Oracle Digital Assistant

A Guide to Enterprise-Grade Chatbots

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Apress®

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“The only way to do great work is to love what you do.”
—Steve Jobs

Every accomplishment starts with the decision to try.

Table of Contents

About the Authors

Luc Bors is Partner and Technical Director at eProseed and member of the global eProseed CTO Office. He has over 20 years of experience in IT. He is a certified specialist in Oracle Application Development Framework (ADF), Oracle MAF, Oracle MCS, Oracle JET, and Oracle Digital Assistant (ODA). He is very interested in new technologies such as chatbots, Digital Assistants (DAs), and IoT.

Luc was promoted to Oracle ACE Director in 2015 because of his experience and knowledge and for his willingness to share with the community. In 2017 he was among the first to become an Oracle Developer Champion, currently known as Oracle Groundbreaker Ambassador. He is the author of the book *Oracle Mobile Application Framework Developer Guide*, is a speaker at international conferences, and regularly publishes articles on his blog and in several printed and digital magazines.

Ardhendu Samajdwer is Senior R&D Architect and UI Consultant at eProseed. He has over 12 years of experience in the IT industry and is Oracle Cloud Platform Enterprise Mobile 2018 Certified Associate Developer. He has been part of development and maintenance of various projects involving migration and implementation of enterprise-level applications. Ardhendu is currently working on Oracle Platform as a Service (PaaS) offerings such as Visual Builder Cloud, Mobile Cloud, and Chatbots in addition to front-end technologies including Oracle JET and React. Lately, he has started making appearances, as a speaker, in OUG conferences.

Mascha van Oosterhout is User Experience Consultant at eProseed. She has a master's degree in industrial design engineering from the Faculty of Human Factors and Design at Delft University of Technology in the Netherlands. She has been a user experience design (UXD) consultant for more than 20 years. She has worked in both private sector companies and public sector organizations and in support of start-up initiatives.

Mascha is experienced in designing, reviewing, and testing graphically clear and user-friendly interfaces. She has passion for putting the end user first and foremost. She gathers user requirements and then specifies interaction design by means of wireframes and graphical layouts. Recently she has increased focus on chatbot dialogs because she is convinced that, in many contexts, conversations are a more natural way to interact than through a graphical interface. She is an expert in user research techniques such as persona modeling, formulating user scenarios, interviewing stakeholders, doing cart sorting research, and usability testing.

About the Technical Reviewer

Frank Nimphius is Master Principal Product Manager at Oracle Corporation. He joined Oracle Product Management more than 20 years ago and has been involved in the development of several Oracle products, including Oracle Forms, Oracle JDeveloper, the Oracle Application Development Framework (ADF), and Oracle Mobile Hub (OMH). In his current product management position, Frank works in the Oracle Digital Assistant (ODA) group that builds Oracle's strategic conversational AI platform. For the last 20+ years at Oracle, Frank enjoyed the many opportunities the product management role offered and became a book author, technical trainer, speaker at international conferences, author of technical collateral and trainings, Java and JavaScript developer, and blogger.

Acknowledgments

This is from Luc:

Never say never again; this is my lesson learned. When I finished my first book some 4 years ago, I was convinced that I would never ever write a book again. Somehow that changed when Oracle released their Digital Assistant. I immediately was and still am convinced of the power of this product and the added value that it provides for our customers.

My urge to share knowledge and the passion for new technologies took over and made me change my mind and tricked me into writing again.

Thanks to Lonneke Dikmans who expressed her support to this project and suggested that I should set up a team of coauthors to make this happen. I could never have done this without the help of Mascha and Ardhendu who added a tremendous amount of effort, enthusiasm, and humor to this project. Thanks to you both for that! Without you, this book would have never been written.

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This is from Mascha:

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Thank you, Luc, for asking me to cooperate in making this happen; without you, I would never have enjoyed this opportunity of being able to write about the other side of coding a digital assistant, namely, the user side. Being a user experience designer, I always put the user first and foremost. We **sell** and **develop** Digital Assistants for our **customers**, but we **create** them for their **users**.

