Negotiating with humans using the Diplomacy game

Angela Fabregues
Carles Sierra

Human negotiations

- not rational at all (mistakes and emotions)
- long term relationships
- natural language
- deal with uncertainty

[1] Lin & Kraus. *'Can automated agents proficency negotiate with humans?'*. Communications of the ACM. 53(1):78-88, 2010.

Research on human negotiations

- not rational at all (mistakes and emotions)
- long term relationships
- natural language
- deal with uncertainty
- application domain for experimentation
- humans to take part in our experiments

[2] Fabregues & Sierra. *'Diplomacy game: the test bed'*. PerAda Magazine, 2009.

Diplomacy

- strategy board game designed in 1954
- popular game with lots of followers
- there are books, a magazine, software applications and forums of players

Diplomacy

[3] Fabregues, Navarro, Serrano & Sierra. *'DipGame: A testbed for Multiagent Systems'*. Autonomous Agent and MultiAgent Systems. Toronto, 2010.

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Diplomacy

- 7 players with units over a map of Europe

Diplomacy

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- goal: to conquer Europe

Diplomacy

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Diplomacy

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- no random elements: ~~turns~~, ~~dice~~, ~~cards~~, ...

Diplomacy

- 7 players with units over a map of Europe
- goal: to conquer Europe
- simultaneous announcement of movements
- no random elements: ~~turns~~, ~~dice~~, ~~cards~~, ...
- players can negotiate and perform cooperative movements

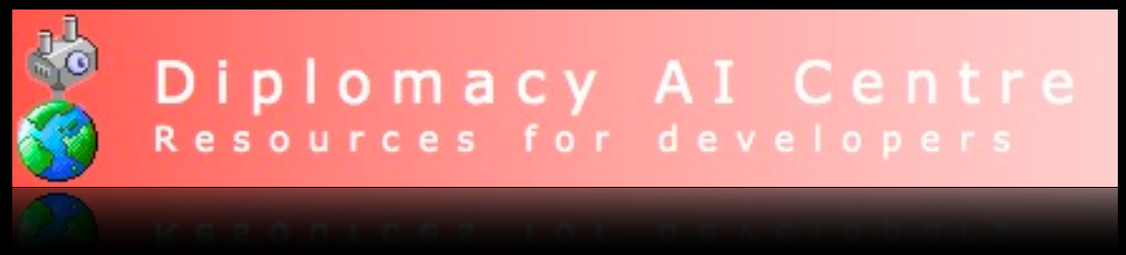
Research on human negotiations **with Diplomacy**

- not rational at all (mistakes and emotions)
- long term relationships
- natural language
- deal with uncertainty
- application domain for experimentation
- humans to take part in our experiments

[3] Fabregues, Navarro, Serrano & Sierra. *'DipGame: A testbed for Multiagent Systems'*. Autonomous Agent and MultiAgent Systems. Toronto, 2010.

Bot development

- a bot is an agent capable of playing
- Eithan Ephrati master thesis under supervision of Daniel Lehman
- a lot of developers are already doing it without negotiation
- they deal with specific tactics and strategy of Diplomacy



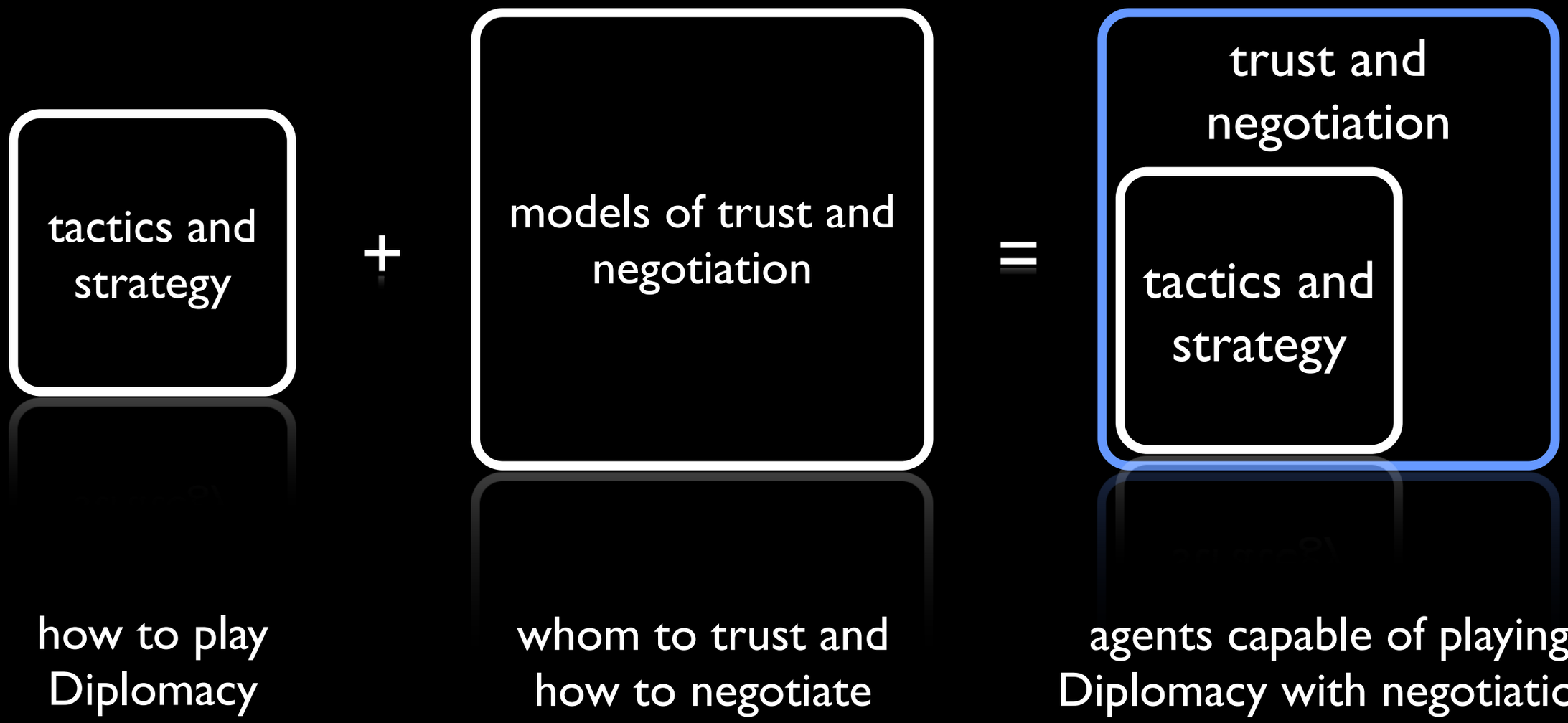
[4] Eithan Ephrati, Master thesis. 1987.

Bot development
with negotiation

- nothing since Sarit Kraus thesis under Daniel Lehman supervision
- many people tried but no one succeeding
- lot of research on negotiation models
- test them building bots of Diplomacy

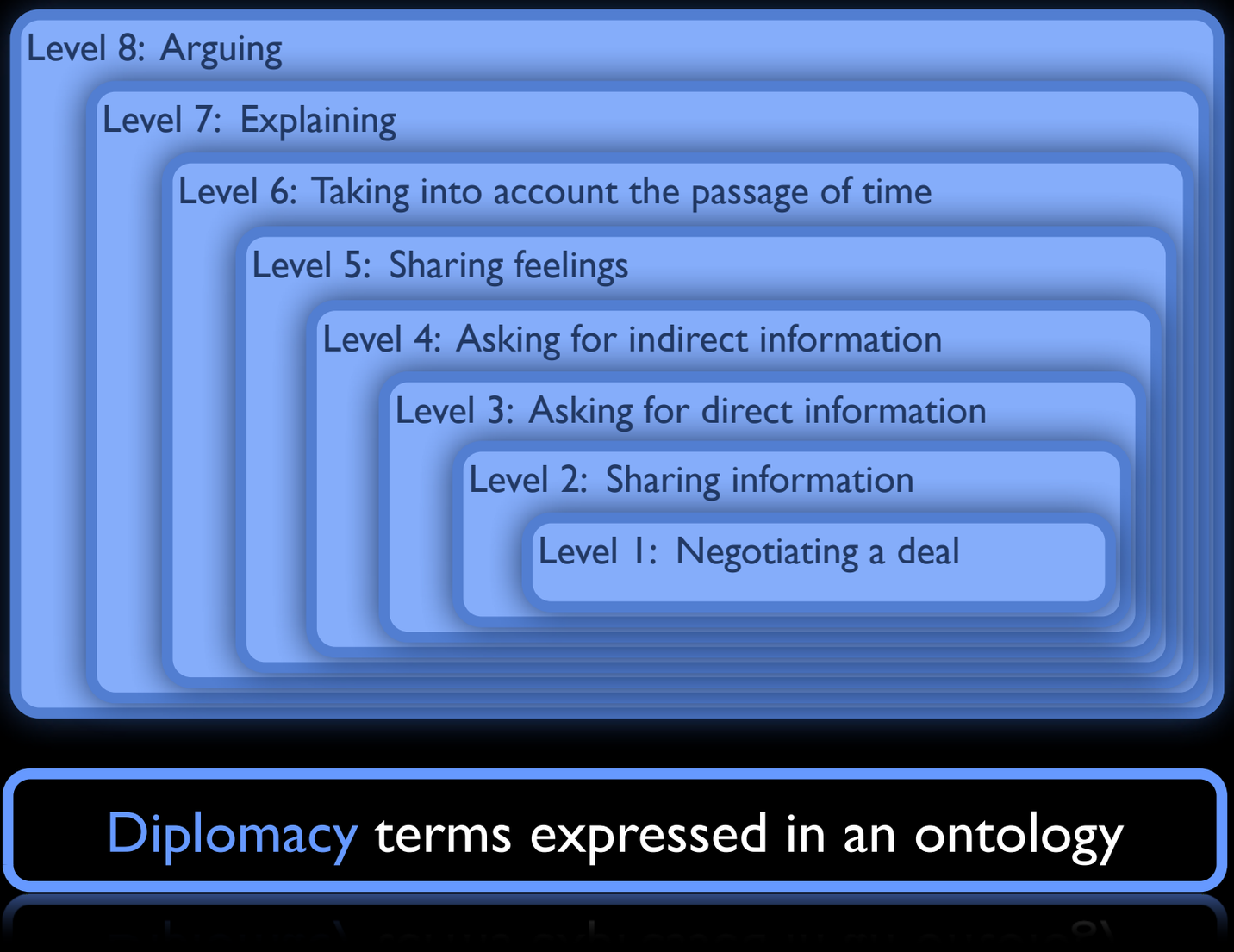
[5] Kraus & Lehmann, '*Designing and building a Negotiating Automated Agent*'. Computational Intelligence, 11(1), pp. 132-171, 1995.

Bot development



[6] Fabregues & Sierra, '*A testbed for multiagent systems*'. Technical Report IIIA-TR-2009-09.

Nagural language



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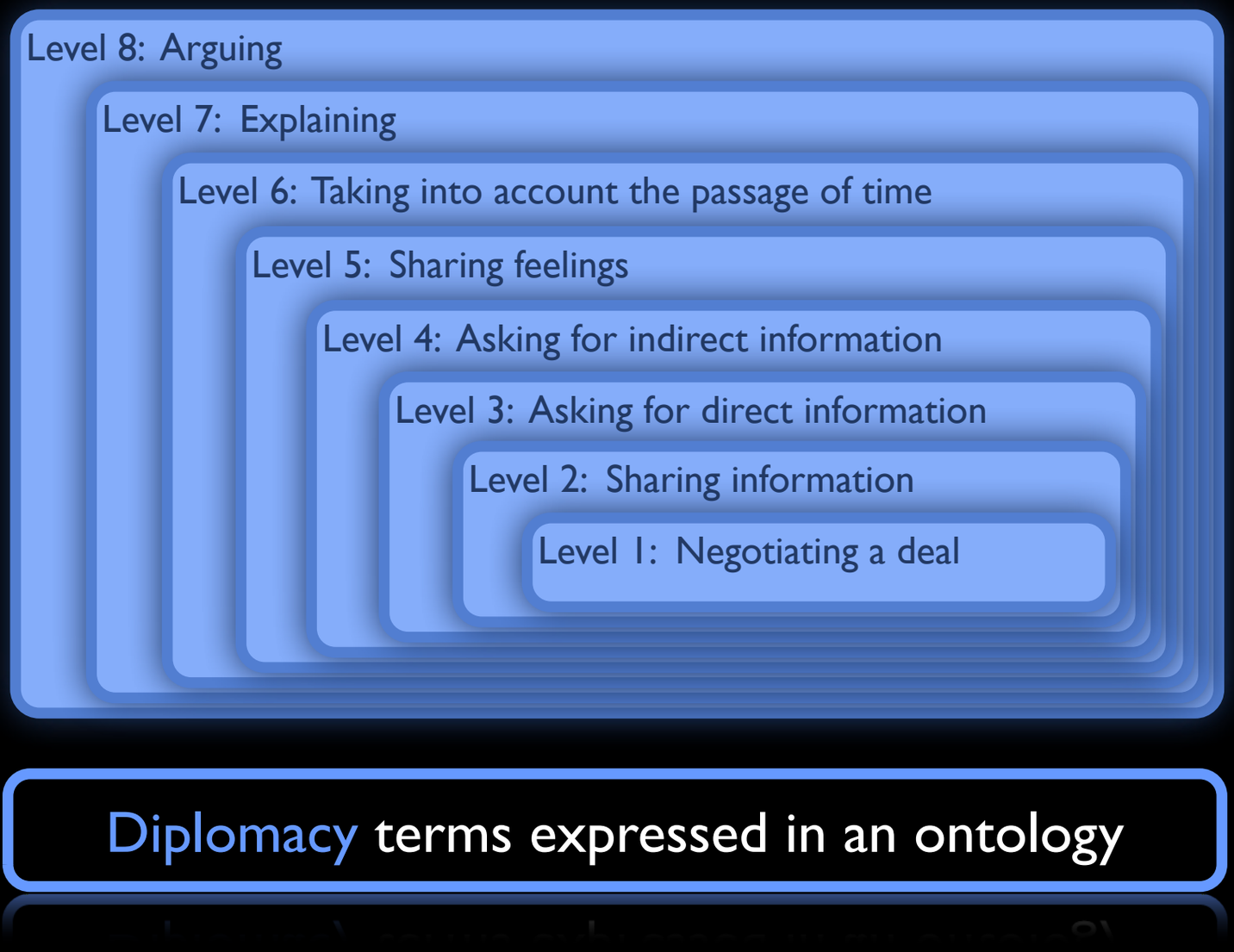
Restricted language



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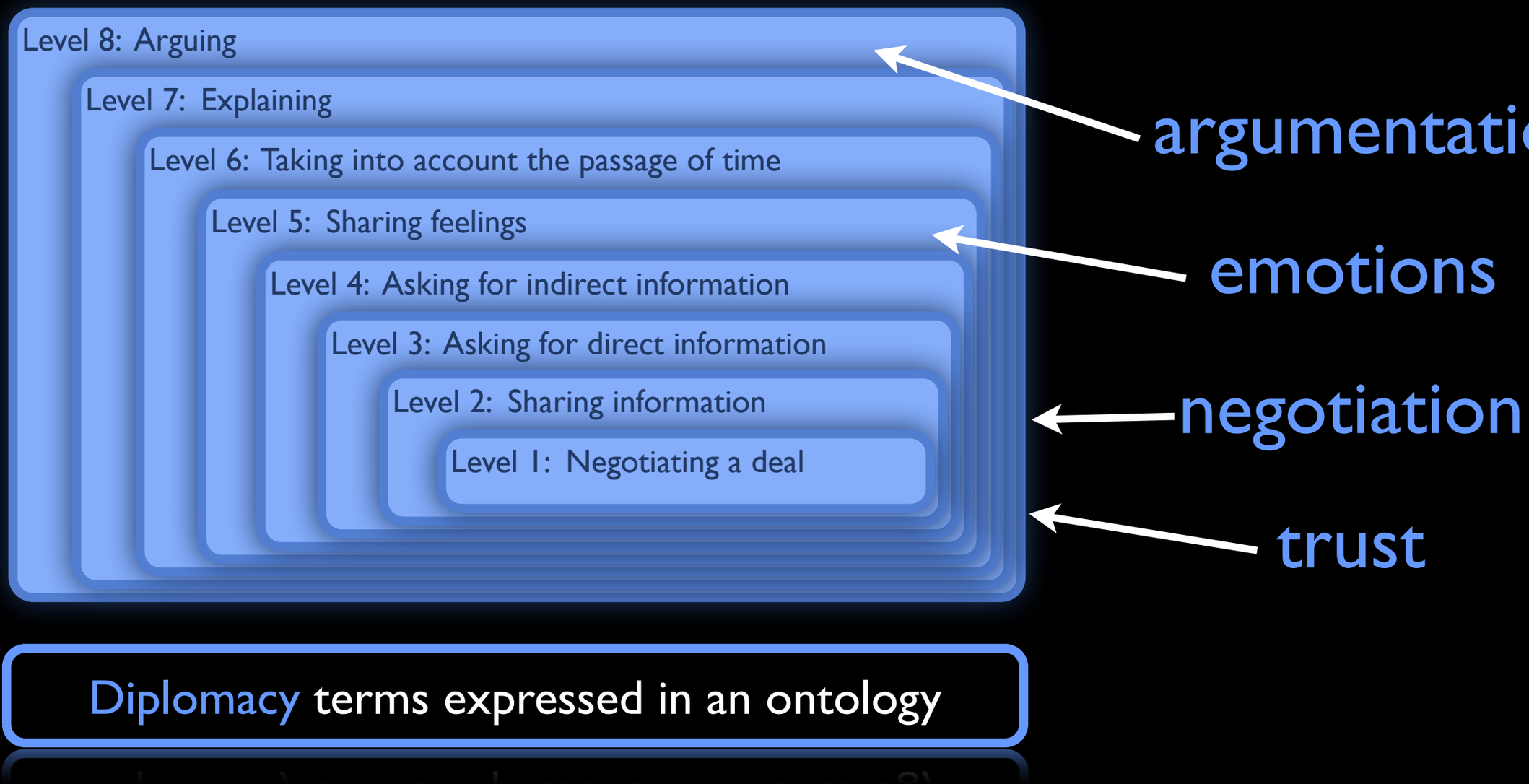

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dipgame - main page

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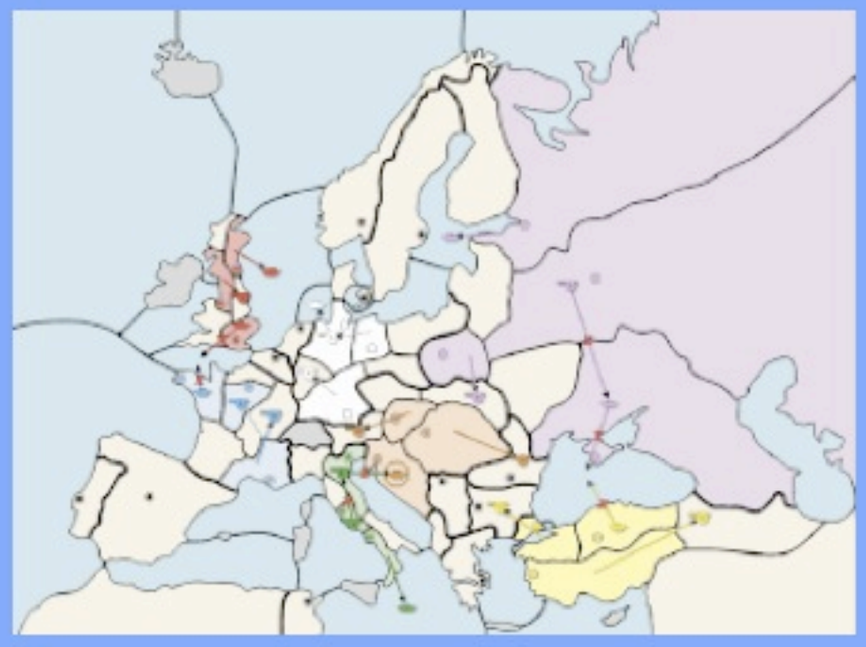
What is Diplomacy?

