

# Lab5 - Let's Play GANs

TA 高嘉豪

- Deadline: August 23, 2022 11:59 p.m.
- **No demo**
- Format: Experimental report (.pdf) and source code (.py). Zip all files in one file and name it like DLP\_LAB5\_yourstudentID\_name.zip.
- If there's any questions, please send them to me via email: chiahaok.cs10@nycu.edu.tw

## 1 Lab Description

In this lab, you need to implement a conditional GAN to generate synthetic images according to multi-label conditions. Recall that we have seen the generation capability of VAE in the previous lab. To achieve higher generation capacity, especially in computer vision, generative adversarial network (GAN) is proposed and has been widely applied on style transfer and image synthesis. In this lab, given a specific condition, your model should generate the corresponding synthetic images (see in Fig. 1). For example, given “red cube” and “blue cylinder”, your model should generate the synthetic images with red cube and blue cylinder. Meanwhile, your generated images would be feed into a pre-trained classifier for evaluation.

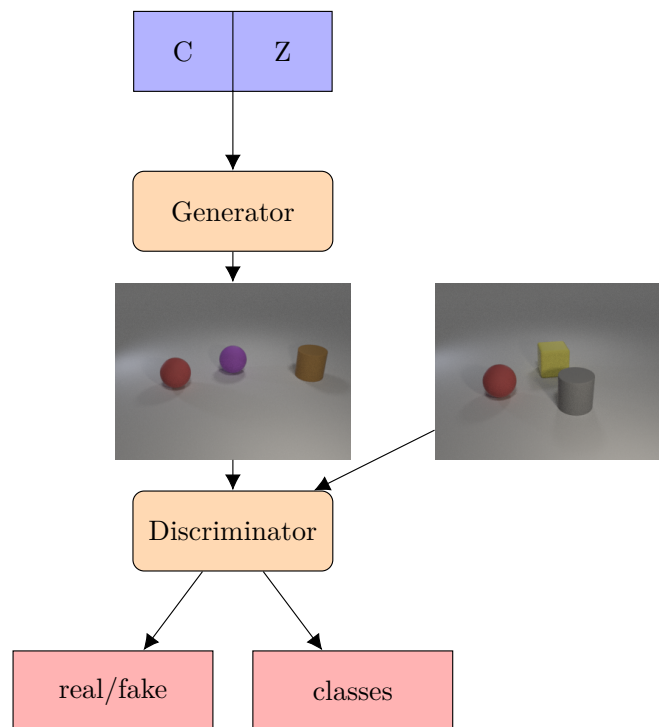


Figure 1: The illustration of cGAN.

## 2 Requirements

- **Implement a conditional GAN**
  - Choose your cGAN architecture.
  - Design your generator and discriminator.
  - Choose your loss functions.
  - Implement the training function, testing function, and dataloader.
- **Generate the synthetic images**
  - Evaluate the accuracy of test.json
  - Evaluate the accuracy of new\_test.json **which will be released before demo.**

## 3 Implementation Details

### 3.1 Architecture of conditional GAN

There are Variants of conditional GAN architectures. You can choose one of the models in the following list or a hybrid version as your conditional GAN structure

- conditional GAN [1]
- Auxiliary GAN [2]
- Projection discriminator [3]
- ...

### 3.2 Design of generator and discriminator.

Many GAN structures are developed to generator high quality images. Basically, all GAN architecture are based on DCGAN which is mainly composed of convolution neural network. You can adopt one of the structures or a hybrid one

- DCGAN
- Super resolution GAN [4]
- Self-attention GAN [5]
- Progressive growing of GAN [6]
- ...

### 3.3 Training loss functions

Besides the significant progress of GAN architectures, the training function is also play an important role. Your loss function should combine with your choice of cGAN as it will take a part in your training function, e.g., auxiliary loss. Here are the reference training loss functions.

- GAN [7]
- LSGAN [8]
- WGAN [9]
- WGAN-GP [10]
- ...

### 3.4 Other implementation details

- You can ignore previous suggestion and choose **any GAN architecture you like**.
- Except for the provided files, you cannot use other training data. (e.g. background image)
- Use the function of a pre-trained classifier, `eval(images, labels)` to compute accuracy of your synthetic images.
- Make use of the `make_grid(images)` and `save_image(images, path)` functions from `torchvision.utils` to save your image (8 images a row, 4 rows).
- The same object will not appear twice in an image.
- The normalization of input images is `transforms.Normalize((0.5, 0.5, 0.5), (0.5, 0.5, 0.5))`. You should not apply normalization on your generated images but apply de-normalization while generating RGB images.
- The resolution of input for pretrained classifier is 64x64. You can design your own output resolution for generator and resize it.

