DETR Fruit Detector

심하은

목차

개요

- Object detection을 위해 DETR Model 개발
- Fruit dataset을 사용해 이미지에서 사과, 오렌지, 바나나를 탐지
- 사과, 오렌지, 바나나 탐지 시 Bounding box 생성

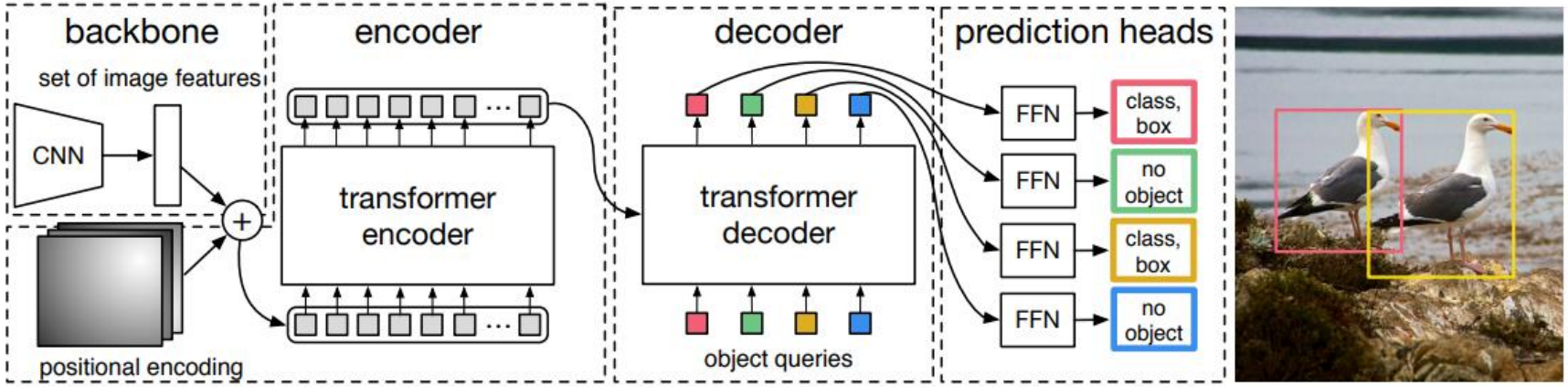
Dataset

Fruit Images for Object Detection

content: Apple, Banana, Orange

- [출처] https://www.kaggle.com/datasets/mbkinaci/fruit-images-for-object-detection

