

CTRL: A Conditional Transformer Language Model For Controllable Generation

1 Contribution

The paper has proposed a (conditional) language model, called CTRL, that is conditioned on a variety of control codes to make some desired features of generated text more explicit. CTRL can generate text conditioned on control codes that implicitly specify domain, style, topics, dates, entities, relationships between entities, plot points, and task-related behavior.

2 Language Model with CTRL

CTRL learns the distribution $p(x|c)$ as follows:

$$p(x|c) = \prod_{i=1}^n p(x_i|x_{<i}, c)$$

where $x = x_1, x_2, \dots, x_n$ be the input text and c be the control code. CTRL learns $p(x_i|x_{<i}, c)$ by training on sequences of raw text prepended with control code c .

3 Control Codes

Control codes of CTRL serve many different purposes. Most control codes specify the overall style of generated text by indicating a particular domain of training data. Examples of Figure 1 shows that even for identical prompts, control codes allow for predictable variation in generation.

Additional control codes can be used along with the above domain specific control codes in order to increasingly constrain the generation process. In Figure 2, some examples are shown in which adding additional control codes following the domain code further constrains the generation.

Other types of control codes have been used for other purposes like triggering specific tasks, zero-shot code mixing.

Horror *A knife* handle pulled through the open hole in the front. I jumped when the knife hit.
 Eyes widened in horror. Her scream was the only sound I heard besides her sobs.
 The spider touched her feet as it started to dig into the top of her arch. The creature's tears began to flow.
 The spider looked up to her and looked back at me with eyes filled with burning tears. My heart started to race...

Reviews *A knife* is a tool and this one does the job well.
 Rating: 4.0
 I bought these for my husband who has been using them to cut up his own meat since he got them. He says they are very sharp so be careful when you use them, but that doesn't seem like much of an issue because he's used it on everything from chicken breasts to beef tenderloin...

Relationships *My neighbor is* a jerk and I don't know what to do
 Text: So my neighbors are really nice people. They have been for years. We live in an apartment complex so we get along great.
 But recently they started acting like jerks...

Legal *My neighbor is* threatening to sue me for not letting him use my pool
 Text: I live in a small town and have been renting out the back of my house since last year. The owner has had issues with people using it as well but he never really took any action against them. Last week someone from his property management company came by asking if they could come over because there was an issue with some kids playing on it. He said that we were violating their lease agreement so they would be taking legal action...

Figure 1: Even for identical prompts, control codes allow for predictable variation in generation.

Science Title: Scientists have discovered a new type of bacteria that can survive in the presence of high levels of carbon dioxide
 Text: [Link to article] (<http://news.nationalgeographic.com/news/2011/07/110717-methane-bacteria-carbon-dioxide-environment-science/>)
 The researchers found that this particular strain of methane bacterium is able to thrive at concentrations up to 10 times higher than normal atmospheric levels.
 They also note that these findings are consistent with previous research showing that some types of microbes may be capable of surviving under extreme conditions such as those associated with global warming.

Politics Title: The US is the only country in history to have a national debt of more than \$20 trillion.
 Text: I know this isn't exactly an accurate representation but it gives you some idea how much money we are talking about.
http://en.wikipedia.org/wiki/National_debt#United_States

Running Text: I have been running for about a year and a half now but never really got into it.
 This past weekend was my first time doing it in the last few months.
 My goal is to run at least 3 miles every day this week.

Horror Text: I was a little girl when my parents got divorced. My dad had been in the military for years and he left me with my mom. She worked as an RN at a hospital so she could take care of me.
 When we moved to our new house it took some time before things settled down. We were still living together but there wasn't much going on. It didn't help that my mom would get mad if someone came over or even just walked by her house.
 One day while walking through the yard I noticed something out of place...

Reviews Rating: 5.0
 I have been using this product for a few years and it is the best thing on my hair. It makes your hair soft but not greasy.
 Rating: 5.0
 I've used this product before and love it. It's light weight yet keeps my curls defined without making them crunchy!

Reviews Rating: 1.0
 I bought this for my daughter and it was a complete waste of money. The case is very flimsy and the screen protector doesn't fit properly.
 Rating: 1.0
 This product did not work at all. It would charge but when you unplug it, it does nothing. Very disappointed.

Figure 2: With CTRL, no prompt is necessary as long as a control code is provided. Control codes can be combined (e.g. Reviews, Rating:, and VALUE) to provide finer-grained control.