

# **DevOps on Z Proof of Technology (PoT)**

*Exercises Using zDT on Cloud*

*Updated April 16 2021*



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## Overview

- Integrated application development and problem analysis ([ADFz](#))
- Managing your source code using modern tools (including [Git](#))
- Building automation ([DBB](#)) for COBOL or PL/I without a specific source code manager or pipeline automation tool (including [Groovy](#) and [Jenkins](#))
- Using a unit testing framework ([zUnit](#)) for COBOL or PLI as part of the development environment
- Application deployments automation to many environments ([UCD](#))
- Expose Mainframe legacy applications via RESTful APIs ([z/OS Connect](#))
- Understand how Mainframe applications use their resources to improve performance ([APA](#))

This material was built using a Windows on cloud that was updated on **April 2021**

Here the desktop background of this image:



The following symbols appear in this document at places where additional guidance is available.

Icon	Purpose	Explanation
	Important!	This symbol calls attention to a particular step or command. For example, it might alert you to type a command carefully because it is case sensitive.
	Information	This symbol indicates information that might not be necessary to complete a step, but is helpful or good to know.
	Trouble-shooting	This symbol indicates that you can fix a specific problem by completing the associated troubleshooting information.

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# LAB 1 - Working with mainframe using COBOL and DB2

## (90 - 120 minutes)

Updated April 16, 2021 (created by Regi, Reviewed by Wilbert)

This lab will take you through the steps of using the [Application Delivery Foundation for z Systems](#) (ADFz) to work with a z/OS system. It will familiarize you with some of the capabilities of this product using a DB2 COBOL batch program that is ABENDING.

On this lab you will connect to a remote z/OS system, submit and execute a program (which ABENDs), identify the program abend, set up a MVS project, edit, compile, and debug a COBOL application. The process would be similar for a PL/I program.

### Overview of development tasks

To complete this tutorial, you will perform the following tasks:

- 1. Connect to a z/OS System.**  
→ You will connect to the z/OS system using a provided z/OS logon userid.
- 2. Execute the DB2/COBOL batch program and verify the ABEND.**  
→ You will submit a COBOL/DB2 batch to execute and verify the bug.
- 3. Use Fault Analyzer to identify the cause of the ABEND**  
→ You will use Fault Analyzer to identify what is causing the ABEND.
- 4. Use the IBM Debug for a temporary fix**  
→ You will modify the field content to bypass the bug
- 5. Modify the COBOL code to fix the bug.**  
→ You will be able to fix the bug changing the COBOL code.
- 6. Use Code Coverage**  
→ You can now verify program areas covered by the test case with Code Coverage
- 7. (Optional) Execute SQL statement when editing the program.**  
→ While editing the COBOL/DB2 program you will be able to execute SQL statements and verify the query results.
- 8. (Optional) Using File Manager**  
→ An example of using File Manager against a z/OS data set.  
File Manager provides formatted editors and viewers. It also provides a full complement of on-line and batch utilities to copy, extract, and load data, to create files and databases, compare and print, and many other utility functions.

## Section 1 – Connect to a z/OS System

You will connect to the z/OS. This section is like LOGON to a TSO. You will use **empot01** as userid and password.

