Robotics in STEAM Education: A Hands-On Journey with Graph Theory Challenges

Teresa Fernández Blanco

Antía Fernández López

Cristina Lois Prados
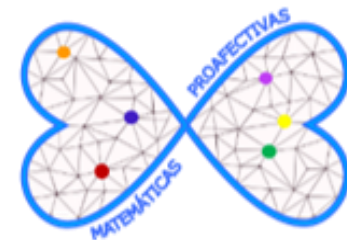
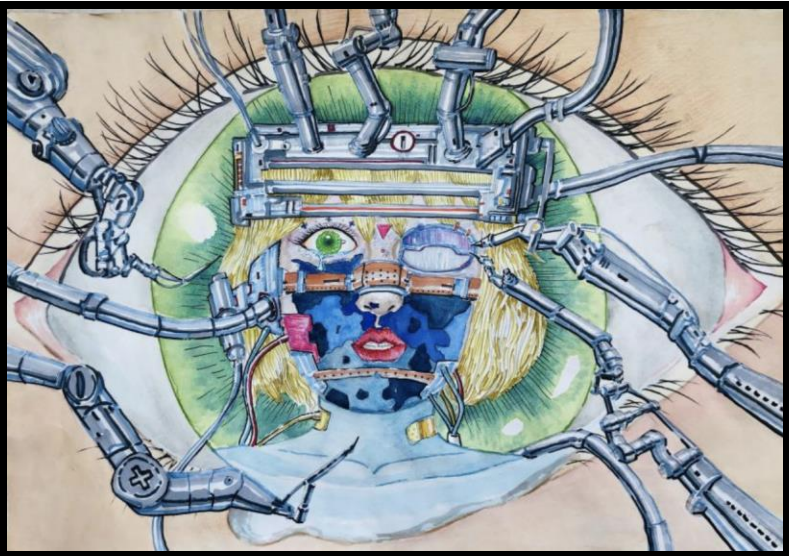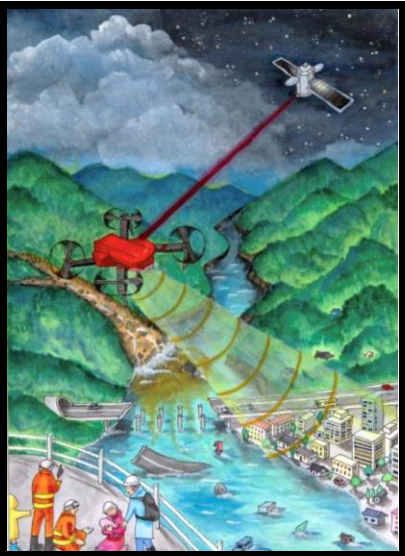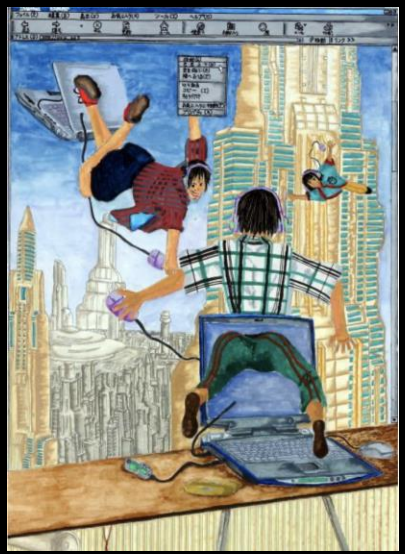INITIAL QUESTIONNARIE BIP

HOW DO KIDS SEE THE FUTURE?

HOW DO "ADULTS" SEE THE FUTURE?

https://youtu.be/G2emilxcHm8

WHAT TECHNOLOGIES HAVE THESE MOVIES PREDICTED?

WHAT TECHNOLOGIES HAVE THESE MOVIES PREDICTED?

Hologram

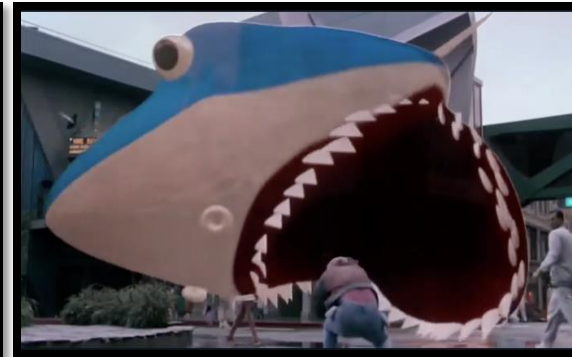Fingerprint reader
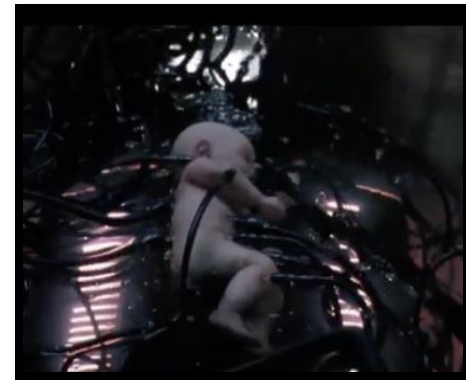

Robot + mechanical arm

Android

VW

Exoskeleton

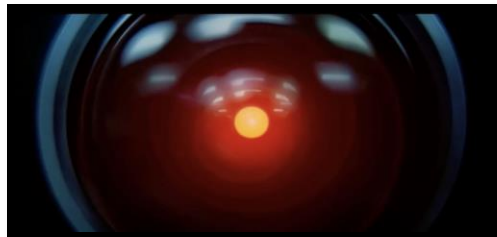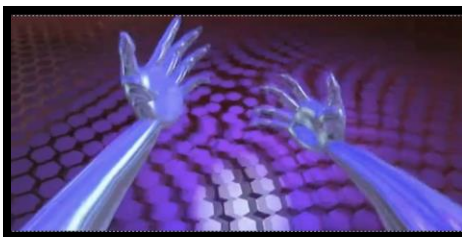3D Printing

Rocket

AR

Cyber-pregnancy

Holographic screen

AI

VR

AI Android

WHICH IS OUR ROLE AS TEACHERS IN THE FUTURE OF SOCIETY AND TECHNOLOGICAL DEVELOPMENT?

CAN WE IGNORE AS TEACHERS THE TECHNOLOGICAL INCLUSION IN CLASSROOM?
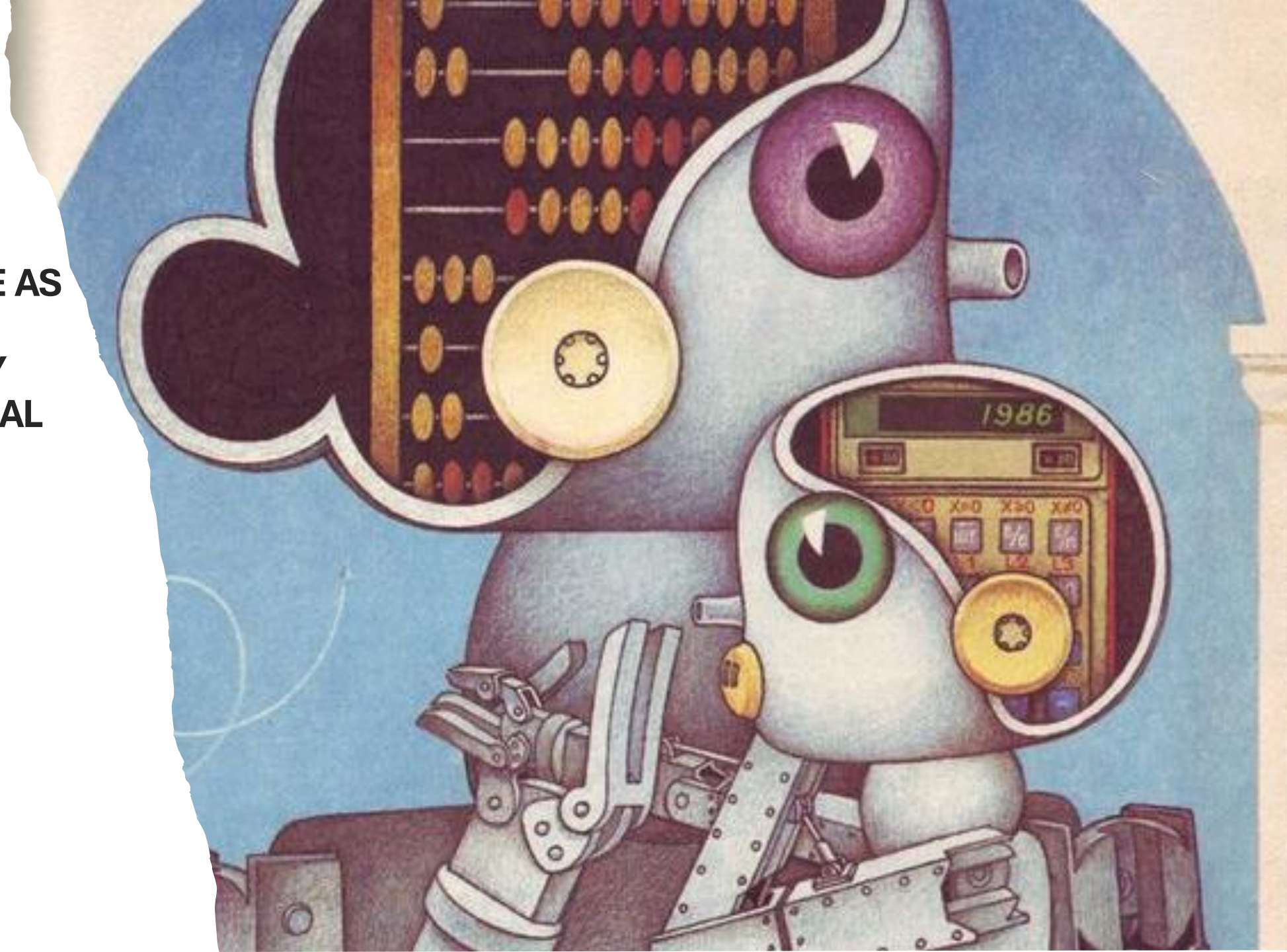
CHALLENGE PRESENTATION

Is it possible nowadays to program an **intelligent home delivery car**?

In the following pictures we can see the city of Brno and an street map of an small part of it
We can find an **area full of restaurants** besides **an urban area**

CHALLENGE PRESENTAION

Is it possible nowadays to program an **intelligent home delivery car**?

Do you have any idea about **how to model this situation**?

