University of science

Vietnam National University Ho Chi Minh City

Report: Searching Solver with NetLogo

Cource: Introduction to Artificial Intelligent

Lecturer:

Nguyen Ngoc Thao

Le Ngoc Thanh

Ho Chi Minh, 03/04/2022

Table of contents

I/ Members:

Le Nguyen Nguyen Anh - 20127438

Le Anh Kiet – 20127542

Dang Hoang Thai - 20127623

Our git repository: https://github.com/nnaaaa/SearchingSolver

II/Assigment Plan:

Dates	Content
15/03/2022 – 22/03/2022	Research before making the project
23/03/2022 – 26/03/2022	Making main file
27/03/2022 – 28/03/2022	Complete base of GBFS, A*, UCS, BFS, DFS
29/03/2022-30/03/2022	Fixing bugs
31/03/2022-03/04/2022	Adding levels and fixing bugs, making videos
03/04/2022 – 05/04/2022	Making video about tests case and write report.

III/Self-assessment:

No.	Criteria	Progress
1	Requirement 1	100%
2	Requirement 2: Level 1	100%
3	Requirement 2: Level 2	100%
4	Requirement 2: Level 3	100%
5	Generate at least 5 test cases for each level with different attributes. Describe them in the experiment section of your report. Videos to demonstrate.	100%
6	Report your algorithms, experiments with some reflection or comments.	100%

IV/Algorithms:

+GBFS: Expanding the most promising node chosen according to a specified rule.

+A*: At each iteration of its main loop, A* needs to determine which of its paths to extend. It does so based on the cost of the path and an estimate of the cost required to extend the path all the way to the goal. Specifically, A* selects the path that minimizes.

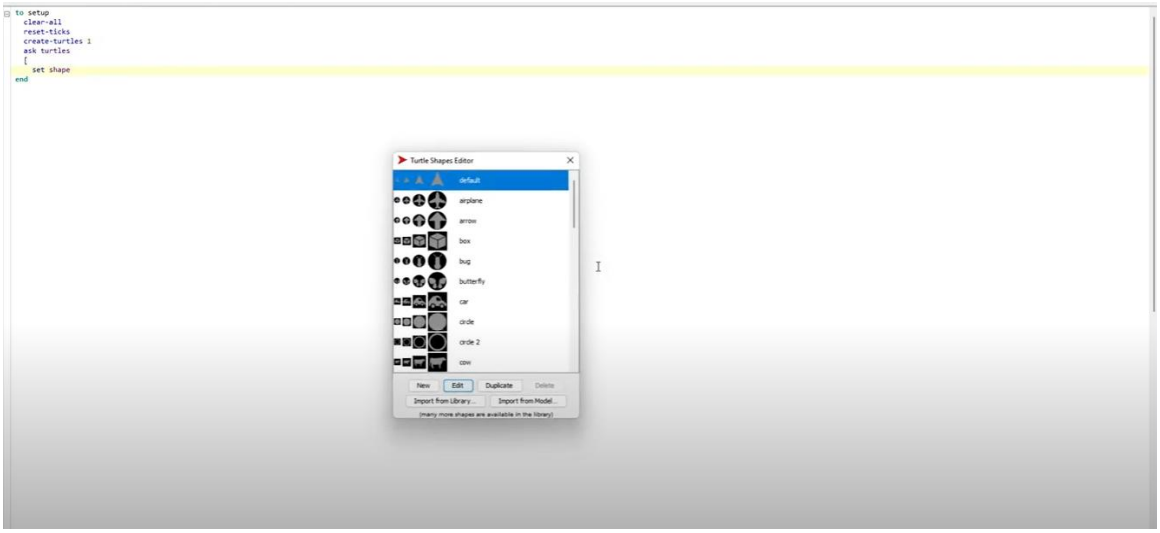
+UCS: Insert only source, then one by one insert when needed. In every step, we check if the item is already in priority queue (using visited array). If yes, we perform decrease key, else we insert it.

+BFS: Is an algorithm for searching a tree data structure for a node that satisfies a given property. It starts at the tree root and explores all nodes at the present depth prior to moving on to the nodes at the next depth level. Extra memory, usually a queue, is needed to keep track of the child nodes that were encountered but not yet explored.

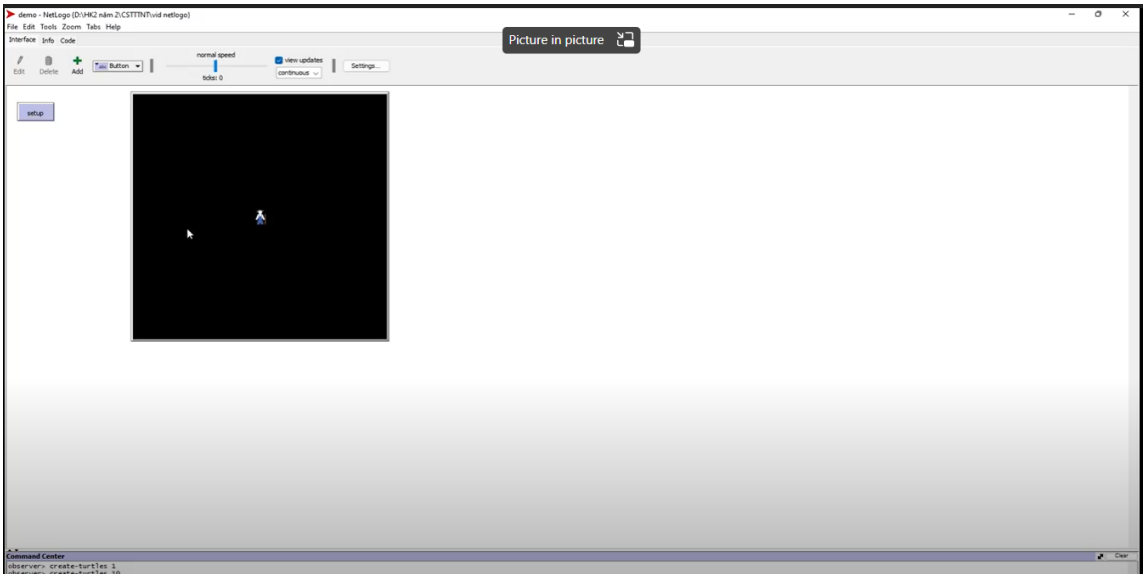
+DFS: Is an algorithm for traversing or searching tree or graph data structures. The algorithm starts at the root node (selecting some arbitrary node as the root node in the case of a graph) and explores as far as possible along each branch before backtracking.

V/Requirement 1 research:

_Show agent shapes:



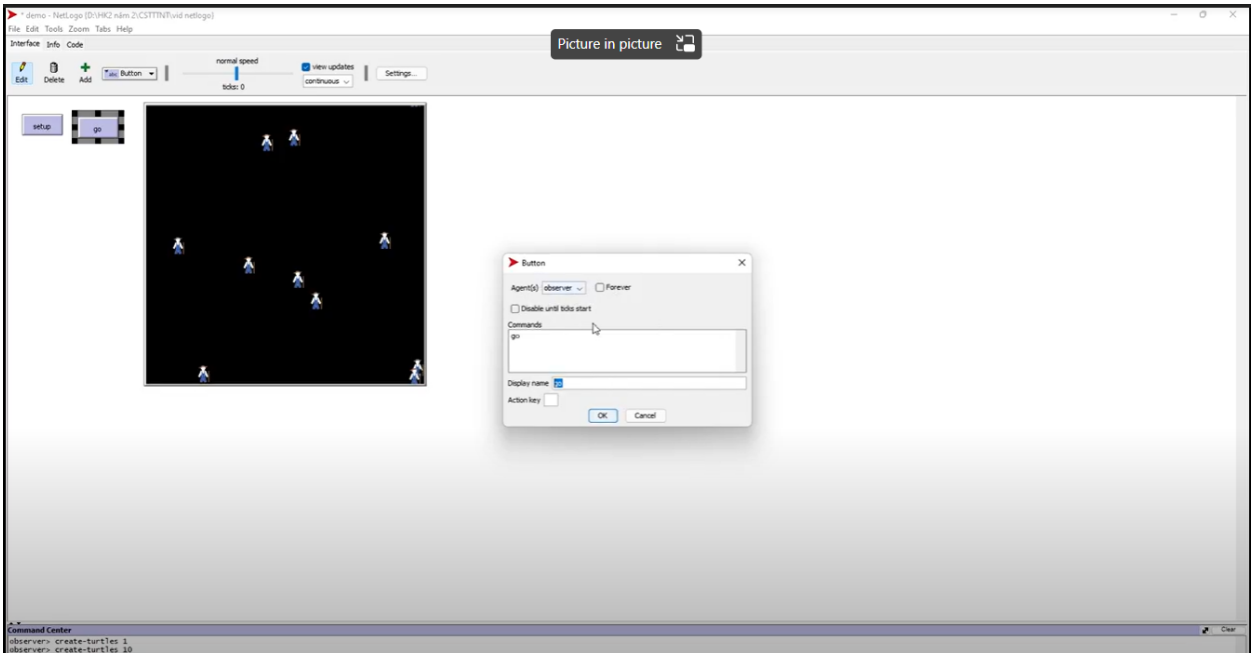
Picking a shape for the agents



After picked a shape (default is a arrow)

We will use the “set shape” command to set it’s icon, we will use this to set the agent as a humand and a house symbolize for agents and destinations.

_Show buttons:



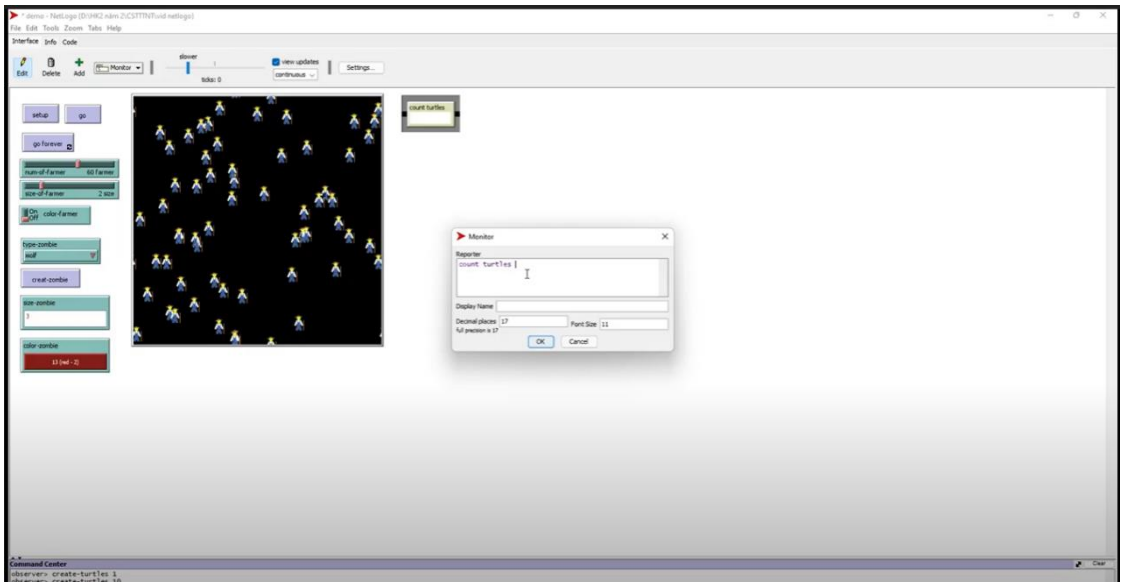
Creating a button with the go function

The button is where user can click on it to trigger a function, we will use it for several purpose

_Showing running parameter of agents:

```
turtles-own [pathogens?]
to setup
  clear-all
  reset-ticks
  create-turtles num-of-farmer
  ask turtles
  [
    set shape "person farmer"
    set size size-of-farmer
    set pathogens? false
    switch-color
    setxy random-xcor random-ycor
  ]
end

to switch-color
  ifelse color-farmer
  [ set color white]
  [ set color yellow]
end

to go
  ask turtles
  [
    ifelse coin?
    [right random 60] [ left random 60]
    forward random 4
    if any? turtles-here with[pathogens?]
    [set pathogens? true]
    if pathogens?
    [
      set size size-zombie
      set color color-zombie
    ]
  ]
end

to-report coin?
  report random 2 = 0
end

to create
  ask one-of turtles
  [
    set size size-zombie
    set color color-zombie
    set pathogens? true
    if type-zombie = "person farmer"
    [set shape "person farmer"]
    if type-zombie = "wolf"
    [set shape "wolf"]
    if type-zombie = "sheep"
    [set shape "sheep"]
  ]
```

Example code of zombie infection

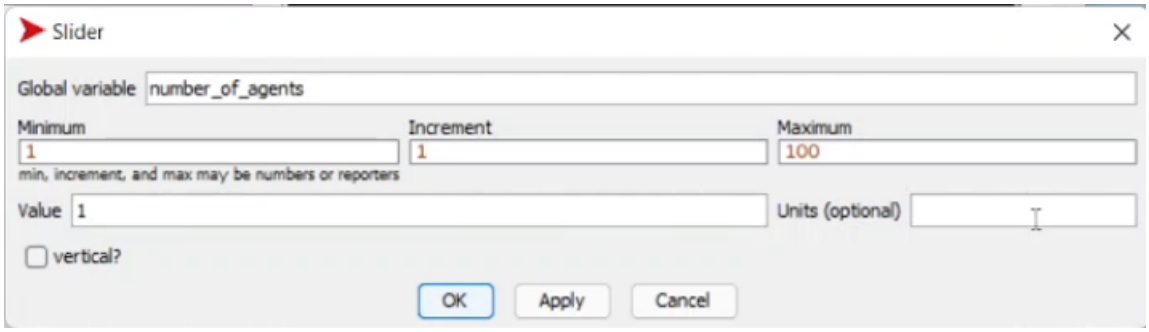


Creating the plot for counting zombie

The plot will count the size of variable, we will use this for determine which algorithm will run fastest.

