UT^2: Human-like Behavior via Neuroevolution of Combat Behavior and Replay of Human Traces

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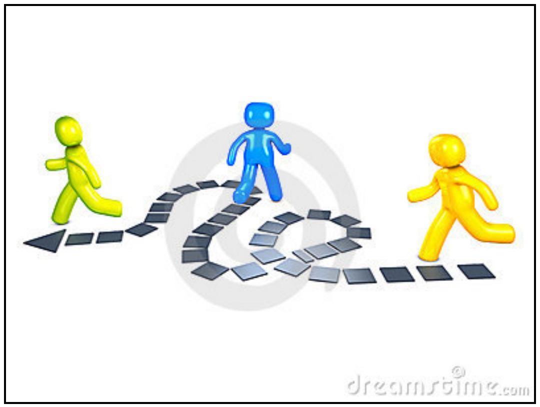
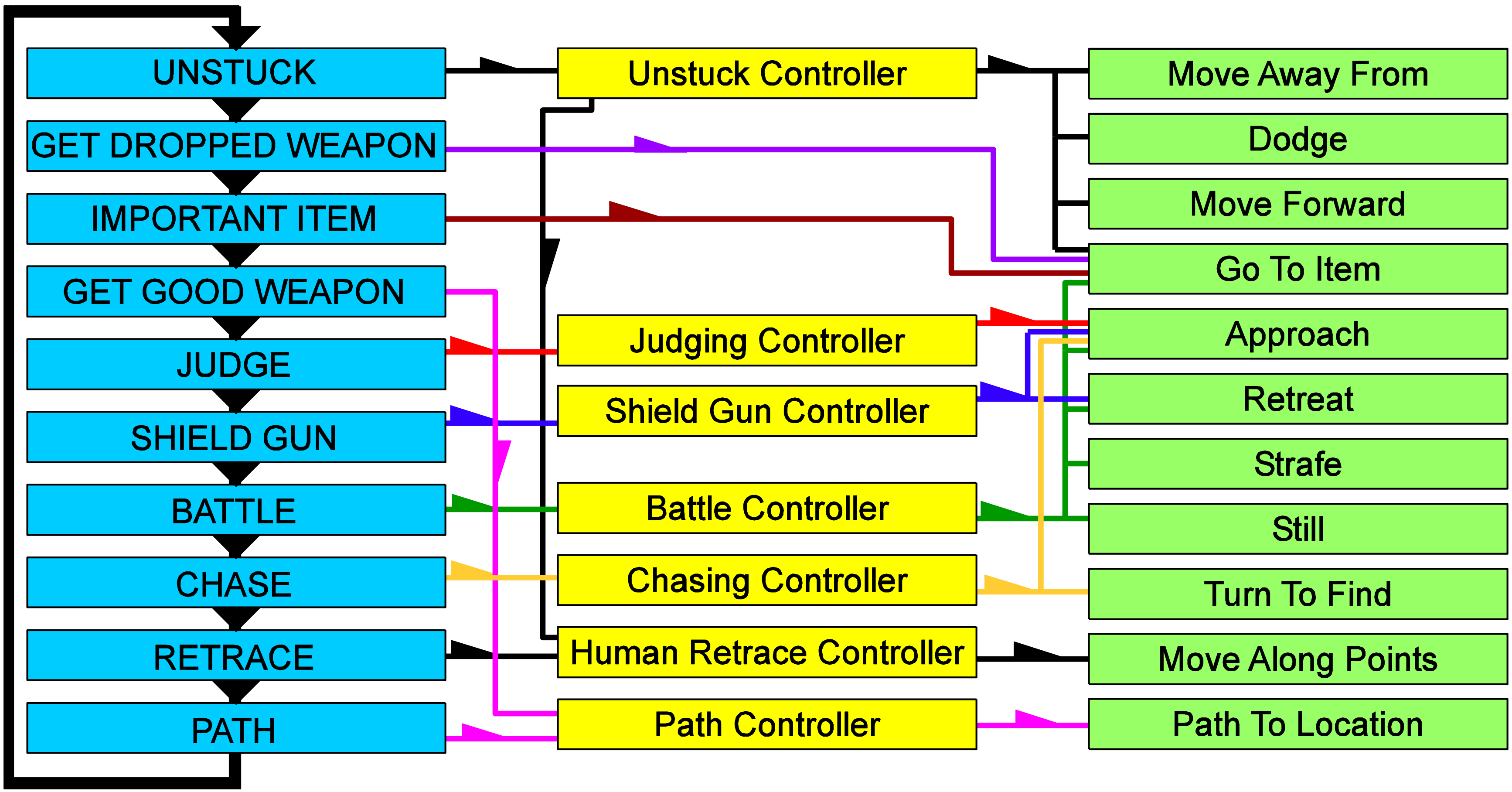
Our Approach: UT^2

