Math expressions solver

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Introduction to Computer Vision, 2023

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Problem description

Developing a system that can recognize and solve *basic handwritten mathematical equations*

Expected value:

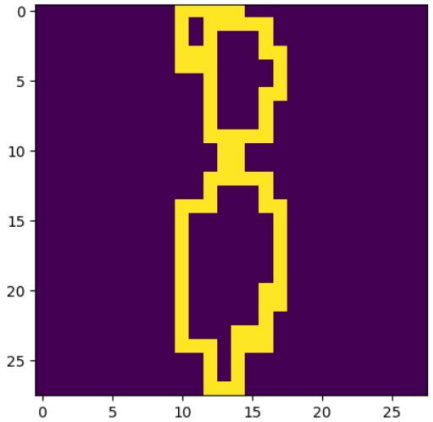
- accurate analysis and solution of handwritten equations
- consider differences in styles, sizes, and orientations of handwritten element

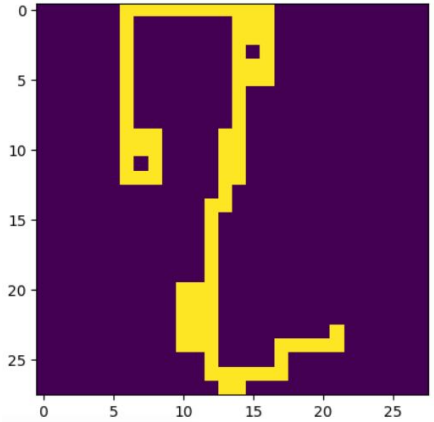
Difficulties:

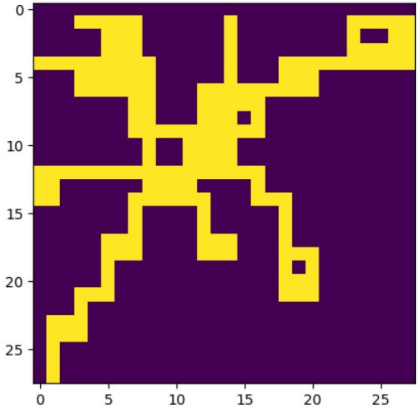
- recognition problems due to significant differences in people's handwriting

Dataset description

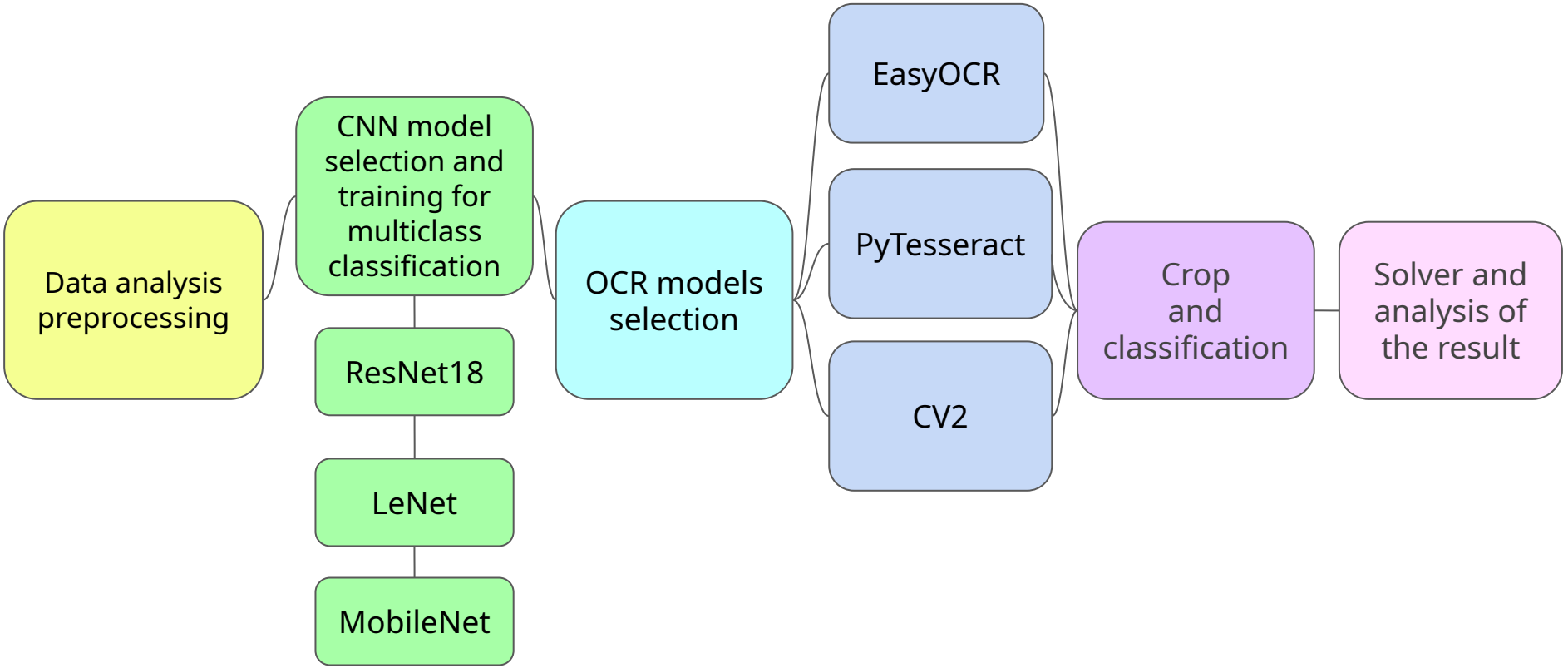
The dataset contains digits [0-9] and operation characters: +, -, * , /, (,).
Complete DataSet 300 000 symbols
Training dataset (60% of Complete DataSet)
Validation dataset (20% of Complete DataSet)
Testing dataset (20% of Complete DataSet)