_Create utilities:

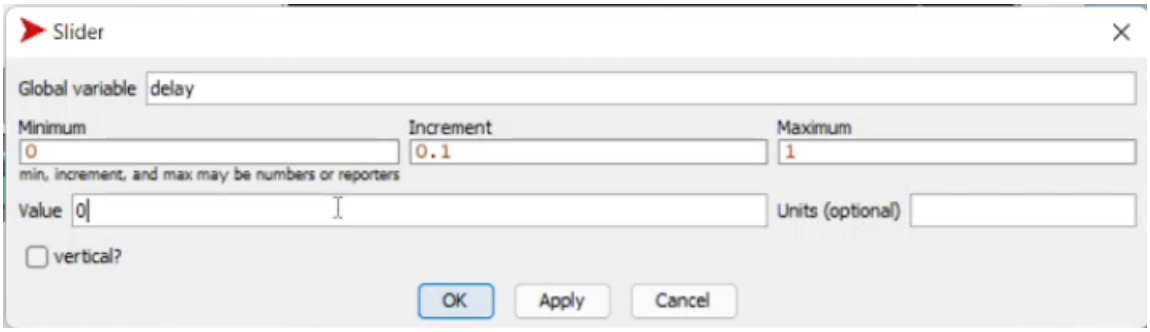
+Slider:



Window when create a slider for setting the number of agents

```
breed [commuters commuter]
to generate-commuters
  ask commuters[die]
  create-commuters number_of_agents[
    set shape "turtle"
    setxy random-xcor random-ycor
  ]
end
```

Code for using the variable number_of_agents



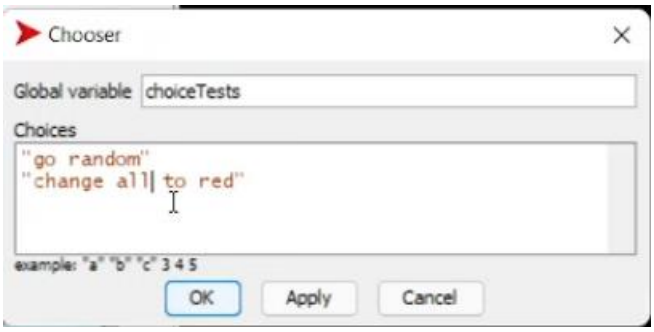
Parameter for using slider as a delay indicator

```
to go
  wait delay
  ask commuters[
    forward random 5
  ]
end
```

Code for use the variable delay

A slider is a bar that create a global variable and change it according to where on the bar that the user drag, in this project, we will use it for change number of agent and speed of the program.

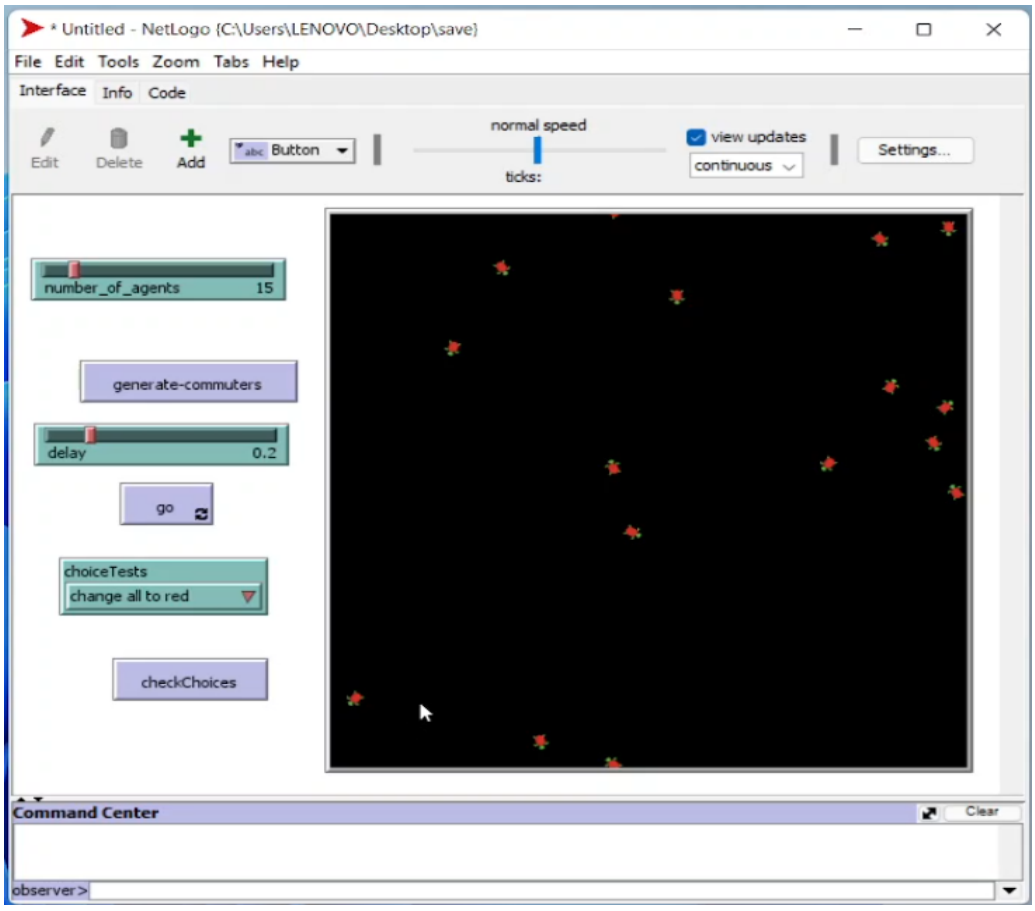
+Chooser



Window for create a example of the chooser

```
to checkChoices
  ask commuters[
    if choiceTests = "go random" [forward random 5]
    if choiceTests = "change all to red" [set color red]
  ]
end
```

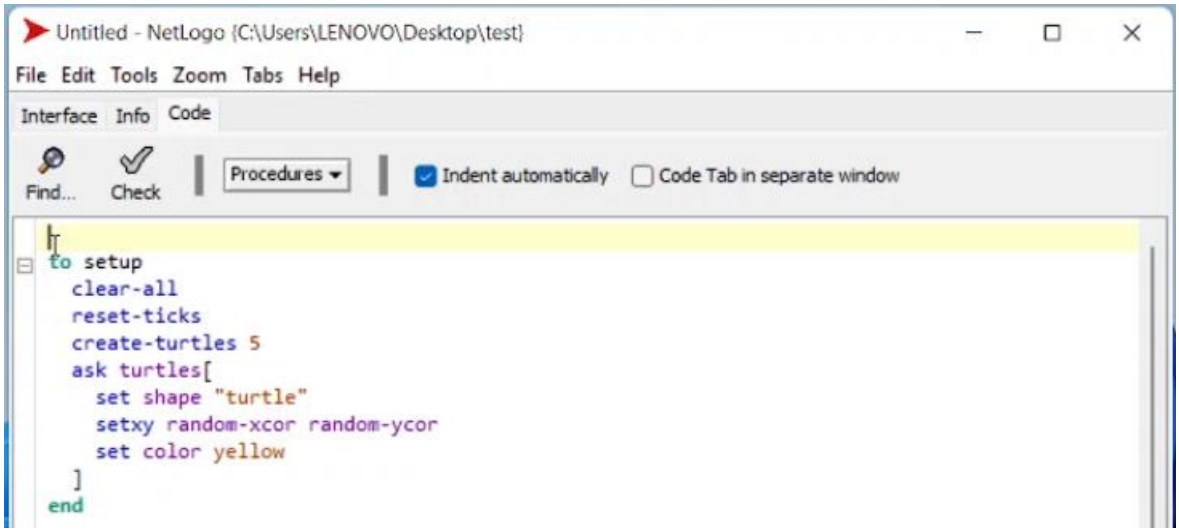
Code for using the variable choiceTests



Result of the example

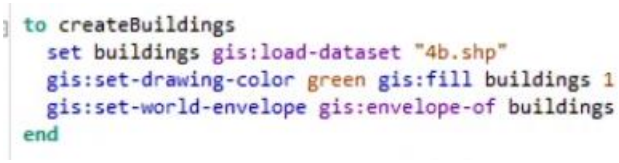
A chooser is a dropdown list that the user can pick an option, we will use this for change the map and change the algorithms when the agent start to walk on the returned path.

_Color agent and the environment:

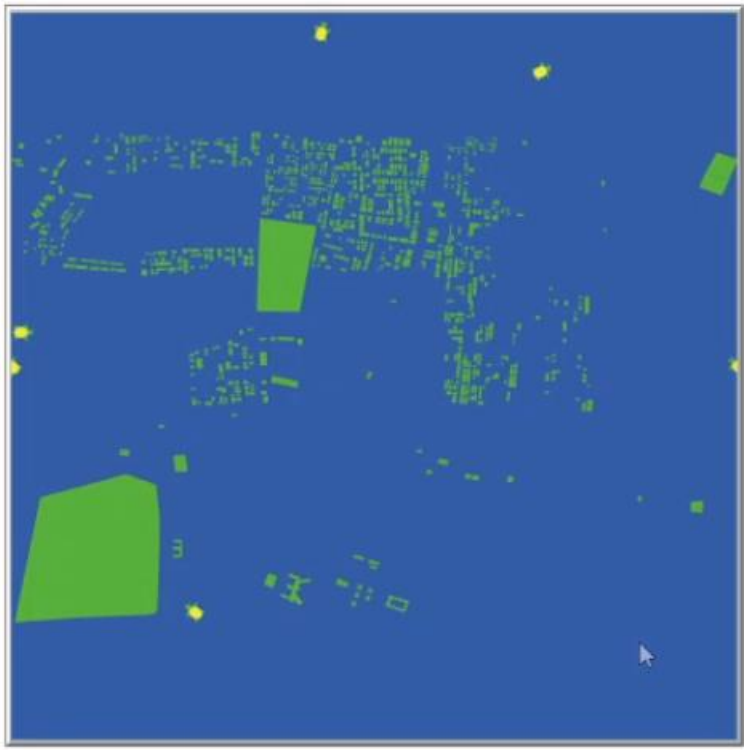


Example code for change color of all agent to yellow

Example code for change color of the background



Example for import map and change color of the building



Result of example

We will use the default command of netLogo and command from the extension gis (because we will use the open street map and qgis in this project) in order to mark the algorithms and the buildings.

VI/Experiments and comments:

Note: With level 1 and 2 we will first color the road it went throught to find the route and when the path is return it will change color, when the agent walk it will delete the parts of return part respectively. Level 3 we will only change the color of the agent and draw the return path. Comments on every test cases will be given through the videos.

