Establishing digital phenotypes for Mental Health using Artificial Intelligence

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Motivation
- Psychological disorders -- leading cause of disability worldwide (~ $1 trillion loss to the global economy)
- Computational analysis of narrative texts using natural language processing (NLP) and other artificial intelligence (AI) techniques applied to texts related to patients could help study these at a large scale

Clinical notes: Contain only professional impressions at point of care

Social media (SM) platforms: Could provide a lens into the patient’s life; they are ubiquitous, pervasive, and recorded at the moment

Word Embeddings, Document Labelling, Supervised Learning
- Word embeddings capture semantics of words as points in vector space
- Can be used as features to train a supervised model for document classification with a small number of ground truth labels

Reddit: Social Media Platform CASE STUDY
- Unique: users post anonymously
- Widespread: over 200 million users
- Active: discussions on mental health with plenty of moderators
- ~Organized: A ‘subreddit’ is a forum dedicated to a specific topic on Reddit. Names start with the token ‘r/’, e.g. ‘r/ADHD’
- Caveats? MESSY
  - User-created subreddits, no restrictions
  - Several subreddits discussing similar issues
  - Posts in subreddits might not conform to the subreddit

Embeddings and Comorbidities
- Subreddits reflect diagnostic comorbidities
- Carry semantic meaning
- Subreddit labels are noisy and overlapping
- Current DSM-5 categories can also be noisy and overlapping
- Is it possible that they are noisy and overlapping in the same way?
- If so, can we do better?

Our overall methodology
- Focus: automated classification of social media posts for predictive analysis
- Approach: Multi-class classification of relevant posts to the appropriate (user-defined) mental health disorder category
- Method: Supervised machine learning with either subreddits or heuristically extracted features as training labels

Results
- Meaningful, reproducible clusters
- RAND index = 0.79
- (Green): >2000 posts
- Cluster 4 ~ crippling alcoholism
- Cluster 7 ~ self harm

Bigger Vision
Leverage NLP/AI for automated web screening:
- For early diagnosis
- For timely intervention and clinical referrals
- To reach a wider, underserved population
- To augment clinical decision making
- Potential healthcare cost savings