Mobility France

Emergence
For an
Opera by Wonders - *Opera Thavmaton*

Introduction

The proposal of program for the Mobility in France of the seminar Erasmus AGTnSTEAM proposes to gather the fruit of the experiences of the preceding mobilities, in Greece, Portugal and Italy, and to make a synthesis in the form of return to its initial foundations. Thus, we rely on the corpus of ancient Greek technologies, as they were presented to us in the museum founded by Kostas Kotsanas. We will distinguish more especially those that history has bequeathed to us under the term of "wonders" (Thavmata), which were automatons capable of realising « wonderful » complex multi-media spectacles, by mobilising the most accomplished technologies of the time.

The choice of these wonders is notably indicated by the "A" of the STEAM method (Science, Technology, Engineering, Art, Mathematics). This introduces the dimension of free creativity, which gives the opportunity to explore new avenues of thought, and to bring to light solutions that have not yet been considered. It offers the opportunity to experiment with a way of thinking that helps to open one's mind to the unknown.

In order to project this technological and cultural heritage into the modernity of our time, we propose a program that allows us to inscribe it in our current digital technology, in particular artificial intelligence. We also propose at the same time, to take the inevitable political measure of our action. This, understood in the sense that the solutions cannot be only technical, but they must be considered in their global social context and in the perspectives that it carries.

Perspective

The first week of our program, spent in Athens and organised by the team of the Museum of Ancient Greek Technologies, immersed us in the social and cultural richness of ancient Greek society. We discovered the birthplace of democracy with, in particular, the desire to open access to knowledge as widely as possible.

At the same time, we discovered in the corpus of the Museum the existence of a strong technological culture. All the elements of an industrial revolution seemed to be present. And yet, this did not happen at that time, but 2 millennia later in Western Europe.

A striking example of this can be seen in the connection between Archimedes' worm pump and Heron's steam sphere: this example raises the question of why they were not coupled by a belt, which would have led to the creation of the first steam engine?

The answer may be found in Aristotle's answer to Plato, when he offered to get him out of prison and prevent him from being killed for advocating education for all. Aristotle answered that he was willing to die, because if he didn't, the whole social system of the time would be called into

question. Namely, the mastery of knowledge by a group, certainly widened, but nevertheless limited to the citizens of Athens: men, not slaves, not foreigners. A group respecting the rules and principles of a culture with limited openness.

Thus, the helical pump being a technological instrument was perhaps not connected to the steam engine presented as an amusement, because one and the other were in fields defined as distinct one from the other. The social convention of the time probably did not allow one to easily contradict Archimedes and Heron. This could perhaps have been done by an inventive foreigner, or a clever slave.

This example, which is undoubtedly only a simplification, gives a symbolic image of the role played by the social functioning of an epoch, in its capacity to be open to new ideas and progress. So that all the intellectual forces and all the talents can be combined, in order to face the stakes of its time. If it fails to do so, it will disappear.

Our era, as we well know, is itself facing important challenges that call into question the global existence of humanity. Whether it is on the ecological level, or on the technological level, or on the level of global political instability. Once again, it is necessary to open up as widely as possible to all talents, regardless of their origins, and to share knowledge. This is what the AGTnSTEAM program contributes to, in its small part.

This is why the program we propose articulates an experimentation based on artificial intelligence, the most modern of our technologies, with a reflection on the political level - in the technical sense of social management.

Key concept : Emergence

Technological

Artificial intelligence is the most powerful of contemporary technologies, expressing the potential of what digital technology brings us. As we perceive it today, it is gradually "learning" to do everything we know how to do (machine learning). And as it worries us, it will soon know how to do everything better than us and, why not, it could do without us. However, this is not in line with the reality of what it is, and what it can bring us.

AI is a tool like any other, made by us, for our needs, and that must be mastered like any other, if we want it to work properly, and then be useful to us. The real power of this tool lies not so much in the fact that it can make simple decisions, such as: if this happens, then I do that. But in the fact that these small decisions combine with each other to produce results with increasingly complex mechanisms. That's what worries us, but that's what makes it valuable.

The major contribution of AI lies precisely in this combinatorial process, which will produce an unexpected result: this is what we call emergence. Our know-how must then focus on mastering this combinatorial process, so that we can keep control of the initiatives taken by the system. And to direct them better and better to bring us solutions that we might not have been able to imagine and implement directly, but that we consider useful for our purposes.

