Interview Assignment:

Intelligent message routing with guardrails

Code Repo: github.com/Franklin112233/intelligent_message_routing

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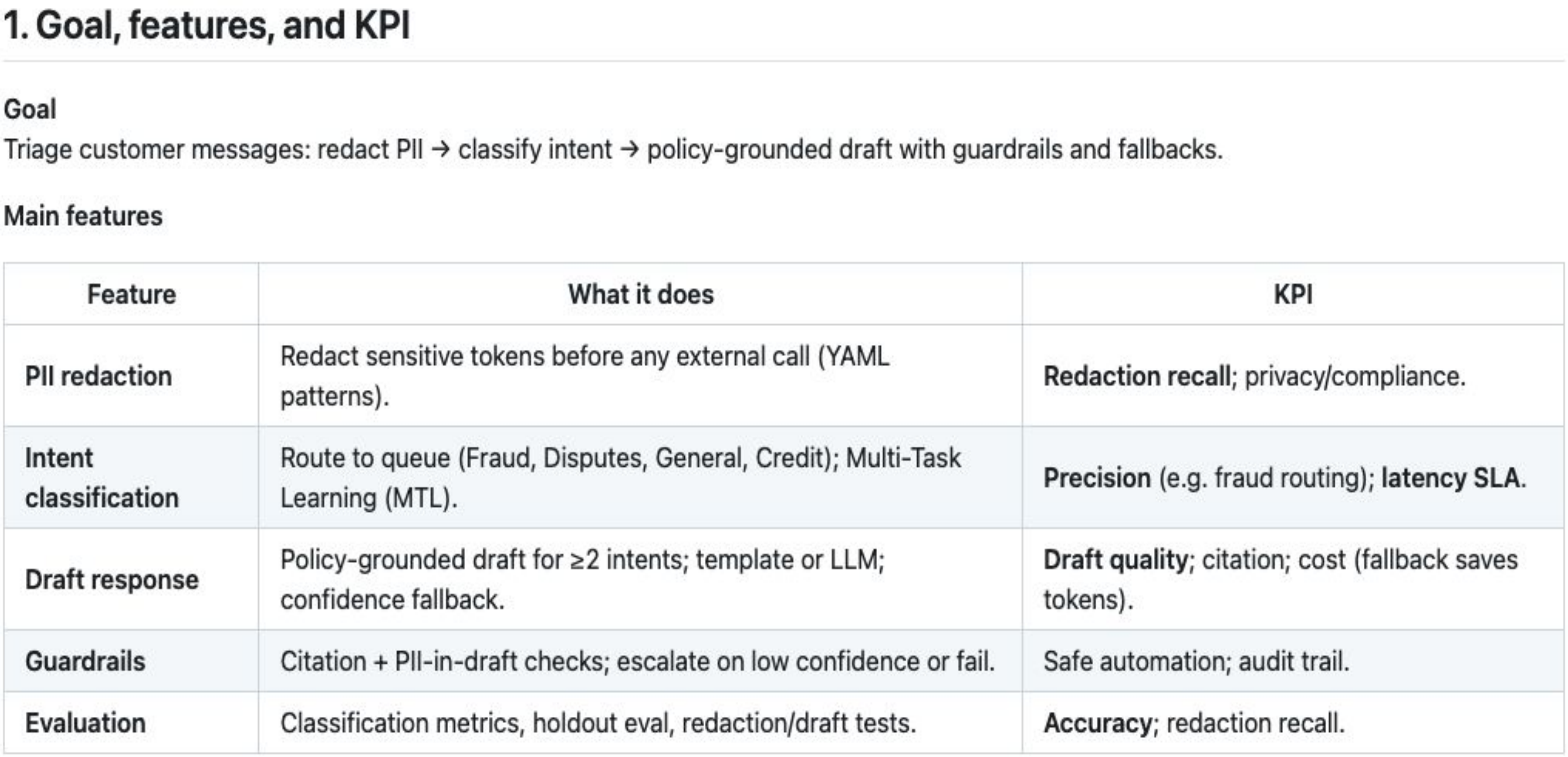


