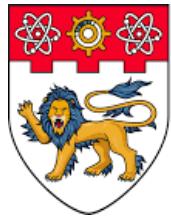


# Joint Multitask Learning for Community Question Answering Using Task-Specific Embeddings

Shafiq Joty

Nanyang Technological  
University



NANYANG  
TECHNOLOGICAL  
UNIVERSITY  
SINGAPORE

Lluís Màrquez

Core AI-Barcelona  
Amazon

Preslav Nakov

Qatar Computing  
Research Institute,  
HBKU



EMNLP-2018



# Community Question Answering (cQA)

- Questions specific to a region or a community are often answered in **community forums**.



stackoverflow



Quora

# Community Question Answering (cQA)

Google search results for "Can I get a Qatar resident permit for my wife while she is currently in Doha". The search took 0.99 seconds and found about 66,700 results.

**None has the answer!**

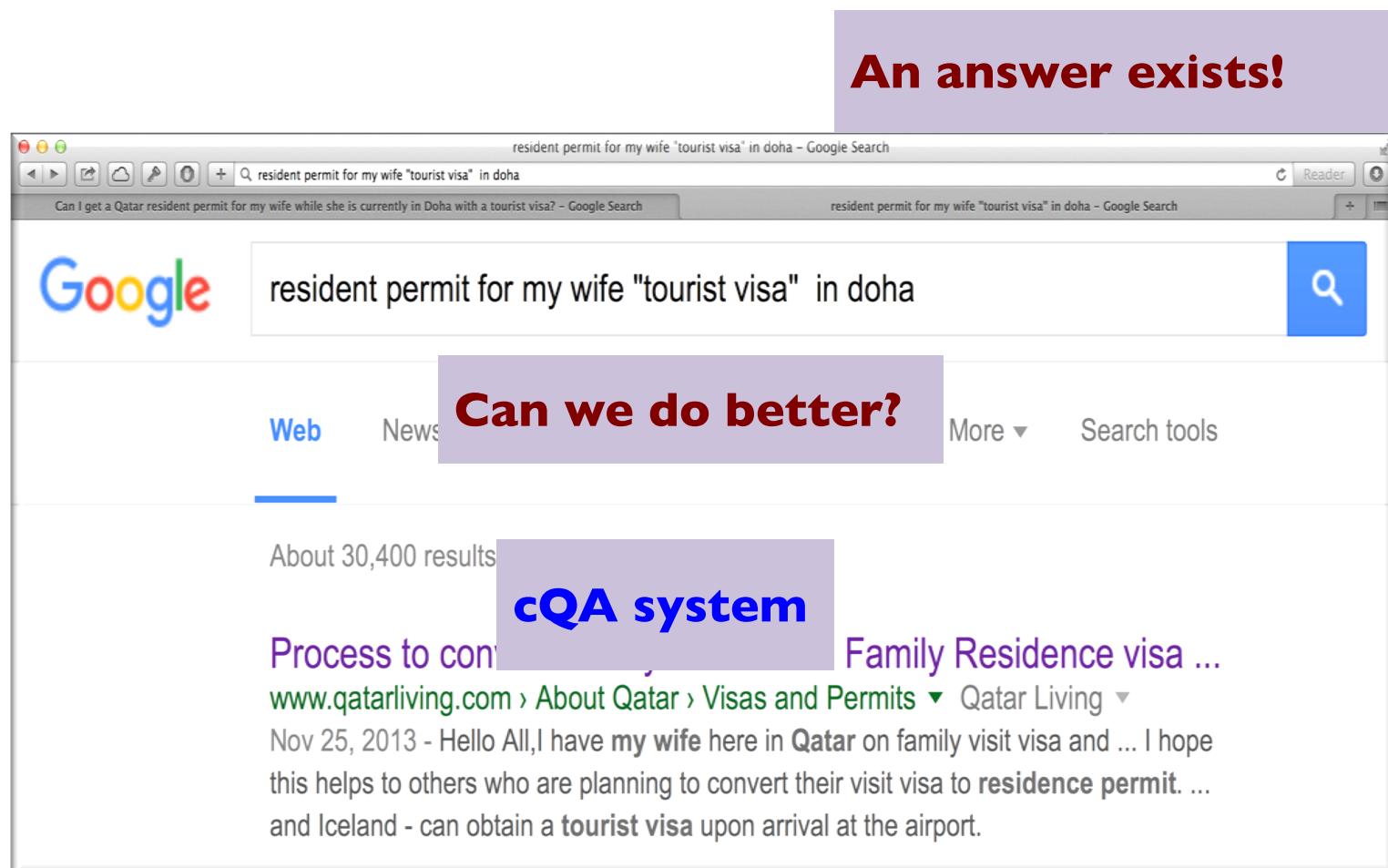
**Residence Permit - Family/Documents/Procedure | Qatar ...**  
www.qatarliving.com › About Qatar › Visas and Permits ▾ Qatar Living ▾  
Jun 13, 2012 - My family is here in Doha on **Visit visa** from last six months and **now** ...  
When i **have** to carry out the medical and finger printing? ... Once were back in **qatar**  
will her family **visa** be void as **shes** left the country and **does not have** an rp? ... Can I  
apply for Hotel Visa for my **wife** and daughter and bring them here ...

**Family Visit Visa to Qatar | Qatar Living**  
www.qatarliving.com › About Qatar › Visas and Permits ▾ Qatar Living ▾  
Family **Visit Visa** I want to get a family **visa** for my **wife**. .... of weeks and i need to bring  
my **wife** here either in **visit** or **resident** can u pls suggest me ... than one month you  
have to take exit permit for that person when he or **she** is leaving. .... (50QR @ ICC  
Doha) - tenancy contract, if engineer profession not required , because i ...

**Qatar visa requirements - visit and residence visa for Doha ...**  
www.onlineqatar.com/info/visa-requirements.aspx ▾  
The **current** regulations are applicable to **GCC residence permit** holders. ... A **tourist**  
can get a **visa** on arrival at the entry points in the country or from **Qatar's** ... or if **she**  
arrives with the sponsor of one of the sponsor family members (wife or sons). ... **while**  
original passport has atleast six-month validity and they should have a ...

