HUST

ĐẠI HỌC BÁCH KHOA HÀ NỘI

HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY

ONE LOVE. ONE FUTURE.

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Computer Vision

Nguyễn Hà Phú Thịnh

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Structure

- Project 1.2 for Classical Computer Vision
  - Picture 1
  - Picture 2
  - Picture 3
  - Picture 4
- Content-Based Image Retrieal
  - Dataset
  - Architecture
  - Evaluation
  - Results

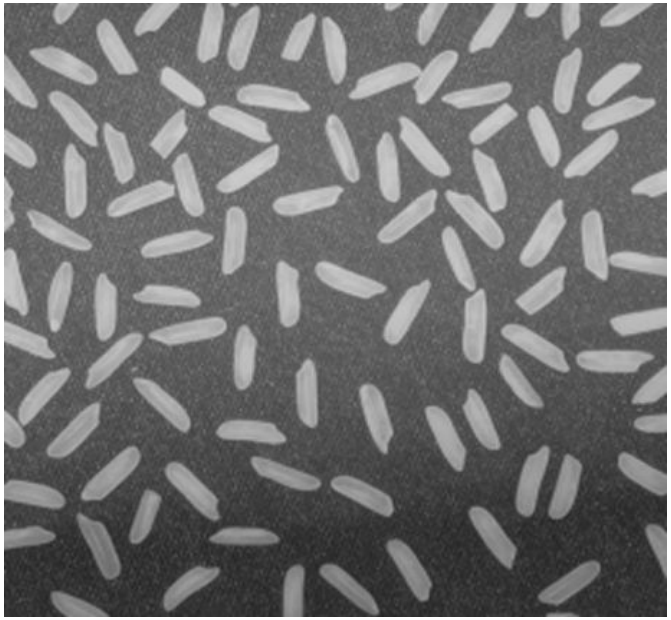
Project 1.2

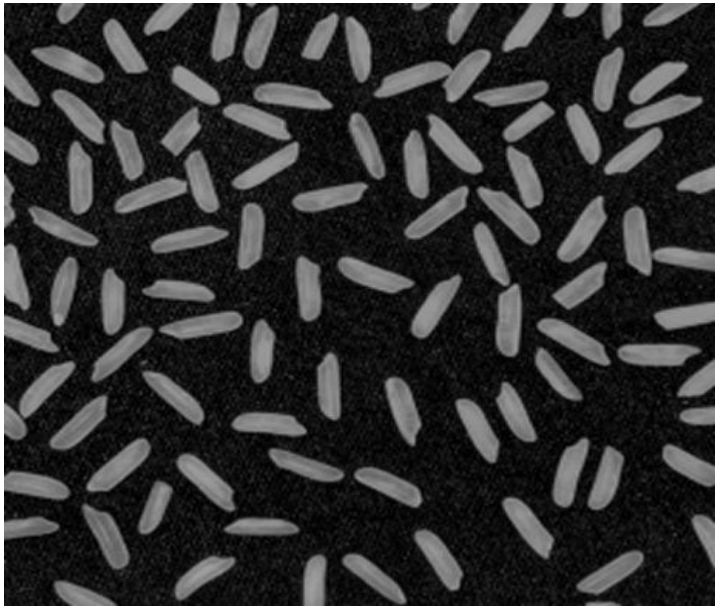
Pic 1 + 2:

- Top Hat transform: fix uneven light
- Median Blur: remove noise
- Otsu's Thresholding: verify rice vs. background
- Morphological Opening: clean up
- Watershed Algorithm: separate touching grains

Pic 1

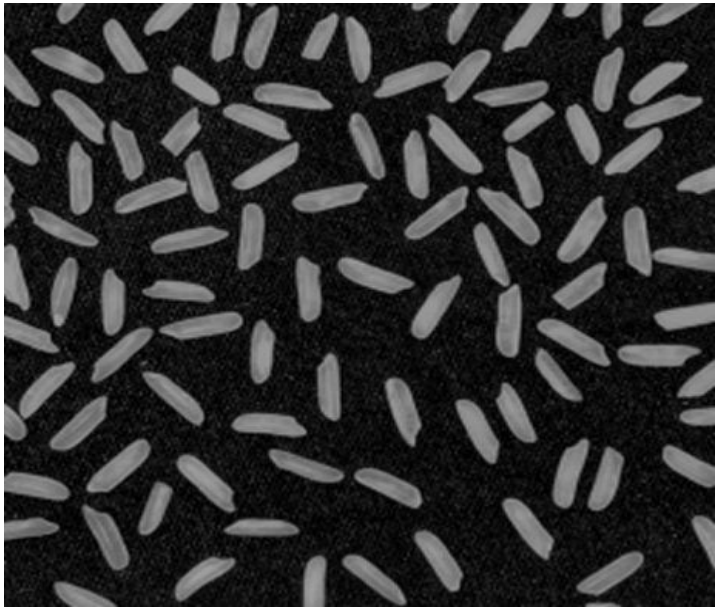
Top-Hat transform: kernel (40x40)

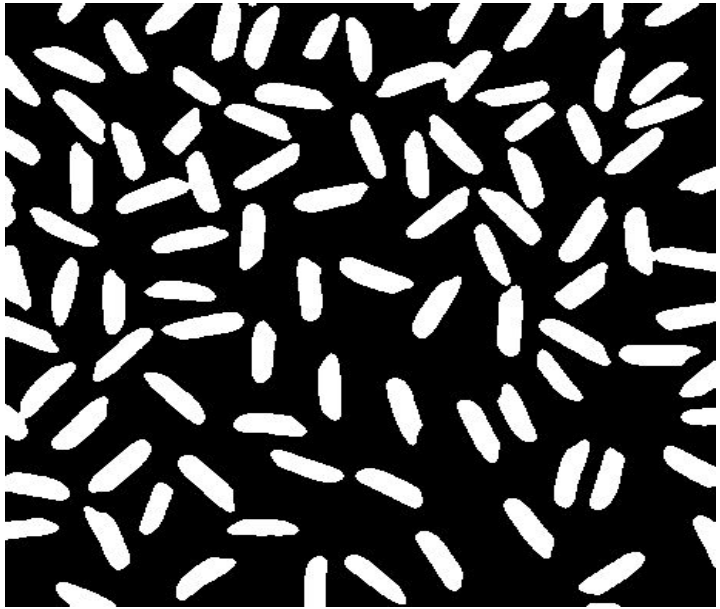




Pic 1

Median Blur (kernel: 5) + Otsu thresh hold (50%)





