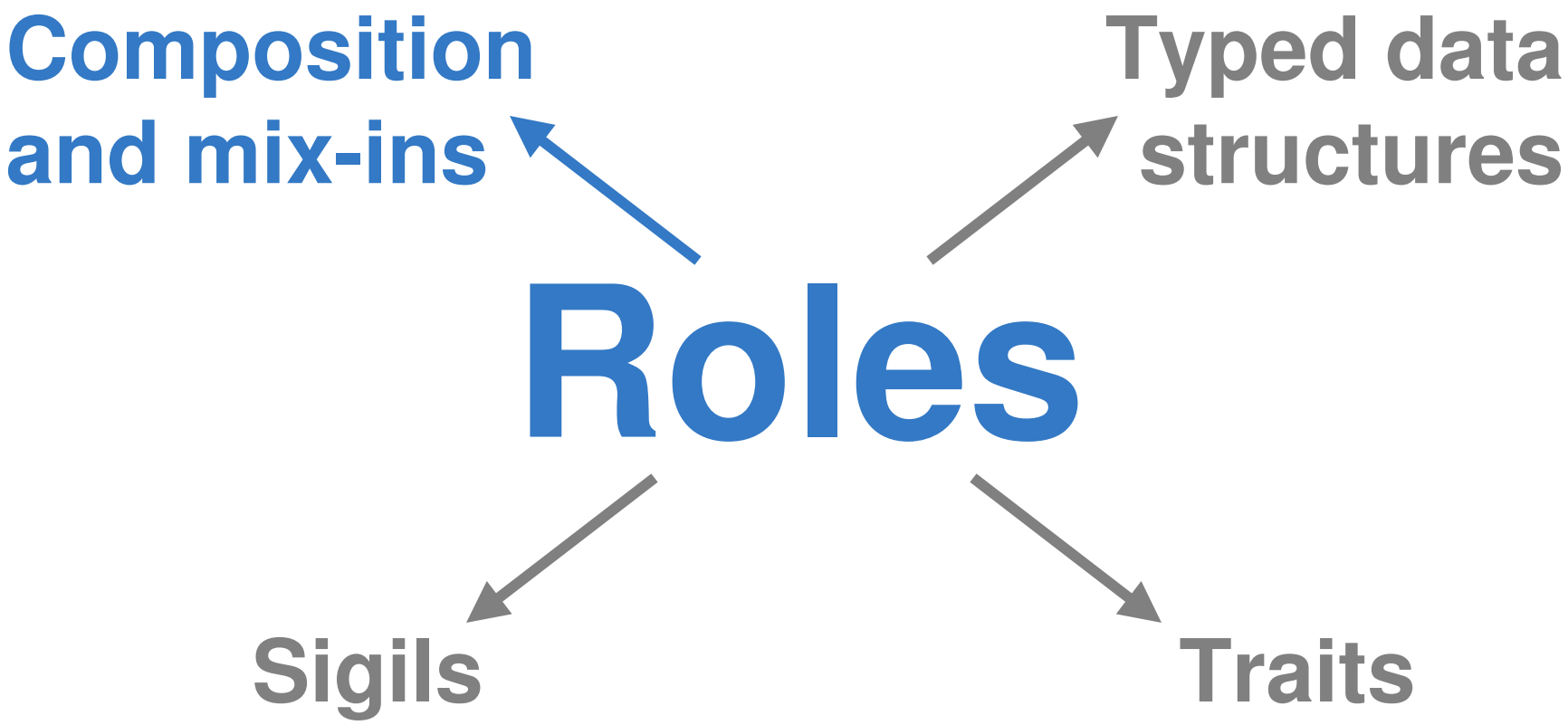

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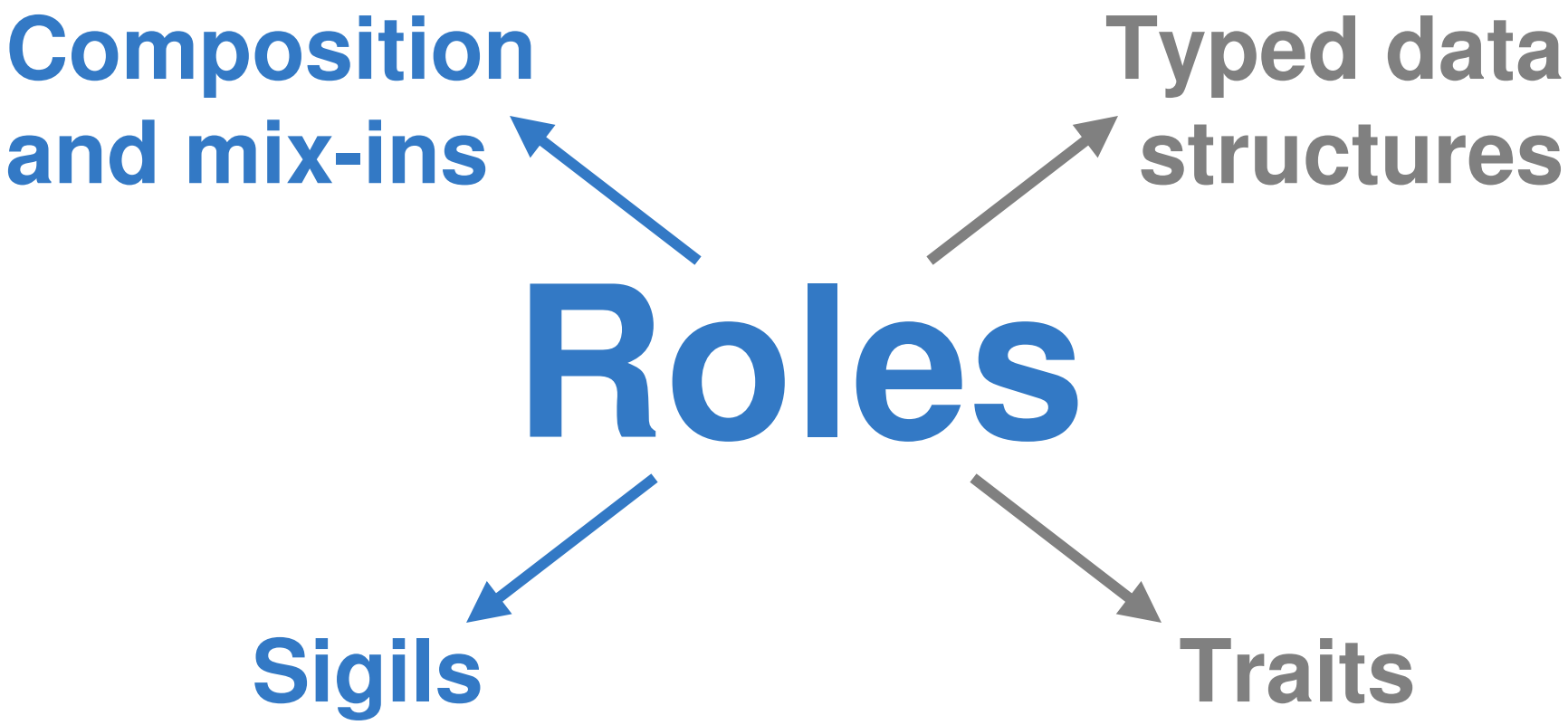

