

## 任务目标：读取高精度地图数据，实现路径规划算法

### 任务分解：

#### 1、使用 protobuf 读取地图文件

#### 运行结果

```
user@user-virtual-machine:~/Desktop/protobuf-3.14.0/example/apollo-v7.0.0$ ./readbasemap base_map.bin
Found 12 junctions in base_map.bin
Junction ID: 195
x:101.621 y:-324.589 z:0
x:94.4182 y:-317.302 z:0
x:90.4182 y:-317.303 z:0
x:86.4182 y:-317.303 z:0
x:79.4153 y:-324.577 z:0
x:79.4111 y:-332.577 z:0
x:101.617 y:-332.589 z:0

Junction ID: 26
x:168.084 y:4.04306 z:0
x:144.956 y:4.04553 z:0
x:144.956 y:0.0455306 z:0
x:144.955 y:-3.95447 z:0
x:152.067 y:-10.7046 z:0
x:156.067 y:-10.7097 z:0
x:160.067 y:-10.7146 z:0
x:168.083 y:-3.95694 z:0

Junction ID: 111
x:340.858 y:-69.0344 z:0
x:340.872 y:-46.4185 z:0
x:332.872 y:-46.4136 z:0
x:325.627 y:-53.4713 z:0
x:325.627 y:-57.4713 z:0
x:325.628 y:-61.4713 z:0
x:332.858 y:-69.0295 z:0

Junction ID: 184
x:86.377 y:-46.1543 z:0
x:86.3804 y:-68.1543 z:0
x:94.3804 y:-68.1531 z:0
x:101.391 y:-61.4987 z:0
x:101.39 y:-57.4987 z:0
x:101.39 y:-53.4987 z:0
x:94.377 y:-46.153 z:0

Junction ID: 60
x:325.724 y:-332.61 z:0
x:347.731 y:-332.61 z:0
x:347.731 y:-328.61 z:0
x:347.731 y:-324.61 z:0
x:340.708 y:-317.455 z:0
x:336.708 y:-317.452 z:0
x:332.708 y:-317.45 z:0
x:325.724 y:-324.61 z:0

Junction ID: 77
x:102.693 y:4.04987 z:0
x:79.3749 y:4.04227 z:0
x:79.3762 y:0.0422747 z:0
x:79.3775 y:-3.95773 z:0
x:86.3716 y:-10.6673 z:0
x:90.3716 y:-10.667 z:0
x:94.3716 y:-10.6664 z:0
x:102.696 y:-3.95013 z:0
```

```
Junction ID: 94
x:340.774 y:-209.159 z:0
x:340.788 y:-185.655 z:0
x:332.788 y:-185.65 z:0
x:325.67 y:-193.159 z:0
x:325.67 y:-197.159 z:0
x:325.669 y:-201.159 z:0
x:332.774 y:-209.155 z:0

Junction ID: 43
x:325.63 y:4.01132 z:0
x:325.626 y:-3.98868 z:0
x:332.893 y:-10.7911 z:0
x:336.893 y:-10.7938 z:0
x:340.893 y:-10.7962 z:0
x:348.228 y:-4.00068 z:0
x:348.232 y:3.99932 z:0

Junction ID: 128
x:86.3983 y:-186.326 z:0
x:86.4017 y:-208.326 z:0
x:94.4017 y:-208.325 z:0
x:101.424 y:-201.141 z:0
x:101.425 y:-197.141 z:0
x:101.425 y:-193.141 z:0
x:94.3983 y:-186.325 z:0

Junction ID: 167
x:152.024 y:-46.1923 z:0
x:144.988 y:-53.4933 z:0
x:144.988 y:-61.4933 z:0
x:167.173 y:-61.4906 z:0
x:167.172 y:-53.4906 z:0
x:160.024 y:-46.2023 z:0
x:156.024 y:-46.1972 z:0

Junction ID: 139
x:340.813 y:-143.669 z:0
x:340.827 y:-120.579 z:0
x:332.827 y:-120.575 z:0
x:325.636 y:-127.515 z:0
x:325.636 y:-131.515 z:0
x:325.634 y:-135.515 z:0
x:332.813 y:-143.664 z:0

Junction ID: 156
x:86.3882 y:-119.836 z:0
x:86.3916 y:-141.836 z:0
x:94.3916 y:-141.835 z:0
x:101.418 y:-135.415 z:0
x:101.42 y:-131.415 z:0
x:101.421 y:-127.415 z:0
```

```

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x:144.956 y:0.0455306 z:0
x:144.955 y:-3.95447 z:0
x:152.067 y:-10.7046 z:0
x:156.067 y:-10.7097 z:0
x:160.067 y:-10.7166 z:0
x:168.083 y:-3.95694 z:0

Junction ID: 111
x:340.858 y:-69.0344 z:0
x:340.872 y:-46.4185 z:0
x:332.872 y:-46.4136 z:0
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x:86.3804 y:-68.1543 z:0
x:94.3804 y:-68.1531 z:0
x:101.391 y:-61.4987 z:0
x:101.39 y:-57.4987 z:0
x:101.39 y:-53.4987 z:0
x:94.377 y:-46.153 z:0

Junction ID: 60
x:325.724 y:-332.61 z:0
x:347.731 y:-332.61 z:0
x:347.731 y:-328.61 z:0
x:347.731 y:-324.61 z:0
x:340.708 y:-317.455 z:0
x:336.708 y:-317.452 z:0
x:332.708 y:-317.45 z:0
x:325.724 y:-324.61 z:0

Junction ID: 77
x:102.693 y:4.04987 z:0
x:79.3749 y:4.04227 z:0
x:79.3762 y:0.0422747 z:0
x:79.3775 y:-3.95773 z:0
x:86.3716 y:-10.6673 z:0
x:90.3716 y:-10.667 z:0
x:94.3716 y:-10.6664 z:0
x:102.696 y:-3.95013 z:0