Pic 1

Clean: Morphological Opening + Watershed Algorithm

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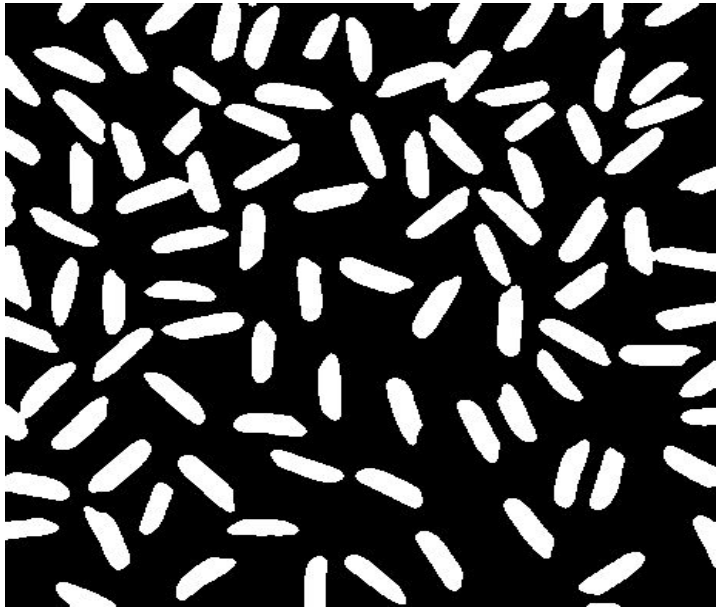
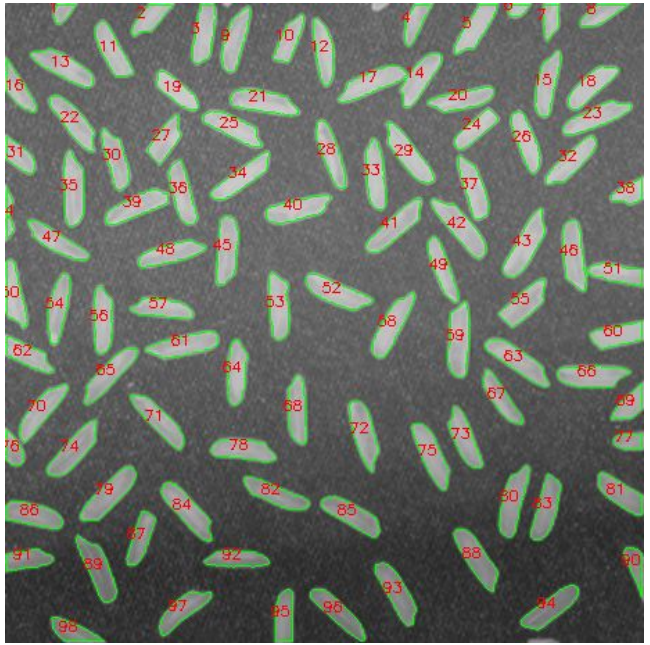
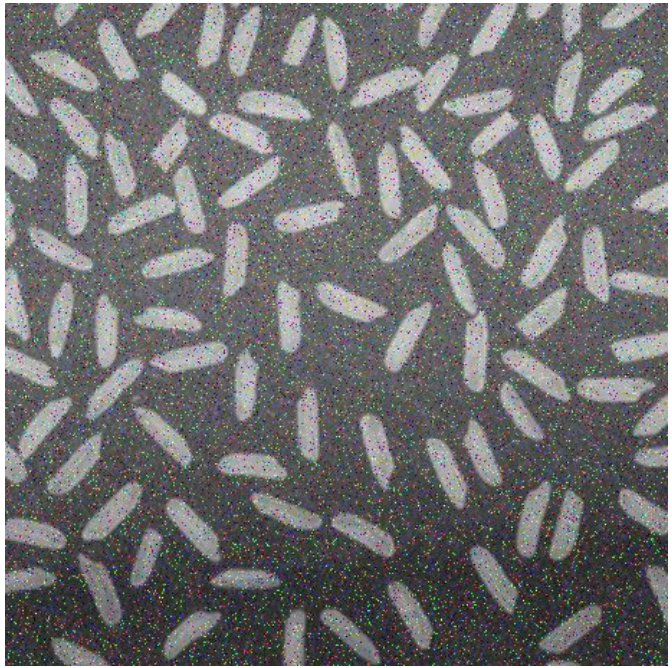
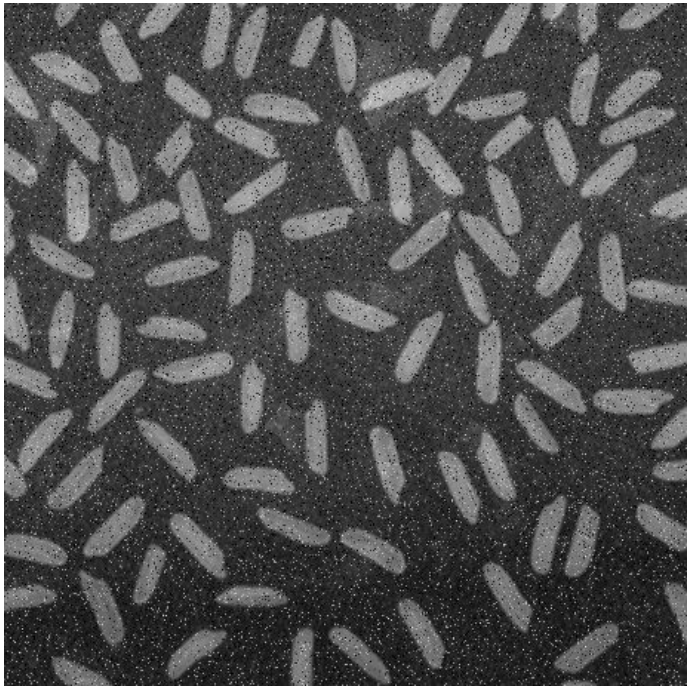




