AtDelfi:
Automatically Designing Legible, Full Instructions

Michael C. Green, Ahmed Khalifa, Gabriella A. B. Barros, Tiago Machado, Andy Nealen, and Julian Togelius

Motivation

Motivation

What is a tutorial?

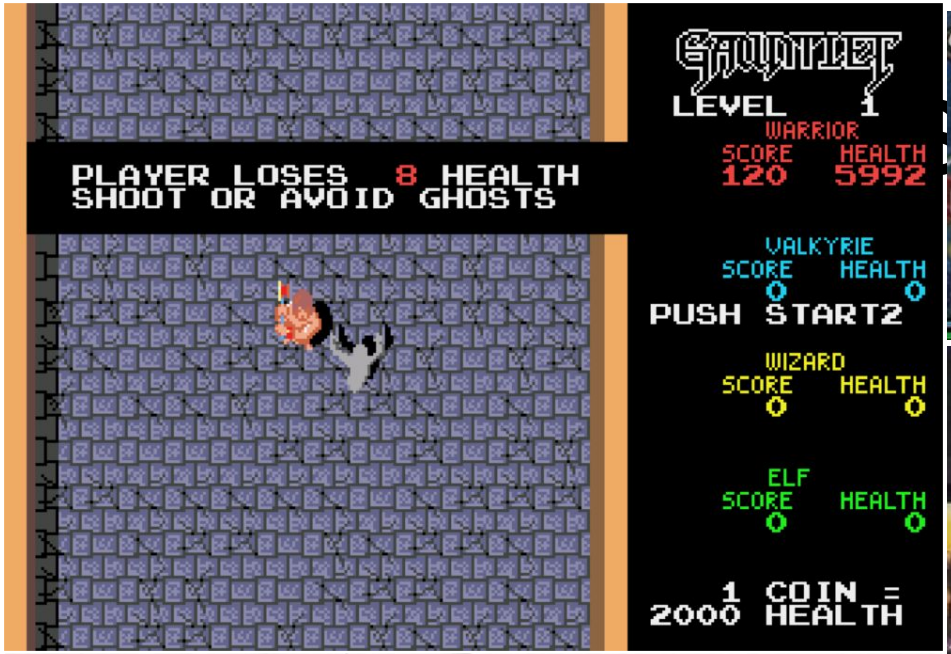
Mechanics and Graphs

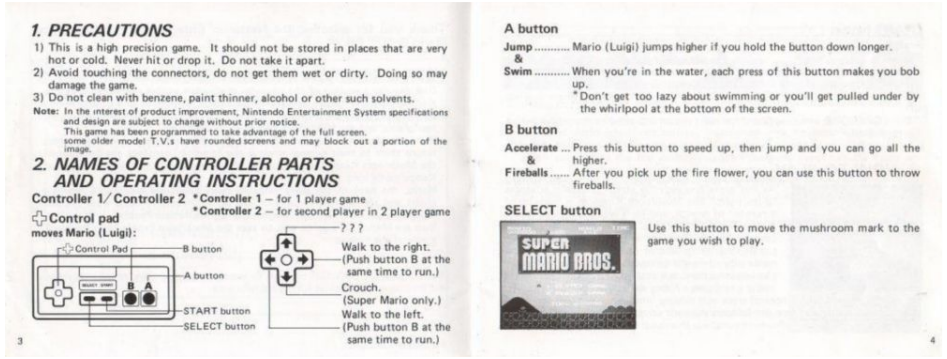
GVGAI Quick Overview

Generating a Tutorial in GVGAI (AtDelfi)

AtDelfi - GVGAI Results

Future Work





1. PRECAUTIONS

1) This is a high precision game. It should not be stored in places that are very hot or cold. Never hit or drop it. Do not take it apart.
2) Avoid touching the connectors, do not get them wet or dirty. Doing so may damage the game.
3) Do not clean with benzene, paint thinner, alcohol or other such solvents.

Note: In the interest of product improvement, Nintendo Entertainment System specifications and design are subject to change without prior notice.
This game has been programmed to take advantage of the full screen.
some older model T.V.s have rounded screens and may block out a portion of the image.

2. NAMES OF CONTROLLER PARTS AND OPERATING INSTRUCTIONS

Controller 1/Controller 2 *Controller 1 – for 1 player game
*Controller 2 – for second player in 2 player game

Control pad
moves Mario (Luigi):

Control Pad
B button
A button
START button
SELECT button
? ? ?
Walk to the right. (Push button B at the same time to run.)
Crouch. (Super Mario only.)
Walk to the left. (Push button B at the same time to run.)

3

A button

Jump & Swim ..... Mario (Luigi) jumps higher if you hold the button down longer.
When you're in the water, each press of this button makes you bob up.
*Don't get too lazy about swimming or you'll get pulled under by the whirlpool at the bottom of the screen.

B button

Accelerate & Fireballs ..... Press this button to speed up, then jump and you can go all the higher.
After you pick up the fire flower, you can use this button to throw fireballs.

SELECT button

Use this button to move the mushroom mark to the game you wish to play.

4

Goals

To explore a new role for artificial intelligence:
Teacher

How can AI automatically generate tutorials for games?

Sub-Questions

*What **kinds of tutorials** can be automatically generated?*

*What **kinds of games** can tutorials be automatically generated for?*

*How **effective** are they? Are some more effective than others?*

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“Tutorial : a paper, book, film, or computer program that provides *practical information* about a specific subject”

—Merriam Webster

“Practical Information?”

- HP/Resource
- Dying
- Movement/Controls
- Enemies/Friends
- Points/Score
- Winning and Losing
- Other Mechanics
- Strategy

“Practical Information?”

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Tutorial Types

1. Teaching using Instruction
2. Teaching using Demonstration
3. Teaching using a Carefully-Designed Experience

Tutorial Types

Teaching using Instruction (Civilization 6)

Teaching using Examples (Megaman X)

Teaching using a Carefully Designed Experience (Super Mario Bros)

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Teaching using Instruction (Civilization 6)

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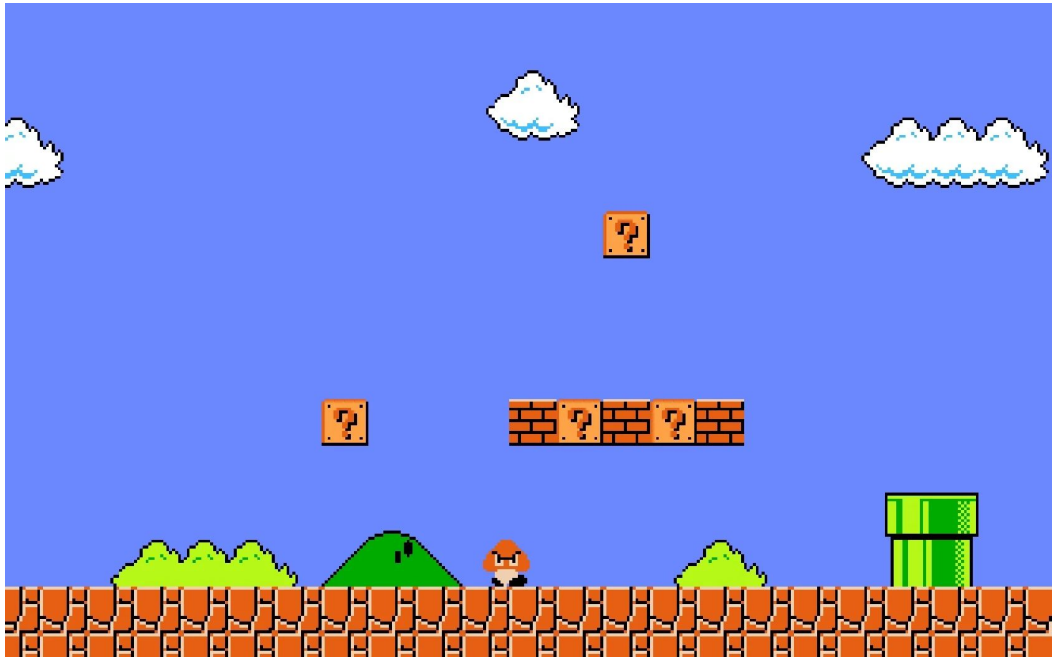
Tutorial Types



Teaching using Instruction (Civilization 6)

Teaching using Examples (Megaman X)

Teaching using a Carefully Designed Experience (Super Mario Bros)

Mechanics and Graphs

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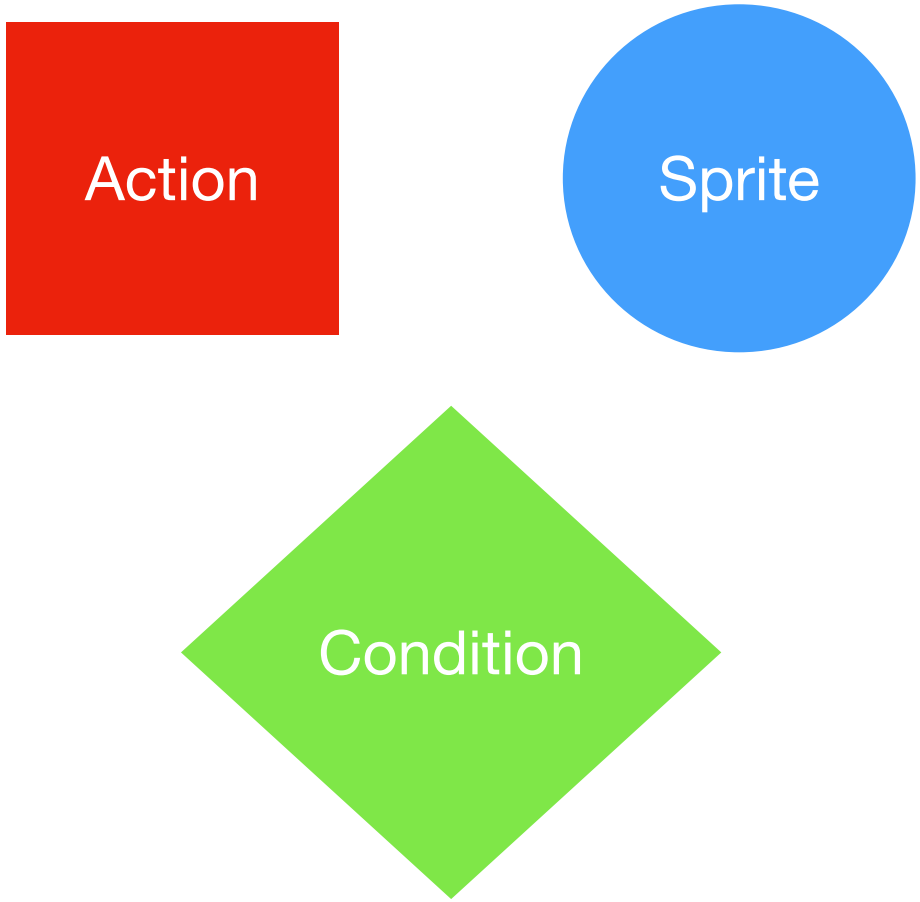
Future Work

