Capston Project 1004

Table of Contents

In [ ]:

1. Introduction

- AccredianTelecom, one of the leading telecom players
- AccredianTelecom is a Telecom networking service company. which allows users to connect amoungfriends or people.

2. Problem Statement

- Which age group is more on AccredianTelecom network
- To identify certain patterns with respect to how the users are making use of AccredianTelecom depending on State, Age & gender.
- To understand a user's demographic characteristics based on their mobile usage, geolocation, and mobile device properties

3. Installing & Importing Libraries

In [1]:
```
!pip install -q datascience
!pip install -q pandas-profiling
```

In [2]:
```
import pandas as pd                                                    # Importin
from pandas_profiling import ProfileReport                             # Import P
#-----------------------------------------------------------------------------
import numpy as np                                                     # Importin
#-----------------------------------------------------------------------------
import matplotlib.pyplot as plt                                        # Importin
import seaborn as sns                                                  # Importin
%matplotlib inline
#-----------------------------------------------------------------------------
import scipy as sp

#pd.set_option('display.max_rows', None)    # Display all rows
#pd.set_option('display.max_columns', None) # Display all columns
```

```
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_29836\2561167681.py:2: Deprecat
ionWarning: `import pandas_profiling` is going to be deprecated by April 1s
t. Please use `import ydata_profiling` instead.
  from pandas_profiling import ProfileReport                           # Impor
t Pandas Profiling (To generate Univariate Analysis)
```

4. Data Acquisition & Description

In [3]:
```
event = pd.read_csv('C:/Users/Abhishek/Downloads/1004 data set/events_data.csv
```

In [4]:
```
event
```

Out[4]:

	event_id	device_id	timestamp	longitude	latitude	city	stat
0	2765368	2.973348e+18	2016-05-07 22:52:05	77.225676	28.730140	Delhi	Delh
1	2955066	4.734221e+18	2016-05-01 20:44:16	88.388361	22.660325	Calcutta	WestBengа
2	605968	-3.264500e+18	2016-05-02 14:23:04	77.256809	28.757906	Delhi	Delh
3	448114	5.731369e+18	2016-05-03 13:21:16	80.343613	13.153332	Chennai	TamilNad
4	665740	3.388880e+17	2016-05-06 03:51:05	85.997745	23.842609	Bokaro	Jharkhan
...	...	...	...	...	...	...	.
3252945	2687452	-1.937028e+18	2016-05-07 23:33:14	73.891597	18.544124	Pune	Maharashtr
3252946	1051580	3.345851e+18	2016-05-03 05:13:30	72.837258	19.018432	Mumbai	Maharashtr
3252947	1316227	-6.406040e+18	2016-05-01 16:03:28	77.235578	28.764065	Delhi	Delh
3252948	381262	-2.920741e+18	2016-05-05 17:22:36	83.326044	17.765488	Visakhapatnam	AndhraPrades
3252949	522592	3.212750e+18	2016-05-07 17:34:18	77.308533	9.779918	Kambam	TamilNad

3252950 rows × 7 columns

In [5]:
```
event.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3252950 entries, 0 to 3252949
Data columns (total 7 columns):
 #   Column     Dtype  
---  ------     -----  
 0   event_id   int64  
 1   device_id  float64
 2   timestamp  object 
 3   longitude  float64
 4   latitude   float64
 5   city       object 
 6   state      object 
dtypes: float64(3), int64(1), object(3)
memory usage: 173.7+ MB
```

In [6]:
```
event.isna().sum()
```

Out[6]:
```
event_id       0
device_id    453
timestamp      0
longitude    423
latitude     423
city           0
state        377
dtype: int64
```

Observation In events data

- Events Data has 7 columns and 3252950 rows
- 5 continous and 2 categorical veriable
- Device id beeing considered as identifier
- Device Id, Lat, Longituted and state has missing values

In [7]:
```
target_states = ['AndhraPradesh', 'Pondicherry','Mizoram','AndamanandNicobarIs

# Filter the data based on the target states
filtered_eventdata = event[event['state'].isin(target_states)]

# Print the filtered data
print(filtered_eventdata)
```

```
         event_id     device_id            timestamp  longitude   latitude  \
5         1078723 -5.124242e+17  2016-05-02 02:21:20  83.398244  17.768149
7          280014 -8.879644e+18  2016-05-05 13:06:01  78.155397  16.390327
12        2334601 -6.018833e+17  2016-05-05 11:17:48  83.380111  17.828583
32        2064864 -2.764521e+18  2016-05-03 23:58:20  83.315014  17.825280
48        1341801  4.986891e+18  2016-05-07 15:24:58  83.324339  17.778384
...           ...           ...                  ...        ...        ...
3252915   2486328 -2.943655e+18  2016-05-03 19:09:18  83.371765  17.800655
3252922   2905298  5.141558e+18  2016-05-04 10:16:36  83.339048  17.751325
3252930   2264739 -3.616572e+18  2016-05-07 12:45:06  83.945946  18.336945
3252943   1045746 -1.370786e+18  2016-05-01 00:15:22  91.911920  25.642058
3252948    381262 -2.920741e+18  2016-05-05 17:22:36  83.326044  17.765488

                 city          state
5        Visakhapatnam  AndhraPradesh
7             Wanparti  AndhraPradesh
12       Visakhapatnam  AndhraPradesh
32       Visakhapatnam  AndhraPradesh
48       Visakhapatnam  AndhraPradesh
...                ...            ...
3252915  Visakhapatnam  AndhraPradesh
3252922  Visakhapatnam  AndhraPradesh
3252930     Srikakulam  AndhraPradesh
3252943       Shillong     Meghalaya
3252948  Visakhapatnam  AndhraPradesh

[329125 rows x 7 columns]
```

In [8]:
```
filtered_eventdata.isna().sum()
```

Out[8]:
```
event_id      0
device_id    69
timestamp     0
longitude    63
latitude     63
city          0
state         0
dtype: int64
```

In [9]:
```
filtered_eventdata["longitude"]=filtered_eventdata["longitude"].fillna(83.3688
filtered_eventdata["latitude"] =filtered_eventdata["latitude"].fillna(17.79881
filtered_eventdata['device_id'].fillna(filtered_eventdata['device_id'].mode()[
```

```
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_29836\1949865122.py:1: Setting
WithCopyWarning:
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: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  filtered_eventdata["longitude"]=filtered_eventdata["longitude"].fillna(83.3
68896)
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_29836\1949865122.py:2: Setting
WithCopyWarning:
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: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  filtered_eventdata["latitude"] =filtered_eventdata["latitude"].fillna(17.79
8819)
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_29836\1949865122.py:3: Setting
WithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  filtered_eventdata['device_id'].fillna(filtered_eventdata['device_id'].mode
()[0], inplace=True)
```

In [10]:
```
filtered_eventdata.isna().sum()
```

Out[10]:
```
event_id     0
device_id    0
timestamp    0
longitude    0
latitude     0
city         0
state        0
dtype: int64
```

In [ ]:
```
```

In [11]:
```
mob = pd.read_excel('C:/Users/Abhishek/Downloads/1004 data set/phon.xlsx')
```

In [12]:
```
mob.isna().sum()
```

Out[12]:
```
Unnamed: 0      0
device_id       0
phone_brand     0
device_model    0
dtype: int64
```

In [13]:
```
mob
```

Out[13]:

	Unnamed: 0	device_id	phone_brand	device_model
0	0	1877775838486906112	vivo	Y13
1	1	-3766087376657243136	小米	V183
2	2	-6238937574958216192	OPPO	R7s
3	3	8973197758510676992	三星	A368t
4	4	-2015528097870763008	小米	红米Note2
...	...	...	...	...
87721	87721	-4961458925928573952	华为	荣耀畅玩4X
87722	87722	-8819817317449262080	华为	荣耀6
87723	87723	-3358291377416934912	华为	荣耀畅玩4
87724	87724	3282788959750982144	小米	MI 2
87725	87725	2491639413207285760	酷比	M1

87726 rows × 4 columns

Observation In Mobile data

- Events Data has 4 columns and 87726 rows
- 2 continous and 2 categorical veriable
- Device id beeing considered as identifier
- No Missing values found

In [14]:
```
age = pd.read_excel('C:/Users/Abhishek/Downloads/1004 data set/age.xlsx')
```

In [15]:
```
age
```

Out[15]:

	Unnamed: 0	device_id	gender	age	group
0	0	-8076087639492063232	M	35	M32-38
1	1	-2897161552818059776	M	35	M32-38
2	2	-8260683887967679488	M	35	M32-38
3	3	-4938849341048082432	M	30	M29-31
4	4	245133531816851904	M	30	M29-31
...	...	...	...	...	...
74640	74640	4682031842235089920	M	30	M29-31
74641	74641	-9178703742877135872	M	30	M29-31
74642	74642	180946546684162304	M	20	M22-
74643	74643	1390702386071992064	M	37	M32-38
74644	74644	89181010588227344	M	25	M23-26

74645 rows × 5 columns

Observation In Age data

- Events Data has 5 columns and 74645 rows
- 3 continous and 2 categorical veriable
- Device id beeing considered as identifier
- Noo null values found

meargging the data frame

In [16]:
```
EveAge=pd.merge(left=filtered_eventdata,right=age,on="device_id",how="left")
```

In [17]:
```
EveAge
```

Out[17]:

	event_id	device_id	timestamp	longitude	latitude	city	state
0	1078723	-5.124242e+17	2016-05-02 02:21:20	83.398244	17.768149	Visakhapatnam	AndhraPradesh
1	280014	-8.879644e+18	2016-05-05 13:06:01	78.155397	16.390327	Wanparti	AndhraPradesh
2	2334601	-6.018833e+17	2016-05-05 11:17:48	83.380111	17.828583	Visakhapatnam	AndhraPradesh
3	2064864	-2.764521e+18	2016-05-03 23:58:20	83.315014	17.825280	Visakhapatnam	AndhraPradesh
4	1341801	4.986891e+18	2016-05-07 15:24:58	83.324339	17.778384	Visakhapatnam	AndhraPradesh
...	...	...	...	...	...	...	...
329120	2486328	-2.943655e+18	2016-05-03 19:09:18	83.371765	17.800655	Visakhapatnam	AndhraPradesh
329121	2905298	5.141558e+18	2016-05-04 10:16:36	83.339048	17.751325	Visakhapatnam	AndhraPradesh
329122	2264739	-3.616572e+18	2016-05-07 12:45:06	83.945946	18.336945	Srikakulam	AndhraPradesh
329123	1045746	-1.370786e+18	2016-05-01 00:15:22	91.911920	25.642058	Shillong	Meghalaya
329124	381262	-2.920741e+18	2016-05-05 17:22:36	83.326044	17.765488	Visakhapatnam	AndhraPradesh

