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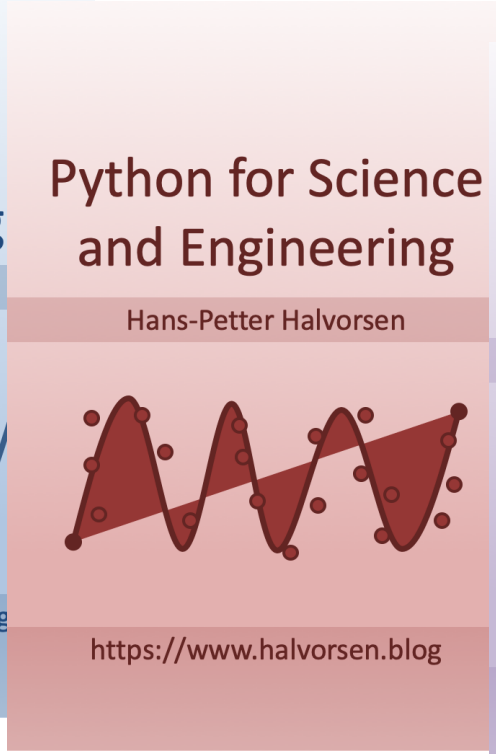
File Handling in Python

Hans-Petter Halvorsen

Free Textbook with lots of Practical Examples

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

Additional Python Resources



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

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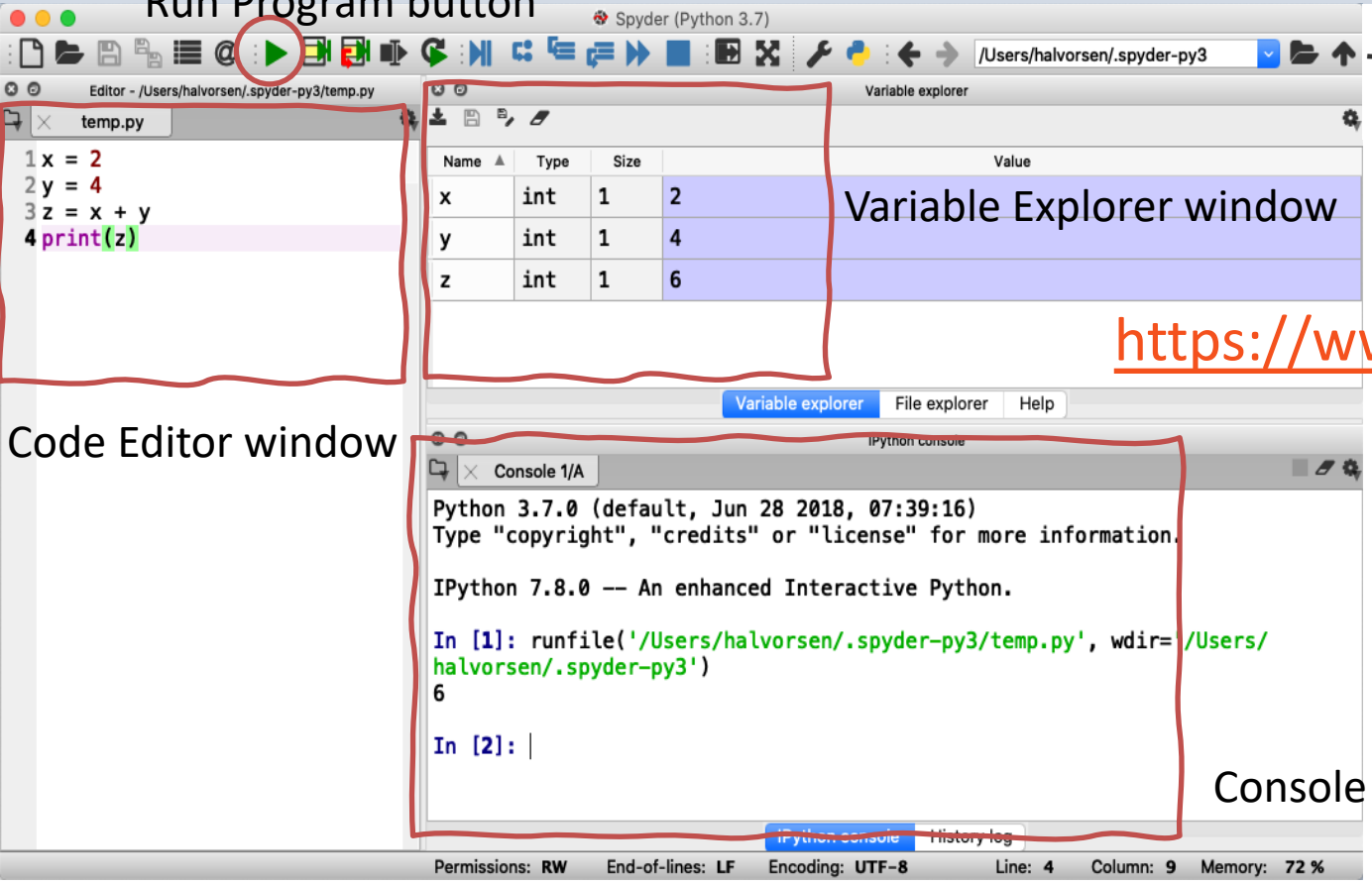
- Write Data to File
- Read Data from File
- Logging Data to File
- Open File in Excel
- Open Data in Python and Plot the Data

