

MoMaTrE (Math Trails and AAR)

Tomás Recio

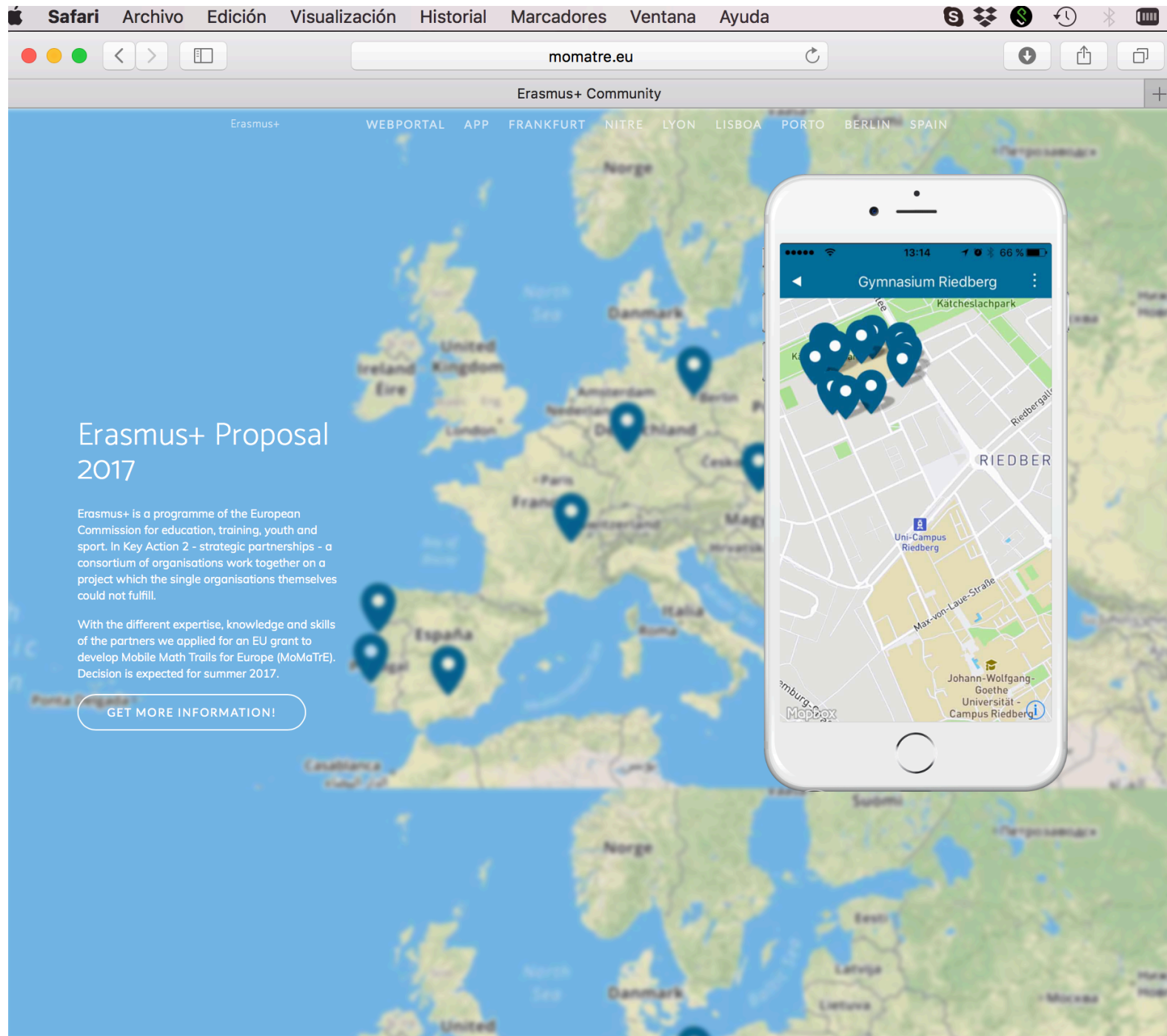
U. Cantabria,

MTM2017-88796-P

<http://www.recio.tk>

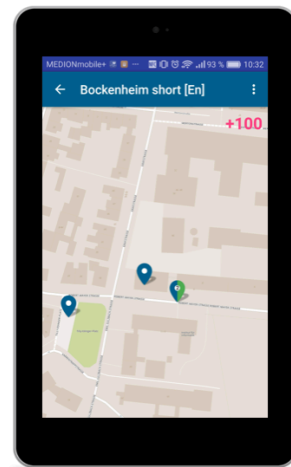
- Erasmus+ Program: Mobile Math Trails in Europe





