

# A Multi-agent Potential Field based bot for a Full RTS Game Scenario

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# Outline

- Background
- Our previous work
  - Papers at AAMAS 08 and AIIDE 08
  - On-line session at AiGameDev.com
- What's new
- Experiments
- Future Work

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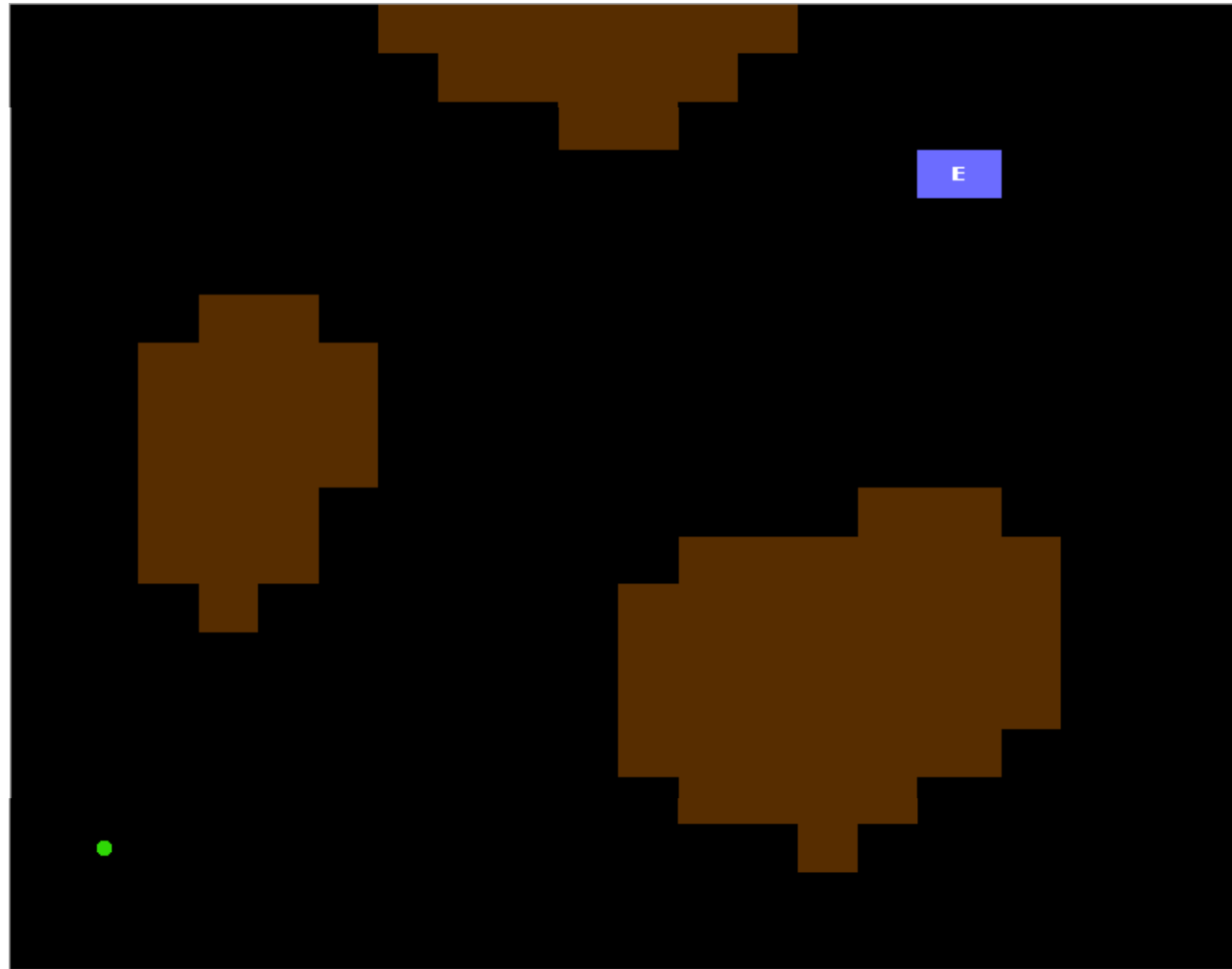
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# The Environment:



# Background of PFs

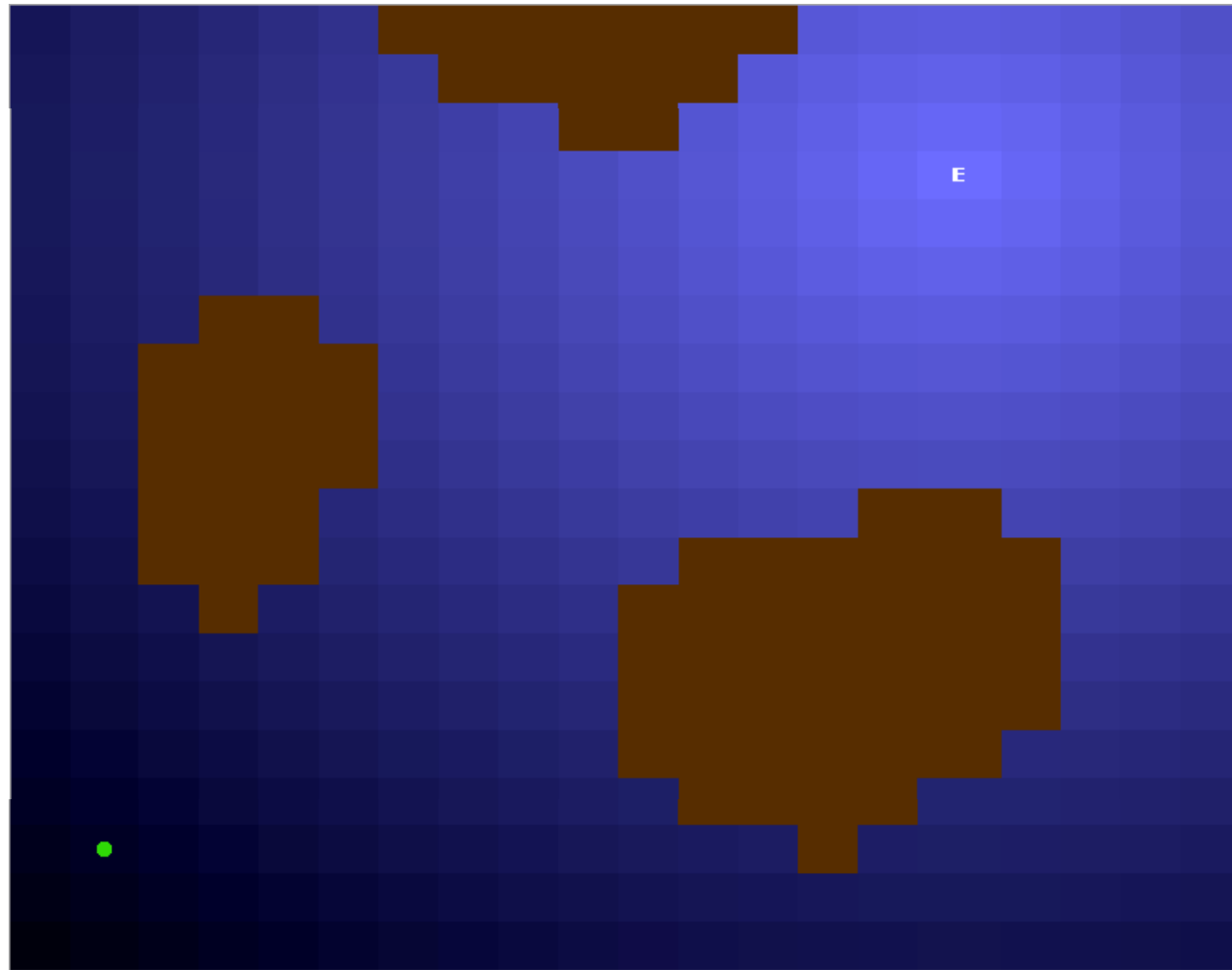


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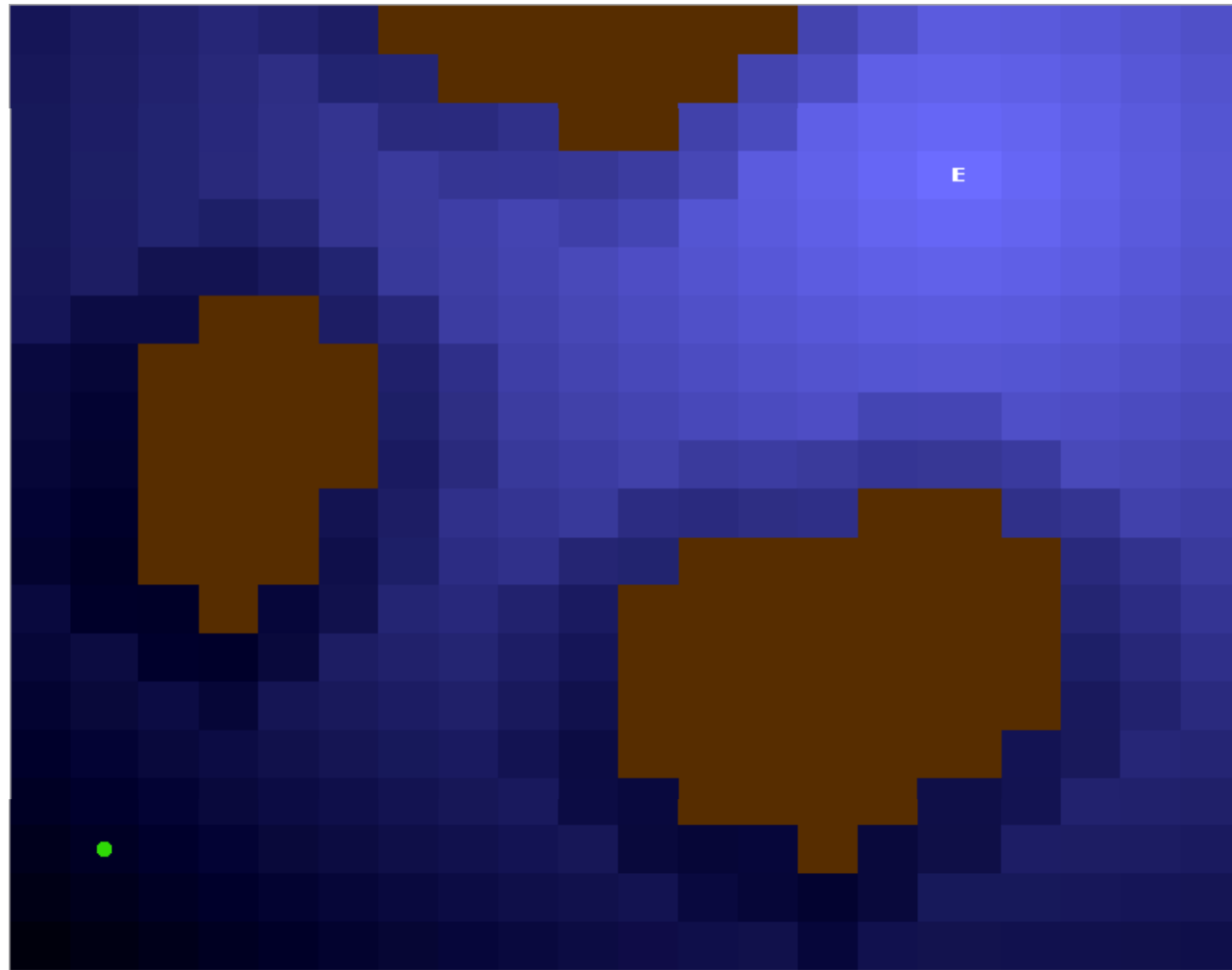
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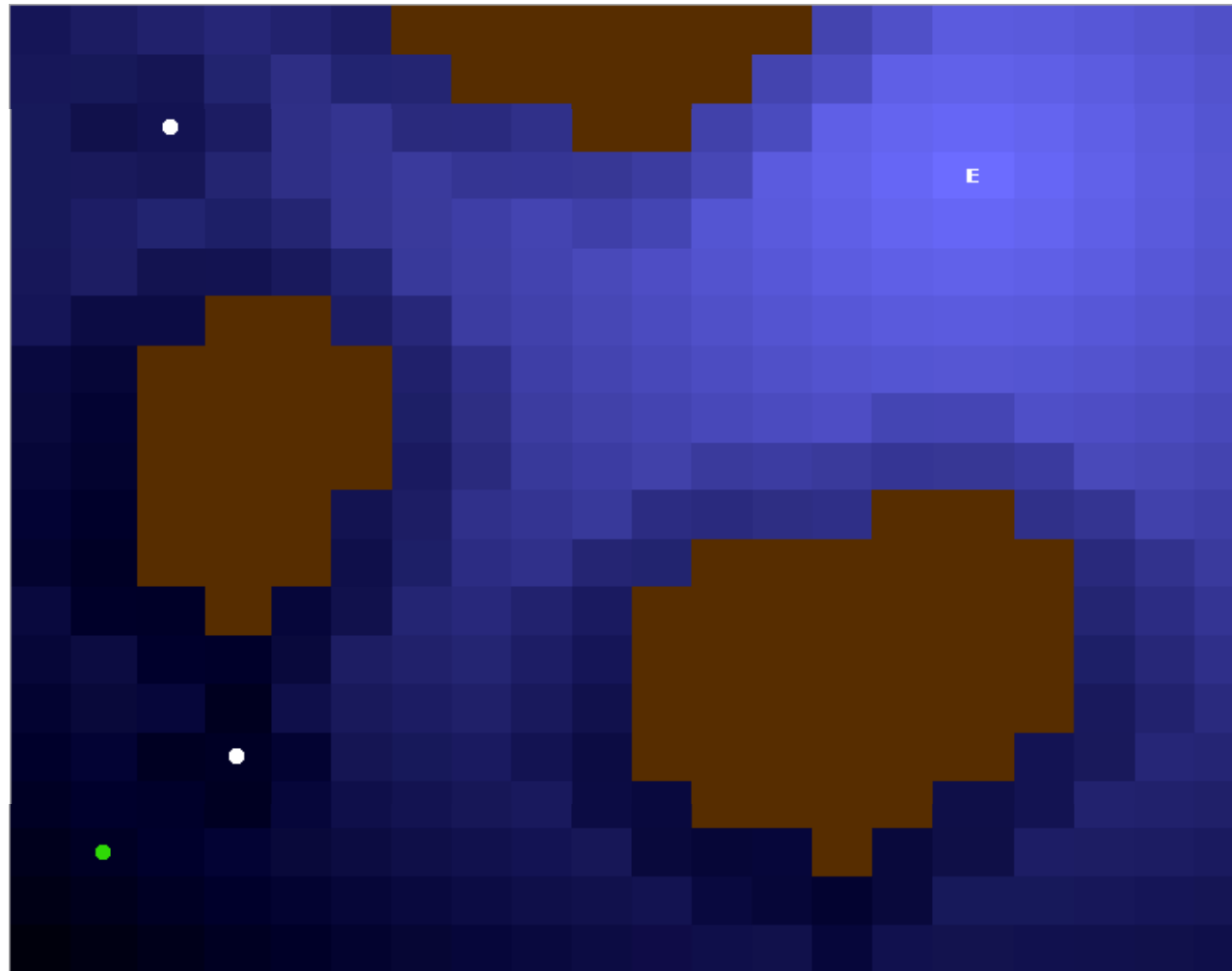
# Background of PFs



