Report on “Automotive NER”

Objective:

Fine tune a large language model (LLM) for performing named entity recognition (NER) task on an automotive dataset. NER task involves processing unstructured text data to extract useful information/entities. This assignment is broken down in three tasks.

1. First task involves analysing the data and identifying what are some entities that can be extracted from this data. We are interested in entities related to automotive domain. Some examples could be component, failure issue, vehicle model, corrective action etc. You may choose what all and how many entities you are planning to extract.
2. Second task is to use an open source LLM of your choice and write the prompt to extract the automotive domain entities from given dataset. Some examples of LLMs include LLaMA 2 7b, Phi-2, Mistral 7b etc. Explore zero shot and few-shot learning and other prompt engineering techniques.
3. Final task is to fine tune the selected LLM on a subset of provided dataset. Be creative in selecting fine-tuning method, generating fine-tuning dataset and training the model.

Evaluate the fine-tuned model against zero-shot/few-shot on a held-out testing dataset.

Report the comparison.

Zero Shot..

Prompt:

```
zero_shot_prompt_template = """
Please generate a structured output from the provided input text. The
input text describes failure issue, vehicle model, corrective action and
affected components etc in vehicle. Your task is to extract entities and
their corresponding labels.
output in the form of Entity and Labels
"""
```

Results:

`Enter the text paragraph:` “In the event of a short circuit or wiring failure, the firmware in the node may fail to shut off the output pin, resulting in overloaded electrical circuits. Overloaded electrical circuits can overheat, increasing the risk of fire.”

Output:

1. Entity: event

   Label: short circuit or wiring failure

2. Entity: firmware

   Label: firmware in the node

3. Entity: failures

   Label: may fail to shut off the output pin

4. Entity: Overloaded electrical circuits

   Label: Overloaded electrical circuits can overheat

5. Entity: risk

   Label: increasing the risk of fire.

Few Shot…

Prompt:

```
prompt_template = """
Please generate a structured output from the provided input text. The
input text describes failure issue, vehicle model, corrective action and
affected components etc in vehicle. Your task is to extract entities and
their corresponding labels.

Example 1:
Input Text:

"ON CERTAIN CLASS A MOTOR HOMES, THE FLOOR TRUSS NETWORK SUPPORT SYSTEM
HAS A POTENTIAL TO WEAKEN CAUSING INTERNAL AND EXTERNAL FEATURES TO BECOME
MISALIGNED. THE AFFECTED VEHICLES ARE 1999 - 2003 CLASS A MOTOR HOMES
MANUFACTURED ON F53 20,500 POUND GROSS VEHICLE WEIGHT RATING (GVWR), FORD
CHASSIS, AND 2000-2003 CLASS A MOTOR HOMES MANUFACTURED ON W-22 22,000
POUND GVWR, WORKHORSE CHASSIS. CONDITIONS CAN RESULT IN THE BOTTOMING OUT
THE SUSPENSION AND AMPLIFICATION OF THE STRESS PLACED ON THE FLOOR TRUSS
NETWORK. THE ADDITIONAL STRESS CAN RESULT IN THE FRACTURE OF WELDS
SECURING THE FLOOR TRUSS NETWORK SYSTEM TO THE CHASSIS FRAME RAIL AND/OR
FRACTURE OF THE FLOOR TRUSS NETWORK SUPPORT SYSTEM. THE POSSIBILITY EXISTS
THAT THERE COULD BE DAMAGE TO ELECTRICAL WIRING AND/OR FUEL LINES WHICH
COULD POTENTIALLY LEAD TO A FIRE."
```

```
Expected Output Format:

[
  {"Entity": "floor truss network support system", "Label": "Component"},
  {"Entity": "internal and external features", "Label": "Component"},
  {"Entity": "ford chassis", "Label": "Component"},
  {"Entity": "1999 - 2003 Class A motor homes (F53 20,500 pound GVWR, Ford
chassis)", "Label": "Vehicle"},
  {"Entity": "2000-2003 Class A motor homes (W-22 22,000 pound GVWR,
Workhorse chassis)", "Label": "Vehicle"},
  {"Entity": "bottoming out the suspension", "Label": "Failure Issue"},
  {"Entity": "amplification of the stress", "Label": "Failure Issue"},
  {"Entity": "floor truss network", "Label": "Component"},
  {"Entity": "fracture of welds", "Label": "Failure Issue"},
  {"Entity": "chassis frame rail", "Label": "Component"},
  {"Entity": "damage to electrical wiring", "Label": "Failure Issue"},
  {"Entity": "fuel lines", "Label": "Component"},
  {"Entity": "fire", "Label": "Failure Issue"}
]

Example 2:
.
.
Example 2:
.
.
"""
```

For full prompt refer repo..

Results:

`Enter the text paragraph:` “In the event of a short circuit or wiring failure, the firmware in the node may fail to shut off the output pin, resulting in overloaded electrical circuits. Overloaded electrical circuits can overheat, increasing the risk of fire.”

[

{"Entity": "short circuit", "Label": "Failure Issue"},

{"Entity": "wiring failure", "Label": "Failure Issue"},

{"Entity": "firmware in the node", "Label": "Component"},

{"Entity": "output pin", "Label": "Component"},

{"Entity": "overloaded electrical circuits", "Label": "Failure Issue"},

{"Entity": "overheating", "Label": "Failure Issue"},

{"Entity": "risk of fire", "Label": "Failure Issue"}

]

Comparison:

The few shot prompting gives better and desired results in the required format as compared to the zero shot prompting.

Zero shot prompting does not perform as per our desired results.

Fine Tuning:

Model selected for fine tuning is OpenAI's `gpt-3.5-turbo`

For fine tuning custom data is created.

For codes, dataset used and collab notebook refer to : GitHub Repo**[Link]**