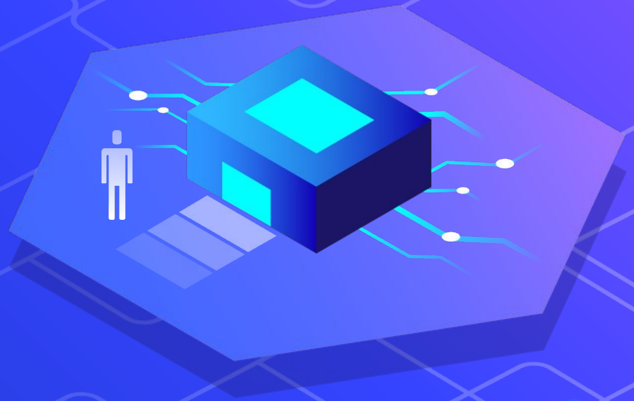
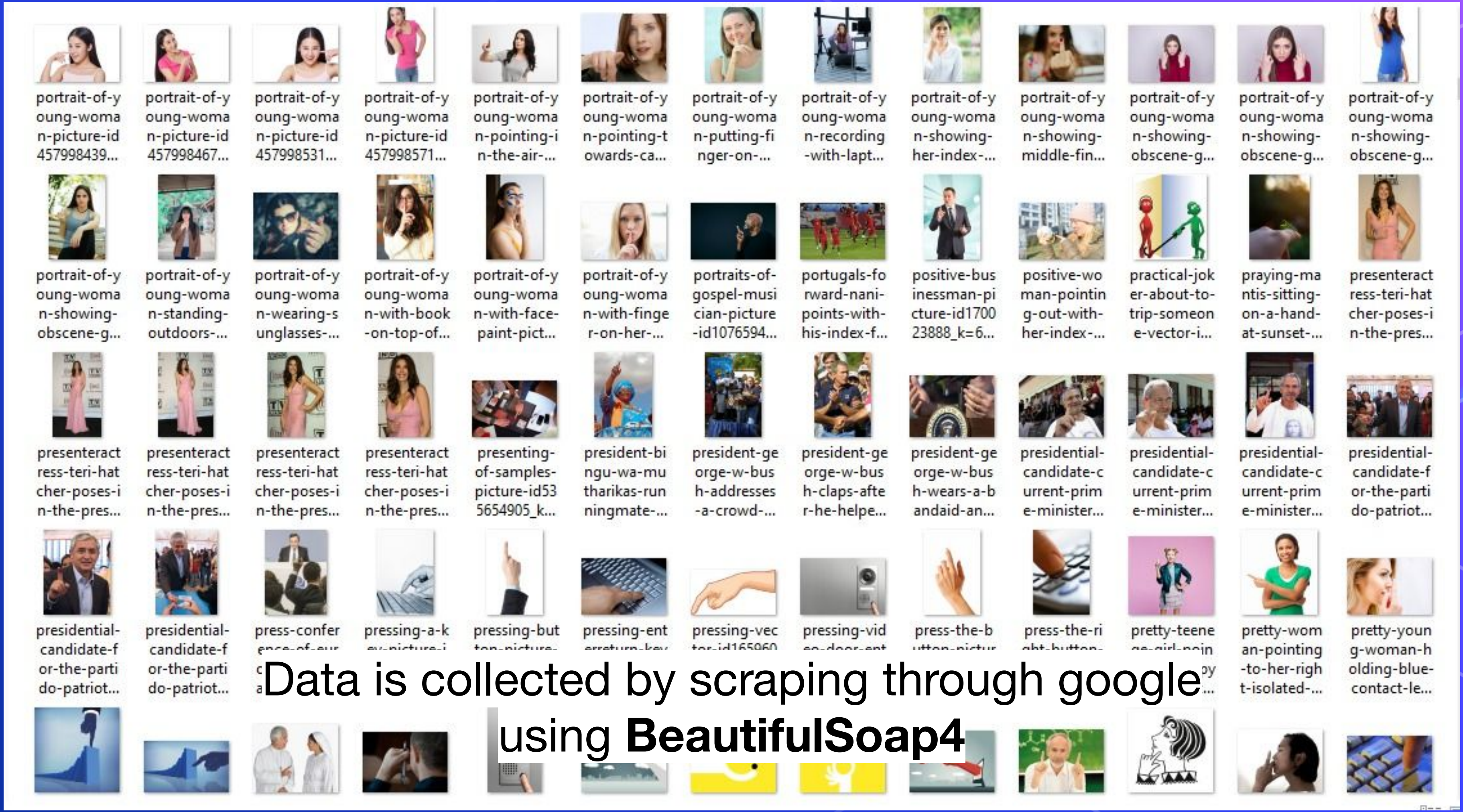
Classification of Numbers on Fingers

