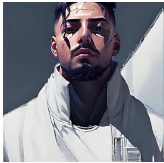



Stock News Sentiment-Analyse-Modell

Textmining Übung zu NLP/Textklassifikation



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Tools:



Intro

Dieses Jupyter Notebook dient als Übung zur Anwendung von Textmining- und NLP-Techniken zur Klassifikation von Aktienmarkt-Nachrichten. Das Ziel besteht darin, anhand von Textmerkmalen wie dem Highlight-Text und der Sentiment-Analyse den Sentiment-Wert (positive, negative oder neutral) vorherzusagen.

Steps

1. Datenerfassung: Sammeln von Textdaten zu Aktienmarkt-Nachrichten. Hierzu nutze ich eine kostenlose [API von marketaux](#), die einen Zugang zu Finanz- und Aktienmarkt-Nachrichten mit umfassender Sentiment-Analyse verschafft.
2. Datenverarbeitung: Vorbereitung der Daten, Textvorverarbeitung und Extraktion relevanter Merkmale.
3. Modellentwicklung: Training von Klassifikationsmodellen basierend auf den Textmerkmalen.
4. Modellbewertung: Bewertung der Modellleistung anhand von Metriken wie Genauigkeit, Präzision und Rückruf sowie der Konfusionsmatrix.

True

marketAux API einrichten und CSV Datei lesen

262

Daten aus dem API Endpunkt extrahieren und in die CSV Datei schreiben

Request fehlgeschlagen mit Status-Code: 402
Zeile wurde zur CSV Datei hinzugefügt.

Datenpräparation

Hier werden die Daten etwas aufgeräumt, Not a Number Werte aussortiert und falsch geschriebene Sentiment-Werte korrigiert. Im Highlight Text wurden Html-Tags mitgeliefert (< em> < /em> usw.). Diese sortieren wir mit html.escape aus. Überlebende Html-Entities und Line-Breaks (\n\n) ersetzen wir auch entsprechend.

	published_at	title	symbol	name	snippet	highlight	
105	2023-06-15T22:25:26.000000Z	Stock rally is deepening beyond AI-fueled craze	MSFT	Microsoft Corporation	(June 16): The stock rally driven by the exube...	Microsoft Corp, which has unveiled a processio...	https://the
196	2023-06-15T21:02:58.000000Z	Dow Jones Futures: Stocks Run As Microsoft Roa...	TSLA	Tesla, Inc.	Dow Jones futures tilted lower after hours, al...	Try SwingTrader. IBD Digital: Unlock IBD's Pre...	ht
162	2023-06-15T18:53:49.000000Z	Market's Starting To Look Like 1987	NVDA	NVIDIA Corporation	iantfoto\n\nWe are not makers of history. We a...	Market Performance: Comparing 1987 and 2023. M...	https://se
101	2023-06-15T23:09:00.000000Z	Tales of Stock Compounding: Does It Always Work?	MSFT	Microsoft Corporation	(1:00) - The Power of Compounding: How Long Do...	Microsoft Corp. (MSFT). We are all familiar wi...	https
2	2023-06-15T21:02:58.000000Z	Dow Jones Futures: Stocks Run As Microsoft Roa...	AAPL	Apple Inc.	Dow Jones futures tilted lower after hours, al...	Microsoft (MSFT) was a big driver for the majo...	ht

y-Zielvariable bestimmen (postive, negative, neutral)

Wir wandeln unser sentiment je nach Wert in target (postive, negative, neutral) um. Unser Modell soll diesen Wert anhand eines Highlight Textes später selber vorhersagen können. Auch gucken wir auf die Verteilung unserer Zielvariable.

```
target
neutral      118
positive     109
negative      33
Name: count, dtype: int64
```

Sample Output

Ein erster Sample Output und ein Blick in die CSV-Datei zeigen bereits einige Probleme. Wir müssen weiter im Datensatz aufräumen bzw. ihn erweitern, da hier auch russische, polnische oder japanische Texte zu finden sind.

	sentiment	target	highlight
231	0.700	positive	TSLA +0,19% Добавить/Убрать из портфеля NVDA -...
149	-0.477	negative	To put this into perspective, if Lisa Su's pro...
32	0.000	neutral	Dow Jones tech giants Apple (AAPL) and Microso...
67	-0.772	negative	CEOs of global companies including Elon Musk o...
106	0.753	positive	What happened Microsoft (NASDAQ: MSFT), a some...

Langdetect

wir ordnen jedem Text seine Sprache zu. Anschließend filtern wir für die weitere Verarbeitung nur nach englischen Texten bzw. reduzieren unser Dataframe auf df_en.

NLTK

Wir nutzen NLTK um Stopwörter auszufiltern und überprüfen die Sentiment-Scores, die wir zuvor mit einem lambda Aufruf etwas umformatiert haben.

```
[nltk_data] Downloading package stopwords to
[nltk_data]   C:\Users\burak\AppData\Roaming\nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package vader_lexicon to
[nltk_data]   C:\Users\burak\AppData\Roaming\nltk_data...
[nltk_data]   Package vader_lexicon is already up-to-date!
```

True

Nach Analyse der Wortfrequenz musste ich feststellen, dass in dem Highlight Text z.B die Aktienamen unproportional (viel Apple) auftauchen. Das Modell lief im ersten Anlauf eventuell dadurch 10% schlechter. Wir nehmen neben den englischen stopwords auch diese Namen raus.

