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CS 6320.001

Project 2 NLP Report

The results were as follows:

Testing Statistics:

	precision	recall	f1-score	support
Cause-Effect	0.857	0.829	0.843	339
Component-Whole	0.551	0.608	0.578	283
Other-Relation	0.879	0.863	0.871	1880
Product-Producer	0.437	0.470	0.453	215
accuracy			0.801	2717
macro avg	0.681	0.692	0.686	2717
weighted avg	0.807	0.801	0.804	2717

I think that these are good results, considering the f1-score is comparable to some of the reports linked in the assignment for Relation Classification (although those have more relations). That being said, there are clearly some holes in the relation classifier, especially when it comes to the Product-Producer and Component-Whole relationships. There is more detail when it comes into the Error Analysis below.

Error Analysis for the 50 sentences (88.00% Accuracy):

ID: 10271 in test file
Sentence: A few weeks after we sent the Taylors our final report , a <e1> letter </e1> arrived from the <e2> headquarters </e2> of the Green Howards in England .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10406 in test file
Sentence: Those early <e1> studies </e1> were directed toward examining the spring <e2> vegetation </e2> green - up and subsequent summer and fall dry - down .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10381 in test file
Sentence: The first five - day <e1> workshop </e1> introduced <e2> tools </e2> for identifying and exploiting market opportunities .
Predicted: Other-Relation
Actual: Other-Relation

ID: 9506 in test file

Sentence: He put a <e1> book </e1> into the <e2> cupboard </e2> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 9584 in test file
Sentence: Preventing computer fraud means outwitting <e2> horde </e2> of <e1> hackers </e1> , crackers , spoofers , and sniffers .
Predicted: Other-Relation
Actual: Other-Relation

ID: 9567 in test file
Sentence: The <e2> methods </e2> adopted for histochemical observations have been described in the preceding <e1> paper </e1> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10418 in test file
Sentence: The operator moved the <e1> data </e1> into the <e2> text box </e2> from the database table column .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10587 in test file
Sentence: A filtered <e2> wheat </e2> <e1> beer </e1> , Sunshine offers a crisp , refreshing alternative to heavier - bodied heffe - weizens .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10064 in test file
Sentence: In Sri Lanka , the <e1> tsunami </e1> resulted in 31187 deaths , 4280 missing people , 23189 injured people , and the <e2> displacement </e2> of 545715 people .
Predicted: Cause-Effect
Actual: Cause-Effect

ID: 8181 in test file
Sentence: These <e1> attributes </e1> are inherited to their <e2> children </e2> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10212 in test file
Sentence: Scientists in Cambridge have discovered that a lowly grape <e1> variety </e1> grown by <e2> peasants </e2> - but despised by noblemen - during the Middle Ages was the mother of many of today's greatest grape varieties .

Predicted: Other-Relation
Actual: Other-Relation

ID: 10176 in test file
Sentence: The <e2> evangelist </e2> blasts the patrons with the <e1> news </e1> that they're going to hell , if they don't come to his meeting and get saved .
Predicted: Product-Producer
Actual: Product-Producer

ID: 9154 in test file
Sentence: The <e1> aircraft </e1> was making a third <e2> approach </e2> to Irkutsk , a scheduled refueling stop , when it crashed .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10047 in test file
Sentence: War and rural <e1> poverty </e1> cause mass <e2> migration </e2> of people and often simultaneous growth of informal development .
Predicted: Cause-Effect
Actual: Cause-Effect

ID: 9995 in test file
Sentence: Their <e1> relationship </e1> is thrown into <e2> chaos </e2> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 8472 in test file
Sentence: The <e1> windshield </e1> of the <e2> cockpit </e2> is much like other windshields except for a few things , laser sensors on the plane find other planes within a 45 mile radius .
Predicted: Product-Producer
Actual: Component-Whole
Analysis: The error is caused by a lack of knowledge. The relation extract system has no knowledge that windshield actually belongs to cockpit

ID: 8278 in test file
Sentence: The SWAT <e1> team </e1> breaks open a 2nd - floor door with a battering <e2> ram </e2> .
Predicted: Component-Whole
Actual: Other-Relation
Analysis: The error is caused by overfitting by trying to fit a relation that does not exist in the test set; ram is not a component of team but the model believed it was.

