Genetic Bike

Group:
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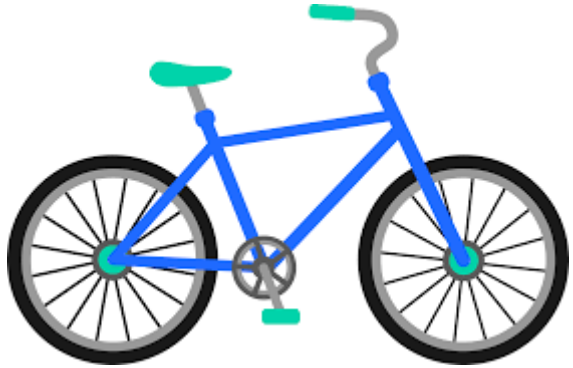
Implementation of a genetic algorithm to design a two dimensional bike with two wheels and two mass points



https://users.hepforge.org/~dgrell/ICTP14/
https://bitbucket.org/bicicletagenetica/bicicletagenetica

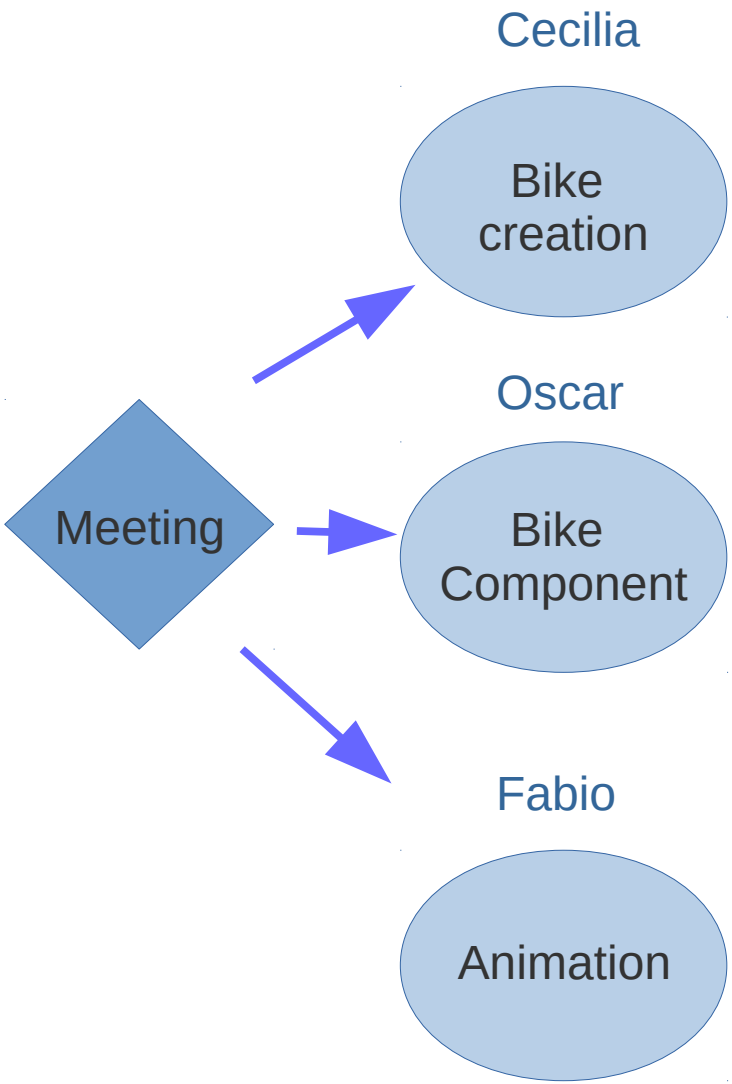
Statements of the problem

- The bike must have two wheels and two loads
- The initial positions of these masses and wheels can be freely chosen by the algorithm.
- The elements are connected by springs whose length, with fix damping constant and spring constant.
- The loads must never touch the ground.
- The optimality of a particular candidate solution (the fitness function) is determined by how far it travels before a mass touches the ground or reaches a fix maximum distance.

What we need to model?

