

[Supplementary material]

A Read-Write Memory Network for Movie Story Understanding

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<https://github.com/seilna/RWMN>

1. Validation and Test performance on All Tasks of MovieQA Benchmark

Table 1 summarizes the performance comparison between our method RWMN and all the methods proposed in the original MovieQA paper [2] or in the official MovieQA leaderboard¹ as of the ICCV submission deadline. We strictly follow the test protocols of the challenge, including training/validation/test split and evaluation metrics. We report the results of all available tasks of Movie QA benchmark, which include six tasks on the test set: *Video+subtitle*, *Subtitle*, *Script*, *DVS*, *Plot*, and *Open-end*, and five tasks on the validation set (*i.e.* the open-end task provides the test set only). We measure the validation performance on the validation data set given by the official split of the public MovieQA benchmark, and obtain the test performance by submitting to RWMN’s prediction on the MovieQA evaluation server. For fair comparison with other methods, we do not use any ensemble or bagging for our RWMN model.

In summary, our RWMN achieves the best performance for four out of five tasks in the validation set, and four out of six tasks in the test set. Note that for the *plot synopsis* task, simple word matching algorithms (with little movie understanding) perform better than memory network models, including MEN2N [2] and our RWMN. It is due to that the plot synopses are given for this task, and much of test QA pairs are generated from plot synopses. Only in the test set of DVS,

¹<http://movieqa.cs.toronto.edu/leaderboard/>.

Method	Video+Subtitle		Subtitles		Scripts		DVS		Plot synopses		Open-end
	val	test	val	test	val	test	val	test	val	test	
MEMN2N [2]	34.2	–	38.0	36.9	42.3	37.0	33.0	35.0	40.6	38.4	–
SSCB-W2V [2]	–	–	24.8	23.7	25.0	24.4	24.8	24.9	45.1	45.6	–
SSCB-TF-IDF [2]	–	–	27.6	26.5	26.1	23.9	24.5	23.3	48.5	47.4	–
SSCB Fusion [2]	21.9	–	27.7	–	28.7	–	24.8	–	56.7	56.7	–
Convnet Fusion (TF-IDF+W2V)	–	–	–	–	–	–	–	–	–	77.6	–
TF-IDF Similarity Weights	–	–	–	–	–	–	–	–	–	76.6	–
TF-IDF on Sentence Level	–	–	–	–	–	–	–	–	–	75.6	–
CNN Word Matching [3]	–	–	–	–	–	–	–	–	72.1	72.9	–
TF-IDF Replicate	–	–	–	–	–	–	–	–	–	47.5	–
Simple TF-IDF	–	–	–	–	–	–	–	–	–	20.7	–
Longest Answer	–	–	–	–	–	–	–	–	–	–	25.6
Deep Embeded Memory Network	–	30.0	–	–	–	–	–	–	–	–	–
Visual Model+LSTM+discriminativeCNN	–	24.3	–	–	–	–	–	–	–	–	–
Video clip feature with simple MLP	–	24.1	–	–	–	–	–	–	–	–	–
Only Video Question Answers Pairs	–	23.6	–	–	–	–	–	–	–	–	–
Video clip feature with LSTM + CNN	–	23.5	–	–	–	–	–	–	–	–	–
video based baselines, ranking loss	–	26.5	–	–	–	–	–	–	–	–	–
RWMN (Single)	38.7	36.3	40.4	38.5	44.0	39.4	40.0	34.2	37.0	34.8	34.8

Table 1. Performance comparison for all tasks on MovieQA public validation/test dataset. (–) indicates that the method does not participate on the task. The description of baselines with no reference can be found in the MovieQA leaderboard.

our RWMN is runner-up, although the performance gap with the best model is very marginal (MEN2N [2]: 35.0% and our RWMN: 34.2%). We hypothesise, its main reason is that the training set of the DVS category is so small (*i.e.* only 1,594 QA pairs in 39 movies), and thus the learning of RWMN is rather unstable due to increased parameters in the read/write networks.

We observe that the performance of RWMN slightly increases by using the sharpening strength introduced by the Neural Turing Machine [1]. Although the memory size of RWMN can be reduced through the read/write network, the memory size is still very large, and it causes a difficulty in effectively drawing attentions on the memory.

2. An Ablation Study on Single-Layer Write/Read Network

Table 2 presents the result of ablation experiments on hyperparameter changes of single-layer write/read network. We report the validation performance of four tasks, by varying n (the number of blocks of \mathbf{E}), the vertical and horizontal convolution size of the write network (f_v^w, f_h^w), the output channel size (f_c^w), the vertical and horizontal stride size of the write network (s_v^w, s_h^w), and the vertical and horizontal convolution size (f_v^r, f_h^r) of the read Network, and output channel size (f_c^r). The time for forward pass of RWMN linearly increases with the convolution filter sizes. Therefore, we set the upper bound of the number of parameters of convolution filters up to about 100,000. Similar to multi-layer write/read Network, no special correlation is observed between the story length n and the hyperparameters of the write/read network. In particular, in all cases, we achieve the best performance when (i) equalizing the horizontal convolution size to d (*i.e.* the memory dimension), or (ii) using the stride size of 1.

