



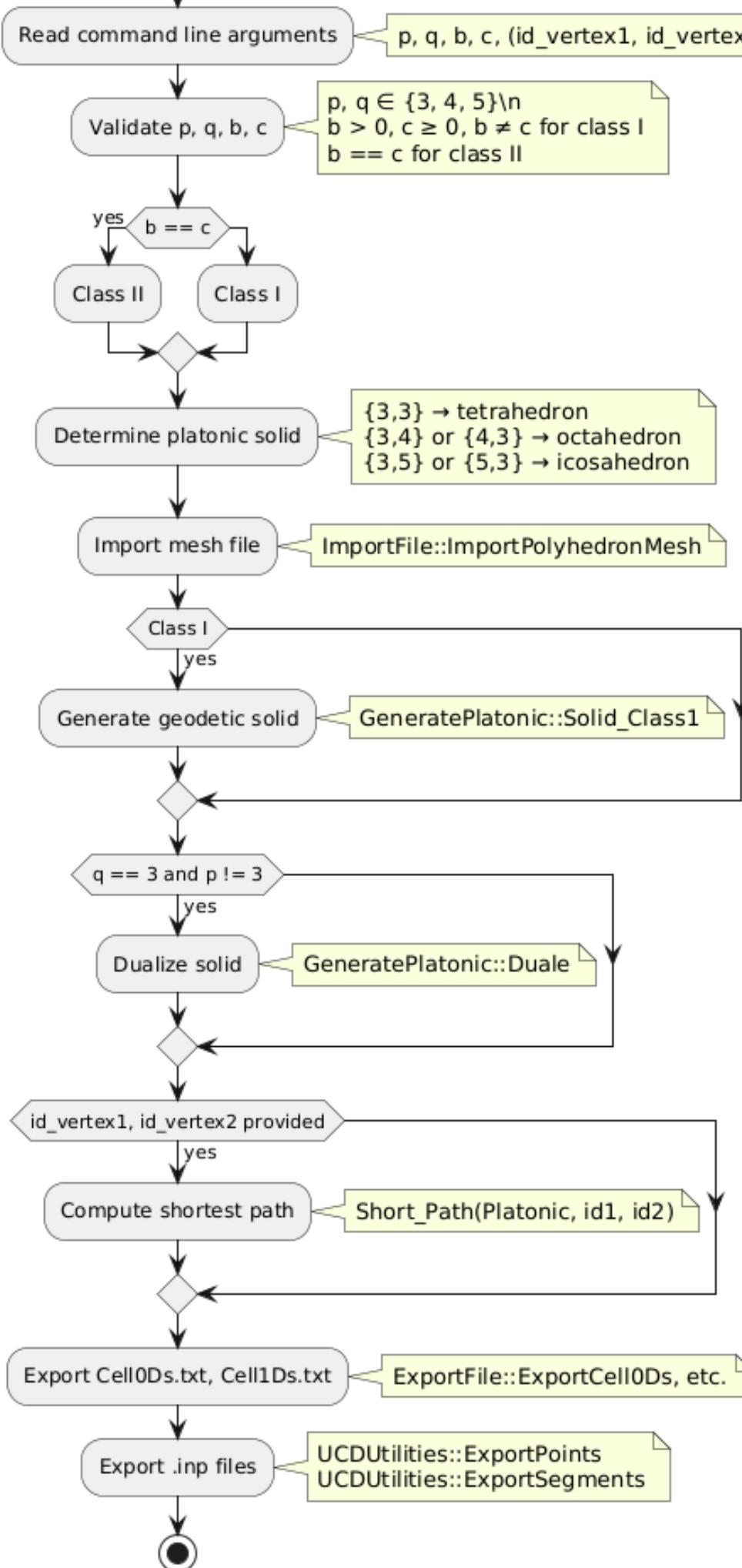
Politecnico  
di Torino

# Programmazione e calcolo scientifico

## Geodesic Polyhedra and their duals



# Program flow



```

appuser@THIS_IS_PCS_DOCKER:~/Data/esercitazione/ProgettoPCS2025/Project/Debug$ ./Project 2 3 1 0
The construction of a geodetic solid

Error: p must be in range 3,4,5
  
```

output 1: {2,3,1,0}

```

appuser@THIS_IS_PCS_DOCKER:~/Data/esercitazione/ProgettoPCS2025/Project/Debug$ ./Project 3 3 0 0
The construction of a geodetic solid

Error : b and c must be non zero integer
  
```

output 2: {3 3, 0,0}

```

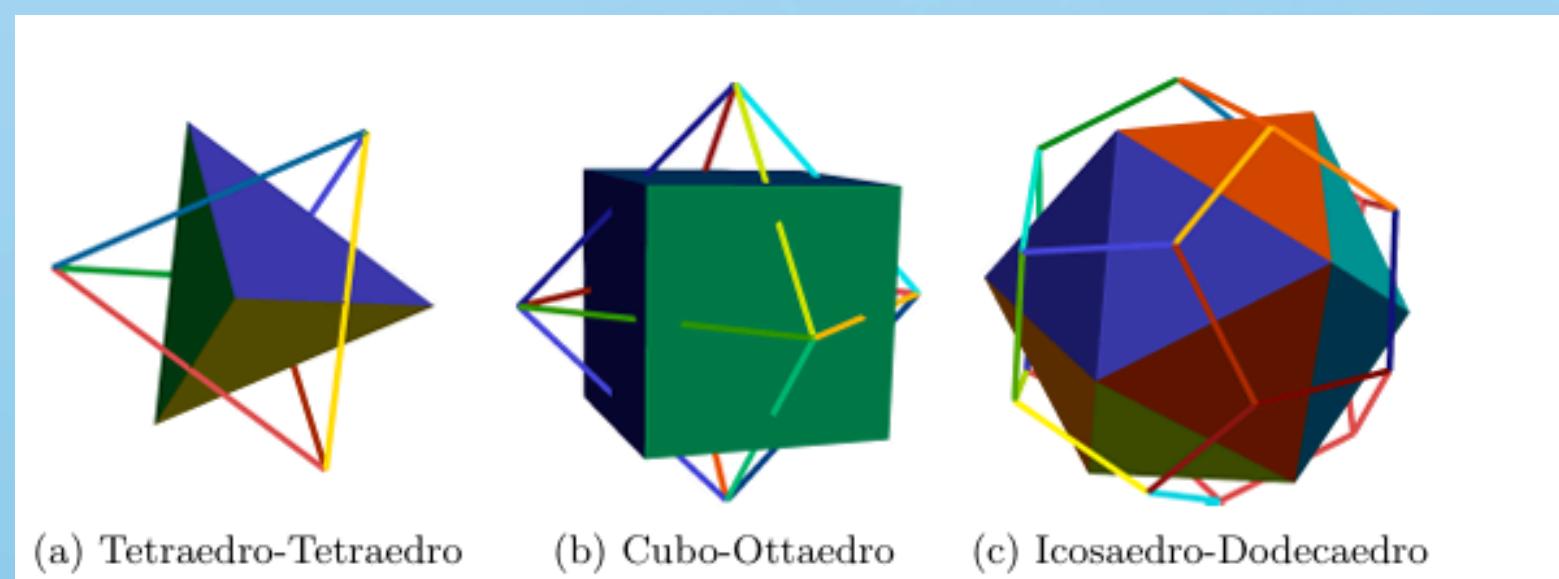
appuser@THIS_IS_PCS_DOCKER:~/Data/esercitazione/ProgettoPCS2025/Project/Debug$ ./Project 3 3 2 0 0 4
The construction of a geodetic solid

Class I
(p, q, b, c, id_vertex1, id_vertex2) = (3, 3, 2, 0, 0, 4)
The platonic polyhedron corresponding to {3,3} is a tetrahedron
Geodetic polyhedron generated.
Path: 0 2 4
The shortest path between 0 and 4 has 2 number of edges
The shortest path between 0 and 4 is 2.33362 long
Generated file: Cell0Ds.txt
Generated file: Cell1Ds.txt
Generated file: Cell2Ds.txt
Generated file: Cell3Ds.txt
Generated file: Cell0Ds.inp
Generated file: Cell1Ds.inp
  
