AIIDE 2014

Artificial Intelligence for
Interactive Media and Games

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Artificial Intelligence and
Interactive Digital
Entertainment Conference

2014

October 3-7, 2014
North Carolina State University
Raleigh, North Carolina, USA

http://www.aiide.org

Proceedings online at: http://www.aaai.org/Library/AIIDE

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
- 120-150 attendees (typically 85% academic, 15% industry)
- 14 papers presented (12 university / 2 joint w. same game co)
- 6 technical sessions
- 4 invited talks (2 industry / 2 academia)
- 15 posters
- 7 “playable experiences” demos
- 5 workshops (immediately before main conference)
- 1 StarCraft AI competition (before conference)

Workshops

1. 3rd Workshop on Games and Natural Language Processing (GAMNLP-14) [full day]
   - NL generation: of speech... to narrative structure
   - NL understanding: of speech... to words... to conversations
2. AI in the Adversarial Real-Time Games Development Process [full day]
   - heavily algorithmic
   - search, optimization, etc.
   - StarCraft

Workshops

3. First Diversity in Games Research Workshop
   - encourage students from under-represented groups to engage in graduate training games research
   - with support from:
     – CRA Committee on the Status of Women in Computing Research
     – Coalition to Diversity Computing
4. Experimental AI in Games Workshop
   - bunch of stuff not yet ready for “prime time”
   - using web search as a game mechanic
   - generating games using crowd sourcing

Workshops

5. 3rd International Workshop on Musical Metacreation
   - computer programs that write music
   - human/computer collaborative performances
   - games that create or modify music

Technical Sessions

1. Human Modeling
2. Procedural Content Generation
3. Strategy AI
4. Narrative
5. NPC Behavior
6. Gameplay Analytics

1. Human Modeling

Toward Personalised Gaming via
Facial Expression Recognition

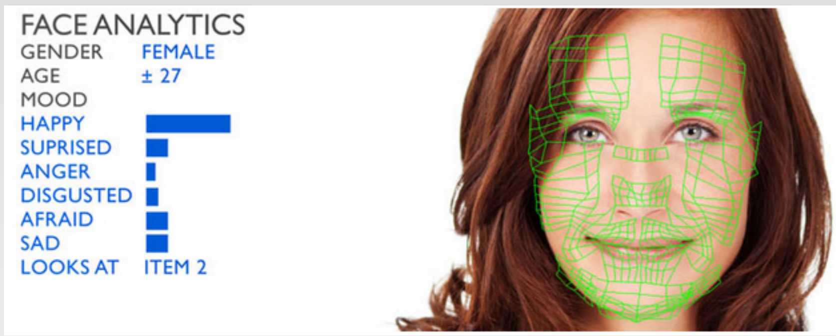
- Pars Blom, Sander Bakkes, Shimon Whiteson, Diederik Roijers, Robert Valenti, Theo Gevers, Intelligent Systems Lab, U. Amsterdam
- Check Tan, U. of Technology, Games Studio, Sydney, Australia

Personalisation via Facial Expressions

- personalization of level difficulty is standard:
  - novice
  - intermediate
  - expert, etc.
- but usually interact with player to select difficulty *before* game begins or *between* levels
- because it would be too disruptive to interrupt player during play
- but, could we do this ***dynamically*** and ***unobtrusively***?

Personalisation via Facial Expressions

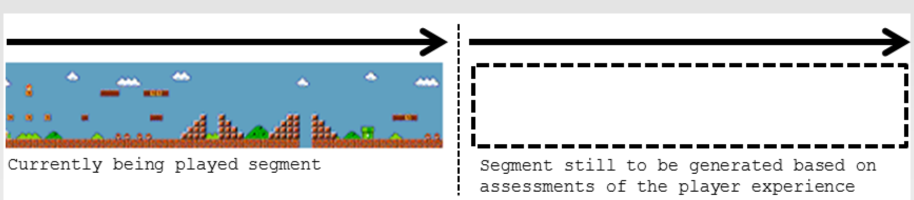
- off-the-shelf facial expression recognition software: INSIGHT (sightcorp.com)



Personalisation via Facial Expressions

INFINITE MARIO BROS

- open-source clone of classic game
- procedurally generated levels and dynamically added segments



