

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

Shafiq Joty

Nanyang Technological  
University

Lluís Màrquez

Core AI-Barcelona  
Amazon

Preslav Nakov

Qatar Computing  
Research Institute,  
HBKU

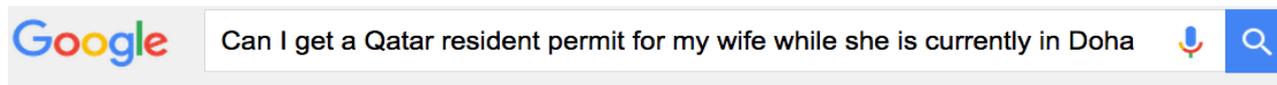


# Community Question Answering (cQA)

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



# Community Question Answering (cQA)



Web News Shopping Videos Images More Search tools

About 66,700 results (0.99 seconds)

**None has the answer!**

## Residence Permit - Family/Documents/Procedure | Qatar ...

[www.qatarliving.com](http://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](http://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](http://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](http://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)

**An answer exists!**

The image shows a screenshot of a Google search page. The search bar contains the text "resident permit for my wife 'tourist visa' in doha". Below the search bar, the "Web" tab is selected. The search results show "About 30,400 results". A prominent result is from "www.qatarliving.com" with the title "About Qatar > Visas and Permits" and a snippet that reads: "Nov 25, 2013 - Hello All,I have my wife here in Qatar on family visit visa and ... I hope this helps to others who are planning to convert their visit visa to residence permit. ... and Iceland - can obtain a tourist visa upon arrival at the airport." Three purple callout boxes are overlaid on the image: one at the top right with the text "An answer exists!", one in the middle with "Can we do better?", and one at the bottom with "cQA system".

# A Question-Comment Thread

## Thread/existing question

### Family visit visa

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 immigration  
In Doha; immigration of  
our family visit visa this

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

### Comments

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 to gate # 1, time every morning



rej2k7

morning if its for 7th



blueagle69

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

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 ONE MORE DOUBT I HAVE WE NEED TO TAKE TICKET  
ALSO FOR EXTEN  
ENOUGH...WE AR

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?



anonymous

DEAR  
THAT PRINT  
WHEN U WENT T  
OFFICE U WENT?



emy007

as they dnt check  
u can go to madinat  
directly to reception

.. 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

Comments

# Community Question Answering

## Visa Extension for My Sister in Law?

Home >> About Qatar >> Advice and Help  
Poster by **dyotlmaj** 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

- ntiqbal: 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.
- blueag69: ... 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)?
- dyotlmaj: 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 kalifa? 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.
- blueag69: 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?
- em007: .. 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 reception without taking any number...

## New Visit Visa Extension?

Home >> About Qatar >> Advice and Help  
Poster by **zamilo** in **Advice and Help**

My brother applied for a visit visa extension for me. It was approved and I was extended for another 4 months. The visa extension form and a sticker in my passport. Any comments?

### Comments

visit visa can extend 1 more month after the 6th month but you...

New incoming question

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 6 months visa; can i get more 2/3 months visa?? what is the procedure?? pls inform.

# Community Question Answering

New incoming question

Qatar LIVING.COM CLASSIFIEDS FORUM GROUPS EVENTS QATAR GUIDE LOG IN POST

## Visa Extension for My Sister in Law?

Home >> About Qatar >> Advice and Help  
Poster by **dyotlmaj** 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

- ntfqbal: 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)?
- dyotlmaj: for wife the visa is extendable for 6mos.

Relevant

Qatar LIVING.COM CLASSIFIEDS FORUM GROUPS EVENTS QATAR GUIDE LOG IN POST

## New Visit Visa Extension?

Home >> About Qatar >> Advice and Help  
Poster by **zamilo** in Advice and Help

My brother applied for a visit visa extension for me. It wv and I was extended for another 4 months. The visa ext printed form and not a sticker in my passport. Any comm

Comments

- anonymo us: visit visa can extend 1 more month after the 6th month. but you need to show a plane ticket that on the expiry you will leave qatar.
- emv007: they dnt stick the sticker anymore; they will only give u printed form mentioning the expiry date...
- zamilo: thanks guys for the comments and info!

