Bridging the Linguistic Divide: Developing a North-South Korean Parallel Corpus for Machine Translation

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Introduction

[4]

- **Division of Korea □ Differences between North and South Korean Languages**
  - **Everyday** North Korean **terms** differ by **38%** from those used in South Korea, while **technical terms** differ by **66%**[1]
  - **29.8%** of **North Korean defectors** need **4 to 5 years** to speak and write like South Koreans, while **51%** need **more than 6 years**[2]
- **Studies** focusing on **machine translation between North and South Korean are rare due to the scarcity of a North-South Korean parallel corpus**[3]

[5]

	Shampoo	Friend
	샴푸 (Shampu)	친구 (Chingu)
	머리물비누 (Meorimulbinu)	동무 (Dongmu)

[1] "Serious language difference between North and South Korea 38% difference for everyday language, 66% for specialized language", SBS news, 2016.
[2] "2016 Survey on Language Awareness of North and South Korea", 국립국어원, 2016.
[3] Hwichan Kim et al., "Zero-shot North Korean to English Neural Machine Translation by Character Tokenization and Phoneme Decomposition", Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics, 2020.
[4] "South&North Korea map"
[5] "Crossing Divides: Two Koreas divided by a fractured language", BBC news, 2019.

Related Works

1. ***North Korean Neural Machine Translation through South Korean Resources*** [1]
   - **North Korean→English**, **North Korean→Japanese machine translation** experiments conducted
   - From **a North Korean news portal**, *Uriminzokkiri*, **news articles** published in **North Korean** and translated into **English** and **Japanese** were aligned to create a total of **5,000 North Korean–English** sentence pairs and a total of **4,700 North Korean–Japanese** sentence pairs

[1] Hwichan Kim et al., "North Korean Neural Machine Translation through South Korean Resources", ACM Transactions on Asian and Low-Resource Language Information Processing, 2023.

Related Works

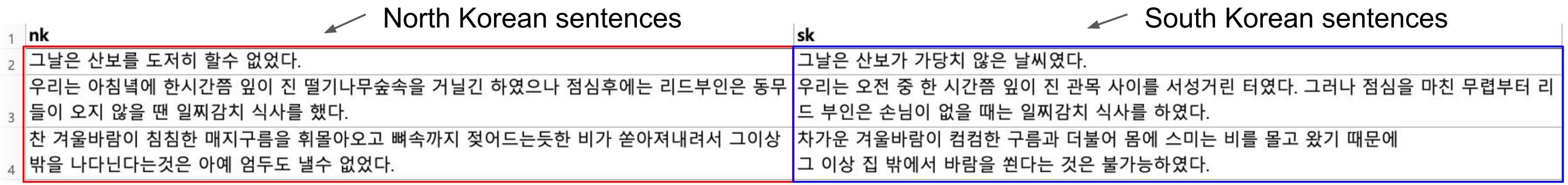
2. *Neural machine translation using south korean-north korean parallel corpus* [1]

- From **Korean Parallel Data,**[2] **"South Korean-English", "North Korean-English" news data** were aligned to create a total of 3,000 **"South Korean-North Korean" sentence pairs**
- Due to the **small size** of the **training data**, only **a few linguistic differences** were observed in the **dataset** and the translation results

[1] Hoyoon Choi et al., "Neural Machine Translation using South Korean-North Korean Parallel Corpus", *Proceedings of Korea Multimedia Society Conference*, 2022.
[2] Jungyeul Park et al., "Korean Language Resources for Everyone", In Proceedings of the 30th Pacific Asia Conference on Language, Information and Computation, 2016.

Contributions

- **Construct a North-South Korean parallel corpus using the North and South Korean versions of the Bible, Classic Novels, and Korean Folk Tales**
- Release the North-South Korean parallel corpus for further research
- Prove the efficacy of the North-South Korean parallel corpus by developing and evaluating a North-South Korean bidirectional translation model