MathCityMap App

Discover the world from a new perspective



Apps available

Android & iOS App available



Flexible Use

Add your own images to create unique trails



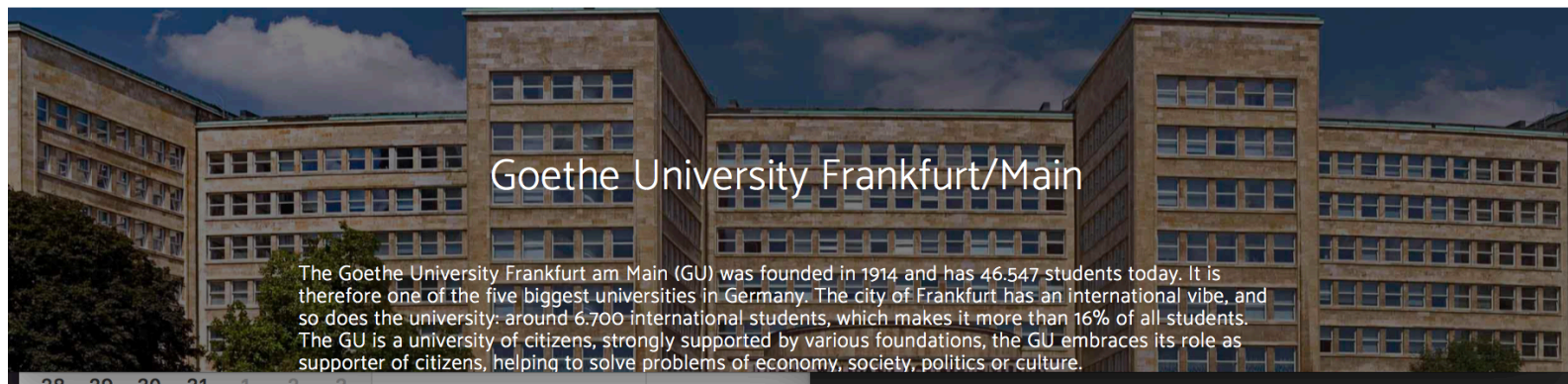
Free to Use

This app is free to download and use for any purpose!



Web Portal

Create your own Math-Trails in the [webportal](#)



Goethe University Frankfurt/Main

The Goethe University Frankfurt am Main (GU) was founded in 1914 and has 46.547 students today. It is therefore one of the five biggest universities in Germany. The city of Frankfurt has an international vibe, and so does the university: around 6.700 international students, which makes it more than 16% of all students. The GU is a university of citizens, strongly supported by various foundations, the GU embraces its role as supporter of citizens, helping to solve problems of economy, society, politics or culture.

INESC-ID (Portugal)



The "Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa" (INESC-ID) is a R&D institute. Currently, we integrate more than one hundred senior researchers and two hundred post-graduation students divided between nineteen research groups, organized in five main research lines:

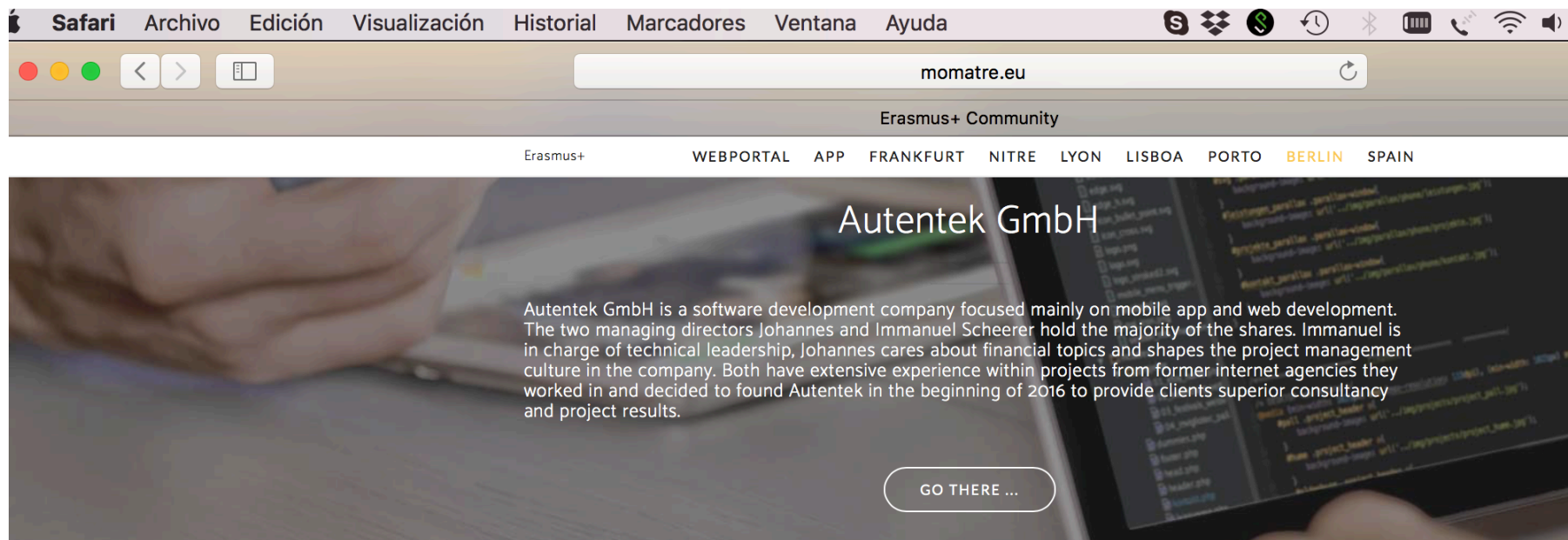
- Computing Systems and Communication Networks
- Embedded Electronic Systems
- Information and Decision Support Systems
- Interactive Intelligent Systems
- Energy Systems

[GET THERE!](#)

Instituto Superior de Engenharia do Porto



Instituto Superior de Engenharia do Porto, a public higher education institution integrated in Polytechnic of Porto, has its roots in 1852. ISEP stands for a social responsible institution, compromised with excellence in the training of high professional, scientific and technical competent citizens. Uses a logic of applied knowledge, favouring an entrepreneurial mind-set and enabling graduates to become able to face today's professional



The Spanish Federation of Mathematics Teacher's Societies (FESPM)

The Spanish Federation of Mathematics Teacher's Societies (FESPM) is a more than 25 years old, non-profit organisation that comprises 21 Mathematics Teachers' Societies with about 5,000 members. It can be clearly stated that the FESPM is the unique organisation gathering mathematic teachers from all pre-university educational levels. The FESPM collaborates with the Spanish Ministry of Education and many of its associated Maths Teachers' Societies have agreements with their corresponding Regional Educational Administrations.

