

Smart Modernization on z/OS

Using WCA4z AI & DevOps to
Extend COBOL CICS DB2 with Java
Only Where It Makes Sense

Hands-on lab guide

Code and templates are shareable

Joseph Taffe-Atkins, IBM
Steve Foley, IBM



Hands on Lab includes:

1. IBM watsonx Code Assistant for Z Understand
2. IBM watsonx Code Assistant for Z Explanation
3. IBM watsonx Code Assistant for Z Refactor
4. IBM watsonx Code Assistant for Z Transform (using live WCA4z Service)
5. IBM DevOps solutions CI/CD Pipeline for Java running CICS
(Git on z/OS, Gradle on z/OS and x86, Git Lab CI and IBM DevOps Deploy aka Urban Code Deploy)
6. IBM DevOps solutions CI/CD Pipeline for COBOL CICS DB2 VSAM Application CICS-
Java
(Git on z/OS, IBM Dependency Based Build, Git Lab CI and IBM DevOps Deploy aka Urban Code Deploy)

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Purpose of the document

This document is designed to guide you through the capabilities of IBM Watsonx Code Assistant for Z, specifically focusing on its ability to execute the Understand, Refactor, and Transform phases. Using a real-world COBOL CICS-to-Java scenario, you will experience how the Watson AI Code Transformation Model can help modernize applications where transitioning from COBOL to Java makes sense within a "best fit language" approach.

By following the step-by-step instructions in this guide, you will gain hands-on experience with IBM Watsonx Code Assistant for Z, helping you build confidence in using it for modernization initiatives—especially during an adoption project. Depending on your specific environment, adjustments to the execution sequence may be necessary.

Who is this guide for?

IBM Watsonx Code Assistant for Z is designed to support various roles, including:

- Architects – to plan and oversee modernization strategies.
- Business analysts – to understand and define refactoring opportunities.
- Developers – to implement and optimize code transformation.

What to Expect

This scenario demonstrates how Java and COBOL developers can collaborate to refactor and implement a feature originally written in COBOL but better suited for Java. The IBM Watsonx Code Assistant for Z Refactoring Assistant helps developers identify the right components to modularize and convert into reusable services, enabling a more efficient, scalable, and modernized application architecture.

Whether you are new to IBM Watsonx Code Assistant for Z or looking to integrate it into your projects, this guide will provide you with the foundational knowledge needed to leverage AI-powered code transformation with confidence.

The hands-on flow for this lab and the client storyline

wca4z / GenappExtended-Java / Issues / #1

Add a new rule to the POSTCODE IF / ELSE or EVALUATE validation

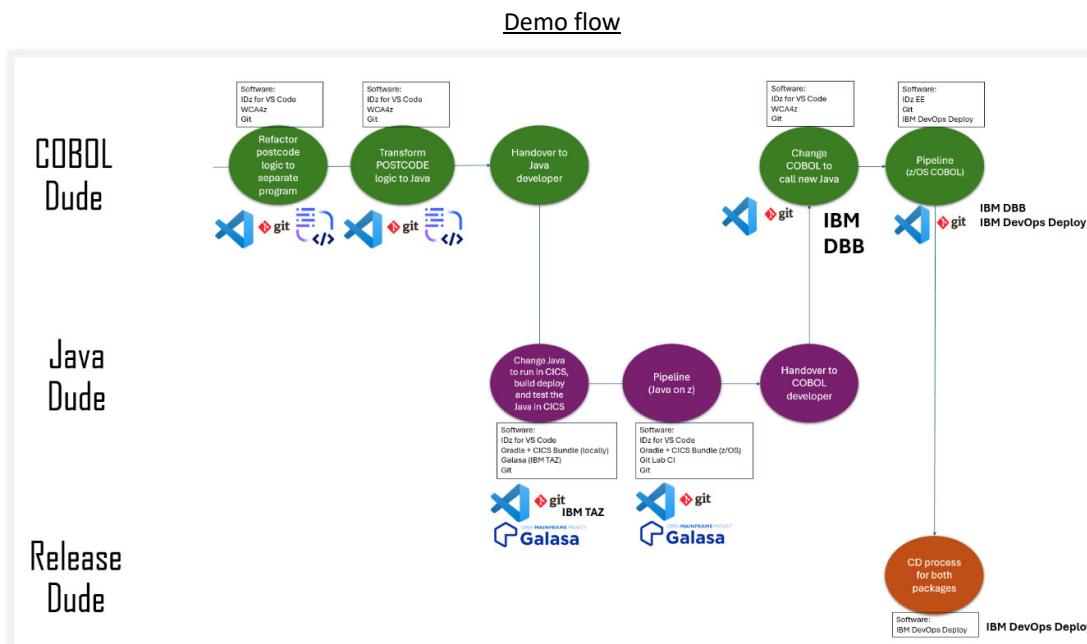
Open Issue created 4 months ago by wca4z

Business users have stated that the POSTCODE logic needs an additional validation rule for 'EU' in the function that is within the COBOL program, LGACUS01.

The technical architect stated the POSTCODE logic is better suited in Java therefore we will separate this function from LGACUS01 into its own Java module and call it from COBOL CICS using CICS APIs.

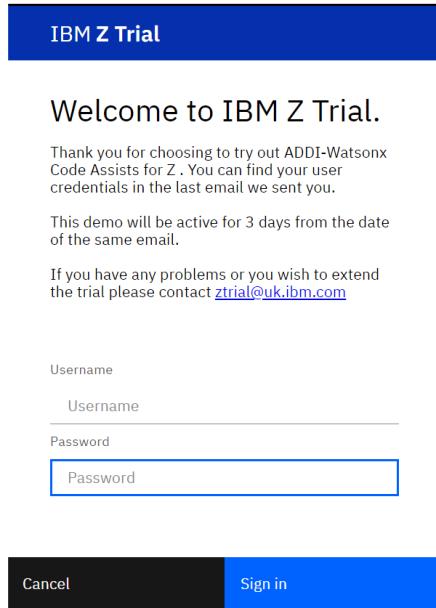
0 0 0 Create merge request

- Customer Fact 1**
They want to make changes to application functions in the most suitable language on Z and not just COBOL.
- Customer Fact 2**
They determined that the POSTCODE logic, originally written in COBOL, is better suited to Java and they have available zIIP capacity.
- Customer Fact 3**
Some business logic, better suited for Java, is already implemented in COBOL. They plan to migrate this logic to Java as changes to functions are required.
- Customer Fact 4**
COBOL and Java developers are paired up to ensure successful migration to Java before adding any new functionality in Java.

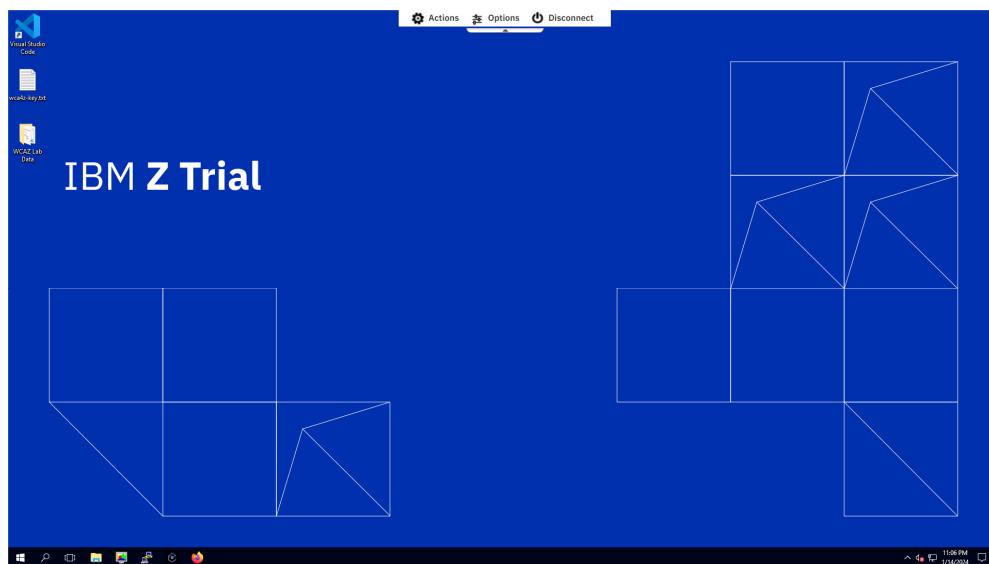


How to login and initialize the lab

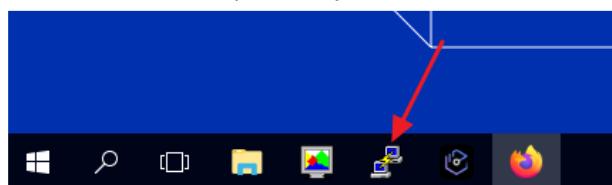
1. Get your access for workshop link provided prior to the workshop.



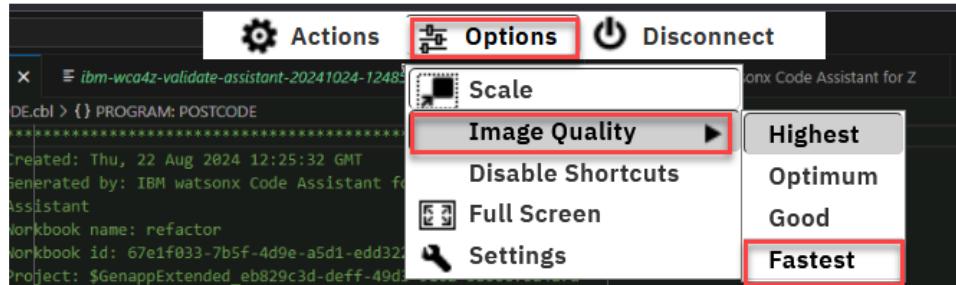
2. Login with your credentials to get into IBM Z TRIAL.



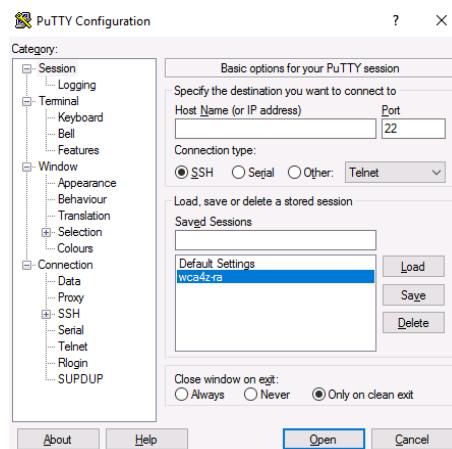
3. On RDP browser, Open Putty from taskbar.



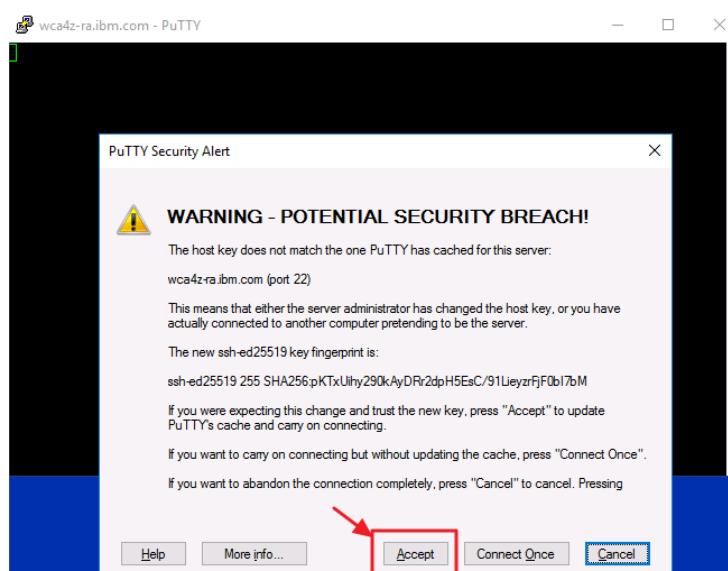
4. Adjust your session to the optimal performance by selecting this at the top middle of your screen. ***Please note, if you screen freezes up during your session, please refresh the browser screen! Apologies for the inconvenience caused.***



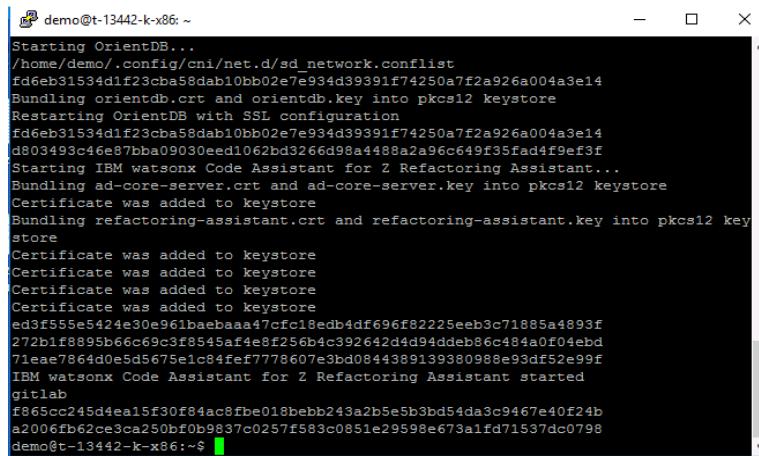
5. select wca4z-ra and click on open.



6. After clicking on Open in previous step following warning will pop-up. Select "Accept". This will be displayed only first time.



- Auto scripts will run on Putty to start the Refactoring Assistant.
- Wait until message “IBM Watson code assistant for Z Refactoring Assistant started” is displayed on putty. **Leave putty running. If prompted for ID and password, its IBMUSER and sys1**

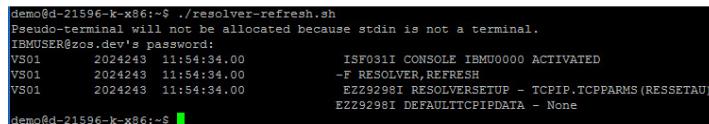


```

demo@t-13442-k-x86: ~
Starting OrientDB...
/home/demo/.config/cni/net.d/sd_network.conflist
fd6eb31534d1f23cba58dab10bb02e7e934d39391f74250a7f2a926a004a3e14
Bundling orientdb.crt and orientdb.key into pkcs12 keystore
Restarting OrientDB with SSL configuration
fd6eb31534d1f23cba58dab10bb02e7e934d39391f74250a7f2a926a004a3e14
d803493c46e7bba09030eed1062bd3266d98a4488a2a96c649f35fad4f9ef3f
Starting IBM Watsonx Code Assistant for Z Refactoring Assistant...
Bundling ad-core-server.crt and ad-core-server.key into pkcs12 keystore
Certificate was added to keystore
Bundling refactoring-assistant.crt and refactoring-assistant.key into pkcs12 key
store
Certificate was added to keystore
ed3f555e5424e30e961baeba447fcf18edb4df696f82225eeb3c71885a4893f
272b1f8895b66c69c3f8545af4e8f256b4c392642d4d94ddeb86c484a0f04ebd
71ea7864d0e5d5675e1c84fef7778607e3bd0844389139380988e93df52e99f
IBM Watsonx Code Assistant for Z Refactoring Assistant started
gitlab
f865cc245d4ea15f30f84acf8be018beb243a2b5e5b3bd54da3c9467e40f24b
a2006fb62ce3ca250bf0b9837c0257f583c0851e29598e673a1fd71537dc0798
demo@t-13442-k-x86: ~

```

Now enter ./resolver-refresh.sh after the command above has completed.



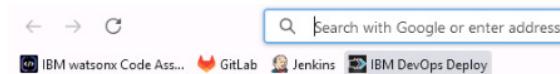
```

demo@d-21596-k-x86: ~$ ./resolver-refresh.sh
Pseudo-terminal will not be allocated because stdin is not a terminal.
IBMUSER@zos.dev's password:
VS01      2024243  11:54:34.00      ISFO31I CONSOLE IBMU0000 ACTIVATED
VS01      2024243  11:54:34.00      -F RESOLVER,REFRESH
VS01      2024243  11:54:34.00      EZZ9298I RESOLVERSETUP - TCPIP.TCPPARMS (RESSETAU)
EZ9298I DEFAULTTCPIPDATA - None
demo@d-21596-k-x86: ~

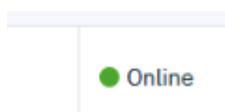
```

Leave putty running.

- Open Firefox from the desktop and navigate to IBM DevOps Deploy and login with **admin/admin**



- Navigate to “Resources” and then “Agents” and confirm that you see both agents online



Let's view the Git Lab ticket where you need to make the code change to a mainframe existing transaction

1. Open Firefox and type in this URL to access the Git Lab ticket:

<http://wca4z-gitlab.ibm.com:10880/wca4z/genappextended-java/-/issues/1> which is showing the work you will undertake but you being the developer has decided to do this in Java instead of COBOL.

You will be prompted for ID and password which is

ID: wca4z-git

Password : P@assw0rd

□ wca4z / GenappExtended-Java / Issues / #1

Add a new rule to the POSTCODE validation

Edit

⋮

Open □ Issue created 6 months ago by wca4z

Business users have stated that the POSTCODE logic needs an additional validation rule for EU in the function that is within the COBOL program, LGACUS01. There are other rules like UK, GB and DN in there rule. It was IF / ELSE or EVALUATE logic, using FUNCTION UPPER CASE.

The technical architect stated the POSTCODE logic is better suited in Java therefore we will separate this function from LGACUS01 into its own Java module and call it from COBOL CICS using CICS APIs.

Edited just now by wca4z

0

0



Create merge request

⋮

Drag your designs here or [click to upload](#).

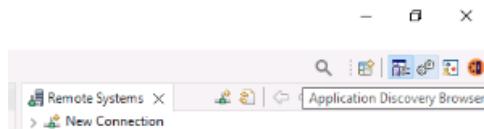
How to execute the Understand phase using IBM Developer for z Systems

1. Open IBM IDz on RDP browser from taskbar. Please allow some time for this to load (3 minutes).

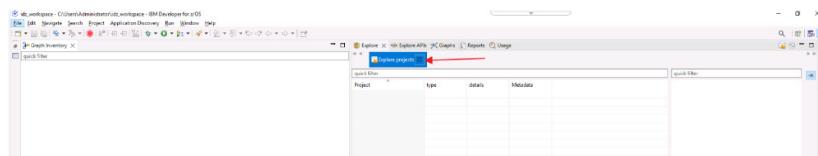


When prompted for workspace name in IDz, select the default one.

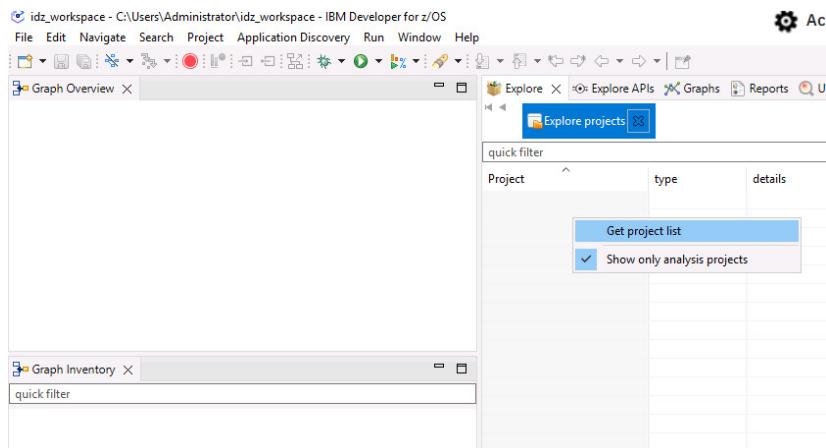
2. If not already open, can you open the “Application Discovery Browser” eclipse perspective from the top right of the eclipse view



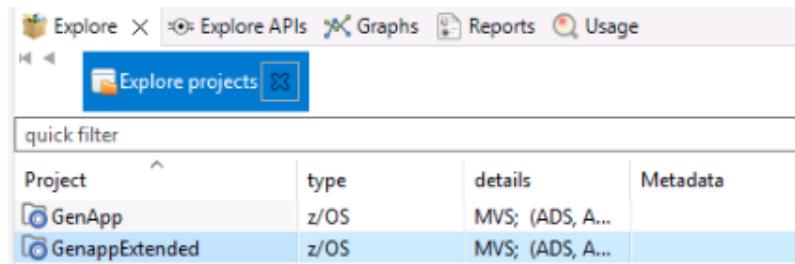
3. In Aqua Eclipse, “Explore projects” tab will be opened by default.



4. Right click in the blank space below “Explore projects” and Select option “Get project list”.



5. All projects will be listed. Single click “GenApp-Extended1”.



The screenshot shows a software interface with a navigation bar at the top containing links for Explore, Explore APIs, Graphs, Reports, and Usage. Below the navigation bar is a toolbar with a magnifying glass icon and a refresh button. The main area is titled "Explore projects". A "quick filter" dropdown is open, showing the "Project" column header. A table lists two projects:

Project	type	details	Metadata
GenApp	z/OS	MVS; (ADS, A...)	
GenappExtended	z/OS	MVS; (ADS, A...)	

6. (If NOT done in STEP 1 above) Open Firefox and type in this URL to access the Git Lab ticket:

<http://wca4z-gitlab.ibm.com:10880/wca4z/genappextended-java/-/issues/1> which is showing the work you will undertake but you being the developer has decided to do this in Java instead of COBOL.

