WorldTraderSim

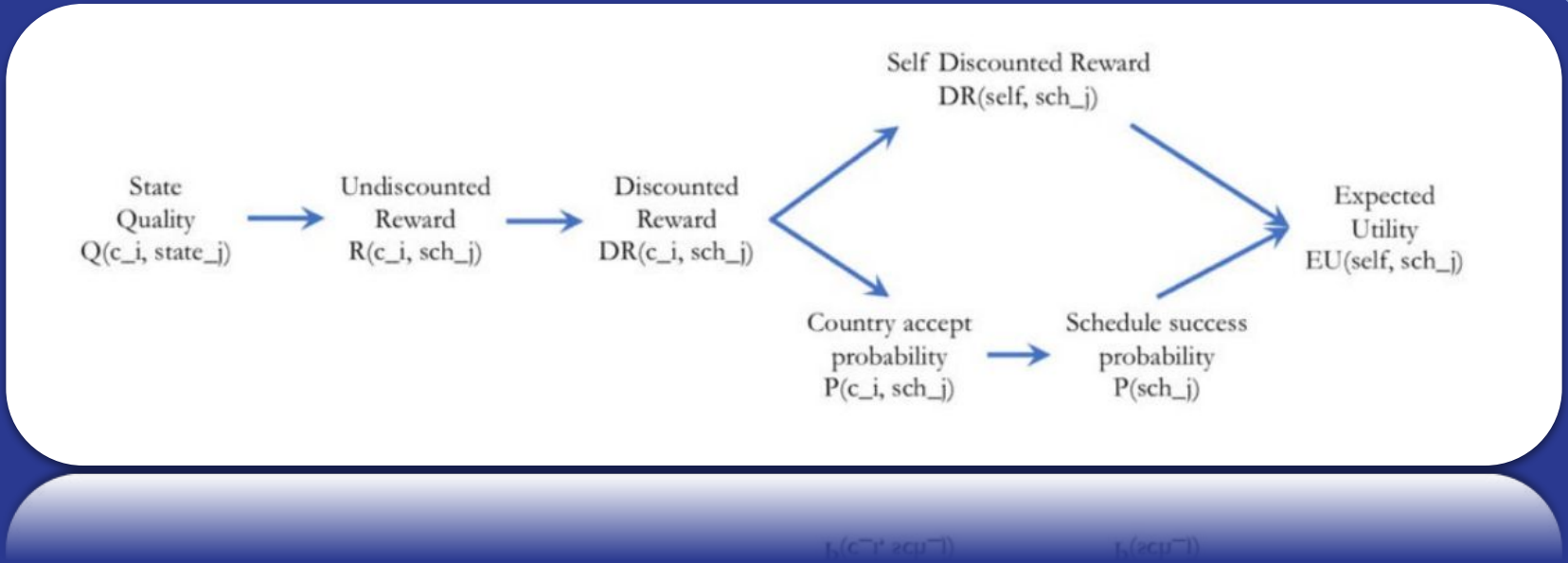
CS-5260 - John Ford

Translating Search Concepts

The programming project for Vanderbilt's CS-5260 focused on adapting multiple abstract search concepts into concrete implementations.

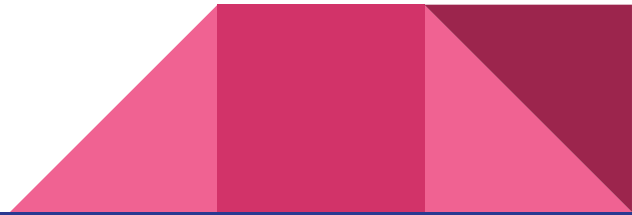
- Graphs
- Strategies
- Heuristics
- Reward
- Utility

Performance Measures



Challenges

- Modeling state
- Interpreting results
- Constraining search space
- Improving results
- Improving performance



