



UCT Department of Computer Science
Computer Science 1015F

Functions



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Problem 1 Introduction

- Write a program to print out the reverse of a sentence.
- For example:
 - Computer becomes retupmoC
- Use first principles - i.e., process the string character-by-character.
- Use functions to make your program readable/modular.



Function

- ❑ A function is a named block of statements that can be executed/called within a program.
- ❑ We have already used some functions:
 - `print`, `eval`, `round`, ...
- ❑ Python stops what it is doing, runs the function, then continues from where it stopped.
- ❑ Functions enable reuse and modularity of code.
- ❑ Functions help us to write longer/more complex programs.

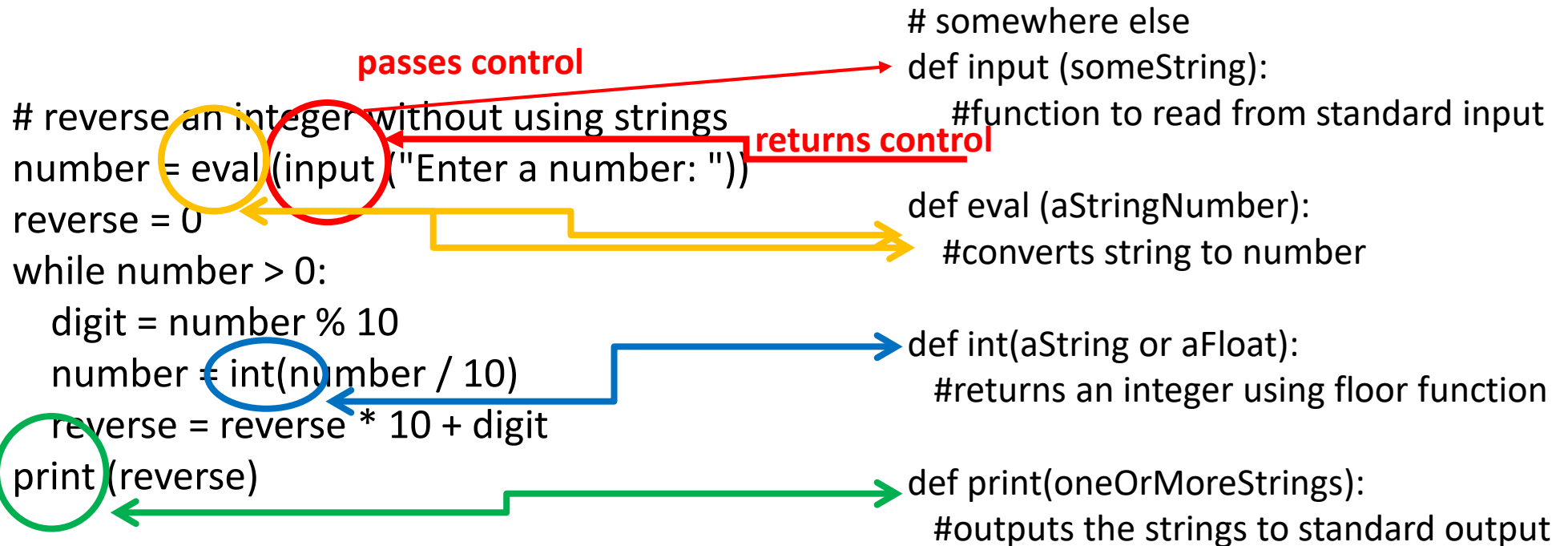


So far:

```
# reverse an integer without using strings
number = eval (input ("Enter a number: "))
reverse = 0
while number > 0:
    digit = number % 10
    number = int(number / 10)
    reverse = reverse * 10 + digit
print (reverse)
```



Function - example



Function Definition / Use

▣ Functions can be defined and used in any order, as long as they are used after definition.

▣ To define a function:

```
def some_function ():  
    statement1  
    statement2  
    . . .
```


▣ To use/call/invoke a function:

```
some_function ()
```



Code refactoring

▣ Functions can refactor code to avoid duplication

<pre>print ("Welcome") print ("to") print ("CS1") print ("Welcome") print ("to") print ("CS2") print ("Welcome") print ("to") print ("CS3")</pre>		<pre>def welcome(): print ("Welcome") print ("to") welcome () print ("CS1") welcome () print ("CS2") welcome () print ("CS3")</pre>
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Parameters

▣ Parameters allow variation in function behaviour

```
print ( "Welcome" )
```

```
print ( "to" )
```

```
print ( "CS1" )
```

```
print ( "Welcome" )
```

```
print ( "to" )
```

```
print ( "CS2" )
```

```
print ( "Welcome" )
```

```
print ( "to" )
```

```
print ( "CS3" )
```



```
def welcome(grp):
```

```
    print ( "Welcome" )
```

```
    print ( "to" )
```

```
    print (grp)
```

```
welcome ( "CS1" )
```

```
welcome ( "CS2" )
```

```
welcome ( "CS3" )
```



Parameters

- Every function can have a list of parameters in its definition.
- called the **formal parameters**
- Whenever the function is called/invoked a value must be provided for each of the formal parameters
- called the **actual parameters** or **arguments**

- Within the function body, the parameters can be used like variables.



