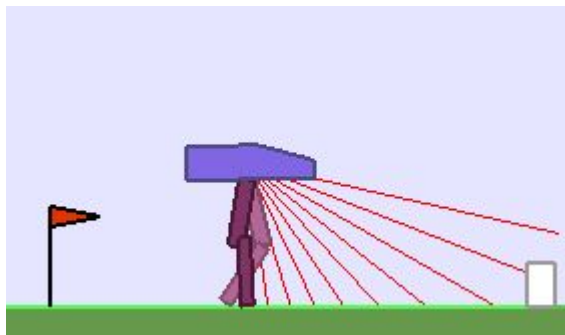# **TeachMyAgent**: a Benchmark for Automatic Curriculum Learning in Deep RL

Clément Romac[1]*, Rémy Portelas[1]*, Katja Hofmann[2], Pierre-Yves Oudeyer[1]

*Equal contribution, [1]Flowers Lab - Inria (FR), [2]Microsoft Research Cambridge (UK)
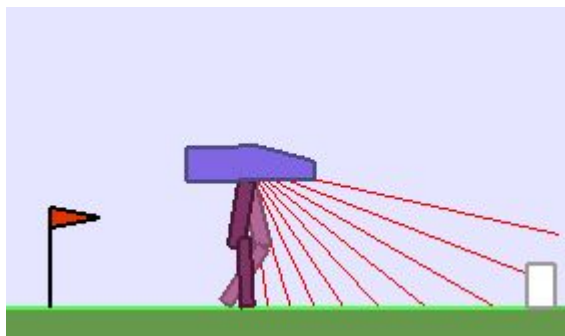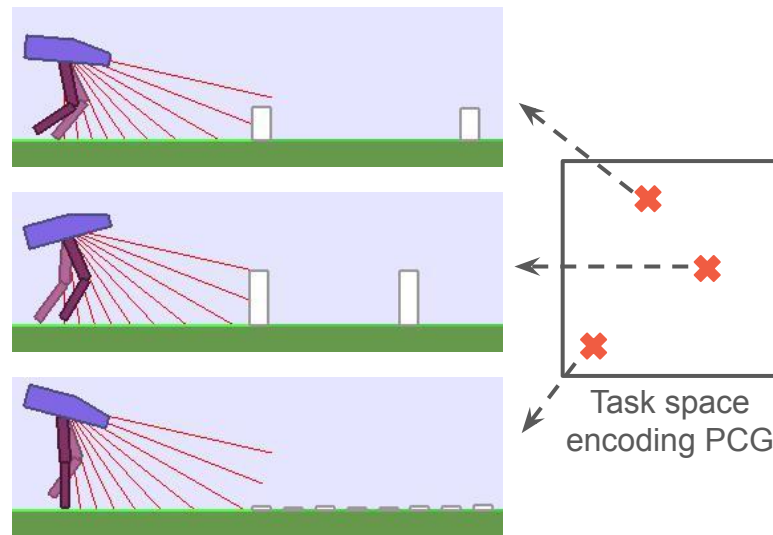
Designing Deep RL agents that can generalise

Single task proposed

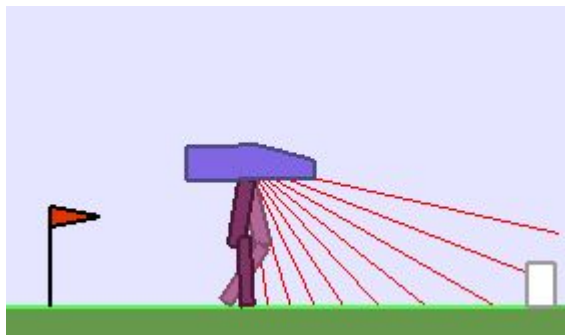# Designing Deep RL agents that can generalise

Single task proposed

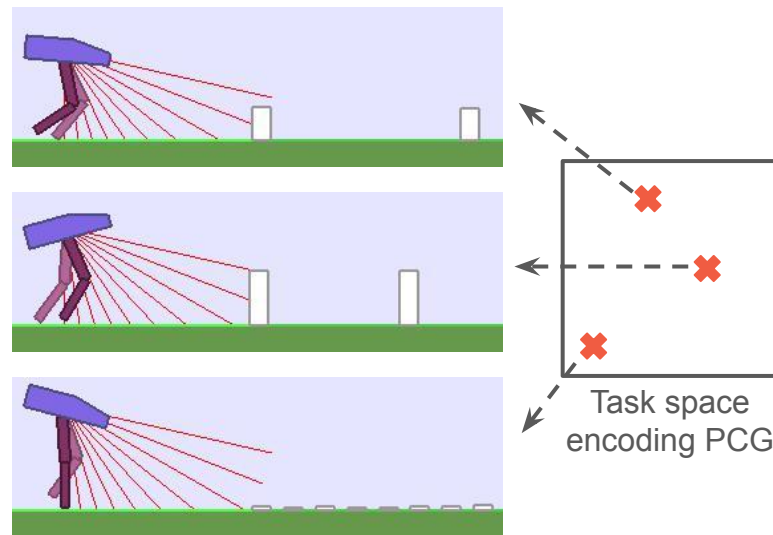Multiple tasks using *Procedural Content Generation* (PCG)

Task space encoding PCG

Designing Deep RL agents that can generalise

Single task proposed

Multiple tasks using *Procedural Content Generation* (PCG)

Task space encoding PCG

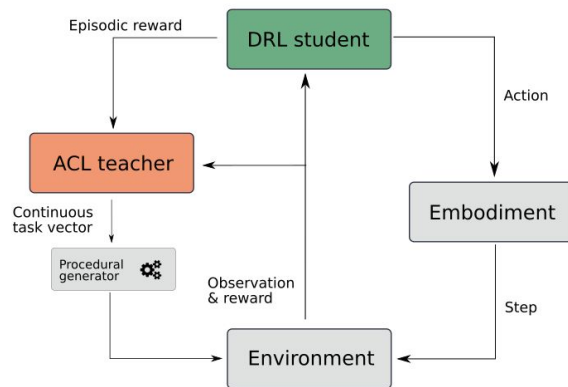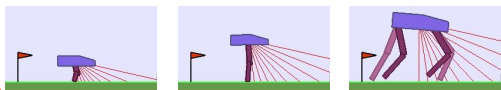⇒ **How can we design an efficient curriculum ?**

Existing ACL methods
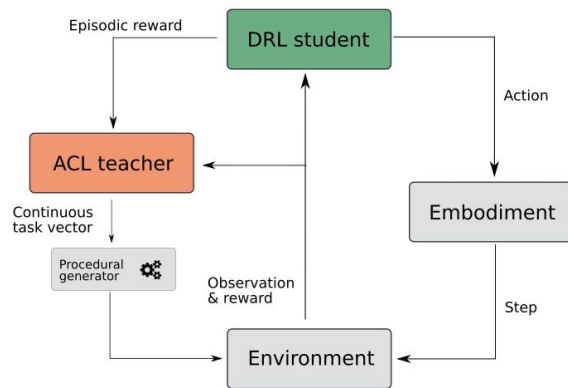
Existing ACL methods

ALP-GMM *(Portelas et al., 2019)*

Comparison:
- Covar-GMM *(Moulin-Frier et al., 2014)*
- RIAC *(Baranes & Oudeyer, 2009)*

Environments:
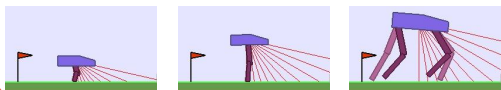

— Maximize Learning Progress

Existing ACL methods

ALP-GMM *(Portelas et al., 2019)*

Comparison:
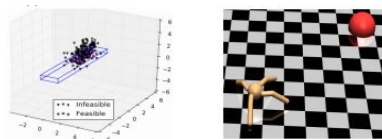- Covar-GMM *(Moulin-Frier et al., 2014)*
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Environments:

GoalGAN *(Florensa et al., 2018)*

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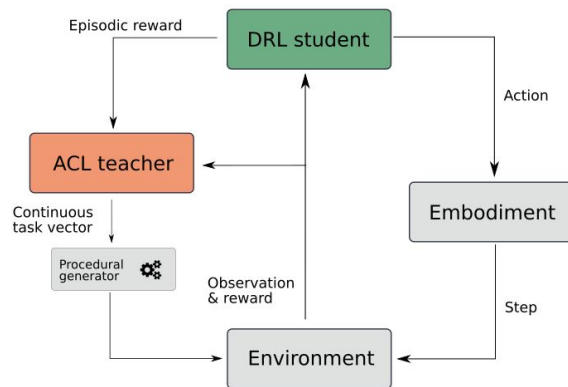
Environments:

Setter-Solver *(Racanière et al., 2020)*

Comparison:
- GoalGAN

Environments:

─── Maximize Learning Progress
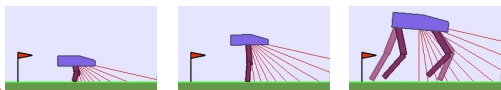
─── Generate goals using Neural Networks

Existing ACL methods

ALP-GMM *(Portelas et al., 2019)*

Comparison:
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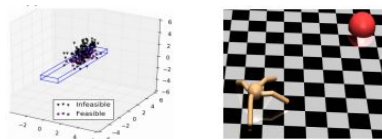- RIAC *(Baranes & Oudeyer, 2009)*

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Comparison:
- RIAC *(Baranes & Oudeyer, 2009)*

Environments:

Setter-Solver *(Racanière et al., 2020)*

Comparison:
- GoalGAN

Environments:

SPDL *(Klink et al., 2020)*
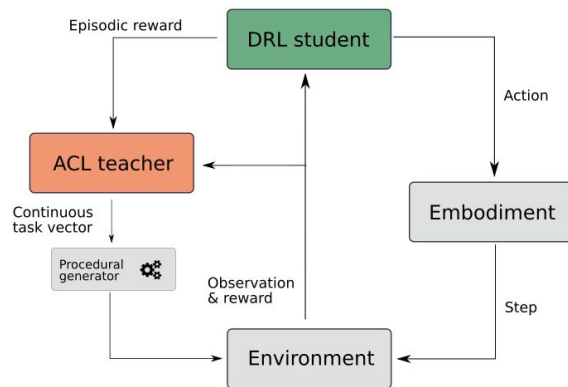
Comparison:
- ALP-GMM
- GoalGAN

Environments:

ADR *(OpenAI et al., 2019)*

Comparisons:
- /

Environments:

Episodic reward — DRL student — Action — Embodiment — Step — Environment — Observation & reward — ACL teacher — Continuous task vector — Procedural generator
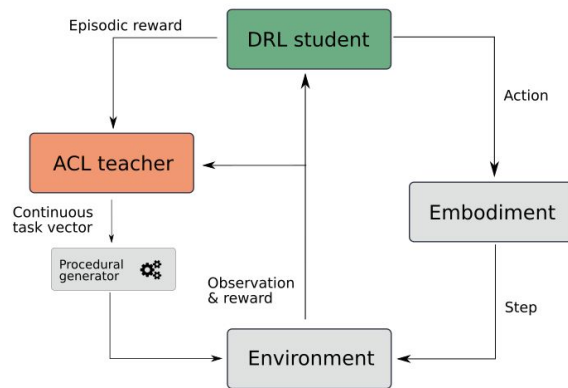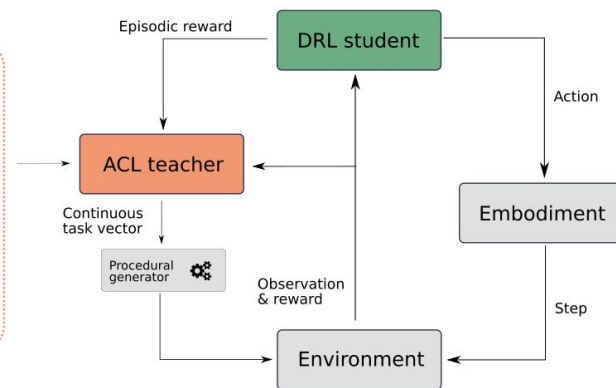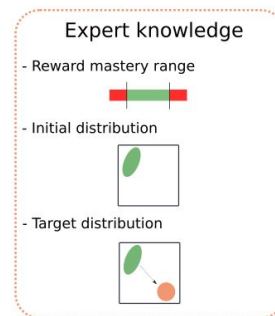
— Maximize Learning Progress

— Generate goals using Neural Networks

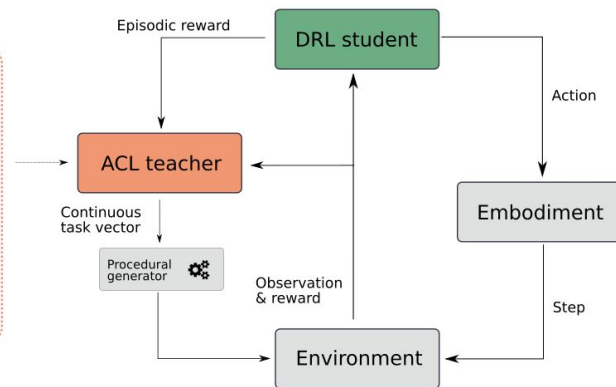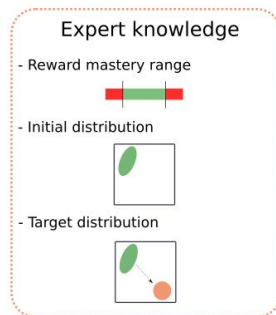— Shift a task distribution according to student's capabilities

Diverse expert knowledge used
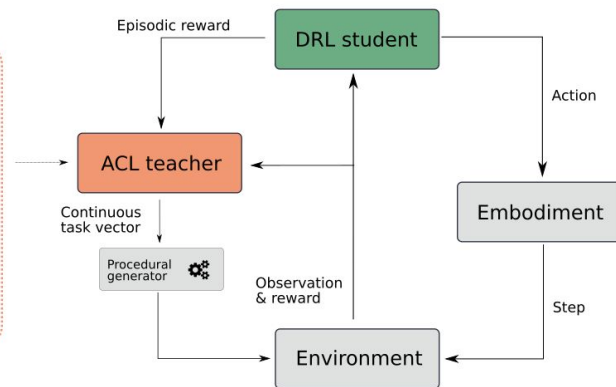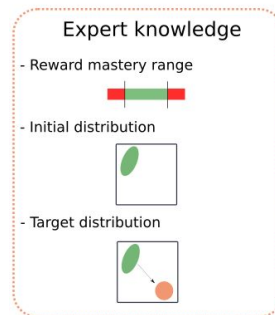
Diverse expert knowledge used

Diverse expert knowledge used

ALGORITHM	$\mathcal{D}_{init}$	$\mathcal{D}_{target}$	REWARD MASTERY RANGE
ADR	REQ.		REQ.
ALP-GMM	OPT.		
COVAR-GMM	OPT.		
GOAL-GAN	OPT.		REQ.
RIAC			
SPDL	REQ.	REQ.	
SETTER-SOLVER		OPT.	REQ.

REQ.: Required
OPT.: Optional

Diverse expert knowledge used

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RIAC			
SPDL	REQ.	REQ.	
SETTER-SOLVER		OPT.	REQ.

