

Geoffrey Shmigelsky

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Milestone #1: Chatbot Demonstration

Educational Cognitive Agent in Virtual Reality

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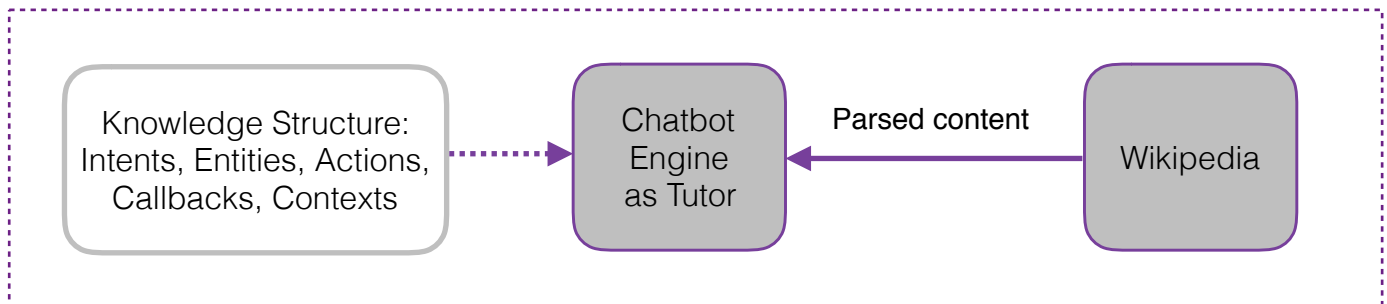
Project Summary

I am creating a Cognitive Tutor that exists in Virtual Reality. It is designed to give a small course on the Serengeti and answer questions about the park. Acting both as an instructor and tutor, a Chatbot engine provides the intelligence and conversational capabilities.



MileStone #1 Proposal

For the first milestone, the deliverable is a functional Chatbot trained on Wikipedia content for the Serengeti and related pages. The chatbot is to be testable using either FaceBook Messenger, Slack or Kik. It will include short lectures and question/answer session.

