Computational Physics

Controlling Python

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Announcements

Finish Reading Chapter 2

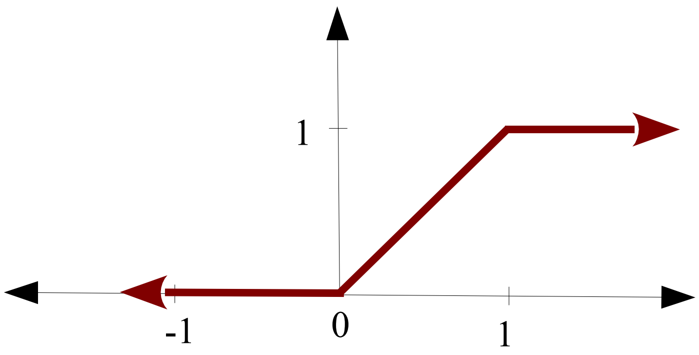
- Sections 2.4 - 2.7 Pages 46 – 87
- Turn-In Questions
  - 2 questions on reading due next Tuesday

Controlling Python

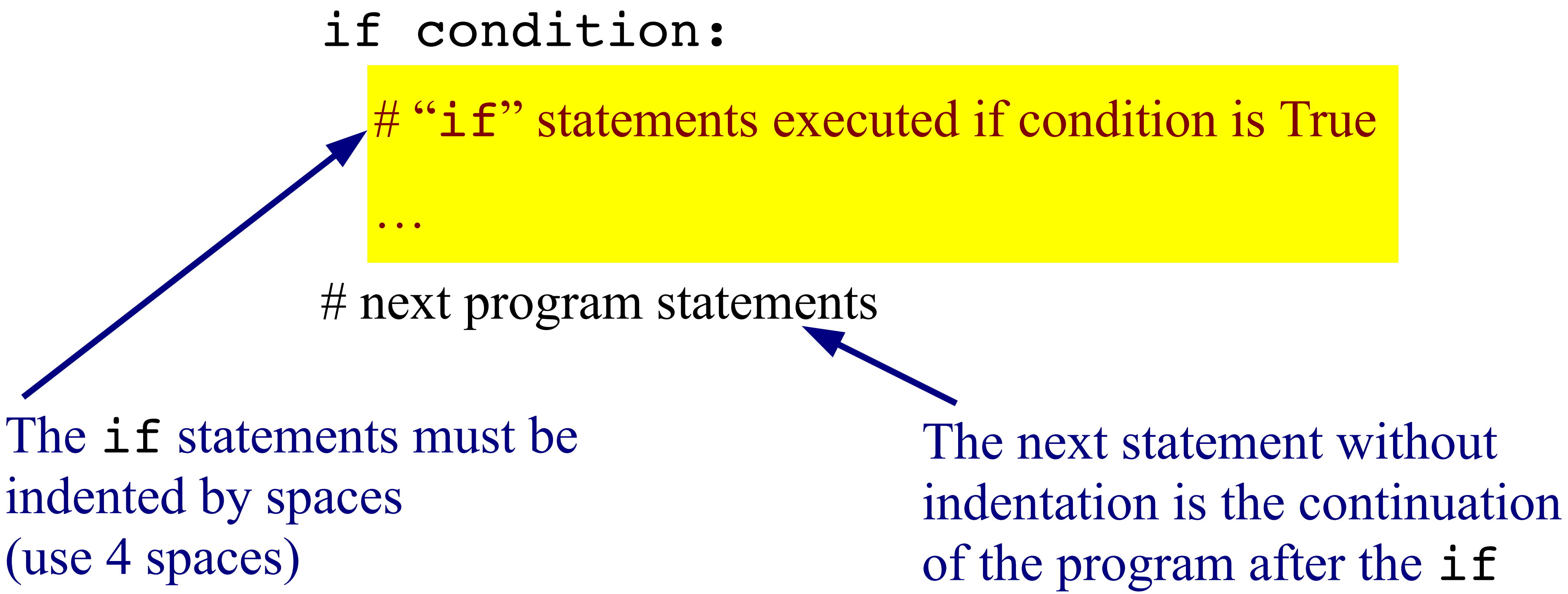
Often we will want our programs to do something only if a certain condition is true. That is the flow of our computer programs often needs to branch.