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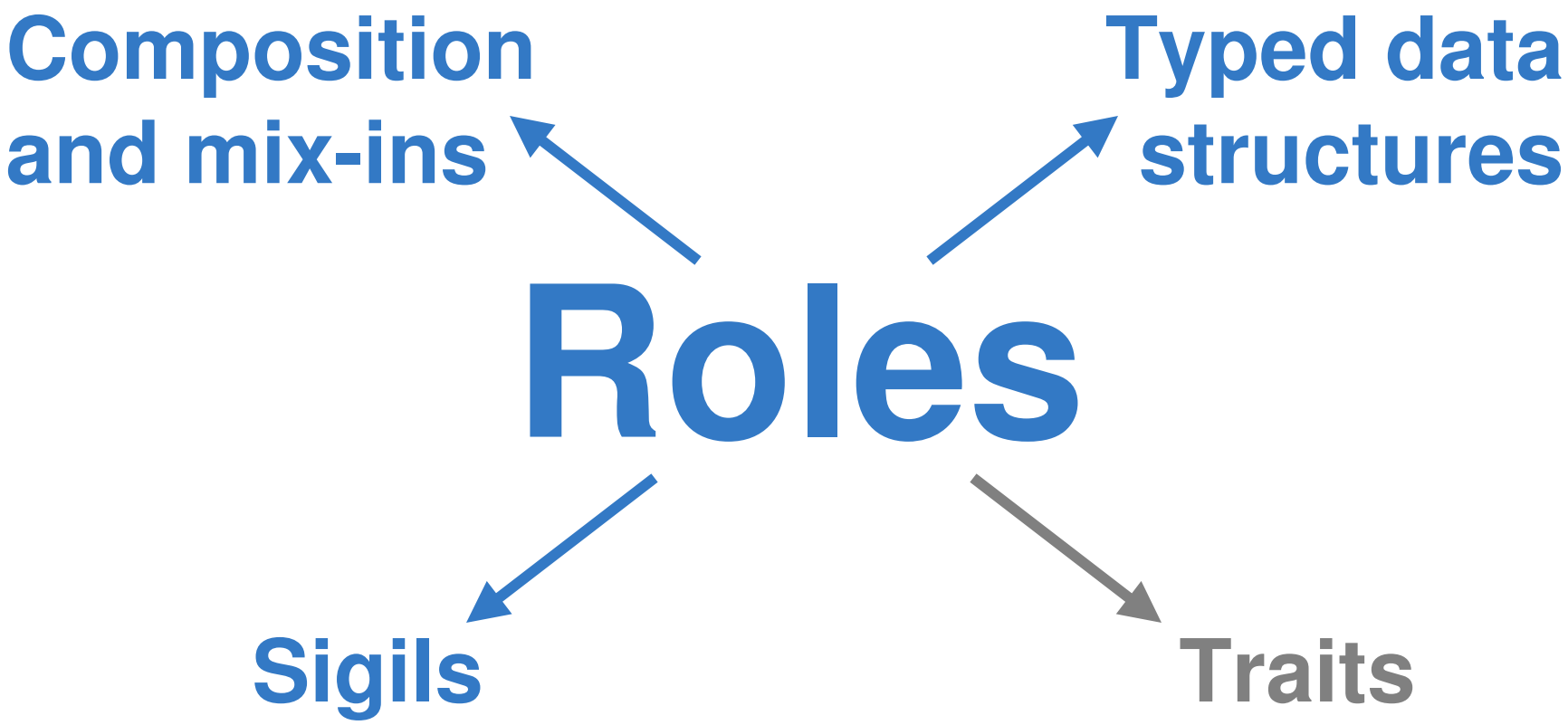