- Geometry of the problem (two dimensions+time)
- Bicycle object
- Ground shape
- Physics (spring, masses, wheel, gravity)
- Time evolution (Runge-Kutta)
- Evolution (genetic algorithm to find the best bike)
- Visualization (visual interface)

How do we split the work?



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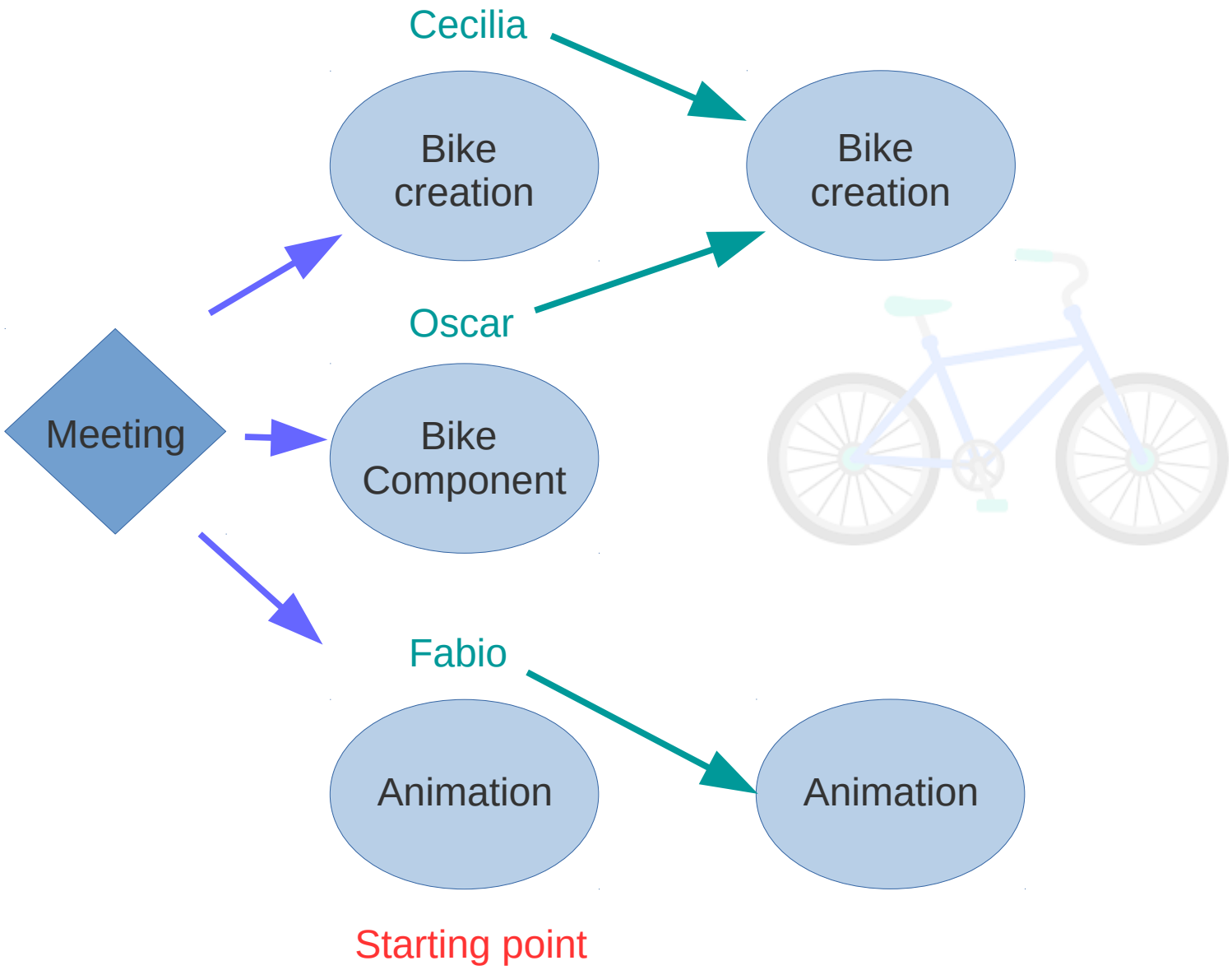

