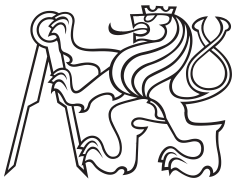
Bachelor Project



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Use of chatbots in website navigation

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Declaration

I hereby declare I have written this work independently and quoted all the sources of information used in accordance with methodological instructions on ethical principles forwriting an academic paper. Moreover, I state that this work has neither been submitted nor accepted for any other degree.

In Prague, 21. May 2019

Abstract

The aim of this thesis is to study, analyze and show the way we can use Artificial Intelligence-based chatbots to create human-like communications with the technology, in our case with web-pages. Oftentimes users waste plenty of time looking for information on the website, so chatbots, powered by AI, can improve users' interaction with websites by serving as a complementary tool for website navigation. This work contains the study of the subject, analysis of the existing solution, proposal of my own solution and user testing to evaluate the benefits of using chatbots for website navigation.

Keywords: Chatbot, Website Navigation, Artificial Intelligence

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Abstrakt

Cílem této práce je nastudovat, zanalyzovat a ukázat způsob, jakým můžeme používat chatboty založené na umělé inteligenci ke zlepšení lidské komunikace s technologií, v našem případě s webovými stránkami. Často uživatelé ztrácejí spoustu času hledáním informací na webových stránkách. Chatboti s umělou inteligencí mohou zlepšit interakci uživatelů s webovými stránkami v podobě doplňkového nástroje při procházení webu. Tato práce obsahuje studium problematiky, analýzu stávajícího řešení, návrh vlastního řešení a testování uživatelů pro vyhodnocení přínosů používání chatbotu při procházení webových stránek.

Klíčová slova: Chatbot, Navigace na Webu, Umělá Inteligence

Překlad názvu: Use of chatbots in website navigation

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Chapter 1

Introduction

With the exponential growth of technology in the modern world, the process of finding and navigating new information is becoming more overwhelming each day.
The brain of the modern generation average representative, that has been raised with the internet, process information differently. Nowadays young people can hardly recall information they received somewhere, but they can easily remember the way to find this information. The pros and cons of influence that technology has on our brain is not the main topic of this thesis, but it should be taken into consideration that technology has a bigger influence on us than ever before. Fortunately, engineers are constantly looking for new ways to solve the issues that we face and one of the core principles is to make technology more user-friendly is the simplification. A big role in simplifying communication with our devices play chatbots and voice assistants. It is human nature to communicate using the voice, and with the expansion of Artificial Intelligence, particularly Natural Language Processing, engineers are able to create bots that can understand human language, the context of conversations and give relevant responses.

The goal of this paper is to study, analyze and demonstrate how chatbots, powered by Artificial Intelligence can change users' communication with webpages and hypothetically simplify it. I have chosen this topic because

a lot of people I know often get frustrated when they need to find some information on a website that they never used before and I was in a similar situation as well, thus it seemed like an interesting problem for me to solve.

In the following chapters, I will go through different aspects of Chatbots and the role Artificial Intelligence plays in their design and implementation, after that, I will describe the steps I had to take for implementing the demo application which demonstrates the use of chatbots as a complementary tool for website navigation and in the end will do usability testing to evaluate the results.

Chapter 2

Familiarization with the topic

In this chapter, we will get familiar with different types of chatbots. We will dig deeper into the history of chatbots, its' definition and different types of their implementation.

2.1 Chatbot concept and history

- **1950** - The year 1950 can be proclaimed the beginning of chatbots' era. It is all started when British computer scientist, Alan Turing, published the article titled as "Computer Machinery and Intelligence", which was the first to introduce his concept of what is now known as the Turing test to the general public.
- **1966** - The first conversational bot was designed in 1966 at the MIT Artificial Intelligence Laboratory by Joseph Weizenbaum. Its' name was ELIZA and it was able to pass restricted During Test. It was based on keyword identification and preprogrammed responses due to the lack of appropriate tools as Natural Language Processing.

- **1972** - Later in 1972, the second significant step was made in chatbot development, the PARRY chatbot was developed. PARRY was an early example of a chatterbot, implemented in 1972 by psychiatrist Kenneth Colby. Instead of single keywords, it used groups of keywords and used synonyms if keywords were not found.

- **1995** - In 1995 The A.L.I.C.E. or Artificial Linguistic Internet Computer Entity was introduced. It was an award-winning artificial intelligence (A.I.) natural language processing chatterbot.

- **2001** - In 2001 Smarterchild was built, in many ways, it was the precursor to Apple's Siri and Samsung's S Voice. By this time Natural Language Processing was already widely used in chatbots and continued its' expansion to the chatbots of 21 century.

- **2010-2015** - Over the next decades, all big tech companies introduced their own chatbots, starting with Siri (2010), Google Now (2012), Alexa (2015), and Cortana in (2015). These bots are able to respond to voice commands, play music, and perform internet searches, among other tasks.

Now, as the reader got familiar with a brief history of chatbots, it is time to give a precise definition of what chatbot really is. The following definition is given by the Oxford dictionary, which in my opinion is the most suitable for this paper.

[Val]

Definition 2.1. "Chatbot is a computer program designed to simulate conversation with human users, especially over the Internet." [Dic]

In other words, Chatbot is a program that interacts with a user through text messages, a virtual assistant that exists within a website, application, smart speaker or instant messenger and helps to get better interactions with technology. Such a bot is an automated system of communication with users.

2.2 Fields of use

Chatbots nowadays have a big potential in every field, but let's have a look at those areas where Chatbots find their best use today according to the knowledge I got after searching the web.

Customer Service and E-commerce
The prime field which benefits from Chatbots is Customer Service and E-commerce. Thanks to their availability to answer queries 24/7, chatbots are set to replace customer service phone lines or search tools for e-commerce sites.

Health
Another significant field where chatbots shine is healthcare. Sometimes it is hard to make an appointment due to lack of a doctor's time and self-help can bring more harm than good. Well taught chatbots can gather needed information and give relevant advice, remind to take medicines and also make appointments with a real doctor if needed. HealthTap is one such app that provides free access to healthcare information and lets users speak to a medical professional.

Productivity
There are plenty of productivity bots that can help you by tracking things, making schedules, automating other things. Slack, for instance, also support Chatbots and they are perfectly integrated into workflow and help their users organize the work.

News and Publishing
With the growth of information amounts and limits of its' consumption media essentially needs more personalization. Due to the high rank of personalization that Chatbots give, it is a great tool for media. A good example of

Chatbots' use in Media is CNN news chatbot.

Entertainment

Chatbots have big perspectives in entertainment due to their ability to simulate someone and communicate with people. They can be great storytellers, entertainers or they can simulate your favourite fictional character, which also helps companies to expand their brand.

Social Tools

Chatbots and AI can even improve conversations between users, operating in the background to give contextual options and activities based on the topic of discussion and they also can create polls, suggest games and make your conversation more interesting in many ways. A good example of this would be a Microsoft Cortana which is integrated into Skype chats.

Dining

A lot of services are trying to make food delivery as easy as possible. Chatbots help to make this process even easier. Big companies like Pizza Hut and Taco Bells have their own Chatbots where you can order food without installing an app.

Travel

Sometimes planning the trip can be very overwhelming. It requires finding the tickets, place to stay, things to do and many more. Chatbots can make this process easier by automating many routine tasks.

In general, Chatbots are useful in any field where it comes to communication with a user. It can automate many tasks that user does and make the process easier, so there are many more areas where chatbots can be used.

2.3 Advantages and Disadvantages of Chatbots

In this section, I will analyze the advantages and disadvantages of Chatbots in general. The assumptions and knowledge presented in this section is an aggregation of information available on the internet and my personal beliefs.

2.3.1 Advantages

The cost effectiveness

Hiring human resources is a big money investment that companies have to do in order to function properly, but for some tasks, automated chatbots can be a good substitute for human resources. Chatbots can handle easy tasks as consulting or booking a room for customers. This is a valid advantage if only the operating costs are lower than the salaries for the employees. I will consider it as an advantage because in my opinion operating costs for chatbots are lower than the salaries for the employees at least in European countries. The greatest advantage of Chatbots over humans in this area is that Chatbots can run without a stop and do not need to get paid.[fi]

Response time

Another great advantage of using chatbots is quick response time. Chatbots provide responses within a couple of seconds, comparing to people it is a really good result. Also, customers do not have to wait in a queue until the assistant will get to them, in the case of chatbots each customer has its' own assistant living in their browser window. [fi]

Availability

With the use of Chatbots, companies are able to constantly be in touch with their customers, which can increase the loyalty of their clients. The virtual assistants can work without a stop for years and do not need off time.

2.3.2 Disadvantages

The Lack of Deep Understanding

The first problem that users face when they are communicating with a chatbot is their inability to understand some implicit meaning that humans tend to put into words. Although chatbots can perfectly deal with a well-constructed question with clear intent, it is much harder for them to deal with irony, sarcasm or humor. This problem can be partially solved with the improvement of Artificial Intelligence which powers these conversations, but for now, it is not advanced enough to understand human language in full spectrum.[fi]

Improvisation Incapability

Another problem with Chatbots is that they can perform well while a conversation does not leave the reach of a preprogrammed algorithm. Unfortunately, it is impossible to predict all conversation scenarios and preprogram them, so developers create leading questions to get a user to the right conversation flow. If a user answers leading questions incorrectly, a chatbot will continue repeating these leading question and will leave customer annoyed and angry. [fi]

Not for Every Field

As it was mentioned earlier Chatbots are a good solution for companies, whose customers behave predictably. It can be such services as food delivery, hotel booking, taxi, or any other service where customers need to get some information or accomplish an action.

However, there are many things for which chatbots are not good enough yet. In some cases, companies need to provide an individual approach to their customers to keep them satisfied, and in some cases, the quality of service provided is more important than the number of clients. That is the main reason why some companies prefer humans to do this job.

[fi]

2.4 Types of chatbots

In this section, I would like to take a closer look at different types of chatbots and their differences.

2.4.1 Menu/Button-Based Chatbots

The basic type of chatbots is menu/button-based chatbots. These chatbots are based on decision tree hierarchies presented to the user in form of buttons. A user is required to make several selections by choosing the buttons that will lead to the answer. This type of chatbots is good for answering frequently asked questions and are the easiest for implementation, but when scenarios are getting more complex with more variables and it is harder to predict how a user will react, these chatbots usually fail.[Phi]

2.4.2 Keyword Recognition-Based Chatbots

Another advanced type of chatbots is keyword recognition based chatbots. Their main difference is that they can listen to what users type, recognize the keyword and give an appropriate response based on this input. These chatbots use Artificial Intelligence to determine how to serve an suitable response to the user's questions.[Phi]

2.4.3 Contextual Chatbots

The most advanced type of chatbots these days are contextual chatbots. In addition to Natural Language Processing and Natural Language Understanding, they also utilize another branch of Artificial Intelligence known as Machine Learning. It helps chatbots to remember conversations with specific users and learn from these conversations, gather data and improve automatically over time. This feature dramatically improves communication with a chatbot, as it shortens the time of conversation and makes interaction easier as soon as bot starts to understand users' needs. In the next chapter, I will cover the branches of Artificial Intelligence that are mostly used in intelligent chatbots [Phi]

Chapter 3

Artificial Intelligence related to contextual chatbots

3.1 Conversational Artificial Intelligence

Let's start with a definition of Artificial Intelligence. In my opinion, this definition is the most suitable from the topic I cover in this chapter and was the most accurate among definitions I found during my research.

Definition 3.1. "Artificial Intelligence, or AI, is the field that studies the synthesis and analysis of computational agents that act intelligently." [PM10]

In this context, an agent is perceived as something that does something in an environment. It can be anything from airplanes to humans, any object that acts in some way. In this work, we are interested in the action itself, so what an agent does is the main focus, because we judge an agent by its actions.
We can call agent intelligent when:

- what it does is appropriate for its circumstances and its goals, taking into account the short-term and long-term consequences of its' actions.
- it is flexible to changing environments and changing goals
- it learns from experience
- it makes appropriate choices given its perceptual and computational limitations.

Definition 3.2. "A computational agent is an agent whose decisions about its actions can be explained in terms of computation." [PM10]

In other words, the decision can be broken down into primitive operations that can be implemented in a physical device.
[PM10]

3.1.1 Natural Language Processing

There are plenty of branches of Artificial Intelligence out there but in this thesis, we will exclusively cover Natural Language Processing, because it is highly related to Intelligent Chatbots.

Definition 3.3. "Natural Language Processing is the ability of a computer to process the same language - spoken or written - that humans use in normal discourse." [Pro91]

From the research point of view it is defined as follows.

Definition 3.4. "Natural Language Processing is the field of study within cognitive science which deals with linguistic behavior" [Pro91]

For AI research, Natural Language Processing is viewed in the context of discovering what intelligence is and how it can be embedded into a computer.

There are three issues that need to be resolved to make a computer process the same language input that people use in communication:

- What are the levels of structure for an NLP system? To resolve this issue NLP is broken down into nice components with a clearly defined functionality,
  an idealization of sorts.
- How do they interact? To resolve this issue each component is assigned an information processing task depending on what aspect a particular theory emphasizes,
  a prioritization of sorts.
- What formalisms are used to model that interaction and its outcome? To resolve this issue, computational concerns determine how the particular system based on a given approach is best implemented,
  an optimization of sorts.

