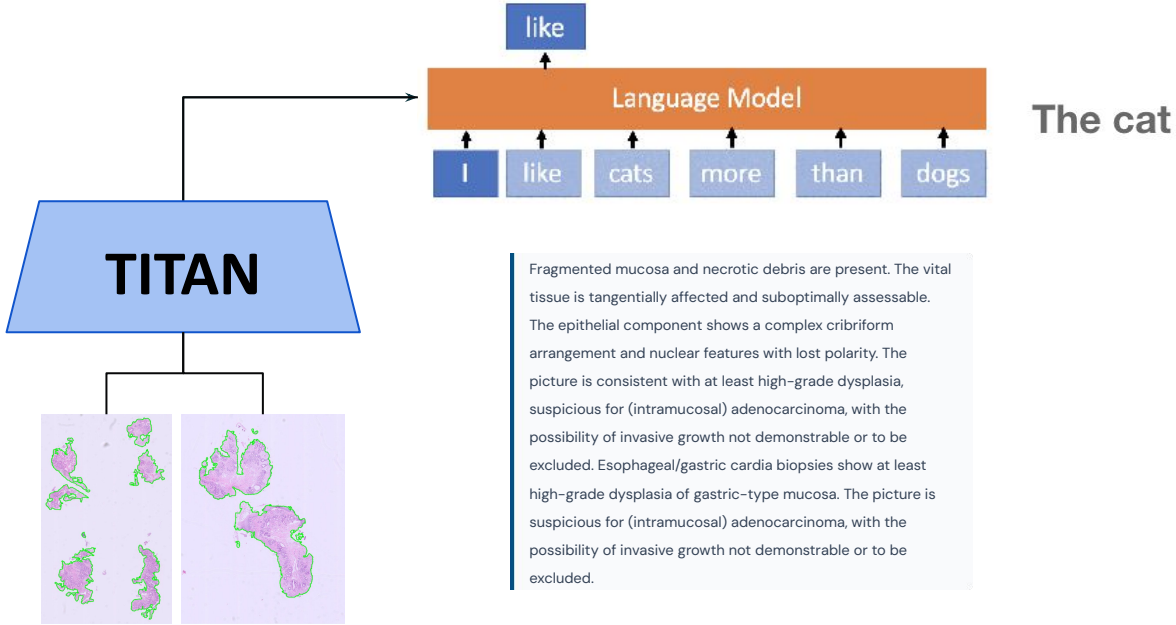
Barrett MMLLM

Bryan Cardenas
Robert Jan Schlimbach
High Performance Machine Learning

SURF

3) How do we model long-range dependencies?



SURF

Image source

Data Preprocessing: RL-1003

Standardization Step

Raw Database Record (Unstructured)

"Microscopie": "In agreement with colleague elsewhere, fragmented mucosa and necrotic debris. The vital tissue is tangentially affected and suboptimally assessable. The epithelial component shows a complex cribriform arrangement and nuclear features with lost polarity. The picture is consistent with at least high-grade dysplasia, possibly invasive growth not demonstrable or to be excluded.\n\nAddendum 29-12-2023: The case was also reviewed in the context of the national advisory body for esophageal neoplasia (LANS case 1003) with the conclusion: at least high-grade dysplasia of gastric-type mucosa, the picture is suspicious for (intramucosal) adenocarcinoma, possibly invasive growth not demonstrable or to be excluded. 1xLGD, 9x HGD",\n"Conclusie": "Esophageal/gastric cardia biopsies (Symbiant Hoorn T23-036668): at least high-grade dysplasia of gastric-type mucosa, the picture is suspicious for (intramucosal) adenocarcinoma, possibly invasive growth not demonstrable or to be excluded.\nMaterial was also reviewed in the context of panel evaluation.",\n"Diagnose": "esophagus*biopsy*high-grade dysplasia*adenocarcinoma*no certain diagnosis*panel"

Cleaned Clinical Text (Ground Truth)

Fragmented mucosa and necrotic debris are present. The vital tissue is tangentially affected and suboptimally assessable. The epithelial component shows a complex cribriform arrangement and nuclear features with lost polarity. The picture is consistent with at least high-grade dysplasia, suspicious for (intramucosal) adenocarcinoma, with the possibility of invasive growth not demonstrable or to be excluded. Esophageal/gastric cardia biopsies show at least high-grade dysplasia of gastric-type mucosa. The picture is suspicious for (intramucosal) adenocarcinoma, with the possibility of invasive growth not demonstrable or to be excluded.