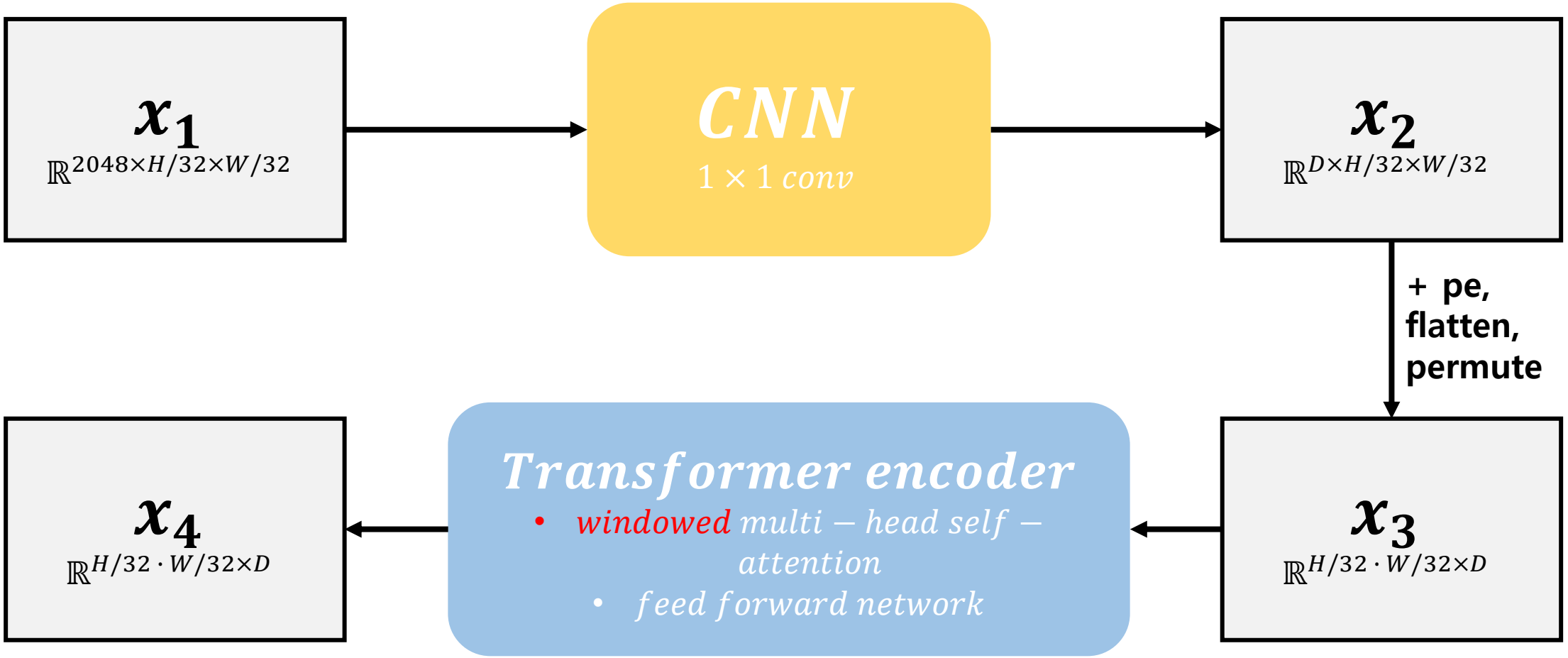
DETR(DEtection TRansformer) 구조



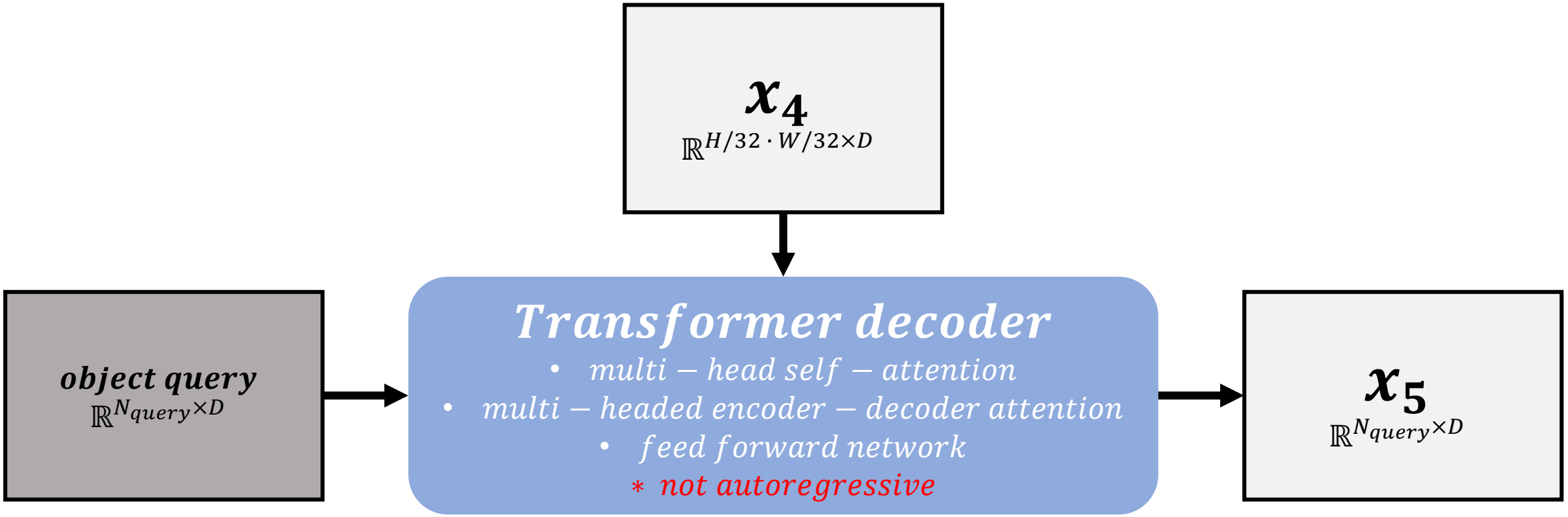
- Backbone
- Transformer encoder - window attention 기능 추가
- Transformer decoder
- Prediction feed-forward network

