Modeling Emotion in Team Coordination

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Grand Goal: Future action prediction

What my opponent thinks I'm thinking

What I'm really thinking of

Grand Goal: future action prediction

Given observed behavior/actions, predict future actions.

How would we do this?

Learn a mapping from state/action to the next action.

Why would this be a bad solution?

Grand Goal: future action prediction

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Learn a mapping from state/action to the next action.

Why would this be a bad solution?

- Requires a lot of samples - If the agent deviates, you are completely loss.
- Ambiguous - Picking up a plate can mean setting the table or putting it away.

Grand Goal: future action prediction

Simulation Theory: what would you have done if you were that person?

Given the observed actions, infer the most likely goals.

With the belief about the goals, predict actions to complete such goals.

How would you do this?

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How would you do this?

- Hidden Markov Model – Sub-goals generate actions [1].
- Hybrid Dynamic Bayesian Network – A plan represented as a tree of actions [2].
- Markov Decision Process – Generate a sequence of actions "on the fly" [3].

But we still see this … Why?

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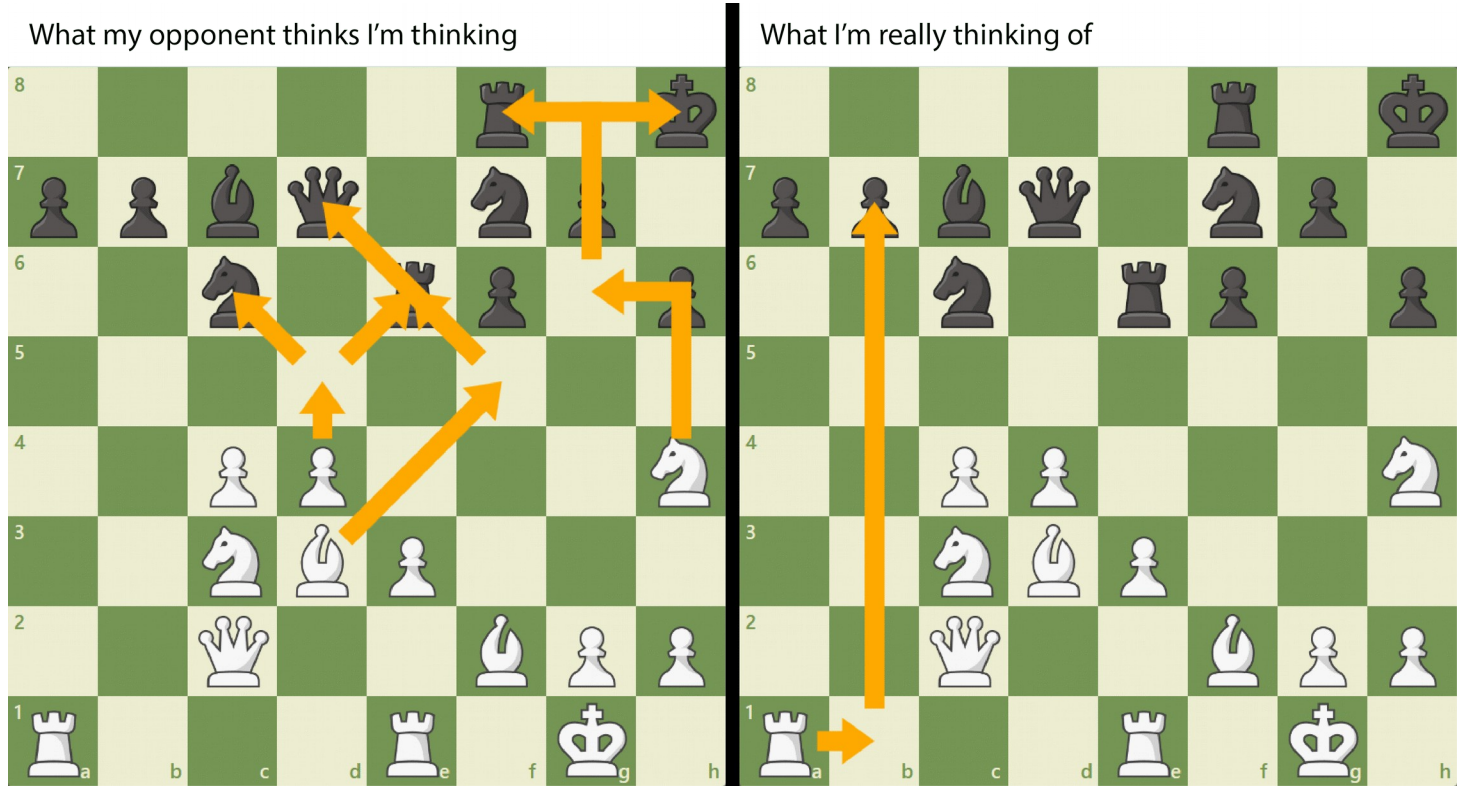
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Because humans are irrational!

