In [68]:

```
%matplotlib inline

import numpy as np
import pandas as pd
import matplotlib as mpl
import matplotlib.pyplot as plt
from scipy import stats
```

In [2]:

```
import glob
```

In [72]:

```
import seaborn as sns
```

1. 原始数据分段

In [3]:

```
sample_data = './data/raw/driving/AA00001.csv'
```

In [45]:

```
rawdf = pd.read_csv(sample_data)
```

观察数据

In [46]:

```
rawdf
```

Out[46]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
0	AA00001	AAA9102001	120	115.944523	28.651165	1	
1	AA00001	AAA9102001	120	115.944523	28.651165	1	
2	AA00001	AAA9102001	120	115.944523	28.651165	1	
3	AA00001	AAA9102001	120	115.944523	28.651165	1	
4	AA00001	AAA9102001	120	115.944523	28.651165	1	
5	AA00001	AAA9102001	120	115.944523	28.651165	1	
6	AA00001	AAA9102001	120	115.944523	28.651165	1	
7	AA00001	AAA9102001	120	115.944523	28.651165	1	
8	AA00001	AAA9102001	120	115.944523	28.651165	1	
9	AA00001	AAA9102001	120	115.944523	28.651165	1	
10	AA00001	AAA9102001	120	115.944523	28.651165	1	
11	AA00001	AAA9102001	120	115.944523	28.651165	1	
12	AA00001	AAA9102001	120	115.944523	28.651165	1	
13	AA00001	AAA9102001	120	115.944523	28.651165	1	
14	AA00001	AAA9102001	120	115.944523	28.651165	1	
15	AA00001	AAA9102001	120	115.944523	28.651165	1	
16	AA00001	AAA9102001	120	115.944523	28.651165	1	
17	AA00001	AAA9102001	120	115.944523	28.651165	1	
18	AA00001	AAA9102001	120	115.944523	28.651165	1	
19	AA00001	AAA9102001	120	115.944523	28.651165	1	
20	AA00001	AAA9102001	120	115.944523	28.651165	1	
21	AA00001	AAA9102001	120	115.944523	28.651165	1	
22	AA00001	AAA9102001	120	115.944523	28.651165	1	
23	AA00001	AAA9102001	120	115.944523	28.651165	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
24	AA00001	AAA9102001	120	115.944523	28.651165	1	
25	AA00001	AAA9102001	120	115.944523	28.651165	1	
26	AA00001	AAA9102001	120	115.944523	28.651165	1	
27	AA00001	AAA9102001	120	115.944523	28.651165	1	
28	AA00001	AAA9102001	120	115.944523	28.651165	1	
29	AA00001	AAA9102001	120	115.944523	28.651165	1	
...	...	...	...	...	...	...	
163464	AA00001	AAA9102001	189	115.822031	28.705926	1	
163465	AA00001	AAA9102001	189	115.822023	28.705925	1	
163466	AA00001	AAA9102001	189	115.822016	28.705925	1	
163467	AA00001	AAA9102001	189	115.822015	28.705923	1	
163468	AA00001	AAA9102001	189	115.822013	28.705921	1	
163469	AA00001	AAA9102001	189	115.822011	28.705923	1	
163470	AA00001	AAA9102001	189	115.822010	28.705923	1	
163471	AA00001	AAA9102001	189	115.822011	28.705923	1	
163472	AA00001	AAA9102001	189	115.822011	28.705923	1	
163473	AA00001	AAA9102001	189	115.822000	28.705926	1	
163474	AA00001	AAA9102001	189	115.822000	28.705926	1	
163475	AA00001	AAA9102001	189	115.821998	28.705926	1	
163476	AA00001	AAA9102001	189	115.821996	28.705928	1	
163477	AA00001	AAA9102001	189	115.821996	28.705928	1	
163478	AA00001	AAA9102001	189	115.821996	28.705928	1	
163479	AA00001	AAA9102001	189	115.822006	28.705925	1	
163480	AA00001	AAA9102001	189	115.822006	28.705925	1	
163481	AA00001	AAA9102001	189	115.822006	28.705925	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
163482	AA00001	AAA9102001	189	115.822006	28.705925	1	
163483	AA00001	AAA9102001	189	115.822006	28.705925	1	
163484	AA00001	AAA9102001	189	115.822006	28.705925	1	
163485	AA00001	AAA9102001	189	115.822006	28.705925	1	
163486	AA00001	AAA9102001	189	115.822018	28.705936	1	
163487	AA00001	AAA9102001	189	115.822018	28.705936	0	
163488	AA00001	AAA9102001	189	115.822018	28.705936	0	
163489	AA00001	AAA9102001	189	115.822018	28.705936	0	
163490	AA00001	AAA9102001	189	115.822018	28.705936	0	
163491	AA00001	AAA9102001	189	115.822018	28.705936	0	
163492	AA00001	AAA9102001	189	115.822018	28.705936	0	
163493	AA00001	AAA9102001	189	115.822018	28.705936	0	

163494 rows × 13 columns

In [47]:

```
rawdf.describe()
```

Out[47]:

	direction_angle	lng	lat	acc_state	right_turn_signals	left_tu
count	163494.000000	163494.000000	163494.000000	163494.000000	163494.0	
mean	168.162764	115.816108	28.333468	0.968647	0.0	
std	110.191409	0.767840	0.753407	0.174270	0.0	
min	0.000000	114.156420	26.564133	0.000000	0.0	
25%	63.000000	115.479943	27.959188	1.000000	0.0	
50%	181.000000	115.855331	28.650861	1.000000	0.0	
75%	264.000000	116.181520	28.705685	1.000000	0.0	
max	359.000000	117.998560	29.998430	1.000000	0.0	

In [48]:

```
rawdf.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 163494 entries, 0 to 163493
Data columns (total 13 columns):
vehicleplatenumber    163494 non-null object
device_num            163494 non-null object
direction_angle       163494 non-null int64
lng                   163494 non-null float64
lat                   163494 non-null float64
acc_state             163494 non-null int64
right_turn_signals    163494 non-null int64
left_turn_signals     163494 non-null int64
hand_brake            163494 non-null int64
foot_brake            163494 non-null int64
location_time         163494 non-null object
gps_speed             163494 non-null int64
mileage               163494 non-null int64
dtypes: float64(2), int64(8), object(3)
memory usage: 16.2+ MB
```

In [49]:

```
rawdf[df.gps_speed > 0]
```

Out[49]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
110	AA00001	AAA9102001	114	115.944571	28.651140	1	
111	AA00001	AAA9102001	110	115.944603	28.651126	1	
112	AA00001	AAA9102001	108	115.944643	28.651118	1	
113	AA00001	AAA9102001	108	115.944691	28.651106	1	
114	AA00001	AAA9102001	108	115.944753	28.651090	1	
115	AA00001	AAA9102001	112	115.944816	28.651071	1	
116	AA00001	AAA9102001	112	115.944878	28.651050	1	
117	AA00001	AAA9102001	112	115.944941	28.651030	1	
118	AA00001	AAA9102001	115	115.945001	28.651006	1	
119	AA00001	AAA9102001	115	115.945070	28.650981	1	
120	AA00001	AAA9102001	115	115.945141	28.650955	1	
121	AA00001	AAA9102001	115	115.945213	28.650925	1	
122	AA00001	AAA9102001	116	115.945290	28.650891	1	
123	AA00001	AAA9102001	116	115.945370	28.650856	1	
124	AA00001	AAA9102001	117	115.945453	28.650818	1	
125	AA00001	AAA9102001	116	115.945538	28.650780	1	
126	AA00001	AAA9102001	117	115.945623	28.650741	1	
127	AA00001	AAA9102001	118	115.945705	28.650703	1	
128	AA00001	AAA9102001	117	115.945783	28.650666	1	
129	AA00001	AAA9102001	115	115.945941	28.650598	1	
130	AA00001	AAA9102001	115	115.946026	28.650563	1	
131	AA00001	AAA9102001	115	115.946115	28.650526	1	
132	AA00001	AAA9102001	115	115.946205	28.650488	1	
133	AA00001	AAA9102001	115	115.946300	28.650448	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
134	AA00001	AAA9102001	116	115.946396	28.650406	1	
135	AA00001	AAA9102001	116	115.946495	28.650365	1	
136	AA00001	AAA9102001	115	115.946596	28.650321	1	
137	AA00001	AAA9102001	115	115.946701	28.650278	1	
138	AA00001	AAA9102001	115	115.946806	28.650236	1	
139	AA00001	AAA9102001	115	115.946913	28.650193	1	
...	...	...	...	...	...	...	
163407	AA00001	AAA9102001	122	115.820278	28.706785	1	
163408	AA00001	AAA9102001	127	115.820368	28.706743	1	
163409	AA00001	AAA9102001	126	115.820440	28.706701	1	
163410	AA00001	AAA9102001	125	115.820501	28.706658	1	
163411	AA00001	AAA9102001	127	115.820570	28.706613	1	
163412	AA00001	AAA9102001	126	115.820638	28.706573	1	
163413	AA00001	AAA9102001	127	115.820700	28.706533	1	
163414	AA00001	AAA9102001	129	115.820761	28.706485	1	
163415	AA00001	AAA9102001	128	115.820828	28.706438	1	
163416	AA00001	AAA9102001	128	115.820965	28.706341	1	
163417	AA00001	AAA9102001	130	115.821033	28.706288	1	
163418	AA00001	AAA9102001	130	115.821103	28.706231	1	
163419	AA00001	AAA9102001	132	115.821170	28.706175	1	
163420	AA00001	AAA9102001	134	115.821235	28.706116	1	
163421	AA00001	AAA9102001	132	115.821300	28.706063	1	
163422	AA00001	AAA9102001	132	115.821363	28.706010	1	
163423	AA00001	AAA9102001	134	115.821420	28.705958	1	
163424	AA00001	AAA9102001	135	115.821473	28.705903	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
163425	AA00001	AAA9102001	135	115.821525	28.705851	1	
163426	AA00001	AAA9102001	133	115.821573	28.705803	1	
163427	AA00001	AAA9102001	133	115.821625	28.705758	1	
163428	AA00001	AAA9102001	131	115.821670	28.705721	1	
163429	AA00001	AAA9102001	130	115.821711	28.705690	1	
163430	AA00001	AAA9102001	120	115.821755	28.705665	1	
163431	AA00001	AAA9102001	109	115.821800	28.705651	1	
163432	AA00001	AAA9102001	97	115.821841	28.705648	1	
163433	AA00001	AAA9102001	79	115.821878	28.705653	1	
163434	AA00001	AAA9102001	66	115.821910	28.705666	1	
163435	AA00001	AAA9102001	48	115.821933	28.705690	1	
163436	AA00001	AAA9102001	43	115.821953	28.705715	1	

113459 rows × 13 columns

In [50]:

```
len(rawdf)
```

Out[50]:

163494

预处理

In [29]:

```
import time
```

In [51]:

```
rawdf['timestamp'] = rawdf['location_time'].apply(lambda x: time.mktime(time.strptime(x,'%Y-%m-%d %H:%M:%S')))
```

In [52]:

```
rawdf
```

Out[52]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
0	AA00001	AAA9102001	120	115.944523	28.651165	1	
1	AA00001	AAA9102001	120	115.944523	28.651165	1	
2	AA00001	AAA9102001	120	115.944523	28.651165	1	
3	AA00001	AAA9102001	120	115.944523	28.651165	1	
4	AA00001	AAA9102001	120	115.944523	28.651165	1	
5	AA00001	AAA9102001	120	115.944523	28.651165	1	
6	AA00001	AAA9102001	120	115.944523	28.651165	1	
7	AA00001	AAA9102001	120	115.944523	28.651165	1	
8	AA00001	AAA9102001	120	115.944523	28.651165	1	
9	AA00001	AAA9102001	120	115.944523	28.651165	1	
10	AA00001	AAA9102001	120	115.944523	28.651165	1	
11	AA00001	AAA9102001	120	115.944523	28.651165	1	
12	AA00001	AAA9102001	120	115.944523	28.651165	1	
13	AA00001	AAA9102001	120	115.944523	28.651165	1	
14	AA00001	AAA9102001	120	115.944523	28.651165	1	
15	AA00001	AAA9102001	120	115.944523	28.651165	1	
16	AA00001	AAA9102001	120	115.944523	28.651165	1	
17	AA00001	AAA9102001	120	115.944523	28.651165	1	
18	AA00001	AAA9102001	120	115.944523	28.651165	1	
19	AA00001	AAA9102001	120	115.944523	28.651165	1	
20	AA00001	AAA9102001	120	115.944523	28.651165	1	
21	AA00001	AAA9102001	120	115.944523	28.651165	1	
22	AA00001	AAA9102001	120	115.944523	28.651165	1	
23	AA00001	AAA9102001	120	115.944523	28.651165	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
24	AA00001	AAA9102001	120	115.944523	28.651165	1	
25	AA00001	AAA9102001	120	115.944523	28.651165	1	
26	AA00001	AAA9102001	120	115.944523	28.651165	1	
27	AA00001	AAA9102001	120	115.944523	28.651165	1	
28	AA00001	AAA9102001	120	115.944523	28.651165	1	
29	AA00001	AAA9102001	120	115.944523	28.651165	1	
...	...	...	...	...	...	...	
163464	AA00001	AAA9102001	189	115.822031	28.705926	1	
163465	AA00001	AAA9102001	189	115.822023	28.705925	1	
163466	AA00001	AAA9102001	189	115.822016	28.705925	1	
163467	AA00001	AAA9102001	189	115.822015	28.705923	1	
163468	AA00001	AAA9102001	189	115.822013	28.705921	1	
163469	AA00001	AAA9102001	189	115.822011	28.705923	1	
163470	AA00001	AAA9102001	189	115.822010	28.705923	1	
163471	AA00001	AAA9102001	189	115.822011	28.705923	1	
163472	AA00001	AAA9102001	189	115.822011	28.705923	1	
163473	AA00001	AAA9102001	189	115.822000	28.705926	1	
163474	AA00001	AAA9102001	189	115.822000	28.705926	1	
163475	AA00001	AAA9102001	189	115.821998	28.705926	1	
163476	AA00001	AAA9102001	189	115.821996	28.705928	1	
163477	AA00001	AAA9102001	189	115.821996	28.705928	1	
163478	AA00001	AAA9102001	189	115.821996	28.705928	1	
163479	AA00001	AAA9102001	189	115.822006	28.705925	1	
163480	AA00001	AAA9102001	189	115.822006	28.705925	1	
163481	AA00001	AAA9102001	189	115.822006	28.705925	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
163482	AA00001	AAA9102001	189	115.822006	28.705925	1	
163483	AA00001	AAA9102001	189	115.822006	28.705925	1	
163484	AA00001	AAA9102001	189	115.822006	28.705925	1	
163485	AA00001	AAA9102001	189	115.822006	28.705925	1	
163486	AA00001	AAA9102001	189	115.822018	28.705936	1	
163487	AA00001	AAA9102001	189	115.822018	28.705936	0	
163488	AA00001	AAA9102001	189	115.822018	28.705936	0	
163489	AA00001	AAA9102001	189	115.822018	28.705936	0	
163490	AA00001	AAA9102001	189	115.822018	28.705936	0	
163491	AA00001	AAA9102001	189	115.822018	28.705936	0	
163492	AA00001	AAA9102001	189	115.822018	28.705936	0	
163493	AA00001	AAA9102001	189	115.822018	28.705936	0	

163494 rows × 14 columns

统计间隔时间

In [53]:

```
# 所有数据下移一行，下面用来做差值用
rawdf_shift = rawdf.shift(1)
```

In [54]:

```
rawdf_shift
```

Out[54]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
0	NaN	NaN	NaN	NaN	NaN	NaN	
1	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
2	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
3	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
4	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
5	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
6	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
7	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
8	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
9	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
10	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
11	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
12	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
13	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
14	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
15	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
16	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
17	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
18	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
19	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
20	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
21	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
22	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
23	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
24	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
25	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
26	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
27	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
28	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
29	AA00001	AAA9102001	120.0	115.944523	28.651165	1.0	
...	...	...	...	...	...	...	
163464	AA00001	AAA9102001	189.0	115.822038	28.705925	1.0	
163465	AA00001	AAA9102001	189.0	115.822031	28.705926	1.0	
163466	AA00001	AAA9102001	189.0	115.822023	28.705925	1.0	
163467	AA00001	AAA9102001	189.0	115.822016	28.705925	1.0	
163468	AA00001	AAA9102001	189.0	115.822015	28.705923	1.0	
163469	AA00001	AAA9102001	189.0	115.822013	28.705921	1.0	
163470	AA00001	AAA9102001	189.0	115.822011	28.705923	1.0	
163471	AA00001	AAA9102001	189.0	115.822010	28.705923	1.0	
163472	AA00001	AAA9102001	189.0	115.822011	28.705923	1.0	
163473	AA00001	AAA9102001	189.0	115.822011	28.705923	1.0	
163474	AA00001	AAA9102001	189.0	115.822000	28.705926	1.0	
163475	AA00001	AAA9102001	189.0	115.822000	28.705926	1.0	
163476	AA00001	AAA9102001	189.0	115.821998	28.705926	1.0	
163477	AA00001	AAA9102001	189.0	115.821996	28.705928	1.0	
163478	AA00001	AAA9102001	189.0	115.821996	28.705928	1.0	
163479	AA00001	AAA9102001	189.0	115.821996	28.705928	1.0	
163480	AA00001	AAA9102001	189.0	115.822006	28.705925	1.0	
163481	AA00001	AAA9102001	189.0	115.822006	28.705925	1.0	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
163482	AA00001	AAA9102001	189.0	115.822006	28.705925	1.0	
163483	AA00001	AAA9102001	189.0	115.822006	28.705925	1.0	
163484	AA00001	AAA9102001	189.0	115.822006	28.705925	1.0	
163485	AA00001	AAA9102001	189.0	115.822006	28.705925	1.0	
163486	AA00001	AAA9102001	189.0	115.822006	28.705925	1.0	
163487	AA00001	AAA9102001	189.0	115.822018	28.705936	1.0	
163488	AA00001	AAA9102001	189.0	115.822018	28.705936	0.0	
163489	AA00001	AAA9102001	189.0	115.822018	28.705936	0.0	
163490	AA00001	AAA9102001	189.0	115.822018	28.705936	0.0	
163491	AA00001	AAA9102001	189.0	115.822018	28.705936	0.0	
163492	AA00001	AAA9102001	189.0	115.822018	28.705936	0.0	
163493	AA00001	AAA9102001	189.0	115.822018	28.705936	0.0	

163494 rows × 14 columns

In [55]:

```
# 下一秒时间减去上一秒时间，如果差值过大那么则数据需要分段
rawdf_timestamp_minus = rawdf['timestamp'] - rawdf_shift['timestamp']
```

In [56]:

```
rawdf_timestamp_minus.describe()
```

Out[56]:

```
count    1.634930e+05
mean     2.134516e+01
std      6.976751e+03
min      0.000000e+00
25%      1.000000e+00
50%      1.000000e+00
75%      1.000000e+00
max      2.817568e+06
Name: timestamp, dtype: float64
```

In [116]:

```
rawdf_timestamp_minus
```

Out[116]:

```
0         NaN
1         2.0
2         1.0
3         1.0
4         1.0
5         1.0
6         1.0
7         1.0
8         1.0
9         1.0
10        1.0
11        1.0
12        1.0
13        1.0
14        1.0
15        1.0
16        1.0
17        1.0
18        1.0
19        1.0
20        1.0
21        1.0
22        1.0
23        1.0
24        1.0
25        1.0
26        1.0
27        1.0
28        1.0
29        1.0
          ...
163464    1.0
163465    1.0
163466    1.0
163467    1.0
163468    1.0
163469    1.0
163470    1.0
163471    1.0
163472    1.0
163473    1.0
163474    1.0
163475    1.0
163476    1.0
163477    1.0
163478    1.0
163479    1.0
163480    1.0
163481    1.0
163482    1.0
163483    1.0
163484    1.0
163485    1.0
163486    1.0
163487    1.0
163488    1.0
163489    1.0
163490    1.0
163491    1.0
```

```
163492    1.0
163493    1.0
Name: timestamp, Length: 163494, dtype: float64
```

In [119]:

```
# 看看差别 1 秒以上的有多少
len(rawdf_timestamp_minus[rawdf_timestamp_minus > 1])
```

Out[119]:

2668

In [121]:

```
# 看看差别 2 秒以上的有多少
len(rawdf_timestamp_minus[rawdf_timestamp_minus > 2])
```

Out[121]:

173

In [133]:

```
# 看看差别 5 秒以上的有多少
len(rawdf_timestamp_minus[rawdf_timestamp_minus > 5])
```

Out[133]:

77

In [131]:

```
# 看看差别 10 秒以上的有多少
len(rawdf_timestamp_minus[rawdf_timestamp_minus > 10])
```

Out[131]:

76

In [132]:

```
# 看看差别 30 秒以上的有多少
len(rawdf_timestamp_minus[rawdf_timestamp_minus > 30])
```

Out[132]:

76

In [137]:

```
# 看看差别 60 秒以上的有多少
len(rawdf_timestamp_minus[rawdf_timestamp_minus > 100])
```

Out[137]:

71

目前来看间隔 2 秒 的以上的点明显减少，10 秒以上基本不再变化，所以 10 秒可做分界点

In [94]:

```
rawdf_timestamp_minus_max = int(np.max(rawdf_timestamp_minus).item())
```

In [150]:

```
# 统计下间隔时间的分布图
timestamps_minus_lengths = [len(rawdf_timestamp_minus[rawdf_timestamp_minus > length]) for length
in range(1, 100)]
```

In [154]:

```
timestamps_minus_lengths
```

Out[154]:

```
[2668,
 173,
 93,
 77,
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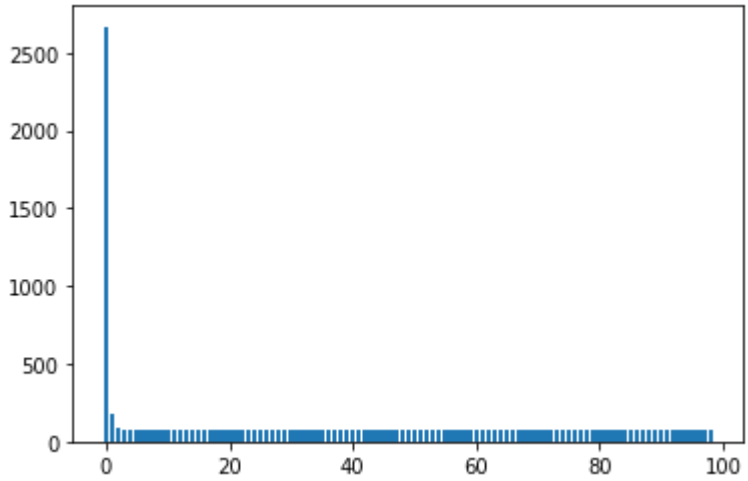
70,
69,
69,
69,
69]

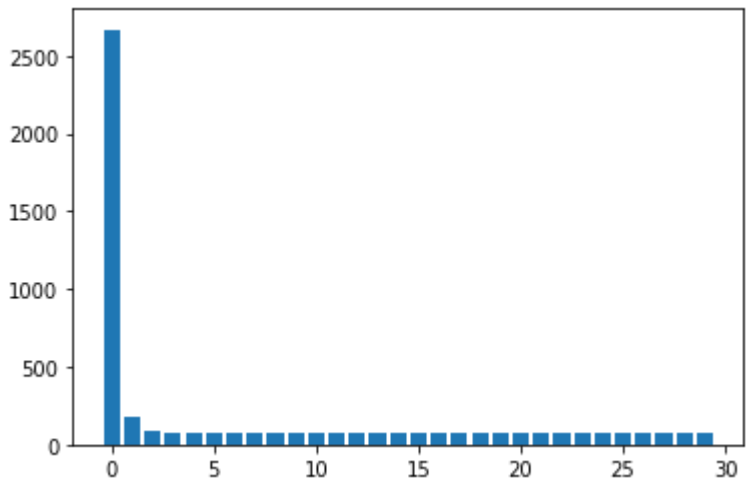
In [157]:

```
# 间隔时间为 1-100 秒的时候，数量有多少
plt.bar(range(len(timestamps_minus_lengths)), timestamps_minus_lengths)
plt.show()
```



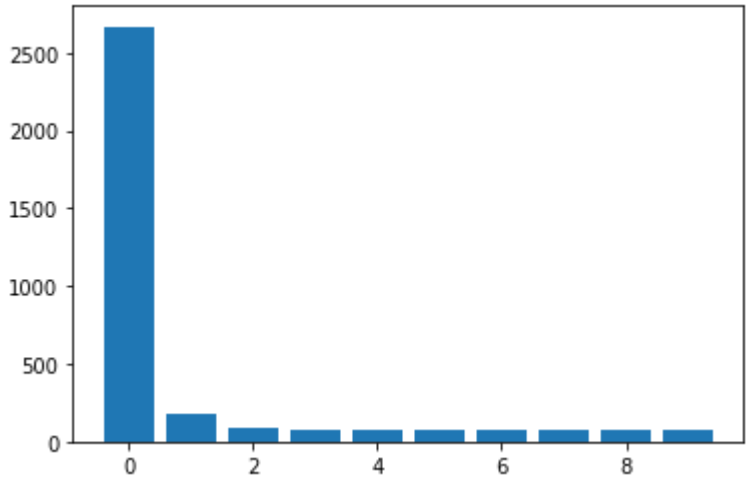
In [158]:

