

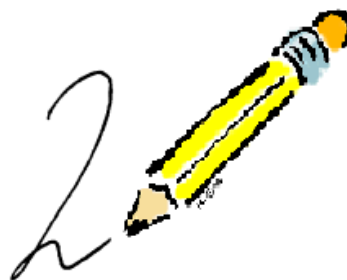
Introduction

- Pen & Pencil or Keyboard?
- Tablets – since the 1950's
- Motivation



Handwriting Recognition

- On-line vs. Off-line
- Recognition Problems
 - Language symbols (In Chinese – too many)
 - Pattern recognition (Diff. styles in English)
 - Shape discrimination (Similar symbols)
 - Noisy data
- Fundamental property of writing



113 LELAND'S ITINERARY.

Poore Village with a Paroch Chyrch and a Priory yn the fame Town of *Cluny* Monkes.

From *Falemuth* to *Trewardreth* by the Sowth Se the Ground is metely ferrytle of Corn and Grefse, and no Tyn Werkes from *Falemuth* to *Dudman* Forceland.

In the mydde Way betwene *Falemuth* and *Dudman* is an Ister or Rok beryng Grefse cawled *Grefe*, a ii. Acres abowt, but standyng yn the myddes torring up right. Ther bredeth yn the Ille Se Fowle.

Fro *Dudman* Forceland to *Trewardreth* the Contre sum-what baren of Grefse and Corne, and replenifhid with Tynne Werkes, with Vaynes yn the Se Clyves of Coper.

From *Trewardreth* to *Fowey* Town ys ii. Myles. Bytwene thes Townes by the Sowth Se ther is plenty of Corn and Grefse, but no Tynne Werkes.

The Town of *Fowey* ys a Market Town walled defensibly to the Se Coft, and hath Gates also. Yn the Towne is but one Chyrche, but the Howfes of the Towne be well buylded of Stone, and yl inhabited. Also at the Entery of the Haven on the West Syd is a Blokke Howfe and a Chapel of S. *Catarine* be the fame. Also ther is on the fame Syd a Towre with Ordenans for Defens of the Haven.

On the West Syde a ii. Myles up yn the Haven ys a Fysher Towne cawled *Gullant*.

At the Hedd of the ful Se Marke of this Haven, and a Quarter of a Myle more is the Toune of *Loft Whythiel* having a Market, and ys the Shyre Towne of *Cornwal*. For ther the Shyre is kept by the Shryfe ons yn the Moneth. Also at this Towne is *Quynag* of Tynne twys a Yere. And by the Shyre Hawle appere Ruines of auncyent Buyldinges. It is the Duke of *Cornwal*. evydently knownen that yt hath flowed to *Loft Whythiel*; but the Spuing of the Sandes of the Tynne Werkes hath stoppe

yt now. The litle rownd Castel of *Loftormel* standith in the Kinges Parke ny to *Loftwithiel*. At the Est Syde of the Haven's Mowth of *Fowey* stondesth a Towr for the Defens thereof, and a Chapel of S. *Savvior* a lytle above the fame. Ny by the sayd Towr standith a Fysfhar Village cawled *Poiruan*.

