The initial points are shown in the google earth using the kml file (by editing the given kml starter file)

//Indication of the place marks on the google earth.

Starter.kml

```
 <?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://earth.google.com/kml/2.0">
<Document>
<Style id="z1">
<LabelStyle>
     <color>ff0000cc</color>
   </LabelStyle>
<IconStyle><Icon><href>http://www.google.com/intl/en_us/mapfiles/ms/micons/blue-dot.png</href></
Icon></IconStyle>
</Style>

<Placemark><name>Exposition/Vermont</name>
<description>Expo/Vermont is an at-grade light rail station in the Los Angeles County Metro Rail
system, located on Exposition Boulevard at Vermont Avenue, in the Exposition Park District of Los
Angeles.</description>
<styleUrl>#z1</styleUrl>
      <Point><coordinates>-118.291696,34.018531</coordinates></Point>
</Placemark>


<Placemark><name> Vermont/Jefferson</name>
<description>S Vermont Ave / W Jefferson Blvd median real estate price is $567,114, which is more
expensive than 59.0% of the neighborhoods in California and 89.9% of the neighborhoods in the
U.S.</description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.291210,34.025374</coordinates></Point>
</Placemark>

<Placemark><name>Jefferson/Figueroa</name>
<description>Chase Bank Jefferson and Figueroa branch is located at 3335 S Figueroa St, Ste N, Los
Angeles, CA 90007. </description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.280317,34.022256</coordinates></Point>
</Placemark>

<Placemark><name>Figueroa/Exposition</name>
<description>Exposition & Figueroa. 3726 S. Figueroa Street Los Angeles CA 90007 USA</
description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.282270, 34.018619</coordinates></Point>
</Placemark>

<Placemark><name>USC Viterbi</name>
<description>The Viterbi School of Engineering is located at the University of Southern California in
the United States. It was renamed following a $52 million donation by Andrew Viterbi</description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.288818, 34.020404</coordinates></Point>
</Placemark>

<Placemark><name>Doheny Library</name>
<description>The Edward L. Doheny Jr. Memorial Library is a library located in the center of campus
at the University of Southern California.</description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.283737, 34.020180</coordinates></Point>
</Placemark>

<Placemark><name>Taper Hall</name>
<description>Mark Taper Hall of Humanities is a building within California and is nearby to Saint
James Park and Jefferson</description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.284540,34.022196</coordinates></Point>
</Placemark>
```

<Placemark><name>Salvatori Centre</name>
<description>Salvatori Computer Science Center in Los Angeles</description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.289452,34.019485</coordinates></Point>
</Placemark>

<Placemark><name>Troy Hall</name>
<description>Troy Hall is home to the new Master's Village for first year graduate students, a two building complex offering a variety of affordable room</description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.282,34.0251155</coordinates></Point>
</Placemark>

</Document></kml>

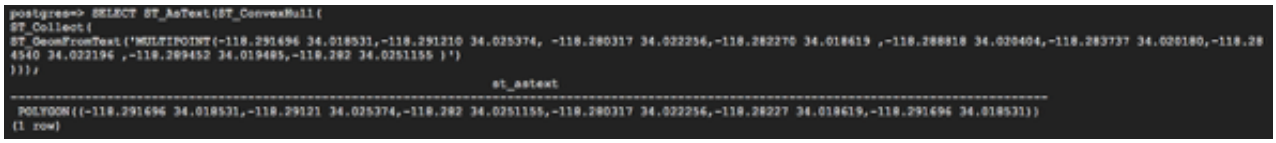
Convex Hull

Postgres is used in executing the queries.
Google cloud platform is used to execute the queries.

Query:

```
Select AT_AsText(ST_ConvexHull(
ST_Collect(
ST_GeomFromText('MULTIPOINT(-118.291696 34.018531, -118.291210 34.025374, -118.280317
34.022256, -118.282270 34.018619,-118.288818 34.020404, -118.283737 34.020180, -118.284540
34.022196, -118.289452 34.019485, -118.282 34.0151155)'))));
```

Screenshot of the executed query with input and output.



