

kddCup2012

May 16, 2018

1 KDD Cup 2012, Track 2

1.1 Predict the click-through rate of ads given the query and user information.

1.2 <https://www.kaggle.com/c/kddcup2012-track2#Description>

2 Imports

```
In [1]: import sys
        sys.path.append("/home/satluri/Downloads/fastai/courses/dl1/") # go to parent dir
```

```
In [2]: %matplotlib inline
        %reload_ext autoreload
        %autoreload 2
```

```
In [3]: from fastai.structured import *
        from fastai.column_data import *
        np.set_printoptions(threshold=50, edgeitems=20)
```

```
PATH='data/'
```

```
In [4]: from IPython.display import HTML
```

3 Load 10million Rows of Training Dataset

```
In [5]: train = pd.read_csv(f'{PATH}track2/training.txt', low_memory=False, delimiter='\t',
                            nrows=10000000,
                            names=['Click', 'Impression', 'DisplayURL', 'AdID', 'AdvertiserID',
                                    'Depth', 'Position', 'QueryID', 'KeywordID', 'TitleID', 'Descr',
                                    'UserID'])
```

```
In [6]: train.head()
```

```
Out[6]:
```

	Click	Impression	DisplayURL	AdID	AdvertiserID	Depth	\
0	0	1	4298118681424644510	7686695	385	3	
1	0	1	4860571499428580850	21560664	37484	2	
2	0	1	9704320783495875564	21748480	36759	3	
3	0	1	13677630321509009335	3517124	23778	3	

```
4      0      1  3284760244799604489  20758093      34535      1
```

	Position	QueryID	KeywordID	TitleID	DescriptionID	UserID
0	3	1601	5521	7709	576	490234
1	2	2255103	317	48989	44771	490234
2	3	4532751	60721	685038	29681	490234
3	1	1601	2155	1207	1422	490234
4	1	4532751	77819	266618	222223	490234

```
In [7]: display(DataFrameSummary(train).summary())
```

	Click	Impression	DisplayURL	AdID	AdvertiserID	\
count	1e+07	1e+07	1e+07	1e+07	1e+07	
mean	0.0511591	1.2184	9.73735e+18	1.60191e+07	22701	
std	0.260904	1.31903	4.94648e+18	7.17309e+06	11633.7	
min	0	1	4.82437e+14	1.00003e+06	78	
25%	0	1	5.51113e+18	9.02744e+06	15878	
50%	0	1	1.06001e+19	2.02211e+07	23808	
75%	0	1	1.43404e+19	2.11639e+07	30802	
max	127	1019	1.84459e+19	2.22373e+07	39164	
counts	10000000	10000000	10000000	10000000	10000000	
uniques	51	185	22275	276791	14251	
missing	0	0	0	0	0	
missing_perc	0%	0%	0%	0%	0%	
types	numeric	numeric	numeric	numeric	numeric	

	Depth	Position	QueryID	KeywordID	TitleID	\
count	1e+07	1e+07	1e+07	1e+07	1e+07	
mean	1.90676	1.45688	2.73561e+06	27986.3	130058	
std	0.695407	0.618329	5.62501e+06	86207.4	388581	
min	1	1	0	0	0	
25%	1	1	757	219	340	
50%	2	1	31291	2264	6133	
75%	2	2	1.84502e+06	15374	63366.2	
max	3	3	2.62436e+07	1.24972e+06	4.05141e+06	
counts	10000000	10000000	10000000	10000000	10000000	
uniques	3	3	2110768	374042	928143	
missing	0	0	0	0	0	
missing_perc	0%	0%	0%	0%	0%	
types	numeric	numeric	numeric	numeric	numeric	

	DescriptionID	UserID
count	1e+07	1e+07
mean	83834.7	4.70812e+06
std	273476	5.71037e+06
min	0	14
25%	213	407480
50%	2930	2.17577e+06

```

75%          33612  7.13561e+06
max          3.17181e+06  2.39076e+07
counts      10000000  10000000
uniques      741972  1965069
missing      0  0
missing_perc 0%  0%
types        numeric  numeric

```

```

In [8]: # Convert 'Click' to Boolean
mask = train.Click >= 1
column_name = 'Click'
train.loc[mask, column_name] = True
mask = train.Click < 1
train.loc[mask, column_name] = False

```

```

In [9]: display(DataFrameSummary(train).summary())

