Identifying Interchangeabilities Between ICE and EV Manufacturing Processes
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Introduction

- The Knudsen Institute is a 501(c)(3) non-profit organization which works to advance America’s defense industrial base surge capacity, with a focus on small & medium manufacturers.
- This project aims to identify interchangeable and non-interchangeable manufacturing capacities for emerging EV production from traditional ICE production.

Web Scraping and Model Training of Manufacturer Sites

![Diagram of NLP model training](image)

**Figure 1.** This figure shows how an NLP model is trained.

1. Web scraped 34 small and medium scale manufacturers sites (ONEDA, Sphere Brake Defense, MIASA, and more)
   - Utilized Beautiful Soup and Selenium
2. Passed in text data to train NER (Natural Entity Recognition) Models.
   - Flair, Bert, Camembert, and more as these were the most popular and fastest Hugging Face models to detect manufacturing capabilities for each website
3. Tested and improved model using machine learning metrics.

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Insights into Model Metrics

**Figure 2.** This figure shows the Precision scores of various NER models

**Figure 3.** This figure shows the Recall scores of various NER models

**Figure 4.** This figure shows the F1 scores of various NER models

**Precision**
The number of correctly labeled items divided by the total number of correct items.

\[
\text{Precision} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}}
\]

**Recall**
Measures how many correct items it labels relative to total items.

\[
\text{Recall} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Negative}}
\]

**F1 Score**
Measures accuracy by combining both precision and recall into a single value.

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F1 \text{ Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}}
\]

Future Goals

- Dynamically generate testing data through using popular text generation models, including scraping other automotive manufacturers’ websites and test the model’s performance on these data sources
- Test the model’s performance on data scraped from the 30+ websites during the first semester and on unstructured and faulty data
- Use the insights gained from the processes above to continuously retrain and retest the model
- Convert the project into an open-source effort, and eventually develop a custom LLM that The Knudsen Institute can use to gain insights into automotive manufacturer capabilities
- Further steps would include converting the model’s functionality to detect capabilities of non-automotive manufacturers

Conclusions and Findings

Targeted three specific key components of the automotive supply chain to find similarities between ICE and EV processes:
- **Aluminum Die Casting**
  - EVs use aluminum for the body panels to counteract the weight of the powertrain. ICE vehicles are also switching to aluminum body panels for weight savings and improving fuel efficiency
  - 5 axis CNC Machining - A sophisticated tool used in aluminum die casting that does so in 5 directions, the 3 cartesian axes and 2 more for rotation, used in both vehicle manufacturing processes
- **Certifications** - Some EV-specific certifications for the manufacturing of lithium-ion batteries
  - Examples: IATF 16949, ISO 14001, ISO 9001

**Figure 5.** 5-Axis CNC Machining

**Figure 6.** Aluminum Die Casting