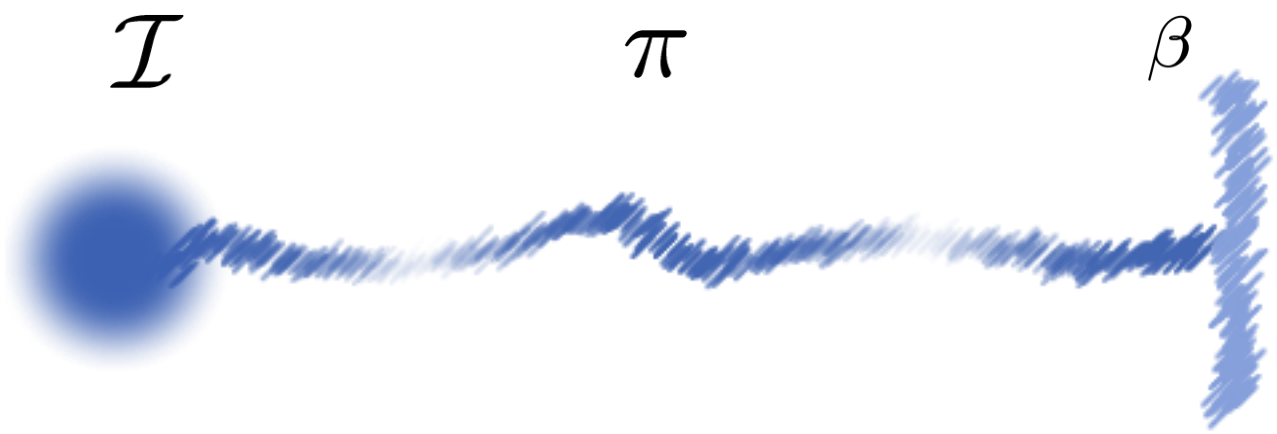
Policy Switching Towards Transferring Behavioural Knowledge

Gheorghe Comanici

Options



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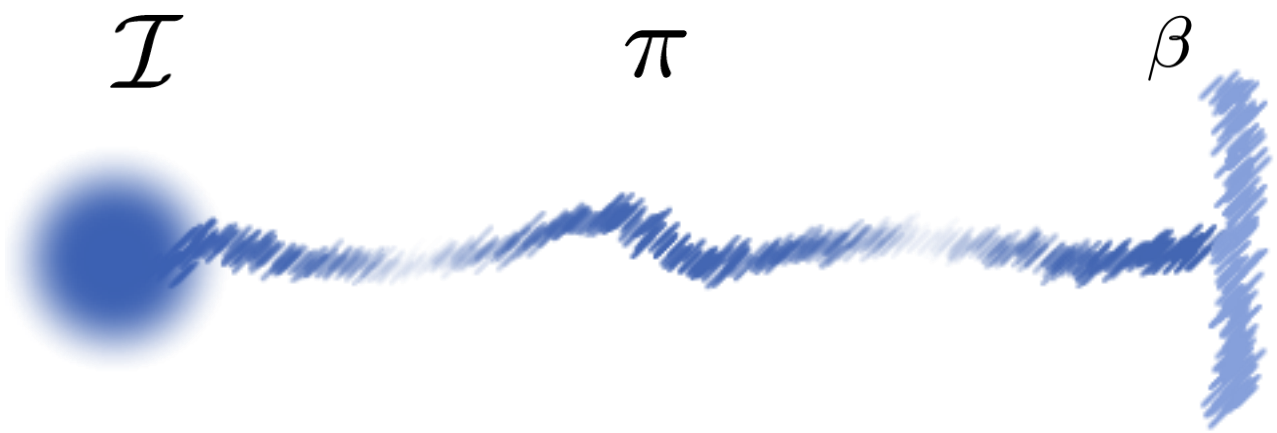
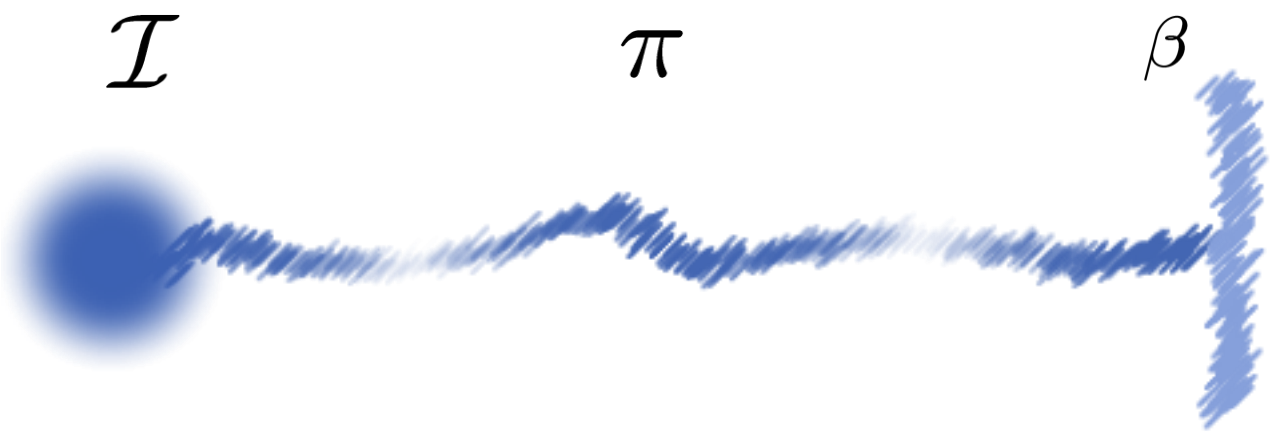


Keywords : start, use, stop

Options

- Manager hires an assistant



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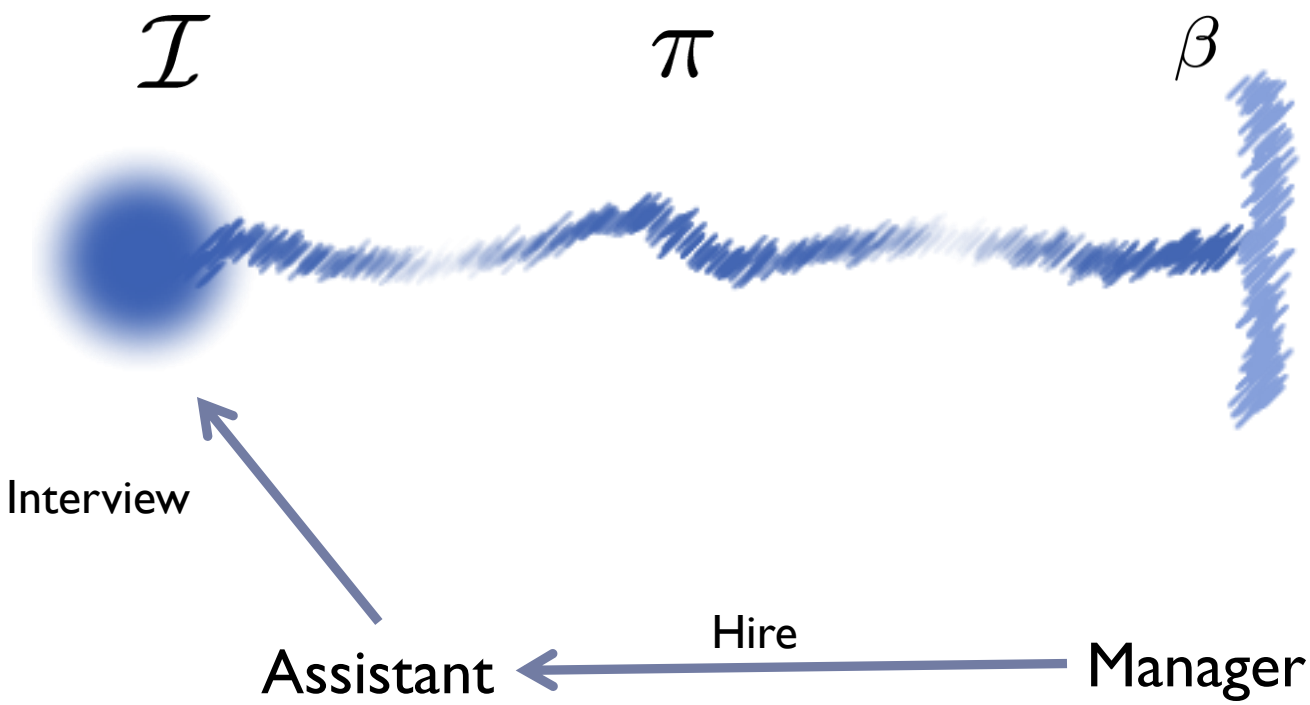