Diplomacy is a strategy game in which you have to negotiate with other players in order to control Europe. All players take turns to secretly talk with one another and try to make alliances. After the negotiation phase, players decide their token movements. All movements are executed concurrently.

What is DipGame?

DipGame is the site of the Multiagent Systems' testbed developed at the IIIA-CSIC in Barcelona. Apart from entertaining human players, the goal of the site is to allow Artificial Intelligence researchers to test their models by implementing them into a bot. This site also provides the software tools needed to develop such bots.

PLAY NOW



- New Game
- Saved Games
- Publications
- Bot Develop.
- Diplomacy

"In Diplomacy, your victory is not given by swords, but by words.
And it is your tongue what will have to be sharp, not your weapon."

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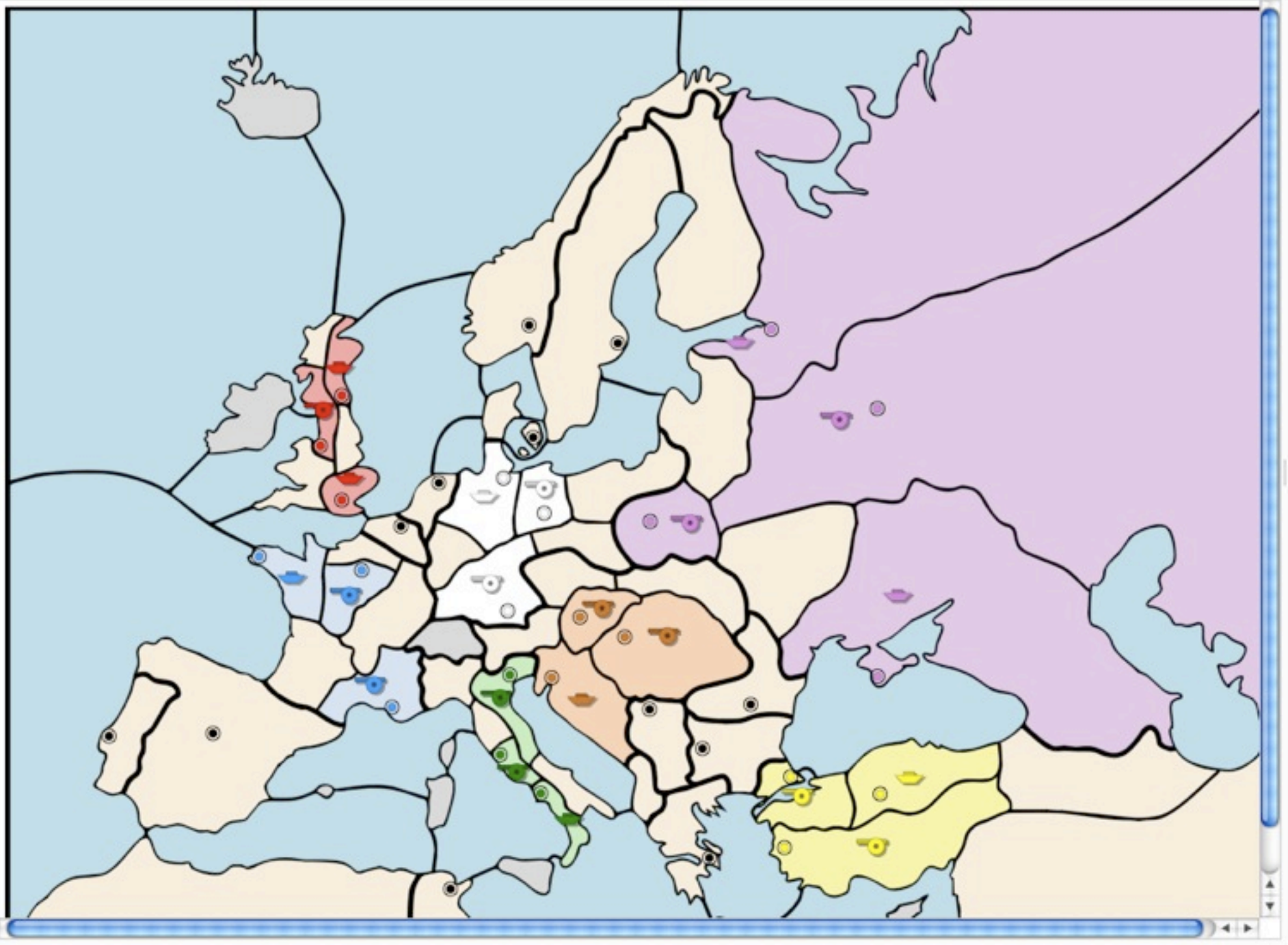

Orders | State

LVP No order
EDI No order
LON No order

Send orders

Return to saved games

Aus | Fra | Ger | Ita | Rus | Tur

Spring Moves 1901
You are England

MOS *Moscow* - Home of Russia

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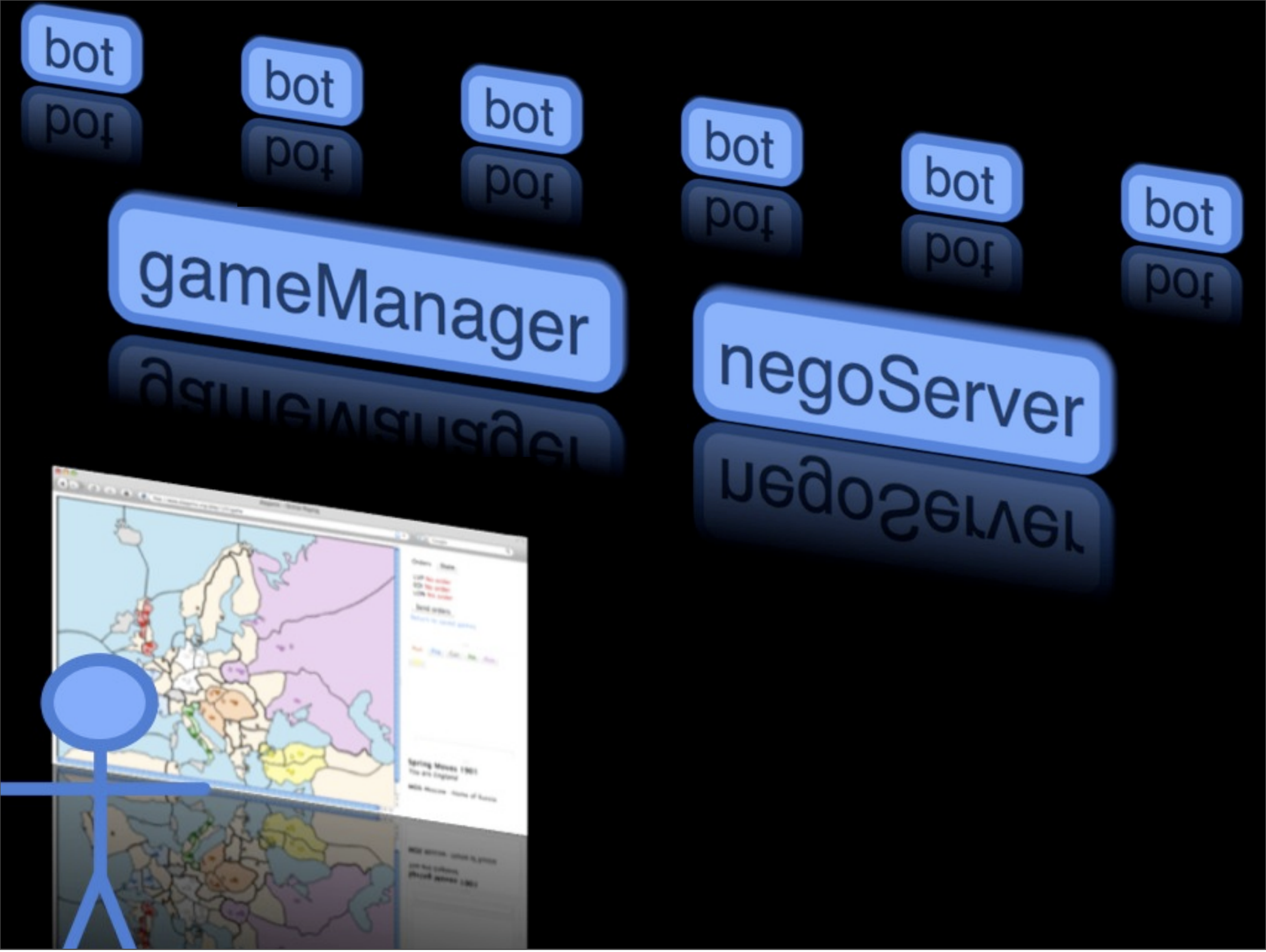
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gameManager
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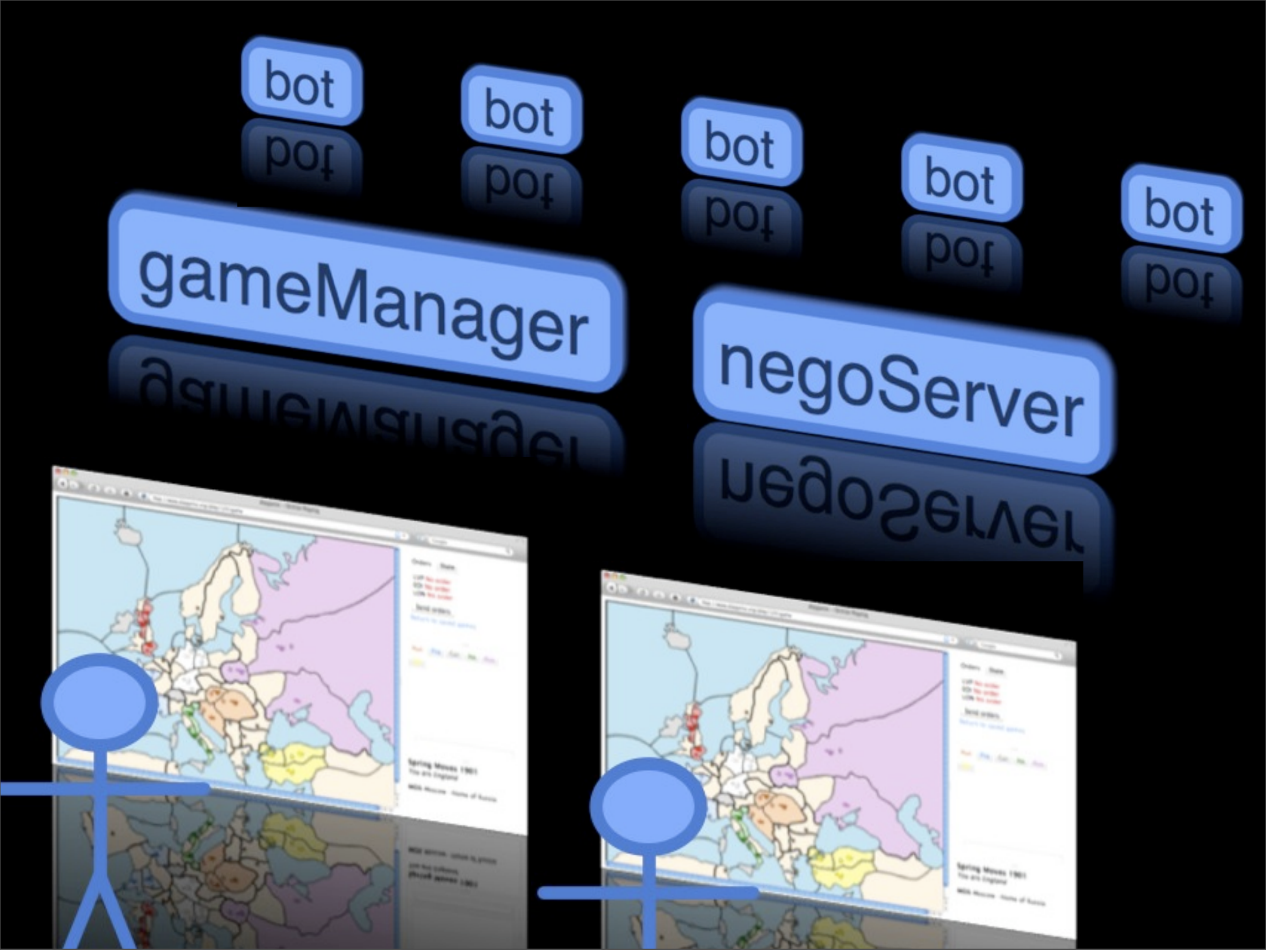
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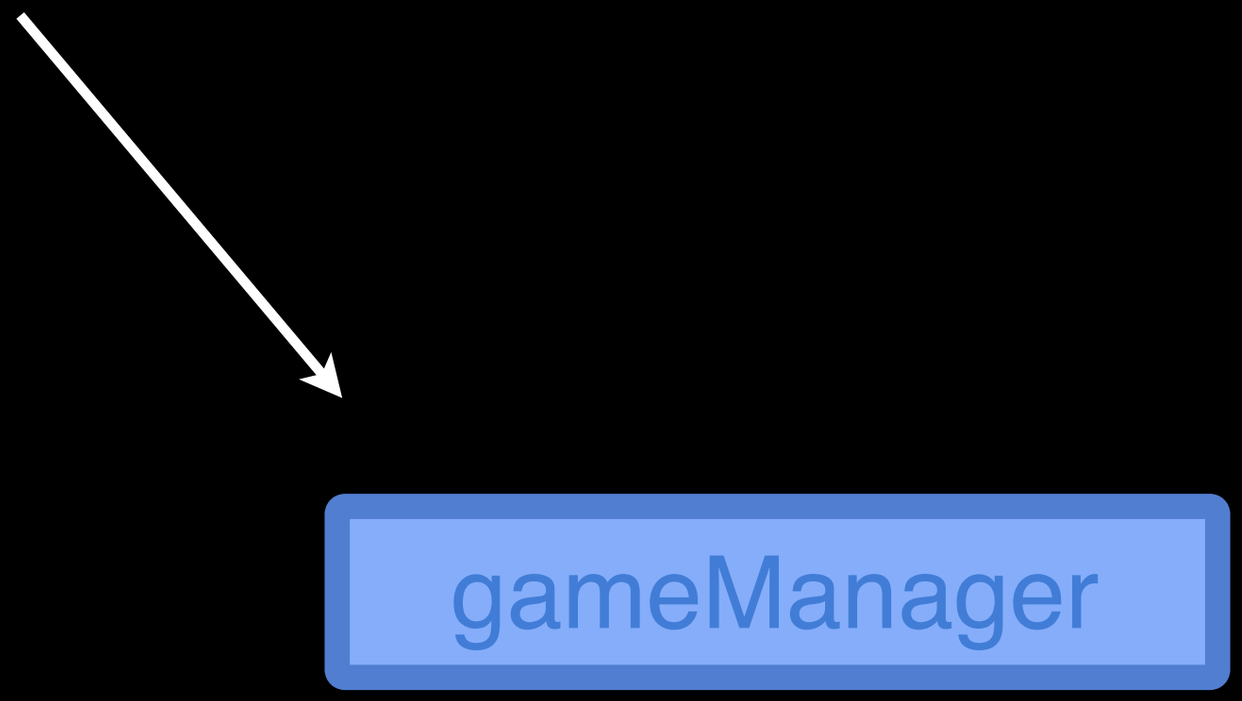
Bot development framework

manages the players,
resolves the orders, ...



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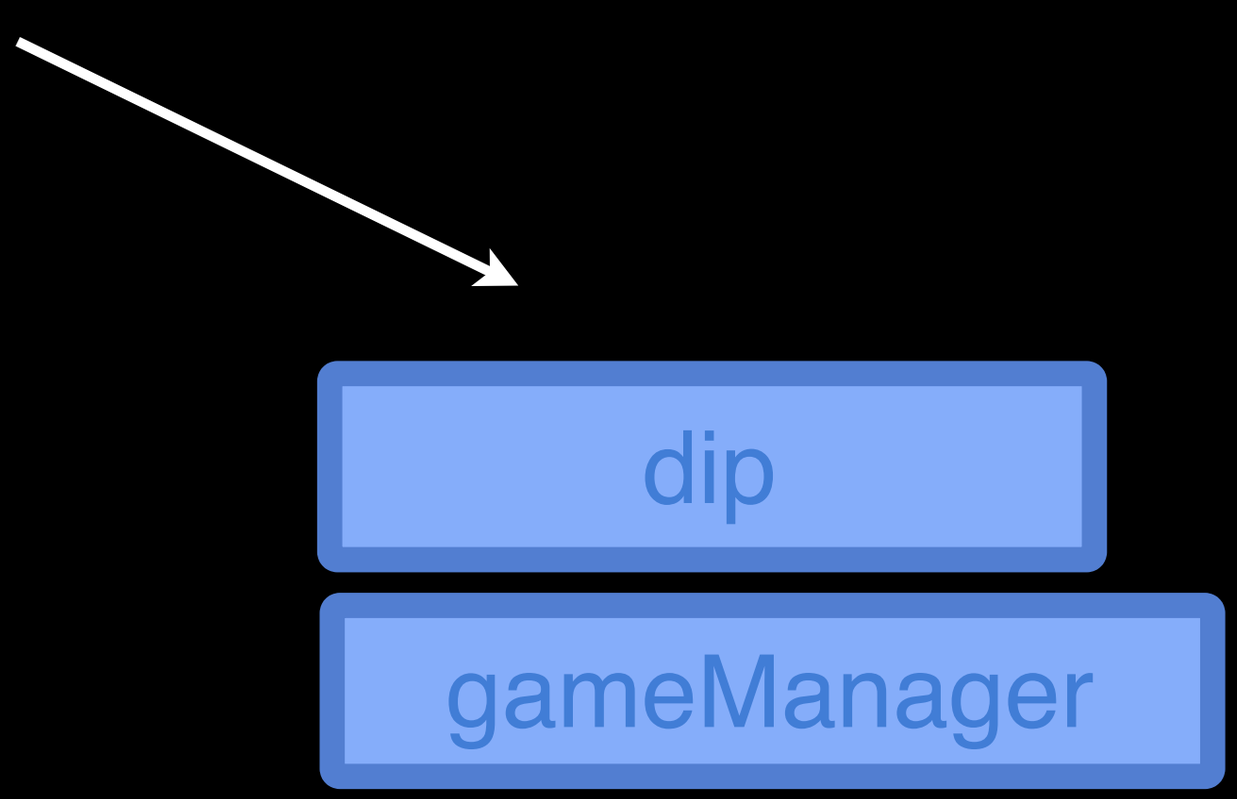
Bot development framework

