Supplementary Material:
Commonsense for Generative Multi-Hop Question Answering Tasks

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1 Experimental Setup

Datasets We test our model with and without commonsense addition on two challenging datasets that require multi-hop reasoning and external knowledge: NarrativeQA (Kočiskỳ et al., 2018) and QAngaroo-WikiHop (Welbl et al., 2018). NarrativeQA is a generative QA dataset where the passages are either stories or summaries of stories, and the questions ask about complex aspects of the narratives such as event timelines, characters, relations between characters, etc. Each question has two answers which are generated by human annotators and usually cannot be found in the passage directly. We focus on the summary subtask in this paper, where summaries have lengths of up to 1000 words.

We also test our model on WikiHop, a fact based, multi-hop dataset. Questions in WikiHop often require a model to read several documents in order to obtain an answer. We focus on the multiple-choice part of WikiHop, where models are tasked with picking the correct response from a pool of candidates. We rank candidate responses by calculating their generation probability based on our model. As this is a multi-document QA task, we first rank the candidate documents via TF-IDF cosine distance with the question, and then take the top k documents such that their combined length is less than 1300 words.

Evaluation Metrics We evaluate NarrativeQA on the metrics proposed by its original authors: Bleu-1, Bleu-4 (Papineni et al., 2002), METEOR (Banerjee and Lavie, 2005) and Rouge-L (Lin, 2004). We also evaluate on CIDEr (Vedantam et al., 2015) as it places emphasize on annotator consensus. For WikiHop, we evaluate on accuracy.

Training Details In training for both datasets, we minimize the negative log probability of generating the ground-truth answer with the Adam optimizer (Kingma and Ba, 2015) with an initial learning rate of 0.001, a dropout-rate of 0.2 (dropout is applied to the input of each RNN layer) and batch size of 24. We use 256 dimensional word embeddings and a hidden size of 128 for all RNNs and $k = 3$ hops of multi attention. At inference time we use greedy decoding to generate the answer.

2 Commonsense Extraction Examples

In Tables 1, 2, and 3, we demonstrate extracted commonsense examples for questions that require commonsense to reach an answer. We bold words in the question and in the extracted commonsense in cases where the commonsense knowledge explicitly bridges gaps between implicitly connected words in the context or question. The relevant context is also displayed, with context words that are key to answering the question (via commonsense) marked in bold. These are then followed by a context visualization described in the next section.

3 Commonsense Integration Visualization

We also visualize how much commonsense information is integrated into each part of the context by providing a visualization of the $\mathbf{z}_i$ value (see end of Sec. 3.3) for $i \in \{1, 2, 3\}$, which is the gate value signifying how much commonsense-attention representation is used in the output context representation. In the following examples, we use shades of blue to represent the average of $(1 - \mathbf{z}_i)$ at each word in the context (normalized within each hop), with deeper blue indicating the use of more commonsense information. As a general trend, we see that in the earlier hops, words which are near tokens that occur in both the con-

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text and commonsense paths have high activation, but the activation becomes more focused on the passage's key words with respect to the question, as the number of hops increase.