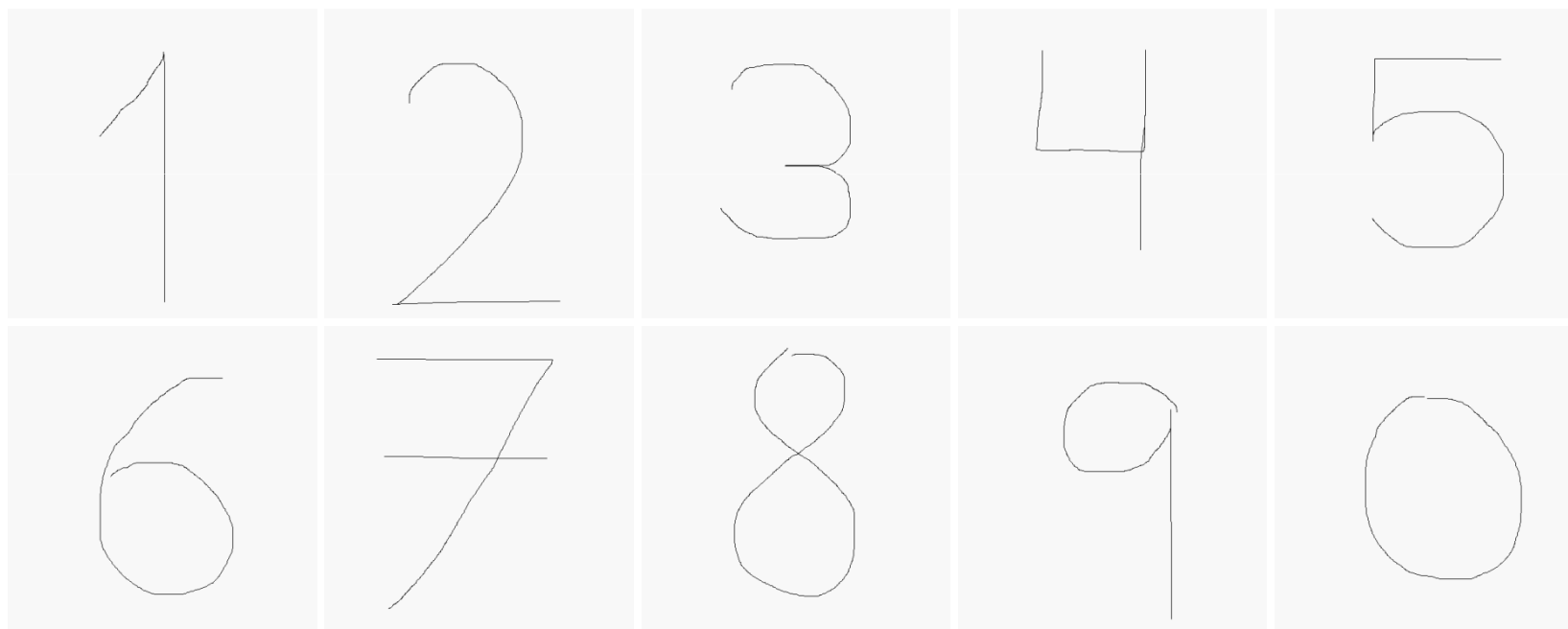
A Myle beyond *Poiruan* on the Est Syde of the fame Haven stondesth a poore Fisfhar Village cawled *Bodennek*. Ther is the Passage or *trajectus* to *Fowey*.

ii. Myles above *Bodennek* ynto the Land Northward is a Creke apou the North Syde, wheryn ys a Sel of ii. Blake Monkes of *Montegu*, and is dedicat to S. *Sirice* and *Julit*.

