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LivestockMind: A Large Language Model for Livestock Health Caring

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Research Summary



1. Background & Constraints

01

General-purpose LLMs face three constraints in veterinary use

01

Vet - specific hallucinations

Answers appear unreliable from website while lacking evidence from authoritative veterinary sources.

Solve Plan

Local knowledge retrieval
RAG evidence grounding

02

Knowledge access bottleneck

Parametric memory is hard to bind to the target textbook corpus and local knowledge base.

Solve Plan

Various Fine Tuning Training

03

Insufficient veterinary reasoning

Without retrieved evidence, tool logs and Trace records, answer provenance is difficult to audit.

Solve Plan

Agent Trace



1. Background & Constraints

01

General-purpose LLMs face three constraints in veterinary use

Q: How can I treat bloating in cows? Answer in English.



How can I treat bloat in cows? Answer in English.



To treat bloat in cows, you must act **quickly**, as it can be fatal within hours. The treatment depends on whether it is **frothy bloat** (gas trapped in foam) or **free-gas bloat** (physical obstruction preventing burping).

Here is a step-by-step emergency protocol:

Step 1: Assess the Severity (Immediate)

- **Mild (cow is still standing, eating, or chewing cud):** You can attempt conservative treatment.
- **Severe (cow is down, struggling to breathe, mouth open, tongue out, or extremely distended on the left side):** This is a **life-threatening emergency**. Call a veterinarian immediately and start first aid.

Step 2: Emergency First Aid for Severe Bloat

If the cow is down or cannot breathe, you must relieve the pressure **immediately**:

- **Trocaring (Rumenocentesis):** Insert a large-bore trocar and cannula into the left flank (the paralumbar fossa, halfway between the last rib and the hip bone, and a hand's width below the transverse processes of the vertebrae).



How can I treat bloating in cows? Answer in English.

Bloating (ruminal tympany) in cows is a serious condition caused by excessive gas accumulation in the rumen. It can become life-threatening if not treated promptly.

Immediate Treatment

1. Remove the cow from the source of feed

- Stop access to lush legumes (such as alfalfa or clover) or high-concentrate feeds that may be causing the bloat.

2. Encourage movement

- Walk the cow gently to stimulate rumen activity and gas release.

3. Administer an anti-foaming agent (for frothy bloat)

- Vegetable oil, mineral oil, or commercial anti-foaming products can help break down foam and release trapped gas.
- Follow veterinary recommendations for dosage.

4. Pass a stomach tube

- For free-gas bloat, a stomach tube may allow accumulated gas to be released.
- If foam blocks the tube, anti-foaming agents can be administered.

5. Emergency decompression

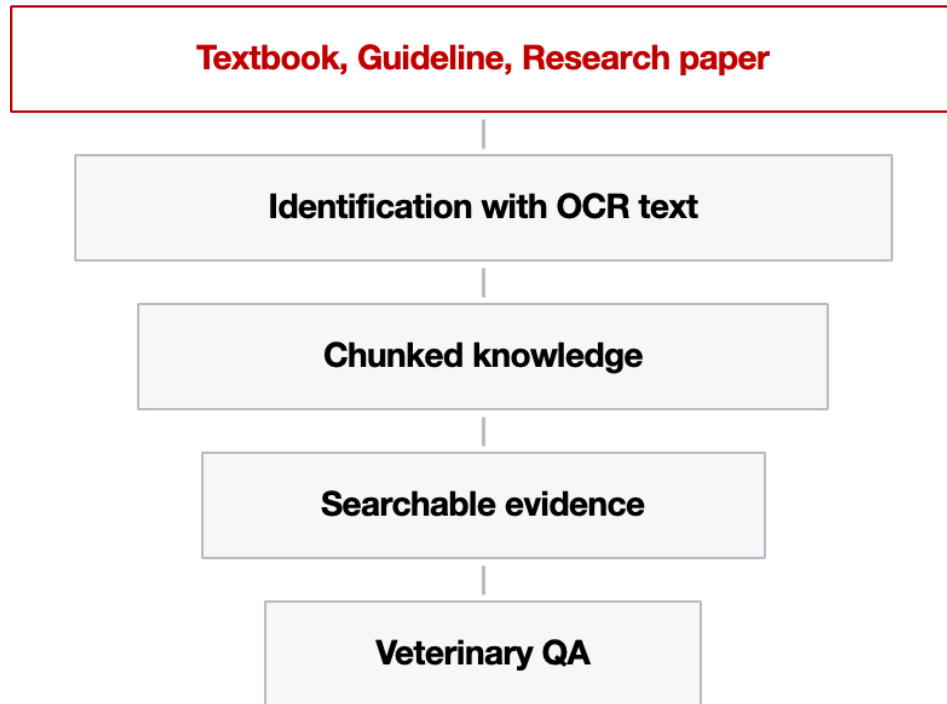
- In severe cases where the cow is in respiratory distress and other measures fail, a veterinarian may perform trocarization or rumen puncture to release gas.



