

LLaDA: Large Language Diffusion Models

Autoregressive LLM

Ken

► : LLM

▶ : LLM

▶ : LLaDA masking diffusion 8B LLaMA3 8B

- ▶ : LLM
- ▶ : LLaDA masking diffusion 8B LLaMA3 8B
- ▶ : in-context learning instruction-following





AR LLM



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LLaDA Eq.3, Eq.4 remask



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LLaDA Eq.3, Eq.4 remask





$$p(x) = \prod_{i=1}^L p(x_i \mid x_{<i})$$

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▶ : AR

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:
: AR
: 8B

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LM

GPT-2



LM

GPT-2

▶ LM GPT-2



masked : MaskGIT

LLaDA

► Forward: $t \quad t \sim U[0, 1]$

LLaDA

- ▶ Forward: t $t \sim U[0, 1]$
- ▶ Reverse:

LLaDA

- ▶ Forward: $t \quad t \sim U[0, 1]$
- ▶ Reverse:
- ▶ : Causal mask Transformer

LLaDA

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- ▶ AR 1

LLaDA

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LLaDA

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▶ AR 1

▶ LLaDA

▶

masked token CE :

$$\mathcal{L}(\theta) = -\mathbb{E}_{t, x_0, x_t} \left[\frac{1}{t} \sum_{i=1}^L \mathbf{1}[x_t^i = M] \log p_{\theta}(x_0^i \mid x_t) \right]$$

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$$-\mathbb{E}_{p_{\text{data}}(x_0)} [\log p_{\theta}(x_0)] \leq \mathcal{L}(\theta)$$



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- ▶ Pre-train: 2.3T tokens 1B/8B seq length
4096 Warmup-Stable-Decay

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- ▶ SFT: 4.5M prompt-response pairs prompt response

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- ▶ SFT: 4.5M prompt-response pairs prompt response
- ▶ Sampling: step
- ▶ Sampling remask low-confidence remasking

▶ : ARM baseline LLaDA

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▶ : FLOPs 6

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- ▶ : AR

8B

Base

► LLaDA 8B Base vs LLaMA2 7B Base

8B

Base

- ▶ LLaDA 8B Base vs LLaMA2 7B Base
- ▶ 15

8B Base

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- ▶ 15
- ▶ LLaDA 8B Base vs LLaMA3 8B Base

8B

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8B

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- ▶ Table 1

8B

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- ▶ GSM8K: 70.3 (LLaDA) vs 48.7 (LLaMA3 8B Base)

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- ▶ MATH: 31.4 vs 16.0
- ▶ HumanEval: 35.4 vs 34.8

SFT

- ▶ LLaDA SFT RL instruction-following

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SFT

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- ▶ LLaMA3 Instruct

SFT

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- ▶ : AR

Reversal Curse

► : forward reversal

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▶ Table 4

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► 8B LM LLM

3

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▶

- ▶ 8B LM LLM
- ▶
- ▶ reversal reasoning AR

▶ $< 10^{23}$ FLOPs



$< 10^{23}$ FLOPs

▶ $< 10^{23}$ FLOPs



RL

▶ $< 10^{23}$ FLOPs



▶ RL



▶ KV cache

▶ $< 10^{23}$ FLOPs



▶ RL

▶ KV cache



▶ : AR

▶ : AR

▶ : remask step CFG

- ▶ : AR
- ▶ : remask step CFG
- ▶ : RLHF/RLAIF agent AR

► LLaDA AR LLM 8B

▶ LLaDA AR LLM 8B
▶ reversal

▶ LLaDA AR LLM 8B
▶ reversal
▶ RL AR

▶ LLaDA AR LLM 8B
▶ reversal
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▶ : AR

Q&A

Q1. BERT

A. mask $t \sim U[0, 1]$

Q2. reversal

A.

Q3.

A. 1 1step AR step - sampling /

- ▶ Paper: Large Language Diffusion Models (Nie et al.)

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- ▶ Local source PDF:
../_papers/LargeLanguageDiffusionModels.pdf