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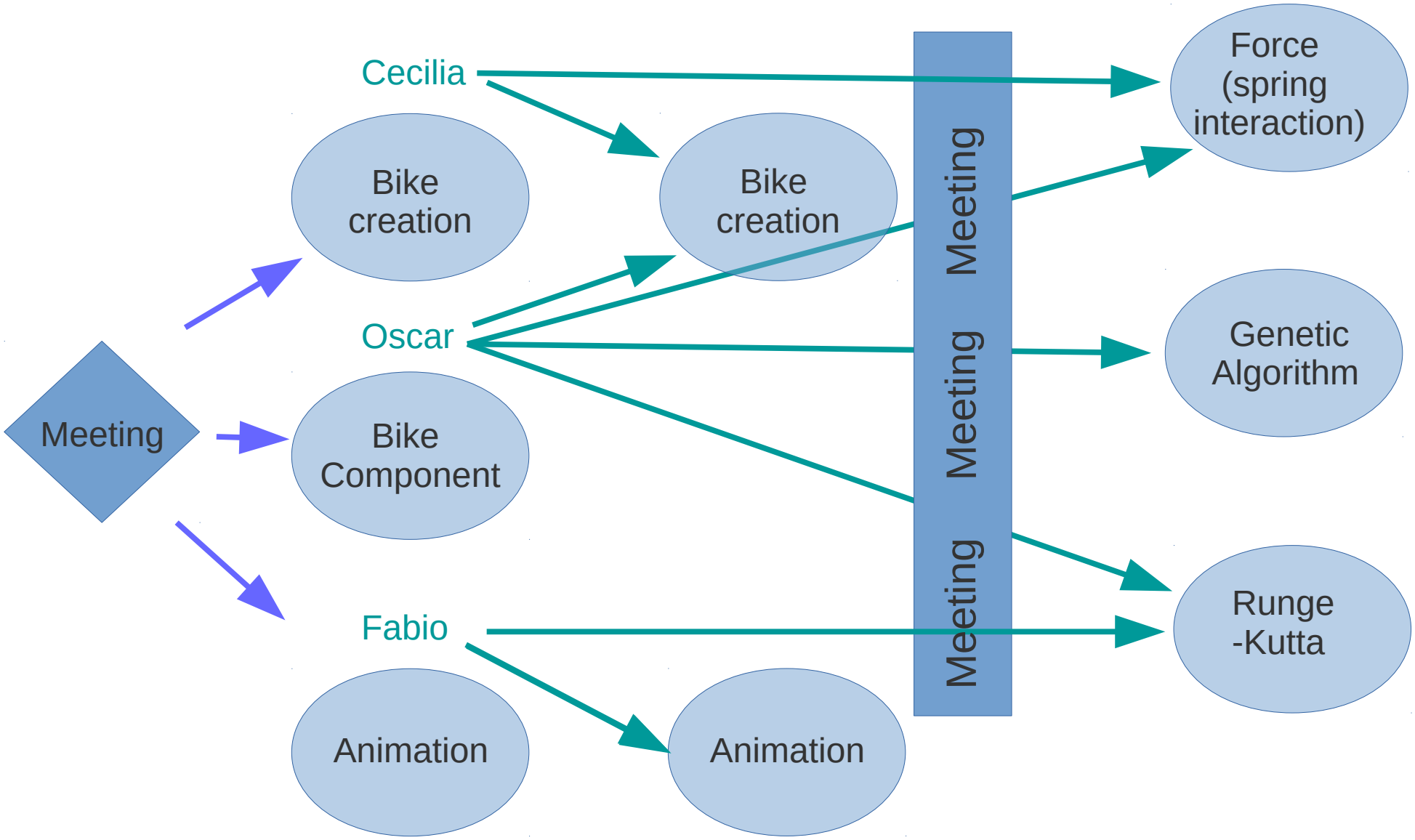