329125 rows × 11 columns

In [18]:
```
dataall=pd.merge(left=EveAge,right=mob,on="device_id",how="left")
```

In [19]:
```
dataall
```

Out[19]:

	event_id	device_id	timestamp	longitude	latitude	city	state
0	1078723	-5.124242e+17	2016-05-02 02:21:20	83.398244	17.768149	Visakhapatnam	AndhraPradesh
1	280014	-8.879644e+18	2016-05-05 13:06:01	78.155397	16.390327	Wanparti	AndhraPradesh
2	2334601	-6.018833e+17	2016-05-05 11:17:48	83.380111	17.828583	Visakhapatnam	AndhraPradesh
3	2064864	-2.764521e+18	2016-05-03 23:58:20	83.315014	17.825280	Visakhapatnam	AndhraPradesh
4	1341801	4.986891e+18	2016-05-07 15:24:58	83.324339	17.778384	Visakhapatnam	AndhraPradesh
...	...	...	...	...	...	...	...
329120	2486328	-2.943655e+18	2016-05-03 19:09:18	83.371765	17.800655	Visakhapatnam	AndhraPradesh
329121	2905298	5.141558e+18	2016-05-04 10:16:36	83.339048	17.751325	Visakhapatnam	AndhraPradesh
329122	2264739	-3.616572e+18	2016-05-07 12:45:06	83.945946	18.336945	Srikakulam	AndhraPradesh
329123	1045746	-1.370786e+18	2016-05-01 00:15:22	91.911920	25.642058	Shillong	Meghalaya
329124	381262	-2.920741e+18	2016-05-05 17:22:36	83.326044	17.765488	Visakhapatnam	AndhraPradesh

329125 rows × 14 columns

In [20]:
```
dataall.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 329125 entries, 0 to 329124
Data columns (total 14 columns):
 #   Column         Non-Null Count   Dtype  
---  ------         --------------   -----  
 0   event_id       329125 non-null  int64  
 1   device_id      329125 non-null  float64
 2   timestamp      329125 non-null  object 
 3   longitude      329125 non-null  float64
 4   latitude       329125 non-null  float64
 5   city           329125 non-null  object 
 6   state          329125 non-null  object 
 7   Unnamed: 0_x   240842 non-null  float64
 8   gender         240842 non-null  object 
 9   age            240842 non-null  float64
 10  group          240842 non-null  object 
 11  Unnamed: 0_y   240842 non-null  float64
 12  phone_brand    240842 non-null  object 
 13  device_model   240842 non-null  object 
dtypes: float64(6), int64(1), object(7)
memory usage: 37.7+ MB
```

In [21]:
```
dataall.describe()
```

Out[21]:

	event_id	device_id	longitude	latitude	Unnamed: 0_x	age
count	3.291250e+05	3.291250e+05	329125.000000	329125.000000	240842.000000	240842.000000
mean	1.626038e+06	9.478685e+16	82.467417	17.596729	35900.501765	31.152527
std	9.404014e+05	5.341850e+18	2.215380	1.537158	20590.376326	9.825075
min	5.985000e+03	-9.222173e+18	12.567400	10.941103	33.000000	12.000000
25%	8.114810e+05	-4.718484e+18	82.226211	17.744599	18233.000000	24.000000
50%	1.627460e+06	-2.849262e+16	83.339626	17.774964	36599.000000	29.000000
75%	2.440367e+06	4.883859e+18	83.372565	17.807230	51906.000000	35.000000
max	3.252943e+06	9.220807e+18	92.859813	41.871900	74595.000000	88.000000

5. Data Pre-Profiling

- Handling missing values in device id, replaceing with mode.
- Handling missing values in Latititude and longitude replaceing with mode.

In [22]:
```
null_frame = pd.DataFrame(index=dataall.columns.values)
null_frame['Null Frequency']=dataall.isnull().sum().values
percent=dataall.isnull().sum().values/dataall.shape[0]
null_frame["Missing%"]=np.round(percent,decimals=4)*100
```

In [23]:
```
null_frame.transpose()
```

Out[23]:

	event_id	device_id	timestamp	longitude	latitude	city	state	Unnamed: 0_x	gender
Null Frequency	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88283.00	88283.00
Missing%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.82	26.82

In [25]:
```
dataall.isna().sum()
```

Out[25]:
```
event_id            0
device_id           0
timestamp           0
longitude           0
latitude            0
city                0
state               0
Unnamed: 0_x    88283
gender          88283
age             88283
group           88283
Unnamed: 0_y    88283
phone_brand     88283
device_model    88283
dtype: int64
```

6. Data Pre-Processing

- This section is emphasised on performing data manipulation over unstructured data for further processing and analysis.
- To modify unstructured data to strucuted data you need to verify and manipulate the integrity of the data by:
  - Handling missing data,
  - Handling redundant data,
  - Handling inconsistent data,
  - Handling outliers,
  - Handling typos

In [26]:
```
dataall["device_id"]=abs(dataall["device_id"])
```

In [27]:
```
dataall=dataall.drop(["Unnamed: 0_x","Unnamed: 0_y"], axis=1)
```

In [28]:
```
dataall["gender"].fillna(dataall['gender'].mode()[0], inplace=True)

dataall["phone_brand"].fillna(dataall['phone_brand'].mode()[0], inplace=True)
dataall["device_model"].fillna(dataall['device_model'].mode()[0], inplace=True


dataall["age"].fillna(dataall['age'].mode()[0], inplace=True)
dataall["group"].fillna(dataall['group'].mode()[0], inplace=True)
```

In [29]:
```
dataall.isna().sum()
```

Out[29]:
```
event_id        0
device_id       0
timestamp       0
longitude       0
latitude        0
city            0
state           0
gender          0
age             0
group           0
phone_brand     0
device_model    0
dtype: int64
```

In [30]:
```
data=dataall.copy()
```

7. Data Post-Profiling

In [31]:
```
data.isna().sum()
```

Out[31]:
```
event_id        0
device_id       0
timestamp       0
longitude       0
latitude        0
city            0
state           0
gender          0
age             0
group           0
phone_brand     0
device_model    0
dtype: int64
```

In [32]:
```
data["phone_brand"].unique()
```

Out[32]:
```
array(['小米', '三星', '华为', '波导', 'OPPO', '酷派', '魅族', '天语', '优米', 'vivo',
       'TCL', '维图', '一加', '夏新', 'HTC', '百立丰', '联想 ', '美图', '大Q', '海信',
       '酷比魔方', '锤子', '中国移动', 'LG', '朵唯', '乐视', '奇酷', '爱派尔', '努比亚', '欧博信',
       '语信', '小杨树', '聆韵', 'ZUK', '康佳', '富可视', '诺基亚', '欧新', '酷比', '黑米',
       '奥克斯', '沃普丰', '欧奇', 'LOGO', '优购', '梦米', '纽曼', '糖葫芦', '西米', '酷珀',
       '海尔', '邦华', '华硕', '乡米', '摩托罗拉', '诺亚信', '米歌'], dtype=object)
```

In [33]:
```
replacement_mapping ={'vivo': 'vivo',
 '小米': 'Xiǎomǐ',
 'OPPO': 'OPPO',
 '三星': 'Samsung',
 '酷派': 'Coolpad',
 '联想 ': 'Lenovo',
 '华为': 'Huawei',
 '奇酷': 'Cool',
 '魅族': 'meizu',
 '斐讯': 'Phicomm',
 '中国移动': 'zhongfu mobile',
 'HTC': 'HTC',
 '天语': 'tianyu',
 '至尊宝': 'Zhi zun bao',
 'LG': 'LG',
 '欧博信': 'Hakuhin in Europe',
 '优米': 'Umidigi',
 'ZUK': 'ZUK',
 '努比亚': 'Nubia',
 '惠普': 'HP',
 '尼比鲁': 'Nibiru',
 '美图': 'meitu',
 '乡米': 'Villain',
 '摩托罗拉': 'Motorola',
 '梦米': 'Dream rice',
 '锤子': 'hammer',
 '富可视': 'Richness',
 '乐视': 'LeEco',
 '海信': 'Hisense',
 '百立丰': 'Bai Lifeng',
 '一加': 'One plus',
 '语信': 'Linguistic',
 '海尔': 'Haier',
 '酷比': 'Cooler',
 '纽曼': 'Newman',
 '波导': 'waveguide',
 '朵唯': 'Duowei',
 '聆韵': 'Listen to the rhyme',
 'TCL': 'TCL',
 '酷珀': 'Cooler',
 '爱派尔': 'Aipaer',
 'LOGO': 'LOGO',
 '青葱': 'Lush',
 '果米': 'Fruit rice',
 '华硕': 'Asus',
 '昂达': 'Onda',
 '艾优尼': 'Acene',
 '康佳': 'Konka',
 '优购': 'Premium purchase',
 '邦华': 'Banghua',
 '赛博宇华': 'Cyberwa',
 '黑米': 'black rice',
 'Lovme': 'Lovme',
 '先锋': 'pioneer',
 'E派': 'E faction',
```

```
'神舟': 'Shenzhou',
'诺基亚': 'Nokia',
'普耐尔': 'Piner',
'糖葫芦': 'Sugar',
'亿通': 'Yitong',
'欧新': 'New European',
'米奇': 'Mickey',
'酷比魔方': 'Coolbite',
'蓝魔': 'Blue demon',
'小杨树': 'Small poplar tree',
'贝尔丰': 'Bellferta',
'糯米': 'Sticky rice',
'米歌': 'Rice song',
'E人E本': 'E people e',
'西米': 'Sago',
'大Q': 'Large Q',
'台电': 'Taipower',
'飞利浦': 'Philips',
'唯米': 'Rice',
'大显': 'Greatly',
'长虹': 'Changhong',
'维图': 'Vitamin',
'青橙': 'Orange',
'本为': 'This is',
'虾米': 'Shrimp',
'夏新': 'Xia Xin',
'帷幄': 'Curtain',
'百加': 'Hundred and Maca',
'SUGAR': 'SUGAR',
'欧奇': 'Oichi',
'世纪星': 'Century star',
'智镁': 'Magnesium',
'欧比': 'Obi',
'基伍': 'Foundation',
'飞秒': 'Femondo',
'德赛': 'Virtue',
'易派': 'Easily',
'谷歌': 'Google',
'金星数码': 'Venus Digital',
'广信': 'Widely believed',
'诺亚信': 'Noah',
'MIL': 'THOUSAND',
'白米': 'White rice',
'大可乐': 'Cola',
'宝捷讯': 'Baoxun',
'优语': 'Excellent language',
'首云': 'Shouyun',
'瑞米': 'Ryme',
'瑞高': 'Ruigao',
'沃普丰': 'Walpone',
'摩乐': 'Caravan',
'鲜米': 'Fresh rice',
'凯利通': 'Kellytong',
'唯比': 'Only',
'欧沃': 'Owa',
'丰米': 'Rich rice',
```

```
 '恒宇丰': 'Hengyufeng',
 '奥克斯': 'Oaks',
 '西门子': 'Siemens',
 '欧乐迪': 'Oletdi',
 'PPTV': 'PPTV'}
```

