

# Disentanglement in RL

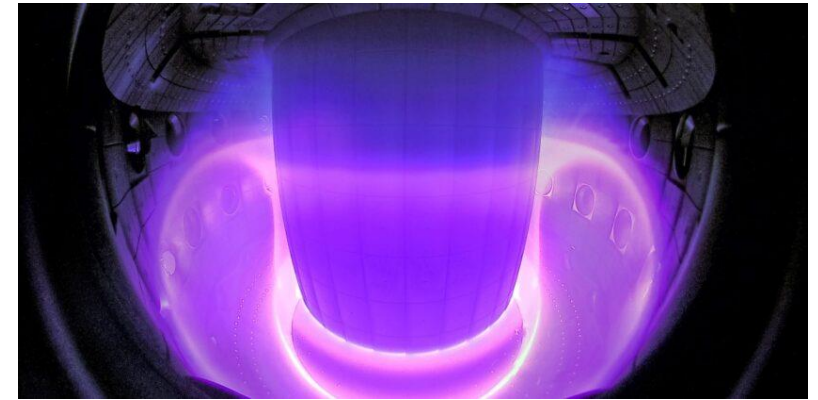
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Alvaro Cauderan

Supervised by Benjamin Estermann

# What is RL?

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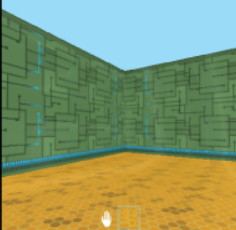
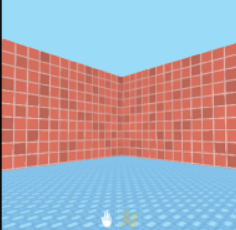
# DARLA

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Disentangling the state space

