AIIDE'08

Artificial Intelligence for
Interactive Media and Games

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Artificial Intelligence and
Interactive Digital
Entertainment Conference

2008

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Stanford University
Stanford, California, USA

Mission Statement

AIIDE is the definitive point of interaction between entertainment software developers interested in AI and academic and industrial AI researchers. Sponsored by the Association for the Advancement of Artificial Intelligence (AAAI), the conference is targeted at both the research and commercial communities, promoting AI research and practice in the context of interactive digital entertainment systems with an emphasis on commercial computer and video games.

By the Numbers

- 3 days
- about 130 attendees
  - about 80% academic, 20% industry [guessing]
- 26 papers presented
  - 23 academic, 3 industry
- 8 technical sessions
- 1 panel (mixed)
- 5 invited talks
  - 1 academic, 4 industry
- 7 poster/demos (all academic)

Technical Sessions

1. Applications of Reinforcement Learning
2. Singular Techniques
3. Planning for Actions, Story and Design
4. Social Intelligence
5. Stochastic and Evolutionary Approaches
6. Hierarchical Models for Behavior and Plot
7. Robustness and New Capabilities from Reasoning
8. Unconventional Pathfinding Applications & Approaches

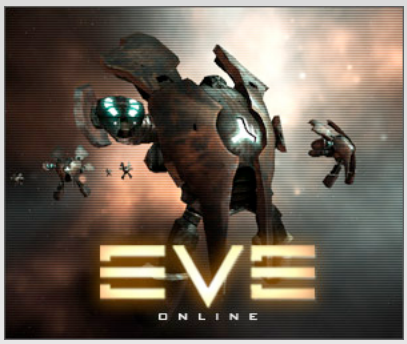
1. Applications of Reinforcement Learning

Intelligent Trading Agents for Massively Multi-player Game Economies

- J. Reeder, U. Central Florida
- G. Sukthankar, U. Central Florida
- M. Georgiopoulos, U. Central Florida
- G. Anagnostopoulos, Florida Inst. of Technology

Intelligent Trading Agents...

- *Goal:* create intelligent trading agents for virtual markets
- *Example:* Eve Online
  - 220,000 active players
  - 460,000 player characters
  - trading billions of units per month



Intelligent Trading Agents...

- Roles for autonomous trading agents in MMORPG marketplaces
  - provide liquidity for human players in less active markets (cf. Wall Street)
  - mechanism for game designers to manage markets (e.g., deflate prices)

Intelligent Trading Agents...

- focus on the problem of creating agents with good "financial tactics" in buying and selling
- show that a reinforcement learning approach based on the market microstructure can give a trading agent a competitive advantage in amassing wealth over standard fixed policies.
- also need to protect agents from player exploitation (the introduction of easily duped trading agents in the virtual market would create an easy avenue for smart players to cheaply acquire rare items
- imbuing agents with the ability to learn trading policies from recent historical data will make them potentially more resistant to predatory trading practices.

Intelligent Trading Agents...

Table 1: Agent trading options (ISK: EVE Currency)

Agent Action	Description
0	Do Nothing
1	Bid 10% lower than the current Best Bid
2	Bid 1 ISK below the current Best Bid
3	Bid 1 ISK above the current Best Bid
4	Bid 10% higher than the current Best Bid
5	Place a Market Buy order

agent trains on recent market data to learn optimal trading strategy

Intelligent Training Agents...

Table 2: Average normalized cost for all buying and selling policies.

