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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)

> <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

# Introduction

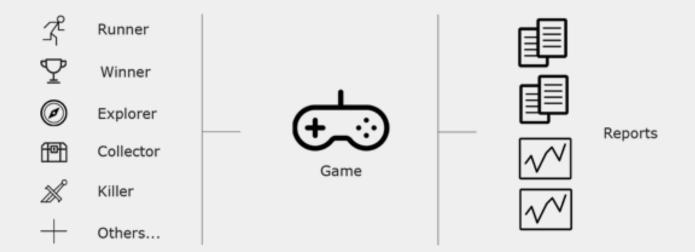
- > Games evolve
- > Quality Assurance (QA) of the game
  - > Human play-testing
  - > Automatic/Agent-based playtesting
  - X Low adaptability, time consuming
  - X Game dependent
- → Use of <u>a team of</u> General Agents
  - > Rules, Levels, NPCs, parameters
  - > General goals
  - ✓ Flexibility, adaptability
  - ✓ Methodology general enough to be adaptable to different games

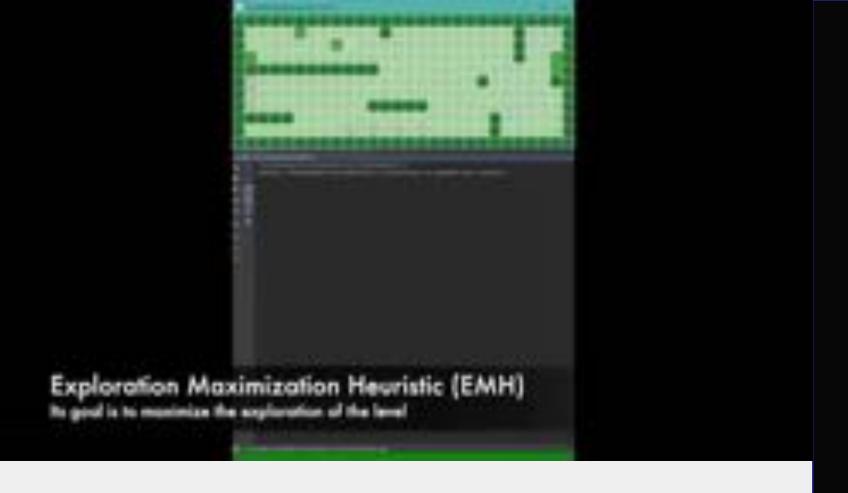
# Introduction

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

#### Overview

- > General team with differentiated objectives
- → Flexibility, adaptability

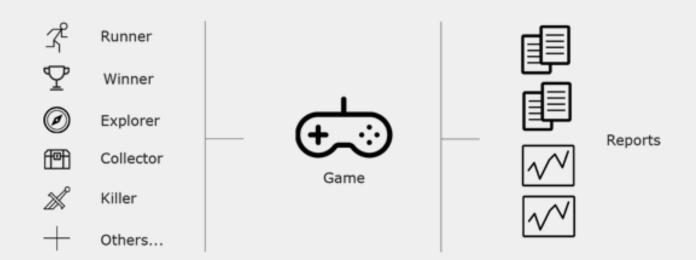




https://www.youtube.com/watch?v=aLgPm9kbfY8

#### Overview

- > General <u>team</u> with differentiated objectives
- → Flexibility, adaptability
- → Different behaviors, diverse information



#### The Team

> Differentiated *general* objectives

→Winner →Collector

→Map explorer →Killer

→Novelty explorer →Risk analyst

→Curious →Semantic

→Competence seeker →Scholar

→ Record breaker

#### 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

### 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

### 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

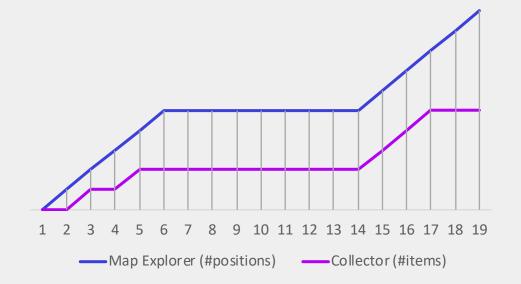
# Methodology

#### 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

#### **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

#### **Variations**

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

# 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

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

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Abstruct—General Video Game Playing (GVGP) has become a popular line of research in the past years, leading to the existence of a wide range of general algorithms created to tackle this challenge. This paper proposes taking advantage of this research to help in game design and testing processes. It introduces a methodology consisting of using a team of Artificial General Intelligence agents with differentiated goals (winning, exploring, collecting items, killing NPCs, etc.) and skill levels. Using several agents with distinct behaviours that play the same game simultaneously can provide substantial information to influence design and bug fixing. Two methods are proposed to aid game design: 1) the evaluation of a game based on the expected performance in the behaviour of each of the agents, and 2) the provision of visual information to analyse how the expectence of the appents evalves during the plays. Having

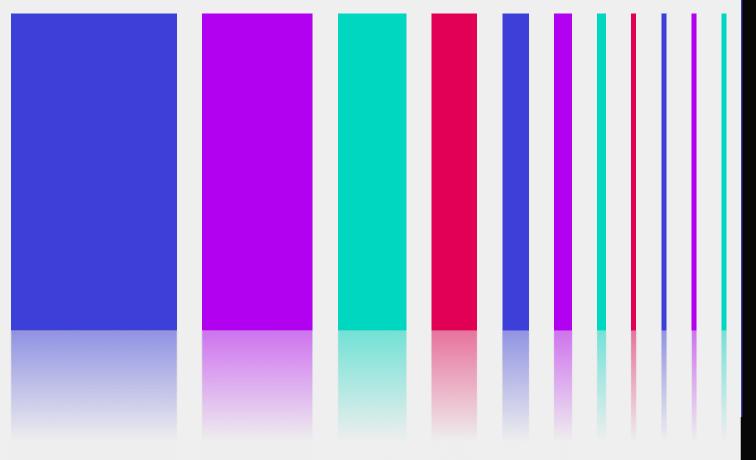
NPCs, etc.) and skill level. This set up provides a flexibility that would not be possible using just one. The designer can choose the agents to run and set their expected targets of performance. Each of the specialists selected plays the game under evaluation focusing on its own goal and, as a result, a Logging System and two types of reports are generated. The first one gives information about how accurate the estimated performance for each of the behaviours is, compared to the actual results. The second one shows a graph that provides visual feedback of how certain information of the game is retrieved by the agents and evolves during the play-through.

This team of general agents is meant to respond to changes

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



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Thanks!:D

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http://kisenshi.github.io/

- > Reinforcement Learning
- > Planning Algorithms
- > Parameter Optimisation
- > The Challenge of General AI

### Reinforcement Learning (RL)

- > Offline training
- > Performance depends on the complexity of the environment  $\rightarrow$  rewards delayed on time
- ✓ Arcade Games (ALE), *AlphaGo*, *Doom*...
- X Starcraft

### **Planning Algorithms**

- > Forward model
- > Budget, roll-outs
- → Parameter optimisation

#### 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

#### 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