Urban area

Restaurants zone

MBOT2

CYBERPI →

MBOT2

CYBERPI

MOTHERBOARD
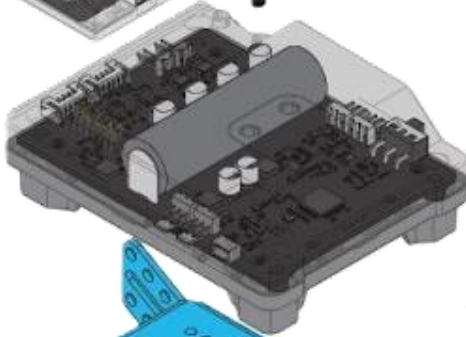
MBOT2

CYBERPI

MOTHERBOARD
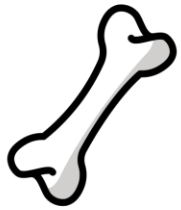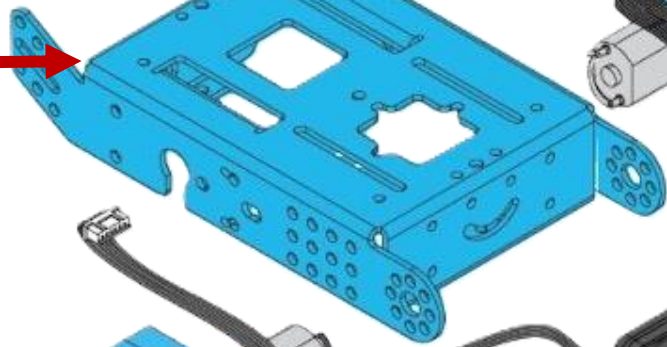
CHASIS

MBOT2

CYBERPI
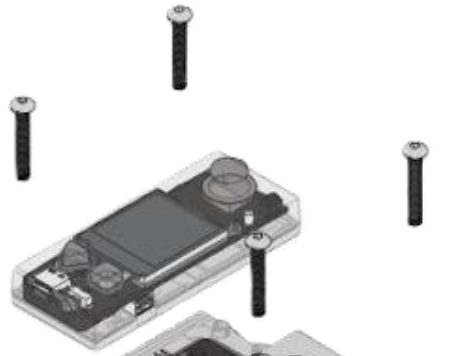
MOTHERBOARD
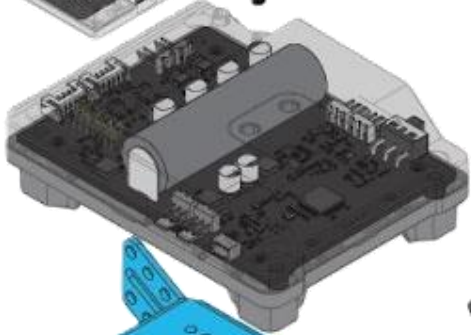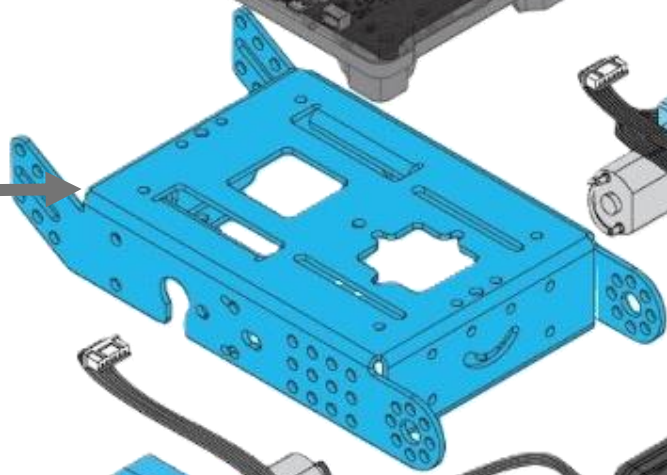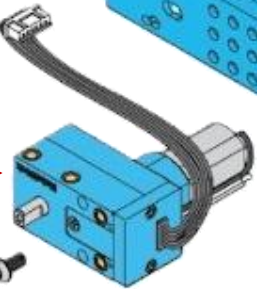
CHASIS
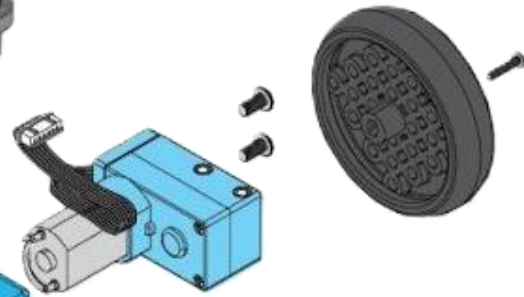
MOTORS

WHEELS

MBOT2

CYBERPI

MOTHERBOARD
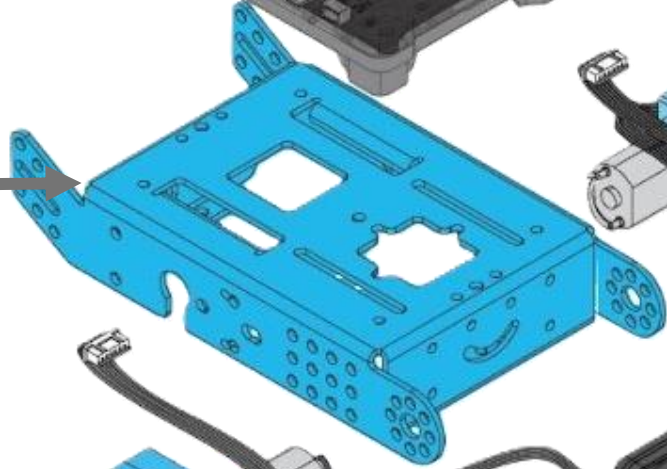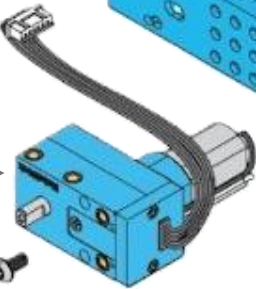
CHASIS
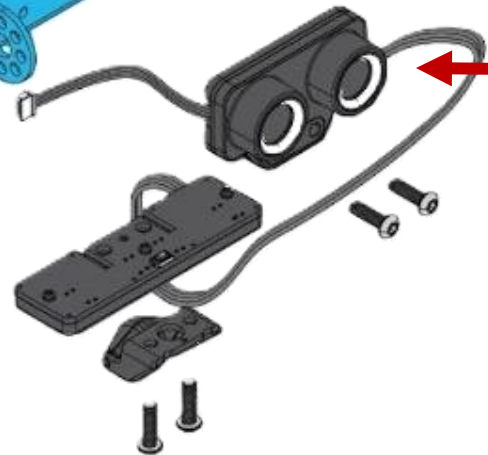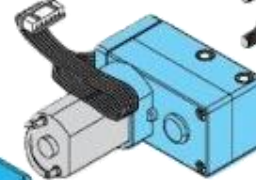
MOTORS

WHEELS

ULTRASONIC SENSOR

MBOT2

CYBERPI
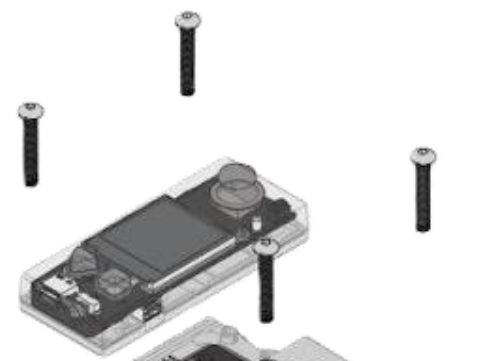
MOTHERBOARD
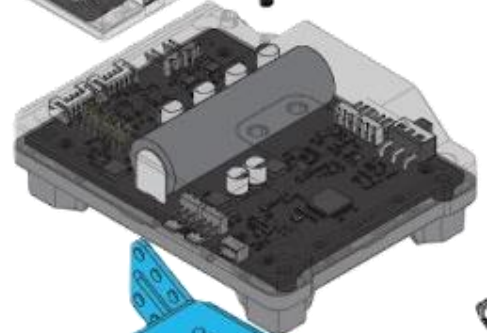
CHASIS
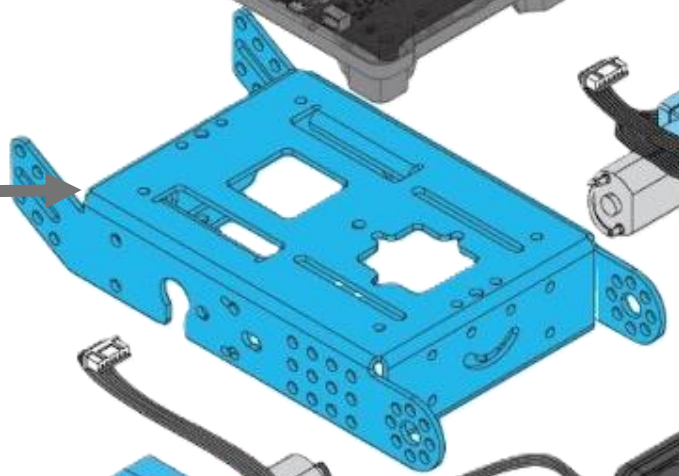
MOTORS
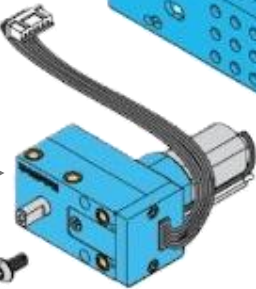
WHEELS
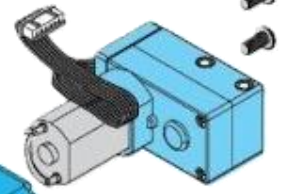
ULTRASONIC SENSOR

