Deriving Consensus for Multi-Parallel Corpora: An English Bible Study

Patrick Xia      David Yarowsky

code, resources, slides: www.github.com/pitrack/monolign
Deriving Consensus for Multi-Parallel Corpora: An English Bible Study
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Bitext
Deriving Consensus for Multi-Parallel Corpora: An English Bible Study

Bitext

I like Taipei
Deriving Consensus for Multi-Parallel Corpora: An English Bible Study

Bitext

I like Taipei
我喜欢台北
Deriving Consensus for Multi-Parallel Corpora: An English Bible Study

Bitext

I like Taipei
我喜歡台北
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Bitext

N:1sg V N:Loc

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Multi-parallel corpora
I like Taiwan

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<tr>
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<td>喜欢</td>
<td>台北</td>
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</tbody>
</table>

Multi-parallel corpora

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Multi-parallel corpora

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N:1sg  V  N:Loc
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Deriving Consensus for **Multi-Parallel Corpora**: An English Bible Study

**Bi-Text**

N:1sg  V  N:Loc

I like Taipei

我 喜欢 台北

N:1sg  V  N:Loc

I love Taipei

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我♡ 台北
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"Tag Projection"
Deriving Consensus for Multi-Parallel Corpora: An English Bible Study

(Mayer and Cysouw, 2014)
Deriving Consensus for Multi-Parallel Corpora: An English Bible Study

- 800+ languages, verse-aligned
  - 27 English versions (New Testament)

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• 800+ languages, verse-aligned
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• Improved English consensus → improved low-resource tag projection from a common source

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Deriving Consensus for Multi-Parallel Corpora: An English Bible Study

- 800+ languages, verse-aligned
  - 27 English versions (New Testament)
- Improved English consensus → improved low-resource tag projection from a common source

Examples:

New Simplified: Then Herod secretly called the astrologers ...
Montgomery: Thereupon Herod sent secretly for the Magi ...
Lexham: Then Herod secretly summoned the wise men ...

(Mayer and Cysouw, 2014)
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Deriving Consensus for Multi-Parallel Corpora: An English Bible Study

New Simplified:  Then Herod secretly called the astrologers ...

Montgomery:    Thereupon Herod sent secretly for the Magi ...

Lexham        Then Herod secretly summoned the wise men ...

Where do these go if the goal is:  Paraphrases?  Tag projection?
Thereupon Herod sent secretly for the Magi...

Which one would a low-resource Bible likely choose?

Where do these go if the goal is: Paraphrases? Tag projection?
Deriving a Consensus

1. Creating a candidate matching
2. Corpus Matchings
3. Consensus + Resources

New Simplified: Then Herod secretly called the astrologers ...
Montgomery: Thereupon Herod sent secretly for the Magi ...
Lexham: Then Herod secretly summoned the wise men ...
Creating a candidate matching

• Randomly select first document

New Simplified:

Then Herod secretly called the astrologers
Creating a candidate matching

- Randomly select first document

New Simplified:

Then Herod secretly called the astrologers

RB NNP RB VBD DT NNS
Creating a candidate matching

• Initialize matching

Matching:

Then | Herod | secretly | called | the | astrologers
RB   | NNP   | RB      | VBD    | DT  | NNS
Creating a candidate matching

• Initialize matching

Matching:

Then  Herod  secretly  called  the  astrologers
RB    NNP     RB        VBD      DT      NNS
Creating a candidate matching

- For each document, score possible edges

Matching:

- Then
- Herod
- secretly
- called
- the
- astrologers

RB  NNP  RB  VBD  DT  NNS

Montgomery:

Thereupon Herod sent secretly for the Magi

Score: 0
Creating a candidate matching

• For each document, score possible edges

Matching:

Then: RB
Herod: NNP
secretly: RB
called: VBD
the: DT
astrologers: NNS

Montgomery:

RB
NNP
VBD
RB
IN
DT
NNS

Thereupon Herod sent secretly for the Magi

New Simplified
Montgomery
Score: 0
Creating a candidate matching

• For each document, score possible edges

Matching:

Then  Herod  secretly  called  the  astrologers
RB   NNP   RB   VBD   DT   NNS

Montgomery:

RB   NNP   VBD   RB   IN   DT   NNS
Thereupon Herod sent secretly for the Magi

Score: 0
Creating a candidate matching

- For each document, score possible edges

Matching:

Montgomery:

New Simplified → Montgomery
Score: 0
Creating a candidate matching

• Take maximum weight matching

Matching:

Montgomery:

Thereupon Herod sent secretly for the Magi

New Simplified → Montgomery
Score: 0
Creating a candidate matching

- Take maximum weight matching

Matching:

Montgomery:
Creating a candidate matching

• Merge

Matching:

Then, Thereupon  Herod  secretly  called, sent  for  the  astrologers, Magi

RB  NNP  RB  VBD  IN  DT  NNS
Creating a candidate matching

• Merge

Matching:

Then, Thereupon  Herod  secretly  called, sent  for  the  astrologers, Magi

RB  NNP  RB  VBD  IN  DT  NNS

New Simplified Montgomery

Score: 20
Creating a candidate matching

- Repeat for each document

Matching:

Lexham:

Then Herod secretly summoned the wise men

New Simplified Montgomery → Lexham
Score: 20
Creating a candidate matching

• Repeat for each document

Matching:

Then, Thereupon NNP
Herod NNP
secretly RB
called, sent VBD
for IN
the DT
astrologers, Magi NNS

Lexham:

RB Then NNP Herod NNP
secretly RB summoned VBD
the DT
wise JJ
men NNS

New Simplified
Montgomery → Lexham
Score: 20
Creating a candidate matching

• Repeat for each document

Matching:

Lexham:

- Then, Thereupon
- Herod
- secretly
- called, sent
- for
- the
- astrologers, Magi

New Simplified Montgomery → Lexham
Score: 20
Creating a candidate matching

• Repeat for each document

Matching:

Then, Thereupon  Herod  secretly  called, sent  for  the  astrologers, Magi

Then, Thereupon  Herod  secretly  called, sent  for  the  astrologers, Magi

Lexham:

Then  Herod  secretly  summoned  the  wise  men

New Simplified Montgomery → Lexham

Score: 20
Creating a candidate matching

• Repeat for each document

Matching:

Lexham:

New Simplified Montgomery → Lexham
Score: 20
Creating a candidate matching

Matching:

Then, Thereupon  Herod  secretly  called, sent, summoned  for  the  wise  astrologers, Magi, men

RB  NNP  RB  VBD  IN  DT  JJ  NNS

New Simplified Montgomery Lexham
Score: 40
Deriving a Consensus

1. Creating a candidate matching
2. Corpus Matchings
3. Consensus + Resources

New Simplified
Montgomery
Lexham
Score: 40
Corpus Matchings
Corpus Matchings

• Run for N=10 iterations
  • Rescore edge weights
    • Re-align bitexts with inferred word lists
  • Randomization of document order
Corpus Matchings

• Run for N=10 iterations
  • Rescore edge weights
    • Re-align bitexts with inferred word lists
  • Randomization of document order

Iteration 1

New Simplified
Montgomery
Lexham

Score: 40
Corpus Matchings

• Run for N=10 iterations
  • Rescore edge weights
    • Re-align bitexts with inferred word lists
  • Randomization of document order

Iteration 1
New Simplified
Montgomery
Lexham
Score: 40

Iteration 2
New Simplified
Lexham
Montgomery
Score: 45
Corpus Matchings

• Run for N=10 iterations
  • Rescore edge weights
    • Re-align bitexts with inferred word lists
  • Randomization of document order

Iteration 1
New Simplified
Montgomery
Lexham
Score: 40

Iteration 2
New Simplified
Lexham
Montgomery
Score: 45

Iteration 3
Lexham
Montgomery
New Simplified
Score: 38
Corpus Matchings

- Run for N=10 iterations
  - Rescore edge weights
    - Re-align bitexts with inferred word lists
  - Randomization of document order

<table>
<thead>
<tr>
<th>Iteration</th>
<th>Language Pair</th>
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<tbody>
<tr>
<td>1</td>
<td>New Simplified Montgomery, Lexham</td>
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<tr>
<td>2</td>
<td>New Simplified Lexham, Montgomery</td>
<td>45</td>
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<td>3</td>
<td>Lexham, Montgomery, New Simplified</td>
<td>38</td>
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<td>4</td>
<td>Lexham, New Simplified Montgomery</td>
<td>42</td>
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Corpus Matchings