Irrelevant

Qatar LIVING.COM CLASSIFIEDS FORUM GROUPS EVENTS QATAR GUIDE LOG IN POST

## 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 kalifa? We need to extend our family visit visa this month end then six months finished ...

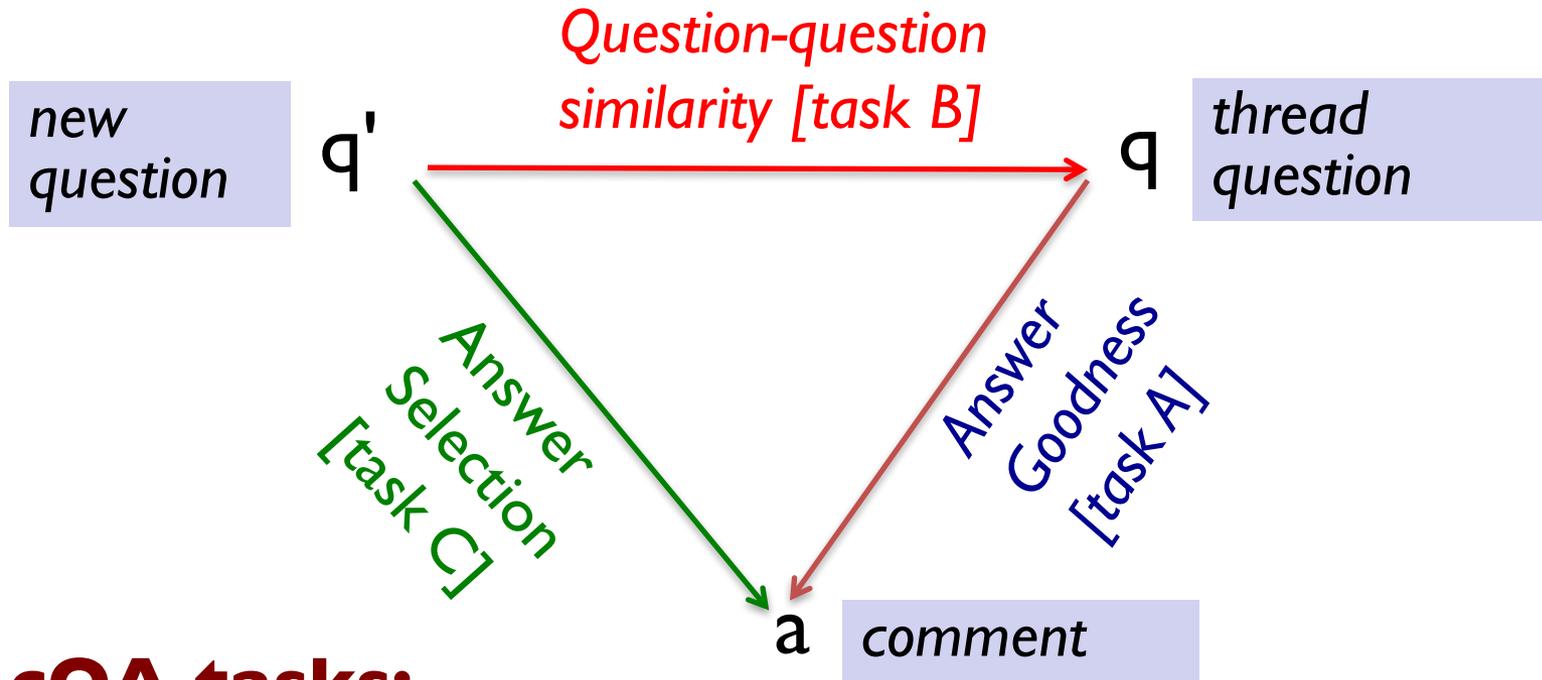
Comments

- roj2k7: 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?
- emv007: .. 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 reception without taking any number...

Relevant

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.

