

Exception Handling

In any programming language there are 2 types of errors are possible.

1. Syntax Errors
2. Runtime Errors

1. Syntax Errors:

The errors which occurs because of invalid syntax are called syntax errors.

Eg 1:

```
x=10  
if x==10  
    print("Hello")
```

SyntaxError: invalid syntax

Eg 2:

```
print "Hello"
```

SyntaxError: Missing parentheses in call to 'print'

Note:

Programmer is responsible to correct these syntax errors. Once all syntax errors are corrected then only program execution will be started.

2. Runtime Errors:

Also known as exceptions.

While executing the program if something goes wrong because of end user input or programming logic or memory problems etc then we will get Runtime Errors.

Eg: `print(10/0)` ==>ZeroDivisionError: division by zero

`print(10/"ten")` ==>TypeError: unsupported operand type(s) for /: 'int' and 'str'

```
x=int(input("Enter Number:"))  
print(x)
```

D:\Python_classes>py test.py

Enter Number:ten

ValueError: invalid literal for int() with base 10: 'ten'

Note: Exception Handling concept applicable for Runtime Errors but not for syntax errors

What is Exception:

An unwanted and unexpected event that disturbs normal flow of program is called exception.

Eg:

ZeroDivisionError

TypeError

ValueError

FileNotFoundException

EOFError

SleepingError

TyrePuncturedError

It is highly recommended to handle exceptions. The main objective of exception handling is Graceful Termination of the program(i.e we should not block our resources and we should not miss anything)

Exception handling does not mean repairing exception. We have to define alternative way to continue rest of the program normally.

Eg:

For example our programming requirement is reading data from remote file locating at London. At runtime if london file is not available then the program should not be terminated abnormally. We have to provide local file to continue rest of the program normally. This way of defining alternative is nothing but exception handling.

try:

 read data from remote file locating at london

except FileNotFoundException:

 use local file and continue rest of the program normally

Q. What is an Exception?

Q. What is the purpose of Exception Handling?

Q. What is the meaning of Exception Handling?

Default Exception Handing in Python:

Every exception in Python is an object. For every exception type the corresponding classes are available.

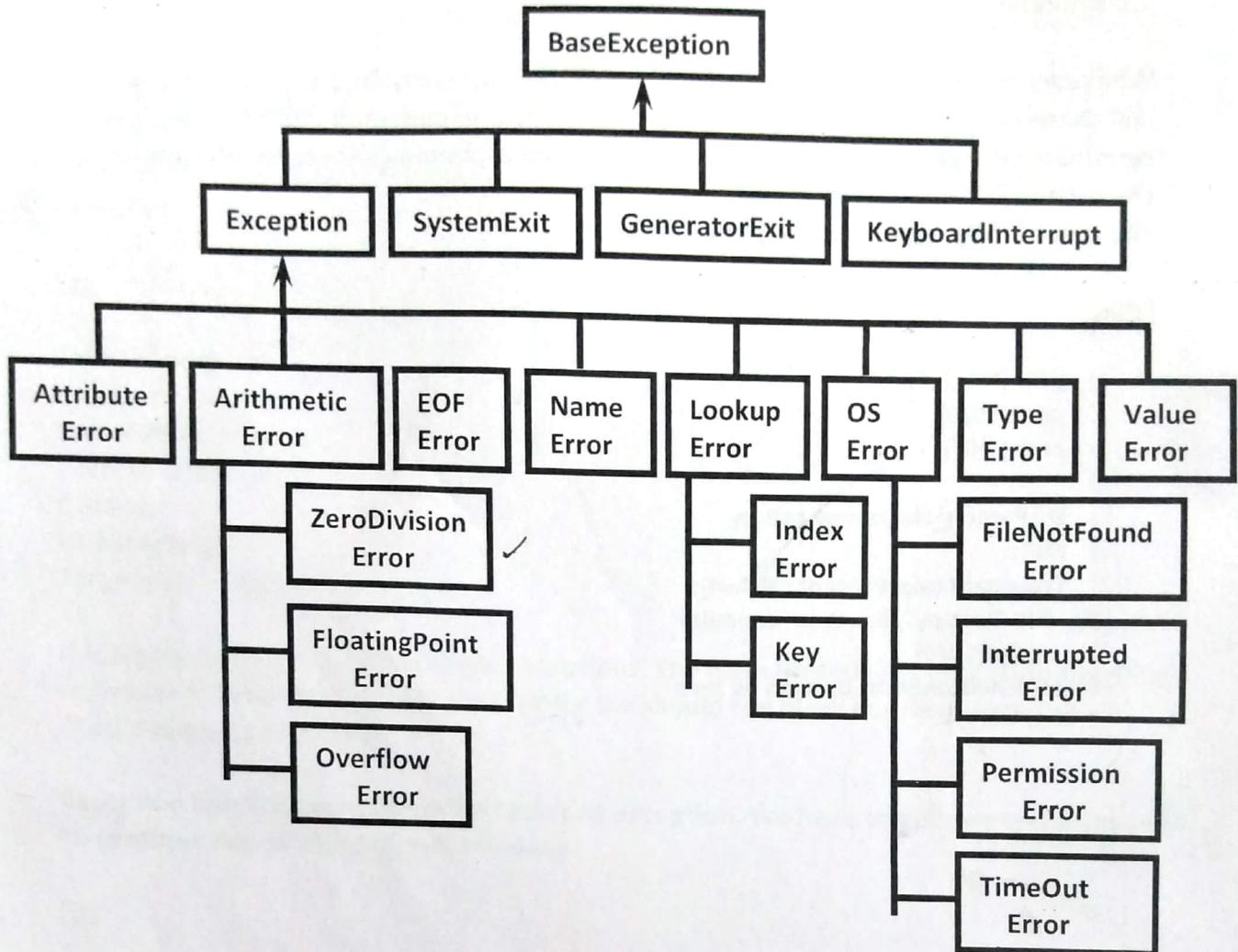
Whenever an exception occurs PVM will create the corresponding exception object and will check for handling code. If handling code is not available then Python interpreter terminates the program abnormally and prints corresponding exception information to the console.

