



Computers that can Negotiate

ERCIM Cor Baayen Award

Tim Baarslag

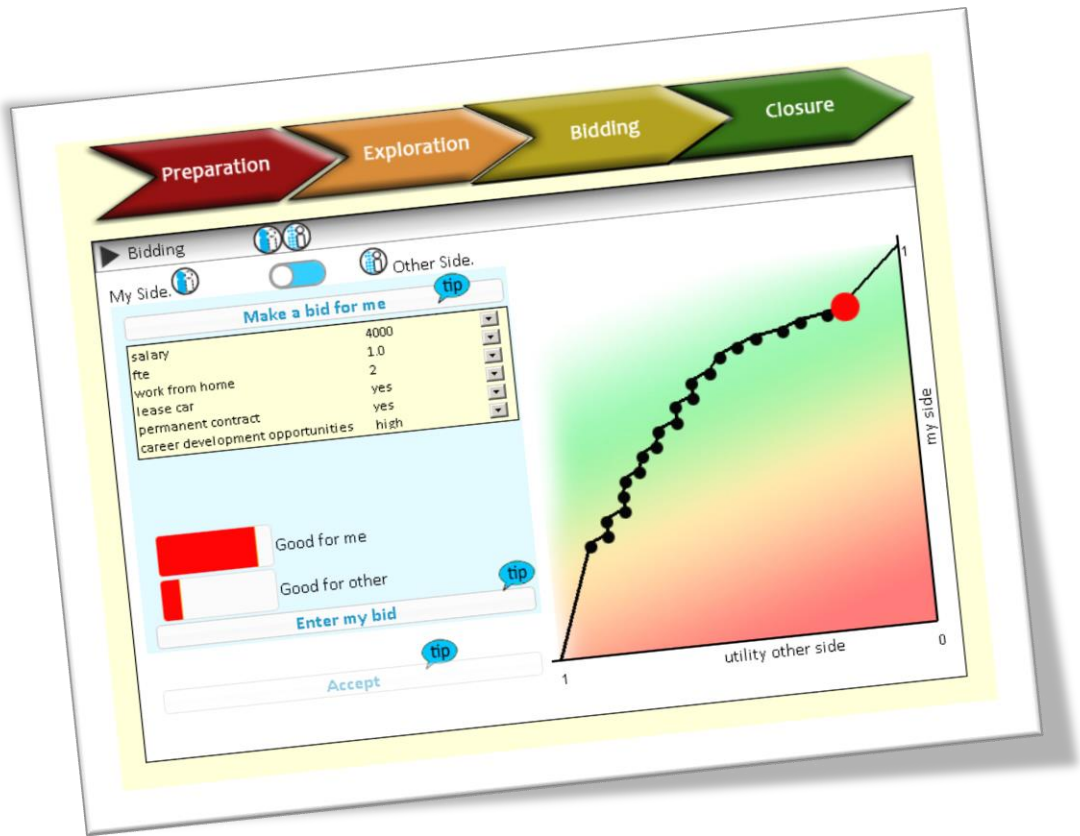
CWI

Researcher in Centrum Wiskunde & Informatica (CWI),
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Science in the Netherlands

Negotiation

- Negotiation is everywhere around us.
- Many **human deficiencies**:
 - Leaving money on the table, bounded rationality
 - Biases & emotions, time & costs