DETR - Backbone

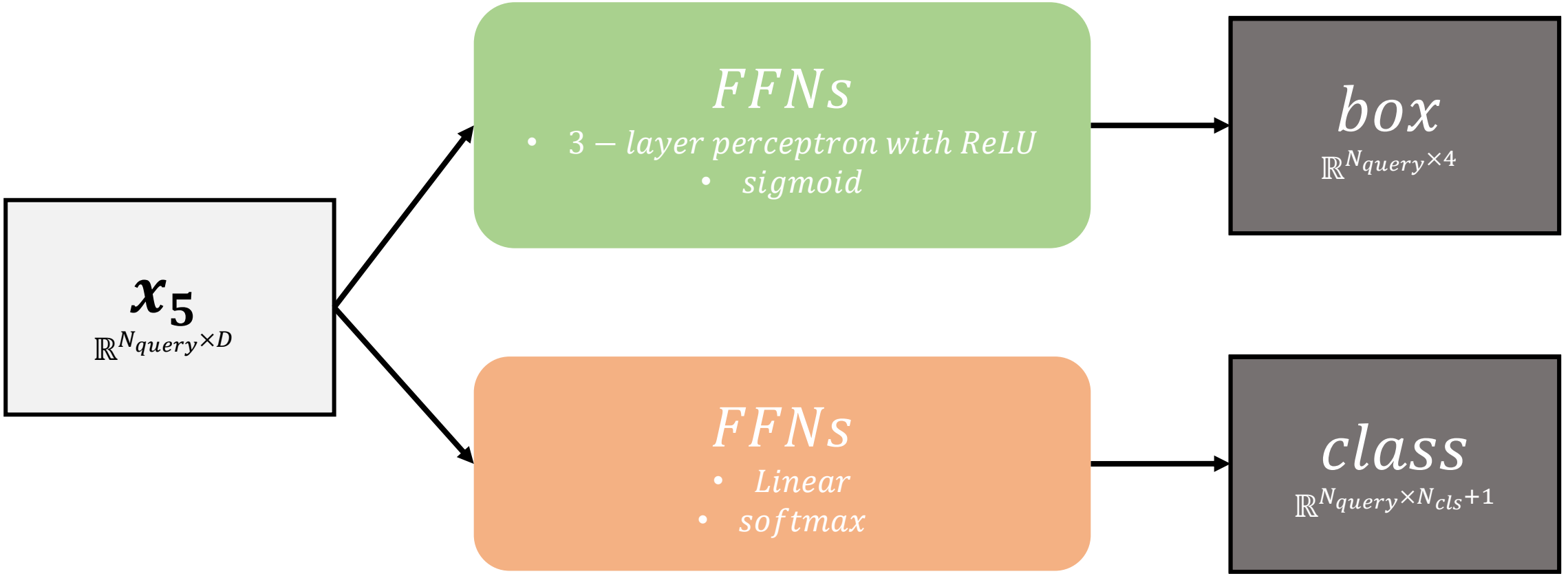
DETR – Transformer encoder



DETR – Transformer decoder



DETR – Prediction feed-forward networks(FFNs)



Loss

$$\boldsymbol{index\ \sigma(i), probability\ of\ class\ c_i\ as\ \hat{p}_{\sigma(i)}\ (c_i\ ), predicted\ box\ as\ \hat{b}_{\sigma(i)}}$$
$$\boldsymbol{hyper\ Parameters\ \lambda_{iou}, \lambda_{L1}}$$

$$\mathcal{L}_{box}\left(b_i, \hat{b}_{\sigma(i)}\right) = \lambda_{iou}\mathcal{L}_{iou}\left(b_i, \hat{b}_{\sigma(i)}\right) + \lambda_{L1}\left\|b_i - \hat{b}_{\sigma(i)}\right\|_1$$

$$\mathcal{L}_{match}\left(y_i, \hat{y}_{\sigma(i)}\right) = -\mathbb{1}_{\{c_i \neq \emptyset\}}\hat{p}_{\sigma(i)}(c_i) + \mathbb{1}_{\{c_i \neq \emptyset\}}\mathcal{L}_{box}(b_i, \hat{b}_{\sigma(i)})$$

$$\hat{\sigma} = argmin_{\sigma \in \mathfrak{S}_N} \sum_{i}^{N} \mathcal{L}_{match}\left(y_i, \hat{y}_{\sigma(i)}\right)$$

$$\mathcal{L}_{Hungarian}(y_i, \hat{y}) = \sum_{i=1}^{N}[-\log \hat{p}_{\hat{\sigma}(i)}(c_i) + \mathbb{1}_{\{c_i \neq \emptyset\}}\mathcal{L}_{box}(b_i, \hat{b}_{\sigma(i)})]$$

Hyper Parameters

- image size $= 224$
- batch size $= 32$

- n_query $= 100$
- $\lambda_{iou} = 2$
- $\lambda_{L1} = 5$

- learning rate $=$ 1e-4
- Training epoch $= 1000$

- dim $= 256$
- Transformer nheads $= 8$
- attention window size $= 7$
- global attention iter $= 3$

