# CE810 - Game Design 2

## **Lab** - Searchable Design Spaces

Joseph Walton-Rivers & Piers Williams

Monday, 14 May 2018

University of Essex

# Intro

# Design Spaces

- In this morning's session we talked about Game Parameters

# Design Spaces

- In this morning's session we talked about Game Parameters
- These are properties which help to define the game

# Design Spaces

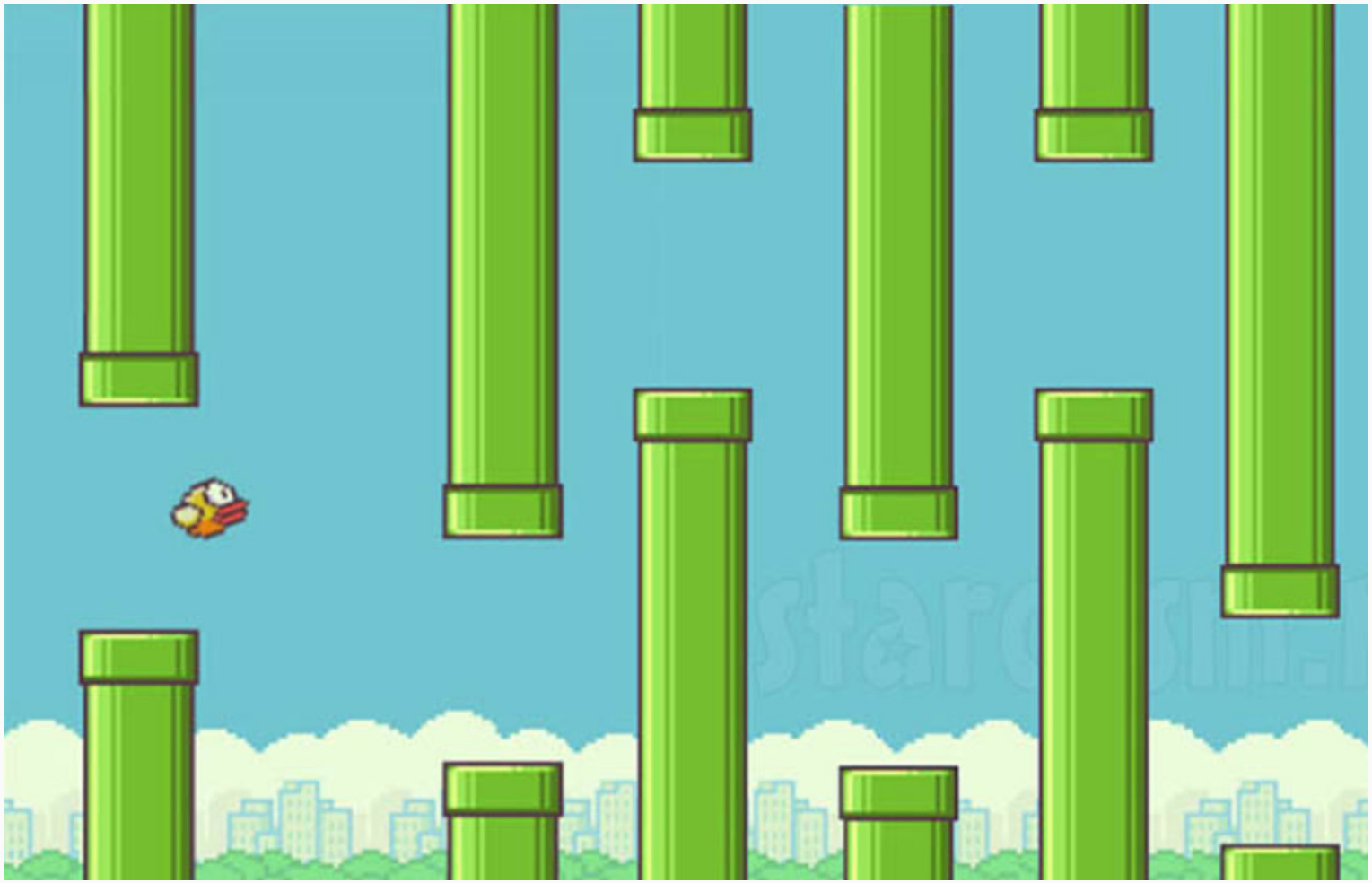
- In this morning's session we talked about Game Parameters
- These are properties which help to define the game
- These are often **dependant** on one another.

# Flappy Bird

# Exercise: Game Parameters

## Question

What game parameters are there for *Flappy Bird*?



