

Experience-Driven Procedural Content Generation

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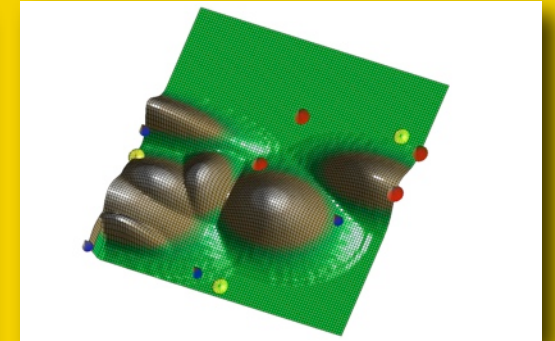
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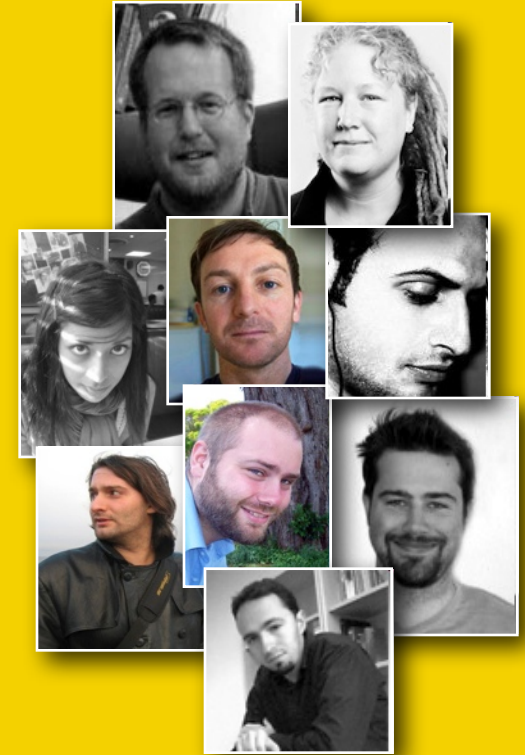
IT University of Copenhagen (ITU)

Denmark



Center for Computer Games Research @ ITU

- <http://game.itu.dk>
- Established in 2003
- 7 Faculty, 6 PhD students
- Research Areas:
 - Humanities/Arts/Social Sciences:
Game Theory, Game Design and Analysis
 - Technology/Computing:
AI, Usability, Player Experience,
Cognitive/Affective Modeling



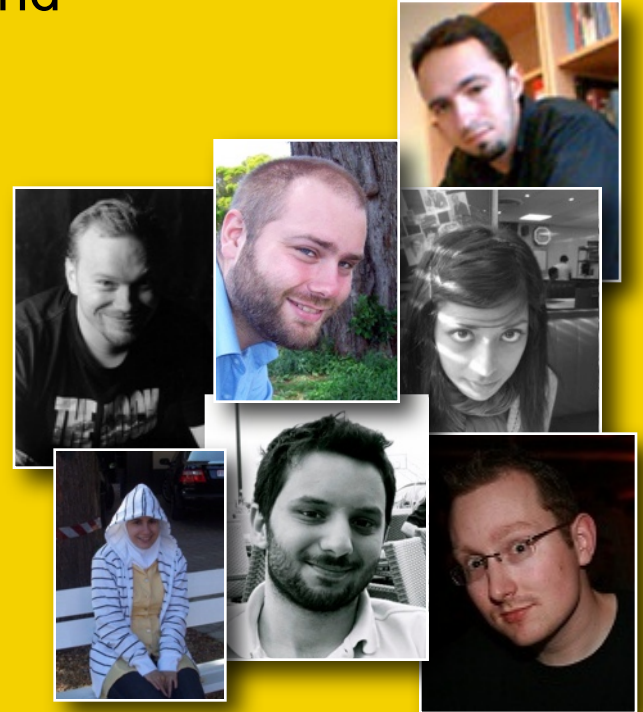
Game AI/Technology SIG

Specialization in Artificial Intelligence and Game technology

- Games and Entertainment
 - Personalization
 - Adaptation
 - Procedural Content Generation
- Games and HealthCare
 - Exertainment, Wiihabilitation
- Games and Education
 - Serious games for conflict resolution

