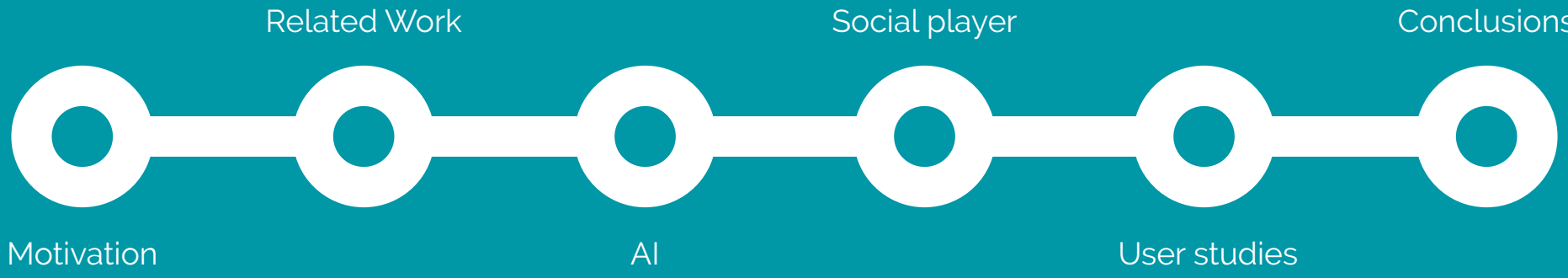
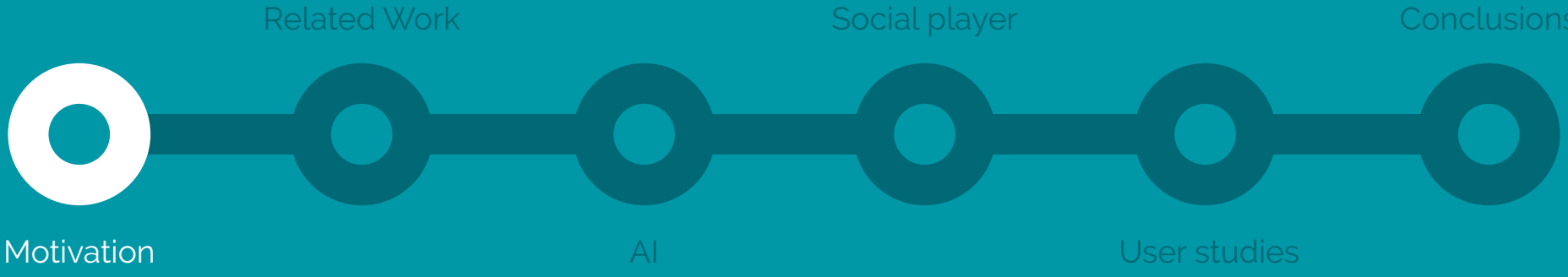
TÉCNICO LISBOA

EMYS: a social robot that plays “Sueca”

69930 - Filipa Isabel Nogueira Correia

Outline


Related Work
Social player
Conclusions
Motivation
AI
User studies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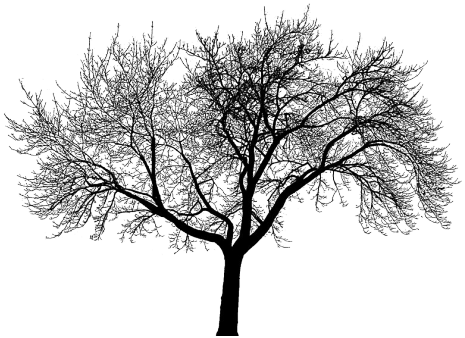
Motivation

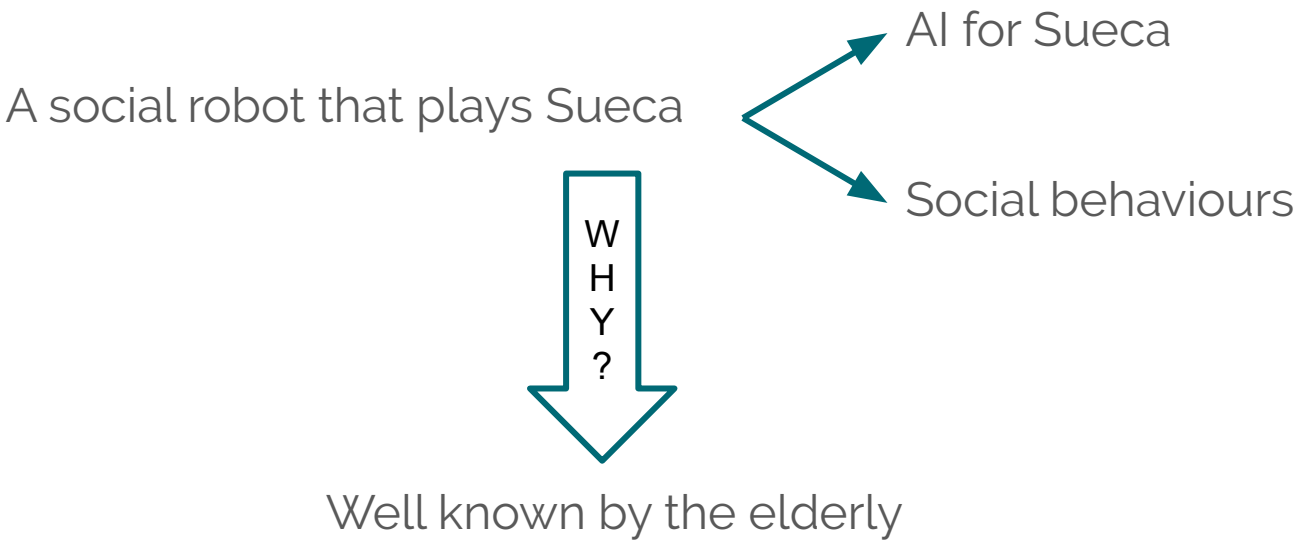


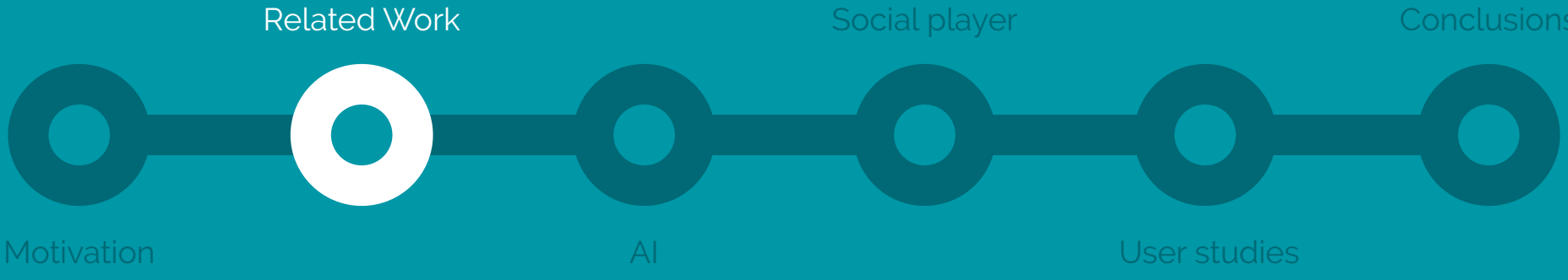
Complexity

Motivation

Can an artificial player be social?

