







# Set Up a RAG Chatbot in AWS Bedrock

 <p>Today is my best friend's wedding. Explain his wife who he really is.</p>	 <p>What is the latest update on the Express Entry for PR?</p>
 <p>[REDACTED] is a complex person with a childlike "needy mode" that he occasionally falls into. He loves himself and can be quite particular about his hobbies and interests. Despite his popularity, he is a romantic at heart and is head over heels for his wife.<sup>[1][2]</sup> <a href="#">Show details &gt;</a></p>	 <p>The latest update on Express Entry for PR is that Immigration, Refugees, and Citizenship Canada (IRCC) has announced the 2025 Express Entry categories, which include new and updated categories. The new category is Education, and the Transport category has been removed. IRCC has also added social services occupations to the healthcare category.<sup>[1][2]</sup> <a href="#">Show details &gt;</a></p>
<input type="text" value="Enter your message here"/> 	<input type="text" value="Enter your message here"/> 

***Ryoichi (Rio) Homma***

***March 2025***

# Table of Contents

<b>Introduction .....</b>	<b>3</b>
<b>Used Tools &amp; Concepts .....</b>	<b>3</b>
<b>Objectives .....</b>	<b>3</b>
<b>Project Challenges .....</b>	<b>4</b>
<b>Amazon Bedrock .....</b>	<b>4</b>
<b>Data Source .....</b>	<b>4</b>
<b>Amazon S3 .....</b>	<b>4</b>
<b>Web Crawler .....</b>	<b>5</b>
<b>Knowledge Base Configuration .....</b>	<b>7</b>
<b>AI Models .....</b>	<b>8</b>
<b>Knowledge Base Synchronization .....</b>	<b>9</b>
<b>Testing My Chatbot .....</b>	<b>10</b>
<b>Demonstration .....</b>	<b>11</b>
<b>Performance Optimization &amp; Results with Data .....</b>	<b>13</b>
<b>References .....</b>	<b>14</b>

## Introduction:

**RAG (Retrieval Augmented Generation) chatbot** is an AI-powered chatbot that enhances AI language models by incorporating documentation as a data source. This technique enables the chatbot to provide accurate and up-to-date responses, even if the required information is the latest or unavailable online. While non-RAG chatbots rely on pre-trained data and may struggle to offer current or specialized knowledge, the RAG chatbots can retrieve information from a specific knowledge base or external sources. This makes RAG chatbots particularly useful for applications, where up-to-date information is critical, such as legal or government updates, product releases, or personalized content.

## Used Tools and Concepts:

The AWS services I used in this project were **Amazon Bedrock, S3, and OpenSearch Serverless**. Key concepts include storing data in S3, creating a Knowledge Base, requesting access to AI models, how chatbot generates responses using AI models and Knowledge Base, and utilizing vector stores for efficient retrieval.

## Objectives:

### Use Case 1 – Personalized Q&A Chatbot

Since my best friend recently got engaged, I wanted to give them something unique, meaningful, and a little humorous gift. Then, I decided to build an application integrated with an RAG chatbot that answers questions about him, allowing his fiancée to learn more about him in a fun way. This not only makes them laugh but also helps them start their new life together with a deeper understanding.

### Use Case 2 – Automated Immigration Updates

Whenever the Government of Canada announces new rules or updates regarding temporary residents and Permanent Residency (PR), I usually spend 15 to 20 minutes searching through multiple documents and sources to verify the information's accuracy. I realized that the RAG chatbot could streamline this process by providing reliable updates directly from trusted sources if I could successfully integrate with public web links in the Knowledge Base. This would significantly reduce my search time while ensuring access to accurate and up-to-date information.

## Project Challenges:

The most challenging part of this project was creating the Knowledge Base since I encountered several errors related to permission policies. I struggled to determine which permission policies to add and how to configure them in the IAM console to grant the necessary service access in the IAM account. Additionally, setting up the data source for the Web Crawler was difficult – my initial attempts to sync the data either failed or never completed successfully. By researching solutions through the AWS blog, I was able to resolve these issues. Overcoming these challenges provided valuable insights into AWS service integration and permission management.