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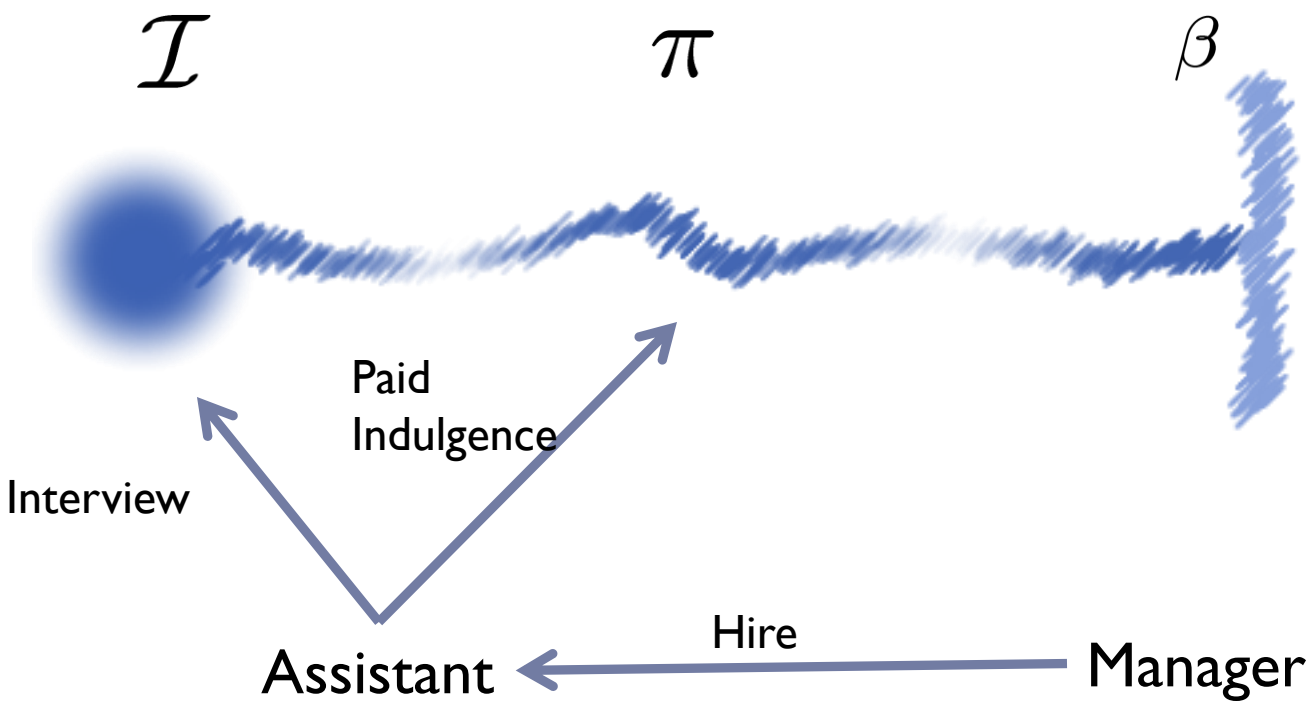

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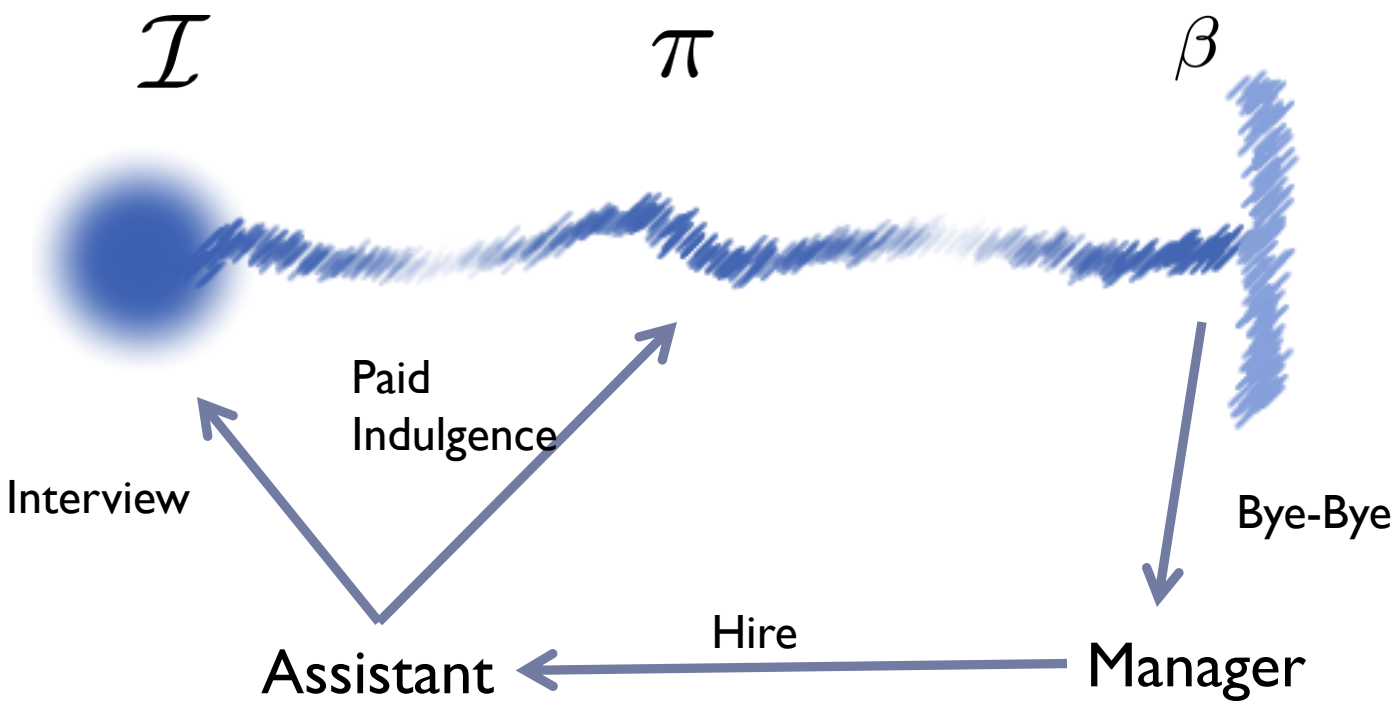

