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# **Development and Evaluation of a Service Bot in the e-Government Sector**

## **Bachelor Thesis**

am Fachgebiet Agententechnologien in betrieblichen Anwendungen und der  
Telekommunikation (AOT)

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# Abstract

Though not a recent phenomenon, chatbots and voice assistants are increasingly gaining unprecedented attention as a successor for mobile and web apps. While still emerging with no defined standards or set protocols, with a hype on the rise, tensions between industry giants with products like Amazon's Alexa, Apple's Siri or the Google Assistant unveil new examples for providing an enriched user experience for consumers and businesses. The surrounding ecosystem also plays a major role in spreading the platforms available while exploring new horizons with alternative approaches and business models. Today voice assistance are already present around indoor spaces, in the car or on the go. They live in smartphones, on fancy TV sets or even as stand-alone devices. Yet, they are still a new terrain to discover and great potential to unleash in numerous contexts.

One such scenarios involves the public sector. In this work, we explore the Alexa Skills Kit by Amazon in combination with respective services to develop a voice assistant for the local city council extending the current chatbot's functionality available on <http://service.berlin.de>. We touch on the technical challenges and possibilities in implementing a Software as a Service (SaaS) system for e-Government inquiries and analyse its usability as well as its effectiveness in replacing traditional information lookup. We then examine the goals we define for our use case to our achievement with the APIs and SDKs available at the time. With respect to those, we also report on the opportunities, challenges and limitations faced in the development process.

Finally, we study the current state of voice assistants and service bots on the market and the future of this trend from a technical and a social point of view.

**[SUPERVISOR NOTE] CONCLUSION: DAS ERGEBNIS DER ARBEIT SOLLTE MAN ZUM SCHLUSS NOCH IM ABSTRACT ERGÄNZEN.]**

# Zusammenfassung

Auch wenn Chatbots und Sprachassistenten keine Randerscheinung mehr sind, erlangen sie in letzter Zeit eine steigende Bedeutung als Nachfolger von mobilen Anwendungen und Web Applikationen. Trotz des Mangels an definierten Standards oder feste Protokolle, mit einer zunehmenden Aufmerksamkeit auf dem Markt herrscht große Konkurrenz. Ob es durch Amazons Alexa, Apples Siri oder den Google Sprachassistenten hervorgeht, zeigen sich zahlreiche Beispiele, wie die Nutzererfahrung auf privaten oder Geschäftsebene weitgehend bereichert werden kann. Mit Lock-in Effekten spielen Drittanbieter eine große Rolle bei der Verbreitung der einen oder anderen Plattform und sorgen für neue Interaktionsmodelle. Der steigende Nutzen von Sprachassistenten zuhause, im Büro und unterwegs erlaubt viele neue Erkenntnisse und Erfahrungen, die dem Marktumfeld zu verdanken sind.

Auch im öffentlichen Dienst wird dieser Nutzen vertreten und wertvoll eingeschätzt. In der folgenden Recherche untersuchen wir Alexa von Amazon im Zusammenhang mit anderen verfügbaren Plattformen und erweitern die Fähigkeiten des Sprachassistenten durch den Webauftritt des berliner Stadtportals (BerlinOnline) um weitere Dienste sowohl für die vielfältigen und mehrsprachigen Einwohner der Hauptstadt als auch deren Senatsverwaltung. Als Grundlage wird auf die Funktionalität des Chatbots auf dem Stadtportal <http://service.berlin.de> zurückgegriffen. Anhand dieses Anwendungsfalls werden die prinzipiellen Möglichkeiten und Herausforderungen bei der Implementierung eines Sprachassistenten für die Stadtverwaltung aus technischer und organisatorischer Sicht analysiert. Zusätzlich wird die Usability des Systems als Ergänzung für einen Abfragedienst in Erwägung gezogen. Anschließend werden die erreichten Ziele mit den gesetzten Anforderungen in Perspektive gestellt. Darüber hinaus wird über Systemgrenzen sowie individuellen und systematischen Fehlerquellen berichtet, die bei der Entwicklung behandelt worden sind.

