MLDS HW3-1

TAs
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Update

- 5/8 : 更新Baseline Model

Baseline Model (⅝ Update)

- Generator
  - input = (100,)
  - Dense(128*16*16, ‘relu’)
  - Reshape((16, 16, 128))
  - Upsampling
  - Conv2D(128, kernel = 4)
  - Relu
  - Upsampling
  - Conv2D(64, kernel = 4)
  - Relu
  - Conv2D(3, kernel = 4)
  - tanh

- Training
  - Adam(lr = 0.0002, beta = 0.5)

- Discriminator
  - input = (64, 64, 3)
  - Conv2D(32, kernel = 4)
  - Relu
  - Conv2D(64, kernel = 4)
  - ZeroPadding
  - Relu
  - Conv2D(128, kernel = 4)
  - Relu
  - Conv2D(256, kernel = 4)
  - Relu
  - Flatten
  - Dense(1, sigmoid)

Outline

- Timeline
- Task Descriptions
- Model & Training tips
- Submission & Rules
- Q&A

Timeline

Three Parts in HW3

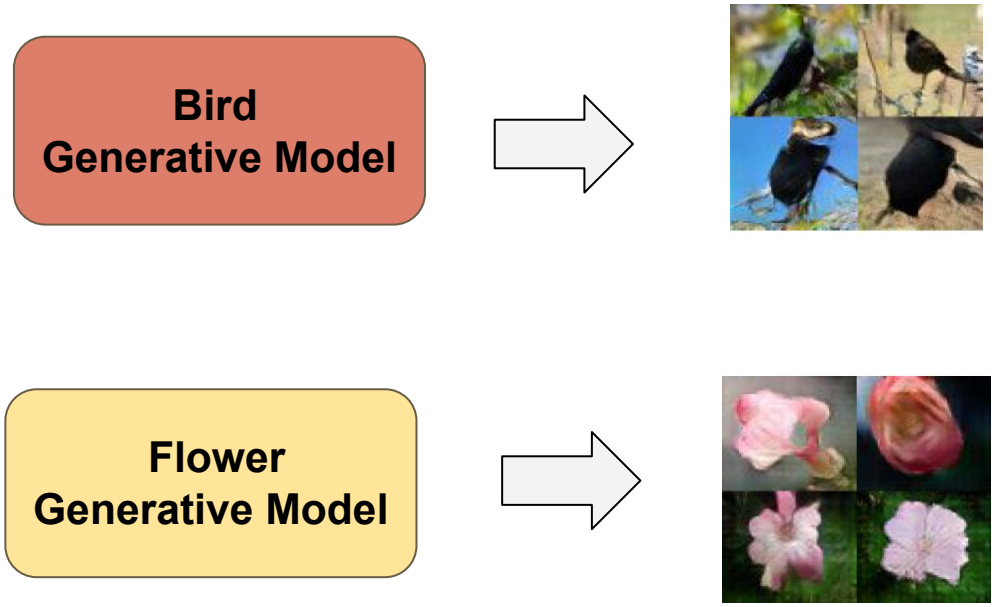
- (3-1) Image Generation
- (3-2) Text-to-Image Generation
- (3-3) Style Transfer

Schedule

- 5/4 :
  - Release HW3-1
- 5/11 :
  - Release HW3-2
- 5/18:
  - Release HW3-3
- 6/8:
  - All HW3 due (including HW3-1, HW3-2, HW3-3)
- 上台分享

