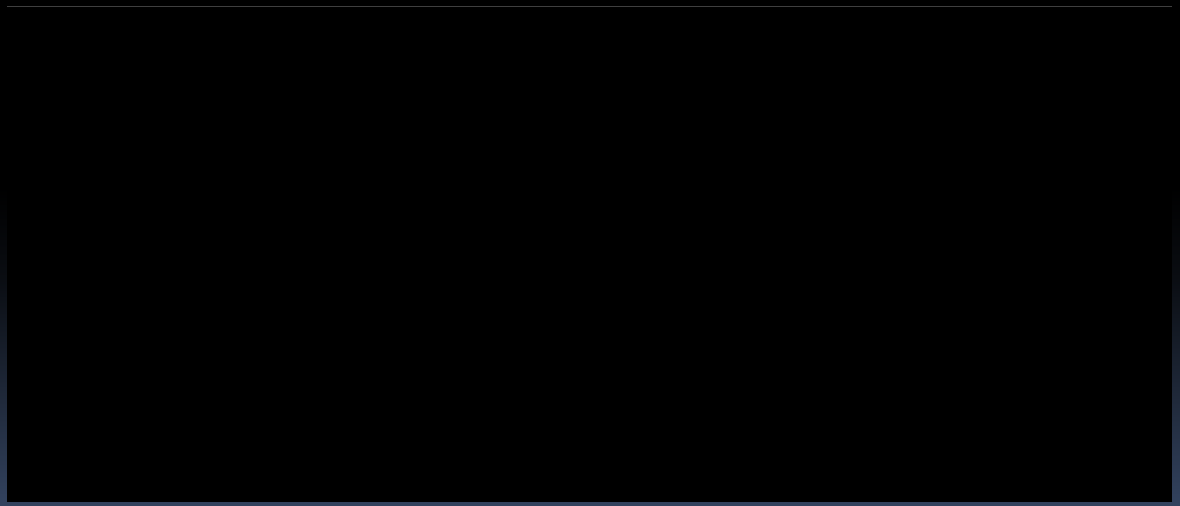
AI in Games

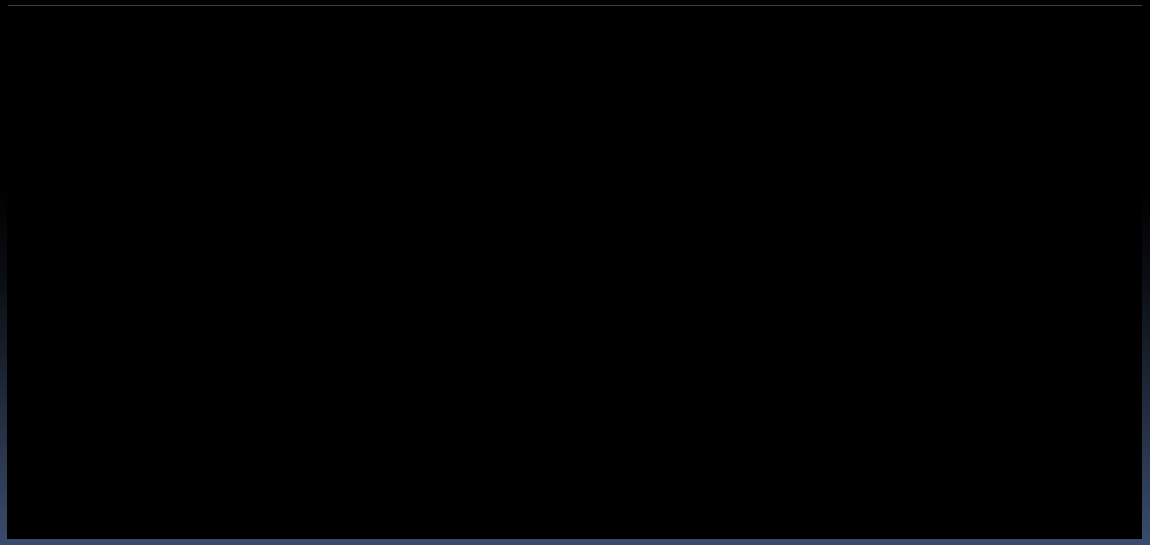
Artificial Intelligence

- Artificial intelligence (AI) in games is the application of AI techniques to enhance the play experience.
  - Also known as gameplay programming.
- But games often get it wrong…