The five components that are essential in linguistics are morphology, syntax, sound level, semantics, and pragmatics. These components are represented in Natural Language Processing systems as levels of structure.
There are three different schools of thought that promote approaches to NLP systems:

- The traditional linguistic approach that aims at determining the details of sentence structure based on a grammar.
- The AI approach that aims at modeling language according to Appropriate knowledge representations
- The connectionism approach that aims at modeling language according to neural network algorithms.

These strategies differ as to what role the different NLP components have, what the analysis level of NLP should be, how language is viewed in general, and what significance is given to the computer program manipulating Natural

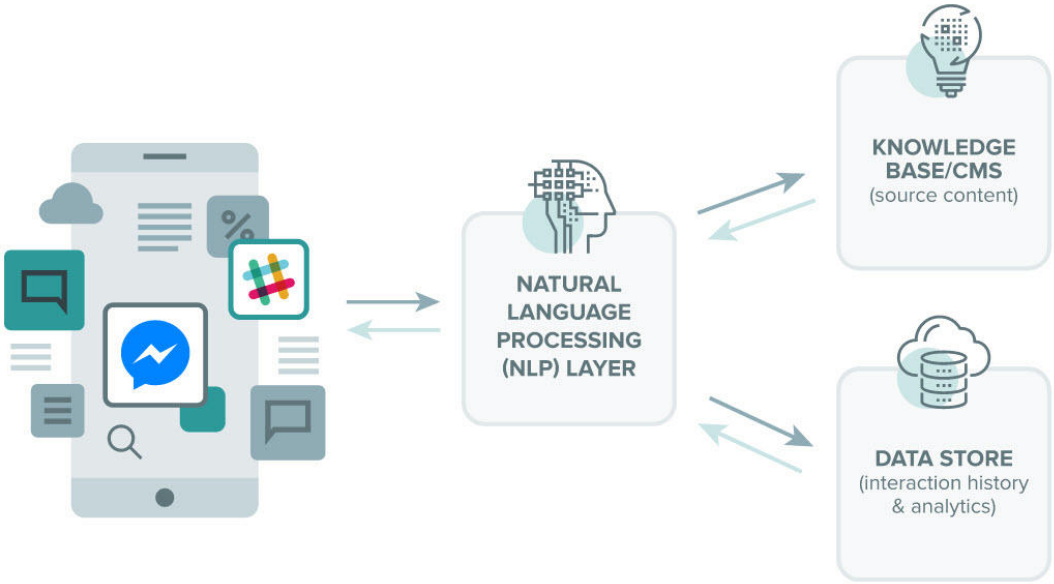

Figure 3.1: Use of NLP in Chatbots [Bot]

Language.
[Pro91]

So why do we need Natural Language Processing in chatbots? To put it simply, NLP makes communication easier and more natural for the user, therefore it attracts more people and makes technology more useful and attractive for businesses and for users in general. The role that NLP plays in Chatbot implementation is shown in figure 3.1.

3.1.2 Natural Language Understanding

Definition 3.5. "Natural language understanding (NLU) is a branch of artificial intelligence (AI) that uses computer software to understand input made

in the form of sentences in text or speech format [Rou]

Natural Language Understanding(NLU) is a subset of Natural Language Processing(NLP), which also focused on understanding human language. The difference between Natural Language Processing and Natural Language Understanding is that NLU is dealing with untrained individuals and focuses on understanding their intents from the input. Natural Language Processing is also capable of understanding human mistakes like misspellings and mispronunciations.

> NLU uses algorithms to reduce human speech into a structured ontology. AI fishes out such things as intent, timing, locations and sentiments. [Rou]

The prominent focus of NLU is to create chatbots which are able to effectively communicate with untrained people - regular users. There are many big companies that are working on NLU including Google, Apple, Microsoft, IBM, Amazon, etc. [Rou]

3.2 Machine Learning

Definition 3.6. Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves [Sys]

Machine Learning is a branch of Artificial Intelligence which focuses on automatic learning without any human interference. For learning purposes, Machine Learning algorithms observe data, look for patterns to make better decisions in the future based on the examples that were provided.

Although Machine Learning enables to process big amounts of data, it also requires a lot of time and effort to train it properly. [Sys]

In this chapter, I covered the principles of Artificial Intelligence that are mostly used in intelligent chatbots. In the following chapters I will take a closer look at the services that lets developers use these principles in their applications and chose the one for my application.

Chapter 4

Use of chatbots for webpage navigation

This chapter is an introduction to the problem that is the main topic of this thesis - the use of chatbots as a complementary tool for website navigation. In future chapters, it will be opposed to traditional website navigation. By traditional navigation, I mean website navigation which uses graphical user interface as the main tool for users' interaction with the website through graphical icons and visual indicators. To some extent, a chatbot can also be called a graphical user interface, but in the context of this paper, I oppose it to the traditional user interface since it mainly uses users' text input, processes it and displays relevant information.
In this chapter, I will describe the problematics which are the main focus of this paper and will analyze existing solutions.

4.1 Problematics

With the rise of internet usage average person consumes more information per unit of time than ever before. Websites are designed to be more user-friendly and UX designers are working on placing right information in the right place

to make it more readable and easier to navigate.

Even though proper website design and content distribution made some success in making websites user-friendly, many users are still frequently getting lost in the massive amount of content. The frustration of users that cannot easily find the information they need may result in dissatisfaction of customer, wrong understanding of content and users' disappointment in website or service they use. Also, it is harder to predict how a user will navigate the website and harder to understand users' needs. Deep understanding of users' needs can result in proper ad placement and higher user satisfaction, which brings more customers.

4.2 Solutions

The good solution for this problematics is a Chatbot named Alex developed by Intellexer which is shown on figure 4.1. This chatbot can help users with information about one of their products — Intellexer Summarizer. The product has its own website. Intuitively it's not always clear what this or that function may perform, what complicated terms mean, what the difference between similar products is, or how to get a discount, etc. Chatbot perfectly handles such queries, providing users with short answers or redirecting them to the pages they are looking for. Alex mainly works as a customer support and also helps people navigate the webpage. Many Chatbots, described in previous chapters, have the same concept. Even though its' aim is to help users navigate the website and give them relevant information its' main purpose is to answer questions and explain things that can be misunderstood. [Int]

During my research, it was hard to find a solution that concentrates exclusively on these problems, which means that this particular scenario of chatbots' use is not the most popular. In the next Chapter, I will introduce my own way of using chatbot particularly as a complementary tool for website navigation and the evaluation of the possible benefits will be taken at the end of this paper.

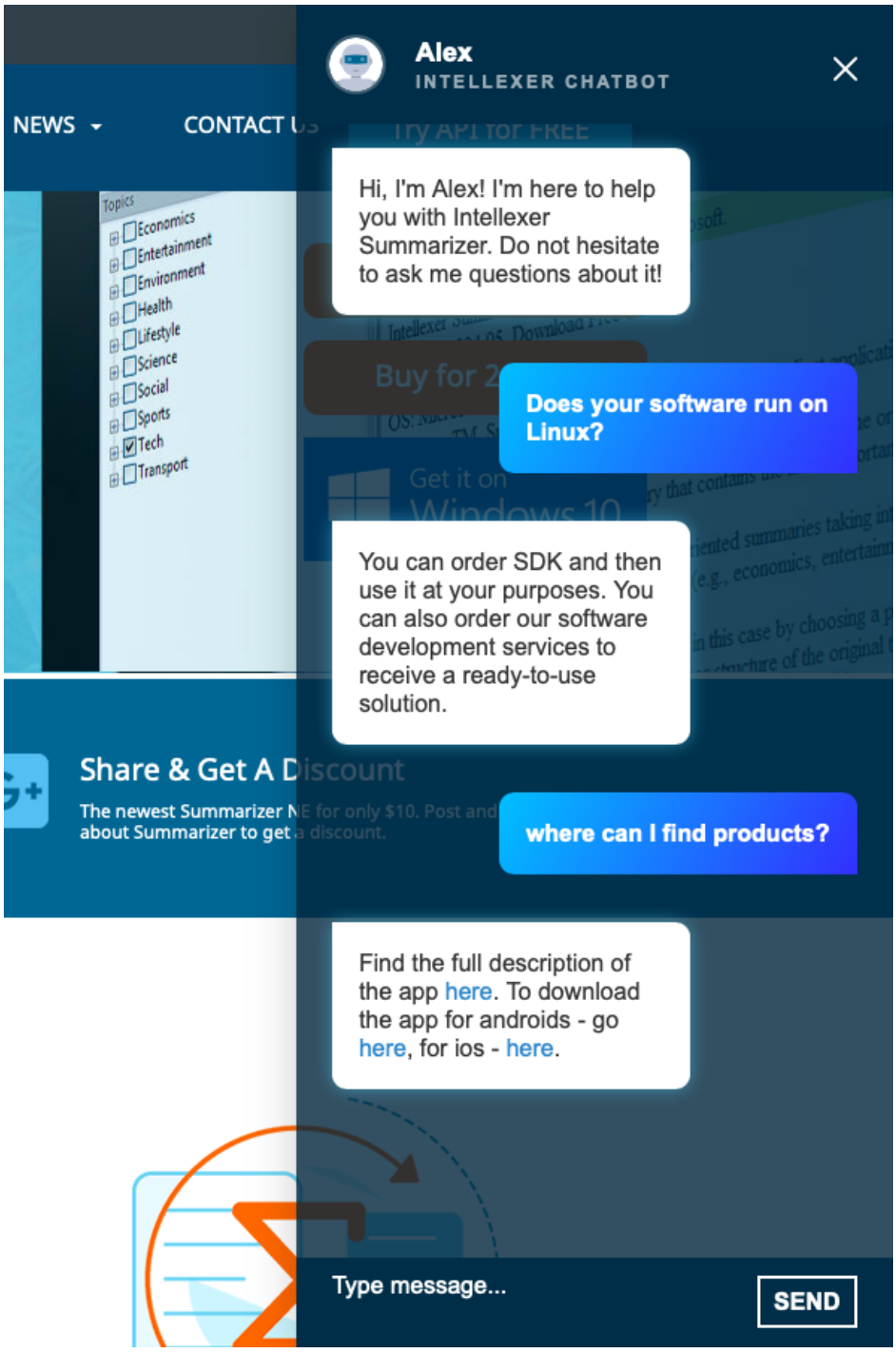

Figure 4.1: Example of communication with Alex [Int]

Chapter 5

Demo Application

In the following chapters of my thesis, I would like to introduce my solution to the problem I described in the last chapter of the theoretical part. Also, I will do a comparison between the existing state (traditional navigation with a searchbar) and my solution.
The comparison will take a form of user testing and further evaluation of steps user need to take to achieve a pre-described goal and overall user satisfaction with a process of looking for information with these 2 ways. This part consists of 3 big chapters. In the beginning, I will compare different services that let us work with Artificial Intelligence. The second chapter is the introduction, where I will describe the output of this work and the reasons behind this kind of implementation and the implementation itself, where I will dig deeper into the process of creating the front-end and back-end for my demo application and integration of Watson Assistant into my app. Also, I will describe the use cases that we choose for demonstration and testing purposes and the process of training Watson Assistant for these particular purposes. This chapter will be followed by the user testing section, where I would evaluate the benefits of using chatbot as a complementary tool for website navigation by comparing the results of users using my application and original FEE webpages. The next will be the evaluation of results which will tell us if using chatbot really is beneficial or not. After that, the conclusion will follow.

5.1 Motivation

During my first year of study in this faculty, I often was frustrated and couldn't find the information I needed on the webpage, so I was writing emails to Study Office, and the most frequent answer was a link to a specific webpage on FEE website. In this work, I wanted to demonstrate that modern days chatbots that use natural language understanding are able to do the same job. They can ask questions, understand user intents and redirect users to the relevant pages. Adding a chatbot to the web page has the potential to increase web page usability. There are many areas where chatbots can be useful but in this thesis, I decided to use the FEE webpage for demonstration how this way of navigation can solve problems that I was facing being a freshman.

Chapter 6

Analysis of existing frameworks

Implementing Artificial Intelligence can be a hard task to accomplish. Nowadays every developer can integrate Artificial Intelligence into their applications with the help of Application Programming Interface. Thanks to these frameworks, developed to improve the work with Artificial Intelligence, more applications start using AI, as it makes apps more intelligent and easy to use. In this chapter, I would like to cover 4 frameworks that are currently used the most according to Techworld.com.

6.1 Wit AI

One of the most popular frameworks that are currently used is Wit AI 6.1 that was developed by Facebook. It lets developers use Conversational Artificial Intelligence in Facebook chatbots. Also, developers can integrate Wit into their applications using one of the official clients or the HTTP API.
Wit uses Natural Language Processing to understand user input, recognizes user intents and gives relevant responses that were pre-programmed by the developer.

After that developers can get these answers through API and use in their application.

