# Writing Good Error Messages

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## Roadmap

Introduction

Part 1: Good error messages are useful error messages

Part 2: A little framework for useful messages

## Introduction

Paul Keating

on the internet: BoarGules

- Started with Python 1.5.2
- Has programmed in Python for a living since 1999
- First came to EuroPython at Charleroi, Belgium in 2003
- Supports an application with embedded languages
  - Python – with 2 huge APIs
  - An SQL dialect
  - A spreadsheet-like formula-oriented language
  - Other domain-specific mini-languages
- … that can all call one another

## Useful for Who?

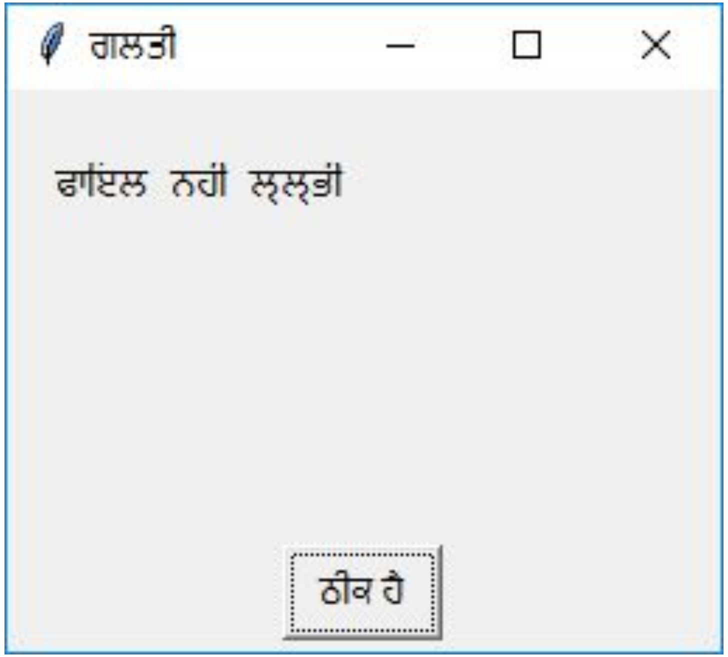
Be clear about who you expect to be reading your message:

- Interactive application: reader is probably an end-user
- Batch program: reader is a developer or does application support
- API: reader is a programmer (but maybe not very experienced)

Sometimes there are two audiences:

- The programmer who is calling into your library module
- The end-user of that progammer’s application

## Is it understandable?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## Is it understandable?

A stack trace is

- Indispensable to a programmer
- Of some value to a superuser
- Gobbledygook to everyone else
- Not useful to anyone without access to the source code

## Is it understandable?

```
phone_numbers = {"Paul": "+31641890432",
                 "Emergency": "112",
                 "Voicemail": "+316240641890432" }
...
num = phone_numbers(customer)


Traceback (most recent call last):
  File "Tutorial101", line 26, in lookup_number
    num = phone_numbers(customer)
TypeError: 'dict' object is not callable
```

## Is it understandable?

`ResultSet` object has no attribute `'prefix'`.

## Is it understandable?

`ResultSet` object has no attribute `'prefix'`. You're probably treating a list of items like a single item. Did you call `find_all()` when you meant to call `find()`?

## Is it understandable?

```
class ResultSet(list):
    """A ResultSet is just a list that keeps track of the
       SoupStrainer that created it."""
    def __init__(self, source, result=()):
        super(ResultSet, self).__init__(result)
        self.source = source
    def __getattr__(self, key):
        raise AttributeError(
            "ResultSet object has no attribute '%s'. You're ⤸
             probably treating a list of items like a single ⤸
             item. Did you call find_all() when you meant to ⤸
             call find()?" % key
```

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## Is it explicit?

```
try:
    FSettlementProcess.CreateSettlementsFromTrade(trade,
           defaultProcessMessage, nettingRuleQueryCache)
except:
    logger.Log("Something went wrong with trade {0}"
               .format(trade.Oid()))
```

## Is it explicit? – `traceback` is your friend

```
try:
    FSettlementProcess.CreateSettlementsFromTrade(trade,
           defaultProcessMessage, nettingRuleQueryCache)
~~except:~~
    ~~logger.Log("Something went wrong with trade {0}"~~
           ~~.format(trade.Oid()))~~
except RuntimeError:
    logger.Log("Unexpected failure while processing Trade {0}"
           .format(trade.Oid()))
    logger.Log(traceback.format_exc())
```