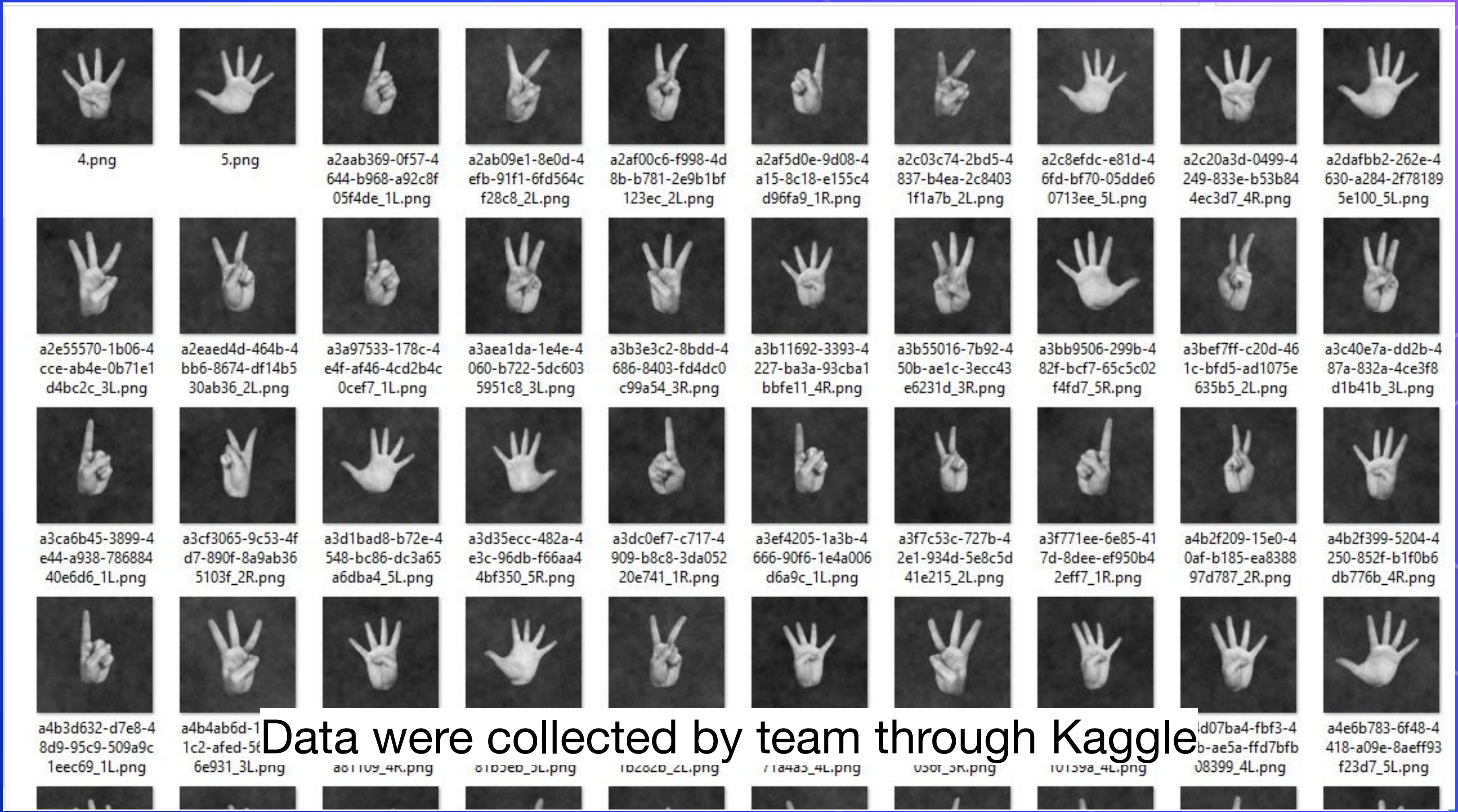
This Classification has 7 steps

1. Data gathering




portrait-of-young-woman-picture-id457998439...
portrait-of-young-woman-picture-id457998467...
portrait-of-young-woman-picture-id457998531...
portrait-of-young-woman-picture-id457998571...
portrait-of-young-woman-pointing-in-the-air-...
portrait-of-young-woman-pointing-towards-ca...
portrait-of-young-woman-putting-finger-on-...
portrait-of-young-woman-recording-with-lapt...
portrait-of-young-woman-showing-her-index-...
portrait-of-young-woman-showing-middle-fin...
portrait-of-young-woman-showing-obscene-g...
portrait-of-young-woman-showing-obscene-g...
portrait-of-young-woman-showing-obscene-g...
portrait-of-young-woman-showing-obscene-g...
portrait-of-young-woman-standing-outdoors-...
portrait-of-young-woman-wearing-sunglasses-...
portrait-of-young-woman-with-book-on-top-of...
portrait-of-young-woman-with-face-paint-pict...
portrait-of-young-woman-with-finger-on-her-...
portraits-of-gospel-musician-picture-id1076594...
portugals-forward-nani-points-with-his-index-f...
positive-businessman-picture-id170023888_k=6...
positive-woman-pointing-out-with-her-index-...
practical-joker-about-to-trip-someone-vector-i...
praying-mantis-sitting-on-a-hand-at-sunset-...
presenteractress-teri-hatcher-poses-in-the-pres...
presenteractress-teri-hatcher-poses-in-the-pres...
presenteractress-teri-hatcher-poses-in-the-pres...
presenteractress-teri-hatcher-poses-in-the-pres...
presenteractress-teri-hatcher-poses-in-the-pres...
presenting-of-samples-picture-id535654905_k...
president-bingu-wa-mutharikas-runningmate-...
president-george-w-bush-addresses-a-crowd-...
president-george-w-bush-claps-after-he-helpe...
president-george-w-bush-wears-a-bandaid-an...
presidential-candidate-current-prime-minister...
presidential-candidate-current-prime-minister...
presidential-candidate-current-prime-minister...
presidential-candidate-for-the-partido-patriot...
presidential-candidate-for-the-partido-patriot...
presidential-candidate-for-the-partido-patriot...
press-conference-of-eur
pressing-a-key-picture-i
pressing-button-picture-
pressing-enter-return-key
pressing-vector-id165960
pressing-video-door-ent
press-the-button-pictur
press-the-right-button-
pretty-teenage-girl-poin
pretty-woman-pointing-to-her-right-isolated-...
pretty-young-woman-holding-blue-contact-le...