I also want to thank Lonneke Dikmans and Ronald van Luttikhuizen for encouraging and supporting me and many times expressing their enthusiasm about the book.

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Finally, I want to thank my beloved parents, for being enthusiastic and proud of me, for believing in me, and for always reassuring me by saying "Als iemand kan schrijven, ben jij het."

Introduction

Chatbots, or nowadays mostly called Digital Assistants, found their way into the enterprise. They assist users to execute administrative tasks in an interactive way, making these tasks simpler and less time-consuming. Throughout the book, you will learn to understand the core concepts of Digital Assistants.

This book provides you with an on-ramp to the development of enterprise-grade chatbots and digital assistants. It is based on real-life experience and explains everything you need to know to start building your own digital assistant (DA) using Oracle technologies. By reading this book, you will become familiar with the concepts involved in DA development from both a user experience and a technical point of view. You will learn to create Digital Assistants using Oracle technologies, including the Oracle Digital Assistant Cloud.

In the first part of the book, you will learn the basic principles of digital assistant – AKA chatbot – technology. After this you will be guided through the steps involved in designing a Digital Assistant, including how to make sure that the user receives a satisfying experience when using the assistant. In the second part of the book, you will learn how to implement the digital assistant that was designed in the first part. You'll begin with a basic implementation, later enhancing that implementation with multilanguage support, Q and A (QnA), and Webviews. The final part of the book adds a deep dive into custom component development, sentiment analyses, and speech.

This book is intended for designers and developers who want to implement digital assistants using Oracle technologies and cloud platform. This book is ideal for readers new to creating digital assistants and covers aspects of design, including user experience design, before moving into the technical implementation. Readers experienced in creating digital assistants on other platforms will find the book useful for making the transition to Oracle technologies and the Oracle Digital Assistant Cloud.

> **Chapter 1.** This chapter introduces Oracle Digital Assistant as a platform for developing apps for natural conversational interfaces. The platform makes it easy to build sophisticated digital assistants or simple chatbots that can connect and extend multiple backend systems, like Oracle ERP, HCM, and CX.

Chapter 2. In this chapter, you will find answers to key questions that you face when designing Digital Assistants. What is the business pain we are trying to solve? What is the existing journey users take and how can it be improved? What is the appropriate channel to reach the users and how can it best be used? What is the conversation between the bot and user and the dialog option and how can the dialog be enhanced to use the channel's properties, media, and facilities to improve the user interactivity? What are the key vocabulary and entities exchanged in the dialog and needed to access the backend systems? Many, many questions that need to be answered before the actual implementation can be achieved.

Chapter 3. To make sense of the technical implementation of the Digital Assistant, in this chapter, you will be introduced to Travvy, the Digital Assistant for Extreme Hiking Holidays. Using a step-by-step approach, you will get acquainted with Travvy so you know all the ins and outs in order to understand all the steps of the technical implementation.

Chapter 4. In this chapter, you will learn how Oracle Digital Assistant allows developers to sit with designers to enter the initial flow into the Digital Assistant Cloud. This will speed up the transition between design and technical implementation, as the designer actually can see how the DA behaves and how the flow is executed.

Chapter 5. This chapter explains the areas involved in the technical implementation, such as flow, intents, and entities. Together these form the heart and body of your digital assistant. You will learn to implement and understand this and how to use the training facilities in order to make your DA understand what the user means.

Chapter 6. In this chapter, you will introduce your Digital Assistant to the user. You will learn how to configure channels. The DA can run on any messaging service that supports webhooks, calls that allow real-time messaging without polling

Chapter 7. This is where you learn how to implement multilanguage support: You can use multiple-language approach or single-language approach. The latter is what is used by Oracle Digital Assistant, extended with the use of translation services.

Chapter 8. Natural language conversations are, by their very nature, free-flowing. But they may not always be the best way for your bot to collect information from its users. For example, some situations, like entering credit card or passport details, require users to enter specific information (and enter it precisely). To help your bot's users to enter this type of information easily, your bot can call an external application, which provides forms with labels, options, choices, check boxes, data fields, and other UI elements. You will learn how to achieve this by using Webview components.

