



Zero-Shot Stratification Of Mind-Intelligence Set

Akhilesh C. Srivastava^{1*}, Jayshree Jain², Shashidhar V. Govindaraju³

¹Department of Computer Science, Pacific University, Udaipur, India

²Department of Computer Science, Pacific University, Udaipur, India

³Bhaktivedanta College of Vedic, Education Navi Mumbai, Navi Mumbai, India

Abstract

The sacred text of Bhagavad-Gita defines four different operating planes, namely Senses (Body), Mind, Intelligence, and Soul (Consciousness). All human beings delve into one of the operating planes while thinking or performing any action. Bhagavad-Gita also gives a hierarchy of these four things in human existence. Accordingly, the Mind is superior to the Senses, the Intelligence is above the Mind, and the Soul is higher than the Intelligence. The Intelligence can thus control the Mind. The activities performed at the Mind and Intelligence planes normally appear to be amalgamated and inseparable due to the poor cognition of “Mind” and “Intelligence” in the vocabulary of day-to-day talking. No language dictionary delineates Mind and Intelligence without overlapping perceptions. This paper explored the use of the Bhagavad-Gita knowledge framework to automatically separate the text samples representing the actions of Mind and Intelligence. A test was performed with 120 hand-tagged samples comprising 30 samples for each Senses, Mind, Intelligence, and Soul plane. The results gave a classification accuracy score of 75.0% for stratification of the Mind-Intelligence set, considering only the top similarity labels. The accuracy goes up to 83.3% for the top two similarity labels. The testing was done with the help of Google’s pre-trained language model, which used Bidirectional Encoder Representations from Transformers (BERT) for pre-training. This research on automatic stratification of the Mind-Intelligence set actions is highly important as knowing Mind actions as different from those of Intelligence is a pre-requisite for solving Mind-related human challenges. Present work is thus very promising and encouraging for future studies.

1. INTRODUCTION

If the actual cause behind our actions is known, we will always be happy or at least know the cause of the unhappiness resulting from some actions. Psychological studies demonstrated that we don't know the actual cause behind our actions and often make up the reasons to justify our actions [1]. Imagine if we knew the reasons for our actions, then similar to machines, the desired outcomes can be engineered from our actions, leading to success in achieving intended goals. The state of not knowing the actual reasons behind our actions may result from our incomplete knowledge about the self. Knowledge of self comprises a study of the key constituents of a human's existence, such as body, mind, intelligence, consciousness, and related aspects. The present work explores the possibility of using a Machine Learning (ML) based approach to automatically separate the Mind and Intelligence actions of humans based on the understanding of "Mind" and "Intelligence" as described in Bhagavad-Gita. Identifying and understanding Mind-related actions as separate from Intelligence actions is an important prerequisite for activating Intelligence to control unreasonable demands of the Mind, which is the key motivation behind present work.

Section 2 below presents the knowledge framework derived from Bhagavad-Gita used for the required knowledge of self to understand the Mind, Intelligence, and related aspects of human existence. Section 3 discusses the Mind-Intelligence set and related Human-Challenge that help identify the research objective for the present work. Section 4 briefly presents the literature review for contemporary scientific understanding of Mind and Intelligence. Section 5 then presents the approach used for the test samples, text classifier, and experiments deployed for this work. The results, discussion, and future scope are presented in Section 6. The conclusion given in the last Section 7 is followed by Acknowledgement and References.

2. THE KNOWLEDGE DERIVED FROM BHAGAVAD-GITA

Bhagavad-Gita Verse 3.42, given below in the original Sanskrit script and the English transliteration, is one of the two Verses used in the present work to understand the knowledge of self.

