

Ink Analysis

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CSE 481b
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Announcements

- VisualStudio Express
 - Free, Hobbyist version of VS 2005
- Presentations, Tuesday Jan 23
 - 15 minute presentation + 3 minutes discussion
 - PowerPoint slides
 - Group order: A, B, C, D

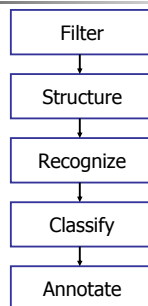
Today's lecture

- Handwriting Recognition
- Structure Recognition
- Classification
- Annotation
- JNT Note Format

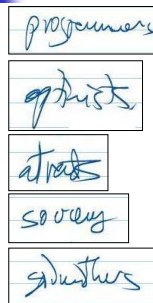
Ink Analysis for Search

- Output
 - Mapping of search results to source
 - Reflect underlying structure
 - Handle different types of search queries
 - Raw text
 - Boolean
 - Typed queries ("481 as a course number")
 - Object queries (Course numbers)
 - Environment (List, Prose, Mathematics, . . .)

Ink Analysis Pipeline



Handwriting Recognition: Identify the following words

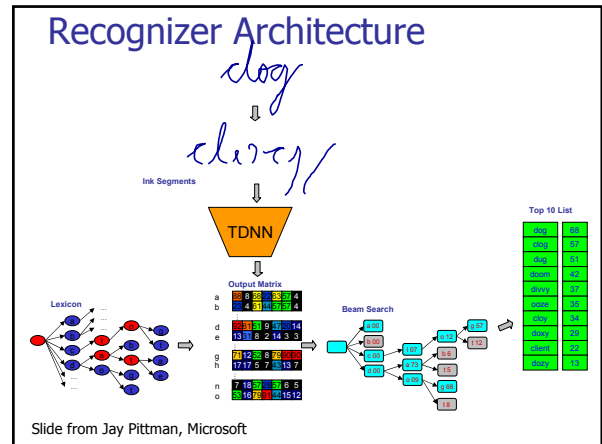


Recognition results

Converted text:
All propounders are oppugns), Perhaps 2-3 motion sorcery especially attracts Those who believe in happy adios of Sais godmothers

Ink from note:
opugns

Alternative:
oppugns),
optimists,
optimists,
oppugns),
opuises),
opuises),
optimist,
optimists



Recognizer Training

- Collect large set of training data
- Samples of known inputs that can be used to set "weights" in reco engine
- Needed to build a recognizer
 - Dictionary
 - Language samples
- Commercial recognizers based on massive data sets

Tablet PC Recognition API

- Basic idea:
 - Ink In, Text Out

Recognition Code I

```

private Recognizers recognizers;
private Recognizer recognizer;

public Form1() {
    InitializeComponent();
    this.inkCollector = new InkCollector(this.inkPanel.Handle);
    this.inkCollector.Enabled = true;
    this.recognizers = new Recognizers();
    this.recognizer = recognizers.GetDefaultRecognizer();
}

```

Recognition Code II

```

private void OnRecoClick(object sender, EventArgs e) {
    RecognizerContext recoContext = this.recognizer.CreateRecognizerContext();
    recoContext.Factoid = GetFactoid();
    recoContext.Strokes = this.inkCollector.Ink.Strokes;

    recoContext.EndInkInput();

    RecognitionStatus recoStatus;
    RecognitionResult recoResult = recoContext.Recognize(out recoStatus);

    if (recoStatus != RecognitionStatus.NoError)
        return;

    string result = recoResult.TopString;

    RecognitionAlternate topAlt = recoResult.TopAlternate;
}

```

Factoids

- Bias the recognizer towards certain types of content
 - DEFAULT
 - CURRENCY
 - NUMBER
 - TELEPHONE
 - EMAIL
 - UPPERCHAR

Reading Journal Notes

- Journal Reader to import .JNT
- .JNT -> XML -> Custom Format
- Journal format gives an initial parsing
 - You may want to undo this parsing and work with ink at the page level

JNT Format

- Journal Document
 - List of Journal Pages
- Journal Page
 - List of Content
- Content
 - Journal Drawing, Journal Paragraph, other stuff

Journal Drawing

- Uninterpreted Ink
 - Base64String

```
if (childNodes.Name.ToLower().Equals("inkobject")) {  
    string base64Ink = childNode.InnerText;  
    ink = new Ink();  
    ink.Load(Convert.FromBase64String(base64Ink));  
}
```

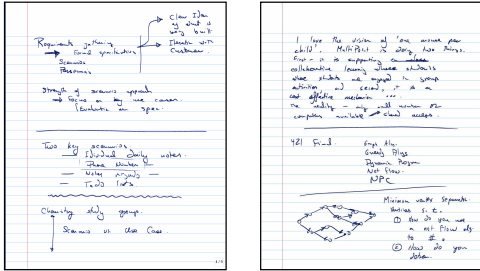
Text Structure

- JournalParagraph
 - List of JournalLines
- JournalLine
 - List of JournalInkWords
- JournalInkWord
 - Alternate List
 - Uninterpreted Ink