### 1.1 Working with the IDz workspace

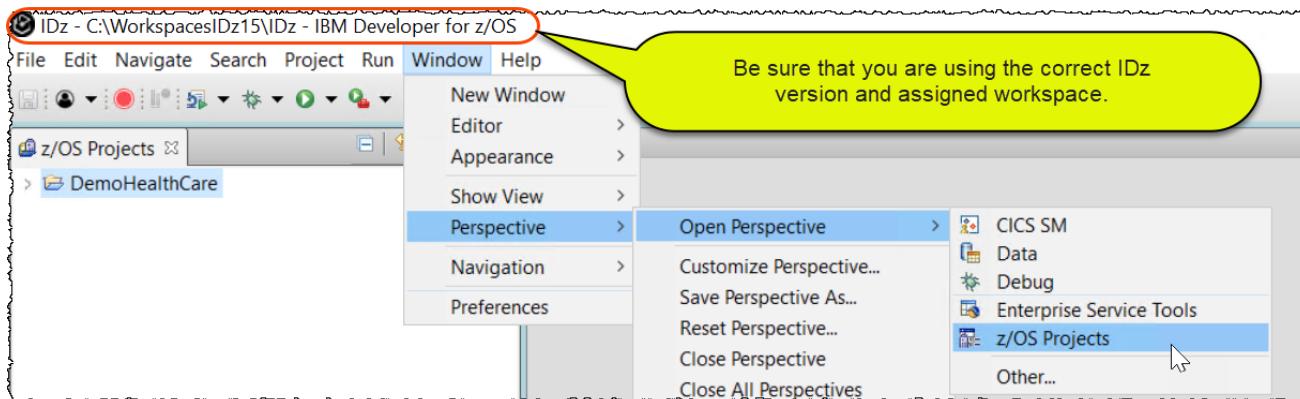
#### 1.1.1 Start IBM Developer for z Systems version 15

- ▶▶ Using the windows desktop double click on **IDz V15** icon.
- ▶▶ Verify that the message indicates that it is **Version 15.0.1**

**IMPORTANT** -> This icon will start an eclipse workspace that has already some definitions required for this lab.  
PLEASE DO NOT start IDz using other way than this icon.



#### 1.1.2 ▶▶ Open the z/OS Projects perspective by selecting Window > Perspective > Open Perspective > z/OS Projects



#### **z/OS Projects perspective**

Use the z/OS Projects perspective to define the connection, connect to, and work with remote systems, and to create, edit, and build projects, subprojects, and files on remote UNIX, Linux for z Systems, and z/OS systems.

The z/OS Projects perspective contains the many views like Remote Systems view, z/OS Projects view, Properties view, Outline view, Remote Error List view, z/OS File System Mapping view, Remote System Details view, Team view, Property Group Manager view and Snippets view



You can close and open views to customize the perspective.

To open one of the views that were closed:

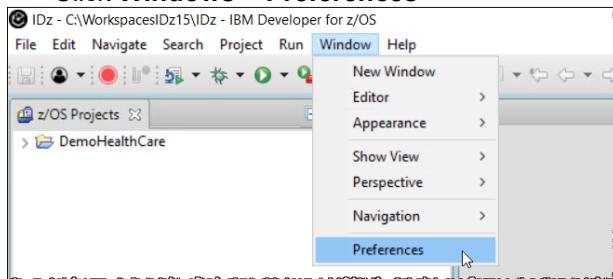
1. In the workbench, select **Window > Show View**.

A menu that lists the views associated with the z/OS Projects perspective is displayed.

2. Click the name of the view you want to open.

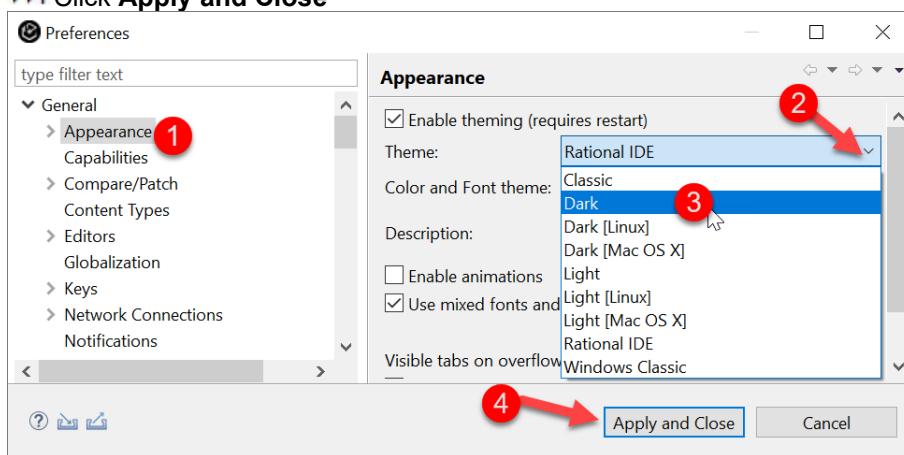
1.1.3 Starting on version 15 the developer can change the workspace appearance. If you want to try that

▶▶ Click Windows > Preferences



1.1.4 ▶▶ Under General select Appearance and on Theme select Dark.