## Is it unambiguous?

```
if payment.original() and payment.original().type != payment.type:
    if not payment.type in LimitedPaymentType:
        raise ValidationError('Users with profile component "Add '
            'Pmts to Simulated" can only use limited fee types.')
```

*(...many lines of code...)*

```
if not (payment.original() and not payment.type in
            LimitedPaymentType):
        raise ValidationError('Users with profile component "Add '
            'Pmts to Simulated" can only use limited fee types.')
```

## Is it unambiguous?

```
if payment.original() and payment.original().type != payment.type:
    if not payment.type in LimitedPaymentType:
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            'Pmts to Simulated" can only use limited fee types.')
```

*(...many lines of code...)*

```
if not (payment.original() and not payment.type in
            LimitedPaymentType):
        raise ValidationError('Users with profile component "Add '
            'Pmts to Simulated" can only use limited fee types..')
```

## Does it point in the right direction?

```
def validate_settlement(settle, action):
   if settle.record_type == 'Settlement':
      import FValidationSettlement
      FValidationSettlement.settlement_validations (
          settle, action)

   try :    validate_settlement(e, op)
   except: raise AttributeError("Error occurred in "
           "call to validate_settlement")
```

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## Does it point in the right direction?

```
def validate_settlement(settle, action):
   if settle.record_type == 'Settlement':
      import FValidationSettlement
      FValidationSettlement.settlement_validations (
          settle, action)

   ~~try  :    validate_settlement(e, op)~~
   ~~except: raise AttributeError("Error occurred in "~~
           ~~"call to validate_settlement")~~
   validate_settlement(e, op)
```

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## Does it work?

```
try:
    curve_name = get_default_spread_curve(ins)
    (...many lines of code...)
    ins.Commit()
except Exception as e:
    print("Cannot commit Instrument {0} on {1}\n{2}"
                .format(ins.Name(), curve_name, e))
```

## Does it work?

But suppose the exception is in here somewhere...

```
try:
    curve_name = get_default_spread_curve(ins)
    (...many lines of code...)
    ins.Commit()
except Exception as e:
    print("Cannot commit Instrument {0} on {1}\n{2}"
                .format(ins.Name(), curve_name, e))
```

## Does it work? *Exception chains*

*Original exception*

```
Traceback (most recent call last):
File "FAutoLink", line 303, in get_default_spread_curve
  u = ins.Underlying().Name()
AttributeError: 'NoneType' object has no attribute 'Name'
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
File "FAutoLink", line 545, in link_instrument
  print("Cannot commit Instrument {0} on {1}\n{2}"
              .format(ins.Name(), curve_name, e))
UnboundLocalError: local variable 'curve_name'
referenced before assignment
```

*Exception in* except

## Does it work? *No exception chaining in Python 2*

*No mention of the original exception*

*Exception in* `except`

```
Traceback (most recent call last):
File "FAutoLink", line 545, in link_instrument
  print("Cannot commit Instrument {0} on {1}\n{2}"
                .format(ins.Name(), curve_name, e))
UnboundLocalError: local variable 'curve_name' referenced before
assignment
```

## Does it work? *Force a zero-divide to test the message*

```
try:
    temp = 2 / 0
    curve_name = get_default_spread_curve(ins)
    (...many lines of code...)
    ins.Commit()
except Exception as e:
    print("Cannot commit Instrument {0} on {1}\n{2}"
                .format(ins.Name(), curve_name, e))
```

## Part 2:
## A little framework for useful error messages

- The situation
- The requirement
- The solution

## A little framework for useful error messages

The situation

- The software environment
- The people who write the error messages
- The validation rules

