

Student: Megh Shah
Mentor: Dr. Tara Sainath, Google, Inc.
<https://sites.google.com/site/tsainath/>

SAIDL Induction Documentation:

Part 3

Decision Transformer

Explanation of some important concepts:

- 1) **Transformers:** Transformers were developed to solve the problem of sequence transduction, or neural machine translation. That means any task that transforms an input sequence to an output sequence. This includes speech recognition, text-to-speech transformation, etc.

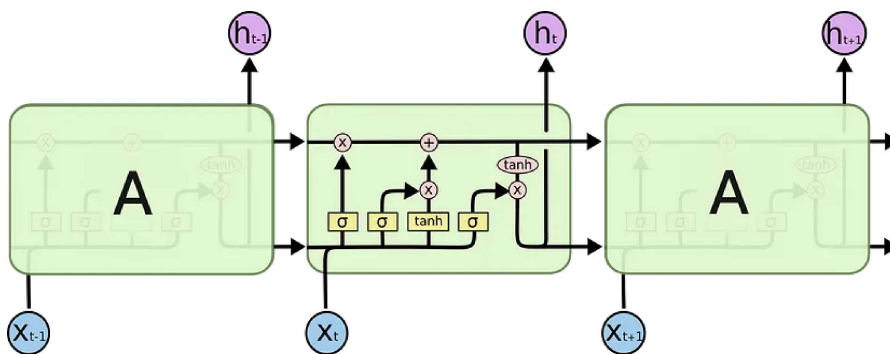
A transformer model is a neural network that learns context and thus meaning by tracking relationships in sequential data like the words in this sentence. Transformer models apply an evolving set of mathematical techniques, called attention or self-attention, to detect subtle ways even distant data elements in a series influence and depend on each other.



2) Long-Short Term Memory(LSTM): LSTMs make small modifications to the information by multiplications and additions. With LSTMs, the information flows through a mechanism known as cell states. In this way, LSTMs can selectively remember or forget things that are important and not so important.

Each cell takes as inputs x_t (a word in the case of a sentence to sentence translation), the previous cell state and the output of the previous cell. It manipulates these inputs and based on them, it generates a new cell state, and an output.

The limitation of LSTM is that : The sequential computation in it inhibits parallelization i.e. we cannot have all outputs together at once because it is sequential. The previous one has to be evaluated before we get the present one.



Results(Using LSTM) :

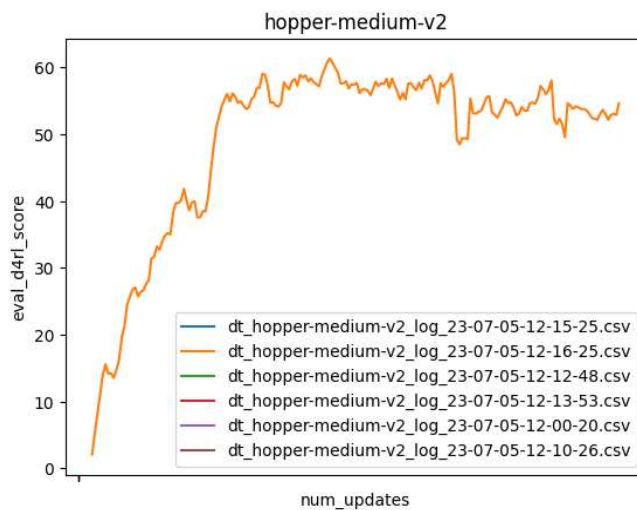
The RL score is around 59.69 for the LSTM, details are listed below in the table.

```
{'eval/avg_reward': 1922.4958449093106, 'eval/avg_ep_len': 611.7}  
normalized d4rl score: 59.69350095324769
```

```
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```

evaluated on env: Hopper-v3
total num of checkpoints evaluated: 1
d4rl score mean: 59.69350
d4rl score std: 0.00000
d4rl score var: 0.00000

```
=====
```



In comparison, the transformer from the DT paper has an RL score of around 67.60. Typically because transformers are much stronger at sequence modeling compared to LSTMs, which can suffer from vanishing gradient problems, they have higher RL scores.

Base of code:

- <https://github.com/nikhilbarhate99/min-decision-transformer>
- <https://blogs.nvidia.com/blog/2022/03/25/what-is-a-transformer-model/>

References:

- <https://github.com/nikhilbarhate99/min-decision-transformer>
- <https://blogs.nvidia.com/blog/2022/03/25/what-is-a-transformer-model/>
- <https://jalammar.github.io/illustrated-transformer/>
- <https://www.geeksforgeeks.org/deep-learning-introduction-to-long-short-term-memory/>