

De la clase anterior ...

Desarrollamos el algoritmo de línea de barrido, cuya estructura general se basa en las siguientes funciones

01

```
def  
ENCUENTRAINTERSECCIONES(S):
```

Inicializa una cola de eventos Q vacía. Inserta los puntos finales de los segmentos en Q con el orden definido (mayor y primero). I

Inicializa una estructura de estado T vacía.

while Q no es vacía:

 Extrae p de Q, siguiente evento.

 MANEJAREVENTO(p)

02

```
def MANEJAREVENTO(p):
```

Si p es un inicio de segmento:

Introducir el segmento correspondiente en T

INTERSECCIONSEGMENTO(p,r)

INTERSECCIONSEGMENTO(p,s) donde r y s son los nuevos vecinos de p en T

Si p es un fin de segmento:

Extraer r, s, los vecinos de p en T

eliminar el segmento correspondiente en T

INTERSECCIONSEGMENTO(r,s)

Si p es una intersección:

Intercambiar T el orden de r, s los segmentos que se intersectan en p

Para q y t los nuevos vecinos de s y r, respectivamente

INTERSECCIONSEGMENTO(q,s)

INTERSECCIONSEGMENTO(t,r)

Reportar intersección

03

```
def INTERSECCIONSEGMENTO(r,s):
```

if r y s no se encuentran en la lista L de intersecciones calculadas and if r y s se intersectan:
Crear un evento p, la intersección de r,s, introducir p en Q

Estructuras necesarias

<u>Segmento</u>	Inicio, Fin, id identificador del evento
<u>Evento</u>	Coordenadas, tipo de evento (inicio, fin,...), ids de segmento(s),
Q	Cola de eventos, debe mantener en todo el orden en que se insertan los eventos
T	El estado, que representa donde se encuentra la línea en cada punto del barrido, mantiene los segmentos en orden (x ascendente)
L	Lista de los pares de id de segmentos cuya intersección ya se verificó

Complejidad (en tiempo)

01

```
def  
ENCUENTRAINTERSECCIONES(S):
```

Inicializa una cola de eventos Q vacía. Inserta los puntos finales de los segmentos en Q con el orden definido (mayor y primero). I

Inicializa una estructura de estado T vacía.

while Q no es vacía:Extrae p de Q, siguiente evento.

MANEJAREVENTO(p)

$O(2n + n_i)$

$O(n \log n)$

02

def MANEJAREVENTO(p):

Si p es un inicio de segmento: $O(\log n)$

Introducir el segmento correspondiente en T

INTERSECCIONSEGMENTO(p,r)

INTERSECCIONSEGMENTO(p,s) donde r y s son los nuevos vecinos de p en T

Si p es un fin de segmento:

Extraer r, s, los vecinos de p en T $O(\log n)$

eliminar el segmento correspondiente en T

INTERSECCIONSEGMENTO(r,s)

Si p es una intersección:

Intercambiar T el orden de r, s los segmentos que se intersectan en p

Para q y t los nuevos vecinos de s y r, respectivamente

INTERSECCIONSEGMENTO(q,s)

INTERSECCIONSEGMENTO(t,r)

Reportar intersección $O(\text{constante})$

03

```
def INTERSECCIONSEGMENTO(r,s):
```

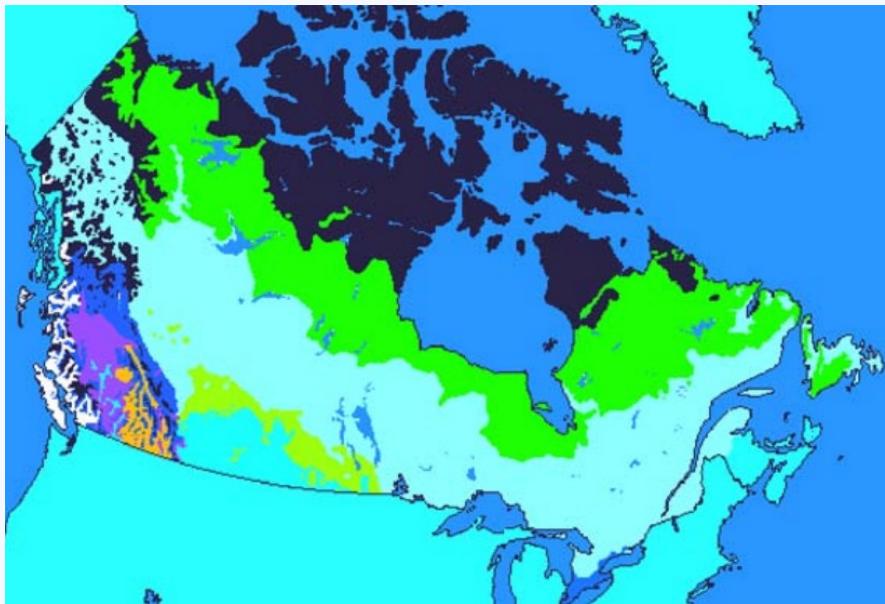
if r y s no se encuentran en la lista L de intersecciones calculadas and if r y s se intersectan:
Crear un evento p, la intersección de r,s, introducir p en Q

$O(\log n)$

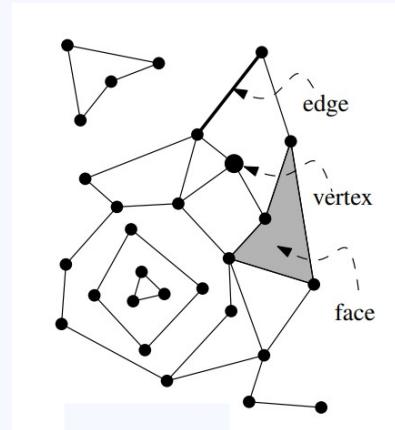
La complejidad es $O(n \log n + m \log n)$, con m el numero de intersecciones encontradas.

Aristas doblemente conexas (doubly connected edges)

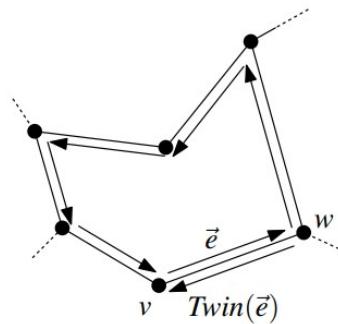
Las subdivisiones del plano, que dividen una región en áreas etiquetadas, son fundamentales en la representación de información geoespacial, como mapas temáticos.



Consideramos mapas como subdivisiones planares inducidas por el mapa.. Buscamos una representación que permita operaciones locales, como recorrer la frontera de una cara o acceder a una cara vecina mediante un borde común. La representación que discutiremos se llama "doubly-connected edge".



