



# Rescue the Acne Face

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資訊所 藍翊庭

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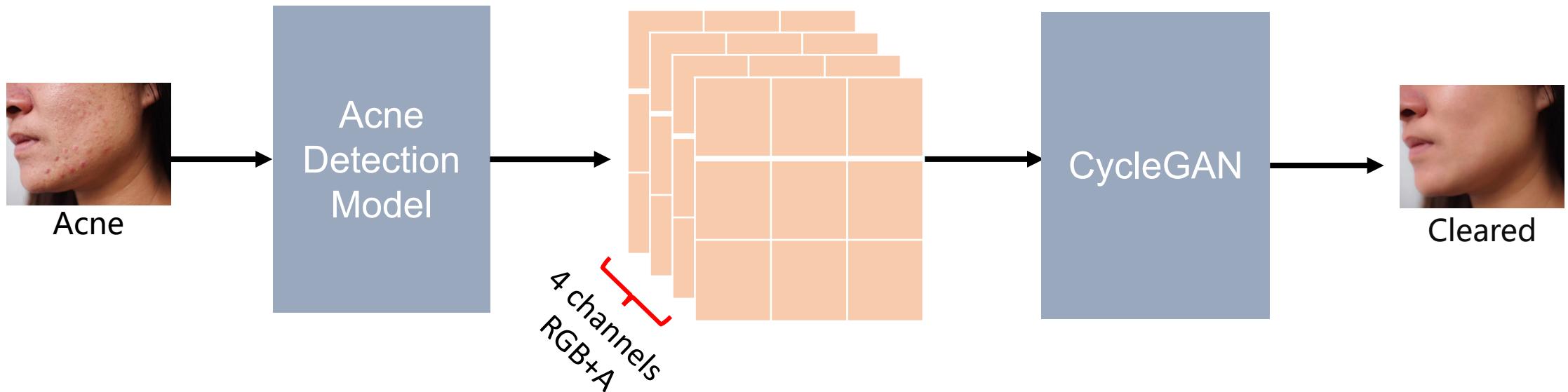
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醫資所 黃書堯



# Preliminary Methods

Due to the absence of paired images of the same individuals with and without acne, the dataset is considered unpaired. Therefore, CycleGAN is used for the image translation tasks.



## Initial Objective with CycleGAN:

Utilize the acne locations as the fourth channel in CycleGAN. Using an RGB+A format, where "A" represents the Acne feature channel.

# CycleGAN Experiment

200 epochs



1000 epochs



# Challenge

## Information Asymmetry in Image Data

- **Acne Face Images:** Predominantly profile views and eyes closed. (側臉、閉眼)
- **Clean Face Images:** Predominantly frontal views and eyes open. (正臉、睜眼)

## Problem

Limited availability of frontal acne images, likely leading to information asymmetry.

## Solution

Decision to adjust the dataset by utilizing **paired data** with GAN for generation.

# Methods

## Method 1: Paired Data Generation

- Add artificial acne (red noise) to acne-free frontal face images to create a paired dataset.
- Use the **Pix2Pix** model for image-to-image translation.

## Method 2: Image Inpainting

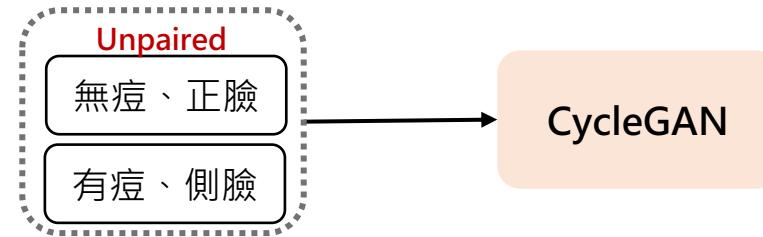
- Use **YOLO v8** for object detection to identify and mark the location of acne.
- Apply **Image Inpainting** techniques to erase the acne.

## Method 3: Filtering Techniques

- Use **YOLO v8** for object detection to mark the location of acne.
- Employ **Bilateral** and **Median filters** to remove the acne.