In [34]:
```
for index, row in data.iterrows():
    phone_brand = row["phone_brand"]
    if phone_brand in replacement_mapping:
        data.at[index, 'phone_brand'] = replacement_mapping[phone_brand]
```

In [35]:
```
data["phone_brand"].unique()
```

Out[35]:
```
array(['Xiǎomǐ', 'Samsung', 'Huawei', 'waveguide', 'OPPO', 'Coolpad',
       'meizu', 'tianyu', 'Umidigi', 'vivo', 'TCL', 'Vitamin', 'One plus',
       'Xia Xin', 'HTC', 'Bai Lifeng', 'Lenovo', 'meitu', 'Large Q',
       'Hisense', 'Coolbite', 'hammer', 'zhongfu mobile', 'LG', 'Duowei',
       'LeEco', 'Cool', 'Aipaer', 'Nubia', 'Hakuhin in Europe',
       'Linguistic', 'Small poplar tree', 'Listen to the rhyme', 'ZUK',
       'Konka', 'Richness', 'Nokia', 'New European', 'Cooler',
       'black rice', 'Oaks', 'Walpone', 'Oichi', 'LOGO',
       'Premium purchase', 'Dream rice', 'Newman', 'Sugar', 'Sago',
       'Haier', 'Banghua', 'Asus', 'Villain', 'Motorola', 'Noah',
       'Rice song'], dtype=object)
```

In [36]:
```
data.head()
```

Out[36]:

	event_id	device_id	timestamp	longitude	latitude	city	state	genc
0	1078723	5.124242e+17	2016-05-02 02:21:20	83.398244	17.768149	Visakhapatnam	AndhraPradesh	
1	280014	8.879644e+18	2016-05-05 13:06:01	78.155397	16.390327	Wanparti	AndhraPradesh	
2	2334601	6.018833e+17	2016-05-05 11:17:48	83.380111	17.828583	Visakhapatnam	AndhraPradesh	
3	2064864	2.764521e+18	2016-05-03 23:58:20	83.315014	17.825280	Visakhapatnam	AndhraPradesh	
4	1341801	4.986891e+18	2016-05-07 15:24:58	83.324339	17.778384	Visakhapatnam	AndhraPradesh	

In [37]:
```
data.dtypes
```

Out[37]:
```
event_id          int64
device_id       float64
timestamp        object
longitude       float64
latitude        float64
city             object
state            object
gender           object
age             float64
group            object
phone_brand      object
device_model     object
dtype: object
```

In [38]:
```
data.to_csv("C:\\Users\\Abhishek\\Downloads\\readyforEDA.csv")
```

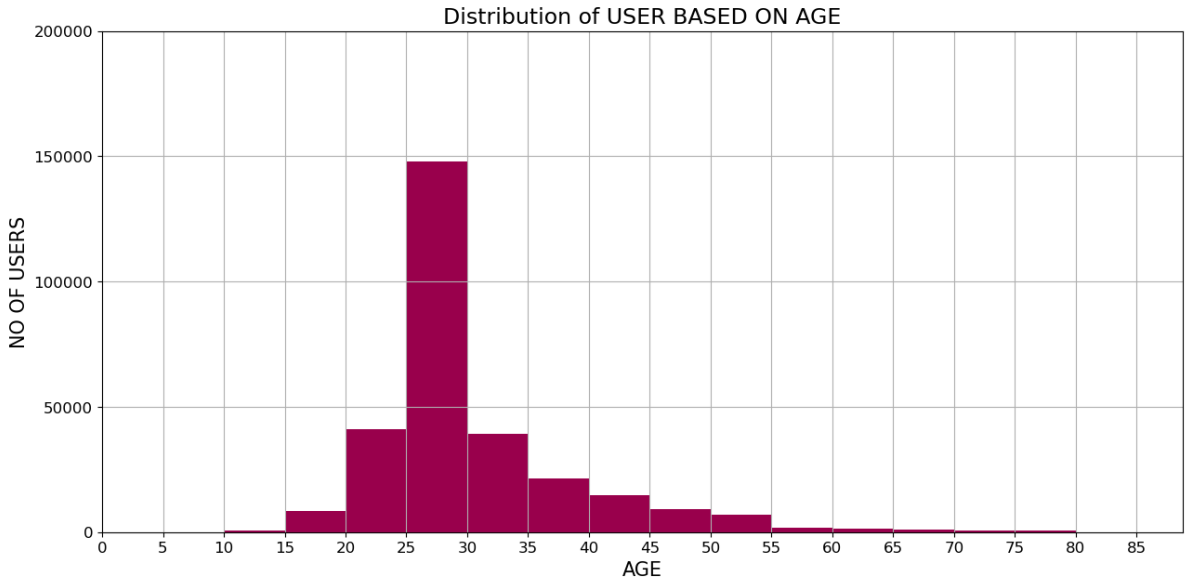
Shortlisting data for top 10 brand only

In [39]:
```
targetbrand = ["Xiǎomǐ","Samsung","Huawei","OPPO","vivo ","meizu","Coolpad","H

# Filter the data for top 10 brand
data_top10brand = data[data['phone_brand'].isin(targetbrand)]
```

8. Exploratory Data Analysis

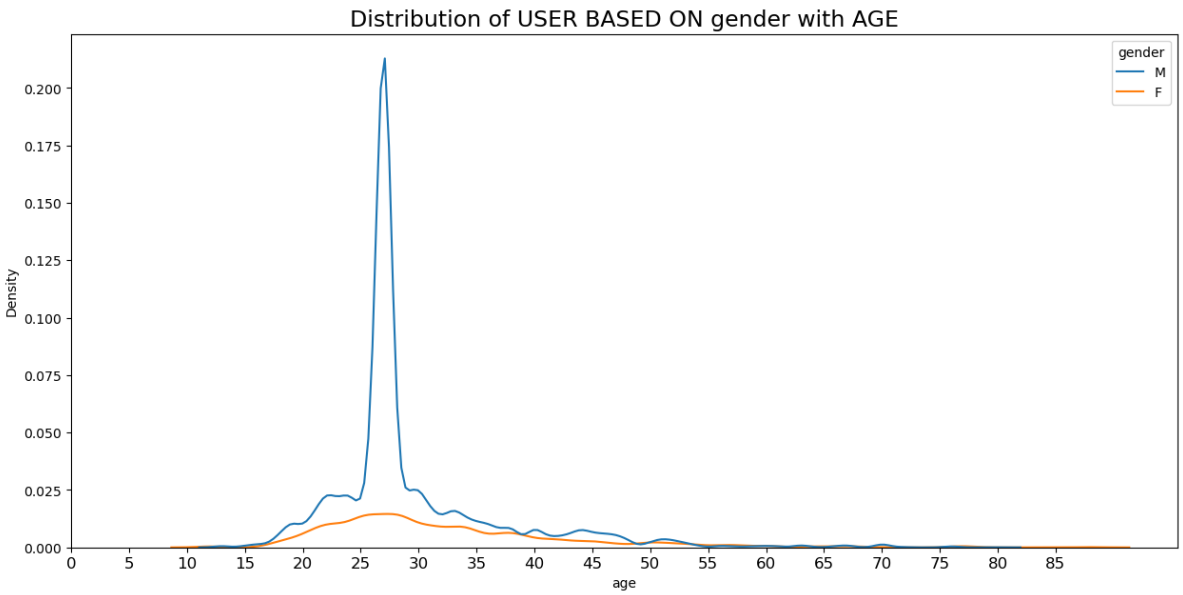
- This section is emphasised on asking the right questions and perform analysis using the data.
- Note that there is no limit how deep you can go, but make sure not to get distracted from right track.

In [63]:
```
figure=plt.figure(figsize=[15,7])
data_top10brand['age'].plot.hist(bins=np.arange(10, 90, 5),color="#99004C",gri

plt.xlabel("AGE",size=15)
plt.ylabel("NO OF USERS",size=15)
plt.title("Distribution of USER BASED ON AGE",size=17)

plt.xticks(ticks=np.arange(0, 90, 5), size=12)
plt.yticks(ticks=np.arange(0, 250000, 50000), size=12)
plt.show()
```



- Based on comprehensive data,we have found that the majority of our users fall within the age range of 20 to 35.

In [64]:
```
figure=plt.figure(figsize=[15,7])

sns.kdeplot(data=data_top10brand, x="age", hue="gender")


plt.title("Distribution of USER BASED ON gender with AGE",size=17)

plt.xticks(ticks=np.arange(0, 90, 5), size=12)

plt.show()
```

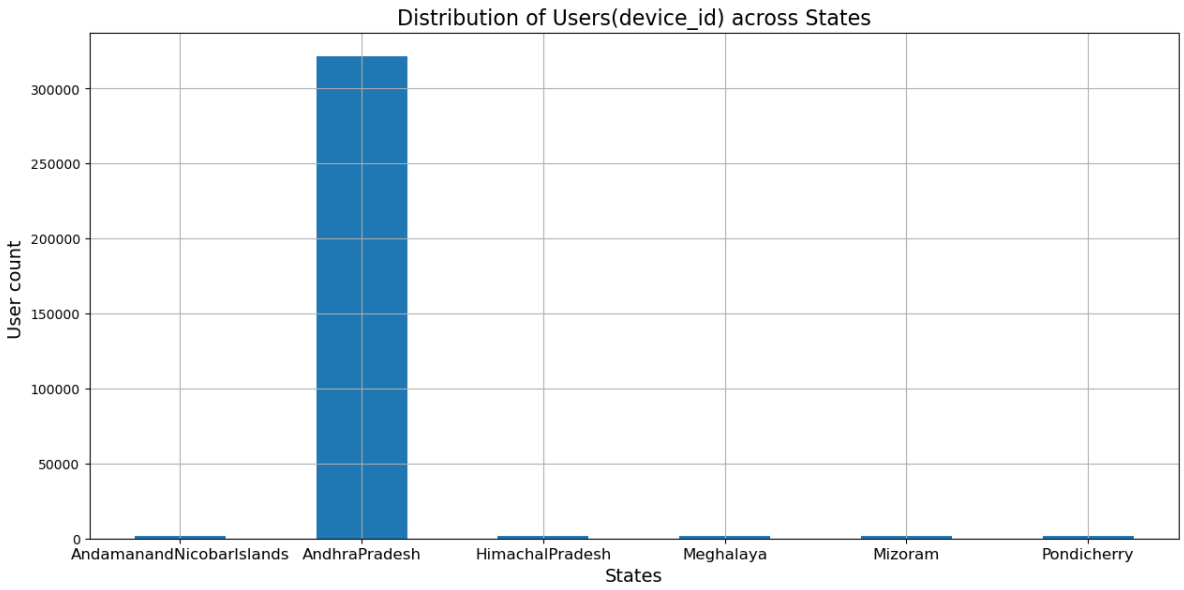


- Male users are More as compared to female users

1.Distribution of Users(device_id) across States

In [65]:
```
figure = plt.figure(figsize=[15, 7])


data.groupby(by=['state'])['device_id'].count().plot.bar()


plt.xticks(size=12, rotation=0
        )

plt.xlabel(xlabel='States', size=14)
plt.ylabel(ylabel='User count ', size=14)

plt.title(label='Distribution of Users(device_id) across States', size=16)
plt.grid(b=True)
plt.show()


plt.show()
```