Un edge delimita dos faces (por lo general), le tenemos que dar dirección. Medio-edge delimita un solo face. Twins son dos half-edges adyacentes. Definimos una orientación antihoraria para definir el next de cada half-edge. La face correspondiente a un half-edge siempre se encuentra a su izquierda



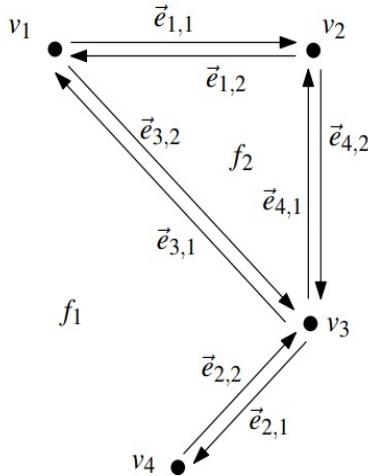
En resumen esta estructura, doubly connected edge list, contiene tres tipos de registros: half-edges, vertices , faces.

Para cada vertice tenemos Coordenadas(v) tambien EdgeIncidente(v) a un half-edge que tiene v como su origen.

Para un face f ComponenteExterior(f) es un half-edge en su frontera exterior. Para una cara no acotada esto es null. ComponenteInterior(f), contiene por cada hueco un half-edge en la frontera de este hueco.

Para un half-edge e tenemos Origen(e) que apunta a un vertice, Twin(e) a su half-edge opuesto, FaceIncidente(e) al face adyacente, tambien tenemos Next(a) y Prev(e) a el siguiente y anterior half-edge.

Por ejemplo...



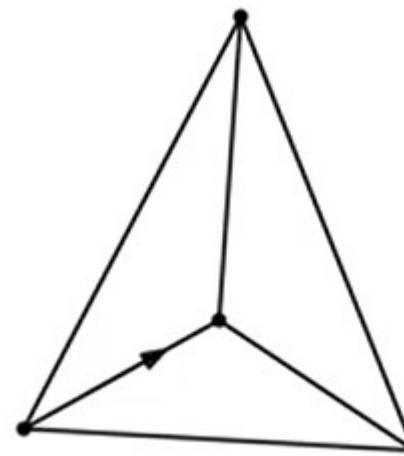
Vertex	Coordinates	IncidentEdge
v_1	$(0, 4)$	$\vec{e}_{1,1}$
v_2	$(2, 4)$	$\vec{e}_{4,2}$
v_3	$(2, 2)$	$\vec{e}_{2,1}$
v_4	$(1, 1)$	$\vec{e}_{2,2}$

Face	OuterComponent	InnerComponents
f_1	nil	$\vec{e}_{1,1}$
f_2	$\vec{e}_{4,1}$	nil

Half-edge	Origin	Twin	IncidentFace	Next	Prev
$\vec{e}_{1,1}$	v_1	$\vec{e}_{1,2}$	f_1	$\vec{e}_{4,2}$	$\vec{e}_{3,1}$
$\vec{e}_{1,2}$	v_2	$\vec{e}_{1,1}$	f_2	$\vec{e}_{3,2}$	$\vec{e}_{4,1}$
$\vec{e}_{2,1}$	v_3	$\vec{e}_{2,2}$	f_1	$\vec{e}_{2,2}$	$\vec{e}_{4,2}$
$\vec{e}_{2,2}$	v_4	$\vec{e}_{2,1}$	f_1	$\vec{e}_{3,1}$	$\vec{e}_{2,1}$
$\vec{e}_{3,1}$	v_3	$\vec{e}_{3,2}$	f_1	$\vec{e}_{1,1}$	$\vec{e}_{2,2}$
$\vec{e}_{3,2}$	v_1	$\vec{e}_{3,1}$	f_2	$\vec{e}_{4,1}$	$\vec{e}_{1,2}$
$\vec{e}_{4,1}$	v_3	$\vec{e}_{4,2}$	f_2	$\vec{e}_{1,2}$	$\vec{e}_{3,2}$
$\vec{e}_{4,2}$	v_2	$\vec{e}_{4,1}$	f_1	$\vec{e}_{2,1}$	$\vec{e}_{1,1}$

Ejemplo, necesidad double-connected edge list

Queremos dar una orientación consistente a los edges de la siguiente figura



Solucion, half edges

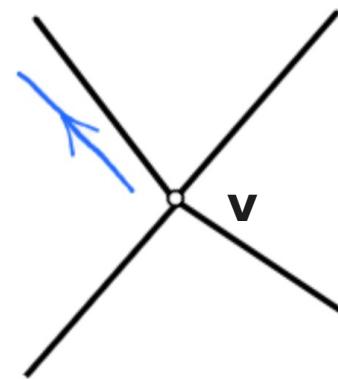
Para esta estructura, doubly connected-edge necesitamos guardar lo siguiente:

<u>Vertice, v</u>	Coordenadas(v), IncidentEdge(v) un half-edge con v como su origen
<u>Half-edge, e</u>	Origin(e) [vertice], Twin(e) [half-edge], Next(e) [half-edge], Prev(e) [half-edge], IncidentFace(e) [face] face que se encuentra hacia la izquierda de e
<u>Face, f</u>	OuterComponent(f)[half-edge] un half-edge con el que se recorra su frontera exterior, OuterComponent(f)[half-edge] half-edge sobre su frontera interior

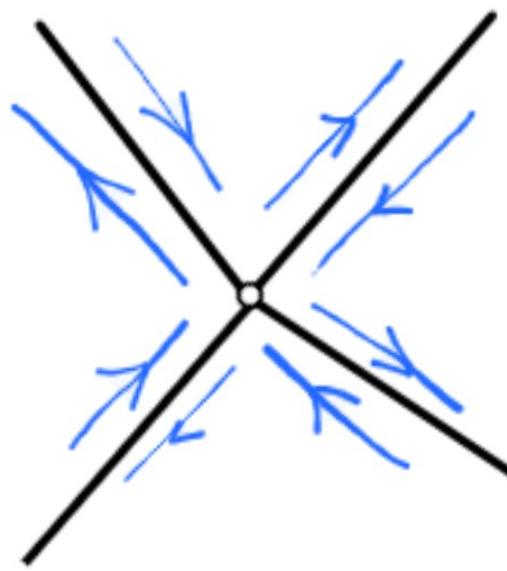
Es esta informacion es suficiente?

Supongamos en el siguiente caso, para v , tener todos los vertices incidentes

IncidentEdge(v)