```

output 3:

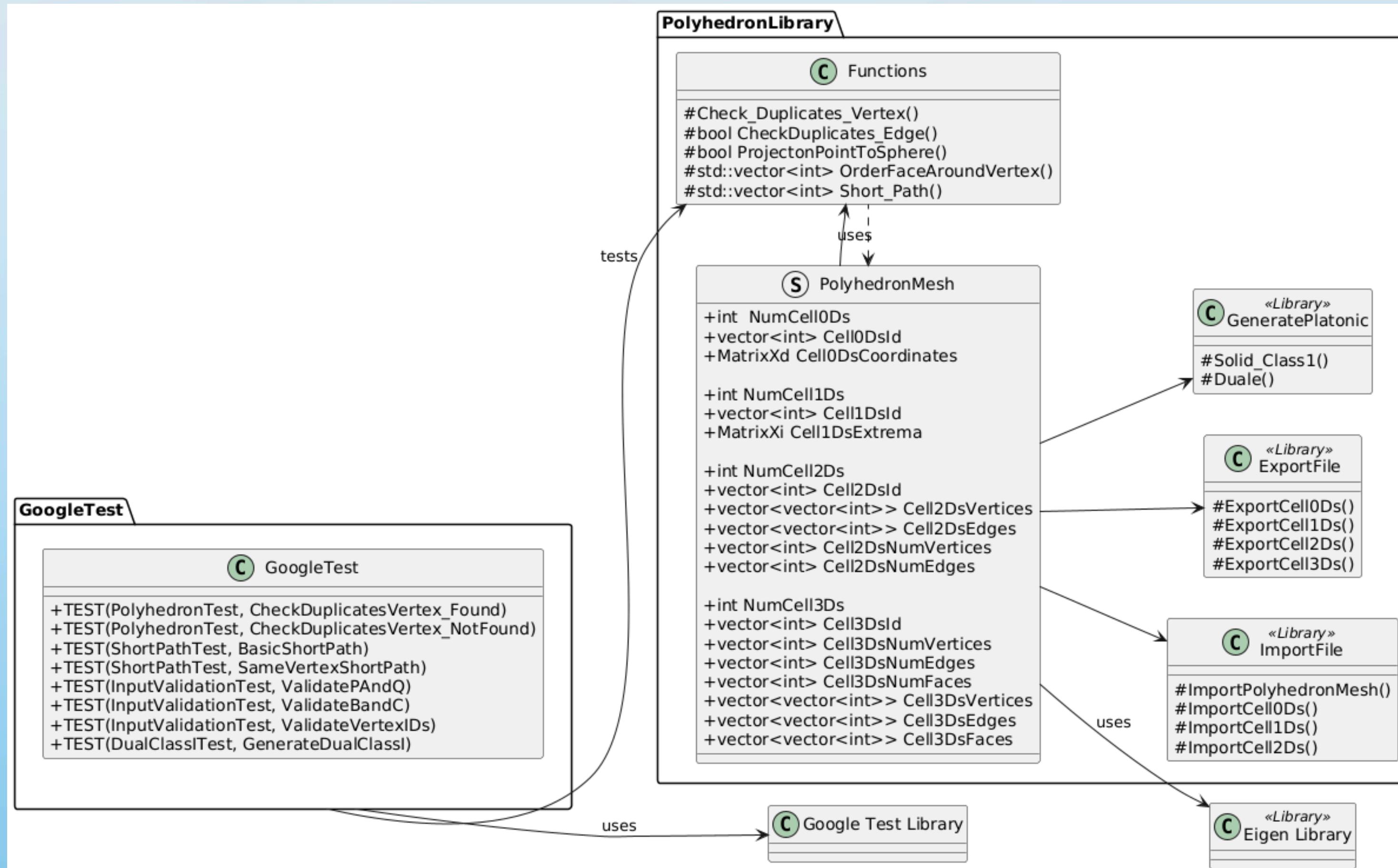
{3, 3, 2 , 0, 0, 4}

calcolo del cammino  
minimo

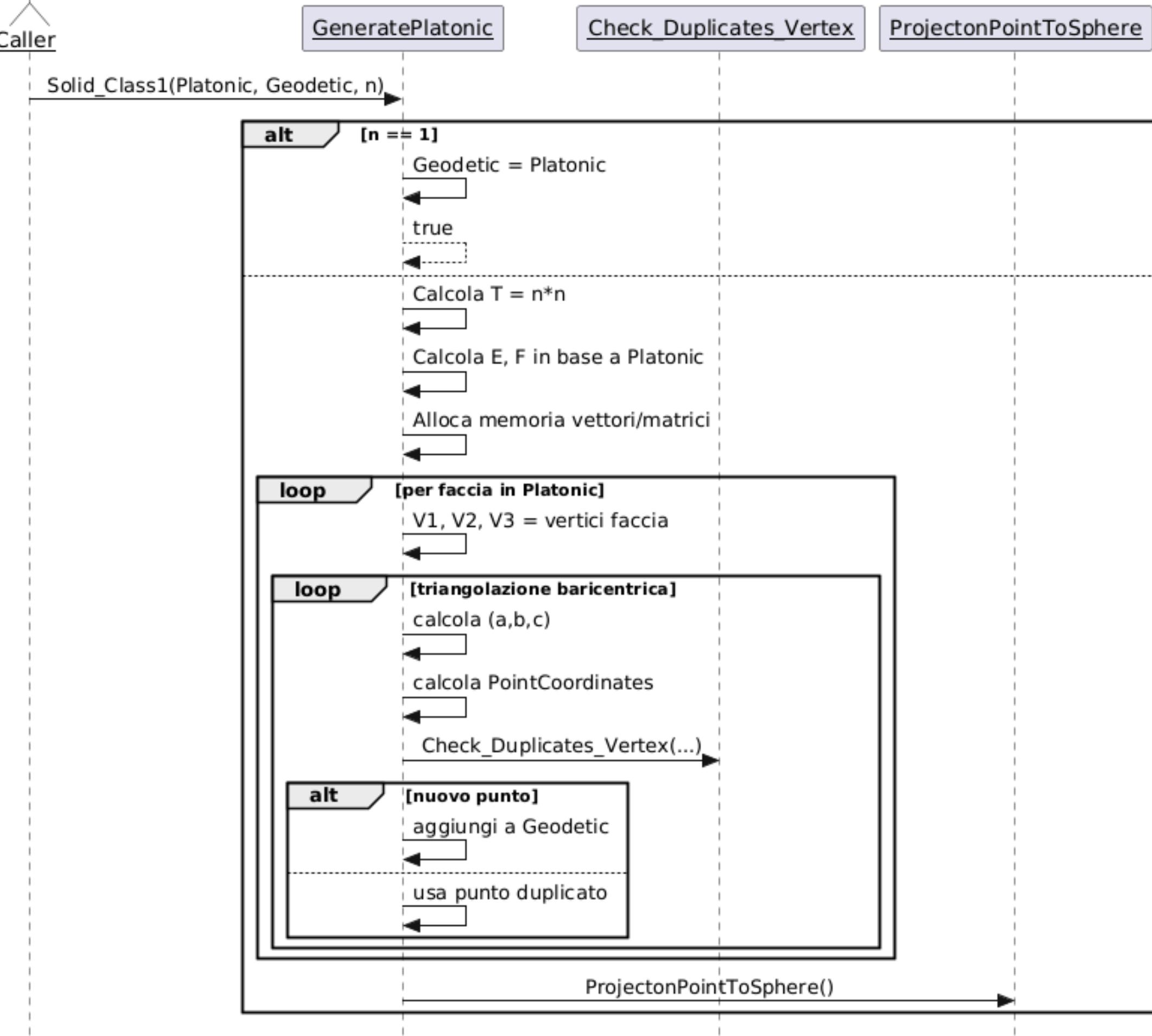