Commonsense Extraction and Visualization Examples

Question	What shore does Michael's **corpse** wash **up** on?
Context	"..as the play begins nora and cathleen receive word from the priest that a **body**, that may be their brother michael, has washed up on shore in donegal, the island farthest **north** of their home island of inishmaan.."
Answers	the shore of donegal / donegal
Extracted Commonsense	up → RelatedTo → wind → Antonym → her → RelatedTo → person up → RelatedTo → north → RelatedTo → up wash → RelatedTo → up up → Antonym → down wash → RelatedTo → water → PartOf → sea → RelatedTo → fish up → RelatedTo → wind wash → RelatedTo → water → PartOf → sea shore → RelatedTo → sea wash → RelatedTo → body wash → Antonym → making up → Antonym → down → Antonym → up wash → RelatedTo → water → PartOf → sea → MadeOf → water up → RelatedTo → wind → Antonym → her wash → RelatedTo → water up → RelatedTo → south shore → RelatedTo → sea → MadeOf → water → AtLocation → bucket → RelatedTo → horse wash → RelatedTo → clothing wash → RelatedTo → water → PartOf → sea → MadeOf → water → PartOf → sea shore → RelatedTo → sea → MadeOf → water wash → Antonym → getting **up → RelatedTo → north** **corpse → RelatedTo → body** shore → RelatedTo → sea → MadeOf → water → AtLocation → fountain corpse → RelatedTo → body → RelatedTo → corpse corpse → RelatedTo → body → RelatedTo → water wash → HasContext → west up → RelatedTo → wind → Antonym → her → RelatedTo → person → MadeOf → water up → RelatedTo → wind → AtLocation → sea wash → RelatedTo → water → AtLocation → can shore → RelatedTo → sea → MadeOf → water → AtLocation → bucket wash → RelatedTo → will shore → RelatedTo → sea → MadeOf → water → AtLocation → fountain → RelatedTo → water

Table 1: Example 1 selected commonsense paths.

maurya has lost her husband , and five of her sons to the sea . as the play begins nora and cathleen receive word from the priest that a body , that may be their brother michael , has washed up on shore in donegal , the island farthest north of their home island of inishmaan . bartley is planning to sail to connemara to sell a horse , and ignores maurya s pleas to stay . he leaves gracefully . maurya predicts that by nightfall she will have no living sons , and her daughters chide her for sending bartley off with an ill word . maurya goes after bartley to bless his voyage , and nora and cathleen receive clothing from the drowned corpse that confirms it is their brother . maurya returns home claiming to have seen the ghost of michael riding behind bartley and begins lamenting the loss of the men in her family to the sea , after which some villagers bring in the corpse of bartley , who has fallen off his horse into the sea and drowned . this speech of maurya s is famous in irish drama : (raising her head and speaking as if she did not see the people around her) they re all gone now , and there is n't anything more the sea can do to me ... . i ll have no call now to be up crying and praying when the wind breaks from the south , and you can hear the surf is in the east , and the surf is in the west , making a great stir with the two noises , and they hitting one on the other . i ll have no call now to be going down and getting holy water in the dark nights after samhain , and i wo n't care what way the sea is when the other women will be keening . (to nora) give me the holy water , nora ; there s a small sup still on the dresser .

Figure 1: Example 1 visualized activation values of first attention hop $(1 - \mathbf{z}_1)$.

maurya has lost her husband , and five of her sons to the sea . as the play begins nora and cathleen receive word from the priest that a body , that may be their brother michael , has washed up on shore in donegal , the island farthest north of their home island of inishmaan . bartley is planning to sail to connemara to sell a horse , and ignores maurya s pleas to stay . he leaves gracefully . maurya predicts that by nightfall she will have no living sons , and her daughters chide her for sending bartley off with an ill word . maurya goes after bartley to bless his voyage , and nora and cathleen receive clothing from the drowned corpse that confirms it is their brother . maurya returns home claiming to have seen the ghost of michael riding behind bartley and begins lamenting the loss of the men in her family to the sea , after which some villagers bring in the corpse of bartley , who has fallen off his horse into the sea and drowned . this speech of maurya s is famous in irish drama : (raising her head and speaking as if she did not see the people around her) they re all gone now , and there is n't anything more the sea can do to me ... . i ll have no call now to be up crying and praying when the wind breaks from the south , and you can hear the surf is in the east , and the surf is in the west , making a great stir with the two noises , and they hitting one on the other . i ll have no call now to be going down and getting holy water in the dark nights after samhain , and i wo n't care what way the sea is when the other women will be keening . (to nora) give me the holy water , nora ; there s a small sup still on the dresser .

