МОСКОВСКИЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ
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ОТЧЕТ

Лабораторная работа №3
по дисциплине «Методы машинного обучения»

Тема: «Обработка пропусков в данных, кодирование категориальных признаков, масштабирование данных»

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In [90]:
```
import pandas as pd
import numpy as np
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
from sklearn.preprocessing import MinMaxScaler, StandardScaler, Nor
malizer
```

In [16]:
```
df = pd.read_csv('HRDataset_v13.csv')
df.head()
```

Out[16]:

	Employee_Name	EmpID	MarriedID	MaritalStatusID	GenderID	EmpStatusID	Dep
0	Brown, Mia	1.103024e+09	1.0	1.0	0.0	1.0	
1	LaRotonda, William	1.106027e+09	0.0	2.0	1.0	1.0	
2	Steans, Tyrone	1.302053e+09	0.0	0.0	1.0	1.0	
3	Howard, Estelle	1.211051e+09	1.0	1.0	0.0	1.0	
4	Singh, Nan	1.307060e+09	0.0	0.0	0.0	1.0	

5 rows × 35 columns

In [17]:
```
row_number = df.shape[0]
column_number = df.shape[1]

print('Данный датасет содержит {} строк и {} столбца.'.format(row_n
umber, column_number))
```

```
Данный датасет содержит 401 строк и 35 столбца.
```

1. Обработка пропусков в данных

In [18]:
```
for col in df.columns:
    null_count = df[df[col].isnull()].shape[0]
    if null_count > 0:
        column_type = df[col].dtype
        percent = round((null_count / row_number) * 100, 3)
        print('{} - {} - {}. Тип - {}'.format(col, null_count, perc
ent, column_type))
```

```
Employee_Name - 91 - 22.693. Тип - object
EmpID - 91 - 22.693. Тип - float64
MarriedID - 91 - 22.693. Тип - float64
MaritalStatusID - 91 - 22.693. Тип - float64
GenderID - 91 - 22.693. Тип - float64
EmpStatusID - 91 - 22.693. Тип - float64
DeptID - 91 - 22.693. Тип - float64
PerfScoreID - 91 - 22.693. Тип - float64
FromDiversityJobFairID - 91 - 22.693. Тип - float64
PayRate - 91 - 22.693. Тип - float64
Termd - 91 - 22.693. Тип - float64
PositionID - 91 - 22.693. Тип - float64
Position - 91 - 22.693. Тип - object
State - 91 - 22.693. Тип - object
Zip - 91 - 22.693. Тип - float64
DOB - 91 - 22.693. Тип - object
Sex - 91 - 22.693. Тип - object
MaritalDesc - 91 - 22.693. Тип - object
CitizenDesc - 91 - 22.693. Тип - object
HispanicLatino - 91 - 22.693. Тип - object
RaceDesc - 91 - 22.693. Тип - object
DateofHire - 91 - 22.693. Тип - object
DateofTermination - 298 - 74.314. Тип - object
TermReason - 92 - 22.943. Тип - object
EmploymentStatus - 91 - 22.693. Тип - object
Department - 91 - 22.693. Тип - object
ManagerName - 91 - 22.693. Тип - object
ManagerID - 99 - 24.688. Тип - float64
RecruitmentSource - 91 - 22.693. Тип - object
PerformanceScore - 91 - 22.693. Тип - object
EngagementSurvey - 91 - 22.693. Тип - float64
EmpSatisfaction - 91 - 22.693. Тип - float64
SpecialProjectsCount - 91 - 22.693. Тип - float64
LastPerformanceReview_Date - 194 - 48.379. Тип - object
DaysLateLast30 - 194 - 48.379. Тип - float64
```

1.1 Удаление пустых значений

In [19]:
```
# удаление строк с пустыми значениями Employee_Name
df = df[df['Employee_Name'].notna()]

# удаление столбца company
df.drop(columns=['LastPerformanceReview_Date'], inplace=True)
```

In [21]:
```
row_number = df.shape[0]
column_number = df.shape[1]

print('Данный датасет содержит {} строк и {} столбца.'.format(row_n
umber, column_number))
```

```
Данный датасет содержит 310 строк и 34 столбца.
```

1.2 Заполнение нулями

In [22]:
```
df['DaysLateLast30'] = df['DaysLateLast30'].fillna(0)
```

In [58]:
```
df[df['DaysLateLast30'].isnull()].shape
```

Out[58]:
```
(0, 34)
```

1.3 Внедрение значений в числовых данных

In [97]:
```
df_2 = pd.read_csv('restaurant-scores-lives-standard.csv')
df_2.head()
```

