info.md

Assignment 2: Bin Packing using GA

What fitness functions I implemented

Absolute value (p1 metric)

```
def fitness_abs(ind, weights):
    bw = bin_weights(weights, ind)
    mu = sum(bw) / K
    fitness = 1 / (np.sum(np.abs(np.array(bw) - mu)) + 1)
    return utils.FitObjPair(fitness=fitness, objective=max(bw) - min(bw))
```

Euclid distance (p2 metric)

```
def fitness_pow2(ind, weights):
    bw = bin_weights(weights, ind)
    mu = sum(bw) / K
    fitness = 1 / (np.sum(np.pow(np.abs(np.array(bw) - mu, 2))) + 1)
    return utils.FitObjPair(fitness=fitness, objective=max(bw) - min(bw))
```

sqrt distance (p_{1/2} metric)

```
def fitness_root(ind, weights):
    bw = bin_weights(weights, ind)
    mu = sum(bw) / K
    fitness = 1 / (np.sum(np.sqrt(np.abs(np.array(bw) - mu))) + 1)
    return utils.FitObjPair(fitness=fitness, objective=max(bw) - min(bw))
```

What I tried

- I used grid search to find optimal parameters
- Grid search was performed with following settings:
  - REPEATS = 50
  - MAX_GEN = 500
  - POP_SIZE = 1000
- These were parameters on the grid:

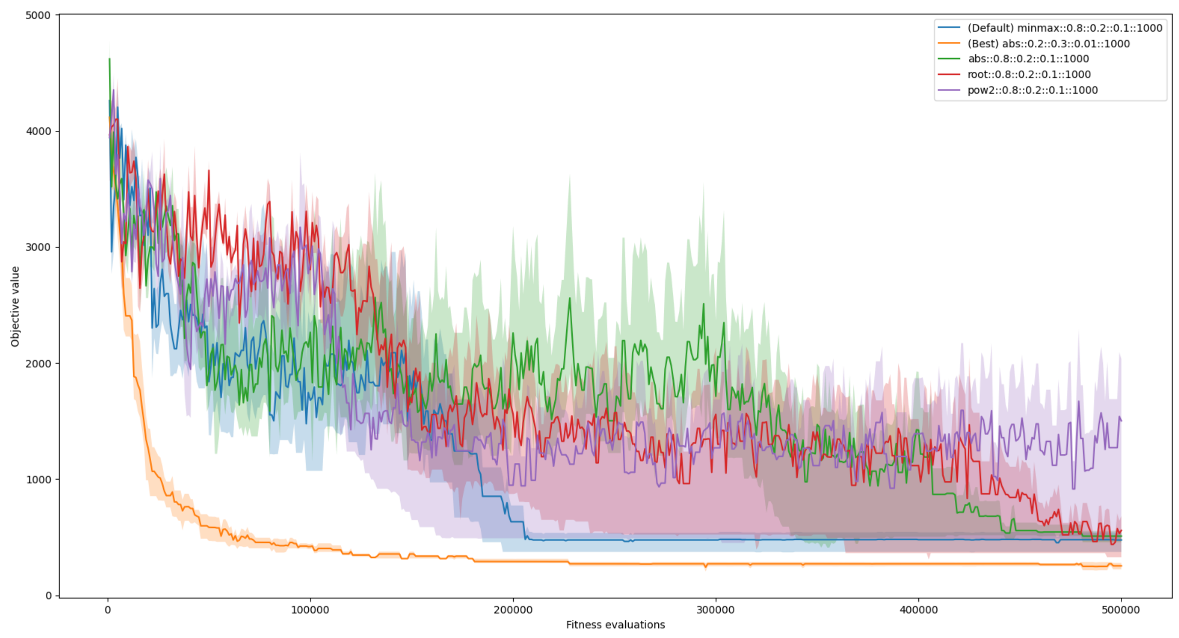
```
# Options
variants = {
    "fitness" : [fitness_minmax, fitness_abs, fitness_root, fitness_pow2],
    "cross_prob": [0.2, 0.5, 0.8],  # crossover prob
    "mut_prob": [0.01, 0.05, 0.1, 0.2, 0.3],  # mutation prob
    "mut_fip_prob": [0.01, 0.05, 0.1, 0.2, 0.3],  # prob of flipping during mutation
    "pop_s": [50000]  # population size
}

# Create grid
varNames = sorted(variants)
experiments = [dict(zip(varNames, prod)) for prod in it.product(*(variants[varName] for varName in varNames))]

# Train
for experiment in experiments:
    ...
    ...
```

Best Result: 37

- When grid search finished, I used the best found parameters and run GA with greater population
- Settings:
  - REPEATS = 100
  - MAX_GEN = 600
  - POP_SIZE = 50,000
- These were the best params found by grid search:
  - fitness = fitness_abs (p1 metric)
  - cross_prob = 0.2
  - mut_prob = 0.3
  - mut_fip_prob = 0.01
  - population_size = 10,000
  - generations = 500 (conveged to best value after 329 generations)
- **Best Result**
  - **Objective value (max-min): 37**
  - after 329 generations

Figure

- I include single figure
- It includes few runs from the grid search:
  - default settings
  - best found settings
  - all implemented fitness functions with otherwise default settings
- We can see, that much lover cross probability
  - significantly improves of convergence
  - significantly reduces variance of results
- legend is in the format fitness::cross_prob::mut_prob::mut_fip_prob::population_size


(Default) minmax::0.8::0.2::0.1::1000
(Best) abs::0.2::0.3::0.01::1000
abs::0.8::0.2::0.1::1000
root::0.8::0.2::0.1::1000
pow2::0.8::0.2::0.1::1000
Objective value
Fitness evaluations