RGB SENSOR

- **WHICH CONTENTS ARE WE WORKING?**

- **WHICH OTHER PORPOSALS COULD BE MADE WITH THESE RESOURCES?**
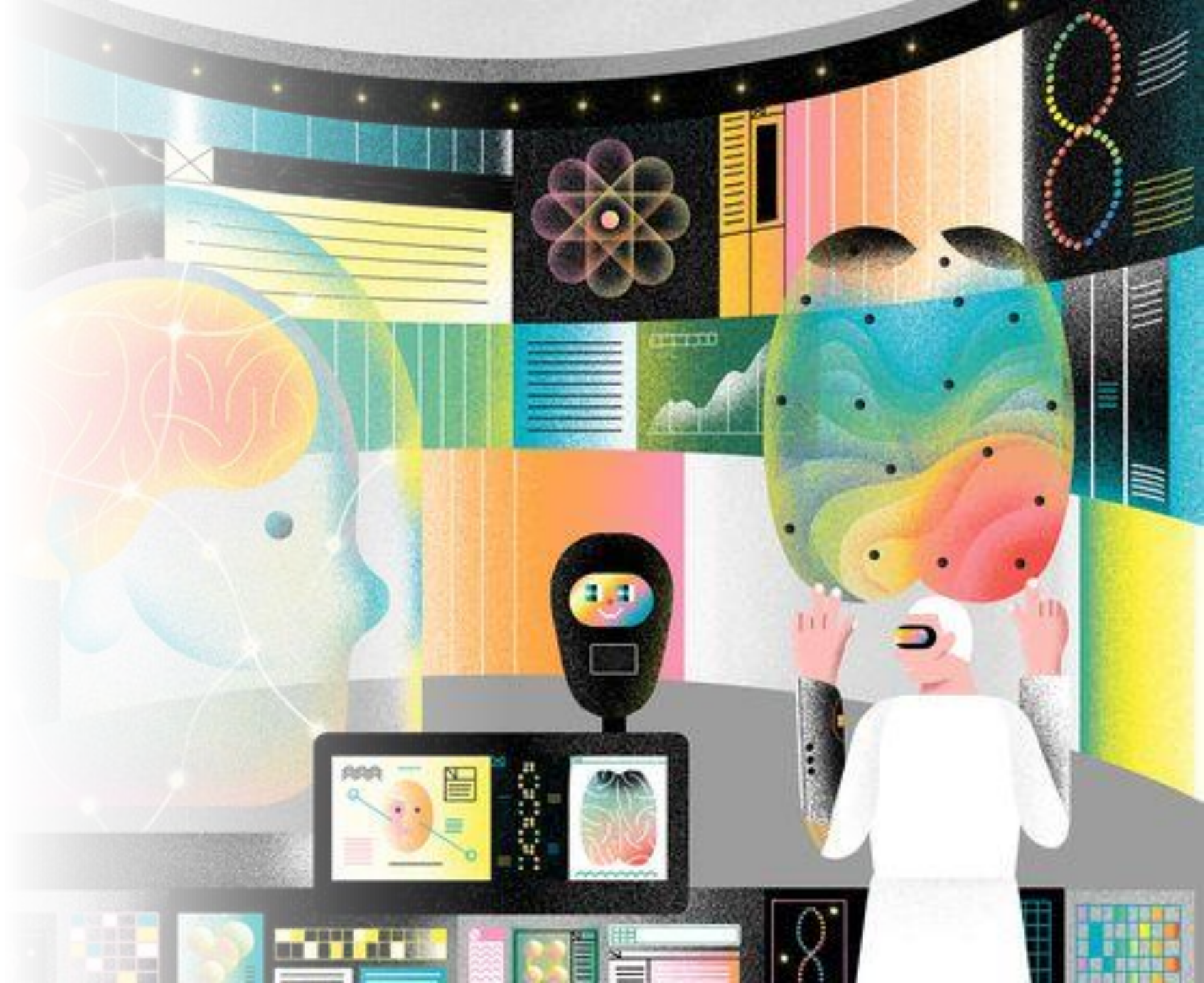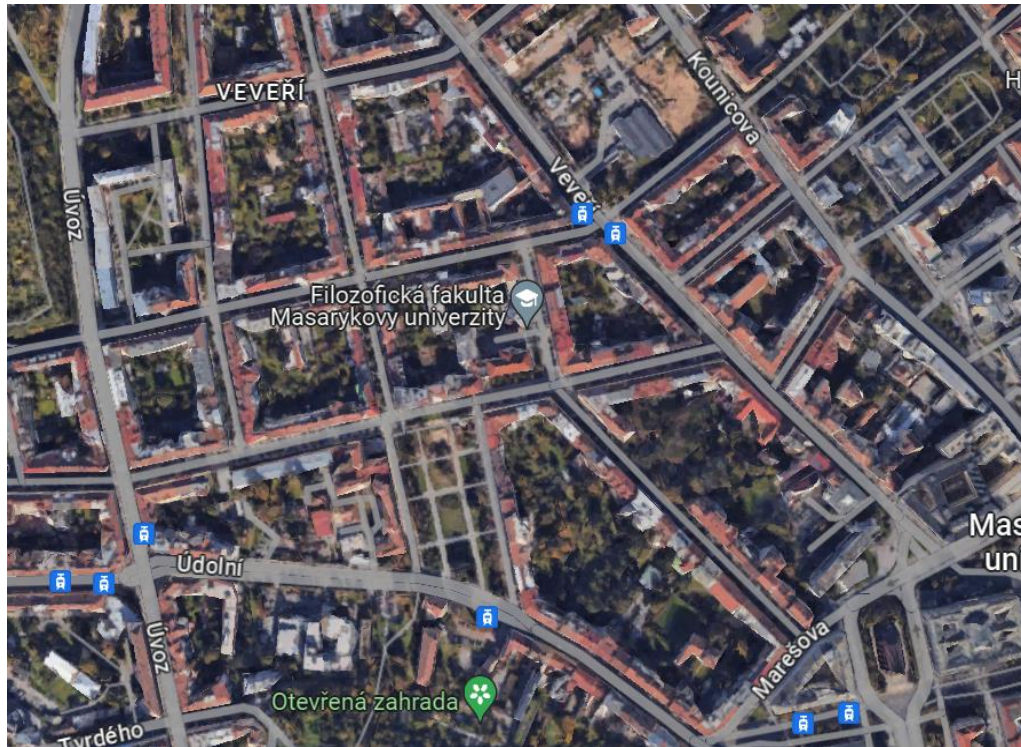
INTELLIGENT FOOD DELIVERY CAR (Model formulation)

Is it possible nowadays to program an **intelligent home delivery car**?

Do you have any idea about **how to model this situation**?
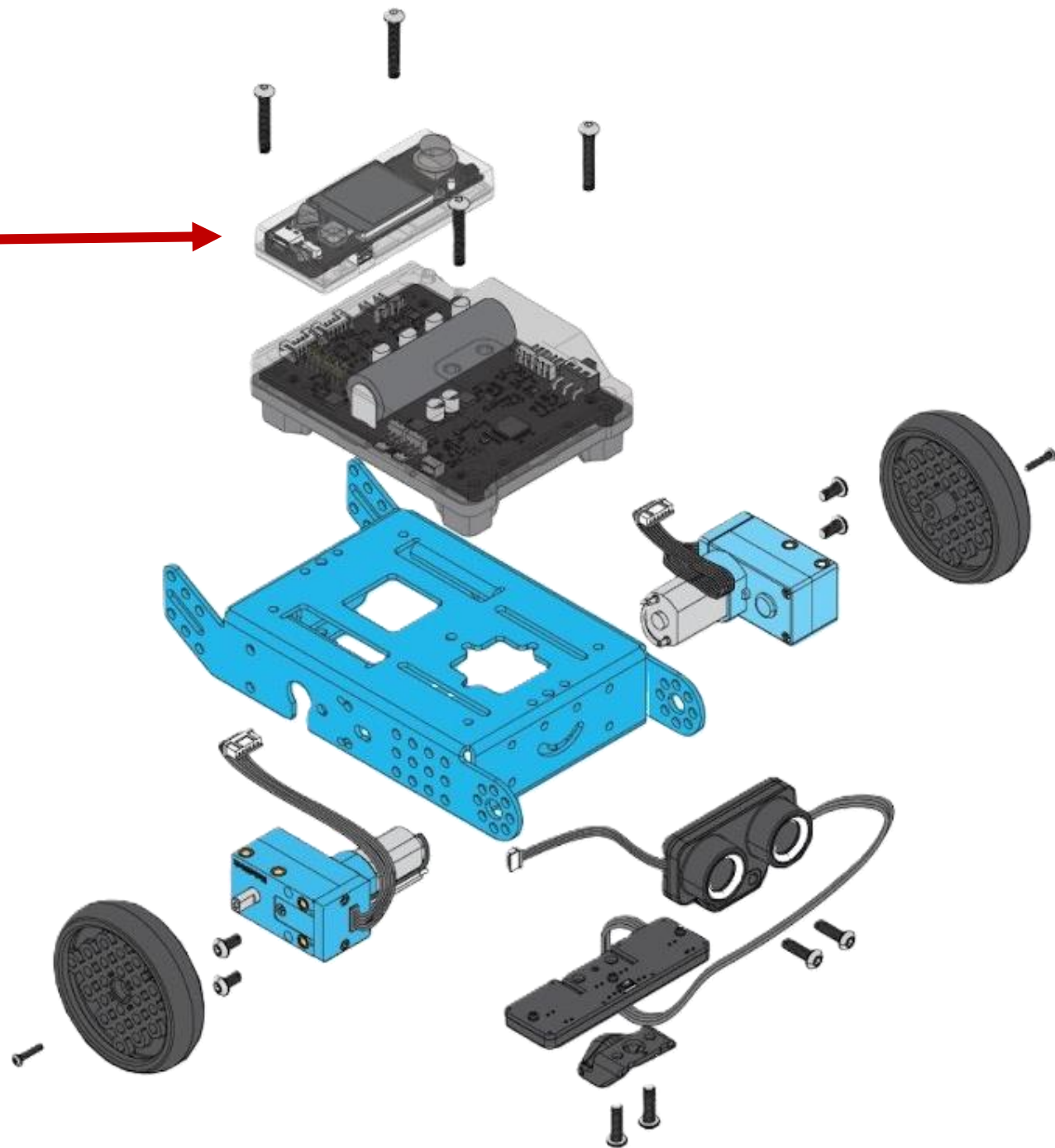
Urban area

