# Ensemble Learning



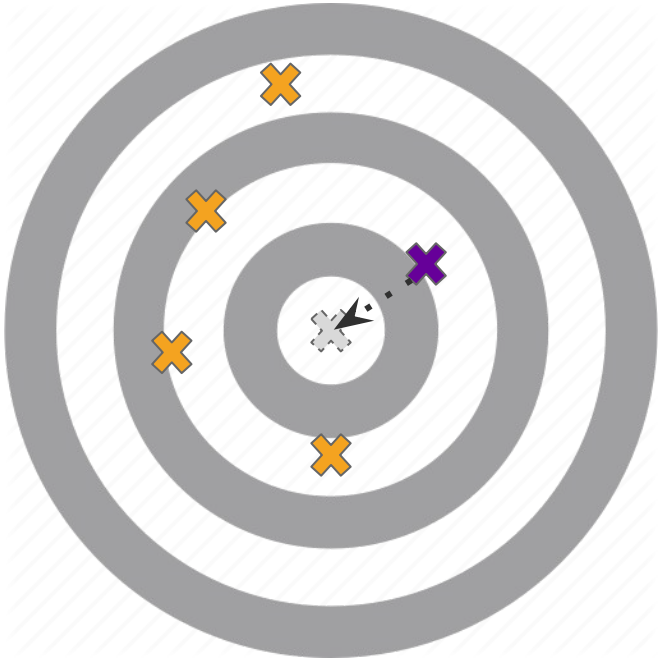
**Why use ensembles?**

Improve generalization performance

Can solve more complex problems than single classifiers

Reduce the risk of overfitting

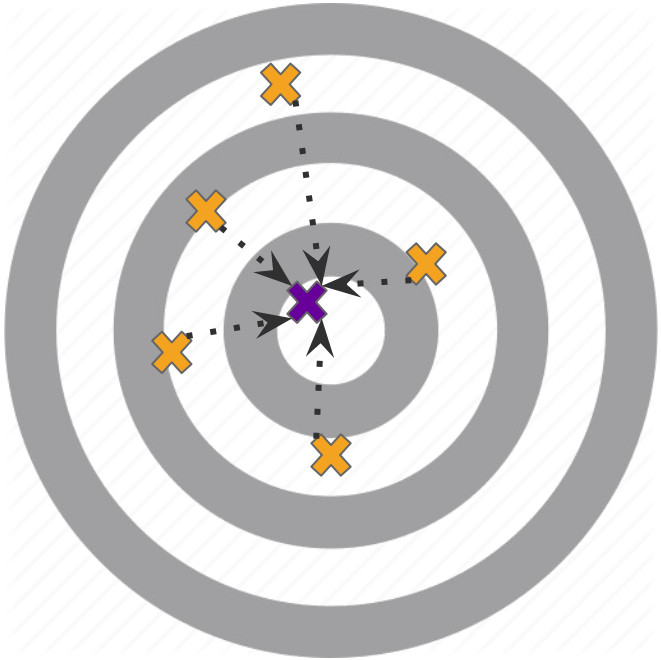
# Ensemble Learning



**How do we construct the ensemble predictor?