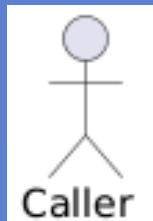


# Geodesic Polyhedra Generator

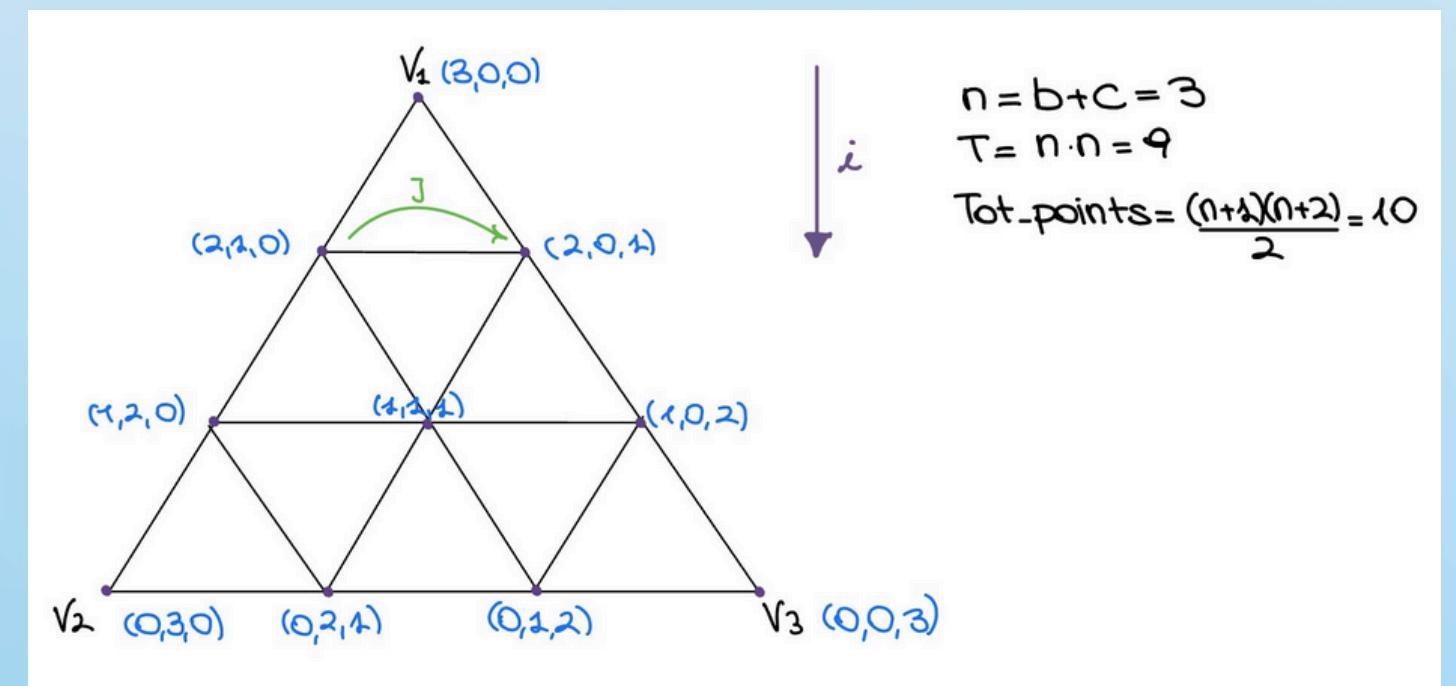
Componenti principali, librerie e test automatizzati



