Second Workshop (W1) on AI in Adversarial Real-Time Games

https://www.cs.ualberta.ca/~mburo/aiide14ws

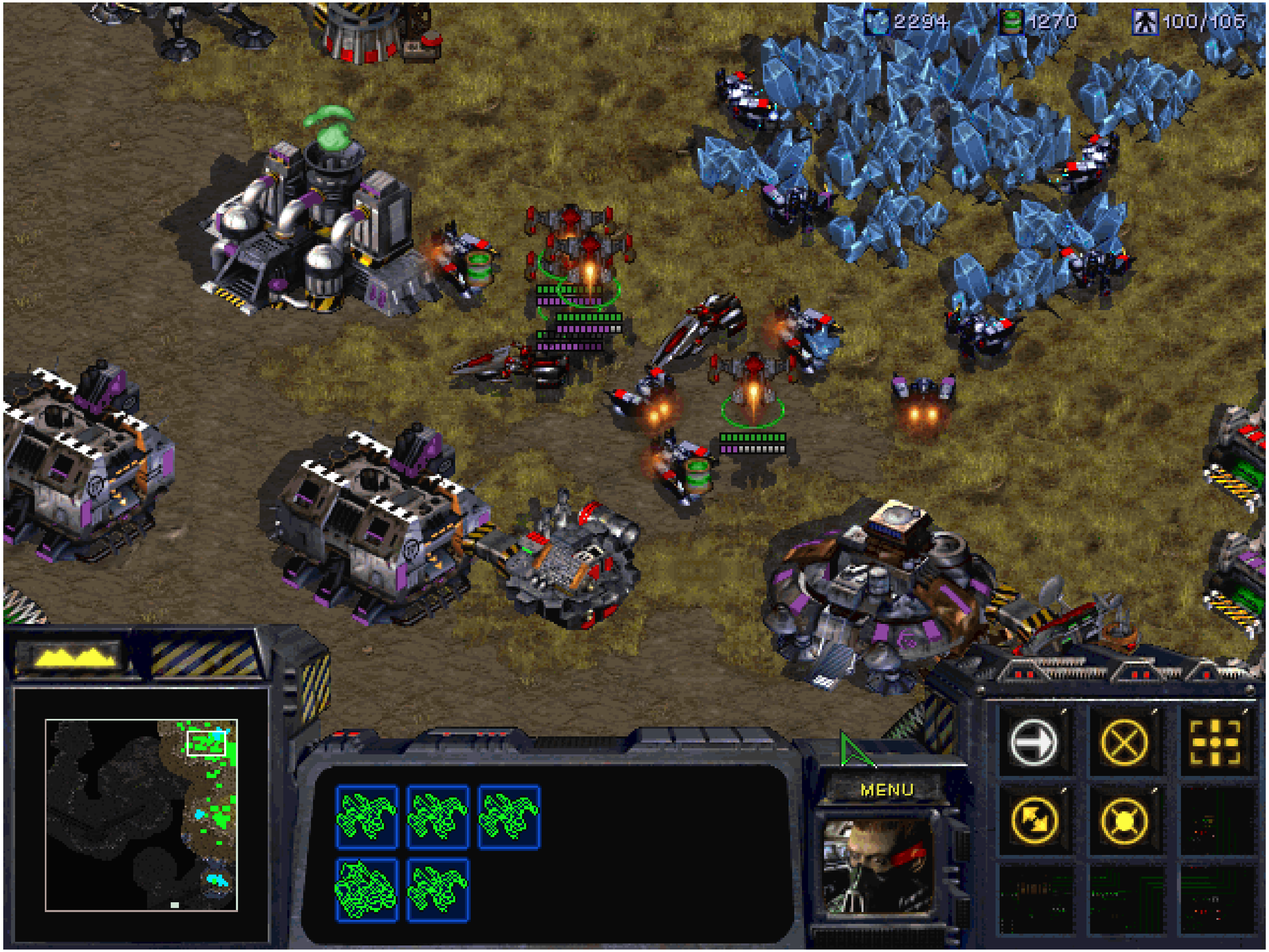
Co-organizers: M. Buro and S. Ontañón

4 submissions, 3 accepted, 2 invited talks

8 PC Members

14 Attendees

StarCraft



Activities

- Paper Session [1:30h]
- Invited Talks [1:40h]
- StarCraft Competition Report + Replays [1:10h]

