Imagen Video: High Definition Video Generation with Diffusion Models

LLVM Paper Discussion

10.23.23

Bug Hunter

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The role of a Bug Hunter

- Adversarial reader
- Find issues with
  - Rigor
  - Correctness
  - Reproducibility
  - Clarity
- Challenge the choices that were made

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FID

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CLIP scores

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Correct math

The remainder is only empirically driven

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Not public

Proprietary dataset

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Clear if and only if you read their previous work

FID

FVD

- Not an absolute metric
- Interpretable reporting must include comparison to other model performances

we evaluated Imagen Video on several different metrics, such as FID FVD and frame-wise CLIP scores for video-text alignment. Below, we explore 1) *scaling* 2) *parameterization* 3) *distilling*

FID

FVD

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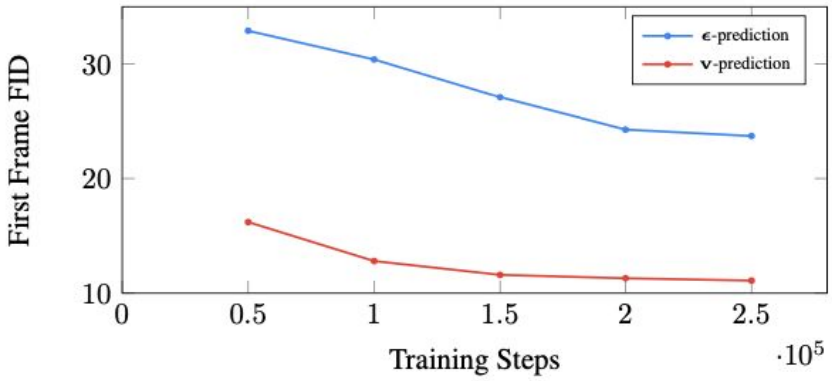

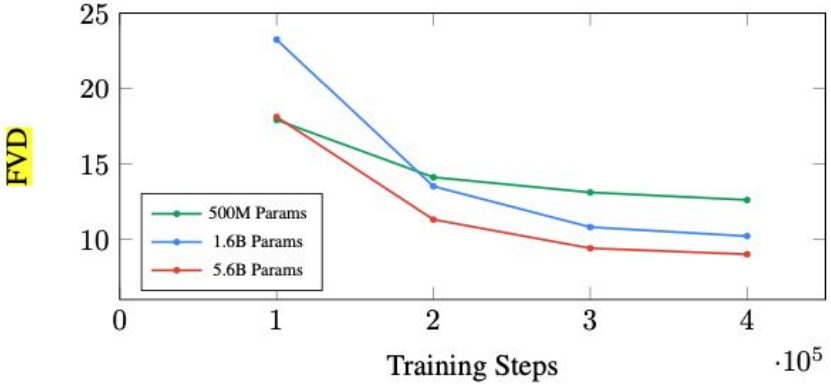

Evaluates ε-prediction vs v-prediction

Evaluates parameter size of Base model

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CLIP scores

- **Is** an absolute metric
- Does not comment on
  - Granularity
  - Temporal consistency

Guidance w	Base Steps	SR Steps	CLIP Score	CLIP R-Precision	Sampling Time
constant=6	256	128	25.19±.03	92.12±.53	618 sec
oscillate(15,1)	256	128	25.02±.08	89.91±.96	618 sec
constant=6	256	8	25.29±.05	90.88±.50	135 sec
oscillate(15,1)	256	8	25.15±.09	88.78±.69	135 sec
constant=6	8	8	25.03±.05	89.68±.38	35 sec
oscillate(15,1)	8	8	25.12±.07	90.97±.46	35 sec
ground truth			24.27	86.18	

Challenge the choices that were made

- Video U-net (Ho et al. 2022b)
- V-prediction (Salimans & Ho 2022)
- Conditioning augmentation (Ho et al 2022a)
- Classifier-free guidance (Ho & Salimans 2021)
- Progressive distillation (Salimans & Ho 2022)

Challenge the choices that were made

- Video U-net (Ho et al. 2022b) — Engineered from performant image synthesis model
- V-prediction (Salimans & Ho 2022) — Empirically justified for Imagen
- Conditioning augmentation (Ho et al 2022a) — Justified from performance on image synthesis
- Classifier-free guidance (Ho & Salimans 2021) — Empirically justified for Imagen
- Progressive distillation (Salimans & Ho 2022) — Faster sampling


Imagen

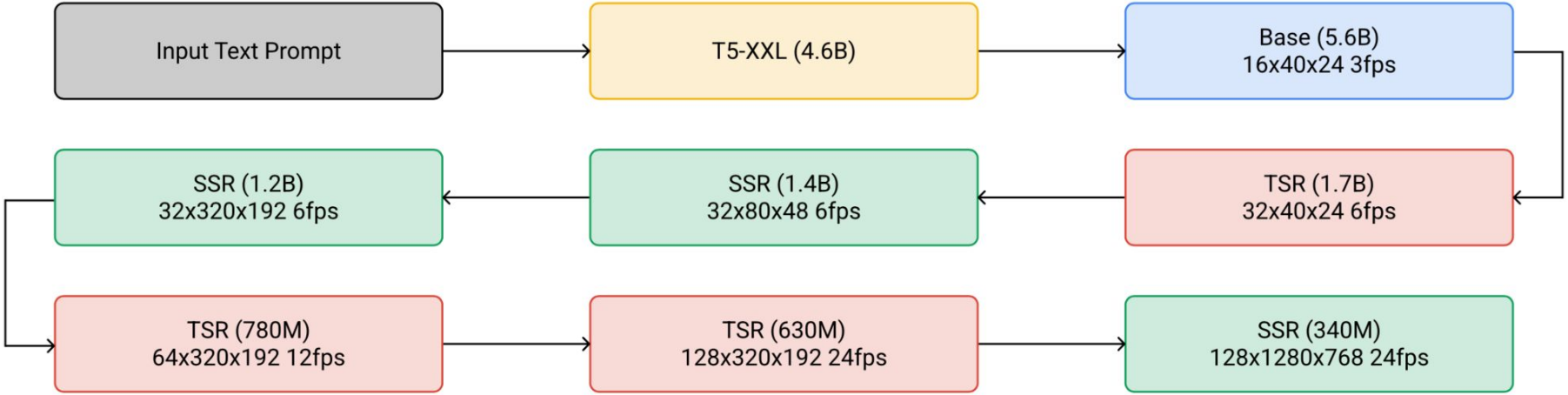

Imagen

Temporally consistent in pixel space

Inaccurate spacial super-resolution

Not consistent with objects in real space

The architecture



One more thing...

Why use diffusion?

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NYU

Yann Lecun's opinion

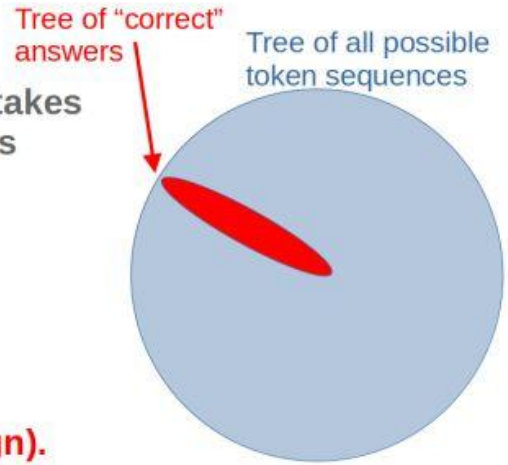
Unpopular Opinion about AR-LLMs

Y. LeCun

- Auto-Regressive LLMs are **doomed**.
- They cannot be made factual, non-toxic, etc.
- They are not controllable

- Probability e that any produced token takes us outside of the set of correct answers
- Probability that answer of length n is correct:
  - $P(\text{correct}) = (1-e)^n$

- **This diverges exponentially.**
- **It's not fixable (without a major redesign).**



Temporal attention is unlikely to fix the issue

A 3D model of a 1800s victorian house. Studio lighting.

A 3D model of a car made out of sushi. Studio lighting.

A 3D model of an elephant origami. Studio lighting.

Continuity in representation space

- Videos are 3-dimensional projection of a 4-dimensional scene
- There must be object continuity
- 3D object synthesis is a prerequisite for usable video synthesis
- It may be that Transformers can be used as a base of the pipeline