

The Rise of Potential Fields in Real Time Strategy Bots



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Outline

- Background
- Our approach
- Bot v1 (presented at AAMAS april 2008) against Bot v2 (presented at AIIDE october 2008)
- Experiments
- Future Work

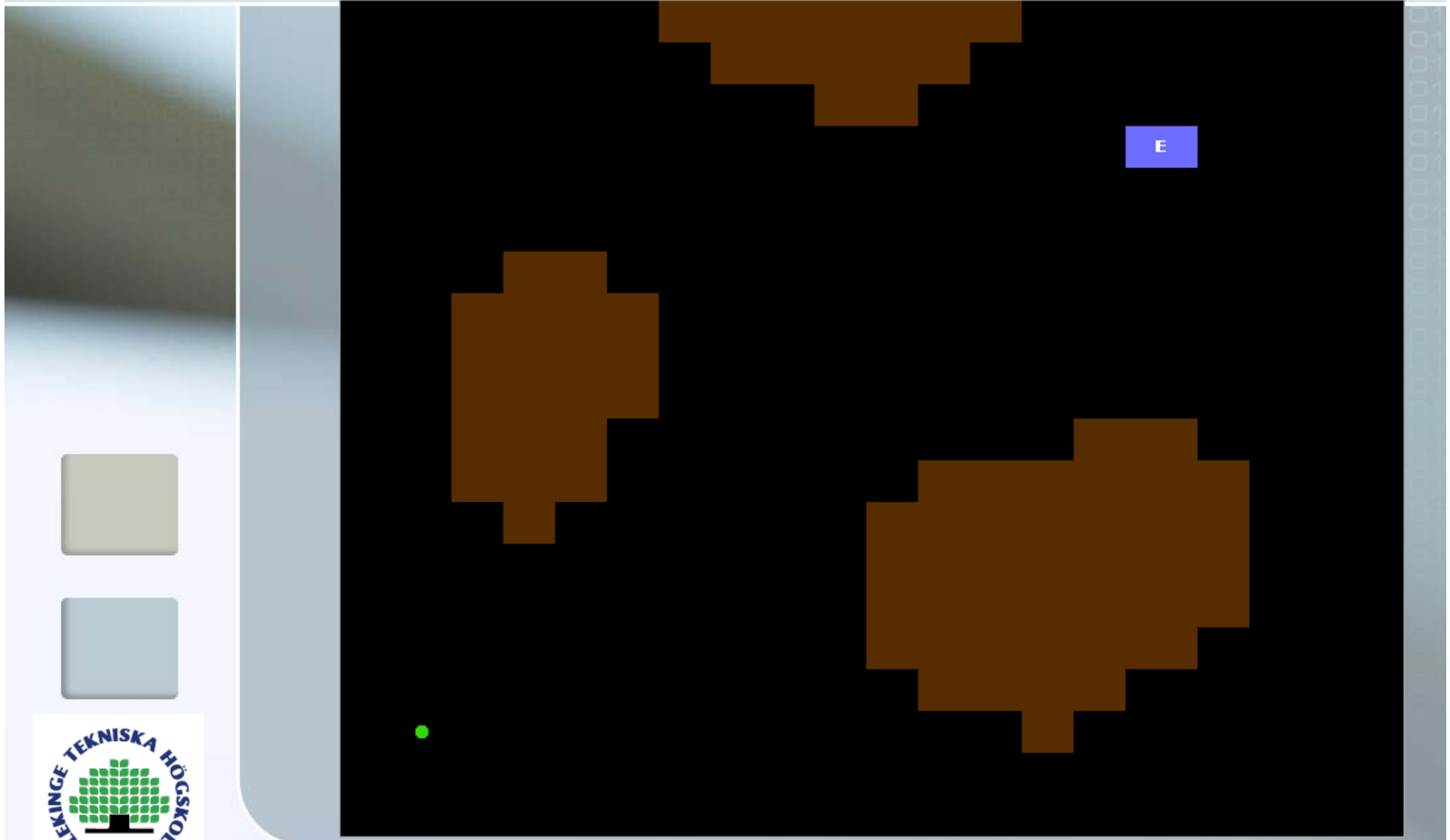


Background

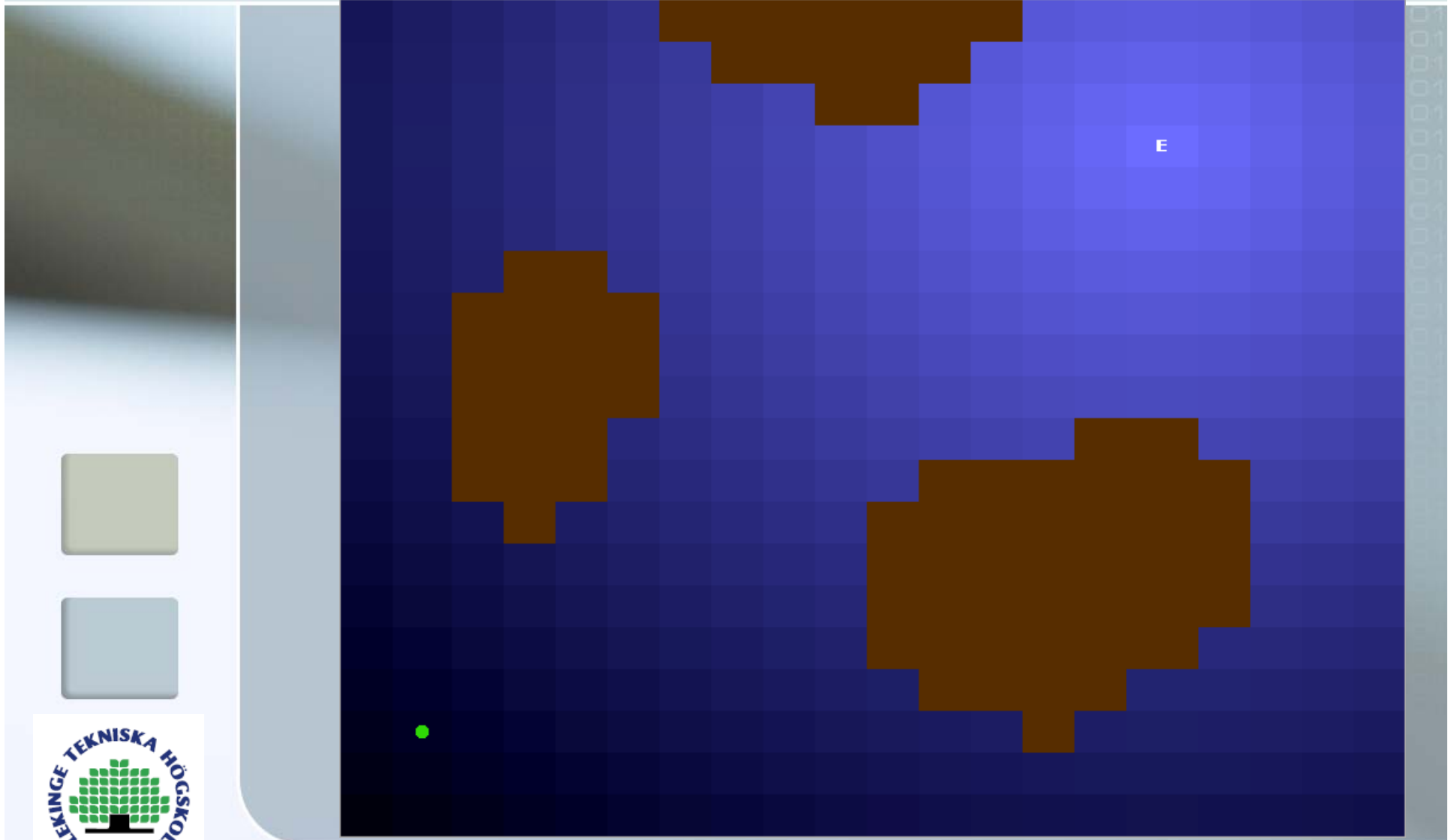
- Potential Fields is a concept origin from the area of Robotics
 - First mentioned in 1985 by Oussama Khatib
- A potential field is generated by placing an attractive or repelling charge at an interesting point, and let the charge generate a field that gradually fades to 0.



