
Wisent: A General Framework for Reliable Representation Identification and Representation Steering

Anonymous Author(s)

Affiliation

Address

email

Abstract

1 Representation engineering is a powerful method for identifying and modifying
2 high-level concepts within the internal layers of large language models. Despite its
3 potential, real-life deployments of activation steering remain difficult. We present
4 Wisent, a flexible, open-source framework for monitoring and steering internal
5 activations of large language models. Practical applications of the framework show
6 XXX percent hallucination reduction, XXX percent improvement in coding ability
7 and deep personalization capabilities.

8 1 Introduction

9 Large language models, with billions of parameters and Internet-scale training dataset, have displayed
10 significant capabilities across a wide range of tasks, such as writing, coding or reasoning.

11 However, their internal mechanisms of generating the next token cannot be precisely explained, with
12 interactions between layers and parameters increasing in complexity as the size of these models
13 increases.

14 Experiments with representation engineering (also known as steering or activation steering) have
15 shown activation modification to be a powerful method of identifying and influencing high-level
16 concepts (representations) within the layers of an LLM. Despite strong empirical performance on
17 selected truthfulness, safety or personalization tasks, representation engineering methods lack a
18 universal formulation and a unifying framework for understanding the underlying phenomenon,
19 comparing methods and applying them to new problems.

20 We propose Wisent, a modular framework for analyzing the internal mechanisms within a large
21 language model and influencing them to improve performance and individual alignment. Wisent
22 surpasses state of the art performance in identifying particular behaviors

23 2 Representation Engineering Problem

24 We formulate the **Representation Engineering Problem** as the following:

25 For a given model M and a Representation

26 Basic primitives and definitions of key terms are outlined in Appendix A.

27 **3 Representation Reading**

28 **3.1 Classifier**

29 **3.2 Detection Handling Method**

30 **4 Representation Control**

31 **4.1 Classifier**

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170 **A Wisent Primitives**

171 **A.1 Model**

172 **A.2 Contrastive Pair**

173 **A.3 Activations**

174 **A.4 Activation Collection Method**

175 **A.5 Additional Utilities**

176 **B Representation Reading Functionalities**

177 **B.1 Classifier**

178 **B.2 Detection Handling Method**

179 **C Representation Control Functionalities**

180 **D Ablation**

181 **A All supported benchmarks**

182 This section enumerates all benchmarks used in our study, the task traits, the evaluation protocol, and
183 the contrastive pair generation method applied to produce minimally perturbed negative targets. We
184 first merged the *coding* and *mathematics* benchmark lists you provided and then appended them to
185 the original master list.

186 **Contrastive pair generation methods (definitions)**

187 **Reading Comprehension Abstention Swap** [RC-Abstain] For extractive/open-domain RC: positive
188 is the gold span; negative is an abstention (e.g., “Not provided in the text.”). If gold is
189 *No answer*, the negative is a confident but wrong claim.

190 **Conversational Reading Comprehension Abstention** [ConvRC-Abstain] As RC-Abstain, but
191 with dialogue context (CoQA). Negatives are generic abstentions; yes/no items are flipped
192 when applicable.

193 **Language Modeling Corrupted Continuation** [LM-CorruptCont] Language modeling: positive
194 is the true continuation; negative is a corrupted continuation (local shuffles/randomization)
195 to break coherence.

196 **Two-Choice Flip** [2C-Flip] Two-option tasks (PIQA, COPA, WinoGrande, CB): negative is simply
197 the other option.

198 **Multichoice First Distractor** [MC-FirstDistr] Multi-choice tasks: negative = the first incorrect
199 option in the provided order (deterministic).

200 **Multichoice Random Distractor** [MC-RandDistr] Multi-choice tasks: negative = a randomly cho-
201 sened incorrect option from the same set (used for GPQA).

202 **Multichoice Letter Swap** [MC-LetterSwap] Multi-choice tasks scored over option letters (Truth-
203 fulQA MC1/MC2): negative = the first incorrect letter.

204 **Boolean Flip** [Bool-Flip] Binary tasks (BoolQ): negative is the opposite boolean label.

205 **Exact Match Partial Mask** [EM-PartialMask] Exact-match free-form answers (HLE-EM): nega-
206 tive is the gold text with partial token masking (approximately 1/3 words, or partial masking
207 for single-word answers).

- 208 **Keyword-Preserving Token Deletion** [KP-Del] Coding tasks: negative program created by deleting non-keyword tokens while preserving syntax-critical keywords; aims to remain plausible but fail unit tests.
- 211 **Summary Content-Word Drop** [Summ-WordDrop] Code-to-text summarization: negative description formed by dropping content words (nouns/verbs) while keeping scaffolding words to preserve superficial form.
- 214 **Numeric Offset (+1) Perturbation** [Num+1] Math QA: negative is the correct numeric answer offset by a small integer (typically +1); for non-integer answers, apply the minimal unit offset.
- 217 **Evaluation types (definitions)**
- 218 **Log-likelihood option scoring** [LL] The model scores each provided option/target by conditional log-probability given the prompt. Metrics typically compute accuracy over the highest-likelihood choice (MC tasks) or compare likelihoods of gold vs. negative targets.
- 221 **Text generation string matching** [TG] The model generates free-form text (or a number), which is then judged by task-specific metrics (e.g., exact match on numerical value for GSM8K/MATH; span/string matching for RC tasks; structured checks for DROP). Used also for CoT/generative GPQA variants and HLE-Exact-Match.
- 225 **Perplexity (language modeling)** [PPL] The model’s next-token distribution is evaluated over a reference text to compute Perplexity (lower is better). Used for language-modeling corpora like WikiText.
- 228 **Code execution against unit tests** [CE] The model generates code, which is executed in a sandbox against unit tests provided by a dataset (e.g., pass@1). Applies to HumanEval/MBPP/APPS, MultiPL-E, DS-1000, LiveCodeBench, etc.

Table 1: Benchmarks (short names), evaluation abbreviations, contrastive method (short), and traits. Versions merged where applicable.

Benchmark	Eval	Method [CM]	Traits
DROP ?	[TG]	RC-Abstain	reading comprehension
ReCoRD ?	[TG]	RC-Abstain	reading comprehension
SQuAD2 ?	[TG]	RC-Abstain	reading comprehension
WebQuestions ?	[TG]	RC-Abstain	factual QA
Natural Questions ?	[TG]	RC-Abstain	factual QA
TriviaQA ?	[TG]	RC-Abstain	factual QA
CoQA ?	[TG]	ConvRC-Abstain	conversational RC
BoolQ ?	[LL]	Bool-Flip	boolean RC
WinoGrande ?	[LL]	2C-Flip	commonsense
PIQA ?	[LL]	2C-Flip	commonsense
COPA ?	[LL]	2C-Flip	causal reasoning
HellaSwag ?	[LL]	MC-FirstDistr	commonsense
SWAG ?	[LL]	MC-FirstDistr	commonsense
OpenBookQA ?	[LL]	MC-FirstDistr	science MCQ
ARC ?	[LL]	MC-FirstDistr	science MCQ
RACE ?	[LL]	MC-FirstDistr	RC (MC)
MMLU ?	[LL]	MC-FirstDistr	multi-subject exams
GPQA ?	[LL]/[TG]	MC-RandDistr	expert STEM exams
SuperGPQA ?	[LL]	MC-FirstDistr	expert STEM exams
HLE ?	[TG]/[LL]	EM-PartialMask; MC-FirstDistr	expert exams
GSM8K ?	[TG]	Num+1	mathematics
ASDiv ?	[TG]	Num+1	mathematics
Arithmetic ?	[TG]	Num+1	mathematics

Benchmark	Eval	Method [CM]	Traits
MATH ?	[TG]	Num+1	mathematics (contest)
MATH-500 ?	[TG]	Num+1	mathematics (contest)
AIME ??	[TG]	Num+1	mathematics (contest)
HMMT ?	[TG]	Num+1	mathematics (contest)
PolyMath ?	[TG]	Num+1	mathematics (multiling.)
LiveMathBench ?	[TG]	Num+1	mathematics (EN/ZH)
MBPP ?	[CE]	KP-Del	coding (Python)
HumanEval ?	[CE]	KP-Del	coding (Python)
CoNaLa ?	[CE]	KP-Del	coding (Python)
CONCODE ?	[CE]	KP-Del	coding (Java)
Mercury ?	[CE]	KP-Del	coding (multi-language)
HumanEval+ ?	[CE]	KP-Del	coding (Python)
InstructHumanEval ?	[CE]	KP-Del	coding (Python)
MBPP+ ?	[CE]	KP-Del	coding (Python)
APPS ?	[CE]	KP-Del	coding (Python)
DS-1000 ?	[CE]	KP-Del	coding (Python)
MultiPL-E ?	[CE]	KP-Del	coding (multi-language)
CodeXGLUE ?	[TG]	Summ-WordDrop	coding (code-to-text)
ReCode ?	[CE]	KP-Del	coding (Python)
LiveCodeBench ?	[CE]	KP-Del	coding (Python)
TruthfulQA ?	[LL]	MC-LetterSwap	truthfulness
CB ?	[LL]	2C-Flip	NLI
WikiText (2/103) ?	[PPL]	LM-CorruptCont	language modeling

231 Category legend

- █ RC/ODQA
- █ Multi-choice Reasoning
- █ Exams & Knowledge Tests
- █ Mathematics
- █ Coding
- █ Other (Truthfulness/NLI/LM)

Abbreviation legend

- [LL] Log-likelihood option scoring
- [TG] Text generation (string match)
- [PPL] Perplexity (LM)
- [CE] Code execution vs. unit tests

Method [CM] codes

- | | |
|----------------|------------------------------|
| RC-Abstain | RC abstention swap |
| ConvRC-Abstain | Conversational RC abstention |
| LM-CorruptCont | LM corrupted continuation |
| 2C-Flip | Two-choice flip |
| MC-FirstDistr | First distractor (MC) |
| MC-RandDistr | Random distractor (MC) |
| MC-LetterSwap | Letter swap (MC) |
| Bool-Flip | Boolean flip |
| EM-PartialMask | Exact-match partial mask |
| KP-Del | Keyword-preserving deletion |
| Summ-WordDrop | Summary word drop |
| Num+1 | Numeric offset (+1) |

²³² **B Per-Task Results**

²³³ **C Detailed Classification Results**

²³⁴ **D Benchmark-Aided Steering Results**

²³⁵ **E Optimal Sample Size Calculations**

²³⁶ **F Fully Synthetic Generation**

²³⁷ **G Agentic Capabilities**