Application of Swarm Intelligence to AIs

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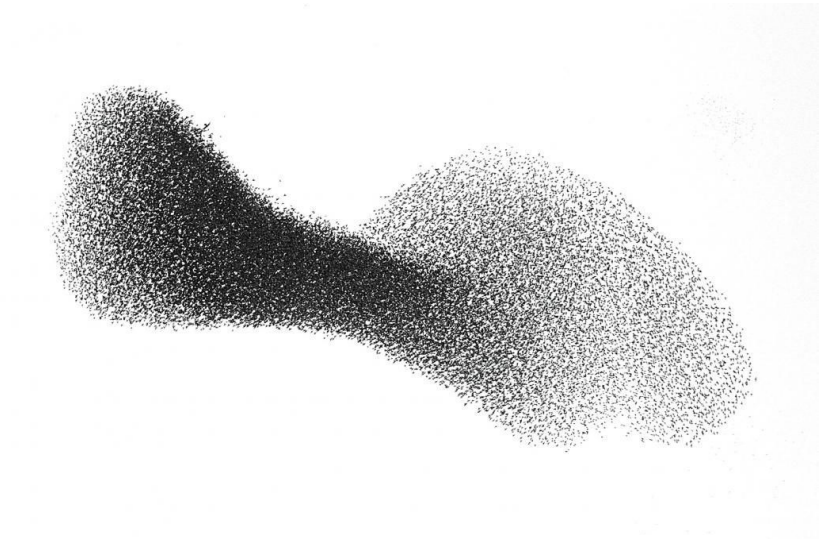
Motivation

Allow for “group work” amongst different AIs

- Make use of the biases within each AI to generate more insightful answers



https://www.newsweek.com/swarm-intelligence-ai-algorithm-predicts-future-418707

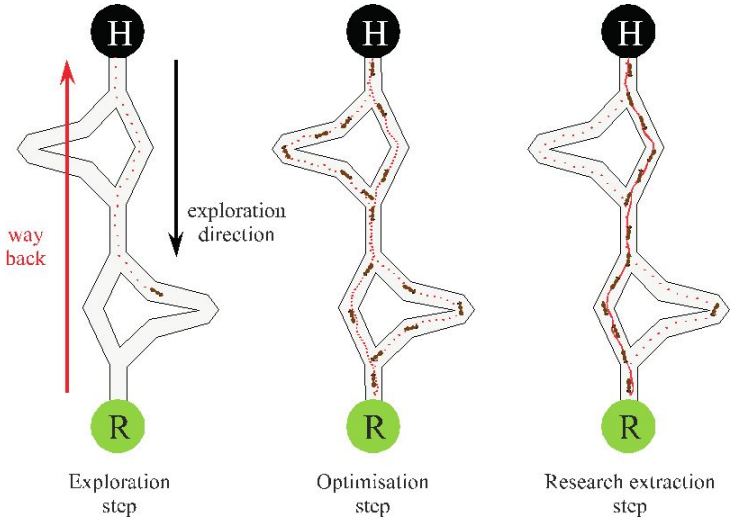
Goal

- Given a query and the individual responses of different chatbots, create an algorithm that amalgamates this knowledge into one final response

Related Work

Traditional Swarm Technologies (e.g ant colony optimization algorithm)

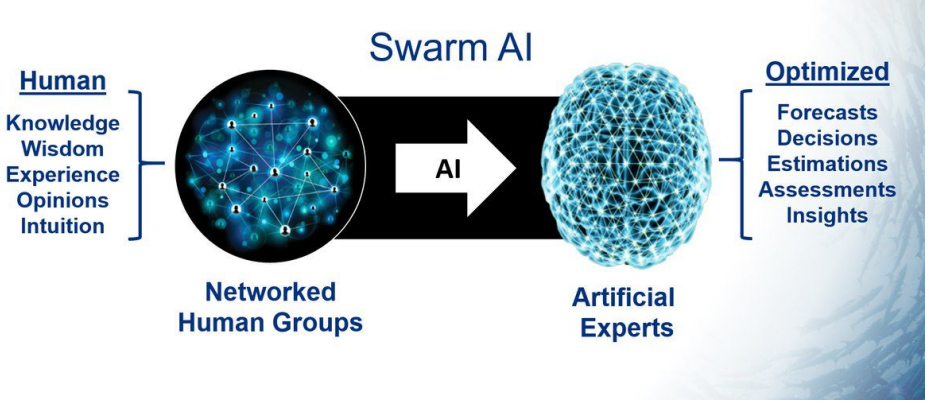
- Simulates behavior of simple organisms
- AI not simple enough to replicate



Related Work

Artificial Swarm Intelligence

- Uses AI moderation to mimic swarm behavior amongst humans
- Requires human input



Approach

Uses Artificial Swarm algorithm on AI generated answers

- AI are made to replicate human neural processes
- Group work algorithm made to take advantage of human neural processes would be most effective