## Amazon Bedrock:

Amazon Bedrock is one of the AWS services that simplifies the development of generative AI applications. It acts as an AI model marketplace, where developers and engineers can find, use, and test AI models from different providers like Meta. In this project, I used Amazon Bedrock to create the Knowledge Base, enabling the chatbot to retrieve relevant information efficiently.



## Data Source (Amazon S3 and Web Crawler):



### Use Case 1 – Store Documentation in S3



The Knowledge Base is linked to Amazon S3, which serves as the storage source for the Knowledge Base's row documentation. Amazon S3 is AWS's scalable storage service, where developers and engineers can store various types of objects such as documents, videos, and audio within the same bucket.

### Data source details

**Choose data source**  
Select the data source that you want to configure in the next step. You can add up to 5 data sources in a Knowledge Base.

 **Amazon S3**   
Object storage service that stores data as objects within buckets.

 **Web Crawler - *Preview***   
Web page crawler that extracts content from public web pages you are authorized to crawl.

 **Custom**   
Create a data source directly in Amazon Bedrock. A custom data source allows the flexibility to automatically ingest documents into your vector database directly.

In the S3 bucket, I uploaded the documentation that makes up the AI chatbot's knowledge. Initially, the setup did not work, but I figured out that Amazon Bedrock is a regional service soon after. This means that both the S3 bucket and the Knowledge Base must be in the same AWS region for proper integration. After ensuring they were aligned, the connection functioned as expected.

Files and folders

Configuration

Files and folders (15 total, 10.2 MB)

Find by name

Name	Folder	Type	Size	Status
<a href="#">BestFriend_EnglishVer..docx</a>	-	application/vnd.openxmlform...	304.3 KB	✓ Succeeded
<a href="#">BestFriend_FunnyEpisodes_Engl...</a>	-	application/vnd.openxmlform...	303.4 KB	✓ Succeeded
<a href="#">ISFJ Relationships.pdf</a>	-	application/pdf	315.3 KB	✓ Succeeded
<a href="#">ISFJ (擁護者タイプ) の恋愛スタ...</a>	-	application/pdf	1.3 MB	✓ Succeeded
<a href="#">ISTP Relationships.pdf</a>	-	application/pdf	314.7 KB	✓ Succeeded
<a href="#">ISTP (巨匠タイプ) の恋愛スタ...</a>	-	application/pdf	1.6 MB	✓ Succeeded
<a href="#">ISTPの恋愛傾向と相性を深める7...</a>	-	application/pdf	2.6 MB	✓ Succeeded
<a href="#">Official_ISFJ_EnglishVer..pdf</a>	-	application/pdf	285.1 KB	✓ Succeeded
<a href="#">Official_ISTP_EnglishVer..pdf</a>	-	application/pdf	285.8 KB	✓ Succeeded
<a href="#">ルールと新婦へのアドバイス.do...</a>	-	application/vnd.openxmlform...	19.7 KB	✓ Succeeded


## Use Case 2 – Add Source URLs

Instead of using S3, I selected **Web Crawler** as a data source and added source URLs. This is because the Web Crawler extracts content from the specified public web pages, enabling the chatbot to provide the latest information as long as those pages are updated. This ensures that responses remain current and reliable without requiring manual data uploads.

### Data source details

#### Choose data source


Select the data source that you want to configure in the next step. You can add up to 5 data sources in a Knowledge Base.



**Amazon S3**

Object storage service that stores data as objects within buckets.


☐



**Web Crawler - *Preview***

Web page crawler that extracts content from public web pages you are authorized to crawl.

☒



**Custom**

Create a data source directly in Amazon Bedrock. A custom data source allows the flexibility to automatically ingest documents into your vector database directly.

