\subsection{Information Extraction}

In the field of scenario-based autonomous driving testing, the three essential elements of reconstructing a scenario are road network, environment information and traffic actors trajectory. In the dataset used in our work, the crash sketch, drawn by accident investigators, includes road structure and vehicle trajectories, while the crash summary is a textual description of the accident, including road structure, environment information, and vehicle trajectories. Extracting, integrating and validating data from these two modalities is the primary challenge faced by our work.

Inspired by the application of large models, we employed prompt engineering techniques, using strategies such as few-shot learning, chain-of-thought prompting, and self-validation to train the LLM to extract and verify information from multi-modal data. In the task of trajectory extraction, unlike previous rule-based path planning approaches, we chose to train the LLM using real traffic trajectory data, enabling it to predict vehicle trajectories in crash data. The advantage of this approach is that the trajectory paths output by TrackMate are more realistic.

\subsubsection{Extract Road Network & Environment Information}

通过对原始数据的研究可以发现，道路网络的信息在crash sketch以及summary中都有所描述，但是在部分数据中，crash summary仅包含对事故车辆所在路段的描述

\subsubsection{Extract Traffic Actors Trajectory}

\subsection{Crash Scenario Reconstruction}

\subsection{ADS Testing}

In the task of extracting vehicle trajectories, CMIEA extracts vehicle trajectories from both the Crash sketch and Crash summary. It then uses an LLM to verify the information from the two trajectories, ensuring consistency in the data extracted from different modalities before integrating the two vehicle trajectories into one. For the Road network, we opt to extract this from the crash summary because key information like broken road lines and lane directions are often omitted in images, which leads to the inability to correctly extract the road network from the Crash sketch. Finally, CMIEA extracts environmental information such as weather and lighting based on the descriptions in the crash summary.

In our work, we have developed a Domain Specific Language (DSL) based on a tree structure for scenario descriptions, consisting of nodes and their attributes. Nodes correspond to objects in the traffic scene, such as roads, vehicles, pedestrians, etc., and attributes describe these objects, with attribute values serving as nodes that are further described by other attributes. For example, the attribute of the node-road is road structure, with possible values including [straight, curved, intersection, T-junction]. The attribute value for straight road itself becomes a new node, described by the attribute-straight road parameters. Specific values for the attribute-straight road parameters include [width, length, number of lanes]. Our constructed Domain Specific Language encompasses detailed descriptions of the three essential elements of scenario reconstruction—vehicle trajectory, road network, and environmental information—allowing for the accurate construction of test cases.

\subsubsection{Extract Road Network & Environment Information}