Motivation


AI for Sueca
A social robot that plays Sueca
Social behaviours
WHY?
Well known by the elderly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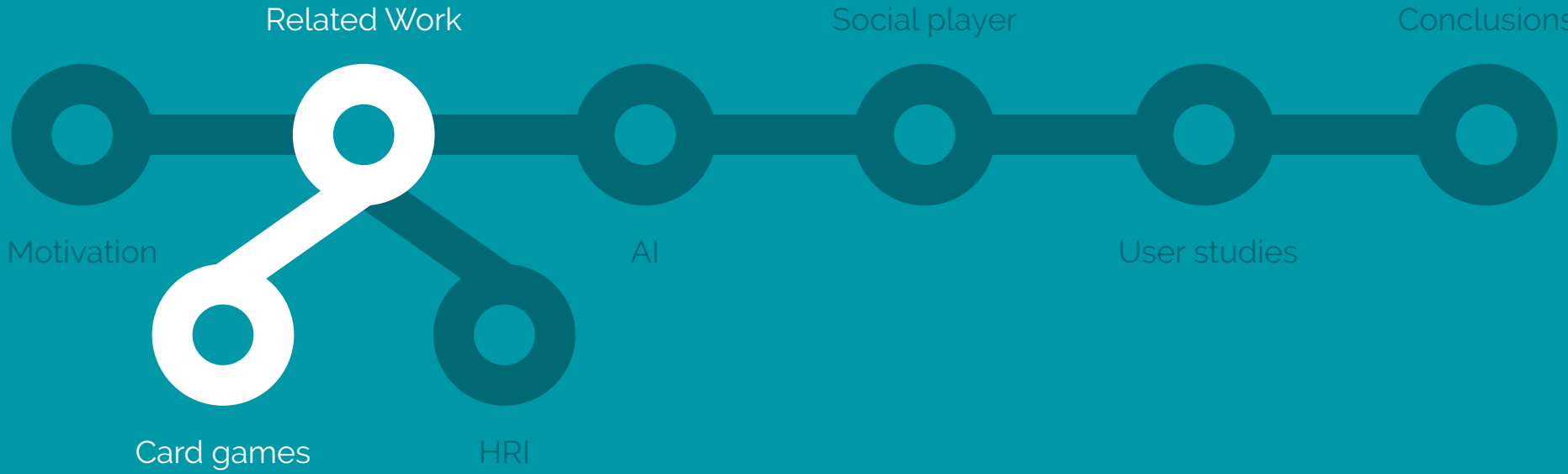
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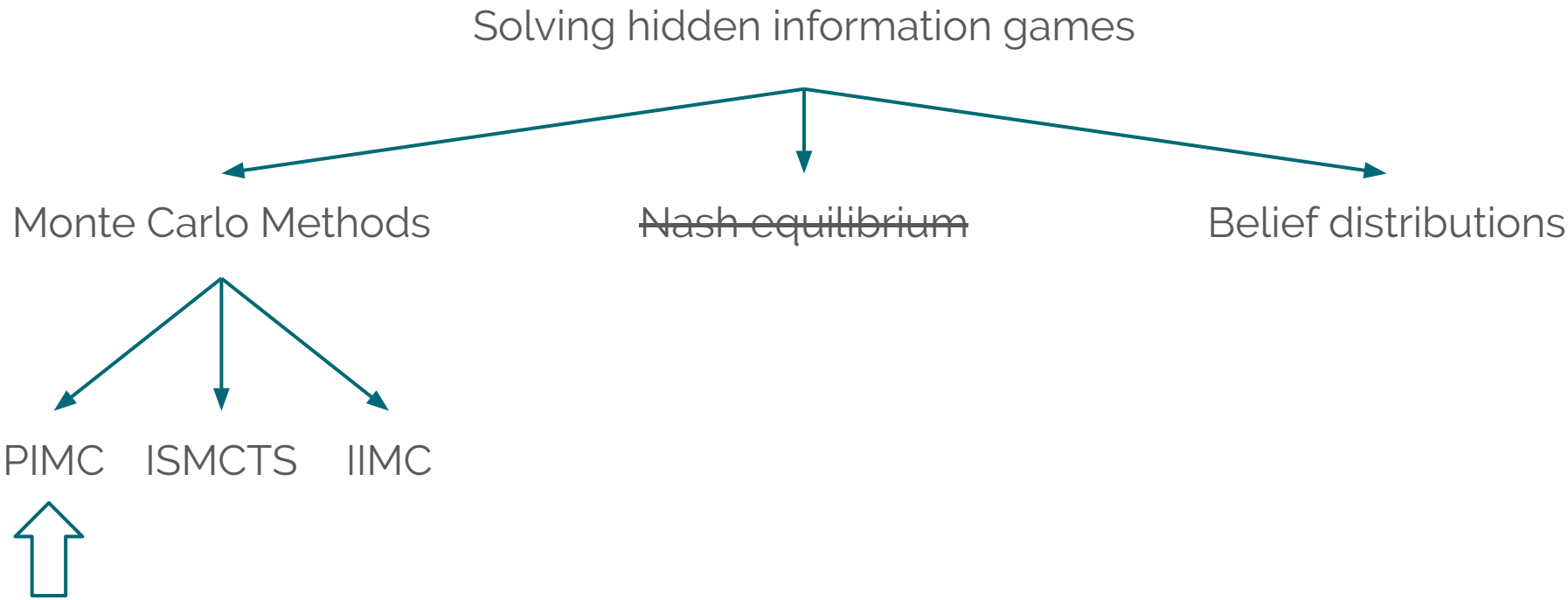
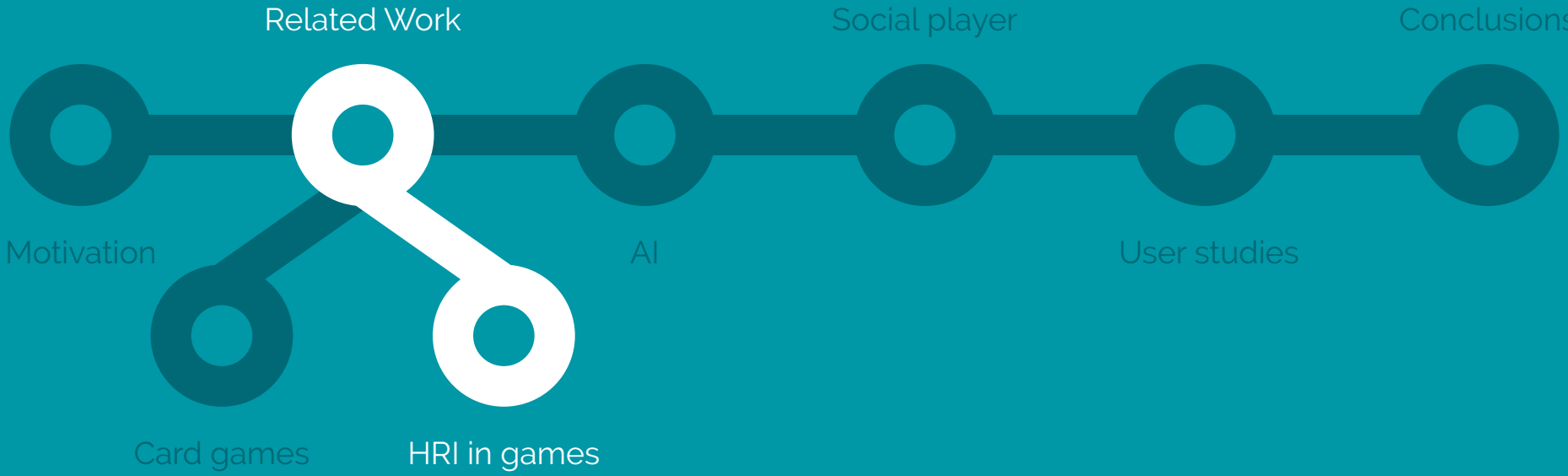
Card games
HRI

Card games


Solving hidden information games
Monte Carlo Methods
~~Nash equilibrium~~
Belief distributions
PIMC
ISMCTS
IIMC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HRI in games

