

## Genetic Algorithms (Program 2)

Repository: <https://github.com/CalKey3D/AIClass461.git>

I think the main challenges of writing this program were related to the criteria for the fitness function. Just getting all of that logic implemented properly took a fair amount of time. Beyond that though, I had some interesting difficulties with SciPy. I was using Pycharm, and I kept trying to install it without success, and going down the rabbit hole of error troubleshooting proved unsuccessful. So instead, I went ahead and added a softmax function to the program itself. Apart from those two things, I would say everything went fairly smoothly.

I think the final schedule produced is reasonable but probably not incredibly optimal. I think there could be some improvement. One thing I noticed was that my best schedules actually got worse after implementing the dynamic mutation rate. I initially had the mutation rate set to be fixed at 0.01, and that seemed to provide schedules with fitness of around 13, but after adding the dynamic rates they shifted down to about 11-12. I think the reasoning for this is that the current implementation halves the rate every generation that it finds improvement. Thus, the mutation very quickly starts having minimal effect. I would probably adjust this some, but I decided against it since the instructions on the assignment gave those details.

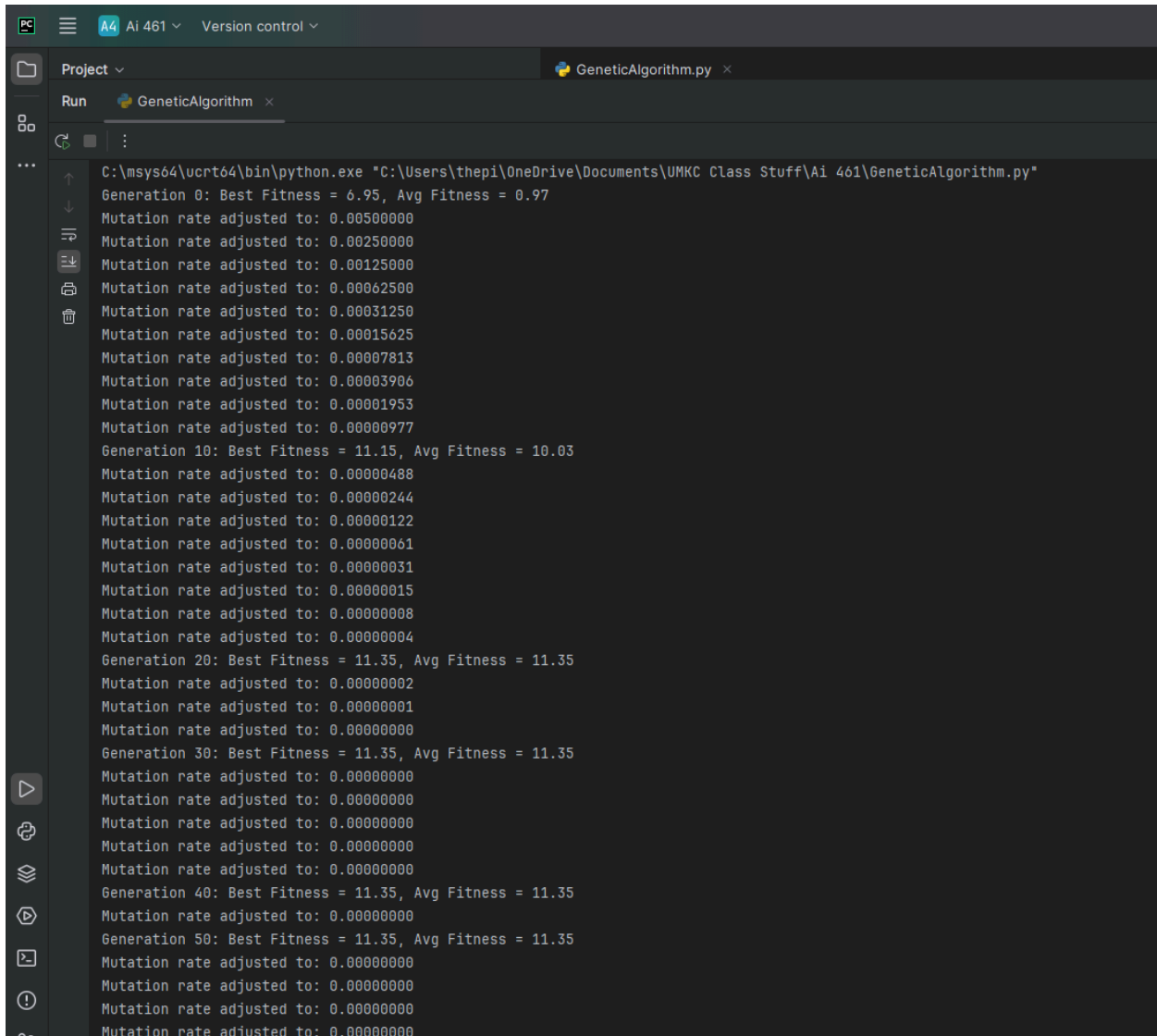
In terms of looking through the schedule visually, nothing appears to be terribly out of place, though there are some peculiar things I notice. Frank 119 seems to be used for almost every time slot, and also Tyler is teaching four of the classes. To me, that sounds suboptimal.