ID: 8646 in test file

Sentence: The message <e1> body </e1> was comprised of the <e2> phrase </e2> "hey , check this out ! " .
Predicted: Other-Relation
Actual: Other-Relation

ID: 9826 in test file
Sentence: Gary Oldman , whose name has vanished from the main credits , is Lecter's disfigured victim who wants revenge , specifically to feed the evil doctor to his <e2> singular </e2> of wild <e1> boars </e1> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10006 in test file
Sentence: Six Flags' reorganization plan is supported by a steering <e2> committee </e2> of its secured <e1> creditors </e1> and led by investment firm Avenue Capital Management , which would take control of the company under the plan .
Predicted: Product-Producer
Actual: Other-Relation
Analysis: The word embedding made it seem as if creditors

ID: 8453 in test file
Sentence: A Saudi <e1> prisoner </e1> escaped an American <e2> detention </e2> in the desert .
Predicted: Other-Relation
Actual: Other-Relation

ID: 8486 in test file
Sentence: The drone <e1> strike </e1> that resulted in the <e2> death </e2> of Pakistan's most wanted terrorist is believed to be a result of deliberately planted false intelligence , sources in South Waziristan have confirmed .
Predicted: Cause-Effect
Actual: Cause-Effect

ID: 9747 in test file
Sentence: For a time <e1> class </e1> became the dominant research topic for <e2> sociology </e2> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 9934 in test file
Sentence: Venous insufficiency (a failure of the valves in the <e1> veins </e1> of the <e2> leg </e2> that causes congestion and slowing of blood circulation in the veins) .
Predicted: Cause-Effect
Actual: Component-Whole

Analysis: The error might be caused by a lack of understanding of the Component-Whole relation, as there is low recall in the model for it, and wrongly interprets them as having a causal relation, as there is a relationship detected in the embedding.

ID: 8887 in test file
Sentence: The <e2> results </e2> have been documented in two <e1> films </e1> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 8760 in test file
Sentence: The ongoing drought means that there is little <e1> water </e1> flowing into the <e2> lakes </e2> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 8831 in test file
Sentence: This invention relates to a mooring fender apparatus , particular an apparatus to protect the <e1> gunnel </e1> and rub rail of a <e2> boat </e2> .
Predicted: Other-Relation
Actual: Component-Whole
Analysis: The error might be caused by a lack of understanding of the Component-Whole relation, as there is low recall in the model for it. It is unable to identify gunnel as a part of the boat even if it has understanding in the embedding for other relations.

ID: 10558 in test file
Sentence: The <e1> speech </e1> was about a <e2> conversation </e2> I had with my daughter .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10246 in test file
Sentence: Another reason for the impression of <e2> energy </e2> and optimism caused by many <e1> posters </e1> is their very nature as images of propaganda .
Predicted: Cause-Effect
Actual: Cause-Effect

ID: 8670 in test file
Sentence: A Psi - Comp implant <e1> hardwire </e1> has been put into the human <e2> brain </e2> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 8110 in test file
Sentence: The State Capital is a disgusting sewer and Bruno is just one in the <e2> mischief </e2> of filthy <e1> rats </e1> that proliferate there .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10663 in test file
Sentence: The <e1> rabbits </e1> are unhappy when left alone in a <e2> hutch </e2> in the garden , as they need company .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10680 in test file
Sentence: For a sit - down snack the <e2> cook </e2> bakes the batter in a mini - muffin <e1> pan </e1> and serves the smaller version muffins with a lemon cream on the side .
Predicted: Other-Relation
Actual: Other-Relation

ID: 8315 in test file
Sentence: The <e2> position </e2> of the Catholic Church on the matter is defined in <e1> canon law </e1> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10001 in test file
Sentence: A <e2> mechanic </e2> tightens the bolt with a <e1> spanner </e1> 0 . 25 m long .
Predicted: Other-Relation
Actual: Other-Relation