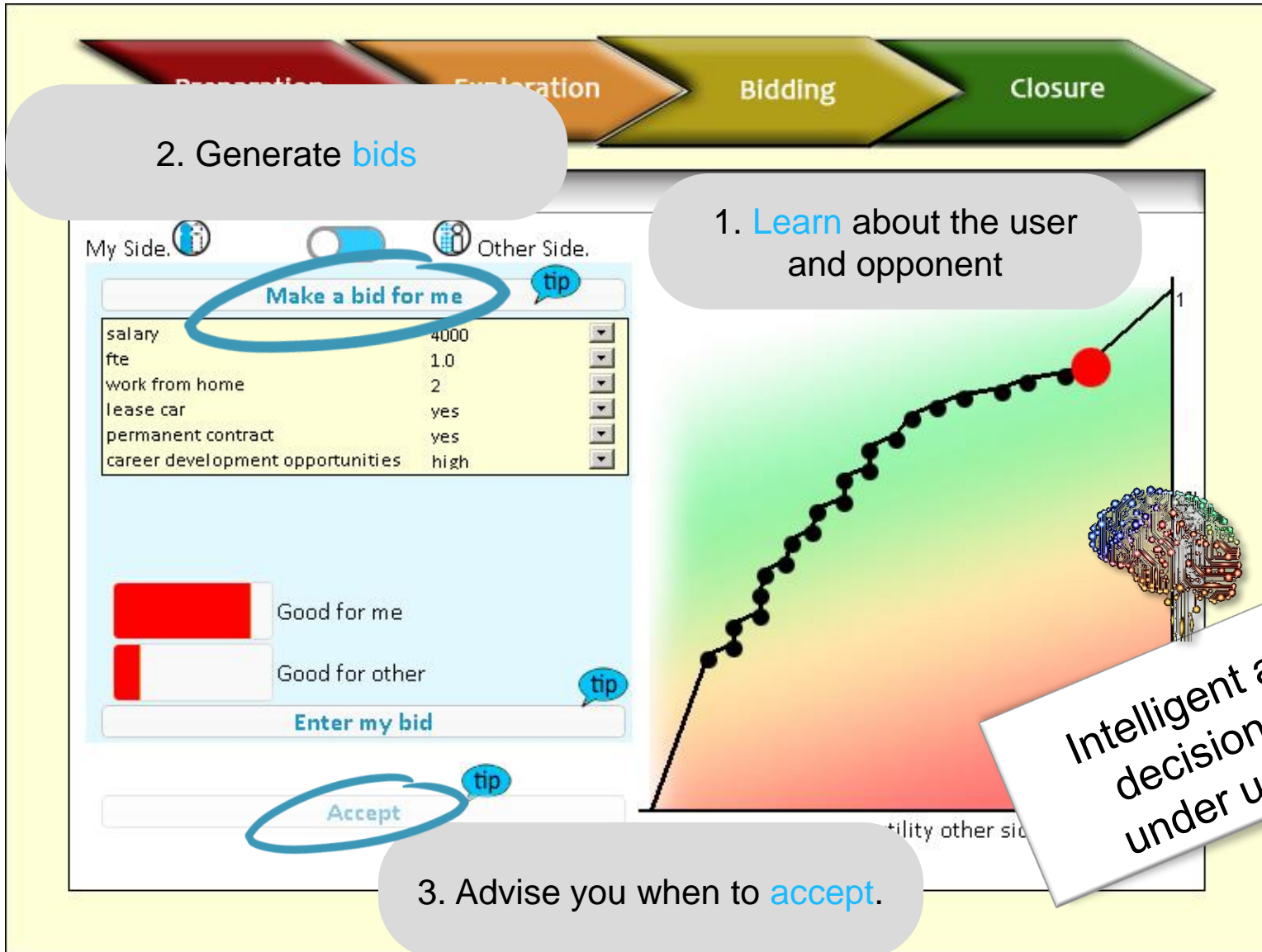




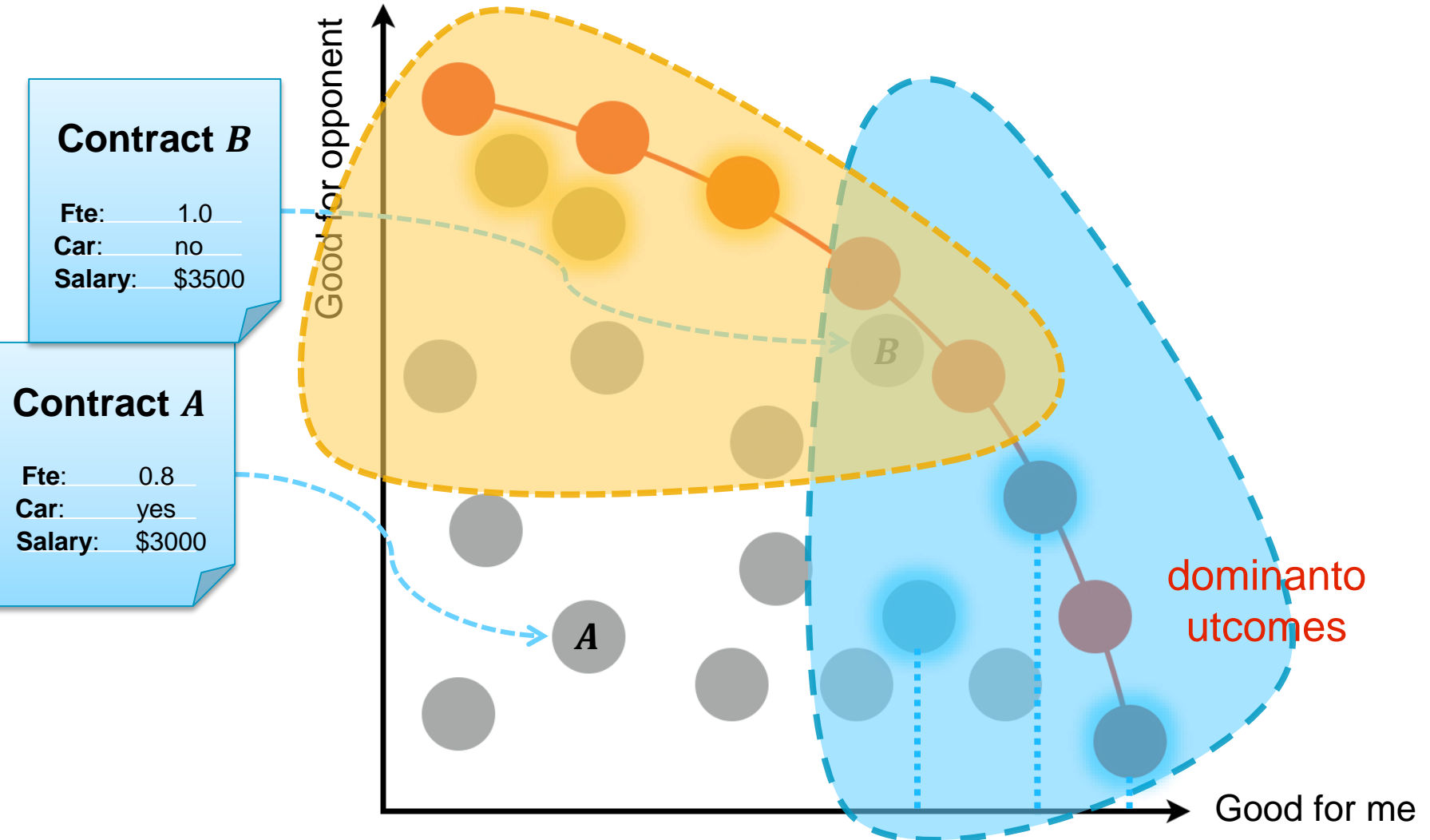
Research line I

NEGOTIATION SUPPORT

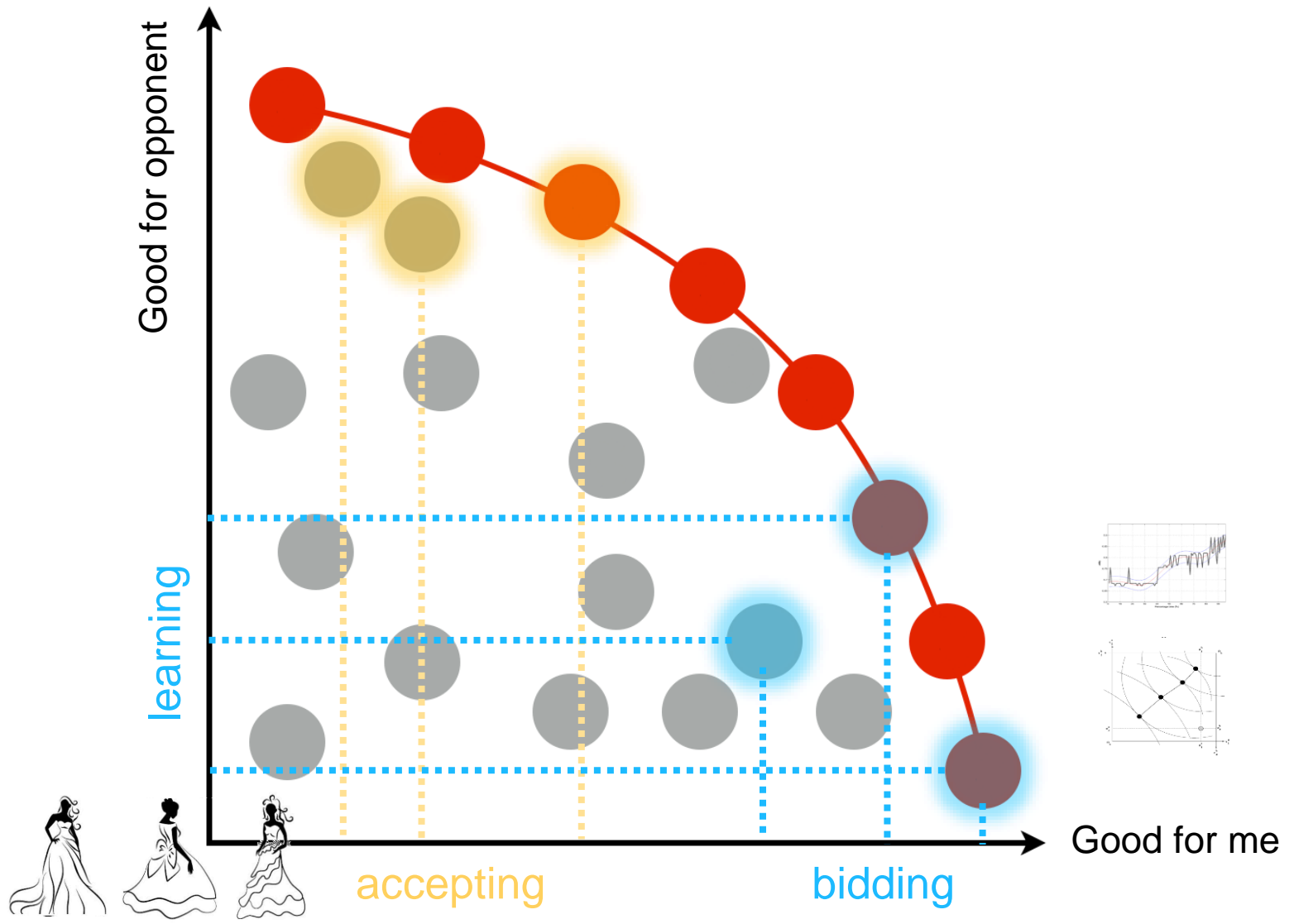
Negotiation support requirements



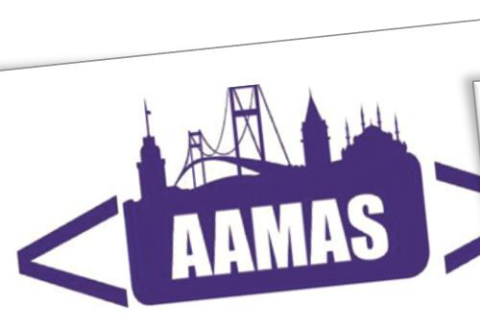
Automated negotiation challenges



Automated negotiation challenges



The Automated Negotiating Agent Competition