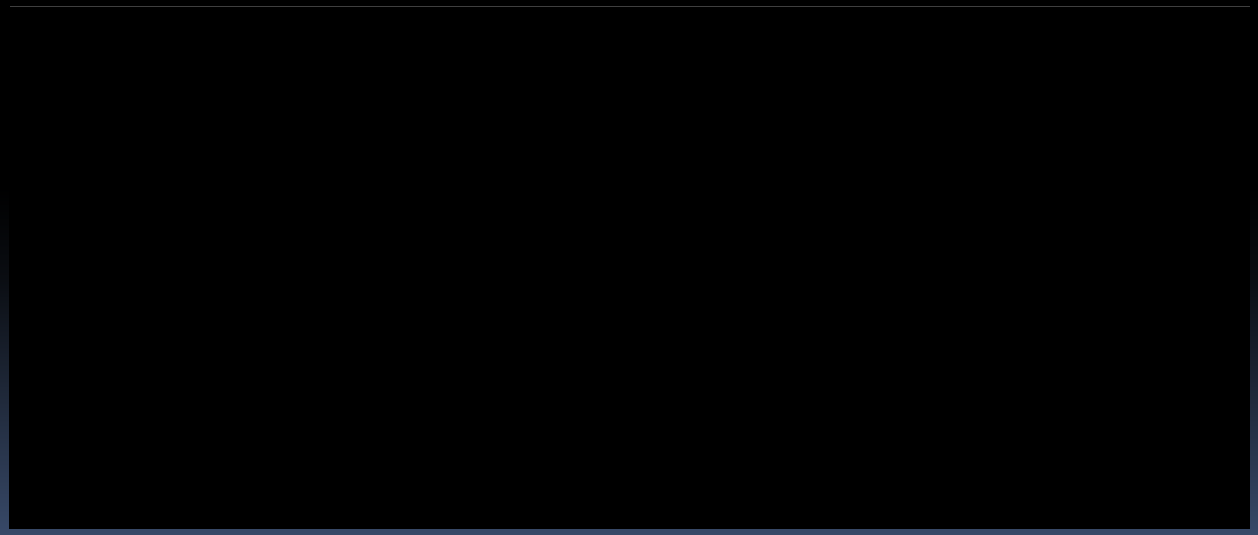
AI Example #1



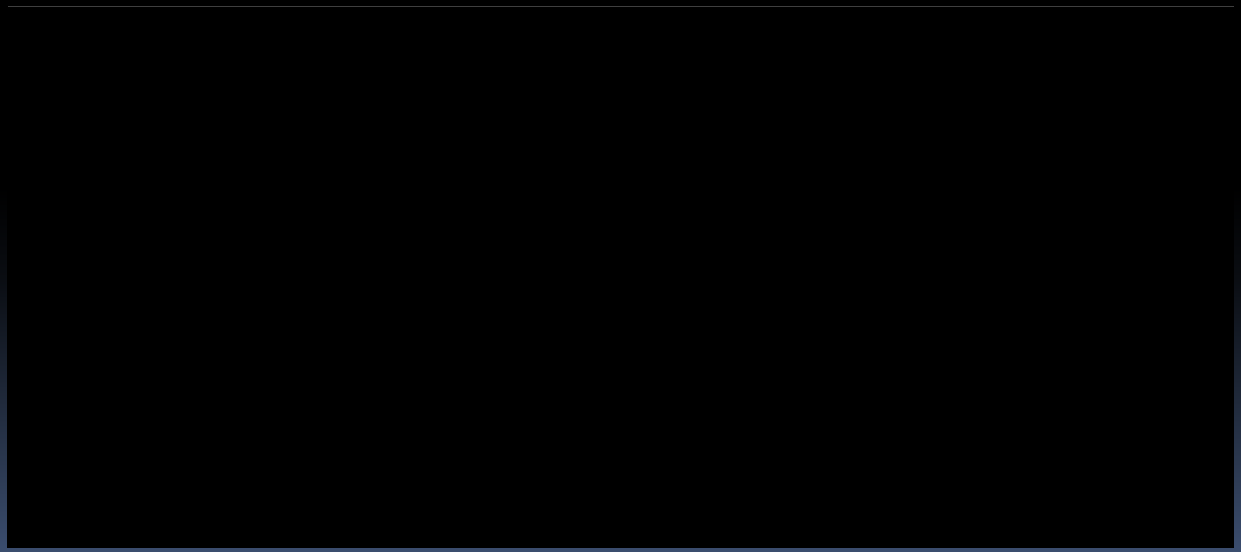
AI Example #2



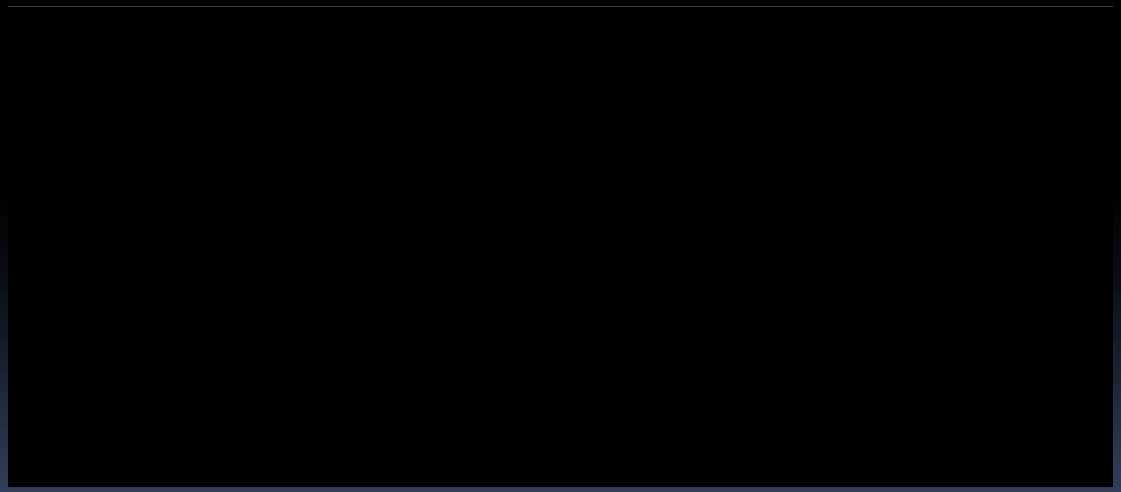
AI Example #3



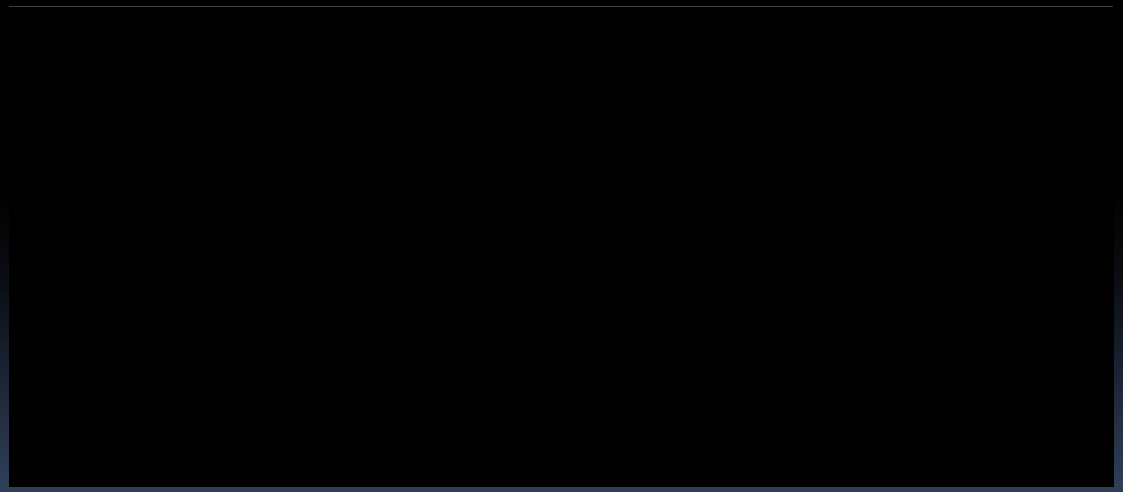
AI Example #4



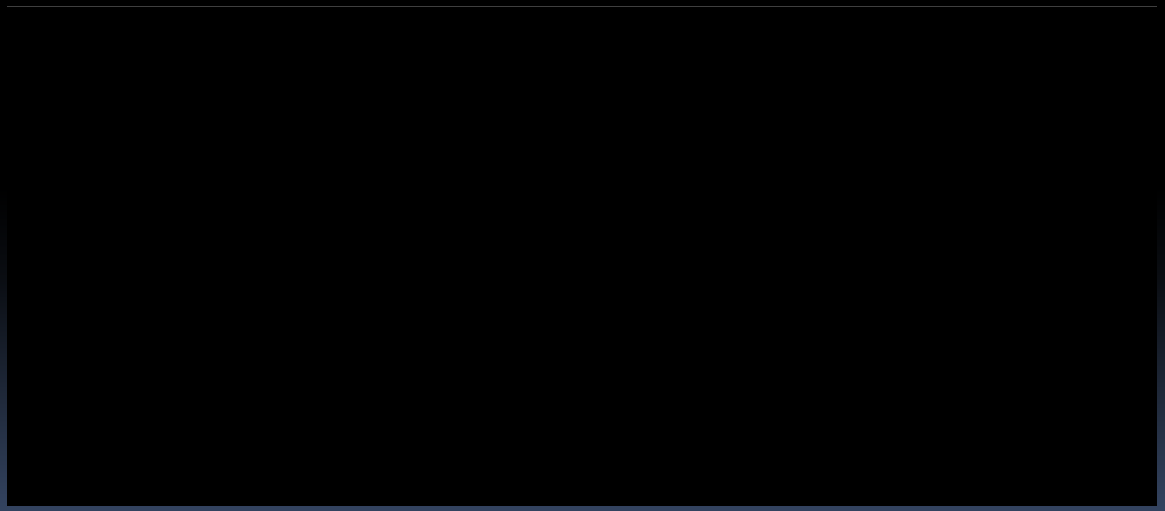
AI Example #5



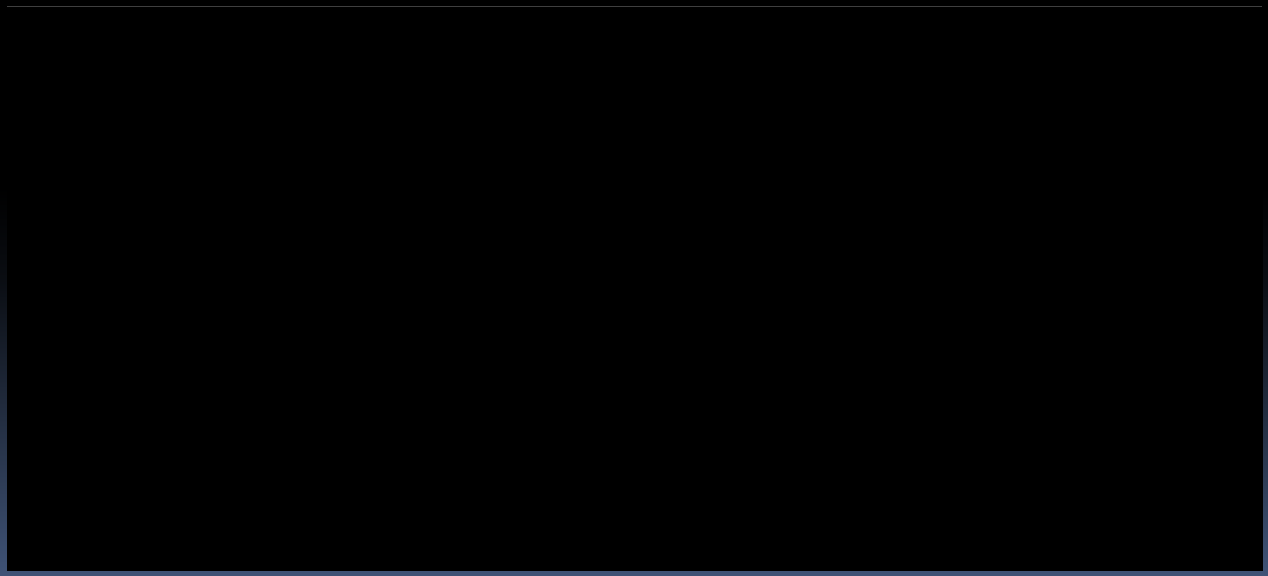
AI Example #6



AI Example #7



AI Example #8



Areas of AI in Games

- Perception
  - Language
  - Vision
- Processing
  - Searching
  - Planning
  - Game Trees
- Learning
  - Neural networks

AI Entities

- When creating artificial intelligence, the purpose is to produce entities that are able to operate independent of human direction
  - Often these entities are called non-player characters (NPCs)
- These entities need to have the following properties:
  - autonomy = needs no direct involvement to perform duties
  - reactivity = must be able to perceive and react to its environment
  - proactivity = must exhibit goal-directed behaviour
  - (sociability = interacts with other agents)

Multi-Agent Applications

- Example: RoboCup
  - robot soccer league
  - international competition
  - also offers search & rescue, RoboCup junior, and a dance competition

- Game example: Sports Games
  - Game AI has to coordinate multiple team members for a common goal, not just for their individual goals.

