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Interactive seismic data Quality Control assistant

EAGE Annual 2025 hackathon

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Background : QC



Ensuring data integrity by identifying and mitigating noise, acquisition artifacts, and errors is crucial for accurate imaging and reliable interpretation.

Traditional QC

- Manual inspection of gathers and sections
- Repetitive filtering and muting
- Notes and annotations exist only as external comments

What's Missing

- No persistent memory of previous user decisions
- No automation driven by user feedback
- No adaptive, data-aware suggestions



The solution ?

IQC A gen AI agent capable of playing with the data

Interface

Input prompt
Text

Agent reply
Text and images



IQC Assistant

An intelligent agent designed for interactive quality control and optimization of seismic data.

Your Question

Examples:

- load file mydata.sgy
- plot QC summary
- show inline section 150
- detect bad traces
- adjust thresholds to 0.2 and 2.5

Assistant Reply

Send

Made with ❤️ for the [EAGE Annual 2025 hackathon](#) by Xiaoxuan Zhu and Valentin Cassayre

Simple Example : Listing datasets



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Your Question

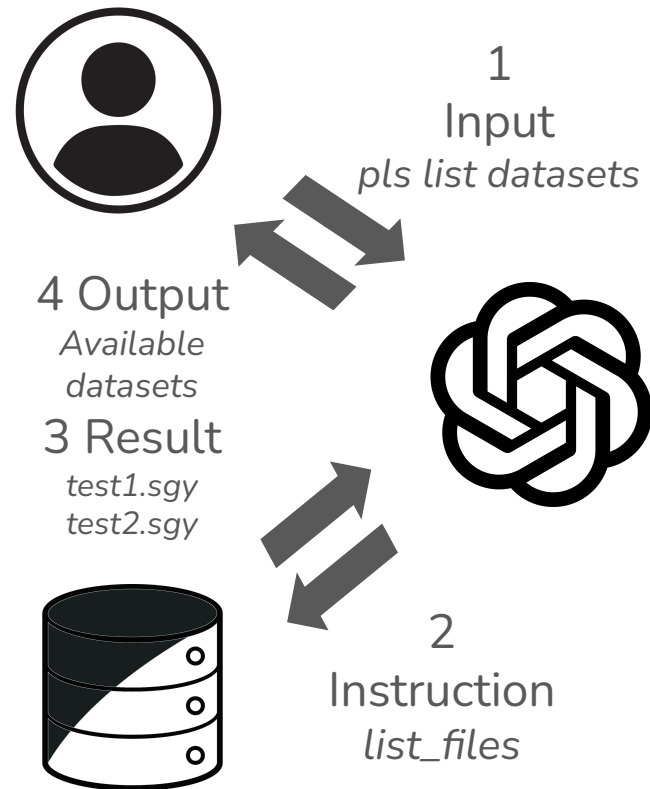
What dataset are available?

Assistant Reply

We have two dataset files available:

1. F3_8-bit_int.segy
2. Poseidon3D_Final_PSDM-Decimated_vels.segy

Which one would you like to load and work with for your seismic data processing and QC?



Simple Example : Load a dataset



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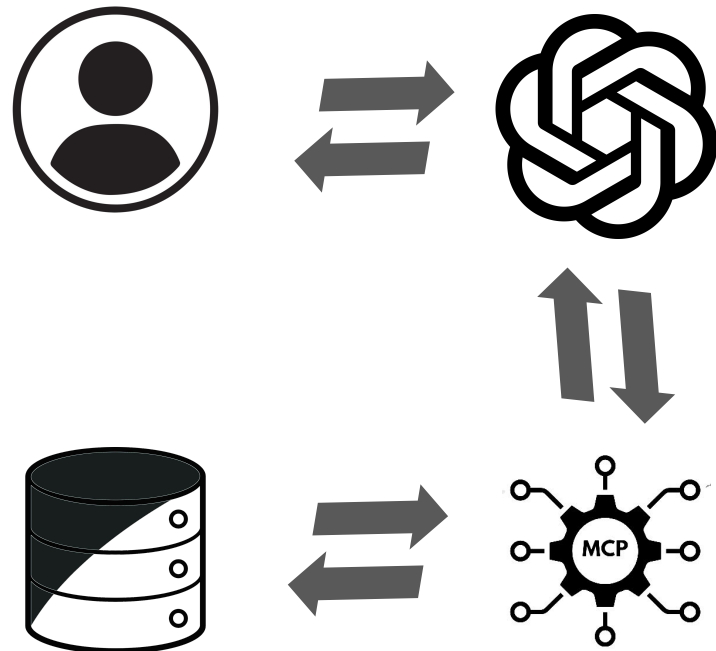
load F3_8-bit_int.sgy