Describe the overall CV pipeline suitable to solve the problem



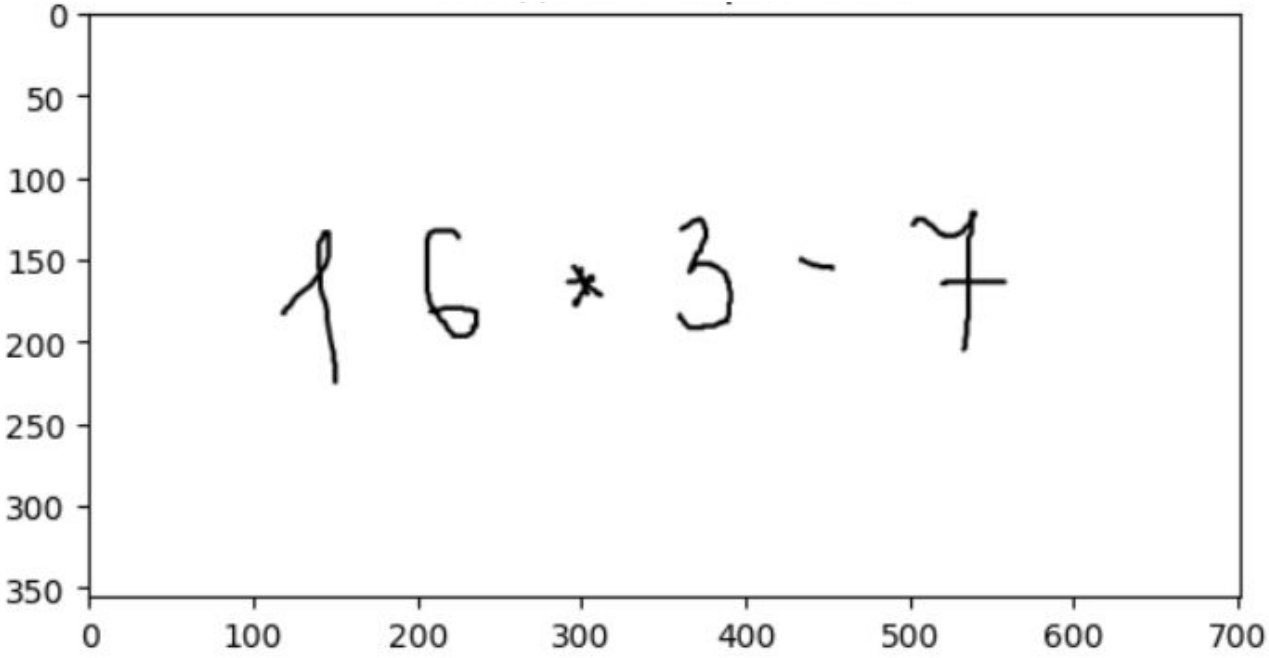
About CNN models

Model	Train_acc	Valid_acc	Test_acc
ResNet18	0.96736	98.71933	0.98703
LeNet	0.98326	98.25666	0.98488
MobileNet	0.98737	98.57333	0.98777

