

DevOps and Software Engineering Project

DEC. 1/2022

KEDIR NASIR OMER

IBM DevOps and Software Engineering Specialization

1. Applied Software Engineering
2. Applied DevOps
3. Cloud Computing
4. Agile Development and Scrum
5. Linux Commands and Shell Scripting
6. Git and GitHub
7. Python for Data Science, AI & Development
8. Python Project for AI & Application Development
9. Containers w/ Docker, Kubernetes & OpenShift
10. Application Development using Microservices and Serverless
11. Test Driven Development (TDD)
12. Continuous Integration and Continuous Delivery (CI/CD)
13. Application Security and Monitoring
14. DevOps and Software Engineering Capstone Project



Content

- ✓ Project Background
- ✓ Create and Execute Sprint Plans
- ✓ Develop a RESTful Service Using Test Driven Development (TDD)
- ✓ Add Continuous Integration (CI) and Security to a Repository
- ✓ Deploy My Application to Kubernetes
- ✓ Build an Automated CD DevOps Pipeline
- ✓ Conclusion
- ✓ Acknowledgment



Project Background



DevOps Capstone Project

Course Introduction

© IBM Corporation. All rights reserved.

IBM Developer

SKILLS NETWORK 



Click here to play the video

➤ Problem Statement

- ✓ I have been asked by the customer account manager at my company to develop an **account microservice** to keep track of the customers on our **e-commerce** website. Since it is a microservice, it is expected to have a well-formed **REST API** that other microservices can call. This service initially needs to **create, read, update, delete, and list** customers.

- ✓ I have also been told that someone else has started on this task. They have already developed the database model and a **Python Flask-based** REST API with an endpoint to create a customer account. I just need to plan to add the REST APIs to read, update, delete, and list accounts. Since I will be working in an online lab environment, I will need to plan my work to get that environment ready for development.



Input



Create and Execute Sprint Plans

Output



➤ Agile Planning

- ✓ I will start my project by building an Agile plan for the first sprint. At this point, I am planning and not producing code deliverables, so some development teams call this stage “Sprint 0” or a planning sprint. my goal is to simulate what an actual Agile development team would do to plan sprints.

- ✓ I will begin by creating a GitHub repository for the project and adding this repository to a **Zenhub kanban board**. I will use this board to build and manage the Agile plan. Next, I will build a user story template in GitHub that I will later use to write Ill-structured user stories.

Task 1A) planning-repository-done- <https://github.com/kedibeki/devops-capstone-project>

The screenshot shows a GitHub repository page for 'kedibeki / devops-capstone-project'. The repository is public and was generated from the 'ibm-developer-skills-network/aolwx-devops-capstone-template'. The main code tab is selected, showing a single commit by 'kedibeki' titled 'Initial commit' at timestamp 'bb9d04d 5 minutes ago'. The commit includes 1 file and 1 commit. The repository has 1 branch and 0 tags. On the right side, there's an 'About' section for the 'IBM DevOps and Software Engineering Project' with details like Readme, Apache-2.0 license, 0 stars, 1 watching, and 0 forks. Below that are sections for 'Releases' (no releases published), 'Packages' (no packages published), and 'Languages' (Python 81.2%, Makefile 8.4%, Dockerfile 5.3%, Shell 4.9%, Procfile 0.2%). At the bottom, there's a 'README.md' editor with the title 'DevOps Capstone Template' and a note about the license being Apache 2.0 and Python 3.9.

kedibeki / **devops-capstone-project** Public

generated from ibm-developer-skills-network/aolwx-devops-capstone-template

<> Code Issues Pull requests Zenhub Actions Projects Wiki Security Insights Settings

main 1 branch 0 tags Go to file Add file <> Code

kedibeki Initial commit bb9d04d 5 minutes ago 1 commit

File	Commit Message	Time Ago
.devcontainer	Initial commit	5 minutes ago
bin	Initial commit	5 minutes ago
deploy	Initial commit	5 minutes ago
service	Initial commit	5 minutes ago
tekton	Initial commit	5 minutes ago
tests	Initial commit	5 minutes ago
.flaskenv	Initial commit	5 minutes ago
.gitattributes	Initial commit	5 minutes ago
.gitignore	Initial commit	5 minutes ago
LICENSE	Initial commit	5 minutes ago
Makefile	Initial commit	5 minutes ago
Procfile	Initial commit	5 minutes ago
README.md	Initial commit	5 minutes ago
requirements.txt	Initial commit	5 minutes ago
setup.cfg	Initial commit	5 minutes ago

README.md

DevOps Capstone Template

License Apache 2.0 Python 3.9

About

IBM DevOps and Software Engineering Project

- Readme
- Apache-2.0 license
- 0 stars
- 1 watching
- 0 forks

Releases

No releases published Create a new release

Packages

No packages published Publish your first package

Languages

Language	Percentage
Python	81.2%
Makefile	8.4%
Dockerfile	5.3%
Shell	4.9%
Procfile	0.2%

Task 1B) planning-story-template-done-in Zenhub, create a kanban board workspace

The screenshot shows a GitHub repository page for 'kedibeki / devops-capstone-project'. The repository is public and was generated from 'ibm-developer-skills-network/aolwx-devops-capstone-template'. The 'Issues' tab is selected, showing one open issue. The main content area displays an 'ISSUE_TEMPLATES #1' issue. This template includes sections for 'Details and Assumptions' (containing placeholder text like 'As a [role], I need [function], So that [benefit]') and 'Acceptance Criteria' (containing Gherkin-like placeholder text). To the right of the issue, there is a sidebar for 'Zenhub' integration. It shows a pipeline named 'capstone-project' with a single step labeled 'New Issues'. A tooltip for the pipeline says: 'Click the pin icon to assign high priority status. Once pinned, a high priority badge is applied in the issue and it's placed at the top of the pipeline in the board.' Below the pipeline, there are fields for 'Assignees' (No one—assign yourself), 'Labels' (None yet), 'Projects' (None yet), 'Sprints' (No sprint assigned), 'Milestone' (No milestone), 'Estimate' (with a scale from 1 to 40), and 'Epic' (Not inside an epic). At the bottom of the issue view, there is a comment section with 'Write' and 'Preview' tabs, and a note about GitHub Community Guidelines.

Task 1C) planning-user-stories-done

The screenshot shows a GitHub repository page for `kedibeki / devops-capstone-project`. The repository is public and was generated from `ibm-developer-skills-network/aolwx-devops-capstone-template`. The main navigation bar includes links for Pull requests, Issues, Codespaces, Marketplace, and Explore. On the right side, there are buttons for Pin, Unwatch (1), Fork (0), and Star (0). The repository name and description are displayed prominently.

The page features a dark-themed interface with several sections:

- Code, Issues (1), Pull requests, Zenhub (highlighted), Actions, Projects, Wiki, Security, Insights, Settings:** These are standard GitHub navigation items.
- Filters:** A dropdown menu for filtering issues.
- New Issues:** Shows 8 issues, including:
 - `devops-capstone-project #8 Deploy your Docker image to Kubernetes`
 - `devops-capstone-project #7 Containerize your microservice using Docker`
- Icebox:** Shows 0 issues / 0 points. Description: "Low priority Issues that do not need to be addressed in the near future."
- Product Backlog:** Shows 0 issues / 0 points. Description: "Upcoming Issues that have been reviewed, estimated, and prioritized top-to-bottom."
- Sprint:** Shows 0 issues / 0 points.

A sidebar on the left contains links for Board, Epics, Reports, and Roadmap, along with an "Invite your team" button. The bottom of the page shows the user's profile information: Kedir Omer (kedibeki).