Politics

Just as the characteristics of the political social organisation of ancient Greece allowed for the emergence of its technological excellence, French history contains an event of the same nature. Indeed, when Louis XIV undertook to unify French society politically, he built the Palace of Versailles, so that all the French nobility could be his "guests", and take the measure of the benefits of life in the union he proposed. The luxury of the life offered was quickly adopted, but this caused a serious financial problem: as France did not produce any luxury items at that time,

the money offered by the king went abroad.

The king and his minister of finance Colbert decided to create from scratch an industry of luxury and the French art of living. They created the Manufactures Royales to supply the products bought by the nobles, and they encouraged the independent craftsmen to develop their excellence. They pushed very strongly for the opening to foreign talents, in order to feed the dynamics of this movement. This led to the emergence of a very strong economy and cultural characteristic, which is still very much alive today.

The practice of technological emergence from artificial intelligence, and the reflection on the social emergence produced by a political system, understood as a form of social organisation, will thus be woven throughout the week-long seminar that we propose.

Pedagogical sequence

Technological emergence

We propose that the conception of the pedagogical programs be done in reference to the "Wonders" of Greek antiquity (the Thavmata). These were automaton devices, capable of producing small complex shows, using movement, sound, images, scenery changes, and other scenic effects. A reminder of these wonder objects, present in the corpus of the Museum of Ancient Greek Technologies, will be given as an introduction to the practical work sessions.

The program of this practical work will consist of an exploration of the specific territory of emergence in a system with autonomous behaviours. This will be done through the play between robots that can move and have relational behaviours, taking into account each other and the audience. Their operation, both independent and collective, will produce a global "emergent" response. In the context of our workshop, this response will be evaluated on its "artistic" value.

The practical work will be introduced by a basic presentation of the principle of the functioning of a computer algorithm. This will be followed by a presentation of the specific abilities of robots: to move, to perceive and react to obstacles, to have a particular formal appearance, to produce sounds. A particular sequence will be done with the visual artist Edwige Aplogan, who will help us to think about the "customisation" of robots, so that they can form a diverse but coherent group. The heart of the work of the participants will consist in the parameterisation of all the manifestations of the robots, movement, appearance, sounds (with material and presets panel prepared in advance), to bring each of these robots to be particular "characters".

The robots thus created will then be, like the Wonders of antiquity, modern-day Thavmata. The final stage will consist of experimenting with the way in which these different characters, when placed in the presence of one another, will, through their combinatorial play, give rise to an "Opera". This practical work will allow the participants to experience concretely what it means to "govern the emergence" of a system with autonomous behaviours.

Social emergence

The program will have a special day, including a visit to the Château de Versailles, a political machine dedicated to the social transformation of France by Louis XIV. This tour will focus on the French lifestyle that was invented there, and the luxury that characterised it. It will be followed by a visit to one of the Royal Manufactures, the Manufacture de Céramique de Sevres (Manufacture of Ceramics of Sevres), with its museum and its research and production activities, which is still very dynamic today.

These visits will be accompanied by three others:

- The Espace Pierre-Gilles de Gênes, a human size and prestigious place which is a platform for

reflection and exchange of practices around scientific culture.

- The Museum of the Conservatoire National des Arts et Métiers (National Conservatory of Arts and Crafts), with one of the oldest and most complete collections of the technologies of the industrial revolution.

- The Bibliothèque Nationale de France (French National Library), department of complex digital works of art, which has conducted in recent years a specific research directed by Florent Aziosmanoff, on the preservation of this corpus. It is in this context that the experience of Kostas Kostsanas and his Museum of Ancient Greek Technologies was invited, for a conference and an exhibition.

The program ends each day at 5:00 p.m., in order to have time to enjoy Paris, including visits to museums that have evening openings, shows, or other outings.

OLYMPUS
Opera by Wonders - *Thavmata Opera*

Synopsis
The opera Olympus takes the theme of the tension between peace and war, evoked through the play between the audience and a set of four gods from Greek mythology: Apollo, Hermes, Ares, Athena. The latter are embodied by autonomous mobile robots, in relation with their environment. The conception is based on the principles of living art, taking into account the relationship of the device with the public.