Personalisation via Facial Expressions

Algorithm 1 Facial Expression-based Gradient Ascent Optimisation

procedure GAOPTIMIZE(e_t, e_{t-1}) ▷ Emotion vectors of current and previous segment
  $\alpha \leftarrow 5 * (1 - Var(e_1))$ ▷ Calculate α, scale to action space
  for $each : chunk$ **do**
    if playerDies(t) **then**
      $\phi = round(5 * \alpha * e_t[Anger])$
      $chunk.decreaseChallengeLevel(\phi)$
    else if segmentFinished(t) **then**
      if $e_t[Neutral] <= 0.8 * \alpha$ **then**
        $chunk.decreaseChallengeLevel(1)$
      else
        $\epsilon \leftarrow argmax_e|e_t - e_{t-1}|$
        $nextAction \leftarrow round(\epsilon * \alpha)$
        if $e \in \{angry, neutral\}$ **then**
          $nextAction \leftarrow -nextAction$
        $nextChallengeLevel \leftarrow previousChallengeLevel + nextAction$
        return $newChallengeLevel$

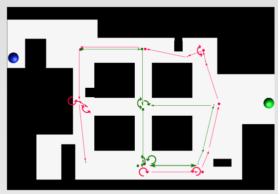
Personalisation via Facial Expressions

- pilot user study with 10 participants:
  - P = personalized system preferred
  - S = static perferred
  - B = both preferred equally
  - N = neither preferred
- Next step?
  - more accuracy
  - other inputs
    - gaze
    - body
    - ...

Participant	Easy	Normal	Hard
1	P	P	S
2	P	P	N
3	S	P	P
4	P	P	N
5	P	P	P
6	P	P	S
7	P	S	S
8	S	S	N
9	P	S	P
10	S	P	P
Totals	**70% P**	**70% P**	**40% P**
	30% S	30% S	30% S
	0% B	0% B	0% B
	0% N	0% N	30% N

2. Procedural Content Generation

Generative Methods for Guard and Camera Placement in Stealth Games



- Qihan Xu, Jonathan Tremblay, Clark Verbrugge
  School of Computer Science, McGill U., Montreal, Quebec, Canada

Guard and Camera Placement

- Stealth Games
  - e.g., *Mark of the Ninja, Metal Gear Solid*
  - more puzzle than combat
  - ***placement*** of guards (NPCs) and cameras greatly affects challenge
  - a lot of effort to design levels that are believable and challenging
  - can we automate this placement?

Guard and Camera Placement

Contributions (quoting authors):

- A heuristic approach to camera placement based on weakening a solution to the well known "art gallery problem" for simple polygons.
- The design of a flexible, grammar-based method for defining roadmap-based guard patrol routes.
- Application of quantitative metrics that demonstrate how different parametrizations affect the existence of level solutions and player perception of difficulty.

Guard and Camera Placement

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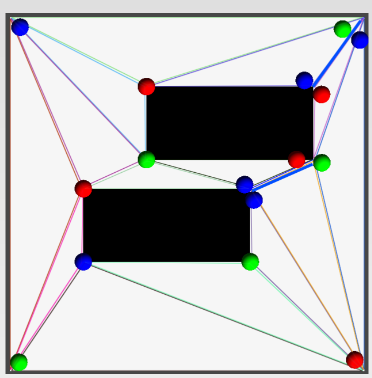

Guard and Camera Placement

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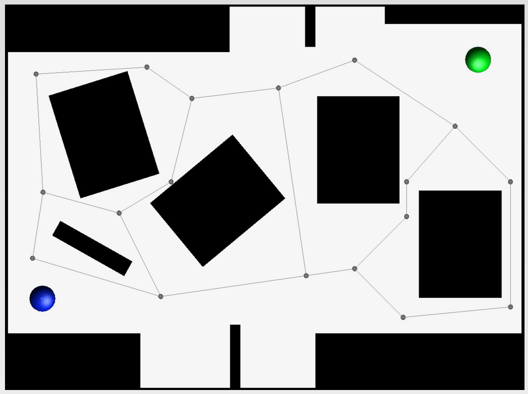


Guard and Camera Placement

- Application of quantitative metrics that demonstrate how different parametrizations affect the existence of level solutions and player perception of difficulty.