By Est the Haven of *Fowey* apou a iii. Myles ys a fnawle Creke

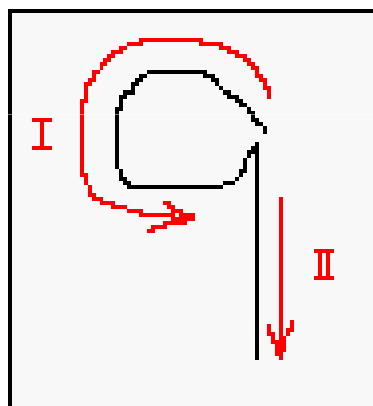
Approach and Method

- The alphabet: {1, 2, 3, ... 9, 0}

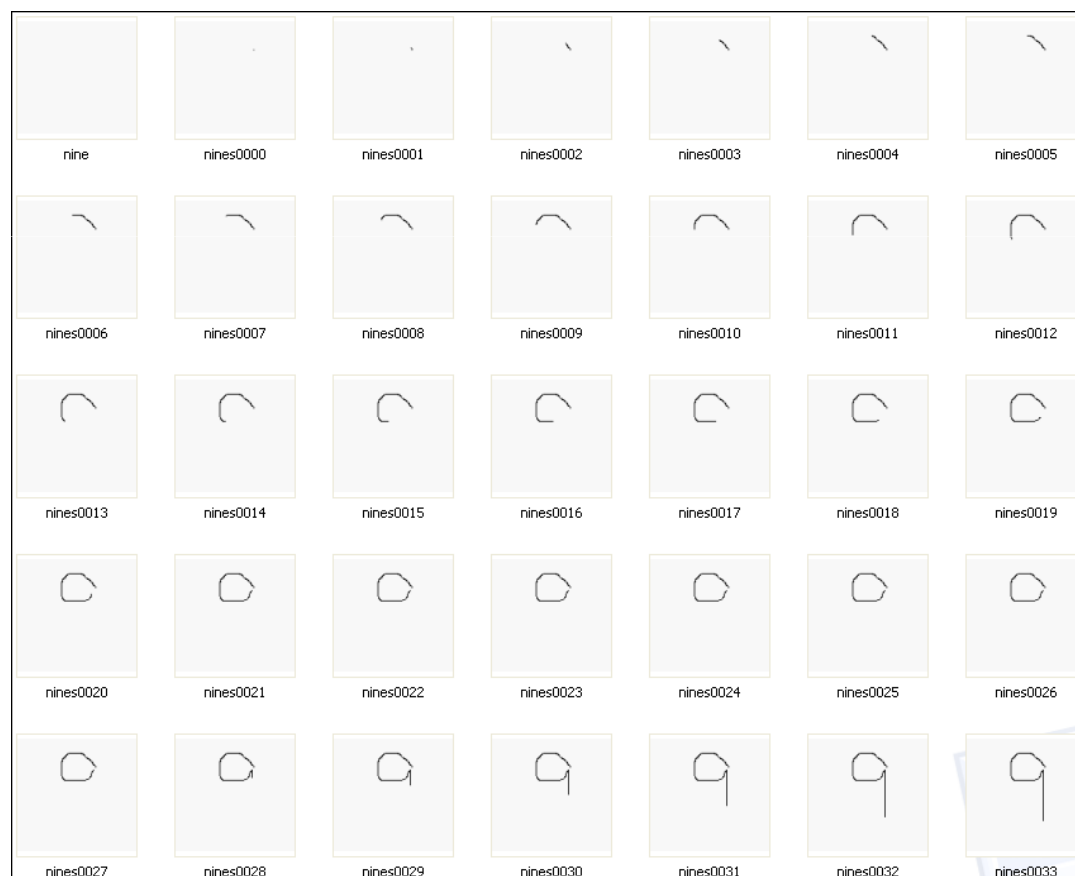


Approach and Method

- Learning Process:



Video file converted to image sequence

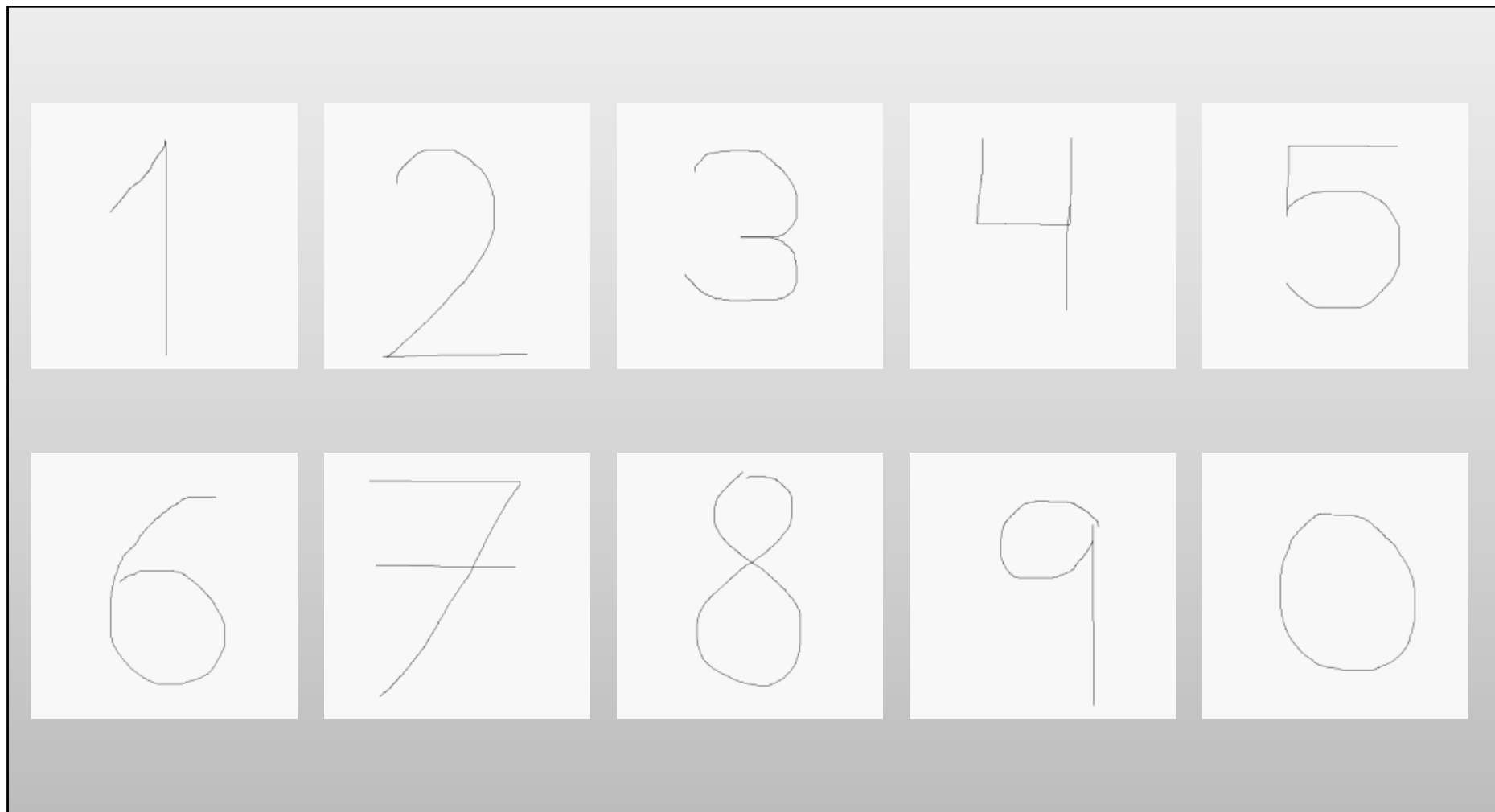


Approach and Method

How to choose the right symbol?