Technology

User/Player Modeling, Real-Time Adaptation, Multimodal Interaction

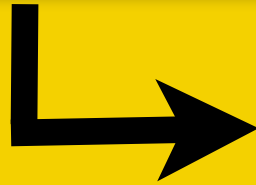


Today's Presentation

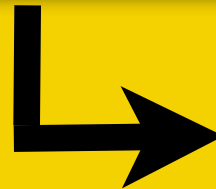
- Introduction to
 - Player Experience Modeling
 - Procedural Content Creation/Generation
 - Their relation: EDPCG
- Showcased via dissimilar case-studies
 - Entertainment, Health Care, Education

Core Idea of EDPCG

Capture player
experience



Model the effect
of game content



Optimize player
experience

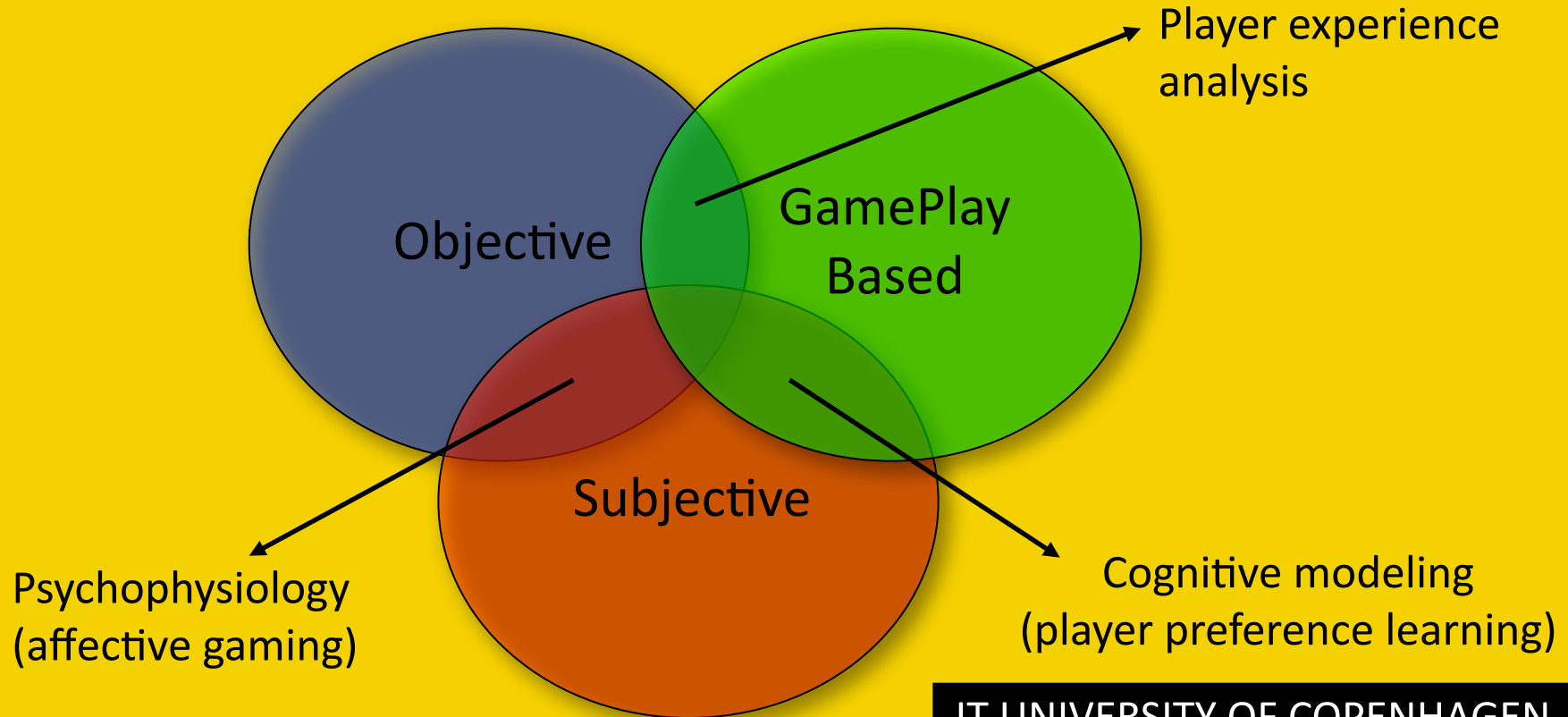
Research questions of EDPCG

- How to capture **Player Experience**?
- How to represent **content**?
- How to evaluate the **quality** of content?
- How to **optimize** game content for Player Experience?