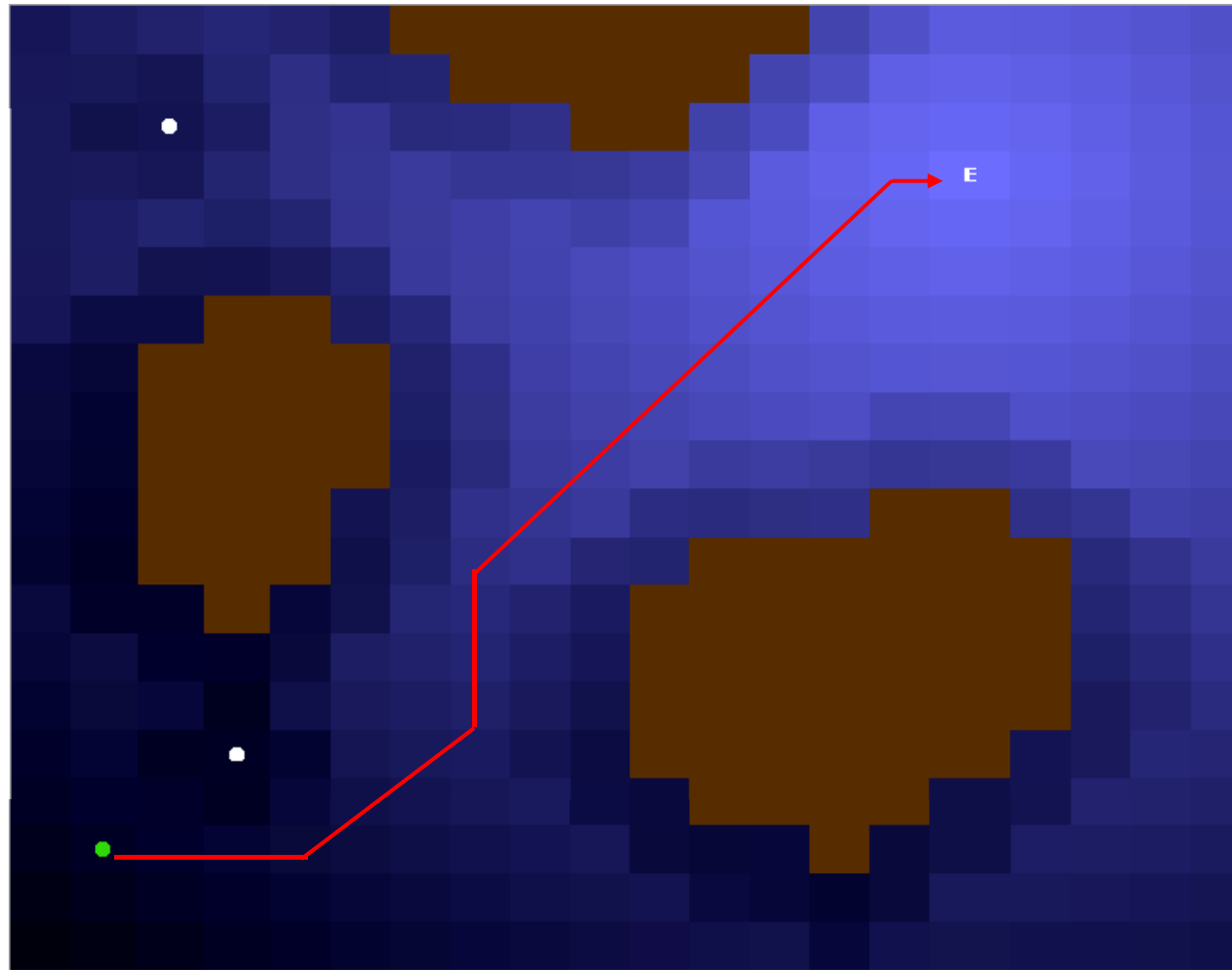
# Background of PFs



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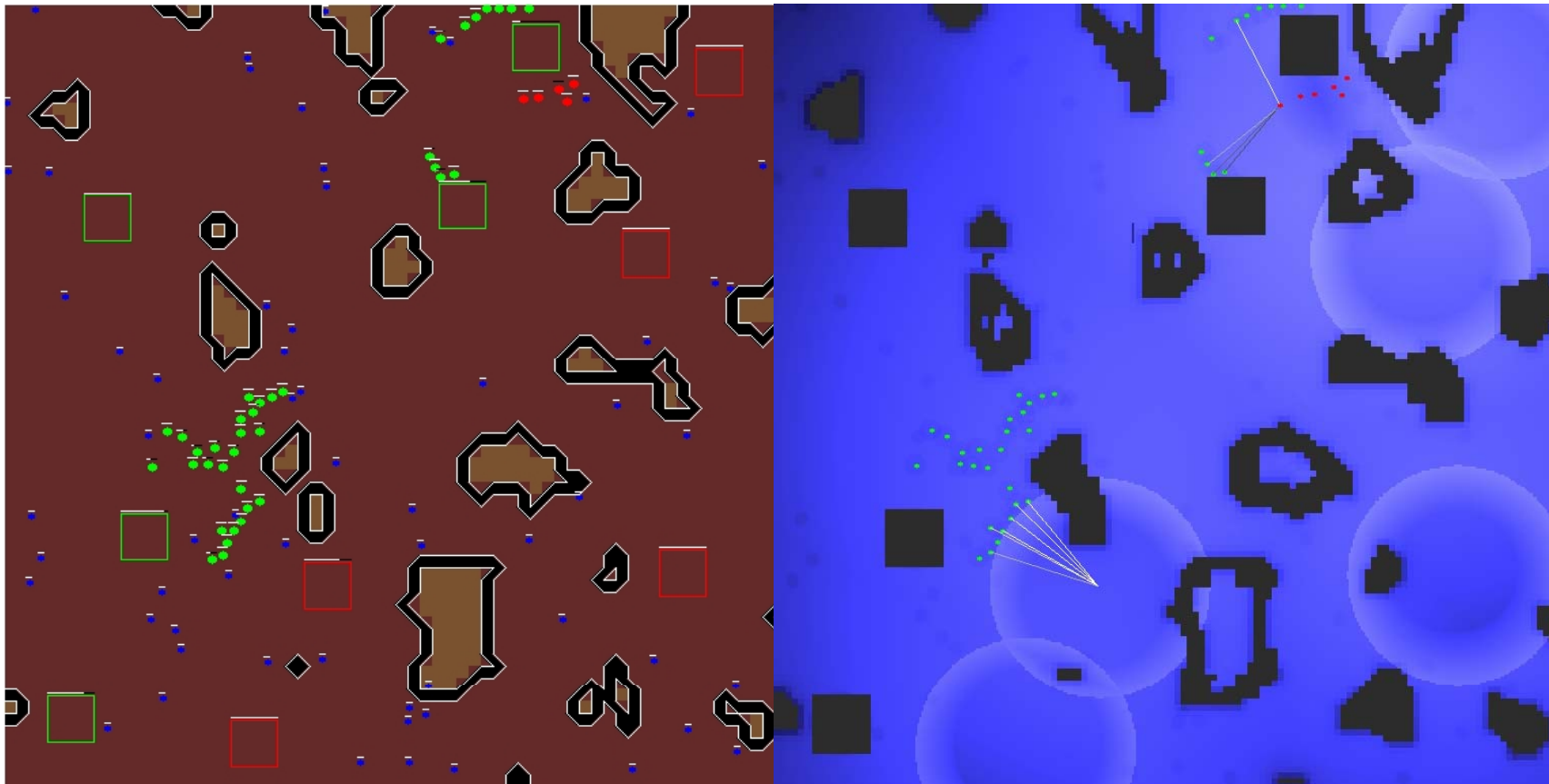
# Background of PFs



# Our paper from last year

- A scenario with 50 tanks and 5 bases
  - Fixed amount of units
  - No fog-of-war
- Navigation with PFs.
- Coordinated movement.
- Coordinated attacks at Maximum Shooting Distance.
- Retreat from enemy fire when weapons are on cooldown.
- Simple tactics: Destroy tanks first, then bases.

