Artificial Intelligence
CC482

Risk Game

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Non – AI Agents

Human Agent:

The only agent that can choose how many troops that can be sent to attack the neighboring enemy.

Completely Passive Agent:

Loops on all owned countries then places his bonus troops in the country with least number of troops. Does not attack the enemy.

Aggressive Agent:

Loops on all owned countries and places his bonus troops in the country with most number of troops, then checks all his possible attacks and performs a single attack on the enemy country with most troops that he can attack.

Nearly Pacifist Agent:

Like the passive agent, this agent places all his troops in the country with least number of troops, then checks all his neighboring enemy countries that he can attack and performs an attack on the country with least number of troops.

AI Agents

Greedy Agent:

Uses a heuristic function where the agent checks the number of countries owned by the enemy plus the number of troops in such countries. The agent generates all possible states from the current state where he performs all possible attacks, and calculates the heuristic of all generated states, then chooses the state with the least heuristic number.

Uses priority queue to keep track of the state with the best heuristic.

A* Agent:

Uses the same heuristic, however this agent keeps expanding nodes until it either reaches a goal state, where he has conquered the whole map, or the number of expanded states exceeds 10,000. Upon choosing the best path for the next step, such state propagates all the way up to the current state's child, where the decision is taken.

Uses priority queue to keep track of the state with the best heuristic.

RTA* Agent:

Similar to A* Agent, however when he leaves a state to visit the child with the best heuristic, he changes the current state's heuristic value to be the total cost of the second best choice it had. In addition, this agent assumes that every game is the initial state where the g(n), the cost to the root, is always 1.

Uses priority queue to keep track of the state with the best heuristic.

Minimax Agent:

Uses different heuristic where for each state he faces, he calculates the number of possible attacks that he can perform + the number of owned countries that are safe from enemy attacks. Uses alpha-beta pruning.

Evaluation

C: number of children explored

P = f*L + T

L = number of turns played to win

T = number of expanded states

Note: in Greedy we do not need to make a complete search to reach goal state, we only expand one node and go to the best state among them.

Agent 1	Agent 2	F	L	T	P	C
Greedy	Passive	1	18	1	19	641
A*	Passive	1	18	171	189	6818
RTA*	Passive	1	18	171	189	6558

Agent 1	Agent 2	F	L	T	P	C
Greedy	Passive	100	18	1	1801	641
A*	Passive	100	18	171	1971	6818
RTA*	Passive	100	18	171	1971	6558

Agent 1	Agent 2	F	L	T	P	C
Greedy	Passive	10000	18	1	180001	641
A*	Passive	10000	18	171	180171	6818
RTA*	Passive	10000	18	171	180171	6558

Minimax Agent vs Passive Agent:

It took 18 turn (which is the number of not owned countries by the minimax agent at initial state) for minimax to defeat passive agent in USA MAP

Minimax Agent vs Aggressive Agent or Pacifist Agent:

Minimax agent and Aggressive agent got into a dead end (infinite loop) where minimax is attacking a certain country in it's turn and aggressive attacking the same country again so nothing will change, because only one attack is allowed every turn.

Minimax Agent vs Human Agent:

It took approx. 40 turns for Minimax to defeat Human (varies from one player to another) assuming Human agent puts all troops in one country and can attack with number of troops of the attacking country - 1.

Minimax Agent vs Greedy Agent:

Minimax agent and Aggressive agent got into a dead end (infinite loop) after 108 turns, both of the agents start attacking each other in a certain region of countries over and over again, because only one attack is allowed every turn.