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OF MATHEMATICS
AND PHYSICS
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STOCK User Manual

Prague, Czech Republic, 2020

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1. Installation

Before going through the instructions and details in this document, you should install the STOCK application. To install it and run it, please refer to section 3.1. in the development documentation that you received along with this document.

2. Instructions

This section describes in more detail how to use the STOCK application, assuming that you already went through the installation process, regardless of how you decided to run the application (locally or directly on web). STOCK is built as an admin Single Page Application and each view follows the structure shown in Figure 1.

There is a sidebar on the left which provides navigation throughout the application views such as Dashboard, Companies, History and Analysis. In the sidebar you will also see brief information regarding your account if you are logged in, such as username or full name if you decided to provide it to us, there are more details regarding this on Profile section 2.9. You can fold and unfold the sidebar at any time using the three lines icon on the top right corner of it. The horizontal navigation bar on top gives you access to a global search for companies, user actions if you are logged in such as Profile and Logout and Language change. The content of each view of the application will be shown in the empty space in the center.

Figure 1: STOCK application structure

In the STOCK application, you can access some views without needing to create an account and login, such as Dashboard described in section 2.1., Article details described in section 2.2. and Company profile described in section 2.4. In these views, you will be able to see the same information that a logged user does. To be able to see all views in STOCK, you will need to create an account as explained in section 2.5., which will expand your sidebar with three more views, Companies described in section 2.3., History described in section 2.7. and Analysis described in section 2.8.

You will also be able to see and modify your Profile, described in section 2.9.

2.1. Dashboard

The Dashboard, shown in Figure 2, has three main parts as follows. The first one is the chart that shows the weekly opening and closing prices of a selected company, respectively the black and the blue line. Hovering over the lines, will give you more detailed information and the exact price at the corresponding point in time. You can also check the values of the previous/next week by clicking on the two arrows on the top right corner of the chart. However, since these data are current prices, if you are now seeing the current week, you will not be able to see the data for the next week as that information is not yet available, but you can still check the previous weeks.

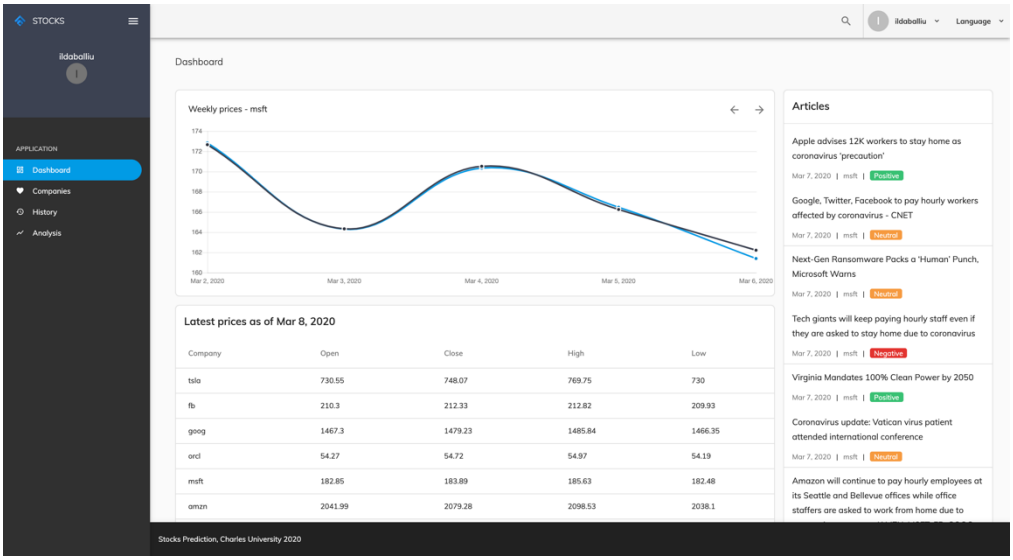

Figure 2: Dashboard

By default, the chart will show the opening and closing prices for Microsoft (company symbol: msft[1]). If you would like to see another company, you can do so by selecting the company you want from the list below the chart which takes us to the second main part of the Dashboard: Latest prices. This list contains all companies currently in our system and it shows the latest prices of each of them, specifically opening price, closing price, minimum price of the day and maximum price of the day. If you click on any of the rows, the information displayed on the chart will belong to the company you clicked on. However, if you click on the company symbol, it will take you to the company's profile page, which is explained in section 2.4.

The third main part of the Dashboard is the Articles section. For each company in our database, we are collecting articles from different sources and processing them as explained in the detailed development documentation that you received along

[1] Company symbol is the identifying symbol of the company in the stock market.

with this document. For each article, you can see the title, publishing date, company for which it talks about and also each article has an indicator: Positive, Negative or Neutral which suggests how the content of these articles might affect the company in question. However, please note that since the library used perform the sentiment analysis to get these indicators is an open source library, you should consider these results only as suggestions. If you want to see more details regarding an article, you can click on it and you will be redirected to the Article details page explained in section 2.2.

2.2. Article Details

You will be able to see the Article Details view on Figure 3 by clicking on one of the articles on your Dashboard. Here you will also be able to see the title of the article, publishing date, company for which it talks about and the sentiment analysis indicator. Furthermore, you will be able to see the source and navigate to the site where the article was originally published, by clicking on Source. Depending on the length of the article, you will be able to read here a preview of it or fully.

