## Feature engineering

PREPROCESSING FOR MACHINE LEARNING IN PYTHON



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## What is feature engineering?

Feature engineering: Creation of new features from existing ones

- Improve performance
- Insight into relationships between features
- Need to understand the data first!
- Highly dataset-dependent



## Feature engineering scenarios

ld	Text
1	"Feature engineering is fun!"
2	"Feature engineering is a lot of work."
3	"I don't mind feature engineering."

user	fav_color	
1	blue	
2	green	
3	orange	

## Feature engineering scenarios

ld	Date		
4	July 30 2011		
5	January 29 2011		
6	February 05 2011		

user	test1	test2	test3
1	90.5	89.6	91.4
2	65.5	70.6	67.3
3	78.1	80.7	81.8

## Let's practice!

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# Encoding categorical variables

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## **Categorical variables**

```
user subscribed fav_color
0 1         y         blue
1 2         n         green
2 3         n         orange
3 4         y         green
```

## Encoding binary variables - pandas

```
0  y
1  n
2  n
3  y
Name: subscribed, dtype: object
```

print(users["subscribed"])

```
print(users[["subscribed", "sub_enc"]])
```

```
      subscribed
      sub_enc

      y
      1

      n
      0

      n
      0

      n
      0

      y
      1
```

```
users["sub_enc"] = users["subscribed"].apply(lambda val: 1 if val == "y" else 0)
```

## Encoding binary variables - scikit-learn

```
from sklearn.preprocessing import LabelEncoder

le = LabelEncoder()
users["sub_enc_le"] = le.fit_transform(users["subscribed"])

print(users[["subscribed", "sub_enc_le"]])
```

```
      subscribed
      sub_enc_le

      0
      y
      1

      1
      n
      0

      2
      n
      0

      3
      y
      1
```

## One-hot encoding

fav\_color
blue
green
orange
green

Values: [blue, green, orange]

• blue: [1, 0, 0]

• green: [0, 1, 0]

• orange: [0, 0, 1]

fav\_color\_enc
[1, 0, 0]
[0, 1, 0]
[0, 0, 1]
[0, 1, 0]

```
print(users["fav_color"])
0
       blue
      green
     orange
3
      green
Name: fav_color, dtype: object
print(pd.get_dummies(users["fav_color"]))
   blue
         green
                orange
0
3
                     0
```

## Let's practice!

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## Engineering numerical features

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```
print(temps)

     city day1 day2 day3
0     NYC 68.3 67.9 67.8
1     SF 75.1 75.5 74.9
2     LA 80.3 84.0 81.3
3     Boston 63.0 61.0 61.2
```

```
temps["mean"] = temps.loc[:,"day1":"day3"].mean(axis=1)
print(temps)
```

```
city day1 day2 day3 mean

0 NYC 68.3 67.9 67.8 68.00

1 SF 75.1 75.5 74.9 75.17

2 LA 80.3 84.0 81.3 81.87

3 Boston 63.0 61.0 61.2 61.73
```

#### **Dates**

print(purchases)

```
date purchase

0 July 30 2011 $45.08

1 February 01 2011 $19.48

2 January 29 2011 $76.09

3 March 31 2012 $32.61

4 February 05 2011 $75.98
```

#### **Dates**

```
purchases["date_converted"] = pd.to_datetime(purchases["date"])
purchases['month'] = purchases["date_converted"].dt.month
print(purchases)
```

```
date purchase date_converted
                                             month
      July 30 2011
0
                      $45.08
                                 2011-07-30
   February 01 2011
                     $19.48
                                 2011-02-01
    January 29 2011
                     $76.09
                                 2011-01-29
3
                                 2012-03-31
                                                 3
      March 31 2012
                    $32.61
   February 05 2011
                      $75.98
                                 2011-02-05
```

## Let's practice!

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## **Engineering text features**

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### **Extraction**

Regular expressions: code to identify patterns

```
import re
my_string = "temperature:75.6 F"
temp = re.search("\d+\.\d+", my_string)
print(float(temp.group(0)))
```

```
• \d+
```

- \.
- \d+

75.6

## Vectorizing text

TF/IDF: Vectorizes words based upon importance

- TF = Term Frequency
- IDF = Inverse Document Frequency



### Vectorizing text

```
from sklearn.feature_extraction.text import TfidfVectorizer
print(documents.head())
     Building on successful events last summer and ...
0
                Build a website for an Afghan business
     Please join us and the students from Mott Hall...
     The Oxfam Action Corps is a group of dedicated...
3
     Stop 'N' Swap reduces NYC's waste by finding n...
tfidf_vec = TfidfVectorizer()
text_tfidf = tfidf_vec.fit_transform(documents)
```

```
Adatacamp
```

### **Text classification**

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

## Let's practice!

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