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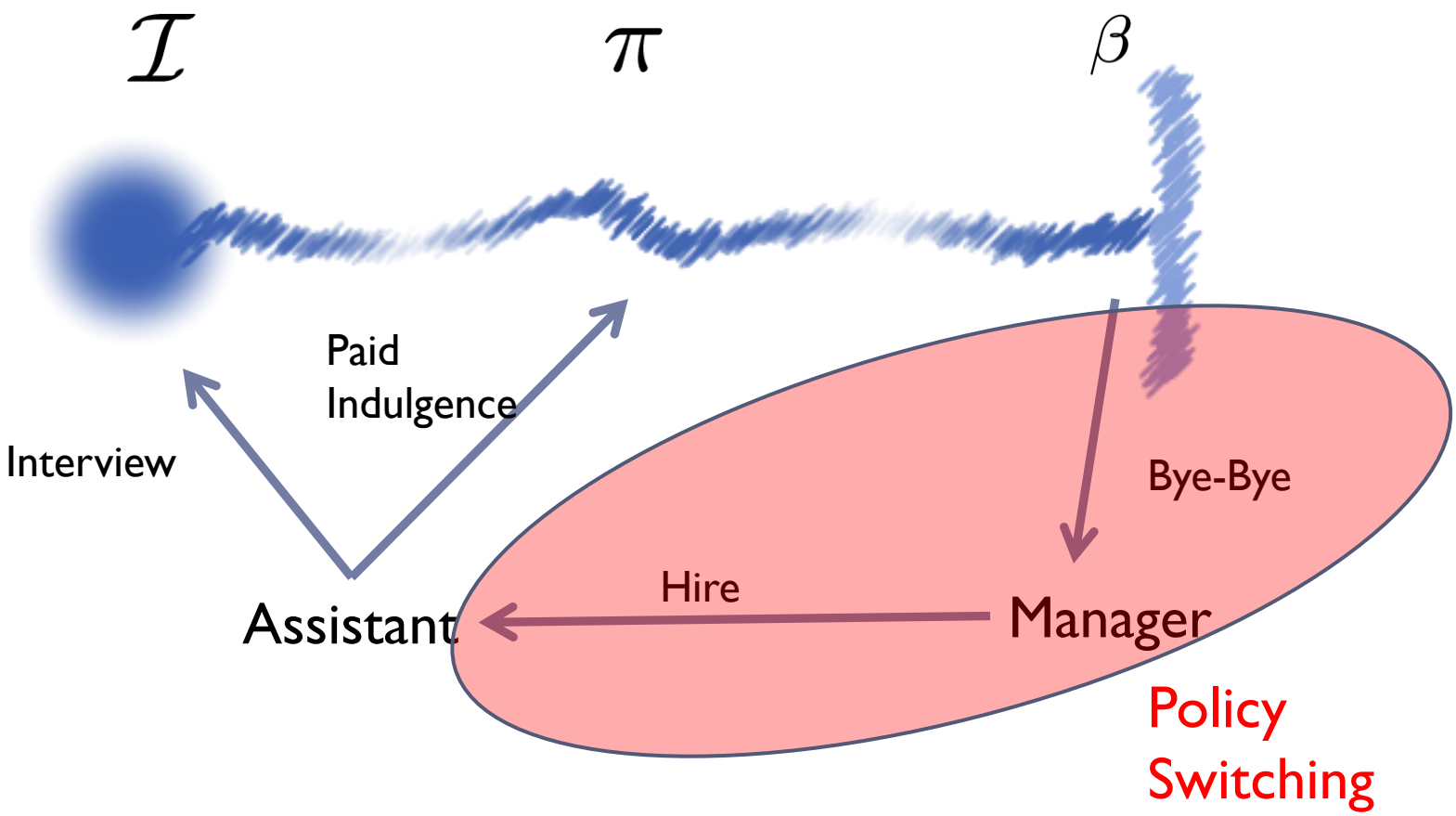

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- Comes with education → Prior info
- You're the boss! → Specific design and subgoals
- You get more coffee breaks → Computational efficiency

Termination model

- Usual model : flip a biased coin after every step

$$\beta : (S \times A \times R)^* \rightarrow [0, 1]$$

- Proposed model : increased dissatisfaction

$$\tau : (S \times A \times R)^* \rightarrow [0, 1]$$

  - with monotonicity on the set of histories
  - 0 for empty histories

Termination model

- The two formulations are equivalent
  - Given one ...

$$\beta(h) = \frac{\tau(h) - \tau(h_-)}{1 - \tau(h_-)}$$

  - Given the other ...

$$\tau(h) = \tau(h_-) + (1 - \tau(h_-))\beta(h)$$

Termination model

- Why use the new formulation?

Generalizing biased coins is ridiculous!

- We seek to generalize functions that preserve the structure of histories :

MONOTONICITY

Termination model

- Mathematical formulation proposed based on "bounded exponential growth"

$$\frac{dp}{dt} = mp - \frac{m}{P}p^2$$

- Termination is logistic :

$$\tau(h) = [1 + \exp(-(l(h) - \theta_0))]^{-1}$$

  - on "history length" : linear combination of positive features

$$l(h) = \sum_{s,a,r \in h} \phi_{s,a,r}\theta$$

Comanici, G. , Precup D., 2010

Policy Switching

- Combine termination and option choice
- Exploit differentiation in *policy gradient methods:*