Screenshot of kml file in Google Earth

ConvexHull.kml

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://earth.google.com/kml/2.0">
<Document>

 <Style id="z1">
<LabelStyle>
     <color>ffffffccc</color>
   </LabelStyle>
<IconStyle><Icon><href>http://www.google.com/intl/en_us/mapfiles/ms/micons/blue-dot.png</href></
Icon></IconStyle>
</Style>

 <description>Convex Hull</description>
   <Placemark id="c1">
      <name>convex path</name>
      <styleUrl>#z1</styleUrl>
       <LineString>
         <coordinates>
         -118.2916,34.018531,0
         -118.2912,34.025374,0
         -118.2820,34.025115,0
         -118.2803,34.022256,0
         -118.2822,34.018619,0
         -118.2916,34.018531,0
         </coordinates>
      </LineString>

   </Placemark>

<Placemark><name>Exposition/Vermont</name>
<description>Expo/Vermont is an at-grade light rail station in the Los Angeles County Metro Rail
system, located on Exposition Boulevard at Vermont Avenue, in the Exposition Park District of Los
Angeles.</description>
<styleUrl>#z1</styleUrl>
      <Point><coordinates>-118.291696,34.018531</coordinates></Point>
</Placemark>


<Placemark><name> Vermont/Jefferson</name>
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U.S.</description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.291210,34.025374</coordinates></Point>
</Placemark>

<Placemark><name>Jefferson/Figueroa</name>
<description>Chase Bank Jefferson and Figueroa branch is located at 3335 S Figueroa St, Ste N, Los
Angeles, CA 90007. </description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.280317,34.022256</coordinates></Point>
</Placemark>

<Placemark><name>Figueroa/Exposition</name>
<description>Exposition & Figueroa. 3726 S. Figueroa Street Los Angeles CA 90007 USA</
description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.282270, 34.018619</coordinates></Point>
</Placemark>

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<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.288818, 34.020404</coordinates></Point>
</Placemark>
```

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</Placemark>

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<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.284540,34.022196</coordinates></Point>
</Placemark>

<Placemark><name>Salvatori Centre</name>
<description>Salvatori Computer Science Center in Los Angeles</description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.289452,34.019485</coordinates></Point>
</Placemark>

<Placemark><name>Troy Hall</name>
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<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.282,34.0251155</coordinates></Point>
</Placemark>

</Document>

</kml>

Three Nearest Neighbours

For Computing three nearest neighbours, Troy Hall(Home) is taken as the focal point to which the three neighbours are nearby.

ScreenShot of the Query execution:
A table is created and the values are inserted into the table.

```
postgres=> select * from spatial_db;
        name         |                          pt_shape
---------------------+------------------------------------------------------------
 Exposition/vermont  | 0101000020E6100000F017B325AB925DC0297B4B395F024140
 Vermont/Jefferson   | 0101000020E61000002A91442FA3925DC098158A743F034140
 Jefferson/Figueroa  | 0101000020E6100000D2E0B6B6F0915DC0E411DC48D9024140
 Figueroa/Exposition | 0101000020E610000015A930B610925DC0C80A7E1B62024140
 USC Viterbi         | 0101000020E6100000C11F7EFE7B925DC0925A28999C024140
 Doheny Library      | 0101000020E610000092EA3BBF28925DC043041C4295024140
 Taper Hall          | 0101000020E6100000D99942E735925DC00F0D8B51D7024140
 Salvatori Centre    | 0101000020E6100000C170AE6186925DC09CE1067C7E024140
 Troy Hall           | 0101000020E6100000355EBA490C925DC0B48F15FC36034140
(9 rows)
```

Table creation Commands:

```
create table spatial_db( name varchar(61) );

select AddGeometryColumn('spatial_db','pt_shape', 4326, 'POINT',2);
```

Insertion:

```
insert into spatial_db (name, pt_shape) values ('Exposition/vermont' ,
ST_GeomFromText('Point(-118.291696,34.018531)', 4326));

insert into spatial_db (name, pt_shape) values ('Vermont/Jefferson' ,
ST_GeomFromText('Point(-118.291210,34.025374)', 4326));

insert into spatial_db (name, pt_shape) values ('Jefferson/Figueroa' ,
ST_GeomFromText('Point(-118.280317,34.022256)', 4326));

insert into spatial_db (name, pt_shape) values ('Figueroa/Exposition' ,
ST_GeomFromText('Point(-118.282270,34.018619)', 4326));

insert into spatial_db (name, pt_shape) values ('USC Viterbi' ,
 ST_GeomFromText('Point(-118.288818, 34.020404)', 4326));

insert into spatial_db (name, pt_shape) values ('Doheny Library' ,
ST_GeomFromText('Point(-118.283737, 34.020180)', 4326));

insert into spatial_db (name, pt_shape) values ('Taper Hall' ,
ST_GeomFromText('Point(-118.284540,34.022196)', 4326));

insert into spatial_db (name, pt_shape) values ('Salvatori Centre' ,
ST_GeomFromText('Point(-118.289452,34.019485)', 4326));

insert into spatial_db (name, pt_shape) values ('Troy Hall' ,
ST_GeomFromText('Point(-118.282,34.0251155)', 4326));
```

Query

