Slide set 1 exercises

(NOTE: you can merge the subprojects in to the same document)

Exercise 1

Time series scaling exercise. Download audio file 'kuusi.wav' from Moodle 1st folder to your own work folder and load it to Python:

```
from scipy.io import wavfile
Fs, y = wavfile.read('./Kuusi.wav')
```

NOTE: the file is either uint8 or uint16-type, convert it to double using:

```
y=double(y)
```

remove mean with **y=y-np.mean(y)**
and scale it so that the maximum and minimum are between -1…1.
y=y/np.max(np.abs(y))

(NOTE: speech time series may be nonsymmetric in y-axis, do not worry about that).
Include figures and code in your analysis pdf.

Max 3 p.

Exercise 2

For this exercise, use for example **Librosa** (or similar) package to downsample **y_low** directly, for example

```
import librosa
y_low, s = librosa.load('Kuusi.wav', sr=2000) # Downsample 8kHz to 2kHz
```

and test how low you can reduce the **sr** from 8000 Hz in order to understand the message. Play sound using (and modifying), for example, "python_play_sound_example.py" from the file folder.
How low you can resample it from the original sampling rate that you can understand the message? (Ignore the Nyquist limit because "resample" operations in librosa will deal it automatically)
Include figure(s) and code in your analysis answer.

Max 2 p.

Exercise 3

Download ‘kuusi.wav’ instead of the sinusoidal in the *average_filter.py* code.

and change the variable name of ‘y’ if you want for easy processing and the associate operations to ‘data’ variable.

- Modify sliding window computation code, (download *average_filter.py* from code folder) and uncomment both ’skewness’ and ’kurtosis’ functions in sliding window loop, so that the both functions are computed frame-by-frame basis. Idea is that you produce time-varying curves of skewness and kurtosis along the original time series, and you can observe the fluctuations in all curves at once)

- Experiment with the window size parameter len1=1, up to hundreds so that the energy curve is smooth and ‘nice-looking’. What is the purpose of ‘smoothness in energy curve’ Think is in the context of machine processing.

- Explain using your own words what those functions do and speculate how you can use them in time series analysis. The main target can be either classification or regression. Explain verbally also what the Python function **’moment’** does.

- Modify the code to show the fluctuations with ‘AMZN.pkl’ data (choose whichever channel you want, for example ‘Open’ meaning daily opening prize for Amazon stock). What is window size for smooth energy curve?

Include figures and code to your analysis answer.

Max 6 p.

Exercise 4

Although machine learning includes all parametric algorithms that finds the optimized parameters from the data, for example ‘one coefficient linear filter’, machine learning is usually associated with neural networks.

Explain verbally:

- What is your own opinion about machine learning, what does it contain?
- Why are the neural networks having so dominant role in machine learning?
- Why there are so many architectures in neural networks?
- How is the architecture decided?

Answer briefly, extract your thoughts to 2-5 sentences per token.

Max 4 p.