kepler-dataset-exploratory-analysis

February 6, 2022

1 Kepler candidates dataset Exploratory Data Analysis.

[1]:
```
import pandas as pd
import matplotlib.pyplot as plt

%matplotlib inline
```

[2]:
```
data = pd.read_csv('cumulative.csv')
```

[3]:
```
data.head()
```

[3]:
```
   rowid     kepid kepoi_name   kepler_name koi_disposition koi_pdisposition  \
0      1  10797460  K00752.01  Kepler-227 b       CONFIRMED        CANDIDATE
1      2  10797460  K00752.02  Kepler-227 c       CONFIRMED        CANDIDATE
2      3  10811496  K00753.01           NaN  FALSE POSITIVE   FALSE POSITIVE
3      4  10848459  K00754.01           NaN  FALSE POSITIVE   FALSE POSITIVE
4      5  10854555  K00755.01  Kepler-664 b       CONFIRMED        CANDIDATE

   koi_score  koi_fpflag_nt  koi_fpflag_ss  koi_fpflag_co     …      \
0      1.000              0              0              0     …
1      0.969              0              0              0     …
2      0.000              0              1              0     …
3      0.000              0              1              0     …
4      1.000              0              0              0     …

   koi_steff_err2  koi_slogg  koi_slogg_err1  koi_slogg_err2  koi_srad  \
0           -81.0      4.467           0.064          -0.096     0.927
1           -81.0      4.467           0.064          -0.096     0.927
2          -176.0      4.544           0.044          -0.176     0.868
3          -174.0      4.564           0.053          -0.168     0.791
4          -211.0      4.438           0.070          -0.210     1.046

   koi_srad_err1  koi_srad_err2         ra        dec  koi_kepmag
0          0.105         -0.061  291.93423  48.141651      15.347
1          0.105         -0.061  291.93423  48.141651      15.347
2          0.233         -0.078  297.00482  48.134129      15.436
3          0.201         -0.067  285.53461  48.285210      15.597
```

```
4          0.334         -0.133  288.75488  48.226200      15.509

[5 rows x 50 columns]
```