REQ.: Required
OPT.: Optional

⇒ **No existing systematic comparison**

TeachMyAgent

ACL methods | DRL students | PCG Environments | Embodiments | Two experiment types
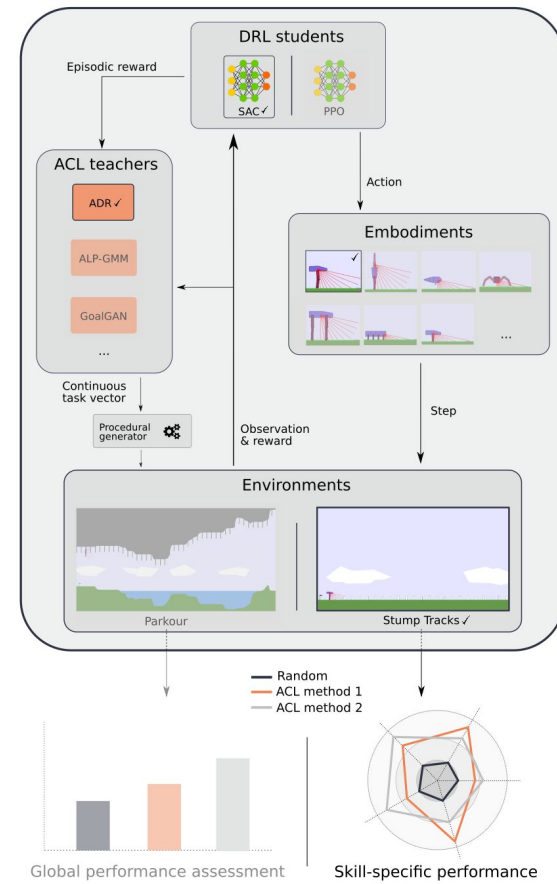
TeachMyAgent

ACL methods | DRL students | PCG Environments | Embodiments | Two experiment types

- Multiple **SOTA ACL algorithms**, in a **common API**

  - Taken from open-source code or **re-implemented**
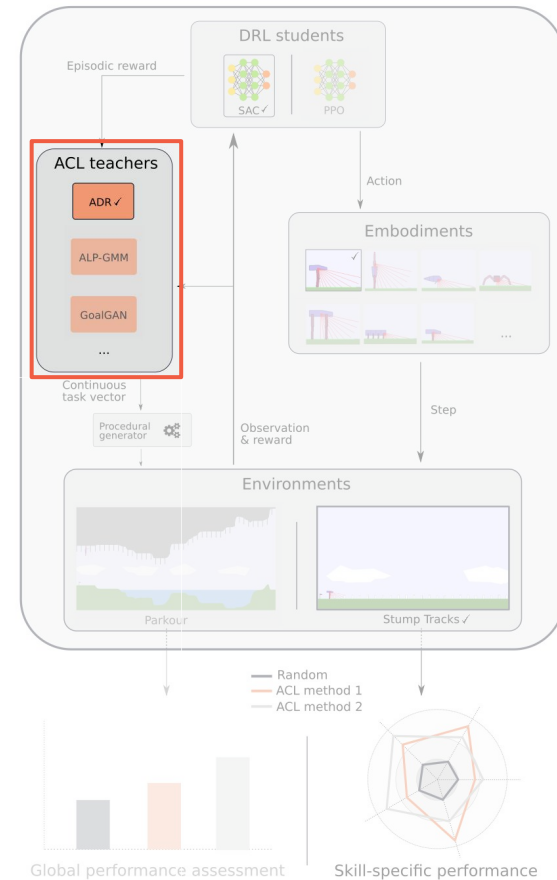
TeachMyAgent

ACL methods | **DRL students** | PCG Environments | Embodiments | Two experiment types
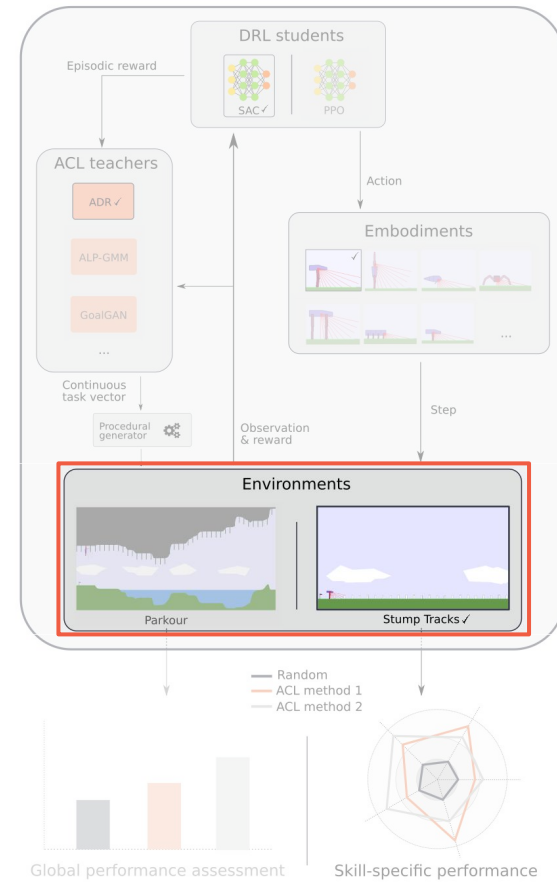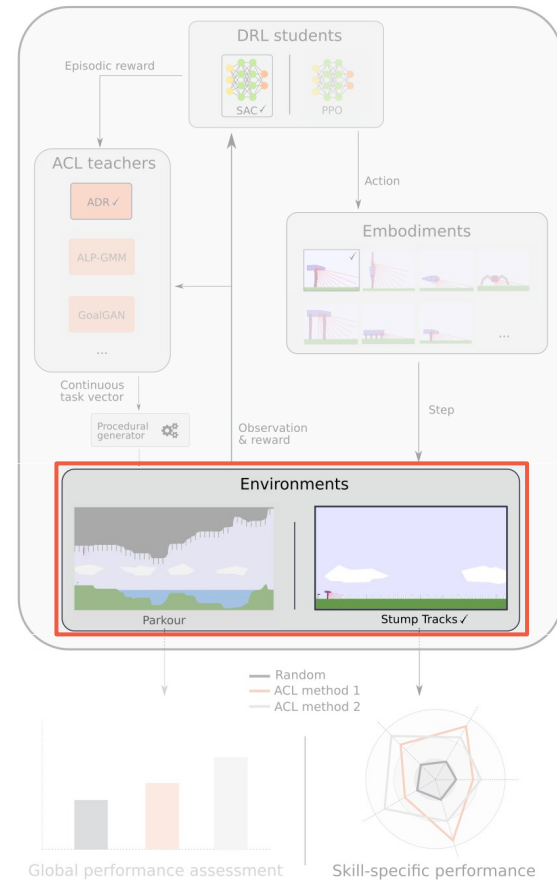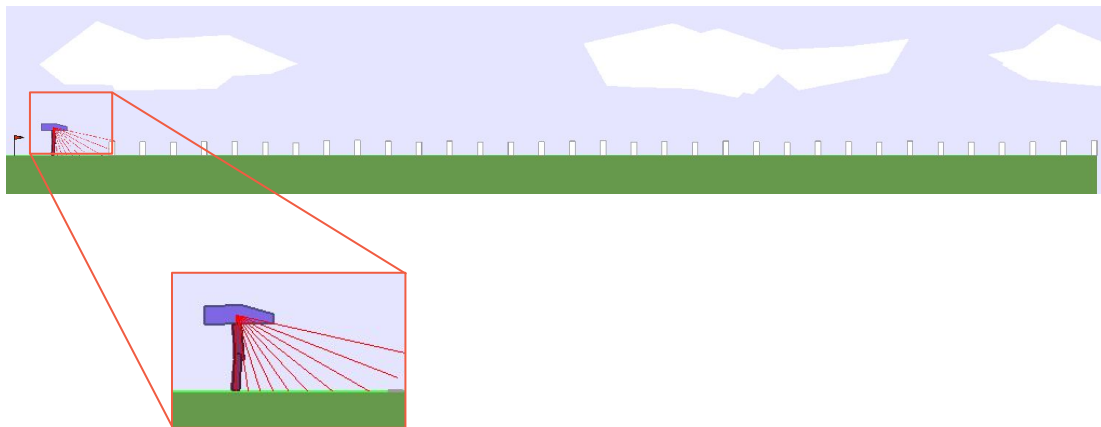
- Multiple **SOTA ACL algorithms**, in a **common API**