Item	OBS	IMB0	SV	RL (best)	VWAP	SMO	UFMO	LMMO
Buying								
Carbon Polymers	0	0	1	**-0.028504579**	0.082028063	0.14643748	0.158661913	0.133918673
Ceramic Powder	1	0	0	**0.002357998**	0.094899403	0.145539648	0.15691056	0.127830972
Crystallite Alloy	1	0	0	**0.159725478**	0.201720732	0.219629257	0.228338457	0.222763274
Fernite Alloy	1	0	1	**0.109048314**	0.145763227	0.165234565	0.16647955	0.167223286
Hexite	0	1	0	**-0.00674535**	0.052654967	0.102081265	0.102325669	0.096176695
Platinum Technite	1	0	0	**0.026604871**	0.053103663	0.066995723	0.065303677	0.066490438
Rolled Tungsten	0	0	1	**0.109001374**	0.213010068	0.250940359	0.261046177	0.248051276
Silicon Diborite	1	0	0	**0.14209394**	0.293296089	0.396878418	0.368555284	0.398358207
Sulfuric Acid	1	0	1	**0.035423585**	0.086367207	0.108323317	0.111466645	0.102229287
Titanium Chromide	0	0	1	**0.03438384**	0.066614538	0.080647685	0.0836483741	0.076908795
Selling								
Crystalline Carbonide	0	0	0	**-0.042070845**	-0.031703087	0.059422992	0.058534444	0.058171544
Fernite Carbide	1	0	0	**-0.022444448**	-0.008468892	0.037583333	0.03736483	0.039398718
Fullerides	0	0	0	**-0.025773631**	-0.021543334	0.032569338	0.029058182	0.03510464
Sylramic Fibers	0	0	0	**-0.03238247**	-0.030585387	0.04085	0.044264554	0.0448763
Titanium Carbide	1	1	0	**-0.030455756**	-0.020375989	0.041083696	0.04590129	0.035326763
Tungsten Carbide	1	0	0	**-0.03466989**	-0.003565254	0.05535917	0.055273444	0.054097885

2. Singular Techniques

Lightweight Procedural Animation with Believable Physical Interactions

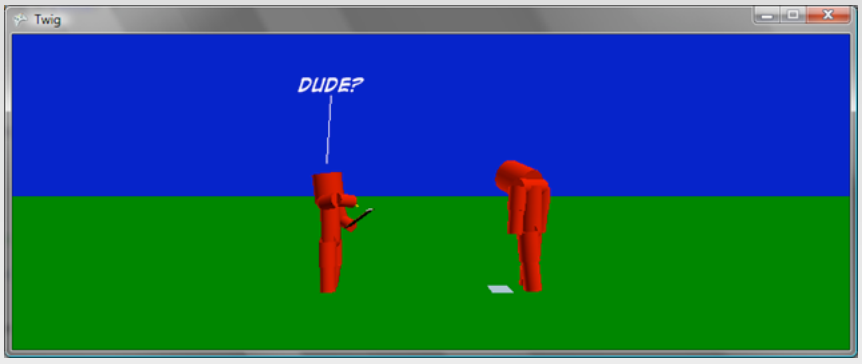
- Ian Horswill, Northwestern University

twig

- Library for
  - Procedural animation
  - Simple physics
- Intended for interactive narrative
  - Fast
  - AI-friendly
  - Supports scripting, running as a server, or direct authoring of behaviors
- Work in progress
- Open source
  - Runs under XNA
  - Ought to run on Xbox (not tested)
- Two applications
  - Simulation of Ainsworth's "safe home base" phenomenon
  - Webcomic

Lightweight Procedural Animation...

- http://twigblog.wordpress.com



Lightweight Procedural Animation

script fragment

```
Bryan: say "They're doing medical experiments on us?" Michael
Bryan: hold script
Bryan: goto camera 3.6 &
Bryan: say "You bastards!" camera
Michael: goto Bryan 0.25 (-1 0 0) &
Thug: goto Bryan 0.5 (0 0 0) &
Michael: say "Quiet!" Bryan
Michael: say "They'll hear you!" Bryan
Bryan: say "I'm not some lab animal!" Michael
Thug: say "I'm with AAAI.\nCome with me" Bryan
Bryan: lookat Thug
Bryan: say "I know my rights!" Thug
Bryan: say "IRB would never sign off on this!" Michael
Thug: hold Bryan
Michael: say "It's run by Alberto Gonzales now." Bryan &
Bryan: fight Thug
pause 0.5
Bryan: say "Widgets of the world unite!" Thug
Thug: goto offstage &
Bryan: drop script
Bryan: "Soylent green!\nIt's made out of pixels!" Bryan
titles: fadetoblack 2
```


3. Planning for Actions, Story and Design

Simulation-Based Story Generation with a Theory of Mind

- H. Chang & V. Soo, National Tsing Hua University, Taiwan

Simulation-Based Story Generation...