Formal and Actual Parameters

```
def some_function (a, b, c):  
    print (a)  
    print (b+c)
```

formal parameters
(or just “parameters”)



```
some_function (12, 23, 34)
```

actual parameters
or “arguments”

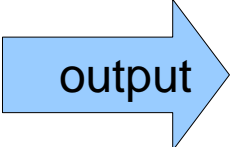


Pass-By-Value

- ❑ Only a copy of the value of a parameter is ever sent to a function.
- ❑ So if there is an original variable, it cannot be changed by the function changing the parameter.

```
def some_function (a):  
    a=a+1  
    print (a)
```

```
b = 12  
some_function (b)  
print (b)
```

 13
12

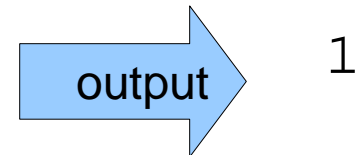


Scope and Local Variables 1/2

- ▣ New variables can be created and used within functions but they disappear when the function ends.
- called **local variables**

```
def some_function ():  
    a = 1  
    print (a)
```

```
some_function ()
```



Scope and Local Variables 2/2

▣ Local variables names (and parameters) that are the same as global variable names temporarily hide the global variables.

```
def some_function (a,c):  
    a = 3  
    b = 3  
    print (a,b)
```

```
a = 1  
b = 2  
some_function (1,2)  
print (a,b)
```

output →
3 3
1 2



Global Variables

- ▣ Global variables can be accessed but not changed.
- ▣ Use the **global** statement to allow changes to a global variable.

```
def some_function (a):  
    global b  
    b = 4  
    a = 3
```

```
b = 2  
some_function (b)  
print (b)
```

output → 4

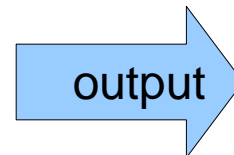


Return Values

- ▣ Functions can return values just like mathematical functions.
- ▣ Use the **return** statement with an expression.
- ▣ Can be used anywhere in function and will return immediately.

```
def square (x):  
    return x*x
```

```
y = square (12)  
print (y)
```



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Problem 1

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docstring

- ▣ Functions should be documented by specifying their purpose in a string immediately after the header.
- ▣ It is recommended that you use `"""` (triple quotes - for multi-line strings) for all **docstrings**.
- ▣ Use `func.__doc__` to check the docstring.

```
def cube (x):  
    """Return the cube of x."""  
    return x*x*x  
  
def square (x):  
    """Return the square of x.  
    x can be any numerical value"""  
    return x*x
```



nested functions

▣ Functions can be composed similarly to mathematical functions.

```
def cube (x):  
    return x*x*x
```

```
def square (x):  
    return x*x
```

```
def power (a, b):  
    return a**b
```

```
print (power (cube (2), square (2)))
```



main function

❑ Common practice is to wrap a program into a function called "main", then invoke this function to execute the program.

```
# cube program

def cube (x):
    return x*x*x

def main ():
    print (cube (2))

main()
```



Writing your own modules

- ❑ Any file with functions can be imported.
- ❑ Check `__name__` variable
 - if it is `"__main__"`, then this file was executed
 - otherwise, this file was imported

```
# cube module
```

```
def cube (x):
```

```
    return x*x*x
```

```
def main ():
```

```
    print (cube (2))
```

```
if __name__=="__main__":
```

```
    main()
```

```
# test cube module
```

```
import a
```

```
print (a.cube(3))
```



Problem 2

- ❑ Convert the freewifi program to use functions, with all the best practices for using functions.



Problem 3 Intro 1/2

□ Write an application to tell what country or body of water the International Space Station is over right now. Use best practices for functions.



□ Extend your application to give the next time the ISS will fly over South Africa



Problem 3 Intro 2/2

- <http://api.open-notify.org/iss-now.json> Will give the current latitude and longitude of the International Space Station
- <http://www.geonames.org/export/web-services.html#countrycode> Can help us find a country name from a latitude and longitude
- <http://www.geonames.org/export/web-services.html#ocean> Can help us find the ocean name from a latitude and longitude



International Space Station



- ❑ First component launched in 1998
- ❑ Modular space station
- ❑ Largest man-made body in orbit
- ❑ Can often be seen with the naked eye from Earth
- ❑ Science!



Default values for parameters

- ❑ Functions can have zero or more parameter with default values in their definition.
- ❑ All parameters with default values **must be at the end of the parameter list**
 - e.g., once you have a default value, all subsequent parameters must have a default value as well.
- ❑ Evaluated at the time of function definition, not invocation
- ❑ Whenever the function is called/invoked, the arguments with default values are **optional**.
- ❑ Within the fn body, parameters still used as variables.

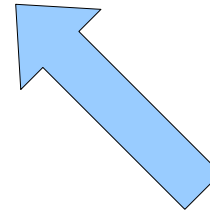


Recall: Formal Parameters

```
def some_function (a, b, c):
```

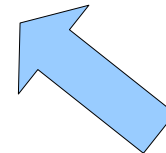
```
    print (a)
```

```
    print (b+c)
```



formal parameters

```
some_function (12, 23, 34)
```



actual parameters

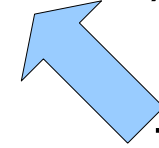


Default values for formal parameters

```
def some_function (a, b, c=10):
```

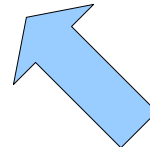
```
    print (a)
```

```
    print (b+c)
```



formal parameter
with default value

```
some_function (12, 23, 34)
```



```
some_function (12, 23)
```

optional parameter



Problem 3

□ Write an application to tell what country or body of water the International Space Station is over right now. Use best practices for functions.

□

□ Extend your application to give the next time the ISS will fly over South Africa