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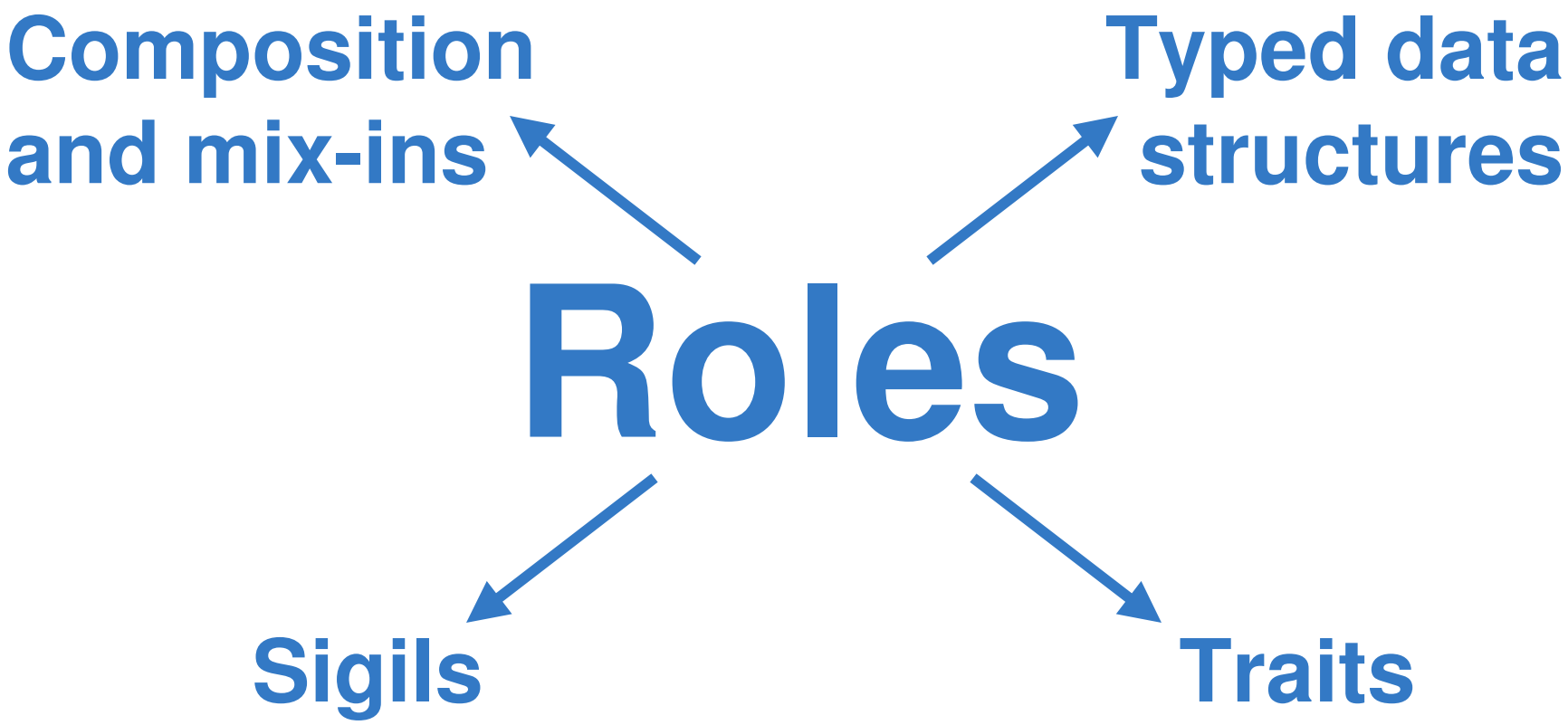