You will be prompted for ID and password which is

ID: wca4z-git

Password : P@assw0rd

□ wca4z / GenappExtended-Java / Issues / #1

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Edited just now by wca4z

Like 0

Dislike 0



Create merge request

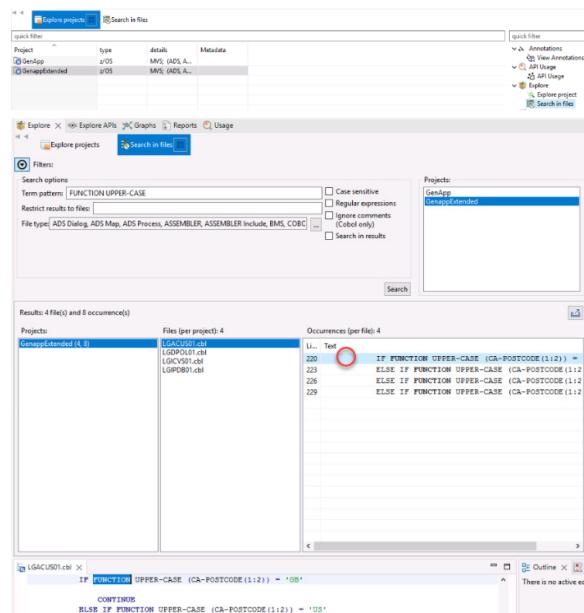
▼

Drag your designs here or [click to upload](#).

7. The clues given about where the code change needs to occur are the following:
- The “**POSTCODE**” validation routine needs changing
 - Assuming there is some **IF / ELSE** or **EVALUATE** logic in the code
 - Can you think of other things in the ticket to help you locate the exact program where the change needs to happen?
 - FUNCTION UPPER-CASE** is potentially code used in the POSTCODE rules

Using the WCA4z Understand capability, you will try to locate the program that needs to be changed in the GenappExtended application.

8. Return back to ADDI in IBM Developer for z/OS and double click in “Search in files” under “Explore projects” for the GenappExtended project.



9. Optional – click on the 3 dots next to ‘File Types’ and uncheck everything except for COBOL.
10. From the COBOL syntax above in **bold** from **(a)-(d)**, you will try to locate the program that has the POSTCODE validation rule. You will be putting the COBOL syntax to help you locate the program in the “Term pattern” input field and select “Search” each time until you locate the program.
11. When you get to searching the COBOL syntax in **(d)** you should see that **LGACUS01** is clearly where the POSTCODE Validation is. Double click on the text next to line 220 (see illustration above) to be shown the text below.

There are other ways to explore and get to the program using the Understand capability. This was one of many ways. Feel free to explore after the lab.

12. Now, let's look at this program in more detail. Single click the "Explore" tab then single click "Explore projects", single click project 'GenApp-Extended1' and new tab with all options will appear at the right side.

Project	type	details	Metadata
GenApp	z/OS	MVS; (ADS, A...	
GenappExtended	z/OS	MVS; (ADS, A...	

- quick filter
- Annotations
 - View Annotations
- API Usage
 - API Usage
- Explore
 - Explore project
 - Search in files
- Layouts
 - Screen Layout
- Mainframe Graphs
 - AAuto Graph
 - CAT Job Triggering Flow
 - CAT Paths
 - Control-M Graph
 - Cross Applications Callgraph API
 - Dataset Flow
 - Flow Chart
 - Job Callgraph
 - Job Flow
 - Mainframe Layout
 - Program Callgraph
 - Program Flow
 - Screen Callgraph
 - Transaction Callgraph
 - TWS Graph
- Mainframe Reports
 - Complexity Reports
 - Datasets Reports
 - Dead Code Reports
 - Impact Reports
 - Inventory Reports
 - Miscellaneous Reports
 - Where Used Reports
- Resolutions
 - Manage Resolutions
- Usage in Jobs

13. On the right side, **double click** to open option "Program Flow" and select **LGACUS01** and "finish".

GenappExtended - Program Flow Analysis

Analysis resources

Select single resource on which analysis should be generated

Available programs

- LGACDB01
- LGACDB02
- LGACUS01**
- LGACV01
- LGAPDB01
- LGAPOL01
- LGAPV01
- LGASTAT1
- LGDPDB01
- LGDPOL01

Name _____

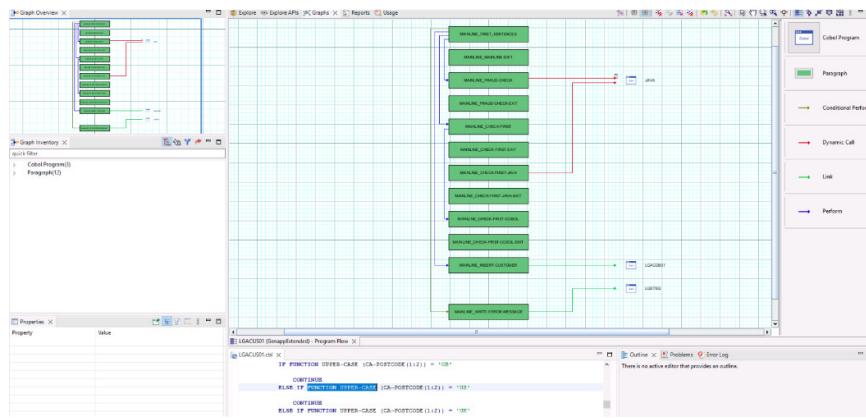
Finish Cancel

- Layouts
 - Screen Layout
- Mainframe Graphs
 - AAuto Graph
 - CAT Job Triggering Flow
 - CAT Paths
 - Control-M Graph
 - Cross Applications Callgraph API
 - Dataset Flow
 - Flow Chart
 - Job Callgraph
 - Job Flow
 - Mainframe Layout
 - Program Callgraph
 - Program Flow
 - Screen Callgraph
 - Transaction Callgraph
 - TWS Graph
- Mainframe Reports
 - Complexity Reports
 - Datasets Reports
 - Dead Code Reports
 - Impact Reports
 - Inventory Reports
 - Miscellaneous Reports
 - Where Used Reports

14. Click on the 3 dots, then open the Legend to understand the diagram



15. Analyse the Program Flow chart



Information: This application and lab use a simple framework for invoking Java programs from COBOL. Appendix A provides an overview of COBOL and Java inter-operation in CICS, and Appendix B describes the simple framework used in this lab.

16. Right click on the CHECK-FIRST-COBOL paragraph and select “view analysis source” to double confirm the logic is correct.

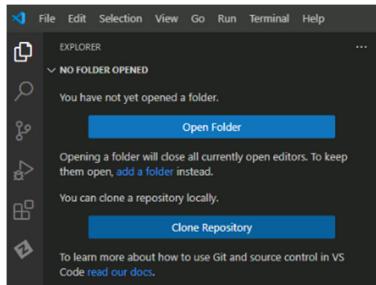
In this **Understand** phase,

1. Here is the logic that needs to be changed in program LGACUS01.
2. The Java developer has identified that they would rather want to implement this feature in Java instead of COBOL.
3. They will look to Refactor this code to its own COBOL service to then transform to the logic to Java.
4. Especially as the program is already calling Java CICS from the COBOL CICS program to do some fraud checking.

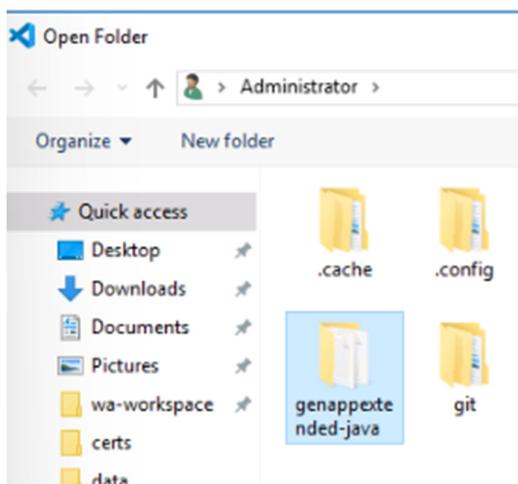
We will use this knowledge in next steps to Refactor and Transform.

How to execute the Refactor phase using VS Code

1. Open VS Code, then click on “Open Folder”

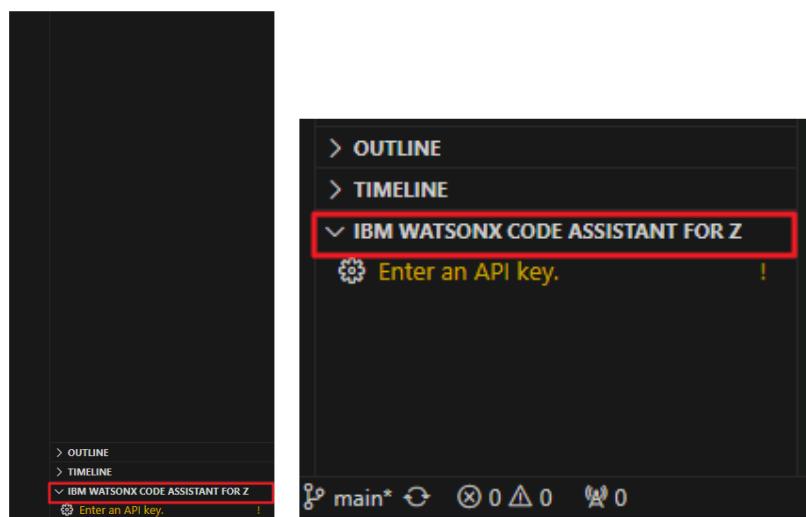


2. Then select the folder “genappextended-java” from C:\Users\Administrator. This folder is an already cloned a Git repository where you will be working from.

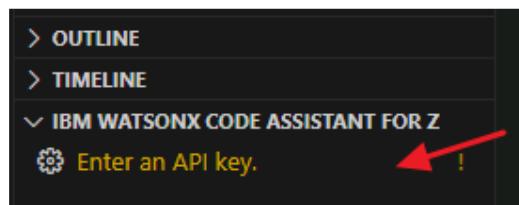


3. Then click select “Select Folder” (give it time to load).

1. On the EXPLORER menu, expand the “IBM WATSONX CODE ASSISTANT FOR Z” at the left corner of the visual studio.



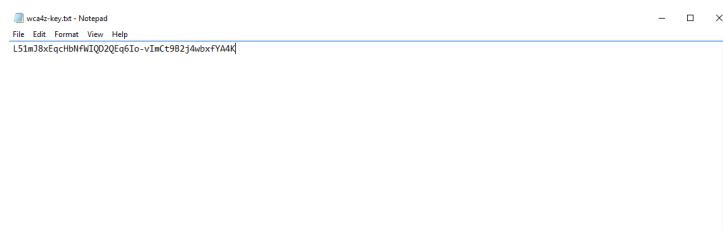
2. You can see warning “Enter an API key” in yellow colour.



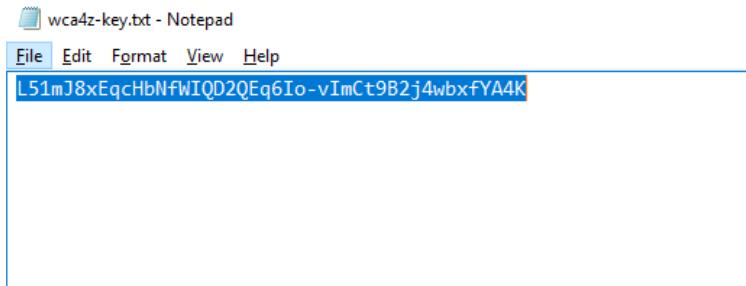
3. To get the API key, minimize all windows and go to desktop.



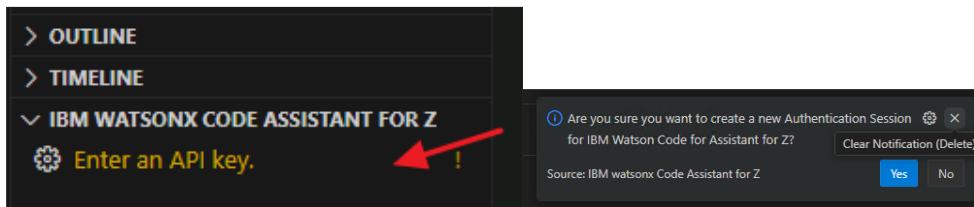
4. Click on notepad named “wca4z-key.txt” to open it.



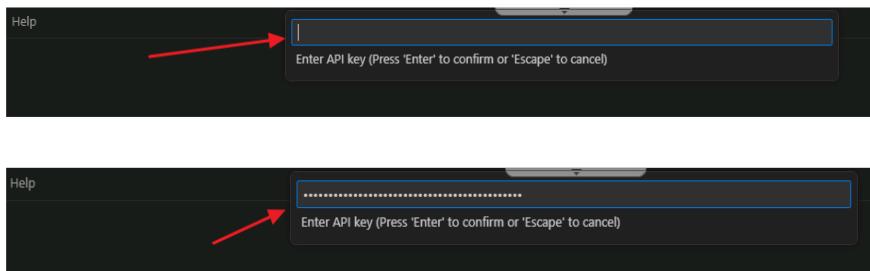
5. Copy API key from the notepad and go back to VS code.



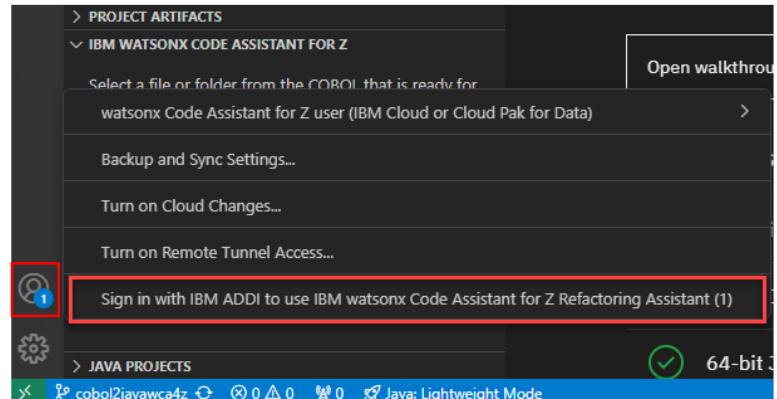
6. Click on warning to get an option “Enter an API key” besides the warning. Click on this option. You may see this warning, if you do, select yes.



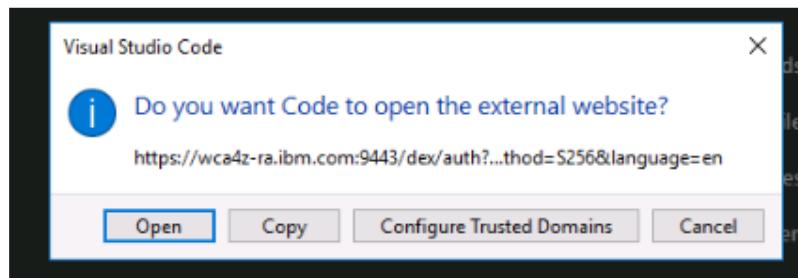
7. At the top middle an input bar will open. Give API key just copied from notepad and press enter.



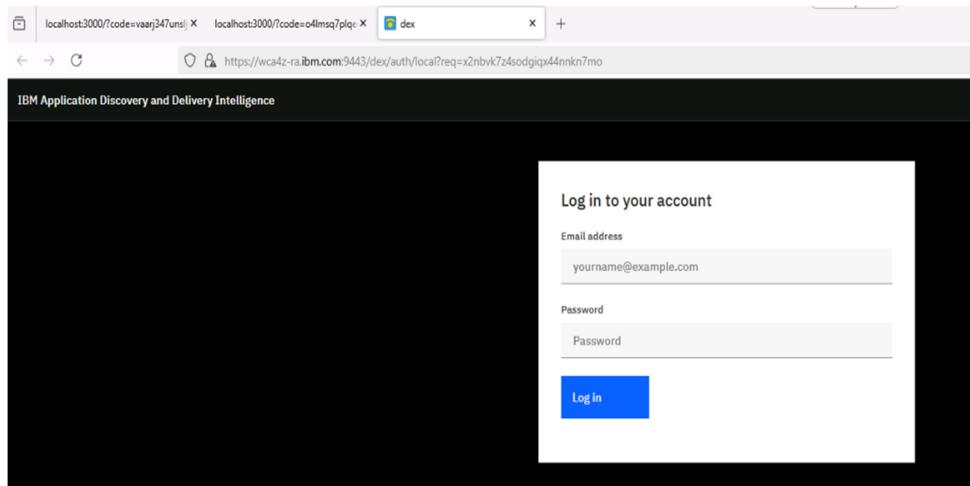
4. Now, go to accounts, and select sign in “IBM Watsonx Code Assistant for Z Refactor Assistant”



5. You will see this prompt. Select ‘Open’ and then a browser will pop to enter your credentials to log into Refactor Assistant.



6. Login using the following credentials.



ID: dev@wca4z-ra.ibm.com

Password: password

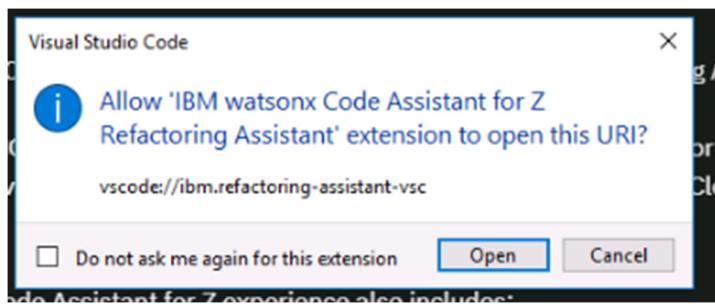
Log in to your account

Email address
dev@wca4z-ra.ibm.com

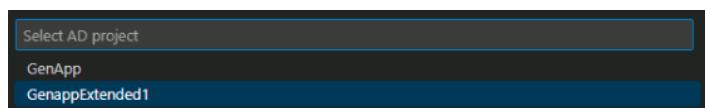
Password

Log in

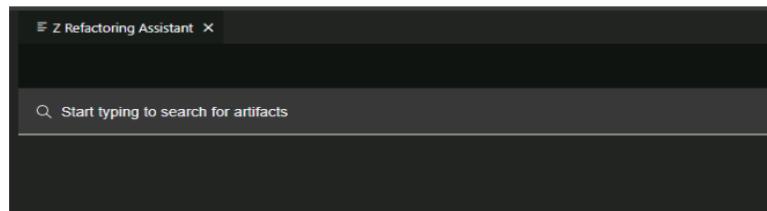
7. As soon as you select enter, navigate back to VS Code (the VS Code logo will be flashing on the taskbar). Then select “Open”.



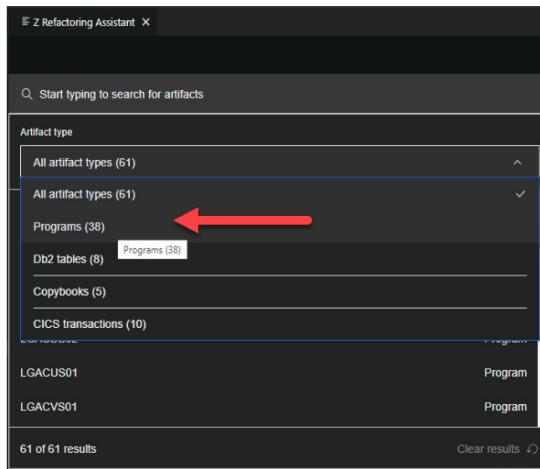
8. If prompted, select “GenappExtended1” project.



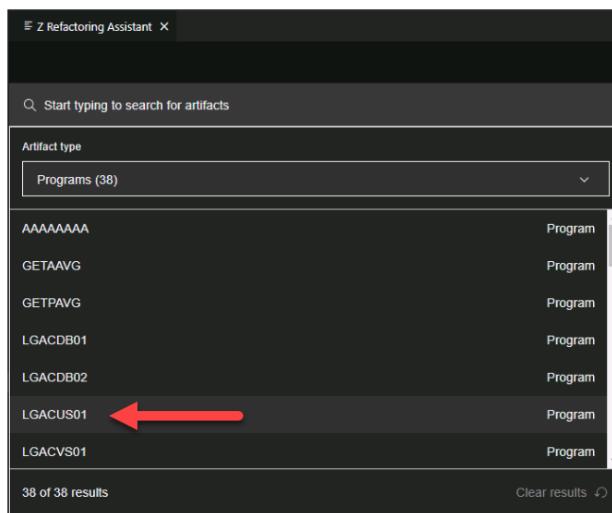
9. Single click on “**Start typing to search for artifacts**”



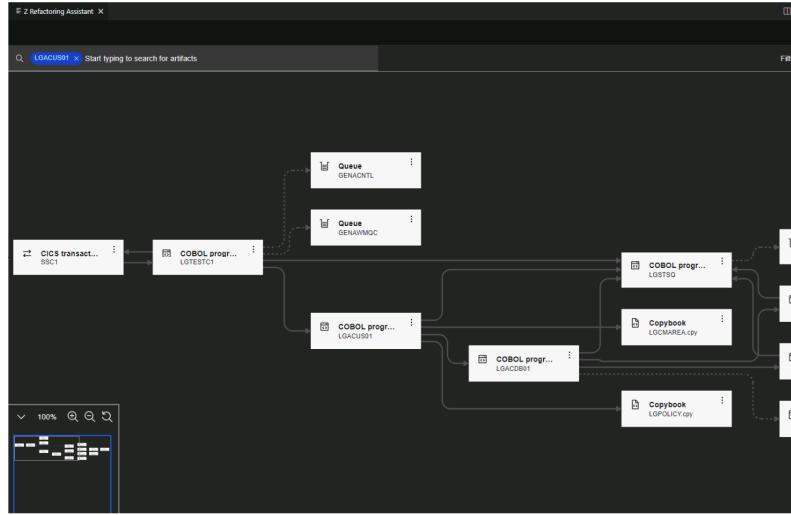
10. Then Select “**All artifact types**” and then select "**Programs**" programs.



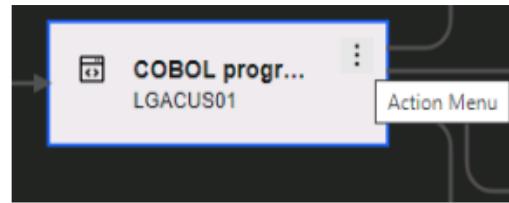
11. From the dropdown list of Programs, click on **LGACUS01** and press enter.