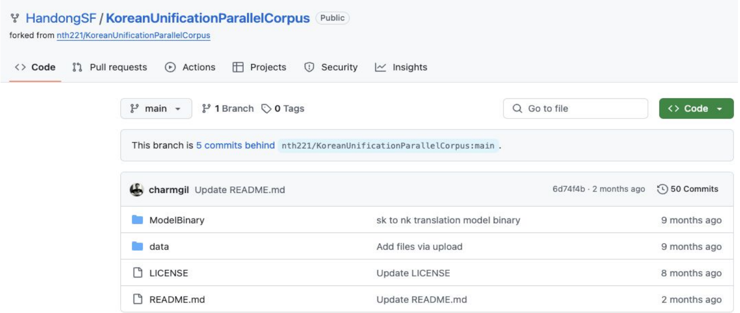


1	nk	sk
2	그날은 산보를 도저히 할수 없었다.	그날은 산보가 가당치 않은 날씨였다.
3	우리는 아침녘에 한시간쯤 잎이 진 떨기나무숲속을 거닐긴 하였으나 점심후에는 리드부인은 동무들이 오지 않을 땐 일찌감치 식사를 했다.	우리는 오전 중 한 시간쯤 잎이 진 관목 사이를 서성거린 터였다. 그러나 점심을 마친 무렵부터 리드 부인은 손님이 없을 때는 일찌감치 식사를 하였다.
4	찬 겨울바람이 침침한 매지구름을 휘몰아오고 뼈속까지 젖어드는듯한 비가 쏟아져내려서 그이상 밖을 나다닌다는것은 아예 엄두도 낼수 없었다.	차가운 겨울바람이 컴컴한 구름과 더불어 몸에 스미는 비를 몰고 왔기 때문에 그 이상 집 밖에서 바람을 쐰다는 것은 불가능하였다.

an example of the sentence pairs in the North-South Korean Parallel Corpus

Contributions

- Construct a North-South Korean parallel corpus using the North and South Korean versions of the Bible, Classic Novels, and Korean Folk Tales
- **Release the North-South Korean parallel corpus for further research**
- Prove the efficacy of the North-South Korean parallel corpus by developing and evaluating a North-South Korean bidirectional translation model



HandongSF / KoreanUnificationParallelCorpus

forked from nth221/KoreanUnificationParallelCorpus

This branch is 5 commits behind `nth221/KoreanUnificationParallelCorpus:main` .

charmgil Update README.md 6d74f4b · 2 months ago 50 Commits

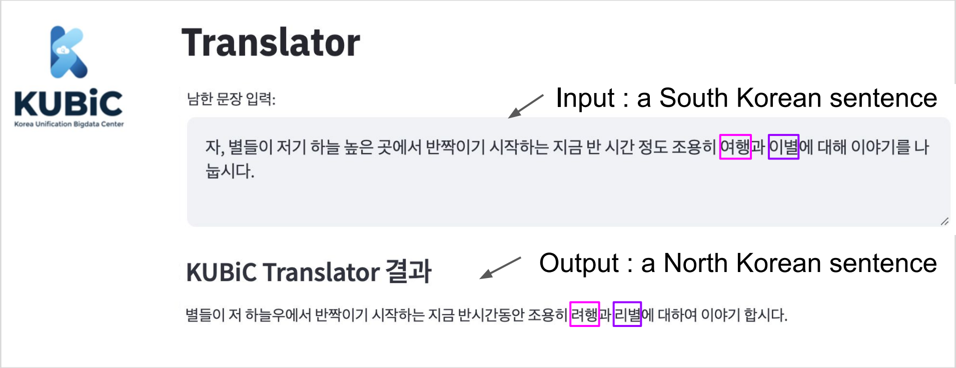
ModelBinary	sk to nk translation model binary	9 months ago
data	Add files via upload	9 months ago
LICENSE	Update LICENSE	8 months ago
README.md	Update README.md	2 months ago

the North-South Korean Parallel Corpus published to Github

https://github.com/HandongSF/KoreanUnificationParallelCorpus

Contributions

- Construct a North-South Korean parallel corpus using the North and South Korean versions of the Bible, Classic Novels, and Korean Folk Tales
- Release the North-South Korean parallel corpus for further research
- **Prove the efficacy of the North-South Korean parallel corpus by developing and evaluating a North-South Korean bidirectional translation model**



Translator

남한 문장 입력:

Input : a South Korean sentence

자, 별들이 저기 하늘 높은 곳에서 반짝이기 시작하는 지금 반 시간 정도 조용히 여행과 이별에 대해 이야기를 나눕시다.

KUBiC Translator 결과

Output : a North Korean sentence

별들이 저 하늘우에서 반짝이기 시작하는 지금 반시간동안 조용히 려행과 리별에 대하여 이야기 합시다.

