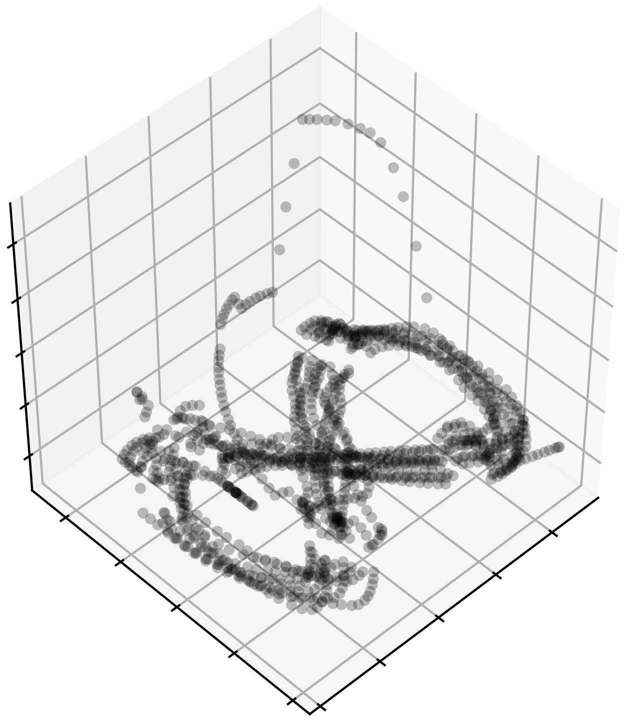
fitting a self organizing map to in-game data

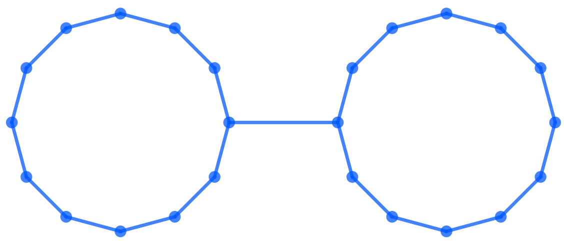
The file `q3dm1-path2.csv` contains a sequence

$$\boldsymbol{x}[1] : \boldsymbol{x}[2] : \boldsymbol{x}[3] : \boldsymbol{x}[3] : \cdots : \boldsymbol{x}[n]$$

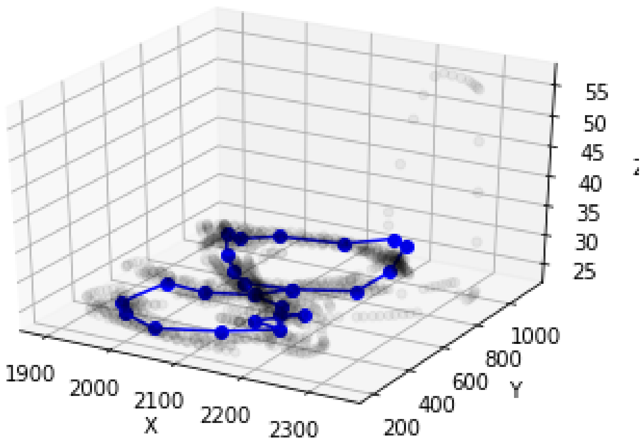
of 3D locations the avatar of a human player was seen at while moving around the Quake III map *q3dm1*. When plotted, these data look like this



Fit a self organizing map of $k = 24$ neurons into the given data points $\boldsymbol{x}[t]$. This SOM should have the following topological- or *map space* structure



Plot the data in `q3dm1-path2.csv` together with the SOM you fitted to it. Plot data points in black and SOM weights and their connections in blue. **Note:** if your fitted SOM looks "twisted", then run the training algorithm again, until you obtain a better fit.



Once you have fitted your SOM, determine how well its weights $\boldsymbol{w}_1, \ldots, \boldsymbol{w}_k$ represent the data. To do this, compute the mean squared error

$$E = \frac{1}{n} \sum_{t=1}^{n} \min_i \left\| \boldsymbol{x}[t] - \boldsymbol{w}_i \right\|^2$$

Round your result to *two* decimals and enter it here

$$E = 1671.85$$

action primitives from in-game data

Given the sequence

$$\boldsymbol{x}[1] : \boldsymbol{x}[2] : \boldsymbol{x}[3] : \boldsymbol{x}[3] : \cdots : \boldsymbol{x}[n]$$

of subsequent 3D locations contained in file `q3dm1-path2.csv`, compute a sequence

$$\boldsymbol{v}[1] : \boldsymbol{v}[2] : \boldsymbol{v}[3] : \boldsymbol{x}[3] : \cdots : \boldsymbol{v}[n-1]$$

of velocity vectors where

$$\boldsymbol{v}[t] = \boldsymbol{x}[t+1] - \boldsymbol{x}[t]$$

Given your sequence of velocity vectors, compute their average

$$\mathbb{E}\big[\boldsymbol{v}\big] = \frac{1}{n-1}\sum_{t=1}^{n-1} \boldsymbol{v}[t]$$

Enter your result here. That is, replace the dots in the following expression by the appropriate numbers rounded to *four* decimals.

$$\mathbb{E}\big[\boldsymbol{v}\big] = \begin{bmatrix} -0.338 \\ 0.1112 \\ 0. \end{bmatrix}$$

Run k-means clustering on the velocity vectors $\boldsymbol{v}[t]$ to estimate representative velocities or *action primitives* $\boldsymbol{a}_1, \boldsymbol{a}_2, \ldots, \boldsymbol{a}_k$. For $k = 24$, compute the average

$$\mathbb{E}\big[\boldsymbol{a}\big] = \frac{1}{k}\sum_{i=1}^{k} \boldsymbol{a}_i$$

Enter your result here. That is, replace the dots in the following expression by the appropriate numbers rounded to *four* decimals.

$$\mathbb{E}\big[\boldsymbol{a}\big] = \begin{bmatrix} -7.8100e-02 \\ -5.9163e+00 \\ -4.0000e-04 \end{bmatrix}$$