provides: representation of the game state and the orders



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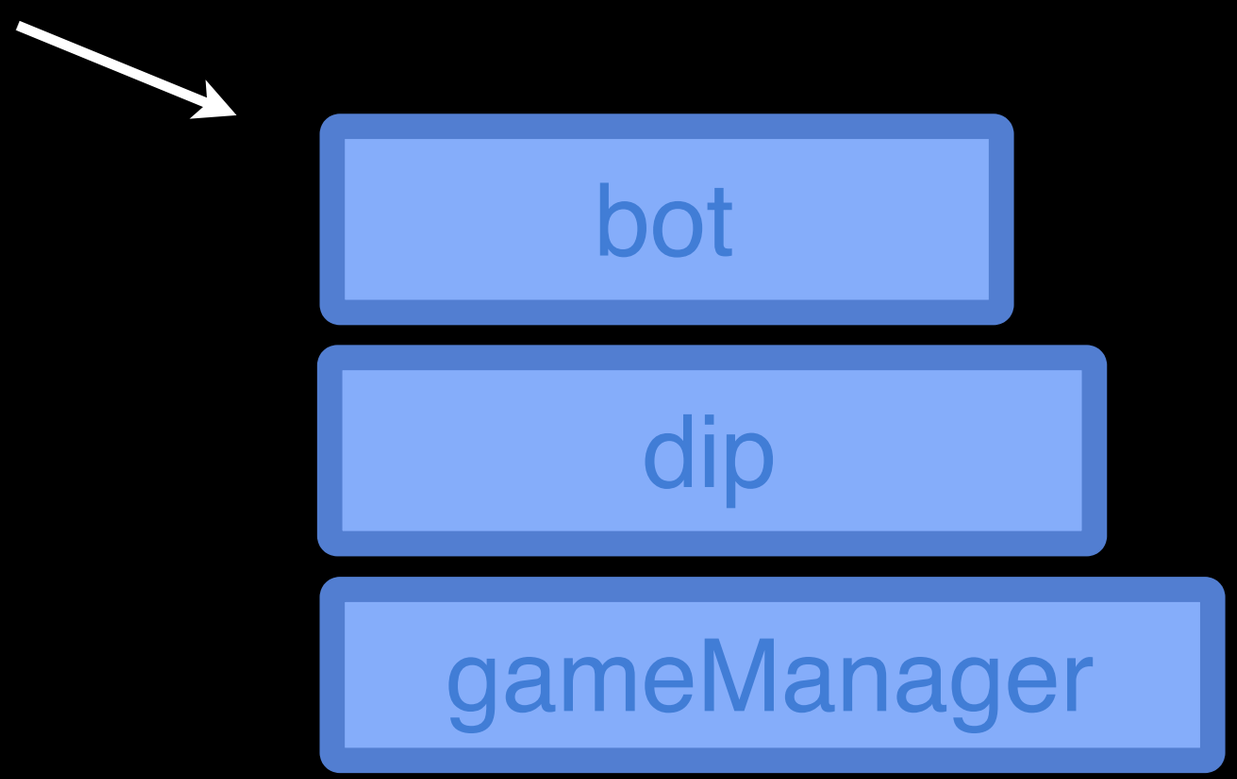
Bot development framework

provides: the best action
requires: action evaluation



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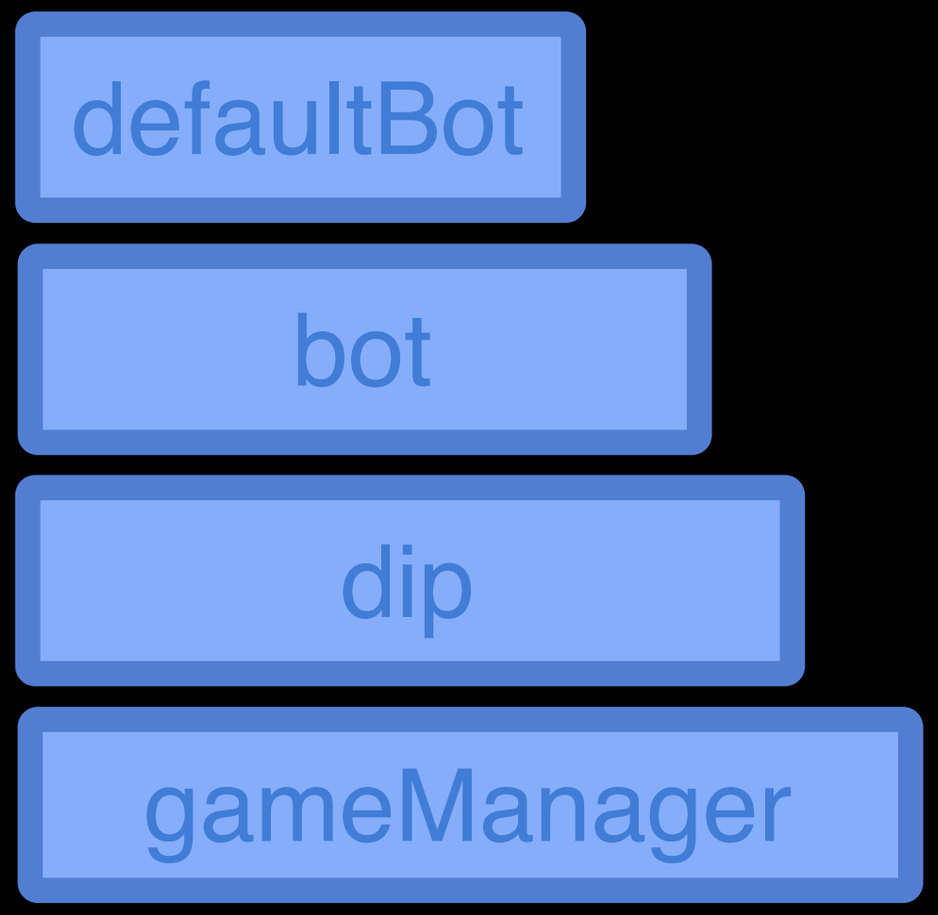
Bot development framework

plays Diplomacy
without negotiation



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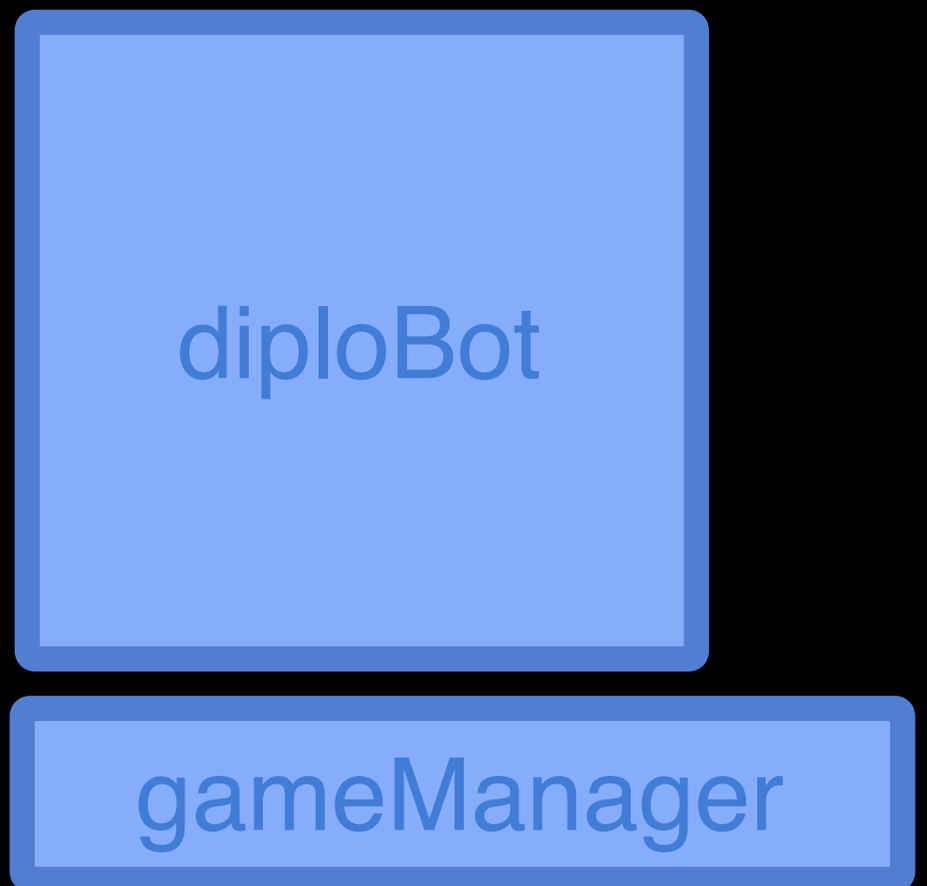

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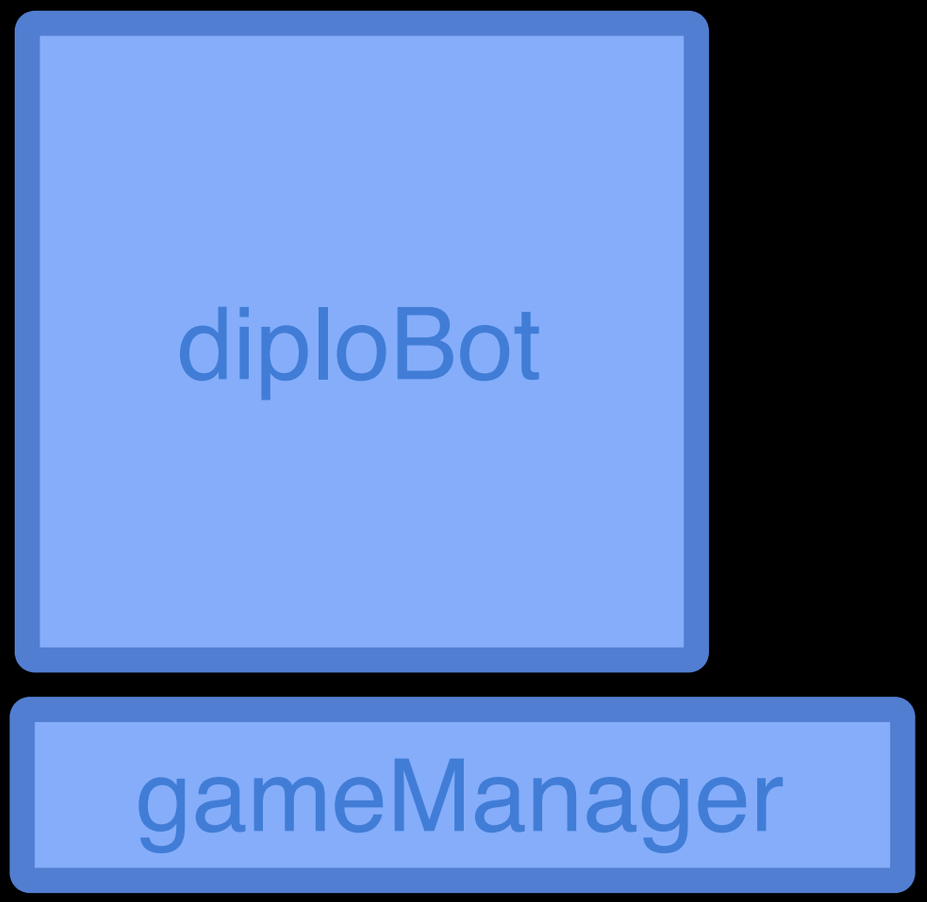

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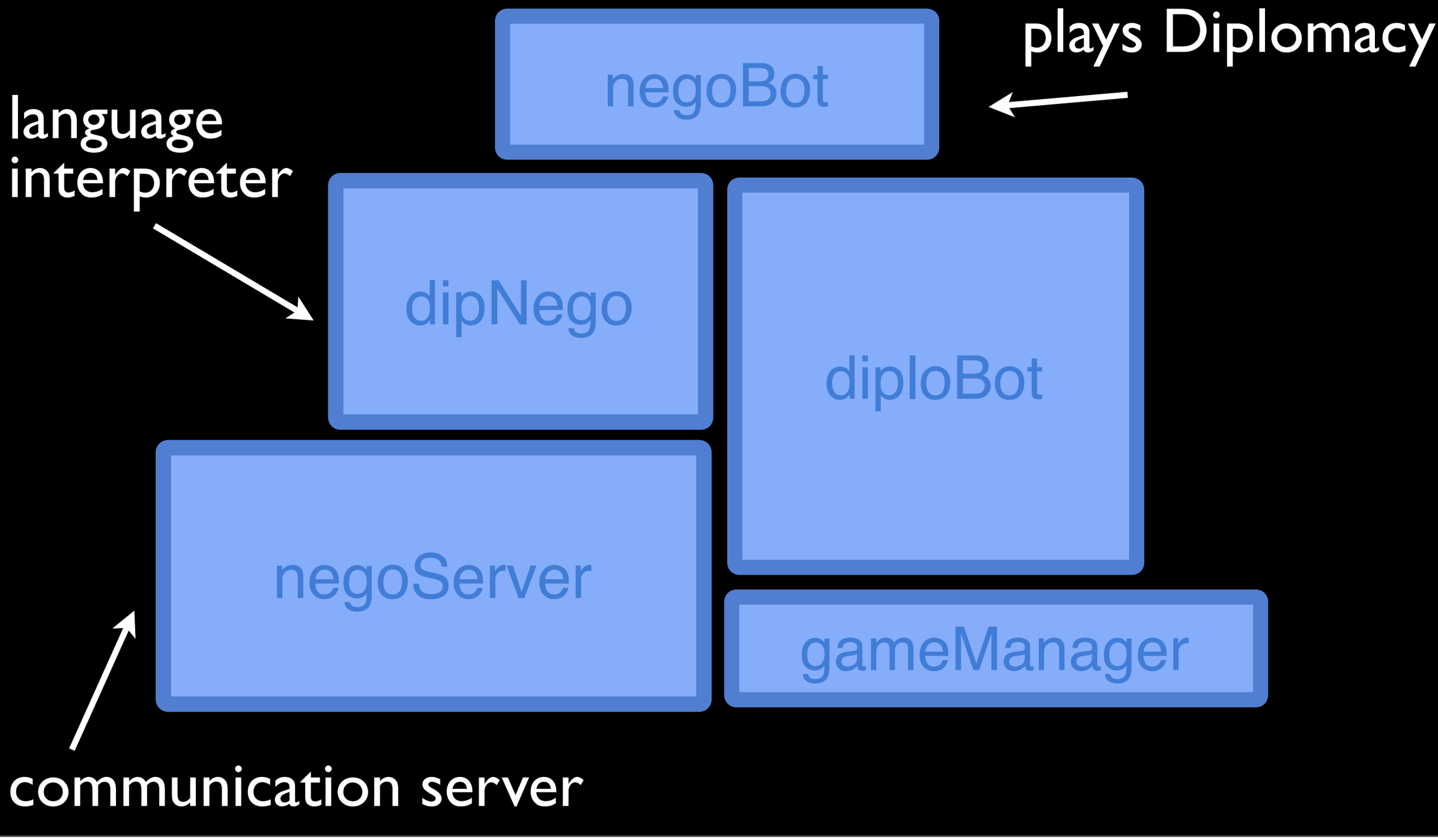

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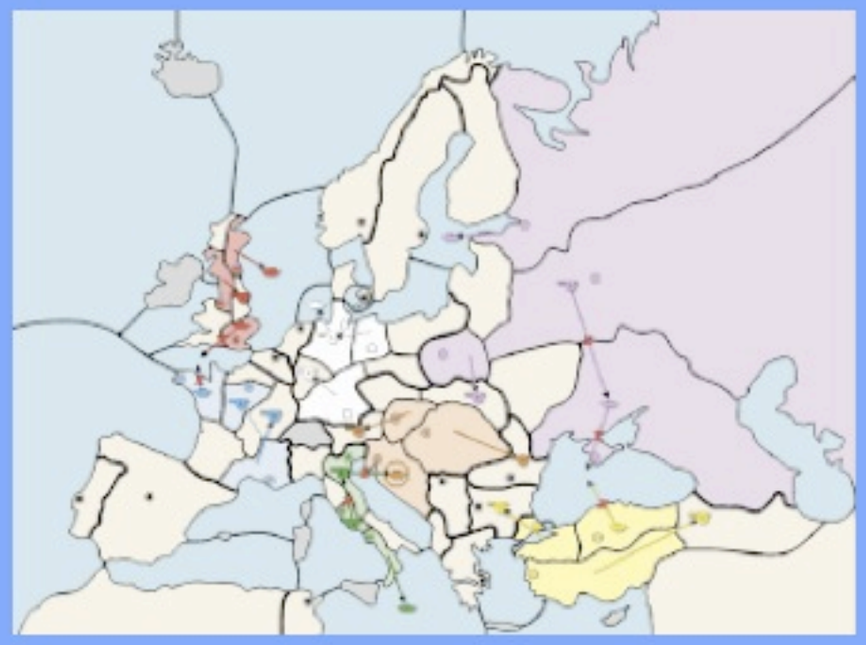

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- Saved Games
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- D[illegible]macy

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Diplomacy

Bot development

Bots are software agents (programs) that play. In dipGame you can play Diplomacy against bots. You also can develop your own bot. This is specially interesting for multiagent systems' researchers as described in [1]. These are the resources that you will need:

dip *A framework for bot development.*

dipNego *A communication library that allows players to negotiate.*

dipWebClient *A web-based interface to visualise and play games.*

dipGameManager *A program that receives the movements that each player want to perform, manages the game and informs those players about the outcome of their movements.*

dipBots *Available bots. Use them as an example of how you can develop your own.*

dipTestbedTools *A sourceforge project is already available for the development of these tools at http://diptestbedtools.sourceforge.net.*