# Final Result



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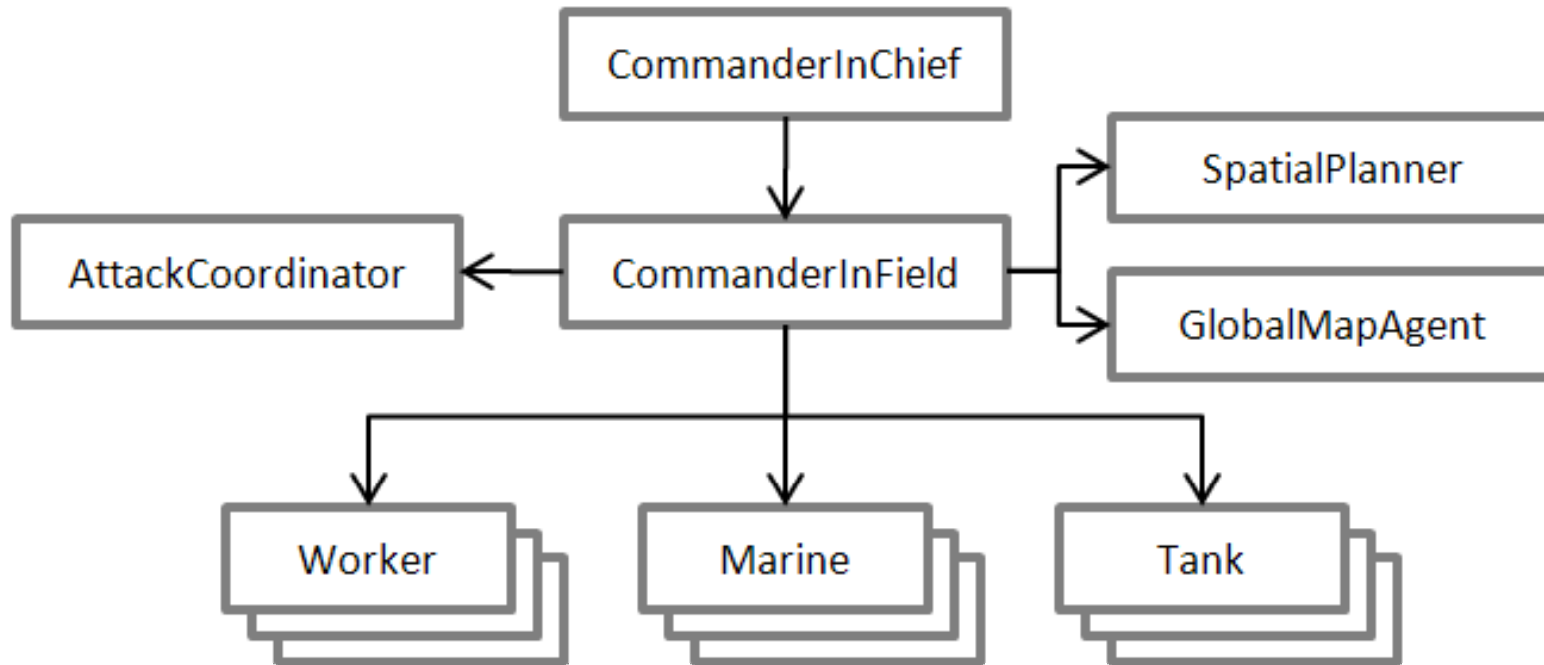
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# What's new

- Full RTS scenario
  - Start with a base and some workers.
  - Gather resources from minerals.
  - Build Barracks, Factories and additional bases.
  - Construct more workers, marines and tanks.
  - Destroy the opponent forces.
- Modify the Tankbattle bot to Full RTS

# Re-design the Multi-agent system



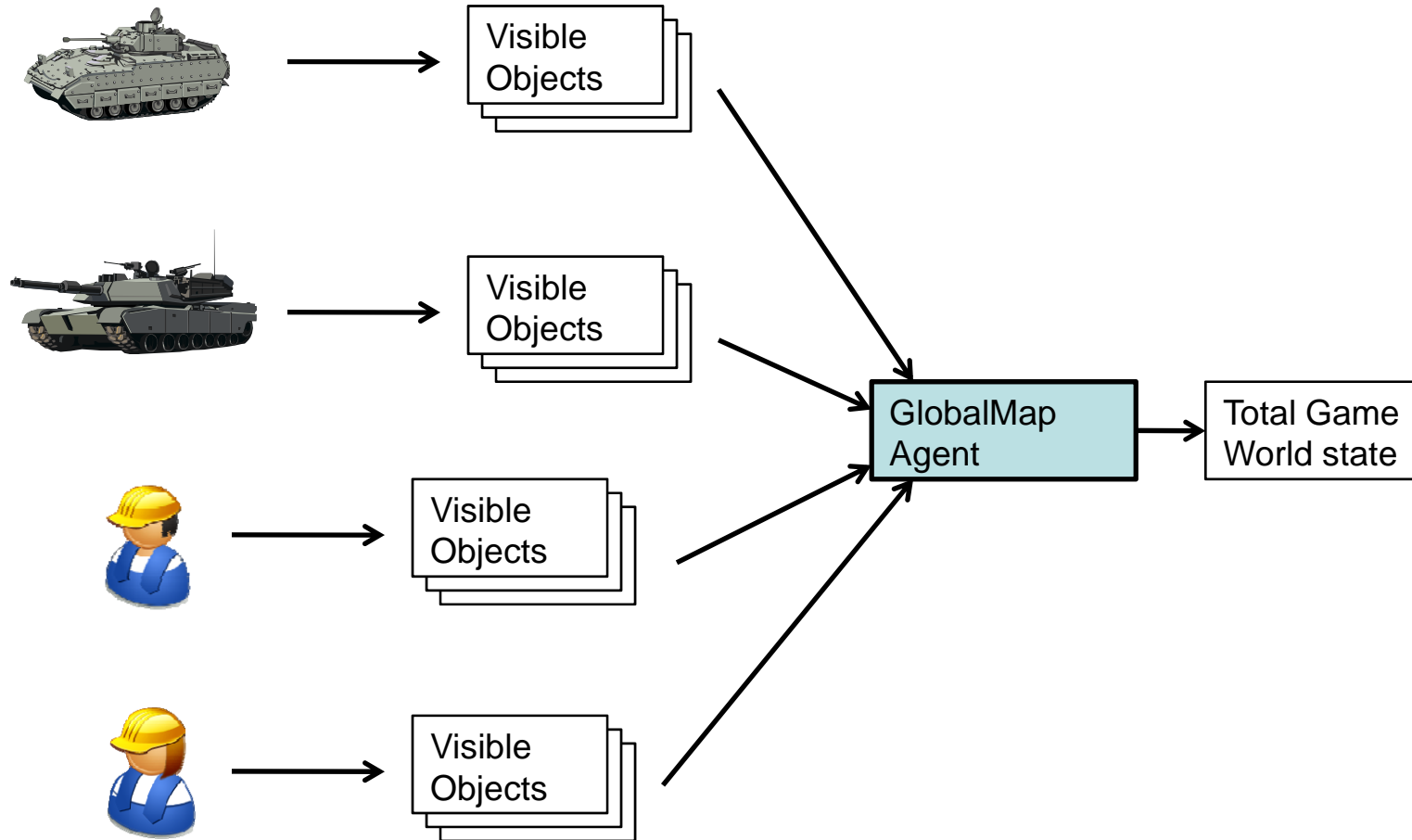
# Commander Agents

- CommanderInChief
  - Generate a plan, build order, for the game.
    - [build 5 workers]
    - [send 2 workers to explore]
    - [build a barrack]
    - [construct 5 marines]
    - ...
  - Update plan if necessary
    - If a barrack is destroyed, add [build a barrack] first in the plan.