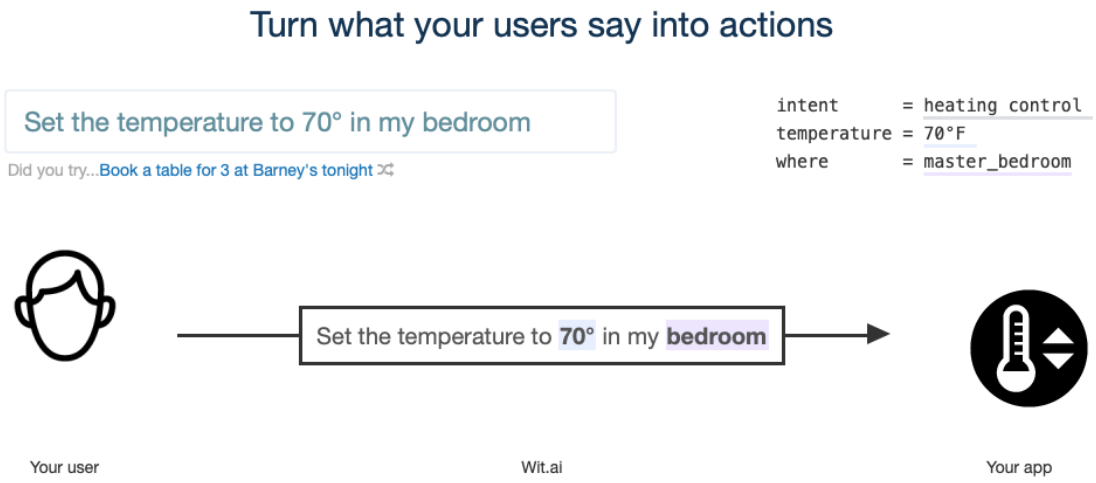

Figure 6.1: Intent and entity recognition scheme [Wit]

To turn user input into an action developer has to accomplish 3 easy steps:

1) Get or create a command. It can be easily done with Wit toolkit, which is available on their website, where developers can either create their own commands or use an existing command from Wit community.
2) Make a request as shown on figure 6.2.

Figure 6.2: JavaScript request example [Wit]

3) Use response in the application.

This is a brief introduction to the Wit AI framework, which has many extra options. More information you can get at their official website www.wit.ai [Wit]

6.2 Google Dialogflow

Even though The Dialogflow (formerly Api.ai) was bought by Google only in 2016, it now has a big potential. Dialogflow matches the input to the most suitable intent, based on information contained in the intent (examples, entities used for annotations, contexts, parameters, events) and the agent's machine learning model. Dialogflow transforms the text input into actionable data and returns output data as a JSON response object. Available SDKs are Android, iOS, Cordova, HTML, JavaScript, Node.js, .NET, Unity, Xamarin, C++, Python, Ruby, PHP, Epson Moverio, Botkit, and Java. Brazilian Portuguese, Chinese, English, Dutch, French, German, Italian, Japanese, Korean, Portuguese, Russian, Spanish, and Ukrainian are the languages Dialogflow can support. The tremendous amount of people that use Google Services and amount of Data Google collects enable the company to develop a very personalized experience with their chatbots because they can use this data and adapt to the user. Dialogflow also includes an analytics tool that

can measure the engagement or session metrics like usage patterns, latency issues etc. [Dia]

6.3 Microsoft Bot Framework

Microsoft Bot Framework is a platform that helps developers to integrate their bots to many platforms. The bot itself is created with the use of SDK called Microsoft Bot Builder. Another Microsoft service which is related to Chatbots is LUIS NLP system, which lets developers to use NLP in their applications. MS Bot Builders support many programming languages and platforms, including .NET and C, which makes it the best option for many enterprises. All connections between Microsoft Bot Framework and other services are easily made through their website. The big amount of languages supported, and the ability to run on many platforms make MS Bot Framework one of the most successful framework for building a chatbot. [Chu]

6.4 IBM Watson

IBM Watson™ Assistant is a bot platform developed by IBM which lets developers create bots for their needs and deploy them across multiple channels.

6.4.1 How it works

Figure 6.3 shows the overall architecture:

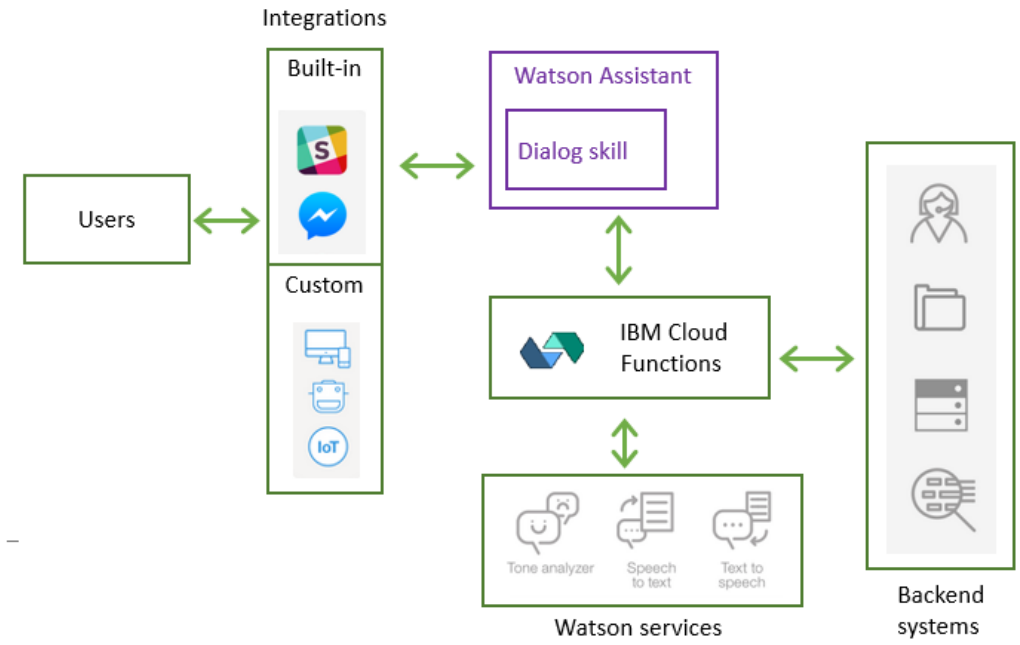

Figure 6.3: IBM Watson component diagram [IBMa]

1) Users interact with the assistant through one or more of these integration points:

- A chat bot that you publish directly to an existing social media messaging platform, such as Slack or Facebook Messenger.
- A simple chat bot user interface that is hosted by IBM Cloud.
- Custom application that you develop, such as a mobile app or a robot with a voice interface.

2) The assistant receives user input and routes it to the dialog skill.

3) The dialog skill interprets the user input further, then directs the flow

of the conversation and gathers any information that it needs to respond or perform a transaction on the users' behalf. [IBMa]

6.5 Comparison table

The information in table 6.1 and 6.2 is taken from the comparison table made by datamonsters.com. It gives a brief overview of features and programming languages supported by different frameworks we discussed in this Chapter.

Chatbot	Features	Programming languages / Apps / Integration	Clients/Fields	Technical details
Microsoft Bot Framework	Understands the user's intent. To give your bot more human-like senses, you can incorporate LUIS for natural language understanding, Cortana for voice, and the Bing APIs for search.	Bot Builder SDK (.NET SDK and Node.js SDK.) Bot Connector Developer Portal Bot Directory	Is used to build and deploy high quality bots	The framework provides the Direct Line REST API, which you can use to host your bot in an app or website.
Dialogflow	Dialogflow matches the query to the most suitable intent based on information contained in the intent (examples, entities used for annotations, contexts, parameters, events) and the agent's machine learning model. Dialogflow transforms the query text into actionable data and returns output data as a JSON response object. Leverage predefined knowledge packages collected over several years.	SDKs: Android iOS Cordova HTML JavaScript Node.js .NET Unity Xamarin C++ Python Ruby PHP (community supported) Epson Moverio Botkit Java	Conversational Platform for bots, applications, services, and devices.	-

Table 6.1: Frameworks comparison [Dat]

Wit.ai	Allows to use: Entities Intents Context Actions Natural Language Process (NLP)	Node.js client Python client Ruby client On other platforms: HTTP API	Used by over 65,000 developers to build applications and devices that you can talk or text to.	Is available for developers to use with iOS, Android, Windows Phone, Raspberry Pi, Python, C and Rust. JavaScript plugin.
IBM Watson	Built on a neural network (one billion Wikipedia words). Has three main components: Intents, Entities, Dialog	Node SDK Java SDK Python SDK iOS SDK Unity SDK	Healthcare, Finance, Legal, Retail, Fantasy Football	-

Table 6.2: Frameworks comparison [Dat]

All of the solutions described in this chapter would be suitable for my application, but for the implementation, I decided to use IBM Watson Assistant service, because for me it appeared more straightforward and easy to use.

Chapter 7

Implementation

For the demonstration purposes, I have decided to implement an application, that imitates the original FEE website and uses a chatbot as a complementary tool for website navigation. This application has restricted functionality to pre-defined use cases that will be covered in the following chapters and does not provide the full range of information, that original website provides. The reason behind it is that this application is meant to be a demonstration of how chatbots can improve our interaction with websites.
The diagram shown in Figure 7.1 gives a summary of the application that I implemented for my thesis. It will be described deeper in following chapters dedicated to the implementation of particular parts of the application.

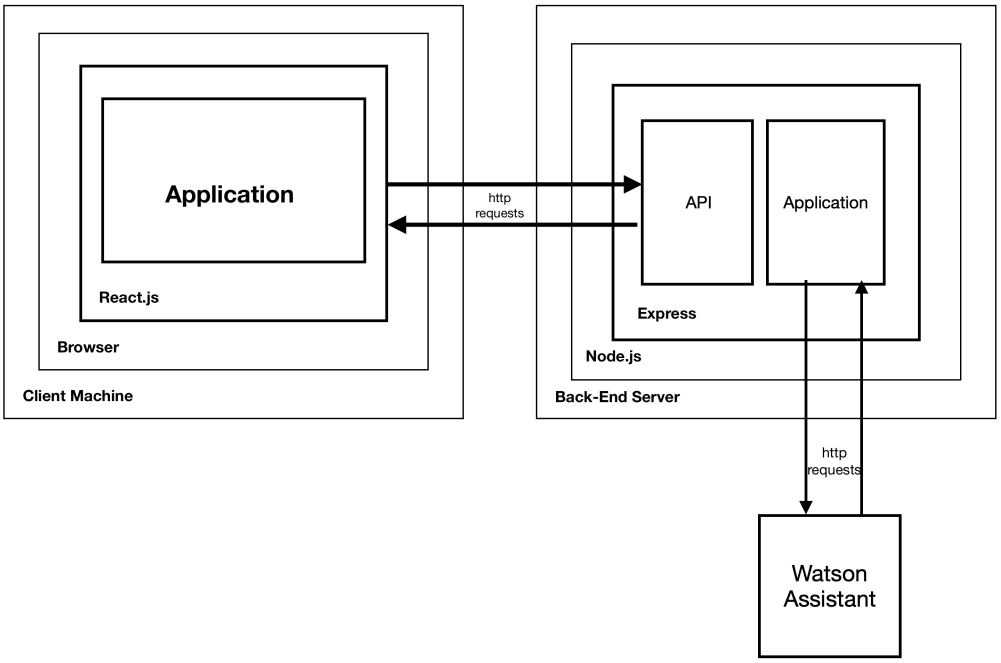

Figure 7.1: Application infrastructure

There are a few different reasons why this implementation proved itself as the most optimal solutions among the others. The first thought which came to my mind when I was thinking about implementation is to integrate the chatbot to existing pages, but this idea was not really considered since I don't have access to FEE website source code and no idea of how it was implemented. The other option was to make a chatbot without integration with any website, but it does not really fit the purpose of this work, which was to demonstrate how chatbots can serve as a complementary tool for website navigation and be used with the classic user interface at the same time. So the most optimal solution, that corresponds with the goals that were defined for my work, turned out to be the implementation of an application that looks like a FEE website and has a chatbot integrated into it, which is intended to improve the user experience.

7.1 Demonstrational Use Cases

To demonstrate the use of chatbots as a complementary tool for webpage navigation and conduct the testing I defined a few use cases which will serve as a base for implementation. Covering all use cases that original FEE website provide was not a priority for the goals defined in this paper. The use cases are meant to be the same for my application and for original Web Pages so that on the basis of this use cases we could create Task scenarios and compare user actions for particular use case.

7.1.1 General questions

Besides being able to understand a list of intents for the use cases that I will define in this chapter the chatbot is able to understand basic intents like request generic personal attributes, request capabilities of the bot, end the conversation, greet the bot, ask if speaking to a human or a bot, etc. In this context, the word "intent" is understood as an intention of a user visiting a webpage. It can be users' will to find some information or any other form of users' needs, but in the section called "IBM Watson training process," I will describe what word "intent" means in the context of a chatbot training process. In my application when chatbot recognizes intents that are connected to its' capabilities or description it answeres "I am a demo assistant for showcase purposes, you can ask me anything related to pre-defined use-cases described in the thesis". When user greets the chatbot, it greets him back. When a user finishes the conversation, the chatbots says "bye". When the chatbot can not understand a user's intent, it redirects him to Study Office.

7.1.2 Use case 1: A user wants to get information about the admission process to the faculty

The first use case that I have chosen for implementation is the case when someone is willing to find information about the admission process to the faculty. The chatbot is implemented in a way that it specifies what degree this person is interested in and when needed information is collected it gives a relevant answer and redirects the user to the webpage with the admission process for a specific degree

7.1.3 Use case 2: A user wants to get information about important dates in the academic year

The second use case is intended for people that are looking for information that can be found in a timetable. The chatbot is implemented to understand that user wants to know about a particular date and once it understands this intent it will respond and redirect the user to the timetable webpage.