```
# 间隔时间为 1-30 秒的时候，数量有多少
plt.bar(range(len(timestamps_minus_lengths[:30])), timestamps_minus_lengths[:30])
plt.show()
```



In [159]:

```
# 间隔时间为 1-10 秒的时候，数量有多少
plt.bar(range(len(timestamps_minus_lengths[:10])), timestamps_minus_lengths[:10])
plt.show()
```



基本上可以看到间隔时间 3 秒的时候，就稳定差不多了，我们就选 10 秒作为时间段间隔吧。

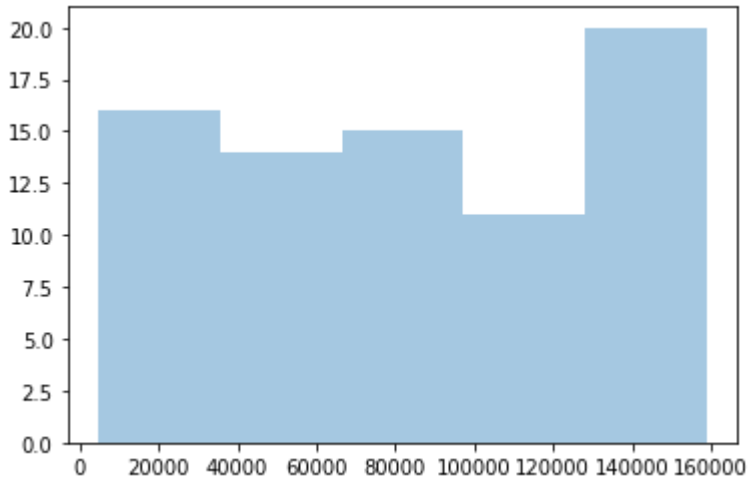
即如果前一条数据和后一条数据间隔超过 10 秒，那就切开

In [160]:

```
# 看看大约分割点在哪个地方分布较多
sns.distplot(np.where(rawdf_timestamp_minus > 10), kde=False)
```

Out[160]:

<matplotlib.axes._subplots.AxesSubplot at 0x130a8a450>



看起来在分割点位置比较平均

开始分割

将大的 DataFrame 按照时间段划分为小的 DataFrames

In [163]:

```
rawdf['timestamp_minus'] = rawdf_timestamp_minus
```

In [164]:

```
rawdf
```

Out[164]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
0	AA00001	AAA9102001	120	115.944523	28.651165	1	
1	AA00001	AAA9102001	120	115.944523	28.651165	1	
2	AA00001	AAA9102001	120	115.944523	28.651165	1	
3	AA00001	AAA9102001	120	115.944523	28.651165	1	
4	AA00001	AAA9102001	120	115.944523	28.651165	1	
5	AA00001	AAA9102001	120	115.944523	28.651165	1	
6	AA00001	AAA9102001	120	115.944523	28.651165	1	
7	AA00001	AAA9102001	120	115.944523	28.651165	1	
8	AA00001	AAA9102001	120	115.944523	28.651165	1	
9	AA00001	AAA9102001	120	115.944523	28.651165	1	
10	AA00001	AAA9102001	120	115.944523	28.651165	1	
11	AA00001	AAA9102001	120	115.944523	28.651165	1	
12	AA00001	AAA9102001	120	115.944523	28.651165	1	
13	AA00001	AAA9102001	120	115.944523	28.651165	1	
14	AA00001	AAA9102001	120	115.944523	28.651165	1	
15	AA00001	AAA9102001	120	115.944523	28.651165	1	
16	AA00001	AAA9102001	120	115.944523	28.651165	1	
17	AA00001	AAA9102001	120	115.944523	28.651165	1	
18	AA00001	AAA9102001	120	115.944523	28.651165	1	
19	AA00001	AAA9102001	120	115.944523	28.651165	1	
20	AA00001	AAA9102001	120	115.944523	28.651165	1	
21	AA00001	AAA9102001	120	115.944523	28.651165	1	
22	AA00001	AAA9102001	120	115.944523	28.651165	1	
23	AA00001	AAA9102001	120	115.944523	28.651165	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
24	AA00001	AAA9102001	120	115.944523	28.651165	1	
25	AA00001	AAA9102001	120	115.944523	28.651165	1	
26	AA00001	AAA9102001	120	115.944523	28.651165	1	
27	AA00001	AAA9102001	120	115.944523	28.651165	1	
28	AA00001	AAA9102001	120	115.944523	28.651165	1	
29	AA00001	AAA9102001	120	115.944523	28.651165	1	
...	...	...	...	...	...	...	
163464	AA00001	AAA9102001	189	115.822031	28.705926	1	
163465	AA00001	AAA9102001	189	115.822023	28.705925	1	
163466	AA00001	AAA9102001	189	115.822016	28.705925	1	
163467	AA00001	AAA9102001	189	115.822015	28.705923	1	
163468	AA00001	AAA9102001	189	115.822013	28.705921	1	
163469	AA00001	AAA9102001	189	115.822011	28.705923	1	
163470	AA00001	AAA9102001	189	115.822010	28.705923	1	
163471	AA00001	AAA9102001	189	115.822011	28.705923	1	
163472	AA00001	AAA9102001	189	115.822011	28.705923	1	
163473	AA00001	AAA9102001	189	115.822000	28.705926	1	
163474	AA00001	AAA9102001	189	115.822000	28.705926	1	
163475	AA00001	AAA9102001	189	115.821998	28.705926	1	
163476	AA00001	AAA9102001	189	115.821996	28.705928	1	
163477	AA00001	AAA9102001	189	115.821996	28.705928	1	
163478	AA00001	AAA9102001	189	115.821996	28.705928	1	
163479	AA00001	AAA9102001	189	115.822006	28.705925	1	
163480	AA00001	AAA9102001	189	115.822006	28.705925	1	
163481	AA00001	AAA9102001	189	115.822006	28.705925	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	r
163482	AA00001	AAA9102001	189	115.822006	28.705925	1	
163483	AA00001	AAA9102001	189	115.822006	28.705925	1	
163484	AA00001	AAA9102001	189	115.822006	28.705925	1	
163485	AA00001	AAA9102001	189	115.822006	28.705925	1	
163486	AA00001	AAA9102001	189	115.822018	28.705936	1	
163487	AA00001	AAA9102001	189	115.822018	28.705936	0	
163488	AA00001	AAA9102001	189	115.822018	28.705936	0	
163489	AA00001	AAA9102001	189	115.822018	28.705936	0	
163490	AA00001	AAA9102001	189	115.822018	28.705936	0	
163491	AA00001	AAA9102001	189	115.822018	28.705936	0	
163492	AA00001	AAA9102001	189	115.822018	28.705936	0	
163493	AA00001	AAA9102001	189	115.822018	28.705936	0	

163494 rows × 15 columns

In [166]:

```
rawdf[0: 1]
```

Out[166]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	right_t
0	AA00001	AAA9102001	120	115.944523	28.651165	1	

In [173]:

```
from copy import deepcopy
```

In [174]:

```
count = 10
start, end = 0, 0
rawdf_subs = []
for index, row in rawdf.iterrows():
    # 如果间隔时间超过阈值，那么就切开
    if row.timestamp_minus > 10:
        end = index
        # 切开
        rawdf_sub = rawdf[start: end]
        start = end
        # 汇总到列表
        rawdf_subs.append(deepcopy(rawdf_sub))
```

看看切开的结果，第一段、第二段数据，验证下没问题。从第二段数据开始，第一条数据的 timestamp_minus 应该大于 10

In [180]:

```
rawdf_subs[0]
```

Out[180]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	righ
0	AA00001	AAA9102001	120	115.944523	28.651165	1	
1	AA00001	AAA9102001	120	115.944523	28.651165	1	
2	AA00001	AAA9102001	120	115.944523	28.651165	1	
3	AA00001	AAA9102001	120	115.944523	28.651165	1	
4	AA00001	AAA9102001	120	115.944523	28.651165	1	
5	AA00001	AAA9102001	120	115.944523	28.651165	1	
6	AA00001	AAA9102001	120	115.944523	28.651165	1	
7	AA00001	AAA9102001	120	115.944523	28.651165	1	
8	AA00001	AAA9102001	120	115.944523	28.651165	1	
9	AA00001	AAA9102001	120	115.944523	28.651165	1	
10	AA00001	AAA9102001	120	115.944523	28.651165	1	
11	AA00001	AAA9102001	120	115.944523	28.651165	1	
12	AA00001	AAA9102001	120	115.944523	28.651165	1	
13	AA00001	AAA9102001	120	115.944523	28.651165	1	
14	AA00001	AAA9102001	120	115.944523	28.651165	1	
15	AA00001	AAA9102001	120	115.944523	28.651165	1	
16	AA00001	AAA9102001	120	115.944523	28.651165	1	
17	AA00001	AAA9102001	120	115.944523	28.651165	1	
18	AA00001	AAA9102001	120	115.944523	28.651165	1	
19	AA00001	AAA9102001	120	115.944523	28.651165	1	
20	AA00001	AAA9102001	120	115.944523	28.651165	1	
21	AA00001	AAA9102001	120	115.944523	28.651165	1	
22	AA00001	AAA9102001	120	115.944523	28.651165	1	
23	AA00001	AAA9102001	120	115.944523	28.651165	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rigl
24	AA00001	AAA9102001	120	115.944523	28.651165	1	
25	AA00001	AAA9102001	120	115.944523	28.651165	1	
26	AA00001	AAA9102001	120	115.944523	28.651165	1	
27	AA00001	AAA9102001	120	115.944523	28.651165	1	
28	AA00001	AAA9102001	120	115.944523	28.651165	1	
29	AA00001	AAA9102001	120	115.944523	28.651165	1	
...	...	...	...	...	...	...	
4605	AA00001	AAA9102001	90	116.712471	28.787298	1	
4606	AA00001	AAA9102001	92	116.712745	28.787288	1	
4607	AA00001	AAA9102001	92	116.713015	28.787276	1	
4608	AA00001	AAA9102001	92	116.713283	28.787263	1	
4609	AA00001	AAA9102001	92	116.713550	28.787251	1	
4610	AA00001	AAA9102001	93	116.713818	28.787235	1	
4611	AA00001	AAA9102001	94	116.714085	28.787216	1	
4612	AA00001	AAA9102001	94	116.714351	28.787195	1	
4613	AA00001	AAA9102001	95	116.714618	28.787171	1	
4614	AA00001	AAA9102001	95	116.714886	28.787148	1	
4615	AA00001	AAA9102001	96	116.715156	28.787123	1	
4616	AA00001	AAA9102001	96	116.715425	28.787096	1	
4617	AA00001	AAA9102001	97	116.715693	28.787070	1	
4618	AA00001	AAA9102001	97	116.715960	28.787040	1	
4619	AA00001	AAA9102001	98	116.716225	28.787008	1	
4620	AA00001	AAA9102001	98	116.716490	28.786976	1	
4621	AA00001	AAA9102001	99	116.716755	28.786940	1	
4622	AA00001	AAA9102001	100	116.717018	28.786901	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	righ
4623	AA00001	AAA9102001	100	116.717281	28.786861	1	
4624	AA00001	AAA9102001	100	116.717541	28.786818	1	
4625	AA00001	AAA9102001	101	116.717798	28.786773	1	
4626	AA00001	AAA9102001	101	116.718055	28.786725	1	
4627	AA00001	AAA9102001	102	116.718308	28.786675	1	
4628	AA00001	AAA9102001	102	116.718563	28.786623	1	
4629	AA00001	AAA9102001	103	116.718820	28.786568	1	
4630	AA00001	AAA9102001	104	116.719073	28.786508	1	
4631	AA00001	AAA9102001	104	116.719326	28.786445	1	
4632	AA00001	AAA9102001	104	116.719578	28.786383	1	
4633	AA00001	AAA9102001	105	116.719830	28.786320	1	
4634	AA00001	AAA9102001	105	116.720081	28.786256	1	

4635 rows × 15 columns

In [177]:

```
rawdf_subs[1]
```

Out[177]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	righ
4635	AA00001	AAA9102001	341	116.879581	28.793825	1	
4636	AA00001	AAA9102001	341	116.879581	28.793825	1	
4637	AA00001	AAA9102001	341	116.879581	28.793825	1	
4638	AA00001	AAA9102001	341	116.879581	28.793825	1	
4639	AA00001	AAA9102001	341	116.879581	28.793825	1	
4640	AA00001	AAA9102001	341	116.879581	28.793825	1	
4641	AA00001	AAA9102001	341	116.879581	28.793825	1	
4642	AA00001	AAA9102001	341	116.879581	28.793825	1	
4643	AA00001	AAA9102001	341	116.879581	28.793825	1	
4644	AA00001	AAA9102001	341	116.879581	28.793825	1	
4645	AA00001	AAA9102001	341	116.879581	28.793825	1	
4646	AA00001	AAA9102001	341	116.879581	28.793825	1	
4647	AA00001	AAA9102001	341	116.879581	28.793825	1	
4648	AA00001	AAA9102001	341	116.879581	28.793825	1	
4649	AA00001	AAA9102001	341	116.879581	28.793825	1	
4650	AA00001	AAA9102001	341	116.879581	28.793825	1	
4651	AA00001	AAA9102001	341	116.879581	28.793825	1	
4652	AA00001	AAA9102001	341	116.879581	28.793825	1	
4653	AA00001	AAA9102001	341	116.879581	28.793825	1	
4654	AA00001	AAA9102001	341	116.879581	28.793825	1	
4655	AA00001	AAA9102001	341	116.879581	28.793825	1	
4656	AA00001	AAA9102001	341	116.879581	28.793825	1	
4657	AA00001	AAA9102001	341	116.879581	28.793825	1	
4658	AA00001	AAA9102001	341	116.879581	28.793825	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rigl
4659	AA00001	AAA9102001	341	116.879581	28.793825	1	
4660	AA00001	AAA9102001	341	116.879581	28.793825	1	
4661	AA00001	AAA9102001	341	116.879581	28.793825	1	
4662	AA00001	AAA9102001	341	116.879581	28.793825	1	
4663	AA00001	AAA9102001	341	116.879581	28.793825	1	
4664	AA00001	AAA9102001	341	116.879581	28.793825	1	
...	...	...	...	...	...	...	
9185	AA00001	AAA9102001	13	117.311765	29.328135	1	
9186	AA00001	AAA9102001	13	117.311765	29.328135	1	
9187	AA00001	AAA9102001	13	117.311765	29.328135	1	
9188	AA00001	AAA9102001	13	117.311765	29.328135	1	
9189	AA00001	AAA9102001	13	117.311765	29.328135	1	
9190	AA00001	AAA9102001	13	117.311765	29.328135	1	
9191	AA00001	AAA9102001	13	117.311765	29.328135	1	
9192	AA00001	AAA9102001	13	117.311765	29.328135	1	
9193	AA00001	AAA9102001	13	117.311765	29.328135	1	
9194	AA00001	AAA9102001	13	117.311765	29.328135	1	
9195	AA00001	AAA9102001	13	117.311765	29.328135	1	
9196	AA00001	AAA9102001	13	117.311745	29.328148	1	
9197	AA00001	AAA9102001	13	117.311745	29.328148	1	
9198	AA00001	AAA9102001	13	117.311745	29.328148	1	
9199	AA00001	AAA9102001	13	117.311745	29.328148	1	
9200	AA00001	AAA9102001	13	117.311745	29.328148	1	
9201	AA00001	AAA9102001	13	117.311745	29.328148	1	
9202	AA00001	AAA9102001	13	117.311745	29.328148	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rigl
9203	AA00001	AAA9102001	13	117.311745	29.328148	1	
9204	AA00001	AAA9102001	13	117.311745	29.328148	1	
9205	AA00001	AAA9102001	13	117.311745	29.328148	1	
9206	AA00001	AAA9102001	13	117.311745	29.328148	1	
9207	AA00001	AAA9102001	13	117.311745	29.328148	1	
9208	AA00001	AAA9102001	13	117.311745	29.328148	1	
9209	AA00001	AAA9102001	13	117.311745	29.328148	1	
9210	AA00001	AAA9102001	13	117.311745	29.328148	1	
9211	AA00001	AAA9102001	13	117.311745	29.328148	1	
9212	AA00001	AAA9102001	13	117.311740	29.328153	1	
9213	AA00001	AAA9102001	13	117.311740	29.328153	0	
9214	AA00001	AAA9102001	13	117.311740	29.328153	0	

4580 rows × 15 columns

将以上切开的数据持久化保存一下，以后备作他用。

In [183]:

```
output_folder = './data/segments/driving'
```

In [187]:

```
from os.path import basename, dirname, join, exists
from os import makedirs
from pathlib import Path
```

In [188]:

```
exists(output_folder) or makedirs(output_folder)
```

In [185]:

```
# 文件名
stem = Path(sample_data).stem
stem
```

Out[185]:

'AA00001'

In [190]:

```
for index, rawdf_sub in enumerate(rawdf_subs):
    output_path = join(output_folder, f'{stem}_{index}.csv')
    rawdf_sub.to_csv(output_path)
    print(f'saved to {output_path}')
```

saved to ./data/segments/driving/AA00001_0.csv
saved to ./data/segments/driving/AA00001_1.csv
saved to ./data/segments/driving/AA00001_2.csv
saved to ./data/segments/driving/AA00001_3.csv
saved to ./data/segments/driving/AA00001_4.csv
saved to ./data/segments/driving/AA00001_5.csv
saved to ./data/segments/driving/AA00001_6.csv
saved to ./data/segments/driving/AA00001_7.csv
saved to ./data/segments/driving/AA00001_8.csv
saved to ./data/segments/driving/AA00001_9.csv
saved to ./data/segments/driving/AA00001_10.csv
saved to ./data/segments/driving/AA00001_11.csv
saved to ./data/segments/driving/AA00001_12.csv
saved to ./data/segments/driving/AA00001_13.csv
saved to ./data/segments/driving/AA00001_14.csv
saved to ./data/segments/driving/AA00001_15.csv
saved to ./data/segments/driving/AA00001_16.csv
saved to ./data/segments/driving/AA00001_17.csv
saved to ./data/segments/driving/AA00001_18.csv
saved to ./data/segments/driving/AA00001_19.csv
saved to ./data/segments/driving/AA00001_20.csv
saved to ./data/segments/driving/AA00001_21.csv
saved to ./data/segments/driving/AA00001_22.csv
saved to ./data/segments/driving/AA00001_23.csv
saved to ./data/segments/driving/AA00001_24.csv
saved to ./data/segments/driving/AA00001_25.csv
saved to ./data/segments/driving/AA00001_26.csv
saved to ./data/segments/driving/AA00001_27.csv
saved to ./data/segments/driving/AA00001_28.csv
saved to ./data/segments/driving/AA00001_29.csv
saved to ./data/segments/driving/AA00001_30.csv
saved to ./data/segments/driving/AA00001_31.csv
saved to ./data/segments/driving/AA00001_32.csv
saved to ./data/segments/driving/AA00001_33.csv
saved to ./data/segments/driving/AA00001_34.csv
saved to ./data/segments/driving/AA00001_35.csv
saved to ./data/segments/driving/AA00001_36.csv
saved to ./data/segments/driving/AA00001_37.csv
saved to ./data/segments/driving/AA00001_38.csv
saved to ./data/segments/driving/AA00001_39.csv
saved to ./data/segments/driving/AA00001_40.csv
saved to ./data/segments/driving/AA00001_41.csv
saved to ./data/segments/driving/AA00001_42.csv
saved to ./data/segments/driving/AA00001_43.csv
saved to ./data/segments/driving/AA00001_44.csv
saved to ./data/segments/driving/AA00001_45.csv
saved to ./data/segments/driving/AA00001_46.csv
saved to ./data/segments/driving/AA00001_47.csv
saved to ./data/segments/driving/AA00001_48.csv
saved to ./data/segments/driving/AA00001_49.csv
saved to ./data/segments/driving/AA00001_50.csv
saved to ./data/segments/driving/AA00001_51.csv
saved to ./data/segments/driving/AA00001_52.csv
saved to ./data/segments/driving/AA00001_53.csv
saved to ./data/segments/driving/AA00001_54.csv
saved to ./data/segments/driving/AA00001_55.csv
saved to ./data/segments/driving/AA00001_56.csv
saved to ./data/segments/driving/AA00001_57.csv
saved to ./data/segments/driving/AA00001_58.csv
saved to ./data/segments/driving/AA00001_59.csv
saved to ./data/segments/driving/AA00001_60.csv

```
saved to ./data/segments/driving/AA00001_61.csv
saved to ./data/segments/driving/AA00001_62.csv
saved to ./data/segments/driving/AA00001_63.csv
saved to ./data/segments/driving/AA00001_64.csv
saved to ./data/segments/driving/AA00001_65.csv
saved to ./data/segments/driving/AA00001_66.csv
saved to ./data/segments/driving/AA00001_67.csv
saved to ./data/segments/driving/AA00001_68.csv
saved to ./data/segments/driving/AA00001_69.csv
saved to ./data/segments/driving/AA00001_70.csv
saved to ./data/segments/driving/AA00001_71.csv
saved to ./data/segments/driving/AA00001_72.csv
saved to ./data/segments/driving/AA00001_73.csv
saved to ./data/segments/driving/AA00001_74.csv
saved to ./data/segments/driving/AA00001_75.csv
```

2. 速度加速度预处理

速度处理

先拿其中一个分段的数据来处理

In [195]:

```
len(rawdf_subs[10])
```

Out[195]:

2223

In [196]:

```
rawdf_subs[10]
```

Out[196]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
28110	AA00001	AAA9102001	189	115.860948	28.816311	1	
28111	AA00001	AAA9102001	191	115.860946	28.816265	1	
28112	AA00001	AAA9102001	192	115.860945	28.816288	1	
28113	AA00001	AAA9102001	199	115.860926	28.816196	1	
28114	AA00001	AAA9102001	203	115.860911	28.816158	1	
28115	AA00001	AAA9102001	203	115.860900	28.816123	1	
28116	AA00001	AAA9102001	204	115.860881	28.816083	1	
28117	AA00001	AAA9102001	203	115.860860	28.816036	1	
28118	AA00001	AAA9102001	202	115.860835	28.815981	1	
28119	AA00001	AAA9102001	203	115.860803	28.815920	1	
28120	AA00001	AAA9102001	203	115.860770	28.815848	1	
28121	AA00001	AAA9102001	202	115.860733	28.815773	1	
28122	AA00001	AAA9102001	200	115.860700	28.815700	1	
28123	AA00001	AAA9102001	200	115.860665	28.815621	1	
28124	AA00001	AAA9102001	200	115.860625	28.815543	1	
28125	AA00001	AAA9102001	201	115.860588	28.815461	1	
28126	AA00001	AAA9102001	200	115.860551	28.815381	1	
28127	AA00001	AAA9102001	197	115.860520	28.815300	1	
28128	AA00001	AAA9102001	194	115.860493	28.815216	1	
28129	AA00001	AAA9102001	196	115.860466	28.815131	1	
28130	AA00001	AAA9102001	199	115.860436	28.815050	1	
28131	AA00001	AAA9102001	201	115.860401	28.814966	1	
28132	AA00001	AAA9102001	202	115.860360	28.814878	1	
28133	AA00001	AAA9102001	202	115.860320	28.814791	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
28134	AA00001	AAA9102001	202	115.860275	28.814701	1	
28135	AA00001	AAA9102001	201	115.860233	28.814608	1	
28136	AA00001	AAA9102001	201	115.860193	28.814513	1	
28137	AA00001	AAA9102001	201	115.860151	28.814416	1	
28138	AA00001	AAA9102001	204	115.860105	28.814325	1	
28139	AA00001	AAA9102001	204	115.860056	28.814233	1	
...	...	...	...	...	...	...	
30303	AA00001	AAA9102001	53	115.822090	28.705791	1	
30304	AA00001	AAA9102001	53	115.822090	28.705791	1	
30305	AA00001	AAA9102001	53	115.822090	28.705791	1	
30306	AA00001	AAA9102001	53	115.822090	28.705791	1	
30307	AA00001	AAA9102001	53	115.822090	28.705791	1	
30308	AA00001	AAA9102001	53	115.822090	28.705791	1	
30309	AA00001	AAA9102001	53	115.822090	28.705791	1	
30310	AA00001	AAA9102001	53	115.822090	28.705791	1	
30311	AA00001	AAA9102001	53	115.822090	28.705791	1	
30312	AA00001	AAA9102001	53	115.822090	28.705791	1	
30313	AA00001	AAA9102001	53	115.822090	28.705791	1	
30314	AA00001	AAA9102001	53	115.822090	28.705791	1	
30315	AA00001	AAA9102001	53	115.822090	28.705791	1	
30316	AA00001	AAA9102001	53	115.822090	28.705791	1	
30317	AA00001	AAA9102001	53	115.822090	28.705791	1	
30318	AA00001	AAA9102001	53	115.822090	28.705791	1	
30319	AA00001	AAA9102001	53	115.822090	28.705791	1	
30320	AA00001	AAA9102001	53	115.822090	28.705791	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
30321	AA00001	AAA9102001	53	115.822090	28.705791	1	
30322	AA00001	AAA9102001	53	115.822090	28.705791	1	
30323	AA00001	AAA9102001	53	115.822090	28.705791	1	
30324	AA00001	AAA9102001	53	115.822090	28.705791	1	
30325	AA00001	AAA9102001	53	115.822090	28.705791	1	
30326	AA00001	AAA9102001	53	115.822090	28.705791	1	
30327	AA00001	AAA9102001	53	115.822050	28.705865	1	
30328	AA00001	AAA9102001	53	115.822050	28.705865	1	
30329	AA00001	AAA9102001	53	115.822050	28.705865	0	
30330	AA00001	AAA9102001	53	115.822050	28.705865	0	
30331	AA00001	AAA9102001	53	115.822050	28.705865	0	
30332	AA00001	AAA9102001	53	115.822050	28.705865	0	

2223 rows × 15 columns

这段还可以，有完整的加速和减速过程，先分析下速度的情况。

In [204]:

```
segdf = rawdf_subs[10]
```

In [205]:

```
speed = segdf.gps_speed
```

In [206]:

```
speed
```

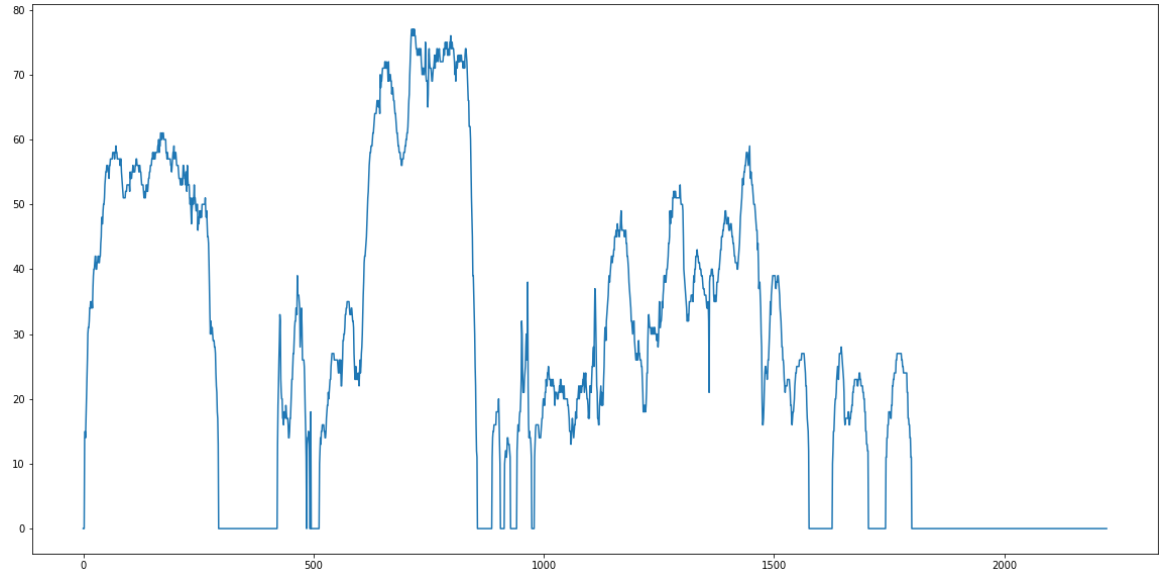
Out[206]:

```
28110     0
28111     0
28112     0
28113    14
28114    15
28115    14
28116    17
28117    20
28118    23
28119    26
28120    30
28121    31
28122    31
28123    32
28124    34
28125    34
28126    35
28127    34
28128    35
28129    35
28130    34
28131    37
28132    39
28133    40
28134    40
28135    41
28136    42
28137    42
28138    40
28139    40
          ..
30303     0
30304     0
30305     0
30306     0
30307     0
30308     0
30309     0
30310     0
30311     0
30312     0
30313     0
30314     0
30315     0
30316     0
30317     0
30318     0
30319     0
30320     0
30321     0
30322     0
30323     0
30324     0
30325     0
30326     0
30327     0
30328     0
30329     0
30330     0
```

```
30331    0
30332    0
Name: gps_speed, Length: 2223, dtype: int64
```

In [300]:

```
plt.figure(figsize=(20, 10))
plt.plot(range(len(speed)), speed)
plt.show()
```



可以看到开了好多段，有加速有减速

速度平滑（已废弃）

但原始数据有点过于极端，比如速度数据会突然变成 0。我们用窗口来平滑一下，这里使用汉宁窗口，hanning，即利用窗口卷积平滑。

In [305]:

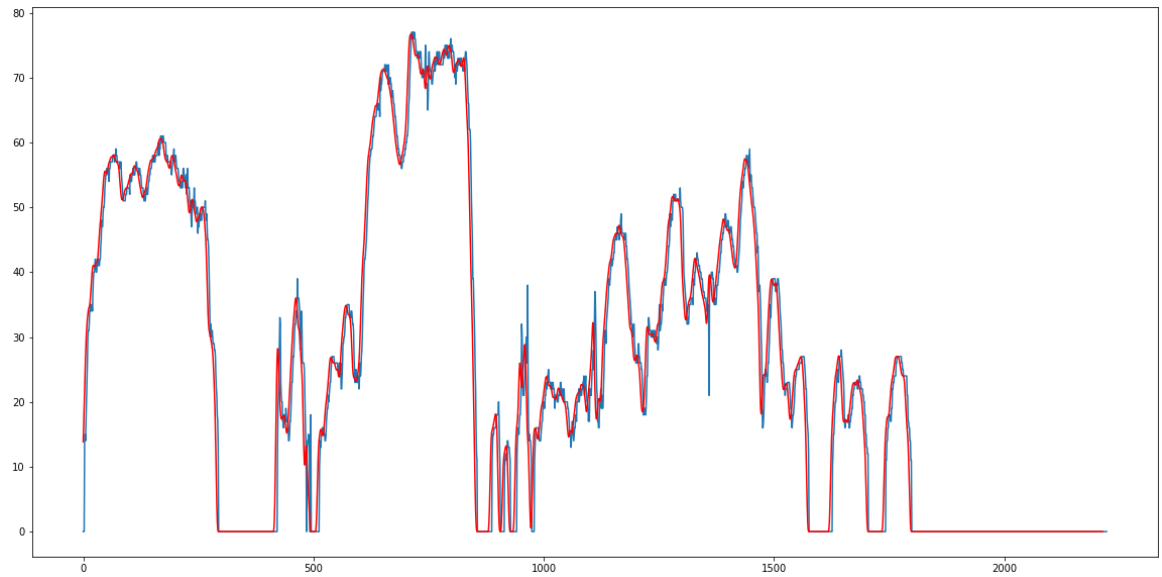
```
# 窗口大小为 10，即窗口内进行卷积操作
hanning_window_size = 10
```

In [306]:

```
hanning_weights = np.hanning(hanning_window_size)
speed_smooth = np.convolve(hanning_weights / hanning_weights.sum(), speed)[hanning_window_size - 1: -hanning_window_size + 1]
```

In [307]:

```
plt.figure(figsize=(20, 10))
plt.plot(range(len(speed)), speed)
plt.plot(range(len(speed_smooth)), speed_smooth, color='red')
plt.show()
```



目前来看作用不大，那就用原数据吧。

加速度处理

下面来分析下加速度情况

In [309]:

```
# 下移一行，方便前后速度作差
segdf_shift = segdf.shift(1)
```

In [310]:

```
segdf_speed_minus = segdf['gps_speed'] - segdf_shift['gps_speed']
```

In [312]:

```
segdf_speed_minus.describe()
```

Out[312]:

```
count    2222.000000
mean        0.000000
std         1.828535
min       -18.000000
25%         0.000000
50%         0.000000
75%         0.000000
max        18.000000
Name: gps_speed, dtype: float64
```

In [314]:

```
# 加速度 = 速度除以时间
segdf['acc'] = segdf_speed_minus / segdf['timestamp_minus']
```

In [319]:

```
segdf['acc'] = segdf['acc'].fillna(0)
```

In [320]:

```
segdf
```

Out[320]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
28110	AA00001	AAA9102001	189	115.860948	28.816311	1	
28111	AA00001	AAA9102001	191	115.860946	28.816265	1	
28112	AA00001	AAA9102001	192	115.860945	28.816288	1	
28113	AA00001	AAA9102001	199	115.860926	28.816196	1	
28114	AA00001	AAA9102001	203	115.860911	28.816158	1	
28115	AA00001	AAA9102001	203	115.860900	28.816123	1	
28116	AA00001	AAA9102001	204	115.860881	28.816083	1	
28117	AA00001	AAA9102001	203	115.860860	28.816036	1	
28118	AA00001	AAA9102001	202	115.860835	28.815981	1	
28119	AA00001	AAA9102001	203	115.860803	28.815920	1	
28120	AA00001	AAA9102001	203	115.860770	28.815848	1	
28121	AA00001	AAA9102001	202	115.860733	28.815773	1	
28122	AA00001	AAA9102001	200	115.860700	28.815700	1	
28123	AA00001	AAA9102001	200	115.860665	28.815621	1	
28124	AA00001	AAA9102001	200	115.860625	28.815543	1	
28125	AA00001	AAA9102001	201	115.860588	28.815461	1	
28126	AA00001	AAA9102001	200	115.860551	28.815381	1	
28127	AA00001	AAA9102001	197	115.860520	28.815300	1	
28128	AA00001	AAA9102001	194	115.860493	28.815216	1	
28129	AA00001	AAA9102001	196	115.860466	28.815131	1	
28130	AA00001	AAA9102001	199	115.860436	28.815050	1	
28131	AA00001	AAA9102001	201	115.860401	28.814966	1	
28132	AA00001	AAA9102001	202	115.860360	28.814878	1	
28133	AA00001	AAA9102001	202	115.860320	28.814791	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
28134	AA00001	AAA9102001	202	115.860275	28.814701	1	
28135	AA00001	AAA9102001	201	115.860233	28.814608	1	
28136	AA00001	AAA9102001	201	115.860193	28.814513	1	
28137	AA00001	AAA9102001	201	115.860151	28.814416	1	
28138	AA00001	AAA9102001	204	115.860105	28.814325	1	
28139	AA00001	AAA9102001	204	115.860056	28.814233	1	
...	...	...	...	...	...	...	
30303	AA00001	AAA9102001	53	115.822090	28.705791	1	
30304	AA00001	AAA9102001	53	115.822090	28.705791	1	
30305	AA00001	AAA9102001	53	115.822090	28.705791	1	
30306	AA00001	AAA9102001	53	115.822090	28.705791	1	
30307	AA00001	AAA9102001	53	115.822090	28.705791	1	
30308	AA00001	AAA9102001	53	115.822090	28.705791	1	
30309	AA00001	AAA9102001	53	115.822090	28.705791	1	
30310	AA00001	AAA9102001	53	115.822090	28.705791	1	
30311	AA00001	AAA9102001	53	115.822090	28.705791	1	
30312	AA00001	AAA9102001	53	115.822090	28.705791	1	
30313	AA00001	AAA9102001	53	115.822090	28.705791	1	
30314	AA00001	AAA9102001	53	115.822090	28.705791	1	
30315	AA00001	AAA9102001	53	115.822090	28.705791	1	
30316	AA00001	AAA9102001	53	115.822090	28.705791	1	
30317	AA00001	AAA9102001	53	115.822090	28.705791	1	
30318	AA00001	AAA9102001	53	115.822090	28.705791	1	
30319	AA00001	AAA9102001	53	115.822090	28.705791	1	
30320	AA00001	AAA9102001	53	115.822090	28.705791	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
30321	AA00001	AAA9102001	53	115.822090	28.705791	1	
30322	AA00001	AAA9102001	53	115.822090	28.705791	1	
30323	AA00001	AAA9102001	53	115.822090	28.705791	1	
30324	AA00001	AAA9102001	53	115.822090	28.705791	1	
30325	AA00001	AAA9102001	53	115.822090	28.705791	1	
30326	AA00001	AAA9102001	53	115.822090	28.705791	1	
30327	AA00001	AAA9102001	53	115.822050	28.705865	1	
30328	AA00001	AAA9102001	53	115.822050	28.705865	1	
30329	AA00001	AAA9102001	53	115.822050	28.705865	0	
30330	AA00001	AAA9102001	53	115.822050	28.705865	0	
30331	AA00001	AAA9102001	53	115.822050	28.705865	0	
30332	AA00001	AAA9102001	53	115.822050	28.705865	0	

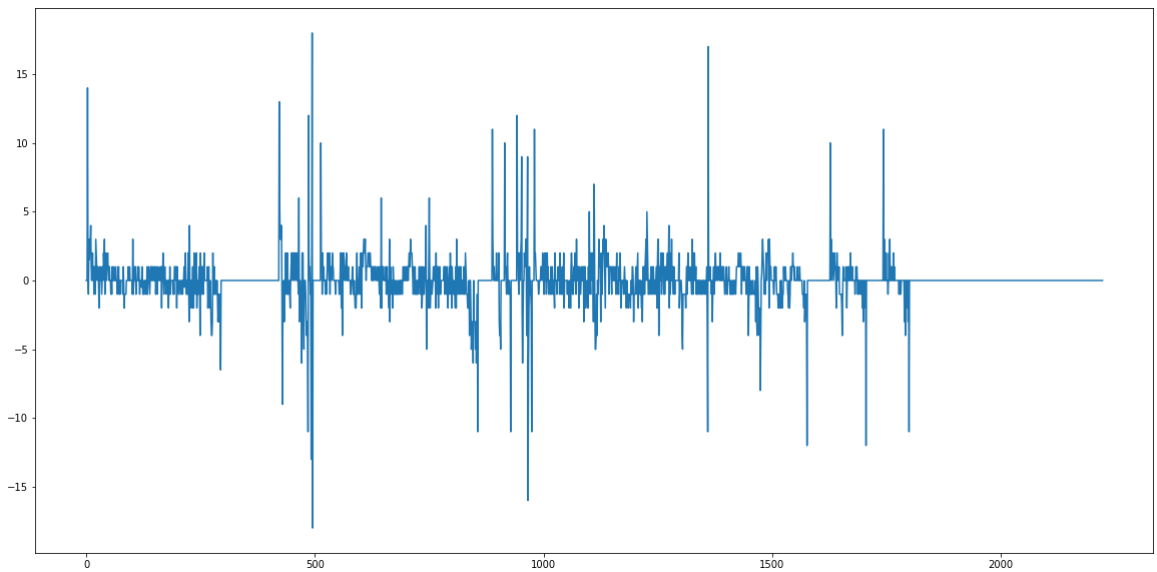
2223 rows × 16 columns

In [321]:

```
acc = segdf.acc
```

In [327]:

```
# 绘制加速度数据
plt.figure(figsize=(20, 10))
plt.plot(range(len(acc)), acc)
plt.show()
```



加速度数据平滑（已废弃）

其实照理来说加速度还蛮准的，不是脏数据。但原始数据有点过于极端。我们用窗口来平滑一下，这里还是使用汉宁窗口。

In [328]:

```
# 窗口大小为 5，即窗口内进行卷积操作
hanning_window_size = 5
```

In [330]:

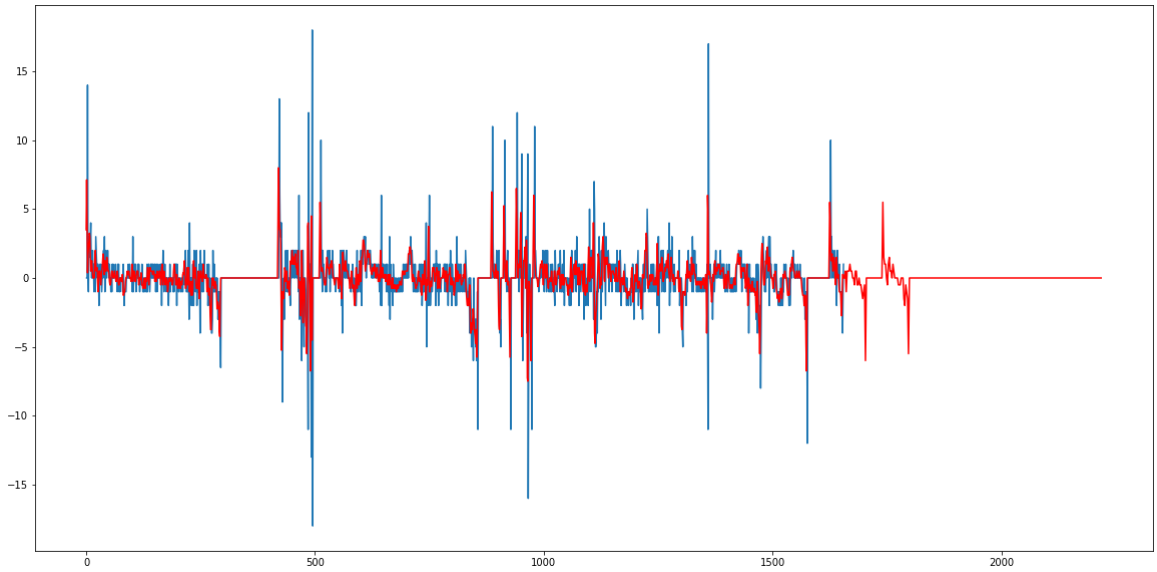
```
hanning_weights = np.hanning(hanning_window_size)
acc_smooth = np.convolve(hanning_weights / hanning_weights.sum(), acc)[hanning_window_size - 1: -h
anning_window_size + 1]
```

In [331]:

```
# 绘制平滑后的效果
plt.figure(figsize=(20, 10))
plt.plot(range(len(acc_smooth)), acc_smooth, color='red')
plt.show()
```

In [333]:

```
# 平滑前和平滑后的对比
plt.figure(figsize=(20, 10))
plt.plot(range(len(acc)), acc_speed, label='raw')
plt.plot(range(len(acc_smooth)), acc_smooth, label='smooth', color='red')
plt.show()
```



窗口卷积平滑了之后，可以看到非常极端的数据就去除了。

所以我们后面就用平滑加速度吧，将平滑后的加速度赋值为加速度

统计下

In [340]:

```
segdf
```

Out[340]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
28110	AA00001	AAA9102001	189	115.860948	28.816311	1	
28111	AA00001	AAA9102001	191	115.860946	28.816265	1	
28112	AA00001	AAA9102001	192	115.860945	28.816288	1	
28113	AA00001	AAA9102001	199	115.860926	28.816196	1	
28114	AA00001	AAA9102001	203	115.860911	28.816158	1	
28115	AA00001	AAA9102001	203	115.860900	28.816123	1	
28116	AA00001	AAA9102001	204	115.860881	28.816083	1	
28117	AA00001	AAA9102001	203	115.860860	28.816036	1	
28118	AA00001	AAA9102001	202	115.860835	28.815981	1	
28119	AA00001	AAA9102001	203	115.860803	28.815920	1	
28120	AA00001	AAA9102001	203	115.860770	28.815848	1	
28121	AA00001	AAA9102001	202	115.860733	28.815773	1	
28122	AA00001	AAA9102001	200	115.860700	28.815700	1	
28123	AA00001	AAA9102001	200	115.860665	28.815621	1	
28124	AA00001	AAA9102001	200	115.860625	28.815543	1	
28125	AA00001	AAA9102001	201	115.860588	28.815461	1	
28126	AA00001	AAA9102001	200	115.860551	28.815381	1	
28127	AA00001	AAA9102001	197	115.860520	28.815300	1	
28128	AA00001	AAA9102001	194	115.860493	28.815216	1	
28129	AA00001	AAA9102001	196	115.860466	28.815131	1	
28130	AA00001	AAA9102001	199	115.860436	28.815050	1	
28131	AA00001	AAA9102001	201	115.860401	28.814966	1	
28132	AA00001	AAA9102001	202	115.860360	28.814878	1	
28133	AA00001	AAA9102001	202	115.860320	28.814791	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
28134	AA00001	AAA9102001	202	115.860275	28.814701	1	
28135	AA00001	AAA9102001	201	115.860233	28.814608	1	
28136	AA00001	AAA9102001	201	115.860193	28.814513	1	
28137	AA00001	AAA9102001	201	115.860151	28.814416	1	
28138	AA00001	AAA9102001	204	115.860105	28.814325	1	
28139	AA00001	AAA9102001	204	115.860056	28.814233	1	
...	...	...	...	...	...	...	
30303	AA00001	AAA9102001	53	115.822090	28.705791	1	
30304	AA00001	AAA9102001	53	115.822090	28.705791	1	
30305	AA00001	AAA9102001	53	115.822090	28.705791	1	
30306	AA00001	AAA9102001	53	115.822090	28.705791	1	
30307	AA00001	AAA9102001	53	115.822090	28.705791	1	
30308	AA00001	AAA9102001	53	115.822090	28.705791	1	
30309	AA00001	AAA9102001	53	115.822090	28.705791	1	
30310	AA00001	AAA9102001	53	115.822090	28.705791	1	
30311	AA00001	AAA9102001	53	115.822090	28.705791	1	
30312	AA00001	AAA9102001	53	115.822090	28.705791	1	
30313	AA00001	AAA9102001	53	115.822090	28.705791	1	
30314	AA00001	AAA9102001	53	115.822090	28.705791	1	
30315	AA00001	AAA9102001	53	115.822090	28.705791	1	
30316	AA00001	AAA9102001	53	115.822090	28.705791	1	
30317	AA00001	AAA9102001	53	115.822090	28.705791	1	
30318	AA00001	AAA9102001	53	115.822090	28.705791	1	
30319	AA00001	AAA9102001	53	115.822090	28.705791	1	
30320	AA00001	AAA9102001	53	115.822090	28.705791	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
30321	AA00001	AAA9102001	53	115.822090	28.705791	1	
30322	AA00001	AAA9102001	53	115.822090	28.705791	1	
30323	AA00001	AAA9102001	53	115.822090	28.705791	1	
30324	AA00001	AAA9102001	53	115.822090	28.705791	1	
30325	AA00001	AAA9102001	53	115.822090	28.705791	1	
30326	AA00001	AAA9102001	53	115.822090	28.705791	1	
30327	AA00001	AAA9102001	53	115.822050	28.705865	1	
30328	AA00001	AAA9102001	53	115.822050	28.705865	1	
30329	AA00001	AAA9102001	53	115.822050	28.705865	0	
30330	AA00001	AAA9102001	53	115.822050	28.705865	0	
30331	AA00001	AAA9102001	53	115.822050	28.705865	0	
30332	AA00001	AAA9102001	53	115.822050	28.705865	0	

2223 rows × 16 columns

3. 聚类处理

示例

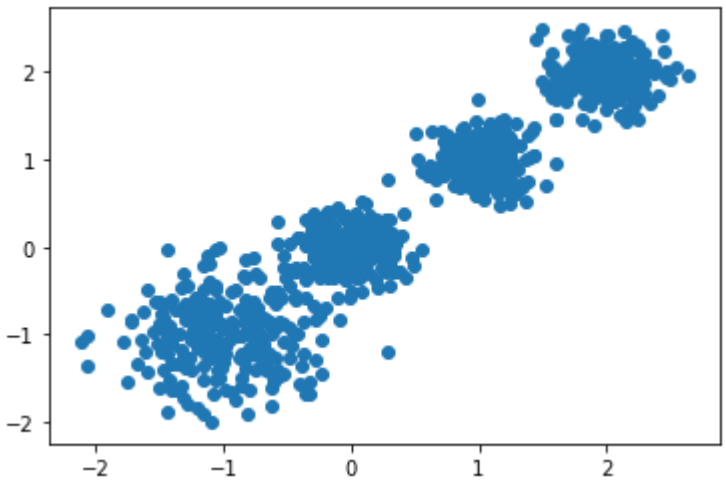
首先我们随机创建一些二维数据作为训练集，选择二维特征数据，主要是方便可视化。代码如下：

In [344]:

```
import matplotlib.pyplot as plt
from sklearn.datasets.samples_generator import make_blobs

# X为样本特征，Y为样本簇类别，共1000个样本，每个样本2个特征，对应x和y轴，共4个簇，
# 簇中心在[-1,-1], [0,0],[1,1], [2,2]， 簇方差分别为[0.4, 0.2, 0.2]
X, y = make_blobs(n_samples=1000, n_features=2, centers=[[-1, -1], [0, 0], [1, 1], [2, 2]],
                  cluster_std=[0.4, 0.2, 0.2, 0.2], random_state=9)

plt.scatter(X[:, 0], X[:, 1], marker='o')  # 假设暂不知道y类别，不设置c=y，使用kmeans聚类
plt.show()
```

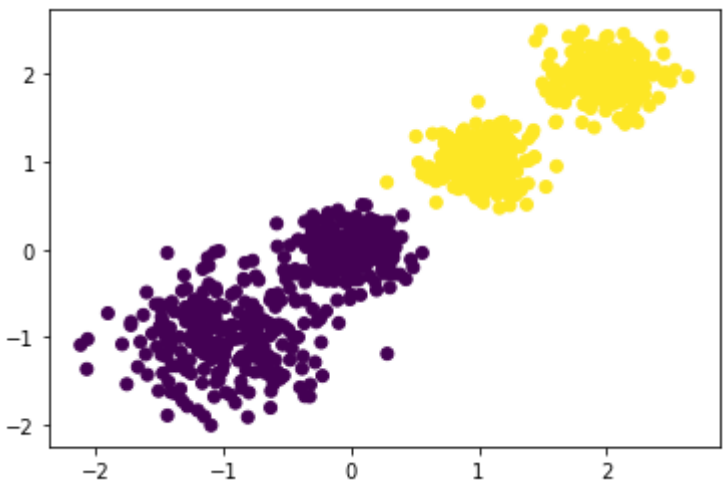


现在我们来用K-Means聚类方法来做聚类，首先选择k=2，代码如下：

In [345]:

```
from sklearn.cluster import KMeans

y_pred = KMeans(n_clusters=2, random_state=9).fit_predict(X)
plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.show()
```



现在我们来看看我们用Calinski-Harabasz Index评估的聚类分数，分数越高聚的越好

In [348]:

```
from sklearn import metrics
print(metrics.calinski_harabaz_score(X, y_pred))
```

3116.1706763322227

/usr/local/lib/python3.7/site-packages/sklearn/utils/deprecation.py:85: DeprecationWarning: Function calinski_harabaz_score is deprecated; Function 'calinski_harabaz_score' has been renamed to 'calinski_harabasz_score' and will be removed in version 0.23.
  warnings.warn(msg, category=DeprecationWarning)

准备数据

下面让我们把现有的速度和加速度数据变成 X

In [404]:

```
segdf['speed'] = segdf['gps_speed']
```

In [405]:

```
X = segdf[['gps_speed', 'acc']]
```

In [406]:

```
X
```

Out[406]:

	gps_speed	acc
28110	0	0.0
28111	0	0.0
28112	0	0.0
28113	14	14.0
28114	15	0.5
28115	14	-1.0
28116	17	3.0
28117	20	1.5
28118	23	3.0
28119	26	3.0
28120	30	4.0
28121	31	1.0
28122	31	0.0
28123	32	1.0
28124	34	2.0
28125	34	0.0
28126	35	1.0
28127	34	-1.0
28128	35	1.0
28129	35	0.0
28130	34	-1.0
28131	37	3.0
28132	39	2.0
28133	40	1.0
28134	40	0.0
28135	41	1.0
28136	42	1.0
28137	42	0.0
28138	40	-2.0
28139	40	0.0
...	...	...
30303	0	0.0
30304	0	0.0
30305	0	0.0
30306	0	0.0
30307	0	0.0

	gps_speed	acc
30308	0	0.0
30309	0	0.0
30310	0	0.0
30311	0	0.0
30312	0	0.0
30313	0	0.0
30314	0	0.0
30315	0	0.0
30316	0	0.0
30317	0	0.0
30318	0	0.0
30319	0	0.0
30320	0	0.0
30321	0	0.0
30322	0	0.0
30323	0	0.0
30324	0	0.0
30325	0	0.0
30326	0	0.0
30327	0	0.0
30328	0	0.0
30329	0	0.0
30330	0	0.0
30331	0	0.0
30332	0	0.0

2223 rows × 2 columns

归一化一下

In [407]:

```
from sklearn.preprocessing import MinMaxScaler
```

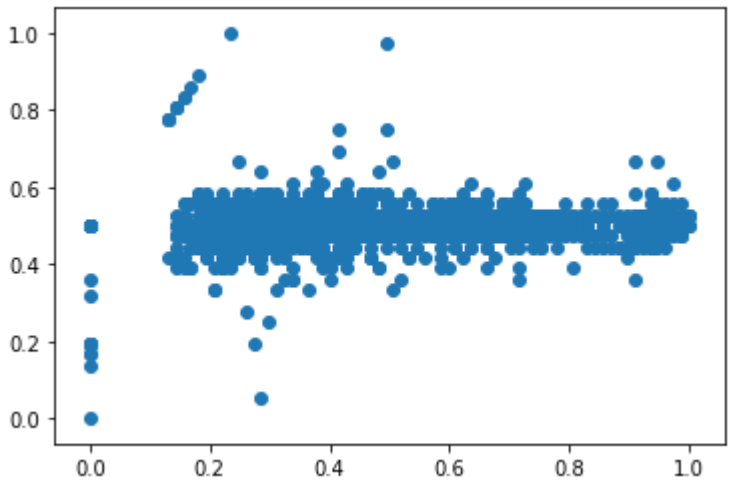
In [408]:

```
X = MinMaxScaler().fit_transform(X)
```

看看效果

In [413]:

```
plt.scatter(X[:, 0], X[:, 1], marker='o')
plt.show()
```



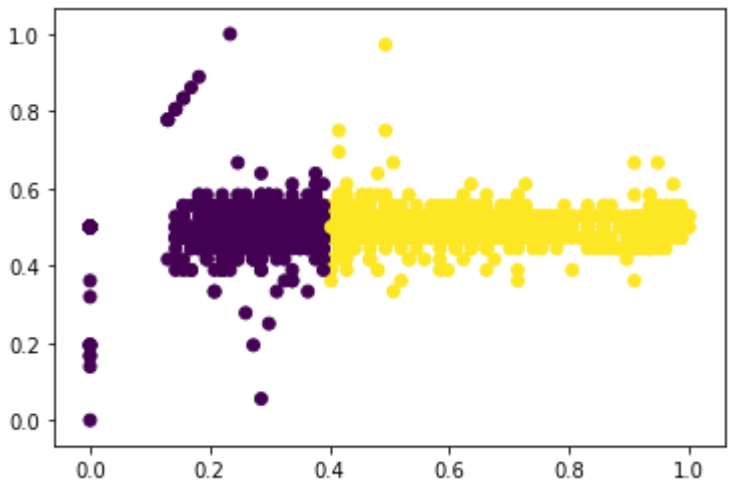
初步尝试 KMeans

尝试 2 堆聚类

In [414]:

```
from sklearn.cluster import KMeans

y_pred = KMeans(n_clusters=2, random_state=9).fit_predict(X)
plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.show()
```



In [415]:

```
from sklearn import metrics
print(metrics.calinski_harabaz_score(X, y_pred))
```

6019.884015952393

/usr/local/lib/python3.7/site-packages/sklearn/utils/deprecation.py:85: DeprecationWarning: Function calinski_harabaz_score is deprecated; Function 'calinski_harabaz_score' has been renamed to 'calinski_harabasz_score' and will be removed in version 0.23.
  warnings.warn(msg, category=DeprecationWarning)

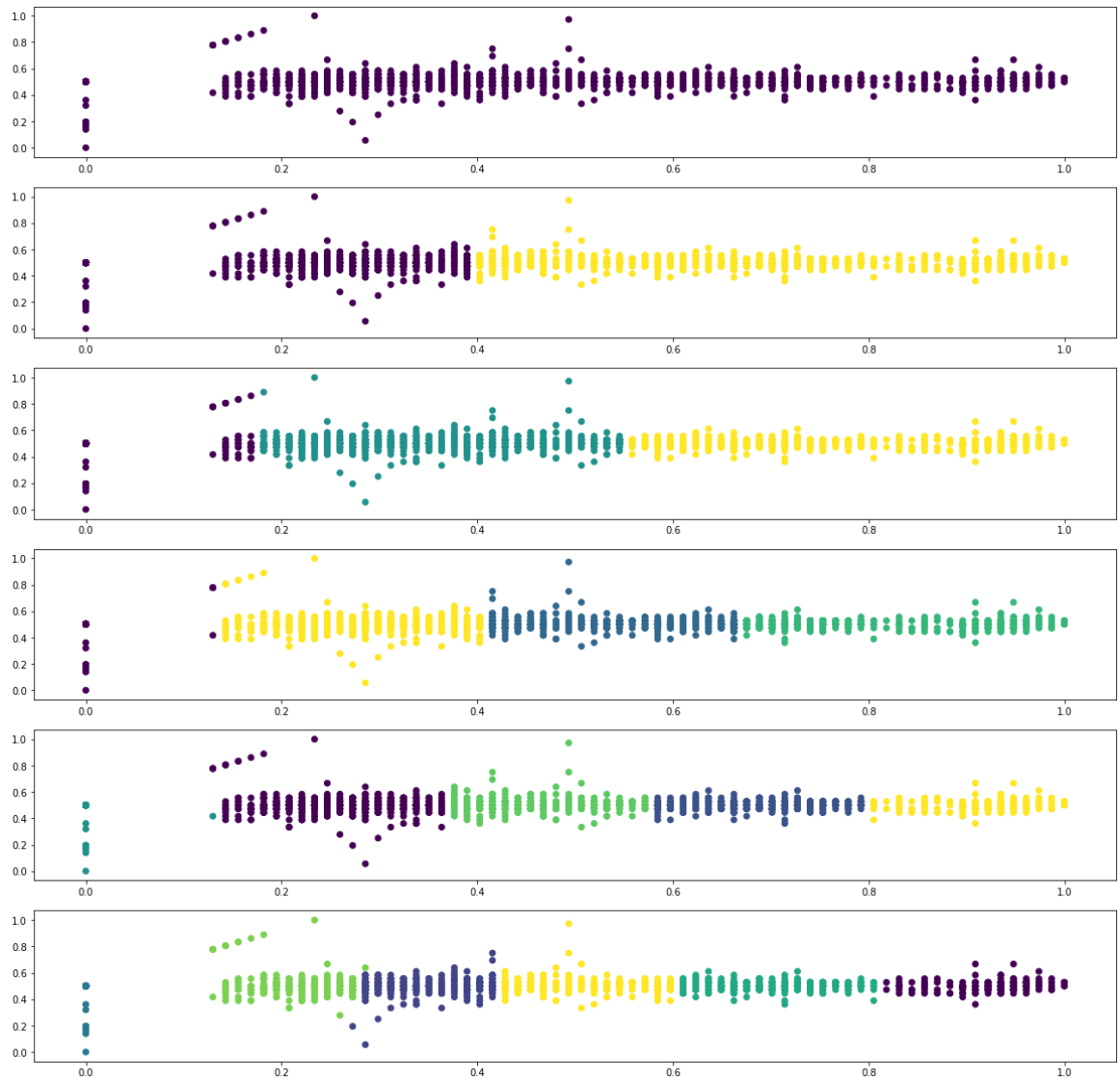
尝试多堆聚类

In [416]:

```
n_clusters = 6
```

In [417]:

```
plt.figure(figsize=(20, 20))
for i in range(1, n_clusters + 1):
    plt.subplot(n_clusters, 1, i)
    y_pred = KMeans(n_clusters=i, random_state=9).fit_predict(X)
    plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.show()
```



发现都是纵向切割的，根据速度切割，而不是根据加速度切割。但现在加速和减速其实是应该明显要区别出来的，所以再引入一维数据。

筛选数据

这里我们把速度和加速度为 0 的数据筛掉再试试。

In [418]:

```
segdf_filtered = segdf[(segdf.speed > 0) & (segdf.acc != 0)]
```

In [419]:

```
segdf_filtered
```

Out[419]:

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
28113	AA00001	AAA9102001	199	115.860926	28.816196	1	
28114	AA00001	AAA9102001	203	115.860911	28.816158	1	
28115	AA00001	AAA9102001	203	115.860900	28.816123	1	
28116	AA00001	AAA9102001	204	115.860881	28.816083	1	
28117	AA00001	AAA9102001	203	115.860860	28.816036	1	
28118	AA00001	AAA9102001	202	115.860835	28.815981	1	
28119	AA00001	AAA9102001	203	115.860803	28.815920	1	
28120	AA00001	AAA9102001	203	115.860770	28.815848	1	
28121	AA00001	AAA9102001	202	115.860733	28.815773	1	
28123	AA00001	AAA9102001	200	115.860665	28.815621	1	
28124	AA00001	AAA9102001	200	115.860625	28.815543	1	
28126	AA00001	AAA9102001	200	115.860551	28.815381	1	
28127	AA00001	AAA9102001	197	115.860520	28.815300	1	
28128	AA00001	AAA9102001	194	115.860493	28.815216	1	
28130	AA00001	AAA9102001	199	115.860436	28.815050	1	
28131	AA00001	AAA9102001	201	115.860401	28.814966	1	
28132	AA00001	AAA9102001	202	115.860360	28.814878	1	
28133	AA00001	AAA9102001	202	115.860320	28.814791	1	
28135	AA00001	AAA9102001	201	115.860233	28.814608	1	
28136	AA00001	AAA9102001	201	115.860193	28.814513	1	
28138	AA00001	AAA9102001	204	115.860105	28.814325	1	
28140	AA00001	AAA9102001	200	115.860013	28.814138	1	
28142	AA00001	AAA9102001	199	115.859926	28.813945	1	
28144	AA00001	AAA9102001	200	115.859843	28.813750	1	

	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
28146	AA00001	AAA9102001	200	115.859768	28.813555	1	
28148	AA00001	AAA9102001	200	115.859686	28.813351	1	
28149	AA00001	AAA9102001	200	115.859643	28.813243	1	
28150	AA00001	AAA9102001	201	115.859593	28.813131	1	
28151	AA00001	AAA9102001	202	115.859541	28.813021	1	
28153	AA00001	AAA9102001	204	115.859426	28.812781	1	
...	...	...	...	...	...	...	
29791	AA00001	AAA9102001	300	115.823830	28.704260	1	
29793	AA00001	AAA9102001	302	115.823775	28.704291	1	
29795	AA00001	AAA9102001	302	115.823718	28.704326	1	
29797	AA00001	AAA9102001	303	115.823663	28.704360	1	
29799	AA00001	AAA9102001	303	115.823611	28.704391	1	
29803	AA00001	AAA9102001	302	115.823505	28.704453	1	
29805	AA00001	AAA9102001	302	115.823455	28.704481	1	
29807	AA00001	AAA9102001	303	115.823411	28.704506	1	
29809	AA00001	AAA9102001	303	115.823371	28.704531	1	
29811	AA00001	AAA9102001	300	115.823335	28.704551	1	
29813	AA00001	AAA9102001	299	115.823301	28.704568	1	
29853	AA00001	AAA9102001	310	115.823091	28.704648	1	
29855	AA00001	AAA9102001	317	115.823066	28.704673	1	
29857	AA00001	AAA9102001	316	115.823036	28.704701	1	
29859	AA00001	AAA9102001	314	115.823000	28.704733	1	
29863	AA00001	AAA9102001	313	115.822930	28.704791	1	
29865	AA00001	AAA9102001	312	115.822893	28.704820	1	
29867	AA00001	AAA9102001	310	115.822848	28.704853	1	

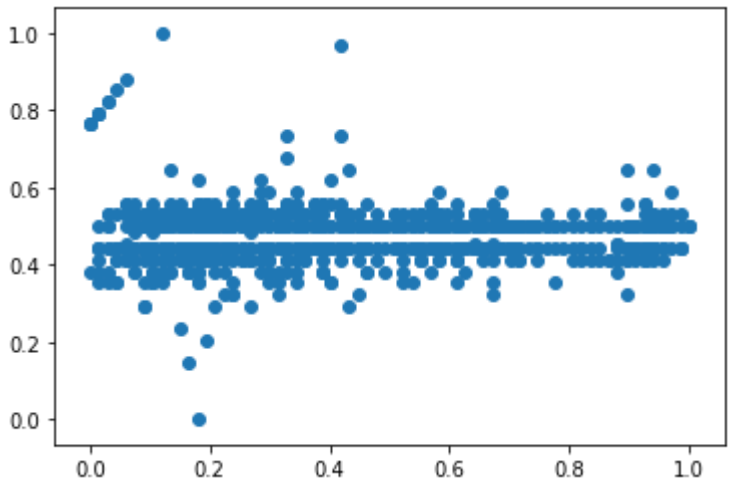
	vehicleplatenumber	device_num	direction_angle	lng	lat	acc_state	rig
29869	AA00001	AAA9102001	308	115.822798	28.704888	1	
29871	AA00001	AAA9102001	308	115.822746	28.704925	1	
29875	AA00001	AAA9102001	309	115.822628	28.704998	1	
29877	AA00001	AAA9102001	309	115.822566	28.705040	1	
29887	AA00001	AAA9102001	308	115.822256	28.705256	1	
29889	AA00001	AAA9102001	309	115.822200	28.705300	1	
29891	AA00001	AAA9102001	309	115.822146	28.705340	1	
29899	AA00001	AAA9102001	313	115.821950	28.705495	1	
29901	AA00001	AAA9102001	316	115.821916	28.705526	1	
29903	AA00001	AAA9102001	320	115.821890	28.705556	1	
29905	AA00001	AAA9102001	327	115.821871	28.705586	1	
29907	AA00001	AAA9102001	338	115.821861	28.705615	1	

942 rows × 18 columns

看看可视化效果

In [430]:

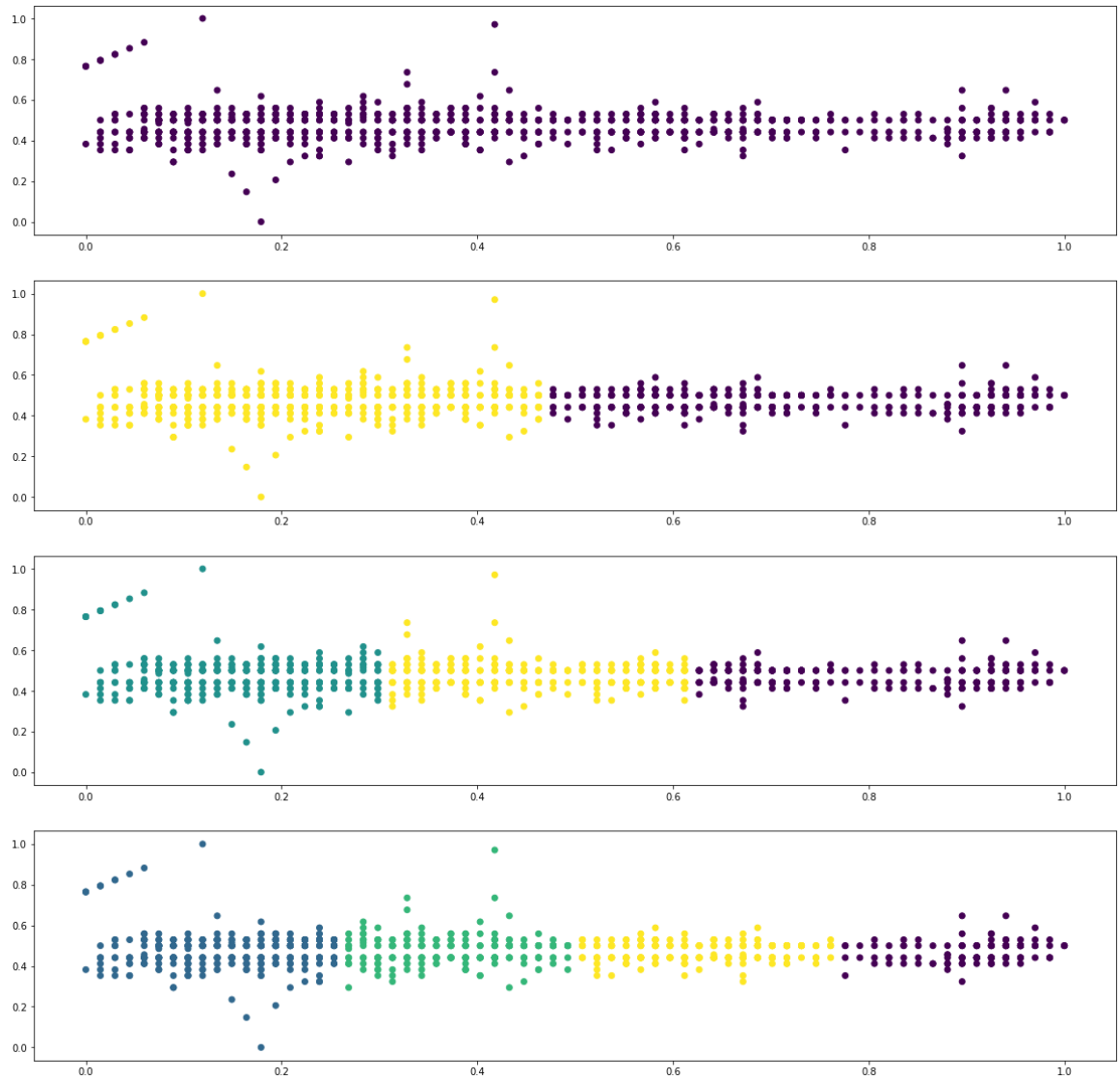
```
X = segdf_filtered[['gps_speed', 'acc']].values
X = MinMaxScaler().fit_transform(X)
plt.scatter(X[:, 0], X[:, 1])
plt.show()
```



尝试聚类

In [431]:

```
n_clusters = 4
plt.figure(figsize=(20, 20))
for i in range(1, n_clusters + 1):
    plt.subplot(n_clusters, 1, i)
    y_pred = KMeans(n_clusters=i, random_state=9).fit_predict(X)
    plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.show()
```



依然还是没法把加速减速分开

加速减速速度处理

没法分开怎么办呢？单独加一维来辅助吧，定义一维加速状态，比如加速就是 1，减速就是 -1，停止就是 0

In [439]:

```
# 定义加速、减速、停止的状态
def speed_state(acc):
    if acc > 0: return 1
    if acc == 0: return 0
    if acc < 0: return -1
```

In [454]:

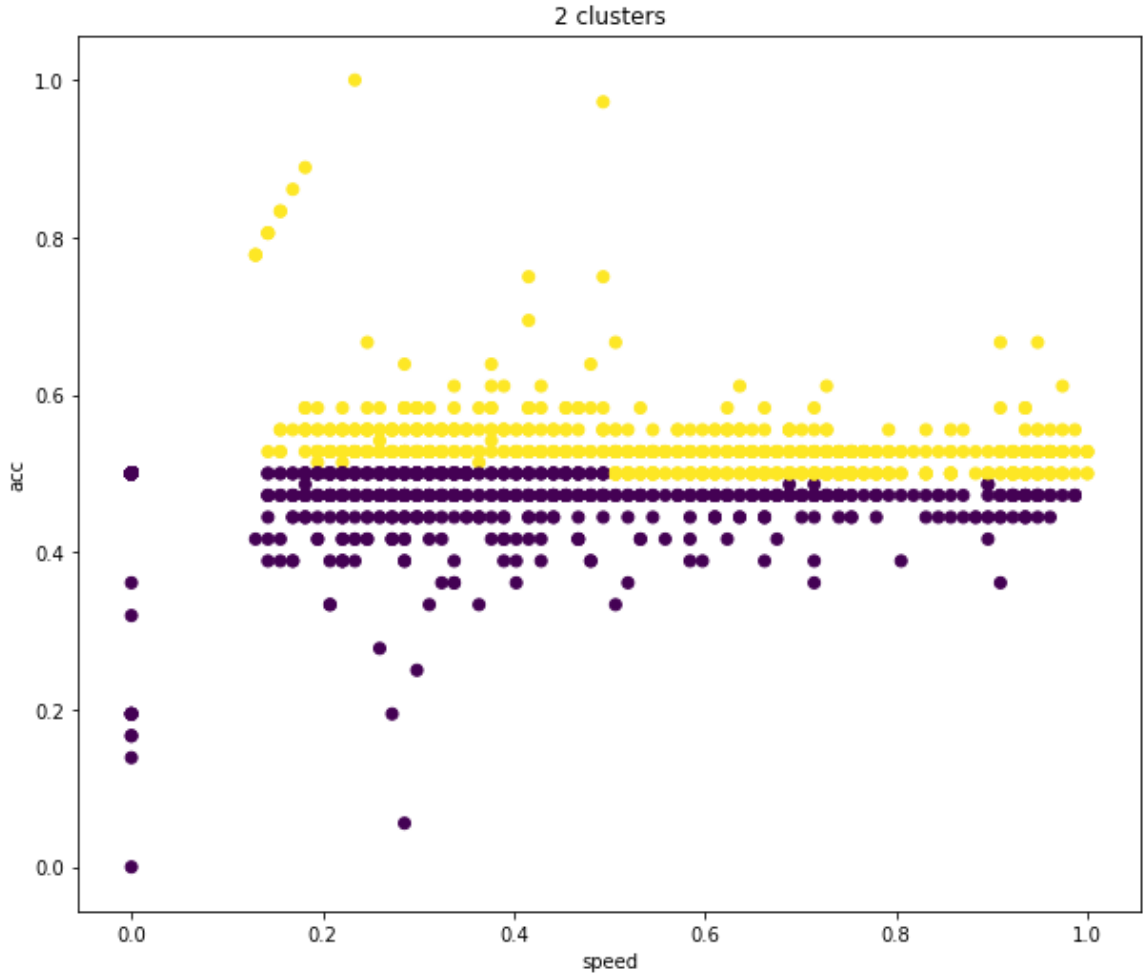
```
segdf['speed_state'] = segdf['acc'].apply(speed_state)
```

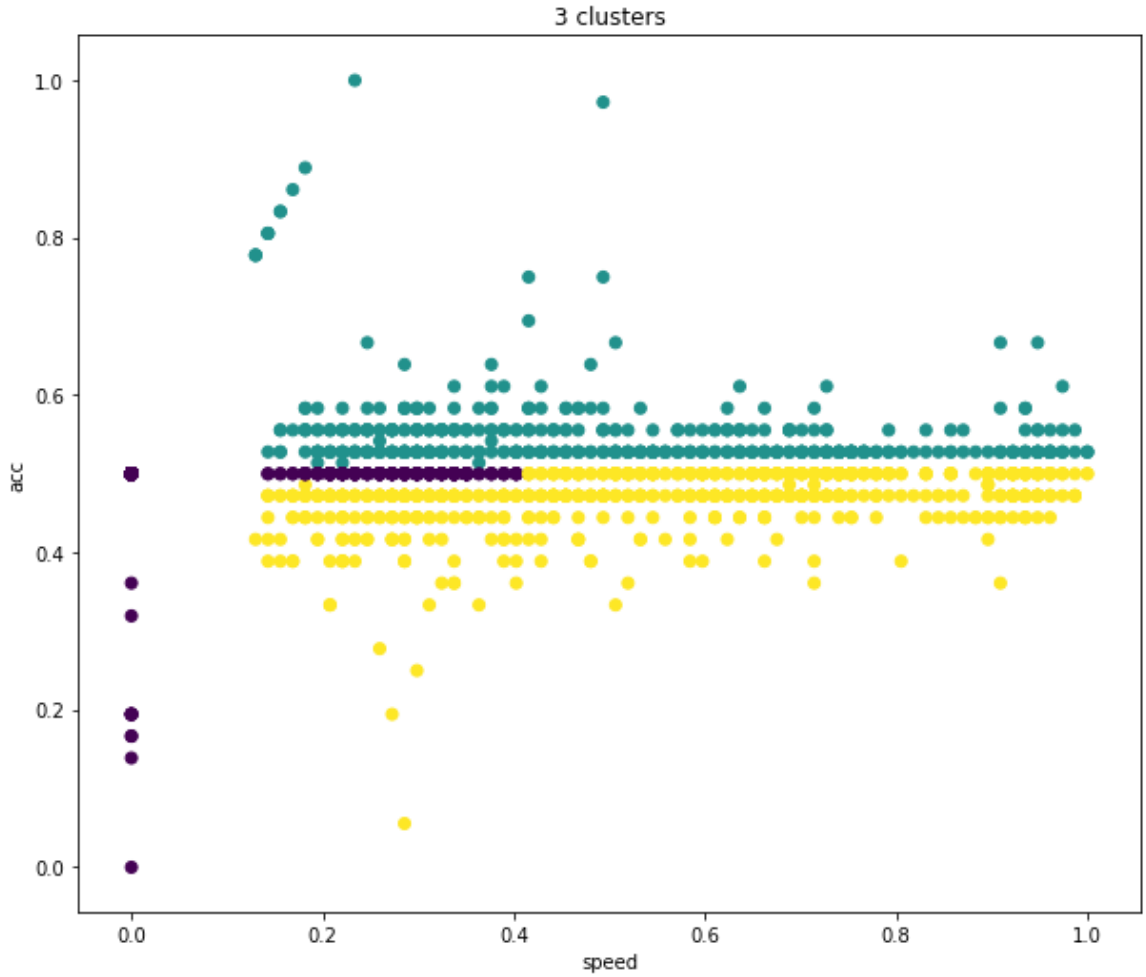
In [461]:

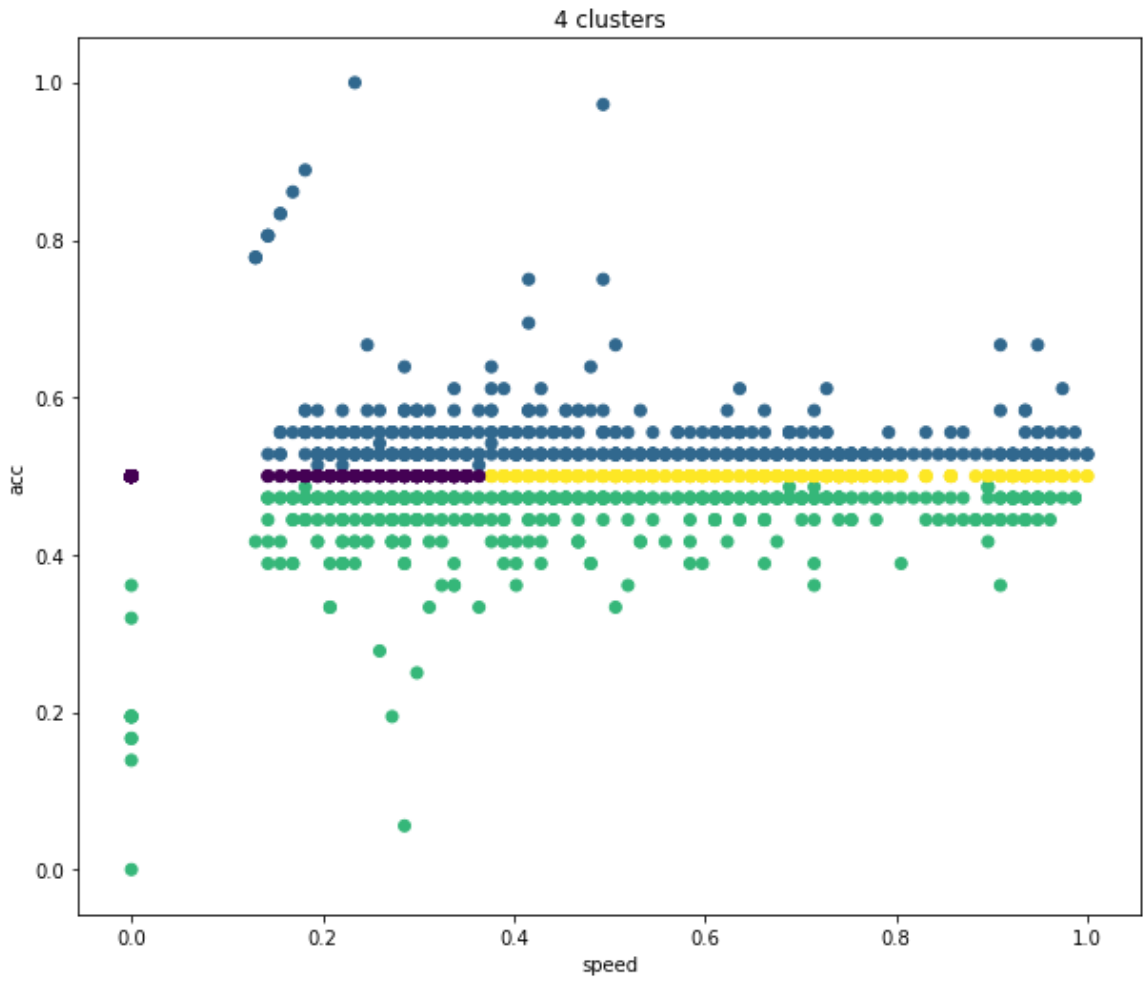
```
X = segdf[['speed', 'acc', 'speed_state']].values
X = MinMaxScaler().fit_transform(X)
```

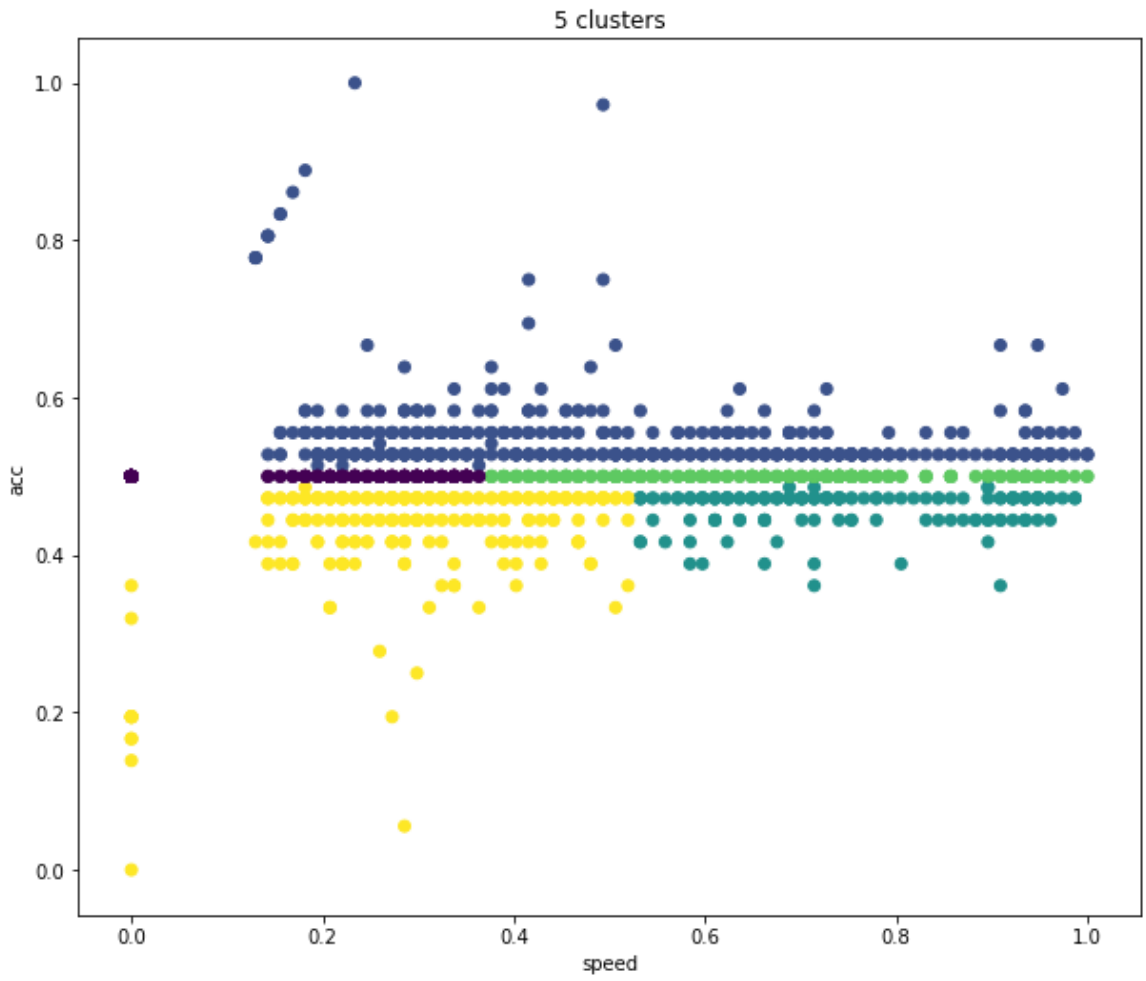
In [462]:

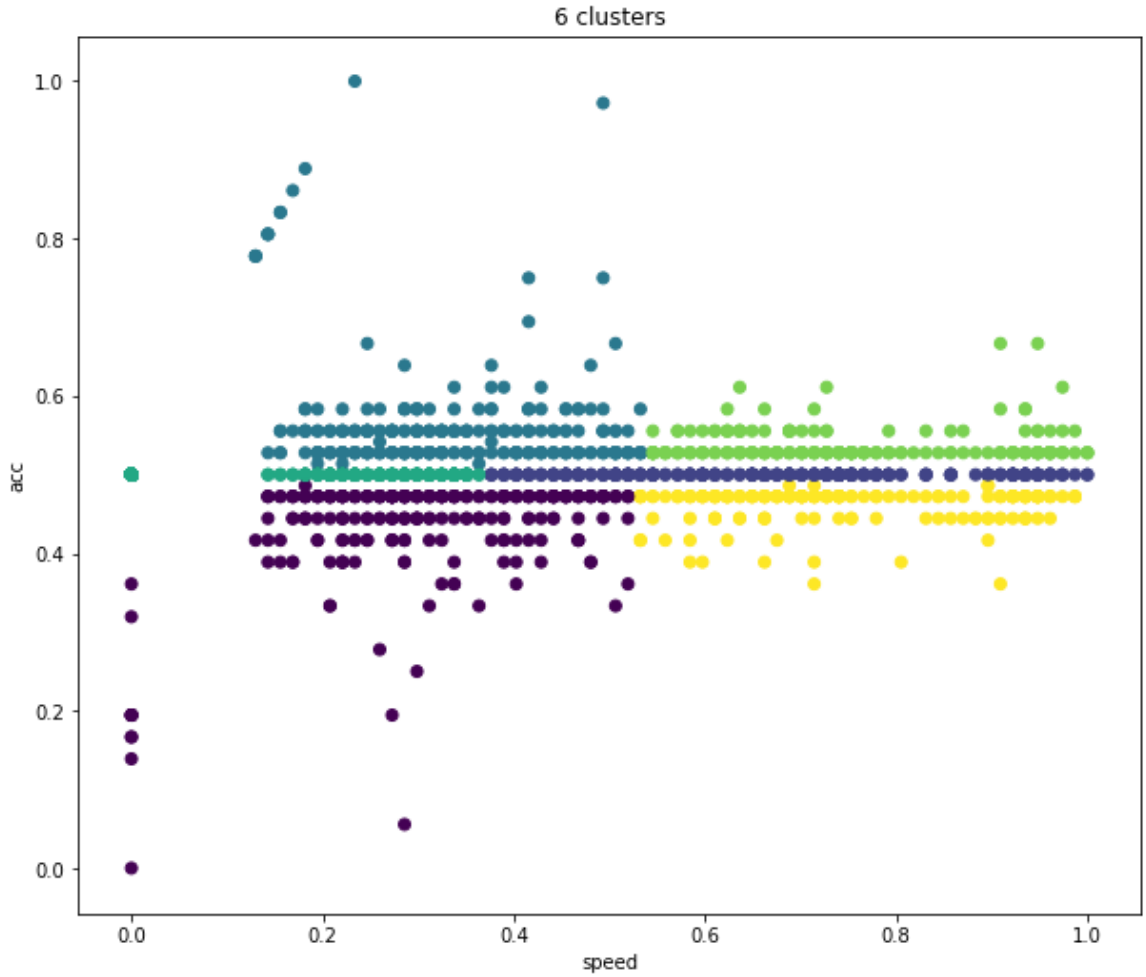
```
# 聚类 2 堆 - 8 堆
n_clusters = 10
figsize_x = 10
plt.figure(figsize=(10, figsize_x * n_clusters))
for i in range(2, n_clusters + 1):
    ax = plt.subplot(n_clusters, 1, i)
    ax.set_title(f'{i} clusters')
    y_pred = KMeans(n_clusters=i, random_state=9).fit_predict(X)
    plt.scatter(X[:, 0], X[:, 1], c=y_pred)
    plt.ylabel('acc')
    plt.xlabel('speed')
plt.show()
```

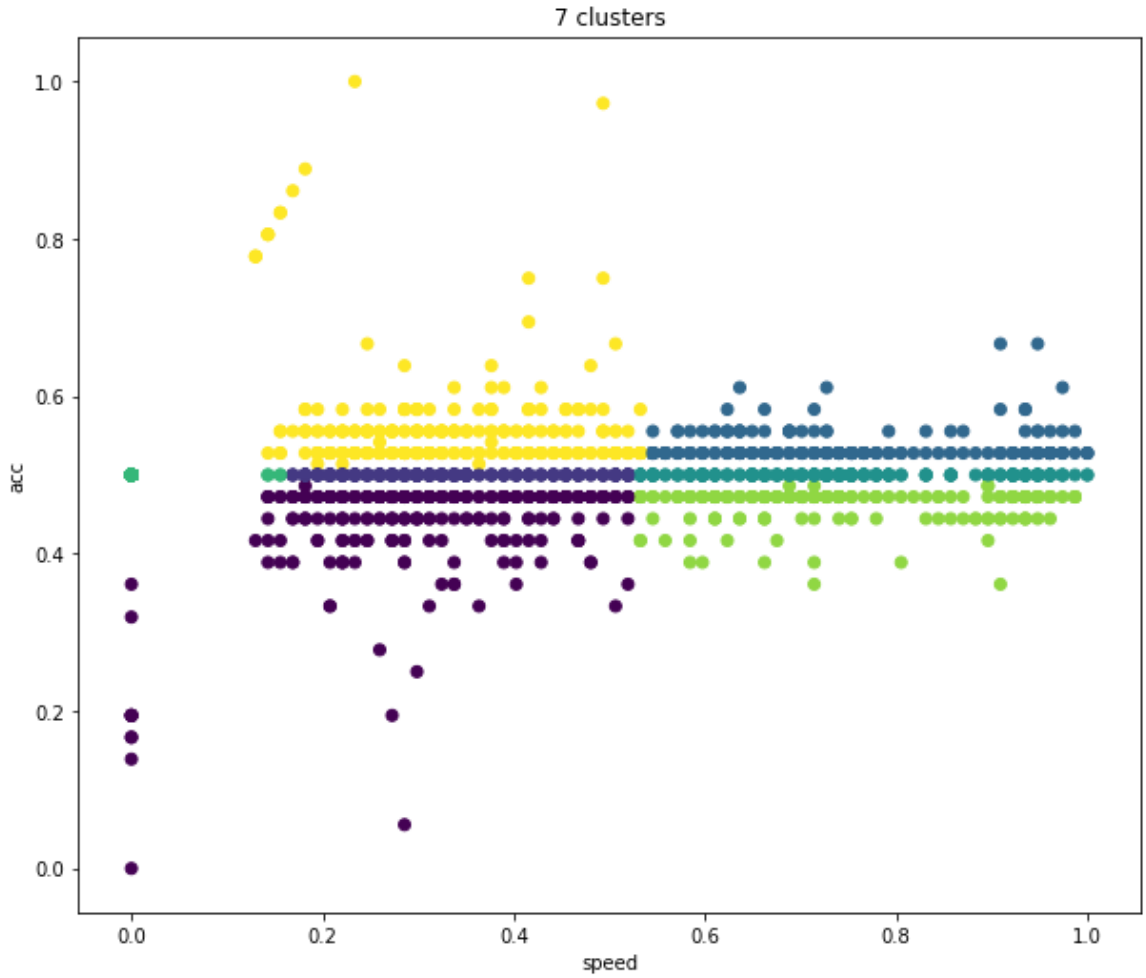

2 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0

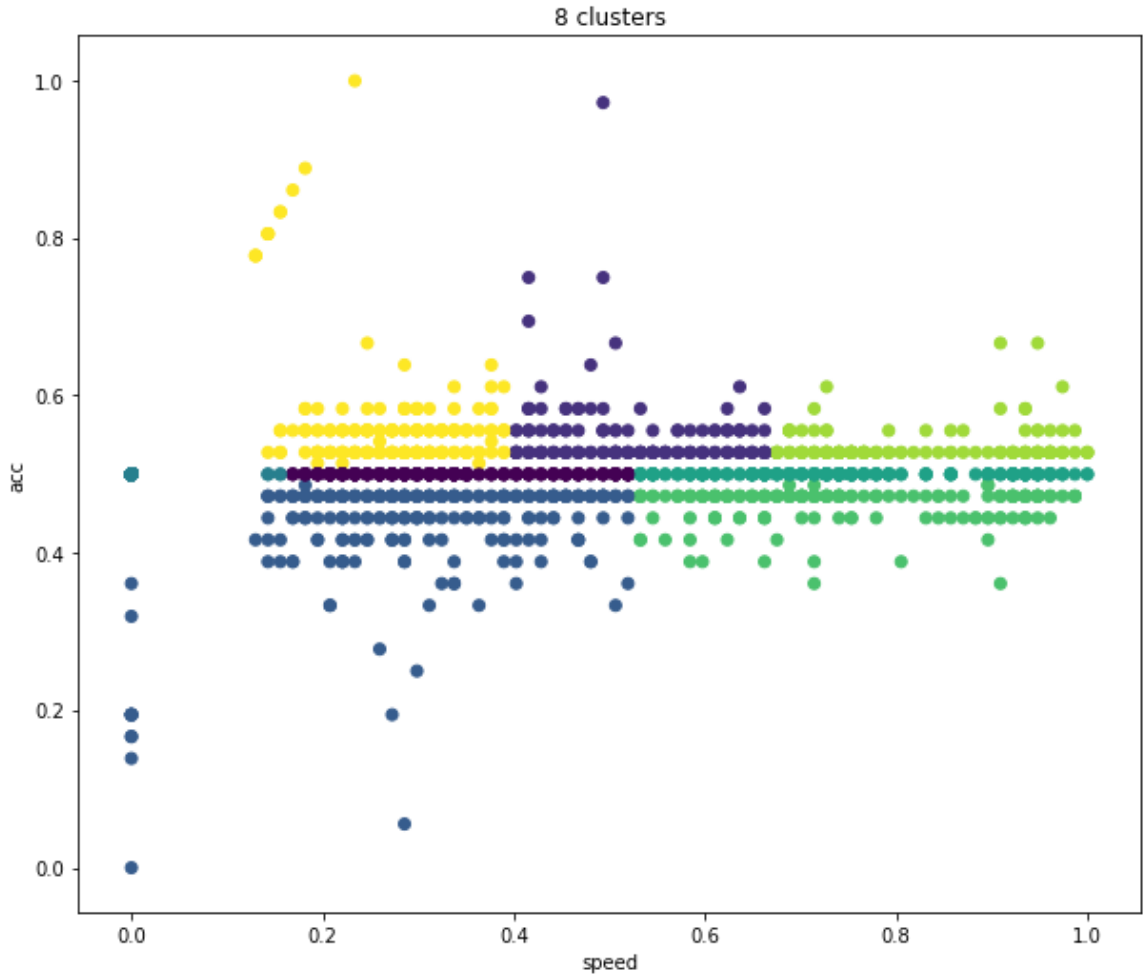

3 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0

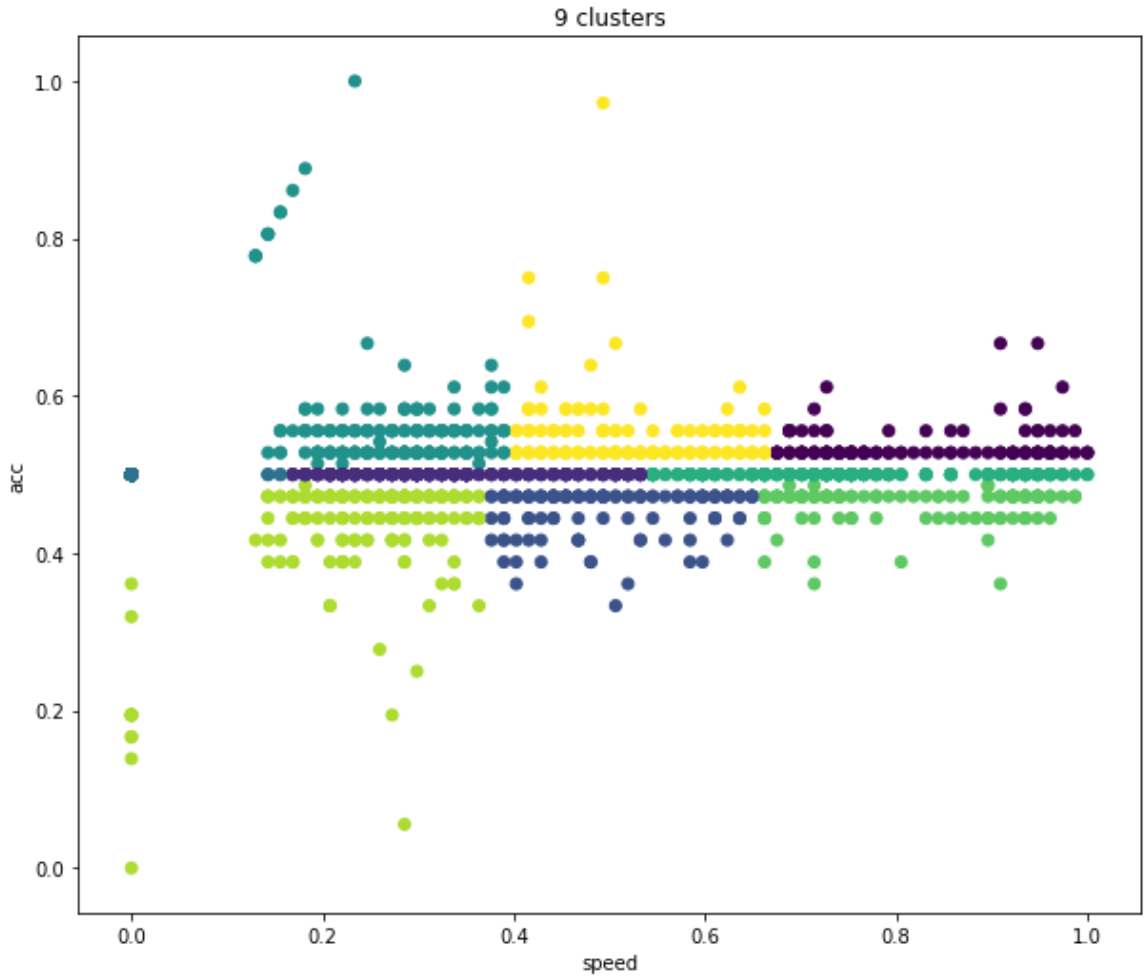

4 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0

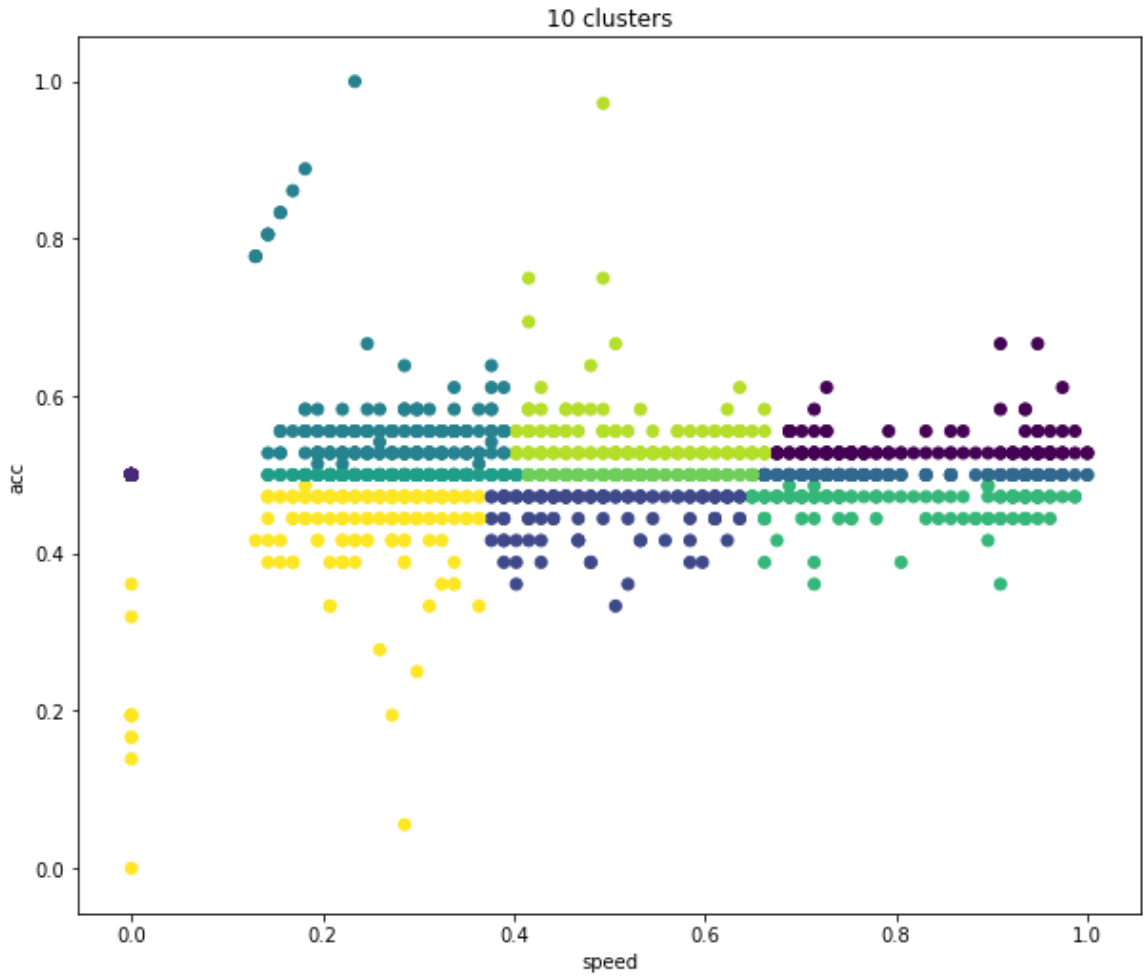

5 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0


6 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0


7 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0


8 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0


9 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0



卧槽聚出来了！

速度和加速度不是 0 的还在里面，那咱们直接去掉吧，估计效果会更好。

In [464]:

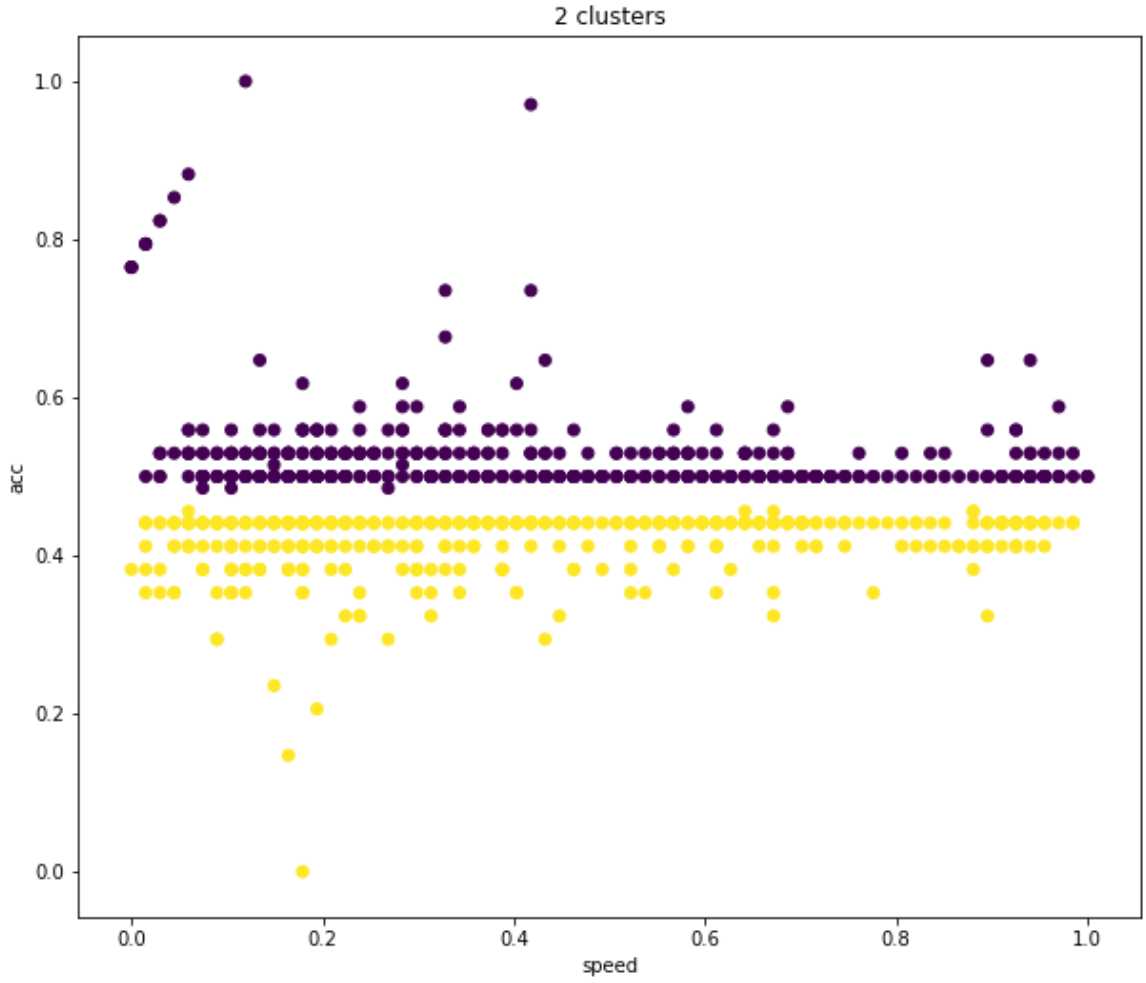
```
segdf_filtered['speed_state'] = segdf_filtered['acc'].apply(speed_state)
X = segdf_filtered[['speed', 'acc', 'speed_state']].values
X = MinMaxScaler().fit_transform(X)
```

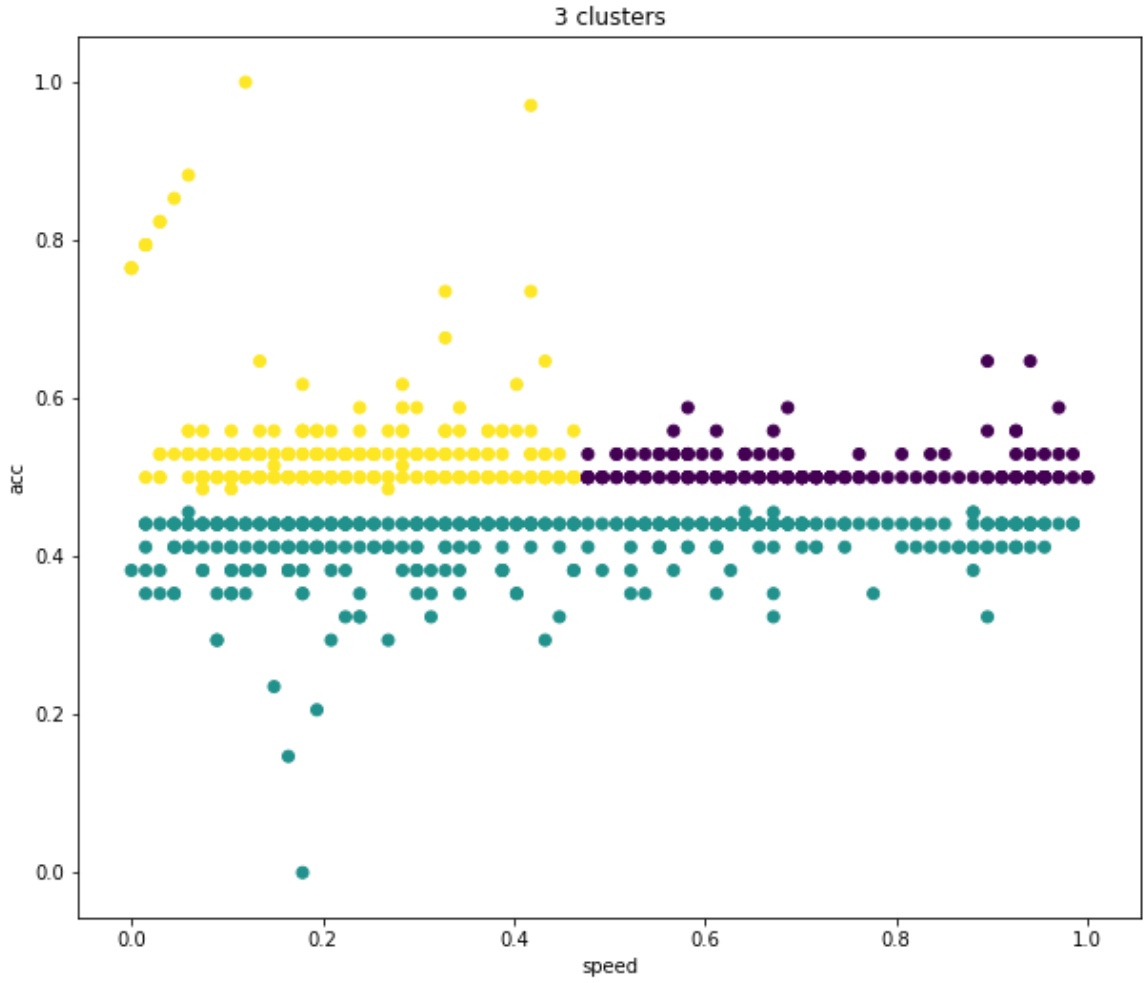
```
/usr/local/lib/python3.7/site-packages/ipykernel/__main__.py:1: SettingWithCopyWarni
ng:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