Wir generieren eine aufgeräumtere highlight Text Spalte

```
0    increased one per cent.. US jobless claims sur...
1    Shahid Jamil. Fast. could think first two-thir...
2    (MSFT) big driver major indexes, (AAPL) Meta P...
3    Legendary investor Warren Buffett, ardent supp...
4    Te Pūkenga, New Zealand's largest tertiary edu...
5    Combined fact regular, retail investor unprece...
6    Combined fact regular, retail investor unprece...
7    Gerstner's pure play AI stock picks bit later,...
8    Gerstner's pure play AI stock picks bit later,...
11   Shares (AAPL), Cisco Systems (CSCO), Salesforc...
Name: highlight_cleaned, dtype: object
```

Erneutes zählen der Wortfrequenz

[('stock', 40), ('market', 33), ('trading', 33), ('AI', 31), ('price', 27), ('shares', 23), ('companies', 23), ('one', 21), ('Meta', 20), ('new', 19), ('year', 19), ('top', 19), ('', 19), ('company', 18), ('high', 18), ('Inc.', 18), ('June', 17), ('stocks', 17), ('(AAPL)', 15), ('also', 15), ('-', 15), ('tech', 15), ('first', 14), ('Inc', 14), ('Amazon', 14), ('', 14), ('big', 13), ('technology', 13), ('Shares', 13), ('Market', 13), ('rose', 12), ('(MSFT)', 12), ('Platforms', 12), ('2023', 12), ('U.S.', 12), ('including', 12), ('last', 12), ('data', 11), ('would', 11), ('like', 11), ('higher', 11), ('Corp.', 11), ('earnings', 11), ('currently', 11), ('close', 10), ('(NVDA)', 10), ('billion', 10), ('streak', 10), ('global', 10), ('Holdings', 10), ('could', 9), ('economic', 9), ('rate', 9), ('record', 9), ('May', 9), ('S&P', 9), ('recent', 9), ('CEO', 9), ('electric', 9), ('quarter', 9), ('2023.', 9), ('Corporation.', 9), ('Toyota', 9), ('available', 8), ('Systems', 8), ('2023,', 8), ('Street', 8), ('following', 8), ('end', 8), ('Elon', 8), ('Musk', 8), ('two', 8), ('EV', 8), ('per', 7), ('sales', 7), ('(META)', 7), ('surged', 7), ('expected', 7), ('retail', 7), ('giant', 7), ('Oracle', 7), ('story', 7), ('all-time', 7), ('get', 7), ('interest', 7), ('Advanced', 7), ('Micro', 7), ('(', 7), ('vehicle', 7), ('previous', 7), ('Inc.'s', 7), ('winning', 7), ('work', 7), ('claims', 6), ('unexpectedly', 6), ('think', 6), ('far', 6), ('Thursday', 6), ('key', 6), ('making', 6), ('investing', 6), ('years.', 6), ('(AAPL)', 6), ('future', 6), ('boosting', 6), ('analysts', 6), ('company's', 6), ('reached', 6), ('Amazon.com', 6), ('Tesla', 6), ('Intel', 6), ('Trust', 6), ('14,', 6), ('(TSLA)', 6), ('AAPL', 6), ('Dow', 6), ('Jones', 6), ('Inc.', 6), ('five', 6), ('paid', 6), ('nearly', 6), ('\$1', 6), ('revenue', 6), ('point', 6), ('Adobe', 6), ('report', 6), ('.', 6), ('Zacks', 6), ('Technology', 6), ('Group', 6), ('growth', 6), ('15', 6), ('Wall', 6), ('investors', 6), ('announced', 6), ('China', 6), ('controls', 6), ('international', 6), ('Nasdaq', 6), ('software', 6), ('make', 6), ('list', 6), ('time', 6), ('TSLA', 6), ('increased', 