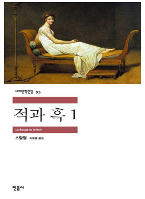
an example translation output of the SK → NK model

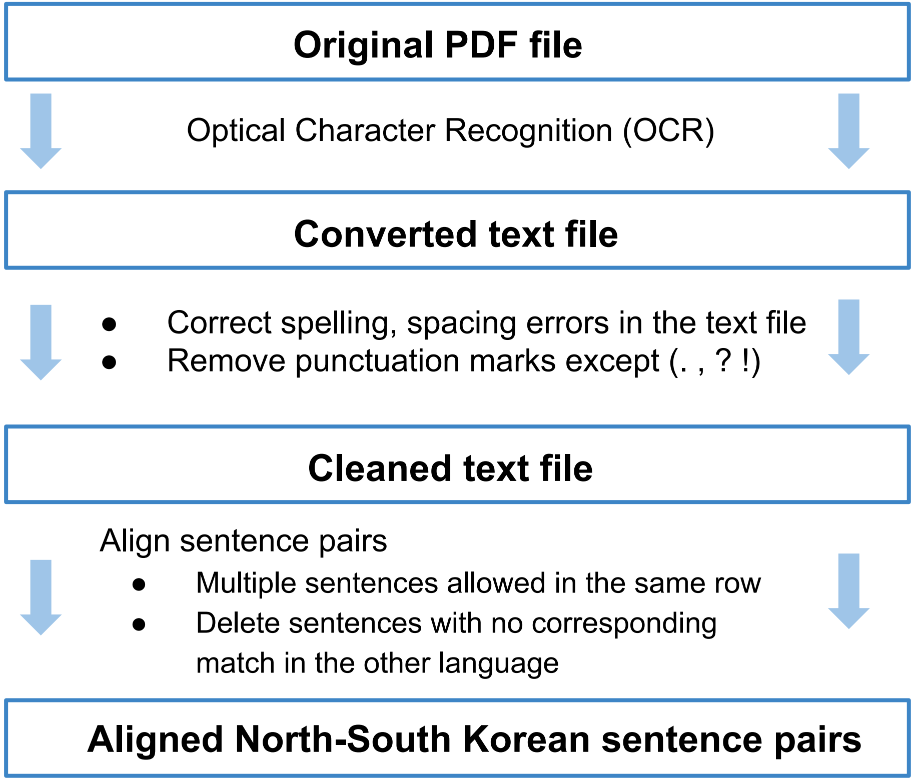
North-South Korean Parallel Corpus

North – South Korean Parallel Corpus Construction

Information Center on North Korea operated by the *Ministry of Unification* in South Korea

- English Classic Novel
- French Classic Novel
- Korean Folk Tales





Original PDF file

Optical Character Recognition (OCR)

Converted text file

- Correct spelling, spacing errors in the text file
- Remove punctuation marks except (. , ? !)

Cleaned text file

Align sentence pairs

- Multiple sentences allowed in the same row
- Delete sentences with no corresponding match in the other language

Aligned North-South Korean sentence pairs

North Korean Science and Technology Network of the *Korea Institute of Science and Technology Information*