Task 1D) planning-product backlog-done

The screenshot shows a GitHub Zenhub dashboard for a repository named `devops-capstone-project`. The dashboard is organized into several sections:

- Top Navigation:** Includes a search bar, navigation links for Pull requests, Issues, Codespaces, Marketplace, and Explore, and user profile icons.
- Repository Information:** Shows the repository name (`kedibeki/devops-capstone-project`), a public status badge, and a note indicating it was generated from `ibm-developer-skills-network/aolwx-devops-capstone-template`.
- Issue Management:** A central area for managing issues, featuring sections for New Issues, Icebox, Product Backlog, and Sprint. The Product Backlog section lists several tasks:
 - devops-capstone-project #7 Containerize your microservice using Docker
 - devops-capstone-project #8 Deploy your Docker image to Kubernetes
 - devops-capstone-project #3 Read an account from the service
 - devops-capstone-project #4 Update an account in the service
 - devops-capstone-project #5
- Side Navigation and Tools:** On the left, there's a sidebar with links for Board, Epics, Reports, Roadmap, and an Invite your team button. Below the sidebar, the user `Kedir Omer` is listed. At the bottom right, there's a blue button labeled "Issues".
- Bottom Navigation:** Includes links for Code, Issues (with 1), Pull requests, Zenhub (highlighted), Actions, Projects, Wiki, Security, Insights, and Settings.

Task 1E) planning-labels-done

Product Backlog
5 Issues

- devops-capstone-project #2**
Set up the development environment
Technical debt
- devops-capstone-project #3**
Read an account from the service
enhancement
- devops-capstone-project #4**
Update an account in the service
enhancement
- devops-capstone-project #5**
Delete an account from the service
enhancement
- devops-capstone-project #6**
List all accounts in the service
enhancement

Task 1F) planning-kanban-done

Product Backlog

5 Issues

Project	Issue Description	Type
Project #7 Microservice	devops-capstone-project #2 Set up the development environment	Technical debt
Project #8 Image to	devops-capstone-project #3 Read an account from the service	enhancement
	devops-capstone-project #4 Update an account in the service	enhancement
	devops-capstone-project #5 Delete an account from the service	enhancement
	devops-capstone-project #6 List all accounts in the service	enhancement

Start here

Write a test

Clean code

Test fails

Develop a RESTful Service Using Test Driven Development (TDD)

Workable
code - how
to improve?

REFACTOR

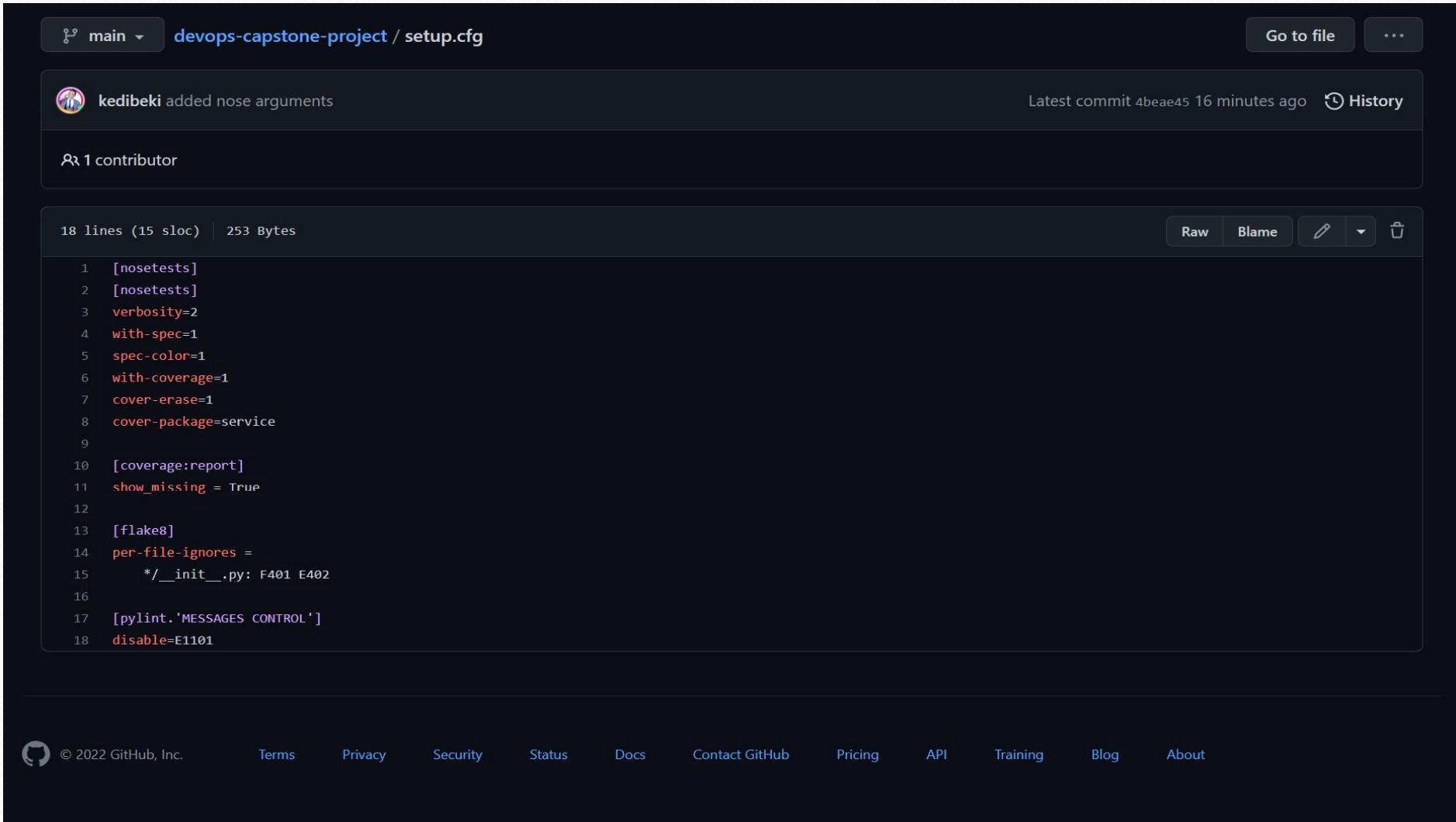
GREEN

Write code
to make
test pass

Code passes test

- ✓ I will complete Sprint 1 by configuring the capstone project environment and developing the Customer Account microservice using test driven development (TDD).
- ✓ Configuring the capstone project environment includes cloning my GitHub repo using the starter template provided and installing all the prerequisite software to get the environment ready. Next, before I begin the development of the Customer Account microservice,
- ✓ I will first find my user story in the kanban board, move it to "In progress," and assign myself to it.
- ✓ I will create tests for the RESTful Flask service and write enough code for the tests to pass. To test my service, I will write test cases for these functions: read, update, delete, and list. As I develop, I will run nosetests to ensure that all unit tests pass and use the coverage tool to ensure at least 95% coverage.

Task 2A) rest-setup.cfg-done



The screenshot shows a GitHub repository page for 'devops-capstone-project'. The file 'setup.cfg' is displayed. The commit history shows a single commit by 'kedibeki' adding nose arguments. The code editor displays the configuration file 'setup.cfg' with the following content:

```
1 [nosetests]
2 [nosetests]
3 verbosity=2
4 with-spec=1
5 spec-color=1
6 with-coverage=1
7 cover-erase=1
8 cover-package=service
9
10 [coverage:report]
11 show_missing = True
12
13 [flake8]
14 per-file-ignores =
15     */__init__.py: F401 E402
16
17 [pylint.'MESSAGES CONTROL']
18 disable=E1101
```

The GitHub interface includes standard navigation and file management buttons like 'Raw', 'Blame', and a pencil icon for editing.