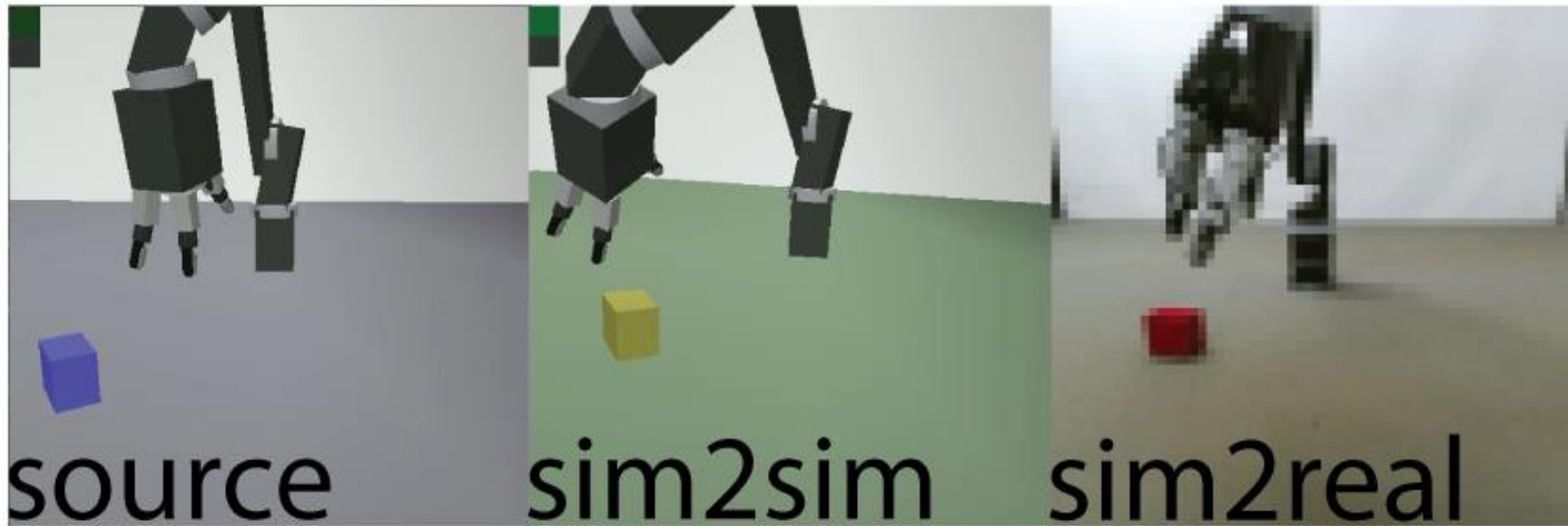
# Task #1

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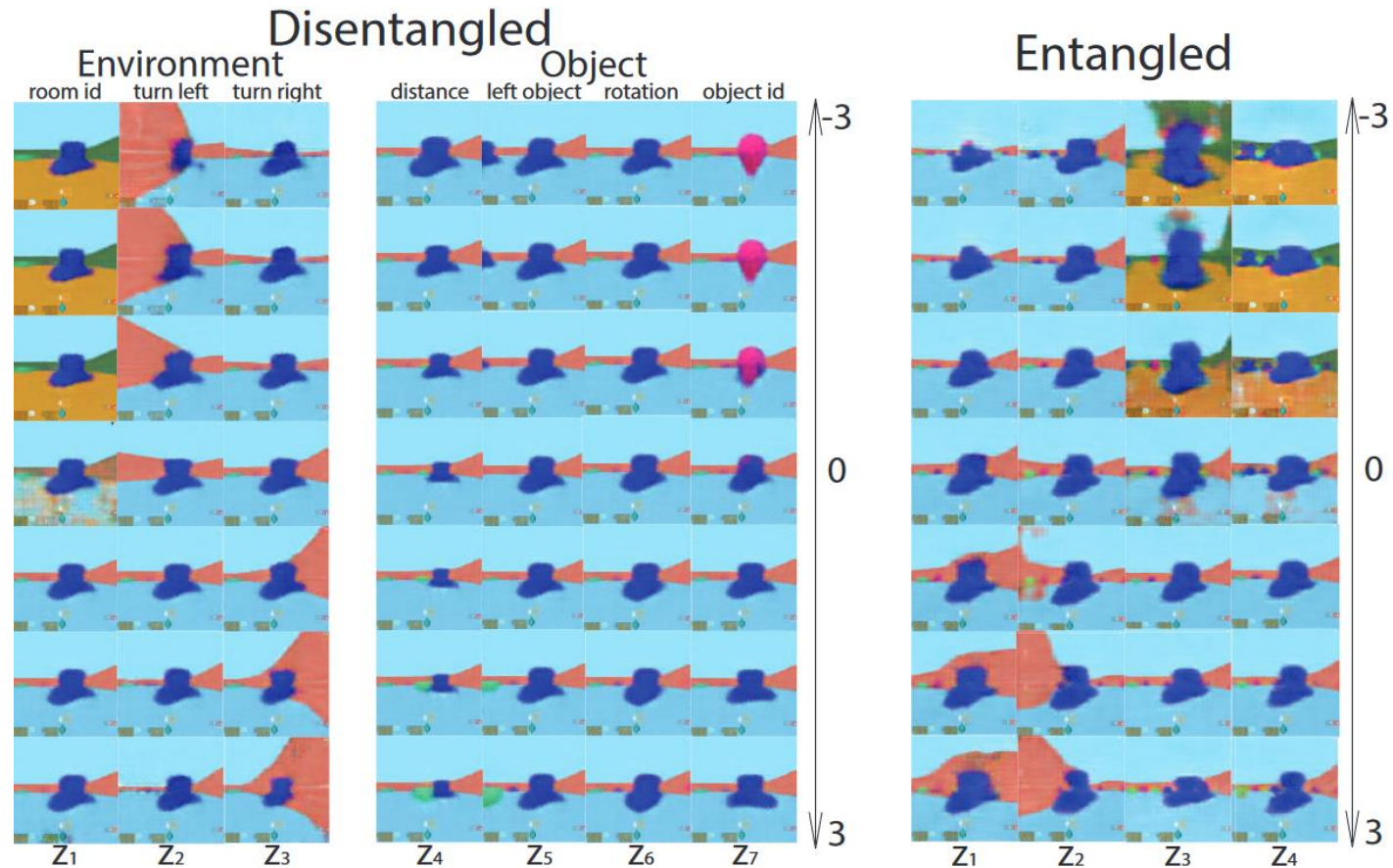
| object<br>room  | <br> | <br> | <br> | <br> | <br> | <br> |
|---|---|--|--|--|--|--|
|   | $D_S$   | $D_S$  |  |  | $D_U$  | $D_U$  |
|  | $D_T$   | $D_S$  | $D_U$  | $D_U$  |  |  |

# Task #2

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# Disentangled representation

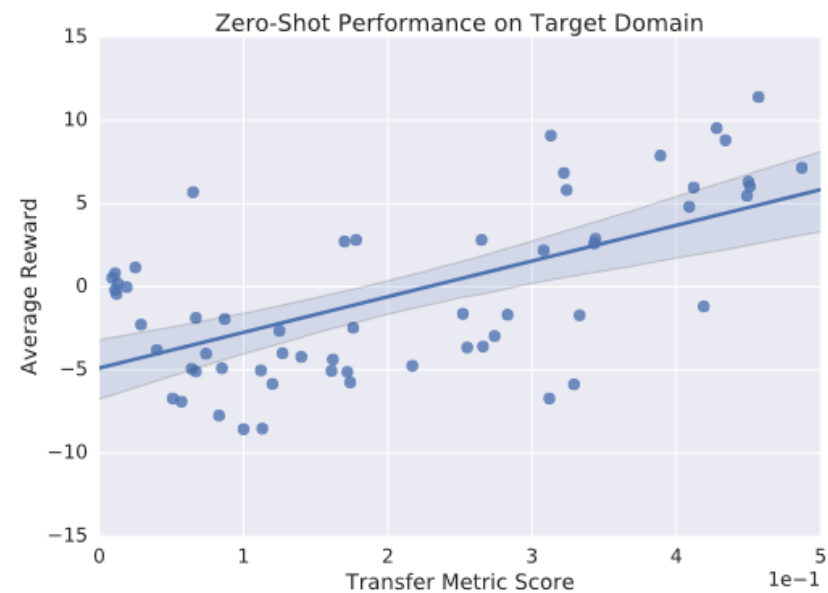


[Higgins et al. 2018]