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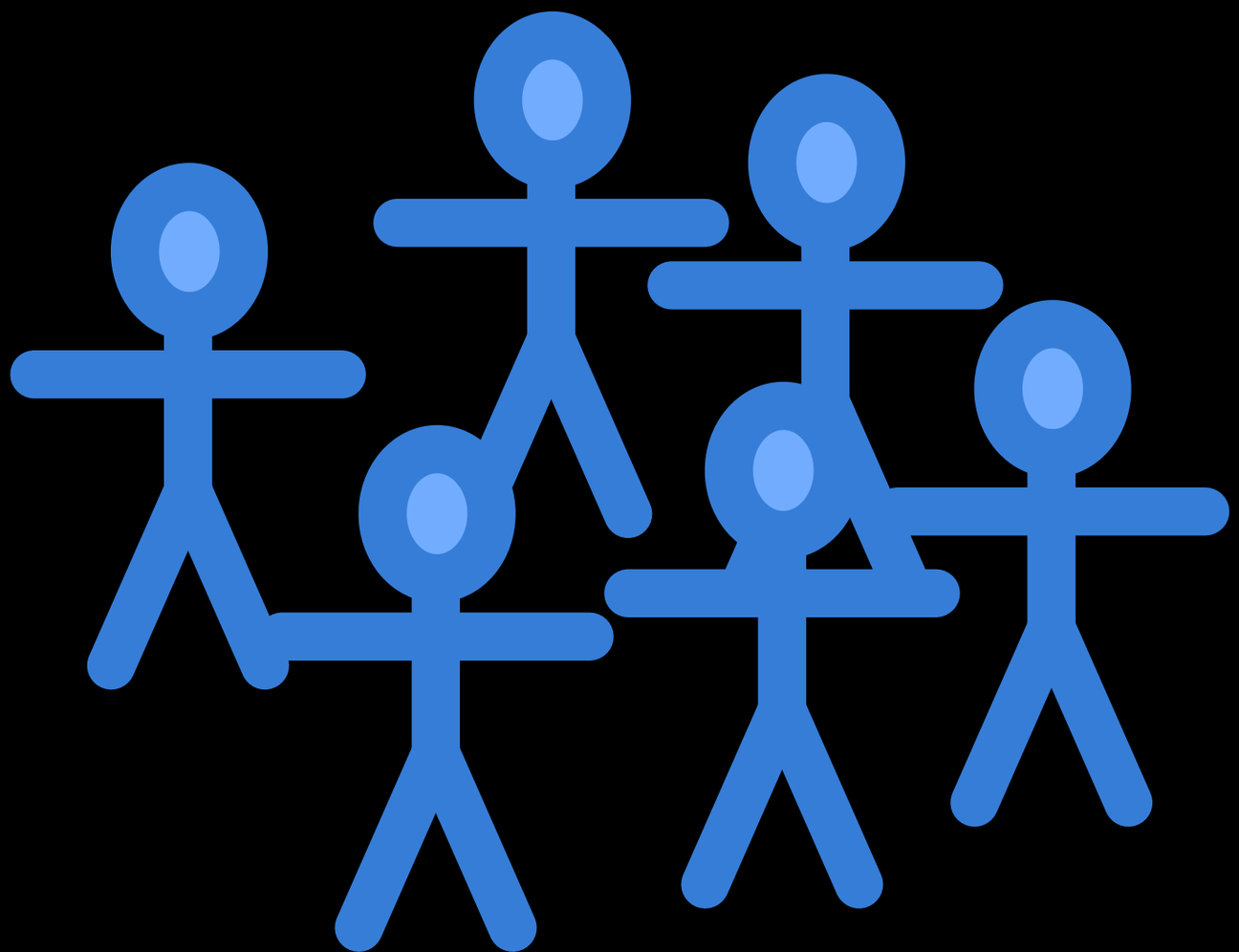
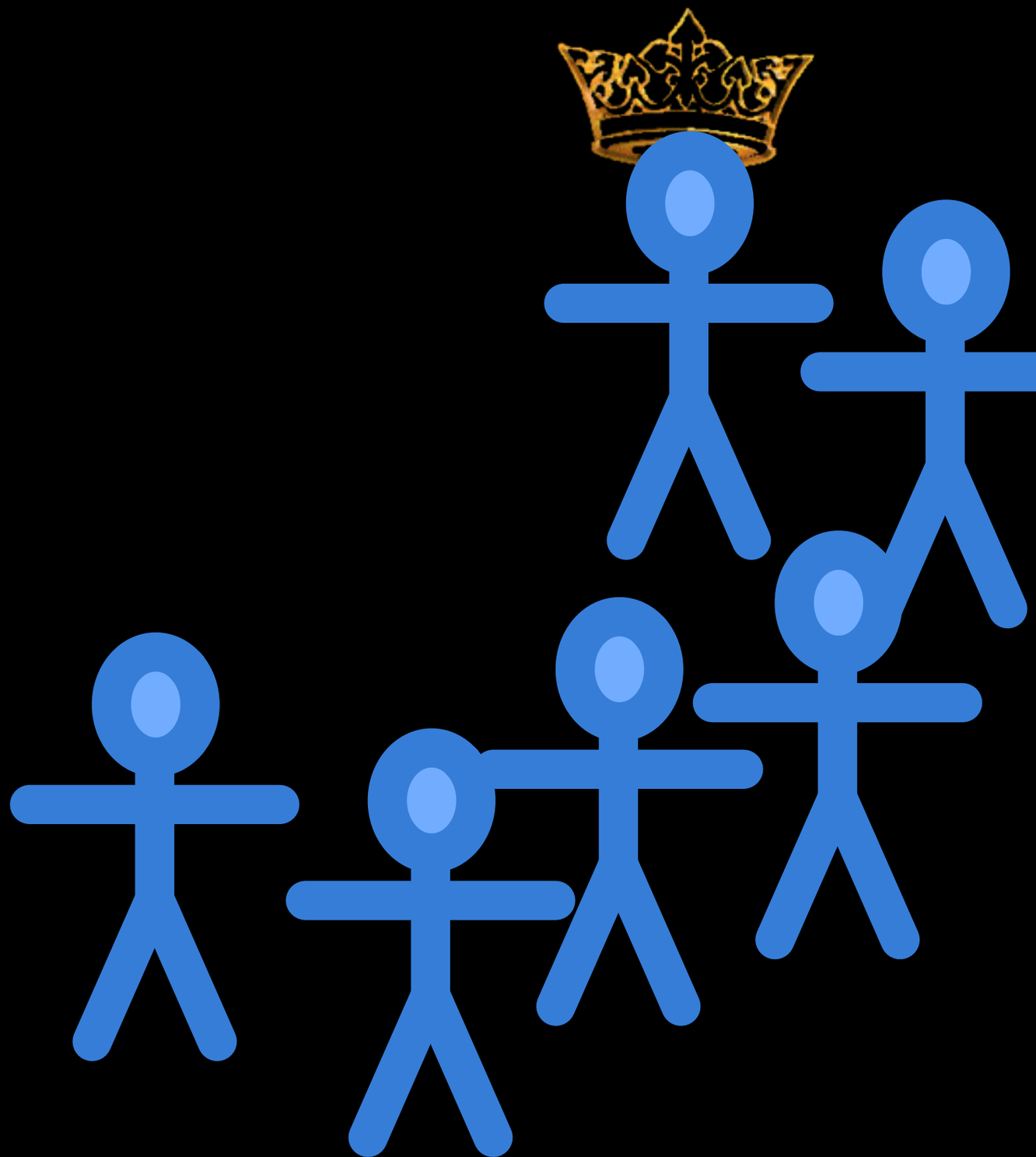
The Diplomat

[6] Kraus & Lehmann, *'Designing and building a Negotiating Automated Agent'*. Computational Intelligence, 11(1), pp. 132-171, 1995.

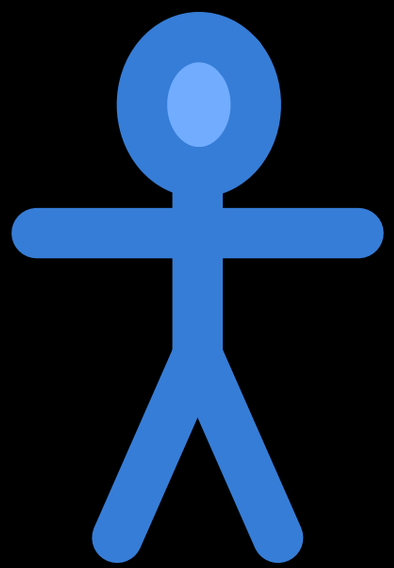
Organisations



Organisations

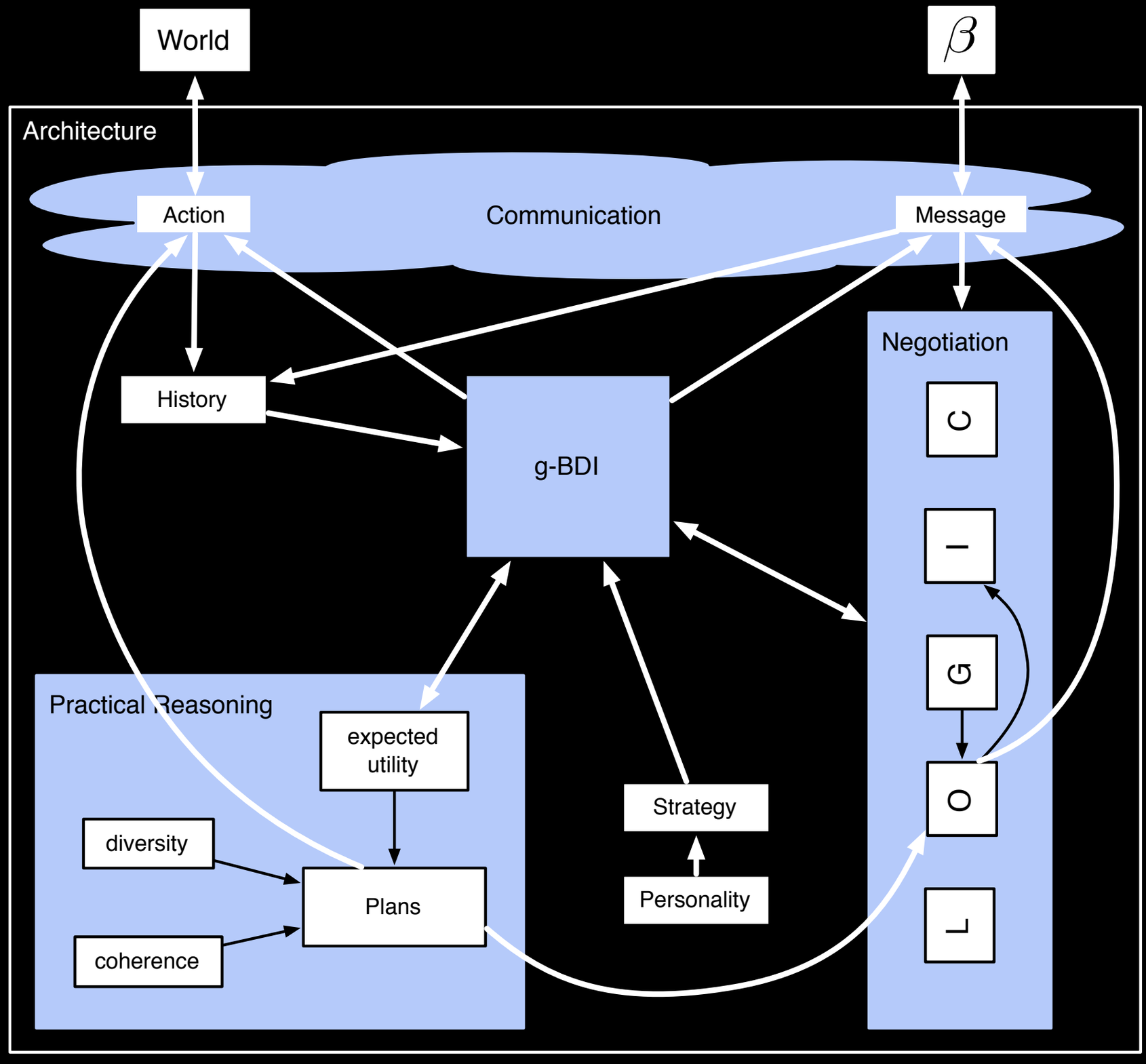


Caramelman #?



[7] Fabregues & Sierra, '*An agent architecture for simultaneous bilateral negotiations'*. ACAN, 2010.

Architecture



Architecture

- what can we do?
- what can we say?
- what do we think about others and about us?

[7] Fabregues & Sierra, '*An agent architecture for simultaneous bilateral negotiations*'. ACAN, 2010.

Architecture

- what should we do? how?
- what should we say? to whom? when?
- how our actions/messages will affect the image of others on us?

[7] Fabregues & Sierra, '*An agent architecture for simultaneous bilateral negotiations*'. ACAN, 2010.

Architecture

- we decided about actions and messages.
- how to interpret the messages and actions?
- how is the time affecting to us?

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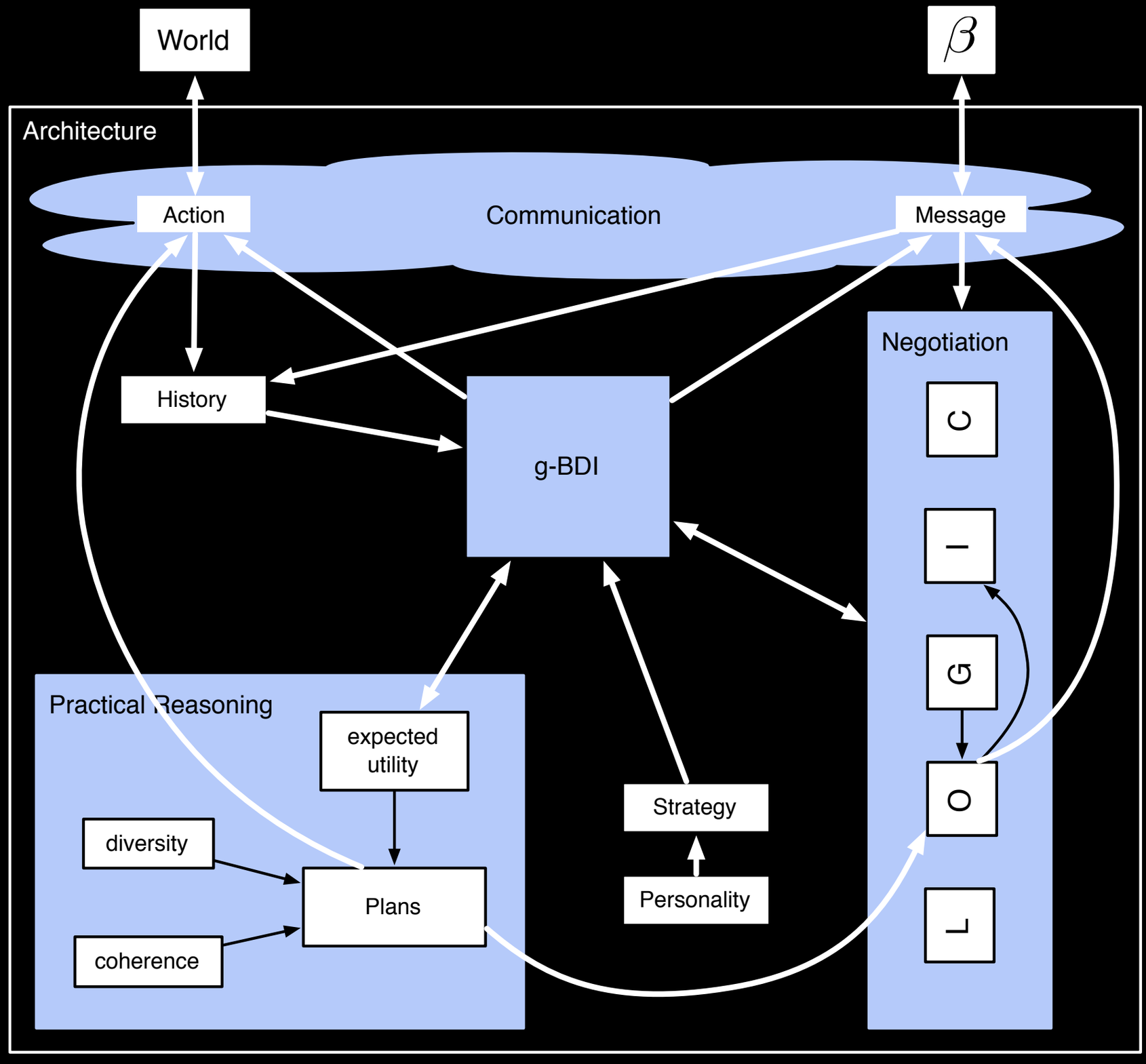
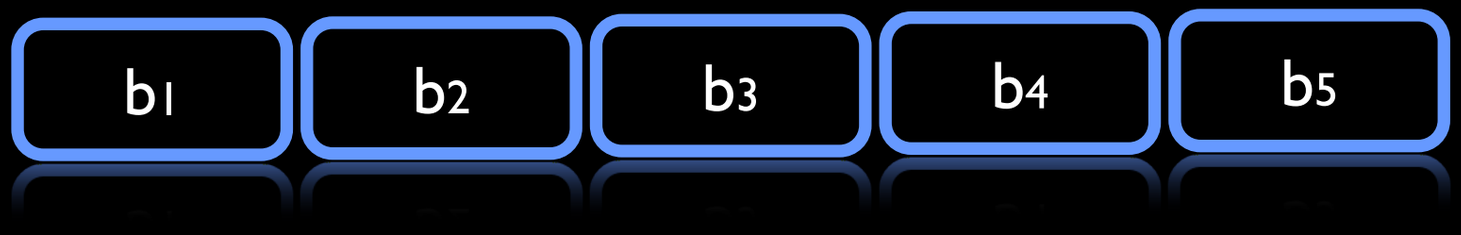
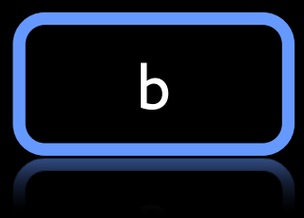
Architecture



Practical reasoning

- a plan is a set of basic plans





agent

action

time

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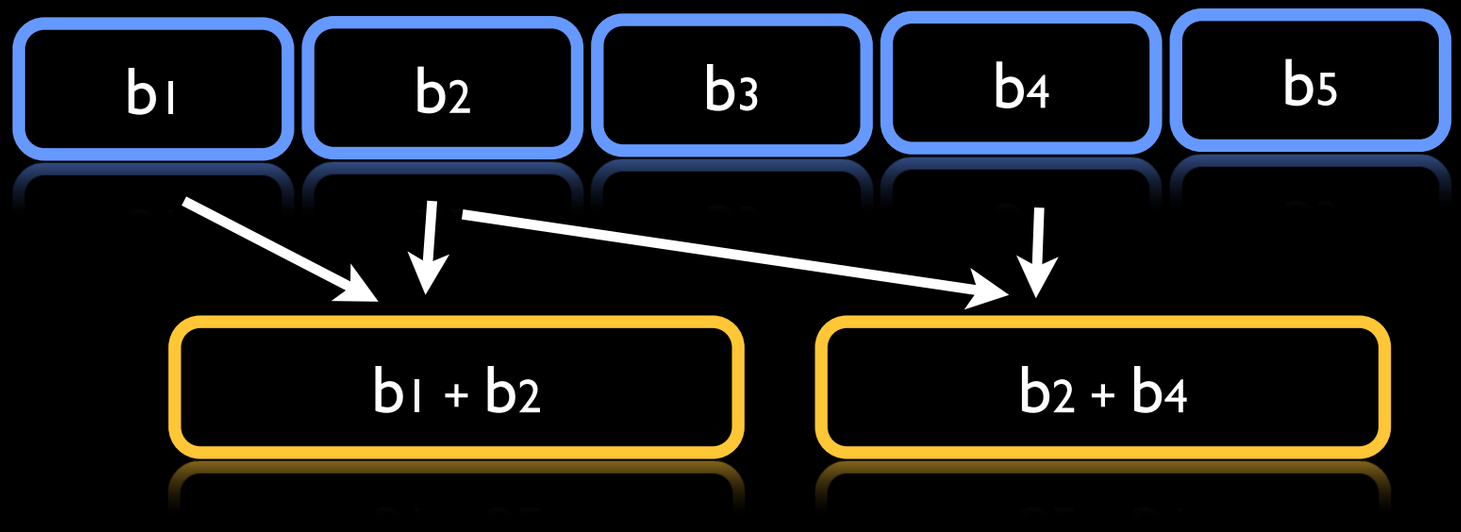
Practical Reasoning

- a plan is a set of basic plans
- deals are signed on small plans affecting only two agents