Schließlich nehmen wir den aktuellen Trend von Sprachassistenten und Chatbot-Dienste unter der Lupe und diskutieren eventuelle Zukunftsentwicklung mit dem gegebenen Stand jenseits des e-Governance Bereichs. **[SUPERVISOR NOTE] CONCLUSION: DAS ERGEBNIS DER ARBEIT SOLLTE MAN ZUM SCHLUSS NOCH IM AB-**

**STRACT ERGÄNZEN.]**

# Acknowledgements

[ possibility to make inline notes ] **[CITATION]** when a citation is missing

 **To-DO:** todos

**[TO CITE]**

**[SUPERVISOR NOTE] BITTE BETREUERNOTIZEN AUCH IM FLIESSTEXT  
MIT \SN{TEXT} ]**

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# Chapter 1

## Introduction

With over a third of the world’s population projected to own a smartphone in 2018 [13] and a substantial fraction thereof using smarthome gadgets and appliances on a daily basis, AI’s role has become more interesting than ever in many disciplines including but not limited to productivity and entertainment. Many technologies we take for granted today, such as dictation and word prediction, recommender systems or other digital analytics depend on Machine Learning and Natural Language Processing techniques that were only made possible thanks to the high computational power shipped in most devices gradually overtaking the consumer market. This transition also facilitated the introduction of a new form of interaction through conversation with the hardware, paving the way to an aspiration modern societies have been striving globally [9]. Whether in blockbuster 60s drama as seen in “Breakfast at Tiffany’s” (1961) or in Sci-Fi romance in the movie “Her” (2013), an obsession with voice technologies is featured throughout from an answering machine on tape to a fully personalized but mass-produced voice-based operating system to even become a protagonist.

Conversational bots were already prevalent since the 80s in the form of Question/Answer systems based on query programming languages like PROLOG and SQL. ELIZA, considered as the world’s first chatbot and though quite superficial as an NLP-based programme for psychoanalysis, already at its early stages demonstrated how humans can become emotionally attached to machines, transcending over the anomaly of making conversation *not* with a human [15]. Today, combining ML with retrieval-based approaches allows a more advanced interaction with the system and yields smarter and more personalized conversations between man and machine. Consequently, it is no longer a surprise that chatbots acquire social skills to make Xiaoice, the empathetic bot from China, possibly a new kind of friend made of silicon revoking the fiction element from “Her”.

So far, voice assistants represent an additional layer of abstraction from software

beyond the graphical user interface (GUI) and are hence the closest we have come towards human communication. They de-construct another barrier between the user and the hardware as voice communication generally does not require profound computer literacy and the conversational models rely on our inherent ways of expression. As they simulate the human aspect and imitate its behaviour for instance with small-talk abilities [12], voice assistants are regarded as a convenience for daily tasks and are on their way to becoming a de-facto replacement to sophisticated actions we perform on the screen. In fact voice searches now compose a large marget segment 「 [check quality of statistics](#) 」 and are predicted to make up about 30% [6] [14] of all searches by 2020 with currently highest rates coming from the youngest generations based on a survey [16] by Global Web Index. According to the Alpine.ai 2017 Voice Labs report there were 33 million voice-first devices in circulation in 2017 worldwide [1] with tremendous shifts in number of units sold between 2015 and 2017. This and more statistics hint at a revolutionary change towards our use as much as the introduction of the GUI and mouse were to the command line interface. Increasingly, we recognize voice as a *new* user interface, also known as Voice User Interface (VUI), and analyse good practices and design guidelines for it.

Since sound and voice are primal stimuli in the human brain [8], using them becomes more instinctive, making us in turn process our ideas starting with an “inner voice” that translates easiest into words when we speak it before “funneling” it to actions [3]. Arguably, on a market scale, this gives voice assistants today a competitive innovation advantage (CIA) for they are hence more accessible to further demographic groups with a growing wider acceptance.

Meanwhile, statistics [10] show that time spent on messaging apps already surpassed average uptime on social media , which indicates how the former is more desirable as a communication format on mobile platforms and how having a conversation is an easier way to interact with a device instead of downloading an app for every task. 「 [link ok?](#) 」 Further, the speech-to-text/text-to-speech domain has become more powerful with steadily increasing processing power, an effect of Moore’s law we only get to understand lately in addition to the gradual lessening of the dominance of Chomskyan theories of linguistics (e.g. transformational grammar) [4]. With an integration in most modern operating systems, speaking to a device has become no longer a absurd novelty. Inadvertently, Google Now, the voice assistant built into the OS currently with the highest usage shares among computer and smartphones [5], supports understanding of multiple languages in the same sentence for multilingual interaction. Moreover, the Echo Dot recorded the peak for best-sellers for 2017 on Amazon with unprecedented numbers showing a high customer retention and satisfaction rate [11]

As we constantly challenge our expectations towards technology, our not too far-fetched imagination makes us question the ability of AI to make a machine able to react to everything we say. Although we are still far from this step, at least for the consumer level, we dedicate a lot of effort to make it happen with examples like IBM's Watson. And as long as we still do not exactly understand human intelligence yet, it is hard to fathom AI as a holistic field. As such, it is therefore more realistic to consider the current works in the field as *intelligence amplification* [3] empowering human take better decisions beyond their normal brain processing power.