Assistant Reply

The SEG-Y file "F3_8-bit_int.sgy" has been successfully loaded. It contains 463 samples per trace at a 4.0 ms sample interval, with a spatial coverage of 225 inlines by 300 crosslines.

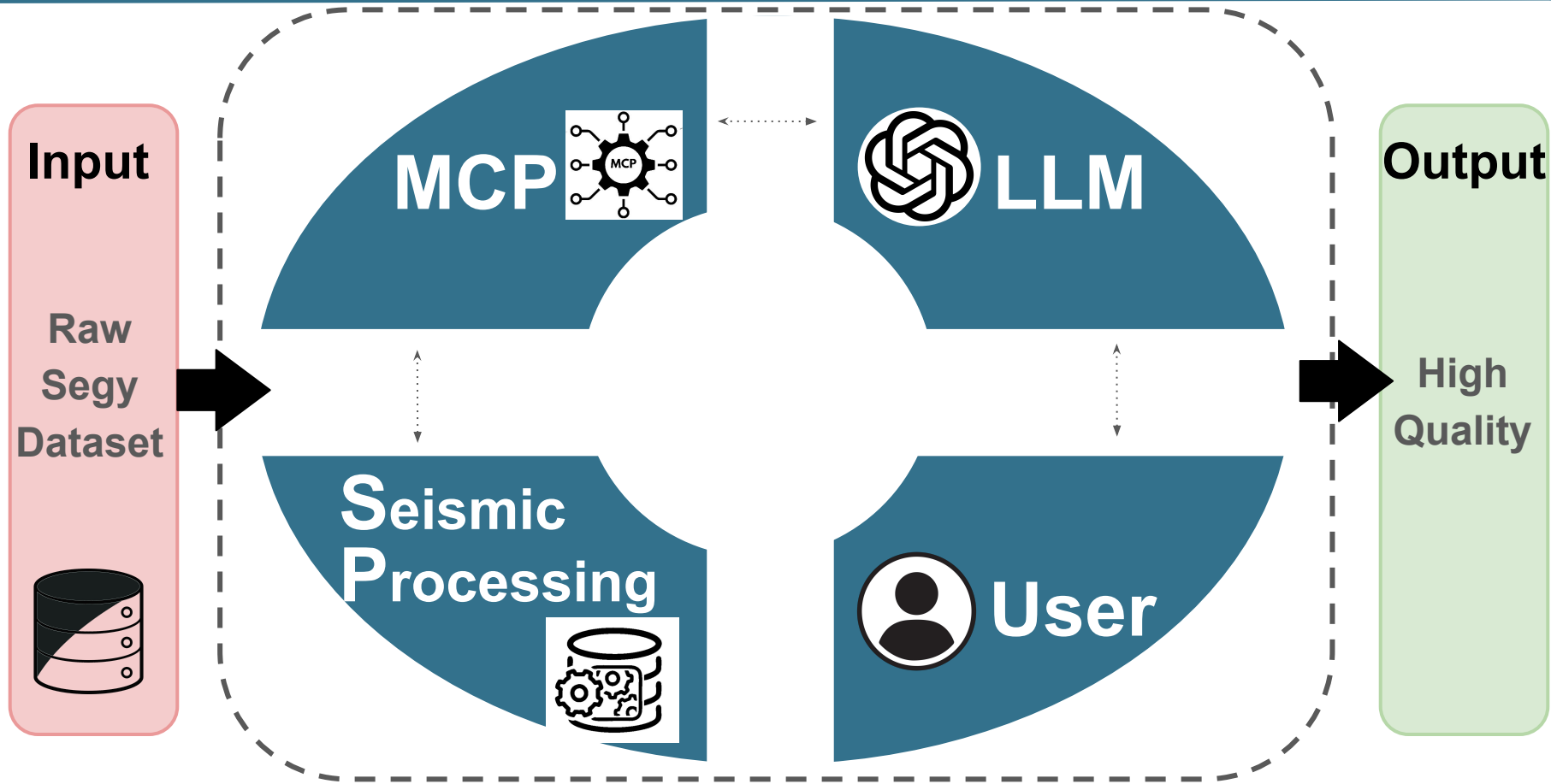
To start, I recommend performing an initial QC summary to understand the data quality, including zero or NaN traces, amplitude distribution, and noise levels.

