competency_intro_python

November 4, 2023

[1]:
```python
import numpy
import math
import matplotlib.pyplot as plt
```

[2]:
```python
#Pierce Zhang, CMOR220, Fall 2023
#competency_intro_python.ipynb
#Answers the questions to the intro to Python competency
#Last modified: November 4, 2023
```

[3]:
```python
# Generates several numpy arrays as specified in the competency problem 1 parts␣
↪(a) - (e)
a = numpy.arange(11, 50, 2)
print("a = \n",a)

b = numpy.arange(0,9).reshape((3,3))
print("b = \n",b)

c = numpy.linspace(0,2,30)
print("c = \n",c)

d = numpy.random.rand(25)
print("d = \n",d)

e = numpy.random.rand(25,25)
print("e = \n",e)
```

```
a =
 [11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49]
b =
 [[0 1 2]
 [3 4 5]
 [6 7 8]]
c =
 [0.         0.06896552 0.13793103 0.20689655 0.27586207 0.34482759
 0.4137931  0.48275862 0.55172414 0.62068966 0.68965517 0.75862069
 0.82758621 0.89655172 0.96551724 1.03448276 1.10344828 1.17241379
 1.24137931 1.31034483 1.37931034 1.44827586 1.51724138 1.5862069
 1.65517241 1.72413793 1.79310345 1.86206897 1.93103448 2.        ]
```

```
d =
 [0.02776508 0.33774725 0.85370803 0.99866826 0.29467043 0.24943983
 0.56657121 0.26350579 0.67958869 0.37660111 0.53503673 0.28238488
 0.39446486 0.0848489  0.37772193 0.72465804 0.09219974 0.14724914
 0.33082595 0.25181089 0.84433618 0.97869846 0.35673888 0.82797515
 0.95422865]
e =
 [[4.99100777e-01 7.00620168e-01 4.56362185e-01 7.88301353e-01
  9.40787391e-01 6.31403494e-01 7.55675193e-01 5.12093127e-01
  9.64402216e-01 2.23625672e-01 5.13120054e-01 8.32758994e-01
  1.91139094e-01 2.49661425e-01 4.15223088e-01 7.20221819e-01
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  4.94071152e-02]
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  3.76414332e-01 2.24462045e-02 2.70683410e-01 2.49878793e-01
  6.42915613e-01 2.18579454e-01 8.27110491e-01 5.59788245e-01
  9.06726844e-01 6.15737156e-01 7.49112060e-01 5.02989157e-01
  1.55983631e-01 7.58988524e-02 6.14874935e-01 5.69434746e-01
  7.84519698e-01 2.25866634e-01 5.75523327e-01 9.88002864e-01
  4.59449438e-01]
 [3.13731960e-01 4.72360541e-01 1.11570153e-02 3.08903933e-01
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  9.52906406e-01 8.54217993e-04 3.69586459e-01 8.79942269e-01
  7.64905346e-01 5.28742212e-01 6.46322911e-01 8.53174742e-01
  5.51376050e-01 2.61243266e-01 8.37676701e-01 1.42176015e-01
  8.27078808e-01 5.64541158e-01 1.02462670e-01 3.42385192e-01
  6.85465983e-01]
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  4.29251936e-01 2.34394380e-01 6.26514963e-01 5.90383723e-02
  1.30773176e-02 7.86962741e-01 3.32509034e-01 3.58432666e-01
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  8.39185657e-01]
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  6.02864840e-01]
 [1.56811967e-01 1.32539908e-01 2.56854298e-01 4.02356019e-01
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```

```
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 2.69679442e-01 9.24896363e-01 7.79325435e-01 7.53695959e-01
 1.97328952e-01]]
```

[4]:
```
# Defines a Pauli matrix and performs several operations on its and the transpose
sig_2 = numpy.mat([[0,-1j],[1j,0]])
# Matrix product of the Pauli matrix transpose with itself
prod = sig_2.T * sig_2
print("prod = \n",prod)
# Component-wise product
prod_elem = numpy.multiply(sig_2.T,sig_2)
print("prod_elemen = \n",prod_elem)
```

```
# Add third row of 1's and delete middle row of result
sig_2_mod = numpy.delete(numpy.vstack((sig_2,[1,1])),1,axis=0)
print("sig_2_mod = \n",sig_2_mod)
```

```
prod =
 [[-1.+0.j  0.+0.j]
 [ 0.+0.j -1.+0.j]]
prod_elemen =
 [[0.+0.j 1.-0.j]
 [1.-0.j 0.+0.j]]
sig_2_mod =
 [[ 0.+0.j -0.-1.j]
 [ 1.+0.j  1.+0.j]]
```

[5]:
```
# Define special matrix A as specified by the competency
A = numpy.diag([1,1,1,1],k=1) + numpy.diag([1,1,1,1],k=-1) + numpy.diag([math.
 ↪sqrt(i) for i in range(1,6)])
print("A = \n",A)
# Iterate over all entries and calculate sum by adding
A_sum = 0
for entry in numpy.nditer(A):
    A_sum += entry
print("sum of A = ",A_sum)
# Iterate over all columns and display sum using slicing and sum
for col_i in range(A.shape[1]):
    print("sum of column",col_i,"=",sum(A[0:A.shape[0],col_i]))
# Solve specified system of equations from the competency
b = numpy.ones((A.shape[0],1))
x = numpy.linalg.solve(A,b)
print("x = \n",x)
```

