ELEC 576 / COMP 576 – Assignment 0 (Fall 2025)

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1. Python Machine Learning Stack (Anaconda)

Task 1 – Paste `conda info`

> I am using Python installed via Homebrew on macOS with venv + pip for package management, instead of Anaconda, as permitted by head TA Kesha (see Piazza post @12).

Here are the following commands ran to show the relevant information:

```
python --version
pip list
python -m site
python -m platform
```

Output:

```
apple@MacBook-Air-668 HW0 % python --version
Python 3.12.11
apple@MacBook-Air-668 HW0 % pip list
Package                   Version
------------------------- -----------
absl-py                   2.1.0
ace_tools                 0.0
altgraph                  0.17.4
anyio                     4.9.0
certifi                   2024.12.14
cffi                      1.17.1
charset-normalizer        3.4.0
click                     8.2.1
colorlog                  6.9.0
contourpy                 1.3.1
cryptography              45.0.7
cycler                    0.12.1
decompyle3                3.9.2
easydict                  1.13
et_xmlfile                2.0.0
fake-useragent            2.2.0
filelock                  3.16.1
fonttools                 4.55.3
fsspec                    2024.12.0
graphviz                  0.8.4
grpcio                    1.69.0
```

```
h11                          0.16.0
h2                           4.2.0
hf-xet                       1.0.2
hpack                        4.1.0
httpcore                     1.0.9
httpx                        0.28.1
huggingface-hub              0.27.0
hyperframe                   6.1.0
idna                         3.10
imageio                      2.36.1
iniconfig                    2.0.0
Jinja2                       3.1.5
joblib                       1.4.2
kiwisolver                   1.4.8
lazy_loader                  0.4
libxml2-python               2.13.8
macholib                     1.16.3
Markdown                     3.7
markdown-it-py               3.0.0
MarkupSafe                   3.0.2
matplotlib                   3.10.0
mdurl                        0.1.2
menpo                        0.11.1
mpmath                       1.3.0
mxnet                        1.6.0
networkx                     3.4.2
numpy                        None
onnx                         1.17.0
onnxsim                      0.4.36
opencv-python                4.10.0.84
openpyxl                     3.1.5
packaging                    24.2
pandas                       2.2.3
pathlib2                     2.3.7.post1
pillow                       11.1.0
pip                          25.1.1
pluggy                       1.5.0
prettytable                  3.12.0
protobuf                     5.29.2
pycparser                    2.22
pycryptodome                 3.23.0
pydumpck                     1.20.1
Pygments                     2.19.0
pyinstaller                  6.14.1
pyinstaller-hooks-contrib 2025.5
pyparsing                    3.2.1
pytest                       8.3.4
python-dateutil              2.9.0.post0
pytz                         2024.2
PyYAML                       6.0.2
redis                        6.2.0
regex                        2024.11.6
requests                     2.32.3
rich                         13.9.4
```

```
safetensors               0.5.0
scidatetime               1.20.5
scikit-image              0.25.0
scikit-learn              1.6.0
scipy                     1.15.0
setuptools                75.6.0
sgtpyutils                1.20.8
six                       1.17.0
sniffio                   1.3.1
spark-parser              1.8.9
sympy                     1.13.1
tensorboard               2.18.0
tensorboard-data-server   0.7.2
threadpoolctl             3.5.0
tifffile                  2024.12.12
timm                      1.0.12
tinyaes                   1.1.1
tokenizers                0.21.1
torch                     2.5.1
torchvision               0.20.1
tqdm                      4.67.1
transformers              4.50.0
typing_extensions         4.12.2
tzdata                    2024.2
uncompyle6                3.9.2
urllib3                   2.2.3
vastai                    0.2.8
wcwidth                   0.2.13
Werkzeug                  3.1.3
wheel                     0.45.1
xdis                      6.1.4
apple@MacBook-Air-668 HW0 % python -m site
sys.path = [
    '/Users/apple/Downloads/HW0',

'/opt/homebrew/Cellar/python@3.12/3.12.11/Frameworks/Python.framework/Vers
ions/3.12/lib/python312.zip',

'/opt/homebrew/Cellar/python@3.12/3.12.11/Frameworks/Python.framework/Vers
ions/3.12/lib/python3.12',

'/opt/homebrew/Cellar/python@3.12/3.12.11/Frameworks/Python.framework/Vers
ions/3.12/lib/python3.12/lib-dynload',
    '/opt/homebrew/lib/python3.12/site-packages',
    '/opt/homebrew/opt/python-tk@3.12/libexec',
    '/opt/homebrew/opt/python-gdbm@3.12/libexec',

'/opt/homebrew/opt/python@3.12/Frameworks/Python.framework/Versions/3.12/l
ib/python3.12/site-packages',
]
USER_BASE: '/Users/apple/Library/Python/3.12' (doesn't exist)
USER_SITE: '/Users/apple/Library/Python/3.12/lib/python/site-packages'
(doesn't exist)
ENABLE_USER_SITE: True
```

```
apple@MacBook-Air-668 HW0 % python -m platform
macOS-15.6.1-arm64-arm-64bit
apple@MacBook-Air-668 HW0 %
```