  [Dave Churchill]
- Group Discussion [0:45h]
- Workgroups + Reporting [1:30h]
- Dinner

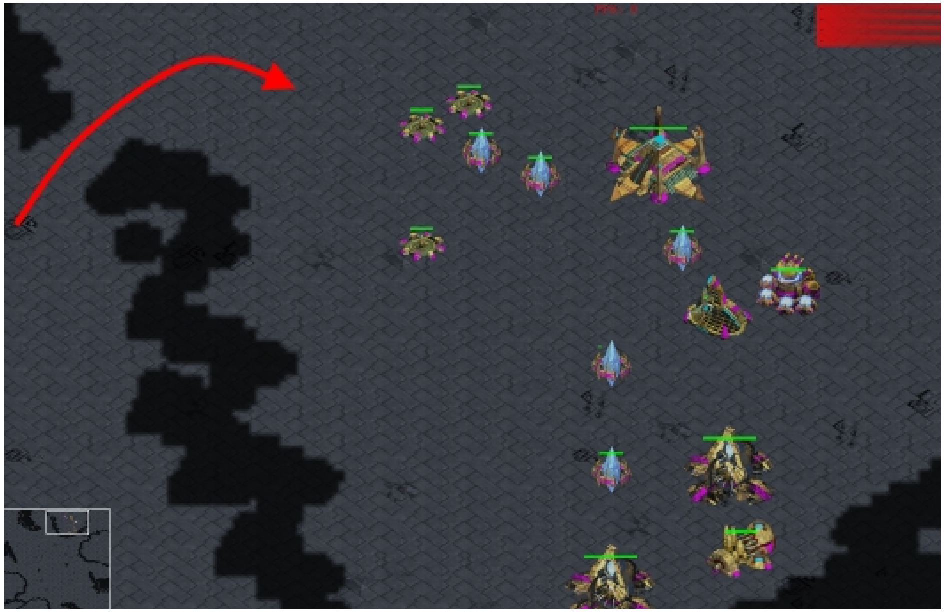
Paper and Invited Talk Summaries

Building Placement Optimization in Real-Time Strategy Games

- **Authors**
  - Nicolas Barriga, Marius Stanesu, **Michael Buro**
- **Premise**
  - Building placement is key in RTS games, but current bots don't do a good job
- **Approach**
  - Genetic Algorithm explores space of building placements
  - Game simulator (SparCraft) predicts the outcome of battles for given building configurations

Building Placement Optimization in Real-Time Strategy Games

- **Results**
  - Between 35 to 68% of losses turned into wins
  - Comparable to human building placement performance (from replays)