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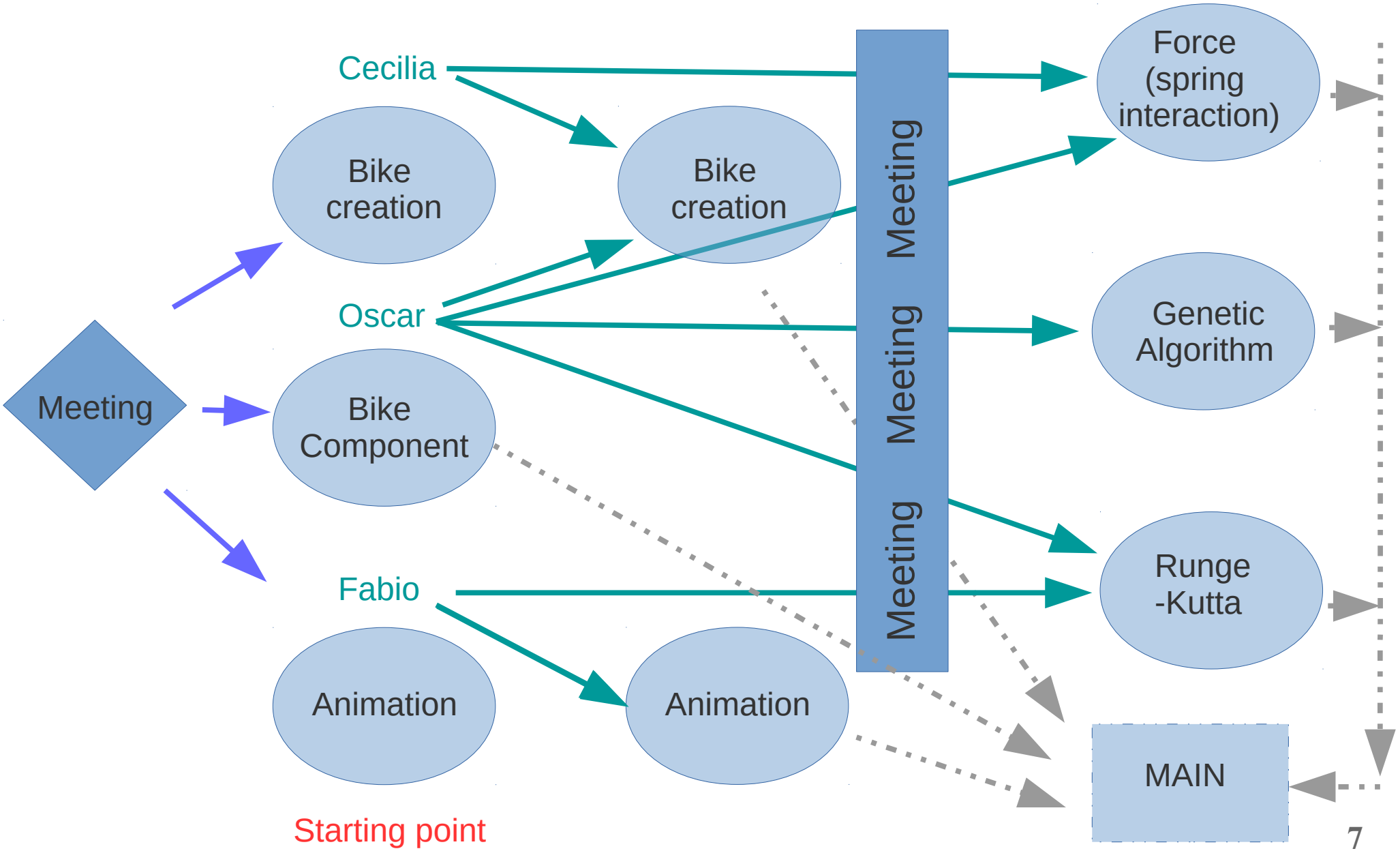
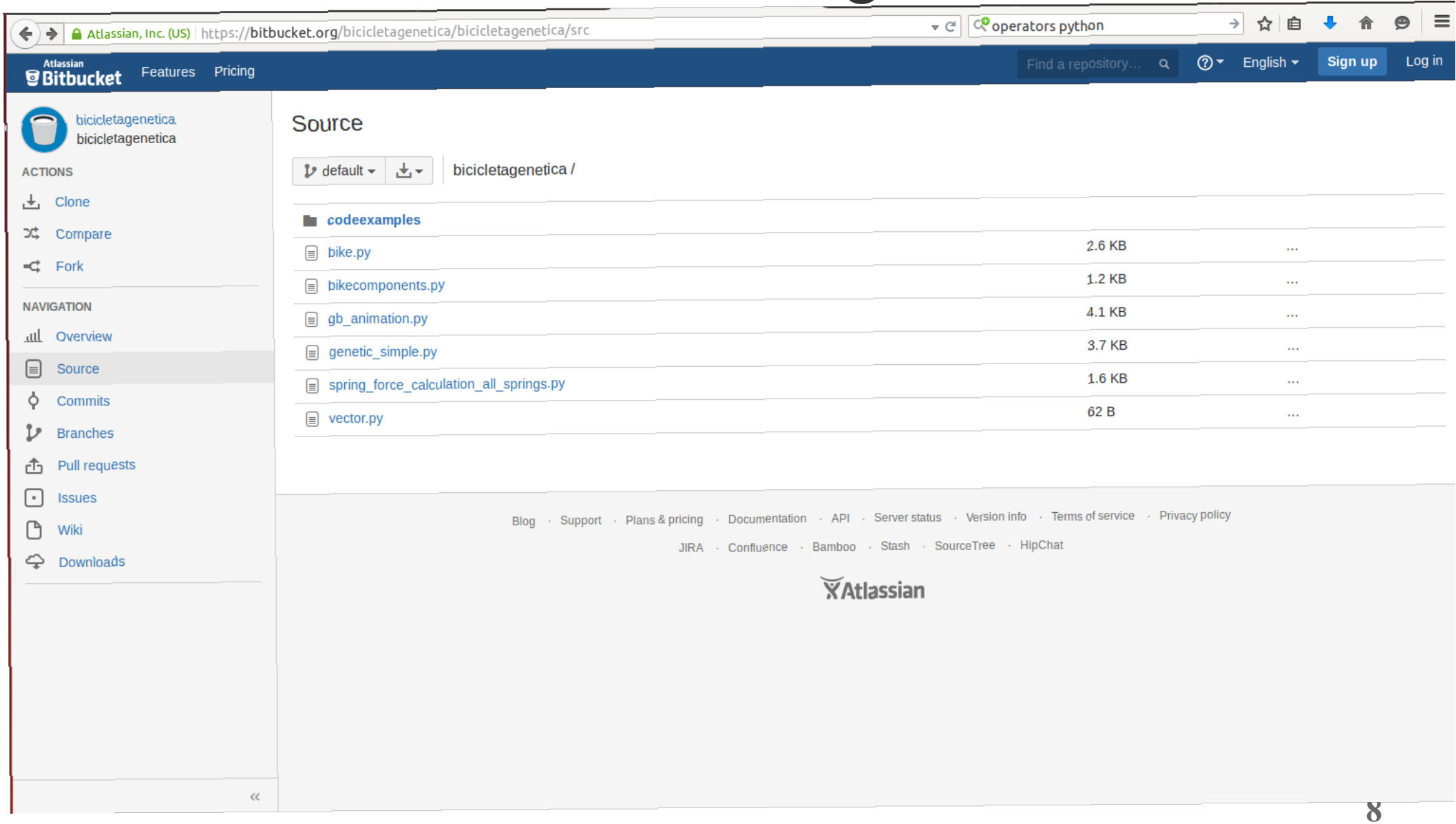