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2. IPython/Jupyter & MATLAB transition

Task 2 – Linear Algebra Equivalents

Use any matrix/vector of your choice. Paste the commands you ran and the outputs.

My code (.py file and Jupyter notebook):

```
t2.py ( In the Zip File. As it is of length 294 lines, I have attached it
separately. There is an ipynb file also kept in the zip file with all
codes and outputs.)
```

Outputs (from VSCode):

```
================================================================================
======
Baseline arrays
================================================================================
======
Array A:
[[  1.   2. ...  11.  12.]
 [ 13.  14. ...  23.  24.]
 ...
 [277. 278. ... 287. 288.]
 [289. 290. ... 299. 300.]]

Array v: [0.     0.0909 0.1818 0.2727 0.3636 0.4545 0.5455 0.6364 0.7273
0.8182 0.9091 1.    ]
A.shape                                 (25, 12)
v.shape / v_col.shape                   (12,) / (12, 1)

================================================================================
======
Dimensions & sizes
================================================================================
======
ndims(A) = np.ndim(A) = A.ndim          2 = 2
numel(A) = np.size(A) = A.size          300 = 300
size(A) = np.shape(A) = A.shape         (25, 12) = (25, 12)
size(A,1) → A.shape[0]                  25
size(A,2) → A.shape[1]                  12

================================================================================
======
```

```
Array construction & blocks
================================================================================
======
[1 2 3; 4 5 6]: (shape=(2, 3))
[[1. 2. 3.]
 [4. 5. 6.]]
np.block([[a,b],[c,d]])                constructed
blk.shape                              (4, 4)

================================================================================
======
Indexing & slicing
================================================================================
======
a(end) → vec[-1]                       9
a(2,5) → A[1,4]                        17.0
a(2,:) → A[1,:]                        [13. 14. 15. 16. 17. 18. 19. 20.
21. 22. 23. 24.]
a(1:5,:) → A[:5,:]                     [[ 1.  2.  3.  4.  5.  6.  7.  8.
9. 10. 11. 12.]
 [13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24.]
 [25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36.]
 [37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48.]
 [49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60.]]
a(end-4:end,:) → A[-5:,:]              [[241. 242. 243. 244. 245. 246.
247. 248. 249. 250. 251. 252.]
 [253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264.]
 [265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276.]
 [277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288.]
 [289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300.]]
a(1:3,5:9) → A[0:3,4:9]                [[ 5.  6.  7.  8.  9.]
 [17. 18. 19. 20. 21.]
 [29. 30. 31. 32. 33.]]
a([2,4,5],[1,3]) via ix_               [[13. 15.]
 [37. 39.]
 [49. 51.]]
a(3:2:21,:) → A[2:21:2,:]              [[ 25.  26. ...  35.  36.]
 [ 49.  50. ...  59.  60.]
 ...
 [217. 218. ... 227. 228.]
 [241. 242. ... 251. 252.]]
a(1:2:end,:) → A[::2,:]                [[  1.   2. ...  11.  12.]
 [ 25.  26. ...  35.  36.]
 ...
 [265. 266. ... 275. 276.]
 [289. 290. ... 299. 300.]]
flipud(a) → A[::-1,:]                  [[289. 290. ... 299. 300.]
 [277. 278. ... 287. 288.]
 ...
 [ 13.  14. ...  23.  24.]
 [  1.   2. ...  11.  12.]]
a([1:end 1],:) → A[np.r_[0:len(A),0],:] [[  1.   2. ...  11.  12.]
 [ 13.  14. ...  23.  24.]
 ...
```

```
 [289. 290. ... 299. 300.]
 [  1.   2. ...  11.  12.]]

================================================================================
======
Transpose / Conjugate transpose
================================================================================