The rest of the program won't be executed.

Eg:

```
1) print("Hello")
2) print(10/0)
3) print("Hi")
4)
5) D:\Python_classes>py test.py
6) Hello
7) Traceback (most recent call last):
8)   File "test.py", line 2, in <module>
9)     print(10/0)
10) ZeroDivisionError: division by zero
```

Python's Exception Hierarchy



Every Exception in Python is a class.

All exception classes are child classes of BaseException.i.e every exception class extends BaseException either directly or indirectly. Hence BaseException acts as root for Python Exception Hierarchy.

Most of the times being a programmer we have to concentrate Exception and its child classes.

Customized Exception Handling by using try-except:

It is highly recommended to handle exceptions.

The code which may raise exception is called risky code and we have to take risky code inside try block. The corresponding handling code we have to take inside except block.

```
try:
    Risky Code
except XXX:
    Handling code/Alternative Code
```

without try-except:

```
1. print("stmt-1")
2. print(10/0)
3. print("stmt-3")
4.
5. Output
6. stmt-1
7. ZeroDivisionError: division by zero
```

Abnormal termination/Non-Graceful Termination

with try-except:

```
1. print("stmt-1")
2. try:
3.     print(10/0)
4. except ZeroDivisionError:
5.     print(10/2)
6. print("stmt-3")
7.
8. Output
9. stmt-1
10. 5.0
11. stmt-3
```

Normal termination/Graceful Termination

Control Flow in try-except:

```
try:
    stmt-1
    stmt-2
    stmt-3
except XXX:
    stmt-4
stmt-5
```

case-1: If there is no exception

1,2,3,5 and Normal Termination

case-2: If an exception raised at stmt-2 and corresponding except block matched
1,4,5 Normal Termination

case-3: If an exception raised at stmt-2 and corresponding except block not matched
1, Abnormal Termination

case-4: If an exception raised at stmt-4 or at stmt-5 then it is always abnormal termination.

Conclusions:

1. within the try block if anywhere exception raised then rest of the try block wont be executed even though we handled that exception. Hence we have to take only risky code inside try block and length of the try block should be as less as possible.
2. In addition to try block, there may be a chance of raising exceptions inside except and finally blocks also.
3. If any statement which is not part of try block raises an exception then it is always abnormal termination.