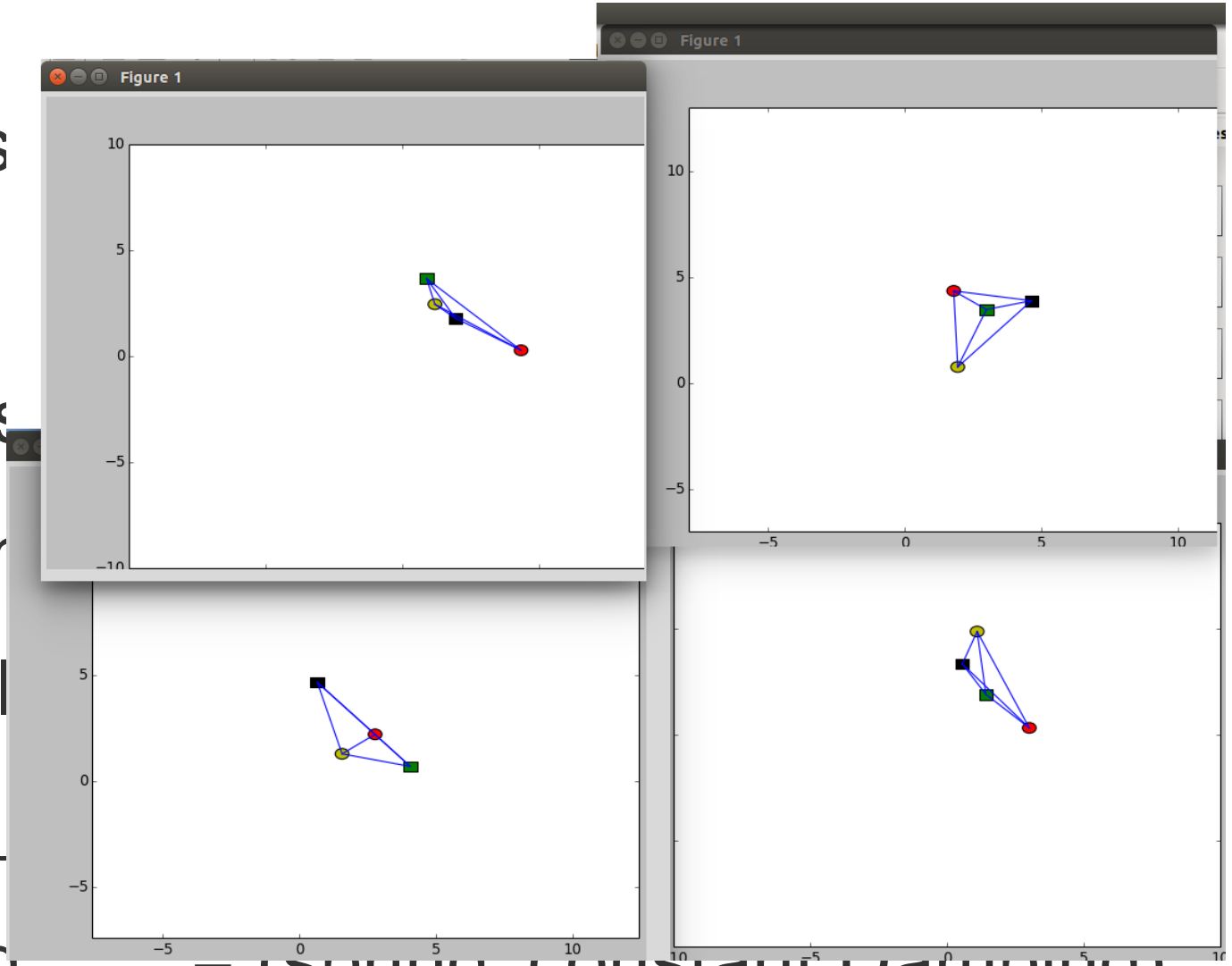