☐

## Source URLs

Remember that you must only use the Web Crawler to index your own web pages, or web pages that you have authorization to crawl and must respect robots.txt configurations. The web crawler will respect robots.txt in accordance to the [RFC 9309](#). It's not recommended to crawl large websites, such as wikipedia.org, without filters or scope limits. Crawling large websites will take a very long time to crawl.

### Source URLs

<a href="https://www.canada.ca/en/immigration-refugees-citizenship/news/notices.html">https://www.canada.ca/en/immigration-refugees-citizenship/news/notices.html</a>	<a href="#">Remove</a>
<a href="https://www.canada.ca/en/immigration-refugees-citizenship/services/immigrate">https://www.canada.ca/en/immigration-refugees-citizenship/services/immigrate</a>	<a href="#">Remove</a>
<a href="https://www.cbcnews.com/2025/02/breaking-canada-announces-major-changes">https://www.cbcnews.com/2025/02/breaking-canada-announces-major-changes</a>	<a href="#">Remove</a>
<a href="https://immigration.ca/immigration-to-canada-overview/">https://immigration.ca/immigration-to-canada-overview/</a>	<a href="#">Remove</a>
<a href="https://immigration.ca/canada-express-entry-immigration/">https://immigration.ca/canada-express-entry-immigration/</a>	<a href="#">Remove</a>
<a href="https://immigration.ca/express-entry-skilled-immigration/">https://immigration.ca/express-entry-skilled-immigration/</a>	<a href="#">Remove</a>
<a href="https://immigrationnewscanada.ca/">https://immigrationnewscanada.ca/</a>	<a href="#">Remove</a>
<a href="https://www.cbc.ca/news">https://www.cbc.ca/news</a>	<a href="#">Remove</a>
<a href="#">Add Source URLs</a>	

You can add 2 more URLs.

Under **Sync Scope**, I initially selected “Default”, causing errors or preventing the data source from successfully synchronizing with the Knowledge Base. To resolve this issue, I switched to “Host only” and added the following URL regex filters. This adjustment finally allowed me to complete the synchronization successfully.

## Sync scope [Info](#)

### Website domain range

Limit crawling to web pages that belong to the same host, or also crawl sub domains. Sub domains could take longer to crawl than other options.

- ☐ **Default**  
Limit crawling to web pages that belong to the same host and with the same initial URL path. For example, with a seed URL of "https://aws.amazon.com/bedrock/" then only this path and web pages that extend from this path will be crawled, like "https://aws.amazon.com/bedrock/agents/". Sibling URLs like "https://aws.amazon.com/ec2/" are not crawled, for example.
- ☒ **Host only**  
Limit crawling to web pages that belong to the same host. For example, with a seed URL of "https://aws.amazon.com/bedrock/", then web pages with "https://docs.aws.amazon.com" will also be crawled, like "https://aws.amazon.com/ec2".
- ☐ **Subdomains**  
Include crawling of any web page that has the same primary domain as the seed URL. For example, with a seed URL of "https://aws.amazon.com/bedrock/" then any web page that contains "amazon.com" will be crawled, like "https://www.amazon.com".

**ⓘ** Make sure you are not crawling potentially excessive web pages if you choose other options besides default. It's not recommended to crawl large websites, such as wikipedia.org, without filters or scope limits. Crawling large websites will take a very long time to crawl.

### Maximum throttling of crawling speed


The maximum number of URLs crawled per host per minute.

URLs/host/minute

Values between 1 and 300 URLs per host per minute. Higher values will decrease sync time but increase the load on the host.

**URL regex filter**

Add patterns to include or exclude certain URLs in accordance with your scope. For example, exclude all URLs that end

Note: [Supported file types](#)  will be crawled regardless of scope and if there's no exclusion pattern for the file type. If


**Include patterns****Exclude patterns****Regex include pattern**

[Remove](#)

A valid regular expression. The maximum of the characters is 1000.