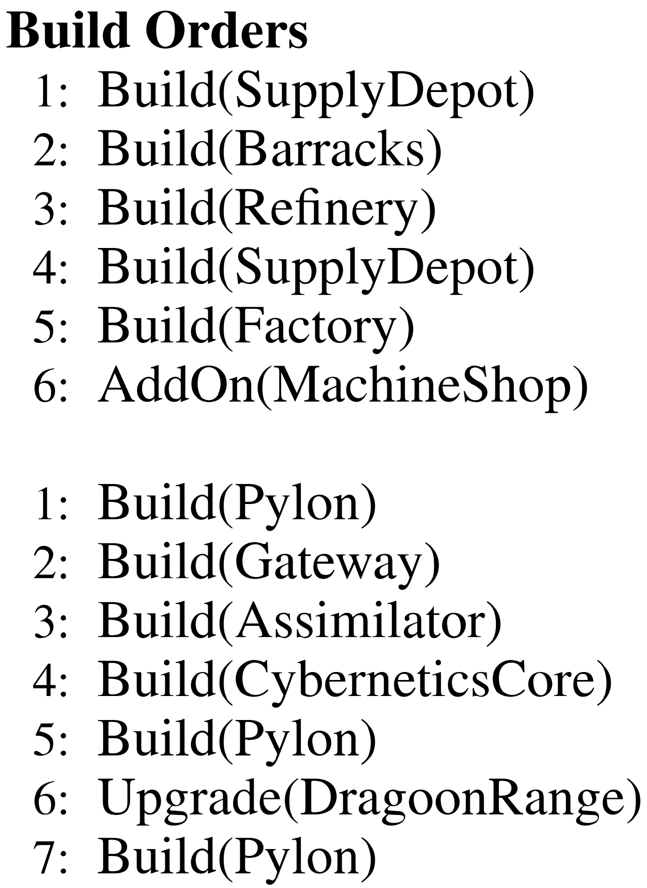


Sequential Pattern Mining in StarCraft:Brood War for Short and Long-Term Goals

- **Authors**
  - Michael Leece, **Arnav Jhala**
- **Premise**
  - Most AI solutions for RTS games require a significant amount of hand-crafting. Can we learn those from experts automatically?
- **Solution**
  - Generalized Sequential Patterns (GSP)
  - General algorithm for mining frequent patterns from sequences
  - 500 professional-level StarCraft replays

Sequential Pattern Mining in StarCraft:Brood War for Short and Long-Term Goals

- **Results**
  - Many interesting patterns detected: build orders, action spamming, army movement
- **Next step**
  - Learn patterns to be used as methods in HTN planning (into a bot)



Build Orders

1: Build(SupplyDepot)
2: Build(Barracks)
3: Build(Refinery)
4: Build(SupplyDepot)
5: Build(Factory)
6: AddOn(MachineShop)

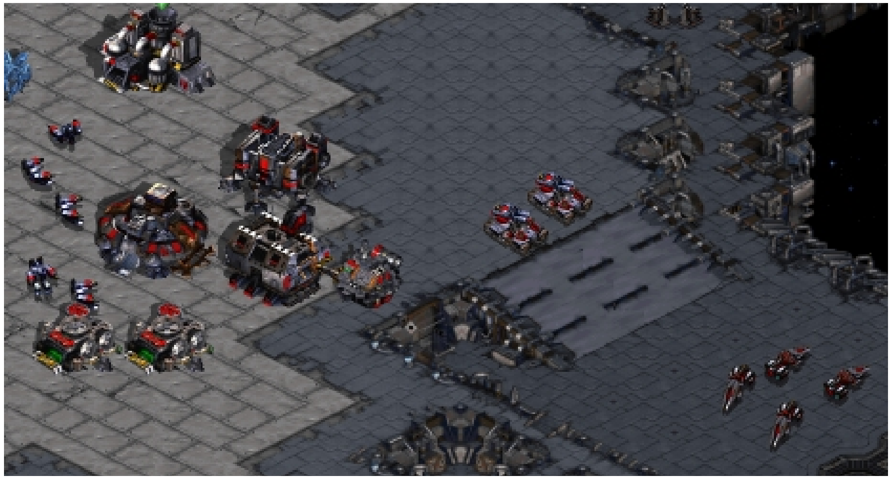
1: Build(Pylon)
2: Build(Gateway)
3: Build(Assimilator)
4: Build(CyberneticsCore)
5: Build(Pylon)
6: Upgrade(DragoonRange)
7: Build(Pylon)