Opera Olympus is based on the principle that peace is preserved as long as art, culture, education, trade, diplomacy and exchange in the broadest sense are active. This is represented in the opera by the audience's relationship with Apollo and Hermes. If these subjects are neglected, it leaves the opportunity for Ares to carry out his aggression through violent attitudes.

When this happens, a collective effort of wisdom and constructive defense is needed, by nurturing the relationship to Athena, to stop the period of crisis and achieve a balance of peace and prosperity.

The responsibility of the preservation and the good functioning of this dramaturgical balance rests therefore on the behavior of the public.

Distribution
The opera is composed of 4 characters, representing 4 gods of the Greek Olympus. They are embodied through their behavior, their appearance and their sound signature. • Apollo - (Apollo) / art, knowledge
   God of the sun, arts and beauty.
• Hermes - (Mercury) / trade, commerce
   God of travel, trade, diplomacy and writing.
• Ares - (Mars) / aggression, destruction

God of war, violence and destruction.
- <u>Athena</u> - (Minerva) / defense, wisdom
  Goddess of intelligence, home, wisdom and war strategy.

Systemic scenario
• The audience must maintain the appropriate relationship with Apollo and Hermes, to allow each of them to perform their function, and thus prevent Ares from attacking.

• If Apollo and Hermes cannot fulfill their normal function, they emit a signal (Bluetooth) of abandonment. Ares perceives this signal and triggers the "Ares Attack" mode. • During the "Ares Attack", Apollo and Hermes spin around with a distress sound. • To stop the Ares Attack mode, the audience must surround Athena tightly. • In normal mode, Ares and Athena are walking around quietly.

Behavioral level
Participants will have to define and assign the different behaviors of the 4 gods, by assembling the behavioral vocabulary provided to them.

<u>Vocabulary</u>
- Move forward: slow-medium-fast
- Turn

- Sinuate
- Vibrate in place
- jerk: forward-backward
- Twirl on the spot
- Make a circle
- Obstacle avoidance: near / far; stop / divert / turn around

<u>Presets</u>
Characters have four different levels of behavior:

• *Normal behavior* - permanent (interspersed with the expression of satisfaction). • *Satisfaction behavior* - when they can perform their function correctly in normal mode, Apollo or Hermes periodically trigger this satisfaction behavior, which is repeated by the other 3 characters.

• *Abandonment behavior* - for Apollo and Hermes, a warning sound if they cannot fulfill their normal function for a given time (10 seconds, for example). Then, without returning to normal, the "Ares Attack" is triggered.

• *Crisis behavior* - adopted during an attack by Mars - introduced by "Ares Attack", until released by Athena. The exit of the " Ares Attack " mode is done by the public that closely surrounds Athena

<u>Distribution</u>
• Apollo
Normal : turns on itself or small circles, with grace. Signals his state of crisis if he is not surrounded on all sides by the public.
Satisfaction : specific sound.
Crisis : turns on itself, specific sound.

• Hermes
Normal : circulates quickly, the public must allow him to move as freely as
possible. *Satisfaction* : specific sound.
Crisis : turns on itself, specific sound.

• Ares
Normal : free circulation, quiet.
Satisfaction : specific sound.
Crisis : " Ares Attack " mode, fast and spectacular. Puts the other robots in danger and frightens
(annoys) the public.

• Athena
Normal : free movement, quiet.
Satisfaction : specific sound.
Crisis : Slowly turns on itself, specific sound. The public must surround her on all sides.

Communication level (Bluetooth)
• Satisfaction, triggering content mode, common response.
• Triggering of "Ares Attack" mode (done by Apollo or Hermes).
• Return to normal mode, by Athena.

Plan level

Combination
Common grip on the robot + low platform, cylinder base to scaffold the
body. Body, for each robot, rising to 80 cm. Shapes: tube or cylinder, light
material. Light and mobile superstructures.
Thematic decor.