======
A.' → A.T shape                          (12, 25)
A'  → A.conj().T equals C.T.conj()?      True

================================================================================
======
Arithmetic (matrix vs elementwise)
================================================================================
======
Matrix multiply a*b → X @ Y shape        (2, 2)
Element-wise multiply a.*b → X*X: (shape=(2, 3))
[[ 1.  4.  9.]
 [16. 25. 36.]]
Element-wise divide a./b → X/X: (shape=(2, 3))
[[1. 1. 1.]
 [1. 1. 1.]]
Element-wise power a.^3 → (X**3)[0,0]  1.0

================================================================================
======
Logical / find / masking
================================================================================
======
(A>0.5) dtype & count                    bool, 300
find(A>0.5) → first 5 (r,c)              [(0, 0), (0, 1), (0, 2), (0, 3),
(0, 4)]
a(:,find(v>0.5)) → A[:, v>0.5] shape     (25, 6)
a(:,find(v>0.5)) with v as (N,1)         (25, 6)
a(a<0.5)=0 → min(A_copy)                 1.0
a.*(a>0.5) sum                           45150.0

================================================================================
======
Assignment / copies / flatten
================================================================================
======
a(:)=3 → unique(B)                       [3.]
y=x (reference) shares memory?           True
y=x.copy() shares memory?                False
y=x(2,:) equal? & is view?               True, True
y=x(:) → flatten shapes                  (300,) & (300,)

================================================================================
======
Ranges / vectors
================================================================================
======
```

```
1:10 → np.arange(1.,11.): (shape=(10,))
[ 1.  2.  3.  4.  5.  6.  7.  8.  9. 10.]
0:9  → np.arange(10.): (shape=(10,))
[0. 1. 2. 3. 4. 5. 6. 7. 8. 9.]
[1:10]' shape                          (10, 1)

============================================================================
======
Zeros / Ones / Eye / Diag
============================================================================
======
zeros(3,4) shape                       (3, 4)
zeros(3,4,5) shape                     (3, 4, 5)
ones(3,4) shape                        (3, 4)
eye(3): (shape=(3, 3))
[[1. 0. 0.]
 [0. 1. 0.]
 [0. 0. 1.]]
diag(A[:3,:3])                         [ 1. 14. 27.]
diag(v,0): (shape=(3, 3))
[[9 0 0]
 [0 8 0]
 [0 0 7]]

============================================================================
======
Random (Generator + legacy)
============================================================================
======
default_rng(42).random((3,4)): (shape=(3, 4))
[[0.774  0.4389 0.8586 0.6974]
 [0.0942 0.9756 0.7611 0.7861]
 [0.1281 0.4504 0.3708 0.9268]]
np.random.rand(3,4) (legacy): (shape=(3, 4))
[[0.9145 0.3866 0.7539 0.0938]
 [0.7339 0.2944 0.5451 0.4292]
 [0.6186 0.1679 0.0703 0.7896]]

============================================================================
======
Grids: linspace / meshgrid / mgrid / ogrid / ix_
============================================================================
======
linspace(1,3,4): (shape=(4,))
[1.     1.6667 2.3333 3.    ]
meshgrid shapes                        (6, 9) & (6, 9)
mgrid shapes                           (9, 6) & (9, 6)
ogrid shapes                           (9, 1) & (1, 6)
ix_ shapes                             (9, 1) & (1, 6)
f(X,Y)=X+Y via ix_ sample (corners): (shape=(2,))
[ 0 13]

============================================================================
======
```

```
Tile & Concatenate
================================================================================
======
repmat(A2x3,2,3) → np.tile shape       (4, 9)
[a b] → hstack & column_stack          (2, 6) & (2, 4)