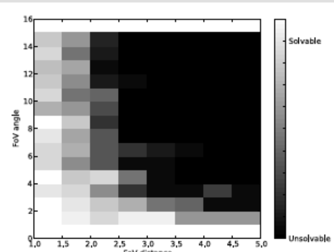


Figure 5: RRT success ratio from 0% to 100% for different camera FoV angles and ranges.

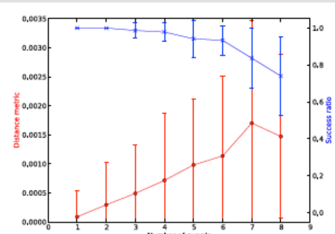
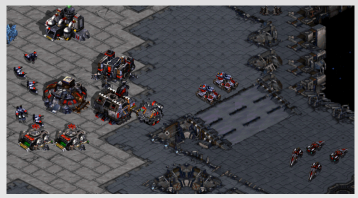


Figure 6: Success ratio (×'s, blue) and distance metric (○'s, red) *vs.* number of guards in the test level.

3. Strategy AI

Game Tree Search over High-Level Game States in RTS Games

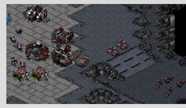


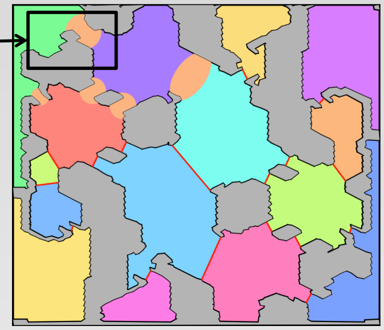
- Albert Uriarte and Santiago Ontanon, Computer Science Dept., Drexel

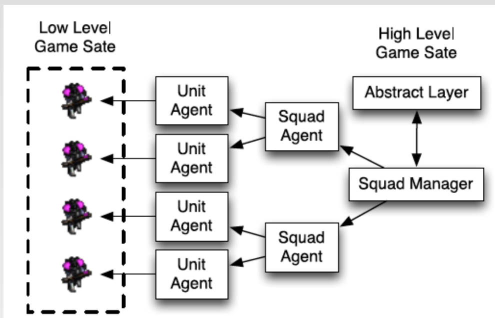
High-Level Game Tree Search

- "Classic" AI algorithms
  - search trees in state space (based on "next move")
    - alpha-beta search
    - Monte Carlo tree search (MCTS)
  - successfully applied to chess, checkers, cards, ...
  - but for RTS games, state space gets ***really*** big
- Basic solution approach:
  - apply ***abstraction*** to state space to get smaller searches

High-Level Game Tree Search







High-Level Game Tree Search

Algorithm 1 MCTS Considering Durations

```
function MctsSearch(s_0)
    n_0 ← CreateNode(s_0, ∅)
    while withing computational budget do
        n_l ← TreePolicy(n_0)
        △ ← DefaultPolicy(n_l)
        Backup(n_l, △)
    return (BestChild(n_0)).action

function CreateNode(s, n_0)
    n.parent ← n_0
    n.lastSimult ← n_0.lastSimult
    n.player ← PlayerToMove(s, n.lastSimult)
    if BothCanMove(s) then
        n.lastSimult ← n.player
    return n

function DefaultPolicy(n)
    lastSimult ← n.lastSimult
    s ← n.s
    while withing computational budget do
        p ← PlayerToMove(s, lastSimult)
        if BothCanMove(s) then
            lastSimult ← p
        simulate game s with a policy and player p
    return s.reward
```

High-Level Game Tree Search

- Experimental Evaluation using StarCraft

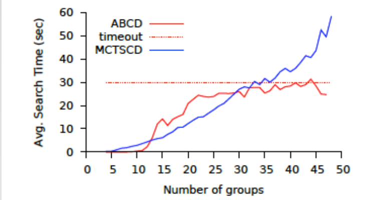


Figure 5: Average search time for each algorithm grouped by the number of groups in the high-level state.

