

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

Cris Guerrero-Romero,  
*IGGI Conference 2018*

# Introduction

## General Video Game Playing (GVGP)

> Frameworks: ALE, GVGAI framework, OpenAI Gym, Project Malmö (+ others)

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

→ Variety of algorithms + active community

# Introduction

- > Games evolve
- > Quality Assurance (QA) of the game
  - > Human play-testing
  - > Automatic/Agent-based playtesting
  - X Low adaptability, time consuming
  - X Game dependent

→ Use of a team of General Agents

- > Rules, Levels, NPCs, parameters
- > General goals
- ✓ Flexibility, adaptability
- ✓ Methodology general enough to be adaptable to different games

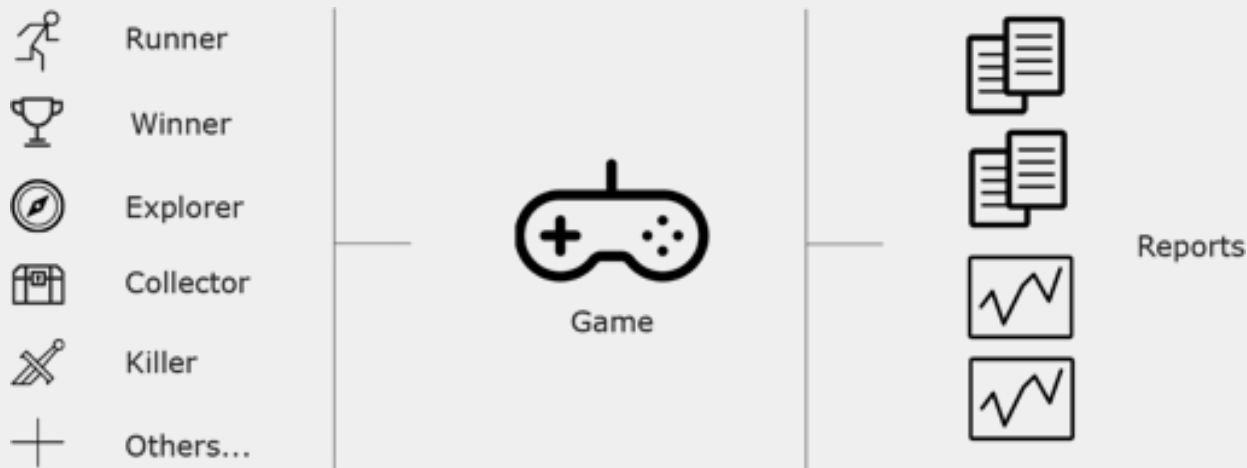
# Introduction

# Methodology


- > *Overview*
- > *The Team*
- > *Reports*
- > *Logging System*

## Overview

- > General team with differentiated objectives
- Flexibility, adaptability



# Methodology



Exploration Maximization Heuristic (EMH)  
Its goal is to maximize the exploration of the level

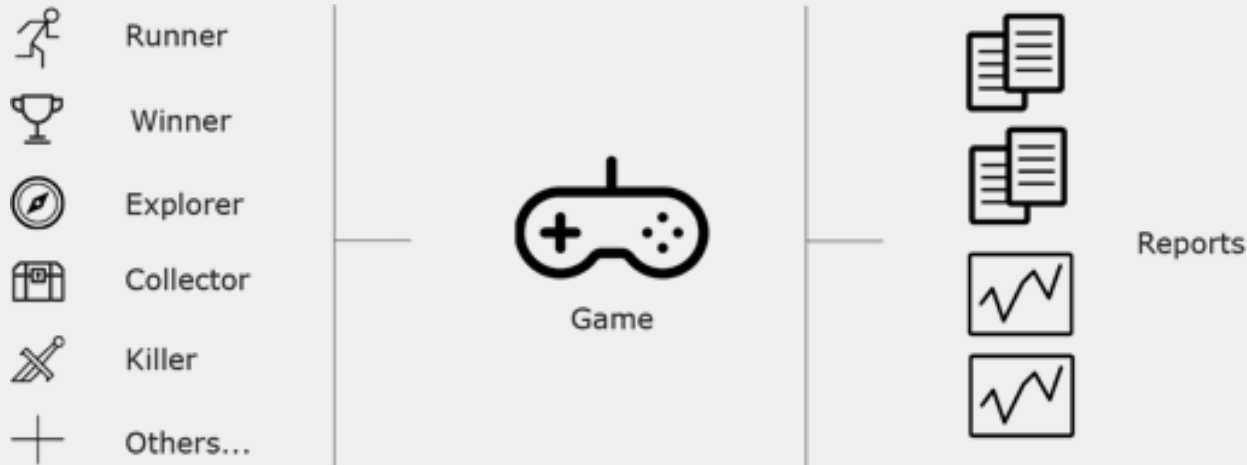
<https://www.youtube.com/watch?v=aLgPm9kbfY8>

