ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Distributed Computing

Prof. R. Wattenhofer

Lossless Cool-Chic: Fast Lossless Compression with Overfitted Decoders

Image compression is still steadily improving. Learned compression methods now outperform classical codecs, but they tend to be computationally expensive—especially at decoding time. This limits their practical deployment.
Cool-Chic [2] offers a fast alternative by using extremely compact decoders that are overfitted to a single image. These decoders are small enough to be transmitted alongside the compressed image, making Cool-Chic very efficient at decoding.
However, Cool-Chic is currently limited to lossy compression. The challenge for lossless compression is that the decoder must perfectly reconstruct the image without any errors, which leaves less room for approximation and overfitting tricks. So far, Cool-Chic cannot be directly applied in the lossless setting.
But what if we could extend the Cool-Chic principle to lossless compression? In particular, what if we overfit a small, super-resolution-based lossless model to a single image, similar to the SReC [1] framework?
This project explores exactly that:

- We aim to build a **Lossless Cool-Chic**: a fast, per-image lossless compression scheme using overfitted, compact decoders.
- We will start from super-resolution-based lossless models like SReC and aggressively scale them down.
- Each image will get its own tiny decoder, optimized specifically for that image.
- The decoder weights will be transmitted alongside the compressed image, enabling fast, lossless reconstruction.

The goal is to develop a system that combines the speed and flexibility of Cool-Chic with the guarantees of lossless compression.
Requirements:
Strong programming skills in Python, solid understanding of machine learning, and an interest in learned compression. Familiarity with entropy coding or super-resolution is a plus but not mandatory.

Weekly meetings will be scheduled to address questions, discuss progress, and brainstorm next steps.

Contact

In a few short sentences, please describe your interest in this project and any relevant coding experience or background (e.g., projects or coursework).

- Till Aczel: taczel@ethz.ch, ETZ G60.1

References

[1] Sheng Cao, Chao-Yuan Wu, and Philipp Krähenbühl. "Lossless Image Compression through Super-Resolution". In: *arXiv preprint arXiv:2004.02872* (2020).

[2] Théo Ladune et al. "Cool-chic: Coordinate-based low complexity hierarchical image codec". In: *Proceedings of the IEEE/CVF International Conference on Computer Vision*. 2023, pp. 13515–13522.