Pic 2

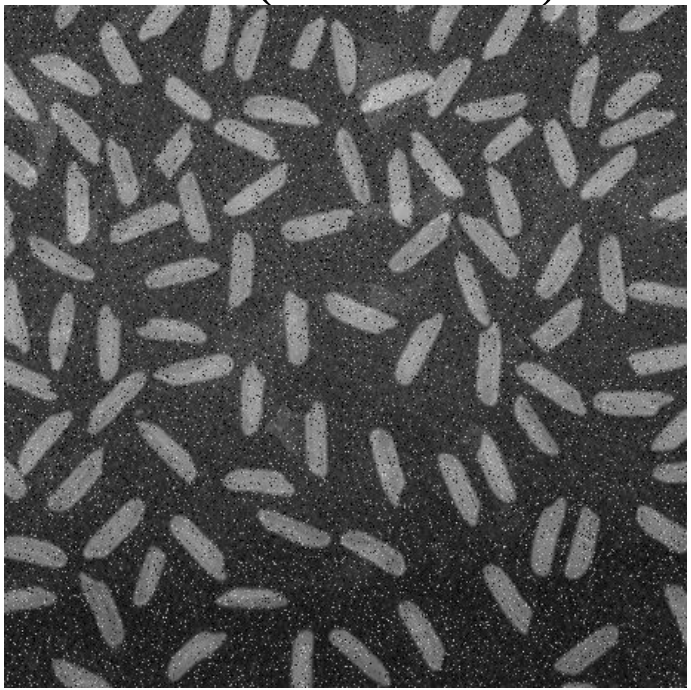
Top-Hat transform: kernel (40x40)

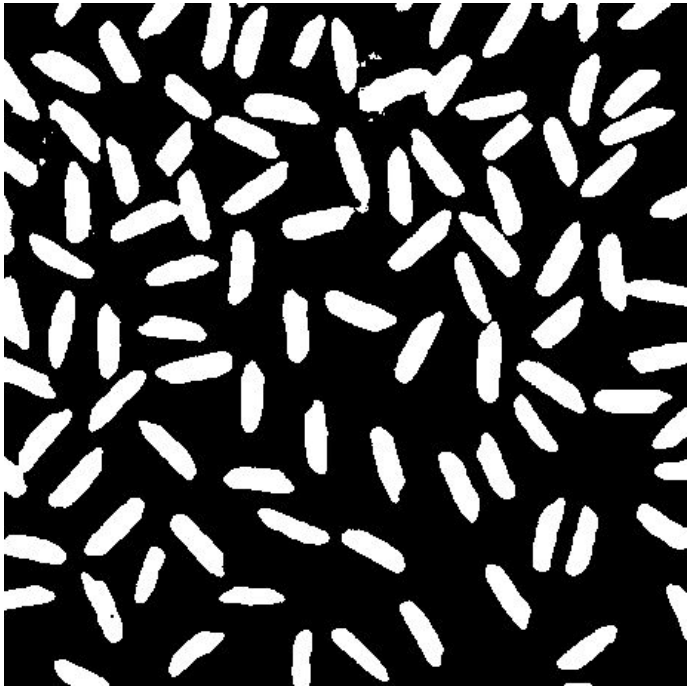




Pic 2

Median Blur (kernel: 5) + Otsu thresh hold





Pic 2

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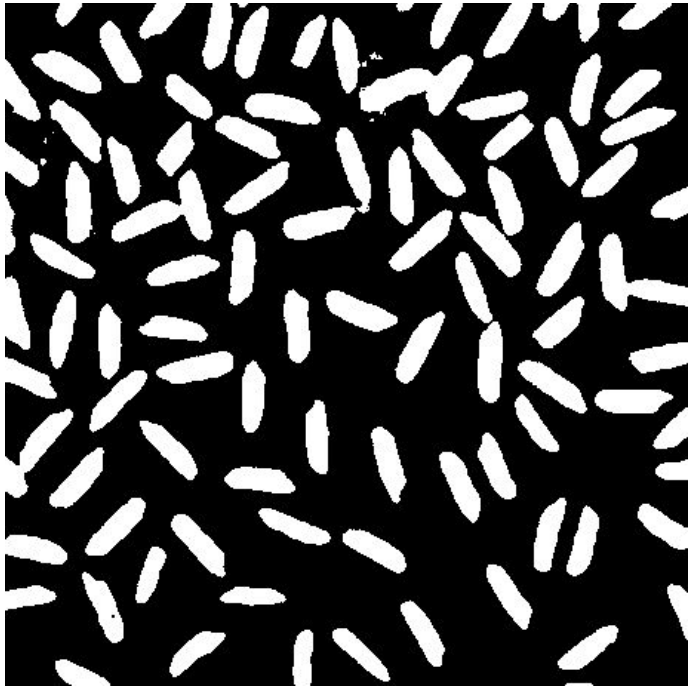
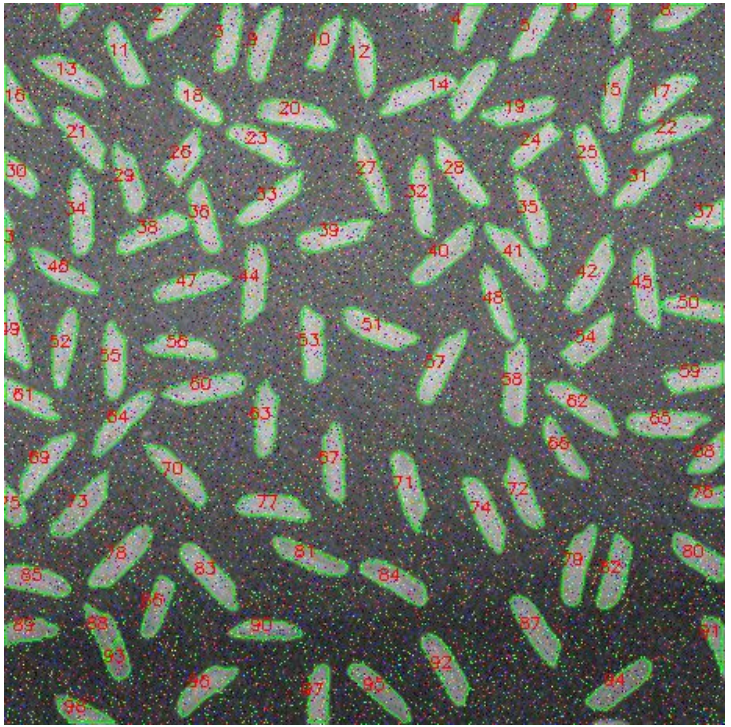




