BookComet Web Application

Project 2: Building and Deploying a Containerized Python Application with Flask and MongoDB on Azure Kubernetes Service (AKS)

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Course Name: Database Systems and Cloud Computing

Course Code: AIN3003 (1)

Logo retrieved from: BrandCrowd

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Introduction

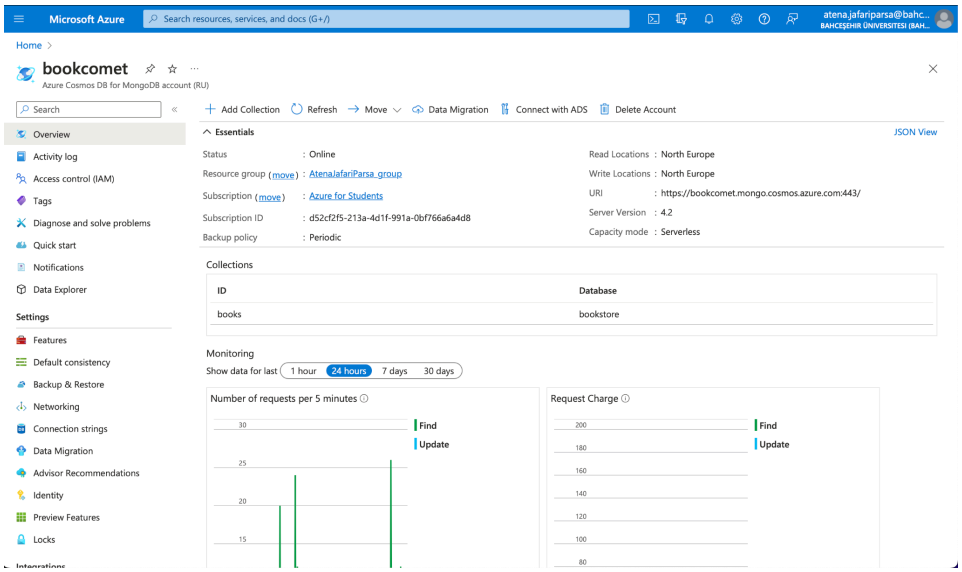
Books are one of the oldest means of sharing knowledge in human history. From ancient scrolls to kindles, there has always been a similar pattern: words and sentences, symbols, numbers, visualizations, etc. This shows the importance of finding an effective way to represent, share and store these blocks of knowledge, called books.
Considering the advances of Information Technology (IT), cloud-based online applications are a modern and easy way for the users to access books to buy/borrow them for reading.

Abstract

- The aim of the project is to build and deploy a Containerized Python Application with Flask and MongoDB on Azure Kubernetes Service (AKS).
- For this purpose, first the data should be retrieved and stored in a proper format (through Azure CosmosDB Cloud shell (in Javascript)) which has been explained below in *Data Retrieval*.
- After the extension of MongoDB for Visual Studio Code was installed, and through the connection string, VSCode was connected to the Azure CosmosDB and the database was accessed and tested by some sample queries.
- Then a python script called app.py was written for the app routes to perform the CRUD operations. The necessary files including some html templates were also added.
- The image containing the python app was built. After logging into the azure account and the ACR, the image was tagged and pushed to the ACR.
- After that, a Kubernetes service and cluster is created on Azure. A single-image web app is created as the corresponding ACR and the pushed image is selected. The .yaml file is downloaded, and the app is kept.
- Under the Kubernetes resources in the cluster, services and ingresses is selected. After clicking on the app name, the External IP can be observed.

Azure Cosmos DB Set-up & Data Retrieval

After creating an Azure CosmosDB resource on Azure portal, the *Bookstore* database is created. It uses an Azure server in North Europe (Ireland) region.