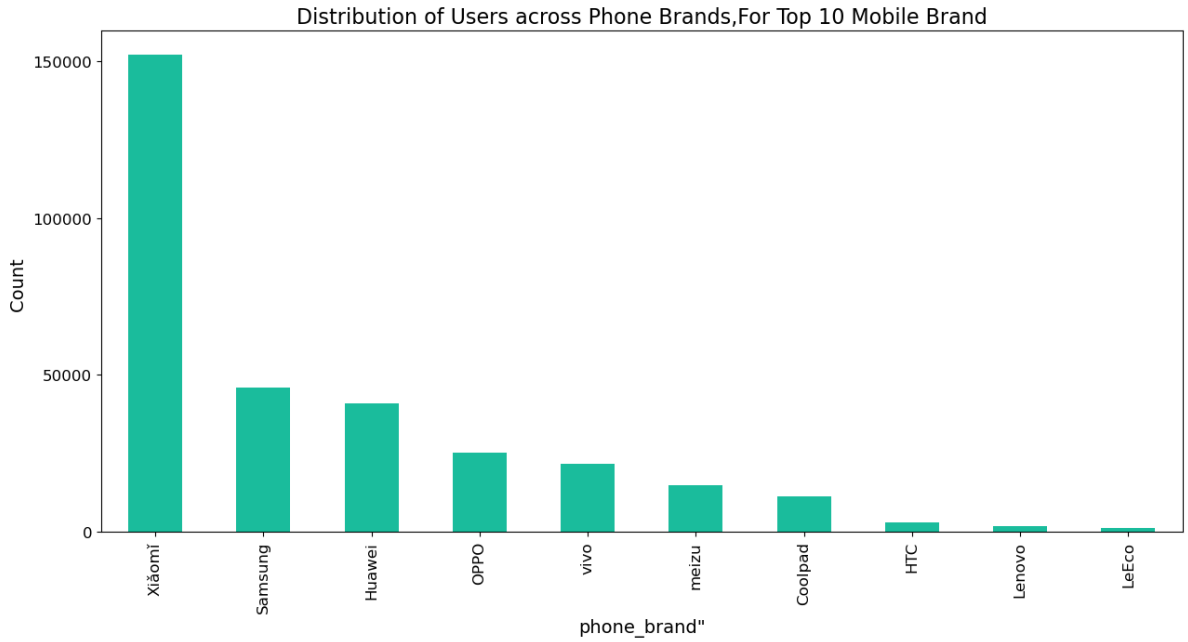
```
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_17940\889067946.py:14: Matplot
libDeprecationWarning: The 'b' parameter of grid() has been renamed 'visible'
since Matplotlib 3.5; support for the old name will be dropped two minor rele
ases later.
  plt.grid(b=True)
```



- Andhra Pradesh, a state in India, has a significant number of users.
- This slide will provide an overview of the user statistics in Andhra Pradesh

2. Distribution of Users across Phone Brands(Consider only 10 Most used Phone Brands).

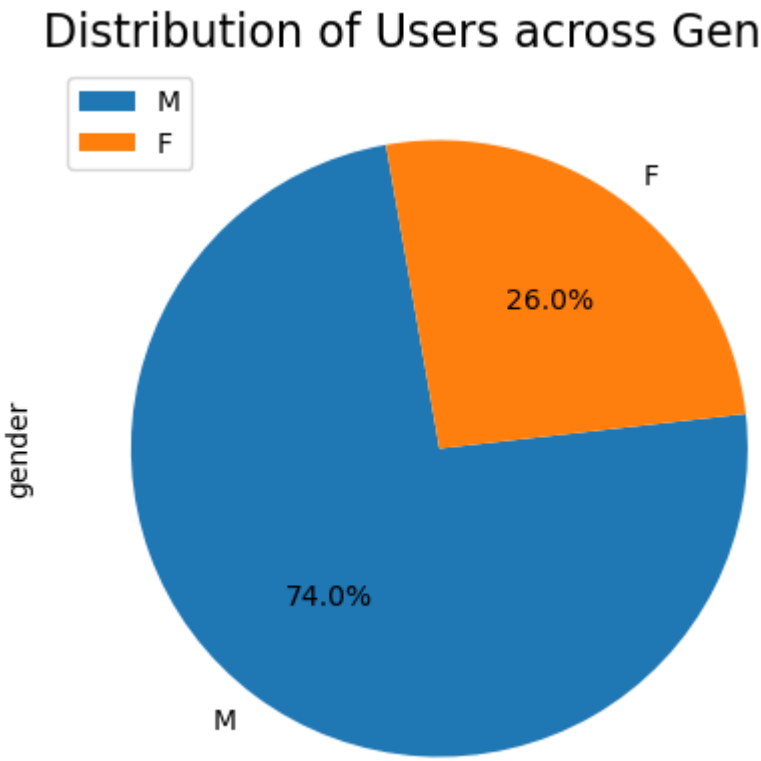
In [66]:
```
figure = plt.figure(figsize=[15, 7])
data["phone_brand"].value_counts()[0:10].plot.bar(color='#1ABC9C',

                                                  )
plt.xticks(size=12, rotation=90)
plt.yticks(ticks=np.arange(0, 170000, 50000), size=12)
plt.xlabel(xlabel='phone_brand"', size=14)
plt.ylabel(ylabel='Count ', size=14, rotation=90
        )
plt.title(label='Distribution of Users across Phone Brands,For Top 10 Mobile B
plt.show()
```



- The global smartphone market has witnessed significant changes in recent years, with consumers embracing a variety of brands and models.
- Highlight Xiaomi, Samsung, and Huawei as the leading brands.
- Xiaomi - Rising in Popularity

3 Distribution of Users across Gender.

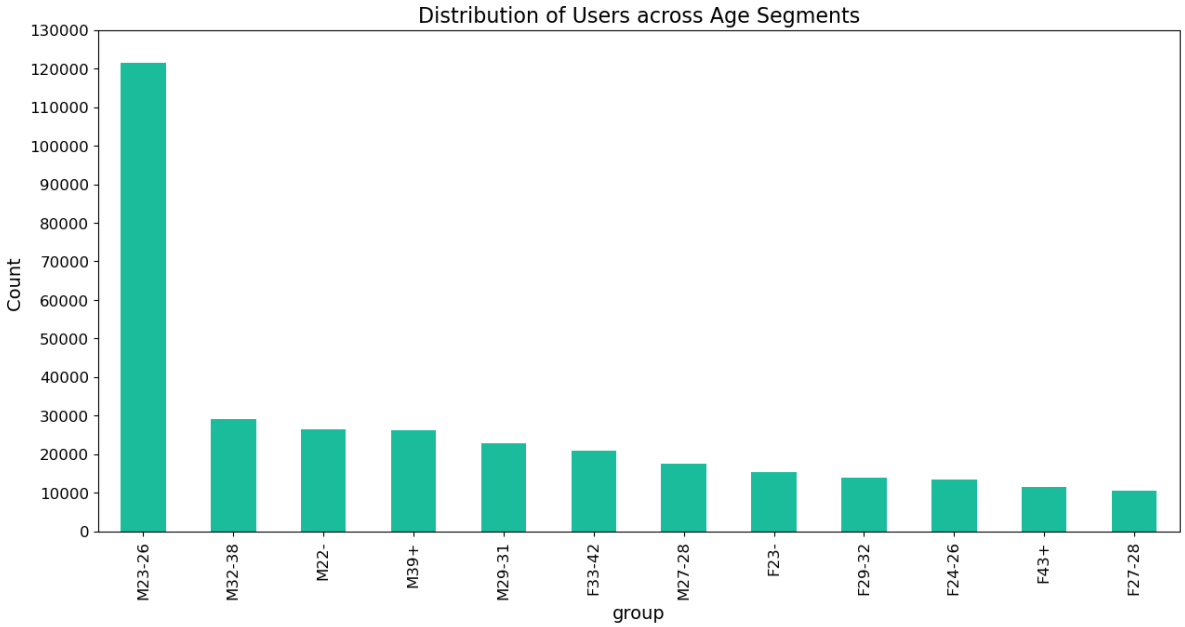
In [67]:
```
figure = plt.figure(figsize=[5, 5])
data['gender'].value_counts().plot.pie(autopct='%3.1f%%',startangle=100,legend
#% value autopct='%3.1f%%' shows the % value in pie chart

plt.title(label='Distribution of Users across Gender', size=16,color='black')#

plt.show() # Dispaly the output by rendering visual on the screen
```



- The user base consists of 74% male users and 26% female users.
- This data indicates a slight majority of male users

4. Distribution of Users across Age Segments.

In [68]:
```
figure = plt.figure(figsize=[15, 7])
data["group"].value_counts().plot.bar(color='#1ABC9C')
plt.xticks(size=12, rotation=90)
plt.yticks(ticks=np.arange(0, 140000, 10000), size=12)
plt.xlabel(xlabel='group', size=14)
plt.ylabel(ylabel='Count ', size=14,rotation=90)
plt.title(label='Distribution of Users across Age Segments', size=16)
plt.show()
```