Task Descriptions

HW3-1: Image Generation 2/2

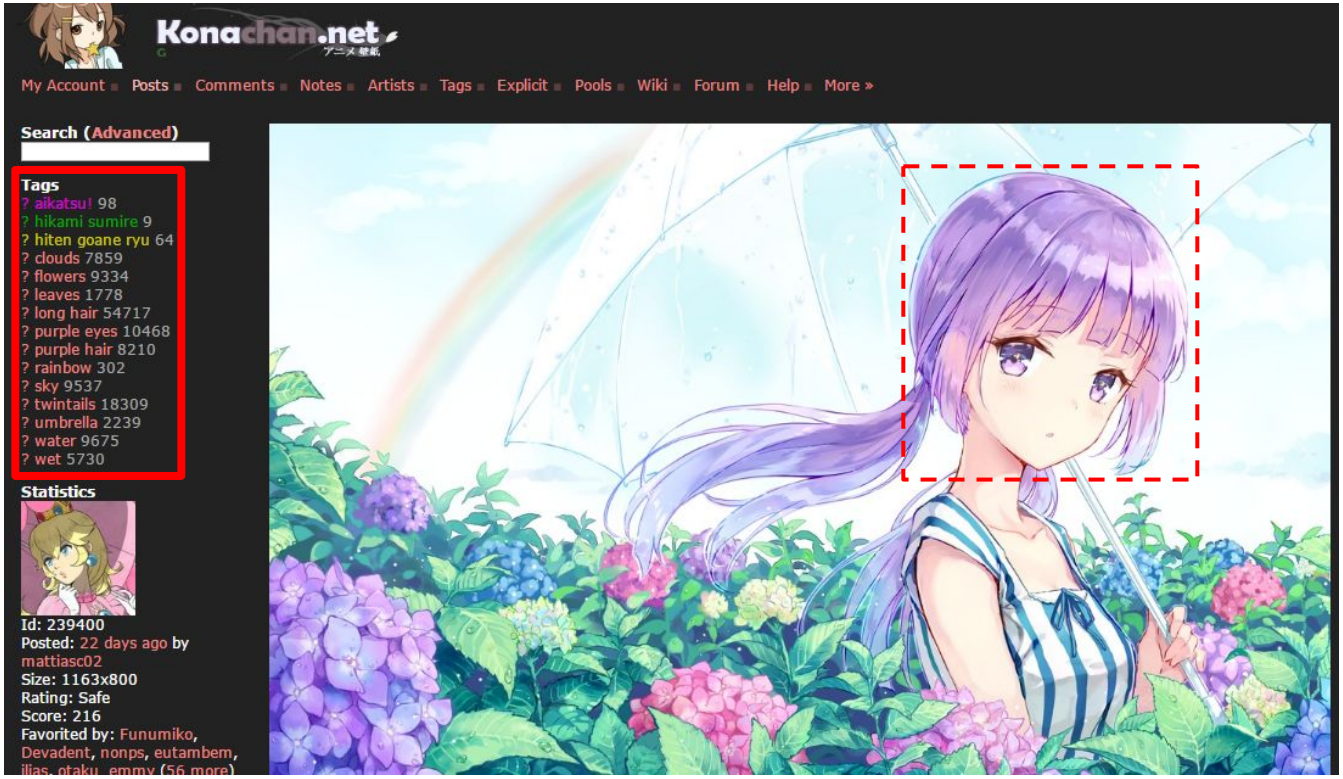


HW3-1: Image Generation 2/2

Anime Generative Model

Data Collections 1/2

- Anime dataset

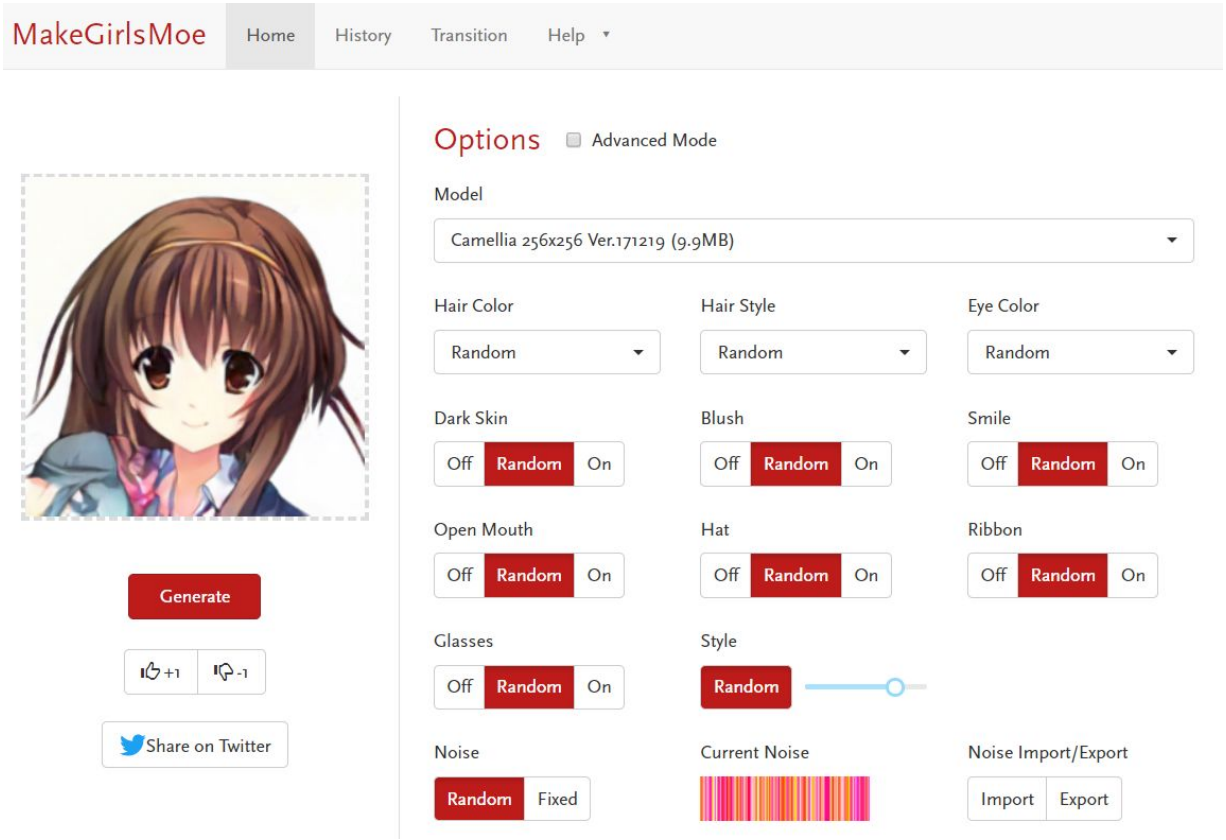


http://konachan.net/post/show/239400/aikatsu-clouds-flowers-hikami_sumire-hiten_goane_r