- Different methods:
 1. Normalizing vector length using “stretching”
 2. Normalizing vector length using interpolation
 3. Using relative chain codes
 4. Divide and conquer
- Final decision – Difference L1 norm

Results – using methods 1,2

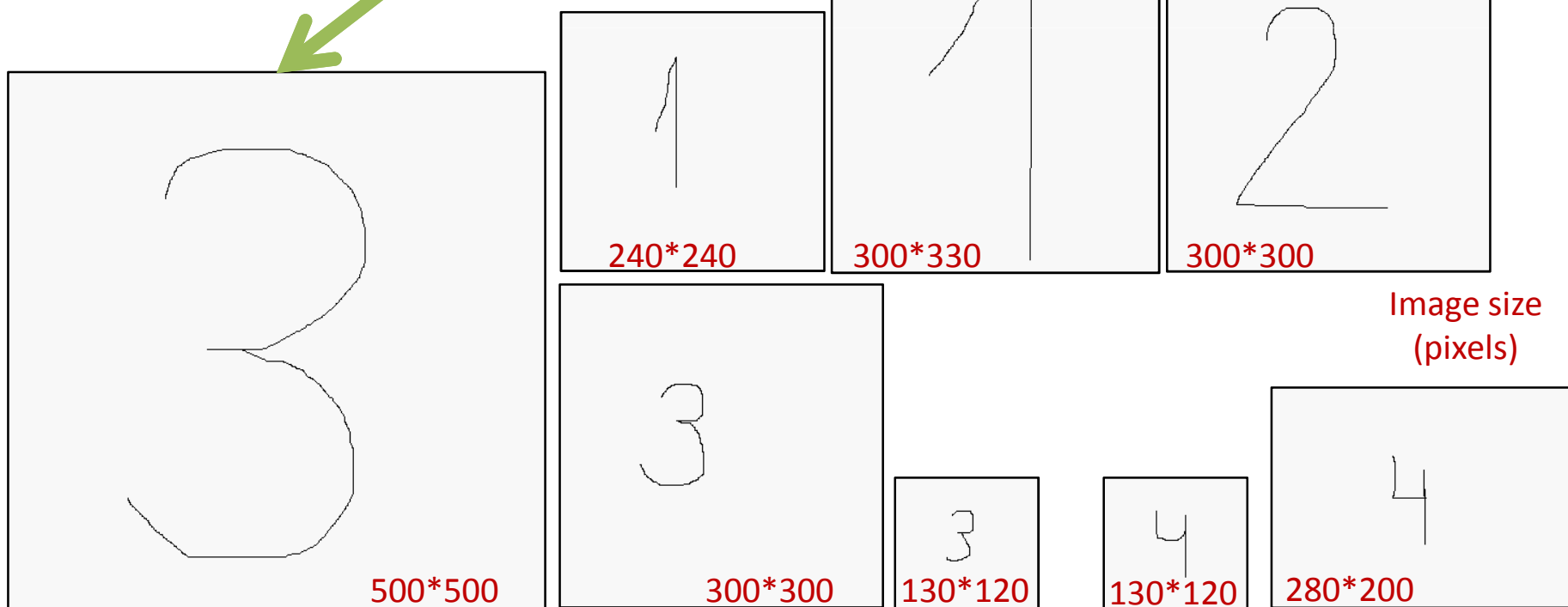


The alphabet - 500*500 pixels each

Results – using methods 1,2

Average error (degrees)
 1, 2, **3**, 4, 5, 6, 7, 8, 9, 0
 82,87,**46**, 98, 75,78,67,76,82,93 (Method-1)
 82,87,**26**,114,80,78,87,76,91,94 (Method-2)

Average error (degrees)
1, 2, 3, 4, 5, 6, 7, 8, 9, 0
19,82,91,98,102,117,109,139,63,126
18,81,85,98, 94, 116, 83,142,85,127



