

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

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

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

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 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 (billions 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

^aThere are many others!

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

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!

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

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

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

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 dynamics 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

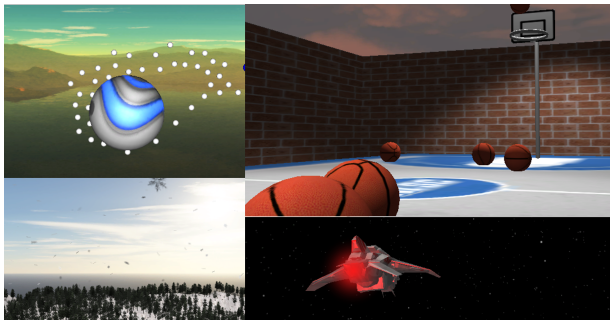
A brief
introduction
to game
architectures

Are we
missing a
language?

Abstraction
mismatch

Existing
solutions

Casanova as a
first step
towards a



Casanova 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



Demo

- www.youtube.com/watch?v=_dE3EQ_aPbE&sns=em

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

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

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
- Setup materials can be found at: <https://github.com/vs-team/casanova-mk2/wiki/Workshop>

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!