Data is collected by scraping through google using **BeautifulSoap4**


4.png
5.png
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a2ab09e1-8e0d-4efb-91f1-6fd564cf28c8_2L.png
a2af00c6-f998-4d8b-b781-2e9b1bf123ec_2L.png
a2af5d0e-9d08-4a15-8c18-e155c4d96fa9_1R.png
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a2c8efdc-e81d-46fd-bf70-05dde60713ee_5L.png
a2c20a3d-0499-4249-833e-b53b844ec3d7_4R.png
a2dafbb2-262e-4630-a284-2f781895e100_5L.png
a2e55570-1b06-4cce-ab4e-0b71e1d4bc2c_3L.png
a2eaed4d-464b-4bb6-8674-df14b530ab36_2L.png
a3a97533-178c-4e4f-af46-4cd2b4c0cef7_1L.png
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a3b3e3c2-8bdd-4686-8403-fd4dc0c99a54_3R.png
a3b11692-3393-4227-ba3a-93cba1bbfe11_4R.png
a3b55016-7b92-450b-ae1c-3ecc43e6231d_3R.png
a3bb9506-299b-482f-bcf7-65c5c02f4fd7_5R.png
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a3ca6b45-3899-4e44-a938-78688440e6d6_1L.png
a3cf3065-9c53-4fd7-890f-8a9ab365103f_2R.png
a3d1bad8-b72e-4548-bc86-dc3a65a6dba4_5L.png
a3d35ecc-482a-4e3c-96db-f66aa44bf350_5R.png
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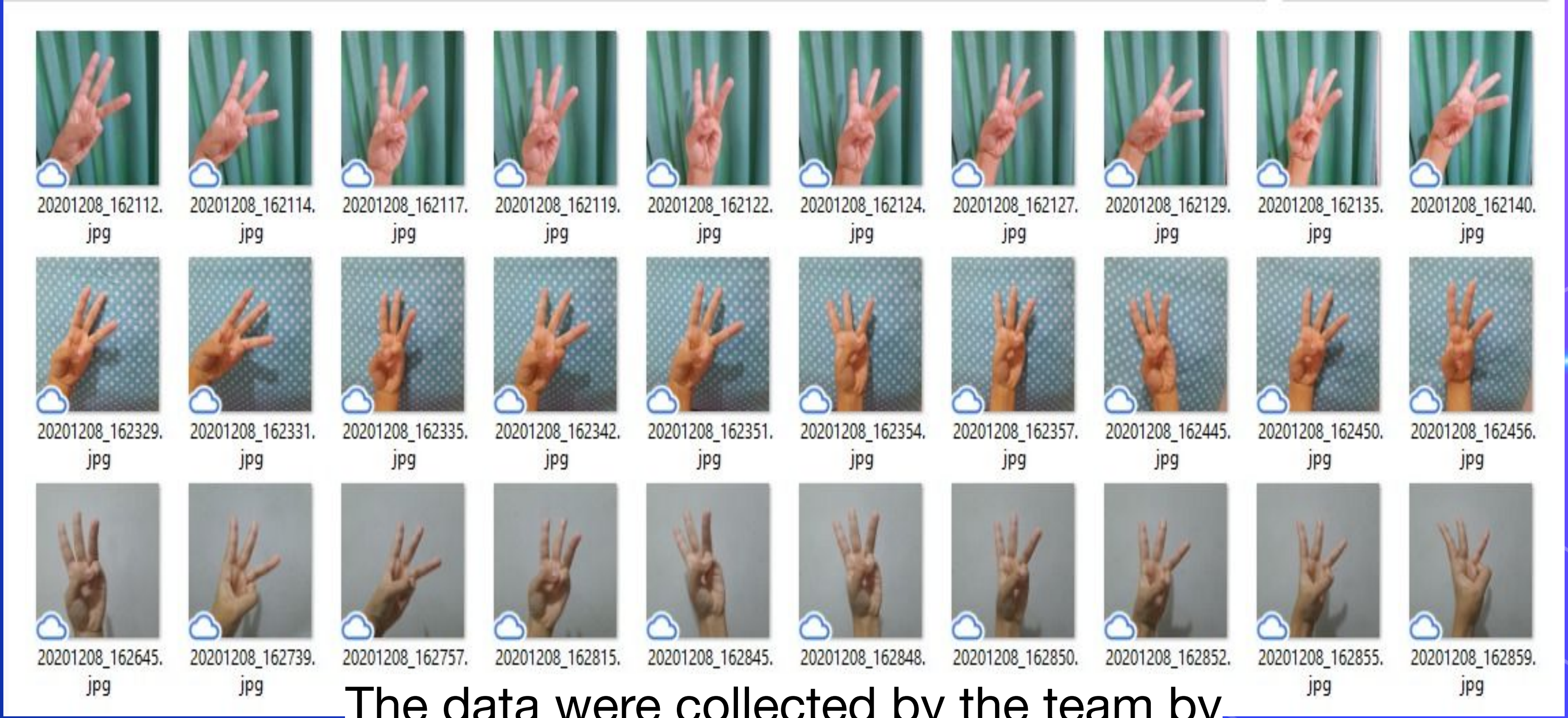
a4b2f209-15e0-40af-b185-ea838897d787_2R.png
a4b2f399-5204-4250-852f-b1f0b6db776b_4R.png
a4b3d632-d7e8-48d9-95c9-509a9c1eec69_1L.png
a4b4ab6d-11c2-afed-5
6e931_3L.png
a81109_4R.png
81b5eb_5L.png
1b282b_2L.png
71a4a3_4L.png
036f_3R.png
10139a_4L.png
d07ba4-fbf3-4
b-ae5a-ffd7bfb08399_4L.png
a4e6b783-6f48-4418-a09e-8aeff93f23d7_5L.png