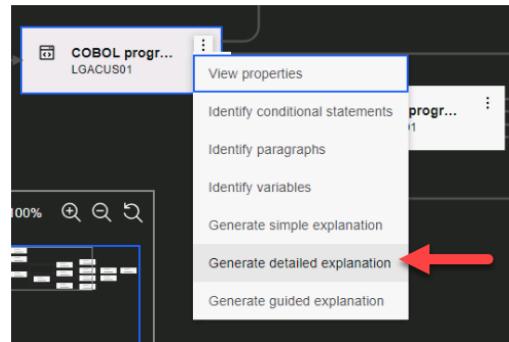
12. The graph for **LGACUS01** Program will open. Take time to analyse it.



13. In the Understand phase, we checked the program flow for **LGACUS01** programs and we checked the IF/ELSE conditions for the **POSTCODE** in the code.
Click on the 3 dots/ellipses besides the **LGACUS01** to get below options.



14. After clicking on the 3 dots/ellipses besides the **LGACUS01**, you will get the following options.



- a. View properties
- b. Identify conditional statements.
- c. Identify paragraphs.
- d. Identify tables/file access statements.
- e. Identify variables
- f. Generate simple explanation (This is the WCA4z Code Explanation feature)
- g. Generate detailed explanation (This is the WCA4z Code Explanation feature)
- h. Generate guided explanation (This is the WCA4z Code Explanation feature)

15. Review the Code Explanation feature which uses AI to explain to the COBOL developer what the function does.

Please note, to execute Code Explanation, you need to have entered in the API Key in the previous step.

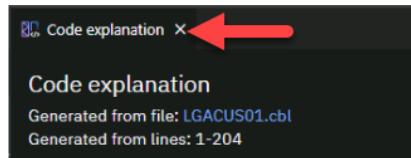
The screenshot shows a "Code explanation" interface. At the top, it says "Generated from file: LGACUS01.cbl" and "Generated from lines: 1-204". There is an "AI" button. Below this, a "Detailed explanation" section is expanded, showing:

- Summary of the business purpose of the program**: The program is designed to process customer data in a specific format using the Language Environment (LE) programming language. It retrieves customer information from a database and performs various operations on it before returning the results.
- Inputs and outputs of the program**:
 - Input: The program receives input through a communication area (DFHCOMMAREA), which contains customer data in a specific format defined by the LGPOLICY copybook.
 - Output: The program returns output through the same communication area or an error message if any issues occur during processing.
- Detailed functional summary of the program**:
 - Initialization: The program initializes variables such as transaction ID, terminal ID, task number, and other necessary fields.
 - Processing**:
 - Retrieve customer data: The program links to another program (LGACDB01) to retrieve customer data based on the provided criteria.
 - Perform calculations: The program calculates the length required for the communication area and checks if enough space is available. If not, it sets an error code and terminates execution.
 - Insert customer details: The program inserts customer details into the communication area after retrieving them from the database.
 - Handle errors: If any errors occur during processing, the program generates an error message containing relevant information about the error and its location within the communication area. This message is then linked to another program (LGSTSQ) for further handling.

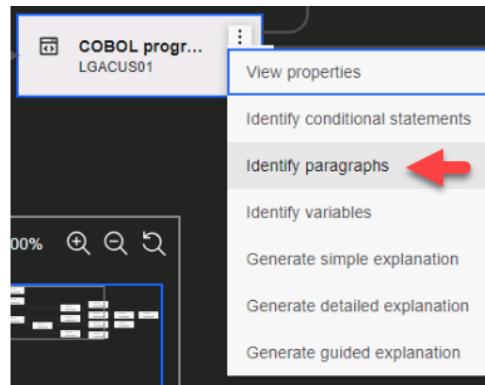
At the bottom, there is a link "How is this rating data used?" and two small icons.

- Regenerate the explanation
- Download the code explanation
- Insert as a comment in the COBOL program
- Copy the explanation

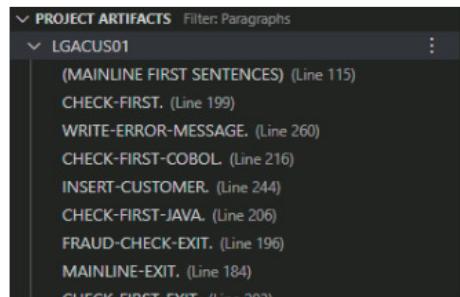
16. Close the explanation by clicking the 'X', once you have finished reviewing the code explanation.



17. Go back to the “Z Refactoring Assistant” window, click on the 3 dots/ellipses besides the **LGACUS01** and select **Identify paragraphs** to display all paragraphs in the code in order.

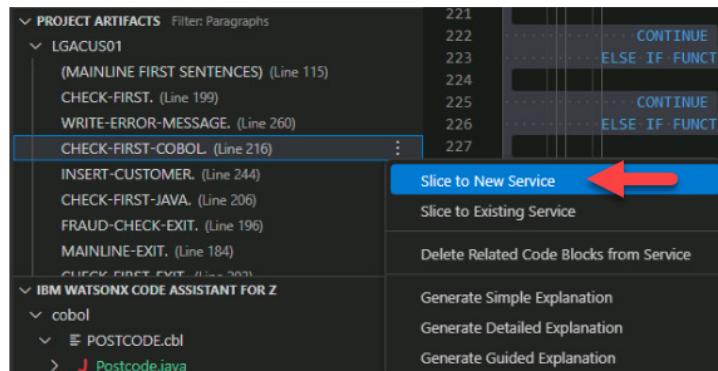


18. It will open the “Project Artifacts” section and show the COBOL paragraphs

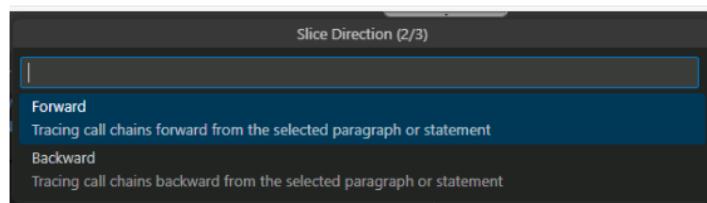


19. Single click on paragraph **CHECK-FIRST-COBOL** in “Project Artifacts” section and then single left click on the CHECK-FIRST-COBOL paragraph in that view.

20. Click on the 3 dots/ellipses besides the CHECK-FIRST-COBOL and select “**Slice to New Service**” and then give it a name of **POSTCODE**.



21. Select **forward** and then press **enter** when you see ‘paragraph,’. This will give your sliced code a tag name of ‘paragraph’.



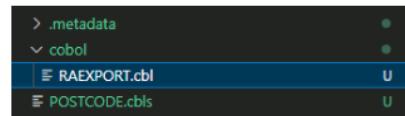
22. Confirm that the extracted logic is correct in the view on the right. This view shows you’re your code before you extract it into a COBOL program, hence the **.cbls** extension.

The screenshot shows the 'POSTCODE.cbls' editor window. The code is displayed in a syntax-highlighted text area. The code starts with a * Check postcode (COBOL version) comment and performs various moves and function calls to determine the response code based on the input postcode. The code ends with an ELSE MOVE '82' TO WS-RESPONSE-CODE block.

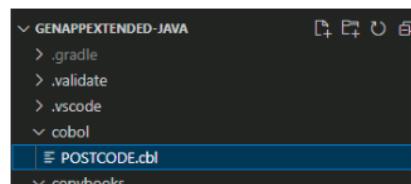
```
/* Check postcode (COBOL version)
MOVE '00' TO WS-RESPONSE-CODE.
MOVE SPACES TO WS-RESPONSE-MESSAGE.
IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'GB'
    CONTINUE
ELSE IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'US'
    CONTINUE
ELSE IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'UK'
    CONTINUE
ELSE IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'DN'
    CONTINUE
ELSE
    MOVE '82' TO WS-RESPONSE-CODE
    STRING 'Invalid postcode: ' CA-POSTCODE
    DELIMITED BY SIZE INTO WS-RESPONSE-MESSAGE
END-IF.
```

23. Once finished, you typically right click on the POSTCODE.cbls file and select **watsonx Code Assistant for Z > Generate Service Code** and give it a name called **RAEXPORT**.

This is what you would view. **However, this lab doesn't require you to do this because the COBOL program has already been extracted for you.**



24. This lab has extracted the POSTCODE refactored program for you already and stored it here.



25. For the rest of this lab, you will use this COBOL program called POSTCODE.

26. Open the program and you will see the code.

A screenshot of the WatsonX Code Assistant interface. The left sidebar shows a file tree with 'GENAPPXTENDED-JAVA', 'cobol' (selected), and 'POSTCODE.cbl' (selected). The main pane displays the COBOL code for 'POSTCODE.cbl'. The code includes sections like IDENTIFICATION DIVISION, DATA DIVISION, and PROCEDURE DIVISION. A red arrow points to the 'POSTCODE.cbl' entry in the file tree, and another red arrow points to the code in the editor.

```

1  *****
2  * created: Thu, 22 Aug 2024 12:25:32 GMT
3  * Generated by: IBM WatsonX Code Assistant For Z Refactoring
4  *
5  * Assisted by:
6  *   workspace name: refactor
7  *   workspace id: 67e1f933-7b5f-4d9e-a5d1-edd32255fa5
8  *   Project: $genappExtended_eb829c3d-deff-49d3-91e2-5858cf0dd47d
9  *****
10 IDENTIFICATION DIVISION.
11 PROGRAM-ID. POSTCODE.
12
13 DATA DIVISION.
14 WORKING-STORAGE SECTION.
15 01 DFHCOMAREA-1.
16    COPY LGMAREA.
17 01 WS-RESPONSE.
18    03 WS-RESPONSE-CODE      PIC 9(2).
19    03 WS-RESPONSE-MESSAGE  PIC X(78).
20
21 LINKAGE SECTION.
22
23 PROCEDURE DIVISION.
24 CHECK-FIRST-COBOL.
25   * Check postcode (COBOL version)
26     MOVE '00' TO WS-RESPONSE-CODE.
27     MOVE SPACES TO WS-RESPONSE-MESSAGE.
28     IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'GB'
29       CONTINUE
30     ELSE IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'US'
31       CONTINUE
32     ELSE IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'UK'
33       CONTINUE
34     ELSE IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'DN'
35       CONTINUE
36     ELSE
37       MOVE '92' TO WS-RESPONSE-CODE
38       STRING 'Invalid postcode:' CA-POSTCODE
39         DELIMITED BY SIZE INTO WS-RESPONSE-MESSAGE
40     END-IF.
41
42   EXIT PROGRAM.
43
44
45
46
47

```

Please note: Because we are transforming this COBOL functionality to Java, we don't need to think about how we call this new COBOL module from the main COBOL module.

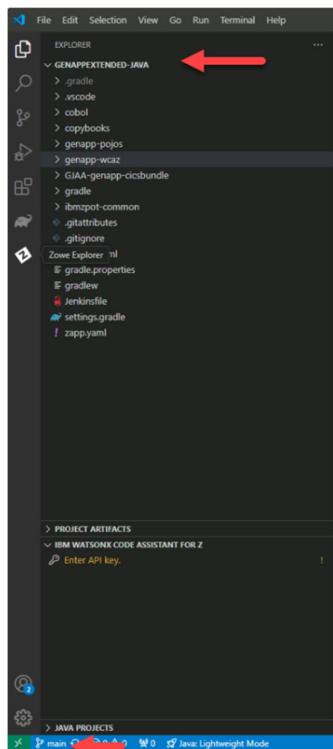
In this **Refactor** phase,

1. The Java developer (accompanied with the COBOL developer) has collaborated using their individual logins to RA to refactor service to POSTCODE validation.
2. They both (Java and COBOL developer) used the web user interface to enable better collaboration.
3. Now the Java developer is ready to Transform the COBOL service to Java using AI.

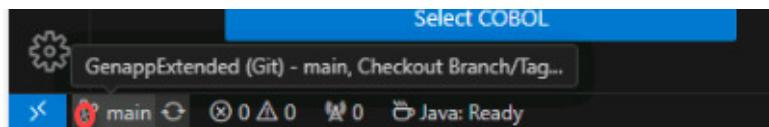
We will use this refactored program for the Transform phase next.

How to execute the WCA4z Transform Phase using VS Code

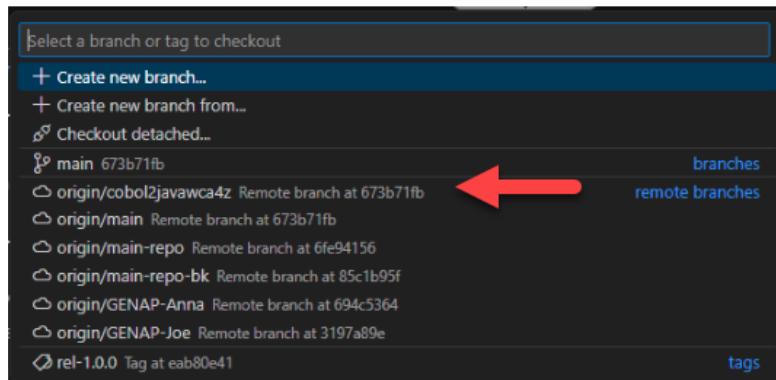
8. In the VS Code, you will see a Git repository that has already been cloned in your repo called '**GENAPPEXTENDED-JAVA**' on branch '**main**'.



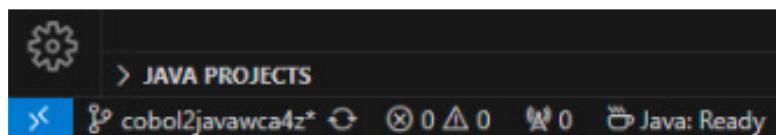
9. Switch from the main branch (production) to your own personal branch (**cobol2javawca4z**) by clicking '**main**'.



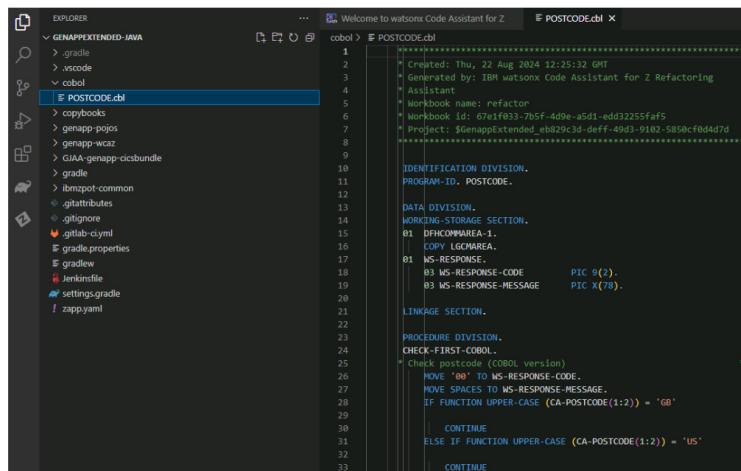
10. Then select **cobol2javawca4z** branch



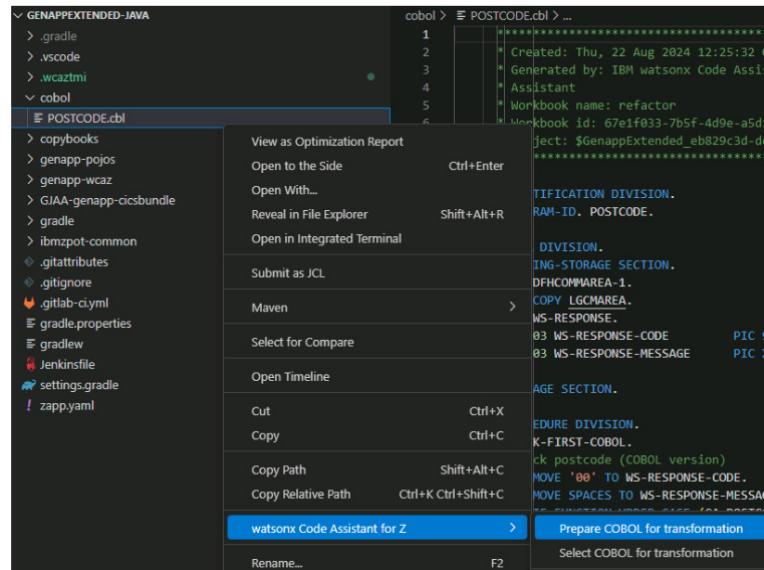
11. To confirm your branch has been switched, you should see this:



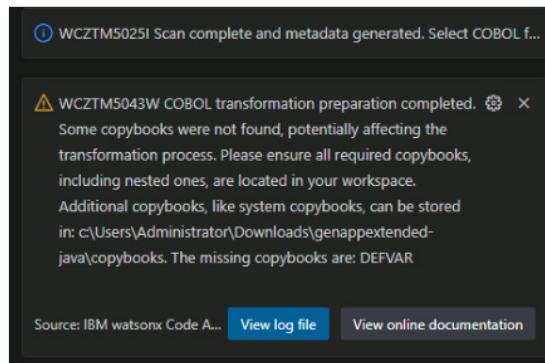
12. Locate the program POSTCODE.cbl in the Project Explorer which is the refactored program from the previous task.



13. Right click **POSTCODE** and go to “**watsonx Code Assistant for Z**” then click on option “**Prepare COBOL for Transformation**”.



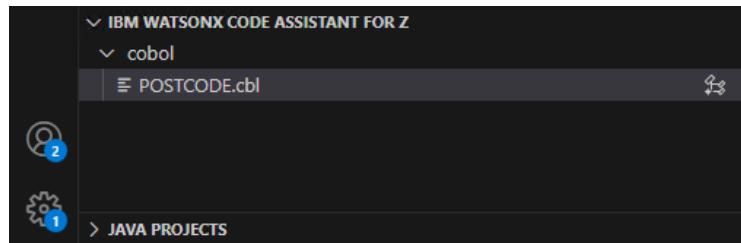
When you see this, this means the Prepare COBOL for transformation step is complete.



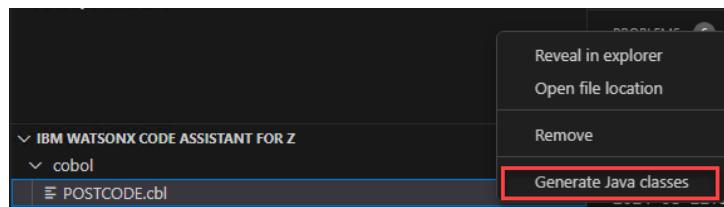
14. Then right click **POSTCODE** and go to “**watsonx Code Assistant for Z**” then click on option “**Select COBOL for Transformation**”.

The screenshot shows the IBM Watsonx Code Assistant for Z interface. On the left, there's a file tree with nodes like 'cobol', 'POSTCODE.cbl', 'copybo', 'genapp', etc. A context menu is open over the 'POSTCODE.cbl' node, listing options such as 'View as Optimization Report', 'Open to the Side', 'Open With...', 'Reveal in File Explorer', 'Open in Integrated Terminal', 'Submit as JCL', 'Maven', 'Select for Compare', 'Open Timeline', 'Cut', 'Copy', 'Copy Path', 'Copy Relative Path', 'Rename...', and 'watsonx Code Assistant for Z'. The right side of the interface shows a COBOL source code editor with lines 198 to 221 visible. The code includes sections like 'CHECK-FIRST.', 'PERFORM CHECK', 'EXIT.', 'CHECK-FIRST-JAVA.', 'Check postcode (', 'CALL JAVA U', 'EXIT.', 'CHECK-FIRST-COBOL', 'Check postcode (', 'MOVE '00' TO ', 'MOVE SPACES TO ', 'IF FUNCTION U', and 'EXIT.'.

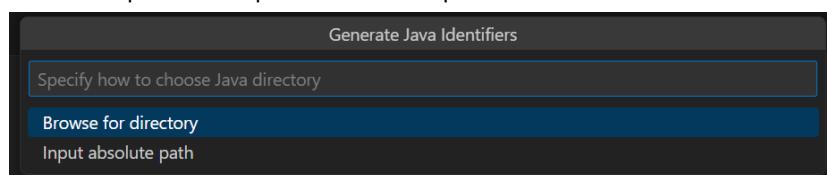
15. This will import the COBOL program into “IBM WATSONX CODE ASSISTANT FOR Z”.



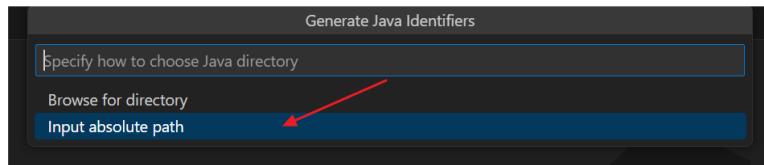
16. Right Click on ‘cobol\POSTCODE’ and select ‘Transform to Java’.



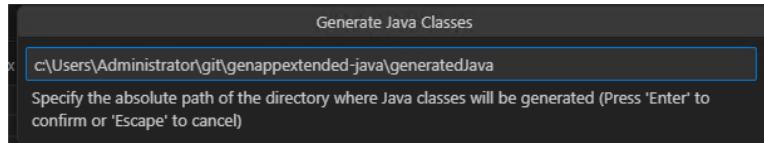
17. This will open new input bar in the top middle.



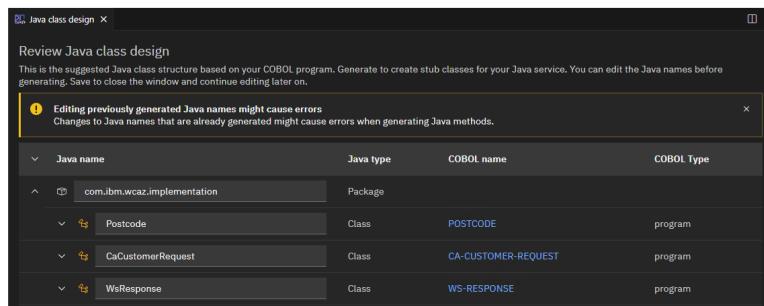
18. Click on “**Input absolute path**” option.