Restaurants zone

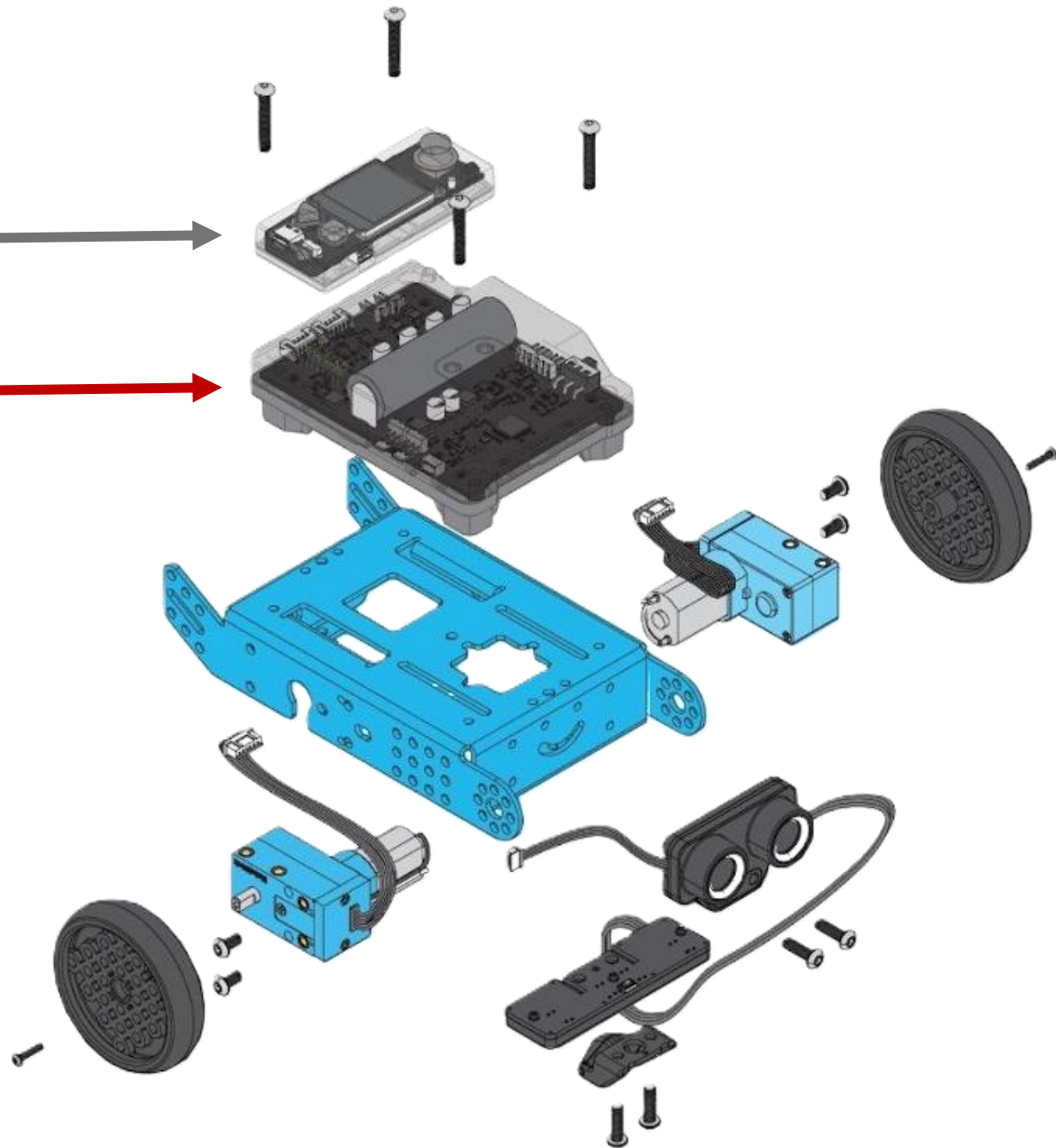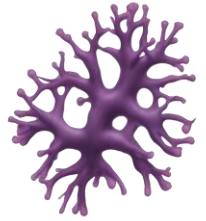# INTELLIGENT FOOD DELIVERY CAR (Model formulation)
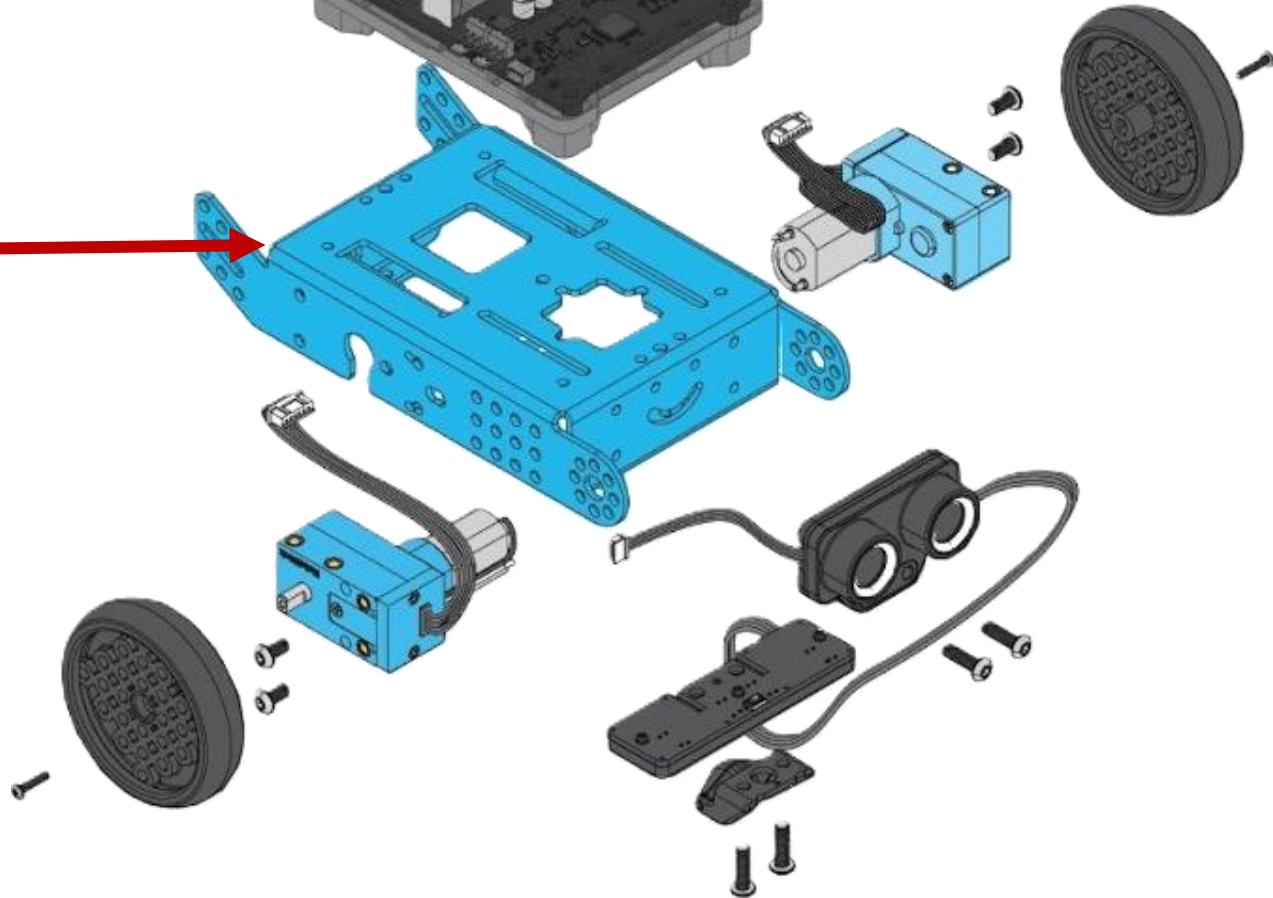
Is it possible nowadays to program an **intelligent home delivery car**?

Do you have any idea about **how to model this situation**?

Urban area

Restaurants zone

INTELLIGENT FOOD DELIVERY CAR (Model formulation)

Is it possible nowadays to program an **intelligent home delivery car**?

Do you have any idea about **how to model this situation**?

Urban area
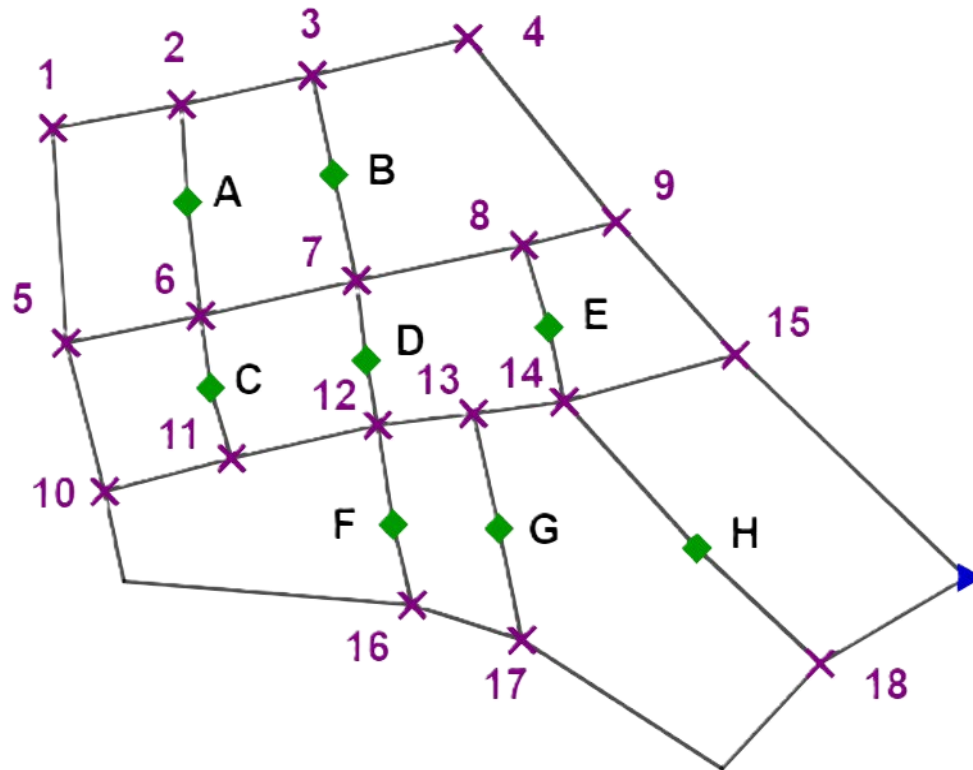
Restaurants zone

INTRODUCTION TO GRAPH THEORY

Problem of the Königsberg's bridges

Is it possible to pass throw all the bridges without crossing anyone two times?