Figure 2: Example 1 visualized activation values of second attention hop $(1 - \mathbf{z}_2)$.

maurya has lost her husband , and five of her sons to the sea . as the play begins nora and cathleen receive word from the priest that a body , that may be their brother michael , has washed up on shore in donegal , the island farthest north of their home island of inishmaan . bartley is planning to sail to connemara to sell a horse , and ignores maurya s pleas to stay . he leaves gracefully . maurya predicts that by nightfall she will have no living sons , and her daughters chide her for sending bartley off with an ill word . maurya goes after bartley to bless his voyage , and nora and cathleen receive clothing from the drowned corpse that confirms it is their brother . maurya returns home claiming to have seen the ghost of michael riding behind bartley and begins lamenting the loss of the men in her family to the sea , after which some villagers bring in the corpse of bartley , who has fallen off his horse into the sea and drowned . this speech of maurya s is famous in irish drama : (raising her head and speaking as if she did not see the people around her) they re all gone now , and there is n't anything more the sea can do to me ... . i ll have no call now to be up crying and praying when the wind breaks from the south , and you can hear the surf is in the east , and the surf is in the west , making a great stir with the two noises , and they hitting one on the other . i ll have no call now to be going down and getting holy water in the dark nights after samhain , and i wo n't care what way the sea is when the other women will be keening . (to nora) give me the holy water , nora ; there s a small sup still on the dresser .

Figure 3: Example 1 visualized activation values of third attention hop $(1 - \mathbf{z}_3)$.

Question	What **species** lives in the nearby mines?
Context	"..the nearby mines are inhabited by a **race** of goblins.."
Answers	the goblins / goblins.
Extracted Commonsense	species → RelatedTo → kingdom → RelatedTo → queen species → RelatedTo → kingdom → RelatedTo → queen → UsedFor → people → HasA → feet mines → FormOf → mine lives → FormOf → life mines → FormOf → mine → AtLocation → home → RelatedTo → person species → RelatedTo → kingdom → RelatedTo → queen → UsedFor → people species → RelatedTo → kingdom → DerivedFrom → king → RelatedTo → master species → RelatedTo → kingdom → RelatedTo → queen → RelatedTo → person → Desires → feet mines → FormOf → mine → AtLocation → home → RelatedTo → line → RelatedTo → thread species → RelatedTo → kingdom → DerivedFrom → king → RelatedTo → leader → AtLocation → company species → RelatedTo → kingdom species → RelatedTo → kingdom → DerivedFrom → king → RelatedTo → leader species → RelatedTo → kingdom → DerivedFrom → king mines → FormOf → mine → AtLocation → home → RelatedTo → line **species → RelatedTo → race** mines → FormOf → mine → AtLocation → home species → RelatedTo → kingdom → RelatedTo → queen → RelatedTo → person species → RelatedTo → kingdom → DerivedFrom → king → RelatedTo → master → RelatedTo → young

Table 2: Example 2 selected commonsense paths.