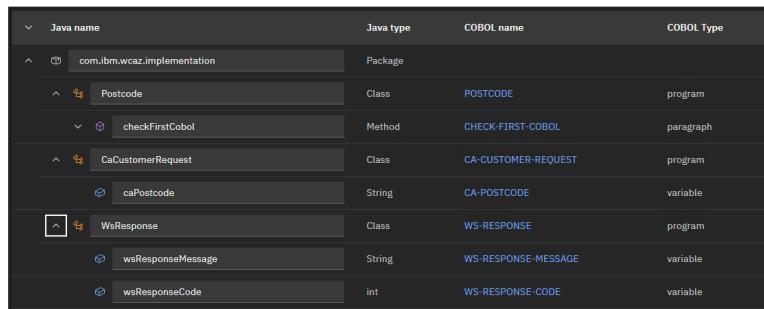
19. Press **end** to reach end of the default path and type addition to path \generatedJava.



20. New tab, **Code transformation**, will open.



21. Click to expand different artifacts using following buttons.

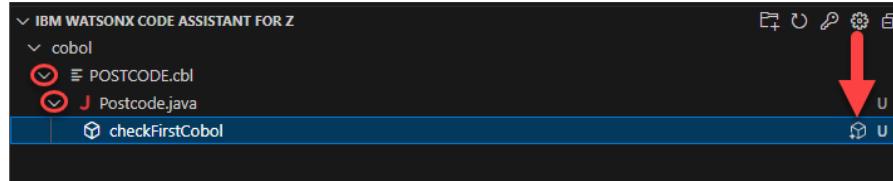


22. At the right bottom of ‘Code transformation’ tab, click on “Generate Java classes”.

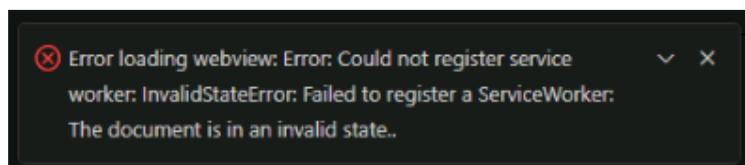


23. Click on the icon to the left after expanding the **POSTCODE.cbl** and **Postcode.java**.

IF THE TWISTY TAKES TOO LONG TO LOAD THEN PLEASE RESTART VS CODE AND TRY AGAIN. IT CAN TAKE UP TO 30 SECONDS FOR THE TWISTY TO LOAD.

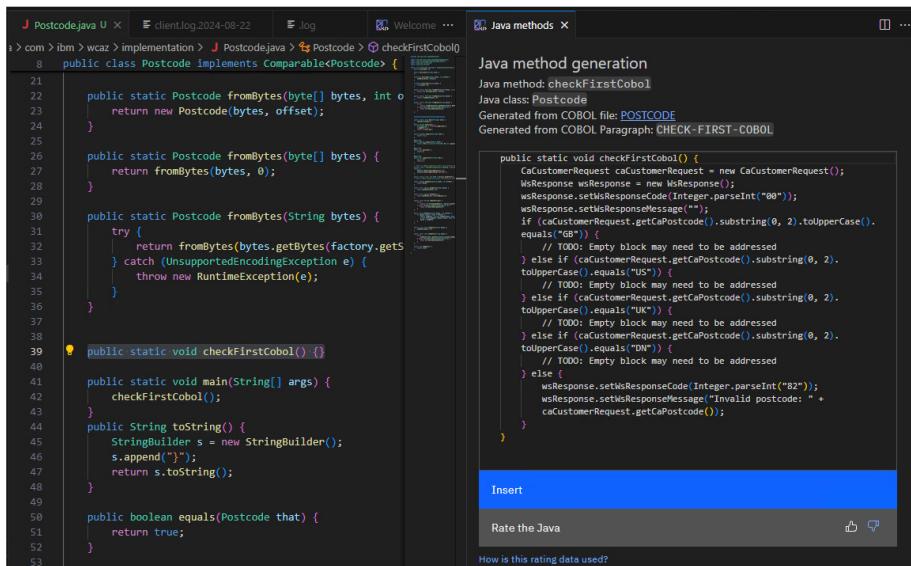


IF YOU SEE THIS ERROR AFTER SELECTING THE OPTION ABOVE.



RESTART VS CODE AND WAIT FOR ABOUT A MINUTE, THEN RETRY THE ACTION ABOVE.

24. After clicking on icon, Java method gets generated on the right , click on **insert**



Generated java method for ‘postcode’ will get inserted in the java class.

25. Once done, all the methods are now tick marked that means it is not empty.
26. The WCA4z AI is continuously evolving, which means the transformed Java code it generates may vary over time.

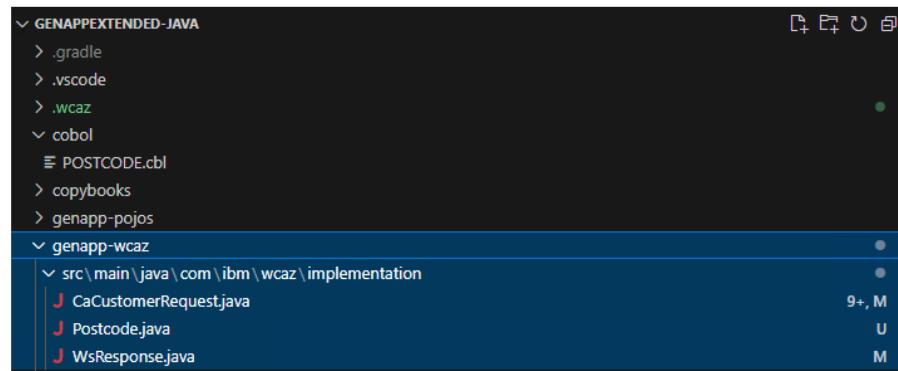
To ensure consistency during your lab experience, we've already included the version of the transformed Java that was generated at the time the lab was created. This version has been copied into the Gradle project folder within the repository (you'll find the exact path listed below).

We copied this code ahead of time because if you were to re-run the transformation today, the Java might look slightly different due to ongoing updates in the AI model. By providing a fixed version, we avoid inconsistencies and make sure everyone in the lab is working from the same baseline.

Additionally, we've already applied the necessary changes to make the Java code CICS-compatible—that is, runnable in a CICS environment. These changes are specific modifications required for the Java application to interact properly with CICS, IBM's transaction processing system for mainframes, so a client can gain the best of both worlds in running COBOL (traditional) and Java (newer) languages on one platform.

You'll be able to review exactly what those CICS-specific changes are in the following section of the lab.

genapp-wcaz\src\main\java\com\ibm\wcaz\implementation



Note: “Transformed Java” refers to the Java code that has been automatically generated from COBOL source code by the WCA4z AI. Since the AI can improve and update how it transforms the code, the output might change slightly depending on when the transformation is done e.g. you may see more or less classes, with different names.

In this **Transform** phase,

1. We imported this workbook using IBM watsonx code assistant for z.
2. We generated Java classes and Java methods.

We executed steps for **Understand, Refactor and Transform** phases to create java classes and methods for the **postcode validation** functionality in **POSTCODE** program.

Now, let's review the changes that have already taken place in your transformed Java (read only section)

This section explains the key steps that were taken to make the transformed Java code callable from COBOL via CICS. These updates ensure that Java logic can be triggered by COBOL programs and that input/output data is handled properly within the hybrid application structure.

1. Annotate the checkFirst method of the Postchck class with @CICSPProgram
 - to enable the method to be invoked via EXEC CICS LINK
2. Update the CaCustomerRequest constructor method
 - to initialise the Java object with the input data provided by the COBOL caller
3. Add a method to the WsResponse class, and invoke it at the end of checkFirst
 - to create and return the output data expected by the COBOL caller

Background Information

In order to minimise the following code changes, most of the code (including the CICS API commands and JCICS method calls) has been encapsulated within a common framework provided with the lab environment. It is not necessary to understand the framework code in order to complete this lab, but reference information is provided in the Appendices for those who are interested. You can choose which Appendices to review depending on your level of interest:

Appendix A provides a short overview of COBOL and Java interoperability in CICS

Appendix B provides an overview of the 3 functions provided by the framework

Appendix C provides a technical overview of the framework

Appendix D lists the COBOL source code used in the framework

Appendix E lists the Java source code used in the framework

Feel free to continue with the lab instructions - you can reference an Appendix if required as you proceed.

1) Annotate the method to be invoked from COBOL with a @CICSProgram

Java Method Annotated with @CICSProgram

To enable COBOL to invoke Java logic, the checkFirstCobol method in the Postcode class was annotated with @CICSProgram.

- This annotation marks the method as callable from COBOL using the EXEC CICS LINK command.
- As part of this, CICS automatically generated a corresponding PROGRAM definition named LGACJV02.

Code Elements:

- **Note 1:** Required CICS package was imported.
- **Note 2:** The method was marked with @CICSProgram("LGACJV02"), making it callable via COBOL.

This setup allows COBOL programs to seamlessly invoke this Java method as part of hybrid application logic.

```
package com.ibm.wcaz.implementation;  
.  
.  
public static void checkFirstCobol() {  
.  
.
```

Change made:

```
package com.ibm.wcaz.implementation;  
import com.ibm.cics.server.invocation.CICSProgram; // Note 1  
.  
.  
@CICSProgram("LGACJV02") // Note 2  
public static void checkFirstCobol() {  
.  
.
```

2) Retrieve the input data provided by the COBOL caller

Input Data Retrieved from COBOL Caller

When COBOL invokes a Java program, it can pass input data that needs to be captured and processed on the Java side. This was achieved in the CaCustomerRequest class by leveraging the constructor.

- The no-argument constructor initializes request data using a CobolData object.
- The caPostcode field is populated from COBOL-provided input.

Code Elements:

- **Note 1:** Framework package for CobolData was imported.
- **Note 2:** A new CobolData object (input) was instantiated.
- **Note 3:** Input data from COBOL was assigned to the caPostcode variable.

This ensures that when the COBOL caller invokes the Java method, the input is properly captured and available for business logic execution.

```
package com.ibm.wcaz.implementation;  
.  
. .  
public class CaCustomerRequest implements Comparable<CaCustomerRequest> {  
.  
    public CaCustomerRequest() {  
    }  
}
```

Change made:

```
package com.ibm.wcaz.implementation;  
import com.ibmzpot.common.CobolData; // Note 1  
.  
. .  
public class CaCustomerRequest implements Comparable<CaCustomerRequest> { .  
    public CaCustomerRequest() {  
        CobolData input = new CobolData(); // Note 2  
        this.caPostcode = input.getCobolData(); // Note 3  
    }  
}
```

3a) Create a method to return the response data to the COBOL caller

Response Method Created in WsResponse Class

To send data back to COBOL after Java logic executes, a method named returnWsResponse was added to the WsResponse class.

- This method constructs a CobolData object named output, which is populated with the response.
- Formatting conventions (2-digit code with leading zero, 78-character padded message) were applied to meet COBOL expectations.

Code Elements:

- **Note 1:** Framework package for CobolData was imported.
- **Note 2:** Method returnWsResponse was defined.
- **Note 3:** output object instantiated.
- **Note 4:** Response code padded to two digits.
- **Note 5:** Response message padded to 78 characters.
- **Note 6:** output was populated with both fields.
- **Note 7:** The method was closed properly within the class scope.

This design guarantees that COBOL receives well-formed and expected response structures from the Java logic.

```
package com.ibm.wcaz.implementation;

.

.

public class WsResponse implements Comparable<WsResponse> {
    .

    .

}
```

Change made:

```
package com.ibm.wcaz.implementation;

import com.ibm.zpot.common.CobolData; // Note 1

.

public class WsResponse implements Comparable<WsResponse> {

    .

    public void returnWsResponse() { // Note 2
        CobolData output = new CobolData(); // Note 3
        // pad the response code with leading zeros Note 4
        String fixedResponseCode = String.format("%02d", this.wsResponseCode);
        // pad the response msg with trailing spaces Note 5
        String fixedResponseMessage = String.format("%-78s", this.wsResponseMessage);
        output.putCobolData(fixedResponseCode + fixedResponseMessage); // Note 6
    } // Note 7

}
```

3b) Invoke the method to return the response data to the COBOL caller

Response Method Invoked in Postcode.checkFirstCobol

After completing the core business logic inside checkFirstCobol, the new returnWsResponse method was invoked as the final step.

- This ensures response data is packaged and returned to the COBOL caller before the method exits.

Code Elements:

- **Note 1:** returnWsResponse() is invoked as the **last statement** inside checkFirstCobol.

This final invocation completes the end-to-end flow: from COBOL to Java and back—firmly establishing the round-trip communication between COBOL and transformed Java.

Change made:

```
@CICSProgram("LGACJV02")  
public static void checkFirstCobol() {  
    .  
    .  
    wsResponse.returnWsResponse(); // Note 1  
}
```

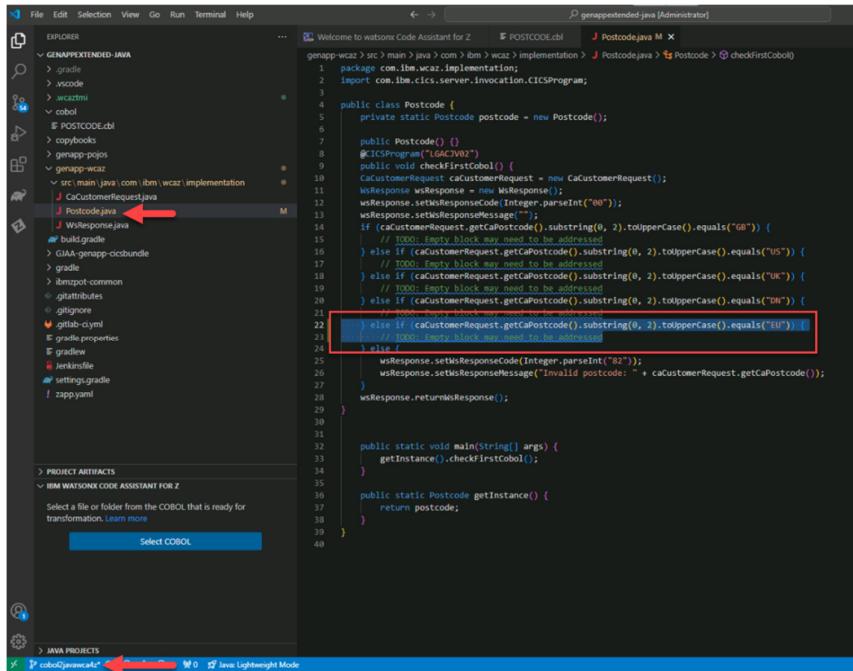
Note 1: This statement invokes the **returnWsResponse** method you created in Step 3a. It needs to be the very last statement in **checkFirstCobol**, i.e. after the business logic, and before the implicit return to the COBOL caller.

Implement the new feature in Java

Remember what it says in your Git Lab ticket: <http://wca4z-gitlab.ibm.com:10880/wca4z/genappextended-java/-/issues/1>

Now, locate the Java program, postcode.java and open it in your editor and add this change (highlighted) in your postcode.java.

Note: Make sure there are no syntax errors. You will see red lines if there are any syntax errors.



The screenshot shows the Watsonx Code Assistant for Z interface. On the left, the 'EXPLORER' panel displays the project structure under 'GENAPPEXTENDED-JAVA'. In the center, the 'CODE' panel shows the 'Postcode.java' file. A red box highlights the line of code being added:

```
    } else if (caCustomerRequest.getCaPostcode().substring(0, 2).toUpperCase().equals("EU")) {  
    // TODO: Empty block may need to be addressed  
}
```

`} else if (caCustomerRequest.getCaPostcode().substring(0, 2).toUpperCase().equals("EU")) {`

`// TODO: Empty block may need to be addressed`

The Java source changes are now complete:

- the **Postcode** class has been updated to enable it to be invoked from COBOL CICS with the new business logic
- the **CaCustomerRequest** class has been updated to receive the input data from COBOL CICS
- the **WsResponse** class has been updated to return the output data to COBOL CICS

You are now ready to build and deploy the Java programs to CICS. Proceed to the next section.

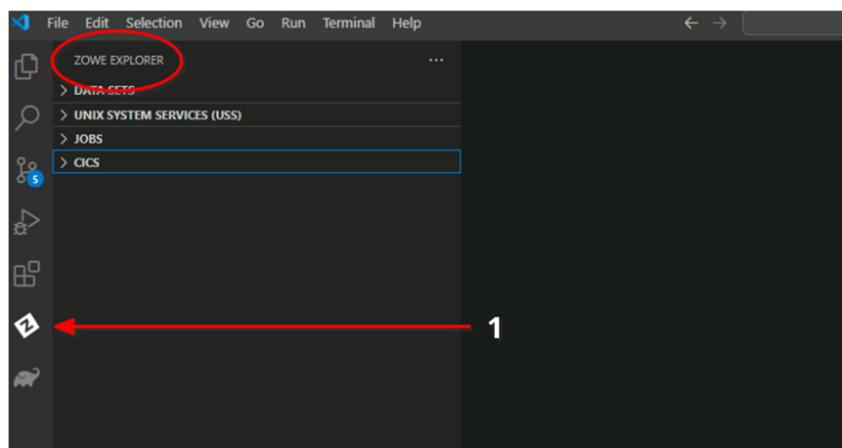
Now, let's build the Java locally, deploy to CICS and test using Galasa part of IBM Test Accelerator for z

Return to Visual Studio Code

- a. **Action:** In the Primary Sidebar (left hand side), confirm your project remains open in the Explorer view
- b. **Optional Action:** In the main Editor area, close any open files

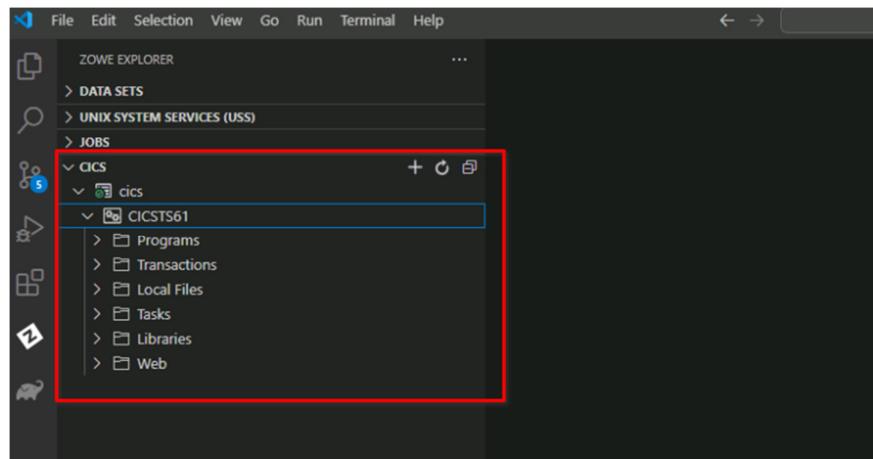
Confirm LGACJV02 (Postcode Java) is not already deployed to CICS

- a) **Action:** In the Activity Bar (left hand side), single click the Zowe Explorer extension icon (shaped like the letter "Z") as illustrated below.
 - **Result:** The VS Code primary sidebar now contains the Zowe Explorer panels:

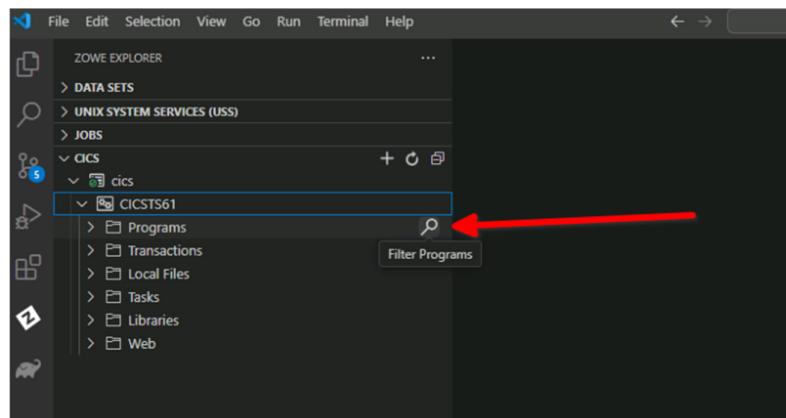


- b) **Action:** At the bottom of the VS Code primary sidebar, in the Zowe Explorer CICS panel, expand the CICS tree recursively until the submenu under CICS region **CICSTS61** is displayed.