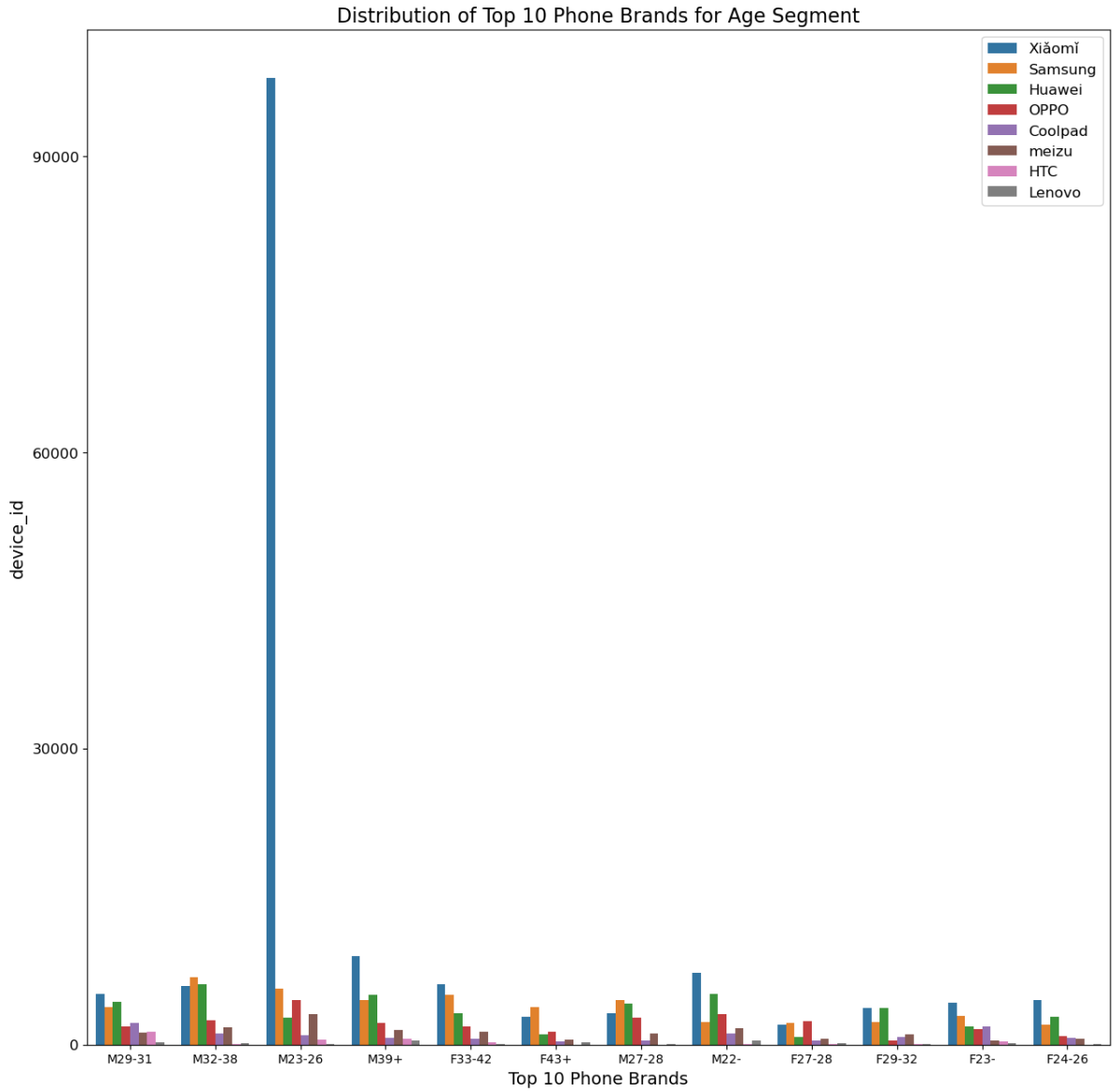
- Understanding the user demographics is crucial for effective targeting and tailoring of products and services.
- The age group M23-36 exhibits the highest number of male users.
- The age group F33-42 exhibits the highest number of Female users

In [ ]:

5. Distribution of Phone Brands(Consider only 10 Most used Phone Brands) for each Age Segment, State, Gender.

Distribution of Top 10 Phone Brands for each Age Segment

In [69]:
```
figure = plt.figure(figsize=[15,15])
sns.countplot(data=data_top10brand, x="group", hue="phone_brand")

plt.yticks(ticks=np.arange(0, 100000,30000), size=12)
plt.xlabel(xlabel='Top 10 Phone Brands', size=14)

plt.ylabel(ylabel='device_id', size=14)

plt.title(label='Distribution of Top 10 Phone Brands for Age Segment', size=16
plt.legend(fontsize=12)

plt.show()
```



- Xiaomi Brand is Rising in Popularity FOR the age group M29-31,M32-26,M39+,F33-42,M22,F29-32,F23-,F24-25
- Samsung brand is Rising in Popularity FOR the age group M32-38,F43+,m27-28,f27-28.

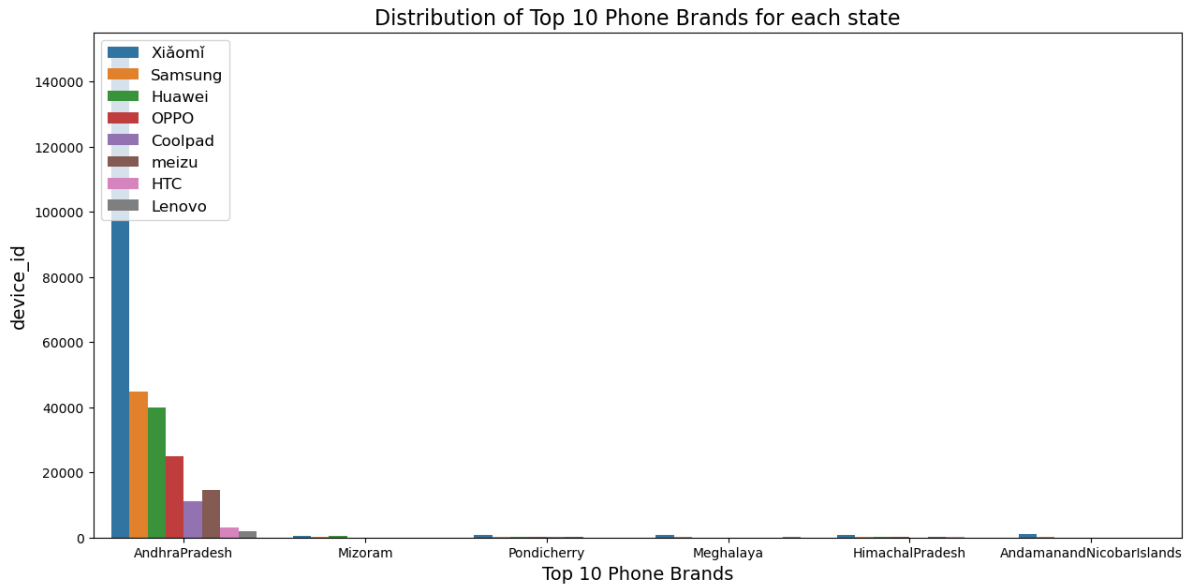
In [70]:
```
data_top10brand.groupby(by=["group",'phone_brand'])['device_id'].count()
```

Out[70]:
```
group  phone_brand
F23-   Coolpad        1835
       HTC             299
       Huawei         1825
       Lenovo          162
       OPPO           1535
                      ...
M39+   Lenovo          396
       OPPO           2224
       Samsung        4481
       Xiăomĭ         8959
       meizu          1524
Name: device_id, Length: 96, dtype: int64
```

In [71]:
```
pd.set_option('display.max_rows', None)    # Display all rows
pd.set_option('display.max_columns', None) # Display all columns
```

Distribution of Top 10 Phone Brands for each State

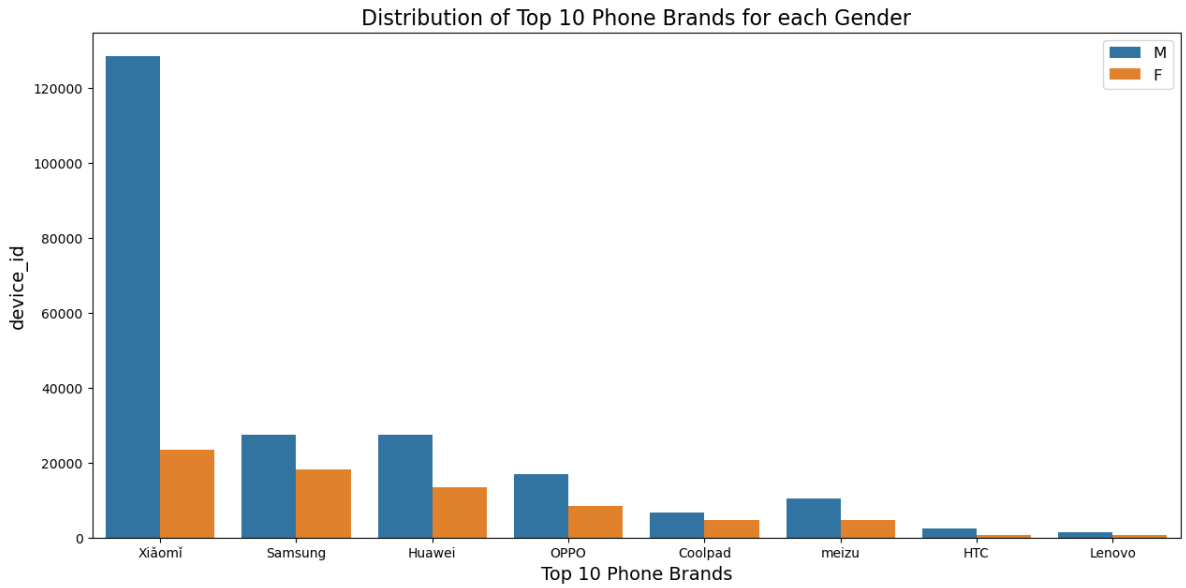
In [72]:
```
figure = plt.figure(figsize=[15, 7])
sns.countplot(data=data_top10brand, x="state",  hue="phone_brand")
plt.yticks()

plt.xlabel(xlabel='Top 10 Phone Brands', size=14)

plt.ylabel(ylabel='device_id', size=14)

plt.title(label='Distribution of Top 10 Phone Brands for each state', size=16)
plt.legend(fontsize=12)

plt.show()
```



- Xiaomi is Rising in Popularity in each State

Distribution of Top 10 Phone Brands for each Gender

In [73]:
```
figure = plt.figure(figsize=[15, 7])
sns.countplot(data=data_top10brand, x="phone_brand", hue="gender")
plt.yticks()

plt.xlabel(xlabel='Top 10 Phone Brands', size=14)

plt.ylabel(ylabel='device_id', size=14)

plt.title(label='Distribution of Top 10 Phone Brands for each Gender', size=16
plt.legend(fontsize=12)

plt.show()
```



- Male users are IN MEJORITY for variety of brands.
- Xiaomi - Rising in Popularity.

