Using a Team of General AI Algorithms to Assist Game Design and Testing

Cristina Guerrero-Romero, Simon Lucas and Diego Perez-Liebana

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Introduction

> Games evolve

> Modifications need to be tested

     > Human play-testing

     > Agent-based playtesting

     X Low adaptability, time consuming

→Use of <u>a team of</u> General Agents

     > Rules

     > Levels

     > NPCs

     > Game parameters

     ✓General goals, flexibility, adaptability

Introduction

Background

> *General Video Game Playing*

> *Automatic Testing*

> *AI Assisted Game Design*

General Video Game Playing (GVGP)

> <u>Frameworks</u>: ALE, GVGAI framework, OpenAI Gym, Project Malmo (+ others)

> <u>Algorithms:</u> Tree Search, Evolutionary Algorithms (EA), Reinforcement Learning (RL)

→ Variety of algorithms + active community

Background

Automatic Testing & AI Assisted Game Design

> Quality Assurance (QA) of the game

> Automatic testing

X Game dependent

✓ Methodology general enough to be adaptable to different games

Background

Automatic Testing & AI Assisted Game Design

> Intrinsic motivation – simulated-based game testing *[1]*

> Procedural Personas *[2]*

> Relative Algorithm Performance (RAPP) *[3]*

> Computationally Intelligent Collaborative EnviROnment (Cicero) *[4]* + SeekWhence *[5]*

> *[1] S. Roohi et al.*

> *[2] Holmgård et al.*

> *[3] S. Nielsen et al.*

> *[4][5] T. Machado et al.*

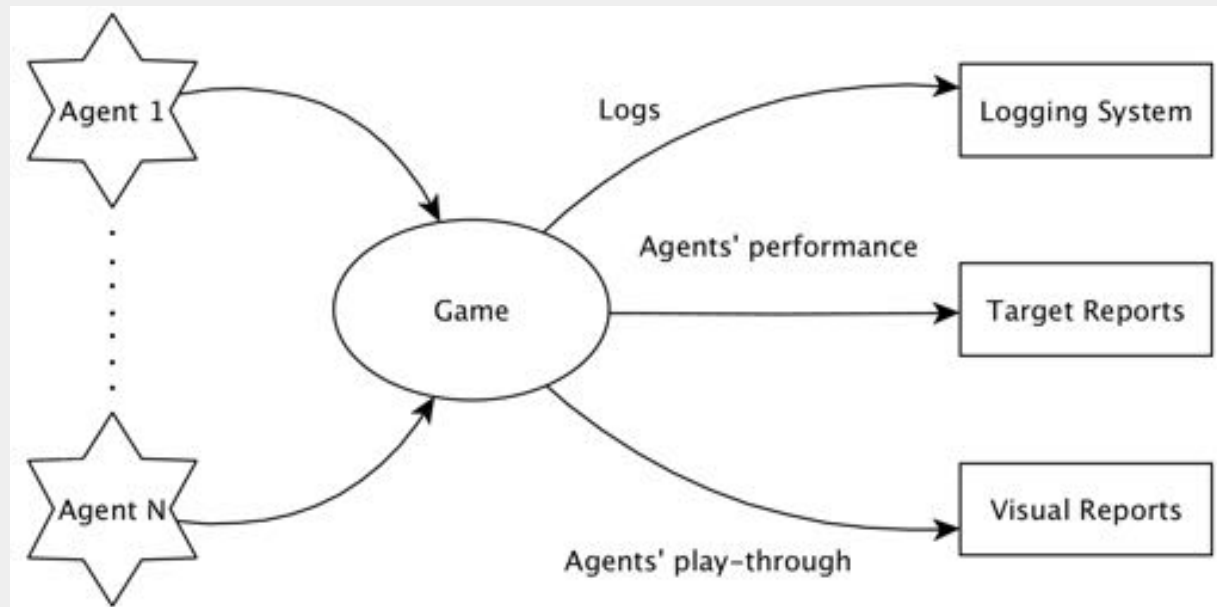# Background

Methodology

> *Overview*

> *The Team*

> *Reports*

> *Logging System*

Overview

> General <u>team</u> with differentiated objectives

→ Different behaviors, diverse information

→ Flexibility, adaptability

Methodology

The Team

> Player-types [1]

> Player motivation profile [2]

> Diversifying heuristics for GVGP [3]

→ Differentiated _general_ objectives

> [1] R. Bartle

> [2] N. Yee

> [3] C. Guerrero-Romero et al.