- *Goal:* "Emergent narrative", i.e., stories emerge from autonomous interactions among NPC's and/or player
- *Challenge:* How to guide narrative to be interesting

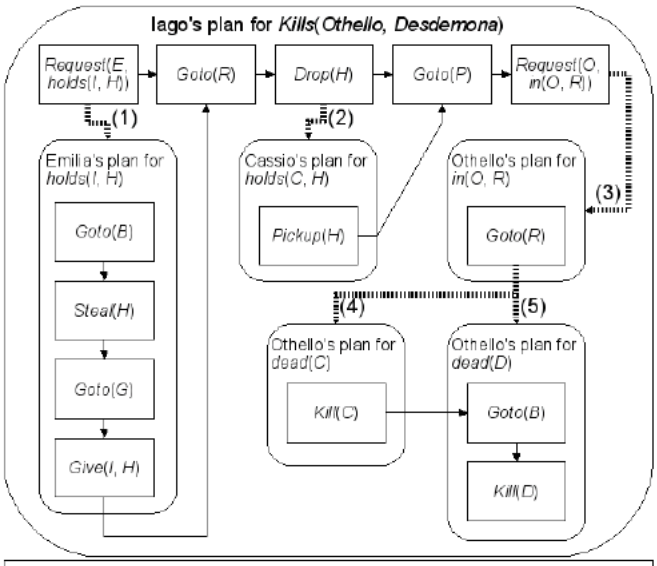


Figure 1: Schematization of Iago's social plan.

Table 1: Belief revision/motivation rules for the *Othello* scenario.

Source	Motivational Rules
Personal motive	**Greed**: $self(?s) \wedge at(?s, ?l) \wedge at(?o, ?l) \wedge precious(?o) \rightarrow holds(?s, ?o)$
	Curiosity: $self(?s) \wedge befriends(?s, ?a) \wedge request(?a, ?s, at(?s, ?l)) \rightarrow at(?s, ?l)$
Emotion	**Jealousy**: $self(?s) \wedge loves(?s, ?a) \wedge loves(?a, ?b) \rightarrow dead(?a) \wedge dead(?b)$
Social disposition	**Obedience**: $self(?s) \wedge loves(?s, ?a) \wedge request(?a, ?s, holds(?a, ?o)) \rightarrow holds(?a, ?o)$
Belief Revision Rules	
Folk psychology: $isGiftFrom(?g, ?a) \wedge isGiftTo(?g, ?b) \wedge holds(?c, ?g) \wedge ((woman(?b) \wedge man(?c)) \vee (man(?b) \wedge woman(?c)) \rightarrow \neg loves(?b, ?a) \wedge loves(?b, ?c)$	