- Bible

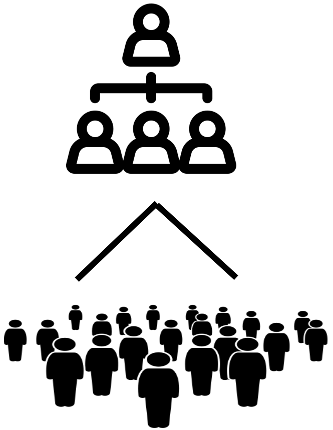
구약전서

신약전서

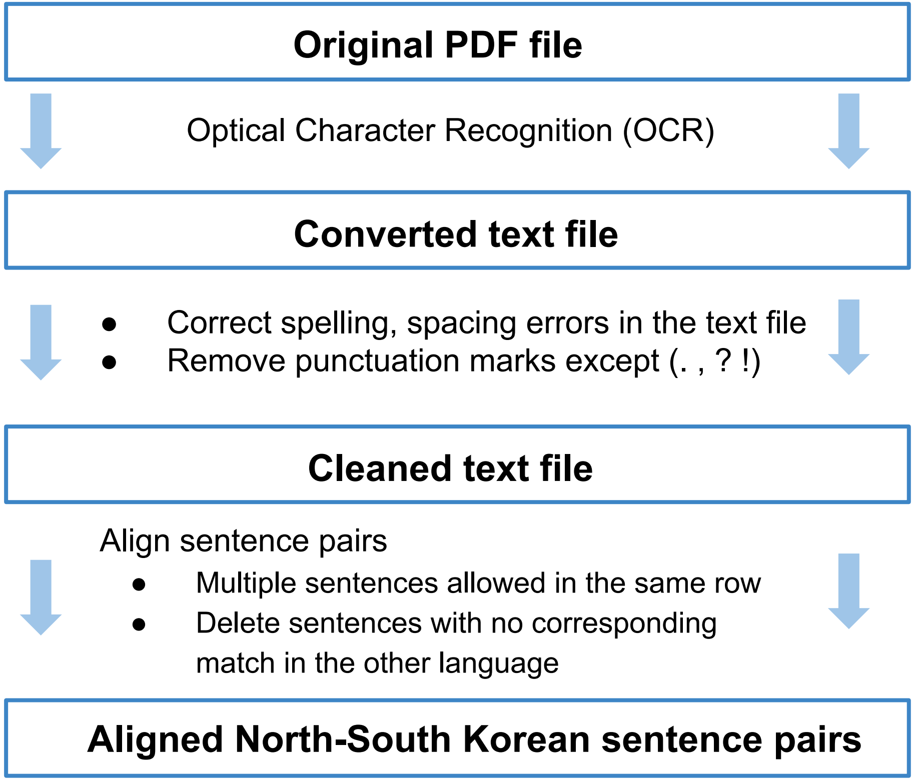
North-South Korean Parallel Corpus

North – South Korean Parallel Corpus Construction

Project Leaders



Twenty student workers



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Optical Character Recognition (OCR)

Converted text file

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Cleaned text file

Align sentence pairs

- Multiple sentences allowed in the same row
- Delete sentences with no corresponding match in the other language

Aligned North-South Korean sentence pairs

- Studied **linguistic differences** between the **North and South Korean** languages to **reduce errors** in the North Korean text
- Each part **reviewed twice** by different students to **reduce individual bias**

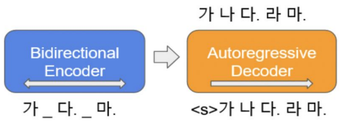
North-South Korean Parallel Corpus

North-South Korean Parallel Corpus

Resource	Title	Sentence Pairs	Total Sentence Pairs
English Classic Novel (translated version)	Jane Eyre	60,331	94,459 (72%)
French Classic Novel (translated version)	The Red and the Black	34,128	
Korean Folk Tales	Onggojip-jeon (옹고집전)	988	6,293 (5%)
	Sukhyang-jeon (숙향전)	3,538	
	Shimchung-jeon(심청전)	1,767	
Bible (translated version)	-	-	29,986 (23%)
-	-	-	130,738 (100%)

Foundation Model : KoBART

- **BART[1] (Bidirectional and Auto-Regressive Transformers)**
  - **BERT[2]**'s **bidirectional encoder** and **GPT[3]**'s **autoregressive decoder combined**
  - Denoising autoencoder that learns to map corrupted sentences to their original forms
  - Achieved high performance in various text generation task



[4]

- **KoBART[4] (South Korean BART)**
  - **BART trai**ned on approximately **40GB** of **South Korean texts** using **text infilling**
  - **Fine-tuning KoBART** with **North Korean texts** attained **high performance "North Korean-Japanese"** and **"North Korean-English"** machine translation[5]

[1] Mike Lewis et al., "BART: Denoising Sequence-to-Sequence Pre-training for Natural Language Generation, Translation, and Comprehension", Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics, 2020.
[2] Jacob Devlin et al., "BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding", Proceedings of the 2019 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, 2019.
[3] Gokul Yenduri et al., "Generative Pre-trained Transformer: A Comprehensive Review on Enabling Technologies, Potential Applications, Emerging Challenges, and Future Directions", IEEE Access, 2024.
[4] https://github.com/SKT-AI/KoBART
[5] Hwichan Kim et al., "North Korean Neural Machine Translation through South Korean Resources", ACM Transactions on Asian and Low-Resource Language Information Processing, 2023.