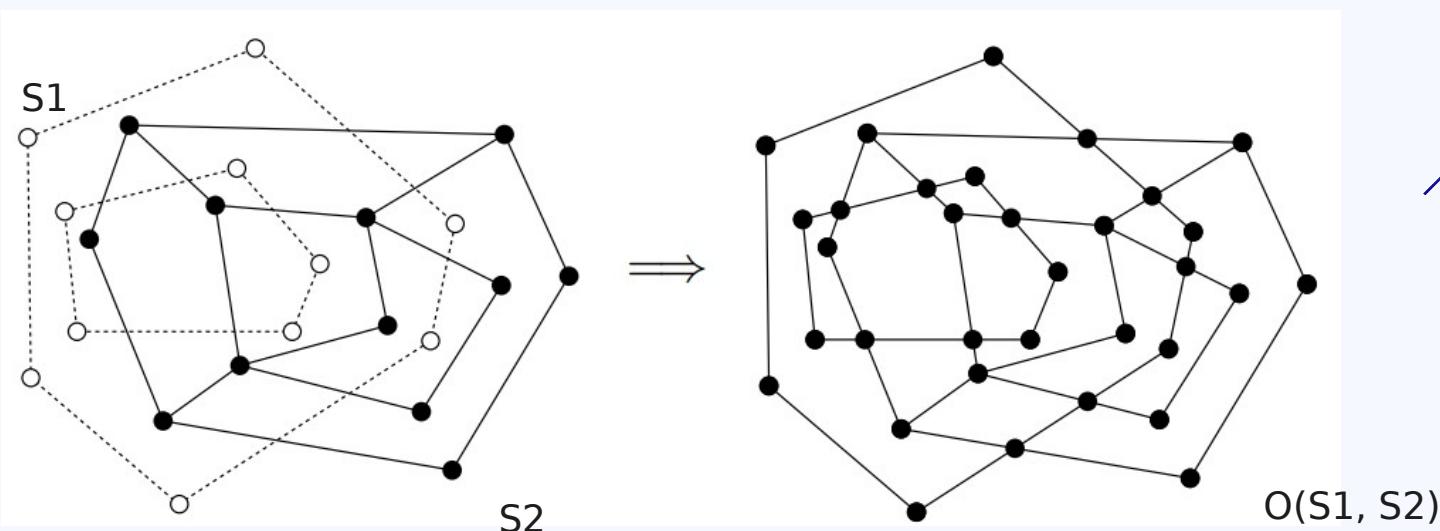


Usando `Next(Twin(IncidentEdge(v)))`

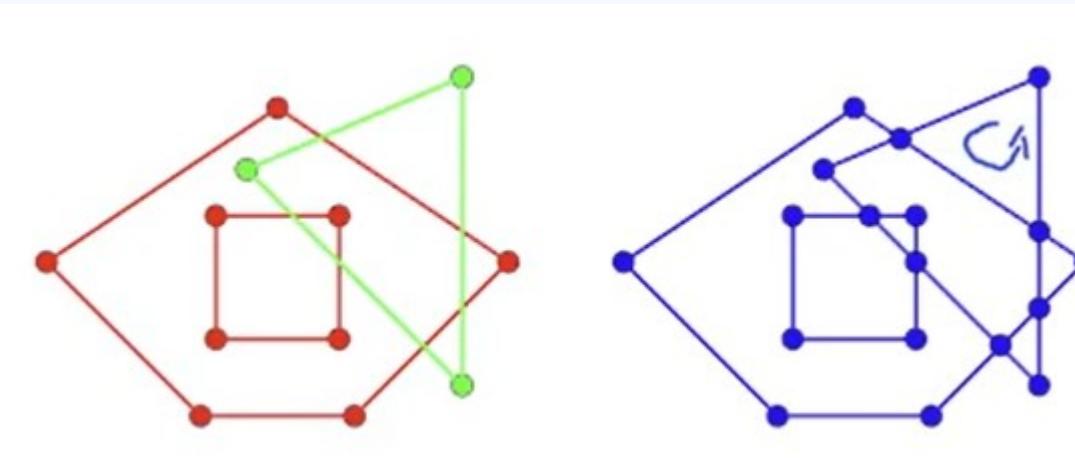


Superposición de 2 subdivisiones

Con esta estructura de dato podemos calcular la superposición de 2 subdivisiones. Se define la superposición de subdivisiones S_1 y S_2 como subdivisión $O(S_1, S_2)$ tal que encontramos un face f en $O(S_1, S_2)$ si solo son faces f_1 en S_1 y f_2 en S_2 tal que f es un conjunto maximal conexo en $f_1 \cap f_2$.



Para la estructura resultante debemos orientar los half-edges de manera que las nuevas faces mantienen la orientación usual, por ejemplo



Queremos que cada face nueva de $O(S_1, S_2)$ tenga la información correspondiente a las faces en S_1 y S_2 .

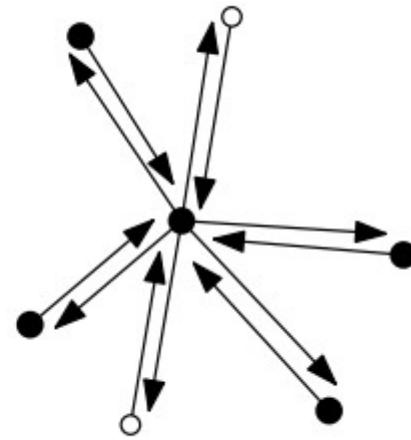
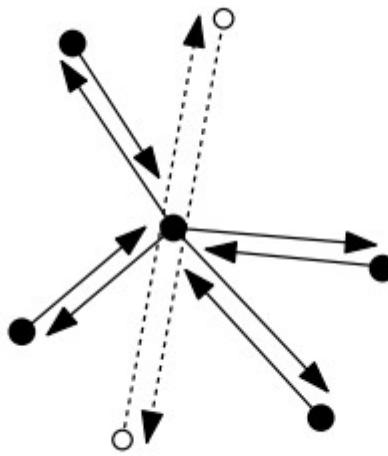
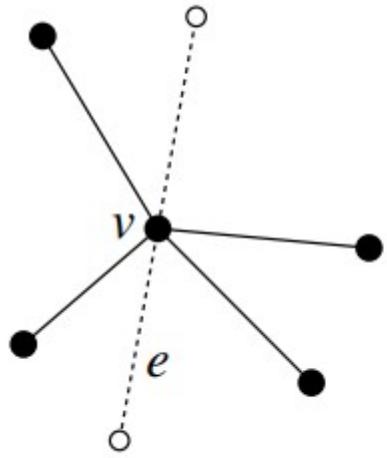
Gran parte de la lista de doubly connected-edges en S_1 y S_2 se puede reusar para la lista de doubly connected-edges en S , se tiene que cambiar los half-edges de S_1 que son cortados por half-edges de S_2 , y viceversa. Podemos mantener registro de half-edges que no han sido cortados por edges del otro mapa. Ya que las correspondientes caras estarán siempre a la izquierda de un half-edge y esto no cambia, aunque el face incidente puede cambiar.

Para resolver el problema de la superposición primero copiamos la lista de doubly connected-edges de S_1 y la de S_2 para formar una nueva lista, su union no es una lista de doubly connected-edges valida, esta es la tarea del algoritmo, encontrar las intersecciones y enlazando de manera apropiada la información en cada una de las listas de doubly connected edges.

Para corregir la lista de doubly connected edges de S usamos el algoritmo de linea de barrido, sobre la lista de segmentos generados por los edges de la union de las subdivisiones. Usamos la cola de eventos, Q, el estado de la linea, T, que mantiene en orden x-ascendente los segmentos localizados sobre la linea y adicionalmente llevamos D, la lista doubly connected edges. Inicialmente, D contiene una copia de las respectivas listas de S1 y S2 y a medida que progrese el algoritmo vamos corrigiendo. La informacion de las faces se corregirá al final, y el estado, T, mantendrá los respectivos registros descritos de los segmentos dentro de la linea de barrido para corregirlos en el evento de encontrar intersección.