5), ('consumers', 5), ('help', 5), ('near', 5), ('major', 5), ('even', 5), ('largest', 5), ('missing', 5), ('based', 5), ('saw', 5), ('Cisco', 5), ('day', 5), ('podcast', 5), ('Amazon,', 5), ('Apple,', 5), ('year.', 5), ('auto', 5), ('year-to-date', 5), ('value', 5), ('Vision', 5), ('level', 5), ('stocks,', 5), ('back', 5), ('dollars', 5), ('year,', 5), ('right', 5), ('return', 5), ('seen', 5), ('week.', 5), ('premarket', 5), ('13-day', 5), ('much', 5), ('latest', 5), ('CEOs', 5), ('Tim', 5), ('Cook', 5), ('visited', 5), ('met', 5), ('Premier', 5), ('Li', 5), ('Qiang', 5), ('official', 5), ('anti-virus', 5), ('blocked', 5), ('travel.', 5), ('(MSFT).', 5), ('portfolio', 5), ('prices', 5), ('week', 5), ('Stock', 5), ('search', 5), ('Corp', 5), ('share', 5), ('capitalization', 5), ('compared', 5), ('generative', 5), ('fiscal', 5), ('battery', 5), ('vehicles', 4), ('Developers', 4), ('Conference', 4), ('since', 4), ('started', 4), ('CAVA', 4), ('closed', 4), ('part', 4), ('sector', 4), ('unprecedented', 4), ('next', 4), ('Treasury', 4), ('yields', 4), ('slid', 4), ('hikes', 4), ('showed', 4), ('spent', 4), ('range', 4), ('call', 4), ('iTunes', 4), ('set', 4), ('target', 4), ('took', 4), ('doesn't', 4), ('well', 4), ('biggest', 4), ('Corp.', 4), ('higher', 4), ('cent', 4), ('500', 4), ('me', 4), ('194%', 4), ('(\$146', 4), ('\$430', 4), ('41.5%', 4), ('(\$130', 4), ('\$184', 4), ('40.4%', 4), ('(\$240', 4), ('\$337', 4), ('127.5%', 4), ('(\$120', 4), ('\$273', 4), ('109%', 4), ('(\$123', 4), ('\$257', 4), ('stretched', 4), ('overvalued?', 4), ('company', 4), ('really', 4), ('becoming', 4), ('third', 4), ('start', 4), ('support', 4), ('strength', 4), ('gains', 4), ('current', 4), ('Fed', 4), ('fell', 4), ('rally', 4), ('.', 4), ('ETFs', 4), ('analysis', 4), ('still', 4), ('Devices', 4), ('fund', 4), ('index', 4), ('total', 4), ('Spotify.', 4), ('(NYSE:', 4), ('expectations', 4), ('favorite', 4), ('Listen', 4), ('intelligence', 4), ('.', 4), ('ministers', 4), ('Ltd.', 4), ('Cabinet', 4), ('version', 4), ('production', 4), ('another', 4), ('world.', 4), ('day.', 4), ('gain', 4), ('significant', 4), ('become', 4), ('Mining', 4), ('Stocks', 4), ('among', 4), ('(NASDAQ:MSFT)', 4), ('climbed', 4), ('yet', 4), ('Methodology.', 4), ('in', 4), ('artificial', 4), ('early', 4), ('around', 4), ('made', 4), ('popular', 4), ('investment', 4), ('believe', 4), ('Buy', 4), ('Thursday', 4), ('chips', 4), ('Tesla's', 4), ('Day', 4), ('Holdings', 4), ('US', 3), ('jobless', 3), ('showing', 3), ('spending', 3), ('news', 3), ('term.', 3), ('Apple's', 3), ('(WWDC)', 3), ('things', 3), ('Cava', 3), ('debut', 3), ('investor', 3), ('company's', 3), ('According', 3), ('display', 3), ('Equity', 3), ('amount', 3), ('information.', 3), ('Gerstner's', 3), ('held', 3), ('event', 3), ('product', 3), ('Gerstner's', 3), ('added', 3),