## 4 Dataset Descriptions

You can download the lab5.zip file from new e3, which includes `readme.txt`, `train.json`, `test.json`, `object.json`, `evaluator.py`, and `classifier_weight.pth`. The dataset itself, `iclevr.zip`, could be downloaded from this [google drive link](#). All the details of the dataset are in the `readme.txt`.

## 5 Scoring Criteria

1. Report (50%)
  - Introduction (5%)
  - Implementation details (15%)
    - Describe how you implement your model, including your choice of cGAN, model architectures, and loss functions. (10%)
    - Specify the hyperparameters (learning rate, epochs, etc.) (5%)
  - Results and discussion (30%)
    - Show your results based on the testing data. (5%) (including images)
    - Discuss the results of different models architectures. (25%) **For example, what is the effect with or without some specific loss terms, or what kinds of condition design is more effective to help cGAN.**
2. Experimental results (50%) (based on results shown in your report)
  - Classification accuracy on `test.json` and `new_test.json`. (25% each)

Accuracy	Grade
$\text{score} \geq 0.8$	100%
$0.8 > \text{score} \geq 0.7$	90%
$0.7 > \text{score} \geq 0.6$	80%
$0.6 > \text{score} \geq 0.5$	70%
$0.5 > \text{score} \geq 0.4$	60%
$\text{score} < 0.4$	0%

3. No demo for this lab.

## 6 Output Examples

Here presents some example output images.

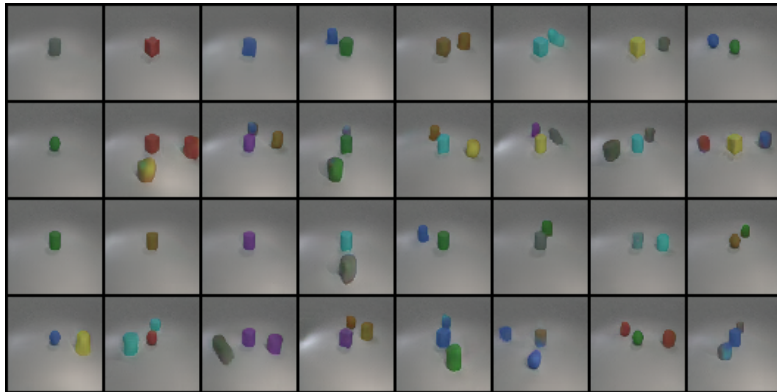


Figure 2: The synthetic images of accuracy of 0.638



Figure 3: The synthetic images of accuracy of 0.806

## References

- [1] Mehdi Mirza and Simon Osindero. Conditional generative adversarial nets, 2014.
- [2] Augustus Odena, Christopher Olah, and Jonathon Shlens. Conditional image synthesis with auxiliary classifier gans, 2016.
- [3] Takeru Miyato and Masanori Koyama. cgans with projection discriminator, 2018.
- [4] Christian Ledig, Lucas Theis, Ferenc Huszar, Jose Caballero, Andrew Cunningham, Alejandro Acosta, Andrew Aitken, Alykhan Tejani, Johannes Totz, Zehan Wang, and Wenzhe Shi. Photo-realistic single image super-resolution using a generative adversarial network, 2016.
- [5] Han Zhang, Ian Goodfellow, Dimitris Metaxas, and Augustus Odena. Self-attention generative adversarial networks, 2018.
- [6] Tero Karras, Timo Aila, Samuli Laine, and Jaakko Lehtinen. Progressive growing of gans for improved quality, stability, and variation, 2017.
- [7] Ian J. Goodfellow, Jean Pouget-Abadie, Mehdi Mirza, Bing Xu, David Warde-Farley, Sherjil Ozair, Aaron Courville, and Yoshua Bengio. Generative adversarial networks, 2014.
- [8] Xudong Mao, Qing Li, Haoran Xie, Raymond Y. K. Lau, Zhen Wang, and Stephen Paul Smolley. Least squares generative adversarial networks, 2016.
- [9] Martin Arjovsky, Soumith Chintala, and Léon Bottou. Wasserstein gan, 2017.
- [10] Ishaan Gulrajani, Faruk Ahmed, Martin Arjovsky, Vincent Dumoulin, and Aaron Courville. Improved training of wasserstein gans, 2017.