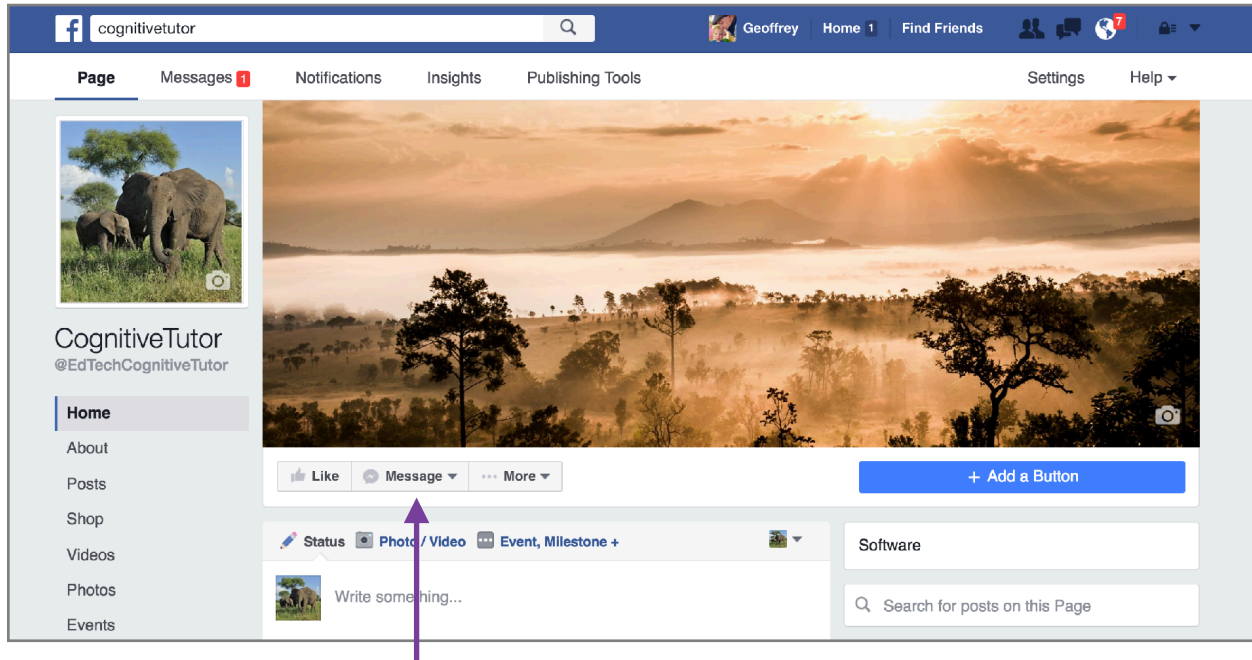


Prototype Chatbot

As per the discussion with my mentor, the Chatbot will be accessible through Facebook Messenger. I have named her AIVRE (pronounced Avery), it is an acronym for:

Artificial Intelligence Virtual Reality for Education

Chatbot Access from Facebook Page



Trying out the Chatbot is best done Facebook Messenger. Each Messenger app requires a corresponding Facebook page, found here: [Facebook page](#). The Messenger chatbot is accessible by clicking on “Message” above. Please keep in mind AIVRE is only partially trained, but she can answer questions about people (Einstein), do math, take notes, search the web, find images.

How the Chatbot is Built

Implementation of the Chatbot consists of numerous components working together. First, content from Wikipedia is migrated into [API.ai](#). For the prototype, this is done manually, but I intend to make the process automatic using a [Python library](#) called Wikipedia 1.4.0. API.ai communicates with Facebook Messenger thanks to Node.js middleware hosted on [Heroku](#).

Components	Function
Wikipedia Content	A series of web pages containing paragraphs and facts about the Serengeti.
Python Wikipedia	A tool to parse Wikipedia pages into dictionaries and arrays.
API.ai	The chatbot engine that takes human input in the form of text and speech to text, determines intents, context and corresponding actions.
Facebook Page	Launch point for the Messenger app.
FB Messenger	Corresponding Messenger client that talks to API.ai.
Heroku	Hosted middleware to facilitate communication between Messenger and API.ai for formatting, testing and additional logic.

Schedule	Tasks
Week 1	Final decision between chatbot engines, Wit.ai, API.ai, or IBM Bluemix.
Week 2	Manually download content into Chatbot from Wikipedia
Week 3, MileStone #1	Connect Chatbot to Messenger, automate wikipedia import into Chatbot

Schedule and Progress

In the first week, the decision was made to go with API.ai vs Wit.ai or IBM Bluemix. I did a detailed comparison to find which work best in VR, API.ai had the most complete Unity Asset Store package.

In the second week, I began uploading content into API.ai for testing, initially building a pizza ordering app and a youtube alarm clock. Limited content from Wikipedia was loaded in to test various import strategies. Specifically how to address the issue of retaining conversation context between topics.

In the third week, I began uploading significant amounts of Wikipedia content. I also gave AIVRE a personality, added the ability to answer math questions and for her take notes. She can address questions about historical figures, lookup content on the Internet, remember your name and even provide images.

Most importantly I activated a layer between API.ai and Facebook Messenger on Heroku. Allowing for the editing of communication between the two platforms. The [Github](#) repo is publicly available being a fork of an open source project. This means it is possible to chat, test and debug AIVRE in real time using Messenger.

I have only run into two problems. The first is a bug in the Wikipedia Python library where it will not download the table of contents, which is preventing the autoloading. The second is contexts in API.ai; once a context lost, there is no way to get it back. The issue is they need to be set at the end of every communication, which makes it possible to loose context with the wrong question. When AIVRE loses context, the conversation sounds robotic and disjointed. It is obvious when this happens in Messenger, but I think can solve with problem with JSON inside the VR Agent.

Wikipedia

In the Wikipedia image below of the Serengeti, API.ai is loaded with this specific content. Please note the Table of Contents, paragraphs of content for History, facts to the right, and related images.

