Your Mind, Quantified

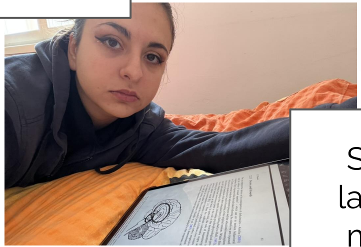
nearine

"You are not the person I used to know"

“You are not the person I used to know”

Major Depressive Episode in 2021

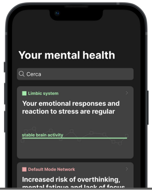
Researching and developing the concept



Studying how to launch innovative medical devices

Failed first round of investment

Project Manager in SaMD company



Launch of free version of Nearine

2021

2022

2023

2024

2025

What's Nearine?

See how your **stress levels** evolve based on your **Heart Rate Variability** and activities, using your Apple Watch

Explore **intuitive charts** that track your stress, mood, and habits over time **to reveal hidden partners** and psycho-social triggers

Write notes when you notice patterns or shifts. Your insights are just as important as the numbers

Access bite-sized, easy-to-understand **neuroscience content to help you interpret your data** and better understand your mind

Starting from self-awareness to build fulfilling lives

nearine

Technology as our ally for self-awareness

“The **quantified self movement** empowers individuals to track biological, physical, behavioral, and environmental data with the goal of gaining personal insights and driving change.”

Hoogendoorn, M. & Funk, B. (2018). Machine Learning for the Quantified Self: On the Art of Learning from Sensory Data. Springer.

But with such a constant flow of information, how do we transform raw data into meaningful health insights?