Footer links include: Terms, Privacy, Security, Status, Docs, Contact GitHub, Pricing, API, Training, Blog, and About.

Task 2B) rest-tech-debt-done

capstone-project > Board

Filters ▾ Find issues (f+i) New Issue

Backlog	In Progress	Review/QA	Done
3 Issues / 42 Points	0 Issues / 0 Points	2 Issues / 8 Points	
devops-capstone-project #9 nt 1 t: Nov 29 - Dec 6, 2022 debt	devops-capstone-project #6 List all accounts in the service ↳ Sprint: Nov 29 - Dec 6, 2022 21 technical debt	Review/QA Issues open to the team for review and testing. Code complete, pending feedback.	devops-capstone-project #2 Set up the development environment ↳ Sprint: Nov 29 - Dec 6, 2022 3 technical debt
devops-capstone-project #10 nt 2 t: Dec 6 - Dec 13, 2022 debt	devops-capstone-project #4 Update an account in the service ↳ Sprint: Nov 29 - Dec 6, 2022 8 technical debt		devops-capstone-project #3 Read an account from the service ↳ Sprint: Nov 29 - Dec 6, 2022 5 technical debt
devops-capstone-project #11 nt 3 t: Dec 13 - Dec 20, 2022 debt	devops-capstone-project #5 Delete an account from the service ↳ Sprint: Nov 29 - Dec 6, 2022 13 technical debt		

Task 2 C) read-accounts

capstone-project > Board

Filters ▾ Find issues (f+i) New

Backlog	In Progress	Review/QA	Done
3 Issues / 42 Points	0 Issues / 0 Points	Review/QA	2 Issues / 8 Points
ips-capstone-project #9 nt 1 t: Nov 29 - Dec 6, 2022 debt	devops-capstone-project #6 List all accounts in the service ↳ Sprint: Nov 29 - Dec 6, 2022 21 technical debt	Issues open to the team for review and testing. Code complete, pending feedback.	devops-capstone-project #2 Set up the development environment ↳ Sprint: Nov 29 - Dec 6, 2022 3 technical debt
ips-capstone-project #10 nt 2 t: Dec 6 - Dec 13, 2022 debt	devops-capstone-project #4 Update an account in the service ↳ Sprint: Nov 29 - Dec 6, 2022 8 technical debt		devops-capstone-project #3 Read an account from the service ↳ Sprint: Nov 29 - Dec 6, 2022 5 technical debt
ips-capstone-project #11 nt 3 t: Dec 13 - Dec 20, 2022 debt	devops-capstone-project #5 Delete an account from the service ↳ Sprint: Nov 29 - Dec 6, 2022 13 technical debt		

Task 2 D) list-accounts

capstone-project > Board

Find issues (f+i)

In Progress

2 Issues / 21 Points

ect #9

2022

devops-capstone-project #4
Update an account in the service

↳ Sprint: Nov 29 - Dec 6, 2022

8 technical debt

ect #10

2022

devops-capstone-project #5
Delete an account from the service

↳ Sprint: Nov 29 - Dec 6, 2022

13 technical debt

ect #11

2022

Review/QA

0 Issues / 0 Points

Review/QA

Issues open to the team for review and testing. Code complete, pending feedback.

Done

3 Issues / 29 Points

devops-capstone-project #2
Set up the development environment

↳ Sprint: Nov 29 - Dec 6, 2022

3 technical debt

devops-capstone-project #3
Read an account from the service

↳ Sprint: Nov 29 - Dec 6, 2022

5 technical debt

devops-capstone-project #6
List all accounts in the service

↳ Sprint: Nov 29 - Dec 6, 2022

21 technical debt

Task 2 E) update-accounts

capstone-project > Board



Find issues (f+i)



In Progress



1 Issue / 13 Points

ect #9
2022

devops-capstone-project #5
Delete an account from the service
↳ Sprint: Nov 29 - Dec 6, 2022
13 technical debt

ect #10
2022

ect #11
2022

Review/QA



0 Issues / 0 Points

Review/QA

Issues open to the team for review and testing. Code complete, pending feedback.

Done



4 Issues / 37 Points

environment

↳ Sprint: Nov 29 - Dec 6, 2022

3 technical debt

devops-capstone-project #3
Read an account from the service

↳ Sprint: Nov 29 - Dec 6, 2022

5 technical debt

devops-capstone-project #6
List all accounts in the service

↳ Sprint: Nov 29 - Dec 6, 2022

21 technical debt

devops-capstone-project #4
Update an account in the service

↳ Sprint: Nov 29 - Dec 6, 2022

8 technical debt

Task 2 F) delete-accounts

capstone-project > Board

Filters Find issues (f+i) New Is

Backlog	In Progress	Review/QA	Done
0 Issues / 0 Points	0 Issues / 0 Points	0 Issues / 0 Points	5 Issues / 50 Points
ops-capstone-project #9 nt 1 t: Nov 29 - Dec 6, 2022 1 debt	In Progress Issues currently being worked on by the team.	Review/QA Issues open to the team for review and testing. Code complete, pending feedback.	Read an account from the service Sprint: Nov 29 - Dec 6, 2022 5 technical debt
ops-capstone-project #10 nt 2 t: Dec 6 - Dec 13, 2022 1 debt			devops-capstone-project #6 List all accounts in the service Sprint: Nov 29 - Dec 6, 2022 21 technical debt
ops-capstone-project #11 nt 3 t: Dec 13 - Dec 20, 2022 1 debt			devops-capstone-project #4 Update an account in the service Sprint: Nov 29 - Dec 6, 2022 8 technical debt
			devops-capstone-project #5 Delete an account from the service Sprint: Nov 29 - Dec 6, 2022 13 technical debt

Task 2 G) rest-create-done

The screenshot shows a terminal window with the following content:

```
File Edit Selection View Go Run Terminal Help
EXPLO... ... launch.json test_routes.py routes.py ×
> OPEN EDITOR: devops-capstone-project > service > routes.py > ...
PROJECT
  launch...
  devops...
    > .devc...
    > bin
    > deploy
    > service
      > __py...
      > com...
      __ini...
      config...
      mod...
      rout...
    > tekton
    > tests
      __ini...
      facto...
      test...
      test...
      test...
    > NPM SCRIPTS
    > TIMELINE
78 ######
79 # READ AN ACCOUNT
80 #####
81
82 # ... place your code here to READ an account ...
83 @app.route("/accounts/<int:account_id>", methods=["GET"])
84 def get_accounts(account_id):
85     """
86     Reads an Account
87     This endpoint will read an Account based on the account_id
88     """
89     app.logger.info("Request to read an Account with id %s", account_id)
90     account = Account.find(account_id)

theia:devops-capstone-project      theia:devops-capstone-project ×
n St.", "phone_number": "555-1212"}'
HTTP/1.1 201 CREATED
Server: gunicorn
Date: Tue, 29 Nov 2022 12:05:51 GMT
Connection: close
Content-Type: application/json
Content-Length: 128
Location: /
{"address": "123 Main St.", "date_joined": "2022-11-29", "email": "john@doe.com", "id": 1, "name": "John Doe", "phone_number": "555-1212"}
(virtualenv) theia:devops-capstone-project$
```

The terminal window also displays the following status bar information:

{new_branch_name} Python 3.9.15 64-bit 0 △ 0 Ln 134, Col 5 Go Live LF UTF-8 Spaces: 4 Python

Task 2 H) rest-read-done

The screenshot shows a code editor interface with a dark theme. The top menu bar includes File, Edit, Selection, View, Go, Run, Terminal, and Help. The left sidebar contains project navigation, including a tree view of a 'devops-capstone-project' directory with subfolders like 'service' and 'tests', and sections for 'NPM SCRIPTS' and 'TIMELINE'. The main editor area displays a Python script named 'routes.py' with the following content:

```
78 #####  
79 # READ AN ACCOUNT  
80 #####  
81 # ... place your code here to READ an account ...  
82 #####
```