# Answer: Game Parameters

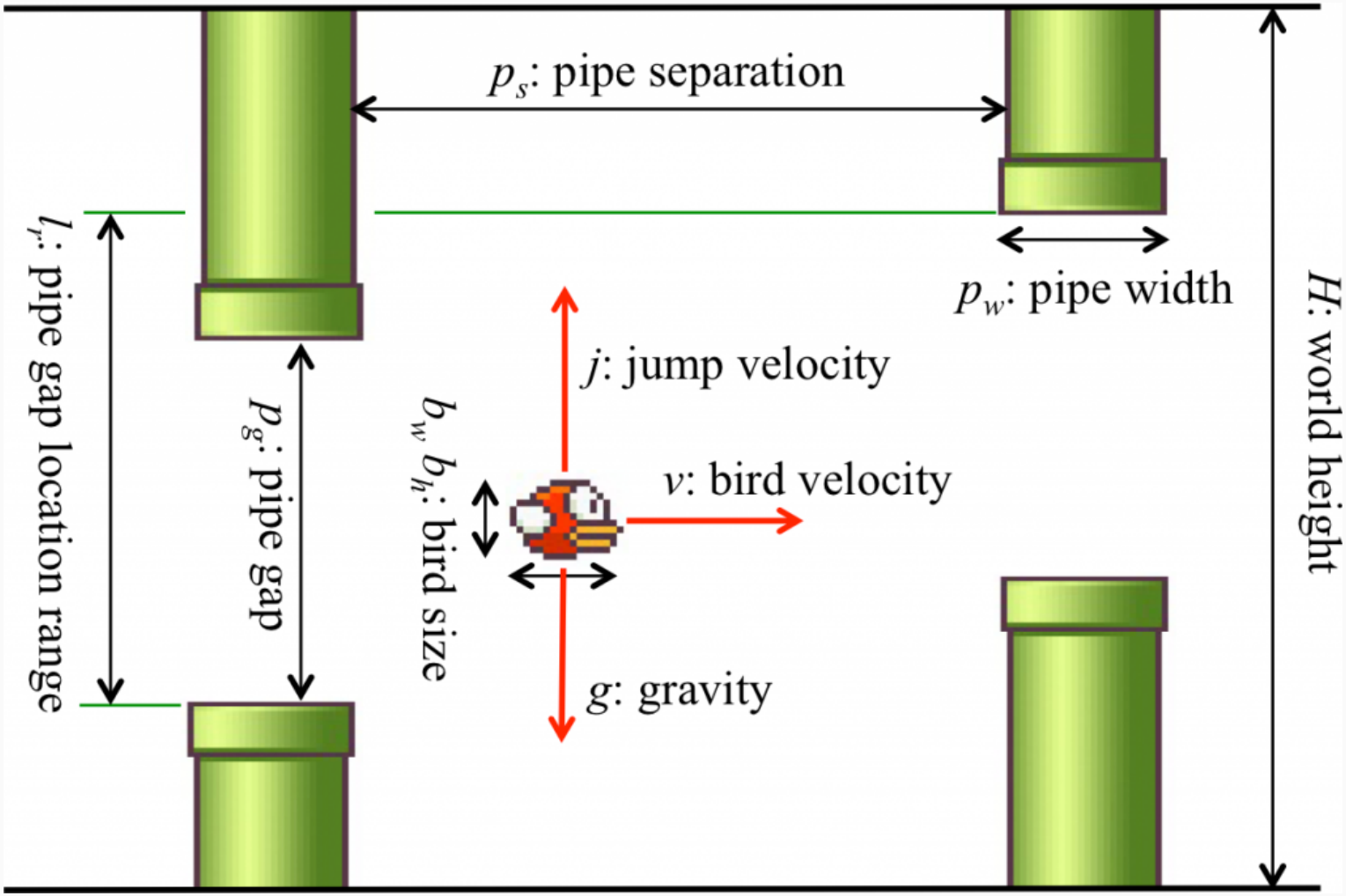



**Figure 1:** paramters by Isaksen et al @ NYU

# Flappy Birds

## Activity

Go to the *Flappy Bird* demo and change the sliders.

How does changing the parameters affect the gameplay?

`http://game.engineering.nyu.edu/projects/exploring-game-space/` [1]

# How does this relate to us?

Isaksen et al basically did the following:

1. Select parameters
2. Repeat *N* times
    2.1 Generate games
    2.2 Evaluate games
    2.3 Record results
3. Analyse results
4. Output result

This is how we're going to think about tuning our own game parameters.

