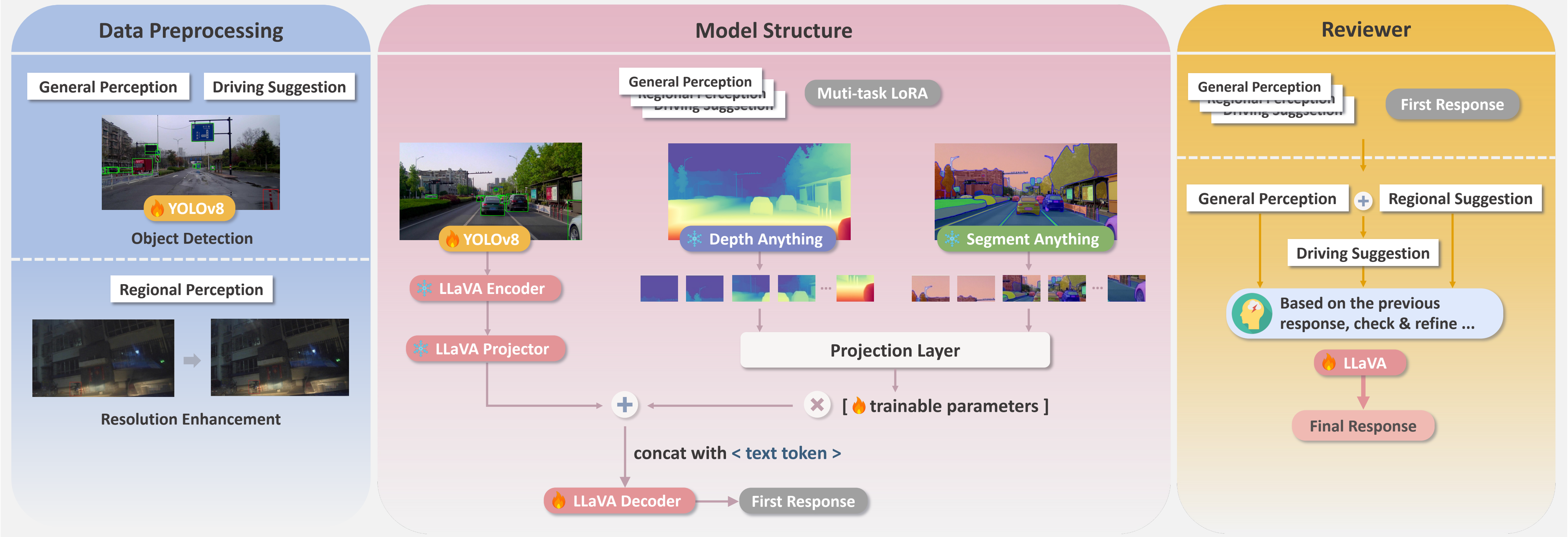


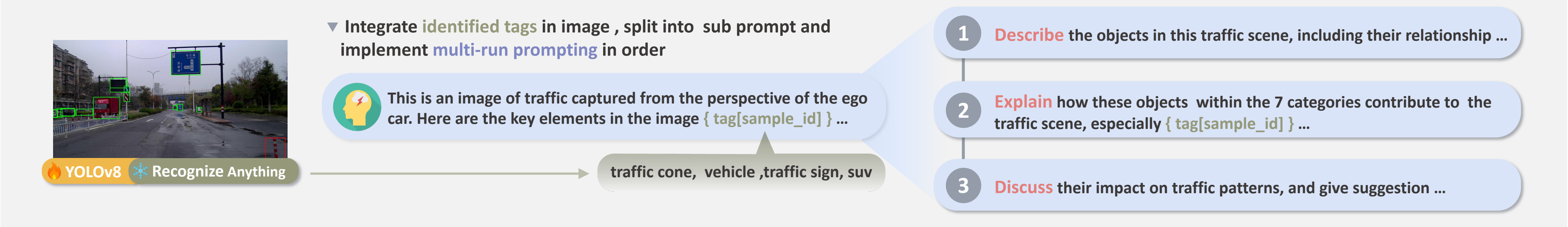
Multimodal Perception and Comprehension of Corner Cases in Autonomous Driving