[GET THERE!](#)



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mathcitymap.eu

Erasmus+ CommunityMathCityMap

MathCityMap

APP ERHÄLTICH BEI
Google Play

Download on the
App Store

Portada

Portal

Cuenta

Tutoriales

Publicaciones

Se ha identificado como
turismomatematico
Pulse para desconectar

Experimenta de forma fácil las matemáticas al aire libre

Guía rápida



PORTAL



TUTORIALES



PUBLICACIONES



NOTICIAS

#mathcitymapspain

El Proyecto

MathCityMap es un proyecto
MATIS I (IDMI, Goethe-Unive
en cooperación con la Univer



Stiftung Rechnen

Idiomas / Languages




Social Media

Tweets por @mathcitym

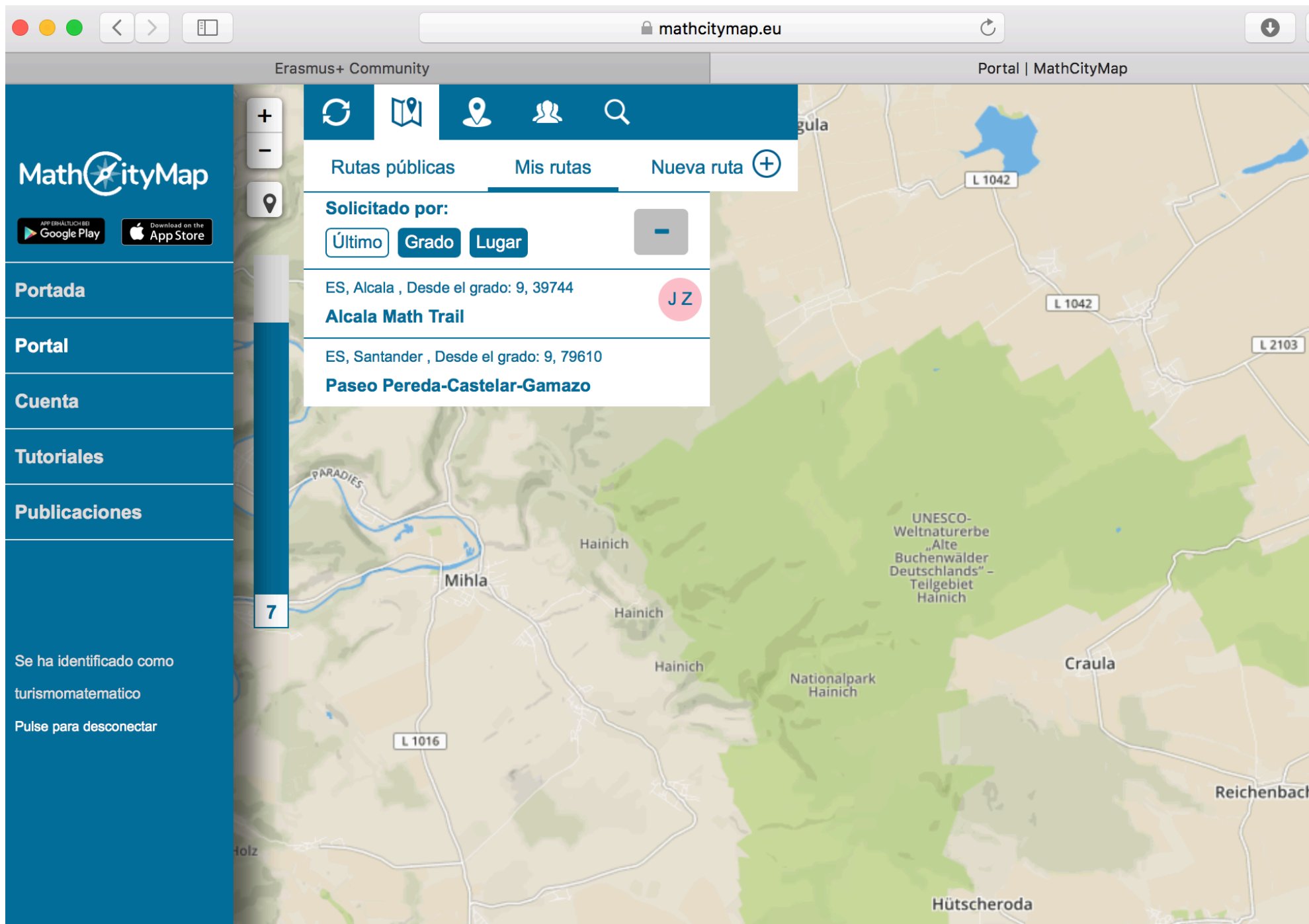


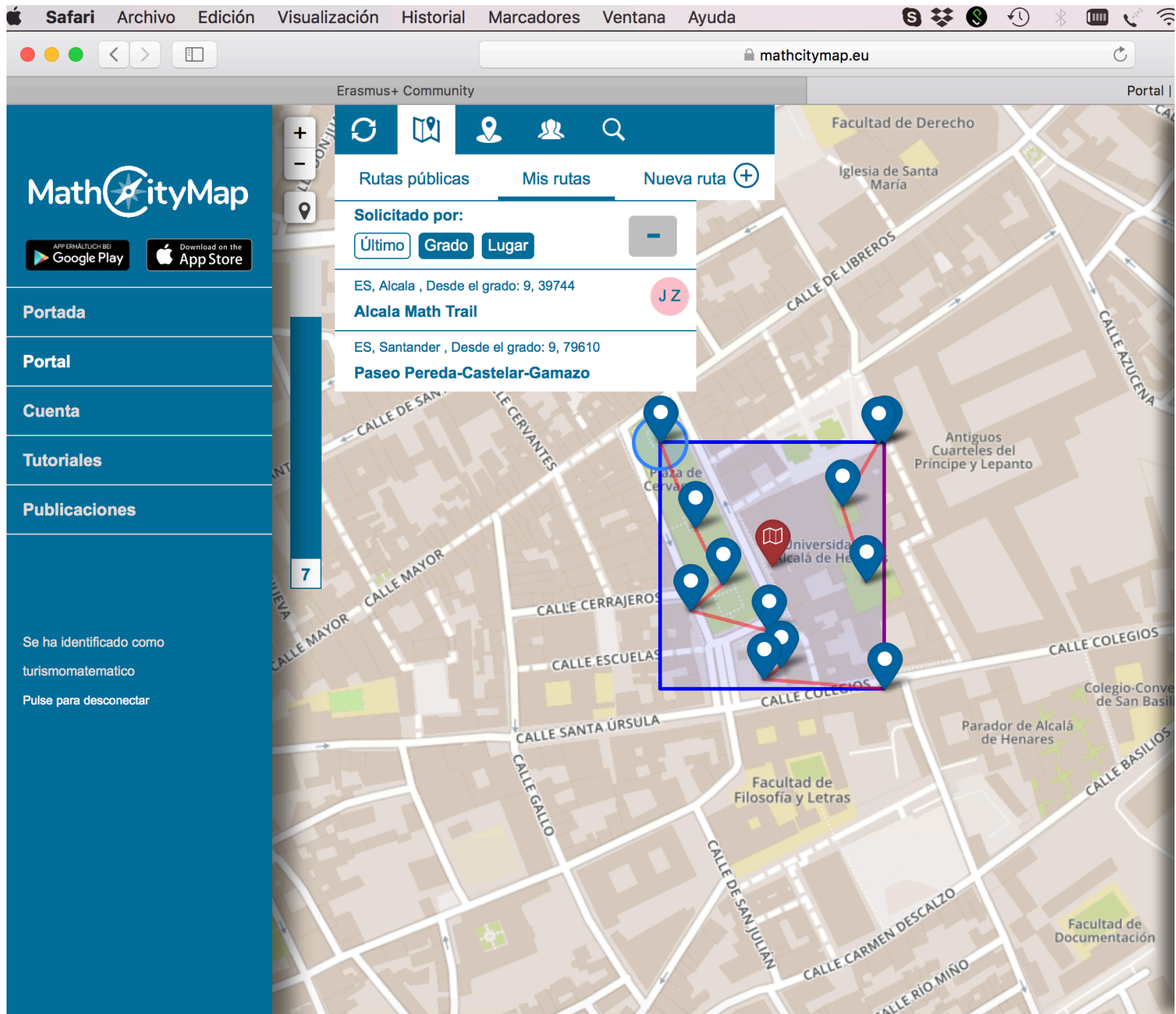
Math City Map

@mathcitymap

Some impressions from our ne
in #frankfurt @Stadt_FFM
spot the #mathematics in the p
#mathcitymap #mcm #outdoor
#mathchat #edtech







✎ Editar



1. Sobre esta ruta

Título*

Alcala Math Trail

Lugar*

ES, Alcala

Gamification*

Puntos gamificación

Desde el grado*

9

Duración aproximada*

Descargar

Augmented reality (to explore math objects in a real world context)

