

PAC-MAN

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Our Goals

Develop an Agent for Pac-Man that would:

Achieve a good score in the ranking

Be a real competitor in a more realist situation

Play with equal success any new level presented to it

Consider level completion speed

Consider survivability and strategy skills to outwit ghosts attempts of entrapment



How we achieved our Goal

Our Strategy Planners

The programming approach was to create a decision-making process in *layers*:

Topographer

- Makes a topography analysis of the game map.
- Computes the information once for each game:
 - Pathways
 - Corridors
 - Crossroads
 - Corridor Adjacencies
 - Ghosts Den



Strategy Advisor

- Before each Pac-Man's move, creates a picture of the game situation.
- Provides valuable information to future strategy plan:
 - Pac-Man Info
 - Crossroads
 - Accessible Crossroads
 - Crossroad Semaphores
 - Ghosts in pursuit at each corridor end
 - ...
 - Ghosts Info
 - Distance to Pac-Man
 - Path to Pac-Man
 - ...



Strategy Analyst

- According to Advisor information.
- Chooses the best game plan and which Execution Agents to call and validates their advised move.



Topographer & Strategy Advisor

What is analyzed

Ghosts Den

- Dynamically calculated.

Pathways

- All non-wall coordinates.

Corridors

- A list of adjacent pathways coordinates and two crossroads as ends.
- Can be:
 - **SAFE** – Has no ghosts;
 - **UNSAFE** – Has 1 or more ghosts.

Corridor Adjacencies

- Pairs of adjacent corridors.

Crossroads

- A coordinate that joins corridors.
- Belongs to all corridors it joins.
- A crossroad directly accessible to Pac-Man (the ends of its corridor) is classified with a semaphore like system:
 - **GREEN** – No ghosts in proximity;
 - **YELLOW** – There are ghosts at a dangerous distance of the crossroad. Pac-Man can escape if he goes directly through that crossroad;
 - **RED** – Considering that the ghosts are in pursuit of Pac-Man, it is impossible for Pac-Man to escape from that crossroad before a ghost gets to it (or a ghost is already inside Pac-Man's Corridor).