Vocabulary
- Superstructures: feathers, articulated poles, balloons, sails, strips...
- Color: red, blue, white, green, gold, silver, translucent
- Materials : natural (branches, leaves...), shiny, transparent, metallic, fabrics,
feathers... - Reference forms: nature, silver, science, arts, weapons

Distribution
• Ares : metal
• Athena : nature (olive branch)
• Apollo : sails
• Hermes : feathers

Sound level

Vocabulary
- Sound signature by character (permanent)
- Satisfaction mode (event)
- Sound declaration war, Ares Attack (event)
- Sound signature during Ares Attack (temporary)

Distribution
• Ares : to be defined
• Athena : to be defined
• Apollo : to be defined
• Hermes : to be defined

Functional breakdown

The functional breakdown of the living art system is composed of a set of a dozen entries, which are as many technical subjects, in different disciplines. They must be harmoniously articulated, to obtain together the expected result. Depending on the project, some of these entities can be fixed, and the others can be the object of pedagogical actions. These are then open to the participants for their definition, their realisation and their parameterisation.

The table below shows these different entries, and the parameterisation carried out for the pedagogical workshop on mobility in France of the AGTnSTEAM program.

The last working session will consist in the participants taking the system in hand, in order to define the organisation they could make of it in their institutions, within the framework of future educational programs.

Entries	*AGTnSTEAM - France Educational application*	*Fixed / Parameterisable / Creation Selection of interventions*
Subject General issue	Emergence, functioning of open complex systems	FIXED
Theme Application, Greek Thavmata	*Olympus, Opéra by Wonders* Balance between war & peace	FIXED
Dramatic système Distribution of the « characters »	4 Greek gods Play in relation to the public	FIXED
Behaviors Robots programming, interactions	Personnalité of the characters Relationship with environnement	PARAMETERISABLE

Fine Art Appearance of the characters	Shapes, colors et materials « Body » expression	PARAMETERISABLE
Music Sound design the characters	Music and sound effects, Personalities and events	PARAMETERISABLE
Structure Chassis and construction	Vertical rod on robot base	FIXED
Electronic Wiring, microcontroller, OS	Reichelt Elektronik JOY-IT Car-set	FIXED

Communication Bluetooth	Reichelt Elektronik JOY-IT Car-set	FIXED
Sensors Infrared / Ultrasonic sensors	Reichelt Elektronik JOY-IT Car-set	FIXED
Mechatronics Chassis and 2 wheels mobility	Reichelt Elektronik JOY-IT Car-set	FIXED

Olympus Characters
Combination of the robot, the chassis and the body

Robot used for the workshop
Reichelt Elektronik / JOY-IT Car-set (67,00 €).

Programming language: Python & MakeCode.
Numerous free programming libraries available, program prepared for the workshop can be provided. _Sensors_: Infrared, Ultrasonic, Line finder. _Actuators_: movement (wheels), sound, light.

SCHEDULE
week of March 27 to 31, 2023

Monday the 27th

Lycée Galilée
28 Rue de Patay, 75013 Paris - Tram 3, Stop: Maryse Bastié / Métro 14, Stop: François Mitterrand

• 9:30 am - Coffee reception - Lycée Galilée.
Protocol introduction
• 10:00 am - Principal of the Lycée Galilée.
• 10:15 am - Partners, Academic representatives.
• 10:30 am - Erasmus organisation / Dimitris Nakos, Chryssa Velissariou.
• _11:15 am - Coffee Break._
• 11:30 am - Visit to Galileo High School.

12:15 - Lunch at Lycée Galilée

Introduction to the program
• 2:00 pm - Introduction to the program " Emergence " / Living Art Lab, Florent Aziosmanoff. • 2:30 pm - Presentation of the Thavmata / Ancient Greek Technologies Museum team. • 2:50 pm - Presentation of the 4 "characters" / Edwige Aplogan.
• 3:15 pm - Presentation of the robots / Pascal Parnois.
• _3:30 pm - Coffee break._
• 3:45 pm - Complexity and emergence, 3 balls exercise / Florent Aziosmanoff. • 4:30 pm - Introduction to the Versailles & Sevres day / Nicole Marie and Lalla Boudmagh. • _5:00 pm - End of the day._

Tuesday 28th

Lycée Galilée

• 9:30 am - Coffee reception - Lycée Galilée.
Programming of the robots
• 10:00 am - Detailed presentation of the robots, functions and programming, prepared settings,

Pascal Parnois and Paul Pham, teachers Lycée Galilée.
Distribution of the four robots into four groups.
• 10:30 am - Handling of the parameterisation interface by the groups.
• *10:45 am - Coffee break.*
• 11:00 - Setting up the robots and interactions.