<https://www.facebook.com/geogebra/videos/10155662725038232/>



TASKS

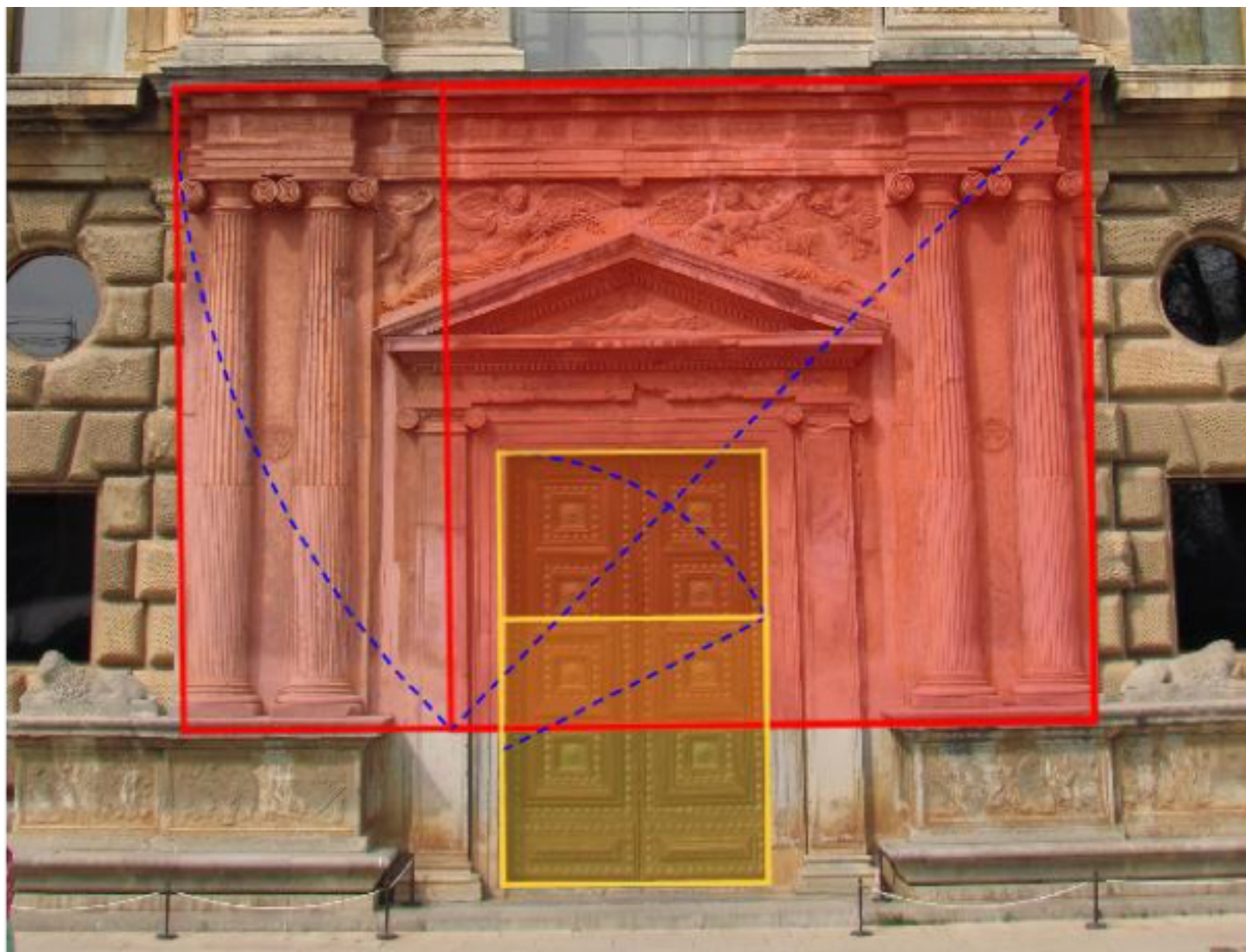
- DESIGNED WITH THE HELP OF A MOBILE PHONE
(AR; AI)
- DEVELOPED WITH THE HELP OF THE MOBILE
PHONE

