

The Challenge of Believability in Video Games: Definition, Agents' Models and Imitation Learning

Fabien TENCÉ, Cédric BUCHE, Pierre DE LOOR and Olivier MARC



1 March 2010

Introduction

Two ways to improve video games:

Introduction

Two ways to improve video games:

Graphics/sound



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Two ways to improve video games:

Graphics/sound



Content/interactions



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Two ways to improve video games:

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~Immersion

Content/interactions



~Presence

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Two ways to improve video games:

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~Immersion

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Goal: Improve presence with artificial characters

Plan

- 1 Believability
- 2 Agents' Models
- 3 Imitation Learning
- 4 Conclusion

Plan

- 1 **Believability**
 - Definition
 - Evaluation
- 2 Agents' Models
- 3 Imitation Learning
- 4 Conclusion

Believability: A Complex Notion from Arts. . .

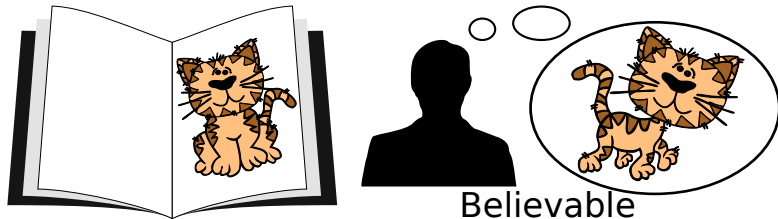
Believable Characters

Characters that achieve the “illusion of life” [Thomas 81].

Believability: A Complex Notion from Arts...

Believable Characters

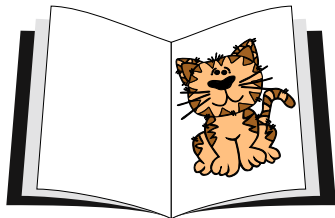
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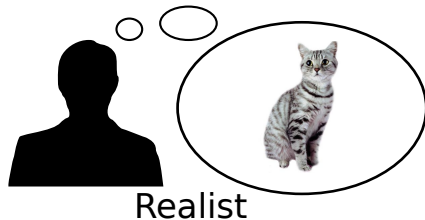
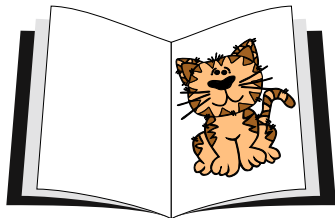
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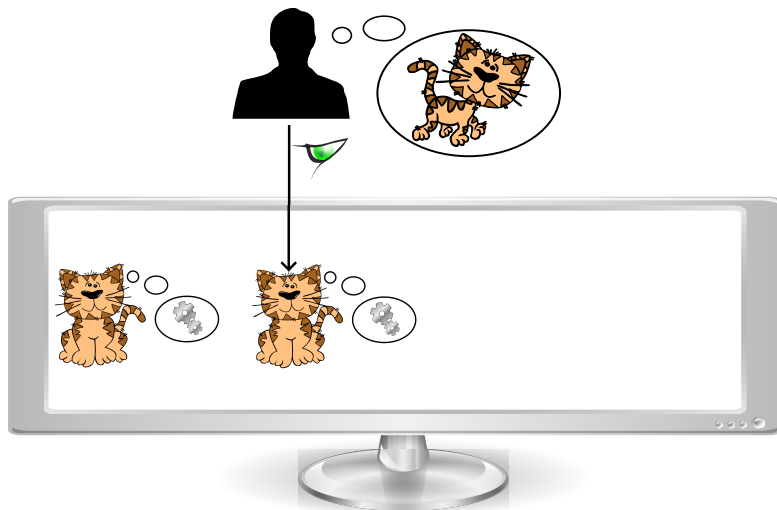


... Applied to Video Games

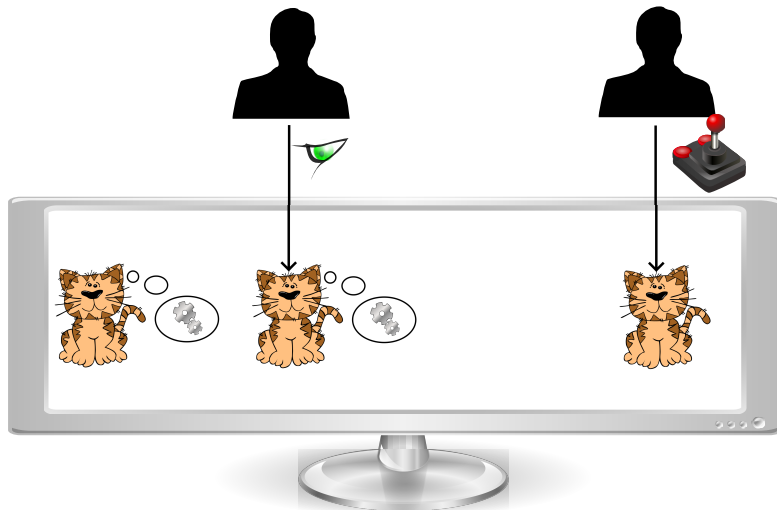


[Livingstone 06]