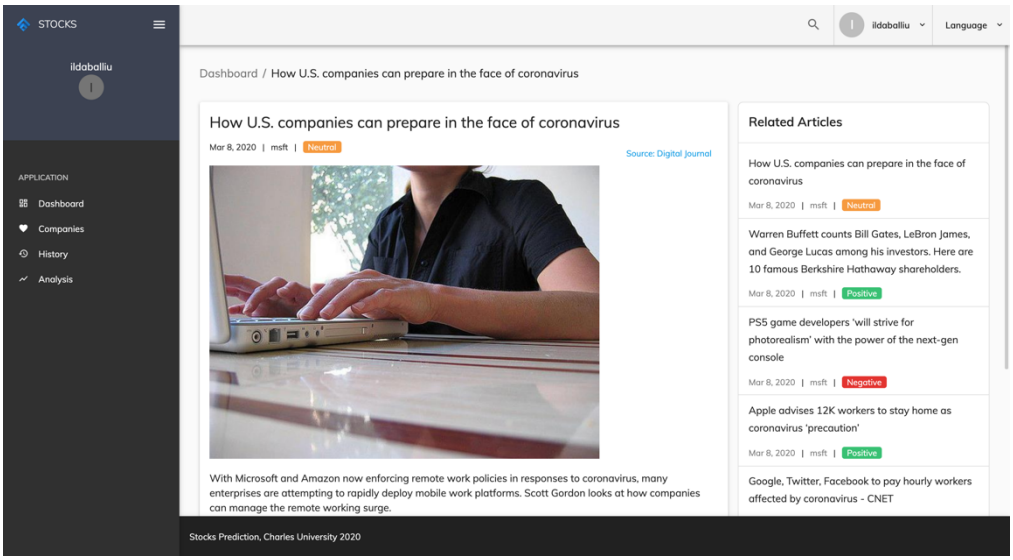

Figure 3: Article Details

On the right side of the screen, there is a list of articles related to the company you selected, to view the details of any of them, it's enough to just click on the desired article.

2.3. Companies

The third menu option on your sidebar is Companies. In the Companies view shown in Figure 4, you will be able to see two lists of companies: Favorite companies and Add more companies. The first list contains all your favorite companies from the companies currently in the database. You can search for a company by name or click on the checkboxes and delete one by one or multiple companies at the same time using the Delete button. The second list contains the full list of companies in our database, except for companies that are already in your

favorites list. You can also use the search bar to look for a company by name and use the checkboxes to add companies to the list of your favorites, one by one or multiple companies at the same time. Clicking on any of the rows in both lists, will take you to the Company profile page of the company you clicked, where you can see more details regarding that company, as described in section 2.4. and will also update your search history by adding the company you just clicked to the list of searched companies, described in section 2.7.

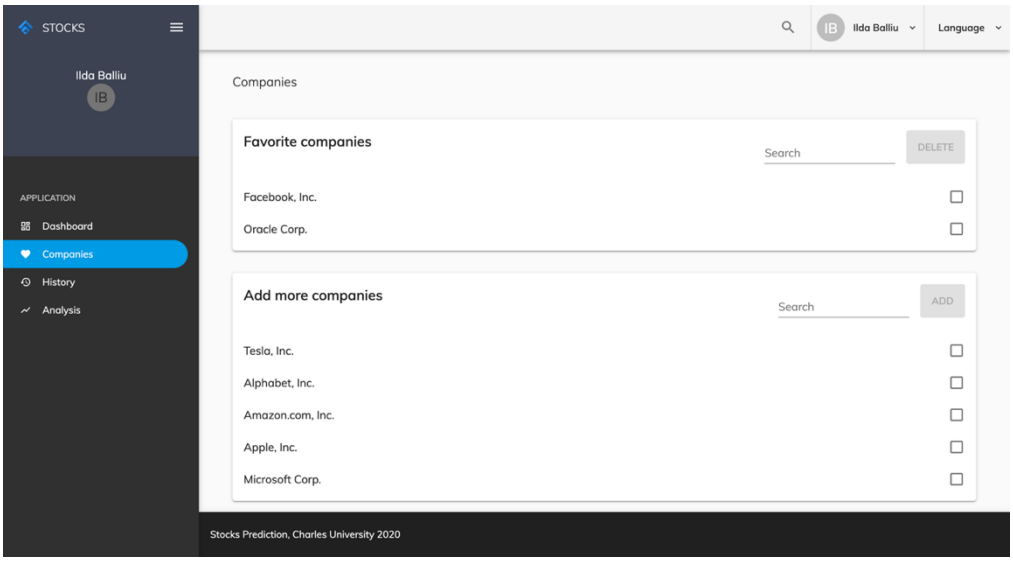

Figure 4: Companies

2.4. Company Profile

The Company Profile page shown in Figure 5, is split into three main sections. The first section, Details & History, contains information regarding the official name of the company, founder, headquarters, a short description of its field and what services it offers, the industry, number of employees and a direct link to visit the official website of the company by clicking on its name.

The second section has two charts side by side where you can see the current week's opening and closing prices and in the other chart, the forecast for the next week's closing price. The method used for the forecasted results in the second chart is a Recurrent Neural Network with its default values, so none of the parameters are tuned or optimized. Hovering over the lines in the chart, will display the exact price on that specific point in time.

Below these two charts, there are three more smaller charts. Correspondingly, the current week's high prices or maximum price of each day, the current week's low prices or minimum price of each day and current week's volume or number of transactions of each day. The number displayed in each of these charts is the last value of the week and the arrow next to it is an indicator if these values are trending up or trending down. Here you can hover over the charts too, to see the exact values.

The third section, Stock Prices History, is an interactive list that enables you to see the historical stock prices, specifically opening price, closing price, high price, low price and volume for each day. You can specify a date from when you want to see the prices and until when, and the list will display all prices we currently have in the database for that period of time. We currently have historical prices as far back as 2003.