इन्द्रियाणि पराण्याहुरिन्द्रियेभ्यः परं मनः ।
मनसस्तु परा बुद्धिर्यो बुद्धेः परतस्तु सः ॥ *aram manah*
manasas tu parā buddhir yo buddheḥ paratas tu saḥ

Verse 3.42 defines four operating planes in our existence, namely Senses (Body), Mind, Intelligence, and Soul (Consciousness) [2]. Knowing the original Sanskrit words for the four operating planes may be good for a better conceptual understanding. In Sanskrit, Sense is "इन्द्रिय" (indriya), Mind is "मन" (man), Intelligence is "बुद्धि" (buddhi), and Soul is called "आत्मा" (atma). All human beings delve into one of the operating planes while thinking or performing any action. Verse 3.42 also gives a hierarchy of these four things in human existence. Accordingly, the Senses are gross and weakest, the Mind is subtle and more powerful than the Senses, the Intelligence is subtler and more powerful than the Mind, and the Soul is subtlest and most

powerful, as depicted in Figure 1. Per this knowledge, the true self is the “Soul” with Senses, Mind, and Intelligence as the resources available for various performances in life. The size of the four segments in the triangle and their relative positions in Figure 1 represent the four planes' gross and subtle nature and hierarchy. Senses are gross at the lowermost position, Soul as subtlest at the topmost position, and Mind and Intelligence falling in the middle. The arrow shows relative power, with the Senses as the least powerful and the Soul as the most powerful. The portions of the triangle area corresponding to the four operating planes also represent the relative duration for which one delved on that plane over a given time interval. As discussed further, the Bhagavad-Gita also tells us, for the highest success in life, what is the best titration of the areas for the four segments on the triangle in Figure 1 and how to achieve that.

From a systemic view, one may like to perceive Senses as actors who perform all life's actions under the influence of Mind, Intelligence, and Soul. Senses being gross are analogous to the hardware of a machine. Mind, Intelligence, and Soul being subtle, are similar to the software, which manipulates the performance of the Senses. Bhagavad-Gita Verse 3.43, given below in the original Sanskrit script and the English transliteration, provides the best use of the four constituents in human existence described in Verse 3.42. Verse 3.43 tells that knowing the true self is the Soul, one should endeavor to delve into the Soul plane, use Intelligence to steady the flickering Mind, and keep the Senses fit for various actions [3].

एवं बुद्धेः परं बुद्ध्वा संस्तभ्यात्मानमात्मना ।
जहि शत्रुं महाबाहो कामरूपं दुरासदम् ॥

*evam buddheḥ param buddhvā samstabhyātmānam ātmanā
jahi śatruṁ mahā-bāho kāma-rūpaṁ durāsadam*

The knowledge framework thus derived from Bhagavad-Gita Verses 3.42 and 3.43 is used in Section III below to understand the Mind and Intelligence activities and related Human-Challenge.

3. THE MIND-INTELLIGENCE SET

The four operating planes of Senses, Mind, Intelligence, and Soul, are named “Stratification of Mind-Intelligence Set” in the context of the practical difficulty faced while stratifying the Mind and the Intelligence-related activities. The Mind and Intelligence-related actions normally appear to be amalgamated and inseparable. The problem in separating the Mind and Intelligence plane activities can be traced to the poor cognition of Mind and Intelligence in the vocabulary of day-to-day talking in any language. No dictionary delineates Mind and Intelligence without overlapping perceptions. For example, the meaning of the word “thinking” in "The mother was thinking about her child, who was writing an important examination," and "The scientist was thinking about fixing the satellite into orbit" alludes to different activities at two different operating planes. The meaning of the word “thinking” in the first sentence is likely to be related to ‘worrying,’ which is an activity on the Mind plane. The same word's meaning in the second sentence maps to ‘solving,’ which is an activity on the intelligence plane. A dictionary, however, doesn't help distinguish between these

two different meanings of “thinking.” Figure 2 picturizes the overlap between the Mind and the Intelligence plane activities and the perceived difficulty in stratifying them.