How to print exception information:

try:

1. print(10/0)
2. except ZeroDivisionError as msg:
3. print("exception raised and its description is:",msg)
- 4.
5. Output exception raised and its description is: division by zero

try with multiple except blocks:

The way of handling exception is varied from exception to exception. Hence for every exception type a separate except block we have to provide. i.e try with multiple except blocks is possible and recommended to use.

Eg:

try:

except ZeroDivisionError:
 perform alternative
 arithmetic operations

```
except FileNotFoundError:  
    use local file instead of remote file
```

If try with multiple except blocks available then based on raised exception the corresponding except block will be executed.

Eg:

```
1) try:  
2)     x=int(input("Enter First Number: "))  
3)     y=int(input("Enter Second Number: "))  
4)     print(x/y)  
5) except ZeroDivisionError :  
6)     print("Can't Divide with Zero")  
7) except ValueError:  
8)     print("please provide int value only")  
9)  
10) D:\Python_classes>py test.py  
11) Enter First Number: 10  
12) Enter Second Number: 2  
13) 5.0  
14)  
15) D:\Python_classes>py test.py  
16) Enter First Number: 10  
17) Enter Second Number: 0  
18) Can't Divide with Zero  
19)  
20) D:\Python_classes>py test.py  
21) Enter First Number: 10  
22) Enter Second Number: ten  
23) please provide int value only
```

If try with multiple except blocks available then the order of these except blocks is important .Python interpreter will always consider from top to bottom until matched except block identified.

Eg:

```
1) try:  
2)     x=int(input("Enter First Number: "))  
3)     y=int(input("Enter Second Number: "))  
4)     print(x/y)  
5) except ArithmeticError :  
6)     print("ArithmeticError")  
7) except ZeroDivisionError:  
8)     print("ZeroDivisionError")  
9)  
10) D:\Python_classes>py test.py
```

- 11) Enter First Number: 10
- 12) Enter Second Number: 0
- 13) ArithmeticError

Single except block that can handle multiple exceptions:

We can write a single except block that can handle multiple different types of exceptions.

```
except (Exception1,Exception2,exception3,...): or  
except (Exception1,Exception2,exception3,...) as msg :
```

Parenthesis are mandatory and this group of exceptions internally considered as tuple.

Eg:

```
1) try:  
2)   x=int(input("Enter First Number: "))  
3)   y=int(input("Enter Second Number: "))  
4)   print(x/y)  
5) except (ZeroDivisionError,ValueError) as msg:  
6)   print("Plz Provide valid numbers only and problem is: ",msg)  
7)  
8) D:\Python_classes>py test.py  
9) Enter First Number: 10  
10) Enter Second Number: 0  
11) Plz Provide valid numbers only and problem is: division by zero  
12)  
13) D:\Python_classes>py test.py  
14) Enter First Number: 10  
15) Enter Second Number: ten  
16) Plz Provide valid numbers only and problem is: invalid literal for int() with b  
17) ase 10: 'ten'
```

Default except block:

We can use default except block to handle any type of exceptions.
In default except block generally we can print normal error messages.

Syntax:

```
except:  
    statements
```

Eg:

```
1) try:  
2)   x=int(input("Enter First Number: "))  
3)   y=int(input("Enter Second Number: "))  
4)   print(x/y)
```

```
5) except ZeroDivisionError:  
6)     print("ZeroDivisionError:Can't divide with zero")  
7) except:  
8)     print("Default Except:Plz provide valid input only")  
9)  
10) D:\Python_classes>py test.py  
11) Enter First Number: 10  
12) Enter Second Number: 0  
13) ZeroDivisionError:Can't divide with zero  
14)  
15) D:\Python_classes>py test.py  
16) Enter First Number: 10  
17) Enter Second Number: ten  
18) Default Except:Plz provide valid input only
```

***Note: If try with multiple except blocks available then default except block should be last, otherwise we will get SyntaxError.