Chapter 9. Frequently asked questions (FAQs), by their very nature, are common questions that are simply looking for an answer: "What are your opening times?", "Can I use my credit card?", "How many times a week do you deliver?" These FAQs (or QnAs) often already exist in a company. In this chapter, you will learn how to bring them into your bot.

Chapter 10. You will learn how to build Custom Components. Whenever the Digital Assistant needs a specific action that's outside of the functions provided by the built-in components, such as returning backend data or implementing business logic, we need to use a custom component. These components are specific to the use case, so they need to be specifically built.

Chapter 11. The reasoning behind using sentiment analysis is human psychology. When they feel happy or neutral, people tend to take bad news or frustration in a more accepting way. By understanding context right from the beginning, a chatbot can select the best course of action and apply very different patterns. You will learn how to add sentiment analyses to your Digital assistant, and in addition to that, you will learn how to implement speech as a channel.

We have created a weblog dedicated to this book and the Digital Assistant in general:

https://oda-book.blogspot.com/

This weblog will be used to post additional content and other articles that can be used to build great Digital Assistants.

No prior knowledge of chatbot technology is assumed. Everything you need to know to become a master is contained in this book. We hope you enjoy this book!

PART I

Foundations

CHAPTER 1

Introduction to Oracle Digital Assistant

Over the past decades, the size of computers has changed from huge warehouse-sized supercomputers to tiny pocketsize smartphones. The way people interact with computers or use programs has changed too. From client server or browser based on desktop and laptop to the use of apps on tablet and smartphone. Over the last couple of years, the use of apps has changed drastically. Where originally there used to be "one app for each task," nowadays more and more people want to have "one app for all tasks." The use of messaging apps such as WeChat, Snapchat, Skype, Slack, and Facebook Messenger has exploded. Besides that, virtual private assistants such as Google Home, Amazon Echo, Apple Siri, and Microsoft Cortana found their way into people's lives. Let's have a look at how this happened and how Oracle took the opportunity to fill a gap between consumer use and enterprise use.

A Brief History of Chatbots

The history of chatbots started about 70 years ago when Alan Turing[1] stated that a truly intelligent machine is one that cannot be distinguished from a human in a text-only conversation. Eventually this led to the "Turing Test" which can be used to prove whether a machine is truly exhibiting intelligent behavior or not. In his 1950 paper "Computing Machinery and Intelligence," he laid the foundation of what we now know as chatbots or Digital Assistants.

[1] **Alan Turing is** often called the father of modern computing. He was a brilliant mathematician and logician. He developed the idea of the modern computer and artificial intelligence. During the Second World War, he worked for the English government breaking the enemy's codes, and Churchill said he shortened the war by 2 years.

L. Bors et al., *Oracle Digital Assistant*, https://doi.org/10.1007/978-1-4842-5422-6_1

About 15 years after Turing, MIT AI Laboratory created ELIZA. This was a natural language processing computer program, able to simulate human conversations, based on scripted responses. Where many early users were convinced of ELIZA's intelligence and understanding, in fact ELIZA was not able to have a conversation with true understanding, and it did not take a very long time before it became very obvious that you are talking to a machine

Shortly after ELIZA, in 1972 PARRY was created at Stanford University. PARRY was the first "chatbot" that actually had a conversational strategy. During the first International Conference on Computer Communications in 1972, PARRY and ELIZA were set up to talk to each other.

From ELIZA and PARRY to the next milestone in "chatbot" history, it took almost two decades. In the late 1980s, Jabberwacky was developed. Jabberwacky (still online at `www.jabberwacky.com`) aims to simulate natural human chat in an interesting, entertaining, and humorous manner. Jabberwacky is the first "chatbot" that uses artificial intelligence and as such is able to learn. It learns from the conversations that it has had in the past.

At the end of the last century and the beginning of the millennium, other "chatbots" made their appearance such as Dr. Sbaitso, ALICE, and SmarterChild. ALICE (Artificial Linguistic Internet Computer Entity) was based on ELIZA. Even though ALICE can set up a conversation with a user, based on user input and pattern recognition, ALICE has never been able to pass the Turing Test.