How to Capture Player Experience

- **Subjectively**
 - Asking players: self-report questionnaires (ranking, preferences)
 - **Pros:** subjective self-reported notions of emotional states
 - **Cons:** memory dependent, noisy, post-experience, intrusive
- **Objectively**
 - Physiology (GCR, EEG, EMG, BVP,...); eye-tracking; facial expression; speech
 - **Pros:** reliable measures of user experience
 - **Cons:** noisy; technically non plausible; games have a particular impact on physiology and facial expression; verbal cues are rare; based on annotation of other players
- **GamePlay-Based**
 - Player game preferences (what players do relates to their experience)
 - **Pros:** real-time efficiency, not intrusive
 - **Cons:** strong assumption about similarity of people, limitations in available information

Player Experience Modeling (PEM)



Game Content

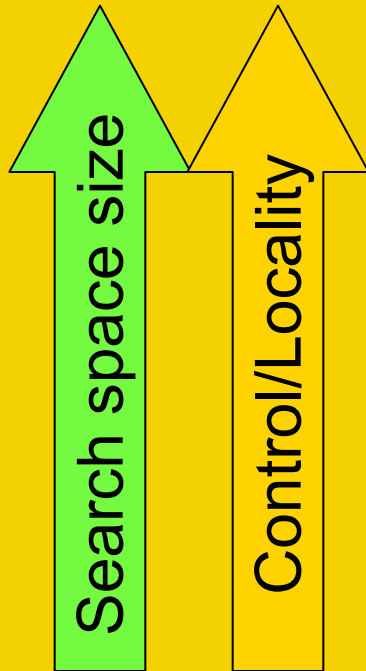
Building blocks of a Game (and Player Experience)

- NPC behavior
- Quest/story
- Camera parameters/settings
- Audio settings
- Levels, maps, tracks
- Game mechanics, game design
- Graphics/textures

We need (ED)PCG to...

- Automate game design and testing processes
- Design new games
- Tailor player experience

Representing Content (e.g. Dungeon Map)



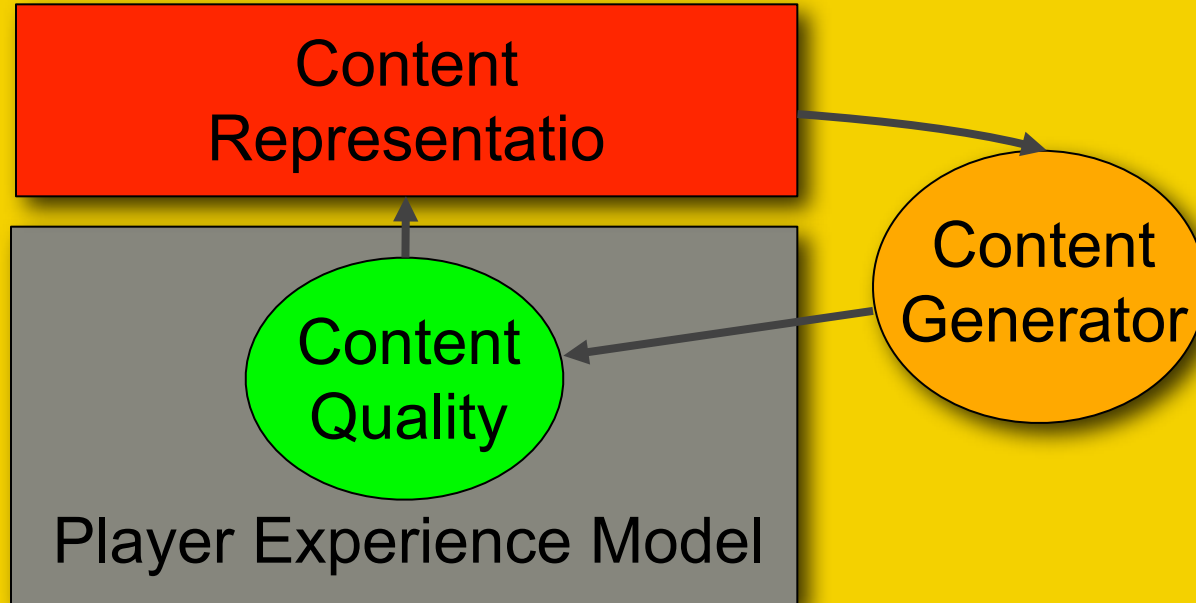
- Directly: grid
- More indirectly: position and orientation of walls
- Even more indirectly: patterns of walls and floor
- Very Indirectly: number of rooms and doors
- Indirectly: random seed