- **Result:**

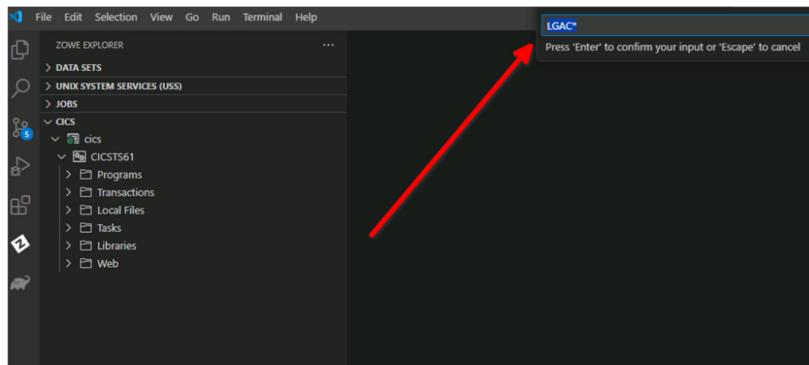


- c) **Action:** To the right of the “Programs” entry, click the “Filter Programs” icon (shaped like a magnifying glass) as illustrated below:

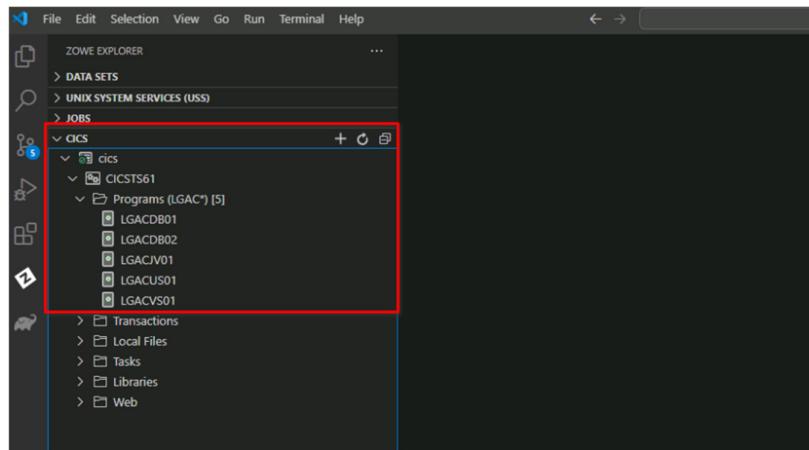


- **Result:** A filter prompt will open in the VS Code command palette at the top of the display.

- d) **Action:** In the VS Code command palette (top of display), type a filter value of **LGAC*** and press <ENTER>, then press <ENTER> again to confirm.



- **Result:** All programs matching the filter are displayed in the Zowe Explorer panel:



- e) **Action:** Review the list of programs displayed and note **LGACJV02** is **NOT** listed.
- **Info:** **LGACJV02** is the **@CICSProgram** annotation you assigned to **Postcode** method **CheckFirstCobol**; it's not listed because the Java program has not been deployed to CICS yet.

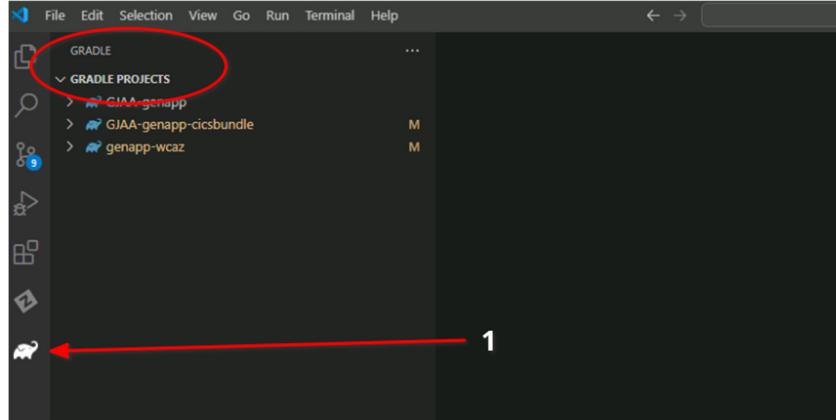
- f) **Optional Action:** The CICS Explorer can also be used to display a list of installed programs. If you're familiar with the CICS Explorer:
- return to IBM Developer for Z and switch to the CICS SM perspective
 - In the Host Connections view, connect to CMCI CICSTS61
 - In the CICSplex Explorer view, single click CICSTS61
 - In the Programs view, review the list of installed programs and note **LGAJV02** is **NOT** listed

3. Perform a local build of the generated Java

- a) **Info:** You will perform a local build using the VS Code **Gradle for Java** extension.

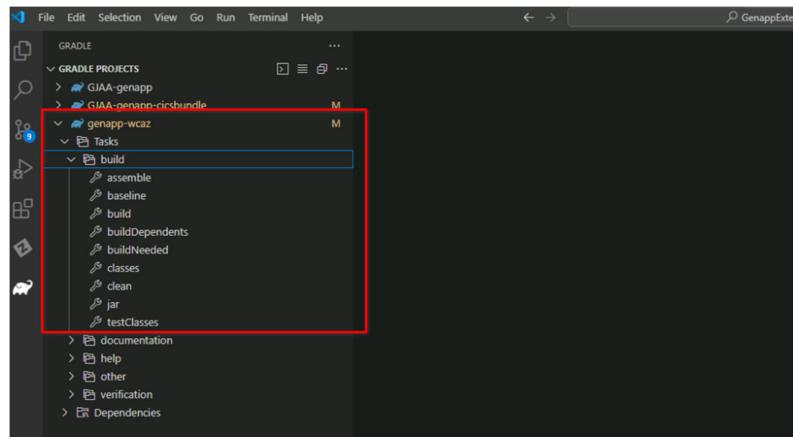
- b) **Action:** In the VS Code activity bar (left hand side), single click the Gradle extension icon (shaped like an elephant) as illustrated below.

- **Result:** The VS Code primary sidebar now displays your Gradle project:

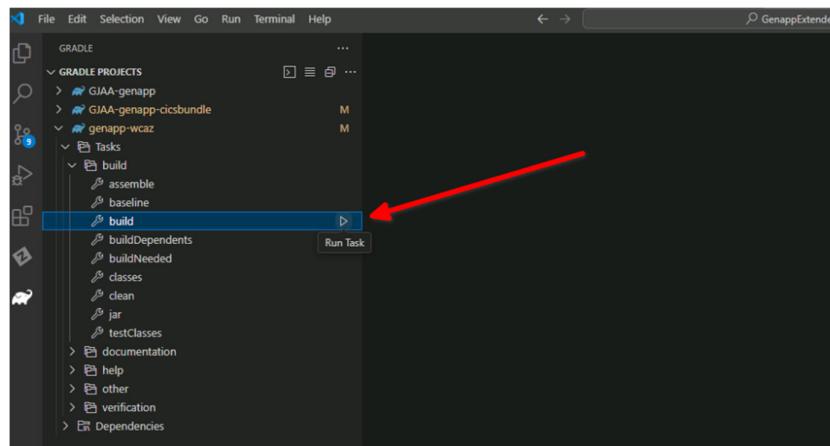


- c) **Action:** In the VS Code Gradle project list, recursively expand the **genapp-wcaz** project until the **build** menu is displayed as illustrated below.

- **Result:** The **build** menu for **genapp-wcaz** is displayed:



- d) **Action:** To the right of the **build** task, single click the “**Run Task**” icon, as illustrated below:



- **Info:** The build task compiles the Java source into Java bytecode.
- **Result:** A gradle build of **genapp-wcaz** is performed, and the result of the build is displayed in the VS Code Terminal view:

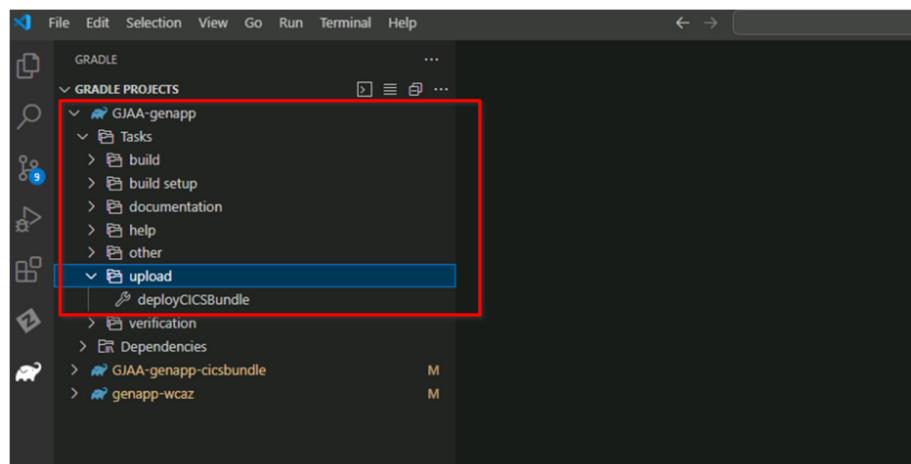
A screenshot of the VS Code Terminal view. The terminal window shows the output of a Gradle build. The output includes the message "gradle in offline mode", the directory path "Directory 'C:\Program Files\Semeru\jdk-11.0.20.101-openj9' (Windows Registry) used for java instal", and the final success message "BUILD SUCCESSFUL in 10s". The word "BUILD SUCCESSFUL" is highlighted with a red rectangular box.

- e) **Action:** Review the result of the build task. “**BUILD SUCCESSFUL**” in green letters denotes a successful build. If the build was unsuccessful, review and correct any errors; then repeat the build task. Notify the lab instructor you need assistance.

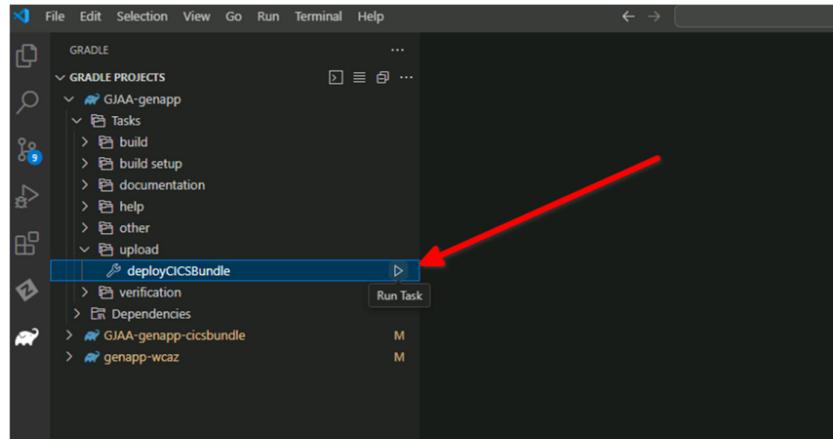
4. Deploy the generated Java to CICS

- a) **Info:** You will deploy the Java program to CICS using the VS Code Gradle for Java extension and the **CICS bundle Gradle plugin**.

- b) **Action:** In the VS Code Gradle project list, recursively expand the **GJAA-genapp** project until the **upload** menu is displayed as illustrated below.
 - **Result:** The Upload menu for GJAA-genapp is displayed:



- c) **Action:** To the right of the **deployCICSBundle** task, single click the “Run Task” icon, as illustrated below:



- **Info:** Running the **deployCICSBundle** task results in the following actions:
 - the Java is packaged as an OSGi bundle inside a CICS bundle project
 - the CICS bundle project is uploaded to z/OS
 - the associated CICS bundle resource is installed into the target CICS region
 - the OSGi bundle is deployed to the target CICS JVM server
 - CICS automatically installs a PROGRAM resource for each @CICSprogram annotation it detects
- **Result:** The result of the **deployCICSBundle** task is displayed in the VS Code Terminal view as illustrated below:

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS Z/OS RESOURCES TABLE Z/OS EXPLORER Z/OS CONSOLE
Adding Java-based bundle part: 'C:\Users\Administrator\GenappExtended-java\genapp-wcaz\build\libs\genapp-wcaz-0.1.0.jar'
Adding non-Java-based bundle parts from 'src/main/bundleParts'

> Task :GJAA-genapp-cicsbundle:deployCICSBundle
Task deployCICSBundle

Deprecated Gradle features were used in this build, making it incompatible with Gradle 9.0.
You can use '--warning-mode all' to show the individual deprecation warnings and determine if they come from your own scripts.
See https://docs.gradle.org/8.1.1/userguide/command_line_interface.html#sec:command_line_warnings

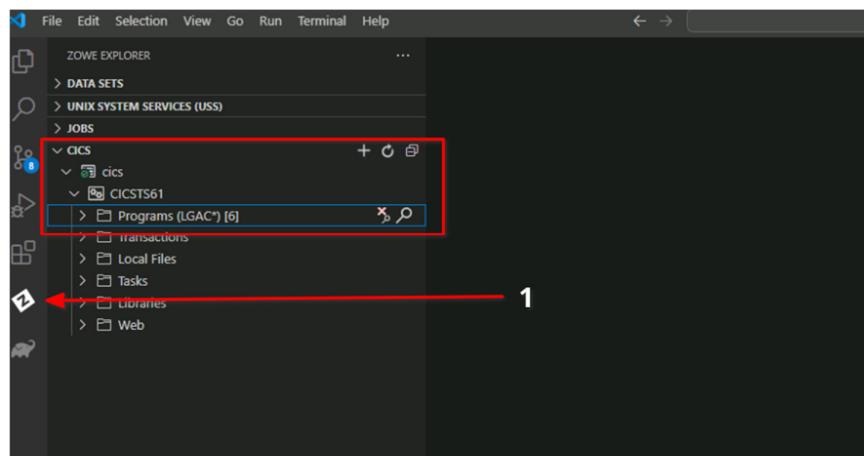
BUILD SUCCESSFUL in 13s
9 actionable tasks: 6 executed, 3 up-to-date
  
```

The terminal window shows the command 'Task deployCICSBundle' being run. It outputs build logs and then displays a green box around the 'BUILD SUCCESSFUL' message at the bottom.

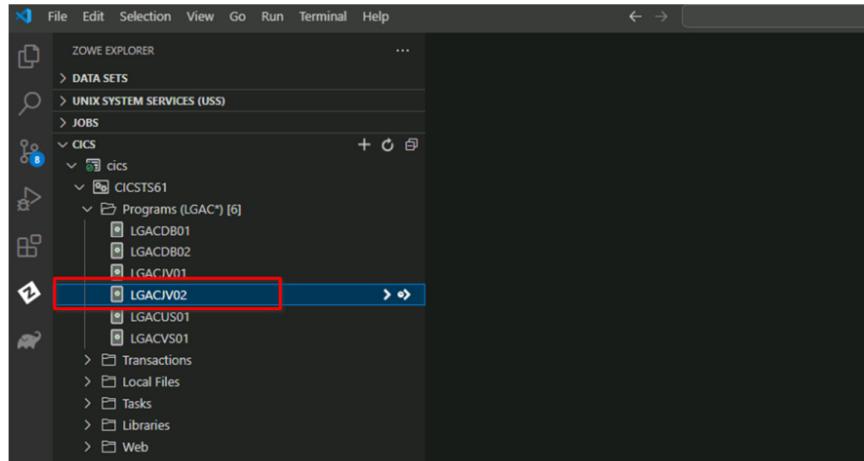
- d) **Action:** Review the result of **deployCICSBundle** task. “**BUILD SUCCESSFUL**” in green letters denotes a successful deployment. If the deployment was unsuccessful, review the error messages to determine what went wrong. Notify the lab instructor if you need help.

5. Confirm LGACJV02 (Postcode Java) has been deployed to CICS

- a) **Action:** In the VS Code activity bar (left hand side), single click the Zowe Explorer extension icon (shaped like the letter “Z”).
- **Result:** The VS Code primary sidebar reverts to show the Zowe Explorer panels. At the bottom of the primary sidebar, the Zowe Explorer CICS panel should still show the list of programs in region CICSTS61, filtered with LGAC* (as illustrated below):

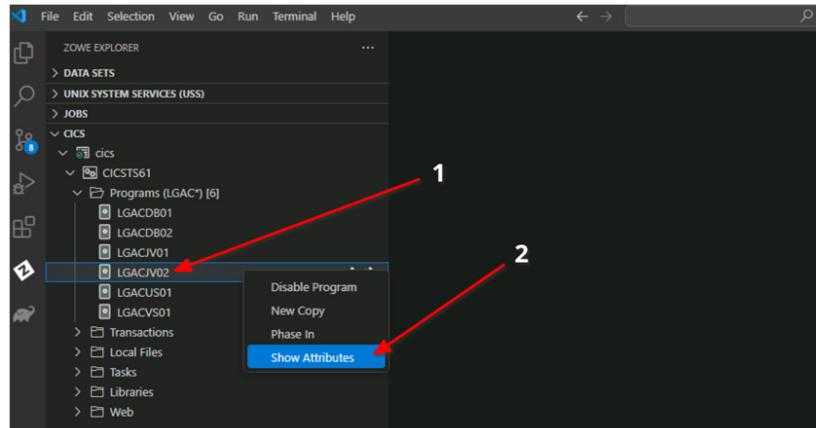


- b) **Action:** Underneath the **CICSTS61** entry in the expanded CICS profile, double click the **Programs (LGAC*)** item to refresh the list of programs.
- **Result:** The list of installed programs is refreshed as illustrated below:



- c) **Action:** Review the list of programs displayed and confirm **LGACJV02 IS NOW listed.**
- **Info:** CICS automatically installs a **PROGRAM** resource for each **@CICSprogram** annotation it detects during deployment

- d) **Action:** Right click the **LGACJV02** program entry; from the resultant pop-up menu, click **Show Attributes**



- **Result:** A new VS Code view opens displaying the attributes for program **LGACJV02**

Attribute	Value
KEYDATA	D3C7C1C3D1E3F0F2
ALOADTIME	00:00:00.000000
APIST	OPENAPI
APPLICATION	-1
APPLMAJORVER	-1
APPLMICROVER	-1
APPLMINORVER	-1
BASDEFINEVER	0
CEDFSTATUS	CEDF
CHANGEAGENT	DYNAMIC
CHANGEAGREL	0740
CHANGETIME	2024-12-17T08:15:08.000000+00:00
CHANGEUSRID	CICSUSER
COBOLTYPE	NOTAPUBLIC
CONCURRENCY	REQUIRED
COPY	NOTREQUIRED
CURRENTLOC	NOCOPY
DATALOCATION	ANY
DEFINERESOURCE	GIAA010
DEFINETIME	2024-12-17T08:15:08.000000+00:00

- e) **Action:** At the top of the Program Attributes view, in the **Search Attribute** box, type **JVMCLASS** as illustrated below.

- **Result:** A filter is applied to the Program Attributes view, and now shows the value associated with the attribute **JVMCLASS**

1	<table border="1"> <thead> <tr> <th>Attribute</th><th>Value</th></tr> </thead> <tbody> <tr> <td>JVMCLASS</td><td>osgi.com.ibm.wca.implementation.Postcode#checkFirstCobol</td></tr> </tbody> </table>	Attribute	Value	JVMCLASS	osgi.com.ibm.wca.implementation.Postcode#checkFirstCobol
Attribute	Value				
JVMCLASS	osgi.com.ibm.wca.implementation.Postcode#checkFirstCobol				

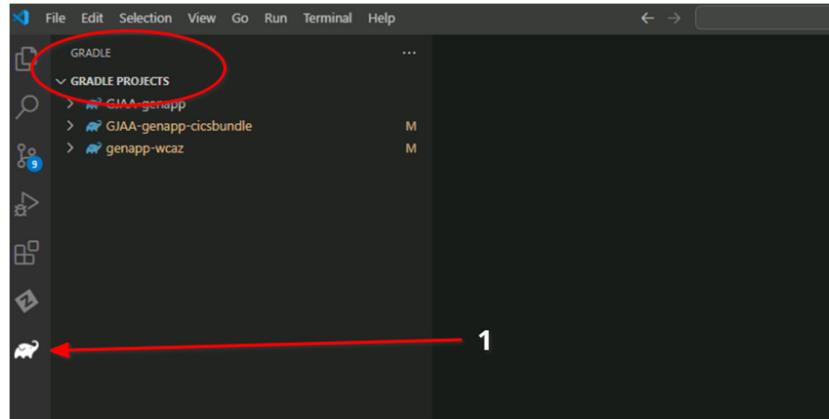
- f) **Action:** Confirm the **JVMCLASS** attribute for program **LGACJV02** has the value **osgi:com.ibm.wcaz.implementation.Postcode#checkFirstCobol**
- **Info:** This Jute value confirms **LGACJV02** is targeting the **@CICSProgram** annotated method **checkFirstCobol** in class **com.ibm.wcaz.implementation.Postcode** in an OSGi bundle.
- g) **Action:** In the **Search Attribute** box, search instead for **usecount**
- **Quiz question:** What is the value of **usecount**? What does this tell you?
- h) **Action:** Close the Program Attributes view by single clicking the **X** in the tab at the top of the view.
- **Result:** The Program Attributes view is closed.
- i) **Optional Action:** The CICS Explorer can also be used to validate the new program has been deployed. If you're familiar with the CICS Explorer:
- return to IBM Developer for Z and switch to the CICS SM perspective
 - In the Host Connections view, connect to CMCI CICSTS61 (if not connected already)
 - In the CICSplex Explorer view, single click CICSTS61
 - In the Programs view, refresh the list of installed programs and confirm **LGACJV02** has now been installed

6. Test the deployed Java program

- a) **Info:** You will test the deployed Java program by triggering **Galasa** tests from within the VS Code Gradle for Java extension. The Galasa tests will in turn invoke the deployed Java program via the CICS Command Level Interpreter transaction **CECI** - by executing the command **EXEC CICS LINK PROGRAM(LGACJV02)**.
- b) **Info:** Galasa is an open source integration test framework. Galasa tests can be easily created using **IBM Test Accelerator for Z** - the Galasa tests used to invoke the deployed Java are already provided in the lab environment. Ask a lab instructor if you would like more information about Galasa and/or IBM Test Accelerator for Z.

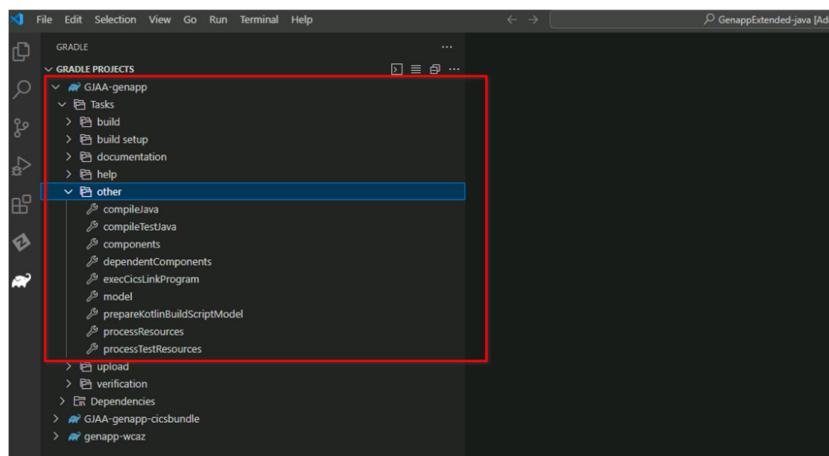
c) **Action:** In the VS Code activity bar (left hand side), single click the Gradle extension icon (shaped like an elephant).

- **Result:** The VS Code primary sidebar reverts to show your Gradle project illustrated below:

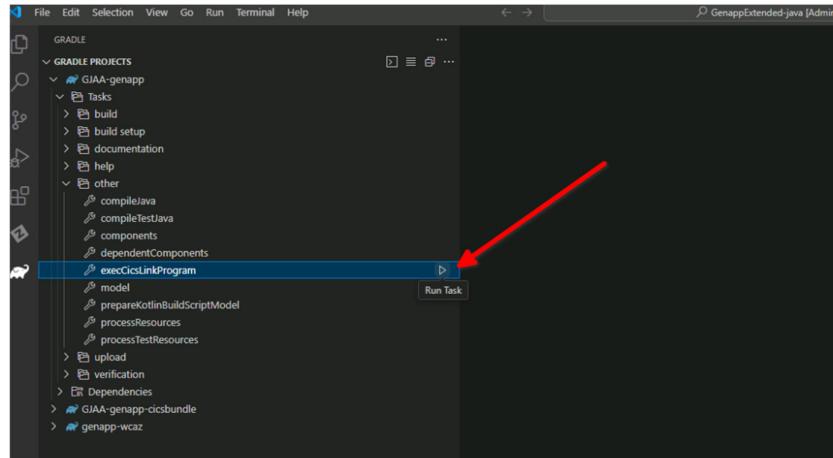


d) **Action:** In the VS Code Gradle project list, recursively expand the **GJAA-genapp** project until the **other** menu is displayed.

- **Result:** The **other** menu for **GJAA-genapp** is displayed as illustrated below:



- e) **Action:** To the right of the **execCicsLinkProgram** task, single click the “Run Task” icon as illustrated below:



- **Info:** The **execCICSLinkProgram** task invokes the deployed Java program via EXEC CICS LINK as described previously.
- **Result:** The **execCICSLinkProgram** task might take up to 2 minutes to complete - please be patient :-). The result of the task is displayed in the VS Code Terminal view as illustrated below:

```
gradle in offline mode
-----
> Task :GJAA-genapp-cicsbundle:execCicsLinkProgram
BUILD SUCCESSFUL in 44s
1 actionable task: 1 executed
<-----> 0% WAITING
> IDLE
submitted-time(UTC) name requestor status result test-name
2024-12-12 16:03:24 L29 T-35826-K\Administrator unknown Passed /dev.galasa.genapp.postcode/dev.galasa.genapp.postcode.TestPostcode
```

- f) **Action:** Review the result of test(s) performed by the **execCicsLinkProgram** task.

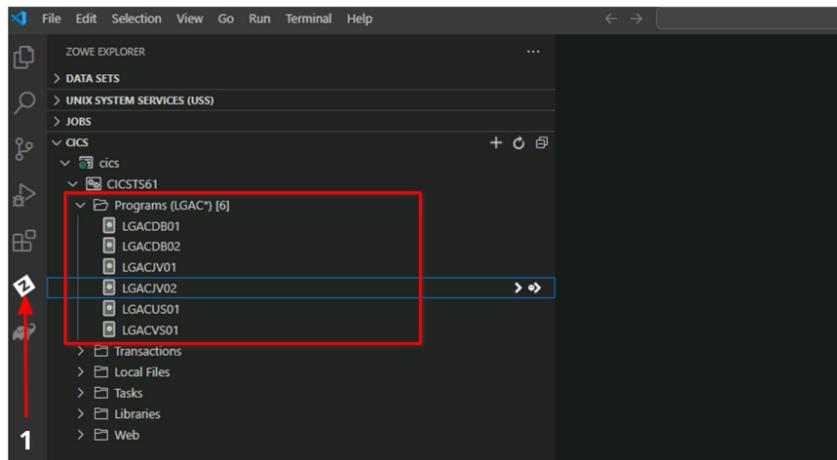
“**BUILD SUCCESSFUL**” in green letters denotes the task itself has completed, but the result of each test (**Passed** or **Failed**) is displayed individually as illustrated above.

- **Info:** The Galasa task consists of one or more EXEC CICS LINK tests: for example one with a valid postcode as input, and perhaps one with an invalid postcode. The response from each test is checked to ensure it contains the appropriate response data.

- g) **Optional Action:** If you want to review the full output from the Galasa task, open the desktop file manager and navigate to **C:\User\Administrator\.galasa\ras\<name>**, where **<name>** denotes the name of the test - the name of each test is displayed with the test result status (e.g., L29 in the above example).

7. Confirm your deployed Java has been executed

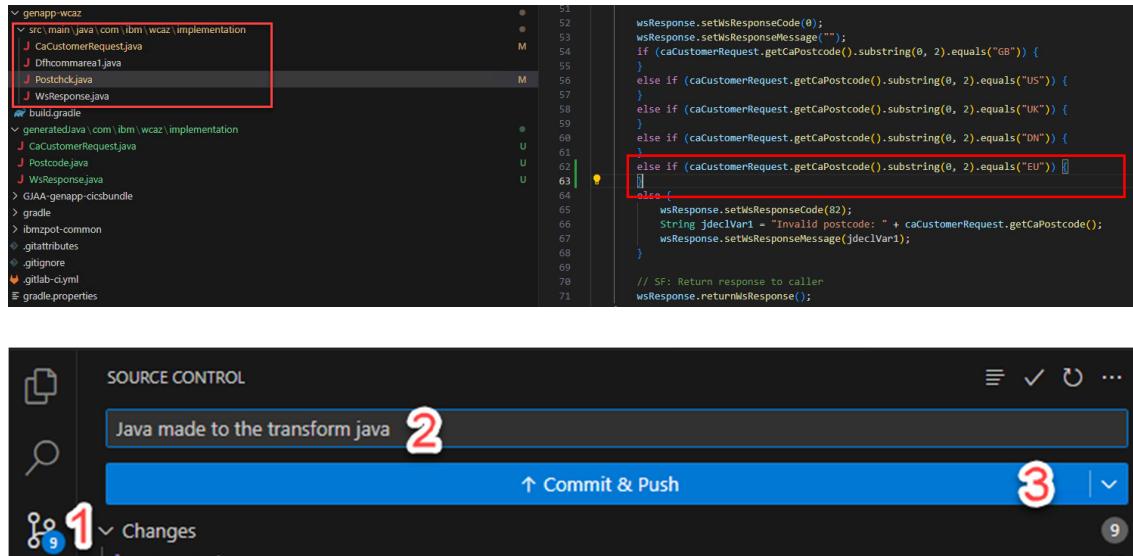
- a) **Action:** In the VS Code activity bar (left hand side), single click the Zowe Explorer extension icon (shaped like the letter “Z”)
- **Result:** The VS Code primary sidebar reverts to show the Zowe Explorer panels. At the bottom of the primary sidebar, the Zowe Explorer CICS panel should still show the list of programs in region CICSTS61, filtered with LGAC* (as illustrated below):



- b) **Action:** Underneath the CICSTS61 entry in the expanded CICS profile, double click the **Programs (LGAC*)** item to refresh the list of programs.
- **Result:** The list of installed programs is refreshed.
- c) **Action:** Right click the **LGACJV02** program entry; from the resultant pop-up menu, click **Show Attributes**
- **Result:** A new VS Code view opens displaying the attributes for program LGACJV02
- d) **Action:** At the top of the Program Attributes view, in the **Search Attribute** box, type **usecount**
- **Quiz question:** What is the value of **usecount**? What does this tell you?

Execute the Java on z DevOps Pipeline

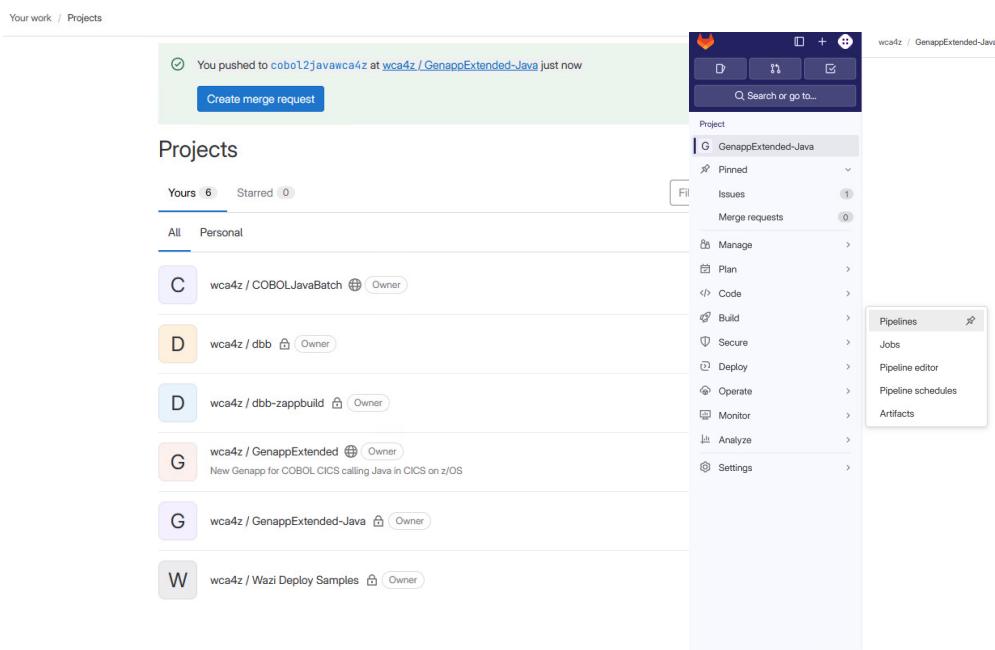
Now the Java changes have been completed, let's deploy your Java via the DevOps pipeline to CICS on z/OS.



```
wsResponse.setWsResponseCode(0);
wsResponse.setWsResponseMessage("");
if (caCustomerRequest.getCaPostcode().substring(0, 2).equals("GB")) {
}
else if (caCustomerRequest.getCaPostcode().substring(0, 2).equals("US")) {
}
else if (caCustomerRequest.getCaPostcode().substring(0, 2).equals("UK")) {
}
else if (caCustomerRequest.getCaPostcode().substring(0, 2).equals("DN")) {
}
else if (caCustomerRequest.getCaPostcode().substring(0, 2).equals("EU")) {
}
else {
    wsResponse.setWsResponseCode(82);
    String jdeCVar1 = "Invalid postcode: " + caCustomerRequest.getCaPostcode();
    wsResponse.setWsResponseMessage(jdeCVar1);
}

// SF: Return response to caller
wsResponse.returnWsResponse();
```

Now login to Git Lab by going to Firefox and clicking the bookmark. It should already be open from before. Then select **GenappExtended-Java** and then **Build > Pipelines**



Then examine each step in the latest pipeline that was just automatically executed based on your Java change that you just pushed in to GitLab.

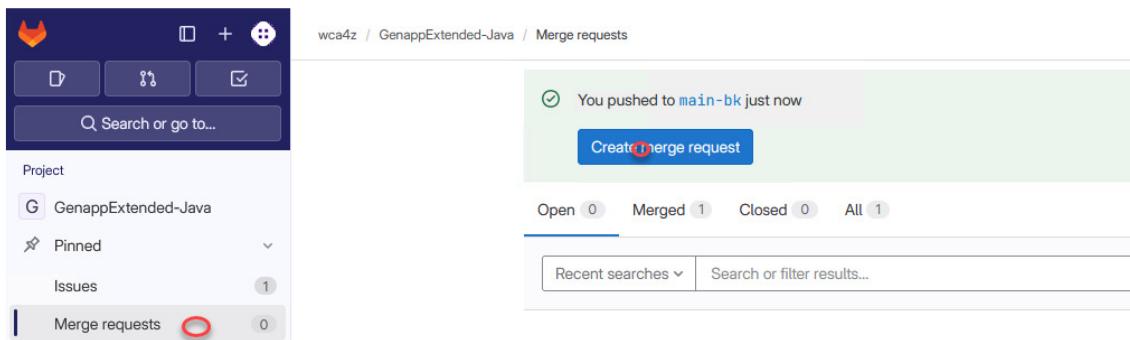
The screenshot shows the GitLab Pipeline interface for the 'GenAppExtended-Java' project. The pipeline has 82 total runs, with 1 being finished. A red arrow points to the 'latest' run, which is labeled 'Java made to the transform java'. This run was created by 'wca4z' for commit 'fa275d7a' and completed 3 minutes ago. It consists of three stages: Setup, Build, and Cleanup, all of which have passed. The 'Build' stage contains one job named '1-Build application'.

IF THE BUILD FAILED, THEN YOU MADE A MISTAKE IN YOUR CODE CHANGE (IF YOU MADE THE CHAGE YOURSELF).

GO BACK TO THE CODE CHANGE SECTION AND DOUBLE CHECK AND ENSURE YOU HAVE MADE THE APPROPRIATE CHANGES. ASK AN INSTRUCTOR FOR HELP, IF NEEDS BE.

ELSE, IF YOU MADE DIDN'T MAKE THE CODE CHANGE AND USED THE PRECOOKED JAVA AND YOU HAVE A FAILURE, PLEASE CONTACT YOUR INSTRUCTOR.

Now we will merge your branch with the main/integration branch. Navigate to ‘**Merge Request**’ and click “Create Merge Request”.



Set these branches as the **Source** and **Target** branches before clicking “Compare branches and continue”.

wca4z / GenappExtended-Java / Merge requests / New

These branches already have an open merge request: I2. Select a different source or target branch.

New merge request

Source branch	Target branch
wca4z/genappextended-java	cobel12javawca4z
wca4z/genappextended-java	main

The form contains the following error:

- Validate branches Another open merge request already exists for this source branch: I2

Compare branches and continue

GenappExtended-Java

Pinned

Issues (1)

Merge requests (0)

Manage

Plan

Code

Build

Secure

Deploy

Operate

Monitor

Analyze

Settings

Switch to rich text editing

Add [description templates](#) to help your contributors to communicate effectively

Assignee: Unassigned [Assign to me](#)

Reviewer: Unassigned

Milestone: Select milestone

Labels: Select label

Merge options:
 Delete source branch when merge request is accepted.
 Squash commits when merge request is accepted. [?](#)

Create merge request Cancel

Then select ‘**Approve**’ and ‘**Merge**’ (see red circle below) once completed.

Uncheck the “Delete source branch” option.

wca4z / GenappExtended-Java / Merge requests / 13

Cobol2javawca4z

Open wca4z requested to merge [cobol2javawca4z](#) into [main](#) just now

Overview 0 Commits 0 Pipelines 0 Changes 0

0 0 0

Pipeline #160 passed Pipeline passed for [fa275d7a](#) on [cobol2javawca4z](#) 8 minutes ago

8v Approve Approval is optional

Ready to merge!

Delete source branch Squash commits Edit commit message
7 commits and 1 merge commit will be added to main.

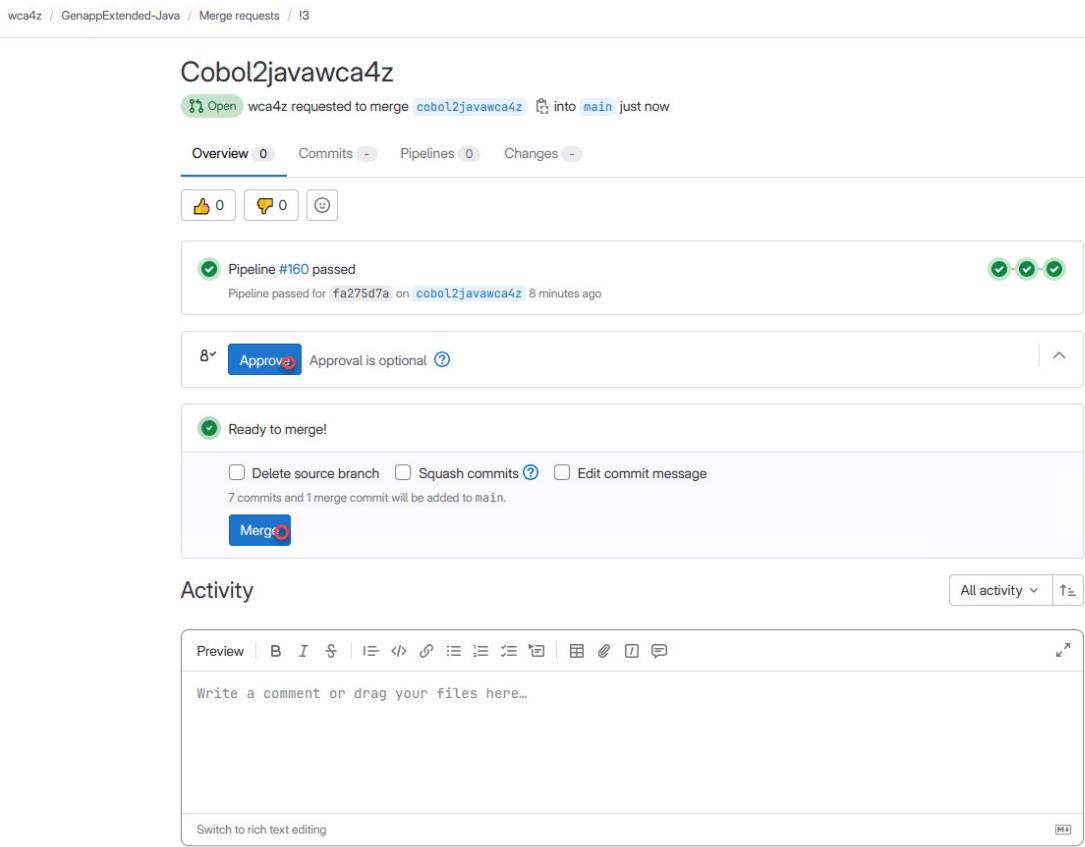
Merge

All activity ▾ ↑

Activity

Preview | B I ⌂ | ↻ ↺ ↻ ↺ | Write a comment or drag your files here...

Switch to rich text editing



Then **double click** the **pipeline execution number** (your number may be different) to view the release pipeline that will now build and package your Java code, ready to be deployed via the route-to-live.

The screenshot shows a GitLab merge request for a branch named "cobel2javawca4z". The pipeline status section indicates that Pipeline #160 has passed, while Pipeline #162 is currently pending. A red arrow points to the "Pipeline #162 pending" entry. Below this, the "Activity" section shows recent interactions: "wca4z approved this merge request just now", "wca4z merged just now", and "wca4z mentioned in commit ade21561 just now". At the bottom, there is a comment input field with placeholder text "Write a comment or drag your files here...".

Follow the steps until its completed. Feel free to explore each step and notice that compared to the developer pipeline, we are packaging to IBM DevOps Deploy.

The screenshot shows the IBM DevOps Deploy pipeline interface for a merge request. The top bar indicates the merge branch is 'cobel2javawca4z' and the target branch is 'main'. The pipeline status shows "Passed" for Pipeline #162, which was created for commit ade21561 and finished just now. The pipeline details show "latest" with 4 jobs queued for 1 second. The pipeline stages are labeled "Setup", "Build", "Packaging", and "Cleanup". Each stage has a green checkmark icon indicating success. The "Build" stage contains a "Clone" job and a "1-Build application" job, both of which have been completed successfully.

The Java is now packaged and ready for the QA process.

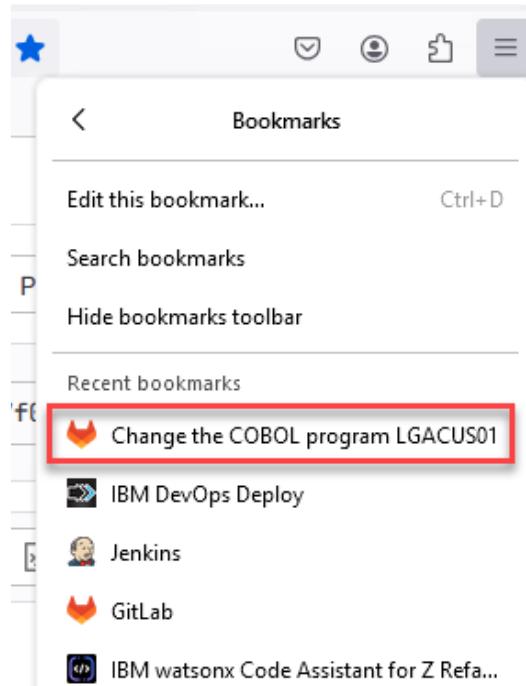
Now, let's change the COBOL CICS to call the Java and execute the COBOL CICS pipeline

Now let's make a change to the COBOL using the GitLab embedded IDE

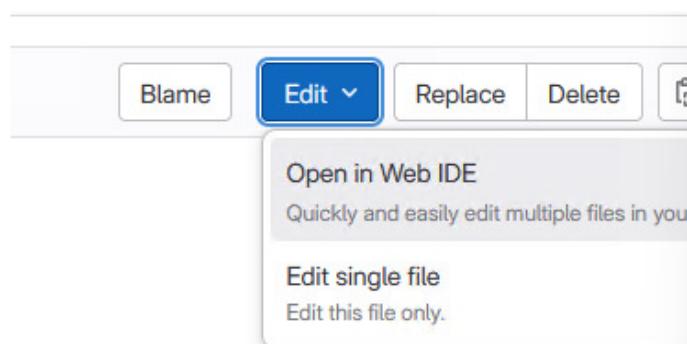
Navigate to this link to access the COBOL program LGACUS01 on the production 'main' branch. We will do something unorthodox and change the program directly on the main branch.

http://wca4z-gitlab.ibm.com:10880/wca4z/GenappExtended/-/blob/main/cics-genapp/base/src/COBOL/LGACUS01.cbl?ref_type=heads

This link is also in the Bookmark menu in Firefox

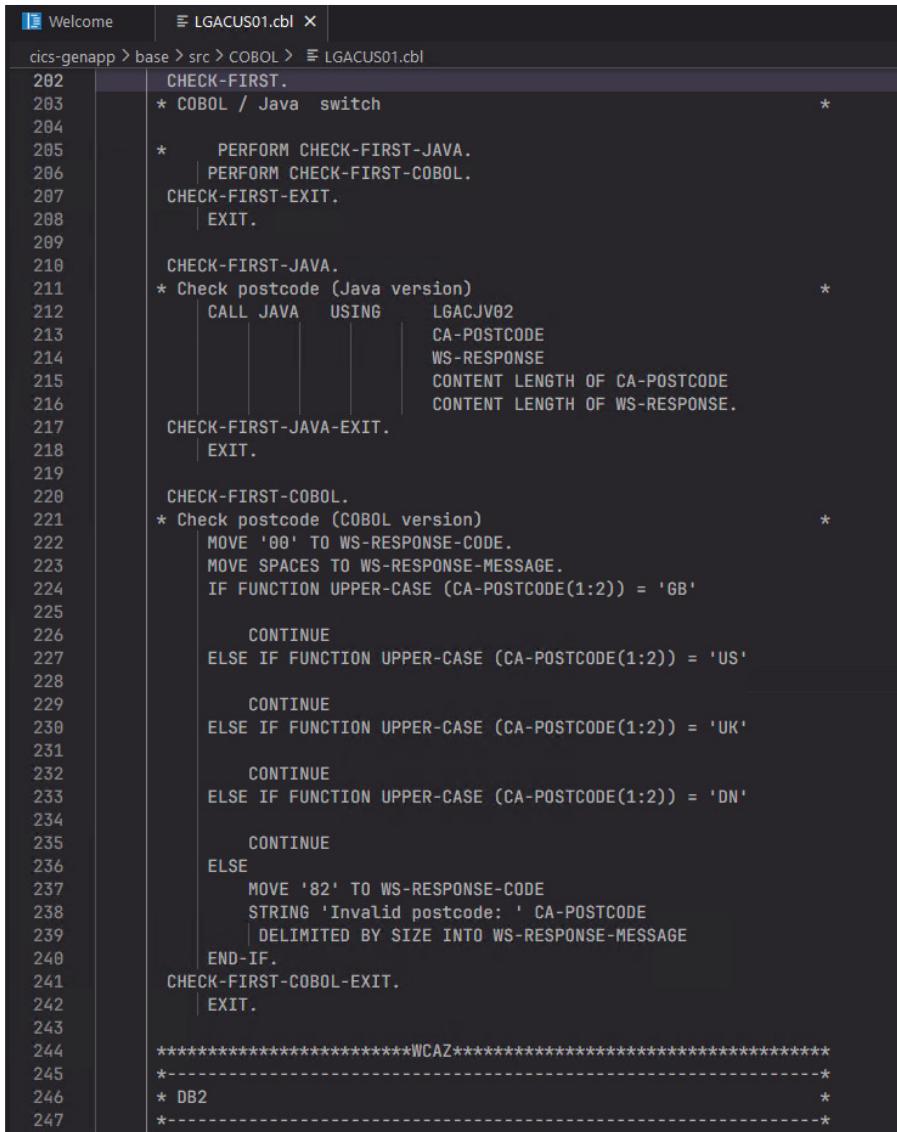


Then navigate to 'Edit' and the 'Open in web IDE', where you will change the code in the inbuilt web IDE.



Then **remove the comment (*)** from **line 204** and place a comment in **line 205** in the same column.
You should change it to this:

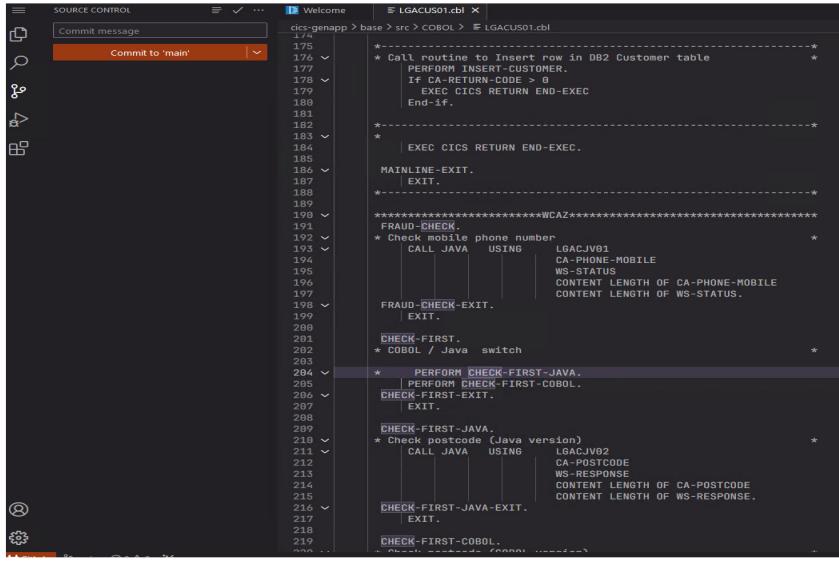
```
PERFORM CHECK-FIRST-JAVA.  
*  PERFORM CHECK-FIRST-COBOL.
```



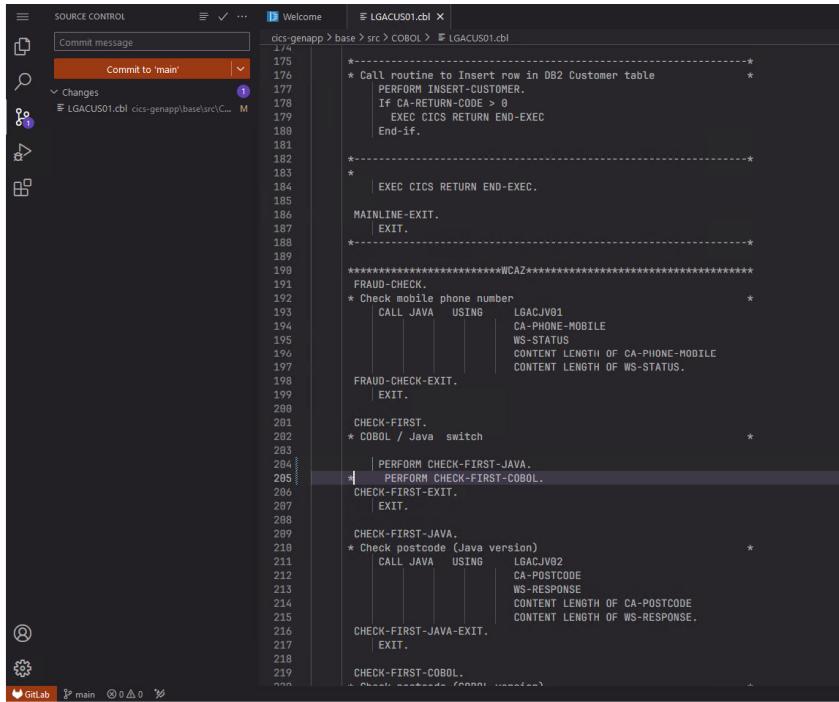
The screenshot shows a terminal window with the title "LGACUS01.cbl". The window displays a COBOL program with line numbers on the left. The code includes sections for CHECK-FIRST, CHECK-FIRST-JAVA, and CHECK-FIRST-COBOL. Line 204 originally contained a comment (*), which has been removed. Line 205 now contains a comment (*). The code uses CALL JAVA and MOVE statements to handle postcode validation across different regions (GB, US, UK, DN).