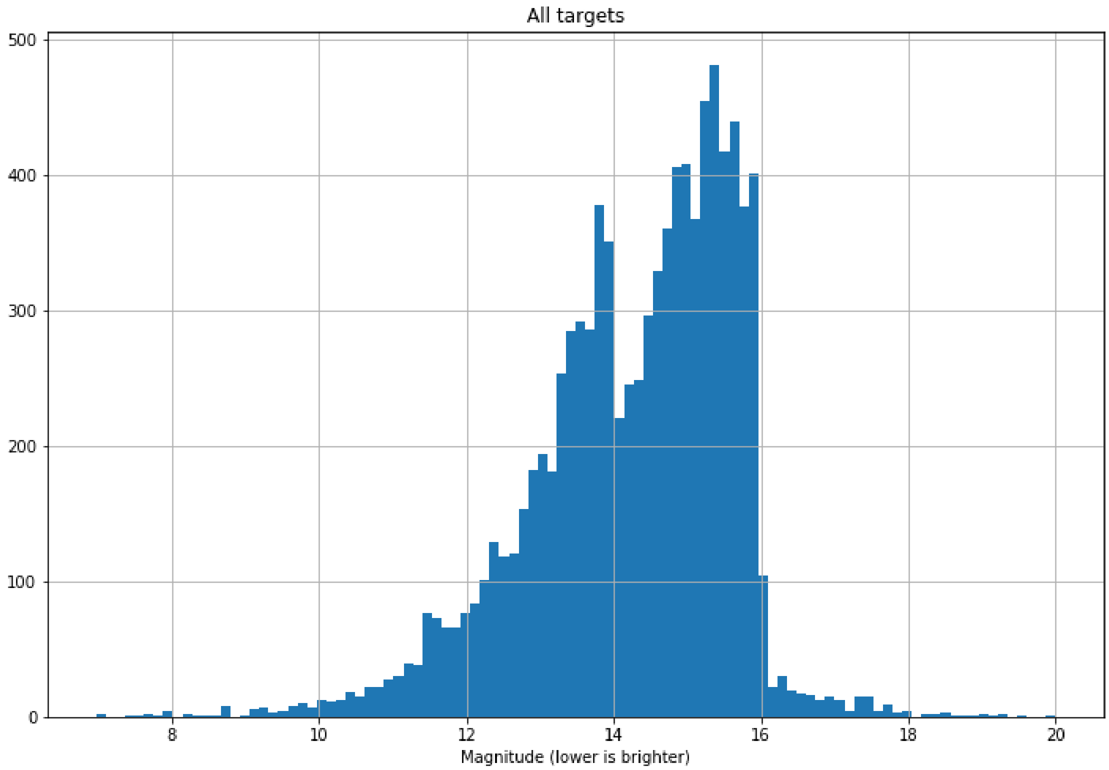
[4]:
```
data.columns
```

[4]:
```
Index(['rowid', 'kepid', 'kepoi_name', 'kepler_name', 'koi_disposition',
       'koi_pdisposition', 'koi_score', 'koi_fpflag_nt', 'koi_fpflag_ss',
       'koi_fpflag_co', 'koi_fpflag_ec', 'koi_period', 'koi_period_err1',
       'koi_period_err2', 'koi_time0bk', 'koi_time0bk_err1',
       'koi_time0bk_err2', 'koi_impact', 'koi_impact_err1', 'koi_impact_err2',
       'koi_duration', 'koi_duration_err1', 'koi_duration_err2', 'koi_depth',
       'koi_depth_err1', 'koi_depth_err2', 'koi_prad', 'koi_prad_err1',
       'koi_prad_err2', 'koi_teq', 'koi_teq_err1', 'koi_teq_err2', 'koi_insol',
       'koi_insol_err1', 'koi_insol_err2', 'koi_model_snr', 'koi_tce_plnt_num',
       'koi_tce_delivname', 'koi_steff', 'koi_steff_err1', 'koi_steff_err2',
       'koi_slogg', 'koi_slogg_err1', 'koi_slogg_err2', 'koi_srad',
       'koi_srad_err1', 'koi_srad_err2', 'ra', 'dec', 'koi_kepmag'],
      dtype='object')
```

1.1 Figures

[5]:
```
ax = data.koi_kepmag.hist(bins=100, figsize=(12, 8))
ax.set_xlabel("Magnitude (lower is brighter)")
ax.set_title("All targets")
```

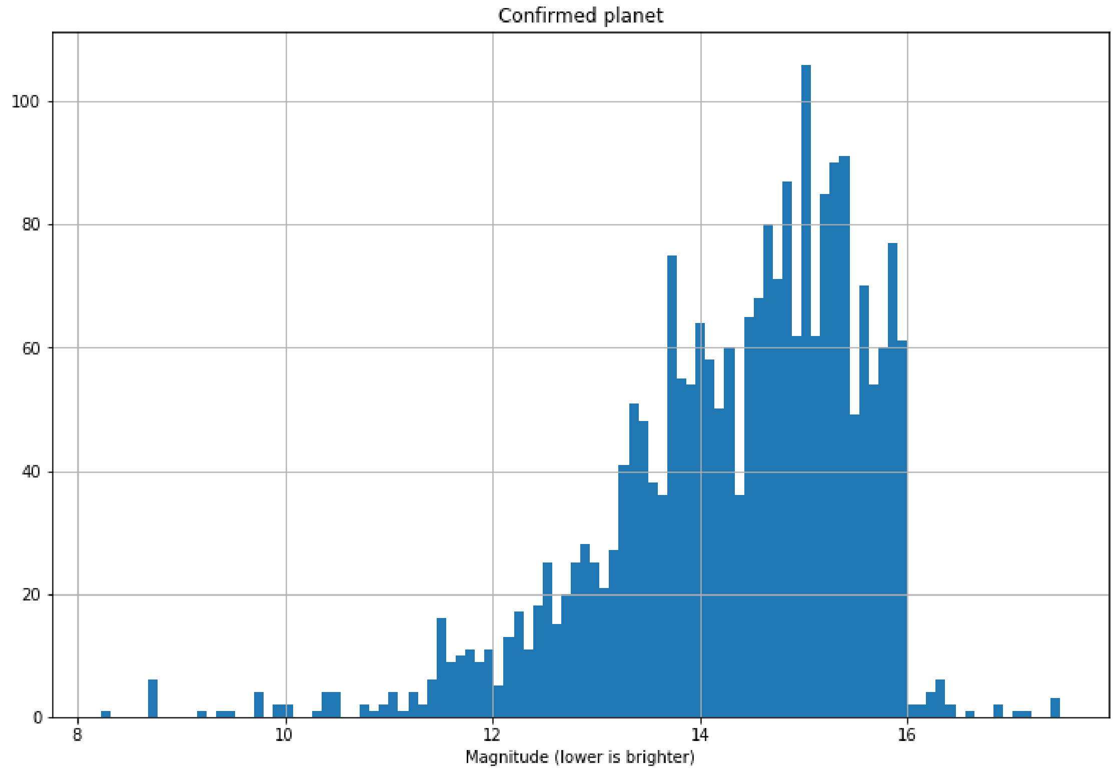
[5]:
```
<matplotlib.text.Text at 0x7f0ef05d8fd0>
```



