Brown University

Exploring Neural Data

Final Project: **Sleep EEG Data Project**

[Data from the laboratory of Dr. Mary Carskadon]

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1. Description of the Data

In this project I will compare sleep data from four subjects. For each of these 4 subjects, we have a baseline night (BSL) of rested sleep and a recovery night following sleep deprivation (REC).

There are 9 channels recorded in DATA:

- EEG Channels:
  - Channel 1: C3/A2
  - Channel 2: O2/A1
  - Channel 8: C4/A1
  - Channel 9: O1/A2
- EOG Channels:
  - Channel 3: ROC/A2
  - Channel 4: LOC/A1
- EMG Channels:
  - Channel 5: Chin EMG 1
  - Channel 6: Chin EMG 2
  - Channel 7: Chin EMG 3

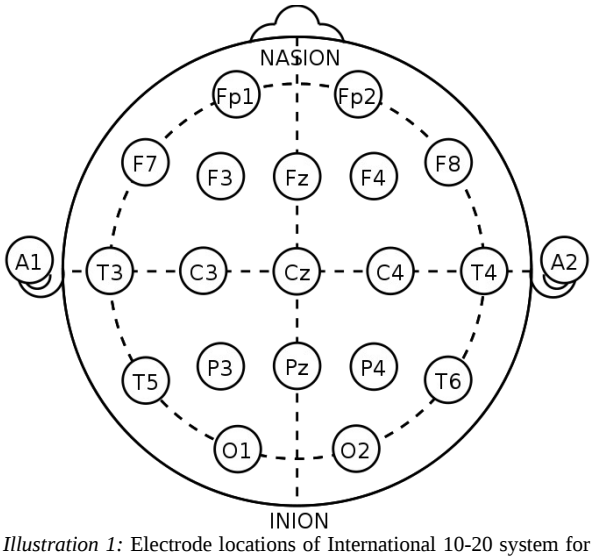

Illustration 1: Electrode locations of International 10-20 system for EEG (electroencephalography) recording

DATA is a channel x samples 2-dimensional array. (So 9 x the number of samples). Srate is the sampling rate. Stages are the researcher classified stages for each 30s epoch in the data set.

2. Choosing A Question

Questions consider with previously described data set.

- How does the amount of time spent in each sleep stage change between the well-rested night and the sleep-deprived night?
- How much variability is there between time spent in each sleep stage between different subjects?

3. Findings

3.1 Figures

3.1.1 *Spectrograms and hypnograms for BSL and REC night sleep*

From data I have ploted spectrograms and hypnograms for BSL and REC night sleep. There are two spectrograms and two hypograms for each tested subject. Later in my work, I used hypnograms to analyze times spent in each stage. The classification scheme in hypograms, is as follows:

7 - Unscored
0 - Awake
1 - NREM Stage 1
2 - NREM Stage 2
3 - NREM Stage 3
4 - NREM Stage 4
5 - REM Sleep
6 - Movement Time

SUBJECT 1 FIGURES:

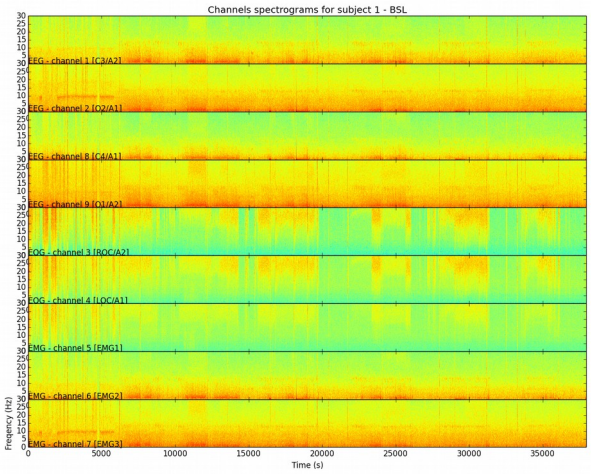

Illustration 2: Spectrograms for subject 1 - BSL

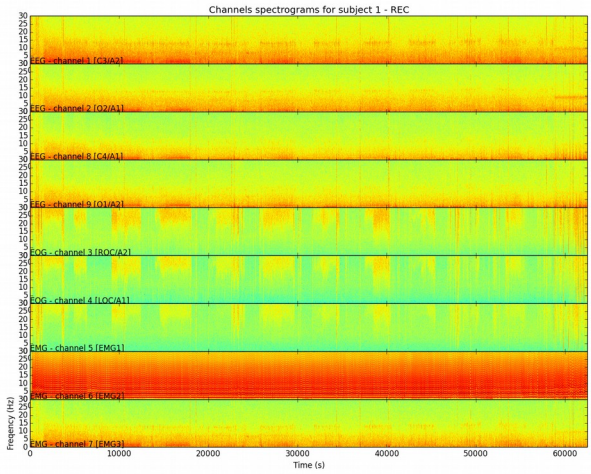

Illustration 3: Spectrograms for subject 1 - REC

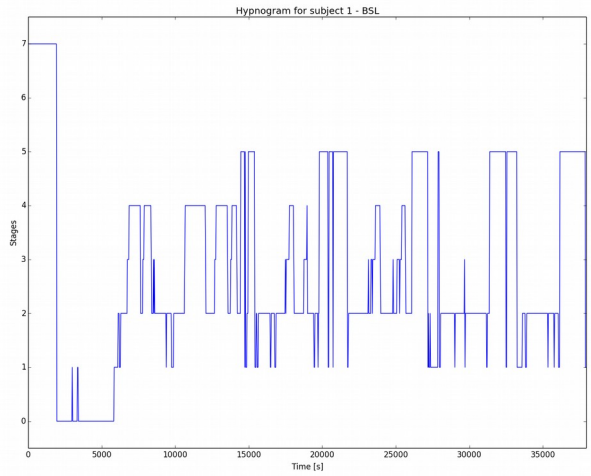

Illustration 4: Hypnogram for subject 1 – BSL night sleep

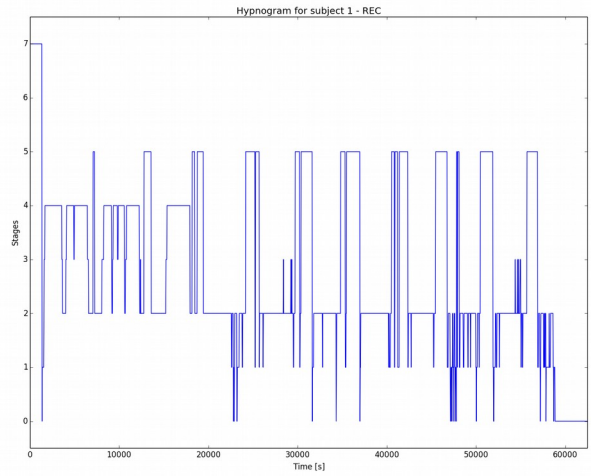

Illustration 5: Hypnogram for subject 1 – REC night sleep

SUBJECT 2 FIGURES:

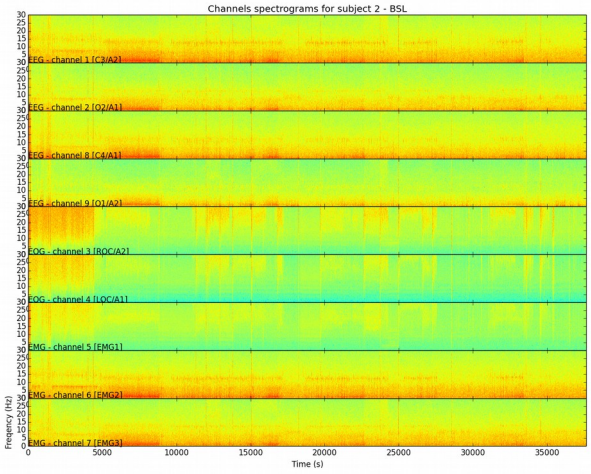

Illustration 6: Spectrograms for subject 2 - BSL

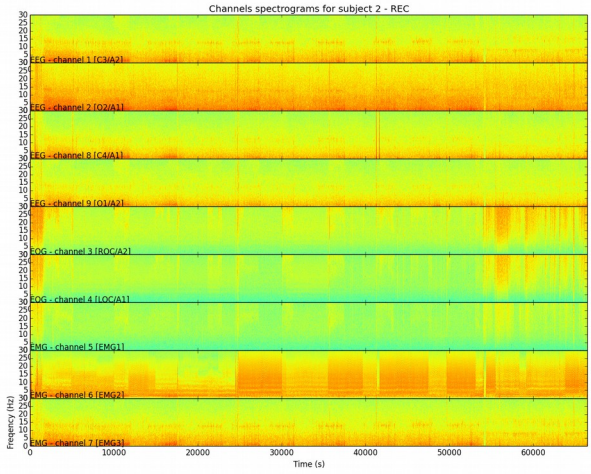

Illustration 7: Spectrograms for subject 2 - REC

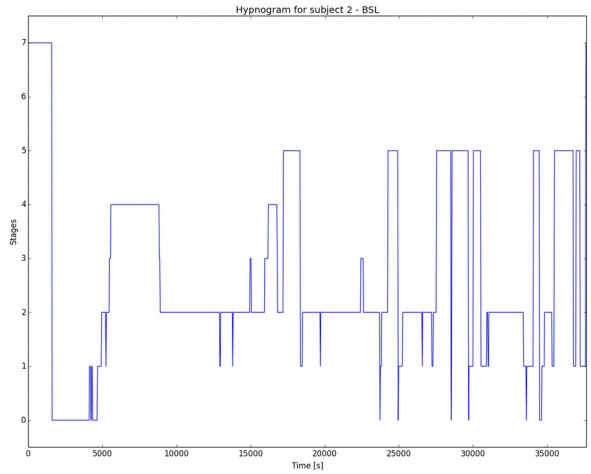

Illustration 8: Hypnogram for subject 2 – BSL night sleep

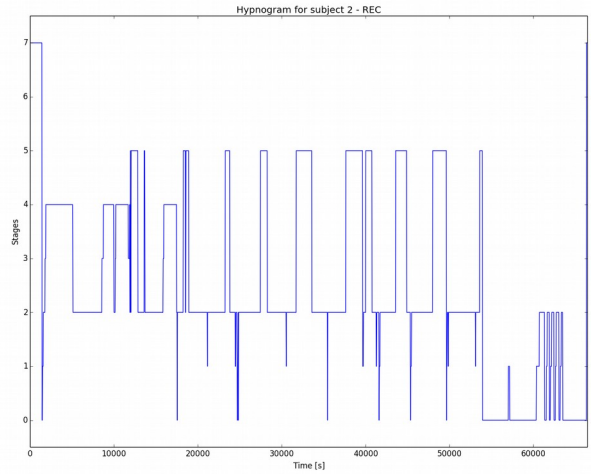

Illustration 9: Hypnogram for subject 2 – REC night sleep

SUBJECT 3 FIGURES:

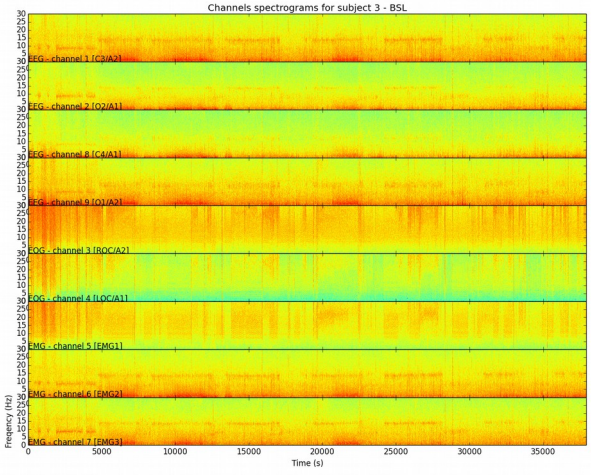

Illustration 10: Spectrograms for subject 3 - BSL

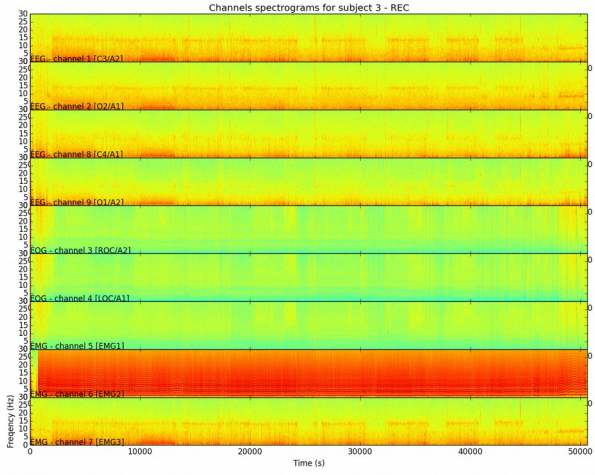

Illustration 11: Spectrograms for subject 3 - REC

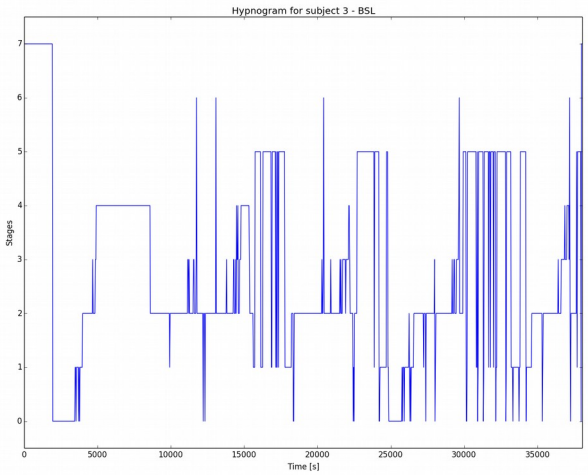

Illustration 12: Hypnogram for subject 3 – BSL night sleep

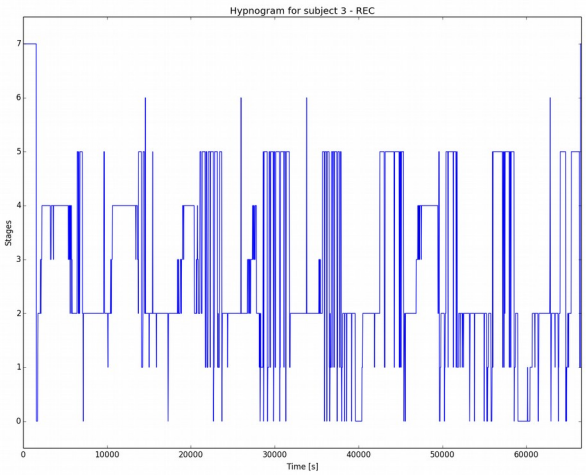

Illustration 13: Hypnogram for subject 3 – REC night sleep

SUBJECT 4 FIGURES:

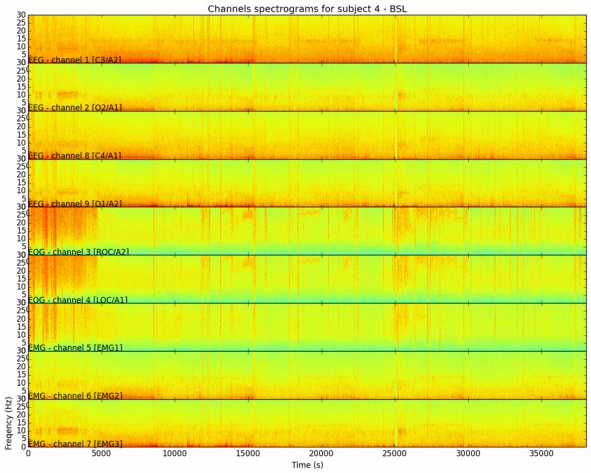

*Illustration 14: S*pectrograms for subject 4 - BSL

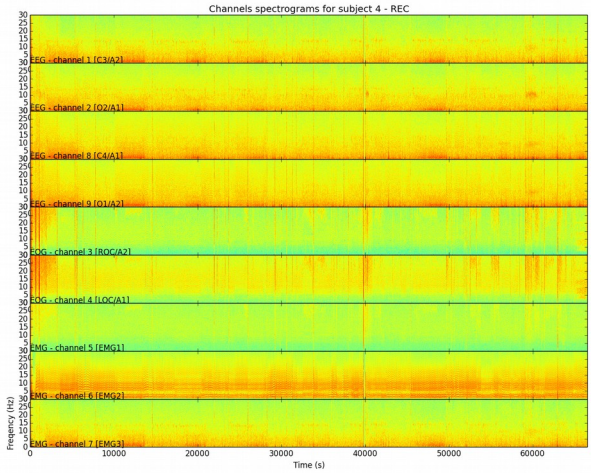

Illustration 15: Spectrograms for subject 4 - REC

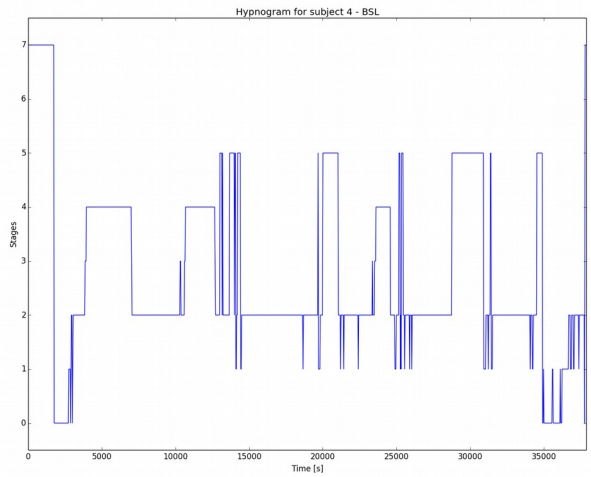

Illustration 16: Hypnogram for subject 4 – BSL night sleep

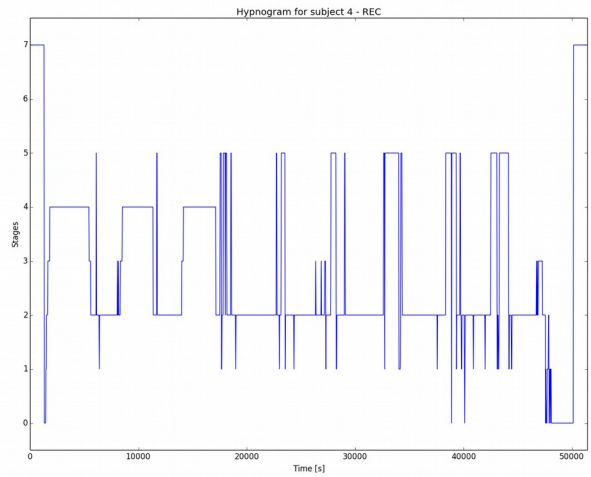

Illustration 17: Hypnogram for subject 4 – REC night sleep

3.1.2 *Comparison of time spent in each sleep stage between BSL and REC night sleep*

Below are plots of normalized time vs stages for BSL and REC night sleep for all four subjects.