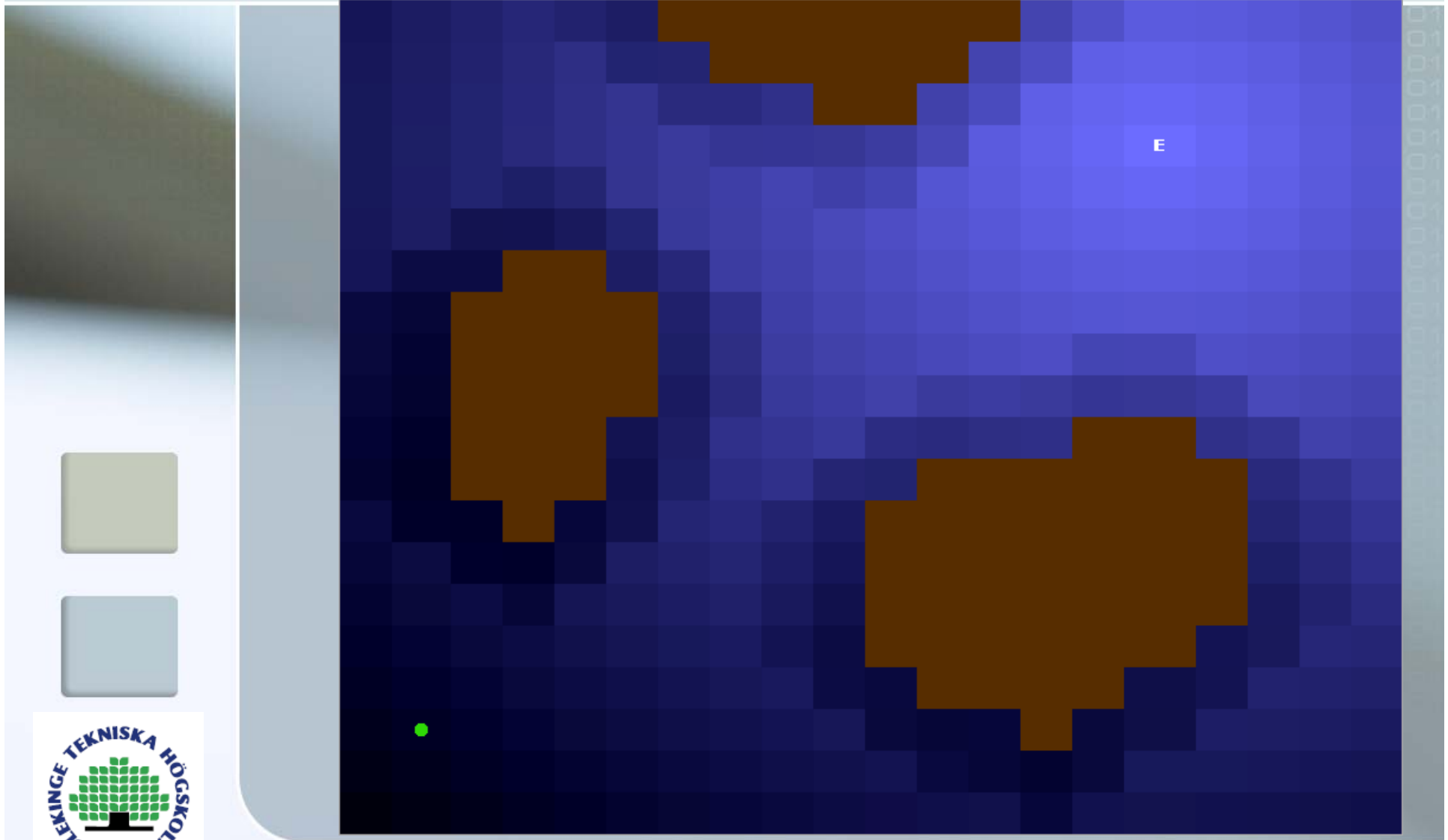
Example



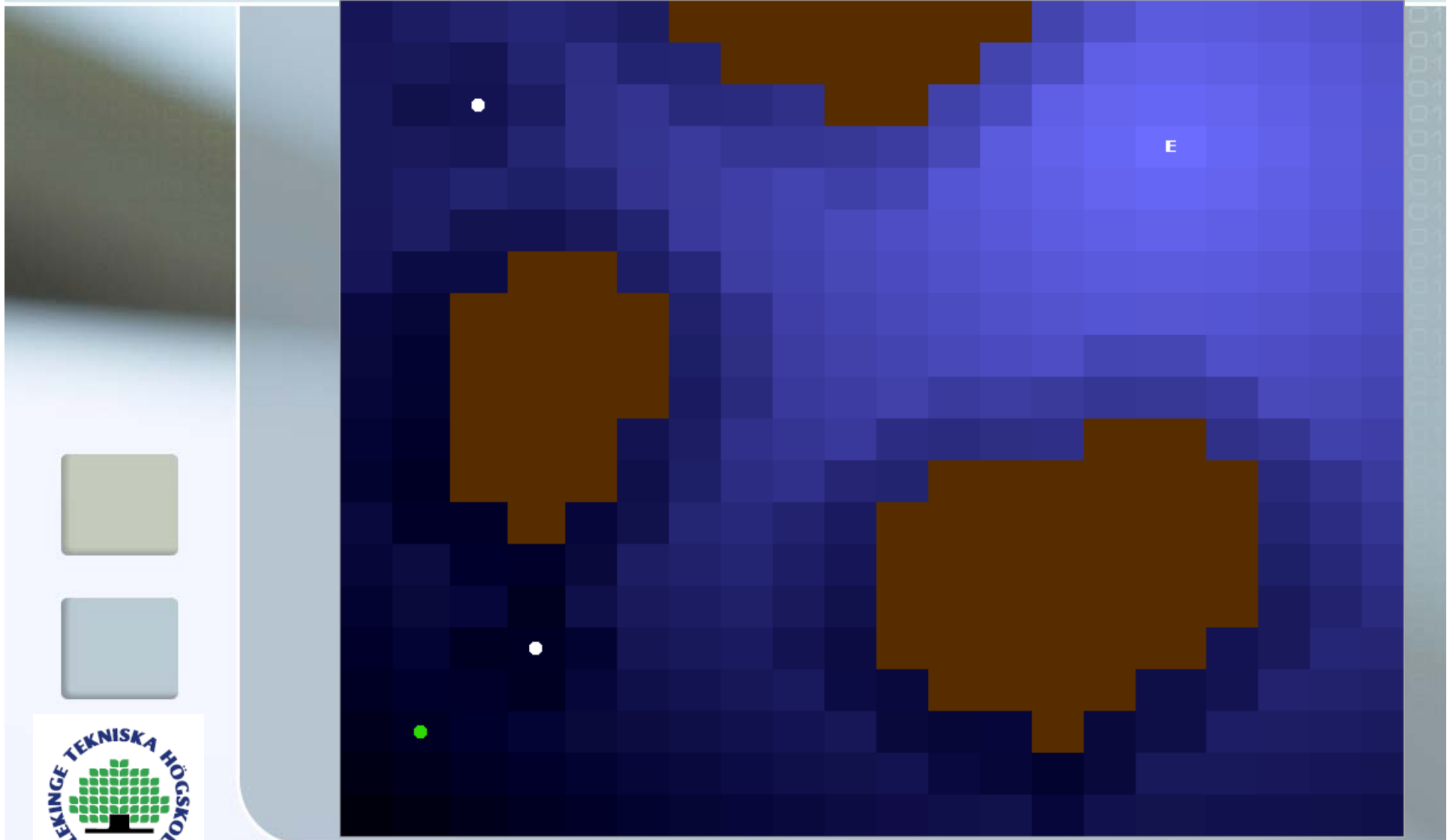
Example



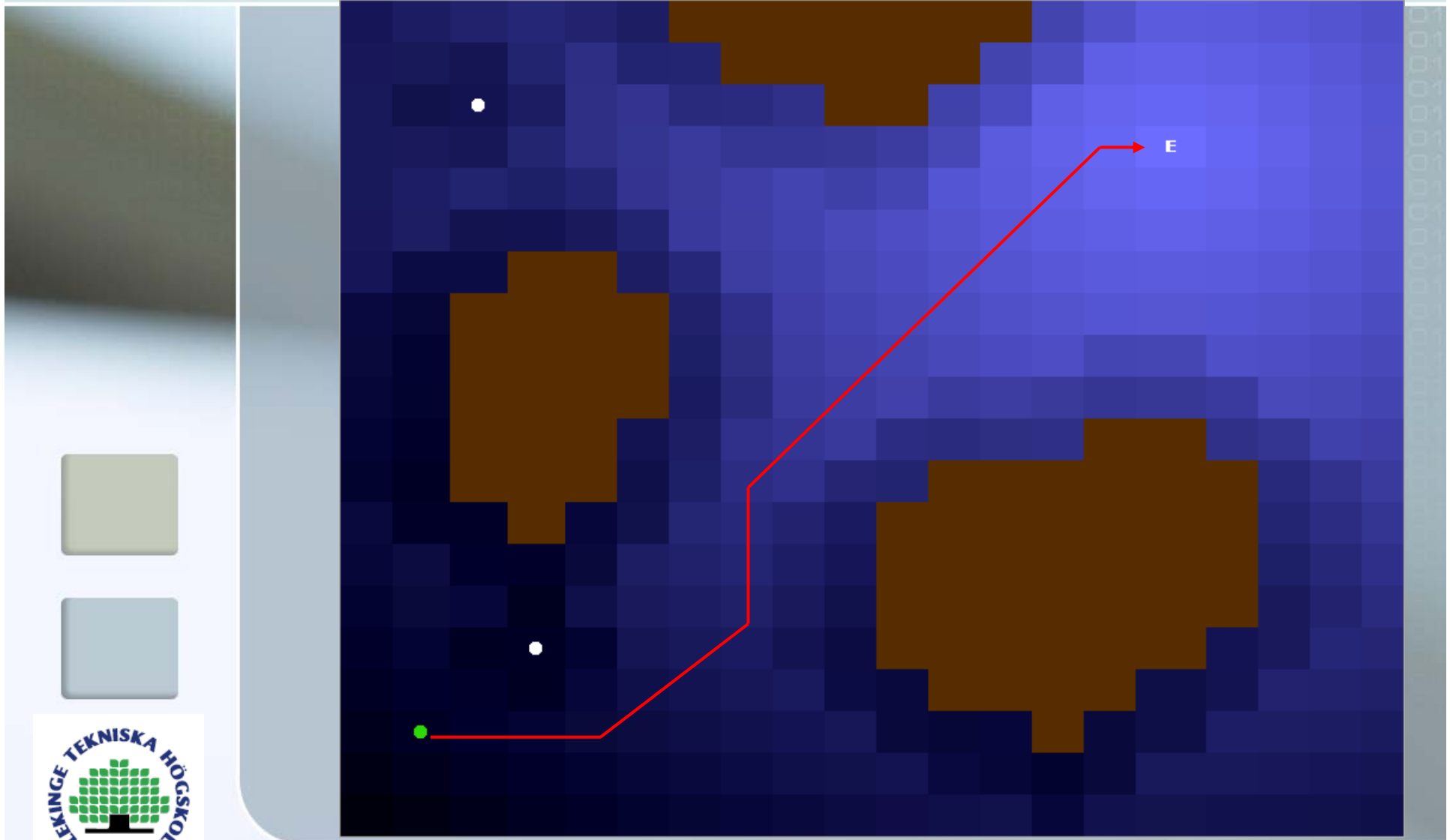
Example



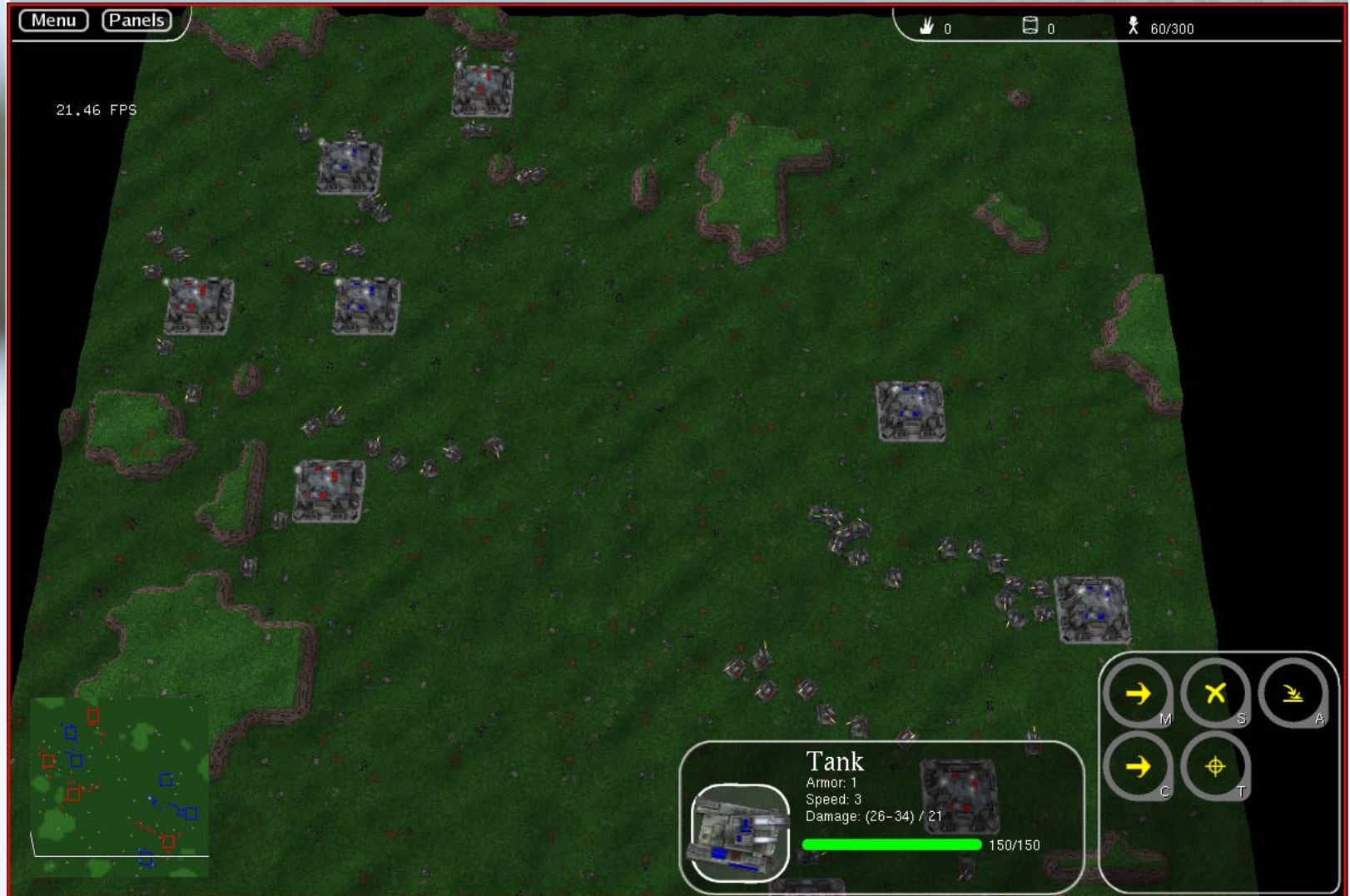
Example



Example



The Environment:



Why ORTS?

- Open-Source RTS game engine.
- Highly configurable.
- Developed at the University of Alberta as a tool for game AI research.
- The yearly tournament is a good way of testing performance.