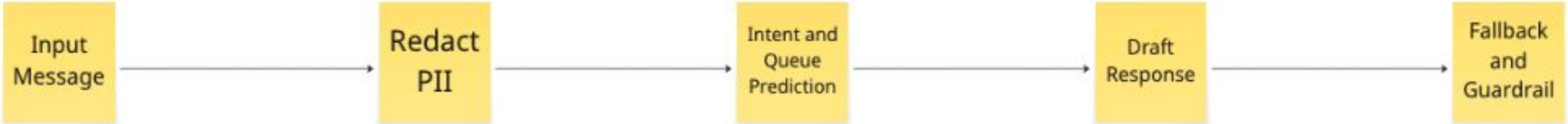
1. Goal, features, and KPI

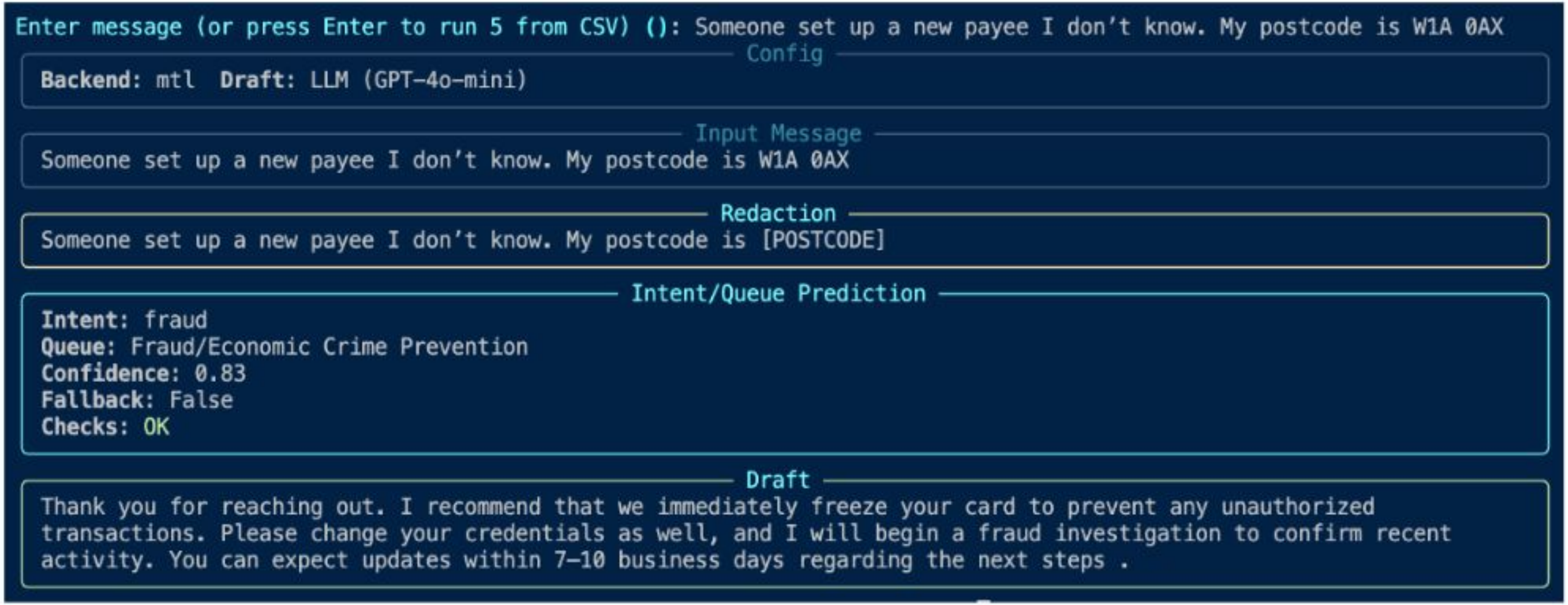
Goal
Triage customer messages: redact PII → classify intent → policy-grounded draft with guardrails and fallbacks.

Main features

Feature	What it does	KPI
PII redaction	Redact sensitive tokens before any external call (YAML patterns).	**Redaction recall**; privacy/compliance.
Intent classification	Route to queue (Fraud, Disputes, General, Credit); Multi-Task Learning (MTL).	**Precision** (e.g. fraud routing); **latency SLA**.
Draft response	Policy-grounded draft for ≥2 intents; template or LLM; confidence fallback.	**Draft quality**; citation; cost (fallback saves tokens).
Guardrails	Citation + PII-in-draft checks; escalate on low confidence or fail.	Safe automation; audit trail.
Evaluation	Classification metrics, holdout eval, redaction/draft tests.	**Accuracy**; redaction recall.

