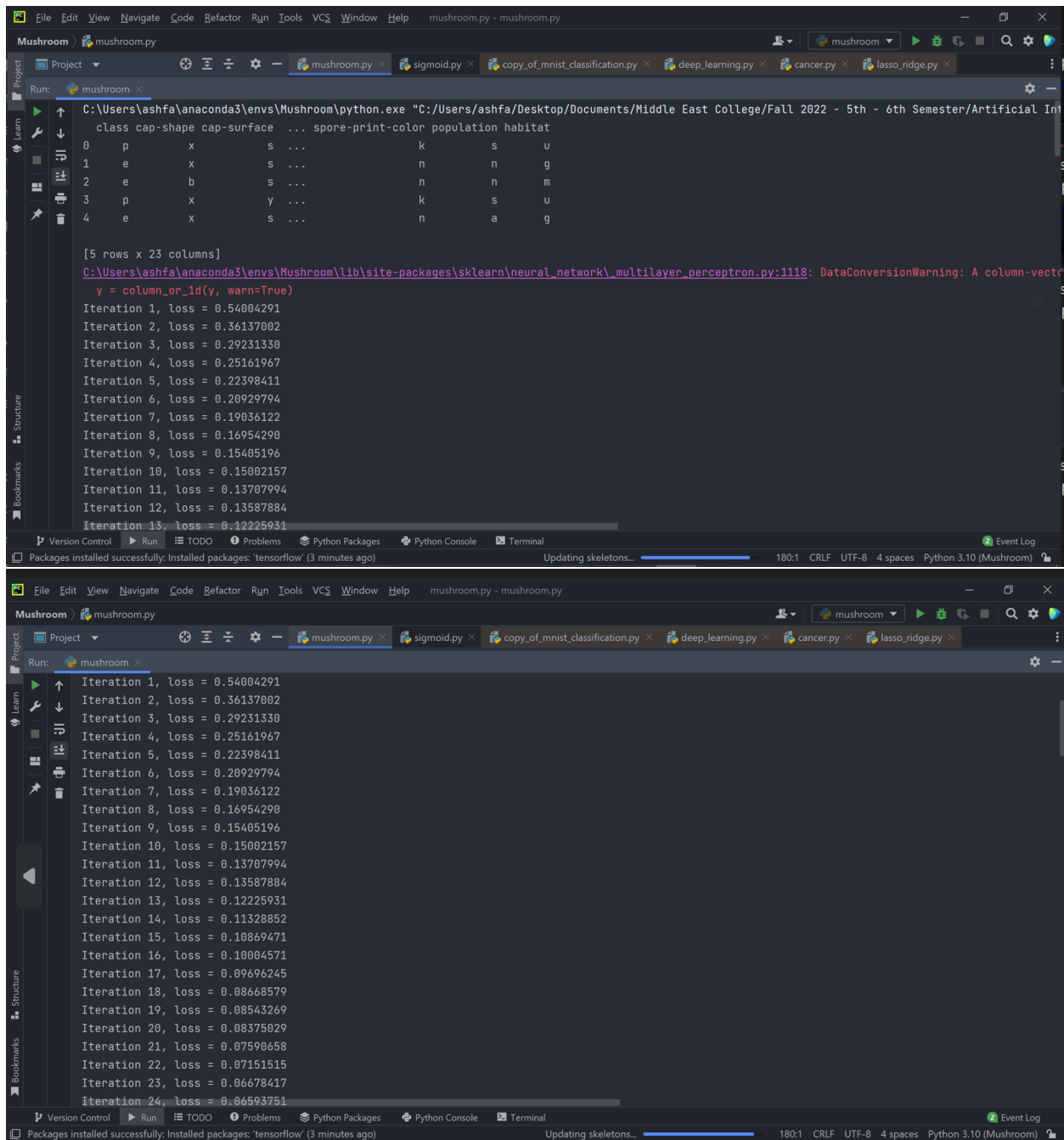


Multilayer Perceptron – Classification Algorithm



```
File Edit View Navigate Code Refactor Run Tools VCS Window Help mushroom.py - mushroom.py
Mushroom mushroom.py
Project
Run:
C:\Users\ashfa\anaconda3\envs\Mushroom\python.exe "C:/Users/ashfa/Desktop/Documents/Middle East College/Fall 2022 - 5th - 6th Semester/Artificial Intelligence"
class cap-shape cap-surface ... spore-print-color population habitat
0 p x s ... k s u
1 e x s ... n n g
2 e b s ... n n m
3 p x y ... k s u
4 e x s ... n a g

[5 rows x 23 columns]
C:\Users\ashfa\anaconda3\envs\Mushroom\lib\site-packages\sklearn\network\_multilayer_perceptron.py:1118: DataConversionWarning: A column-vector y
y = column_or_1d(y, warn=True)
Iteration 1, loss = 0.54004291
Iteration 2, loss = 0.36137002
Iteration 3, loss = 0.29231330
Iteration 4, loss = 0.25161967
Iteration 5, loss = 0.22398411
Iteration 6, loss = 0.20929794
Iteration 7, loss = 0.19036122
Iteration 8, loss = 0.16954290
Iteration 9, loss = 0.15405196
Iteration 10, loss = 0.15002157
Iteration 11, loss = 0.13707994
Iteration 12, loss = 0.13587884
Iteration 13, loss = 0.12225931

Version Control Run TODO Problems Python Packages Python Console Terminal
Packages installed successfully: Installed packages: 'tensorflow' (3 minutes ago) Updating skeletons... 180:1 CRLF UTF-8 4 spaces Python 3.10 (Mushroom) Event Log

File Edit View Navigate Code Refactor Run Tools VCS Window Help mushroom.py - mushroom.py
Mushroom mushroom.py
Project
Run:
Iteration 1, loss = 0.54004291
Iteration 2, loss = 0.36137002
Iteration 3, loss = 0.29231330
Iteration 4, loss = 0.25161967
Iteration 5, loss = 0.22398411
Iteration 6, loss = 0.20929794
Iteration 7, loss = 0.19036122