A methodology for Multi-Agent Potential Fields

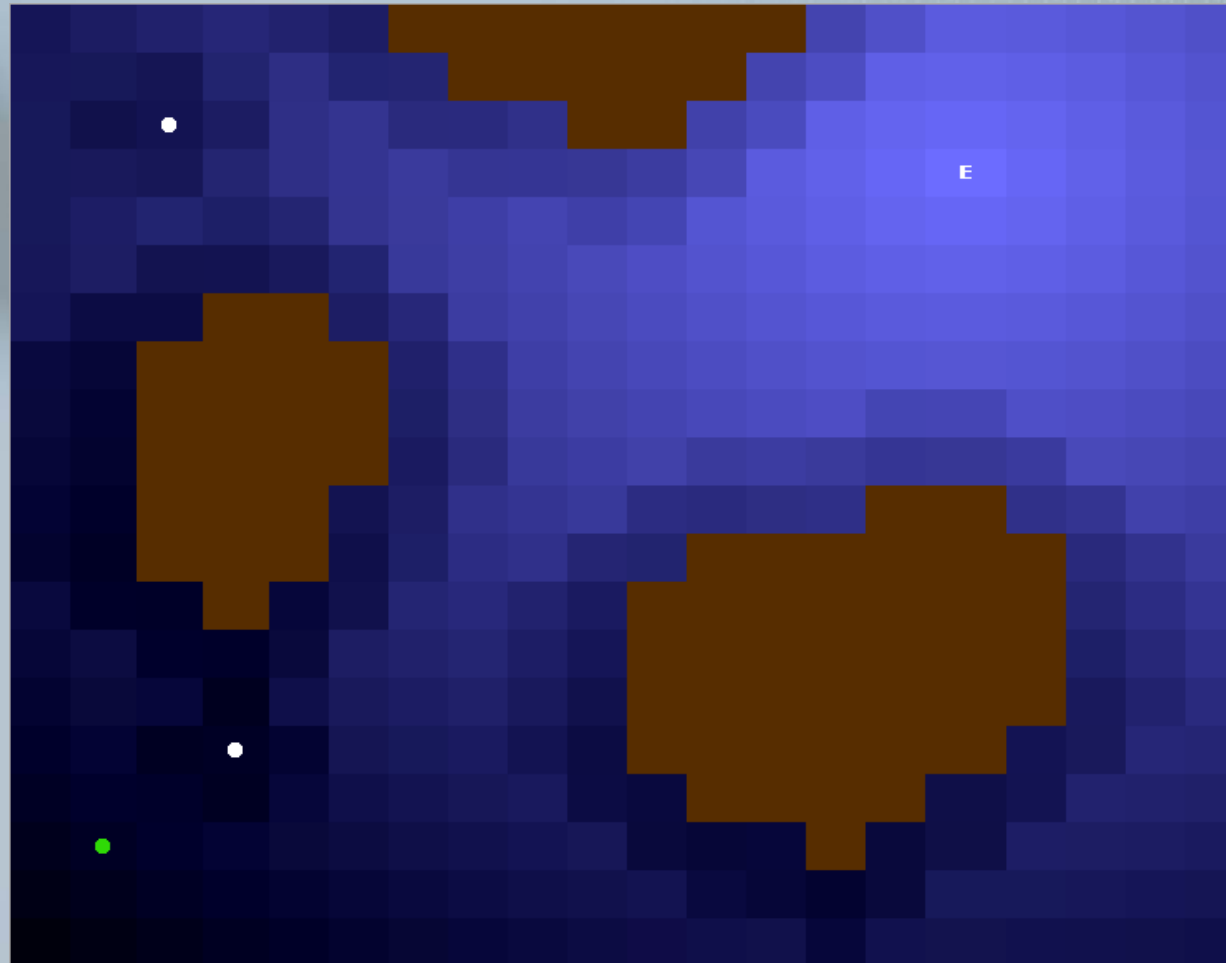
MAPF in ORTS

- Identify game objects
 - Cliffs (impassable terrain)
 - Sheep
 - Own and opponent units and bases
- Identify driving forces
 - Avoid colliding with cliffs
 - Avoid colliding with moving objects
 - Hunt down the enemy's forces
 - Defend the bases
- Three major types of PFs:
 - Static field (terrain)
 - Semi-static field (bases)
 - Dynamic field (units and sheep)



MAPF in ORTS

- Assigning charges

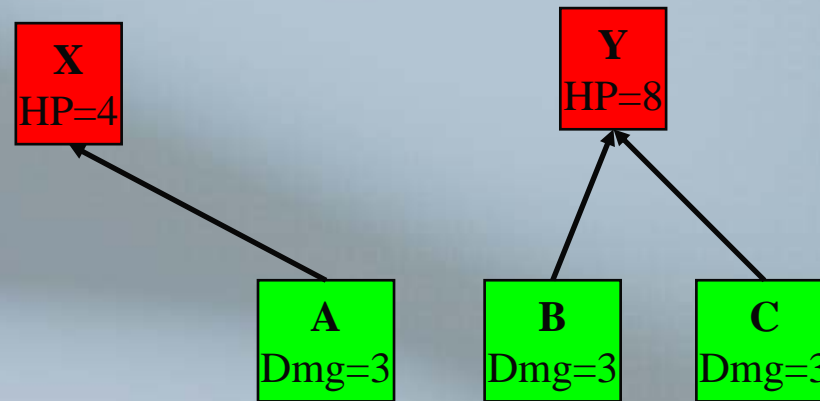


MAPF in ORTS

- Agents of the system
 - Own units
 - Each own unit is an agent.
 - Uses the total potential field for navigation.
 - Fire Coordinator agent
 - Optimize attacks at enemy units/bases within fire range.
 - Movement Coordinator
 - Adds a repelling field at the chosen destination of each unit.



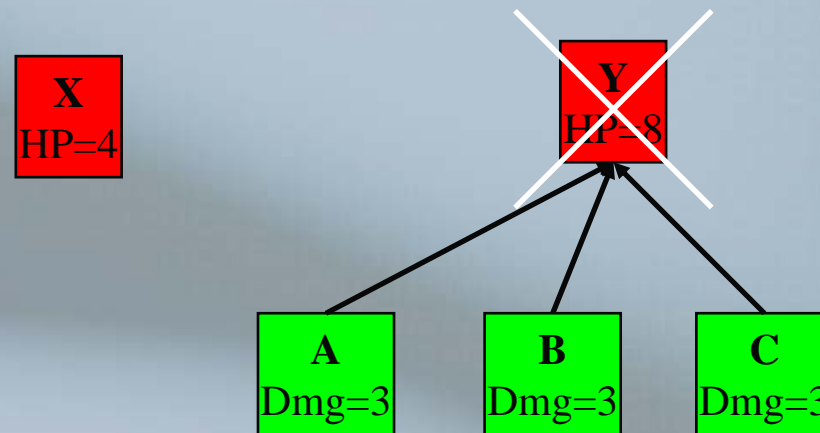
Fire Coordinator Agent



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



Fire Coordinator Agent



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



Bot tactics

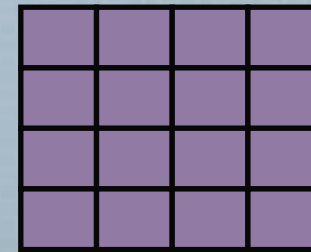
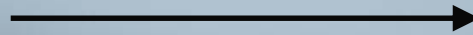
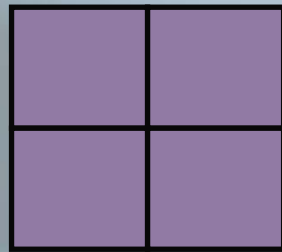
- Start with attacking enemy units, skip bases.
- Start attacking bases when:
 - We have five times as many units as the opponent left.
 - The opponent only have one base left.