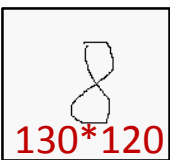
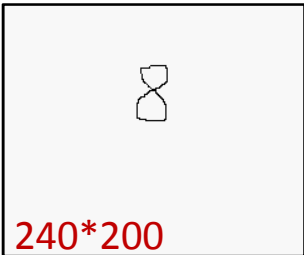
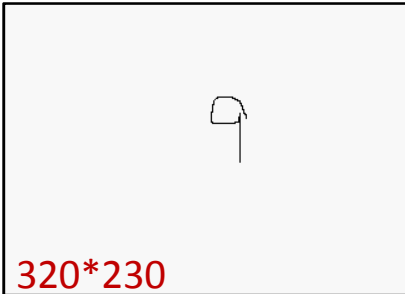
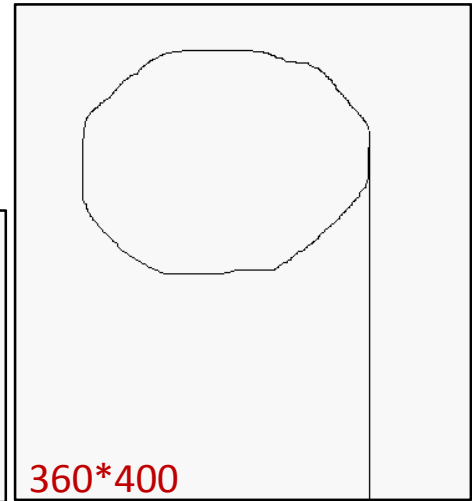
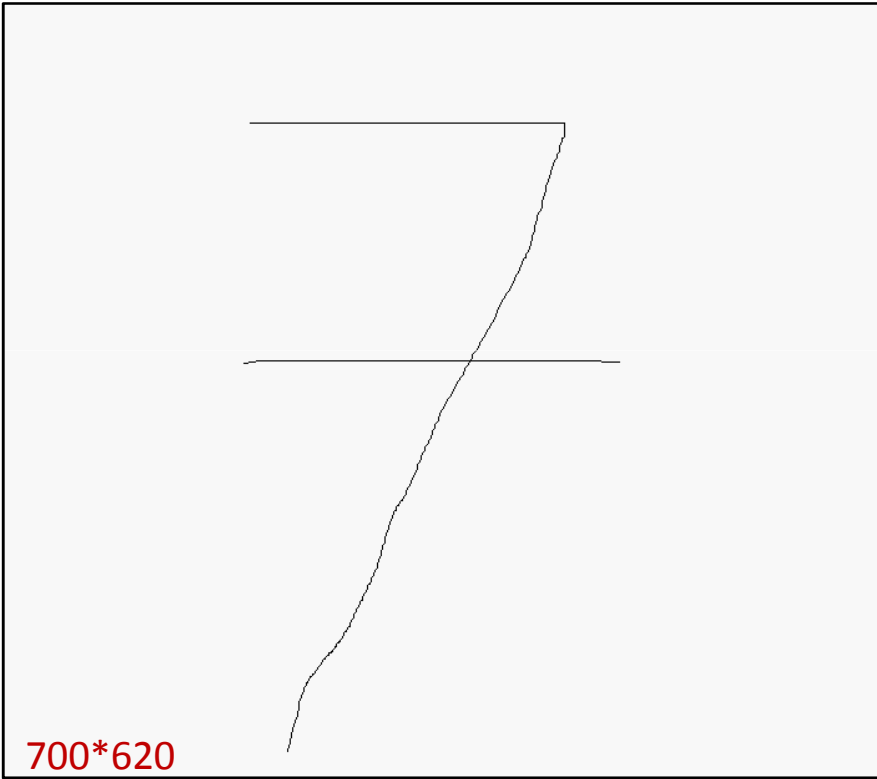