## 1.1 Motivation

With the aforementioned, we try to think how voice assistants could come handy and why we want to invest in such technology, juxtaposing it to available alternatives. If we consider human workforce (i.e. customer service agents) on one hand, it is commonplace that these are more expensive, less available due to restrictive working hours and not always aware of the full circumstances related to an issue they are supposed to fix or a question they are to answer.

Sometimes knowing more about a person could almost become a dangerous tool since it gives room to manipulate them. A client in a shop for instance can have their decision influenced by the seller and eventually get tricked into buying a product based on wrong advice. Although there is practically little the client can normally do to circumvent misinformation if that seller is replaced by an algorithm, having an automated system like a voice assistant step in gives at least a more neutral impression since it are not directly expected to act with malicious intentions.

Since the point of availing voice assistant is to act in a person's interest, we also want an information system not to confuse us or to limit our cognitive abilities. 「 talk about cognitive behaviour 」 Besides, we can at least ensure that a voice assistant will not become moody and intentionally want to make our lives harder for this reason as opposed to a human. And so though a voice assistant or a chat bot may not potentially answer every question we throw at it, we want to at least presume that it would give us no information and not partial truths or lies. This is why most credible companies elaborate explicitly on their terms, conditions and privacy statements making them accountable on the products they produce and the services they offer. A consumer therefore feels more empowered to assert any faults originating from an automated system than from a human and conditionally has an assurance that they can prevent any violations more systematically.

Eventually a person is more likely to develop a certain kind of trust in a machine

more than in a human once the technology is established and widespread. Cars, email, and other gadgets or services we take for granted today are living proof of how this trust can grow is inevitable, for the better or worse and depending on the degree of affinity, aversion or ignorance in a business sector. Trust in a system can grow once it is certified to have little to minimal exceptions. Besides enriching the value chain, it is a key in setting a technology to become an industry standard. Therefore, if a voice assistant is shown to deliver reproducible results disregarding a person's profile, this definitely contributes towards the credibility of the system. This is however not an easy case, since an advanced voice assistant is not expected to be deterministic in most situations, otherwise it becomes boring! We elaborate later on this thesis how utterances [] handle this problem.

On the other hand, information systems range from web pages (e.g. frequently asked questions section (FAQ), forums). These are in most cases even less effective than contacting a human as getting the proper information takes a lot of time, or the level of trustworthiness or participation particularly in a forum is too low, the problem stated is too broad or too specific compared to the answer we are seeking. A user also could come purposefully across false positives in a search and rely on irrelevant information without knowing. Furthermore, some case-related information might be required to have a proper understanding of a situation or a scenario and provide adequate answers. For Example, if a user would like to know if a certain accessory is compatible with their mobile device, they might need to give a model number, which they may or may not know. Consequently, it is of high interest to maintain a system that could determine all these factors autonomously or with the least possible human interference such that a system supersedes the abilities of the classical Q&A approach.

Internationalization is also another factor to take into account. Since languages differ not only in their vocabulary but also grammar, word and sentence structure, developing a voice-first device requires a flexible infrastructure and software stack both able to accommodate these deviations. In that respect, not only is region-specificity important, but also being able to cater for people in a region who do not speak its official language or are residing there temporarily. Especially in businesses where it's difficult to hire skilled foreign-language speaking personnel, a voice assistant can overcome this challenge as it would communicate more accurately and will not have language problems. A customer is then given the option to avoid an inconvenient experience with a call centre representatives where neither of both parties understands the other. For those who have minimal understanding of the language, there are possibly also options to provide help in the native language if the user is given the options he/she can answer a prompt with. At the very least, a VUI could still give feedback to the user of whether it understands the language or not, since algorithms for detecting a language are not as

complex as answering the question once the language is understood. [ approaches to localization? (Translators via Wordnet, Stammsprache,...refer to IRS lecture notes) ]

In the following, we take all these factors into consideration and narrow down a tailored scenario in the e-Government sector. For this we choose to present our solution using Alexa, since among Apple and Google it has the voice-first devices best equipped for its platform, a user base larger than its competition and provides the most mature API and SDKs.