Data exploration and cleaning

Definition of questions and features engineering

Correlations

Takeaways for future predictions

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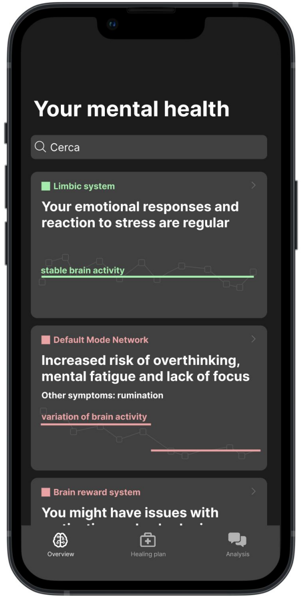
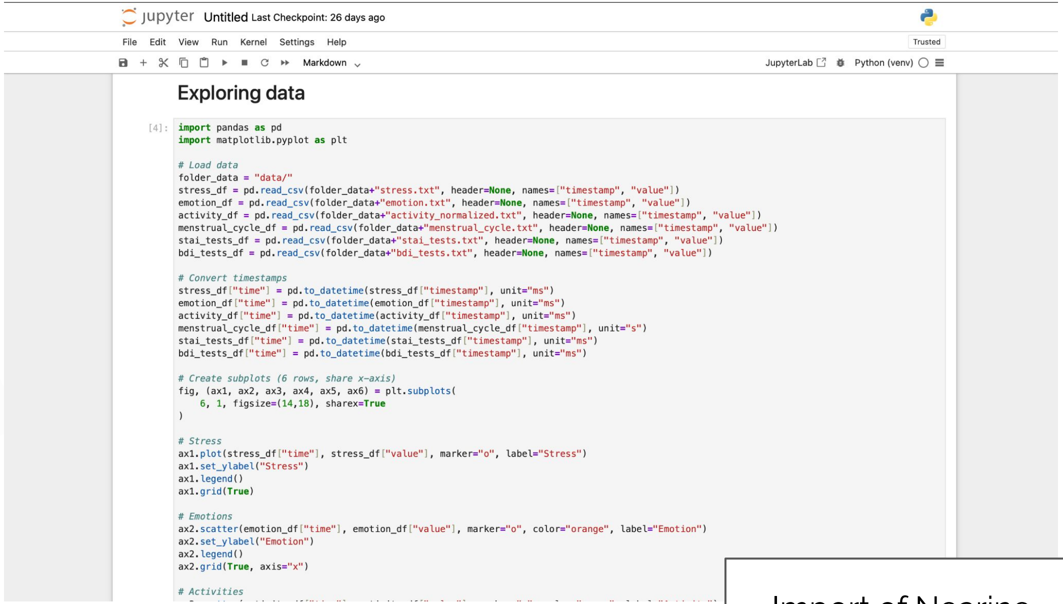
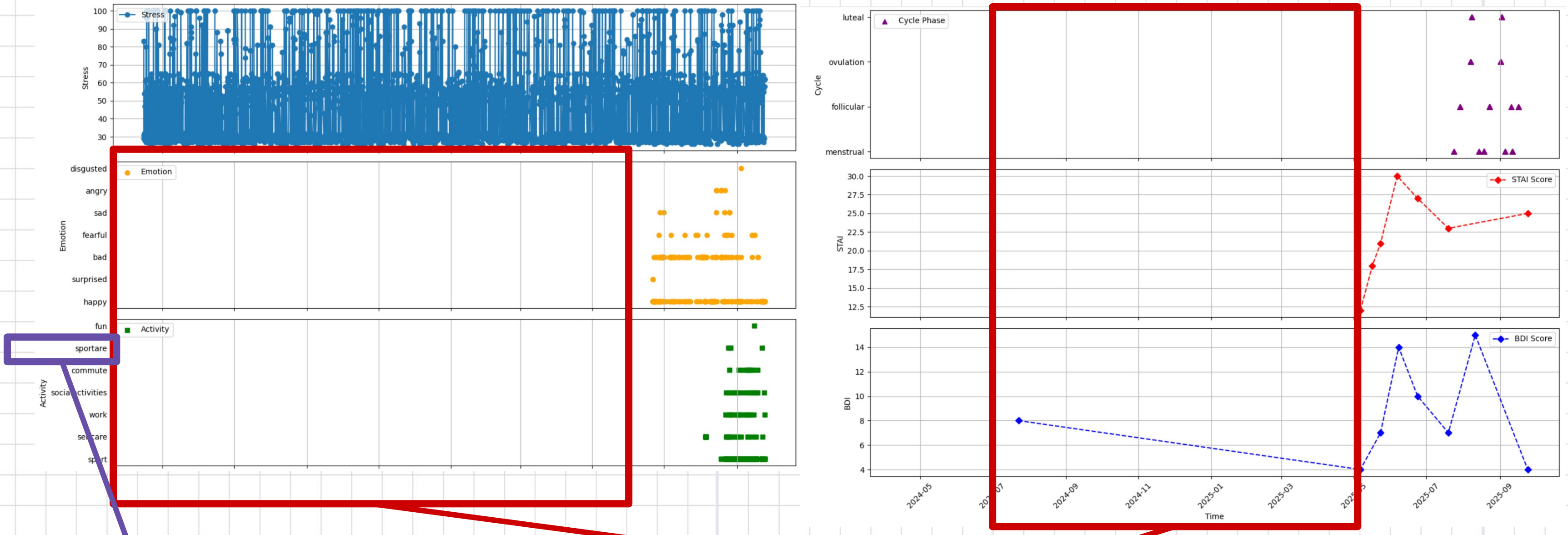
Notes
Emotions
Active calories
Activities
BDI score
Stress level
(based on HRV)
STAI score
Sleep
Menstrual cycle
10:09
1h 30min
50% CURRENT STRESS LEVEL
25% TODAY AVG. STRESS LEVEL
Your mental health
Cerca
Limbic system
Your emotional responses and reaction to stress are regular
stable brain activity
Default Mode Network
Increased risk of overthinking, mental fatigue and lack of focus
Other symptoms: rumination
variation of brain activity
Brain reward system
You might have issues with
Overview
Healing plan
Analysis