How to Evaluate Content Quality

- **Direct utility/fitness**
 - A direct mapping between content and quality; e.g. number of jumps in a platform game
 - Theory-driven vs. data-driven
- **Simulation-based**
 - An AI agent (human-like?) plays the game for a while and content is evaluated through playing style
 - Static (no learnability) vs. dynamic (content quality fluctuates)
- **Interactive fitness**
 - Real-time evaluation via a player or players
 - Implicit (self-reports, verbal cues) vs. explicit (e.g. picking up weapons)

How to optimize Content for Player Experience

- Search for **good** content in the solution space
 - Exhaustive search, gradient search, stochastic (genetic) search, Monte Carlo,...
 - Representation and search space size dependent



Ongoing Projects – Games & Entertainment

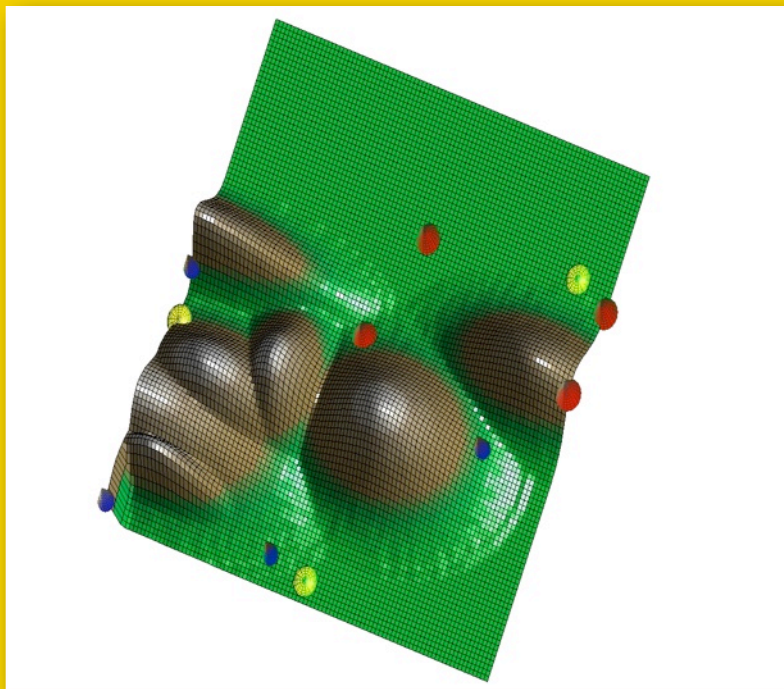
Player Modeling – Tomb Raider Underworld

- Over 1 million player data
 - EIDOS servers
- Player Modeling via self-organization
- Game design
 - Testing and postmortem
 - Is game played as intended
- Tailor player experience



Procedural Map Generation: Multi-Objective Evolution

Pilot RTS Maps



StarCraft Maps



J. Togelius, M. Press, N. Baume, S. Wessing, J. Hagelback, and G. N. Yannakakis.,
Multiobjective Exploration of the StarCraft Map Space, *IEEE CIG*, 2010

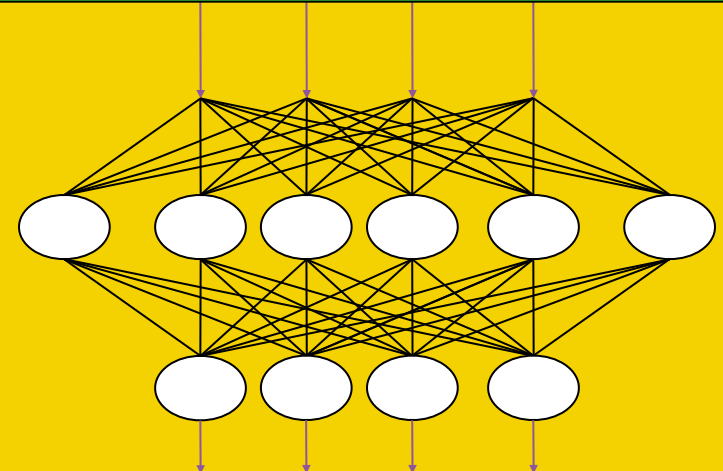
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Emotionally Adaptive Camera

- 36 subjects
- Player Experience model accuracy:
 - 76-88% (3-fold CV)



Camera controls, physiological signals,
Player behavior



Player Experience
(fun, frustration, anxiety, ...)