7.1.4 Use case 3: A user wants to get information about exchange programs to specific country

The third use case is for the students that want to know everything about exchange programs. As long as not all programs are intended for both bachelor and master programs, the first thing that chatbot does is it specifies the degree on which student is studying. Then chatbot asks which country does the student want to go, suggest the appropriate program for specified country and degree and redirects user to the right page.

7.1.5 Use case 4: A user wants to get information about the credit system in the faculty and requirements that he has to meet to successfully finish the semester

The fourth use case is primarily for the students that are already studying in the faculty, but they want to find accurate information about the credit system in the faculty and the requirements they need to meet to successfully finish the semester

7.1.6 Use case 5: A user wants to get information about the personal study plan

The fifth use case is in some way connected to the previous one. This use case is meant for people who are looking for an individual study plan. The reasons might be different, so the role of the chatbot is to understand this intent and redirect to the right page.

7.1.7 Use case 6: A user wants to get information about the possibility to attend classes in English when studying Czech program

The sixth use case describes a situation when a student, who studies in the Czech language wants to know if he can attend classes in English and all rules and restrictions related to this topic. The main goal of the chatbot is to understand this intent based on user input.

7.1.8 Use case 7: A user wants to get information related to transferring from another school or faculty to FEE

The seventh use case is for a situation when a student, who previously studied in another faculty or university, wants to get all related information about transferring to the FEE and grades recognitions

7.1.9 Use case 8: A user wants to get information related to scholarships

The eights use case is based on entity recognition instead of intent recognition. Once the user asks about scholarships or something related to scholarships chatbot specifies the degree user is interested in and redirects him to relevant page

7.2 Application

This section is dedicated to the implementation of the application that showcases the use of chatbots as complimentary tool for website navigation. The section is divided into 4 parts: description of the application, implementation of front-end, implementation of back-end and integration with Watson Assistant service. In following subsections I will briefly describe the technologies I used for implementing this application and the way back-end, front-end and Watson Assistant are connected.

7.2.1 Description

As was mentioned in previous chapters, the application that I implemented for this work is an app, that imitates FEE website and has some added functionality - an assistant that helps to navigate on the website. The main goal of this work was to compare website navigation using traditional graphical user interface with navigating using a chatbot and evaluate the results, therefore the application does not have all the content, that original FEE website has, and some of the pages that are not related to use-cases that I defined in the previous section are disabled.
The chatbot in my application looks like a dock with a fixed position at the bottom of a screen, it overlays other content on each page and is always present for the user. It has a minimalistic design and has an input field, "submit" button and response field. The screenshots are shown on figures 7.2 7.3 7.4 and 7.5

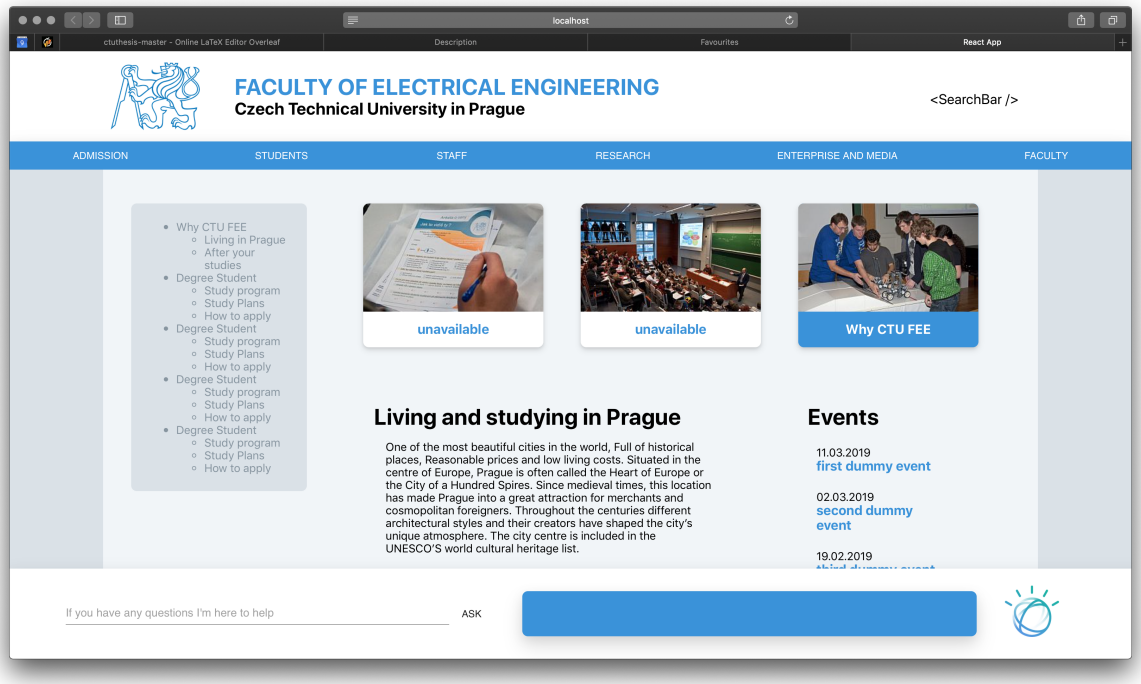

Figure 7.2: Application screenshot

Figure 7.3: Chatbot screenshot 1

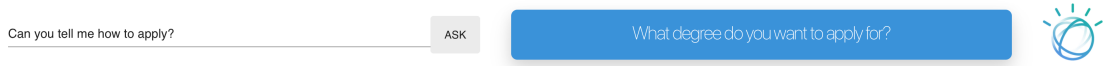

Figure 7.4: Chatbot screenshot 2

Figure 7.5: Chatbot screenshot 3

7.2.2 Front-end

The React.js framework was chosen for front-end implementation in pair with MobX which served as a state management solution. MobX takes an Object Oriented approach to state management which I was familiar with and it served as the main reason to choose this technology.
Front-end is implemented as a Single-Page Application.

> Single-Page Applications (SPAs) are Web apps that load a single HTML page and dynamically update that page as the user interacts with the app. [Was]

The reason is that it lets easily change the content of a webpage by rerendering only particular components of a page without loading any additional HTML files. This solution appeared reasonable for me, as it serves well for dynamic change of webpage content during interaction with a chatbot.

7.2.3 Back-end

The back-end of the application is implemented in Node.js. In this application, the back-end is used only for passing messages between front-end and Watson Assistant service. The reason behind choosing Node.js is that IBM has Watson Node.js SDK that lets easily integrate Watson services into Node.js application. Because back-end was not the main focus of this work I used back-end implementation from example application on Watson developer cloud as a base for my back-end and integrated it into my application. The project, which served as a base for back-end of my application can be found on *https://github.com/watson-developer-cloud/assistant-simple*

7.2.4 Integration with Watson Assistant

The first thing to do when we are initializing conection to IBM Watson Assistant Service is to get session Id. For getting session id on the client side I am sending request to back-end by calling endpoint that returns session id obtained from Watson Assistant service. The code is shown on figure 7.6

```
getSessionId = () => {
  axios.get('http://localhost:3002/api/session').then( (res) => {
    this.sessionId = res.data.session_id
  })
}
```

Figure 7.6: Getting session id on front-end

On back-end a request needs to be sent to IBM Watson using their API for Node.js to obtain session id. The code is shown on figure 7.7

```
app.get('/api/session', function (req, res) {
  assistant.createSession({
    assistant_id: process.env.ASSISTANT_ID || '{assistant_id}',
  }, function (error, response) {
    if (error) {
      return res.send(error);
    } else {
      return res.send(response);
    }
  });
});
```

Figure 7.7: Get session id on back-end

After we have session id and configuration on back-end is set we can start sending messages to IBM Watson from client side by calling the endpoint on back-end. The code is shown on figure 7.8

```
sendUserInput = (userInput: string) => {
  console.log(this.sessionId)
  axios.post('http://localhost:3002/api/message', {
    session_id : this.sessionId,
    input: {
      message_type: 'text',
      text: userInput
    },
    context: {
      global: {
        system: {
          turn_count: 1
        }
      }
    }
  }).then(res => {
    if (res.data.output.generic[0]) {
      this.watsonResponse = res.data.output.generic[0].text
      if (res.data.output.generic[1]) {
        this.watsonResponse = this.watsonResponse + ' ' + res.data.output.generic[1].text
      }
    }
  })
}
```

Figure 7.8: Sending user input on client side

After the endpoint is called we form request on back-end and send request to IBM Watson. After we recieve the response we send it back to client side. The code is shown on figure 7.9

```
// Endpoint to be called from the client side
app.post('/api/message', function (req, res) {
  var assistantId = process.env.ASSISTANT_ID || '<assistant-id>';
  if (!assistantId || assistantId === '<assistant-id>>') {
    return res.json({
      'output': {
        'text': 'ASSISTANT ID is missing'
      }
    });
  }
  var contextWithAcc = (req.body.context) ? req.body.context : newContext;

  if (req.body.context) {
    contextWithAcc.global.system.turn_count += 1;
  }
  var textInput = '';
  if(req.body.input) {
    textInput = req.body.input.text;
  }
  var payload = {
    assistant_id: assistantId,
    session_id: req.body.session_id,
    context: contextWithAcc,
    input: {
      message_type : 'text',
      text : textInput,
      options : {
        return_context : true
      }
    }
  };
  // Sends the input to the assistant service
  assistant.message(payload, function (err, data) {
    if (err) {
      return res.status(err.code || 500).json(err);
    }
    return res.json(data);
  });
});
```

Figure 7.9: Sending user input to IBM Watson

7.3 IBM Watson training process

IBM Watson is a web service that provides tools for creating conversations with the use of Natural Language Understanding and Machine Learning. Creating Intents, creating entities and modeling dialogs.

7.3.1 General description of training process

There are 4 fundamental steps to implement an assistant:

- The first step in Chatbot implementation is a creation of a dialog skill. It can be accomplished with the use of the intuitive graphical tool to define training data and dialog. The training data consists of the following artifacts (the examples will be provided in the next section called "training process for particular use cases"):
  - Intents: intents that your users will have when they interact with a Chatbot. According to this intents, Chatbot will be able to provide relevant responses.
  - Entities: An entity describes an object of discussion which provides context for an intent. For example, it can be the name of an item that you want to buy in the e-shop.
  - Dialog: For building dialogs, developers can use graphical tool available on the Watson website. With this tool, it is easy to connect intents, entities, responses and design conversation flow for the Chatbot.
- Create an assistant.
- Add the dialog skill to your assistant.
- Integrate your assistant. Create a channel integration to deploy the configured assistant directly to a social media or messaging channel.

[IBMb]

7.3.2 Training process for particular Use Cases

For modeling a conversation using IBM Watson Assistant online tool we need to take 3 steps: create an intent, create entities and create a dialog using these intents and entities. For creating intent we need to provide examples of questions that correspond to this intent. The more examples provided the more accurate the detection of intent would be. Entities are just values that mean one specific thing. The name of a study program can be a good example of an entity. Entities are used to specify things during conversation. The conversation is created using entities and intents. The response of a chatbot is defined by a developer.
I will demonstrate the full process of creation of a dialog for the first use case with screenshots as it is in IBM Watson Service.
For other use cases, I will provide question examples that I used for modeling intents. Also for each use case I will provide an abstract version of a dialog flow as a diagram, since this form, in my opinion, better represents conversation logic on a paper.