I think to improve the program, as I mentioned, I would want to tweak the mutation rate and how the rate adjusts dynamically. The program functions well without the dynamic rate and still manages to converge relatively quickly, so I do not think adding that functionality was particularly helpful. It could be that I implemented it incorrectly, however, I am not quite certain.

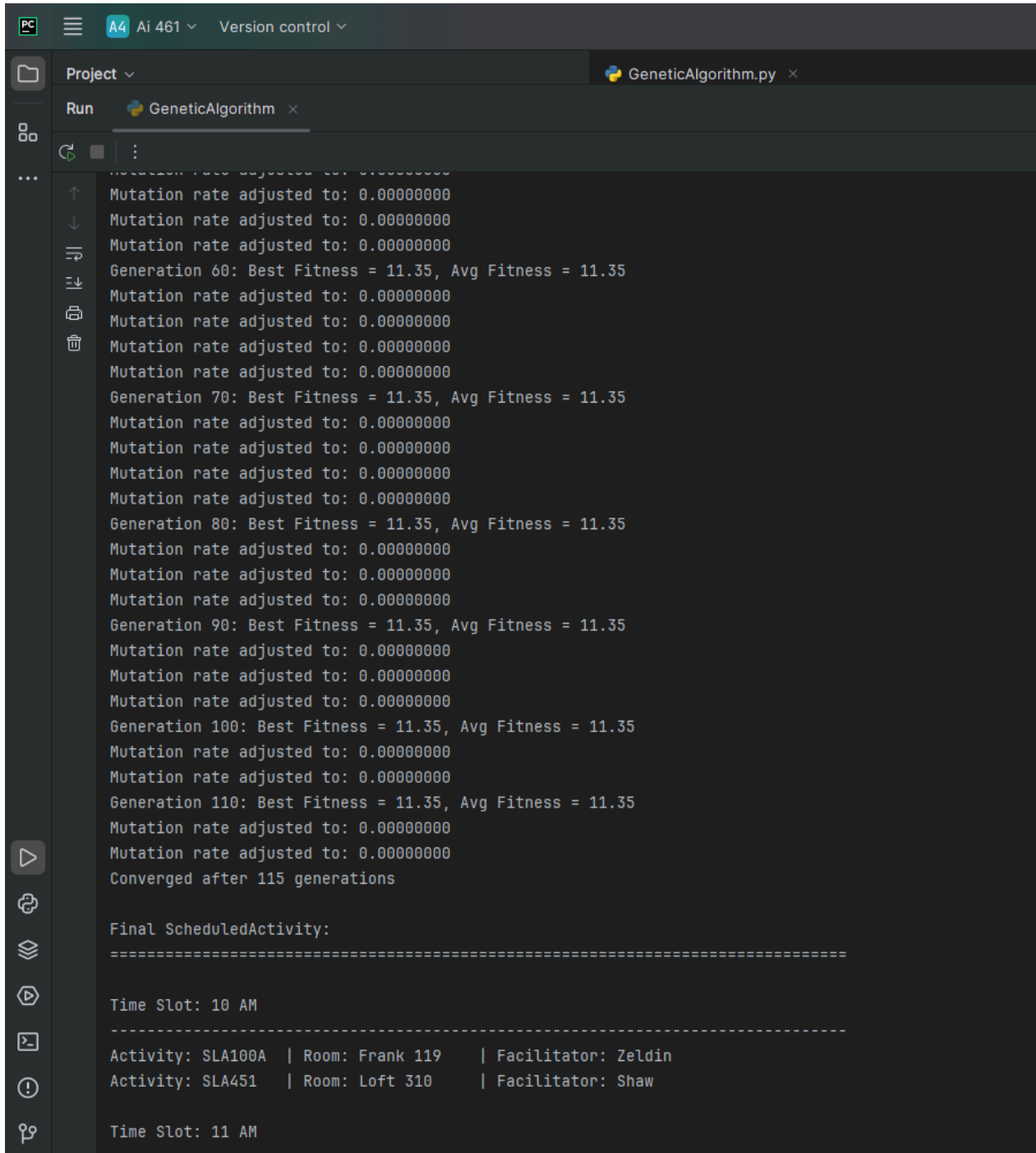
I honestly enjoyed this assignment a fair amount, and I feel like my understanding of genetic algorithms is quite a bit better after completing it. It was nice to see all of the components of the algorithm fit together.

