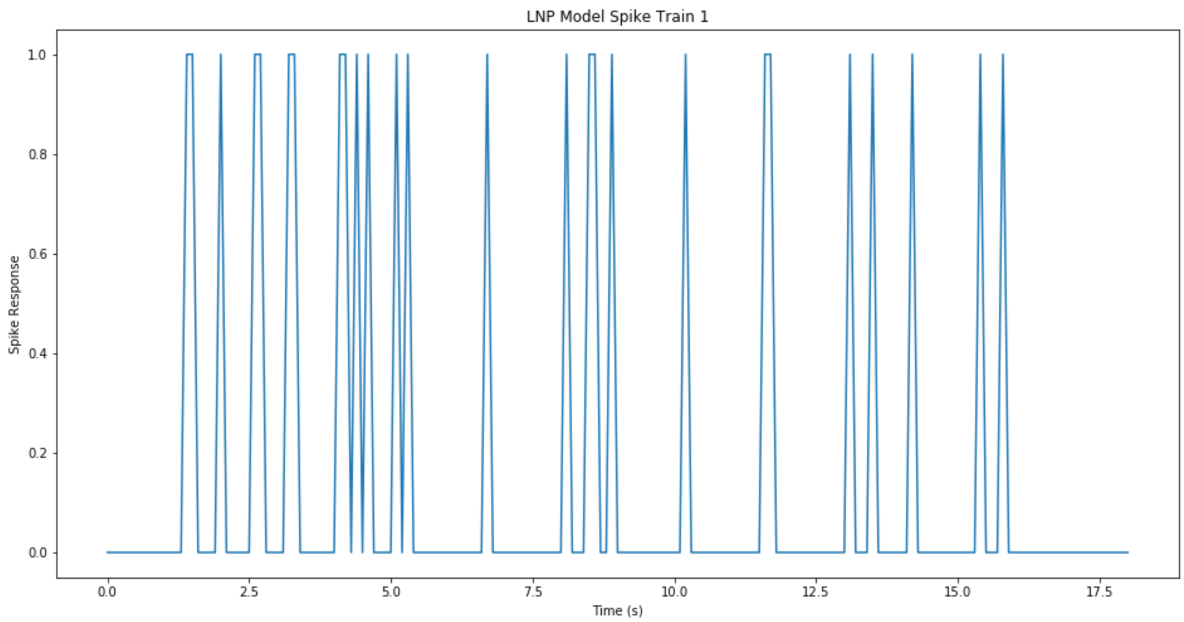
Problem 4

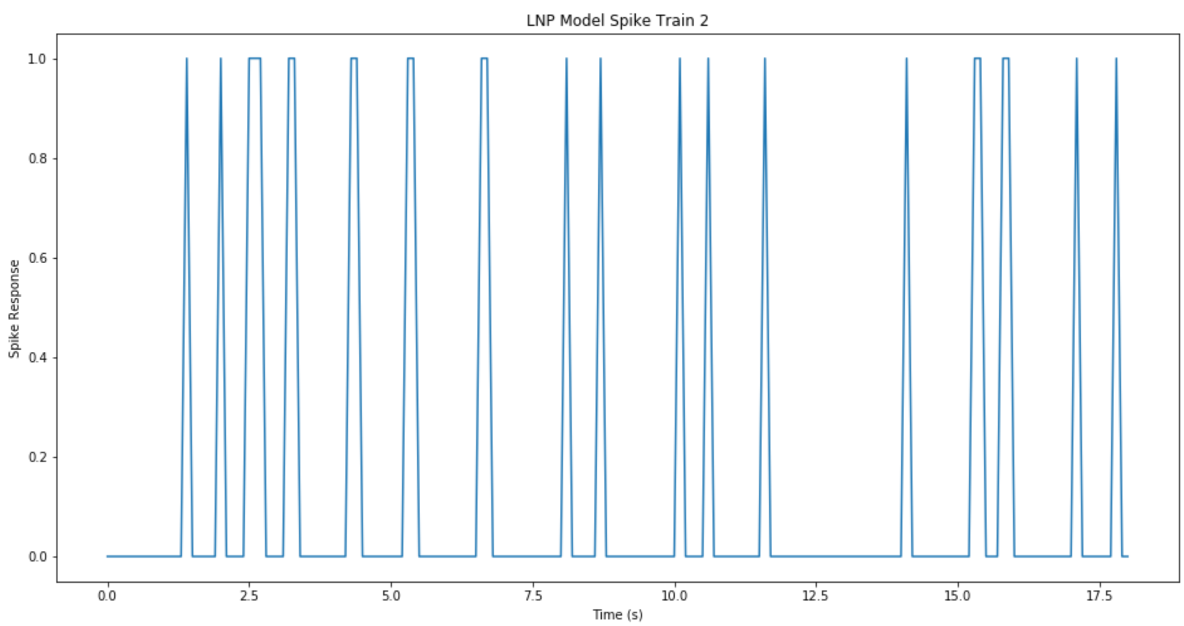
Out[1]: Toggle Code

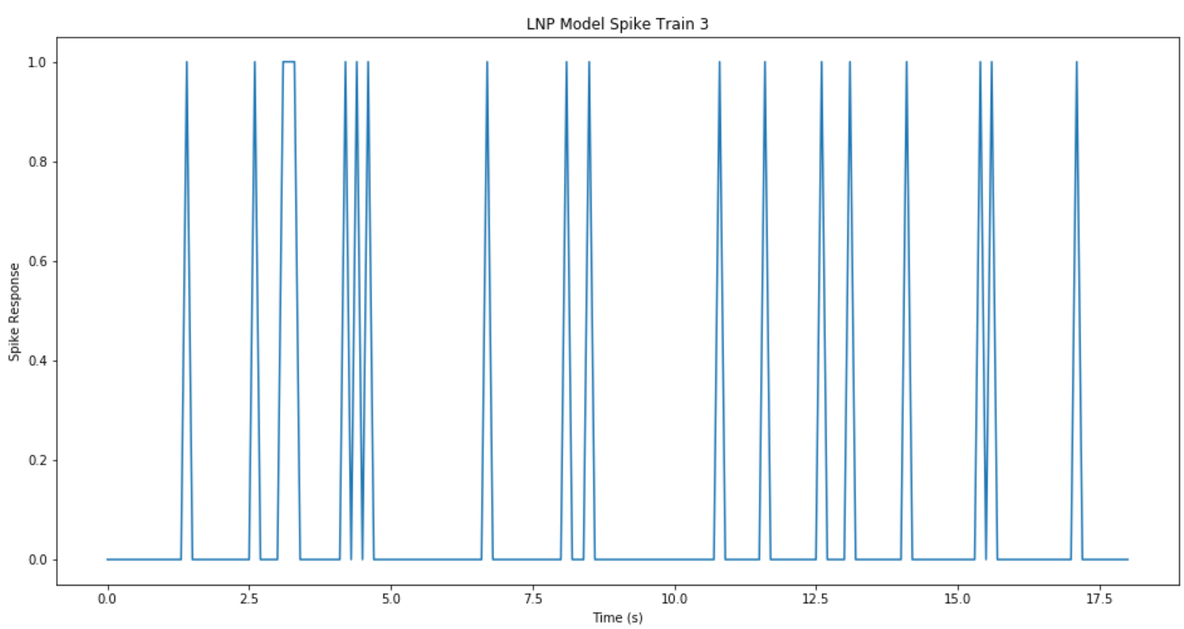
Methods

Using the LN model from problem 3, we generate spike trains using an inhomogeneous possion process. A uniform random variable, $X_t \in [0, 1]$, was generated for each time point corresponding to output of the LN model, $\lambda(t)$. The LN model was normalized by taking the maximum of the LN model output, denoted by λ_{max}. Spike trains were generated by comparing normalized LN model to the generated uniform random variable. Spikes were realized at that time point if the value of the random variable was less than the normalized LN model output. A total number of 1000 spike trains was generated using this procedure, and the ISI Distribution, Fano Factor, and Coefficient of Variation were plotted/calculated. We obtain the ISI distribution by finding the indices of each spike in the spike train, and calculating the number of elements between each spike. For the Fano factor, we simply divide the variance of the spikes in all trains by the mean number of spikes in all trains. Finally, for the Coefficient of Variation, we divide the standard deviation of the ISI distribution, by the mean of the distribution.

