

CAPSTONE PROJECT PRESENTATION

PRESENTED BY
GREENSPACE TEAM 3 THERAPEUTIC ALLIANCE

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AGENDA

- 01 INTODUCTION
- 02 OBJECTIVES & MOTIVATION
- 03 DATA OVERVIEW
- 04 PART 1
- 05 DATA/RESULTS/DISCUSSION
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- 07 APPROACHES/DISCUSSION
- 08 SUMMARY & FUTURE WORK



INTRODUCTION

What is Therapeutic Alliance (TA)?

- Collaborative and affective bond between a therapist and a patient
- Plays a pivotal role and predictor in the efficacy of psychological treatments



References:

- Ardito, R.B., & Rabellino, D. (2011). Therapeutic alliance and outcome of psychotherapy: historical excursus, measurements, and prospects for research. *Frontiers in Psychology*, 2, 270.

Therapist Match

- Personalized matching significantly improves psychotherapy outcomes compared to traditional assignment methods

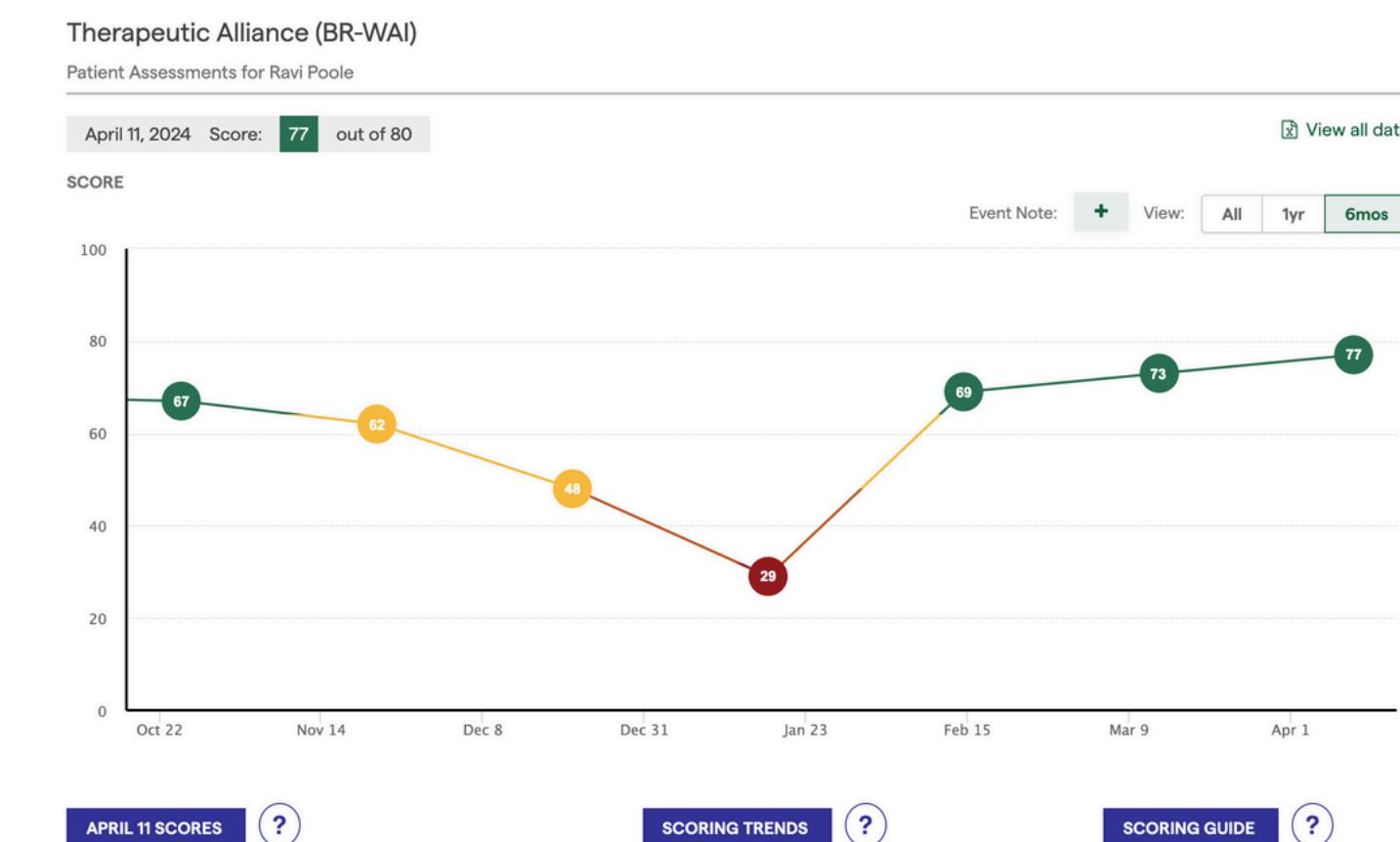
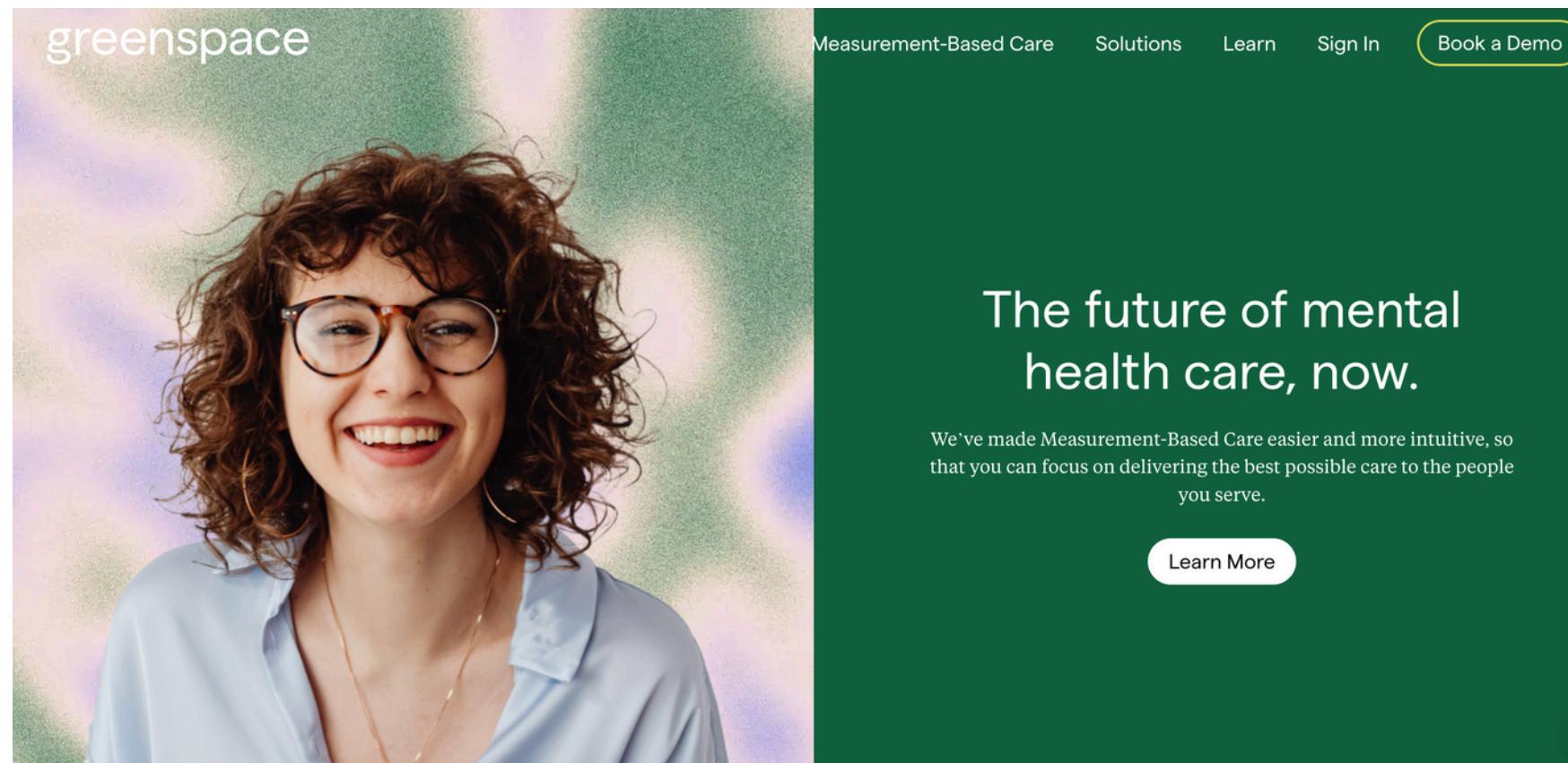


References:

- Martin,D.J.,Garske,J.P.,&Davis,M.K.(2000).Relation of the therapeutic alliance with outcome and other variables: A meta-analytic review. *Journal of Consulting and Clinical Psychology*, 68(3), 438.