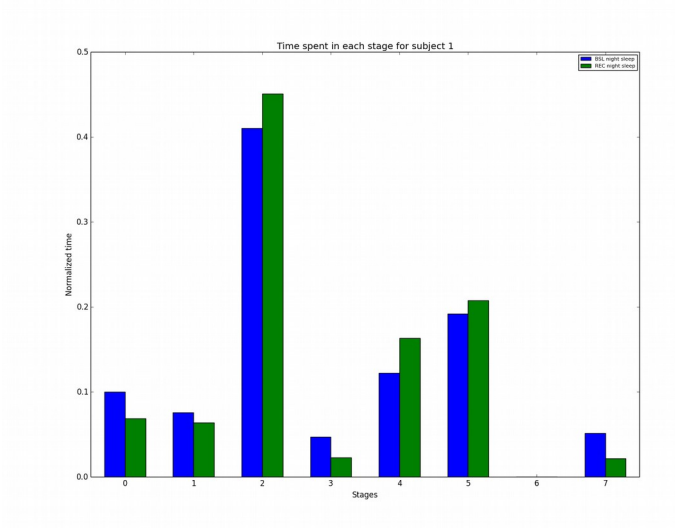

Illustration 18: SUBJECT 1

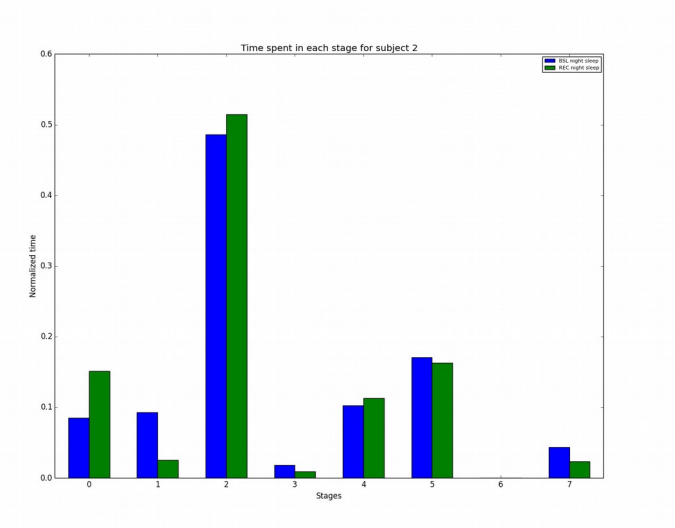

Illustration 19: SUBJECT 2

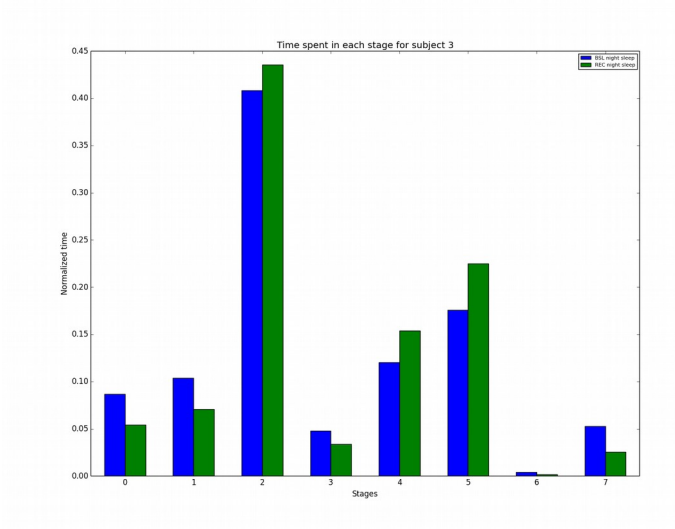

Illustration 20: SUBJECT 3

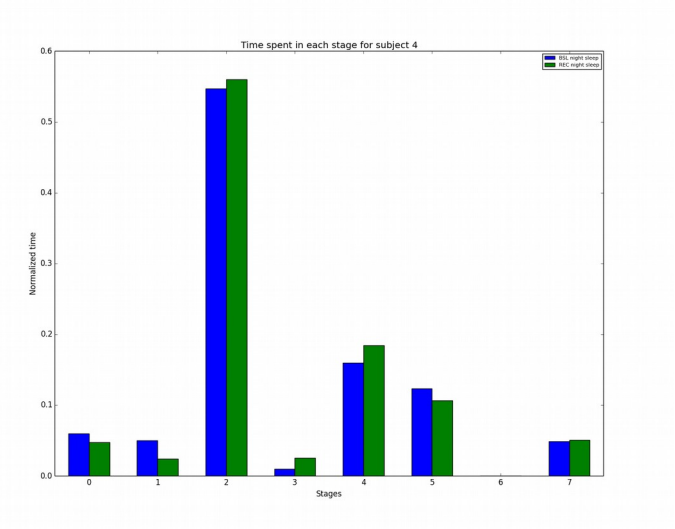

Illustration 21: SUBJECT 4

3.1.3 *Comparison of time spent in each sleep stage between subjects*

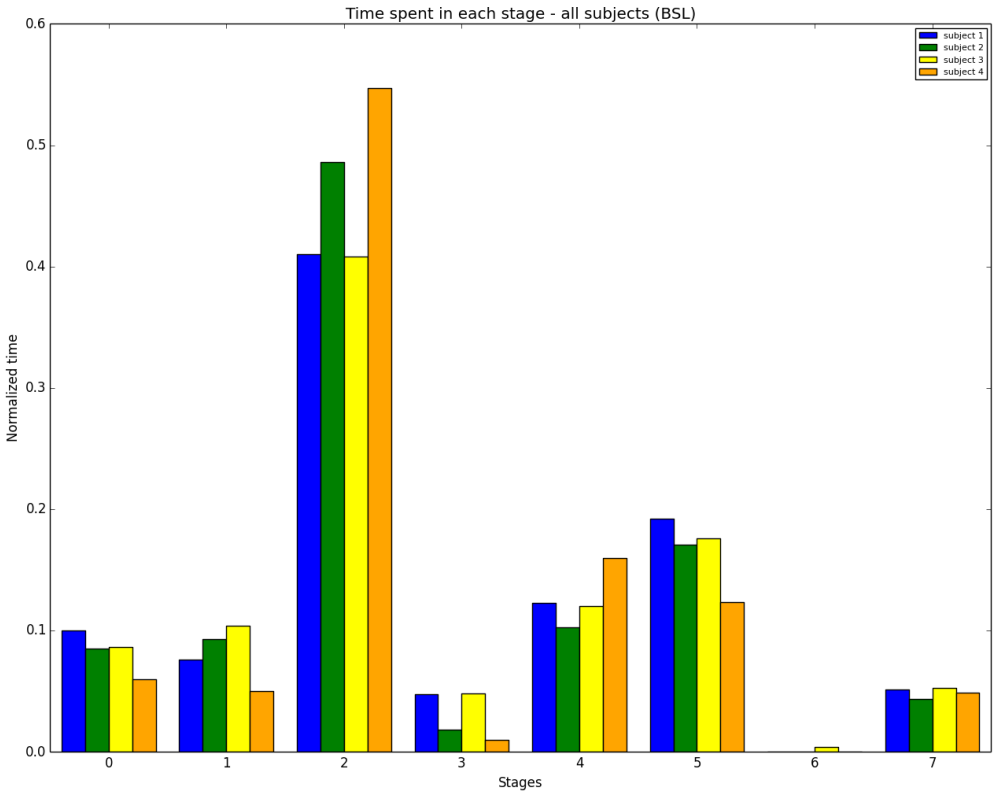

Illustration 22: Baseline sleep night

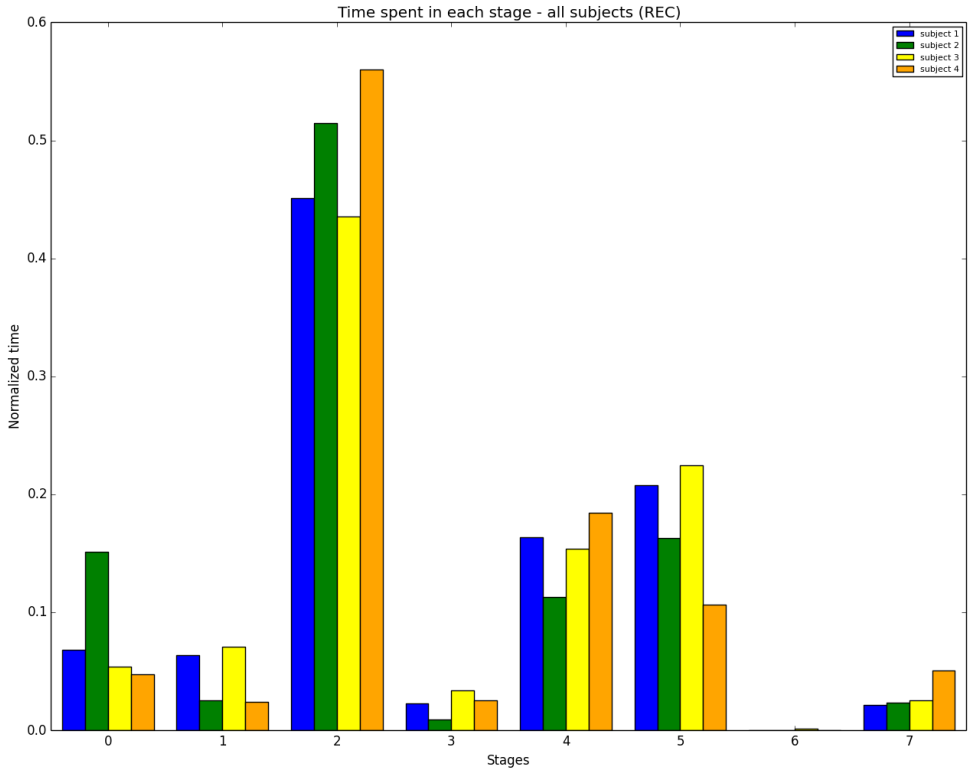

Illustration 23: Recovery sleep night

3.2 Interpretation

3.2.1 *Interpretation of time spent in each sleep stage between BSL and REC night sleep*

According to data ploted under section 3.1.2, one can clearly see, that subjects stayed in average around 50% of their sleep