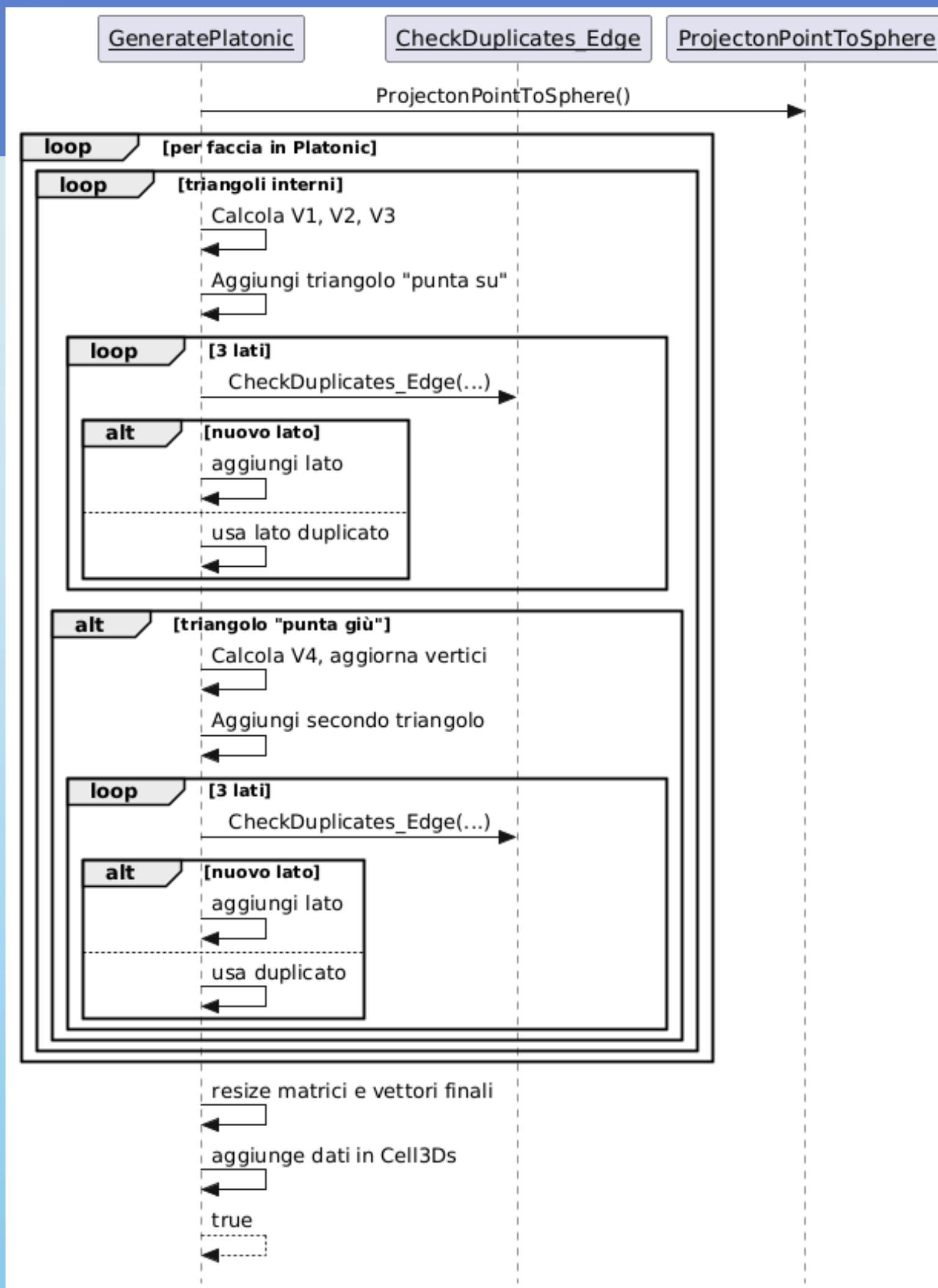
# Solid class I



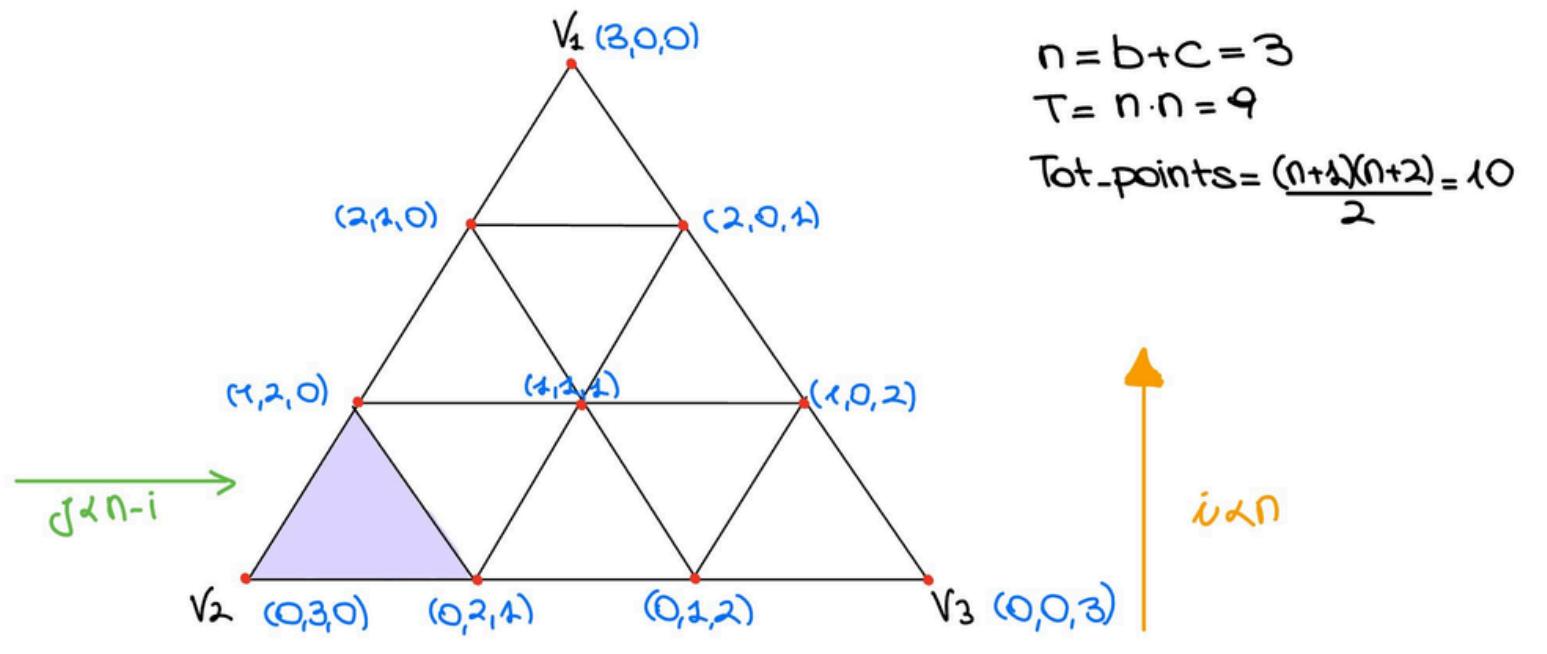
costruzione dei vertici



# Solid class I



costruzione dei lati



# Esempio output

Analizziamo il caso  $\{p, q, b, c\} = \{3, 3, 2, 0\}$

Output cell0Ds

```
Id;X;Y;Z
0;1;1;1
1;1;0;0
2;0;1;0
3;1;-1;-1
4;0;0;-1
5;-1;1;-1
6;0;0;1
7;-1;0;0
8;-1;-1;1
9;0;-1;0
```

Output cell1Ds

```
Id;Origin;End
0;3;4
1;4;1
2;1;3
3;4;5
4;5;2
5;2;4
6;1;2
7;2;0
8;0;1
9;5;7
10;7;2
11;7;8
12;8;6
13;6;7
14;2;6
15;6;0
16;7;4
17;8;9
18;9;7
19;4;9
20;9;3
21;9;1
22;6;9
23;1;6
```