2. App runnable example





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Enter message (or press Enter to run 5 from CSV) (): Someone set up a new payee I don’t know. My postcode is W1A 0AX
╭──────────────────────────────────── Config ────────────────────────────────────╮
│ Backend: mtl  Draft: LLM (GPT-4o-mini)                                          │
╰─────────────────────────────────────────────────────────────────────────────────╯
╭──────────────────────────────── Input Message ─────────────────────────────────╮
│ Someone set up a new payee I don’t know. My postcode is W1A 0AX                 │
╰─────────────────────────────────────────────────────────────────────────────────╯
╭────────────────────────────────── Redaction ───────────────────────────────────╮
│ Someone set up a new payee I don’t know. My postcode is [POSTCODE]              │
╰─────────────────────────────────────────────────────────────────────────────────╯
╭─────────────────────────── Intent/Queue Prediction ────────────────────────────╮
│ Intent: fraud                                                                   │
│ Queue: Fraud/Economic Crime Prevention                                          │
│ Confidence: 0.83                                                                │
│ Fallback: False                                                                 │
│ Checks: OK                                                                      │
╰─────────────────────────────────────────────────────────────────────────────────╯
╭──────────────────────────────────── Draft ─────────────────────────────────────╮
│ Thank you for reaching out. I recommend that we immediately freeze your card to prevent any unauthorized │
│ transactions. Please change your credentials as well, and I will begin a fraud investigation to confirm recent │
│ activity. You can expect updates within 7–10 business days regarding the next steps .                  │
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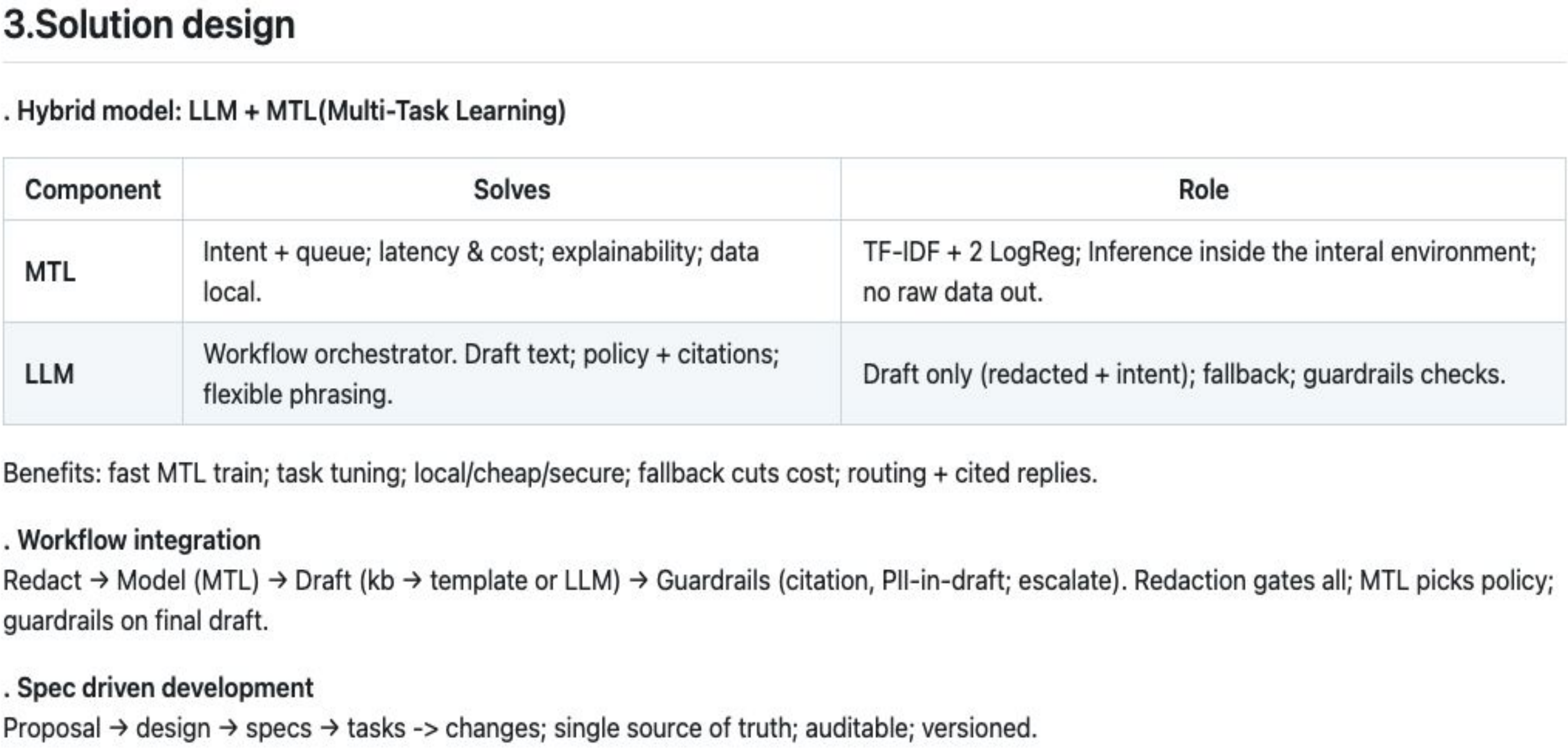