Data were collected by team through Kaggle



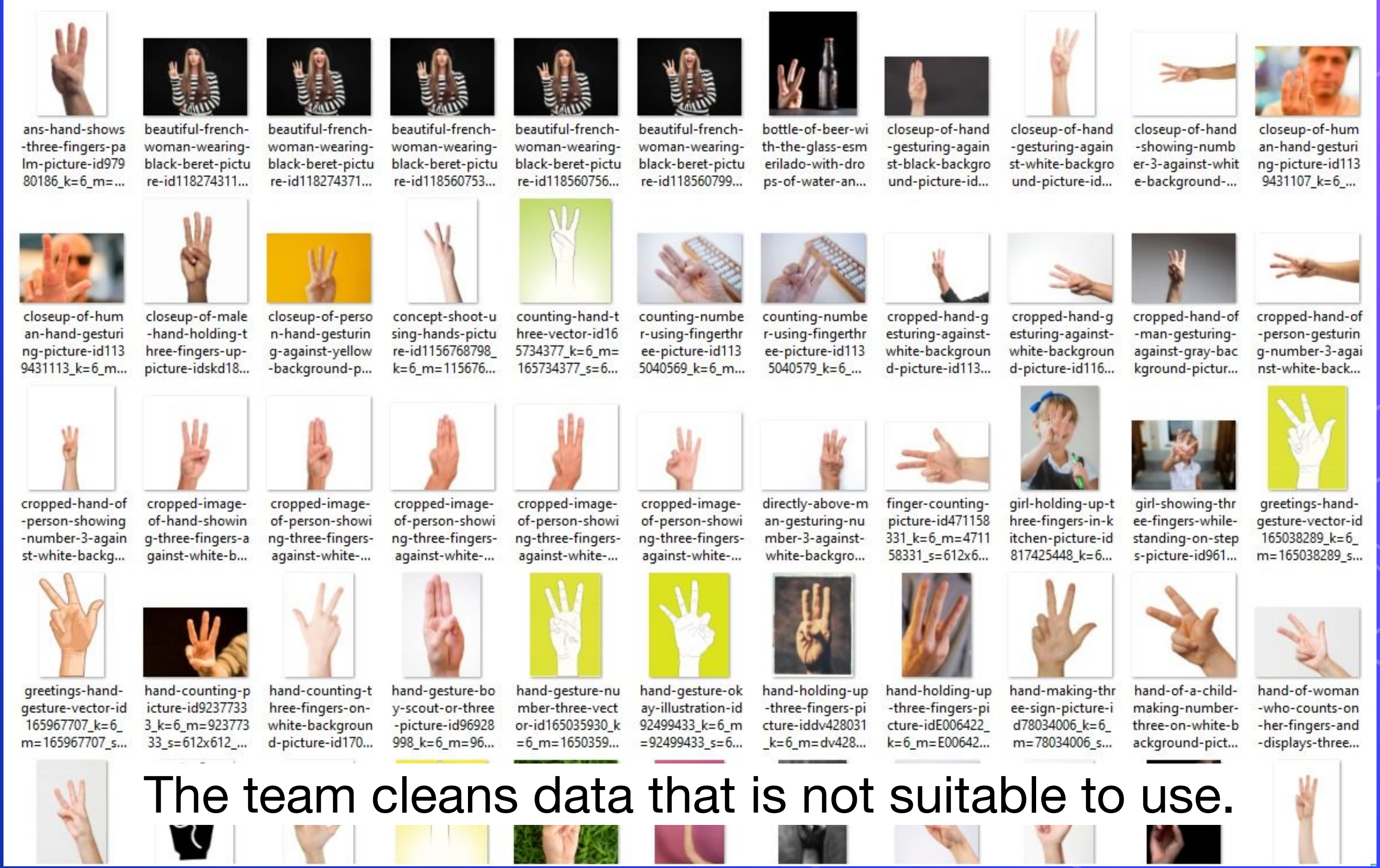
20201208_162112.jpg 20201208_162114.jpg 20201208_162117.jpg 20201208_162119.jpg 20201208_162122.jpg 20201208_162124.jpg 20201208_162127.jpg 20201208_162129.jpg 20201208_162135.jpg 20201208_162140.jpg

20201208_162329.jpg 20201208_162331.jpg 20201208_162335.jpg 20201208_162342.jpg 20201208_162351.jpg 20201208_162354.jpg 20201208_162357.jpg 20201208_162445.jpg 20201208_162450.jpg 20201208_162456.jpg

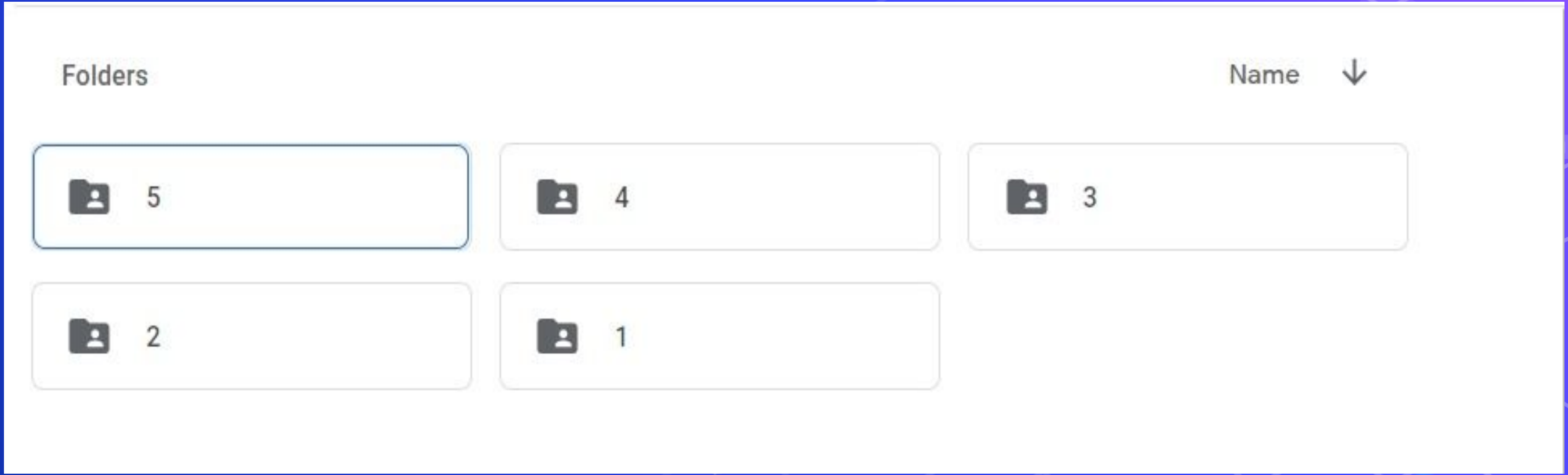
20201208_162645.jpg 20201208_162739.jpg 20201208_162757.jpg 20201208_162815.jpg 20201208_162845.jpg 20201208_162848.jpg 20201208_162850.jpg 20201208_162852.jpg 20201208_162855.jpg 20201208_162859.jpg