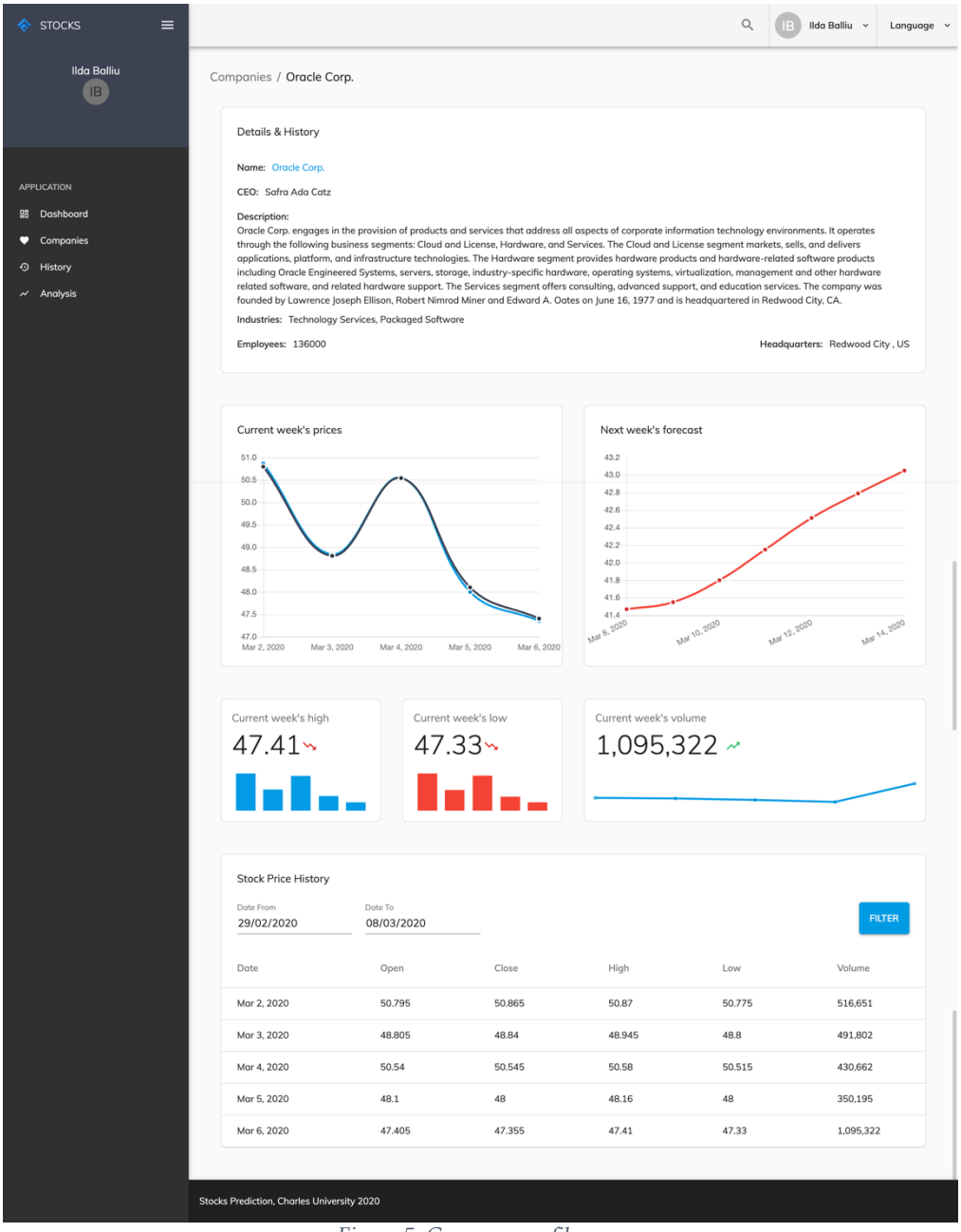

Figure 5: Company profile

2.5. Register

To explore all the features that STOCK provides, a user account is needed. Figure 6 shows the account creation view where you will be asked to provide a valid

username, email, password and confirming the password. A valid username needs to contain at least 5 characters and a valid password must contain at least 8 characters, including one uppercase letter, one lowercase letter and one number. The email field should be a real email account that you can access later because the account needs to be confirmed before you can use the tool as shown in Figure 6. However, there are tooltips (question mark icon) to help you see the requirements for these fields, and error messages will be displayed accordingly before you submit it.

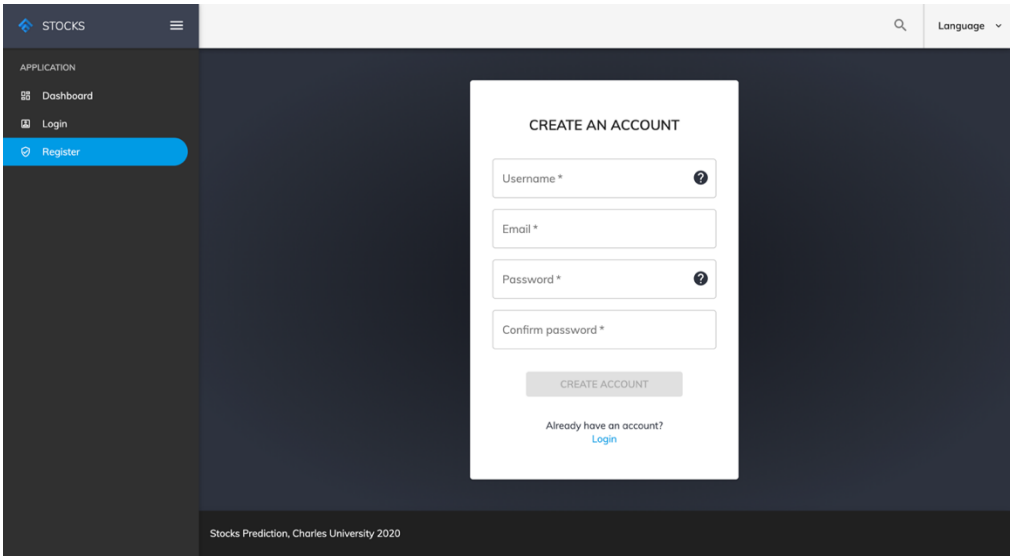

Figure 6: Create account

After submitting the registering form, you will see a confirming green message on the top right corner of your screen and then be redirected to the Confirm account page shown in Figure 7. We will send a six-digit code to the email address you provided us with which you will need to confirm your account before you can login and use it. To confirm your email address, you should enter the six-digit code in the Confirmation code text field. If the code provided is the same code we sent to your email, you will be redirected to the Login page described in the following section 2.6., otherwise you will be notified if there were any errors during the process.