3.Solution design

. Hybrid model: LLM + MTL(Multi-Task Learning)

Component	Solves	Role
MTL	Intent + queue; latency & cost; explainability; data local.	TF-IDF + 2 LogReg; Inference inside the interal environment; no raw data out.
LLM	Workflow orchestrator. Draft text; policy + citations; flexible phrasing.	Draft only (redacted + intent); fallback; guardrails checks.

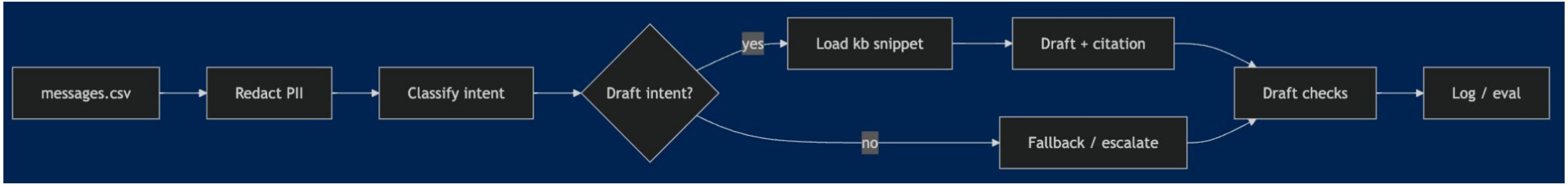
Benefits: fast MTL train; task tuning; local/cheap/secure; fallback cuts cost; routing + cited replies.

. Workflow integration
Redact → Model (MTL) → Draft (kb → template or LLM) → Guardrails (citation, PII-in-draft; escalate). Redaction gates all; MTL picks policy; guardrails on final draft.

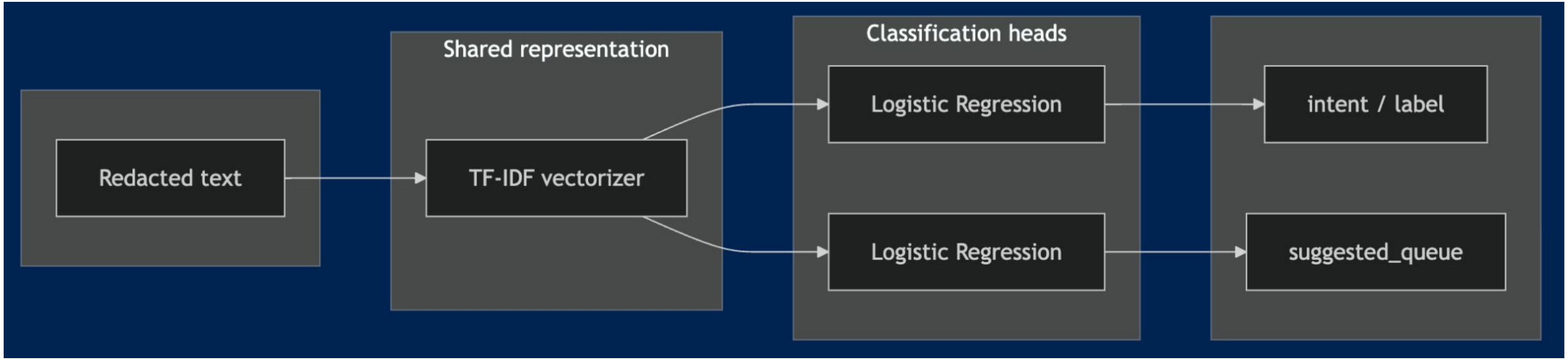
. Spec driven development
Proposal → design → specs → tasks -> changes; single source of truth; auditable; versioned.