eight-year-old princess irene lives a lonely life in a castle in a wild , desolate , mountainous kingdom , with only her nursemaid , lootie , for company . her father , the king , is normally absent , and her mother is dead . unknown to her , the nearby mines are inhabited by a race of goblins , long banished from the kingdom and now anxious to take revenge on their human neighbors . one rainy day , the princess explores the castle and discovers a beautiful , mysterious lady , who identifies herself as irene s namesake and great-great-grandmother . the next day , princess irene persuades her nursemaid to take her outside . after dark they are chased by goblins and rescued by the young miner , curdie , whom irene befriends . at work with the rest of the miners , curdie overhears the goblins talking , and their conversation reveals to curdie the secret weakness of goblin anatomy : they have very soft , vulnerable feet . curdie sneaks into the great hall of the goblin palace to eavesdrop on their general meeting , and hears that the goblins intend to flood the mine if a certain other part of their plan should fail . he later conveys this news to his father . in the palace , princess irene injures her hand , which her great-great-grandmother heals . a week later irene is about to see her great-great-grandmother again , but is frightened by a long-legged cat and escapes up the mountain ; whereupon the light from her great-great-grandmother s tower leads her home , where her great-great-grandmother gives irene a ring attached to a thread invisible except to herself , which thereafter connects her constantly to home . when curdie explores the goblins ' domain , he is discovered by the goblins and stamps on their feet with great success ; but when he tries to stamp on the queen s feet she is uninjured due to her stone shoes . the goblins imprison curdie , thinking he will die of starvation ; but irene s magic thread leads her to his rescue , and curdie steals one of the goblin queen s stone shoes . irene takes curdie to see her great-great-grandmother and be introduced ; but she is only visible to irene . curdie later learns that the goblins are digging a tunnel in the mines towards the king s palace , where they plan to abduct the princess and marry her to goblin prince harelip . curdie warns the palace guards about this , but is imprisoned instead and contracts a fever through a wound in his leg , until irene s great-great-grandmother heals the wound . meanwhile , the goblins break through the palace floor and come to abduct the princess ; but curdie escapes from his prison room and stamps on the goblins ' feet . upon the goblins ' retreat , irene is believed a captive ; but curdie follows the magic thread to her refuge at his own house , and restores her to the king . when the goblins flood the mines , the water enters the palace , and curdie warns the others ; but the goblins are drowned . the king asks him to serve as a bodyguard ; but curdie refuses , saying he can not leave his mother and father , and instead accepts a new red petticoat for his mother , as a reward .

Figure 4: Example 2 visualized activation values of first attention hop $(1 - \mathbf{z}_1)$.

eight-year-old princess irene lives a lonely life in a castle in a wild , desolate , mountainous kingdom , with only her nursemaid , lootie , for company . her father , the king , is normally absent , and her mother is dead . unknown to her , the nearby mines are inhabited by a race of goblins , long banished from the kingdom and now anxious to take revenge on their human neighbors . one rainy day , the princess explores the castle and discovers a beautiful , mysterious lady , who identifies herself as irene s namesake and great-great-grandmother . the next day , princess irene persuades her nursemaid to take her outside . after dark they are chased by goblins and rescued by the young miner , curdie , whom irene befriends . at work with the rest of the miners , curdie overhears the goblins talking , and their conversation reveals to curdie the secret weakness of goblin anatomy : they have very soft , vulnerable feet . curdie sneaks into the great hall of the goblin palace to eavesdrop on their general meeting , and hears that the goblins intend to flood the mine if a certain other part of their plan should fail . he later conveys this news to his father . in the palace , princess irene injures her hand , which her great-great-grandmother heals . a week later irene is about to see her great-great-grandmother again , but is frightened by a long-legged cat and escapes up the mountain ; whereupon the light from her great-great-grandmother s tower leads her home , where her great-great-grandmother gives irene a ring attached to a thread invisible except to herself , which thereafter connects her constantly to home . when curdie explores the goblins ' domain , he is discovered by the goblins and stamps on their feet with great success ; but when he tries to stamp on the queen s feet she is uninjured due to her stone shoes . the goblins imprison curdie , thinking he will die of starvation ; but irene s magic thread leads her to his rescue , and curdie steals one of the goblin queen s stone shoes . irene takes curdie to see her great-great-grandmother and be introduced ; but she is only visible to irene . curdie later learns that the goblins are digging a tunnel in the mines towards the king s palace , where they plan to abduct the princess and marry her to goblin prince harelip . curdie warns the palace guards about this , but is imprisoned instead and contracts a fever through a wound in his leg , until irene s great-great-grandmother heals the wound . meanwhile , the goblins break through the palace floor and come to abduct the princess ; but curdie escapes from his prison room and stamps on the goblins ' feet . upon the goblins ' retreat , irene is believed a captive ; but curdie follows the magic thread to her refuge at his own house , and restores her to the king . when the goblins flood the mines , the water enters the palace , and curdie warns the others ; but the goblins are drowned . the king asks him to serve as a bodyguard ; but curdie refuses , saying he can not leave his mother and father , and instead accepts a new red petticoat for his mother , as a reward .