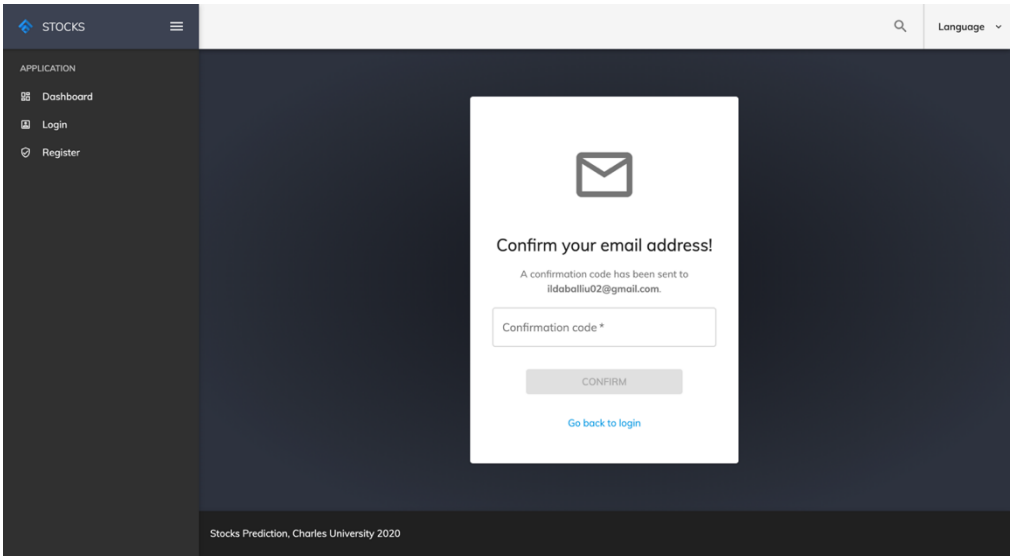

Figure 7: Confirm account

2.6. Login

For the Login page shown in Figure 8, the process is very straightforward. You will need to provide the username and the password you created during the Register process described in 2.5. If your input does not match the requirements, you will be shown the corresponding error message before submitting the form, but you will also be able to check the tooltips for quick information on the requirements of each field. If your credentials don't match the ones you sent us during the register process, an error message will show up on the top right corner of the screen which says what was the problems with your request.

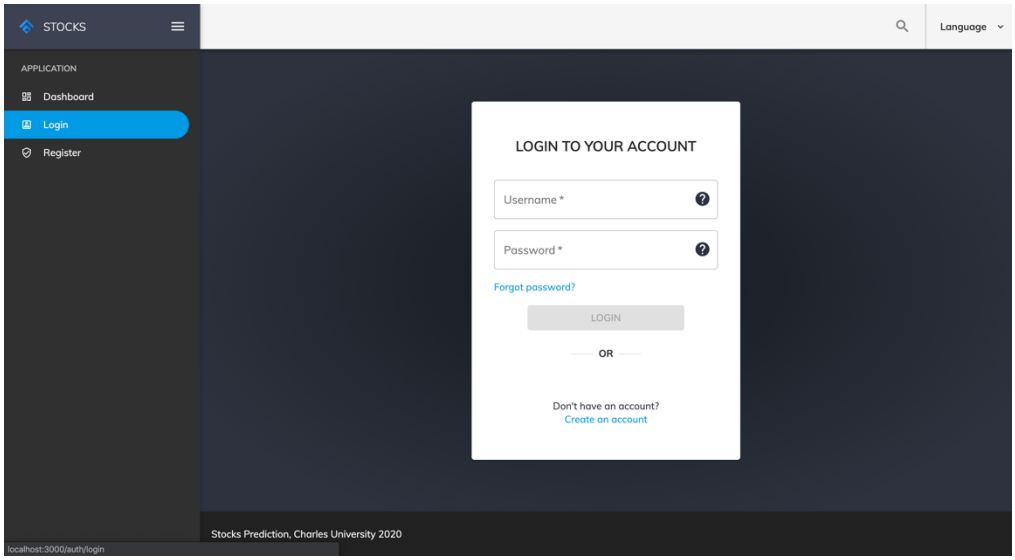

Figure 8: Login

2.7. History

History is related to the searching feature that STOCK provides. On the main navigation bar, which is globally available throughout the application, there is a search icon and by clicking on it, you can search any company that you want to check the profile of. It is possible to search both by company name and by the symbol each company has in the STOCK market. If you don't know the symbol, you can see it from the Dashboard view described in section 2.1., in the list of current prices.

If you are logged in, your search history will be updated once you click on one of the suggestions and then you will be redirected to the company's profile. You will be able to see in history any company that you searched for and the time when you searched it so it is easier for you to keep track of your latest actions. This list will also be updated if you are the Companies view, described in section 2.3., when you click on any of the companies to visit their profile. Figure 9 shows how to search for a company and how will your search history look like.

If you are not logged in, you will still be redirected to the company's profile page, but your search history will not be saved and you will not be able to access it later.