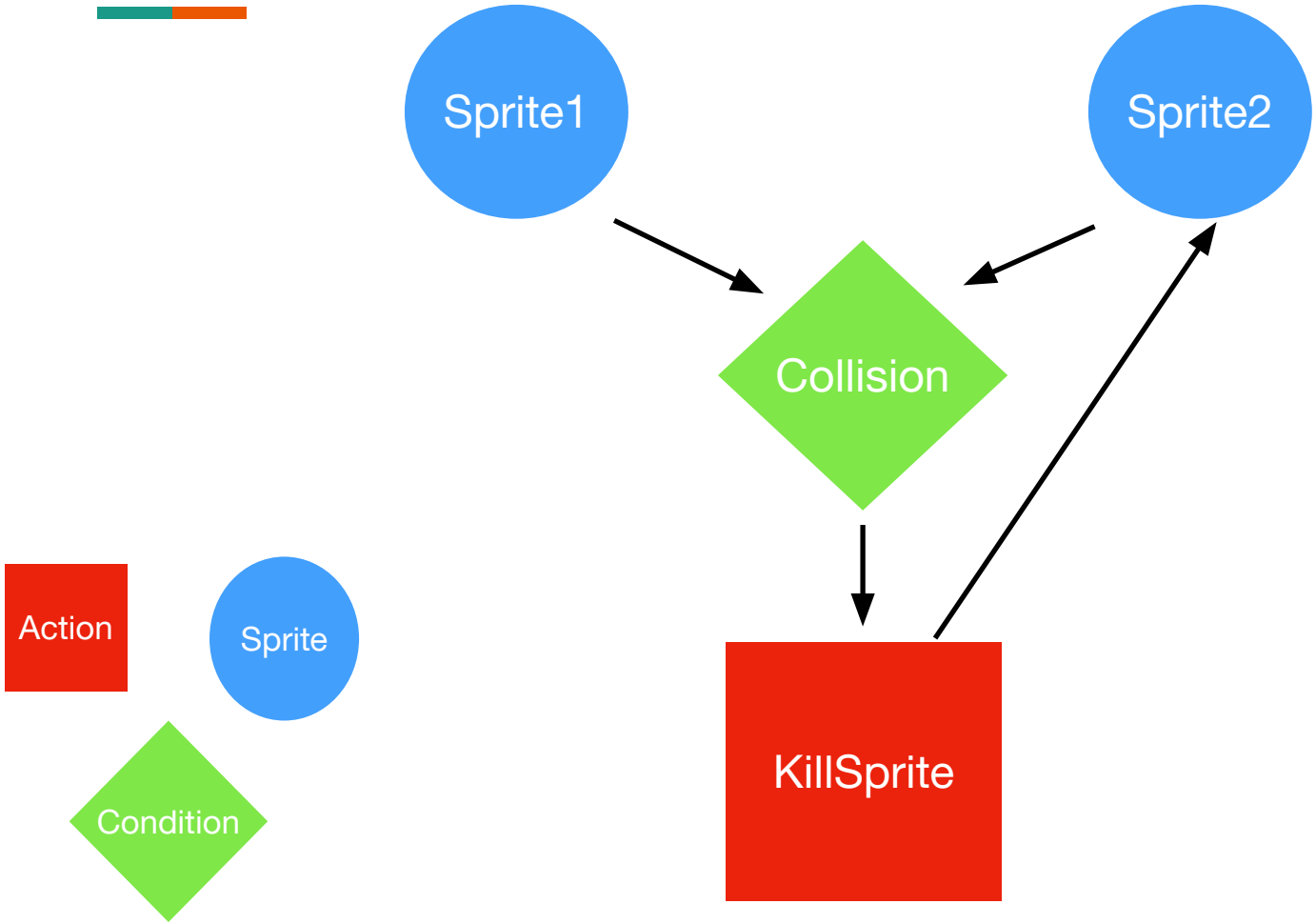
“Game Mechanic: an action that a player can take that changes the game state”

— “Defining Game Mechanics,” Miguel Sicart

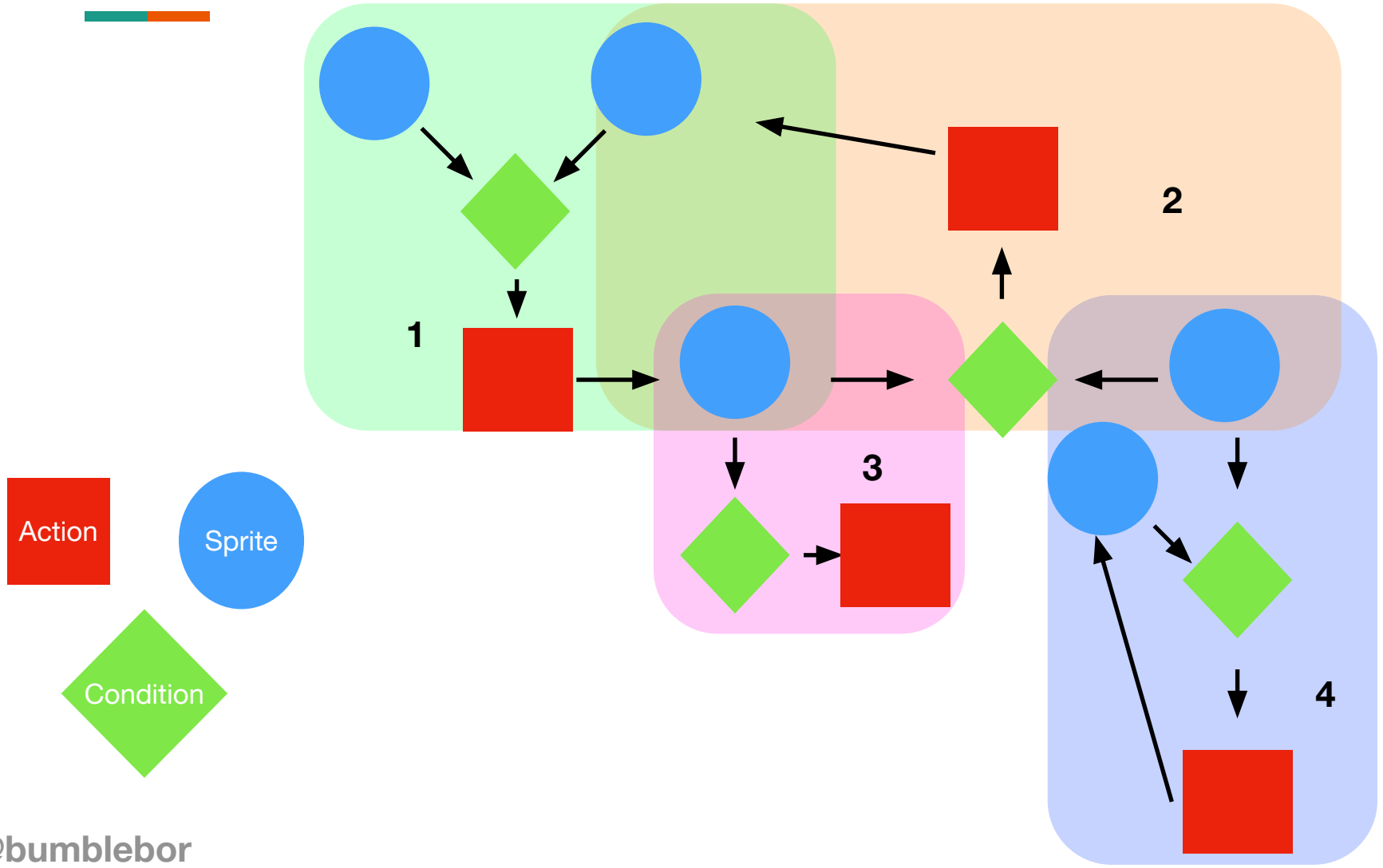
A Directed Mechanic Graph



A Directed Mechanic Graph



A Directed Mechanic Graph



GVGAI
(Quick Overview)

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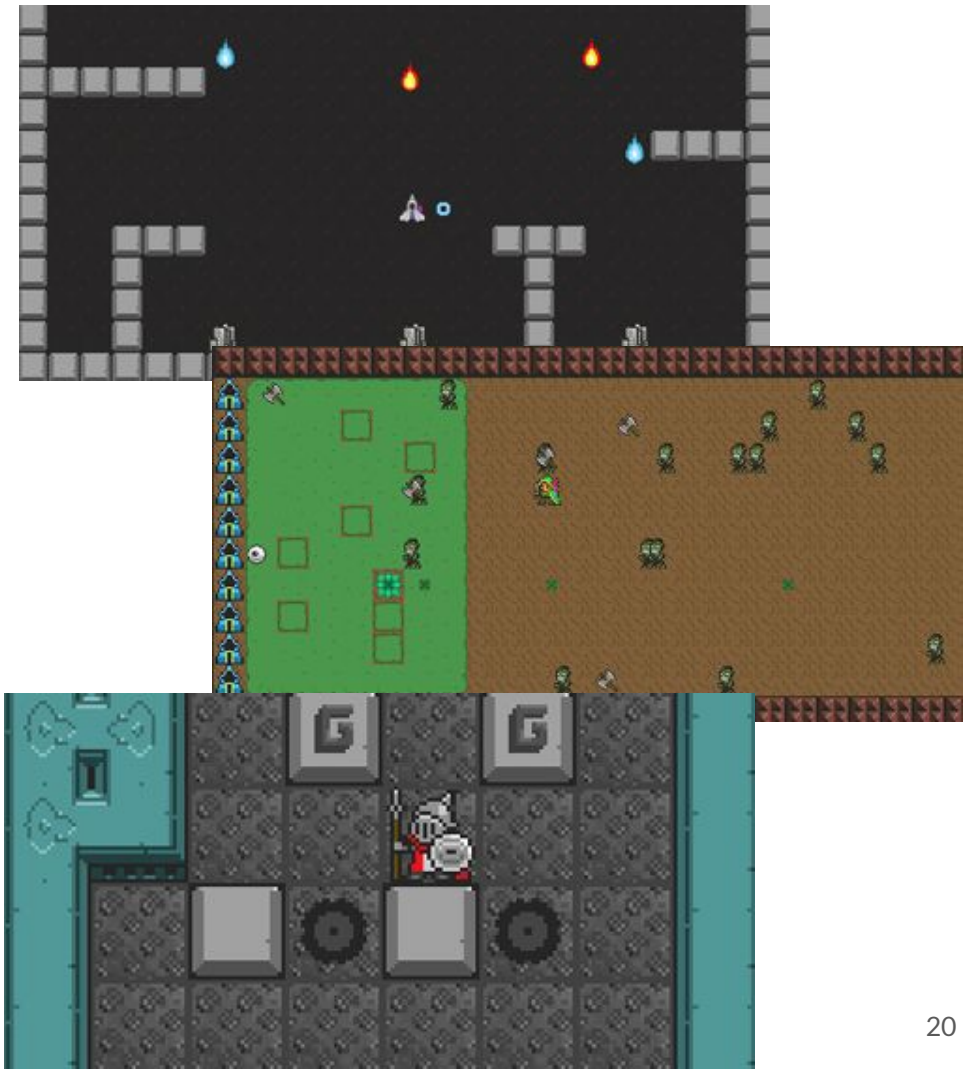
Future Work

General Video Game Artificial Intelligence Framework (GVG-AI)

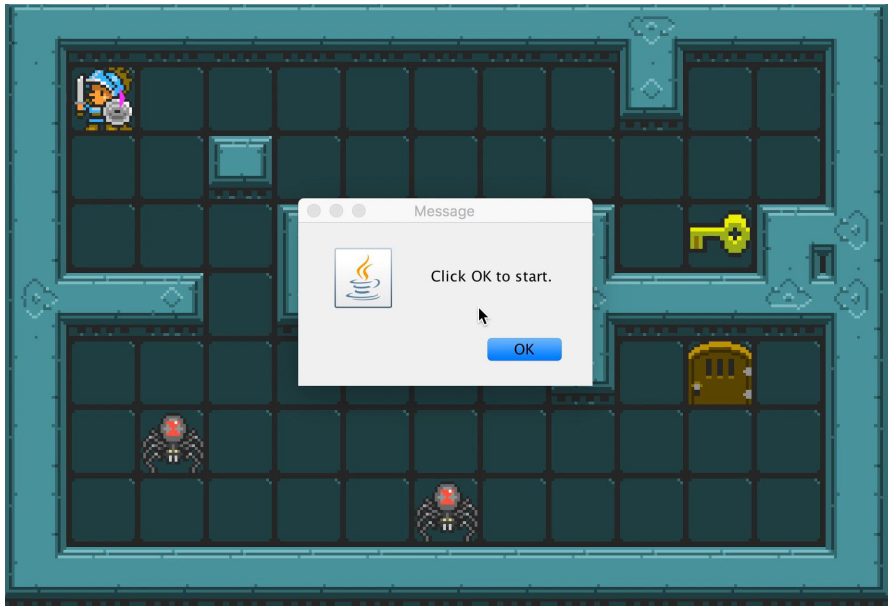
A collection of video games for AI benchmarking

All represented in Video Game Description Language (VGDL)



Video Game Description Language (VGDL)

Level



Spriteset:

"Spider", "Key", "Wall", "Avatar"

Interaction Rules:

If "Spider" collide "Avatar" then Kill "Avatar"

Termination Conditions:

If "Avatar" dies, Game Lost

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Future Work

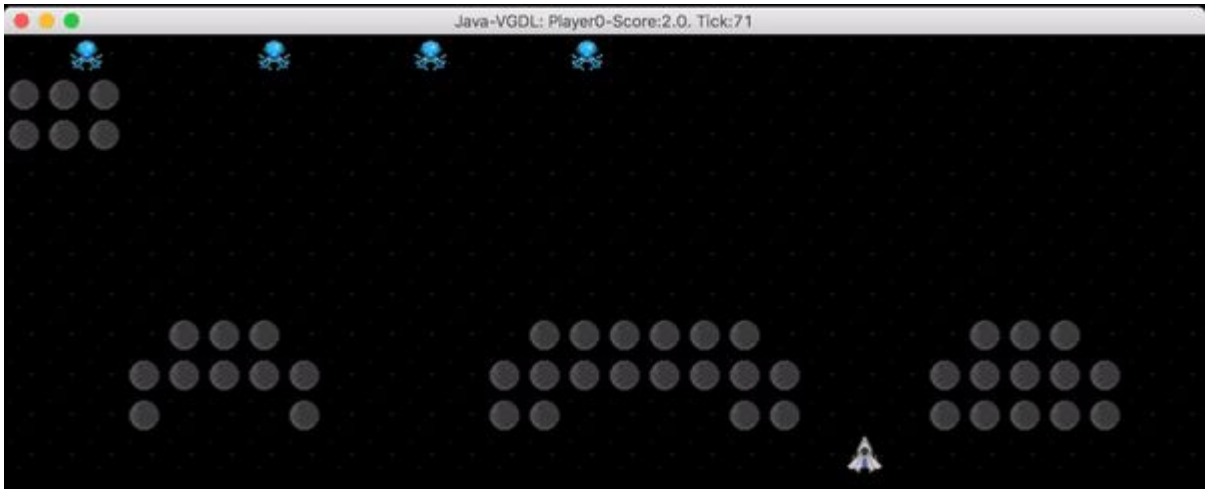
1. Read in VGDL (Video Game Description Language)

Movement
- controls/limits

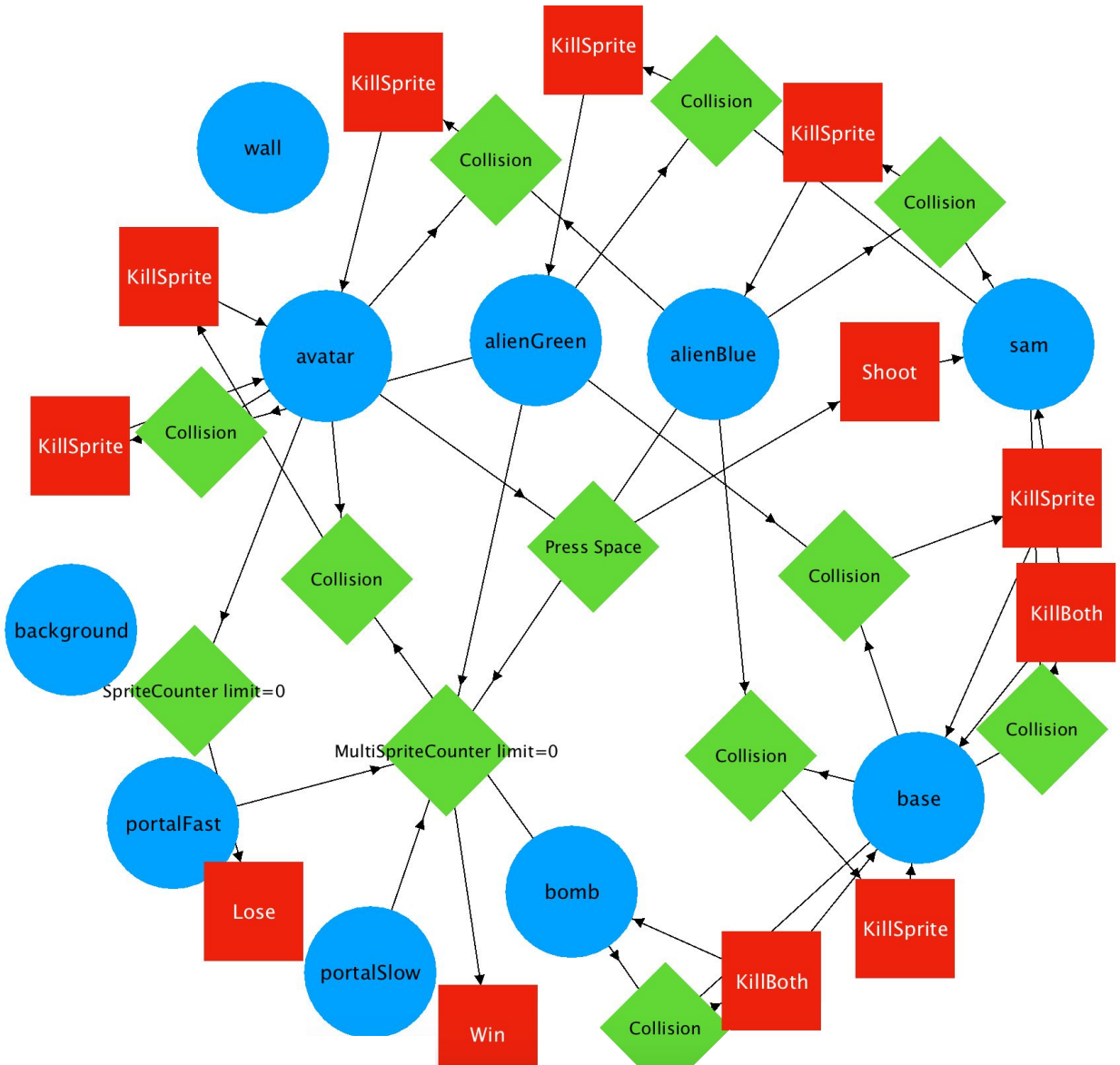
Interactions between objects/sprites
- collisions
- relationships

Termination conditions
- how to win/lose

Score/points/misc



2. Build Mechanic Graph

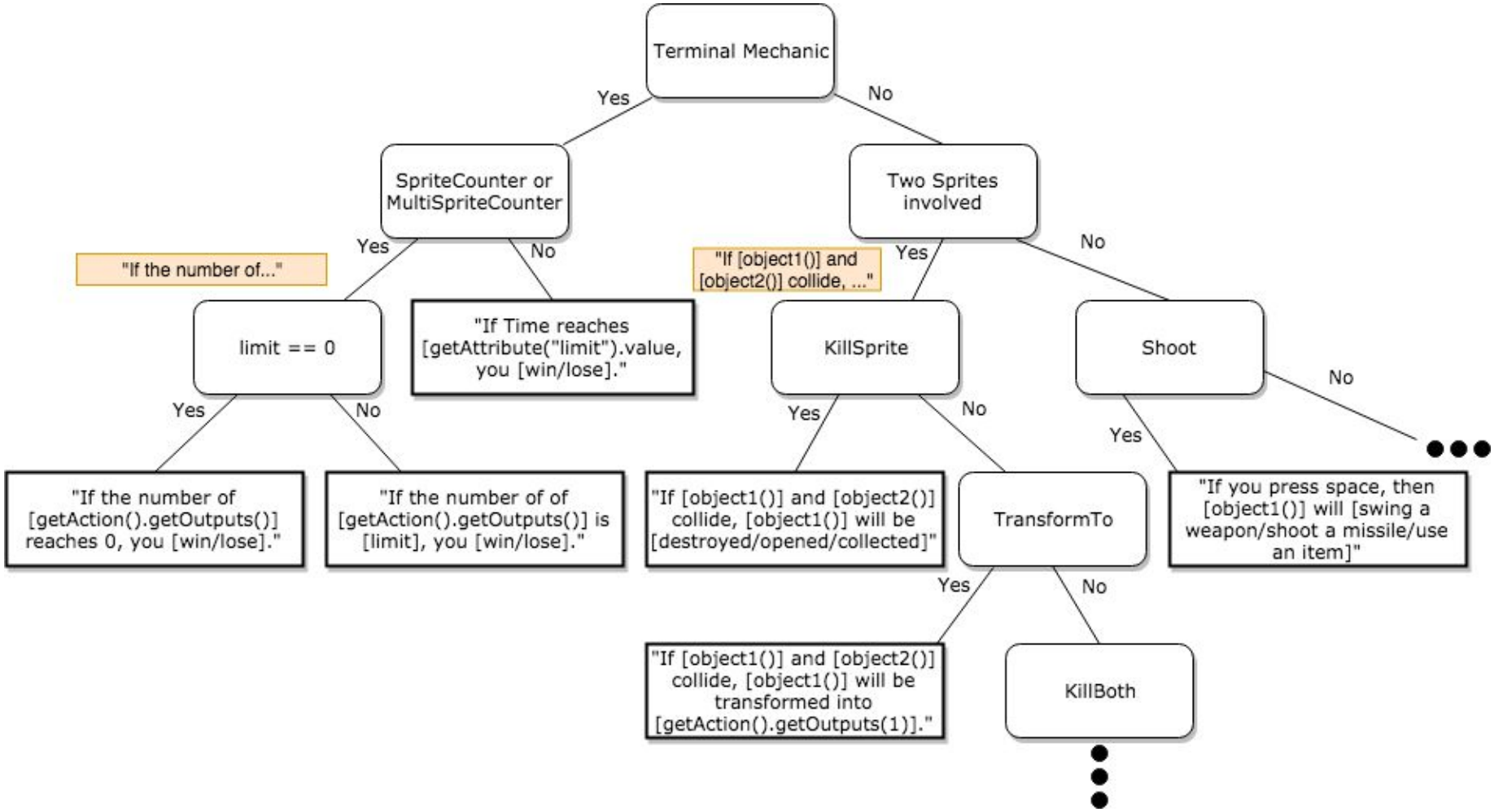


3. Find Critical Paths

"The series of mechanics that lead from player input to a terminal state"

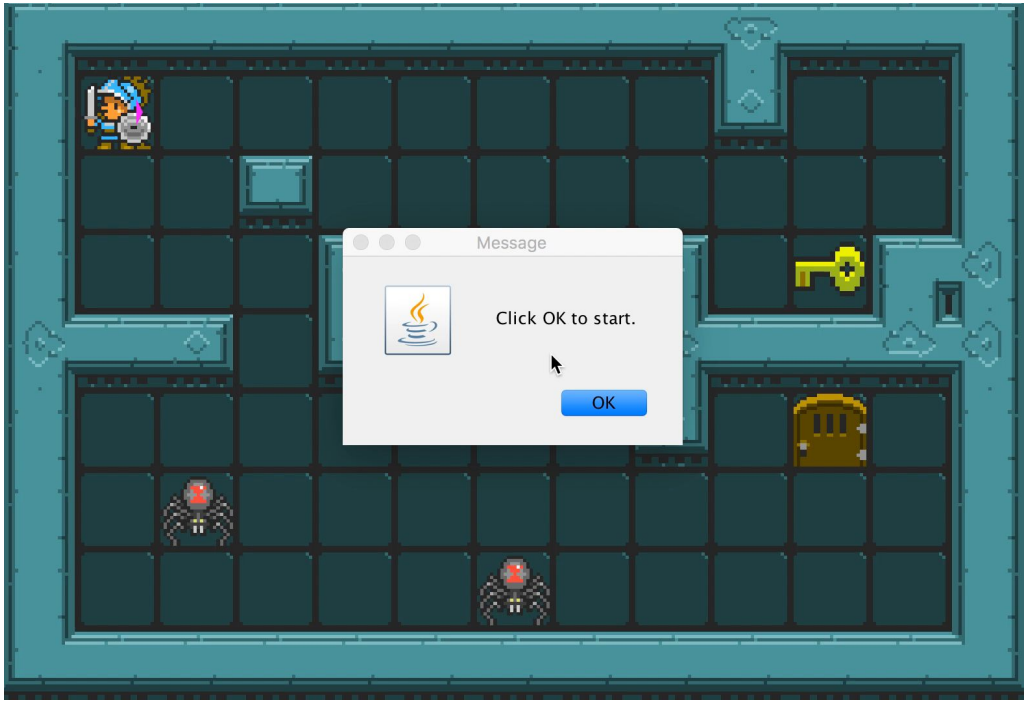
- use to determine how to win and lose the game
- simple breadth first search from avatar to terminal conditions

4. Generate Written Instructions



5. Capture Agent Playthroughs

- adrienctx
- NovelTS
- NovTea
- Number27
- YOLOBOT
- OneStepLookAhead
- DoNothing



