Lab2 : Caption generation with visual attention

Lab Objective:

In this lab, you are going to run a Caption generator by using CNN and RNN language generator trained on the COCO dataset to generate a sentence that describes the image.

Important Date:

1. Submit Experiment Report Deadline: 11/21 (Tue) 12:00
2. Demo date: 11/22 (Wed) after Lab

Requirements:

- Use Python 2.7 in this lab
- Use ResNet101 as a pre-trained CNN model.
- Implement attention model in Show, attend and tell [1]
- Implement attention model in Bottom-Up and Top-Down Attention [3]
- Compare the result of attention mechanisms. (Loss curves, output captions, attention maps)

Environment:

- COCO dataset

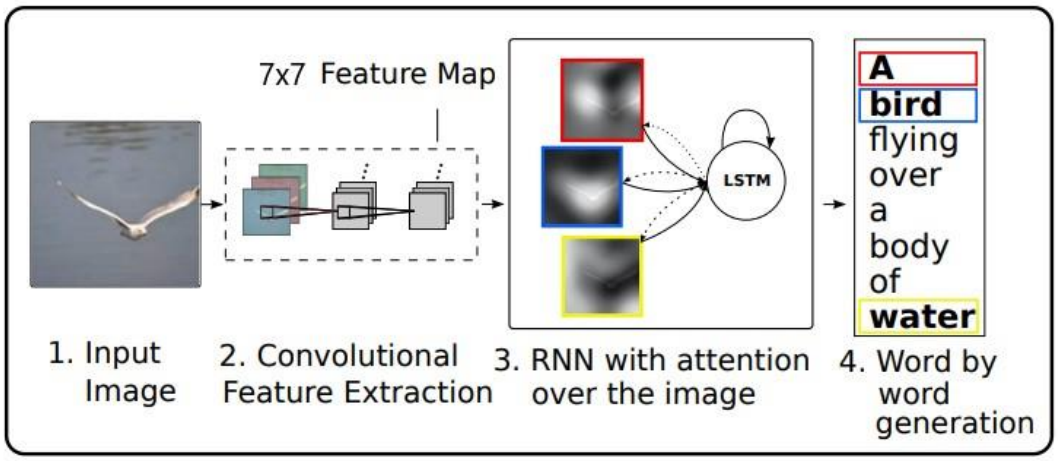
  The COCO dataset is a large-scale object detection, segmentation, and captioning dataset. It consists of 330K images with 5 captions per image.

a man looking at a motorcycle with other motorcycles behind him.
men looking at custom motorcycles in a motorcycle show
a motorcycle sitting on a lush green lawn.
a very nice motorcycle among others and a crowd of people.
an elegantly painted custom motorcycle parked on the grass.

- Project package location: /homework/AI_Training_1108

Lab Description:

- Sample code: https://github.com/ruotianluo/neuraltalk2.pytorch
- Learn how to combine CNN features and RNN language generator with attention model.
- The main structure of caption generator with attention is shown below:



- Attention model
  - Give the feature map weights to increase the importance of features.

A giraffe standing in a forest with trees in the background.

A stop sign is on a road with a mountain in the background.

  - Context vector (output of attention model)

$$C_t = \Sigma_{i=1}^{L} \alpha_{ti} V_i$$

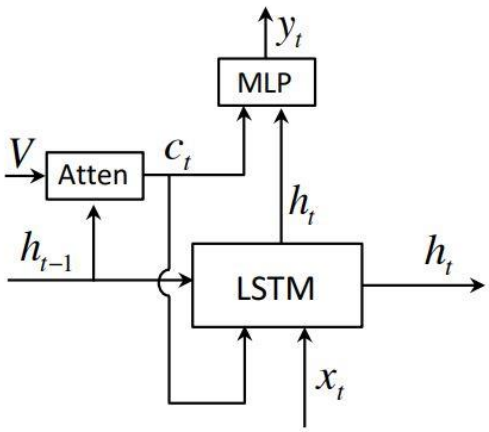
  - Positive weight

$$\alpha_{ti} = softmax(e_{ti}) = exp(e_{ti}) / \Sigma_k exp(e_{tk})$$

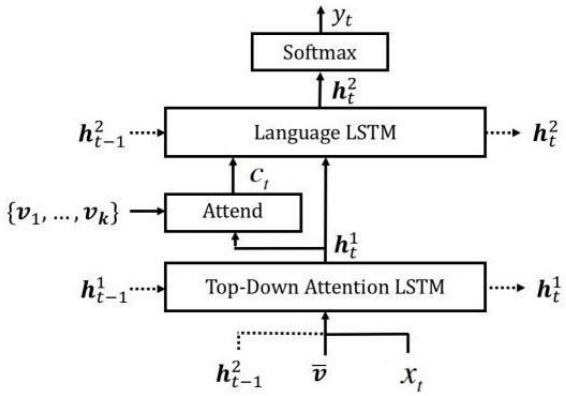
  - Attention

$$\mathbf{e_t} = \mathbf{W} \tanh(\mathbf{W_V V} + \mathbf{W_h h_{t-1}})$$

- Network architecture
  - Show, attend and tell



  - Bottom-Up and Top-Down Attention
    - Separate the LSTM into Attention part and Language part