## The software environment

Python is embedded in an application

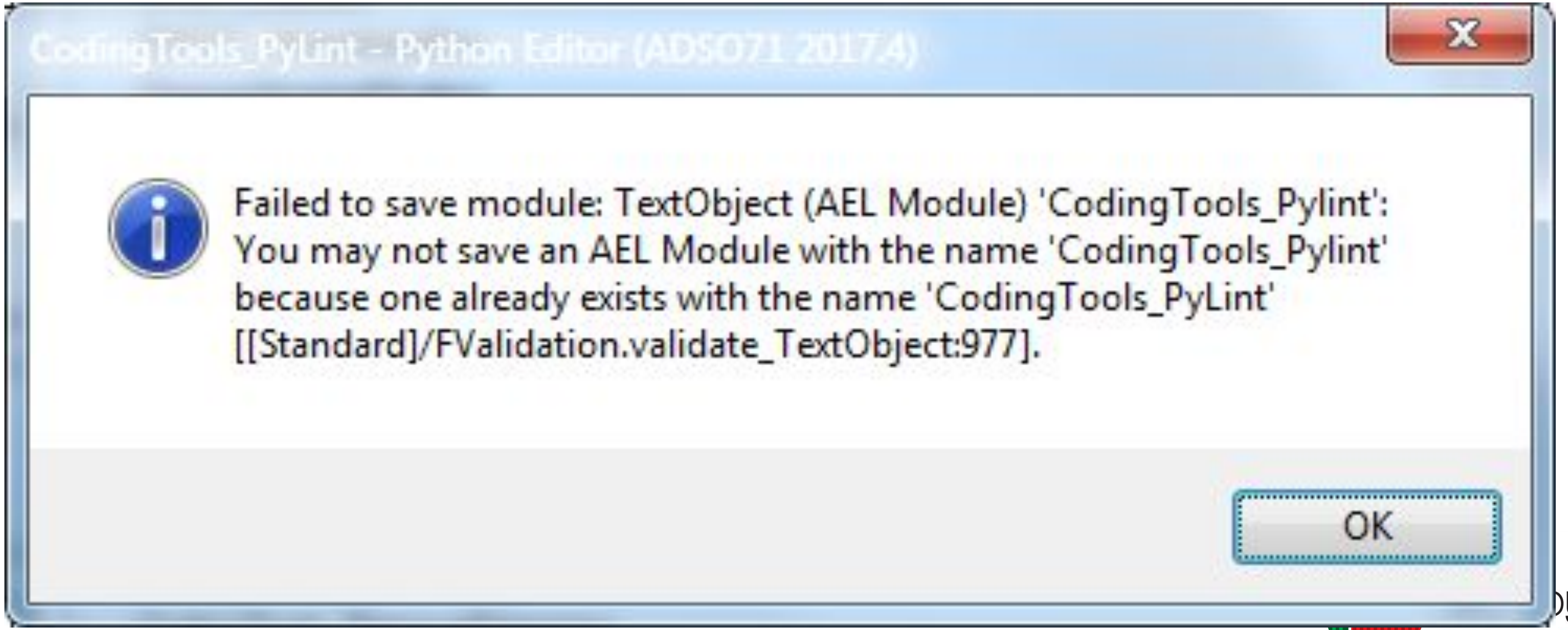
Application calls your validation function before every database save

Your validation function gets the object about to be saved. It can

- Silently return (save succeeds)
- Change the object, then return (save succeeds)
- Raise an exception (application rejects save)
  - Even if you didn't intentionally raise the exception

## The software environment

Application *rejects a save* like this:



Failed to save module: TextObject (AEL Module) 'CodingTools_Pylint': You may not save an AEL Module with the name 'CodingTools_Pylint' because one already exists with the name 'CodingTools_PyLint' [[Standard]/FValidation.validate_TextObject:977].

## The people who write the error messages

May be professional coders, but may also be

- Back office superusers
- Risk managers
- Accountants

## The validation rules

Complex corner-case validation is written by subject experts, not professional coders

End-users often report the message as a bug:

- “It won’t let me save this trade”
- “I ought to be allowed to do that/did the same thing yesterday”
- “Fix the error message”

Developers may also not understand the reason for the validation failure

## A little framework for useful error messages

The requirement

- Simple cut’n’paste coding
- Must be possible to identify the rule (even if there are duplicate messages)
- Unintended exceptions must not bring the system to a halt

## A little framework for useful error messages

The solution

- One simple class
- Distinguish between intentional exceptions and unintentional exceptions

