INF8953DE

REINFORCEMENT LEARNING

PRESENTATION

HOW TO COMBINE TREE-SEARCH METHODS IN REINFORCEMENT LEARNING

A REPRODUCIBILITY STUDY

POLYTECHNIQUE MONTRÉAL

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Introduction

- Project track
  - Reproducibility study
  - Yonathan Efroni, Gal Dalal, Bruno Scherrer, and Shie Mannor. How to combine tree-search methods in reinforcement learning, 2019. https://arxiv.org/abs/1809.01843
- Goal of the project
  - Reproduce & validate the paper’s result
  - Confirm the mathematical results empirically
  - Compare the results

Presentation plan

1. Introduction
2. **<u>Presentation plan</u>**
3. Paper summary
4. Experiments
5. Conclusion
6. Q & A

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Paper summary

- Problem
    - Lookahead tree search methods don't always contract
    - Introduces h-greedy consistency to prove contraction
- Proposed algorithms
    - hm-PI
    - hλ-PI (no empirical results)

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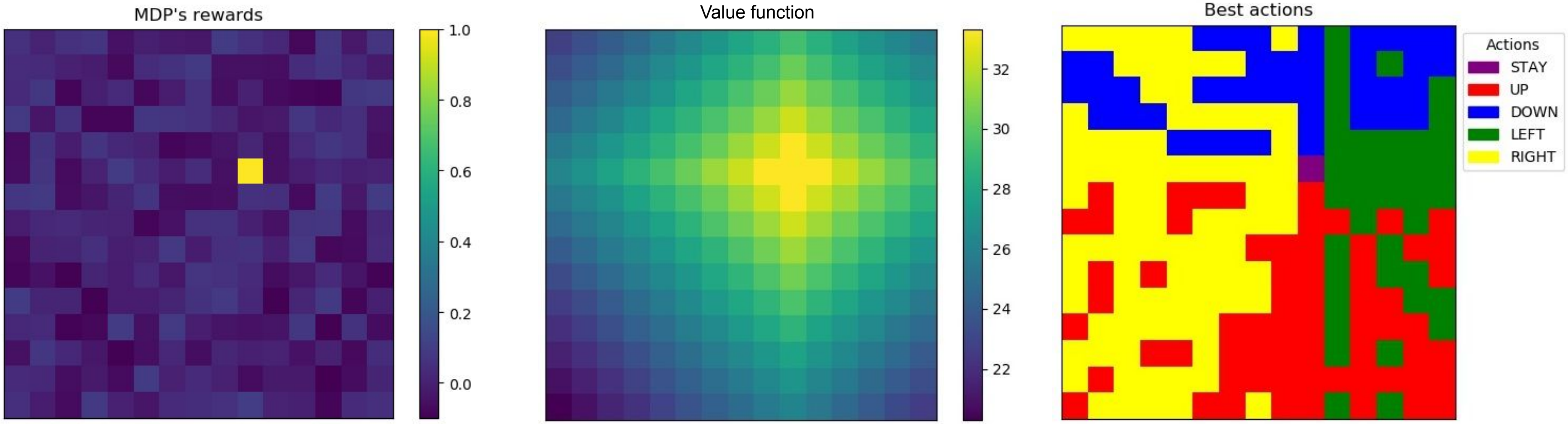
Experiments: Environement

- 10 by 10 Gridworld
- One state with reward 1 & the rest with rewards drawn from [-0.1, 0.1]
- Actions : STAY, UP, DOWN, LEFT, RIGHT