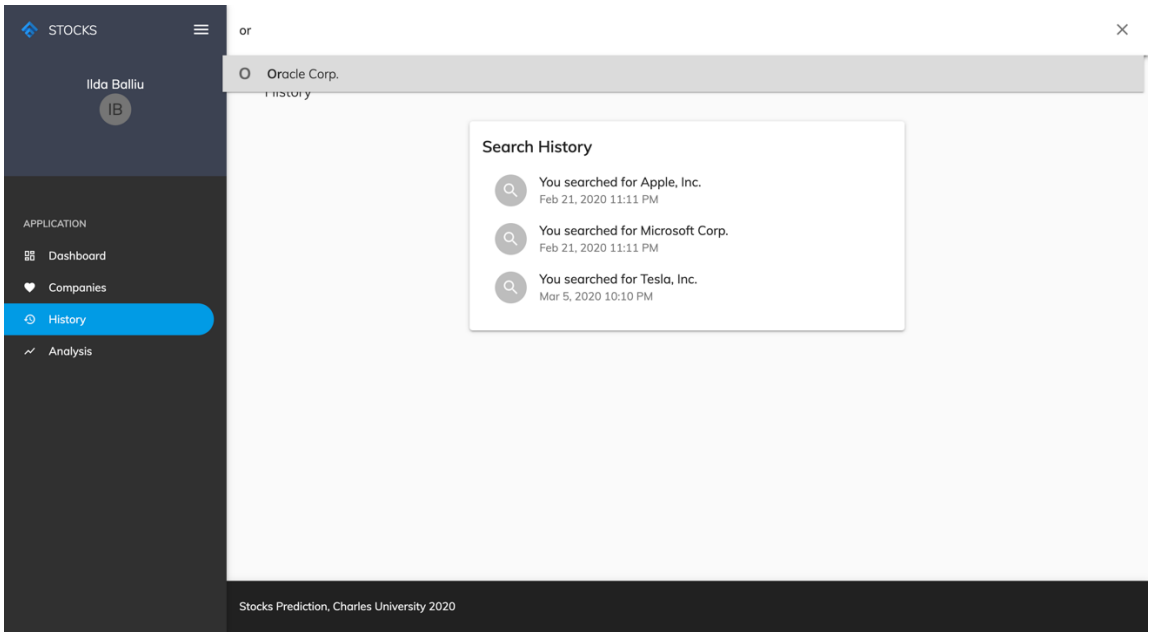

Figure 9: Search history

2.8. Analysis

The Analysis section is where you can tune and build your Machine Learning models. However, if you are accessing the Analysis view for the first time, this list will be empty and you will not be able to perform any actions just yet. To show what you can do in this part of the application, we will create three different models as examples: Linear regression model, Decision Tree model and Recurrent Neural Network model. For a detailed explanation on all the models

and their parameters, please read the development documentation that you received with this document.

- Linear regression model

Even though your list of created models is now empty, you can easily create your first model by clicking on the round blue button with a plus icon on the bottom right corner of the screen. Clicking on it, will take you to the model creation view, shown in Figure 10.

You first need to give your model a personalized name of your choice and choose the company you want to build the model for in the Dataset control section. For this example, we will call the model 'My first linear regression model' and select the company Amazon in the dropdown next to the model name.

Then in the Features section, you can select the features to be used in the prediction: Opening price, Closing price, Minimum price of the day, Maximum price of the day, Volume of transactions. You can choose as many of them as you want. For this example, we will keep all of them selected.
Then, you need to select in Feature to predict section, which one of these features you want to predict, it can only be one of them. We will keep the default selected value for this example, the Opening price.

The next step is Model Control, where you can choose the model type you want to use for your predictions. You can choose one from the list, including: Linear Regression, Elastic Regression, Lasso Regression, Lasso Lars Regression, Ridge Regression, Bayesian Ridge Regression, Decision Tree, Random Forest, Recurrent Neural Network (RNN) with Adam optimizer, RNN with Adamax optimizer, RNN with Nadam optimizer, RNN with SGD optimizer, RNN with RMS Prop optimizer, RNN with Adadelta optimizer.

However, for our first example, we will choose Linear Regression and now we will see that features and parameters belonging to the linear model will show up in Model Control. All the parameters have tooltips that will help you understand what each of them are and how they affect your model. They will be already pre-filled with their default values to prevent any errors and help you build them smoothly.

First, you can specify the Forecast out, Test size and Random State values, which are correspondingly how many days in the future you want to predict for, the size of the test dataset to be used on the model building and the seed of the pseudo random number generator that selects a random feature to update.

Next, you can specify if you want to enable Fit intercept and Normalization for Linear regression model. We will select both these features for our example model. You should see a similar model to Figure 10 below.

Once you are satisfied with the changes you made to your model, click the Save button, and you will get a message that will tell you when your model will start building. You will be redirected to the Analysis overview page, where you will immediately see your model having a Pending status. As soon as the model finishes building and the results are ready, you will receive an email notifying you about it.

However, before explaining what information you can get from the Analysis overview page, we will create our next models.

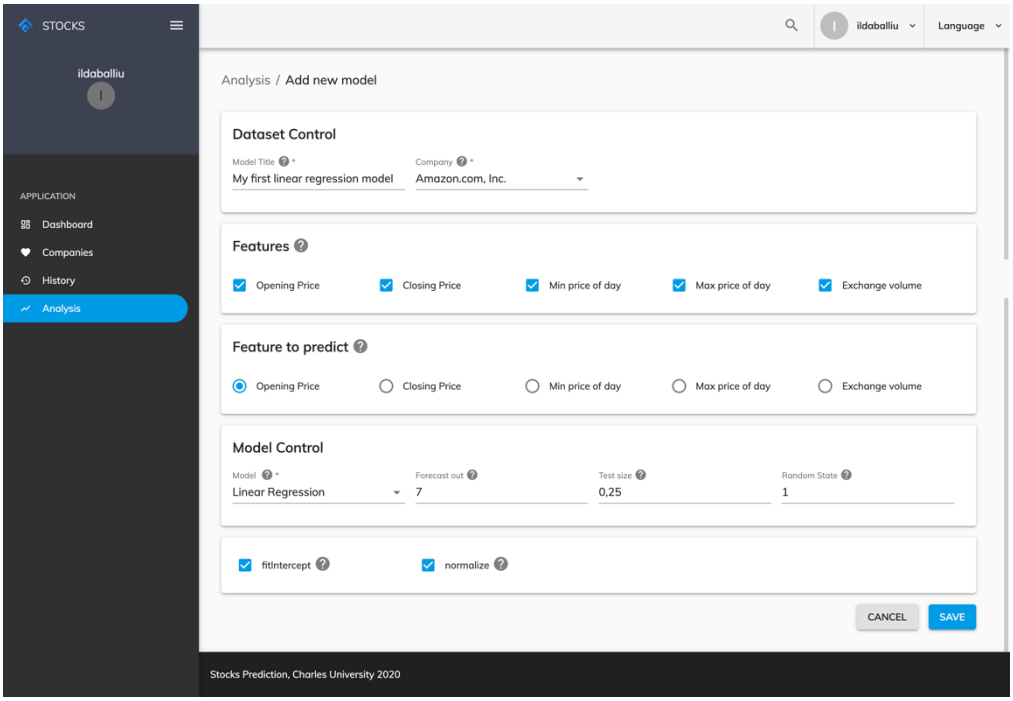

Figure 10: Linear regression model creation

- Decision Tree model

The second example will use a Decision Tree model, and we will tune some of the values. Again, click on the round plus button to go to Model creation view, give your model a name and choose a company in the Data control. For the second example, we will call it 'My first Decision Tree model' and choose Facebook.