HRI in games

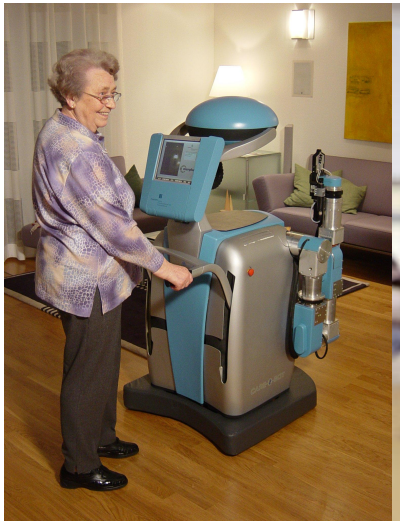
EMYS, the Risk player

- Topology of speeches
- Relevance value of a move
- Power of a player
- Simulation of roles
- Luck perception

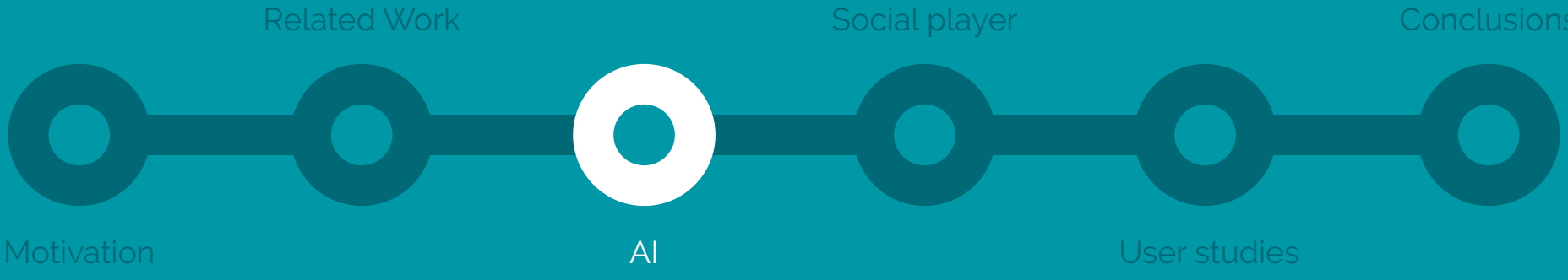
iCat, the chess tutor

- Children tutor
- Careful advices
- Long-term interactions

HRI in games



There is a gap in companion robots for older adults without serious health problems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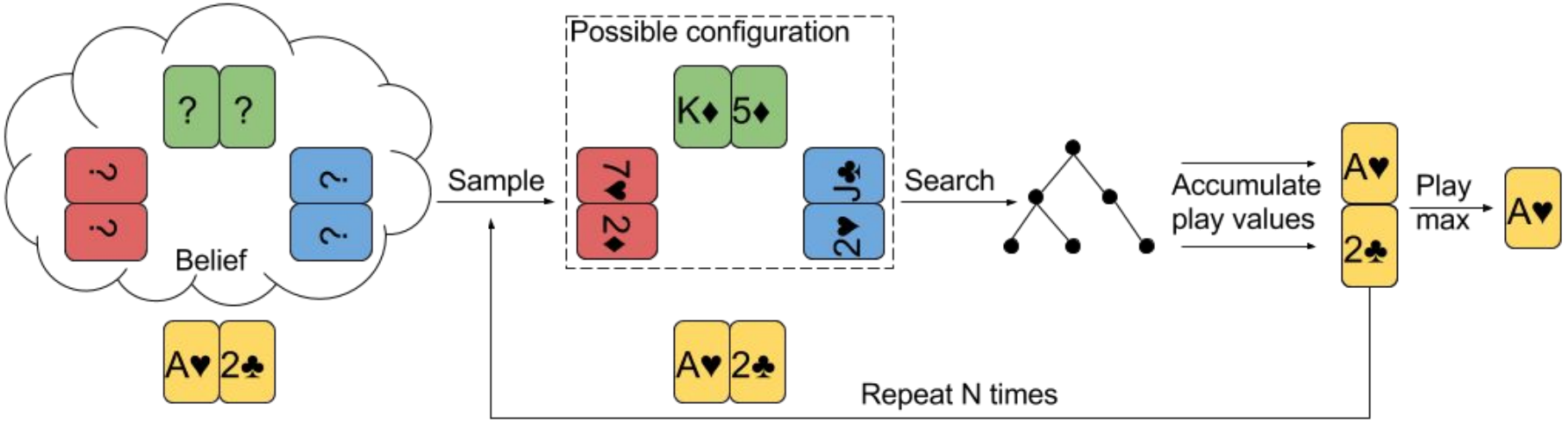
AI

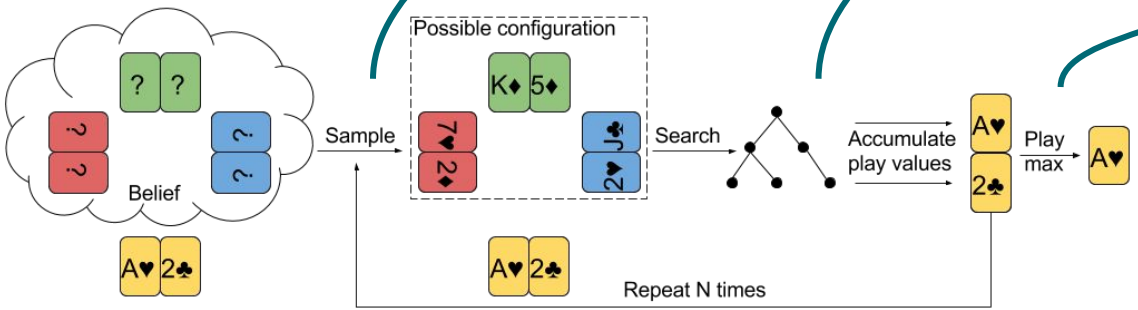
PIMC concept



AI

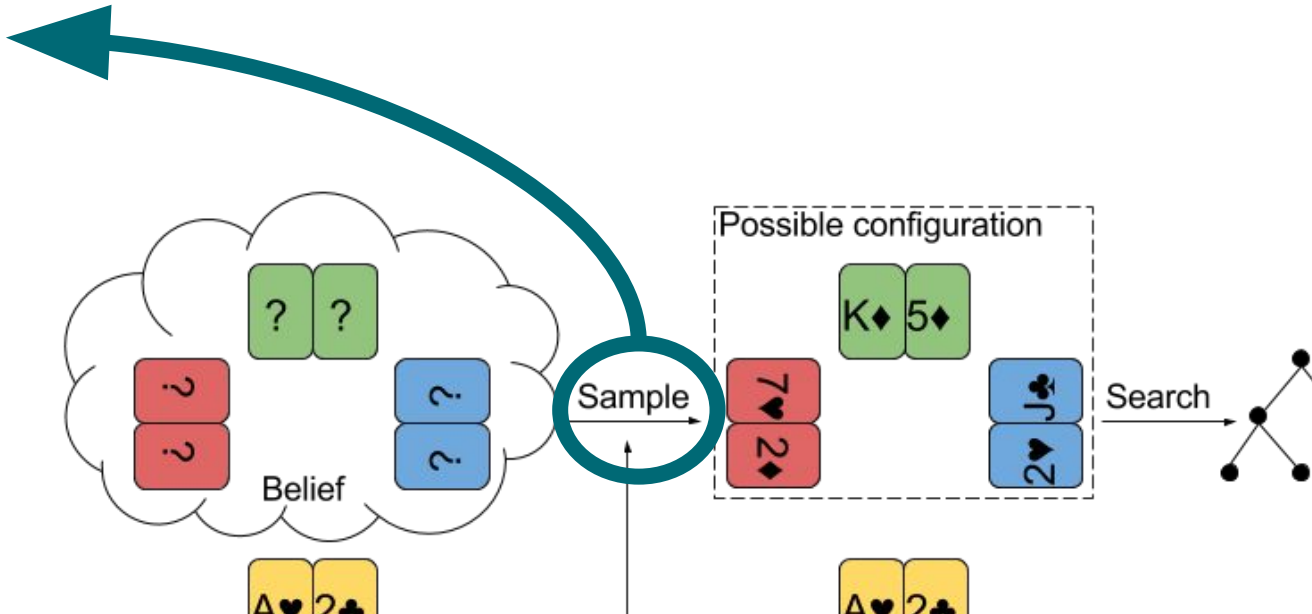
Algorithm 1 PIMC search algorithm

```
1: procedure PIMC(InfoSet I, int N)
2:     for all m ∈ Moves(I) do
3:         val[m] = 0
4:     for all i ∈ {1..N} do
5:         x = Sample(I)
6:         for all m ∈ Moves(I) do
7:             val[m] += PerfInfoValue(x, m)
8:     return argmax_m {val[m]}
```