```

	Click	Impression	DisplayURL	AdID	AdvertiserID	\
count	NaN	1e+07	1e+07	1e+07	1e+07	
mean	NaN	1.2184	9.73735e+18	1.60191e+07	22701	
std	NaN	1.31903	4.94648e+18	7.17309e+06	11633.7	
min	NaN	1	4.82437e+14	1.00003e+06	78	
25%	NaN	1	5.51113e+18	9.02744e+06	15878	
50%	NaN	1	1.06001e+19	2.02211e+07	23808	
75%	NaN	1	1.43404e+19	2.11639e+07	30802	
max	NaN	1019	1.84459e+19	2.22373e+07	39164	
counts	10000000	10000000	10000000	10000000	10000000	
uniques	2	185	22275	276791	14251	
missing	0	0	0	0	0	
missing_perc	0%	0%	0%	0%	0%	
types	bool	numeric	numeric	numeric	numeric	

	Depth	Position	QueryID	KeywordID	TitleID	\
count	1e+07	1e+07	1e+07	1e+07	1e+07	
mean	1.90676	1.45688	2.73561e+06	27986.3	130058	
std	0.695407	0.618329	5.62501e+06	86207.4	388581	
min	1	1	0	0	0	
25%	1	1	757	219	340	
50%	2	1	31291	2264	6133	
75%	2	2	1.84502e+06	15374	63366.2	
max	3	3	2.62436e+07	1.24972e+06	4.05141e+06	
counts	10000000	10000000	10000000	10000000	10000000	
uniques	3	3	2110768	374042	928143	
missing	0	0	0	0	0	
missing_perc	0%	0%	0%	0%	0%	
types	numeric	numeric	numeric	numeric	numeric	

	DescriptionID	UserID
count	1e+07	1e+07
mean	83834.7	4.70812e+06
std	273476	5.71037e+06
min	0	14
25%	213	407480
50%	2930	2.17577e+06
75%	33612	7.13561e+06
max	3.17181e+06	2.39076e+07
counts	10000000	10000000
uniques	741972	1965069
missing	0	0
missing_perc	0%	0%
types	numeric	numeric

```
In [10]: cat_vars = ['AdID', 'AdvertiserID', 'QueryID', 'Depth', 'Position',
                    'KeywordID', 'TitleID', 'DescriptionID', 'UserID']
        #cont_vars = []
```

```
In [11]: #Now that we've engineered all our features, we need to convert to input compatible with
        #This includes converting categorical variables into contiguous integers or one-hot enc
        #normalizing continuous features to standard normal, etc.
```

```
for v in cat_vars: train[v] = train[v].astype('category').cat.as_ordered()
#for v in cont_vars: train[v] = train[v].astype('float32')
```

```
In [12]: # Inspect cardinality of each categorical variable
        cat_sz = [(c, len(train[c].cat.categories)+1) for c in cat_vars]
        cat_sz
```

```
Out[12]: [('AdID', 276792),
          ('AdvertiserID', 14252),
          ('QueryID', 2110769),
          ('Depth', 4),
          ('Position', 4),
          ('KeywordID', 374043),
          ('TitleID', 928144),
          ('DescriptionID', 741973),
          ('UserID', 1965070)]
```

```
In [13]: # Create embeddings
        emb_szs = [(c, min(50, (c+1)//2)) for _,c in cat_sz]
        emb_szs
```

```
Out[13]: [(276792, 50),
          (14252, 50),
          (2110769, 50),
          (4, 2),
```

```
(4, 2),
(374043, 50),
(928144, 50),
(741973, 50),
(1965070, 50)]
```

```
In [14]: train.reset_index(inplace=True)
```

```
In [15]: train, y, nas, mapper = proc_df(train, 'Click', do_scale=True, skip_flds=['Impression'],
```

```
In [16]: train.head()
```

```
Out[16]:
```

	index	AdID	AdvertiserID	Depth	Position	QueryID	KeywordID	\
0	-1.732051	80524	115	3	3	1587	5521	
1	-1.732050	241494	13123	2	2	700463	318	
2	-1.732050	246360	12532	3	3	921914	60497	
3	-1.732050	27054	7172	3	1	1587	2155	
4	-1.732049	169544	10985	1	1	921914	77321	