**Qatar Visit Visa Information and Rules Doha Qatar**  
www.onlineqatar.com/info/visit-visa-qatar.aspx ▾  
Among the nationals who **can obtain** **visit visa** on arrival are Andorra, Australia, ...  
However, to **obtain** **this visa**, they should **have** a **GCC residence permit** and passport  
... A single exit permit costs QR10, **while** the cost of multiple exit permit is ... pay to  
renew **visa** yearly to one guy he **will not now** in **qatar**. so i take already my ...

# Community Question Answering (cQA)



# A Question-Comment Thread

Thread/existing question



Family visit visa e

Home >> About Qatar >

Poster by anonymous in Visas and Permits

Does immigration have any particular time for extending family visit visa? In Doha; immigration office only in Madinat Khalifa? We need to extend our family visit visa this month end then six months finished ...

Does immigratio  
In Doha; immigratio  
our family visit visa this month end then six months finishe

morning if its for 7th month; I was asked to come then.

Comments



rej2k7

morning if its for 7t



blueagle69

Maximum allowed  
daughter need to e  
you want to exten  
captain ... proceed  
12noon..



anonymous

DEAR FRIEND ONE MORE DOUBT I HAVE..WE NEED TO TAKE  
ALSO FOR EXTEN  
ENOUGH...WE ARE



anonymous

DEAR FRIEND THAT PRINT  
WHEN U WENT TO  
OFFICE U WENT?



emy007

as they dnt chec  
u can go to madina  
directly to reception

Maxim... for visit visa is  $1+5=6$  months after that your wife and daughter  
need to exit qatar and they can come back after 3 months. But if you want to  
extend another 1 to 2 months; then u need approval from captain ... proceed to  
gate # 1, time every morning

DEAR FRIEND ONE MORE DOUBT I HAVE..WE NEED TO TAKE  
TICKET ALSO FOR EXTENSION...WE PAY FOR TICKET OR JUST  
BOOKING ENOUGH...WE ARE FROM INDIA

DEAR FRIEND WE NEED TO PAY FOR TICKET OR JUST BOOKING AND  
THAT PRINT OUT ENOUGH? AND WHAT QUESTIONS THEY ASKED WHEN  
U WENT TO IMIGRATION FOR CHILD? IN WHICH IMIGRATION OFFICE U  
WENT?

.. last time we just book the ticket it shows like a real ticket so they extend it as  
they dnt check in system if it is paid or nt lol .. dnt pay for the tickets... and u can  
go to madinat khalifa they r nice people just go to gate no 4 and go directly to

# Community Question Answering

New incoming question

**Visa Extension for My Sister in Law?**

Home >> About Qatar >> Advice and Help  
Poster by dyolimaj in Advice and Help

... my sister's in law is under my sponsorship and her visa will be expired on Nov.17/2012 (3months from the time she arrive in Doha). My question is; can I still extend her visa for another one month?

Comments

nfbqbal: May be its a new rule as I had no problem at all to renew for my in laws or niece nephew .

bob1972: It is correct. 3 mnths for indirect relation and later a month extension after showing a ticket. Go to the Main Immigration.

blueagle69: ... sister in law is falls under indirect relatives of yours as she is the sister of your wife. anyhow you can still extend her visa of 1 month provided air ticket to the immigration officer; without ticket then sorry to say...no EXTENSION...

data\_analyst: Is Visit Visa is of 3 months for wife as well (the visit) visa; do wife comes under direct(blood relations)?

dyolimaj: for wife the visa is extendable for 6mos.

**Family visit visa extension in immigration?**

Home >> About Qatar >> Visas and Permits  
Poster by anonymous in Visas and Permits

Does immigration have any particular time for extending family visit visa? In doha; immigration office only in madina khalifa? We need to extend our family visit visa this month end then six months finished ...

Comments

rej2k7: morning if its for 7th month; I was asked to come then.

blueagle69: Maximum allowed for visit visa is 1+5=6 months after that your wife and daughter need to exit qatar and they can come can back after 3 months. But if you want to extend another 1 to 2 months; then u need approval from captain ... proceed ka sa gate # 1 (first floor) siya matatagpuan every 10-12noon..

anonymous: DEAR FRIEND ONE MORE DOUBT I HAVE..WE NEED TO TAKE TICKET ALSO FOR EXTENSION... WE PAY FOR TICKET OR JUST BOOKING ENOUGH...WE ARE FROM INDIA

anonymous: DEAR FRIEND WE NEED TO PAY FOR TICKET OR JUST BOOKING AND THAT PRINT OUT ENOUGH? AND WHAT QUESTIONS THEY ASKED WHEN U WENT TO IMMIGRATION FOR CHILD? IN WHICH IMMIGRATION OFFICE U WENT?

emy007: ... last time we just book the ticket it shows like a real ticket so they extend it as they dint check in system if it is paid or nt lol .. dint pay for the tickets... and u can go to madinat khalifa they r nice people just go to gate no 4 and go directly to reception without taking any number...

Can I extend my family visit visa after 6 month??