Out[97]:

	business_id	business_name	business_address	business_city	business_state	business_
0	69618	Fancy Wheatfield Bakery	1362 Stockton St	San Francisco	CA	
1	97975	BREADBELLY	1408 Clement St	San Francisco	CA	
2	69487	Hakkasan San Francisco	1 Kearny St	San Francisco	CA	
3	91044	Chopsticks Restaurant	4615 Mission St	San Francisco	CA	
4	85987	Tselogs	552 Jones St	San Francisco	CA	

In [104]:
```
row_number_2 = df_2.shape[0]
column_number_2 = df_2.shape[1]

print('Данный датасет содержит {} строк и {} столбца.'.format(row_n
umber, column_number))
```

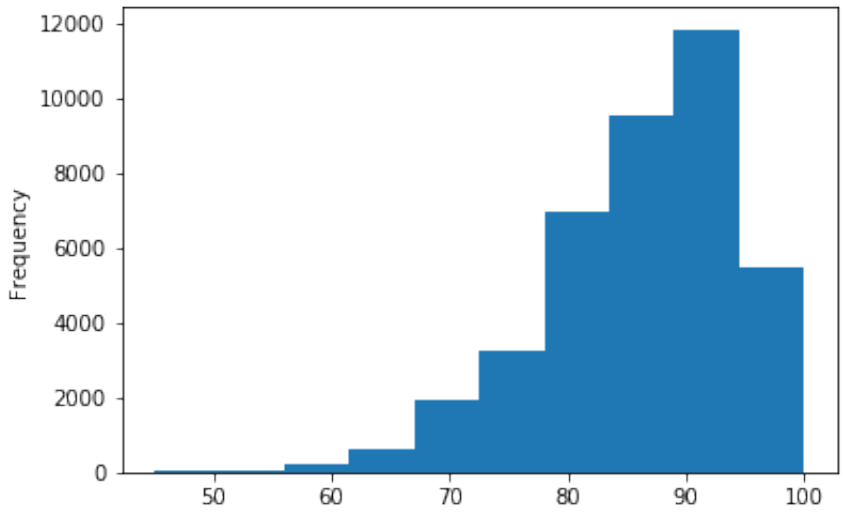
```
Данный датасет содержит 10692 строк и 13 столбца.
```

In [105]:
```
for col in df_2.columns:
    null_count = df_2[df_2[col].isnull()].shape[0]
    if null_count > 0:
        column_type = df_2[col].dtype
        percent = round((null_count / row_number_2) * 100, 3)
        print('{} - {} - {}. Тип - {}'.format(col, null_count, perc
ent, column_type))
```

```
business_postal_code - 1083 - 2.007. Тип - object
business_latitude - 24095 - 44.643. Тип - float64
business_longitude - 24095 - 44.643. Тип - float64
business_location - 24095 - 44.643. Тип - object
business_phone_number - 36539 - 67.699. Тип - float64
inspection_score - 14114 - 26.15. Тип - float64
violation_id - 13462 - 24.942. Тип - object
violation_description - 13462 - 24.942. Тип - object
risk_category - 13462 - 24.942. Тип - object
inspection_score_MinMax - 14114 - 26.15. Тип - float64
inspection_score_Z - 14114 - 26.15. Тип - float64
```

In [106]:
```
df_2['inspection_score'].plot.hist()
```

Out[106]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1205d4320>
```



In [107]:
```
df_2['inspection_score'].describe()
```

Out[107]:
```
count    39859.000000
mean        86.235254
std          8.480003
min         45.000000
25%         81.000000
50%         88.000000
75%         92.000000
max        100.000000
Name: inspection_score, dtype: float64
```

In [108]:
```
mode = df_2['inspection_score'].mode()[0]
```

In [109]:
```
(df_2[df_2['inspection_score'] == mode].shape[0]/row_number_2) * 10
0
```

Out[109]:
```
7.025735089767106
```

In [110]:
```
median = df_2['inspection_score'].describe()['50%']
(df_2[df_2['inspection_score'] == median].shape[0]/row_number_2) *
100
```

Out[110]:
```
4.861690104311415
```

In [111]:
```
imp = SimpleImputer(strategy='most_frequent')
df_2['inspection_score'] = imp.fit_transform(df_2[['inspection_scor
e']])
```

In [112]:
```
df_2[df_2['inspection_score'].isnull()].shape
```

Out[112]:
```
(0, 19)
```

1.4 Внедрение значений в категориальных данных

In [27]:
```
imp = SimpleImputer(strategy='most_frequent')
df['ManagerID'] = imp.fit_transform(df[['ManagerID']])
```

In [57]:
```
df[df['ManagerID'].isnull()].shape
```

Out[57]:
```
(0, 34)
```

2. Кодирование категориальных признаков

In [62]:
```
for col in df.columns:
    column_type = df[col].dtype
    if column_type == 'object':
        print(col)
```