Screen Captures of output below, and final schedule is also in the .txt file I submitted.

Program Output:



```
C:\msys64\ucrt64\bin\python.exe "C:\Users\thepi\OneDrive\Documents\UMKC Class Stuff\Ai 461\GeneticAlgorithm.py"
Generation 0: Best Fitness = 6.95, Avg Fitness = 0.97
Mutation rate adjusted to: 0.00500000
Mutation rate adjusted to: 0.00250000
Mutation rate adjusted to: 0.00125000
Mutation rate adjusted to: 0.00062500
Mutation rate adjusted to: 0.00031250
Mutation rate adjusted to: 0.00015625
Mutation rate adjusted to: 0.00007813
Mutation rate adjusted to: 0.00003906
Mutation rate adjusted to: 0.00001953
Mutation rate adjusted to: 0.00000977
Generation 10: Best Fitness = 11.15, Avg Fitness = 10.03
Mutation rate adjusted to: 0.00000488
Mutation rate adjusted to: 0.00000244
Mutation rate adjusted to: 0.00000122
Mutation rate adjusted to: 0.00000061
Mutation rate adjusted to: 0.00000031
Mutation rate adjusted to: 0.00000015
Mutation rate adjusted to: 0.00000008
Mutation rate adjusted to: 0.00000004
Generation 20: Best Fitness = 11.35, Avg Fitness = 11.35
Mutation rate adjusted to: 0.00000002
Mutation rate adjusted to: 0.00000001
Mutation rate adjusted to: 0.00000000
Generation 30: Best Fitness = 11.35, Avg Fitness = 11.35
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Generation 40: Best Fitness = 11.35, Avg Fitness = 11.35
Mutation rate adjusted to: 0.00000000
Generation 50: Best Fitness = 11.35, Avg Fitness = 11.35
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
```

