

# EVERYBODY WANTS THE SAME. HOW CAN WE ALLOCATE IN A FAIR WAY, WITHOUT CAUSING ENVY?

A very common situation: an institution must allocate school or university places, depending on the preferences of the new students.

## Access to university:

In Catalonia, in the year 2018, more than 33,000 students enrolled in the PAU (university access tests).



This problem has three main attributes:

1. **The allocation system must consider the preferences of the students.**
2. **The objects to be allocated are indivisible: they cannot be shared.**
3. **Money cannot be used.**

## ONE EXAMPLE:

### ALLOCATION OF SCHOOL PLACES FOR CHILDREN

The relevant government agency must allocate public school places in a way that must be both efficient and fair. For that reason:

- Each family delivers a list with their preferences.

ANNA	BERTO	CARLA	DANI
SCHOOL C	SCHOOL B	SCHOOL B	SCHOOL A
SCHOOL B	SCHOOL A	SCHOOL C	SCHOOL C
SCHOOL A	SCHOOL C	SCHOOL A	SCHOOL B

- Each school sorts the children according to their priority.

Priorities are set according to objective data: home address close to school, siblings in the same school...

SCHOOL A 2 places	SCHOOL B 1 place	SCHOOL C 1 place
CARLA, ANNA, BERTO, DANI	ANNA, DANI, BERTO, CARLA	DANI, CARLA, ANNA, BERTO

## TWO POSSIBLE SOLUTIONS:

### 1. Immediate acceptance mechanism

In the first phase, each family states a school as first option. Schools accept the requests according to the priority of the school, until they reach their maximum capacity. If a family is rejected in their first option, it might happen that, in a second phase, their second option is full, and they're given the third, or even the fourth, option.

ANNA	BERTO	CARLA	DANI
SCHOOL C	SCHOOL B	<del>SCHOOL B</del>	SCHOOL A
SCHOOL B	SCHOOL A	<del>SCHOOL C</del>	SCHOOL C
SCHOOL A	SCHOOL C	SCHOOL A	SCHOOL B

### 2. Deferred acceptance mechanism

When a kid is rejected in their first-option school in the first phase, in the next phase the kid requests the school marked as a second option. The school will then compare the priority order of this kid with the order of those kids that were accepted in the first phase; if the priority of this kid is higher than the priority of one of the admitted kids, this child will (tentatively) get the place, and the child accepted in the first phase will be rejected.

	ANNA	BERTO	CARLA	DANI
PHASE 1	SCHOOL C	SCHOOL B	<del>SCHOOL B</del>	SCHOOL A
PHASE 2	<del>SCHOOL C</del>	→	SCHOOL C	
PHASE 3	SCHOOL B	←	<del>SCHOOL B</del>	
PHASE 4		SCHOOL A		

CARLA IS REJECTED IN HER FIRST OPTION.

CARLA GETS ANNA'S PLACE, IT'S HER SECOND OPTION AND SHE HAS PRIORITY.

ANNA GETS BERTO'S PLACE, IT'S HER SECOND OPTION AND SHE HAS PRIORITY.

BERTO GETS A PLACE IN SCHOOL A, IT'S HIS SECOND OPTION.

ANNA	BERTO	CARLA	DANI
<del>SCHOOL C</del>	<del>SCHOOL B</del>	<del>SCHOOL B</del>	SCHOOL A
SCHOOL B	SCHOOL A	SCHOOL C	SCHOOL C
SCHOOL A	SCHOOL C	SCHOOL A	SCHOOL B

### HOW DO BOTH MECHANISMS COMPARE?

The immediate acceptance has one disadvantage: it may generate justified envy. Carla envies Anna, because she's been accepted in School C. Carla prefers School C over School A, which is the one she's been assigned to; besides, her priority is higher. The immediate acceptance procedure can be manipulated: Carla will benefit if she says that her first option is School C.

The deferred acceptance procedure doesn't arise justifiable envy, and it cannot be manipulated. The families have incentives to reveal their real preferences.

Barcelona applies the immediate acceptance mechanism. On the other hand, New York and Boston have adopted the deferred acceptance procedure.

### ANOTHER EXAMPLE

In the United States, starting in 1952, the National Medical Resident Program applies the deferred acceptance mechanism to allocate doctors to hospitals.



You can watch the video *The Match* on YouTube, where this procedure is explained.



Other videos in which Alvin Roth (Nobel Price Economics, 2012) explains assignment problems:



«The Talmud tells of a rabbi who is asked what the Creator of the universe has been doing since the creation. The rabbi answers, "He has been making matches." [...] Even if matches are made in heaven, they are found in marketplaces. And markets, like love stories, begin with desires. Marketplaces help shape and satisfy those desires, bringing together buyers and sellers, students and teachers, job seekers and those looking to hire, and even sometimes those looking for love.»

(Alvin Roth, *Who gets what and why*)