Final Project

EC 400

November 15, 2021

Assignment. Your final project is simple: improve the performance of Coding Exercise 5 as much as you can.

Possible directions to explore:

- Build a better controller.
- Build a better planner. You could do this by generating more images and training a larger convolutional network.
- You could try building a neural network to predict whether there is something in the image ahead that is concerning (e.g., a turn) and pass that information into the controller to adjust your velocity. One possibility: try to predict whether the aim-point will change in the next few seconds.
- Use reinforcement learning to train your system end-to-end. This will be difficult. I would recommend:
  - Try using deep Q-learning first.
  - Replace your controller by a neural network which does something very similar to your actual controller. This will require figuring out how to initialize weights properly.
  - See if you can start the cart in a place where it does particularly poorly and train it just on that stretch.
  - Make sure to look at all the things you can do in https://readthedocs.org/projects/pystk/downloads/pdf/latest/

In general, you can use any technique you want.

What you have to turn in: Your final code and a ten page report outlining what you tried. I want to read about not just what worked but also what didn't work. You should be responsive to questions from me as I grade your code. **You will also have to give a 10-15 minute presentation in class describing what you did.** This presentation will be given on the last day of class.

Grading: You will be graded on:

- The clarity of your writeup and your ability to explain clearly what you did during your presentation.
- Plausibility of your efforts. This is a pass/fail that you will pass if you do not do something insane.
- Your effort (see more below)

You will **not** be graded on how much you ended up improving the times you attained in coding assignment 5.

On effort: Your last homework assignment is due on Nov 17. Your presentation is on Dec 10. That is three weeks, i.e., 15 weekdays. I will subtract three days for thanksgiving break, so that you have 12 weekdays to work on this.

I will assume that each person devotes one hour per day to this class. So the final amount of work I expect is $12 \times$ number of group members $\times 0.8$ hours. I am multiplying by 0.8 because I'm assuming time will be lost due to meetings and coordination problems. So in a six-person group I am expecting $12 \times 6 \times 0.8 = 57.6$ hours of work total.

In particular, **you will not lose points if you try things and they fail.** Instead, what I want to see is evidence that you put in the work. If things fail, document the failures. Turn in the code of things you tried that did not give improvements. If you tried hard to rewrite the PyTuxKart code in a certain way but did not get it to compile, keep evidence of this.

As I listen to your presentation and read your report, I will be estimating how much work you put in. If you put in the required amount of work, you will receive an a 100% on the final project. Because estimation of effort from the final result is not completely precise, I will make sure to err in your favor. If you went very far above and beyond, I will give you more than 100%.

I will also distribute a survey to all of you asking to estimate how much your team members did. I will then decrease the grades of team-members who under-performed. This will be based on interviews with you and the other team members. In general, if X is how much work I am expecting you to do, and Y is how much you actually did based on my estimate, then $\min(Y/X, 100\%)$ will be your numerical score.

I will give a single letter grade bonus to every member of a team that attains the best performance (all tracks, including Cocoa Temple). I will also give a letter grade bonus that every member of a team which uses a "pure RL" approach. These bonuses will not be applied to team members who did not put in the work, as determined by surveys and my interviews with team members. It is possible for a single team to obtain both bonuses.