Class Structure Definition and shearing code design



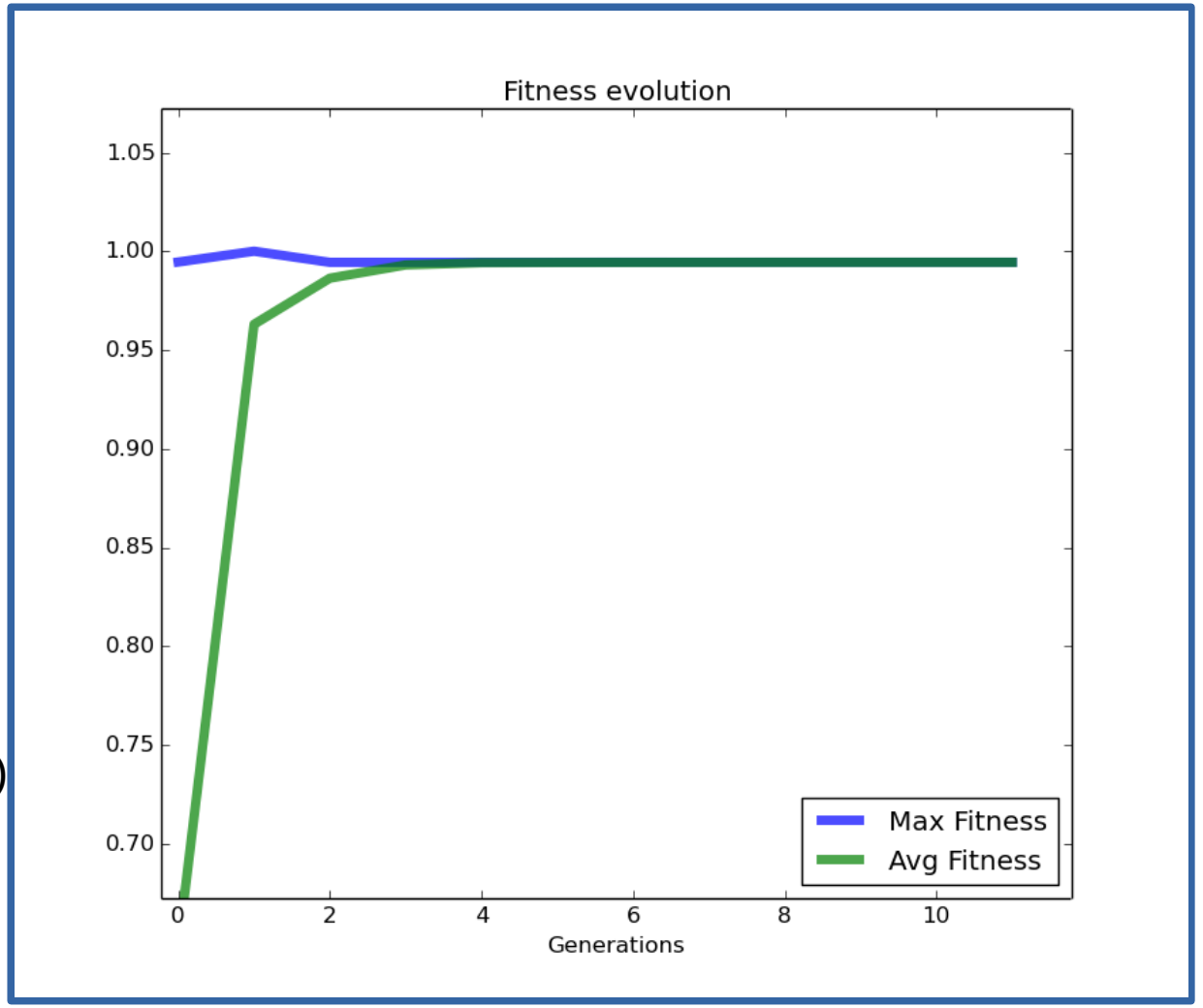
Example: generating the random bikes

- **class Bike:**
- """Bike class
- def __init__(s
  mass_points_tr
- self.wheel
- self.mass_
- self.spring = (spring_constant,Damping)



Example 2: the genetic algorithm

```
import numpy as np
from operator import itemgetter

import matplotlib.pyplot as plt
from math import sqrt

number_fittest = 20
population_size = 200

def fitness (x):
      return sqrt(x)

def avg_fitness(population):
      fit_sum = 0
      for i in population: fit_sum +=
      return fit_sum/len(population)

def max_fitness(population):

      map_pop_fitness = []
      for i in population:
       /
…….
```