## Overview

> General team with differentiated objectives

→ Flexibility, adaptability

→ Different behaviors, diverse information



# 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
  - Exploration Maximization Heuristic (EMH) [1]
    - > 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",  
*Computational Intelligence and  
Games (CIG). IEEE, 2017*

## 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

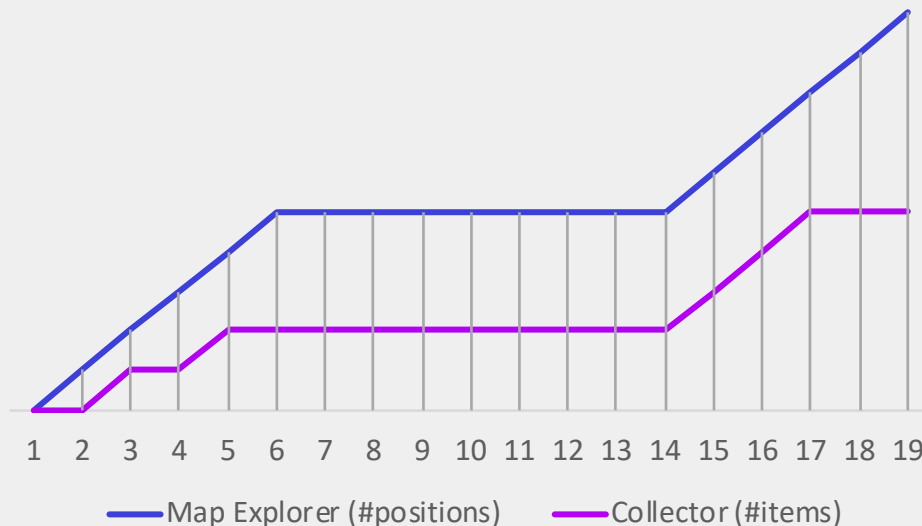
> *Reports & Logging System*

## 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



## 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

## Methodology

> *Reports & Logging System*

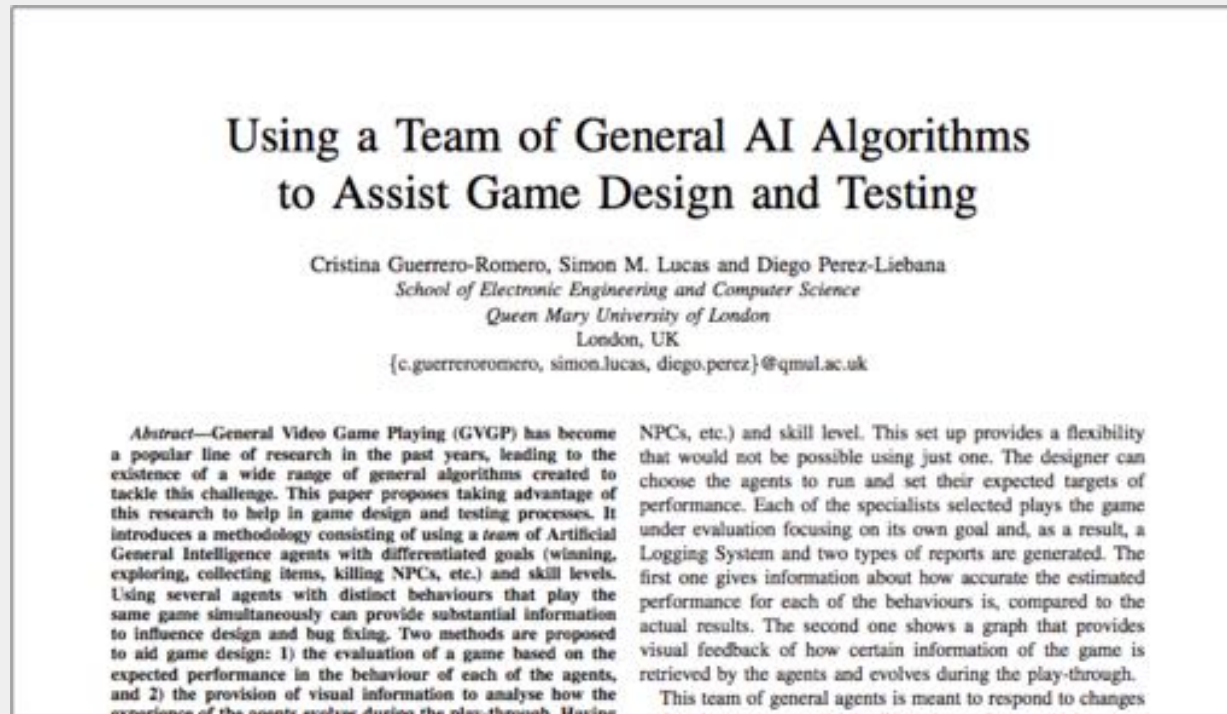
## Variations

- > Agents with different levels of mastery/skills
  - bigger range of choices
  - richer information available
- > Combine agents results
  - greater level of detail