Requirement: The path must start and end at the same point.
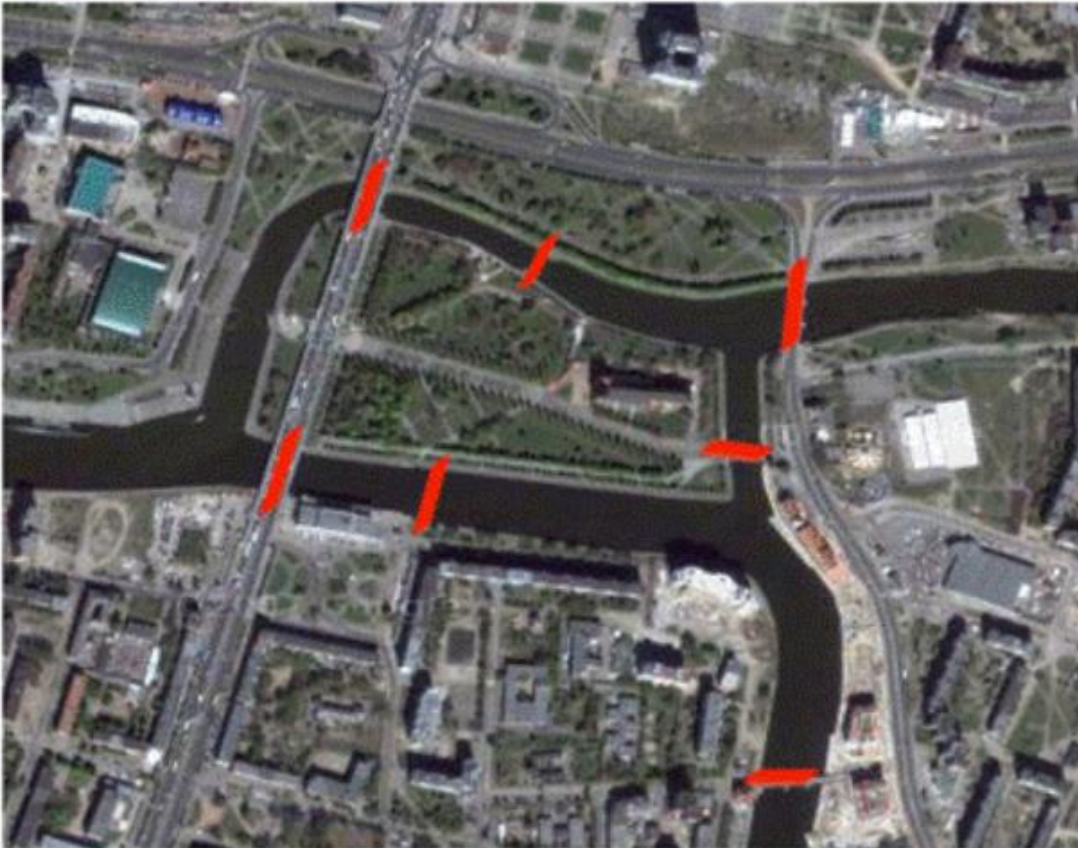
Kaliningrado, previously Königsberg

INTRODUCTION TO GRAPH THEORY

Problem of the Königsberg's bridges

Is it possible to pass throw all the bridges without crossing anyone two times?

Requirement: The path must start and end at the same point.
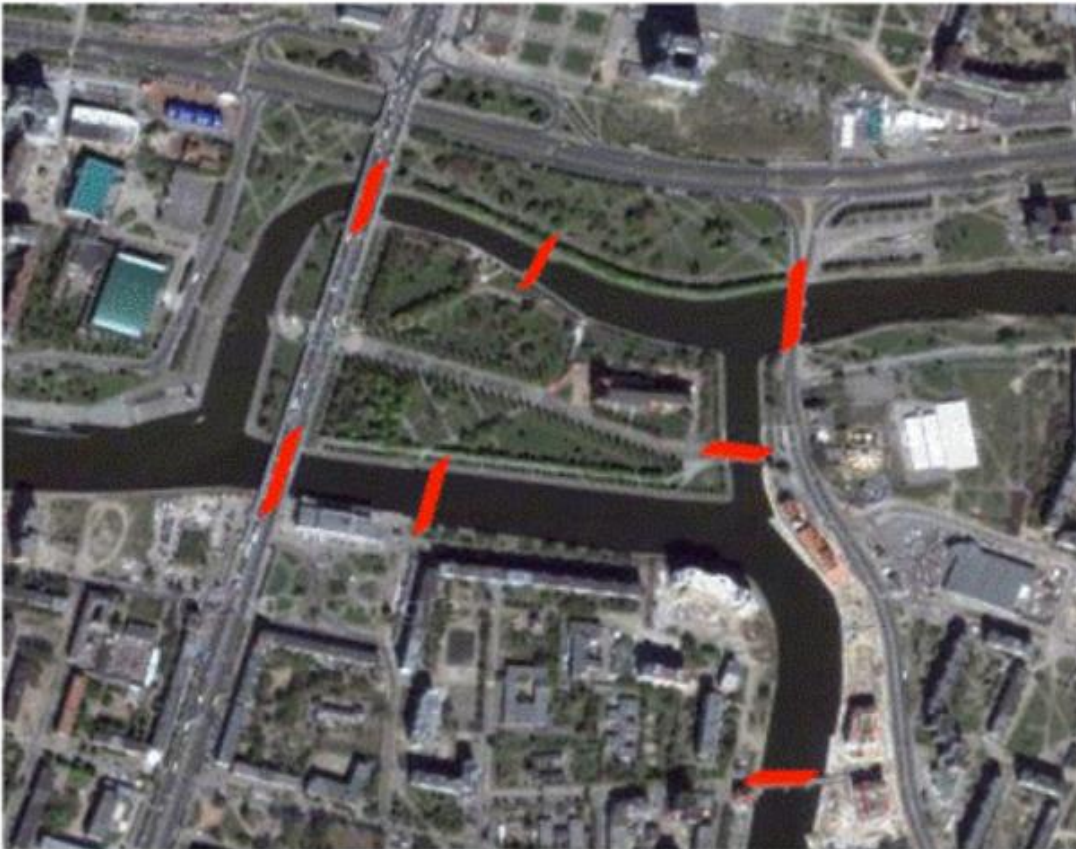
Kaliningrado, previously Königsberg
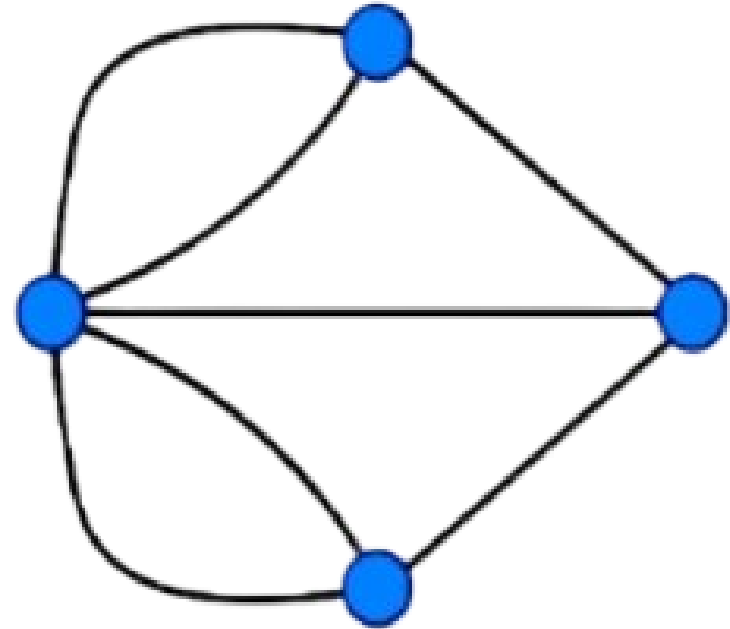
Euler (1736)

INTRODUCTION TO GRAPH THEORY

Can you find a Hamiltonian path? Is it the shortest one?

A **Hamiltonian path** passes throw each vertex exactly once and returns to the departure node
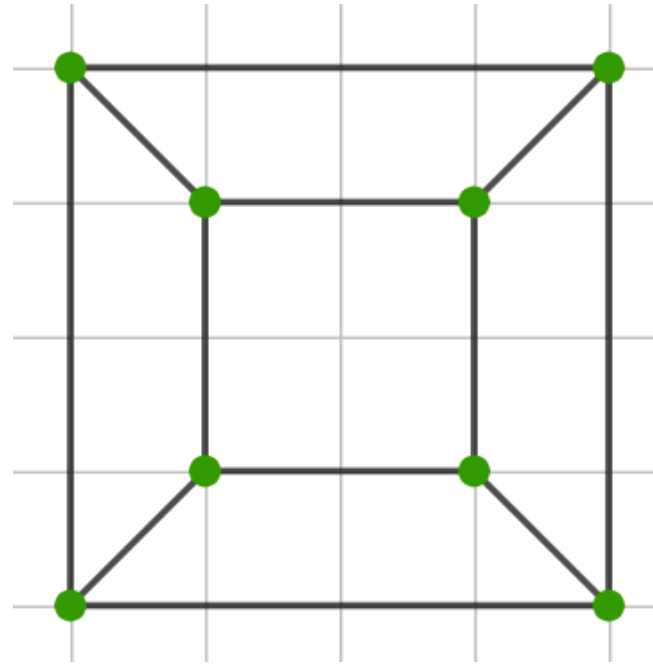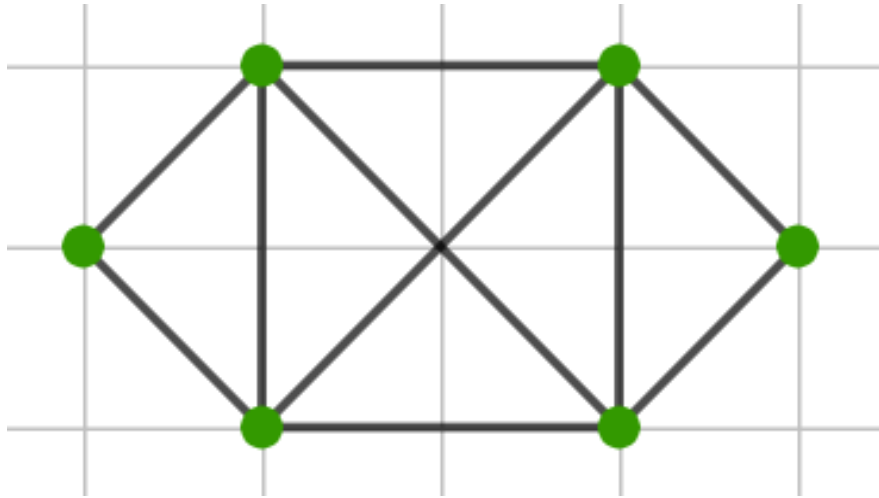
INTRODUCTION TO GRAPH THEORY

Can you find a Hamiltonian path? Is it the shortest one?