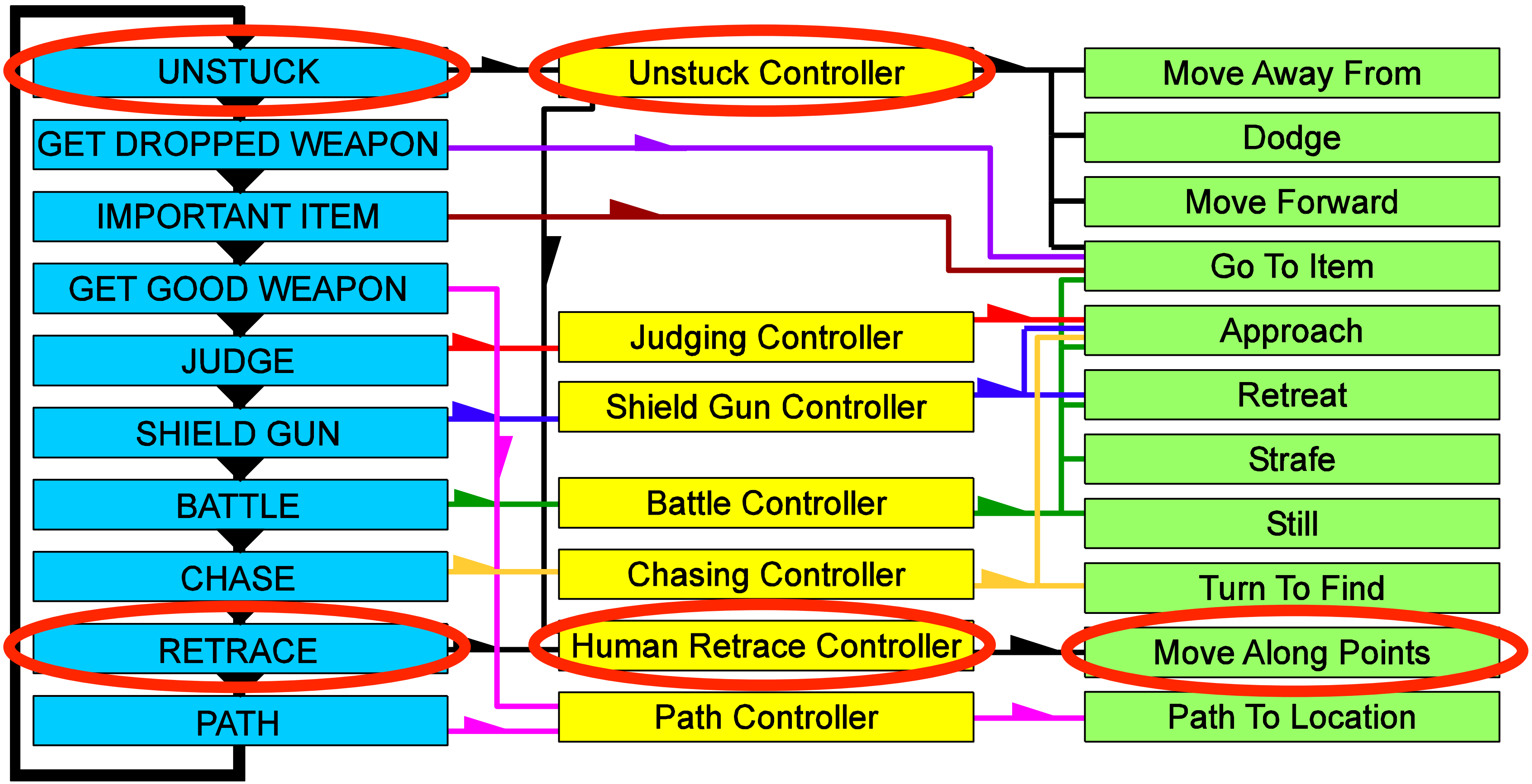
- Human traces to get unstuck and navigate
  - Filter data to get general-purpose traces
  - Future goal: generalize to new levels
- Evolve skilled combat behavior
  - Restrictions/filters maintain humanness
- Probabilistic judging based on experience
  - Also assume that humans judge well