Quantitative Analysis

- **BLEU (Bilingual Evaluation Understudy) Score**[1]

  Calculates the **surface-form similarity** between the candidate and reference texts using **n-gram overlap**, with scores ranging from 0 to 1

Model	BLEU Score
NK → SK	0.442
SK → NK	0.107

  The reason behind the higher score of the NK → SK model

  - **NK → SK** model
    - ❑ The South Korean sentences were drawn from **various publishers for each resource**
    - ❑ There were at least **one** and at most **four reference** sentence (**multiple correct answers**) to compare with the translation output
  - **SK → NK** model
    - ❑ The North Korean sentences were drawn from **one publisher for each resource**
    - ❑ There was **only one reference** sentence (**one correct answer**) to compare with the translation output

[1] Kishore Papineni et al., "Bleu: a method for automatic evaluation of machine translation", Proceedings of the 40th annual meeting of the Association for Computational Linguistics, 2002.

Quantitative Analysis

- **BERT Score**[1]

  Calculates the **semantic-similarity** between candidate and reference texts using the **contextual embeddings** of BERT, with scores ranging from 0 to 1

  Effective for **paraphrase detection** and capturing **dependencies** of **unbounded length**

  - The **NK → SK** and **SK → NK model** all achieved a **high** score
  - **No significant performance difference** between the models regarding semantic similarity

Model	BLEU Score	**BERT Score**
NK → SK	0.442	**0.821**
SK → NK	0.107	**0.815**

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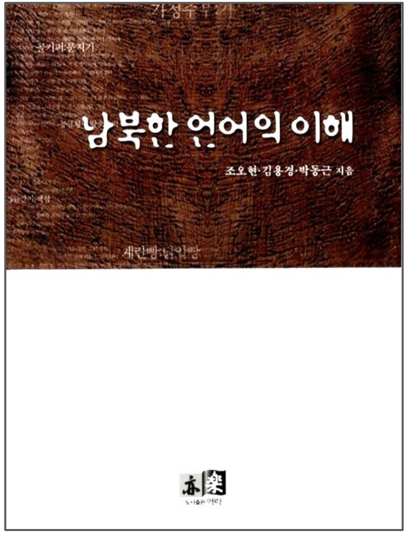
[1] Tianyi Zhang et al., "BertScore: Evaluating Text Generation with BERT", 8th International Conference on Learning Representations, 2020.

Qualitative Analysis

- *Understanding the Languages of North and South Korea*[1]
  - ➢ Ch.2 : **Orthographic** differences (**spelling , word spacing**)
  - ➢ Ch.3 : **Vocabulary** difference



[1] Ohyeon Cho et al., “Understanding the Languages of North and South Korea”, Youkrack, 2002.

Qualitative Analysis

- **Vocabulary difference between North and South Korean**
    - **Loanwords**
- **Spelling difference between North and South Korean**
    - Initial sound rule
    - The addition of “ㅅ” into a compound word
    - **Endings of a word “-아/-어” based on the final syllable vowel of the stem**
- **Word spacing difference between North and South Korean**
    - **Spacing of dependent nouns and particles**
    - Spacing between main and auxiliary predicate elements

Vocabulary difference between North and South Korea

North Korea and South Korea often use **different words to refer to the same meaning**

1) Be something that everyone is interested in and talking about

『North Korean』**말밥에 오르다** (mal-bab-e o-leu-da) = 『South Korean』**화제에 오르다** (hwa-je-e o-leu-da)

Input Sentence (**NK**) →	Translation Output (**SK**)
탁자우의 나의 명함이 나의 이름을 (tag-ja-u-ui na-ui myeong-ham-i na-ui i-leum-eul) **말밥에 올리는**것이였소. (**mal-bab-e ol-li-neun**-geos-i-yeoss-so.)	테이블 위의 내 명함이 내 이름을 (te-i-beul wi-ui nae myeong-ham-i nae i-leum-eul) **화제에 올려**놓았소. (**hwa-je-e ol-lyeo**-noh-ass-so.)
A card of mine lay on the table; this being perceived, **brought my name under discussion.**	

Vocabulary difference between North and South Korea

North Korea uses **less foreign loanwords** than South Korea

1) Curtain

『North Korean』**창가림** (chang-ga-lim) = 『South Korean』**커튼** (keo-teun)

