Modern Computer Games

COMP 521, Fall 2021

Assignment 4

Due date: Friday, December 3, 2021, by 6:00pm

Extension: no penalty if handed in by Monday, December 6, 2021 8:00am

Note: Late assignments will only be accepted with prior **written** permission of the instructor. Please make sure your code is in a professional style: **well-commented,** properly structured, and appropriate symbol names. Marks will be very generously deducted if not!

Description

In this assignment you will build a goal-oriented game AI within Unity.
You must implement the AI system entirely yourself: **do not use any built-in or external implementations, assets, or tools for game AI**. This, however, does not extend to actual pathfinding—you may Unity's internal NavMesh (or any other pathfinding implementation) to navigate characters from one specific location to another specific location.

1. You will first need a basic game level. This assignment requires a bounded rectangular area, styled as an outdoor terrain with a random, but relatively sparse distribution of trees and some garbage cans as well. Tree and garbage can locations should be different on each playthrough, non-overlapping. Your terrain will need to hold 10 trees and 5 garbage cans, while still allowing easy navigation through the area. Provide a first-person view for the player character (camera). **5**

2. Trees should spawn nuts on the ground (non-overlapping) near them, about one every 2s and up to a maximum of 5 nuts at any one time in order to maintain a finite, (slowly) replenished supply. Garbage cans can be in either full or empty states, with their state initialized randomly. Once every 10s garbage cans may change state, provided no squirrels are in them (see below). The existence of nuts and the state of the garbage cans should be visually apparent. **5**

3. The terrain is populated with 5 squirrels, each of which is controlled by its own goal-oriented AI system. Each squirrel is associated with (and initially spawned at) a unique tree (its home tree). Squirrels generally explore and exhibit some kind of simple idle behaviour, gather food (either nuts or whatever they find in garbage cans) which they bring back to their home tree, and practice self-preservation by running away from a player who gets too close.

   Squirrels can observe their current state of the world around them (visual range is up to you) and retain limited memory of past observations, remembering only the locations of the last 5 nuts they observed, the current closest (based on Euclidean distance) tree, and the last 2 garbage cans. Squirrels cannot distinguish between empty and full garbage cans (without actually investigating them).

   The squirrel AI will be based on GOAP. Define an appropriate world state and set of actions with corresponding pre/post-conditions that would allow your squirrels to build plans that achieve their goals. Your design should enable the following behaviours.

   - At least two idle behaviours, one of which involves roaming/exploring randomly.
   - The ability to pick up nuts and bring them back to their home tree. Squirrels should only be able to hold at most 3 nuts at one time, and must reach the home tree in order to drop the nuts.
   - They sometimes gather food from garbage cans (at most one squirrel at a time). If the can is empty they remain stuck in the can for 2s, and if the can is full then they immediately acquire the food and the can is set to empty. Squirrels can only hold 1 unit of garbage at a time, may not combine that with nuts, and also must reach the home tree in order to deposit the food.
   - If the player comes too close (choose a reasonable distance) they immediately flee, seeking refuge in a tree until the player is further away. No more than one squirrel can be in a given tree at the same time.

In a *separate document* describe each component of the world state-vector. List each action and show its pre/post-conditions. For each of the above behaviours describe at least one series of actions that would result in that behaviour. **12**

4. Implement your own GOAP-based AI using your action set and world state. You may use any search approach you wish (but implement it yourself). The plans created by each squirrel should be shown (text is ok), so it is possible to verify that plans are being created, followed, and when re-planning occurs. **12**

5. The player impacts the AI since squirrel's run away. Pressing the space-bar should toggle the player in/out of a ghost-mode, during which the squirrels ignore the player. **6**

   In ghost-mode, the player can create or destroy nuts or toggle the state of a garbage can by clicking on an empty spot on the ground or on a nut or an unoccupied can respectively. Verify that the squirrels react and adjust plans accordingly.

What to hand in

Assignments must be submitted on the due date **before 6pm**. Submit your assignment to *MyCourses*. Note that clock accuracy varies, and late assignments will not be accepted without a medical note: **do not wait until the last minute**.

Include all source code necessary to run your simulation.

This assignment is worth 15% of your final grade. **40**