How Ai Works

useful basics for librarians and researchers

Wayne de Fremery
Dominican University of California
AI overview
AI & Deep Learning

General versus Narrow
Kinds of Data & Tasks / Kinds of Algorithms
Computer Vision

CNN (convolutional neural network)
(N)atural (L)anguage (P)rocessing

RNN (recurrent neural networks)
BERT (Bidirectional Encoder Representations from Transformers)
GPT (Generative Pretrained Transformers)
AI
Optical Character Recognition (OCR)
(using computer vision)
Deep Learning

convolutional neural network
Convolution

Input

1 1 1 0 0
0 1 1 1 0
0 0 1 1 1
0 0 1 1 0
0 1 1 0 0

plus

Filter / Kernel

1 0 1
0 1 0
1 0 1

Descriptive features

4 3 4
2 4 3
2 3 4

Feature (map)

target
Morse Code
(American, 1844; Continental, 1848; International, 1865)

American Standard Code for Information Interchange
(1960s)
### American Standard Code for Information Interchange

<table>
<thead>
<tr>
<th>Binary</th>
<th>Oct</th>
<th>Dec</th>
<th>Hex</th>
<th>Glyph</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000</td>
<td>000</td>
<td>0</td>
<td>0</td>
<td>space</td>
</tr>
<tr>
<td>00001</td>
<td>001</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>00010</td>
<td>002</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>00011</td>
<td>003</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>00010</td>
<td>004</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>00101</td>
<td>012</td>
<td>10</td>
<td>0A</td>
<td>Line Feed</td>
</tr>
<tr>
<td>00111</td>
<td>013</td>
<td>11</td>
<td>0B</td>
<td>Vertical Tab</td>
</tr>
<tr>
<td>01100</td>
<td>014</td>
<td>12</td>
<td>0C</td>
<td>Form Feed</td>
</tr>
<tr>
<td>01101</td>
<td>015</td>
<td>13</td>
<td>0D</td>
<td>Carriage Return</td>
</tr>
</tbody>
</table>

- 10 = line feed
- 13 = carriage return
- 32 = space
- 48 = 0
- 65 = A
- ? = 인
A universal character encoding scheme initiated in 1987. The Unicode Consortium was incorporated in California 1991.
Unicode Code Spaces

Sources:
(above) http://upload.wikimedia.org/wikipedia/commons/8/8e/Roadmap_to_Unicode_BMP.svg (modified by author);
(right) http://www.w3.org/International/articles/definitions-characters/
Digital Fonts

Glyphs mapped to encoding
Digital Fonts

236 157 184 = 인
236 157 184 = 인
236 157 184 = 인
236 157 184 = 인

Glyphs mapped to encoding
진달래꽃

나보기가 역겨워
가실째에는
말엽시 고히 보내드리우리다

여천에 약산
진달래꽃
아름싸다 가실길에 뿌리우리다

가시는거름거름
노한그꽂줄
삽분히즈려밟고 가시옵소서

나보기가 역겨워
가실째에는
죽어도아니 눈물흘니우리다
Convolution

Input

Filter / Kernel

Descriptive features

Feature (map)

plus

(인)

236 157 184
convolutional neural network
**CNNs & Inference**

<table>
<thead>
<tr>
<th>가</th>
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<td>가</td>
</tr>
</tbody>
</table>

**Weight File**

(record of which features best predict/describe objects in training set)

Something.weights

236 157 184
(N)atural (L)anguage (P)rocessing
철도수송력의 강화 위해 기관차실동률 제고에!
신북청기관구 로동자들
신북청기관구 로동자들은 8.15 해방 5주년을 철도수송력의 강화로써 뜻깊게 맞이하고자 기관차 수리의 창발적 노력을 기울이고 있다. 그들은 우선 기관차의 창발적 수리제고를 위하여 남은것을 용감히 퇴치하고 새로운 작업방법을 적용하는데 창발적 노력을 기울이고 있다. 수리직장 로동자들은 4.0 업종에 당하는 수리공구들을 풍동별로 재정비한 후 이를 이용해 수리작업을 하고 있다.