1. Background & Constraints

02

Technology Opportunities



- ◆ **Livestock health management** depends on **specialized veterinary knowledge** that is highly structured and difficult to operationalize at scale.
- ◆ **Authoritative textbooks** contain rich evidence, but they must be digitized, chunked, indexed and retrieved before they can support **model reasoning**.
- ◆ **Specific LLMs starts** from veterinary textbooks, research papers and guideline as its external knowledge foundation.



2. Objective & Significance

1. Ground LivestockMind's answers in authoritative veterinary knowledge.

2. Adapt the base model to veterinary QA and stepwise reasoning.

3. Align outputs with Human Preference - veterinary ethics and safety.

Significance

Purpose

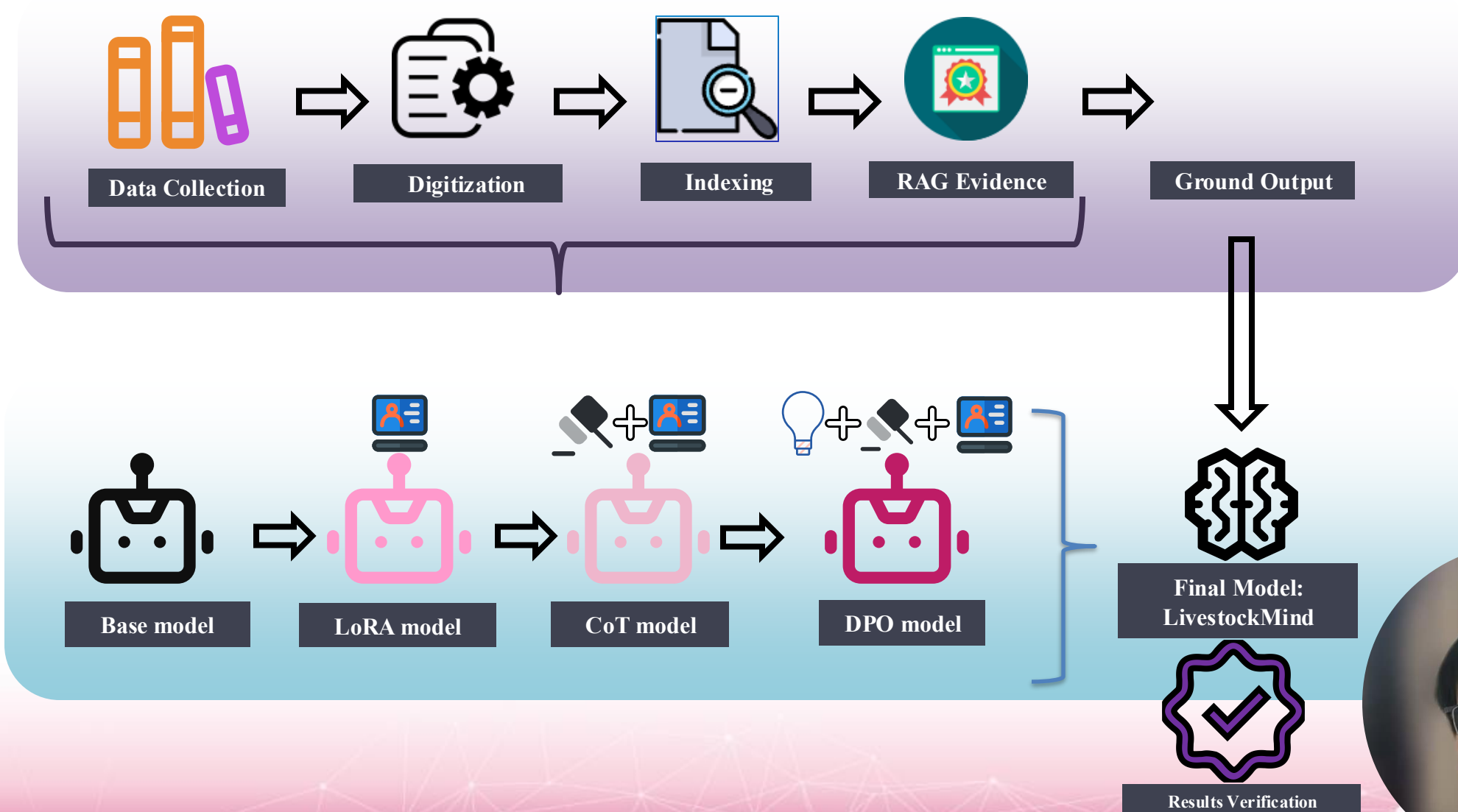
1. Improve reliability, evidence completeness, and answer traceability.