Python Editors

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

Spyder (Anaconda distribution)

Run Program button



Variable Explorer window

Code Editor window

Console window

SPYDER
The Scientific Python Development Environment

https://www.anaconda.com

File Handling in Python

- Python has several functions for creating, reading, updating, and deleting files
- The key function for working with files in Python is the `open()` function.
- The `open()` function takes two parameters; Filename, and Mode.

File Handling in Python

There are four different methods (modes) for opening a file:

- "x" - **Create** - Creates the specified file, returns an error if the file exists
- "w" - **Write** - Opens a file for writing, creates the file if it does not exist
- "r" - **Read** - Default value. Opens a file for reading, error if the file does not exist
- "a" - **Append** - Opens a file for appending, creates the file if it does not exist

In addition you can specify if the file should be handled as binary or text mode

- "t" - **Text** - Default value. Text mode
- "b" - **Binary** - Binary mode (e.g. images)

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Write Data to File

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Write Data to File

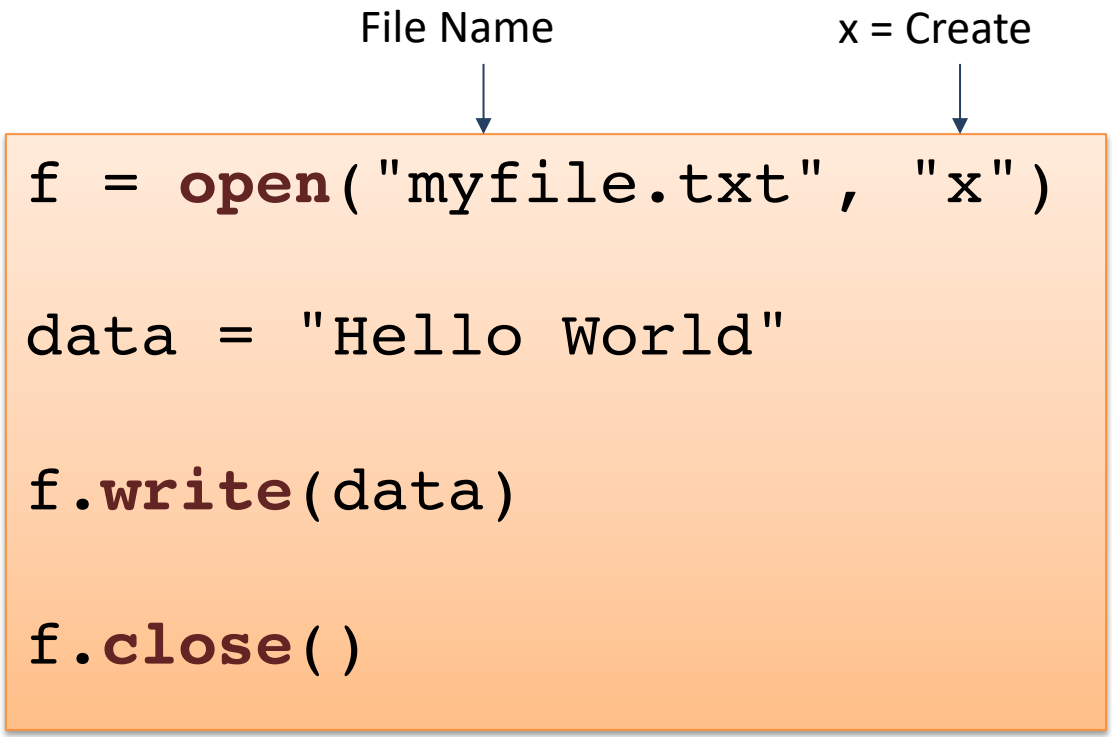
To create a **New** file in Python, use the `open()` method, with one of the following parameters:

- "x" - **Create** - Creates the specified file, returns an error if the file exists
- "w" - **Write** - Opens a file for writing, creates the file if it does not exist
- "a" - **Append** - Opens a file for appending, creates the file if it does not exist

To write to an **Existing** file, you must add a parameter to the `open()` method:

- "w" - **Write** - Opens a file for writing, creates the file if it does not exist
- "a" - **Append** - Opens a file for appending, creates the file if it does not exist

Write Data to File



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Read Data from File

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Read Data from File

To read to an existing file, you must add the following parameter to the open() function:

- "r" - **Read** - Default value. Opens a file for reading, error if the file does not exist

Read Data from File


```
f = open("myfile.txt", "r")

data = f.read()

print(data)

f.close()
```

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Logging Data to File

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Logging Data to File

Typically you want to write multiple data to the, e.g., assume you read some temperature data at regular intervals and then you want to save the temperature values to a File.

Logging Data to File:

```
data = [1.6, 3.4, 5.5, 9.4]

f = open("logdata.txt", "x")

for value in data:
    record = str(value)
    f.write(record)
    f.write("\n")

f.close()
```

Add New Line (or “Enter“)

Read Logged Data from File:

```
f = open("logdata.txt", "r")

for record in f:
    record = record.replace("\n", "")
    print(record)

f.close()
```

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Practical Examples

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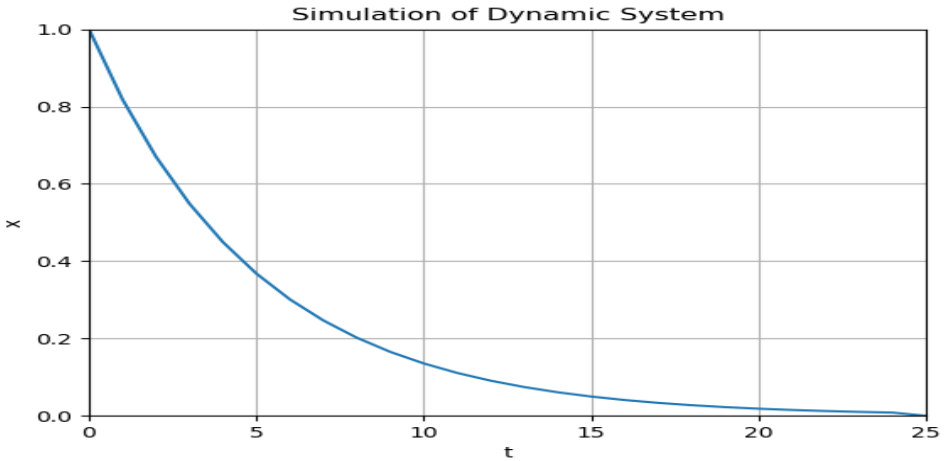
Simulation and Plotting