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- Two **SOTA Deep RL students**
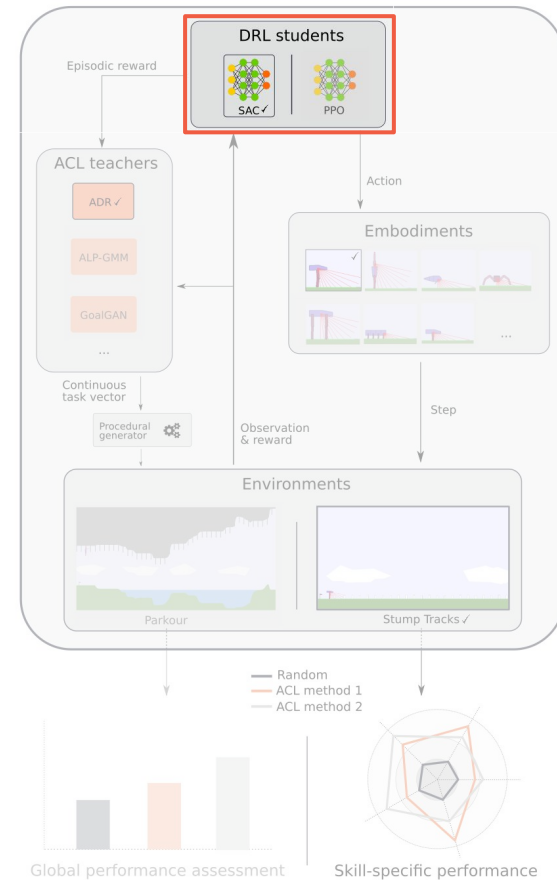
TeachMyAgent

ACL methods | DRL students | **PCG Environments** | Embodiments | Two experiment types

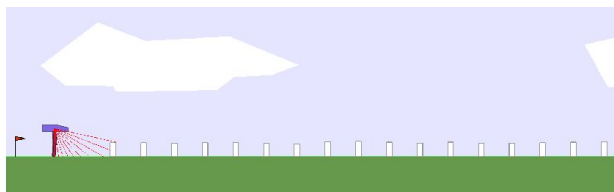- Multiple **SOTA ACL algorithms**, in a **common API**

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TeachMyAgent

ACL methods | DRL students | **PCG Environments** | Embodiments | Two experiment types
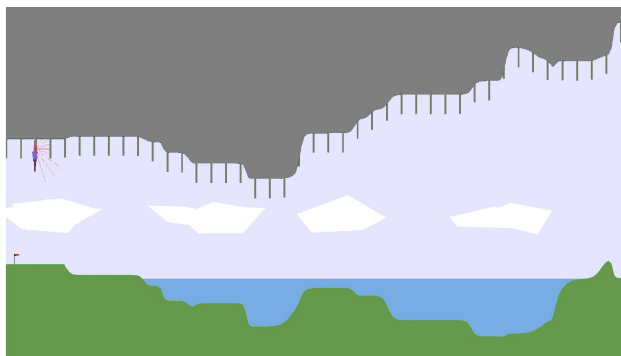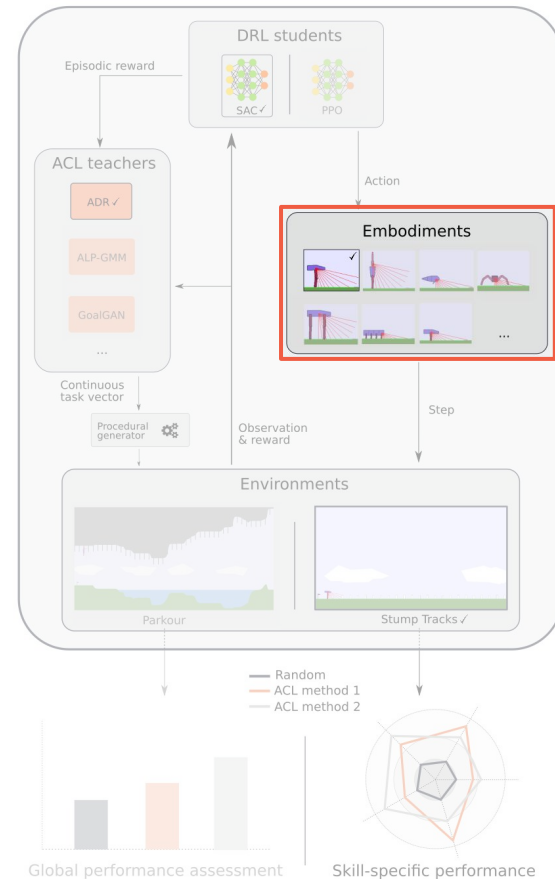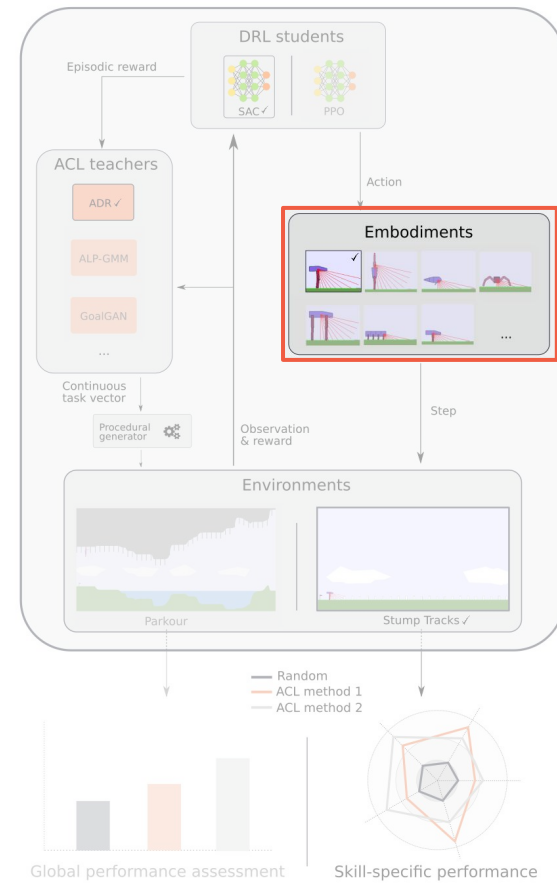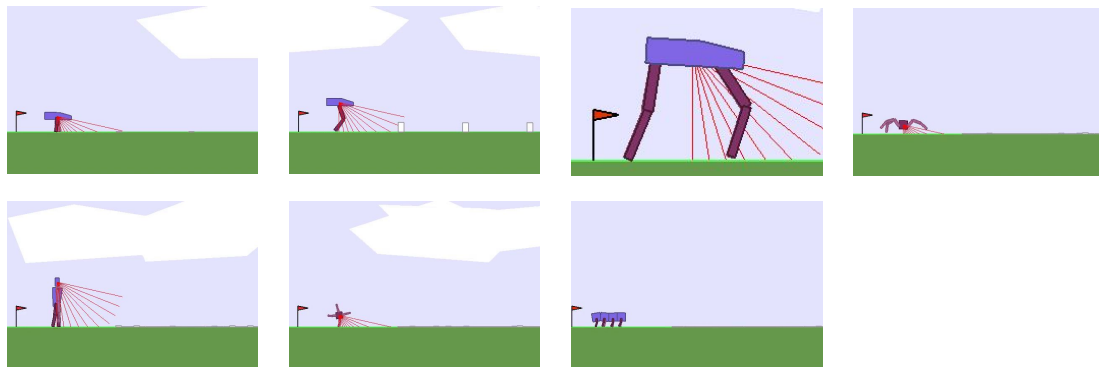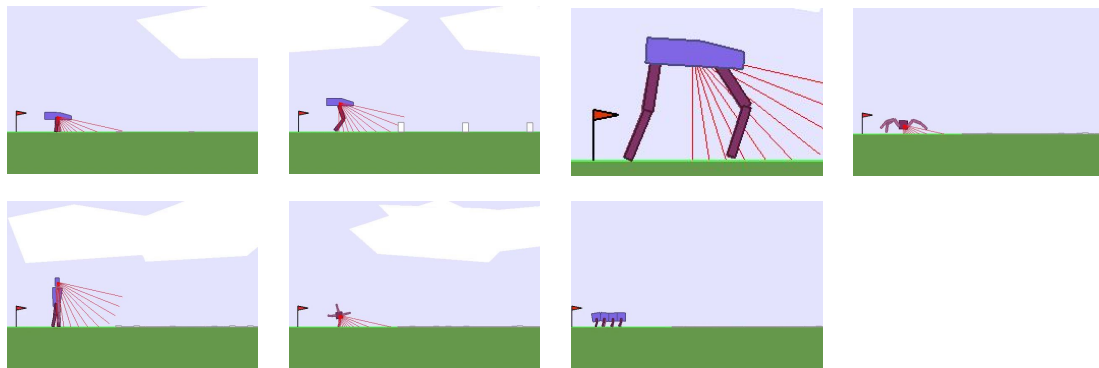
Stump Tracks
(Simple 2D task space)