Modeling humans as irrational agents

The human mind is too complex to be inferred only from their actions.

Factors that affect human behavior (not limited to):

Beliefs
Desire
Contexts
Biases [4]
Affects [5]

Personality
Risk-taking [6]
Trust
Deception
Limited physical and mental capability

Why study emotion in a team?

Emotion has a substantial impact on action [7].

- Lack of studies on predicting actions with emotion.

Emotion is rooted in a dynamic social context [8].

- Emotion should be studied in team dynamics.

Emotion regulation:

- Recognizing motivation influenced by emotion is unhelpful, do something else instead that would be more helpful [7].
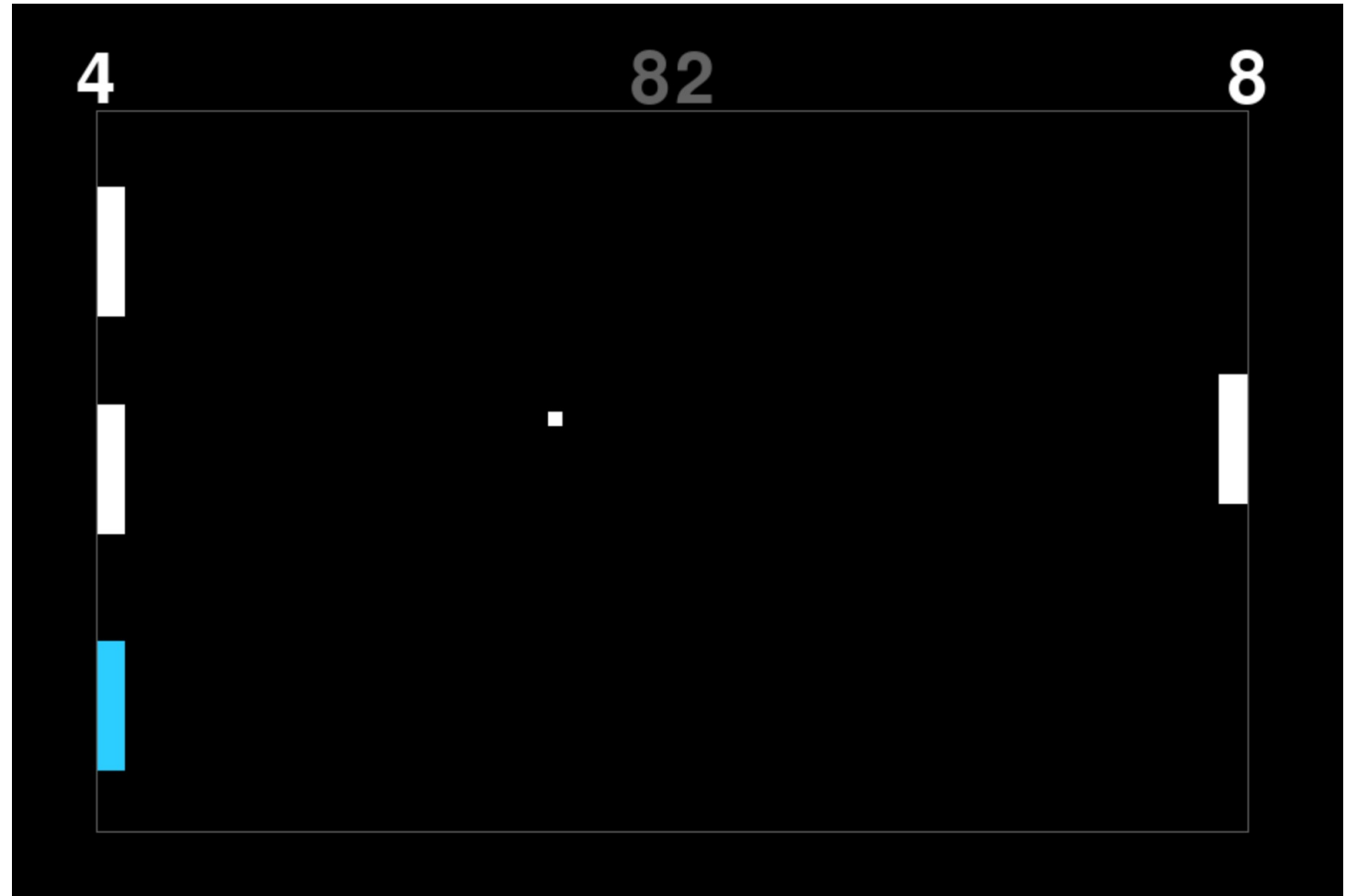
Hypothesis:

Knowing emotional regulation improves future action prediction in team settings.

Experiment: Cooperative Ping-Pong

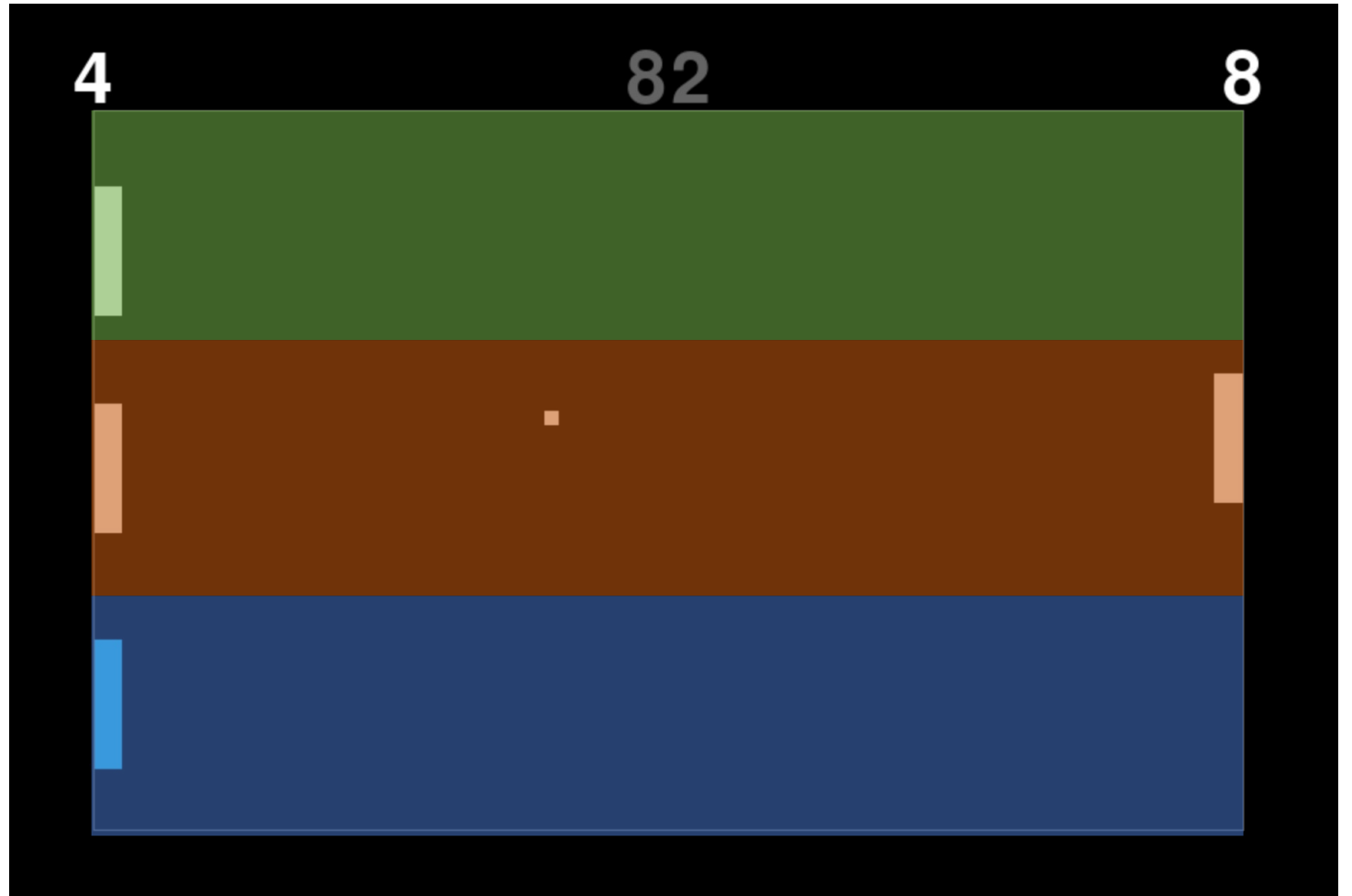A team of 3 participants cooperates against AI in a ping-pong game.