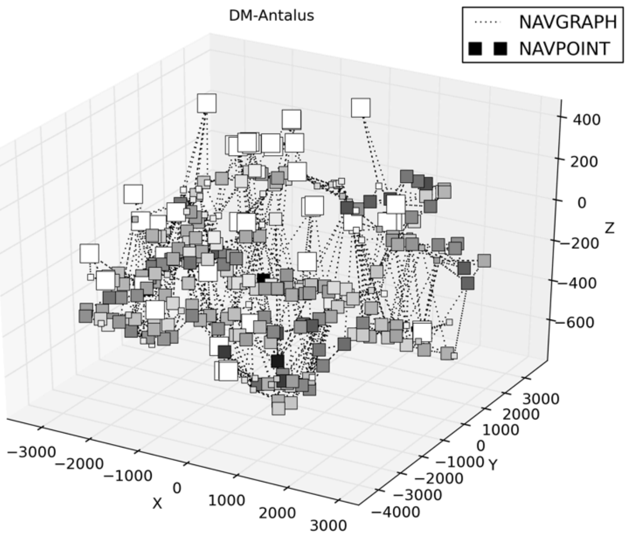
Bot Architecture

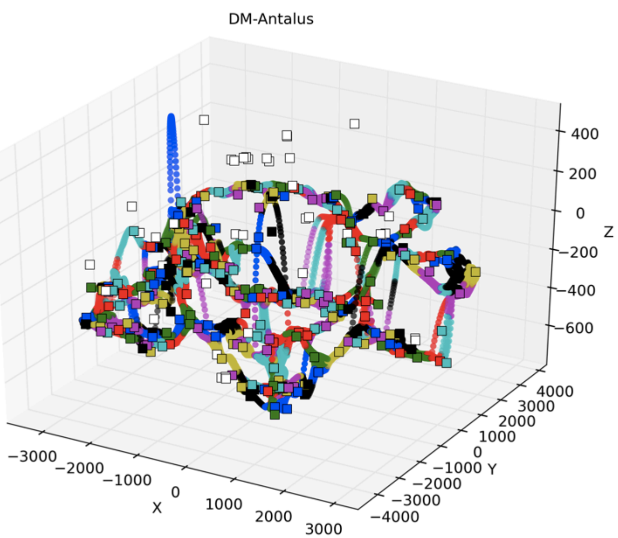


Use of Human Traces



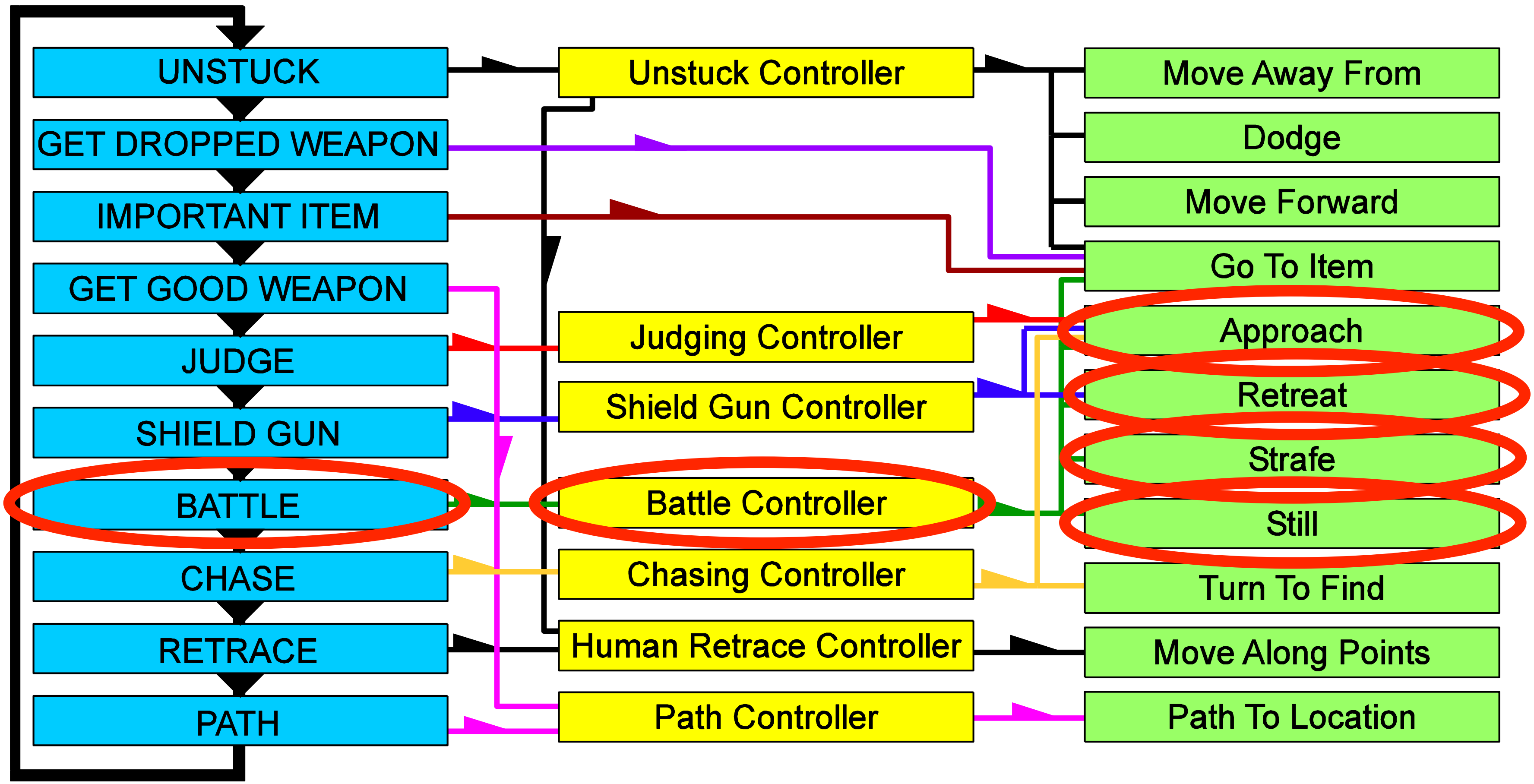
Index and replay nearest traces





- Get unstuck
  - Mix of scripted responses and human traces
  - Human traces used when scripted response fails
- Explore levels
  - Want to explore like humans
  - Synthetic data: lone human wandering levels
  - Allow collisions since humans bump into walls with no problem
  - Resort to A* when retracing does not work