1

### Unpaired Image-to-Image Translation

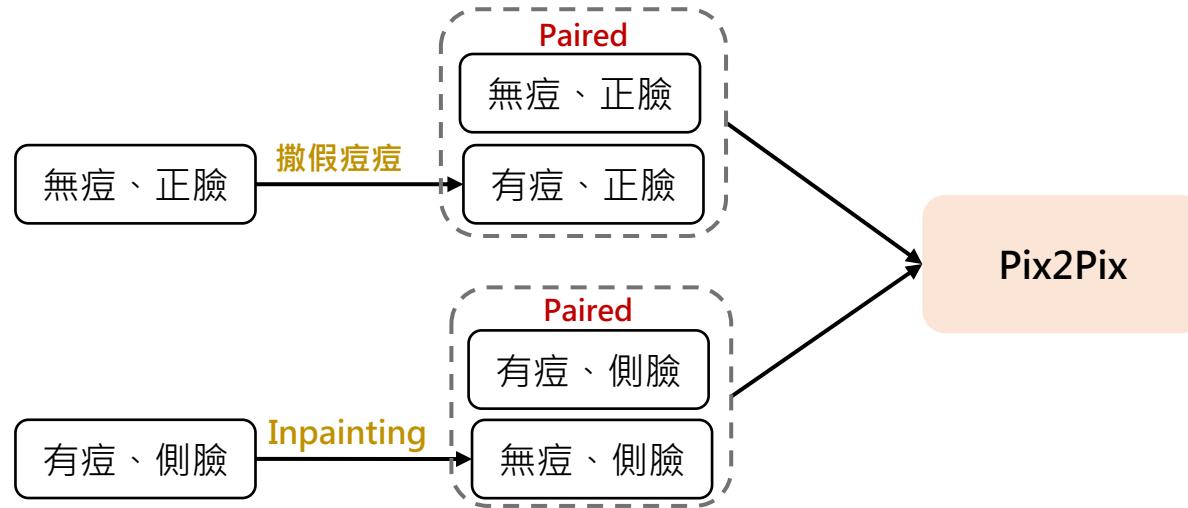


失敗

除痘痘外，存在另一個Domain不一致  
(正臉與側臉)

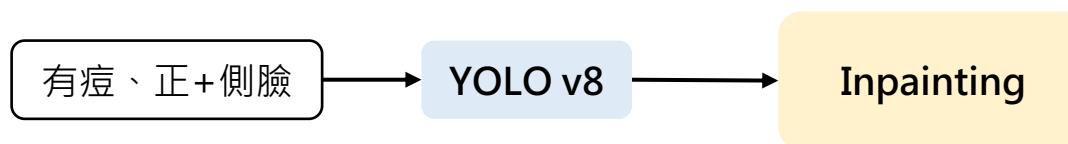
2

### Paired Image-to-Image Translation



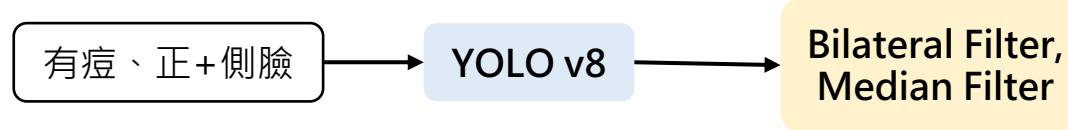
3

### Object Detection + Inpainting



4

### Object Detection + Traditional Smoothing



# Datasets

Type	Dataset	Use For	Num	Split Ratio	Describe
痘痘 正臉	Acne-new dataset	Train YOLO v8 Inference on all models (Choose #acne > 30)	3239	85/10/5	生活照、大部分照片痘痘 數量不多
痘痘 側臉	ACEN04 dataset	Train Pix2Pix Inference on all models	330 out of 3199	97/x/3	挑選其中痘痘分級為1跟2 的照片(1024*1024)
無痘 正臉	Dataset6	Train Pix2Pix	541 out of 1841	100/x/x	挑選不同種族的照片，有 印度人亞洲人等等