PyTesseract example

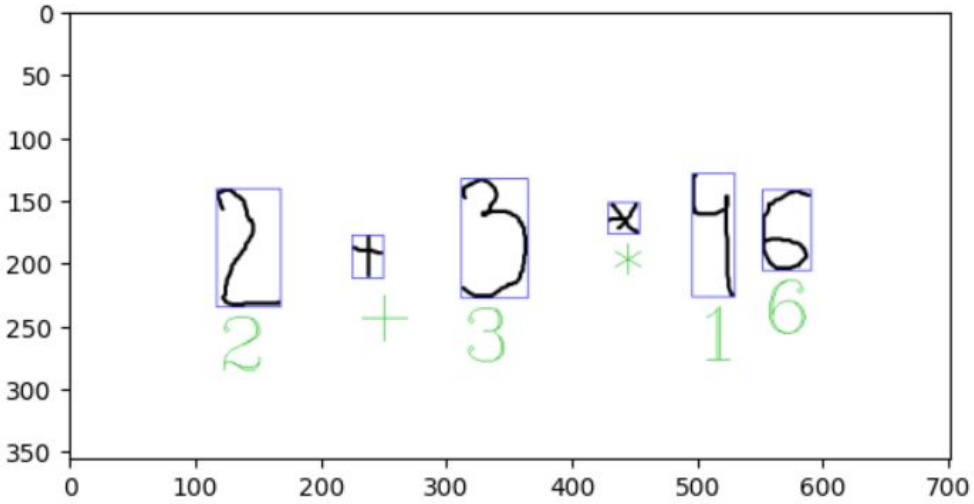
```
Equition in  LaTeX: 4+3-4
Result of calculation: 3
```