## 1.2 The Analyzed Scenario

Berlin.de is an online one-stop-shop for approximately 3,7 million residents of the German capital [2] with [ hundreds/thousands ] of visitors daily for information lookup, appointment bookings and even access to local news. As part of a federal modernization procedure with the help of the ministry of interior, D115 was launched in 2009 [7] as a phone service to help residents find relevant information about a public service or municipality, something that can be tricky if a person has no overview of the local government structure and still not always easy even with the help of search engines nowadays. To promote information accessibility, D115 continuously aims at expanding its reach and services. It is therefore worth exploring, how to offer D115 services in a fashion that takes advantage of conversational abilities beyond its human personnel.

For now, although local authorities rely heavily on their websites to communicate information to the public, the challenge is mainly finding the right service. In a metropolis with a high influx of incomers, it is also very likely that certain services are frequently pursued, meaning that helping find the right public service or authority is a repetitive task. In this context, thinking of a voice assistant as a public service could have several advantages, like offloading some traffic from the phone service, getting over the language barrier in the case of non-german speakers, expatriates or simply helping native customers formulate the right wording for a query in a more intuitive way than using a search box.

## 1.3 Approach and Goals

#### **To-do: Aufgabenstellung:**

-AL: Anschließend soll das Ziel der Arbeit formuliert werden: Entwicklung und Evaluation eines Prototypen für den Anwendungsfall.

- 1- es sollen die Stärken und Schwächen eines solchen System zu analysieren.
- 2- Es sollte zunächst eine Dienstleitung aus dem Berliner Service-Katalog mit dem Chatbot beaufschlagt werden können.
- 3- Nuancen beachten (e.g. 10243 / FHain)
- 4- Smalltalk Fähigkeiten

 **To-do:** - ..it would speak as an advantage for bots if they can determine these things automatically..

- currently most tasks revolve around performing tasks like setting an alarm,
- answer suggestions functionality in chatbot equivalent - next step is to get around the user's frustration by making the bot at least more human.
- Alexa Skill will work in Germany in english and german -> add english after german

## 1.4 Structure of the Thesis

This thesis endeavours to shed light on the following: In Chapter 2, we discuss related work as currently available. We first show a few use cases for chat bots and voice assistants and their implementation. For that we consider [ the City of Vienna chat bot service "WienBot" for German and Singapore/ LA/... for English ] and compare them to the current application available on service.berlin.de. We then introduce the Alexa platform and the idea behind Skills in chapter 3 and discuss how it can overcome a few struggles with respect to its counterparts [ like redundant boilerplate code, smalltalk, but also limitations ]. We also present the frameworks we use in our own implementation, the prerequisites and the artefacts provided initially. Chapter 3 and 4 represent a detailed analysis of our implementation. In particular, [ SOME MORE SENTENCES. In Chapter 4, our solution is presented. This solution covers ... (SOME MORE SENTENCES). ] Chapter 5 evaluates our implementation with respect to our target in the defined [ 4-5 ] use cases. [ SOME MORE SENTENCES ] In Chapter 6, we conclude with how the implementation of this e-Government solution is attainable through Alexa and where future works can be directed.

# **Chapter 2**

## **Background**

### **2.1 Related Work**



✍ **To-DO:** move / remove what is irrelevant **topology of bots**  
**by platform:** -API.ai / Facebook Messenger Chatbots / -wit.ai / -motion.ai / Flask  
**by category**  
 - leisure / - fun bots / - productivity / - more (graph from voicelabs report)  
 - what are classic use cases for their use with prominent examples?  
 Booking tickets (e.g. airline bot)  
 - quick survey of respective 'AppStores'  
**by purpose**  
 -physical locations (home, office, car, phone, in a business)  
 Information bots  
 - mention available service types (information system as a "webpage/database")  
 - vs an interactive bot that gives you customized information on demand hier soll der D115 Anwendungsfall "Beauskunftung" kurz erläutert werden  
 social bots  
 - with advantages / disadvantages  
 - fake news / online reviews  
 more on AI in bots (optional)  
 - use of ML  
 Handyversicherungsbeispiel  
 - from business perspective, the bot is aiming to sell more policies,  
 - the bot tries to determine if there is a nuance in the user's answer (machine acting as a judge!) - e.g. "how did the phone fall off" - MKTG - Aufwand  
**by use case:**  
 - Wienbot  
 - Singapore / LA /...