>120 international participants.
<http://ii.tudelft.nl/anac/>

Time Remaining: 7.4s

Brad ... He is excited to begin negotiating!

Can I provide more information to help us reach consensus?

You'll get 0 shipments of bananas. You'll get 0 shipments of gold.

Perhaps we should split the goods for us both...

I think you'll find this offer better.

You'll get 0 bars of gold, and I'll get 0 bananas.

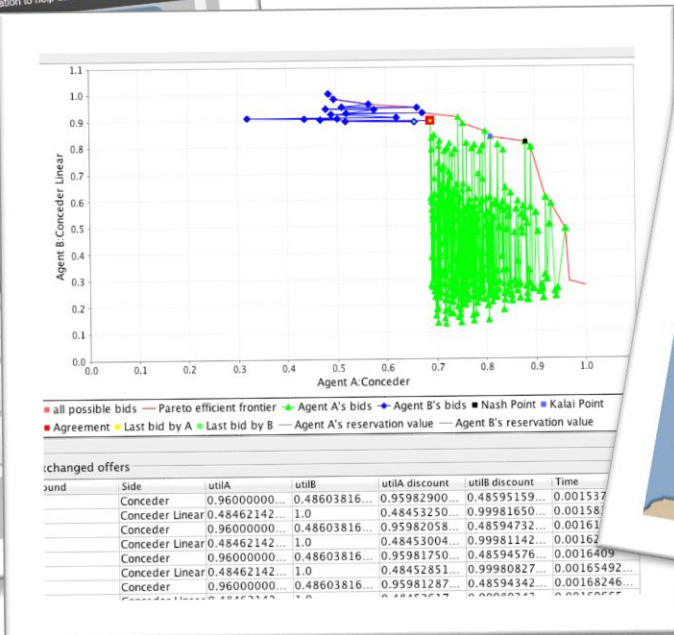
Can I provide more information to help us reach consensus?

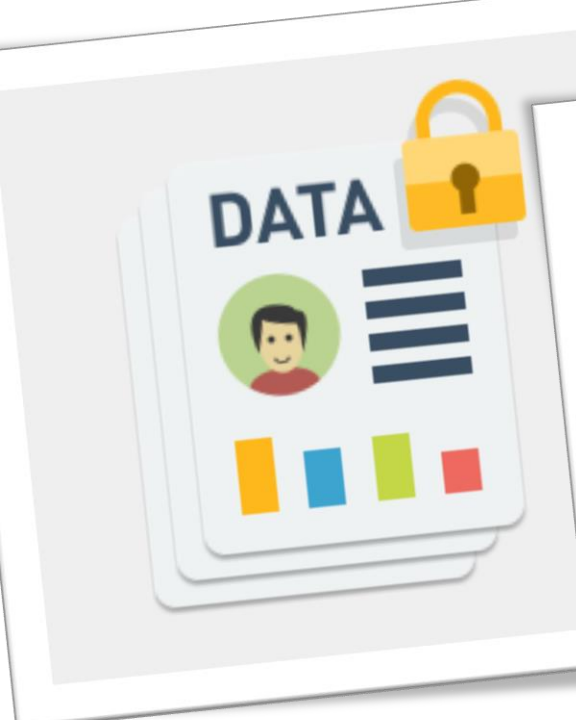
Opponent's	1	0	0	0
Undecided	4	4	5	5
Yours	0	1	0	0
Your Points:	0	2	0	0
Total:	2			

Start an offer

Accept offer (non-binding)

Reject offer (non-binding)