Training process for the first use case

The first thing we need to do is to create an intent that will trigger the dialog. For creating an intent we need to provide examples of questions that determine this intent and AI will learn to understand this intent using these examples. The screenshot of intent definition in Watson Assistant is shown on figure 7.10

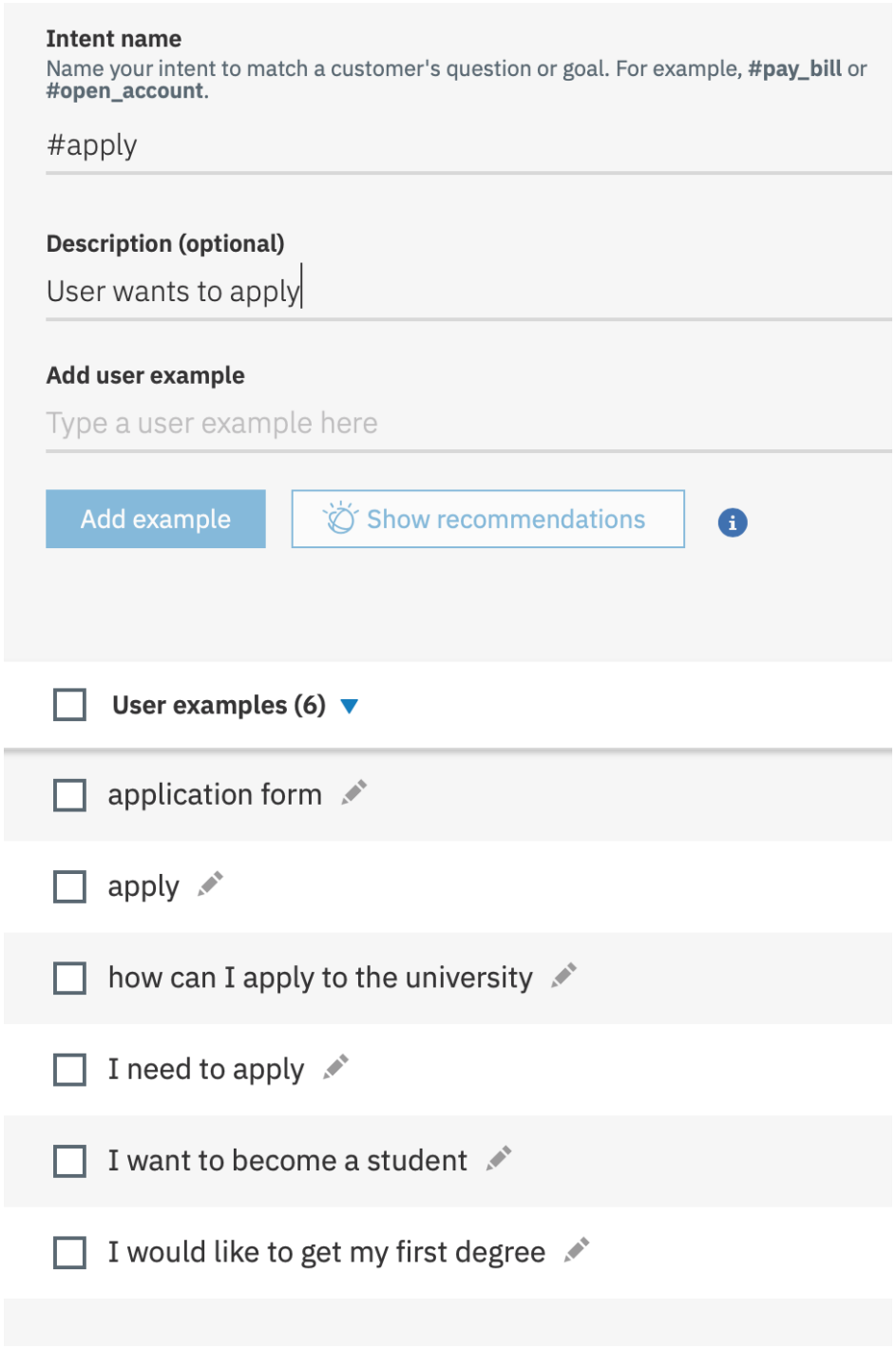

Figure 7.10: Intent definition for the first use case

To give the relevant answer about admission process we need to know what degree the person who is talking to our bot is interested in. We will create an entity called @Degree to determine the degree we are talking about. When the bot understands the intent apply it will check for @Degree, if @Degree is not present he will ask the user to provide this information. Once information is provided Watson will remember this information. The entity definition is shown on figure 7.11 and conversation modeling tool on figure 7.12

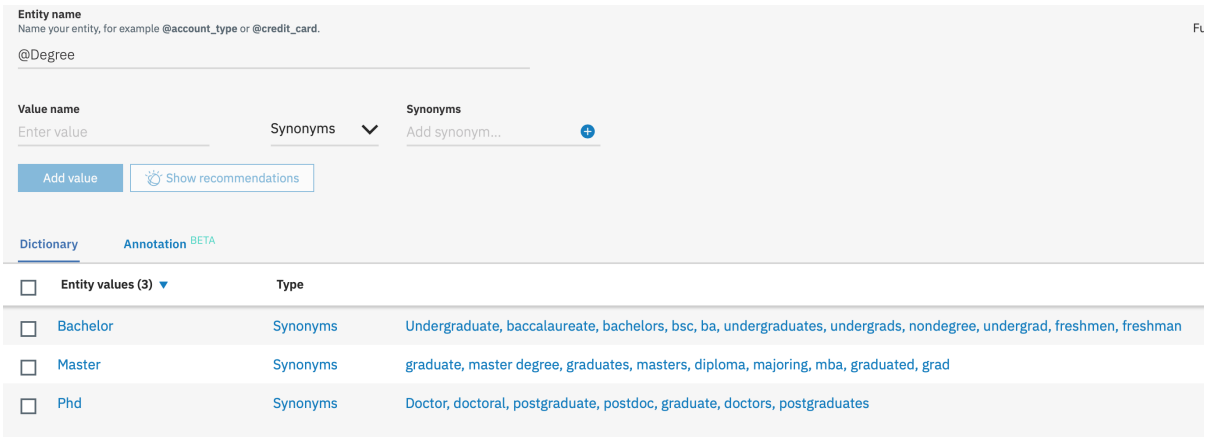

Figure 7.11: Entities definition for the first use case

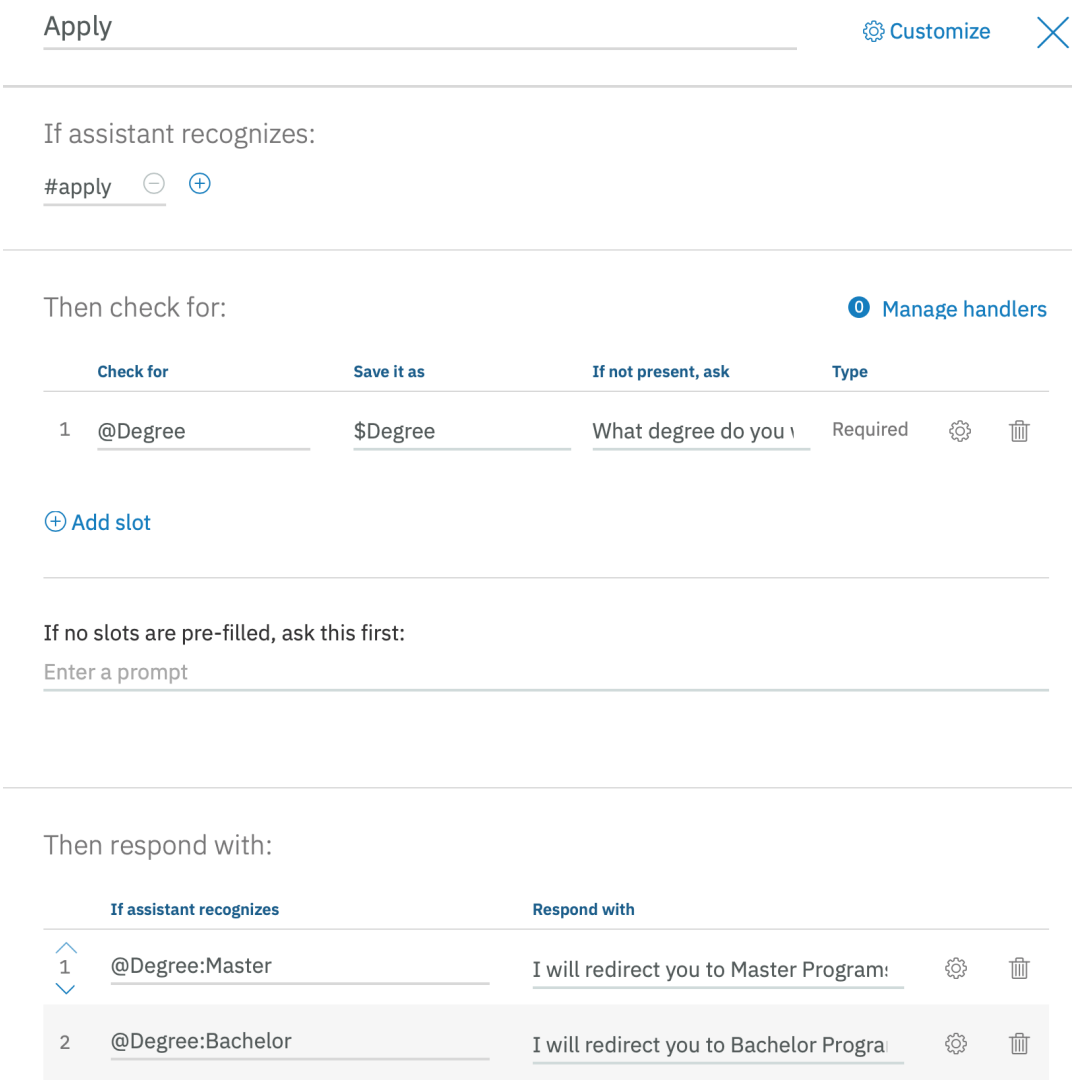

Figure 7.12: Conversation model for the first use case

For every use case, I will provide a diagram that illustrates the process of interaction between chatbot and user in my application. It shows how the conversation was modeled and also includes the additional step specific to my application at the end of every conversation, which is a redirection to the page containing desired information. Diagram is shown on figure 7.13

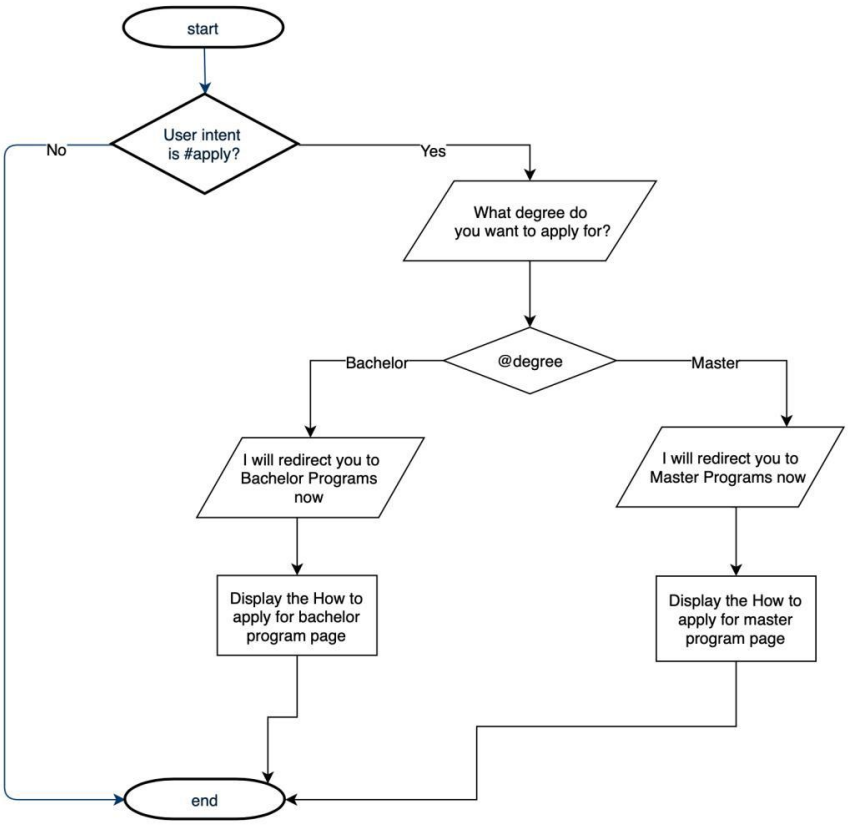

Figure 7.13: use case 1

Training process for the second use case

Diagram that illustrates the process of interaction between chatbot and user is shown on figure 7.14

Question examples for intent "getTime":

1. Schedule for summer ?
2. Schedule for winter ?
3. show me the time
4. Since when

5. Till what time
6. Till what time do I need to apply
7. When are the exams
8. What is the date?

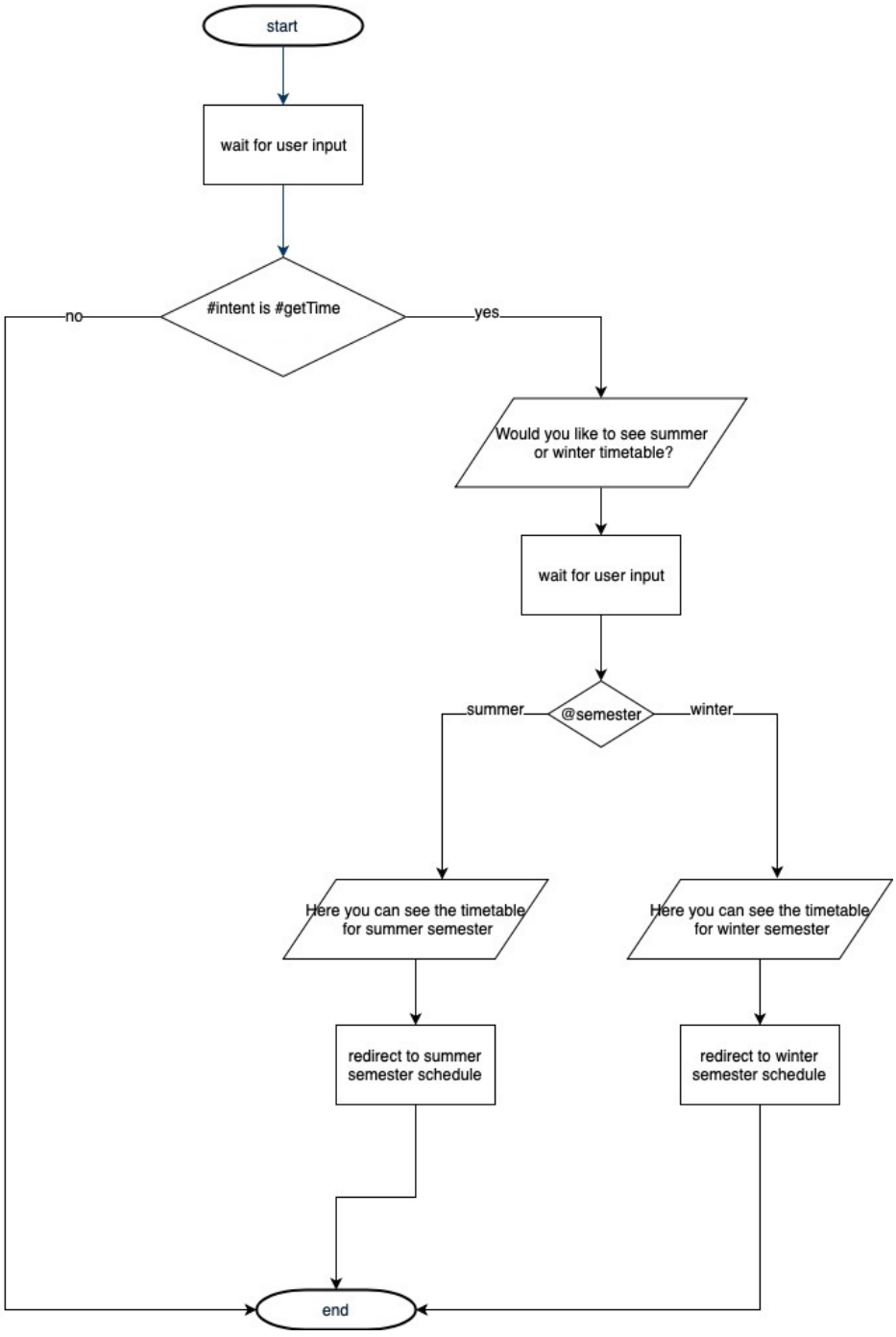

Figure 7.14: use case 2

Training process for the third use case

Diagram that illustrates the process of interaction between chatbot and user is shown on figure 7.15