Iteration 8, loss = 0.16954290
Iteration 9, loss = 0.15405196
Iteration 10, loss = 0.15002157
Iteration 11, loss = 0.13707994
Iteration 12, loss = 0.13587884
Iteration 13, loss = 0.12225931
Iteration 14, loss = 0.11328852
Iteration 15, loss = 0.10869471
Iteration 16, loss = 0.10004571
Iteration 17, loss = 0.09696245
Iteration 18, loss = 0.08668579
Iteration 19, loss = 0.08543269
Iteration 20, loss = 0.08375029
Iteration 21, loss = 0.07590658
Iteration 22, loss = 0.07151515
Iteration 23, loss = 0.06678417
Iteration 24, loss = 0.06593751

Version Control Run TODO Problems Python Packages Python Console Terminal
Packages installed successfully: Installed packages: 'tensorflow' (3 minutes ago) Updating skeletons... 180:1 CRLF UTF-8 4 spaces Python 3.10 (Mushroom) Event Log
```

The screenshot shows an IDE window titled "mushroom.py - mushroom.py". The "Run" console displays the output of a training process, showing the loss value for each iteration from 25 to 48. The loss values are as follows:

Iteration	loss
25	0.06026877
26	0.06272440
27	0.05263031
28	0.04960128
29	0.04504316
30	0.04434038
31	0.04528422
32	0.04492478
33	0.04574880
34	0.04724174
35	0.04007766
36	0.04547707
37	0.04246434
38	0.03782675
39	0.03651486
40	0.03524693
41	0.03524227
42	0.03535663
43	0.03639621
44	0.03435996
45	0.03460049
46	0.03211434
47	0.03299705
48	0.04190155

The IDE interface includes a menu bar (File, Edit, View, Navigate, Code, Refactor, Run, Tools, VCS, Window, Help), a toolbar with icons for running and debugging, and a sidebar with tabs for Project, Run, Learn, Structure, and Bookmarks. The status bar at the bottom indicates "Updating skeletons..." and "180:1 CRLF UTF-8 4 spaces Python 3.10 (Mushroom)".