感謝樊恩宇助教蒐集data

Data Collections 2/2

- Extra data

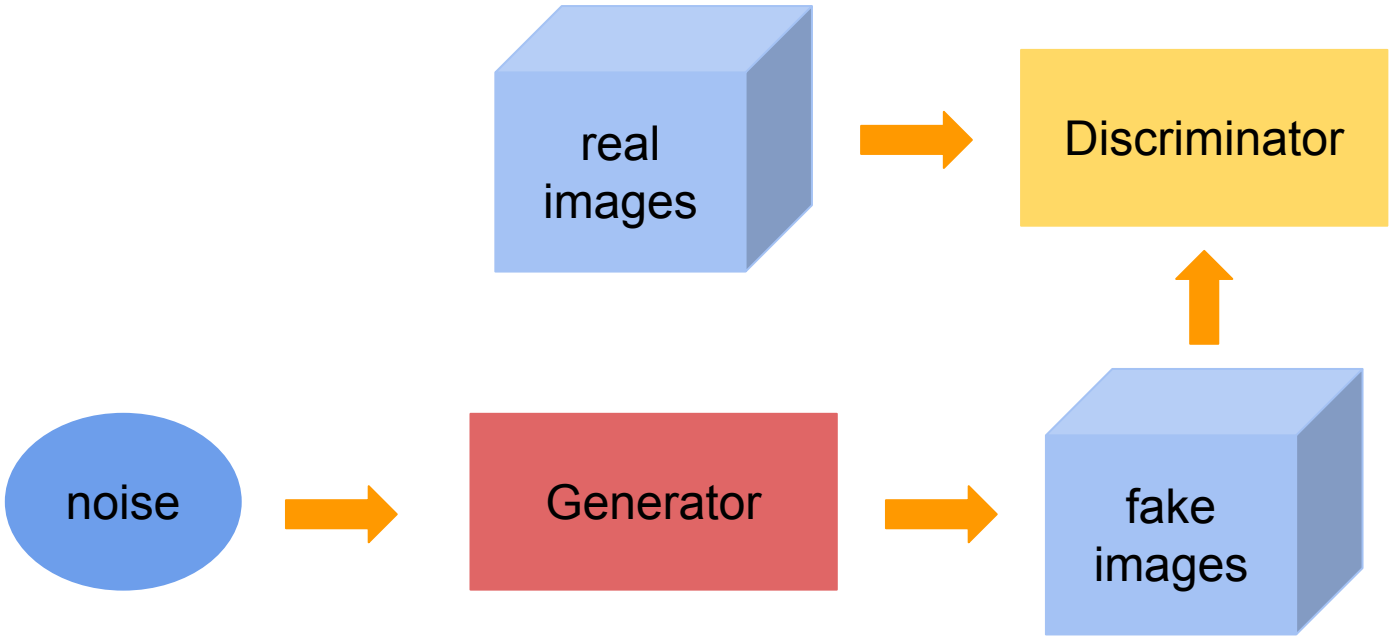


https://make.girls.moe/#/ 感謝吳宗翰同學收集並處理資料

Model & Training Tips

GAN 1/5

- Overview



GAN 2/5

- Discriminator
  - input: images (batch_size, height, width, channels)
  - output: scores (batch_size,)
  - arthitecture: CNN, DNN
- Generator
  - input: noises (batch_size, noise_dim)
  - output: images (batch_size, height, width, channels)
  - arthitecture: CNN, DNN
  - use deconvolution (transpose convolution) layer in CNN

GAN 3/5

- Training procedure
  - repeat max_iteration times
  - repeat d_update times
  - discriminator = update_discriminator(training_data, generator)
  - repeat g_update times
  - generator = update_generator(discriminator)
- Testing procedure
  - noise = sample_batch_noise(batch_size, noise_dim)
  - output_images = generator(noise)

GAN 4/5

- Update discriminator
  - real_images = sample_batch_data(training_data, batch_size)
  - noise = sample_batch_noise(batch_size, noise_dim)
  - fake_images = generator(noise)
  - real_predicts = discriminator(real_images)
  - fake_predicts = discriminator(fake_images)
  - d_loss = loss_d_fn(real_predicts, real_labels, fake_predicts, fake_labels)
  - d_grad = gradients(d_loss, d_params)
  - d_params = updates(d_params, d_grad)
  - # do not update the parameters of generator

GAN 5/5

- Update Generator
  - noise = sample_batch_noise(noise_dim, batch_size)
  - fake_images = generator(noise)
  - fake_predicts = discriminator(fake_images)
  - g_loss = loss_g_fn(fake_predicts, real_labels)
  - g_grad = gradients(g_loss, g_params)
  - g_params = updates(g_params, g_grad)
