Evaluating AI-Generated Image Detection Across Resolution and Complexity

Bachelor Thesis

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1 Introduction & Motivation

Generative AI has become increasingly sophisticated and accessible, enabling the creation of highly realistic images. While these technologies offer significant benefits, they also pose risks, such as facilitating misinformation through fake content. Detecting AI-generated images is critical to mitigating these risks, but current methods may struggle when faced with variations in image resolution and complexity.
This project investigates the robustness of AI-generated image detection methods, focusing on how changes in resolution and complexity influence detection performance.

2 Methodology

The project will be structured in two main stages: generating a diverse set of images and evaluating detection models under varying conditions.

2.1 Stage 1: Image Generation

- Create datasets of AI-generated images using state-of-the-art generative models

2.2 Stage 2: Detection Model Evaluation

- Evaluate existing models tailored for generative AI detection
- Measure training time, detection accuracy, precision, recall, and computational efficiency
- Find the limits of current detection methods and identify when detection may fail

3 Real Image Datasets (non-exhaustive list)

- **Varying across complexity**: MNIST, FashionMNIST, KMNIST, EMNIST, SVHN
- **Varying across resolution**: ImageNet32, ImageNet64, ImageNet128, ImageNet256
- CIFAR-10, CIFAR-100 (Optional)

4 Evaluation Metrics

To assess the performance of detection models, the following metrics will be measured and cross-compared:

- **Accuracy**: Overall correctness of the model in distinguishing AI-generated images from real ones
- **Precision and Recall**: Evaluation of the model's handling of false positives and false negatives
- **Training Time**: Number of epochs for convergence and total training time
- **Efficiency**: Time taken for detection, considering scalability for real-world applications

Detailed Project Outline

We denote the following primary goals (estimated weeks workload):

- Setting up the ETH-cluster, prepare the datasets and the pipeline (*2*)
- Set up and configure generative AI models (*3*)
- Generate datasets with varied resolutions and complexities (*3*)
- Benchmark existing detection models on generated datasets (*3*)
- Analyze model performance under varying conditions (*3*)
- Write final report (*3*)
- Prepare and deliver final presentation (*1*)

Extensions

Depending on time and resources:

- Investigate detection performance on more challenging datasets
- Explore techniques to enhance performance of current detection methods

The Student's Duties

- One meeting per week with the advisors to discuss current matters and further points
- A final report in English, presenting work and results
- A final presentation (15 min) of the work and results obtained in the project