Shape recognition

- Surprisingly challenging because of drawing artifacts
 - Open figures
 - Multiple strokes
 - Imprecise corners
 - Arrows

Structure recognition



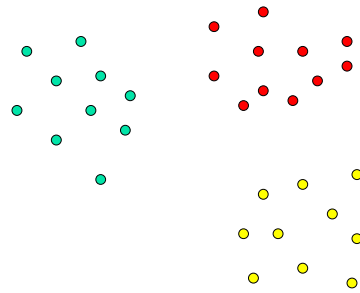
Basic approach for structure recognition

- Grouping by rectangular region
- Heuristics for separating regions
 - White space
 - Separating lines

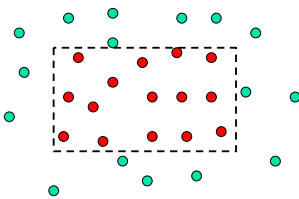
General approach to recognition/classification

- Extraction of features
- Objects become points in high dimensional space
- Construct mapping from features to classes

Clustering



Learning



Heuristic

- Programmatically determine classification based on features

Classification

- Identify different types of text
 - Mathematics
 - Prose
 - Lists
 - Brainstorming
 - Code
 - Domains
 - Chemistry, Physics, Algorithms,

Classification

12-2-06

$$(x+y+z)^2 = (x+y+z)(x+y+z)$$

$$= (x+y+z)(x+y+z)$$

$$(x+y) \quad (x+y) \quad (x+y+z)$$

$$x+y \quad z$$

$$\begin{matrix} x & y & z \\ \downarrow & \downarrow & \downarrow \\ (x+y+z) & (x+y+z) & (x+y+z) \end{matrix}$$

$$\begin{matrix} (x+y+z) & (x+y+z) & (x+y+z) \\ \downarrow & \downarrow & \downarrow \\ (x+y+z) & (x+y+z) & (x+y+z) \end{matrix}$$

$$((x+y+z)(x+y+z))(x+y+z)$$

$$((x+y+z)(x+y+z))(x+y+z)$$

11-1-06

Maths

Class - 9th - 1:10
 English - 2:10
 9:10 - 5:30

✓ L1 - 5:30
 ✓ L2 - 5:30
 ✓ L3 - 5:30
 ✓ L4 - 5:30
 ✓ L5 - 5:30
 ✓ L6 - 5:30
 ✓ L7 - 5:30
 ✓ L8 - 5:30
 ✓ L9 - 5:30
 ✓ L10 - 5:30
 ✓ L11 - 5:30
 ✓ L12 - 5:30
 ✓ L13 - 5:30
 ✓ L14 - 5:30
 ✓ L15 - 5:30
 ✓ L16 - 5:30
 ✓ L17 - 5:30
 ✓ L18 - 5:30
 ✓ L19 - 5:30
 ✓ L20 - 5:30

Annotation

- Identify annotation marks
 - Highlighted text
 - Circles
 - Check marks
 - Cross out

Annotation

11-2-06

Maths

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✓ L1 - 5:30
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 ✓ L10 - 5:30
 ✓ L11 - 5:30
 ✓ L12 - 5:30
 ✓ L13 - 5:30
 ✓ L14 - 5:30
 ✓ L15 - 5:30
 ✓ L16 - 5:30
 ✓ L17 - 5:30
 ✓ L18 - 5:30
 ✓ L19 - 5:30
 ✓ L20 - 5:30

10-11-06

To do

✓ Copy Math
 ✓ Copy English
 ✓ Copy Science
 ✓ Copy History
 ✓ Copy Art
 ✓ Copy Music
 ✓ Copy PE
 ✓ Copy IT
 ✓ Copy French
 ✓ Copy Spanish
 ✓ Copy German
 ✓ Copy Japanese
 ✓ Copy Chinese
 ✓ Copy Korean
 ✓ Copy Indian
 ✓ Copy African
 ✓ Copy Latin
 ✓ Copy Greek
 ✓ Copy Roman
 ✓ Copy Egyptian
 ✓ Copy Mesopotamian
 ✓ Copy Inca
 ✓ Copy Aztec
 ✓ Copy Mayan
 ✓ Copy Maya
 ✓ Copy Olmec
 ✓ Copy Teotihuacan
 ✓ Copy Chalchicomula
 ✓ Copy San Bartolome
 ✓ Copy San Juan
 ✓ Copy San Marcos
 ✓ Copy San Mateo
 ✓ Copy San Pedro
 ✓ Copy San Pablo
 ✓ Copy San Andres
 ✓ Copy San Cristobal
 ✓ Copy San Marcos
 ✓ Copy San Juan
 ✓ Copy San Mateo
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 ✓ Copy San Pablo
 ✓ Copy San Andres
 ✓ Copy San Cristobal