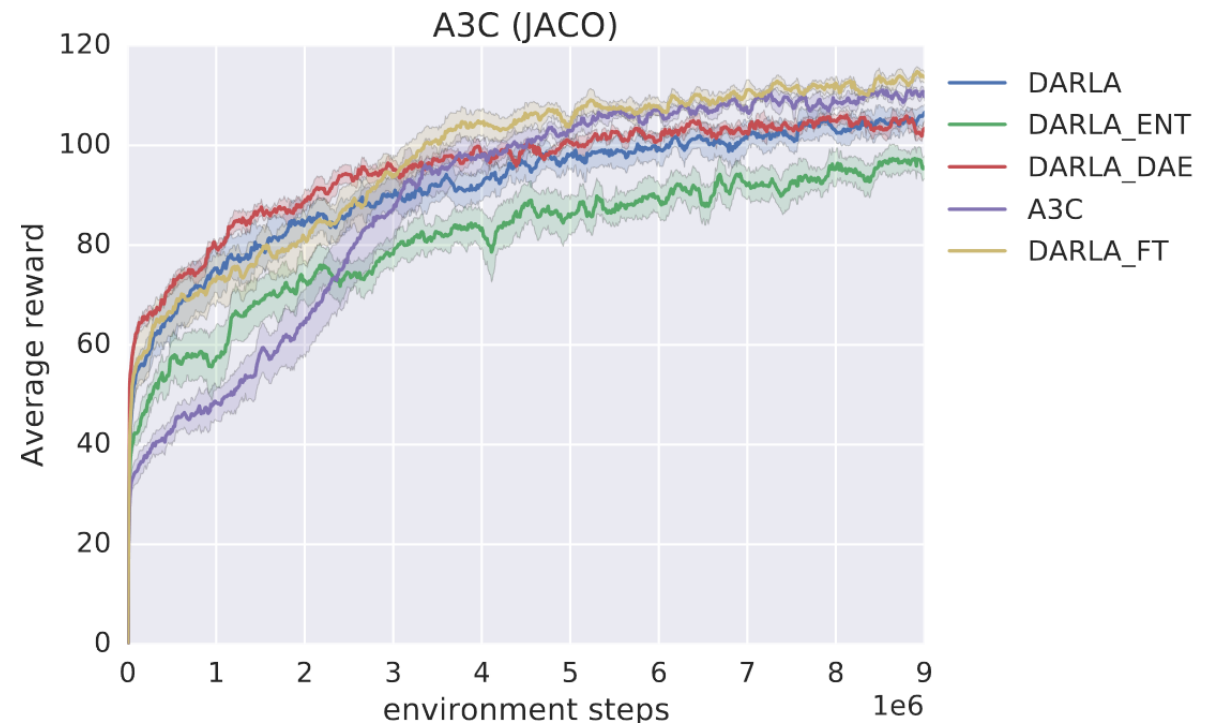
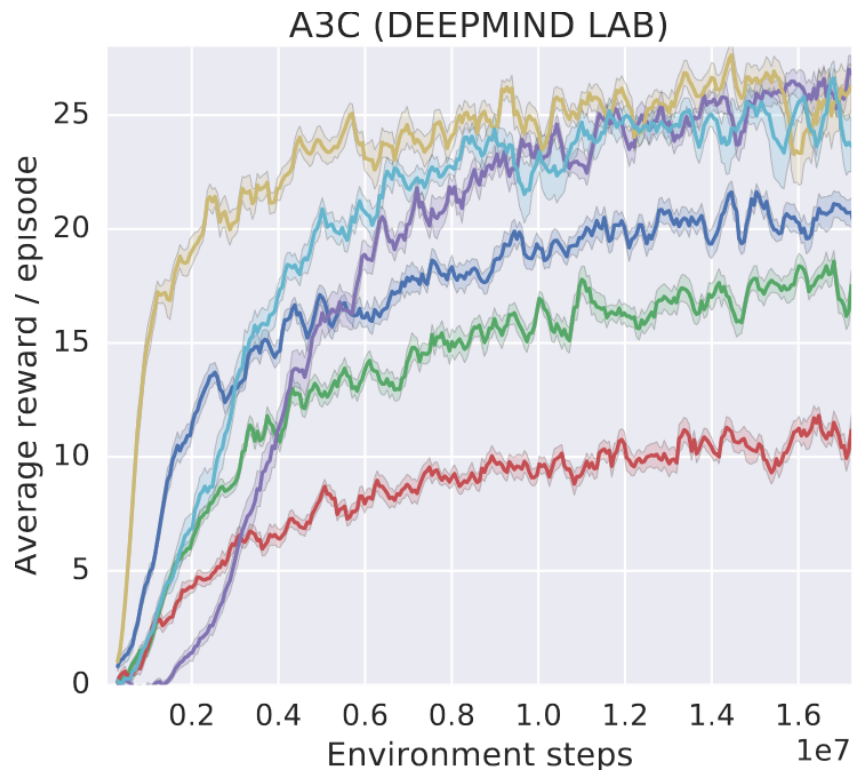
# Results