Greenspace Mental Health

- Comprehensive Measurement Based Care (MBC) platform tailored for mental health professionals and clients.
- Measurement-Based Care involves tracking client progress throughout treatment, using consistent Patient-Reported Outcome Measures (PROMS).





RESEARCH QUESTION & MOTIVATION

Objectives

What needs to happen for the Therapeutic Alliance score between patient and therapist to be high?

Therapist Match

Manage Providers - Adam Chris



Search for therapists

Douglas Allen - demo+therapist6@greenospacehealth.com

80% Match

Hannah Bowman - demo+therapist9@greenospacehealth.com

80% Match

James Salter - demo+therapist4@greenospacehealth.com

80% Match

Joshua Clark - demo+therapist8@greenospacehealth.com

80% Match

Marc Williams - demo+therapist10@greenospacehealth.com

Douglas Allen new

demo+therapist6@greenospacehealth.com

ABC Organization

 Remove



DATA OVERVIEW

Dataset Overview

ASSESSMENTS

- ASSESSMENT_ID
- PARTICIPANT_ID
- DISPLAY_NAME
- CODE

...

TAGS

- TAG_ID
- PATIENT_ID
- SLUG

...

PATIENTS

- PATIENT_ID
- PARTICIPANT_ID
- THERAPEUTIC_ALLIANCE_SCORE
- PATIENT_TYPE
- INOFFICE

...

THERAPISTS

- THERAPISTS_ID
- THERAPEUTIC_ALLIANCE_SCORE

RE

QUESTIONS & RESPONSES

- QUESTION_ID
- RESPONSE_ID
- PATIENT_ID
- QUESTION_TITLE
- RESPONSES
- SCORE_NORMALIZED
- SUICIDALITY_FLAG

...



PART 1

TA SCORE PREDICTION

HOW TO PREDICT?

PATIENT DEMOGRAPHIC :

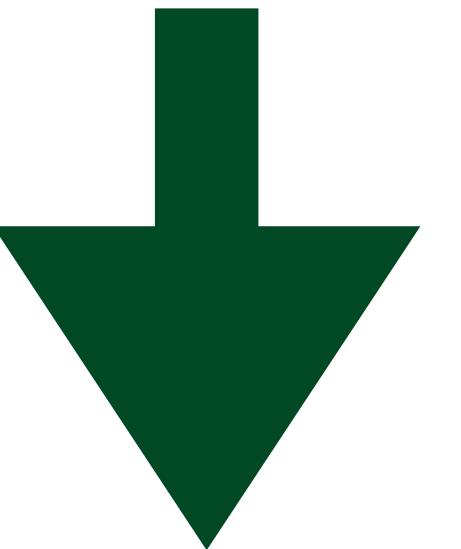
- AGE
- GENDER
- TYPE
- ...

INOFFICE STATUS

SUICIDAL INTENTION

HISTOTICAL MENTAL ASSESSMENT RESULT:

- COMPLETE RATIO
- AVERAGE SCORE



THERAPEUTIC ALLIANCE SCORE

The Models We Tried

Linear Regression

Random Forest

K-Mean Clustering

Lasso Regression

Ridge Regression

Hierarchical Clustering

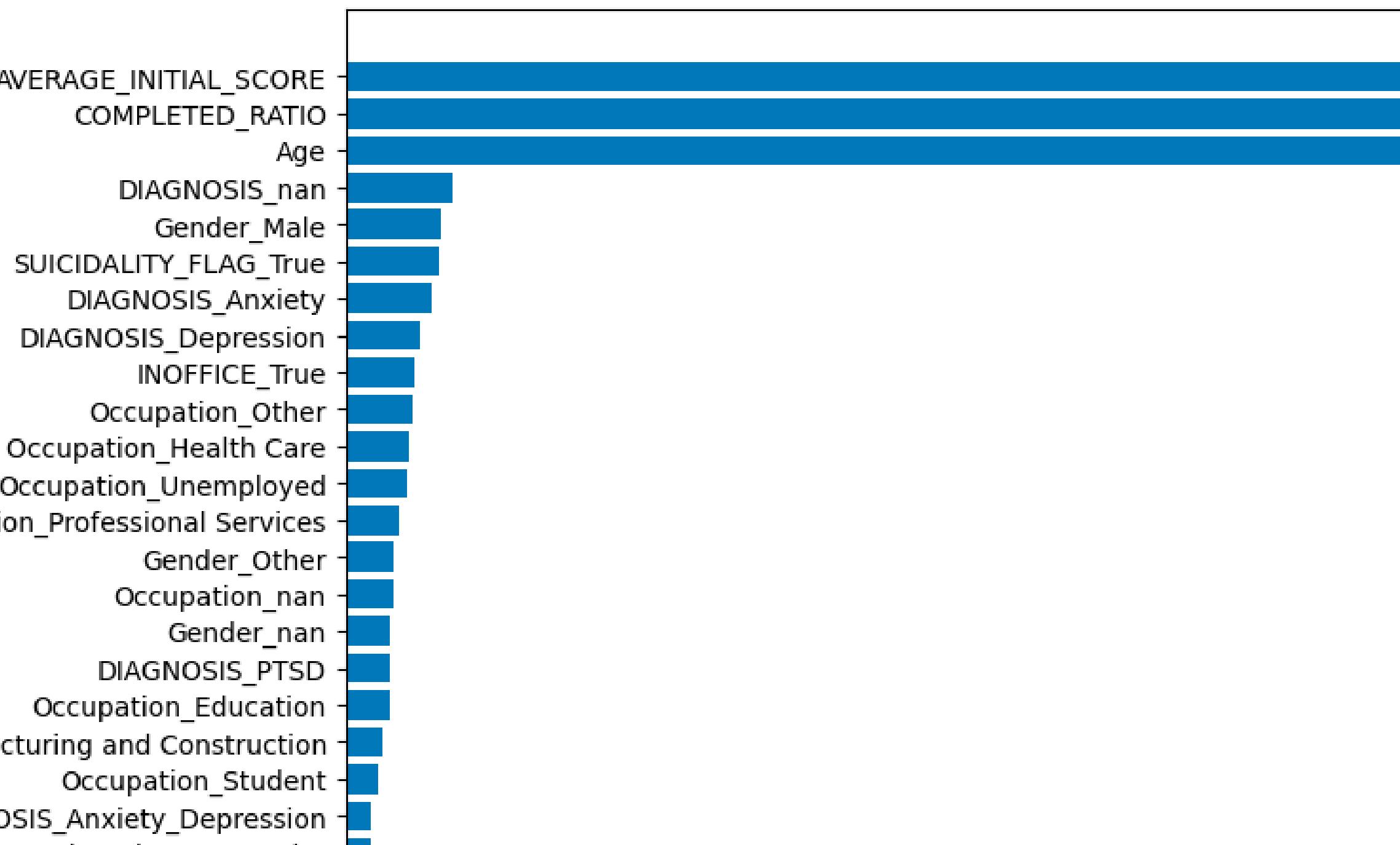
Model Result

RANDOM FOREST

MSE: 220.18

Adjusted R Squared: 0.19

Feature Importance



Discussion

- Not yet good enough
- Complicated nature of TA
 - therapist factors
 - treatment factors
 - relationship factors
- Extensive dataset
 - lots of open-ended questions
 - tailored tags and questions by every clinic
 - lots of missing data
 - lack of therapist demographic



