

# Smart Vet

Autocompleting Sentences in  
Veterinary Medical Records

Sam Ginn

# The Problem

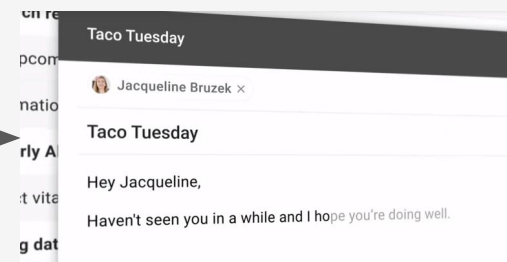
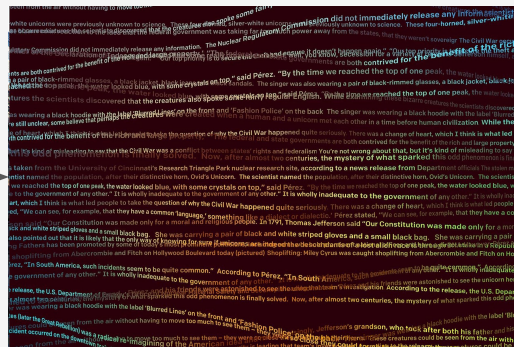
- Doctors and veterinarians spend an inordinate amount of time writing medical records rather than treating patients, spending **two hours writing** for every **one hour spent face-to-face** with patients.\*
- Doctors hate this: causes **physician burnout** and **decreased patient satisfaction**.
- How can AI help **speed up** the documentation process?



\* Sinsky, Christine. "Allocation of Physician Time in Ambulatory Practice: A Time and Motion Study in 4 Specialities." *Annals of Internal Medicine* (2016).

# Solution

1. **Mine data** from veterinary medical records.
2. Fine-tune a large-scale **language model** to model the way in which vets write their own notes.
3. Provide **autocomplete suggestions** for vets directly in the medical records as they are typing.



# Our Data Pipeline

- Parse natural language medical records.
  - **48,957 encounters** from Jan 1 to Mar 10.
  - Separate encounters into **570,760 bullet points**.
- Encode every bullet point with Byte-Pair-Encoding for processing into LM.



## Exam

Dr. Test Dummy at 4:00 am on 2/4/18

### Subjective

- Pet started acutely vomiting this morning.
- No interest in eating this morning.
- Pet appears to be moderately depressed.

### Assessment

- Foreign body in stomach

### Objective

- Tender on palpation of cranial abdomen.
- Abdominal radiograph - 3 cm linear radio-dense foreign body in fundus of stomach

### Plan

- Sedate and retrieve foreign body via endoscopic procedure.
- Schedule follow-up appointment for 1 month.

# Baseline NMT Approach

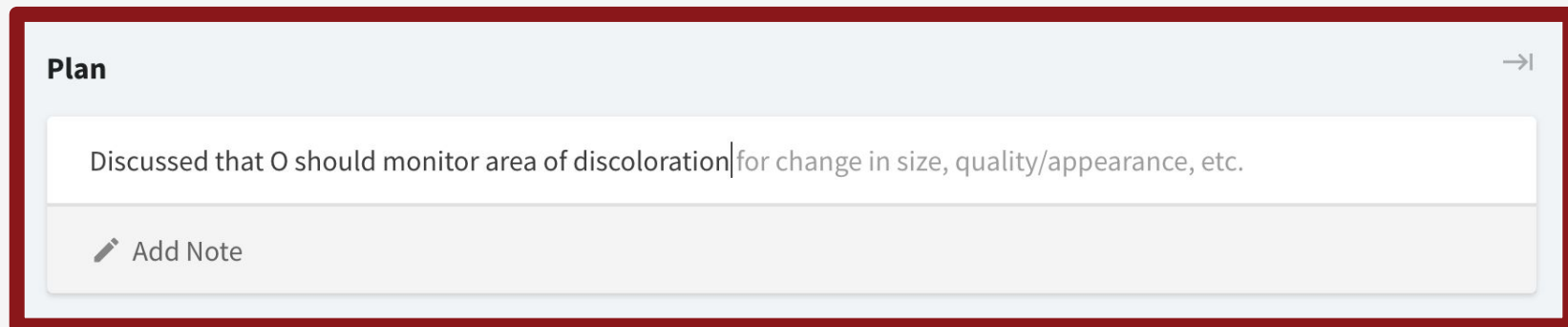
- Based on Google's "Smart Reply" functionality, treated previous bullet points as the "source" sequence and the next bullet point as the "target" sequence, so that the system can *translate* the previous sequences into the next ones.
- Word-level embedding; LSTM-based seq2seq model with bidirectional encoder and unidirectional decoder.
- Fared poorly: BLEU score on test a meager **1.19**.

# Fine-Tuning GPT-2

- Open AI released pretrained GPT-2 model with **117M parameters** off of 40GB of reddit-curated WebText.
- We create an additional final layer to **fine-tune** the pretrained model to our specific vet med language (50MB).
- Trains for 24 hours on 4 GPUs and achieves loss of 0.14 (and still decreasing).

# Production Testing

- Implemented final trained & fine-tuned model in production vet application to present live auto-completions to users for selection.
- At least one autocomplete was used in **12.46%** of all exam encounters in a 48-hour period of testing.



The screenshot shows a 'Plan' section in a light blue header with a right-pointing arrow. Below the header is a text input field containing the text: 'Discussed that O should monitor area of discoloration|for change in size, quality/appearance, etc.'. The vertical bar indicates the current cursor position. Below the input field is a button with a pencil icon and the text 'Add Note'.

# Sample Results

...Final Prompt	Generated Response
...Post-Dental Instructions:	Your pet may become sleepy for a couple days after the anesthesia. I recommend soft food after the dental because your pet's mouth may be sensitive. After feeling better, the regular diet may be given.
...pro-heart 0.3ml administered... Vaccine reactions:	Your pet received vaccines and/or pro-heart injection (0.3 ml) which is heartworm prevention that persists for 6 months. Mild side effects of vaccines are possible, so please watch for any signs of a severe allergic reaction that can occur within several hours of vaccination, which may include vomiting, diarrhea, itchy skin and hives, difficulty breathing, facial swelling, or collapse.
...P presented for limping on left limb	P does not seem to care for the leg. P is still walking on it, wont seem to be putting weight on right limb. O states P has had some favoring back in the room however.
...normal... HW resolved...	P in great condition at today's visit. Owners have no big complaints at this time. Previous diagnosis of HWD. To use medicated shampoo. If no improvement will consider dental, mass removal. To keep us closely updated with any changes at home.
...Rec'd adding in a dental to control pruritus	1) Grade 3 dental diseases 2) Otitis externa d.
...o came in for vaccines	Rabies SQ RR - 1yr DHPPL SQ L - 1yr Bord PO - 1yr
...EENT:	Otitis externa secondary to primary conditions (e.g., over cleaning vs exploration) due to excessive debris throughout ear canals and very mild debris



# Conclusion

- We showed with production testing that our **language model was able to learn to help vets write their notes faster.**
- Fine-tuning general language models to domain-specific (medical) language works surprisingly well.
- Areas of longer, more sentence-like structure perform the best (histories, discharges, recommendations, etc.) while model still suffers in suggestions during Objective portion, where more exam-specific information is included.