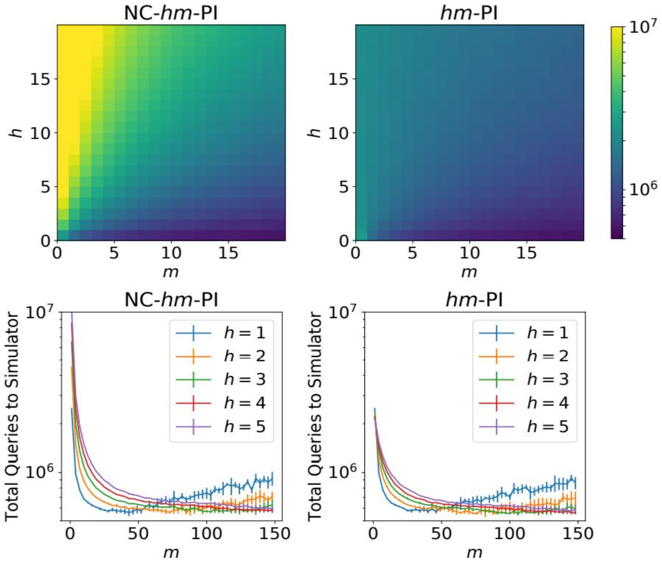


*For example purposes, the figures above are 15 by 15

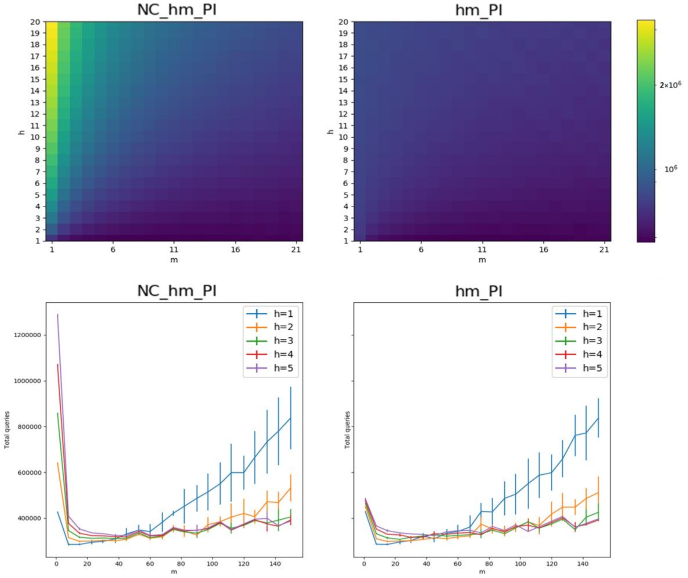
Experiments: Reproducing hm-PI experiment

- NC-hm-PI & hm-PI using the same *h* and *m* hyper parameters
- Total queries to measure the time performance

Paper's results



Experimental results



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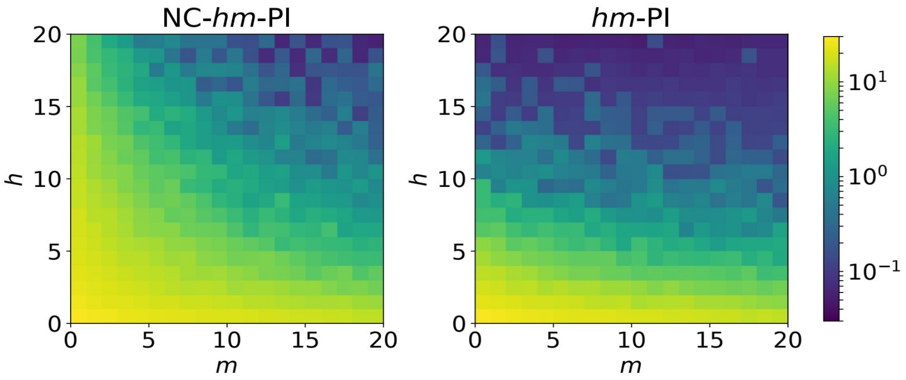
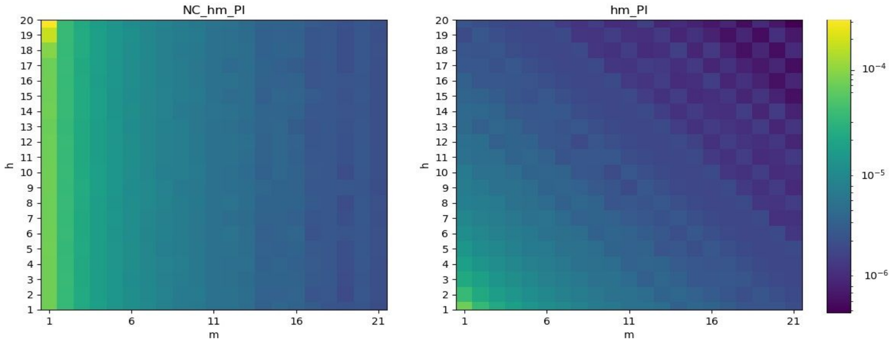
Experiments: Reproducing hm-PI experiments