The data were collected by the team by capturing their own fingers

2. Data preparation


ans-hand-shows-three-fingers-palm-picture-id97980186_k=6_m=...
beautiful-french-woman-wearing-black-beret-picture-id118274311...
beautiful-french-woman-wearing-black-beret-picture-id118274371...
beautiful-french-woman-wearing-black-beret-picture-id118560753...
beautiful-french-woman-wearing-black-beret-picture-id118560756...
beautiful-french-woman-wearing-black-beret-picture-id118560799...
bottle-of-beer-with-the-glass-esmerilado-with-drops-of-water-an...
closeup-of-hand-gesturing-against-black-background-picture-id...
closeup-of-hand-gesturing-against-white-background-picture-id...
closeup-of-hand-showing-number-3-against-white-background-...
closeup-of-human-hand-gesturing-picture-id1139431107_k=6_...
closeup-of-human-hand-gesturing-picture-id1139431113_k=6_m...
closeup-of-male-hand-holding-three-fingers-up-picture-idskd18...
closeup-of-person-hand-gesturing-against-yellow-background-p...
concept-shoot-using-hands-picture-id1156768798_k=6_m=115676...
counting-hand-three-vector-id165734377_k=6_m=165734377_s=6...
counting-number-using-fingerthree-picture-id1135040569_k=6_m...
counting-number-using-fingerthree-picture-id1135040579_k=6_...
cropped-hand-gesturing-against-white-background-picture-id113...
cropped-hand-gesturing-against-white-background-picture-id116...
cropped-hand-of-man-gesturing-against-gray-background-pictur...
cropped-hand-of-person-gesturing-number-3-against-white-back...
cropped-hand-of-person-showing-number-3-against-white-backg...
cropped-image-of-hand-showing-three-fingers-against-white-b...
cropped-image-of-person-showing-three-fingers-against-white-...
cropped-image-of-person-showing-three-fingers-against-white-...
cropped-image-of-person-showing-three-fingers-against-white-...
cropped-image-of-person-showing-three-fingers-against-white-...
directly-above-man-gesturing-number-3-against-white-backgro...
finger-counting-picture-id471158331_k=6_m=471158331_s=612x6...
girl-holding-up-three-fingers-in-kitchen-picture-id817425448_k=6...
girl-showing-three-fingers-while-standing-on-steps-picture-id961...
greetings-hand-gesture-vector-id165038289_k=6_m=165038289_s...
greetings-hand-gesture-vector-id165967707_k=6_m=165967707_s...
hand-counting-picture-id92377333_k=6_m=92377333_s=612x612_...
hand-counting-three-fingers-on-white-background-picture-id170...
hand-gesture-boy-scout-or-three-picture-id96928998_k=6_m=96...
hand-gesture-number-three-vector-id165035930_k=6_m=1650359...
hand-gesture-okay-illustration-id92499433_k=6_m=92499433_s=6...
hand-holding-up-three-fingers-picture-iddv428031_k=6_m=dv428...
hand-holding-up-three-fingers-picture-idE006422_k=6_m=E00642...
hand-making-three-sign-picture-id78034006_k=6_m=78034006_s...
hand-of-a-child-making-number-three-on-white-background-pict...
hand-of-woman-who-counts-on-her-fingers-and-displays-three...

The team cleans data that is not suitable to use.



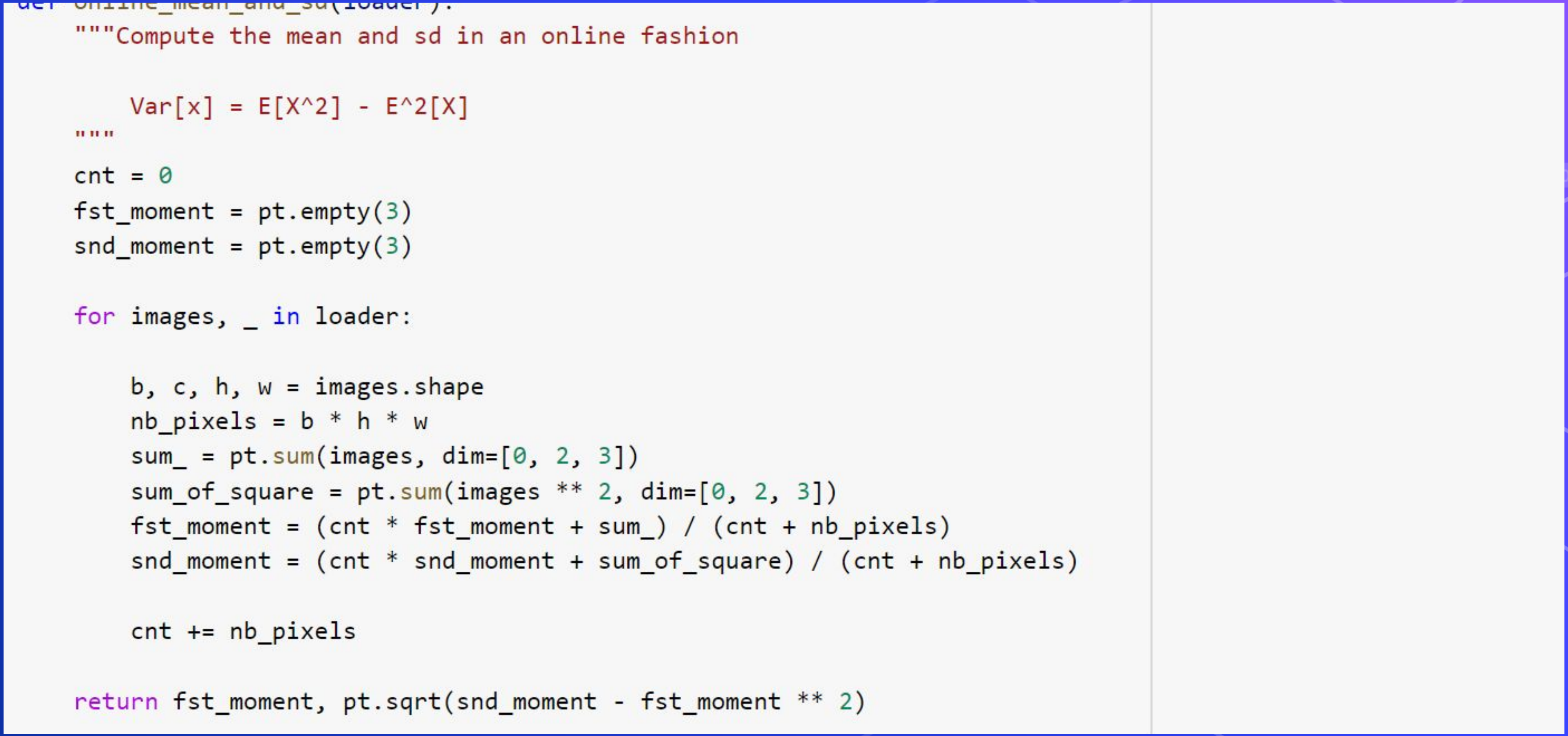
The team devides preprocessing data into the classes (1-5), then we devide it into train and test sets.