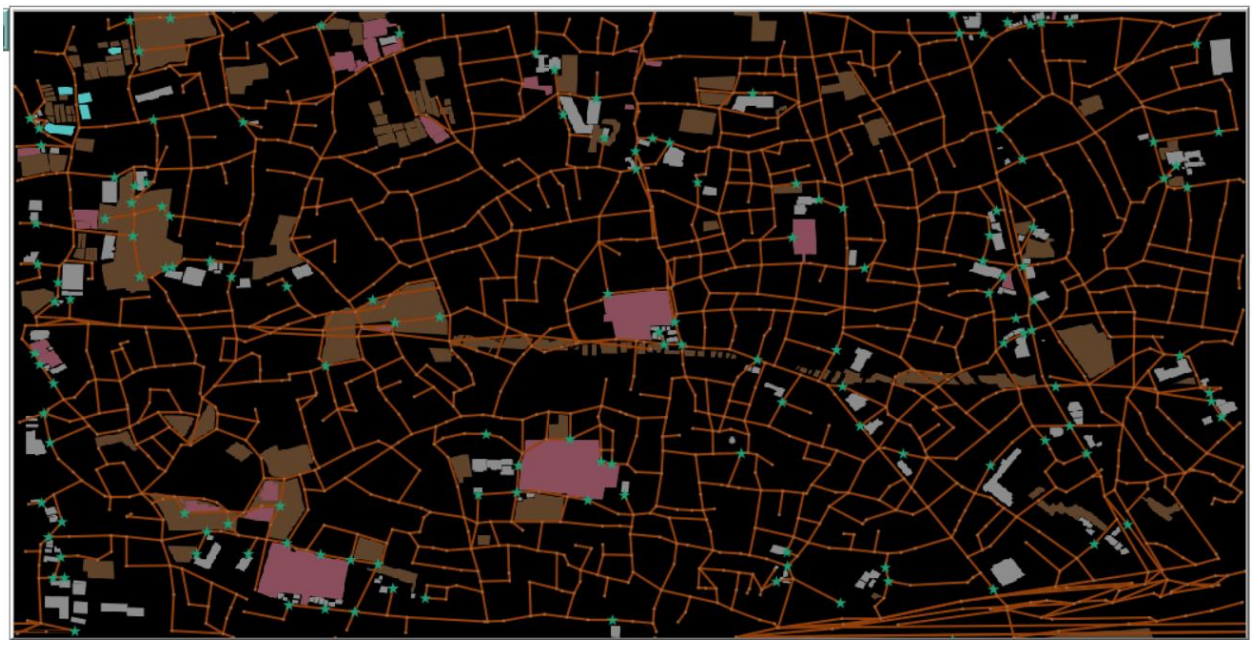
The map

_Maps we used in the project contain 5 maps:

+Tokyo - Japan:

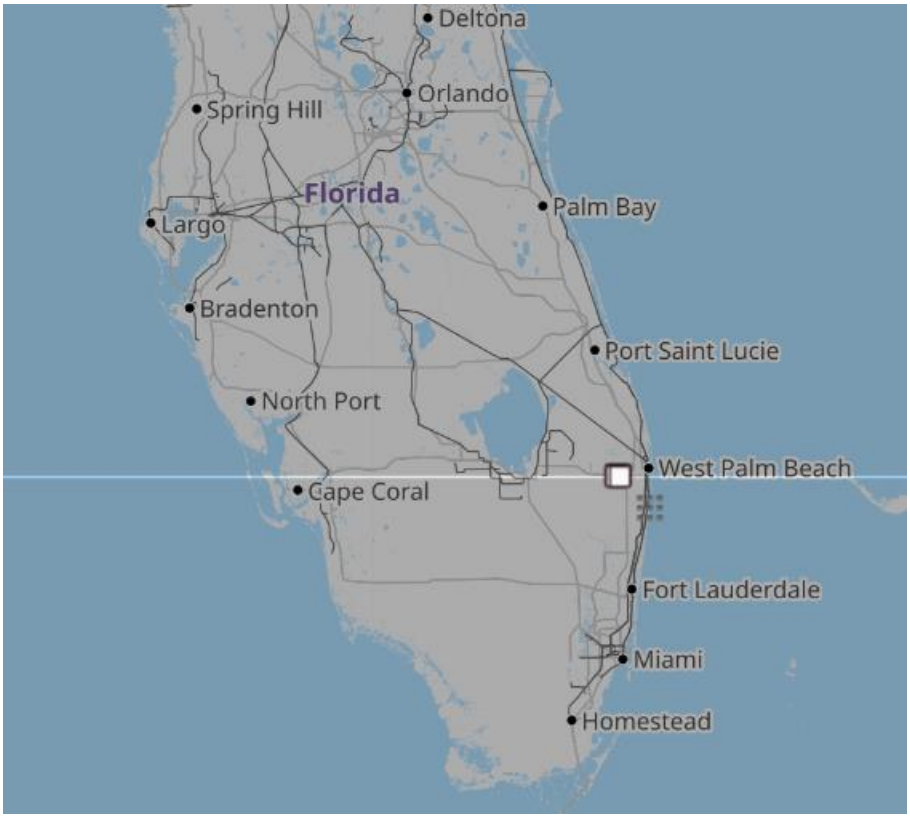
Area in Tokyo we took from far above

Details of the area we took in Tokyo

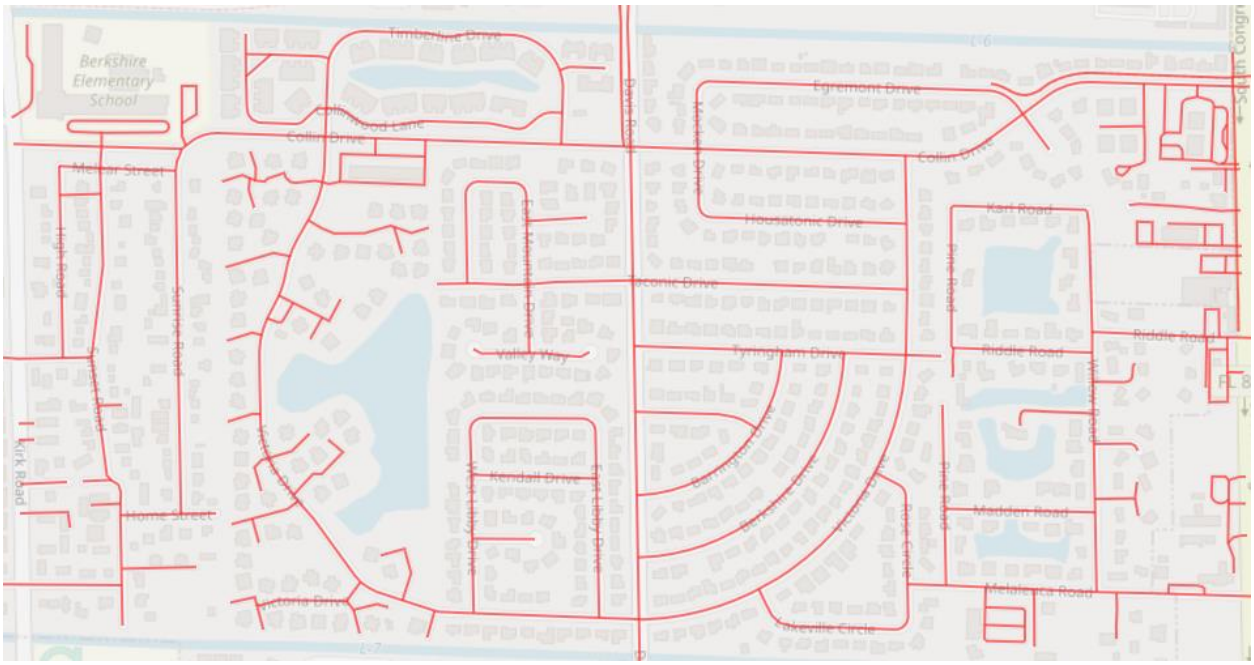


Tokyo map in NetLogo by using gis extensions

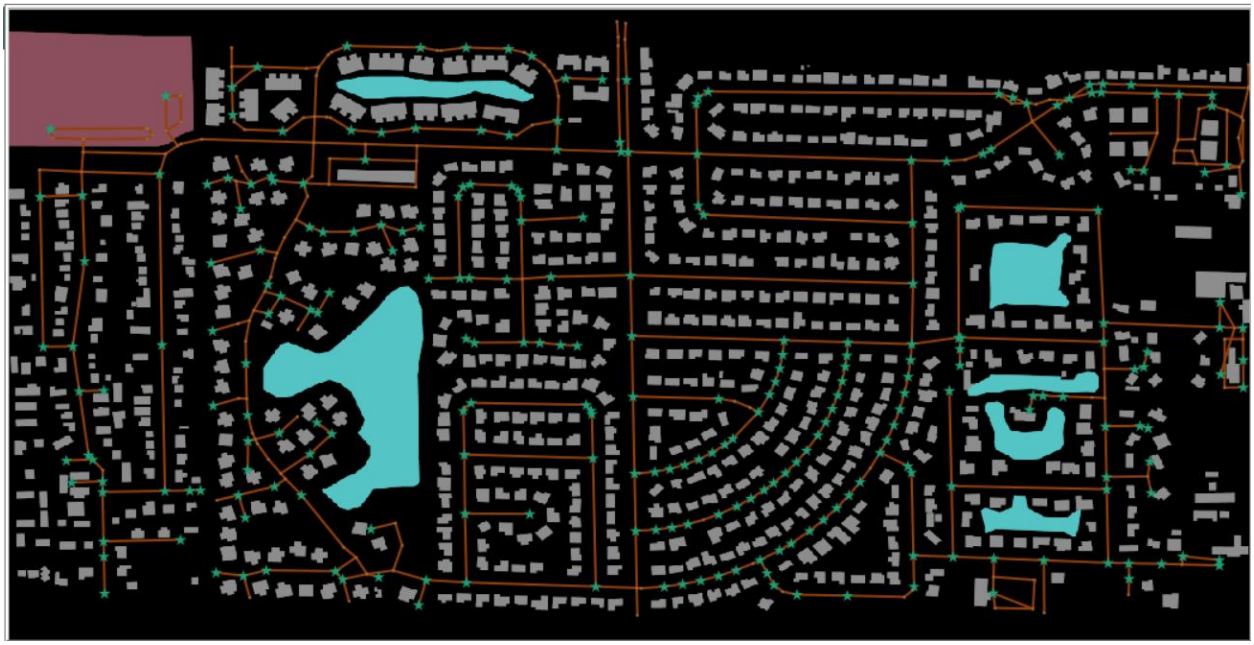
+Florida – America:



Area in Florida we took from far above

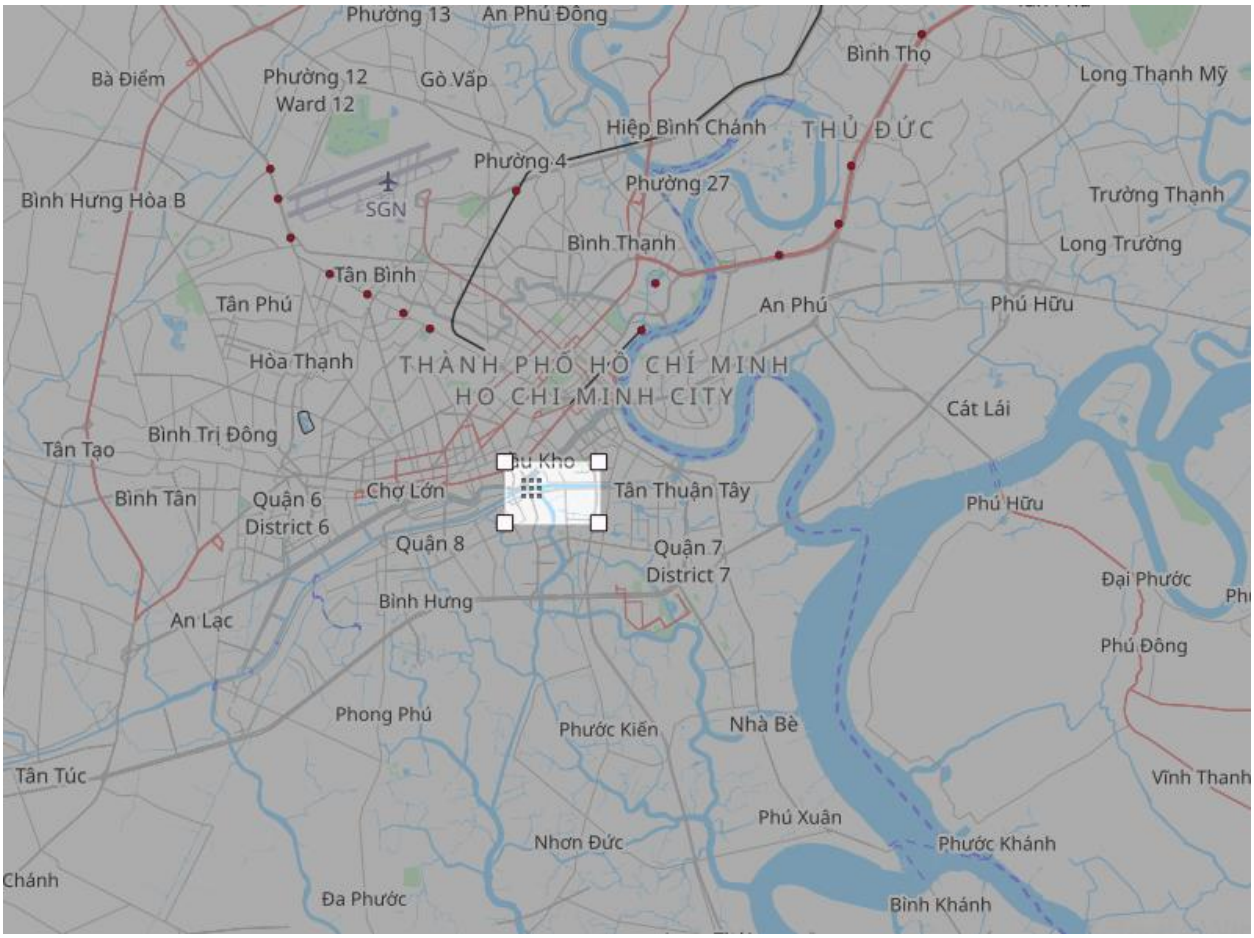


Details of the area we took in Florida

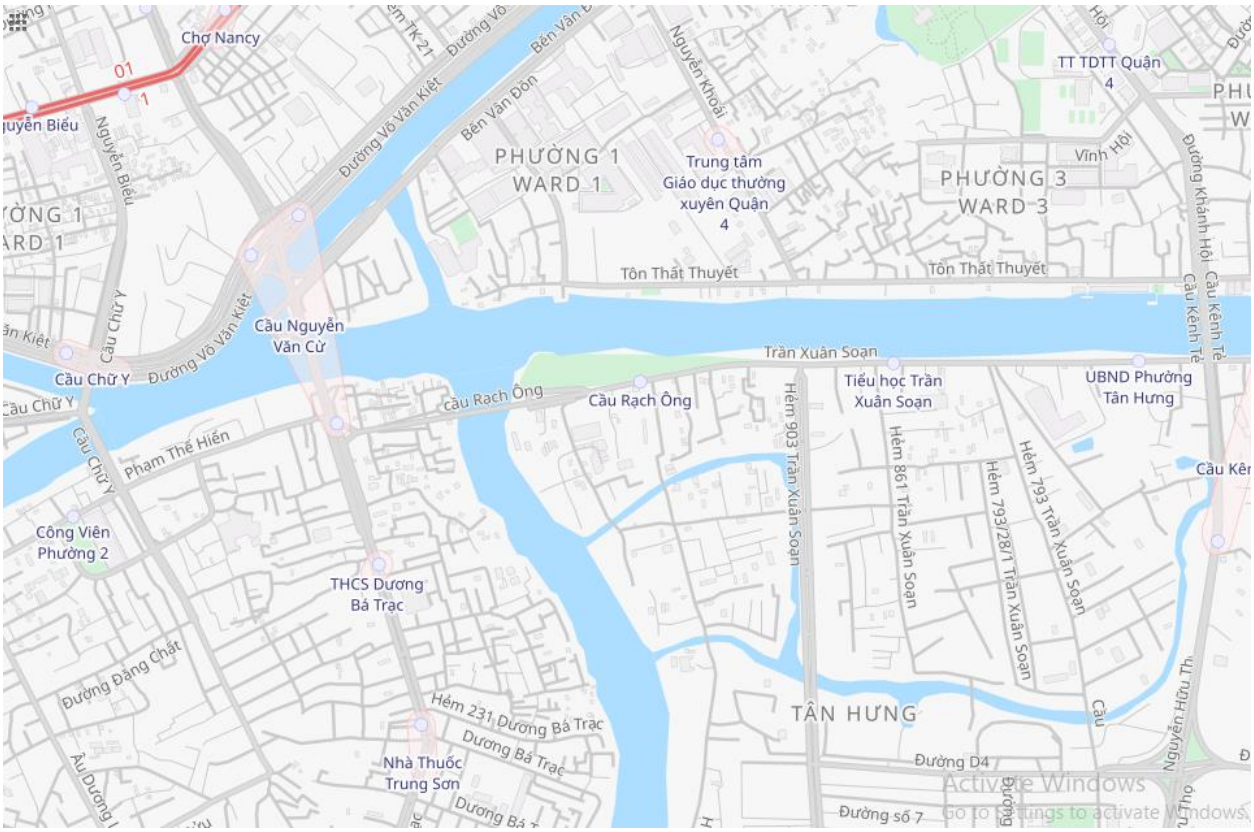


Florida map in NetLogo by using gis extensions

+HoChiMinh – Vietnam:



Area in Ho Chi Minh we took from far above

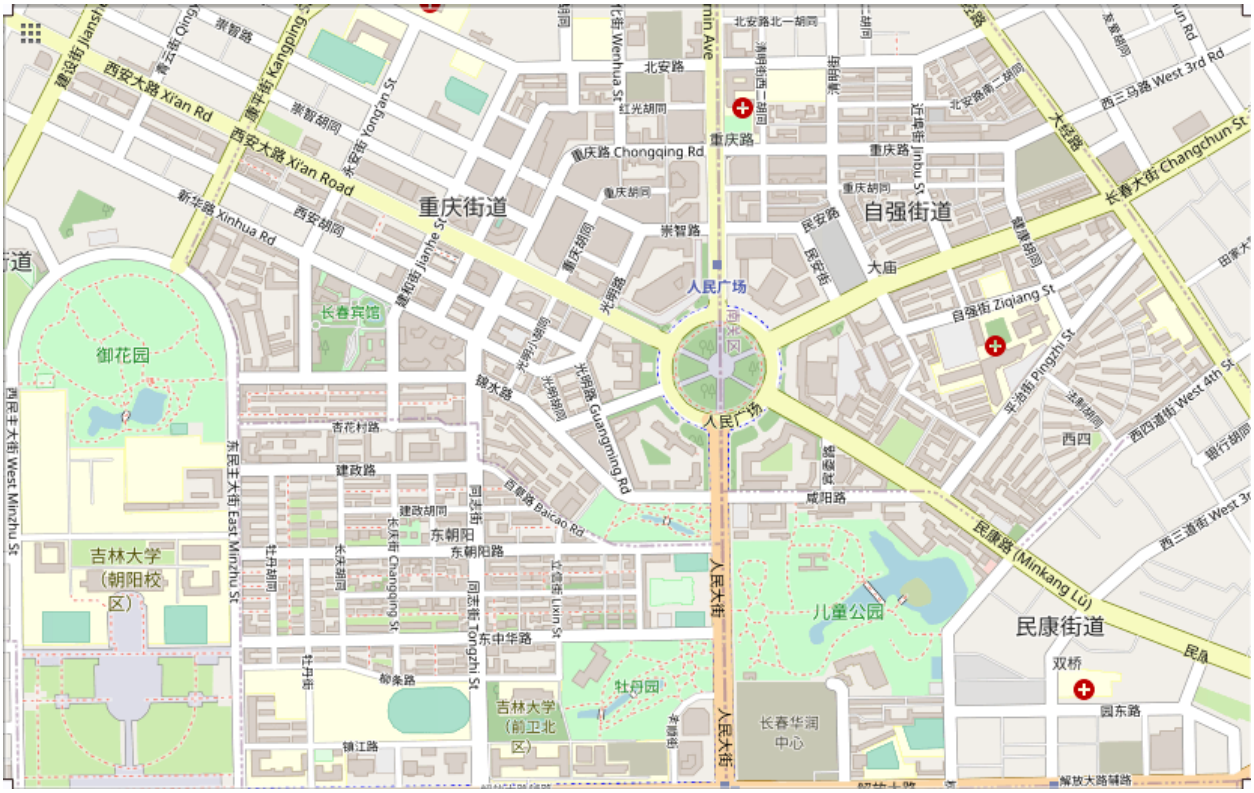


Details of the area we took in Ho Chi Minh (District 7)

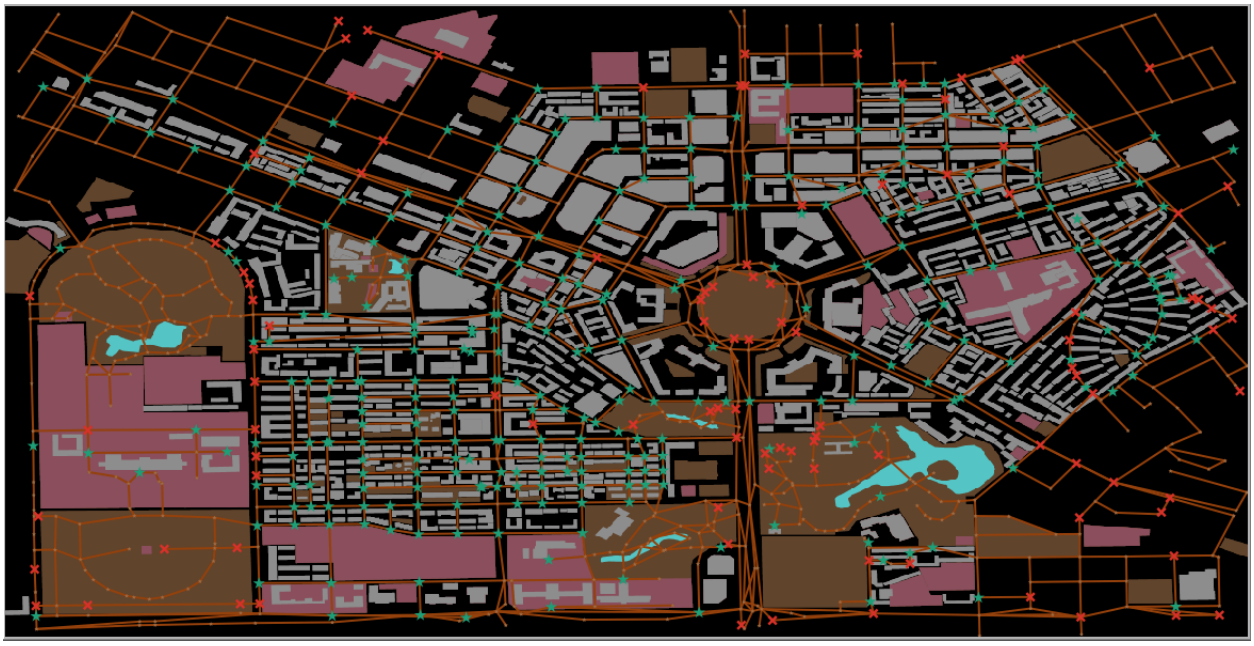
Ho Chi Minh map in NetLogo by using gis extensions

+Changchun – China:

Area in Changchun we took from far above

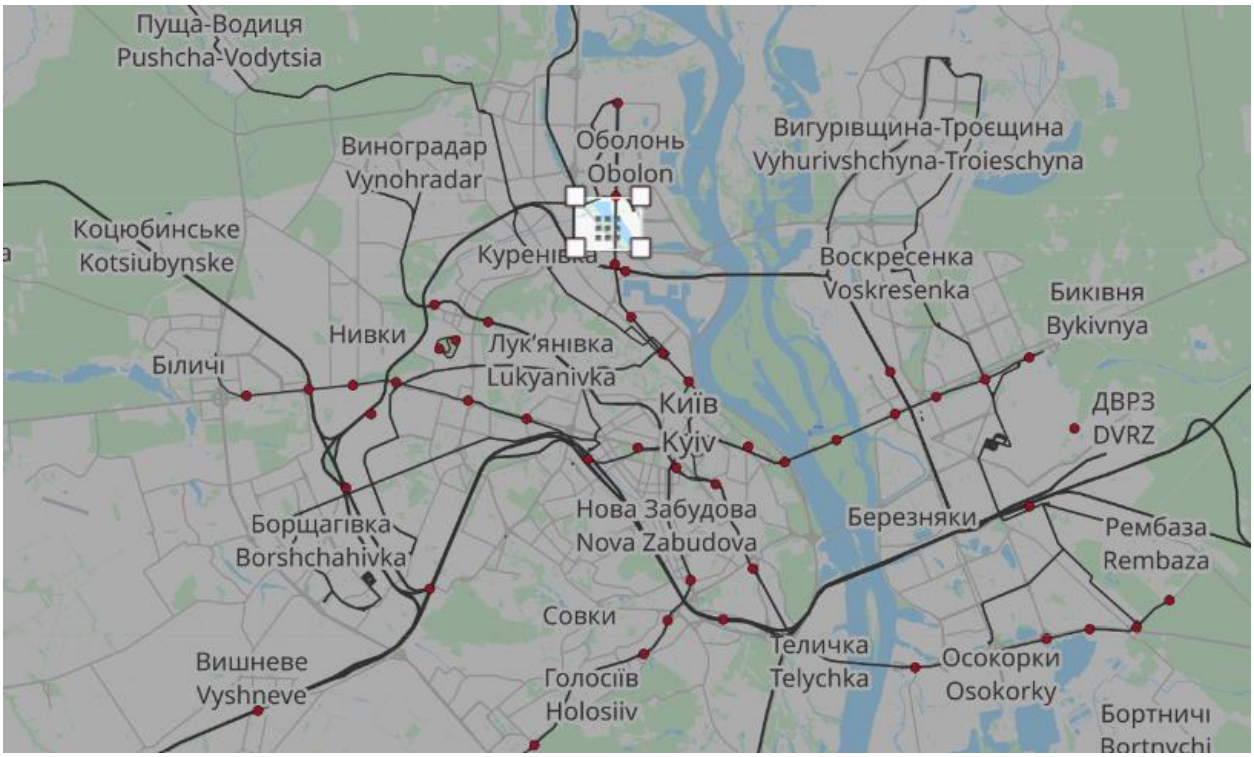


Details of the area we took in Changchun

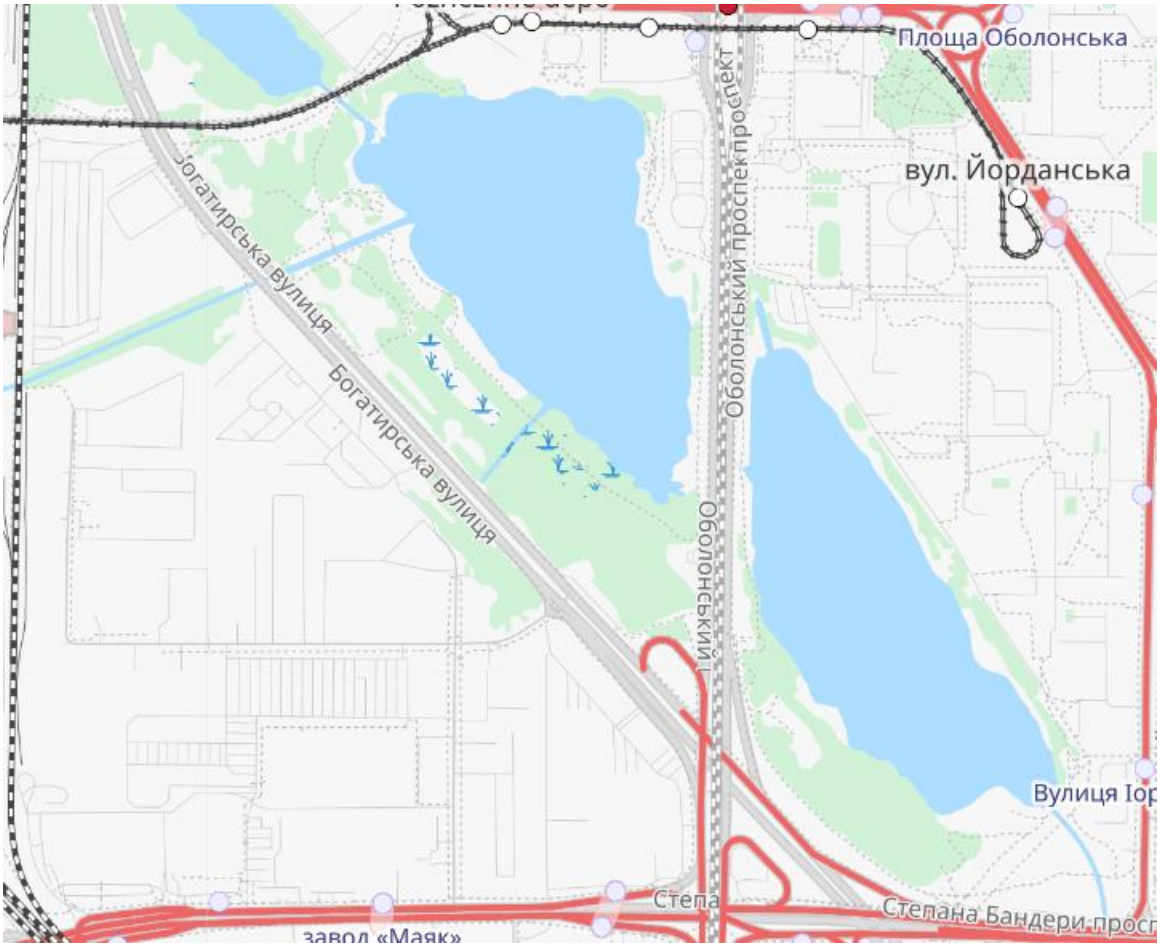


Changchun map in NetLogo by using gis extensions

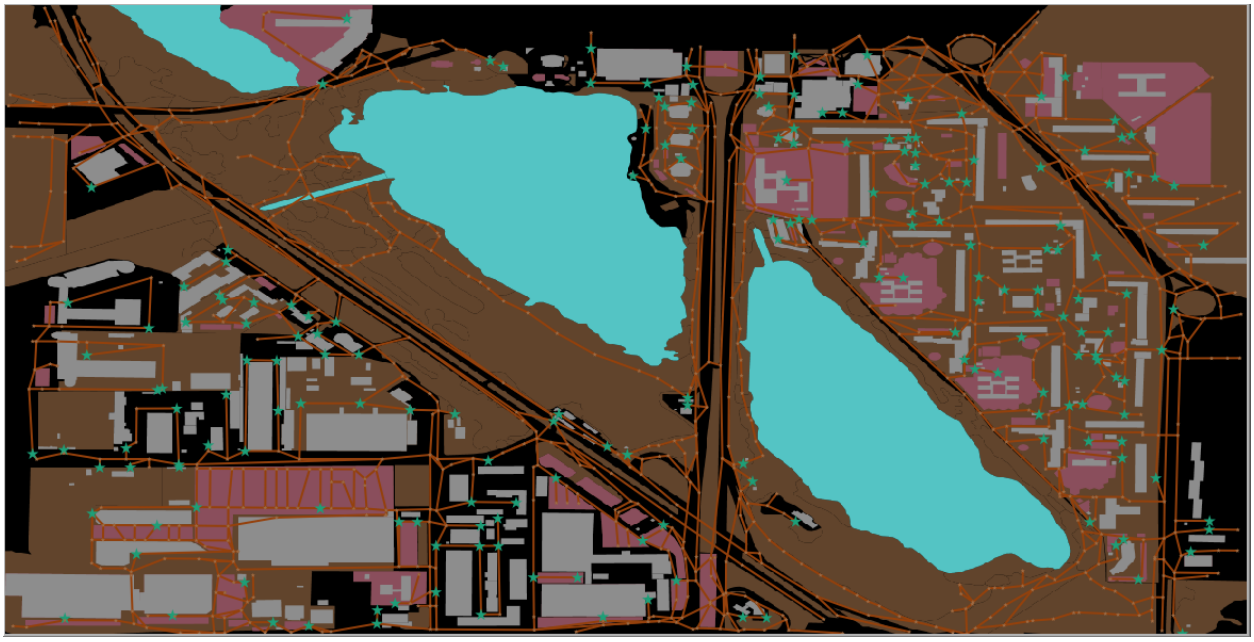
+Kyiv – Ukraine:



Area in Kyiv we took from far above



Details of the area we took in Kyiv

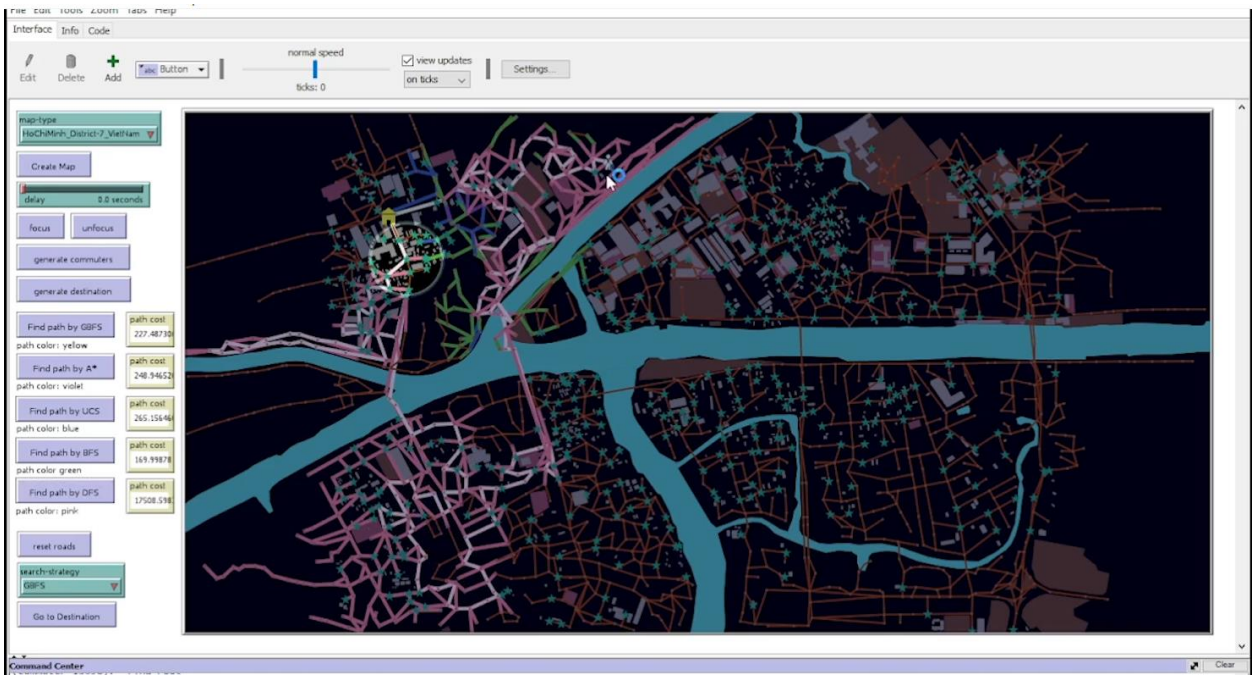


Kyiv map in NetLogo by using gis extensions

Levels

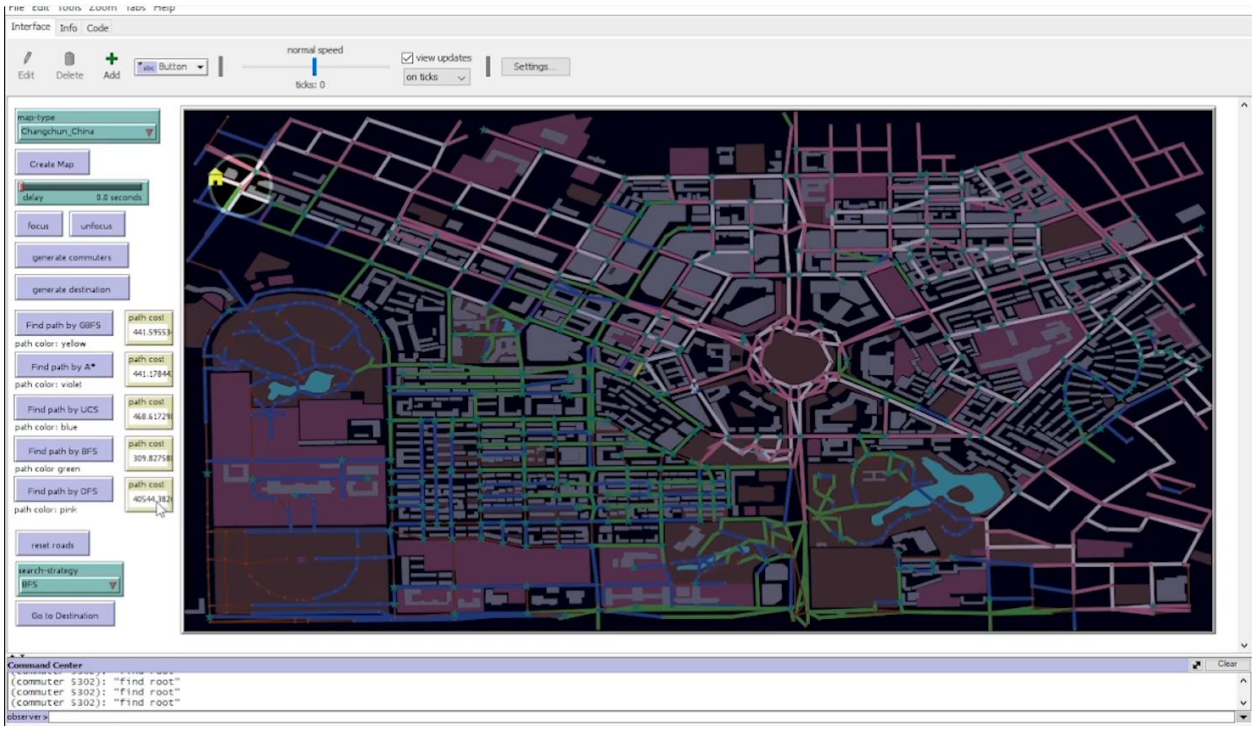
_Level 1:

+Test case 1 + 2 + 3 + 4 + 5:



Result for 5 algorithm on Ho Chi Minh map with 1 agent and 1 destination

+Extra 5 test for Changchun map:

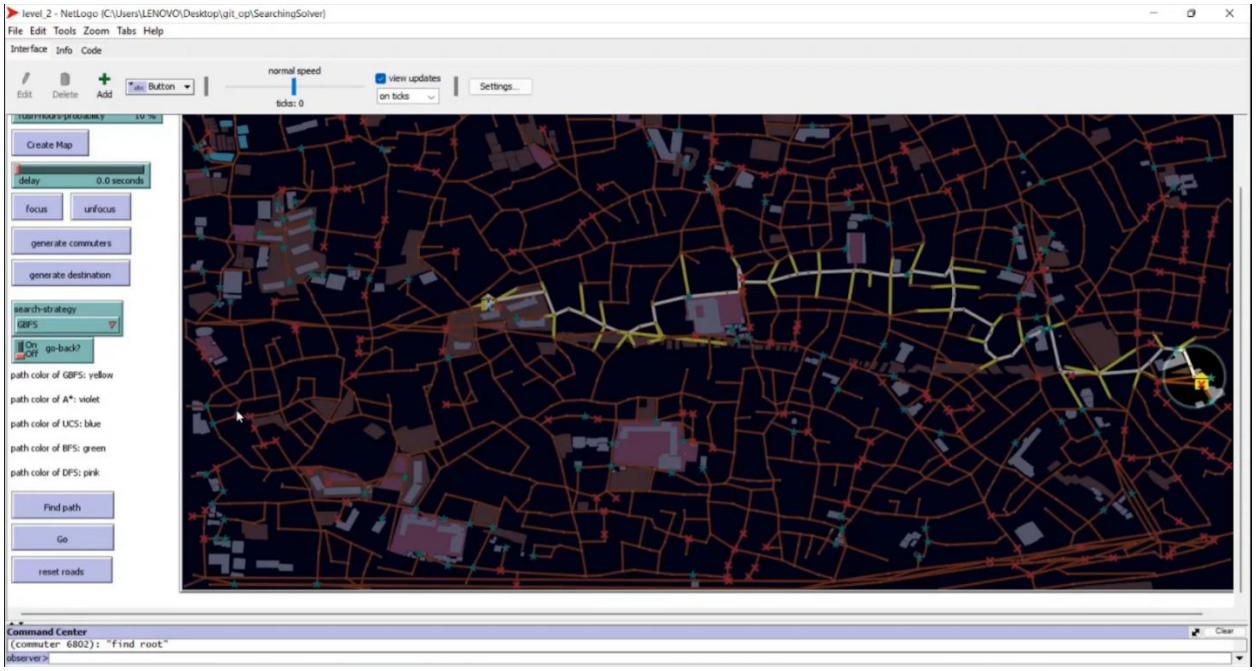


Result for 5 algorithm on Changchun map with 1 agent and 1 destination

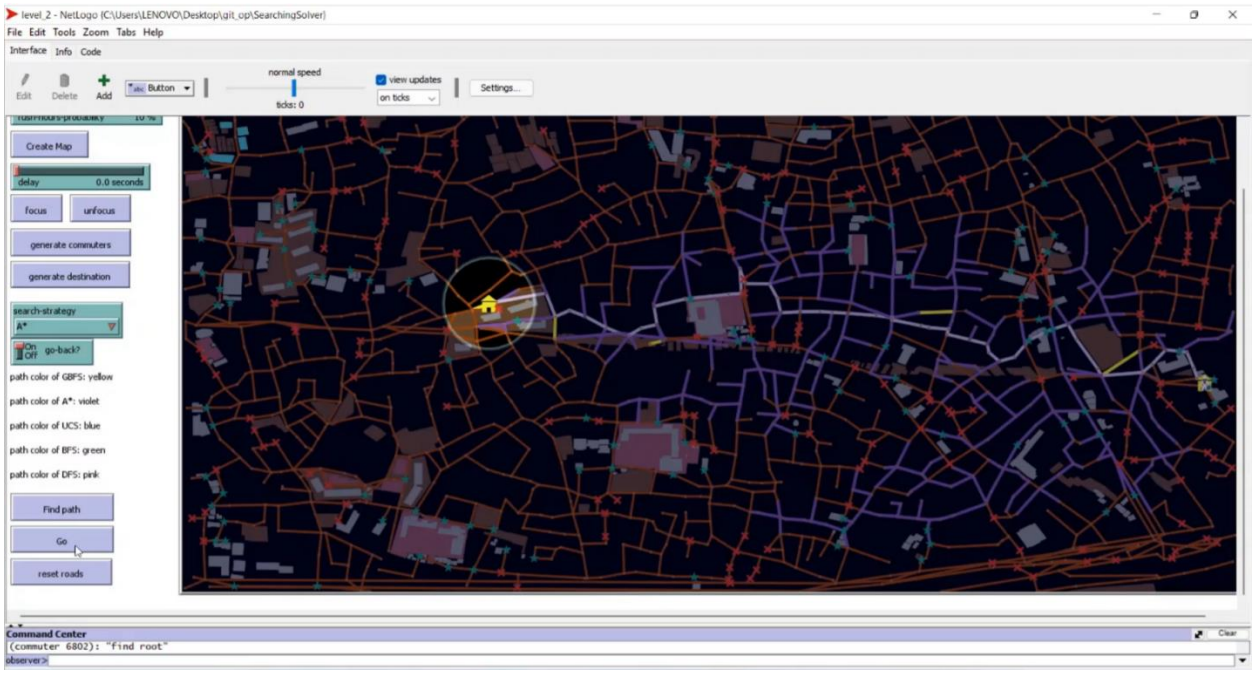
+Comments on level 1: Despite of the fact that A* and GBFS is inform search algorithms, their path cost is greater than BFS. But inform search often have path cost lower than the others. I think DFS which is one of uninform search have the longest path cost and the best time-consuming search strategy. It’s not difficult to find out that in our video. It alway take nearly entire vertices in map.

_Level 2:

+Test case 1:

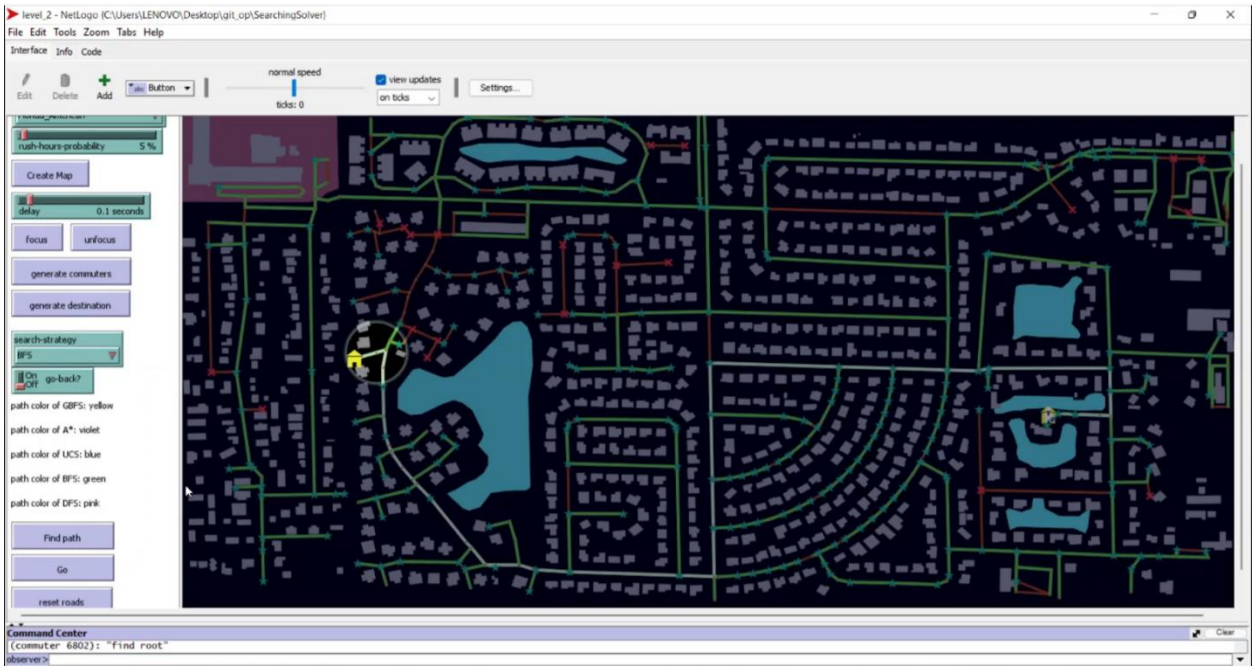


Result of returned path from start to end using GBFS on Tokyo map

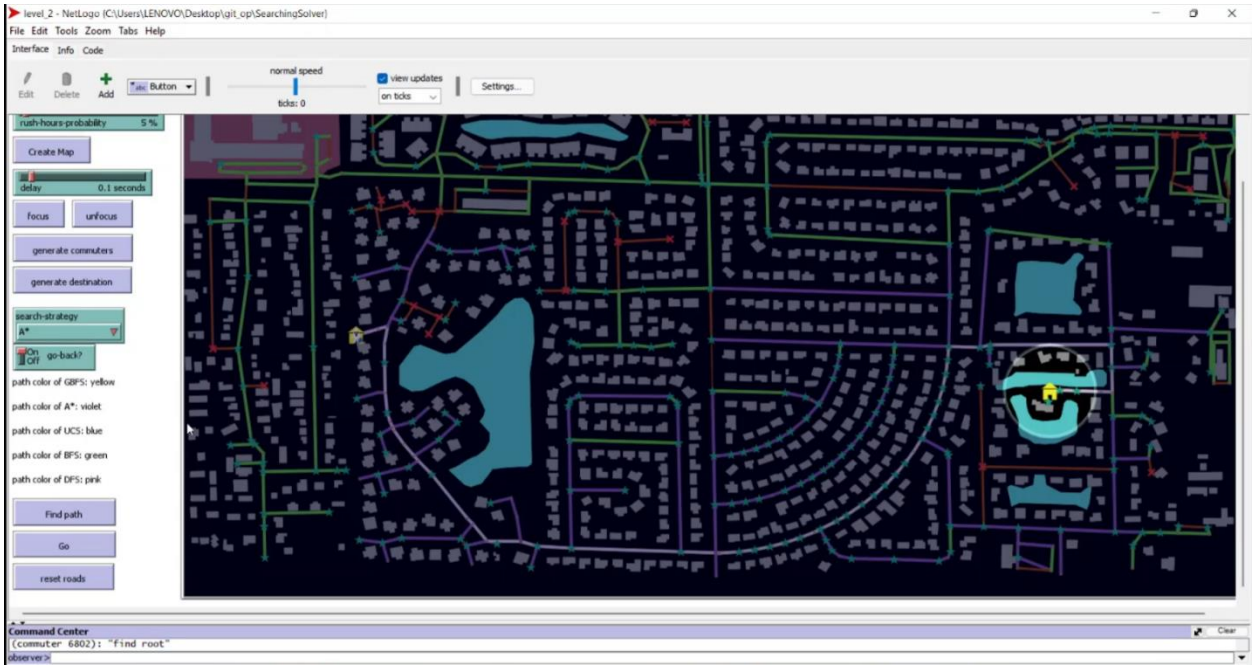


Returned path from end to start using A* on Tokyo map

+Test case 2:

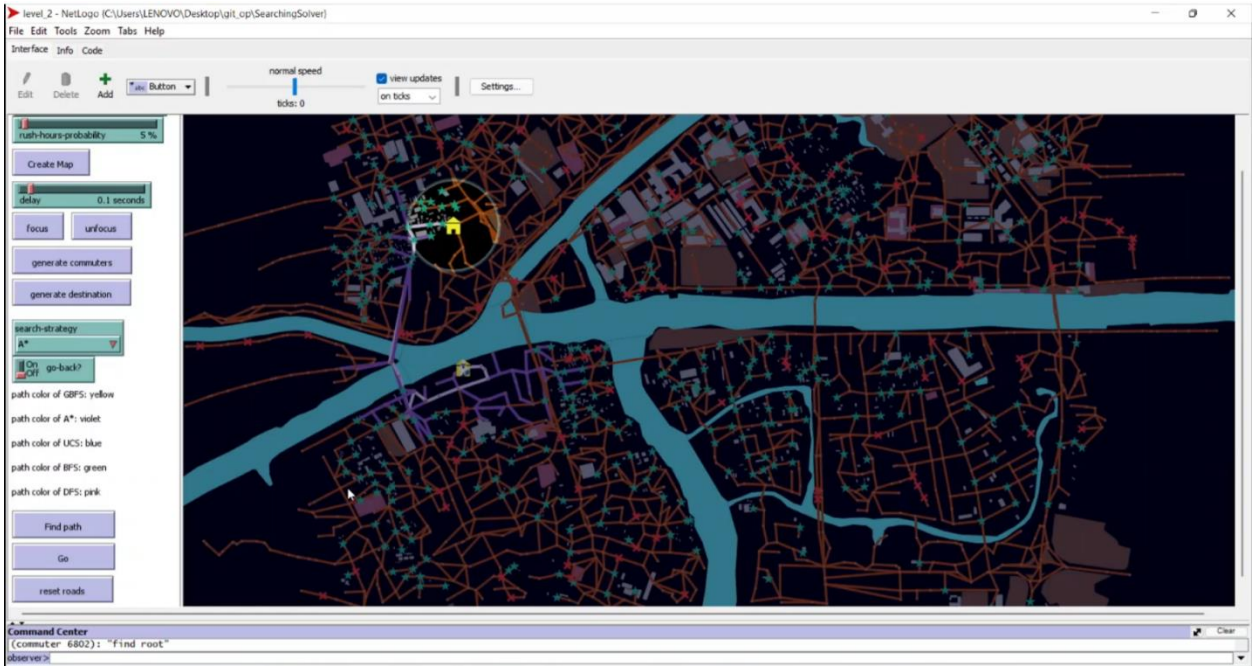


Returned path from start to end using BFS on Florida map

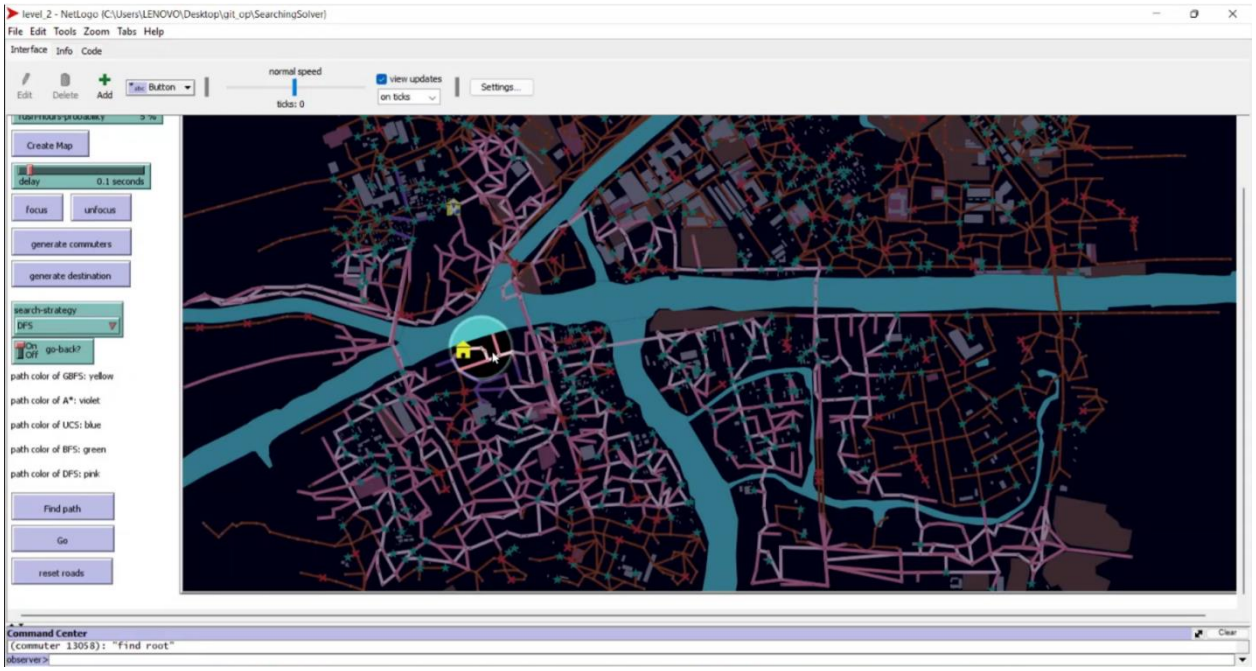


Returned path from end to start using A* on Florida map

+Test case 3:

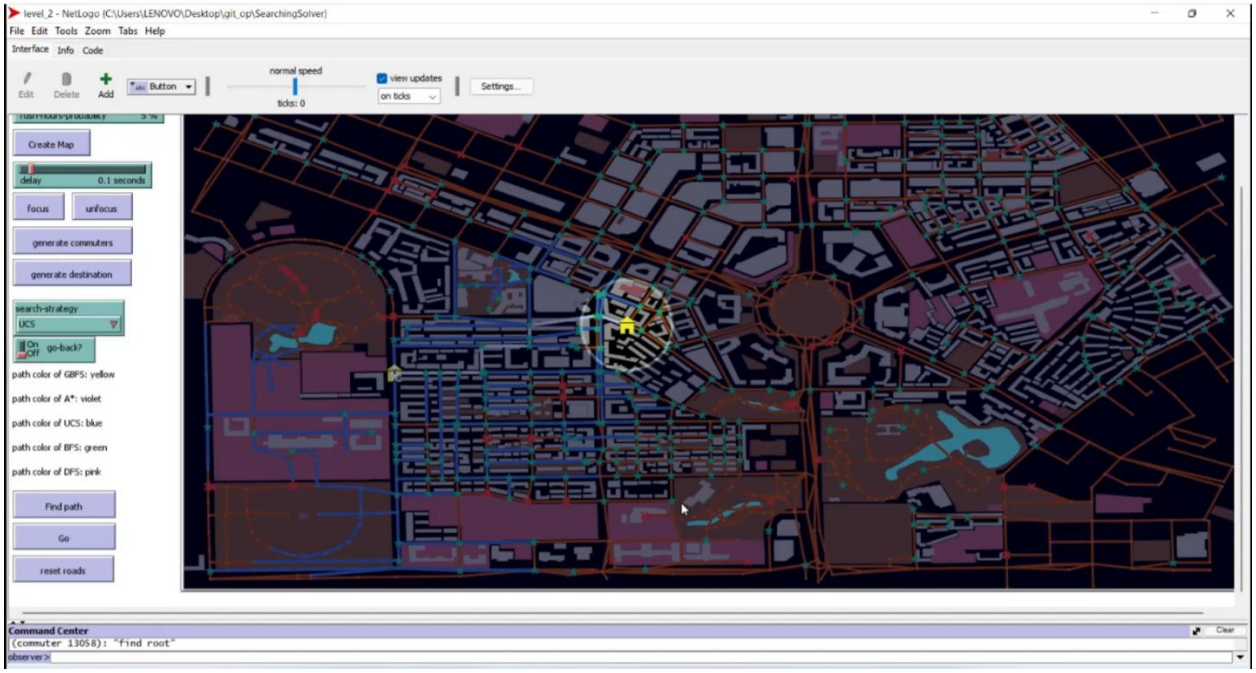


Returned path from start to end using A* on Ho Chi Minh map

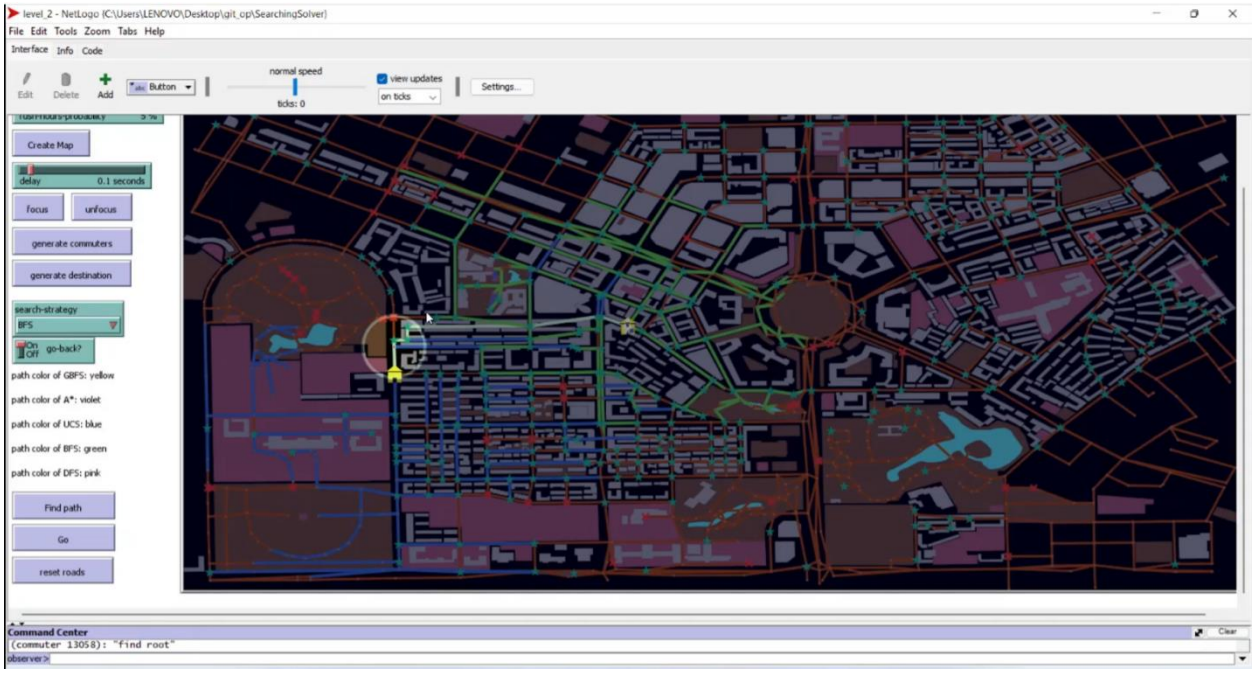


Returned path from end to start using DFS on Ho Chi Minh map

+Test case 4:

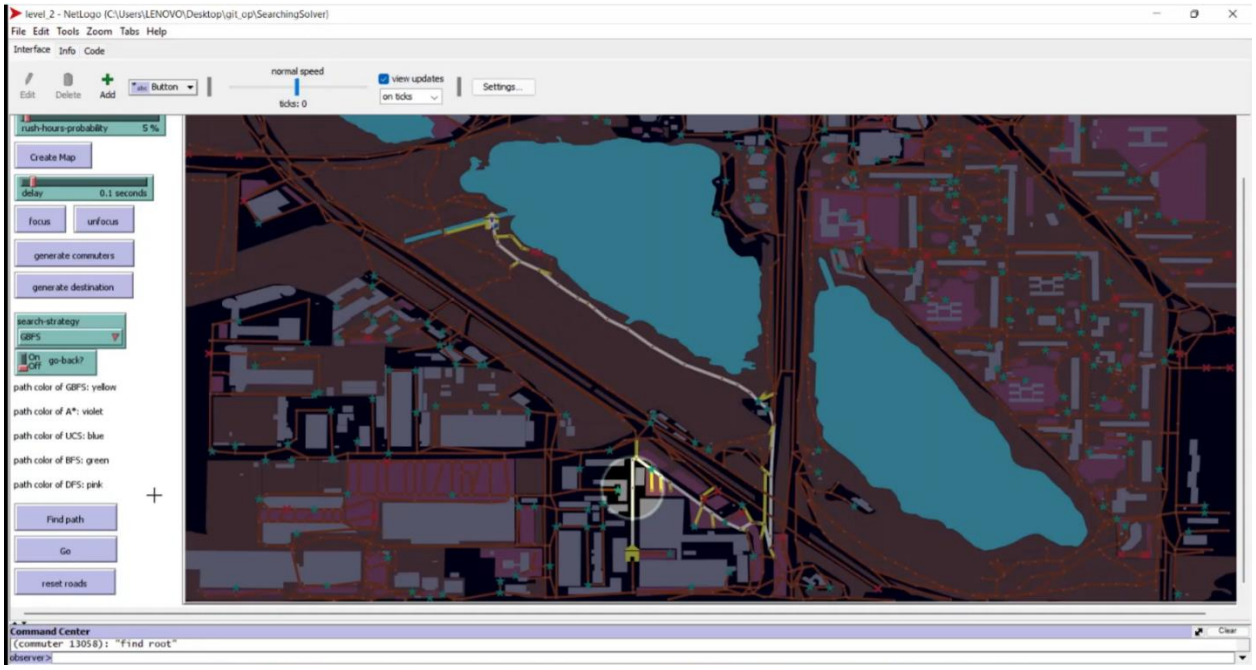


Returned path from start to end using UCS on Changchun map

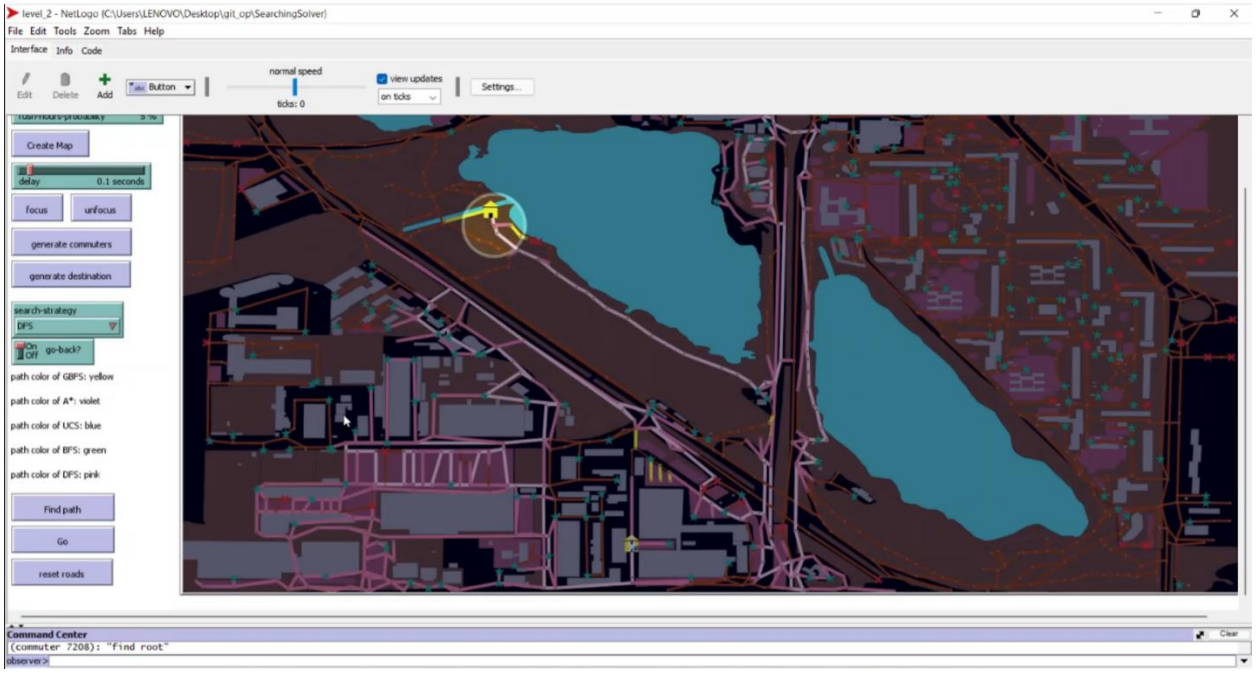


Returned path from end to start using BFS on Changchun map

+Test case 5:



Returned path from start to end using GBFS on Kyiv map



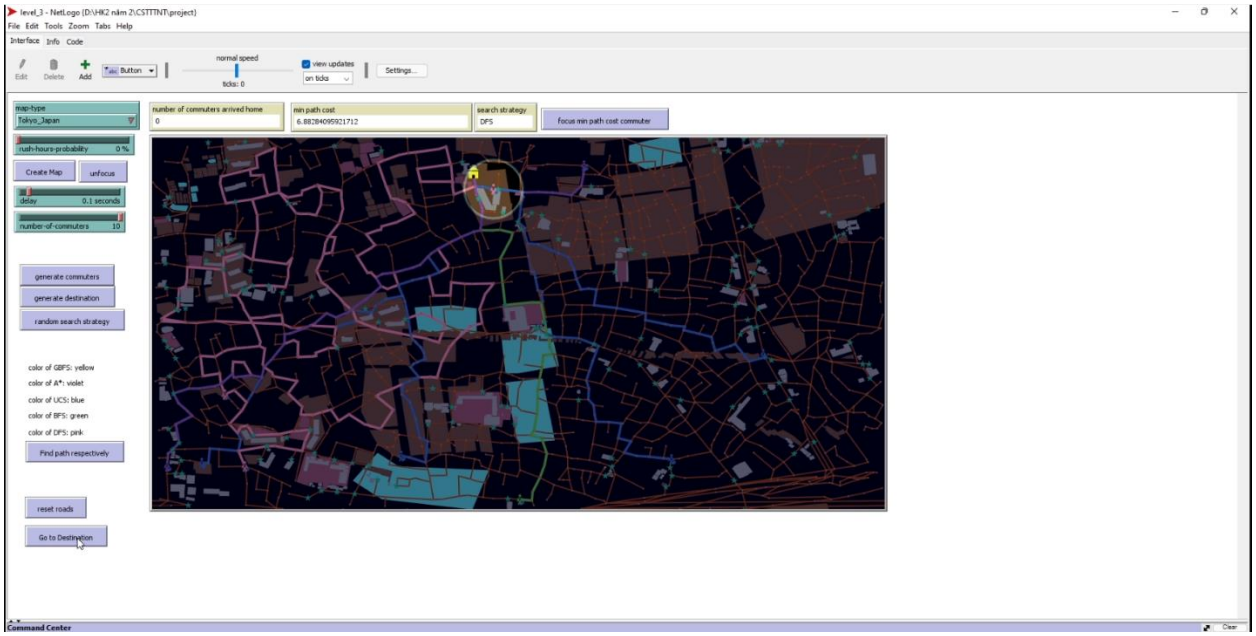
Returned path from end to start using DFS on Kyiv map

+Comments on level 2: Through test cases we can see that DFS and BFS take most of time to run on every map. GBFS, A* and UCS have the run time almost the same but the path returned is different significantly from DFS and BFS. In the map florida, it’s

a quite hard challenge for A* and GBFS with large rush hours, it’s usually stucks somewhere.