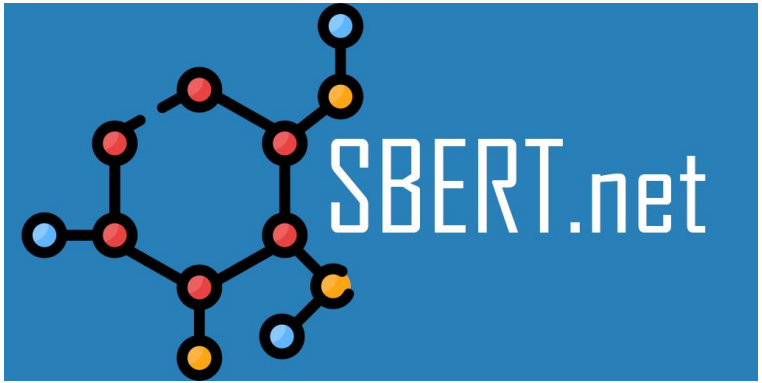
Approach

How Swarm.Ai works

Implementation

1. Calculating the force exerted by each bot
    a. Choose answer
    b. Find direction
    c. Representing Uncertainty
2. Defining how force is exerted on the puck
3. Creating high level physics model

Implementation



1.a Choose answer choice

- Approach: Have bot move towards choice that is most similar to it's output
- Implementation: Use SentenceTransformer score their similarity

Implementation

1.b. Find direction

- Approach: each bot should be an equal distance from it’s answer choice to begin
- Implementation: each bot puck starts in the opposite corner from it’s choice

Implementation

1.c Find magnitude of force based on conviction

- Challenge: Chatbots are not always 100% confident in answers
- Approach: Represent using a conviction matrix calculated using softmax and frequency of answers
- Implementation: Calculate Force based on conviction

```
self.convm = softmax(convic_freq)
self.F = self.dirn * abs(self.F) * conv
```

Implementation

1.c Representing Uncertainty

- Approach: If people are uncertain they have a tendency to switch answers
- Implementation: Bot puck are able to switch answers using the conviction array as probabilities

```
if rand>self.convm[self.allwords.index(self.word)] :
```

Implementation

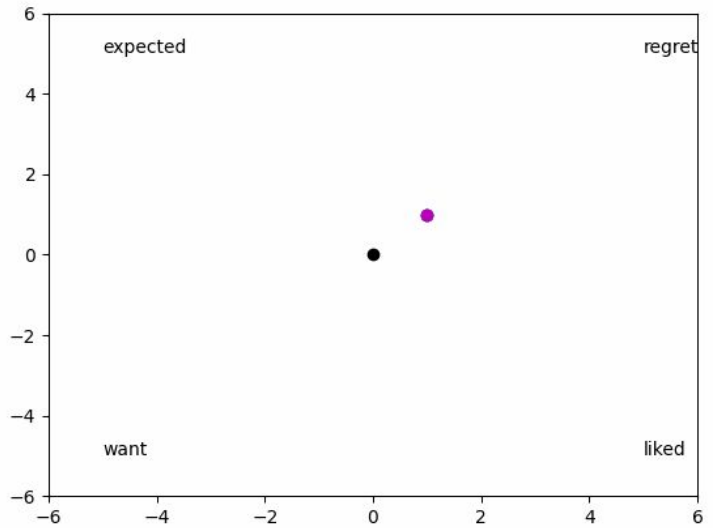
2. Define how bot's forces are exerted on puck

- Approach:Pucks to move in the direction of the bot with the strongest conviction
- Implementation: calculating net force on puck by adding all bot forces

Implementation

3. Creating High-Level physics model

- Implementation: Utilized n-body simulation standard as base



Results

Evaluation metrics

1. **Timing**
2. Accuracy

- Goal: find how much time it takes to generate 1 word
- Setup: Using python timing packages to find seconds to converge on 1 word
- Results: 13.67 seconds
- Implications: current program is not efficient enough to generate substantial text

Results

Evaluation metrics

1. Timing
2. **Accuracy**

- Goal: Ensure bot force calculations are effective
- Setup: Set answer choices to the same as the bot output
- Success: Bot with highest conviction output is chosen
- Result: Out of 20 tests the answer with highest conviction was chosen 19 times

Conclusion

- By using a physics model AI can work together to answer queries
- Current algorithm is slow but effective
- Implication: cooperative AI

Future Work

This Term: Next Steps

- Explore using answer choices that are not the same as the bot's output
- Explore more efficient algorithms, vectorization
- Generating full sentences/phrases

-

Future Work

This Term: Pending Evaluations

- Create a high dimensional vector of strings for all human generated responses and score against individual bots and group model
  - Purpose: quantify “human” nature of responses

Future Work

Next Projects

- Generating the answer choices
- Applications to areas other than text generation

Future Work

Long-Term

- groupwork AI could be an alternative to the creation of “stronger” AI
- AI with more “common sense”

Acknowledgement

I would like to acknowledge my advisor, Bernard Chazelle, along with the following papers and code sources:

https://huggingface.co/tasks/sentence-similarity

https://www.researchgate.net/profile/Louis-Rosenberg/publication/334544553_Artificial_Swarm_Intelligence/links/5d30714fa6fdcc2462e96d27/Artificial-Swarm-Intelligence.pdf

https://www.researchgate.net/publication/300084006_Swarm_Intelligence_from_Natural_to_Artificial_Systems_Ant_Colony_Optimization