Types of AI in Games

Natural Language

- Façade

Computer Vision

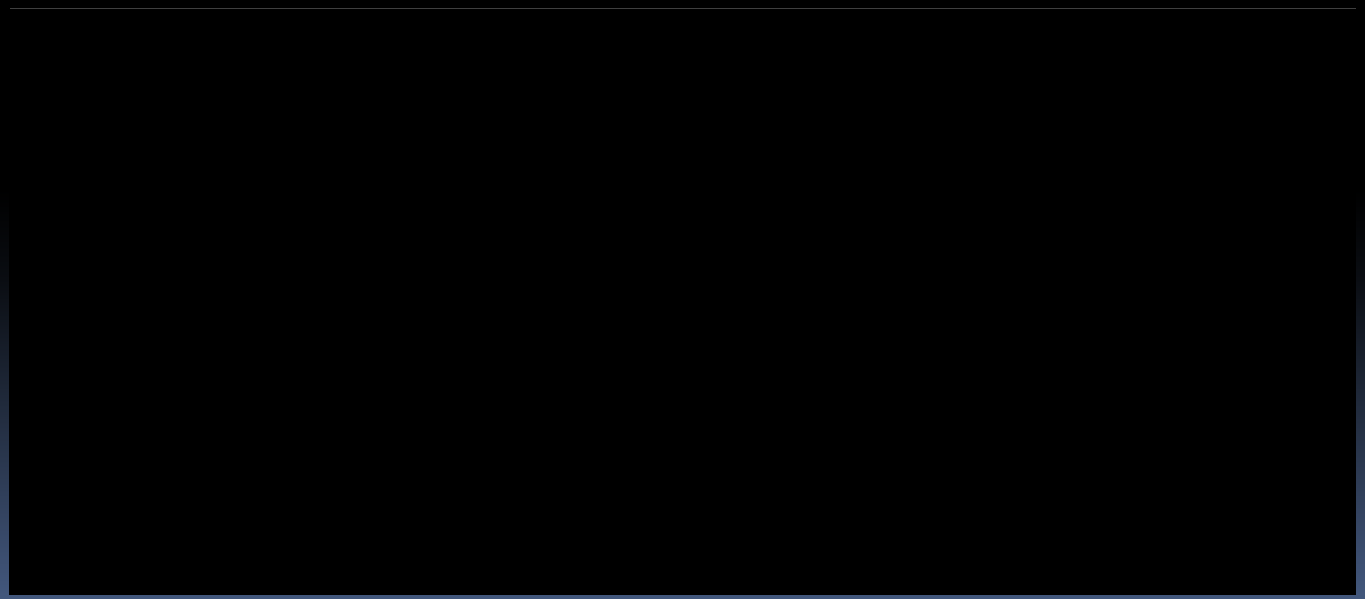
- EyeToy

- Kinect

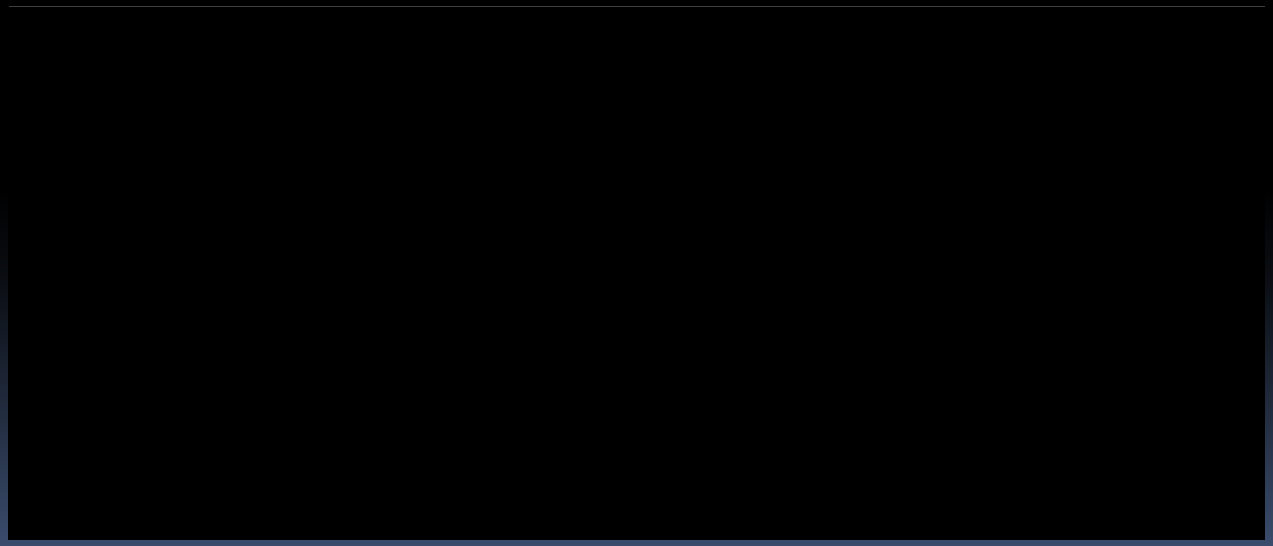
Planning

- F.E.A.R.