Strategy Analyst | Execution Agents

How they change Pac-Man behavior

Pursuit

Focus on eating ghosts

Pac-Man is safe and there are zombie ghosts

Counter

Focus on eating boosts

Pac-Man is almost surrounded

Eating

Focus on eating energies

Pac-Man is safe

Flight

Focus on finding alternative paths

Pac-Man is almost surrounded

Panic

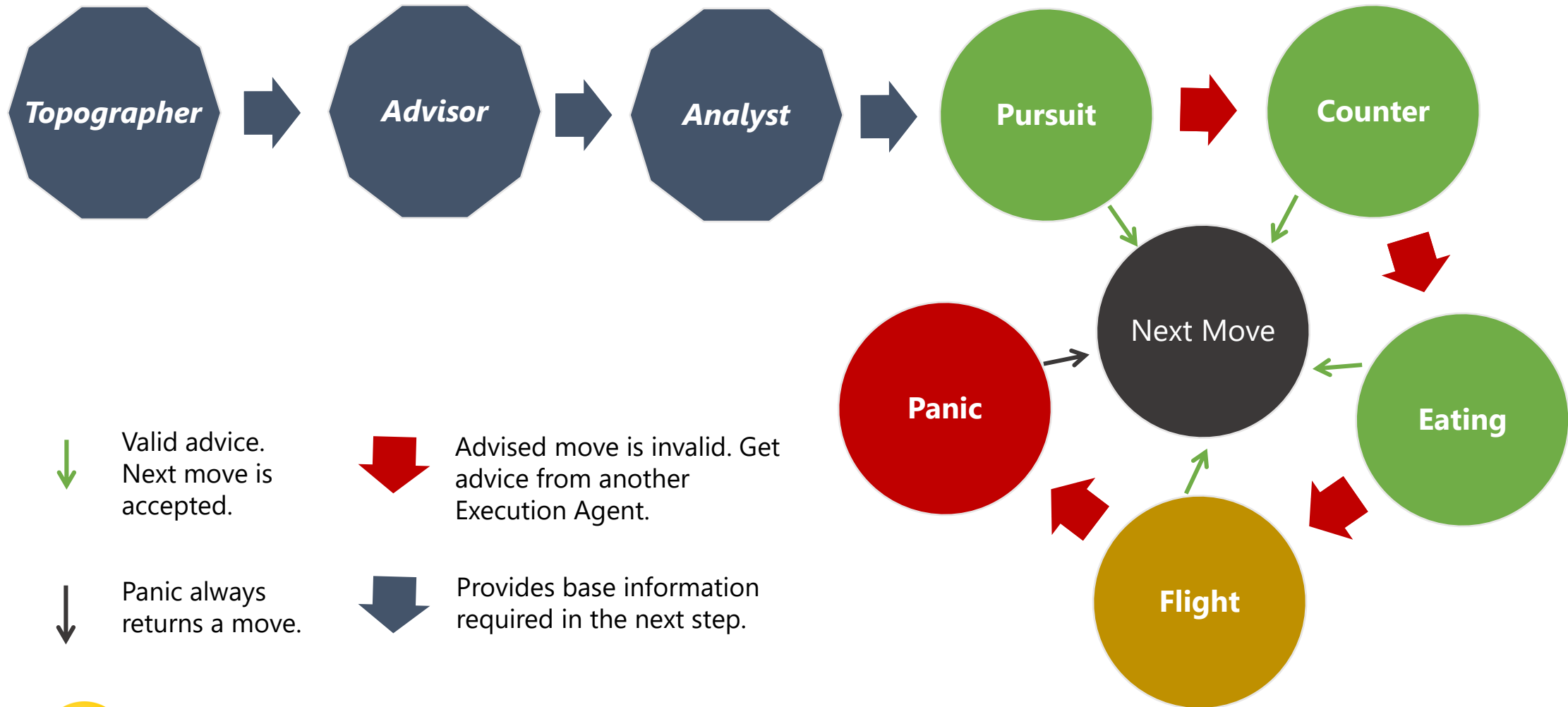
Focus on finding the closest safest corridor/position

