Thread Reconstruction in Conversational Data using Neural Coherence Models

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Problem Definition and Solution

- Given the messages of a thread, construct the thread (reply-to) structure
- Our solution
  - Train a **neural coherence model** based on entity-grid representation of a thread.
  - Use the model to compute coherence scores of all possible reconstructions
  - Select the one with the highest score

Thread Entity-Grid Representation

Author: barspinboy **Post ID:** 1

s_0: im having troubles since i uninstall some of my apps, then when i checked my system registry bunch of junks were left behind by the apps i already uninstall.
s_1: is there any way i could clean my registry aside from expensive registry cleaners.

Author: kees bakker **Post ID:** 2

s_2: use regedit to delete the 'bunch of junks' you found.
s_3: regedit is free, but depending on which applications it were ..
s_4: it's somewhat doubtful there will be less crashes and faster setup.

Author: willy **Post ID:** 3

s_5: i tend to use ccleaner (google for it) as a registry (and system) cleaner.
s_6: using its defaults does pretty well.
s_7: in no way will it cure any hardcore problems as you mentioned, "crashes", but it should clean some of the junk out.
s_8: i further suggest, ..

Author: caktus **Post ID:** 4

s_9: try regseeker.
s_{10}: it's free and pretty safe to use automatic.
s_{11}: then clean out temp files (don't compress any files or use indexing.)
s_{12}: if the c drive is compressed, then uncompress it.

Author: barspinboy **Post ID:** 5

s_{13}: thanks guyz!
s_{14}: i tried all those suggestions you mentioned cclean-ers regedit defragmentation and uninstalling process.
s_{15}: it all worked out and i suffer no more from crashes and ..

Figure: A truncated forum thread from CNET with five posts by temporal order.

Table: Transition of some entities across tree structure of the thread example. Legend: S stands for subject, O for object, X for a role other than subject or object, and – means that an entity does not appear in the sentence.

Tree structure	depth	CLEANER	REGEDIT	TROUBLES	SYSTEM	JUNKS	APPS	REGISTRY	BUNCH
s_0	0	–	–	–	O	X	X	O	O
s_1	1	O	–	–	–	–	–	O	–
s_2 s_5 s_9	2	–O–	O––	– – –	– – –	X––	– – –	–O–	O––
s_3 s_6 s_{10}	3	– – –	S––	– – –	– – –	– – –	– – –	– – –	– – –
s_4 s_7 s_{11}	4	– – –	– – –	– – –	– – –	–X–	– – –	– – –	– – –
s_8 s_{12}	5	––	––	––	––	––	––	––	––

Neural Coherence Model

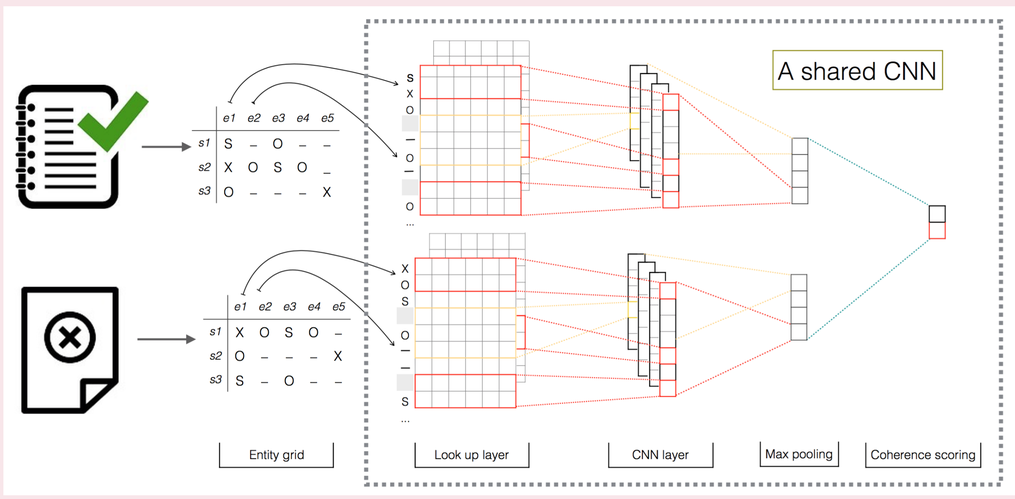

Figure: A Convolutional Neural Network (CNN) architecture for modeling local coherence.

Grid CNN: Convolutional Neural Network over Entity Grid

- Transform each entry in the grid into a distributed representation
- Use convolution and pooling layers to learn high-level features
- Model entity transitions across tree structure

Pairwise end-to-end training

- Input: ordered pairs (T_i, T_j)
  - T_i is **gold** tree of original thread
  - T_j is a valid but **false** tree
  - T_j respects the chronological order of the posts
- Use pairwise ranking approach to learn θ by minimizing the objective:

$$\Im(\theta) = max\{0, 1 - \phi(G_i|\theta) + \phi(G_j|\theta)\} \quad (1)$$

where G_i and G_j are entity grids of T_i and T_j, respectively
θ: set of CNN parameters

Testing

- Given posts of a thread, predict coherence scores of all possible candidate trees
- Choose the tree with the highest coherence score

Experiment

Table: CNET Threads with less than 6 posts

# Train-Dev-Test	Avg. #Posts	Avg. # Sent	Non-trivial replies
1,500-200-500	3.6	27.64	57%

Baselines

All-previous: Linking a post to its previous post in the temporal order
All-first: Linking all the posts to the first post
COS-sim: Linking a post to one of the previous posts with which it has the highest cosine similarity

Table: Performance on the thread reconstruction task.

	Tree-level	Edge-level	
	Acc	F_1	Acc
All-previous	20.00	58.45	65.62
All-first	17.60	54.90	60.27
COS-sim	16.80	53.58	58.75
Grid-CNN	**26.40**	**60.55**	**66.12**

Conclusion

Our contribution

- A neural approach to model the coherence of an entire thread for the thread reconstruction task
- Pairwise ranking method to train the model end-to-end
- Improves performance over trivial baselines

Future work

- Include dialogue act information
- Experiment with threads having more than 5 posts

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