Threshold selection in negative sampling strategy: The selection of thresholds determines the quality of negative samples and affects the performance of the model. In order to select the appropriate upper and lower thresholds and obtain reliable negative samples, specific data analysis is required. The Facebook study[1] shows that nearly 95% of the negative samples are simple samples, nearly 5% of the negative samples are hard negative samples, and nearly 0.1% of the negative samples are false negative samples. Therefore, the upper and lower threshold can be determined based on the percentage of each type of negative samples under different thresholds.

Table I records the number of negative samples in each type when the threshold2 is 0 and the threshold1 is 0.35, 0.34, 0.335 and 0.33, respectively. When the threshold1 is 0.335, the percentage of false negative samples is close to 0.1%. Therefore, in this paper, the threshold1 is chosen as 0.335.

TABLE I. NUMBER OF EACH TYPE OF NEGATIVE SAMPLES AT DIFFERENT UPPER THRESHOLDS

threshold1	***0.35***	***0.34***	***0.335***	***0.33***
Positive	11540	11540	11540	11540
False negative	1036	1136	1165	1682
Hard negative	616191	616091	616062	615545
Simple negative	546459	546459	546459	546459

The number of samples in each type when the threshold1 is 0.335 and the threshold2 is 0.12, 0.121, 0.122 and 0.123, respectively, is shown in Table II. When the threshold2 is selected as 0.121, the percentage of hard negative samples is close to 5%. Therefore, in this paper, the threshold2 is chosen as 0.121.

TABLE II. NUMBER OF EACH TYPE OF NEGATIVE SAMPLES AT DIFFERENT LOWER THRESHOLDS

threshold2	***0.12***	***0.121***	***0.122***	***0.123***
Positive	11540	11540	11540	11540
False negative	1165	1165	1165	1165
Hard negative	60705	59576	58224	57079
Simple negative	1101816	1102945	1104297	1105442

Finally, the threshold1 is chosen as 0.335 and the threshold2 is chosen as 0.121. Based on the selected thresholds, the sample flag function is constructed to filter negative samples for model training.

[1] CAI T T, FRANKLE J, SCHWAB D J, et al. Are All Negatives Created Equal in Contrastive Instance Discrimination? CoRR, 2020, abs/2010.06682.