

# CNS2025: Homework 3

Due: 2025-09-24 23:59

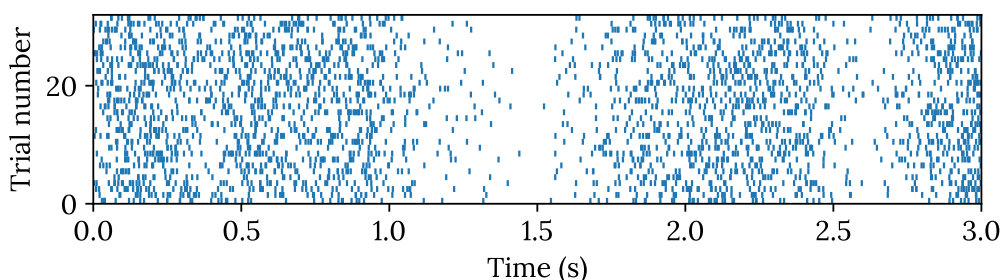
The objective of the homework is to generate spike-trains from given firing rate as a function of time.

## Exercise 1

Load the data file [hw03-data.npz](#) using `np.load`. Find the array of firing rate `f['rates']` in Hz and time step size `f['delta_t'][(0)]` in s in the file. Make a plot of the rate versus time for the duration `duration = delta_t*len(rates)`.

## Exercise 2

Using the “random points in a box” (Do not use the `gen_spikes` functions provided in the `code03.ipynb` file, which implements a different algorithm to be discussed later.) method as discussed in the lecture to construct 100 spike trains (100 trials) based on the given rate function. Make a raster plot similar to the following:



## Exercise 3

Pick a spike train generated above, say `spikes` from trial 100, which should be in time-of-spike representation. Convert it to frame-based representation with  $\Delta t = 0.0001$  s (or `frame_dt = 0.0001`, note that this is different from `delta_t` of original firing rate sampling time) of time between frames so that `frame_times = np.arange(0,duration,frame_dt)` using, for example,

```
frames = np.zeros_like(frame_times)
frames[(spikes/frame_dt).astype(int)] = 1
```

Convert the frame-based spike train into firing rate versus time using a Gaussian kernel of standard deviation  $\sigma = 0.1$  s as well as the `np.convolve()` function and plot the result similar to what was done in [Homework 2](#). Plot the original rate from Ex.1 in the same plot using dashed line for comparison.

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