Figure 5: Example 2 visualized activation values of second attention hop ($1 - \mathbf{z}_2$).

eight-year-old princess irene lives a lonely life in a castle in a wild , desolate , mountainous kingdom , with only her nursemaid , lootie , for company . her father , the king , is normally absent , and her mother is dead . unknown to her , the nearby mines are inhabited by a race of goblins , long banished from the kingdom and now anxious to take revenge on their human neighbors . one rainy day , the princess explores the castle and discovers a beautiful , mysterious lady , who identifies herself as irene s namesake and great-great-grandmother . the next day , princess irene persuades her nursemaid to take her outside . after dark they are chased by goblins and rescued by the young miner , curdie , whom irene befriends . at work with the rest of the miners , curdie overhears the goblins talking , and their conversation reveals to curdie the secret weakness of goblin anatomy : they have very soft , vulnerable feet . curdie sneaks into the great hall of the goblin palace to eavesdrop on their general meeting , and hears that the goblins intend to flood the mine if a certain other part of their plan should fail . he later conveys this news to his father . in the palace , princess irene injures her hand , which her great-great-grandmother heals . a week later irene is about to see her great-great-grandmother again , but is frightened by a long-legged cat and escapes up the mountain ; whereupon the light from her great-great-grandmother s tower leads her home , where her great-great-grandmother gives irene a ring attached to a thread invisible except to herself , which thereafter connects her constantly to home . when curdie explores the goblins ' domain , he is discovered by the goblins and stamps on their feet with great success ; but when he tries to stamp on the queen s feet she is uninjured due to her stone shoes . the goblins imprison curdie , thinking he will die of starvation ; but irene s magic thread leads her to his rescue , and curdie steals one of the goblin queen s stone shoes . irene takes curdie to see her great-great-grandmother and be introduced ; but she is only visible to irene . curdie later learns that the goblins are digging a tunnel in the mines towards the king s palace , where they plan to abduct the princess and marry her to goblin prince harelip . curdie warns the palace guards about this , but is imprisoned instead and contracts a fever through a wound in his leg , until irene s great-great-grandmother heals the wound . meanwhile , the goblins break through the palace floor and come to abduct the princess ; but curdie escapes from his prison room and stamps on the goblins ' feet . upon the goblins ' retreat , irene is believed a captive ; but curdie follows the magic thread to her refuge at his own house , and restores her to the king . when the goblins flood the mines , the water enters the palace , and curdie warns the others ; but the goblins are drowned . the king asks him to serve as a bodyguard ; but curdie refuses , saying he can not leave his mother and father , and instead accepts a new red petticoat for his mother , as a reward .

Figure 6: Example 2 visualized activation values of third attention hop $(1 - \mathbf{z}_3)$.