('1%.', 3), ('slew', 3), ('pointed', 3), ('easing', 3), ('inflation,', 3), ('helping', 3), ('offset', 3), ('worries', 3), ('highs..', 3), ('Data', 3), ('goods', 3), ('vehicles.', 3), ('Visit', 3), ('Podcast', 3), ('platforms', 3), ('addition,', 3), ('achieved', 3), ('raised', 3), ('demand', 3), ('2022', 3), ('today', 3), ('million', 3), ('gaining', 3), ('40', 3), ('three', 3), ('consumer', 3), ('best-performing', 3), ('jumped', 3), ('UnitedHealth', 3), ('monsters', 3), ('DJIA', 3), ('us', 3), ('realize', 3), ('margin', 3), ('valuation', 3), ('AWS', 3), ('giants', 3), ("today's", 3), ('industry,', 3), ('recently', 3), ('mega-cap', 3), ('upside', 3), ('State', 3), ('play:', 3), ('responsible', 3), ('vast', 3), ('majority', 3), ('market's', 3), ('(up', 3), ('36%', 3), ('year)', 3), ('(37%)', 3), ('(39%)', 3), ('(44%)', 3), ('darling', 3), ('Nvidia,', 3), ('159%', 3), ('AI-related', 3), ('excitement.', 3), ('However,', 3), ('1%', 3), ('TV,', 3), ('Facebook', 3), ('.', 3), ('Twitter', 3), ('..', 3), ('consecutive', 3), ('5%', 3), ('announcement', 3), ('-6', 3), ('\$0.50', 3), ('-2.52%.', 3), ('\$0.15', 3), ('0.03%', 3), ('337.60.', 3), ('\$4.99', 3), ('-1.16%', 3), ('\$425.', 3), ('\$0.90', 3), ('\$122.78.', 3), ('\$0.41', 3), ('\$184.32.', 3), ('\$1.55', 3), ('\$271.70.', 3), ('\$3.85', 3), ('-0.80%', 3), ('50%', 3), ('Bull', 3), ('thanks', 3), ('hundreds', 3), ('large-cap', 3), ('(NVDA)', 3), ('Research', 3), ('NVDA,', 3), ('stocks:.', 3), ('Rank', 3), ('North', 3), ('AMD', 3), ('Broadcom', 3), ('Costco', 3), ('already', 3), ('less', 3), ('estimates', 3), ('results', 3), ('long', 3), ('often', 3), ('without', 3), ('according', 3), ('0.3%', 3), ('snapped', 3), ('session,', 3), ('maker', 3), ('Pro', 3), ('world', 3), ("Inc.'s", 3), ('30', 3), ('growing', 3), ('chain', 3), ('Taiwan', 3), ('stake', 3), ('purchased', 3), ('plans', 3), ('move', 3), ('leading', 3), ('-', 3), ('introduced', 3), ('highest', 3), ('Looking', 3), ('provider', 3), ('Earnings', 3), ('difficult', 3), ('IBM', 3), ('Reuters', 3), ('Exploring', 3), ('Price', 3), ('(MSFT)', 3), ('C', 3), ('peers', 3), ('products', 3), ('led', 3), ('session.', 3), ('session', 3), ('NASDAQ', 3), ('Brad', 3), ('posted', 3), ('November', 3), ('social', 3), ('FILE', 3), ('PHOTO:', 3), ('shows', 3), ('MSFT', 3), ('staggering', 3), ('Key', 3), ('talk', 3), ('people', 3), ('combined', 3), ('markets', 3), ('Technologies.', 3), ('year-to-date..', 3), ('rise', 3), ('Corporation,', 3), ('business', 3), ('NVDA', 3), ('came', 3), ('One', 3), ('chip', 3), ('market,', 3), ('reports', 3), ('technology,', 3), ('Maybe', 3), ('run', 3), ('looks', 3), ('surge', 3), ('now.', 3), ('past', 3), ('come', 3), ('valuable', 3), ('sold', 3), ('average', 3), ('trading,', 3), ('trillion.', 3), ('Analysis', 3), ('Financial)', 3), ('TSLA', 3), ('manufacturer', 3), ('leaders', 3), ('enhancing', 3), ('sparked', 3), ('technology.', 3), ('said', 3), ('Free', 3), ('use', 3), ('Ltd.', 3), ('many', 3), ('WFH', 3), ('cent..', 2), ('surpassed', 2), ('expectations,', 2), ('May,', 2), ('building', 2), ('materials.', 2), ('stave', 2), ('recession', 2), ('(NASDAQ:AAPL)', 2), ('Worldwide', 2), ('streaming', 2), ('pace', 2), ('driver', 2), ('indexes,', 2), ('contributing.', 2), ('breadth', 2), ('strong..', 2), ('(CAVA)', 2), ('99%', 2), ('priced', 2), ('IPO', 2), ('22', 2), ('share,', 2), ('range.', 2), ('opened', 2), ('42', 2), ('43.78.', 2), ('Buffett,', 2), ('stock,', 2), ('highlighted', 2), ('base', 2), ('iPhone', 2), ('users', 2), ('ways', 2), ('New', 2), ('Apple's', 2), ('Combined', 2), ('fact', 2), ('regular,', 2), ('decisions,', 2), ('makes', 2), ('appear', 2), ('tedious', 2), ('task', 2), ('always', 2), ('risk', 2), ('either', 2), ('blunder', 2), ('piece', 2), ('pure', 2), ('play', 2), ('picks', 2), ('bit', 2), ('later,', 2), ('mentioned', 2), ('interview', 2), ('Cupertino,', 2), ('California', 2), ('(NASDAQ:AAPL).', 2), ('World', 2), ('Wide', 2), ('(CSCO)', 2), ('Salesforce', 2), ('green', 2), ('sixth', 2), ('guest', 2), ('tell', 2), ('plea se', 2), ('800', 2), ('665', 2), ('0411.', 2), ('Cleantech', 2), ('Climate', 2), ('Change', 2), ('page', 2), ('Investorideas.com.', 2), ('Investorideas.com', 2), ('podcasts', 2), ('(Apple', 2), ('Podcasts)', 2), ('Audible,', 2), ('Spotify,', 2), ('Tunein', 2), ('Stitcher', 2), ('Spreker.com', 2), ('iHeartRadio', 2), ('audio', 2), ('chipmaker', 2), ('intraday', 2), ('JPMorgan', 2), ('driving', 2), ('today.', 2), ('January', 2), ('low', 2), ('1st', 2), ('\$124.15.', 2), ('\$349.35.', 2), ('it's', 2), ('owner', 2), ('ripped', 2), ('180', 2), ('remaining', 2), ('493', 2), ('are,', 2), ('aggregate', 2), ('flat.', 2), ("UK's", 2), ('ten', 2), ('cryptocurrency', 2), ('Pizza', 2), ('upgrade', 2), ('"This', 2), ('reminds', 2), ('growth/margins', 2), ('Services', 2), ('Analysts', 2), ('business.', 2), ('open.', 2), ('Pro.', 2), ('--', 2), ('heights', 2), ('Federal', 2), ('Reserve', 2), ('cutting', 2), ('example,', 2), ('expense', 2), ('number', 2), ('quarterly', 2), ('Roku,', 2), ('visit', 2), ('YouTube', 2), ('10', 2), ('weeks.', 2), ('almost', 2), ('70%', 2), ('broader', 2), ('tech.', 2), ('Sta

