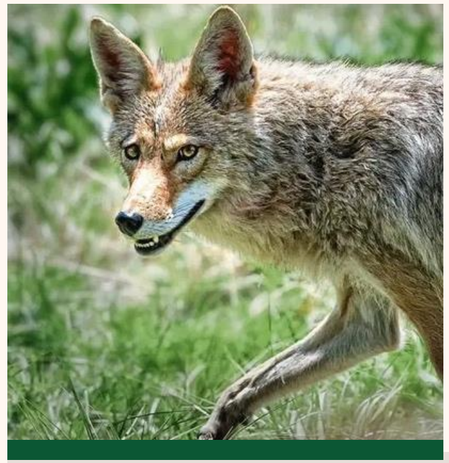
FOXES & COYOTES SIMULATION



SPWC
SANDY PINES WILDLIFE CENTRE

Queen's UNIVERSITY

APSC 103

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4/16/2025

PROBLEM STATEMENT AND GOALS

Sandy Pines Wildlife Centre Struggles to:

- Locate potential canid locations.
- Capture rehabilitated canids.

Computer Simulation Goals:

- Models animal behaviour.
- Optimizes trap placement.

Capture System Goals:

- Humane and minimal stress capture.
- Effective and efficient capture times.

Key Objectives

Requirements:

- Maintainable year-round.
- Within the $10,000 implementation budget.
- Adapt to pre-existing structures in the environment.
- Low maintenance and reusable.

Success Criteria:

- 80% successful when applied to real-life scenarios
- 80% approval rate when used by Sandy Pines Staff
- Changes trap location recommendation based on different inputs

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DESIGN PROCESS OVERVIEW

KEY CHALLENGES

- Finding high quality research on Canids.
- Integrating everyone's different code and debugging code.
- Understanding and fully defining the scope.

1. Defining the problem and scope.
2. Researching Canids, different Simulation Types and Traps.
3. Developing Simulation architecture and planning how to evaluate it.
4. Coding the simulation and iterating through the process.
5. Evaluating the simulation.
6. Documenting and reflecting.

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SOCIAL, ENVIRONMENTAL, AND FINANCIAL CONSIDERATIONS

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- No budget needed; project is entirely simulation-based.
- All tools used were free or provided by Queen’s University.
- Societal and environmental impacts had minimal influence on overall simulation design.
- Environmental impacts were considered during trap method research.
- Focus was on finding safe and humane trapping methods for wildlife.

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FINAL DESIGN SOLUTION

Frontend

- User-Friendly info collection.
- Made using Pygame.
- Conveys information using an easy-to-understand heatmap and grid.