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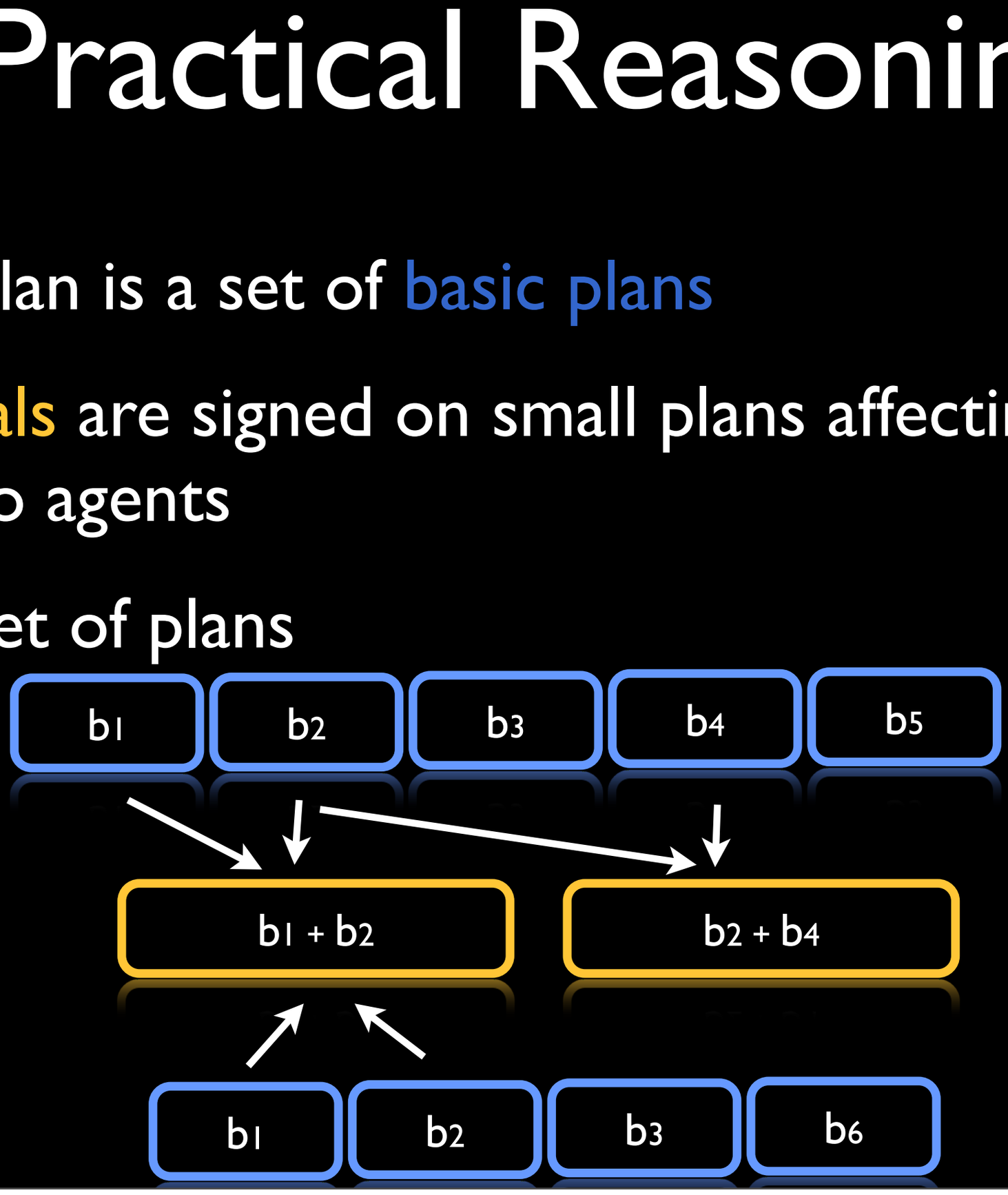
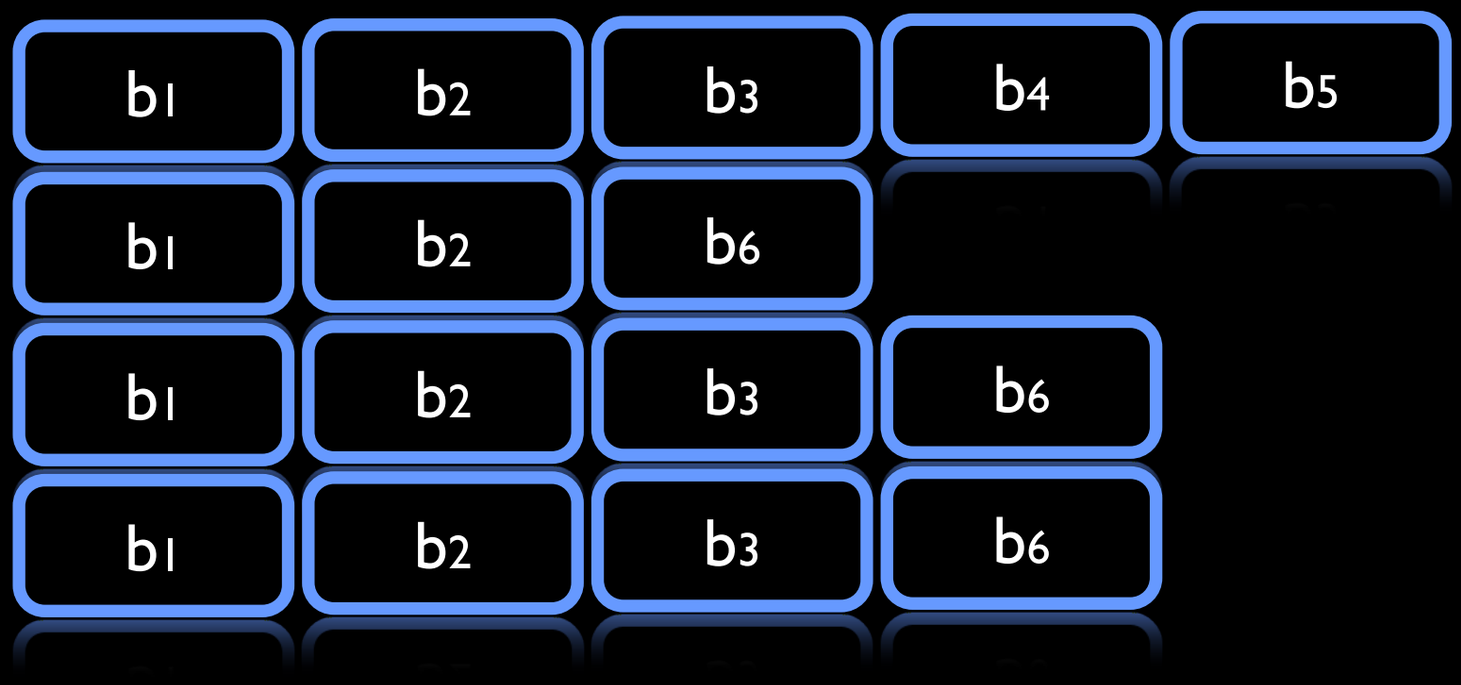


Practical Reasoning

- a plan is a set of basic plans
- deals are signed on small plans affecting only two agents
- a set of plans
- diversity



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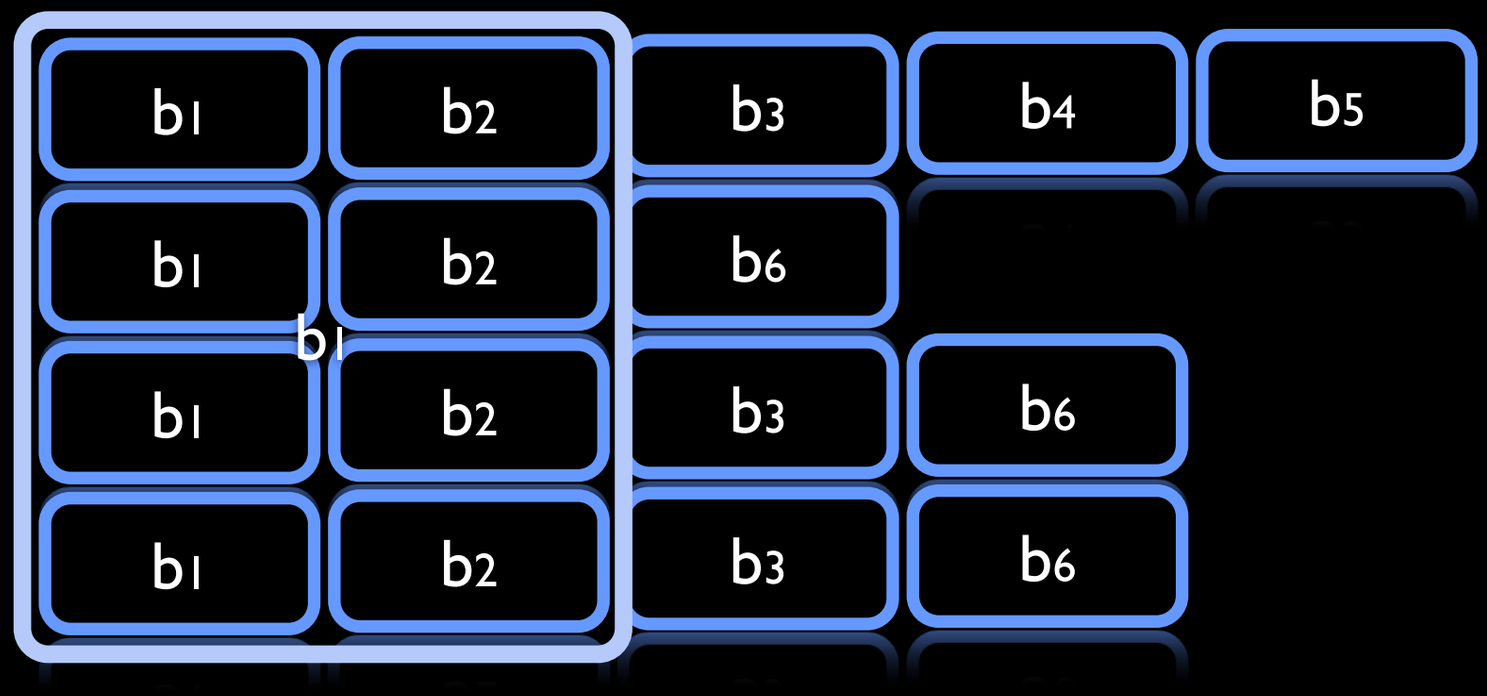

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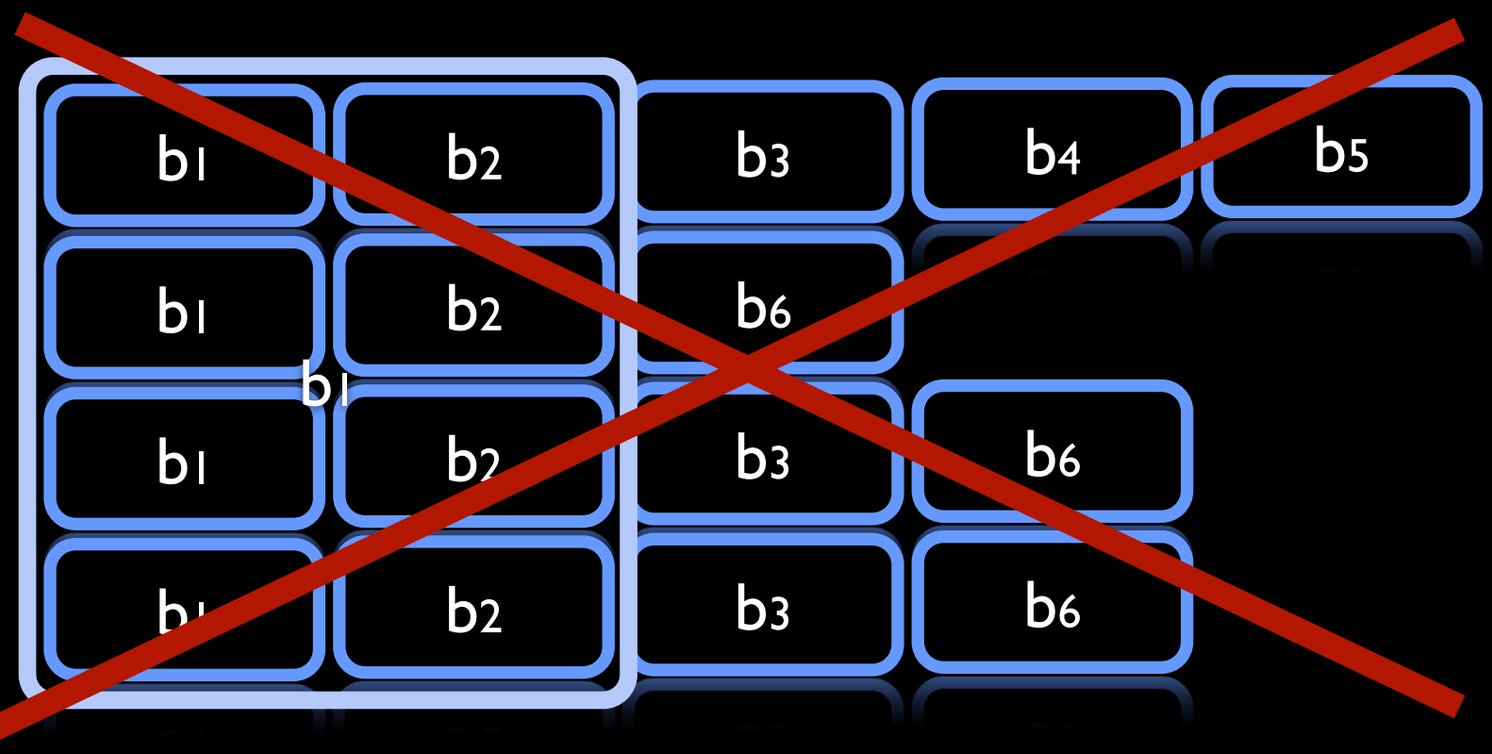

Practical Reasoning

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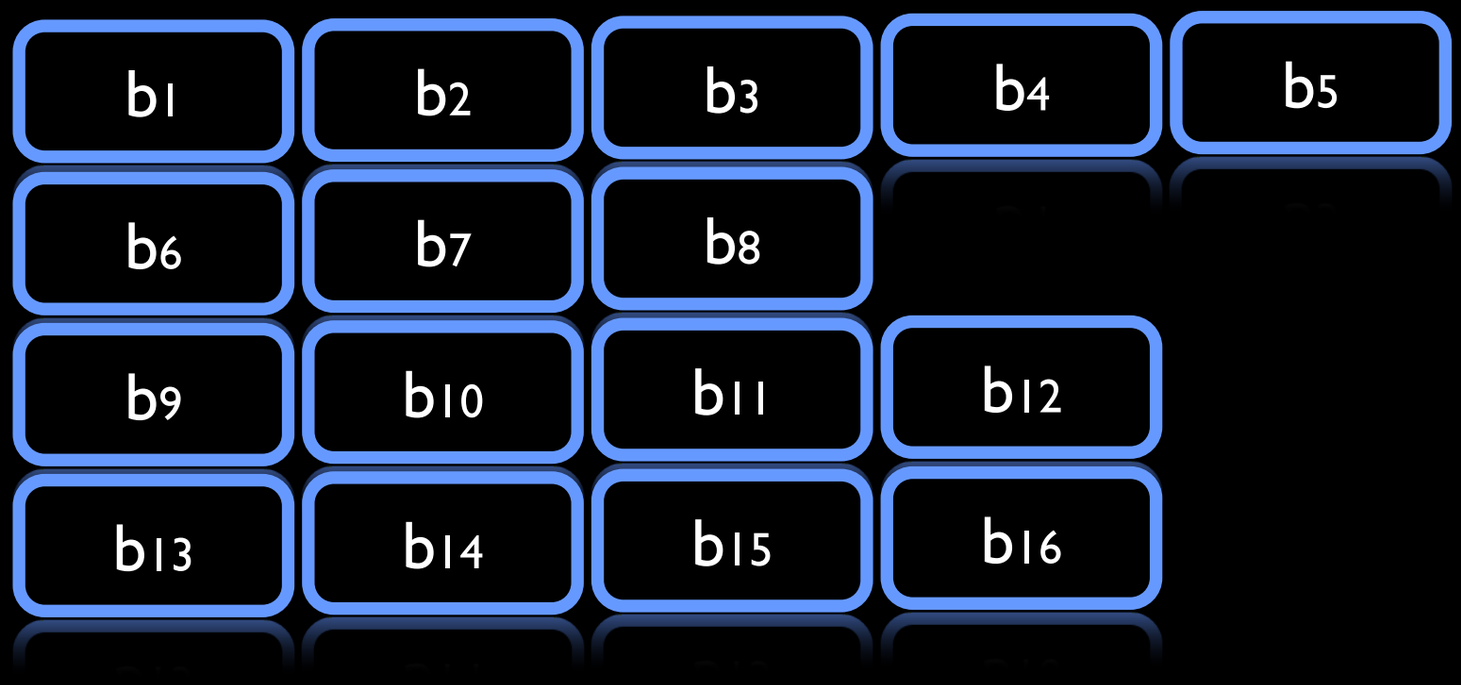
- diversity
- coherence