Initial States

Balanced

Country	Population	MetallicElements	Timber	MetallicAlloys	MetallicAlloysWaste	Electronics	ElectronicsWaste	Housing	HousingWaste
Atlantis	100	100	50	0	0	0	0	0	0
Europa	100	100	50	0	0	0	0	0	0
Pandora	100	100	50	0	0	0	0	0	0
Neuronia	100	100	50	0	0	0	0	0	0
Brick	100	100	50	0	0	0	0	0	0

Unbalanced

Country	Population	MetallicElements	Timber	MetallicAlloys	MetallicAlloysWaste	Electronics	ElectronicsWaste	Housing	HousingWaste
Atlantis	1000	100	10	0	0	0	0	0	0
Europa	1000	10000	500	0	0	0	0	0	0
Pandora	100	1000	50	0	0	0	0	0	0
Neuronia	100	1000	50	0	0	0	0	0	0
Brick	100	50	50	0	0	0	0	0	0

Initial States

Rich

Country	Population	MetallicElements	Timber	MetallicAlloys	MetallicAlloysWaste	Electronics	ElectronicsWaste	Housing	HousingWaste
Atlantis	100	1000	500	0	0	0	0	0	0
Europa	100	100	50	0	0	0	0	0	0
Pandora	100	100	50	0	0	0	0	0	0
Neuronia	100	100	50	0	0	0	0	0	0
Brick	100	100	50	0	0	0	0	0	0

Poor

Country	Population	MetallicElements	Timber	MetallicAlloys	MetallicAlloysWaste	Electronics	ElectronicsWaste	Housing	HousingWaste
Atlantis	100	20	10	0	0	0	0	0	0
Europa	100	100	50	0	0	0	0	0	0
Pandora	100	100	50	0	0	0	0	0	0
Neuronia	100	100	50	0	0	0	0	0	0
Brick	100	100	50	0	0	0	0	0	0

Resource Weights

Balanced

Resource	Weight	Factor
Population	0.3	
MetallicElements	0.025	
Timber	0.015	
MetallicAlloys	0.2	
MetallicAlloysWaste	-0.1	
Electronics	0.35	
ElectronicsWaste	-0.2	
Housing	0.9	
HousingWaste	-0.15	

Prefer Electronics

Resource	Weight	Factor
Population	0.3	
MetallicElements	0.025	
Timber	0.015	
MetallicAlloys	0.2	
MetallicAlloysWaste	-0.1	
Electronics	0.4	
ElectronicsWaste	-0.2	
Housing	0.8	
HousingWaste	-0.05	

Prefer Housing

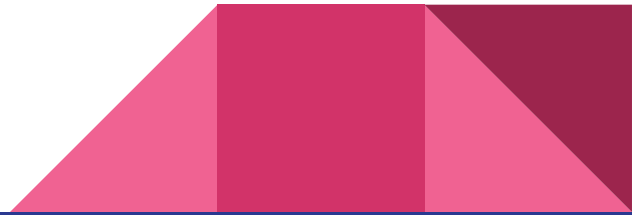
Resource	Weight	Factor
Population	0.3	
MetallicElements	0.025	
Timber	0.015	
MetallicAlloys	0.2	
MetallicAlloysWaste	-0.1	
Electronics	0.35	
ElectronicsWaste	-0.2	
Housing	0.9	
HousingWaste	-0.05	

Search Strategies

- Heuristic Depth First Search
  - Modified the provided reference code HeuristicDepthFirstSearch
    - Using a dictionary of Country states
    - Removing goal states
    - Implementing depth-bound and frontier-size limitations to return results
  - Started off using simply the state quality function
    - Resulted in the AI agent completely ignoring another country's likelihood
    - Never bothered to evaluate any action other than taking resources
  - Changed to use expected utility as the heuristic
    - Results reflected more rational choices relative to resource weights
  - Updated reached implementation
    - By hashing a node's state (world state) dramatic search speedup unlocked