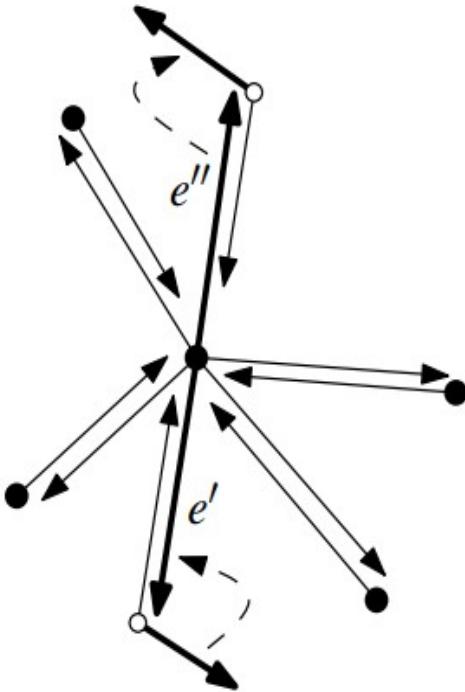
Usamos T, Q las estructuras como anteriormente. Encontramos todas las posibles intersecciones. Si al encontrar un evento, este evento involucra segmentos de S1 y S2 debemos hacer cambios locales a D para contener los registros adecuados de la superposicion.

Cuando un edge de S1 se encuentra con un vertice de S2

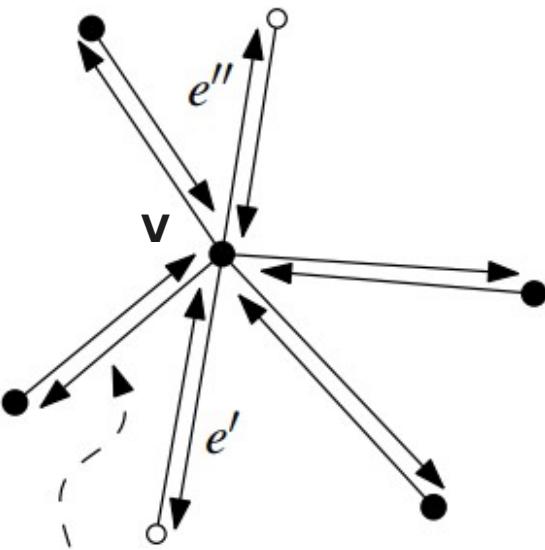


De los dos half-edges de e debemos tener 4, mantenemos dos con origen los extremos del segmento de e y creamos registros de los edges adicionales con sus respectivos Twin(.) .

Ahora debemos cambiar `Prev(.)` y `Next(.)`, primero para los nuevos half edges e' , e''

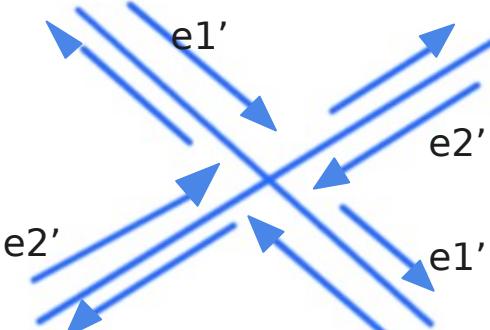
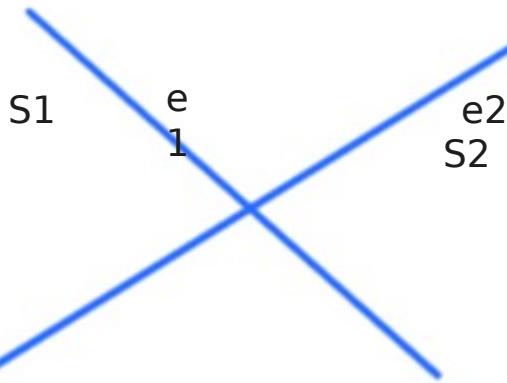


`Next()` es el `Next()` del half-edge anterior, el `Prev()` de estos half-edges es e' , e''



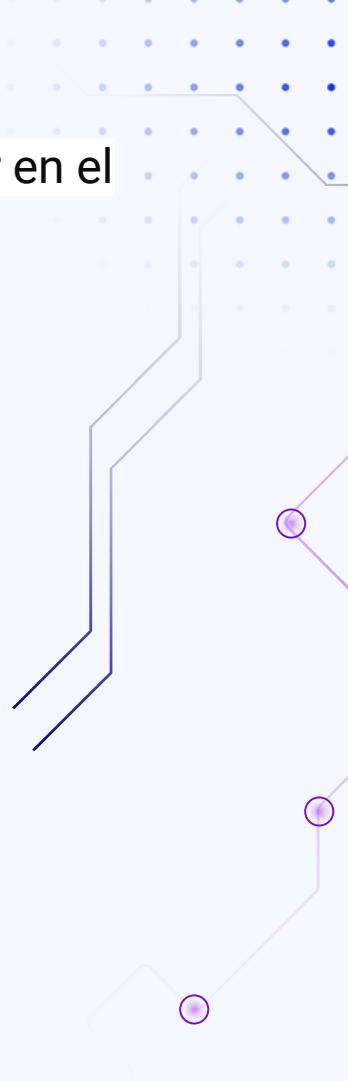
Debemos cambiar `Prev()` y
`Next()` alrededor de v para
poder hacer el recorrido en
el sentido del reloj

En el caso de encontrar intersección de edges de S1 y S2



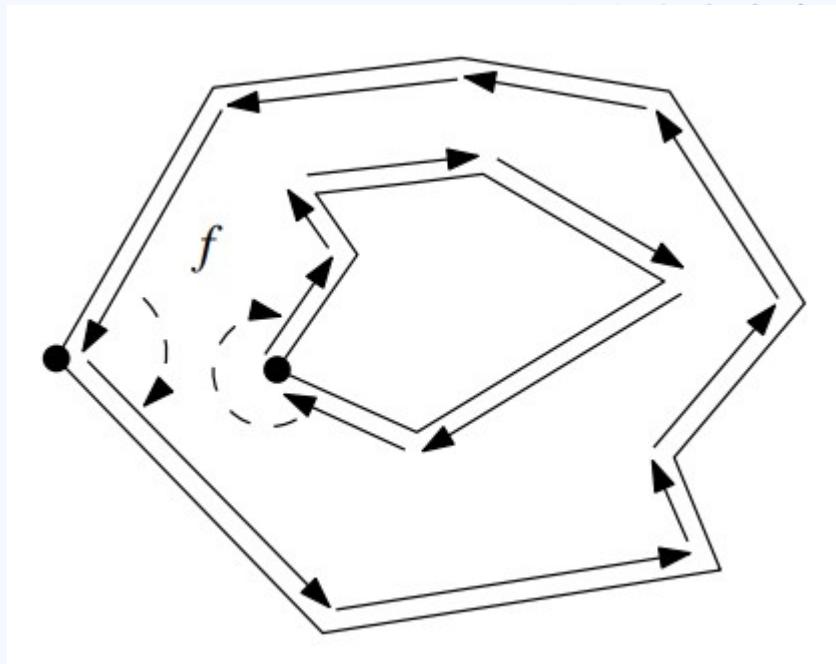
Se deben intercambiar e_1 y e_2 , con sus half-edges por los respectivos half-edges e_1' , e_1'' , e_2' , e_2'' y $\text{Prev}(\cdot)$ y $\text{Next}(\cdot)$.

