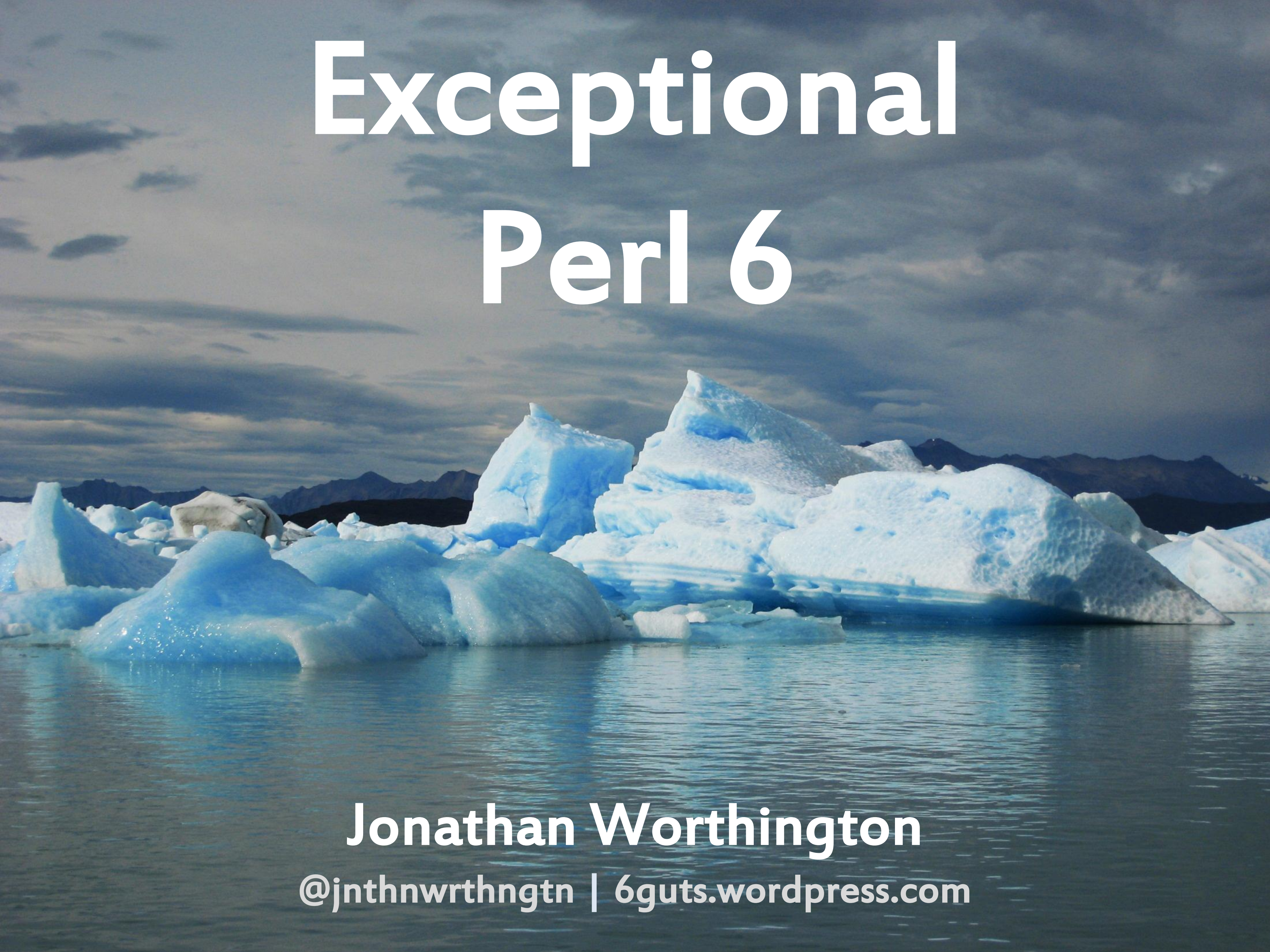


Exceptional Perl 6

Jonathan Worthington

@jnthnwrthngtn | 6guts.wordpress.com

In previous years...

Submit talk(s) to YAPC::EU

One (or maybe two) are accepted

Go to YAPC::EU

Give talk(s)

This year...

Submit talk(s) to YAPC::EU

Both rejected!

This year...

Submit talk(s) to YAPC::EU

Both rejected!