3. More Examples of Question Answering

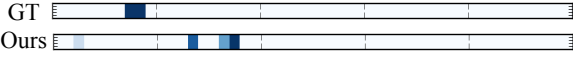
Figure 1–2 illustrate selected qualitative examples of *video+subtitle* problems solved by our methods, including success cases in Figure 1 and near-miss cases in Figure 2. In each example, we present a sampled query video, a question, and five answer choices in which ground truth is in bold and our model’s selection is red checked. Figure 3–6 show qualitative examples of *subtitle*, *script*, *DVS*, and *plot synopsis* tasks, respectively. As shown in the examples, all question answering tasks are highly challenging, and sometimes is not easy even for human. As shown in Figure 6, plot synopsis problems can be effectively addressed using word/sentence matching methods rather than memory network methods with story comprehension, because question and answers are constructed by slightly modifying selected sentences of plot synopsis.

References

- [1] A. Graves, G. Wayne, and I. Danihelka. Neural Turing Machines. *arXiv preprint arXiv:1410.5401*, 2014. 2
- [2] M. Tapaswi, Y. Zhu, R. Stiefelwagen, A. Torralba, R. Urtasun, and S. Fidler. MovieQA: Understanding Stories in Movies through Question-answering. In *CVPR*, 2016. 1, 2
- [3] S. Wang and J. Jiang. A Compare-Aggregate Model for Matching Text Sequences. In *ICLR*, 2017. 1

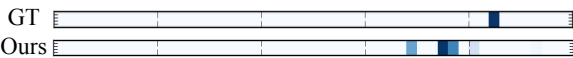
Story sources	write-conv-filter $[f_v^w, f_h^w, f_c^w]$	write-stride $[s_v^w, s_h^w]$	read-conv-filter $[f_v^r, f_h^r, f_c^r]$	Accuracy
Video+Subtitles($n \sim 976$)	MEMN2N			34.2
	[7,16,1]	[1,16]	[3,300,1]	27.0
	[7,271,1]	[1,15]	[3,300,1]	27.2
	[7,300,1]	[3,1]	[3,300,1]	33.9
	[10,300,1]	[3,1]	[3,300,1]	33.8
	[20,300,1]	[10,1]	[3,300,1]	33.4
	[30,300,1]	[20,1]	[3,300,1]	34.0
	[40,300,1]	[30,1]	[3,300,1]	36.2
	[40,300,3]	[30,1]	[3,300,1]	38.6
	[40,1000,3]	[30,1]	[5,1000,1]	38.0
	[40,1000,3]	[30,1]	[5,1000,3]	38.2
Subtitle($n \sim 1558$)	MEMN2N			38.0
	[10,300,1]	[5,1]	[3,300,1]	38.3
	[20,300,1]	[10,1]	[3,300,1]	37.5
	[20,300,3]	[10,1]	[3,300,1]	37.7
	[40,300,3]	[25,1]	[3,300,1]	37.5
	[40,300,3]	[30,1]	[3,300,1]	37.7
	[40,300,3]	[35,1]	[3,300,1]	37.4
	[50,300,3]	[35,1]	[3,300,1]	37.3
	[60,300,3]	[30,1]	[3,300,1]	37.5
	[100,300,3]	[100,1]	[3,300,1]	37.3
	[150,300,3]	[100,1]	[3,300,1]	37.5
	[10,1000,1]	[5,1]	[3,1000,1]	40.4
	[40,1000,3]	[30,1]	[3,1000,1]	40.0
Scripts ($n \sim 2, 877$)	MEMN2N			42.3
	[20,300,3]	[10,1]	[3,300,1]	39.4
	[20,300,1]	[10,1]	[3,300,1]	42.1
	[30,300,1]	[20,1]	[3,300,1]	38.5
	[40,300,1]	[20,1]	[3,300,1]	38.5
	[40,300,3]	[20,1]	[3,300,1]	38.5
	[80,300,3]	[30,1]	[3,300,1]	39.7
	[100,300,3]	[70,1]	[3,300,1]	39.2
	[150,300,1]	[100,1]	[3,300,1]	41.0
	[300,300,1]	[150,1]	[3,300,1]	42.0
	[400,300,1]	[200,1]	[3,300,1]	38.5
	[20,1000,3]	[10,1]	[3,1000,1]	43.0
	[20,1000,1]	[10,1]	[3,1000,1]	44.0
DVS ($n \sim 636$)	MEMN2N			33.0
	[10,300,1]	[5,1]	[3,300,1]	38.3
	[20,300,1]	[10,1]	[3,300,1]	39.3
	[20,300,3]	[10,1]	[3,300,1]	40.0
	[20,500,3]	[10,1]	[3,500,3]	38.7
	[20,700,3]	[10,1]	[3,700,3]	37.8
	[40,300,1]	[20,1]	[3,300,1]	38.7

Table 2. Ablation experiments for several key hyperparameters of RWMN. We fix the stride size of read network to [1,1] in all experiments.



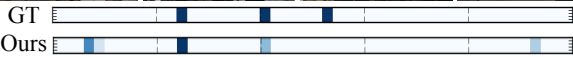
Q. How do Hermione and Ron react when they find out what Umbridge has been doing to Harry as punishment?

- A1. They are outraged**
- A2. They are apathetic
- A3. They are depressed
- A4. They think Harry is lying
- A5. They are ecstatic



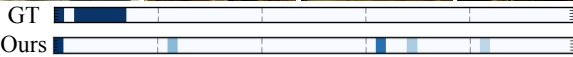
Q. How much money did the robbers steal from the bank?

- A1. None**
- A2. A few thousand dollars
- A3. Just a little
- A4. Over a million dollars
- A5. A few hundred dollars



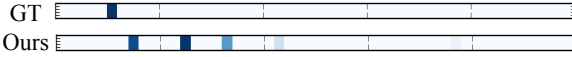
Q. What are the robbers doing in a storage room?