**

**Do we just choose the best model?**

# Ensemble Learning

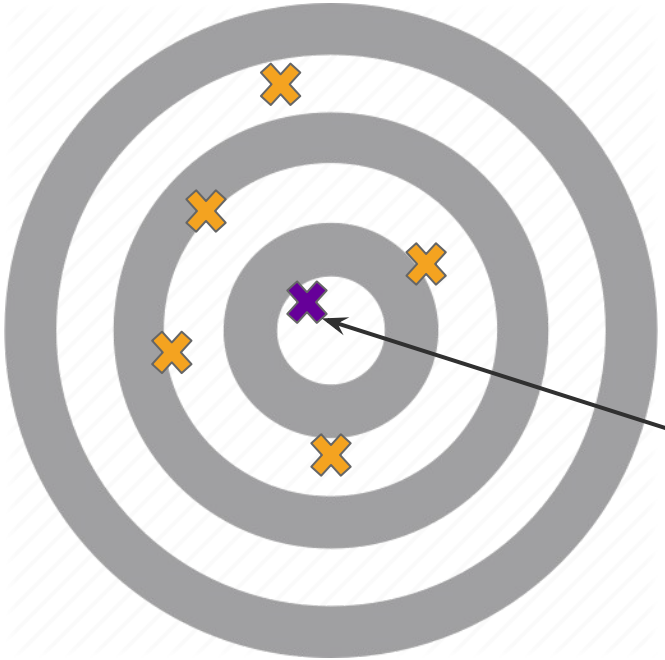


**We try to ‘combine’ the models.**

**Ideally the ensemble predictor is better than all other models.**

**Can we guarantee this?**

# Ensemble Learning



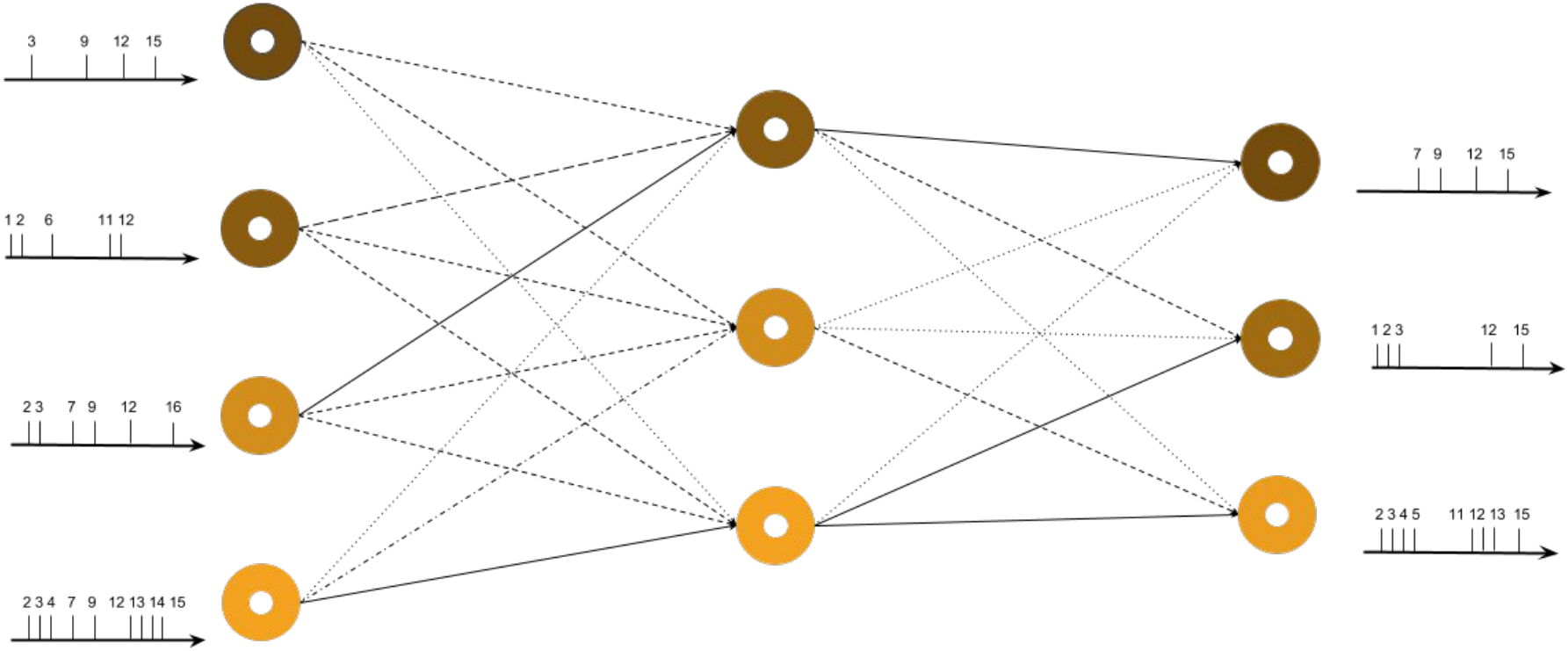
**Yes we can! (under certain conditions)**