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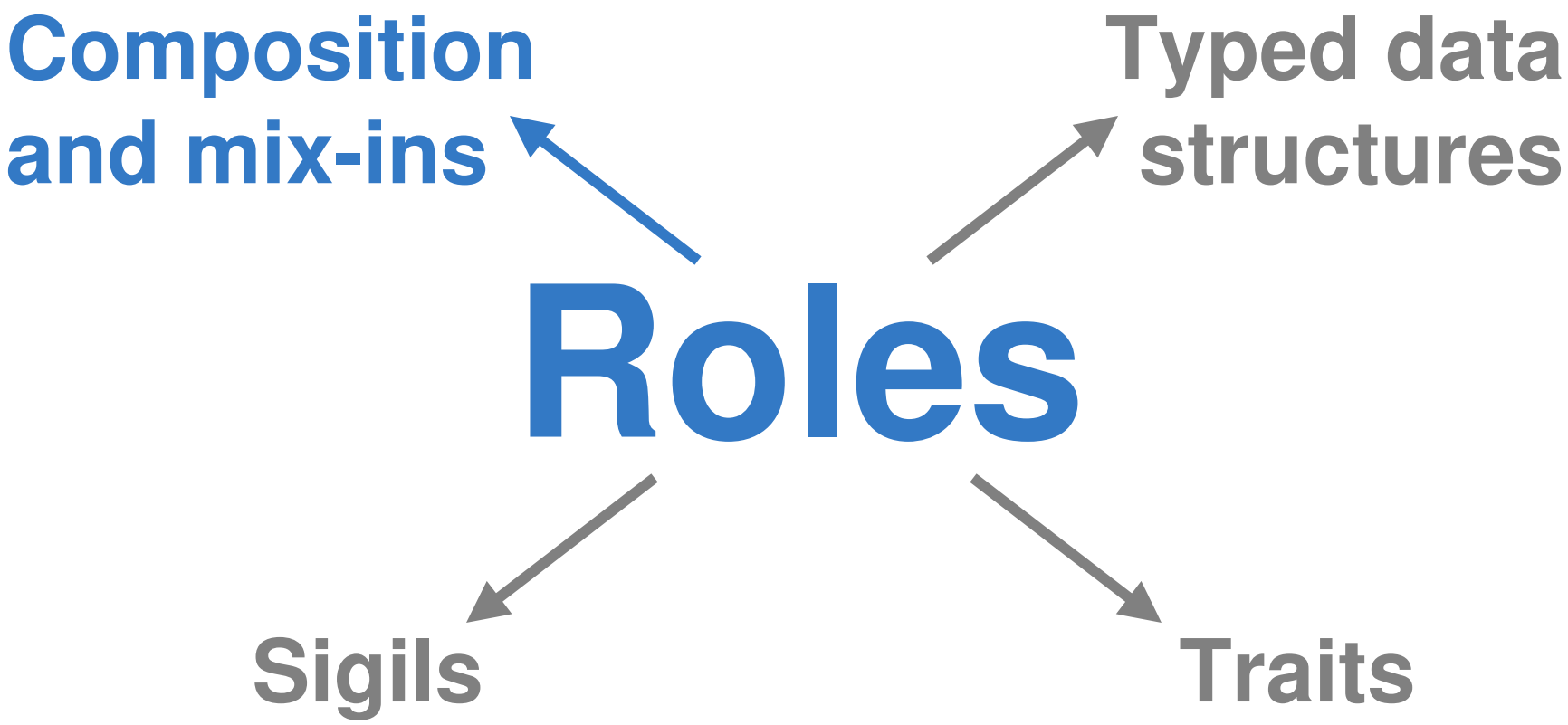

So what is a role anyway?

- A collection of zero or more…
  - Methods
  - Attributes
- Unlike a class, can not be instantiated (if you try, a class is generated for you)
- Classes in Perl 6 are mutable (with the right pragma in force, can be monkey-typed), whereas roles are immutable

What does a role look like?