F.E.A.R. AI



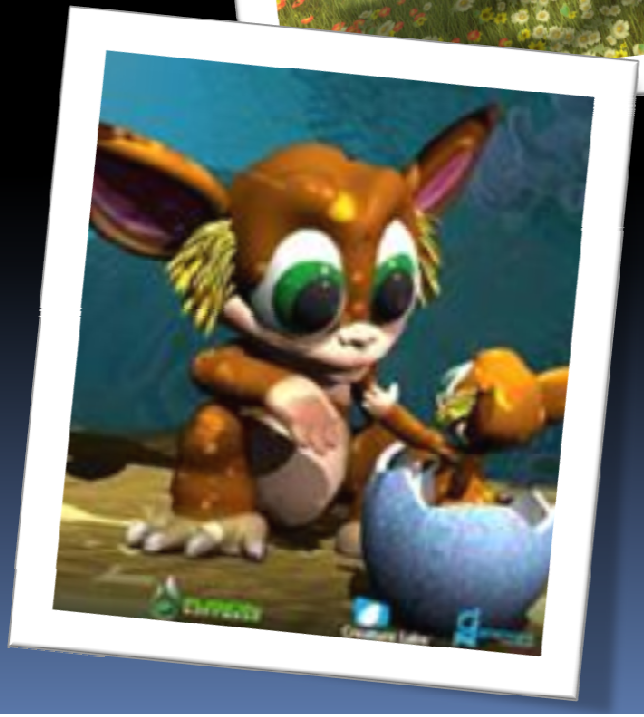
F.E.A.R. AI



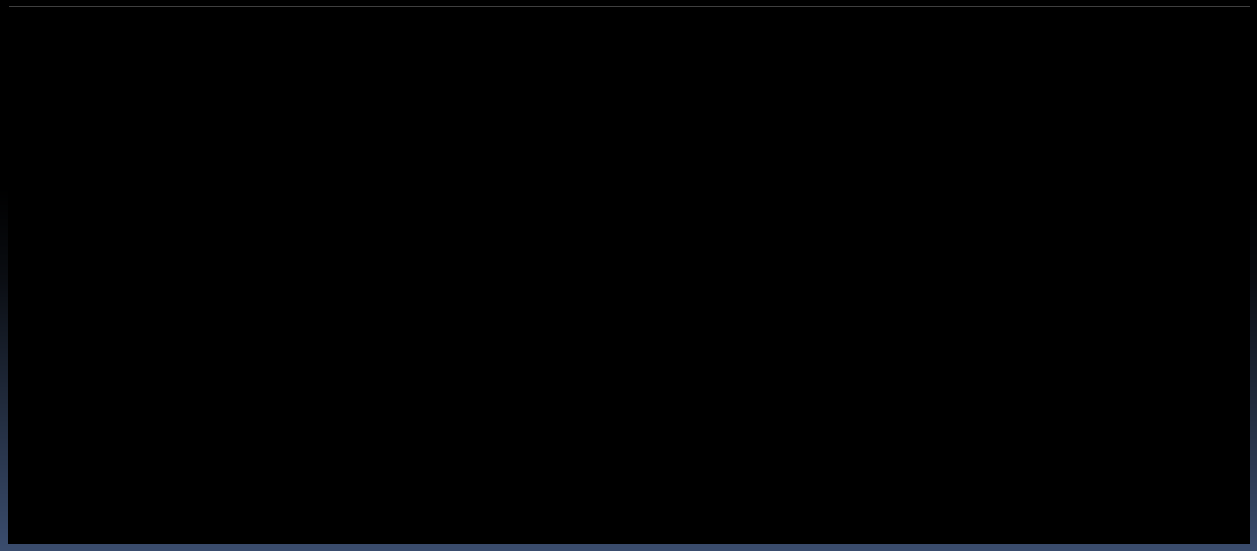
Machine Learning

- Black & White

- Creatures



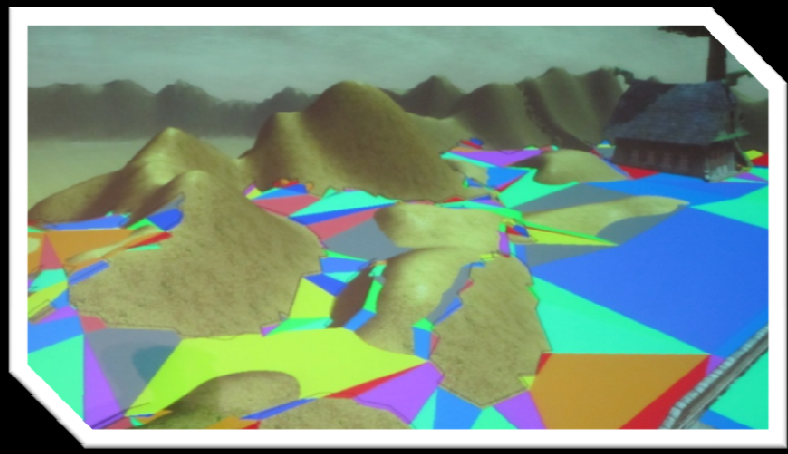
Creatures



AI @ GDC

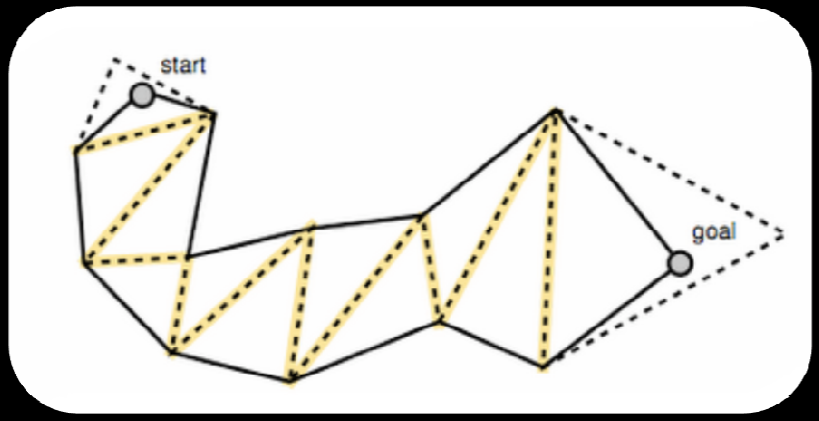
AI @ GDC

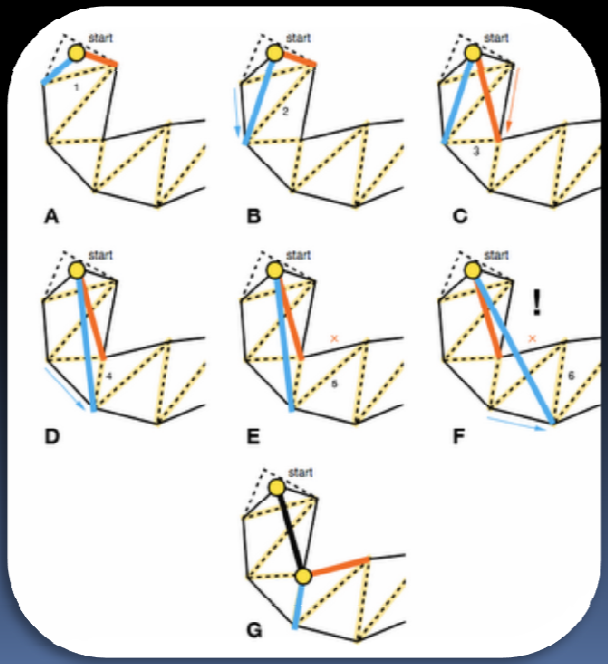
- Pathfinding
  - Planning & A*
- Key ideas:
  - Reduce search space
- Steering
  - Following
  - Flocking
  - Grouping
