Bringing AI to DuckDB with Lance columnar format for multi-modal AI

Chang She

- LanceDB co-founder
- Pandas co-author
- VP Eng @ TubiTV (MLOps / Experimentation)
- Twitter/Github: @changhiskhan

Lance columnar format

High performance unified storage for AI

Unified storage

Store embeddings, text, images, pdfs, videos, audio, point clouds, alongside tabular data.

✨ Plug-and-play

Convert data with 2 lines of code. Compatible with pandas, polars, duckdb, spark, jupyter, and more

Reduce cost

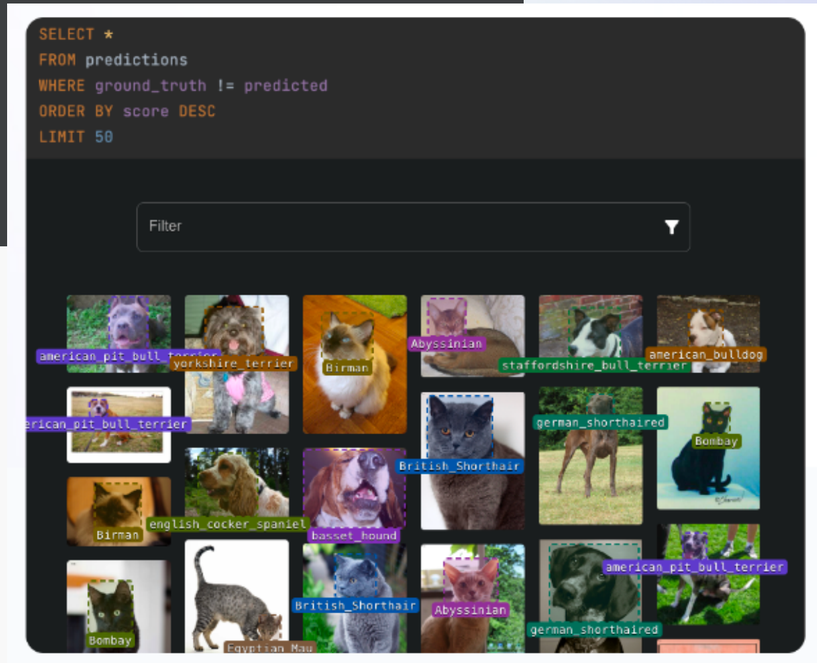
Reduce storage cost by 80%. Replaces parquet, tfrecords, etc. Don't need multiple copies in different formats. Zero-copy schema evolution.

Performance

Reduce training time by up to 3x with faster filtering, shuffling, and data loading. Up to 2000x faster than parquet for AI

Bring AI into DuckDB ecosystem

```
SELECT filename, class, predict('resnet', image) as pred
FROM oxford_pet
WHERE split='train' AND class='samoyed'
USING SAMPLE 1000;
```



Bring AI into DuckDB ecosystem

- Data: Lance extension
- Model: Pytorch / TF extensions
- Scanners: e.g., ffmpeg/opencv scanner for videos
- UDFs: e.g., crop, rotate, sample images, etc
- CUDA integration

Types! Types! Types!

- Composable data systems is not a thing unless types are more interoperable
- Arrow types and DuckDB types are maybe 80% interoperable. Unfortunately AI falls in the missing 20%
  - Nested types - annotations, bounding boxes, labels, etc
  - Extension types - image, embedding, video, point cloud, etc
  - ML specific types - e.g., bf16

DuckDB-Arrow pushdowns

- pyarrow compute kernel is not a standard interface
- Lance format uses datafusion so can pushdown sql str
- Maybe long-term use Substrait as the standard interface across Arrow-compatible formats?
- Lance format has a disk-based vector index, but duckdb / pandas / polars can't access it directly because there's no pushdown available yet.
  - Table function in an extension is viable.
  - Better would be to allow extension to modify the query plan (order by / limit)

Conclusion

- Find us on github: github.com/lancedb/lance ⭐
- New data format for AI is needed
- Need a number of improvements to bridge AI into DuckDB ecosystem
- Looking for collaborators!