- Before training, you need to:
  - ~~Download coco images (2014 train images/ 2014 val images)~~
    - ~~http://cocodataset.org/#download~~
    - ~~Put them in the same directory~~
  - ~~Clone coco-caption evaluation codes from GitHub~~
    - ~~https://github.com/tylin/coco-caption~~
  - Preprocess dates (process json dataset into hdf5/json files)
    - scripts/prepro_images.py
    - scripts/prepro_labels.py
  - Fill out the code in TODO field
    - misc/util.py (using pre-trained ResNet)
    - models/CaptionModel.py (for Show, attend and tell)
    - models/AttModel.py (for Bottom-Up and Top-Down Attention)

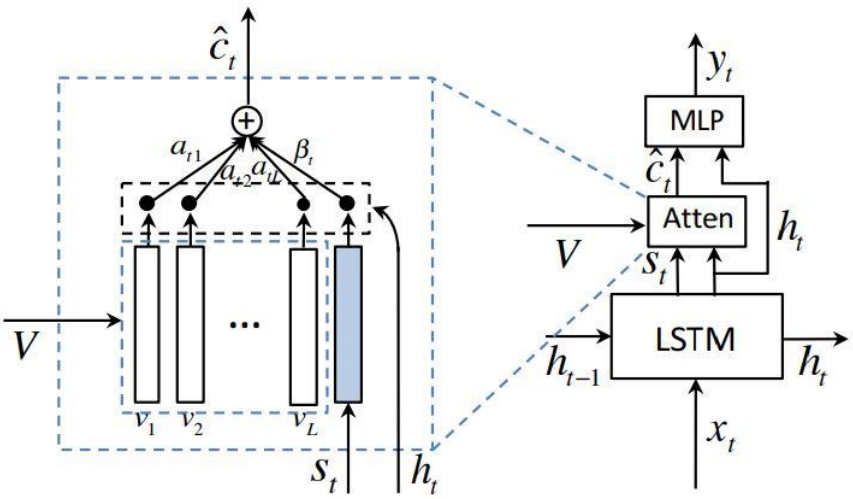
- Training
  - Run at least 5 epoch.
  - Training parameters
    - batch size : 10
    - input encoding size : 512
    - rnn size : 512
    - att hid size: 512
    - fc feat size: 2048
    - att feat size: 2048
    - rnn type: LSTM

    … see more setting of parameters in opt.py
  - Training Settings
    - -- caption_model <*model name*> : choose a caption model
    - --checkpoint_path <*dir*> : the directory to save models

- Training Time: approx. 35mins per epoch on GTX1080 Ti

Extra Bonus:

- Implement attention model in Knowing When to Look [4]
  - Adaptive attention model



References:

[1] Xu, Kelvin, et al. "Show, attend and tell: Neural image caption generation with visual attention." *International Conference on Machine Learning*. 2015.

[2] http://people.ee.duke.edu/~lcarin/Yunchen9.25.2015.pdf

[3] Anderson, Peter, et al. "Bottom-up and top-down attention for image captioning and vqa." *arXiv preprint arXiv:1707.07998* (2017).

[4] Lu, Jiasen, et al. "Knowing when to look: Adaptive attention via A visual sentinel for image captioning." *arXiv preprint arXiv:1612.01887* (2016).

[5] https://github.com/ruotianluo/neuraltalk2.pytorch

Report Spec: [black: Demo, Gray: No Demo]

1. Introduction (15%, 15%)
2. Experiment setup (15%, 15%)
   - The detail of your model
   - Report all your training hyper-parameters
3. Result (30%, 40%)
   - Training loss of attention models.
   - Captions of models.
   - Attention over time.

4. Discussion (20%, 30%)

Demo (20%) [抽人]

------- Criterion of result (Show_attend_tell)----

Minimum loss < 1.8 = 100%

Minimum loss < 1.9 = 90%

Minimum loss < 2.0 = 80%

Minimum loss < 2.2 = 70%

Minimum loss > 2.2 = 0%

評分標準: 40%*實驗結果 + 60%*(報告+DEMO)