Eg:

```
1) try:  
2)     print(10/0)  
3) except:  
4)     print("Default Except")  
5) except ZeroDivisionError:  
6)     print("ZeroDivisionError")  
7)  
8) SyntaxError: default 'except:' must be last
```

Note:

The following are various possible combinations of except blocks

1. except ZeroDivisionError:
1. except ZeroDivisionError as msg:
3. except (ZeroDivisionError,ValueError) :
4. except (ZeroDivisionError,ValueError) as msg:
5. except :

finally block:

1. It is not recommended to maintain clean up code(Resource Deallocating Code or Resource Releasing code) inside try block because there is no guarantee for the execution of every statement inside try block always.
2. It is not recommended to maintain clean up code inside except block, because if there is no exception then except block won't be executed.

Hence we required some place to maintain clean up code which should be executed always irrespective of whether exception raised or not raised and whether exception handled or not handled. Such type of best place is nothing but finally block.

Hence the main purpose of finally block is to maintain clean up code.

```
try:  
    Risky Code  
except:  
    Handling Code  
finally:  
    Cleanup code
```

The speciality of finally block is it will be executed always whether exception raised or not raised and whether exception handled or not handled.

Case-1: If there is no exception

```
1) try:  
2)     print("try")  
3) except:  
4)     print("except")  
5) finally:  
6)     print("finally")  
7)  
8) Output  
9) try  
10) finally
```

Case-2: If there is an exception raised but handled:

```
1) try:  
2)     print("try")  
3)     print(10/0)  
4) except ZeroDivisionError:  
5)     print("except")  
6) finally:  
7)     print("finally")  
8)  
9) Output  
10) try  
11) except  
12) finally
```

Case-3: If there is an exception raised but not handled:

```
1) try:  
2)   print("try")  
3)   print(10/0)  
4) except NameError:  
5)   print("except")  
6) finally:  
7)   print("finally")  
8)  
9) Output  
10) try  
11) finally  
12) ZeroDivisionError: division by zero(Abnormal Termination)
```

*** **Note:** There is only one situation where finally block won't be executed ie whenever we are using os._exit(0) function.

Whenever we are using os._exit(0) function then Python Virtual Machine itself will be shutdown. In this particular case finally won't be executed.

```
1) imports  
2) try:  
3)   print("try")  
4)   os._exit(0)  
5) except NameError:  
6)   print("except")  
7) finally:  
8)   print("finally")  
9)  
10) Output  
11) try
```

Note:

os._exit(0)

where 0 represents status code and it indicates normal termination

There are multiple status codes are possible.

Control flow in try-except-finally:

```
try:  
stmt-1  
stmt-2  
stmt-3  
except:  
stmt-4
```

```
finally:  
    stmt-5  
    stmt6
```

Case-1: If there is no exception

1,2,3,5,6 Normal Termination

Case-2: If an exception raised at stmt2 and the corresponding except block matched
1,4,5,6 Normal Termination

Case-3: If an exception raised at stmt2 but the corresponding except block not matched
1,5 Abnormal Termination

Case-4: If an exception raised at stmt4 then it is always abnormal termination but before
that finally block will be executed.

Case-5: If an exception raised at stmt-5 or at stmt-6 then it is always abnormal
termination

Nested try-except-finally blocks:

We can take try-except-finally blocks inside try or except or finally blocks.i.e nesting of try-except-finally is possible.

try:

try:

except:

except:

General Risky code we have to take inside outer try block and too much risky code we
have to take inside inner try block. Inside Inner try block if an exception raised then inner

except block is responsible to handle. If it is unable to handle then outer except block is responsible to handle.

Eg:

```
1) try:  
2)   print("outer try block")  
3)   try:  
4)     print("Inner try block")  
5)     print(10/0)  
6)   except ZeroDivisionError:  
7)     print("Inner except block")  
8)   finally:  
9)     print("Inner finally block")  
10) except:  
11)   print("outer except block")  
12) finally:  
13)   print("outer finally block")  
14)  
15) Output  
16) outer try block  
17) Inner try block  
18) Inner except block  
19) Inner finally block  
20) outer finally block
```