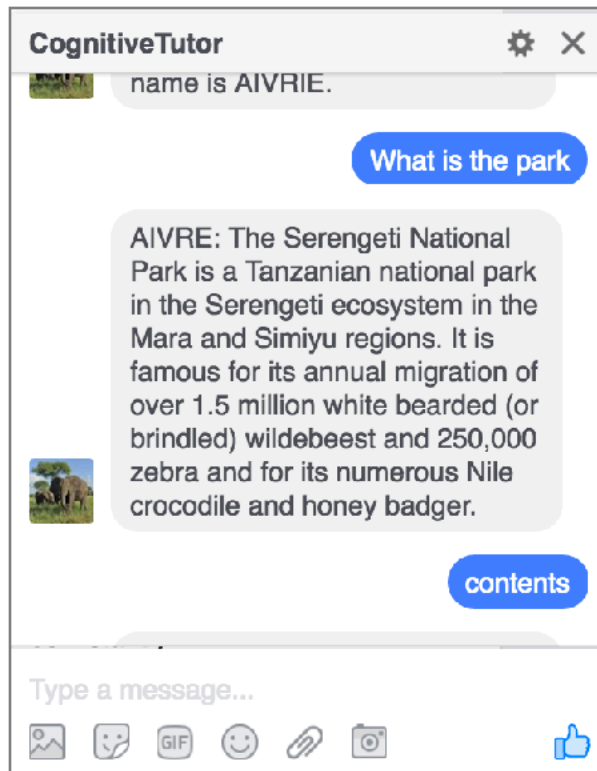
The screenshot shows the Wikipedia article for Serengeti National Park. At the top, it says "Not logged in" with links for "Talk", "Contributions", "Create account", and "Log in". Below that are "Article" and "Talk" tabs, and "Read", "Edit", and "View history" buttons. A search bar is on the right. The main heading is "Serengeti National Park" with coordinates "2°20'S 34°34'E". The text describes it as a Tanzanian national park in the Serengeti ecosystem, famous for its annual migration of over 1.5 million white bearded (or brindled) wildebeest and 250,000 zebra, and for its numerous Nile crocodile and honey badger. A table of contents lists 11 sections: 1 History, 2 Geography, 3 Wildlife, 4 Administration and protection, 5 Proposed road across the northern Serengeti, 6 Proposed extension of park boundaries to Lake Victoria, 7 In popular culture, 8 Properties and lodges, 9 References, 10 Further reading, and 11 External links. The "History" section begins with "The Maasai people had been grazing their livestock in the open plains of eastern Mara". On the right, there is a photo of a savanna landscape and a map of Tanzania showing the park's location. The sidebar on the left contains navigation links like "Main page", "Contents", "Featured content", "Current events", "Random article", "Donate to Wikipedia", "Wikipedia store", "Interaction", "Help", "About Wikipedia", "Community portal", "Recent changes", "Contact page", "Tools", "What links here", "Related changes", "Upload file", "Special pages", "Permanent link", "Page information", "Wikidata item", "Cite this page", "Print/export", "Create a book", "Download as PDF", "Printable version", and "In other projects", "Wikimedia Commons".

The Contents sections forms the list of topics that the Chatbot is aware of and provides the sequence of the lecture(s). For example, History, Geography, and Animals are valid topics. Each topic forms a sub-lecture in the course of the Serengeti. Looking at History, you can see how “The Maasai people” is the first paragraph.

To the right are images API.ai can display and facts it can learn about the Serengeti. You can literally ask AIVRE where the park is and she knows it’s country/longitude/latitude. AIVRE also does intelligent organizing; she realizes that crocodiles and zebras are a type of Wildlife.