TeachMyAgent

ACL methods | DRL students | **PCG Environments** | Embodiments | Two experiment types

Stump Tracks
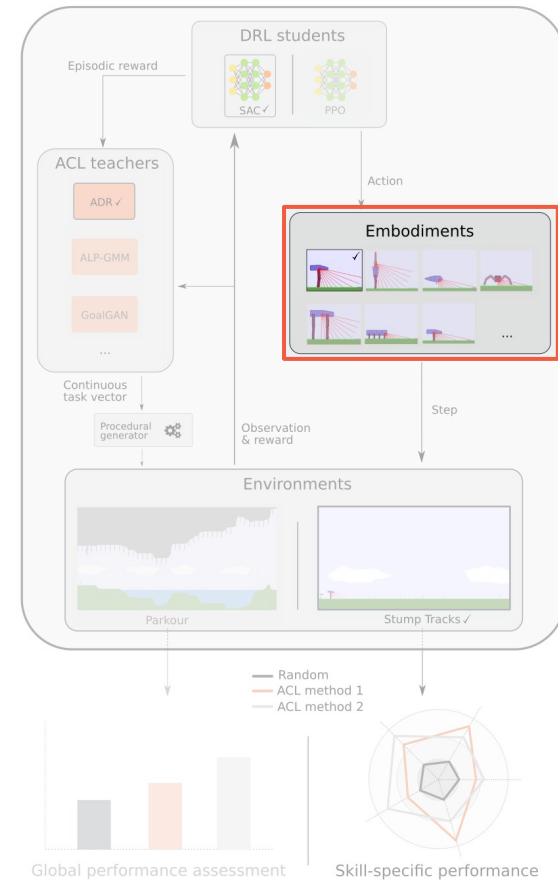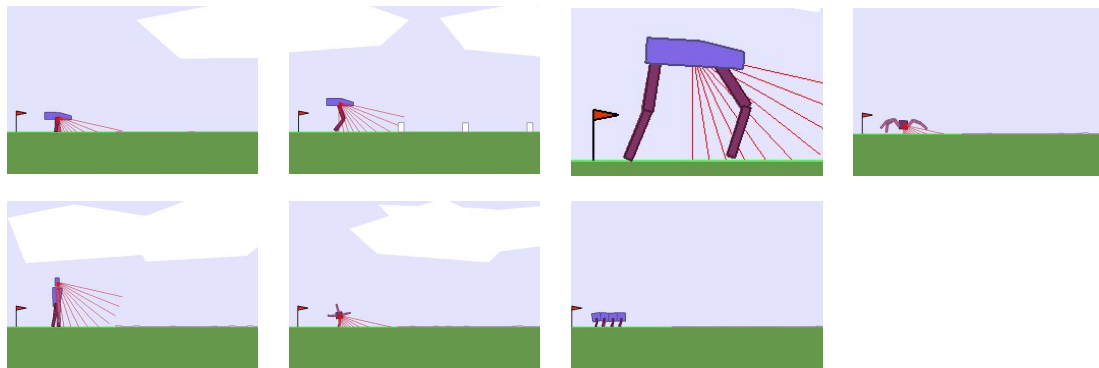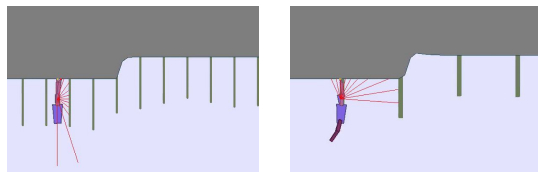(Simple 2D task space)

Parkour
(Complex 6D task space)

TeachMyAgent

ACL methods | DRL students | PCG Environments | **Embodiments** | Two experiment types

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- **PCG** environments

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  - Parkour (complex 6D task space using a CPPN)
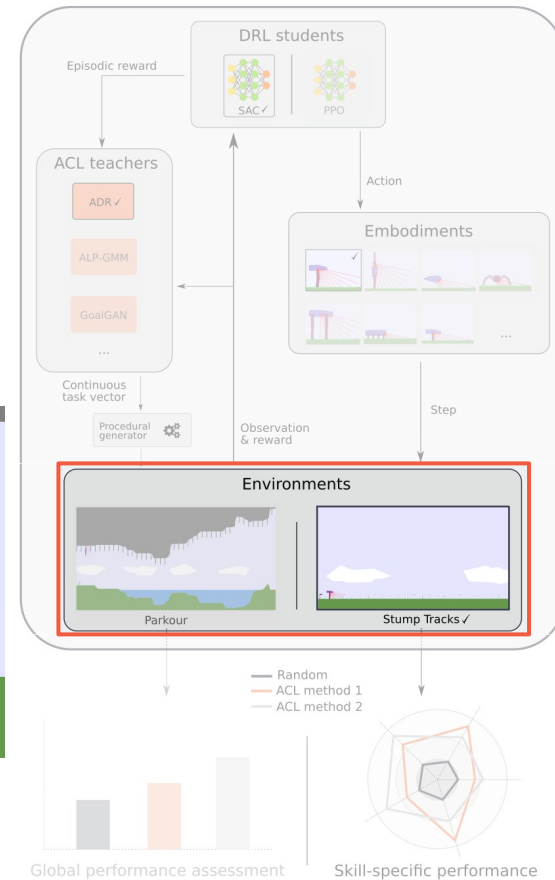
- Multiple **embodiments**

TeachMyAgent

ACL methods | DRL students | PCG Environments | **Embodiments** | Two experiment types