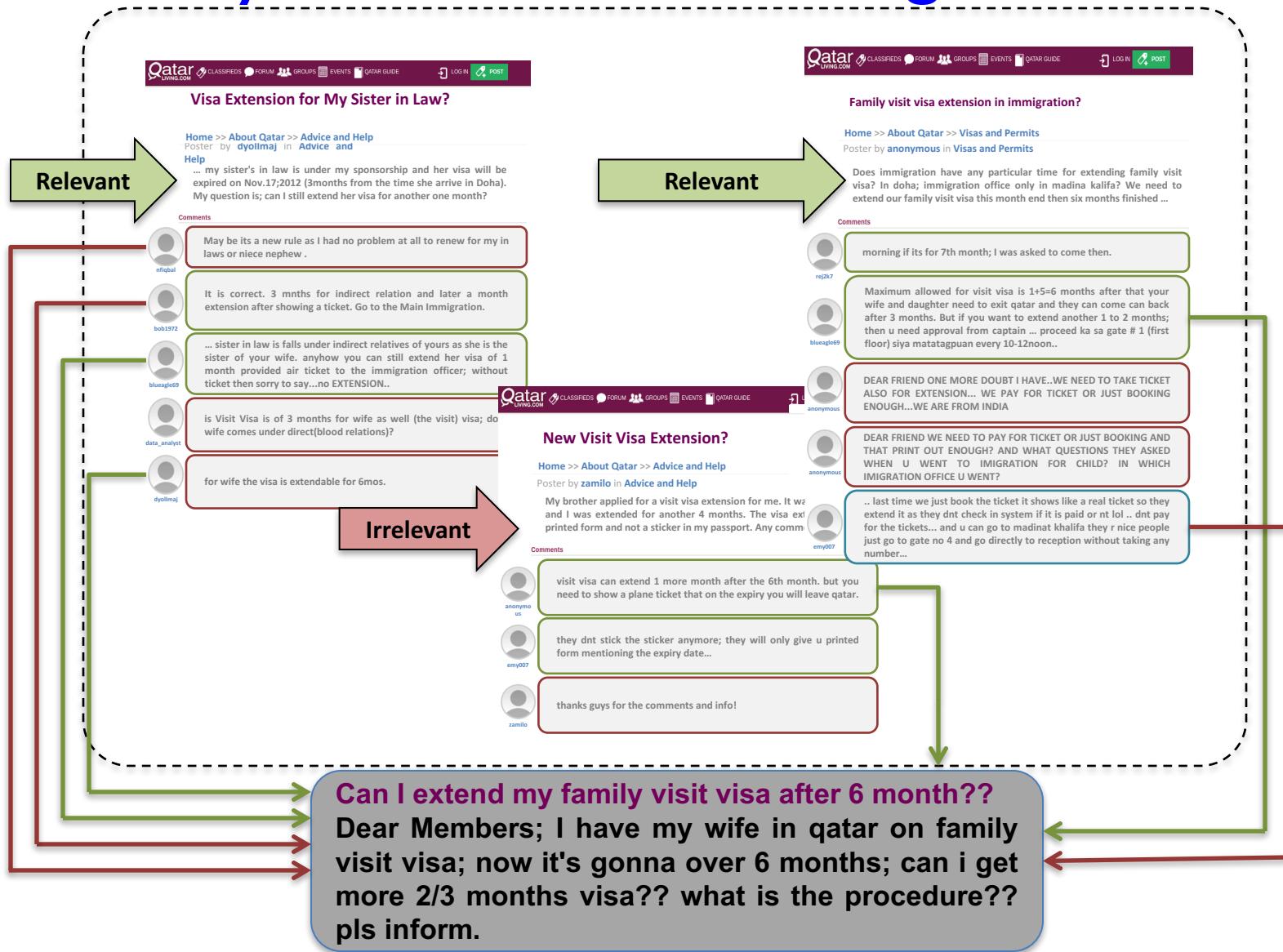
Dear Members; I have my wife in qatar on family visit visa; now it's gonna over 6 months; can i get more 2/3 months visa?? what is the procedure?? pls inform.

Can I extend my family visit visa after 6 month??

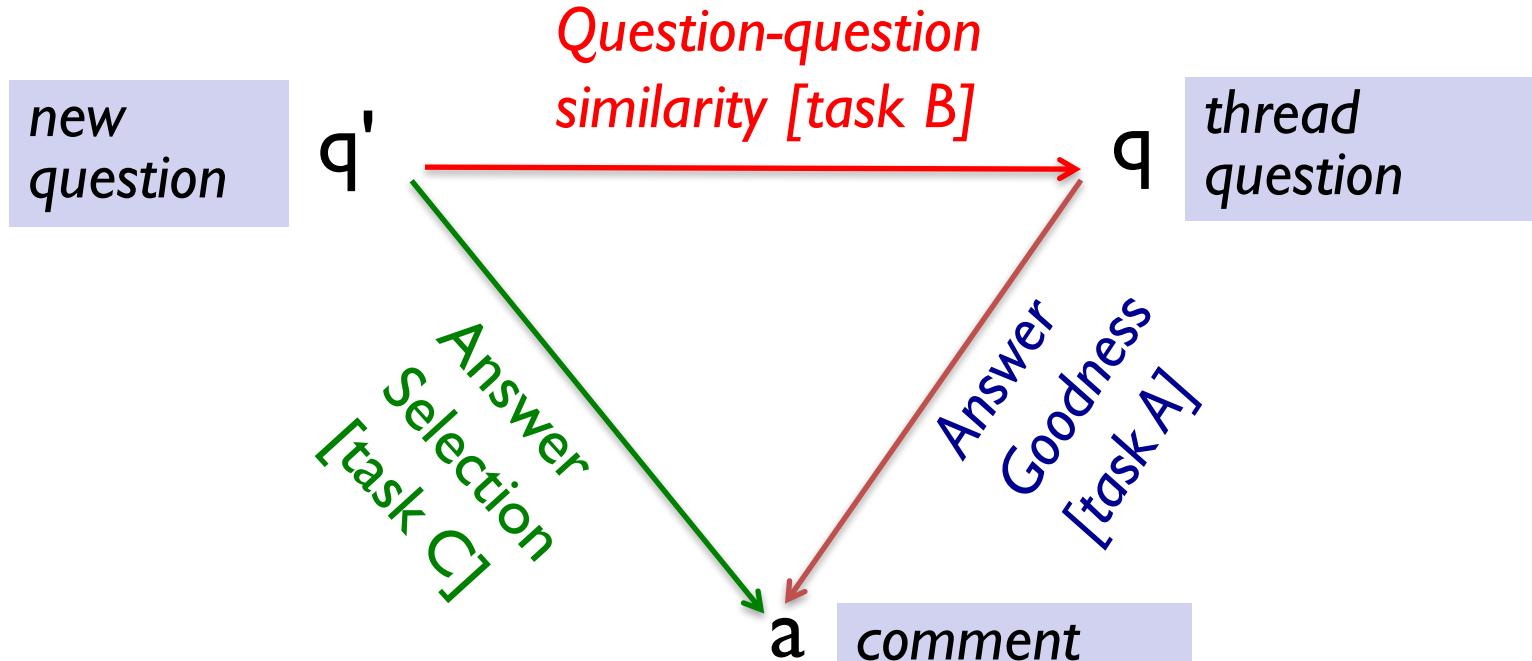
Dear Members; I have my wife in qatar on family visit visa; now it's gonna over 6 months; can i get more 2/3 months visa?? what is the procedure?? pls inform.