  - Separation
  - Arrival
  - Avoidance
- Collisions (pushing)
  - Influence & unit circles



Funnel Algorithm

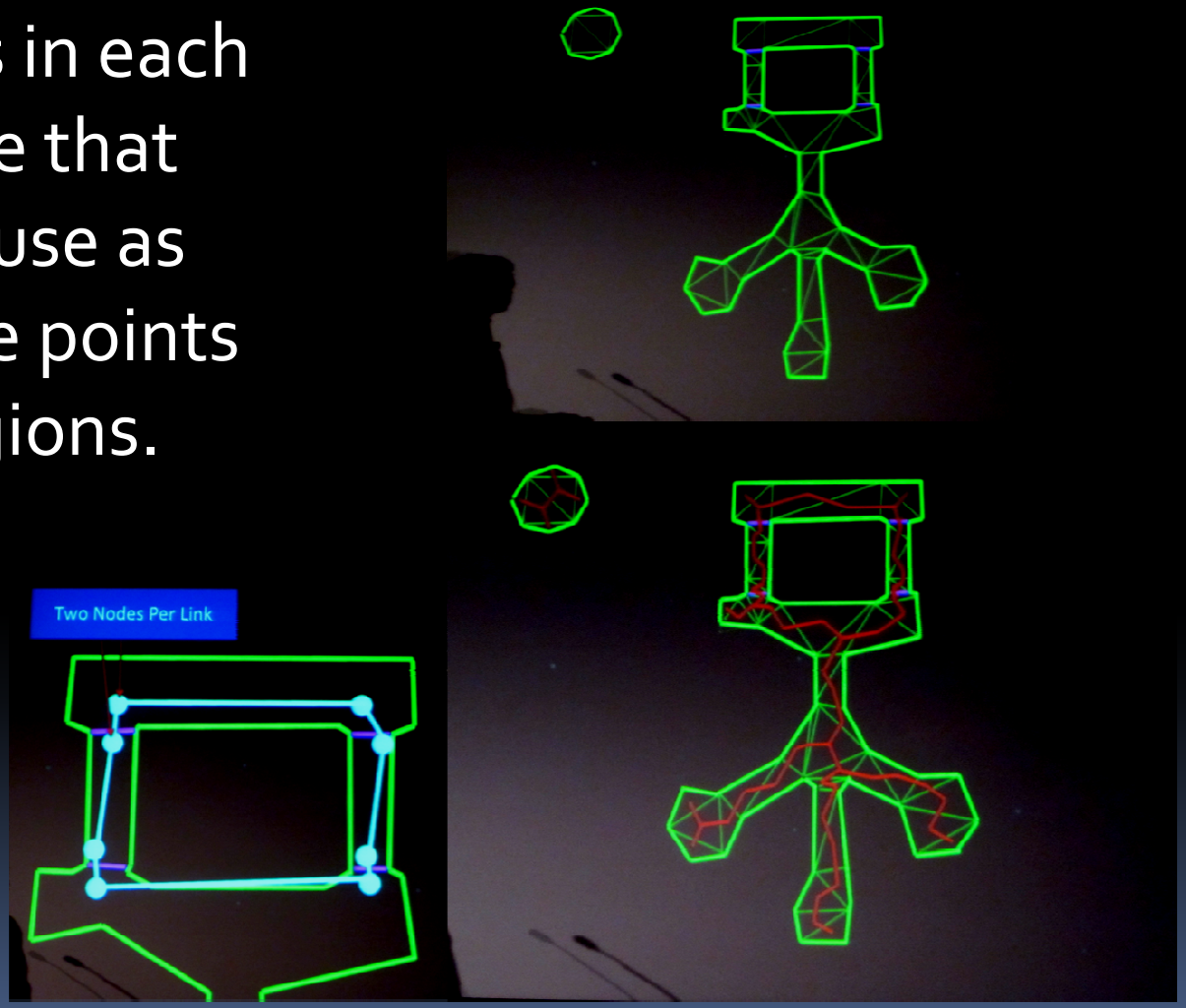
- Used to find quick paths through levels.
- Assumes that level has been decomposed into large polygons.
- Iterate through polygon corners to find narrowest funnel through passage.
- Multiple levels with different granularity
- Note: Always search for straight-line path first ☺