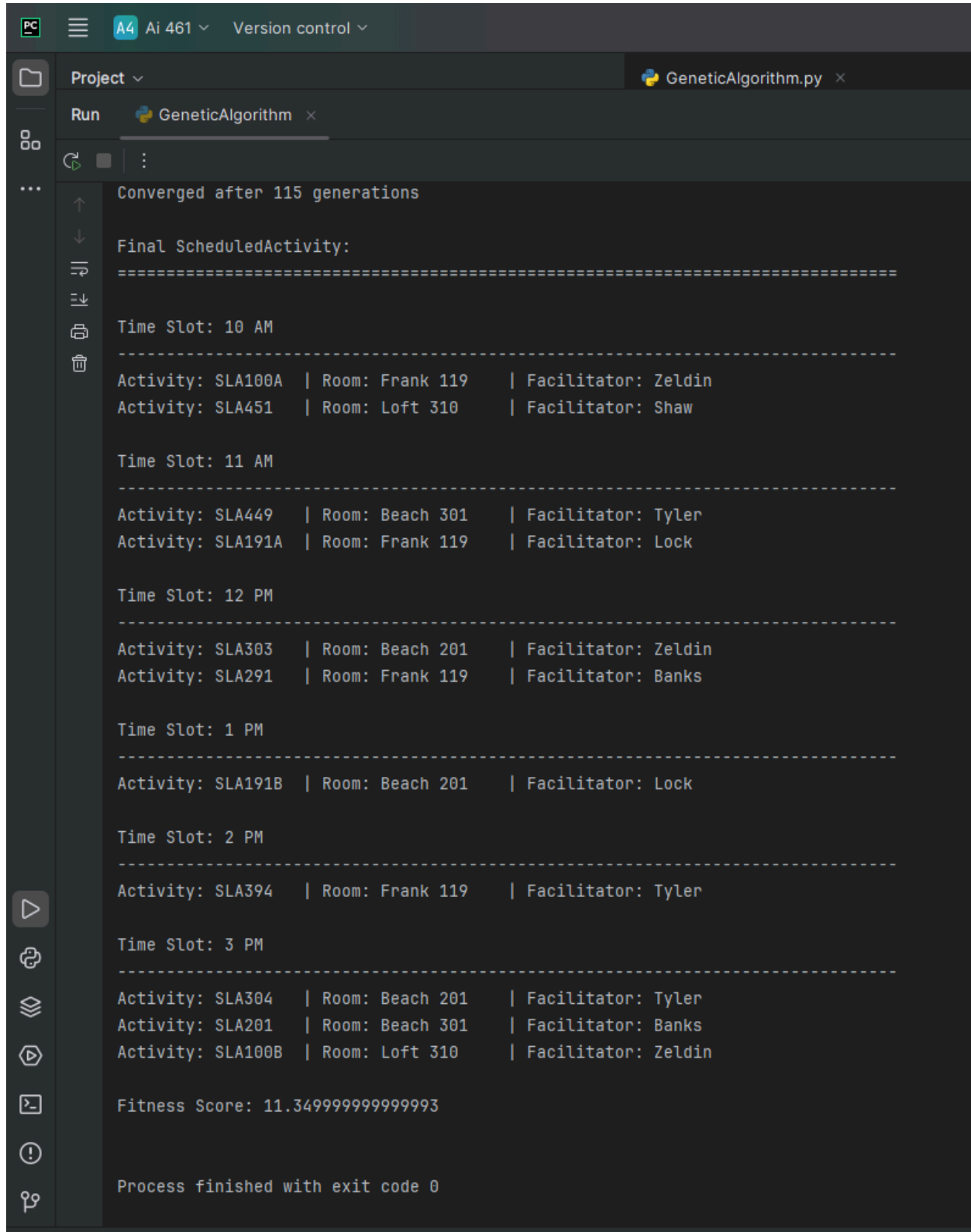


```
PC  A4 Ai 461  Version control  Project  GeneticAlgorithm.py x
Run  GeneticAlgorithm x
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Generation 60: Best Fitness = 11.35, Avg Fitness = 11.35
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Generation 70: Best Fitness = 11.35, Avg Fitness = 11.35
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Generation 80: Best Fitness = 11.35, Avg Fitness = 11.35
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Generation 90: Best Fitness = 11.35, Avg Fitness = 11.35
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Generation 100: Best Fitness = 11.35, Avg Fitness = 11.35
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Generation 110: Best Fitness = 11.35, Avg Fitness = 11.35
Mutation rate adjusted to: 0.00000000
Mutation rate adjusted to: 0.00000000
Converged after 115 generations

Final ScheduledActivity:
=====

Time Slot: 10 AM
-----
Activity: SLA100A | Room: Frank 119 | Facilitator: Zeldin
Activity: SLA451 | Room: Loft 310 | Facilitator: Shaw

Time Slot: 11 AM
```



```
PC A4 Ai 461 Version control
Project GeneticAlgorithm.py
Run GeneticAlgorithm
Converged after 115 generations
Final ScheduledActivity:
=====
Time Slot: 10 AM
-----
Activity: SLA100A | Room: Frank 119 | Facilitator: Zeldin
Activity: SLA451 | Room: Loft 310 | Facilitator: Shaw

Time Slot: 11 AM
-----
Activity: SLA449 | Room: Beach 301 | Facilitator: Tyler
Activity: SLA191A | Room: Frank 119 | Facilitator: Lock

Time Slot: 12 PM
-----
Activity: SLA303 | Room: Beach 201 | Facilitator: Zeldin
Activity: SLA291 | Room: Frank 119 | Facilitator: Banks

Time Slot: 1 PM
-----
Activity: SLA191B | Room: Beach 201 | Facilitator: Lock

Time Slot: 2 PM
-----
Activity: SLA394 | Room: Frank 119 | Facilitator: Tyler

Time Slot: 3 PM
-----
Activity: SLA304 | Room: Beach 201 | Facilitator: Tyler
Activity: SLA201 | Room: Beach 301 | Facilitator: Banks
Activity: SLA100B | Room: Loft 310 | Facilitator: Zeldin

Fitness Score: 11.349999999999993

Process finished with exit code 0
```