(i) LNP Spike Trains


LNP Model Spike Train 1
Spike Response
Time (s)
0.0
0.2
0.4
0.6
0.8
1.0
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5


LNP Model Spike Train 2
Spike Response
Time (s)
0.0
0.2
0.4
0.6
0.8
1.0
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5


LNP Model Spike Train 3
Spike Response
Time (s)
0.0
0.2
0.4
0.6
0.8
1.0
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5

(ii) Fano Factor, Coefficient of Variation, and ISI Distribution

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Fano Factor: 0.870558011049724
Coefficient of Variation: 1.0708175319567474
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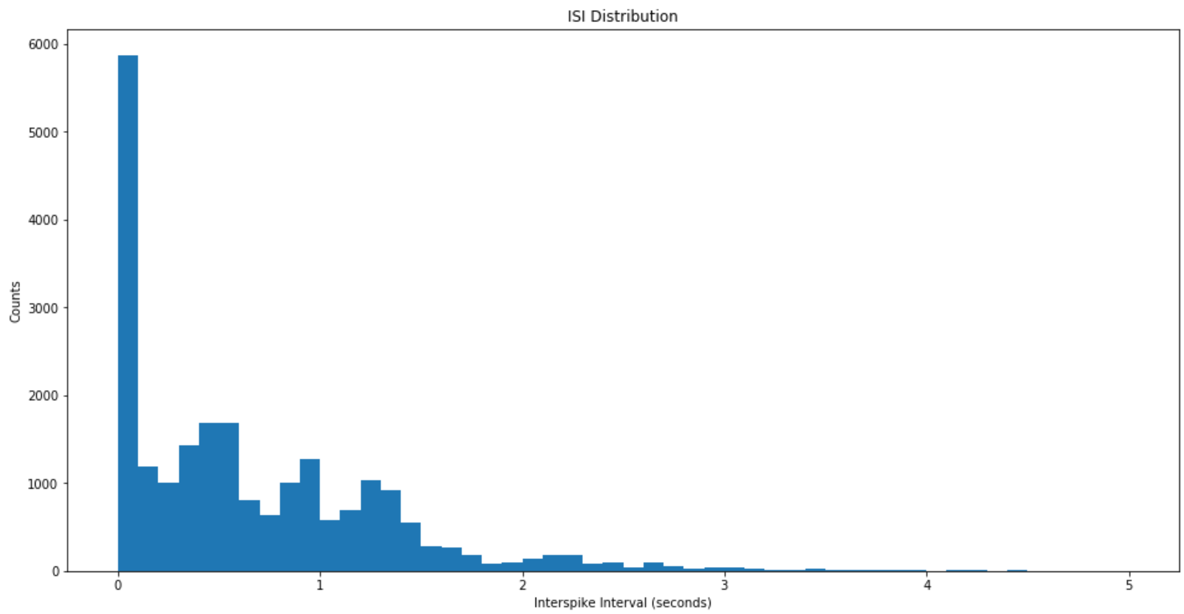

Discussion

The ISI distribution seems to follow a decreasing exponential distribution, which seems to indicate that the process used to generate the spike train is a poisson process. A Fano Factor and Coefficient of Determination of 1, would also indicate that the process is a poisson process. A Fano Factor of 0.87 and Coefficient of 1.07 indicate that the process is close to a poisson process, but not quite one. This may be due to the fact that this process is inhomogeneous instead of homogeneous.