With such overlapping perceptions, the Mind and Intelligence plane activities set is named the Mind-Intelligence (M-I) set. Bhagavad-Gita Verse 3.42 clearly defines Mind and Intelligence as two different constituents of human existence. Verse 3.42 also hierarchically placed the Intelligence plane above that of the Mind because the activities at the Intelligence plane can exercise control on activities at the Mind plane. According to Verse 3.43, Intelligence should be used to steady the fluctuating Mind, making the Mind one’s friend for achieving the set goals. Separating the two sets of activities is a prerequisite for applying such control on Mind by Intelligence. Knowing the challenges of manually separating Mind and Intelligence actions, exploring possible automatic stratification of the Mind-Intelligence set is undertaken as the objective of the present work.

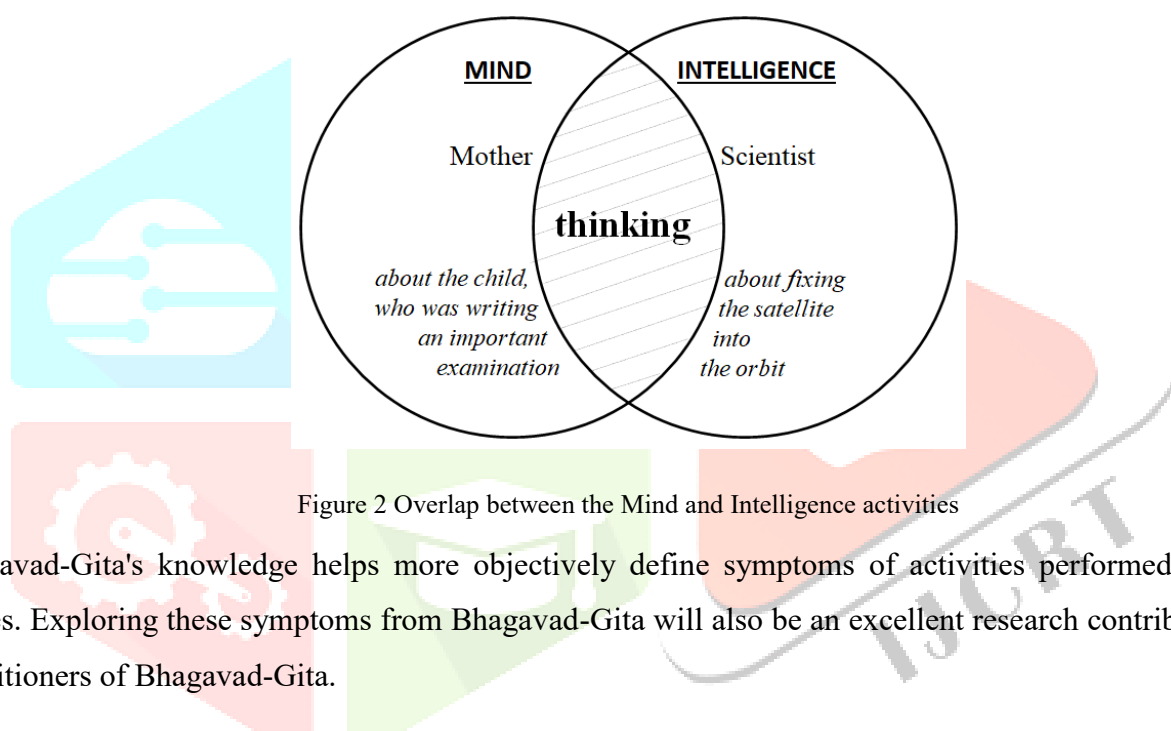


Figure 2 Overlap between the Mind and Intelligence activities

Bhagavad-Gita's knowledge helps more objectively define symptoms of activities performed at the two planes. Exploring these symptoms from Bhagavad-Gita will also be an excellent research contribution to the practitioners of Bhagavad-Gita.

4. CONTEMPORARY SCIENTIFIC UNDERSTANDING

“What is Mind?” has been highly debated by philosophers, psychologists, scientists, and theologians over the past centuries. A commendable creation and compilation of work on “The Sanford Encyclopedia of Philosophy” [4] gave 2868 results for the search on “theory of mind” on its website. Despite diverse theories, a common understanding that stands true for most of the theories is that the Mind [cause] influences the behavior and state [effect] of a person [5]. The behavior here refers to the actions and state, including one or more things such as health, happiness, personal and professional life, education, etc. The behavior and state [“effect”] are observable, but the Mind [“cause”] is not observable. Mind is, therefore, perceived differently by the creators of different theories of Mind in light of the observed behaviors and states.

Computer scientists, especially Artificial Intelligence (AI) scientists, believe in the Classical Computational Theory of Mind (CCTM) proposed by Hilary Putnam [6] and later developed by Jerry Fodor [7] based on the work of Allan Turing [8]. CCTM is based on the theory of “Machine-Functionalism” or “Computationalism”

[6]. Accordingly, CCTM perceives the Mind as a computational system, similar to that of a Turing machine, capable of executing the core mental processes such as reasoning, decision-making, and problem-solving.

However, the ancient scriptural interpretation of the Mind, called “मन” (man) in Sanskrit, differs from CCTM's Mind perception based on Machine-Functionalism. For example, as per the Bhagavad-Gita, Mind only desires but doesn't perform any task except wandering without any aim. The Mind thus doesn't perform by itself but gets the desires fulfilled through the Senses. This is the opposite of the Machine-Functionalism theory, according to which the Mind performs reasoning, decision-making, and problem-solving tasks. Intelligence could be defined as one's ability to effectively and efficiently use available resources. Accordingly, the tasks of Mind, as defined by CCTM, are the tasks of Intelligence.

The scientific view of the Mind in CCTM can be traced to the machine's ability to “think.” The idea of “thinking machines” [8] was further supported by the machine's ability to work under “uncertainty”. The development of Bayesian machines for handling uncertainty is considered a significant achievement of Artificial Intelligence (AI) technology [7]. According to Bhagavad-Gita, as discussed in the previous Section, thinking can be the act of both the Mind and the Intelligence. Bhagavad-Gita clearly defines “Mind” (“मन”) and “Intelligence” (“बुद्धि”) as two different operating planes. Recognizing Mind and Intelligence separately elevates and enables one to leverage Intelligence for neutralizing the harmful effects of the Mind. This important knowledge and perception of Mind and Intelligence were always missing in Scientific research. Therefore, AI scientists seem okay with the unclear boundary between the Mind and Intelligence. Present work, however, is motivated towards exploring clear boundaries between Mind and Intelligence to benefit from rationalizing the Mind using Intelligence.

5. PROPOSED APPROACH

The concept of the four operating planes (Senses, Mind, Intelligence, and Soul), described in the Bhagavad-Gita, is new to the common man. Therefore, the unavailability of the data corresponding to the four operating planes for any hypothesis testing is very natural. Hence, the test data was created manually based on understanding the four operating planes described in Bhagavad-Gita. The data representing an operating plane was chosen as natural language text. A data sample thus appeared as a text string. A text classifier was, therefore, required to stratify the data belonging to a particular operating plane. Without the natural user data, we needed a zero-shot text classifier to perform without training. Google's pre-trained Natural Language Processing (NLP) model, which used Bidirectional Encoder Representations from Transformers (BERT) [9] for pre-training, was thus a good choice for text classification.

Test Samples

The test samples were either manually composed or curated using the data scraped from the net. The text in a sample varied from a single sentence to a few sentences. The samples were deliberately chosen so some didn't look like a question grammatically. Based on the concept of the four operating planes and their symptoms, all 120 samples were hand-tagged to one of the four operating planes. Each of the sentences thus had a manually

assigned tag of “Senses,” “Mind,” “Intelligence”, or “Soul.” The 120 samples comprised 30 samples corresponding to the four operating planes. Figure 3 shows some examples of the test samples for the four categories.

Sample	Hand Tag
What food habits will keep me active and energetic whole day?	senses
I do not like fasting whole day, love to enjoy eating.	senses
I may not grow rich even after generations because earning money is very hard.	mind
How to deal with opinion and criticism of others, they often fill me with negativity?	mind
I want to be successful forever, will reading Bhagavad-Gita or other scriptures help?	intelligence
How do I define one consistent culture across my company's different offices in different locations?	intelligence
How to develop personal mastery for becoming a world class leader?	soul
How to strive for unity and world peace for welfare of the global society?	soul

Figure 3 Examples of the test samples for different operating planes

Text Classifier

Google’s BERT, used as a text classifier, is a neural-network-based state-of-the-art technique for NLP pre-training. BERT understands the intent of the input text using the full context of a word by looking at all the preceding and succeeding words in the sentence. For complex tasks, the BERT models challenge the processing limits of present hardware systems. Sentence-BERT (SBERT) is an improved form of BERT, which is computationally very efficient with a steep reduction in the processing time. SBERT derives fixed-size vectors for input sentences using Siamese network architecture. The vector representation helps find semantic similarity using measures such as cosine-similarity or Euclidean distance. SBERT thus enables complex tasks involving large-scale semantic similarity comparison, clustering, and information retrieval via semantic search [10]. A pre-trained SBERT model implemented by Reimers and Gurevych, a zero-shot model available in the HuggingFace Models Repository, was used to test the approach for stratification of the Mind and Intelligence set.

Experiment Design

All 120 test samples are given as input to Google’s SBERT model for automatically labeling the corresponding operating planes of Senses, Mind, Intelligence, and Soul. The automatically created labels are compared with the manually tagged labels for the “Mind” and “Intelligence” categories to measure accuracy for stratification of the Mind and Intelligence actions. The confusion is not only between the actions performed at the Mind and Intelligence planes but is also sometimes misunderstood as the actions at the Senses or Soul planes. The test samples, therefore, included all four operating planes for measuring the accuracy of identifying the actions performed at the Mind and Intelligence planes.

The zero-shot classification approach allowed SBERT vector representation of the test sample (input text), compared with vector representations corresponding to keywords (or synonyms) of the four operating planes. The SBERT model considered a test sample as an input sentence. SBERT returned a similarity value corresponding to the operating plane's keywords (or synonyms) for each input sentence. The keywords and synonyms used for the four operating levels were as follows:

“senses”: [‘senses,’ ‘body,’ ‘health,’ ‘disease,’ ‘exercise,’ ‘diet’]; “mind”: [‘mind,’ ‘fear,’ ‘failure,’ ‘negative,’ ‘doubt’]; “intelligence”: [‘intelligence,’ ‘skill,’ ‘ability,’ ‘sharp,’ ‘success,’ ‘learn’]; “soul”: [‘soul,’ ‘consciousness,’ ‘leader,’ ‘peace,’ ‘serve,’ ‘spirited,’ ‘gratitude’]

6. RESULTS, DISCUSSION, AND FUTURE SCOPE

Results

The machine-generated labels (considering only top similarity labels) for all 120 test samples are plotted in Figure 4. The input data had 30 manually tagged samples for each Mind and Intelligence category. The cluster labeled “Mind” in Figure 4 has 23 samples correctly recognized by the machine out of the 30 hand-tagged input samples for Mind. Similarly, the cluster labeled “Intelligence” in Figure 4 has 22 samples correctly recognized by the machine out of 30 hand-tagged input samples for Intelligence. Thus, using the learning of the four operating planes as given in Bhagavad-Gita, the machine could correctly label the 45 samples out of the total 60 input samples under the Mind and Intelligence categories together. This provided an accuracy of 75.0% for the stratification of Mind and Intelligence actions using only top similarity labels. The accuracy improves to 83.3% by considering the top two similarity labels.

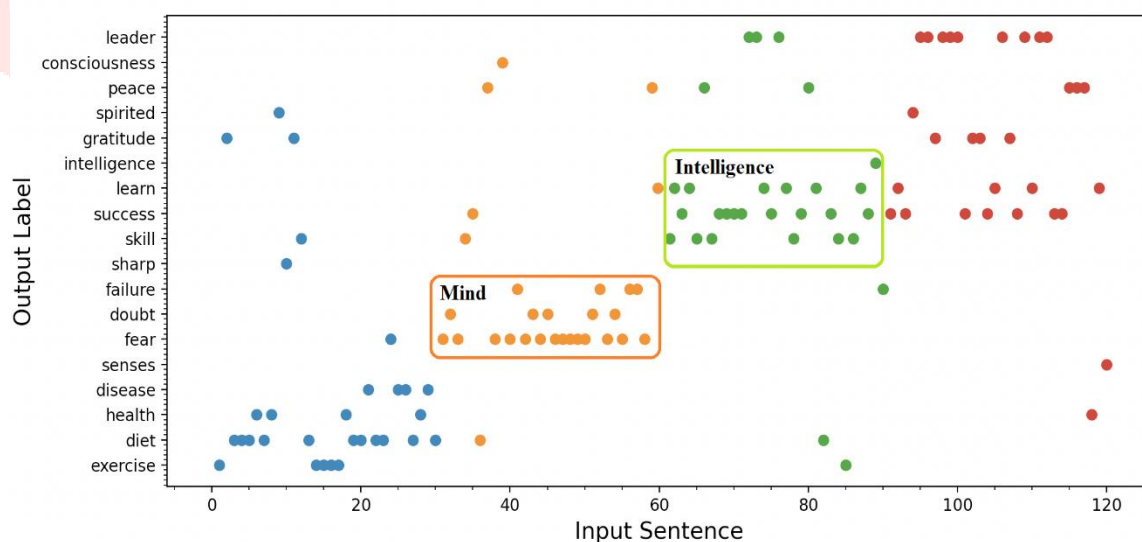


Figure 4 Stratified clusters for Mind and Intelligence activities

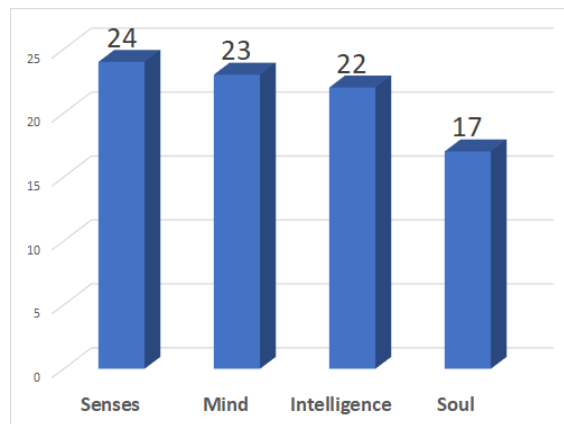


Figure 5 Classification accuracies for the four operating planes

Discussion and Future Scope

The classification accuracy of 75.0% in the given dataset indicates the intuitive and machine-implementable nature of the Bhagavad-Gita knowledge about the four operating planes. As shown in the bar graph of Figure 5, individually, out of the 30 input samples for each of the Senses, Mind, Intelligence, and Soul planes, the machine correctly tags the 24, 23, 22, and 17 samples. The lowest classification accuracy of the cluster for the Soul plane points to the pre-trained language model's poor understanding of the Soul plane and related activities. An increase in accuracy of up to 83.3% for the top two similarity labels shows the scope to improve by pre-training the language model about the four operating planes as described in Bhagavad-Gita. A significant number of the input data for the Soul plane is identified with "success," which was chosen as a synonym for the Intelligence plane. The confusion sounds reasonable as getting success belongs to intelligence, whereas staying successful is the Soul plane function.

Success is, therefore, also closer to the symptoms for the Soul plane and points to a possibility for improvement in selecting the keywords and synonyms. Referring to the discussion earlier in Section III of this paper, exploring the symptoms of Mind and Intelligence planes from Bhagavad-Gita will also be an excellent research contribution to deriving practice models for real-life applications. Thus, the results encourage future research about using Bhagavad-Gita knowledge for improved automation and Artificial Intelligence technology.