The next-generation chatbots included bots from big vendors such as IBM Watson (2006), Apple Siri (2010), Google Now (2012), Amazon Alexa (2015), and Microsoft Cortana (2015). In 2016, Facebook introduced bots for Facebook Messenger that by the end of the year had over 30,000 bots available.

Chatbots are generally used as interfaces, such as extracting product details. Chatbots are task oriented, whereas digital assistants are user focused. Digital assistants provide the ability to combine different chatbot tasks to a single conversation. These assistants can really assist users with tasks such as reminding you of meetings, managing your to-do lists, and so on. When a chatbot is asked to provide such virtual assistance, they usually get confused and ultimately keep asking the same questions for clarification. It is very important to understand that artificial intelligence is not all that it takes to build chatbots. Other skills, including UX and conversation design, play an important role. Bad design can even make a digital assistant fail. Even though chatbots and digital assistants are both considered conversational interfaces, they are very different. One of the biggest differences can be found in how the two maintain

conversational flow. When interacting with chatbots, if you interrupt the conversation in between, the chatbot will most probably fail to remember the context of the interaction, whereas virtual assistants use dynamic conversation flow techniques, so they can understand human intent and keep the flow going.

The following example shows how a well-designed assistant can cope with context change from booking ticket to checking balance:

"I like to **book a ticket** for the Taylor Swift concert in Amsterdam."

- Sure, any preference for where you want to enjoy the gig? We have category A for 84 Euro, category B for 60 Euro, and category C for 35 Euro.

"**How much money** do I have?"

- Which account do you want to know your balance for? A) Savings. B) Credit card. C) Checking account.

"C, checking."

- Well, you have 1500 Euro available.

"Two tickets, category A please."

- Sure. Are you interested in a Taylor Swift merchandise too? We have them on account today.

Most Digital Assistants nowadays go beyond providing simple "request and response" features. They are changing big time the way that brands engage with their customers.

Oracle Digital Assistant

The majority of the aforementioned chatbots were aiming for personal use. Although they could also be used in enterprise solutions, looking at requirements, there were many gaps between what the solutions offer and what the enterprise needs.

Bridging the gap between personal Digital Assistants and enterprise-grade Digital Assistants is exactly where Oracle aims to be, and by the end of 2016, Oracle released their first version of Oracle Digital Assistant. At that time, it was called Oracle Chatbot, and it was part of the Oracle Mobile Cloud Service. Some 2 years later, Oracle released

Oracle Digital Assistant (ODA) cloud service, a product dedicated to developing and running digital assistants. Digital assistants are virtual personal assistants that understand natural language when interacting with users. Typically, simple chatbots resolve users' intent and help them to complete a simple task. Oracle Digital Assistant goes one step beyond that. Each digital assistant contains a collection of specialized skills. The assistants can be trained to use these multiple different "skills." These skills can have their own backend domain integrations and can be used in the course of an across-skill user conversation to work with these backends. They will evaluate user input and invoke the appropriate skill to start or continue the conversation.

Through this approach, everything a user needs to do can be done in a single conversation, without the need to work with multiple chatbots. Users can also switch in the middle of a conversation, and the Digital Assistant will still understand the context of the users' questions. Sharing of context between the skills is key to success and very important in providing a good user experience. Think of something like someone's location, mood, or needs in a particular moment. These attributes can impact what messages the user will be receptive to and, even more critically, when and where.

Oracle Digital Assistant is also capable of initiating a conversation with a user, based on scheduled events that are received from external applications. This is called Application-Initiated Conversation (AIC). The Oracle Digital Assistant can use content of the application's event message to begin a conversation at a predetermined state in the dialog. This is something that differentiates Oracle Digital Assistant from other chatbots, which typically only "speak when spoken to."

Oracle Digital Assistant Core Components

To get a clear understanding of Oracle Digital Assistant (ODA), you need to know its high-level architecture. Oracle Digital Assistant consists of a set of components working together to enable the development and use of enterprise-grade digital assistants. In this section, you will learn what these components are and what their main purpose is.