Dataset

	Class 1	Class 2	Class 3	Class 4	Class 5	Total
Train Set	240	240	240	240	240	1200
Test Set	60	60	60	60	60	300

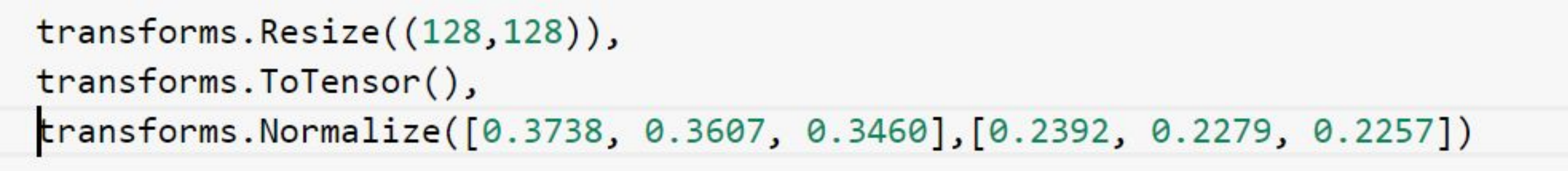
3. Data preprocessing

Get Population mean and STD Of each channel in Image



```
def online_mean_and_sd(loader):
    """Compute the mean and sd in an online fashion

        Var[x] = E[X^2] - E^2[X]
    """
    cnt = 0
    fst_moment = pt.empty(3)
    snd_moment = pt.empty(3)

    for images, _ in loader:

        b, c, h, w = images.shape
        nb_pixels = b * h * w
        sum_ = pt.sum(images, dim=[0, 2, 3])
        sum_of_square = pt.sum(images ** 2, dim=[0, 2, 3])
        fst_moment = (cnt * fst_moment + sum_) / (cnt + nb_pixels)
        snd_moment = (cnt * snd_moment + sum_of_square) / (cnt + nb_pixels)

        cnt += nb_pixels

    return fst_moment, pt.sqrt(snd_moment - fst_moment ** 2)
```

Transform the data



```
transforms.Resize((128,128)),
transforms.ToTensor(),
transforms.Normalize([0.3738, 0.3607, 0.3460],[0.2392, 0.2279, 0.2257])
```

(Normalize based on mean and std
from previous step)

4.
Modelling

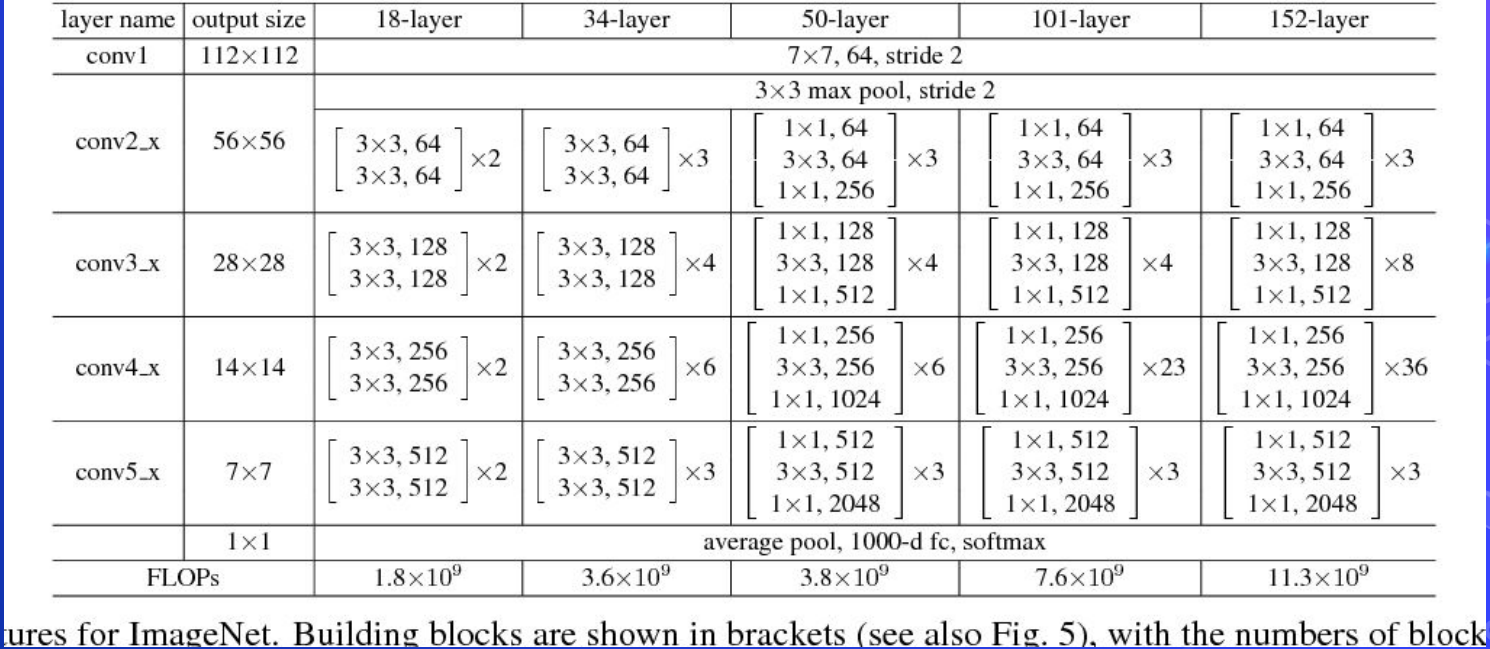
transform function

resnet18

torchvision

5. Training

Dataset will be composed and resized into sizes (128, 128). Data is trained with RESNET 18-layer Architecture and Adam Optimizer :