Question examples for intent "exchange":

1. Tell me about exchange programs
2. What do I need to do to study abroad
3. I want to study abroad
4. Exchange student
5. Exchange programs
6. Double degrees

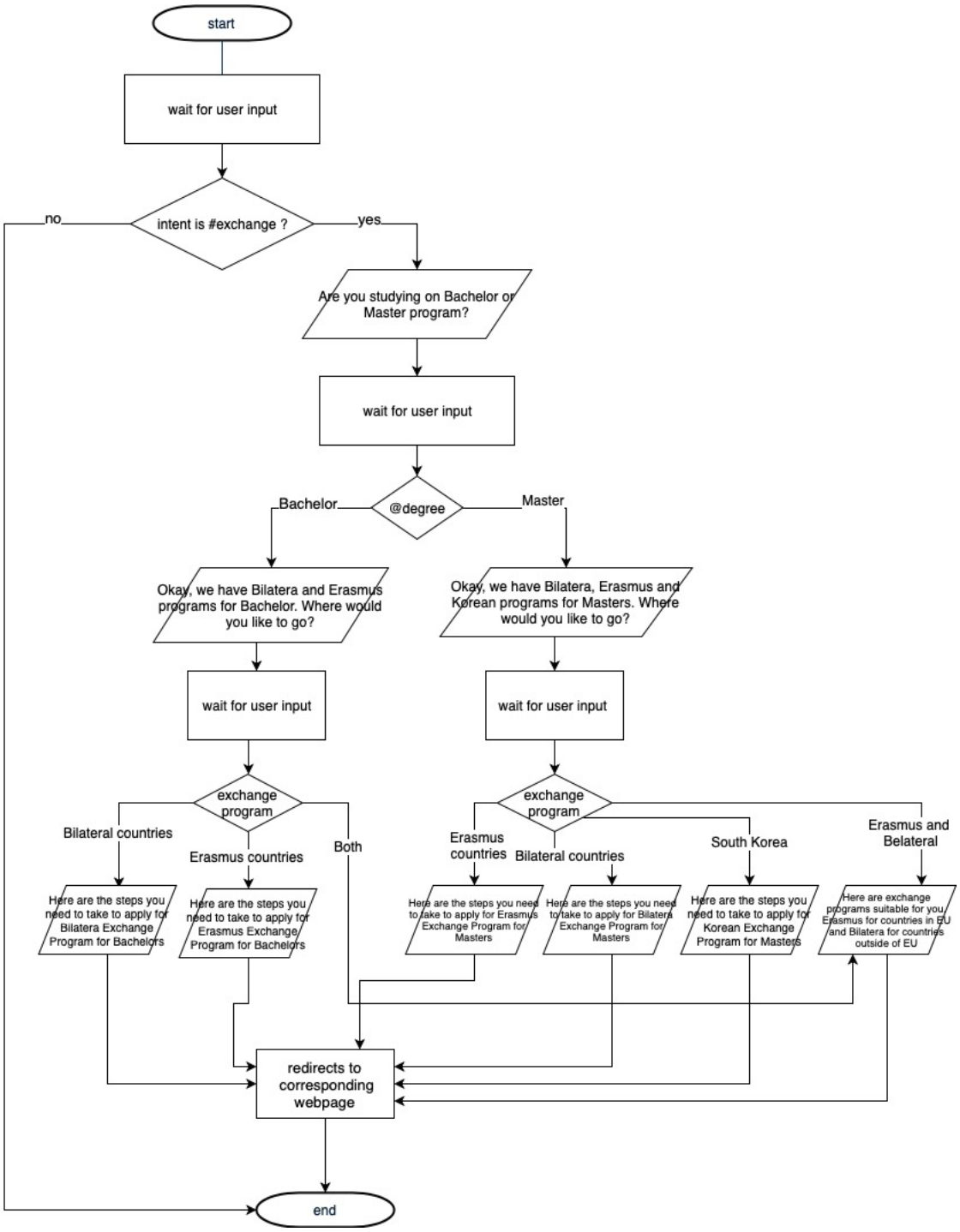

Figure 7.15: use case 3

Training process for the fourth use case

Diagram that illustrates the process of interaction between chatbot and user is shown on figure 7.16

Question examples for intent "getInfoAboutCredits":

1. How many cresdits do I need to continue studying
2. I don't have enough credits
3. I have 13 credits, is it possible to do something about it?
4. What are the reasons I can get excluded?
5. What if I have less credits than needed?
6. What is a credit system?

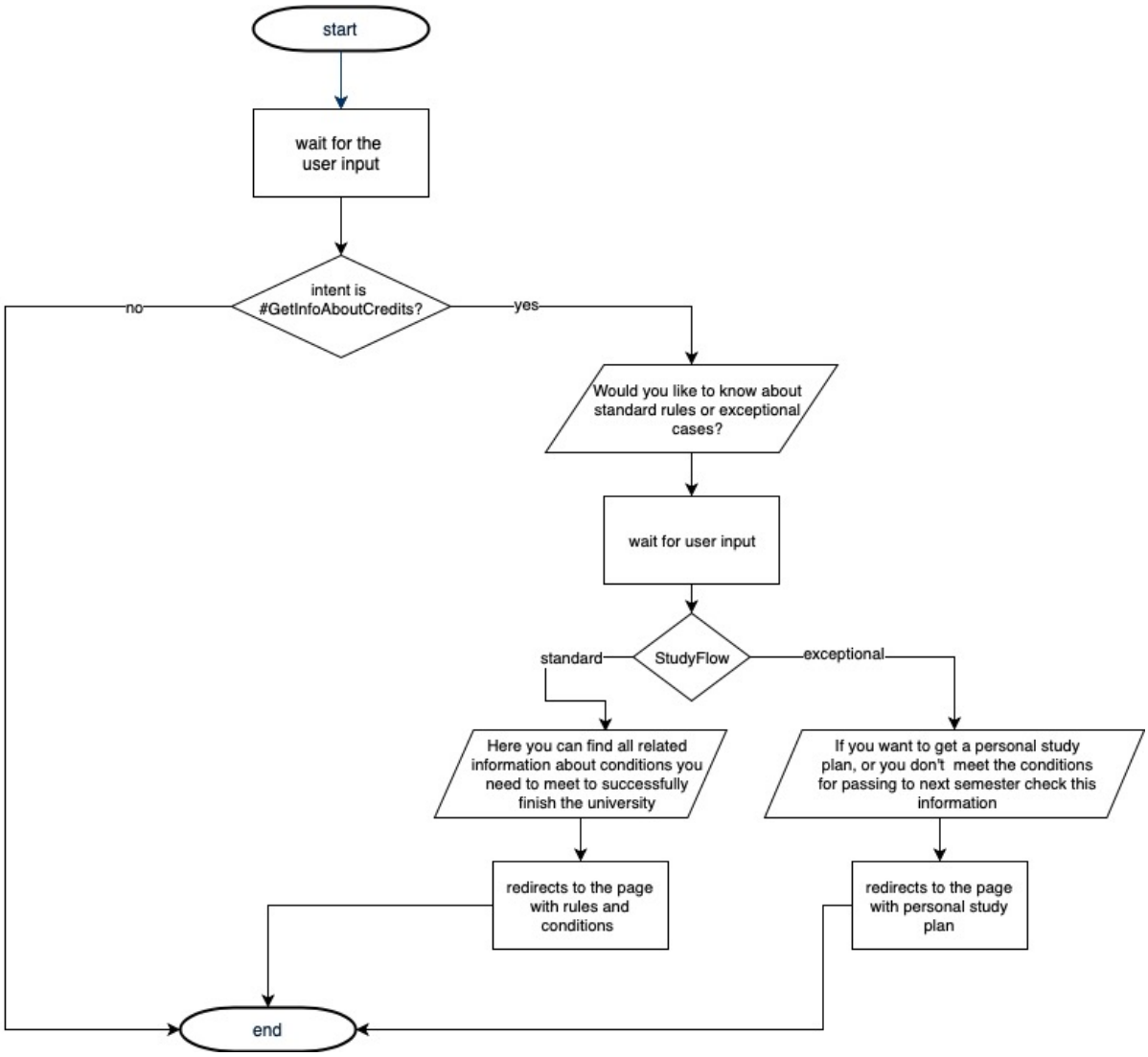

Figure 7.16: use case 4

Training process for the fifth use case

Diagram that illustrates the process of interaction between chatbot and user is shown on figure 7.17

Question examples for intent "getIndividualStudyPlan":
1. Can I ask for changes in my study plan?
2. Can I change my study plan
3. Can I make an exception and continue studying if I don't have enough credits
4. Conditions to have personal study plan
5. Exceptional cases
6. Exceptions in study plan
7. Is it possible to take academic holiday?
8. I want to know about personal study plan?
9. Personal study plan

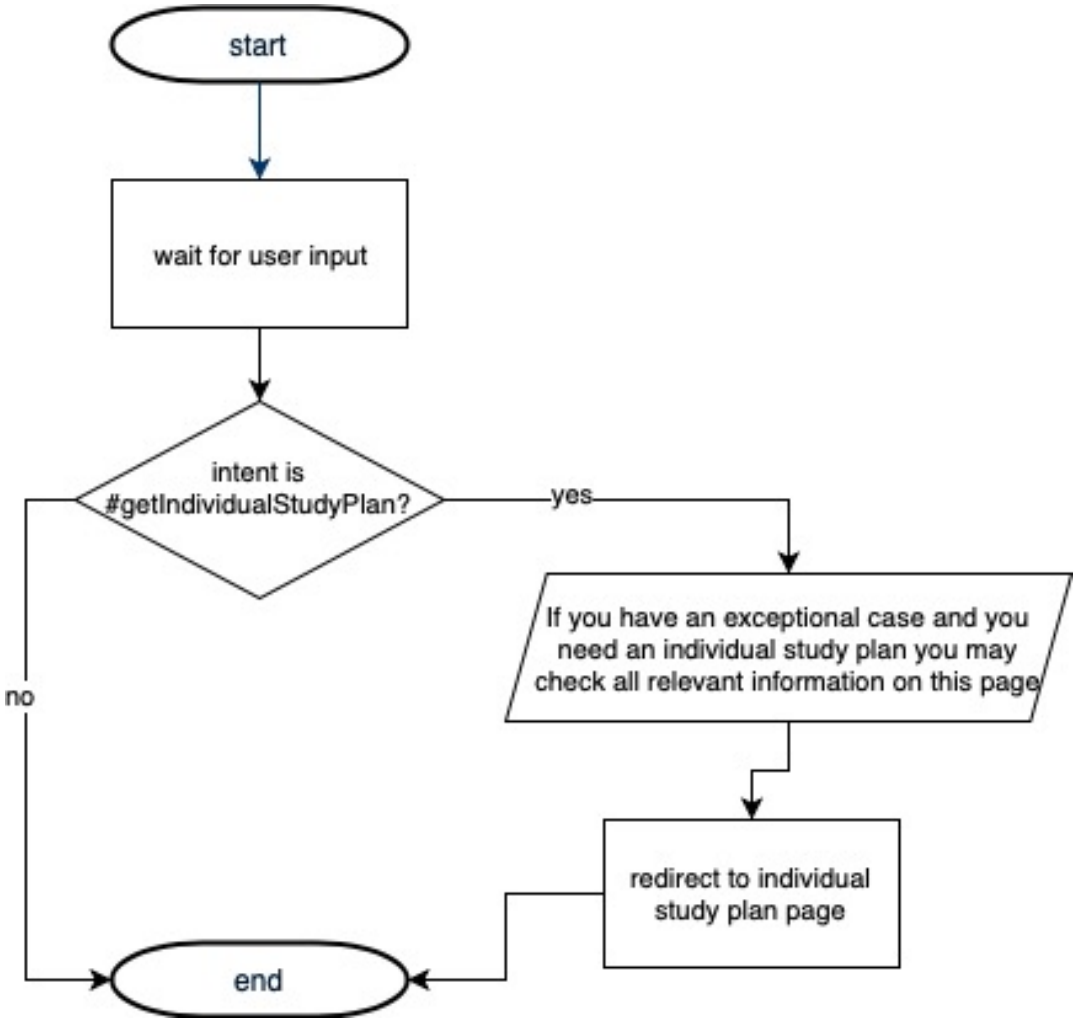

Figure 7.17: use case 5

Training process for the sixth use case

Diagram that illustrates the process of interaction between chatbot and user is shown on figure 7.18

Question examples for intent "attendClassesInEnglish":

1. Can I attend classes in English?

2. Can I enroll in English class?
3. Can I go to English classes while studying in Czech?
4. Can I have lectures in English for free?
5. Do I have to pay for seminars in english?
6. What do I need to do to attend classes in English?