The screenshot shows the same IDE window, now displaying the output of a training process for iterations 48 to 71. The loss values are as follows:

Iteration	loss
48	0.04199155
49	0.03121357
50	0.03125152
51	0.03294021
52	0.03101024
53	0.03102746
54	0.02923499
55	0.03019946
56	0.02792119
57	0.02673443
58	0.02647920
59	0.03119160
60	0.03188887
61	0.02616771
62	0.02376032
63	0.02443487
64	0.02326678
65	0.02835112
66	0.02737032
67	0.02194089
68	0.02273015
69	0.02136360
70	0.02291819
71	0.02423840

The IDE interface remains the same, with the status bar at the bottom indicating "Updating skeletons..." and "180:1 CRLF UTF-8 4 spaces Python 3.10 (Mushroom)".

```
Iteration 72, loss = 0.02110337
Iteration 73, loss = 0.01986323
Iteration 74, loss = 0.02049275
Iteration 75, loss = 0.02396065
Iteration 76, loss = 0.01910544
Iteration 77, loss = 0.02022286
Iteration 78, loss = 0.01987501
Iteration 79, loss = 0.01815289
Iteration 80, loss = 0.03275469
Iteration 81, loss = 0.01984877
Iteration 82, loss = 0.01766507
Iteration 83, loss = 0.01793634
Iteration 84, loss = 0.01832156
Iteration 85, loss = 0.01495861
Iteration 86, loss = 0.01678819
Iteration 87, loss = 0.01736159
Iteration 88, loss = 0.01453534
Iteration 89, loss = 0.01574545
Iteration 90, loss = 0.01812544
Iteration 91, loss = 0.01578334
Iteration 92, loss = 0.01410211
Iteration 93, loss = 0.01605876
Iteration 94, loss = 0.02079684
Iteration 95, loss = 0.01453175
```

Version Control Run TODO Problems Python Packages Python Console Terminal

Packages installed successfully: Installed packages: 'tensorflow' (3 minutes ago) Updating skeletons... 180:1 CRLF UTF-8 4 spaces Python 3.10 (Mushroom)

```
Iteration 95, loss = 0.01453175
Iteration 96, loss = 0.01425190
Iteration 97, loss = 0.01446618
Iteration 98, loss = 0.01286990
Iteration 99, loss = 0.01359185
Iteration 100, loss = 0.01668006
Iteration 101, loss = 0.01456214
Iteration 102, loss = 0.01849545
Iteration 103, loss = 0.01254604
Iteration 104, loss = 0.01211195
Iteration 105, loss = 0.01149954
Iteration 106, loss = 0.01130688
Iteration 107, loss = 0.01660580
Iteration 108, loss = 0.01140737
Iteration 109, loss = 0.01478469
Iteration 110, loss = 0.01328236
Iteration 111, loss = 0.01362303
Iteration 112, loss = 0.01108737
Iteration 113, loss = 0.01320183
Iteration 114, loss = 0.01014711
Iteration 115, loss = 0.01227838
Iteration 116, loss = 0.01893502
Iteration 117, loss = 0.01314316
Iteration 118, loss = 0.01272628
```