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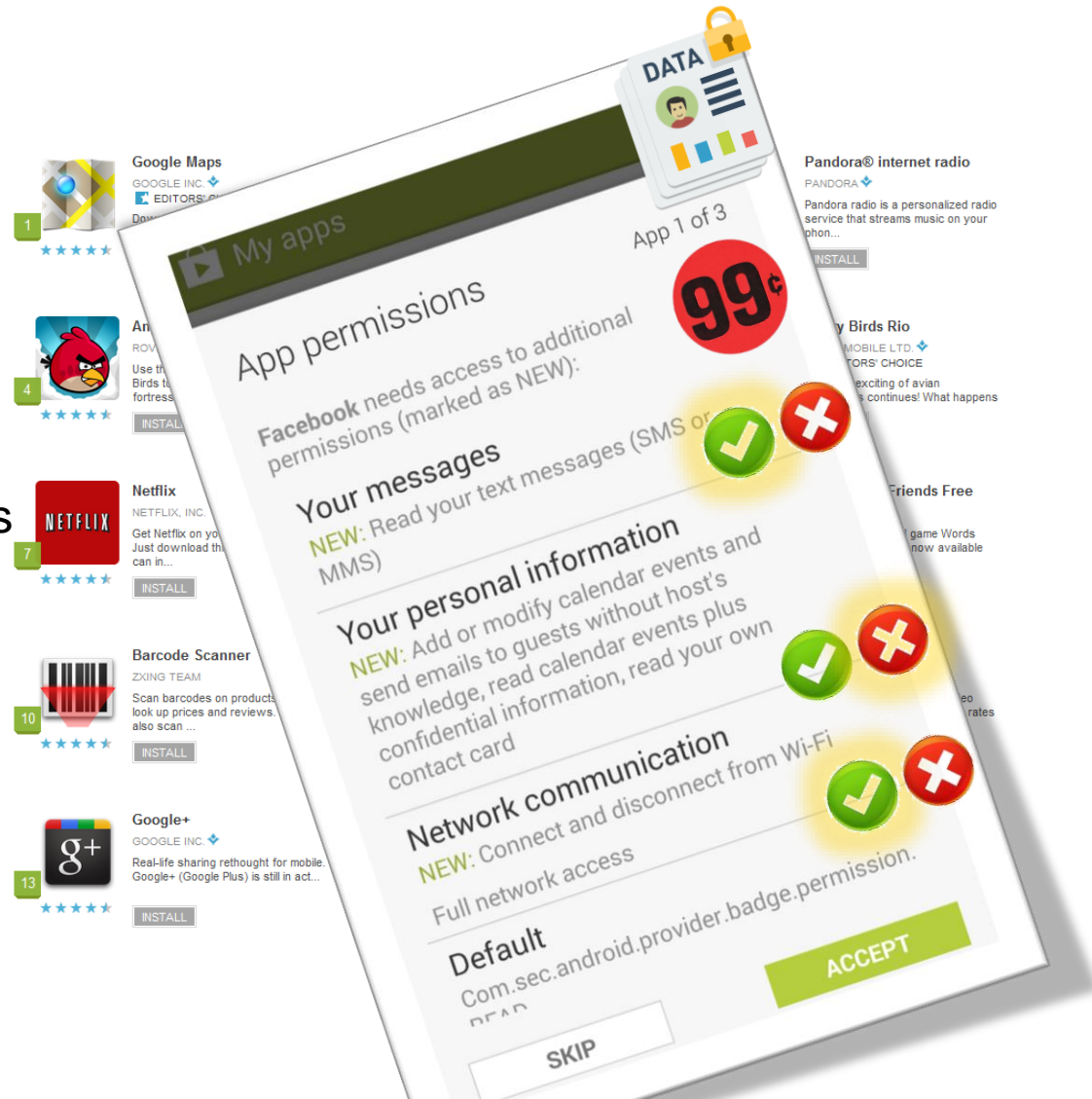
I AGREE