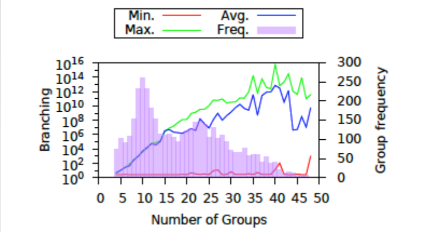
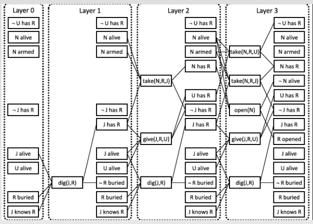


Figure 4: Average branching factor grouped by the number of groups in the high-level state.

4. Narrative

Glaive: A State-Space Narrative Planner Supporting Intentionality and Conflict



- Stephen Ware and R. Michael Young, Computer Science Dept., NC State U.

Narrative Planning

- Narrative? Another word for "story"
- The minimum story is:

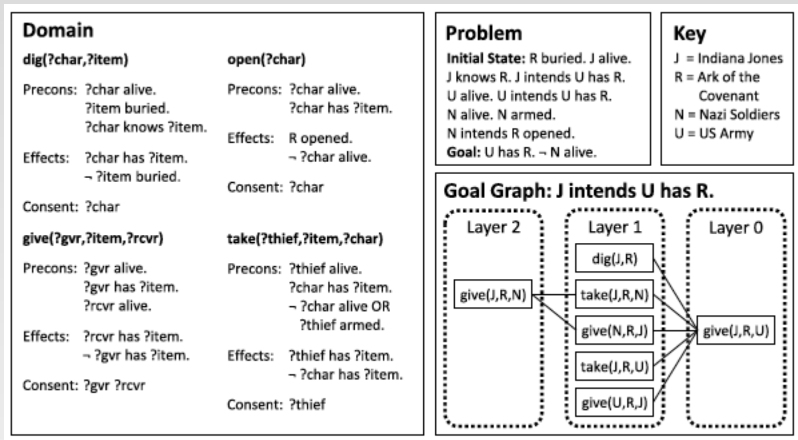
  ...two events and an explanation
- The game AI problem:
  - given
    - a set of characters (and their motivations, etc.)
    - an initial state of the world (including characters)
    - a desired goal state
  - produce
    - a ***believable*** and ***interesting*** story (sequence of events) that goes from initial to final state

Narrative Planning

- Why would you want to do this?
  - save the effort of manual story writing (get more stories and replayability)
  - make story interactive (replan after user actions)
- Why is this hard?
  - tension between two desires:
    - *strong story*: ensure coherent plot defined by author
    - *strong autonomy:* ensure accurate simulation of each character

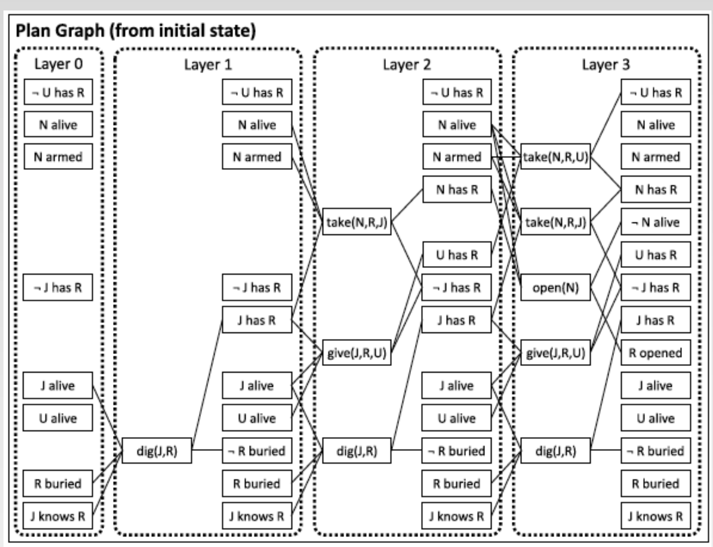
Narrative Planning

- Set up as classic AI planning (search) problem



Indiana Jones and the Raiders of the Lost Ark

Narrative Planning



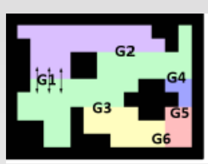
Indiana Jones and the Raiders of the Lost Ark