time in NREM stage 2 and around 18% of their time in REM sleep. One can also see, that time spent in stages NREM 2, 4 and in REM stage, is little bit bigger in REC night sleep. And otherwise in other sleep stages.

3.2.2 *Interpretation of time spent in each sleep stage between subjects*

STAGES		BSL	REC
0	Awake	S1	S2
1	NREM Stage 1	S3	S3
2	NREM Stage 2	S4	S4
3	NREM Stage 3	S3	S3
4	NREM Stage 4	S4	S4
5	REM Sleep	S1	S3
6	Movement Time	/	/
7	Unscored	S3	S4

Table above shows subjects, that spent the most of the time in current stage, during sleep experiment.

4. Interesting programming tricks

I started on this project to late, so unfortunately I didn't include any interesting programming tricks in my project. But I was planing on using logistic regression and neural networks on experimental data.

5. Problems

The biggest problem, that I came across, was different length of experimental data. So first, I didn't know how to analyze time spent in each stage for all subjects. I solved this problem by normalizing time axis in plots under 3.1.2 section.

6. Where should I go next

In future I will try to build a classifier with machine learning algorithms, mentioned under section 4.

7. References

[1] https://d396qusza40orc.cloudfront.net/neuraldata/final%20projects/Sleep%20EEG%20Data%20Project%20%28Unit%204%29.pdf, 9.12.2014

[2] http://www.foocus.com/11%20Handouts/GlenRoldan-ScoringASleepTest.pdf, 9.12.2014

[3] http://en.wikipedia.org/wiki/10-20_system_(EEG), 9.12.2014