

WorldTraderSim

Part2

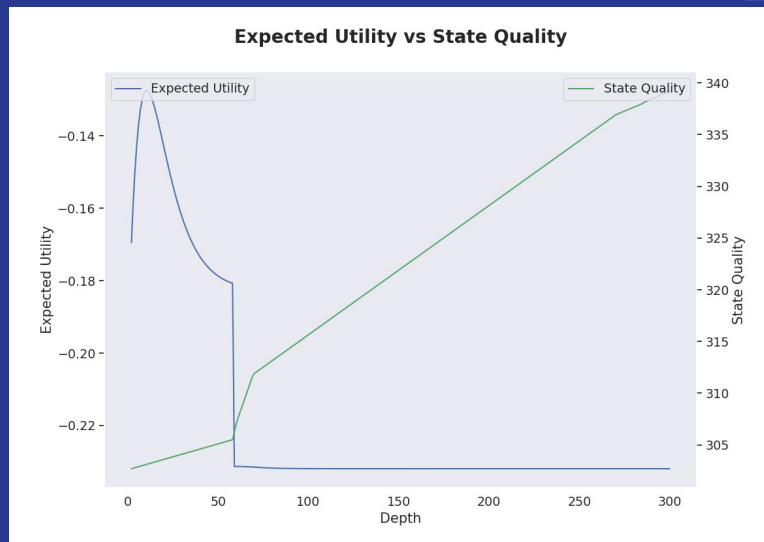
CS-5260 - John Ford

Fixes: Part 1 → Part 2

- **ScheduleEvaluator**
 - Correct usage of gamma (schedule length impact) as a constant applied to depth to exponential diminishing returns
- **TemplateParser**
 - Update parsing regular expression to allow using numbers in resource names



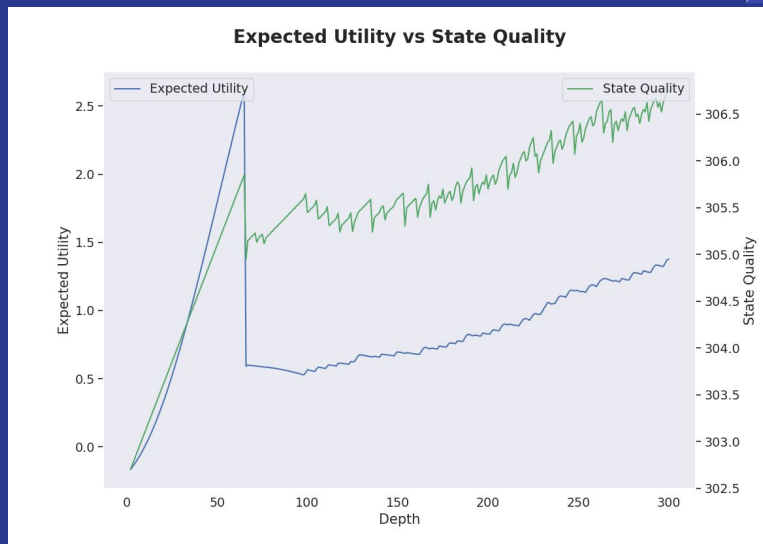
ScheduleEvaluator Fix - Immediately After



Correctly applying gamma (schedule length impact) as specified in the original project sheet drastically altered what were the prior results. Leaving all other settings as seen from Part 1 the same (Unbalanced Start State, Balanced Resource Weights) results in a quick peak of EU that shortly turns downward only a few steps (depth) into the search. Further, now that small changes in discounted reward (DR) aren't unintentionally magnified by depth, the success probability of interacting with other (non-self) countries also drops rather than returning mostly illogical acceptance for possible bad actions.

Forced to choose between ONLY bad actions upon running out of its own resources, the agent again resorts to predatory behavior, either stealing resources (taking w/o giving something of value back) or offloading its waste resources (giving away all negative influences.)


ScheduleEvaluator Fix - Tuned



Thankfully, it didn't take much to encourage the agent to resume the cooperative behavior previously seen in Part 1. Adjusting gamma (schedule length impact) to a value closer to 1 (0.9 to 0.999) made longer sequences of actions viable again.