Project 1.2

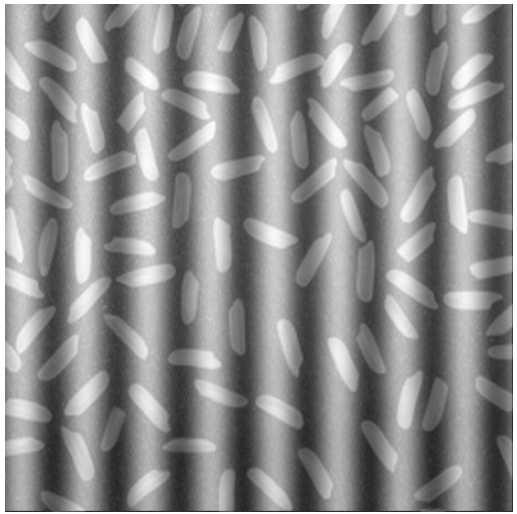
Pic 3:

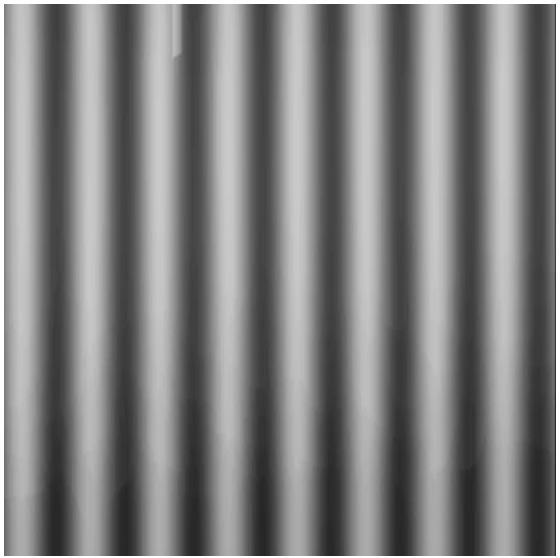
– Vertical Kernel: To isolate the waves

- Image subtraction: To clean the image
- Otsu's Thresholding: verify rice vs. background
- Morphological Opening: clean up
- Watershed Algorithm: separate touching grains

Pic 3

Vertical kernel (1, 80)





Pic 3

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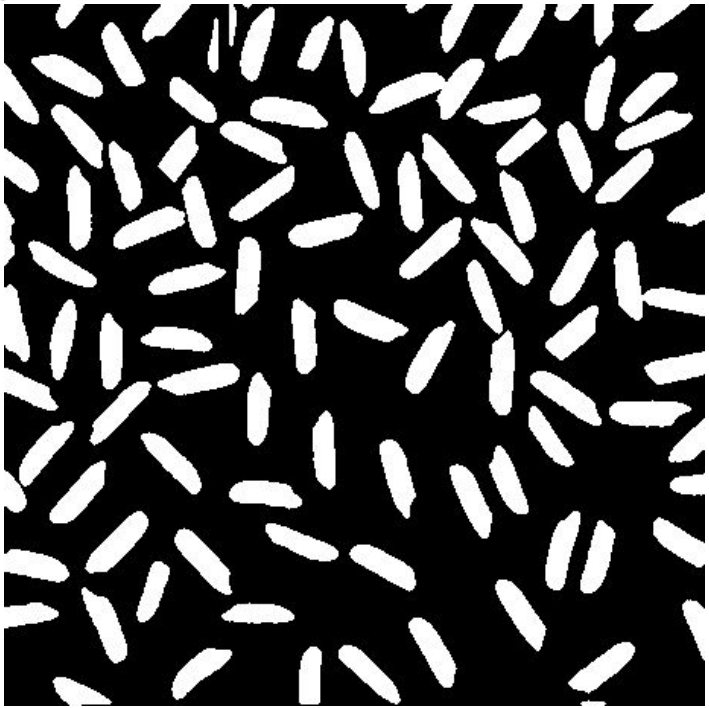

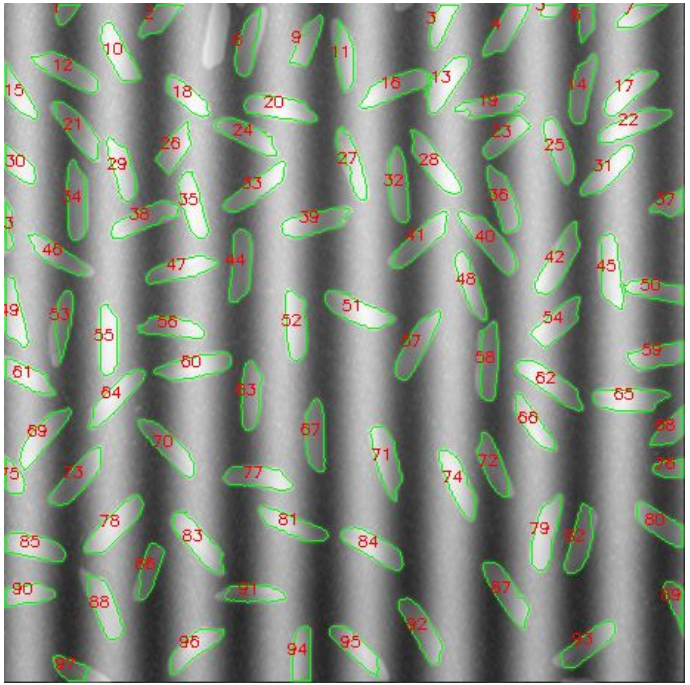

Project 1.2

Pic 4:

- Otsu's Thresholding: Key
- Morphological Opening: clean up
- Watershed Algorithm: separate touching grains