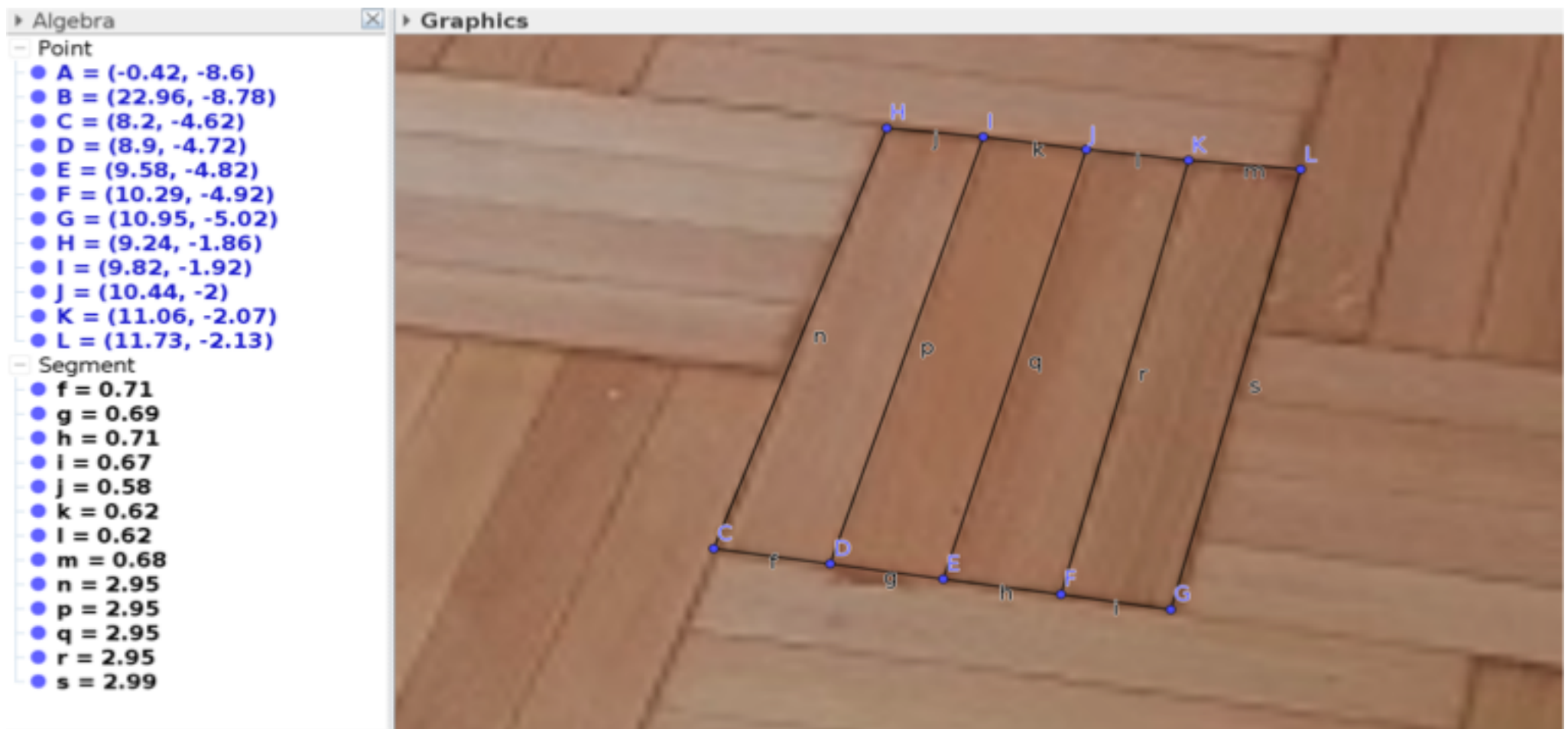
A new scenery

- **Real world** (Smart phones, robotic vision, sensors) – mathematical layer
 - 1) Pre-processed, associated by geo-positioning, markers;
 - 2) Measures {image — Hough transform — recognizing geometric elements } — input GeoGebra — systematic and automatic derivation of geometric properties — generalizing, proving, discovering;
- **Automatically augmented geometric reality**

Ongoing work with F. Botana (U. Vigo) y Z. Kovács (University College
Diocese of Linz), A. Martínez Sevilla (U. Granada), Pilar Vélez-Melón (U.
Nebrija)







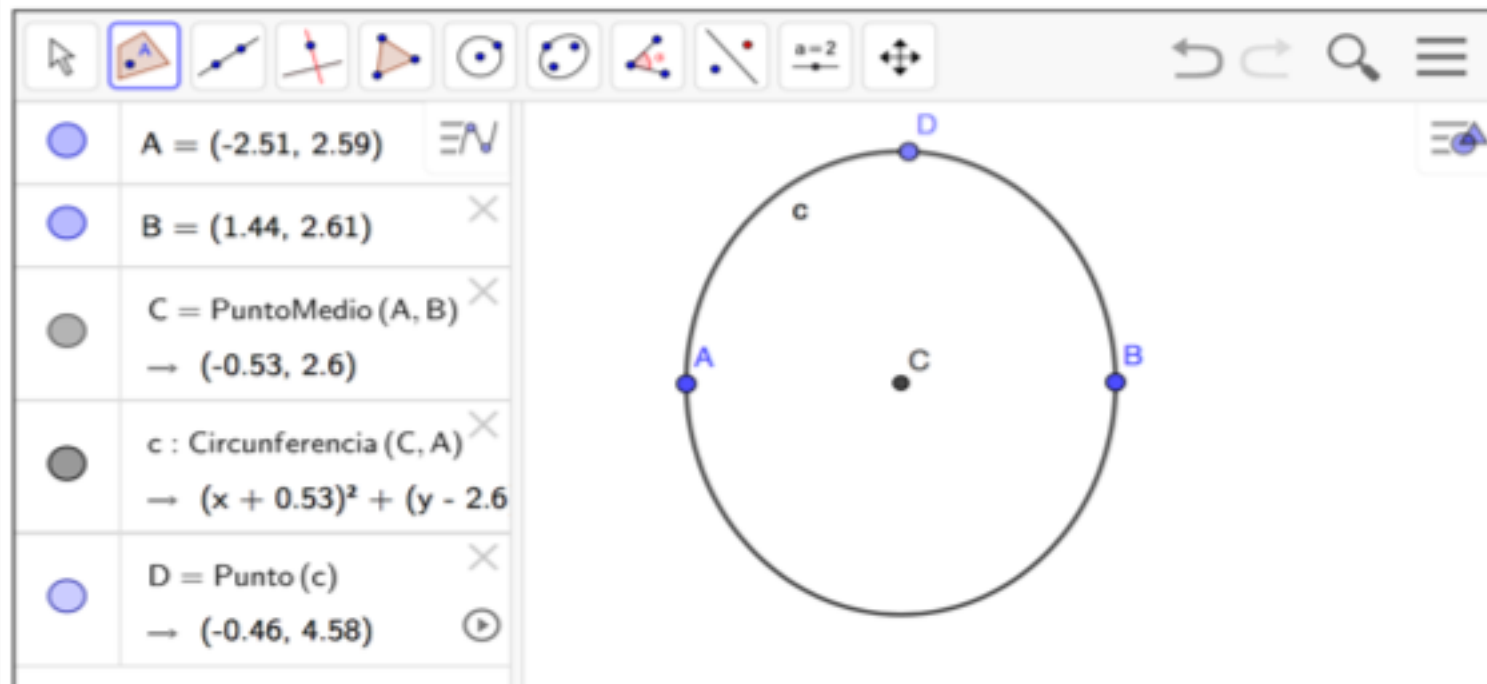
Imaginary detection of reality with an internal representation of a parquet floor being photographed by a smartphone and translated into GeoGebra

Our tool: Combinatorics with geometric elements,
automated application of the automated
reasoning tools developed by Botana, Kovacs,
Recio, Velez.

- <http://htmlpreview.github.io/?https://github.com/kovzol/ag/blob/master/automated-geometer.html>

Welcome to the Automated Geometer!