# The Role of AI

**Problem** Doing evaluations is time consuming

# The Role of AI

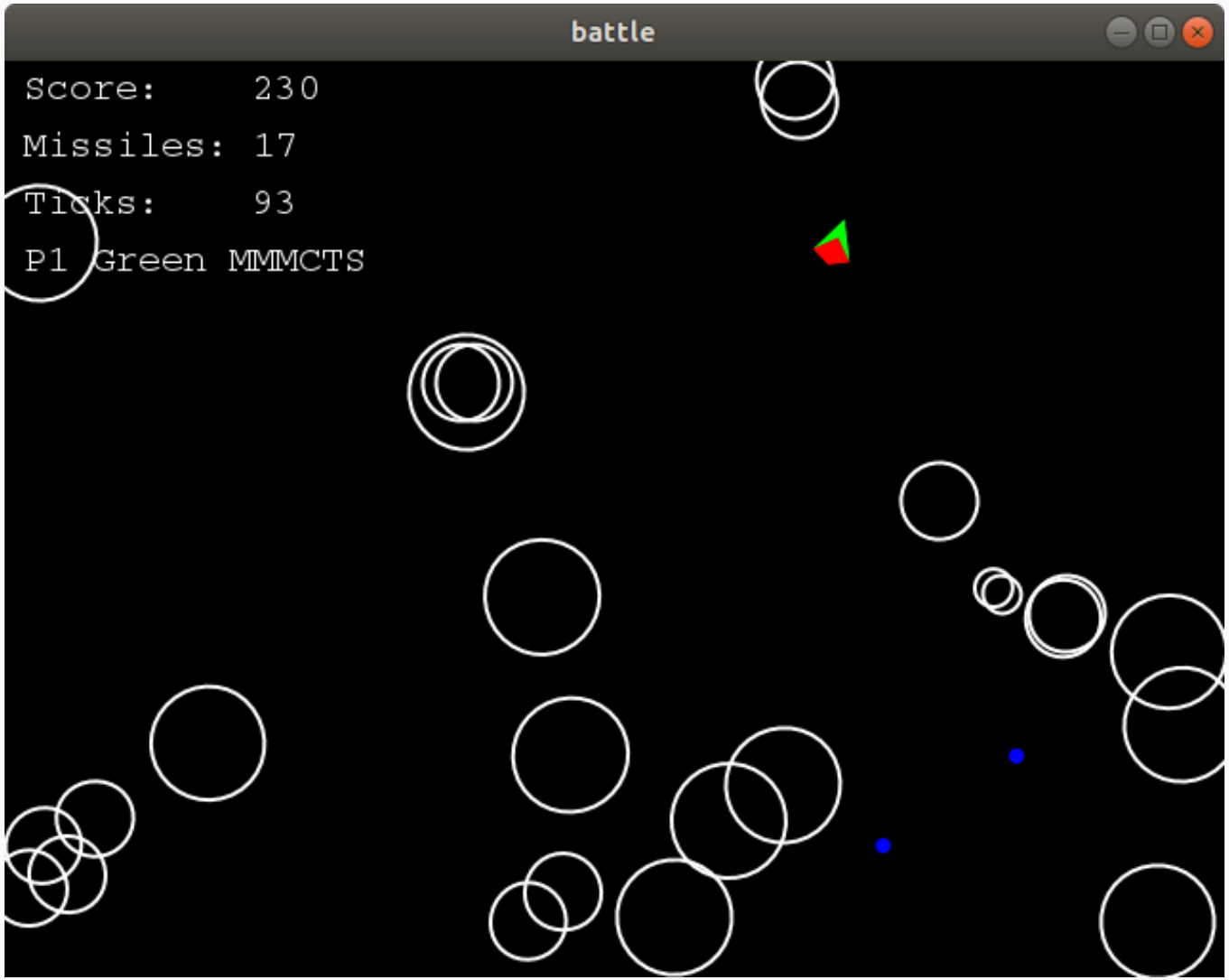
**Problem** Doing evaluations is time consuming

**Solution** Make AIs that play them

# Asteroids

# Asteroids

Lets look at a more complicated example



# Parameters

## Question

What parameters could we change for *Asteroids*?

# Parameters

## Question

What parameters could we change for *Asteroids*?

- Game Length
- Number of bullets
- Speed of bullets
- Number of asteroids
- Number of asteroid children
- Ship speed
- Ship turn rate
- Bullet cost
- Can bullets hit the ship

# Metrics

**Question**

What can we measure about *Asteroids*?