6. Display Instructions with Agent Examples

AtDelfi - GVGAI Results

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~~What is a tutorial?~~

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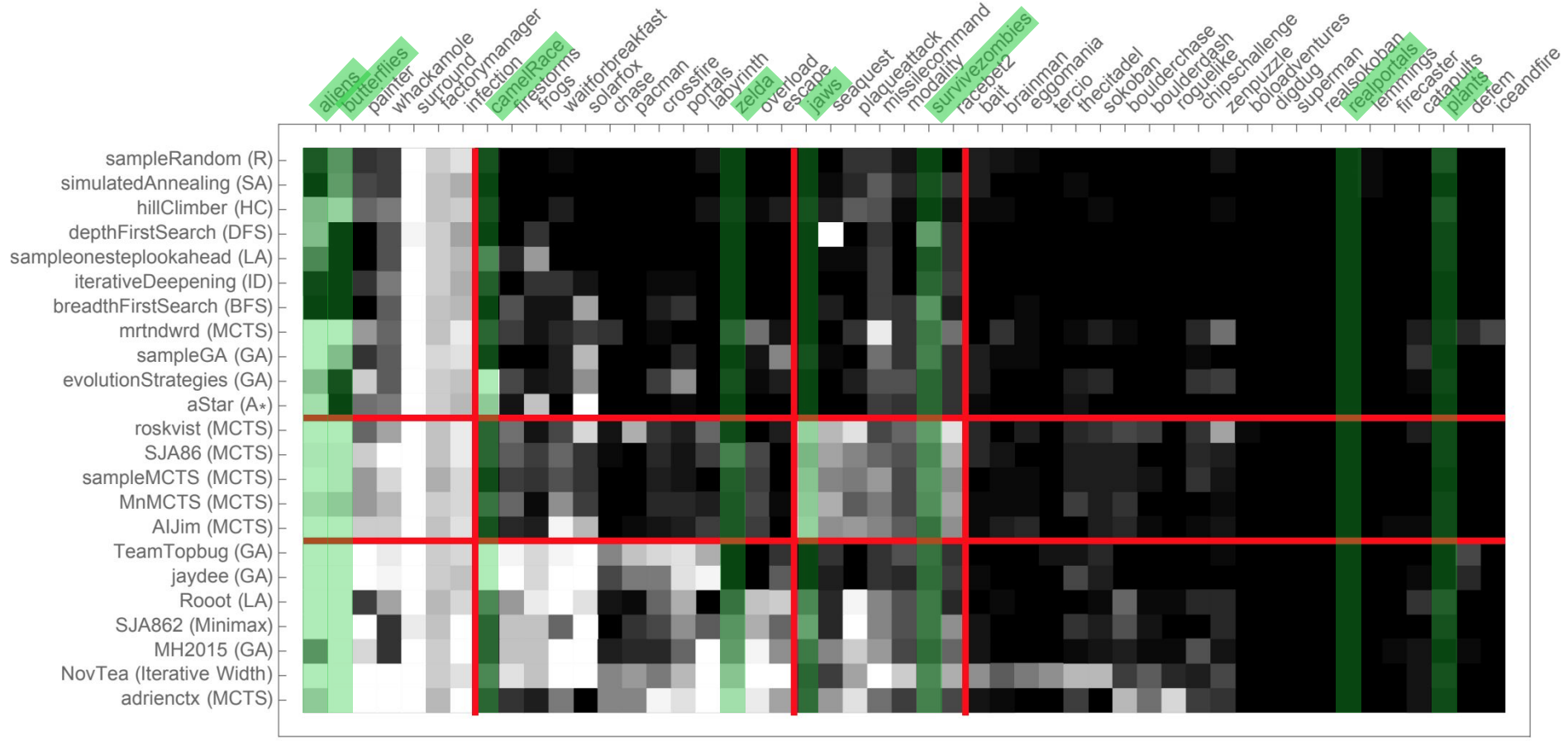
~~GVGAI Quick Overview~~

~~Generating a Tutorial in GVGAI (AtDelfi)~~

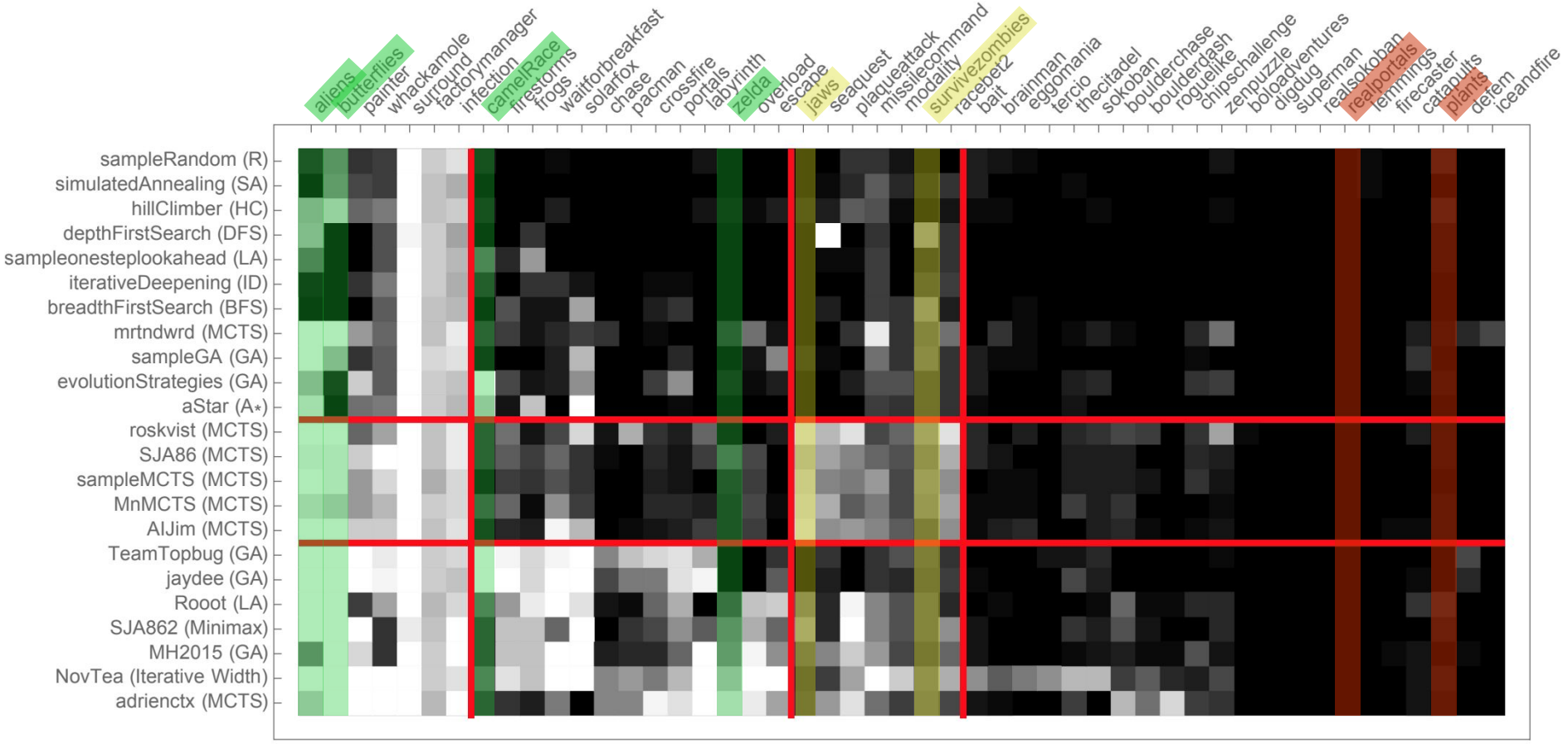
AtDelfi - GVGAI Results

Future Work

Selected Games in GVGAI



Evaluation for Readability



Improvements to AtDelfi

- Explore other Critical Path algorithms
- Objective User Study Evaluation
- More games, different kinds!
- Bugfixes