En el caso de encontrar intersección de vértices, v , se deben reasignar en el orden los Next() y Prev() que tengan como destino, origen v .

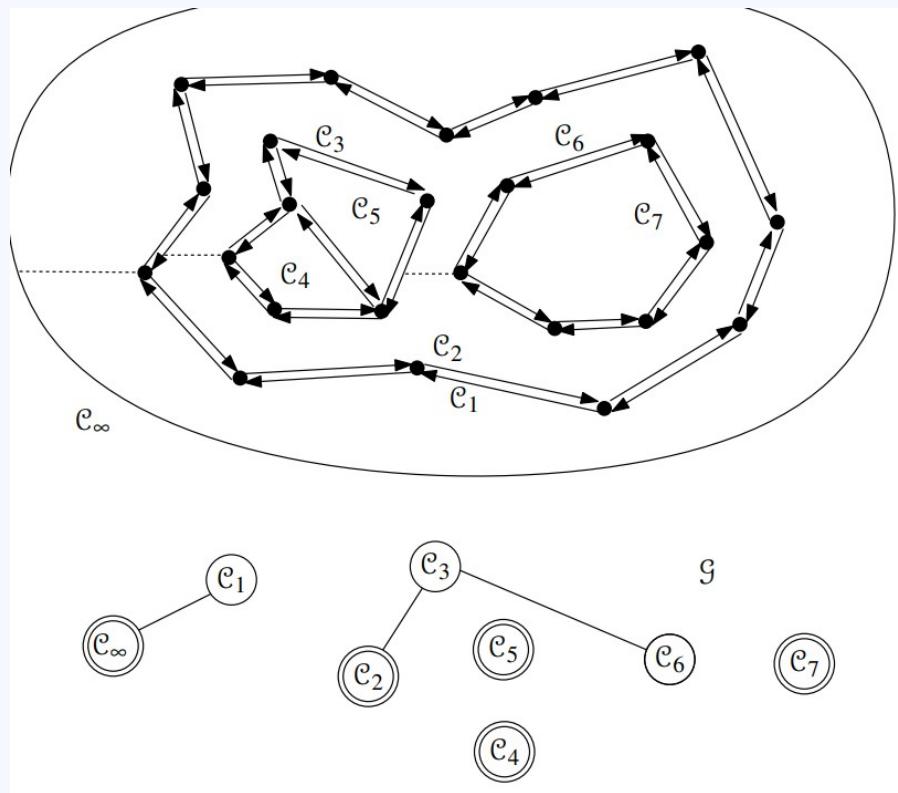


Para el caso de faces, el número de faces serán las diferentes componentes conexas de los bordes exteriores + 1 (cada face tiene una componente conexa excepto el unbounded face exterior).

Para saber si un ciclo de half-edges bordea una face en el interior o exterior se puede usar el siguiente criterio, se toma el vértice de menor componente x , en caso de empate el de menor componente y , luego se mira el ángulo de los half edges alrededor de v , si es menor que 180° es un face exterior, de lo contrario interior



Para decidir que fronteras bordean la misma face construimos un grafo G . para cada ciclo frontera —inner y outer— hay un nodo en G . Hay un nodo por la frontera de la unbounded face. Existe arco entre los ciclos si solo si uno de los ciclos es una frontera de un hueco y el otro tiene un half-edge inmediatamente a la izquierda del vértice más a la izquierda de la frontera del hueco.



Las componentes conexas del grafo son las distintas faces.

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You can describe the topic
of the section here

03

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You can describe the topic
of the section here

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You can describe the topic
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Practical exercise

You can describe the topic
of the section here



01

Theory lesson

You can enter a subtitle here if you need it

Introduction

Mercury is the closest planet to the Sun and the smallest one in the entire Solar System. **This planet's name has nothing to do with the liquid metal**, since Mercury was named after the Roman messenger god. Mercury's surface is filled with craters

Mercury takes a little more than 58 days to complete its rotation, so try to imagine how long days must be there! **Since the temperatures are so extreme, albeit not as extreme** as on Venus, Mercury has been deemed to be non-habitable for humans



“This is a quote, words full of wisdom that someone important said and can make the reader get inspired”



—Someone Famous



Concepts



Mercury

Mercury is the closest planet to the Sun and **the smallest one** in the Solar System—it's only a bit larger than the Moon



Venus

Venus has a beautiful name and is the **second planet from the Sun**. It's hot and has a poisonous atmosphere

What is this topic about?



Mercury

It's the closest planet to the Sun and the **smallest** in the Solar System



Venus

Venus has a beautiful name and is the second planet from the Sun



Mars

Despite being red, Mars is actually a **cold place**. It's full of iron oxide dust

Features of the topic

Mars

Despite **being red**,
Mars is very cold

Neptune

It's the farthest
planet from the Sun

Jupiter

Jupiter is the biggest
planet of them all

Saturn

Saturn is a **gas giant** and has
several rings

Examples



Mercury

It's the closest planet to the Sun and the **smallest** in the Solar System



Venus

Venus has a beautiful name and is the second planet from the Sun



Mars

Despite being red, Mars is actually a **cold place**. It's full of iron oxide dust

Recommendations



Mars

Despite being red,
Mars is very cold



Mercury

Mercury is the closest
planet to the Sun



Venus

Venus is the second
planet from the Sun



Saturn

Saturn is a gas giant
and has several rings



Neptune

Neptune is the
farthest planet from
the Sun



Jupiter

Jupiter is the biggest
planet of them all

Image always reinforce the concept

You can give a brief **description** of the topic you want to talk about here. For example, if you want to talk about Mercury, you can say that it's the smallest planet in the entire Solar System



4,498,300,000

Big numbers catch your audience's attention

9h 55m 23s

Jupiter's rotation period

333,000

The Sun's mass compared to Earth's

386,000 km

Distance between the Earth and the Moon

Awesome words



A picture is worth a thousand words



Practical exercise - calculator

Objective:

Introduce participants to basic coding concepts by building a **simple calculator**

Instructions:

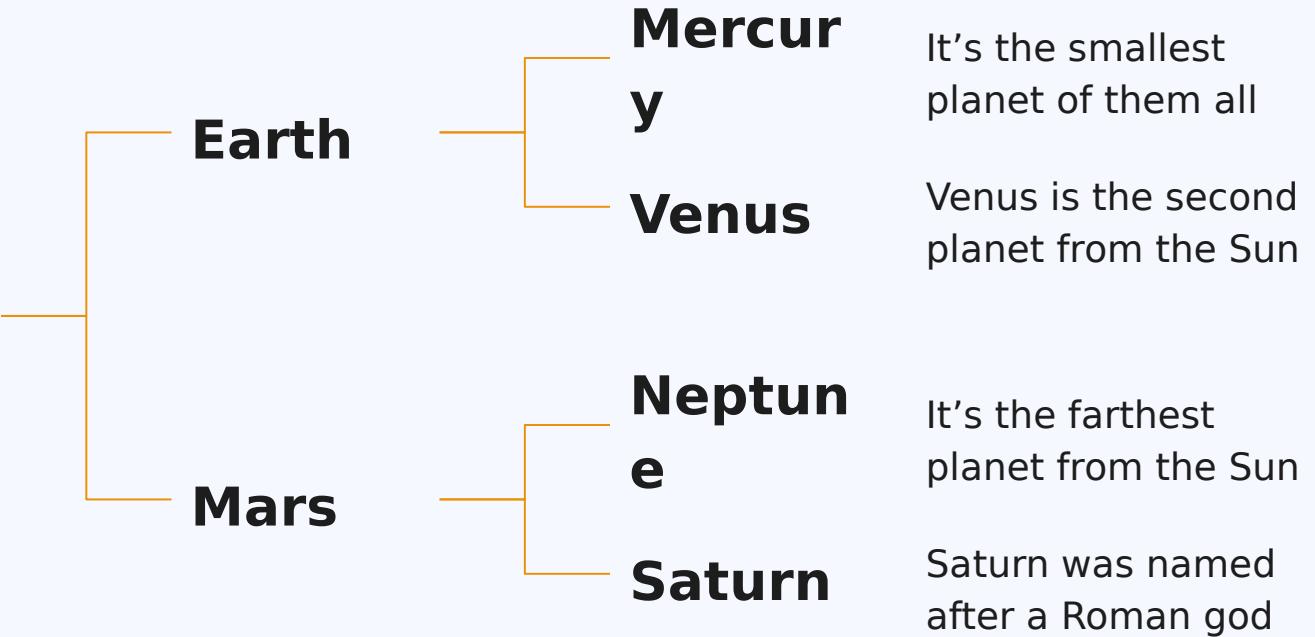
1. Open a Python development environment and write the following code:

```
# Simple Calculator  
num1 = int(input("Enter the first number: "))  
num2 = int(input("Enter the second number: "))  
print("Sum:", num1 + num2)  
print("Difference:", num1 - num2)  
print("Product:", num1 * num2)  
print("Quotient:", num1 / num2)
```

2. Run the program and experiment with different numbers
3. Observe the output

Brainstorm and idea generation

Power
1



Main topic and details

Mars

Despite being red,
Mars is **very cold**

Jupiter

Jupiter is the biggest
planet of them all

Neptune

It's the farthest
planet from the Sun

Saturn

It's a gas giant and
has **several rings**



Popular programming languages

01

Neptun
e

Mercury is the closest planet to the Sun and the **smallest** of them all

02

Venu
s

Venus has a beautiful name and is the **second planet from the Sun**

03

Earth

Earth is the third planet from the Sun and the only one that harbors life in the Solar System

04

Satur
n

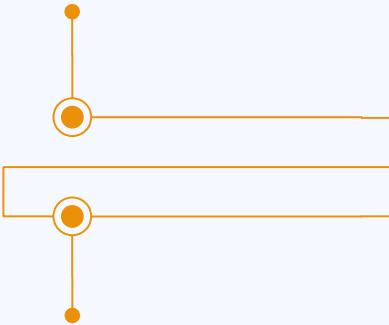
Saturn is a gas giant and has several rings. It's composed mostly of hydrogen and helium

Sequences

Saturn is composed of

hydrogen and helium

First

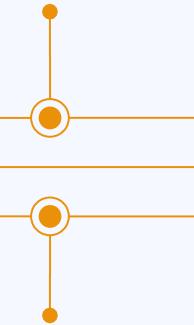


Next

Despite being red,
Mars is **very cold**

Mercury is the
closest planet to the
Sun

Next



Next

Earth is the third
planet from the Sun

Jupiter was named
after a Roman god

Next



Last

Venus has extremely
high temperatures

Classification

Mars	Venus	Mercury	Jupiter
<ul style="list-style-type: none">● Small● Red● Cold● Rocky	<ul style="list-style-type: none">● Small● Hot● Dry● Volcanic	<ul style="list-style-type: none">● Small● Hot● Rocky● Cratered	<ul style="list-style-type: none">● Large● Cold● Gassy● Striped
Mars is full of iron oxide dust	Venus has high temperatures	Mercury is quite a small planet	Jupiter is a huge gas giant

Cause and effect

Problem

- **Mars**

Despite being red,
Mars is very cold

- **Venus**

Venus is the second
planet from the Sun

Solution

- **Mercury**

Mercury is the closest
planet to the Sun

- **Saturn**

Saturn is a gas giant
and has several rings

Question and answer

Question

Is Mercury the closest planet to the Sun and the smallest one in the Solar System? **Note that it's a bit larger than the Moon**

Answer

Venus has a beautiful name and is **the second planet from the Sun**. It's hot and has a poisonous atmosphere

Step-by-step coding

01



Earth

It's the only planet known to **harbor life**

02



Mercury

Mercury is the closest planet to the Sun

03



Jupiter

Jupiter is the **biggest** planet of them all

04



Saturn

Saturn was named after a Roman god

Parts and whole

The whole objective

Mercury is the closest planet to the Sun and the smallest one in the entire Solar System

Parts of the object

- Mercury
- Jupiter
- Venus
- Mars
- Earth
- Saturn
- Mercury

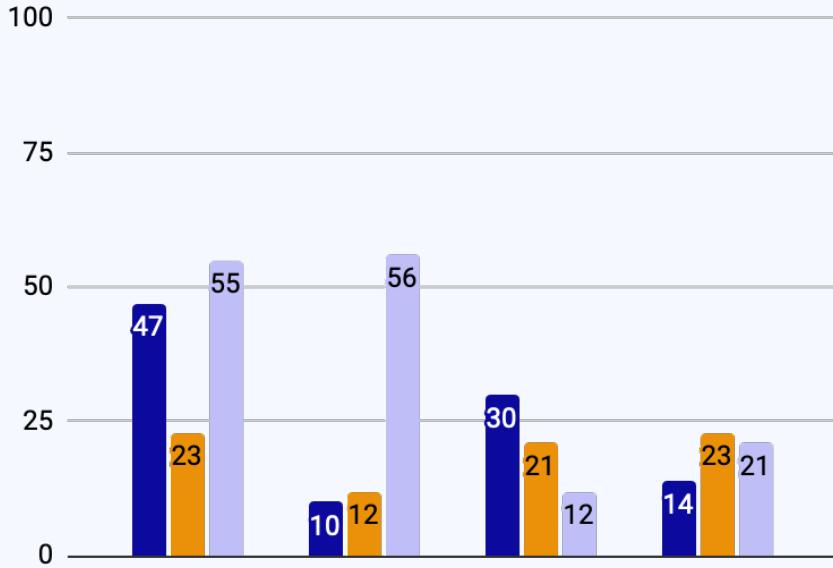
What happens if the parts are missing?

Earth is the third planet from the Sun and the **only one that harbors life in the Solar System**

What's the function of the parts?