In [74]:
```
data_top10brand.groupby(by=['phone_brand',"gender"])['device_id'].count()
```

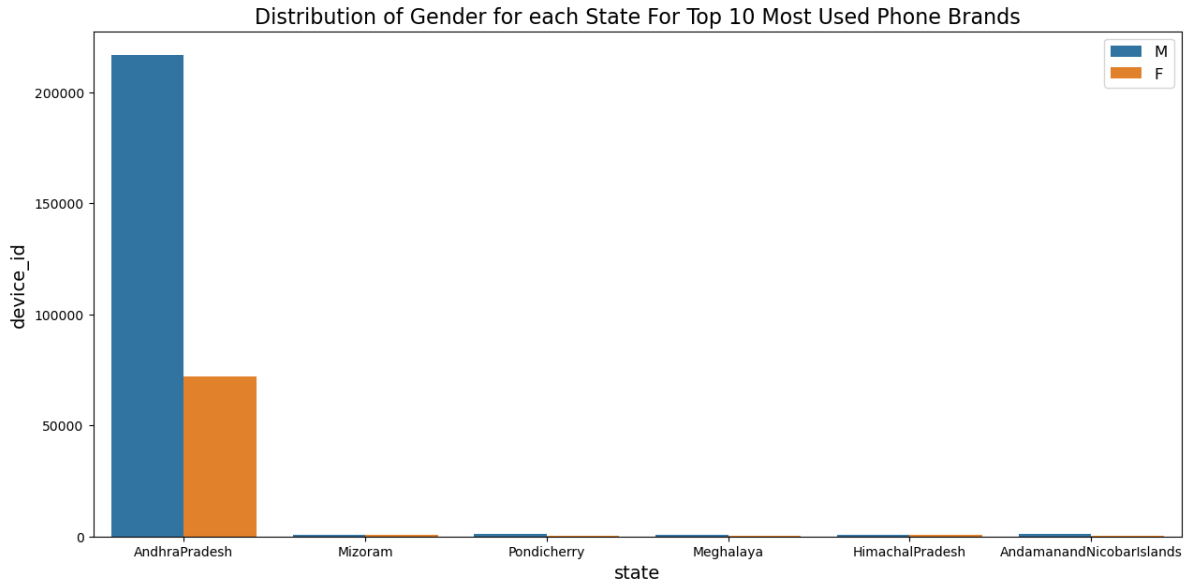
Out[74]:
```
phone_brand  gender
Coolpad      F           4688
             M           6593
HTC          F            641
             M           2545
Huawei       F          13372
             M          27530
Lenovo       F            670
             M           1351
OPPO         F           8498
             M          16885
Samsung      F          18307
             M          27568
Xiǎomǐ       F          23484
             M         128489
meizu        F           4577
             M          10387
Name: device_id, dtype: int64
```

In [ ]:

6. Distribution of Gender for each State, Age Segment, and Phone Brand(Consider only 10 Most Used Phone Brands).

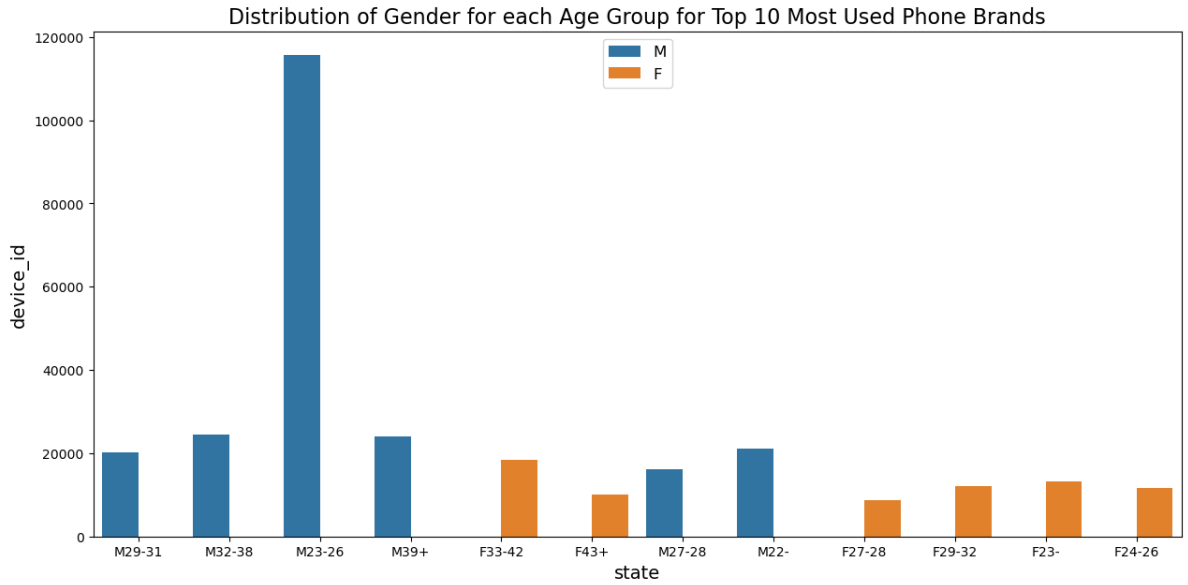
Distribution of Gender for each State For Top 10 Most Used Phone Brands

In [75]:
```
figure = plt.figure(figsize=[15, 7])
sns.countplot(data=data_top10brand, x="state", hue="gender")
plt.yticks()

plt.xlabel(xlabel='state', size=14)

plt.ylabel(ylabel='device_id', size=14)

plt.title(label='Distribution of Gender for each State For Top 10 Most Used Ph
plt.legend(fontsize=12)

plt.show()
```



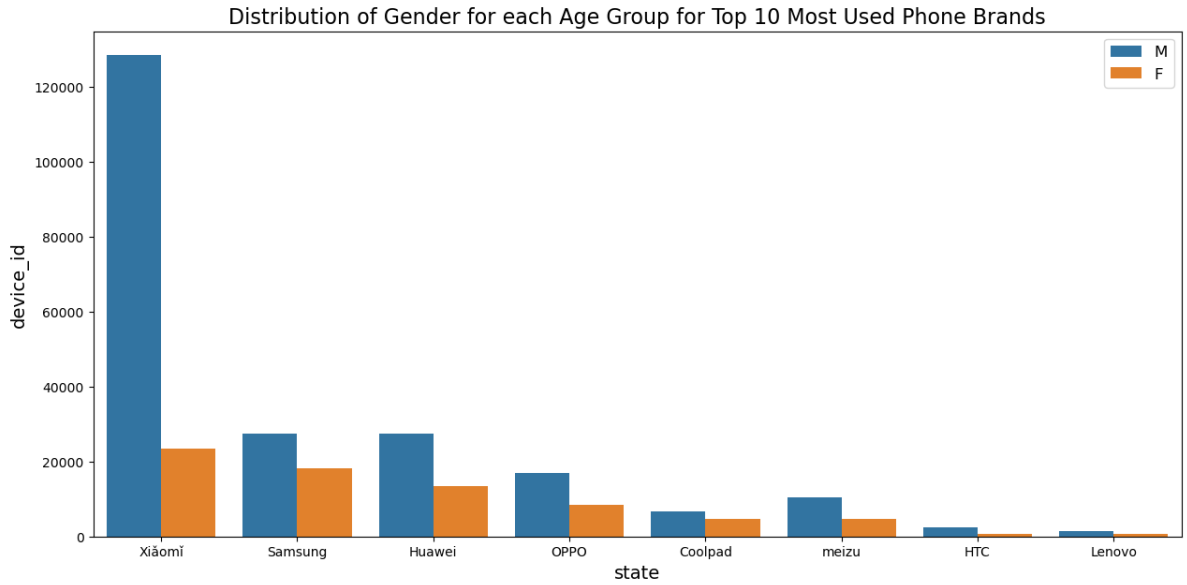
Distribution of Gender for each Age Group for Top 10 Most Used Phone Brands

In [76]:
```
figure = plt.figure(figsize=[15, 7])
sns.countplot(data=data_top10brand, x="group", hue="gender")
plt.yticks()

plt.xlabel(xlabel='state', size=14)

plt.ylabel(ylabel='device_id', size=14)

plt.title(label='Distribution of Gender for each Age Group for Top 10 Most Use
plt.legend(fontsize=12)

plt.show()
```



Distribution of Gender for Top 10 Most Used Phone Brands

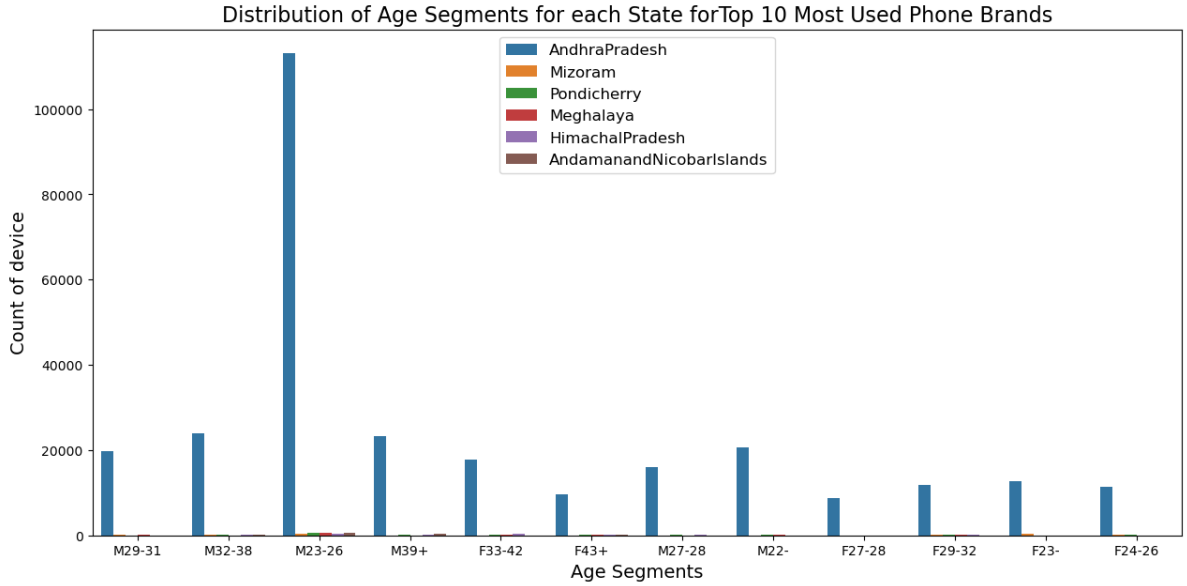
In [77]:
```
figure = plt.figure(figsize=[15, 7])
sns.countplot(data=data_top10brand, x="phone_brand", hue="gender")
plt.yticks()

plt.xlabel(xlabel='state', size=14)

plt.ylabel(ylabel='device_id', size=14)

plt.title(label='Distribution of Gender for each Age Group for Top 10 Most Use
plt.legend(fontsize=12)

plt.show()
```