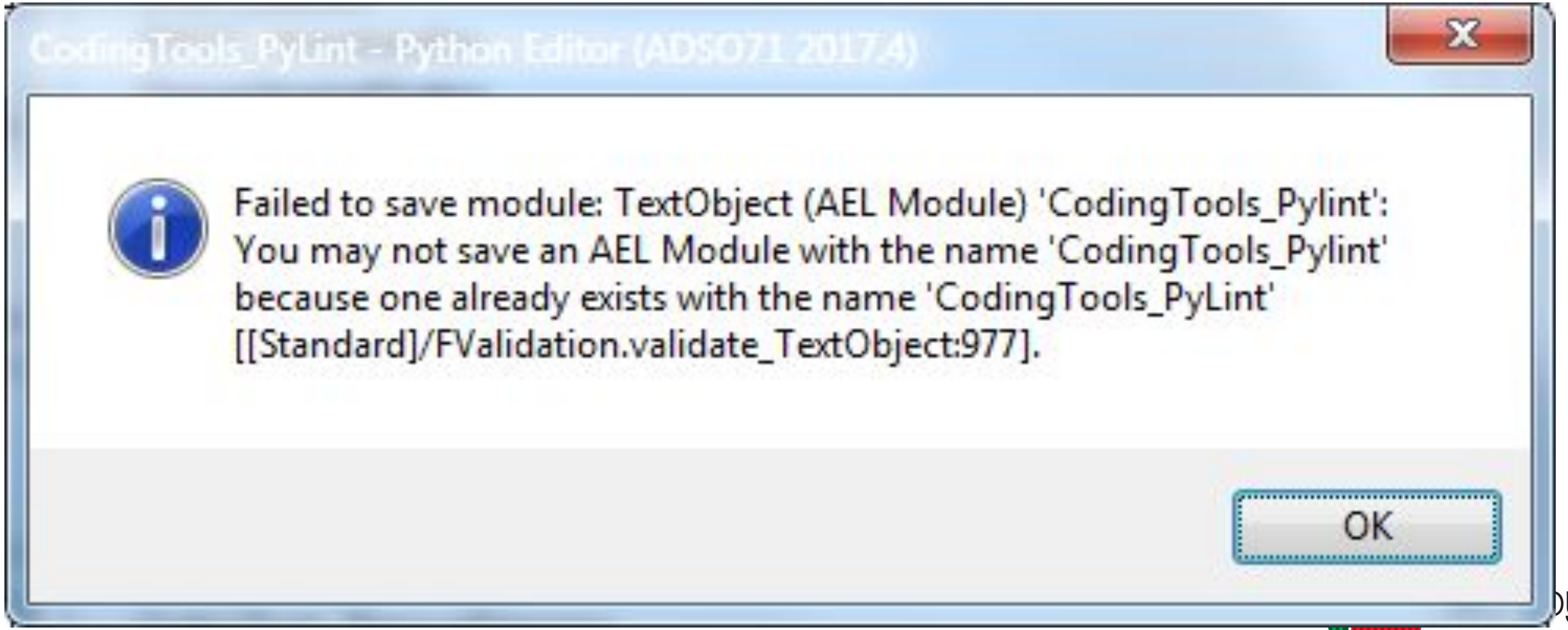
## Solution

Validation error class

```
class ValidationError(RuntimeError):
    def __init__(self, problem):
        RuntimeError.__init__(self,
                        " \n{0} \n[{1}]".format(problem, _line()))
def _line():
    info = inspect.getframeinfo(
           inspect.currentframe().f_back.f_back)
    return "{0}:{2}:{1}".format(*info)
```

## The software environment

Raising a ValidationError causes a pop-up that the end-user sees:



Failed to save module: TextObject (AEL Module) 'CodingTools_Pylint': You may not save an AEL Module with the name 'CodingTools_Pylint' because one already exists with the name 'CodingTools_PyLint' [[Standard]/FValidation.validate_TextObject:977].

## Solution

Validation callback

```
def validate_entity(entity, operation):
    try:
        my_validation_function(entity, operation)
    except ValidationError:
        raise
    except Exception:
        print("Untrapped exception in validation: please report "
              "to support team and include the traceback below")
        traceback.print_exc()
```

## Solution

Validation callback

```
def validate_entity(entity, operation):
    try:
        my_validation_function(entity, operation)
    except ValidationError:
        raise
    except Exception:
        print("Untrapped exception in validation: please report "
              "to support team and include the traceback below")
        traceback.print_exc()
```

The real code derives the function name from `entity`

## When your error message may have two audiences

Deliver different levels of message via different channels

- End-user message in pop-ups
- Stack traces in a log

Define your own exceptions (don't just `raise RuntimeError`)

Raise different kinds of exception for

- Errors on the application programmer's part
- Things you expect the application programmer can anticipate and translate
- Things neither of you can do anything about

## To sum up ...

An error message is a call to action.

What do you expect the reader to do with your error message?

- Is it understandable?
- Is it explicit?
- Is it unambiguous?
- Does it point in the right direction?

## Questions