Getting started with Alexa platform for the first time might seem a little overwhelming especially since amazon is constantly working on the interface and the sdk Throughout the course of this thesis these major changes occurred

Explain what the ASK SDK does

## 2.2 State of the Art

In this section, we conduct a short survey of problems we can face with natural language survey of available We also di Natural Language

### **To-DO:** 2 ¶

- **Chatbot vs. human:** Analyze differences between bot and human response
- disadvantage: a bot wants a sentence broken down in small pieces to avoid errors in lengthy interpretation
- **Why can't robots understand us:** language ambiguities - the need to understand context
  - Syntactical: Homonymy
  - Semantic: Metaphors, sarcasm, and puns
  - dialects: enunciations
  - underlying grammar
  - underlying sentiment
- NLP Progress:** How does it help in enriching the bot experience
  - neural networks: help understanding language patterns and get better over time
  - thought vectors: helps connect different words with related meanings
- **wrap-up:** can bots replace services offered by humans? – mention transition from facets (Altavista) to metasearches to all-in-one (Google).
  - chatbots as enablers in customer service industry
  - conclusion: Although not impossible, it is a bit too far-fetched at this stage.

## 2.2.1 Amazon Web Services and the Alexa Platform

Alexa is the cloud-based voice Service by Amazon powering millions of devices [ **number of requests, ...** ] including its own-branded devices like Echo, Echo Dot, Tap, FireTV as well as cross-platform on Apple's iPhone

### **To-DO:** - Alexa Skills Kit+ Amazon Voice Services

- mention how ability to react to everything is centralized at alexa somewhere
  - talk about SKILLS**
  - ability to retain sessions (explain requests/responses - GET/POST)
  - fulfilling intents
  - nested handlers
- skill service: code - business logic - handles json requests skill interface: configuration (developer portal)
- difference to Lex & Polly
- diff alexa lex
- Major prob: lex is not in german - Alexa Documentation

### 2.2.2 Amazon Voice Service

just like other common chat bot constructs, Alexa Skills Kit (ASK) divides the building model into intents ??, utterances and slots. The Fulfillment part is taken care of through Amazon Lambda contains the programming 「 and business 」 logic to the interface

- Intents

### 2.2.3 Node.js

AWS Lambda supports multiple runtime environments including Python, Java, C# and Go. However, we use Node.js due to its event-driven nature and to take advantage of its non-blocking I/O model. Being single-threaded, Node.js guarantees high performance at large scale with large volumes of requests considered. With its JavaScript (ECMAScript) foundation, it is becoming a standard in web-apps.

🔪 **To-DO:** - Server-side, browser side (Chrome V8), App layer, data layer  
- because it can read our JSON easily and fast - talk about Methodenaufbau (syntax) and firing events

### 2.2.4 Alexa Interfaces

- Echosim.io - Devices - Reverb (iOS)

## 2.3 D115

- summarize infobroschuere\_ BMI08324\_screen\_barrierefrei.pdf
- Use case im Detail
- Welche Daten gibt es?
- Was sind die Erwartungen?
- wie kann man die Güte des Systems beurteilen?
- Meist sollte man in diesem Kapitel die Lösung schon im Auge haben, um die Erwartungen so zu formulieren, dass die Lösung auch geeignet ist?


## 2.4 Frameworks and Data Structures (change title)

- AL: Ich würde erst etwas die Algorithmen und Datenstrukturen (Textanalyse, JSON, ggf. Graphen beschreiben. -AL: Anschließend die Frameworks vorstellen
- AL: Wichtig ist: Aus den Beschreibungen eine Schlussfolgerung ableiten, welche Art von Lösung entwickelt werden soll.

for current bot:

- Lucene **as the golden standard**: spell check, unscharfe suche, Tika / detect language / ...
- Solr - explain what's an intent, whats a slot <https://service.berlin.de/virtueller-assistent/virtueller-assistent-606279.php>  
<https://www.itdz-berlin.de/>