Walkers

TeachMyAgent

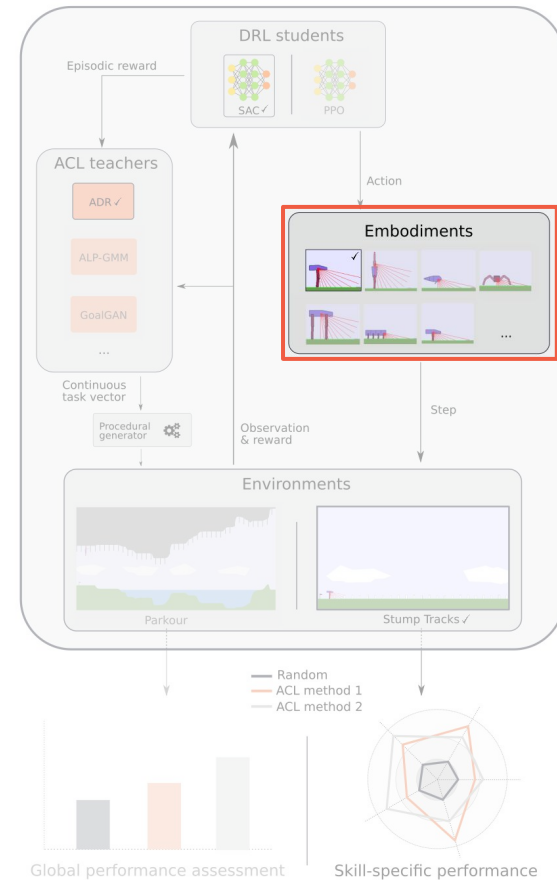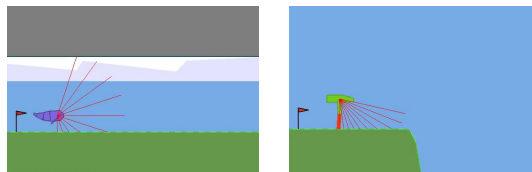ACL methods | DRL students | PCG Environments | **Embodiments** | Two experiment types
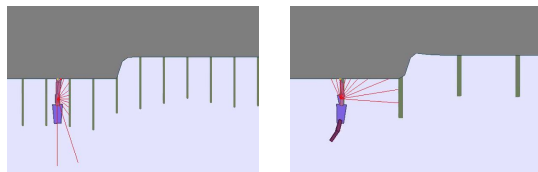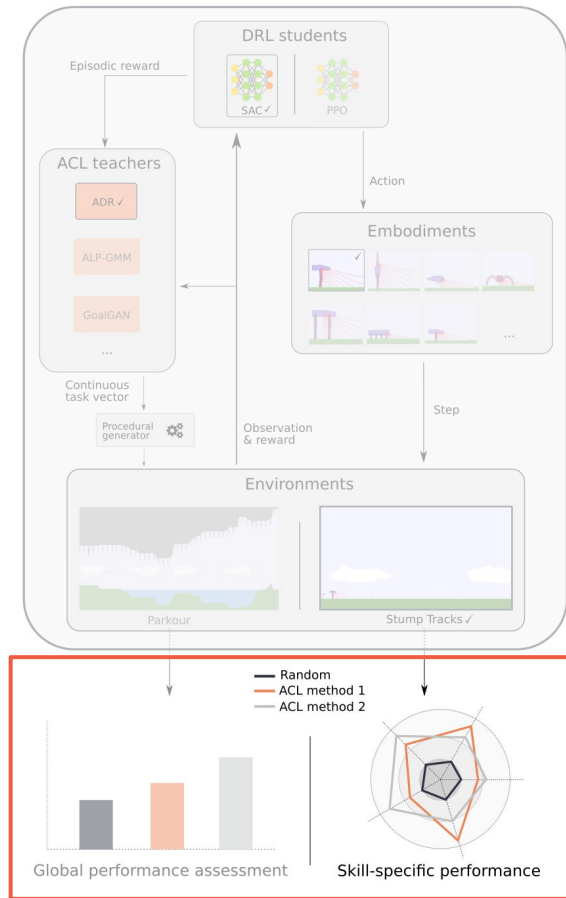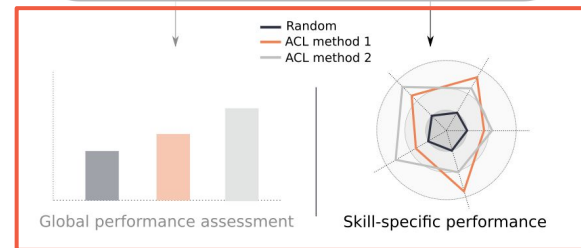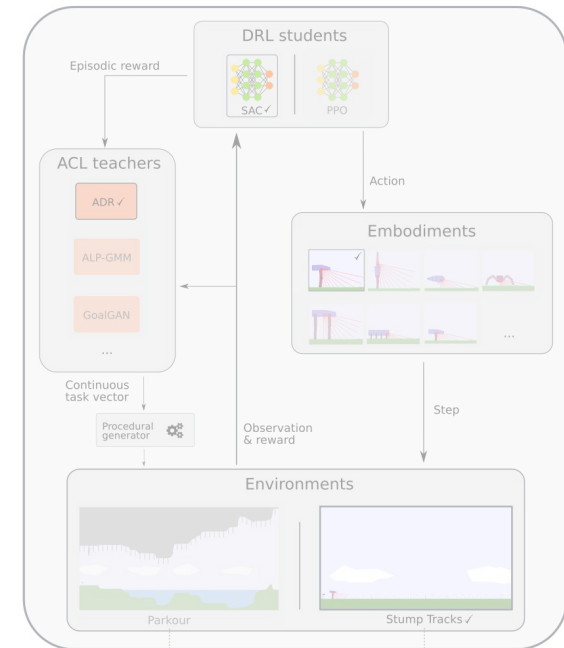
Walkers

Climbers

TeachMyAgent

ACL methods | DRL students | PCG Environments | **Embodiments** | Two experiment types

Walkers

Climbers

Swimmers

TeachMyAgent

ACL methods | DRL students | PCG Environments | Embodiments | **Two experiment types**
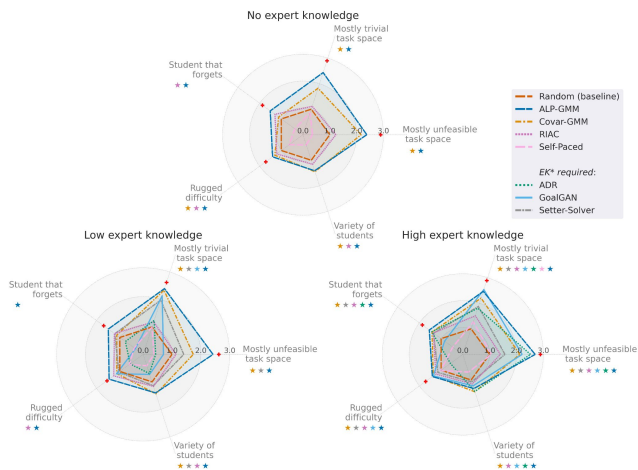
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- Two **SOTA Deep RL students**

- **PCG** environments
    - Stump Tracks (simple 2D task space)
    - Parkour (complex 6D task space using a CPPN)