```
select name, ST_AsText(pt_shape)
from spatial_db
ORDER BY spatial_db.pt_shape <-> ST_GeomFromText('Point (-118.282 34.0251155)', 4326)
LIMIT 4;
```

Screenshot of Executed Query and O/P

```
postgres=> select name,ST_AsText(pt_shape)
from spatial_db
ORDER BY spatial_db.pt_shape <-> ST_GeomFromText('Point(-118.282 34.0251155)',4326)
LIMIT 4;
        name         |           st_astext
---------------------+-------------------------------
 Troy Hall           | POINT(-118.282 34.0251155)
 Jefferson/Figueroa  | POINT(-118.280317 34.022256)
 Taper Hall          | POINT(-118.28454 34.022196)
 Doheny Library      | POINT(-118.283737 34.02018)
(4 rows)
```

3NN.kml

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://earth.google.com/kml/2.0">
<Document>

<description>3 N N </description>
   <Placemark id="n1">
      <LineString>
         <coordinates>
         -118.282000,34.0251155,0
         -118.280317,34.0222560,0
         </coordinates>
      </LineString>
   </Placemark>

   <Placemark id="n2">
      <LineString>
         <coordinates>
         -118.282000,34.0251155,0
         -118.284540,34.0221960,0
         </coordinates>
      </LineString>
   </Placemark>

   <Placemark id="n3">
      <LineString>
         <coordinates>
         -118.282000,34.0251155,0
         -118.283737,34.0201800,0
         </coordinates>
      </LineString>
   </Placemark>


   <Placemark><name>Exposition/Vermont</name>
<description>Expo/Vermont is an at-grade light rail station in the Los Angeles County Metro Rail system, located on Exposition Boulevard at Vermont Avenue, in the Exposition Park District of Los Angeles.</description>
<styleUrl>#z1</styleUrl>
      <Point><coordinates>-118.291696,34.018531</coordinates></Point>
</Placemark>


<Placemark><name> Vermont/Jefferson</name>
<description>S Vermont Ave / W Jefferson Blvd median real estate price is $567,114, which is more expensive than 59.0% of the neighborhoods in California and 89.9% of the neighborhoods in the U.S.</description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.291210,34.025374</coordinates></Point>
</Placemark>

<Placemark><name>Jefferson/Figueroa</name>
<description>Chase Bank Jefferson and Figueroa branch is located at 3335 S Figueroa St, Ste N, Los Angeles, CA 90007. </description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.280317,34.022256</coordinates></Point>
</Placemark>

<Placemark><name>Figueroa/Exposition</name>
<description>Exposition & Figueroa. 3726 S. Figueroa Street Los Angeles CA 90007 USA</description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.282270, 34.018619</coordinates></Point>
</Placemark>

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<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.288818, 34.020404</coordinates></Point>
```

</Placemark>

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<Point><coordinates>-118.284540,34.022196</coordinates></Point>
</Placemark>

<Placemark><name>Salvatori Centre</name>
<description>Salvatori Computer Science Center in Los Angeles</description>
<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.289452,34.019485</coordinates></Point>
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<styleUrl>#z1</styleUrl>
<Point><coordinates>-118.282,34.0251155</coordinates></Point>
</Placemark>
</Document>

</kml>

Screenshot of kml file on Google Earth:

Spirograph:

The given code is edited as required.

Point Generation Code in C:

```
#include <stdio.h>
#include <math.h>

int main(void)
{
   double R = 5.0;
   double r = 1.0;
   double a = 4.0;
   double x1 = R + r - a;
   double y1 = 0;

   double pie = 3.14159;
   int nReverse = 10;

   for(double t = 0.0; t < (pie*nReverse); t+=0.01){
      double x2 = (R+r)*cos((r/R)*t) - a*cos((1+r/R)*t);
      double y2 = (R+r)*sin((r/R)*t) - a*sin((1+r/R)*t);

      double p1 = -118.289144;
      double p2 = 34.021259;

      printf("%lf,",(x2)+p1 );
      printf("%lf,",(y2)+p2);
      printf("\n");
   }


}
```

Screenshot of execution and O/P