Shall I proceed to show the QC summary for this volume?



Once loaded the MCP server keeps it in cache

Agent Workflow



QC example : First order



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Your Question

qc the data

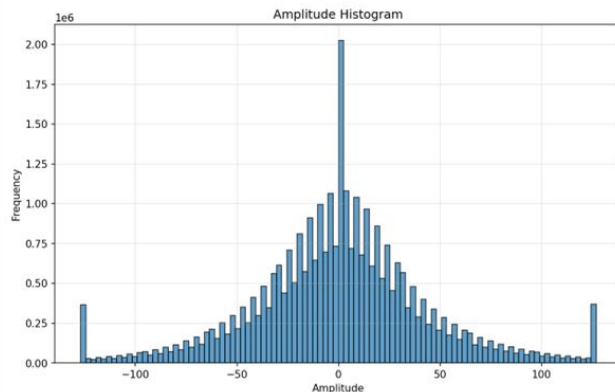
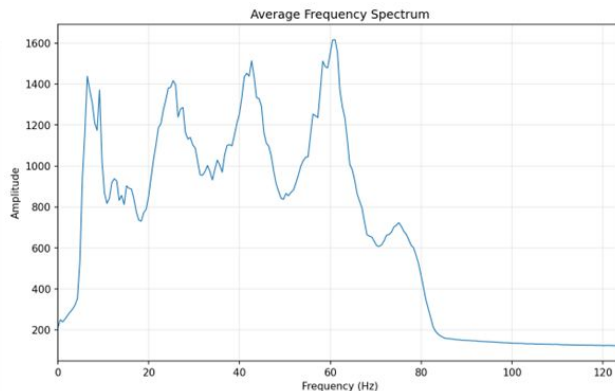
Assistant Reply

Thank you for providing the QC plots for the F3_8-bit_int.sgy volume:

- **QC Summary**: No zero traces, no NaN values, and no bad amplitude traces detected. This indicates initial data integrity is good.
- **Amplitude Histogram**: The amplitude distribution is fairly symmetrical with peaks near zero; some outliers at extreme amplitudes may be present, but they are not numerous.
- **Average Frequency Spectrum**: The signal has strong energy mostly between ~5 Hz and ~80 Hz, peaking near 60 Hz, with attenuation beyond 80 Hz. There is also some noise or artifacts at very low frequencies.
- **Inline 112 and Crossline 150 Sections**: The seismic events are visible with reasonable continuity and no obvious dead traces or severe artifacts.

Overall, the data quality looks decent for the raw 8-bit integer volume.

Analysis



Recommendation

Recommendations for Next Steps:

1. **Amplitude Scaling**:

The amplitude histogram has a narrow peak near zero and some extreme amplitudes. Consider applying a dynamic gain or clipping to reduce extreme outliers and balance amplitude scaling before further processing.

2. **Bandpass Filtering**:

Since the main signal is between 5–80 Hz, I recommend applying a bandpass filter around 5–80 Hz to suppress very low frequency noise and high-frequency unwanted content. This will enhance signal quality and prepare the data for velocity analysis or stacking.

3. **Bad Trace Detection**:

Although no bad traces were detected automatically initially, a stricter threshold or visual inspection of outlier traces may be useful to detect subtle bad traces or noisy traces that just passed default thresholds.