layer name	output size	18-layer	34-layer	50-layer	101-layer	152-layer
conv1	112×112	7×7, 64, stride 2				
conv2_x	56×56	3×3 max pool, stride 2				
		$\begin{bmatrix}3\times3, 64\\3\times3, 64\end{bmatrix}\times2$	$\begin{bmatrix}3\times3, 64\\3\times3, 64\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 64\\3\times3, 64\\1\times1, 256\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 64\\3\times3, 64\\1\times1, 256\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 64\\3\times3, 64\\1\times1, 256\end{bmatrix}\times3$
conv3_x	28×28	$\begin{bmatrix}3\times3, 128\\3\times3, 128\end{bmatrix}\times2$	$\begin{bmatrix}3\times3, 128\\3\times3, 128\end{bmatrix}\times4$	$\begin{bmatrix}1\times1, 128\\3\times3, 128\\1\times1, 512\end{bmatrix}\times4$	$\begin{bmatrix}1\times1, 128\\3\times3, 128\\1\times1, 512\end{bmatrix}\times4$	$\begin{bmatrix}1\times1, 128\\3\times3, 128\\1\times1, 512\end{bmatrix}\times8$
conv4_x	14×14	$\begin{bmatrix}3\times3, 256\\3\times3, 256\end{bmatrix}\times2$	$\begin{bmatrix}3\times3, 256\\3\times3, 256\end{bmatrix}\times6$	$\begin{bmatrix}1\times1, 256\\3\times3, 256\\1\times1, 1024\end{bmatrix}\times6$	$\begin{bmatrix}1\times1, 256\\3\times3, 256\\1\times1, 1024\end{bmatrix}\times23$	$\begin{bmatrix}1\times1, 256\\3\times3, 256\\1\times1, 1024\end{bmatrix}\times36$
conv5_x	7×7	$\begin{bmatrix}3\times3, 512\\3\times3, 512\end{bmatrix}\times2$	$\begin{bmatrix}3\times3, 512\\3\times3, 512\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 512\\3\times3, 512\\1\times1, 2048\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 512\\3\times3, 512\\1\times1, 2048\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 512\\3\times3, 512\\1\times1, 2048\end{bmatrix}\times3$
	1×1	average pool, 1000-d fc, softmax				
FLOPs		1.8×10^9	3.6×10^9	3.8×10^9	7.6×10^9	11.3×10^9

ures for ImageNet. Building blocks are shown in brackets (see also Fig. 5), with the numbers of block

6. Testing

Model that has been saved given the test set image data as testing. At this stage,

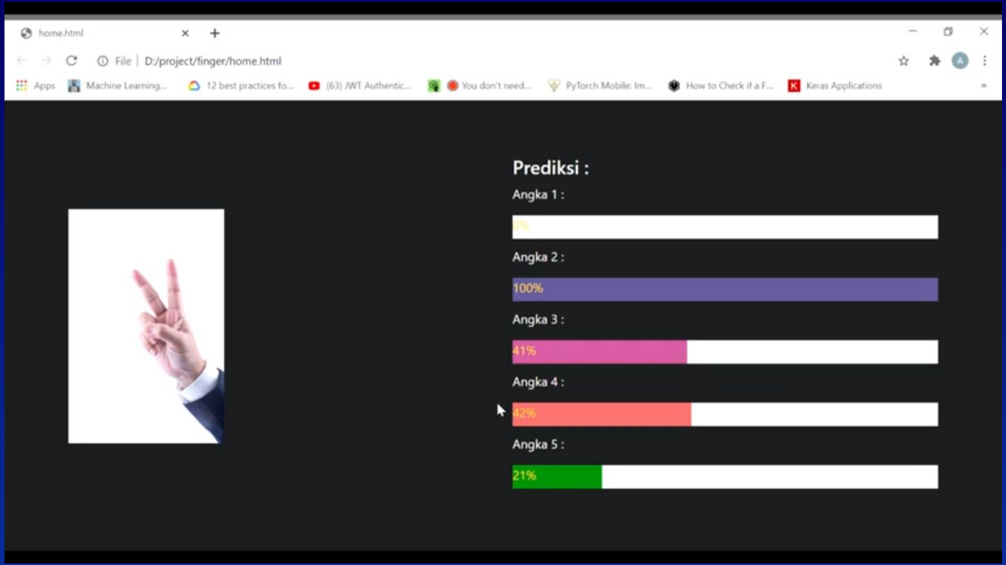
the model can predict how many fingers appear from the given image

7. Deployment

Flask

For web

Prediction on Web



Prediksi :

Angka 1 :

0%

Angka 2 :

100%

Angka 3 :

41%

Angka 4 :

42%

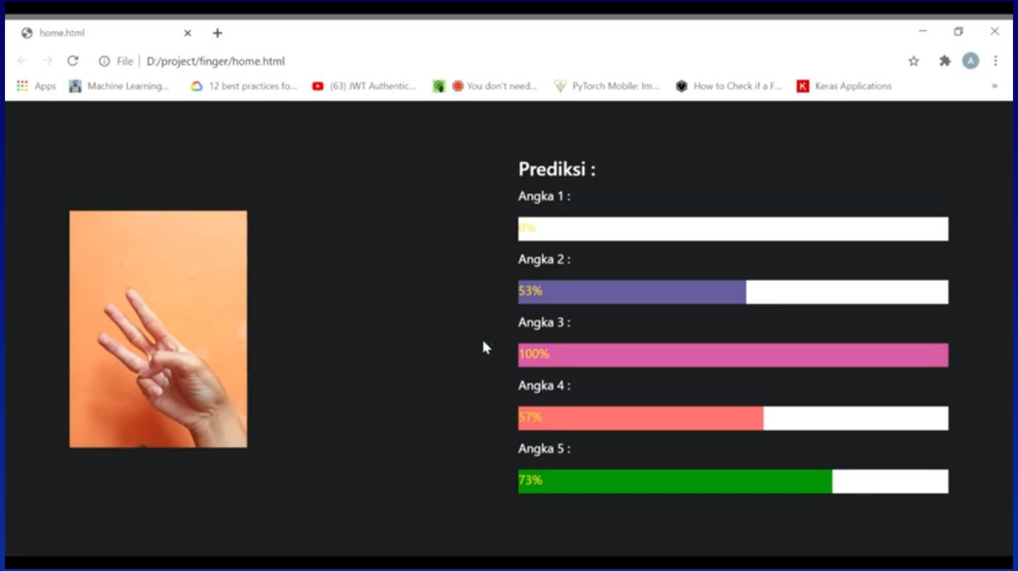
Angka 5 :

21%

Using Flask, the model predict how many fingers appear from the given image.

