

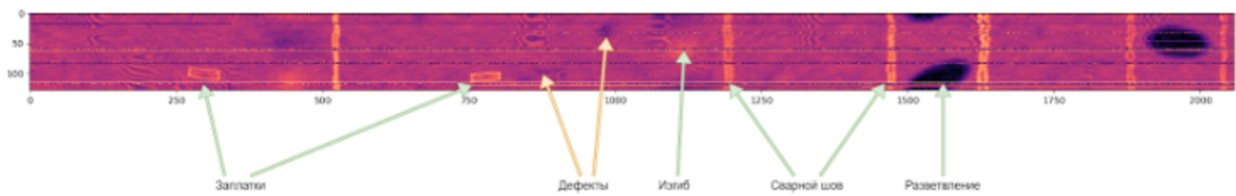
Pipe defect detection

🔗 Link	https://github.com/ITConstructor/Pipe-defect-detection
🌟 Status	Done
📄 Type	Hack

Task description

This task is provided by “Gazprom-neft” and Artificial Intelligence in Industry Association.

Dataset is a set of images of 4096x128 resolution, where labels are two numbers, related to each column of 128 pixels. First number is 0-1, which describes if the column contains defect. Second number is 0-4, which describes a structural element in the related column. The sample is below.



Sample object from dataset

Images provided as pickle files. Output should be a pickle file to and organized like input. Solution have to predict two labels to each column of each image on test dataset and maximize metrics:

$$P_{el} = 0.25 \cdot \sum_y \frac{|\{\bar{y}_i = y | y_i = y\}|}{|\{\bar{y}_i = y | y_i = y\}| + |\{\bar{y}_i = y | y_i \neq y\}|}$$

$$R_{el} = 0.25 \cdot \sum_y \frac{|\{\bar{y}_i = y | y_i = y\}|}{|\{\bar{y}_i = y | y_i = y\}| + |\{\bar{y}_i \neq y | y_i = y\}|}$$

$$F_{el} = \frac{2}{P_{el}^{-1} + R_{el}^{-1}}$$

Metrics for structural element detection

$$P_{\text{defect}} = \frac{|\{\bar{y}_i = y | y_i = 1\}|}{|\{\bar{y}_i = 1 | y_i = y\}| + |\{\bar{y}_i = 1 | y_i \neq 1\}|}$$

$$R_{\text{defect}} = \frac{|\{\bar{y}_i = y | y_i = 1\}|}{|\{\bar{y}_i = 1 | y_i = y\}| + |\{\bar{y}_i \neq 1 | y_i = 1\}|}$$

$$F_{\text{defect}} = \frac{4}{3 \cdot R_{\text{defect}}^{-1} + \left(\frac{\min(P_{\text{defect}}, 0.9)}{0.9}\right)^{-1}}$$

Metrics for defect detection

For more information follow the link:

Хакатон Я-Профессионал 2023| Трек 2

Распознавание магнитограмм от ПАО "Газпром-нефть" и
Ассоциации «Искусственный интеллект в промышленности»

 <https://cogmodel.mipt.ru/iprofitrack2>



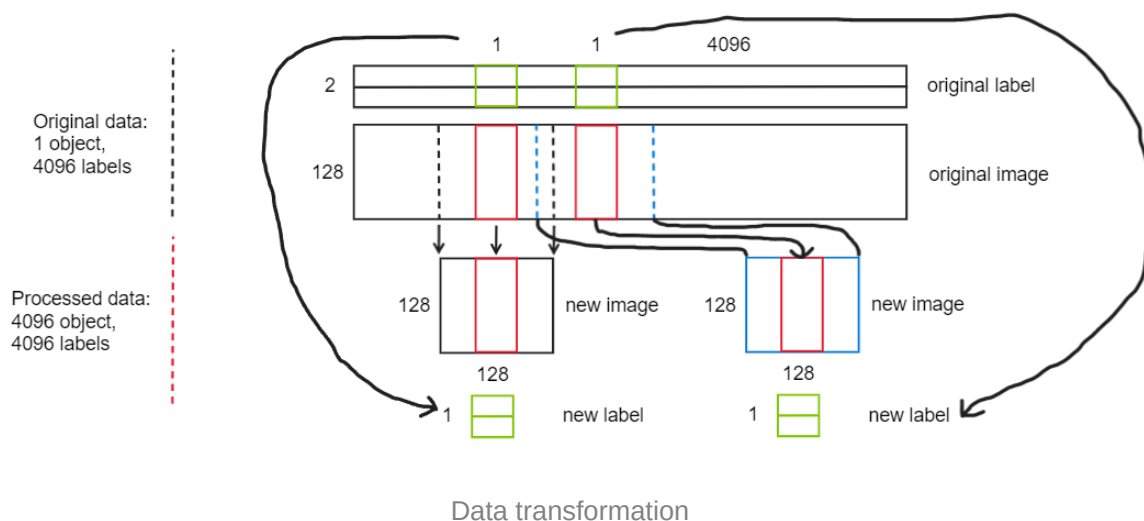
Solution description

The fact that labels are related to each column but not each image is the main problem. Column doesn't contain information of left and right columns, but model should contain it to make good precision. Based on this, tasks was:

1. Preprocess data to give model an ability of solving classic image classification task
2. Create model

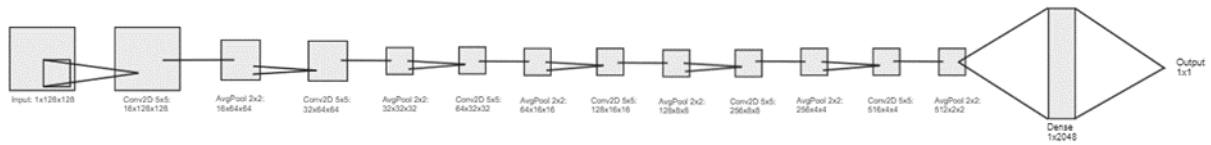
Data preprocessing

The way to preprocess data is split 4096x128 image by columns and make new images of dimension 128x128, which contain column of original image and side columns. Label of a new image is a label related to column from original image. Data transformation process is shown on the image below.



Model creation

The model is CNN with body of sequentially connected convolution and average pooling layers with batch normalization and dropout layers between every convolution and pooling. Head is a linear classifier. There are two models to defect detection and structural element detection. The only difference between these models is the output dimension of linear classifier (1 for first task, 5 for second). Model variant for defect detection is shown on the image below.



Model scheme

Results

Due to a lack of computing resources, model was training only on 10% of the dataset. Accuracy of trained model was 91.2%, but this result isn't representational unfortunately. Despite this, our team became an prize winner.

Stack

Python, PyTorch, Pandas