# Community Question Answering

New incoming question



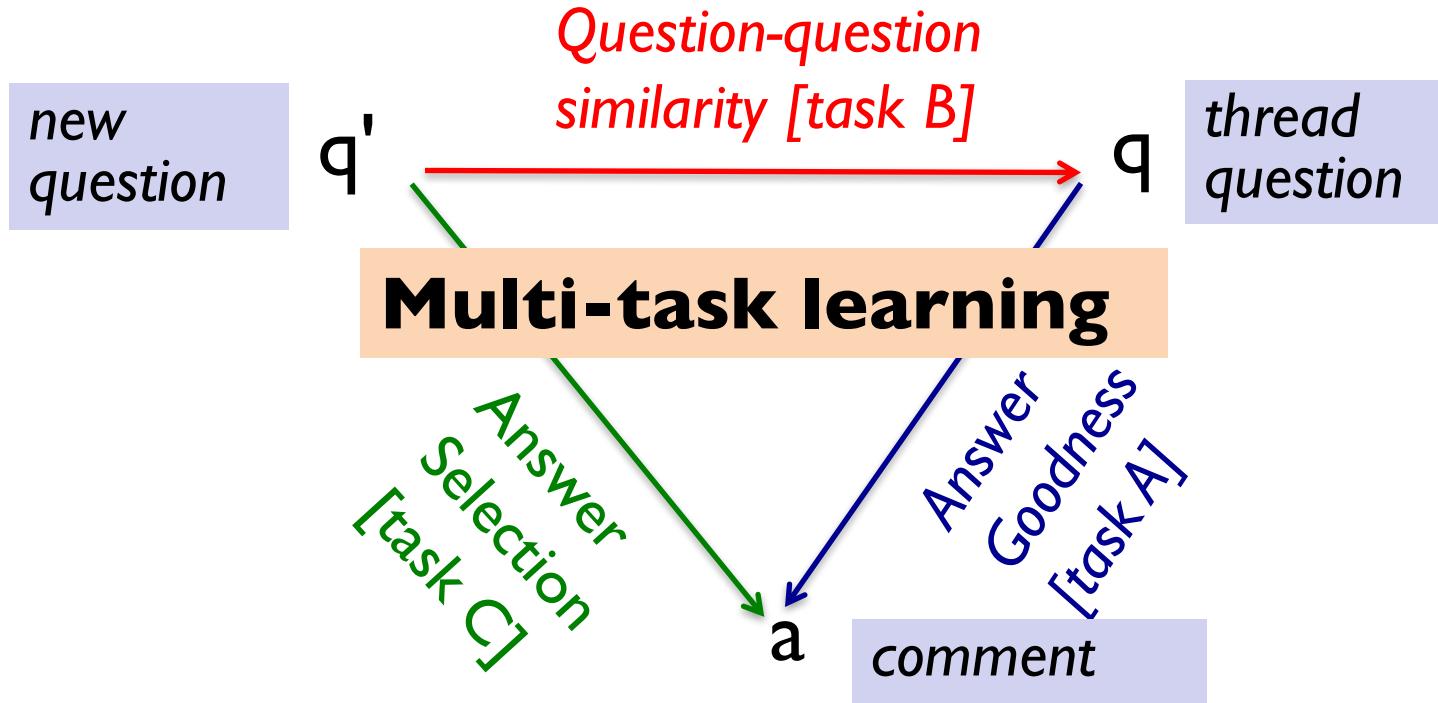
# Research Challenges in cQA



## cQA tasks:

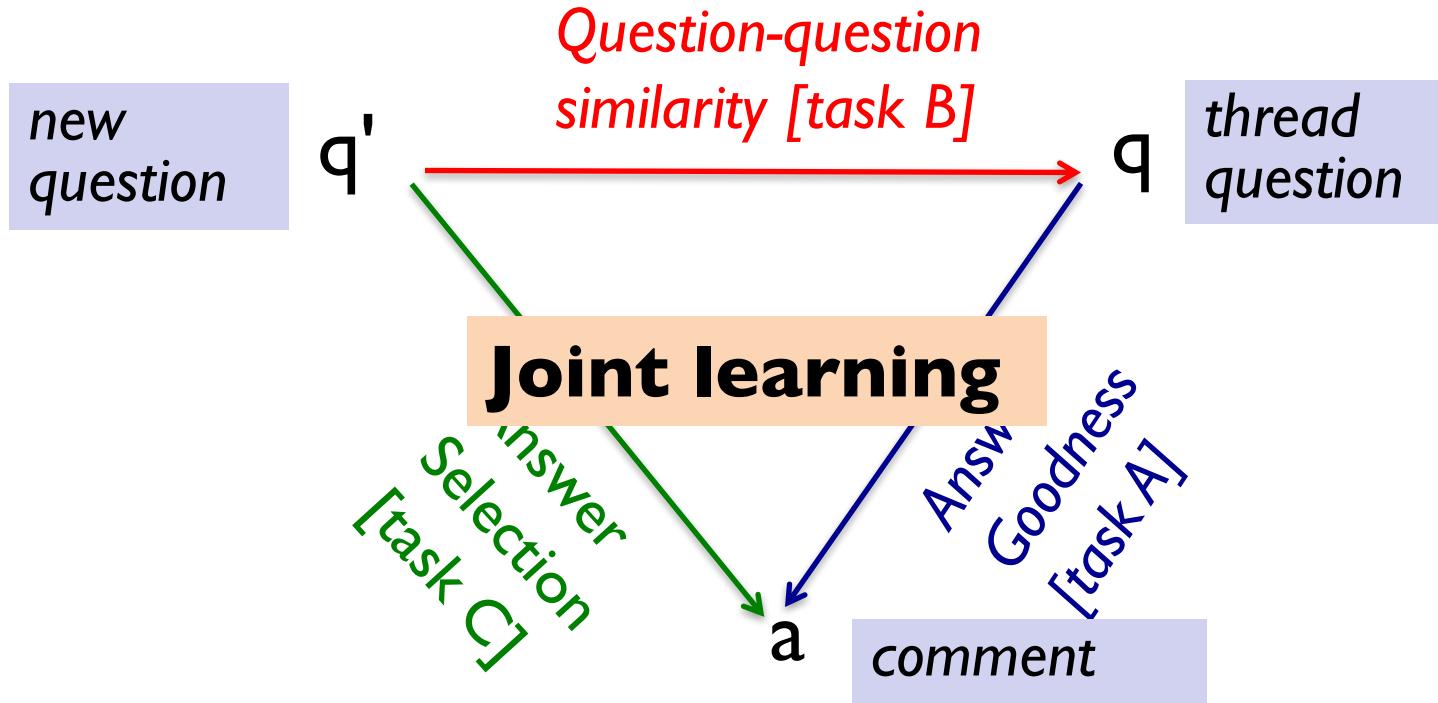
- A.  $q$  to  $a$  (answer goodness) [SemEval'15, SemEval'16]
- B.  $q'$  to  $q$  (question-question similarity) [SemEval'16]
- C.  $q'$  to  $a$  (answer selection; main task) [SemEval'16]