A severe drop in expected utility (EU) is still seen when first beginning to interact with another country, as the calculation still has to take into account a lower success probability across two or more parties rather than just one. However, EU is able to start climbing again after several actions take place between the parties.

Improvements: Part 1 → Part 2

- **Node**
 - Cache STATE_HASH & DEPTH
 - **ScheduleEvaluator**
 - Cache initial state quality calculations
 - Simplify & reduce function calls
 - Allow configuration of calculation variables
 - **TransformAction**
 - Allow creating multiples similar to TransferAction
 - **Configuration**
 - Expose new sections and options
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Here's a quick summary of some improvements that went into place ahead of beginning new experimentation. These were mainly a way to speed-up trying different approaches and seeing how they affected the agent's outcomes.

Additions: Part 1 → Part 2

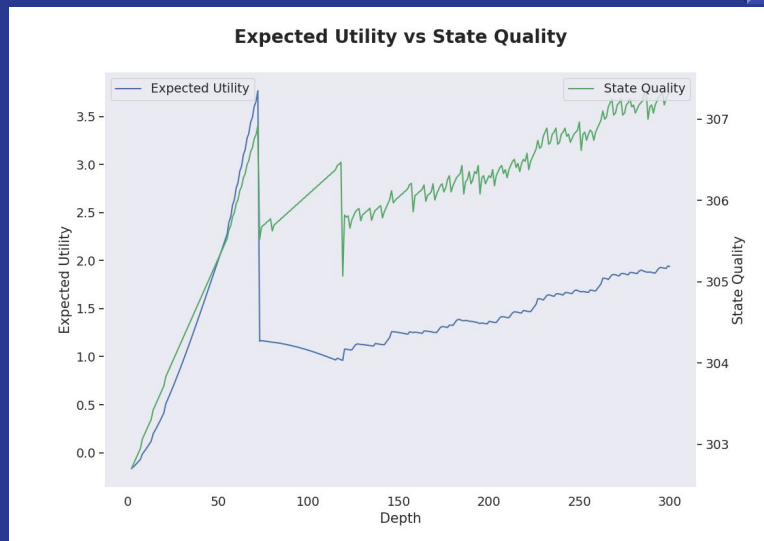
- **Housing2**
 - Housing Net
 - Housing Input = 0.7
 - Housing Output = 0.75
 - Net = 0.05
 - Housing2 Net
 - Housing2 Input = 1.14
 - Housing2 Output = 1.25
 - Net = 0.11



Having corrected some issues and added some improvements, it was time to begin playing with more concepts!

Introducing a new template was easy enough, but balancing it within the set of existing resources took a little bit of math and fine tuning. This was basically attempting to calculate what the “inherent” value of an upgrade should be.

New Housing2 Transform



Adding an additional transformation expanded the number of options for the agent to consider, and with a higher net value resulting from turning Housing into Housing2, the final EU and state quality were both marginally higher. Perhaps unsurprisingly, the agent converted ALL Housing into Housing2. More interestingly, the agent would transfer away Housing2 to another country to “sweeten the deal” on a subsequent transfer of waste products.

Would this trend continue if a subsequent tier was added? What if the net value were to be less to represent a diminishing return on upgrading tiers?