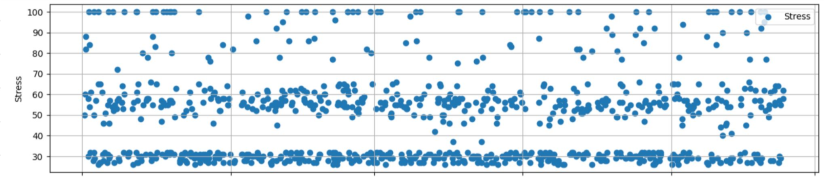

```
import pandas as pd
import matplotlib.pyplot as plt

# Load data
folder_data = "data/"
stress_df = pd.read_csv(folder_data+"stress.txt", header=None, names=["timestamp", "value"])
emotion_df = pd.read_csv(folder_data+"emotion.txt", header=None, names=["timestamp", "value"])
activity_df = pd.read_csv(folder_data+"activity_normalized.txt", header=None, names=["timestamp", "value"])
menstrual_cycle_df = pd.read_csv(folder_data+"menstrual_cycle.txt", header=None, names=["timestamp", "value"])
stai_tests_df = pd.read_csv(folder_data+"stai_tests.txt", header=None, names=["timestamp", "value"])
bdi_tests_df = pd.read_csv(folder_data+"bdi_tests.txt", header=None, names=["timestamp", "value"])

# Convert timestamps
stress_df["time"] = pd.to_datetime(stress_df["timestamp"], unit="ms")
emotion_df["time"] = pd.to_datetime(emotion_df["timestamp"], unit="ms")
activity_df["time"] = pd.to_datetime(activity_df["timestamp"], unit="ms")
menstrual_cycle_df["time"] = pd.to_datetime(menstrual_cycle_df["timestamp"], unit="s")
stai_tests_df["time"] = pd.to_datetime(stai_tests_df["timestamp"], unit="ms")
bdi_tests_df["time"] = pd.to_datetime(bdi_tests_df["timestamp"], unit="ms")

# Create subplots (6 rows, share x-axis)
fig, (ax1, ax2, ax3, ax4, ax5, ax6) = plt.subplots(
    6, 1, figsize=(14,18), sharex=True
)

# Stress
ax1.plot(stress_df["time"], stress_df["value"], marker="o", label="Stress")
ax1.set_ylabel("Stress")
ax1.legend()
ax1.grid(True)

# Emotions
ax2.scatter(emotion_df["time"], emotion_df["value"], marker="o", color="orange", label="Emotion")
ax2.set_ylabel("Emotion")
ax2.legend()
ax2.grid(True, axis="x")

# Activities
```

Import of Nearine data in Python

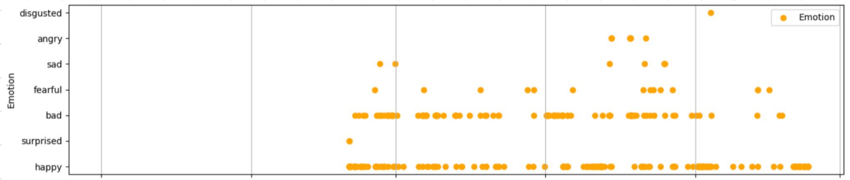


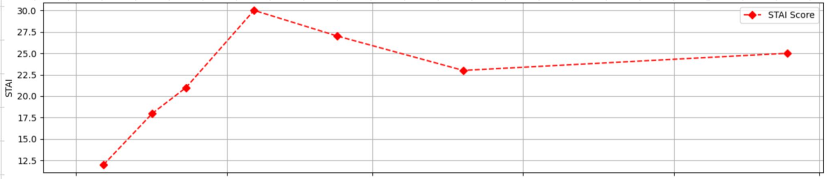
Bug in Nearine: “sportare” label

Lack of user inputs before July 2025

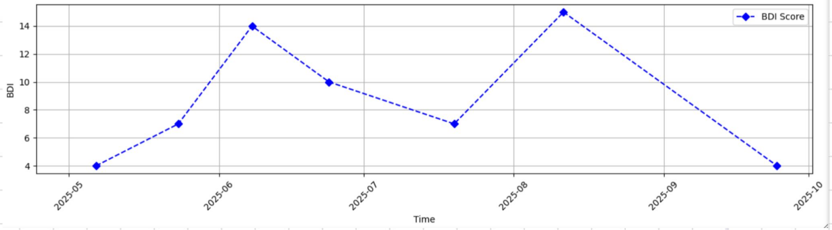

Stress
100
90
80
70
60
50
40
30
Stress


Cycle Phase
luteal
ovulation
follicular
menstrual
Cycle


Emotion
disgusted
angry
sad
fearful
bad
surprised
happy
Emotion


STAI Score
30.0
27.5
25.0
22.5
20.0
17.5
15.0
12.5
STAI


Activity
fun
commute
socialactivities
work
sport
selfcare
Activity


BDI Score
14
12
10
8
6
4
BDI
2025-05
2025-06
2025-07
2025-08
2025-09
2025-10
Time