Input Sentence (**NK**) →	Translation Output (**SK**)
그래 열린 창문으로 손을 디밀어 **창가림**을 치고 (geu-lae yeol-lin chang-mun-eu-lo son-eul di-mil-eo **chang-ga-lim**-eul chi-go) 안을 들여다볼수 있을만큼 틈새를 남겨 놓았소. (an-eul deul-yeo-da-bol-su iss-eul-man-keum teum-sae-leul nam-gyeo noh-ass-so.)	열린 창문으로 손을 집어넣어 **커튼**을 젖히고 (yeol-lin chang-mun-eu-lo son-eul jib-eo-neoh-eo **keo-teun**-eul jeoj-hi-go) 안을 들여다볼 수 있을 만큼만 틈을 남겨 놓았소. (an-eul deul-yeo-da-bol su iss-eul man-keum-man teum-eul nam-gyeo noh-ass-so.)
So putting my hand in through the open window, I drew the **curtain** over it, leaving only an opening through which I could take observations.	

Vocabulary difference between North and South Korea

North Korea uses **less foreign loanwords** than South Korea

1) Curtain

『North Korean』 **창가림** (chang-ga-lim) = 『South Korean』 **커튼** (keo-teun)

Input Sentence (**SK**) →	Translation Output (**NK**)
그러고는 열려 있는 창문 틈으로 손을 넣어서 창문 위로 (geu-leo-go-neun yeol-lyeo iss-neun chang-mun teum-eu-lo son-eul neoh-eo-seo chang-mun wi-lo) **커튼**을 치고 안을 살펴볼 수 있을 만큼만 공간을 남겨 두었소. (**keo-teun**-eul chi-go an-eul deul-yeo-da-bol-su iss-eul-man-keum teum-sae-leul nam-gyeo noh-ass-so.)	그리고는 열려있는 창문틈으로 손을 집어넣어 창문에 (geu-li-go-neun yeol-lyeo-iss-neun chang-mun-teum-eu-lo son-eul jib-eo-neoh-eo chang-mun-e) **창가림**을 치고 안을 들여다보게 하였다. (**chang-ga-lim**-eul chi-go an-eul deul-yeo-da-bo-ge ha-yeoss-da.)
So putting my hand in through the open window, I drew the **curtain** over it, leaving only an opening through which I could take observations.	

Spelling difference between North and South Korea

Endings of a word “-아/-어” based on the final syllable vowel of the stem

North Korean	South Korean
When the **final syllable vowel** of the stem is “ㅣ, ㅐ, ㅔ, ㅚ, ㅟ, ㅢ” and “하” the **ending** of a word is written as **“-여/-였.”**	When the **final syllable vowel** of the stem is “ㅏ, ㅗ,” the **ending** of the word is written as **“-아.”** If not, the **ending** of the word is written as **“-어.”**
e.g., 헤여지다 (he-yeo-ji-da)	e.g., 헤어지다 (he-eo-ji-da)

Spelling difference between North and South Korea

Endings of a word “-아/-어” based on the final syllable vowel of the stem

1) To break off a relationship with someone
『North Korean』헤여지다 (he-yeo-ji-da) = 『South Korean』헤어지다 (he-eo-ji-da)

Input Sentence (**NK**) →	Translation Output (**SK**)
그래 나는 상당한 돈을 주고 적당한 일자리를 얻어준 (geu-lae na-neun sang-dang-han don-eul ju-go jeog-dang-han il-ja-li-leul eod-eo-jun) 다음에 체면을 유지하며 기꺼이 **헤여**졌소. (da-eum-e che-myeon-eul yu-ji-ha-myeo gi-kkeo-i **he-yeo-**jyeoss-so.)	그래서 상당한 돈을 주고 적당한 일자리를 얻어 준 (geu-lae-seo sang-dang-han don-eul ju-go jeog-dang-han il-ja-li-leul eod-eo jun) 다음부터 나는 체면을 되찾고 기꺼이 **헤어**졌소. (da-eum-bu-teo na-neun che-myeon-eul doe-chaj-go gi-kkeo-i **he-eo**-jyeoss-so.)
I was glad to give her a sufficient sum to set her up in a good line of business, and so **get decently rid of her.**	

Spelling difference between North and South Korea

Endings of a word “-아/-어” based on the final syllable vowel of the stem

1) To break off a relationship with someone
『North Korean』헤여지다 (he-yeo-ji-da) = 『South Korean』헤어지다 (he-eo-ji-da)