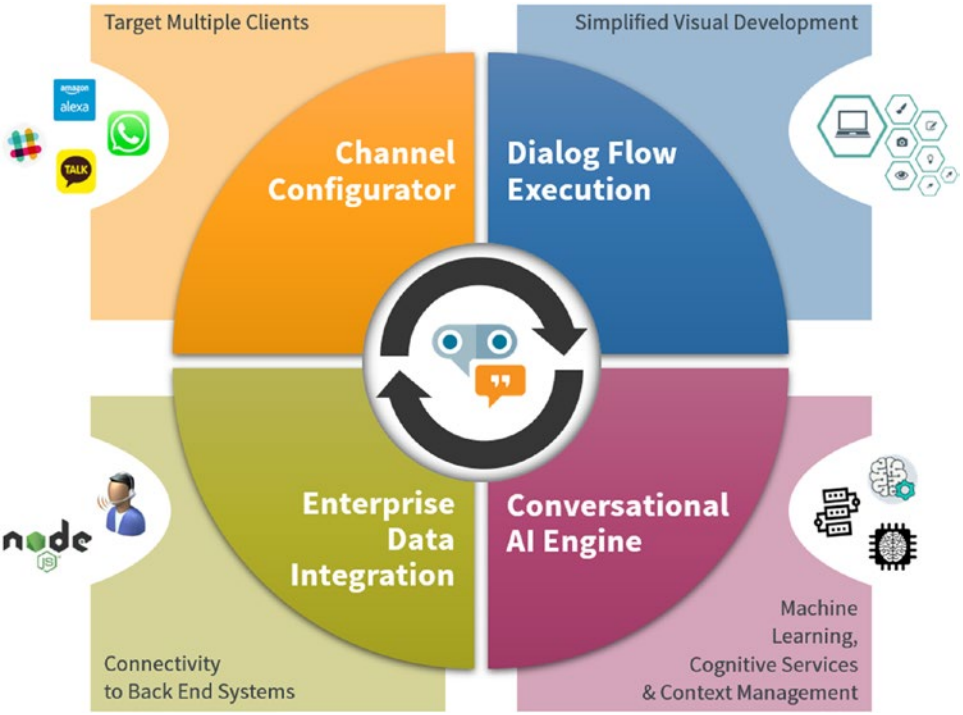

Figure 1-1. *Oracle Digital Assistant – core components*

The Oracle Digital Assistant is a Platform as a Service (PaaS) that enables you to create digital assistants and to expose these to many different interfaces, called channels. Oracle Digital Assistant allows you to create both **Digital Assistants** and **Skills**.

Digital assistants can help users to do multiple tasks in natural language conversations. Each digital assistant typically has its own set of skills.

Skills can be seen as conversational workhorses that can be used with one or many digital assistants. Think of tasks such as ordering flowers in a specific shop or checking the balance on a bank account. With Oracle Digital Assistant, the use of a skill is not limited to a single digital assistant.

Implementation of Skills and Digital Assistants relies on four core components (Figure 1-1) working together:

- The conversational AI engine
  - Enables the Digital Assistant to work with user input
- The dialog flow
  - Defines the interactions that users can have with a specific skill

- Enterprise data integration
  - Enables Digital Assistants to connect to backend systems via their skills
- The channel configurator
  - Enables Digital Assistants to be used in messaging platforms

Before we dive into the development of skills and digital assistants, you need to get some understanding of some of these concepts, which will be explained in the remainder of this chapter. We will first have a look at the conversational AI engine.

Conversational AI Engine

When using Oracle Digital Assistant, you do not have to worry about the technologies that are used to process and understand the natural language or how to work with user input. Oracle Digital Assistant uses different technologies based on neural networks to implement its own conversational AI engine (Figure 1-2). These use linguistic and language modeling to enable processing of natural language from the end user.