Table 1. Transfer performance

| VISION TYPE          | DQN                               | DEEPMIND LAB                      |                                    | JACO (A3C)                          |                                    |
|----------------------|-----------------------------------|-----------------------------------|------------------------------------|-------------------------------------|------------------------------------|
|                      |                                   | A3C                               | EC                                 | SIM2SIM                             | SIM2REAL                           |
| BASELINE AGENT       | $1.86 \pm 3.91$                   | $5.32 \pm 3.36$                   | $-0.41 \pm 4.21$                   | $97.64 \pm 9.02$                    | $94.56 \pm 3.55$                   |
| UNREAL               | -                                 | $4.13 \pm 3.95$                   | -                                  | -                                   | -                                  |
| DARLA <sub>FT</sub>  | <b><math>13.36 \pm 5.8</math></b> | $1.4 \pm 2.16$                    | -                                  | $86.59 \pm 5.53$                    | $99.25 \pm 2.3$                    |
| DARLA <sub>ENT</sub> | $3.45 \pm 4.47$                   | $15.66 \pm 5.19$                  | $5.69 \pm 3.73$                    | $84.77 \pm 4.42$                    | $59.99 \pm 15.05$                  |
| DARLA <sub>DAE</sub> | $7.83 \pm 4.47$                   | $6.74 \pm 2.81$                   | $5.59 \pm 3.37$                    | $85.15 \pm 7.43$                    | $100.72 \pm 4.7$                   |
| <b>DARLA</b>         | $10.25 \pm 5.46$                  | <b><math>19.7 \pm 5.43</math></b> | <b><math>11.41 \pm 3.52</math></b> | <b><math>100.85 \pm 2.92</math></b> | <b><math>108.2 \pm 5.97</math></b> |