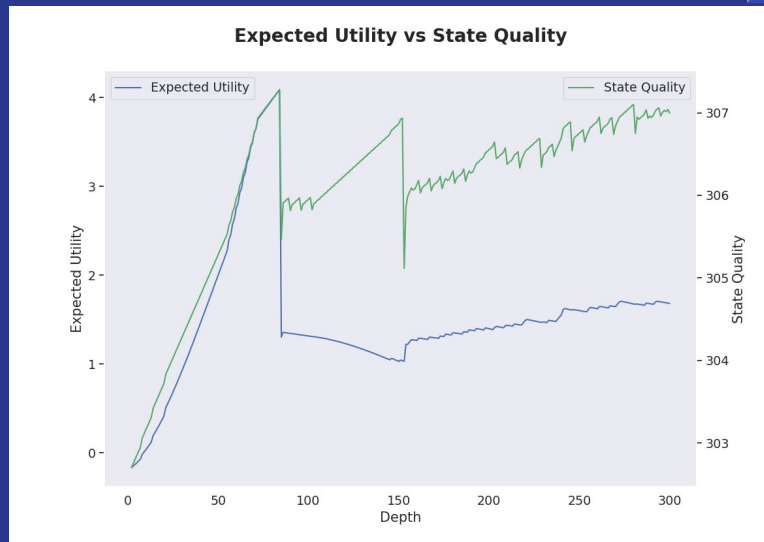
Additions: Part 1 → Part 2

- **Housing3**

- Housing2 Net
 - Housing2 Input = 1.14
 - Housing2 Output = 1.25
 - Net = 0.11
- Housing3 Net
 - Housing3 Input = 1.64
 - Housing3 Output = 1.67
 - Net = 0.03

While the weight of Housing3 is set higher than the previous tier, because it taking in a Housing2 for an input, its net value is actually slightly less than creating Housing from raw materials. Will the agent ever create one with these values, or will it need to be adjusted slightly to make it an “acceptable” action?

New Housing3 Transform



I was surprised to find that the pattern DID hold for introducing yet another tier, even with its net value being slightly less than the original Housing tier. I'd posit that this is because the agent sees a transform as still more beneficial than having to take the intermediary steps to transfer materials back and forth with a neighboring country to create the Tier 1 resource. The agent seems to highly prefer using an upper tier resource to boost the success rate of multiple subsequent transfers that would otherwise be seen as less desirable by the other country, sending along 1 and then requesting back multiple types of resources in return afterward.

This avenue of exploration could be pursued all by itself in many new ways, but at this stage, I wanted to see what would happen if I introduced tiers for a different resource that would compete for a shared input.

Additions: Part 1 → Part 2

- **Electronics2 & Electronics3**

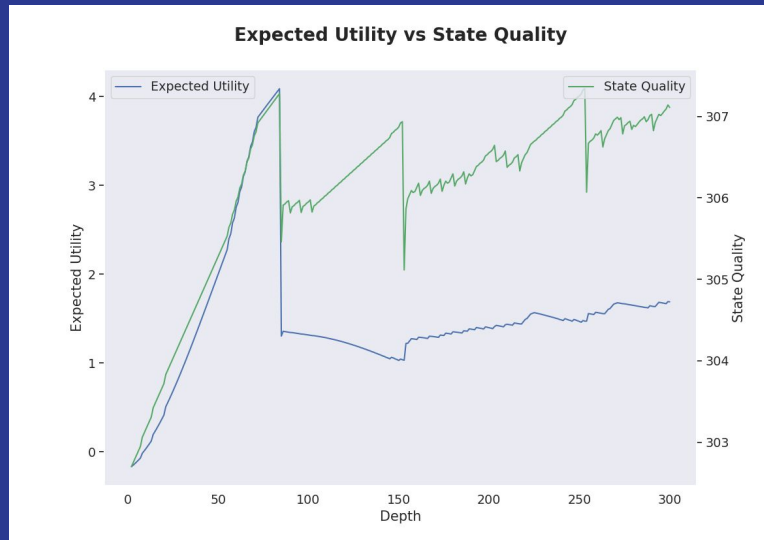
- Electronics Net
 - Electronics Input = 0.475
 - Electronics Output = 0.5
 - Net = 0.025
- Electronics2 Net
 - Electronics2 Input = 0.575
 - Electronics2 Output = 0.625
 - Net = 0.05
- Electronics3 Net
 - Electronics3 Input = 1.05
 - Electronics3 Output = 1.07
 - Net = 0.02



Having corrected some issues and added some improvements, it was time to begin playing with more concepts!

Introducing a new template was easy enough, but balancing it within the set of existing resources took a little bit of math and fine tuning. This was basically attempting to calculate what the “inherent” value of an upgrade should be.