rbucks', 2), ('holdings', 2), ('include', 2), ('(TSLA)', 2), ('eight', 2), ('provides', 2), ('MSFT..', 2), ('synopsis', 2), ('Day:.', 2), ('#1', 2), ('(Strong', 2), ('Buy)', 2), ('First', 2), ('Citizen's', 2), ('Bancshares', 2), ('Carolina-based', 2), ('anomaly', 2), ('beaten-down', 2), ('banking', 2), ('sector.', 2), ('Крупнейшие', 2), ('клиенты', 2), ('TSMC', 2), ('Qualcomm', 2), ('Incorporated', 2), ('MediaTek', 2), ('(TW:', 2), ('Marvell', 2), ('и', 2), ('looking', 2), ('no-brainer', 2), ('now,', 2), ('consider', 2), ('add', 2), ('exposure', 2), ('fast-growing', 2), ('sectors,', 2), ('though', 2), ('Microsoft:', 2), ('12.9%', 2), ('Apple:', 2), ('12.3%', 2), ('Alphabet:', 2), ('7.8%', 2), ('Amazon:', 2), ('6.8%', 2), ('Nvidia:', 2), ('6.6%', 2), ('Tesla:', 2), ('4.2%', 2), ('Platforms:', 2), ('4.1%', 2), ('Broadcom:', 2), ('2.4%', 2), ('PepsiCo:', 2), ('1.7%', 2), ('Wholesale:', 2), ('1.6%', 2), ('Invesco', 2), ('QQQ', 2), ('produced', 2), ('750%', 2), ('(or', 2), ('15.3%', 2), ('annually)', 2), ('time.', 2), ('Subscribe', 2), ('Breakfast', 2), ('Podcasts', 2), ('holds', 2), ('June,', 2), ('hike', 2), ('change', 2), ('Unity', 2), ('winners', 2), ('AAPL)', 2), ('winner', 2), ('video', 2), ('highlights', 2), ('VR', 2), ('well..', 2), ('using', 2), ('ChatGPT', 2), ('January,', 2), ('12,000', 2), ('electric-vehicle', 2), ('moved', 2), ('Podcasts.', 2), ('join', 2), ('free', 2), ('Know', 2), ('.', 2), ('4', 2), ('Wednesday,', 2), ('(AMZN)', 2), ('heavy', 2), ('seven', 2), ('cap', 2), ('500's', 2), ('moving', 2), ('years,', 2), ('supply', 2), ('position', 2), ('trades', 2), ('infrastructure', 2), ('Advisors', 2), ('Executive', 2), ('pause', 2), ('rising', 2), ('rest', 2), ('lost', 2), ('PCI', 2), ('SSC', 2), ('world's', 2), ('payments', 2), ('America,', 2), ('brands', 2), ('feature', 2), ('receive', 2), ('world's', 2), ('0.3%', 2), ('Summit', 2), ('features', 2), ('Past', 2), ('Check', 2), ('platform', 2), ('represent', 2), ('net', 2), ('benefits', 2), ('Investment', 2), ('strong', 2), ('operating', 2), ('industry.', 2), ('every', 2), ('title', 2), ('')s', 2), ('song', 2), ('(TSXV:', 2), ('IWM's', 2), ('investments', 2), ('namely', 2), ('Communications', 2), ('soared', 2), ('Tech', 2), ('gained', 2), ('familiar', 2), ('dot-com', 2), ('Jan', 2), ('3,', 2), ('100', 2), ('safe', 2), ('best', 2), ('prospects', 2), ('way', 2), ('potential', 2), ('AI.', 2), ('months,', 2), ('Lennar', 2), ('(NASDAQ:GOOG)', 2), ('A-rated', 2), ('billionaires', 2), ('compiled', 2), ('34', 2), ('large', 2), ('terms', 2), ('debt', 2), ('rated', 2), ('Fitch,', 2), ('(NYSE:SNOW)', 2), ('(NASDAQ:MSFT)..', 2), ('compile', 2), ('picks,', 2), ('looked', 2), ('Artificial', 2), ('hit', 2), ('high..', 2), ('boosted', 2), ('500,', 2), ('prior', 2), ('2021,', 2), ('month', 2), ('Big', 2), ('jump', 2), ('schedule', 2), ('online', 2), ('outside', 2), ('AI,', 2), ('view', 2), ('logo', 2), ('Paris,', 2), ('turned', 2), ('positive', 2), ('negative', 2), ('lows,', 2), ('\$-8.50.', 2), ('surprised', 2), ('senior', 2), ('Performance:', 2), ('Comparing', 2), ('1987', 2), ('Gains.', 2), ('1987,', 2), ('Industrial', 2), ('Average', 2), ('(DJI)', 2), ('date', 2), ('25%', 2), ('100-Index', 2), ('(NDX,', 2), ('QQQ)', 2), ('39%', 2), ('mainly', 2), ('driven', 2), ('manic', 2), ('behavior', 2), ('select', 2), ('information', 2), ('research', 2), ('stranger's', 2), ('line', 2), ('chart', 2), ('1,', 2), ('home', 2), ('April', 2), ('41%', 2), ('Limited.', 2), ('Technologies', 2), ('Ltd..', 2), ('providing', 2), ('automotive', 2), ('hardware', 2), ('put', 2), ('Su's', 2), ('2027', 2), ('Even', 2), ('Story', 2), ('cloud', 2), ('story.', 2), ('Better', 2), ('analyst', 2), ('AMD)', 2), ('short', 2), ('click', 2), ('(NASDAQ:NVDA).', 2), ('CNBC,', 2), ('stunning', 2), ('2024,', 2), ('shared:.', 2), ('game', 2), ('behavioral', 2), ('lock', 2), ('right.', 2), ('Yesterday', 2), ('(NASDAQ:NVDA)', 2), ('along', 2), ('rallied', 2), ('NVDA)', 2), ('Devices,', 2), ('AMD)', 2), ('lower', 2), ('amid', 2), ('legislation', 2), ('eliminating', 2), ('Section', 2), ('230', 