  - # do not update the parameters of discriminator

Wasserstein GAN 1/3

The output of D is thus not probability anymore.
The D loss turn to be a measure of distance.

$$L_D^{WGAN} = E[D(x)] - E[D(G(z))]$$

$$L_G^{WGAN} = E[D(G(z))]$$

$$W_D \leftarrow clip\_by\_value(W_D, -0.01, 0.01)$$

ref:https://arxiv.org/abs/1701.07875

Wasserstein GAN 2/3

- In each training iteration: **No sigmoid for the output of D**

Learning D — Repeat k times

- Sample m examples $\{x^1, x^2, \dots, x^m\}$ from data distribution $P_{data}(x)$
- Sample m noise samples $\{z^1, z^2, \dots, z^m\}$ from the prior $P_{prior}(z)$
- Obtaining generated data $\{\tilde{x}^1, \tilde{x}^2, \dots, \tilde{x}^m\}$, $\tilde{x}^i = G(z^i)$
- Update discriminator parameters θ_d to maximize
  - $\tilde{V} = \frac{1}{m}\sum_{i=1}^{m} D(x^i) - \frac{1}{m}\sum_{i=1}^{m} D(\tilde{x}^i)$
  - $\theta_d \leftarrow \theta_d + \eta \nabla \tilde{V}(\theta_d)$ **Weight clipping**

Learning G — Only Once

- Sample another m noise samples $\{z^1, z^2, \dots, z^m\}$ from the prior $P_{prior}(z)$
- Update generator parameters θ_g to minimize
  - $\tilde{V} = \frac{1}{m}\sum_{i=1}^{m} \log D(x^i) - \frac{1}{m}\sum_{i=1}^{m} D\left(G(z^i)\right)$
  - $\theta_g \leftarrow \theta_g - \eta \nabla \tilde{V}(\theta_g)$

Wasserstein GAN 3/3

- Implementation Notes:
  - Do not apply sigmoid at the output of D
  - Clip the weight of D
  - Use RMSProp instead of Adam
  - Train more iteration of D (the paper use 5)

Improved WGAN (WGAN-GP) 1/2

Do not clip the weight of D but to add a new objective called "Gradient Penalty".

$$L_D^{WGAN\_GP} = L_D^{WGAN} + \lambda E[(\|\nabla D(\alpha x + (1-\alpha)G(z))\|_2 - 1)^2]$$

