AI algorithms for team formation

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with thanks to:
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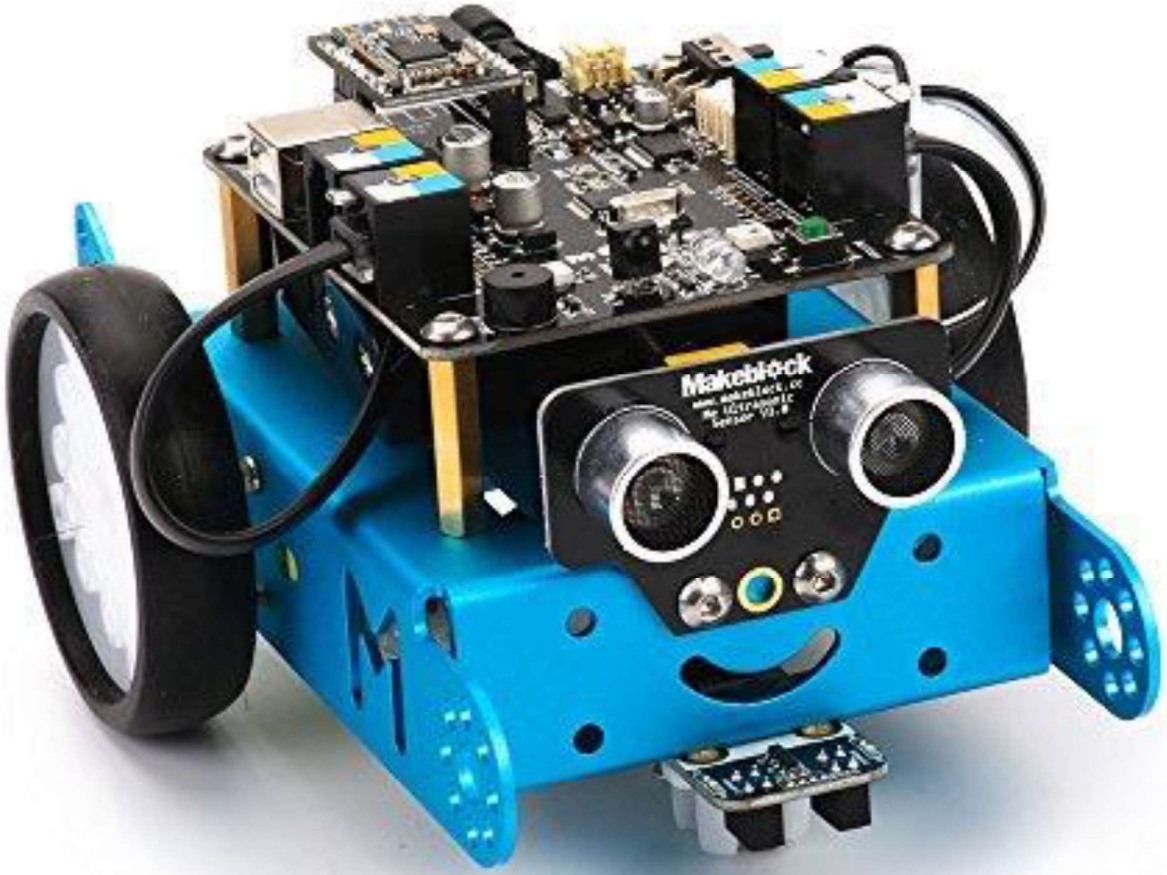
Motivating Example: teams in the classroom

We have a classroom of 30 students and we want to group them into teams.

A task to solve

We have 10 robots to program.
Teams of students are tasked with making their robots dance.



Motivating Example

Competences with competence levels

Gender

Personality

The challenge

How to assign students to teams so that all teams have sufficient competences to perform the task and work well together and all teams are similarly good?

How do we do it?

A teacher specifies the task

What do we need to perform this task?

1. A number of students per robot (e.g. teams of size 3)

	Level	Importance
2. Know how:		
-the robot mechanics work	High	0.4
-to program Arduino-based robots	Medium	0.4
-to play music	Medium	0.2