**URL regex filter**

Add patterns to include or exclude certain URLs in accordance with your scope. For example, exclude all URLs that end

Note: [Supported file types](#)  will be crawled regardless of scope and if there's no exclusion pattern for the file type. If

**Include patterns****Exclude patterns****Regex exclude pattern**

[Remove](#)

A valid regular expression. The maximum of the characters is 1000.

## Knowledge Base Configuration:

*Note: From this step, the workflows for Use Case 1 and Use Case 2 are the same.*

My Knowledge Base uses a vector store, which is a search engine/database that stores data based on their semantic meaning. When users query the Knowledge Base, OpenSearch will find the relevant chunks of data and pass them to Bedrock for response generation.

Embeddings are vector representations of the semantic meaning of a text chunk. I selected **Titan Text Embeddings v2** as the embedding model because it is fast, accurate, and affordable.

**Chunking** is the process of splitting up text into smaller pieces or chunks. This helps improve data search efficiency within the vector store. In the Knowledge Base, chunks are configured to be approximately 300 tokens in size each.

## Review and create

### Step 1: Provide details

[Edit](#)

#### Knowledge Base details

**Knowledge Base name**

my-best-friend-rag-documentation

**Knowledge Base description**

This Knowledge Base stores all documents about my friend.

**Service role**

AmazonBedrockExecutionRoleForKnowledgeBase\_chzzf

**Knowledge base type**

Knowledge base use vector store

**Data source type**

S3

**Log Deliveries**

—

### Step 2: Setup up data source

[Edit](#)

#### Data source: s3-bucket-my-best-friend-rag-bedrock

**Data source name**

s3-bucket-my-best-friend-rag-bedrock

**Account ID**

[REDACTED]

**S3 URI**
s3://my-best-friend-rag-bedrock [🔗](#)
**Customer-managed KMS Key for S3**

-

**KMS key for transient data storage**

-

**Chunking strategy**

Default

**Parsing strategy**

DEFAULT

**Lambda function**

-

**S3 bucket for Lambda function**

-

**Data deletion policy**

DELETE

### Step 3: Select embeddings model and configure vector store

[Edit](#)

#### Embeddings model

**Model**

Titan Text Embeddings v2

**Vector dimensions**

1024

## AI Models:

AI models play a crucial role in the chatbot, as they translate the search results from the Knowledge Base into human-like text. Without AI models, the chatbot would only respond with raw chunks of text from the documents, which would not provide the best user experience.

To get access to AI models in Bedrock, I had to visit the “Model Access” page and request access explicitly. AWS requires this explicit access since some AI model providers have extra forms or rules for usage, and AWS needs to verify the availability of these models.



Models	Access status	Modality
▼ Amazon (4)	1/4 access granted	
Titan Text Embeddings V2	✔ Access granted	Embedding
Nova Pro <a href="#">Cross-region inference</a>	⌚ Available to request	Text & Vision
Nova Lite <a href="#">Cross-region inference</a>	⌚ Available to request	Text & Vision
Nova Micro <a href="#">Cross-region inference</a>	⌚ Available to request	Text
▼ Anthropic (5)	0/5 access granted	
Claude 3.7 Sonnet <a href="#">Cross-region inference</a>	⌚ Available to request	Text & Vision
Claude 3.5 Haiku <a href="#">Cross-region inference</a>	⌚ Available to request	Text
Claude 3.5 Sonnet v2 <a href="#">Cross-region inference</a>	⌚ Available to request	Text & Vision
Claude 3.5 Sonnet <a href="#">Cross-region inference</a>	⌚ Available to request	Text & Vision
Claude 3 Haiku <a href="#">Cross-region inference</a>	⌚ Available to request	Text & Vision
▼ Meta (8)	2/8 access granted	
Llama 3.3 70B Instruct	✔ Access granted	Text
Llama 3.2 1B Instruct <a href="#">Cross-region inference</a>	⌚ Available to request	Text
Llama 3.2 3B Instruct <a href="#">Cross-region inference</a>	⌚ Available to request	Text
Llama 3.2 11B Vision Instruct <a href="#">Cross-region inference</a>	⌚ Available to request	Text & Vision
Llama 3.2 90B Vision Instruct <a href="#">Cross-region inference</a>	⌚ Available to request	Text & Vision
Llama 3.1 405B Instruct <a href="#">Cross-region inference</a>	⌚ Available to request	Text
Llama 3.1 70B Instruct <a href="#">Cross-region inference</a>	⌚ Available to request	Text
Llama 3.1 8B Instruct <a href="#">Cross-region inference</a>	✔ Access granted	Text

