

```
from google.colab import drive
drive.mount('/content/drive')
```

Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).

```
pip install accelerate -U
```

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Requirement already satisfied: accelerate in /usr/local/lib/python3.10/dist-packages (0.31.0)
Requirement already satisfied: numpy>=1.17 in /usr/local/lib/python3.10/dist-packages (from accelerate) (1.25.2)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from accelerate) (24.1)
Requirement already satisfied: psutil in /usr/local/lib/python3.10/dist-packages (from accelerate) (5.9.5)
Requirement already satisfied: pyyaml in /usr/local/lib/python3.10/dist-packages (from accelerate) (6.0.1)
Requirement already satisfied: torch>=1.10.0 in /usr/local/lib/python3.10/dist-packages (from accelerate) (2.3.1)
Requirement already satisfied: huggingface-hub in /usr/local/lib/python3.10/dist-packages (from accelerate) (0.23.4)
Requirement already satisfied: safetensors>=0.3.1 in /usr/local/lib/python3.10/dist-packages (from accelerate) (0.4.3)
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-packages (from torch>=1.10.0->accelerate) (3.15.4)
Requirement already satisfied: typing-extensions>=4.8.0 in /usr/local/lib/python3.10/dist-packages (from torch>=1.10.0->accelerate) (4.12.2)
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Requirement already satisfied: networkx in /usr/local/lib/python3.10/dist-packages (from torch>=1.10.0->accelerate) (3.3)
Requirement already satisfied: Jinja2 in /usr/local/lib/python3.10/dist-packages (from torch>=1.10.0->accelerate) (3.1.4)
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Requirement already satisfied: nvidia-cuda-nvrtc-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch>=1.10.0->accelerate) (12.1.105)
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Requirement already satisfied: nvidia-nccl-cu12==2.20.5 in /usr/local/lib/python3.10/dist-packages (from torch>=1.10.0->accelerate) (2.20.5)
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Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/dist-packages (from Jinja2->torch) (2.1.5)
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Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests->huggingface-hub->accelerate) (2023.7.22)
Requirement already satisfied: mpmath<1.4.0,>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from sympy->torch>=1.10.0->accelerate) (1.3.0)
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!pip install torch -U
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Requirement already satisfied: torch in /usr/local/lib/python3.10/dist-packages (2.3.1)
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Requirement already satisfied: mpmath<1.4.0,>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from sympy->torch) (1.3.0)
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```
!pip install transformers[torch] -U
```

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Requirement already satisfied: transformers[torch] in /usr/local/lib/python3.10/dist-packages (4.41.2)
Collecting transformers[torch]
  Using cached transformers-4.42.3-py3-none-any.whl (9.3 MB)
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-packages (from transformers[torch]) (3.15.4)
Requirement already satisfied: huggingface-hub<1.0,>=0.23.2 in /usr/local/lib/python3.10/dist-packages (from transformers[torch]) (0.23.4)
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Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from transformers[torch]) (24.1)
Requirement already satisfied: pyyaml>=5.1 in /usr/local/lib/python3.10/dist-packages (from transformers[torch]) (6.0.1)
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Requirement already satisfied: regex!=2019.12.17 in /usr/local/lib/python3.10/dist-packages (from transformers[torch]) (2024.5.15)
Requirement already satisfied: requests in /usr/local/lib/python3.10/dist-packages (from transformers[torch]) (2.31.0)
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Requirement already satisfied: nvidia-cusparse-cu12==12.1.0.106 in /usr/local/lib/python3.10/dist-packages (from torch->transformers[torch]) (12.1.0.106)
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Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/dist-packages (from Jinja2->torch->transformers[torch]) (2.1.5)
Requirement already satisfied: mpmath<1.4.0,>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from sympy->torch->transformers[torch]) (1.3.0)
Installing collected packages: transformers
  Attempting uninstall: transformers
    Found existing installation: transformers 4.41.2
    Uninstalling transformers-4.41.2:
      Successfully uninstalled transformers-4.41.2
  Successfully installed transformers-4.42.3