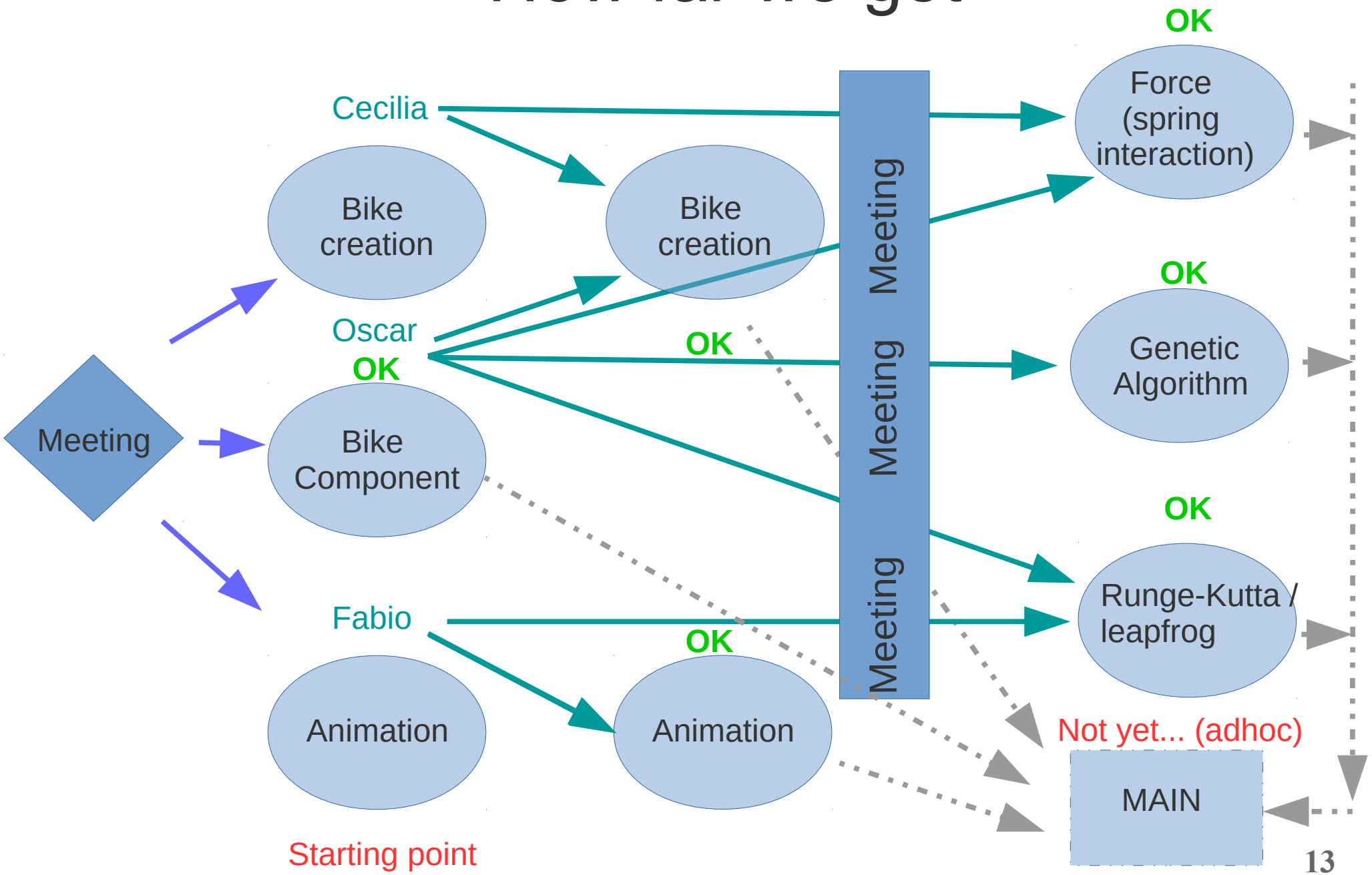
Documentation Example: using Pydoc at the genetic algorithm code

- NAME
- genetic_simple
-
- FUNCTIONS
- avg_fitness(population)
- Average fitness of the population
- crossover(father, mother)
- Crossover (Mean)
- fitness(x)
- Fitness calculation
- max_fitness(population)
- Max fitness of the population

- DATA
- number_fittest = 20
- population_size = 200

Down the hill

How far we get



To Do

- Improve the ground interaction.
- Implement the genetic algorithm for the bikes

Conclusion

- It was a great opportunity to learn more about numerical evaluation of a problem (Euler, Runge kutta forth order, leapfrog and genetic code.)
- Heterogeneous group

Thank you!

Back Up:

- The Euler problem