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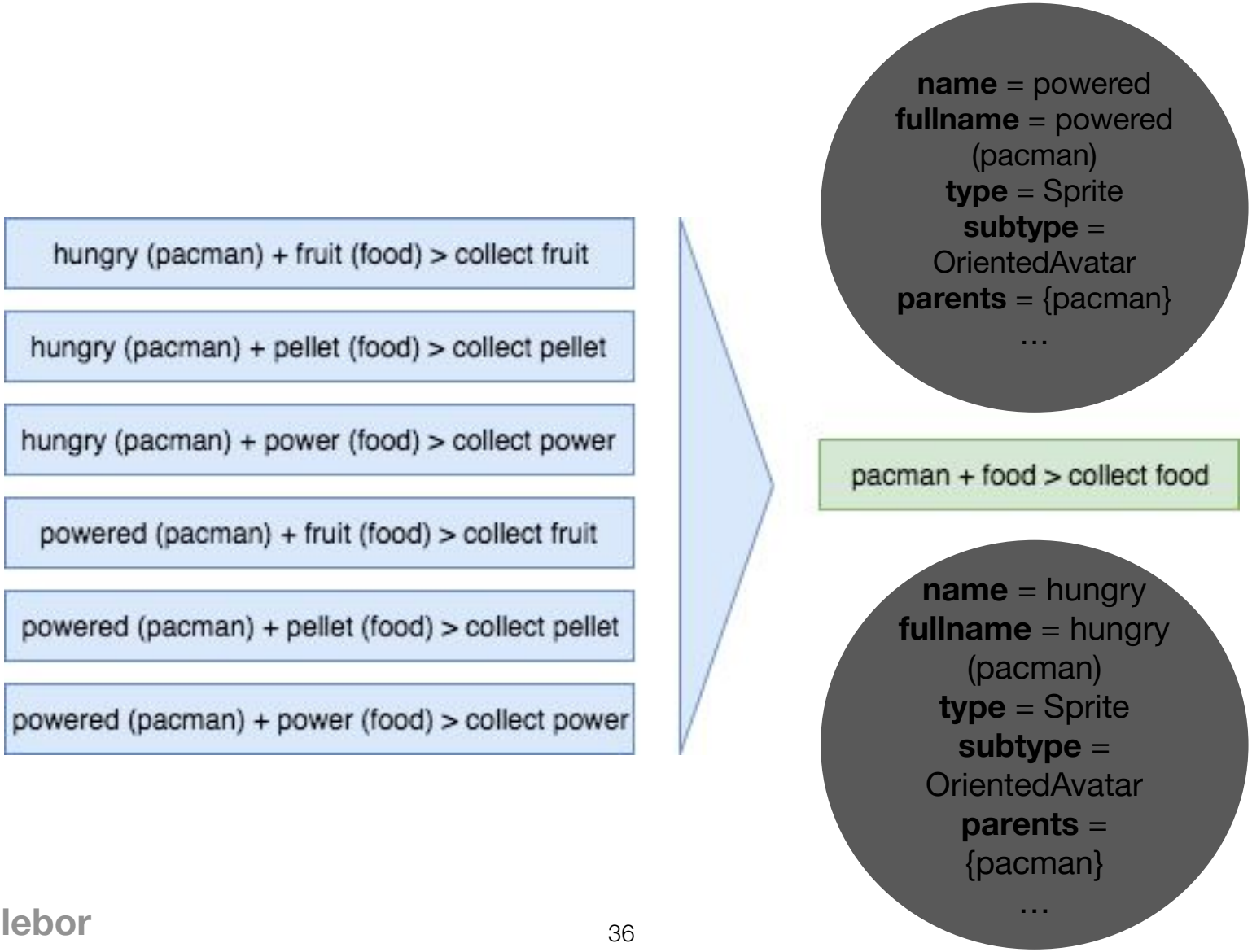
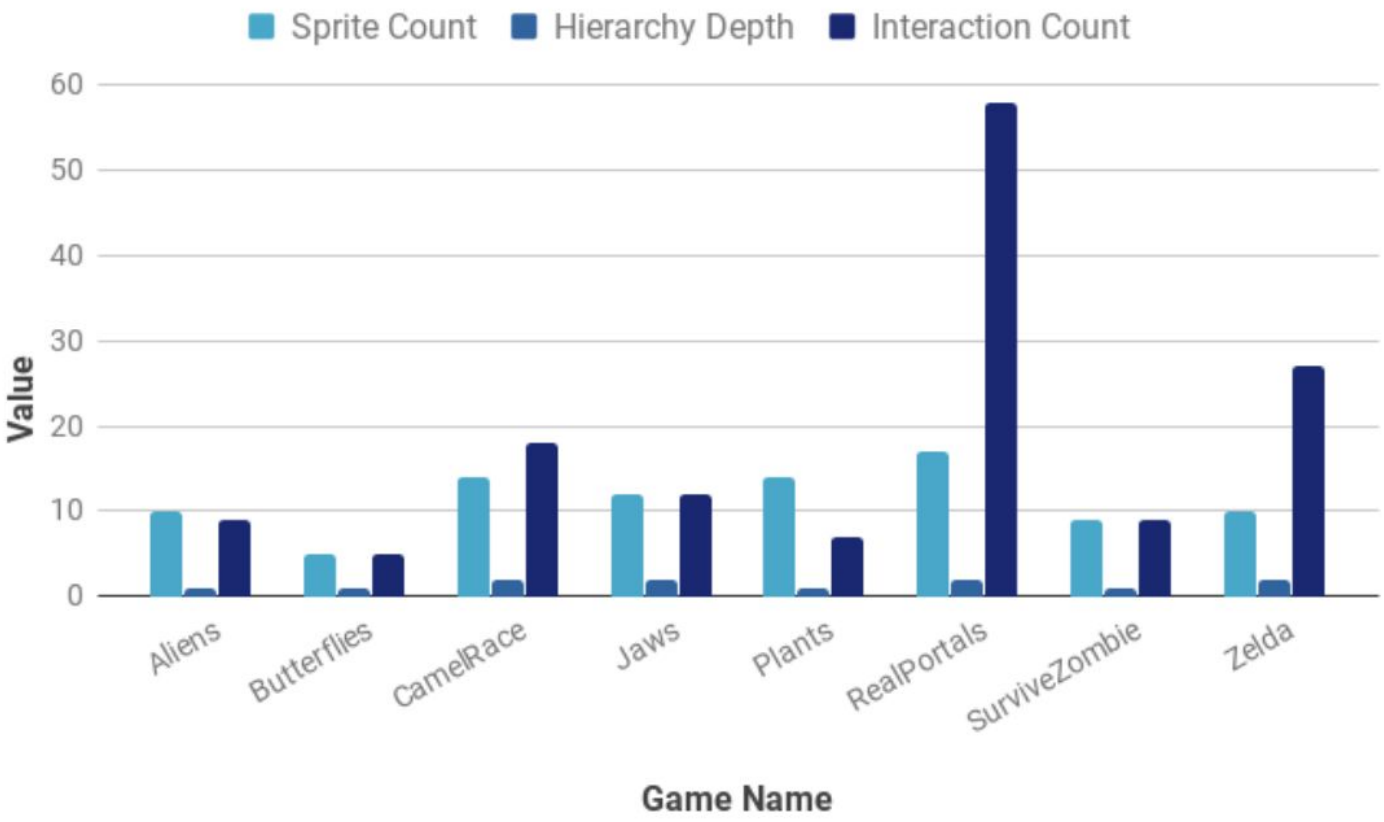
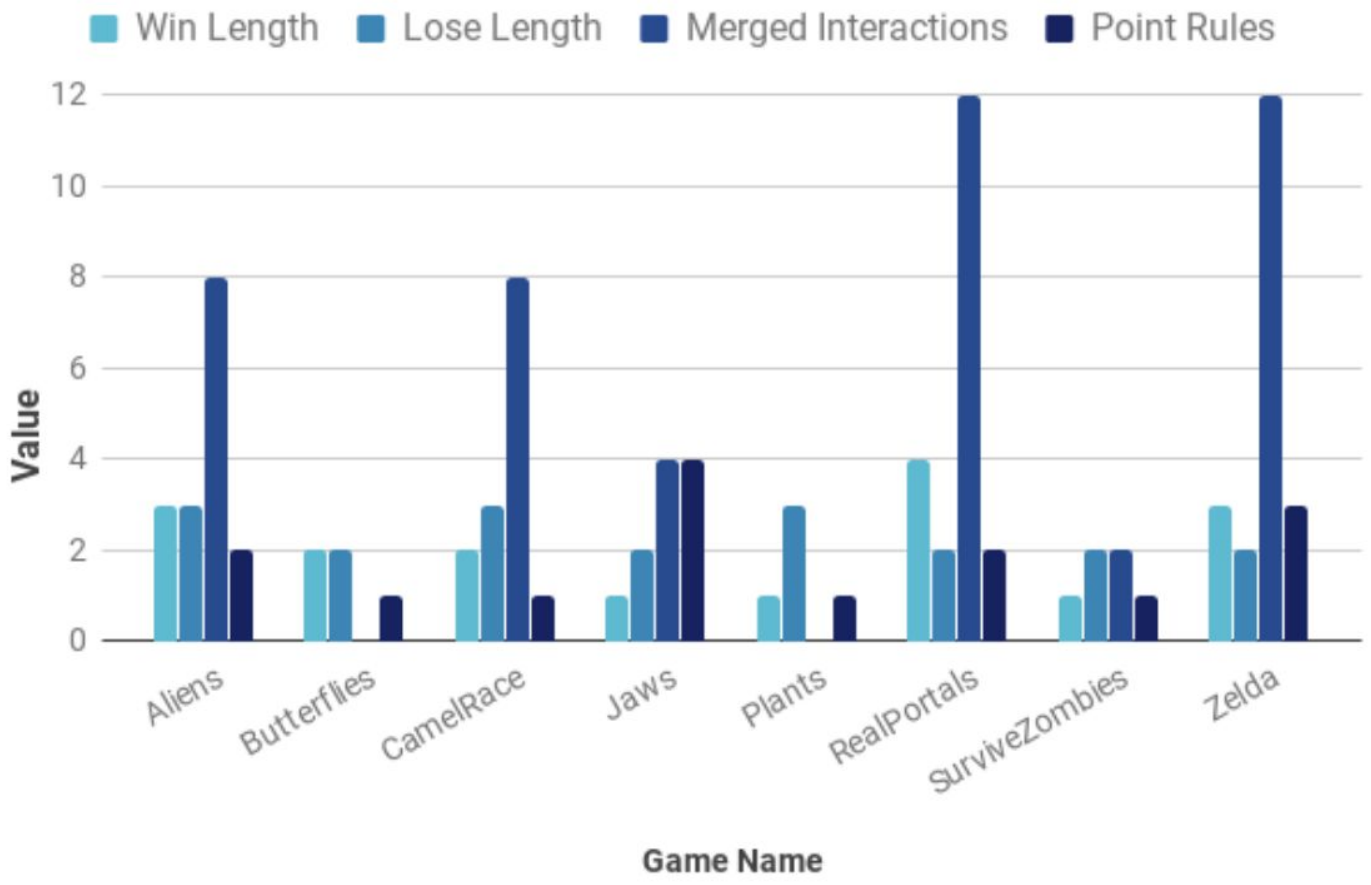
Rule Merging



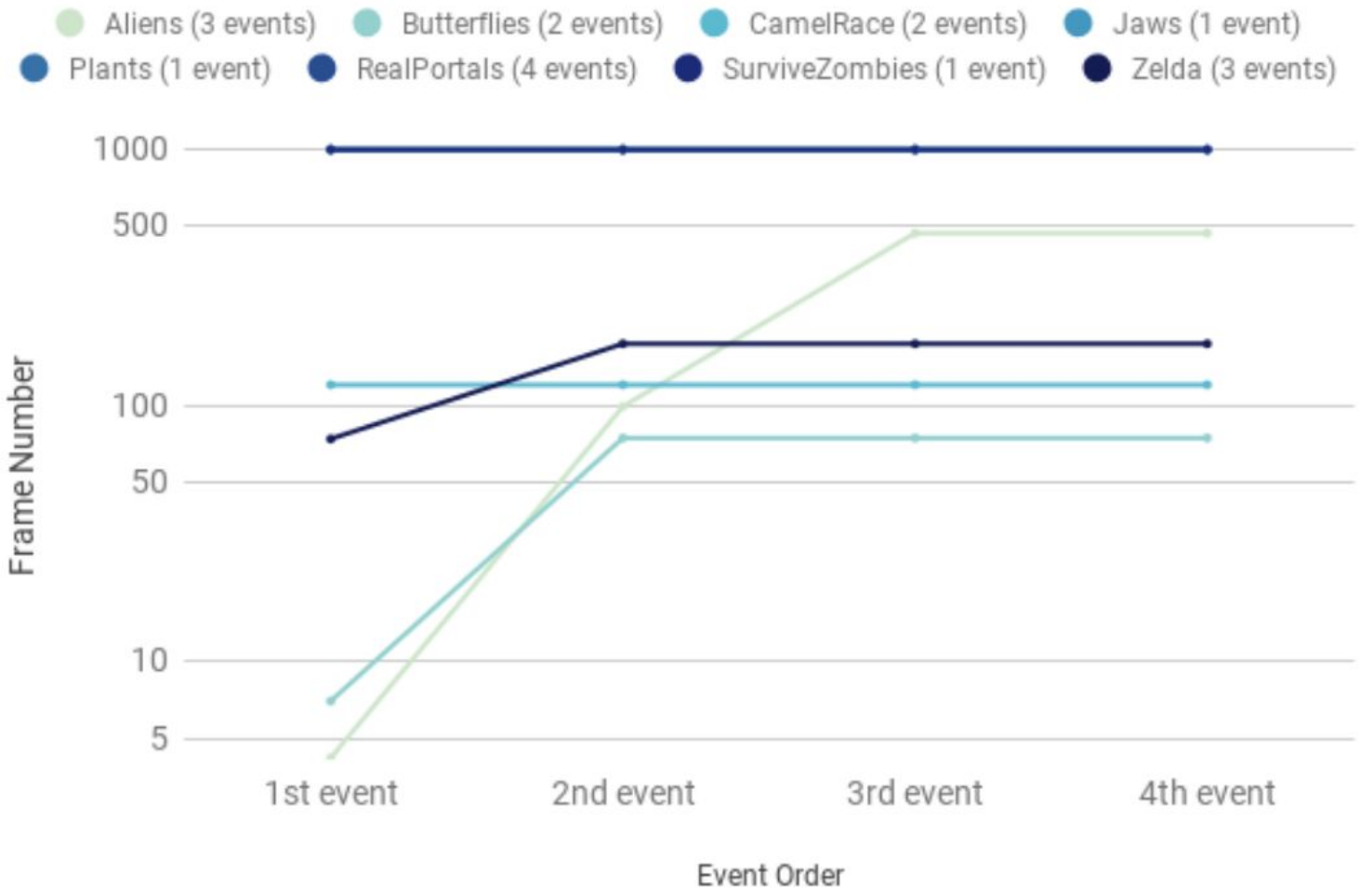
Metrics


Sprite Count
Hierarchy Depth
Interaction Count
60
50
40
30
20
10
0
Value
Aliens
Butterflies
CamelRace
Jaws
Plants
RealPortals
SurviveZombie
Zelda
Game Name