- Introduced with the role keyword
- Methods and attributes declared just as they would be in a Perl 6 class

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```
role DebugLog {
    has @.log_lines;
    has $.log_size is rw = 100;
    ...
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```
role DebugLog {
    has @.log_lines;
    has $.log_size is rw = 100;
    method log_message($message) {
        ...
    }
}
```

What does a role look like?

- Introduced with the role keyword
- Methods and attributes declared just as they would be in a Perl 6 class

```
role DebugLog {
    has @.log_lines;
    has $.log_size is rw = 100;
    method log_message($message) {
        @!log_lines.shift if
            @!log_lines.elems >= $!log_size;
        @!log_lines.push($message);
    }
}
```

Role Composition

- A role is composed into a class using the does trait

```
class WebCrawler does DebugLog {
    ...
}
```

- This adds the methods and attributes to the class
- End result is as if they had been written inside the class in the first place

Mix-ins

- Allow the functionality of a role to be added on a per-object basis (whereas compile time composition works on a per-class basis)
- Does not affect any other instances of the class
- Methods from the role always override any existing methods the object has

Mix-ins Example

- Suppose we want to trace what happens to a certain object
- Mix in the DebugLog role

```
$account does DebugLog;
```

- Later, we can output the lines that were logged

```
$account.log_lines>>.say;
```

Mix-ins Example

- Now we just need to add calls to the log_message method
- We can do this with the .? operator, which calls the method if it exists

```
class Account {
    method change_password($new) {
        self.?log_message(
            "changing password to $new");
        ...
    }
}
```

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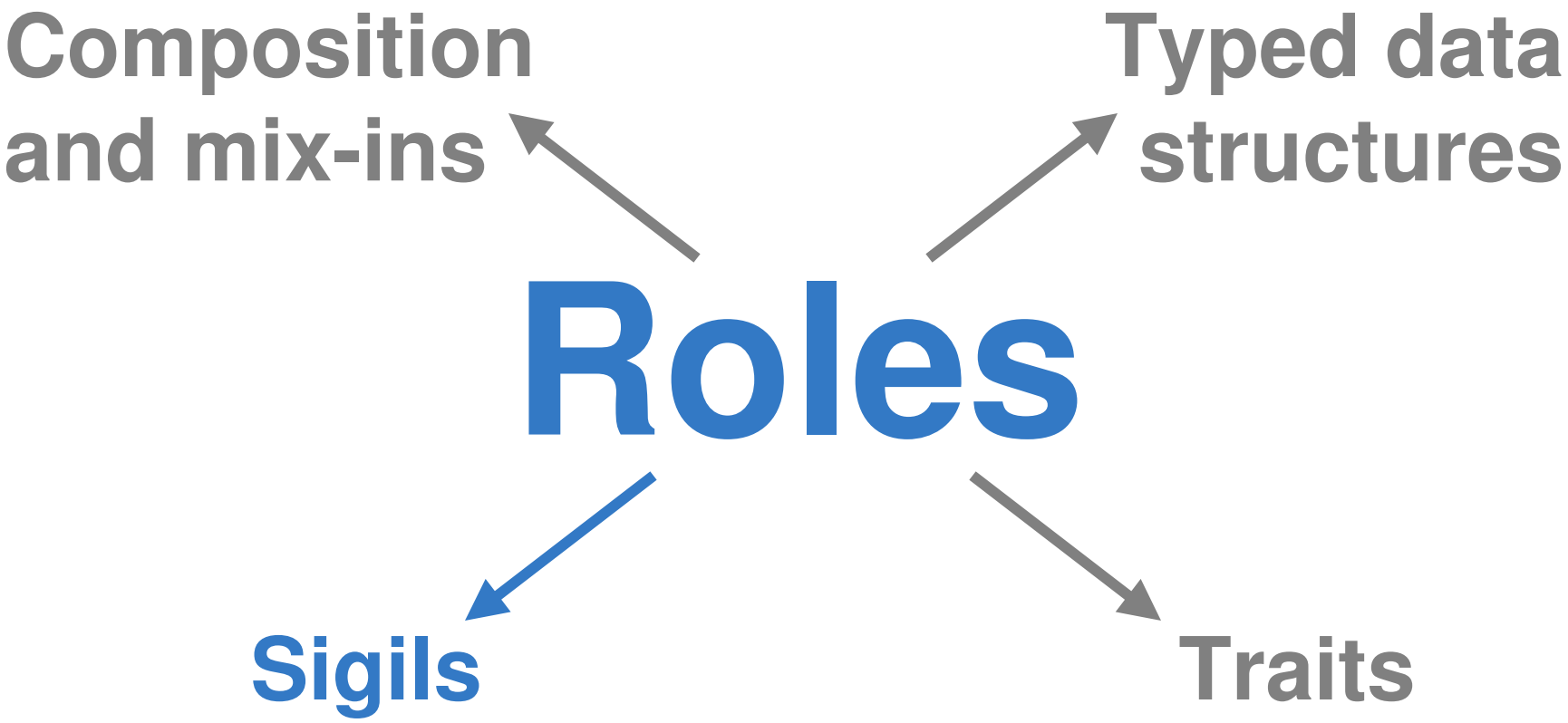

Sigil = Interface Contract

- In Perl 6, a sigil implies an interface contract
- This interface contract is defined by a role
- You can only put things into a variable with that sigil if it does the required role
- Exception: variables with the $ sigil can store anything (if not type-constrained)

@ = Positional

- The @ sigil implies the Positional role
- Promises that there will be a method postcircumfix:<[ ]> that you can call
- This is that gets called when you do an index positionally into something

