Class?

https://moex.inria.fr/mediation/class

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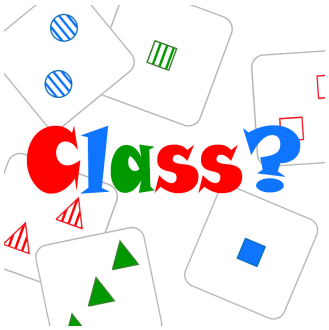


Introduction

Imagine that you live in a forest and that berries are the only food available: black berries, red berries, blue berries, big berries, small berries, clustered berries, etc. Maybe you like the granular red berries but not the the big blue ones, they are too bitter. Maybe the little green berries made you sick. What happens is that you use the characteristics of the berries (color, size, etc.) to choose the ones you will eat. This allows you to classify them with respect to their relevance: you are interested in red berries first and then look at whether they are smooth or grainy, round or elongated.

But different people with different preferences, different experiences or from distant lands can have different classifications. How do you know which berries to pick for pleasing them or for exchanging them for the berries you love?

The central question is: how do we understand each other? By simple cooperation, it is possible to get an idea of the knowledge of others. This is, in particular, how we learn a foreign language: we have our own language and we try to match the words, the categories.

We developed the card game *Class?* to illustrate this.

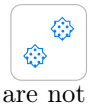
Cards

The game consists of 81 cards, all different, representing a pattern. This pattern is determined by four characteristics that each take exactly one value among three. Those are:

- the number: 1, 2 or 3,
- the color: red, green or blue,
- the shape: square, triangle or round,
- the filling: empty, striped or filled.

For example, one striped green square  , three filled red triangles  , or two blue empty circles  .

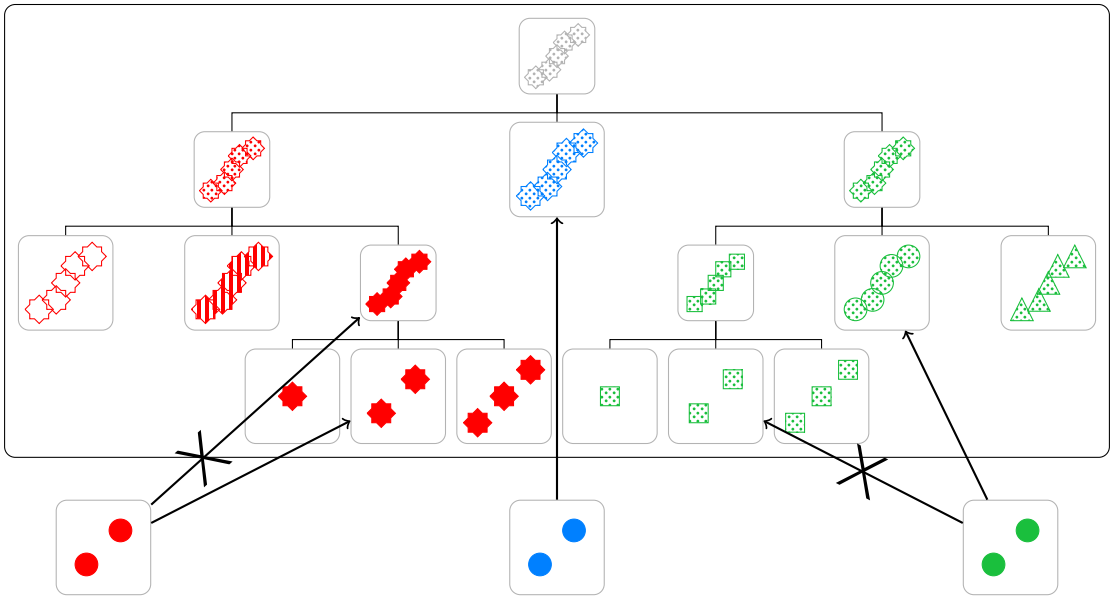
Classifications

Cards may be grouped in classes, representing a set of cards with specific feature values. For example,  represents the class of all cards having two blue elements. To denote that the shape and the filling are not specified for this class neutral shapes and patterns, that cannot be found on any of the cards (here star and dotted), are used. These can be replaced by any value (square, triangle or round; empty, striped or filled).

Classes may be organized into a classification: a tree of classes (growing from top to bottom). Each fork divides all the cards belonging to the class into three subclasses according to a single characteristic: the number, the color, the shape or the filling. Note that on the same level of the tree, the criteria may be different. The top class contains all the cards. And each class contains fewer cards than the class that precedes it and all the class cards that follow it (from top to bottom).