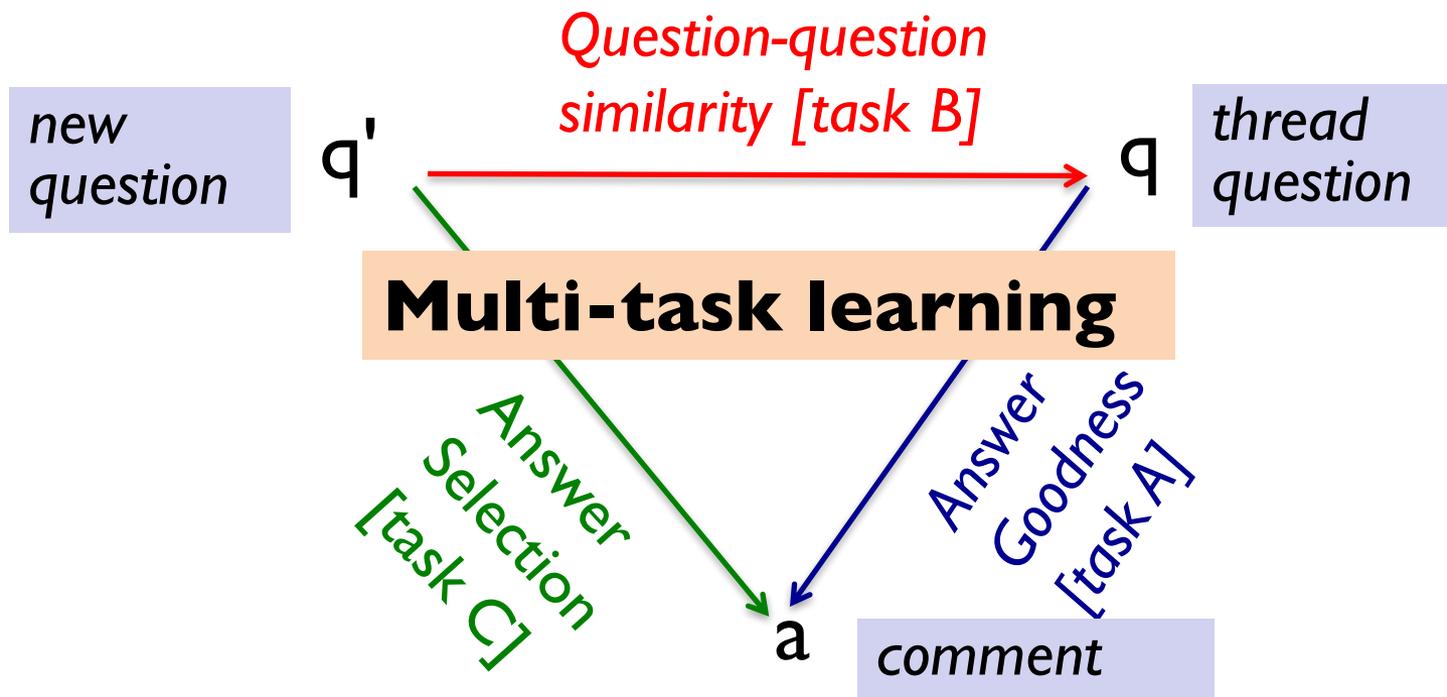
# Research Challenges in cQA



## **cQA tasks:**

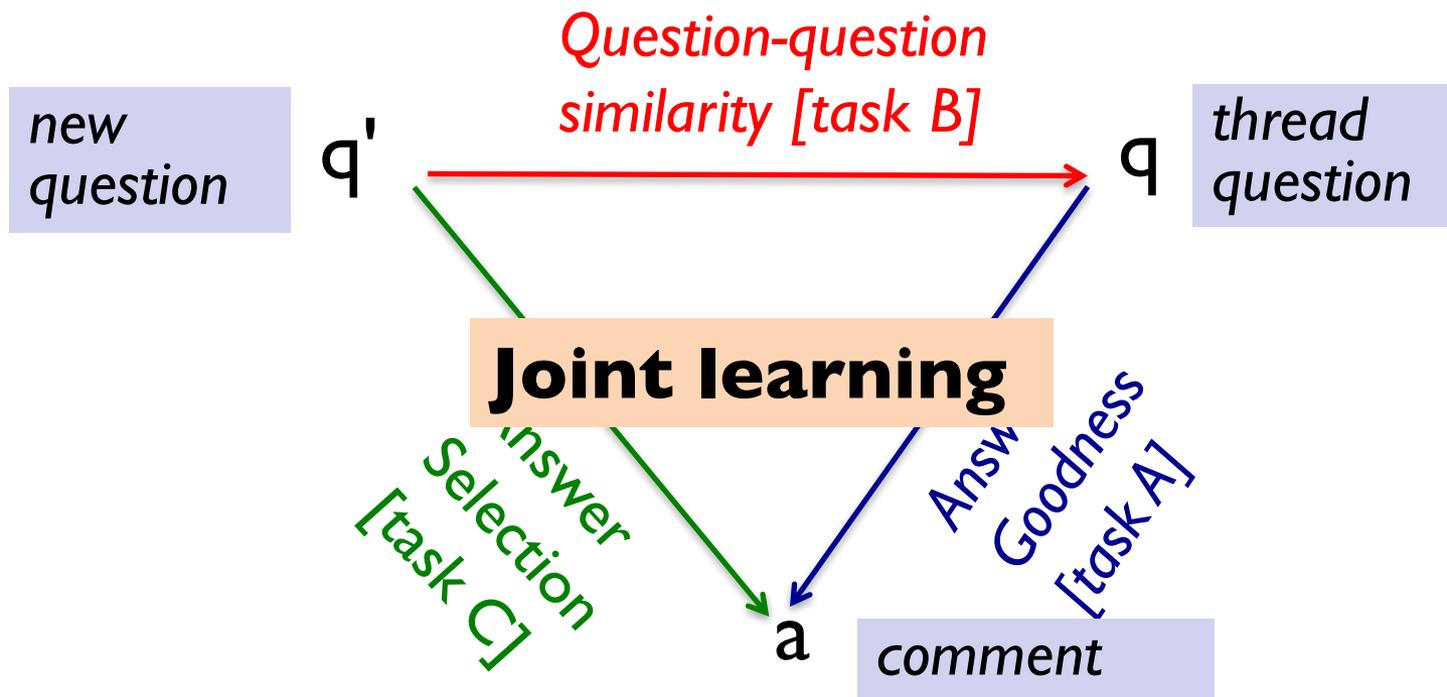
- A.  $q$  to  $a$  (answer goodness) [SemEval'15, SemEval'16]
- B.  $q'$  to  $q$  (question-question similarity) [SemEval'16]
- C.  $q'$  to  $a$  (answer selection; main task) [SemEval'16]