**On average the ensemble is better than any of the models.**

$$\bar{q} = \arg\min_{p} \frac{1}{M} \sum_{i=1}^{M} KL(p||q_i)$$ [1]

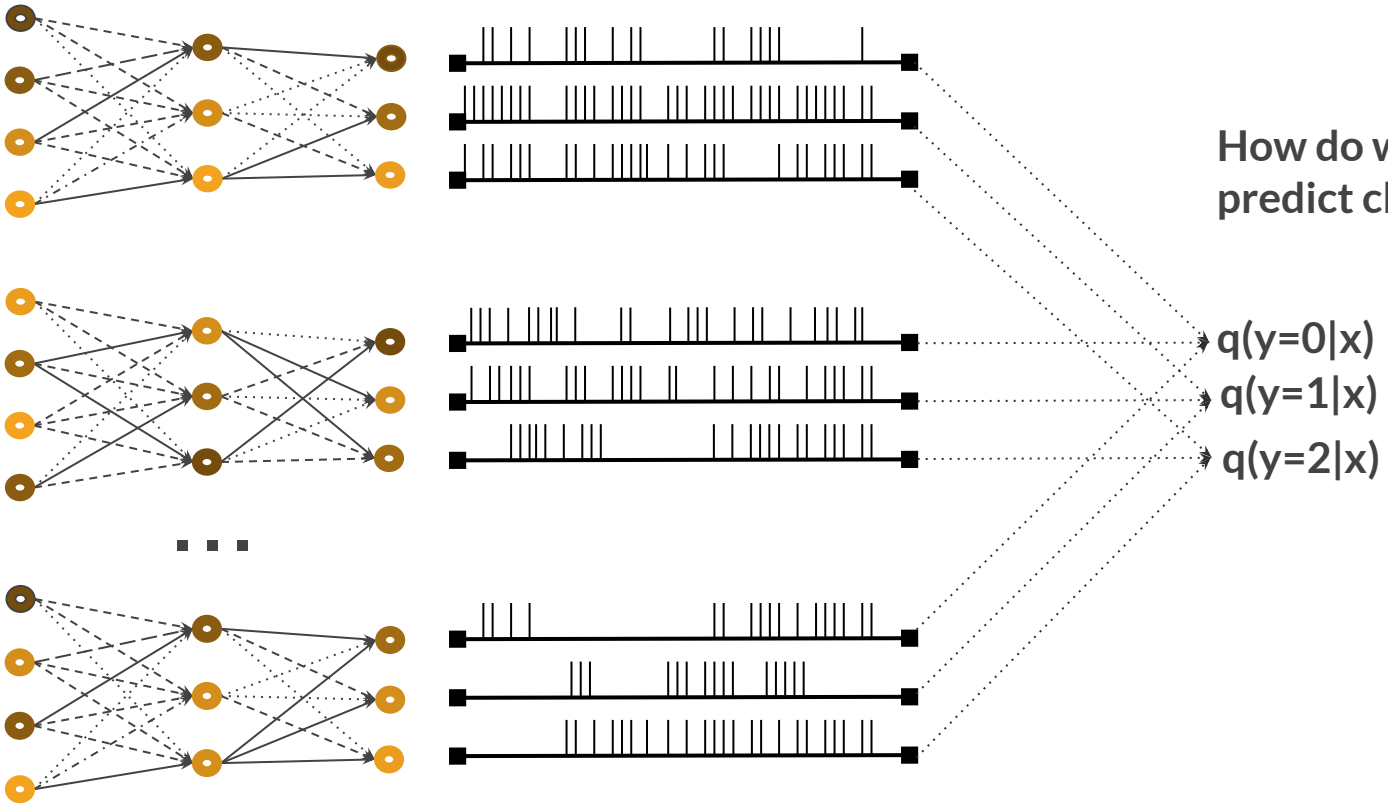
[1] Heskes, Tom (1998). “Selecting weighting factors in logarithmic opinion pools”. In: Advances in neural information processing systems

