ФИЗИКО-МАТЕМАТИЧЕСКИЕ И ТЕХНИЧЕСКИЕ НАУКИ

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PREDICTION OF STOCKS USING MACHINE LEARNING METHODS

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Abstract. *Retail trade or retail is a sale of certain goods to the end consumer or intermediary for further sale, which is implemented through trade in specially equipped premises, through personal sales, etc. Also, retail trade is a commodity exchange process aimed at meeting the demand of customers.*
In addition, the retail sector currently occupies a leading position in terms of the intensity of development of the CIS countries economy. Excellent indicators have been achieved and many companies have reached a new level of trading. By about 2005, more than a dozen major retail chains had passed the billion-dollar milestone in terms of annual net revenue, and this is in dollars. The turnover of individual stores and retail facilities competed with some industrial enterprises with solid turnover and production bases.
Thus, we can claim that the sphere of trade affects the growth and development of related industries. The product promotion chain involves the participation of customers and their demand, as well as other participants in the process. Moreover, the development of trade requires sellers to pay more and more attention to working with the product range and inventory balances. Working with inventory and product balances is a main issue for many retailers. And the many companies needed to make sure that there is a sufficient quantity of goods in the warehouse. Another point is that, exclude overstocking, because this is also one of the problems of retailers with a high degree of accuracy is required to make decisions.
To sum up, making decisions in inventory management directly affects sales volumes, logistics costs, revenue, profit, and profitability. Inventory prediction is a necessary task to maintain an optimal level of inventory. I would like to note that the goal of the project / dissertation is to solve this problem using modern prediction methods based on machine learning technologies. The result is that in this way it is quite possible to analyze the dynamics of sales(consumer demand) thousands or even more products.

Key words: *retail trade, machine learning technology, prediction methods, problem, inventory, retailers, warehouse, balance, overstocking, economy, trading, demand of customers.*

МАШИНАЛЫҚ ОҚЫТУ ӘДІСТЕРІН ҚОЛДАНА ОТЫРЫП ҚОЙМА ҚОРЛАРЫН БОЛЖАУ

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Аңдатпа. *Бөлшектік сауда – бұл белгілі бір тауарларды соңғы тұтынушыға немесе делдалға дейін және одан әрі сату, жеке сату және т.б. сату түрлері арқылы жүзеге асырылады. Ал бөлшек сауда дегеніміз – бұл сұранысты қанағаттандыруға бағытталған тауар айырбастау процесі. Сонымен қатар бөлшек сауда секторы қазіргі уақытта ТМД елдері экономикасының даму қарқындылығы бойынша жетекші орынға ие. Өте жоғары көрсеткіштерге қол жеткізілді және көптеген компаниялар сауда-саттықтың жаңа деңгейіне шықты. Шамамен 2005 жылға қарай оннан астам ірі сауда желілері жылдық таза кірісі бойынша миллиард долларлық межеден өтті. Жеке дүкендер мен бөлшек сауда объектілерінің тауар айналымы және өндірістік базалары бар кейбір өнеркәсіптік кәсіпорындармен бәсекелесті.*
Олай болса, сауда саласы, сабақтас салалардың өсуі мен дамуына әсер етеді деп айтуға

болады. Сауданың дамуы сатушылардан тауар ассортиментімен және тауарлық-материалдық құндылықтармен жұмыс жасауға көбірек көңіл бөлуді талап етеді. Тауарлы-материалдық құндылықтармен істеу көптеген сатушылар үшін басты мәселе болып табылады. Осыған орай компаниялар қоймада тауарлардың жеткілікті мөлшерде екендігіне көз жеткізуі керек. Сондай-ақ тауардың шектен тыс көп болуы да дұрыс емес және мұны болдырмай, алдын алу қажет.
Қорытындылай келе, тауарлы-материалдық құндылықтарды басқаруда шешім қабылдау, сату көлеміне, логистикалық шығындарға, кіріске, пайдаға және рентабельділікке тікелей әсер етеді. Қойма қорларын болжау – бұл түгендеудің оңтайлы деңгейін ұстап тұру үшін қажетті міндет. Жобаның / диссертацияның мақсаты – проблеманы машиналық оқыту технологияларына негізделген заманауи болжау әдістерін қолдану арқылы шешу екенін атап өткіміз келеді. Осылайша мыңдаған немесе одан да көп өнімді сату динамикасын (тұтынушылық сұранысты) әбден талдауға болады.

Түйінді сөздер: *бөлшек сауда, машиналық оқыту технологиясы, болжау әдістері, проблема, тауарлық-материалдық құндылықтар, бөлшек сауда орындары, қойма, баланс, артық қор, экономика, сауда, сатып алушылардың сұранысы.*

ПРОГНОЗИРОВАНИЕ СКЛАДСКИХ ЗАПАСОВ МЕТОДАМИ МАШИННОГО ОБУЧЕНИЯ

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Аннотация. *Розничная торговля - это продажа определенных товаров конечному потребителю или посреднику для дальнейшей продажи, которая осуществляется через торговлю в специально оборудованных помещениях, через личные продажи и т. д. Также розничная торговля – это процесс товарного обмена, направленный на удовлетворение спроса клиентов.*
Кроме того, в настоящее время сектор розничной торговли занимает лидирующие позиции по интенсивности развития экономики стран СНГ. Достигнуты отличные показатели, и многие компании вышли на новый уровень торговли. Примерно к 2005 году более десятка крупных розничных сетей преодолели рубеж в миллиард долларов с точки зрения годовой чистой выручки, и это выражается в долларах. По товарообороту отдельные магазины и торговые объекты конкурировали с некоторыми промышленными предприятиями, имеющими солидный товарооборот и производственную базу.
Таким образом, можно утверждать, что сфера торговли влияет на рост и развитие смежных отраслей. Цепочка продвижения продукта предполагает участие покупателей и их спрос, а также других участников процесса. Более того, развитие торговли требует от продавцов все больше внимания уделять работе с товарным ассортиментом и остатками на складе. Работа с товарными запасами и остатками продуктов является основной проблемой для многих розничных продавцов. И многим компаниям нужно было убедиться, что на складе есть достаточное количество товара. Другой момент - исключить затоваривание, потому что это тоже одна из задач ретейлеров, от которых требуется высокая степень точности принятия решений.
Подводя итог, можно сказать, что принятие решений в управлении запасами напрямую влияет на объемы продаж, логистические затраты, выручку, прибыль и рентабельность. Прогнозирование запасов - необходимая задача для поддержания оптимального уровня запасов. Хотим отметить, что целью проекта / диссертации является решение данной проблемы с использованием современных методов прогнозирования, основанных на технологиях машинного обучения. В результате таким способом вполне возможно анализировать динамику продаж (потребительского спроса) тысяч и даже более товаров.

Ключевые слова*: розничная торговля, технология машинного обучения, методы прогнозирования, проблема, инвентарь, розничные торговцы, склад, баланс, затоваривание, экономика, торговля, спрос покупателей.*

Introduction

Over the past few years, the topic of artificial intelligence (AI) has caused a lot of hype in the media. Machine learning, deep learning, and AI have been mentioned in countless articles, many of which have nothing to do with technology descriptions. We were promised the appearance of virtual interlocutors of cars with autopilot and virtual assistants. Sometimes the future was painted in dark colors, and sometimes it was depicted as utopian: freeing people from routine labor and performing the main work by robots endowed with artificial intelligence. It is important for a future or current expert in the field of machine learning to be able to distinguish a useful signal from noise, to see in inflated press releases changes that can really affect the world. Our future is at stake, and you will play an active role in it: when you finish reading this book, you will join the ranks of those who develop AI systems.

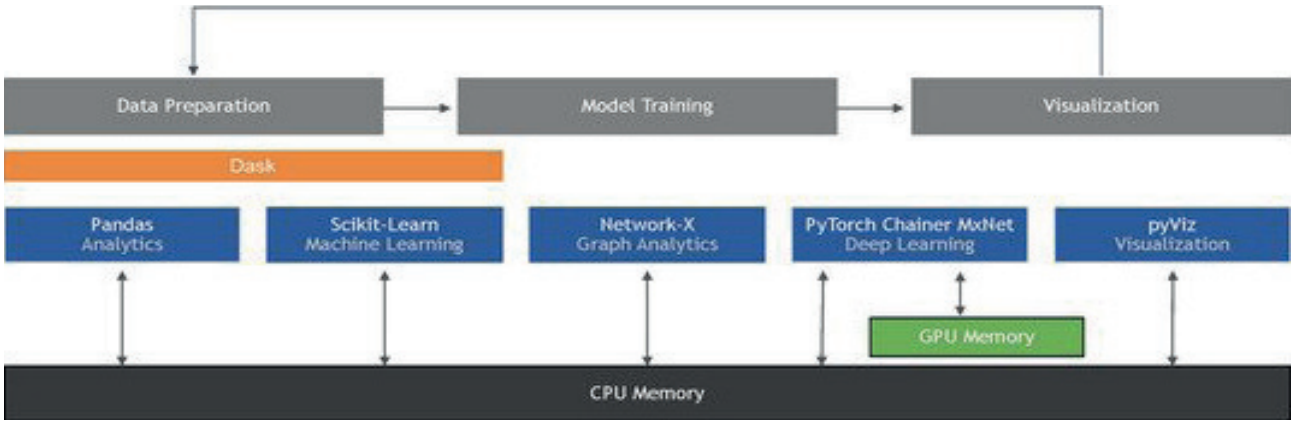


Figure 1: Machine model

So let's look at the following questions: What has deep learning already achieved? how does my project relate to deep learning? what kind of project? how important is it? in what direction will further development go?

This work lays the foundation for further discussion of AI, machine learning, and deep learning.

Problem statement and motivation

The research is that is it possible to predict inventory levels using machine learning?

I researched a lot about this and found the answer. The main reason for creating and working with this project is to find out the answer to this question and motivation, because the development of trade, especially on the Internet, requires sellers to pay more and more attention to working with the range of goods and stock balances. Inventory forecasting is a necessary task to maintain their optimal level. To solve this problem, modern forecasting methods based on machine learning technologies are used. In this way, it is quite possible to analyze the dynamics of sales of thousands of products. However, different product categories require different approaches. Predicting the demand for food and everyday goods is easy, simple algorithms are suitable for this, but when it comes to specialized goods with rare demand, special algorithms and approaches are needed. The task becomes more complicated if the business is interested in forecasting inventory for each "pre-known" buyer.

Research question and objectives

Let's say the buyer has reserved an item, and the seller wants to know: when will the buyer buy back this item, and whether he will buy it back at all?

The approach to solving this problem is based on clustering all products into common groups. Each company, of course, has its own classification of goods: by product line, by manufacturer, by type, etc. In the vast majority of cases, the number of these "types" of goods

is huge. And, of course, some products are sold rarely and very rarely, which leads to difficulties in forecasting, but these products also need to be taken into account. In these conditions, it is necessary to artificially "increase the demand for goods". For this purpose, the clustering of goods by the most important factors is carried out.

Where are the growth points and opportunities for using AI when working with inventory?

For example, a chain of stores consisting of several locations inevitably faces two interrelated problems: the first is the lack of reliable information about the capacity of the store and the second, as a result, it is not clear how much to order goods to the store.

What is the root of the problem?

All stores are different in size, a set of commercial equipment, and if the network is also large, having different store concepts, it is absolutely impossible to understand the exact capacity.

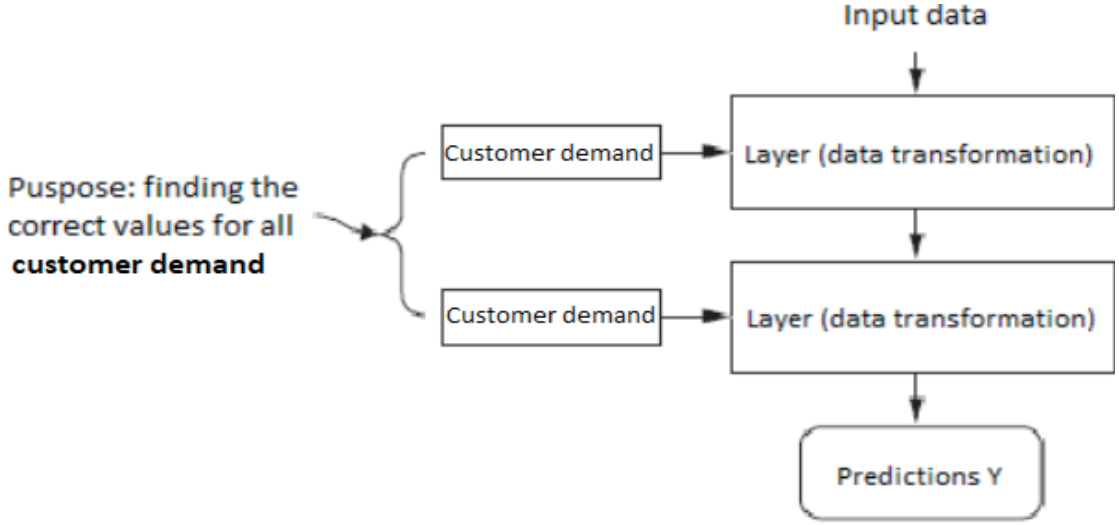
In clothing stores, you are also faced with a seasonal change in the collection, and the number of combinations can be so significant that you can not do without the process of simplifying the calculations. Simplification leads to errors in the calculation, assumptions and, as a rule, an excessive order, frozen money, excessive labor resources and loss of profit for the business.

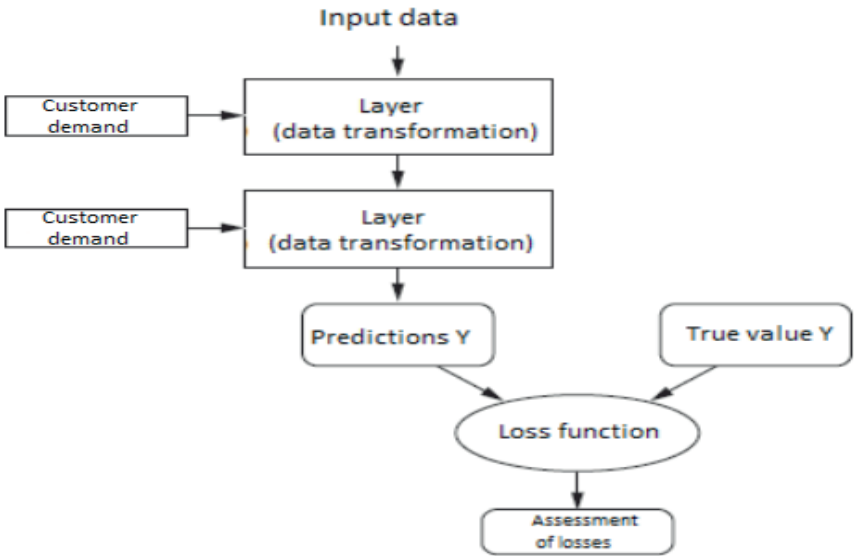
The prototype environment

The essence of machine learning is to transform input into a result, which is revealed by examining many examples of input data and results. You also know that deep neural networks turn the source data into a result by performing a long sequence of simple transformations (layers), and learn these transformations from examples. Now let's see exactly how the training takes place.

What exactly a level does with its input data is determined by its ***customer demand***, which are actually a set of numbers. In technical terms, we can say that the transformation implemented by a layer is parameterized by its customer demand. (Customer demand is also sometimes referred to as layer options.) in this context, training refers to the search for a set of customer demand of all layers in the network, in which the network will correctly map the model input data to the corresponding results. But here's the thing: a deep neural network can contain tens of millions of parameters. Finding the correct value for each of them can be a daunting task, especially if changing the value of one parameter affects the behavior of all the others.

To control something, you first need to be able to observe it. To control the result of a neural network, you need to be able to measure how far this result is from the expected one. This problem is solved by the network loss function, which is also called the target function. The loss function takes the prediction given by the network and the true value (which the network should have returned) and calculates an estimate of the price and customer demand between them, reflecting how well the network did with this particular example.





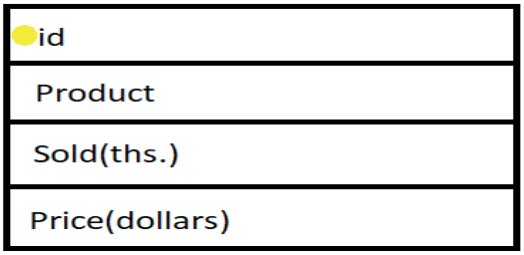
Conclusion

In conclusion, we got a code that analyzes the past history of products. And predicts the future demand of a certain product. This is very convenient for many companies to make the decisions in inventory management that directly affects sales volumes, logistics costs, revenue, profit, and profitability. Inventory prediction is a necessary task to maintain an optimal level of inventory. The code is able to solve this problem using modern prediction methods based on machine learning technologies that can identify and predict results is that in this way it is quite possible to analyze the dynamics of sales(consumer demand) thousands or even more products.

Source systems

The source systems are mainly systems that feed the in-memory platform(Ms Excel) with data; such data could come from shop/ supermarket systems or researches.

Data model



Necessary libraries for Python to create a program

All the Libraries:

```
import math
import csv
import string
import sys
import numpy as np
import pandas as pd
from sklearn.preprocessing import MinMaxScaler
from keras.models import Sequential
from keras.layers import Dense, LSTM
import matplotlib.pyplot as plt
plt.style.use('fivethirtyeight')
```

NumPy short for **"Numerical Python"**, is the main package for performing scientific calculations in python.

Pandas library provides data structures and functions designed to make working with structured data simple, fast and expressive.

The Pandas library combines the high performance of **Numpy's** array tools with the flexible data manipulation capabilities of spreadsheets and relational databases (for example, **based on SQL**). It provides advanced indexing tools that allow you to easily change the shape of data sets, form longitudinal and cross-sections, perform aggregation, and select subsets.

Matplotlib library is the most popular Python tool for creating graphs and other ways to visualize two-dimensional data.

Dataset

```
main = pd.read_csv('manage.csv', encoding= 'unicode_escape')
main
```

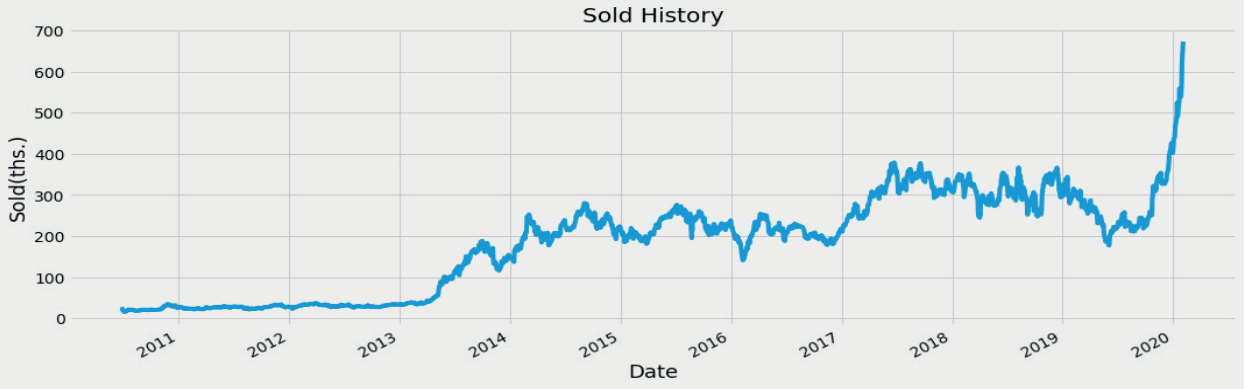
	id	Product	Sold(ths.)	Price(dollars)
0	1	Svet-k LRV 2õ18 S/A (TT-KZ) 2 sht	280.399994	286.040009
1	2	Svet-k LRV 2õ18 S/A ELECTR (TT-KZ) 2sht	272.510010	277.390015
2	3	Svet-k LRV 2X18W S/A KONDENSATOR (TEKSAN)2sht	277.519989	282.109985
3	4	Svet-k LRV 2X18W S/A ELECTRON (TEKSAN)2sht	528.409973	547.200012
4	5	Svet-k LRV 2X36W S/A (TT-KZ)	559.099976	569.559998
...	...	...	...	...
996	997	Sv.OPALLED GEOMETRY48W WH S/U 600x600 3000K(TT...	303.529999	305.500000
997	998	Sv.OPALLED GEOMETRY48W WH S/U 600x600 4500K(TT...	288.200012	308.440002
998	999	Sv.OPALLED GEOMETRY48W WH S/U 600x600 5700K(TT...	309.000000	321.899994
999	1000	Sv.OPALLED GEOMETRY48WBLACK S/U600x600 3000K T...	314.670013	321.640015
1000	1001	Sv.OPALLED GEOMETRY48W BLACKS/U600x600 4500K T...	318.100006	320.100006

1001 rows × 4 columns

	A	B	C	D
1	id	Product	Sold(ths.)	Price(dollars)
2	1	Svet-k LRV 2›	280.399994	286.040009
3	2	Svet-k LRV 2›	272.510010	277.390015
4	3	Svet-k LRV 2›	277.519989	282.109985
5	4	Svet-k LRV 2›	528.409973	547.200012
6	5	Svet-k LRV 2›	559.099976	569.559998

Figure 1. Dataset summary

Prediction



Sold(ths.)	Predictions
329.290009	94.053497
327.029999	94.004158
321.739990	93.892036
326.269989	93.682114
322.369995	93.475861

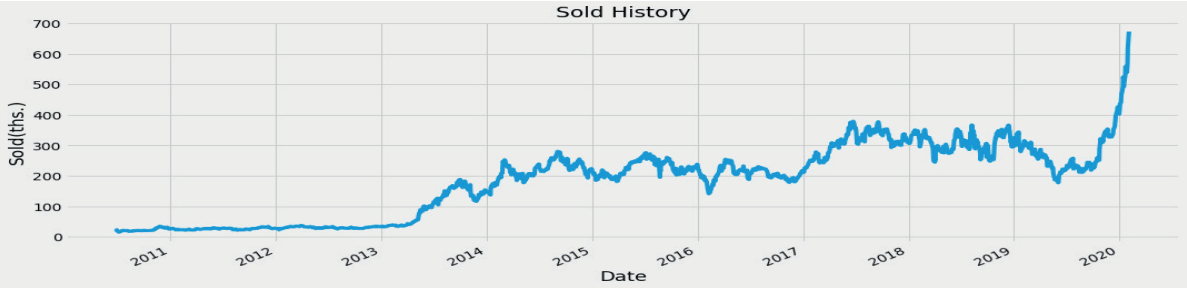
558.080017	133.646652
567.429993	135.104218
618.000000	136.556519
632.520020	138.468933
673.520020	140.730286

Figure 2. The result of training the model. Stock prediction.

Graphs

Graph 1:

```
plt.title('Sold History')
plt.xlabel('Date',fontsize=18)
plt.ylabel('Sold(ths.)',fontsize=18)
plot_stock['Sold(ths.)'].plot(figsize=(16,6))
```



Graph 2:

```
#Plot/Create the data for the graph
train = data[:training_data_len]
valid = data[training_data_len:]
valid['Predictions'] = predictions
#Visualize the data
plt.figure(figsize=(16,8))
plt.title('Sold History')
plt.xlabel('Price', fontsize=18)
plt.ylabel('Sold(ths.)', fontsize=18)
plt.plot(train['Sold(ths.)'])
plt.plot(valid[['Sold(ths.)']])
plt.legend(['Past',  'Predictions'], loc='lower right')
plt.show()
```

Graph 2:

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