[a; b] → vstack & r_                   (4, 3) & (4, 3)

================================================================================
======
Max / norms / logicops
================================================================================
======
max(max(A)) → A.max()                  300.0
max(A) per-column → A.max(0)[:5]       [289. 290. 291. 292. 293.]
max(A,[],2) per-row → A.max(1)[:5]     [12. 24. 36. 48. 60.]
max(A,B) → np.maximum sample: (shape=(2, 3))
[[ 1.  2.  3.]
 [13. 14. 15.]]
norm(v) → np.linalg.norm               5.0
logical_and(a,b): (shape=(3, 3))
[[False False False]
 [False False False]
 [False False False]]
bitand(a,b) → a & b: (shape=(2, 2))
[[0 0]
 [2 0]]
bitor(a,b) → a | b: (shape=(2, 2))
[[5 3]
 [3 7]]

================================================================================
======
inv / pinv / rank / solves (\ and /)
================================================================================
======
inv(M): (shape=(3, 3))
[[ 0.3611 -0.0417 -0.1111]
 [-0.1389  0.2083 -0.1111]
 [ 0.0278 -0.0417  0.2222]]
pinv(M): (shape=(3, 3))
[[ 0.3611 -0.0417 -0.1111]
 [-0.1389  0.2083 -0.1111]
 [ 0.0278 -0.0417  0.2222]]
rank(M)                                3
x = M\bb (square) → solve: (shape=(3,))
[-0.0556 -0.0556  0.6111]
x = Z\y (lstsq) → [intercept, slope]: (shape=(2,))
[3.0061 1.9988]
b/a → Solve A.T x.T = b.T, X shape     (2, 6)

================================================================================
======
Factorizations & solvers
================================================================================
```

```
======
svd: singular values                    [8.8896 3.3201 2.4395]
chol(SPD):
[[3.6056 4.1603 3.8829]
 [0.     4.5489 3.2637]
 [0.     0.     4.3899]]
eig(M) eigenvalues                      [8.+0.j 3.+0.j 3.-0.j]
eig(M,B) generalized eigenvalues (first 3) [0.125 +0.j     0.3333+0.0013j
0.3333-0.0013j]
eig(S) dense eigenvalues                [8.6225+0.j 2.3775+0.j 3.    +0.j]
eigs(L,k=3) eigenvalues (largest magnitude) [3.9962 3.9848 3.9659]
qr(M): diag(R)                          [-3.6056 -4.5489  4.3899]
lu(M) shapes (P,L,U)                    (3, 3), (3, 3), (3, 3)
||PLU - M||_F                           0.0
cg SPD info (0=converged) & residual    0, 1.256515477855323e-14

================================================================================
======
FFT / iFFT
================================================================================
======
len(FFT) & max reconstruction error     32, 2.237726045655905e-16

================================================================================
======
Sorting
================================================================================
======
sort(a) by column → np.sort(A, axis=0): (shape=(5, 5))
[[ 1.  2.  3.  4.  5.]
 [13. 14. 15. 16. 17.]
 [25. 26. 27. 28. 29.]
 [37. 38. 39. 40. 41.]
 [49. 50. 51. 52. 53.]]
sort(a,2) by row → np.sort(A, axis=1): (shape=(5, 5))
[[ 1.  2.  3.  4.  5.]
 [13. 14. 15. 16. 17.]
 [25. 26. 27. 28. 29.]
 [37. 38. 39. 40. 41.]
 [49. 50. 51. 52. 53.]]
[b,I]=sortrows(a,1) → I: (shape=(3,))
[1 2 0]
[b,I]=sortrows(a,1) → b: (shape=(3, 2))
[[1 5]
 [2 7]
 [3 9]]

================================================================================
======
Linear regression via lstsq
================================================================================
======
lstsq coef ~ [intercept, slope]: (shape=(2,))
[ 3.9742 -1.9766]
```

```
================================================================================
======
Decimate / Unique / Squeeze
================================================================================
======
decimate length: before → after        32 → 8
unique(a): (shape=(3,))
[1 2 3]
squeeze(a) shape                       (3, 4)

All MATLAB↔NumPy table items have been exercised. Done.
```