Output cell2Ds

```
Id;NumVertex;Vertex;NumEdges;Edge
0;3;3;4;1;3;0;1;2;
1;3;4;5;2;3;3;4;5;
2;3;1;2;0;3;6;7;8;
3;3;1;2;4;3;6;5;1;
4;3;5;7;2;3;9;10;4;
5;3;7;8;6;3;11;12;13;
6;3;2;6;0;3;14;15;7;
7;3;2;6;7;3;14;13;10;
8;3;5;7;4;3;9;16;3;
9;3;7;8;9;3;11;17;18;
10;3;4;9;3;3;19;20;0;
11;3;4;9;7;3;19;18;16;
12;3;3;9;1;3;20;21;2;
13;3;9;8;6;3;17;12;22;
14;3;1;6;0;3;23;15;8;
15;3;1;6;9;3;23;22;21;
```

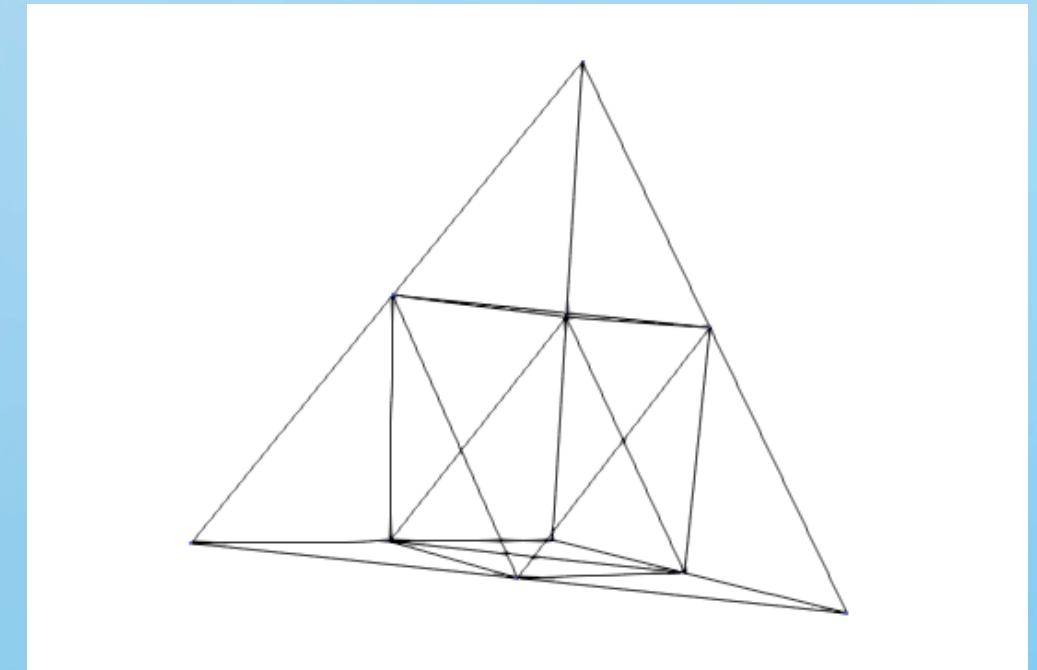
```
appuser@THIS_IS_PCS_DOCKER:~/Data/esercitazione/ProgettoPCS2025/Project/Debug$ ./Project 3 3 2 0
The construction of a geodetic solid

Class I
(p, q, b, c) = (3, 3, 2, 0)
The platonic polyhedron corresponding to {3,3} is a tetrahedron
Geodetic polyhedron generated.
Generated file: Cell0Ds.txt
Generated file: Cell1Ds.txt
Generated file: Cell2Ds.txt
Generated file: Cell3Ds.txt
Generated file: Cell0Ds.inp
Generated file: Cell1Ds.inp
```

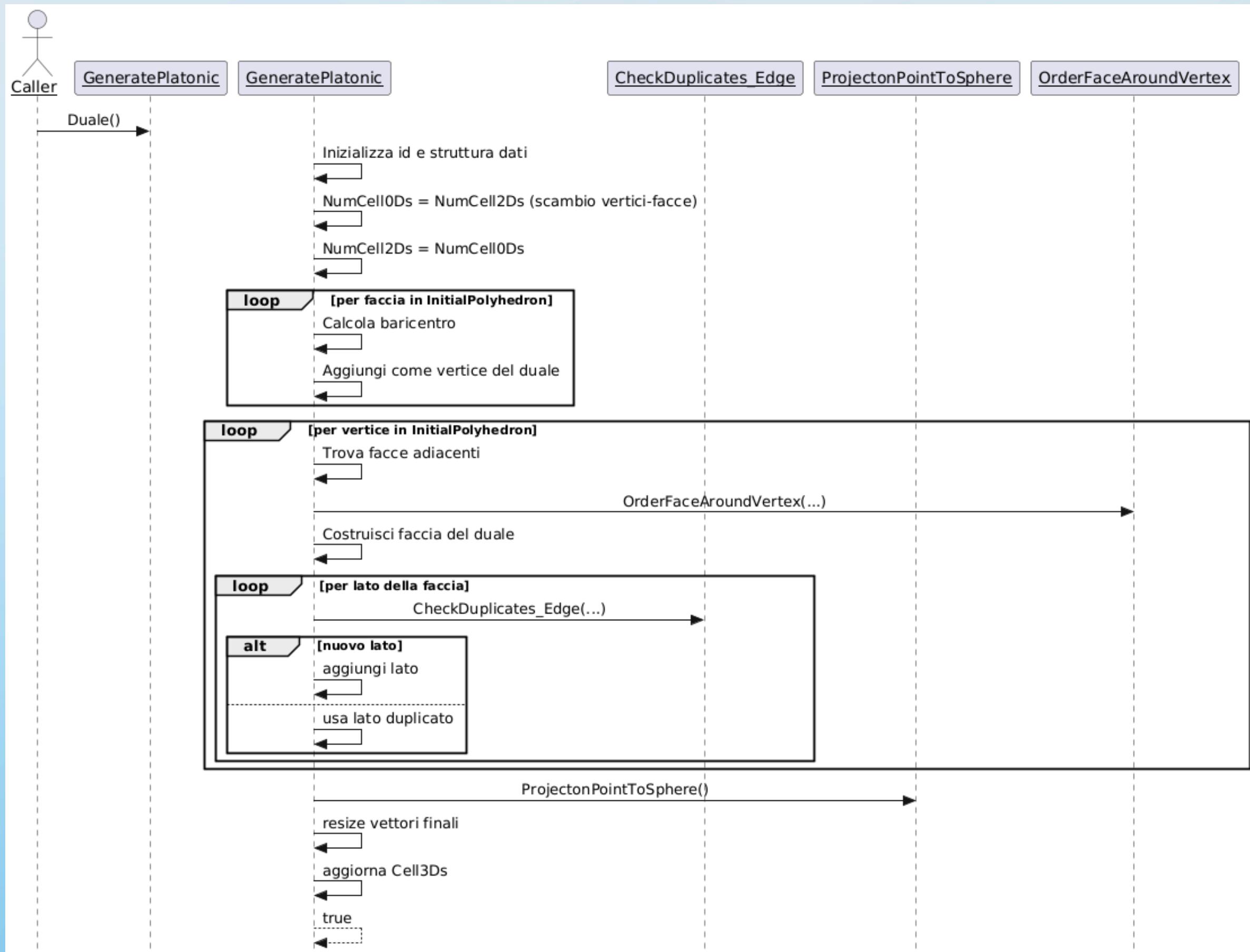
Output cell3Ds

```
Id;NumVertex;Vertex;NumEdges;Edge;NumFaces;Faces
0;10;0;1;2;3;4;5;6;7;8;9;24;0;1;2;3;4;5;6;7;8;9;10;11;12;13;
14;15;16;17;18;19;20;21;22;23;16;0;1;2;3;4;5;6;7;8;9;10;11;1;
2;13;14;15;|
```