Participants cannot talk to each other.

Approach

Split the paddle area into 3 sections: top, mid, bottom.

Assumption: the optimal strategy is assigning each section to a participant (divide and conquer).

Approach

Model of emotion on team coordination:

- Given a participant's emotion, predict whether the participant will invade other sections.

- The parameter that determines the likelihood of invasion is emotional regulation.

- Emotion (categorical) is recognized using OpenFace library from webcam images.

What does it mean to invade other sections?

- When a participant moves out of his/her assigned section to another section.

Data

Cooperative ping pong task (timestamped)

- Position of all paddles (x, y) bounded continuous integers (fixed x).
- Position of the ball (x, y) bounded continuous integers.

Emotion (timestamped, OpenFace library)

- A list of emotions
- Action units (FACS Emotion Classification)
  - presence (boolean)
  - intensity (float)

Timestamps of the ping-pong task and emotions are asynchronous.

Emotion data

- Timestamped
- Action units (intensity, presence)
- A list of emotions:
  - Happiness
  - Sadness
  - Surprise
  - Fear
  - Anger
  - Disgust
  - Contempt
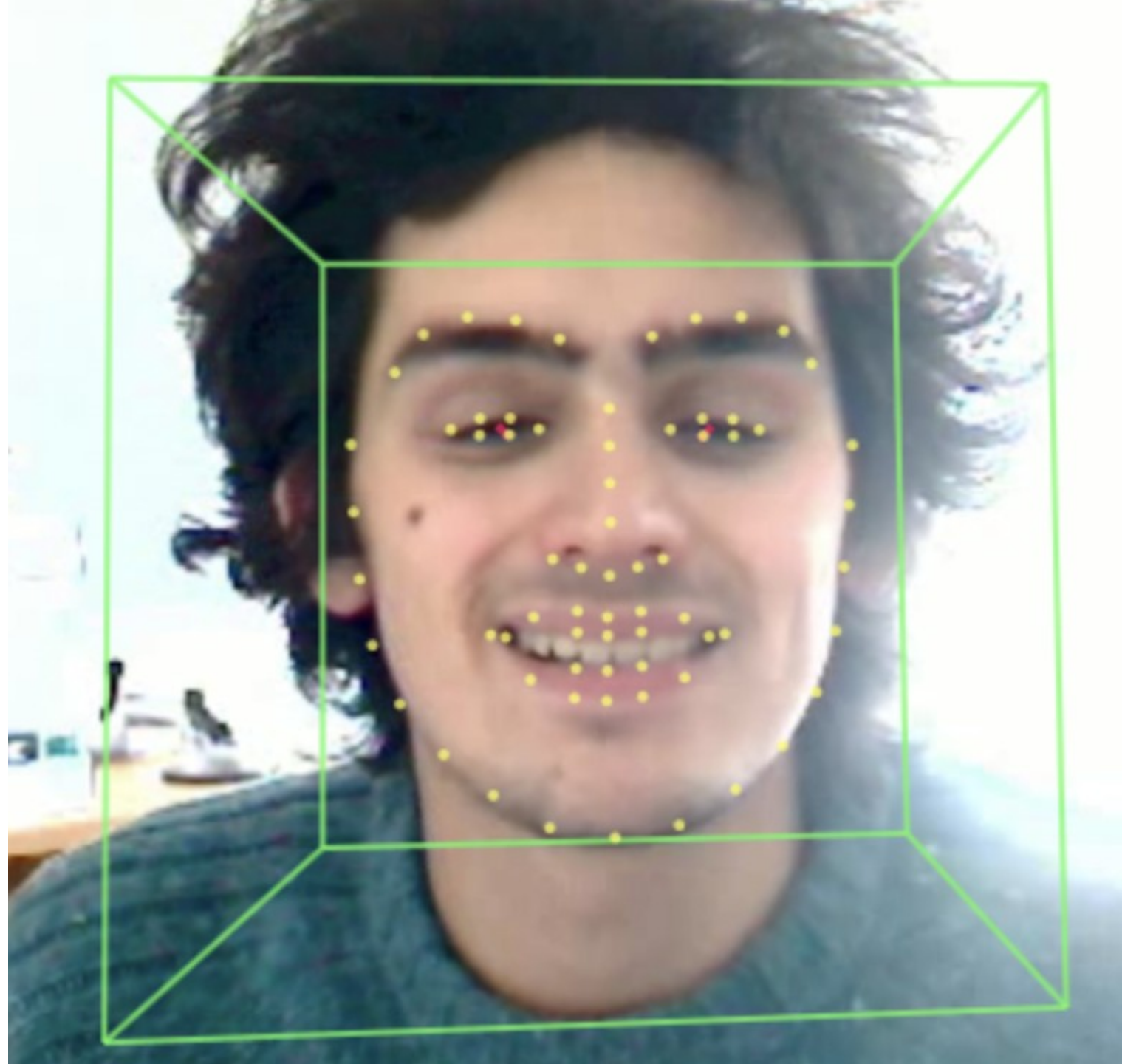
Validation

- The section negotiation model provides labels for invasion at a timestep.

- From emotion, predict whether a member invades a section at a timestep.

- Invasion is a binary label (invasion or no invasion).

- From all timesteps, validate whether the prediction is correct.

Challenges

Observed emotion does not immediately lead to action.

- How long of a time series of observed emotions should be used to predict action?

Modeling section negotiation.

- Once a section is invaded, how do we distinguish between section negotiation period and complete incoordination?
- How do we know when the sections have been successfully reassigned?

Why this project?

- It is simple, allowing incorporation of emotion and emotional regulation into action prediction.

- A proof of concept for studying team dynamics.

- Task and emotion recognition programs are already written.

Potential extension

- Incorporates affect (valence, arousal, emotion)

- Incorporates EEG, fNIRS, heart-rate, and skin conductance data (map switch state space model to valence and arousal)

References

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