# Pix2Pix

- **Data:**

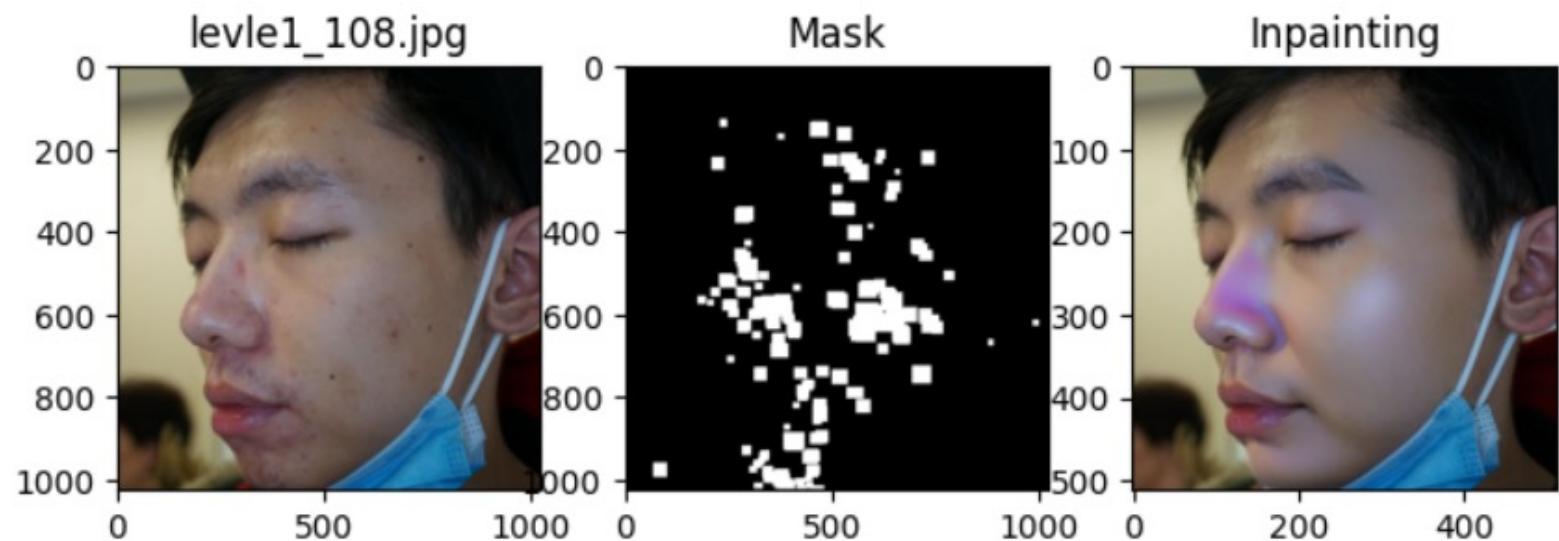


- **Batch size:** 為了加快訓練速度，嘗試將batch size上調為64，但發現結果很糟糕。
- **Epoch:** 我們訓練了最多1200 epochs，但後面發現700 epochs左右的結果就已經很好了。  
顯示越多的訓練epochs不一定有較佳的成果。

# Inpainting

## Inpainting Model

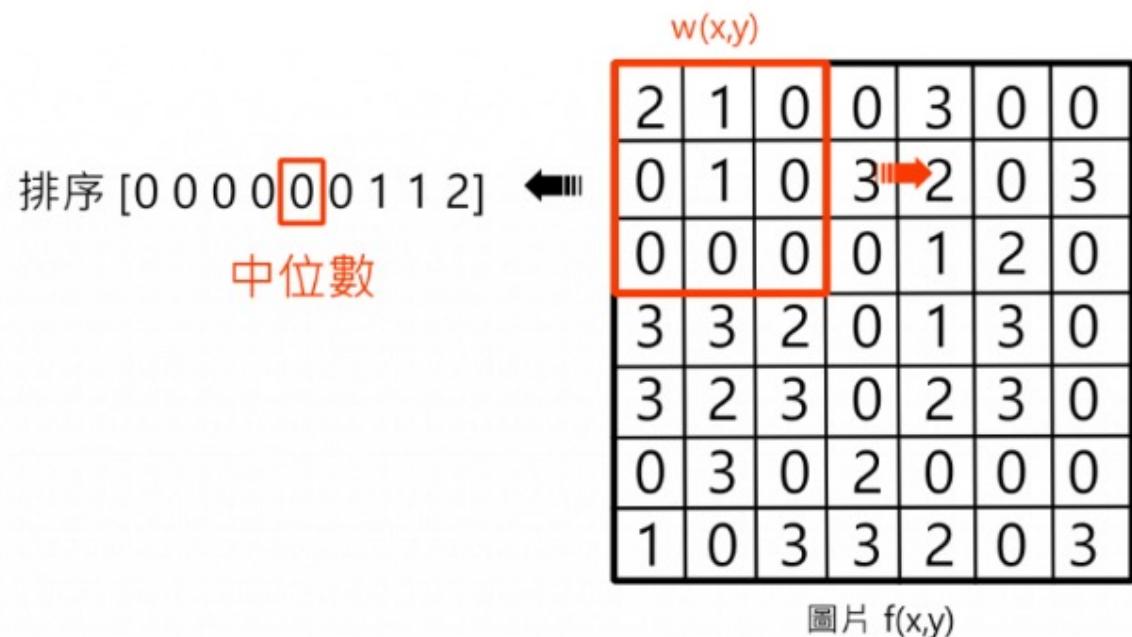
- **Kandinsky 2.2**
- **Stable Diffusion**