# 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

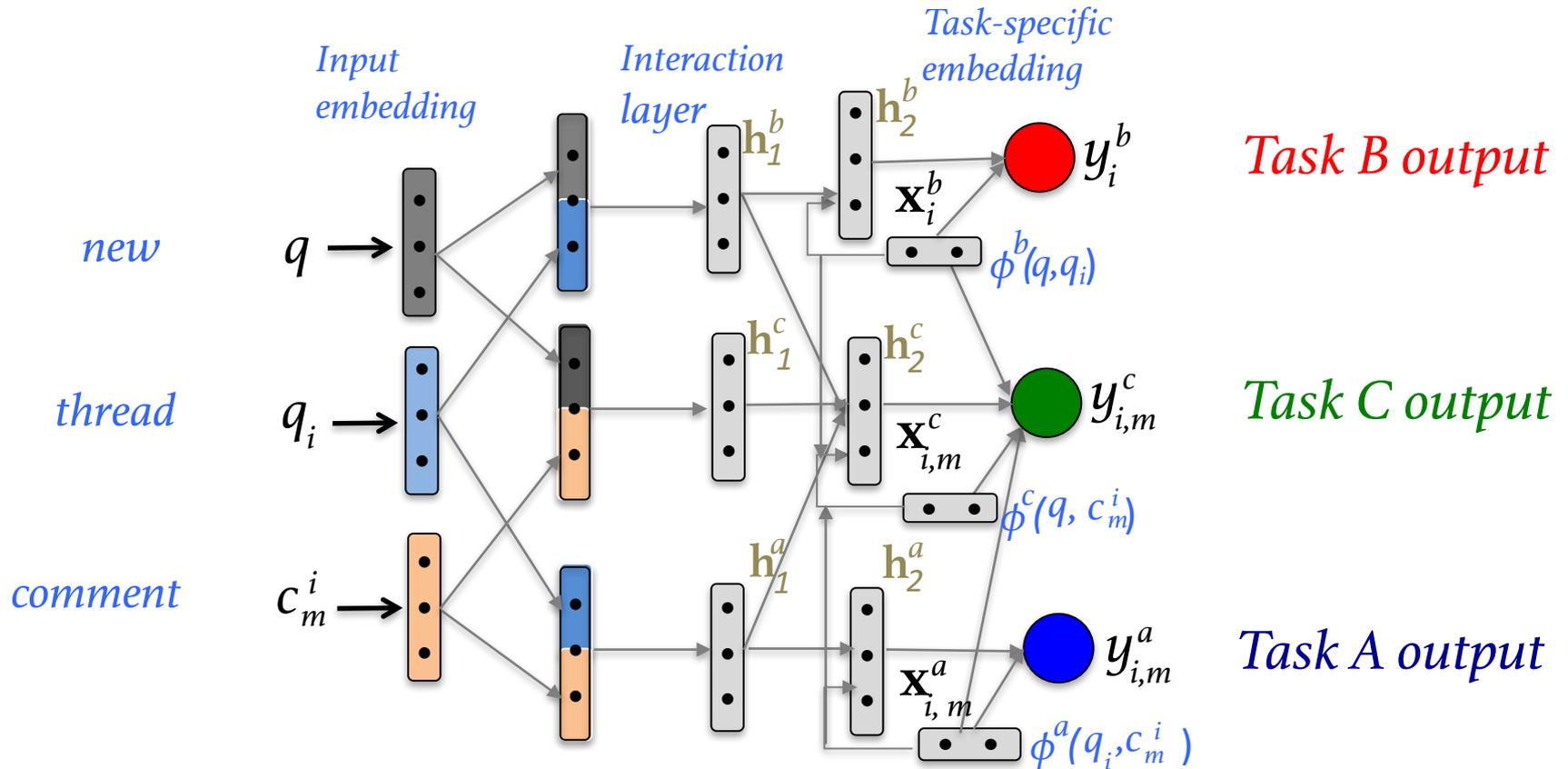


- Similar comments should have same class labels (for **task A** and **task C**)
- Similar questions should have same class labels (for **task B**)