Control flow in nested try-except-finally:

```
try:  
    stmt-1  
    stmt-2  
    stmt-3  
    try:  
        stmt-4  
        stmt-5  
        stmt-6  
    except X:  
        stmt-7  
    finally:  
        stmt-8  
    stmt-9  
except Y:  
    stmt-10  
finally:  
    stmt-11  
stmt-12
```

case-1: If there is no exception

1,2,3,4,5,6,8,9,11,12 Normal Termination

case-2: If an exception raised at stmt-2 and the corresponding except block matched

1,10,11,12 Normal Termination

case-3: If an exception raised at stmt-2 and the corresponding except block not matched

1,11,Abnormal Termination

case-4: If an exception raised at stmt-5 and inner except block matched

1,2,3,4,7,8,9,11,12 Normal Termination

case-5: If an exception raised at stmt-5 and inner except block not matched but outer except block matched

1,2,3,4,8,10,11,12,Normal Termination

case-6: If an exception raised at stmt-5 and both inner and outer except blocks are not matched

1,2,3,4,8,11,Abnormal Termination

case-7: If an exception raised at stmt-7 and corresponding except block matched

1,2,3,.,.,.,8,10,11,12,Normal Termination

case-8: If an exception raised at stmt-7 and corresponding except block not matched

1,2,3,.,.,.,8,11,Abnormal Termination

case-9: If an exception raised at stmt-8 and corresponding except block matched

1,2,3,.,.,.,10,11,12 Normal Termination

case-10: If an exception raised at stmt-8 and corresponding except block not matched

1,2,3,.,.,.,11,Abnormal Termination

case-11: If an exception raised at stmt-9 and corresponding except block matched

1,2,3,.,.,.,8,10,11,12,Normal Termination

case-12: If an exception raised at stmt-9 and corresponding except block not matched

1,2,3,.,.,.,8,11,Abnormal Termination

case-13: If an exception raised at stmt-10 then it is always abnormal termination but before abnormal termination finally block(stmt-11) will be executed.

case-14: If an exception raised at stmt-11 or stmt-12 then it is always abnormal termination.

Note: If the control entered into try block then compulsory finally block will be executed.
If the control not entered into try block then finally block won't be executed.

else block with try-except-finally:

We can use else block with try-except-finally blocks.
else block will be executed if and only if there are no exceptions inside try block.

try:

Risky Code

except:

 will be executed if exception inside try

else:

 will be executed if there is no exception inside try

finally:

 will be executed whether exception raised or not raised and handled or not handled

Eg:

try:

```
    print("try")
    print(10/0)-->1
```

except:

```
    print("except")
```

else:

```
    print("else")
```

finally:

```
    print("finally")
```

If we comment line-1 then else block will be executed b'z there is no exception inside try.
In this case the output is:

try

else

finally

If we are not commenting line-1 then else block won't be executed b'z there is exception inside try block. In this case output is:

```
try  
except  
finally
```

Various possible combinations of try-except-else-finally:

1. Whenever we are writing try block, compulsory we should write except or finally block.i.e without except or finally block we cannot write try block.
2. Wheneever we are writing except block, compulsory we should write try block. i.e except without try is always invalid.
3. Whenever we are writing finally block, compulsory we should write try block. i.e finally without try is always invalid.
4. We can write multiple except blocks for the same try, but we cannot write multiple finally blocks for the same try
5. Whenever we are writing else block compulsory except block should be there. i.e without except we cannot write else block.
6. In try-except-else-finally order is important.
7. We can define try-except-else-finally inside try,except,else and finally blocks. i.e nesting of try-except-else-finally is always possible.

1	try: print("try")	✗
2	except: print("Hello")	✗
3	else: print("Hello")	✗
4	finally: print("Hello")	✗
5	try: print("try") except: print("except")	✓
6	try: print("try") finally: print("finally")	✓
7	try: print("try")	✓

	except: print("except") else: print("else")	
8	try: print("try") else: print("else")	X
9	try: print("try") else: print("else") finally: print("finally")	X
10	try: print("try") except XXX: print("except-1") except YYY: print("except-2")	✓
11	try: print("try") except : print("except-1") else: print("else") else: print("else")	X
12	try: print("try") except : print("except-1") finally: print("finally") finally: print("finally")	X
13	try: print("try") print("Hello") except: print("except")	X
14	try: print("try") except:	X