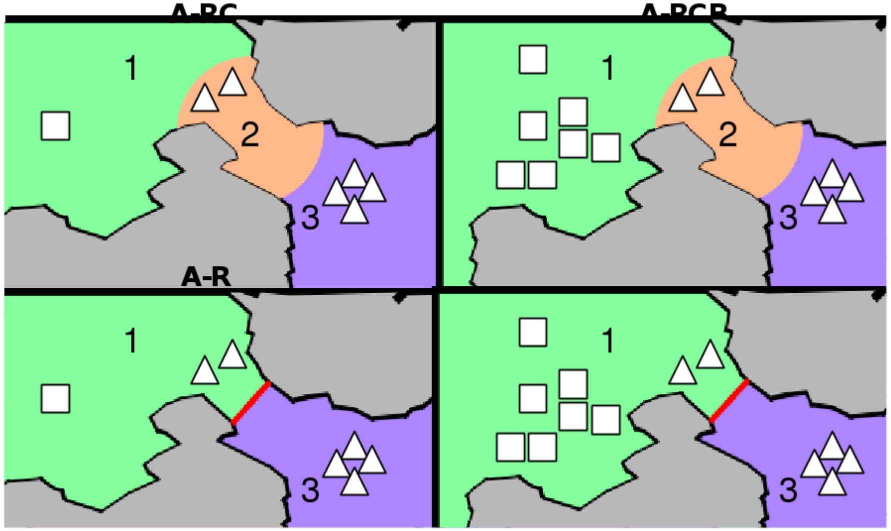
High-Level Representations for Game-Tree Search in RTS Games

- **Authors**
  - **Alberto Uriarte**, Santiago Ontañón
- **Premise**
  - RTS games are too complex for game tree search
  - Can we abstract the game and use game tree search at this abstract level? Will search results still be meaningful?
- **Approach**
  - Proposed four different abstractions of the game state and used them to test game tree search (MCTSCD) in full-game scenarios.
  - Built a simulator that rolls the world forward using the abstractions

High-Level Representations for Game-Tree Search in RTS Games

- **Results**
  - Type of abstraction influences simulator accuracy
  - Impacts gameplay performance
  - Better than built-in AI
  - Worse than existing scripted approaches (from StarCraft competition)