For example:

$$f(x) = \begin{cases} 0, & x \leq 0 \\ x, & 0 < x < 1 \\ 1, & x \geq 1 \end{cases}$$



The *`if`* Statement



```
if condition:
    # “if” statements executed if condition is True

    ...
# next program statements
```

The `if` statements must be indented by spaces (use 4 spaces)

The next statement without indentation is the continuation of the program after the `if`

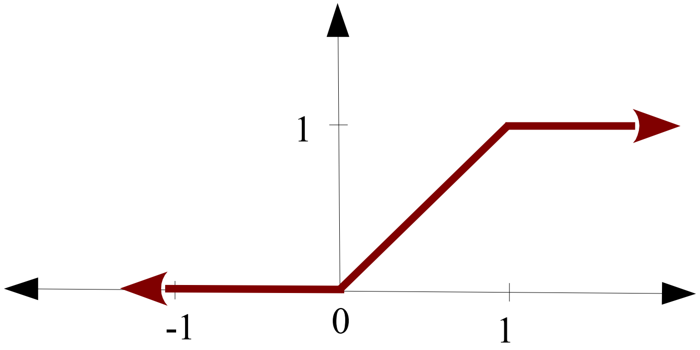
The `if`, *`elif`*, *and* *`else`* Statements

```
if condition1:
    #  “if” statements executed if condition1 is True
    ...
elif condition2:
    #  “else if” statements executed if condition1 is False &
    #   condition2 is True
    ....
else:
    #  “else” statements executed if all conditions are False
    ....
# next program statements
```

The `elif` and `else` statements are optional extensions of the `if` statement.

Using `if` Statements

$$F(x) = \begin{cases} 0, & x \leq 0 \\ x, & 0 < x < 1 \\ 1, & x \geq 1 \end{cases}$$



```
x = float(raw_input("Enter a decimal number (i.e. float): "))

if x<=0:
    Fx = 0
elif x>0 and x<1:
    Fx = x
else:
    Fx = 1

print("F(", x, ") is ", Fx, sep='')
```

The Python Interpreter

Interactive Mode

```
hpc-login-38 58% python

Python 2.7.5 (default, Feb 11 2014, 07:46:25)
[GCC 4.8.2 20140120 (Red Hat 4.8.2-13)] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> 2/3
0
>>> from __future__ import division
>>> 2/3
0.6666666666666666
>>>
```

Continuation lines are needed when entering a multi-line construct. As an example, take a look at this if statement:

```
>>> the_world_is_flat = True
>>> if the_world_is_flat:
...     print("Be careful not to fall off!")
...
Be careful not to fall off!
```

Typing an end-of-file character (`Control-D` on Unix, `Control-Z` on Windows) at the primary prompt causes the interpreter to exit with a zero exit status. If that doesn't work, you can exit the interpreter by typing the following command: `quit()`.

Boolean Expression

Boolean expressions evaluate to bool type values of True or False

```
x == 13          # x equals 13
x != 13          # x does not equal 13
x >= 13          # x is greater than or equal to 13
x <= 13          # x is less than or equal to 13
x > 13           # x is greater than 13
x < 13           # x is less than 13
```

Boolean Expression

Boolean expressions evaluate to bool type values of True or False

```
x == 13            # x equals 13
x != 13            # x does not equal 13
x >= 13            # x is greater than or equal to 13
x <= 13            # x is less than or equal to 13
x > 13             # x is greater than 13
x < 13             # x is less than 13
```

The key words and, or, or not can be used in the boolean expressions

```
hpc-login 400% python
>>> x, y = 0, 1.2
>>> x >= 0 and y < 1
False
>>> x >= 0 or y < 1
True
>>> x > 0 or y > 1
True
```

```
>>> x > 0 or not y > 1
False
>>> -1 < x <= 0   # -1 < x and x <= 0
True
>>> not( x > 0 or y > 0 )
False
>>> bool(5)  # bool(0 or neg.) is False
True
```

using the Python interpreter

The *while* Statement

```
while condition:
    # “while” statements executed if condition is True
    ...
# next program statements
```

The while statements must be indented by spaces (use 4 spaces)

The next statement without indentation is the continuation of the program after the while

The *break* and *continue* Statements

```
while condition:
    ...
    break
    ...
# next program statements
```

```
while condition:
    ...
    continue
    ...
# next program statements
```

The `break` statement allows us to break out of a loop even if the condition in the while statement is not met.

The `continue` statement make the program skip the rest of the indented code in the `while` loop but then goes back to the beginning of the loop

The **`continue`** *statement is rarely used.*

The *break* and *continue* Statements

```
x = 11
while x>10:
    # This loop will continue until one enters a number not
    # greater than 10, except if one enter the number 111.
    #
    x = int(raw_input(“Enter a number no greater than ten: “))
    if x==111:
        # “if” statements executed only if condition is True
        break
# The value of x is either less than 10 or exactly 111.
```

This is an example of nesting an `if` statement in a while loop. The nested block of statements must be further indented (+4 spaces).