Pic 4

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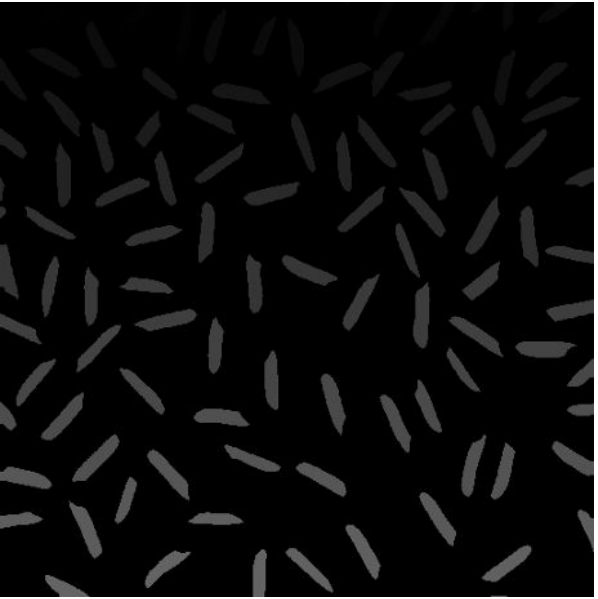
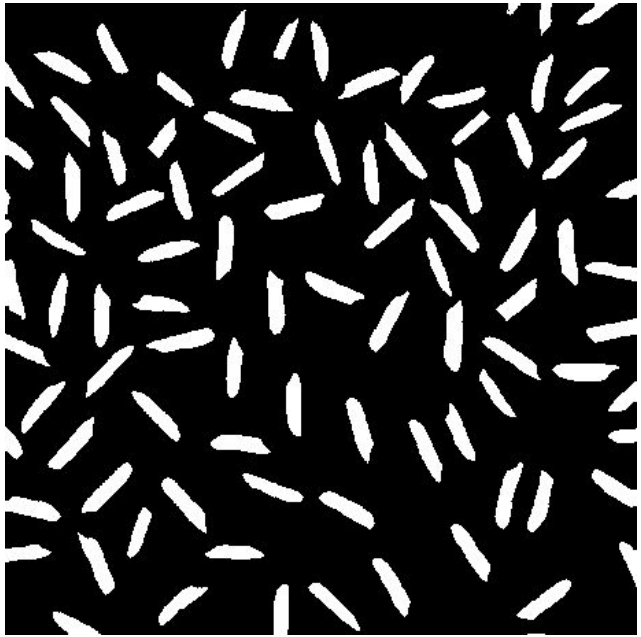
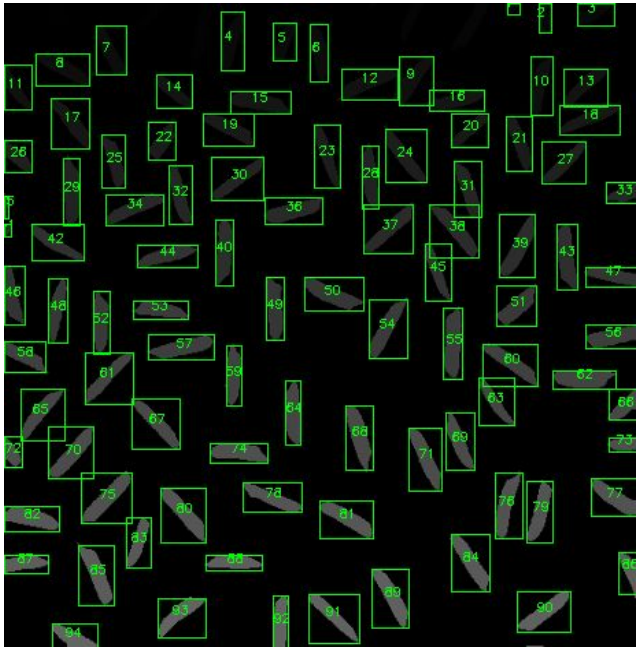
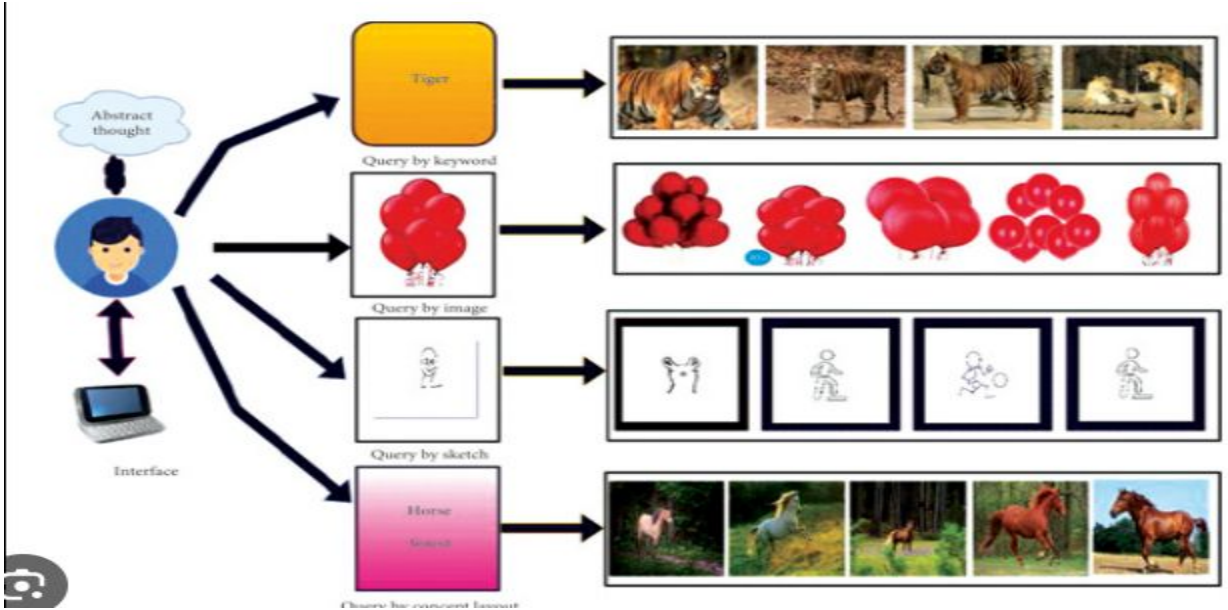






CBIR

- **Goal:** Build a system to retrieve images from a large database that are visually similar to a query image.
- **Challenge:** Semantic gap—pixels are just numbers; the model must understand "architecture," "shape," and "object identity."
- **Application:** Digital asset management, visual search engines (like Google Lens), e-commerce.