Version Control Run TODO Problems Python Packages Python Console Terminal

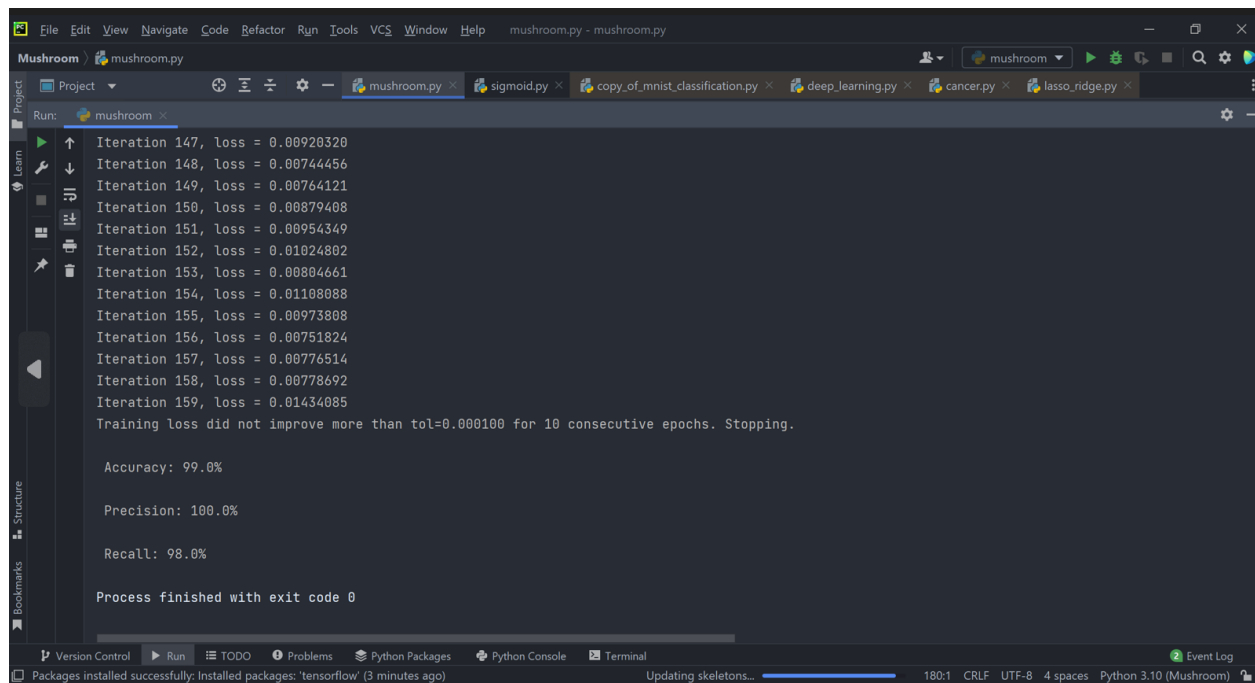
Packages installed successfully: Installed packages: 'tensorflow' (3 minutes ago) Updating skeletons... 180:1 CRLF UTF-8 4 spaces Python 3.10 (Mushroom)

This screenshot shows an IDE window titled 'mushroom.py - mushroom.py'. The 'Run' console displays a series of training iterations from 119 to 142, each with a corresponding loss value. The loss values generally decrease as iterations progress, with a slight increase at iteration 142. The IDE interface includes a menu bar (File, Edit, View, Navigate, Code, Refactor, Run, Tools, VCS, Window, Help), a toolbar with icons for project, run, and search, and a sidebar with 'Project', 'Learn', and 'Structure' views. The status bar at the bottom indicates 'Packages installed successfully: Installed packages: 'tensorflow' (3 minutes ago)' and 'Updating skeletons...'. The bottom right corner shows '180:1 CRLF UTF-8 4 spaces Python 3.10 (Mushroom)'.

```
Iteration 119, loss = 0.01225314
Iteration 120, loss = 0.01134943
Iteration 121, loss = 0.01026959
Iteration 122, loss = 0.01003864
Iteration 123, loss = 0.01061535
Iteration 124, loss = 0.00885365
Iteration 125, loss = 0.01017369
Iteration 126, loss = 0.01426894
Iteration 127, loss = 0.01069769
Iteration 128, loss = 0.00868495
Iteration 129, loss = 0.00900750
Iteration 130, loss = 0.00921149
Iteration 131, loss = 0.00969509
Iteration 132, loss = 0.01025742
Iteration 133, loss = 0.00861083
Iteration 134, loss = 0.00985414
Iteration 135, loss = 0.00834472
Iteration 136, loss = 0.00970792
Iteration 137, loss = 0.01021152
Iteration 138, loss = 0.00995830
Iteration 139, loss = 0.00966329
Iteration 140, loss = 0.00811108
Iteration 141, loss = 0.00843837
Iteration 142, loss = 0.00811047
```