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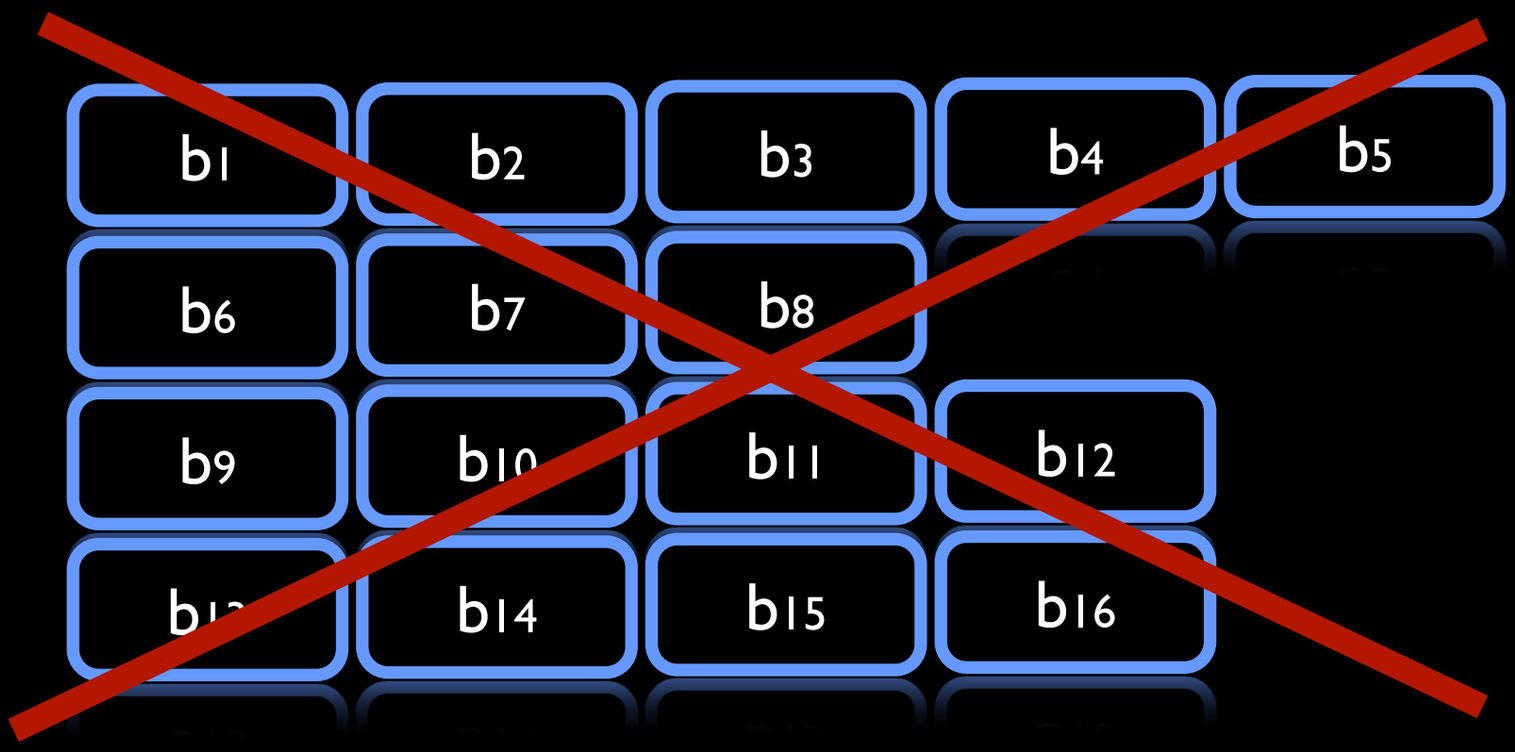
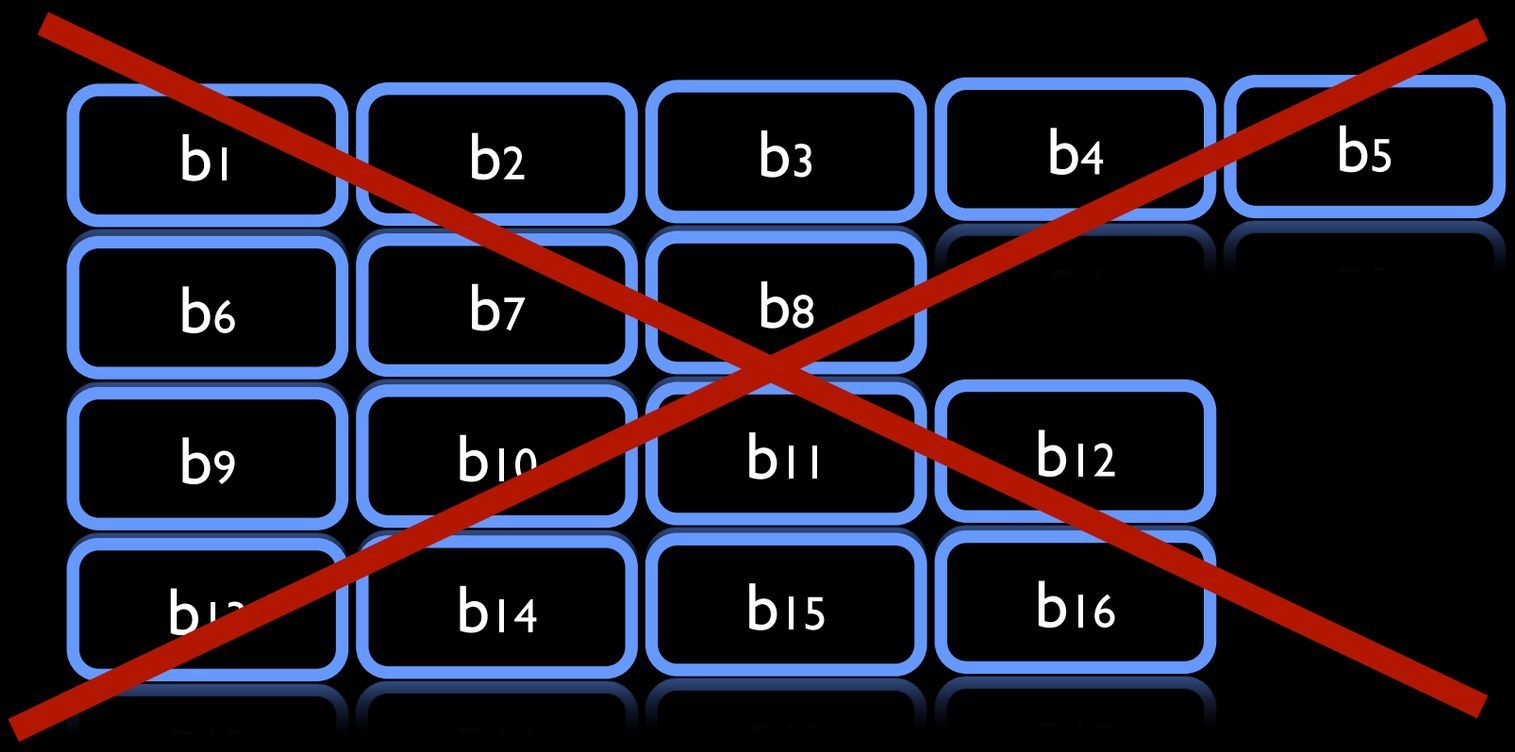


Practical Reasoning

- a plan is a set of basic plans
- deals are signed on small plans affecting only two agents
- a set of plans
- diversity
  trade-off
- coherence



Practical Reasoning

- genetic algorithms
- fitness: utility of the plan
- selection using elitism on a subset of plans that is diverse and coherence
  - Gini measure of the plans similarity
  - popularity: proportion of plans in that contain a given plan (low value)

[7] Fabregues & Sierra, '*An agent architecture for simultaneous bilateral negotiations*'. ACAN, 2010.

Practical Reasoning

diversity

Given a set of plans P we define the *statistical dispersion* of P, $\Delta(P)$, as the Gini measure of the plans similarity.

$$\Delta(P) = \frac{1}{|P|(|P|-1)} \Sigma_{p,q \in P} sim(p,q) \quad (1)$$

coherence

The *popularity* of a basic plan $b \in B$ within a set of plans P is the proportion of plans in P that contain it:

$$pop(b,P) = \frac{|\{p \in P : b \in basic(p)\}|}{|P|} \quad (1)$$

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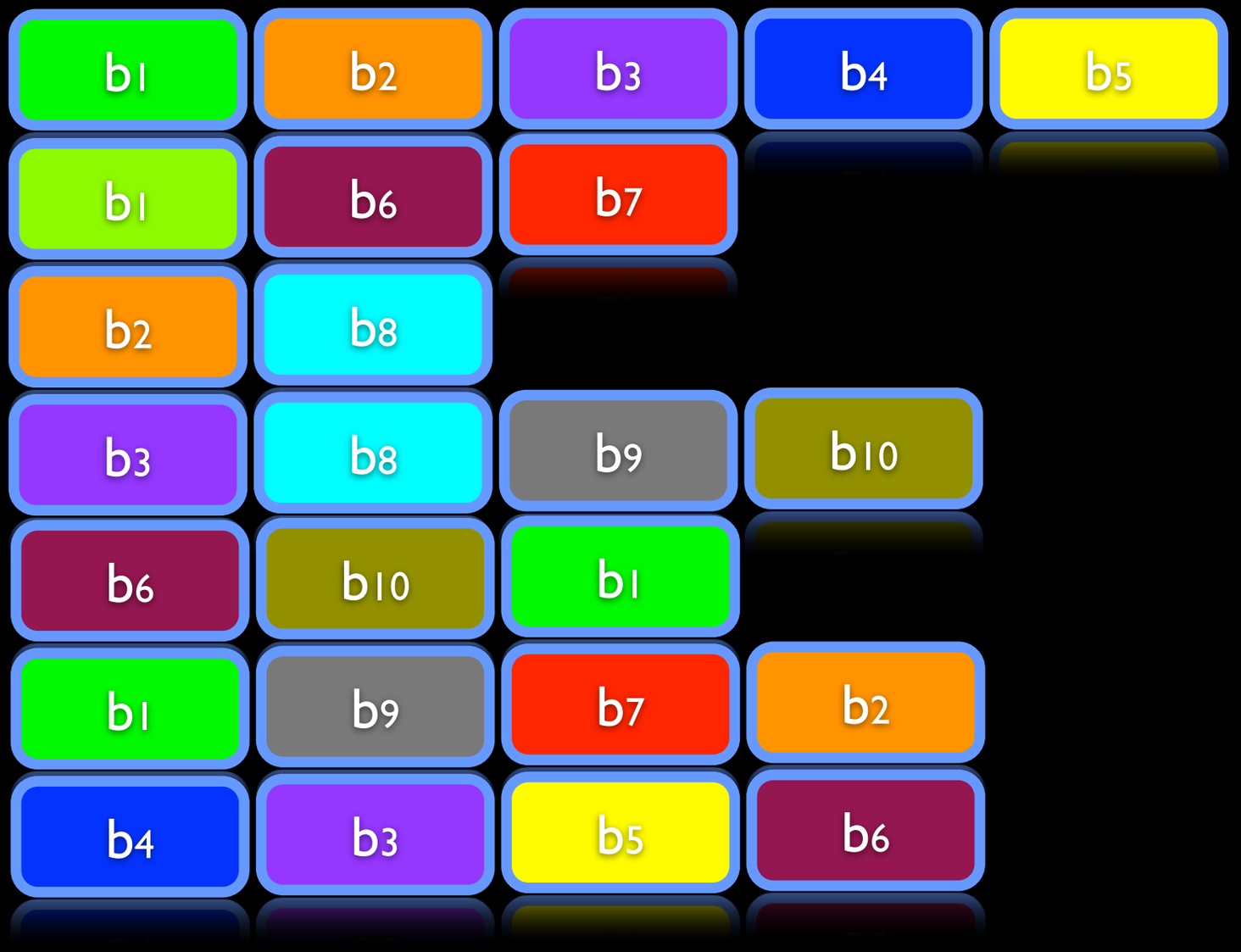
Practical Reasoning



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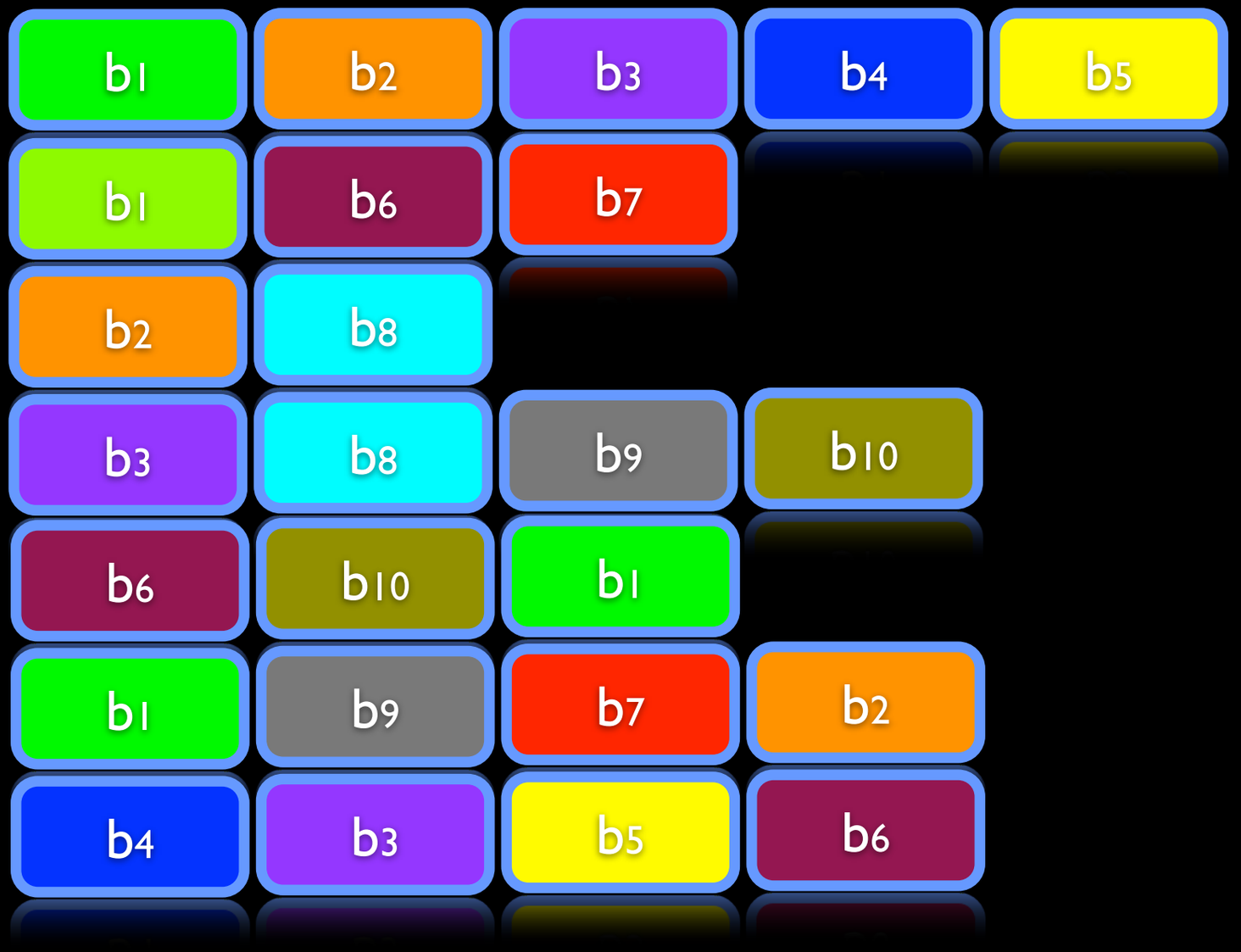

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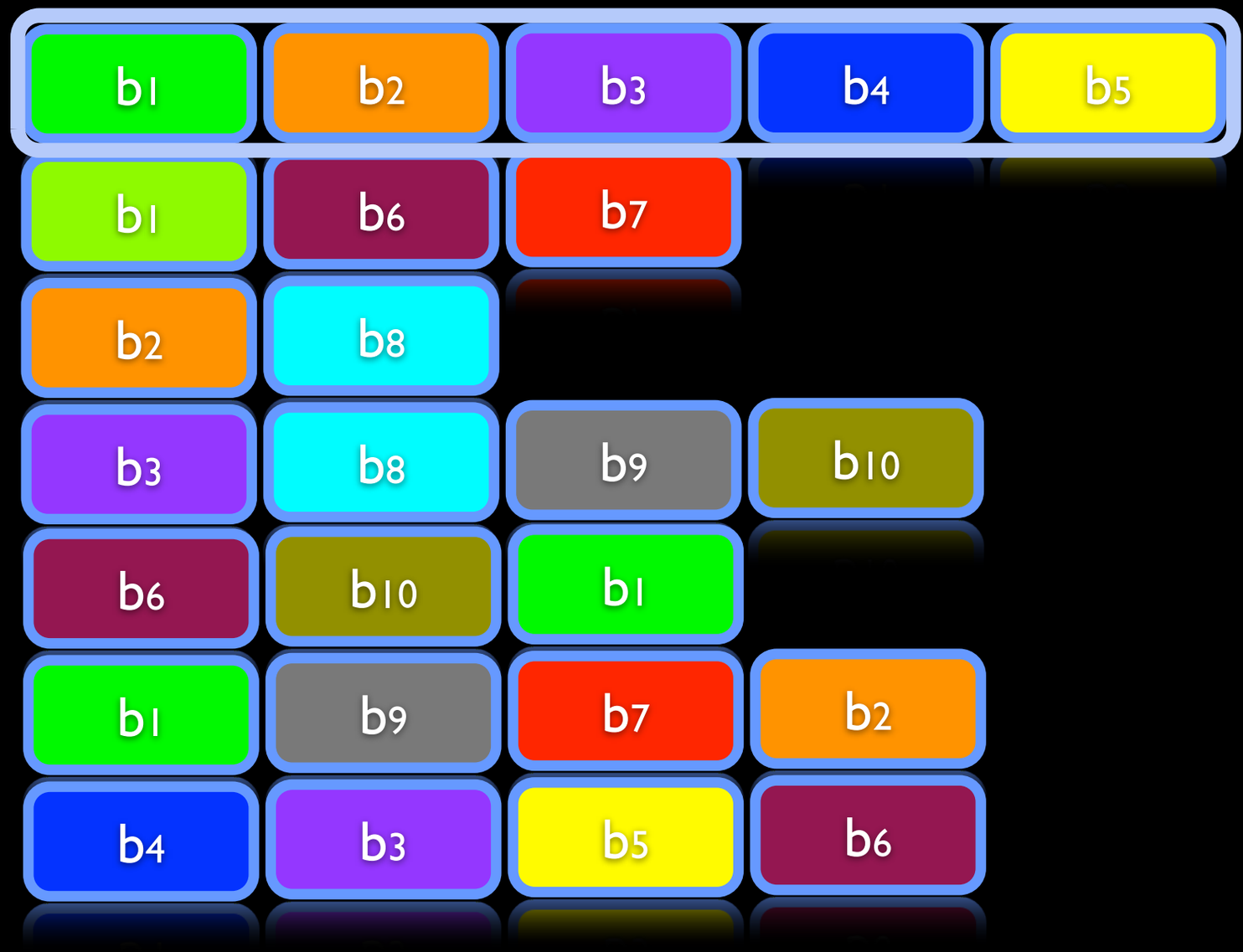
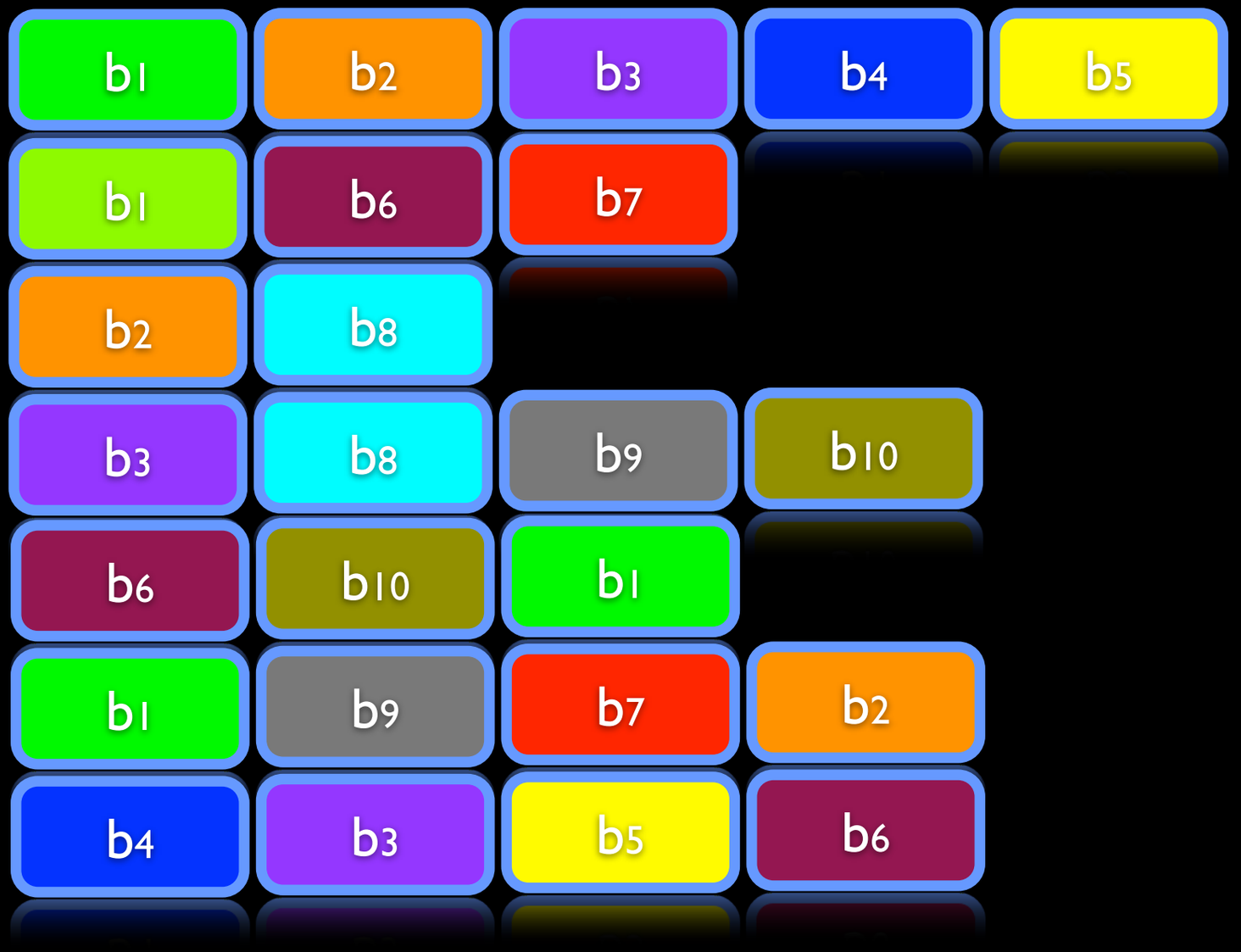


[7] Fabregues & Sierra, '*An agent architecture for simultaneous bilateral negotiations*'. ACAN, 2010.