## 2.4.1 Intents and Slots

 **To-DO**: explain json

OnLaunch IntentHandler intent is triggered by utterance account verlinkungen etc provided in JSON for value lookup, there are

Figure 2.1: Dienstleistungen.json - Primary Nodes

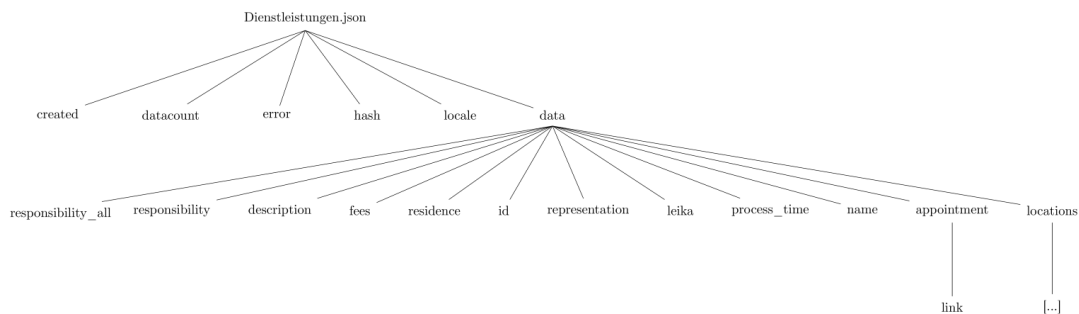



Figure 2.2: Dienstleistungen.json - secondary Nodes



- 616 Intents as `data`, each containing

 **To-DO**: missing variables e.g. are required papers, flag: persönliche Vorsprache ja nein, ...

- `<string> responsibility` denoting in which city halls a service is available

- `<boolean> responsibility_all` a flag set to true in case the service is available in all local authority offices / service points
- `<HTML list string> description` not unified and includes text
- `<string>` not unified and might need to have an `\lstinlineint`— added to it and set to 0 in case service is free
- `<int>residence`
- `<int>id`
- `representation`
- `<long>leika`
- `<string> process_time` need to derive minimum, average and maximum service times instead of a string, as well as conditions
- `<string> name` the name of the service that would make sense to a human
- `<node> appointment` with
  - \* `link` (Key value with URL to /terminvereinbarung page) - check if orphan or if it is for each behörde and in that case how it gets the right one
- `<node> locations`
  - \* `hint`
  - \* `<int> location` one of the 12 authorities
  - \* `url` of that service at that authority
  - \* `<node> appointment` (a second one)
  - .
- `<node> onlineprocessing`
- `<node> prerequisites`
- `<node> links`
- `<node> relation`
- `<node> legal`
- `<node> requirements`
- `<node> forms`
- `<node> authorities`
- `<node> meta`

## 2.5 currently deployed bot

- dienstleistungen.json structure (finding the info through hierarchical nodes)
- interpreting the nodes as intents - traversing the nodes (one level up then to next node)
- no session/no persistence

## 2.6 Implementation Possibilities

- structure of Hitlist on berlin.de is provided by ITDZ - as opposed to Versicherungsfirma z.B (ML tries to detect irregular patterns in case customer is lying). - unfortunately forums vs. FAQs did not work. if i want assistance, i want the customer to tell me the model number - and forums have mostly Schrott!

what the bot currently achieved is at least not give wrong answers, sometimes says idk but it doesn't confuse u. same attitude like in german shops (nur unpassende antworten sind frustrierend!)

- Vorgehensweise: XML -> index über Lucene - > solr knoten...based on sth like when i say am 10. august it gets me masalan events..aha august ist ein monat, monat relates to calendar, calendar relates to events

# Chapter 3

## Skill Implementation: 「 Dienstabfrage 」

- as an example for voice
- System Specifications
- System Structure
- UML Diagrams
- Design Choices
- scopes and granularity

### 3.1 All about Alexa

[https://en.wikipedia.org/wiki/Amazon\\_Alexa](https://en.wikipedia.org/wiki/Amazon_Alexa)  
<https://medium.com/@robinjewsbury/how-to-create-bots-and-skills-for-facebook-messenger-and-amazon-echo-4>  
- Alexa Appstore had over 5,000 functions ("skills") available for users to download,[18] up from 1,000 functions in June 2016. McLaughlin, Kevin (16 November 2016). "Bezos Ordered Alexa App Push"Paid subscription required. The Information. Retrieved 20 November 2016.