```

2、设计数据结构，对读取后的地图数据进行存放，构建 kd-tree

运行结果

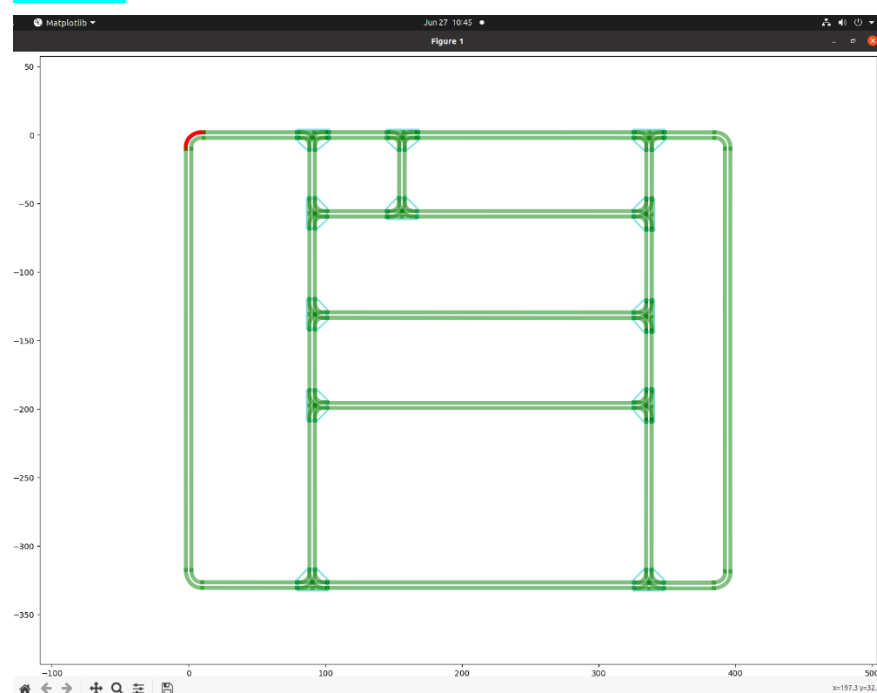
```

please enter coordinates: 1 1
the test node is: (1 1)
the nearest node is: (0.395319, 0.821531)
the nearest node's lane id is: 13_1_1