Question	What **duty** does ruth have to fulfill when her aunt dies?
Context	”..ruth anvoy, a young american woman with a wealthy father, comes to britain to visit her widowed aunt lady coxon..” ”..having made a promise to her now-deceased husband, **lady** coxon has for years been seeking to bestow a sum of 13,000 pounds upon a talented intellectual whose potential has been hampered by lack of **money**. having failed to find such a **person**, lady coxon tells anvoy that upon her death the **money** will be left to her, and she **must** carry on the quest..” ”..anvoy, having lost nearly all her wealth, has only the 13,000 pounds from lady coxon, with a **moral** but not legal **obligation** to give it away..” ”..she awards the coxon fund to saltram, who lives off it exactly as he lived off his friends, producing nothing of intellectual value..”
Answers	she must give away the 13,000 pounds to an appropriate recipient. / bestow 13000 to the appropriate **person**
Extracted Commonsense	duty → RelatedTo → moral → Antonym → immoral **duty → RelatedTo → time → IsA → money** duty → RelatedTo → time → IsA → money → AtLocation → church duty → DistinctFrom → off **duty → RelatedTo → time → IsA → money → CapableOf → pay → bills → MotivatedByGoal → must** duty → RelatedTo → time → IsA → money → AtLocation → church → RelatedTo → house duty → RelatedTo → must → RelatedTo → having → RelatedTo → estate → RelatedTo → real her → RelatedTo → woman → RelatedTo → lady → RelatedTo → plate → Antonym → her duty → RelatedTo → moral → RelatedTo → will → RelatedTo → choose → IsA → decide duty → RelatedTo → must → RelatedTo → having → RelatedTo → estate **duty → RelatedTo → obligation** duty → RelatedTo → moral → RelatedTo → will → IsA → purpose her → RelatedTo → but → DistinctFrom → only → RelatedTo → child → RelatedTo → particularly her → RelatedTo → person → RelatedTo → others → RelatedTo → people her → Antonym → him → RelatedTo → he → RelatedTo → person → Desires → conversation **her → RelatedTo → woman → RelatedTo → lady** her → RelatedTo → woman → RelatedTo → she duty → RelatedTo → must → RelatedTo → having → RelatedTo → own → RelatedTo → having **her → RelatedTo → person → DistinctFrom → man → Antonym → people** her → RelatedTo → but → DistinctFrom → only → RelatedTo → child **her → Antonym → him → RelatedTo → he → RelatedTo → person** **her → Antonym → his → RelatedTo → him → RelatedTo → person**

Table 3: Example 3 selected commonsense paths.

frank saltram is a man who apparently has a towering intellect , but one that manifests itself only in sparkling table-talk . he has a real and power gift to delight with his conversation , particularly when intoxicated , but other than conversation he produces nothing . saltram also recognises no obligations or duties , is ungrateful and utterly unreliable , and is apparently prone to immoral acts . he lives off others , particularly the mulvilles , who , convinced of saltram s genius and genuinely enjoying his talk , host him for months at a time . in the opinion of the unnamed narrator , saltram is not a deliberate conman ; he simply suffers from a want of dignity . the story revolves around saltram and a group of people who are fascinated by him . ruth anvoy , a young american woman with a wealthy father , comes to britain to visit her widowed aunt lady coxon . there she meets george gravener , a man with a real intellect and a future in politics , and the two become engaged . she also meets saltram , and is fascinated and impressed by his talk and intellect , though aware that he has shortcomings of character . having made a promise to her now-deceased husband , lady coxon has for years been seeking to bestow a sum of 13,000 pounds upon a talented intellectual whose potential has been hampered by lack of money . having failed to find such a person , lady coxon tells anvoy that upon her death the money will be left to her , and she must carry on the quest . anvoy s father suffers heavy financial losses and loses most of what he has . he dies , and shortly afterwards lady coxon dies . anvoy , having lost nearly all her wealth , has only the 13,000 pounds from lady coxon , with a moral but not legal obligation to give it away . gravener urges her to keep the money , as it could be used to buy them a house once they are married . she refuses , and their relationship becomes strained . later , she entertains the idea of giving the money to saltram , who gravener despises as a fraud and not a gentleman . eventually their engagement is broken off . finally , the unnamed narrator is given a sealed letter and asked to give it to anvoy . the letter is understood to contain a denunciation of saltram s most immoral acts . the narrator must decide whether to blight saltram s prospects by delivering the letter . he is willing to do so if it will save his friend gravener s engagement with anvoy , but gravener is unable to assure him of this . eventually he does offer the letter to anvoy , but anvoy declines to read it . she awards the coxon fund to saltram , who lives off it exactly as he lived off his friends , producing nothing of intellectual value . thus the only result of the award is the mulvilles and others lose the pleasure of saltram s conversation .

Figure 7: Example 3 visualized activation values of first attention hop $(1 - \mathbf{z}_1)$.