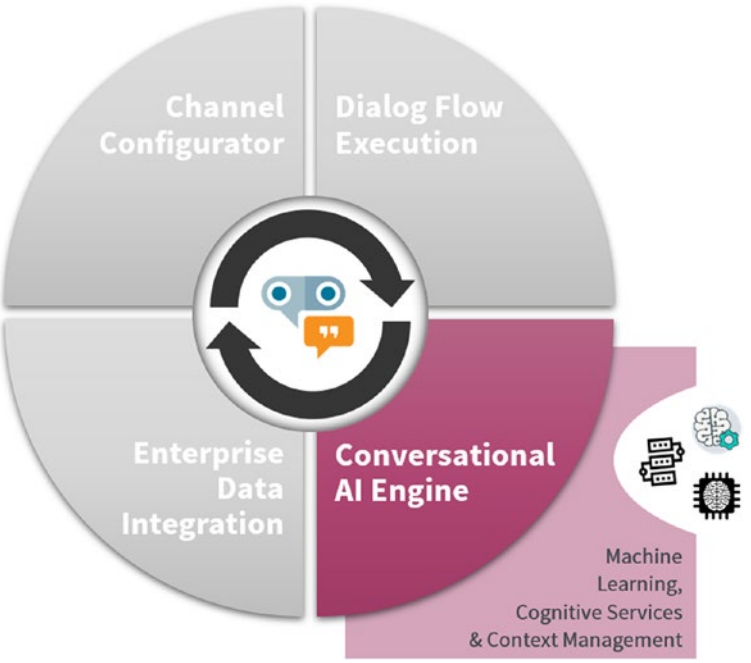

Figure 1-2. *Oracle Digital Assistant – conversational AI engine*

With this in place, the developer can focus on the user conversations instead of having to know all the nitty-gritty details of these underlying algorithms.

Both intents and entities are common NLP (natural language processing) concepts. NLP is the science of extracting the intention of text and relevant information from text.

Intents are groups of tasks or actions that a user expects your skill to perform for them. Intents usually include verbs and nouns such as "give quote," "get dates," and "find trip." They allow your skill to understand what the user wants it to do. In other words, they can determine the users' intent. For instance, a "FindTrip" intent can relate to a direct instruction, such as *I want to find a trip*, but also to other requests, like *I'm really in for a short holiday*, both of which are **utterances** for the same intent.

Whereas intents map words and phrases to a specific action, **entities** add context to the intent itself. They are key identifiers for pieces of user input which enable a skill to fulfill a task. Basically, entities are words that modify the intents (big, modern, outdoor, short, best available). Entities can be divided into user-created entities and system entities. All of the aforementioned concepts will be discussed in more detail throughout this book.

Dialog Flow Execution

The next component to introduce is the **dialog flow** (Figure 1-3). A dialog flow defines the possible interactions users can have with a skill. It describes how a skill responds and behaves according to user input.