철도수송력의 강화로써 의미를 깊게 맞이하고자 기관차 수리의 질적제고를 위한 노력을 강화하고 있다. 그들은 우선 기관차의 창발적 수리제고를 위하여 남은것을 용감히 퇴치하고 새로운 작업방법을 적용하는데 창발적 노력을 기울이고 있다. 수리직장 로동자들은 4.0 업종에 당하는 수리공구들을 풍동별로 재정비한 후 이를 이용해 수리작업을 하고 있다.

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<?xml version="1.0" encoding="UTF-8"?>

(G)enerative
(P)retrained
(T)ransformer

<?xml version="1.0" encoding="UTF-8"?>
철도수송력의 강화위해 기관차실동률 제고에!

(G)enerative
(P)retrained
(T)ransformer

철도수송력의 강화위해 기관차실동률 제고에!
Optical Character Recognition (OCR)
Optical Character Recognition (OCR)

Computer Vision

Natural Language Processing
AI

a bibliographic process

copies &

accounts of difference
“Bibliography is the discipline that studies texts as recorded forms, and the processes of their transmission, including their production and reception.”

D. F. McKenzie. *Bibliography and the Sociology of Texts*
“The domain of information science is the transmission of the universe of human knowledge in recorded form, centering on manipulation (representation, organization, and retrieval) of information, rather than knowing information”

Bibliography

Βιβλιογραφία  book-writing

cr the writing out of books
writing-record
recording/ documenting writing / study of

Patrick Wilson, *Two Kinds of Power: An Essay on Bibliographical Control* (1968)
Bibliography

Enumeration
Description
Analysis
Critique
of
Copies
Enumerative Bibliography
Descriptive Bibliography

How Poetry Mattered in 1920s Korea

1. *One in a crowd* (Choice of anguish)

Author(s):
Paul Verlaine
Remy de Gourmont
Albret Simon
Charles Baudelaire
William Butler Yeats, et al.

Translator:
Kum Ok

Dimensions (w x h in cm): 13.8 x 19.8; spmr 7.4 (mm)
4:6-page (page proportions (width to height): 1:1.45)
Cover material: coated card (thickness: 34 mm)
Color: three (magenta, orange, green)
Image: flowers and musical staff

1 Except when I discuss *Chukchosok* I have used the term “edition” as it is used in Korean bibliographical practice to express “editions” or “books.” Please see my discussion of “editions,” “volumes,” and “books” in Chapter Five.
“Greg’s authority [was] … rooted in classical and medievalist methodologies of textual criticism[; it] pivoted on the organicist historicism of stemmatics.”


“[Books] are products of a particular manufacturing or technical process, and the study of that process for printed texts is usually called analytical bibliography.”

Newly built Hansŏng Tosŏ Chusik Hoesa building, Haksanggye (December 1920), unnumbered front matter (image from microfilm at the National Library of South Korea). The work of establishing Hansŏng Tosŏ's printing facility was completed in April of 1921 and the first materials were printed there in May by No Ki-jŏng. Before May of 1921, materials published by Hansŏng Tosŏ were printed at Ch'oe Nam-sŏn's Sinmun'gwan.
한글글꼴용어사전 (A dictionary of typographic terms for han’gŭl) (Seoul: Sejong Taewang Kinyŏm Saŏphoe, 2000), 46.
Critical Bibliography
(Textual Studies/Critical Editing)
Spine of the Hansŏng Tosŏ issue (left) and the Chungang Sŏkim issue (below).

Sources: Images of Hansŏng Tosŏ issue are from the Hwabong Munn'go (far left) and Appenzeller-Noble Memorial Museum collections (right). Image of the Chungang Sŏkim issue is from the collection of Ch'oe Ch'ŏl-hwan.
参考文献：索引/索引 (sound) page 73 in the Chungang Shān issue (left, in the collection of Ch'oe Ch'ŏn-bwan collection), Hansŏng Tosa issue (center, in Om Tongsip collection) and in the Munhak Sasang p'ŏngmun.
Bibliography

“List Makers”

Enumerative | Descriptive

Information Science

Patrick Wilson Two Kinds of Power: An Essay on Bibliographical Control (1968)
Records of the Court of Chancery of South Carolina, 1671-1779 / edited by Anne King Gregorie; with an introduction by J. Nelson Frierson.
South Carolina. Court of Chancery, court governed.; Anne King Gregorie editor.; American Historical Association, issuing body.