No other mode was possible



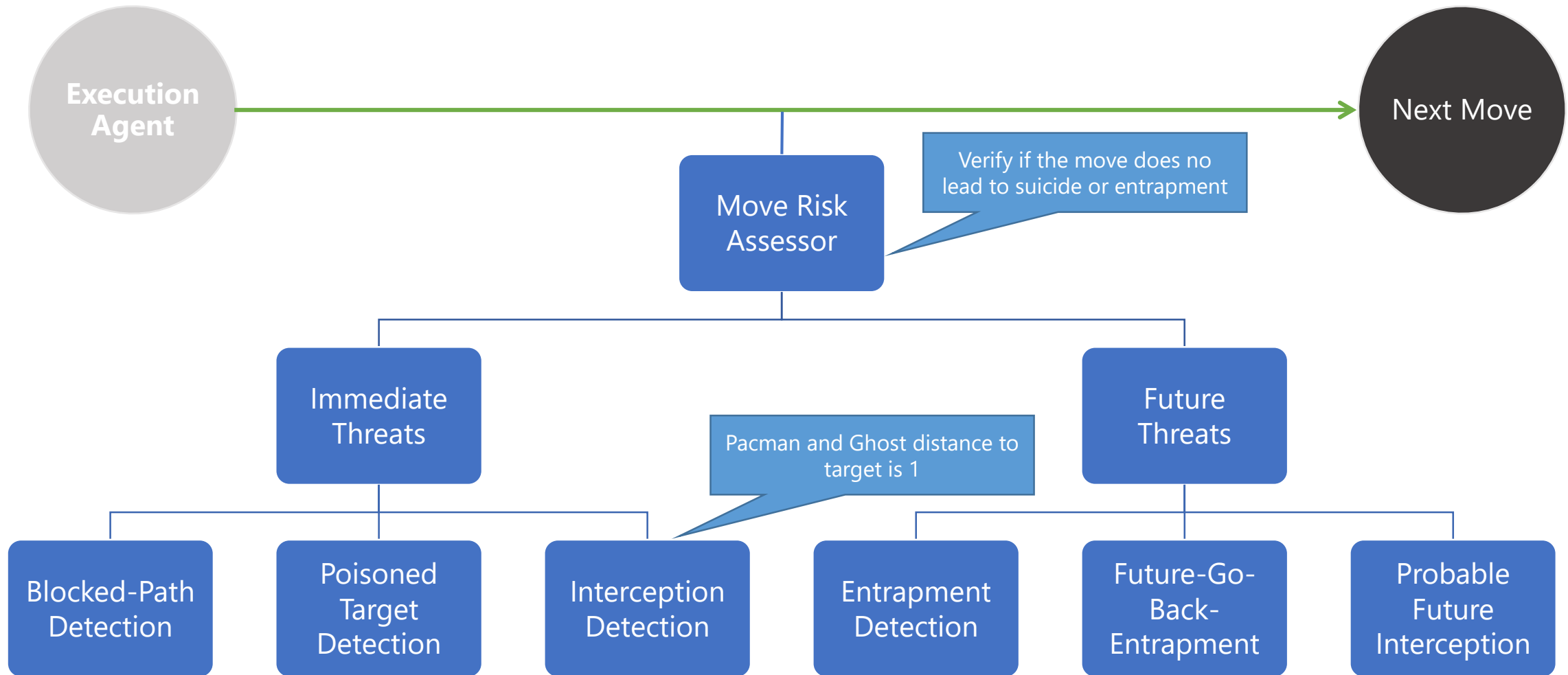
Strategy Analyst | Execution Agents

How the next move is computed



Strategy Analyst | Execution Agents

How the next move is validated



Strategy Analyst | Execution Agents

How Search Tree is used

Type 1 Search

- Used by Strategy Advisor and some execution agents (Eating, Counter, Pursuit);
- Uses A* algorithm with Manhattan Distance as heuristic;
- Search based on corridors (ie. Search Nodes are corridors);
- Returns the shortest path to the target.

Type 2 Search

- Used by Flight execution agent;
- Uses A* algorithm with Manhattan Distance as heuristic;
- Search based on corridors (ie. Search Nodes are corridors);
- Allows avoiding given coordinates;
- Returns n possible paths to the target.

Type 3 Search

- Used by Panic execution agent;
- Uses a custom algorithm;
- Search based only on safety criteria of the immediately adjacent corridors;
- Returns next coordinate



Game Constants

Game Constants are changeable and were tested

- 4 game constants can be changed
- Default values were decided by choosing the best average of a list of averages of 10 simulations each for the situations of Evaluation 2 -> combination of the 3 game constants (results in *results* folder in the repository).

Safe Distance to Crossroad

Minimum escape margin if Pac-Man is racing towards a crossroad against a ghost

Safe Distance to a Ghost

Distance (number of steps) at which a ghost probably isn't in pursuit of Pac-man

Pacman -> Ghost Pursuit Multiplier

Value from 0 to 1.

- 0 -> Pac-Man does not pursue the ghost
- 1 -> Pac-Man pursues any ghost in maximum range until the timeout of the ghost

Number of offensive ghosts

Number of ghosts at unsafe distance to prefer offensive strategy (counter first)



Work Percentages

Based on the amount of work and the contribution to the creation of the architecture of the solution, we agreed the following percentages of work per member:

- Luis Moura 33.(3)%
- Maria Lavoura 33.(3)%
- Pedro Teixeira 33.(3)%