# Sample efficiency

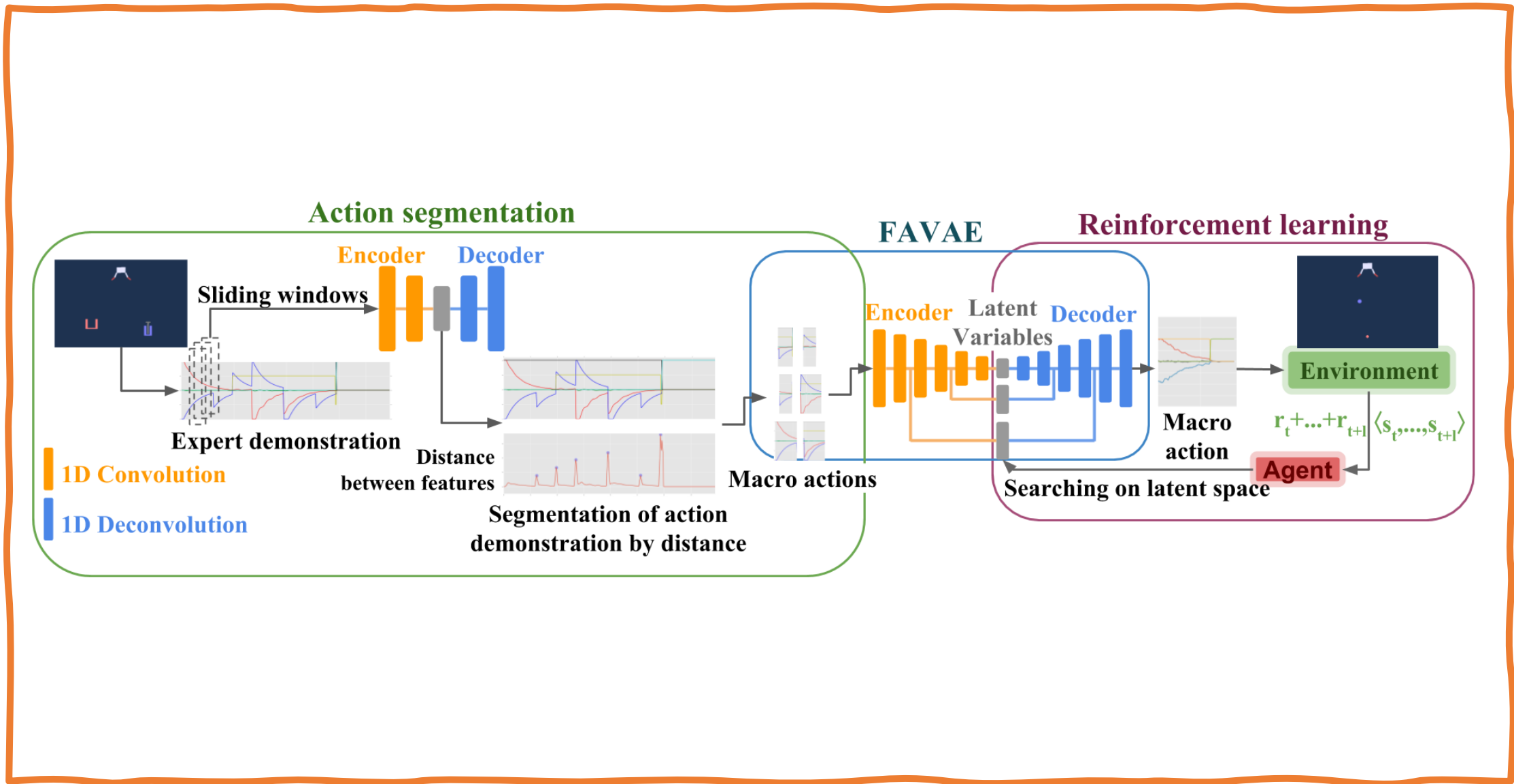




# FaMARL

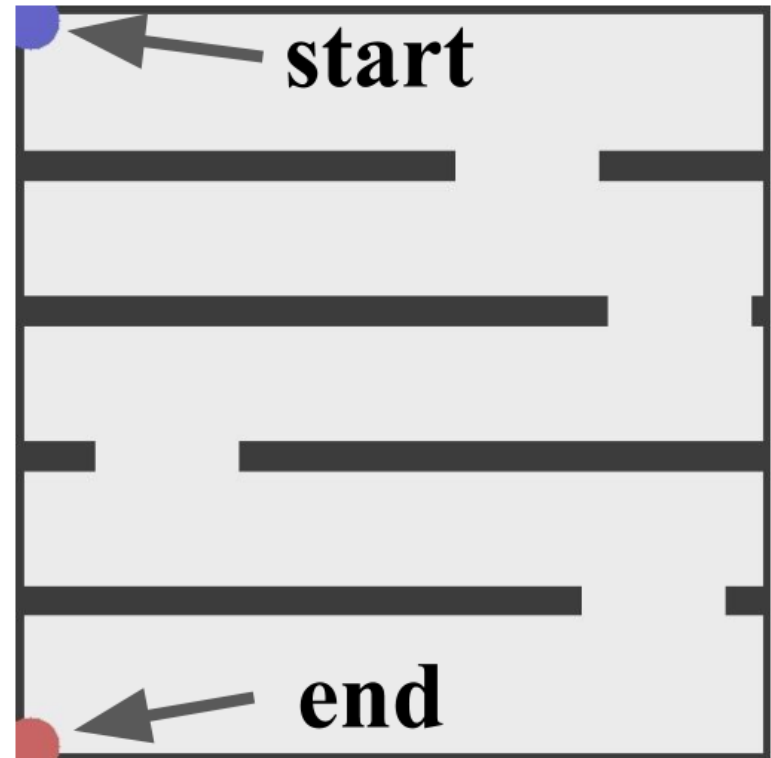
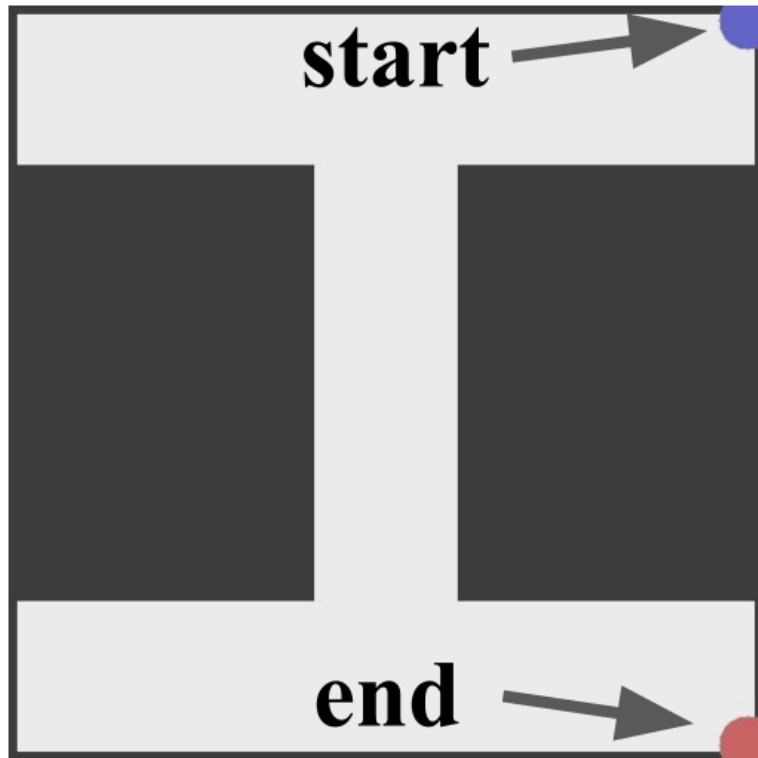
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Disentangling the action space