	TitleID	DescriptionID	UserID
0	7629	573	43525
1	48284	44215	43525
2	529731	29326	43525
3	1195	1405	43525
4	253198	211831	43525

```
In [17]: display(DataFrameSummary(train).summary())
```

	index	AdID	AdvertiserID	Depth	Position	\
count	1e+07	1e+07	1e+07	1e+07	1e+07	
mean	-5.99374e-17	142351	7119.27	1.90676	1.45688	
std	1	71471.4	3856.38	0.695407	0.618329	
min	-1.73205	1	1	1	1	
25%	-0.866025	91745	4702	1	1	
50%	0	135538	7202	2	1	
75%	0.866025	199492	9600	2	2	
max	1.73205	276791	14251	3	3	
counts	10000000	10000000	10000000	10000000	10000000	
uniques	10000000	276791	14251	3	3	
missing	0	0	0	0	0	
missing_perc	0%	0%	0%	0%	0%	
types	numeric	numeric	numeric	numeric	numeric	

	QueryID	KeywordID	TitleID	DescriptionID	UserID
count	1e+07	1e+07	1e+07	1e+07	1e+07
mean	375604	23089.2	84884.7	56447.2	397421
std	558874	54619.6	178163	130458	478950
min	1	1	1	1	1
25%	753	220	339	213	36201

50%	31030	2264	6064	2897	186886
75%	645083	15369	62389.2	33215	604784
max	2.11077e+06	374042	928143	741972	1.96507e+06
counts	10000000	10000000	10000000	10000000	10000000
uniques	2110768	374042	928143	741972	1965069
missing	0	0	0	0	0
missing_perc	0%	0%	0%	0%	0%
types	numeric	numeric	numeric	numeric	numeric

4 DL

```
In [18]: def accuracy(y_pred, targ):
        correct = 0
        for i in range(len(y_pred)):
            clicked = 1 if y_pred[i][0] >= 0.5 else 0
            correct += 1 if clicked == targ[i][0] else 0
        return correct/len(y_pred)
```

```
In [19]: def inv_y(a): return np.exp(a)

        def exp_rmspe(y_pred, targ):
            targ = inv_y(targ)
            pct_var = (targ - inv_y(y_pred))/targ
            return math.sqrt((pct_var**2).mean())
```

```
In [20]: def intersection(lst1, lst2):

        # Use of hybrid method
        temp = set(lst2)
        lst3 = [value for value in lst1 if value in temp]
        return lst3
```

4.1 Train on Rows [0:10million]

```
In [21]: n = len(train)-1
        val_idx = get_cv_idx(n, val_pct=.1)
        val_idx[0:5]
```

```
Out[21]: array([ 919213, 6771366, 8963914, 3878022, 7328559])
```

```
In [22]: batch_val_idx = intersection(val_idx[val_idx>=0], val_idx[val_idx<1000000])
```

```
In [23]: batch_val_idx.sort()
```

```
In [24]: (batch_val_idx[0], batch_val_idx[len(batch_val_idx)-1])
```

```
Out[24]: (2, 999981)
```

```
In [25]: model = ColumnarModelData.from_data_frame(PATH, batch_val_idx,
                                                train[0:1000000], y[0:1000000].astype(np.float32),
                                                cat_vars, bs=4096)
```

```
In [26]: m = model.get_learner(emb_szs, len(train.columns)-len(cat_vars),
                              0.04, 1, [1000,500], [0.001,0.01], y_range=(0,1))
```

```
In [27]: m.crit = F.binary_cross_entropy
m.crit
```