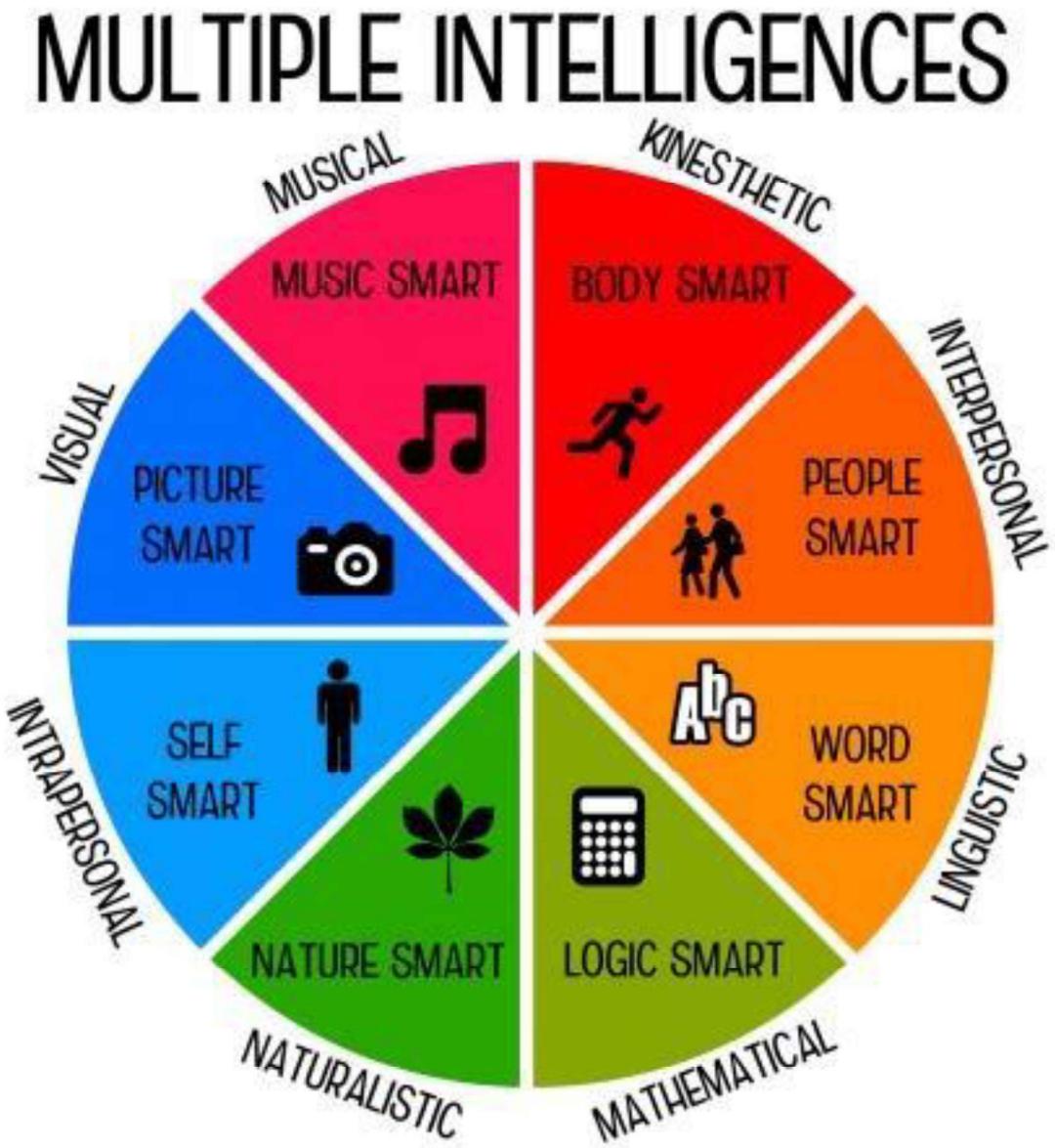
We gather students' information

Competences with competence levels

Gender

Personality

Students complete competence tests

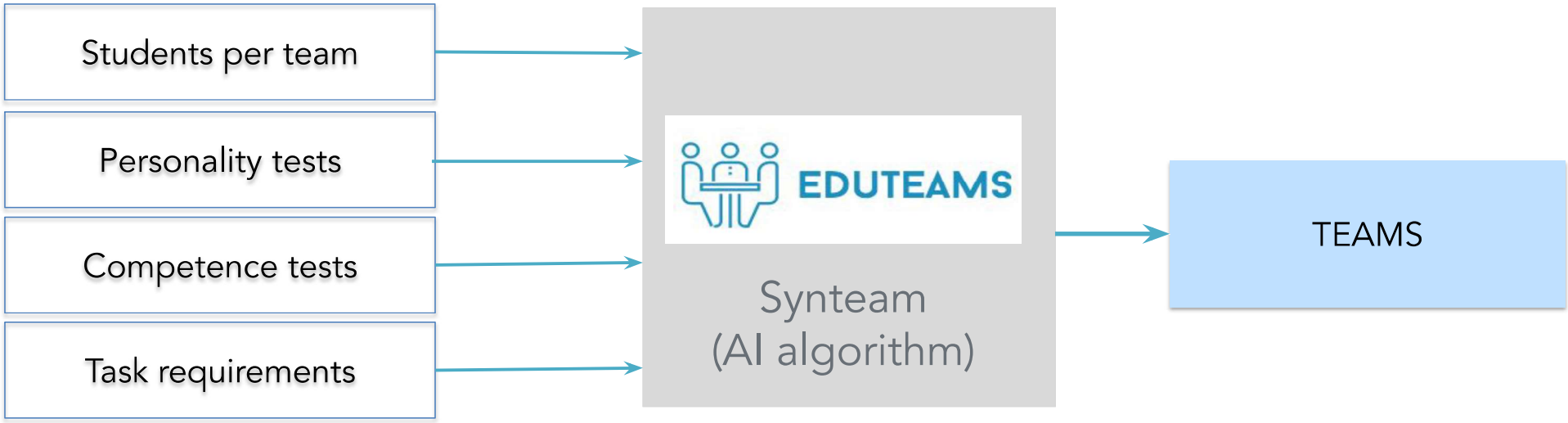


Students complete personality tests

The Post - Jungian Personality Theory

Extraversion	E	Interaction with world	I	Introversion
Sensing	S	Approaching problems	N	Intuition
Thinking	T	Way of making decisions	F	Feeling
Judging	J	Way of living	P	Perceiving

Eduteams computes the teams to form



Eduteams output

- A group of teams such that the members of each team are:
  - diverse in personality
  - diverse in gender
  - proficient to perform the task
- Each competence required by the task is assigned to one student in the team
- Each student is responsible for at least one competence in the task, and……