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Diff. switching

Diff. termination

Diff. policy

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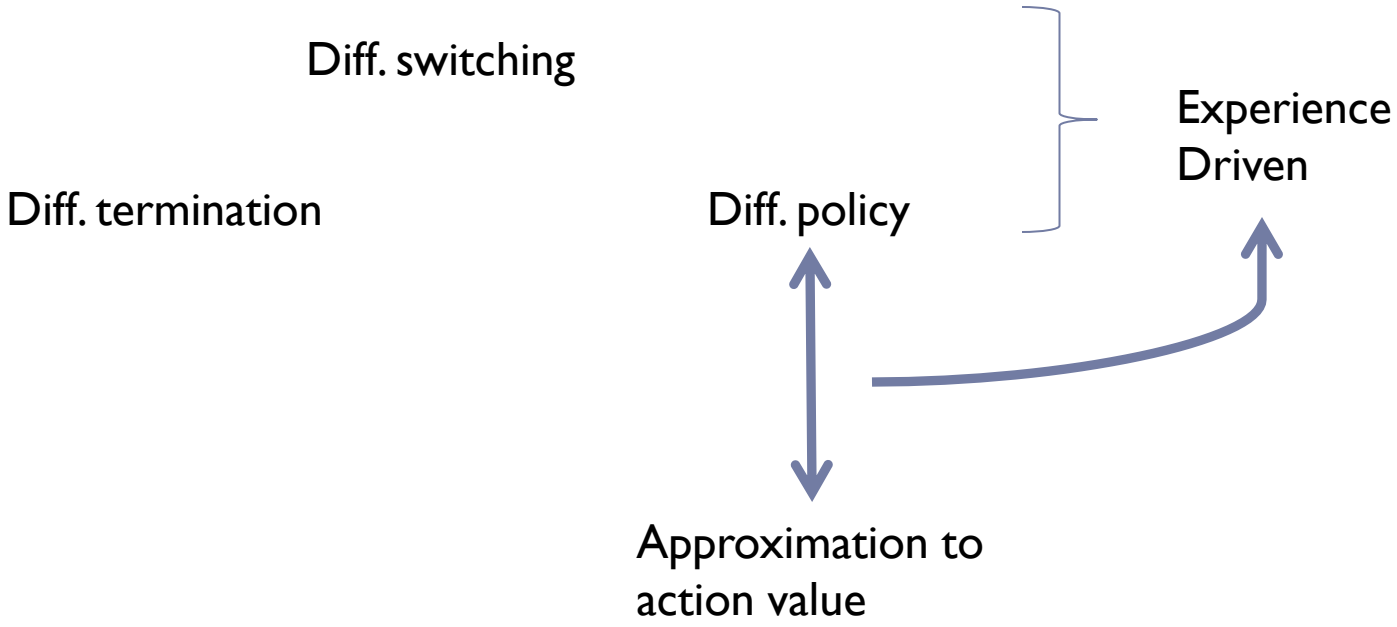

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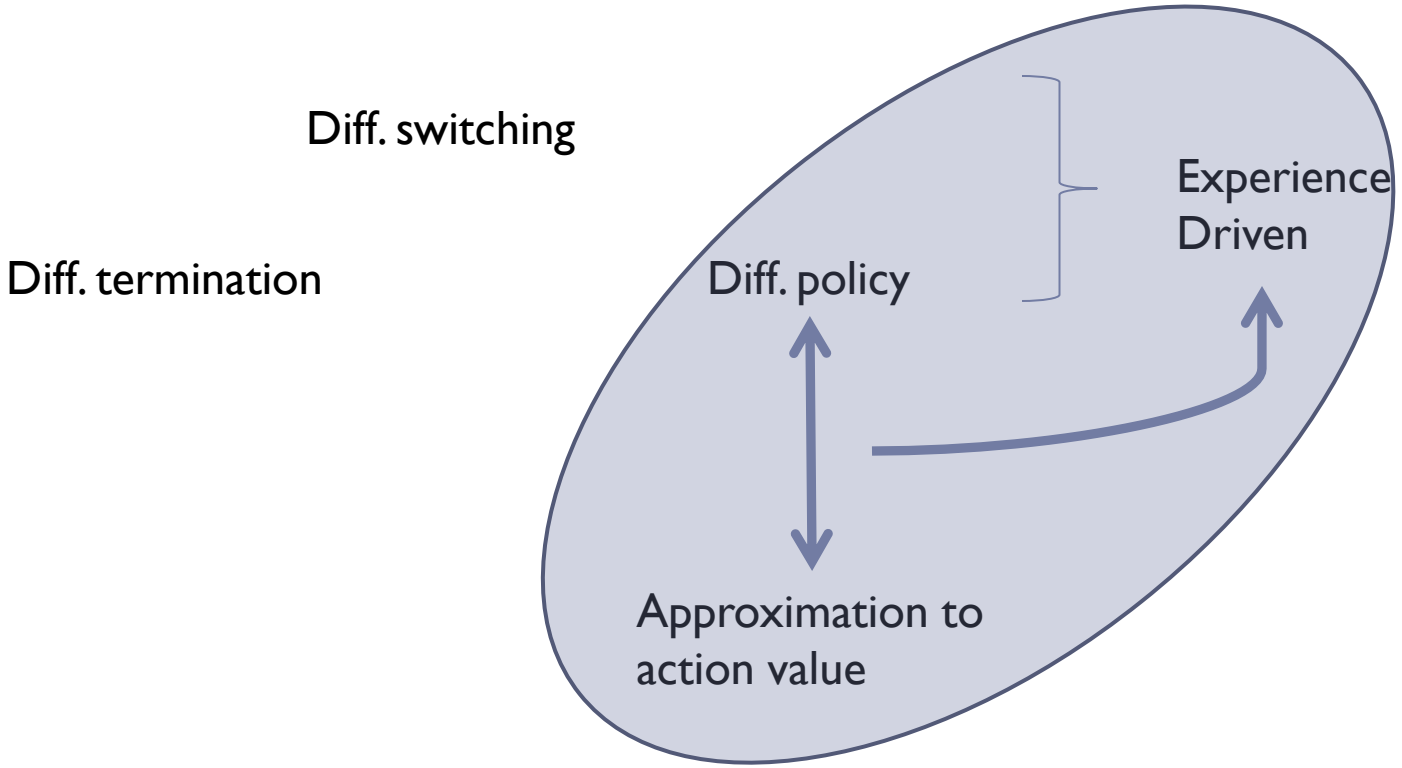

Sutton, R. , McAllester, D., Singh, S., Mansour, Y. 1999

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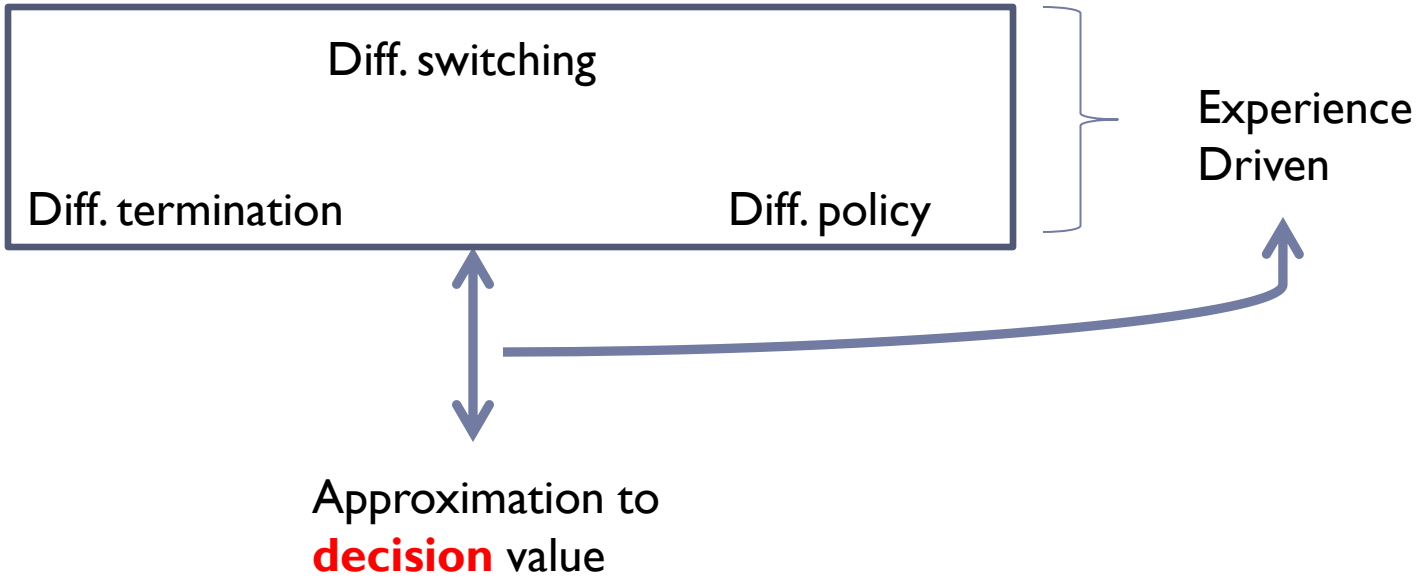