Practical Reasoning



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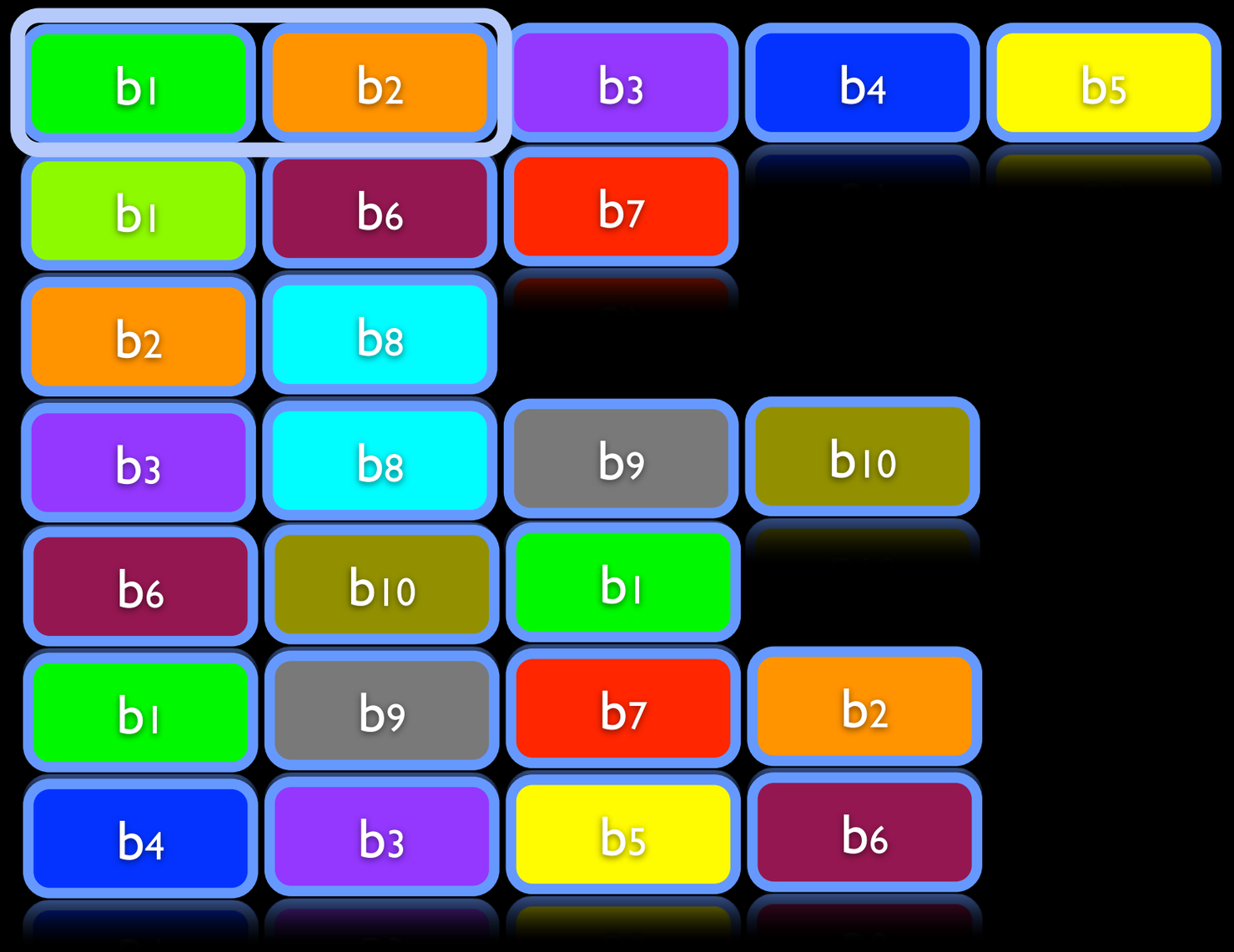

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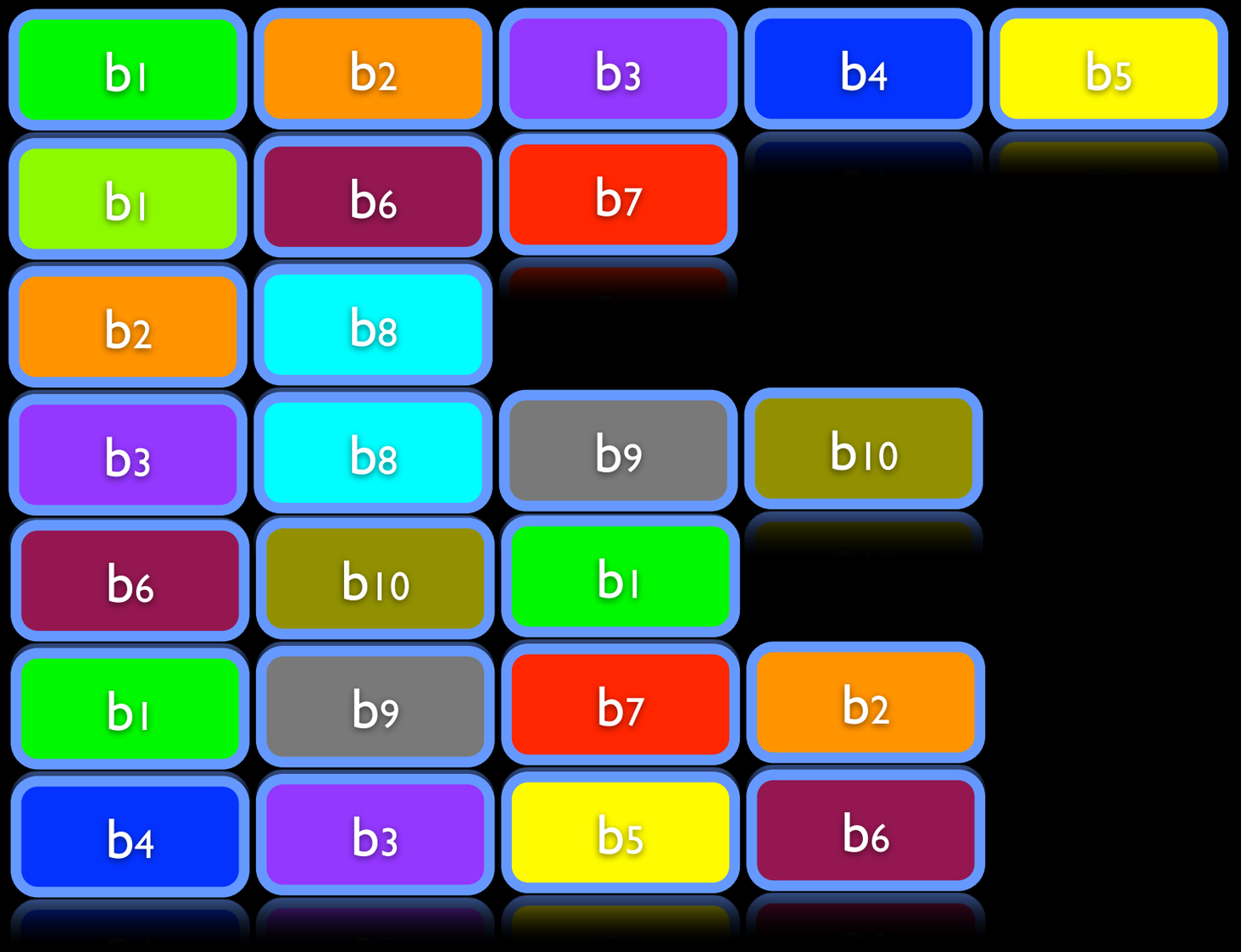

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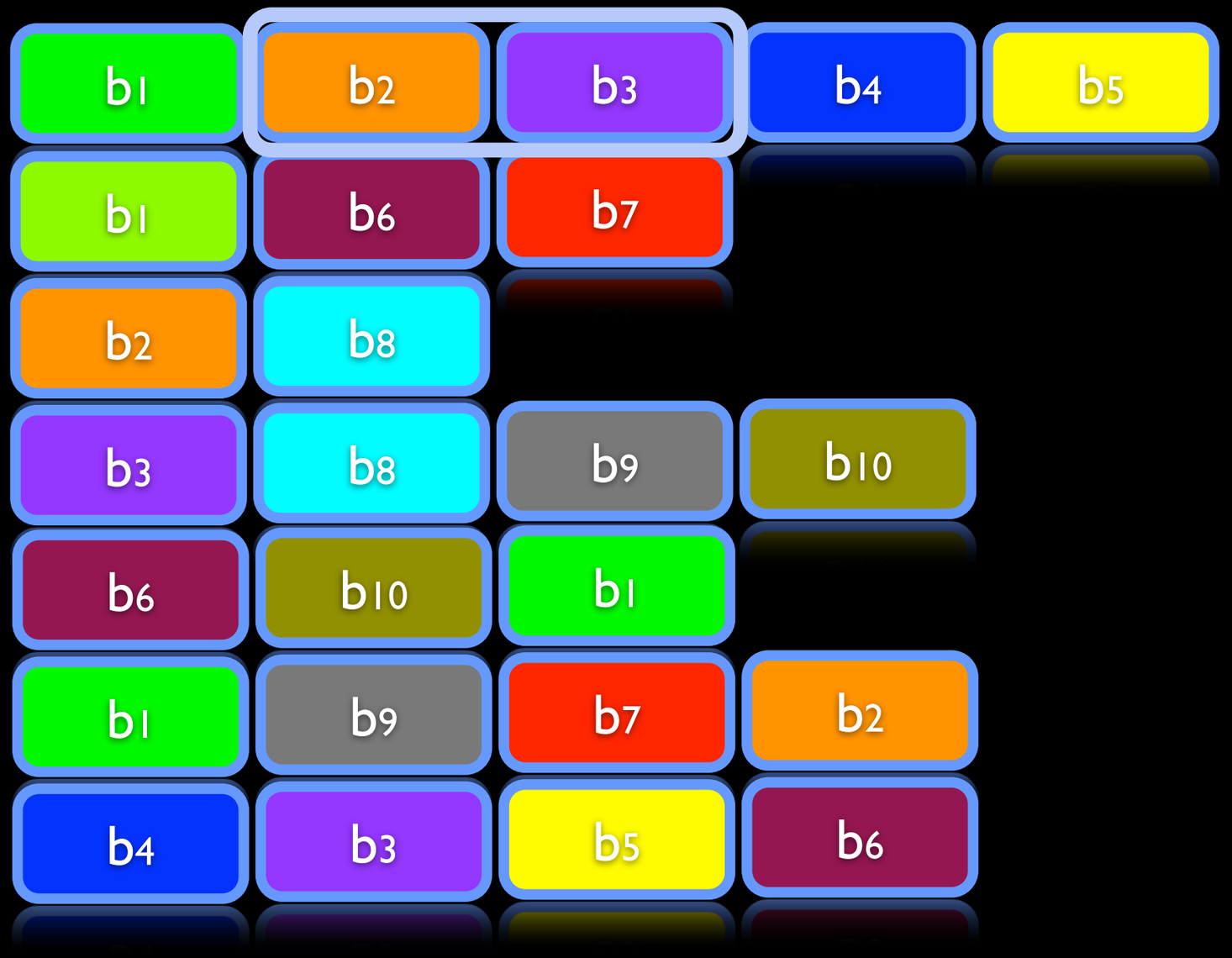

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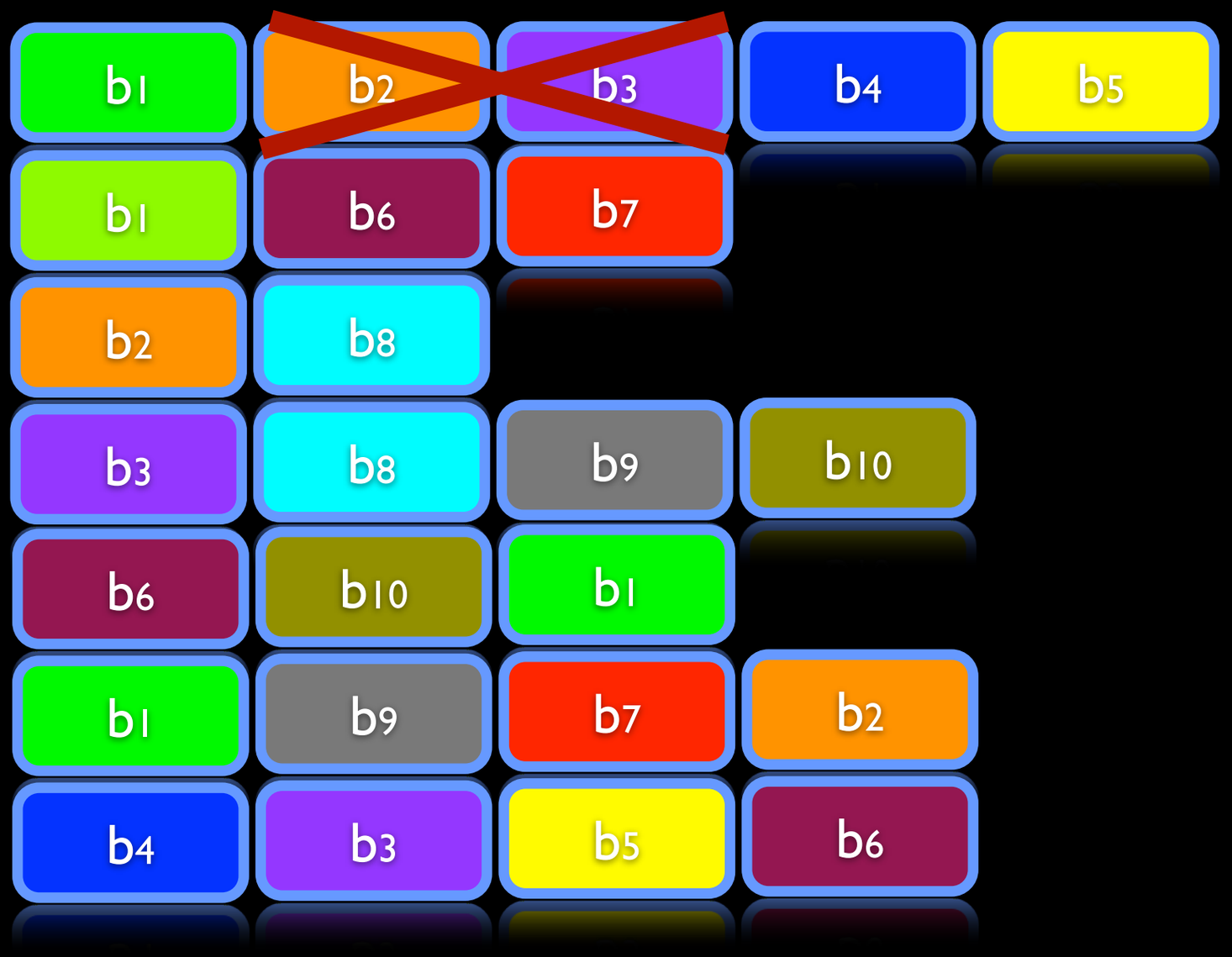

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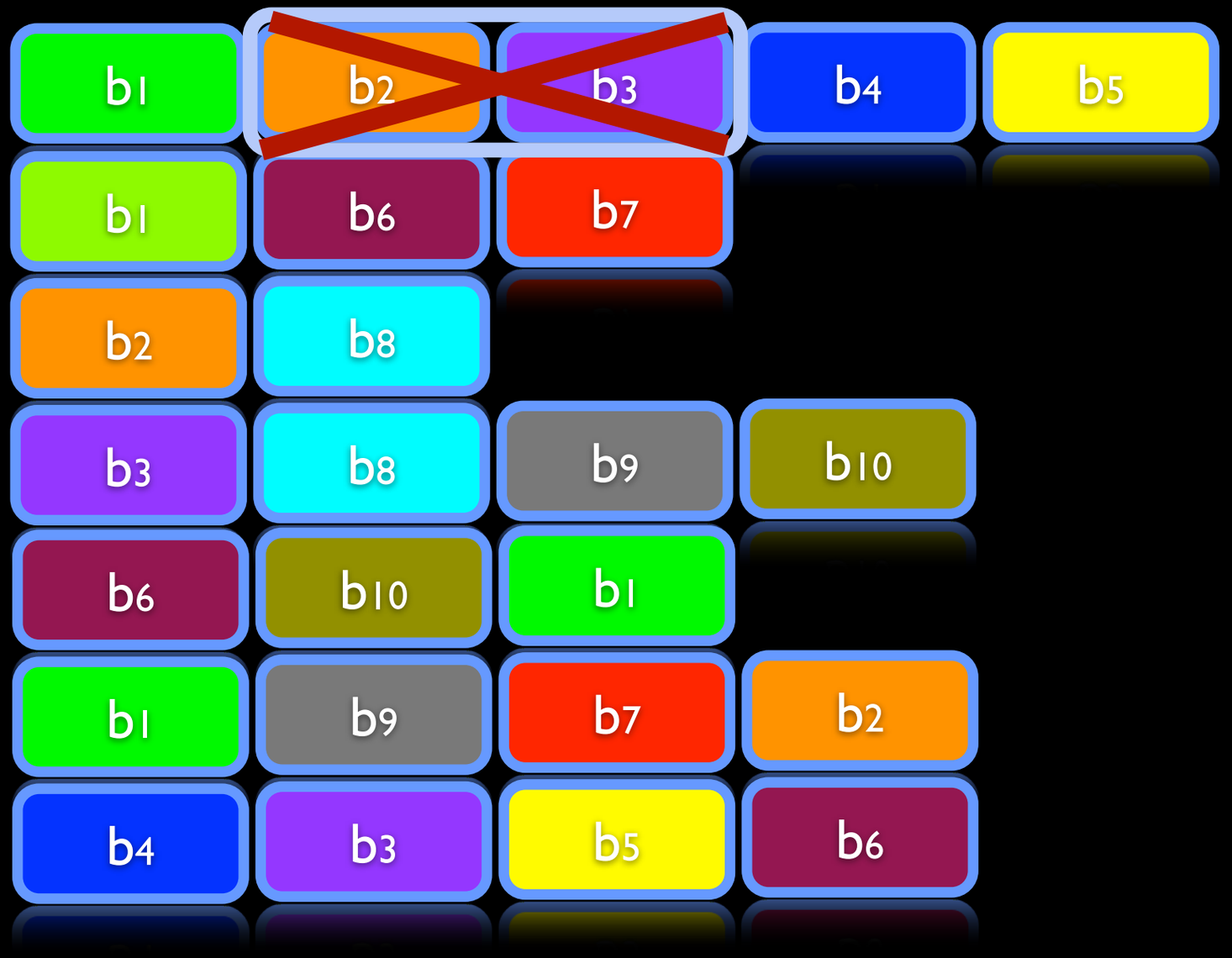