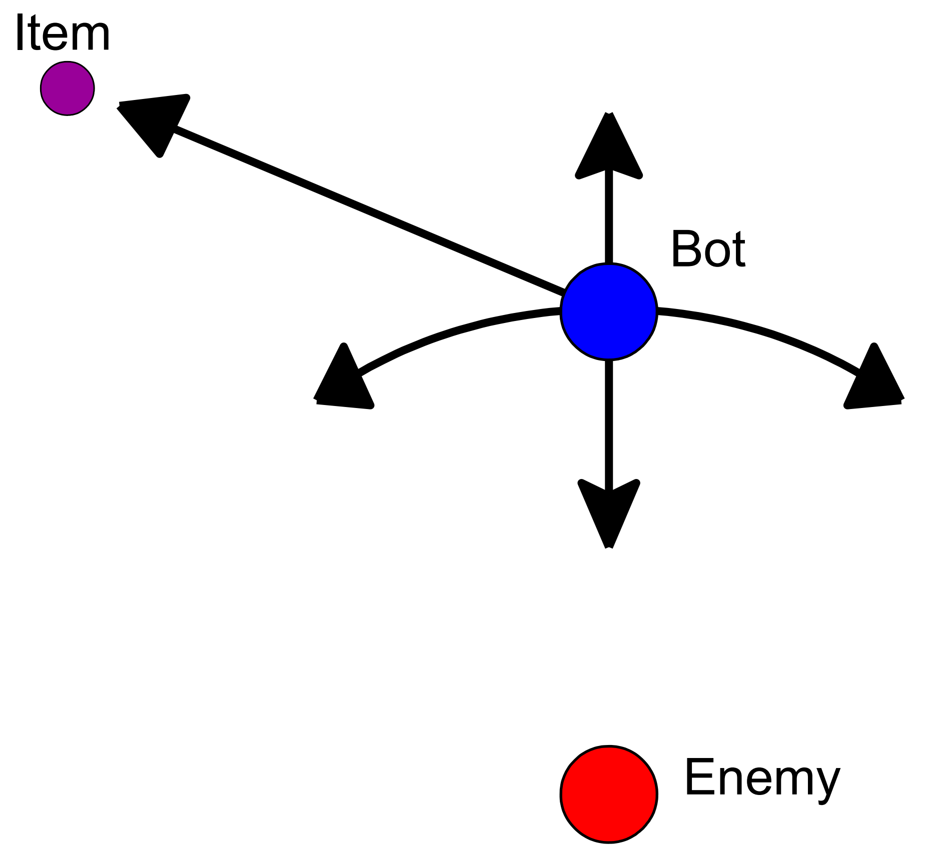
Use of Evolution



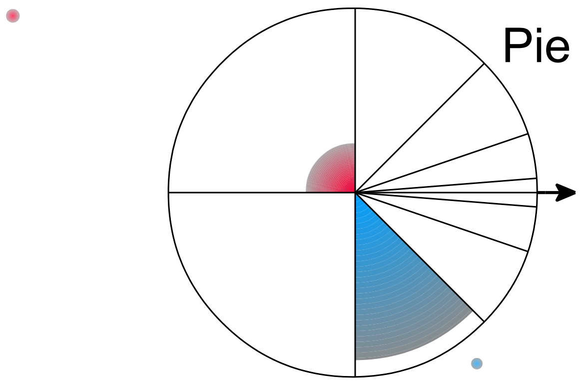
Evolved neural network in Battle Controller defines combat behavior

Battle Controller Outputs

- 6 movement outputs
  - Advance
  - Retreat
  - Strafe left
  - Strafe right
  - Move to nearest item
  - Stand still
- Additional output
  - Jump?