---

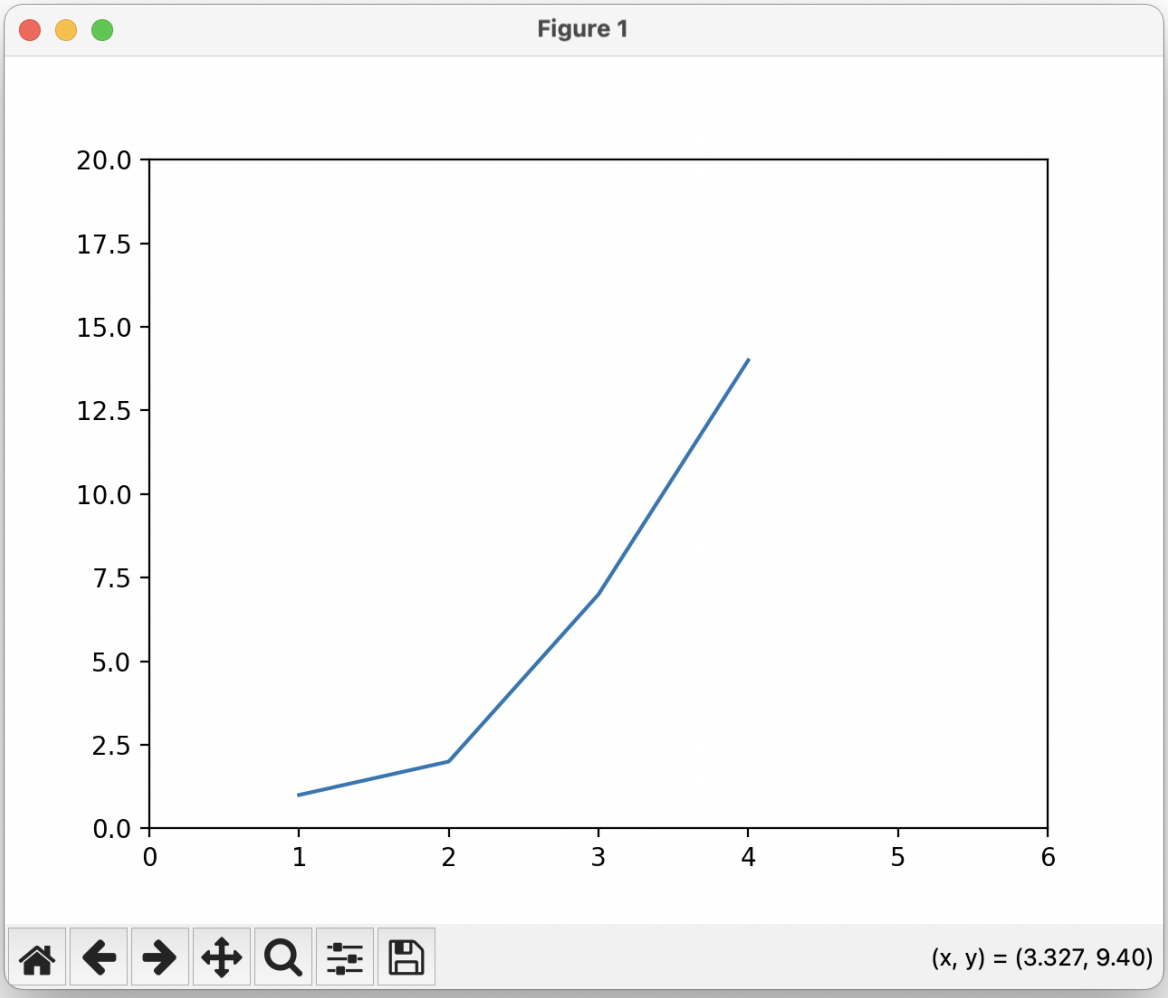
3. Plotting with Matplotlib

Task 3 – Reproduce the given script and paste the figure

Script:

```python
import matplotlib.pyplot as plt
plt.plot([1,2,3,4], [1,2,7,14])
plt.axis([0, 6, 0, 20])
plt.show()
```

Your figure (screenshot or image):