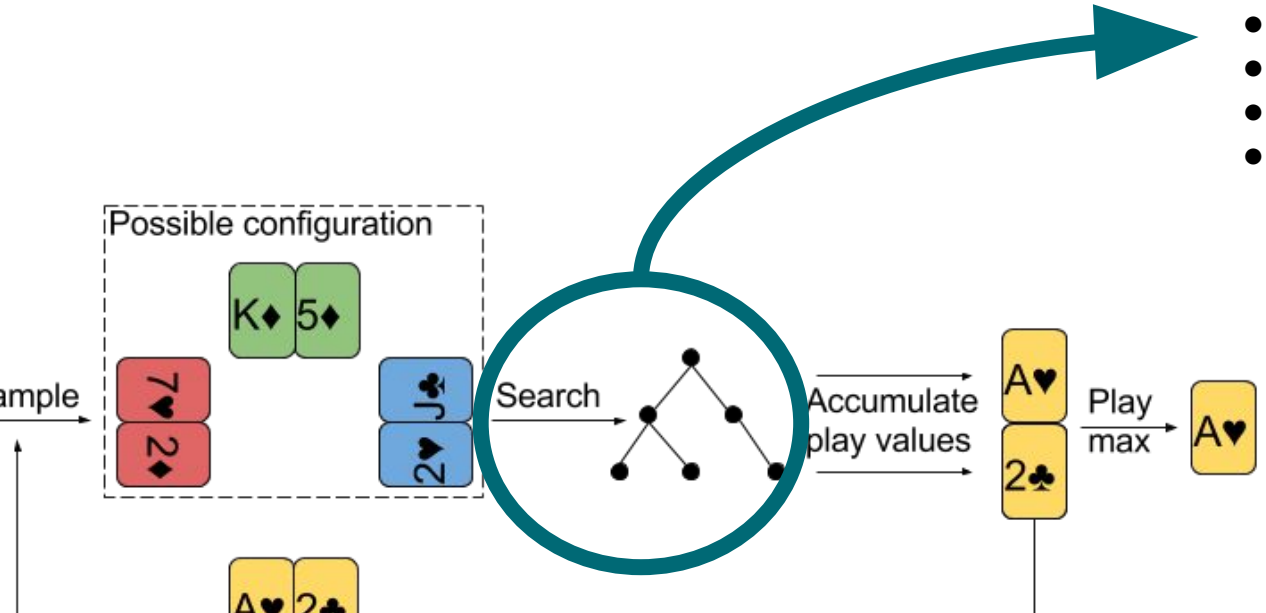
AI

Information set
- Deck
- Suits per player

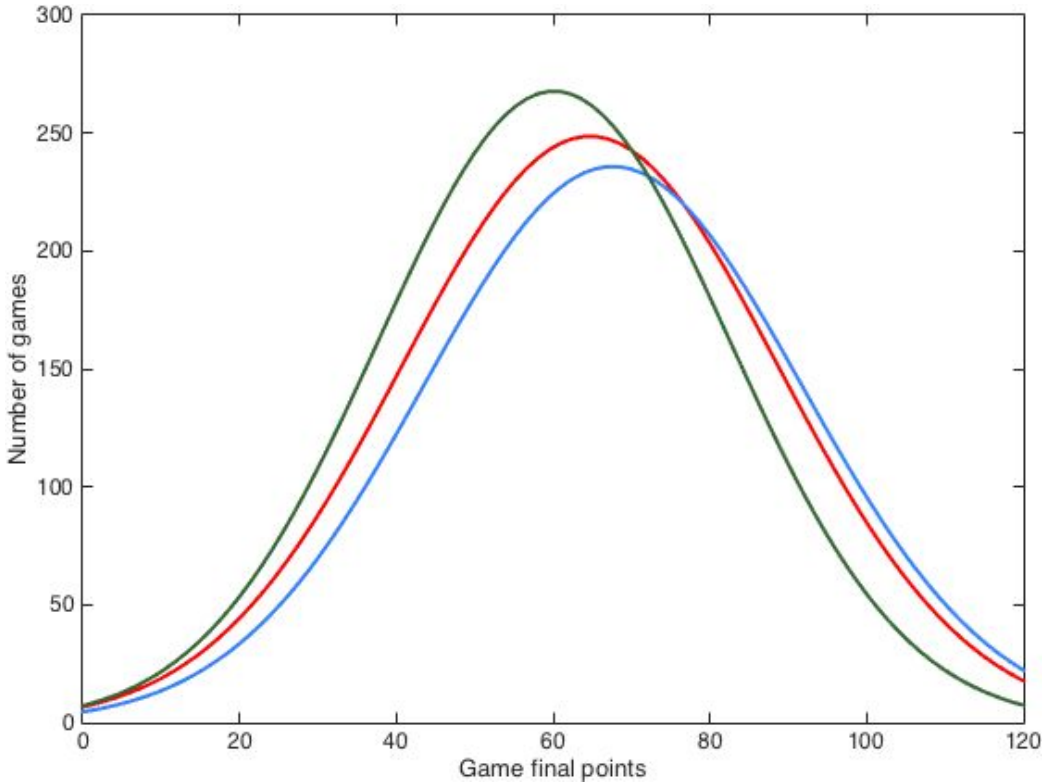


AI

Min Max
- αβ pruning
- Depth limit
- Ordering heuristic
- Transposition table
- Equivalent states removal