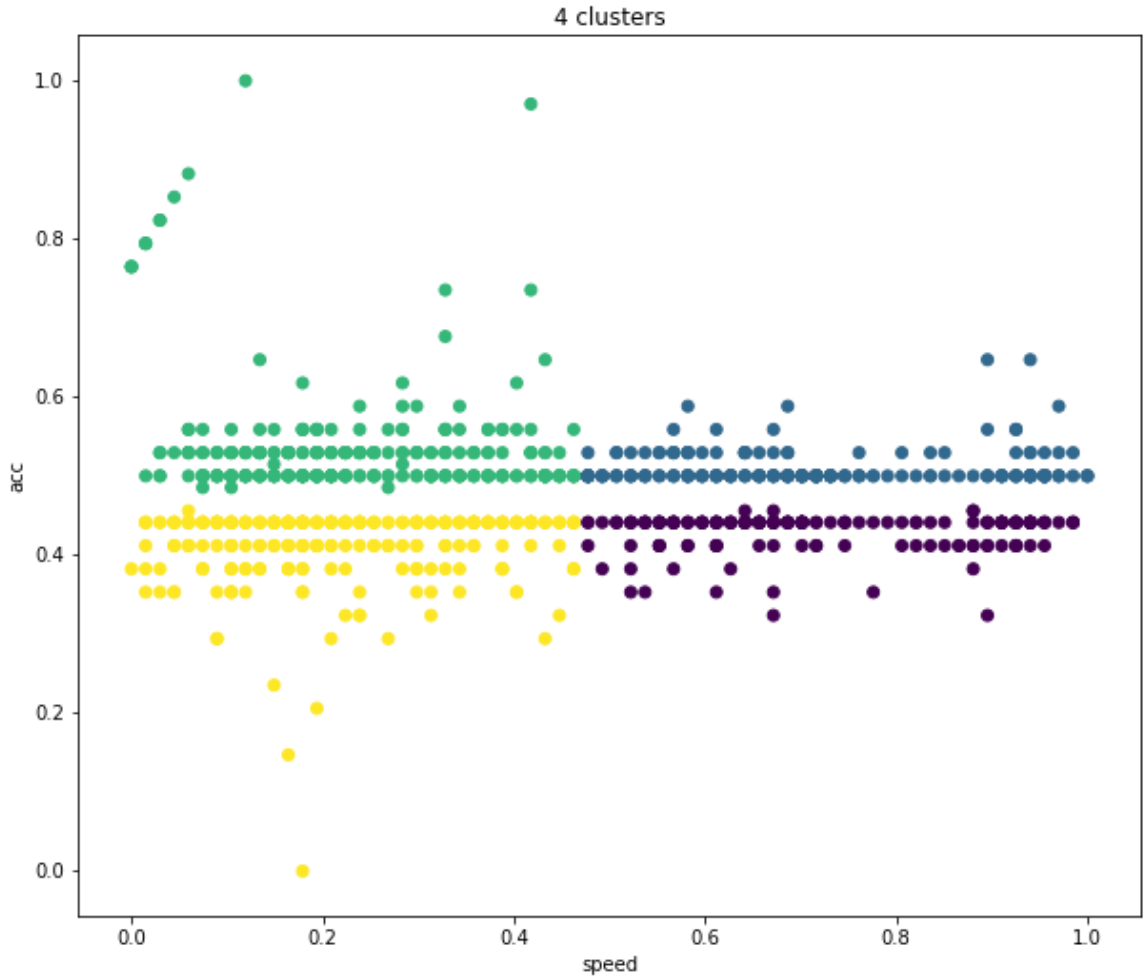
See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/in
dexing.html#indexing-view-versus-copy
  if __name__ == '__main__':
```

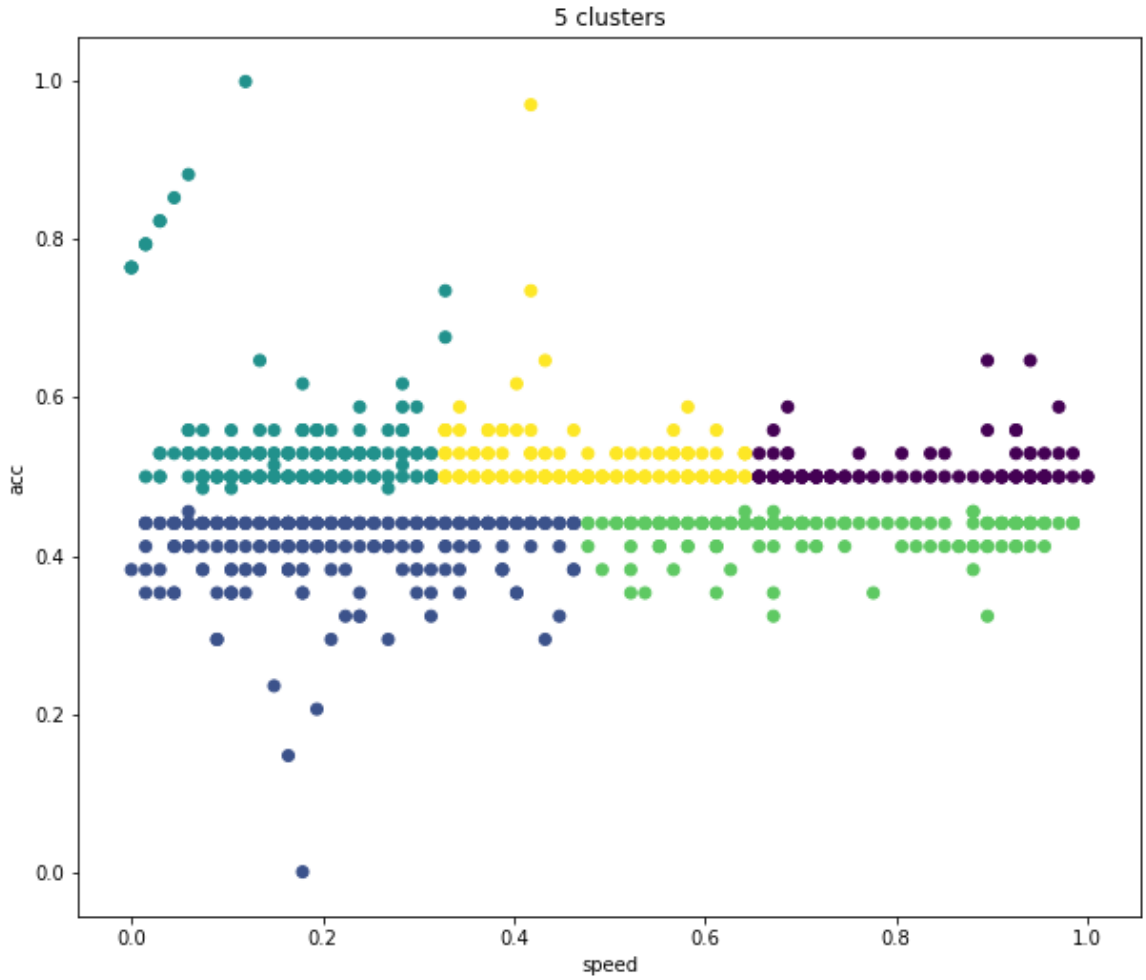
In [465]:

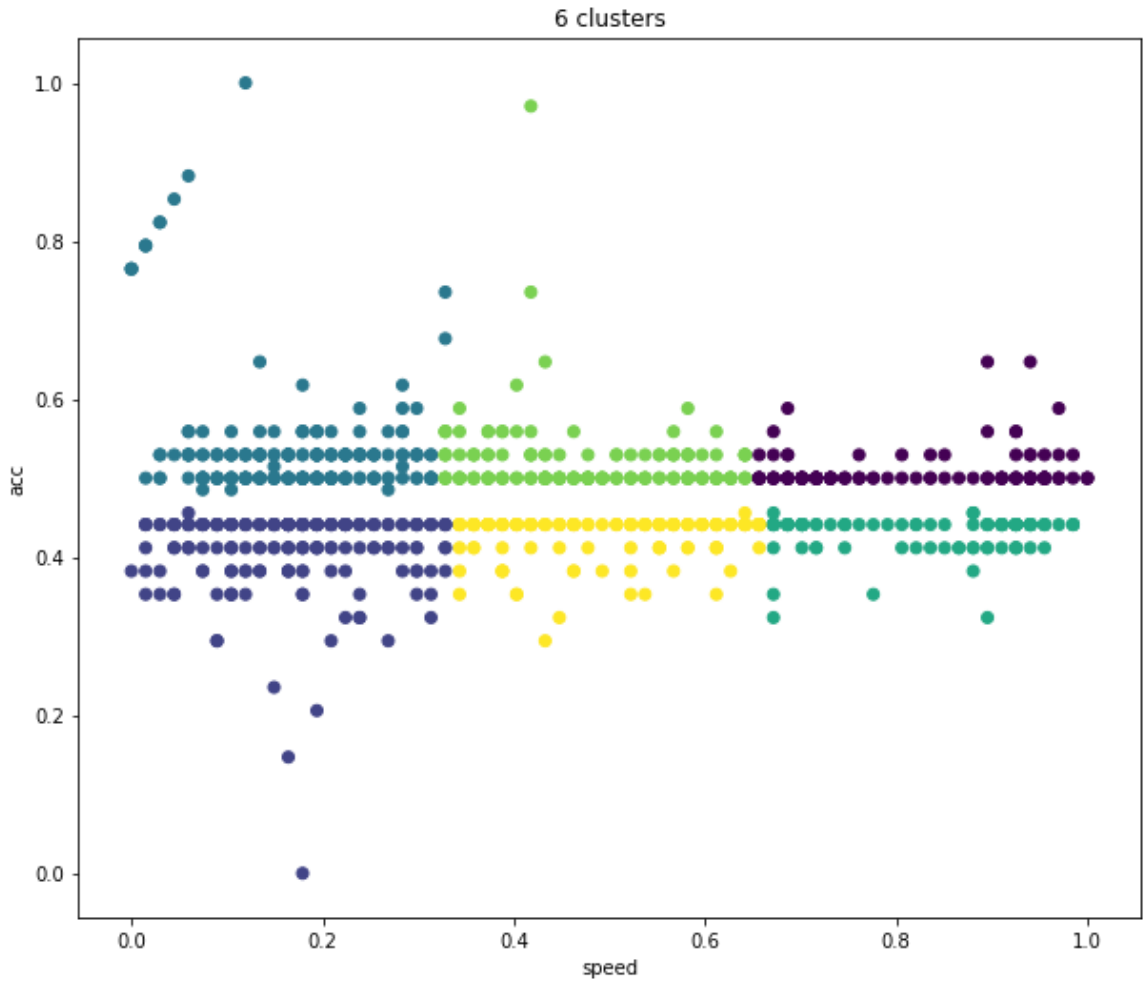
```
# 聚类 2 堆 - 8 堆
n_clusters = 8
figsize_x = 10
plt.figure(figsize=(10, figsize_x * n_clusters))
for i in range(2, n_clusters + 1):
    ax = plt.subplot(n_clusters, 1, i)
    ax.set_title(f'{i} clusters')
    y_pred = KMeans(n_clusters=i, random_state=9).fit_predict(X)
    plt.scatter(X[:, 0], X[:, 1], c=y_pred)
    plt.ylabel('acc')
    plt.xlabel('speed')
plt.show()
```

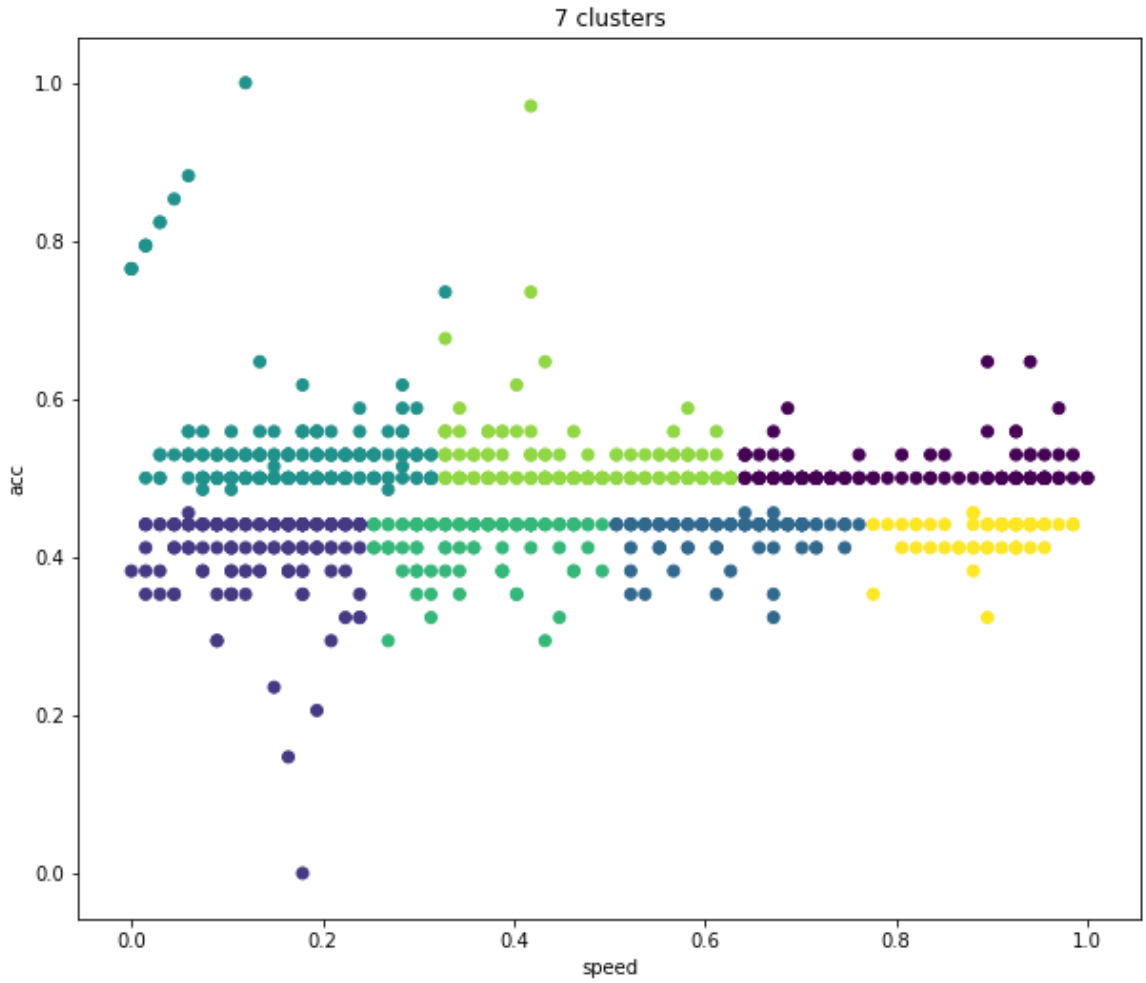

2 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0

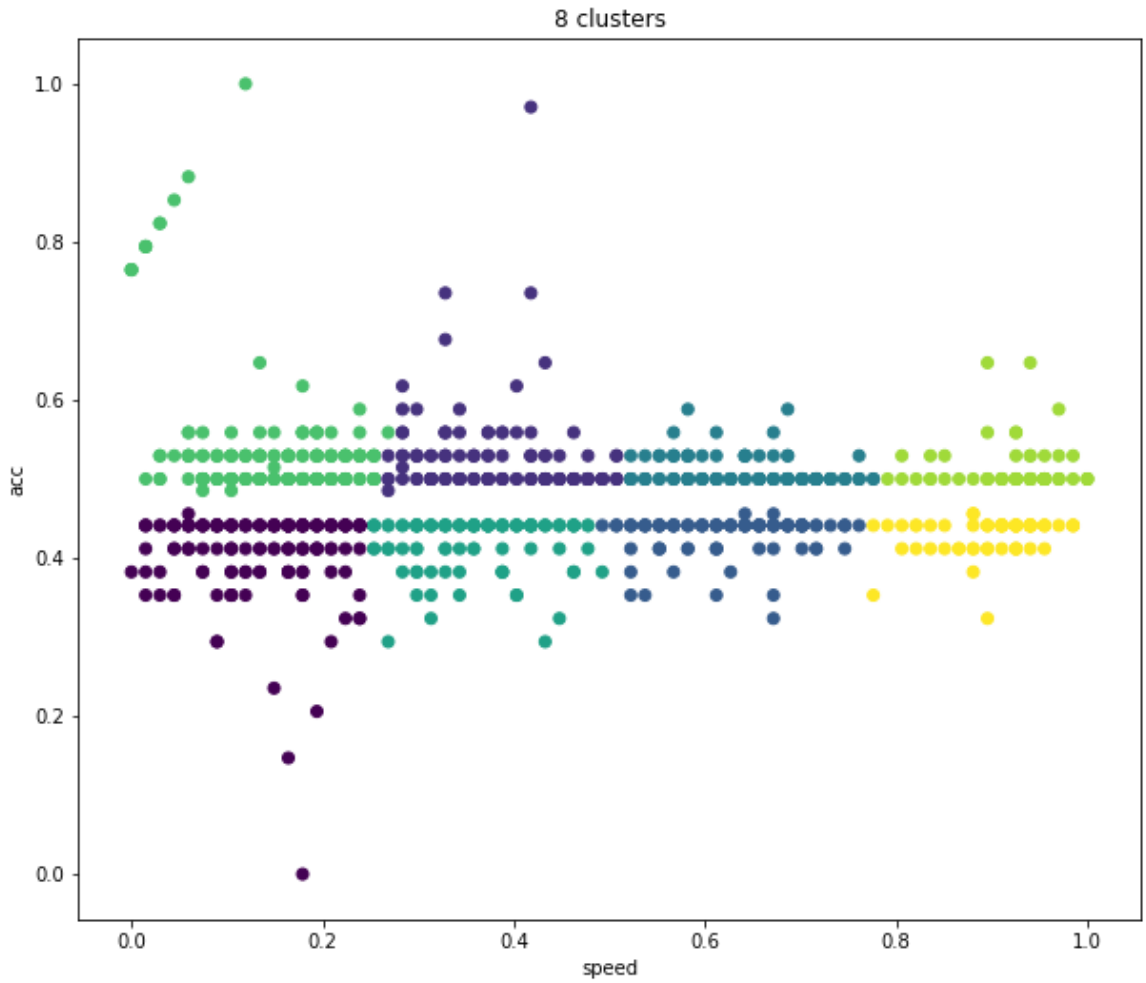

3 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0


4 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0


5 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0


6 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0


7 clusters
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0



看 4 堆的数据，我们聚出来了速度高的加速和减速，速度低的加速和减速。

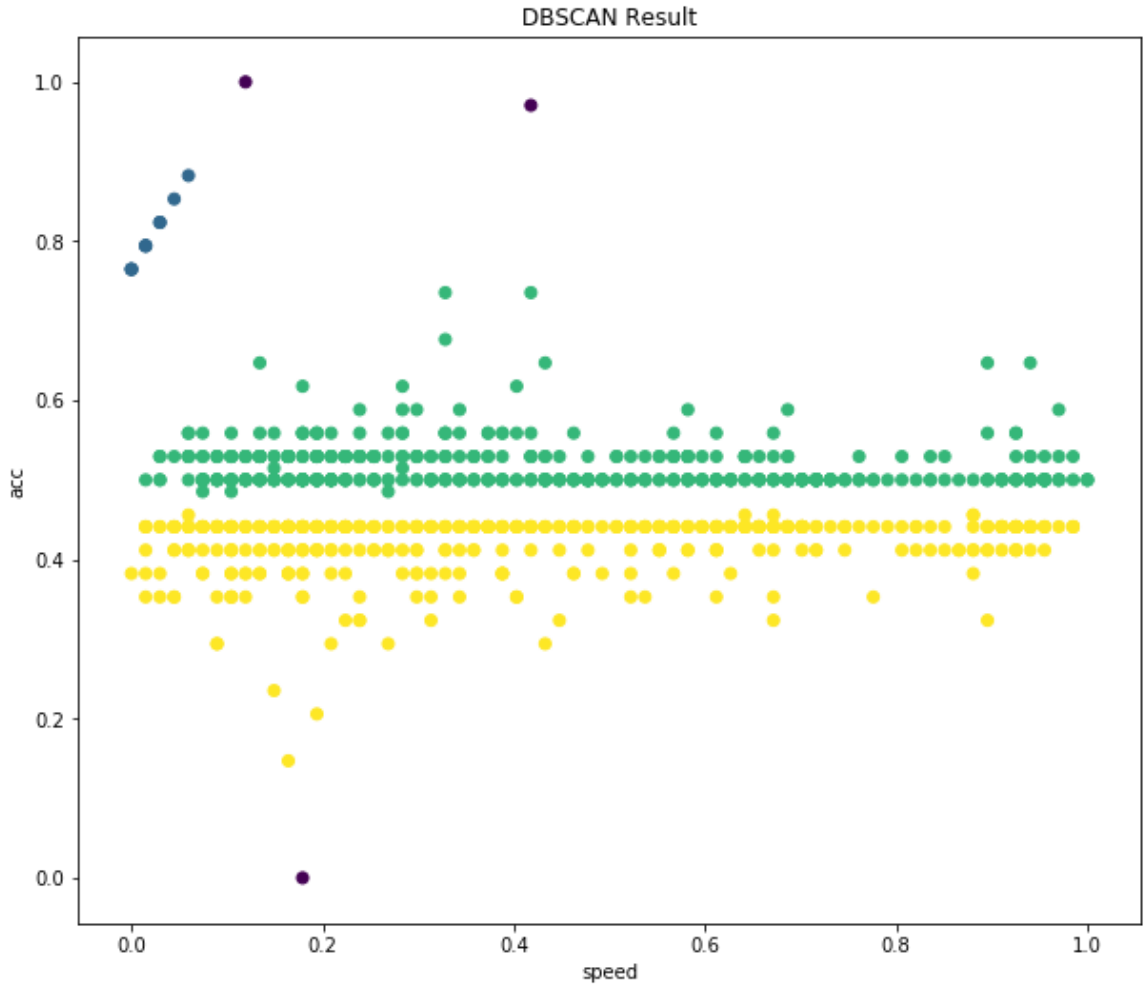
下面我们再尝试其他的聚类方法。

DBScan

基于密度聚类，无法指定堆的数目

In [478]:

```
from sklearn.cluster import DBSCAN
figsize_x = 10
plt.figure(figsize=(10, figsize_x * n_clusters))
ax = plt.subplot(n_clusters, 1, i)
ax.set_title('DBSCAN Result')
y_pred = DBSCAN(eps=0.1).fit_predict(X)
plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.ylabel('acc')
plt.xlabel('speed')
plt.show()
```



In [480]:

```
# 堆数
print(np.unique(y_pred))
```

```
[-1  0  1  2]
```

这里可以看到聚类分成了 4 类。

观察下可以看到有：

- 所有速度的普通加速
- 所有速度的普通减速
- 急加速
- 急减速

还是很不错的！普通加减速和急速加减速分出来了！

可能数据量不够大，因为我们只拿了一个分段来处理。我们把前面所有的分段拿来看看。

这里先保存下历史数据。

In [485]:

```
segdf10 = segdf
segdf_filtered10 = segdf_filtered
```

In [499]:

```
# 把之前所有的分段都拿来，还是之前一样的预处理方式处理下
segdfs = rawdf_subs
xs = []
for segdf in segdfs:
    segdf_shift = segdf.shift(1)
    # 算速度差值
    segdf_speed_minus = segdf['gps_speed'] - segdf_shift['gps_speed']
    # 算加速度
    segdf['acc'] = segdf_speed_minus / segdf['timestamp_minus']
    segdf['acc'] = segdf['acc'].fillna(0)
    # 速度取别名
    segdf['speed'] = segdf['gps_speed']
    # 过滤 0 速度
    segdf_filtered = segdf[(segdf.speed > 0) & (segdf.acc != 0)]
    # 增加速度状态
    segdf_filtered['speed_state'] = segdf_filtered['acc'].apply(speed_state)
    # 数据
    x = segdf_filtered[['speed', 'acc', 'speed_state']].values
    if not len(x): continue
    x = MinMaxScaler().fit_transform(x)
    x = np.array(x)
    xs.append(x)
```

```
/usr/local/lib/python3.7/site-packages/ipykernel/__main__.py:16: SettingWithCopyWarn
ing:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/in
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/usr/local/lib/python3.7/site-packages/ipykernel/__main__.py:16: SettingWithCopyWarn
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See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/in
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dexing.html#indexing-view-versus-copy
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A value is trying to be set on a copy of a slice from a DataFrame.
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See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/in
dexing.html#indexing-view-versus-copy
/usr/local/lib/python3.7/site-packages/ipykernel/__main__.py:16: SettingWithCopyWarn
ing:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/in
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```

```
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```

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Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/in
dexing.html#indexing-view-versus-copy
```

In [565]:

```python
X = np.concatenate(tuple(xs), axis=0)
```

In [566]:

```python
X.shape
```

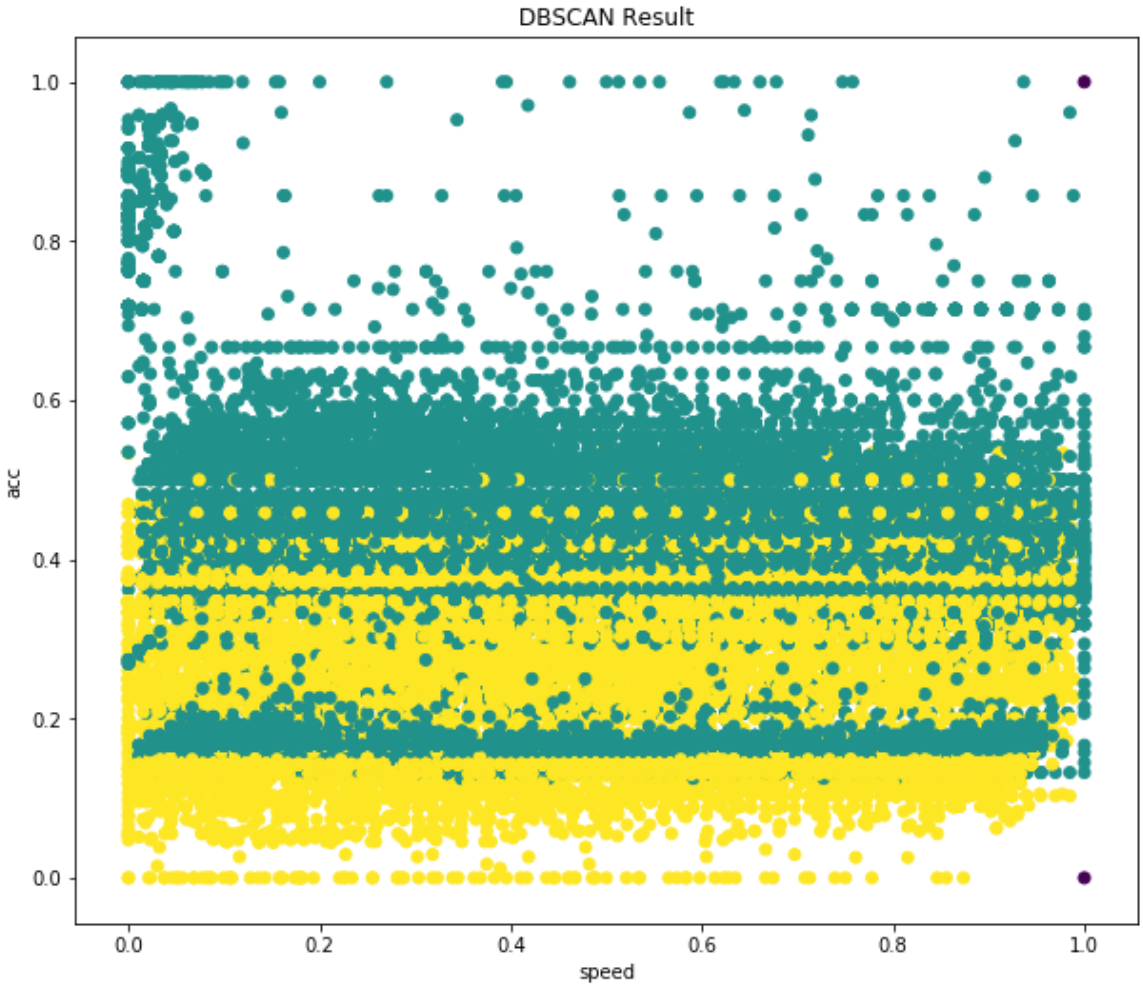
Out[566]:

```
(57693, 3)
```

现在有五万多数据了，来聚类试试

In [504]:

```
from sklearn.cluster import DBSCAN
figsize_x = 10
plt.figure(figsize=(10, figsize_x * n_clusters))
ax = plt.subplot(n_clusters, 1, i)
ax.set_title('DBSCAN Result')
y_pred = DBSCAN(eps=0.1).fit_predict(X)
plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.ylabel('acc')
plt.xlabel('speed')
plt.show()
```

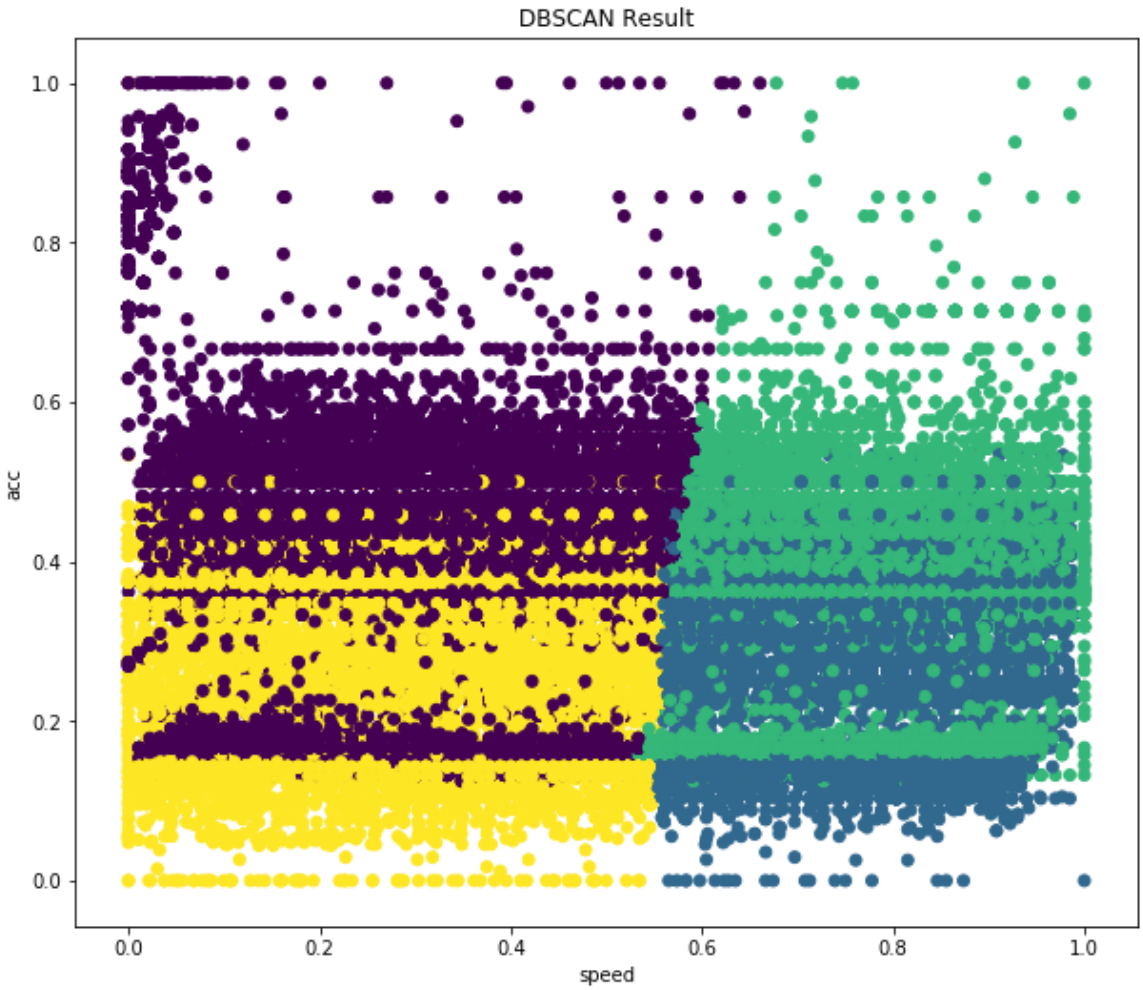


不太行，数据量看来还是不能太大啊，这全都占满了，密度太大了啊。

Kmeans 试试呢再。

In [508]:

```
from sklearn.cluster import KMeans
figsize_x = 10
plt.figure(figsize=(10, figsize_x * n_clusters))
ax = plt.subplot(n_clusters, 1, i)
ax.set_title('DBSCAN Result')
y_pred = KMeans(n_clusters=4).fit_predict(X)
plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.ylabel('acc')
plt.xlabel('speed')
plt.show()
```



这个还不错，能分出：

- 高速加速
- 高速减速
- 低速加速
- 低速减速

再适当控制下数量看看 DBSCAN，觉得这个在数据量适当的情况下应该还不错

In [511]:

```
from random import sample
```

In [514]:

```
x.shape
```

Out[514]:

(6040, 3)

In [535]:

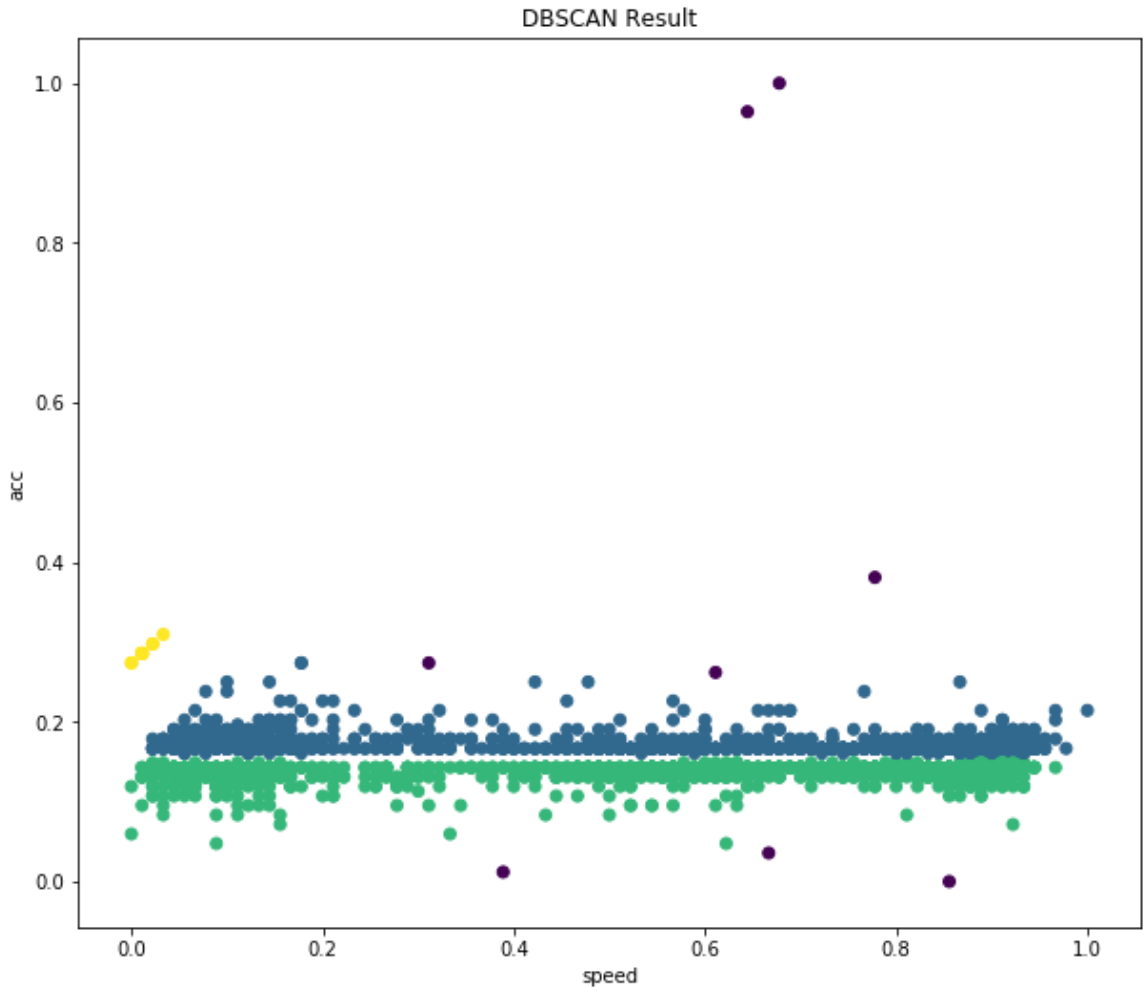
```
X = sample(x.tolist(), 5000)
```

In [536]:

```
X = np.asarray(X)
```

In [547]:

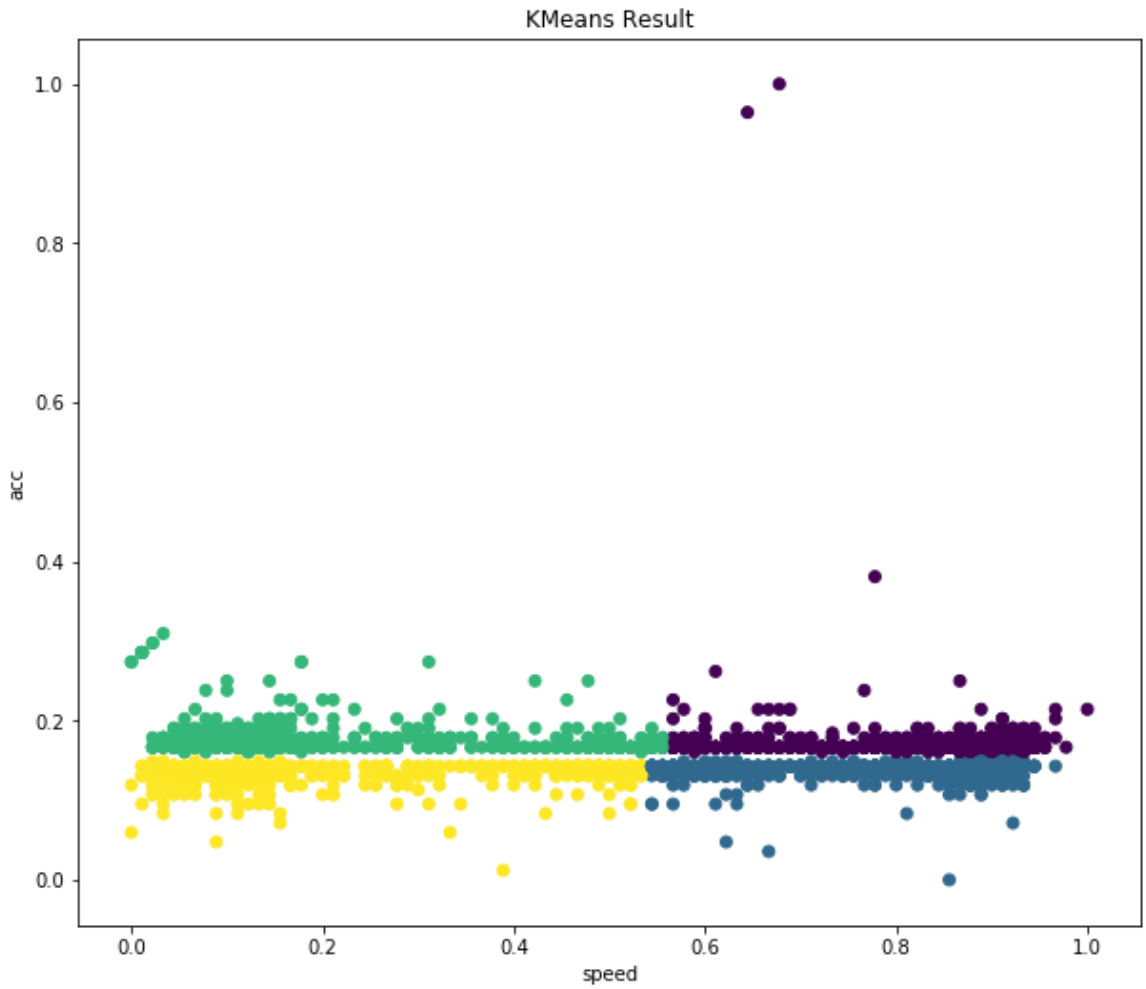
```
from sklearn.cluster import DBSCAN
figsize_x = 10
plt.figure(figsize=(10, figsize_x * n_clusters))
ax = plt.subplot(n_clusters, 1, i)
ax.set_title('DBSCAN Result')
y_pred = DBSCAN(eps=0.05).fit_predict(X)
plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.ylabel('acc')
plt.xlabel('speed')
plt.show()
```