Methodology

The Team

> Differentiated _general_ objectives

→Winner   →Collector

→Map explorer   →Killer

→Novelty explorer   →Risk analyst

→Curious   →Semantic

→Competence seeker   →Scholar

→Record breaker

Methodology

Reports & Logging System

> Generated by agents' playthrough

> Choose the team based on the characteristics of the level/game

> To check the validity of the design of the game

→Performance-target based reports

→Visual reports

→Logging System

Methodology

Performance-target based reports

> Evaluating the game based on the expected performance in the behavior of the agents

> Results in the performance of the agents depends on the type of game [1]

→Exploration Maximization Heuristic (EMH)

> 80% in small / open maps

< 45% in large maps / not completely accessible

> [1] C. Guerrero-Romero et al. : "Beyond Playing to Win: Diversifying Heuristics for GVGAI"

Methodology

> Reports & Logging System

Performance-target based reports

> Provide an estimation of the expected performance of each of the type of agents

→error for each estimation

✓adjust design based on the results

> *Example: Easily accessible level hard to win*

→*high performance for Map explorer*

→*Low performance for Winner*
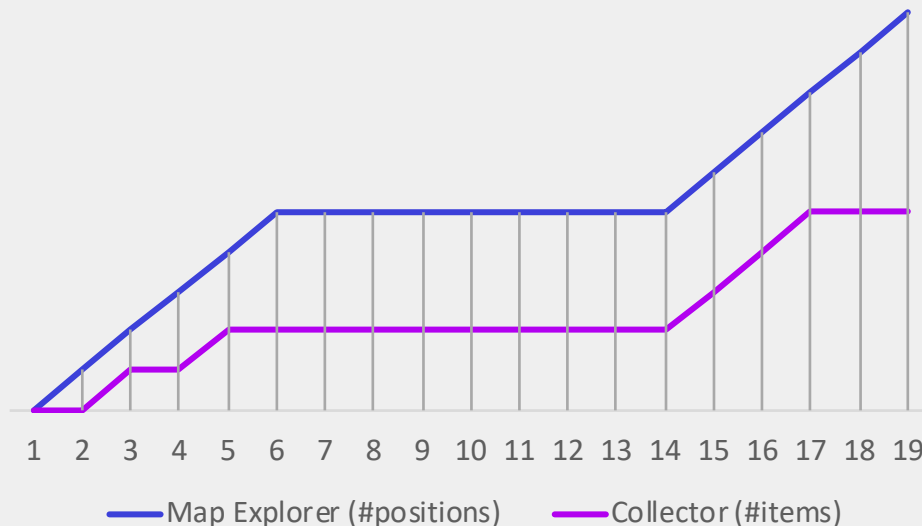
Methodology

> *Reports & Logging System*

Visual reports

> Show how the information retrieved by the agents evolved during the play-through

→Graph with the values by time

>Analyse the shape and evolution of the graph

Map Explorer (#positions)   Collector (#items)

Methodology
> *Reports & Logging System*

Logging System

> Tracks the information resulting from running each of the agents

→Detect anomalies and broken states

> A team with different behaviors

→More game states to log

> Different strategies and measurements [1]

→Agent-based, interpreted, direct and indirect [2]

> [1] M. Nelson, "Game Metrics Without Players: Strategies for Understanding Game Artifacts"

> [2] V. Volz et al., "Gameplay Evaluation Measures"

Methodology
> Reports & Logging System

Variations

> Agents with different levels of mastery/skills

→bigger range of choices

→richer information available

> Combine agents results

→greater level of detail

Methodology

Limitations

> *Reinforcement Learning*

> *Planning Algorithms*

> *Parameter Optimisation*

> *The Challenge of General AI*

Reinforcement Learning (RL)

> Offline training

> Performance depends on the complexity of the environment → rewards delayed on time

