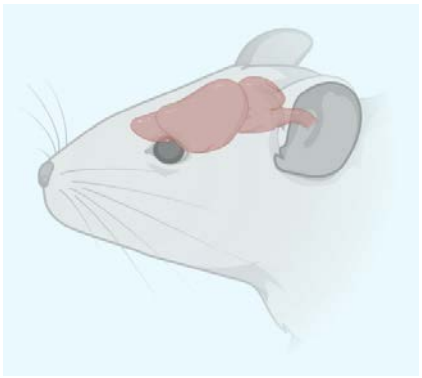
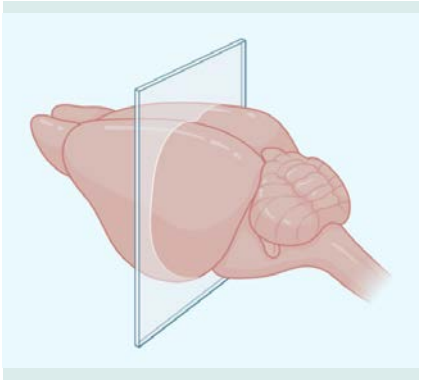
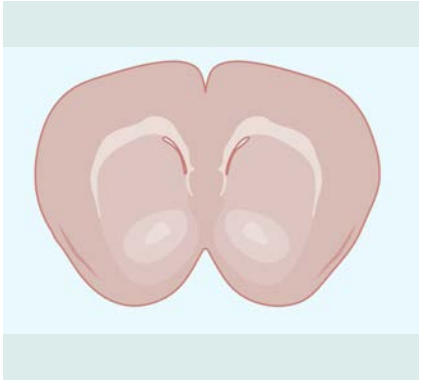
Object classification using Machine Learning

Cell counting in neuroscience has traditionally been performed in sectioned and histochemically labelled material, often by counting all observed objects in a region of interest. One of those cell types that is frequently quantified are Microglia cells, the brains resident immune cells.

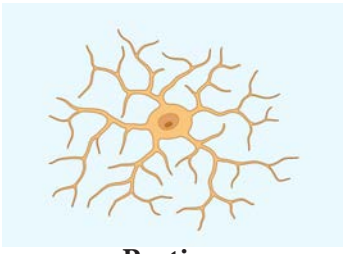




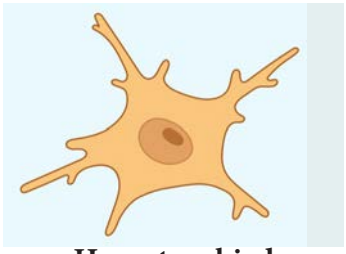


For this, the brains of the animals are removed and sliced in to thin sections. On these sections we then perform some chemical procedures to visualize our cell population of interest (immunohistochemistry). Subsequently we would quantify every cell we can see in a microscope picture. We have recently reported (Anwer et al., 2023; https://doi.org/10.1371/journal.pone.0284480) our machine learning approach to the quantification of Microglia cells. In brief, we have compared and validated different ML architectures that enable the quantification of Microglial cells from tissue sections in a fraction of the time that would taken by a human experimenter.

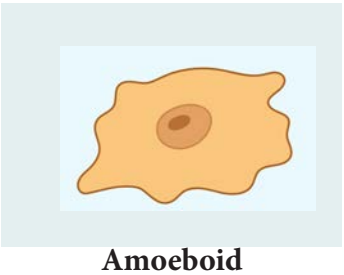
Given our success in the development of the object allocation and quantification algorithm, we would like to add an object classifier to our model. The Microglial cells are usually equally distributed throughout the brain in what is called their "resting state". In this state they are surveying their surroundings for pathogens. Upon detection of a foreign substance, such as a bacteria they would become activated and migrate to the site of inflammation. The different activation states are usually characterised by the shape of the cells (see below). In the proposed MSc project the student will build on our existing model an object classification where the algorithm will be trained to distinguish the located cells based on their appearance.



Resting



Hypertrophied



Amoeboid

We have already sectioned tissue in place in combination with a library of images derived from archived tissue from several experiments. An expert in microglia shape will assist during the classification process. For training of the networks we have a local gaming computer fitted with an RTX3090 as well as access to core hours at the LUNARC computing cluster (https://www.lunarc.lu.se/).

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