Structured Data Extraction

From Free Text to JSON

The reports are unstructured and varied. We use an LLM as an to standardize this data. WIth the data standardized we can do transfer learning using other databases if needed (TCGA/QUILT)

Extraction Rules:

- **Controlled Vocabulary:** Map "Suspicious for..." to specific keys.
- **Semantic Mapping:** Standardize synonyms (e.g., "Goblet cells" → "Intestinal Metaplasia").
- **Comprehensive Lists:** Capture all unique findings per category.

The Clinical Schema

Columnar Findings (Key)

negative_for_dysplasia reactive_changes indefinite_for_dysplasia low_grade_dysplasia high_grade_dysplasia adenocarcinoma

Tissue Types

squamous_epithelium squamocolumnar_junction columnar_mucosa gastric_cardia

Metaplasia

intestinal gastric_type

Inflammation & Other

active_inflammation chronic_inflammation erosive fibrosis

SURF

LLM Evaluation Rubric

Critical Concordance

Does the primary diagnosis (dysplasia grade) match the reference?
(Score 1-4)

Overall Equivalence

The "Clinician Test": Would a pathologist recommend the same action?
(Score 1-4)

Factual Accuracy

Checks for **Hallucinations**. Does the report invent findings?
(Score 1-4)

Factual Completeness

Checks for **Omissions**. Does the report miss findings?
(Score 1-4)

SURF

High Concordance (4/4)

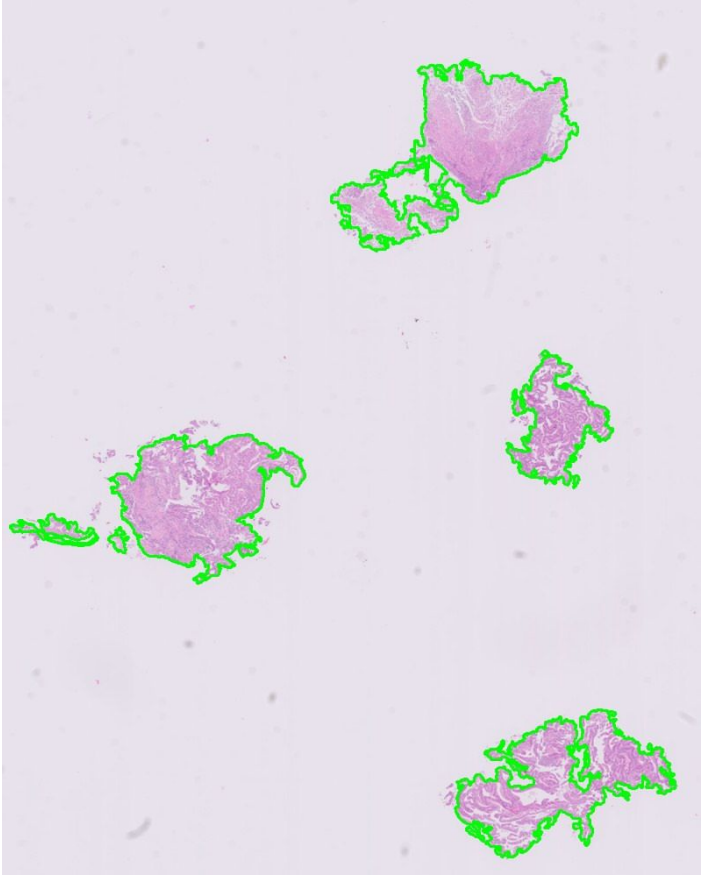
Case: RL-1003

ORIGINAL PATHOLOGIST REPORT (CLEANED)

Fragmented mucosa and necrotic debris are present. The vital tissue is tangentially affected and suboptimally assessable. The epithelial component shows a complex cribriform arrangement and nuclear features with lost polarity. The picture is consistent with at least high-grade dysplasia, suspicious for (intramucosal) adenocarcinoma, with the possibility of invasive growth not demonstrable or to be excluded. Esophageal/gastric cardia biopsies show at least high-grade dysplasia of gastric-type mucosa. The picture is suspicious for (intramucosal) adenocarcinoma, with the possibility of invasive growth not demonstrable or to be excluded.

GENERATED REPORT

Esophageal biopsies show squamocolumnar junction with intestinal metaplasia and (at least) high-grade dysplasia of columnar mucosa. The findings are locally suspicious for adenocarcinoma.