✓ Arcade Games (ALE), *AlphaGo, Doom…*

X *Starcraft*

Limitations

Planning Algorithms

> Forward model

> Budget, roll-outs

→ Parameter optimisation

Limitations

Parameter optimisation

> Impact in the GVGP algorithms' performance

  $\rightarrow$ Roll-outs

  $\rightarrow$ Population size in GA

> Time consuming

> Offline & online approaches

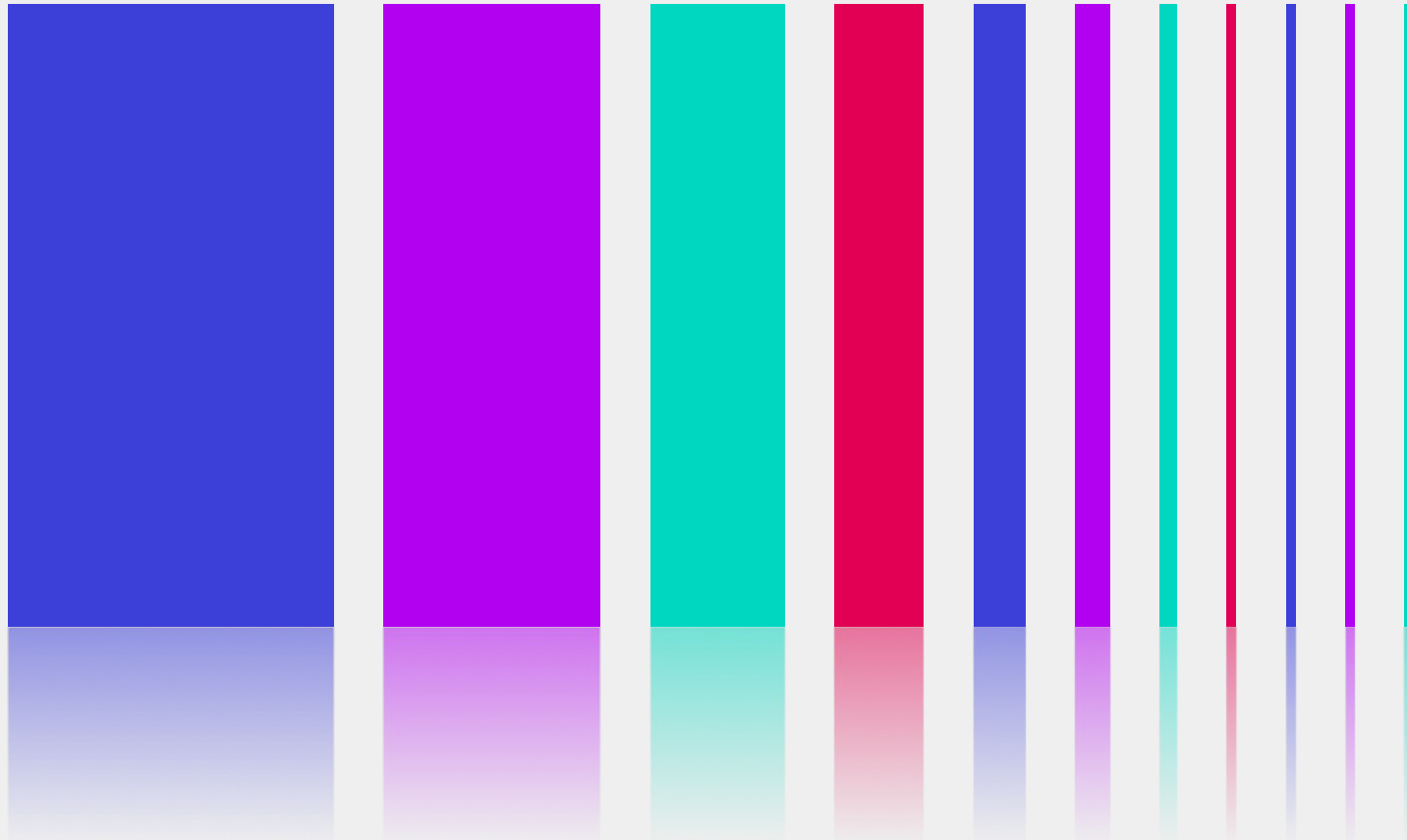$\rightarrow$ Agents must be well tuned to fit the expectations

Limitations

General AI Challenge

> Not possible to use in-game information as a guide

> Not good enough (yet) to generalise to every type of game

> Variety of problems to apply to

> Ongoing research

Limitations

Recap

Questions?

c.guerreroromero@qmul.ac.uk

@kisenshi