HTML2023 HM1 Sample Solution

Problem 1

Self-supervised learning can be considered a type of unsupervised learning. It involves pretraining with unlabeled data to learn representations and then fine-tuning the model for downstream tasks. This approach helps avoid the costs associated with data annotation. In natural language processing (NLP), self-supervised learning is commonly used for tasks like masked sentence prediction and sentence generation. It can also be applied using contrastive learning, which predicts the similarity between samples. For example, images can be divided into patches or rotated. By analyzing the augmented data, models can learn to match images. This can even extend to computer vision (CV) and multimodal tasks such as face recognition and object detection.

Problem 4

Starting from $t = 0$, we know that:

(1) $\forall n,\ t,\ x_{0(t)} = 1$
(2) $w_{0(0)} = 0$

Let $T = T_- + T_+$ be the total updates.

$$
\begin{aligned}
w_{0(T)} &= w_{0(T-1)} + y_{n(T)} x_{0(T)} \\
&\ \ \vdots \\
&= w_{0(0)} + \sum_{t=1}^{T} y_{n(t)} x_{0(t)} \\
&= 0 + \sum_{t=1}^{T} y_{n(t)} \cdot 1 \\
&= \sum_{t=1}^{T_+} 1 + \sum_{t=1}^{T_-} (-1) \\
&= T_+ - T_-
\end{aligned}
$$