7 Distribution of Age Segments for each State, Gender, and Phone Brand(Consider only 10 Most Used Phone Brands).

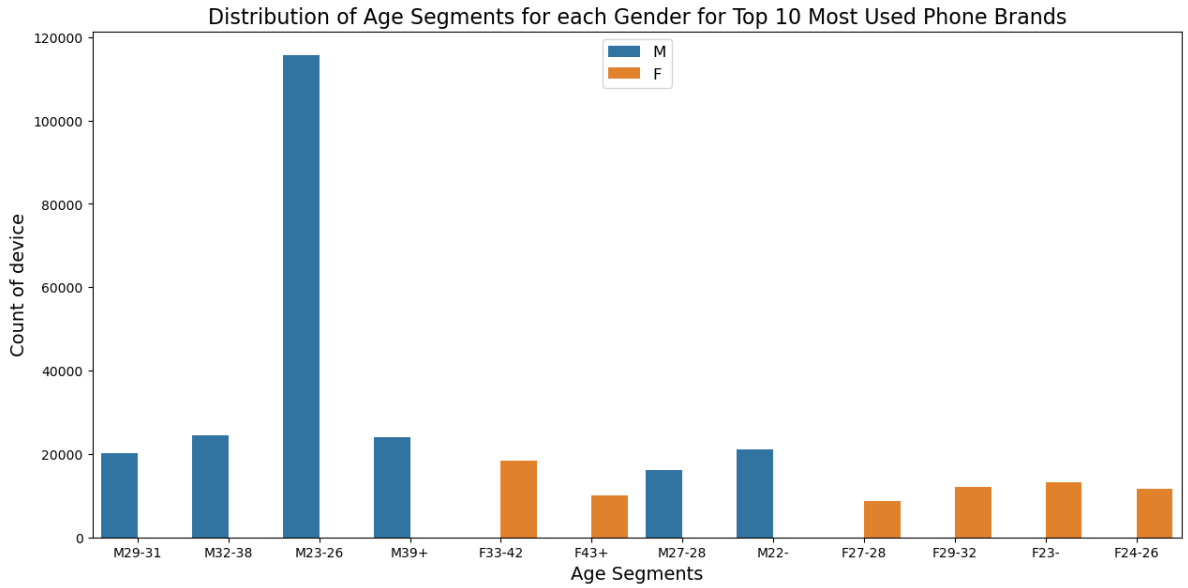
Distribution of Age Segments for each State

In [78]:
```
figure = plt.figure(figsize=[15, 7])
sns.countplot(data=data_top10brand, x="group", hue="state")
plt.yticks()

plt.xlabel(xlabel='Age Segments', size=14)

plt.ylabel(ylabel='Count of device', size=14)

plt.title(label='Distribution of Age Segments for each State forTop 10 Most Us
plt.legend(fontsize=12)

plt.show()
```



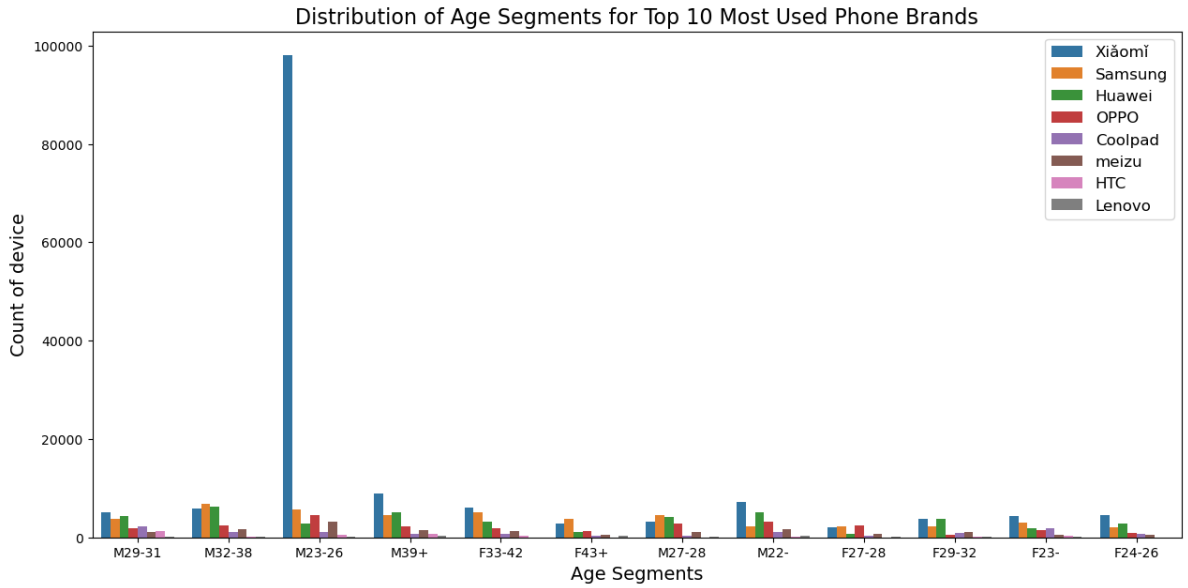
Distribution of Age Segments for each gender

In [79]:
```
figure = plt.figure(figsize=[15, 7])
sns.countplot(data=data_top10brand, x="group", hue="gender")

plt.yticks()

plt.xlabel(xlabel='Age Segments', size=14)

plt.ylabel(ylabel='Count of device', size=14)

plt.title(label='Distribution of Age Segments for each Gender for Top 10 Most
plt.legend(fontsize=12)

plt.show()
```



Distribution of Age Segments for Brand

In [80]:
```
figure = plt.figure(figsize=[15, 7])
sns.countplot(data=data_top10brand, x="group", hue="phone_brand")

plt.yticks()

plt.xlabel(xlabel='Age Segments', size=14)

plt.ylabel(ylabel='Count of device', size=14)

plt.title(label='Distribution of Age Segments for Top 10 Most Used Phone Brand
plt.legend(fontsize=12)

plt.show()
```



8. Hourly distribution of Phone Calls.

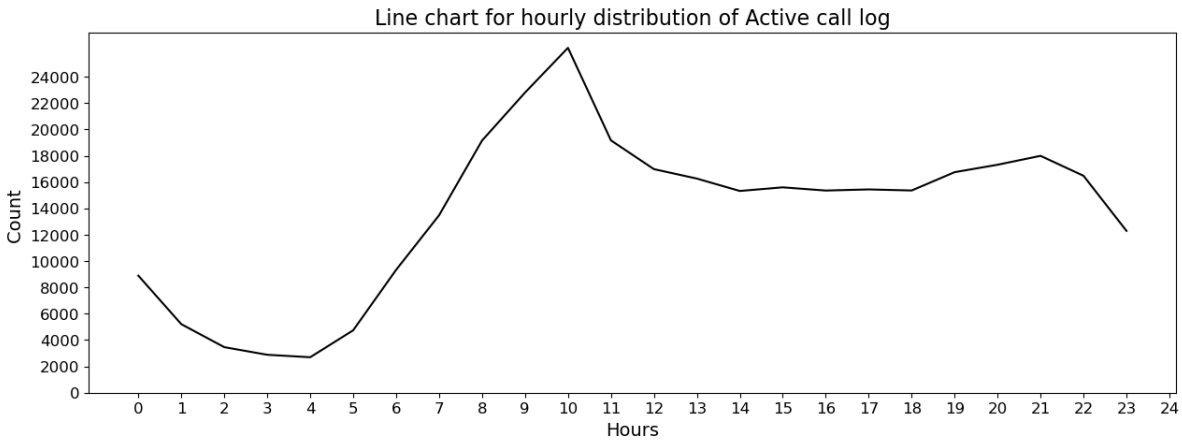
converting to date time format

In [81]:
```
data['timestamp'] = pd.to_datetime(data['timestamp'])
```

In [82]:
```
data['hour'] = data['timestamp'].dt.hour
```

In [ ]:
```

```

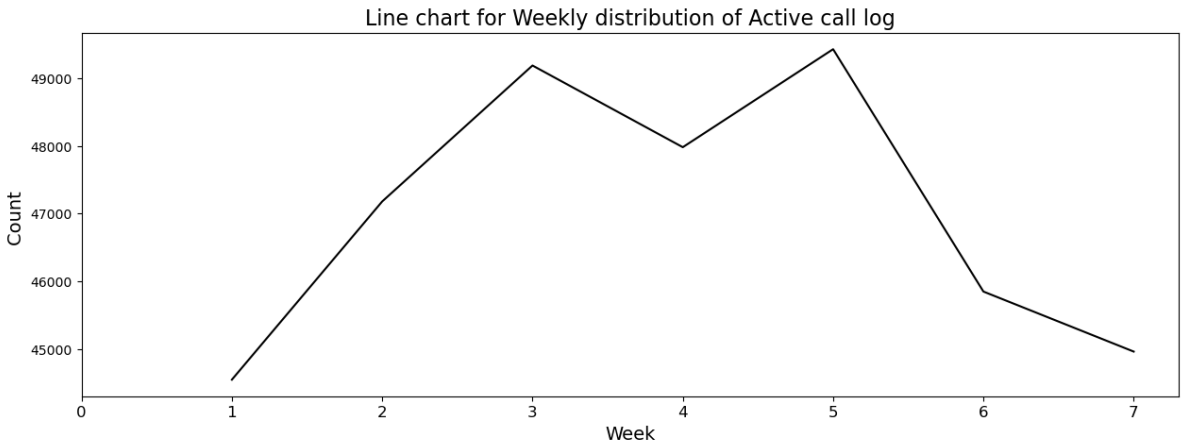
In [83]:
```
figure = plt.figure(figsize=[15, 5])

data.groupby(by = 'hour')["device_id"].count().plot.line(color='black')


plt.xticks(np.arange(0,25,1),size=12)
plt.yticks(np.arange(0,26000,2000),size=12)

plt.xlabel(xlabel='Hours', size=14)
plt.ylabel(ylabel='Count ', size=14,rotation=90)

plt.title(label='Line chart for hourly distribution of Active call log', size=

plt.show()
```



- users are highly active during the designated call hours, specifically from 8.00am to 9:00 pm