```
1 Welcome | LGACUS01.cbl X  
2 cics-genapp > base > src > COBOL > LGACUS01.cbl  
202      CHECK-FIRST.  
203      * COBOL / Java switch *  
204  
205      *      PERFORM CHECK-FIRST-JAVA.  
206      |      PERFORM CHECK-FIRST-COBOL.  
207      CHECK-FIRST-EXIT.  
208      |      EXIT.  
209  
210      CHECK-FIRST-JAVA.  
211      * Check postcode (Java version) *  
212      |      CALL JAVA      USING      LGACJV02  
213      |      CA-POSTCODE  
214      |      WS-RESPONSE  
215      |      CONTENT LENGTH OF CA-POSTCODE  
216      |      CONTENT LENGTH OF WS-RESPONSE.  
217      CHECK-FIRST-JAVA-EXIT.  
218      |      EXIT.  
219  
220      CHECK-FIRST-COBOL.  
221      * Check postcode (COBOL version) *  
222      MOVE '00' TO WS-RESPONSE-CODE.  
223      MOVE SPACES TO WS-RESPONSE-MESSAGE.  
224      IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'GB'  
225          CONTINUE  
226      ELSE IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'US'  
227          CONTINUE  
228      ELSE IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'UK'  
229          CONTINUE  
230      ELSE IF FUNCTION UPPER-CASE (CA-POSTCODE(1:2)) = 'DN'  
231          CONTINUE  
232      ELSE  
233          MOVE '82' TO WS-RESPONSE-CODE  
234          STRING 'Invalid postcode: ' CA-POSTCODE  
235          | DELIMITED BY SIZE INTO WS-RESPONSE-MESSAGE  
236      END-IF.  
237      CHECK-FIRST-COBOL-EXIT.  
238      |      EXIT.  
239  
240      *****WCAZ*****  
241      *-----*  
242      * DB2 *  
243      *-----*
```

Select the Git tab on the left and then “Commit to main” in the orange to save change to production ‘main’ branch. When prompted select “Continue”.



```
cics-genapp > base > src > COBOL > LGACUS01.cbl
175      *-----*
176      * Call routine to Insert row in DB2 Customer table
177      *-----*
178      * PERFORM INSERT-CUSTOMER.
179      * IF CA-RETURN-CODE > 0
180      *   EXEC CICS RETURN END-EXEC
181      * End-if.
182      *
183      *-----*
184      * EXEC CICS RETURN END-EXEC.
185      *
186      *-----*
187      * MAINLINE-EXIT.
188      * EXIT.
189      *
190      *-----*
191      * FRAUD-CHECK.
192      * Check mobile phone number
193      * CALL JAVA USING LGACJV01
194      *           CA-PHONE-MOBILE
195      *           WS-STATUS
196      *           CONTENT LENGTH OF CA-PHONE-MOBILE
197      *           CONTENT LENGTH OF WS-STATUS.
198      *-----*
199      * FRAUD-CHECK-EXIT.
200      * EXIT.
201      *
202      *-----*
203      * CHECK-FIRST.
204      * COBOL / Java switch
205      *
206      *-----*
207      * PERFORM CHECK-FIRST-JAVA.
208      * PERFORM CHECK-FIRST-COBOL.
209      *-----*
210      * CHECK-FIRST-EXIT.
211      * EXIT.
212      *
213      *-----*
214      * CHECK-FIRST-JAVA.
215      * Check postcode (Java version)
216      * CALL JAVA USING LGACJV02
217      *           CA-POSTCODE
218      *           WS-RESPONSE
219      *           CONTENT LENGTH OF CA-POSTCODE
220      *           CONTENT LENGTH OF WS-RESPONSE.
221      *-----*
222      * CHECK-FIRST-JAVA-EXIT.
223      * EXIT.
224      *
225      *-----*
226      * CHECK-FIRST-COBOL.
227      *-----*
```



```
cics-genapp > base > src > COBOL > LGACUS01.cbl
175      *-----*
176      * Call routine to Insert row in DB2 Customer table
177      *-----*
178      * PERFORM INSERT-CUSTOMER.
179      * IF CA-RETURN-CODE > 0
180      *   EXEC CICS RETURN END-EXEC
181      * End-if.
182      *
183      *-----*
184      * EXEC CICS RETURN END-EXEC.
185      *
186      *-----*
187      * MAINLINE-EXIT.
188      * EXIT.
189      *
190      *-----*
191      * FRAUD-CHECK.
192      * Check mobile phone number
193      * CALL JAVA USING LGACJV01
194      *           CA-PHONE-MOBILE
195      *           WS-STATUS
196      *           CONTENT LENGTH OF CA-PHONE-MOBILE
197      *           CONTENT LENGTH OF WS-STATUS.
198      *-----*
199      * FRAUD-CHECK-EXIT.
200      * EXIT.
201      *
202      *-----*
203      * CHECK-FIRST.
204      * COBOL / Java switch
205      *
206      *-----*
207      * PERFORM CHECK-FIRST-JAVA.
208      * PERFORM CHECK-FIRST-COBOL.
209      *-----*
210      * CHECK-FIRST-EXIT.
211      * EXIT.
212      *
213      *-----*
214      * CHECK-FIRST-JAVA.
215      * Check postcode (Java version)
216      * CALL JAVA USING LGACJV02
217      *           CA-POSTCODE
218      *           WS-RESPONSE
219      *           CONTENT LENGTH OF CA-POSTCODE
220      *           CONTENT LENGTH OF WS-RESPONSE.
221      *-----*
222      * CHECK-FIRST-JAVA-EXIT.
223      * EXIT.
224      *
225      *-----*
226      * CHECK-FIRST-COBOL.
227      *-----*
```

Go back to GitLab and navigate to this link <http://wca4z-gitlab.ibm.com:10880/wca4z/GenappExtended> and then go to “Build” and then “Pipelines”.

The screenshot shows the GitLab interface for the 'GenappExtended' repository. The left sidebar has sections like 'Code', 'Merge requests', 'Repository', 'Build', 'Secure', and 'Deploy'. The 'Build' section is expanded, showing 'Pipelines' as a sub-option. The main area shows a commit titled 'Update LGACUS01.cbl' by 'wca4z' from a week ago. Below the commit is a file named 'LGACUS01.cbl' with a size of 12.66 KB. A large portion of the file content is displayed, starting with a copyright notice and ending with a warning about restricted materials.

Then click on the latest pipeline number link that was executed from your COBOL change. In the picture below, this is illustrated as **163** (your pipeline number may be different).

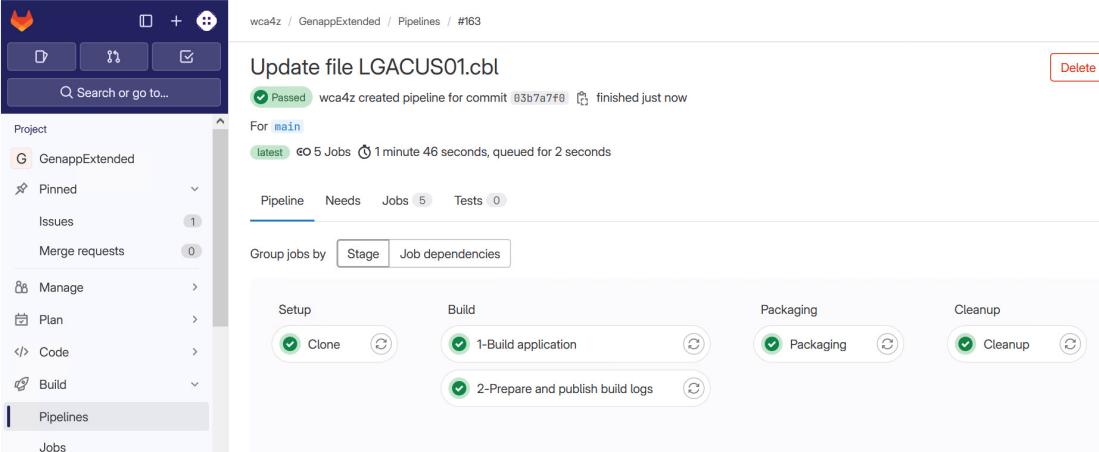
The screenshot shows the 'Pipelines' page in GitLab. The left sidebar has sections like 'Project', 'Issues', 'Merge requests', 'Manage', 'Plan', 'Code', 'Build', and 'Pipelines'. The 'Pipelines' section is selected. The main area lists four pipelines:

Status	Pipeline	Created by	Stages
Passed	Update file LGACUS01.cbl #163	wca4z	Passed
Passed	Update file LGACUS01.cbl #139	wca4z	Passed
Passed	Update file LGACUS01.cbl #138	wca4z	Passed
Passed	Update file LGACUS01.cbl #136	wca4z	Passed

A red arrow points to the pipeline ID '#163' in the first row.

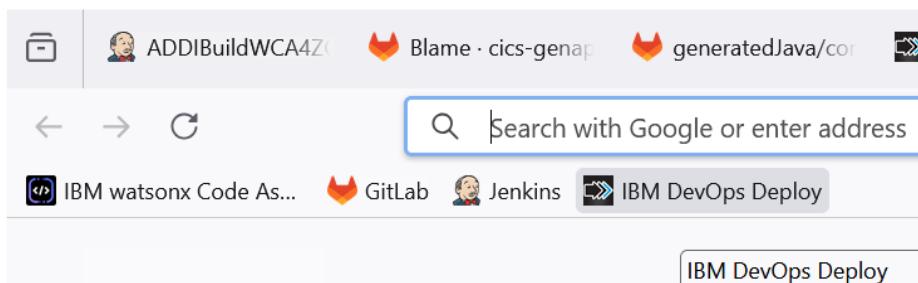
Now, let's deploy the COBOL and Java using the Continuous Deployment process with test automation

Your COBOL program has been automatically cloned to z/OS using [z/OS Git](#), built via [IBM Dependency Based Build](#), Packaged by [IBM DevOps Deploy](#) and you will soon deploy both the Java and COBOL together to your DevTest LPAR system using [IBM DevOps Deploy](#).

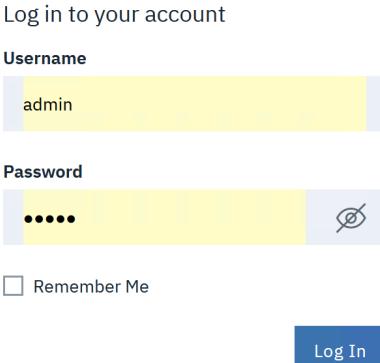


The screenshot shows the IBM DevOps Deploy interface. On the left, there's a sidebar with options like Project, Issues, Merge requests, Manage, Plan, Code, Build, Pipelines, and Jobs. The Pipelines option is selected. In the main area, it says "Update file LGACUS01.cbl" and "Passed: wca4z created pipeline for commit 03b7a7ff". It shows a pipeline for the "main" branch with one job named "latest" (5 jobs, 1 minute 46 seconds, queued for 2 seconds). Below the pipeline details, there are tabs for Pipeline, Needs, Jobs (5), and Tests (0). A button "Group jobs by Stage / Job dependencies" is available. Under the Pipeline tab, there are four stages: Setup, Build, Packaging, and Cleanup. Each stage has two steps: "Clone" (green checkmark), "1-Build application" (green checkmark), "Packaging" (green checkmark), and "2-Prepare and publish build logs" (green checkmark). A "Delete" button is located in the top right corner.

Click on 'IBM DevOps Deploy' bookmark in Firefox

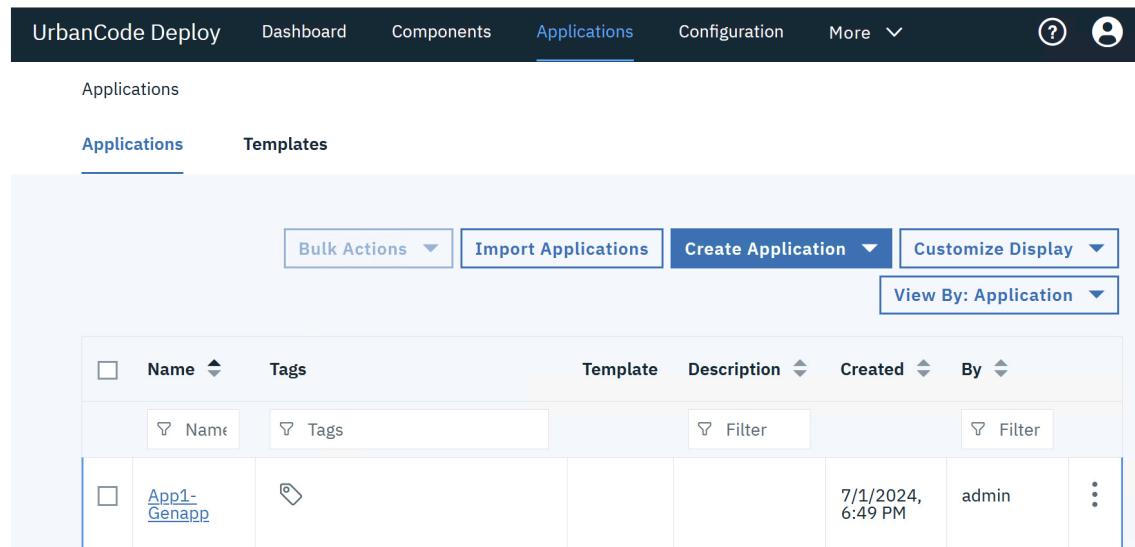


Login with **admin** / **admin** to IBM DevOps Deploy. The ID and password should already be saved.



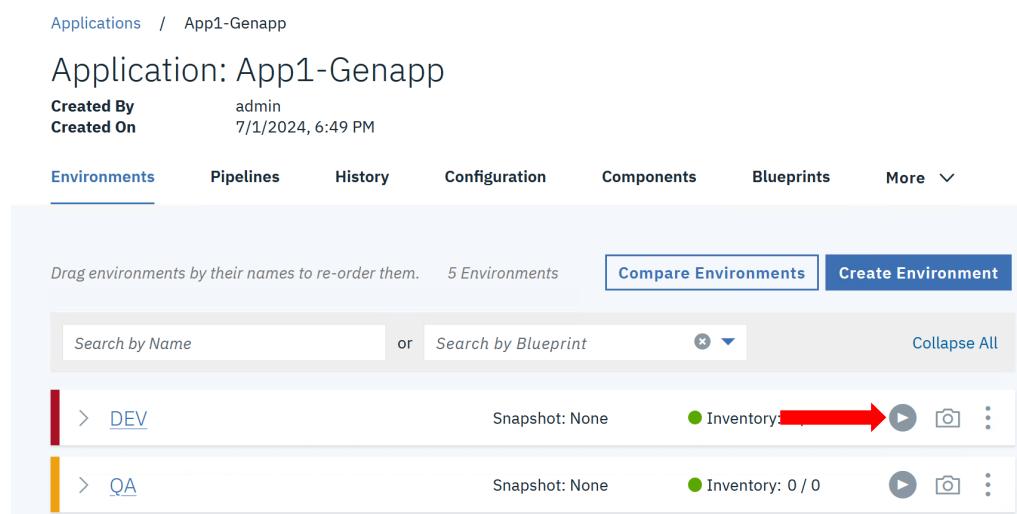
The screenshot shows the IBM DevOps Deploy login page. It has a header "Log in to your account". Below it, there's a "Username" field containing "admin" and a "Password" field containing "*****". There's also a "Remember Me" checkbox and a "Log In" button at the bottom.

Navigate to “Applications” and select “App1-Genapp”.



The screenshot shows the UrbanCode Deploy interface. The top navigation bar has tabs for "UrbanCode Deploy", "Dashboard", "Components", "Applications" (which is underlined), "Configuration", and "More". On the far right are a help icon, a user profile icon, and a gear icon. Below the navigation is a secondary header with "Applications" and "Templates" tabs, where "Applications" is selected. A toolbar below this includes "Bulk Actions", "Import Applications", "Create Application" (which is highlighted with a blue border), and "Customize Display". There is also a "View By: Application" dropdown. The main area is a table with columns: Name, Tags, Template, Description, Created, and By. A row for "App1-Genapp" is selected, indicated by a blue border around its cells. The "Name" column shows "App1-Genapp" and the "Tags" column shows a tag icon.

Then select the “play” button next to the DEV environment, see in illustration below.

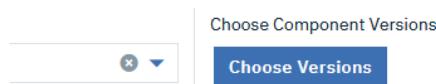


The screenshot shows the "Application: App1-Genapp" page. At the top, it displays "Created By: admin" and "Created On: 7/1/2024, 6:49 PM". Below this is a navigation bar with tabs: "Environments" (which is selected and highlighted in blue), "Pipelines", "History", "Configuration", "Components", "Blueprints", and "More". The main content area is titled "Drag environments by their names to re-order them. 5 Environments". It includes "Compare Environments" and "Create Environment" buttons. Below this is a search bar with "Search by Name" and "Search by Blueprint" fields, and a "Collapse All" button. The environments listed are "DEV" and "QA". The "DEV" environment has a red arrow pointing to the "play" button (represented by a play icon) in the "Actions" column. The "QA" environment has a play button in the same column. Both environments show "Snapshot: None" and "Inventory" status (0 / 0).

Select the following settings and **uncheck** “Only Deploy Changed Versions”.

The screenshot shows a web browser window with the URL <https://172.16.0.7:18443/#applicationProcessRequestForm/main>. The page title is "Run Application Process". There are three dropdown menus: "Application" set to "App1-Genapp", "Environment" set to "DEV", and "Process" set to "Deploy". To the right of these dropdowns is a large empty "Description" text area. Below the dropdowns is a section titled "Select Component Versions or Snapshot" with a "2 Selected | View Selected" link. At the bottom of this section is a checkbox labeled "Only Deploy Changed Versions" which is currently checked. The entire form is contained within a light gray box.

Then select '**Choose Versions**'.



And select the **Latest Available**.

Note: As you are the only one using the system, the latest will be your last COBOL and Java package will be selected for deployment. Alternatively, you could select the package number, which will be the same number as your pipeline number. E.g. if your Java pipeline was 129 and COBOL pipeline was 130, you would select 130 for the COBOL version/package and 129 for the Java version/package.

The screenshot shows a deployment configuration interface. On the left, there's a sidebar with options like "Only Deploy Changed Versions" and "Version Presets". Under "Version Presets", two components are listed: "Component: App1-Genapp-API" (Type: Latest Version) and "Component: App1-Genapp-Java" (Type: Latest Version). Below this is a "Select a Snapshot" dropdown set to "... None ...". At the bottom of the sidebar are links for "Properties" and "Schedule Deployment".

A modal window titled "Select Component" is open on the right. It lists several options under "Latest Available": "Latest with Status", "Versions With Name", "Current Environment Inventory", "Latest Available at Execution Time", "Latest with Status at Execution Time", and "Current Environment Inventory at Execution Time". A "Component" dropdown is set to "App1-Genapp-ZComponent". A "Select For All" button is visible at the bottom right of the modal.

Now select “Submit” to trigger the deployment of your COBOL and Java to CICS on z/OS to the DevTest environment to be tested.

The screenshot shows the deployment configuration interface again. The left sidebar is identical to the previous one. The main area now shows a list of components: "Component: App1-Genapp-API" (Type: Latest Version) and "Component: App1-Genapp-Java" (Type: Latest Version). Below this is a "Select a Snapshot" dropdown set to "... None ...". To the right, a "Choose Component Versions" section has a "Choose Versions" button. At the bottom, there are links for "Properties" and "Schedule Deployment".

On the far right, there are two buttons: "Run Now" (with a toggle switch) and a checkmark icon. At the very bottom are "Submit" and "Cancel" buttons.

Follow the steps in the pipeline, you may need to select ‘expand all’ at the top. Then select the ‘3 dots/ellipsis for each step to explore what is going on.

There is an automated test in the pipeline which will call the AddCustomer z/OS Connect API to add a new customer with a postcode UK to validate the Java is being called from COBOL CICS! If there is a HTTP code 200, then the WCA4Z Java will have been successfully transformed and integrated into CICS, with the new functionality, which will result in a ‘Success’.

Step	Progress	Start Time	Duration	Status	
▼ ⚙️ App1-Genapp-CURLtest	<div style="width: 100%;">1 / 1</div>	2:40:39 PM	0:00:04	Success	
▼ 📈 App1-Genapp-CURLtest	<div style="width: 100%;">1 / 1</div>	2:40:39 PM	0:00:04	Success	
▼ ⚒ curltest (./App1-Genapp/_DEV_LPAR/zos.dev/App1-Genapp-CURLtest)		2:40:39 PM	0:00:04	Success	⋮
1. ⚡ Execute 'Add Customer' API		2:40:40 PM	0:00:03	Success	⋮
6. ⚙️ Update the Git Main Branch				Not Started	
► 7. ⚙️ Update Z component status	<div style="width: 100%;">1 / 1</div>	2:40:43 PM	0:00:25	Success	

In this **Changed Transformed Java and COBOL to call Java and trigger DevOps Pipeline to deploy to COBOL CICS** phase,

1. We changed the Java to run in CICS for this specific use case
2. We changed the COBOL to call Java in CICS
3. We triggered CI process for the Java
4. We triggered CD process for the COBOL and Java.

Lab completed

Appendix A – Java and COBOL interoperability in CICS

CICS Transaction Server for z/OS is a multi-language application server, and provides a simple API to allow programs written in different languages to easily interoperate with each other. The API commands relevant to this lab are described in the sections below, and the full API is documented in the IBM CICS Documentation here -> <https://www.ibm.com/docs/en/cics-ts/6.x?topic=application-development-reference>

CICS API commands used in this Lab

For the purposes of this lab, we will limit the discussion to COBOL and Java, but all programming languages supported by CICS can make use of these API commands.

CICS LINK Command

EXEC CICS LINK PROGRAM(<program-name>)

This command allows a COBOL program to invoke another program written in any language. Java methods can be annotated with CICS program names, making it easy to invoke specific Java methods from COBOL. Similarly, Java programs can invoke COBOL programs using the **link** method provided with the **Program** class; for example, to LINK to a program with the name **PROG01**