M. Schwartz, H. P. Martinez, G. N. Yannakakis, and A. Jhala, **Investigating the Interplay between Camera Viewpoints, Game Information, and Challenge** in Proc. of AIIDE, 2009

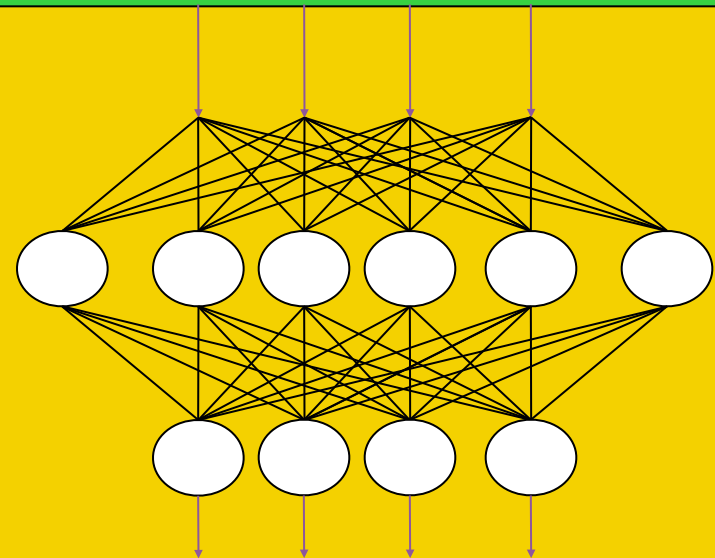
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Mario Bros – Adaptive Content Creation

- 240 subjects (960 games)
- Player Experience model accuracy:
 - **73-92%** (3-fold CV)



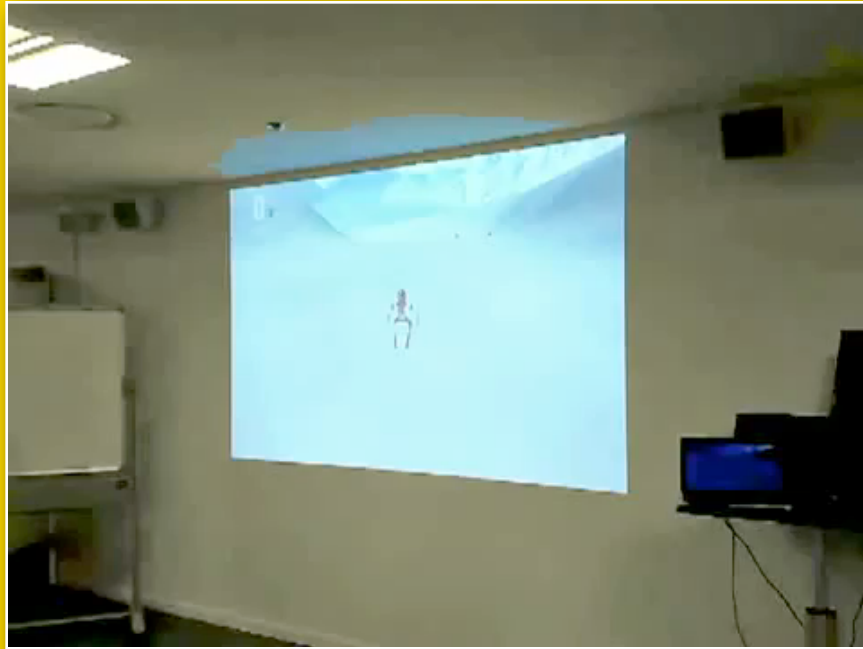
Level features and rules, playing behavior



Player Experience
(fun, frustration, anxiety, ...)