Methodology

# Using a Team of General AI Algorithms to Assist Game Design and Testing [1]

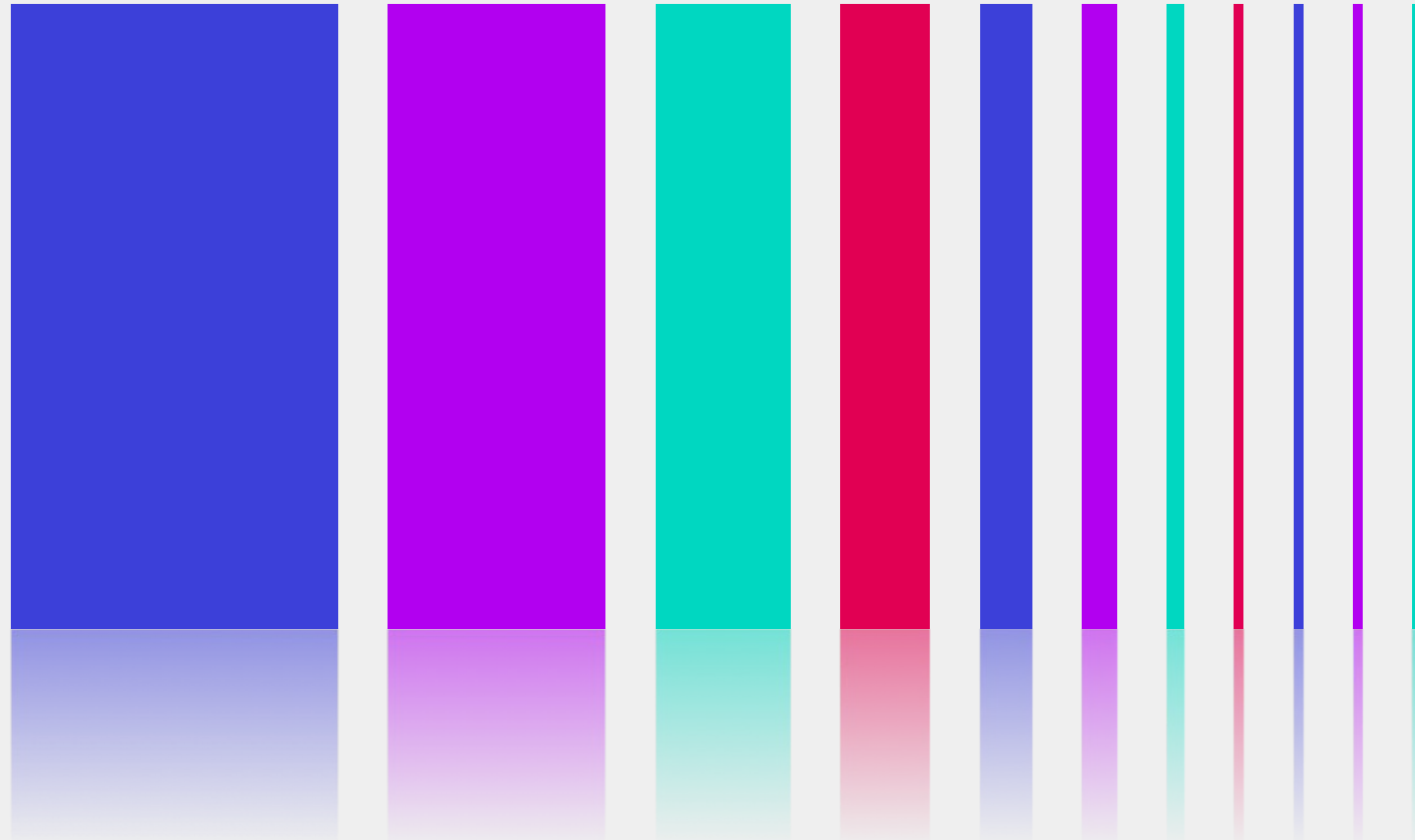
→ <http://kisenshi.github.io/files/paper-team-general-ai-assist.pdf>



> [1] Cristina Guerrero-Romero, Simon M Lucas and Diego Perez-Liebana, *Computational Intelligence and Games (CIG). IEEE, 2018*

## Methodology





Thanks! :D

[c.guerroromero@qmul.ac.uk](mailto:c.guerroromero@qmul.ac.uk)

[@kisenshi](https://twitter.com/kisenshi)

<http://kisenshi.github.io/>

# 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
  - Roll-outs
  - Population size in GA
- > Time consuming
- > **Offline** & **online approaches**
  - 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