# Metrics

**Question**

What can we measure about *Asteroids*?

- Rankings
- Score difference
- Time to win (game ticks)
- Distance travelled

# Metrics

## Exercise

Create a version of *Asteroids* that **disadvantages** the rotate and shoot player over the other agents.

# Asteroids Codebase

# Overview

- Relatively simple
- Easy to change parameters
- Can customise it further if you particularly want something else
- Genetic algorithm included to assist you
    - Only thing it needs … a better Fitness Function

# Running a Game

```
SimpleBattle battle = new SimpleBattle(true, params);
BattleController p1 = new SingleMCTSPlayer(new Random());
battle.playGame(
  p1,
  new MultiRecorder(scoreRecorder, bulletRecorder)
);
```

0

# Parameters?

```
int[] params = new int[N_PARAMS];
Arrays.fill(params, -1);
params[N_MISSILES] = 200;
```

The set of parameters currently supported is in that handy list from slide 9

---

0

# Searching the space

- Searching design spaces can require a lot of computational power.

# Searching the space

- Searching design spaces can require a lot of computational power.
- We can do better

# Searching the space

- Searching design spaces can require a lot of computational power.
- We can do better
- Genetic Algorithms can aid us here

# Searching the space

- Searching design spaces can require a lot of computational power.
- We can do better
- Genetic Algorithms can aid us here
- We have implemented a basic searcher using a GA Library

# Searching the space

- Searching design spaces can require a lot of computational power.
- We can do better
- Genetic Algorithms can aid us here
- We have implemented a basic searcher using a GA Library
- It’ll do for now

# Searching the space

- Searching design spaces can require a lot of computational power.
- We can do better
- Genetic Algorithms can aid us here
- We have implemented a basic searcher using a GA Library
- It’ll do for now
- Head to class “com.fossgalaxy.games.asteroids.battle.jenetics.Jenetics”

# Jenetics: Parameters

```
Arrays.fill(USING, false);
USING[N_MISSILES] = true;
USING[BULLET_TIME_TO_LIVE] = true;
USING[SHIP_MAX_SPEED] = true;
USING[SHIP_STEER_RATE] = true;
USING[BULLET_KILL_SHIP] = true;
```

0

# Jenetics: Limits

```
int[][] limits = {
  {10, 500}, // N_MISSILES
  {20, 100}, // BULLETT_TIME_TO_LIVE
  {1, 10},
  {5, 50},
  {0, 1}
};
```

---

0

# Jenetics: Chromosomes

```
// Convert limits to the chromosomes
List<Chromosome<IntegerGene» genes = Arrays
  .stream(limits)
  .map(x -> IntegerChromosome.of(x[0], x[1], 1))
  .collect(Collectors.toList());

// Chromosomes to genotype
Factory<Genotype<IntegerGene» genotype =
↪    Genotype.of(genes);
```

---

0

# Jenetics: Fitness

```
int[] params = getParamsFromGenotype(genotype);
AIExperiment experiment = new AIExperiment(5,
 ↪    controllerFunctions, params);
Map<String, List<Integer>> scores = experiment.run();
Map<String, Integer> avg = new HashMap<>();
for(Map.Entry<String, List<Integer>> entry : scores.entrySet()){
avg.put(
entry.getKey(),
entry.getValue().stream().mapToInt(Integer::new).sum() / 5);
}
return avg.get("PiersMCTS") - avg.get("RotateAndShoot");
```

---

0

# Jenetics: Engine

```
ExecutorService exec = Executors.newFixedThreadPool(3);
final Engine<IntegerGene, Double> engine = Engine
  .builder(Jenetics::fitness, genotype)
  .populationSize(50)
  .executor(exec)
  .optimize(Optimize.MAXIMUM)
  .build();
```

---

0

# Jenetics: Running it

```
final Genotype<IntegerGene> result = engine.stream()
  .limit(limit.byExecutionTime(Duration.ofMinutes(120)))
  .limit(300)
  .peek( x-> {
    System.out.println("Generation: " + x.getGeneration());
    System.out.println("Best Fitness: " + x.getBestFitness());
    }
  )
  .collect(EvolutionResult.toBestGenotype());

System.out.println(result);
```

---

0

# References i


A. Isaksen, D. Gopstein, and A. Nealen.
**Exploring game space using survival analysis.**
In *FDG*, 2015.

D. Perez, S. Lucas, and J. Liu.
**Lecture slides for ce810.**
2015-2017.