不错，再次分出来了。

In [545]:

```
from sklearn.cluster import KMeans
figsize_x = 10
plt.figure(figsize=(10, figsize_x * n_clusters))
ax = plt.subplot(n_clusters, 1, i)
ax.set_title('KMeans Result')
y_pred = KMeans(n_clusters=4).fit_predict(X)
plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.ylabel('acc')
plt.xlabel('speed')
plt.show()
```



恩，也基本能分出来的。

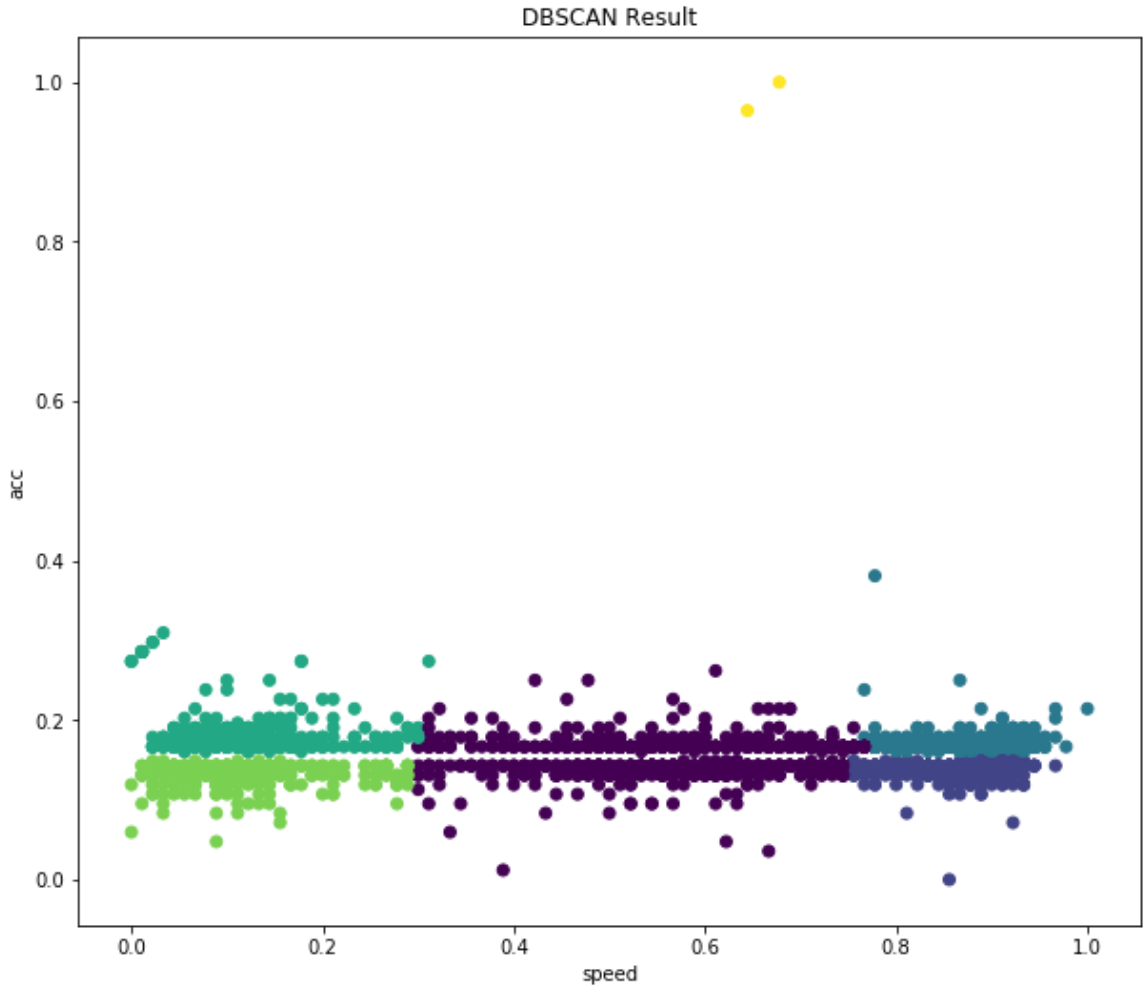
再试试别的聚类。

谱聚类

原理可以搜下

In [551]:

```
from sklearn.cluster import SpectralClustering
figsize_x = 10
n_clusters = 6
plt.figure(figsize=(10, figsize_x * n_clusters))
ax = plt.subplot(n_clusters, 1, i)
ax.set_title('DBSCAN Result')
y_pred = SpectralClustering(n_clusters=n_clusters, gamma=0.4).fit_predict(X)
plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.ylabel('acc')
plt.xlabel('speed')
plt.show()
```



层次聚类

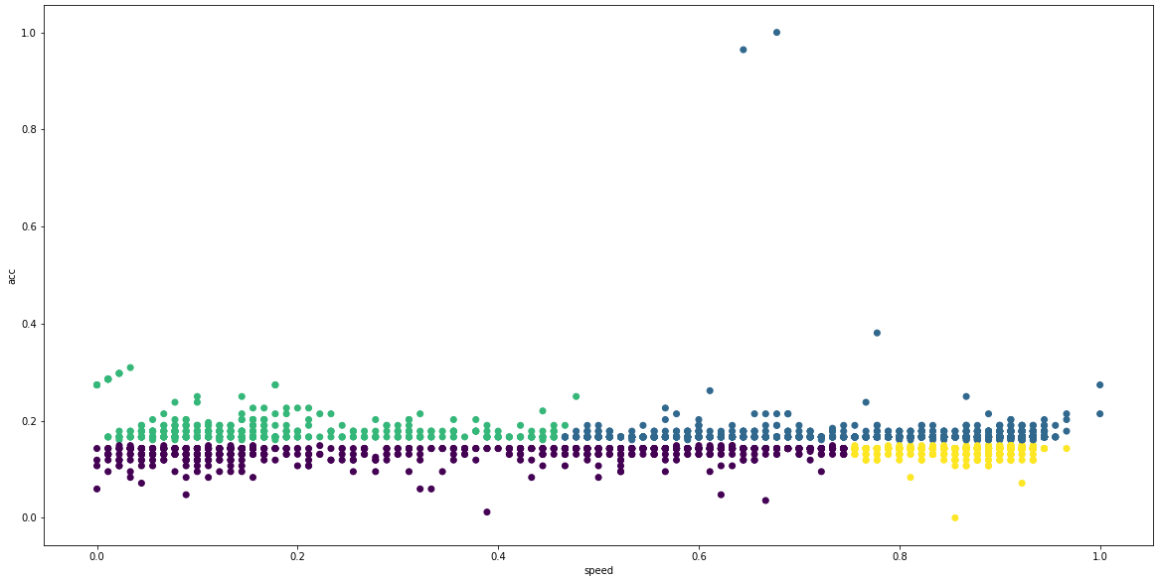
即结合了距离和密度的聚类。

In [570]:

```
X = sample(x.tolist(), 5000)
X = np.asarray(X)
```

In [571]:

```
from sklearn.cluster import AgglomerativeClustering
figsize_x = 10
n_clusters = 4
y_pred = AgglomerativeClustering(n_clusters=n_clusters).fit_predict(X)
plt.figure(figsize=(20, 10))
plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.ylabel('acc')
plt.xlabel('speed')
plt.show()
```



混合高斯模型

In [583]:

```
X = np.concatenate(tuple(xs), axis=0)
X.shape
```

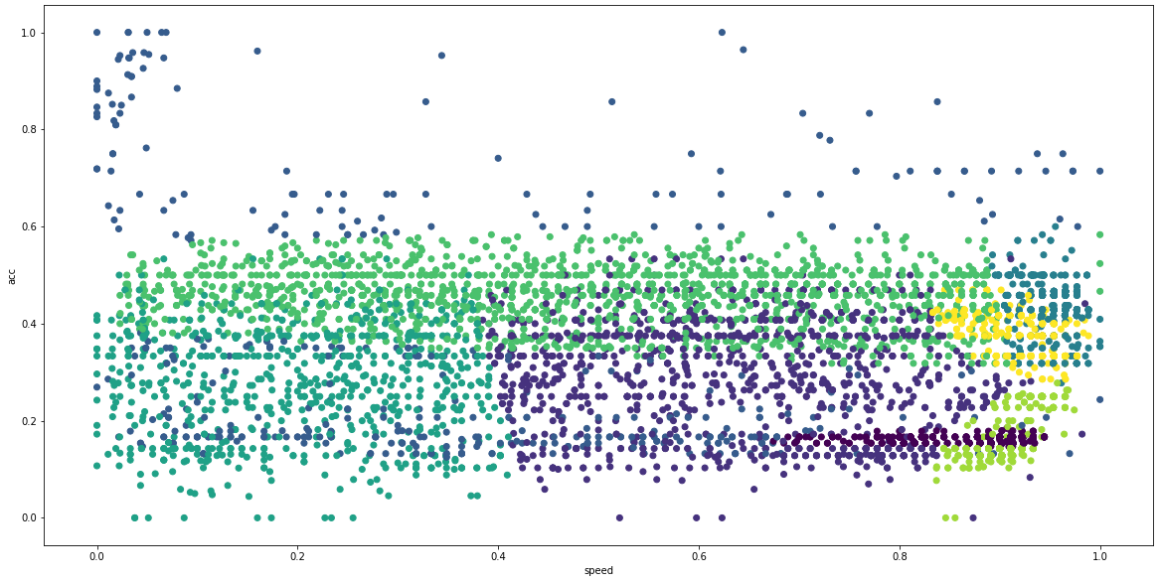
Out[583]:

(57693, 3)

In [596]:

```
X = sample(X.tolist(), 6000)
X = np.asarray(X)

from sklearn.mixture import GaussianMixture
figsize_x = 10
n_clusters = 8
y_pred = GaussianMixture(n_components=n_clusters).fit_predict(X)
plt.figure(figsize=(20, 10))
plt.scatter(X[:, 0], X[:, 1], c=y_pred)
plt.ylabel('acc')
plt.xlabel('speed')
plt.show()
```



可以看到！混合高斯模型能进一步分出来加速度！

目前观测可以分为如下结果：

- 高速急减速
- 高速缓减速
- 高速缓加速
- 高速急加速

还有对应的低速、中速等

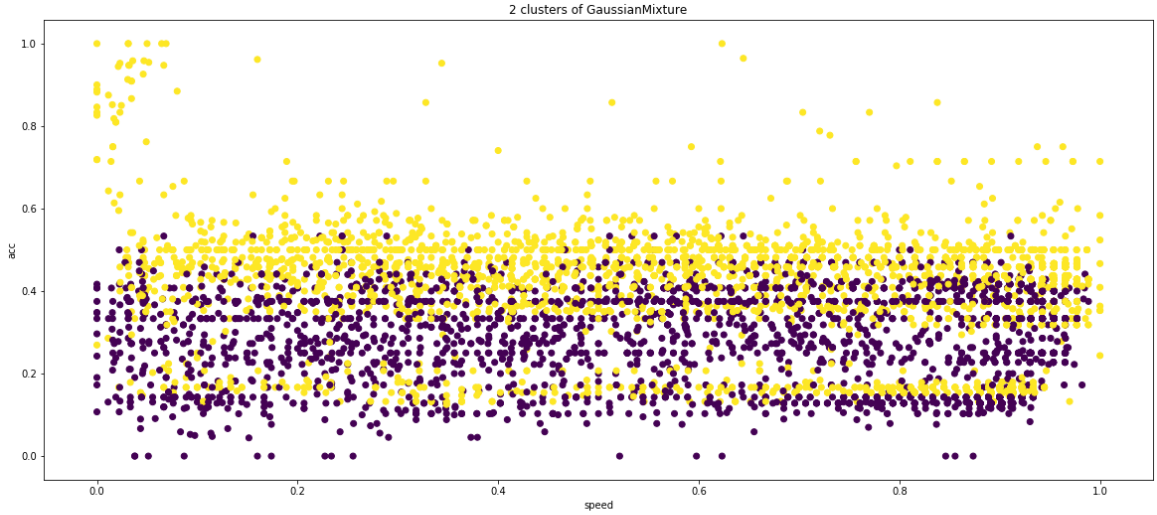
- 中速急减速
- 中速缓减速
- 中速缓加速
- 中速急加速

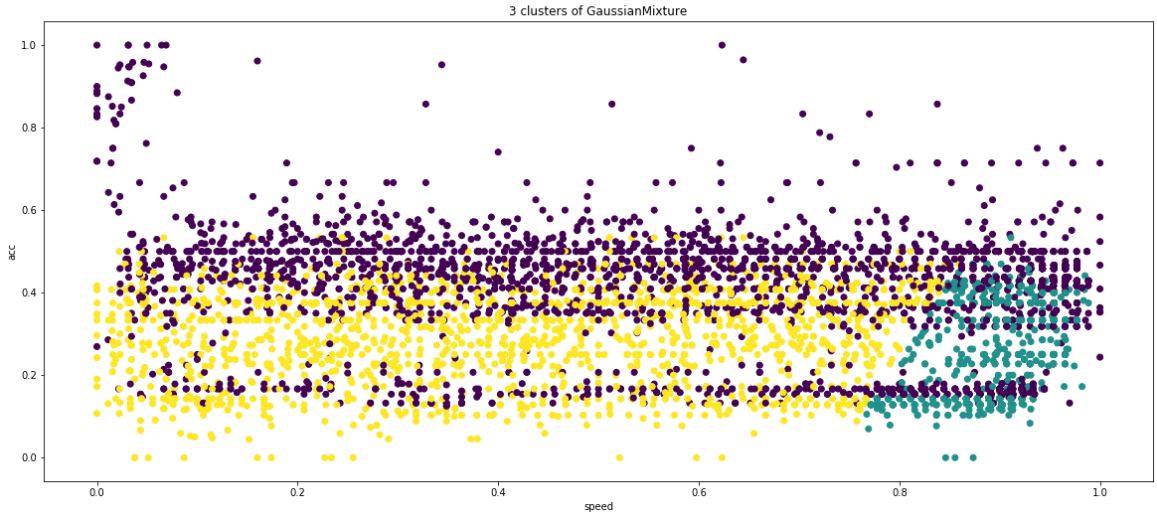
这个再仔细观察下吧

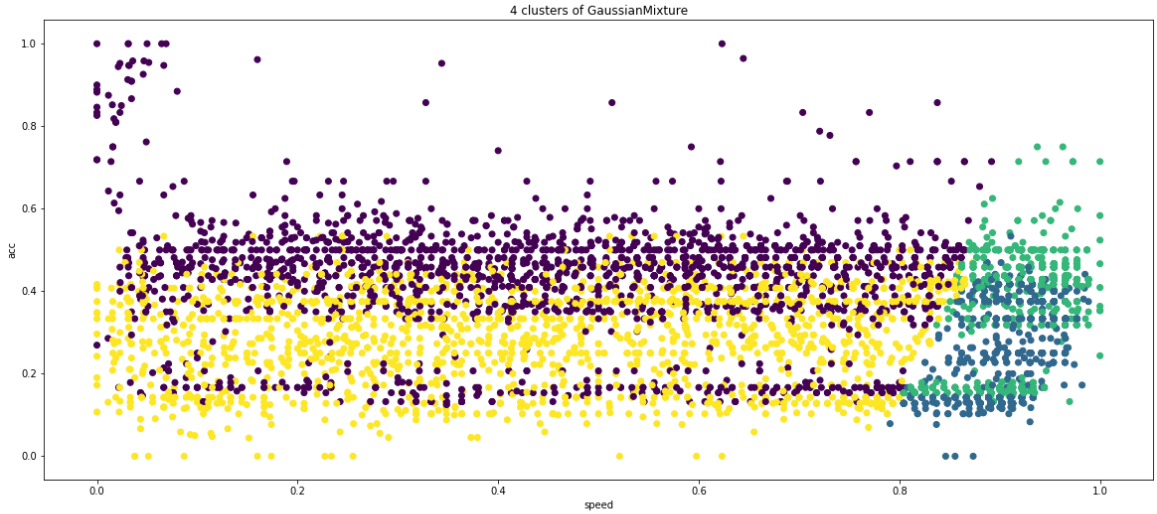
遍历下 cluster 的个数，打印出来

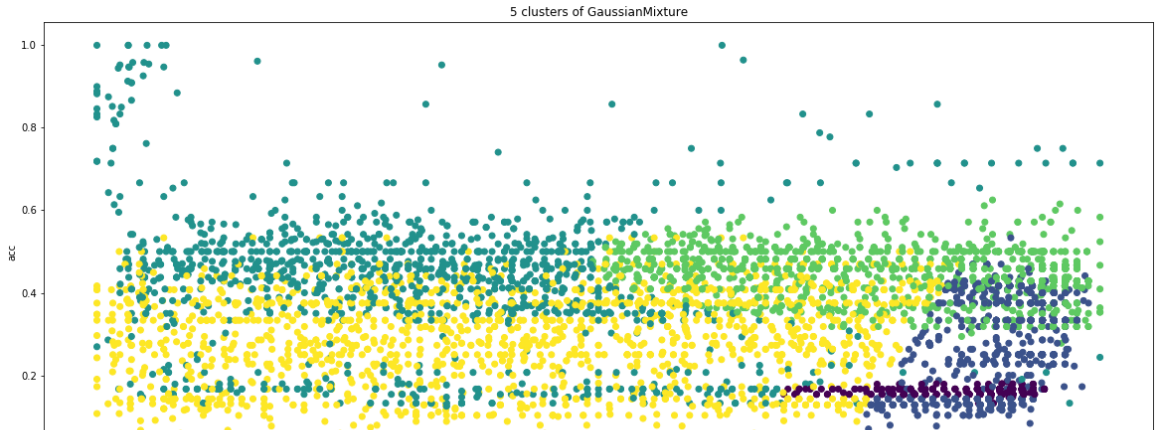
In [599]:

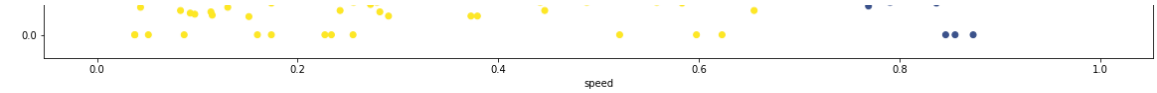
```
# 聚类 2 堆 - 8 堆
n_clusters = 8
figsize_x = 10
plt.figure(figsize=(20, figsize_x * n_clusters))
for i in range(2, n_clusters + 1):
    ax = plt.subplot(n_clusters, 1, i)
    ax.set_title(f'{i} clusters of GaussianMixture')
    y_pred = GaussianMixture(n_components=i).fit_predict(X)
    plt.scatter(X[:, 0], X[:, 1], c=y_pred)
    plt.ylabel('acc')
    plt.xlabel('speed')
plt.show()
```

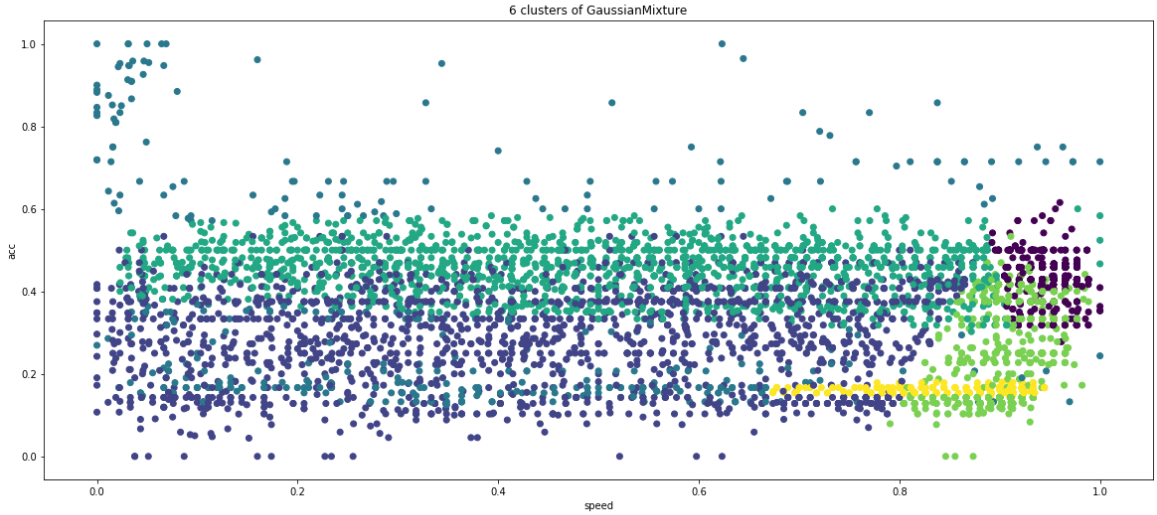

2 clusters of GaussianMixture
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0

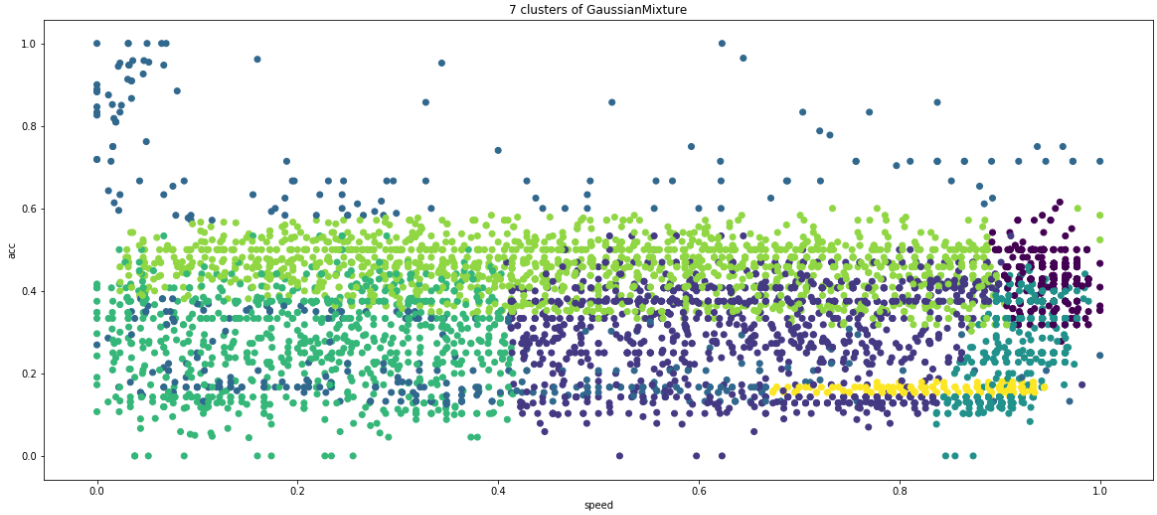

3 clusters of GaussianMixture
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0

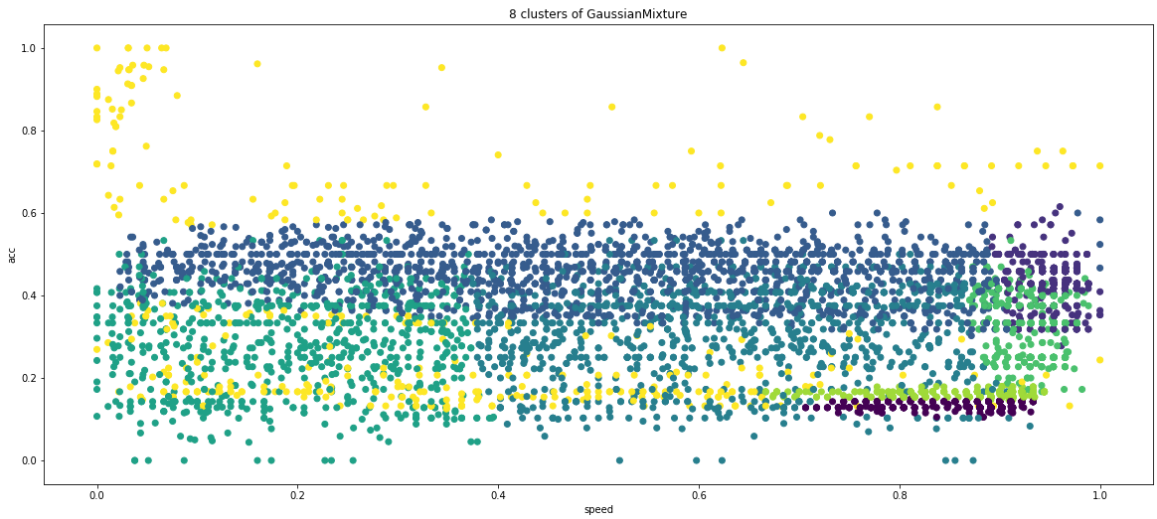

4 clusters of GaussianMixture
acc
speed
0.0
0.2
0.4
0.6
0.8
1.0


5 clusters of GaussianMixture
acc
0.2
0.4
0.6
0.8
1.0









可以看到混合高斯模型效果还是不错的。

可以详细观测下看看，然后分一下。

下一步就是根据聚类的结果，大体划分下数据集，来做个分类器了。

Fighting!