This screenshot is identical to the one above, showing the same training log for 'mushroom.py' in the IDE. The 'Run' console displays iterations 119 through 142 with their respective loss values. The IDE interface, including the menu bar, toolbar, sidebar, and status bar, is also identical to the first screenshot.

```
Iteration 119, loss = 0.01225314
Iteration 120, loss = 0.01134943
Iteration 121, loss = 0.01026959
Iteration 122, loss = 0.01003864
Iteration 123, loss = 0.01061535
Iteration 124, loss = 0.00885365
Iteration 125, loss = 0.01017369
Iteration 126, loss = 0.01426894
Iteration 127, loss = 0.01069769
Iteration 128, loss = 0.00868495
Iteration 129, loss = 0.00900750
Iteration 130, loss = 0.00921149
Iteration 131, loss = 0.00969509
Iteration 132, loss = 0.01025742
Iteration 133, loss = 0.00861083
Iteration 134, loss = 0.00985414
Iteration 135, loss = 0.00834472
Iteration 136, loss = 0.00970792
Iteration 137, loss = 0.01021152
Iteration 138, loss = 0.00995830
Iteration 139, loss = 0.00966329
Iteration 140, loss = 0.00811108
Iteration 141, loss = 0.00843837
Iteration 142, loss = 0.00811047
```



```
File Edit View Navigate Code Refactor Run Tools VCS Window Help mushroom.py - mushroom.py
Mushroom mushroom.py
Project Project
Run: mushroom
Iteration 147, loss = 0.00920320
Iteration 148, loss = 0.00744456
Iteration 149, loss = 0.00764121
Iteration 150, loss = 0.00879408
Iteration 151, loss = 0.00954349
Iteration 152, loss = 0.01024802
Iteration 153, loss = 0.00804661
Iteration 154, loss = 0.01108088
Iteration 155, loss = 0.00973808
Iteration 156, loss = 0.00751824
Iteration 157, loss = 0.00776514
Iteration 158, loss = 0.00778692
Iteration 159, loss = 0.01434085
Training loss did not improve more than tol=0.000100 for 10 consecutive epochs. Stopping.

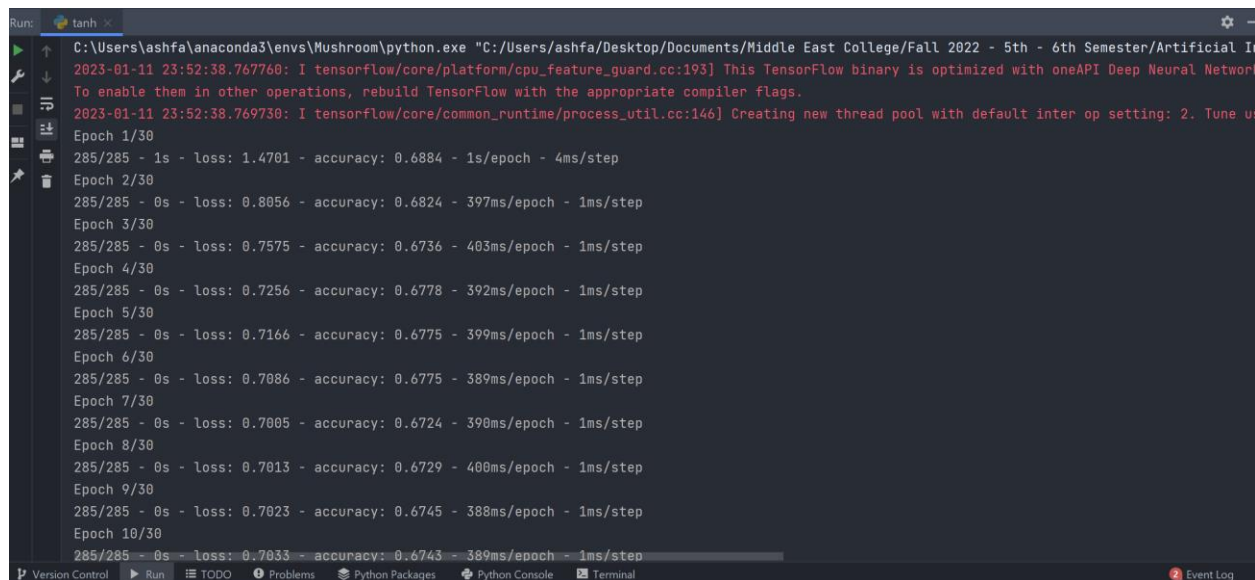
Accuracy: 99.0%

Precision: 100.0%

Recall: 98.0%

Process finished with exit code 0
Version Control Run TODO Problems Python Packages Python Console Terminal
Packages installed successfully: Installed packages: 'tensorflow' (3 minutes ago) Updating skeletons... 180:1 CRLF UTF-8 4 spaces Python 3.10 (Mushroom) Event Log
```