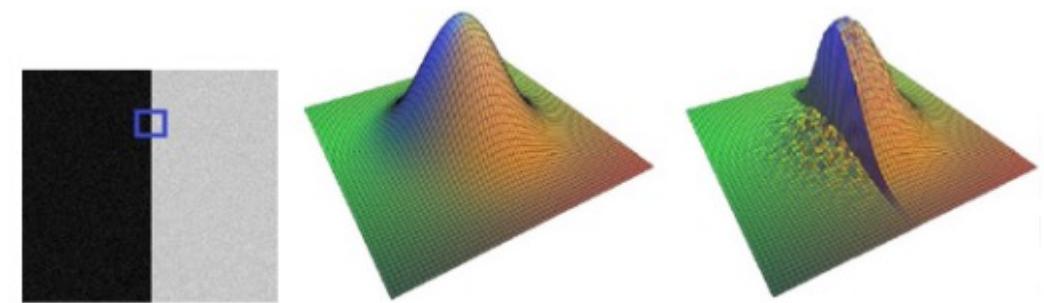
- 根據 Object Detection 結果產生 mask image
- 嘗試調整 conf 大小，結果發現當 $\text{conf} < 0.05$  時 inpainting 的去除效果最好
- Stable Diffusion 的自然度比 Kandinsky 2.2 好

# Filter

## Median Filter



## Bilateral Filter

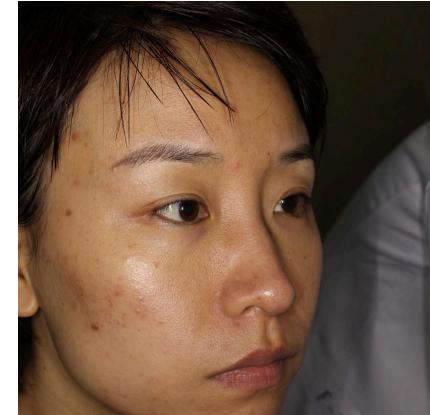


$$I_p = \frac{1}{W_p} \sum_{q \in S} G_{\sigma_s}(\|p - q\|) G_{\sigma_r}(|I_p - I_q|) I_q$$

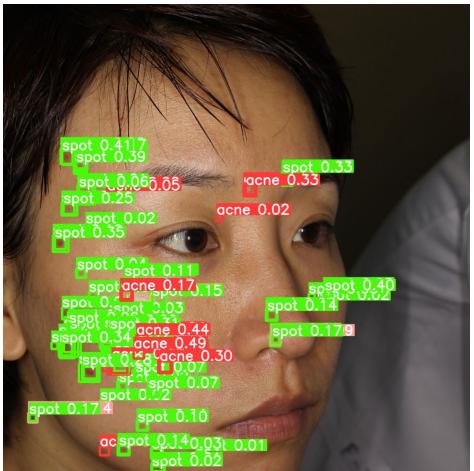
$$W_p = \sum_{q \in S} G_{\sigma_s}(\|p - q\|) G_{\sigma_r}(|I_p - I_q|)$$