Input Sentence (**SK**) →	Translation Output (**NK**)
결국 충분한 돈을 주어 장사를 시작하게 해주고, (gyeol-gug chung-bun-han don-eul ju-eo jang-sa-leul si-jag-ha-ge hae-ju-go,) 깨끗이 **헤어**지고 나니 마음이 후련했소. (kkae-kkeus-i **he-eo**-ji-go na-ni ma-eum-i hu-lyeon-haess-so.)	마침내 저에게 충분한 돈을 지불하고 (ma-chim-nae jeo-e-ge chung-bun-han don-eul ji-bul-ha-go) 그와 **헤여**져 있게 되자 나는 무척 안도감을 느꼈소. (geu-wa **he-yeo**-jyeo iss-ge doe-ja na-neun mu-cheog an-do-gam-eul neu-kkyeoss-so.)
I was glad to give her a sufficient sum to set her up in a good line of business, and so **get decently rid of her.**	

Word Spacing difference between North and South Korea

Spacing of dependent nouns and particles

North Korean	South Korean
Dependent noun **Attach**ed to the preceding verb or adjective stem	**Dependent noun** **Separate**d from the preceding verb or adjective stem
e.g. 없을**만큼** (eobs-eul-**man-keum**)	e.g. 없을 **만큼** (eobs-eul-**man-keum**)
Particles **Attach**ed to the preceding noun	**Particles** **Attach**ed to the preceding noun
e.g. 그녀**만큼** (geu-nyeo-man-keum)	e.g. 그녀**만큼** (geu-nyeo-**man-keum**)

Word Spacing difference between North and South Korea

Spacing of dependent nouns and particles

1) Dependent noun

『North Korean』 없을**만큼** (eobs-eul-man-keum) = 『South Korean』 없을 **만큼** (eobs-eul-man-keum)

Input Sentence (**NK**) →	Translation Output (**SK**)
그 옷은 세상의 어떤 빨래하는 사람도 그보다 더 희게 (geu os-eun se-sang-ui eo-tteon ppal-lae-ha-neun sa-lam-do geu-bo-da deo hui-ge) 할수 없을**만큼** 새하얗고 눈부시게 빛났다. (hal-su eobs-eul-**man-keum** sae-ha-yah-go nun-bu-si-ge bich-nass-da.)	그 옷은 세상 어느 누구도 그보다 더 희게 (geu os-eun se-sang eo-neu nu-gu-do geu-bo-da deo hui-ge) 할 수 없을 **만큼** 새하얗고 눈부시게 빛났다. (hal su eobs-eul **man-keum** sae-ha-yah-go nun-bu-si-ge bich-nass-da.)
His clothes became dazzling white, whiter than anyone in the world could bleach them.	

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Word Spacing difference between North and South Korea

Spacing of dependent nouns and particles

2) Particle

『North Korean』그녀**만큼** (geu-nyeo-man-keum) = 『South Korean』그녀**만큼** (geu-nyeo-man-keum)

Input Sentence (**NK**) →	Translation Output (**SK**)
그 당시에 그녀**만큼** 옳바르고 흠없는 사람이 없었다. (geu dang-si-e geu-nyeo-**man-keum** olh-ba-leu-go heum-eobs-neun sa-lam-i eobs-eoss-da.)	그 당시에는 그녀**만큼** 올바르고 흠 없는 사람이 없었다. (geu dang-si-e-neun geu-nyeo-**man-keum** ol-ba-leu-go heum eobs-neun sa-lam-i eobs-eoss-da.)
She was a righteous woman, blameless among the people of her time.	

Conclusion

1. **Demonstrates the potential** of our **created North-South parallel corpus** as a valuable **resource** for developing a high-quality **machine translation model** between the North and South Korean languages
2. **The BERT Score**[1] results indicate **strong translation performance** for both the NK→SK and SK→NK models
3. **The qualitative analysis** highlights the models' ability to capture **key linguistic differences** between the North and South Korean languages

[1] Tianyi Zhang et al., "BertScore: Evaluating Text Generation with BERT", 8th International Conference on Learning Representations, 2020.

Future Work

1. Due to the **historical period** of the **literary resources** and **the Bible**, the North-South parallel corpus **lacks contemporary vocabularies** and **technical terms**
2. **Expanding the corpus** with sentence pairs from diverse sources, such as **modern literature** and **research papers from the late 20th or 21st century**, is **necessary**

Thank you for your attention

Q&A

- Title of paper: **Bridging the Linguistic Divide: Developing a North-South Korean Parallel Corpus for Machine Translation**

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