- A1. They are taking cocaine.
- A2. They are demolishing the floor.**
- A3. They are communicating with their boss through a secured line.
- A4. They are counting the money.
- A5. They are making various escape plans.



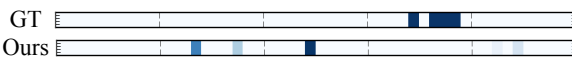
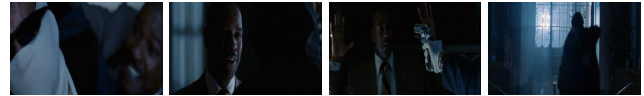
Q. What does Gandalf learn from Pippin's visions?

- A1. Sauron will attack Minas Tirith**
- A2. Sauron will hide in Minas Tirith
- A3. Sauron will attack Erebor
- A4. Sauron will attack The Shire
- A5. Sauron will flee from Minas Tirith



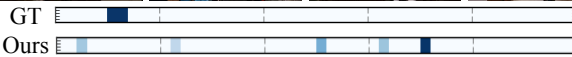
Q. Who is the Minister for Magic?

- A1. Cornell Fudge
- A2. Barty Crouch Sr.
- A3. Dolores Umbridge
- A4. Cornelius Fudge**
- A5. Dumbledore



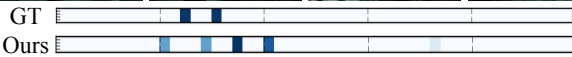
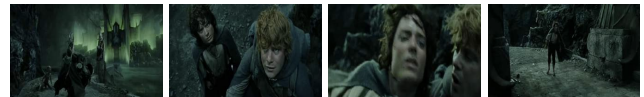
Q. What do the robbers do as revenge for Frazier's attack on Russell?

- A1. They shoot one of the police officers outside the bank
- A2. They shoot a hostage**
- A3. They shoot one of their fellow robbers
- A4. They demand more pizza
- A5. They let the hostages go



Q. How does Kevin respond to Milton's job offer at his firm?

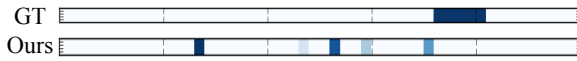
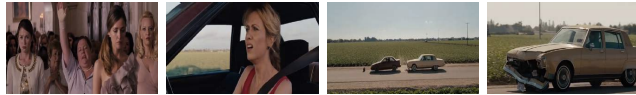
- A1. He refuses at first, but changes his mind when he is offered an upscale apartment.
- A2. He refuses the job.
- A3. He refuses the job, as Mary Ann doesn't want to live in Manhattan.
- A4. He accepts the job.**
- A5. He is reluctant at first, but later he accepts.



Q. What route do Sam, Frodo and Gollum take to reach Mordor?

- A1. They ride a large elevator up to Mordor
- A2. They climb up the side of the mountain to reach Mordor
- A3. They cross a long valley full of carnivorous animals and poisonous water to reach Mordor
- A4. They go up an enormous stairway in the cliff face to reach Mordor**
- A5. They go down an enormous stairway in the cliff face to reach Mordor

Figure 1. Qualitative examples of MovieQA video+subtitle problems solved by our methods. Bold sentences are ground truth answers and red check symbols indicate our model's selection. In each example, we show on which parts our RWMN model attend, over (about two-hour long) entire movie. The attention by the RWMN matches well the ground truth where the question is actually generated.



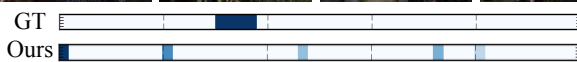
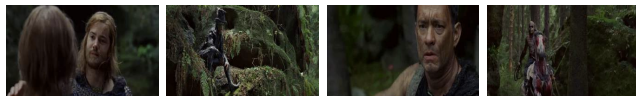
Q. Who is the responding officer for Annie's car accident?

- A1. Officer Helen
~~A2. Officer Ronson~~
 A3. Officer Cholodecki
A4. Officer Rhodes
 A5. Officer Johnson



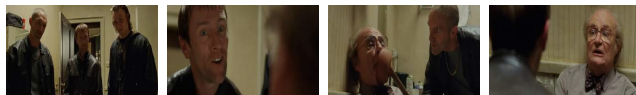
Q. Why did Lillian run away from her wedding?

- ~~A1. Because she spilled something on her dress right before the ceremony and was too embarrassed of everyone seeing~~
 A2. Because of Annie's extravagant planning and out of fear of leaving her life in Milwaukee
 A3. Because it didn't feel right without Annie there
 A4. No reason in particular
A5. Because of Helen's extravagant planning and out of fear of leaving her life in Milwaukee



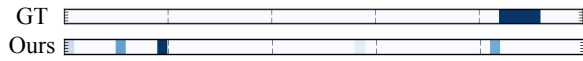
Q. What happens when the Kona tribe attack Zachry and his friends?

- A1. Koba eats Zachry and his friends
~~A2. Zachry is murdered but his companions escape~~
 A3. Zachry, his brother-in-law Adam, and his nephew are all murdered
A4. Zachry escapes but his companions are murdered
 A5. Zachry and his friends all escape from Kona



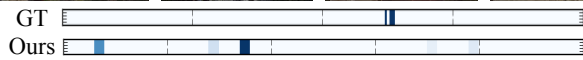
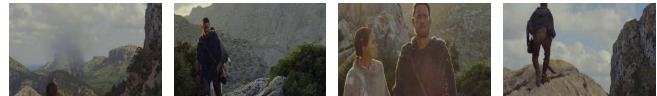
Q. Why do Hoggins' brothers threaten Cavendish?