2. Strengthen domain-specific understanding and logical reasoning ability.

3. Make responses safer, responsible, and professionally appropriate.



3. Research Methodology



3.1 Model Development Processing

Four optimization dimensions define the system objective

- ❖ 60+ Elsevier textbooks converted into a local knowledge base.
- ❖ 30,000 veterinary QA pairs used for LoRA fine-tuning.
- ❖ 30,000 CoT samples used to train reasoning ability.
- ❖ 2,000 preference samples used for safety and ethics.

Ideas
Description

01 Retrieval-Augmented Generation

02 Low-Rank Adaptation + Thinking

03 Logical Enhancement

04 Human Performance Alignment



3.2 Data Collection & Cleansing

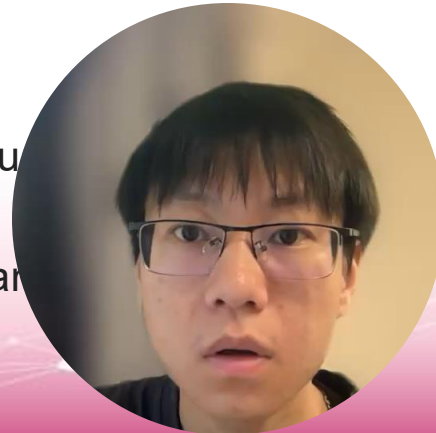


- ❑ 60+ textbook covers all disciplines of veterinary medicine, including anatomy and physiology, pharmacology, internal medicine, surgery, obstetrics, infectious diseases, pathology, and parasitology.