Below the script, a terminal window shows the output of a curl command:

```
theia:devops-capstone-project$ curl -i -X GET http://127.0.0.1:5000/accounts/1  
HTTP/1.1 200 OK  
Server: gunicorn  
Date: Tue, 29 Nov 2022 12:09:57 GMT  
Connection: close  
Content-Type: application/json  
Content-Length: 130  
  
[{"address": "123 Main St.", "date_joined": "2022-11-29", "email": "john@doe.com", "id": 1, "name": "John Doe", "phone_number": "555-1212"}]  
(venv) theia:devops-capstone-project$ curl -i -X GET http://127.0.0.1:5000/accounts/1  
HTTP/1.1 200 OK  
Server: gunicorn  
Date: Tue, 29 Nov 2022 12:10:05 GMT  
Connection: close  
Content-Type: application/json  
Content-Length: 128  
  
{"address": "123 Main St.", "date_joined": "2022-11-29", "email": "john@doe.com", "id": 1, "name": "John Doe", "phone_number": "555-1212"}  
(venv) theia:devops-capstone-project$
```

The bottom status bar indicates the file is 'new_branch_name', the Python version is 'Python 3.9.15 64-bit', and the current line and column are 'Ln 134, Col 5'. It also shows 'Go Live', 'LF', 'UTF-8', 'Spaces: 4', and 'Python'.

Task 2 I) rest-list-done

The screenshot shows a terminal window within a dark-themed code editor interface. The terminal output is displayed in white text on a black background. The command run was `curl -i -X GET http://127.0.0.1:5000/accounts`. The response is as follows:

```
HTTP/1.1 200 OK
Server: gunicorn
Date: Tue, 29 Nov 2022 12:10:05 GMT
Connection: close
Content-Type: application/json
Content-Length: 128

[{"address": "123 Main St.", "date_joined": "2022-11-29", "email": "john@doe.com", "id": 1, "name": "John Doe", "phone_number": "555-1212"}]
```

The terminal status bar at the bottom indicates the following information from left to right: a branch icon followed by `{new_branch_name}`, a Python icon followed by `Python 3.9.15 64-bit`, a file icon followed by `0 △ 0`, a line counter followed by `Ln 134, Col 5`, a Go Live icon, a LF icon, a UTF-8 icon, a spaces icon followed by `Spaces: 4`, a Python icon, and a Q icon.

Task 2 J) rest-update-done

The screenshot shows a terminal window with the following content:

```
File Edit Selection View Go Run Terminal Help
EXPLO... ... launch.json test_routes.py routes.py ×
> OPEN EDITOR: devops-capstone-project > service > routes.py > ...
PROJECT launc...
devops...
> .devc...
> bin
> deploy
service
> __py...
> com...
__ini...
confi...
mod...
rout...
> tekton
tests
__ini...
facto...
test...
test...
test...
> NPM SCRIPTS
> TIMELINE

78 #####
79 # READ AN ACCOUNT
80 #####
81 # ... place your code here to READ an account ...
82 # ... place your code here to UPDATE an account ...

theia:devops-capstone-project theia:devops-capstone-project ×
[{"address": "123 Main St.", "date_joined": "2022-11-29", "email": "john@doe.com", "id": 1, "name": "John Doe", "phone_number": "555-1212"}]
(venv) theia:devops-capstone-project$ curl -i -X PUT http://127.0.0.1:5000/accounts/1 \
> -H "Content-Type: application/json" \
> -d '{"name": "John Doe", "email": "john@doe.com", "address": "123 Main St.", "phone_number": "555-1111"}'
HTTP/1.1 200 OK
Server: gunicorn
Date: Tue, 29 Nov 2022 12:12:42 GMT
Connection: close
Content-Type: application/json
Content-Length: 128

{"address": "123 Main St.", "date_joined": "2022-11-29", "email": "john@doe.com", "id": 1, "name": "John Doe", "phone_number": "555-1111"}]
```

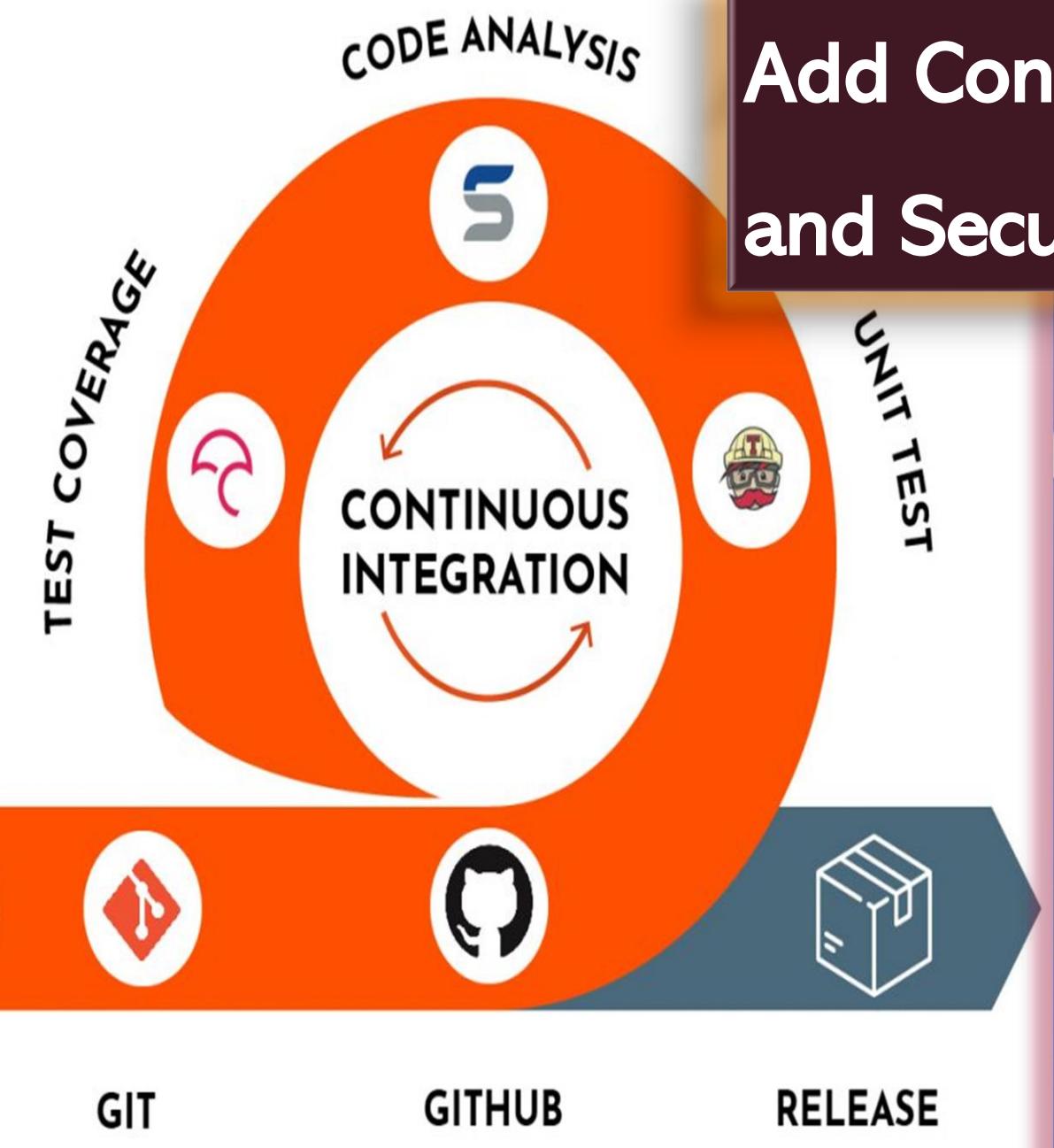
The terminal window includes a sidebar with project navigation, a status bar at the bottom, and a small preview pane on the right.