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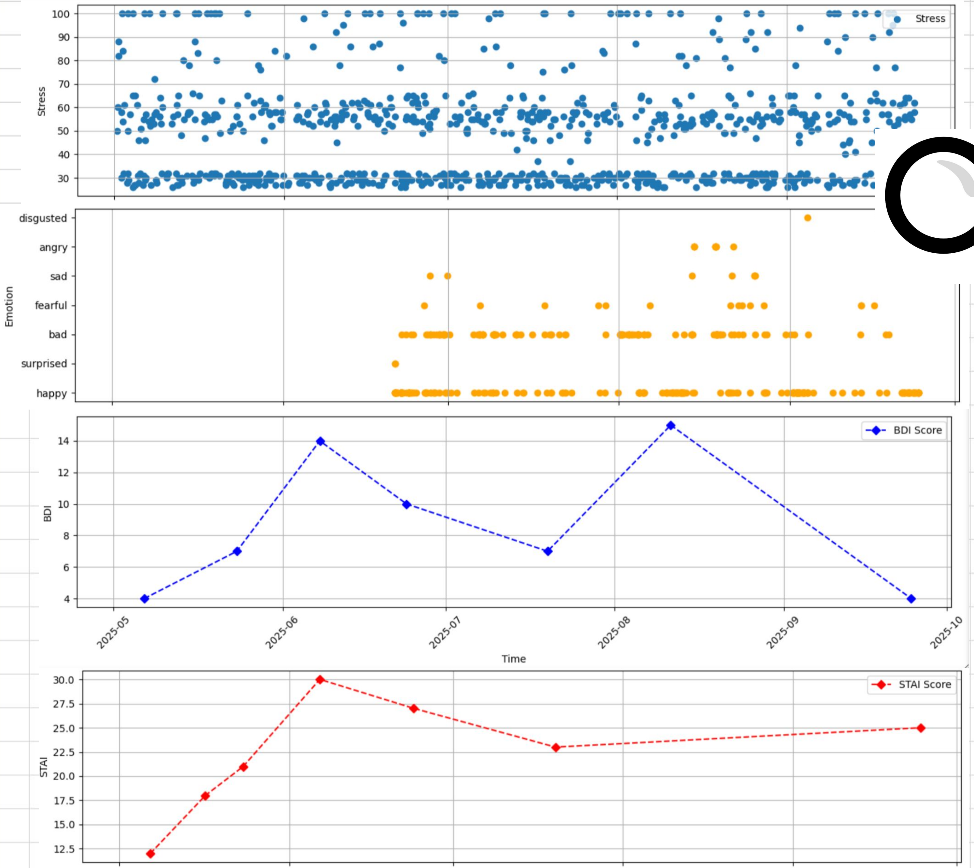
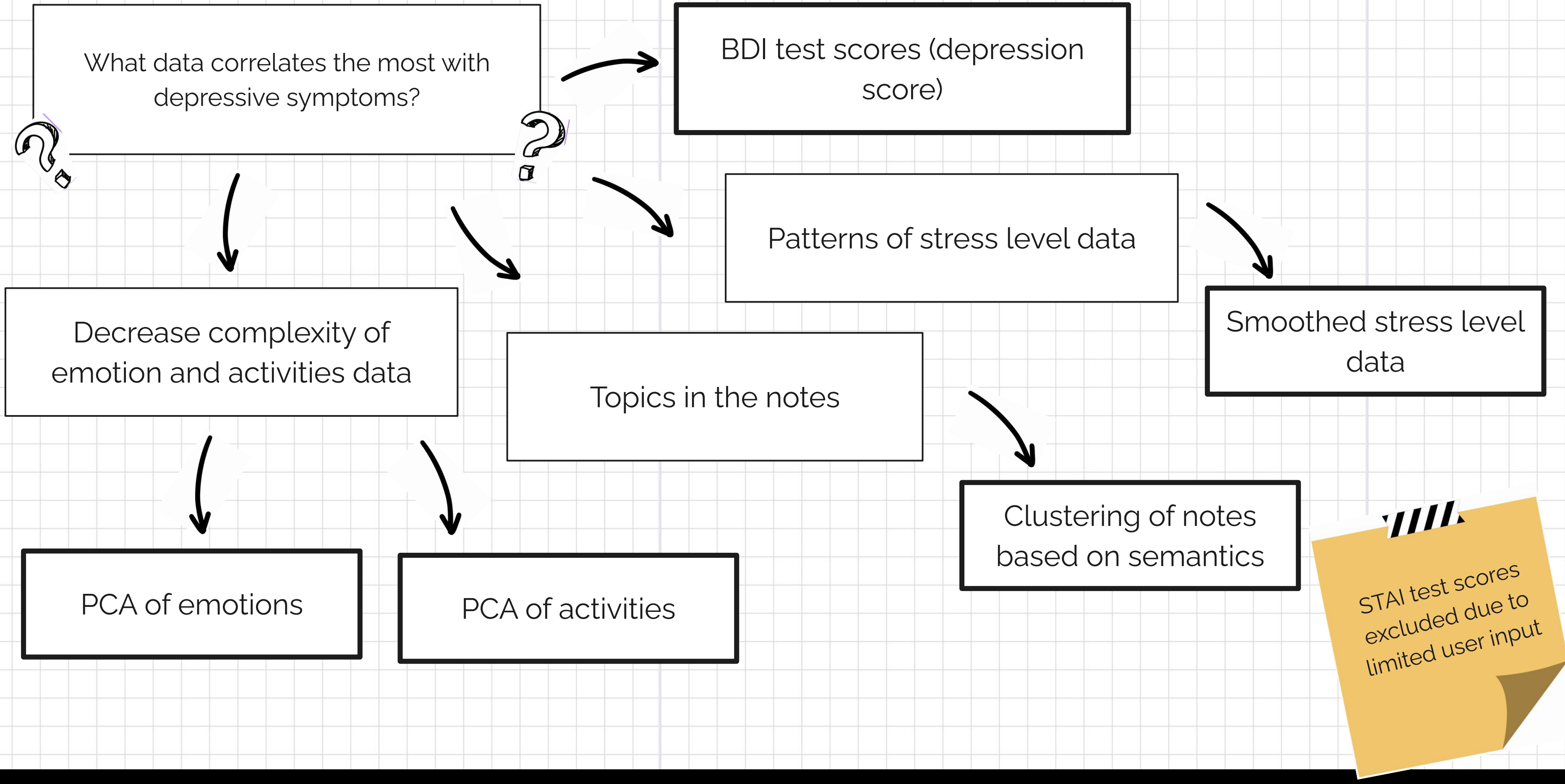