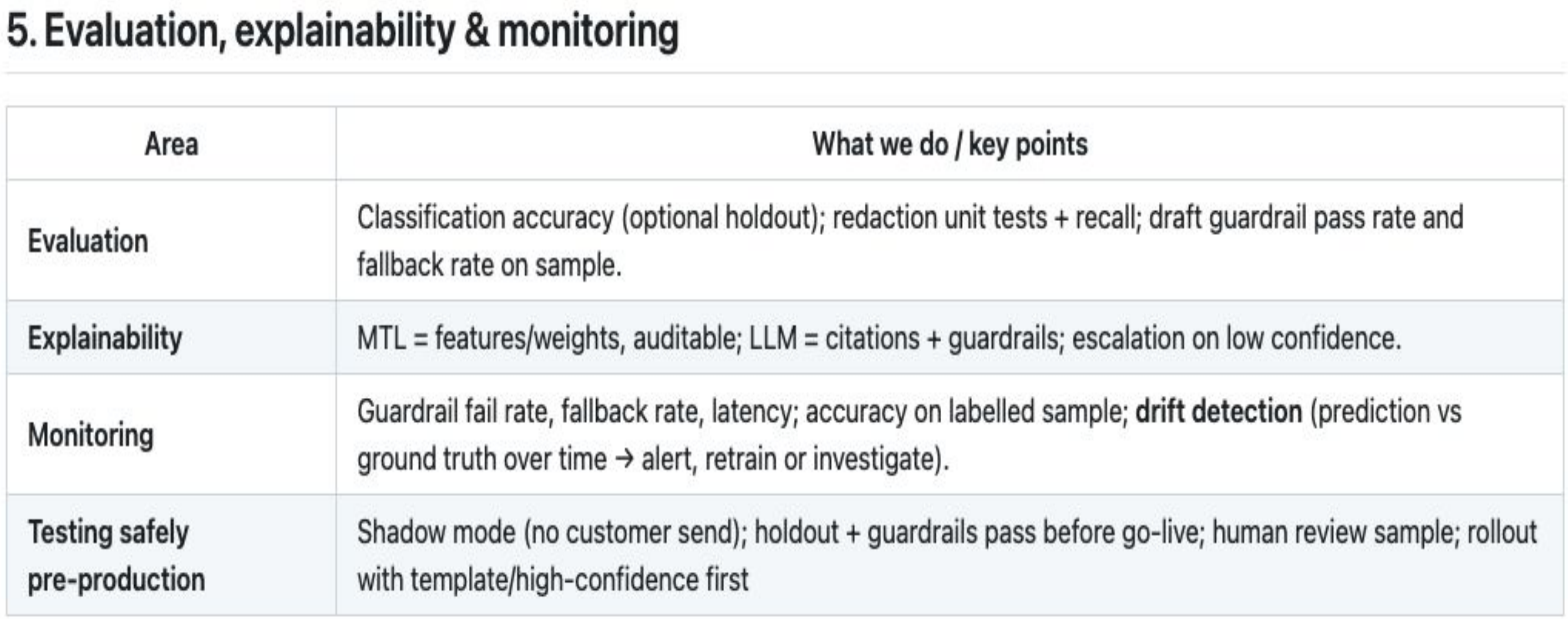
4. Architecture

.System architecture (pipeline)



