# GPU-Based Generation of Digital Bas-Reliefs with PyTorch

## Student

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**Introduction:** A bas-relief is a type of artistic of sculpture which is squished along an axis to create a "2.5-dimensional" sculpture. Typically, they are handmade by talented artists, e.g. by carving the relief into piece of wood. This project deals with the automatic generation of digital bas-relief from 3D scenes. These digital reliefs can then be used to create physical copies of such reliefs by using modern technology such as 3D printers or CNC routers.

**Definition of Task:** The project is divided into two parts. First, a traditional (i.e. not machine learning based) algorithm is implemented to create digital bas-reliefs from arbitrary existing three-dimensional scenes. Then in a second step, this algorithm is used to create a dataset of input/output pairs, where the input represents the original scene and the output represents the generated bas-relief. Finally, a deep learning based neural network is trained to generate such reliefs, which speeds up the conversion dramatically, because it is much faster than the traditional algorithms.

**Result:** After first implementing an already existing traditional algorithm to convert three-dimensional scenes into bas-reliefs, the decision was made to leverage the newly acquired knowledge to develop an own method. This method is able to use recent advances in technology to solve to problem using PyTorch and GPU acceleration. With this, it is possible to generate very high quality bas-reliefs in a relatively short amount of time. The results of the deep learning attempt were unfortunately not very convincing. However, the experimentation was far from exhaustive due to the limited time available for this project. It is very likely that there is a lot more potential to be unlocked for using deep learning to generate digital reliefs. The achieved results may however still be of use for parameter tuning of the newly developed algorithm. This could potentially improve the user experience significantly, allowing the user to find the right parameters for the desired relief-style much faster.
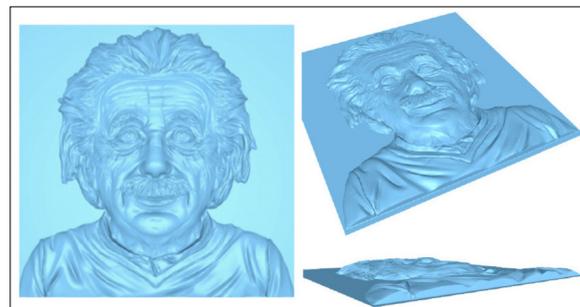
**A relief on a coin (left) and an ancient relief carved into stone (right)**
Bruce Wolfe (left) and University of Florida (right)
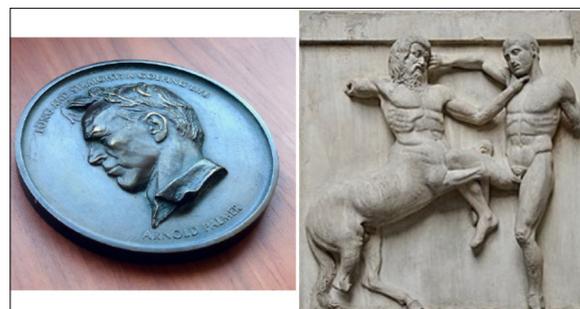


**Digital bas-relief of an Einstein bust. The relief was generated from a 3D model using the new GPU-based method.**
Own presentment



**A 3D print of the Einstein bust bas-relief to prove that the effect translates to reality.**
Own presentment

## Advisor
**Hannes Badertscher**

## Subject Area
**Data Science**