1 Environments and instructions

- Python 3.8
- Run with `python knapsack_ga.py`

2 Details

1. **Genotype**: The genotype is defined as a bit vector `G`. `G[i]=1` means that we put the `i`th box into the knapsack.
2. **Fitness Function**: It is easy to think that we need to put more cost effective boxes into the backpack, so the adaptability function is defined as:

$$\sum total\ values - |\sum total\ weights - max\_weight|$$

3. **Selection and Reproduction**: We use the truncated rank-based selection method and cull the population by 50% at every generation. Meanwhile, we consider the *Elitism* approach to main tain the 50% best individuals from last generation.
4. **Genetic operators**: We define 2 genetic operators:
    1. `crossover(a,b)`, take the genotype `a` and `b` and randomly choose a point. Swap the generic material around this point.
    2. `mutate(a)`, take the genotype `a` and mutate on some random point with probability = 0.3.
5. **Solution Test**: The algorithm terminates when the number of iterations reaches `max_iter` or when 98% of the individuals have the same fitness.