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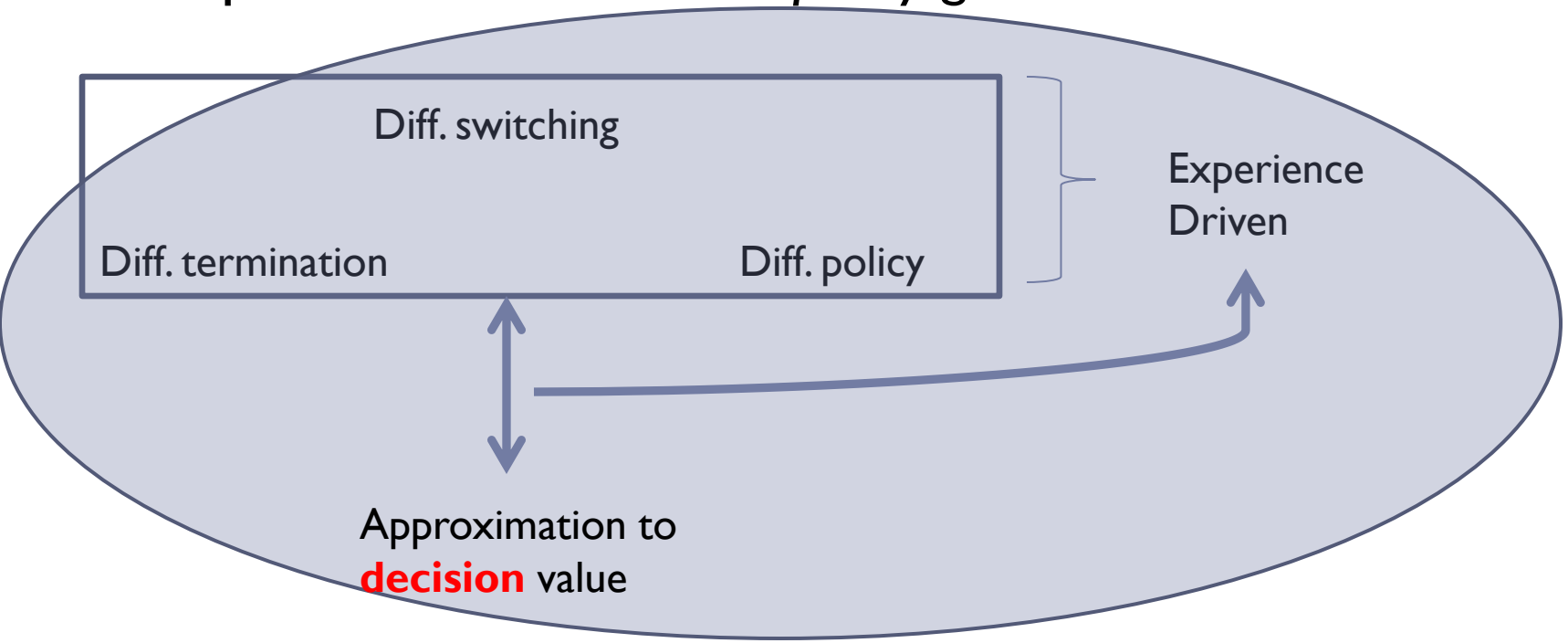

Comanici, G. , Precup D., 2010

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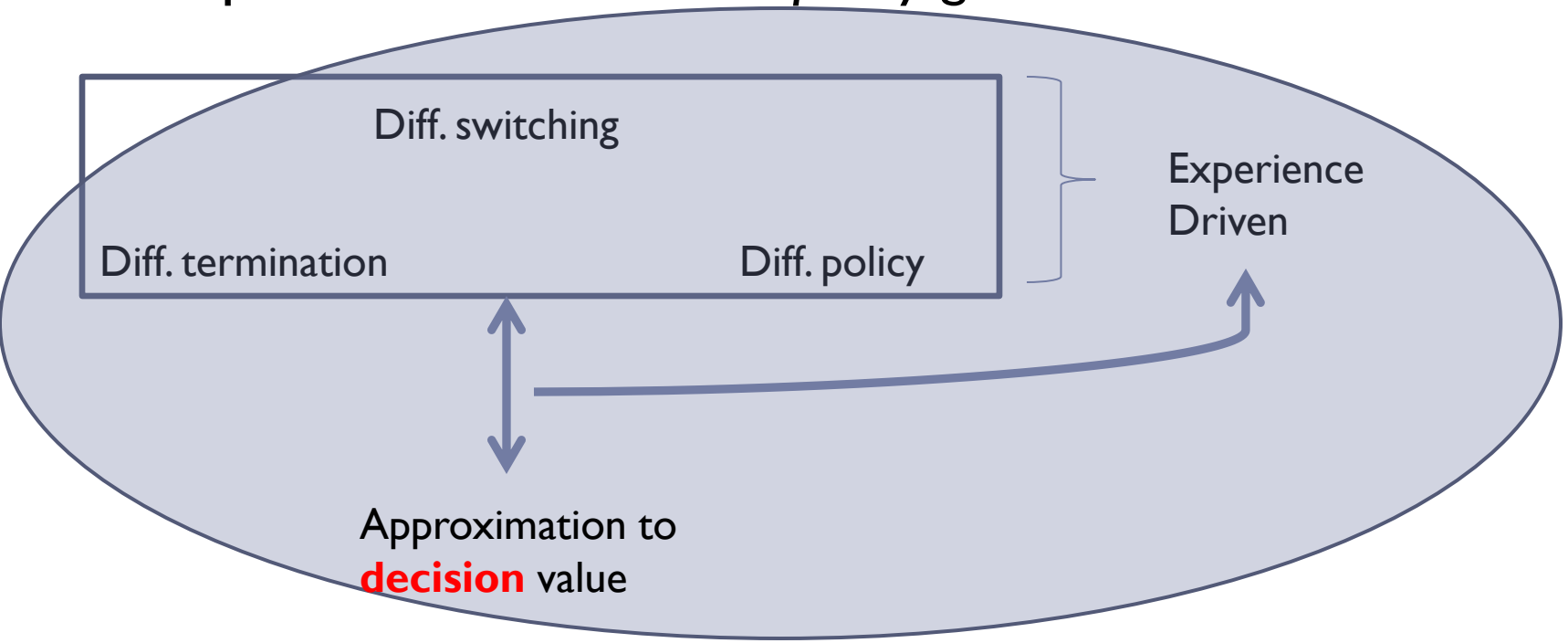

