Task 22: Compulsory Task II

Read up on any innovative technology using NLP (by companies such as Google or IBM, for instance) and write a brief summary about the technology, what it achieves/does, and an overview of how it works (250 - 500 words).

Gmail, by Google, recently added a *'Smart Reply*' feature, an automatic response generator, to its email services. This feature allows a user to reply quickly to an email they have received in their inbox by offering the user three response which are appropriate to the email they have received; for example if a user receives an email regarding an upcoming appointment, they can quickly select one of three options such as "Thanks for reminder", "Confirmed", or "I can't make this appointment" which can send an email reply with a click.

'*Smart Reply*' achieves this by utilising machine learning; this allows it to first analyse the content of the received email which, in turn, creates three replies which '*Smart Reply*' believes are appropriate responses. It can analyse the email received by tokenising and normalising its content and then passing it through a neutral network which works by "building neural networks that take raw words as inputs and learn to induce features as part of the process of learning to classify".[1]

This network can learn to map the content and connect potentially useful replies. The accuracy of this increases the more the user uses this system, thus personalising the feature. This is possible by analysing the user's email history, usage patterns and use of language. The model consistently learns to capture semantic and syntactic patterns in email conversations which allow it to generate more relevant responses; the system utilised here is 'reinforcement learning' in which user interaction and input influence suggested email replies.

Google's blog also highlights the importance of 'hierarchical language models' used in '*Smart Reply*': "We use a hierarchy of modules, each of which considers features that correspond to sequences at different temporal scales, similar to how we understand speech and language."[2] This further shows how the feature can learn language in a more 'natural' and human way and decipher word contexts to improve its functionality.

Ultimately, '*Smart Reply*' gives its users a choice to save time (and potentially eliminate small grammatical errors) by replying quickly to emails however this is still their choice and they can choose to replay manually. It is a good example of the application of Natural Language Processing using neural networks and machine learning systems as outlined above and shows how automatic language-based tasks can work and potentially develop further.

[1] https://web.stanford.edu/~jurafsky/slp3/7.pdf
[2] https://ai.googleblog.com/2017/05/efficient-smart-reply-now-for-gmail.html