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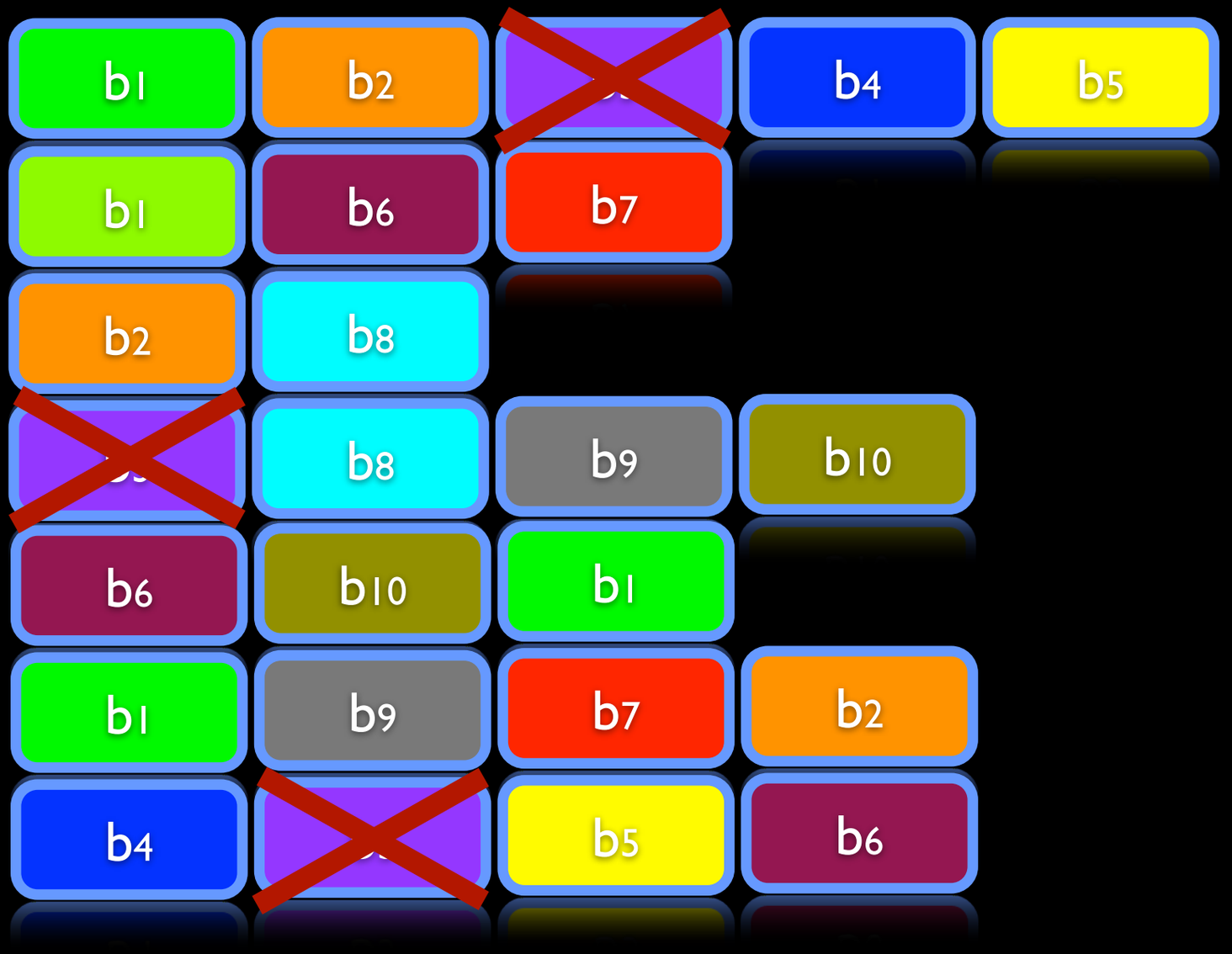

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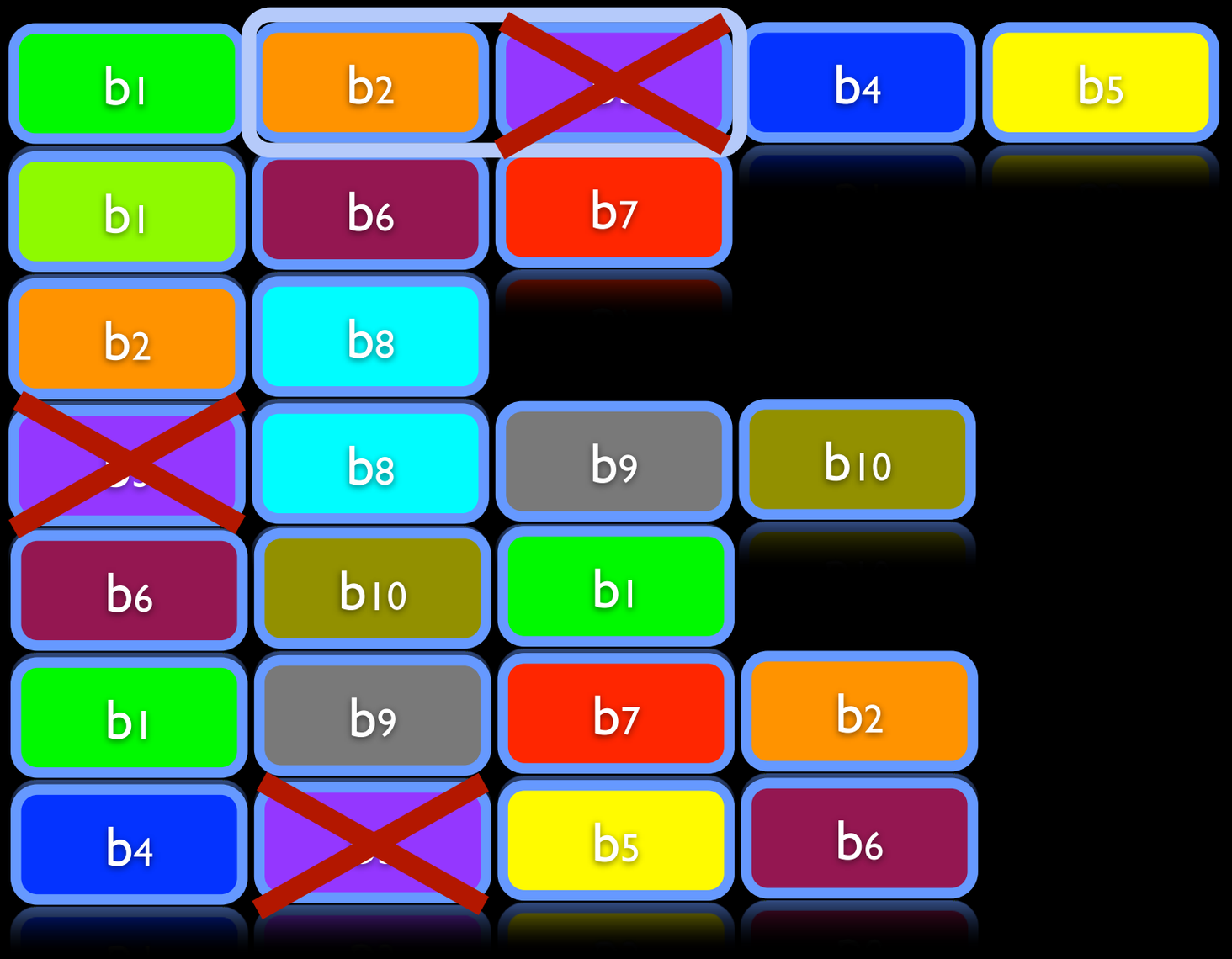

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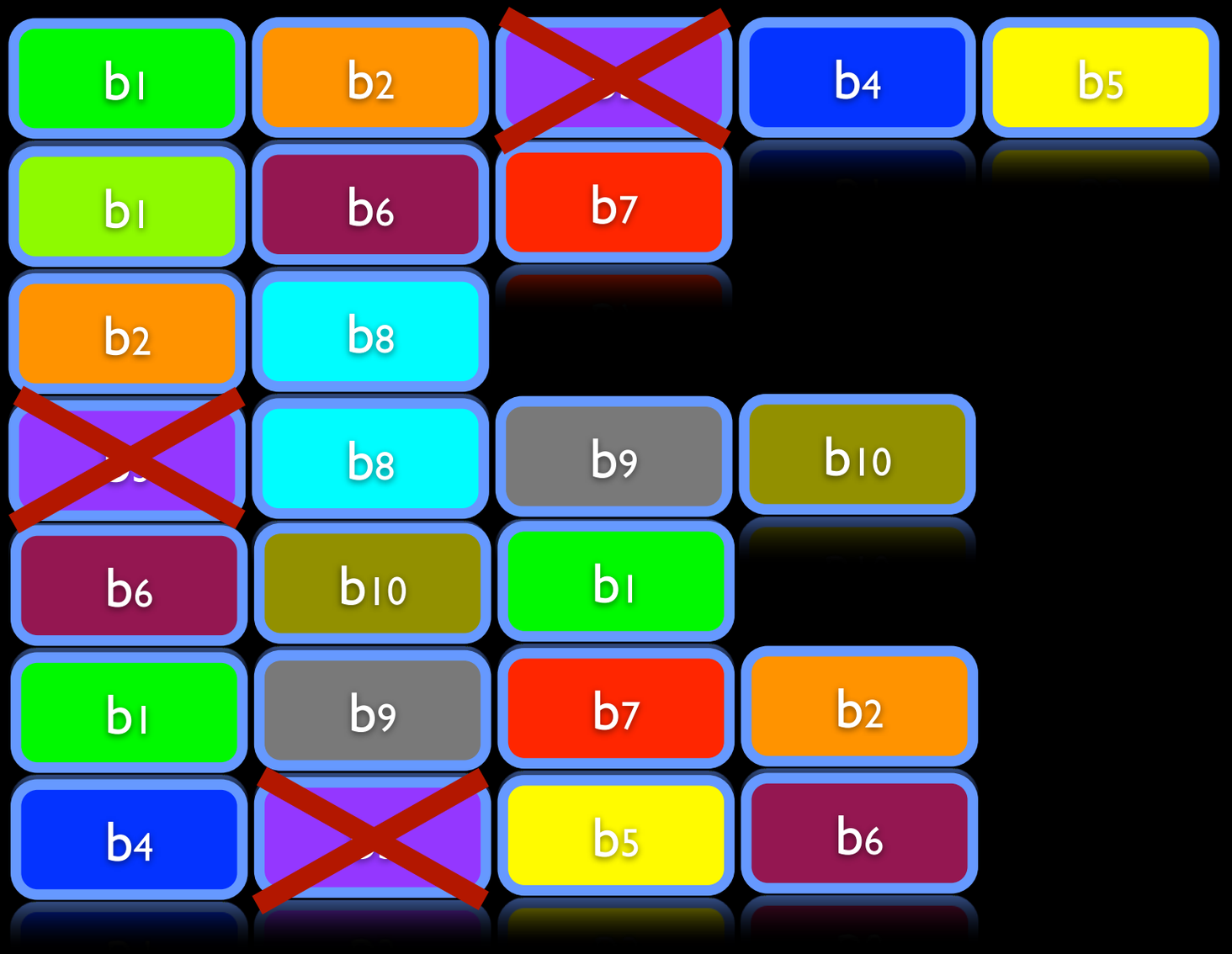

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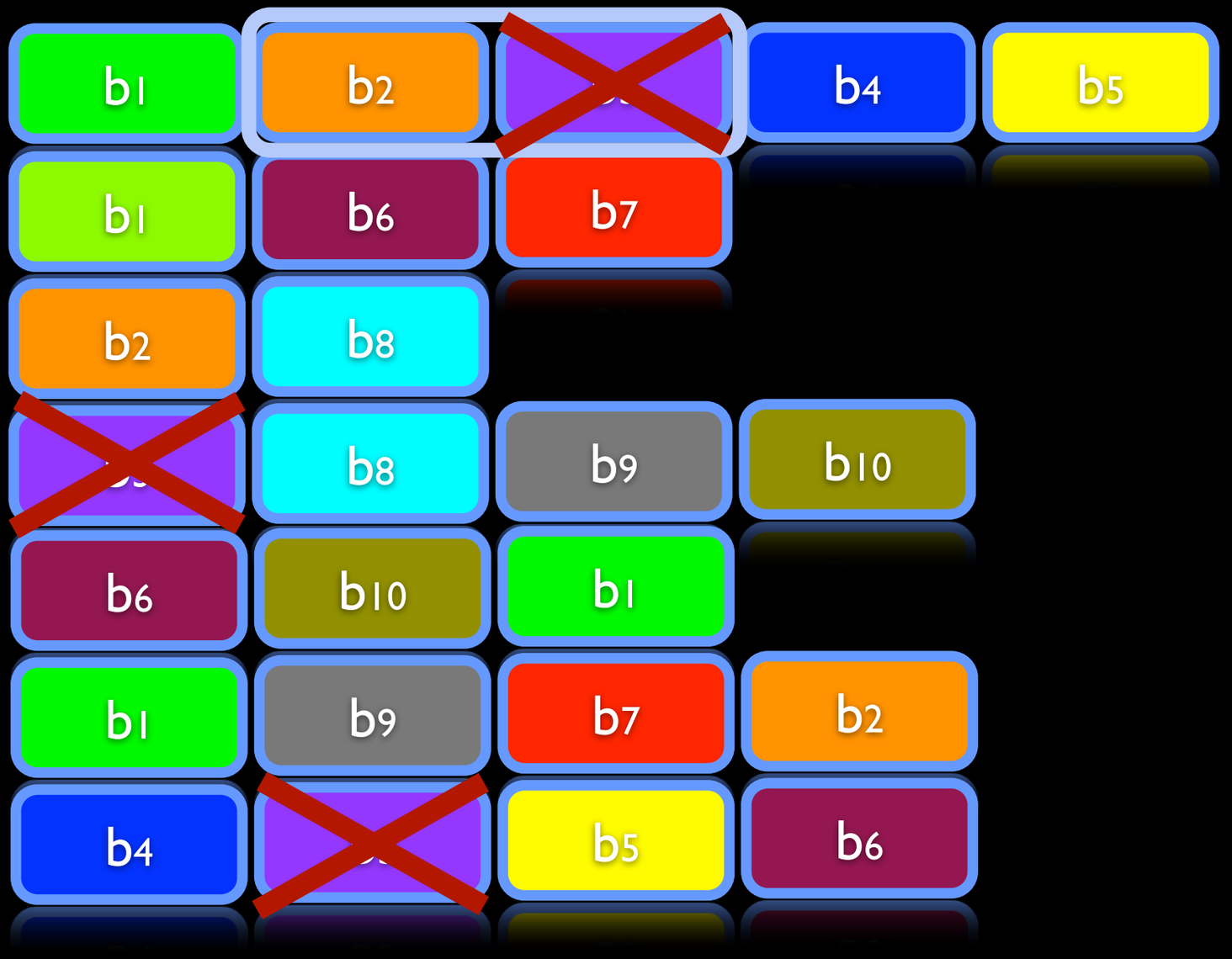

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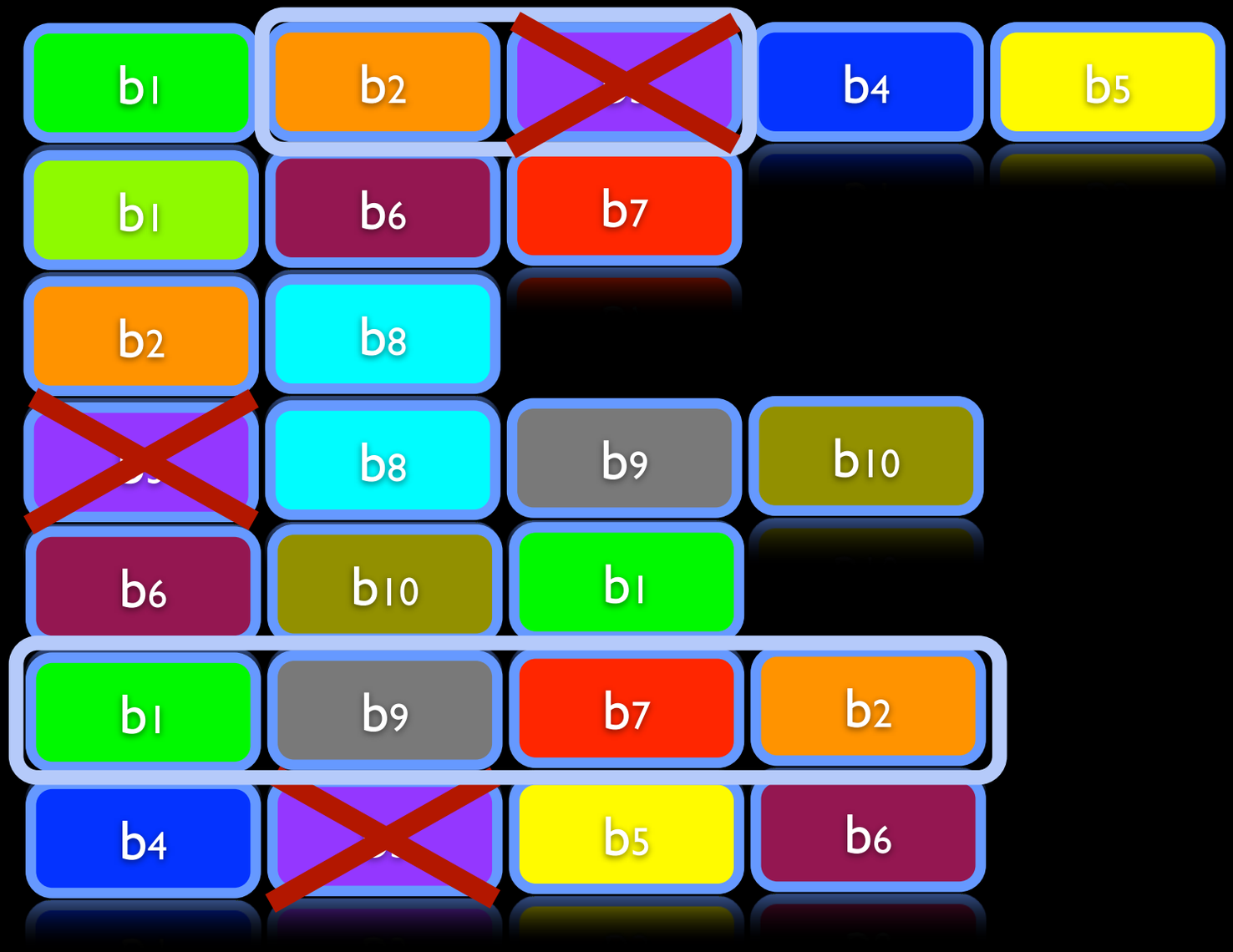

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