# Spiking Neural Networks



# Ensemble of Spiking Neural Networks

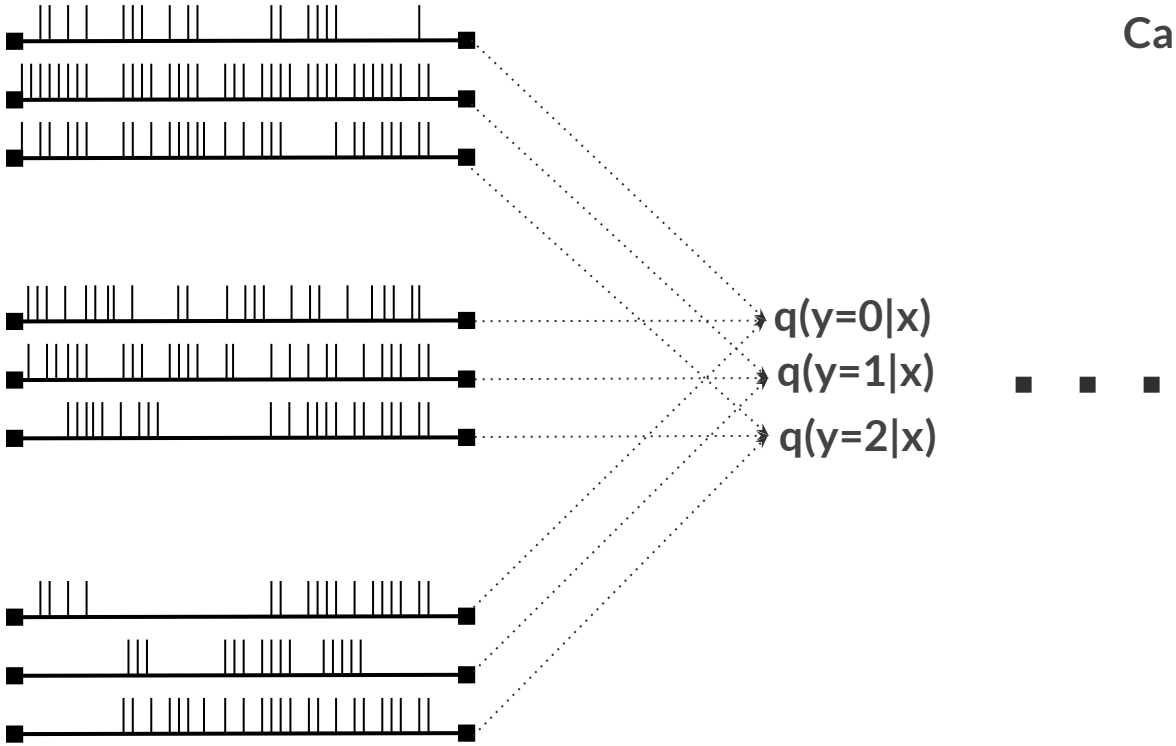




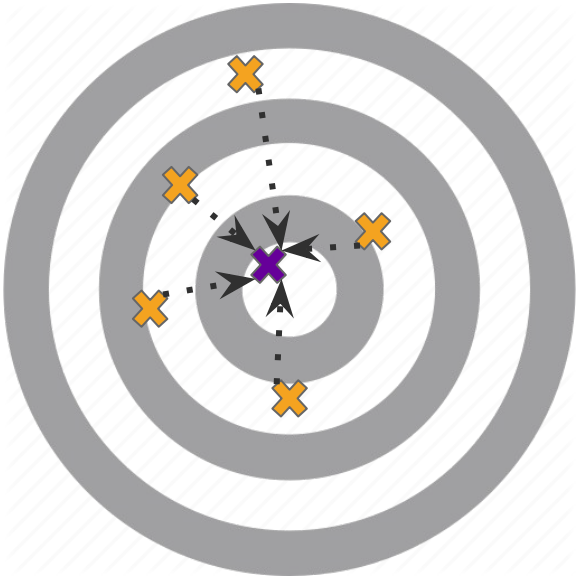
**How do we combine and predict class probabilities?**