Games and HealthCare

Wiihabilitation



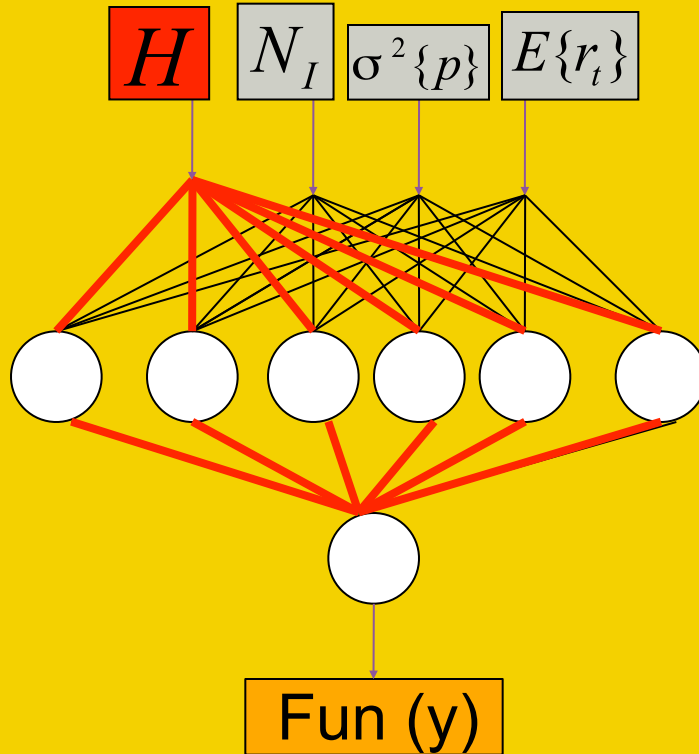
- Difficulty adjustment
- Content = gates
- Content evaluation - player performance

D. Dimovska, P. Jarnfelt and S. Selvig, G. N. Yannakakis, **Towards Procedural Level Generation for Rehabilitation**, in *Proc. of FDG, 2010*