Task 2 K) rest-delete-done

The screenshot shows a terminal window with the following content:

```
File Edit Selection View Go Run Terminal Help
EXPLO... ...
> OPEN EDITOR: launch.json test_routes.py routes.py ...
PROJECT
devops...
> .devc...
> bin
> deploy
service
> __py...
> com...
__ini...
confi...
mod...
rout...
> tekton
tests
__ini...
facto...
test...
test...
test...
> NPM SCRIPTS
> TIMELINE
launch.json
test_routes.py
routes.py
78 ######
79 # READ AN ACCOUNT
80 #####
82 # ... place your code here to READ an account ...
theia:devops-capstone-project      theia:devops-capstone-project x
> -H "Content-Type: application/json" \
> -d '{"name": "John Doe", "email": "john@doe.com", "address": "123 Main St.", "phone_number": "555-1111"}'
HTTP/1.1 200 OK
Server: gunicorn
Date: Tue, 29 Nov 2022 12:13:27 GMT
Connection: close
Content-Type: application/json
Content-Length: 128
{"address": "123 Main St.", "date_joined": "2022-11-29", "email": "john@doe.com", "id": 1, "name": "John Doe", "phone_number": "555-1111"}
(venv) theia:devops-capstone-project$ curl -i -X DELETE http://127.0.0.1:5000/accounts/1
HTTP/1.1 204 NO CONTENT
Server: gunicorn
Date: Tue, 29 Nov 2022 12:13:52 GMT
Connection: close
Content-Type: text/html; charset=utf-8
(venv) theia:devops-capstone-project$
```

The terminal window includes a sidebar with project navigation, a file tree, and various icons for file operations. The status bar at the bottom shows the current branch name, Python version, and other system details.



Add Continuous Integration (CI) and Security to a Repository



- ✓ As part of Sprint 2, I will create a workflow that will build and test every push/pull request to my repository. I will also use Flake8 to lint my code and add quality checks to my CI pipeline and configure nosetests to test the code coverage.
- ✓ I will be moving the corresponding user stories through my kanban board as my work progresses. When I complete a story, I will move it to "Done" and from there to "Closed."
- ✓ In this, I will add secure code practices for the microservice I built by adding Flask-Talisman for security headers and Flask-CORS to establish Cross-Origin Resource Sharing (CORS) policies.
- ✓ To align with the TDD practices, I will write a test case for the security feature I'm trying to implement. The failing test case should eventually pass once I include the necessary code for adding security headers and CORS policies.

Task 3A) sprint2-plan

capstone-project > Board



Find issues (f+i)



New Issue

Icebox

2 Issues



devops-capstone-project #7
Containerize your microservice
using Docker

enhancement



devops-capstone-project #8
Deploy your Docker image to
Kubernetes

enhancement

Product Backlog

0 Issues / 0 Points



Product Backlog

Upcoming Issues that have been reviewed,
estimated, and prioritized top-to-bottom.

Sprint Backlog

4 Issues / 8 Points



devops-capstone-project #17
Need the Ability to Automate
Continuous Integration Checks

⚡ Sprint: Dec 6 - Dec 13, 2022

3 technical debt



devops-capstone-project #18
Need to Add Security Headers and
CORS Policies

⚡ Sprint: Dec 6 - Dec 13, 2022

5 technical debt



devops-capstone-project #10
Sprint 2

⚡ Sprint: Dec 6 - Dec 13, 2022

technical debt



devops-capstone-project #11
Sprint 3

In Progress

0 Issues / 0 Points

In Prog

Issues currently being
treat

Task 3B) ci-workflow-done

generated from [ibm-developer-skills-network/aolwx-devops-capstone-template](#)

Code Issues 3 Pull requests Zenhub Actions Projects Security Insights

All workflows

Showing runs from all workflows

Filter workflow runs

Event	Status	Branch	Actor
added deploy task	Success	main	14 days ago 59s
added link task	Success	main	14 days ago 1m 8s
Merge pull request #19 from fabiangraf96/add-kub...	Success	main	14 days ago 1m 3s
Added Kubernetes support	Success	add-kubernetes	14 days ago 1m 7s
Merge pull request #18 from fabiangraf96/add-doc...	Success	main	14 days ago 1m 5s
Added docker support	Success	add-docker	14 days ago

Task 3 C) ci-badge-done

 README.md	Added badge for Github Actions	15 days ago
 requirements.txt	Added CORS headers	14 days ago
 setup.cfg	Typo in setup.cfg file	15 days ago

 README.md

DevOps Capstone Template

 CI Build passing

 License Apache 2.0  Python 3.9

This repository contains the starter code for the project in [IBM-CD0285EN-SkillsNetwork DevOps Capstone Project](#) which is part of the [IBM DevOps and Software Engineering Professional Certificate](#)

Usage

You should use this template to start your DevOps Capstone project. It contains all of the code that you will need to get started.

Do Not fork this code! It is meant to be used by pressing the **Use this Template** button in GitHub. This will copy the code to your own repository with no connection back to the original repository like a fork would. This is what you want.

Development Environment

Task 3D) ci-kanban-done

capstone-project > Board

Filters ▾ Find issues (f+i) New Issue

Sprint Backlog	In Progress	Review/QA	Done
3 Issues / 5 Points	0 Issues / 0 Points	0 Issues / 0 Points	1 Issue / 3 Points
<p>devops-capstone-project #18 Need to Add Security Headers and CORS Policies ↳ Sprint: Dec 6 - Dec 13, 2022 5 technical debt</p>	<p>In Progress Issues currently being worked on by the team.</p>	<p>Review/QA Issues open to the team for review and testing. Code complete, pending feedback.</p>	<p>devops-capstone-project #17 Need the Ability to Automate Continuous Integration Checks ↳ Sprint: Dec 6 - Dec 13, 2022 3 technical debt</p>
<p>devops-capstone-project #10 Sprint 2 ↳ Sprint: Dec 6 - Dec 13, 2022 technical debt</p>			
<p>devops-capstone-project #11 Sprint 3 ↳ Sprint: Dec 13 - Dec 20, 2022 technical debt</p>			

Task 3E) security-code-done

The screenshot shows a code editor interface with a dark theme. The top menu bar includes File, Edit, Selection, View, Go, Run, Terminal, and Help. On the left, there's a sidebar with various icons and a tree view of the project structure:

- EXPLORE ...
- > OPEN EDITOR: devops-capstone-project > service > __init__.py > ...
- PROJECT: .gitignore, LICENSE, Makefile, Procfile, README.md, requirements.txt, setup.py
- service: com..., __init__.py (selected), config, mod..., routes, tekton, tests, flask..., gitattr..., gitign..., LICENSE
- NPM SCRIPTS
- TIMELINE

The main editor area displays the contents of the __init__.py file:

```
1     """
2     Package: service
3     Package for the application models and service routes
4     This module creates and configures the Flask app and sets up
5     and SQL database
6     """
7     import sys
8     from flask import Flask
9     from service import config
10    from service.common import log_handlers
11
12    # Create Flask application
13    app = Flask(__name__)
14    app.config.from_object(config)
15
16    # Import the routes After the Flask app is created
17    # pylint: disable=wrong-import-position, cyclic-import, wrc
18    from service import routes, models  # noqa: F401 E402
19
20    # pylint: disable=wrong-import-position
21    from service.common import error_handlers, cli_commands  #
22
23    # Set up logging for production
24    log_handlers.init_logging(app, "gunicorn.error")
25
26    app.logger.info(70 * "*")
```

The status bar at the bottom shows the following information: Python 3.9.15 64-bit, 0 Δ 0, Go Live, Ln 1, Col 1, LF, UTF-8, Spaces: 4, Python.