CBIR

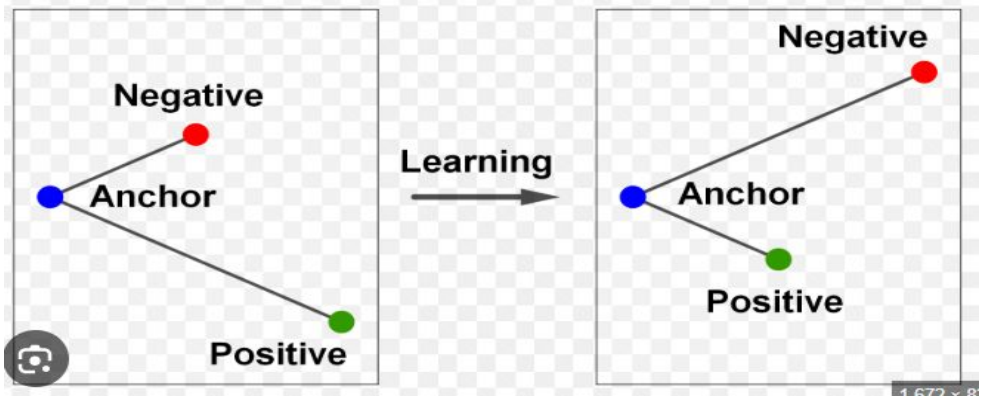
- Dataset:
- Oxford5k:
  - The Oxford Buildings Dataset consists of 5063 images collected from Flickr by searching for particular Oxford landmarks.
  - The dataset contains 11 landmarks. For each landmark there are *ok*, *good*, *junk* and *query* images.
- Paris 6k:
  - buildings dataset with ~6,000 images.

Methodogy

Visual Suggestion: (Three images entering the network: Anchor, Positive, Negative).

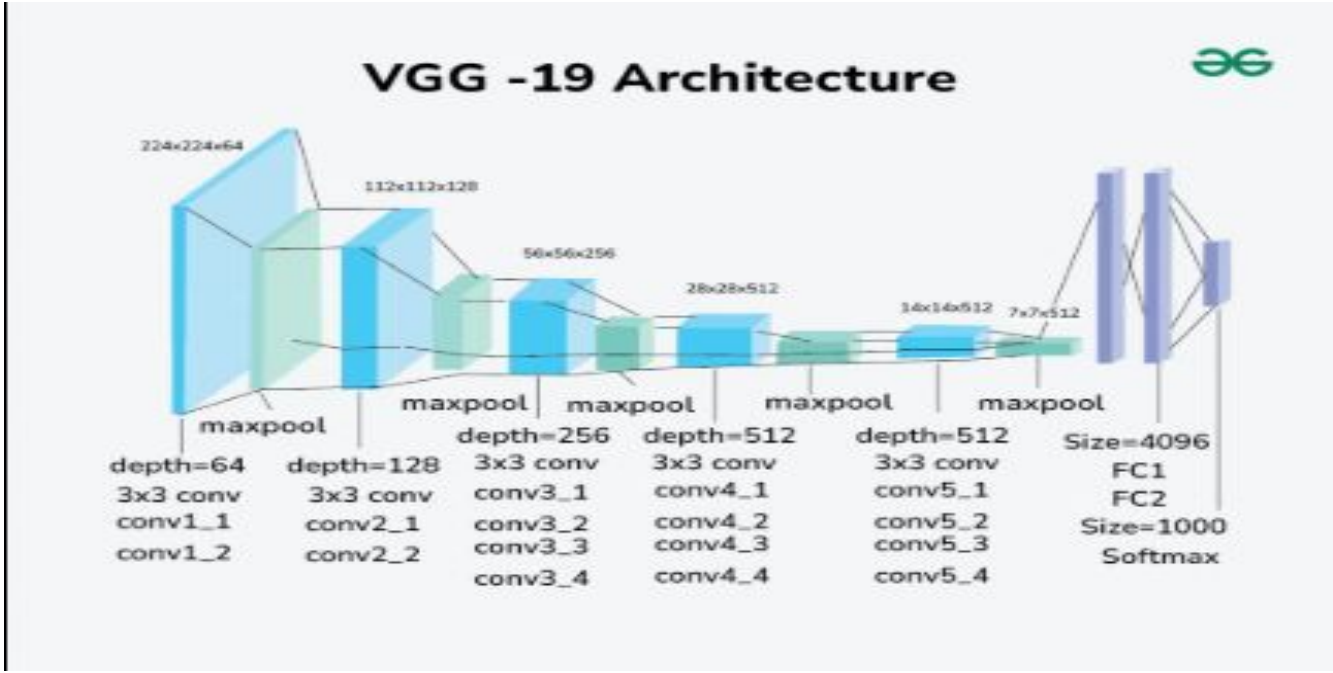
Bullet Points:

- **Approach:** Deep Metric Learning.
- **Architecture:** Siamese Network with Triplet Architecture.
- **Objective:** Learn an embedding space where similar images are close, and dissimilar ones are far apart.
- **Loss Function:** Triplet Margin Loss.