# Inter-task Dependencies in cQA



- Task C is dependent on the other two tasks
- Task B can help solve C
- Task A can help solve C

# Intra-task Dependencies in cQA

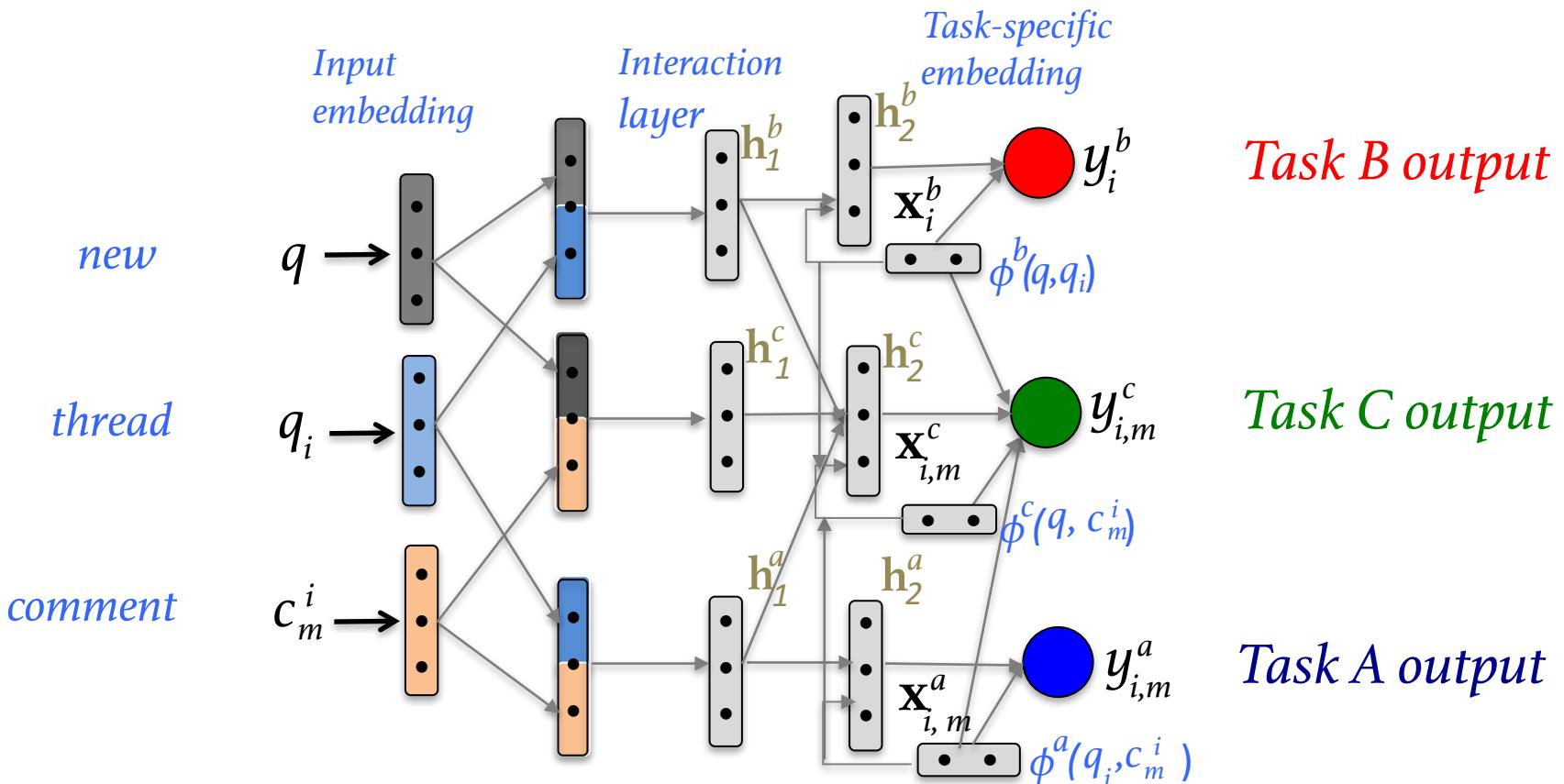


- Similar comments should have same class labels (for **task A** and **task C**)
- Similar questions should have same class labels (for **task B**)

# Our Approach

- Step 1: Learn task-specific embeddings for each task
- Step 2: Model intra- and inter-task dependencies.