- Multiple **embodiments**
    - Walkers / Climbers / Swimmers

- Two types of experiment

TeachMyAgent

ACL methods | DRL students | PCG Environments | Embodiments | **Two experiment types**
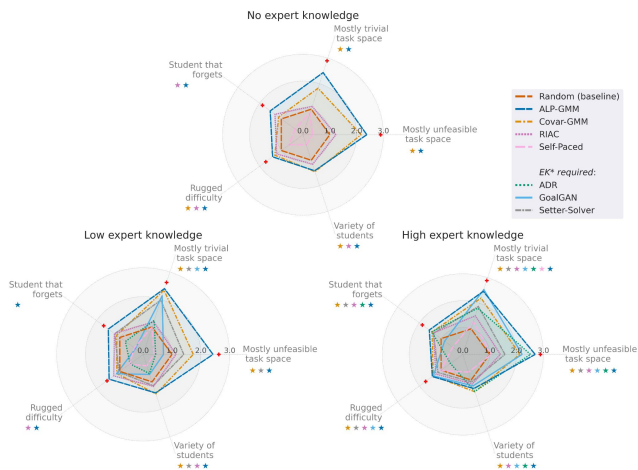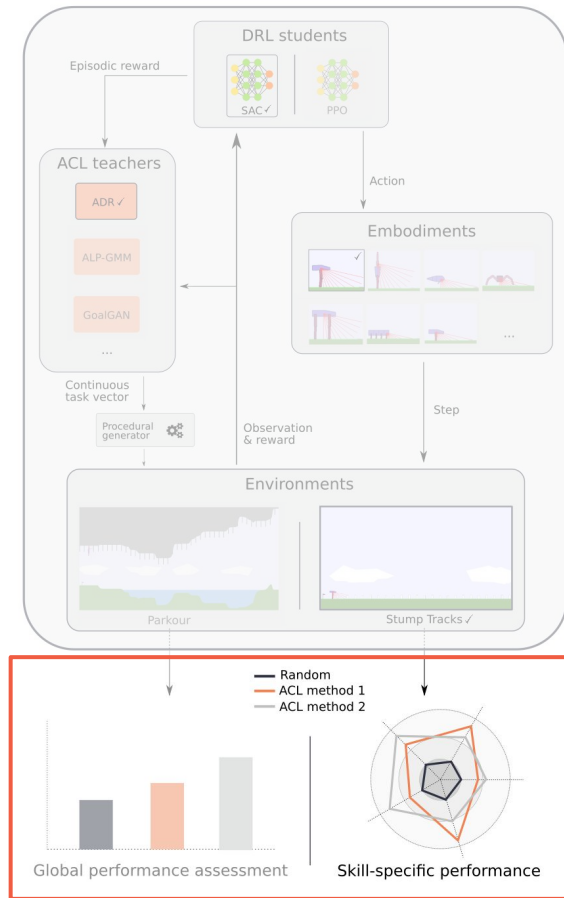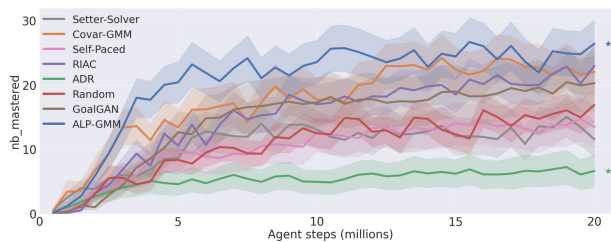
Skill-specific
(using Stump Tracks)

TeachMyAgent

ACL methods | DRL students | PCG Environments | Embodiments | **Two experiment types**


Skill-specific
(using Stump Tracks)

Global performance
(using Parkour)

TeachMyAgent

ACL methods | DRL students | PCG Environments | Embodiments | Two experiment types

- Multiple **SOTA ACL algorithms**, in a **common API**

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  - **Skill-specific**

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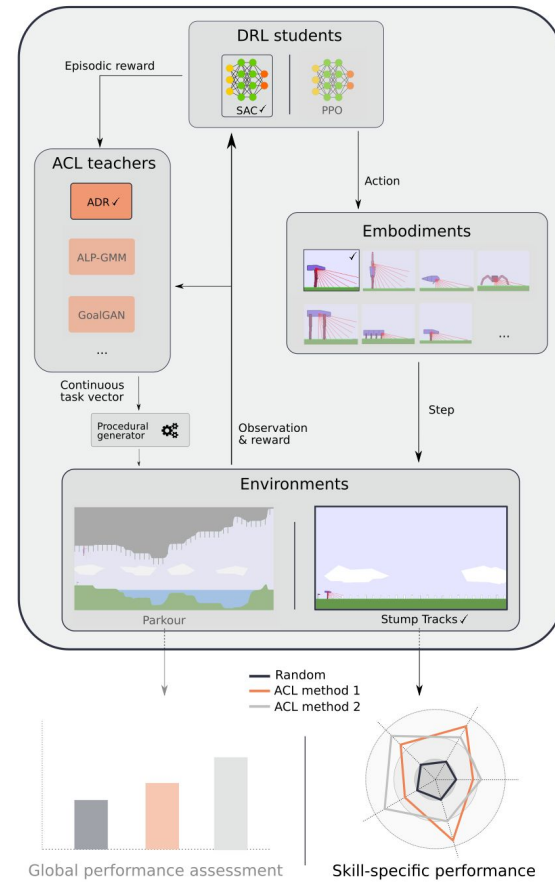
TeachMyAgent

Large-scale experiments

TeachMyAgent

Large-scale experiments
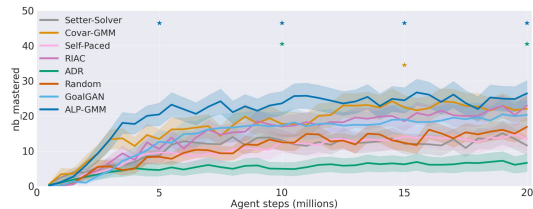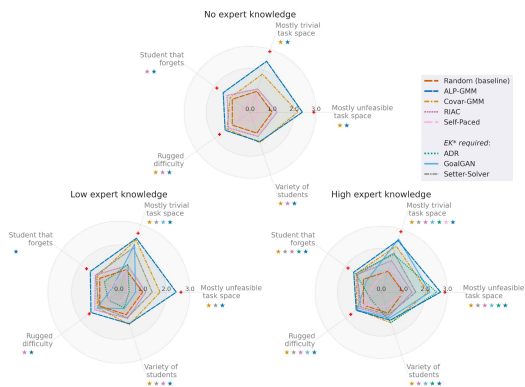
+ Benchmark comparison

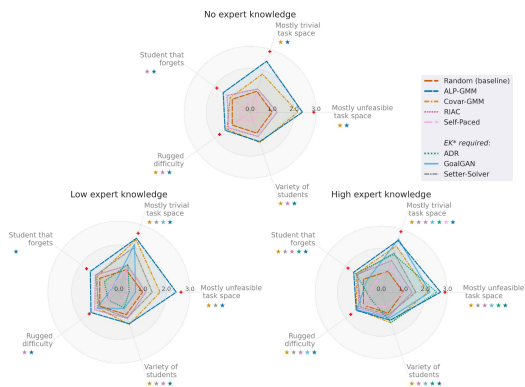# TeachMyAgent

Large-scale experiments
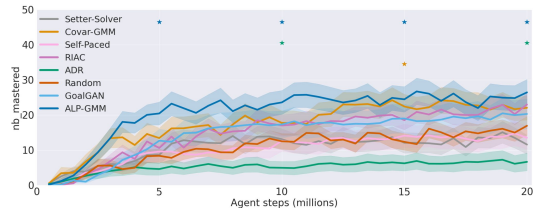
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+ Baselines release