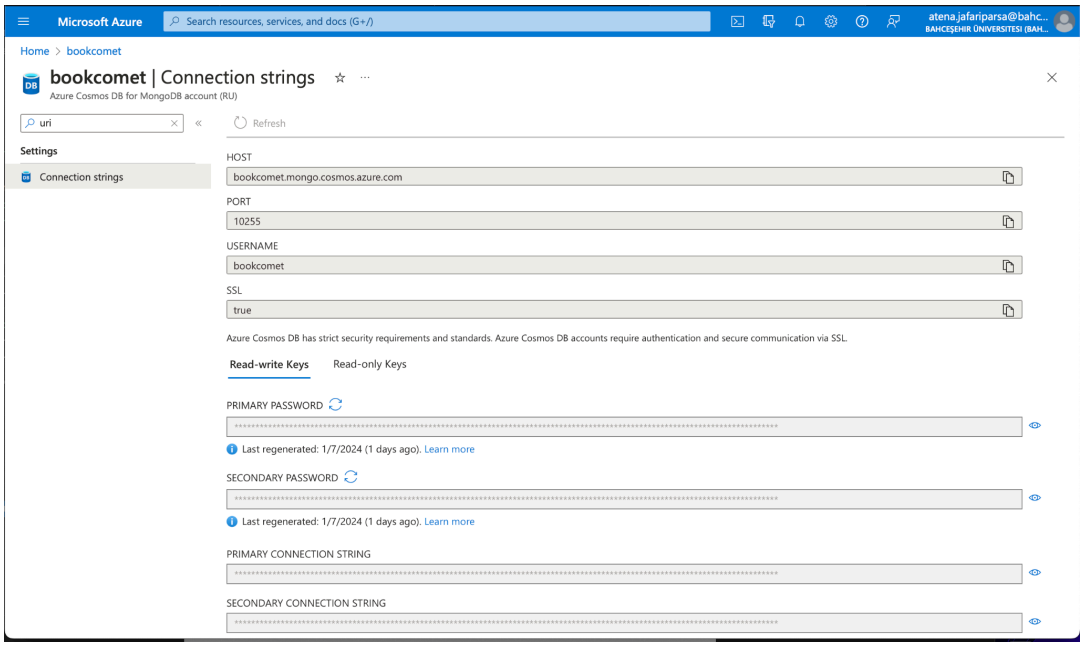
The documents are then stored to *books* collection through the cloud shell provided by Azure Cosmos DB.
The input data initially contained 9 books in the IT category (each document containing the isbn, the book title, the publish year, the price, number of the pages, the category, the link to the cover image of the book, the publisher info. (name and location) with 9 distinct authors in total and 6 distinct publishers and their location. Later, more data was retrieved from https://openlibrary.org/ . For the distinction of the added and initial data, the books added later are from categories different from 'IT', e.g. Fantasy, Sci Fi, etc.

For the ease of the process, first the books, then the corresponding publishers and authors documents are inserted to the collections through Atlas Mongo Shell in this example form:

After all the documents are inserted we check them in the CosmosDB interface or type some queries to confirm the correct insertion. What I used for books collection to look at the documents is: db.{books}.find().pretty() after switching to *bookstore* database.

- Connecting Visual Studio Code to Azure Cosmos DB

After having installed the MongoDB extension, the Bookstore database is connected through the connection string (cosmos uri) that can be found as shown below:



The beginning lines in app.py, import the libraries (e.g. flask, jsonify) and connect Visual Studio Code to the database in Azure Cosmos DB:

```
from flask import Flask, render_template, request, redirect, url_for, jsonify
from pymongo import MongoClient
app = Flask(__name__)
# Replace these values with your Cosmos DB connection string and database/collection
details
cosmos_uri = "****************************************"
client = MongoClient(cosmos_uri)
db = client["bookstore"]
books_collection = db["books"]
```

- Writing the Python Script & Necessary Files for Creating the Web-app

i.e. .dockerignore, app.py, requirements.txt, gunicorn.conf.py, html templates

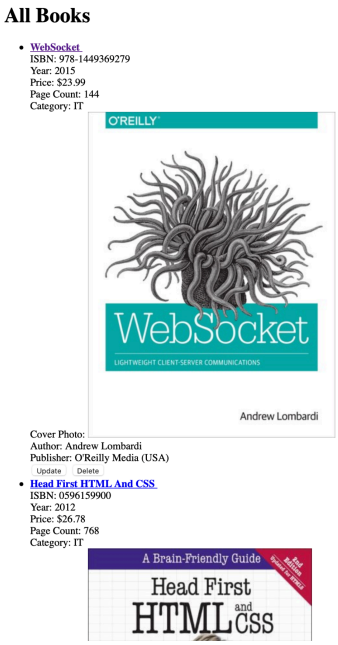
- app.py:

Includes the app routes, the python script for performing CRUD operations on the database. When the app.py is running, the local website can be accessed. The web app can be accessed locally on http://127.0.0.1:5001/ .

- The html Templates

The .html files were added for providing a simpler and more clear interface for the user.

- The main html template is *index.html* which is responsible for the first page that appears on the website and shows all books. The corresponding app route and function in app.py for it is
    - @app.route('/')
    - def index() #which fetches all books and displays them



- The CRUD Operations

Each app route in app.py redirects to one of the html templates:

Create

- @app.route('/add_book', methods=['GET', 'POST'])
- def add_book()
- add_book.html

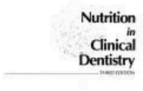
Let's add a new book to the database, we'll get the field values from https://openlibrary.org/works/OL16325201W/Insurgent .