```
Program prog = new Program();
prog.setName("PROG01");
prog.link()
```

CICS Container API Commands

EXEC CICS PUT CONTAINER(<container-name>) FROM(<data-area>)

EXEC CICS GET CONTAINER(<container-name>) INTO(<data-area>)

These commands allow programs to exchange data using CICS containers.

For example, before invoking a target program, a calling program might place data in an input container using

EXEC CICS PUT CONTAINER("INPUT")

The target program can retrieve the input data using

EXEC CICS GET CONTAINER("INPUT")

and place the response in a different container, for example

EXEC CICS PUT CONTAINER("OUTPUT")

When control returns to the calling program, it can retrieve the response using

EXEC CICS GET CONTAINER ("OUTPUT")

Similarly, Java programs can exchange container data with COBOL programs using the **getContainer** and **createContainer** methods provided with the **Channel** class; for example:

```
Container input;
Container output;
input = currentChannel.getContainer("INPUT");
output = currentChannel.createContainer("OUTPUT");
```

The CICS Container API commands can also handle code page conversion automatically. For example, EBCDIC character data stored in a container by a COBOL program can be retrieved by a Java program in UTF-16 (and vice-versa).

Appendix B – Functions provided by the lab interoperability framework

To ensure this lab remains focused on the use of **IBM Watsonx Code Assistant for Z**, the programming changes required to invoke and exchange data between the newly generated Java code and the existing refactored COBOL programs have been encapsulated into a common framework. The objective is to minimise any code changes required by the lab.

This lab-provided framework provides 3 functions:

1) COBOL subroutine to invoke a Java method

A subroutine is provided (named “**JAVA**”), which simplifies invoking a Java method from COBOL to a single CALL statement. The **CALL** takes 3 parameters:

- the name of the target Java program (the value of the **CICSPROGRAM** annotation associated with the target method)
- the name (and length) of the data structure representing the input data
- the name (and length) of the data structure which will contain the response.

Example:

CALL JAVA USING	LGACJV02	<- Target program name
	CA-POSTCODE	<- Input data structure
	WS-RESPONSE	<- Output data structure
	CONTENT LENGTH OF CA-POSTCODE	<- Input length
	CONTENT LENGTH OF WS-RESPONSE.	<- Output length

2) Java method to retrieve input data from COBOL

A Java class (**CobolData**) and method (**getCobolData**) is provided to simplify the retrieval of input data provided by the COBOL caller.

Example:

```
import com.ibmzpot.common.CobolData;           <- the framework package
```

```
CobolData input = new CobolData();           <- instantiate a CobolData object  
this.caPostcode = input.getCobolData();        <- retrieve COBOL-provided data
```

3) Java method to return output data to COBOL

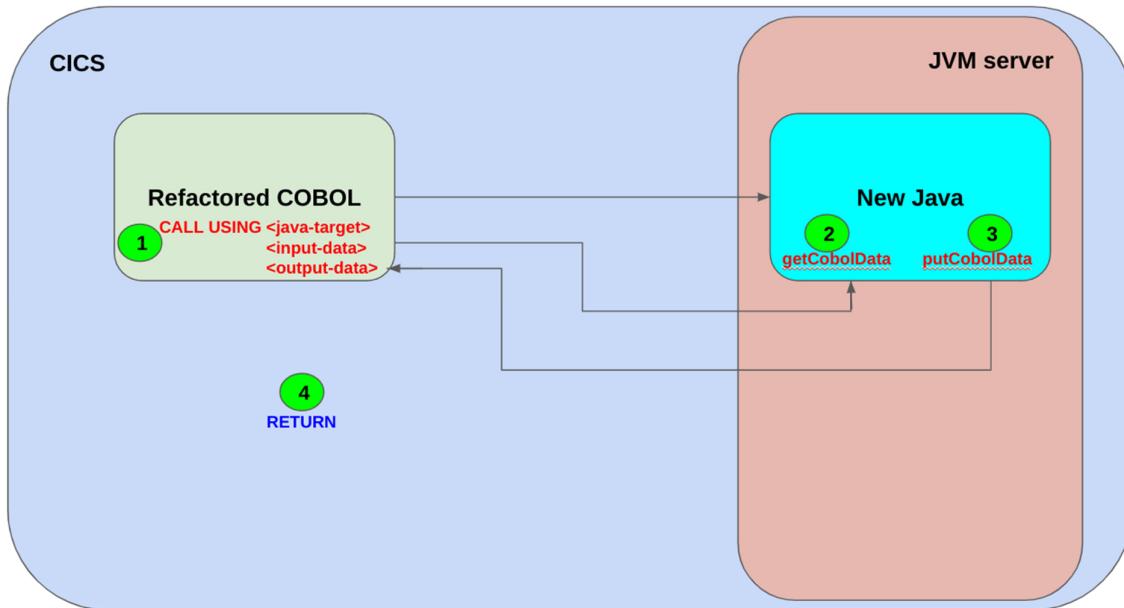
A Java class (**CobolData**) and method (**putCobolData**) is provided to simplify the returning of output data to the COBOL caller.

Example:

```
import com.ibmzpot.common.CobolData;          <- the framework package  
CobolData output = new CobolData();            <- instantiate a CobolData object  
output.putCobolData(responseMsg);             <- return output data to COBOL
```

An illustration and summary of how the three functions can be used together is provided below.

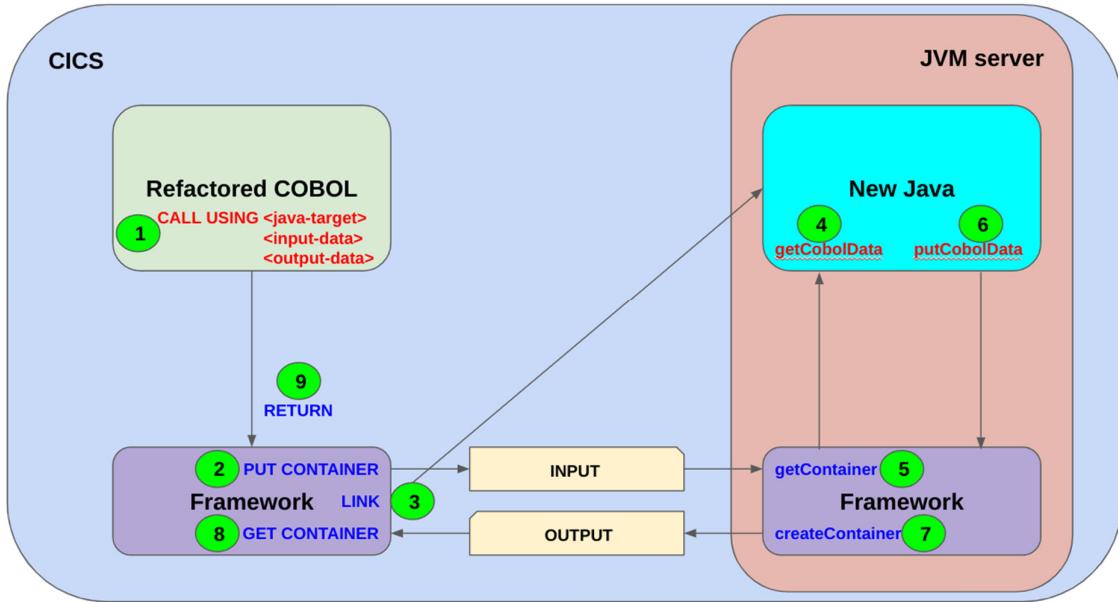
Summary - functions provided by interoperability framework



1. The COBOL application program indirectly invokes the Java application program by directly invoking the framework, passing the name of the target Java program, the name (and length) of the data structure containing the input data, and the name (and length) of the data structure for the response (COBOL CALL)
2. The Java application program retrieves the input data by invoking a method provided by the framework (framework-provided method `getCobolData`)
3. After the Java application program has finished executing its business logic, it invokes a method provided the framework to return the response data to the COBOL application program (framework-provide method `putCobolData`)
4. The framework code has finished executing, resulting in an implicit RETURN back to the COBOL application program

It is not necessary to understand the framework code in order to complete this lab, however for reference, more information is provided in Appendix C (Technical Overview), Appendix D (COBOL source) and Appendix E (Java source).

Appendix C – Framework Technical Overview



1. The application program invokes the framework code, passing the name of the target Java program, the name (and length) of the data structure containing the input data, and the name (and length) of the data structure for the response (COBOL CALL)
2. The framework creates and populates a container containing the input data (EXEC CICS PUT CONTAINER)
3. The framework invokes the target Java program (EXEC CICS LINK)
4. The Java application invokes the framework to retrieve the input data (framework-provided method `getCobolData`)
5. The framework retrieves the input data from the input container (CICS-provided method `getContainer`)
6. After the Java application program has finished executing its business logic, it invokes the framework to return the response data (framework-provide method `putCobolData`)
7. The framework creates and populates a container containing the output data (CICS-provided method `createContainer`)

8. The Java code having finished executing, control returns to the framework program that issued the EXEC CICS LINK. It retrieves the data from the output container and stores it in the data structure for the response (EXEC CICS GET CONTAINER)
9. The framework finishes executing resulting in an implicit RETURN back to the COBOL application program

Appendix D – Framework Source Code (COBOL)

```
*****
* Proxy for invoking a Java program from COBOL in CICS.
* NB. Only intended for demo purposes and not for general use.
*****

IDENTIFICATION DIVISION.
PROGRAM-ID. JAVA.

ENVIRONMENT DIVISION.

DATA DIVISION.

*****  
WORKING-STORAGE SECTION.
01 WORK-FIELDS.
    05 JAVA-CHANNEL          PIC X(16).
    05 INPUT-CONTAINER      PIC X(16).
    05 OUTPUT-CONTAINER     PIC X(16).
    05 MAX-LENGTH           PIC S9(9) COMP.

*****  
LINKAGE SECTION.
    77 JAVA-PROGRAM        PIC X(8).
01 JAVA-INPUT.
    05 FILLER             PIC X OCCURS 1 TO 999999999  
           DEPENDING ON JAVA-INPUT-L.
01 JAVA-OUTPUT.
    05 FILLER             PIC X OCCURS 1 TO 999999999  
           DEPENDING ON JAVA-OUTPUT-L.
    77 JAVA-INPUT-L       PIC S9(9) COMP.
    77 JAVA-OUTPUT-L      PIC S9(9) COMP.  
*****
```

```
*****
PROCEDURE DIVISION USING
    JAVA-PROGRAM
    JAVA-INPUT
    JAVA-OUTPUT
    JAVA-INPUT-L
    JAVA-OUTPUT-L.

*****
MAIN-PROCESSING SECTION.
MOVE 'COBOL2JAVA' TO JAVA-CHANNEL.

IF JAVA-INPUT-L > ZERO
    PERFORM PUT-INPUT-CONTAINER
END-IF.

EXEC CICS LINK PROGRAM(JAVA-PROGRAM)
    CHANNEL(JAVA-CHANNEL)
END-EXEC.

IF JAVA-OUTPUT-L > ZERO
    PERFORM GET-OUTPUT-CONTAINER
END-IF.

MAIN-PROCESSING-EXIT.
EXIT PROGRAM.
```

```
*****
PUT-INPUT-CONTAINER SECTION.  
MOVE SPACES      TO INPUT-CONTAINER.  
STRING  JAVA-PROGRAM      DELIMITED BY SPACE  
      '-INPUT'          DELIMITED BY SIZE  
      INTO INPUT-CONTAINER.
```

```
EXEC CICS PUT CONTAINER(INPUT-CONTAINER)  
CHANNEL(JAVA-CHANNEL)  
FROM(JAVA-INPUT)  
CHAR  
END-EXEC.
```

```
PUT-INPUT-CONTAINER-EXIT.  
EXIT.  
*****
```

```
*****
GET-OUTPUT-CONTAINER SECTION.  
MOVE SPACES      TO OUTPUT-CONTAINER.  
STRING  JAVA-PROGRAM      DELIMITED BY SPACE  
      '-OUTPUT'          DELIMITED BY SIZE  
      INTO OUTPUT-CONTAINER.  
COMPUTE MAX-LENGTH  = JAVA-OUTPUT-L.
```

```
EXEC CICS GET CONTAINER(OUTPUT-CONTAINER)  
CHANNEL(JAVA-CHANNEL)  
INTO(JAVA-OUTPUT)  
FLENGTH(MAX-LENGTH)  
END-EXEC.
```

```
GET-OUTPUT-CONTAINER-EXIT.  
EXIT.  
*****
```

Appendix E – Framework Source Code (Java)

```
package com.ibmzpot.common;

import com.ibm.cics.server.Task;
import com.ibm.cics.server.Channel;
import com.ibm.cics.server.Container;
import com.ibm.cics.server.CicsConditionException;

public class CobolData {

    Task currentTask = Task.getTask();
    Channel currentChannel;
    String currentProgram = currentTask.getProgramName();

    public String getCobolData() {

        Container inputContainer;
        String inputData = null;

        try {
            currentChannel = currentTask.getCurrentChannel();
            if (currentChannel != null) {
                inputContainer = currentChannel.getContainer(currentProgram + "-INPUT");
                if (inputContainer != null) {
                    inputData = inputContainer.getString();
                }
            }
        } catch (CicsConditionException cce) {
            throw new RuntimeException(cce);
        }

        return inputData;
    }
}
```

```
public void putCobolData(String outputData) {  
  
    Container outputContainer;  
  
    try {  
        currentChannel = currentTask.getCurrentChannel();  
        if (currentChannel != null) {  
            outputContainer = currentChannel.getContainer(currentProgram + "-OUTPUT");  
            if (outputContainer == null) {  
                outputContainer = currentChannel.createContainer(currentProgram + "-OUTPUT");  
            }  
            outputContainer.putString(outputData);  
        }  
    } catch (CicsConditionException cce) {  
        throw new RuntimeException(cce);  
    }  
}  
}
```

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