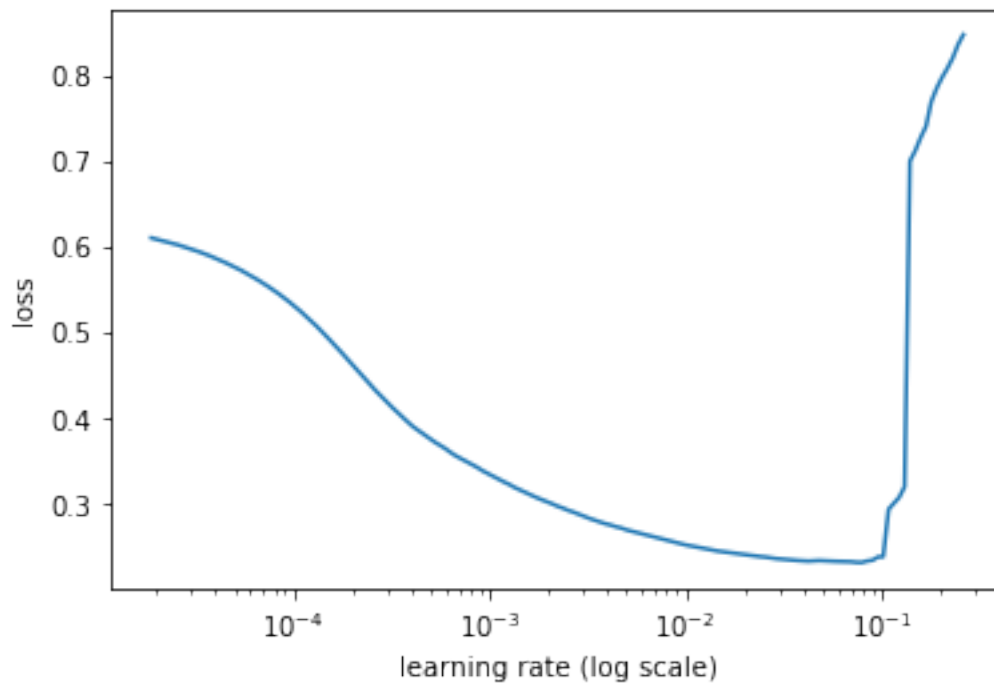
```
Out[27]: <function torch.nn.functional.binary_cross_entropy>
```

```
In [28]: m.lr_find()
```

```
HBox(children=(IntProgress(value=0, description='Epoch', max=1), HTML(value='')))
```

```
77%| | 169/220 [00:18<00:05, 9.26it/s, loss=0.931]
```

```
In [29]: %matplotlib inline
m.sched.plot()
```



```
77%| | 169/220 [00:30<00:09, 5.62it/s, loss=0.931]
```

```
In [30]: lr=2e-3
```

```
In [31]: m.fit(lr, 1, metrics=[accuracy, exp_rmspe])

HBox(children=(IntProgress(value=0, description='Epoch', max=1), HTML(value='')))

32%|      | 71/220 [00:06<00:13, 10.65it/s, loss=0.199]
33%|      | 73/220 [00:06<00:13, 10.53it/s, loss=0.199]

Exception in thread Thread-4:
Traceback (most recent call last):
  File "/home/satluri/anaconda3/lib/python3.6/threading.py", line 916, in _bootstrap_inner
    self.run()
  File "/home/satluri/anaconda3/lib/python3.6/site-packages/tqdm/_tqdm.py", line 144, in run
    for instance in self.tqdm_cls._instances:
  File "/home/satluri/anaconda3/lib/python3.6/_weakrefset.py", line 60, in __iter__
    for itemref in self.data:
RuntimeError: Set changed size during iteration
```

epoch	trn_loss	val_loss	accuracy	exp_rmspe
0	0.18347	0.181097	0.947819	0.157979

```
Out [31]: [array([0.1811]), 0.9478191276510605, 0.157979327252994]
```

```
In [32]: m.save('kddCup2012')
```

```
In [33]: m.load('kddCup2012')
```

```
In [34]: m.fit(lr, 1, metrics=[accuracy, exp_rmspe])
```

```
HBox(children=(IntProgress(value=0, description='Epoch', max=1), HTML(value='')))

epoch      trn_loss  val_loss  accuracy  exp_rmspe
0          0.117032  0.21685  0.936475  0.209048
```

epoch	trn_loss	val_loss	accuracy	exp_rmspe
0	0.117032	0.21685	0.936475	0.209048

```
Out [34]: [array([0.21685]), 0.9364745898359343, 0.20904775300841635]
```

```
In [35]: list(m.data.trn_ds)
```

```
Out [35]: [[array([80524, 115, 1587, 3, 3, 5521, 7629, 573, 43525]),
            array([-1.73205], dtype=float32),
            array([0.], dtype=float32)],
           [array([241494, 13123, 700463, 2, 2, 318, 48284, 44215, 43525]),
            array([-1.73205], dtype=float32),
            array([0.], dtype=float32)]]
```



```

array([0.], dtype=float32)],
[array([27054, 7172, 1587, 3, 1, 2155, 1195, 1405, 43525]),
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array([0.], dtype=float32)],
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array([-1.73204], dtype=float32)],

```

```

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array([-1.73204], dtype=float32),

```

```

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```
In [36]: preds = m.predict()#is_test=True
```

```
In [37]: #preds
```

```
In [38]: # Number of predicted Clicks in the validation set
len(preds[preds>=0.5])
```

```
Out[38]: 2144
```

```
In [39]: # Actual number of Clicks in the validation set
actualClicks = 0
for click in y[val_idx]:
    actualClicks += 1 if click == 1 else 0
actualClicks
```

```
Out[39]: 49176
```