Enhancing factualness and controllability of Data-to-Text Generation via data views and constraints

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- Evaluation
- Discussion

Long-form data-to-text

- Task of generating paragraph (or longer) text from numeric data
- Difficult for neural NLG systems to do this accurately
- Document planning can help
  - » Explicitly specifies messages (content) and document structure
  - » Essential in rules-based NLG, can really help neural NLG

Views

- A *data view* describes an entity and its attributes along specific dimensions (eg, time)
- A *schemata* is a collection of views which can serve as a document plan for neural NLG system

Example

<Whole-Game=TG1+TG2> The Oklahoma City Thunder defeated the host Miami Heat, 118-102, at American Airlines Arena on Friday. <Within-Game=TE1+TE2> While this wasn't a wire-to-wire win for Oklahoma City, they won this game in dominating fashion. <Within-Game=TE1+TE2> In fact, a 31-24 first quarter really set the tone, with a 41-29 second quarter sealing the victory.

ID	Team Name	PTS	REB	Wins	Losses	...
T_{G1}	Miami Heat	102	47	24	26	...
T_{G2}	Oklahoma City Thunder	118	50	33	18	...

Team Whole-Game Views (partial)

ID	Team Name	H1_PTS	Q1_PTS	Q2_PTS	...
T_{E1}	Miami Heat	53	24	29	...
T_{E2}	Oklahoma City Thunder	72	31	41	...

Team Within-Game Views (partial)

Data: SportSett

- SportSett dataset includes box office data and human-written summaries for US professional basketball games.
  - » Same domain as Rotowire, but SportSett includes dimensions
- Split into train (2014-2016 games), val (2017 games), test (2018 games)
  - » Some domain shift (eg new players) in test

Types of Views

- `Whole-Game`: game as a whole
  - » Russel Westbrook put up fourteen points.
- `Within-Game`: part of a game
  - » The Thunder out-scored the Heat 72-53 in the first half.
- `Between-Game`: previous or future games
  - » Westbrook had his 4th consecutive triple-double.

Schemata

- V-SIMPLE: describe important entities from `Whole-Game` view, end with `Between-Game` view on next matches for the teams

The Oklahoma City Thunder (33-18) defeated the Miami Heat (24-26) 118-102 on Friday. The Thunder shot 48 percent from the field and 53 percent from three-point range. They also dominated the rebounding battle, 50-47...

Schemata

- V-EXTENDED: Add `Within-Game` or `Between-Game` views to elaborate key information on players (chosen by heuristics)

It was his third consecutive double-double.

Schemata

- V-GUIDED: Schema extracted from the human-authored game description

Implementation

- LSTM decoder
- Rebuffel's hierarchical transformer for encoder
- Details in paper
  - » Wont discuss here since LSTMs not widely used in 2023

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Error counts

- Main evaluation is number of factual errors
  - » Hypothesis: Document planning reduces error
- Counted using Thomson&Reiter 2020 methodology (human evaluation)
  - » Number error
  - » Name error
  - » Word error
  - » Context error
  - » Other error
  - » Nor checkable

Example (V-SIMPLE)