Available at Law Library Stacks (KFS2315.A545 1671)
COPY

I. A. ABUNDANCE, PLENTY.
    B. FULLNESS, PLENTITUDE.

II. A TRANSCRIPT OR REPRODUCTION OF AN ORIGINAL.
Distance of some kind
(e.g. space)
Distance of some kind
(e.g. space)
Distance of some kind
(e.g. time)
Transform. 化.

Latin *transformāre*, < TRANS- prefix + formāre to form>*
*trans*, ‘across, to or on the farther side of, beyond, over’
化  to become, to change
Accounting

I. To render a reckoning.

Etymology: < Anglo-Norman acounter, acompter, accomptier, accomptere, Anglo-Norman and Old French acunter, Anglo-Norman and Old French, Middle French acompter, Middle French acompter, accompter to count, enumerate (c1100), to relate, tell, to include (something) in a reckoning, count in, to calculate (all early 12th cent.), to consider, deem, to value, consider important (c1280), to present financial accounts (early 14th cent.), to matter, be of account (mid 14th cent.) < a- prefix + cunter, counter COUNT v. Compare Old Occitan acomtar, acontar (c1150), post-classical Latin accomplare (1661 in a British source). The f. forms reflect Anglo-Norman and Middle French acompter, acompter, etc.: for the development of forms of this type and their history in French see discussion at COUNT v.
Distance of some kind (e.g. time and/or space)

Who or what determines?
For what purposes?
In which contexts?
COPIES AND CLAUDE SHANNON

Shannon’s theory of communication became known as “information theory.” As a practical matter it is about making a copy at a distance. It would better be named Copy Theory . . .

Deep Learning

As Bibliographical Processes
Deep Learning
Automated pattern recognition
copies and accounting for them facilitates
Convolutional Neural Networks

Deep Learning


Convolutional Neural Networks

The CNN Architecture for Our Problem with an image of '0' as an input.
**Convolutional Neural Networks**

Convolution

Inputs:

<table>
<thead>
<tr>
<th>1</th>
<th>1</th>
<th>1</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
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<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Filter / Kernel:

<table>
<thead>
<tr>
<th>1</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Useful similarity:

4 3 4
2 4 3
2 3 4

Feature (map):
Deep Learning

copies (like turtles) all the way down

Weight File
(record of which features best predict/describe objects in training set)

Something.weights

229 173 151

236 157 184
**Enumeration**

**Description**

**Step 1**
Collect demonstration data and train a supervised policy.

- A prompt is sampled from our prompt dataset.
- A labeler demonstrates the desired output behavior.
- This data is used to fine-tune GPT-3.5 with supervised learning.

**Step 2**
Collect comparison data and train a reward model.

- A prompt and several model outputs are sampled.
- A labeler ranks the outputs from best to worst.
- This data is used to train our reward model.

**Analysis**

**Critique**

**Step 3**
Optimize a policy against the reward model using the PPO reinforcement learning algorithm.

- A new prompt is sampled from the dataset.
- The PPO model is initialized from the supervised policy.
- The policy generates an output.
- The reward model calculates a reward for the output.
- The reward is used to update the policy using PPO.
opportunities for deep learning
Early-to-Mid Twentieth-Century Korean Periodicals
Deep Learning Project at the National Library of Korea

89,981 images

1,009 rare (kwijungbon) periodical issues

932 colophons identified & transcribed automatically

1910

1960
發行所 韓養浩 三明社
印刷所 韓養浩 三明社
發行所 三明社

訂購方法:

發行所:

電話:

郵政:

地址:

書店:

編輯部:

發行部:

印刷部:

廣告部:

財務部:

法律部:

總務部:

人事部:

會計部:

秘書部:

資料部:

發行部:

廣告部:

編輯部:

印刷部:

財務部:

總務部:

人事部:

會計部:

秘書部:

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發行部:

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財務部:

總務部:

人事部:

會計部:
Segmentation Model

Features

meaningful element

target

4 3 4
2 4 3
2 3 4
<table>
<thead>
<tr>
<th>Features</th>
<th>target labels for meaningful elements</th>
</tr>
</thead>
</table>

Classification Model
Model 2
(Avg. accuracy 78.6%)

Model 3
(Avg. accuracy 92.7%)

Model 4
(Avg. accuracy 95%)

Accuracy of Transcriptions of Colophons
1년:相 印刷
2치：遄
年二月發
定價傘
賞費
京兼啣
三番地
著作
發 行 者 丁 元
京坡府薌
發 行 所 侍天敎報社
印刷者鄭 敬 德
印刷所 朝鮮福
13
12
11
10
9
8
7
6
5
4
3
2
1

Section Model
Segmentation Model
Classification Model
Inswaeso responsible for producing 932 periodical issues.
Newly built Hansŏng Tosŏ Chusik Hoesa building, *Haksannggye* (December 1920), unnumbered front matter (image from microfilm at the NLK).
Type samples from materials printed by Hansŏng Tosŏ Chusik Hoesa

Type samples from page 101 of the May 1921 issue of Haksanggye (top left), page 78 of the August 1922 issue of Chunghak Kangŭirok (top right), page 72 of the June 1935 issue of Ch'ŏrhak (bottom left), and page 157 of the November 1937 issue of Yadam (bottom right).

Source: Han Chae-jun, ed., Han'gŭl kŭlkkol yongŏ sajŏn (A dictionary of typographic terms for han'gŭl) (Seoul: Sejong Taewang Kinyŏm Saŏphoe, 2000), 46.
세계를 한 집으로 보고 사해를 한 형제로 본다고 말이 갓고 풍속이 갓고 역사가 갓고 이해가 가른 한 민족은 더욱이나 한 집안 한 형제로 보게 될 것입니다. 설사 하는 일은 세계 전체를 표준화한다 할지라도 세계가 하로 어 куд에 한 집안 한 형제가 되어가지고 세계 전체의 일을 할 수가 입고 민족과 민족이 어울려져 내 일도 전체의 일이오 내 일도 전체의 일이라 하는데서 其實 사해 형제의 본의가 실현될 줄로 생각합니다. 그것은 오랫동안 관계를 가져온 한 민족이 스스로 어울리지기 쉽고 관계맺기 쉬울 경우에 일하는 까닭이 안이겠습니까. 이 점에서 한 가지로 우리 朝鮮 동포라 하면 그 하는 일의 표준을 세계적이거나 민족적이거나를 물론하고 스스로 동포와 동포가 손목을 잡고 일터에 나아가게 되는 것입니다. 더욱이 그 민족의 일을 그 민족이 자진하야 하지 안이하면 즉 자기의 맛튼 일을...
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第一册

插图：观音菩萨像、大乘佛教寺庙建筑

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Mo文oN is an authoring tool for AI solutions
Mo文oN enables experts to quickly curate big data
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solutions
A Few Examples,
Books of Korean Poetry
AI solutions for text encoding, an example
Drag and Drop images of a rare book into interface
Quickly segment and label text
Use labeled images to build a custom AI solution for encoding similar rare texts, with just a few clicks.
Use custom AI solution to label and encode similar text
Use custom AI solution to label and encode similar text
Export encoded text and related metadata to enable additional search and analysis.
Some additional experiments,
AI solutions for indexing, searching, and analyzing images, an example
Drag and Drop image of Ajanta Cave into interface
Quickly segment and label portions of the image, the Buddha sitting in lotus position for example
Use labeled segments to build a **custom** AI solution for identifying similar visual elements in an image, with just a few clicks.
Use custom AI solution to segment and tag similar elements in the image of Ajanta Cave.
Use the same custom AI solution to search, segment, and label related images, here a picture of the façade of Ajanta Cave XX from 1865.
Export labeled images, segments, and related metadata from growing database of images and labels to empower additional forms of search and analysis.
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Wayne de Fremery
Dominican University of California