4. **Trace and SNR Tools**:

Checking trace amplitude RMS maps and SNR maps across the volume can help locate problematic areas, if any, and guide further targeted processings, such as de-noising or trace interpolation.

Would you like me to proceed with bandpass filtering at 5–80 Hz and then re-assess the QC? Or do you want to explore any other quality checks/tracing steps first?

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Your Question

Could you plot me some sections of the data ?

Assistant Reply

I have plotted four inline sections: 50.112.150.and 200.

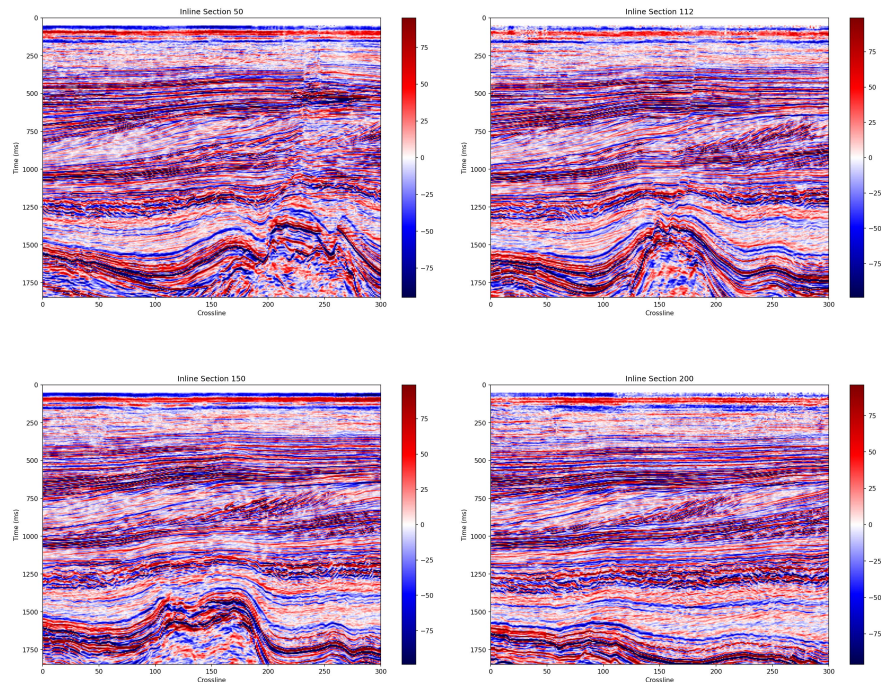
The seismic sections display coherent reflections with some structural features visible, such as dipping events and a possible anticline around crossline 150 in some sections

Would you like me to:

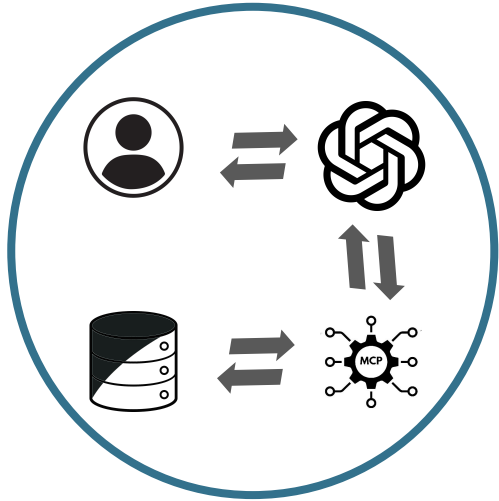
.Plot crossline sections or other directions for comparison?

Perform any quality control analysis (e.g., amplitude histogram, frequency spectrum)?

Proceed with noise attenuation or bad trace detection based on visual inspection?



Conclusion : The power of IQC



- **Interactive Feedback Loop:** IQC learns from geoscientist annotations and decisions, continuously improving QC accuracy.
- **Context-Aware Processing:** MCP provides structured metadata, enabling the LLM to make intelligent, data-driven suggestions.
- **Easily expandable:** Add seismic processing, data loading function to the MCP to add functionality to the agent.
- Web user interface or GitHub Copilot integration.

Thank You!



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Q & A



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