We see what looks like a bi-modal distribution and a sharp cut-off at around 16th magnitude. This is likely the limit at which the noise becomes too much to detect planetary candidates.

[6]:
```
# only the Confirmed planets
ax = data[data.koi_disposition == 'CONFIRMED'].koi_kepmag.hist(bins=100,␣
↪figsize=(12, 8))
ax.set_xlabel("Magnitude (lower is brighter)")
ax.set_title("Confirmed planet")
```

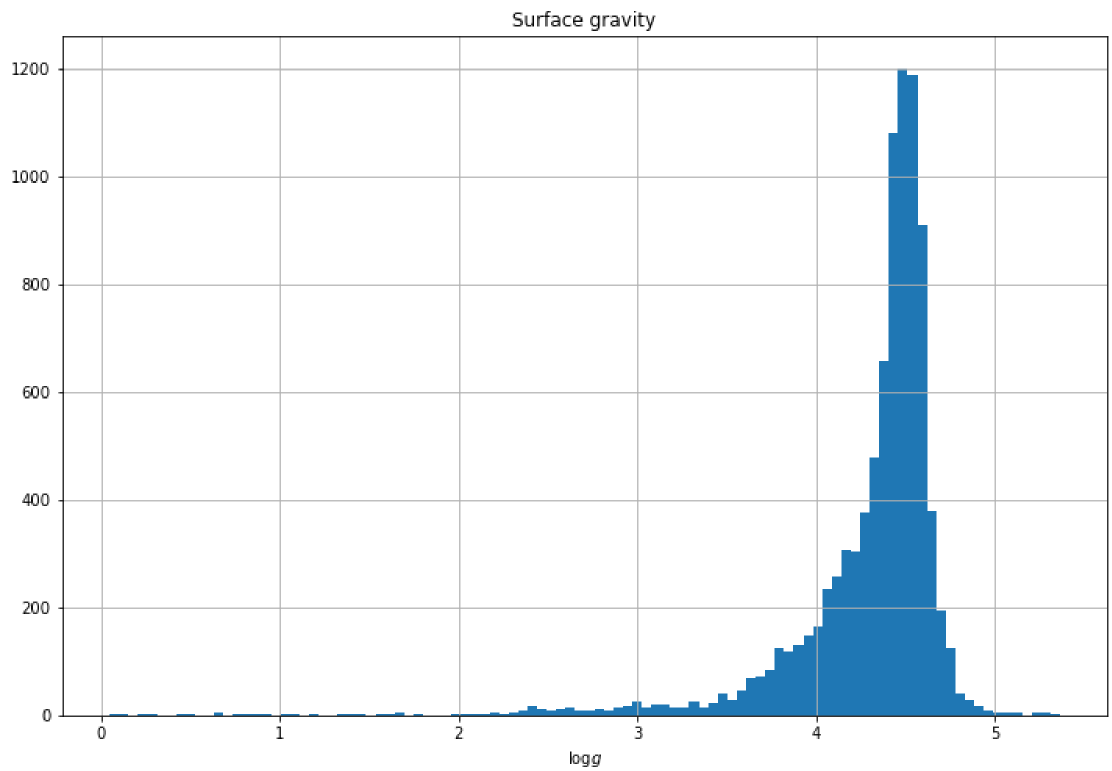
[6]: <matplotlib.text.Text at 0x7f0ef01d0a90>



1.1.1 Surface Gravity of Stars

[7]:
```
ax = data.koi_slogg.hist(bins=100, figsize=(12, 8))
ax.set_xlabel("$\log{g}$")
ax.set_title("Surface gravity")
```