Given the system (differential equation): $\dot{x} = ax$

The solution is given by: $x(t) = e^{at}x_0$

Where $a = -\frac{1}{T}$ T is the time constant, $T = 5$

Initial condition: $x(0) = x_o = 1$ $0 \leq t \leq 25$



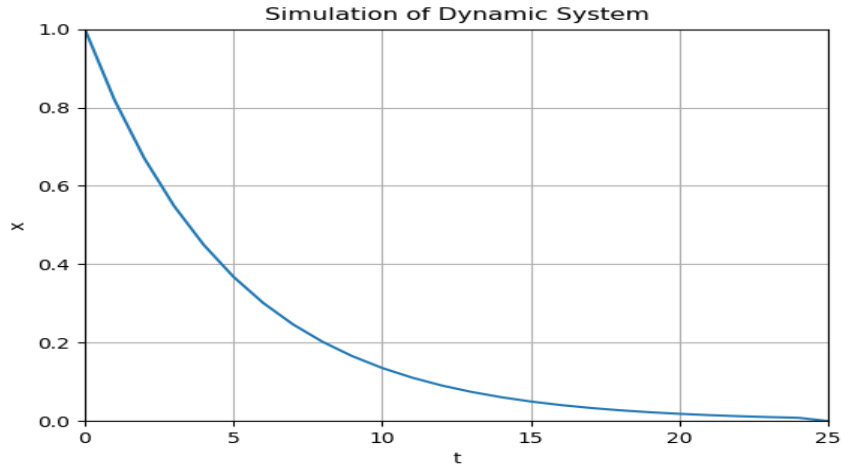
We should add Grid, and proper Title and Axis Labels to the plot

```
import math as mt
import numpy as np
import matplotlib.pyplot as plt

# Model Parameters
T = 5
a = -1/T

# Simulation Parameters
x0 = 1
t = 0
tstart = 0
tstop = 25
increment = 1
x = []
x = np.zeros(tstop+1)
t = np.arange(tstart,tstop+1,increment)

# Define the Function
for k in range(tstop):
    x[k] = mt.exp(a*t[k]) * x0

# Plot the Simulation Results
plt.plot(t,x)
plt.title('Simulation of Dynamic System')
plt.xlabel('t')
plt.ylabel('x')
plt.grid()
plt.axis([0, 25, 0, 1])
plt.show()
```

Logging Simulation Data

simdata.txt

0	1.0
1	0.82
2	0.67
3	0.55
4	0.45
5	0.37
6	0.3
7	0.25
8	0.2
9	0.17
10	0.14
11	0.11
12	0.09
13	0.07
14	0.06
15	0.05
16	0.04
17	0.03
18	0.03
19	0.02
20	0.02
21	0.01
22	0.01
23	0.01
24	0.01




```
import math as mt
import numpy as np
import matplotlib.pyplot as plt

# Open File
f = open("simdata.txt", "w")

def writedata(t, x):
    time = str(t)
    value = str(round(x, 2))
    f.write(time + "\t" + value)
    f.write("\n")

# Model Parameters
T = 5
a = -1/T

# Simulation Parameters
x0 = 1
t = 0
tstart = 0
tstop = 25
increment = 1
x = []
x = np.zeros(tstop+1)
t = np.arange(tstart,tstop+1,increment)

for k in range(tstop):
    x[k] = mt.exp(a*t[k]) * x0
    writedata(t[k], x[k])

f.close()

# Plot the Simulation Results
plt.plot(t,x)
plt.title('Simulation of Dynamic System')
plt.xlabel('t')
plt.ylabel('x')
plt.grid()
plt.axis([0, 25, 0, 1])
plt.show()
```

Code Details

A separate Function for dealing with the Writing to the File has been made. That is of course nor necessary, but the code becomes easier to read and maintain.