1. Scroll down to the end of the book displays and click on Add a new book

Cover Photo: 

Author: Ana Huang
Publisher: Little, Brown Book Group Limited (London, UK)
Update Delete

- **Nutrition in clinical dentistry**
ISBN: 0721624235
Year: 1989
Price: $8.53
Page Count: 465
Category: Science



Cover Photo:
Author: Abraham J. Nizel
Publisher: Saunders (Philadelphia, USA)
Update Delete

Add a New Book

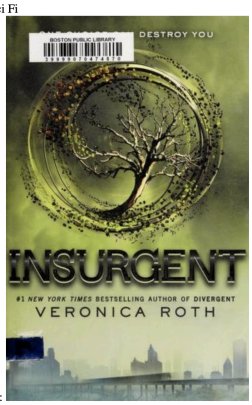
2. Insert the field values in the corresponding boxes for every field, then press Add Book.

Add a New Book

ISBN: 9780062024046
Title: Insurgent
Year: 2012
Price: 5.07
Page: 525
Category: Sci Fi
Cover Photo URL: https://covers.openlibrary.c
Publisher Location: New York, USA
Publisher Name: Katherine Tegen Books. an
Author Name: Veronica Roth
Add Book

Back to All Books

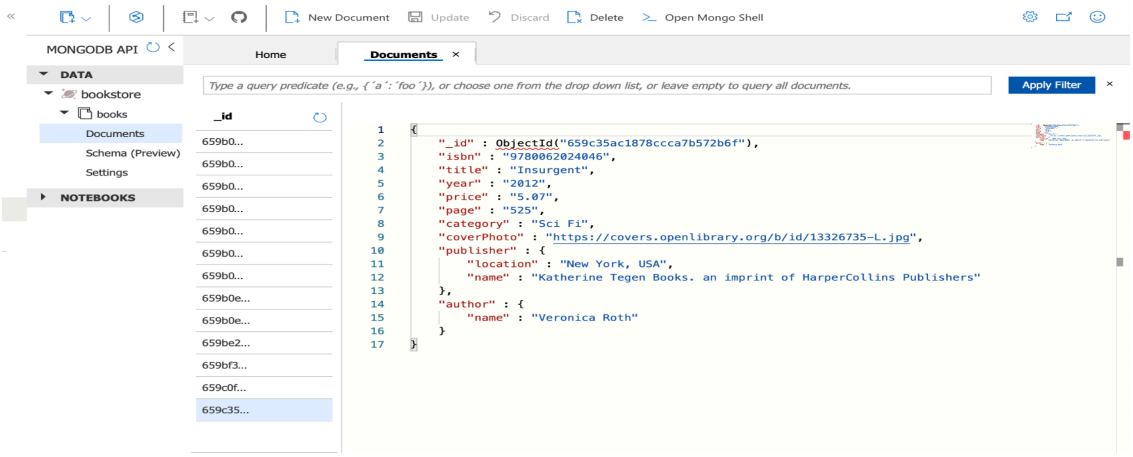
3. The book has been added to the end of the books and is now displayed on the main page.

- **Insurgent**
  ISBN: 9780062024046
  Year: 2012
  Price: $5.07
  Page Count: 525
  Category: Sci Fi
  Cover Photo: 

  Author: Veronica Roth
  Publisher: Katherine Tegen Books. an imprint of HarperCollins Publishers (New York, USA)
  Update Delete

Add a New Book

It has also been added as a document to the books collection in bookstore database in Azure Cosmos DB.



Read

- @app.route('/book/<isbn>')
- def book_details(isbn):
- # Fetches and displays details of a specific book
- book_details.html

1. For the Read operation, simply click on the title of the book in the main page.

All Books

- WebSocket
  ISBN: 978-1449369279
  Year: 2015
  Price: $23.99
  Page Count: 144
  Category: IT

2. View all the available information and details on the book, including the cover image:

Book Details

Title: WebSocket

ISBN: 978-1449369279

Publish_Year: 2015

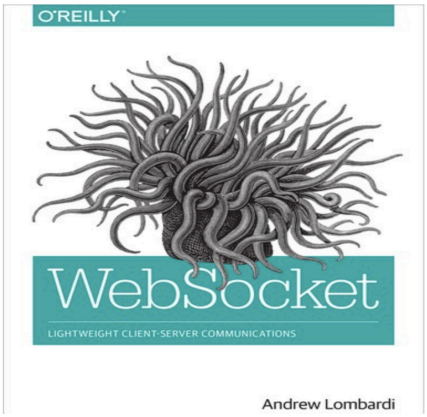
Price: 23.99

Number_of_Pages: 144

Publisher_name: O'Reilly Media

Publish_location: USA

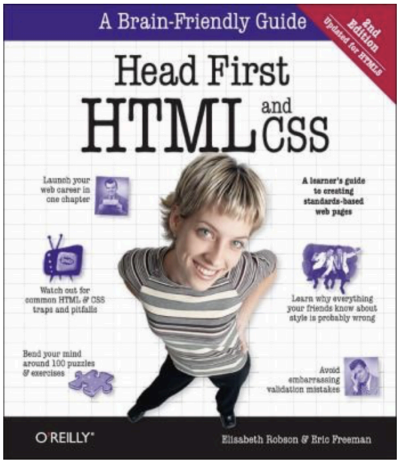
Author: Andrew Lombardi



Update

- @app.route('/update_book/<isbn>', methods=['GET', 'POST'])
- def update_book(isbn)
- update_book.html