```
Employee_Name
Position
State
DOB
Sex
MaritalDesc
CitizenDesc
HispanicLatino
RaceDesc
DateofHire
DateofTermination
TermReason
EmploymentStatus
Department
ManagerName
RecruitmentSource
PerformanceScore
```

2.1 Кодирование категорий целочисленными значениями

In [64]:
```
df['Sex'].unique()
```

Out[64]:
```
array(['F', 'M '], dtype=object)
```

In [74]:
```
le = LabelEncoder()
df['Sex_LabelEncoder'] = le.fit_transform(df['Sex'])
```

In [69]:
```
np.unique(cat_enc_le)
```

Out[69]:
```
array([0, 1])
```

In [71]:
```
le.inverse_transform([0, 1])
```

Out[71]:
```
array(['F', 'M '], dtype=object)
```

In [75]:
```
df[['Sex','Sex_LabelEncoder']].head()
```

Out[75]:

	Sex	Sex_LabelEncoder
0	F	0
1	M	1
2	M	1
3	F	0
4	F	0

2.2. Кодирование категорий наборами бинарных значений

In [76]:
```
df['Position'].unique()
```

Out[76]:
```
array(['Accountant I', 'Administrative Assistant', 'Area Sales Man
ager',
       'BI Developer', 'BI Director', 'CIO', 'Data Architect',
       'Database Administrator', 'Data Analyst', 'Data Analyst ',
       'Director of Operations', 'Director of Sales', 'IT Director
',
       'IT Manager - DB', 'IT Manager - Infra', 'IT Manager - Supp
ort',
       'IT Support', 'Network Engineer', 'President & CEO',
       'Production Manager', 'Production Technician I',
       'Production Technician II', 'Sales Manager', 'Senior BI Dev
eloper',
       'Shared Services Manager', 'Software Engineer',
       'Software Engineering Manager', 'Sr. Accountant', 'Sr. DBA'
,
       'Enterprise Architect', 'Principal Data Architect',
       'Sr. Network Engineer'], dtype=object)
```

In [82]:
```
ohe = OneHotEncoder()
transformed_data = ohe.fit_transform(df[['Position']])
```

In [83]:
```
transformed_data.shape
```

Out[83]:
```
(310, 32)
```

In [85]:
```
transformed_data.todense()[0:10]
```

Out[85]:
```
matrix([[1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.],
        [1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.],
        [1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.],
        [0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.],
        [0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.],
        [0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.],
        [0., 0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.],
        [0., 0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.],
        [0., 0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.],
        [0., 0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0
., 0.]])
```

2.3 Pandas get_dummies

In [86]:
```
pd.get_dummies(df['Position']).head()
```

Out[86]:

	Accountant I	Administrative Assistant	Area Sales Manager	BI Developer	BI Director	CIO	Data Analyst	Data Analyst	D Archit
0	1	0	0	0	0	0	0	0	
1	1	0	0	0	0	0	0	0	
2	1	0	0	0	0	0	0	0	
3	0	1	0	0	0	0	0	0	
4	0	1	0	0	0	0	0	0	

5 rows × 32 columns

In [87]:
```
pd.get_dummies(df['Position'], dummy_na=True).head()
```

Out[87]:

	Accountant I	Administrative Assistant	Area Sales Manager	BI Developer	BI Director	CIO	Data Analyst	Data Analyst	D Archit
0	1	0	0	0	0	0	0	0	
1	1	0	0	0	0	0	0	0	
2	1	0	0	0	0	0	0	0	
3	0	1	0	0	0	0	0	0	
4	0	1	0	0	0	0	0	0	

5 rows × 33 columns

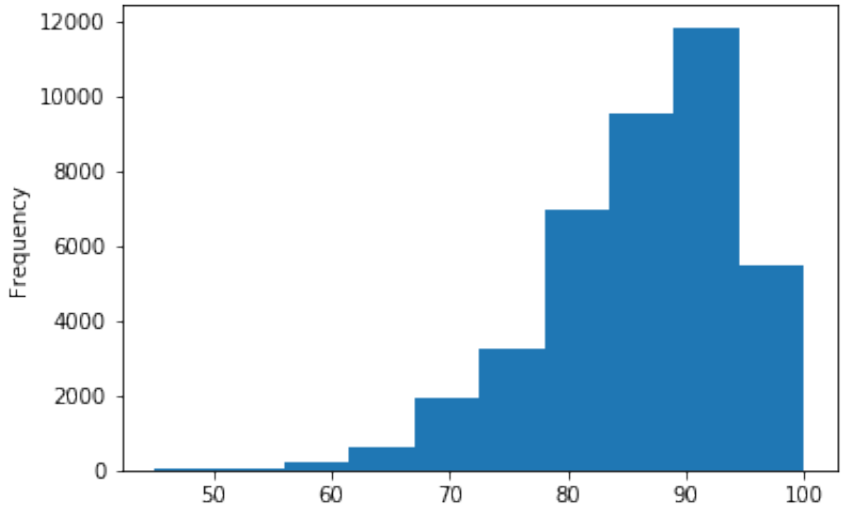
3. Масштабирование данных

3.1 MinMax масштабирование

$$X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}}$$

In [98]:
```
df_2['inspection_score'].plot.hist()
```

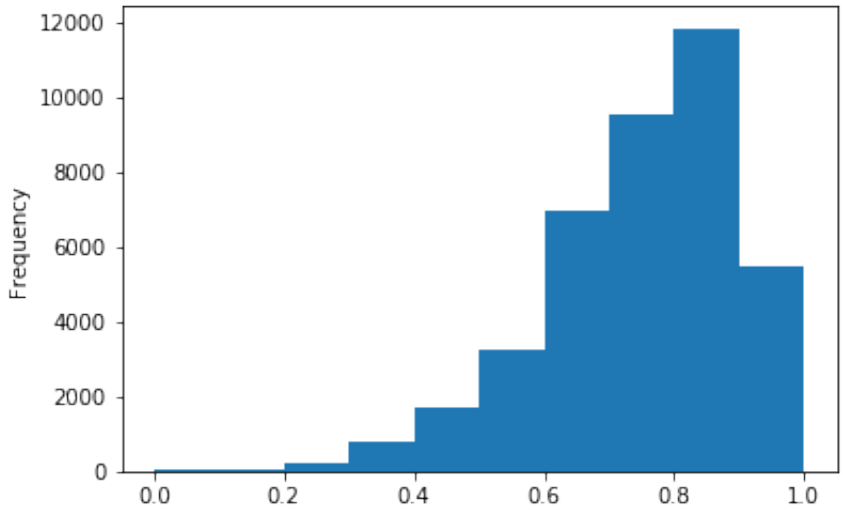
Out[98]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x12214fac8>
```