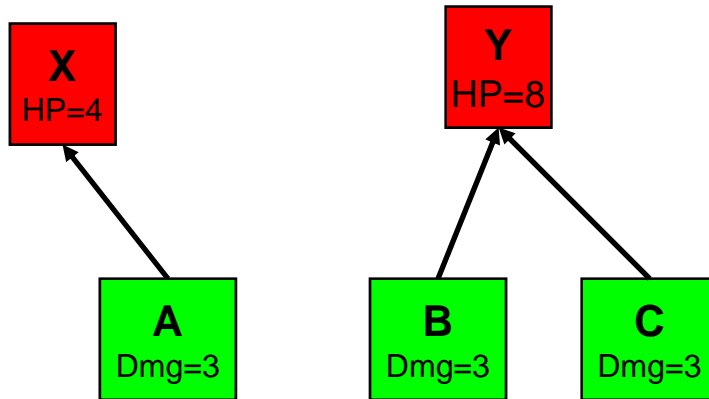
# Commander Agents

- CommanderInField
  - Execute the battle plan.
  - Issue orders to unit- and building agents.
  - Supports parallel constructions.
    - A factory can build tanks at the same time the base constructs new workers.
- Three supporting agents:
  - GlobalMapAgent
  - AttackCoordinator
  - SpatialPlanner

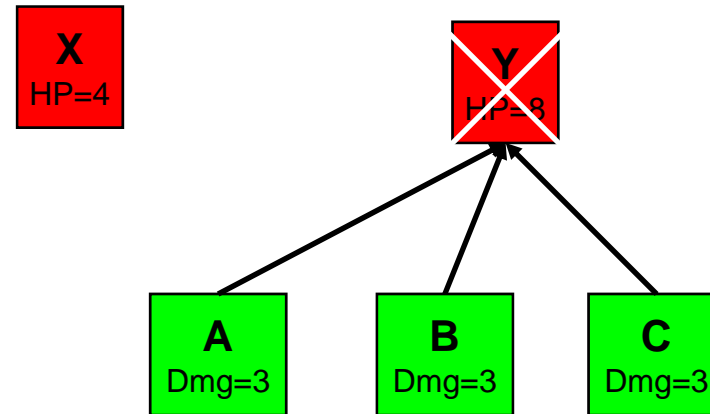
# GlobalMapAgent



# AttackCoordinator agent



Attack the most damaged unit within firerange (common approach).

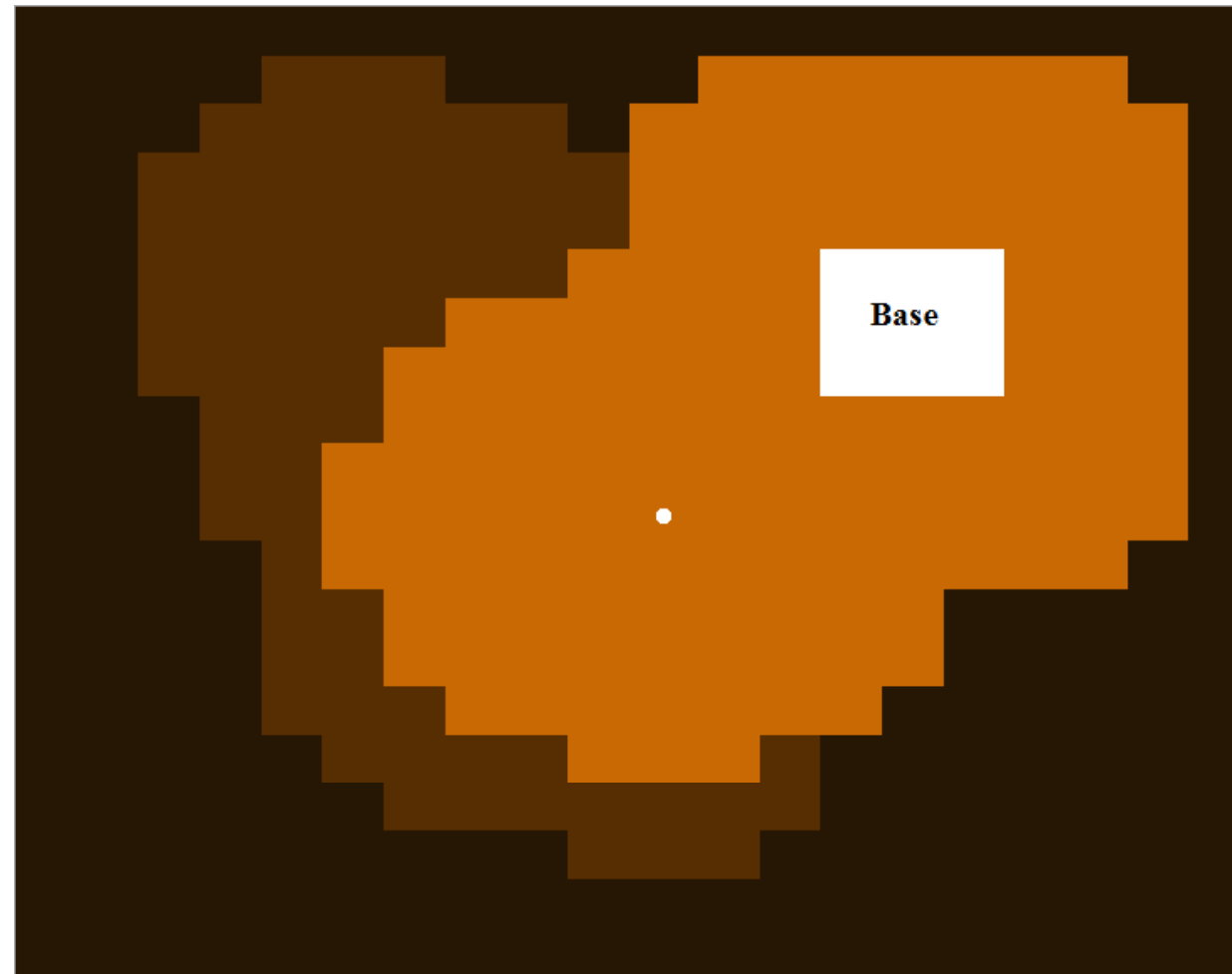


The coordinator agent optimizes attacks to destroy as many units as possible.

# SpatialPlanner agent

- Tactical PFs to support decision making.
  - The field is not associated with a physical object in the game.
- So far two fields:
  - Exploration; where to explore next.
  - Planning for base construction.
- Future:
  - Terrain Analysis.
  - Flanking attacks.
  - Learn from human players by placing pheromones.
  - ...