Export su Paraview



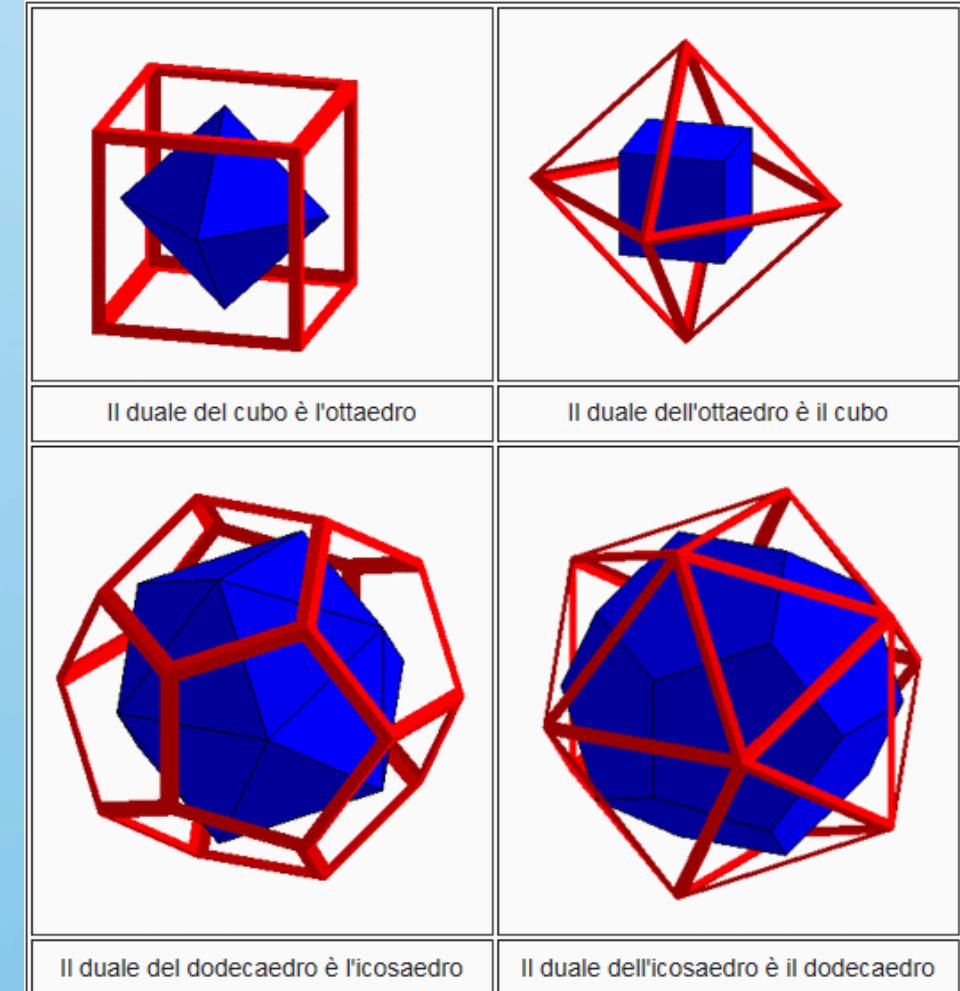
# Duale



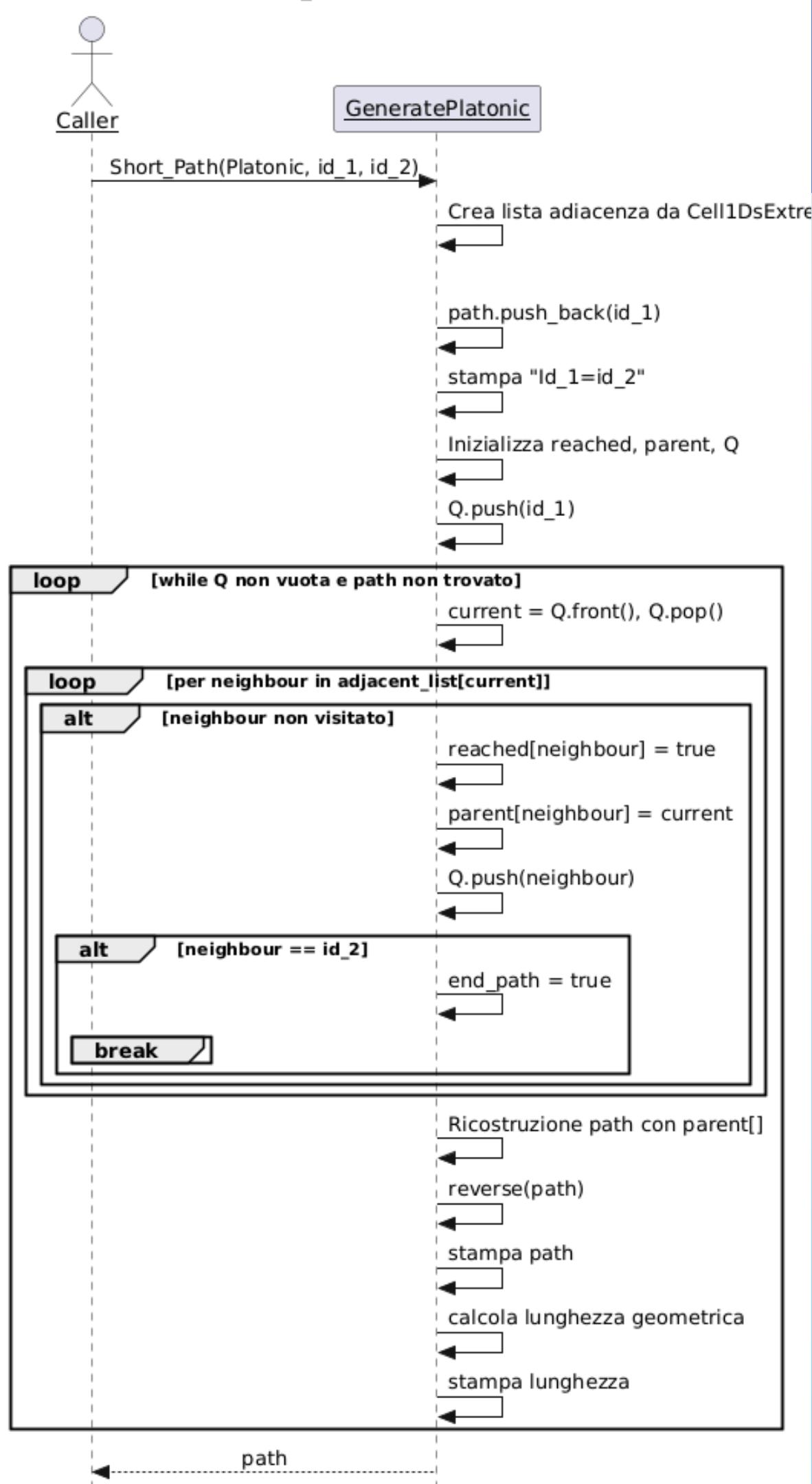
```

Class I
(p, q, b, c) = (5, 3, 2, 0)
The platonic polyhedron corresponding to {5,3} is a dodecahedron
The dodecahedron is the dual of the icosahedron
Dual polyhedron generated.
Dual mesh generated.
Generated file: Cell0Ds.txt
Generated file: Cell1Ds.txt
Generated file: Cell2Ds.txt
Generated file: Cell3Ds.txt
Generated file: Cell0Ds.inp
Generated file: Cell1Ds.inp
Generated file: Cell2Ds.inp
Generated file: Cell3Ds.inp
  