Bot v1 → Bot v2

Increased Granularity

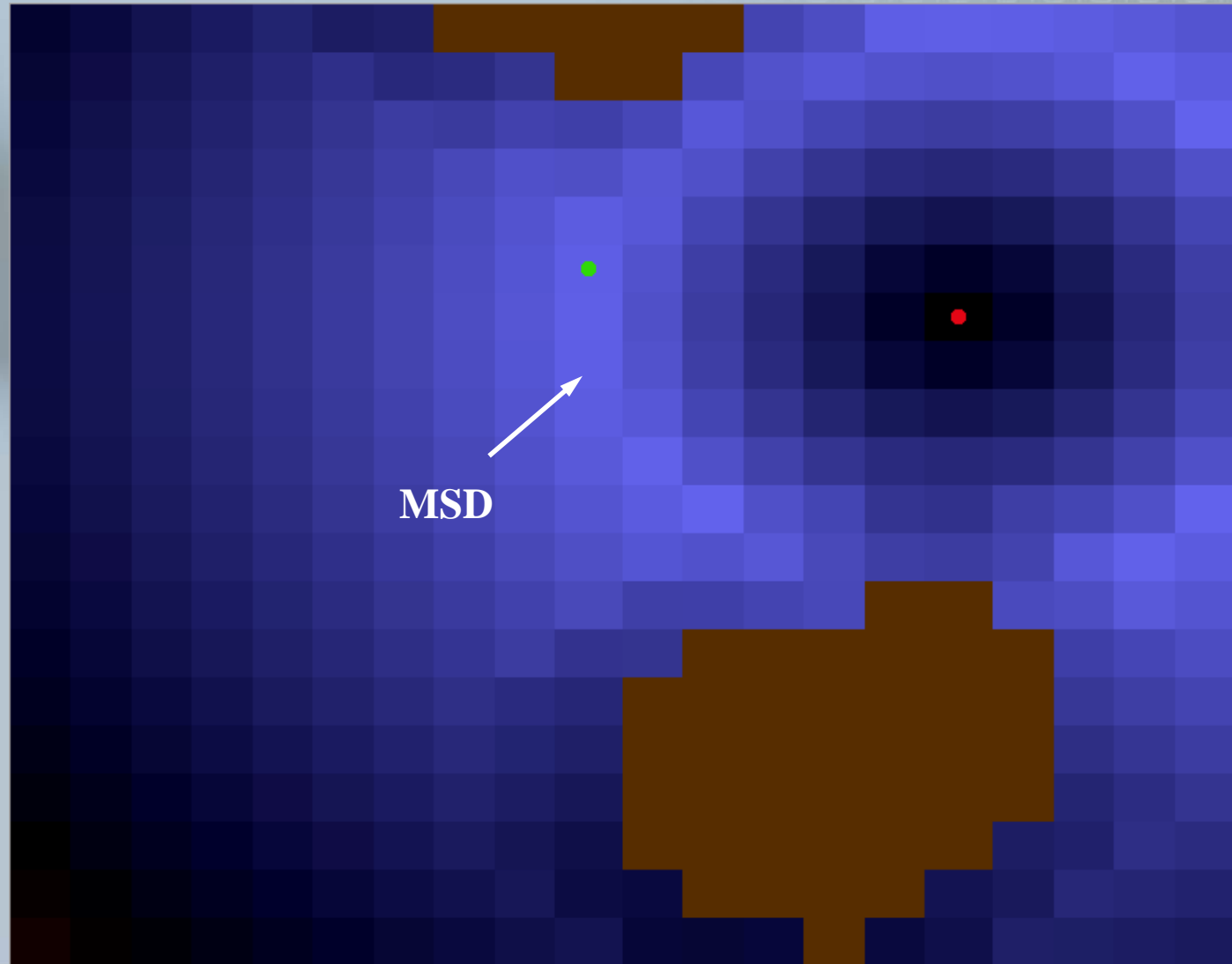


- Tiles of 8x8 points
- Pre-calculated fields
- Copied into total field

- Full Resolution 1x1
- Calculated at runtime using formulas
- Static terrain still pre-calculated



