

Health Language Processing Summer Internship 2020

Perelman School of Medicine - University of Pennsylvania

Team: MTL

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Projects Assigned

Explore Related Work and Create/Reproduce Baselines for 2 shared tasks as part of the **WNUT-2020*** workshop at EMNLP** Conference:

- **WNUT-Task2: Identification of informative COVID-19 English Tweets**
- **WNUT-Task3: Extracting COVID-19 Events from Twitter**

***2020 The 6th Workshop on Noisy User-generated Text (W-NUT)**

****The 2020 Conference on Empirical Methods in Natural Language Processing, *16th – 20th November 2020***

WNUT-Task2

Identification of informative COVID-19 English Tweets

✓ Task objective:

automatically identify* a COVID-19 English Tweet as **informative**** or not.

* ***Binary Classification** problem*

** *information about recovered, suspected, confirmed and death cases; location or travel history of the cases.*

✓ Data Set:

- 10K COVID English Tweets
- 4719 Tweets INFORMATIVE; 5281 Tweets UNINFORMATIVE
- annotated by 3 independent annotators; inter-annotator agreement: Fleiss Kappa at 0.818.
- 70:10:20 split for train: validation: test sets.

WNUT-Task2 (contd.)

✓ Models Trained and Results:

Model	Accuracy (both)	F1 (informative)	Comments
Logistic Regression	0.83	0.82	F1 for informative: 0.82 ; uninformative: 0.85
Convolutional Neural Network	0.86	0.85	1 layered convolutional neural network
Word Embedding	0.82	0.81	2 layered word embedding
Fully Connected Neural Network	0.82	0.79	1 layered FC NN
BERT base-uncased	0.9	0.9	pre-trained with uncased BERT
BERT (DistilBERT)	0.94	0.95	pre-trained with DistilBERT uncased

WNUT-Task2 (contd.)

✓ Models Trained and Results:

Model	Accuracy (both)	F1 (informative)	Comments
Multi-Task BERT base-uncased [auxiliary task: relevant, non-relevant. External dataset]	0.92	0.923	pre-trained with base-uncased BERT

WNUT-Task2 (contd.)

✓ **Leaderboard Rank:**

- Ranked according to the F1 score of submissions
- Top 10

WNUT-Task3

Extracting COVID-19 Events from Twitter

✓ Task objective:

automatically extracting* **COVID-19 related events**** from self-reported Twitter cases

**Slot-filling Task as Binary Classification problem* :

given the tweet t and the candidate slot s , the classification model $f(t, s) \rightarrow \{0, 1\}$ predicts whether s answers its designated question

** *5 events: tested positive, tested negative, can not test, death and cure and prevention.*

✓ Data Set:

- data since 01/15/2020 by tracking keywords using Twitter API
- 7,500 tweets annotated; 2-step: specific-events if answered yes -> slot filling
- 7 Amazon Mechanical Turk annotators
- 60:15:25 for train : validation: test sets

WNUT-Task3 (contd.)

- ✓ Slot filling questions used for annotation:

Event Type	Slot Abbr.	Slot Filling Questions
TESTED POSITIVE — TESTED NEGATIVE	who c. contact relation employer recent v. when / where age / gender duration	Who is tested positive (negative)? Who is in close contact with the person tested positive (negative)? Does the infected person have a relationship with the author of the tweet? Who is the employer of the people tested positive? Where did the people tested positive recently visit? {When, Where} is tested positive (negative) cases reported? What is the {age, gender} of the people tested positive (negative)? How long does it take to get to know the test results?
CAN NOT TEST	who relation when / where symptoms	Who can not get a test? Does the untested person have a relationship with the author of the tweet? {When, Where} is can't-be-tested situation reported? Is the untested person currently experiencing any COVID-19 related symptoms?
DEATH	who relation when / where age symptoms	Who is dead for coronavirus? Does the deceased person have a relationship with the author of the tweet? {When, Where} is the dead case reported? What is the age of the people who is dead of COVID-19? Did the person who was dead experience COVID-19 related symptoms?
CURE & PREVENTION	opinion what who	Does the author of tweet believe the cure method is effective? What is the cure for coronavirus mentioned by the author of the tweet? Who is promoting the cure for coronavirus?

WNUT-Task3 (contd.)

Classifier	Description/Hyper-parameters	F1*
Logistic Regression	<ul style="list-style-type: none">✓ baseline, using n-gram ($n = 1, 2, 3$) features;✓ slot s in the tweet t replaced <TARGET> before computing the n-grams.	0.223
Multi-task BERT model <ul style="list-style-type: none">✓ jointly train final softmax layers of all the sub-tasks in an event by sharing their BERT parameters✓ HuggingFace PyTorch implementation	i. MTBERT base-cased model <ul style="list-style-type: none">✓ 12-layer, 768-hidden, 12-heads, 110M parameters✓ Pre-trained on cased English text✓ Hyper-parameters: 2×10^{-5} learning rate, Adam optimizer, 8 epochs, 32 batches	0.515

**Average F1 over all sub-tasks and tasks*

WNUT-Task3 (contd.)

Classifier	Description/Hyper-parameters	F1 *
Multi-task BERT model ✓ jointly train final softmax layers of all the sub-tasks in an event by sharing their BERT parameters ✓ HuggingFace PyTorch implementation	i. MTBERT base-cased model ✓ Hyper-parameters: 2×10^{-5} learning rate, Adam optimizer, 12 epochs, 64 batch size	0.538
	✓ Hyper-parameters: 3×10^{-5} learning rate , Adam optimizer, 12 epochs, 64 batch size	0.477
	✓ Hyper-parameters: 5×10^{-5} learning rate , Adam optimizer, 12 epochs, 64 batch size	0.413
	ii. MT BERT large-cased ✓ 24-layer, 1024-hidden, 16-heads, 340M parameters ✓ Hyper-parameters: 2×10^{-5} learning rate , Adam optimizer, 8 epochs, 32 batches	0.410
	iii. MT BERT base-uncased ✓ 12-layer, 768-hidden, 12-heads, 110M parameters ✓ Pre-Trained on lower-cased English text	0.426

**Average F1 over all sub-tasks and tasks*

WNUT-Task3 (contd.)

✓ **Leaderboard Rank**

- Ranked according to the overall average F1 score
- Intermediate ranking by average F1 score over all sub-tasks for a task

Other Tasks

- ✓ Contribution to their in-house Health/Disease-Monitoring Pipeline
 - ✓ Improve existing ones
 - ✓ Train with more relevant auxiliary dataset
 - ✓ Annotated health-related tweets (relevant, irrelevant, neutral)
- ✓ Related Work Survey
- ✓ Manuscript Contribution (co-author)
- ✓ System Descriptions Contribution (co-author)