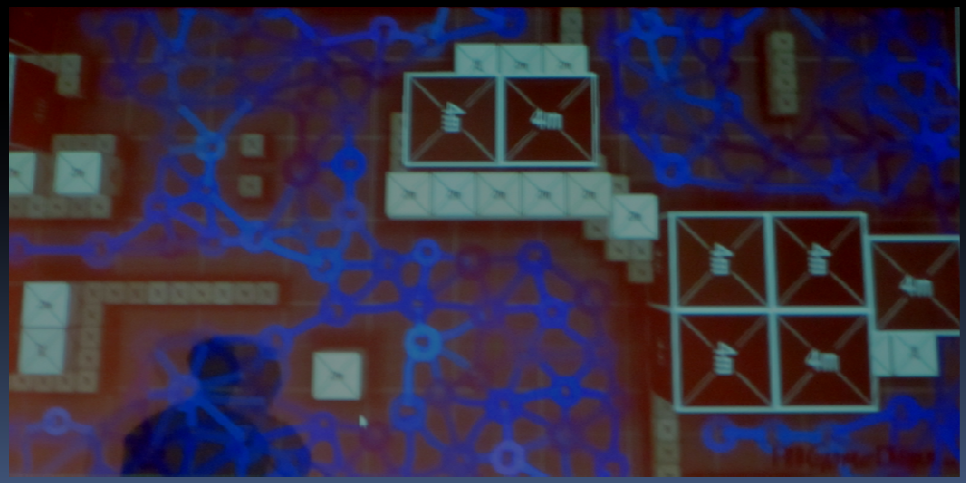
Pathfinding: Portals

- Create spots in each triangle edge that pathfinders use as intermediate points between regions.
- Example:
  - Playstation Move Heroes