```
say @fact[1];
say @fact.postcircumfix:<[ ]>(1);
```

- Note: optimizer (when we have one) may emit something more lightweight

% = Associative

- The % sigil implies the Associative role
- Promises that there will be a method postcircumfix:<{ }> that you can call
- This is that gets called when you do an index associatively into something

```
say %price<Cheese>;
say %price.postcircumfix:<{ }>('Cheese');
```

& = Callable

- The & sigil implies the Callable role
- Promises that the thing can be invoked
- This role is done by things like Block, Sub, Method and so forth
- Will be able to do this role in your own types *(not yet supported in Rakudo)*
- Requires that the method postcircumfix:<( )> is implemented

Aside: Multiple Dispatch

- Since a sigil implies the doing of a role, you can use them in the signature of a multi-sub

```
multi what_is($it) { say "It's a scalar" }
multi what_is(@it) { say "It's an array" }
multi what_is(%it) { say "It's a hash" }
multi what_is(&it) { say "It's code" }

what_is([1,2,3]);                  # It's an array
what_is({ x => 4, y => 2 });# It's a hash
what_is(-> $x { 2 * $x });  # It's code
what_is(42);                       # It's a scalar
```

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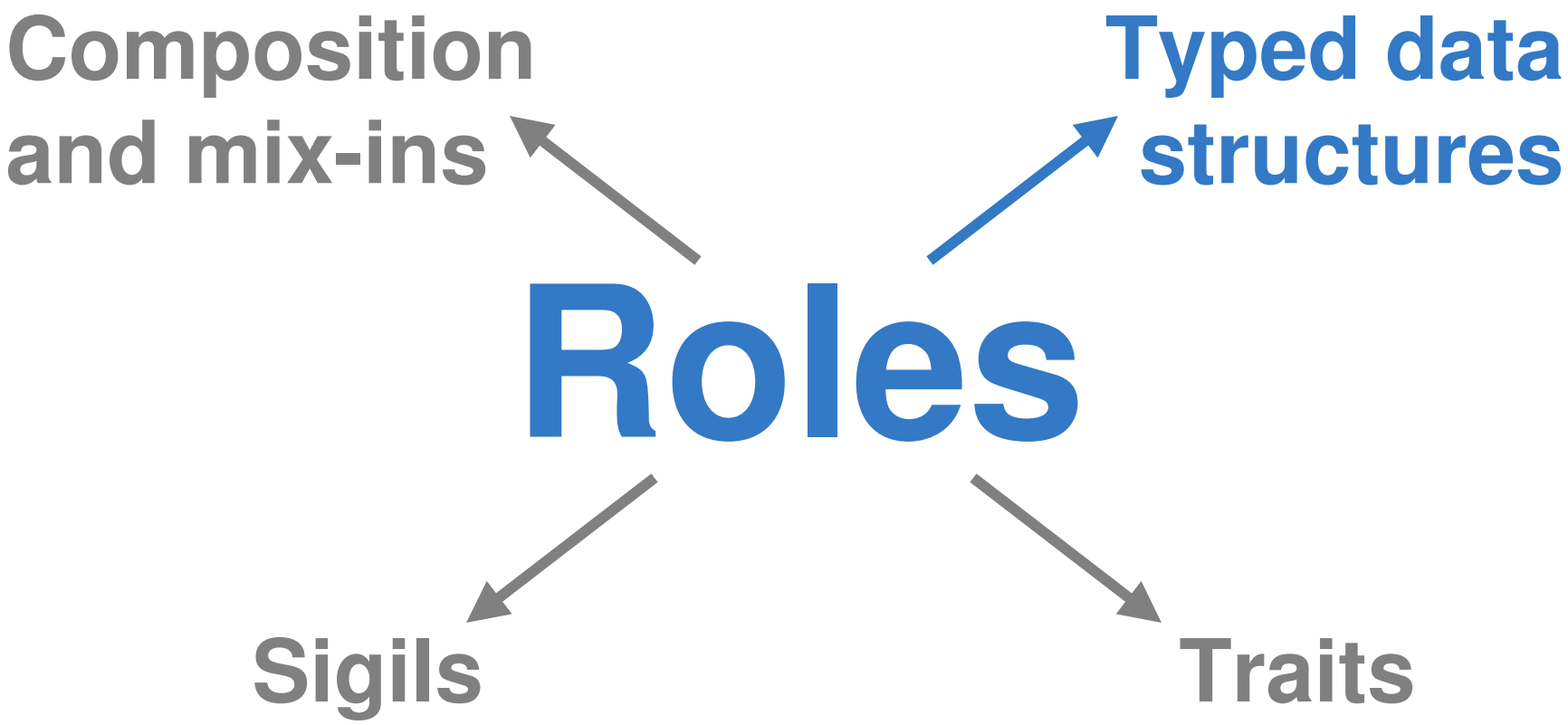

Parametric Roles

- So far, we have seen roles as units of functionality that we can compose into a class or mix in to an existing object
- A role can also take parameters
- Allow for customization of the role's behaviour on a per-use basis
- In the problem space of C++ templates, C#/Java Generics, System F, etc.

Parametric Roles

- Role parameters go in square brackets after the role name