- A1. They want \$10 million
A2. They want Hoggins' share of the profits
~~A3. They want Cavendish to write a bad review of Hoggins' book~~
 A4. They want Cavendish's share of the profits
 A5. They want Cavendish to write a good review of Hoggins' book



Q. What does Annie do when Ted asks her to perform oral sex on him during a ride home?

- A1. She breaks up with him and walks home**
~~A2. She agrees~~
 A3. She takes a taxi home
 A4. She breaks up with him and takes the bus home
 A5. She tells him to wait until they get back to her house



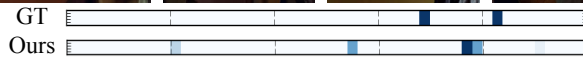
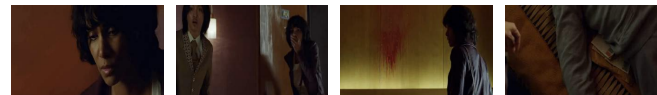
Q. What does Zachry find on his return to the Village after he lead Meronym to the station?

- A1. That the ship took away all his tribe
 A2. That Sonmi-451 has killed his tribe
~~A3. That his niece has been slaughtered by the Kona~~
A4. That his tribe has been killed by the Kona
 A5. That Catkin died after her sickness got worse



Q. Who is Meronym?

- ~~A1. He is a demonic figure~~
 A2. He is Zachry's brother-in-law
 A3. A member of the cannibalistic Kona tribe
 A4. The leader of Mauna Sol
A5. A member of an advanced society



Q. What does Rey find towards the end of the movie?

- ~~A1. She finds evidence that Hooks is planning a nuclear attack.~~
A2. She finds Frobisher's letters to Rufus.
 A3. She finds a recording of Sixsmith's "The Cloud Atlas Sextet".
 A4. She finds evidence that Frobisher is planning to devise a nuclear bomb.
 A5. She finds Sixsmith's letters to Frobisher.

Figure 2. Qualitative examples of MovieQA video+subtitle problems solved by our methods. Bold sentences are ground truth answers and red check symbols indicate our model's selection. In each example, we show on which parts our RWMN model attend, over (about two-hour long) entire movie. The attention by the RWMN matches well the ground truth where the question is actually generated.

(BELL DINGING)
 (TRAIN WHISTLE BLOWING)
 Hi.
 MAGGIE: Hi.
 How many?
 Two.
 Listen, I wanted to get a safe deposit box.
 Can you do that for me?
 (MELLOW MUSIC PLAYING)
 (SIGHS)
 Okay. Your box will be available any time from an hour after opening to
 This is your key.
 Thank you.
 Oh, um, also, if you open a checking account, we'll give you 5% off the
 Oh, here I was hopin' for a free toaster.
 (BOTH LAUGH)
 Why would a bank give out free toasters?
 (CELL PHONE BUZZING)
 Hello, Ma.
 I'm ordering you the French toast.
 Our very patient waitress, Maggie, well, at least it says Maggie on her
 If I don't order at this point, it's just rude.
 MAGGIE:
 I can come back.
 No, it's okay.
 You know what?
 I'm making an executive decision.
 No pancakes.
 I don't like pancakes.
 No pancakes.
 I'm thinkin' hash, but only if it's like chunky style, okay?
 Listen, if you order me eggs and pancakes, I'm gonna kick your behind.

Q. What threat does Greco hold over Trench and Stigman if they don't return his money?

- A1. That he will hurt their families.
- A2. That he will kill them
- A3. That Lean will die.
- A4. That Teemo will die.
- A5. That Deb will die.**

I wish you'd let me clean it.
 - Mum, it's a rental car. Come on!
 Thanks for a lovely Christmas.
 - Bye, Mum.
 Bye bye, my baby.
 She's 22, Mum.
 She's the youngest, she'll always be my baby.
 Take care.
 - Thank you for coming up to visit.
 See you, Pat.
 - Bye bye.
 You come back any time.
 You're always welcome.
 You two take care of each other.
 - We will.
 Bye, darling.
 - Bye, Mum.
 Two weeks on the road. Yes!
 - Holidays.
 Sure as shit beats being in the office.
 Where are we going to go first?
 - I want to see that crocodile place.
 Sounds good to me.
 We almost there?
 Yeah, pretty close.
 Can I have the book?
 - Yep. - Thanks.
 "Ainsley Crocodile Adventure Park.
 You can see the 'salties' being fed and tour the croc farm." -
 Same way you farm anything: Breed 'em, raise 'em, kill 'em and
 Which parts of the crocodile do they sell?
 "Crocodiles are harvested at 18 to 24 months, with 4 foot being
 t in South-East Asia the men believe eating the penis will impr
 and the aggression of the crocodile.