A **Hamiltonian path** passes throw each vertex exactly once and returns to the departure node
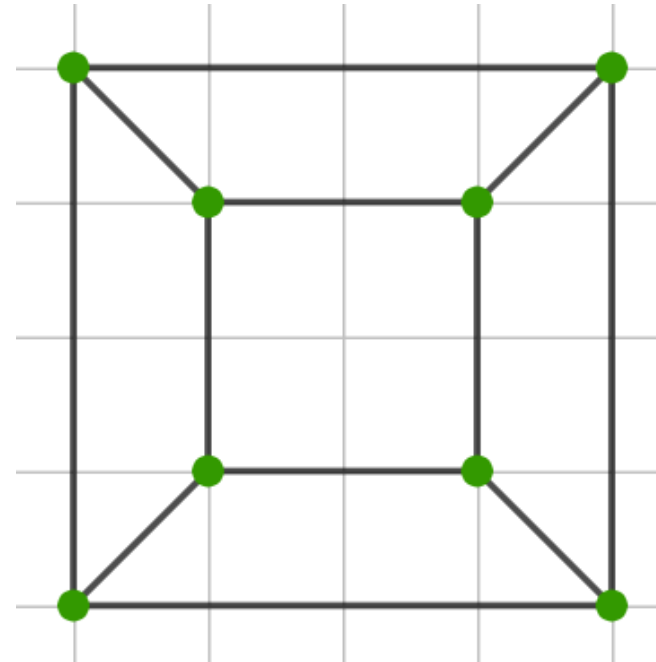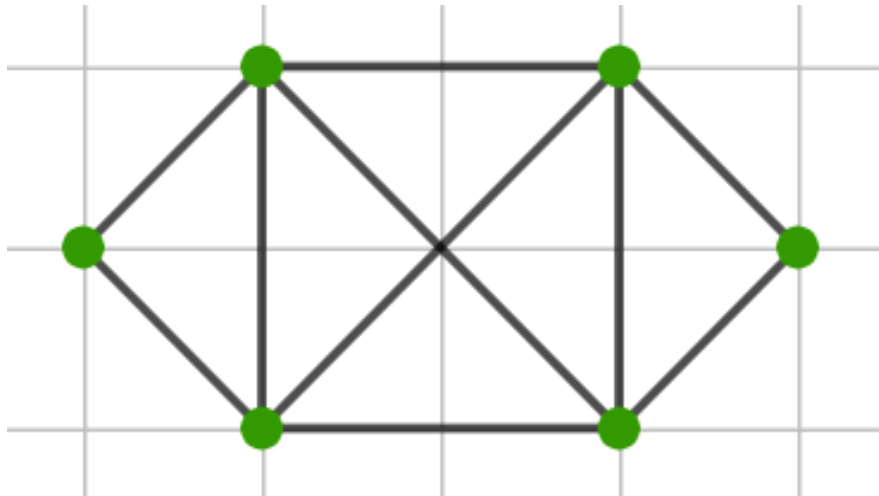
Traveling salesman problem

Given a list of cities (nodes) and the distances (edges) between them, what is the **shortest** possible **path that visits each city (node) exactly once and returns to the departure city**?

Famous because of the contrast between its simple formulation and the difficulty of finding and exact algorithm to solve it

INTELLIGENT FOOD DELIVERY CAR (Route optimization)

Urban area

Can you find a "Hamiltonian path"?

INTELLIGENT FOOD DELIVERY CAR (Route optimization)
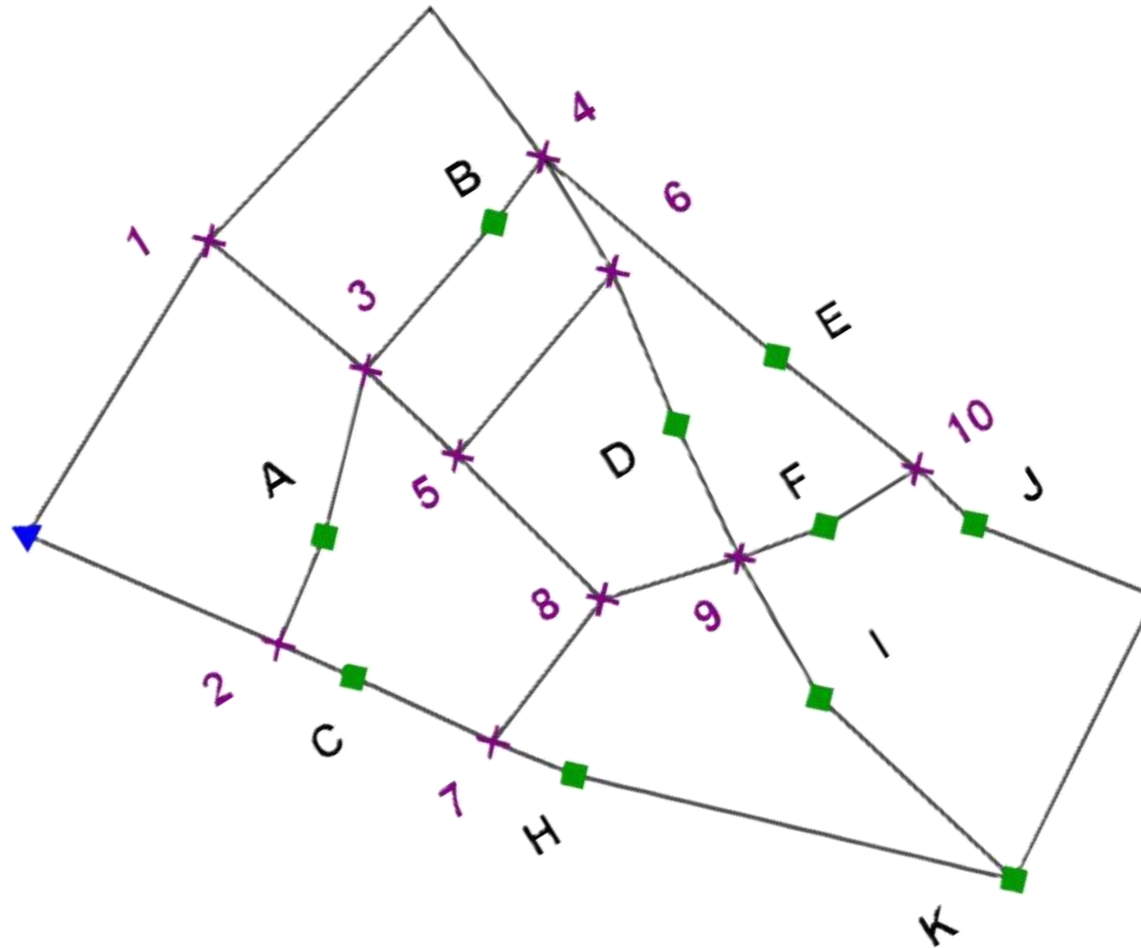
Restaurants area

Can you find a "Hamiltonian path"?

INTELLIGENT HOME DELIVERY CAR (Route optimization)
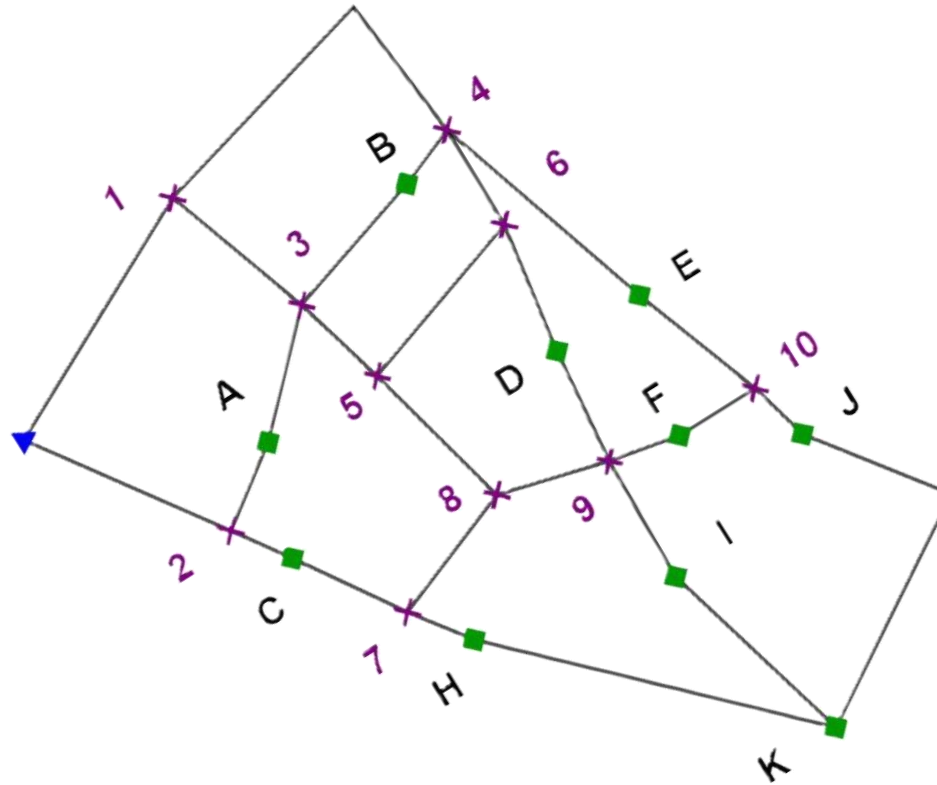
Restaurants area

Can you find a **"Hamiltonian path"**? **Why?**

Which is the maximum number of restaurants (nodes) that you can visit without repeating anyone (starting and finishing the route at the blue triangle)?