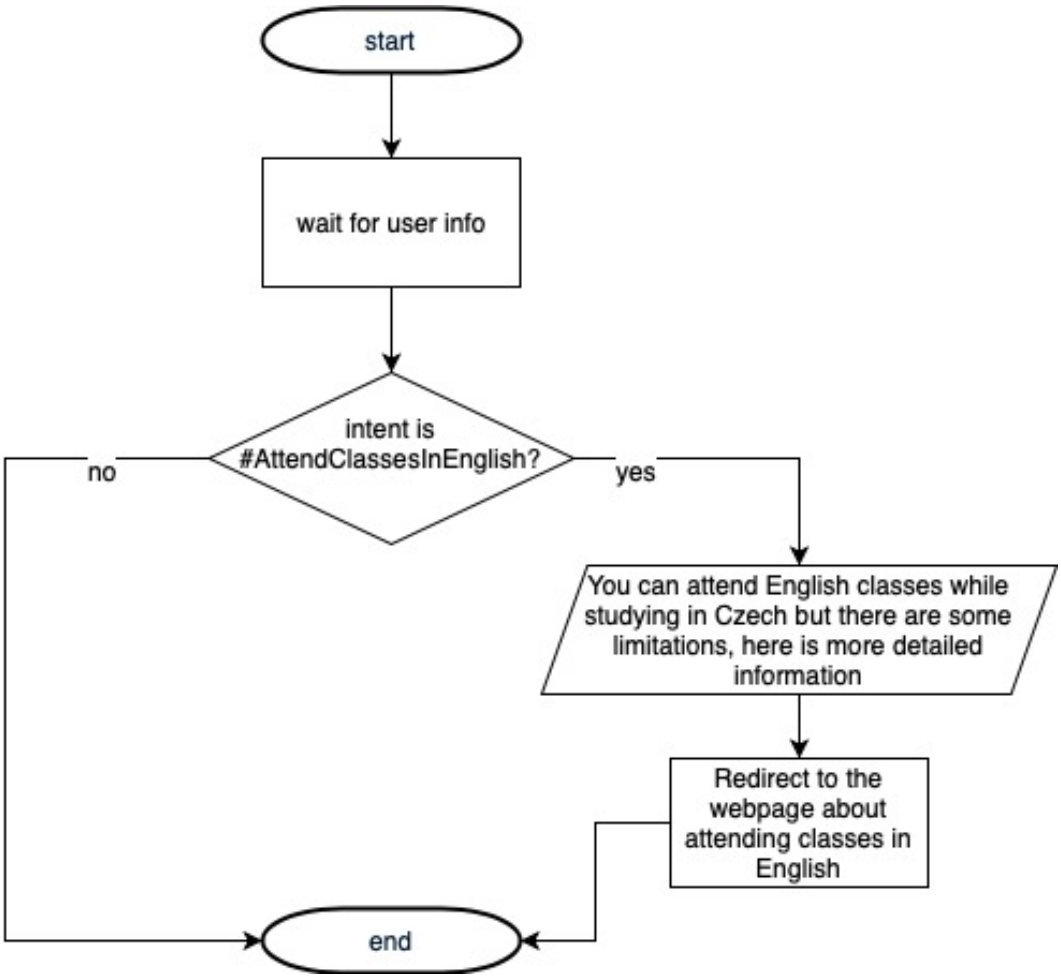

Figure 7.18: use case 6

Training process for the seventh use case

Diagram that illustrates the process of interaction between chatbot and user is shown on figure 7.19
Question examples for intent "transferToTheFaculty": 1. Changed the faculty
2. Changed the university
3. How can I transfer?
4. How can I transfer to this faculty?
5. I am studying in another faculty and I want to transfer here
6. If I am coming from another faculty what do I need to do
7. I used to study in CZU, now I've applied to FEE
8. I would like to change my faculty
9. Previously I studied on FIT, now I applied here, what do I need to do?
10. What do I need to do to get to this faculty from anothe

Question examples for intent "RecognizeTheMarks":
1. Can I recognise my marks?
2. Does the university approve the marks when students transfer from another faculty?
3. Do you recognise marks from previous study
4. I want to recognise the marks
5. What do I need to do to make my marks approved

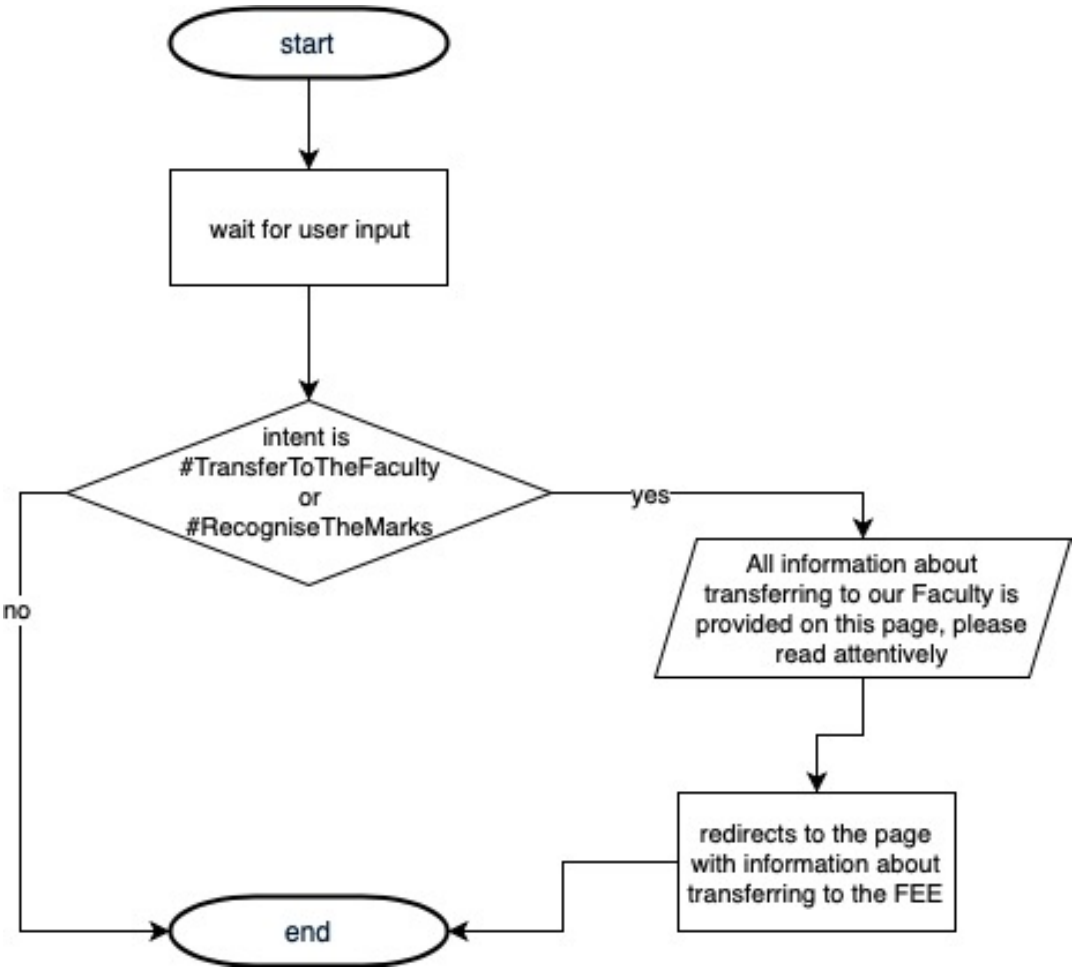

Figure 7.19: use case 7

Training process for the eights use case

Eights use case is implemented on entity recognition. If chatbots recognize word 'scholarship' or its' synonym it will trigger this dialog. Diagram that illustrates the process of interaction between chatbot and user is shown on figure 7.20

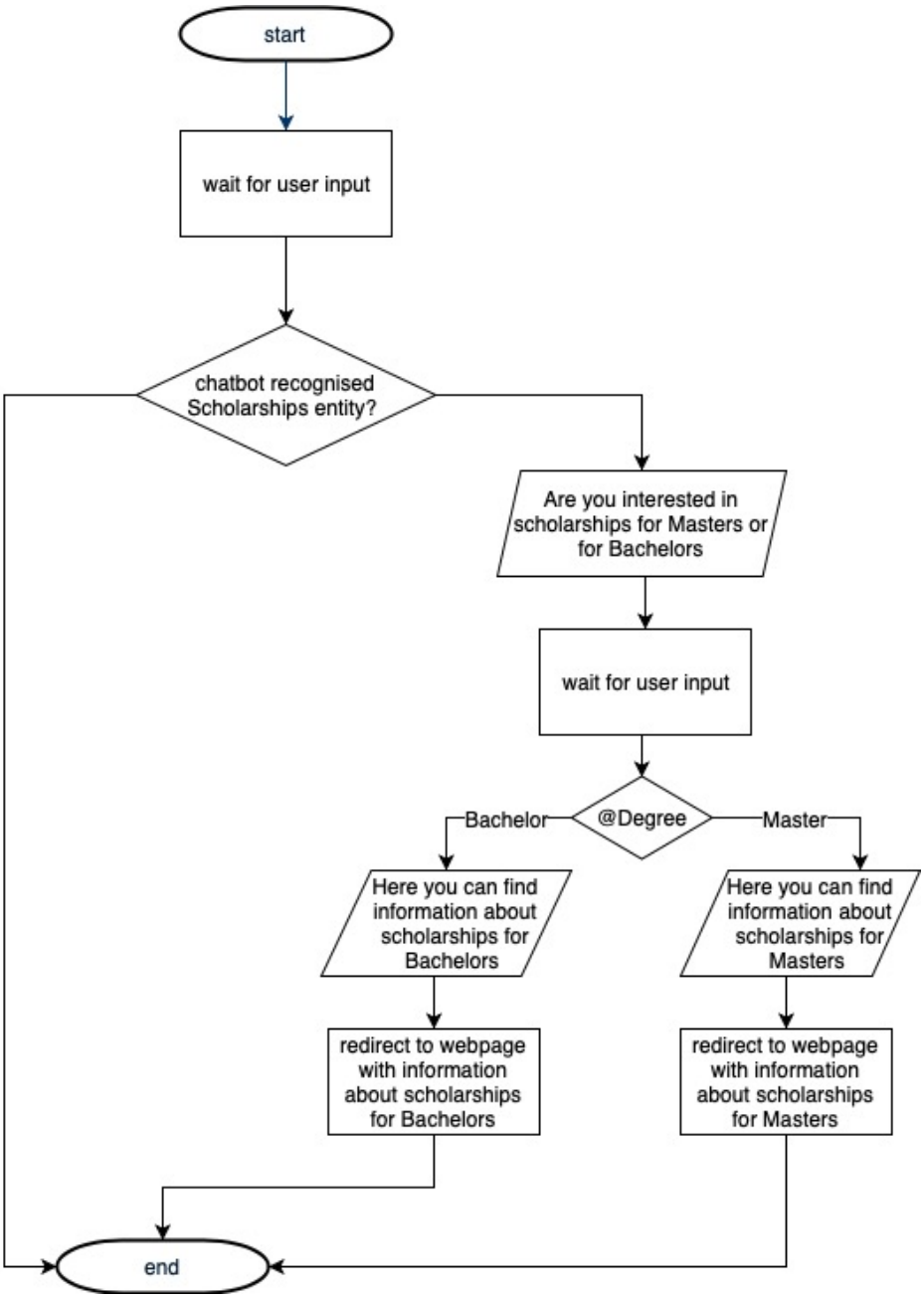

Figure 7.20: use case 8

In this chapter, I described the steps I had to take to implement the demo application. The implementation has helped me to understand how the process of Chatbot creation looks like. Nevertheless, as for any project, for the higher-quality product, the implementation process can be more complicated and there is always a room for improvement. In the next chapter, I will do usability testing and evaluate the benefits of using chatbot as a complementary tool for website navigation

Chapter 8

Usability testing and result assessment

To evaluate the benefits of chatbots' use in website navigation I decided to do usability testing. This chapter consists of 4 sections: pretest, task scenarios, user testing, and result assessment.

8.1 Pretest

From the pretest, we can see that the participants have different experiences with virtual assistants, some participants have used FEE pages before, some not. This diversity is good for our usability testing since I wanted to see how different people with different background will interact with the chatbot.
For testing purposes I have chosen people who are able to communicate in czech and english languages because my webpage is implemented in English and we comparing it with czech version of FEE website. I decided not to do comparison with English version of FEE website, because it has very limited amount of content and thus it makes it easy to find anything without help of any chatbot. Before doing the testing I have prepared a pretest to get better overview of participants.