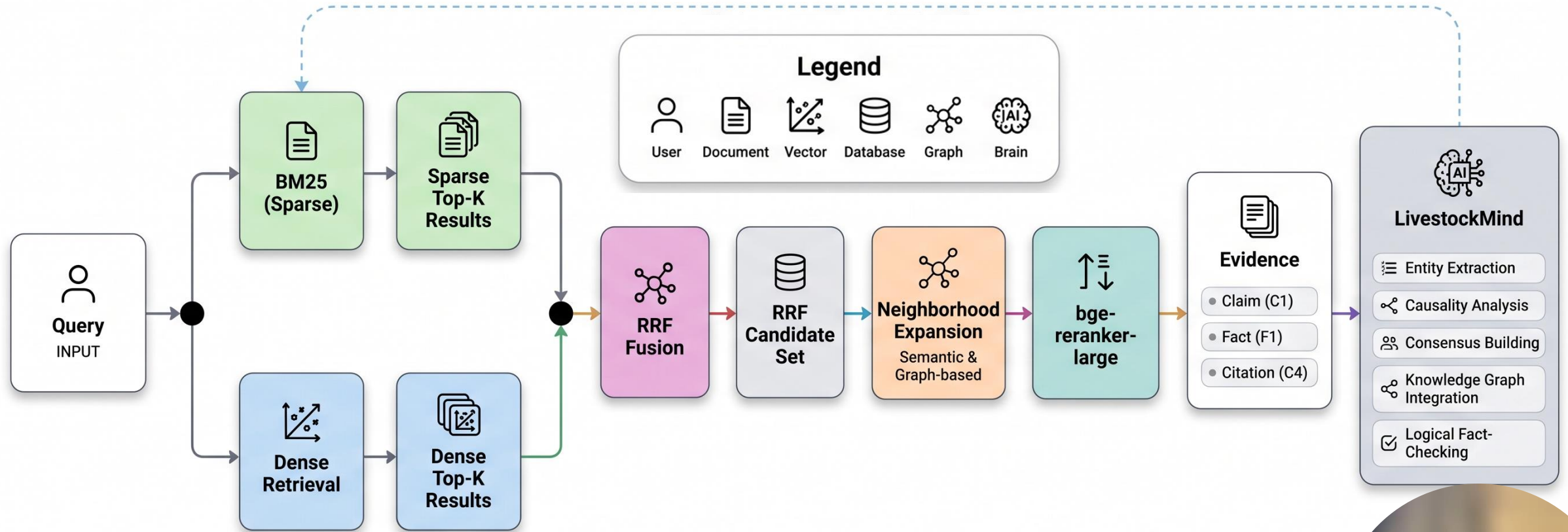
- ❑ Digitizes textbook materials into massive machine-readable text.

- ❑ Provides external evidence for retrieval-enhanced generation.

- For livestock health management, the key requirement is not generic language fluency but access to true knowledge.
- This stage converts authoritative textbook content into the knowledge foundation that LivestockMind can use.



3.3 LivestockMind RAG



- Our self-developed RAG system enables LivestockMind to answer livestock-health questions with more complete, reliable, and context-aware veterinary evidence.



3.4 LivestockMind Fine Tuning Training

LoRA and CoT for livestock-health reasoning

30,000

CoT samples

- Supports stepwise reasoning in livestock veterinary questions.
- Helps organize causes, conditions and recommendations.