In Features, we will keep all of them checked and we will select Closing price in Feature to predict. In the next section, Model Control, we will choose Decision Tree from the list of models and we see that we can tune many more options. We still need to specify the Forecast Out, Test Size and Random State values, for which we will keep their default values.

Next, we have features that belong specifically to the Decision Tree model, for which you can check the tooltips and see how each of them impacts the model. Since we are building a Decision Tree model, an interesting parameter to tune would be Max Depth, which is the depth of the trees, so we will set this to 2048,

and keep the other parameters with default values. Then we click on Save and send the model to be built as in the previous example.

- Recurrent Neural Network with Adam optimizer model

The last model we will build is a Recurrent Neural Network model, applying the Adam optimizer. We will call this model "My first RNN model" and we will select Facebook in Data Control. Then, again we will not uncheck any of the features in Feature control and we will select Closing price in Feature to predict.

In Model Control, we select RNN with adam optimizer from the list of models and since this is a RNN model, batchSize which is the number of samples to be shown to the network before a weight update can be performed, is an interesting feature to tune, so we will set this to 24. Then we can change the scaler to the Robust one in the dropdown and set the drop out value to 0.3. If you want to change any of the other parameters, please feel free to do so, but we will keep the default values for this example. As before, Save the model and it will be built shortly.

Now that we have created our first three models, we can check what information the Analysis page can display. You should have a similar view as in Figure 11 below, where for each model you will see a brief information regarding the models such as the personalized name that you gave your model, the type of the model (Machine Learning model type), the company for which you created the model, the date when you created it and the current status (Created, Pending or Failed).

Moreover, for each model, you will be able to perform two actions: copy and delete the model by clicking on the corresponding icons under Actions. To be able to easily find a model in your list of created models, you can use the filters on top of this list. You can currently filter by model type, company, created date and current status. If you want to remove the filter, just click on the Clear filters button on the right.

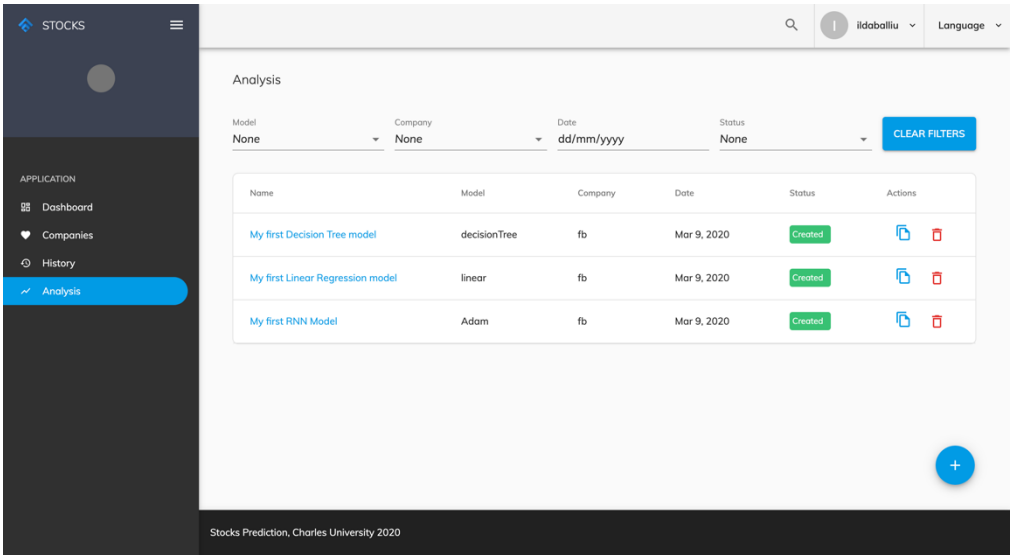

Figure 11: Analysis overview

2.8.1. View model

All three models that we created are already built and you can click on the title of any of them and it will take you to the model view page, where you can see all the details of it and the final results as shown in Figure 12.

