Towards a miniKanren with fair search strategies

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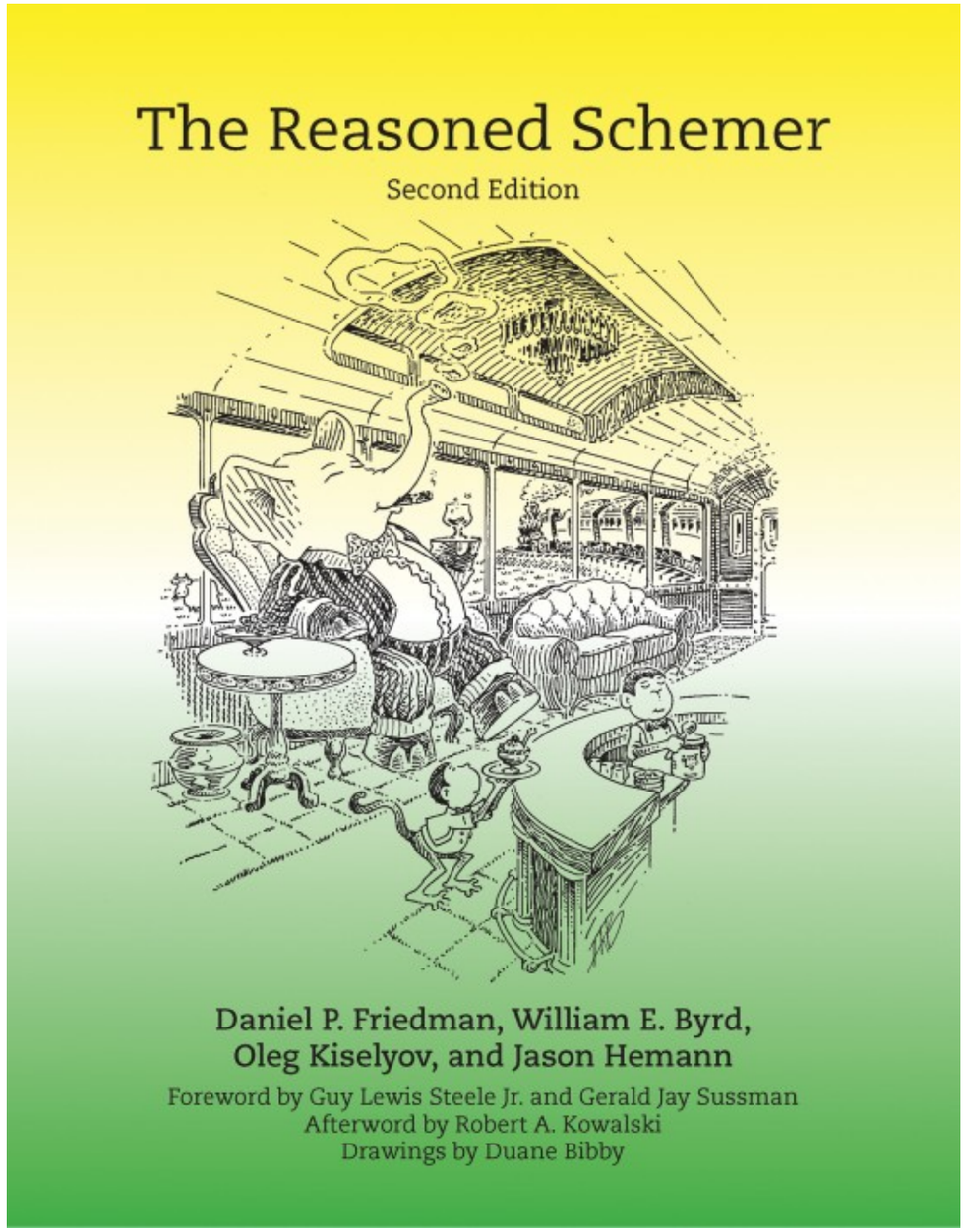
Where to start?



What is fairness?

- fairness in disjunctions (fair, almost-fair, unfair)
- fairness in conjunctions (fair, unfair)

Examples

`(repeatº x xs)` relates `x` with one or more `x` s.

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```
> (run 3 q
    (repeatº 'λ q))

'((λ) (λ λ) (λ λ λ))
```

Fairness in Disjunctions

```
> (run 9 q
    (condᵉ
      [(repeatº '🐜 q)]
      [(repeatº '🐦 q)]
      [(repeatº '🌸 q)]))
```

Fairness in Disjunctions

```
> (run 9 q
    (condᵉ
      [(repeatº '🐜 q)]
      [(repeatº '🐦 q)]
      [(repeatº '🌸 q)]))
```

unfair (current search strategy)

```
'((🐜) (🐜 🐜) (🐦)
  (🐜 🐜 🐜) (🌸)
  (🐜 🐜 🐜 🐜) (🐦 🐦)
  (🐜 🐜 🐜 🐜 🐜) (🌸 🌸))
```

Fairness in Disjunctions

```
> (run 9 q
    (condᵉ
      [(repeatº '🐜 q)]
      [(repeatº '🐦 q)]
      [(repeatº '🌸 q)]))
```

almost-fair

```
'((🐦) (🐜))
  ((🐦 🐦) (🌸))
  ((🐦 🐦 🐦) (🐜 🐜))
  ((🐦 🐦 🐦 🐦) (🌸 🌸))
  ((🐦 🐦 🐦 🐦 🐦))
```

Fairness in Disjunctions