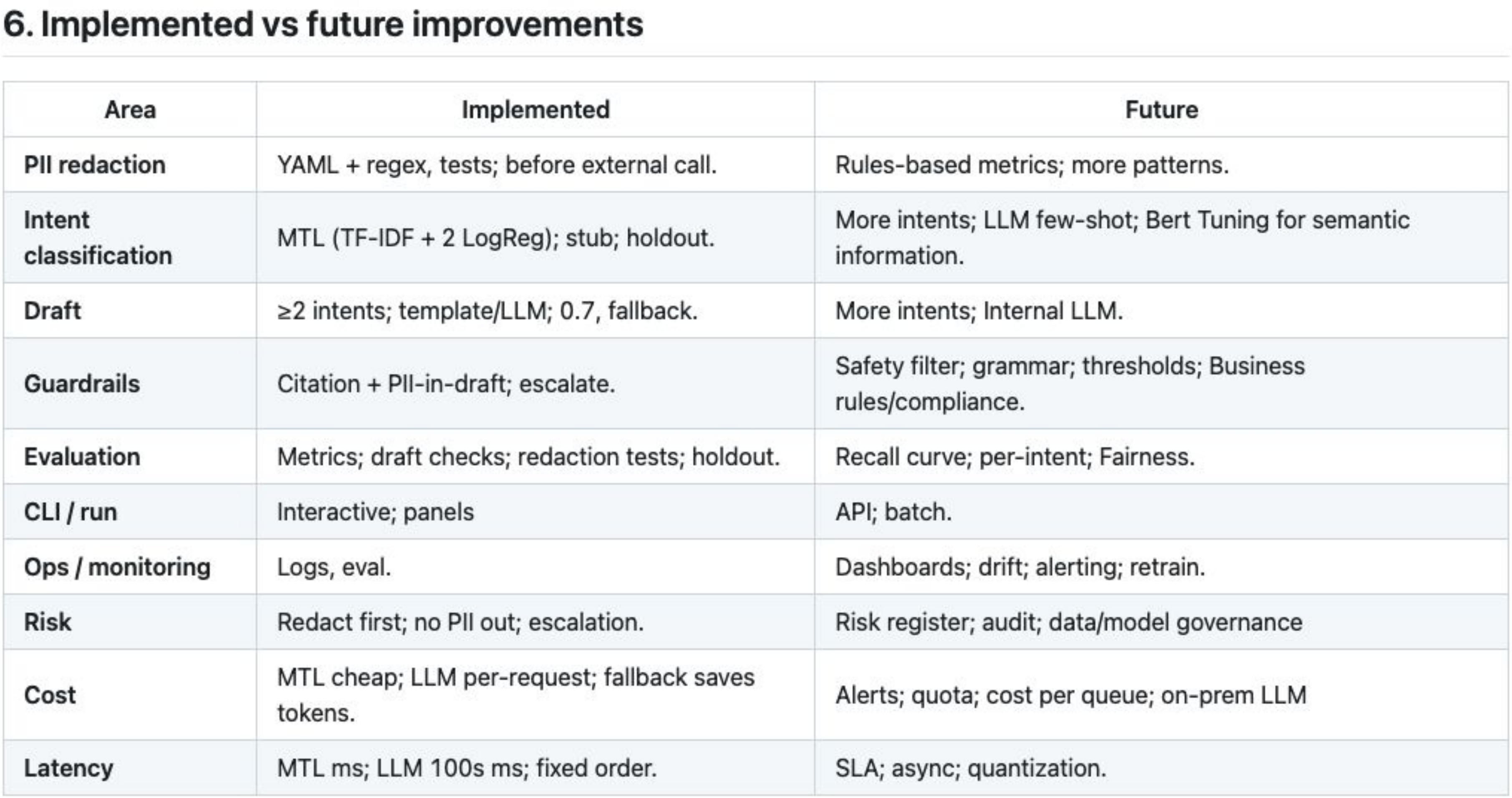
.MTL structure (shared representation, two heads)





5. Evaluation, explainability & monitoring

Area	What we do / key points
Evaluation	Classification accuracy (optional holdout); redaction unit tests + recall; draft guardrail pass rate and fallback rate on sample.
Explainability	MTL = features/weights, auditable; LLM = citations + guardrails; escalation on low confidence.
Monitoring	Guardrail fail rate, fallback rate, latency; accuracy on labelled sample; **drift detection** (prediction vs ground truth over time → alert, retrain or investigate).
Testing safely pre-production	Shadow mode (no customer send); holdout + guardrails pass before go-live; human review sample; rollout with template/high-confidence first



6. Implemented vs future improvements

Area	Implemented	Future
PII redaction	YAML + regex, tests; before external call.	Rules-based metrics; more patterns.
Intent classification	MTL (TF-IDF + 2 LogReg); stub; holdout.	More intents; LLM few-shot; Bert Tuning for semantic information.
Draft	≥2 intents; template/LLM; 0.7, fallback.	More intents; Internal LLM.
Guardrails	Citation + PII-in-draft; escalate.	Safety filter; grammar; thresholds; Business rules/compliance.
Evaluation	Metrics; draft checks; redaction tests; holdout.	Recall curve; per-intent; Fairness.
CLI / run	Interactive; panels	API; batch.
Ops / monitoring	Logs, eval.	Dashboards; drift; alerting; retrain.
Risk	Redact first; no PII out; escalation.	Risk register; audit; data/model governance
Cost	MTL cheap; LLM per-request; fallback saves tokens.	Alerts; quota; cost per queue; on-prem LLM
Latency	MTL ms; LLM 100s ms; fixed order.	SLA; async; quantization.