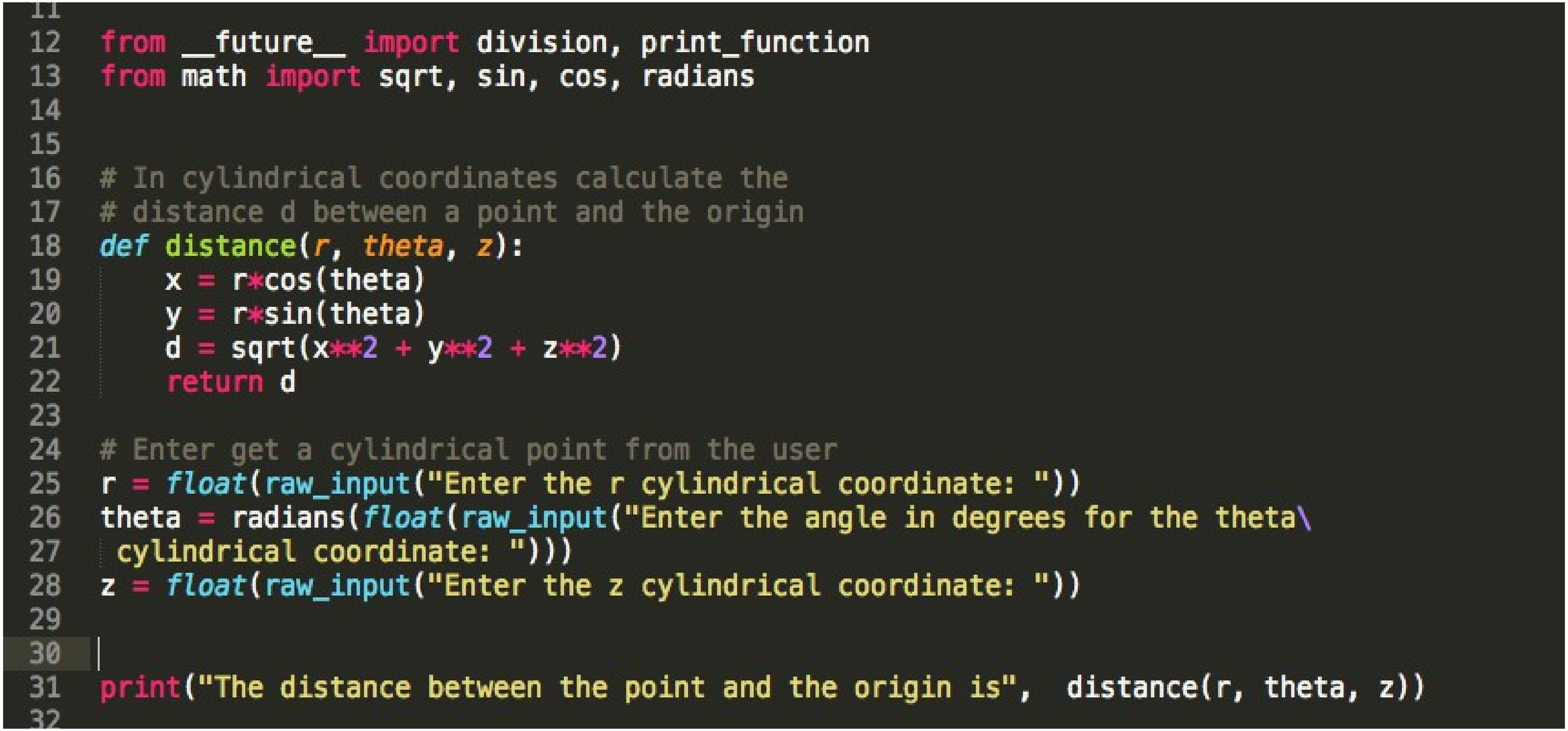
User Defined Functions

Python allows you to define your own functions

```
import numpy as np
# In cylindrical coordinates calculate the
# distance "d" between a point and the origin
#
def distance(r, theta, z):
    x = r*np.cos(theta)
    y = r*np.sin(theta)
    d = np.sqrt(x**2 + y**2 + z**2)
    return d
```

- The `function` statements must be indented by spaces
  - use 4 spaces
- The next statement without indentation is the continuation of the program after the `function`