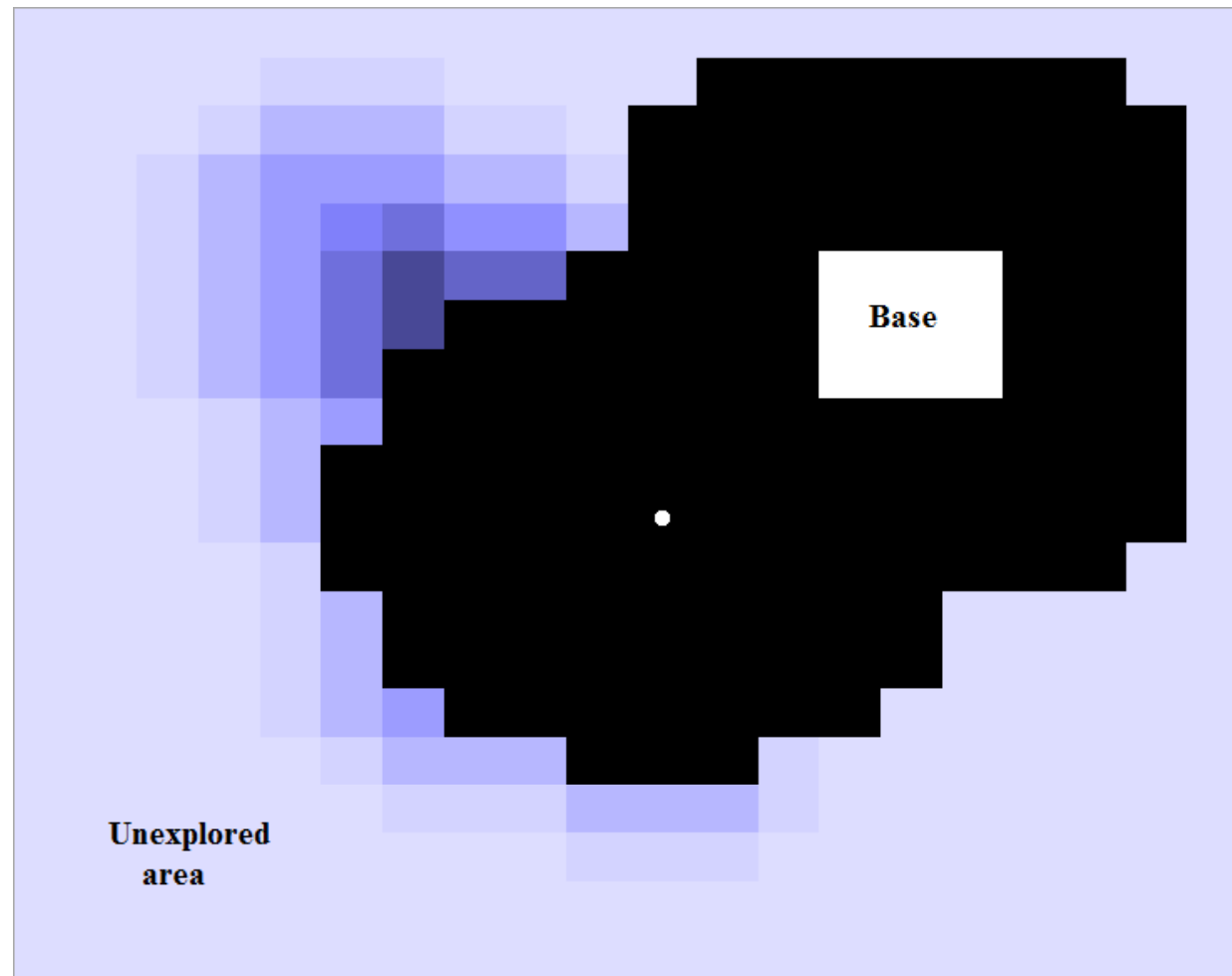
# Exploration: The Problem



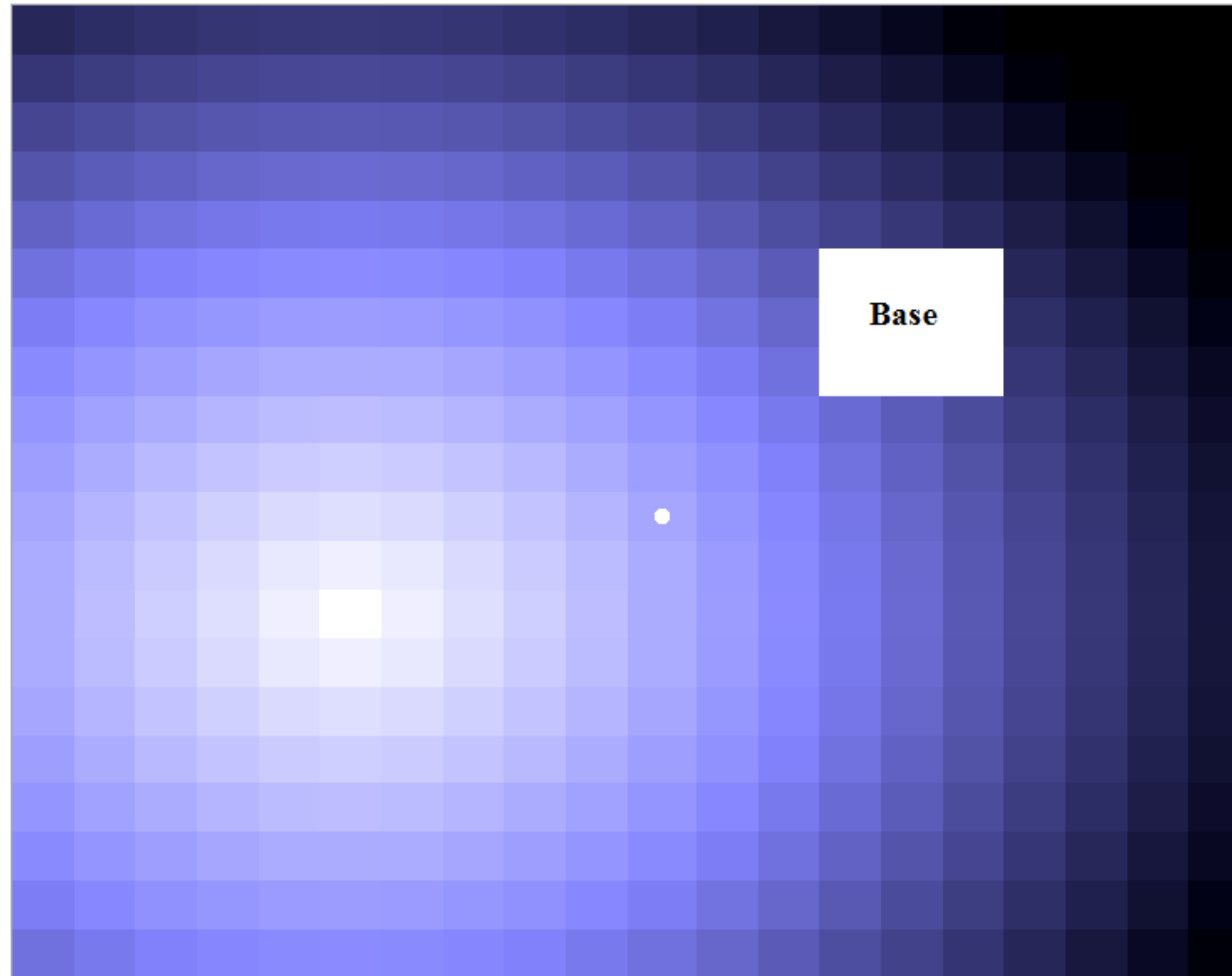
# SpatialPlanner: Find spot

- Init:
  - Assign explore value  $E(x,y)=0$  to each tile (16x16 points).
- For each frame:
  - $E(x,y)++$  for all tiles.
  - Set  $E(x,y)=0$  if:
    - tile(x,y) is visible by a unit.
    - tile(x,y) is known to be impassable.
- To find spot:
  - Calculate importance value for each tile:
    - $\text{importance}(x,y) = 2.4 * E(x,y) - 0.1 * \text{distance}$
  - Move to the tile with highest importance.