▶▶ Click Apply and Close

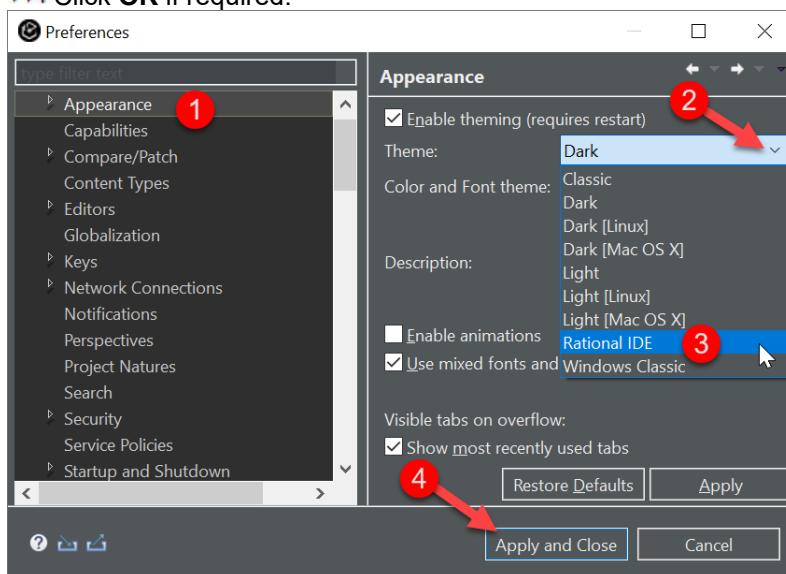


1.1.5 Since all picture here were done using "Rational IDE" theme we recommend to return to the default.

▶▶ Again, click Windows > Preferences

▶▶ Under General select Appearance and on Theme select Rational IDE and click Apply and Close

▶▶ Click OK if required.



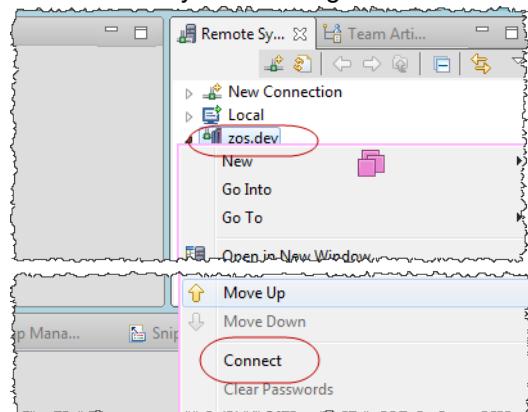
## 1.2 Connecting to the z/OS Remote system

### 1.2.1 To Connect to the z/OS system:

► Using the *Remote Systems* view on the top and right side of the screen:

Right-click on **zos.dev** and select **Connect**

**Notice:** Since you are using a cloud instance the response to the right click may be delayed first time.

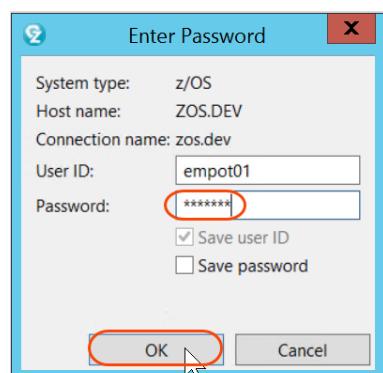


### 1.2.2 You will be prompted for your z/OS userid and password.

► Type **empot01** as userid (might be already there) and **empot01** as password.

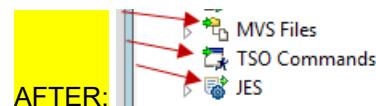
The userid and password **can be any case; don't worry about having it in UPPER case.**

### 1.2.3 ► Click **OK** to connect to z/OS.



**Be Patient!** The connection could take a while depending on the network condition.

Notice that some folder icons changed after connected. A small green arrow is added.