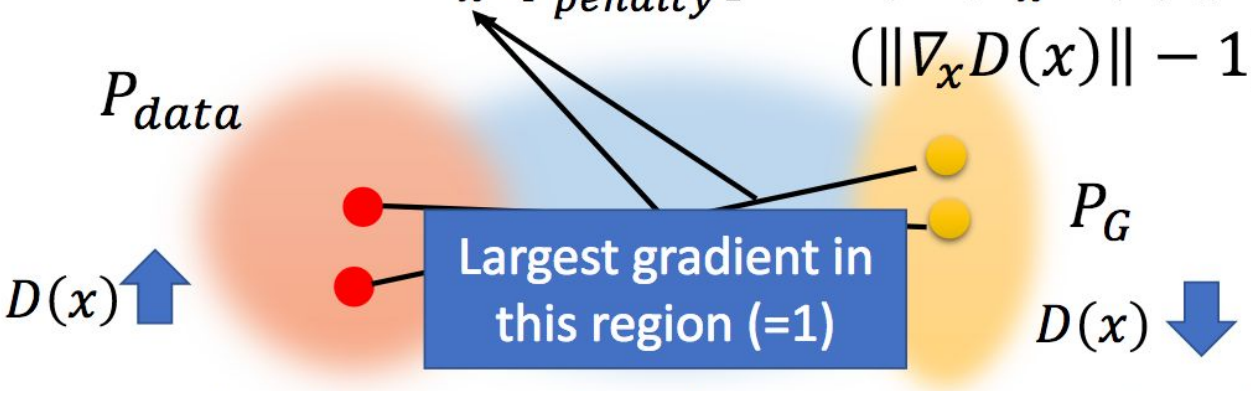
$$L_G^{WGAN\_GP} = L_G^{WGAN}$$

ref:https://arxiv.org/pdf/1704.00028.pdf

Improved WGAN (WGAN-GP) 2/2

$$W(P_{data}, P_G) \approx \max_D \{E_{x\sim P_{data}}[D(x)] - E_{x\sim P_G}[D(x)] - \lambda E_{x\sim P_{penalty}}[\cancel{max(0, \|\nabla_x D(x)\| - 1)}]\}$$

$$(\|\nabla_x D(x)\| - 1)^2$$



ref:https://arxiv.org/pdf/1704.00028.pdf

Least Squares GAN

1 1 0 -1

$$\min_D V_{\mathrm{LSGAN}}(D) = \frac{1}{2}\mathbb{E}_{\boldsymbol{x}\sim p_{\mathrm{data}}(\boldsymbol{x})}\left[(D(\boldsymbol{x})-b)^2\right] + \frac{1}{2}\mathbb{E}_{\boldsymbol{z}\sim p_{\boldsymbol{z}}(\boldsymbol{z})}\left[(D(G(\boldsymbol{z}))-a)^2\right]$$

$$\min_G V_{\mathrm{LSGAN}}(G) = \frac{1}{2}\mathbb{E}_{\boldsymbol{z}\sim p_{\boldsymbol{z}}(\boldsymbol{z})}\left[(D(G(\boldsymbol{z}))-c)^2\right], \quad (2)$$

1 0

ref:https://arxiv.org/abs/1611.04076

Little Results

GAN result

WGAN result

Submission & Grading

Data & format

- Anime Dataset
  - training data: 33.4k (image, tags) pair
  - **faces/**, tags.csv, sample_testing_text.txt

blue eyes
red hair
short hair

- training tags file format
  - img_id <comma> tag1 <colon> #_post <tab> tag2 <colon> #_post
  - tags.csv is **not** used in HW3-1

```
1 0,touhou:17705 |chen:423 |moneti daifuku :60 |animal ears:12241 |catgirl:4903 |
2 1,touhou:17697 |onozuka komachi:224 |shikieiki yamaxanadu:217 |$
3 2,original:25774 |blonde hair:25457 |doll:1040 |dress:16585 |pink eyes:3896 |ta
4 3,amagi brilliant park:111 |musaigen no phantom world:39 |nichijou:142 |kawakam
```

tags.csv

- testing text file format
  - testing_text_id <comma> testing_text
  - testing text only includes **'color hair'** and **'color eyes'**, only alphabetic char involved.
  - sample_testing_text.txt is **not** used in HW3-1

```
1 1,blue hair blue eyes
2 2,blue hair green eyes
3 3,blue hair red eyes
4 4,green hair blue eyes
```