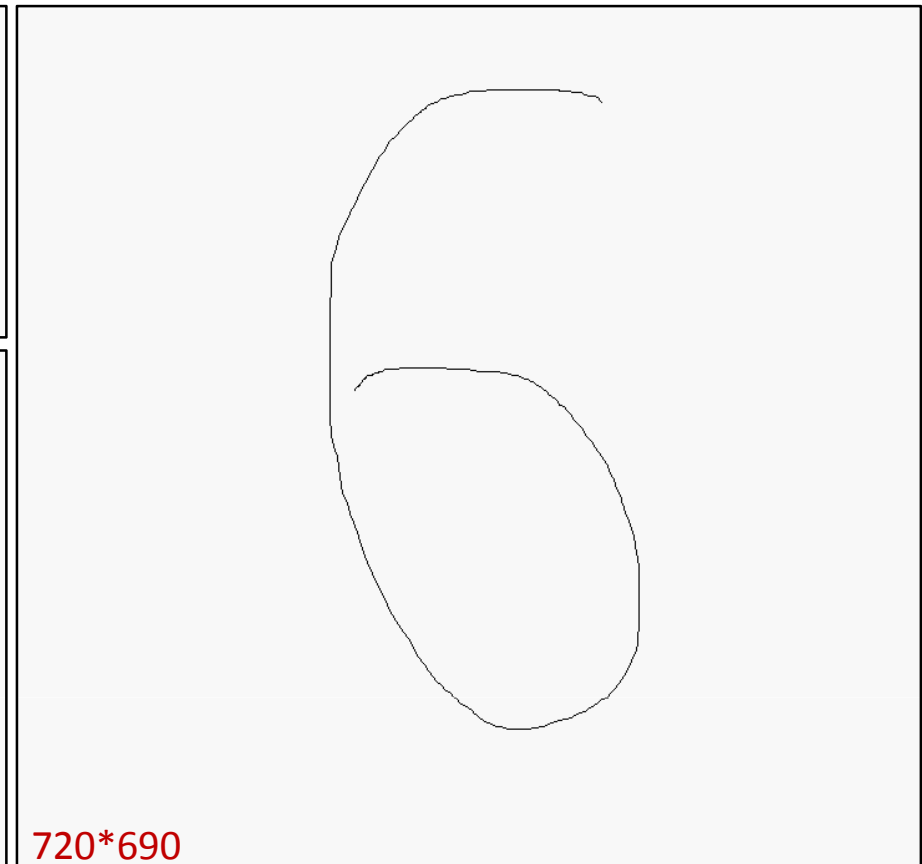
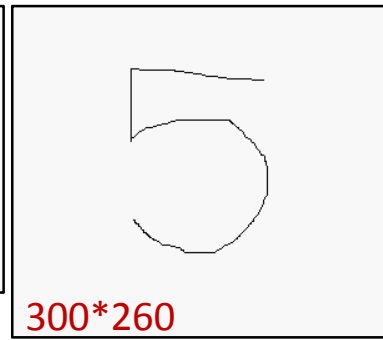
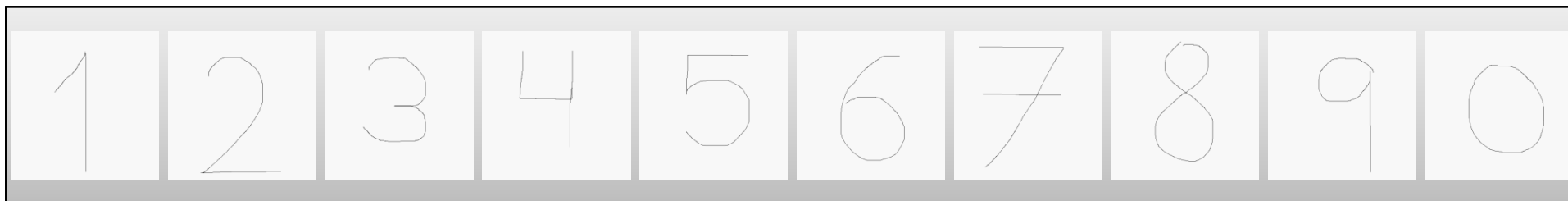
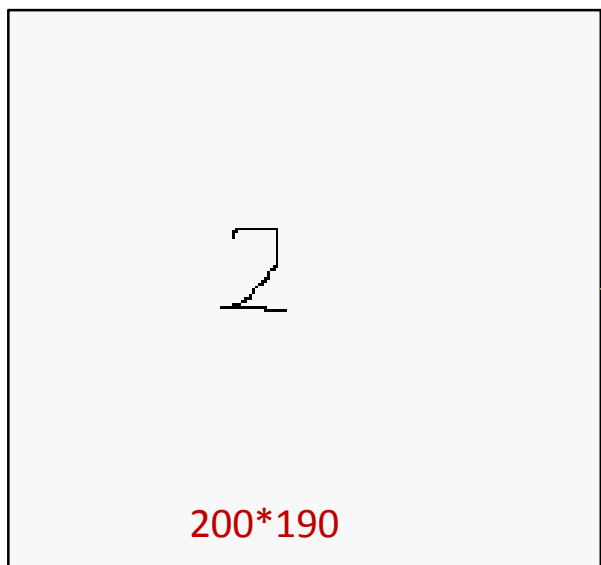