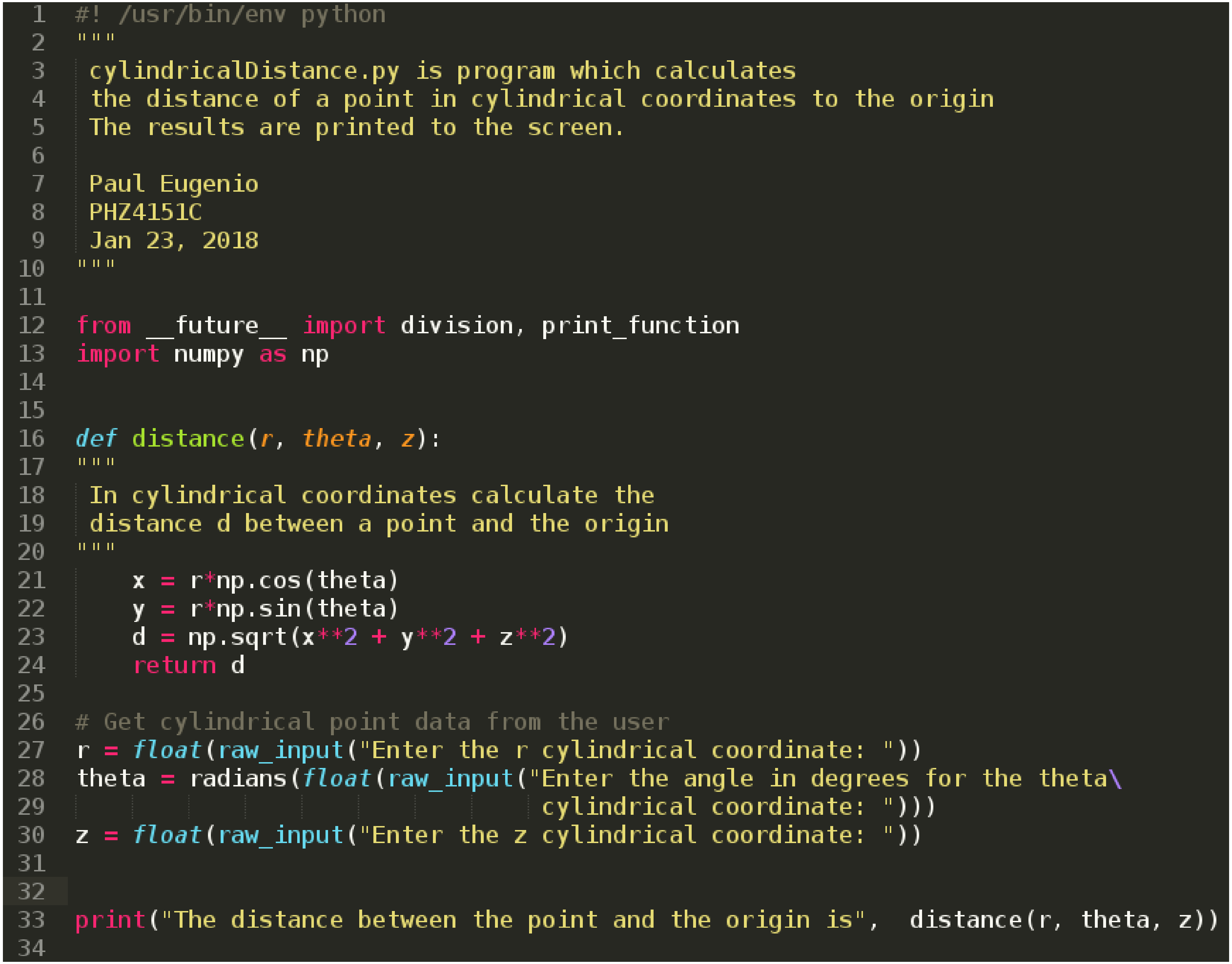
cylindricalDistance.py



```python
from __future__ import division, print_function
from math import sqrt, sin, cos, radians


# In cylindrical coordinates calculate the
# distance d between a point and the origin
def distance(r, theta, z):
    x = r*cos(theta)
    y = r*sin(theta)
    d = sqrt(x**2 + y**2 + z**2)
    return d

# Enter get a cylindrical point from the user
r = float(raw_input("Enter the r cylindrical coordinate: "))
theta = radians(float(raw_input("Enter the angle in degrees for the theta\
 cylindrical coordinate: ")))
z = float(raw_input("Enter the z cylindrical coordinate: "))



print("The distance between the point and the origin is",  distance(r, theta, z))
```

Let's get working

cylindricalDistance.py



```python
#! /usr/bin/env python
"""
 cylindricalDistance.py is program which calculates
 the distance of a point in cylindrical coordinates to the origin
 The results are printed to the screen.

 Paul Eugenio
 PHZ4151C
 Jan 23, 2018
"""

from __future__ import division, print_function
import numpy as np


def distance(r, theta, z):
"""
 In cylindrical coordinates calculate the
 distance d between a point and the origin
"""
    x = r*np.cos(theta)
    y = r*np.sin(theta)
    d = np.sqrt(x**2 + y**2 + z**2)
    return d

# Get cylindrical point data from the user
r = float(raw_input("Enter the r cylindrical coordinate: "))
theta = radians(float(raw_input("Enter the angle in degrees for the theta\
                                 cylindrical coordinate: ")))
z = float(raw_input("Enter the z cylindrical coordinate: "))


print("The distance between the point and the origin is",  distance(r, theta, z))

```