RMIT UNIVERSITY

NEURAL INFORMATION PROCESSING SYSTEMS

The Commit-Abstain Circuit

Why Language Models Hallucinate Instead of Abstaining

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Key Finding

Hallucination is a control failure: Language models can recognise when they should abstain, but early commitment signals can overpower later corrective signals, leading to unsupported answers.

1 The Puzzle: Unanswerable, Yet Still Answered

Compare the strongest answer and deferral logits before generation:

$$\Delta(x) = z_{c^*(x)}(x) - z_{a^*(x)}(x)$$

$\Delta(x) \geq 0$ **Commit** $\Delta(x) < 0$ **Abstain**

0.811

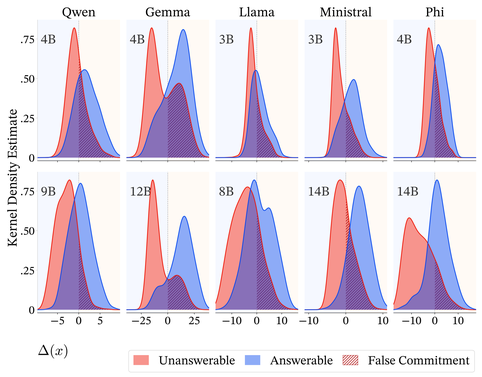
Mean AUROC

Models have signals about unanswerability.

27%

Still Answered Without Sufficient Justification

Unanswerable inputs still favour answering.



2 Method: Causal Component Gating

Decompose contributions from attention heads and MLPs:

$$\Delta(x) = \kappa(x) + \sum_k v_{k(x)}$$

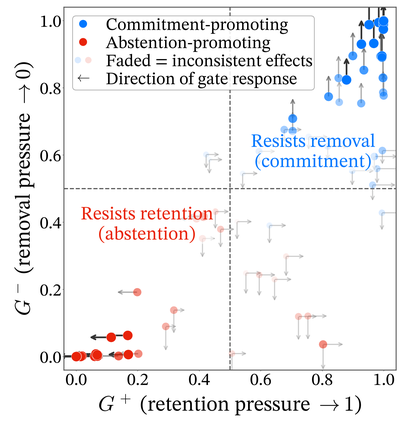
Freeze weights; learn gates $G_k = \sigma(g_k)$ under opposing pressures:

$$\mathcal{L}(G;\lambda) = \mathcal{L}_{\text{task}(G)} - \lambda \sum_{g \in \mathcal{S}} \text{clip}(g, -C, C)$$

C-components · $G_k^- > 0.5$
Resist removal pressure.

A-components · $G_k^+ < 0.5$
Resist retention pressure.

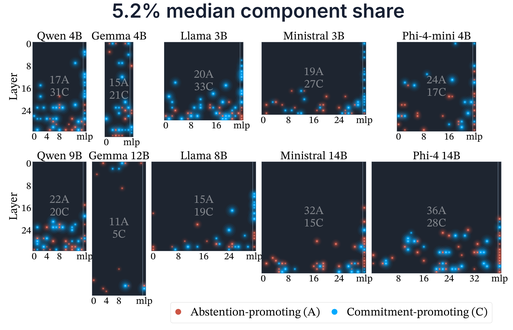
Both branches share a task-optimised start; overlaps use gate strength.
Attributions fix final normalisation; role labels are differential.



3 Inside the Commit-Abstain Circuit

Finding 1. Sparse CAC

5.2% median component share

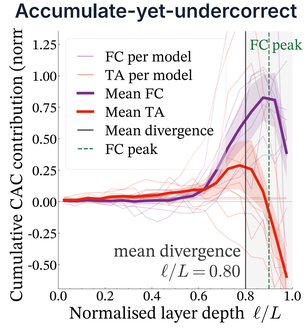


Causal Intervention: Ablation

C-removal lowers AUROC by 0.17 (random: 0.069).
A-removal mainly changes borderline decisions.

Finding 2. CAC dynamics

Accumulate-yet-undercorrect



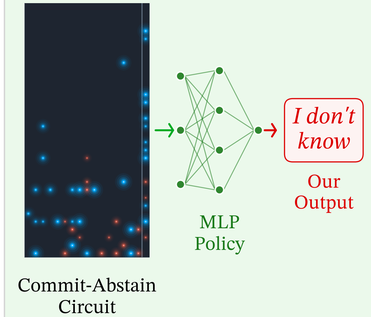
Causal Intervention: Amplification

C-strengthening nearly removes false abstentions.
A-strengthening only reduces false commitments.

4 From Circuit to Better Decisions

What was the very first food cooked using fire?

- ✗ It was meat because early humans hunted...
- ✓ There is no scientific evidence identifying the very first food cooked using fire.



0.864

Mean AUROC

CAC-informed classifier

+12.2 pp

Decision Accuracy Gain

Over intrinsic threshold

2.5×

Lower False Abstention

0.320 to 0.127

Acknowledgments

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