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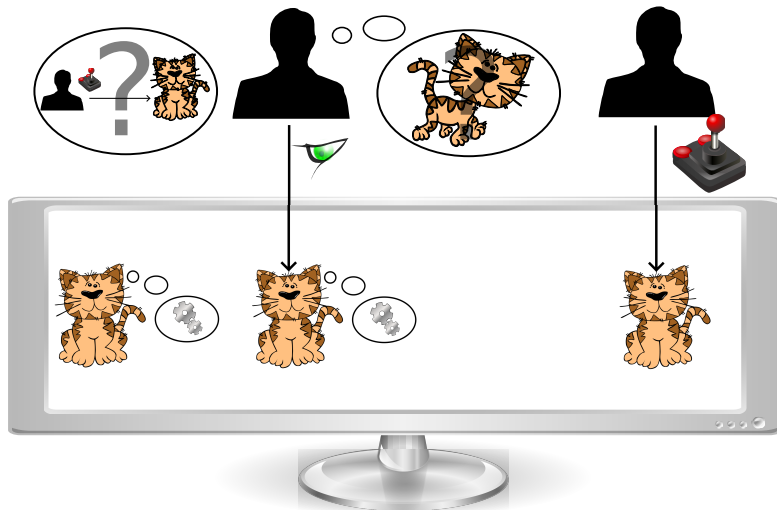


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Believability Definition

Believable Characters in Video Games

Characters giving the illusion that they are controlled by a living entity

Believability Definition

Believable Characters in Video Games

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Pro/Con:

- ✗ Reminds users that they are in a video game
- ✓ Agents are not tagged as being artificial

Evaluation of Believability

Parameters:

- Judges
- Experience
- Measures

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 - Level of experience [Bossard 09]
 - Cultural origin [Mac Namee 04]
 - Actors or spectators
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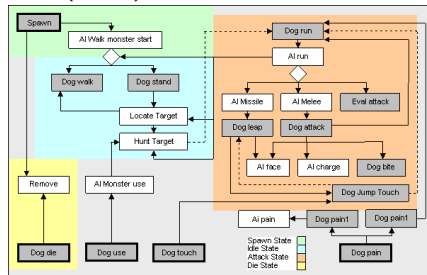
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 - Judges know who is human and who is not
- Measures
 - Questionnaire and/or body's response monitoring
 - Questions/Answers

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- 2 Agents' Models
 - In Industry
 - In Research
- 3 Imitation Learning
- 4 Conclusion

Commonly-Used Models in Industry

- Finite state machines (FSM)

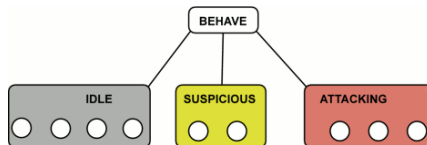


Commonly-Used Models in Industry

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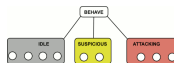


Commonly-Used Models in Industry

- Finite state machines (FSM)



- Behavior trees



- Planners [Orkin 06, Fikes 71]

State: (phone#, recipe, hungry?)

Goal: (-- , -- , **NO**)



Models for Believability

Main work:

- Embodied conversational agents [Cassell 01]
- The Oz project [Bates 92, Reilly 96, Loyall 97]
- Non-Player Characters [Mac Namee 04]
- Animated pedagogical agents [Lester 97]

Models for Believability

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Pro/Con:

- ✓ Could be used in adventure/role-playing video games
- ✗ Aim at the other definition of believability
- ✗ Not suited for games with a lot of action

Models for Believability in Action Games

Work for agents in first person shooters:

- Probabilistic model, whole behavior [Le Hy 04]
- Classifier Systems, whole behavior [Robert 05]
- Probabilistic model, move behavior [Gorman 06]
- Neural network, aiming/shooting/weapon [Gorman 07]

Models for Believability in Action Games

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Problems:

- Very hard to compare believability
- Models for whole behavior are rare

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- 3 Imitation Learning**
 - Definition and Advantages
 - Application to Machine Learning
- 4 Conclusion

Definition and Advantages

Imitation Learning

Increased tendency to execute a previously demonstrated behavior.

Definition and Advantages

Imitation Learning

Increased tendency to execute a previously demonstrated behavior.

Advantages:

- May improve believability [Schaal 99]
- Make character design possible for non-programmers
- Mostly used in robotics, application to video games possible

Imitation is Complex

“Fitness function”:

- Believability

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Over-learning and Over-generalization :

- An agent is not a film
- But it should copy the behavior

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Additional constraints:

- Fast and online learning can enhance believability
- Can handle a lot a examples (MMO)

Work Using Imitation Learning

Algorithms to learn by imitation:

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- [Rao 04] used by [Gorman 06]
 - Based on Metzoff's work

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Imitation learning for those models:

- Increase believability
- Simplify the parametrization

Outlook

Next steps:

- 1 Define a believability evaluation for first person shooters
- 2 Find/Develop models that can generate believable behaviour
- 3 Use imitation learning to learn the parameters
- 4 Compare the models

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