12:30 am - Lunch at Lycée Galilée

Espace Gilles de Gênes
10, rue Vauquelin, 75005 Paris. Bus 27, Stop: Berthollet-Vauquelin (from Lycée Galilée) Olympus,

Opéra by Wonders 8/10

AGTnSTEAM Erasmus+ / Mobilité France / Lycée Galilée - Living Art Lab / Mars 2023

A player in scientific mediation
• 2:00 pm - Departure for Espace Gilles de Gênes (public transportation).
• 2:30 pm - Espace Gilles de Gênes Meeting with Paul Boniface, Trace Group, in charge of mediation programs, presentation of the EGdG activity, contacts and informal exchanges. • 3:30 pm - Conference by researcher, Complex systems and emergence.
• *5:00 pm - End of the day.*

Wednesday 29th

Versailles

A palace as a political machine
• 9:00 am - Meeting point **Lycée Galilée**, departure of the bus for
Versailles. • 10:00 am - Château de Versailles Free walk in the park.
• 11:30 am - Guided tour of the Palace of Versailles.

1 pm - Picnic at Versailles.

Sèvres

A factory of excellence
• 2:00 pm - Meeting point with the bus to Sèvres.
• 2:30 pm - Guided tour of the Manufacture and the Ceramics Museum of Sèvres.
• 4:00 pm - Free visit.
• 4:30 pm - Bus to return to Lycée Galilée.
• *5:00 pm - Break.*

Gastronomic dinner, Paris
237, Boulevard Raspail, 75014 Paris - Métro 4 & 6, Stop: Raspail

• 7:30 pm - Meeting at Lycée Hôtelier Guillaume Tirel.

• *10:00 pm - End of the day.*

Thursday 30th

Museum of the National Conservatory of Arts and Crafts
60, rue Réaumur, 75003 Paris - Métro 3 & 11, Stop: Arts et Métiers

Major collection of the industrial revolution
• 10:00 am - CNAM Museum.
• 10:00 am - Meeting at the CNAM Museum, group entrance. Free visit.
• 11:45 - Return to Lycée Galilée, public transportation.

12:30 - Lunch at Lycée Galilée

Lycée Galilée

Dressing of the robot characters
• 2:00 pm - Presentation of the characters and their appearance, Edwige Aplogan, fine art artist. Presentation of the possibilities of dressing, materials, composition of each and harmonisation of the group of gods.
• 2:30 pm - Handling by the group.
• *3:30 pm - coffee break.*
• 3:45 pm - Finalisation of the characters, tests and adjustments of the behaviour settings.
• *5:00 pm - End of the day.*

Comédie Française
1 place Colette, 75001 Paris, métro Palais Royal - Metro 1 et 7, Stop: Palais

Royal. • 7:45 pm - Meeting at the Comédie Française, show.

Friday the 31st

National Library of France - BNF
Quai François Mauriac, 75013 Paris - Métro 14, Stop: Bibliothèque François Mitterrand

Preservation of complex digital art works
• 10:00 am - Meeting at the BNF.
  Presentation of the institution and its strategy of preservation of digital works, Jean-Philippe Humblot, engineer in charge of this program.
• 10:30 am - Presentation of the research conducted with the BNF on the preservation of digital artworks, presentation of the preserved collection, Florent Aziosmanoff.
• 11:00 am - Consultation in half-groups of the preserved collection, accompanied by Florent

Aziosmanoff / alternating with the free visit of the public spaces of the BNF - 30 mn per group. •
12:00 - Departure to the Lycée Galilée, on foot.

12:30 - Lunch at Lycée Galilée

Lycée Galilée

Finalisation of the mobility
• 2:00 pm - Finalising Olympus, Opera by Wonders, fine tuning of the robots & bodies. •
2:30 pm - Presentation of results: show, explanations, photos and videos. • 2:50 pm -
Protocol closing ceremony, Lycée Galilée, Partners, Academic representatives. • *3:00 pm
- Coffee break.*
• 3:30 pm - The participants take up the proposed pedagogical program and define a free variation
  of this program, in groups.
• 4:30 pm - Conclusion of the mobility week.
• *5:00 pm - End of the week.*