Q. Where is the Blackwater Barry Tour being held?

- A1. In a wildlife park**
- A2. In the Mangrove swamps**
- A3. On the river
- A4. On the crocodile island
- A5. In a zoo

Well, for my part, I would just like to say...
 that as the new guy taking over for you...
 I hope I can fill your shoes...
 because from the looks of the people here...
 and what they think about you, they seem awfully big.
 As most of you know, I just moved here recently...
 from Des Moines with my wife Patty here...
 and Kimberly our 14-month-old...
 and you all have made us feel so welcome.
 Warren, I want you to feel just as welcome...
 to drop by the office to visit any time you want.
 As we've been discussing the last couple of weeks...
 I might have some questions about our various products...
 like the universal life policy we're launching next month.
 And...
 Anyway, here's to you, Warren.
 Warren...
 how do you feel about these young punks taking our jobs?
 Seems like some kind of conspiracy to me.
 I've known Warren here...
 probably longer than most of you have been alive.
 Warren and I go way back...
 way back...
 to the horse and buggy days at Woodmen.
 But that's ancient history.
 Anyway, I know something about retirement...
 and what I want to say to you out loud, Warren...
 so all these young hotshots can hear...
 is that all those gifts over there...
 don't mean a Goddamn thing.
 And this dinner doesn't mean a Goddamn thing.
 And the Social Security and pension...

Q. Who writes back to Schmidt from Tanzania?

- A1. Helen
- A2. Ngudu
- A3. A nun**
- A4. The president
- A5. Roberta

With the coming of the Second World War...
 ...many eyes in imprisoned Europe turned hopefully, or desperately...
 ...toward the freedom of the Americas.
 Lisbon became the great embarkation point.
 But not everybody could get to Lisbon directly.
 And so a torturous, roundabout refugee trail sprang up.
 Paris to Marseilles...
 ...across the Mediterranean to Oran.
 Then, by train or auto or foot, across the rim of Africa...
 ...to Casablanca in French Morocco.
 Here, the fortunate ones, through money or influence or luck...
 ...might obtain exit visas and scurry to Lisbon.
 And from Lisbon to the New World.
 But the others wait in Casablanca.
 And wait and wait...
 ...and wait.
 To all officers:
 Two German couriers carrying official documents murdered on train from Oran.
 Murderer and possible accomplices headed for Casablanca.
 Round up all suspicious characters and search them for stolen document.
 Important.
 May we see your papers?
 I don't think I have them on me.
 - In that case, you'll have to come along.
 - Wait. It's possible that I...
 Yes. Here they are.
 These papers expired three weeks ago.
 You'll have to come along.
 Halt!
 Halt!
 - What on earth is going on there?
 - I don't know, my dear.

Q. What happens to Ugarte while he is in police custody?

- A1. He is abducted by the Germans
- A2. He dies**
- A3. He is beaten
- A4. He commits suicide**
- A5. He suffers a heart attack

Figure 3. Qualitative examples of MovieQA *subtitle* problems solved by our methods. Bold sentences are ground truth answers and red check symbols indicate our model's selection.

```

<TITLE>ALMOST FAMOUS by Cameron Crowe's </TITLE> <script>
/* Break-out-of-frames script By Website Abstraction (http://wsabstract.com)
Above notice MUST stay entact for use */
if (window!= top) top.location.href=location.href
</script>
Cameron Crowe December, 1998
A close-shot of a yellow legal tablet.
A young hand comes into frame, holding a pencil.
For a few moments, we hear only the soft scratching of pencil on paper, as cr
es.
The hand carefully erases and corrects an error or two along the way.
And then the sound of an old friend...
the warm crackle of a vinyl record...
as we now hear Alvin and the Chipmunks' "Christmas Song."
A lone palm tree rises up into a yellow afternoon sky.
Behind it, the sparkling blue of the Pacific Ocean and the city of San Diego.
A dry, hot Southern California day.
Even the wind is lazy, and a little bored.
Santa Claus wears shorts and sandals, ringing a bell as he collects for the S
This is Christmas in the Southland.
No snow, no winter wonderland.
Just a pleasantly thick heat and an unchanging season, as music continues.
Turning the corner, walking into frame is ELAINE MILLER, 35.
She is a tall woman, consumed by the fevered conversation she's
Having with her pale young son WILLIAM, late pre-teens.
They stand apart from the other shoppers.
All around them is the highly-charged salesmanship of the season...
silver glittering fake Christmas trees.
She hurries her son through the commercial juggernaut, continuing their livel
ing stops her.
A Workman is affixing letters to a store-front.
He has already placed the MERRY...
now he's finishing the XMAS.
Elaine is strong, but always pleasant, always clear about her purpose in this

```

Q. What does William as a 15-year old boy wish to become?

- A1. A lawyer and a rock journalist
- A2. A lawyer
- A3. A rock musician
- A4. A rock journalist**
- A5. An underground paper reporter

```

BRIDESMAIDS
Written by
Annie Mumolo
Annie is in nice lingerie, happily getting ready for the day.
She puts a lot of effort into her appearance.
Products everywhere, too many hair-flips, eye-cream, no hair out of place.
She walks into the bedroom, where TED, a gorgeous man sleeps.
She sneaks back into the bed, carefully positioning herself and moving the shee
She coughs and nudges Ted to wake him up then pretend sleeps.
TED Good morning.
TED Annie pretends to wake up.
Wow, you look beautiful.
What?
No.
I don't.
Oh my God its the morning.
I look terrible.
I just woke up.
TED Last night was fun.
ANNIE Yeah, I had the best time.
ANNIE I have't had that much fun on a first date in years, ever...
ANNIE She brushes the hair off his forehead as if he were her long time lover.
TED So listen Annie, I like you.
TED So, I want to be up front with you.
TED I'm not really looking for a relationship right now.
TED Annie's eyes grow large.
TED She uncomfortably smiles at him, nodding.
ANNIE Oooooo.
ANNIE Oops.
ANNIE I mean, yeah.
ANNIE What?
TED I just want to be honest right off the bat.