Narrative Planning

- Technical issues
  - resolving conflicts (between characters)
  - heuristics for searching space efficiently
  - many other very technical issues in planning and representation

5. NPC Behavior

Belief-Driven Pathfinding Through Personalized Map Abstraction



- Davide Aversa and Savros Vassos, Dept of Computer, Control and Management Engineering, Sapienza U. of Rome

Belief-Driven Pathfinding

- Pathfinding
  - NPC finding an appropriate path to navigate from current location to desired location
  - essential mechanism in many games
  - crucial for interaction quality and believability
  - A* algorithm most commonly used
- Belief-Driven/Personalized?
  - rather than all NPC's sharing same pathfinding module
  - each NPC plans path based on what it has observed or been told (beliefs) about environment

Belief-Driven Pathfinding

- *Technical challenge:* reduce expense of doing this for large maps and large number of NPCs
- *Solution approach*: apply A* to ***abstraction(s)*** of map

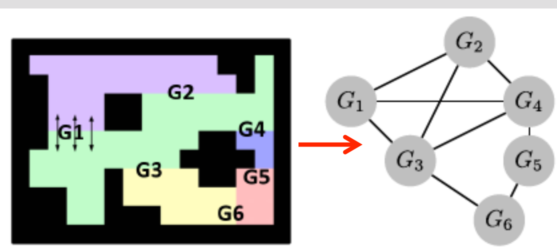
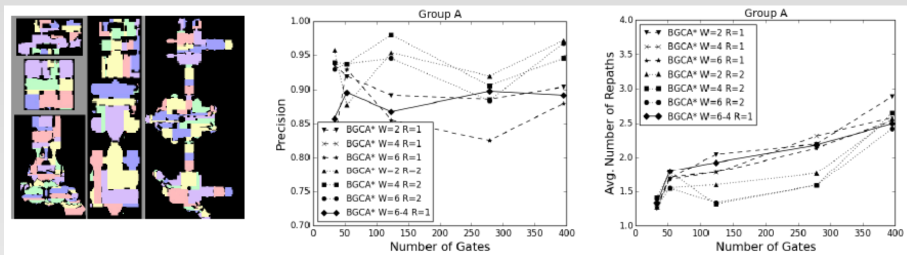


Figure 1: A small map decomposed in five regions, and a corresponding gate connectivity graph. Gate G_1 is a set of three portals, each of which is denoted by a double arrow.

Belief-Driven Pathfinding

Experimental results:



6. Gameplay Analytics

Developing Social Identity Models of Players from Game Telemetry Data

- Chon-u Lim and D. Fox Harrell, Computer Science and Artificial Intelligence Lab, MIT

[poster/short paper]

Gameplay Analytics

- Analytics?
  - gathering data (stats) from gameplay
  - player actions, timing, scores, customization, etc.
  - applying statistical analyses, data mining, machine learning, etc.
  - to better understand game design
  - make better games
  - sell more games...

Gameplay Analytics

- Player statistics in *Team Fortress 2* (FPS) predicted aspects of their identities expressed their social networking profiles:
  - number of friends
  - number of uploaded screenshots
  - number of uploaded videos

Gameplay Analytics

1. Veteran players with high customization have higher number of friends
2. Offensive-driven players upload more screenshots
3. Stealth or support-driven players upload more videos

Privacy concerns?

Invited Talks

- Constraint-Based Multitasking in *The Sims 4*
  - Peter Ingebretson, Senior Software Engineer, Electronic Args
- Tracking Sports Players and Understanding Their Movements
  - Peter Carr, Disney Research

Invited Talks [cont'd]

- Natural Language Dialogue in Interactive Learning Environments
  - Kristy Boyer, NC State U.
- Vegans at Your Barbecue: How to Feed Hungry Game AI Developers
  - Squirrel Eiselroh, GuildHall at the Southern Methodist U.

Questions? Comments?

- P.S. The other big yearly game AI confab is the yearly AI Summit at GDC
  - March 14-18, 2016, San Francisco
  - organized by the AI Game Programmers Guild (http://gameai.com)
  - approx 85% industry, 15% academic