- Sufficient decisions : "use π_1" and "switch **from** π_1 **to** π_2 "

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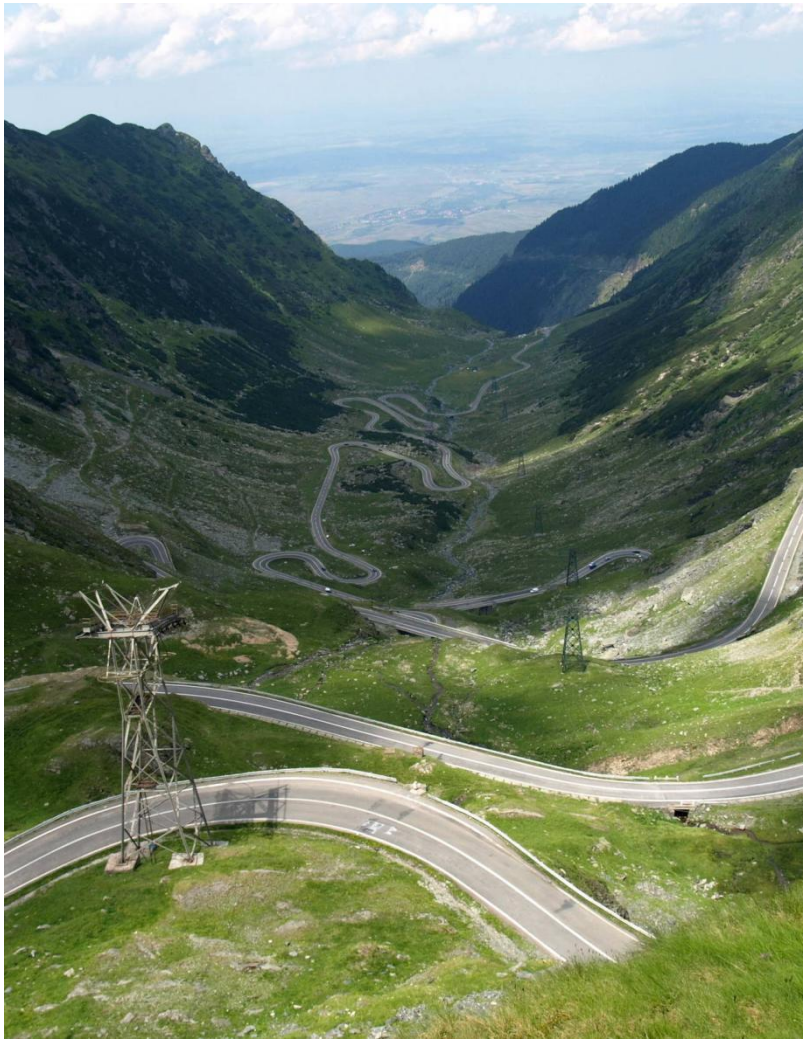
Behavioural Knowledge



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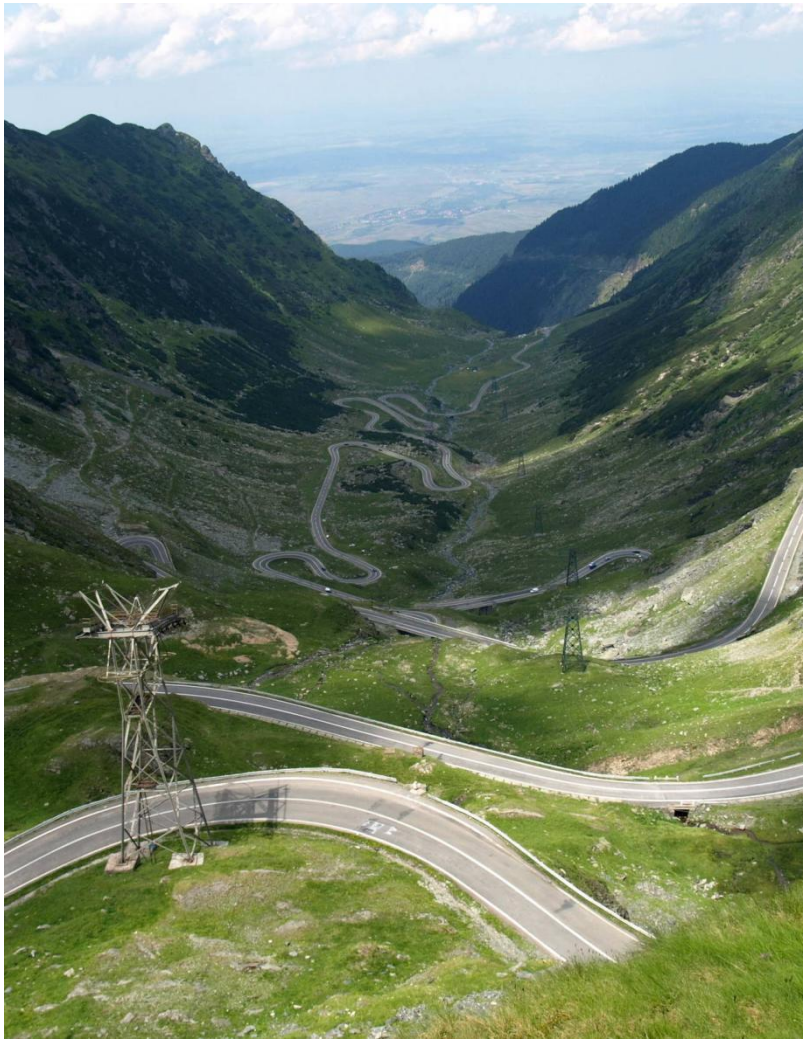
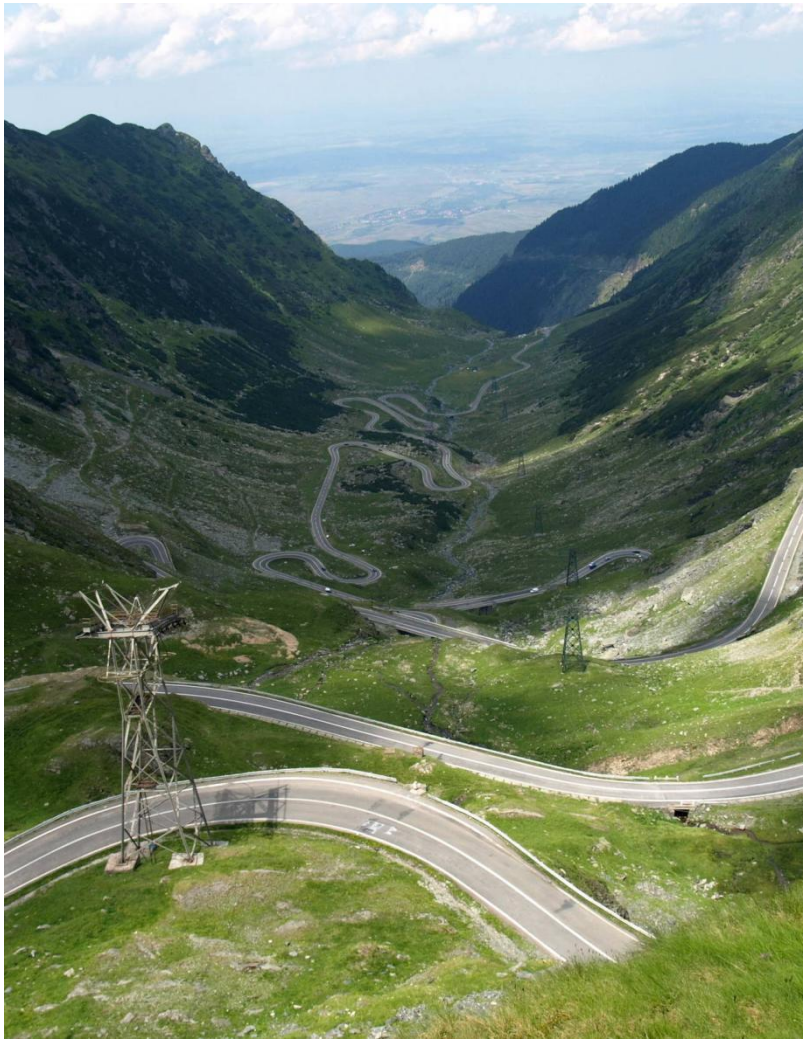
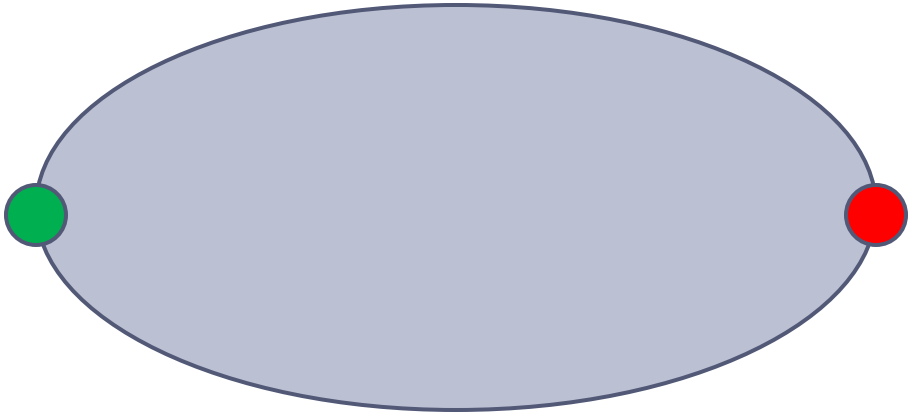