# Our Approach

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

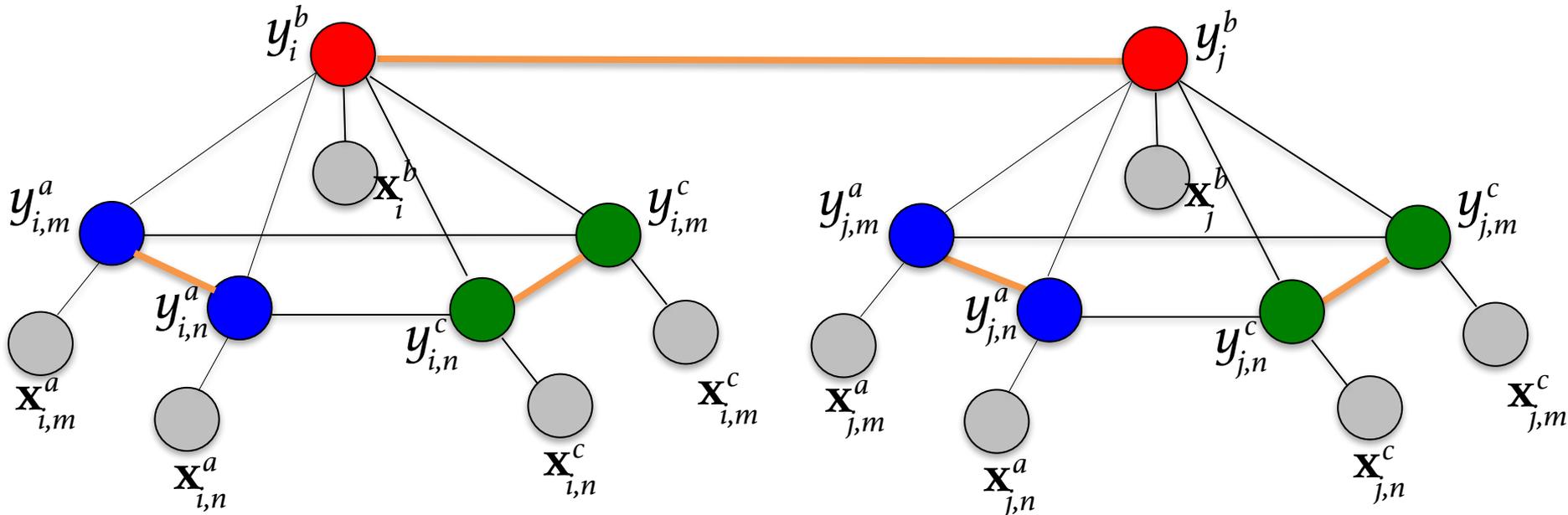
# Task-specific Representation for cQA



**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	<b>MAP</b>	<b>AvgRec</b>	<b>MRR</b>
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
SUper 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