The pretest consists of 7 questions:
1. Are you a male or female?
2. How old are you?
3. Are you a student?
4. Have you ever used FEE website?
5. Do you use virtual assistants?
6. Have you ever had troubles finding something on a webpage?
7. Do you agree that this information will be used for testing purposes and will be used in my thesis?

Participant 1

Pretest results:
1. male
2. 28
3. yes
4. yes, I'm FEE student
5. I use google assistant sometimes
6. yes
7. yes

Participant 2

Pretest results:
1. Female
2. 26
3. Yes
4. No
5. No
6. Sometimes
7. yes

Participant 3

Pretest results:
1. Man
2. 26
3. No, graduated last year

4. no
5. almost never
6. yes
7. yes

Participant 4

Pretest results:
1. female
2. 22
3. yes
4. just once
5. I use siri
6. I don't think so
7. yes

Participant 5

Pretest results:
1. male
2. 23
3. yes
4. yes
5. yes
6. not often, but yes
7. yes

8.2 Task scenarios

Task scenario 1

Description:
User wants to know how to apply for master degree and when summer semester starts. It covers use cases 1 and 2.
Goals:

1. Find a page with information about admission process to the faculty for Master degree
2. Find a page with information about the time when summer semester starts

Task scenario 2

Description:
User wants to go to Canada on exchange program and wants to get information about exchange programs in FEE. Covers use case 3
Goals:
1. Find a page with information about exchange program to Canada

Task scenario 3

Description:
User does not have enough credits to enroll in next semester. User wants to get information about amount of credits he needs for enrolling in next semester and if he can ask for personal study plan in case he does not meet the conditions. Covers use cases 4, 5
Goals:
1. Find a page with information about general rules in the faculty
2. Find a page with information about the individual study plan

Task scenario 4

Description:
User wants to know if he can attend classes in English while studying in Czech. Covers use case 6
Goals:
1. Find a page with information attending classes in English

Task scenario 5

Description:
User wants to transfer to FEE from another faculty and wants to know if his grades will be recognized. Covers use case 7
Goals:
1. Find a page with information about transferring process to FEE

Task scenario 6

Description:
User wants to know about scholarships.
Goals:
1. Find a page with information about scholarships.

8.3 User testing

In this section will include logging of the first participant. Because in many cases logging process is similar I will include other participants only in the table with results

8.3.1 Participant 1

Task scenario 1: FEE website

Logging:
1. Navigated to admissions
2. Clicked on "Master programs"
3. Navigated to students section
4. Navigated to timetable

The test was completed in 2 minutes and required 4 steps

Task scenario 1: Demo application

Logging:
1. Typed "I want to apply for Master degree" in chatbot field
2. Typed "When I summer semester starts?"

The test was successfully completed in 1 minute and required 2 step

Task scenario 2: FEE website

Logging:
1. Navigated to "Students" section
2. In a searchbar typed "Exchange programs to Canada"
3. Returned back to FEE homepage
4. Navigated to "Students" section
5. Navigated to "Study abroad" section
6. Navigated to "General information about other exchange programs" section

The test was successfully completed in 5 minutes and required 6 step

Task scenario 2: Demo application

Logging:
1. Typed "How to go study in Canada"

The test was unsuccessfully completed, chatbot could not understand the intent

Task scenario 3: FEE website

Logging:
1. Typed "how to enroll in next semester" in a searchbar
2. Could not find anything, returned back to FEE homepage
3. Typed "required amount of credits" in a serbar
4. Could not find anything, returned back to FEE homepage
5. Navigated to "Students" section

The test was not completed, participant gave up after 8 minutes

Task scenario 3: Demo application

Logging:
1. Typed "How many credits do I need to pass to next semester?"
2. After chatbot asked if he wanted to know about basic rules or exceptional cases, answered "expeptional cases"

The test was successfully completed in 1 minute and required 2 steps

Task scenario 4: FEE website

Logging:
1. Typed "classes in English" in searchbar
2. Navigated to PRE subject tought in English
3. Typed "attend classes in English while studying in Czech"
4. Could not find anything, navigated back to homepage
5. Navigated to "Students" section
6. Used a fulltext search to find word "english"
7. Could not find anything, gave up searching

The test was not completed, participant gave up after 7 minutes

Task scenario 4: Demo application

Logging:
1. Typed "I want to attend classes in English while studying in czech"

The test was successfully completed in less than 1 minute and required 1 step

Task scenario 5: FEE website

Logging:
1. Navigated to "Students" section
2. In a searchbar typed "transfer to FEE"
3. From searchresults navigated to the goal page

The test was successfully completed in 2 minutes and required 3 steps

Task scenario 5: Demo application

Logging:
1. Typed "I have transfered to FEE, how do I recognise my marks?"

The test was successfully completed in 1 minute and required 1 step

Task scenario 6: FEE website

Logging:
1. Typed "scholarships" in searchbar
2. Navigated to "scholarships" page

The test was successfully completed in 1 minute and required 1 step

Task scenario 6: Demo application

Logging

1. Typed "scholarships" in chatbot field, chatbot responded and redirected user to the scholarship page

The test was completed successfully in 1 minute and required 1 steps

8.4 Result assessment

From the results of usability testing, we can conclude that for the defined use-cases chatbot navigation performed better than standard website navigation. In some cases, the chatbot could not understand users' input and the test was marked as a failure. In other cases, participants were not patient enough to complete the goal using traditional website navigation, so these cases were marked as a failure as well. For most of the scenarios, searching for information with a chatbot was more effective and fast. In the table 8.1 the testing results are listed. It includes the number of steps user had to take to reach the goal, time spent, and success or failure status of a test.

Participant	1	2	3	4	5	6
Task Scenario 1: original FEE website	Steps: 4 Time: 2min success	Steps: 6 time: 3min success	Steps: 4 time: 2min success	Steps: 4 time: 1min success	Steps: 8 time: 5min success	Steps: 4 time: 1min success
Task Scenario 1: demo app with chatbot	Steps: 2 Time: 1min success	Steps: 2 time: 1min success	Steps: 2 time: 1min success	Steps: 2 time: 1min success	Steps: 2 time: 1min success	Steps: 2 time: 1min success
Task Scenario 2: original FEE website	Steps: 6 Time: 5min success	Steps: 7 time: 3min success	Steps: 4 time: 2min success	Steps: 2 time: 1min success	Steps: 2 time: 1min success	Steps: 8 time: 5min success
Task Scenario 2: demo app with chatbot	Failure	Steps: 3 time: 2min success	Steps: 3 time: 1min success	Steps: 3 time: 1min success	Steps: 3 time: 2min success	Steps: 3 time: 1min success
Task Scenario 3: original FEE website	Failure	Steps: 11 time: 8 min success	Steps: 9 time: 6 min success	Failure	Failure	Steps: 5 time: 3min success
Task Scenario 3: demo app with chatbot	Steps: 2 time: 1min success	Steps: 2 time: 1min success	Failure	Steps: 4 time: 3min success	Steps: 3 time: 2min success	Steps: 2 time: 1min success
Task Scenario 4: original FEE website	Failure	Steps: 14 time: 10min success	Steps: 10 time: 8min success	Failure	Failure	Steps: 8 time: 6min success
Task Scenario 4: demo app with chatbot	Steps: 1 Time: 1min success	Steps: 1 time: 1min success	Steps: 1 time: 1min success	Steps: 1 time: 1min success	Steps: 1 time: 1min success	Steps: 1 time: 1min success
Task Scenario 5: original FEE website	Steps: 3 Time: 5min success	Steps: 4 time: 3 min success	Steps: 3 time: 4min success	Steps: 4 time: 5min success	Steps: 2 time: 2min success	Steps: 2 time: 2min success
Task Scenario 5: demo app with chatbot	Steps: 1 Time: 1min success	Steps: 1 time: 1min success	Steps: 1 time: 1min success	Failure	Steps:1 time: 1min success	Steps:1 time: 1min success
Task Scenario 6: original FEE website	Steps: 2 Time: 1min success	Steps: 2 time: 1min success	Steps: 5 time: 2min success	Steps: 10 time: 5min success	Steps: 3 time: 1min success	Steps: 2min time: success
Task Scenario 6: demo app with chatbot	Steps: 1 Time: 1min success	Steps: 1 Time: 1min success	Steps: 1 Time: 1min success	Steps: 1 Time: 1min success	Steps: 1 Time: 1min success	Steps: 1 Time: 1min success

Table 8.1: results

Chapter 9

Evaluation

After implementation and comparing the number of steps a user needs to take to achieve the same goal using traditional website navigation and navigation with an intelligent chatbot I can assume that it definitely benefits user experience, but the implementation itself takes some time and effort.
After comparing the time users needed to complete a goal for every successfully finished task I can say that on average the goals were completed 2,8 minutes faster and took 3.98 fewer steps while using chatbot than traditional navigation. These number was calculated as an arithmetic mean of differences in time that it took to finish a task using the chatbot and traditional navigation. Also, during 36 tests users failed to find information using chatbot 3 times and 6 times while using traditional navigation.
Use of Artificial Intelligence (AI), in particular, made it possible to create a chatbot which is able to understand different user inputs without evaluating particular keywords and is able to evaluate the whole sentence and understand its' meaning instead.
All of that can tell us that using chatbot as a complementary tool for website navigation is a good option for websites that want to improve their website's user experience and are willing to invest some extra money in it. It is not the easiest task to integrate this feature to the existing project, at least in the form that I introduced in this work, but it is easy to integrate it at the beginning of development process and train it alongside with development

process of the webpage.

Chapter 10

Conclusion

The goals of this bachelor thesis were demonstration and analysis of the use of AI-powered chatbots as a complementary tool for website navigation and the way they can affect the interaction between people and websites.

I would like to say that this work has accomplished its' goals. This paper includes the study of the topic, analysis of existing solutions and demonstration of how AI based chatbots can improve users' interaction with pages by serving as a complementary tool for website navigation. In the end, I performed a usability test that has proved that using chatbots can bring certain benefits to user experience. For me personally, this work gave a better understanding of how developers can use Artificial Intelligence in their applications even without having a deep knowledge about its' implementation. Also, it gave me a better understanding of how companies use chatbots in business to improve communication with customers and helped me to learn how to apply AI principles in web-application and how can it affect user experience.

Nevertheless, there is a lot of room for improvement of the application that I introduced in this work. The training process needs more time and more

user input to improve the recognition of users' intents. Also, various different answers can be preprogrammed to make conversations more humanlike. The voice recognition feature would bring the interaction with a chatbot to another level.

Appendix A

Application Setup Instructions

Several things are required to run this application:

1. **npm** to run the back-end server
2. **Yarn** to run the fron-end application

When **npm** and **Yarn** are installed in order to run the application you need to take 6 steps:

1. Go to Back-end application root directory
2. Install dependencies
3. Run **PORT=3002 npm start**
4. Go to Front-end application root directory
5. Install dependencies
6. Run **yarn start**

Note: It is important to specify the port 3002 when running Back-end application, since Front-end application is configured to communicate with

http://localhost:3002

Code is also available online on https://github.com/penkobor/penkobor-thesis-fe.git (Front-End) and https://github.com/penkobor/penkobor-thesis-be (Back-end)

Appendix B

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ZADÁNÍ BAKALÁŘSKÉ PRÁCE

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Fakulta/ústav: **Fakulta elektrotechnická**

Zadávající katedra/ústav: **Katedra počítačů**

Studijní program: **Softwarové inženýrství a technologie**

II. ÚDAJE K BAKALÁŘSKÉ PRÁCI

Název bakalářské práce:

Use of Chatbots in website navigation

Název bakalářské práce anglicky:

Use of Chatbots in website navigation

Pokyny pro vypracování:

Demonstrate and analyze the use of chatbots for web browsing purposes, and the way AI (Artificial Intelligence) can improve people interaction. Follow the instructions below:
1. Define the term chatbot, describe the history and present state of chatbots.
2. Analyze existing solutions and ways of chatbot's use in webpage navigation.
3. Select some existing web pages and design and implement your solution of chatbot's use as a complementary tool for website navigation. Try to implement AI principles where it is reasonable and possible.
4. For selected web pages define typical user navigation scenarios (search for specific information - for example, phone number, specific form or document, address, etc.). Evaluate at least time, number of necessary steps and complexity of the search process in the case by using chatbot and in the case of standard browser navigation. Compare both cases and analyze the differences.
5. Evaluate the possible benefits of chatbot usage including AI principles.

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Datum zadání bakalářské práce: **13.02.2019** Termín odevzdání bakalářské práce: **24.05.2019**

Platnost zadání bakalářské práce: **20.09.2020**

Ing. Pavel Náplava, Ph.D. podpis vedoucí(ho) práce	podpis vedoucí(ho) ústavu/katedry	prof. Ing. Pavel Ripka, CSc. podpis děkana(ky)

III. PŘEVZETÍ ZADÁNÍ

Student bere na vědomí, že je povinen vypracovat bakalářskou práci samostatně, bez cizí pomoci, s výjimkou poskytnutých konzultací.
Seznam použité literatury, jiných pramenů a jmen konzultantů je třeba uvést v bakalářské práci.

. _____
Datum převzetí zadání

_____
Podpis studenta