Factoring with Roles

This year...

Submit talk(s) to YAPC::EU

Both rejected!

Factoring with Roles

But...there already was a roles talk accepted

This year...

Submit talk(s) to YAPC::EU

Both rejected!

Factoring with Roles

But...there already was a roles talk accepted

Debugging Perl 6 Programs

This year...

Submit talk(s) to YAPC::EU

Both rejected!

Factoring with Roles

But...there already was a roles talk accepted

Debugging Perl 6 Programs

Well, debugging is, a rather boring topic, as we saw last year ☺

This year...

Submit talk(s) to YAPC::EU

Both rejected!

Then moritz++ - who did have accepted talks - couldn't come to YAPC ☹

This year...

Submit talk(s) to YAPC::EU

Both rejected!

Then moritz++ - who did have accepted talks - couldn't come to YAPC ☹

So, he passed this talk on to me ☺

But roles are niiiice...

And we all gotta debug...

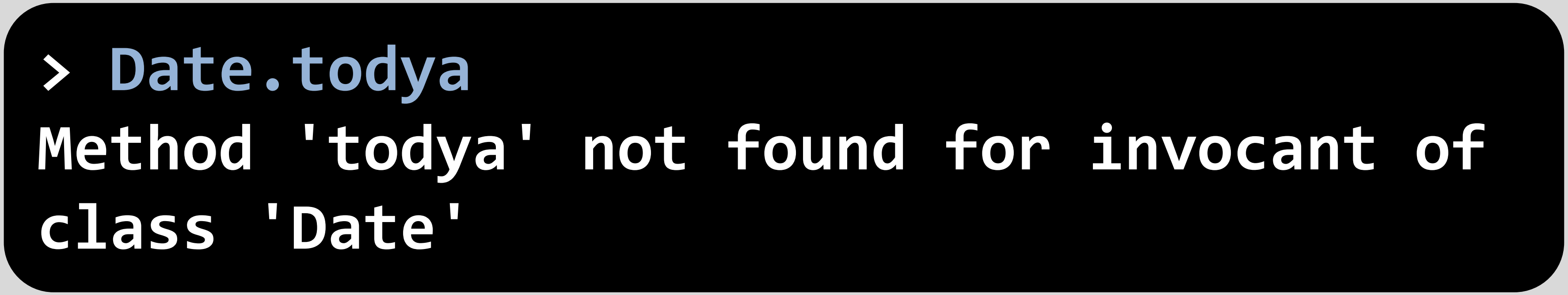
So, today, I proudly present…

Exceptional Perl 6:

A study of the design, throwing and catching of Perl 6 exceptions, which may be factored as roles, and their debugging

REPL Exploration

We attempt to call the **today** method on the class **Date**, but make a silly typo



```
> Date.todya
Method 'todya' not found for invocant of
class 'Date'
```

This causes an exception to be thrown; a human-readable message describes the issue

REPL Exploration

To further explore exceptions, we use **try** in order to capture the exception into **$!**

```
> try Date.todya; say "Oops: $!"
Oops: No such method 'todya' for invocant
of type 'Date'
```

Interpolating it in a string once again yields the same human-readable message

REPL Exploration

From what we've seen so far, the contents of **$!** could be a string. But **WHAT** is it really?

```
> try Date.todya; say $!.WHAT
X::Method::NotFound()
```

From this we see that we don't have a string, but an **object** of type **X::Method::NotFound**

REPL Exploration

To find out more about the exception object, we dump it using the **perl** method

```
> try Date.todya; say $!.perl
X::Method::NotFound.new(
    method   => "todya",
    typename => "Date",
    private  => Bool::False
)
```