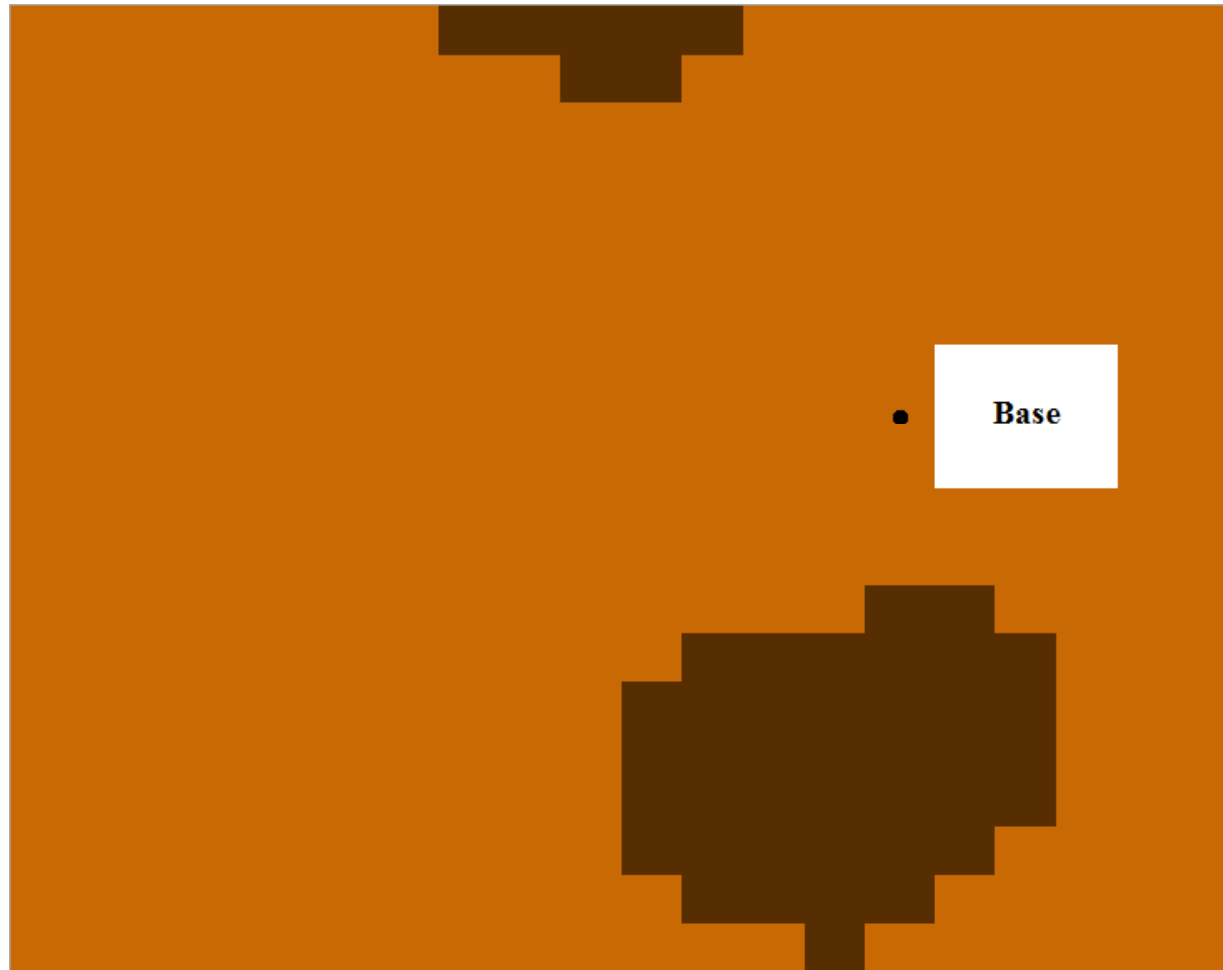
# SpatialPlanner: Find spot



# Navigation: Move to spot

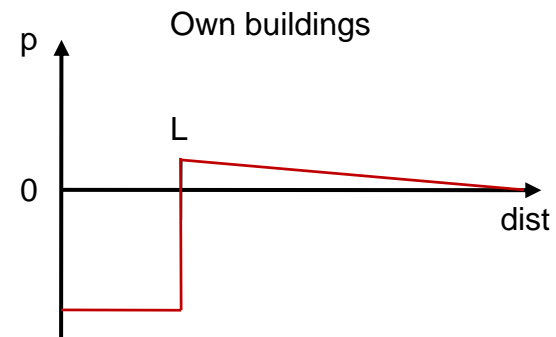
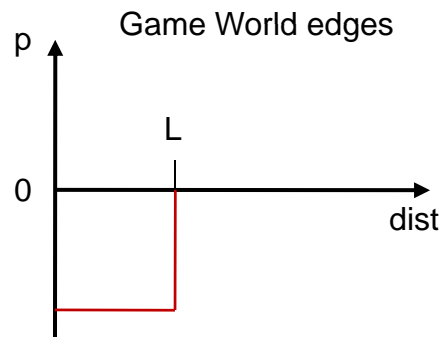
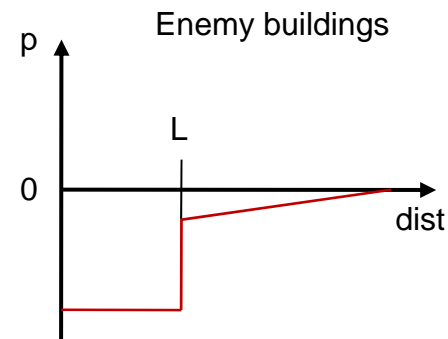
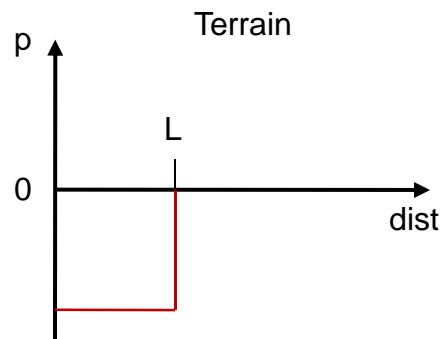


# Build structure: The Problem



# SpatialPlanner: Find spot

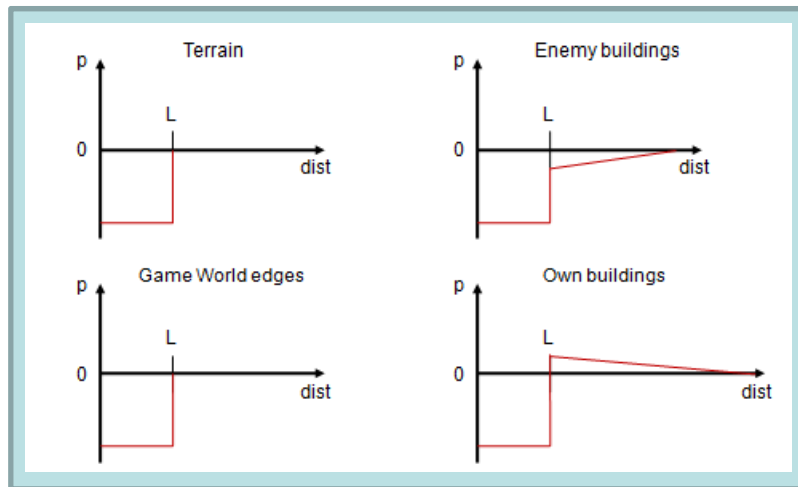
- Base construction field created from subfields.



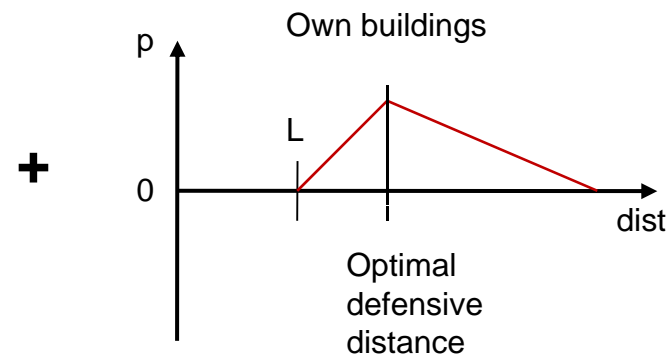
Weight and sum the subfields

# SpatialPlanner: Find spot

- Different structures can have different features, for example a defensive missile tower.