```

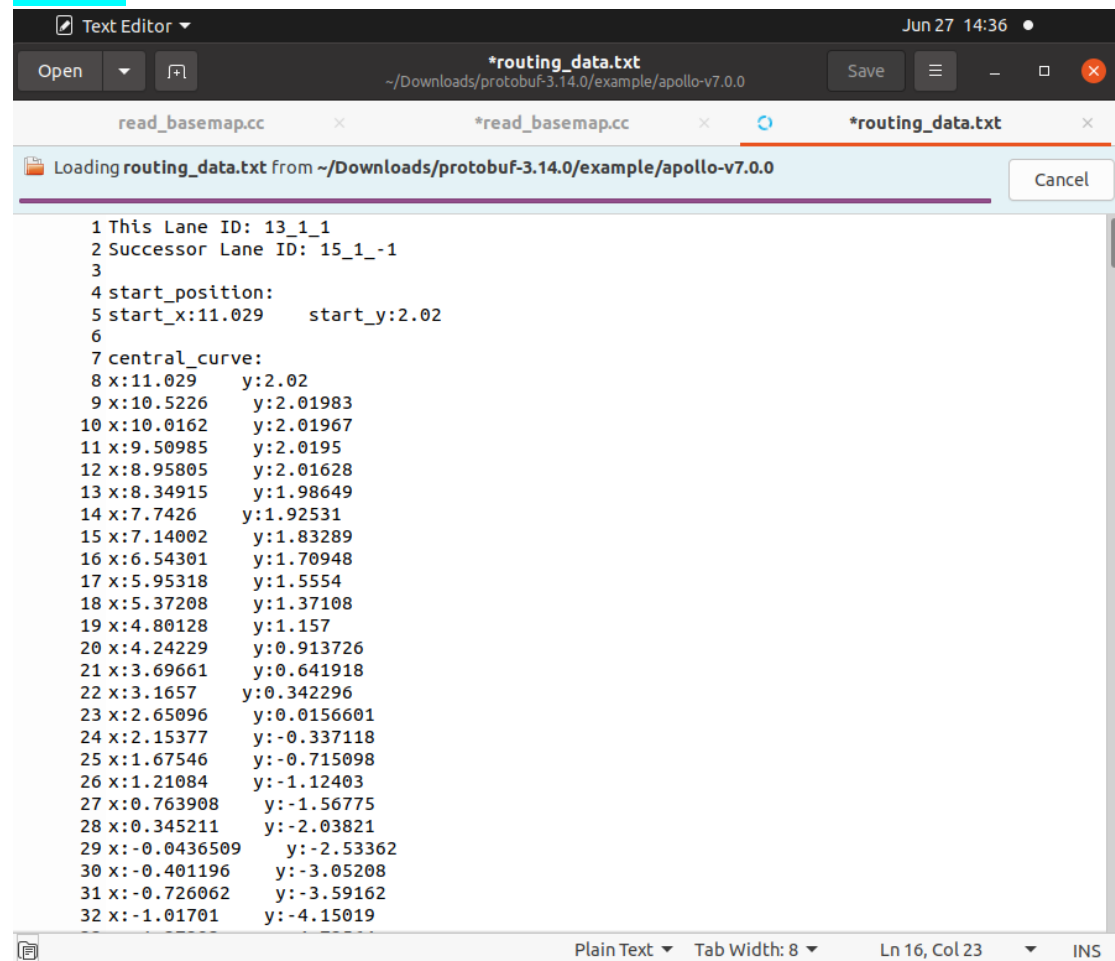
3、可以尝试用图形库将地图展示出来

运行结果



4、根据输入坐标，找到坐标所在的道路，以及后续路径点

运行结果



```
1 This Lane ID: 13_1_1
2 Successor Lane ID: 15_1_-1
3
4 start_position:
5 start_x:11.029    start_y:2.02
6
7 central_curve:
8 x:11.029    y:2.02
9 x:10.5226   y:2.01983
10 x:10.0162  y:2.01967
11 x:9.50985  y:2.0195
12 x:8.95805  y:2.01628
13 x:8.34915  y:1.98649
14 x:7.7426   y:1.92531
15 x:7.14002  y:1.83289
16 x:6.54301  y:1.70948
17 x:5.95318  y:1.5554
18 x:5.37208  y:1.37108
19 x:4.80128  y:1.157
20 x:4.24229  y:0.913726
21 x:3.69661  y:0.641918
22 x:3.1657   y:0.342296
23 x:2.65096  y:0.0156601
24 x:2.15377  y:-0.337118
25 x:1.67546  y:-0.715098
26 x:1.21084  y:-1.12403
27 x:0.763908 y:-1.56775
28 x:0.345211 y:-2.03821
29 x:-0.0436509 y:-2.53362
30 x:-0.401196 y:-3.05208
31 x:-0.726062 y:-3.59162
32 x:-1.01701  y:-4.15019
```