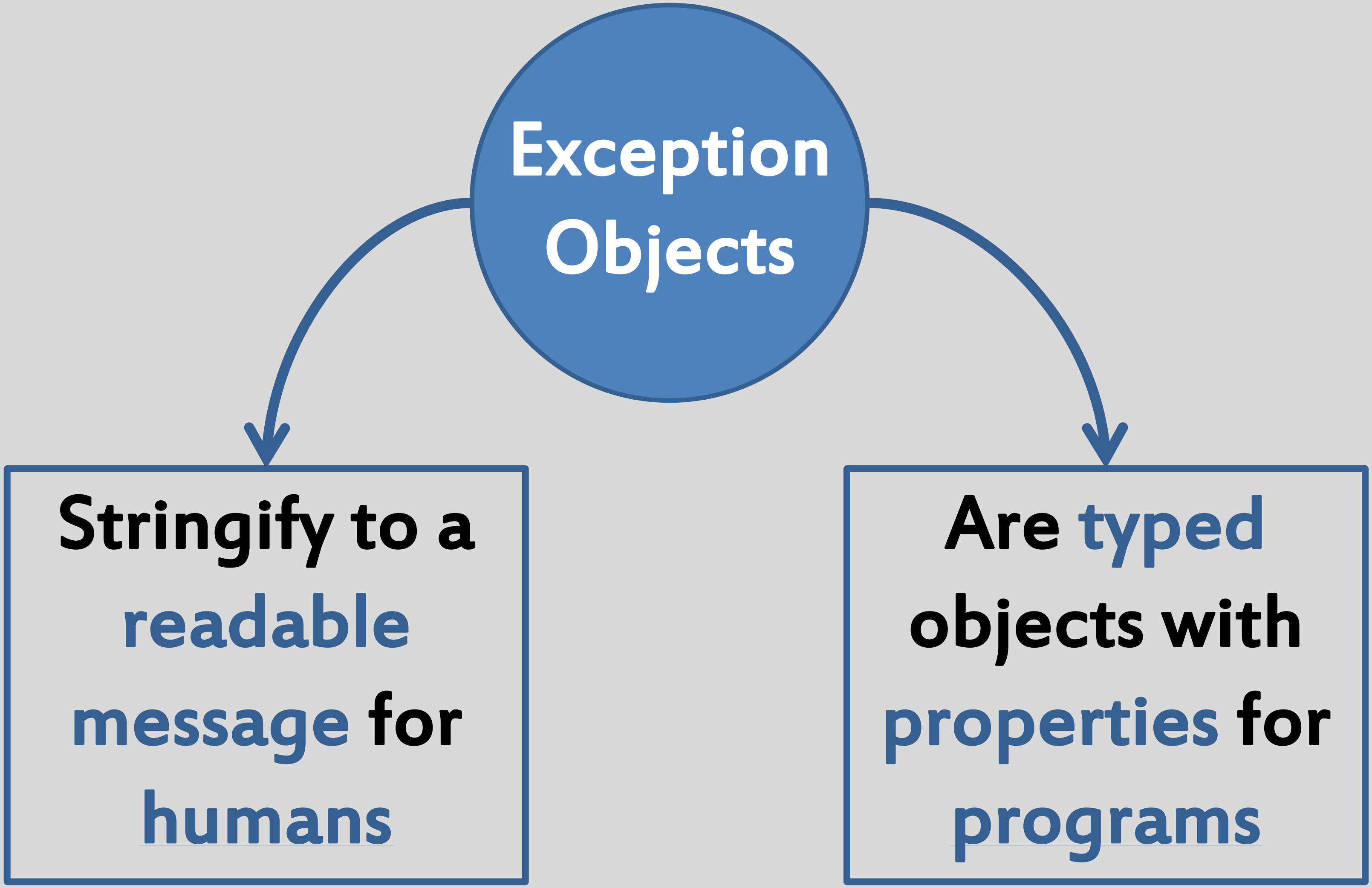
REPL Exploration

The details held in the exception object are available through method calls

```
> try Date.todya; say $!.method()
todya
```

The methods enable programs to easily extract information about what went wrong

For Us and Them



Exception Objects

Stringify to a readable message for humans

Are typed objects with properties for programs

Significant Lines of Code

```
my regex insigline {
    ^ \s* [ <?> | '#' .* | '{' | '}' ] \s* $
}

sub MAIN(*@files) {
    my $total = 0;
    for @files -> $filename {
        $total += lines($filename.IO).grep(
            { $_ !~~ /<&insigline>/ }
        ).elems;
    }
    say $total;
}
```

Significant Lines of Code

When all the files passed to the script exist and are readable, things work out fine...

```
$ perl6 siglines.p6 A.pm B.pm
156
```

When one of them doesn't exist, less fine...

```
$ perl6 siglines.p6 A.pm B.pm C.pm
Unable to open filehandle from path 'C.pm'
```

try

We already know we could use try...

```
my $total = 0;
for @files -> $filename {
    try {
        $total += lines($filename.IO).grep(
            { $_ !~~ /<&insigline>/ }
        ).elems;
    }
    note "Can't read $filename" if $!;
}
say $total;
```

try

We already know we could use try...

☺ Fixes the problem at hand

☹ Swallows any exception, not just IO ones

☹ We have to examine $! after the try, which doesn't feel as clean as we may desire

CATCH

```
for @files -> $filename {
    try {
        $total += lines($filename.IO).grep(
            { $_ !~~ /<&insigline>/ }
        ).elems;
        CATCH {
            when X::IO {
                note "Couldn't read $filename";
            }
        }
    }
}
```

CATCH phasers trigger when an exception is thrown, and place it in $_ to allow smartmatching against it

CATCH

```
my $total = 0;
for @files -> $filename {
    $total += lines($filename.IO).grep(
        { $_ !~~ /<&insigline>/ }
    ).elems;
    CATCH {
        when X::IO {
            note "Couldn't read $filename";
        }
    }
}
say $total;
```

Any block can have a CATCH phaser, so we can place it directly in the loop body - much cleaner!

CATCH

```
my $total = 0;
for @files -> $filename {
    $total += lines($filename.IO).grep(
        { $_ !~~ /<&insigline>/ }
    ).elems;
    CATCH {
        when X::IO {
            note "Couldn't read $filename";
        }
    }
}
say $total;
```

As CATCH goes inside of the scope, we can see the scope's lexicals!

CATCH and Rethrows

If a **CATCH** block does not successfully smart-match an exception, it is re-thrown for the next handler in the dynamic scope to consider

```
CATCH {
    when X::IO {
        note "Couldn't read $filename";
    }
}
```

Anything not an X::IO is rethrown

default

To catch any type of exception, use the **default** block inside of a CATCH

```
CATCH {
    when X::IO {
        note "Couldn't read $filename";
    }
    default {
        note "Failed to process $filename";
    }
}
```

Take a look, pass it on

A **CATCH** block that doesn't smart-match the exception may still take action based on it

```
CATCH {
    $logger.log_file_error($filename, $_);
}
```

However, since it didn't successfully smart-match, the exception will be re-thrown

?

We have typed exceptions for errors from built-ins, the compiler, etc.

But where and how are they defined?

A peek inside Rakudo

Looking inside Rakudo's **CORE.setting**, we find that exception types are simply **class definitions**

```
my class X::Method::NotFound is Exception {
    has $.method;
    has $.typename;
    has Bool $.private = False;
    method message() {
        # ...
    }
}
```

Exceptional Perl 6:

A study of the design, throwing and catching of Perl 6 exceptions, **which may be factored as roles,** and their debugging

A factoring challenge

All syntax errors should match **X::Syntax**

All Pod-related errors should match **X::Pod**

Clearly not all syntax errors are Pod errors, but not all Pod errors are going to be syntax errors

Roles are a neat solution to this kind of issue

Using roles

Roles provide a way to categorize exceptions and factor out shared properties

```
my role X::Comp is Exception {
    has $.filename;
    has $.line;
    has $.column;
    has @.modules;
    #...
}
my role X::Syntax does X::Comp { }
my role X::Pod                 { }
```

All compilation errors have a file, line, column and module trace

Using roles

Roles provide a way to categorize exceptions and factor out shared properties

```
my role X::Comp is Exception {
    has $.filename;
    has $.line;
    has $.column;
    has @.modules;
    #...
}
my role X::Syntax does X::Comp { }
my role X::Pod                 { }
```

Factor out the default parent Exception also

Role composition

Something that is a Pod error and a syntax error may compose both of the roles

```
my class X::Syntax::Pod::BeginWithoutIdentifier
        does X::Syntax
        does X::Pod
{
    method message() {
        '=begin must be followed by an identifier;'
             ~ ' (did you mean "=begin pod"?)'
    }
}
```

Why role composition?

When a role is composed into a class, its attributes and methods are **copied** to the class

If two roles supply the same method, it is detected as a **conflict** at **compile time**

The class must **explicitly resolve** the conflict, by providing a method of that name that does so

Exceptional Perl 6:

A study of the design, throwing and catching of Perl 6 exceptions, which may be factored as roles, and their debugging

Poll::Simple

A very simple module for delivering polls

A list of options are passed to **new**

The **vote** method is used to vote on an option

There **result_graph** method renders a the current results as a ASCII-art bar graph

Poll::Simple

```
class Poll::Simple {
    has @.options;
    has %!scores;

    submethod BUILD(:@!options) {
        %!scores{$_} = 0 for @!options;
    }

    method vote($option) {
        if $option eq any(@!options) {
            %!scores{$option}++;
        }
        else {
            die "Invalid poll option '$option'";
        }
    }
}
```

Poll::Simple

The rendering of the bar graph will he handled by another module, **Text::BarGraph**

```
use Text::BarGraph;

class Poll::Simple {
    # ...

    method result_graph() {
        render_graph(%!scores);
    }
}
```

Text::BarGraph

```
module Text::BarGraph;

sub render_graph(%data, :$label_char_limit = 25,
                 :$overall_width = 75) is export {
    my $label_chars = [min] %data.keys.max(*.chars),
                            $label_char_limit;
    my $bar_width   = $overall_width - ($label_chars + 2);
    my $max_value   = %data.values.max;

    join "\n", %data.kv.map: -> $label, $value {
        my $entry = $label.chars > $label_chars
            ?? $label.substr(0, $label_chars)
            !! $label;
        $entry ~= ' ' x 1 + $label_chars - $label.chars;
        $entry ~= '=' x $bar_width * $value / $max_value;
    }
}
```

Let's give this a try...

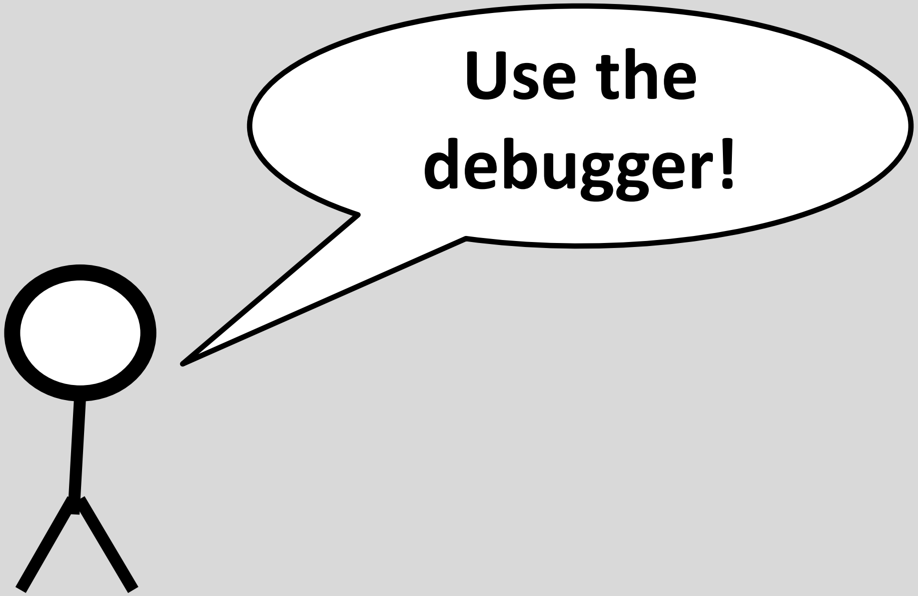
```
use Poll::Simple;

# Create a poll.
my $best_beer = Poll::Simple.new(
    options => < Stout Lager Porter Ale Pilsner >
);

# Show the graph (all zero votes so far).
say $best_beer.result_graph();
```