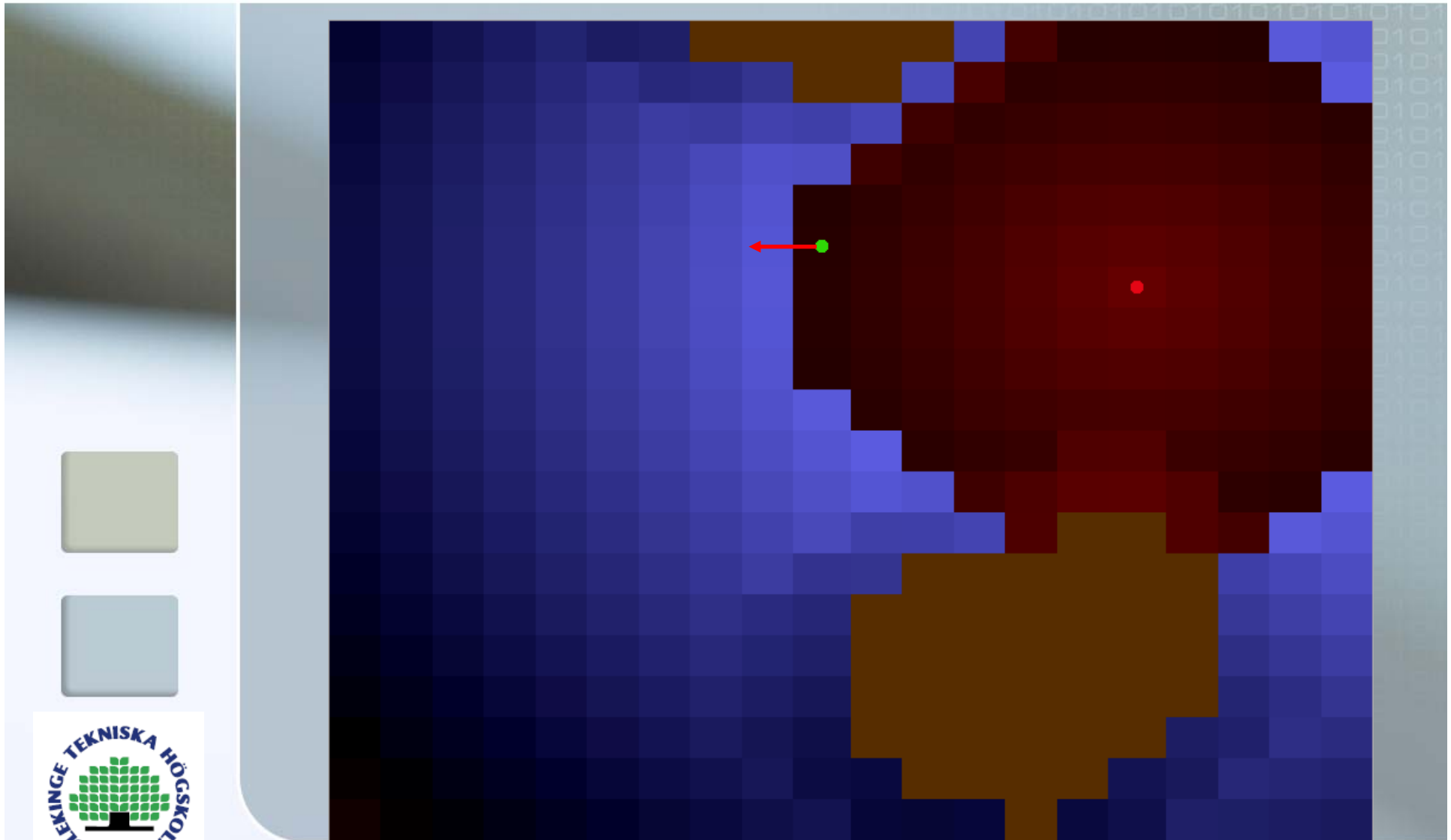
Unit attacking



MSD



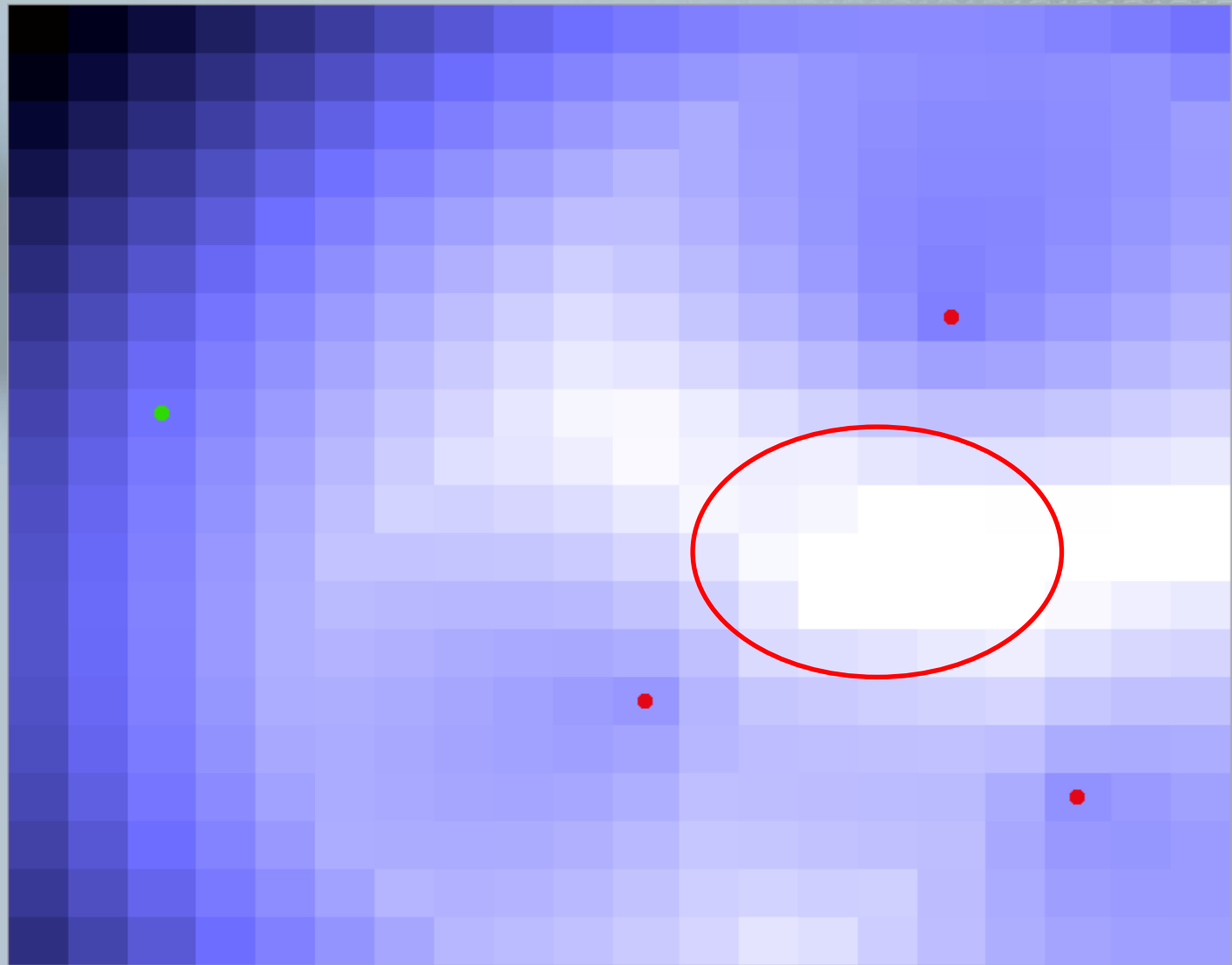
Unit in cooldown – Defensive Field



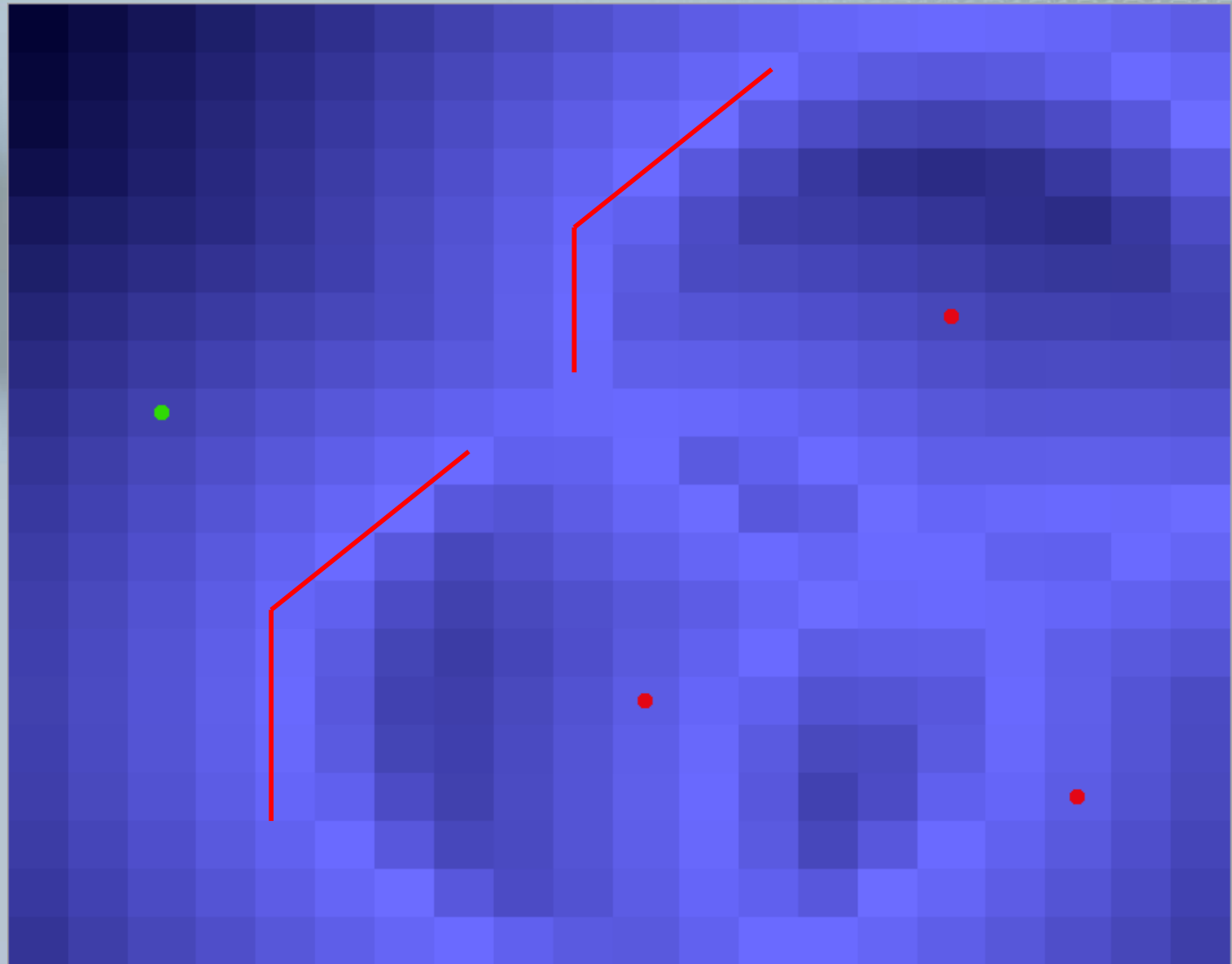
Local optima - Trail



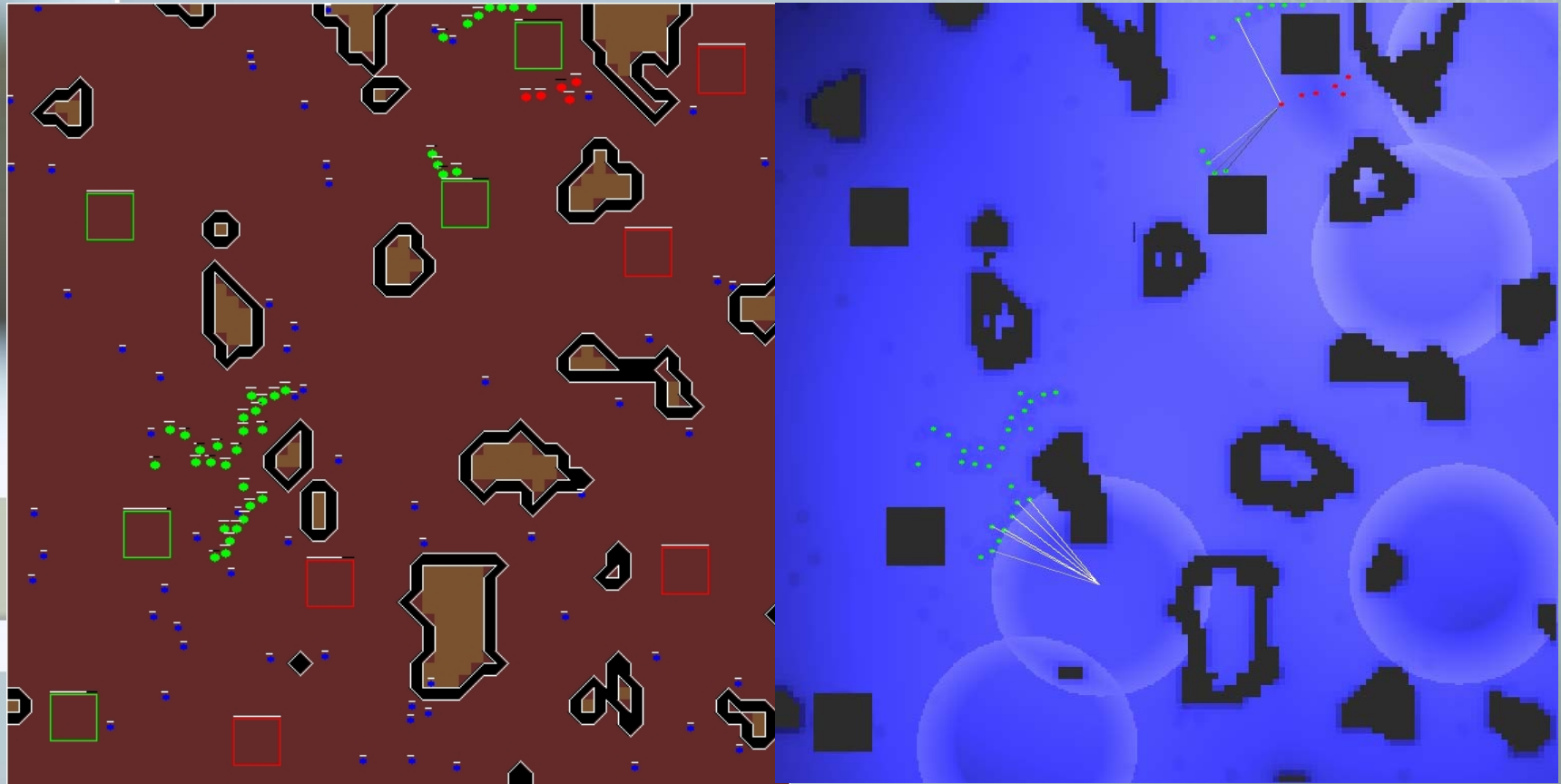
Sum potentials



Use highest potential



Final Result



Experiments

- Bot v1 participated in 2007 years' ORTS tournament.
 - Bad result, but the technique showed some promise
- Updated to Bot v2 and played 100 games against each of the top teams from the tournament.
- Participated in 2008 years' ORTS tournament.



Results: Bot v1

Team	Win %	Wins/games	Avg Units	Avg Bases
NUS	0%	0/100	0.01	0.00
