**Abstract**

Finding the polarity of feelings in texts is a far-reaching task. Whilst the field of natural language processing has established sentiment analysis as an alluring problem, many feelings are left uncharted. In this study, we analyze the optimism and pessimism concepts from Twitter posts to effectively understand the broader dimension of psychological phenomenon. Towards this, we carried a systematic study by first exploring the linguistic peculiarities of optimism and pessimism in user-generated content. Later, we devised a multi-task knowledge distillation framework to simultaneously learn the target task of optimism detection with the help of the auxiliary task of sentiment analysis and hate speech detection. We evaluated the performance of our proposed approach on the benchmark Optimism/Pessimism Twitter dataset. Our extensive experiments show the superiority of our approach in correctly differentiating between optimistic and pessimistic users. Our human and automatic evaluation shows that sentiment analysis and hate speech detection are beneficial for optimism/pessimism detection.

**Method**

Knowledge Distillation Setting Given a dataset $D$, a student model $S$ learns only to mirror the logits generated by a teacher $T$, minimizing the cross entropy loss between the outputs of the student model and the outputs of the teacher model:

$$L_{KD} = \sum_{(x,y) \in D} \ell(f(x; \theta_S), f(x; \theta_T)).$$

**Loss with respect to a Single Teacher:** We augmented the patient knowledge loss to use Teacher Annealing:

$$L_T = (1 - \alpha) L_{KD} + \alpha \cdot (L_{KD} + \beta \cdot L_{PKD}).$$

$\alpha$ linearly decreases from 1 towards 0.

**Loss with respect to Multiple Teachers:** Given the tasks $\{T_1, \ldots, T_i\}$, we define the multi-task loss as:

$$L_{MTKD} = \sum_{T_i} L_{T_i}.$$

**Datasets**

- **Tweets’ Average Annotation distribution**
- **Hashtags**
- **First Person Pronouns**

**Analysis**

- **Original tweet:** I don't know how they can be so perfect.
- **Pessimistic correction:** I don't know how they can be so perfect liars!
- **Optimistic correction:** flawless! I don't know how they can be so perfect.

**Results**

<table>
<thead>
<tr>
<th>Model</th>
<th>Test Acc.</th>
<th>Dev Acc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BERTweet</td>
<td>84.84</td>
<td>84.58</td>
</tr>
<tr>
<td>MTKD OPT + Hate</td>
<td>86.52</td>
<td>85.30</td>
</tr>
<tr>
<td>MTKD OPT + Sent</td>
<td>86.23</td>
<td>85.44</td>
</tr>
<tr>
<td>MTKD OPT + Hate + Sent</td>
<td>86.69</td>
<td>85.14</td>
</tr>
<tr>
<td>MTKD no KD</td>
<td>82.11</td>
<td>81.82</td>
</tr>
<tr>
<td>MTKD vanilla BERT</td>
<td>85.64</td>
<td>84.71</td>
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<tr>
<td>MTKD downsampling</td>
<td>86.19</td>
<td>85.23</td>
</tr>
<tr>
<td>XLNet Base</td>
<td>84.25</td>
<td></td>
</tr>
<tr>
<td>BEKT Base with SLA [Al+21]</td>
<td>85.69</td>
<td></td>
</tr>
</tbody>
</table>

**Conclusions and Future Work**

- We have presented a multi task learning methodology for optimism detection and highlighted a relationship that can be explored between optimism, sentiment and mental health.
- We have explored linguistic characteristics expressed in optimism and pessimism.
- The relationship between optimism-pessimism and mental health constructs can be further explored.

**References**
