

Bachelor's Thesis Assignment



Institut: Department of Intelligent Systems (DITS) 164309
Student: **Sultanov Artur**
Programme: Information Technology
Title: **AI-Powered Web Application for Galaxy Morphology Classification on Red Hat OpenShift**
Category: Artificial Intelligence
Academic year: 2024/25

Assignment:

1. Study the area of Vision Transformer (ViT) models, focusing on their architecture, application, and benefits in image classification tasks.
2. Learn about galaxy morphology classification and the integration of machine-learning techniques in astronomy, including existing applications.
3. Prepare and augment the Galaxy Dataset used for galaxy morphology classification training. Use advanced data augmentation techniques to enhance the diversity and quality of the training data.
4. Select a suitable ViT-based model and fine-tune it on the galaxy dataset. Optimize the model architecture to improve performance for galaxy morphology classification.
5. Use Red Hat OpenShift for model training and publish the trained model on Hugging.
6. Design and implement a web application that integrates the trained model, allowing users to upload and classify galaxy images. Ensure the application is scalable and reliable, leveraging the Red Hat OpenShift Container Platform for deployment.
7. Conduct thorough functional and performance testing of the web application. Optimize the application for real-time inference, ensuring high reliability and accuracy. Analyze the application's effectiveness in classifying galaxy morphologies and discuss its implications.

Literature:

- AYYADEVARA V Kishore, REDDY Yeshwanth. *Modern Computer Vision with PyTorch - Second Edition*. Packt Publishing, June 2024. ISBN 9781803231334.
- TIMSINA Prem. *Building Transformer Models with PyTorch 2.0: NLP, computer vision, and speech processing with PyTorch and Hugging Face (English Edition)*. Bpb Publications, 2024. ISBN 9789355517494.
- LIU James, KARTALTEPE Jeyhan, ROSE Caitlin, PATTNIAK Rohan. *Galaxy Morphology Classifications of Simulated JWST NIRCам Images using Vector Quantized Variable Auto Encoder*. American Astronomical Society Meeting #241, Bulletin of the American Astronomical Society, vol. 55, no. 2, January 2023, e-id 2023n2i105p11. Bibcode: 2023AAS...24110511L.
- [GitHub - soliao/Galaxy-Zoo-Classification: Classify the morphologies of distant galaxies](#)
- Zoobot framework (CNN model + datasets):
[GitHub - mwalsley/zoobot: Classifies galaxy morphology with Bayesian CNN](#)

Requirements for the semestral defence:
Items 1 to 5.

Detailed formal requirements can be found at <https://www.fit.vut.cz/study/theses/>

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Head of Department: Kočí Radek, Ing., Ph.D.
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