

CFHT Genetic Algorithm, 2012

Initialization:

- Take the observations that are valid for the night.
- Observations (the genes) can be specified for GN, GS, or both.
- Try to pack them as densely as possible into chromosomes (representing ordered schedules).
- The fitness / score of a chromosome is the sum of the fitnesses of its genes.
- Chromosomes are associated with either GN or GS.
- This gives the initial population.

Evolution:

- **Mating:**
 - Pick one of the best 25% chromosomes and another arbitrary chromosome from the same site.
 - Say:
 - C1 = A B C D E F G H I J
 - C2 = K L M N O
 - Pick a point in C1 and a point in C2.
 - Create two new chromosomes using the genes in C1 up to the point selected, and then continue with the genes in C2 from the point selected:
 - C3 = A B C D N O
 - C4 = K L M E F G H I J
 - If either of these are valid and score higher than the worst of C1 or C2, replace C1 or C2.
- **Interleaving**
 - As above, pick two chromosomes.
 - Interleave them:
 - C3 = A K B L C M D E N F O G
 - C4 = K A L B M C E D F N G O
 - If either these are valid and score higher than the worst of C1 or C2, replace C1 or C2.
- **Mutation Swap:**
 - Pick one chromosome and randomly try to swap the placement of two of its genes.
 - In the prototype, this will not affect the fitness, but can alter the chromosome for use with the other techniques.

- **Mutation Replace:**
 - Pick one chromosome and randomly select a number of positions. Replace them with other genes.

EXAMPLE:

- 600 minutes to schedule
- 1000 randomly generated observations of between 30 and 120 minutes.
 - 10% chance of a lower bound timing constraints (e.g. start time must be greater than 120).
 - 10% chance of an upper bound timing constraint (e.g. end time must be less than 500).
- 1000 iterations of the genetic algorithm (where each operation is attempted once).

RESULTS:

- Schedule output: entries are of the form (start time, observation index).
- GN starts off with a best-schedule fitness of 240.8, and increases to 251.2. (4.3% improvement)
- GS starts off with a best-schedule fitness of 241.2, and increases to 439.2. (82.1% improvement)
- Difference is coincidental: different RNG seed, different # observations, different # iterations will all give different results.