In [84]:
```
data['day_of_week'] = data['timestamp'].dt.day_of_week + 1
```

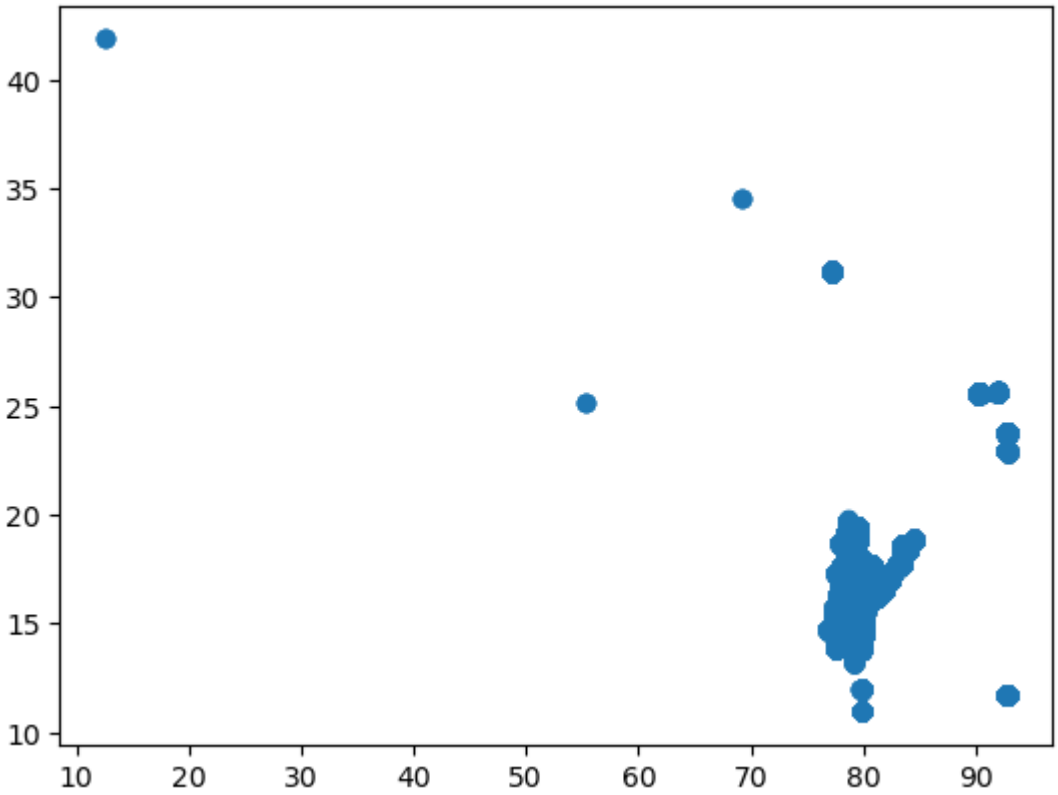
In [85]:
```
figure = plt.figure(figsize=[15, 5])

data.groupby(by = 'day_of_week')["device_id"].count().plot.line(color='black')


plt.xticks(np.arange(0,8,1),size=12)


plt.xlabel(xlabel='Week', size=14)
plt.ylabel(ylabel='Count ', size=14,rotation=90)

plt.title(label='Line chart for Weekly distribution of Active call log', size=

plt.show()
```



- Users tend to be less active on calls on Sundays and Saturdays
- Possible reasons for decreased activity (e.g., rest days, family time)

Handling Improper Lat & Long

In [86]:
```
plt.scatter(x=data['longitude'], y=data['latitude'])
plt.show()
```

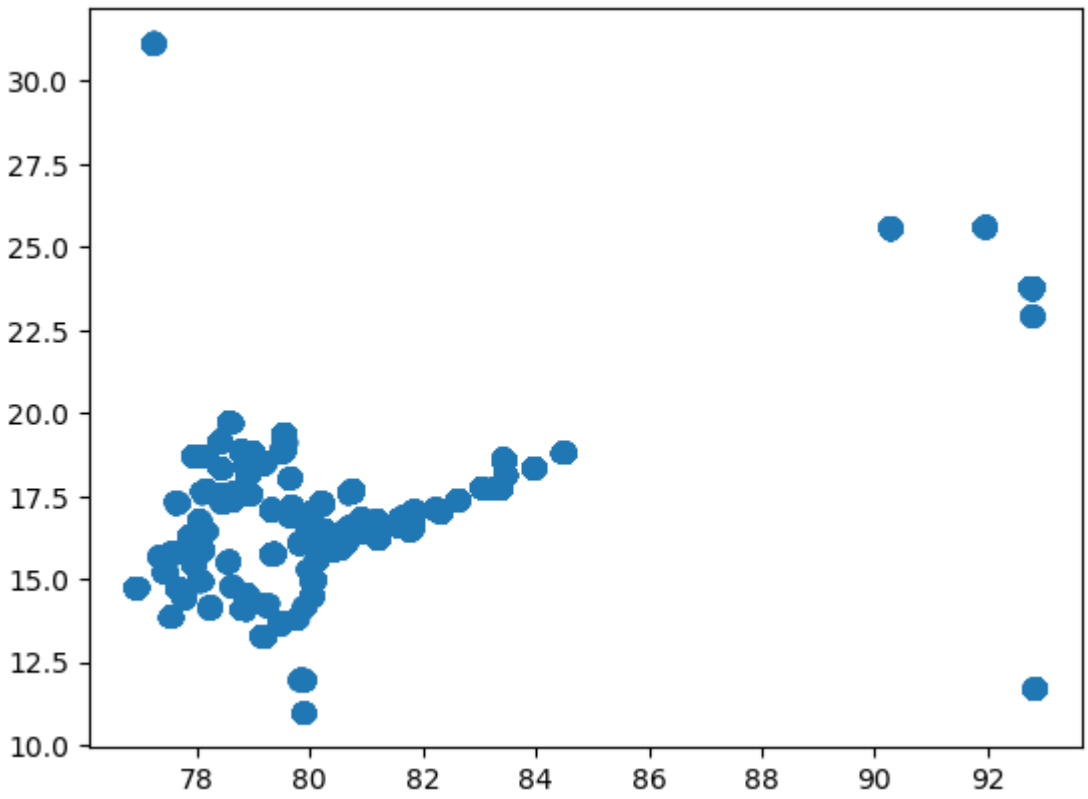


In [87]:
```
data['latitude'][(data['latitude']>20) & (data['longitude']<60)]=17.798819# ch
data['longitude'][(data['latitude']>20) & (data['longitude']<60)]=83.368896 #c

data['latitude'][(data['latitude']<30) & (data['longitude']<60)]=17.798819# ch
data['longitude'][(data['latitude']<30) & (data['longitude']<60)]=83.368896 #c

data['latitude'][(data['latitude']>30) & (data['longitude']<75)]=17.798819# ch
data['longitude'][(data['latitude']>30) & (data['longitude']<75)]=83.368896 #c

data['latitude'][(data['latitude']<30) & (data['longitude']<75)]=17.798819# ch
data['longitude'][(data['latitude']<30) & (data['longitude']<75)]=83.368896 #c
```

```
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_17940\1978007308.py:1: Setting
WithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  data['latitude'][(data['latitude']>20) & (data['longitude']<60)]=17.798819#
changing lat latitude']>20 and longitude']<60
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_17940\1978007308.py:2: Setting
WithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  data['longitude'][(data['latitude']>20) & (data['longitude']<60)]=83.368896
#changing lon latitude']>20 and longitude']<60
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_17940\1978007308.py:4: Setting
WithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  data['latitude'][(data['latitude']<30) & (data['longitude']<60)]=17.798819#
changing lat latitude']<30) & (data['longitude']<60)
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_17940\1978007308.py:5: Setting
WithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  data['longitude'][(data['latitude']<30) & (data['longitude']<60)]=83.368896
#changing lon latitude']<30) & (data['longitude']<60)]
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_17940\1978007308.py:7: Setting
WithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame
```

```
See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  data['latitude'][(data['latitude']>30) & (data['longitude']<75)]=17.798819#changing lat latitude']>30) & (data['longitude']<75)
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_17940\1978007308.py:8: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  data['longitude'][(data['latitude']>30) & (data['longitude']<75)]=83.368896#changing lon latitude']>30) & (data['longitude']<75)]
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_17940\1978007308.py:10: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  data['latitude'][(data['latitude']<30) & (data['longitude']<75)]=17.798819#changing lat latitude']<30) & (data['longitude']<75)
C:\Users\Abhishek\AppData\Local\Temp\ipykernel_17940\1978007308.py:11: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  data['longitude'][(data['latitude']<30) & (data['longitude']<75)]=83.368896#changing lon latitude']<30) & (data['longitude']<75)]
```

In [88]:
```
plt.scatter(x=data['longitude'], y=data['latitude'])
plt.show()
```



In [ ]:
```

```

Plot the Users on the Map.

In [89]:
```
pip install folium
```

```
Requirement already satisfied: folium in c:\users\abhishek\anaconda3\lib\site
-packages (0.14.0)
Requirement already satisfied: numpy in c:\users\abhishek\anaconda3\lib\site-
packages (from folium) (1.23.5)
Requirement already satisfied: branca>=0.6.0 in c:\users\abhishek\anaconda3\l
ib\site-packages (from folium) (0.6.0)
Requirement already satisfied: jinja2>=2.9 in c:\users\abhishek\anaconda3\li
b\site-packages (from folium) (2.11.3)
Requirement already satisfied: requests in c:\users\abhishek\anaconda3\lib\si
te-packages (from folium) (2.28.1)
Requirement already satisfied: MarkupSafe>=0.23 in c:\users\abhishek\anaconda
3\lib\site-packages (from jinja2>=2.9->folium) (2.0.1)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\abhishek\anacon
da3\lib\site-packages (from requests->folium) (2022.9.14)
Requirement already satisfied: charset-normalizer<3,>=2 in c:\users\abhishek\
anaconda3\lib\site-packages (from requests->folium) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in c:\users\abhishek\anaconda3\li
b\site-packages (from requests->folium) (3.3)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\users\abhishek\ana
conda3\lib\site-packages (from requests->folium) (1.26.11)
Note: you may need to restart the kernel to use updated packages.
```

In [90]:
```
import folium
from folium.plugins import MarkerCluster

latitude_list = data["latitude"]
longitude_list = data["longitude"]

map = folium.Map(location=[latitude_list[0], longitude_list[0]], zoom_start=12

marker_cluster = MarkerCluster().add_to(map)
for lat, lon in zip(latitude_list, longitude_list):
    folium.Marker(location=[lat, lon], icon=None).add_to(marker_cluster)
map
```

Out[90]: Make this Notebook Trusted to load map: File -> Trust Notebook

9. Summarization---

-

In [ ]:

9.1Conclusion

-

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]: