Four Interdisciplinary subjects in Computer science, linguistics and psychology for Master/ARPE internships and PhDs

Table des matières

Supervisors

Alain Finkel
Téléphone : Alain Finkel : +33 (0)1 81 87 54 56
Email : finkel@ens-paris-saclay.fr
Laboratoire Méthodes Formelles
Ecole Normale Supérieure Paris-Saclay
4, avenue des Sciences
91190 Gif-sur-Yvette, France

Key words

Computer science, linguistics and psychology, computational psychotherapy, psychiatry, systematic AI assistance for psychotherapy,

Location

The Master and the PhD will be supervised by Alain Finkel at the Ecole Normale Supérieure Paris-Saclay. The internships, visits and PhD could probably be made in co-tutelle with colleagues at Montréal. A one-year stay in Montreal with co-supervision by colleagues in Montreal is strongly considered.

Qualifications and Connections

This internship and the PhD are opened to strongly motivated and excellent Master students who like both computer science *and* linguistics. Knowledges in cognitive-behavioural psychology and philosophy will be a plus.

Ideally, the candidate holds a Master degree in Computer Science (or Applied Mathematics) equivalently is graduated from a Computer Science (or Applied Mathematics) Engineering School. Ideally, the candidate has

strong knowledge both in computer science (formal methods, IA, ML, neural nets, LLM,...) or applied mathematics (probability, statistics, ML,...) *and* in computationnal linguistics ; knowledges in cognitive psychology and philosophy will also be appreciated. The internship is an ideal opportunity for starting a PhD thesis (that could be made in collaboration with University of Montréal).

1 AUTOPSY : Automating Cognitive Behavioral Therapy Modules

Keywords

Cognitive Behavioral Therapy, emotions, LLM, linguistics, NLP, IA

Introduction to Cognitive Behavioral Therapy

Cognitive Behavioral Therapy (CBT) was developed by both Albert Ellis and Aaron T. Beck [7, 2]. Ellis created Rational Emotive Behavior Therapy in the 1950s, focusing on changing irrational beliefs through disputation. Beck developed Cognitive Therapy in the 1960s, targeting automatic negative thoughts and underlying cognitive schemas using cognitive restructuring. Both approaches have significantly shaped modern CBT practices, with Ellis's Rational Emotive Behavior Therapy and Beck's Cognitive Therapy serving as foundational models.

More precisely, Beck [2] introduced the role of automatic negative thought patterns, cognitive distortions, and interpretation systems that arise in response to specific situations. He proposed that these automatic thoughts are often distorted and not reflective of reality. Beck suggested that underlying cognitive schemas, or deeply held beliefs, shape the way individuals interpret experiences. Hence, it is crucial to identify negative thoughts and cognitive distortions. The therapist begins by identifying the specific negative automatic thoughts and cognitive distortions that a patient experiences, which are often the root cause of emotional distress. It is crucial to understand the underlying schemas and belief systems that contribute to these thought patterns in order to effectively address and modify them. Then, cognitive restructuring involves using techniques such as thought records, Socratic questioning, and behavioral experiments to challenge and modify negative automatic thoughts. Patients are encouraged to test the validity of their thoughts and develop more balanced, realistic perspectives through guided cognitive exercises and therapeutic discussions.

There are many reasons to consider automating certain tasks of therapists without attempting to fully automate therapy : the lack of therapist availability, the cost of therapy, improving therapist training, increasing patient engagement between sessions by providing automatically corrected exercises, etc. Certain tasks, such as detecting cognitive distortions[1], identifying mental operations used and maladaptive cognitive schemas, detecting inconsistencies (verbal or multimodal) during oral interviews and/or in written texts by the patient, for example, in their thought journal, are suitable for automatic processing. A recent article [3] proposes using the power of large language models (LLMs) to detect cognitive distortions following three steps : (1) distinguishing the patient's subjective thoughts from objec-

tive facts ; (2) identifying the patient's reasoning ; (3) identifying schemas (à la Young).

Aside science and after the main presentation of CBT, Bandler and Grinder "created" [1] the meta-model, that will be the basis of future NLP, distinguishing three main categories of cognitive distortions : information processing : deletion, generalization, and distortion.

Recently, we analyzed narrative, introspective accounts from dreams (using freely accessible dream databases). Cortal has started to automate the cognitive analysis of emotions [8] described in narrative texts [4, 6, 5].

Research Program

— After formalizing subjective experience, we will use the theory of facts and interpretations and the emotion analysis in [8] to automatically (1) separate facts from interpretations, identifying the interpretation operators used : generalization, causality, meaning, modalities, judgment. (2) Identify primary emotions. (3) Identify the territories associated with emotions. (4) Determine the actions to take in the world or changes to make in the worldview. The idea would be to automatically suggest actions of both types.

— There will be a "prompt engineering" dimension to find prompts that produce a "good" analysis. We will need some examples of "handmade" analyses that can be included in the prompts for LLMs, which should improve automatic analysis. The idea would be to use a large LLM to produce "good" automatic analyses, then train a smaller LLM to replicate these analyses. The smaller LLM would then be used in production, in a website or mobile application ; the tool would automatically analyze a person's narrative. Ideally, the analysis is done client-side, so there are no GDPR issues, as nothing is processed or stored on our side.

Applications

Many applications to automatising CBT. This text analysis work can also be applied to non-therapeutic texts to improve writing, detect distortions, etc.

Recruitment Needs

— 1 PhD student ENS in co-supervision with UdM, UQAM, Concordia. Skills/interests in AI, NLP, LLM, and CBT psychology.
— 1 post-doc at ENS, UdM, UQAM, Concordia. Skills/interests in AI, NLP, LLM, and CBT psychology.

Références

[1] Richard Bandler and John Grinder. *The Structure of Magic I : A Book about Language and Therapy*. Science and Behavior Books, Palo Alto, CA, 1975.

[2] Aaron T. Beck. *Cognitive Therapy and the Emotional Disorders*. International Universities Press, New York, NY, 1976.

[3] Zhiyu Chen, Yujie Lu, and William Yang Wang. Empowering psychotherapy with large language models : Cognitive distortion detection through diagnosis of thought prompting, 2023.

[4] Gustave Cortal, Alain Finkel, Patrick Paroubek, and Lina Ye. Emotion recognition based on psychological components in guided narratives for emotion regulation. In *EACL 2023*.

[5] Gustave Cortal, Alain Finkel, Patrick Paroubek, and Lina Ye. Natural language processing for cognitive analysis of emotions. *Semantics, Memory and Emotion 2022 and European Mathematical Psychology Group 2022*, 2022. CoRR abs/2210.05296.

[6] Gustave Cortal, Alain Finkel, Patrick Paroubek, and Lina Ye. Détection de l'émotion à partir de ses composantes à l'aide d'un corpus de récits émotionnels. In *EGC 2023*, pages 665–666, 2023.

[7] Albert Ellis. *Reason and Emotion in Psychotherapy*. Lyle Stuart, New York, NY, 1962.

[8] Alain Finkel. *Manuel d'analyse cognitive des émotions : Th éorie et applications*. Dunod, Paris, 2022.