```

Q. What happens after Annie and Lillian reconcile?

- A1. Helen gets jealous again and insults Annie**
- A2. Annie helps Lillian cancel the wedding
- A3. Lillian helps Annie prepare for her wedding
- A4. Annie helps Lillian prepare for her wedding**
- A5. Annie helps Lillian break-up with her fiance

```

<u>BATMAN</u>
Screenplay by
Sam Hamm
Based on the Character Created by
Bob Kane
<u>FIRST DRAFT</u>
October 20, 1986
<u>EXT.
CITYSCAPE - NIGHT</u>
The place is Gotham City.
The time, 1987 -- once removed.
The city of Tomorrow: stark angles, creeping shadows, dense, crowded, airless, a random tangle of s
self-generating, almost subterranean in its aspect...
as if hell had erupted through the sidewalks and kept on growing.
A dangling fat moon shines overhead, ready to burst.
<u>EXT.
CATHEDRAL - NIGHT</u>
Amid the chrome and glass sits a dark and ornate Gothic anomaly: old City Cathedral, once grand, no
h since boarded up and scheduled for demolition.
On the rooftop far above us, STONE GARGOYLES gaze down from their shadowy, windswept perches, keepi
over the distant streets below, sightless guardians of the Gotham night.
One of them is moving.
<u>EXT.
GOTHAM SQUARE - NIGHT</u>
The pulsing heart of downtown Gotham, a neon nightmare of big-city corruption, almost surreal in it
Hookers wave to drug dealers.
Street hustlers slap high- fives with three-card monte dealers.
They all seem to <u>know</u> each other...
with one conspicuous exception:
A TOURIST FAMILY, Mom, Dad, and little Jimmy, staring straight ahead as they march in perfect locke
drag.
They've just come out of a bit show two blocks over; the respectable theatre crowd has thinned out,
lls in hand -- they find themselves adrift in the predatory traffic of Gotham's meanest street.
MOM For God's sake, Harold, can we please just get a <u>taxi</u>??
DAD I'm <u>trying</u> to get a --
Three cabs streak pass and disappear.
MOM grimaces in frustration as LITTLE JIMMY consults a subway map.

```

Q. Where does the Joker set a trap for Vicki?

- A1. At the Gotham Museum of Art**
- A2. At her house
- A3. At Gotham Police Station
- A4. At the Gotham Museum of History
- A5. At Bruce's mansion

```

CHRONICLE
Written by
Max Landis
Based on a story by
Josh Trank and Max Landis
CUT - to indicate time lapses within a scene
The room is dingy.
Unkempt.
The camera sits on the bed, on its side, facing the door.
We can hear someone moving around off screen.
The door handle clicks; someone's trying it.
Then nothing.
Then, suddenly, loud pounding on the door.
Andrew's voice is scratchy and prone to cracking.
He speaks with a rushed mix of fear and anxiety.
ANDREW What do you want, I'm getting ready for school-
MR. DETMER Why is the door locked, unlock this fucking door right now.
The bed stirs as Andrew sits down.
MR. DETMER (CONT'D) I said unlock this door.
MR. DETMER (CONT'D) UNLOCK
ANDREW You're drunk-
MR. DETMER Listen, you don't tell me- IF I'M
ANDREW It's seven thirty.
ANDREW In the AM.
ANDREW You're drunk, dad, that's crazy-
MR. DETMER What're you doing in there.
ANDREW I'm filming this.
MR. DETMER What?
ANDREW I bought a camera.
ANDREW I'm filming all your shit from now on.
There's a beat, and then we can hear Mr. Detmer moving away from the door.
Equally dingy.

```

Q. What does Matt do to stop Andrew from hurting innocent lives?

- A1. Matt impales Andrew with a spear from a statue**
- A2. Matt impales Andrew with a sword from a statue**
- A3. Matt doesn't do anything about it
- A4. Matt convinces him by talking to him
- A5. Matt stops Andrew by kidnapping his children

Figure 4. Qualitative examples of MovieQA *script* problems solved by our methods. Bold sentences are ground truth answers and red check symbols indicate our model's selection.

The driver leaves.
00:08:15,825 --> 00:08:18,800
Sighing, she digs out her keys and starts to fit it into the lock.
00:08:19,661 --> 00:08:21,575
Now, CAMERA FOLLOWING, she goes into the Salon.
00:08:21,983 --> 00:08:32,183
It is also empty -- stripped bare.
00:08:38,536 --> 00:08:41,239
There are squares of the wall's original color where paintings used to hang, th
00:08:41,389 --> 00:08:46,636
She rushes now, going into the bedroom, CAMERA FOLLOWING crazily, lurching and
00:08:46,811 --> 00:08:55,762
The bedroom, too, is empty.
00:08:56,005 --> 00:09:11,353
She goes to the built-in wardrobe closets and throws open all the doors.
00:09:11,529 --> 00:09:15,479
Only some hangers remain.
00:09:18,106 --> 00:09:18,631
She pulls open the drawers -- nothing.
00:09:19,315 --> 00:09:21,592

Q. What does Bartholomew reveal to Reggie about Carson Dyle's brother?

- A1. That Carson's brother is a professional thief
- A2. That Carson's brother is bedridden
- A3. That Carson's brother is in Africa
- A4. That Carson's brother is dead