INTRODUCTION TO GRAPH THEORY
Traveling salesman problem (Algorithms)

An **algorithm** is as a **sequence of instructions** that can be used to solve a problem

If it provides an **optimal solution** (the most profitable), we say that the **algorithm is exact**

If it is **almost optimal** and we control the margin of error, the **algorithm is approximated**

If it produces a solution and we don't know how far is from the optimal one, it is **heuristic**

INTRODUCTION TO GRAPH THEORY
Traveling salesman problem (Algorithms)

An **algorithm** is as a **sequence of instructions** that can be used to solve a problem

If it provides an **optimal solution** (the most profitable), we say that the **algorithm is exact**

If it is **almost optimal** and we control the margin of error, the **algorithm is approximated**

If it produces a solution and we don't know how far is from the optimal one, it is **heuristic**

ANT'S COLONY OPTIMIZATION ALGORITHM
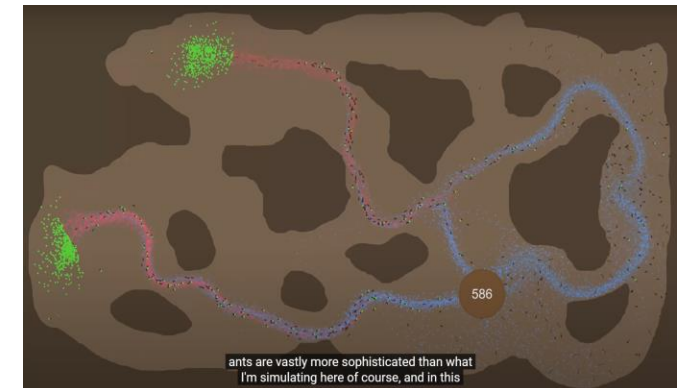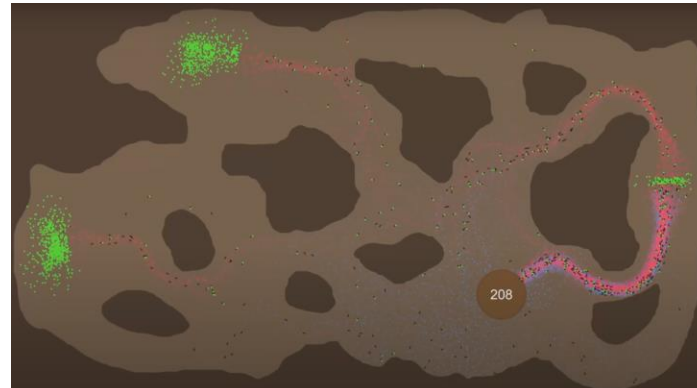
[Coding Adventure: Ant and Slime Simulations (from 9' 8'' to 10' 8'')](#)

INTELLIGENT FOOD DELIVERY CAR (Route optimization)
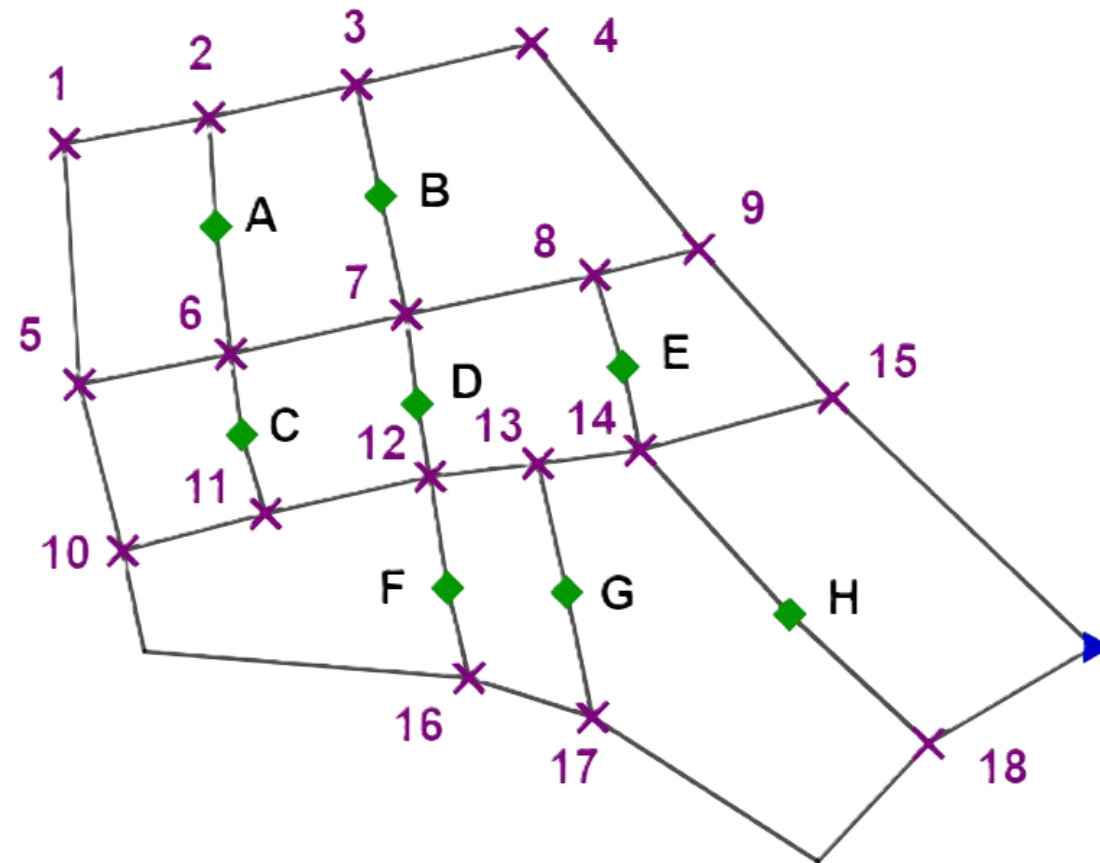
Urban area

How can you generate a RANDOM "Hamiltonian path"?

INTELLIGENT FOOD DELIVERY CAR (Route optimization)
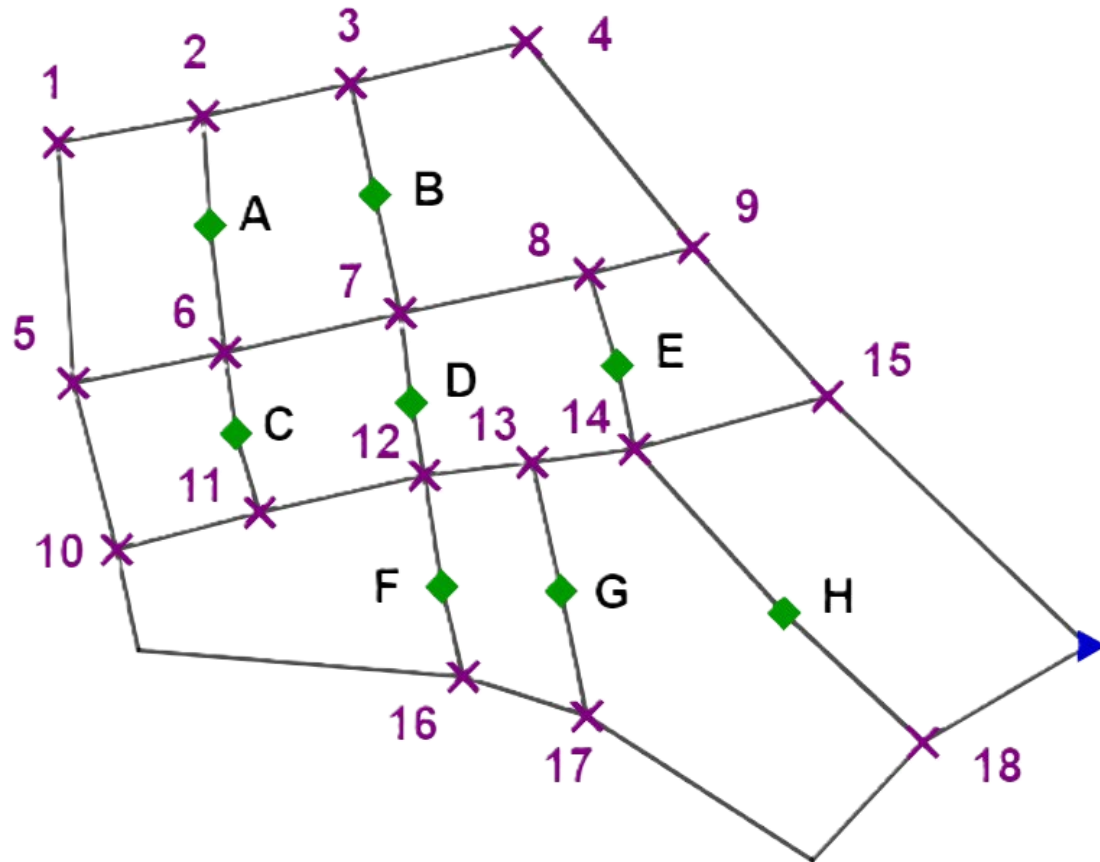
Urban area

How can you generate a RANDOM "Hamiltonian path"?

Random letters generator

Registration of the Hamiltonian path

INTELLIGENT FOOD DELIVERY CAR (Route optimization)

Urban area
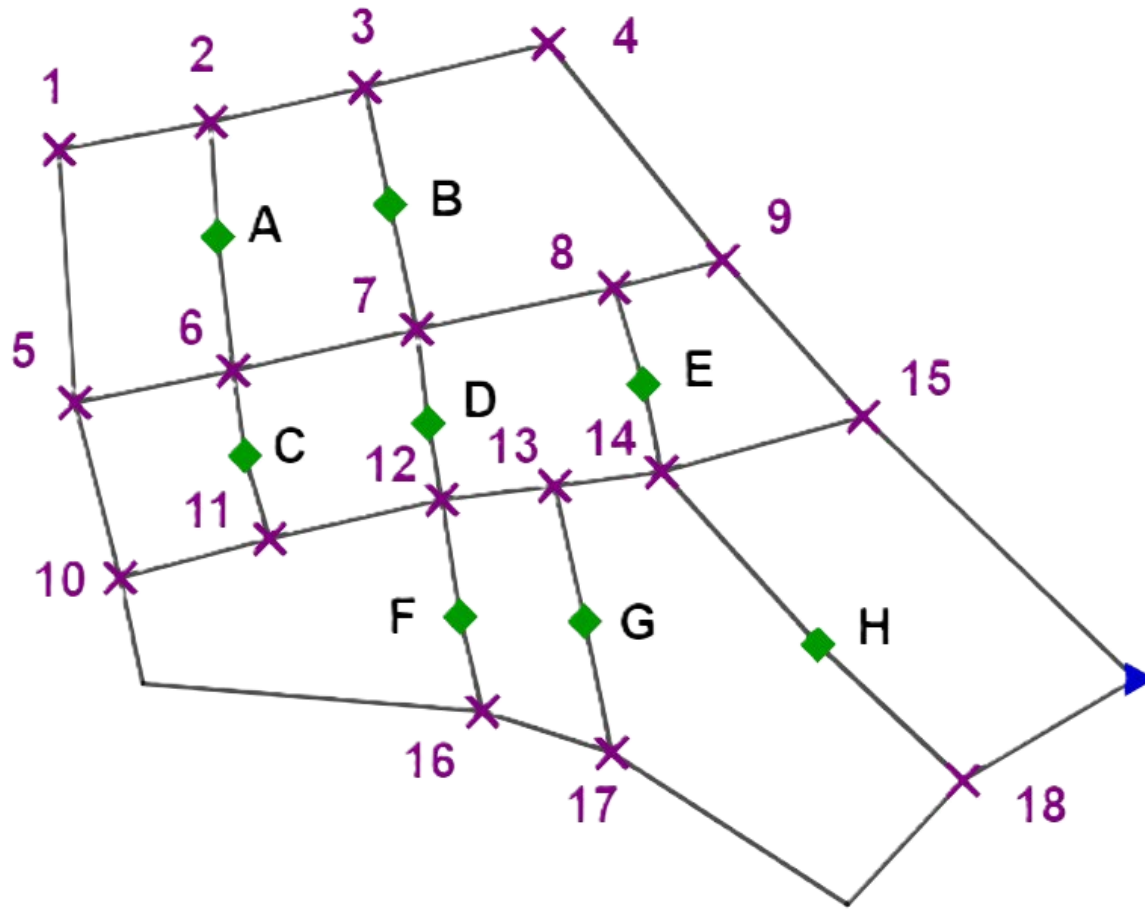
Do you think that we have already found the optimal solution?