```

output {5, 3, 2, 0}  
costruzione del duale



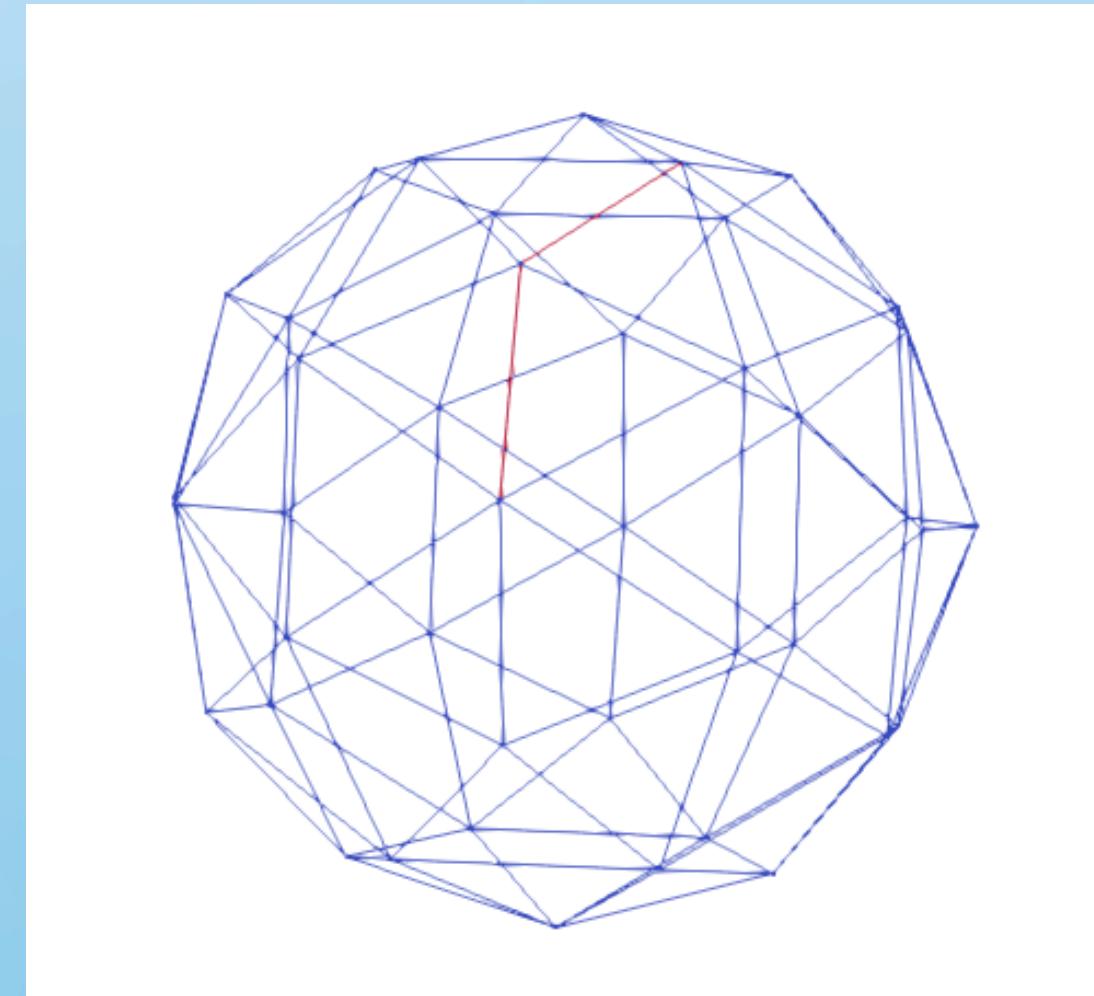
# Short Path



```

appuser@THIS_IS_PCS_DOCKER:~/Data/esercitazione/ProgettoPCS2025/Project/Debug$ ./Project 3 5 2 0 1 9 7 8
The construction of a geodetic solid

Class I
(p, q, b, c, id_vertex1, id_vertex2) = (3, 5, 2, 0, 1, 9)
The platonic polyhedron corresponding to {3,5} is an icosahedron
Geodetic polyhedron generated.
Path: 1 0 9
The shortest path between 1 and 9 has 2 number of edges
The shortest path between 1 and 9 is 1.09307 long
Generated file: Cell0Ds.txt
Generated file: Cell1Ds.txt
Generated file: Cell2Ds.txt
Generated file: Cell3Ds.txt
Generated file: Cell0Ds.inp
Generated file: Cell1Ds.inp
  
```



output {3, 5, 2 , 0, 1, 9, 7, 8}  
calcolo del cammino minimo  
(evidenziato in rosso)

# Funzioni di supporto

## Funzioni di supporto



«Controlli»

### Check\_Duplicates\_Vertex

- input: matrice (matrice delle coordinate)
- input: vector (coordinate del punto che vorrei aggiungere)
- input: vertex\_check\_id
- input: duplicate\_id
- output: bool

Verifica se il punto di coordinate vector  
è già presente in matrice.  
Se lo è, salva in duplicate\_id,  
l'id del punto già aggiunto.