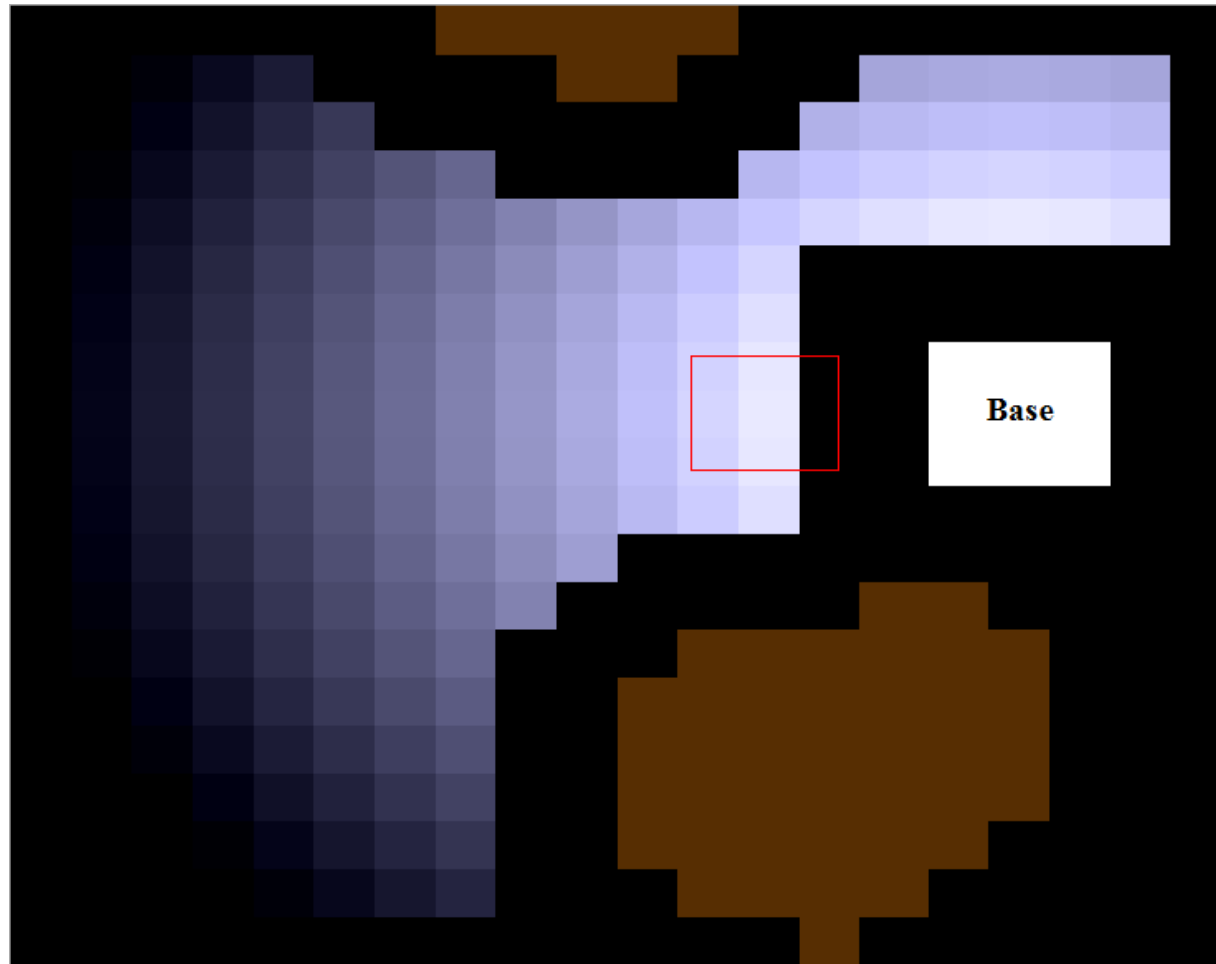


Basic Features

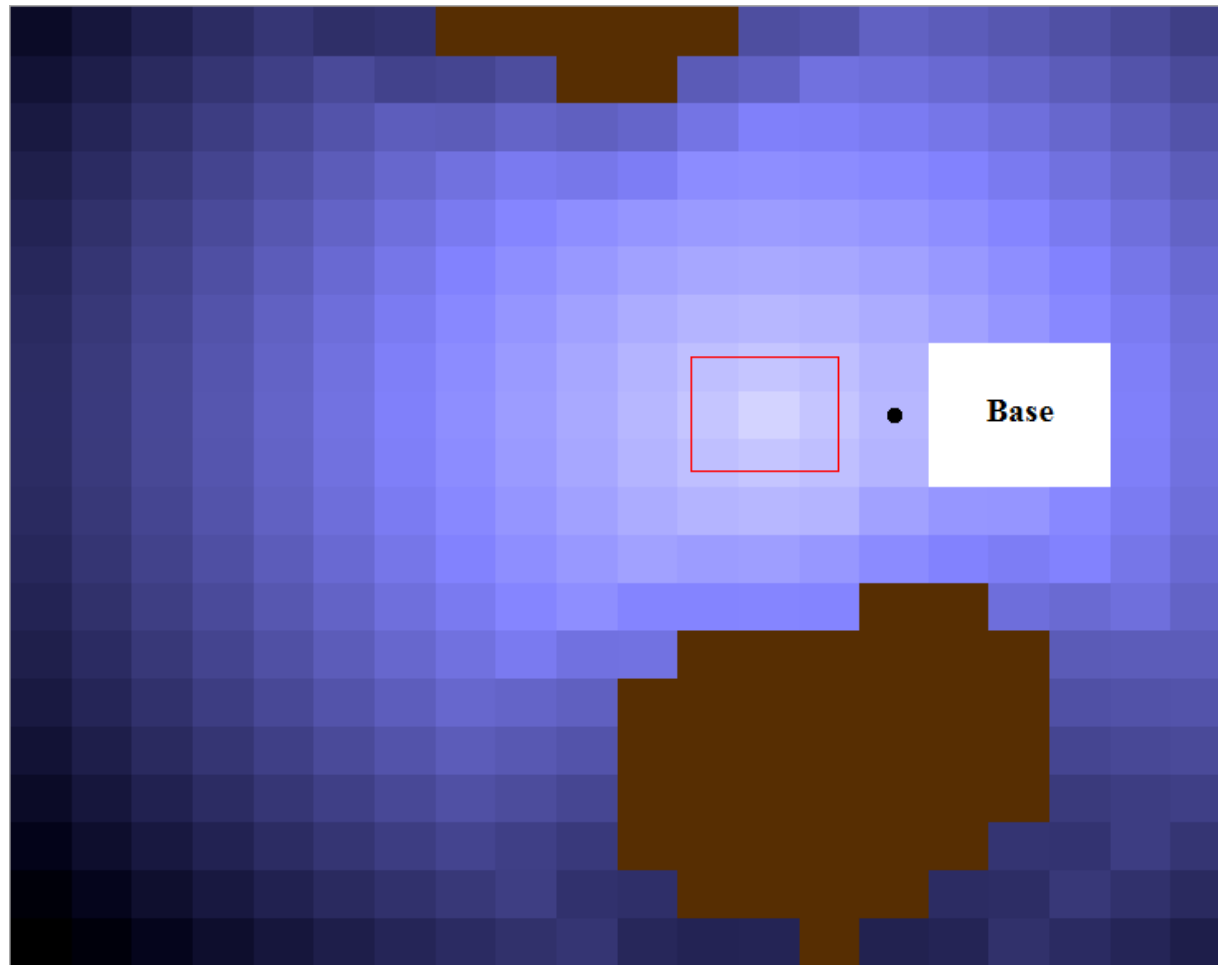


Defensive Distance

# SpatialPlanner: Find spot



# Navigation: Move to spot



# Experiments

- Participated in ORTS 2008 tournament.
- Unfortunately very few participants (we and Univ. of Alberta).

Team	Win (%)	Wins/Games	DC
BTH	82.5%	330/400	0
UofA	17.5%	70/400	3

# Conclusion

- UofA has performed well in previous tournaments and we were still able to win quite easily.
- The addition of potential field based tactical fields can solve some common RTS problems.
- Our weak spot is how the overall strategy is handled.

# The Future

- Better high-level tactics.
- Adaptivity
- Add features to the SpatialPlanner:
  - Terrain Analysis.
  - Special combat tactics like flanking.
  - Learning from human players by placing pheromones.
  - ...
- More complex scenarios:
  - Combinations of more unit types.
  - Handle additional structures defensive towers and walls.
  - Can't do this in ORTS, so we're migrating to Spring.

# Questions?

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