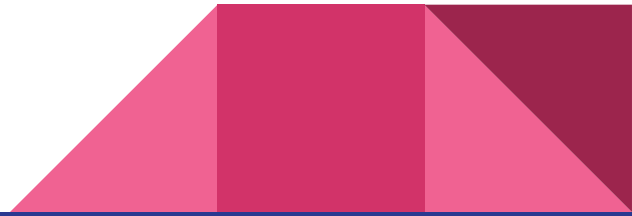
Search Strategies

- Best First Search
  - Modified the provided reference code for GreedyBestFirstSearch
    - Changes identical to HeuristicDepthFirstSearch
  - Priority queue usage for frontier killed search performance
    - With frontier size tending to be much larger than expanded nodes, repeatedly performing the EU calculation for the heuristic blew up search times
    - Need to revisit the priority queue logic to avoid redundant calculation of EU for nodes where it has been performed previously

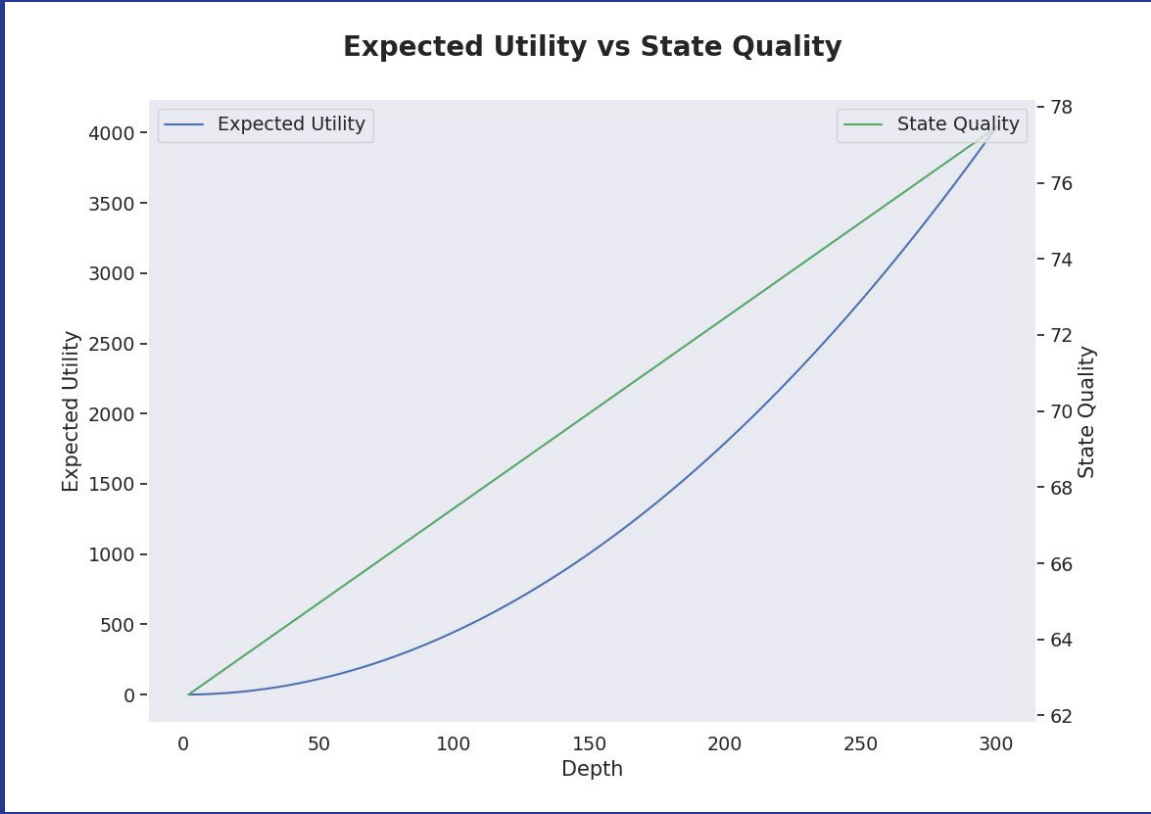


State Quality & Expected Utility

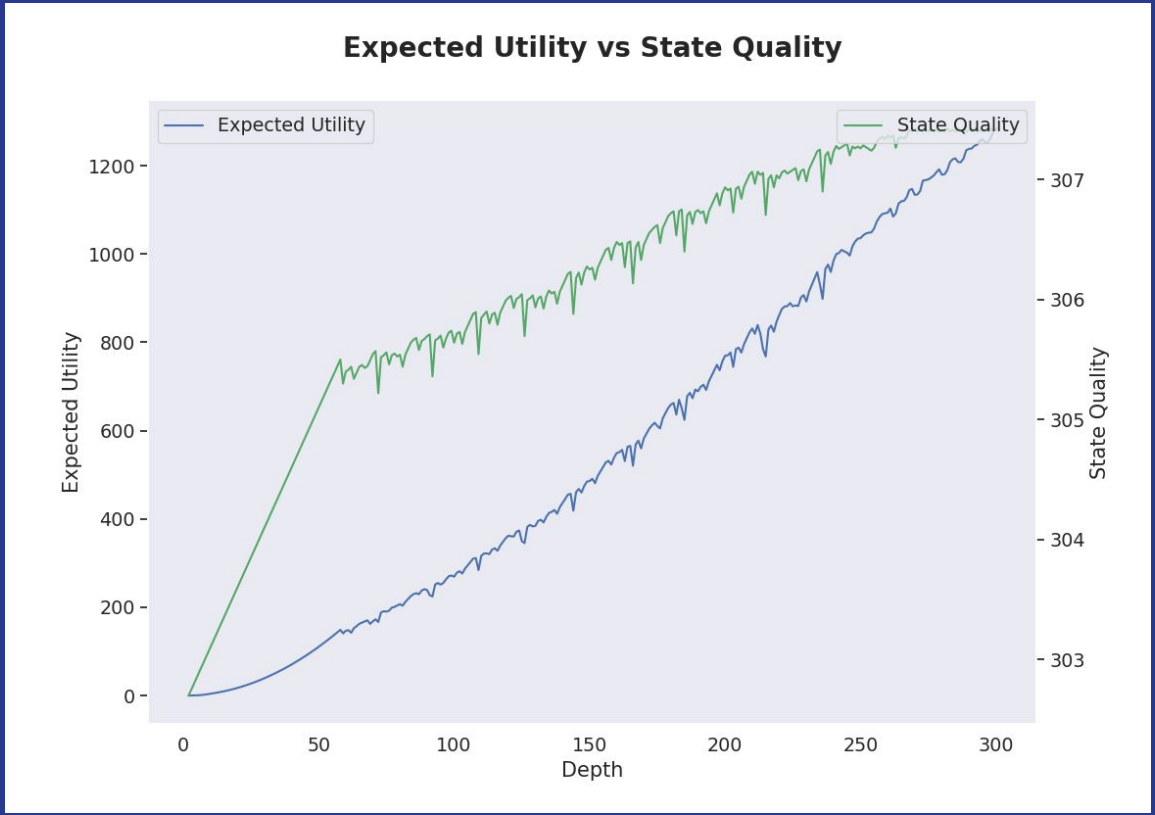
- Simple Weighted Sum
  - More emphasis placed on adjusting weights and initial state
  - Effective even without adding proportionality
  - Limited resources and simulation time still prohibited excess in most scenarios
- Expected Utility values remained constant
  - Length impact factor was 0.9
    - Didn’t want to overly penalize long-term strategies
  - Failed schedule factor was -0.25
    - Allowed for some risk but not too much