# Object Detection Result

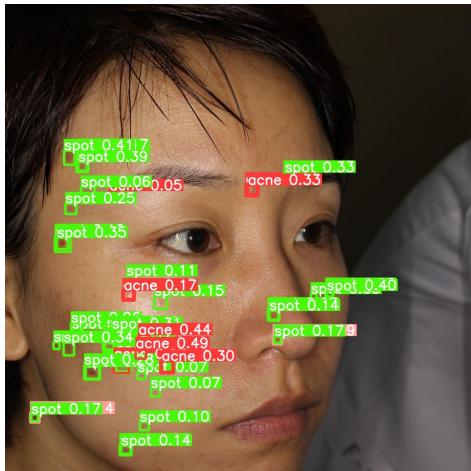
Original Image



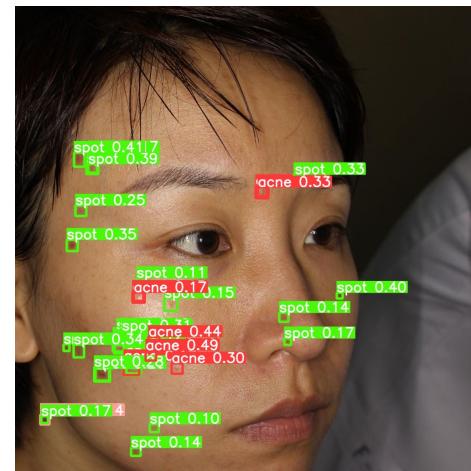
conf > 0.01



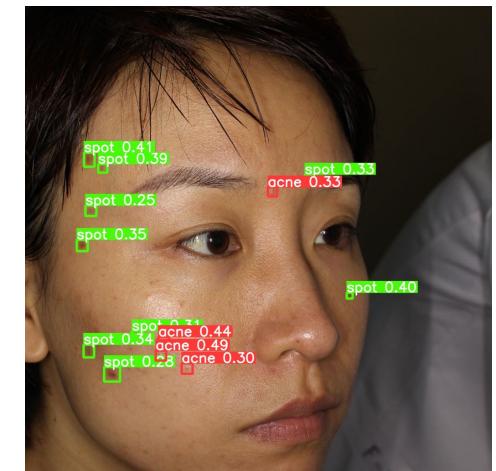
conf > 0.05



conf > 0.1



conf > 0.2



Integration of YOLO Results in Inpainting and Filtering

# Inpainting Result

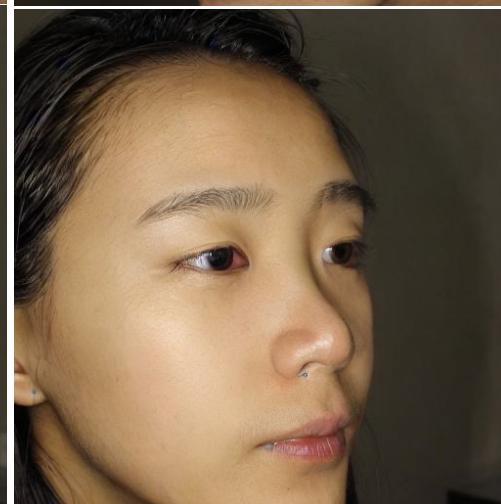
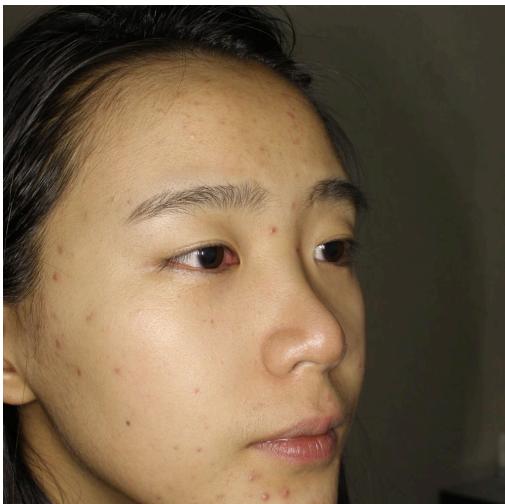
Original



Kandinsky 2.2



stable



# Median Filter V.S. Bilateral Filter

Original



Median Filter



Bilateral Filter



**Original**



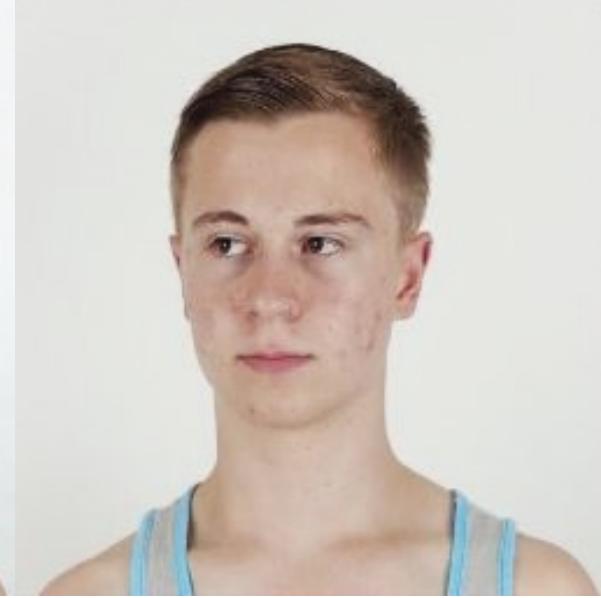
**Median Filter**



**Inpainting**



**Pix2Pix**



**Original**



**Median Filter**



**Inpainting**



**Pix2Pix**



# Survey

- 從測試集隨機選取20張痘痘照片，分別為10張正臉生活痘痘照與10張側臉痘痘照。
- 每份問卷包含5張照片，分為四個版本：A、B、C、D卷
- 收集回答數量：A卷57份、B卷43份、C卷29份、D卷27份，共156份問卷。