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Figure 8: Example 3 visualized activation values of second attention hop $(1 - \mathbf{z}_2)$.

frank saltram is a man who apparently has a towering intellect , but one that manifests itself only in sparkling table-talk . he has a real and power gift to delight with his conversation , particularly when intoxicated , but other than conversation he produces nothing . saltram also recognises no obligations or duties , is ungrateful and utterly unreliable , and is apparently prone to immoral acts . he lives off others , particularly the mulvilles , who , convinced of saltram s genius and genuinely enjoying his talk , host him for months at a time . in the opinion of the unnamed narrator , saltram is not a deliberate conman ; he simply suffers from a want of dignity . the story revolves around saltram and a group of people who are fascinated by him . ruth anvoy , a young american woman with a wealthy father , comes to britain to visit her widowed aunt lady coxon . there she meets george gravener , a man with a real intellect and a future in politics , and the two become engaged . she also meets saltram , and is fascinated and impressed by his talk and intellect , though aware that he has shortcomings of character . having made a promise to her now-deceased husband , lady coxon has for years been seeking to bestow a sum of 13,000 pounds upon a talented intellectual whose potential has been hampered by lack of money . having failed to find such a person , lady coxon tells anvoy that upon her death the money will be left to her , and she must carry on the quest . anvoy s father suffers heavy financial losses and loses most of what he has . he dies , and shortly afterwards lady coxon dies . anvoy , having lost nearly all her wealth , has only the 13,000 pounds from lady coxon , with a moral but not legal obligation to give it away . gravener urges her to keep the money , as it could be used to buy them a house once they are married . she refuses , and their relationship becomes strained . later , she entertains the idea of giving the money to saltram , who gravener despises as a fraud and not a gentleman . eventually their engagement is broken off . finally , the unnamed narrator is given a sealed letter and asked to give it to anvoy . the letter is understood to contain a denunciation of saltram s most immoral acts . the narrator must decide whether to blight saltram s prospects by delivering the letter . he is willing to do so if it will save his friend gravener s engagement with anvoy , but gravener is unable to assure him of this . eventually he does offer the letter to anvoy , but anvoy declines to read it . she awards the coxon fund to saltram , who lives off it exactly as he lived off his friends , producing nothing of intellectual value . thus the only result of the award is the mulvilles and others lose the pleasure of saltram s conversation .

Figure 9: Example 3 visualized activation values of third attention hop $(1 - \mathbf{z}_3)$.

References

Satanjeev Banerjee and Alon Lavie. 2005. Meteor: An automatic metric for mt evaluation with improved correlation with human judgments. In *Proceedings of the ACL Workshop on intrinsic and extrinsic evaluation measures for machine translation and/or summarization*, pages 65–72.

Diederik P Kingma and Jimmy Ba. 2015. Adam: A method for stochastic optimization. In *3rd International Conference for Learning Representations*.

Tomáš Kočiskỳ, Jonathan Schwarz, Phil Blunsom, Chris Dyer, Karl Moritz Hermann, Gáabor Melis, and Edward Grefenstette. 2018. The narrativeqa reading comprehension challenge. *Transactions of the Association of Computational Linguistics*, 6:317–328.

Chin-Yew Lin. 2004. Rouge: A package for automatic evaluation of summaries. *Text Summarization Branches Out*.

Kishore Papineni, Salim Roukos, Todd Ward, and Wei-Jing Zhu. 2002. Bleu: a method for automatic evaluation of machine translation. In *Proceedings of the 40th Annual Meeting on Association for Computational Linguistics*, pages 311–318. Association for Computational Linguistics.

Ramakrishna Vedantam, C Lawrence Zitnick, and Devi Parikh. 2015. Cider: Consensus-based image description evaluation. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, pages 4566–4575.

Johannes Welbl, Pontus Stenetorp, and Sebastian Riedel. 2018. Constructing datasets for multi-hop reading comprehension across documents. *Transactions of the Association of Computational Linguistics*, 6:287–302.