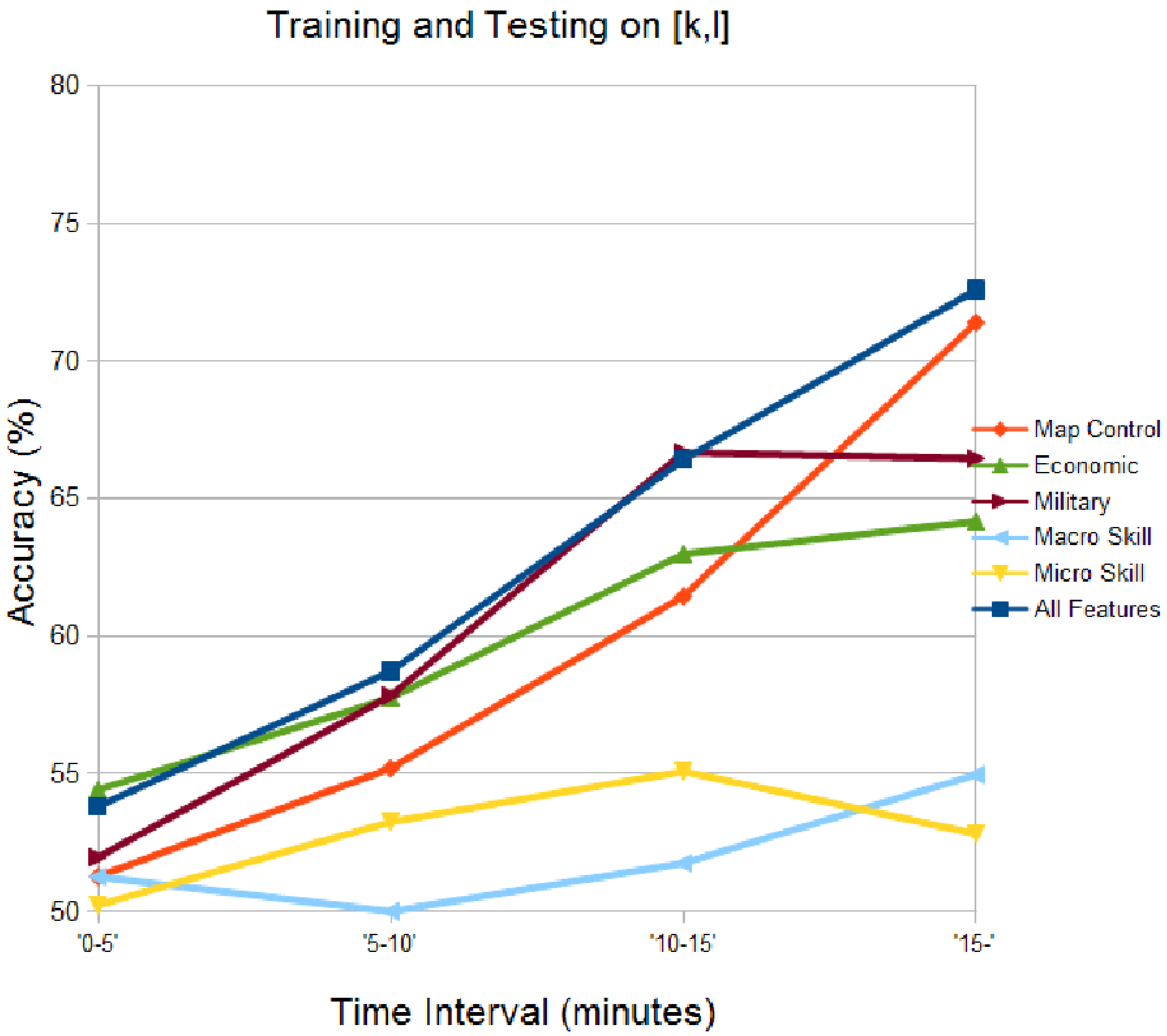


Invited Talk 1

“State Evaluation and Opponent Modelling in Real-Time Strategy Games”

[Graham Erickson]

- Build order clustering from replays for game balancing and finding best response strategies
- Global RTS game state evaluation trained on replays
- Micro-skill estimation by comparing player with base-line player