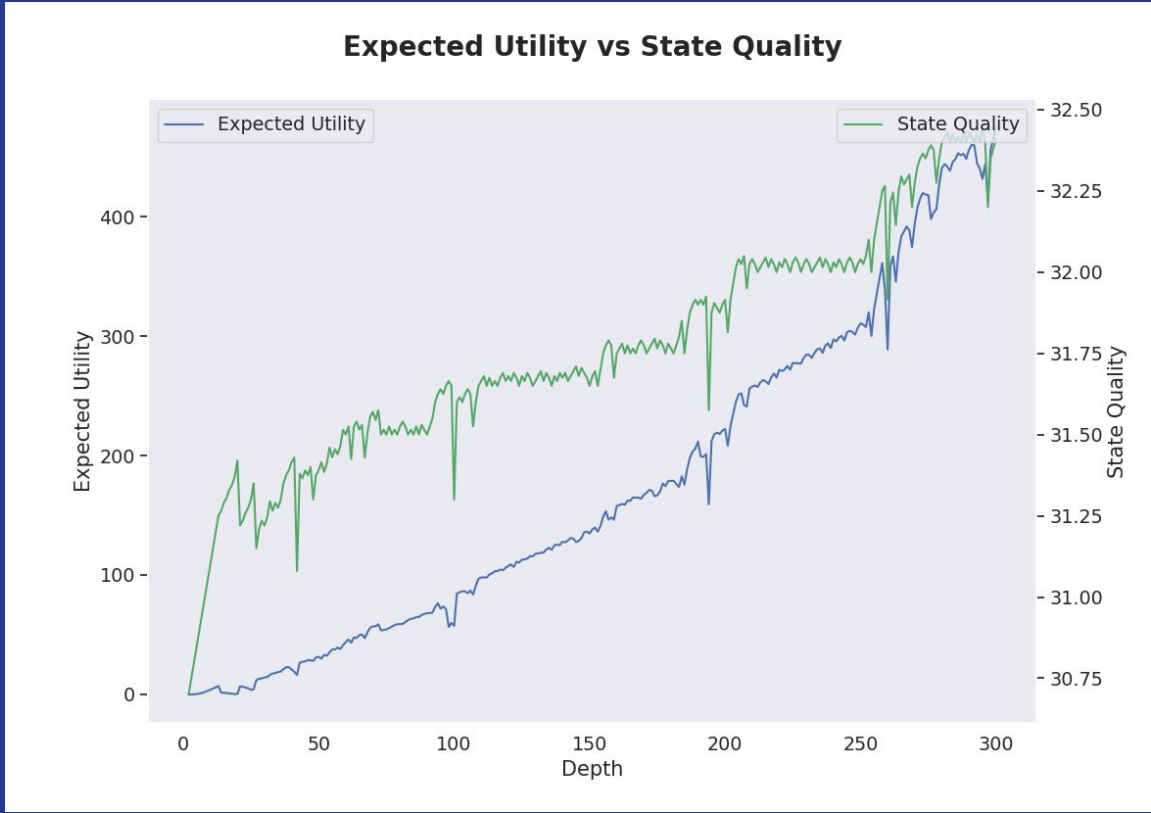
Example 1 - Rich Country



Example 2 - Unbalanced Start



Example 3 - Poor Country



Citations

- EU Heuristic
  - https://piazza.com/class/lbpfjbrwi0ca3/post/34
  - Credit to Zack Braasch for leading to a better search outcome through discussion
- EU vs State Quality Graphs
  - https://piazza.com/class/lbpfjbrwi0ca3/post/44
  - Credit to Reid Hall for excellent graphing ideas
- Powerpoint Preparation
  - https://piazza.com/class/lbpfjbrwi0ca3/post/43
  - Credit to Brian Goldsmith for bravely putting out an example set of slides
- Reference Code
  - https://github.com/hedgecrw/CS5260
  - Credit to Professor Will Hedgecock for providing great reference code