```
role Can[::Contents] {
    method top_up(Contents $substance) {
        say "Yay...more {Contents.perl}!";
    }
}
```

- What goes between the square brackets is a signature, just like with a sub/method.

Parametric Roles

- To do a parametric role, pass the parameters in square brackets

```
class Beer { }
class Coke { }
my Can[Beer] $starobrno .= new;
$starobrno.top_up(Beer.new);   # Works
$starobrno.top_up(Coke.new);   # Exception
```

- It's much like doing a sub call
- Part of the type name; Can[Beer] is a different type to Can[Coke].

Parametric Roles

- If a role takes just one positional parameter (like our current example), you can use the of keyword to specify the parameter

```
my Can of Beer $starobrno .= new;
```

- Can nest these too

```
my Pack of Can of Beer $six_pack .= new;
```

Parametric Role Variants

- Can define multiple variants of a role that take different parameters
- Selected using the same mechanisms as multiple dispatch

```
role Can[::Contents] { # One parameter
    ...
}
role Can {             # No parameters
    ...
}
```

Typed Arrays

- Typed arrays restrict what may be stored inside them

```
my Str @langs = <Perl Ruby PHP Python>;
@langs = 1, 2, 3;           # Error, Int
@langs[2] = 'Smalltalk'; # Fine, Str
push @langs, 4.2;           # Error, Num
```

- Implemented as a parametric role
- Can also write it as:

```
my @langs of Str = <Perl Ruby PHP Python>;
```

Typed Hashes

- Typed hashes restrict what can be stored as the values

```
my Int %word_counts;
%word_counts<monkey> = 5;       # OK
%word_counts<badger> = 0;       # OK
%word_counts<monkey> = "none"; # Error
```

- Can build up nested typed data structures

```
my @doc_word_counts of Hash of Int;
```

A Common Fail

- Note that the sigil already implies one level of parametric type
- What does this declare?

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my Array @walruses;
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```
my Array @walruses;
```

- What does this signature accept?