Research line II

PRIVACY NEGOTIATIONS

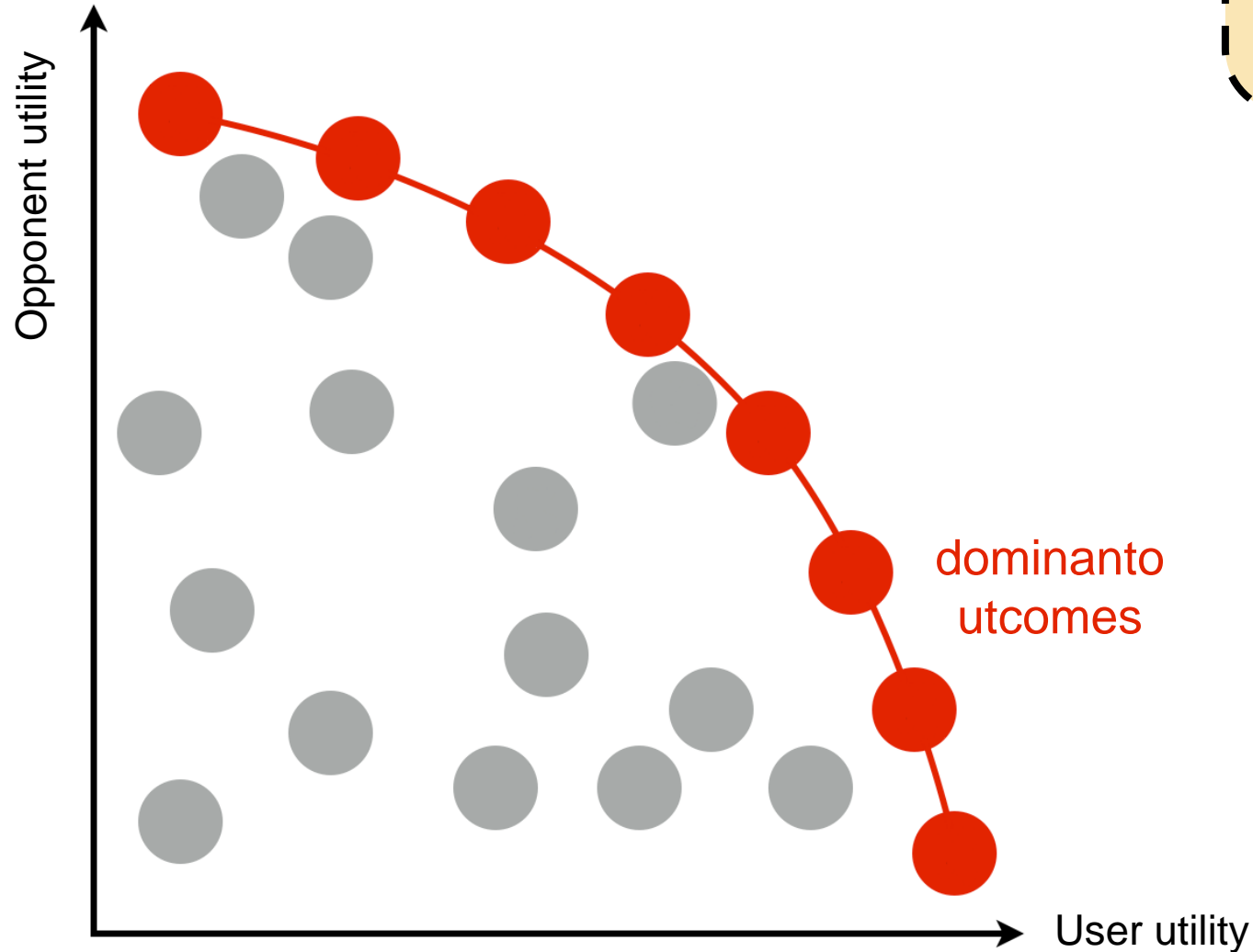
Privacy in the digital economy

- Our data is the currency of many digital services
- Problems
 - Take it or leave it approach
 - One size fits all
 - Opaque business models
- What if we could **negotiate** our privacy decisions?
- Agent **representation** with **incomplete** preferences

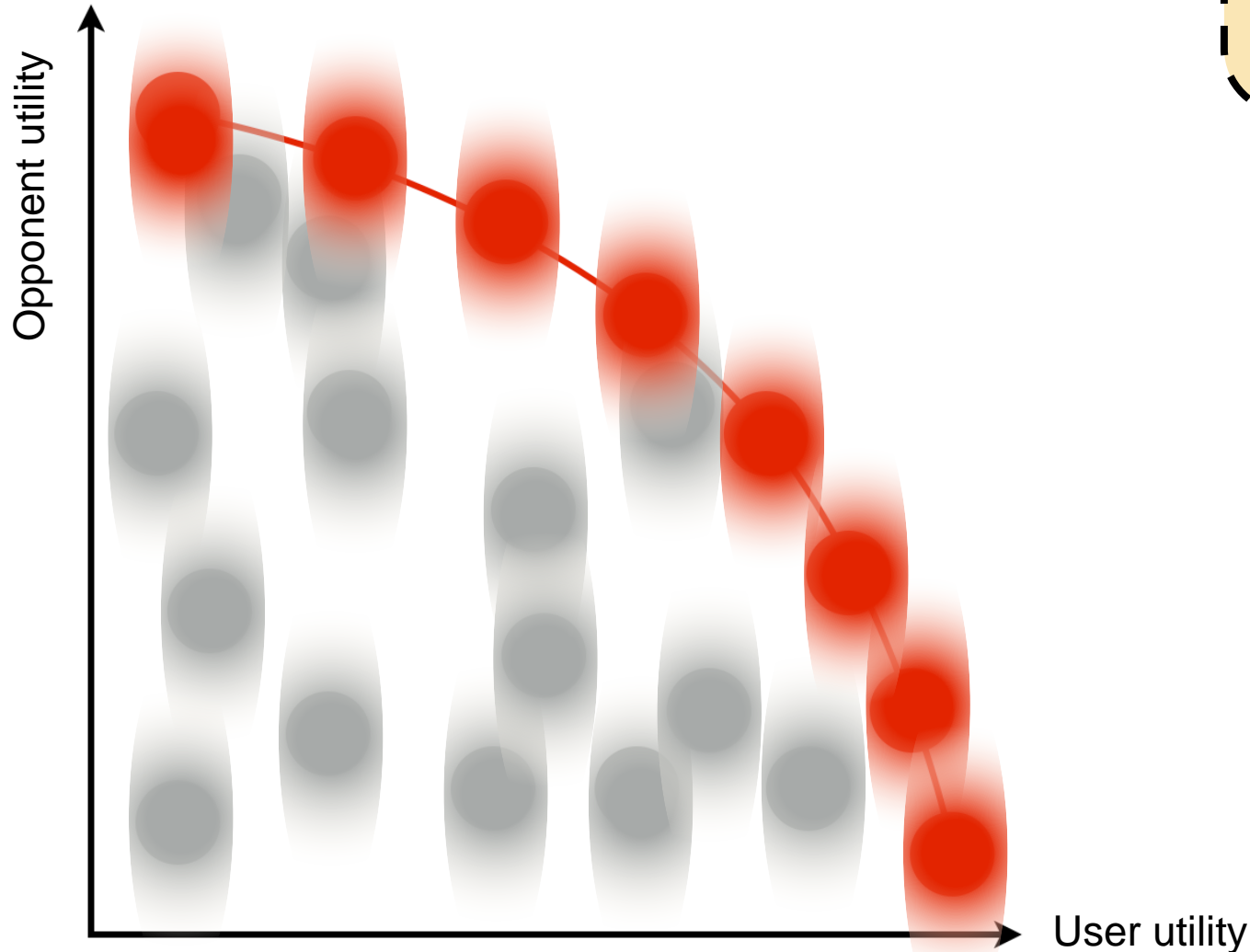


State of the art: no uncertainty

State-of-the-art
no uncertainty



State of the art: opponent uncertainty

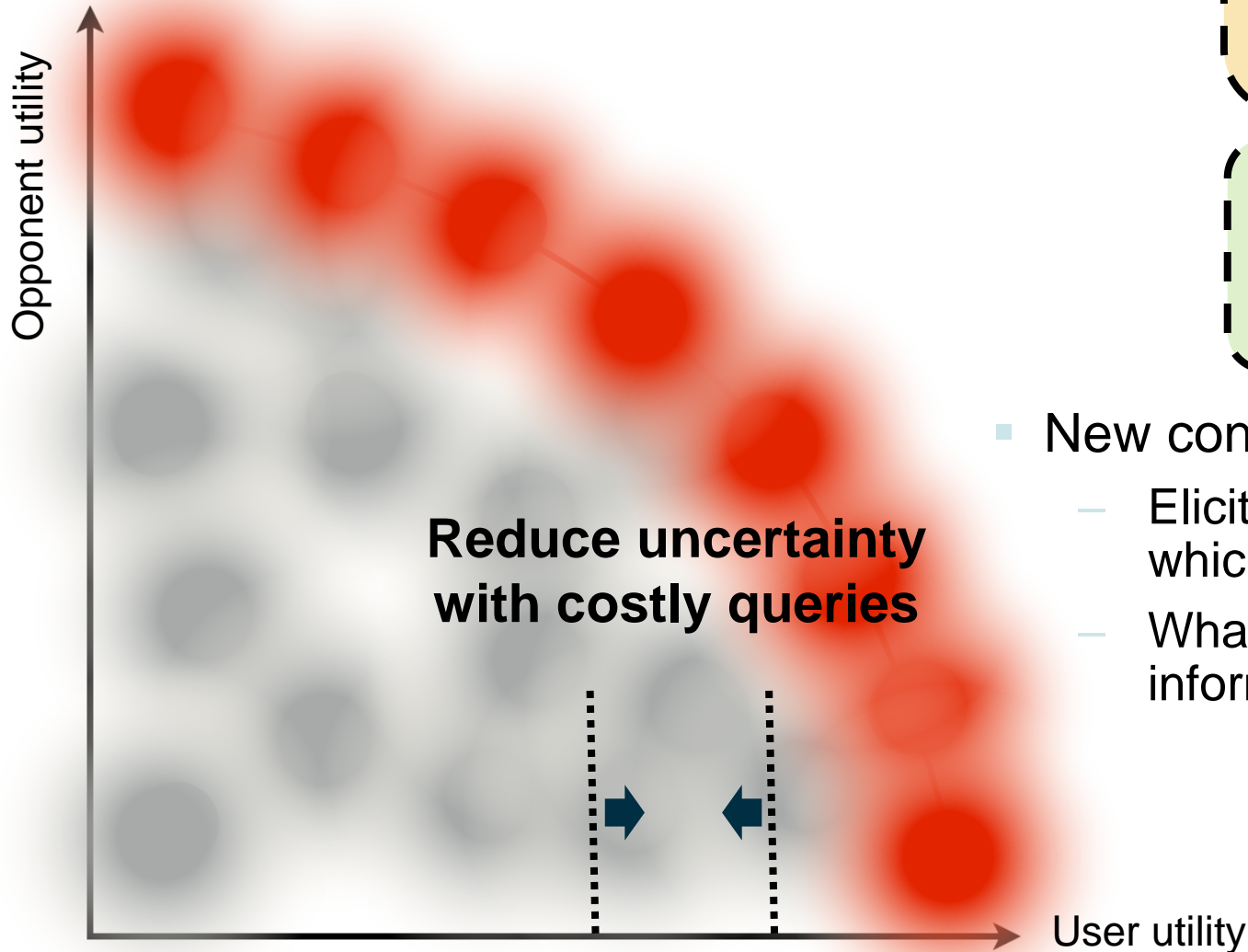


State-of-the-art

no uncertainty

opponent
uncertainty

Key future challenge: full uncertainty



State-of-the-art

no uncertainty
opponent
uncertainty

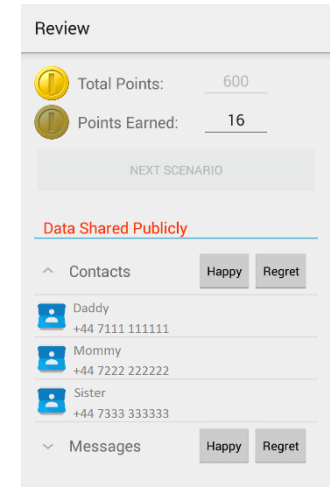
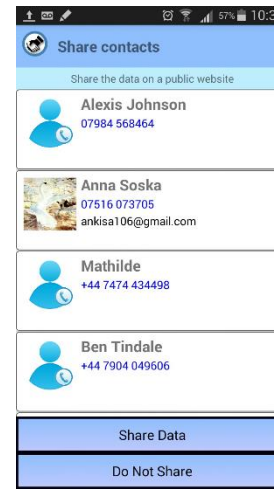
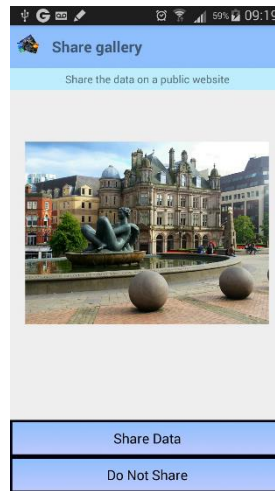
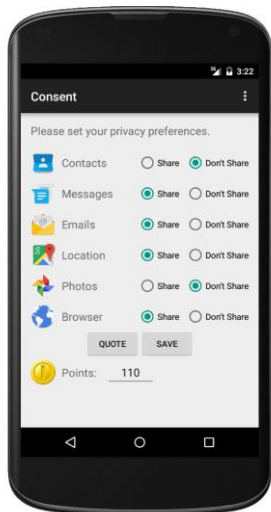
Unexplored

full uncertainty

- New concepts required:
 - Elicitation on-the-fly: which **queries** to ask?
 - What is (costly) user information **worth**?

First results: personalized privacy negotiations

- Tested with mobile app and **real, personal, publically published data**
- Results show that negotiation gives users **control**, and more **meaningful consent**



Current applications

- Internet of Things privacy management
- Social media preferences
- Smart energy cooperatives



Further pointers

Science Home News Journals Topics Careers

Log in | My acc




Divide these items between you and your partner.