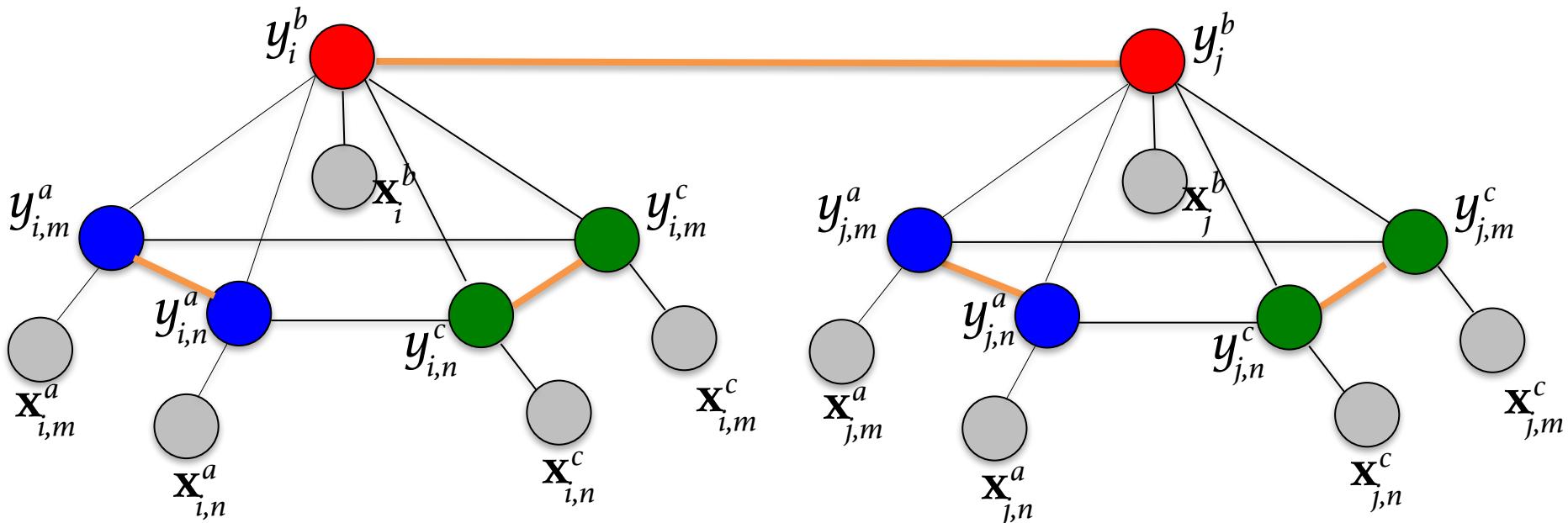
# Task-specific Representation for cQA



Train for each task separately

- Considers interactions between input elements
- Combines automatic and manually-designed features
- Does not consider inter- and intra-task dependencies

# Inter- & Intra-task Dependencies for cQA



**The model:**

$$p(\mathbf{y}|\theta, \mathbf{x}) = \frac{1}{Z(\theta, \mathbf{x})} \prod_{t \in \tau} \left[ \prod_{u \in V_t} \psi_n(y_u | \mathbf{x}, \mathbf{w}_n^t) \right] \prod_{(s,t) \in \tau \times \tau} \left[ \prod_{(u,v) \in E_{st}} \psi_e(y_{uv} | \mathbf{x}, \mathbf{w}_e^{st}) \right]$$

**Training:** RMSProp

**Inference:** Loopy BP

Experimented with different graph structures

# Embeddings and Pairwise Features

- **Google skip-gram vectors:** 300-dimensions; embedding for a question/comment is the average of the word embeddings.
- **Syntax-based:** Parse the question (or comment) using the Stanford neural parser, and use the 25-dimensional vectors.
- **QL word2vec vectors:** Use fine-tuned word embeddings pretrained on all the available in-domain Qatar Living data.
- **Pairwise Features:** Cosine similarity, MT features (BLEU, NIST, TER, METEOR), BLEU components (n-gram prec, n-gram matches, length ratio, brevity penalty).
- **Node Features:** Comment features (different statistics on word types), meta features (same user answering, position as reciprocal rank).

# cQA Datasets

SemEval-2016 Task 3 (Nakov et al., 2016)

- 387 new questions
- 6,959 related questions
- 56,988 answers

# Main Results for Task B

Systems	MAP	AvgRec	MRR
UH-PRHLT (best at SE-2016)	76.70	90.31	83.02
DNN (task B network)	76.27	90.27	83.57
DNN + Gold A, C	77.17	90.71	84.73
DNN + Predicted A, C	76.43	90.34	83.62
<b>DNN+CRF</b>	<b>76.87</b>	<b>90.66</b>	<b>84.44</b>

- DNN model yields strong results; close to the best model in SemEval'16
- DNN+CRF yields further improvements and achieves state-of-the-art results

# Main Results in Task C

Systems	MAP	AvgRec	MRR
SUpper team (best at SE-2016)	55.41	<b>60.66</b>	61.48
DNN (task C network)	54.24	58.30	61.47
DNN + Gold A, B	63.49	71.16	68.19
DNN + Pred A, B	55.11	58.69	60.10
DNN-ABC (local)	54.32	59.87	61.76
<b>DNN+CRF</b>	<b>56.01</b>	60.22	<b>63.25</b>

- DNN model gets strong results
- CRF yields state-of-the-art results improving over DNN by about 2 points

# Conclusions & Future Work

- Feed-forward neural network to learn task-specific embeddings
- Joint multi-task learning framework with global normalization
- Improvements in both task B and task C