```
A =
 [[1.         1.         0.         0.         0.        ]
 [1.         1.41421356 1.         0.         0.        ]
 [0.         1.         1.73205081 1.         0.        ]
 [0.         0.         1.         2.         1.        ]
 [0.         0.         0.         1.         2.23606798]]
sum of A =  16.38233234744176
sum of column 0 = 2.0
sum of column 1 = 3.414213562373095
sum of column 2 = 3.732050807568877
sum of column 3 = 4.0
sum of column 4 = 3.23606797749979
x =
 [[-0.17237343]
 [ 1.17237343]
 [-0.48561297]
 [ 0.66873292]
```

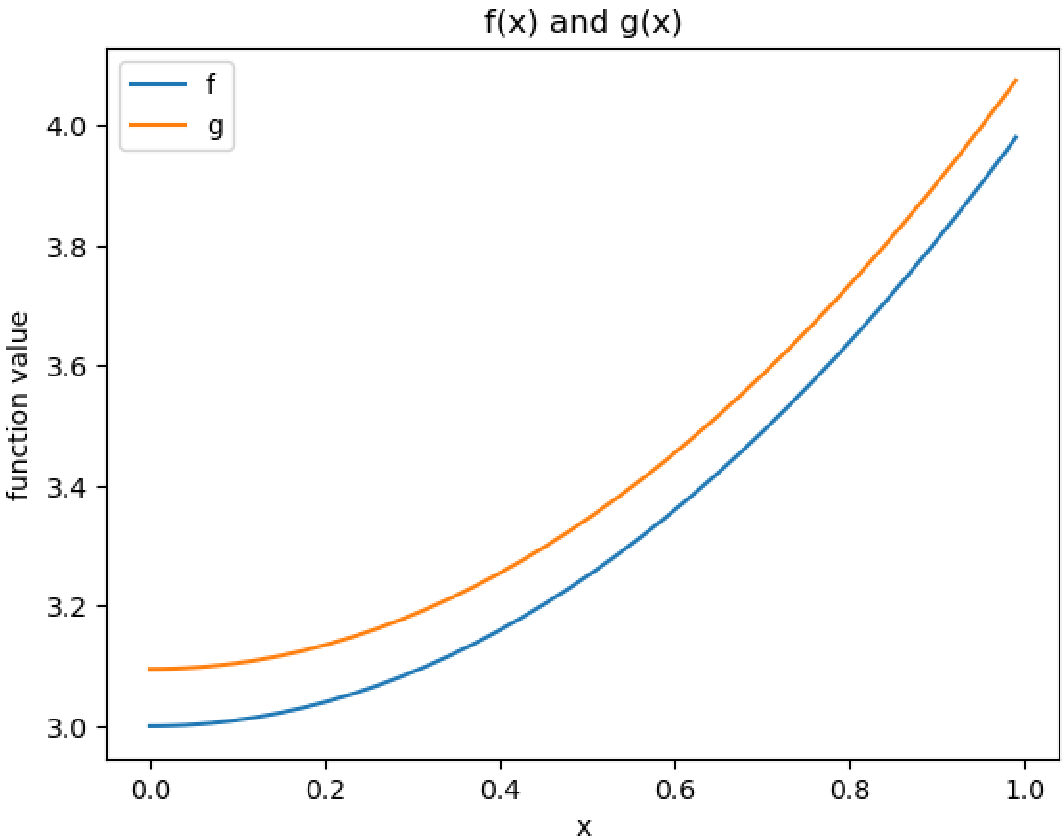
```
[ 0.14814714]]
```

[6]:
```
def f(x):
    return x*x + 3
```

[7]:
```
def g(x):
    return f(x) + numpy.random.rand()*0.1
```

[8]:
```
# Solves problem 5 of the competency
x_domain = numpy.arange(0,1,0.01)
f_range = f(x_domain)
g_range = g(x_domain)
# Declare new plot
plt.figure()
# Plot f and g off x_domain
plt.plot(x_domain,f_range)
plt.plot(x_domain,g_range)
# Labels and titles
plt.xlabel("x")
plt.ylabel("function value")
plt.legend(["f","g"])
plt.title("f(x) and g(x)")
```

[8]:
```
Text(0.5, 1.0, 'f(x) and g(x)')
```


f(x) and g(x)
f
g
function value
x
4.0
3.8
3.6
3.4
3.2
3.0
0.0
0.2
0.4
0.6
0.8
1.0

[ ]: