Video prediction models as rewards for reinforcement learning (Escontrela, et al. 2023)

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Advanced Topics in Reinforcement Learning, Theresa Eimer, Prof. Dr. rer. nat. Marius Lindauer,
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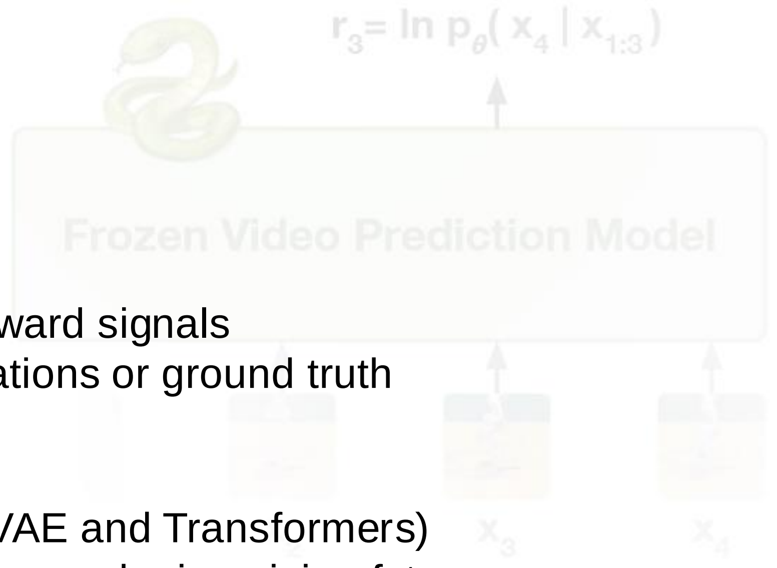
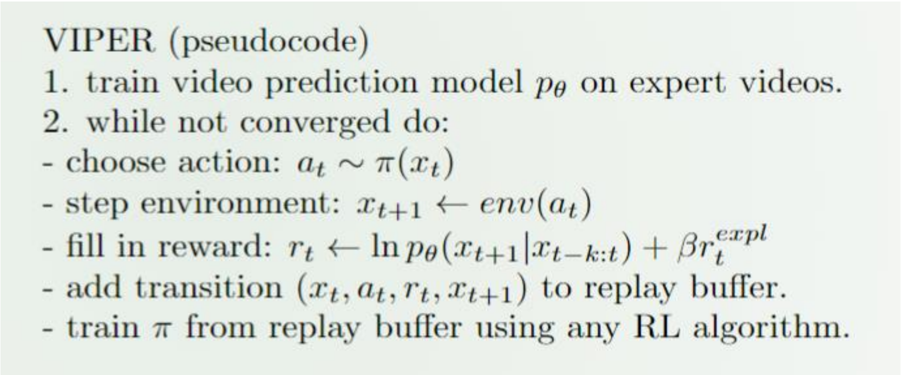

$r_3 = \ln p_\theta(x_4 | x_{1:3})$
Frozen Video Prediction Model
x_3
x_4

VIPER

- Pretrained video prediction models to derive reward signals
- learns complex behaviors without action annotations or ground truth rewards

- VideoGPT (*2021,* Video Generation using VQ-VAE and Transformers)
- DreamerV3 (*2023,* learns a env-model and improves by imagining future scenarios)



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VIPER (pseudocode)
1. train video prediction model $p_\theta$ on expert videos.
2. while not converged do:
- choose action: $a_t \sim \pi(x_t)$
- step environment: $x_{t+1} \leftarrow env(a_t)$
- fill in reward: $r_t \leftarrow \ln p_\theta(x_{t+1}|x_{t-k:t}) + \beta r_t^{expl}$
- add transition $(x_t, a_t, r_t, x_{t+1})$ to replay buffer.
- train $\pi$ from replay buffer using any RL algorithm.
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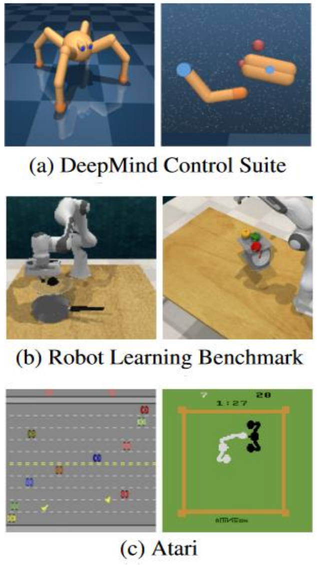
Escontrela, Alejandro, et al. "Video prediction models as rewards for reinforcement learning." *Advances in Neural Information Processing Systems* 36 (2024).

Video prediction models as rewards for reinforcement learning (Escontrela, et al. 2023)

- Open source https://escontrela.me/viper
  - Notebooks, checkpoints and example applications
- Straight forward algorithm
  - Custom or improved VideoGPT models
  - Widely available training data
  - Highly applicable to human-like models


(a) DeepMind Control Suite

(b) Robot Learning Benchmark

(c) Atari

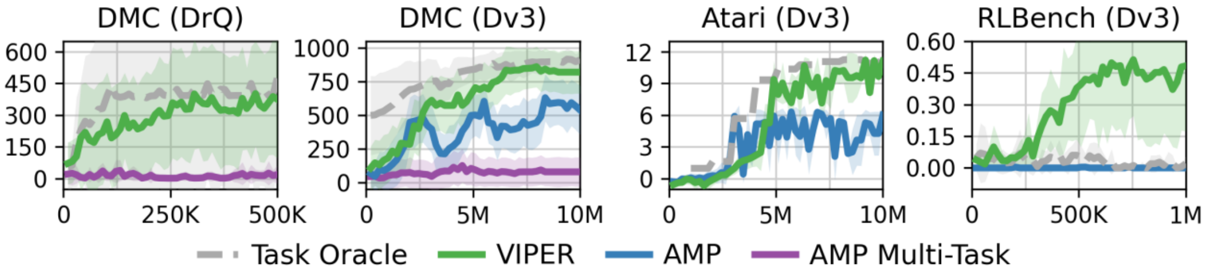


Fig.1 and Fig.2: Aggregated results across 15 DMC tasks (top a), 7 Atari games (top c), and 6 RLBench tasks (top b). DMC results are provided for DrQ and DreamerV3 (Dv3) agents. Atari and RLBenchmark results are reported for DreamerV3. Atari scores computed using Human-Normalized mean.

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