I guess you should always think about the code structure, because when your program grows it may become ”messy“. Also consider reuse where possible, i.e., create Functions in separate files, etc.

```
def writedata(t, x):
    time = str(t)
    value = str(round(x, 2))
    f.write(time + "\t" + value)
    f.write("\n")
```

Convert to String values

Show values with 2 Decimals

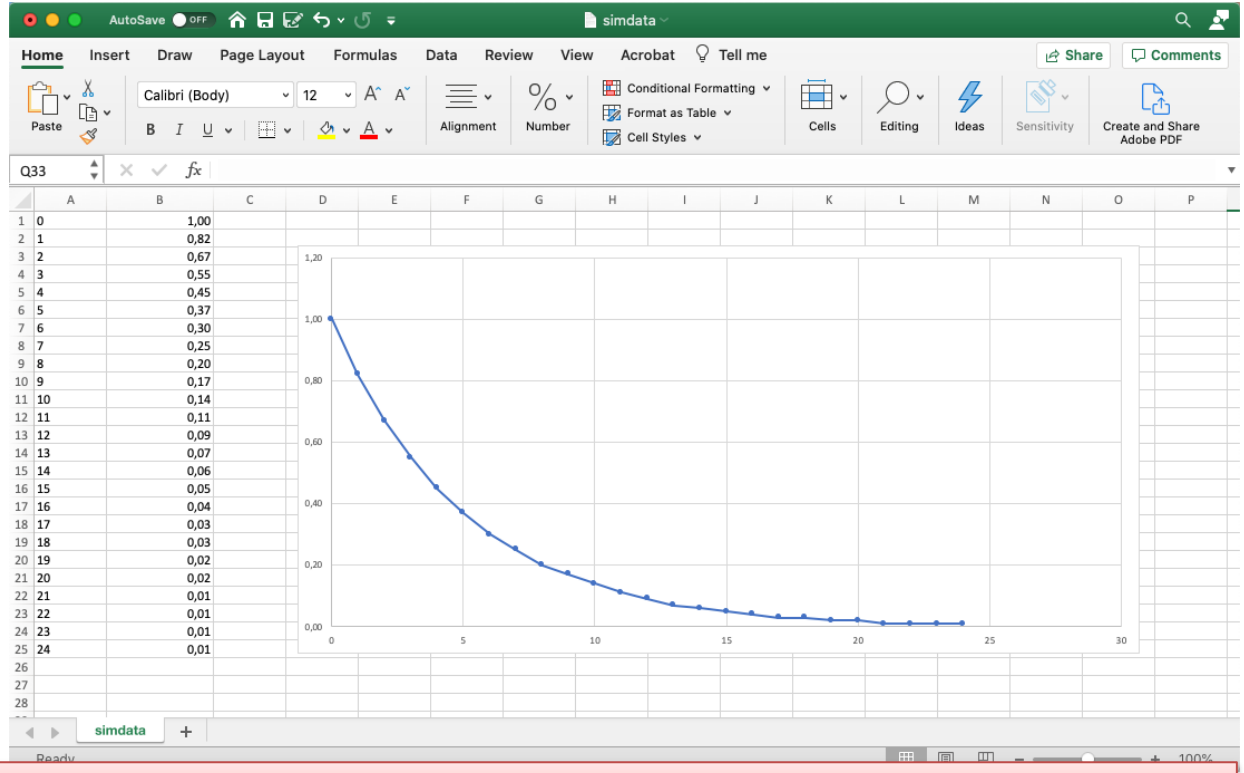
Add New Line (or “Enter“)

Add **Tabulator**, so the t and x will be in 2 separate columns in the file

Open Data in Excel

simdata.txt

0	1.0
1	0.82
2	0.67
3	0.55
4	0.45
5	0.37
6	0.3
7	0.25
8	0.2
9	0.17
10	0.14
11	0.11
12	0.09
13	0.07
14	0.06
15	0.05
16	0.04
17	0.03
18	0.03
19	0.02
20	0.02
21	0.01
22	0.01



