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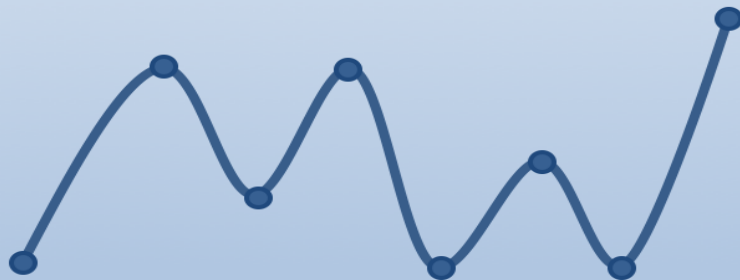
# Introduction to Python

Hans-Petter Halvorsen

# Free Textbook with lots of Practical Examples

## Python Programming

Hans-Petter Halvorsen



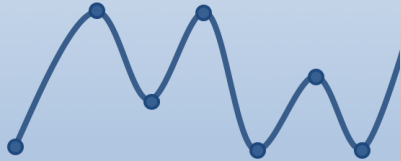
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# Additional Python Resources

## Python Programming

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## Python for Science and Engineering

Hans-Petter Halvorsen



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## Python for Control Engineering

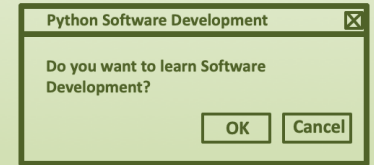
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## Python for Software Development

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<https://www.halvorsen.blog/documents/programming/python/>

# Contents

- Introduction
- What is Python?
- Python Editors
- Python Programming Examples



# The New Age of Programming

- The way we create software today has changed dramatically the last 30 years, from the childhood of personal computers in the early 80s to today's powerful devices such as Smartphones, Tablets and PCs.
- The Internet has also changed the way we use devices and software. We still have traditional desktop applications, but Web Sites, Web Applications and so-called Apps for Smartphones, etc. are dominating the software market today.
- We need to find and learn Programming Languages that are suitable for the New Age of Programming.

# What is Python

- Python is a fairly old Programming Language (1991) compared to many other Programming Languages like C# (2000), Swift (2014), Java (1995), PHP (1995).
- Python has during the last 10 years become more and more popular.
- Today, Python has become one of the most popular Programming Languages.

# Why Python?

- Python is fun to learn and use and it is also named after the British comedy group called **Monty Python** (indicating its fun 😊)
- Python has a simple and flexible code structure, and the code is easy to read
- Python is highly **extendable** due to its high number of free available Python Packaged and Libraries
- **Cross Platform:** Python can be used on all platforms (Windows, macOS and Linux).
- Python is **multi-purpose** and can be used for to program Web Applications, Enterprise Applications and Embedded Applications, and within Data Science and Engineering Applications
- The **popularity** of Python is growing fast
- Python is **open source and free to use**
- The growing **Python community** makes it easy to find documentation, code examples and get help when needed

# Python Editors

- Python IDLE
- **Spyder** (Anaconda distribution)
- PyCharm
- **Visual Studio Code**
- Visual Studio
- Jupyter Notebook
- ...

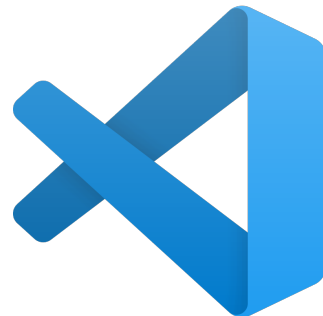


SPYDER

The Scientific Python Development Environment



ANACONDA®





# Python IDLE

```
Python 3.7.0 Shell
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 26 2018, 23:26:24)
[Clang 6.0 (clang-600.0.57)] on darwin
Type "copyright", "credits" or "license()" for more information
.
>>> print("Hello World!")
Hello World!
>>> x=3
>>> x
3
>>> y=3*x
>>> y
9
>>> a=2
>>> b=5
>>> y=a*x+b
>>> print(y)
11
>>> | https://www.python.org
```

- The programming language is maintained and available from (Python Software Foundation): <https://www.python.org>
- Here you can download the basic Python features in one package, which includes the Python programming language interpreter
- A basic code editor, or an integrated development environment, called IDLE
- To basic to have any practical use

# Spyder (Anaconda distribution)

```
1 import math as mt
2 import numpy as np
3 import matplotlib.pyplot as plt
4
5
6 # Model Parameters
7 T = 5
8 a = -1/T
9
10 # Simulation Parameters
11 x0 = 1
12 t = 0
13
14 tstart = 0
15 tstop = 25
16
17 increment = 1
18
19 x = []
20 x = np.zeros(tstop+1)
21
22 t = np.arange(tstart, tstop+1, increment)
23
24
25 # Define the Function
26 for k in range(tstop):
27     x[k] = mt.exp(a*t[k]) * x0
28
29
30 # Plot the Simulation Results
31 plt.plot(t,x)
32 plt.title('Simulation of Dynamic System')
33 plt.xlabel('t')
34 plt.ylabel('x')
35 plt.grid()
36 plt.axis([0, 25, 0, 1])
37 plt.show()
```