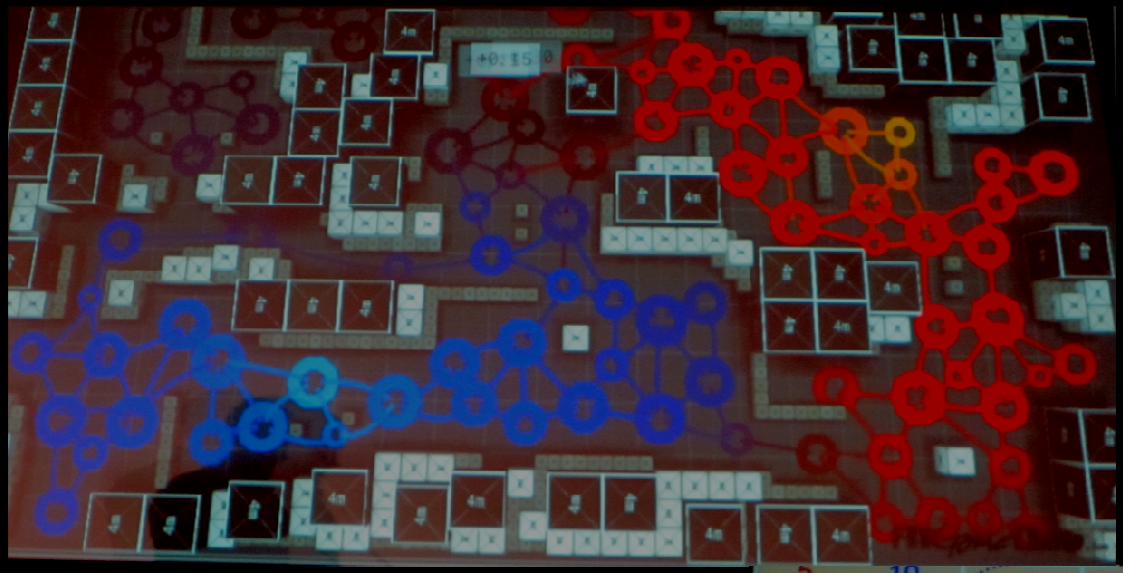


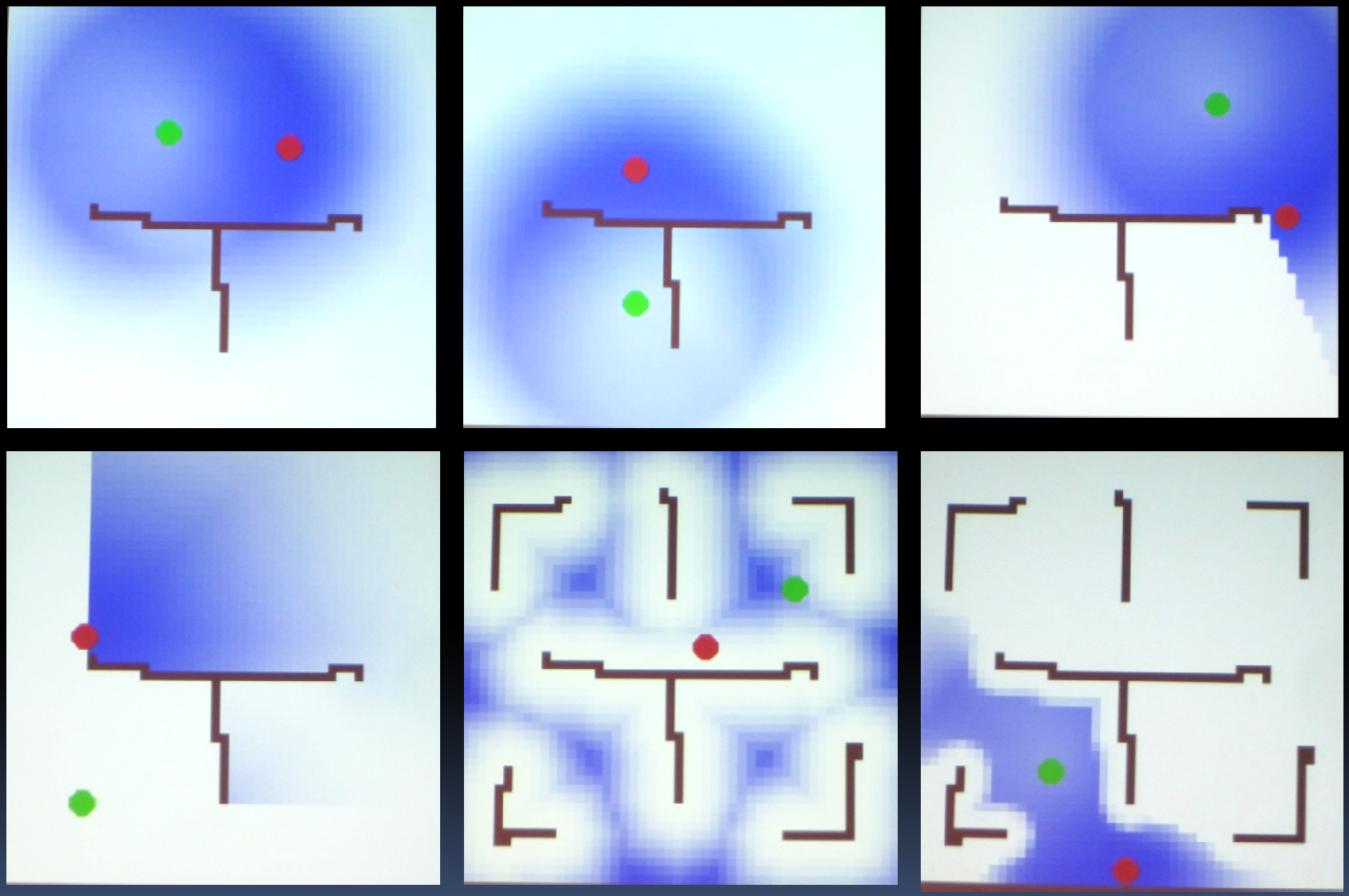
Influence Maps

- Shows areas of control and influence for players.
- Implications:
  - Shows possible actions, future moves.
  - Defend where threatened, attack where weakest.
  - Emergent feigns and feints, teamwork.
- Based off spatial function:
  - Travel time, line-of-sight, A* penalty, path speed, target bias, weapon choice, multipliers.



Influence Maps





Intelligent NPCs

- Flow
  - Dynamic splines, dynamic lane forming.
  - Problems: twitching, piling up.
- Obstacle avoidance
  - Case-sensitive steering behaviour.
  - Social rules, self-organizing lanes.
- Action stations
  - e.g. benches, ATMs.
  - Stations "capture" NPCs in given area, take over brains & animation.
  - Once done, release NPC.
- More nuanced characters.

Bringing Bioshock Infinite's Elizabeth to Life

- Keep companion character interesting and active, without being annoying.
  - "Look at" markers
  - "Smart terrain"
  - Movement within cone along "golden path".

- Combat:
  - Higher positive weight for cover positions,
  - Higher negative weight for "line of fire" positions
- Better to be entertaining than algorithmically complex.

Ellie: Buddy AI in The Last of Us

- Wanted to make Ellie feel as "real" as possible
  - "No cheating".
    - No teleporting, realistic reactions and behaviours.
- Sparse assistance
  - Reluctant shooting
  - Rare supply help
- Scripted behaviours.

Saint's Row 3: Vehicles

- 90 days to create 90+ vehicles with 350 parameters each.
  - Variables highly interdependent.
  - Removed most, replaced with bounding box for physics, to create the general "feel".
- Start with average vehicle, then move to uncommon cases.
  - Iteration all the time.
- Can create impression of speed by altering perceptions.
  - Low vehicle cameras,
  - high speed camera shake,
  - increased field-of-view.

AI Issues

- Nearest neighbour searches are slow
- Player intent
  - What does a click mean?
- Destructive interference (conflicting goals)
- Grid resolution
  - Grid elements < body size

- Hierarchical searching
  - Problems with aiming for section, then searching in section.
- Randomness
  - Can produce seemingly oppressive behaviour.
  - Use Gaussians, filter out results (especially in near-win conditions).

Architecture for AI

- AI algorithms are notorious short on resources.
  - Cycles, memory
- AI components: analog to electrical components.
  - Broad classification, key properties, defined I/O, interchangeable
- Class design
  - Minimal classes, data lifetime, locality of reference.
- Multithreading
  - Run planners in parallel (SIMD)
  - Break down engine into modules (like entities)
    - Perception, behaviour tree, pathfinder, targeting, animation, standard movement (wolf/shark example).
    - Physics, sensory, movement, behaviour, reasoning, animation.
  - Maximize read-only data

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