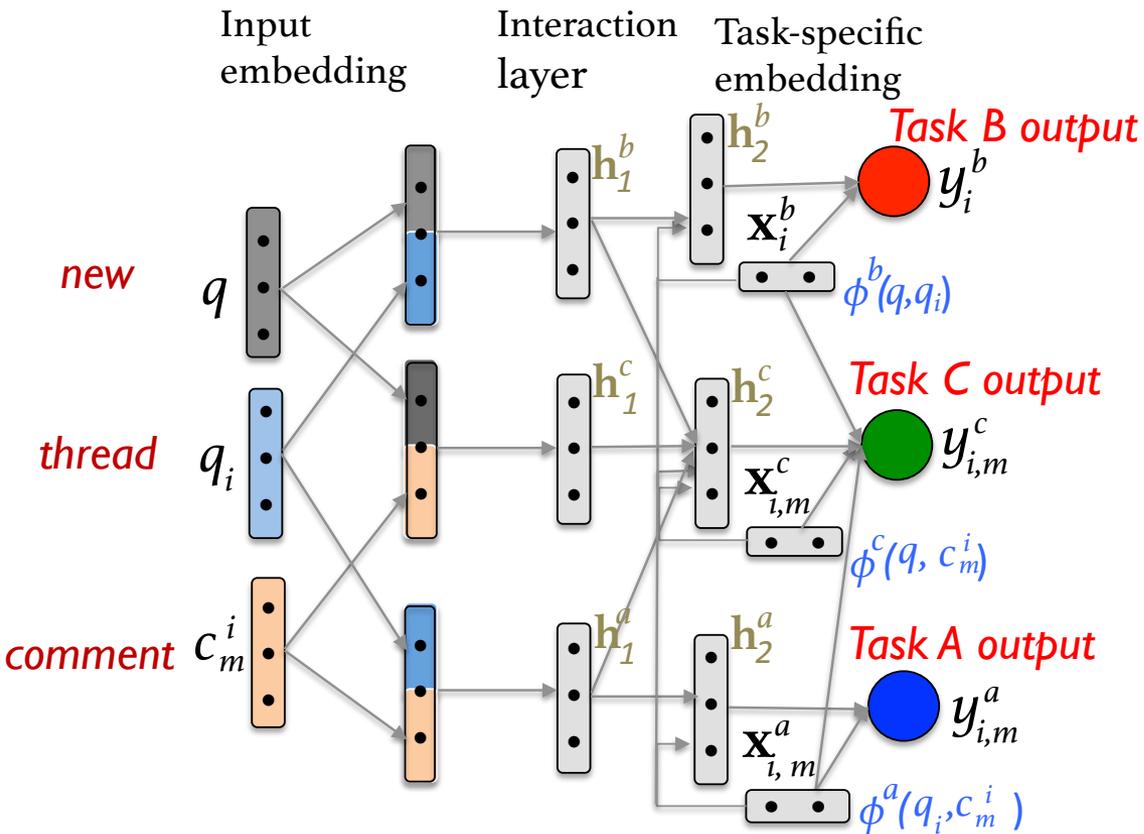
In future,

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

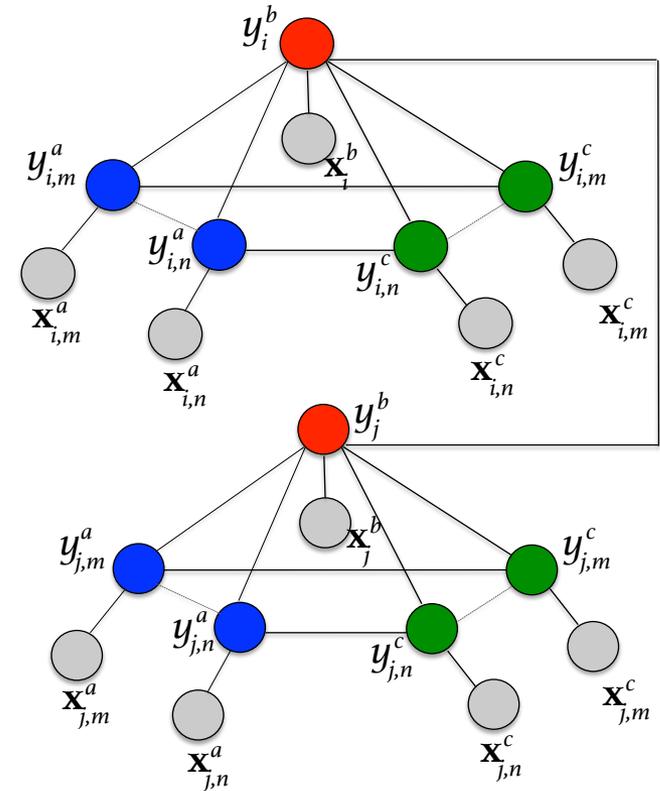
Thanks!

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>	<b>200</b>	<b>67</b>	<b>-</b>	<b>50</b>	<b>70</b>	<b>387</b>
<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>-</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	$DNN_C$	Subtask C network	54.24	58.30	61.47
2	$DNN_{C+PA}$	$DNN_C$ with A predicted labels	55.21 (+0.97)	58.36 (+0.06)	62.69 (+1.22)
3	$DNN_{C+PB}$	$DNN_C$ with B predicted labels	54.17 (-0.04)	58.17 (-0.13)	62.55 (+1.08)
4	$DNN_{C+PA+PB}$	$DNN_C$ with A and B predicted labels	55.11 (+0.90)	58.69 (+0.39)	60.10 (-1.37)
5	$CRF_{AC}$	CRF with A-C connections	55.42 (+1.18)	58.69 (+0.39)	63.25 (+1.78)
6	$CRF_{BC}$	CRF with B-C connections	55.20 (+0.96)	58.87 (+0.57)	62.30 (+0.83)
7	$CRF_{ACBC}$	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	$CRF_{all}$	CRF with all pairwise connections	55.81 (+1.57)	60.15 (+1.85)	62.68 (+1.21)
9	$CRF_{ACBC,C^f}$	$CRF_{ACBC}$ with fully connected C	55.73 (+1.49)	59.77 (+1.47)	62.80 (+1.33)
10	$CRF_{ACBC,A^fC^f}$	$CRF_{ACBC}$ with fully connected A and C	55.54 (+1.30)	59.86 (+1.56)	62.54 (+1.07)
11	$CRF_{ACBC,B^fC^f}$	$CRF_{ACBC}$ with fully connected B and C	55.67 (+1.43)	<b>60.22</b> (+1.92)	62.80 (+1.33)
12	$CRF_{ACBC,f}$	$CRF_{ACBC}$ with all layers fully connected	55.81 (+1.57)	60.15 (+1.85)	<b>63.25</b> (+1.78)