A5. That Carson had no brother

00:09:11,724 --> 00:09:24,221
GANDALF leads ARAGORN, LEGOLAS, THEODEN and GIMLI through dark woodland.
00:09:24,221 --> 00:09:26,273
The MOVING FOREST of FANGORN.
00:09:26,796 --> 00:09:29,669
opens before them.
00:09:29,669 --> 00:09:36,781
creating an AVENUE of TREES, which allows them access along the old ISENGARD ROAD.
00:09:36,781 --> 00:09:39,454
A THICK, HUMID MIST fills the forest.
00:09:39,454 --> 00:09:46,041
The Return of the King ANGLE ON: The FOEST SEPARATES ahead, REVEALING: the RUINS of.
00:09:46,041 --> 00:09:47,189
All about, the GREAT STONE WALL is cracked and splintered into countless jagged shards.
00:09:47,189 --> 00:09:49,001
Far off, half veiled int he swirling STEAM, the TOWER of ORTHANC stands.

Q. Who takes a look at the palantir when Gandalf retrieves it from Saruman?

- A1. Frodo
- A2. Pippin**
- A3. Bilbo
- A4. Sam
- ~~A5. Gandalf~~

00:10:20,578 --> 00:10:22,140
Jenny's blindfolded with John's tie.
00:11:05,817 --> 00:11:09,711
She pets the pups.
00:12:07,259 --> 00:12:08,259
The Grogans' old hatchback arrives at the airport.
00:12:39,514 --> 00:12:41,360
The pup's sitting excitedly on the passenger seat.
00:12:42,000 --> 00:12:46,998
John watches as he paws at the upholstery.
00:13:28,142 --> 00:13:29,733
The pup stares at him.
00:13:38,906 --> 00:13:42,435
A police car drives past.
00:13:48,377 --> 00:13:50,421
John pulls into the driveway.

Q. How do readers accept John's column on Marley?

A1. It becomes a hit with readers

- A2. It becomes a flop with readers
- A3. It becomes an average hit with readers
- A4. Readers felt John's column contains adult contents.
- A5. John's column becomes unnoticed by the readers

00:07:25,193 --> 00:07:28,012
Mrs. Gump heads Forrest to the porch.
00:07:28,012 --> 00:07:29,774
She bends down to look Forrest in the eye.
00:07:45,842 --> 00:07:48,683
The principal sighs, then stands up.
00:07:48,813 --> 00:07:57,184
Forrest sits outside the principal's office and waits.
00:07:58,490 --> 00:08:00,736
The principal stands in front of Mrs. Gump.
00:08:02,138 --> 00:08:03,882
Forrest, sitting left, listens.
00:08:43,572 --> 00:08:50,779
Forrest sits outside the principal's office.
00:09:01,101 --> 00:09:06,768
Loud organic male grunts are heard coming from inside the house.
00:09:01,101 --> 00:09:04,066
Forrest sits on a swing outside the house.

Q. Why does Forrest undertake a three-year marathon?

- A1. He wants to find Jenny
- A2. Upset that Jenny left he decides to go for a run one morning and just keeps running**
- A3. He wants to get back in shape
- A4. He wants to raise awareness for cancer
- ~~A5. He wants to travel the country but doesn't want to drive~~

Figure 5. Qualitative examples of MovieQA DVS problems solved by our methods. Bold sentences are ground truth answers and red check symbols indicate our model's selection.

Criminals Robert Trench and Michael Stigman are questioned by the United States Border Patrol after a meeting with drug lord Manny "Papi" Greco in Mexico.

Unknown to Stigman, Trench is an undercover DEA agent and reports to his superior, Jessup, that he failed to acquire cocaine from Greco that they could use as evidence to convict him.

Against Jessup's orders, Trench decides to remain undercover and assist Stigman in robbing \$3 million from Greco, so they can prosecute Greco for money laundering.

Trench has a rendezvous with fellow DEA agent and former lover, Deb Rees, who is also seeing another man, while Stigman, an undercover Intelligence Specialist with the Navy SEALs, meets with his commanding officer, Harold Quince, who instructs Stigman to kill Trench so the Navy can use the stolen money to fund unauthorized covert operations.

During the heist, Trench and Stigman are surprised to find \$43.125 million in the vault instead of the expected \$3 million.

After the heist, Stigman follows orders to betray Trench and escape with the money, managing to pull his gun right as Trench is about to pull his own.

Unwilling to kill Trench, Stigman wounds Trench in the shoulder and leaves with the money.

Learning of this, Quince attempts to have Stigman killed. Stigman escapes after learning the money will be transferred to a Navy base in Corpus Christi.

Meanwhile, a man named Earl aggressively interrogates the bank manager about the stolen money and also questions the vet who treated Trench's wounds as he tracks Trench's movements.

Trench goes to Stigman's apartment to find out where he took the money, only to have Stigman contact him from a sniper's post across the street.

Q. What threat does Greco hold over Trench and Stigman if they don't return his money?

- A1. That he will hurt their families.
- A2. That he will kill them
- A3. That Lean will die.
- A4. That Teemo will die.
- A5. That Deb will die.**

The mayor of Gotham City orders District Attorney Harvey Dent and Police Commissioner James Gordon to increase police activity and combat crime in preparation for the city's bicentennial.

Reporter Alexander Knox and photojournalist Vicki Vale begin to investigate reports of a vigilante dubbed "Batman", who is targeting the city's criminals.