Perez, Sarah (3 June 2016). "Amazon Alexa now has over 1,000 Functions, up from 135 in January". TechCrunch. Retrieved 5 August 2016.

### 3.2 Difference Between Lex and Alexa Skills

<https://stackoverflow.com/questions/42982159/differences-between-using-lex-and-alexa#URL>  
<https://aws.amazon.com/lex/faqs/>

<https://aws.amazon.com/about-aws/whats-new/2017/09/export-your-amazon-lex-chatbot-to-the-alexa-skills-kit/>

Amazon Lex is a service for building conversational interfaces using voice and text. Powered by the same conversational engine as Alexa, Amazon Lex provides high quality speech recognition and language understanding capabilities, enabling addition of sophisticated, natural language chatbots to new and existing applications. Amazon Lex reduces multi-platform development effort, allowing you to easily publish your speech or text chatbots to mobile devices and multiple chat services, like Facebook Messenger, Slack, Kik, or Twilio SMS. Native interoperability with AWS Lambda, AWS MobileHub and Amazon CloudWatch and easy integration with many other services on the AWS platform including Amazon Cognito, and Amazon DynamoDB makes bot development effortless.

### 3.3 APIs and SDKs

- swagger for handling JSON requests?

- <https://github.com/alexa/alexa-skills-kit-sdk-for-nodejs>

### 3.4 challenges

- und Lösungen dafür

- eine Überführung in Alexa, not writing everything new in alexa. such that when you want to do it in another system what do u want to integrate?

- use external web service maybe? in case that helps instead of alexa doing everything..

- konten hosting to be on alexa

- wo hilft mir alexa, was mach ich lieber woanders?

- Ähnlichkeitsmaße -levenstein-distanz, IFTTT

Error: There was a problem with your request: "werden?" in the sample utterance "TestIntent was soll aus dieser Skill werden?" is invalid. Sample utterances can consist of only unicode characters, spaces, periods for abbreviations, underscores, possessive apostrophes, and hyphens.

do not use "?"



## Chapter 4

### Skill Implementation: 「 Kosten-/Terminabfrage」

- as an example for text
- implementing the answer suggestions as buttons
- passing data to the Bürgeramt terminseite  
<https://console.dialogflow.com/api-client/>  
<https://console.actions.google.com>

Hey:

do this set up as prerequisites first as a deployment script

- install aws cli - install ask cli - set up a profile on AWS - ask init etc.

<https://docs.aws.amazon.com/cli/latest/userguide/cli-chap-getting-started.html>

There is no AWS credential setup yet, do you want to continue the initialization?

<https://developer.amazon.com/docs/smapi/quick-start-alexa-skills-kit-command-line-interface.html>

Manage IAM roles (User, groups, rights, policies etc.)

all logs go onto cloudwatch including when the request is not right etc...can be helpful to know what users want, beyond testing

amazon does not disclose available values for their slot types (lists), but they give you examples here

===

finally, we had to resolve to the information publicly available to tailor custom scenarios

=== once you upload the new lambda, the old one is gone, unless you version it like this: <https://docs.aws.amazon.com/lambda/latest/dg/versioning-aliases.html>

=====

first i got screwed over with this Big nerd ranch then this happened: alexa-skill module - so don't use this tutorial, although very helpful for a beginner and makes you

understand what happens under the hood, it has been abstracted in many other function and the logic is no longer the same. - which explains why no one starred it

<https://github.com/matt-kruse/alexa-app>

<https://www.bignerdranch.com/blog/developing-alexa-skills-locally-with-nodejs-deploying-your-skill-to-staging/>

# Chapter 5

## Evaluation

### **To-DO:** NPR

time series a-b testing weighting use of correlations in the legal system (got, defaulting) search map predicts ur personality fear of judging, fear,... interdependence with robots likelihood of having different social circles for a lasting relationship  
- see how many use the skill after publishing

- benchmarks
- strengths and weaknesses
- challenges
- performance
- usability
- feasibility of using the studied agents
- node.js?
- amazon's system testing options (incl. Betas)
- system usability scales (ISO, DIN)
- Con: Alexa skills are listed in the amazon shop page. Sehr unübersichtlich just like prime
- impression: Amazon collects data and makes something "intuitive out of it for you". e.g. fire stick setup already had account linked before connecting to the internet! scary/funny/ but then it could be counterintuitive at some point if u want to do ur own customizations.
- removing bias in recruitment of participants (diversify based on what categories?)
- EVAL: AUC/ROC, true positives, false...no of utterances to text
- compare with Wiener Stadportal as a benchmark for a bot  
<https://www.wien.gv.at/bot/> <http://www.vienna.at/wienbot-chatbot-der-stadt->

wien-informiert-als-virtueller-beamter/5590853      <https://digitalcity.wien/wienbot-auszeichnung-fuer-chatbot-der-stadt-wien/> singaporebot