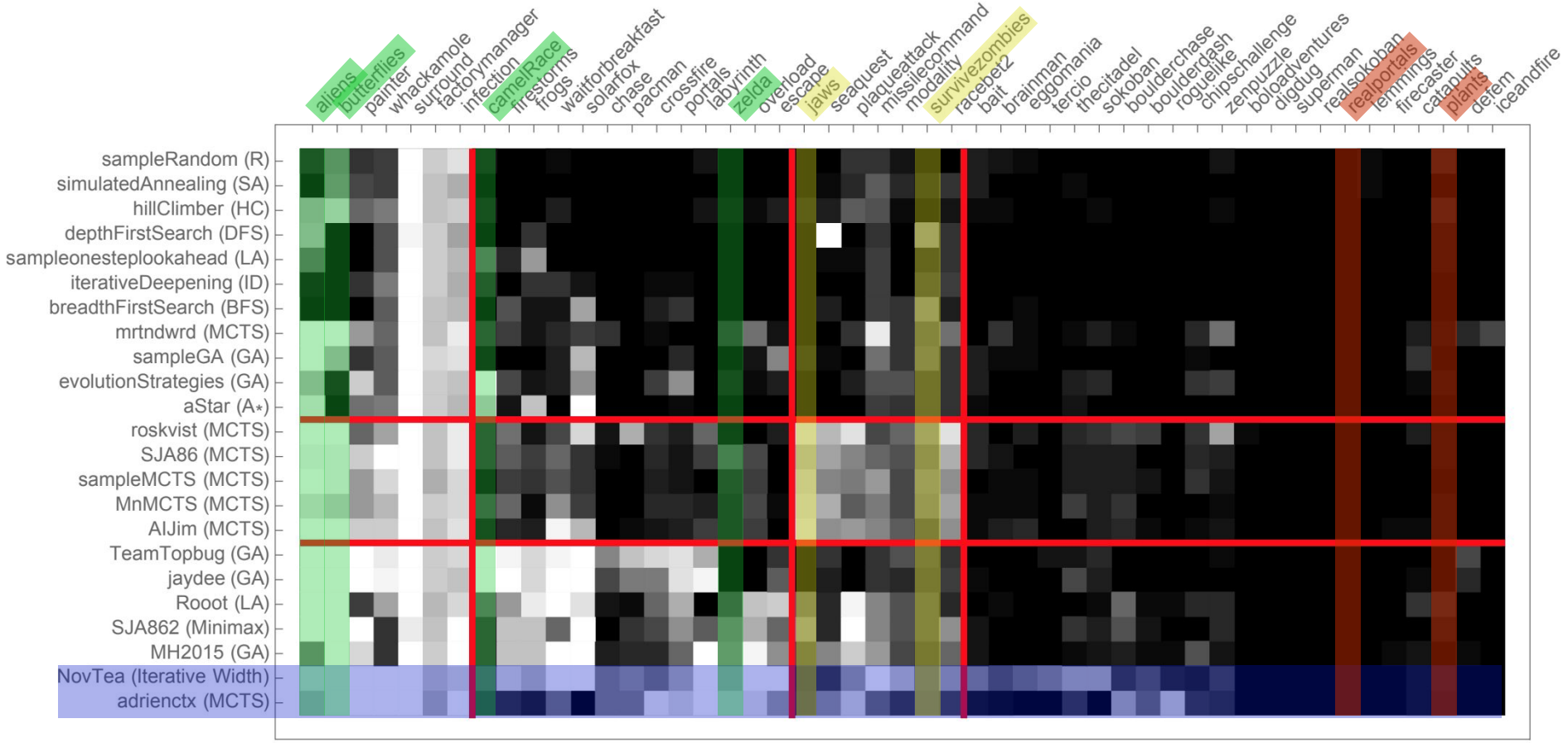
Metrics


Win Length
Lose Length
Merged Interactions
Point Rules
12
10
8
6
4
2
0
Value
Aliens
Butterflies
CamelRace
Jaws
Plants
RealPortals
SurviveZombies
Zelda
Game Name

Metrics


Aliens (3 events)
Butterflies (2 events)
CamelRace (2 events)
Jaws (1 event)
Plants (1 event)
RealPortals (4 events)
SurviveZombies (1 event)
Zelda (3 events)
1000
500
100
50
10
5
Frame Number
1st event
2nd event
3rd event
4th event
Event Order

Correlations Between Agent Performance and Tutorial Readability



@bumblebor

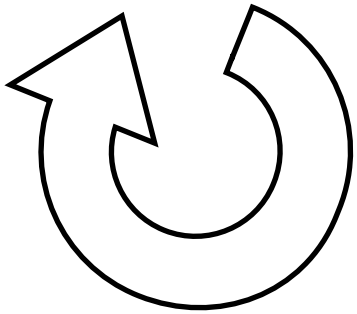
Use A* to Learn Mechanics

Evolve “Well-Designed” Exp ario

Various Disabilities using Mechanic Graph

+

Mario Level

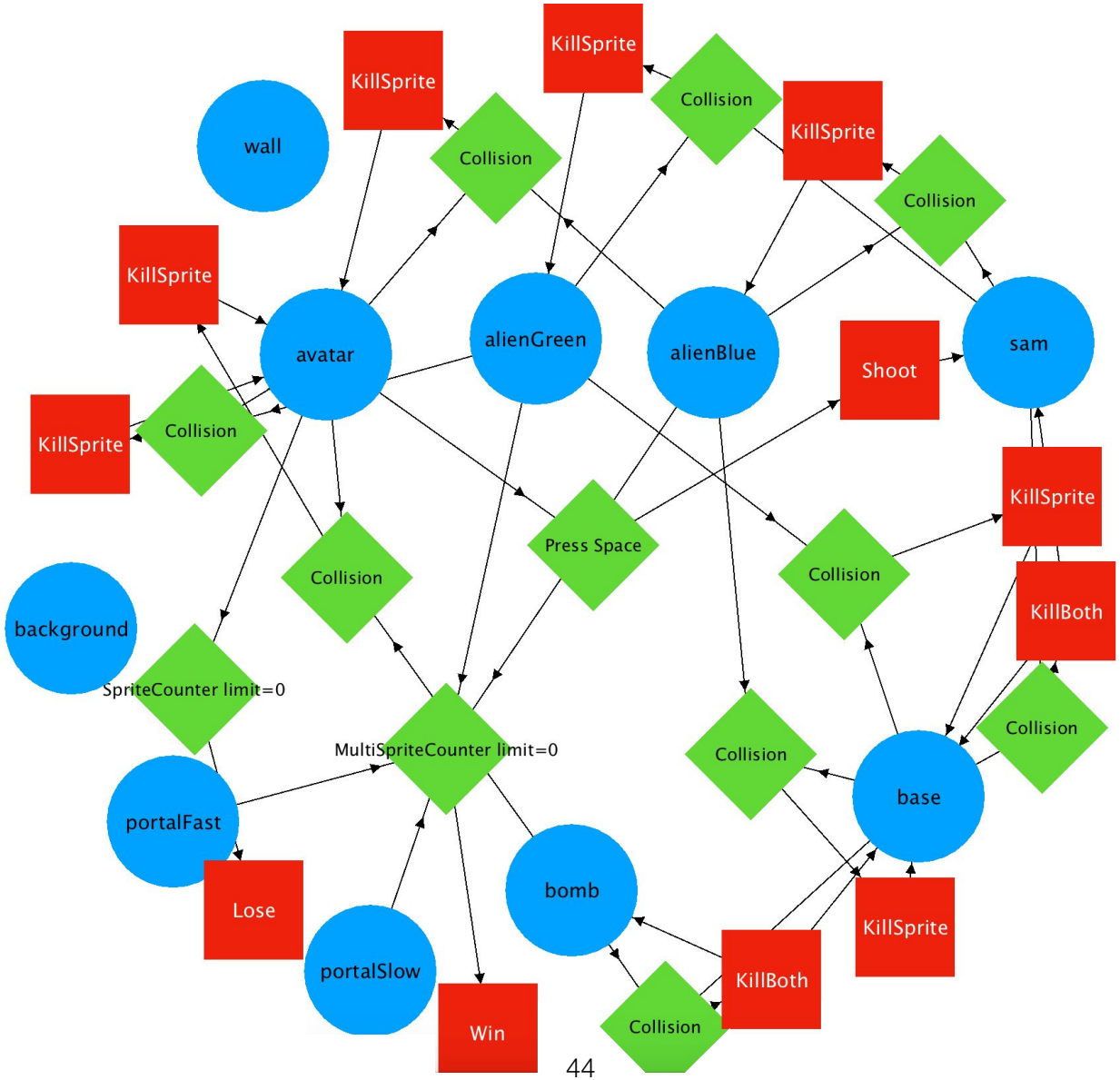


Fitness = Entropy of distance between agent deaths

Learn Mechanics w/o a Forward Model

- Summerville/Osborne's Gemini system
- Summerville's "Latent Causal Affordances"
- Guzdial's Game Engine Learning
- Visual information + game state (or domain knowledge)
- Only visual information (no state at all)

3. Find Critical Paths



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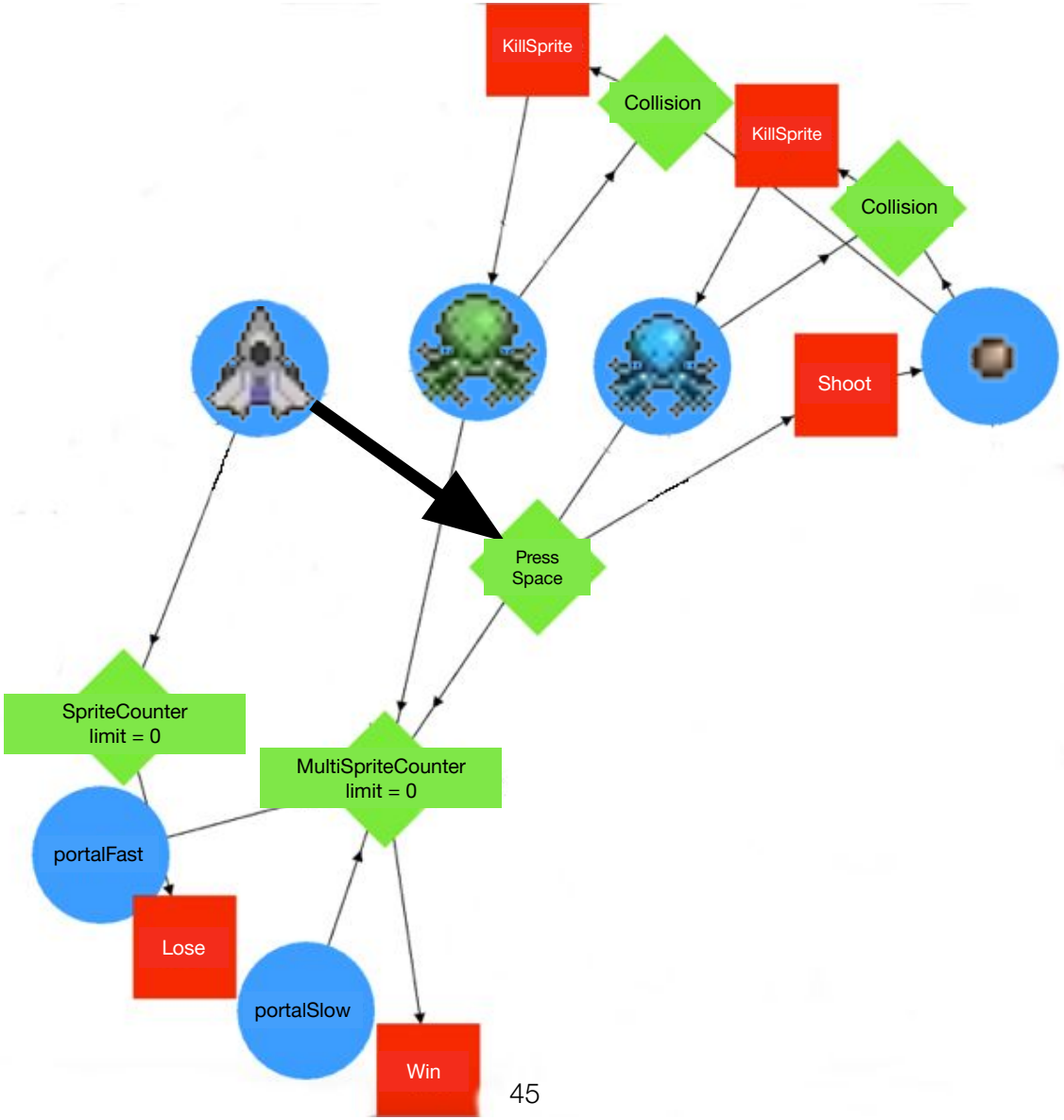