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sub herd(Array @cats) { ... }
```

- Answer for both: an Array of Array.
- (Well, really a Positional of Array)

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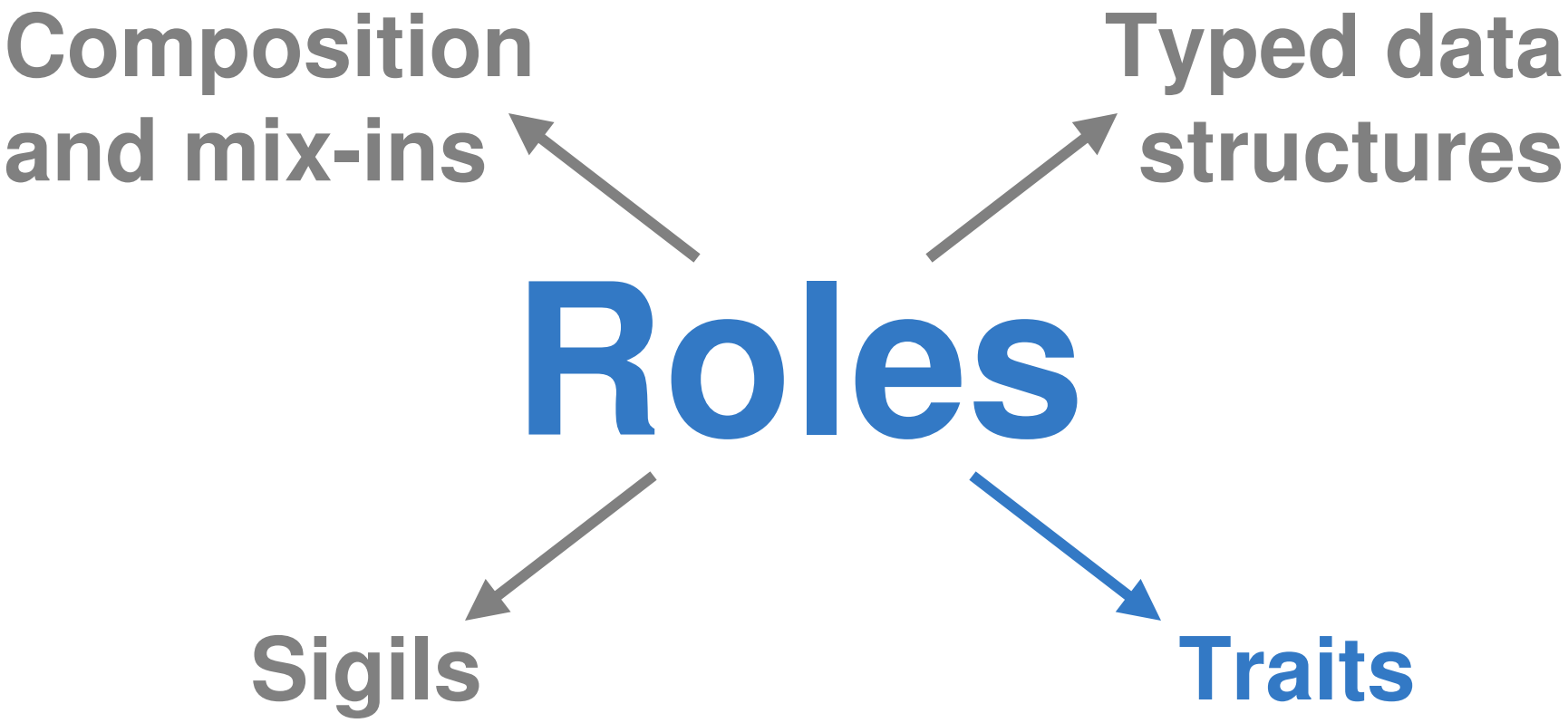

So what are traits anyway?

- A Perl 6 trait is something applied to a declarand
  - A class that is currently being declared
  - A routine that is currently being declared
  - A variable that is currently being declared

Some Built-in Traits

- A method or sub is marked as being exported using a trait

```
module Walrus {
    sub lose_bukit() is export { ... }
}
```

- Inheritance works through trait application too

```
class PolarBear is Bear {
    ...
}
```

Trait Dispatch

- Which trait to do is decided by a multiple dispatch
- If the trait name is a type name (e.g. class or role), then the type is looked up and passed as the second positional argument
- Otherwise, a pair of the given name is passed

Implementing A Trait Handler

- Inside the trait implementation you can do pretty much whatever you like
- However, often a well-behaved trait will mix in a role that provides an attribute of the same name
- Basic example: a **`doc`** trait

```
sub answer() is doc('Compute the answer') {
    return 42;
}
say &answer.doc;
```

Implementing A Trait Handler

- Declare a role to hold the documentation string

```
role doc {
    has $.doc is rw;
}
```

- Then implement a trait mod to apply it to our routine

```
multi trait_mod:<is>(Routine $r, doc,
                     $text) {
    $r does doc($text);
}
```

Traits On Variables

- Can also apply a trait to a container
- Here's how we write the handler…

```
multi trait_mod:<is>(Container $c, doc,
                     $text) {
    $c does doc($text);
}
```

- …and how we use it.

```
my %counts is doc('Count of each word');
say %counts.doc;
```

Traits On Classes

- Here be dragons: for classes, the jury is still out on what you get as the declarand (the meta-class or some under-construction type object)

```
multi trait_mod:<is>(Class $c, doc,
                     $text) {
    $c does doc($text);
}
```

```
class Bar is doc('Serves beer') { }
say Bar.HOW.doc;
```

Another Routine Trait Example

- Goal: install a wrapper on a routine that calls log_message on any parameter that does DebugLog

```
multi trait_mod:<is>(Routine $r is rw, :$logging!) {
    ...
}
```

Another Routine Trait Example

- Goal: install a wrapper on a routine that calls log_message on any parameter that does DebugLog

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multi trait_mod:<is>(Routine $r is rw, :$logging!) {
    $r.wrap(sub (*@pos, *%named) {
        ...
    });
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        for @pos, %named.values -> $param {
            ...
        }
        ...
    });
}
```

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        for @pos, %named.values -> $param {
            if $param ~~ DebugLog {
                $param.log_message("Passed to " ~
                    $r.name);
            }
        }
        ...
    });
}
```

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                $param.log_message("Passed to " ~
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            }
        }
        nextsame;
    });
}
```

That's All!

Thank You!

Questions?