## 去除效果

請評價痘痘和痘疤去除的完成度。是否還可以看到瑕疵？

## 自然度

處理後皮膚與原皮膚相比，是否顯得和諧？還是存在不自然的過渡、紋理變化？

## 真實度

整張圖片與原照片是否保持一致？有無非預期的效果，如雜點、異物、陰影、意外的鬍子或紅唇，或模糊不清？

# Survey Result

正臉生活痘痘照	Median Filter	Inpainting	Pix2Pix
去除效果	$3.55 \pm 0.98$	$4.10 \pm 0.66$	$2.83 \pm 0.98$
自然度	$2.53 \pm 1.13$	$3.73 \pm 0.90$	$3.22 \pm 0.96$
真實度	$2.58 \pm 1.11$	$3.63 \pm 0.95$	$3.21 \pm 1.00$

側臉痘痘特寫照	Median Filter	Inpainting	Pix2Pix
去除效果	$3.19 \pm 1.07$	$3.80 \pm 0.87$	$3.40 \pm 0.90$
自然度	$2.16 \pm 0.97$	$3.73 \pm 0.81$	$3.27 \pm 0.97$
真實度	$2.23 \pm 1.00$	$3.67 \pm 0.87$	$3.27 \pm 0.98$

全部痘痘照	Median Filter	Inpainting	Pix2Pix
去除效果	$3.38 \pm 1.04$	$3.96 \pm 0.78$	$3.10 \pm 0.99$
自然度	$2.36 \pm 1.07$	$3.73 \pm 0.86$	$3.24 \pm 0.97$
真實度	$2.42 \pm 1.07$	$3.65 \pm 0.92$	$3.24 \pm 0.99$