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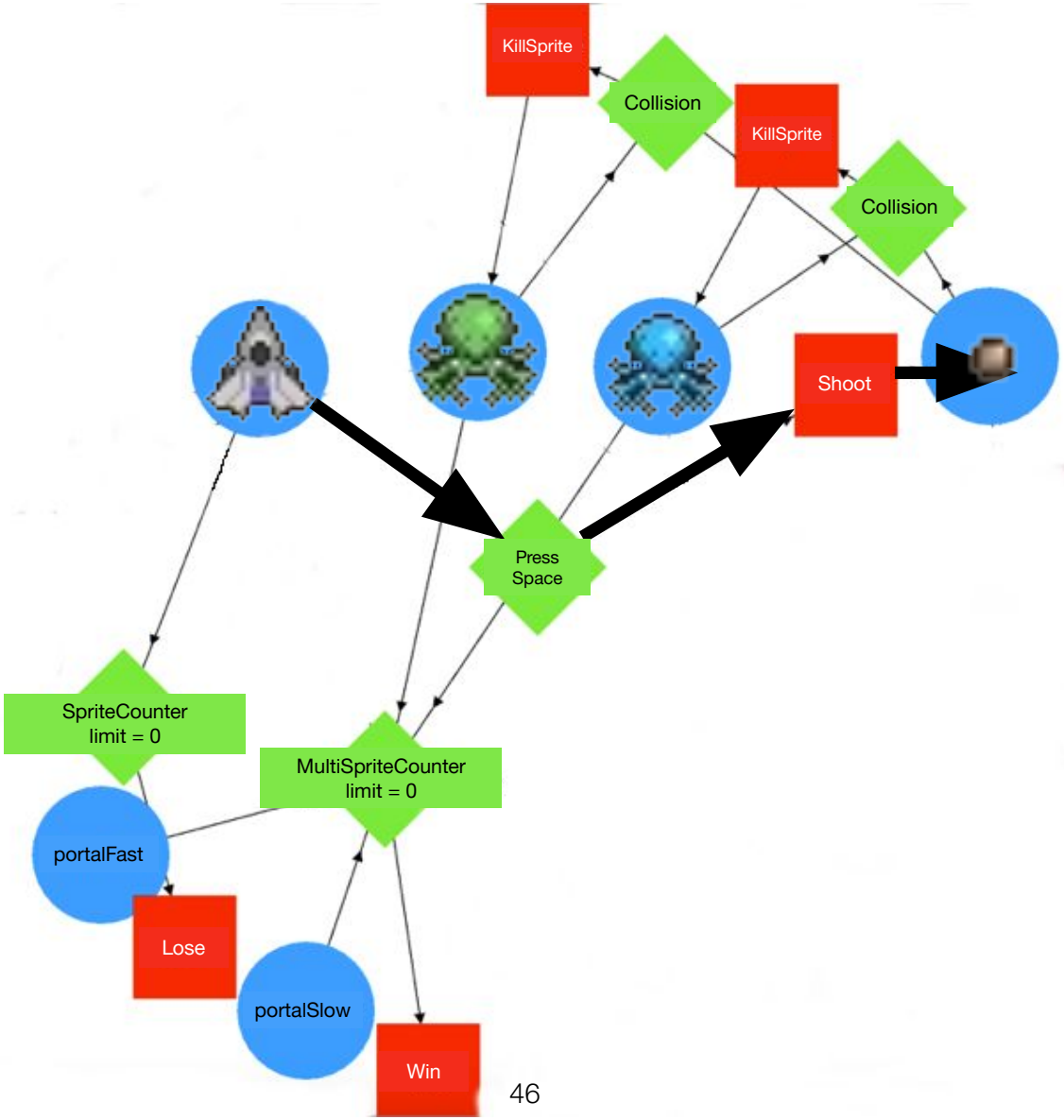

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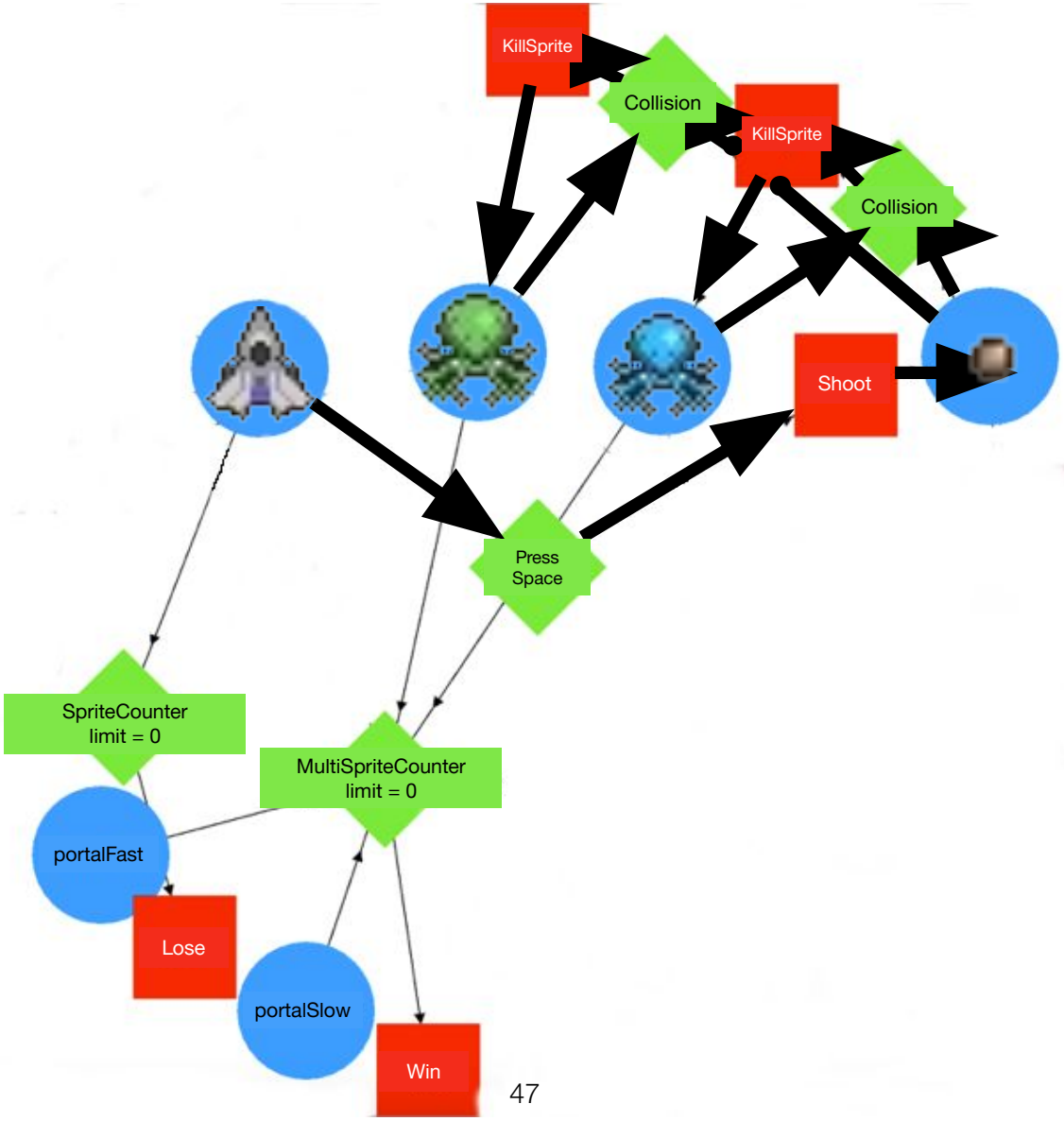

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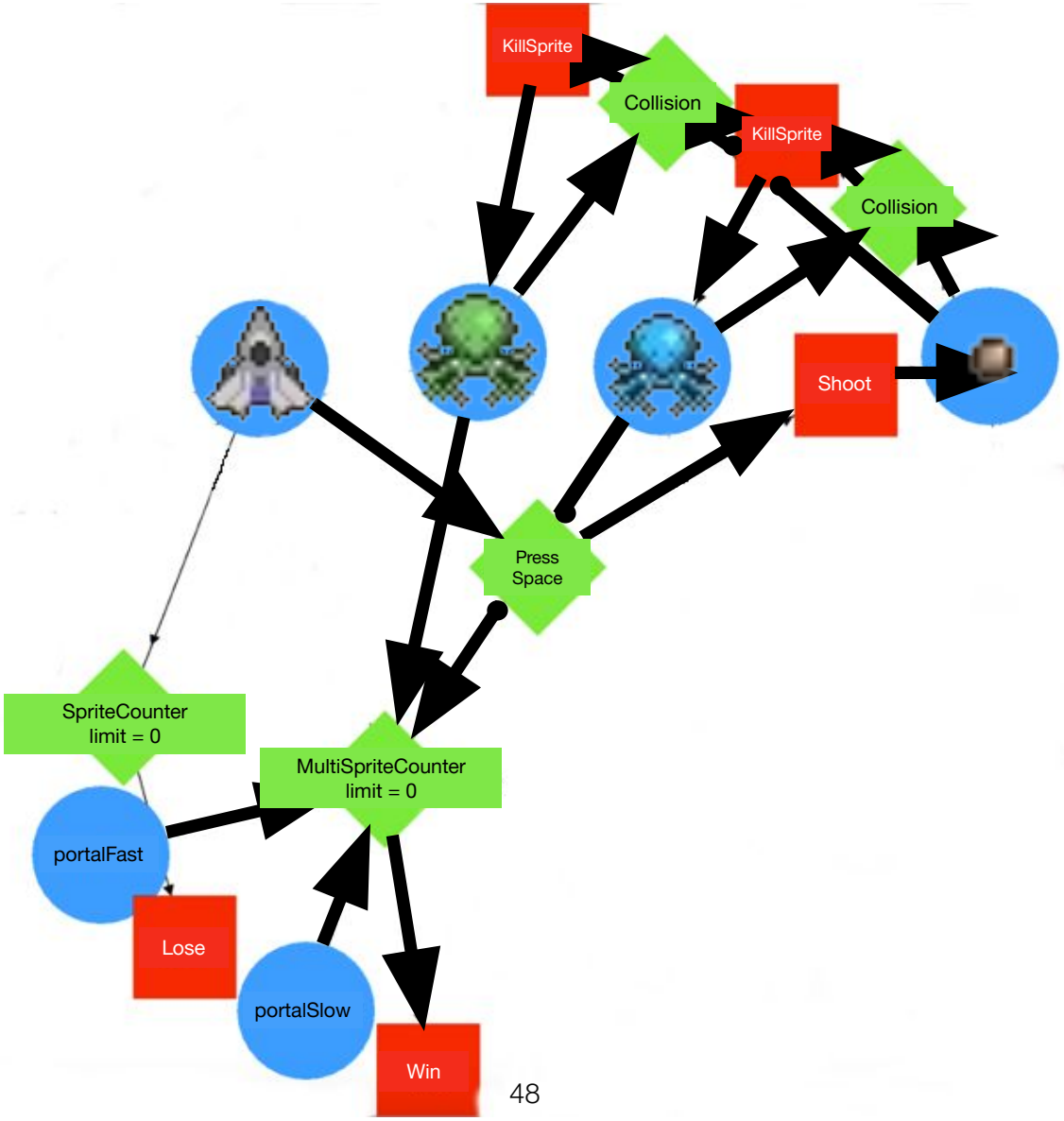