We actually play with the leaves of the tree (having no successor). For each of the 81 cards, and whatever the classification, there is a single leaf class in which it belongs.

The following figure shows how to attach cards to a classification:



Rules

Start

Each player receives 10 cards, the other cards constitute the deck (facing down).

Additionally one of the players, the knower, receives a "board" with a classification that he does not show to the other player, the guesser, and that he must respect during the game.

One card from the deck is turned, this is the first class. Then the knower begins.

Turn

Players play turn by turn placing on the table one or more cards from their hand that must belong to the same leaf class:

- either by adding them to a class already on the table,
- or by creating a new class. The knower can create a new class only if he cannot add to an existing class. When creating a new class, players must then draw a new card from the deck.

After the guesser plays, the knower indicates whether the played cards are correct. They are if:

- they all belong to that class according to the classification,
- and, if they are a new class, this class did not previously exist on the table.

This is communicated by the knower simply by a yes/no answer. In the case a mistake is made, the guesser takes all the played cards back in his hand and draws a new card from the deck.

End

The game ends when one of the players has no more cards. The guesser can try to guess the classification that was used.

Points and Winner

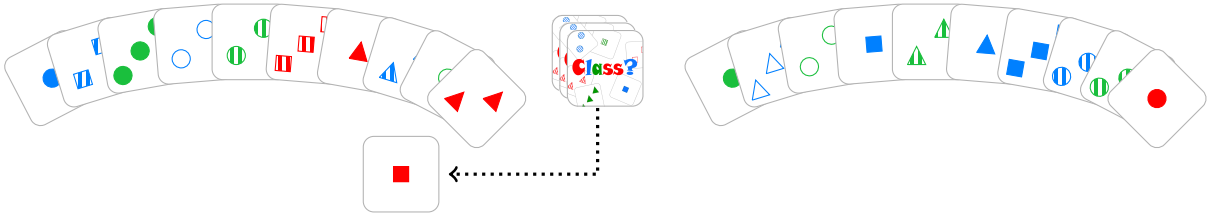
At the end of the game, each player scores as many points as there are cards left. After several rounds (players may exchange roles), the player with the least points wins. In the event of a tie, the player who guessed the classification correctly most often wins.

Note

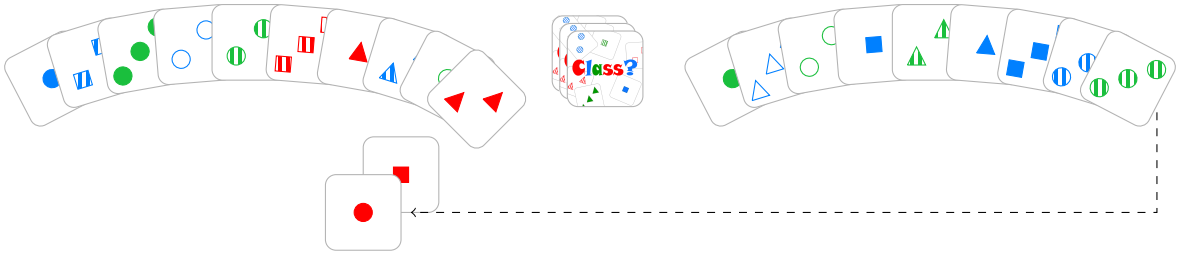
- all the cards that are played must be played to the same leaf class,
- players are not required to play all their cards belonging to a leaf class *at the same time*.

Sample Game

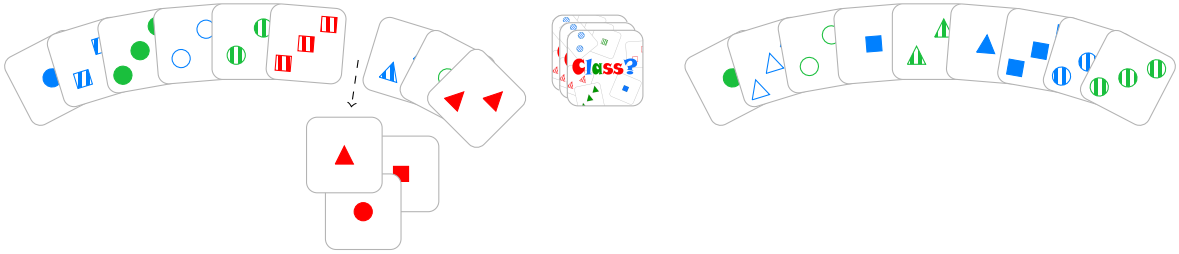
Initial situation (the guesser left, the knower right, who has the classification pictured above), one card drawn from the deck is the first class:



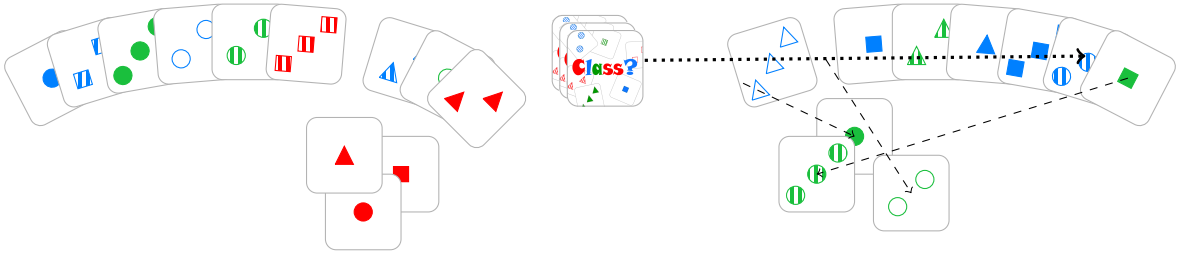
The knower (right) is obliged to add the unique card from this class that he has:



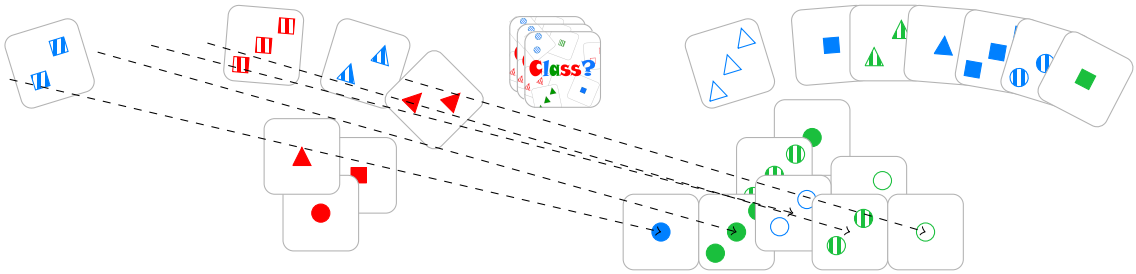
The guesser (left) adds one card to the class, it is correct:



The knower (right) creates another class with three cards and draws one new card from the deck:



The guesser (left) plays five cards:



This is incorrect: he takes his cards back and draws a new card from the deck. And so on until one of the players has exhausted his cards.

Questions

For those who are bored:

- What is the maximum height of a classification?
- What is the smallest number of leaf classes in a classification of maximum height?
- How many classes are there in the largest classification? And how many leaf classes?
- If we exhaust all the cards, do you think we will know exactly what the classification is?
- What happens if you delete a card category (for example all red cards)? And what happens if we add one?
- Can the game work if instead of the question "What color is the card?" we ask ourselves "Is the card green?".

Variants

- The knower may announce the number of leaf classes at the beginning.
- The game may be played with multiple guessers.
- It is possible to divide the set of cards in half and play two games in parallel, since in general we do not exhaust all the cards.
- It is possible to play twice with the same classification but with two different guessers. Afterwards the guessers can compare their guesses of the classification.

The science behind

The cards correspond to objects in the world (which are much more numerous than 81) and classifications are our ways of organizing them; it is the knowledge we have learned.

The game illustrates different aspects:

- Everyone can organize their knowledge in the way that seems most useful for them, the most appropriate: there is no "good" representation.
- It is possible to learn the way that someone else classifies the objects through interacting with simple yes/no answers.

Can computers do it?

mOeX

Have you heard of artificial intelligence? One of its topics is the representation of knowledge: it is possible to express a "worldview" in a computer on which it can reason. The mOeX research team studies the rules by which knowledge, such as the classifications used in the game, can be created, developed and evolved.

This type of work is related to answering questions you may ask yourself:

- Can you guess how other people see the world?
- Can you know how they organize what they see?
- Is there a unique way to organize/store your items?
- Can you imagine how a computer sees the world?
- Can you imagine how an eskimo sees the world?
- Can you imagine how your teacher sees the world?
- Can you imagine how your neighbor sees the world?

And yet, you get to get along pretty well... In principle, you have tried, you have made a mistake, you have corrected yourself, you have learned that others may see the world differently. Our goal is to determine how computers can achieve this goal. How they evolve their knowledge/representation of the world according to their experience.