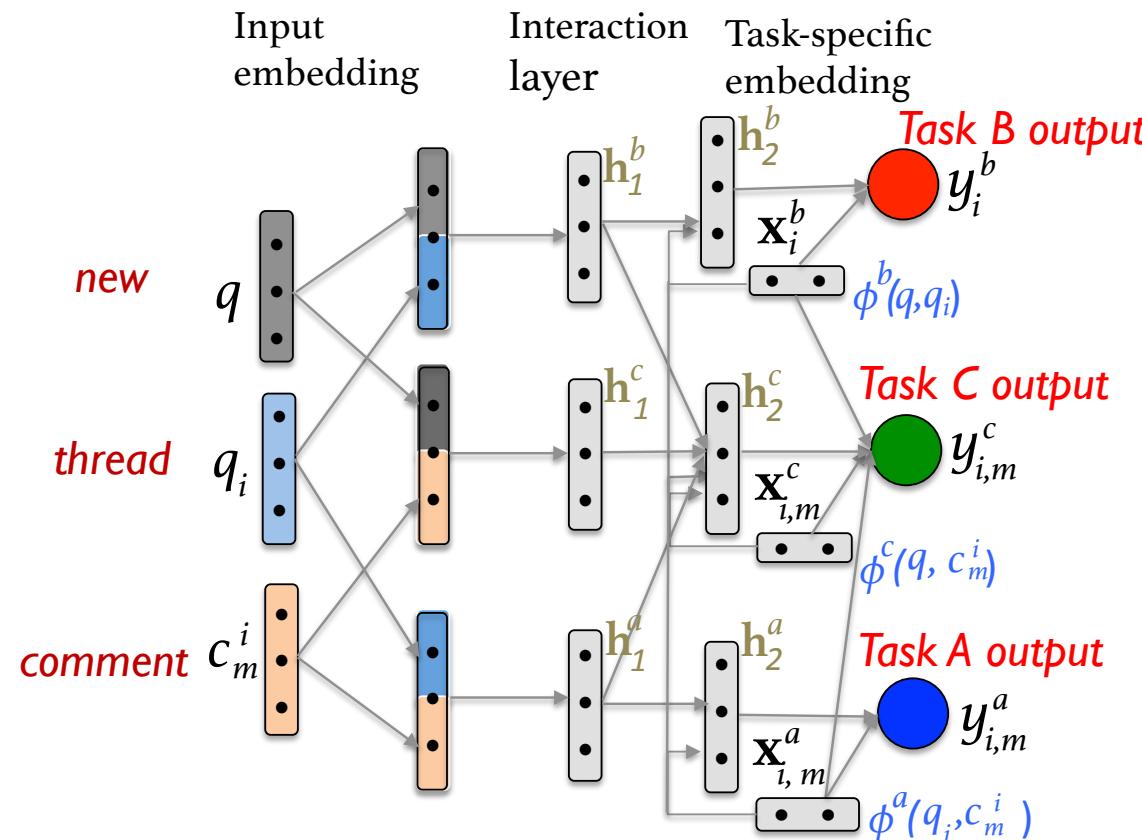
In future,

- Couple DNN and CRF for end-to-end training
- Better embeddings (ELMo, BERT)
- Evaluate on Semeval-2017 dataset

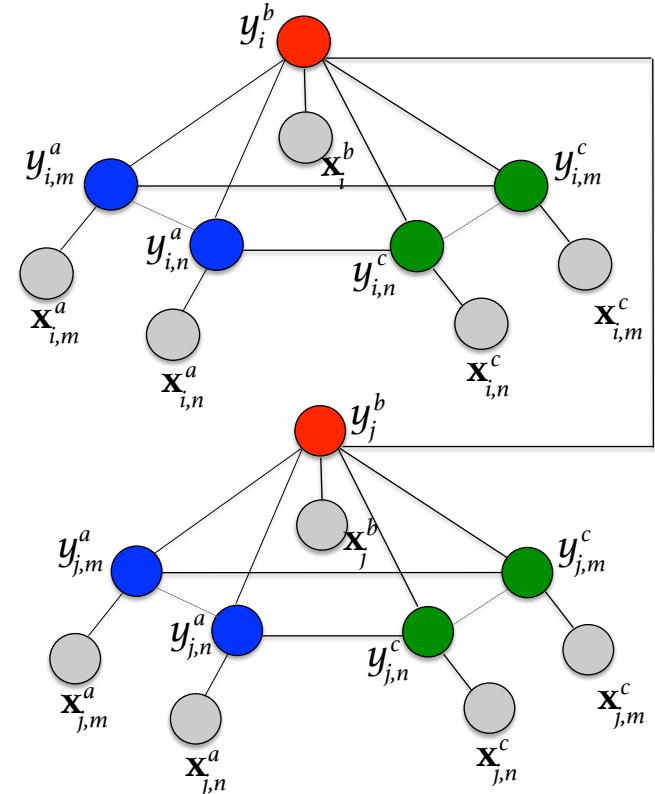
# Thanks!

# Questions?

# Multi-Task cQA Model



Feed-forward NN for cQA tasks  
& task-specific encoding



Joint CRF model

# cQA Datasets

- SemEval-2016 Task 3 (Nakov et al., 2016)

Category	Train (1st part)	Train (2nd part)	Train+Dev+Test (from SemEval 2015)	Dev	Test	Total
<b>Original Questions</b>	200	67	-	50	70	387
<b>Related Questions</b>	<b>1,999</b>	<b>670</b>	<b>2,480+291+319</b>	<b>500</b>	<b>700</b>	<b>6,959</b>
– <i>Perfect Match</i>	181	54	-	59	81	375
– <i>Relevant</i>	606	242	-	155	152	1,155
– <i>Irrelevant</i>	1,212	374	-	286	467	2,339
<b>Related Comments (with respect to Original Question)</b>	<b>19,990</b>	<b>6,700</b>	<b>14,893+1,529+1,876</b>	<b>5,000</b>	<b>7,000</b>	<b>56,988</b>
– <i>Good</i>	1,988	849	7,418+813+946	345	654	13,013
– <i>Bad</i>	16,319	5,154	5,971+544+774	4,061	5,943	38,766
– <i>Potentially Useful</i>	1,683	679	1,504+172+156	594	403	5,191
<b>Related Comments (with respect to Related Question)</b>	<b>14,110</b>	<b>3,790</b>	-	<b>2,440</b>	<b>7,000</b>	<b>27,340</b>
– <i>Good</i>	5,287	1,364	-	818	2,767	10,236
– <i>Bad</i>	6,362	1,777	-	1,209	3,090	12,438
– <i>Potentially Useful</i>	2,461	649	-	413	1,143	4,666