ID: 9889 in test file
Sentence: Real <e2> metrosexuals </e2> use <e1> moisturizers </e1> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 8474 in test file
Sentence: Then I remembered - - my <e1> paper </e1> was in the <e2> desk drawer </e2> .
Predicted: Other-Relation
Actual: Other-Relation

ID: 9868 in test file
Sentence: Three people had been killed in a <e2> fire </e2> after the <e1> quake </e1> and hundreds of people were injured .
Predicted: Cause-Effect

Actual: Cause-Effect

ID: 9734 in test file
Sentence: Copy of all <e2> documents </e2> being discussed at the <e1> meeting </e1> were available for inspection .
Predicted: Other-Relation
Actual: Other-Relation

ID: 9668 in test file
Sentence: There is a red indicator <e1> button </e1> on the <e2> dash </e2> to the left of the steering wheel and it is stationary .
Predicted: Component-Whole
Actual: Component-Whole

ID: 8259 in test file
Sentence: The competitor <e1> car </e1> achieved the top fuel efficiency using a small internal combustion <e2> engine </e2> .
Predicted: Other-Relation
Actual: Component-Whole
Analysis: The error might be caused by a lack of understanding of the Component-Whole relation, as there is low recall in the model for it. It is also possible the embeddings were not trained well to detect a relationship between car and engine.

ID: 9905 in test file
Sentence: Of course , the most common things in <e1> seawater </e1> , besides the hydrogen and oxygen that make up the water itself , are sodium and chloride <e2> ions </e2> , which are the components of common table salt and make ocean water taste salty to us .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10536 in test file
Sentence: These are the <e1> walls </e1> of the Byzantine <e2> fortress </e2> that surrounds the Acropolis of Lindos on the Island of Rhodes .
Predicted: Component-Whole
Actual: Component-Whole

ID: 9186 in test file
Sentence: The <e1> petition </e1> described the <e2> oil </e2> as being useful for salads and culinary purposes .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10304 in test file
Sentence: At 73 meters underwater , a petty <e2> officer </e2> reached the surface using his Drager <e1> apparatus </e1> .

Predicted: Other-Relation
Actual: Other-Relation

ID: 9192 in test file
Sentence: High - frequency geometric <e1> ray theory </e1> is used to study the refracted arrival from a <e2> layer </e2> embedded in an infinite medium .
Predicted: Other-Relation
Actual: Other-Relation

ID: 10669 in test file
Sentence: These <e1> observations </e1> determine the high spatial resolution stellar <e2> kinematics </e2> within the nuclei of these galaxies .
Predicted: Other-Relation
Actual: Other-Relation

ID: 8240 in test file
Sentence: The aircraft was written off in the <e1> accident </e1> due to the severe <e2> impact </e2> caused by the KLM aircraft , and the resulting fire .
Predicted: Cause-Effect
Actual: Cause-Effect

ID: 8377 in test file
Sentence: <e1> Neuralgia </e1> (TN) is the most common cause of chronic sinusitis <e2> headache </e2> .
Predicted: Cause-Effect
Actual: Cause-Effect

ID: 10443 in test file
Sentence: Her split <e1> skirt </e1> was in a <e2> trunk </e2> of clothing that still hadn't arrived from Washington , but she looked forward to the freedom .
Predicted: Other-Relation
Actual: Other-Relation

Lessons Learned: I learned that there is a lot of variation between possible models to implement the same problem. I read about papers that used just Bidirectional LSTMS, Bidirectional LSTM with Attention, Transformers, etc. This was very interesting. I also learned a lot because the implementation was open-ended, so I was able to learn how to research a problem in NLP and how to select an appropriate model. I also learned how to use the keras_self_attention package. I also became more familiar with the concepts I had previously used in Homework 2 such as one-hot encoding, embedding, and more. I found it interesting that the validation error was significantly different than the test error, and I learned a bit

about why that could be the case by researching it. I also gained experience solving problems through neural networks and keras.