THE DISTRIBUTION OF TEAMS IS FAIR

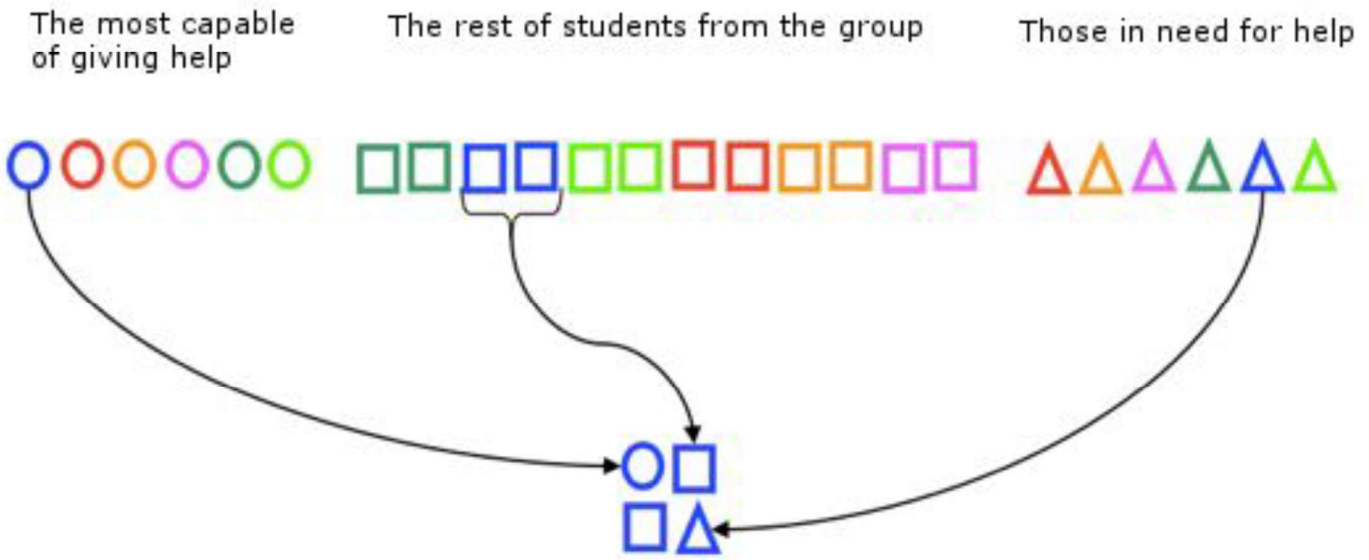
Experimental Results

Current school practice: Teacher Method

BASE TEAMS: Stables Heterogeneous	

Base of team formation:

In order to create teams, we need to divide the students in three sub-groups:



First Experiment - Treball de Sintesi

Institut Torras i Bages, 1st year of Secondary Education

98 students

Each classroom was divided into teams of size three (31 teams)

1) We apply random sampling to split each class into two halves of similar size.
2) We partitioned one of the halves into teams using SynTeam. The other half was divided by the teacher method.
3) All teams performed the task and we collected the final marks of students.
4) We calculated the geometrical average of teams' results composed by teacher and composed by SynTeam.

Second Experiment - Scratch Programming

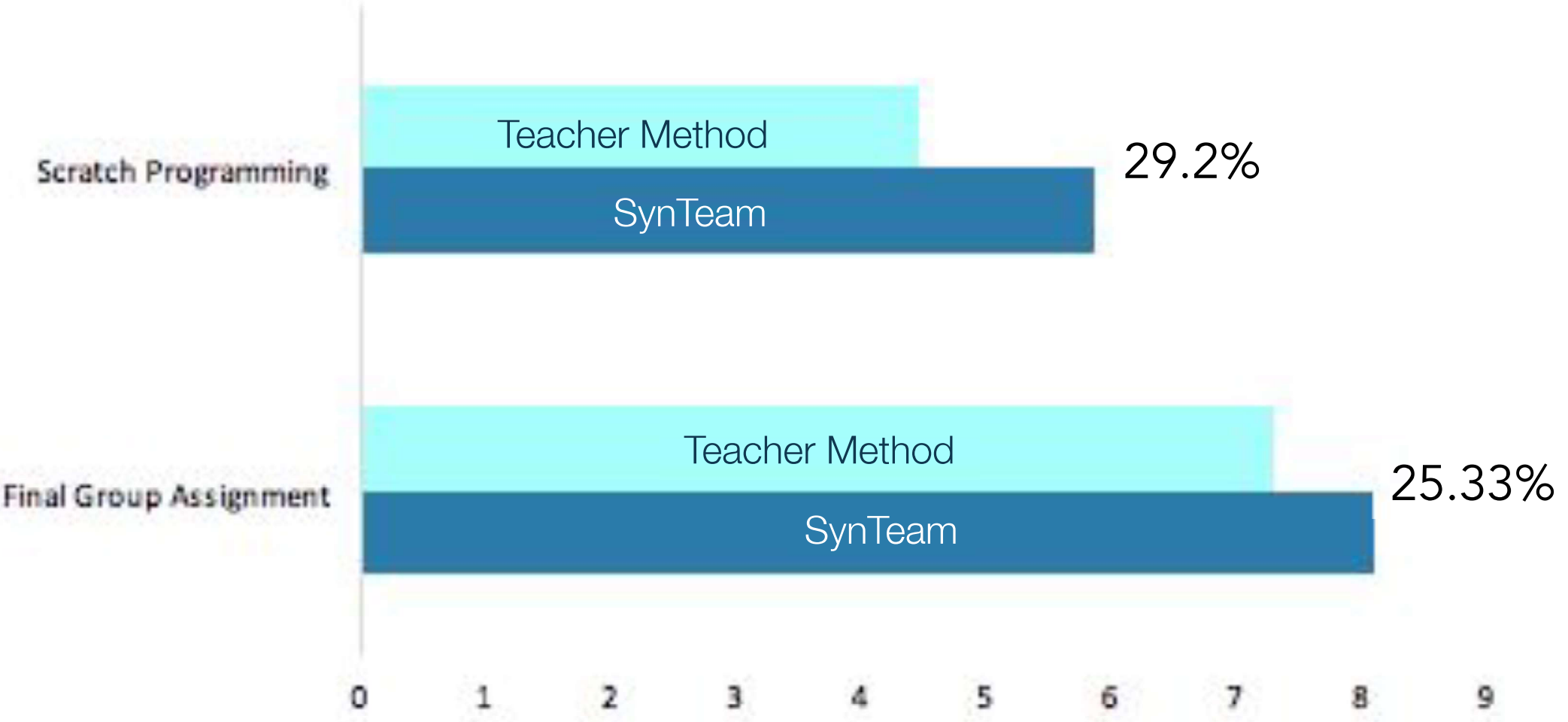
Institut Broggi, Institut Olorda and Institut Torras i Bages