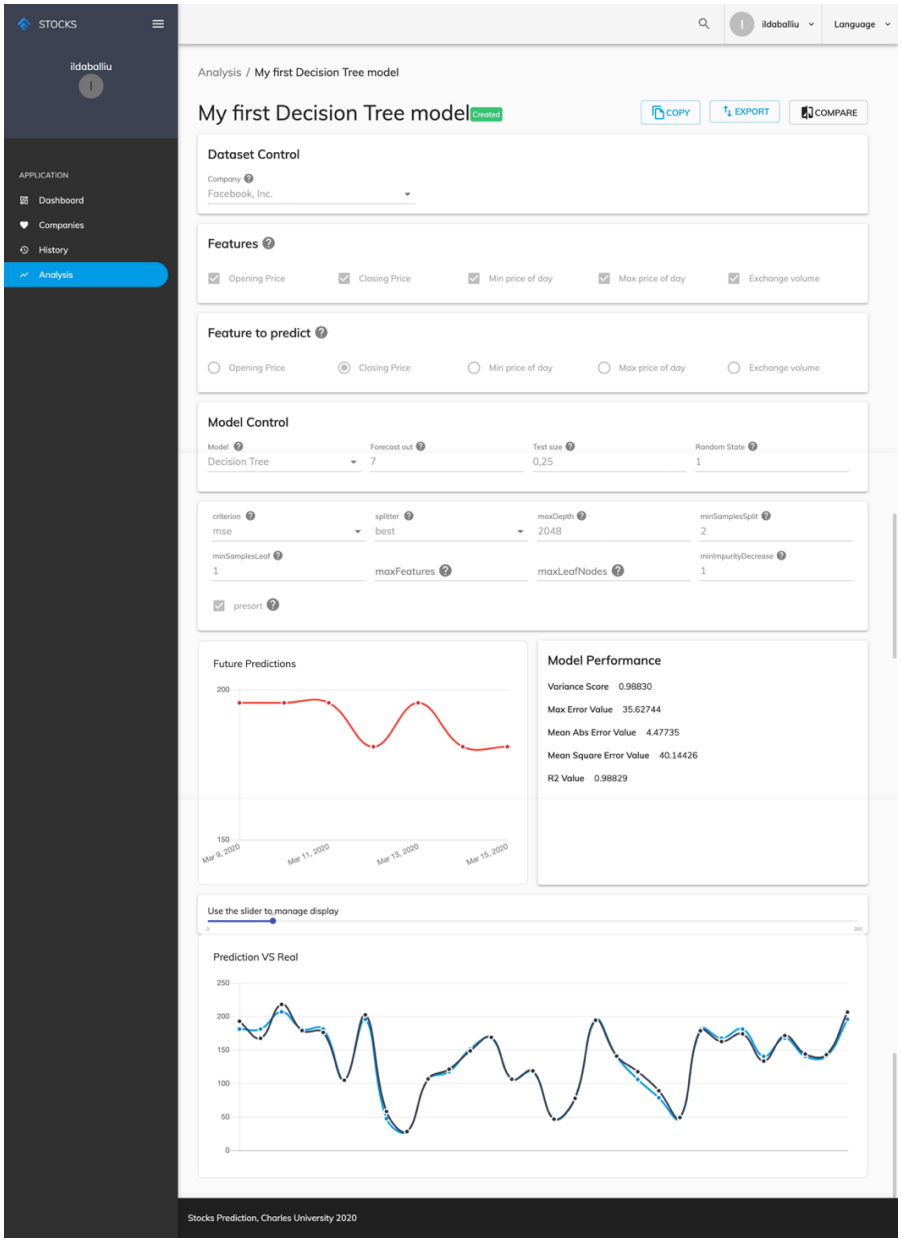

Figure 12: View model

Starting from the top, first you will be able to see the title of your model and its status. On the right, there are three buttons which are explained further later in section 2.8.2., but from there you can copy a model, export it to PDF or compare it to another model that you have created.

Next, you can see in Dataset Control the company that you chose to run your models for, in Features the features that you used in the model and in Feature to predict which was the target feature of your model. In Model Control you can see the model type you chose and its corresponding parameters with the tuned values that you previously chose.

The Future Predictions, Model Performance and Prediction VS Real are the sections that show the results of your model. In the first one, you can see the predicted prices of your tuned model using a dataset with the size of your Test Size value and you will see as many values as the Forecast Out value that you set, Model Performance has simple metrics like Variance and Error values and the chart in Prediction VS Real shows how the feature you predicted, compares to the real ones using validation predictions trained on the training dataset (1 – Test Size) and tested on the remaining dataset . Hovering over the chart line will give you precise information regarding the values and you can use the slider to feed more data to the chart.

2.8.2. Copy, compare, export

The View Model page described in section 2.8.1. offers three more important features:

- You can copy your model.

  Clicking on the Copy button will redirect you to Create Model view described in section 2.8., but your model will be prefilled with the data of the model you copied it from. You can customize it again and send it for re-build. Please note that you will need to give it a different name because the current one is an identifier of your previously created model.

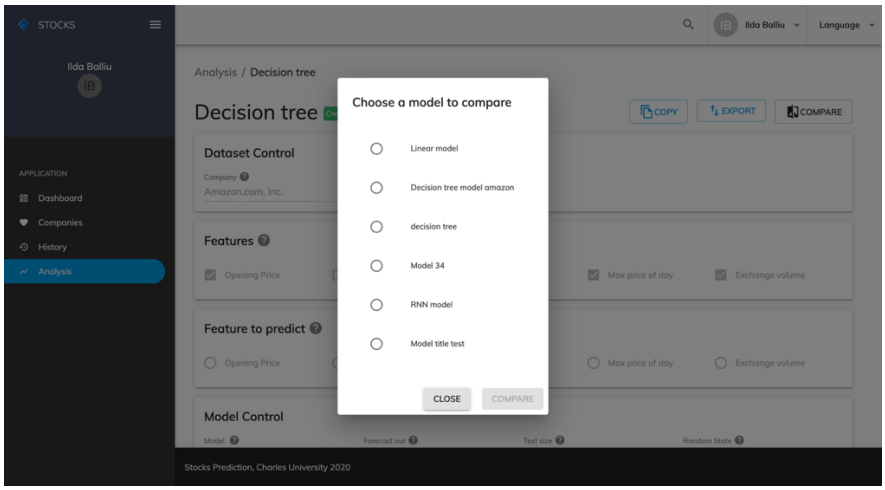

Figure 13: Compare models

- You can compare your model with another one.

  To compare two models by clicking on the Compare button, you first need to choose from the list of your models which one you want to compare the current one to. A pop up will show up once you click on Compare button and you just need to select the model you want to compare it to as shown in Figure 13. If you don't have any other models created already, you will see a button 'Create model' from where you will be redirected to the model creation view. After this step, you will be shown both models next to each other and you can compare and interpret for yourself their results.

- You can export your model to PDF and download it.

  Clicking on the Export button will generate and download a PDF of your model, with all its details: title, status, company, features used, feature you predicted, model type and its corresponding parameters with the values you gave them, Feature Predictions chart, Model Performance metrics and Prediction VS Real chart. The details of each are described in section 2.8.

2.9. Profile

After following the account creation instructions in section 2.5., and logging in as described in section 2.6., you will be able to see and modify your profile information. By clicking on your name/username on the top right of the screen, you will see a dropdown where you have the option to go to My Profile and Logout.

Clicking on My Profile will show you a view like in Figure 14 where there are two main sections: Contact Info and Account Info. Contact info contains the personal information you provided to us, such as your username. It is optional to add your first name and last name and you can update this at any time. In Account Info, you can change your password by putting your current password and the new password you want to have, confirm the password one more time and then click on Update Password. Here you can also delete your account, by clicking on Delete account button which will show you a pop-up message asking you to confirm that you want to delete your account. After this, your account will be deleted permanently and cannot be recovered.