Tanh Function



```
Run: tanh
C:\Users\ashfa\anaconda3\envs\Mushroom\python.exe "C:/Users/ashfa/Desktop/Documents/Middle East College/Fall 2022 - 5th - 6th Semester/Artificial In
2023-01-11 23:52:38.767760: I tensorflow/core/platform/cpu_feature_guard.cc:193] This TensorFlow binary is optimized with oneAPI Deep Neural Network
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
2023-01-11 23:52:38.769730: I tensorflow/core/common_runtime/process_util.cc:146] Creating new thread pool with default inter op setting: 2. Tune us
Epoch 1/30
285/285 - 1s - loss: 1.4701 - accuracy: 0.6884 - 1s/epoch - 4ms/step
Epoch 2/30
285/285 - 0s - loss: 0.8056 - accuracy: 0.6824 - 397ms/epoch - 1ms/step
Epoch 3/30
285/285 - 0s - loss: 0.7575 - accuracy: 0.6736 - 403ms/epoch - 1ms/step
Epoch 4/30
285/285 - 0s - loss: 0.7256 - accuracy: 0.6778 - 392ms/epoch - 1ms/step
Epoch 5/30
285/285 - 0s - loss: 0.7166 - accuracy: 0.6775 - 399ms/epoch - 1ms/step
Epoch 6/30
285/285 - 0s - loss: 0.7086 - accuracy: 0.6775 - 389ms/epoch - 1ms/step
Epoch 7/30
285/285 - 0s - loss: 0.7005 - accuracy: 0.6724 - 390ms/epoch - 1ms/step
Epoch 8/30
285/285 - 0s - loss: 0.7013 - accuracy: 0.6729 - 400ms/epoch - 1ms/step
Epoch 9/30
285/285 - 0s - loss: 0.7023 - accuracy: 0.6745 - 388ms/epoch - 1ms/step
Epoch 10/30
285/285 - 0s - loss: 0.7033 - accuracy: 0.6743 - 389ms/epoch - 1ms/step
Version Control Run TODO Problems Python Packages Python Console Terminal Event Log
```

```
Run: tanh
Epoch 11/30
285/285 - 0s - loss: 0.7082 - accuracy: 0.6817 - 392ms/epoch - 1ms/step
Epoch 12/30
285/285 - 0s - loss: 0.7084 - accuracy: 0.6815 - 389ms/epoch - 1ms/step
Epoch 13/30
285/285 - 0s - loss: 0.7085 - accuracy: 0.6808 - 394ms/epoch - 1ms/step
Epoch 14/30
285/285 - 0s - loss: 0.7087 - accuracy: 0.6794 - 392ms/epoch - 1ms/step
Epoch 15/30
285/285 - 0s - loss: 0.7089 - accuracy: 0.6789 - 393ms/epoch - 1ms/step
Epoch 16/30
285/285 - 0s - loss: 0.7096 - accuracy: 0.6783 - 393ms/epoch - 1ms/step
Epoch 17/30
285/285 - 0s - loss: 0.7100 - accuracy: 0.6769 - 388ms/epoch - 1ms/step
Epoch 18/30
285/285 - 0s - loss: 0.7110 - accuracy: 0.6759 - 391ms/epoch - 1ms/step
Epoch 19/30
285/285 - 0s - loss: 0.7115 - accuracy: 0.6741 - 392ms/epoch - 1ms/step
Epoch 20/30
285/285 - 0s - loss: 0.7121 - accuracy: 0.6709 - 389ms/epoch - 1ms/step
Epoch 21/30
285/285 - 0s - loss: 0.7131 - accuracy: 0.6658 - 405ms/epoch - 1ms/step
Epoch 22/30
285/285 - 0s - loss: 0.7116 - accuracy: 0.6623 - 391ms/epoch - 1ms/step
Installing packages failed: Installing packages: error occurred. Details... (today 18:12)
```

```
Run: tanh
285/285 - 0s - loss: 0.7116 - accuracy: 0.6623 - 391ms/epoch - 1ms/step
Epoch 23/30
285/285 - 0s - loss: 0.7118 - accuracy: 0.6555 - 389ms/epoch - 1ms/step
Epoch 24/30
285/285 - 0s - loss: 0.7119 - accuracy: 0.6498 - 392ms/epoch - 1ms/step
Epoch 25/30
285/285 - 0s - loss: 0.6806 - accuracy: 0.6206 - 385ms/epoch - 1ms/step
Epoch 26/30
285/285 - 0s - loss: 0.6397 - accuracy: 0.5978 - 387ms/epoch - 1ms/step
Epoch 27/30
285/285 - 0s - loss: 0.6495 - accuracy: 0.6029 - 391ms/epoch - 1ms/step
Epoch 28/30
285/285 - 0s - loss: 0.6691 - accuracy: 0.6191 - 392ms/epoch - 1ms/step
Epoch 29/30
285/285 - 0s - loss: 0.6691 - accuracy: 0.6191 - 390ms/epoch - 1ms/step
Epoch 30/30
285/285 - 0s - loss: 0.6691 - accuracy: 0.6191 - 395ms/epoch - 1ms/step
178/178 [=====] - 1s 2ms/step - loss: 0.6691 - accuracy: 0.6191
Test loss with tanh activation: 66.91317558288574%
Test accuracy with tanh activation: 61.90643906593323%

Process finished with exit code 0
```