What is the probability of succeding with such an small number of iterations?

INTELLIGENT FOOD DELIVERY CAR (Route optimization)

Restaurant area
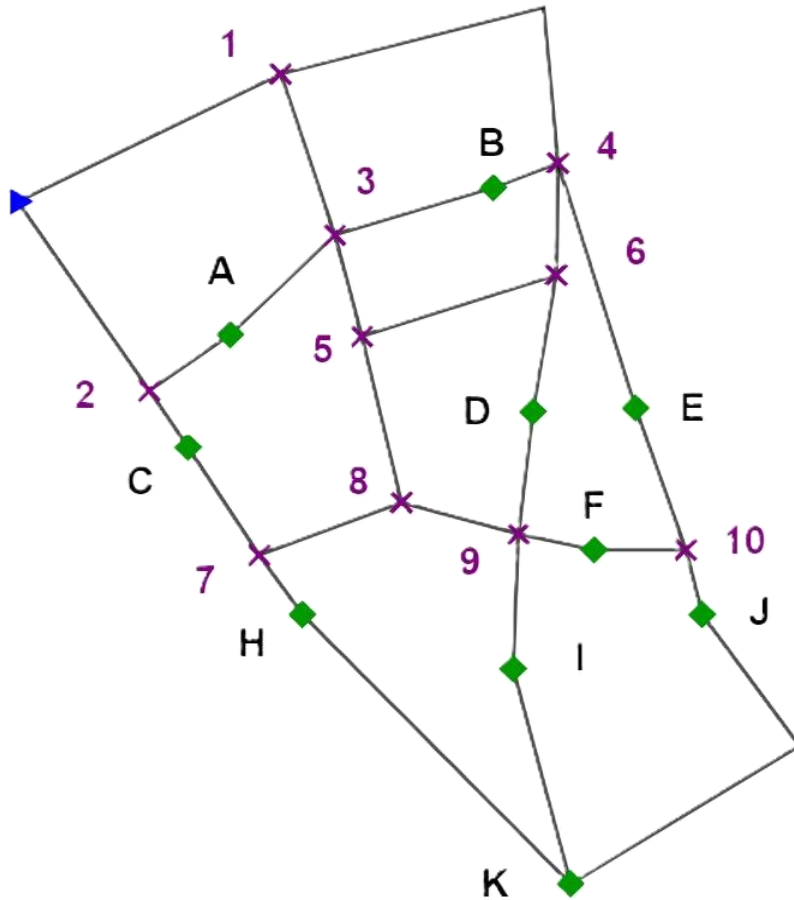
How can you generate a RANDOM "Hamiltonian path"?

Random letters generator

Registration of the Hamiltonian path

INTELLIGENT FOOD DELIVERY CAR (Coding)

DECISIONS

- **How to follow the road**

- **When there is a crossing, how to know which direction to follow**

- **How to make stops at food/delivery stations**

ROLES

- **Line-follow team (2 members)**

- **Programmers (2 members)**

- **Enviroment responsable (1 memmber)**

TPACK

TECHNOLOGICAL KNOWLEDGE (TK)

TECHNOLOGICAL PEDAGOGICAL KNOWLEDGE

TECHNOLOGICAL CONTENT KNOWLEDGE

TPK

TCK

TPACK

PEDAGOGICAL KNOWLEDGE (PK)

PCK

CONTENT KNOWLEDGE (CK)

PEDAGOGICAL CONTENT KNOWLEDGE

MKT

SUBJECT MATTER KNOWLEDGE

PEDAGOGICAL CONTENT KNOWLEDGE

COMMON CONTENT KNOWLEDGE (CCK)

SPECIALIZED CONTENT KNOWLEDGE (SCK)

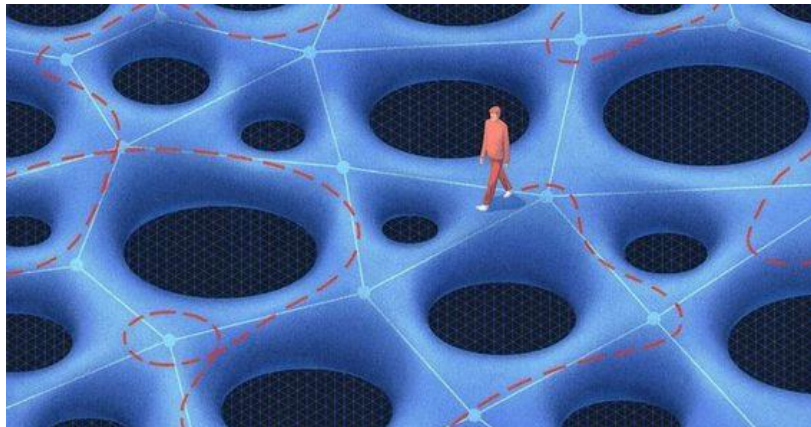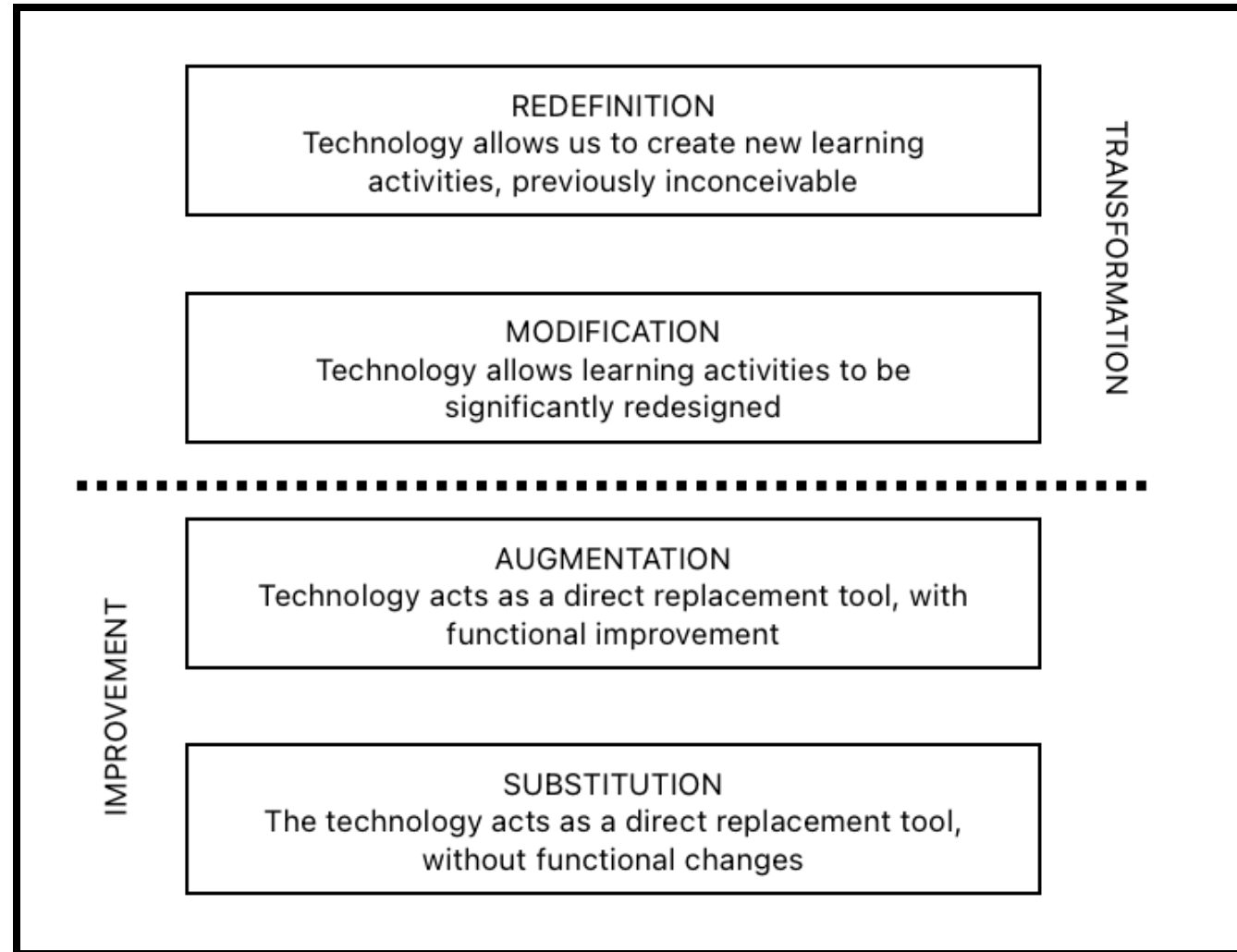KNOWLEDGE OF CONTENT AND STUDENTS (KCS)

KNOWLEDGE OF CONTENT AND CURRICULUM (KCC)

HORIZON CONTENT KNOWLEDGE (HCK)

KNOWLEDGE OF CONTENT AND TEACHING (KCT)

DIDACTICAL SUITABILITY

Dialogue Interaction Communication

INTERACTIONAL (Negotiation)

Attitudes Affections Motivations Beliefs Emotions

AFECTIVE (Implication)

MEDIATIONAL (Availability)

Technical and temporary resources

DIDACTIC SUITABILITY

Situational, conceptual, propositional compression. Procedural, argumentative and communicative competence. Metacognitive competence

COGNITIVE (Proximity and cognitive demand)

ECOLOGICAL (Adaptation)

Curriculum School Society

EPISTEMIC (Representativeness and connections)

Diversidad of interconnected meanings

Diversity of objects: Situations; languages; concepts; propositions; procedures; arguments... Diversity of processes: Representation, argumentation; generalization;...

SAMR model

FINAL QUESTIONNARIE BIP