# DNN Results

## Subtask A

<i>System</i>	MAP	AvgRec	MRR
Random order	52.80	66.52	58.71
Chronological order	59.53	72.60	67.83
ConvKN (second at SE-2016)	77.66	88.05	84.93
Kelp (best at SE-2016)	79.19	88.82	86.42
<b>DNN<sub>A</sub> (subtask A network)</b>	<b>76.20</b>	<b>86.52</b>	<b>84.95</b>

## Subtask B

<i>System</i>	MAP	AvgRec	MRR
Random order	46.98	67.92	50.96
IR order	74.75	88.30	83.79
ConvKN (second at SE-2016)	76.02	90.70	84.64
UH-PRHLT (best at SE-2016)	76.70	90.31	83.02
<b>DNN<sub>B</sub> (subtask B network)</b>	<b>76.27</b>	<b>90.27</b>	<b>83.57</b>
DNN <sub>B</sub> + A gold labels	76.10	89.96	83.62
DNN <sub>B</sub> + C gold labels	77.19	90.78	83.73
DNN <sub>B</sub> + A and C gold labels	77.12	90.71	83.73

## Subtask C

<i>System</i>	MAP	AvgRec	MRR
Random order	15.01	11.44	15.19
IR+Chron. order	40.36	45.97	45.83
Kelp (second at SE-2016)	52.95	59.27	59.23
SUPER team (best at SE-2016)	55.41	60.66	61.48
<b>DNN<sub>C</sub> (subtask C network)</b>	<b>54.24</b>	<b>58.30</b>	<b>61.47</b>
DNN <sub>C</sub> + A gold labels	61.14	66.67	66.86
DNN <sub>C</sub> + B gold labels	56.29	61.11	62.67
DNN <sub>C</sub> + A and B gold labels	63.49	71.16	68.19

# cQA Results

## Subtask B Results

#	System	Comments	MAP	AvgRec	MRR	Acc	P	R	F <sub>1</sub>
1	DNN <sub>B</sub>	Subtask B network	76.27	90.27	83.57	76.39	<b>89.53</b>	33.05	48.28
2	DNN <sub>B+PA</sub>	DNN <sub>B</sub> with A predicted labels	76.08	89.99	83.38	77.40	86.41	38.20	52.98
3	DNN <sub>B+PC</sub>	DNN <sub>B</sub> with C predicted labels	76.33	90.38	83.62	77.40	83.19	40.34	54.34
4	DNN <sub>B+PA+PC</sub>	DNN <sub>B</sub> with A and C predicted labels	76.43	90.34	83.62	77.11	78.74	42.92	55.56
5	CRF <sub>Bf</sub>	CRF with fully connected B	76.41	90.34	83.81	77.00	84.62	37.76	52.23
6	CRF <sub>ACBC,Bf</sub>	CRF <sub>ACBC</sub> with fully connected B	<b>76.89</b>	90.87	84.19	77.86	76.00	<b>48.93</b>	<b>59.53</b>
7	CRF <sub>ACBC,AfBf</sub>	CRF <sub>ACBC</sub> with fully connected A and B	76.51	90.64	84.19	78.29	83.47	43.35	57.06
8	CRF <sub>ACBC,BfCf</sub>	CRF <sub>ACBC</sub> with fully connected B and C	76.87	<b>90.96</b>	84.44	77.86	78.68	45.92	58.00
9	CRF <sub>ACBC,f</sub>	CRF <sub>ACBC</sub> with all layers fully connected	76.25	90.38	<b>84.62</b>	<b>78.57</b>	81.20	46.35	59.02

# cQA Results

## Subtask C Results

#	System	Comments	MAP ( $\Delta$ )	AvgRec ( $\Delta$ )	MRR ( $\Delta$ )
1	DNN <sub>C</sub>	Subtask C network	54.24	58.30	61.47
2	DNN <sub>C+PA</sub>	DNN <sub>C</sub> with A predicted labels	55.21 (+0.97)	58.36 (+0.06)	62.69 (+1.22)
3	DNN <sub>C+PB</sub>	DNN <sub>C</sub> with B predicted labels	54.17 (-0.04)	58.17 (-0.13)	62.55 (+1.08)
4	DNN <sub>C+PA+PB</sub>	DNN <sub>C</sub> with A and B predicted labels	55.11 (+0.90)	58.69 (+0.39)	60.10 (-1.37)
5	CRF <sub>AC</sub>	CRF with A-C connections	55.42 (+1.18)	58.69 (+0.39)	63.25 (+1.78)
6	CRF <sub>BC</sub>	CRF with B-C connections	55.20 (+0.96)	58.87 (+0.57)	62.30 (+0.83)
7	CRF <sub>ACBC</sub>	CRF with A-C and B-C connections	<b>56.00</b> (+1.76)	60.20 (+1.90)	<b>63.25</b> (+1.78)
8	CRF <sub>all</sub>	CRF with all pairwise connections	55.81 (+1.57)	60.15 (+1.85)	62.68 (+1.21)
9	CRF <sub>ACBC,C<sup>f</sup></sub>	CRF <sub>ACBC</sub> with fully connected C	55.73 (+1.49)	59.77 (+1.47)	62.80 (+1.33)
10	CRF <sub>ACBC,A<sup>f</sup>C<sup>f</sup></sub>	CRF <sub>ACBC</sub> with fully connected A and C	55.54 (+1.30)	59.86 (+1.56)	62.54 (+1.07)
11	CRF <sub>ACBC,B<sup>f</sup>C<sup>f</sup></sub>	CRF <sub>ACBC</sub> with fully connected B and C	55.67 (+1.43)	<b>60.22</b> (+1.92)	62.80 (+1.33)
12	CRF <sub>ACBC,f</sub>	CRF <sub>ACBC</sub> with all layers fully connected	55.81 (+1.57)	60.15 (+1.85)	<b>63.25</b> (+1.78)