154 students

Each classroom was divided into teams of size two (75 teams)

1) We apply random sampling to split each class into two halves of similar size.
2) We partitioned one of the halves into teams using SynTeam. The other half was divided by the teacher method.
3) All teams performed the task and we collected the final marks of teams.
4) We calculated the geometrical average of teams' results composed by teacher and composed by SynTeam.

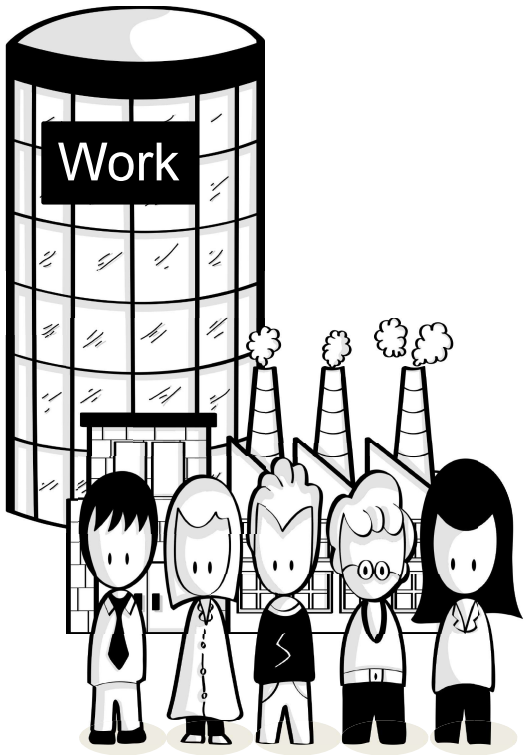
Results Comparison

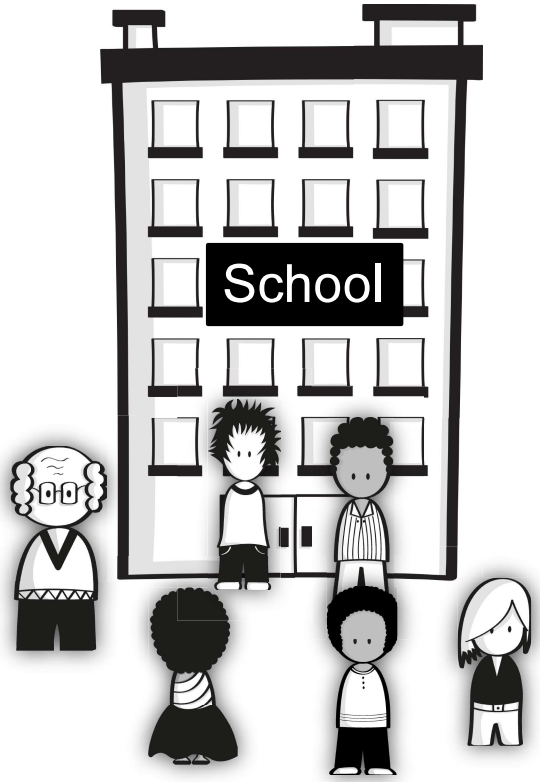


Conclusion

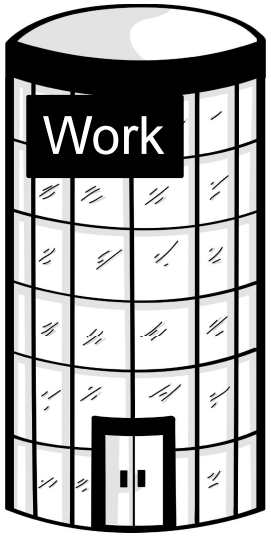
Synteam (our algorithm for team formation)
outperforms current school practice

