Computational and Differential Geometry
Homework1 1

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Indicaciones

1. Fecha de entrega: 27 de agosto de 2023 hasta las 11:55 pm.
2. Único medio de entrega e-aulas.
3. Formato de entrega: **Un único** archivo **.ipynb** con códigos en python, descripciones de códigos y procesos, y respuestas a las preguntas. No entregar archivos comprimidos .zip o equivalentes.
4. Solo es permitido el uso de librerías "básicas" (numpy, matplotlib, seaborn, pandas, etc). En ningún caso será válida la solución lograda, total o parcialmente, por el uso de una librería especializada para resolver problemas de geometría computacional.
5. La tarea **debe** realizarse **individualmente**.
6. Cualquier tipo de fraude o plagio es causa de anulación directa de la evaluación y correspondiente proceso disciplinario.
7. Las entregas están sujetas a herramientas automatizadas de detección de plagio en códigos.
8. Las tareas no entregadas antes de la hora indicada tendrán calificación de 0.0.

Support each piece of code with a thorough explanation of its methods, techniques, functions, and tricks. Reference your search source (papers, books, tutorials, websites, etc.). Add any necessary bibliographical references or links.

1. (1 point). Write down a code able to identify whether a pair of segments share points. Three possible answers should be available: segments do not intersect, segments do intersect giving the intersection point, and segments do intersect giving an intersection interval.

   Let $S(x_1, y_1, x_2, y_2)$ the segment connecting the points (x_1, y_1) and (x_2, y_2). Consider the segments

   $$S_1 = S(1, 2, 3, 4), \quad S_2 = S(3, 4, 5, 6), \quad S_3 = (2, 3, 5, 6), \quad \text{and} \quad S_4 = (4, 5, 5, 6)$$

   Use your code to evaluate intersections of S_1 with S_2, S_3 and S_4.

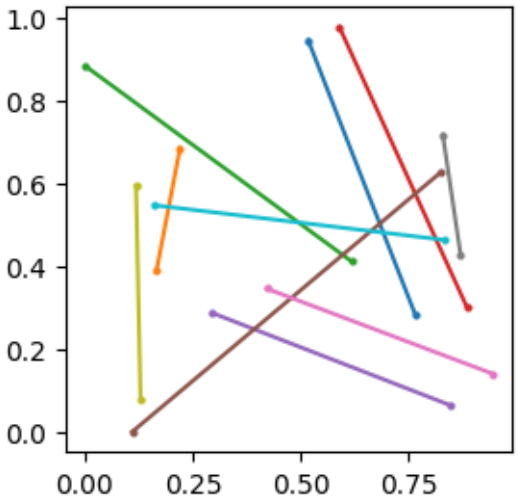
2. (2 points). Generate a set of points using the following code

```
np.random.seed(23)
X = np.random.rand(20, 2)
```

   - Implement the Jarvis-March algorithm for the generated points. Illustrate the process with plots.
   - Which models could be implemented by the convex hull algorithm? Which systems could be described by the model? In those cases, what do represent the points and the hull?

3. (2 points). Implement **the sweep line algorithm** and apply it to the set of segments given in the attached file (segmentos.csv). Identify intersection points and intersecting segments. Plot the process and the result.

   This is the plot of the given segments



Submit:
Upload to the platform an **.ipynb** file with answers, codes, descriptions and plots.