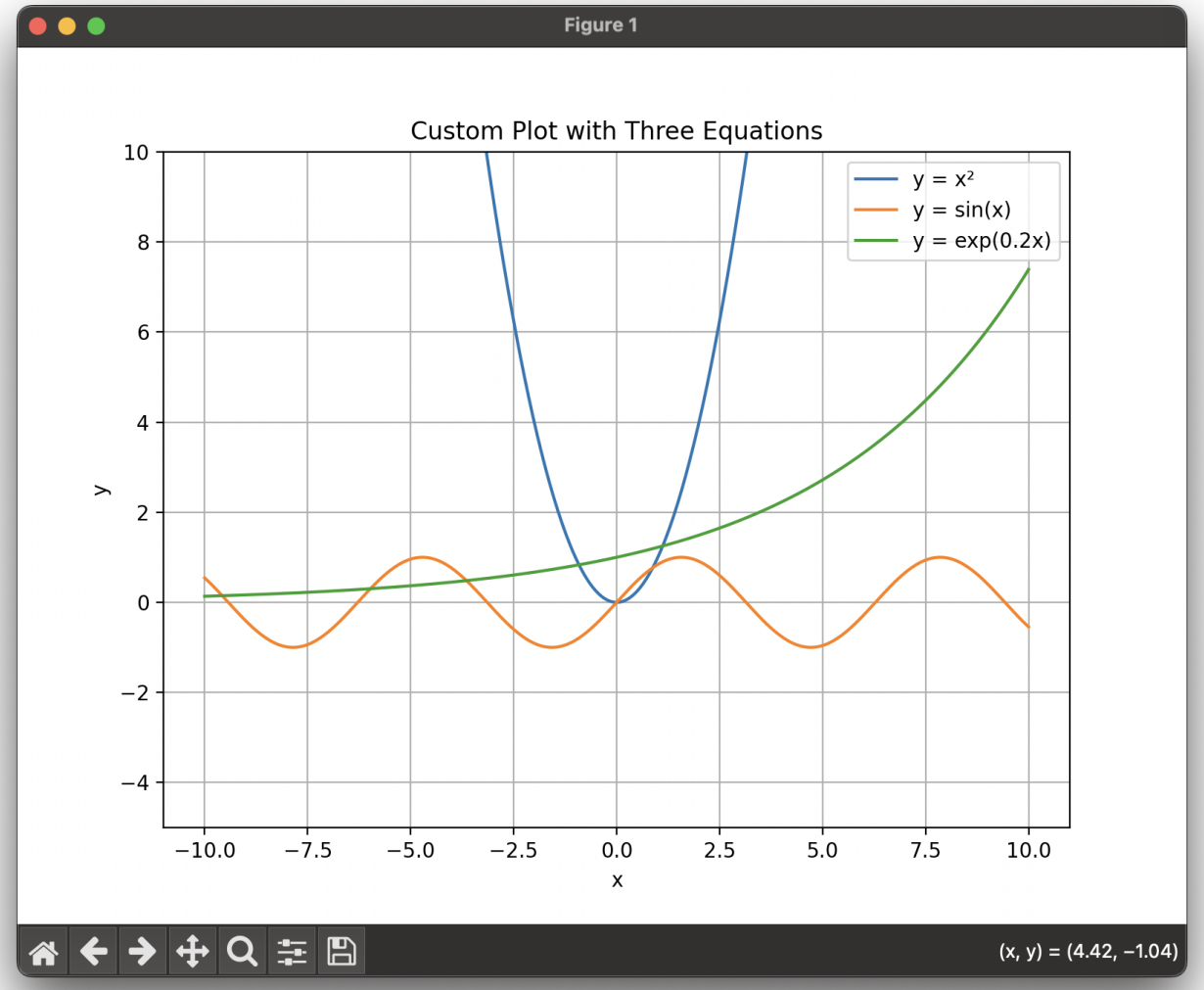
Task 4 – Create your own figure

Paste your code (and figure) below.

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

# Define x range
x = np.linspace(-10, 10, 400)

# Three equations
y1 = x**2  # quadratic
y2 = np.sin(x)  # sine wave
y3 = np.exp(0.2 * x)  # exponential growth

# Plot all three
plt.figure(figsize=(8, 6))
plt.plot(x, y1, label="y = x²")
plt.plot(x, y2, label="y = sin(x)")
plt.plot(x, y3, label="y = exp(0.2x)")
```

```
# Labels, legend, grid
plt.xlabel("x")
plt.ylabel("y")
plt.ylim(-5, 10) # limit y-axis for better visibility
plt.title("Custom Plot with Three Equations")
plt.legend()
plt.grid(True)

plt.show()
```

Your figure:



---

4. Version Control (Git/GitHub)

Task 5 – Paste the Version Control account

- GitHub username: `Dv04`
- GitHub Student Developer Pack status: `Approved`

---

5. IDE + Git Integration

Task 6 – Create a project, commit, and push to GitHub (public)

- IDE used: `VS Code`
- Repo link (public): `https://github.com/Dv04/Coded/tree/main/Rice/Intro_to_DL/Assignment_export/Assignment_0`

Declaration

I declare that the work I am submitting is my own and that I have not copied it from anyone else or from any other source.

AI tools were used for formatting purposes (grammar/layout) with permission from head TA Kesha as seen in Piazza post @12.