	A	B
1	0	1,00
2	1	0,82
3	2	0,67
4	3	0,55
5	4	0,45
6	5	0,37
7	6	0,30
8	7	0,25
9	8	0,20
10	9	0,17
11	10	0,14
12	11	0,11
13	12	0,09
14	13	0,07
15	14	0,06
16	15	0,05
17	16	0,04
18	17	0,03
19	18	0,03
20	19	0,02
21	20	0,02
22	21	0,01
23	22	0,01
24	23	0,01
25	24	0,01

Depending on your Settings in Excel, you may need to convert the Decimal Point from “.” to “,“

Open Data in Excel

simdata.txt

0	1.0
1	0.82
2	0.67
3	0.55
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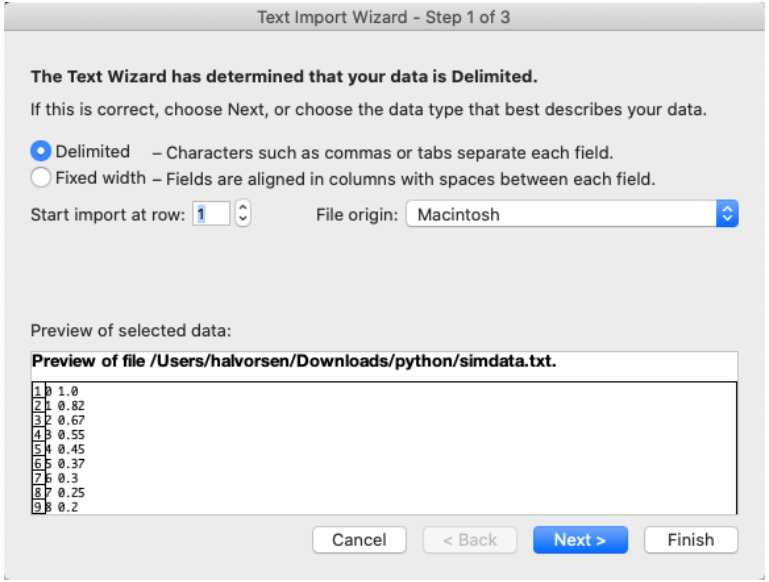
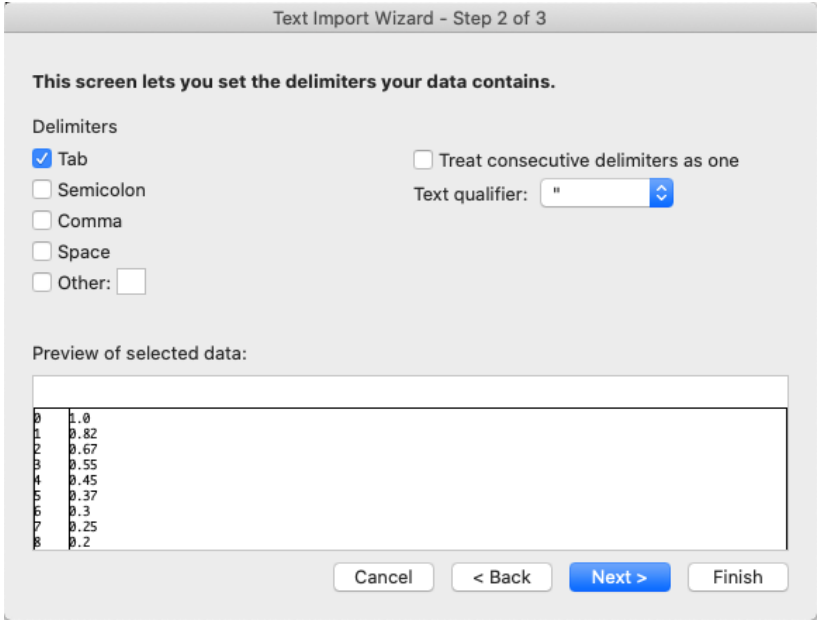
5	0.37
6	0.3
7	0.25
8	0.2
9	0.17
10	0.14
11	0.11
12	0.09
13	0.07
14	0.06
15	0.05
16	0.04
17	0.03
18	0.03
19	0.02
20	0.02
21	0.01
22	0.01
23	0.01
24	0.01