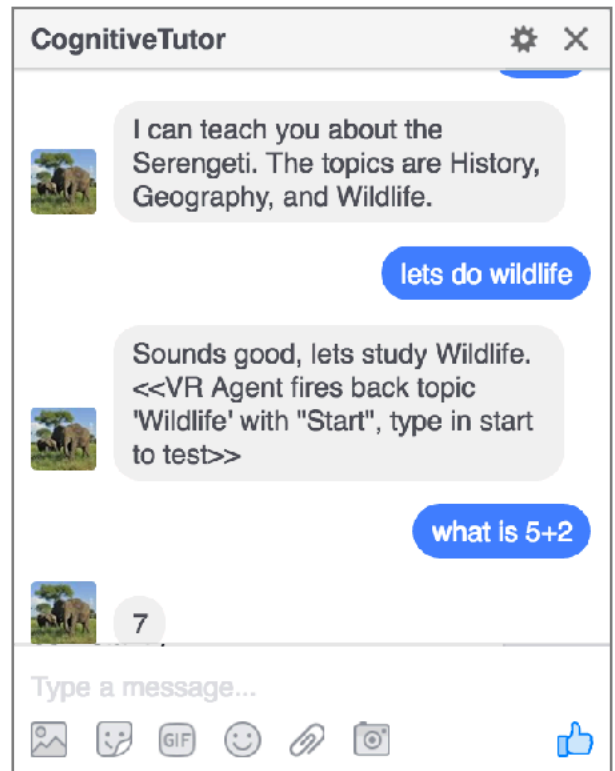
Chatbot Examples

These images represent screen shots of Facebook Messenger as I chat with AIVRE. I can communicate with AIVRE using the keyboard or my voice. My goal is to get her smart enough that the conversation is almost human like for the specific topic of the Serengeti.



In the image above, AIVRIE has told me her name and is telling me about the Serengeti National Park. Note how she knows that when I say “park” she knows it means the Serengeti.

Her answer is verbatim from the first paragraph of Wikipedia. Which means I can use Wikipedia to give a short summary of almost any topic. The idea is for her to be able to answer questions about any link that exists on the Wikipedia pages of the Serengeti, for example, by explaining what is the Mara region.



In this image, AIVRE is performing two key functions.

First, she is listing topics she can talk about given her current level of training. Once Wildlife is chosen, it becomes the **active context**.

Second, AIRVE is also showing what she is expecting the VR client to send back to initiate changes in conversation state. She is also showing off some math skills.

What is not shown here is the extensive JSON structure she has sent back, but it is quite important.

Further Training

AIVRE communication with humans only improves with each conversation. Every time she is unable to match a human's input to a matching intent, it gets flagged as an error. I can easily go in and improve AIVRE by helping clarify her understanding. Specifically by matching unrecognized input to the proper intents and contexts. She uses Machine Learning to improve her heuristic mapping of English expressions.

Another aspect of training is using all links as topics AIVRE should be able to answer - they become Entities in API.ai. This data is easily accessible in Python Wikipedia. By pulling the summary pages of every relevant link on a Wikipedia page, it possible for AIVRE to provide a summary of almost every relevant topic that a user may question her on.

Finally, Using Google's McParseFace deep learning library, it is easy to parse the entire Wikipedia page into nouns, verbs, prepositions etc. By doing a Python Set interesting all the nouns on a page with all the links, it is also possible to identify any missing nouns that AIVRE should be aware of. Likewise, by rewording the parsed content into questions, it provides additional training examples for API.ai. It is best that API.ai has about half a dozen to a dozen Q&A examples to work with to determine a users's Intent.

API.ai provides the core of the intelligence of AIVRE, as with any machine learning applications, the more data the better. AIVRE retrains on every new example, error or correction, learning in almost real time.

Conclusion

AIVRE is functioning as a Chatbot in Facebook Messenger. She is not perfect, but she does have the core content of the Serengeti course. More so she can give a small lecture and answer factual questions. Using Messenger it is possible to provide human communication via the keyboard and voice commands. With Heroku I can track and debug any miscommunications. Once I have loaded 20 to 30 pages of Wikipedia, her knowledge of the Serengeti, its history, people and wildlife will be quite deep. Keep in mind that using Facebook Messenger is only a stepping stone, the true interface to the Chatbot will be inside Virtual Reality.