Some “visual” observations

- In mid-august: spike in the depression score + cluster of “angry” emotion + cluster “fearful”
- End of September: decrease in depression score + decrease in the frequency of “bad” emotion
- For the anxiety score it is unknown, as user input is missing
- The frequency of 100% stress level spikes seem to follow a repetitive pattern (low second-half july, high first half august, low second half august, high first half september)

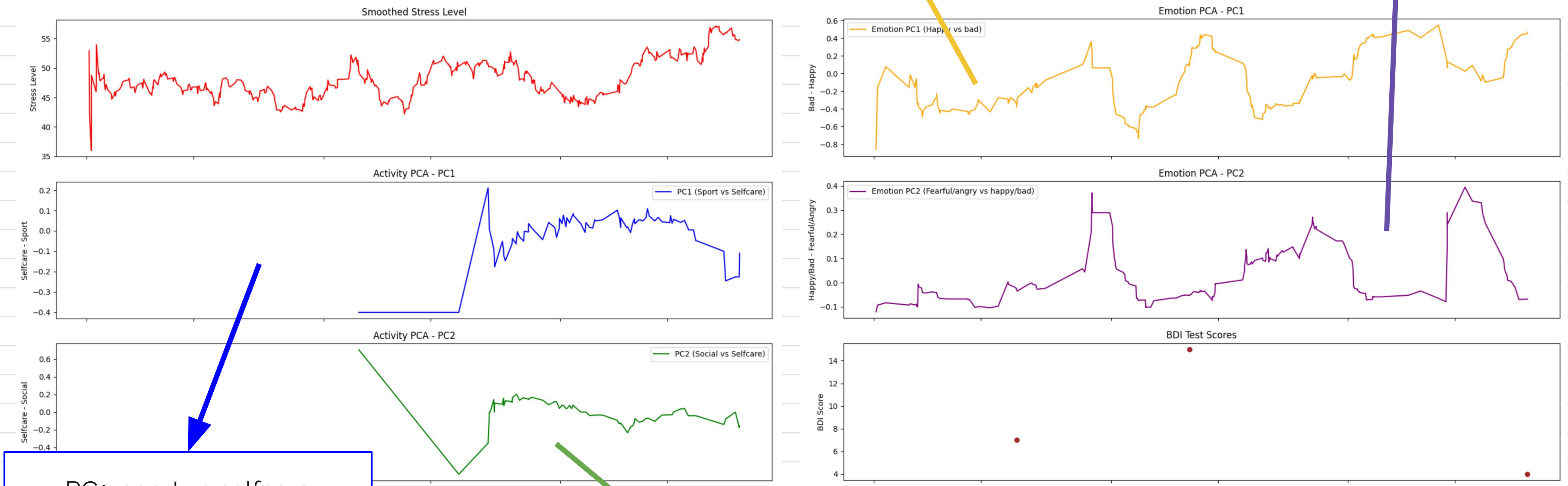
What data could I potentially use to predict an increase in depressive symptoms?

What data correlates the most with depressive symptoms?


What data correlates the most with depressive symptoms?
BDI test scores (depression score)
Patterns of stress level data
Smoothed stress level data
Decrease complexity of emotion and activities data
Topics in the notes
Clustering of notes based on semantics
PCA of emotions
PCA of activities
STAI test scores excluded due to limited user input

PC1: happy vs bad (valence)

PC2: fearful/angry vs happy/bad (arousal)



PC1: sport vs selfcare

PC2: social activities vs selfcare

	cluster	cluster_label	cluster_label_short
0	2	better, increasing, stress, today, work	better, increasing
11	0	catch, focus, tasks, today, tried	catch, focus
23	1	argh, best, feeling, overwhelmed, panic	argh, best
31	3	argh, relief, today, tried, understanding	argh, relief

Cluster about "overwhelmed" / "panic" around period of peak BDI score

Cluster about "tasks" / "tried" before period of peak BDI score

Cluster about "relief" / "understanding" around period of decrease BDI score

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Analysis
of correlations

Depression scores vs
emotions, activity, stress

Depression scores vs
semantic clusters of notes

Analysis
of correlations

Depression scores vs
emotions, activity, stress

Depression scores vs
semantic clusters of notes

```
Correlation with BDI:
stress_mean              -0.747643
stress_std                0.550531
stress_integral          -0.596691
stress_slope             -0.178195
activity_PC1_mean        -1.000000
activity_PC1_std               NaN
activity_PC1_integral    -1.000000
activity_PC1_slope             NaN
activity_PC2_mean         1.000000
activity_PC2_std               NaN
activity_PC2_integral     1.000000
activity_PC2_slope             NaN
emotion_PC1_mean         -0.693095
emotion_PC1_std           0.763308
emotion_PC1_integral     -0.777341
emotion_PC1_slope         0.053591
emotion_PC2_mean         -0.204946
emotion_PC2_std           0.019092
emotion_PC2_integral     -0.198089
emotion_PC2_slope        -0.313062
Name: value, dtype: float64
```

Perfect correlation between activities and BDI score, probably due to low quantity of data