Input image

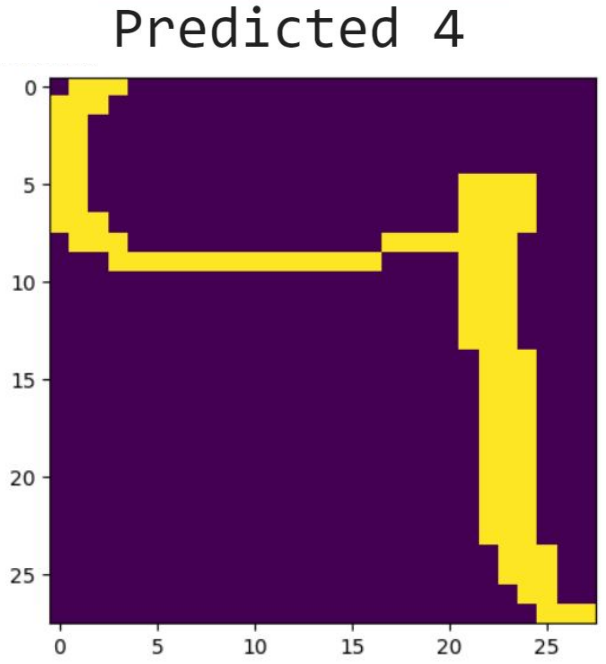


PyTesseract example#2

PyTesseract with boxes

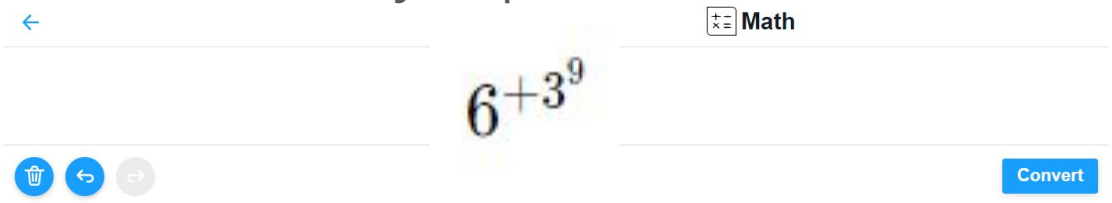


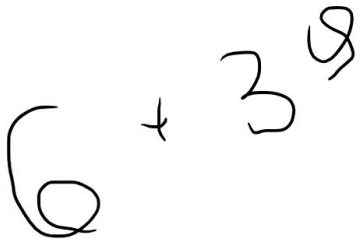
Predict CNN for box



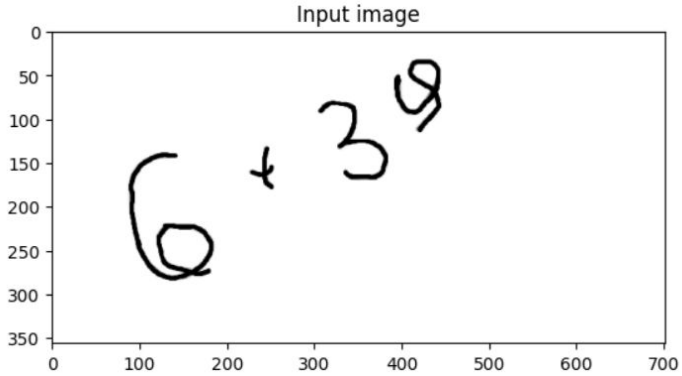
Current solution

MyScript.com

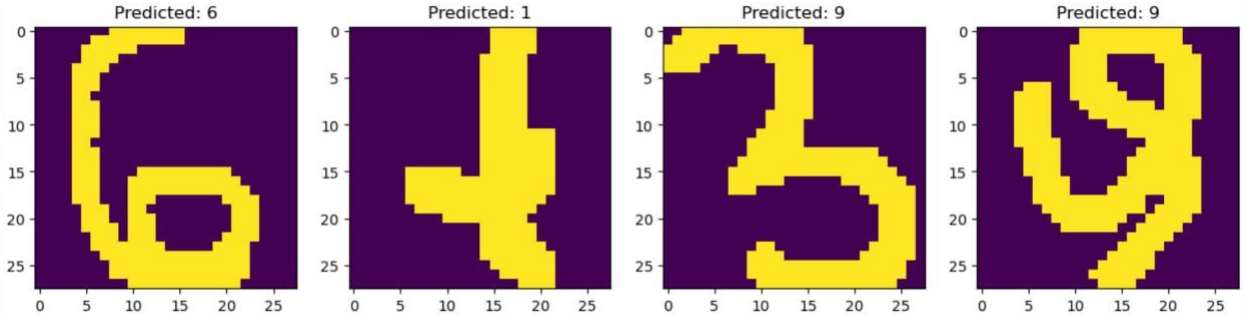




```
Equition in  LaTeX: 662
Result of calculation: 662
```