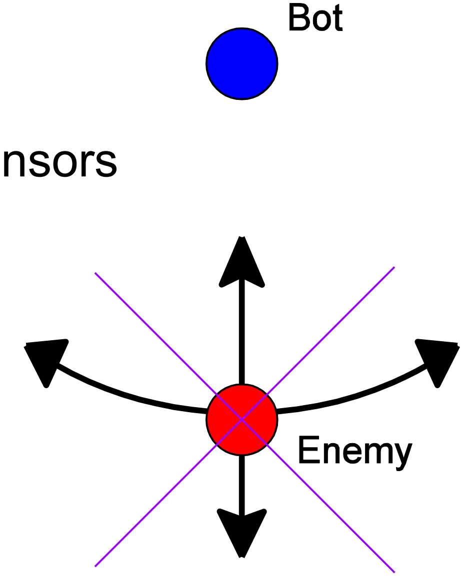
Battle Controller Inputs



Pie slice sensors for enemies

Ray traces for walls/level geometry

Opponent movement sensors

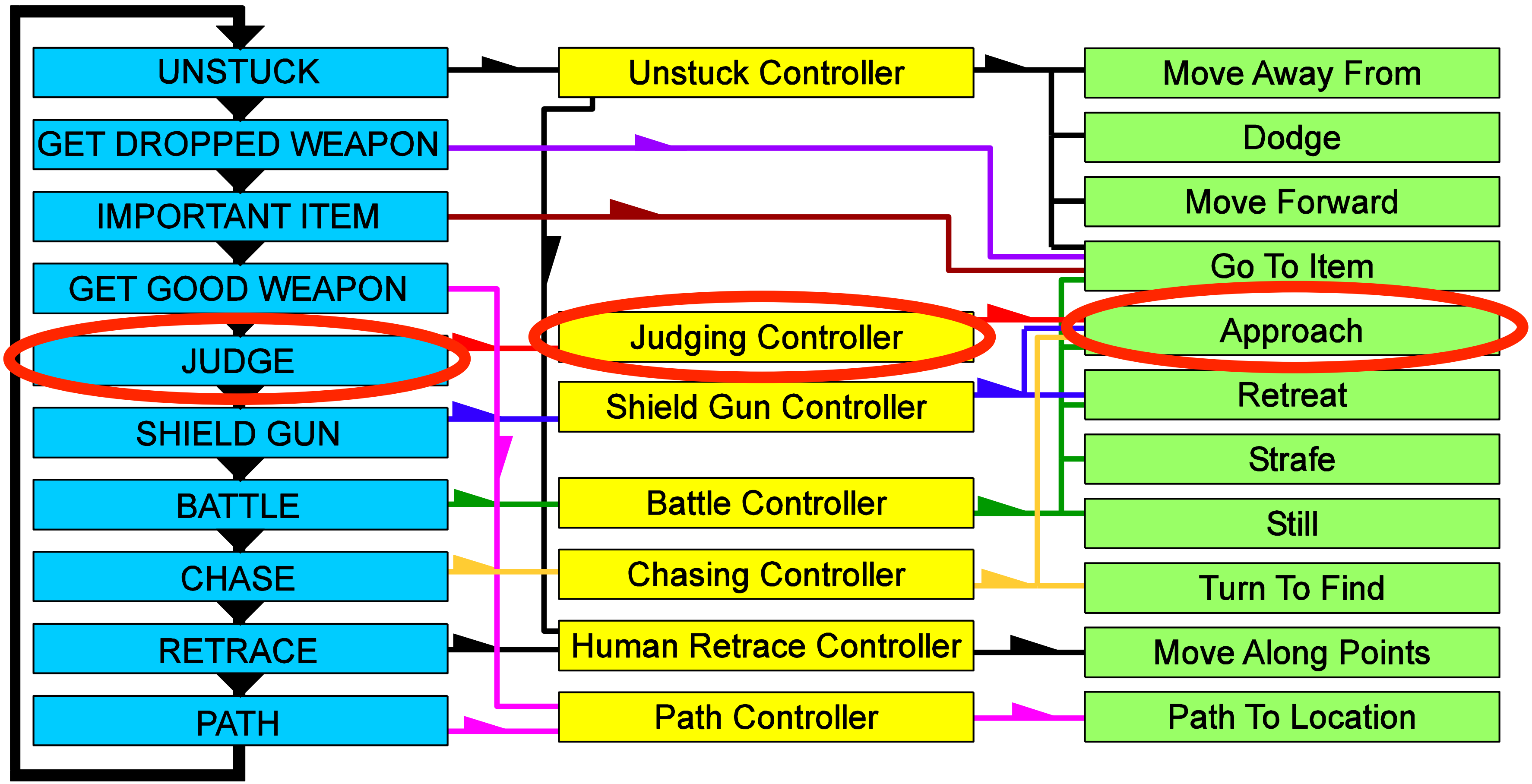


Other misc. sensors for current weapon properties, nearby item properties, etc.