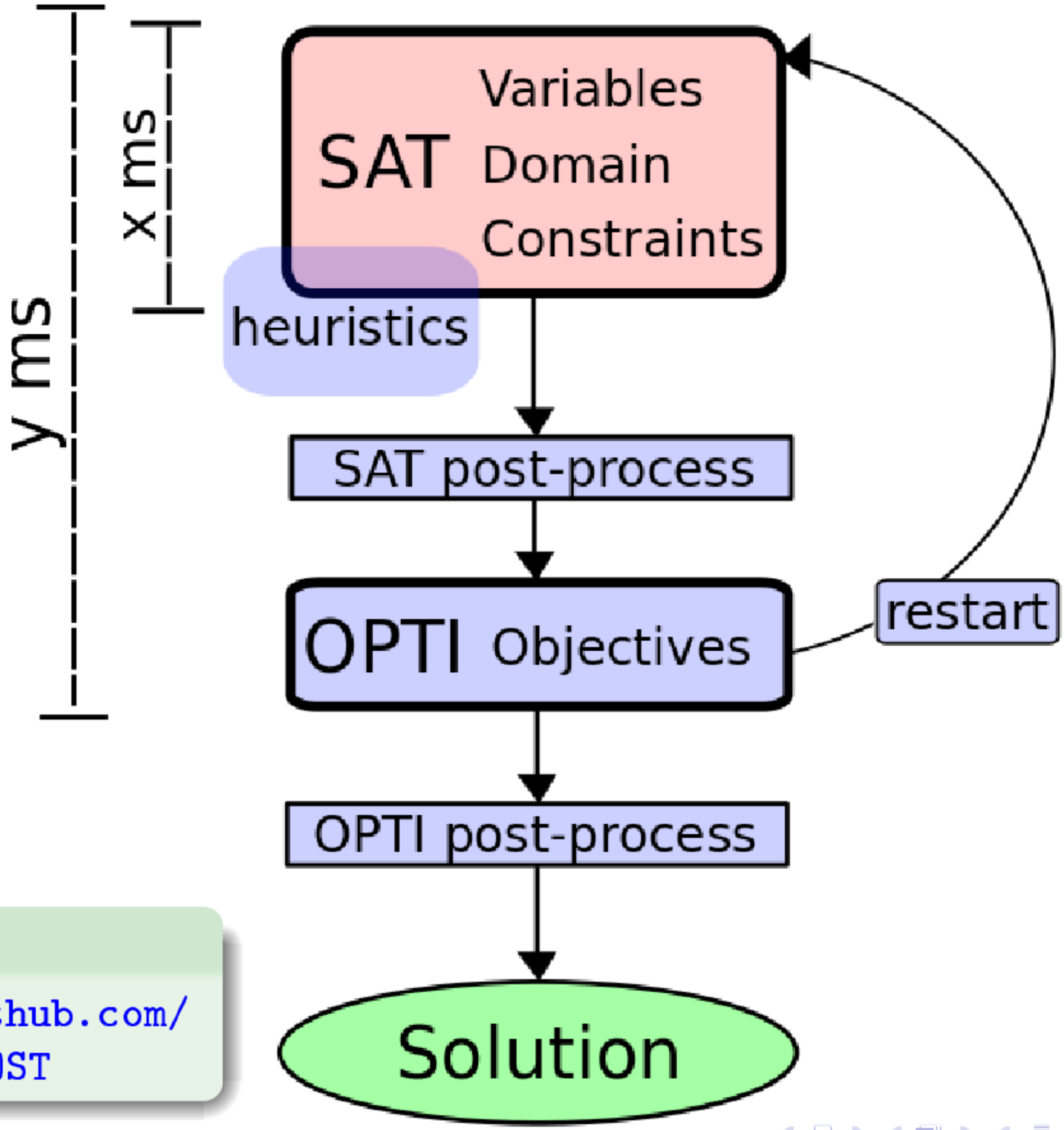

Training and Testing on [k,l]
Accuracy (%)
80
75
70
65
60
55
50
'0-5'
'5-10'
'10-15'
'15-'
Time Interval (minutes)
Map Control
Economic
Military
Macro Skill
Micro Skill
All Features

Invited Talk 2

“GHOST: A Stealth Solver” [Florian Richoux]

- Free Software C++ Constraint Satisfaction Solver Architecture
- Anytime, local search SAT solver + optimizer
- FAST!
- Applied to RTS Sub-Tasks:
  - Target Selection
  - Wall Building
  - Build order optimization
- Promising results!

Architecture of GHOST



Source code

https://github.com/richoux/GHOST

Workgroup 1: Benchmark Problems

Problems

- Solutions still mainly scripted
- Only playing full-game tournaments may hinder progress on sub-problems

Solution: Sub-game competitions
=> Simpler, fosters modularity and generality

Idea: Sub-games relevant to full-game
=> Modules can be used in full-game bots

Sub-Game Candidates

- Small combat situations: n vs. m units

  [regular / randomized unit stats]
- Multiagent pathfinding: 100 zerglings vs. 4 bunkers?
- Base attack / defense
- Place buildings and survive attack waves
- Create / prevent expansion
- Faction unit/structure/techtree subsets

Will be considered for next year's competition

Workgroup 2: RTS AI History Before StarCraft

- RL
- Influence maps
- Single-agent planning (e.g. HTN)
- Learning from demonstration
- Adversarial search and simulation

  (e.g. RandomAlphaBeta, MCPlan, RTSplan)

Workgroup 2: RTS AI History Since StarCraft

- Divide and conquer, modularizing AI
- Learning from replay data
- Build order recognition / optimization
- Tactical adversarial real-time search (ABCD, Portfolio Greedy Search, Combinatorial UCT, ...)
- High-level strategy selection with UCB
- **High-level strategies still SCRIPTED**

Workgroup 2:
What should we be working on next?

StarCraft

Sub-games? Generalizations?

Reactivity/Planning

1. Plan recognition + best response
2. Holistic approach: scale up game-tree search

(**Two ideas presented in 10:15a session tomorrow**)

Learning

- Opponent modeling (in-game, from replays)
- Game mechanics from interacting with game
  => Simulators

Questions?