## Knowledge Base Synchronization:

Although the S3 bucket has been connected to the Knowledge Base since its creation, synchronizing the data is still necessary. This is because synchronization is the process that actually transfers the data from S3 into the Knowledge Base and OpenSearch Serverless.

The synchronization process involves three key steps as below:

1. **Ingesting** – Bedrock takes the data from S3.
2. **Processing** – Bedrock chunks and embeds the data.
3. **Storing** – Bedrock stores the processed data in the vector store, OpenSearch Serverless.

✓ Sync completed for data source - 's3-bucket-my-best-friend-rag-bedrock'

[Amazon Bedrock](#) > [Knowledge Bases](#) > my-best-friend-rag-documentation

## my-best-friend-rag-documentation

Test

Delete

### Knowledge Base overview

Edit

**Knowledge Base name**

my-best-friend-rag-documentation

**Knowledge Base ID**

[REDACTED]

**Log Deliveries**

Configure log deliveries and event logs in the [Edit](#) page.

**Knowledge Base description**

This Knowledge Base stores all documents about my friend.

**Status**

✓ Available

**Retrieval-Augmented Generation (RAG) type**

Vector store

**Service Role**

[AmazonBedrockExecutionRoleForKnowledgeBase\\_chzzf](#)

**Created date**

March 08, 2025, 21:08 (UTC-08:00)

### Data source (1)

Sync

Stop sync

Add

Add documents from S3

Data sources contain information returned when querying a Knowledge Base.

Find data source

< 1 >

<input checked="" type="checkbox"/>	Data so...	Status	Data sour...	Account ID	Source Link	Last sync ...	Last
<input checked="" type="checkbox"/>	s3-bucket...	✓ Available	S3	19472241...	s3://my-b...	March 08,...	-

## Testing My Chatbot:

My initial attempt to test my chatbot with **Llama 3.1 8B** as the AI model caused an error because it was unavailable on-demand. To fix this, I switched to **Llama 3.3 70B**, AWS offered on-demand as a newer and more efficient model.

When I asked about topics unrelated to the Knowledge Base's data, the chatbot was unable to respond. This means that the chatbot only knows the information I stored in S3. It does not have access to any information outside of the Knowledge Base.

Additionally, you can disable the **Generate Response** setting to see the raw chunks of data directly from the Knowledge Base. During testing, the chatbot just threw a list of paragraphs to answer a question. In contrast, the AI model transforms these chunks into a coherent sentence when generating responses.

## Demonstration:

### Use Case 1 – Personalized Q&A Chatbot



Today is my best friend's wedding. Explain his wife who he really is.



Tell us his funny stories.



██████████ is a complex person with a childlike "needy mode" that he occasionally falls into. He loves himself and can be quite particular about his hobbies and interests. Despite his popularity, he is a romantic at heart and is head over heels for his wife.<sup>[1][2]</sup>

[Show details >](#)



He loves to brag about being able to cook fried rice after becoming a working adult. He also has a habit of saying "I want to marry her" every time he talks to his friend on the phone since meeting his wife.<sup>[1]</sup> He has a funny routine with his friend ██████████ where they go to a sauna-spa to get "refreshed" but then immediately ruin it by eating a hot bowl of ramen at Yamaoka-ya.<sup>[2]</sup>

[Show details >](#)



What kind of boy was he like?



What would you recommend his wife to do when he is depressed?