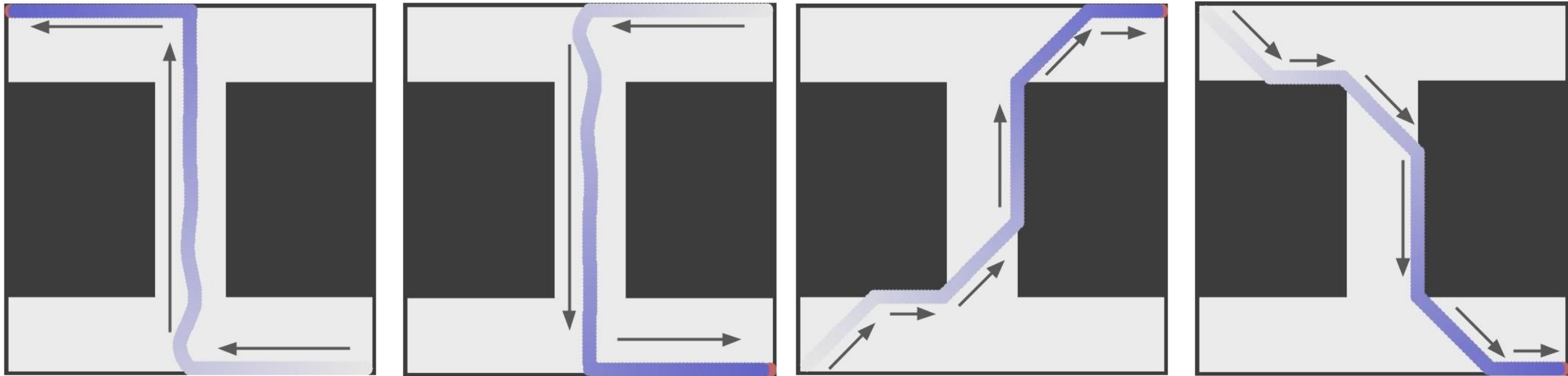
# Task #1

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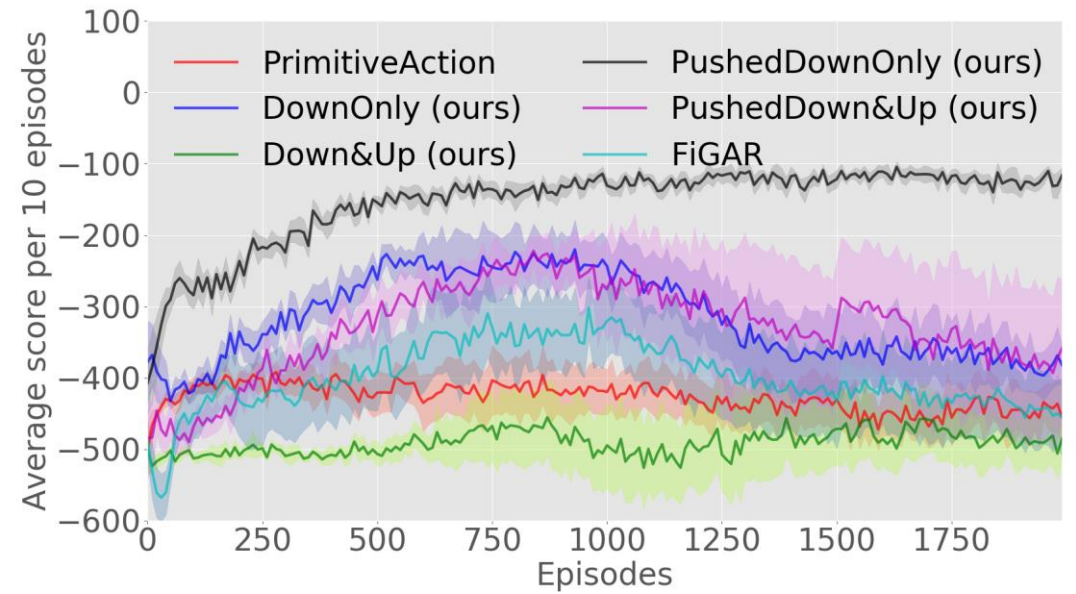
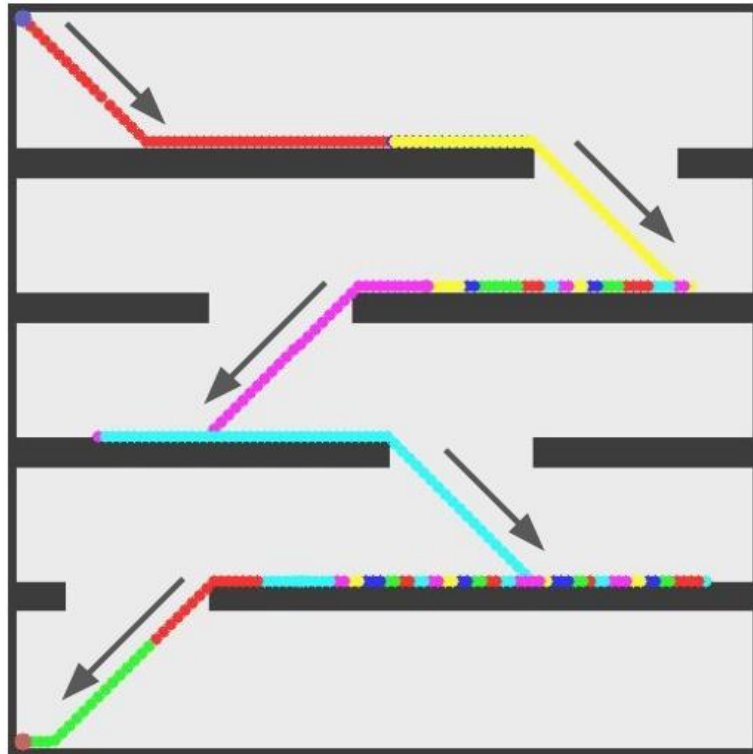
# Trajectory Generation