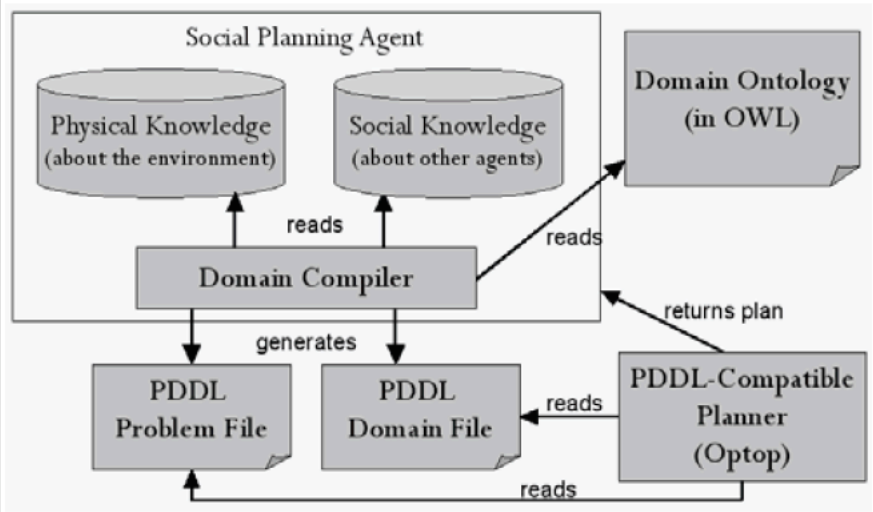


Figure 2: Architecture of the social planning agent.

Simulation-Based Story Generation...

- "our main concern is whether the system can generate new stories"

4. Social Intelligence

Otello: A Next-Generation Reputation System for Humans and NPCs

- M. Sellers, Online Alchemy, Inc.

Next-Generation Reputation System...

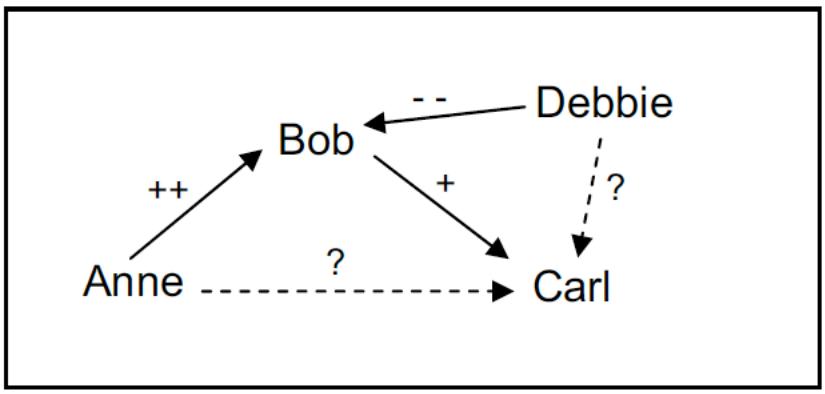


Figure 1: Anne does not know Carl, so his reputation with her comes through Bob. Debbie does not trust Bob, so his opinion of Carl does not matter to her.

Next-Generation Reputation System...

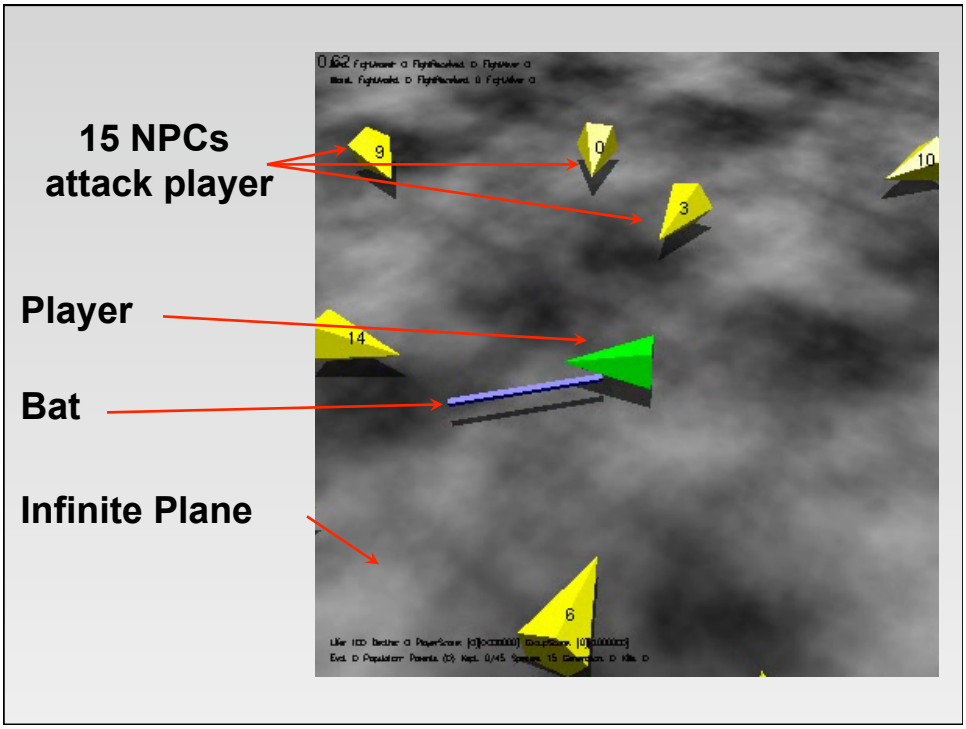
- as more games merge into online social spaces, reputation systems are becoming increasingly important to players looking for gaming partners
- also new gameplay ideas
  - compete on who is more respected, more loved, or more feared
  - reward players who fill social roles, such as being reputation “hub”, etc.