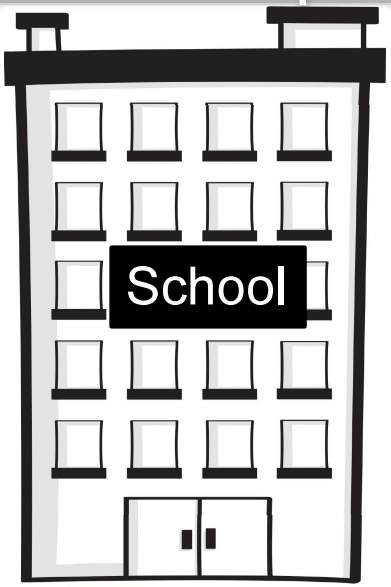
Motivating example: teams for internships

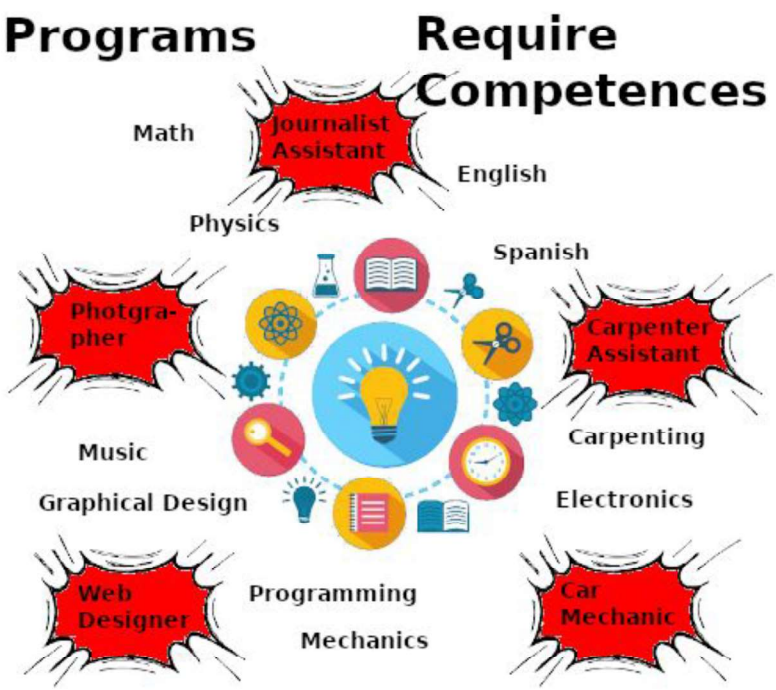


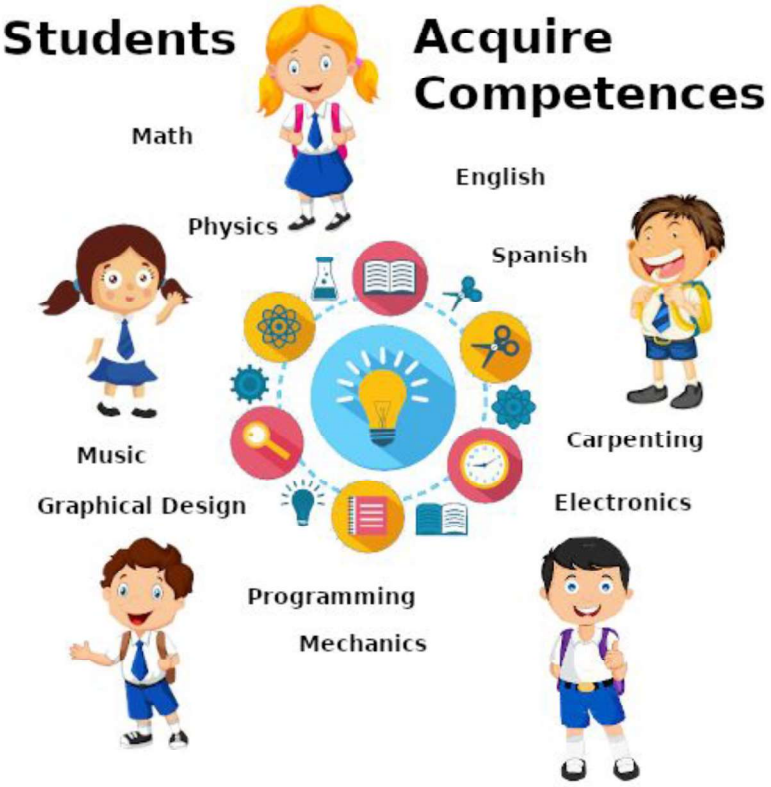


Motivating example: teams for internships



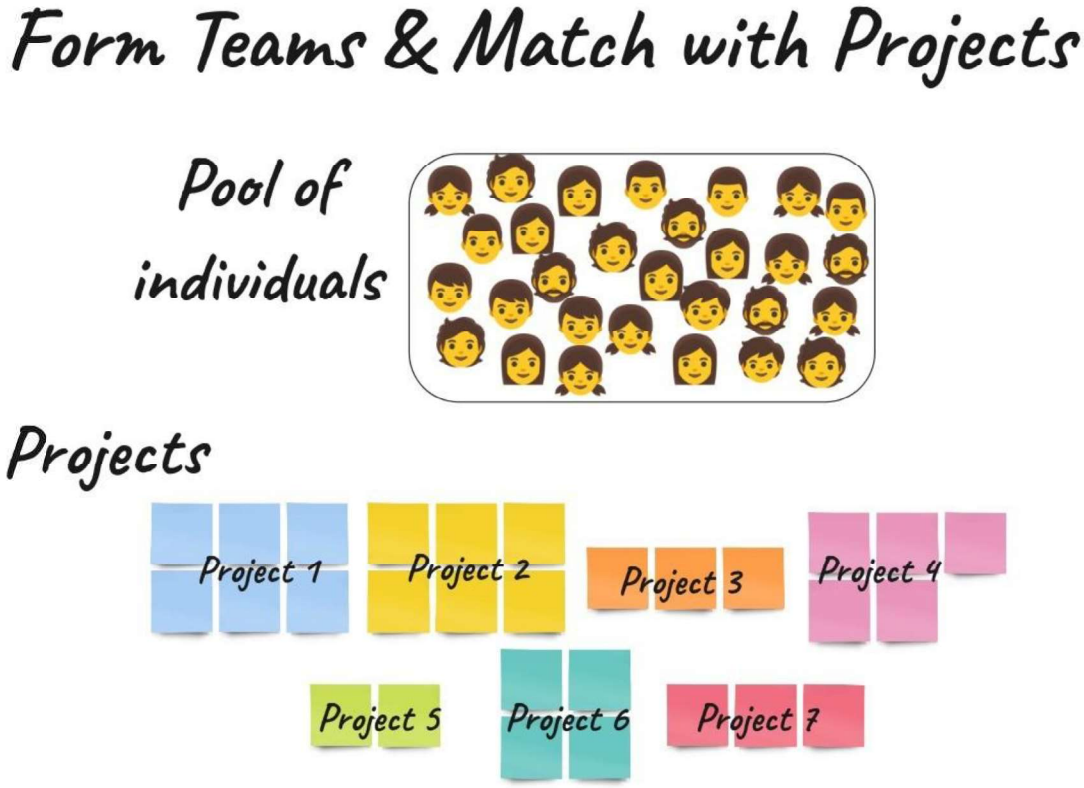






The general problem that we want to solve

- Many *different* projects to solve
- Many individuals available to team up and work in projects
- One team per project
- An individual can be on at most one team
- Each team performs exactly one project



What do we consider when making teams?

- Necessary competencies/skills/knowledge
  - Depending on the project, different skills are needed. A team with the required skills performs better than a team missing skills.
- Diverse personality