#### In case of connection errors...

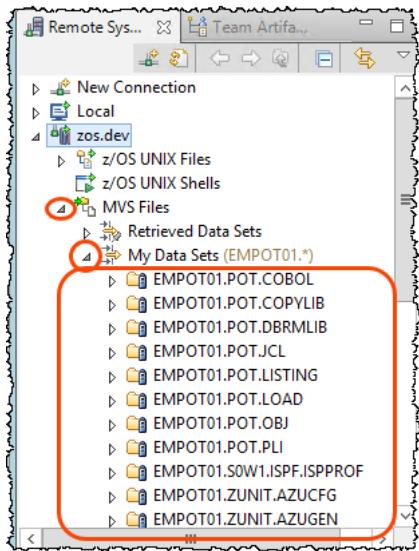
If you have errors during the connection it is because the z/OS system is not available.

You also may have network issues.

Try to open a Windows command prompt and type **ping zos.dev**.

If you do not receive a reply, Contact the instructor. Your connection is broken.

1.2.5 ► Expand MVS Files and My Data Sets to see MVS data sets that starts with EMPOT01.\*



### Remote Systems view

The Remote Systems view shows all existing connections to remote systems. Connections are persisted, containing the information needed to access a remote host. The view contains a prompt to create new connections, and pop-up menu actions to rename, copy, delete, and reorder existing connections. Connections contain attributes, or data, that are saved between sessions of the workbench. These attributes are the connection name, the remote system's host name and system type, an optional description, and a user ID that is used by default by each subordinate subsystem, at connection time.

## Section 2 Execute the DB2/COBOL batch program and verify the ABEND.

To make your job easier, you will group together all the assets that you will work with. This is a new development concept for TSO/ISPF users, since TSO/ISPF does not provide such capability. To accomplish this task, you will create a z/OS project and select which assets will be part of this project.

### What is a z/OS project?

After you define a z/OS-connection and connect to that system, you can define a z/OS project under that system. You can define the z/OS project, however, only when you are connected to the system. Application Delivery Foundation for z Systems assigns a set of default properties from the set of system properties. However, changes that you make to system properties do not affect the definition of an existing project. If you change your system properties to reference a new compiler release, for example, the reference affects only those projects that are defined subsequent to the change. This isolation of system data from existing projects is beneficial because it lets you develop your code without disruption. You can introduce changes to the project definition at a time of your choosing.

### Creating a new MVS subproject

MVS subprojects contain the development resources that reside on an MVS system. You can create multiple subprojects in a z/OS project.

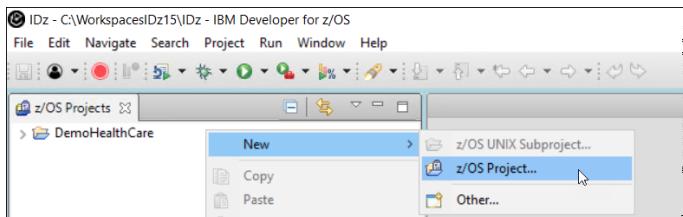
Before you create an MVS subproject, you need to have completed the following tasks:

- Connecting to a remote system
- Creating a z/OS project

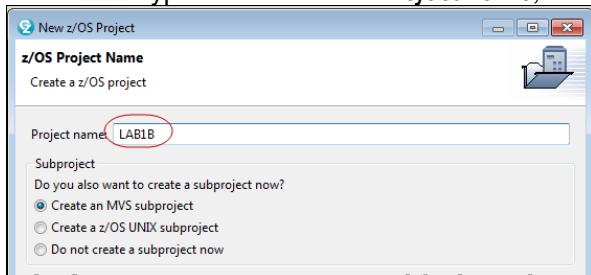
## 2.1 Submit a COBOL/DB2 batch to execute

The advantage of creating a z/OS Project is that we just focus on those datasets and members that are being constructed or updated, instead of having all the mainframe datasets or members. At any time if you need to see a dataset not added to the project, just go to the z/OS Systems view and add it. In addition, at any time, you can remove from your project the datasets that you don't need anymore.