AI

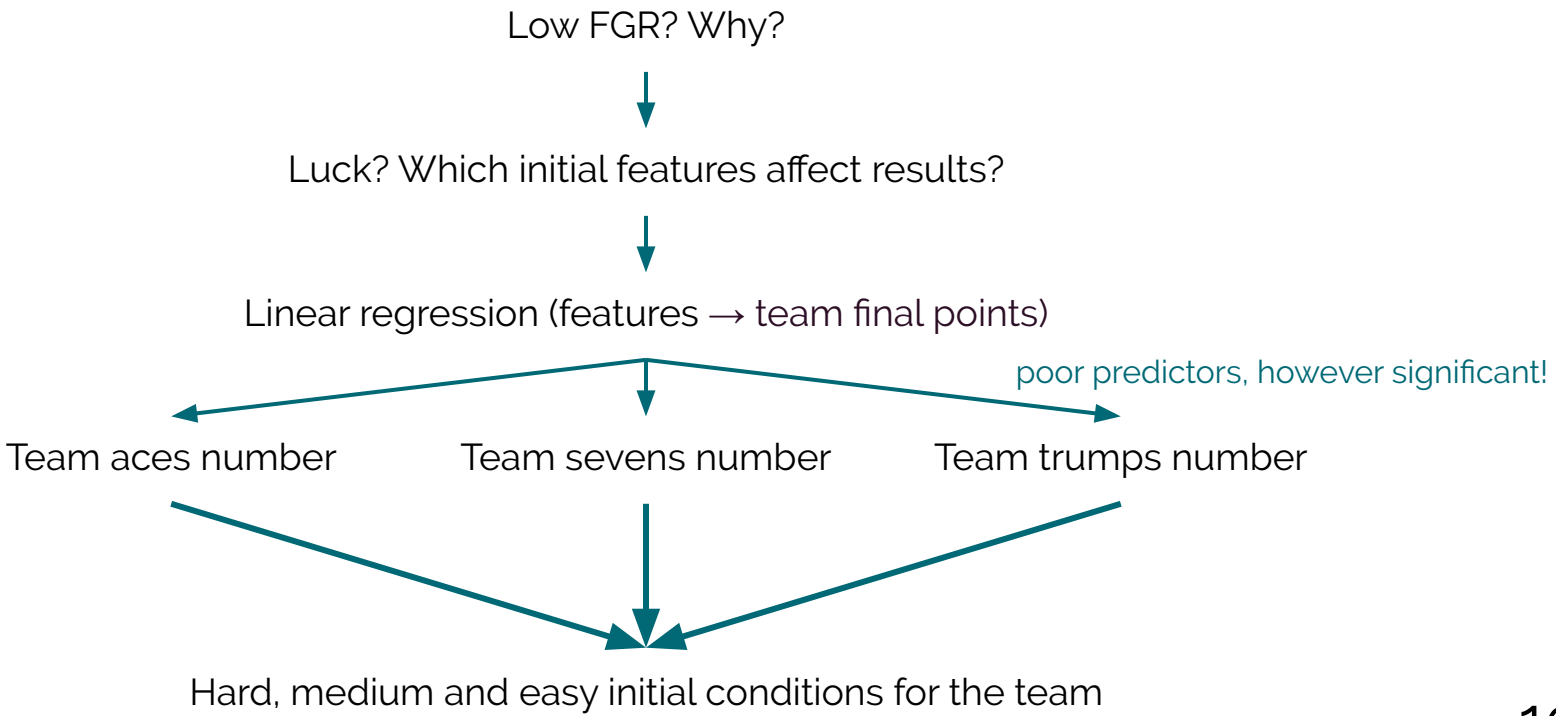


Benchmark: Rule-based Player

	FGR
2RB vs 2RB	50,4%
1RB 1Rand vs 2Rand	53,4%
2RB vs 2Rand	62,9%

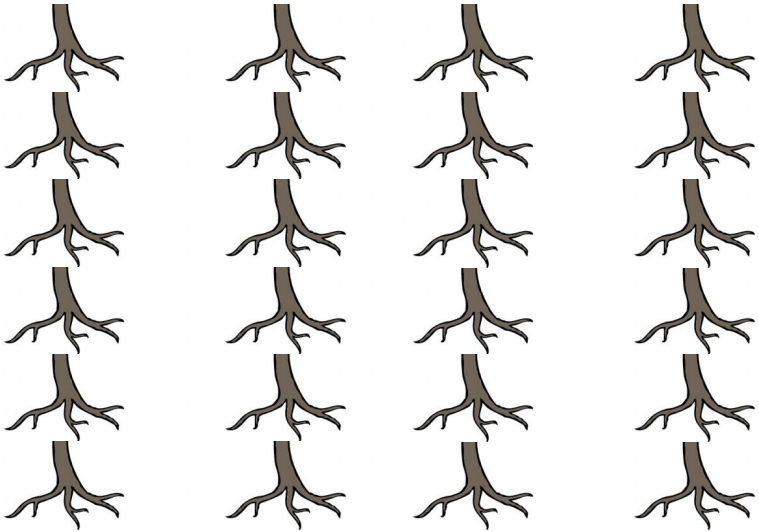
Team impact!

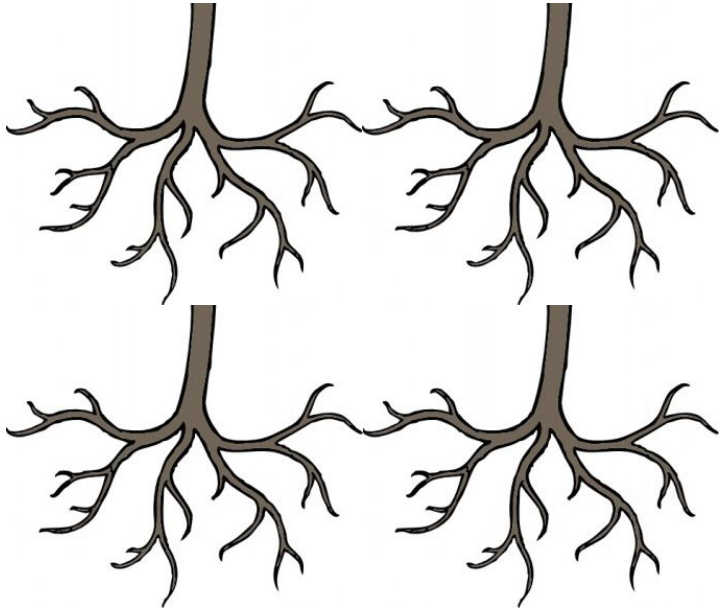
AI


Low FGR? Why?
Luck? Which initial features affect results?
Linear regression (features → team final points)
poor predictors, however significant!
Team aces number
Team sevens number
Team trumps number
Hard, medium and easy initial conditions for the team

AI

Implementing PIMC...





AI

Parametrizing...

Trick Player

- Utility func.: u_1
- Depth limit: 1 trick

Deep-1 Player

- Utility func.: u_1
- Depth limit depends on the tree size

Deep-2 Player

- Utility func.: u_2
- Depth limit depends on the tree size

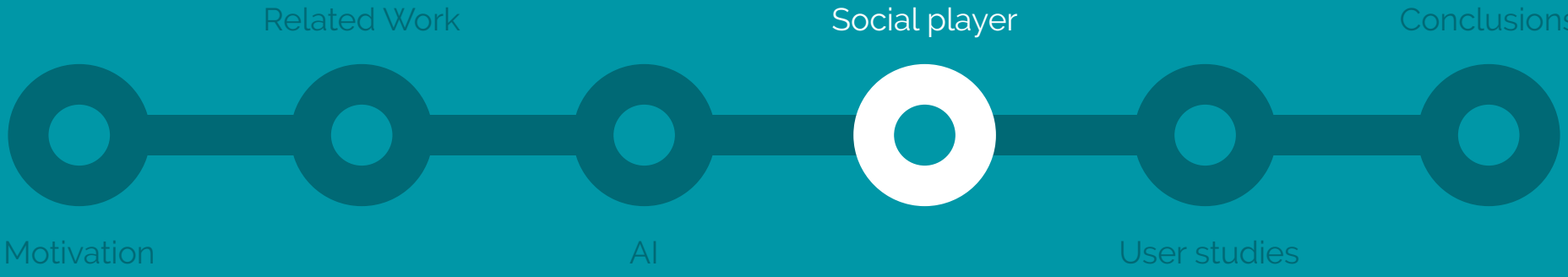
$$u_1 = \begin{cases} teamPoints, & teamPoints \geq opponentTeamPoints \\ -opponentTeamPoints, & teamPoints < opponentTeamPoints \end{cases}$$

$$u_2 = \begin{cases} 2, & teamPoints > 90 \\ 1, & teamPoints > 60 \\ 0.1, & teamPoints > 30 \\ -2, & opponentTeamPoints > 90 \\ -1, & opponentTeamPoints > 60 \\ -0.1, & opponentTeamPoints > 30 \end{cases}$$

