

0.1 Determine the Operators

As explained in ??, there are many possible configurations for an evolutionary algorithm. Therefore, we run simulations for all possible combinations of operators. We use the results, to filter out operators for subsequent evaluation steps that may not be promising.

0.1.1 Experimental Setup

To avoid confusion, we refer to each unique phase combination as a model-configuration. For instance, one model-configuration would consist of **[a DatabBasedInitiator, an ElitismSelector, a OnePointCrosser, SamplingBasedMutator and a FittestSurvivorRecombiner]**. We refer to a specific model-configuration in terms of its abbreviated operators. For instance, the earlier example is denoted as **[DBI-ES-OPC-SBM-FSR]**.

The model-configuration set contains **[144]** elements. We choose to run each model-configuration for **[50]** evolution cycles. For all model-configurations, we use the same set of **[4]** factual process instances, which are randomly sampled from the test set. We ensure, that the outcomes of these factuals are evenly divided. We decide to return a maximum of **[1000]** counterfactuals for each factual case. Within each evolutionary cycle, we generate **[100]** new offsprings. We keep the mutation rate at **[0.1]** for each mutation type. Hence, across all cases that are mutated, the algorithm deletes, inserts, and changes **[1%]** of events. We collect the means viability and its components across the iterative cycles of the model.

0.1.2 Results

Figure 1 shows the bottom and top-**[k]** model-configurations based on the viability after the final iterative cycle. We also show how the viability evolves for each iteration.**[change evolutionary cycle to iterative cycle]** The results reveal a couple of patterns. First, all of the top-**[k]** algorithms use **[either CaseBasedInitiator or SampleBasedInitiator]** as initiation operation. In contrast, the bottom-**[k]** all use **[RandomInitiator]** as initialisation. Second, we see that most of the top-**[k]** algorithms use the **[ElitismSelector]**.

The complete table of results is in ??.

ATTACHMENT: tbl:average-viability

In Figure 2, we see the effects of each operator type, except the mutation operation.

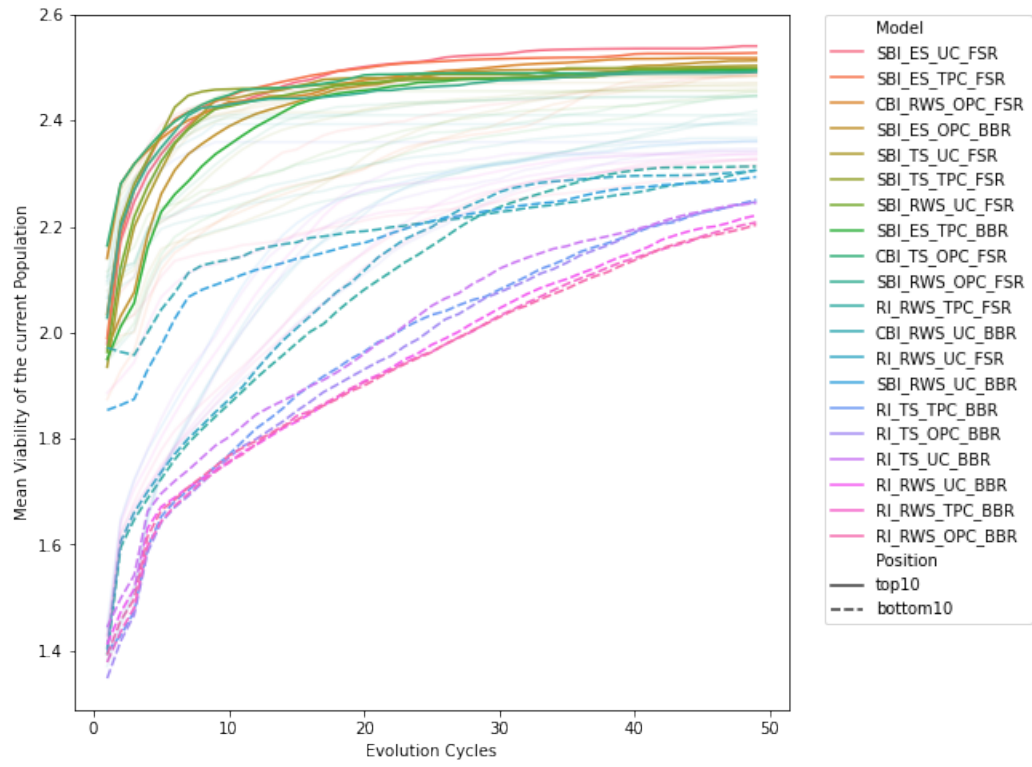


Figure 1: This figure shows the average viability of the [10] best and worst model-configurations. The x-axis shows how the viability evolves for each evolutionary cycle.