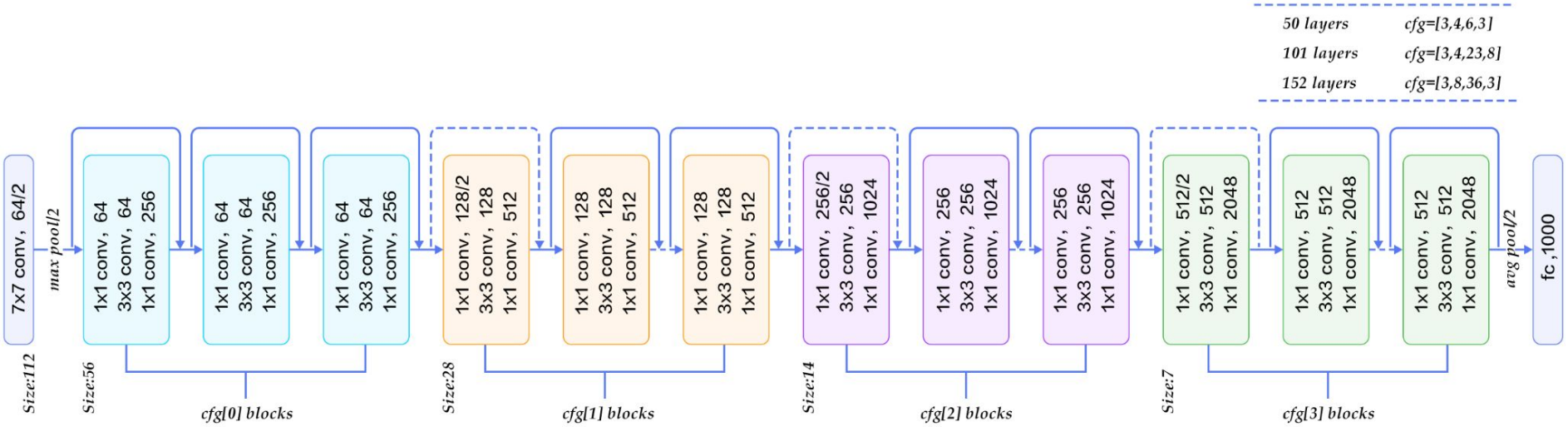
Model

Backbone: VGG-19



Model

Backbone: Resnet-50



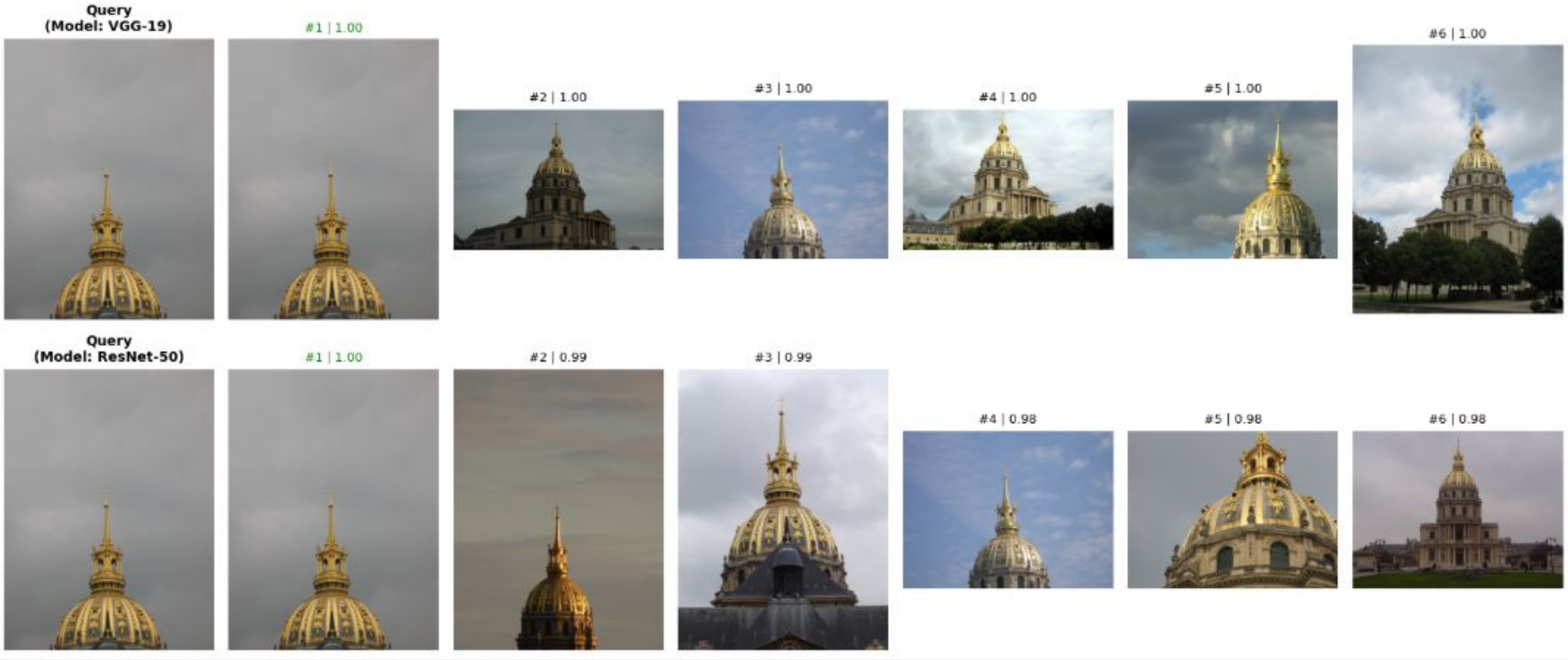
Configuration

```python
# Configuration
CONFIG = {
    'oxford_data_dir': '/kaggle/input/oxford5k/images/',
    'oxford_gt_path': '/kaggle/input/oxford5k/groundtruth.json',
    'paris_data_dir': '/kaggle/input/paris6k/Paris6k/',
    'batch_size': 32,  # Larger batch size for 2 GPUs
    'num_epochs': 80,
    'learning_rate': 1e-5,
    'num_workers': 4,
    'embedding_dim': 2048,
    'backbone': 'resnet50', # Options: 'resnet50', 'vgg19'
    'device': torch.device("cuda" if torch.cuda.is_available() else "cpu")
}
```

