Parallelized N-Queens Project Report

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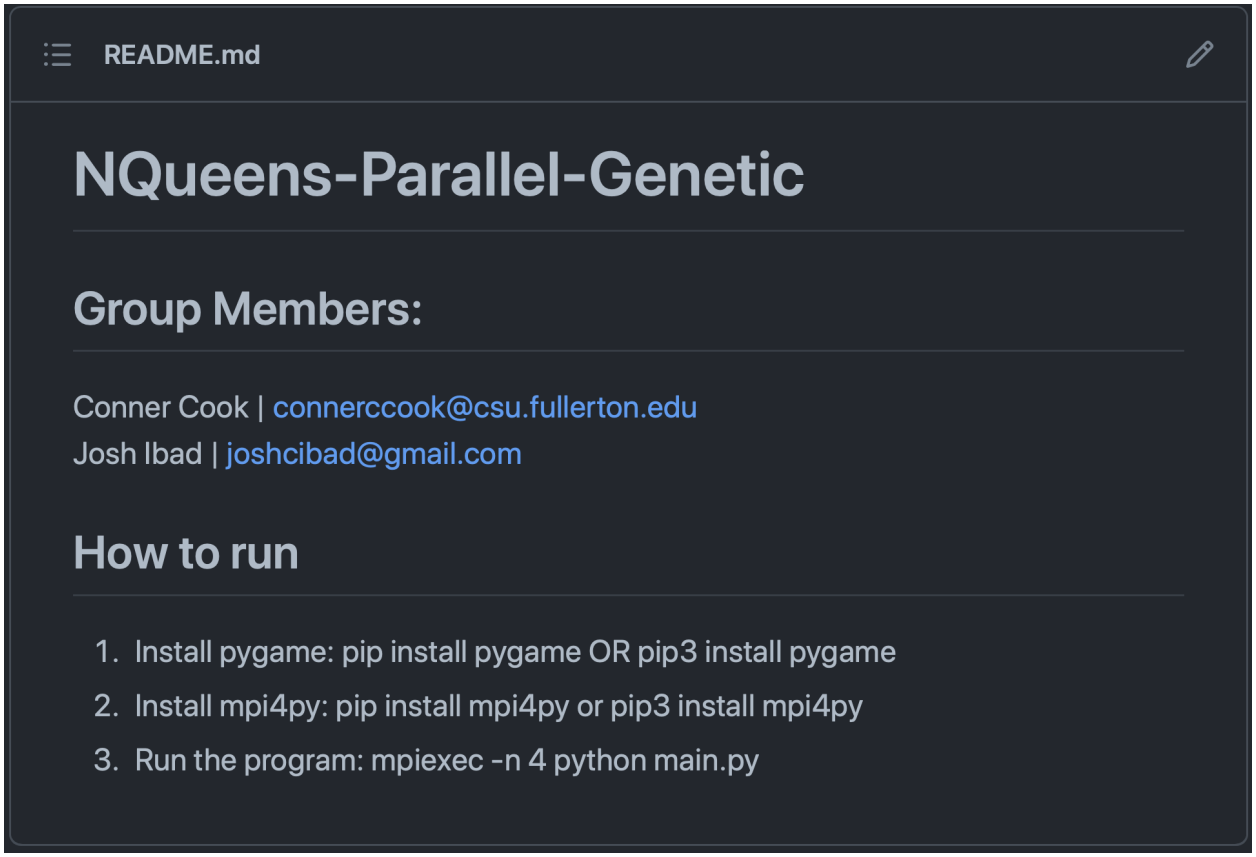
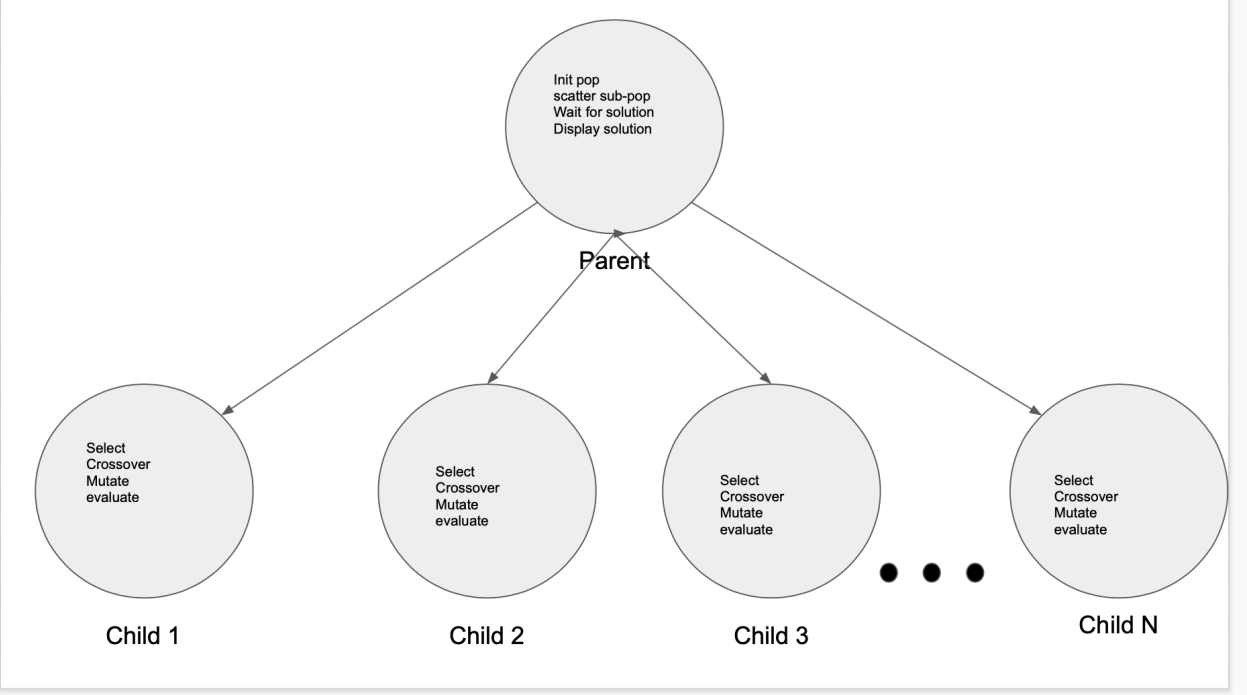
README.md Screenshot:



General UML Diagram:



Pseudocode:

Parent Pseudocode:

```
def genetic_search(N, pmut, n=100):

    # init all the mpi basic variables
    comm = MPI.COMM_WORLD
    p_size = comm.Get_size()
    rank = comm.Get_rank()
    res = none
    solution = none

    # a list of possible elements in a candidate
    gene_pool = list(range(N))

    # broadcast the genepool to child processes
    gene_pool = comm.bcast(gene_pool, root = 0)

    # wait for children to create the subpopulations
```

```
    # gather all the sub populations the childrens made
    Grid_population = comm.gather(sub_population, root=0)

    # merge them into one list
    Population = mergeLists(grid_population)

    Solution_req = comm.irecv(res)

    While solution not found:
        random.shuffle(population)
        #split the list into multiple sublists
        Population = splitList(population, size)

        #scatter the lists to the children
        Sub_population = comm.scatter(population, root=0)

        #wait for correct solution

    return res
```

Child Pseudocode:

```
Sub_pop_size = size of N / p_size

# creates random population of candidates with elements in the gene pool
# and size of population
Sub_population = init_population(sub_pop_size, genepool)

# parent gathers the sub_populations

# receive the randomized sub_populations from parent

while solution not found:

    for child_iter in length of CHILD_ITERATIONS:
        # select_3way_tourny is the selection and crossover function
        res = select_3way_tourny(sub_population, sub_pop_size, gene_pool)
        If res is found:
            comm.isend(res,0,0)

    # mutate some elements for variety
    for candidate in sub_population:
```

```
            mutate(candidate, pmut)

    If solution is found:
            solution = comm.bcast(solution, root = 0)
            return solution
```

How to run:

Install the dependencies:

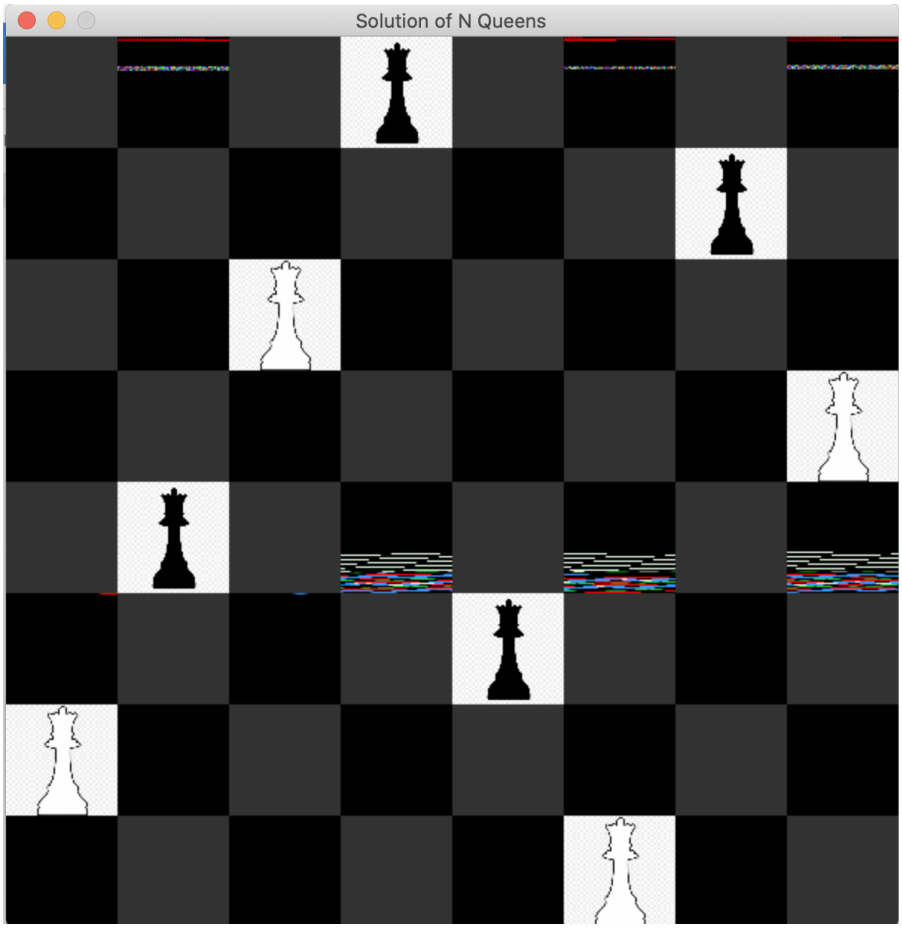
pip install pygame
pip install mpi4py

Run program:

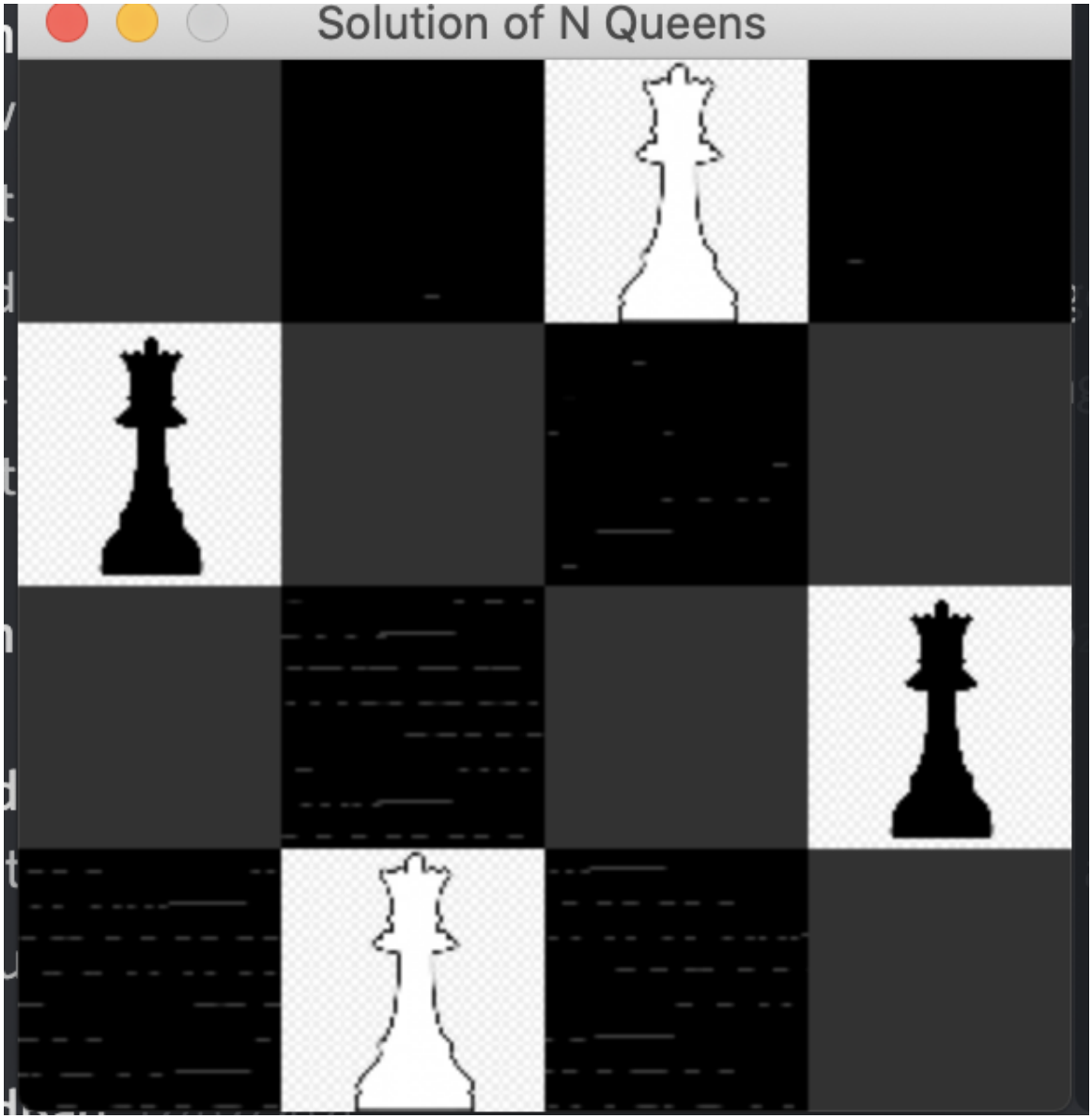
mpiexec -n 2 python main.py

Example Snippets:

```
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 2.2339932918548584 s to run
PS D:\CS\!CPSC_474\project-2-connerjosh> mpiexec -n 4 python main.py
pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
Board size: 12

pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 1.9790351390838623 s to run
pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 1.976034164428711 s to run
pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 1.9730346202850342 s to run
This function took 0.21106362342834473 s to run
[1, 4, 7, 3, 8, 11, 2, 0, 5, 1, 9, 6]
PS D:\CS\!CPSC_474\project-2-connerjosh> mpiexec -n 4 python main.py
pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
Board size: 14

pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 12.888439655303955 s to run
pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 12.89043664932251 s to run
pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 12.885439157485962 s to run
This function took 11.525977611541748 s to run
[5, 10, 2, 0, 12, 7, 4, 13, 1, 8, 11, 3, 6, 9]
PS D:\CS\!CPSC_474\project-2-connerjosh> mpiexec -n 4 python main.py
pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
Board size: 15

pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 7.089092254638672 s to run
pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 7.082091808319092 s to run
pygame 2.1.0 (SDL 2.0.16, Python 3.9.2)
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 7.08708930015564 s to run
This function took 4.495999813079834 s to run
[2, 6, 14, 12, 8, 1, 5, 13, 9, 0, 3, 11, 7, 10, 4]
PS D:\CS\!CPSC_474\project-2-connerjosh>
```




```
project-2-connerjosh on  main [$!?] via 🐍v3.9.5
❯ mpiexec -n 2 python main.py                                          (base)
pygame 2.1.0 (SDL 2.0.16, Python 3.9.5)
Hello from the pygame community. https://www.pygame.org/contribute.html
pygame 2.1.0 (SDL 2.0.16, Python 3.9.5)
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 3.664238929748535 s to run
This function took 0.06104111671447754 s to run
[6, 4, 2, 0, 5, 7, 1, 3]
```




```
project-2-connerjosh on  main [$!?] via 🐍v3.9.5 took 2m1s
❯ mpiexec -n 2 python main.py
pygame 2.1.0 (SDL 2.0.16, Python 3.9.5)
Hello from the pygame community. https://www.pygame.org/contribute.html
pygame 2.1.0 (SDL 2.0.16, Python 3.9.5)
Hello from the pygame community. https://www.pygame.org/contribute.html
This function took 0.00226593017578125 s to run
This function took 1.5602490901947021 s to run
[1, 3, 0, 2]
```