sample testing_text.txt

Data & format

- Extra data
  - training data: 36.7k (image, tags) pair
  - **images/**, tags.csv
- training tags file format
  - img_id <comma> hair tag <space> eyes tag
  - tags in extra data only includes ‘color hair’ and ‘color eyes’
  - tags.csv is **not** used in HW3-1

black eyes
red hair

```
1 0,aqua hair aqua eyes
2 1,aqua hair aqua eyes
3 2,aqua hair aqua eyes
4 3,aqua hair aqua eyes
5 4,aqua hair aqua eyes
```

tags.csv

Data Link

- Anime Dataset
- Extra Data

HW3 Grading Policy:

- HW3-1 Code (image generation) : 5%
- HW3-2 Code (text-to-image generation): 5%
- Report : 15%
- HW3-3 (Bonus, style transfer): 2%
- 分工表 : 0.5%
- 上台分享 : 1%
- 上台分享前三名 : 1%

HW3 Report Questions

- Model Description
  - Describe the models you use to, including the model architecture, objective function for G and D.
    - Image Generation (2%)
    - Text-to-image Generation (2%)
- Experiment settings and observation
  - Show generated images
    - Image Generation (1%)
    - Text-to-image Generation (1%)
- Compare your model with WGAN, WGAN-GP, LSGAN (choose 1) (**Image Generation Only**)
  - Model Description of the choosed model (1%)
  - Result of the model (1%)
  - Comparison Analysis (1%)
- Training tips for improvement (**Image generation Only**) (6%)

Training Tips for improvement

- Pick three tips in the following website
  - https://github.com/soumith/ganhacks
  - Please implement these tips on image generation
- Total : 6%, 2% for each
  - Which tip & implement details (1%)
  - Result (image or loss...etc.) and Analysis (1%)
- Only the following tips are accepted
  - 1, 2, 3, 4, 5, 6, 9, 13, 14, 17

HW3-1 Code Grading

- Reproduce Score : 2%
- Baseline Scroe : 2%
- TA Review : 1% (**mode collapse**)

Output Format Requirement

- The generated images should be in Directory **samples/**
  - **請大家繳交時就將產生的結果傳到samples/，助教利用script reproduce時也請同學將結果輸出到這個資料夾。為保證reproduce結果相同，請同學將random的部份固定**
  - **批改作業會在azure上，請同學繳交前在機台上檢查**
  - 已經在github裡的image -> samples/gan_original.png
  - run_gan.sh -> samples/gan.png
- Each generated image must be resized to **64 x 64**
- Generate 25 image into one png
  - sample code is in baseline.py
  - 為防止同學產生的圖片不一致，請同學使用baseline.py裡的**save_imgs()**

Baseline Model

- Anime Face Recognition
- Github for baseline.py
- How to run:
  - pip install opencv-python
  - Download pre-trained model in Here.
  - python baseline.py --input <input_image>
- Generate 25 images in one png
  - if faces > 20: pass
- 下週二(5/8)會釋出最簡單架構

Allow Packages

- Python 3.6
- **Tensorflow r.16 ONLY** (CUDA 9.0)
- PyTorch 0.3 / torchvision (**0.4 is not allowed**)
- Keras 2.0.7 (Tensorflow backend only)
- MXNet 1.1.0
- CNTK 2.4
- matplotlib
- skimage
- numpy, scipy
- Python Standard Library
- If you want to use other packages, please ask TAs for permission first!
- new allowed package: pandas, tensorlayer, gensim, nltk

Submission on Github

- Only one branch **master** is needed
- Only **generator** and **inference** mode is needed
- Remember to put your **pre-trained models or download scripts** so that we can run your code successfully

Submission

- Deadline: 2018/06/08 GMT+8 24:00
- **hw3/** should contain the following files:
    - **run_gan.sh (hw3-1)**
    - **run_cgan.sh (hw3-2)**
    - **extra_run.sh (hw3-3, bonus)**
    - **samples/, samples/gan_original.png**
    - **report.pdf**
    - **pre-trained model, python code...**
  - If some files are too big, upload to your cloud and download them when running your run.sh
- TAs will run your scripts in the following order to generate images
  - bash run_gan.sh (hw3-1)
  - All scripts must output in **10 minutes**.
  - shell script裡面請寫**相對路徑**
- HW3-2, 3-3格式會在之後釋出

Q&A

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