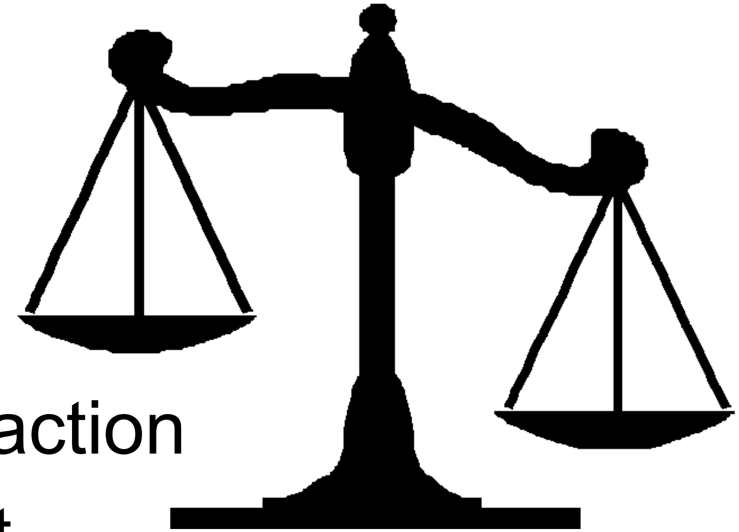
Evolving Battle Controller

- Used NSGA-II with 3 objectives
  – Damage dealt
  – Damage received (negative)
  – Geometry collisions (negative)
- Evolved in DM-1on1-Albatross
  – Small level to encourage combat
  – One native bot opponent
- High score favored in selection of final network
- Final combat behavior highly constrained

Playing the judging game



Judging



- When to judge
  - More likely after more interaction
  - More likely as time runs out
  - Judge if successful judgment witnessed
- How to judge
  - Assume equal # humans and bots
  - Mostly judge probabilistically
  - Assume target is human if it judged correctly

Humanness results

Most human bots

bot name	humanness %
UT^2	21.0526 %
HumanLikeBot	17.6471 %
ICE-WCCI2012	7.6923 %

Most human humans

player name	humanness %
Craig Speelman	40.0000 %
Chris Holme	21.4286 %
John Weise	11.1111 %
Samaneh Rastegari	9.0909 %