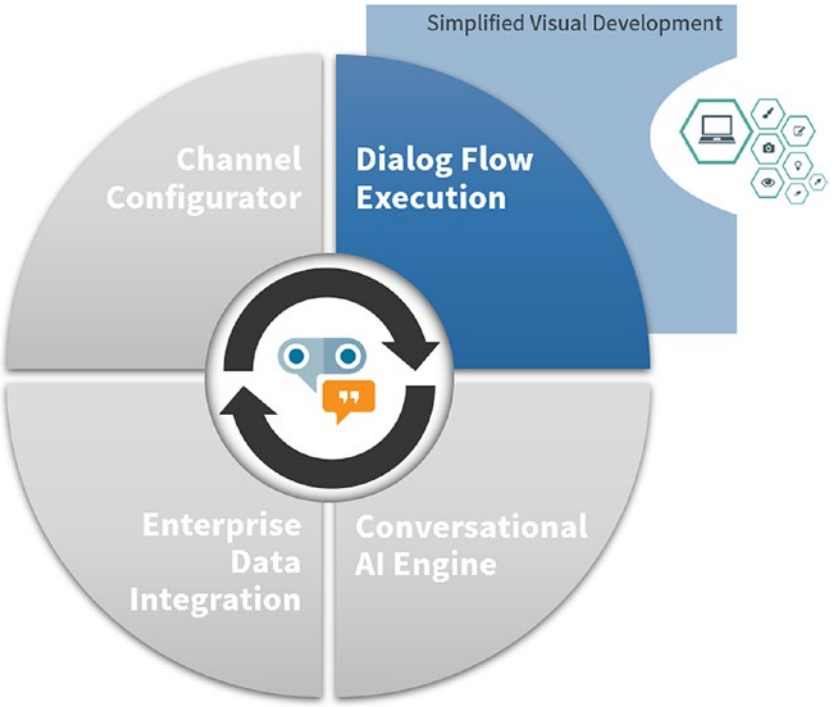

Figure 1-3. *Oracle Digital Assistant – dialog flow execution*

Oracle Digital Assistant enables you to define a context-aware conversational dialog. To have a context-aware dialog is very important as an end user will not necessarily stick to the matter and can potentially branch off into different states and context during a conversation. For example, if a user wants to buy flowers, but before he can continue to the payment, he has to check the balance on his account.

At some point in the flow, they would instruct the assistant to "Pay the flowers." The response of the assistant could be "from which account." The user would pick "Checking Account" but actually has no clue how much money there is in that account. Then the user would switch context to ask for the current balance. In other words, change the state from transferring money to the flower shop to checking balance. At some point, the user will decide to return to paying the flowers.

The Oracle Digital Assistant platform enables you to work with these kinds of scenarios with built-in state management. You as a developer do not have to code and maintain the solution.

Enterprise Data Integration

When creating enterprise-grade Digital Assistants, it is somewhat obvious that these also need to have a way to access enterprise data (Figure 1-4). Oracle Digital Assistant facilitates connections to backend systems. It helps you extend backend systems such as Oracle HCM, Oracle ERP, and Oracle CX. However, you are not limited to Oracle products. You can also connect to third-party applications. All of this can be done, as can be expected from enterprise solutions, in a secure and scalable manner.

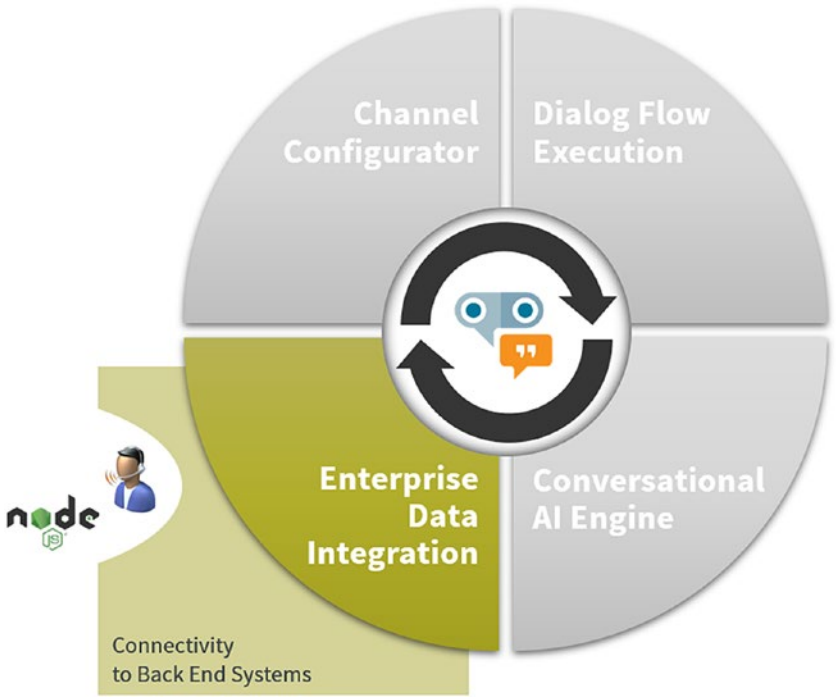

Figure 1-4. *Oracle Digital Assistant – enterprise data integration*

For the integration of enterprise data in Oracle Digital Assistant, you can use **custom components**. They provide your skill with generic functions like outputting text, or they can return information from a backend and perform custom logic. You as a developer can create custom components, developed in JavaScript and deployed onto a Node.js server. Custom components can be invoked during a dialog flow to retrieve information from backend systems or to perform transactions in backend systems. Of course, these actions will use APIs that you have to make available in your backend systems.