```
> (run 9 q
    (condᵉ
      [(repeatº '🐜 q)]
      [(repeatº '🐦 q)]
      [(repeatº '🌸 q)]))
```

fair

```
'((🐜) (🐦) (🌸)
  (🐜 🐜) (🐦 🐦) (🌸 🌸)
  (🐜 🐜 🐜) (🐦 🐦 🐦) (🌸 🌸 🌸))
```

(Search) Space

`Space ::= Null | (Pair State Space) | (→ Space)`

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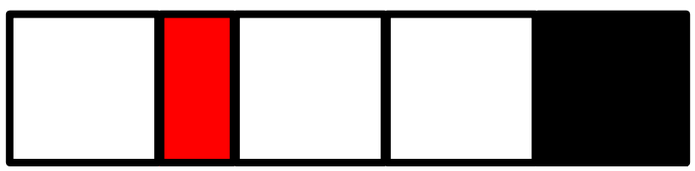
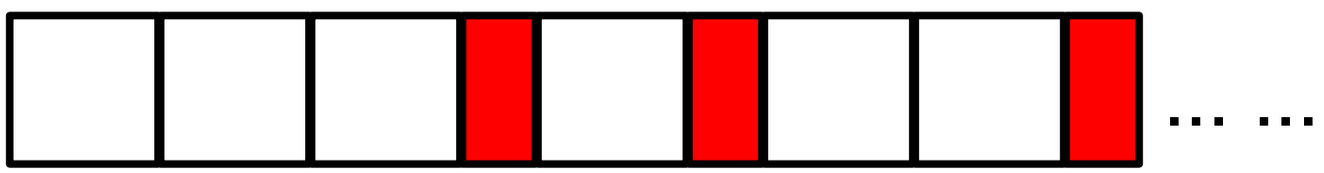
`Space ::= Null | (Pair State Space) | (→ Space)`

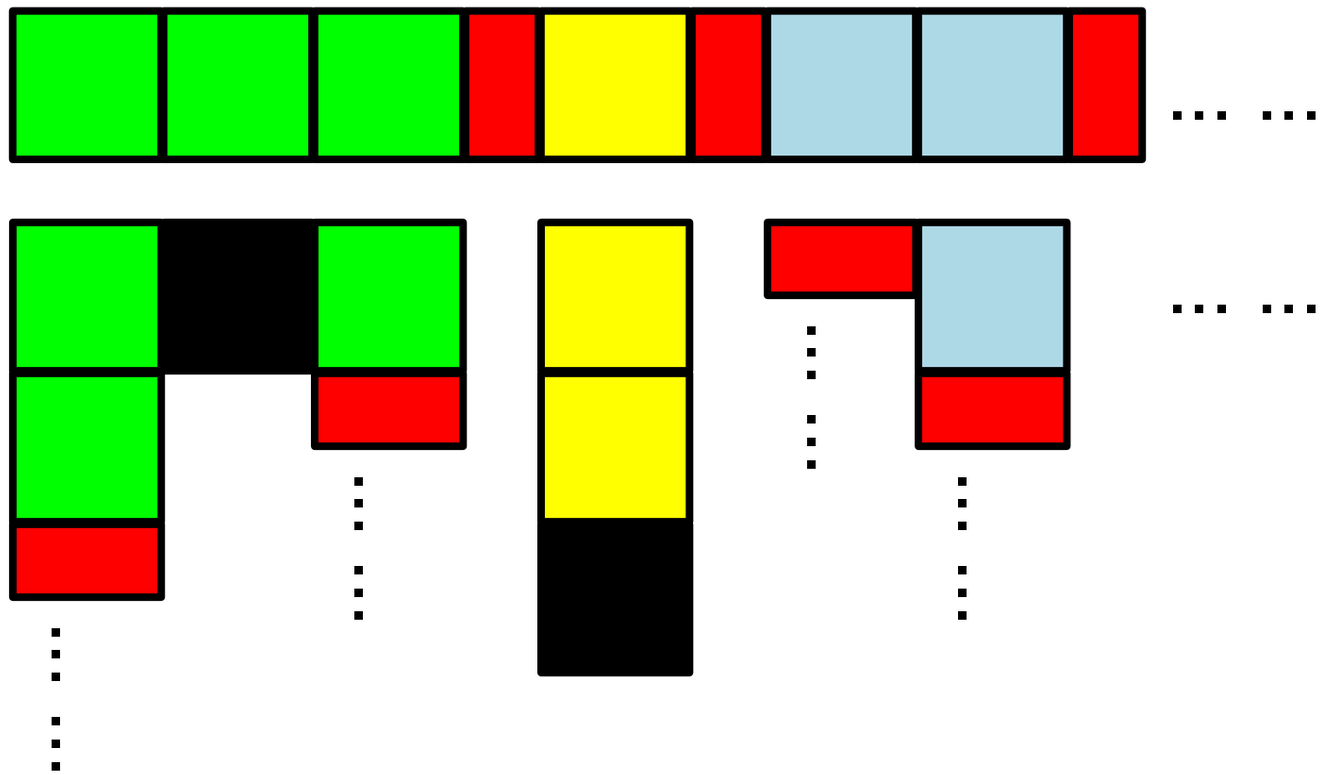
a space with three states



a space with possibly infinite states



Fairness in Conjunctions



Search Strategies

strategy	**disj**	**conj**
DFSi	unfair	unfair
DFSbi	almost-fair	unfair
DFSf	fair	unfair
BFS	fair	fair

Why fairness?

- produce answers in less unexpected order
  - **`repeatº`** examples
    - BFS produces answer in order of cost
- perform more stably when permuting clauses

Q & A