	<pre> print("except") print("Hello") except: print("except") </pre>	
15	<pre> try: print("try") except: print("except") print("Hello") finally: print("finally") </pre>	✗
16	<pre> try: print("try") except: print("except") print("Hello") else: print("else") </pre>	✗
17	<pre> try: print("try") except: print("except") try: print("try") except: print("except") </pre>	✓
18	<pre> try: print("try") except: print("except") try: print("try") finally: print("finally") </pre>	✓
19	<pre> try: print("try") except: print("except") if 10>20: print("if") else: print("else") </pre>	✗
20	<pre> try: print("try") </pre>	✓

```

try:
    print("inner try")
except:
    print("inner except block")
finally:
    print("inner finally block")
except:
    print("except")

```

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```

try:
    print("try")

except:
    print("except")
    try:
        print("inner try")
    except:
        print("inner except block")
    finally:
        print("inner finally block")

```



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```

try:
    print("try")
except:
    print("except")
finally:
    try:
        print("inner try")
    except:
        print("inner except block")
    finally:
        print("inner finally block")

```



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```

try:
    print("try")
except:
    print("except")
try:
    print("try")
else:
    print("else")

```



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```

try:
    print("try")
    try:
        print("inner try")
    except:
        print("except")

```



25	<pre> try: print("try") else: print("else") except: print("except") finally: print("finally") </pre>	X
----	--	---

Types of Exceptions:

In Python there are 2 types of exceptions are possible.

1. Predefined Exceptions
2. User Defined Exceptions

1. Predefined Exceptions:

Also known as in-built exceptions

The exceptions which are raised automatically by Python virtual machine whenever a particular event occurs, are called pre defined exceptions.

Eg 1: Whenever we are trying to perform Division by zero, automatically Python will raise ZeroDivisionError.

```
print(10/0)
```

Eg 2: Whenever we are trying to convert input value to int type and if input value is not int value then Python will raise ValueError automatically

```
x=int("ten")==>ValueError
```

2. User Defined Exceptions:

Also known as Customized Exceptions or Programmatic Exceptions

Some time we have to define and raise exceptions explicitly to indicate that something goes wrong ,such type of exceptions are called User Defined Exceptions or Customized Exceptions

Programmer is responsible to define these exceptions and Python not having any idea about these. Hence we have to raise explicitly based on our requirement by using "raise" keyword.

Eg:

InSufficientFundsException
InvalidInputException
TooYoungException
TooOldException

How to Define and Raise Customized Exceptions:

Every exception in Python is a class that extends Exception class either directly or indirectly.

Syntax:

```
class classname(predefined exception class name):  
    def __init__(self,arg):  
        self.msg=arg
```

Eg:

```
1) class TooYoungException(Exception):  
2)     def __init__(self,arg):  
3)         self.msg=arg
```

TooYoungException is our class name which is the child class of Exception

We can raise exception by using raise keyword as follows

```
raise TooYoungException("message")
```

Eg:

```
1) class TooYoungException(Exception):  
2)     def __init__(self,arg):  
3)         self.msg=arg  
4)  
5) class TooOldException(Exception):  
6)     def __init__(self,arg):  
7)         self.msg=arg  
8)  
9) age=int(input("Enter Age:"))  
10) if age>60:  
11)     raise TooYoungException("Plz wait some more time you will get best match soon!!!")  
12) elif age<18:  
13)     raise TooOldException("Your age already crossed marriage age...no chance of getting ma-  
rrriage")  
14) else:  
15)     print("You will get match details soon by email!!!!")  
16)  
17) D:\Python_classes>py test.py
```

```
18) Enter Age:90
19) __main__.TooYoungException: Plz wait some more time you will get best match soon!!!
20)
21) D:\Python_classes>py test.py
22) Enter Age:12
23) __main__.TooOldException: Your age already crossed marriage age...no chance of g
24) etting marriage
25)
26) D:\Python_classes>py test.py
27) Enter Age:27
28) You will get match details soon by email!!!
```

Note:

raise keyword is best suitable for customized exceptions but not for pre defined exceptions