TeachMyAgent

Large-scale experiments

Open Source release

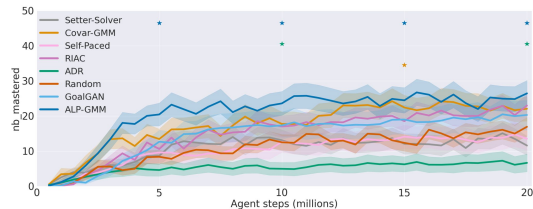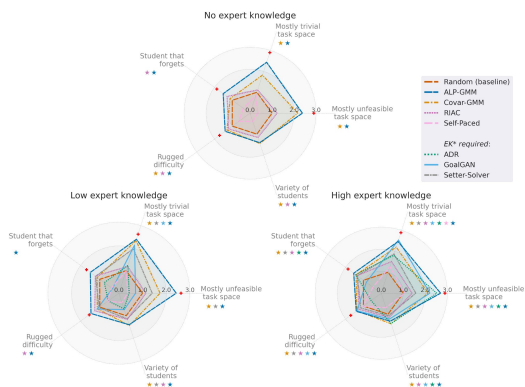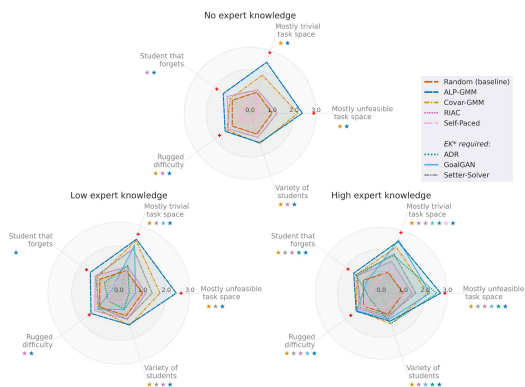+ **Benchmark comparison**

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TeachMyAgent

Large-scale experiments

Open Source release

+ **Benchmark comparison**

+ **Our (well-documented) full platform**

+ **Baselines release**

TeachMyAgent

Large-scale experiments

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+ **Simple APIs to extend it**

TeachMyAgent

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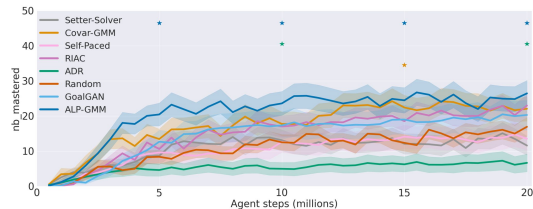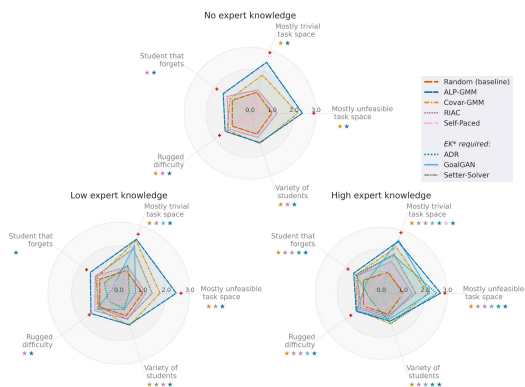
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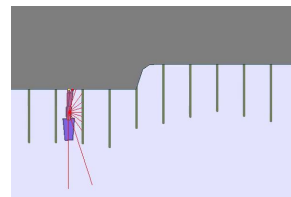**+ Simple APIs to extend it**
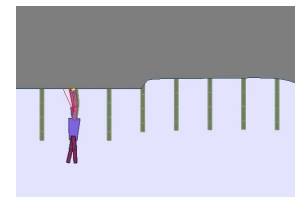
+ Jupyter notebooks to reproduce figures
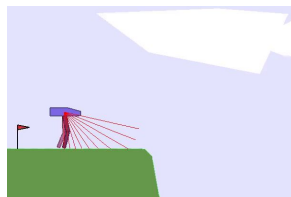
Discussion
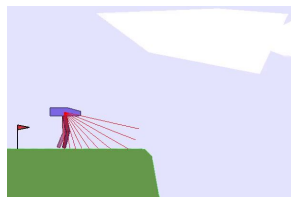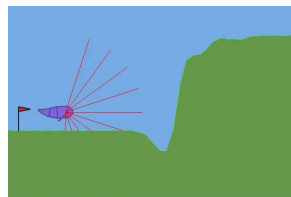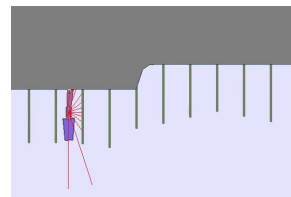

Robust walker
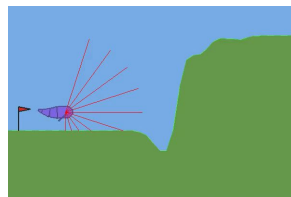
Realistic fish

Jumping chimp

Realistic creepers
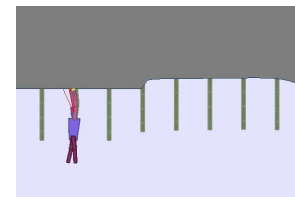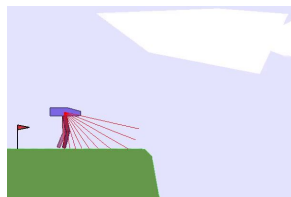
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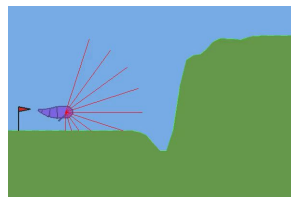Robust walker   Realistic fish   Jumping chimp   Realistic creepers

TeachMyAgent: a platform for systematic study of ACL methods !
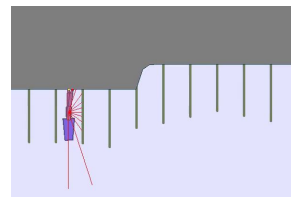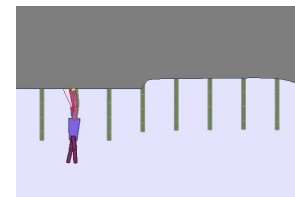
Discussion

Robust walker

Realistic fish

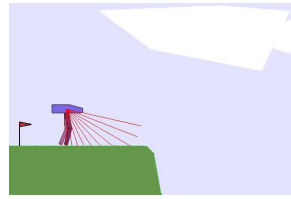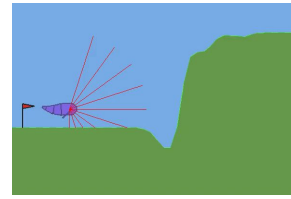Jumping chimp

Realistic creepers

TeachMyAgent: a platform for systematic study of ACL methods !

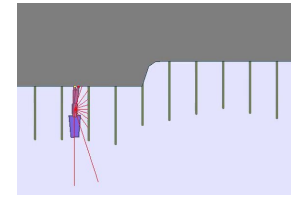Version 1.0 ⇒ More **teachers** / **environments** could be added
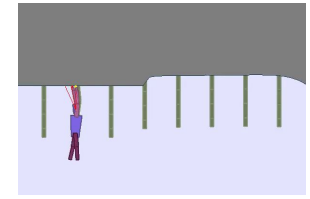
Discussion

Robust walker

Realistic fish

Jumping chimp

Realistic creepers

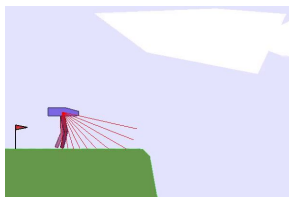*TeachMyAgent*: a platform for systematic study of ACL methods !

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Website: http://developmentalsystems.org/TeachMyAgent/

Code: https://github.com/flowersteam/TeachMyAgent

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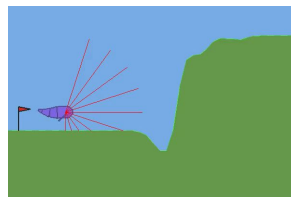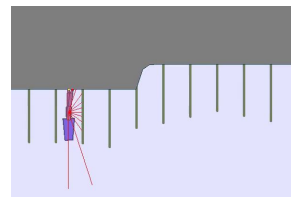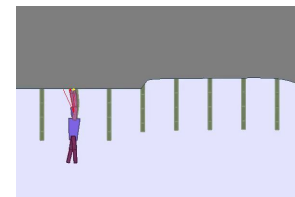**Version 1.0** ⇒ More **teachers** / **environments** could be added

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Thank you !