• Run for N=10 iterations
  • Rescore edge weights
    • Re-align bitexts with inferred word lists
  • Randomization of document order

• For each verse, keep the maximum weight matching

<table>
<thead>
<tr>
<th>Iteration 1</th>
<th>Iteration 2</th>
<th>Iteration 3</th>
<th>Iteration 4</th>
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<tr>
<td>New Simplified</td>
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<td>Lexham</td>
<td>Lexham</td>
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<tr>
<td>Montgomery</td>
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<td>Montgomery</td>
<td>New Simplified</td>
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<tr>
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<td>Montgomery</td>
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<tr>
<td>Score: 40</td>
<td>Score: 45</td>
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<td>Score: 42</td>
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</tbody>
</table>
Corpus Matchings

- Run for N=10 iterations
  - Rescore edge weights
    - Re-align bitexts with inferred word lists
  - Randomization of document order
- For each verse, keep the maximum weight matching
Then, Thereupon, first

Herod, Herodes

secretly, privately
called, sent, summoned

for the wise

astrologers, Magi, men, Magians, magi

RB NNP RB VBD IN DT JJ NNS
A Bible in a low-resource language can align or project to a single matching instead of several different versions.
Deriving a Consensus

1. Creating a candidate matching
2. Corpus Matching
3. Consensus + Resources
• Another format:

<table>
<thead>
<tr>
<th>worldwide</th>
<th>newsimplified</th>
<th>montgomery</th>
<th>etheridge</th>
<th>godword</th>
<th>majority</th>
<th>lexham</th>
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<th>contemporary</th>
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<td>magi</td>
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Consensus + Resources

• Another format:

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**Consensus + Resources**

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<table>
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**Consensus + Resources**

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<td></td>
<td>wise</td>
<td></td>
</tr>
<tr>
<td>men</td>
<td>astrologers</td>
<td>Magi</td>
<td>Magians</td>
<td>men</td>
<td>men</td>
<td>men</td>
<td>Magi</td>
<td>men</td>
</tr>
</tbody>
</table>
Then Herod, secretly called for the wise men.
Consensus + Resources

Consensus POS and dependency parses reinforce annotations
Consensus + Resources

Consensus POS and dependency parses reinforce annotations

• Softer Consensus Tags
Consensus POS and dependency parses reinforce annotations

- Softer Consensus Tags
- POS:
  - “TIME”: Sg. Noun (1.00) → Sg. Noun (0.94), Pl. Noun (0.05) ...
  - “SECRET”: Sg. Noun (0.54), Adj (0.46) → Adj (0.51), Sg. Noun (0.47) ...
Consensus + Resources

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- Lexical Heads:
  - “SECRET”: in (0.28), is (0.06), kept (0.04) ... → in (0.32), place (0.05), mystery (0.04)
Consensus + Resources

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  • “SECRET”: in (0.28), is (0.06), kept (0.04) ... → in (0.32), place (0.05), mystery (0.04)...

Paraphrase Discovery

• “SECRET”: secret (0.59), mystery (0.19), private (0.04) ...
Consensus + Resources
Consensus + Resources

Richer exploration and analysis of text meaning
Richer exploration and analysis of text meaning

- Translator/author variation:
  - “HYMENAEUS”: Hymenaues (0.82), Hymenius (0.04), Hymeneus (0.04), Humenaios (0.04)
  - ...
Richer exploration and analysis of text meaning

- Translator/author variation:
  - “HYMENAEUS”: Hymenaues (0.82), Hymenius (0.04), Hymeneus (0.04), Humenaios (0.04)
- Historical language usage:
  - “BLAZES”: burns (0.48), burning (0.33), burneth (0.10), blazes (0.04)
Consensus + Resources

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Consensus + Resources

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Can shed insight into textual or theological debates
Deriving a Consensus
Deriving a Consensus

1. Creating a candidate matching
Deriving a Consensus

1. Creating a candidate matching
2. Corpus Matching
Deriving a Consensus

1. Creating a candidate matching
2. Corpus Matching
3. Consensus + Resources
Deriving a Consensus

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What’s next?
Deriving a Consensus

1. Creating a candidate matching
2. Corpus Matching
3. Consensus + Resources

What’s next?

Up to you! Code/resources/slides available at
Deriving a Consensus

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www.github.com/pitrack/monolign
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Thank You!