

## Master thesis (Computer Science / eXtended AI)

The **Computational Humanities** group at the Julius-Maximilians-Universität Würzburg develops algorithms for analyzing cultural data such as images, video, and audio recordings with applications for the humanities. The group is embedded in the Center for Artificial Intelligence and Data Science (CAIDAS) and the Center for Philology and Digitality (ZPD).

In cooperation with the [Chair of Egyptology](#), we offer a master thesis on the topic of

### Automatic Colorization of Relief Images

in which selected deep learning methods for image coloring are to be implemented, tested and further developed for use in Egyptology.

#### Application scenario

The Temple of Horus Behedet in Edfu is the best-preserved temple in Egypt. It offers an extensive, fully preserved corpus of inscriptions and passes on theological traditions and cult practices in text and images. The majority of the relief wall decorations are ritual scenes in which the king can be seen performing the sacrificial cult. Since 2016, a Würzburg-based mission has been working on annual campaigns in Edfu, since 2019 with DFG funding. The reliefs of certain rooms in the temple were documented photographically and redrawn in a second step. It is known that the reliefs were once painted in color, of which only remnants remain, as the restorations on behalf of the Würzburg mission have shown. In the redrawing, the remains of color, where present, are mapped. This results in a blotchy picture.

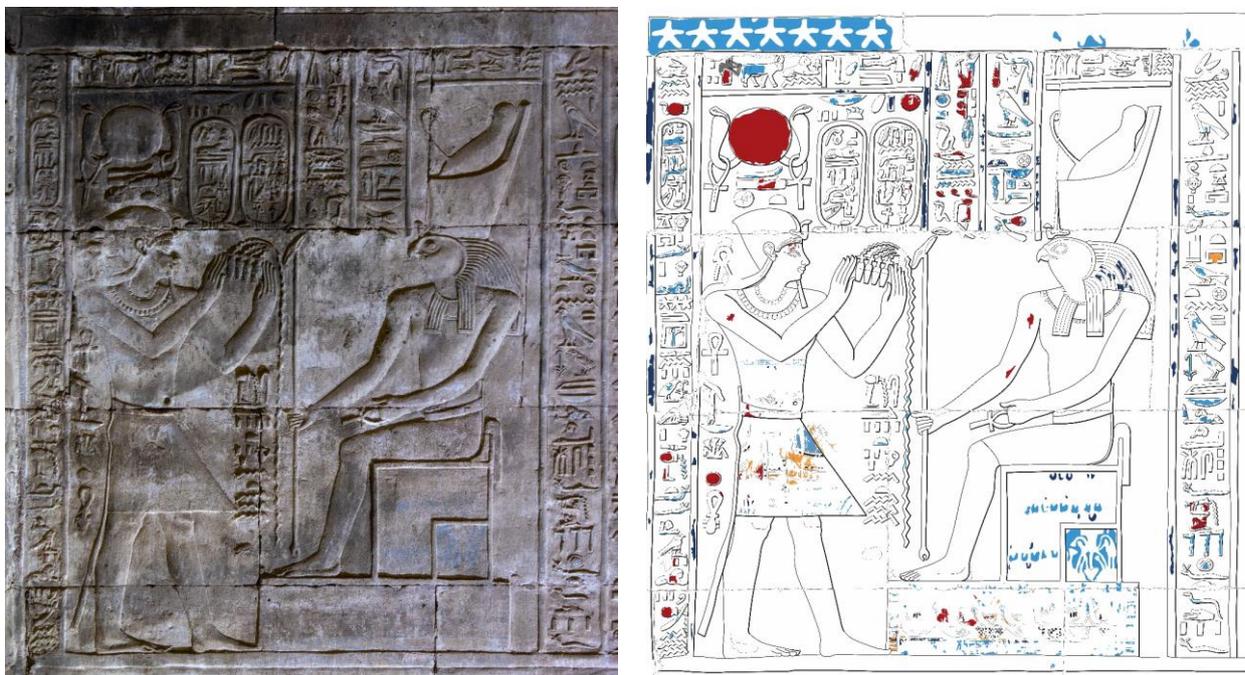


Fig. 1: Example of a photograph and line drawing together with the remains of the paint that came to light during the restoration: west wall, 3rd register, scene 1. Drawing: Svenja Dirksen. (© HBP Würzburg)

## Computer Science Task

The aim of this master thesis is to investigate whether current image colorization methods can be used to simulate reliefs in their original colors. For this purpose, a literature study on deep learning methods for colorization (e.g. CNNs, GANs, diffusion-based models) has to be carried out first. A particular focus is on methods that can be constrained or guided by individual color examples (by user or by example) and can thus consistently complete a partially colored example. Promising methods (such as [1]) should be re-implemented, tested, further developed and (if necessary) adapted for the specific application. The first step is to use pre-trained models or perform pre-training with arbitrary image datasets. In the second step, these models shall be refined on color photograph data of preserved Egyptian art and, finally, adapted to existing patterns (color remnants) in the target examples. All methods must first be evaluated using standard measurements and then (in collaboration with the Chair of Egyptology) assessed for the plausibility of results and their usability for Egyptological research.

[1] Richard Zhang, Jun-Yan Zhu, Phillip Isola, Xinyang Geng, Angela S. Lin, Tianhe Yu, Alexei A. Efros: Real-time user-guided image colorization with learned deep priors. ACM Trans. Graph. 36(4): 119:1-119:11 (2017)

## Requirements

The following knowledge is required for successful completion:

- Qualification / acquisition of all ECTS points for a master thesis in M.Sc. Computer Science / XtAI
- Very good knowledge of Python and deep learning environments (especially PyTorch)
- Very good knowledge of image processing (e.g. through lectures of the Chair of Computer Science IV) as well as machine learning and deep learning
- Interest in interdisciplinary research
- Willingness to work in an interdisciplinary team

If you are interested, please send an e-mail with some information about your interests and previous experience to

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