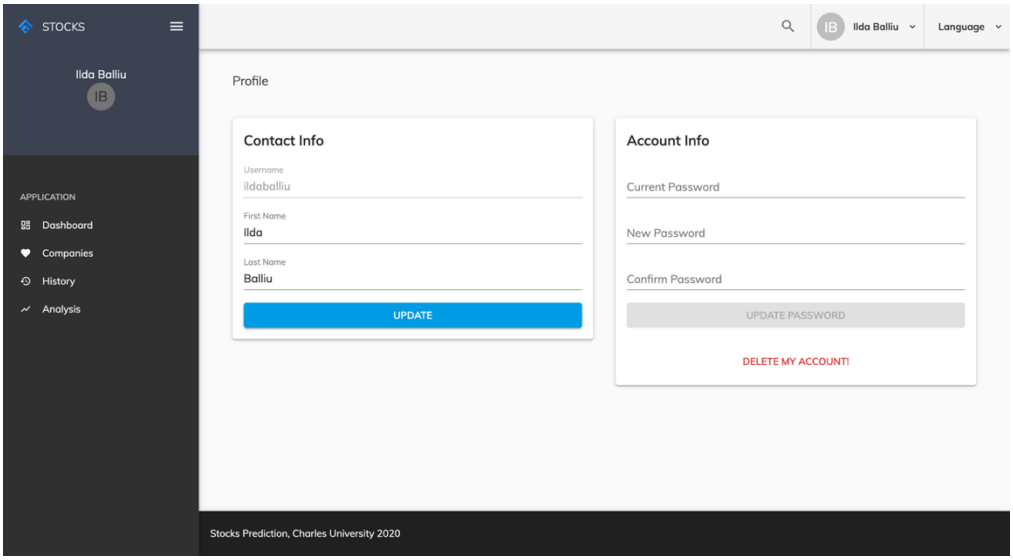

Figure 14: Profile

To Logout, click on your name/username and choose Logout from the dropdown menu. Your session will end you will be redirected to the Dashboard view, described in section 2.1.

2.10. Language

The STOCK application is available in two languages, English and Czech. To change your preferred language, go to the Language menu on the top right and select the one you want the application to display. Figure 15 is an example of the View Model described in section 2.8.1. in Czech language. Please note that none of the students working on this project are Czech speakers, so the translations might not be 100% accurate.

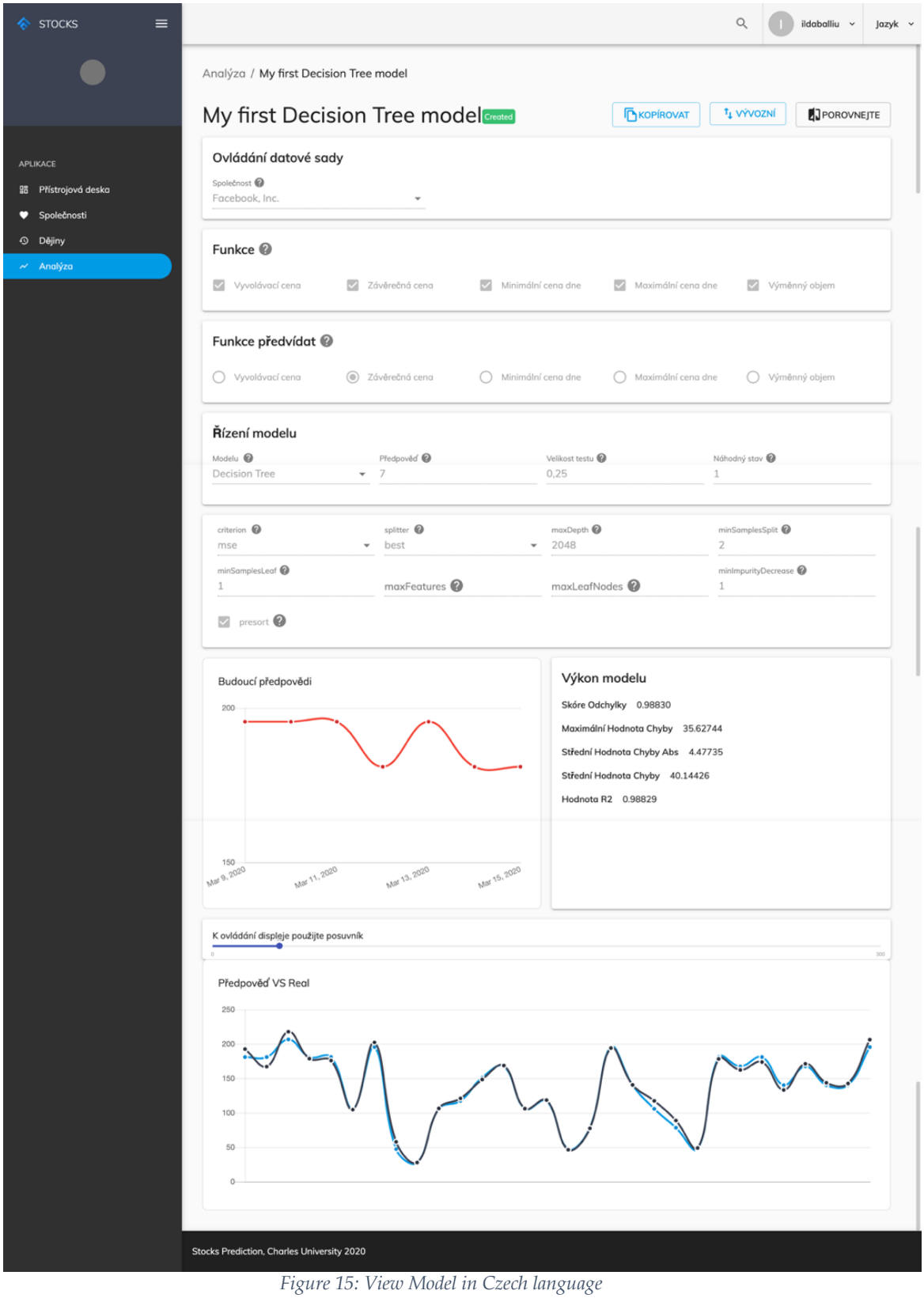

Figure 15: View Model in Czech language