[7]:
```
<matplotlib.text.Text at 0x7f0eefdefda0>
```



1.1.2 Right Ascension and Declination

[8]:
```
confirmed = data[data.koi_disposition == 'CONFIRMED']

ra, dec = data.ra, data.dec
ra_c, dec_c = confirmed.ra, confirmed.dec
```

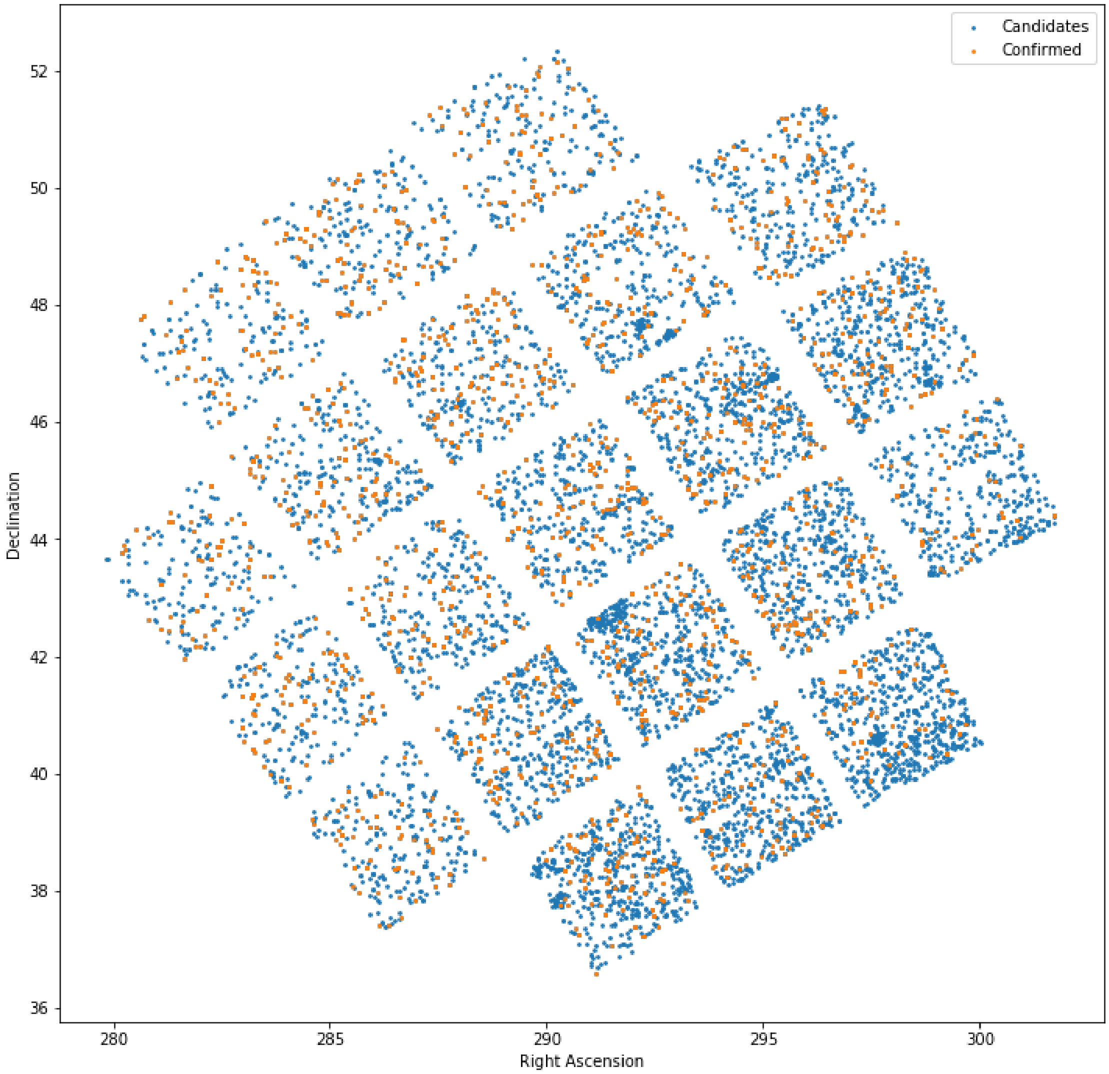
[9]:
```
fig = plt.figure(figsize=(12, 12))

plt.scatter(ra, dec, s=3, label='Candidates')
plt.scatter(ra_c, dec_c, s=3, label="Confirmed")

plt.xlabel("Right Ascension")
plt.ylabel("Declination")

plt.legend()
```

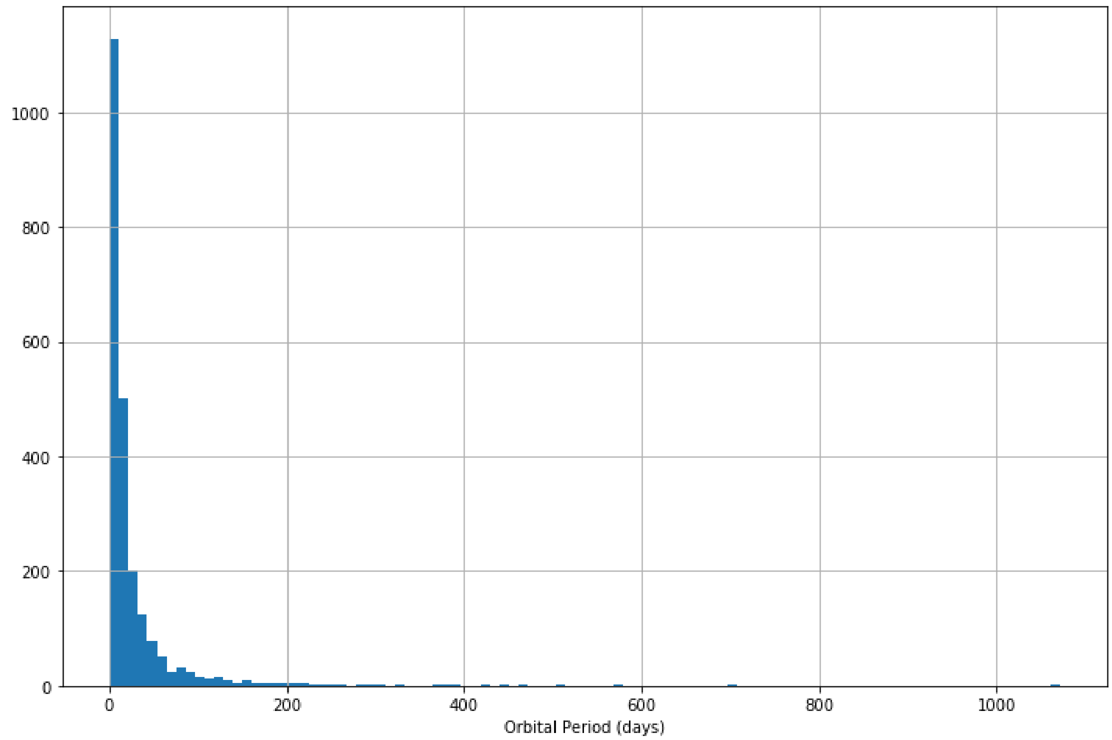
[9]: <matplotlib.legend.Legend at 0x7f0eef77cbe0>



1.1.3 Orbital periods of confirmed planets

[10]:
```
ax = confirmed.koi_period.hist(bins=100, figsize=(12, 8))
ax.set_xlabel("Orbital Period (days)")
```

[10]: <matplotlib.text.Text at 0x7f0eef7aa358>

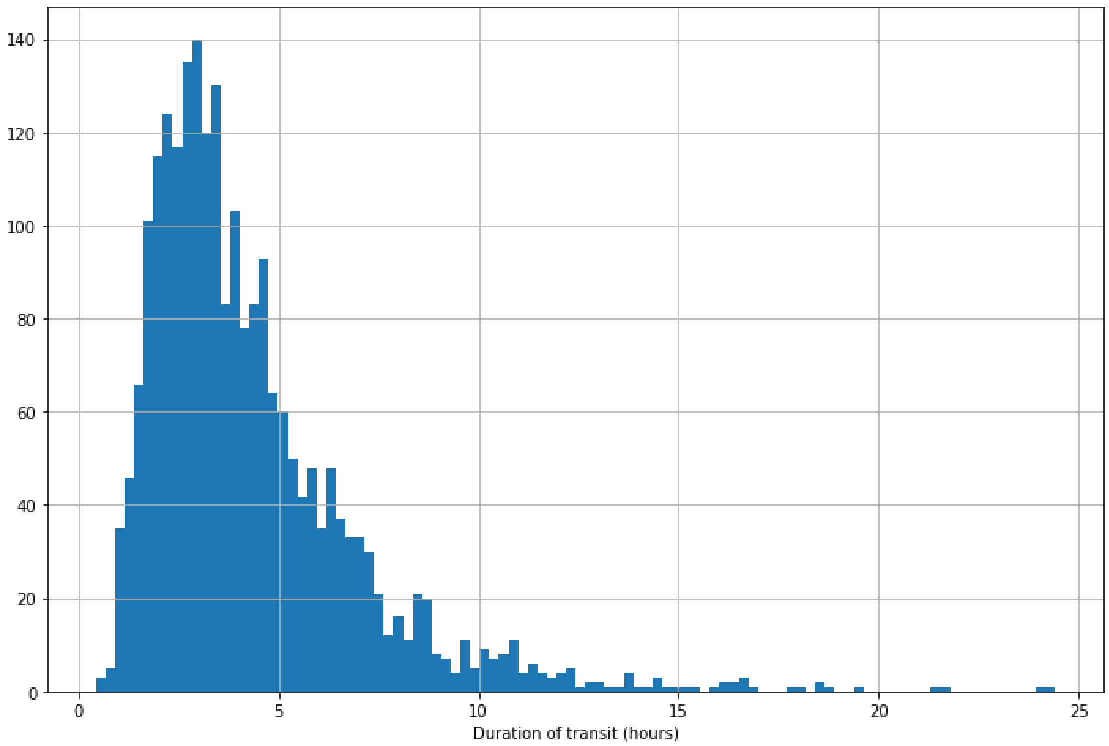


Most confirmed planets have lower orbital periods. This makes sense, the closer the planet is to its parent star, the more likely it is to eclipse it (and hence the more likely it is to be observed.)

1.1.4 Duration of planetary transits

[11]:
```
ax = confirmed.koi_duration.hist(bins=100, figsize=(12, 8))
ax.set_xlabel("Duration of transit (hours)")
```

[11]:
```
<matplotlib.text.Text at 0x7f0eef694d30>
```



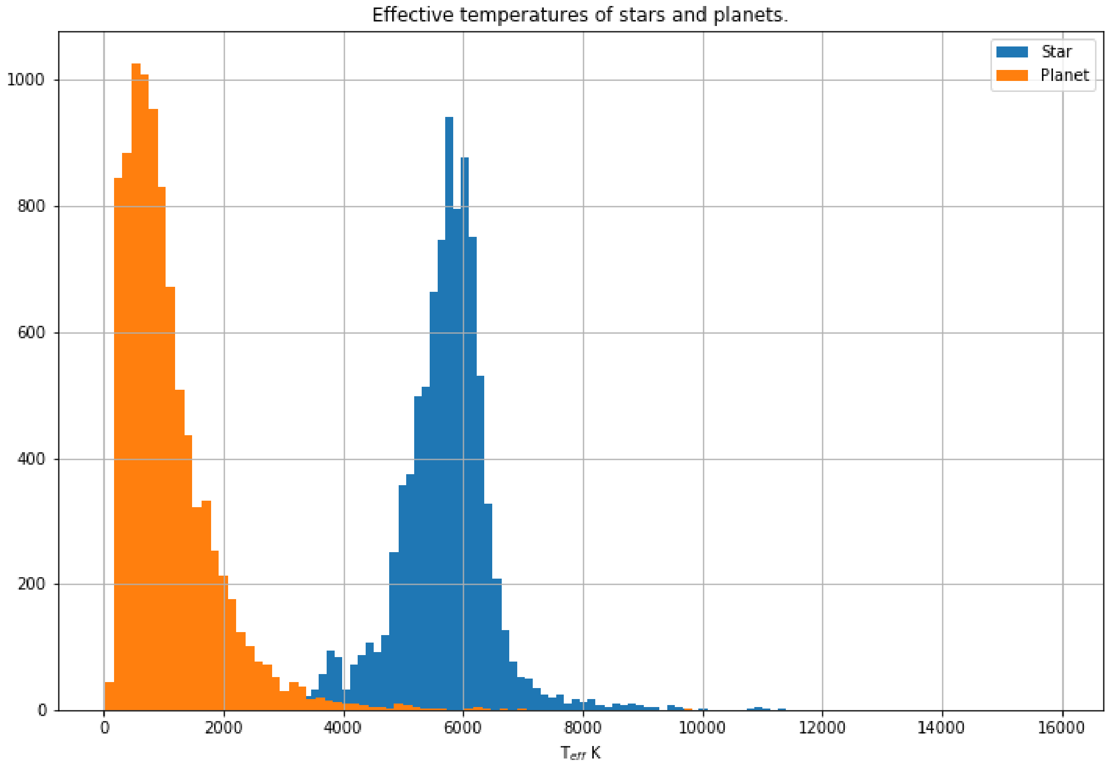
Durations are on the order of hours, with more detections at smaller hours, again showing the detection bias towards smaller orbits.