  - Teams with diverse, complementary personalities perform better
- Motivation
  - Interest in the scope of the project *motivates* team members to perform better
- Social Cohesion
  - Coherent teams whose team members like and trust each other, tend to be more effective

How do we do it?
We developed a new AI algorithm, edu2com, to match teams with jobs (internships)

Empirical evaluation: an actual-world case study

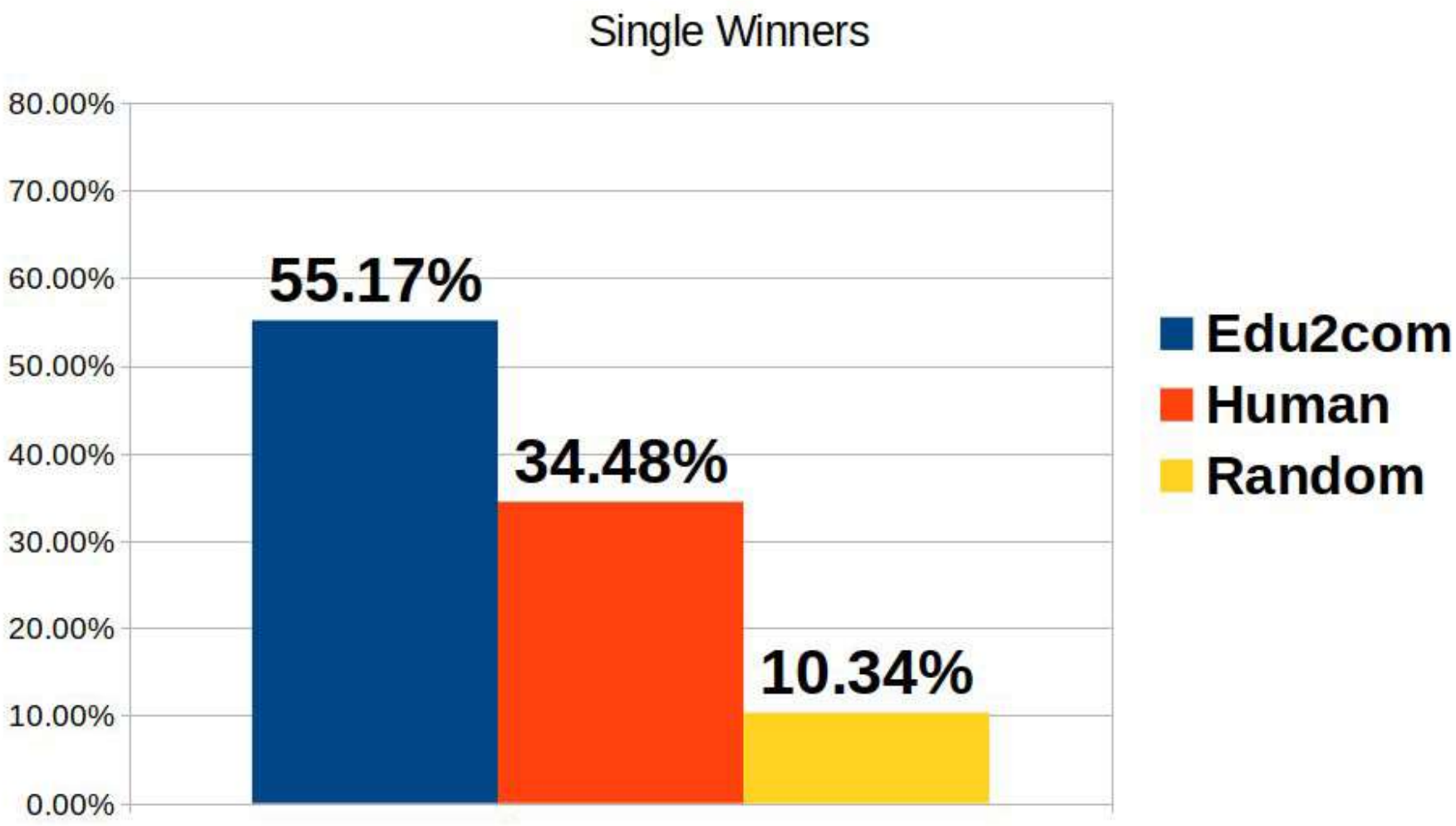
- Evaluation with actual-world data provided by Fondazione Bruno Kessler, which run the school-work alternation program in Trento
- 100 students with competencies described in the European Dictionary of Professional Competences, Skills and Qualifications (ESCO)
- 50 internship offers in industry with competencies described in ESCO