- |   |    |
|---|----|
| 1 | 很差 |
| 2 | 差  |
| 3 | 普通 |
| 4 | 好  |
| 5 | 很好 |

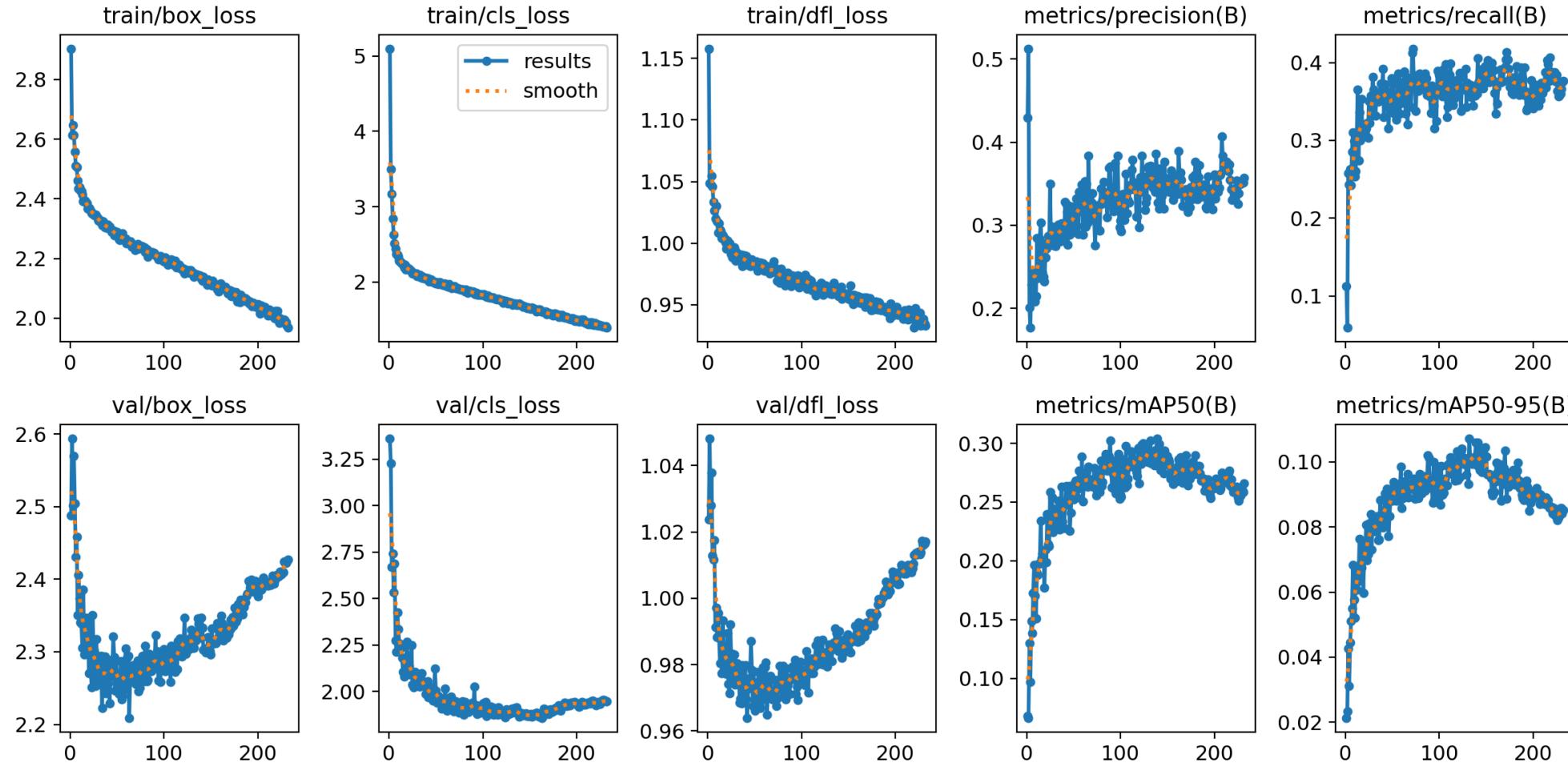
# Reference

- BuyumeDatasets. (2023). *acne-new Dataset*. Roboflow Universe. Available at: <https://universe.roboflow.com/buyumedatasets/acne-new> (Accessed: 15 June 2024).
- Isola, P., Zhu, J.-Y., Zhou, T., & Efros, A. A. (2017). Image-to-Image Translation with Conditional Adversarial Networks. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), pp. 1125-1134.
- Zhu, J.-Y., Park, T., Isola, P., & Efros, A. A. (2017). Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks. In Proceedings of the IEEE International Conference on Computer Vision (ICCV), pp. 2223-2232.
- Pix2pix Github : <https://github.com/junyanz/pytorch-CycleGAN-and-pix2pix>
- Kaggle : <https://www.kaggle.com/datasets/wedyan78/dataset6>
- Kaggle : <https://www.kaggle.com/datasets/manuelhettich/acne04>
- Inpainting : <https://huggingface.co/docs/diffusers/using-diffusers/inpaint>