DPO for professional safety

2,000

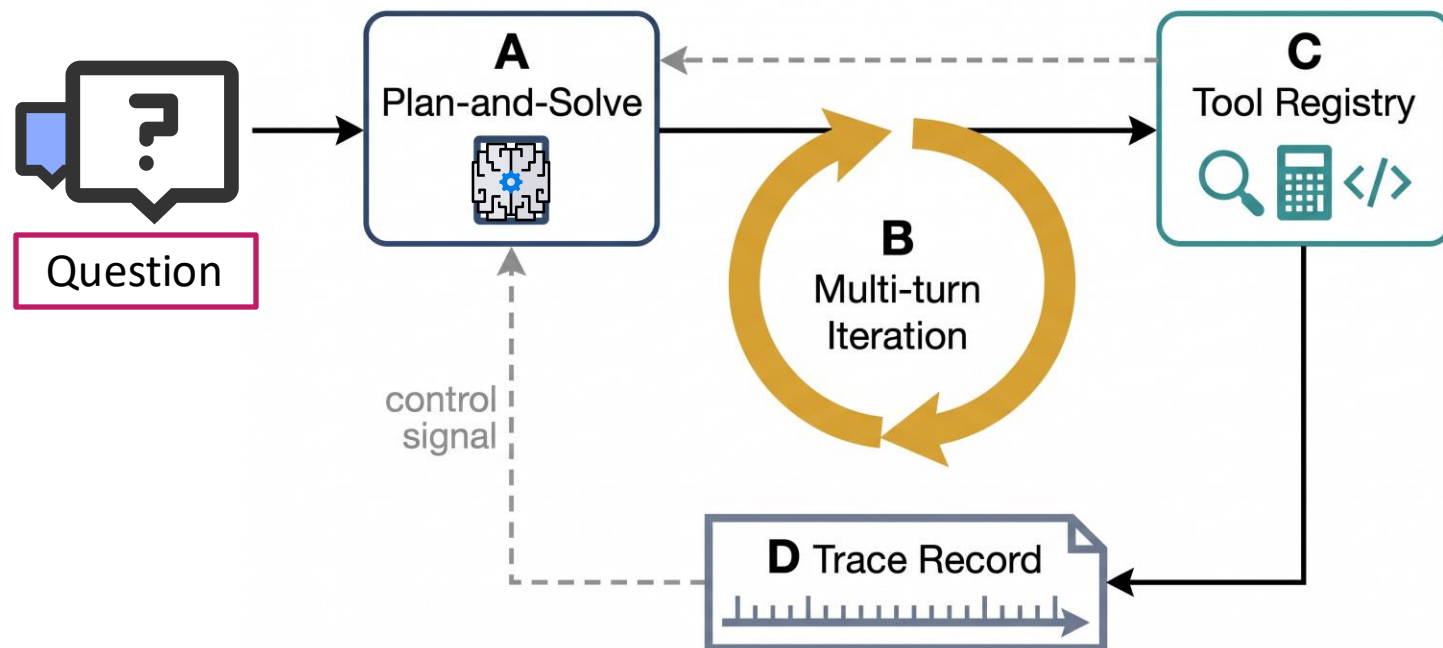
Preference samples

- Aligns responses with veterinary ethics and safety.
- Supports responsible output in high-stakes health contexts.

- Trains LivestockMind to reason step by step through complex livestock veterinary questions.
- Aligns LivestockMind's responses with veterinary ethics, safety, and professional standards.



3.5 LivestockMind With Agent



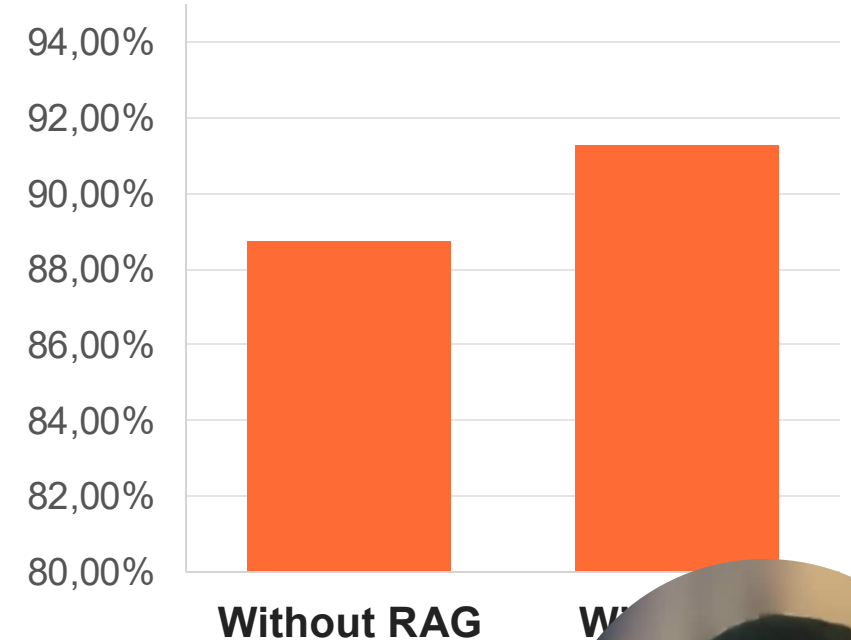
- **Structured tool use:** Standardizes RAG retrieval and MySQL queries through a unified Tool Registry.
- **Transparent reasoning path:** Records tool calls, retrieved evidence, and intermediate reasoning through Trace logs.
- **Auditable answer generation:** Makes LivestockMind's livestock-health responses easier to review, verify, and improve.