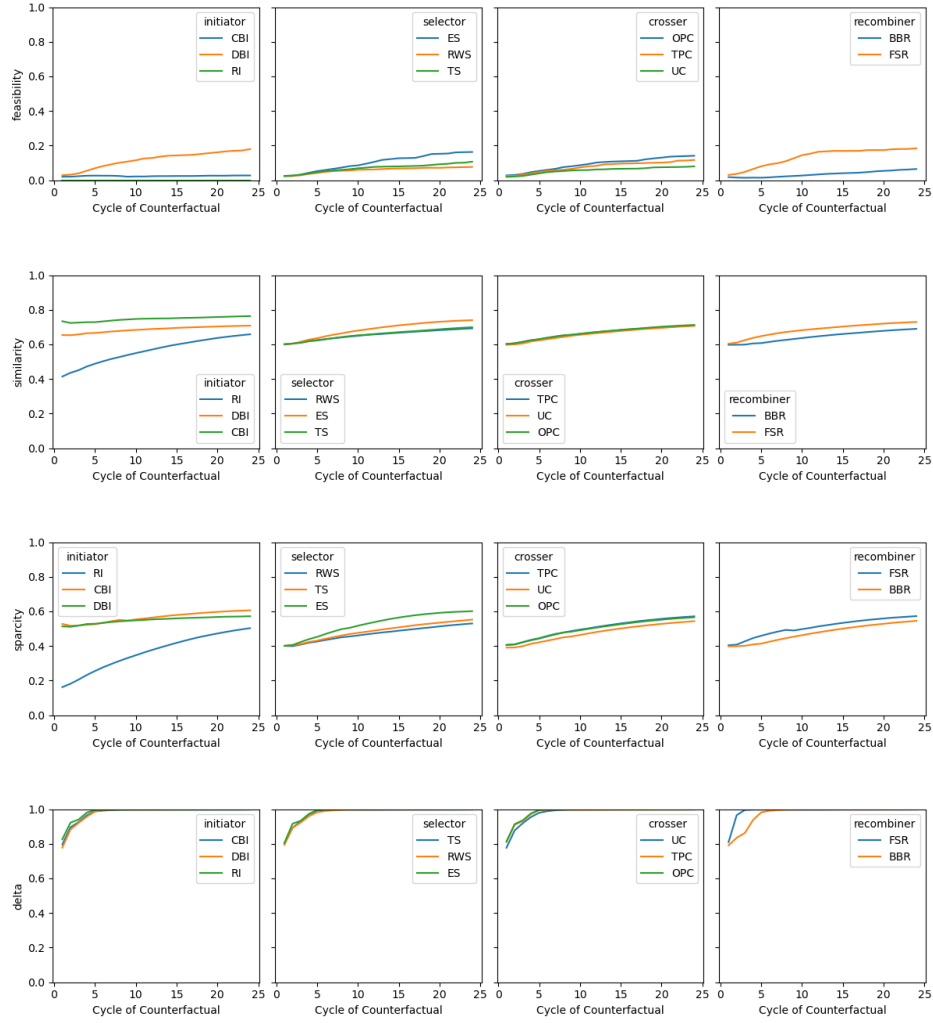


Figure 2: Shows the evolution of each viability measure over the entire span of iterative cycles. Each figure adjust the respective operator type by taking the average over all other operator types. **[Make sure, that the legends are aligned in color.]**

Starting with some commonalities accross operator-type and measure, the figure shows that the initiator heavily determines the starting point for each measure. For instance, the **[RandomInitiator]** starts well below the other initiator operations when it comes to sparsity and similarity. Another noteworthy general observation is the delta measure **[Change some of the names to align with Dice4EL]**. Here, for each operator type we see a movement towards the highest possible delta value. Hence, most configurations are capable of changing the source class to the desired class.

In terms of viability Figure ??, shows an increase only for cases, in which the **[SampleBasedInitiator]** is used. Similar holds for recombination with **[FittestSurvivorRecombiner]**.

The results for the selection operator type are undeniably in favor of **[ElitismSelector]** for all viability measures. The same holds for the recombination operation. Here, the **[FittestSurvivorRecombiner]** yields better results.

When it comes to the crossing operation, the results indicate, the differences between **[OnePointCrosser]** and **[TwoPointCrosser]** are inconclusive for all viability measures except feasibility. One can explain that by noting, that both operations are very similar in nature. However, cutting the sequence only once retains produces less impossible sequences for the child sequences.

0.1.3 Discussion

Moving forward, we have to choose a set of operators and also determine suitable hyperparameters for each. In the next experiment we consider the following operators: We choose the **[SampleBasedInitiator]** as it might increase our chances to generate feasible variables.

For selection, we will use the **[ElitismSelector]**, as it generally appears to return better results.

Furthermore, we choose to move forward with the **[OnePointCrosser]**. This crossing operation is slightly better in yielding feasible results.

For selection and recombination, we use the **[ElitismSelector]** and the **[FittestIndividualRecombiner]**, respectively. They all outcompete their alternatives for all similarity, sparsity and feasibility.

In the next experiment we vary mutation rates, using **[SBI-ES-OPC-SBM-FIR]**.