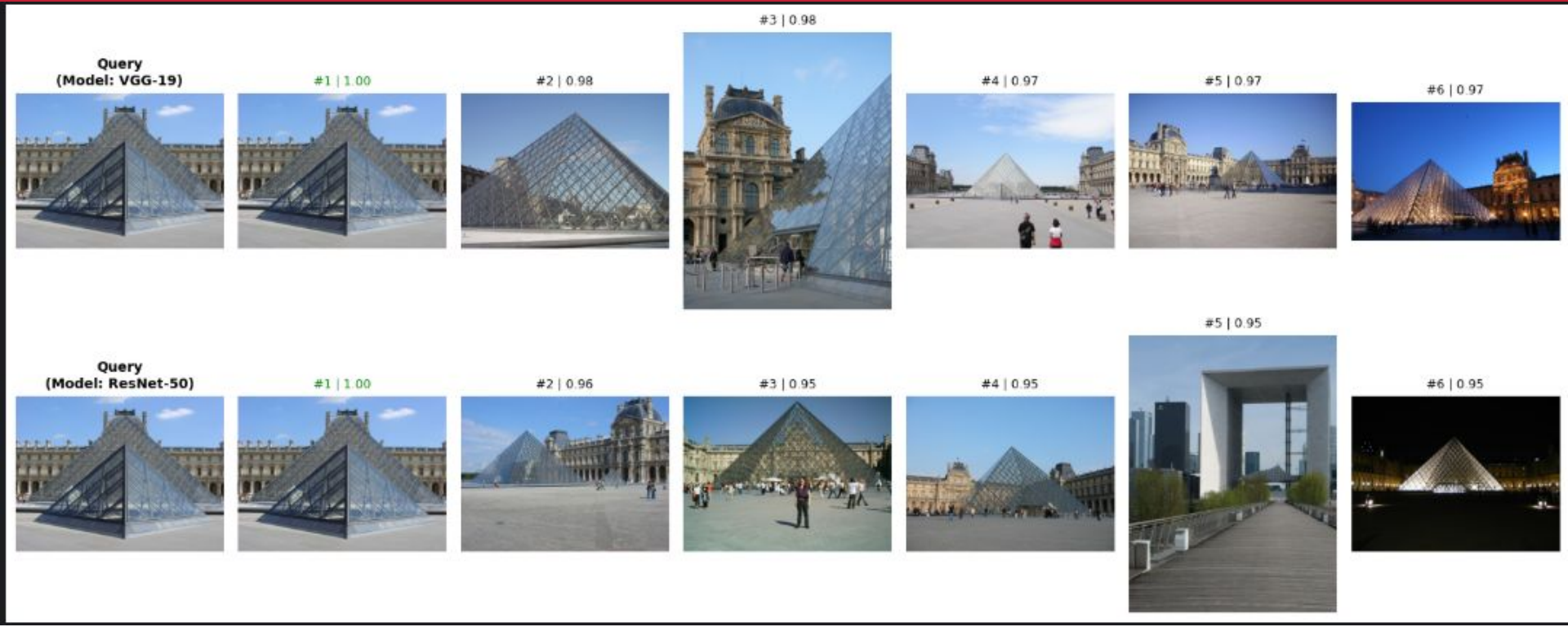
Evaluation: Quantitative Results

Metric	ResNet-50	VGG-19
System Metrics		
Index Size (MB)	54.90	54.90
Vector Dimension	2048	2048
Number of Images	6960	6960
Quality Metrics		
mAP	**0.8640**	0.8002
MRR	**0.9864**	0.9301
NDCG@10	**0.9879**	0.9277
NDCG@20	**0.9851**	0.9314

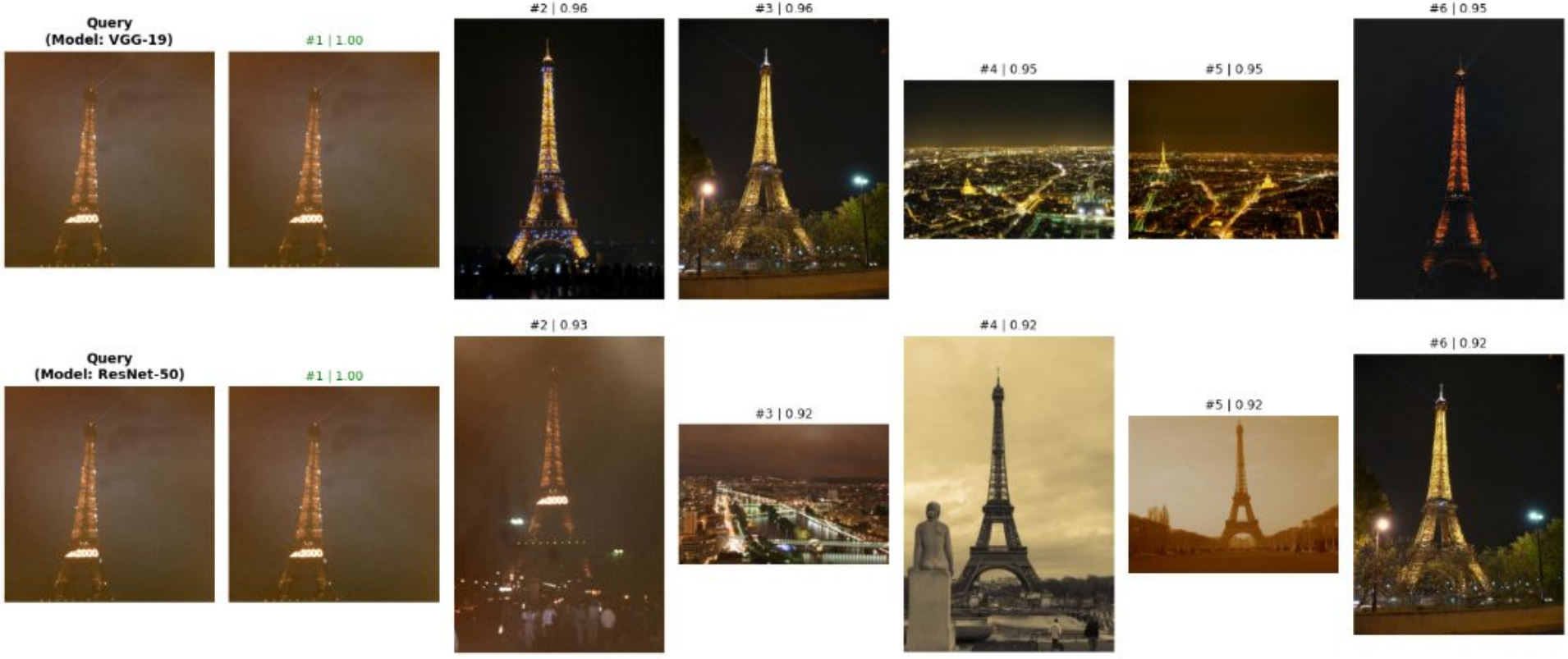
Evaluation: qualitative assessment



Evaluation: qualitative assessment



Evaluation: qualitative assessment



Evaluation: qualitative assessment

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THANK YOU !