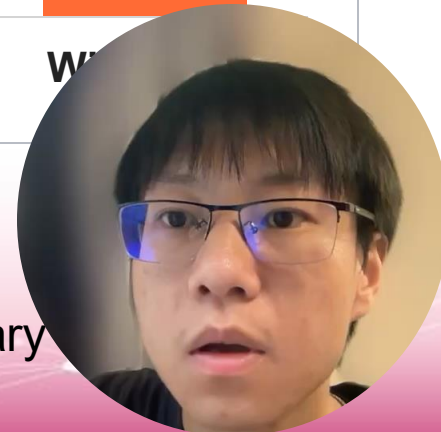
4. Research Results

Retrieval Method	Embedding Model	Top-K	Accuracy
No-RAG	multilingual-e5-small	0	88.76%
BM25	all-MiniLM-L6-v2	5	91.28%
BM25	multilingual-e5-small	5	90.94%
BM25	all-MiniLM-L6-v2	10	90.77%
Dense	multilingual-e5-small	3	91.11%
Dense	all-MiniLM-L6-v2	5	90.94%
Dense	multilingual-e5-small	1	90.44%
Our	all-MiniLM-L6-v2	5	92.28%

RAG ablation: MCQ accuracy



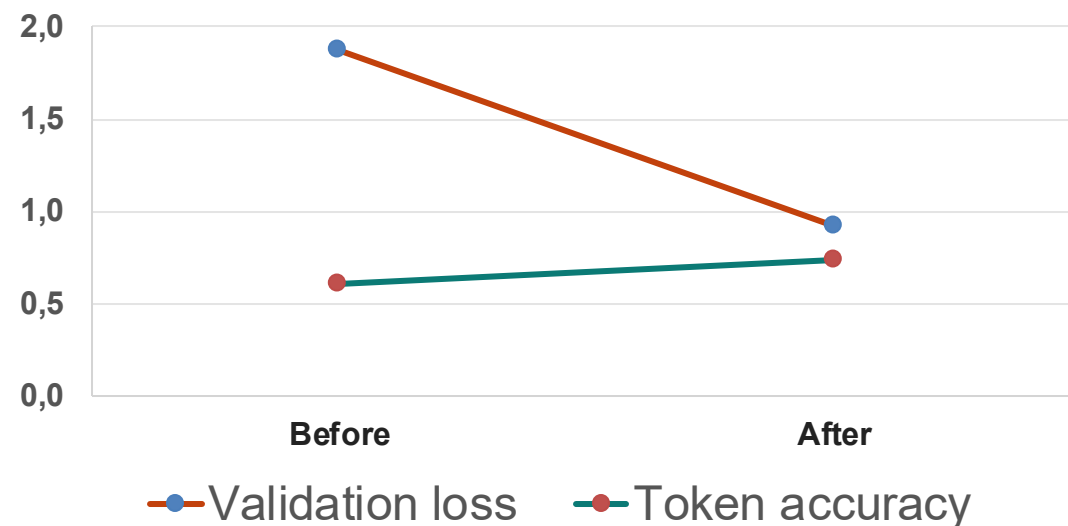
- RAG improves LivestockMind's reliability by grounding its answers in authoritative veterinary



4. Research Results

Checkpoint Step	Validation Loss	Validation Entropy	Validation Token Accuracy
6	1.8747	1.4557	0.6035
18	1.0474	1.0257	0.7119
30	0.9906	0.9881	0.7211
48	0.9541	0.9211	0.7275
72	0.9312	0.8617	0.7326
132	0.9270	0.7609	0.7379
158	0.9230	0.7322	0.7382
Deepseek-v3.2	-	1.3322	0.7123

LivestockMind fine-tuning dynamics



Loss: 1.8747→0.9255 Token accuracy: 0.6035→0.7382

- Fine-tuning improves LivestockMind's livestock veterinary QA capability by adapting the model to domain-specific knowledge and reasoning patterns.



5. Research Summary: Our LivestockMind Demo

How can I treat bloating in cows? Answer in English.



Bloat treatment in cattle must be tailored to the type of bloat (frothy vs. free-gas) and the severity of the animal's distress. Immediate intervention is critical, as severe bloat can be fatal within hours.

The following outlines a structured approach to diagnosis and treatment.

Differentiation: Frothy Bloat vs. Free-Gas Bloat Before initiating treatment, it is essential to distinguish between the two primary forms of ruminal tympany:

- **Frothy Bloat (Primary Bloat):** Characterized by a stable foam mixed with the rumen contents, trapping fermentation gases. The rumen feels doughy on palpation. A stomach tube will not relieve gas because the foam plugs the tube.
- **Free-Gas Bloat (Secondary Bloat):** Characterized by free gas accumulating above the rumen contents, often due to an esophageal obstruction (e.g., choke, vagal nerve damage) or an inability to eructate. The rumen feels tense and tympanic. A stomach tube can typically relieve the gas.

Treatment Protocols

Mild Cases (Animal standing, alert, mild distension)

- **Immediate Management:** Remove the animal from the offending pasture or feed source. Provide access to dry hay (e.g., grass hay) to alter the rumen environment. Encourage gentle walking to stimulate eructation and rumen motility.
- **Oral Anti-foaming Agents (for frothy bloat):** Administer an anti-foaming agent orally. In an emergency where commercial products are unavailable, vegetable oil (e.g., canola, corn oil, peanut oil) can be used at a dose of **250-500 mL per adult cow** administered via drench or stomach tube. Mineral oil is less effective but can be used. Commercial products like **Poloxalene** (e.g., Bloat-Guard®) are highly effective and should be used per label instructions. (Source: *Merck Veterinary Manual*, Bloat in Ruminants - Treatment; NSW Government - Bloat in Livestock).

Moderate Cases (Animal distressed, moderate distension, frequent urination, kicking at belly)

- **Stomach Tube (for free-gas bloat):** Pass a stomach tube (3/4 to 1 inch in diameter, 8-10 feet long) to relieve free gas. This is both diagnostic and therapeutic. If free gas is released, the animal will show immediate relief.
- **Stomach Tube with Anti-foaming Agent (for frothy bloat):** If a stomach tube does not relieve gas, it confirms frothy bloat. Administer an anti-foaming agent (e.g., 250-500 mL vegetable oil or a commercial product like Tympanol or Bloataway) directly through the tube into the rumen. After dosing, keep the animal moving to help mix the agent with the foam. (Source: UNL Extension, *Bloat Prevention and Treatment in Cattle*, G2018; *Merck Veterinary Manual*).

Severe Cases (Animal recumbent, severe distension, respiratory distress, cyanosis, imminent death) This is a life-threatening emergency requiring immediate veterinary intervention. Delay can be fatal within hours.

- **Trocarization (Emergency Rumenotomy):** In severe free-gas bloat, a large-bore trocar and cannula (2.5 cm diameter) can be inserted into the rumen at the point of maximum distension on the left paralumbar fossa. A skin incision is required before inserting the instrument. This provides immediate relief. (Source: *Merck Veterinary Manual*, Bloat in Ruminants - Treatment).
- **Emergency Rumenotomy (Surgical Opening):** If a trocar fails to relieve the bloat (common in peracute frothy bloat), an emergency rumenotomy must be performed. This involves a surgical incision directly into the rumen to explosively release the contents. Recovery is usually uneventful. (Source: *Merck Veterinary Manual*, Bloat in Ruminants - Treatment; UNL Extension, G2018).
- **Post-Emergency Care:** After trocarization or rumenotomy, administer an anti-foaming agent through the cannula or directly into the rumen. The cannula can remain in place for several hours until the animal stabilizes. (Source: *Merck Veterinary Manual*).

Chronic Bloat For animals with chronic, recurrent bloat due to pressure on the esophagus (e.g., from abscesses or lymphadenopathy), a veterinarian may surgically create a **ruminal fistula** (a permanent opening in the left flank). This allows for continuous release of gas for 1-2 months, allowing underlying tissue swelling to resolve. If natural healing does not close the fistula, surgical repair is required. (Source: UNL Extension, G2018).

Prevention and Long-Term Management

- **Grazing Management:** Gradually introduce cattle to lush, legume-rich pastures (e.g., alfalfa, clover). Fill cattle with dry hay before turning them out. Avoid turning hungry cattle onto lush pastures. Use rotational grazing to maintain uniform forage quality.
- **Dietary Additives:** Feed anti-bloat supplements containing **Poloxalene** (an ionophore) which can reduce the incidence of frothy bloat.
- **Pasture Composition:** Seed pastures with grass-legume mixtures to reduce the risk of high-risk legumes.
- **Weather Considerations:** Be vigilant during warm, humid weather conditions that promote rapid legume growth and froth production. Graze in the afternoon. (Source: USDA NRCS, *Bloat and Pasture*; NSW Government).

Reference Sources

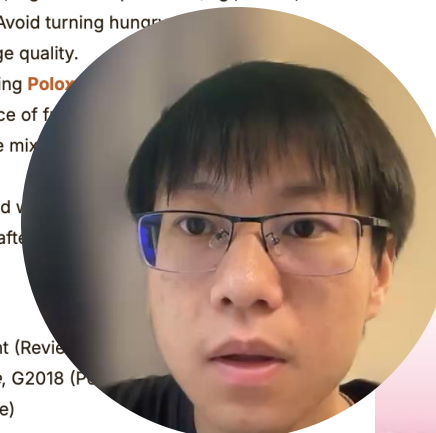
- *Merck Veterinary Manual*, Bloat in Ruminants - Treatment (Revised 2018)
- UNL Extension, *Bloat Prevention and Treatment in Cattle*, G2018 (PDF)
- NSW Government, *Bloat in Livestock* (Webinar and Guide)
- USDA NRCS, *Bloat and Pasture*
- Green Hills Veterinary Clinic, *Cattle Bloat

Veterinary Knowledge: Explain the mechanisms, palpation differences, and gastric tube response of both conditions.

Veterinary Reasoning: The answer follows the order of diagnosis: differentiation → severity (mild, moderate, severe) → corresponding treatment → chronic condition → prevention and management.

Veterinary Safety: The answer repeatedly emphasizes that severe bloat is an emergency.

Veterinary Trackable: Authoritative textbooks that can be traced.



LivestockMind



CityU

5. Research Summary



Veterinary knowledge

60+ Elsevier research textbooks anchor LivestockMind in livestock health expertise.



Grounded generation

RAG supplies evidence for high-precision livestock veterinary answers.



Trained reasoning

LoRA and CoT adapt the model to veterinary QA and stepwise reasoning.



Responsible workflow

DPO, Agent Trace and n8n support safer, auditable system use.

- LivestockMind is a high-precision livestock-health LLM system that integrates a self-deployable pipeline, LoRA/CoT/DPO optimization, and traceable Agent workflows to deliver reliable, grounded veterinary QA.





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Thank You!

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