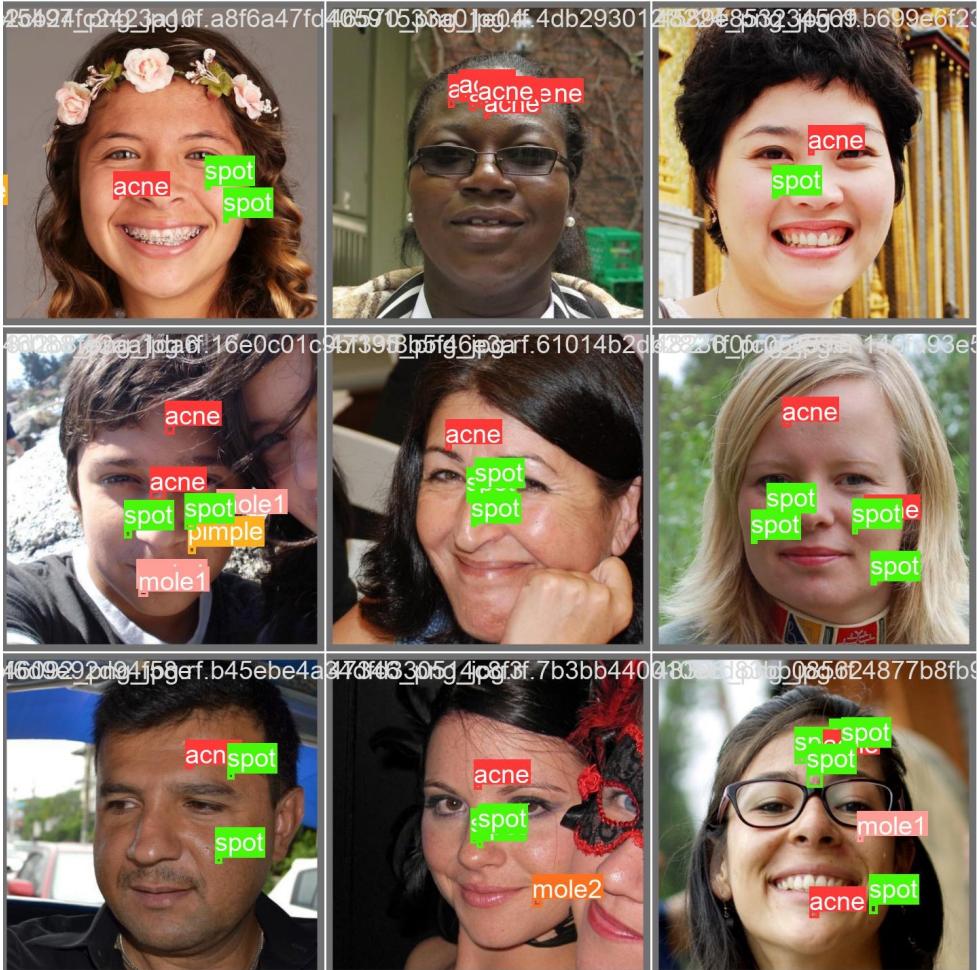
# Appendix

# Object Detection Result

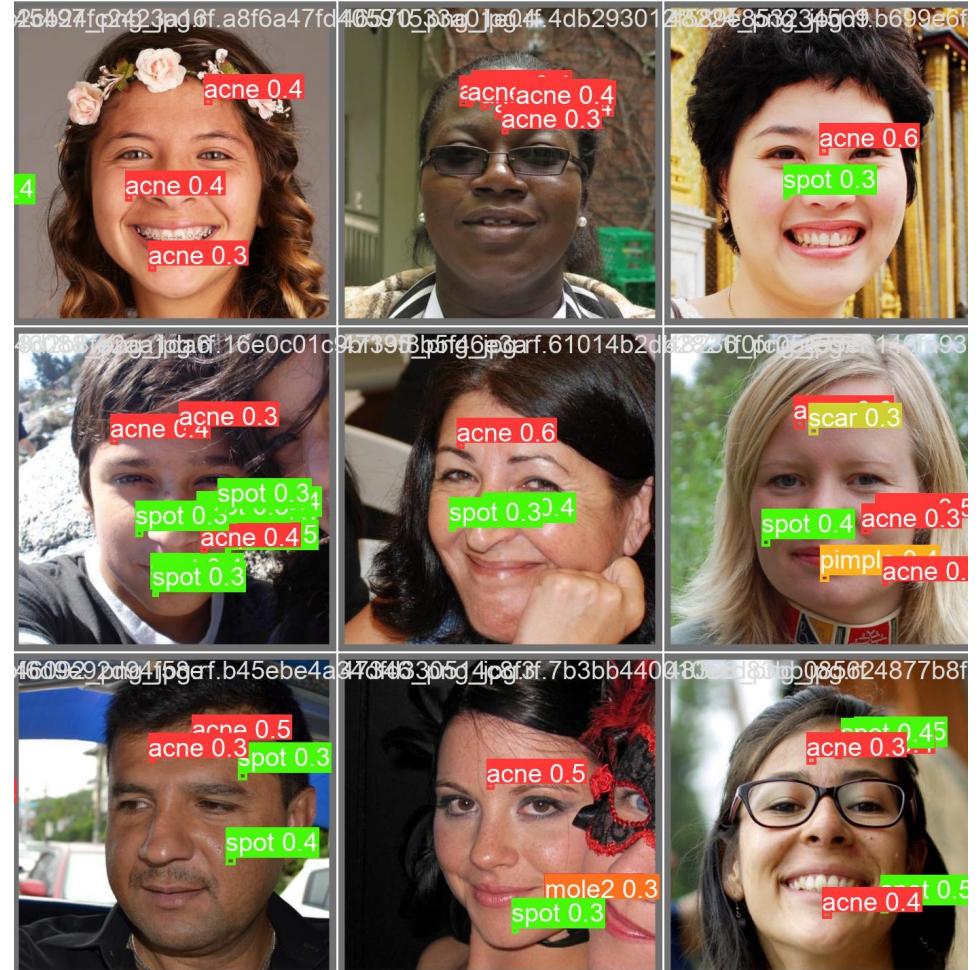
- 5 class
- early stopping at 232 epoch
- best on epoch 132



# Object Detection Result



Original label



YOLO detection result

Thank you