- Transformer encoder depth $= 6$
- Transformer decoder depth $= 6$

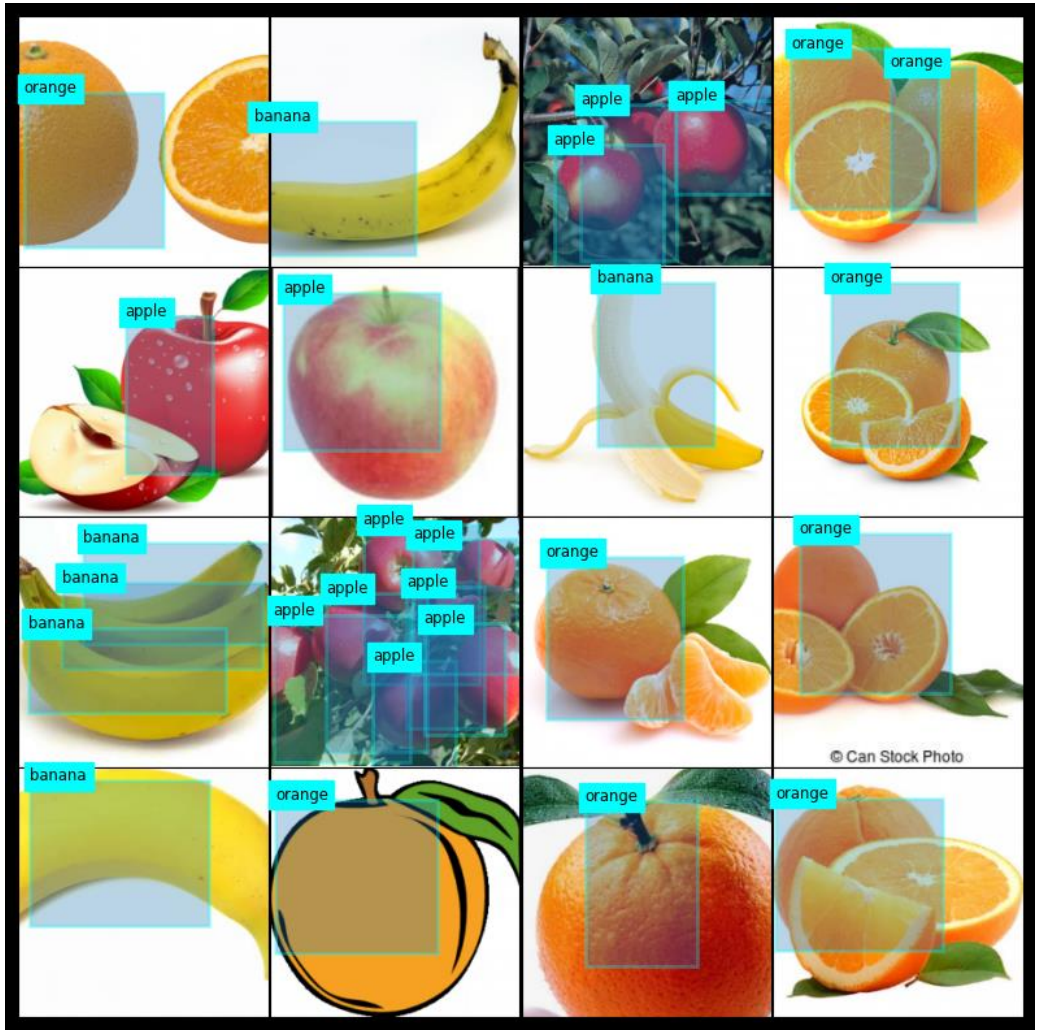
Training Process

- Fruit dataset의 이미지 preprocessing 진행
  - Image Resizing: C X H X W ->3 X 224 X 224
  - Padding

- Model의 input으로 preprocessing된 이미지와 100개의 object query 사용
- Transformer encoder에서 window attention 수행, 3번에 한번 씩 global attention 수행

- Model의 prediction과 ground truth간의 $\mathcal{L}_{match}$을 구해 총 loss의 합계가 작은 pair간 $\mathcal{L}_{Hungarian}$ 계산
- Adam optimizer(lr=1e-4)을 사용 및 gradient clipping(max norm=0.1) 적용하여 학습

Result – 1000 epoch



Reference

- [DETR] https://arxiv.org/pdf/2005.12872.pdf
- [window attention] https://arxiv.org/pdf/2203.16527.pdf

Source code

- [Notebook] https://github.com/5121eun/dl/blob/main/detr_example.ipynb
- [Model] https://github.com/5121eun/dl/blob/main/models/detr.py