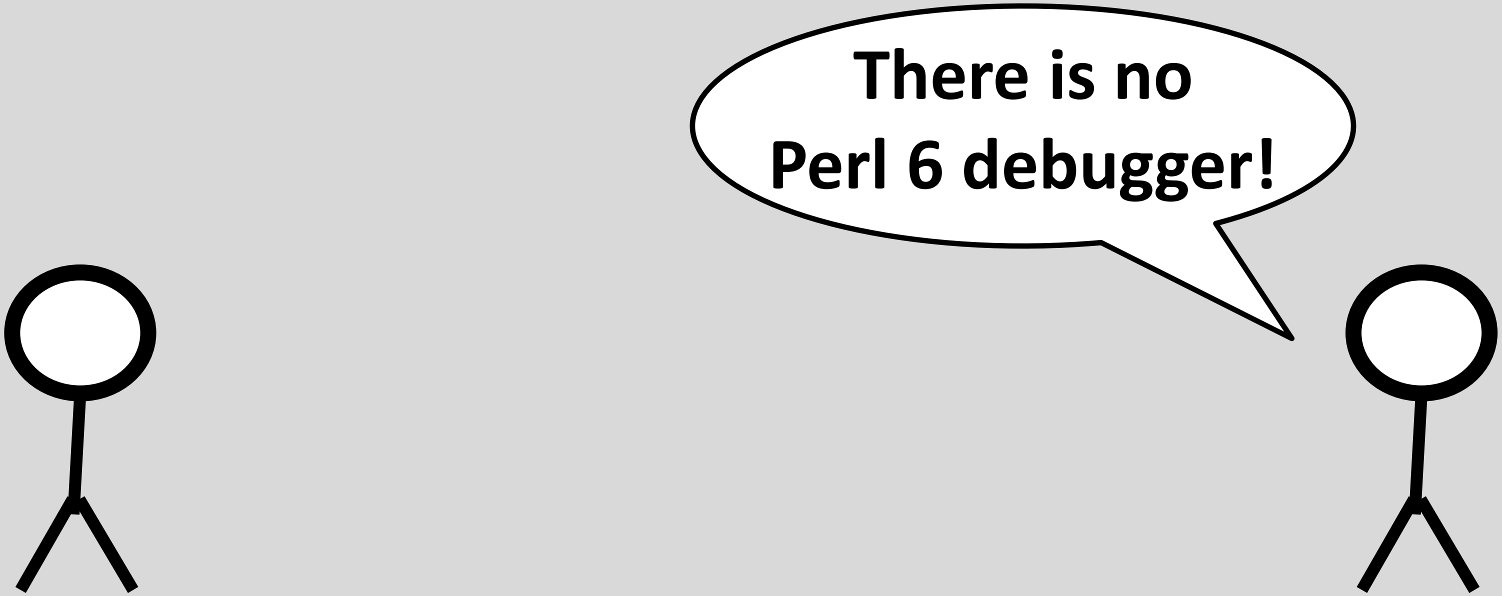
Let's give this a try...

```
use Poll::Simple;

# Create a poll.
my $best_beer = Poll::Simple.new(
    options => < Stout Lager Porter Ale Pilsner >
);

# Show the graph (all zero votes so far).
say $best_beer.result_graph();
```

```
$ perl6 -I. z.p6
Divide by zero
  ...
```

OH NOES!!!


Use the debugger!



There is no Perl 6 debugger!

OH YES
THERE IS!

OH NO THERE ISN'T!

do live_demo() or fail;

Typed exceptions

At the moment, voting for an invalid option dies with a simple string

```
method vote($option) {
    if $option eq any(@!options) {
        %!scores{$option}++;
    }
    else {
        die "Invalid poll option '$option'";
    }
}
```

Let's make it a **typed exception!**

Adding Typed Exceptions

Our typed exception carries information on what is wrong and what to try, and can use it to produce a human-readable message also

```
class X::Poll::Simple::InvalidOption is Exception {
    has $.invalid;
    has @.valid;

    method message() {
        "'$.invalid()' is not a valid answer; vote any of:\n" ~
            @.valid.join(", ")
    }
}
```

Using Typed Exceptions

The typed exception can be used with **die** in place of a string message

```
method vote($option) {
    if $option eq any(@!options) {
        %!scores{$option}++;
    }
    else {
        die X::Poll::Simple::InvalidOption.new(
            invalid => $option,
            valid   => @!options
        );
    }
}
```

Using Typed Exceptions

Alternatively, create the exception object and then call the **throw** method on it

```
method vote($option) {
    if $option eq any(@!options) {
        %!scores{$option}++;
    }
    else {
        X::Poll::Simple::InvalidOption.new(
            invalid => $option,
            valid   => @!options
        ).throw;
    }
}
```

What's next?

Exceptions from the compiler and CORE setting are now typed; still some work in those issued by the meta-model and a couple of other cases

Getting all of the exceptions documented in p6doc (for more on p6doc, see pmichaud's talk)

More work on the Rakudo debugger!

Thank you!

Questions?

E: jnthn@jnthn.net
T: @jnthnwrthngtn
W: 6guts.wordpress.com