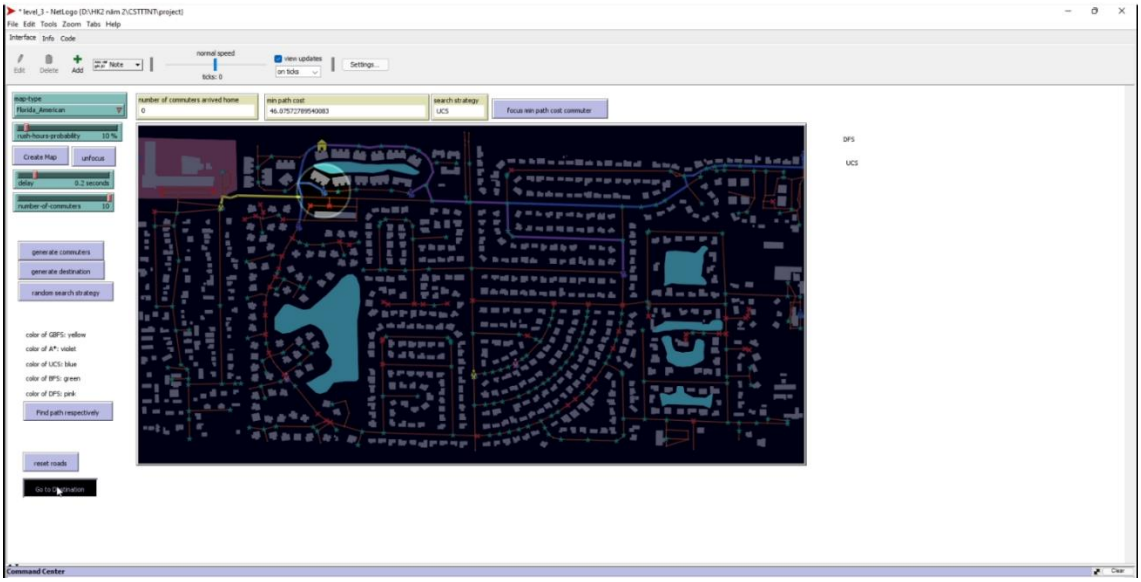
_Level 3:

+Test case 1:



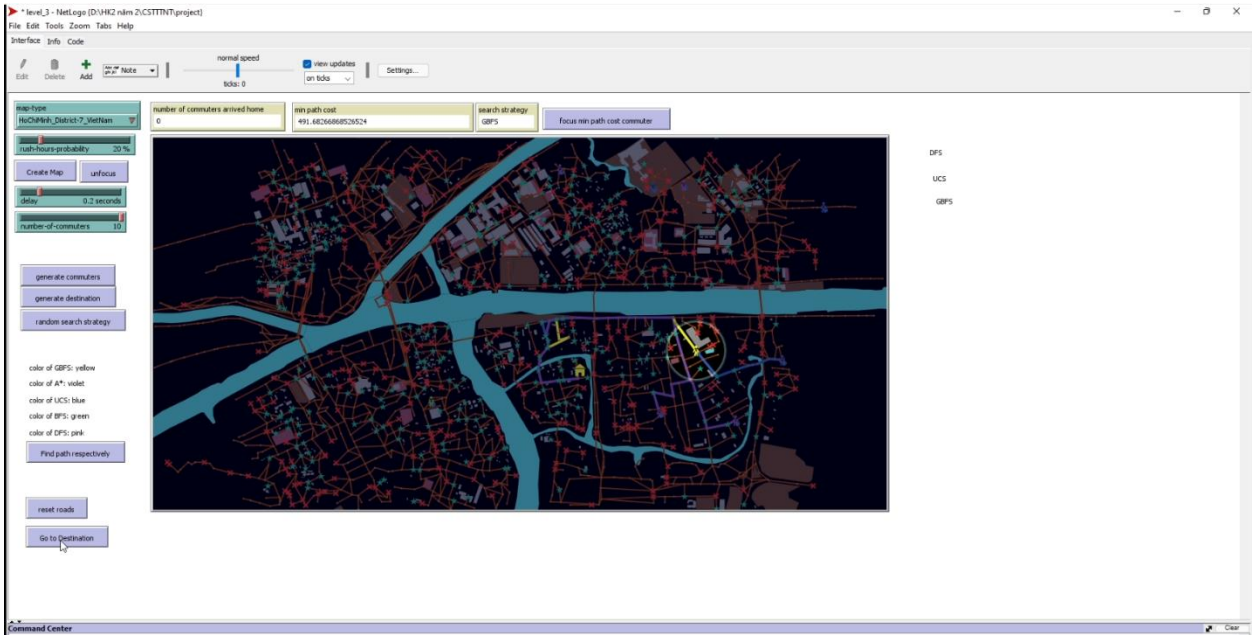
Before go home on Tokyo map

+Test case 2:



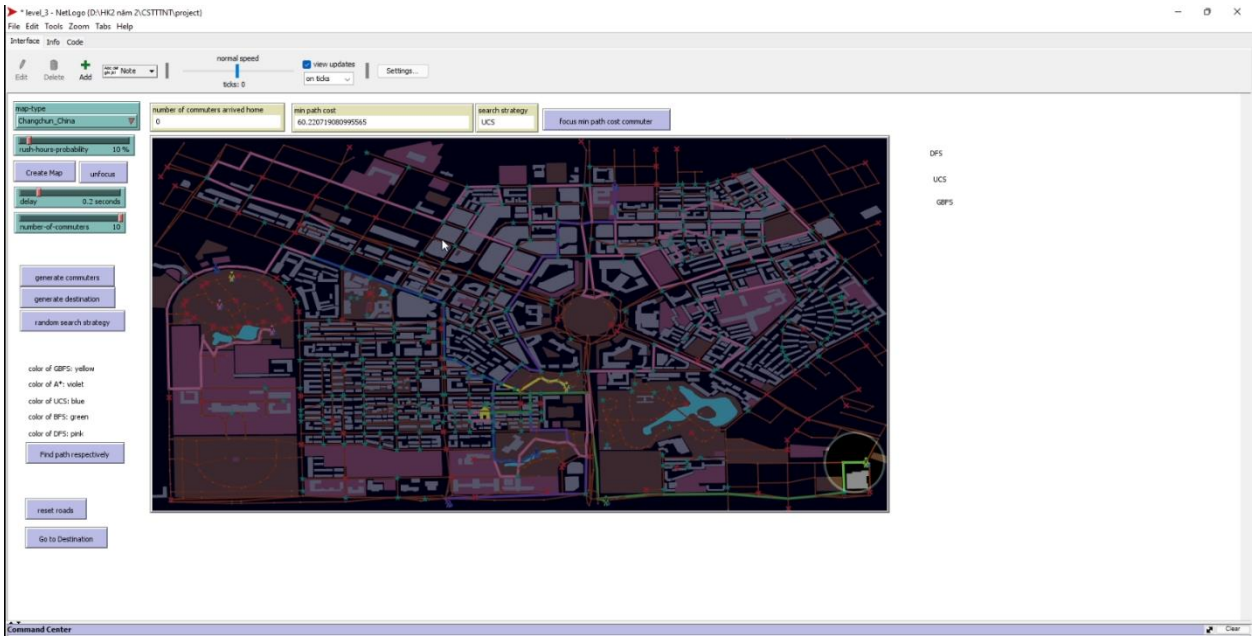
Before go home on Florida map

+Test case 3:



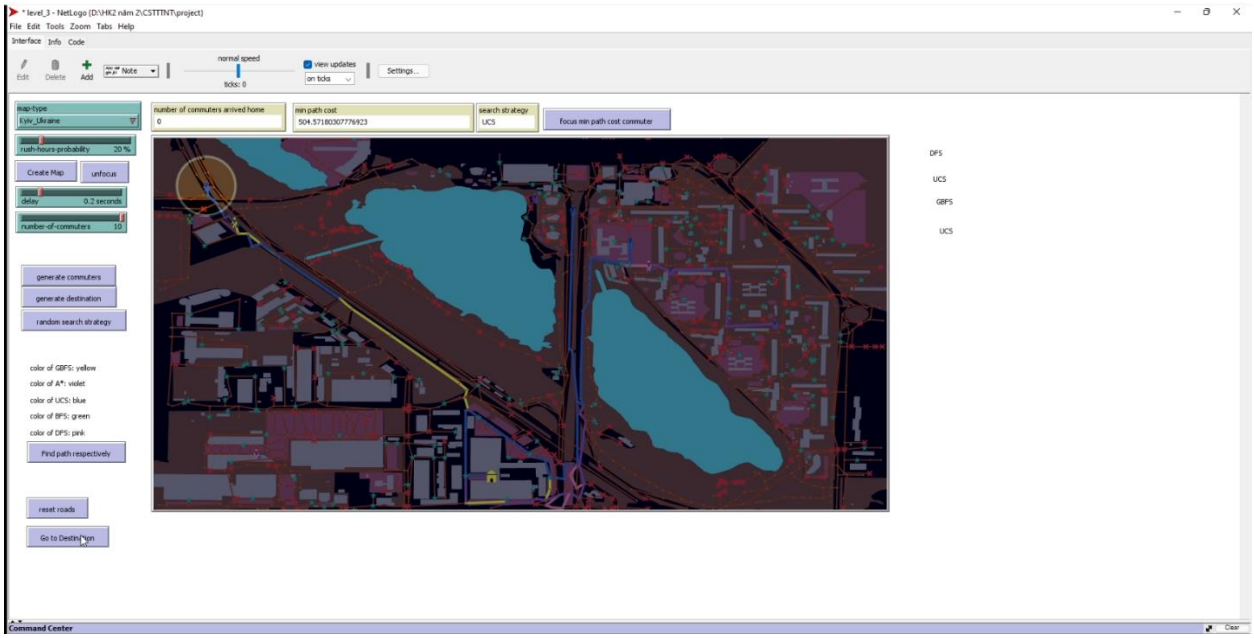
Before go home on Ho Chi Minh map

+Test case 4:



Before go home on Changchun map

+Test case 5:



Before go home on Kyiv map

+Comments on level 3: Through five test cases with five different maps, the result that we got was that there were three test cases where UCS gave the lowest cost. But this result is subjective because the agents are randomly placed. So the UCS is just the best in this test. And with this level, we also have rush-hours-probability which creates blocked roads.

VII/Videos for requirements:

https://drive.google.com/drive/folders/1D2cX7LCNhO8DSybnni_RRAwM0tTfS43M?usp=sharing

Containing:

_Requirement 1: videos for requirement 1.

_Requirement 2: videos for test cases of 3 levels.

VIII/Files in the project:

_”images” folder: Photos about the buttons in the project.

_”map”: folder: Maps used in the project.

_”map color” folder: Colors used for agents and environment.

_”map_from_statelite”: Images about the are we took the map from.

_map_key” folder: Images for us to know which color was used for which algorithm in the project.

_”level_1.nlogo”, “level_2.nlogo”, “level_3.nlogo”: code for 3 levels.

_”map_key.md”, “README.md”, “map_key.pdf”: files for further explaination.

_”report.pdf”: report for this project.

IX/References:

https://ccl.northwestern.edu/netlogo/docs/

https://mygeodata.cloud/converter/osm-to-shp

https://www.youtube.com/watch?v=NGNCenhcUu4

https://github.com/abmgis/abmgis/tree/master/Chapter08-Networks/Models/GMU-Social

http://www.cs.us.es/~fsancho/?e=131

https://www.youtube.com/watch?v=3CIokwPBDFE