Empirical evaluation: an actual-world case study

- Edu2Com builds teams in less than 50 minutes.
- These cases cannot be solved by commercial optimization technology

Validation

Edu2com outperforms human expert on team formation



Explaining team formation

Who would like to challenge the team formation algorithm?

- the team maker running the algorithm
- the team members distributed in teams

Explaining team formation

We differentiate two types of questions to the team formation algorithm:

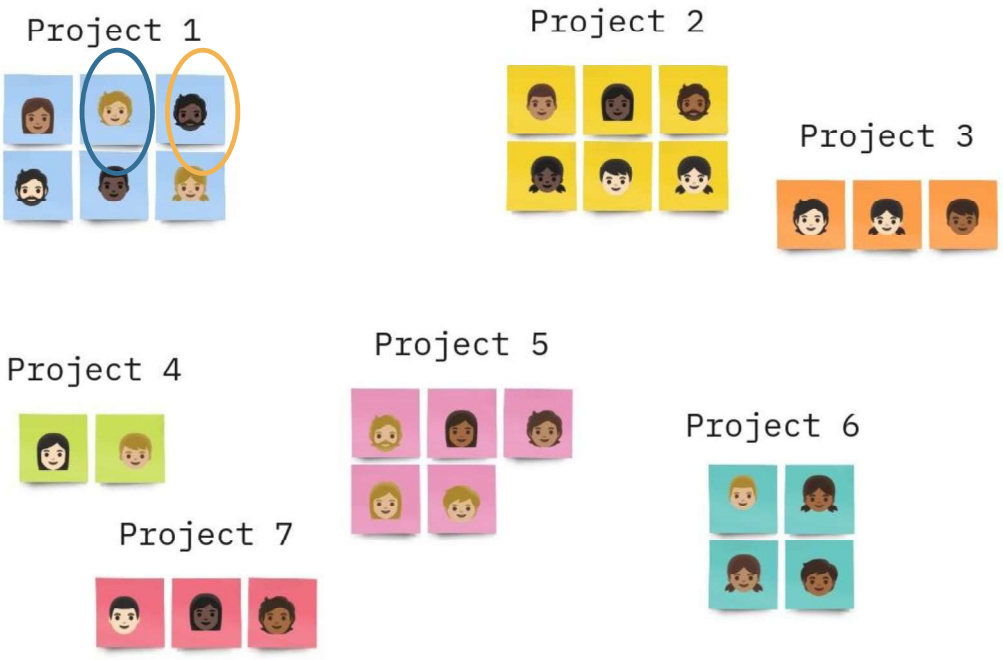
1. questions regarding the ***assignment*** of a person to a project, e.g.,
   a. why is John working in Project 1?; or
   b. why isn't Laura working in Project 2?; or
   c. why is Patrick working in Project 2, while Laura is not?, etc.
2. questions regarding the ***collaborations*** established, e.g.,
   a. why are John and Peter working together; or
   b. why a team consisting of Laura, Patrick and John was not formed?, etc

Building contrastive explanations

- Compute two allocations of teams to projects:
  - the original allocation of teams to projects
  - the query-compliant allocation of teams to projects.
- Build contrastive explanations by computing *relative differences* between the original and the query-compliant allocations,