Image size
(pixels)

Results



The alphabet - 500*500 pixels each



Average error (degrees)

1, **2**, 3, 4, 5, 6, **7**, 8, 9, 0

Method 1:

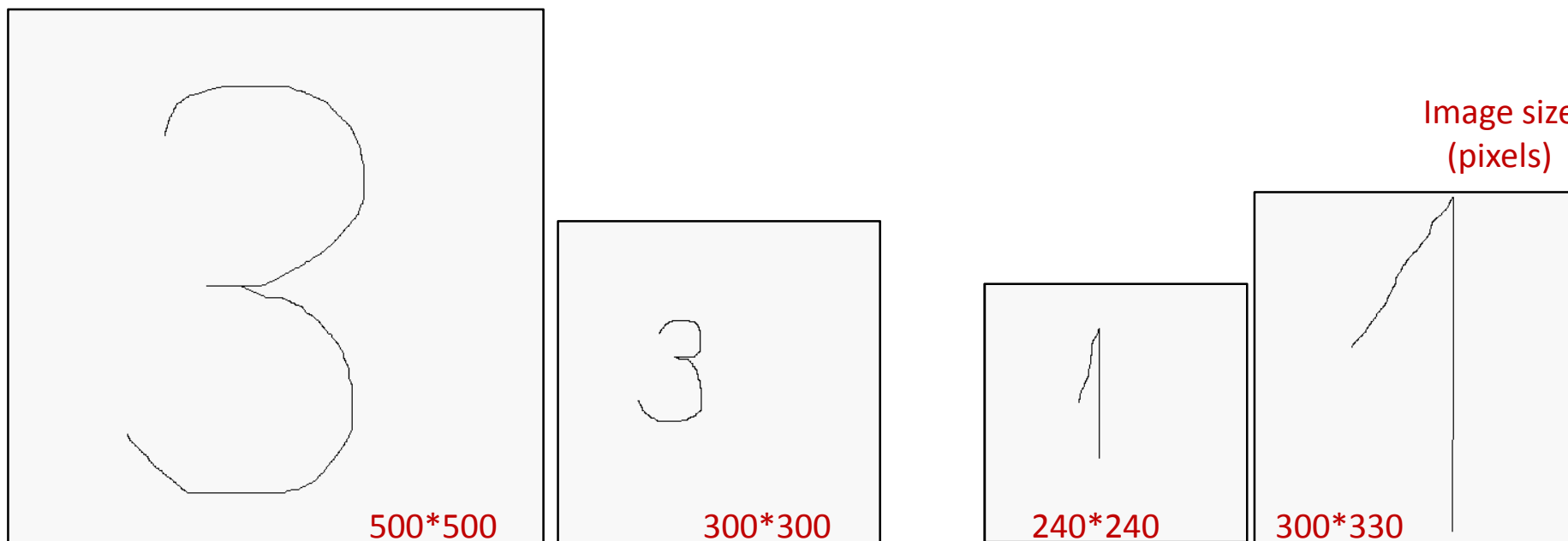
53,89,84,116,116,112,**31**,101,106,126

Method 2:

61,**15**,80,100,112,103,**17**,101,103,60

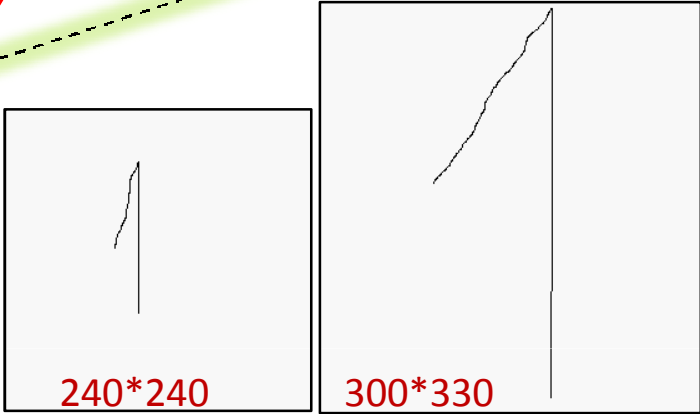
Results – using method 3

Complete failure



Results – using method 3

Complete failure



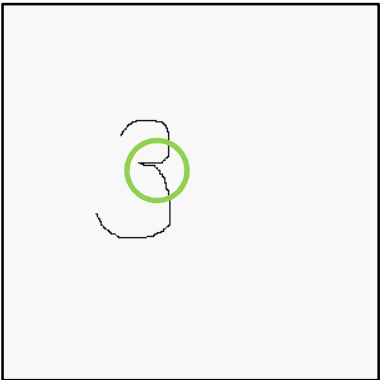
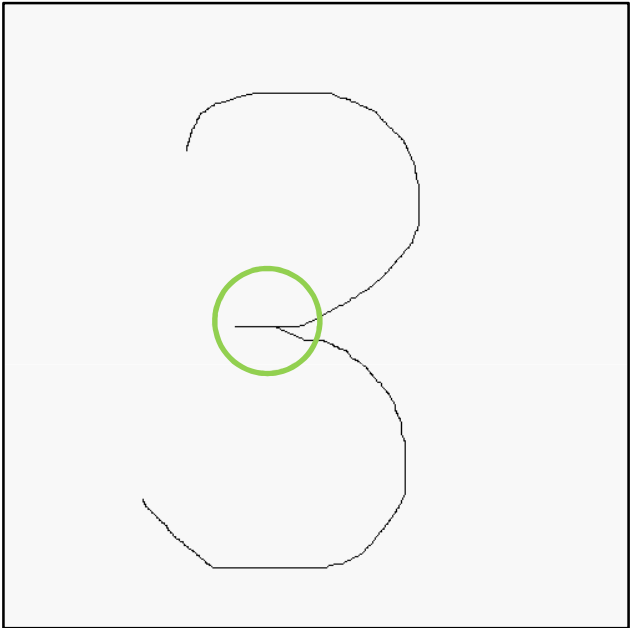
Two compared vectors describing the same symbol:

Symbol '1' in alphabet: 0, 0, 0, 0, 0 ... 0, 0, -75, 0, 0, 0, 0, 0
Symbol '1' tested: 0, 0, 0, 0, 0 0, 0, -150, 0, 0, 0, 0, 0

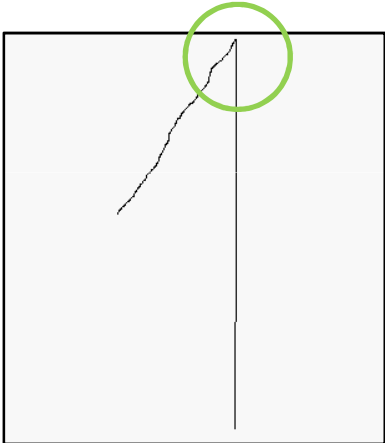
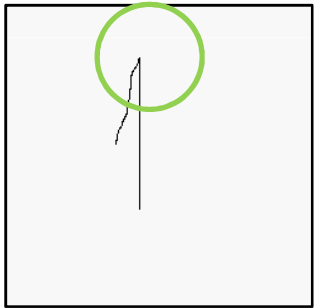
Two compared vectors describing different symbols:

Symbol '1' in alphabet: 0, 0, 0, 0, 0 ... 0, 0, -75, 0, 0, 0, 0, 0
Symbol '0' tested: 0, -5, -5, -5, 0 -5, -5, 0, 0, -3, -5, -4, 0

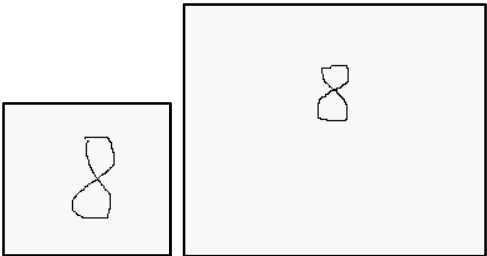
Discussion – method 4



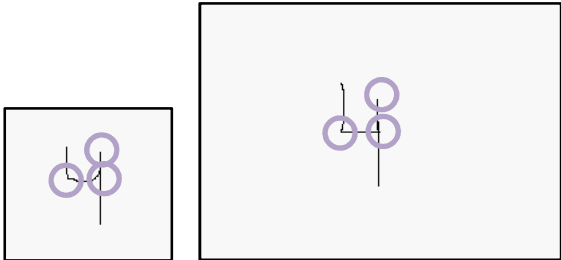
Symbols consisting of 2 sections



Symbols consisting of 1 section



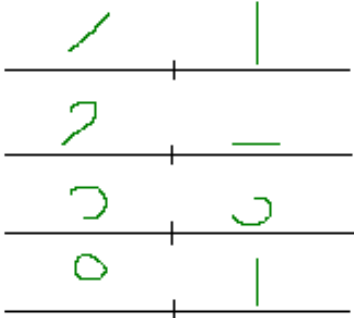
Symbols consisting of 4 sections



Discussion – method 4

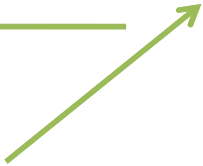
Symbols consisting of 1 section

0, 6, 8



Symbols consisting of 2 sections

1, 2, 3, 9



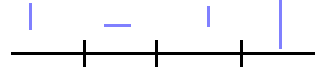
Symbols consisting of 3 sections

5, 7



Symbols consisting of 4 sections

4



Conclusions

- Chain codes consisting of absolute angles has shown useful
- Improvements
- Using relative angles representation