Behavioural Knowledge = Policies



Policy transfer

- Example : subgoals



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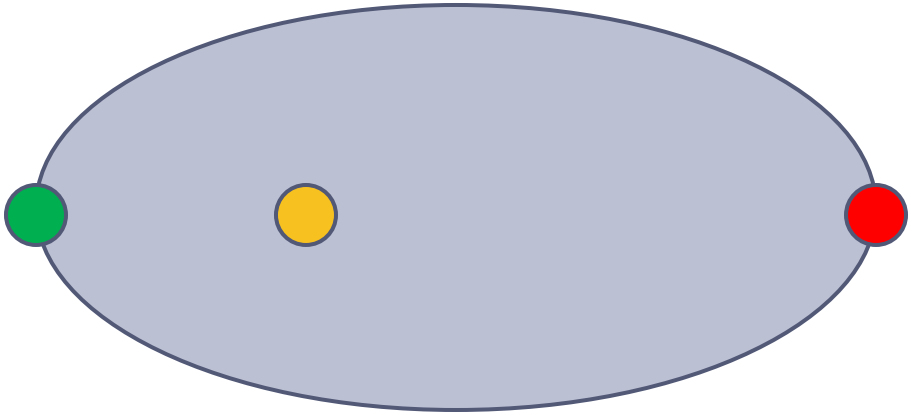

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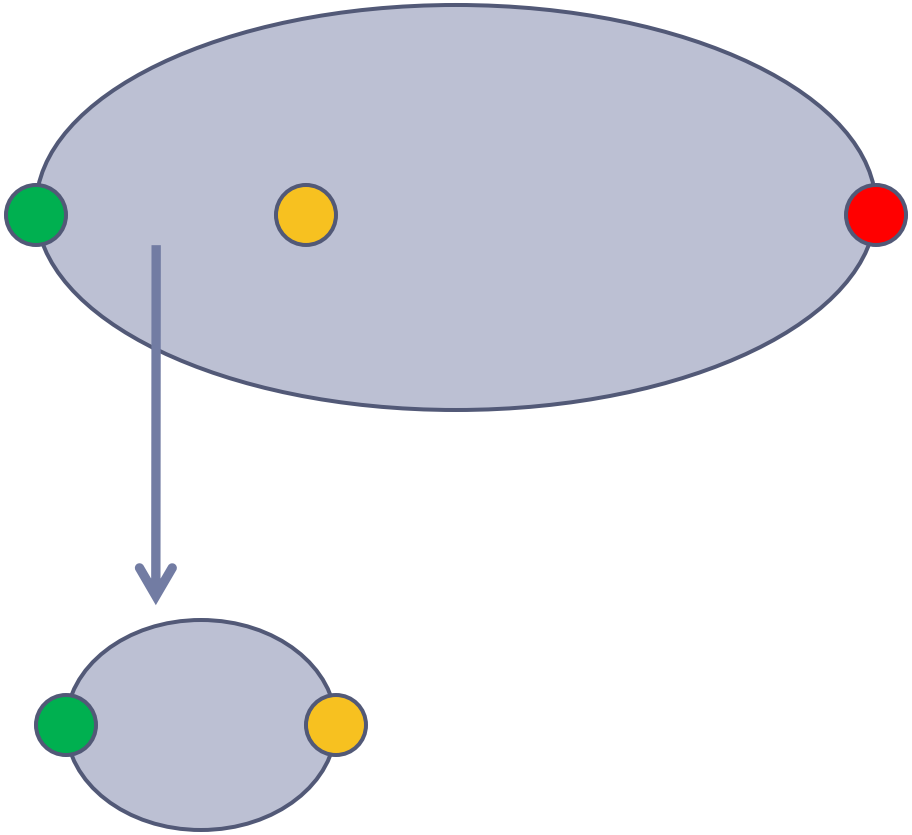