High Concordance (4/4)

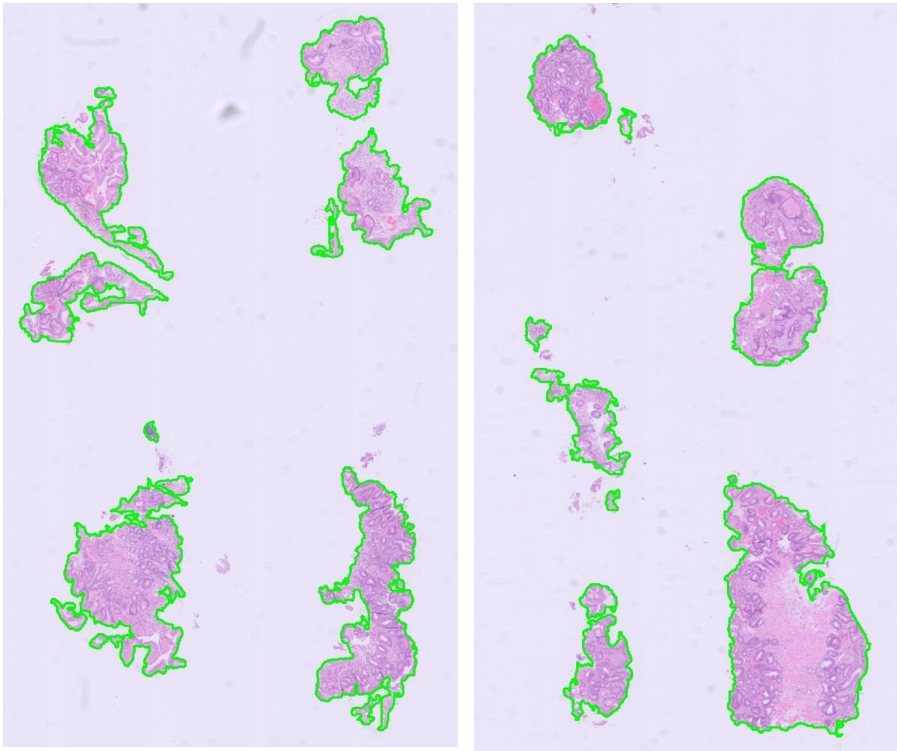
Case: RL-1051

ORIGINAL PATHOLOGIST REPORT

The material shows esophageal biopsies of columnar mucosa with intestinal metaplasia and locally low-grade dysplasia. There is gastric cardia-type mucosa with low-grade dysplasia on a background of intestinal metaplasia. The squamocolumnar junction is preserved in some fragments, showing typical transition zones with mild chronic inflammation. No evidence of high-grade dysplasia or malignancy is seen in the examined levels.

GENERATED REPORT

Fragments of gastric cardia-type mucosa with varying degrees of intestinal metaplasia are identified. In another section, the squamocolumnar junction shows low-grade dysplasia of columnar-type epithelium. The dysplasia is characterized by nuclear stratification and hyperchromasia extending to the surface.



Critical Hallucination (1/4)