Read Simulation Data

simdata.txt

0	1.0
1	0.82
2	0.67
3	0.55
4	0.45
5	0.37
6	0.3
7	0.25
8	0.2
9	0.17
10	0.14
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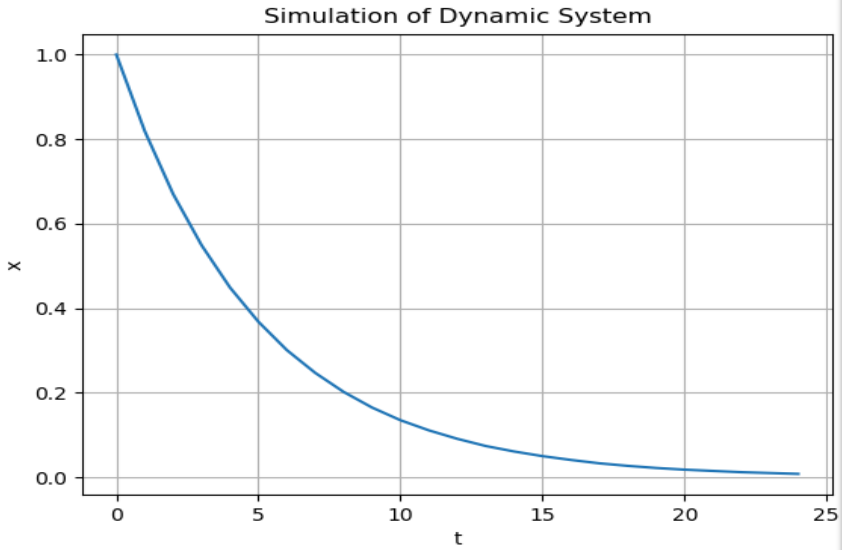
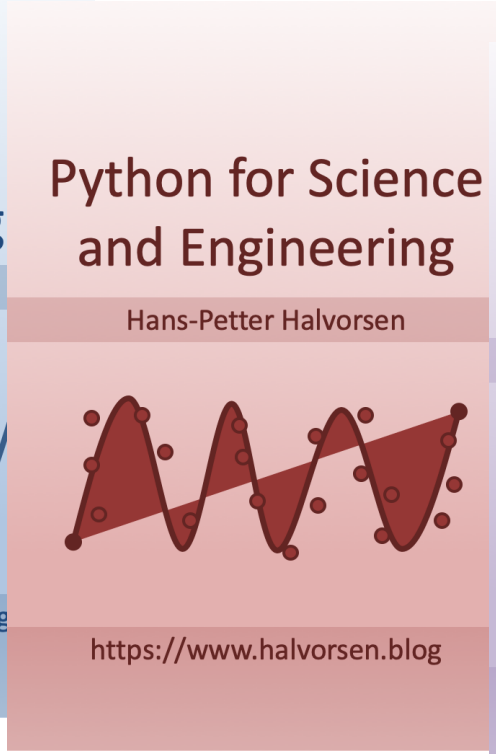
17	0.03
18	0.03
19	0.02
20	0.02
21	0.01
22	0.01
23	0.01
24	0.01




```
import matplotlib.pyplot as plt

f = open("simdata.txt", "r")

t = []
x = []

for record in f:
    record = record.replace("\n", "")

    time, value = record.split("\t")

    t.append(int(time))
    x.append(float(value))


f.close()


# Plot the File Data
plt.plot(t,x)
plt.title('Simulation of Dynamic
System')
plt.xlabel('t')
plt.ylabel('x')
plt.grid()
plt.show()
```

Additional Python Resources



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