Name	Type	Size	Value
T	int	1	5
a	float	1	-0.2
increment	int	1	1
k	int	1	24
t	int64	(26,)	[ 0  1  2 ... 23 24 25]
tstart	int	1	0
tstop	int	1	25
x	float64	(26,)	[1. 0.81873075 0.67032005 ... 0.01005184 0.00822975 0. ...
x0	int	1	1

Figure 1: Simulation of Dynamic System

The plot shows a decaying exponential curve of x versus t. The x-axis ranges from 0 to 25, and the y-axis ranges from 0.0 to 1.0. The curve starts at (0, 1.0) and decays towards 0 as t increases.

<https://www.anaconda.com>

- The Spyder editor is included with the Anaconda distribution
- All you need in one installation package
- Excellent for Science and Engineering
- Simulations and Mathematics calculations
- Similar features as the MATLAB Editor

# Spyder (Anaconda distribution)

Run Program button

The screenshot displays the Spyder Python IDE interface. The top toolbar features a green play button (Run Program button) circled in red. The main workspace is divided into three windows:

- Code Editor window:** Contains a Python script named `temp.py` with the following code:

```
1 x = 2
2 y = 4
3 z = x + y
4 print(z)
```
- Variable Explorer window:** A table showing the state of variables in memory:

Name	Type	Size	Value
x	int	1	2
y	int	1	4
z	int	1	6
- IPython console window:** Shows the execution output:

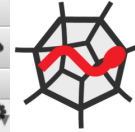
```
Python 3.7.0 (default, Jun 28 2018, 07:39:16)
Type "copyright", "credits" or "license" for more information.

IPython 7.8.0 -- An enhanced Interactive Python.

In [1]: runfile('/Users/halvorsen/.spyder-py3/temp.py', wdir='/Users/halvorsen/.spyder-py3')
6

In [2]: |
```

At the bottom of the interface, a status bar displays: Permissions: RW, End-of-lines: LF, Encoding: UTF-8, Line: 4, Column: 9, Memory: 72 %.



SPYDER

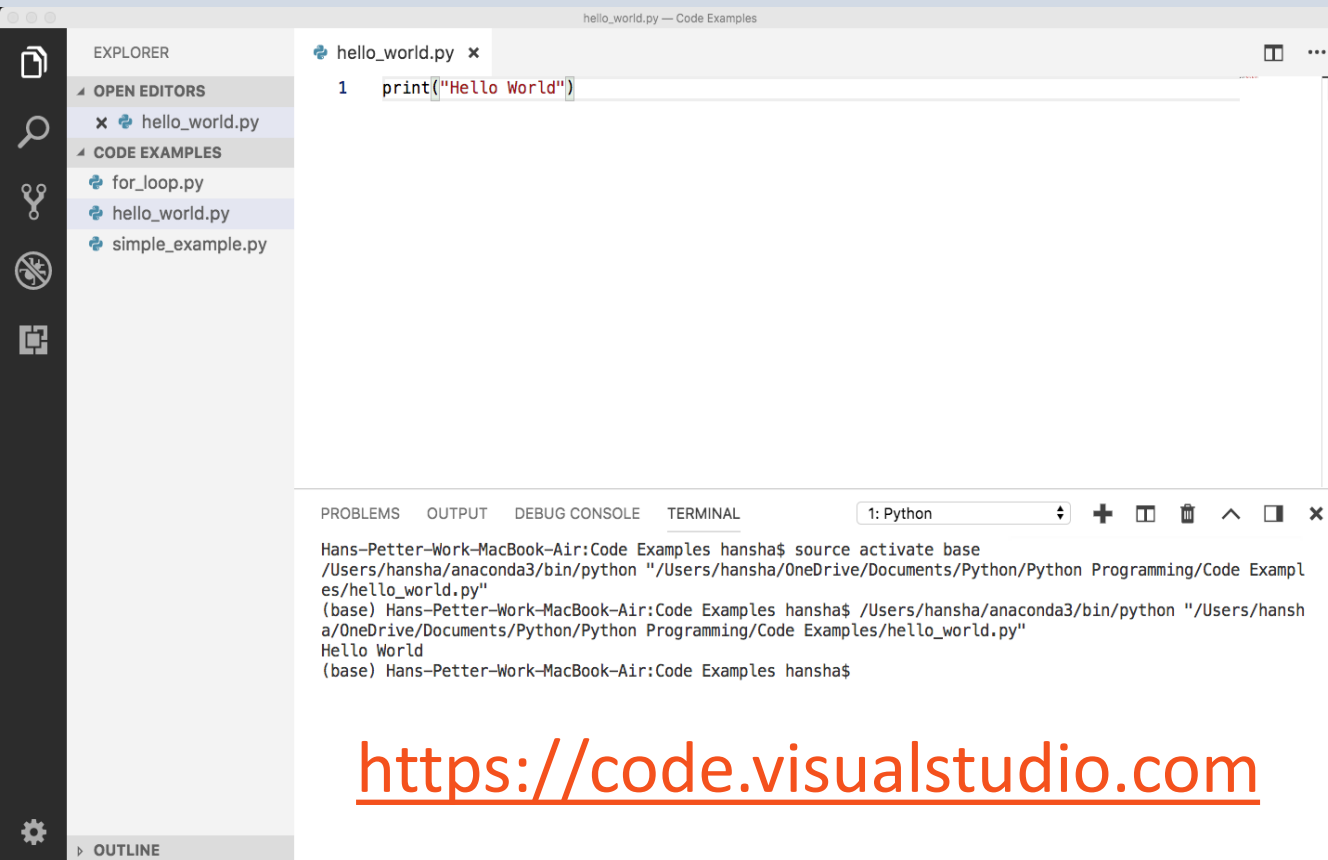
The Scientific Python Development Environment