AI

Most significant rate

Favourable Games Rate (%)	Hard Games	Medium Games	Easy Games
Trick Player	3,7	53,3	95
Deep-1 Player	0	59,4	100
Deep-2 Player	0	58,9	100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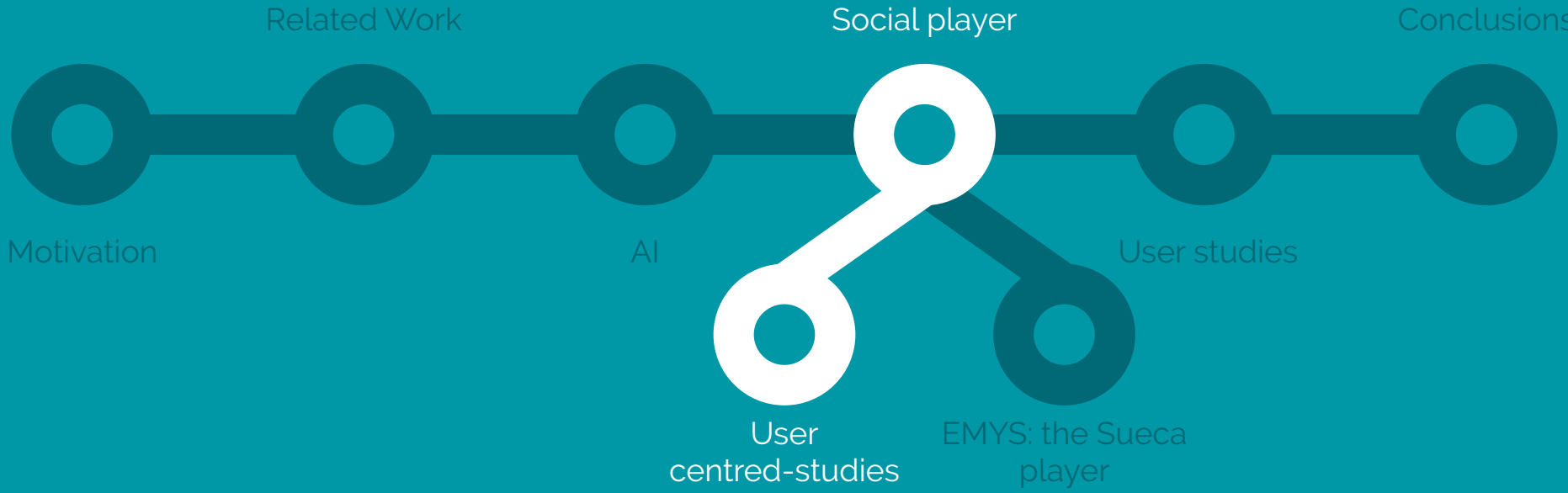
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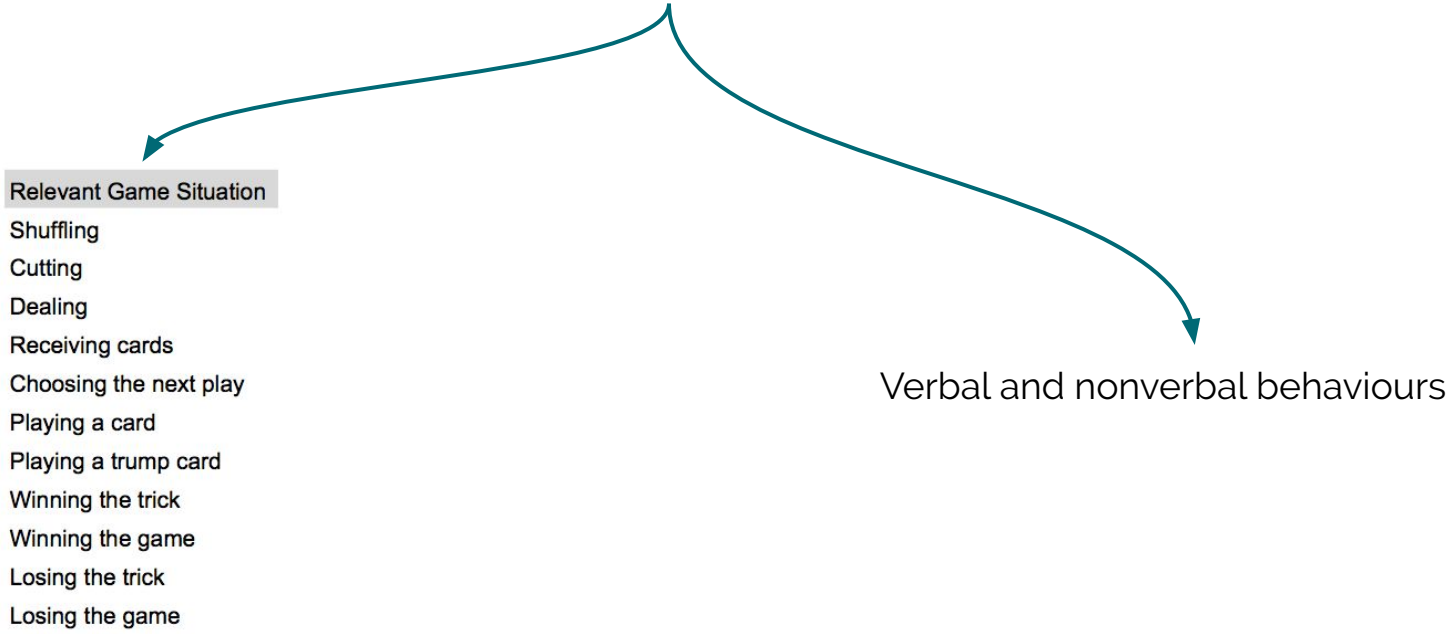
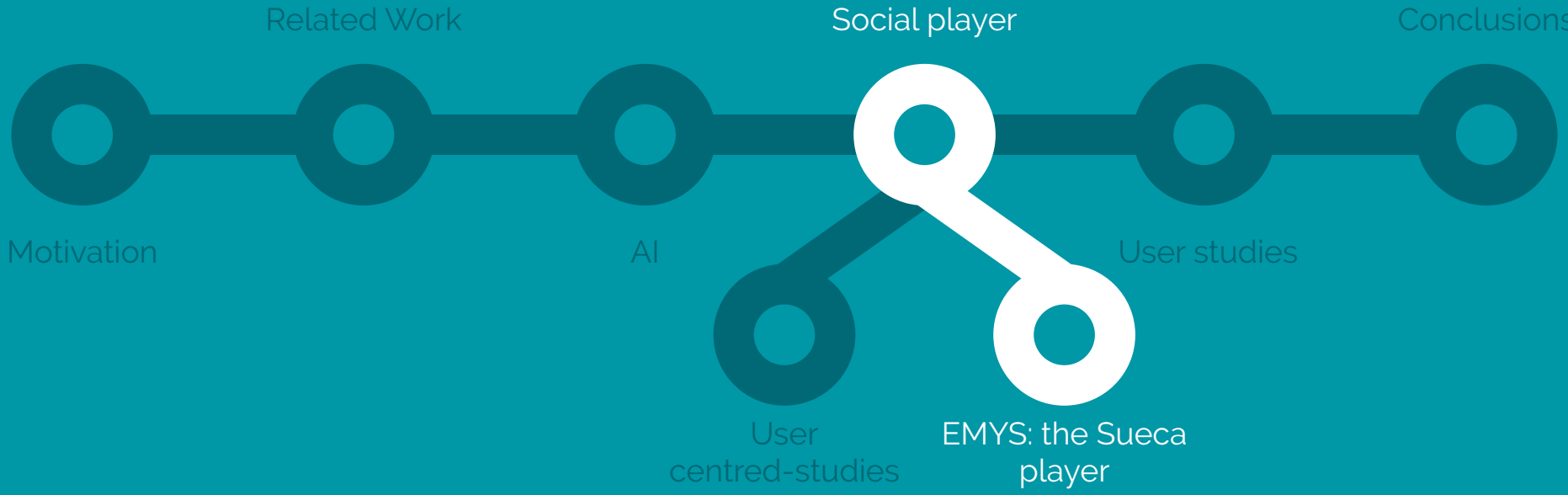
User centred-studies
EMYS: the Sueca player