Jupiter is a gas giant and the biggest planet in the Solar System

You can use this graph



Follow the link in the graph to modify its data and then paste the new one here. [For more info, click here](#)



Mercury

Mercury is the closest planet to the Sun



Jupiter

Jupiter is the biggest planet of them all



Saturn

Saturn was named after a Roman god

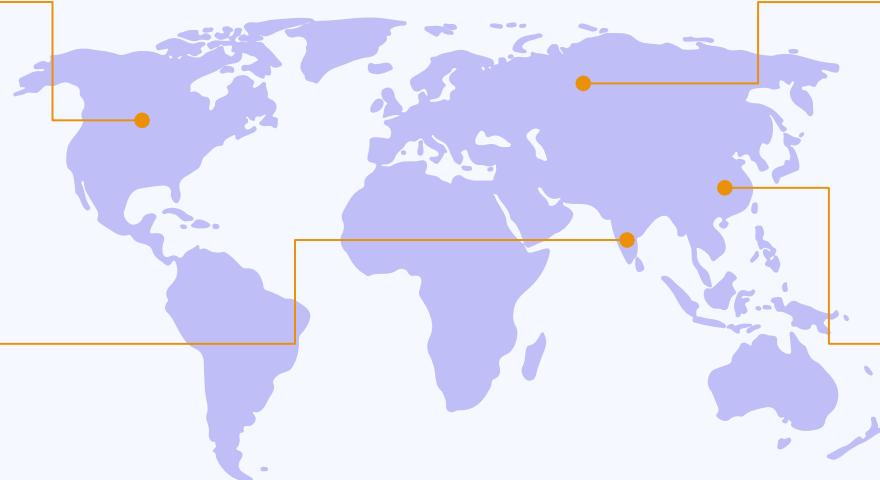
This is a map

USA

Despite being red, Mars is **very cold**

India

Jupiter is the biggest planet of them all



Russia

Neptune is the farthest planet from the Sun

China

Saturn is a **gas giant** and has several rings

Mockups

You can replace the images on the screen with your own work. Just right-click on them and select “Replace image”



Thanks!

Do you have any questions?