Variable Explorer window

Code Editor window

Console window

# Visual Studio Code



<https://code.visualstudio.com>

- Open Source Code Editor from Microsoft
- Easy to use
- You can download Extensions for Python programming and lots of other Programming languages
- Excellent if you use a mix of different programming languages
- For Programmers

# Python Programming

- We use the basic IDLE editor or another Python Editor like Spyder (included with Anaconda distribution) or Visual Studio Code, etc.

```
print("Hello World!")
```

# Python Programming

```
Python 3.7.4 Shell
Python 3.7.4 (v3.7.4:e09359112e, Jul 8 2019, 14:5
4:52)
[Clang 6.0 (clang-600.0.57)] on darwin
Type "help", "copyright", "credits" or "license()"
for more information.
>>> x = 2
>>> y = 4
>>> z = x + y
>>> print(z)
6
>>> |
```

Ln: 9 Col: 4

You enter one  
command at a time

Basic Python example using  
the Python Shell (IDLE)

Or use the Editor (File->New File)

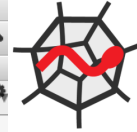
```
test.py - /Users/halvorsen/Downloads/python/test.py...
x = 2
y = 4
z = x + y
print(z)
|
```

Ln: 5 Col: 0

```
x = 2
y = 4
z = x + y
print(z)
```

Your Python files ends with .py

# Python Programming



SPYDER

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Editor - /Users/halvorsen/untitled0.py

```
1#!/usr/bin/env python3
2# -*- coding: utf-8 -*-
3"""
4Created on Fri Aug 21 14:19:52 2020
5
6@author: halvorsen
7"""
8
9
```

Name	Type	Size	Value
x	int	1	2
y	int	1	4
z	int	1	6

IPython console

```
Python 3.7.0 (default, Jun 28 2018, 07:39:16)
Type "copyright", "credits" or "license" for more information.

IPython 7.8.0 -- An enhanced Interactive Python.

In [1]: x = 2
In [2]: y = 4
In [3]: z = x + y
In [4]: print(z)
6
In [5]: |
```

Permissions: RW End-of-lines: LF Encoding: ASCII Line: 9 Column: 1 Memory: 71 %

Basic Python example  
using the **Console  
window** in Spyder

You enter one  
command at a time

```
x = 2
y = 4
z = x + y
print(z)
```

# Python Programming

The screenshot displays the Spyder Python IDE interface. The top window is the Code Editor, showing a Python script named `temp.py` with the following code:

```
1 x = 2
2 y = 4
3 z = x + y
4 print(z)
```

The Variable explorer window shows the following table of variables:

Name	Type	Size	Value
x	int	1	2
y	int	1	4
z	int	1	6

The IPython console window shows the execution of the script:

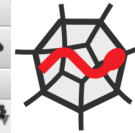
```
Python 3.7.0 (default, Jun 28 2018, 07:39:16)
Type "copyright", "credits" or "license" for more information.

IPython 7.8.0 -- An enhanced Interactive Python.

In [1]: runfile('/Users/halvorsen/.spyder-py3/temp.py', wdir='/Users/halvorsen/.spyder-py3')
6

In [2]: |
```

The status bar at the bottom indicates: Permissions: RW, End-of-lines: LF, Encoding: UTF-8, Line: 4, Column: 9, Memory: 72 %.



SPYDER

The Scientific Python Development Environment

Basic Python example using the **Code Editor window** in Spyder

You create a program and save it as a file with the `.py` file extension

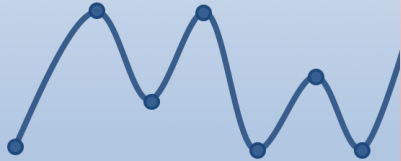
```
x = 2
y = 4
z = x + y
print(z)
```



# Additional Python Resources

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## Python for Science and Engineering

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## Python for Control Engineering

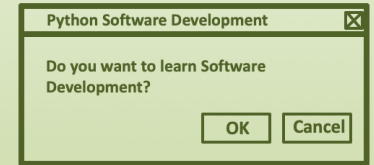
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## Python for Software Development

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<https://www.halvorsen.blog/documents/programming/python/>

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