2), ('immunity', 2), ('companies..', 2), ('law', 2), ('allow', 2), ('prosecution', 2), ('media', 2), ('emerging', 2), ('reports.', 2), ('they'll', 2), ('buying', 2), ('stock's', 2), ('valued', 2), ('trillion', 2), ('(NVDA).', 2), ('2024', 2), ('days.', 2), ('seems', 2), ('Index', 2), ('Semiconductor', 2), ('action', 2), ('dropping', 2), ('better', 2), ('14', 2), ('sessions,', 2), ('yesterday', 2), ('witnessing', 2), ('(NASDAQ:NVDA)', 2), ('Nvidia's', 2), ('center', 2), ('Based', 2), ('so.', 2), ('Director', 2), ('Harvey', 2), ('119,795', 2), ('\$403.17.', 2), ('selling', 2), ('snap', 2), ('five-day', 2), ('beyond', 2), ('year's', 2), ('rally.', 2), ('X.', 2), ('NVDA)', 2), ('Tuesday,', 2), ('streak.', 2), ('charging', 2), ('station', 2), ('California,', 2), ('August', 2), ('included', 2), ('believes', 2), ('shown', 2), ('standard', 2), ('adding', 2), ('arguably', 2), ('sought-after', 2), 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('manner.', 1), ('Auto', 1), ('manufacturers', 1), ('gurus', 1), ('GM,', 1), ('Ford,', 1), ('Stellantis', 1), ('Ferrari..', 1), ('automaker', 1), ('Motor', 1), ('(TM,', 1), ('Tuesda y', 1), ('morning', 1), ('next-generation', 1), ('announced..', 1), ('Motor.', 1), ('lette r,', 1), ('contained', 1), ('31,000', 1), ('signatures,', 1), ('risks', 1), ('civilizatio n.', 1), ('Palantir', 1), ('PLTR)', 1), ('Alex', 1), ('Karp', 1), ('calling', 1), ('don't', 1), ('store.', 1), ('Newly', 1), ('installed', 1), ('car', 1), ('chargers', 1), ('Super', 1), ('Charging', 1), ('Carlsbad,', 1), ('Sept.', 1), ('2018.', 1), ('fast-charging', 1), ('p redominant', 1), ('U.S.', 1), ('opening', 1), ('streams', 1), ('maker..', 1), ('week,', 1), ('spectacular', 1), ('60%', 1), ('April.', 1), ('predicted', 1), ('"serious', 1), ('recessio n"', 1), ('responded', 1), ('reducing', 1), ('vehicles..', 1), ('alleviation', 1), ('challen ges,', 1), ('signs', 1), ('stability,', 1), ('rebounded,', 1), ('approaching', 1), 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('23.', 1), ('Christmas', 1), ('December', 1), ('25.', 1), ('Juneteenth', 1), ('SpaceX,', 1), ('attends', 1), ('roundtabl e', 1), ('6th', 1), ('edition', 1), ('"Choose', 1), ('France"', 1), ('Chateau', 1), ('de', 1), ('Versailles,', 1), ('France', 1), ('15,', 1), ('Lawler', 1), ('decision', 1), ('networ k', 1), ('require', 1), ('additional', 1), ('capital', 1), ('part..', 1), ('Owners', 1), ('F ord', 1), ('access', 1), ('Superchargers', 1), ('starting', 1), ('2024.', 1), ('(TSLA).', 1), ('row', 1), ('108.5%', 1), ('60', 1), ('12.5%', 1), ('\$3.56', 1), ('\$4.07', 1), ('foreca st', 1), ('rebound', 1), ('32.5%', 1), ('\$4.72.', 1), ('Single-Stock', 1), ('Racing', 1), ('Hit', 1), ('Billion-Dollar', 1), ('AUM', 1), ('weeks,', 1), ('Motors', 1), ('headlines', 1), ('finance', 1), ('record-breaking', 1), ('climb', 1), ('broke', 1), ('pause.', 1), ('tra ck', 1), ('billion-dollar', 1), ('single-stock', 1), ('ETF.', 1), ('general', 1), ('Gigafact ory', 1), ('Gruenheide', 1), ('Berlin,', 1), ('Germany,', 1), ('30,', 1), ('2022.', 1), ('la id', 1), ('sweeping', 1), ('plan', 1), ('radical', 1), ('redesign', 1), ('factories,', 1), ('sending', 1), ('clearest', 1), ('signal', 1), ('intention', 1), ('capture', 1), ('larger', 1), ('electrics,', 1), ('outsold', 1), ('rivals', 1), ('ven', 1), ('40%.', 1), ('re', 1), ('again,', 1), ('though,', 1), ('begin..', 1), ('Whether', 1), ('extends', 1), ('depend', 1), ('RBC', 1), ('Capital', 1), ('Markets', 1), ('Tom', 1), ('Narayan', 1), ('feeling', 1), ('upbeat', 1), ('envisions', 1), ('robotaxis..', 1), ('Robotaxis', 1), ('time,', 1), ('Naray an,', 1), ('highly', 1), ('bullish', 1), ('financially', 1), ('becomes', 1), ('autonomou s..', 1), ('"We', 1), ('believe...', 1), ('jetcityimage.', 1), ('Due', 1), ('factors,', 1), ('political', 1), ('social,', 1), ('economic,', 1), ('technological,', 1), ('controversial', 1), ('debated', 1), ('(NASDAQ:TSLA).', 1), ('reversed', 1), ('recovering', 1), ('sharp', 1), ('losses', 1), ('historic', 1), ('win', 1), ('Wednesday..', 1), ('unemployment', 1), ('261,0 00', 1), ('fall', 