```

```

import pandas as pd
import numpy as np
import torch
from transformers import AutoTokenizer, AutoModelForSequenceClassification, Trainer, TrainingArguments
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score
from sklearn.preprocessing import LabelEncoder

# Load and preprocess the data
data = pd.read_csv('/content/drive/MyDrive/Naive/training_data (2).csv')

# Check the column names
print(data.columns)

# Combine symptom columns into a single text column
data['text'] = data[['Symptom_1', 'Symptom_2', 'Symptom_3']].apply(lambda x: ' '.join(x.dropna().astype(str)), axis=1)

# Encode the labels to integers
label_encoder = LabelEncoder()
data['label'] = label_encoder.fit_transform(data['Disease'])

# Extract features and labels
X = data['text'].tolist()
y = data['label'].tolist()

# Split the data into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Load BioBERT tokenizer and model
tokenizer = AutoTokenizer.from_pretrained("dmis-lab/biobert-base-cased-v1.1")
model = AutoModelForSequenceClassification.from_pretrained("dmis-lab/biobert-base-cased-v1.1", num_labels=len(set(y)))

# Tokenize the data
train_encodings = tokenizer(X_train, truncation=True, padding=True, max_length=512)
test_encodings = tokenizer(X_test, truncation=True, padding=True, max_length=512)

# Convert to torch Dataset
class Dataset(torch.utils.data.Dataset):
    def __init__(self, encodings, labels):
        self.encodings = encodings

```

```

        self.labels = labels

    def __getitem__(self, idx):
        item = {key: torch.tensor(val[idx]) for key, val in self.encodings.items()}
        item['labels'] = torch.tensor(self.labels[idx])
        return item

    def __len__(self):
        return len(self.labels)

train_dataset = Dataset(train_encodings, y_train)
test_dataset = Dataset(test_encodings, y_test)

# Define training arguments
training_args = TrainingArguments(
    output_dir='./results',          # output directory
    num_train_epochs=3,              # number of training epochs
    per_device_train_batch_size=8,   # batch size for training
    per_device_eval_batch_size=8,    # batch size for evaluation
    warmup_steps=500,                # number of warmup steps for learning rate scheduler
    weight_decay=0.01,               # strength of weight decay
    logging_dir='./logs',            # directory for storing logs
    logging_steps=10,
)

# Define the Trainer
trainer = Trainer(
    model=model,                      # the instantiated PyTorch Transformers model to be trained
    args=training_args,               # training arguments, defined above
    train_dataset=train_dataset,      # training dataset
    eval_dataset=test_dataset         # evaluation dataset
)

# Train the model
trainer.train()

# Evaluate the model
preds_output = trainer.predict(test_dataset)
preds = np.argmax(preds_output.predictions, axis=1)
accuracy = accuracy_score(y_test, preds)
precision = precision_score(y_test, preds, average='weighted')
recall = recall_score(y_test, preds, average='weighted')
f1 = f1_score(y_test, preds, average='weighted')

print(f'Accuracy: {accuracy}')
print(f'Precision: {precision}')
print(f'Recall: {recall}')
print(f'F1 Score: {f1}')

```

```
Index(['Disease', 'Symptom_1', 'Symptom_2', 'Symptom_3'], dtype='object')
Some weights of BertForSequenceClassification were not initialized from the model checkp
You should probably TRAIN this model on a down-stream task to be able to use it for prec
```

[1476/1476 1:07:38, Epoch 3/3]