Mob boss Carl Grissom, who has already been targeted by Dent, discovers his mistress is involved with his second-in-command, Jack Napier. With the help of corrupt police lieutenant Max Eckhardt, Grissom sets up Napier to be murdered during a raid at the Axis Chemicals plant. During the ensuing shootout, Napier kills Eckhardt, after which Batman suddenly appears.

The two struggle, and Napier is accidentally knocked into a vat of chemical waste.

Batman flees, and Napier is presumed dead.

Batman is, in actuality, Bruce Wayne, a billionaire industrialist who, as a child, witnessed his parents' murder at the hands of a young psychopathic mugger.

Bruce meets and falls for Vicki at a fundraiser, and the two begin a relationship.

Meanwhile, Napier survives the accident, but is horribly disfigured with chalk-white skin, emerald-green hair and a permanent ruby-red grin.

Already a sociopath, Napier is driven completely insane by his plight, he reinvents himself as "The Joker", kills Grissom in revenge for his set-up, and usurps his criminal empire.

In addition, the Joker seeks retaliation against Batman, whom he blames for his disfigurement.

During his research for information about Batman, the Joker himself also falls for Vicki.

The Joker begins to terrorize the city, first by lacing hygiene products with a deadly chemical known as "Smilex", which causes victims to laugh to death when used in certain combinations.

The Joker then sets a trap at the Gotham Museum of Art for Vicki, and he and his henchmen vandalize the surrounding works of art.

Batman arrives and rescues Vicki, and the pair escape in the Batmobile.

Q. What happens to Napier during his fight with Batman?

- A1. He is pushed of a tall building.
- A2. He is knocked into a window and falls through it.
- A3. He is knocked into a vat of chemical waste.**
- A4.** He falls into a hole and breaks his leg.
- A5. He gets shot and is fatally wounded.

Warren Schmidt is retiring from his position as an actuary with Woodmen of the World, an insurance company in Omaha, Nebraska.

After a retirement dinner, Schmidt finds it hard to adjust to his new life, feeling useless.

He sees a television advertisement about a foster program for African children, Plan USA, and decides to sponsor a child.

He soon receives an information package with a photo of his foster child, a small Tanzanian boy named Ndugu Umbo, to whom he relates his life in a series of candid, rambling letters.

Schmidt visits his young successor to offer his help, but the offer is politely declined.

As he leaves the building, Schmidt sees the contents and files of his office, the sum of his entire career, set out for garbage collectors. He describes to Ndugu his longtime alienation from Helen, his wife, who suddenly dies from a blood clot in her brain just after their purchase of a Winnebago Adventurer motor home.

Jeannie, his only daughter, and her fiancé Randall Hertzler arrive from Denver.

They console him at the funeral, but Jeannie later berates him for taking his wife for granted, such as by refusing to fully pay for the Winnebago and burying her in a cheap casket.

He asks her to move back to take care of him, but she refuses.

Meanwhile, Randall tries to entice him into a pyramid scheme.

Schmidt feels his daughter could do better than Randall, a waterbed salesman.

After the couple leaves, Schmidt is overcome by loneliness.

He stops showering, sleeps in front of the television, and goes shopping with a coat over pajamas to load up on frozen foods.

In his wife's closet he discovers some hidden love letters disclosing his long-ago affair with Ray, a mutual friend, whom Schmidt angrily confronts.

He decides to take a journey alone in his new Winnebago to visit his daughter and convince her not to marry Randall.

He tells Jeannie he's leaving early for the wedding, but she makes it clear she doesn't want him there until right before the ceremony.

Schmidt decides to visit places from his past, including his college campus and fraternity at University of Kansas and his hometown in Nebraska.

Q. Who writes back to Schmidt from Tanzania?

- A1. Helen
- A2. Ngudu
- A3. A nun**
- A4.** The president
- A5. Roberta

Annie Walker is a single woman in her late 30s.

Following the failure of her bakery, she lost her boyfriend and her savings, forcing her to take a job as a sales clerk in a jewelry store and to share an apartment with an obnoxious roommate Gil and his sister Brynn.

Her business's failure was so painful that she has given up baking entirely.

She has a no-strings-attached sexual relationship with the self-absorbed Ted but hopes for something more from him.

Her best friend, Lillian, is virtually her only source of happiness.

Lillian becomes engaged and asks Annie to be her Maid of Honor.

At the engagement party, Annie meets Lillian's bridesmaids: cynical cousin Rita; idealistic friend Becca; the groom's raunchy sister Megan; and Helen, the rich and beautiful wife of the groom's boss.

Helen and Annie, who are jealous of each other's friendship with Lillian, take an instant dislike to each other, but Lillian persuades them to spend time together.

Annie takes Lillian and the bridesmaids to a Brazilian steak restaurant for lunch before going to a chic bridal shop.

However, Helen must use her influence to gain entry to the shop because Annie didn't make a reservation.

While trying on gowns, the whole party with the exception of Helen, who chose not to eat before the fitting becomes sick from food poisoning.

Later, Annie's suggestion of a bachelorette party at Lillian's parents' lake house is overruled in favor of a trip to Las Vegas planned by Helen.

Q. Who are Lillian's bridesmaids?

- A1. Rita, Becca, Jill, Helen
- A2. Rita, Becca, Megan, Helen**
- A3. Rita, Becca, Megan, Jill
- A4. Jill, Becca, Megan, Helen
- A5. Rita, Jill, Megan, Helen

Figure 6. Qualitative examples of MovieQA *plot synopsis* problems solved by our methods. Bold sentences are ground truth answers and red check symbols indicate our model's selection.