PART 2

THERAPIST MATCHING

Recommendation Systems

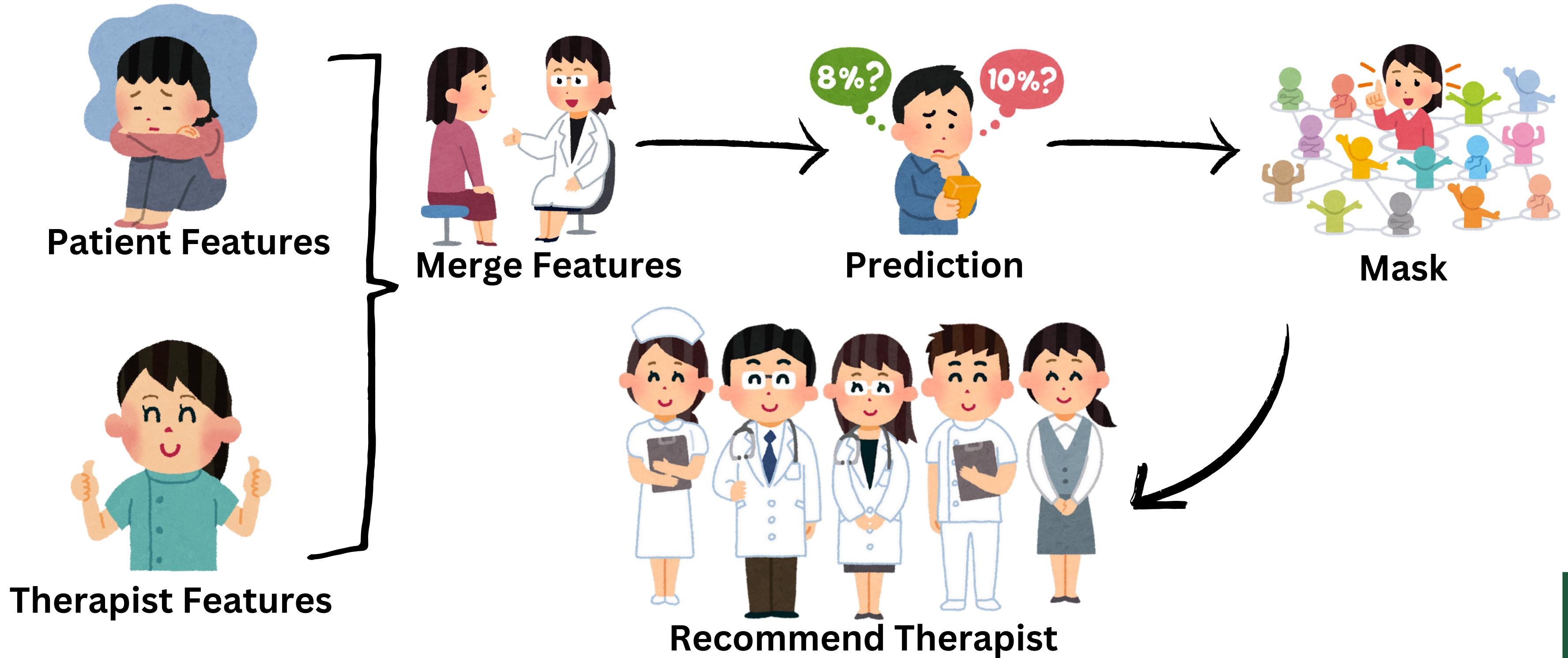
- Prioritize matching based on patient similarities and assigned rankings according to match logic.
- Suggest most suitable therapists for a new patient.

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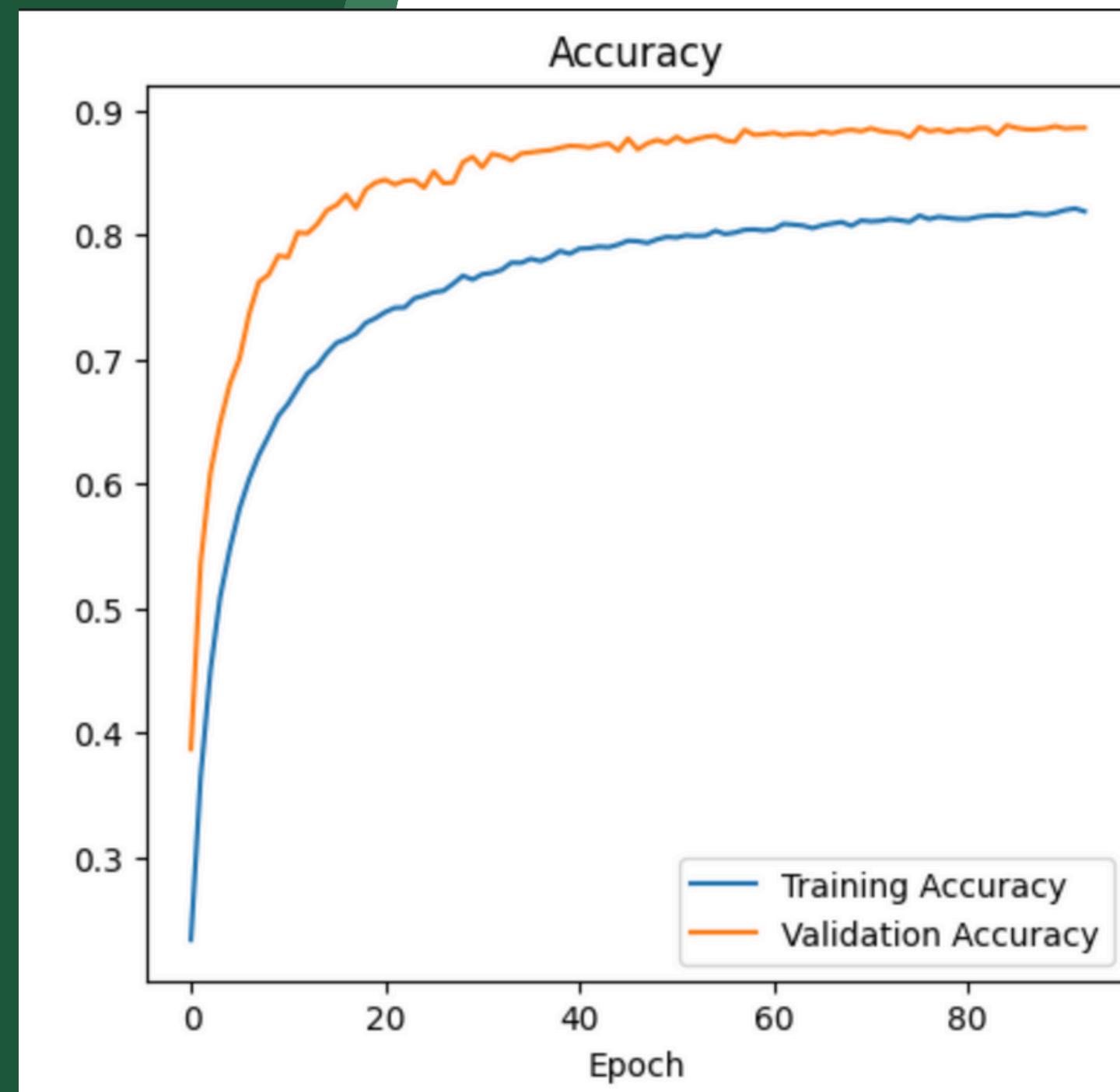
Dense Neural Networks (DNN)

- Study matching performance based on existing dataset, dig into the relationships and interactions between therapists and patients.
- The true therapist may not be the most suitable therapist.

DNN Model



DNN Result



Validation on new sample:

- **4 correct prediction among 23 new patient**
- **17.39% Accuracy**

Problem:



- Class **imbalance**
- Therapists **outside the clinics** would be recommended

RECOMMENDATION SYSTEM

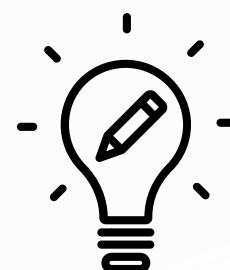
Collaborative Filtering

- User-item interactions
- Match based on user behavior data such as rating history and interaction data

Content-Base Filtering

- Attributes of users and items
- Match based on user or item's specific characteristics

Hybrid System:



We measure the similarity between users by their features

Recommendation System

Assume TA score and therapist performance play important roles in matching

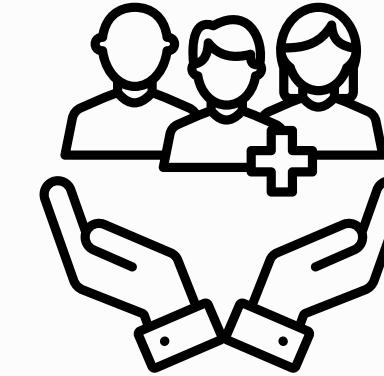
New Patient



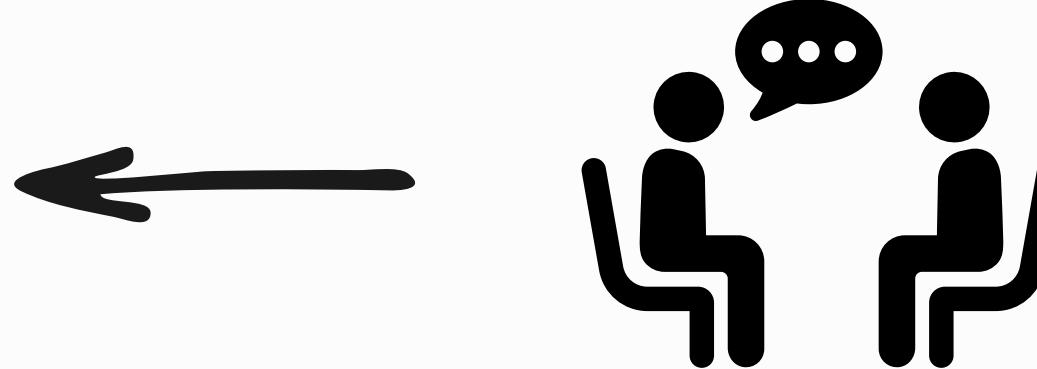
Same Clinic



Similar Patients



Output Recommendations



Therapist Effectiveness

Approach 1

Euclidean distance based

PATIENT SIMILARITY

Based on patient type, suicidality_flag, initial assessment types and scores, measure Euclidean distance

SEARCH THERAPISTS

Find top 5 most similar patients and their therapists

THERAPIST EFFECTIVENESS

Rank therapists base on TA score* therapist performance

Approach 1

Euclidean distance based

```
# New patient
new_patient = {'OASIS':55, 'RAS':35.71, 'PATIENT_TYPE':'Adult', 'SUICIDALITY_FLAG': False}
```

The top 5 most similar patients to the new patient:

Patient: f8b840948245227022f986816ec76a3c

Distance: 2.50

Patient: 2ecc09c8a4c373b0c8248a79e6b4a08f

Distance: 3.07

Patient: 7db30faf82be6b7029d5faa29ea5797c

Distance: 3.07

Patient: 313b0c745b26689086e6c11c7400aaed

Distance: 4.36

Patient: 9e93c206740a8d78519aba3c86b22ba6

Distance: 4.36

Top 3 recommended therapists with additional details:

Therapist ID: 250df331c4f0e6212b2ccb3a1f4d42f4

Therapist's Average TA Score: 89.14

Active Patients: 17

Total Patients: 124

Weighted Success Rate: 71.42%

Improvement Effects:

OASIS: 71.70%

RAS: 66.67%

Therapist ID: 16309734720247da00062bba0fd63a25

Therapist's Average TA Score: 84.23

Active Patients: 7

Total Patients: 301

Weighted Success Rate: 66.96%

Improvement Effects:

OASIS: 68.00%

RAS: 57.14%

Therapist ID: 5704c7bf89f727fe5302f9c76da0ef03

Therapist's Average TA Score: 88.00

Active Patients: 17

Total Patients: 228

Weighted Success Rate: 63.40%

Improvement Effects:

OASIS: 63.95%

RAS: 60.00%

Approach 2

Cosine similarity based

PATIENT SIMILARITY

Cosine
Similarity

THERAPIST EFFECTIVENESS

Average Score
Improvements

HYBRID APPROACH

Combine
them to
recommend

	Approach 1	Approach 2
Measure similarity	Euclidean distance	Cosine similarity
How to Rank	TA score * weighted therapist performance	Average score improvement
Dataset	Only include therapists with Therapeutic Alliance score	Include all therapists
Therapist counts	Thousands	2-3x
Patient counts	10 Thousands	4x
Accuracy	$9/20 = 0.45$	$5/20 = 0.25$

Discussion on two directions

Recommendation Algorithms

DNN

Approach	Assumption: TA score and performance of each therapist play important role in matching	May capture real-world matching behaviors
Interpretability	Straightforward and easy to interpret	Black box - hard to interpret
Outcome	Recommend theoretically suitable therapists, but may differ from real world matching	Assigned therapists based on historical data, which may not always indicate the best match
Limitation	Hard to validate	Class imbalance



FUTURE WORK

Future Work

Expand Data Collection

Real-World Validation

Cross-Clinic Performance Analysis



ACKNOWLEDGMENTS



Project Partner
Greenspace, Nicholas, Maria



Instructor
Mostafa, Cassie



Professor
Jeff



TA
Sofia



**THANK YOU
FOR
LISTENING**