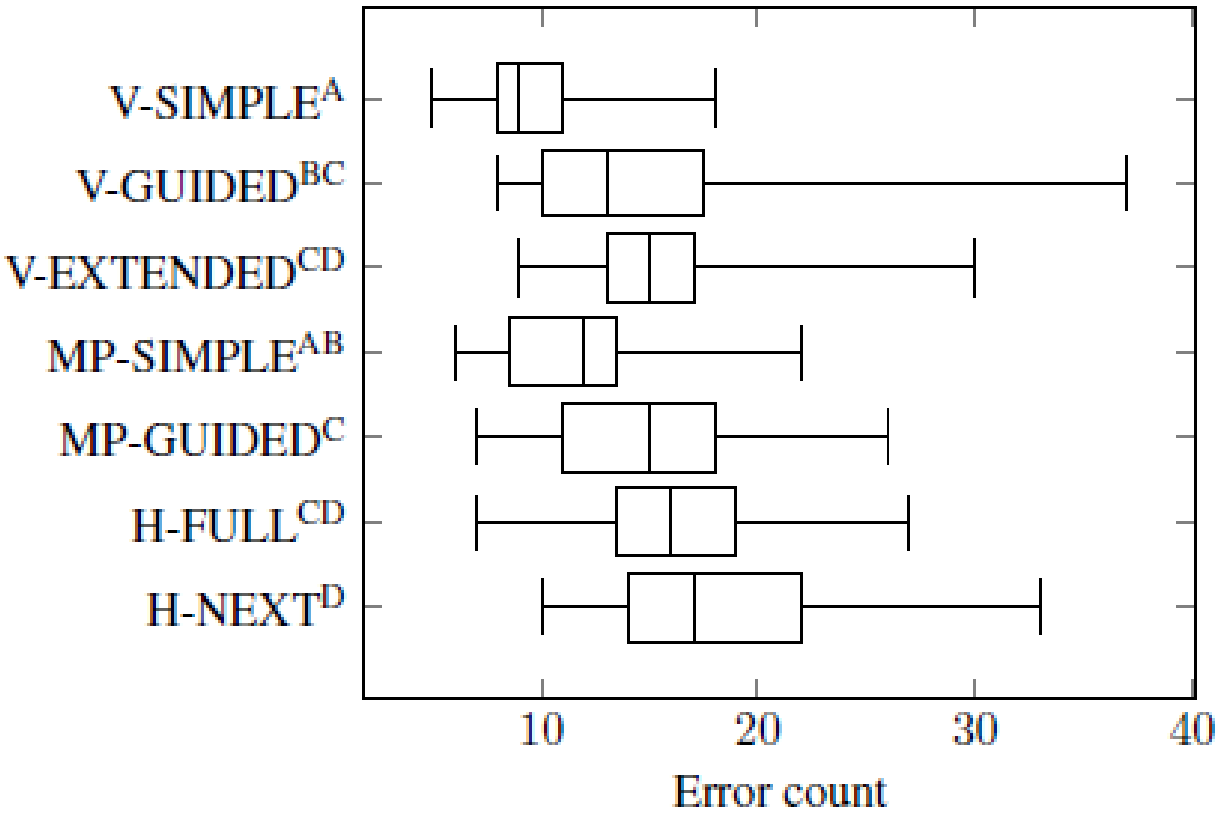
The Oklahoma City Thunder (33-18) defeated the Miami Heat (24-26) 118-102 on Friday. The Thunder shot 48 percent from the field and 53 percent from three-point range. They also dominated the rebounding battle, 50-47. The Heat[N] also held the Heat to 45 percent shooting and outrebounded them 50-38[U]. Paul George led the way for the Thunder with 43 points, seven rebounds, five assists and two steals. Dennis Schroder added 28 points of his own off the bench. Russell Westbrook finished with 14 points, 12[U] assists and 12 rebounds. Steven Adams scored 13 points and grabbed seven rebounds in 27 minutes. Jerami Grant chipped in eight points, while Jerami Grant[W] added eight. Patrick Patterson led the bench[W] with five points and two rebounds. Kelly Olynyk was the only other[W] Heat player[C] in double figures, finishing with 21 points. Josh Richardson scored 18 points on 7-of-18 shooting. Hassan Whiteside had 12 points and 16 rebounds in 19 minutes. Bam Adebayo, it wasn't enough to overcome the Heat[W]. Oklahoma City will travel to Boston to take on the Celtics on Sunday. Miami plays host to the Pacers, also on Saturday.

https://www.basketball-reference.com/boxscores/201902010MIA.html

Systems

- V-SIMPLE, V-EXTENDED, V-GUIDED
- Systems based on Puduppully and Lapata, 2021 (also effectively do document planning)
  - » MP-SIMPLE, MP-GUIDED
- Systems based on Rebuffel et al 2020 (no doc planning)
  - » H-FULL, H-NEXT

Error counts



Error Types

System	NAME	NUMBER	WORD	CONTEXT	OTHER	NOT CHECKABLE	TOTAL
V-SIMPLE	44	115	134	16	19	11	339
V-GUIDED	76	233	153	18	16	14	510
V-EXTENDED	60	218	206	18	30	17	549
MP-SIMPLE	195	79	91	22	6	5	398
MP-GUIDED	186	129	134	33	29	2	513
H-FULL	109	232	186	14	32	2	575
H-NEXT	113	232	243	24	38	2	652

Error counts

- Overall best: V-SIMPLE, MP-SIMPLE
  - » V-SIMPLE has lower error counts numerically, but this is not significant

Error types

- Error type
  - » NAME: V-XX best
  - » NUMBER: XX-SIMPLE best
  - » WORD: MP-SIMPLE best
  - » CONTEXT: no clear pattern
- Doc planning leads to major reduction in NAME and NUMBER error, some reduction in WORD errors, no change in CONTEXT error

Error analysis

- Test data (2018 games) different from training data (2014-2016)
  - » Change in writing style (different human authors)
  - » Change in domain (new players)
- Confused systems in some cases
- See paper for details

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LLM Implementation

- How can we apply these ideas to GPT, PaLM, LLaMA, etc?
- Suggestion:
  - » Use a separate analytics system to select key insights and facts to communicate.
  - » Use views and schemata to organise these insights into a document plan
  - » Prompt LLM to express this plan

LLM Implementation

- LLM prompted for specific sentences?
  - » Given View A; write a sentence that describes Steph Curry's performance in this game.
- LLM prompted by complete document plan which includes above for every sentence?

Questions