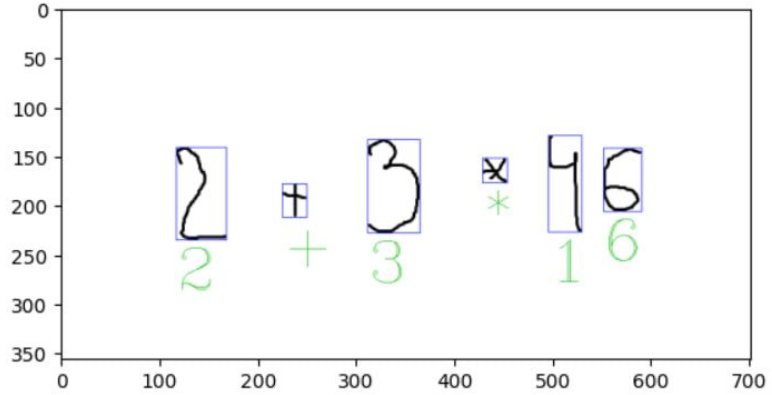
ResNet18



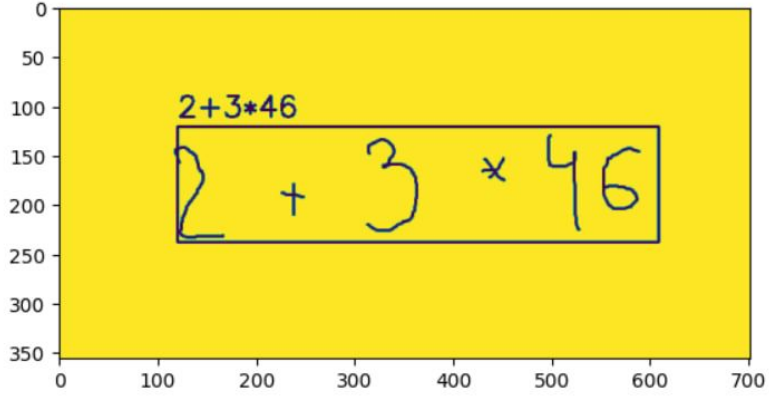
PyTesseract

Good examples of the obtained results

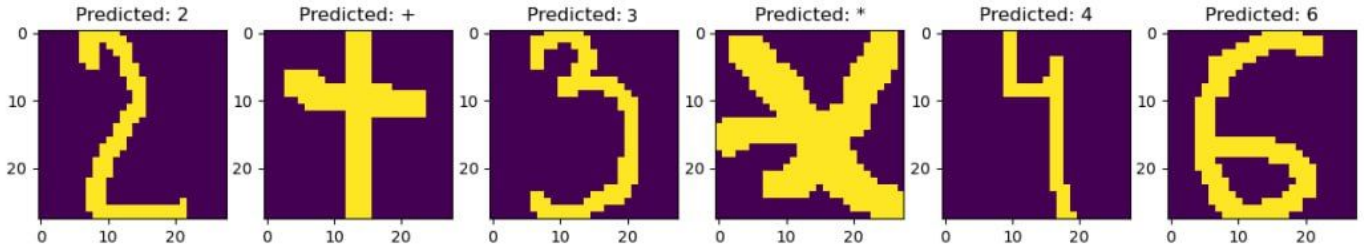
PyTesseract



EasyOCR

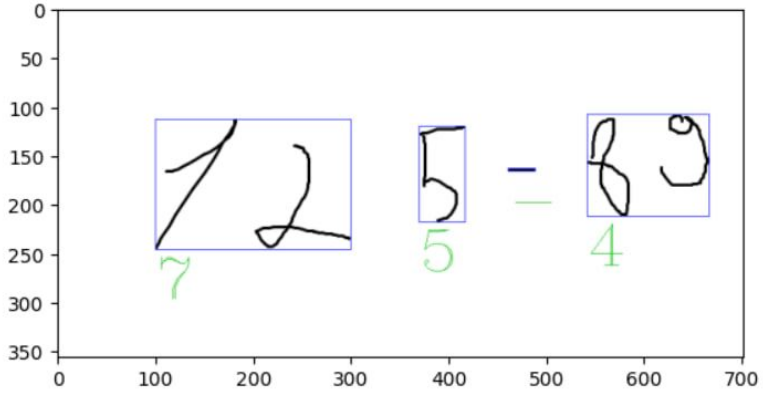


CV2 + ResNet18

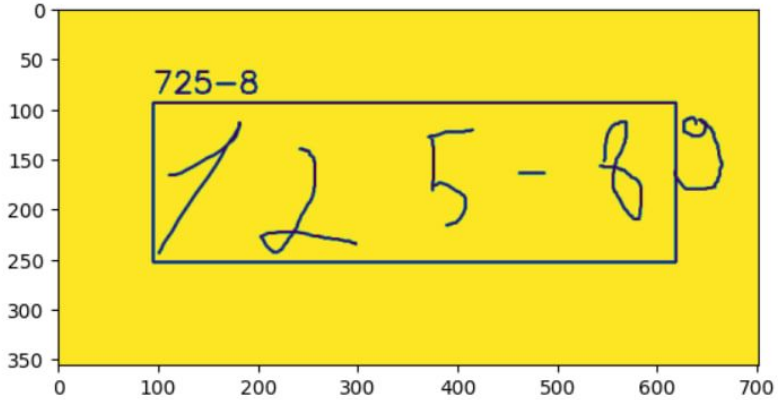


Bad examples of the obtained results

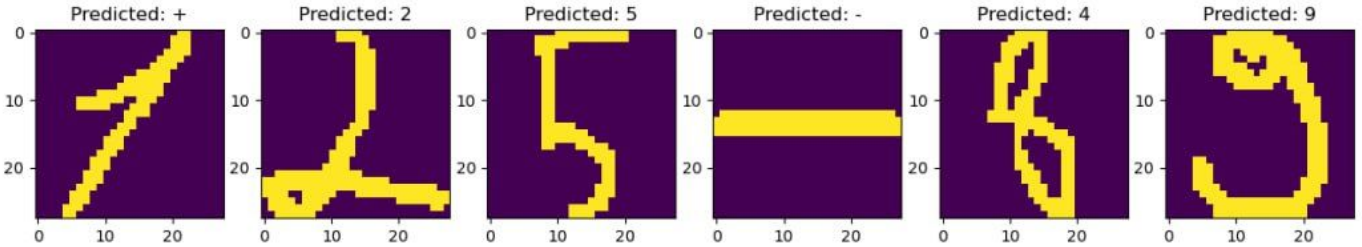
PyTesseract



EasyOCR



CV2 + ResNet18



Results

We use 5 images with equations for test models

$$Mean\ score = \frac{\sum_{i=1}^{i=n} \frac{m_{true_i}}{m_{all_i}}}{n},$$

$n - number\ of\ tests$

$i - number\ of\ test$

$m_{true} - number\ of\ correctly\ recognized\ symbols\ of\ test$

$m_{all} - number\ of\ all\ symbols\ of\ test$

EasyOCR
Mean Score: 0.849

PyTesseract
Mean Score: 0.521

PyTesseract + CNN
Mean Score: 0.641

CV2 + CNN
Mean Score: 0.7954

Our team

Ekaterina Nikolaeva

Data preprocessing
Train ResNet18
OCR with cv2

Yekaterina Smolenkova

Data preprocessing
Train LeNet and MobileNet
EasyOCR, pyTesseract