$q(y=0|x)$
$q(y=1|x)$
$q(y=2|x)$

# Ensemble of Spiking Neural Networks

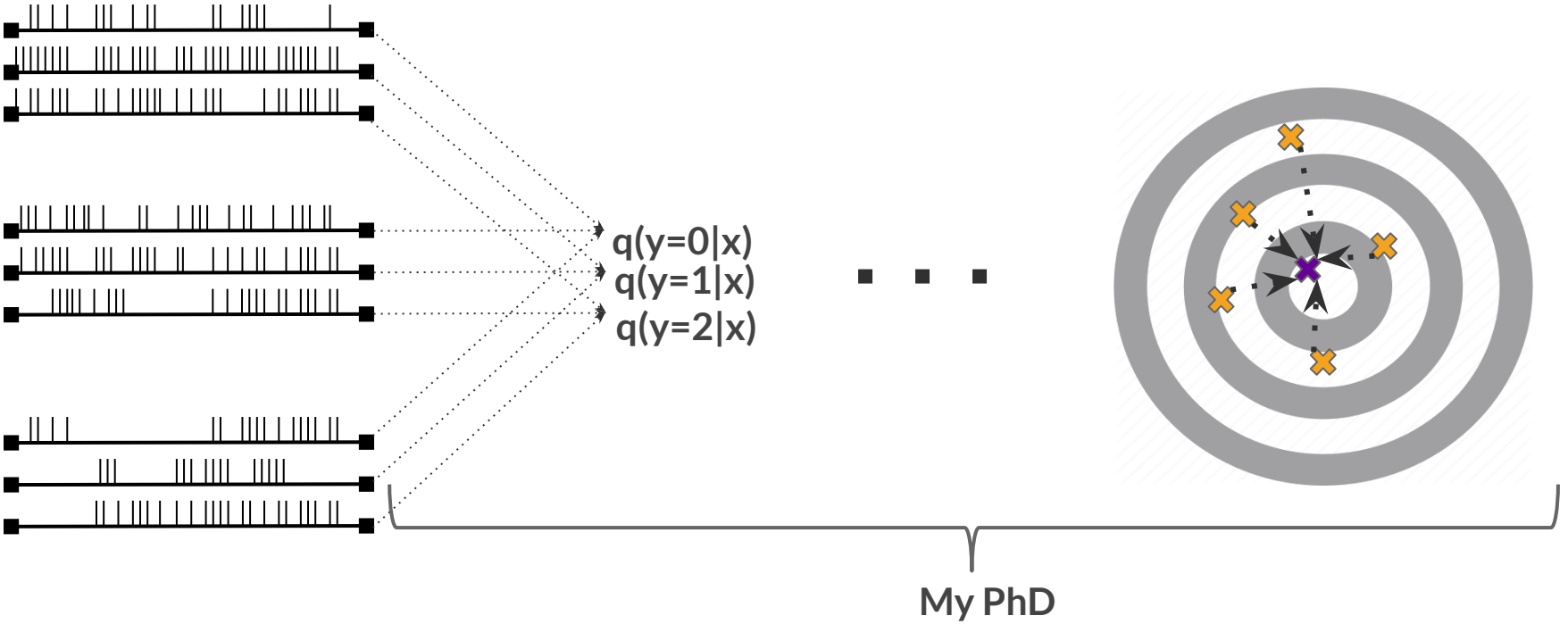



**Can we make the same guarantee?**



# Ensemble of Spiking Neural Networks

MANCHESTER 1824
The University of Manchester




**We show that we can make the guarantee (under some conditions).**