Most human epic bots

skill level	humanness %
1	33.3333 %
4	28.5714 %
2	11.1111 %
3	0.0000 %

Judging results

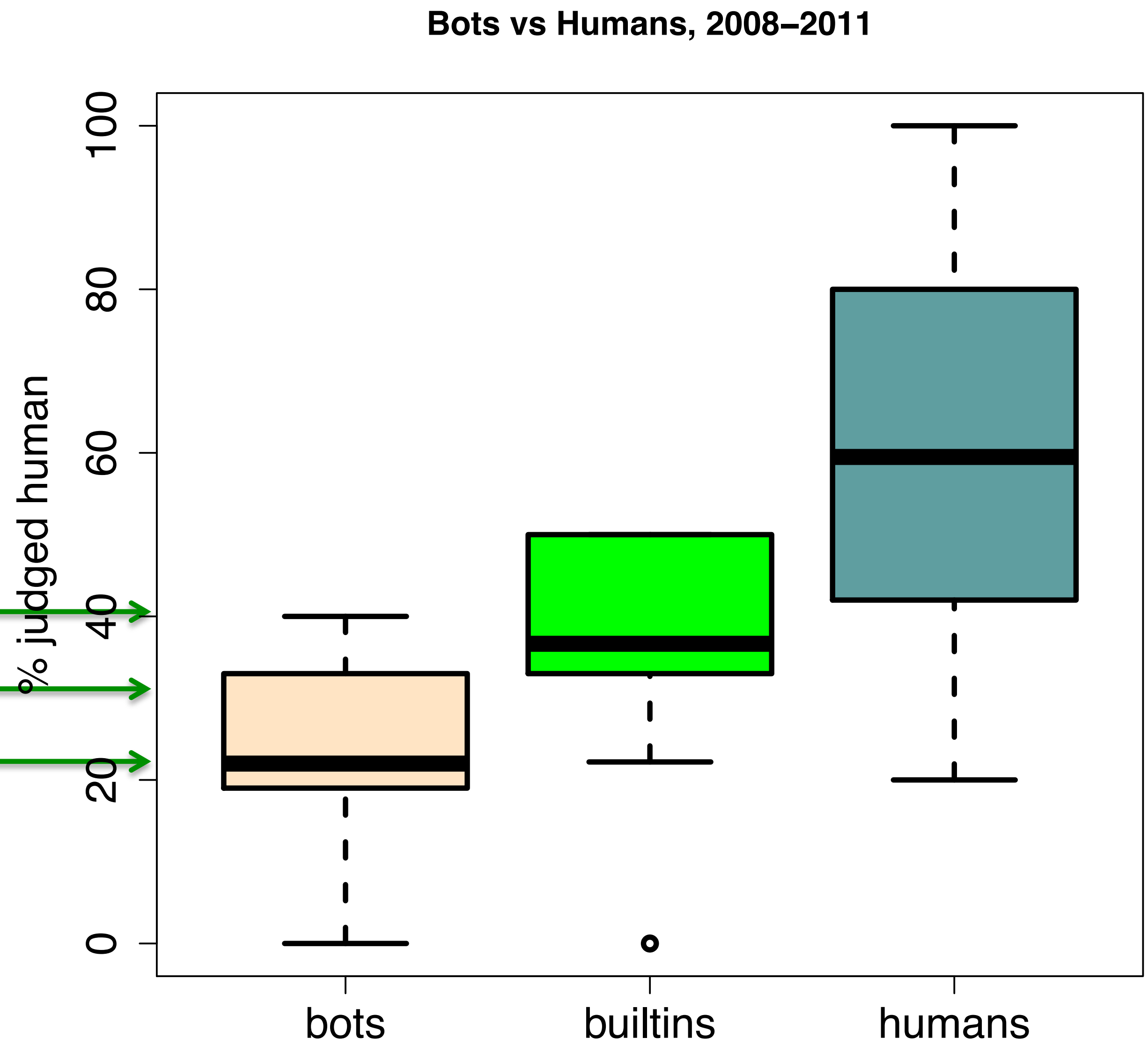
Best bot judges

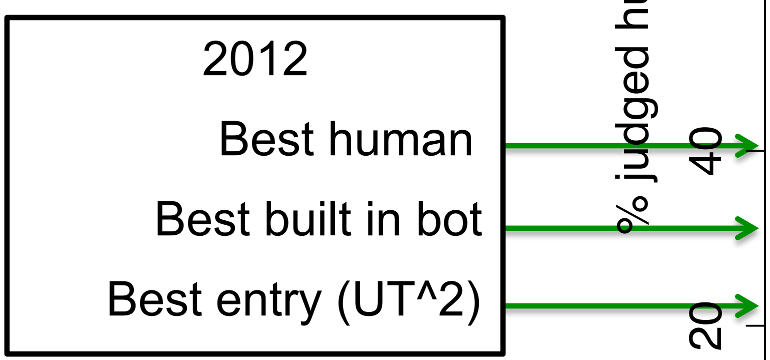
bot name	accuracy %
UT^2	53.8462 %
HumanLikeBot	51.2195 %
ICE-WCCI2012	40.0000 %

Best human judges

human name	accuracy %
John Weise	63.4146 %
Chris Holme	61.9048 %
Samaneh Rastegari	56.8182 %
Craig Speelman	50.0000 %

Where do we stand?





Discussion

- Bot humanness is still low!
- Native bots are still most human!
- Humans are not very human either!
- Does judging change the game?
- Does the API hinder our progress?
- More detailed judgment analysis…

Questions?

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