1), ('248,000..', 1), ('Further,', 1), ('Commerce', 1), ('Department's', 1), ('May's', 1), ('April's', 1), ('0.4%', 1), ('rise.', 1), ('marked', 1), ('Tesla's', 1), ('continuous', 1), ('observed', 1), ('fair', 1), ('yesterday's', 1), ('after-hours', 1), ('s ell-off', 1), ('persists', 1), ('see', 1), ('located', 1), ('channel', 1), ('246.16', 1), ('250.23.', 1), ('"reality', 1), ('check"', 1), ('inane', 1), ('"scores"', 1), ('comes', 1), ('courtesy', 1), ('Beacon', 1), ('profiled', 1), ('yes', 1), ('blowing', 1), ('away', 1), ('EV-maker', 1), ('rating.', 1), ('Nearly', 1), ('EVs', 1), ('LiveOne's', 1), ('Slacker', 1), ('Radio', 1), ('(that', 1), ('includes', 1), ('PodcastOne)', 1), ('11,', 1), ('Company', 1), ('accrued', 1), ('ad-supported', 1), ('approximately', 1), ('2.9', 1), ('million**.', 1), ('ended', 1), ('2%', 1), ('Thursday..', 1), ('slightly', 1), ('hotter', 1), ('expecte d', 1), ('contraction', 1), 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mps.', 1), ('joined', 1), ('nationwide.', 1), ('(GOOGL.0)', 1), ('cautioning', 1), ('employee
es', 1), ('chatbots,', 1), ('Bard,', 1), ('program', 1), ('world,', 1), ('four', 1), ('tol
d', 1), ('Reuters.', 1), ('(LUV)', 1), ('read', 1), ('article', 1), ('Zacks.com', 1), ('her
e..', 1), ('\$6', 1), ('12', 1), ('millions', 1), ('rights', 1), ('allowed', 1), ('customer
s', 1), ('videos.', 1), ('(GOOG):', 1), ('GOOG', 1), ('~8%', 1), ('Q2', 1), ('~\$106', 1),
('~\$144', 1), ('~\$124.', 1), ('~125%', 1), ('increase', 1), ('~\$87', 1), ('~\$109.', 1), ('ap
peared', 1), ('searches', 1), ('Hong', 1), ('Kong's', 1), ('anthem,', 1), ('instead', 1),
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e.', 1), ('Inc-owned', 1), ('shopping', 1), ('compete', 1), ('Amazon..', 1), ('capabilitie
s', 1), ('visualise', 1), ('apparel', 1), ('different', 1), ('body', 1), ('types', 1), ('fin
d', 1), ('image-recognition', 1), ('Inc-ownedGoogle,', 1), ('space,', 1), ('thatgenerative',
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ual', 1), ('EdgeVerve', 1), ('Inbenta', 1), ('Jio', 1), ('Pushing', 1), ('Integrate', 1),
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nd.', 1), ('embracing', 1), ('Web3,', 1), ('blockchain', 1), ('strategic', 1), ('investment
s,', 1), ('payment', 1), ('digital', 1), ('transactions.', 1), ('Fiserv', 1), ('became', 1),
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terCard', 1), ('Visa..', 1), ('constructed', 1), ('GICS,', 1), ('advisors', 1), ('indexing',
1), ('\$500', 1), ('-0.27%)..', 1), ('collapsed', 1), ('80%', 1), ('reining', 1), ('richly',
1), ('companies.', 1), ('Scope.', 1), ('Attribute', 1), ('Details', 1), ('232.17', 1), ('Pro
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ed,', 1), ('Rapyd', 1), ('Network,', 1), ('Solid', 1), ('Technologies,', 1), ('Railsbank',
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PL)', 1), ('Regional', 1), ('Management', 1), ('(RM)', 1), ('determine', 1), ('buy', 1),
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y', 1), ('PYPL.', 1), ('Davis', 1), ('Sacks', 1), ('venture', 1), ('capitalist', 1), ('-0.4
6%', 1), ('executive', 1), ('getting', 1), ('job', 1), ('done..', 1), ('Remote', 1), ('Wor
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('PayAnywhere', 1), ('LLC,', 1), ('Payleven', 1), ('GmbH,', 1), ('Square', 1), ('SumUp', 1),
1), ('Verifone', 1), ('eWAY', 1), ('Stripe', 1), ('Card', 1), ('Ltd,', 1), ('Revolut', 1),
('others.', 1), ('fourth', 1), ('unique', 1), ('regret', 1), ('wake', 1), ('dip', 1), ('non
e', 1), ('-1.17%.', 1), ('historically', 1), ('inflation', 1), ('competition', 1), ('headwi
nds,', 1), ('continues', 1), ('deliver.', 1), ('Maintains', 1), ('Recommendation.', 1), ('Fi
ntel', 1), ('9,', 1), ('maintained', 1), ('coverage', 1), ('(NASDAQ:PYPL)', 1), ('recommenda
tion..', 1), ('Analyst', 1), ('Suggests', 1), ('49.89%', 1), ('Upside.', 1), ('one-year',
1), ('96.29.', 1), ('executive', 1), ('David', 1), ('fan', 1), ('work-from-home', 1), ('(WF
H)', 1), ('policies..', 1), ('work,', 1), ('“WFH', 1), ('four-day', 1), ('two-day', 1), ('w
eek.', 1)]