«Controlli»

### CheckDuplicates\_Edge

- input: matrice, v1, v2
- input: edge\_check\_id
- input: duplicate\_id
- output: bool

Funzionamento analogo a Check\_Duplicates\_Vertex



«Proiezione sulla sfera»

### ProjectonPointToSphere

- input: vertices

Normalizza ogni punto sulla sfera unitaria.  
Preservando gli edges e le facce



«Ordinamento delle facce»

### OrderFaceAroundVertex

- input: dual\_Coordinates
- input: unordered\_faces
- output: ordered\_faces

Dato il vettore unordered\_faces di facce adiacenti attorno  
ad un vertice comune, questa funzione le riordina in modo tale  
che ogni faccia condivide un edge con la faccia successiva  
del vettore ordered\_faces.

# Solid class II

## pseudocodice

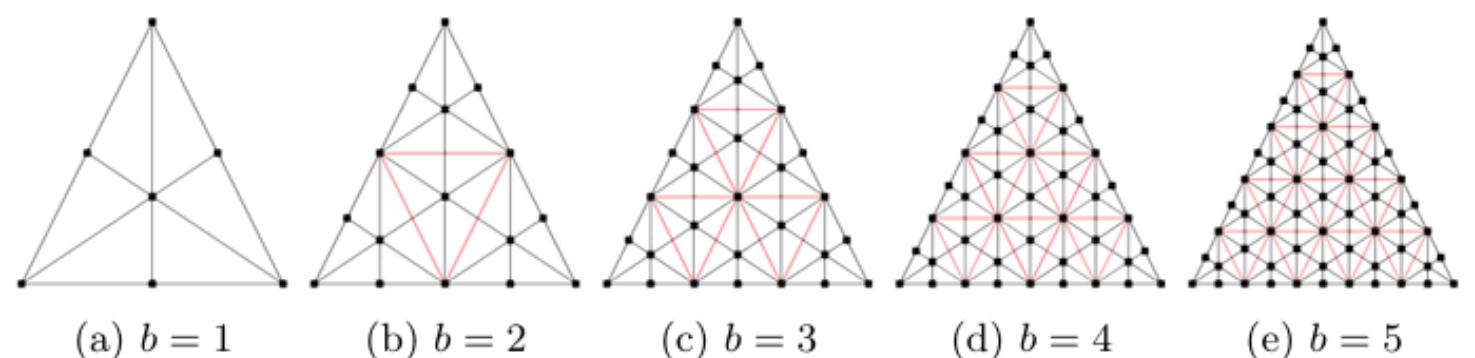
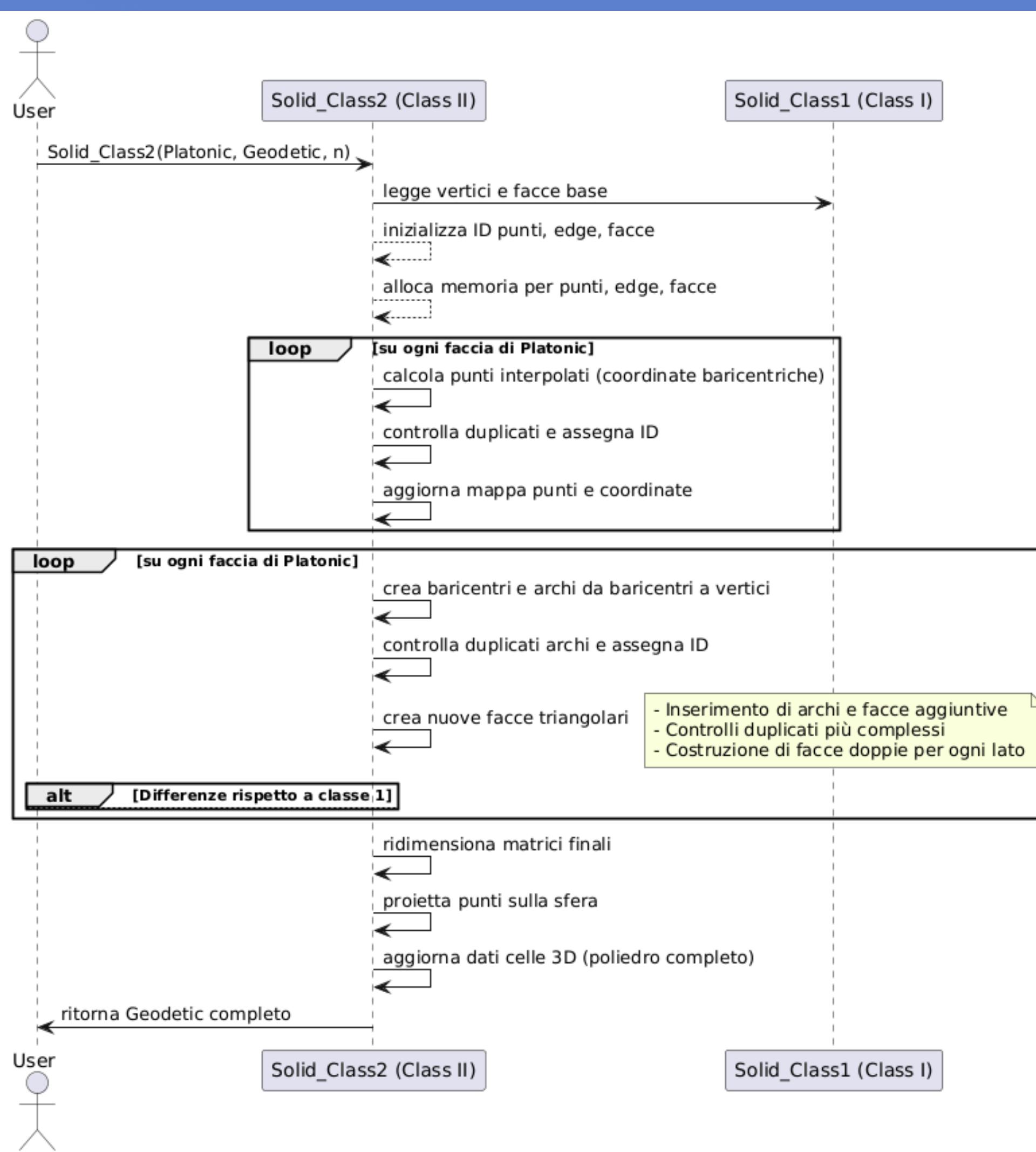


Figure 5: Triangolazione caratterizzante le facce dei poliedri geodetici di classe II, per  $c = b$ . I triangoli rossi sottostanti indicano la triangolazione relativa di classe I, con lo stesso valore per  $b$  e  $c = 0$ .

```
appuser@THIS_IS_PCS_DOCKER:~/Data/esercitazione/ProgettoPCS2025/Project/Debug$ ./Project 3 4 2 2
The construction of a geodetic solid

Class II
(p, q, b, c) = (3, 4, 2, 2)
The platonic polyhedron corresponding to {3,4} is an octahedron
Class II construction not yet implemented.
Generated file: Cell0Ds.txt
Generated file: Cell1Ds.txt
Generated file: Cell2Ds.txt
Generated file: Cell3Ds.txt
Generated file: Cell0Ds.inp
Generated file: Cell1Ds.inp
```

output {3, 4, 2, 2}



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