Lecture 04

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Arthur Molnar

Introduction
to unit testing

Exceptions
Exception
handling
Specifications
and exceptions

Introduction to Unit Testing. Exceptions

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Overview

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Introduction
to unit testing

Exceptions
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and exceptions

1 Introduction to unit testing

2 Exceptions
- Exception handling
- Specifications and exceptions

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What is testing?

Observing the behavior of a program over many executions.

- We execute the program for some input data and compare the result we obtain with the known correct result.
- **Questions**:
  - How do we choose input data?
  - How do we know we have run enough tests?
  - How do we know the program worked correctly for a given test? (known as the oracle problem)

Testing

- Testing cannot prove program correctness, and cannot identify all defects in software. However, what it **can** prove is incorrectness, if at least one test case gives wrong results.
- **Problems with testing**
  - We cannot cover a function's input space
  - We have to design an oracle as complex as the program under test
  - Certain things are practically outside of our control (e.g. platform, operating system and library versions, possible hardware faults)

Unit Testing

- Tests that verify the functionality of a specific section of code, usually at function level.

- Testing is done in isolation. Test small parts of the program independently

How to test a function

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1. Write the function's specification

2. Create a test function called *test_ < function_name >* that has no input parameters, does no return anything and calls no functions except the one under test (e.g. *test_add_student()*)

3. Add test cases to the test function using Python's assert[1] keyword

4. Run the test function. It should fail with an *AssertionError*

5. Write the code for the function under test

6. Test functions that do not raise *AssertionError* must complete quietly

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[1]https://docs.python.org/3/reference/simple_stmts.html#the-assert-statement

Exceptions

An **exception** is an event that disrupts normal program flow

- Exceptions are present and used in many programming languages
- They are raised by code to signal an exceptional situation
- Your code will both raise (create) exceptions as well as "treat" them

NB!

The presence of an exception does not automatically mean that there's an error in the code

Exceptions

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Most programming languages that support exceptions[2] use a common terminology and syntax

- Raising or throwing exceptions
- Catching or treating an exception
- Exception propagation
- **try** / **raise** (throw) / **except** (catch) keywords

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[2]https://docs.python.org/3/tutorial/errors.html#exceptions

Exception handling

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Exception handling is the process of handling error conditions in a program systematically by taking the necessary action.

```
try :
    # code that may raise exceptions
except ValueError :
    # code that handles the situation
```

Exception handling

A few points from the Python syntax above

- If you want to catch exceptions, the code has to be in a **try** - **except** block
- Exceptions are caught according to type
- A try block can catch **one**, **several** or **all** exception types
- Creating exceptions in your code is done using the **raise** keyword
- You can provide additional arguments (such as an error message) to exceptions you raise

Exception handling

Where is an exception handlded:

1. The function where the exception was raised
2. Any function that called the raising function (transitively)
3. The Python runtime, in which case program execution stops

Discussion

If the phrase *"unhandled exception has occurred in you application..."* sounds familiar, now you understand what happened!

Demo

Exceptions example, **ex08_Exceptions.py**

Exception handling

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When to use exceptions?

- Signal an exceptional situation - the function is unable to do its work (e.g. function preconditions are violated, or the function encountered a situation in which it cannot make progress - a required file was not found, was not accessible, etc.)

- Enforce function preconditions

- Generally speaking, you should **not use** exceptions to control program flow!

Function specification

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Is a way to abstract **functions** that only works if we provide:

- Meaningful function name
- Short description (the problem solved by the function)
- Type and meaning of each input parameter
- Conditions over the input parameters (**preconditions**)
- Type and meaning of each output parameter
- Relation between input and output parameters (**post condition**)
- **Exceptions** raised by the function

Exceptions and function specification

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- **Precondition** - condition that must be true prior to running a section of code
- **Post condition** - condition that must be true after running a section of code

```
def gcd(a, b):
    '''
    Return the greatest common divisor of two
        positive integers
    a,b - integers
    Return the greatest common divisor of a and b
    Raise ValueError if a <= 0 or b <= 0
    '''
```