User centred-studies

4 participants from a day-home care institution playing Sueca

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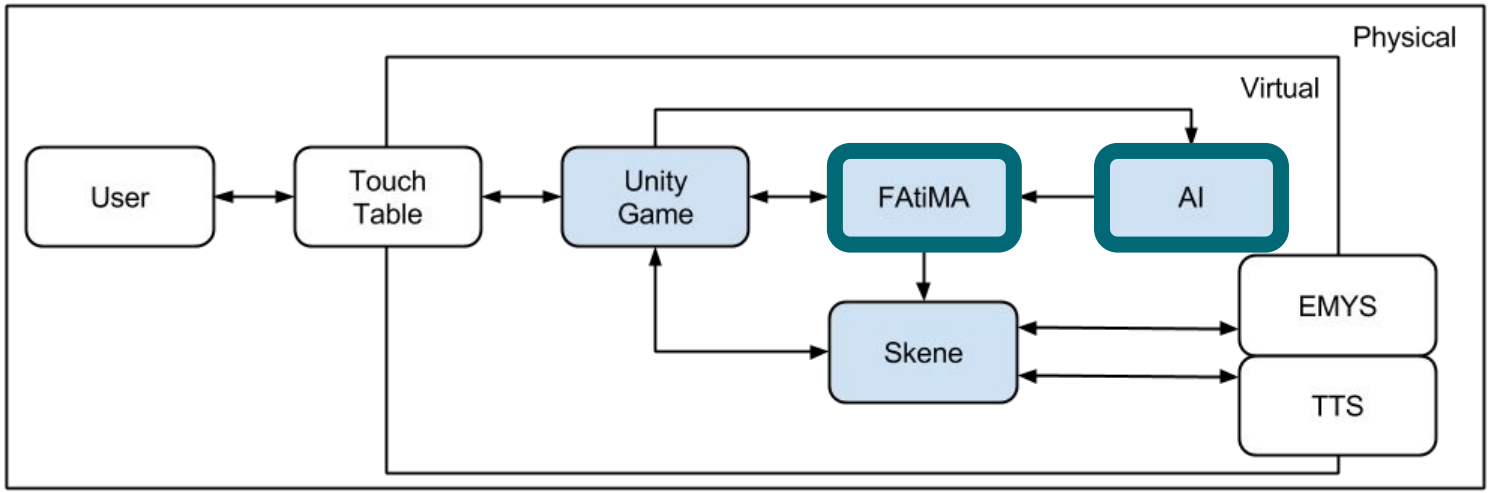


EMYS: the Sueca player

Relevant Game Situation

Shuffling

Cutting

Dealing

Receiving cards

Choosing the next play

Playing a card

Playing a trump card

Winning the trick

Winning the game

Losing the trick

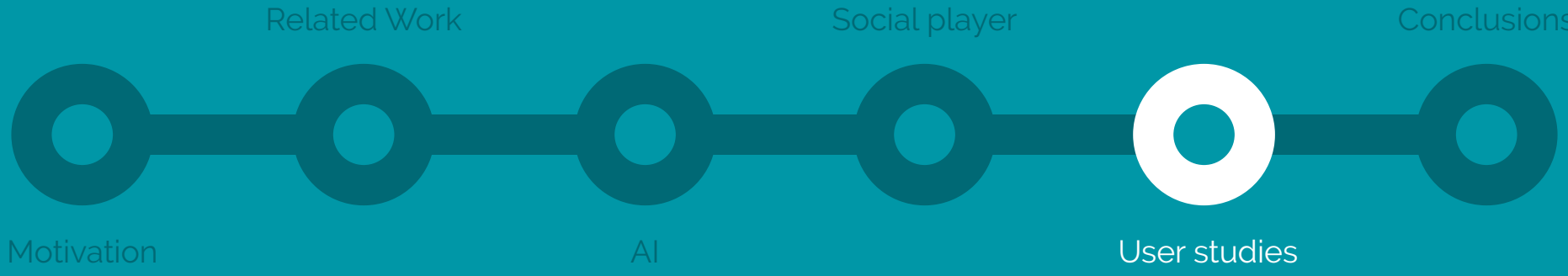
Losing the game

Session Start	Session End	GameEnd		Trick End	Receive Cards
Greeting	Win	Single Win	Single Lost	Self	Self
	Lost	Double Win	Double Lost	Team	
	Draw	Quad Win	Quad Lost	Opponent	
		Team Cheat	Draw	Opponent Zero	
		Other Cheat			
Play	**Playing**	**Shuffle**	**Cut**	**Deal**	**Next Player**
Self Happy	New Trick	Self	Self	Self	Team
Happy For	Following	Other	Other	Other	Opponent
Gloating	Not Following				
Resentment	Cut				
Self Pitty					
Pitty					

EMYS: the Sueca player

Human-like behaviours:

- speech frequency
- emotional state (FAtiMA)
  - posture
  - subcategory of some utterances
- competitive to the opponent
- encouraging to the partner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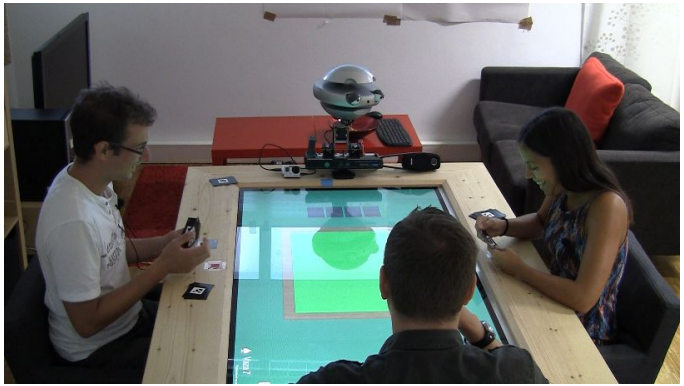
User studies

60 participants



(1) Pre-questionnaire
- PANAS
- Human-Robot Trust

(2) Playing with EMYS

(3) Pos-questionnaire
- PANAS
- Human-Robot Trust
- Networked Minds

User studies

Trust in the partner

Social Presence of the partner

Affect felt

User studies

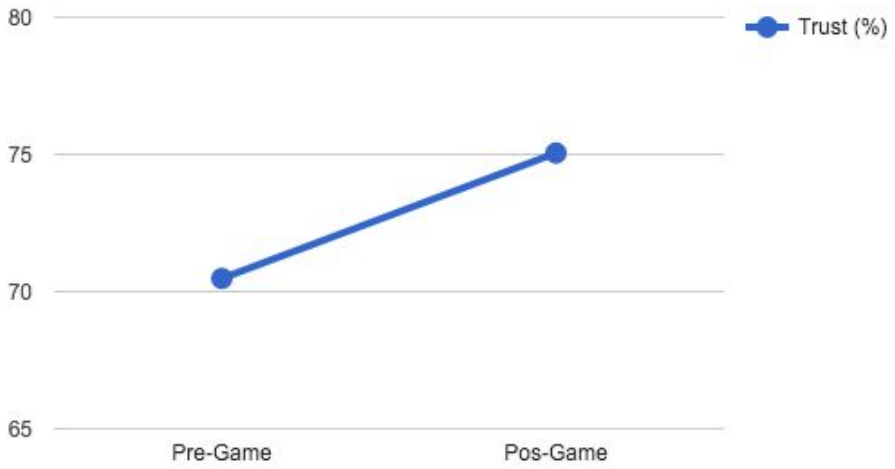
Trust

Are there changes in trust after the experience of interacting with the Sueca partner?
[Mixed ANOVA test]