### 2.1.1 Using the z/OS Projects view (on the top and left), right click and select New > z/OS Project...

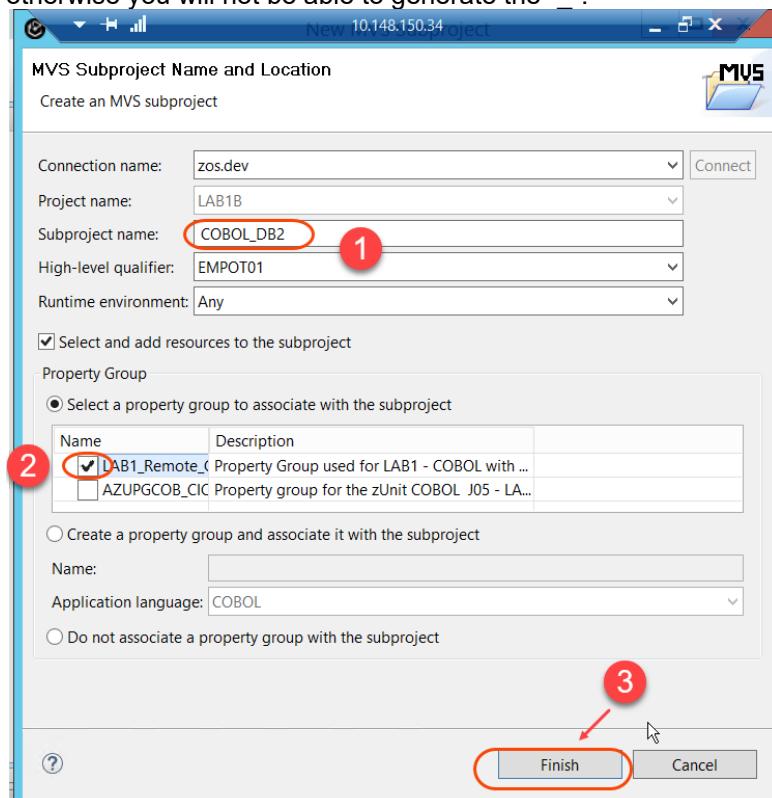


### 2.1.2 Type LAB1B as the Project name, select Create an MVS subproject and click Finish.

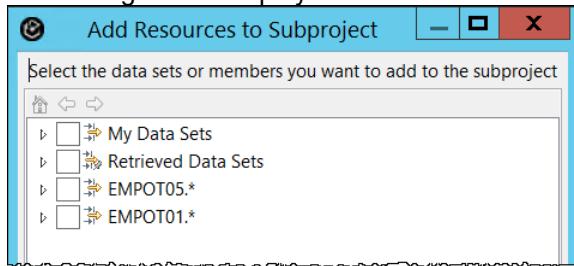


### 2.1.3 Type COBOL\_DB2 as Subproject Name, select LAB1\_Remote\_Cobol.. as the property group and click Finish .

**TIP:** If using Spanish or Brazilian keyboard you must activate the correct language in the bottom, right corner, otherwise you will not be able to generate the “\_”.



This dialog will be displayed:



### Can't you find the property group above?



It is because you are using a wrong workspace. Close IDz, go back to the step 1.1.1 and be sure you start IDz from the icon that is on the windows desktop.