WarsawB	0%	0/100	1.05	0.01
UBC	24%	24/100	4.66	0.92
Uofa.06	32%	32/100	4.20	1.45
Average	14%	14/100	2.48	0.60

Note: Team NUS won **315/320** games (98%) againsts all opponents in 2007 years' tournament



Results: Bot v2

Team	Win %	Wins/games	Avg Units	Avg Bases
NUS	100%	100/100	28.05	3.62
WarsawB	99%	99/100	31.82	3.21
UBC	98%	98/100	33.19	2.84
Uofa.06	100%	100/100	33.19	4.22
Average	99.25%	99.25/100	31.56	3.47

14% → 99.25%



Results: ORTS 2008

Team	Tot Win %	Blekinge	Lidia	NUS
Blekinge	98%	-	96	100
Lidia	43%	4	-	82
NUS	9%	0	18	-



To sum up...

- Potential fields is a successful option to more conventional navigation with A* .
- Can be used in more complex scenarios (Full RTS).
 - Participated in ORTS 2008
 - We won 82.5% of the games against Uofa
 - Working paper
- Can handle imperfect information.
 - Enabled FoW for our bot
 - Opponent bots still had perfect information
 - Won over 97% of the games against the four teams
 - Paper to be presented at CIG 08



Future Work

- Combine with more high-level planning of tactics.
- Evaluate in other environments.
- On-line adaptivity of the bot.
 - Winratio of 52% against NUS instead of 100% over 200 games.
 - The AI is obviously balanced...
 - ... but is it more fun?
 - Experiments will be held at DreamHack winter 2008.



Questions?