Answer:

time ⟶ Trust (p=0.03)

[time, partner] ↛ Trust (p=0.65)



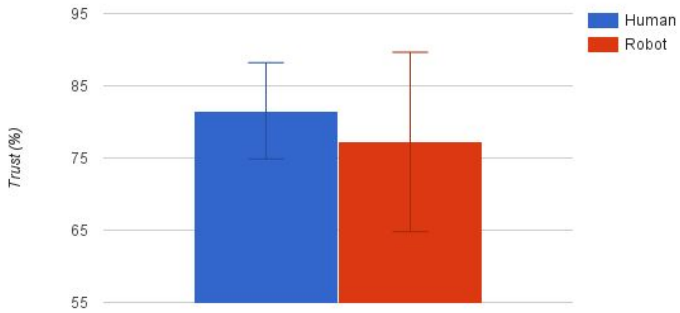
User studies

Trust

Are the trust levels influenced by the partner (robot or human)?
[Welch test]

Answer:

partner ⟶ Trust ($p=2x10^{-6}$)



User studies

Trust

Are the trust levels influenced by the game results?
[Two-way ANOVA test]

Answer:

game result $\not\rightarrow$ Trust ($p=0.065$)

[game result, partner] $\not\rightarrow$ Trust ($p=0.507$)

User studies

Social Presence

Is the social presence influenced by the Sueca partner (robot or human)?
[One-way ANOVA test]

Note: Networked Minds Questionnaire has 6 dimensions

Answer:

partner ↛ co-presence (p=0.217)

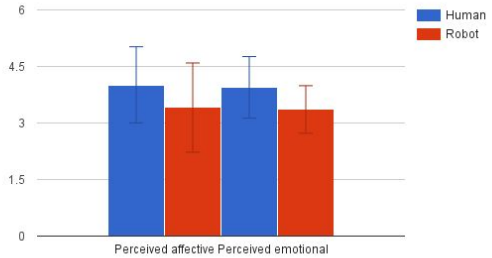
partner ↛ attentional allocation (p=0.965)

partner ↛ perceived message understanding (p=0.777)

partner ⟶ perceived affective understanding (p=0.007)

partner ⟶ perceived emotional interdependence (p=0.046)

partner ↛ perceived behavioural interdependence (p=0.406)



User studies

Affect

Are there changes in positive/negative affect after interacting with the Sueca partner? [Mixed ANOVA test]

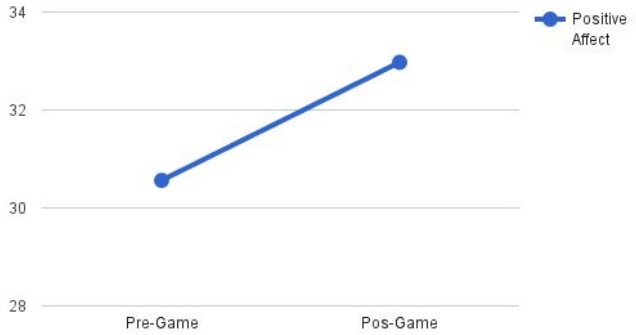
Answer:

time ⟶ positive affect (p=0.008)

[time, partner] ↛ positive affect (p=0.488)time

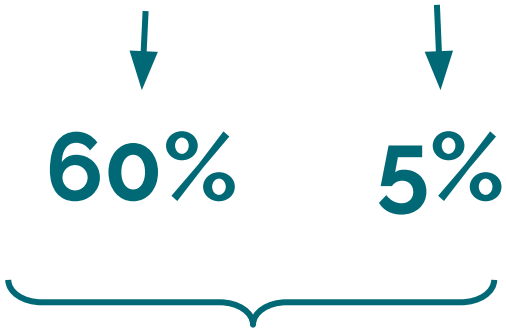
time ↛ negative affect (p=0.267)

[time, partner] ↛ negative affect (p=0.184)

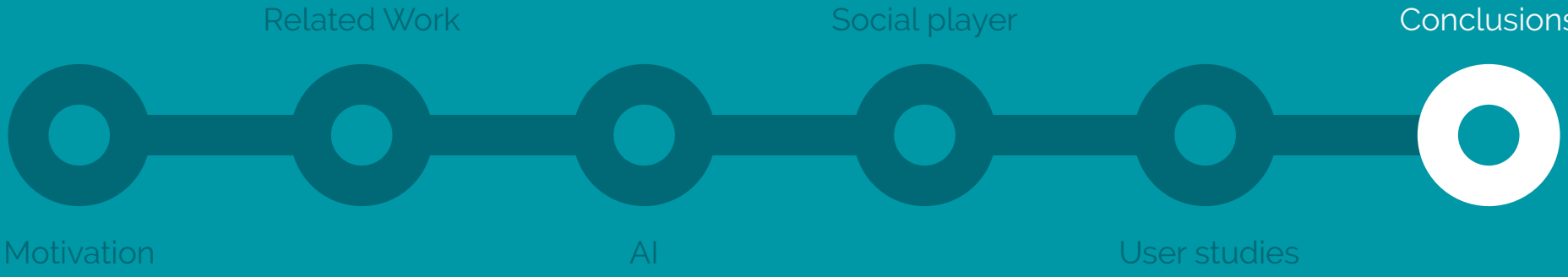


User studies

The robot team won 12 and drawn 1 sessions out of 20



FGR: 65%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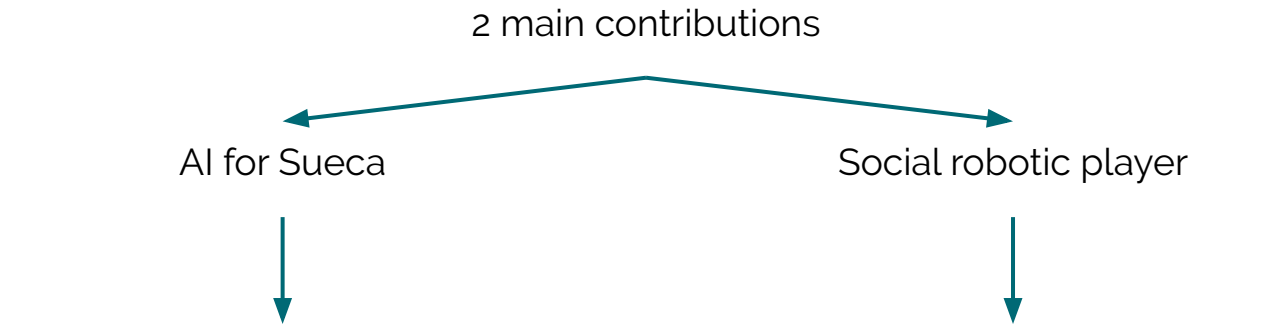

Future Work

Technical improvements:

- to create a heuristic for the utility function
- machine learning from collected games to infer a current world approximation
- to improve the linear regression of the final points
- transposition table as LFU or LRU
- to generate games of different initial conditions
- to explore other emotions of FAtiMA
- to avoid redundancy of utterances during the session

HRI next steps:

- expand the scenario for an older audience

Thank you!