Task 3 F) security-headers-done

The screenshot shows a code editor interface with a terminal window open. The terminal window is titled "Python - Get Started" and displays a series of command-line errors. The errors are all variations of "bash: syntax error near unexpected token `app'". This indicates that the user is attempting to run Python code (specifically a file named "CORS(app)") from a terminal window, which is not the intended environment for running Python scripts.

```
__init__.py > Python - Get Started
devops-capstone-project > service > __init__.py > ...
1  """
2      Package: service
3      Package for the application models and service routes
4      This module creates and configures the Flask app and sets up
5      and SQL database

theia:project >
bash: /home/theia/venv/bin/activate: No such file or directory
theia:project$ CORS(app)
bash: syntax error near unexpected token `app'
theia:project$ 
theia:project$ 
theia:project$ 
theia:project$ 
theia:project$ 
theia:project$ 
theia:project$ 
theia:project$ 
theia:project$ from flask_cors import CORS
from: can't read /var/mail/flask_cors
theia:project$ CORS(app)
bash: syntax error near unexpected token `app'
theia:project$ CORS(app)
bash: syntax error near unexpected token `app'
theia:project$ CORS(app)
bash: syntax error near unexpected token `app'
theia:project$ CORS(app)
bash: syntax error near unexpected token `app'
theia:project$ CORS(app)
bash: syntax error near unexpected token `app'
theia:project$ CORS(app)
bash: syntax error near unexpected token `app'
theia:project$ CORS(app)
```

File Edit Selection View Go Run Terminal Help

EXPLO... ... _init__.py > Python - Get Started

> OPEN EDITOR: devops-capstone-project > service > __init__.py > ...

PROJECT .gitignore LICENSE Mak... Proc... REA... requi... setu... service > com... __init__.py confi... mod... rout... > tekton > tests .flaskenv .gitattributes .gitignore LICENSE > NPM SCRIPTS > TIMELINE

main* Python 3.9.15 64-bit 0 △ 0 Go Live Ln 1, Col 1 LF UTF-8 Spaces: 4 Python

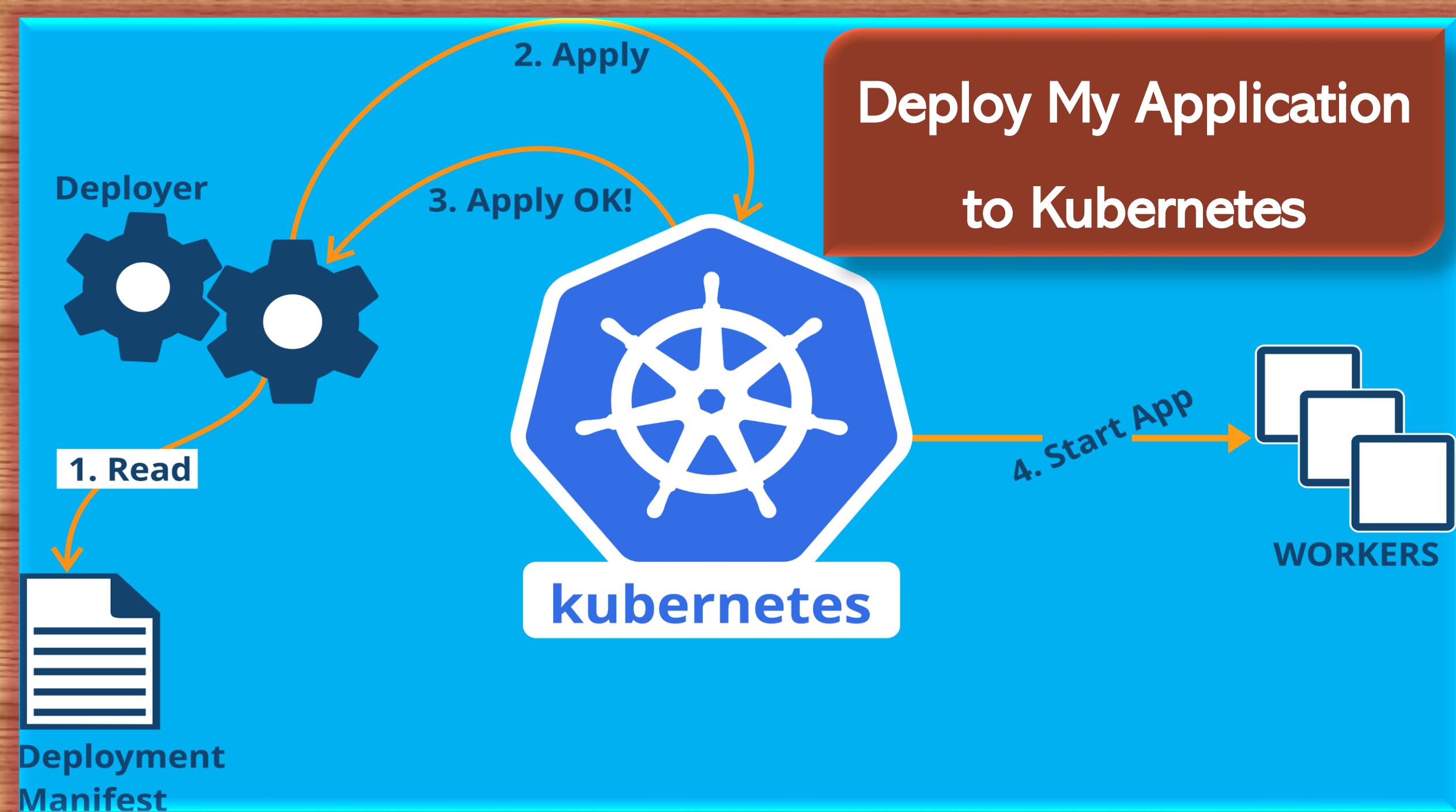
Task 3 G) security-kanban-done

capstone-project > Board

Filters ▾ Find issues (f+i) New Issue

Add a pipeline ...

Review/QA	Done	Closed
+ 0 Issues / 0 Points	+ 2 Issues / 8 Points	+ ~6 Issues / 6 PRs
Review/QA	Done	Closed
Issues open to the team for review and testing. Code complete, pending feedback.	<p>devops-capstone-project #17 Need the Ability to Automate Continuous Integration Checks Sprint: Dec 6 - Dec 13, 2022 3 technical debt</p> <p>devops-capstone-project #18 Need to Add Security Headers and CORS Policies Sprint: Dec 6 - Dec 13, 2022 5 technical debt</p>	<p>devops-capstone-project #5 Delete an account from the service Sprint: Nov 29 - Dec 6, 2022 13 technical debt</p> <p>devops-capstone-project #4 Update an account in the service Sprint: Nov 29 - Dec 6, 2022 8 technical debt</p> <p>devops-capstone-project #6 List all accounts in the service Sprint: Nov 29 - Dec 6, 2022 21 technical debt</p> <p>devops-capstone-project #2 Set up the development environment Sprint: Nov 29 - Dec 6, 2022</p>



- ✓ On Sprint 3, I will work on two user stories sequentially. This will involve creating a Docker image of my microservice and manually deploying the same to an OpenShift/Kubernetes cluster.
- ✓ At first, I will find my user story "Containerize my microservice using Docker" in the kanban board, move it to "In Progress," and assign it to myself.
- ✓ Next, I will create the Dockerfile and then use it to build to Docker image called "accounts." I will push this image to the IBM Cloud Container Registry. I will use this image to deploy to Kubernetes/OpenShift as part of the "Deploy my Docker image to Kubernetes" user story.
- ✓ For my second user story, the first task will include creating a PostgreSQL service in OpenShift, which will serve as the database in Kubernetes for my application. I will move on to creating manifest YAML files for deploying the Docker image to the OpenShift cluster.