5. Stochastic and Evolutionary Approaches

- Constructing Complex NPC Behavior via Multi-Objective Neuroevolution
  - J. Schrum & R. Mukkulainen, U. Texas Austin

Constructing Complex NPC Behavior...

- *Goal:* Discover NPC behavior automatically
- *Benefits:*
  - save production time/effort
  - learn counterintuitive behaviors
  - find weaknesses in static scripts
  - tailor behavior to human plays



6. Hierarchical Models for Behavior and Plot

Hierarchical Petri Nets for Story Plots Featuring Virtual Humans

- D. Balas, C. Brown, A. Abonyi & J. Gemrot, Charles U. in Prague

Hierarchical Petri Nets...

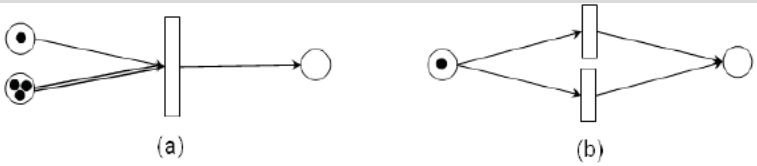


Fig. 2. Petri Nets examples. a) The action generates one token if there is one token in the upper container and two in the lower container. b) The two actions are in conflict. Had there been two tokens in the container, the actions could run in parallel.

Hierarchical Petri Nets

- formal and graphical (intelligible, like FSM's)
- story plots can be branching
- episodes can happen *in parallel*
- can be hierarchical

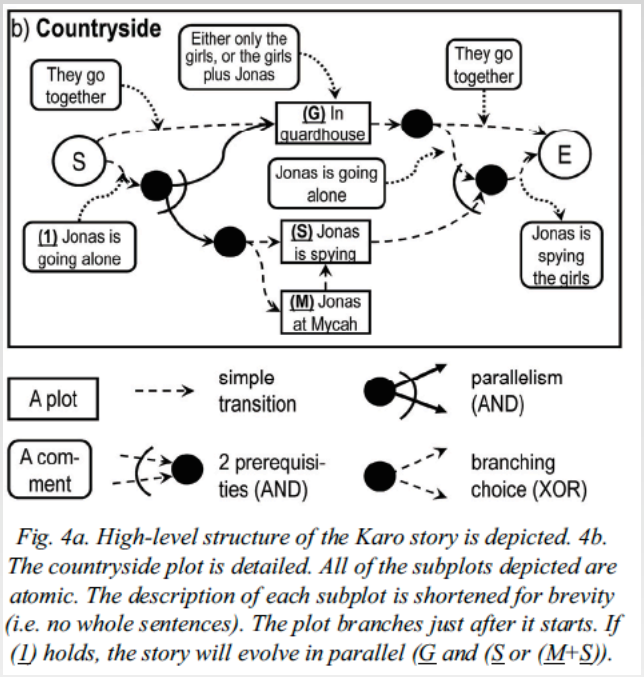


Fig. 4a. High-level structure of the Karo story is depicted. 4b. The countryside plot is detailed. All of the subplots depicted are atomic. The description of each subplot is shortened for brevity (i.e. no whole sentences). The plot branches just after it starts. If (1) holds, the story will evolve in parallel (G and (S or (M+S)).