1.1.5 Temperatures and Radii of stars and planets

[12]:
```
ax = data.koi_steff.hist(bins=100, figsize=(12, 8), label="Star")
ax.set_xlabel("T$_{eff}$ K")
ax.set_title("Effective temperatures of stars and planets.")

data.koi_teq.hist(ax=ax, bins=100, label='Planet')
ax.legend()
```

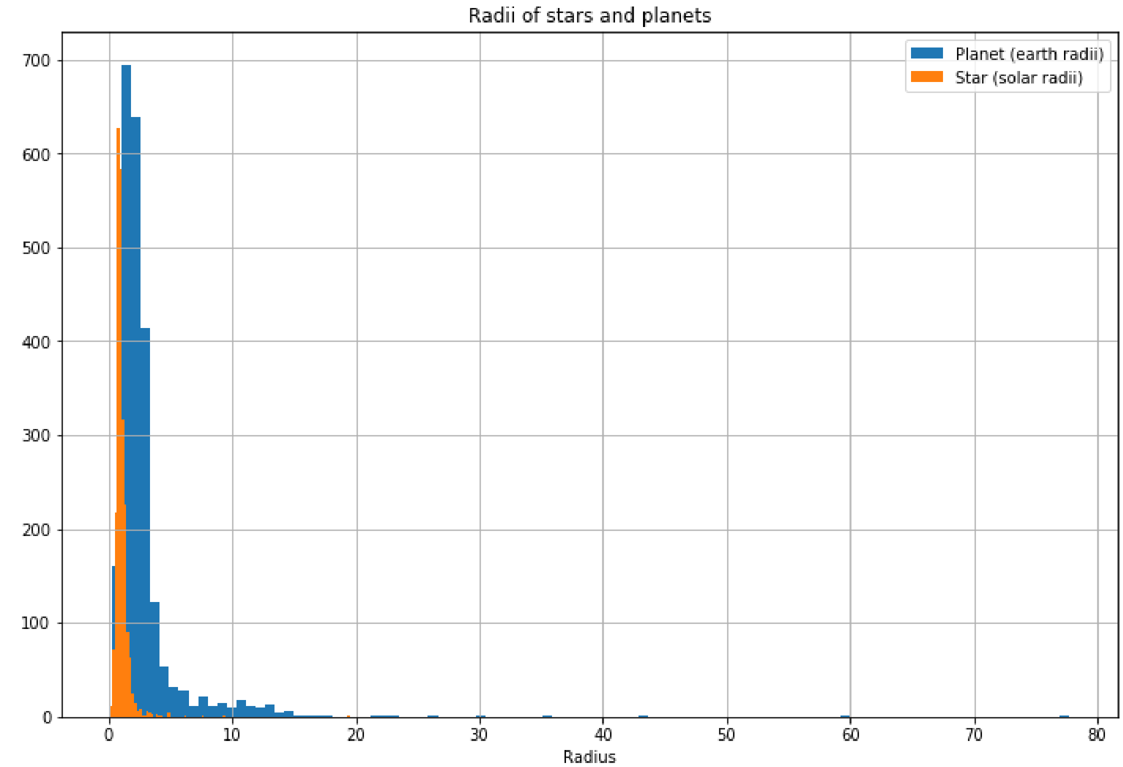
[12]: <matplotlib.legend.Legend at 0x7f0eef9af240>



[13]:
```
# radius only for stars with a confirmed planet, the rest is not known.
ax = confirmed.koi_prad.hist(bins=100, label='Planet (earth radii)')
ax.set_title("Radii of stars and planets")

confirmed.koi_srad.hist(ax=ax, bins=100, figsize=(12, 8), label="Star (solar␣
↪radii)")
ax.set_xlabel("Radius")
ax.legend()
```

[13]: <matplotlib.legend.Legend at 0x7f0eed38ae48>


Radii of stars and planets
Planet (earth radii)
Star (solar radii)
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
Radius