Case: RL-1136

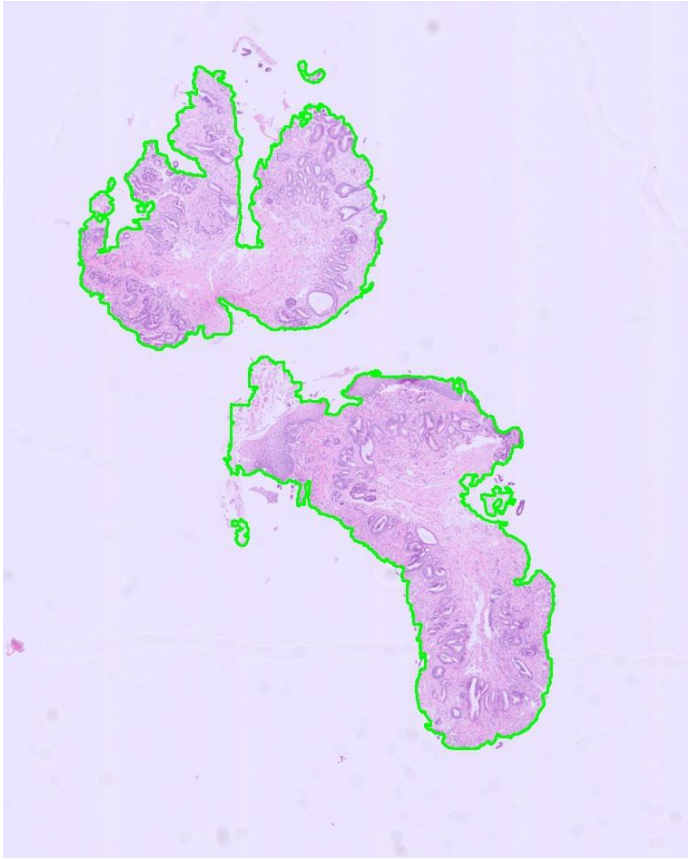
ORIGINAL PATHOLOGIST REPORT

Esophageal biopsies show suboptimally evaluable tissue with significant crushing artifact and thermal damage. The epithelial changes are best classified as indefinite for dysplasia due to the obscuring inflammation and technical artifacts. There is limited active inflammation present. No definite high-grade dysplasia or carcinoma is identified in this material.

GENERATED REPORT

Esophageal biopsies show columnar-type mucosa with findings of at least high-grade dysplasia, suspicious for adenocarcinoma. The neoplastic glands appear to be surrounded by muscle bundles suggesting potential invasion. There is marked nuclear atypia and loss of polarity consistent with a malignant process.

⚠Error: Model hallucinated malignancy.



Missed Diagnosis (1/4)

Case: RL-1094

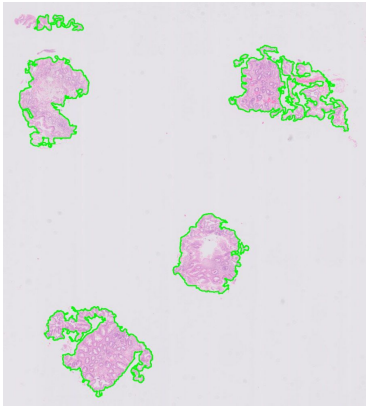
ORIGINAL PATHOLOGIST REPORT

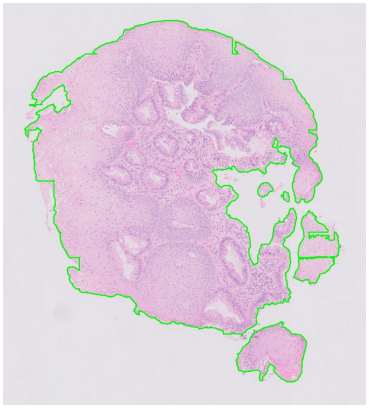
Local epithelial changes best classified as low-grade dysplasia are present in the second fragment. Other fragments show epithelial changes best classified as indefinite for dysplasia with regenerative atypia. The background shows chronic inflammation and intestinal metaplasia. Follow-up is recommended.

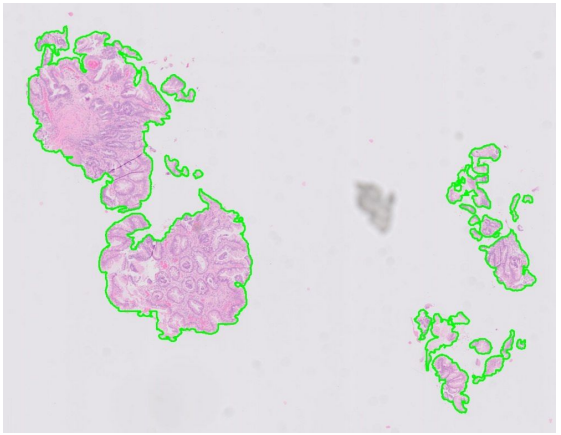
GENERATED REPORT

Esophageal biopsies show squamocolumnar junction with scattered chronic inflammation. There is focal intestinal metaplasia without specific features of dysplasia. No dysplasia identified. The epithelium appears reactive but within normal limits for this location.

⚠ Error: Missed Diagnosis / Surveillance.







Examples Tabular Summary

Case ID	Reference Finding	Generated Finding	Status
RL-1003	High-Grade Dysplasia	High-Grade Dysplasia	Match
RL-1051	Low-Grade Dysplasia	Low-Grade Dysplasia	Match
RL-1145	Benign (Hamartoma)	Benign (No Dysplasia)	Match
RL-1002	Indefinite/LGD	LGD (Indefinite omitted)	Minor Discrepancy
RL-1136	Indefinite	High-Grade (Cancer)	Hallucination
RL-1094	Low-Grade Dysplasia	No Dysplasia	Missed Dx