Your partner sees the same items but with different values

You get some items, and your partner will get the rest

If you get a great deal for you then we will pay a bonus!

If you often get low scores then your work may be rejected

Items to Split between You and Partner	Value Each to You	Number You Get
	0	0
	7	0
	1	0

Fellow Turker: I want the hat too, but I can let you have the books

You: I don't care about the books, you can have them and 1 ball

Fellow Turker: 2

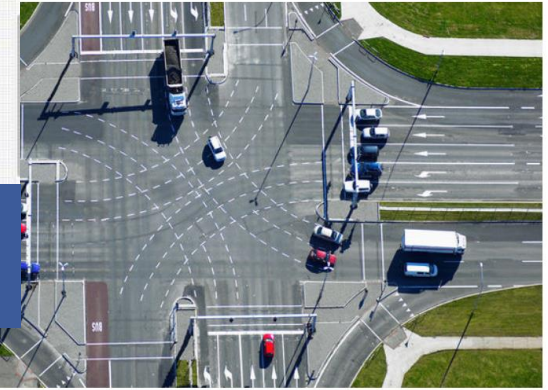
You: Ok, deal

Type Message Here:

Message

No deal was agreed

facebook



Autonomous vehicles might negotiate with each other for right of way.

Photo_Concepts/iStockphoto

How artificial intelligence could negotiate better deals for humans

Science



Wie würde eine Maschine unsere Gehaltsverhandlung führen?

WIRED

- Lewis et al. *Deal or No Deal? End-to-End Learning for Negotiation Dialogues*. Facebook AI, 2017.
- Baarslag et al. *How would a machine conduct our salary negotiations?* Wired, 2017.
- Baarslag et al. *How artificial intelligence could negotiate better deals for humans*. Science, 2017.