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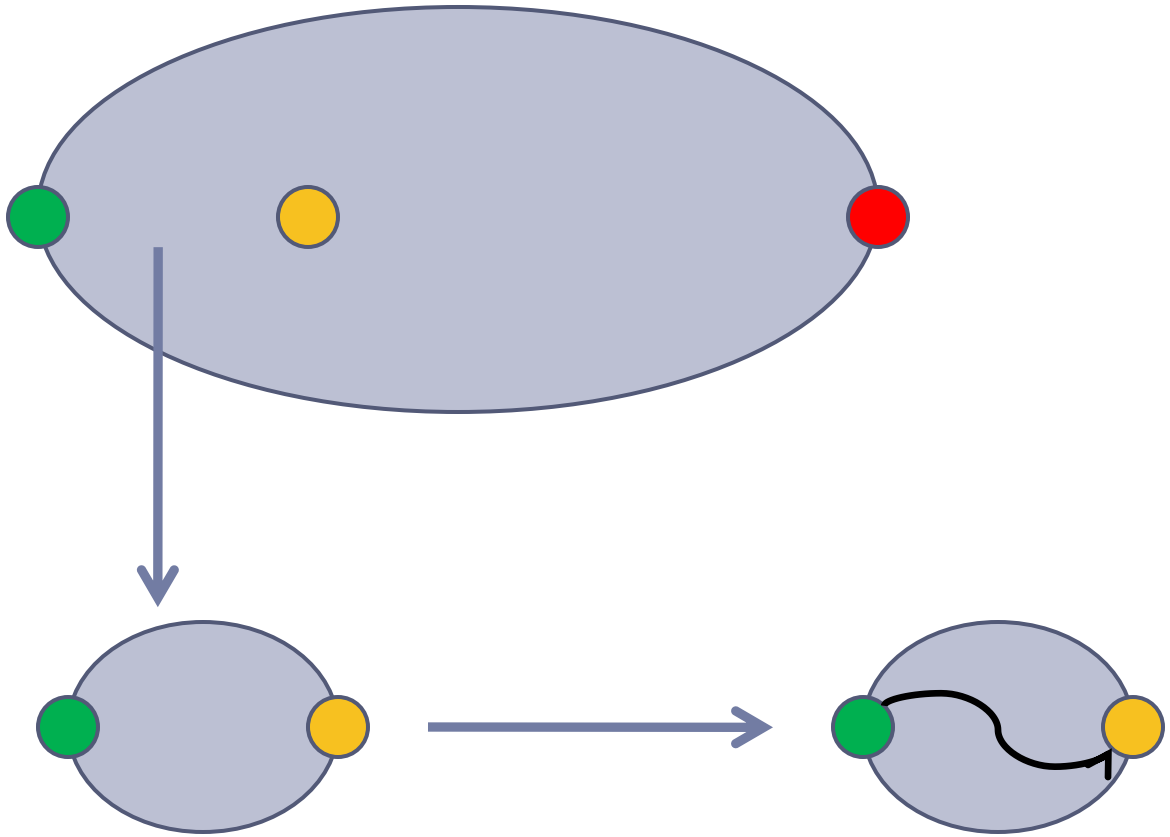

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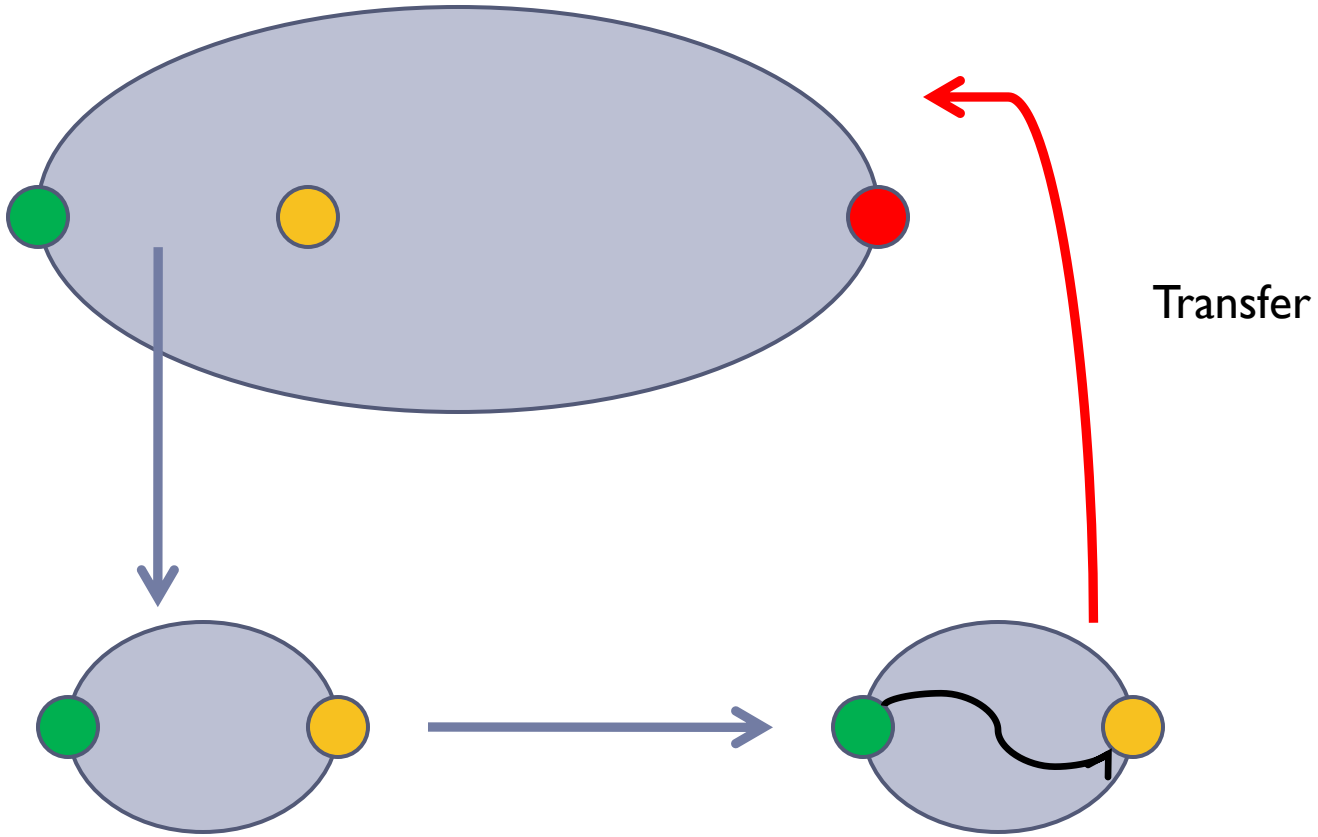

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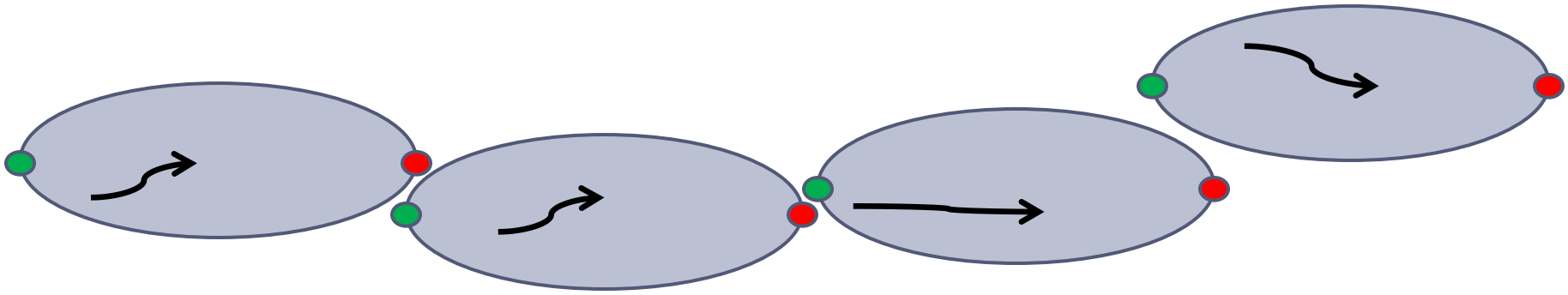

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