Let us consider this initial input construction (you may freely edit the construction or upload another one as well; only the visible points will be observed):



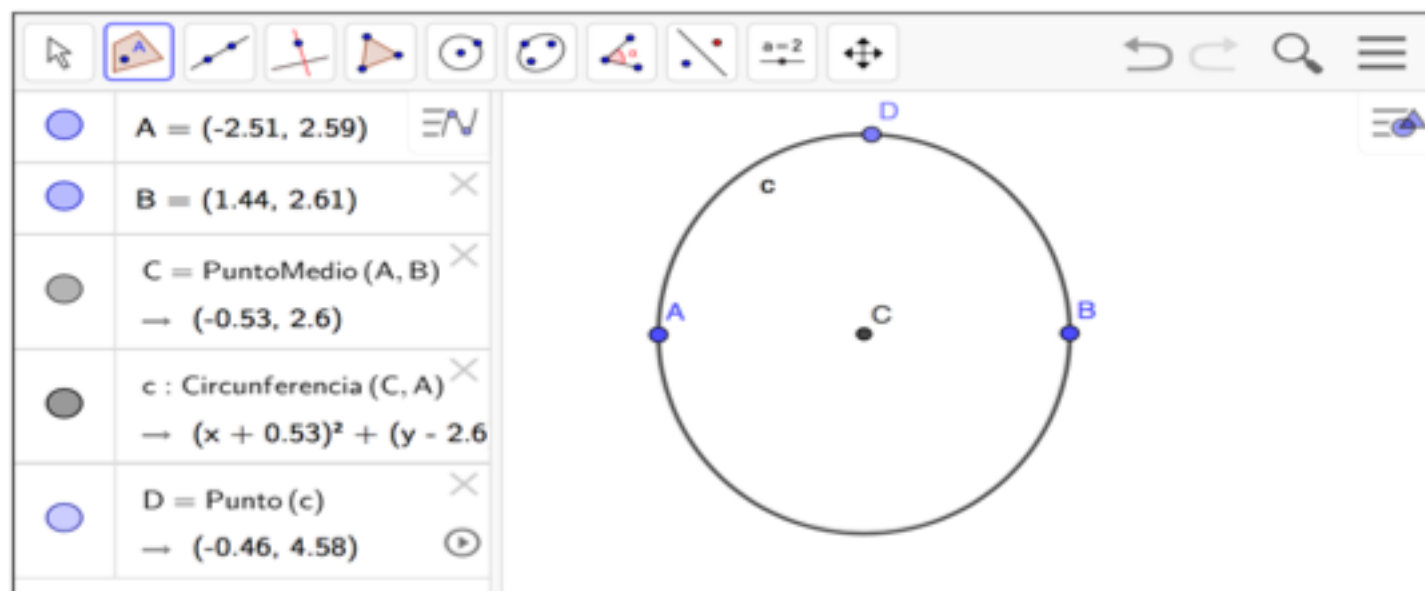
Select relations to check:

- Collinearity of three points
- Equality of distances between two points
- Perpendicularity of segments defined by two points**
- Parallelism of segments defined by two points

Start discovery

Welcome to the Automated Geometer!

Let us consider this initial input construction (you may freely edit the construction or upload another one as well; only the visible points will be observed):



Select relations to check:

- ☐ Collinearity of three points
- ☐ Equality of distances between two points
- ☒ Perpendicularity of segments defined by two points
- ☐ Parallelism of segments defined by two points

Now the following theorems can be obtained:

1. $AD \perp BD$

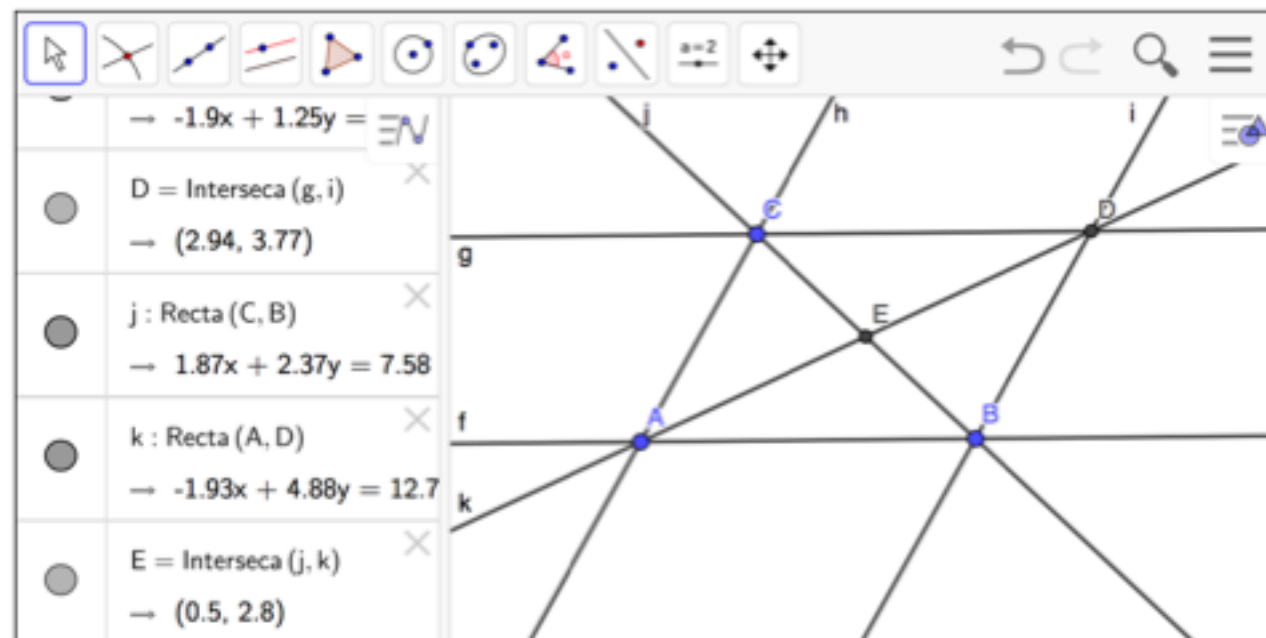
Finished, found 1 theorems among 15 possible statements.