NLTK basierter Sentiment-Analyser. Der Output ist identisch mit unseren extrahierten Sentiment Werten.

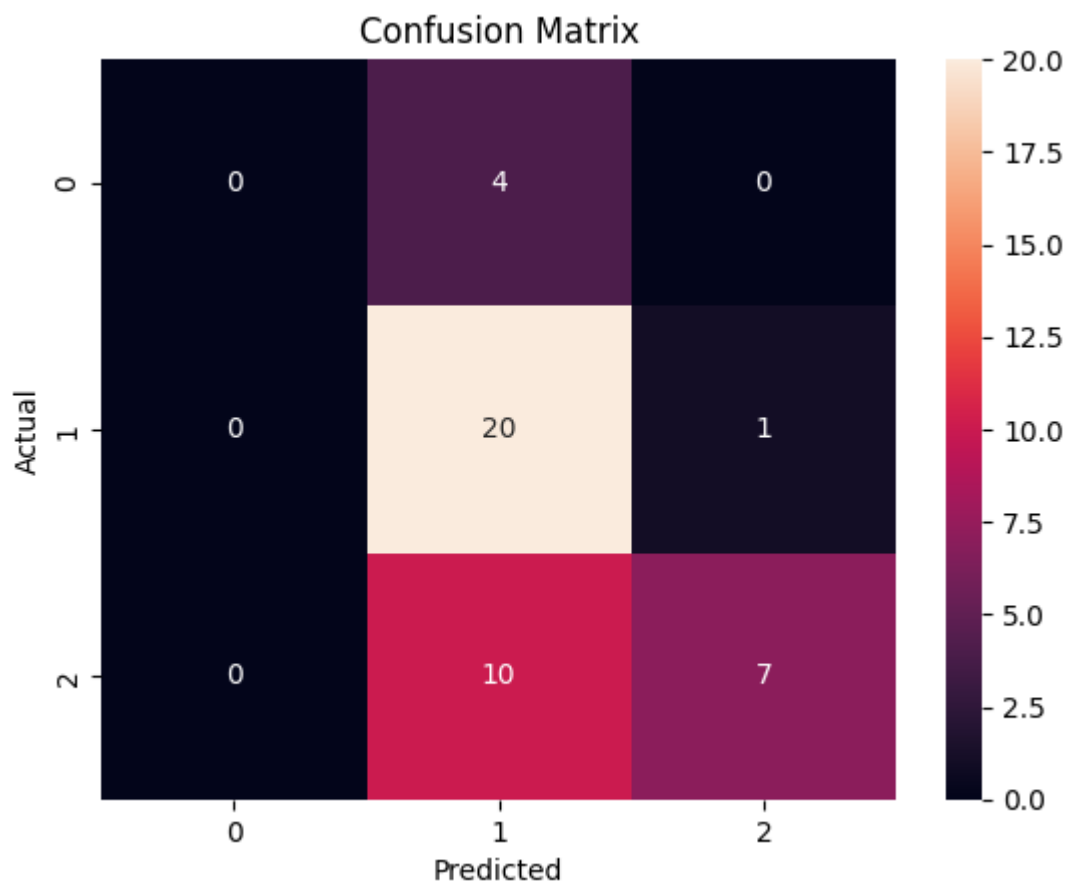
Modellentwicklung

Der Multinomial Naive Bayes (MNB) als effizienter Algorithmus und klassiker unter den Textklassifikationsmodellen eignet sich für unseren Datensatz gut. Zum einen arbeiten wir mit Textdaten (highlight_cleaned), zum anderen haben wir mehr als zwei Sentiment-Klassen und der MNB ist ein Multiklassenklassifikationsmodell der effektiv mit mehreren Klassen modellieren kann. Der Naive Bayes geht zudem davon aus, dass die Merkmale unabhängig voneinander sind und liefert unter dieser Annahme gute Ergebnisse. Das eignet sich gut auch in unserem Fall.

Evaluierung

Accuracy: 0.6428571428571429
Precision: 0.6482843137254901
Recall: 0.6428571428571429

Konfusionsmatrix



Test-Beispiel

Input text: DAX still on upwards trend besides Euro-Zone being in recession.
Predicted class: ['neutral']

Input text: Kraken Exchange in fear of its Liquidity due to SEC war.
Predicted class: ['neutral']

Input text: No significant movement of Ethereum signals upcoming low Volatility-Era in Crypto.
Predicted class: ['positive']

Input text: Upwards movement after Bitcoin breaks free from downside trend.
Predicted class: ['positive']