Task 4 A) sprint3-plan

Task 4 A) sprint3-plan

The screenshot shows a Jira board titled "capstone-project > Board". The board is divided into four columns: Sprint Backlog, In Progress, Review/QA, and Done.

- Sprint Backlog:** Contains 4 issues / 16 points. Issues include:
 - devops-capstone-project #7 Containerize your microservice using Docker (Sprint: Dec 13 - Dec 20, 2022, 3 technical debt)
 - devops-capstone-project #8 Deploy your Docker image to Kubernetes (Sprint: Dec 13 - Dec 20, 2022, 5)
 - devops-capstone-project #20 Create a CD Pipeline to Automate Deployment to Kubernetes (Sprint: Dec 13 - Dec 20, 2022, 8)
 - devops-capstone-project #11 Sprint 3
- In Progress:** Contains 0 issues / 0 points. Description: Issues currently being worked on by the team.
- Review/QA:** Contains 0 issues / 0 points. Description: Issues open to the team for review and testing. Code complete, pending feedback.
- Done:** Contains 3 issues / 8 points. Issues include:
 - devops-capstone-project #17 Need the Ability to Automate Continuous Integration Checks (Sprint: Dec 6 - Dec 13, 2022, 3 technical debt)
 - devops-capstone-project #18 Need to Add Security Headers and CORS Policies (Sprint: Dec 6 - Dec 13, 2022, 5 technical debt)
 - devops-capstone-project #10 Sprint 2 (Sprint: Dec 6 - Dec 13, 2022, 1 technical debt)

At the top right, there are buttons for "Find issues (f+i)", "New Issue", and a plus sign. At the bottom right, there is a blue "Sync" icon.

Task 4 B) Kubernetes-app-output

The screenshot shows a terminal window with two tabs: "Dockerfile" and "Your Application". The "Your Application" tab is active, displaying the URL <https://kedirnasir10-8080.theiaopenshift-1-labs-prod-theiaopenshift-4-tor01.proxy.cognitiveclass.ai> and the JSON response {"name": "Account REST API Service", "version": "1.0"}. The "theia:devops-capstone-project" tab shows log output from a Docker container, including the message "[INFO] [glogging] Worker exiting (pid: 7)" and the command "docker push us.icr.io/\$SN_ICR_NAMESPACE/accounts:1". The bottom status bar indicates the file is "add-docker*", has 0 changes, and shows the current line and column as Ln 16, Col 12.

```
File Edit Selection View Go Run Terminal Help
Dockerfile Your Application ×
< > ⌂ https://kedirnasir10-8080.theiaopenshift-1-labs-prod-theiaopenshift-4-tor01.proxy.cognitiveclass.ai ⌂
{"name": "Account REST API Service", "version": "1.0"}

theia:devops-capstone-project ×
[2022-11-30 11:28:05 +0000] [INFO] [glogging] Worker exiting (pid: 7)
theia:devops-capstone-project$ docker push us.icr.io/$SN_ICR_NAMESPACE/accounts:1

add-docker* ⌂ 0 △ 0
Go Live Ln 16, Col 12 LF UTF-8 Spaces: 4 Docker ⌂
```

Task 4 C) Kubernetes-docker-done

capstone-project > Board

Filters ▾

Review/QA

0 Issues / 0 Points

Review/QA

Issues open to the team for review and testing. Code complete, pending feedback.

Done

4 Issues / 11 Points

3 technical debt

devops-capstone-project #18
Need to Add Security Headers and CORS Policies

⚡ Sprint: Dec 6 - Dec 13, 2022

5 technical debt

devops-capstone-project #10
Sprint 2

⚡ Sprint: Dec 6 - Dec 13, 2022

technical debt

devops-capstone-project #7
Containerize your microservice using Docker

⚡ Sprint: Dec 13 - Dec 20, 2022

3 technical debt

Closed

~6 Issues / 7 PRs

technical debt

devops-capstone-project #5
Delete an account from the service

⚡ Sprint: Nov 29 - Dec 6, 2022

13 technical debt

devops-capstone-project #4
Update an account in the service

⚡ Sprint: Nov 29 - Dec 6, 2022

8 technical debt

devops-capstone-project #6
List all accounts in the service

⚡ Sprint: Nov 29 - Dec 6, 2022

21 technical debt

devops-capstone-project #2
Set up the development

Find issues (f+i)



New Issue



Add a pipeline ...



Task 4 D) Configuration of the Docker file and Task 4 E) kubernetes-images

```
13 lines (13 sloc) | 410 Bytes

1 FROM python:3.9-slim
2 # Create working folder and install dependencies
3 WORKDIR /app
4 COPY requirements.txt .
5 RUN pip install --no-cache-dir -r requirements.txt
6 # Copy the application contents
7 COPY service/ ./service/
8 # Switch to a non-root user
9 RUN useradd --uid 1000 theia && chown -R theia /app
10 USER theia
11 # Run the service
12 EXPOSE 8080
13 CMD ["gunicorn", "--bind=0.0.0.0:8080", "--log-level=info", "service:app"]
```

```
theia:devops-capstone-project ×
```

```
(venv) theia:devops-capstone-project$ docker image ls
REPOSITORY          TAG      IMAGE ID   CREATED        SIZE
accounts            latest   798105b3a86a  41 minutes ago  201MB
us.icr.io/sn-labs-alvarolaham/accounts  1        798105b3a86a  41 minutes ago  201MB
<none>              <none>   a5e2148e7274  52 minutes ago  201MB
python               3.9-slim  a612918ff2a3  13 days ago   125MB
postgres             alpine   e4c9576cbbba  2 weeks ago   218MB
(venv) theia:devops-capstone-project$ █
```

Task 4 F) Kubernetes-deploy-accounts

The screenshot shows a terminal window with several tabs open, displaying Kubernetes resources and configuration files.

Dockerfile:

```
FROM python:3.9-slim
# Create working folder and install dependencies
WORKDIR /app
COPY requirements.txt .
```

theia:devops-capstone-project × theia:project

NAME	READY	STATUS	RESTARTS	AGE
pod/accounts-56857dcd75-764w2	0/1	ImagePullBackOff	0	31m
pod/accounts-56857dcd75-njplg	0/1	ImagePullBackOff	0	31m
pod/accounts-56857dcd75-v9179	0/1	ImagePullBackOff	0	31m

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
service/accounts	ClusterIP	172.21.227.63	<none>	8080/TCP	29m

NAME	READY	UP-TO-DATE	AVAILABLE	AGE
deployment.apps/accounts	0/3	3	0	31m

NAME	DESIRED	CURRENT	READY	AGE
replicaset.apps/accounts-56857dcd75	3	3	0	31m

NAME	HOST/PORT	PATH	SERV
ICES	PORT TERMINATION WILDCARD		
route.route.openshift.io/accounts	accounts-sn-labs-kedirnasir10.labs-prod-openshift-sa n-a45631dc5778dc6371c67d206ba9ae5c-0000.us-east.containers.appdomain.cloud		acco
unts	<all> edge None		
theia:devops-capstone-project\$			

Ln 14, Col 1 Go Live LF UTF-8 Spaces: 4 Docker

Task 4 G) Kubernetes-done

capstone-project > Board

Filters ▾ Find issues (f+i)