Elapsed time: 0h 0m 1s

Please reload the page if you want to start a new experiment.

Welcome to the Automated Geometer!

Let us consider this initial input construction (you may freely edit the construction or upload another one as well; only the visible points will be observed):



Select relations to check:

- ☐ Collinearity of three points
- ☐ Equality of distances between two points
- ☐ Perpendicularity of segments defined by two points
- ☐ Parallelism of segments defined by two points

Now the following theorems can be obtained:

1. $E \in AD$
2. $E \in BC$
3. $AB = CD$
4. $AC = BD$
5. $AE = DE$
6. $BE = CE$

Finished, found 6 theorems among 55 possible statements.

Elapsed time: 0h 0m 3s

Please reload the page if you want to start a new experiment.

Welcome to the Automated Geometer!

Let us consider this initial input construction (you may freely edit the construction or upload another one as well; only the visible points will be observed):



	$C = (2, 4)$	
	$D = \text{PuntoMedio}(A, B)$ $\rightarrow (0.5, 1)$	
	$E = \text{PuntoMedio}(B, C)$ $\rightarrow (3, 2.5)$	
	$F = \text{PuntoMedio}(C, A)$ $\rightarrow (-0.5, 2.5)$	
	$G = \text{PuntoMedio}(D, E)$ $\rightarrow (1.75, 1.75)$	



Select relations to check:

Collinearity of three points
Equality of distances between two points
Perpendicularity of segments defined by two points
Parallelism of segments defined by two points

Start discovery



Select relations to check:

☐ Collinearity of three points
☐ Equality of distances between two points
☐ Perpendicularity of segments defined by two points
☐ Parallelism of segments defined by two points

Now the following theorems can be obtained:

- | | | | | | | | | | |
|---------------|---------------|---------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| 1. $D \in AB$ | 6. $AD = BD$ | 11. $BE = CE$ | 16. $DG = EG$ | 21. $AC \perp CF$ | 26. $AD \perp EF$ | 31. $BC \perp BE$ | 36. $BE \perp DF$ | 41. $CF \perp DE$ | 46. $DG \perp EG$ |
| 2. $F \in AC$ | 7. $AD = EF$ | 12. $BE = DF$ | 17. $AB \perp AD$ | 22. $AC \perp DE$ | 27. $AF \perp CF$ | 32. $BC \perp CE$ | 37. $BF \perp BG$ | 42. $CF \perp DG$ | |
| 3. $E \in BC$ | 8. $AF = CF$ | 13. $BG = FG$ | 18. $AB \perp BD$ | 23. $AC \perp DG$ | 28. $AF \perp DE$ | 33. $BC \perp DF$ | 38. $BF \perp FG$ | 43. $CF \perp EG$ | |
| 4. $G \in BF$ | 9. $AF = DE$ | 14. $CE = DF$ | 19. $AB \perp EF$ | 24. $AC \perp EG$ | 29. $AF \perp DG$ | 34. $BD \perp EF$ | 39. $BG \perp FG$ | 44. $DE \perp DG$ | |
| 5. $G \in DE$ | 10. $BD = EF$ | 15. $CF = DE$ | 20. $AC \perp AF$ | 25. $AD \perp BD$ | 30. $AF \perp EG$ | 35. $BE \perp CE$ | 40. $CE \perp DF$ | 45. $DE \perp EG$ | |

Finished, found 46 theorems among 665 possible statements.

Elapsed time: 0h 0m 20s

Please reload the page if you want to start a new experiment.

Some recent references for these ideas:

- MARTÍNEZ-SEVILLA, Álvaro; RECIO, Tomás. GeoGebra y Realidad Aumentada en la Divulgación de la Matemática. III Foro Iberoamericano de Divulgación y Cultura Científica (Córdoba, Spain, 2017). <http://www.oei.es/historico/divulgacioncientifica/IMG/pdf/orales-3.pdf>
- F. Botana, Z. Kovács, A. Martínez-Sevilla, T. Recio. Automatically Augmented Reality with GeoGebra. In: Augmented Reality in Educational Settings. (Ed. Theodosia Prodromou). Sense Publishers. To appear.
- Carlos Ureña, Álvaro Martínez-Sevilla and Tomás Recio. Augmented Reality, Maths Walks and GeoGebra. Communication to the CADGME WG7 - Augmented and Virtual Reality in Mathematics Education Workshop. Coimbra, June 2018. <https://www.uc.pt/en/congressos/cadgme2018/generalinformation/workgroupshops>
- Francisco Botana, Zoltán Kovács and Tomas Recio: Towards an Automated Geometer. AISC 2018. Suzhou. <http://aisc2018.cc4cm.org>
- Francisco Botana, Zoltán Kovács and Tomas Recio: Automated Geometer, a web based discovery tool (extended abstract). ADG 2018 Nanning. <http://adg2018.cc4cm.org>
- KOVÁCS, Zoltan; RECIO, Tomás and VÉLEZ, M.Pilar. Using Automated Reasoning Tools in GeoGebra in the Teaching and Learning of Proving in Geometry. In: International Journal of Technology in Mathematics Education, to appear: <http://www.researchinformation.co.uk/time/contents/timecont.php>

Thanks!