Discard result and check it again in the next months

```
Correlation with BDI:
stress_mean              -0.747643
stress_std                0.550531
stress_integral          -0.596691
stress_slope             -0.178195
activity_PC1_mean        -1.000000
activity_PC1_std               NaN
activity_PC1_integral    -1.000000
activity_PC1_slope             NaN
activity_PC2_mean         1.000000
activity_PC2_std               NaN
activity_PC2_integral     1.000000
activity_PC2_slope             NaN
emotion_PC1_mean         -0.693095
emotion_PC1_std           0.763308
emotion_PC1_integral     -0.777341
emotion_PC1_slope         0.053591
emotion_PC2_mean         -0.204946
emotion_PC2_std           0.019092
emotion_PC2_integral     -0.198089
emotion_PC2_slope        -0.313062
Name: value, dtype: float64
```

Perfect correlation between activities and BDI score, probably due to low quantity of data

Discard result and check it again in the next months

The higher the depression score the **higher the variability of emotional valence**

The higher the depression score, the **more negative** their emotional valence over time.

```
Correlation with BDI:
stress_mean              -0.747643
stress_std                0.550531
stress_integral          -0.596691
stress_slope             -0.178195
activity_PC1_mean        -1.000000
activity_PC1_std               NaN
activity_PC1_integral    -1.000000
activity_PC1_slope             NaN
activity_PC2_mean         1.000000
activity_PC2_std               NaN
activity_PC2_integral     1.000000
activity_PC2_slope             NaN
emotion_PC1_mean         -0.693095
emotion_PC1_std           0.763308
emotion_PC1_integral     -0.777341
emotion_PC1_slope         0.053591
emotion_PC2_mean         -0.204946
emotion_PC2_std           0.019092
emotion_PC2_integral     -0.198089
emotion_PC2_slope        -0.313062
Name: value, dtype: float64
```

Inverse correlation between **depression** and **stress level** (mean and cumulative)

Temporal offset or **compensatory behavior**?

The higher stress variability the higher the depression

Perfect correlation between activities and BDI score, probably due to low quantity of data

The higher the depression score the **higher the variability of emotional valence**

The higher the depression score, the **more negative** their emotional valence over time.

```
Correlation of shifted stress features with BDI (7d shift):
 timestamp                  -0.435960
mean_stress_prev_days       -0.604671
std_stress_prev_days         0.570673
integral_stress_prev_days   -0.952349
Name: value, dtype: float64
Correlation of shifted stress features with BDI (14d shift):
 timestamp                  -0.435960
mean_stress_prev_days       -0.743999
std_stress_prev_days         0.543824
integral_stress_prev_days   -0.644848
Name: value, dtype: float64
Correlation of shifted stress features with BDI (21d shift):
 timestamp                  -0.435960
mean_stress_prev_days       -0.807721
std_stress_prev_days        -0.637605
integral_stress_prev_days    0.999117
Name: value, dtype: float64
```

The higher the cumulative stress in the previous 21 days, the higher the BDI score

Analysis
of correlations

Depression scores vs
emotions, activity, stress

Depression scores vs
semantic clusters of notes

cluster_id	top_keywords	num_notes	median_BDI	mean_BDI
1	argh, best, feeling, overwhelmed, panic	8	15.0	15.000000
3	argh, relief, today, trying, understanding	5	15.0	10.600000
2	better, increasing, stress, today, work	13	10.0	11.384615
0	argh, catch, motivated, tasks, tried	4	8.5	8.500000
4	focused, noticed, overwhelmed, today, tried	10	7.0	9.100000

Notes about “overwhelm” and “panic” associated with the period with highest BDI score

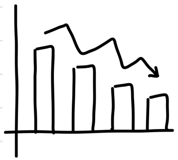
The higher stress variability the higher the depression

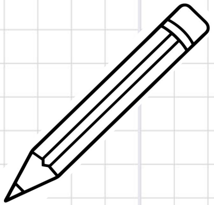
The higher the cumulative stress in the previous 21 days, the higher the BDI score

The more depressed the person feels (higher BDI), the **higher the variability of emotional valence**

The more depressed the person feels (higher BDI), the **more negative** their emotional valence over time.

Notes about “overwhelm” and “panic” associated with the period with highest BDI score





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Reflections

Individualized analysis of data

Iterative process based on this first learnings

Potentially use it for predictions

Technology doesn’t make us less human.
It can make us more aware of who we truly are

Thank you

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