Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Casanova: a language for game development

Dr. Giuseppe Maggiore

Hogeschool Rotterdam
Rotterdam, Netherlands

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Introduction

Introduction

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Lecture topics

- The relevance of games and beyond
- A brief introduction to game architectures
- Are we missing a language?
- Casanova as a first step towards a solution

The relevance of games and beyond

The relevance of games and beyond

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Background

- Games are a huge market (**b**illions of worth, countless hours spent)
- Changing the entertainment landscape, overtaking music and movies
- Large industry, with lots of technical innovation and inspiring work

The relevance of games and beyond

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Beyond entertainment

- The success of games is inspiring more and more people
- What if we can make other stuff as engaging?
- And so, *serious games* are born

The relevance of games and beyond

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Serious games

- Using game mechanics to bring serious applications to life
- Simulators, training applications, rehabilitation, school, and much more
- Countless applications could benefit from games, accelerating progress and culture from many angles

The relevance of games and beyond

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

What is stopping us?

- Great, so where is my "learn math by blowing zombies up" game?
- Serious games makers do not have huge resources
- Here comes the problem: **games are very hard and expensive to build**

The relevance of games and beyond

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

What is stopping us?

- Great, so where is my "learn math by blowing zombies up" game?
- Serious games makers do not have huge resources
- Here comes the problem: **games are very hard and expensive to build**
- **This heavily impacts the viability of games in such innovative applications**

The relevance of games and beyond

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Our take

- Our goal is to study and optimize the technical aspects of game development
- We look for complexity in the process and try to automate it
- We focus on the *programming languages* side of the equation[a]

[a] There are many others!

A brief introduction to game architectures

A brief introduction to game architectures

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

The game loop - a source of complexity

- Games need to run in real time
- Frames must be sent to the screen at 30/60Hz
- It's all a big loop!

A very simplified game architecture

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

```
1  state = GameState()
2  while Running:
3    state = update(state, dt)
4    state.Draw()
```

A brief introduction to game architectures

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

The game loop - a source of complexity

- `update` covers the dynamics of the game
- The game is a *hybrid system*
- The continuous parts are simple: just integrate numerically (`P = P + V * dt`)
- The discrete parts are less simple: large concurrent state machines!

Discrete architectures

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

```
1 switch action:
2   case RUNNING:
3     ...
4   case FIGHTING:
5     ...
6   ...
```

The game loop - a source of complexity

Discrete architectures

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

```
1  switch action:
2    case RUNNING:
3      ...
4    case FIGHTING:
5      ...
6    ...
```

The game loop - a source of complexity

- That's not how we think!

Are we missing a language?

Are we missing a language?

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Idea

- Most of what makes a game a game is the discrete part of the dynamics
- Create interesting patterns that introduce *controlled* variation
- These dynamics define game logic, AI, and more

Specification of discrete dynamics

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

```
1  repeat
2    for c in checkpoints:
3      velocity = normalize(position - c)
4      wait (distance(position, c) < 1m)
5      animation = look around
6      wait 3s
```

Idea

Specification of discrete dynamics

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

```
1  repeat
2    for c in checkpoints:
3      velocity = normalize(position - c)
4      wait (distance(position, c) < 1m)
5      animation = look around
6      wait 3s
```

Idea

- Now imagine the “big switch” to implement this

Abstraction mismatch

Abstraction mismatch

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Idea

- The description of these dymamics is usually difficult to find back in code
- In this translation we lose a lot of the original intention
- It is harder to maintain, extend, and experiment with code

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Existing solutions

Existing solutions

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Idea

- There are possible solutions (threads, strategy pattern, monadic coroutines, etc.)
- They all suffer from performance drawbacks, and have lots of hidden complexities

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Casanova as a first step towards a solution

Casanova as a first step towards a solution

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Idea

- We will now present Casanova, a domain specific language (DSL) for game development
- The language has time as a first class primitive
- All computations are specified as transformations of the state
- Continuous and discrete dynamics are both directly supported

Continuous dynamics

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

```
1  entity Asteroid = {
2    inherit UnityAsteroid
3    Velocity : Vector3
4
5    rule Position = Position + Velocity * dt
6
7    Create() =
8    {
9      Velocity      = new Vector3(...)
10     UnityAsteroid = UnityAsteroid.Instantiate(...)
11   }
12 }
```

Discrete dynamics

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

```
1  worldEntity World = {
2    inherit UnityBob
3
4    rule Velocity, CurrentAnimation =
5      for c in Checkpoints do
6        let dir0 = c - Position
7        yield dir0, BobAnimation.Walk
8        wait Vector3.Dot(dir0, c - Position) < 0.0f
9        yield Vector3.zero, BobAnimation.Idle
10       wait 1.0f
11
12   Create() =
13     {
14       UnityBob = UnityBob.Find()
15     }
16 }
```

Casanova as a first step towards a solution

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Ok, surely it does not work?

- We have been eating our own dog food quite extensively :)
- We have built a lot of samples and smaller games with Casanova

Casanova as a first step towards a solution

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Ok, surely it does not work?

- We have been eating our own dog food quite extensively :)
- We have built a lot of samples and smaller games with Casanova
- The good: quite simply, **it works**
- The bad: has a bit of a learning curve

Casanova as a first step towards a solution

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

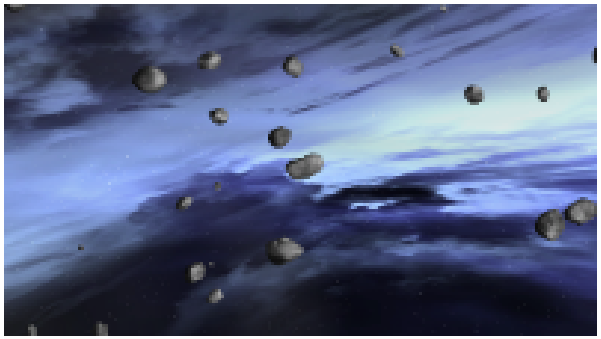
A brief introduction to game architectures

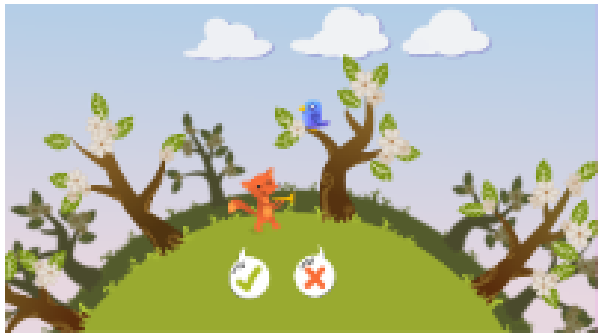
Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a





Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Conclusion

Conclusion

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

Lecture topics

- Game dynamics are hard to express
- By defining programming languages that support the building blocks of these dynamics, we can achieve higher productivity
- Games have a huge potential, and this way we hope to unlock it

This is it!

Casanova: a language for game development

Dr. Giuseppe Maggiore

Introduction

The relevance of games and beyond

A brief introduction to game architectures

Are we missing a language?

Abstraction mismatch

Existing solutions

Casanova as a first step towards a

The best of luck, and thanks for the attention!