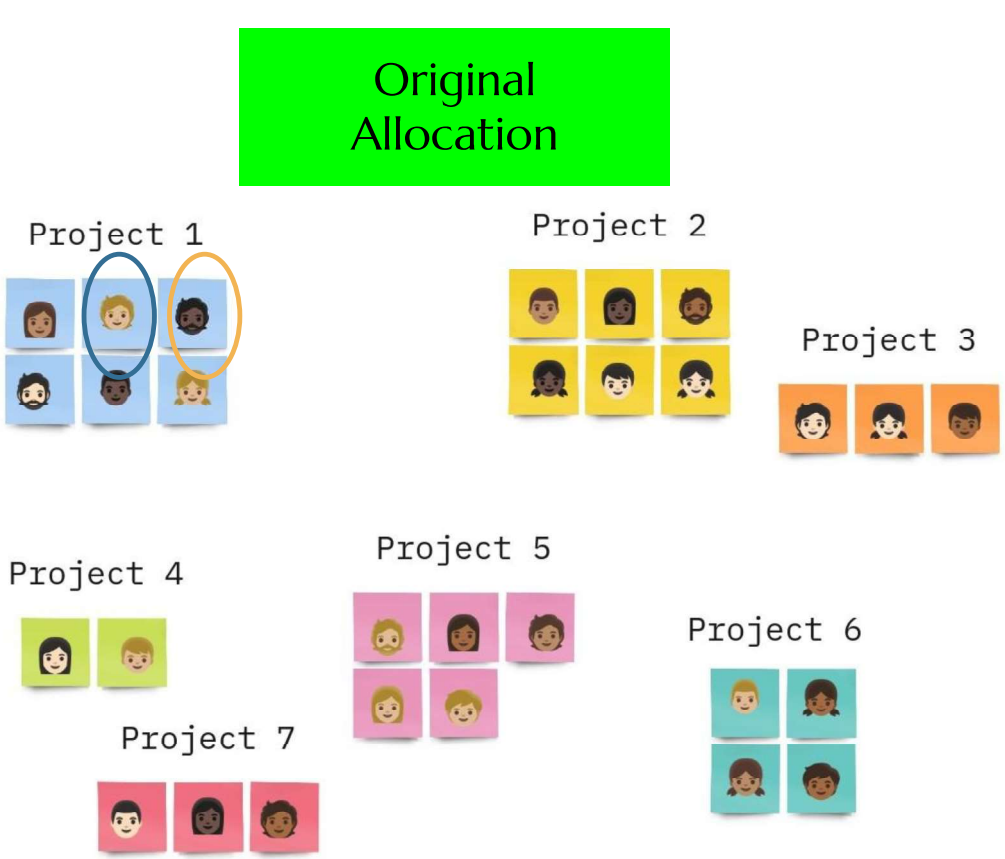
Query: **Why are John and Peter in the same team (Project 1)?**

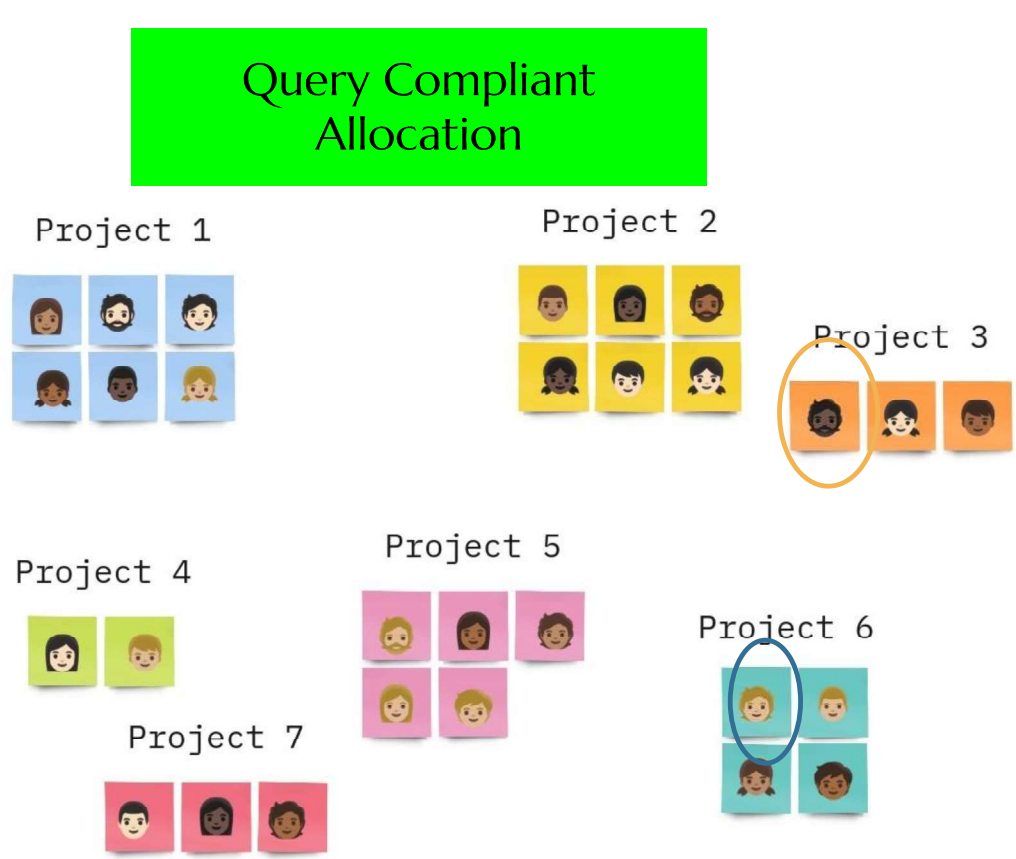
Original Allocation



Query: **Why are John and Peter in the same team (Project 1)?**

(Part of an) explanation:
“‘If John and Peter were not in the same team, John would be assigned to Project 3, for which he is less skilled, and Peter would be assigned to Project 6 which he likes less than Project 1.”





Thank you for your attention!
Now, demo time!