Sigmoid Function

```
Run: sigmoid x
C:\Users\ashfa\anaconda3\envs\Mushroom\python.exe "C:/Users/ashfa/Desktop/Documents/Middle East College/Fall 2022 - 5th - 6th Semester/Artificial Intelligence/2023-01-11 23:54:31.265717: I tensorflow/core/platform/cpu_feature_guard.cc:193] This TensorFlow binary is optimized with oneAPI Deep Neural Network To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
2023-01-11 23:54:31.267192: I tensorflow/core/common_runtime/process_util.cc:146] Creating new thread pool with default inter op setting: 2. Tune us
Epoch 1/30
285/285 - 1s - loss: 1.0747 - accuracy: 0.5770 - 1s/epoch - 4ms/step
Epoch 2/30
285/285 - 0s - loss: 0.6027 - accuracy: 0.7023 - 407ms/epoch - 1ms/step
Epoch 3/30
285/285 - 0s - loss: 0.5329 - accuracy: 0.7700 - 382ms/epoch - 1ms/step
Epoch 4/30
285/285 - 0s - loss: 0.4887 - accuracy: 0.7919 - 400ms/epoch - 1ms/step
Epoch 5/30
285/285 - 0s - loss: 0.4441 - accuracy: 0.8159 - 380ms/epoch - 1ms/step
Epoch 6/30
285/285 - 0s - loss: 0.4143 - accuracy: 0.8291 - 375ms/epoch - 1ms/step
Epoch 7/30
285/285 - 0s - loss: 0.3903 - accuracy: 0.8386 - 387ms/epoch - 1ms/step
Epoch 8/30
285/285 - 0s - loss: 0.3708 - accuracy: 0.8489 - 375ms/epoch - 1ms/step
Epoch 9/30
285/285 - 0s - loss: 0.3531 - accuracy: 0.8575 - 376ms/epoch - 1ms/step
Epoch 10/30
285/285 - 0s - loss: 0.3368 - accuracy: 0.8656 - 457ms/epoch - 2ms/step
Version Control Run TODO Problems Python Packages Python Console Terminal
Installing packages failed: Installing packages: error occurred. Details... (today 18:12) 1:1 (32 chars) CRLF UTF-8 4 spaces Python 3.10 (Mushroom) Event Log
```

```
Project Run: sigmoid x sigmoid.py tanh.py mushroom.py
Epoch 11/30
285/285 - 0s - loss: 0.3230 - accuracy: 0.8713 - 378ms/epoch - 1ms/step
Epoch 12/30
285/285 - 0s - loss: 0.3101 - accuracy: 0.8790 - 378ms/epoch - 1ms/step
Epoch 13/30
285/285 - 0s - loss: 0.2987 - accuracy: 0.8852 - 390ms/epoch - 1ms/step
Epoch 14/30
285/285 - 0s - loss: 0.2879 - accuracy: 0.8887 - 376ms/epoch - 1ms/step
Epoch 15/30
285/285 - 0s - loss: 0.2783 - accuracy: 0.8920 - 378ms/epoch - 1ms/step