- NC-hm-PI & hm-PI using the same *h* and *m* hyper parameters
- Distance from optimal value function

Paper's results



Experimental results



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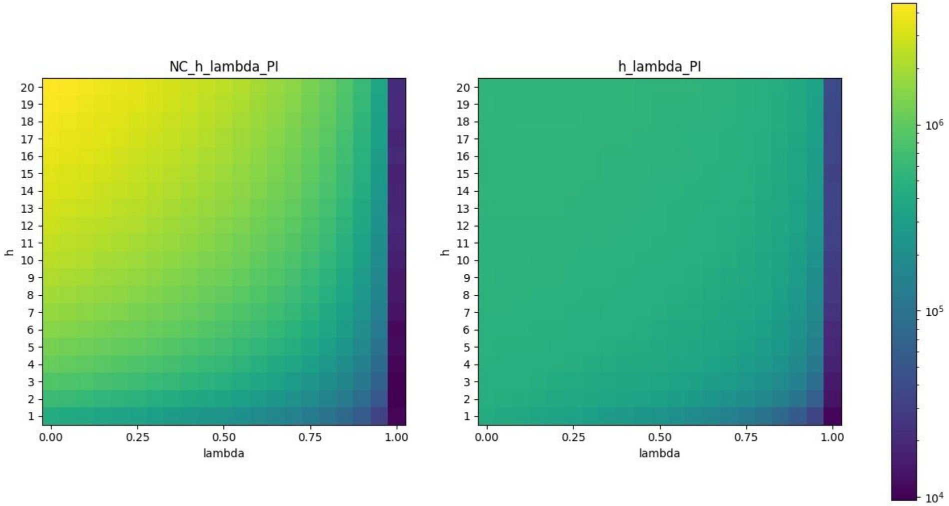
Experiments: Exploring results with hλ-PI

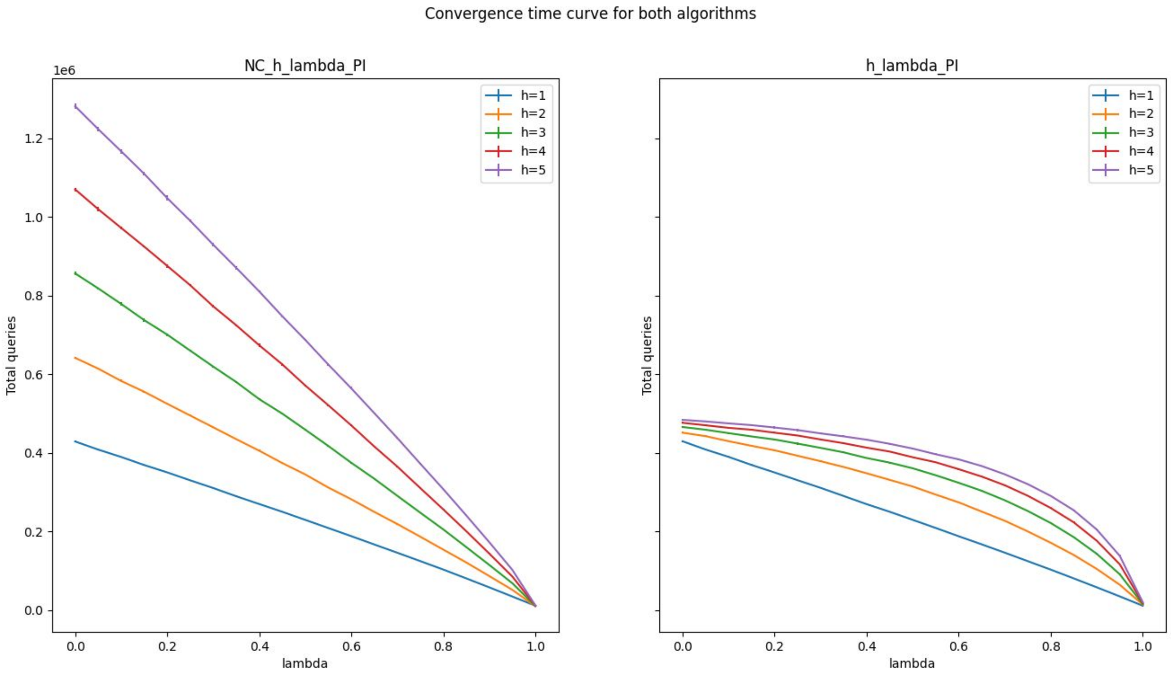
- NC-hλ-PI & hλ-PI using the same *h* and *λ* hyper parameters
- Total queries to measure the time performance