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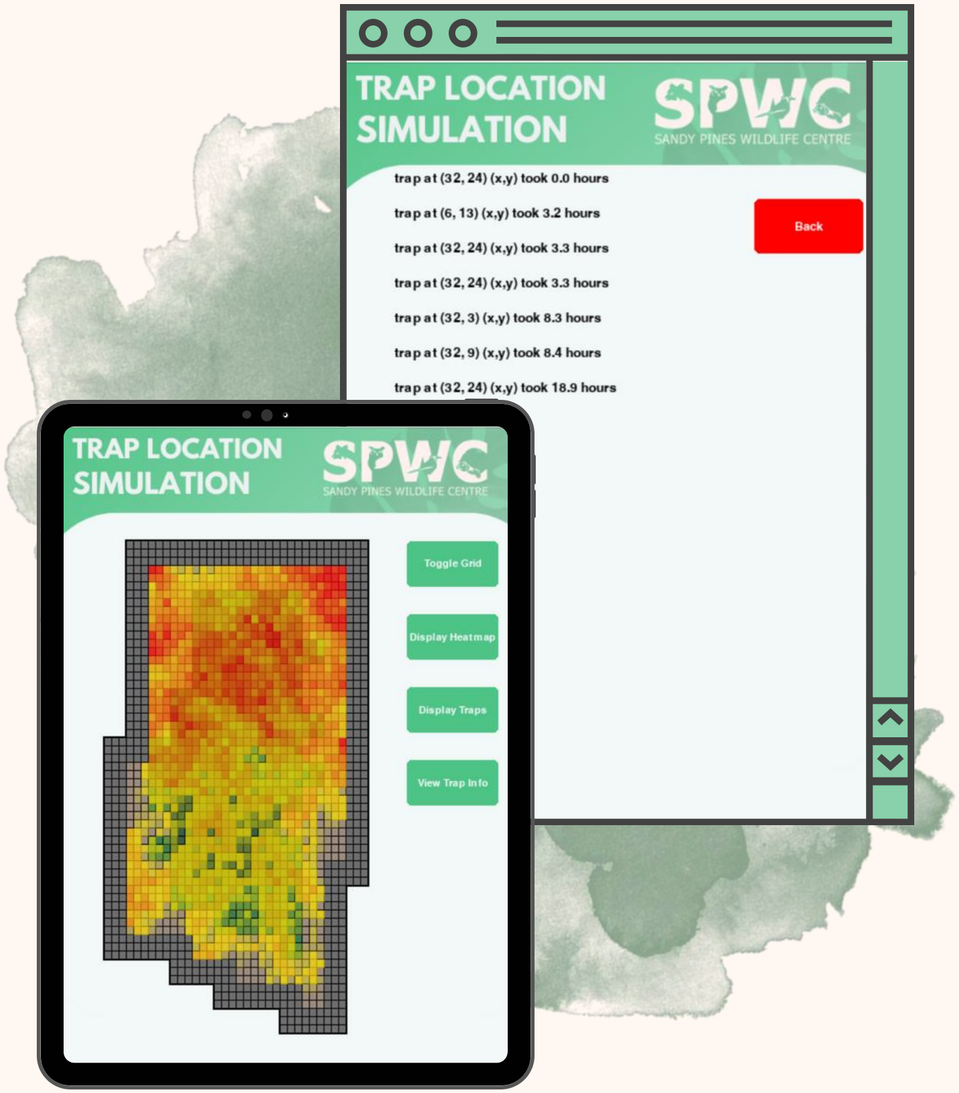

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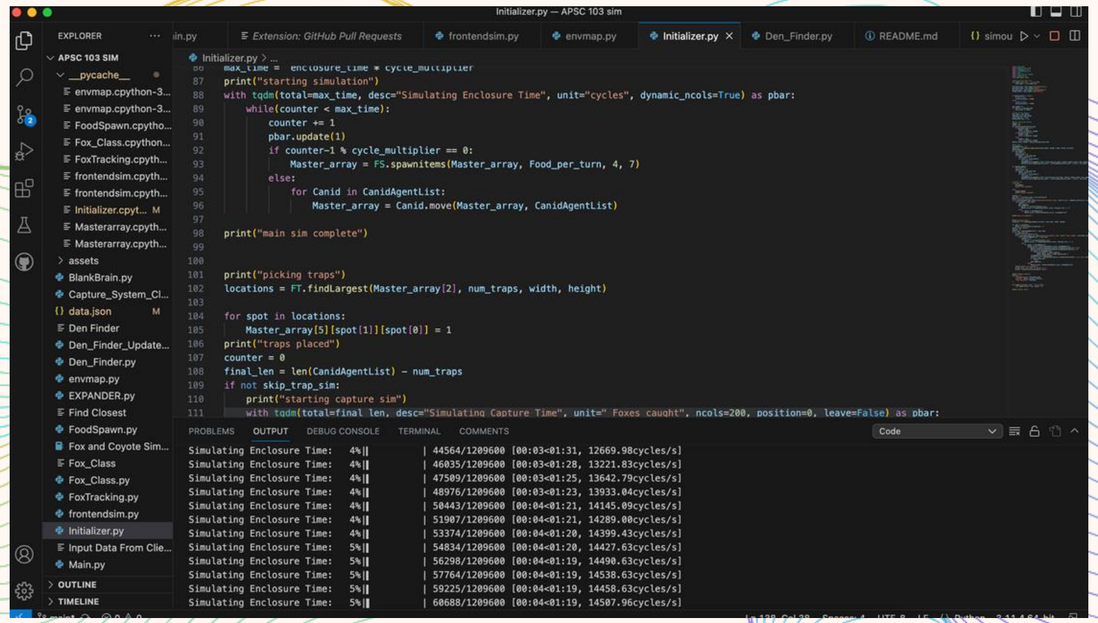
FINAL DESIGN SOLUTION

Backend

- Works using an agent-based model.
- Uses researched behaviours.
- Loops through all foxes, then outputs data.




```
Simulating Enclosure Time: 100%|██████████| 1209422/1209600 [02:11<00:00, 13265.40cycles/s]
Simulating Enclosure Time: 100%|██████████| 1209600/1209600 [02:11<00:00, 9187.28cycles/s]
main sim complete
picking traps
traps placed
starting capture sim

Simulating Capture Time: 0 Foxes caught [00:00, ? Foxes caught/s]trap at 1616 (x,y) took 3.4063888888888885 hours to capture the canids
trap at 2516 (x,y) took 3.474722222222222 hours to capture the canids
trap at 1716 (x,y) took 3.4822222222222226 hours to capture the canids
trap at 1021 (x,y) took 8.43138888888889 hours to capture the canids
```

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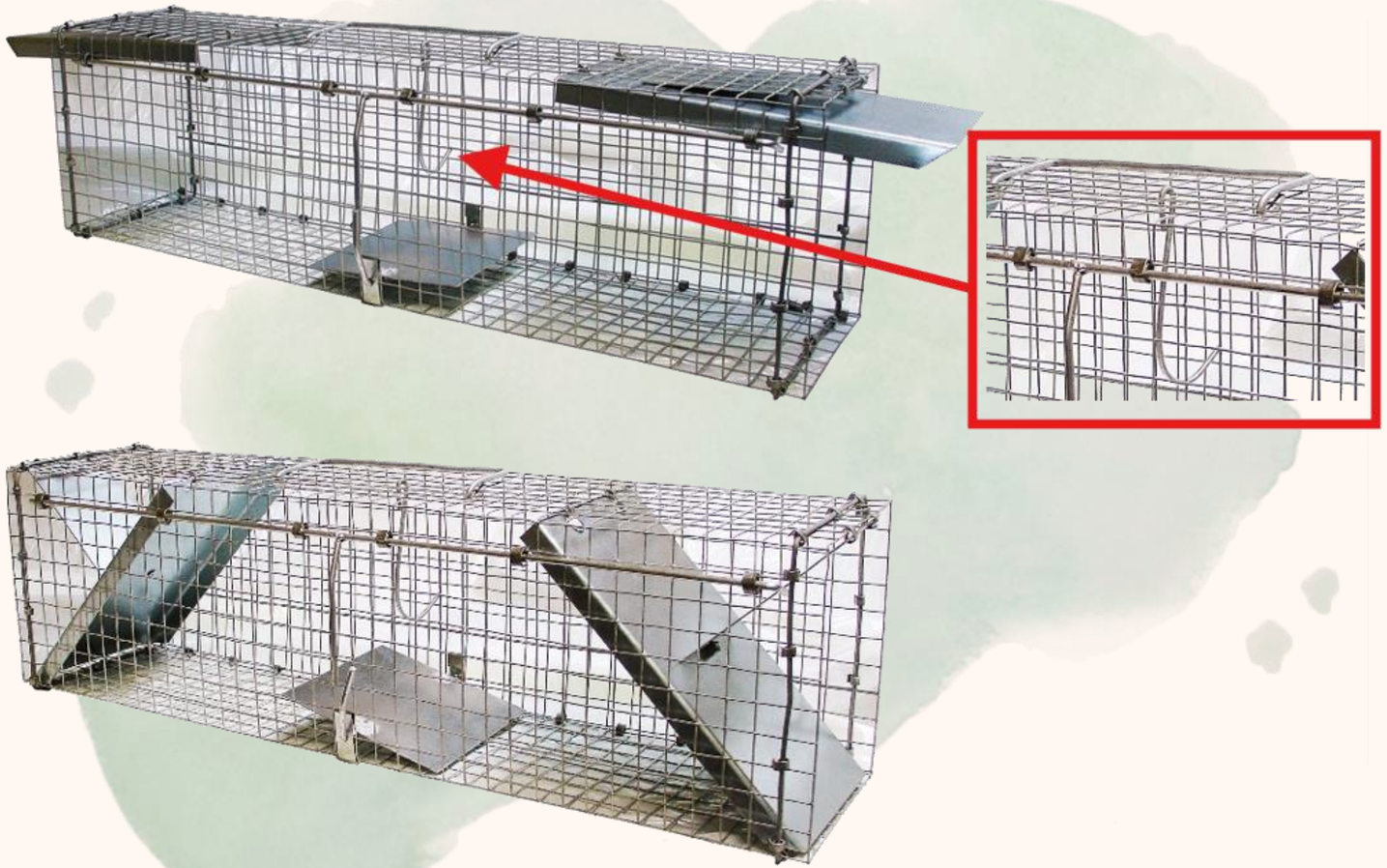
FINAL DESIGN SOLUTION

Traps

- Locations are determined through the simulation.
- We suggest a safe shelter trap disguised to mimic a den environment.
- Can be found commercially
- (starting at 205 CAD).



EVALUATING SOLUTIONS

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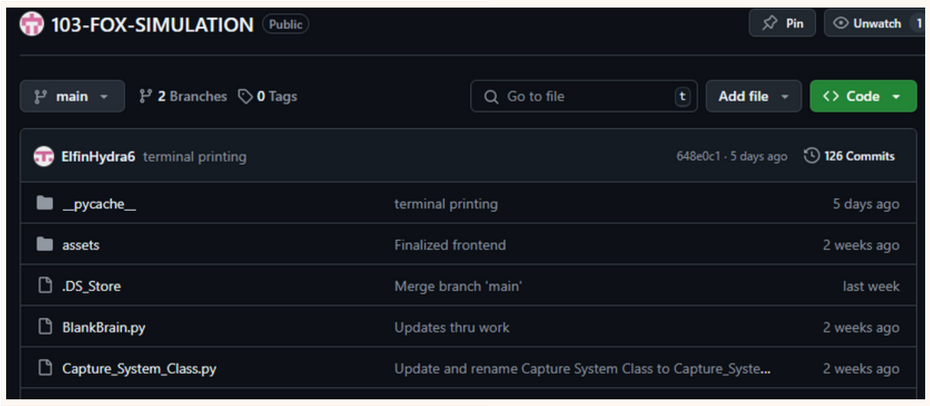
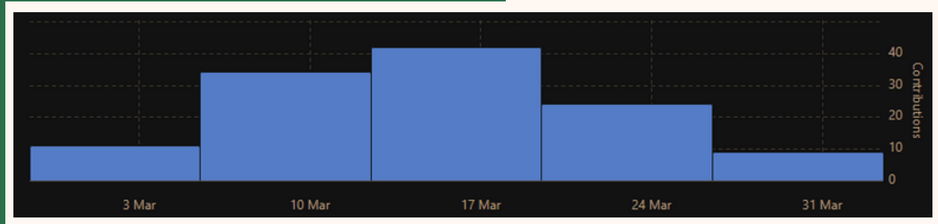
Requirements

- Passes Trap Requirements ☑
- Frontend Survey Results Pass ☑
- Back End Tests Pass / Efficient Capturing ☑
- Troubles Targeting Specific Canids ☒

AREAS FOR IMPROVEMENT

GITHUB





Lessons Learned

- Version control through Git was crucial for collaboration and avoiding merge conflicts.
- Setting aside sufficient time for testing and evaluating the final model.
- Clear communication prevents duplication of work and ensures task alignment.

Potential Improvements

- Refactor codebase to improve performance and reduce redundancy.
- Gathering more research data on foxes and coyotes to enhance the canid brain.
- Introduce more complex environment dynamics.

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AFTER PROJECT CONSIDERATIONS

- Code is being delivered to the clients through a GitHub link and executable file (as shown in the demo later).

- There is no physical prototype to dispose of or deliver to the clients.

CONCLUSION & NEXT STEPS

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SUMMARY OF KEY POINTS

- Developed a fully code-based simulation modelling agent-environment interactions.
- The system supports trap placement, environment evolution, and autonomous agent behaviour.
- The design met the project objectives and is openly accessible on GitHub.

FUTURE RECOMMENDATIONS

- Implement **reinforcement learning** to optimize agent decision-making.
- Expand the simulation to support **multi-agent scenarios**.
- Deploy the simulation in a **browser-based interface** for accessibility.
- Gather user testing **feedback** for usability improvements.

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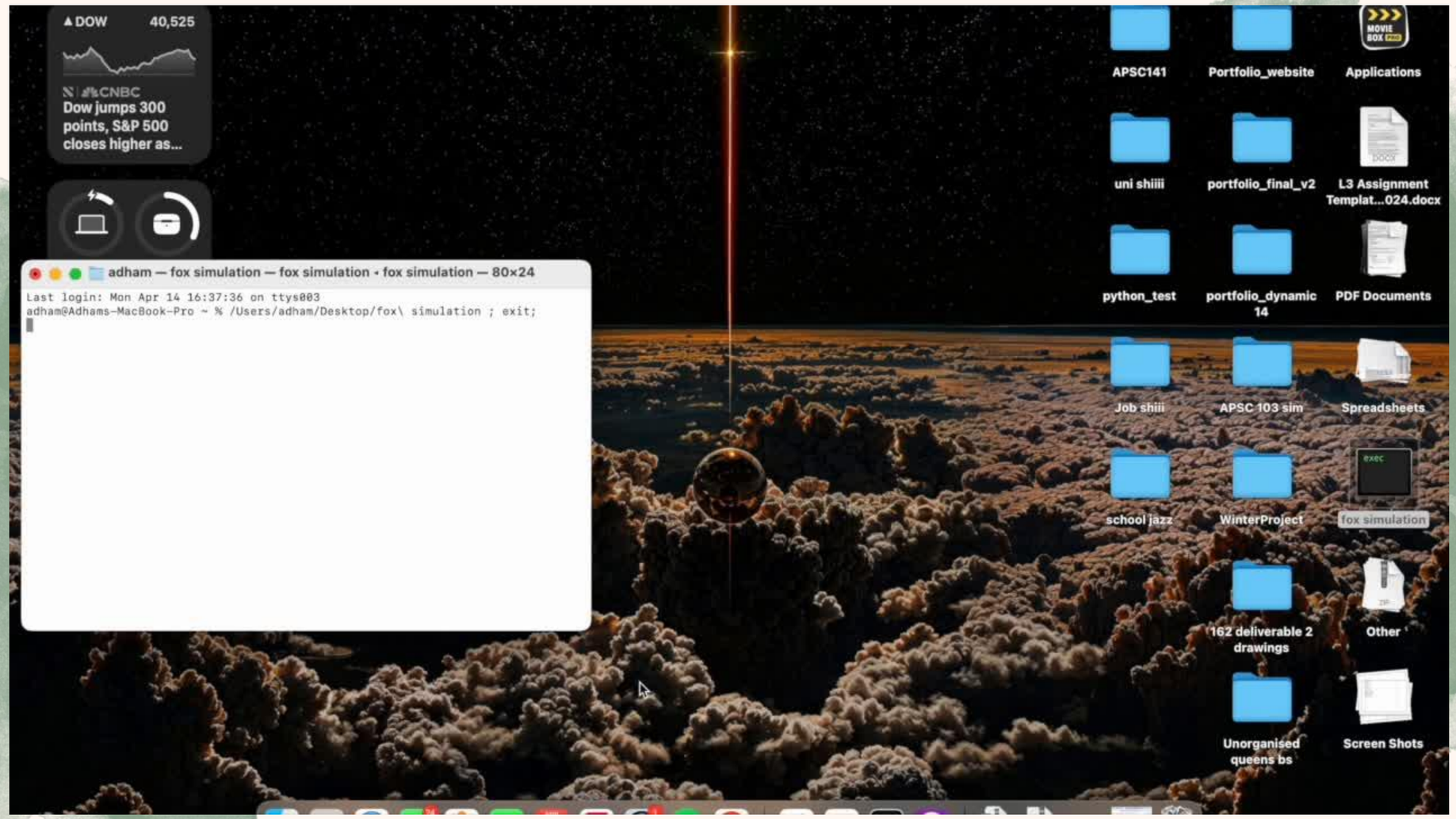
DEMO



THANK YOU

DON’T HESITATE TO ASK QUESTIONS !

Together, we can make a difference for wildlife.

HTTPS://843C.CARRD.CO/

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