7. CONCLUSION

Bhagavad-Gita provides valuable knowledge for automatic stratification actions performed at the Mind and Intelligence planes. Using Bhagavad-Gita knowledge, we explored automatically separating text samples corresponding to Mind and Intelligence actions. A test was performed with 120 hand-tagged samples comprising 30 samples for each Senses, Mind, Intelligence, and Soul plane. The results gave a classification accuracy score of 75.0% for stratification of the Mind-Intelligence set, considering only the top similarity

labels in Google's pre-trained language model, which used BERT. The accuracy goes up to 83.3% for the top two similarity labels. This research on automatic stratification of the Mind- Intelligence set is highly important as knowing Mind actions as different from intelligence is a pre-requisite for solving Mind-related Human-Challenges. Present work is thus very promising and encouraging for future studies.

ACKNOWLEDGEMENT

The authors wish to acknowledge Bhaktivedanta College of Vedic Education, Navi Mumbai, for providing access to its library, which has a rich collection of ancient Vedic scriptures.

REFERENCES

- [1] T. Stafford, "Why we don't always know the true causes of our actions," BBC Future, 05-Jun-2013. [Online]. Available: <https://www.bbc.com/future/article/20130605-why-not-to-trust-your-gut-feeling> (accessed Jan. 4, 2022).
- [2] A. C. B. S. Prabhupada, "Karma-Yoga" in Bhagavad-Gita As It Is, Mumbai: Bhaktivedanta Book Trust, 1972, verse 3.42, ch. 3, ISBN: 978-93-84564-19-3. [Online]. Available: <https://vedabase.io/en/library/bg/3/42/>
- [3] A. C. B. S. Prabhupada, "Karma-Yoga" in Bhagavad-Gita As It Is, Mumbai: Bhaktivedanta Book Trust, 1972, verse 3.43, ch.3, ISBN: 978-93-84564-19-3. [Online]. Available: <https://vedabase.io/en/library/bg/3/43/>
- [4] Stanford Encyclopedia of Philosophy. [Online]. Available: <https://plato.stanford.edu/search/search?query=theory+of+Mind> (accessed Jan. 4, 2022).
- [5] Stanford University, "How the human mind shapes reality," Stanford News, 11-Jun-2018. [Online]. Available: <https://news.stanford.edu/2018/06/11/four-ways-human-mind-shapes-reality/> (accessed Jan. 4, 2022).
- [6] D. L. Anderson, "Hilary Putnam (1926–2016): A Lifetime Quest to Understand the Relationship between Mind, Language, and Reality," Mind & Matter Vol. 14(1), pp. 87-95. [Online]. Available: https://mind.ilstu.edu/community/isu/anderson_hilary_putnam_obituary.pdf (accessed Jan. 4, 2022).
- [7] M. Rescorla, "The Computational Theory of Mind," in Stanford Encyclopedia of Philosophy Archive, Spring 2017 ed. [Online]. Available: <https://stanford.library.sydney.edu.au/archives/spr2017/entries/computational-mind/> (accessed Jan. 4, 2022).
- [8] A. M. Turing, "I. Computing Machinery And Intelligence," Mind, vol. LIX, no. 236, pp. 433–460, Oct. 1950, DOI: 10.1093/mind/LIX.236.433. [Online]. Available: <https://doi.org/10.1093/mind/LIX.236.433> (accessed Jan. 4, 2022).
- [9] J. Devlin, M. W. Chang, K. Lee, and K. Toutanova, "BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding," in Proceedings of NAACL: Human Language Technologies, Minneapolis, Minnesota, vol. 1, pp. 4171–4186, Jun. 2019, DOI: 10.18653/v1/N19-1423.
- [10] N. Reimers and I. Gurevych, "Sentence-BERT: sentence embeddings using Siamese BERT-Networks," Aug. 2019. [Online]. Available: <https://arxiv.org/abs/1908.10084v1> (accessed Nov. 13, 2021).