## 5.1 Results

usability metrics: - heuristic eval - guidelines (**jakob nielsen, ralf molich whitepaper**)

- biggest usability flaw
- cognitive walkthrough
- step-by-step approach
- questions..wil the user tr and achive
- pluralistic walkthrough
- panel method
- hallway testing
- A/B Test
- speed and Bottlnecks

- clientele: census / SOEP, who can use the bot
- make a small prediction (Bus Analytics)
- this Hassloch thing from MKTG

## 5.2 Discussions

- Evaluate the system:
- is it trivial to build such a bot or not / what is the aufwand
- how does it react with longer sentences? some service names are long
- what does levenstein distanz cause
- wie leicht kann ich eine antwort finden auf das was ich suche?
- how am i going to classify my tests?
- are chatbots being pushed on the market or is there a demand? (kleine Umfrage basteln?)
- how easy or difficult it is to make a bot: planing poker - varianz anschauen zw. leicht und schwer und iterativ darüber sprechen
- wo kann der Kunde (Sawa2 kan el end user or the senat in our case) help optimize the bot masalan bürgeramt beyektebo, welche Rechtsgrundlage keine auffällige Probleme masalan zay Perso, PA, personalausweis, how to introduce expert mode so that if u add it with a special character it knows what u want, just like alexa knows when u rename the lamp - refer again to use cases and exper vs personal field

# Chapter 6

## Conclusion and Future Work

### 6.1 Summary

### 6.2 Conclusion

### 6.3 Future Work

- use machine learning to rank higher demands for more popular services.
- matkhoshesh fel 7etta di awi - for now hitlist already given.
- future of bots. deren Einsatz. roles (As judges, catereres in hotels (that hotel botler)

We are going to build neurons so they can bridge together (Alexa Podcast 18) Otherwise they will forget Branches stop growing when they reach another branch Intelligenceaggreation - amplification We are voice-first approach (as said earlier: Inner voice) We do not know much about human brain /intelligence- -the point is not in taking over but making Internet more powerful (Podcast) information will appear as you need it: Voice first not voice only - less time to look at screen.

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# Appendices

## Appendix A: Abbreviations

<b>AWS</b>	Amazon Web Services
<b>ASK</b>	Alexa Skills Kit
<b>AVS</b>	Alexa Voice Service
<b>ARN</b>	Amazon Resource Name
<b>MVP</b>	Minimum Viable Product
<b>AI</b>	Artificial Intelligence
<b>NLP</b>	Natural Language Processing
<b>ML</b>	Machine Learning
<b>GUI</b>	Graphical User Interface
<b>VUI</b>	Voice User Interface
<b>ACID</b>	Atomicity, Identity, .. criteria
<b>appx</b>	approximately



## Appendix B: Glossary

<b>Intent</b>	erklärung
<b>Slot</b>	erklärung
<b>Utterance</b>	erklärung
<b>Alexa</b>	erklärung
<b>Alexa Skill</b>	erklärung
<b>Lambda Function</b>	erklärung
<b>Alexa Skills Kit</b>	erklärung
<b>Amazon Developer Console</b>	erklärung
<b>AWS Lambda</b>	erklärung
<b>Amazon Lex</b>	erklärung
<b>Amazon Polly</b>	erklärung
<b>ElasticSearch</b>	erklärung
<b>node.js</b>	Framework built on top of JavaScript
<b>Interaction Model</b>	erklärung
<b>Service</b>	bot, AWS, Berlin.de
<a href="https://docs.aws.amazon.com/general/latest/gr/glos-chap.html">https://docs.aws.amazon.com/general/latest/gr/glos-chap.html</a>	
<b>Application ID</b>	erklärung
<b>Skill ID</b>	erklärung
<b>Bot</b>	Unless otherwise mentioned, yeb2a Cha
<b>Hitlist</b>	erklärung
<b>Voice-first</b>	an always-on, intelligent piece of hardware