Step Training Loss

10	3.808600
20	3.713200
30	3.695500
40	3.717400
50	3.671900
60	3.663800
70	3.619800
80	3.646000
90	3.575000
100	3.518300
110	3.467000
120	3.433600
130	3.313800
140	3.211600
150	3.221900
160	3.147200
170	2.965100
180	2.834800
190	2.870000
200	2.719600
210	2.579800
220	2.512300
230	2.388800
240	2.278400
250	2.130500
260	2.125800
270	2.077000
280	1.823200
290	1.749600
300	1.588200
310	1.574800
320	1.395000
330	1.251200
340	1.274100
350	1.065500
360	1.001300
370	0.935200
380	0.829100
390	0.789700
400	0.876500
410	0.651300
420	0.674500
430	0.575700

440	0.502500
450	0.538400
460	0.539300
470	0.497600
480	0.358000
490	0.348600
500	0.422800
510	0.342000
520	0.280900
530	0.191700
540	0.211800
550	0.229300
560	0.394300
570	0.242300
580	0.134600
590	0.100000
600	0.206800
610	0.155600
620	0.167700
630	0.163000
640	0.143400
650	0.123100
660	0.237600
670	0.262800
680	0.154800
690	0.108700
700	0.054900
710	0.190900
720	0.132900
730	0.048100
740	0.273200
750	0.167800
760	0.094000
770	0.300900
780	0.149300
790	0.149700
800	0.105100
810	0.137300
820	0.141000
830	0.239400
840	0.129300
850	0.130300
860	0.115700
870	0.210200
880	0.195500
890	0.277600
900	0.309100

910	0.075200
920	0.291300
930	0.216300
940	0.071300
950	0.085900
960	0.114000
970	0.106100
980	0.197100
990	0.063800
1000	0.132300
1010	0.097800
1020	0.079100
1030	0.106800
1040	0.103500
1050	0.159400
1060	0.109800
1070	0.182400
1080	0.074300
1090	0.086600
1100	0.146100
1110	0.196800
1120	0.132600
1130	0.095700
1140	0.102100
1150	0.280100
1160	0.070800
1170	0.052300
1180	0.111700
1190	0.080300
1200	0.048600
1210	0.052700
1220	0.068500
1230	0.138900
1240	0.062100
1250	0.127100
1260	0.113100
1270	0.268800
1280	0.172400
1290	0.066800
1300	0.072000
1310	0.139100
1320	0.120700
1330	0.089300
1340	0.155300
1350	0.132700
1360	0.126000
1370	0.083000

7/3/24, 3:39 PM

BioBERT_Naive_Bayes_Code_final.ipynb - Colab


1380	0.156400
1390	0.325500
1400	0.080600
1410	0.145700
1420	0.142900
1430	0.126700
1440	0.100900
1450	0.166700
1460	0.061800
1470	0.141500

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 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

```
import matplotlib.pyplot as plt


# Extract training loss from log_history
train_losses = [item['loss'] for item in trainer.state.log_history]

# Plot eval F1 score
plt.figure()
plt.plot(trainer_state['eval_f1s'], label='Eval F1 Score')
plt.xlabel('Epoch')
plt.ylabel('F1 Score')
plt.title('Evaluation F1 Score')
plt.legend()
plt.show()

 Show hidden output

nlt.figure(figsize=(10, 5))

# Plot the training loss
plt.figure(figsize=(10, 5))
# Extract loss values from log_history
loss_values = [entry['loss'] for entry in trainer.state.log_history if 'loss' in entry]
plt.plot(loss_values, label='Training Loss')
plt.xlabel('Steps')
plt.ylabel('Loss')
plt.title('Training Loss')
plt.legend()
plt.show()
```

```
 Show hidden output

n_classes = len(list(data.Disease.unique()))
n_classes

41

plt.subplot(2, 2, 3)

def get_model_metrics():
    model = GaussianNB()
    model.fit(X_train, y_train)

    # Make predictions on the test set
    y_pred = model.predict(X_test)

    # Calculate precision, recall, and F1 score
    precision = precision_score(y_test, y_pred, average='weighted')
    recall = recall_score(y_test, y_pred, average='weighted')
    f1 = f1_score(y_test, y_pred, average='weighted')

    accuracy = accuracy_score(y_test, y_pred)
```