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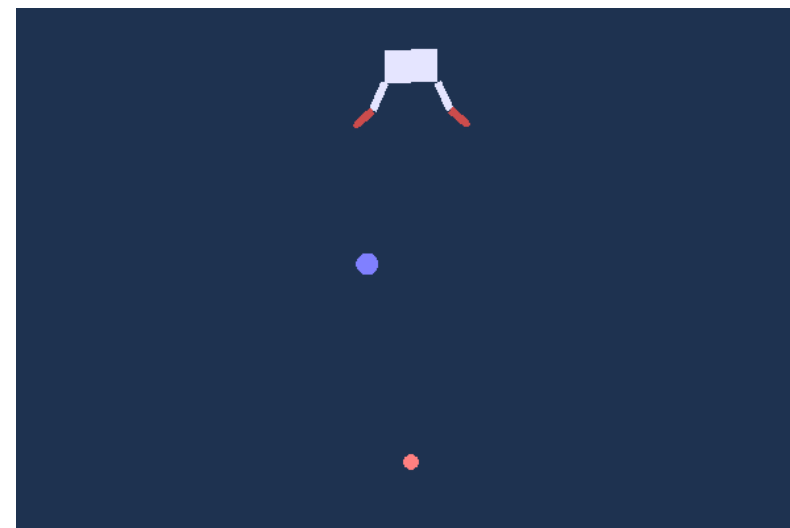
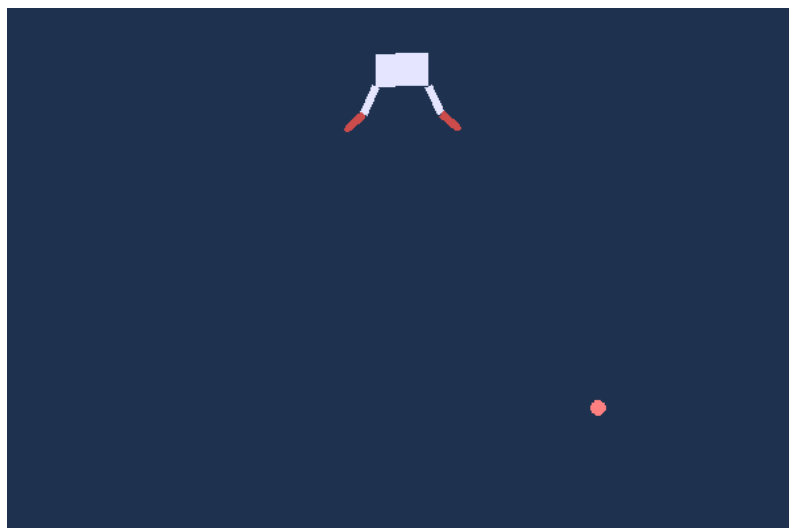
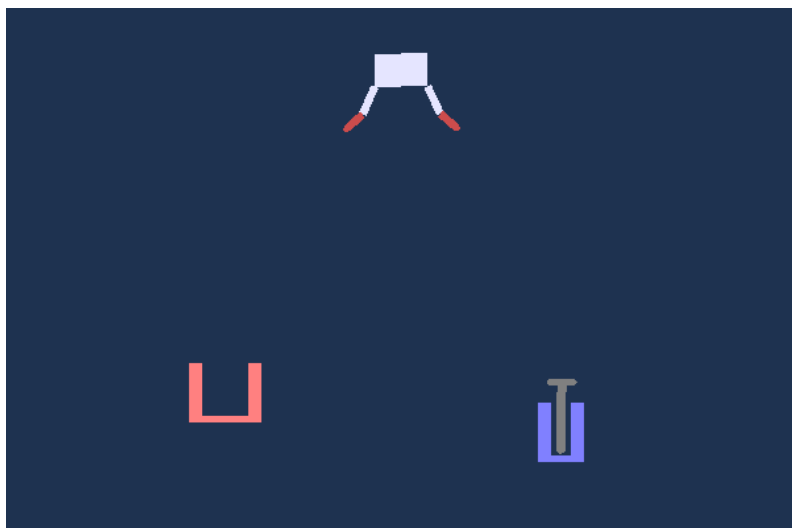
# Results