New Issue +

In Progress	Review/QA	Done	Closed
0 Issues / 0 Points	0 Issues / 0 Points	5 Issues / 16 Points	~6 Issues / 7 PRs
In Progress	Review/QA	Done	Closed
Issues currently being worked on by the team.	Issues open to the team for review and testing. Code complete, pending feedback.	5 technical debt	devops-capstone-project #5 Delete an account from the service
		4 Sprint: Dec 6 - Dec 13, 2022	Sprint: Nov 29 - Dec 6, 2022
		13 technical debt	devops-capstone-project #10 Sprint 2
		4 Sprint: Dec 6 - Dec 13, 2022	Sprint: Nov 29 - Dec 6, 2022
		technical debt	devops-capstone-project #4 Update an account in the service
		4 Sprint: Dec 13 - Dec 20, 2022	Sprint: Nov 29 - Dec 6, 2022
		3 technical debt	8 technical debt
		4 Sprint: Dec 13 - Dec 20, 2022	devops-capstone-project #6 List all accounts in the service
		21 technical debt	Sprint: Nov 29 - Dec 6, 2022
		4 Sprint: Dec 13 - Dec 20, 2022	devops-capstone-project #2 Set up the development environment
		5	Sprint: Nov 29 - Dec 6, 2022

In Progress

Review/QA

Done

Closed

devops-capstone-project #5
Delete an account from the service

Sprint: Nov 29 - Dec 6, 2022

13 technical debt

devops-capstone-project #10
Sprint 2

Sprint: Nov 29 - Dec 6, 2022

technical debt

devops-capstone-project #4
Update an account in the service

Sprint: Nov 29 - Dec 6, 2022

8 technical debt

devops-capstone-project #6
List all accounts in the service

Sprint: Nov 29 - Dec 6, 2022

21 technical debt

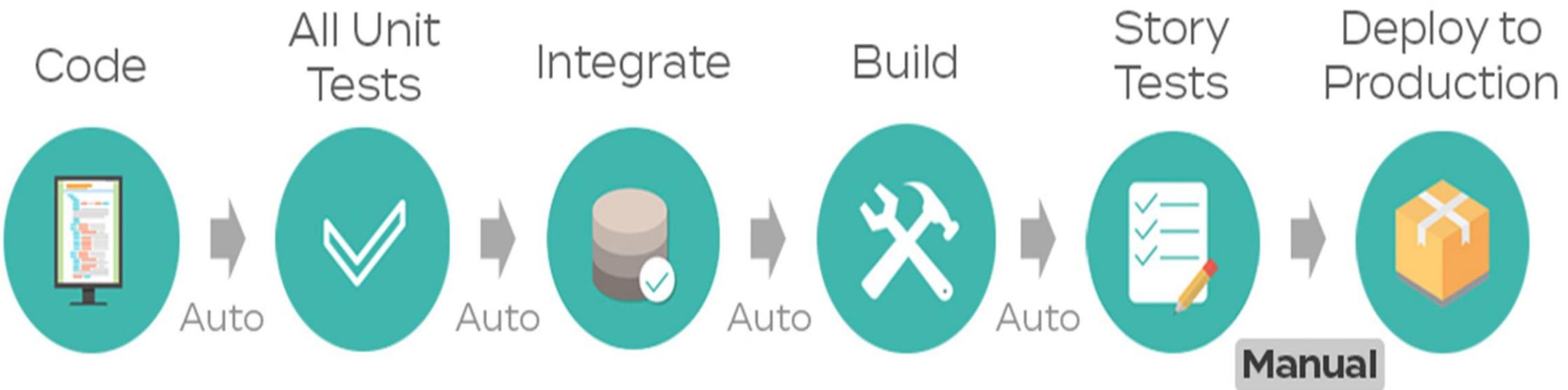
devops-capstone-project #2
Set up the development environment

Sprint: Nov 29 - Dec 6, 2022

5

Build an Automated CD DevOps Pipeline

Continuous Delivery



- ✓ I will automate the deployment to Kubernetes using the Tekton pipeline so that when the pipeline is triggered, the accounts service will be deployed to Kubernetes without requiring any manual intervention.
- ✓ To start, I will find the user story "Create a CD pipeline to automate deployment to Kubernetes" in the kanban board, move it from the "Sprint Backlog" to "In Progress," and assign it to myself.
- ✓ Next, I will create the CD pipeline, involving tasks for cloning, linting, unit testing, building, and deploying the service to an OpenShift/Kubernetes cluster.
- ✓ I will create a new branch for this story and start working on it. Once the task is completed, I will commit and push my changes from my local environment to my GitHub repository. Finally, I will create pull requests and merge my code to the main or master branch.
- ✓ When I complete a story, I will move it to "Done" and from there to "Closed."

Task 5 A) tekton pipeline run- [https://github.com/kedibeki/devops-capstone-project/blob/main/Task%205%20A\)%20tekton%20pipeline%20run.txt](https://github.com/kedibeki/devops-capstone-project/blob/main/Task%205%20A)%20tekton%20pipeline%20run.txt)

Task 5 B) cd-pipeline-done

capstone-project > Board

Review/QA Done Closed

Find issues (f+i)

Review/QA
0 Issues / 0 Points

Done
6 Issues / 24 Points

Closed
~6 Issues / 7 PRs

Review/QA
Issues open to the team for review and testing. Code complete, pending feedback.

Done
technical debt

devops-capstone-project #7
Containerize your microservice using Docker
Sprint: Dec 13 - Dec 20, 2022
3 technical debt

devops-capstone-project #8
Deploy your Docker image to Kubernetes
Sprint: Dec 13 - Dec 20, 2022
5

devops-capstone-project #20
Create a CD Pipeline to Automate Deployment to Kubernetes
Sprint: Dec 13 - Dec 20, 2022
8

Closed
devops-capstone-project #5
Delete an account from the service
Sprint: Nov 29 - Dec 6, 2022
13 technical debt

devops-capstone-project #4
Update an account in the service
Sprint: Nov 29 - Dec 6, 2022
8 technical debt

devops-capstone-project #6
List all accounts in the service
Sprint: Nov 29 - Dec 6, 2022
21 technical debt

devops-capstone-project #2
Set up the development environment
Sprint: Nov 29 - Dec 6, 2022



Conclusion



➤ Results and Achievements

- ✓ I have effectively **demonstrated** and **solve** the problem of my company's customer account manager request which is:
- ✓ Created an **account microservice** to keep track of the customers who shop on our **e-commerce** website.
- ✓ The microservice a well formatted **REST API** that other microservices can call.
- ✓ Customers can now be **created, read, updated, deleted, and listed** for the service.

Reference

➤ IBM DevOps and Software Engineering Professional Certificate: Capstone Project

- ✓ Visit My GitHub Portfolio: <https://github.com/kedibeki/devops-capstone-project>
- ✓ Visit IBM's Specialization Page: <https://www.cmysera.org/professional-certificates/devops-and-software-engineering>
- ✓ Visit IBM's Capstone Project Page: <https://www.cmysera.org/learn/devops-capstone-project?specialization=devops-and-software-engineering>

Acknowledgment

➤ IBM and Coursera: IBM DevOps and Software Engineering Specializations Professional Certificate Instructors

- ✓ **John Rofrano**- Senior Technical Staff Member, DevOps Champion at IBM Research
- ✓ Upkar Lidder- Senior Software Engineer
- ✓ Rav Ahuja- Global Program Director
- ✓ Sam Prokopchuk- Skills Network Data Scientist
- ✓ Ramesh Sannareddy- Data Engineering Subject Matter Expert
- ✓ Joseph Santarcangelo- Ph.D., Data Scientist at IBM
- ✓ Alex Parker- Offering Manager for IBM Cloud Kubernetes Service

