a) Hard Negatives ($\mathcal{N}_{hard}$)

Hard POI

Section

b) Popular Sample ($\mathcal{N}_{pop}$)

Popular POI

Section

c) Random Sample ($\mathcal{N}_{rand}$)

Random POI

Negative Sampling loss

$$\mathcal{L}_{NS} = (1-\beta) \mathcal{L}_{Focal} + \beta \mathcal{L}_{Rank}$$

$\mathcal{L}_{NS}$

Stage 1 - Clean Forward Pass

$$\mathcal{L}_{clean} = \mathcal{L}_{NS}(e) + \lambda_{cl}\mathcal{L}_{CL}(e)$$

Stage 3 - Parameter Update

Stage 2 - Adversarial Forward Pass

Fast Gradient Method (FGM)

$$g = \nabla_e \mathcal{L}_{clean}$$

$$\delta_{adv} = \epsilon \cdot \frac{g}{\|g\|_2}$$

Embeddings

Fusion

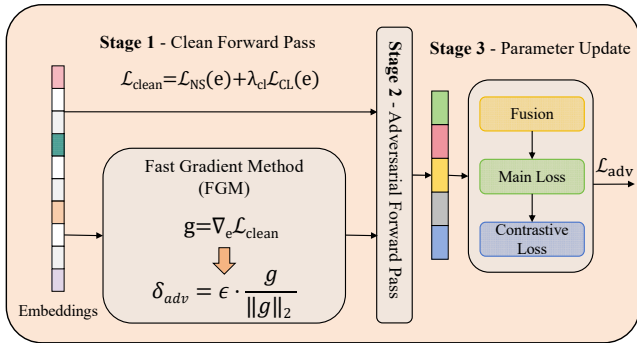Main Loss

Contrastive Loss

$\mathcal{L}_{adv}$

(a) Multi-Strategy Negative Sampling

(b) Adversarial Perturbation Generation