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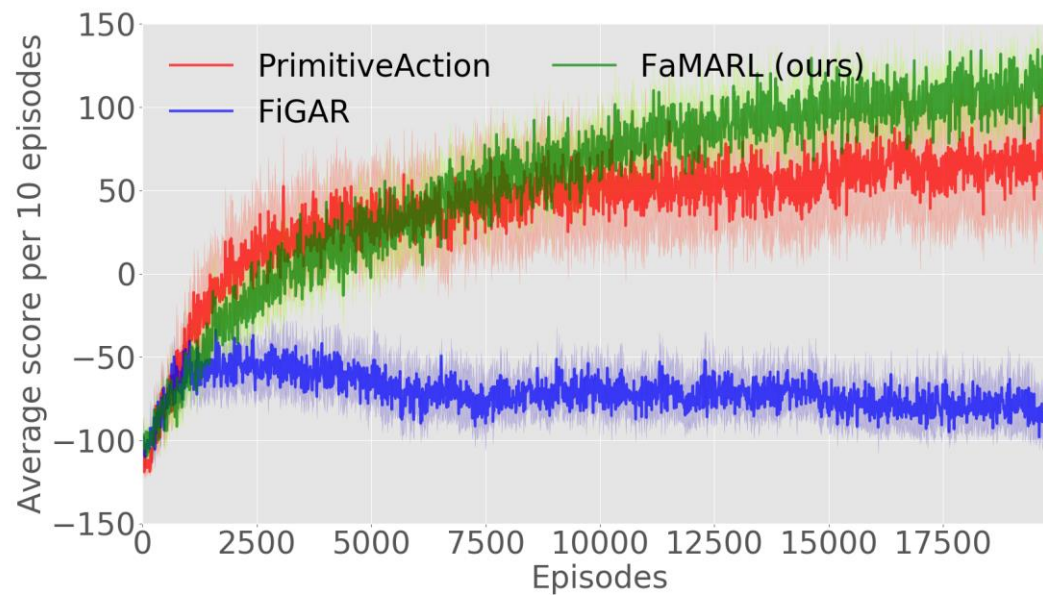
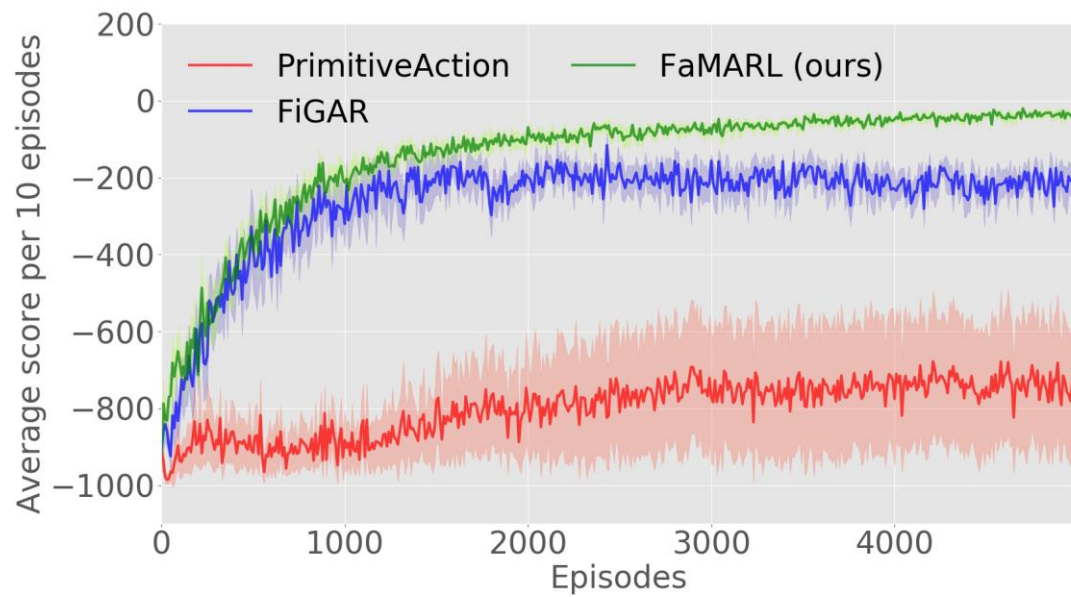
# Task #2

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# Results

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# References

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- Higgins, I., Pal, A., Rusu, A., Matthey, L., Burgess, C., Pritzel, A., Botvinick, M., Blundell, C. & Lerchner, A.. (2018). DARLA: Improving Zero-Shot Transfer in Reinforcement Learning.
- Heecheol Kim, Masanori Yamada, Kosuke Miyoshi, Hiroshi Yamakawa (2019). Macro Action Reinforcement Learning with Sequence Disentanglement using Variational Autoencoder