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7. Robustness and New Capabilities from Reasoning

Recombinable Game Mechanics for Automated Design Support

- M. Nelson, Georgia Inst. of Technology
- M. Mateas, U. California Santa Cruz

Recombinable Game Mechanics...

- GameMaker and Alice provide support for novices to *implement* games
- How about a similar approach for *designing game mechanics*?

Recombinable Game Mechanics...

- Factor game design into four areas
  - *abstract mechanics:* state and state evolution
  - *concrete representation:* audiovisual realization of game state
  - *thematic content:* real-world references a game makes
  - *control mappings:* how player interacts with game
- Library of combinable components at all levels

```
(defmechanic 'single-use-item
  "Using ?item makes it disappear from inventory."
  :vocab 'inventory
  :template-vars '((item ?item))
  :axioms
    '((Implies (Happens (UseOn ?item object) time)
               (Happens (Lose ?item) time))))

(defmechanic 'move-up
  "Event ?event moves sprite ?sprite up a tile."
  :vocab 'tile-world
  :template-vars '((event ?event)
                   (sprite ?sprite))
  :axioms
    '((Implies
        (And (HoldsAt (At ?sprite x y) time)
             (Happens ?event time))
        (And (Initiates (At ?sprite x (- y 1)) time)
             (Terminates (At ?sprite x y) time)))))
```


8. Unconventional Pathfinding Applications and Approaches

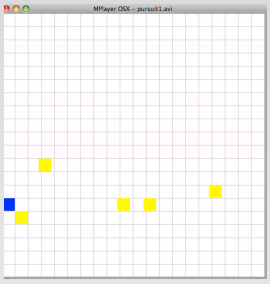
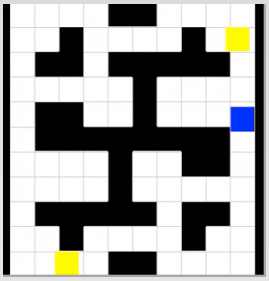
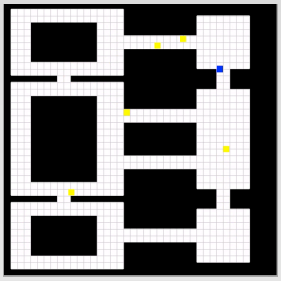
A Cover-Based Approach to Multi-Agent Moving Target Pursuit

- A. Isaza, J. Lu, V. Bulitko & R. Greiner, U. Alberta

A Cover-Based Approach...

- *Goal:* an efficient multi-agent system (algorithm) that is capable of capturing a single moving target
- *Challenge:* to coordinate multiple pursuers
- *Solution:* an elegant uniform algorithm based on “cover sets”

A Cover-Based Approach...

Panels & Invited Talks

- Realistic Human Characters
  - Chris Darken, Naval Postgraduate School
  - Richard Evans, EA/Maxis
  - Borut Pfeifer, EA Los Angeles
  - Michael Mateas, UC Santa Cruz
- Experiments in Musical Intelligence
  - David Cope, UC Santa Cruz
- The AI of Spore
  - Eric Grundstrom, EA/Maxis

Invited Talks

- Halo 3 Objective Trees: A Declarative Approach to Multiagent Coordination
  - Damian Isla, Bungie Studios
- The Past, Present and Future of Game AI
  - Steve Rabin, Nintendo of America
- Performing Intent
  - Doug Church, EA Los Angeles
  - Borut Pfeifer, EA Los Angeles

Questions? Comments?