Prediction on Web

Using Flask, the model predict how many fingers appear from the given image.



Prediksi :

Angka 1 :

0%

Angka 2 :

53%

Angka 3 :

100%

Angka 4 :

57%

Angka 5 :

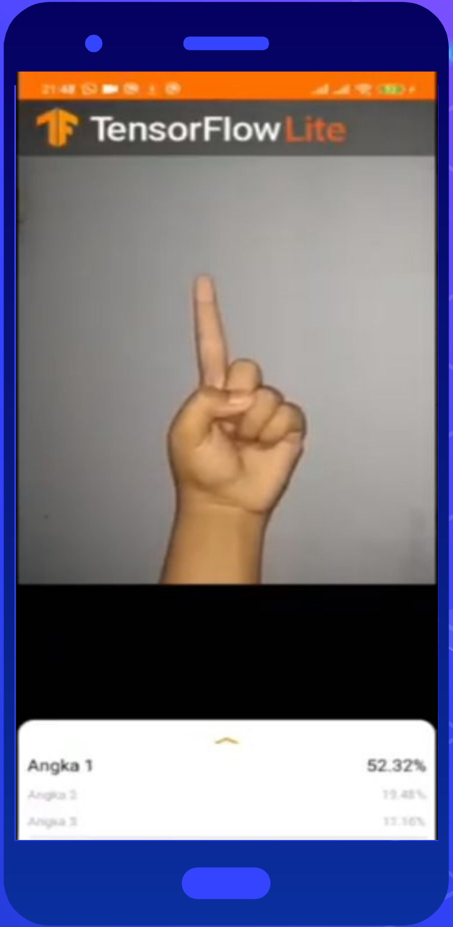
73%

TensorFlow Lite

For android

Prediction on Android

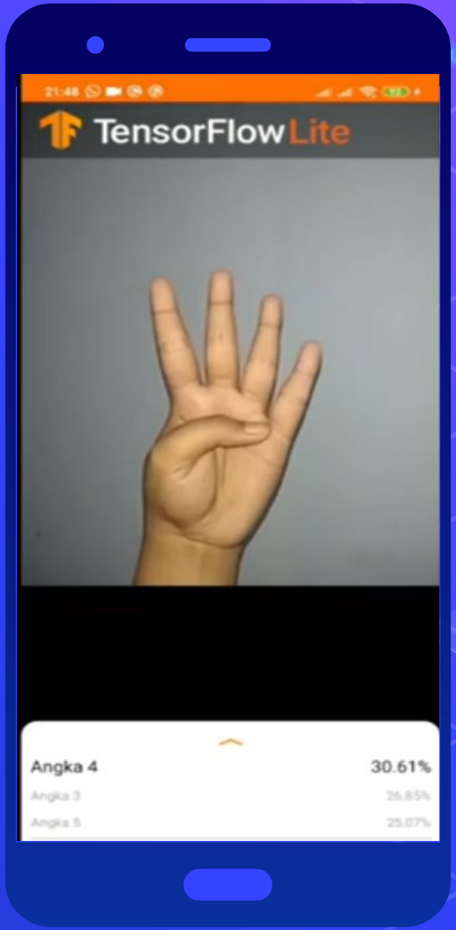
Using TFLite, the model predict how many fingers appear from the given image.



Angka 1	52.32%
Angka 2	19.48%
Angka 3	13.16%

Prediction on Android

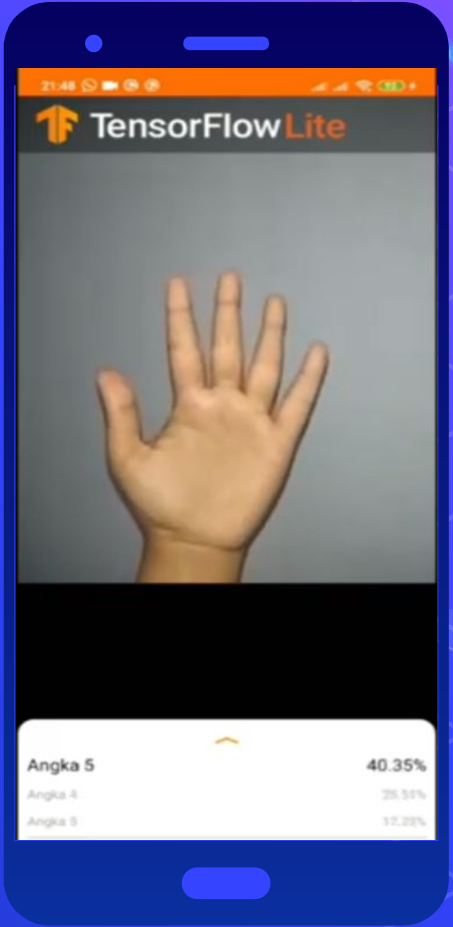
Using TFLite, the model predict how many fingers appear from the given image.



Angka 4	30.61%
Angka 3	26.85%
Angka 5	25.07%

Prediction on Android

Using TFLite, the model predict how many fingers appear from the given image.



TensorFlow Lite

Angka 5 40.35%

Angka 4 25.51%

Angka 5 17.23%

Repository

Youtube	Classification of Numbers on Fingers
Github	Finger Classification Resnet18
Kaggle	Dataset Fingers
TFLite	Finger Application

Tim Hore

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Risca Naquitasia	18523136

Thanks!