1. Scroll down to the book you would like to update, then press Update under the *Publisher:*

- **Head First HTML And CSS**
  ISBN: 0596159900
  Year: 2012
  Price: $26.78
  Page Count: 768
  Category: IT
  Cover Photo: 

  Author: Elizabeth Robson
  Publisher: O'Reilly Media (USA)
  Update Delete

2. Update the value, and press Update again. The updates would be applied to the website and the database in Azure Cosmos DB simultaneously.

Please note that after a book is published in real life, fields like ISBN, book title, publish year and author's name cannot be changed. However, values like price, can keep getting updated as time goes on. This is why the Price field was used for the update operation.

Update Book Price

Invalid input. Please enter a valid numeric value for Price.

Price: 26.78

Update Price

Back to Book Details

Delete

- @app.route('/delete_book/<isbn>', methods=['GET', 'POST'])
- def delete_book(isbn)
- delete_book.html

1. Proceed to the book that has to be deleted and press the Delete button next to Update. After the Delete button is pressed, the book would be removed immediately both from the website and from the database.

- **Nutrition in clinical dentistry**
  ISBN: 0721624235
  Year: 1989
  Price: $8.53
  Page Count: 465
  Category: Science

  Cover Photo:
  Author: Abraham J. Nizel
  Publisher: Saunders (Philadelphia, USA)
  Update Delete

Building the Docker Image and Pushing It to Azure Container Registry (ACR)

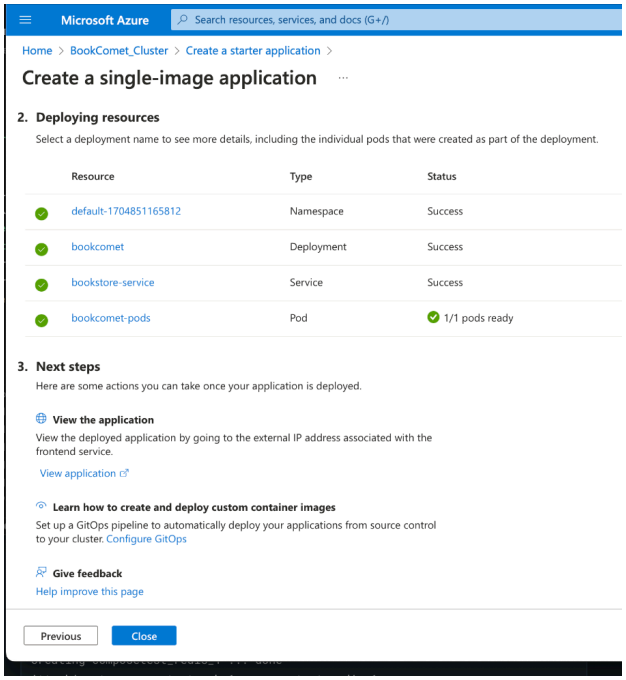
After confirming that the web app can be accessed locally on http://127.0.0.1:5001/ and works as desired, the next step is to prepare it for deployment on Azure Kubernetes Service (AKS). In order to do that, the python application should be containerized in a Docker image and pushed to ACR.

After deciding the image name, this command should be run in the terminal in the same directory as the project for the Docker image to be built:
docker build -t mybookstore .

After logging in to the azure account and the ACR (by using the Access Keys), and tagging (docker tag mybookstore myregistry2024p.azurecr.io/mybookstore) the Docker image should be pushed to the container: docker push myregistry2024p.azurecr.io/mybookstore

Setting Up Azure Kubernetes Service

After logging in to Azure portal, a Kubernetes Service resource named BookComet_Cluster is created. Then, a single image web app is created and the container (MyRegistry2024P) and the image is selected. An automatic .yaml file (YAML_5.text) is then created for the deployment. Keep is selected for the app.



- How to access the deployed app

BookComet_Cluster is selected, then, under kubernetes resources, the option services and ingresses is selected. The service (bookstore-service) is selected and eventually, the External IP. This is how the deployed app could be accessed.

http://bookcomet.northeurope.cloudapp.azure.com/