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Physical Interactive Games

Game Adaptation for maximizing fun



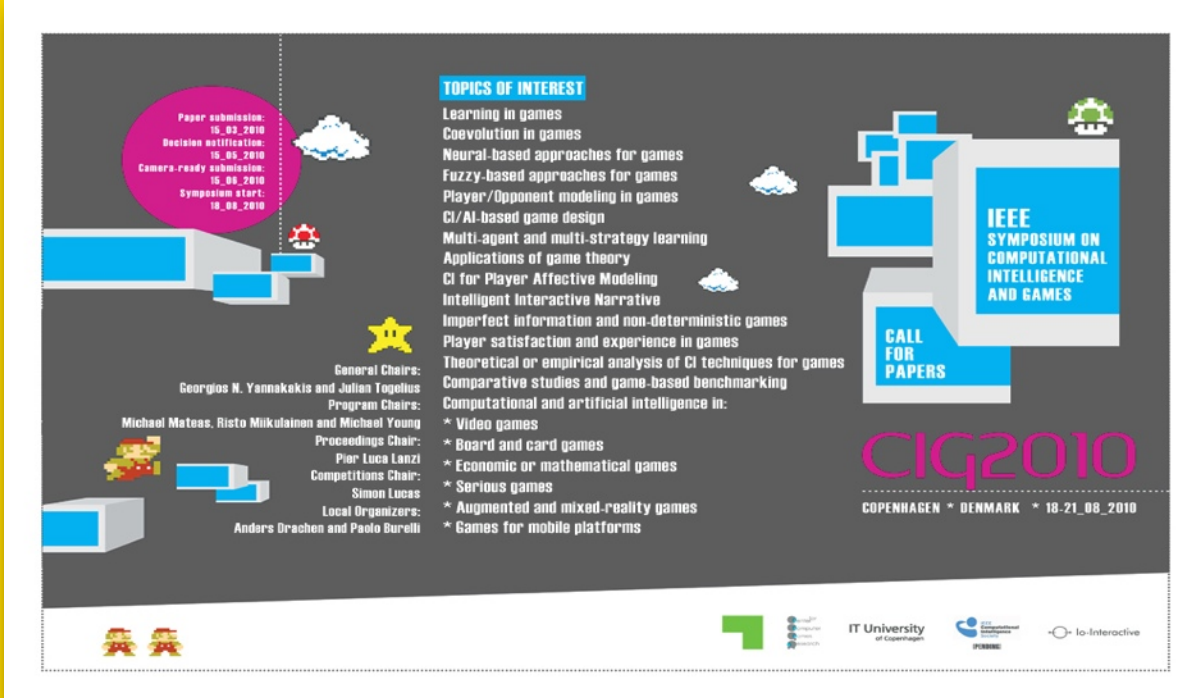
Games and Education

Serious/Pervasive Games for Conflict Resolution

- Design games for teaching social skills in schools
- User (cognitive, affective) modeling
 - User preferences
 - Natural interaction (face, speech)
- Adaptive quest generation of co-op puzzle games
- EU funded project: “SIREN”



2010 IEEE CIG – ITU, August, 2010



The poster is a call for papers for the IEEE Symposium on Computational Intelligence and Games (CIG2010). It features a dark grey background with blue and white geometric shapes, including a staircase on the left and a large blue box on the right. The text is organized into several sections: submission deadlines, topics of interest, chairs, and event details. The IEEE logo is in the top right, and the CIG2010 logo is in the bottom right. Logos for IT University of Copenhagen, PERMIS, and Io-Interactive are at the bottom.

Paper submission: 15. 03. 2010
Decision notification: 15. 05. 2010
Camera-ready submission: 15. 06. 2010
Symposium start: 18. 08. 2010

TOPICS OF INTEREST

- Learning in games
- Coevolution in games
- Neural-based approaches for games
- Fuzzy-based approaches for games
- Player/Opponent modeling in games
- CI/AI-based game design
- Multi-agent and multi-strategy learning
- Applications of game theory
- CI for Player Affective Modeling
- Intelligent Interactive Narrative
- Imperfect information and non-deterministic games
- Player satisfaction and experience in games
- Theoretical or empirical analysis of CI techniques for games
- Comparative studies and game-based benchmarking
- Computational and artificial intelligence in:
 - * Video games
 - * Board and card games
 - * Economic or mathematical games
 - * Serious games
 - * Augmented and mixed-reality games
 - * Games for mobile platforms

General Chairs:
Georgios N. Yannakakis and Julian Togelius

Program Chairs:
Michael Mateas, Risto Miikulaimon and Michael Young

Proceedings Chair:
Pier Luca Lanzi

Competitions Chair:
Simon Lucas

Local Organizers:
Anders Drachen and Paolo Burelli

IEEE SYMPOSIUM ON COMPUTATIONAL INTELLIGENCE AND GAMES

CALL FOR PAPERS

CIG2010

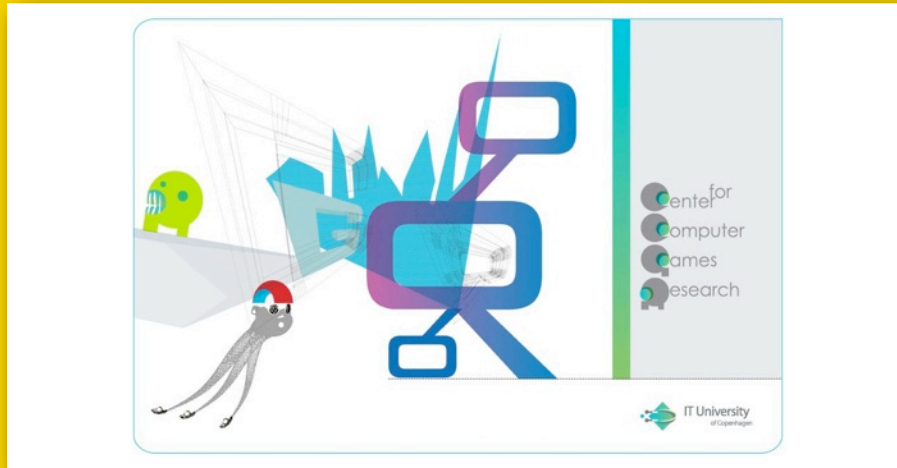
COPENHAGEN * DENMARK * 18-21. 08. 2010

IT University of Copenhagen, PERMIS, Io-Interactive

First ever PCG competition: Level generation in Mario Bros

Further Information

game.itu.dk



gameAI.itu.dk