He was a quiet boy at school but a total clown among his friends. He had a free spirit and would often ignore conversations that didn't interest him. He was also known to be a bit of an oddball and had a unique sense of humor.<sup>[1][2][3]</sup>

[Show details >](#)



Invite him on a touring trip, a drive, a camping trip, or to a baseball game to help him feel better when he's depressed.<sup>[1][2]</sup>

[Show details >](#)

## Use Case 2 – Automated Immigration Updates



What is the latest update on the Express Entry for PR?



The latest update on Express Entry for PR is that Immigration, Refugees, and Citizenship Canada (IRCC) has announced the 2025 Express Entry categories, which include new and updated categories. The new category is Education, and the Transport category has been removed. IRCC has also added social services occupations to the healthcare category.<sup>[1][2]</sup>

[Show details >](#)



Are STEM occupations considered in the Express Entry categories?



Yes, STEM occupations are considered in Express Entry categories.<sup>[1][2][3]</sup> To be eligible, you must have accumulated at least 6 months of full-time, continuous work experience in a single STEM occupation listed in the table.<sup>[4][5]</sup>

[Show details >](#)



Are web developer and software engineer still considered in the STEM?



No, web developers and programmers, and software engineers and designers are not considered in the STEM occupations in Express Entry categories.<sup>[1]</sup>

[Show details >](#)

## Performance Optimization & Results with Data:

### Use Case 1 – Personalized Q&A Chatbot

I compared response speed by testing identical prompts while storing **15 vs. 5** documents in S3. As a result, I discovered that the response speed might hypothetically depend on the volume of stored documents, according to the following data:

#### Test Results:

- 1<sup>st</sup> Prompt: **4.61 sec.** (15 docs) → **3.26 sec.** (5 docs)
- 2<sup>nd</sup> Prompt: **5.70 sec.** (15 docs) → **5.50 sec.** (5 docs)
- 3<sup>rd</sup> Prompt: **6.18 sec.** (15 docs) → **5.78 sec.** (5 docs)
- 4<sup>th</sup> Prompt: **6.81 sec.** (15 docs) → **6.80 sec.** (5 docs)

#### Key Findings:

On average, the response speed was **0.49 seconds faster** when storing fewer documents. This is probably because the AI chatbot took longer to process and retrieve information from the larger volume of documents.

#### Trade-Off:

While reducing the number of documents could improve the performance of response speed, it may also negatively affect the quality of responses. Finding the right balance between speed and knowledge depth is crucial for optimizing chatbot performance.

***Note:** Since their wedding is still upcoming and the application would be a surprise, I haven't shown it to them yet.*

### Use Case 2 – Automated Immigration Updates

I used to spend approximately 15 to 20 minutes searching for reliable sources and reading through numerous documents every time the IRCC announced new updates regarding immigration, especially Express Entry rules for PR. However, the RAG chatbot can now retrieve updates directly from added source URLs and provide the relevant information with reliable sources, reducing my search time by **66.67 % to 75%** – from **15-20 minutes** to only **5 minutes** (including the time to verify accuracy).

## References:

- How to set up a RAG chatbot in AWS Bedrock: A Step-by-Step Guide.* (n.d.). Community.aws. <https://community.aws/content/2tnxBahN1n18B1Aqfsn1yoNQ7cq/how-to-set-up-a-rag-chatbot-in-aws-bedrock-a-step-by-step-guide>
- Implement web crawling in Amazon Bedrock Knowledge Bases | Amazon Web Services.* (2024, August 29). Amazon Web Services. <https://aws.amazon.com/blogs/machine-learning/implement-web-crawling-in-knowledge-bases-for-amazon-bedrock/>
- Sonawane, P. (2025, February 22). Building an AI-Powered RAG chatbot on Bedrock via the AWS console. *Medium*. <https://medium.com/@piyushsonawane10/building-an-ai-powered-rag-chatbot-on-bedrock-via-the-aws-console-8ac62cf3e6b6>