In [99]:
```
sc1 = MinMaxScaler()
df_2['inspection_score_MinMax'] = sc1.fit_transform(df_2[['inspecti
on_score']])
```

In [100]:
```
df_2['inspection_score_MinMax'].plot.hist()
```

Out[100]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x120dcdfd0>
```



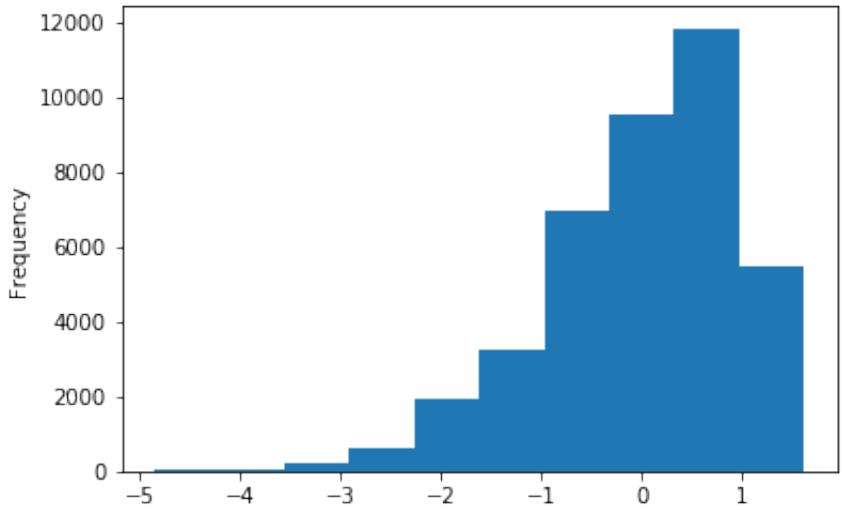
3.2 Масштабирование данных на основе Z-оценки

$$z = \frac{x - \mu}{\sigma}$$

In [101]:
```
sc2 = StandardScaler()
df_2['inspection_score_Z'] = sc2.fit_transform(df_2[['inspection_score']])
```

In [102]:
```
df_2['inspection_score_Z'].plot.hist()
```

Out[102]: <matplotlib.axes._subplots.AxesSubplot at 0x11d76da20>



3.3. Нормализация данных

In [113]:
```
sc3 = Normalizer()
df_2['inspection_score_Norm'] = sc3.fit_transform(df_2[['inspection_score']])
```

In [114]:
```
df_2['inspection_score_Norm'].plot.hist()
```

Out[114]: <matplotlib.axes._subplots.AxesSubplot at 0x120b4cf28>