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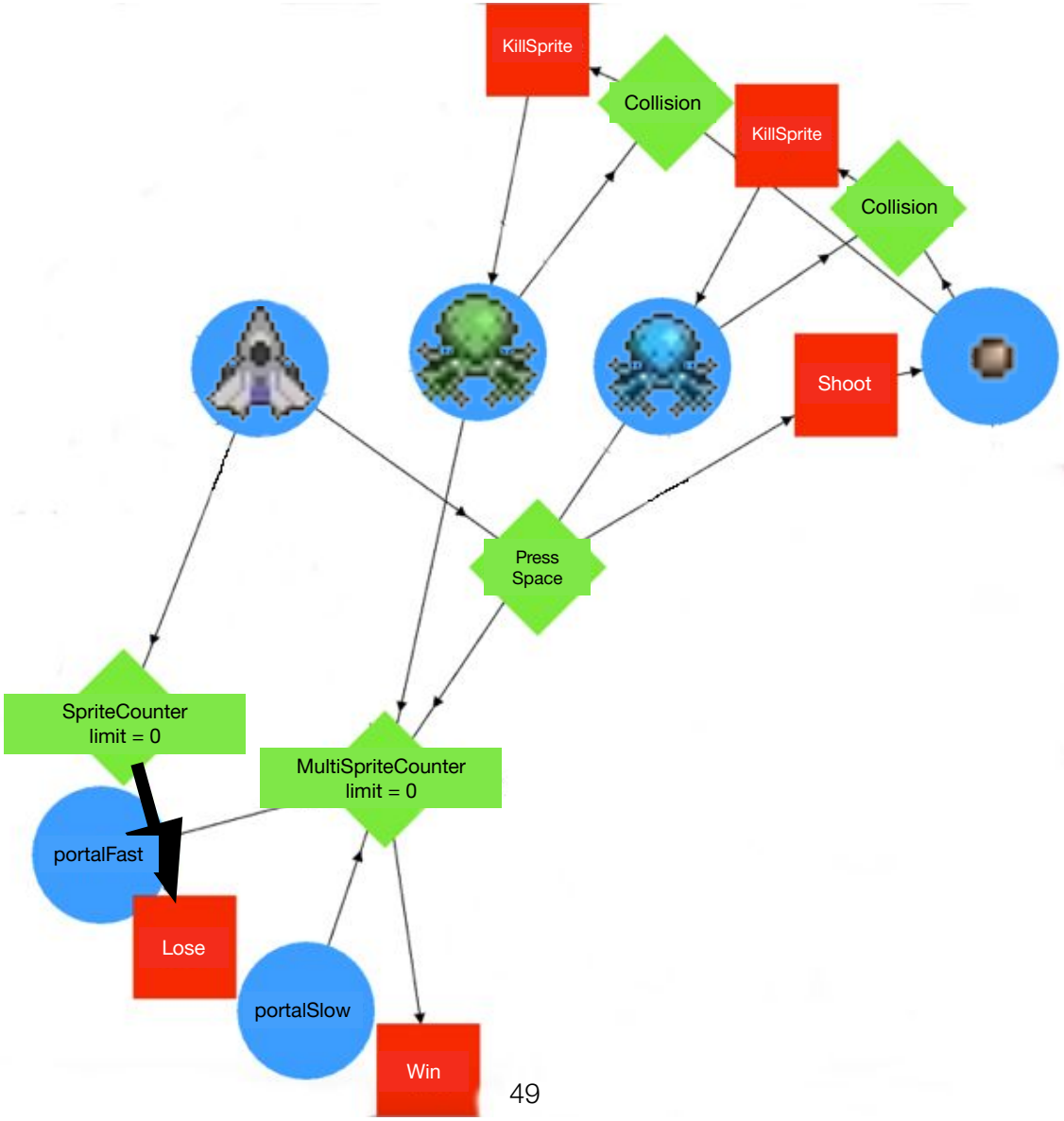

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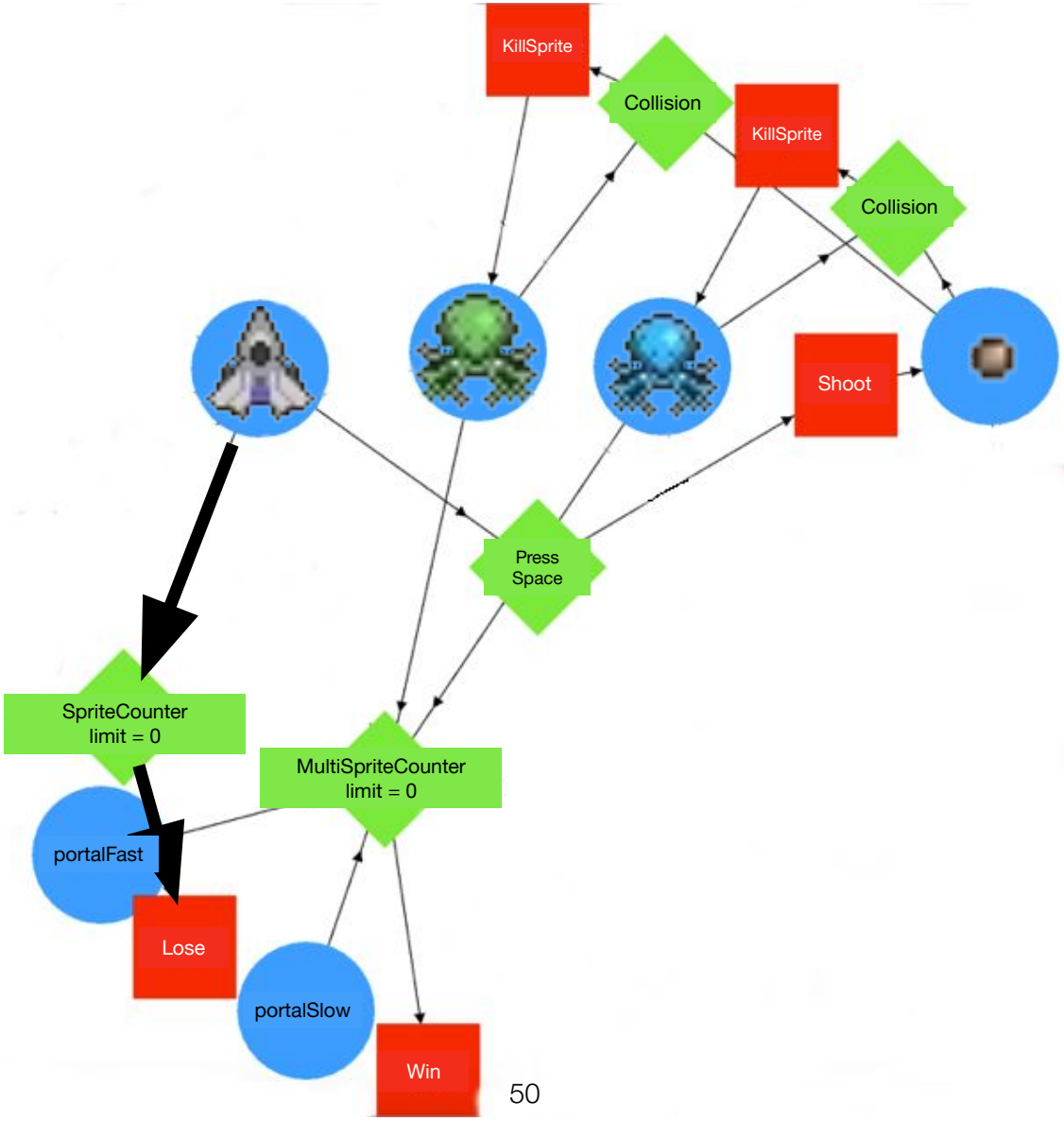
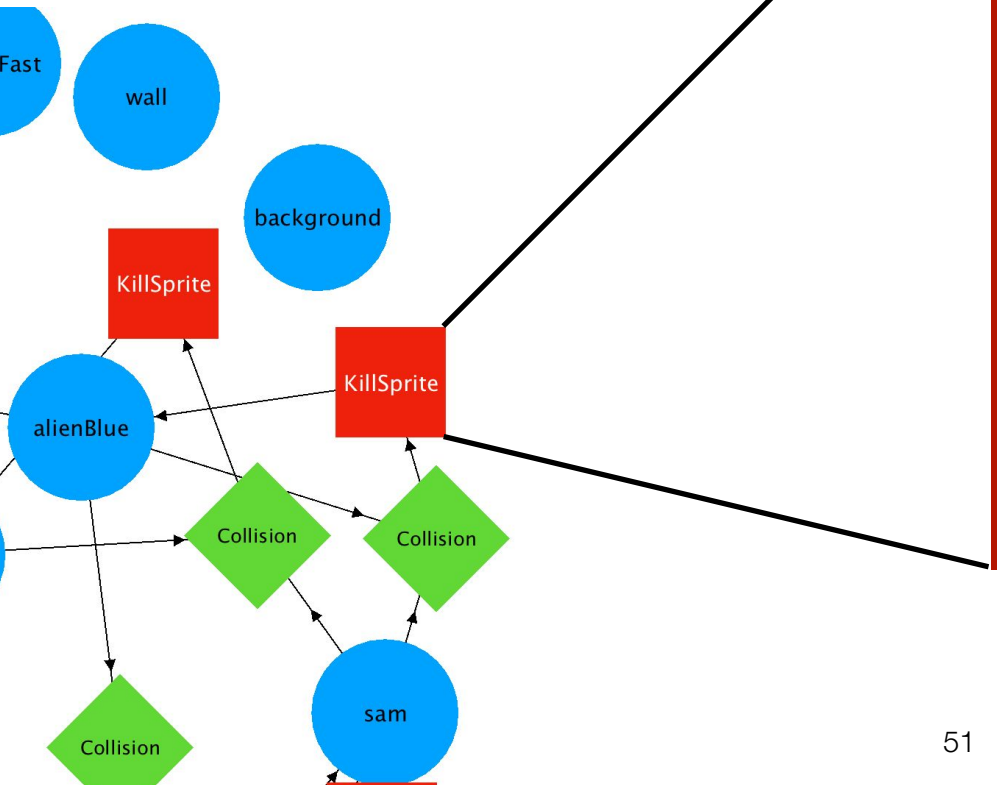


2. Build Mechanic Graph



name = KillSprite
fullname = KillSprite
type = Action
subtype = Interaction
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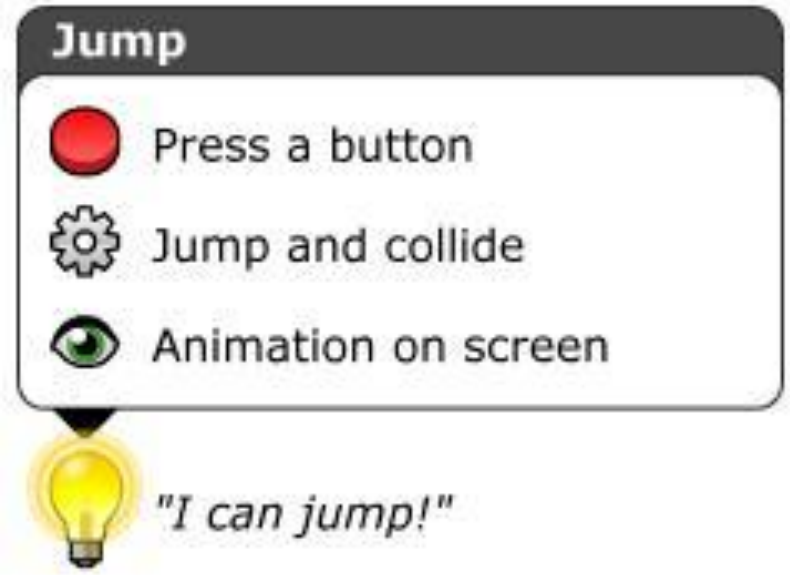
inputs = {collision#006}
outputs = {alienBlue}
attributes = {“ScoreChange” : “2”}

Expensive!

Skill Atoms - Dan Cook



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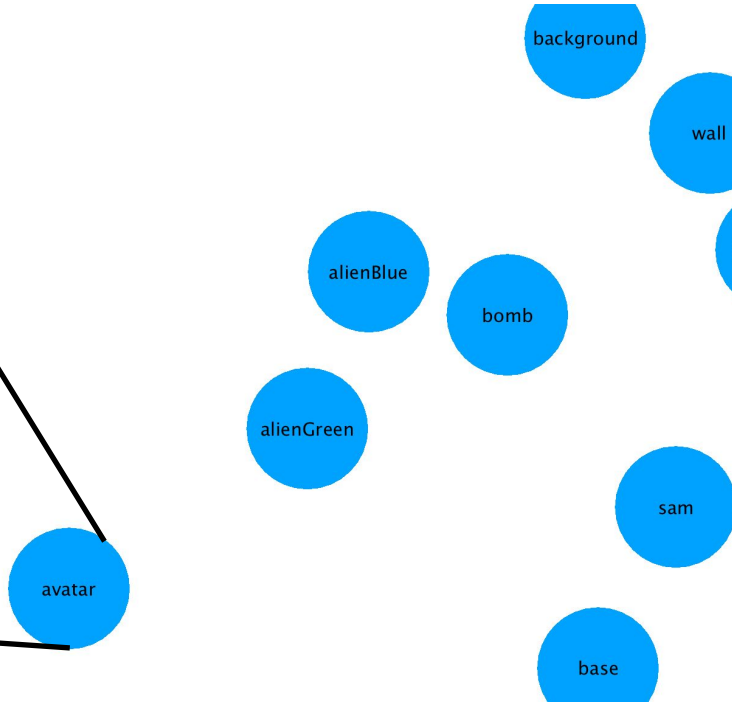
name = avatar
fullname = avatar
(FlakAvatar)
type = Sprite
subtype = FlakAvatar
parents = empty
inputs = empty
outputs = empty
attributes =
[“img”: “oryx/spaceship1”,
“stype : “sam”]