youremail@freepik.com

+34 654 321 432

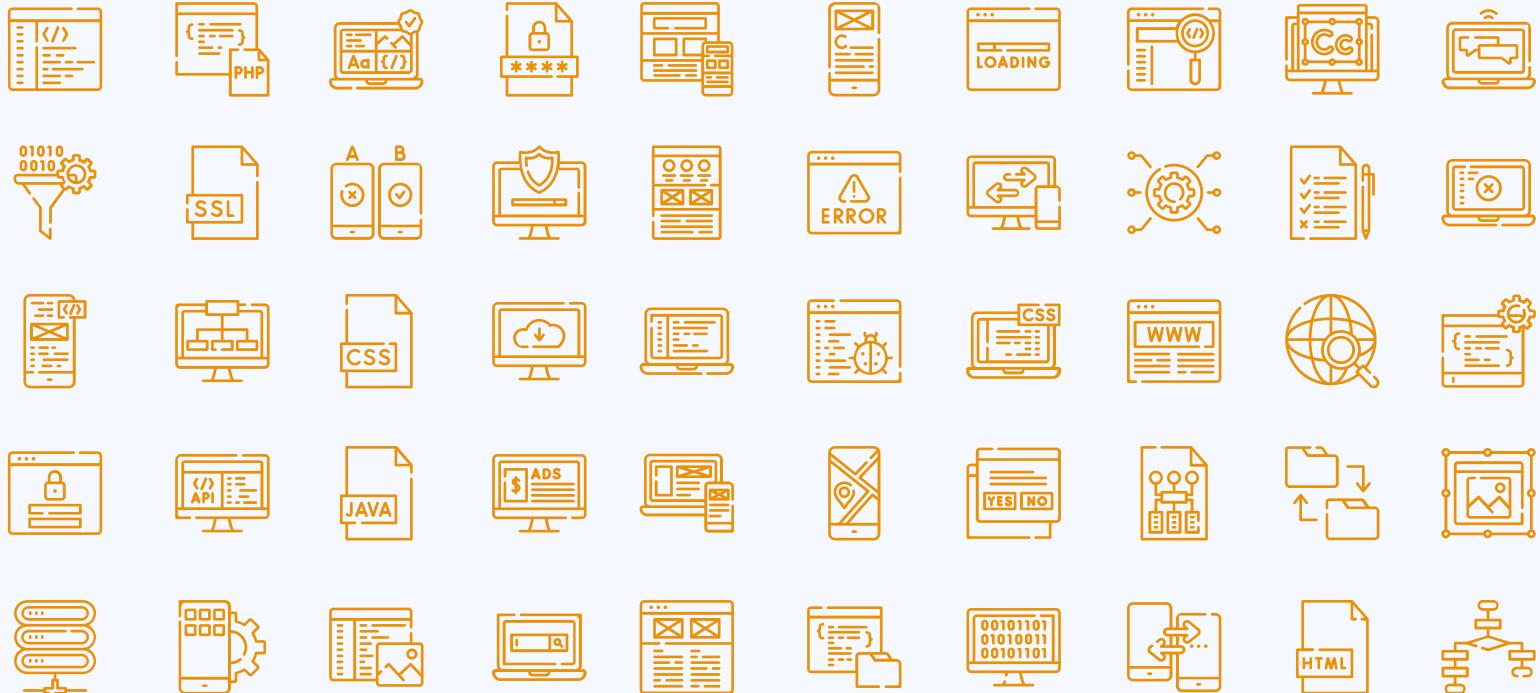
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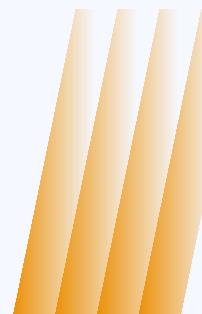
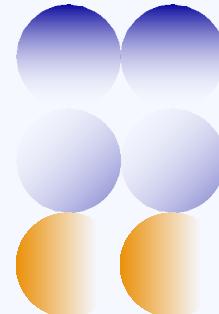
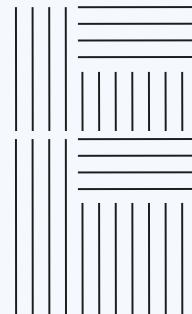
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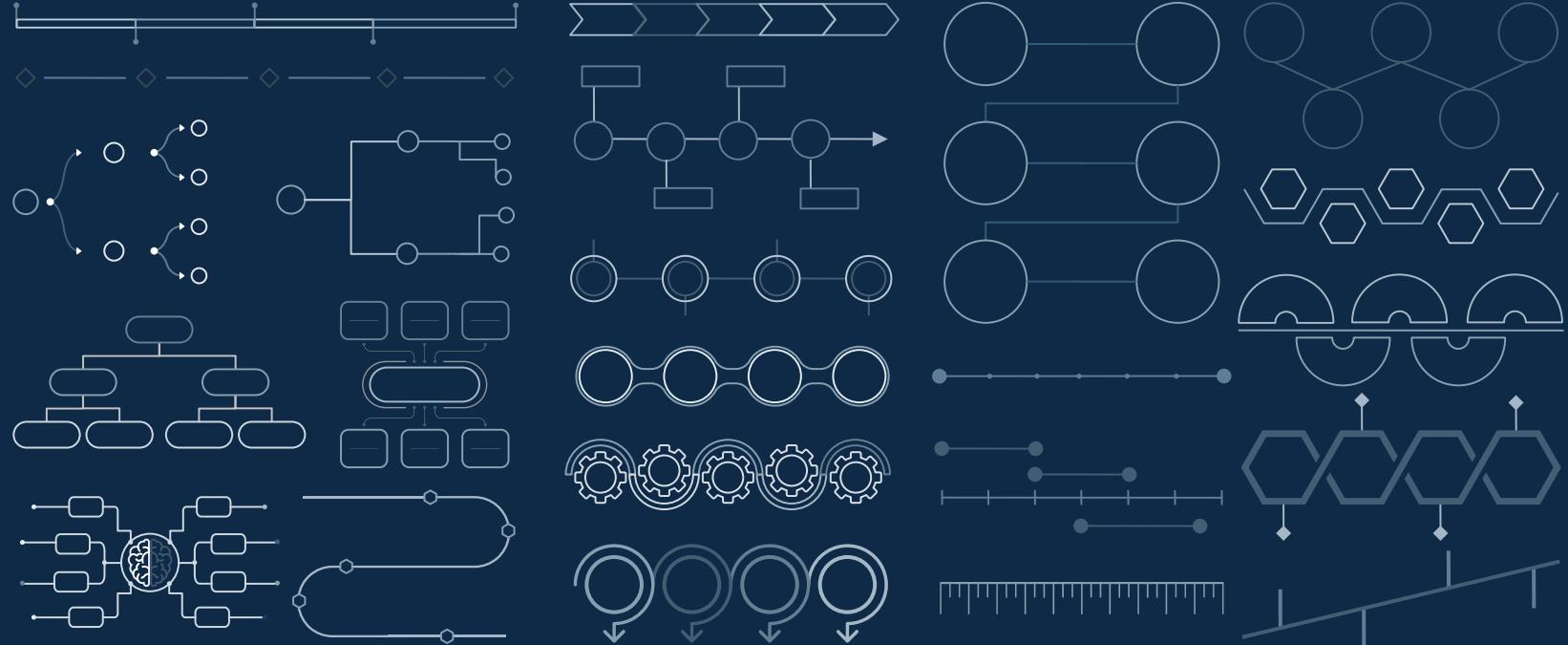
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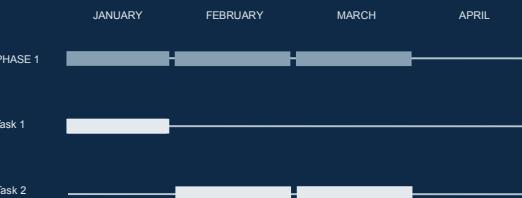
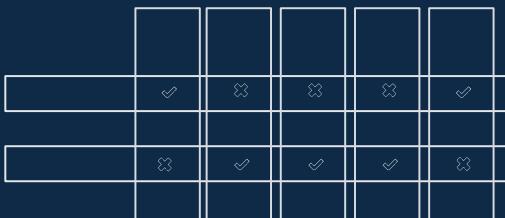
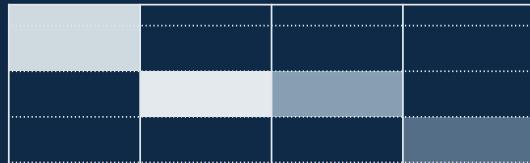
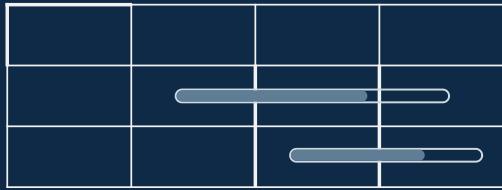
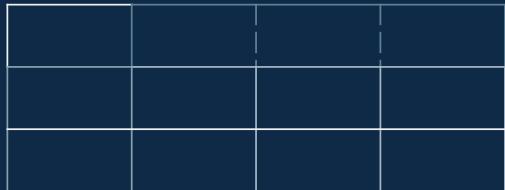
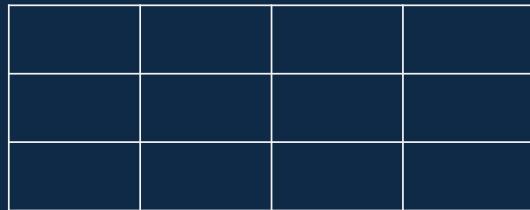
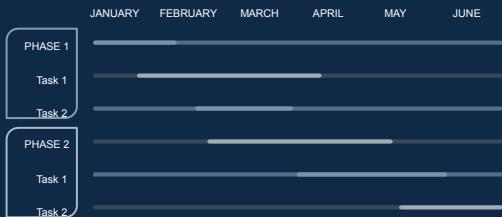
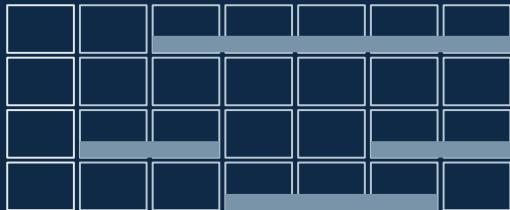
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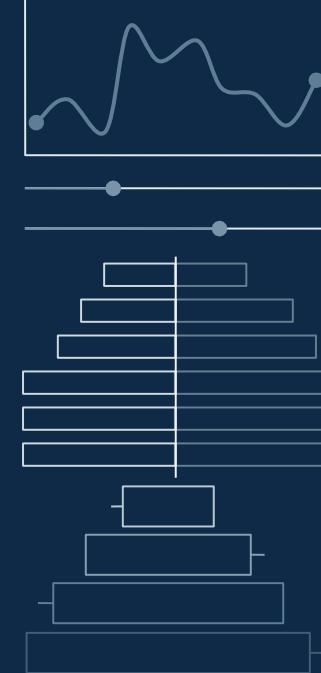
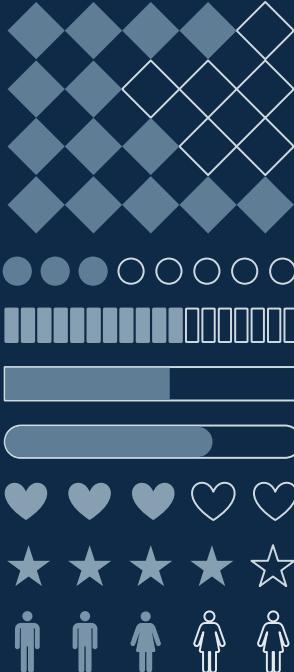
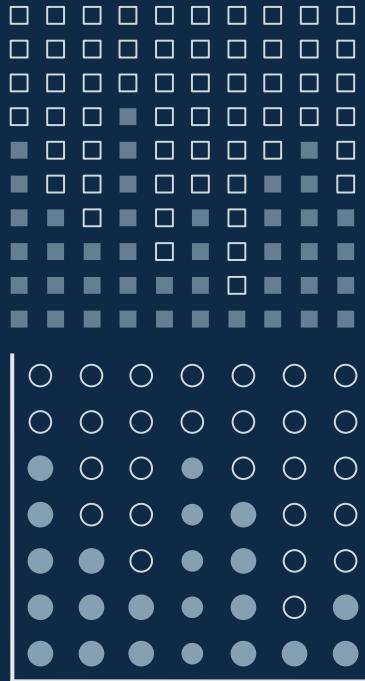












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