Multiple Resource Tiers



Seemingly, more choices just means more choices. The agent pursued both of the Tier 3 resources, Electronics3 and Housing3. It also traded both away to benefit its transfer success. After the initial ramp where the agent country was consuming only its own resources, both of the large upticks in state quality are a transfer of a single Tier 3 resource to a neighbor country followed by a long succession of transfers back to itself from that country, up until success probability presumably dropped below an acceptable level and other actions became desirable again.

Extreme Run

Params

- Depth Bound = 3,000
- Frontier Max = 100,000,000
- Schedule Length Impact = 0.9999
- Schedule Failed Impact = 0.95
- Success Midpoint = 0 (neutral)
- TransformQuantityMax = 5

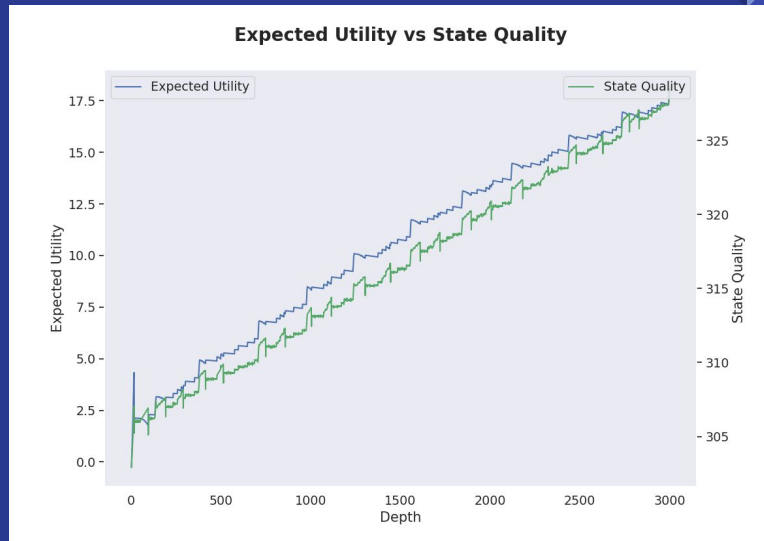
Observations

- Total Actions = 515
- Memory Used = 6GB
- Time Taken = 37 minutes
- Initial Expansion Round = ~68ms
- Final Expansion Round = ~2,225ms
- Max Frontier Length = 497,158



Before closing out Part 2, what would the extreme end of this sort of search look like?

Extreme Run



2023-04-22 16:33:30,946 - root - INFO - Final Agent Country State Quality = 328.48499999999996

2023-04-22 16:33:30,959 - root - INFO - Schedule Expected Utility = 18.07276895659615

2023-04-22 16:33:30,959 - root - INFO - Country Schedule Success - Atlantis 100.00%

2023-04-22 16:33:30,959 - root - INFO - Country Schedule Success - Europa 94.69%

2023-04-22 16:33:30,959 - root - INFO - Country State Diff - Atlantis
[ResourceQuantity(name='MetallicElements', quantity=-135),
ResourceQuantity(name='Timber', quantity=-8),
ResourceQuantity(name='MetallicAlloys', quantity=-19),
ResourceQuantity(name='MetallicAlloysWaste', quantity=375),
ResourceQuantity(name='Electronics3', quantity=91),
ResourceQuantity(name='ElectronicsWaste', quantity=275),
ResourceQuantity(name='Housing3', quantity=8),
ResourceQuantity(name='HousingWaste', quantity=30)]

2023-04-22 16:33:30,959 - root - INFO - Country State Quality Change - Atlantis 25.834999999999998

2023-04-22 16:33:30,959 - root - INFO - Country State Diff - Europa
[ResourceQuantity(name='MetallicElements', quantity=-1030),
ResourceQuantity(name='Timber', quantity=-62),
ResourceQuantity(name='MetallicAlloys', quantity=14),
ResourceQuantity(name='Electronics3', quantity=19),
ResourceQuantity(name='Housing3', quantity=2)]

2023-04-22 16:33:30,959 - root - INFO - Country State Quality Change - Europa
3.88999999999999864