$$T^{\pi}_{\lambda} v \overset{\text{def}}{=} (1-\lambda) \sum_{j=0}^{\infty} \lambda^j (T^{\pi})^{j+1} v$$
$$= v + (I - \gamma \lambda P^{\pi})^{-1} (T^{\pi} v - v).$$

Time of convergence for both algorithms (in number of calls)



Experiments: Exploring results with hλ-PI



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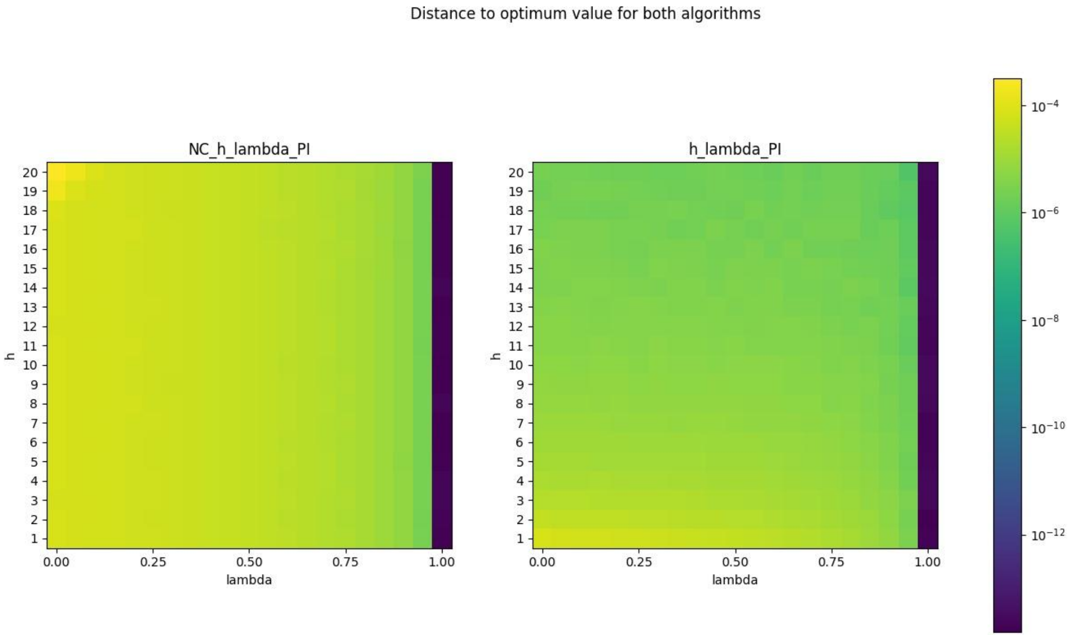
Experiments: Exploring results with hλ-PI



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Conclusion

- Results are similar
- We can affirm the findings reported in the original work
- Reproducibility issues & caveats
  - Missing parameters (ex: the size of the gridworld)
  - Unspecified procedures (ex: how to count queries *in practice*)
  - Unintuitive notation
- Link to our study and code
  https://github.com/AdamPrevost/INF8953.git

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Q & A