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Method

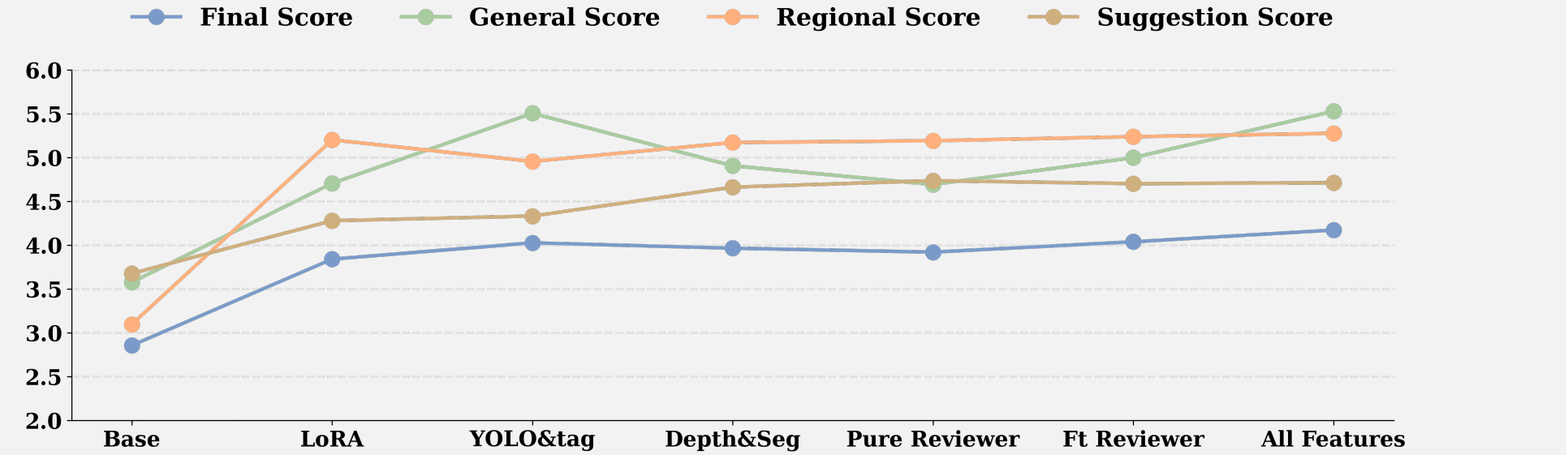


Prompting Mechanism Design



Experiment

Id	Setting	Belu 1	Belu 2	Belu 3	Belu 4	General	Regional	Suggestion	LLM judge	Final Score
1	LLaVA (Base)	1.735	0.883	0.481	0.278	3.577	3.097	3.677	3.450	2.856
2	Finetune 1 (LoRA)	0.820	0.472	0.283	0.172	4.707	5.203	4.280	4.730	3.841
3	2 + YOLOv8 + tag	1.262	0.699	0.405	0.242	5.507	4.957	4.333	4.932	4.027
4	2 + Depth & Seg	0.476	0.280	0.170	0.106	4.907	5.173	4.663	4.914	3.966
5	2 w/ Reviewer (Pure 1)	0.299	0.176	0.108	0.068	4.693	5.193	4.737	4.874	3.921
6	3 w/ Reviewer (Finetuned 1)	0.565	0.333	0.201	0.124	5.000	5.239	4.703	4.999	4.039
7	2 w/ all features	0.485	0.287	0.174	0.107	5.530	5.277	4.713	5.173	4.173



Our three-stage approach significantly improves LLaVa's performance, with the combined method achieving a 46% increase in Gemini score (from 2.856 to 4.173) through enhanced perception and reviewing process.

Idea Key Points

Our proposed framework integrates several advanced components, These innovations collectively contribute to our successful results in our metric. Key highlights include:

- YOLO-based Image Detection:**
 - Finetuned YOLO to enhance small object detection and recognition.
- Resolution Enhancement:**
 - Improved image quality to support accurate visual processing.
- Multi-Task Perception Enhancement:**
 - Depth Anything* for depth estimation and spatial understanding.
 - Segment Anything* for precise object and region segmentation.
 - Recognize Anything* for robust object and feature identification.
- Lora-based Adaption:** Efficient fine-tuning of LLaVa-1.5-7b for seamless integration of multi-modal information.

Ablation Study

- LoRA Rank Effects (8-64):** We observed that higher ranks showed decreased performance under constant training time. Extended training periods led to overfitting issues, significantly reducing the model's ability to generalize to new scenarios.
- Handling Missed Scene Factors:** The model initially missed critical scene elements like traffic cones. Integration of *Recognize Anything* for automated tagging of important scene factors during inference significantly improved contextual understanding.
- Reviewer Module Findings:** The reviewer let the model revisit images to refine its initial response. Interestingly, we found that using a model with lower testing score to train the reviewer resulted in better refinement ability compared to a higher-scoring one. We hypothesize that this is due to lower-scoring models developing stronger revising capabilities by learning to transform low-quality responses into high-quality ones.