Epoch 16/30
285/285 - 0s - loss: 0.2695 - accuracy: 0.8985 - 387ms/epoch - 1ms/step
Epoch 17/30
285/285 - 0s - loss: 0.2612 - accuracy: 0.8994 - 369ms/epoch - 1ms/step
Epoch 18/30
285/285 - 0s - loss: 0.2532 - accuracy: 0.9006 - 426ms/epoch - 1ms/step
Epoch 19/30
285/285 - 0s - loss: 0.2460 - accuracy: 0.9010 - 397ms/epoch - 1ms/step
Epoch 20/30
285/285 - 0s - loss: 0.2395 - accuracy: 0.9026 - 376ms/epoch - 1ms/step
Epoch 21/30
285/285 - 0s - loss: 0.2329 - accuracy: 0.9043 - 375ms/epoch - 1ms/step
Epoch 22/30
285/285 - 0s - loss: 0.2273 - accuracy: 0.9061 - 378ms/epoch - 1ms/step
Version Control Run TODO Problems Python Packages Python Console Terminal
Installing packages failed: Installing packages: error occurred. Details... (today 18:12) 1:1 (32 chars) CRLF UTF-8 4 spaces Python 3.10 (Mushroom) Event Log
```

```
Run: sigmoid x
285/285 - 0s - loss: 0.2273 - accuracy: 0.9061 - 378ms/epoch - 1ms/step
Epoch 23/30
285/285 - 0s - loss: 0.2217 - accuracy: 0.9101 - 370ms/epoch - 1ms/step
Epoch 24/30
285/285 - 0s - loss: 0.2160 - accuracy: 0.9149 - 374ms/epoch - 1ms/step
Epoch 25/30
285/285 - 0s - loss: 0.2120 - accuracy: 0.9138 - 385ms/epoch - 1ms/step
Epoch 26/30
285/285 - 0s - loss: 0.2076 - accuracy: 0.9195 - 375ms/epoch - 1ms/step
Epoch 27/30
285/285 - 0s - loss: 0.2030 - accuracy: 0.9200 - 455ms/epoch - 2ms/step
Epoch 28/30
285/285 - 0s - loss: 0.1987 - accuracy: 0.9233 - 379ms/epoch - 1ms/step
Epoch 29/30
285/285 - 0s - loss: 0.1952 - accuracy: 0.9238 - 375ms/epoch - 1ms/step
Epoch 30/30
285/285 - 0s - loss: 0.1916 - accuracy: 0.9267 - 382ms/epoch - 1ms/step
178/178 [=====] - 0s 1ms/step - loss: 0.1892 - accuracy: 0.9249
Test loss with sigmoid activation: 18.921099603176117%
Test accuracy with sigmoid activation: 92.49032735824585%

Process finished with exit code 0
```

Version Control Run TODO Problems Python Packages Python Console Terminal Event Log

Installing packages failed: Installing packages: error occurred. Details... (today 18:12) 1:1 (32 chars) CRLF UTF-8 4 spaces Python 3.10 (Mushroom)