#### *– PROPERTY GROUP*



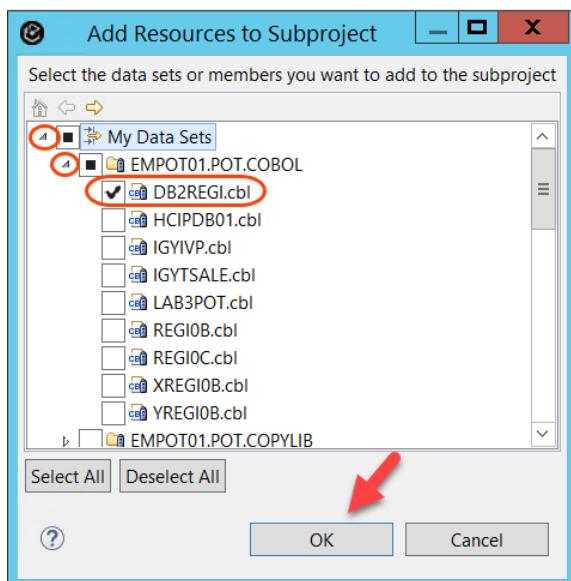
Property groups provide a way to manage resource properties, share them easily across systems, projects, resources, and users, and maintain consistency in your development and build environment.

You can, for example, define a property group that points to copybooks. This is something like //STEP LIB; otherwise, some of the variables used in the program are not resolved.

## 2.2 Add z/OS resources to the MVS subproject

To make the data sets available to your remote project named *LAB1B*, you will need to add them. For this lab we just want to add one member..

2.2.1 ► On the dialog below, expand **My Data Sets**, **EMPOT01.POT.COBOL** , select **DB2REGI.cbl**, and click **OK**

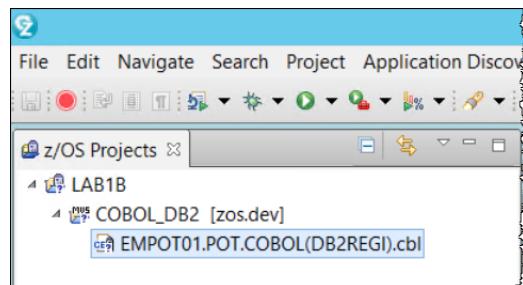


2.2.2 You should see a z/OS Project named **LAB1B** in your *z/OS Projects view*.

► Click **z/OS Projects view** (on left) and under **COBOL\_DB2**, you will now see **DB2REGI** member added to your project.

Notice that creating a Remote project is a good practice to isolate the code you are working on, but you could work on your code without creating this project.

Our lab involves a small update so you could work directly on the *Remote System* perspective without having to create a Remote project.



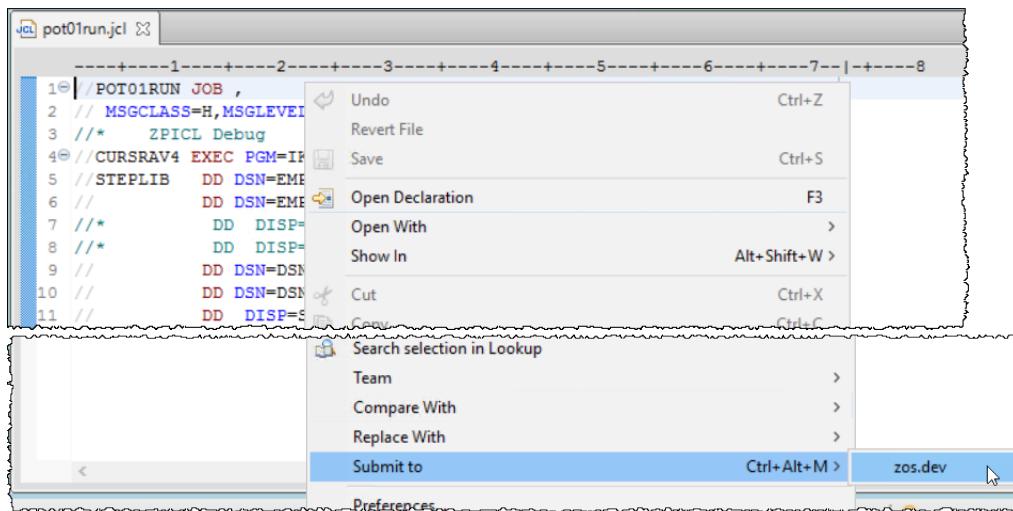
### 2.3 Submit a JCL to execute the COBOL program

The JCL to execute the program is available on the local windows folder: "C:\ADF\_POT\empot01". You will use this JCL to execute a batch COBOL/DB2 on z/OS.

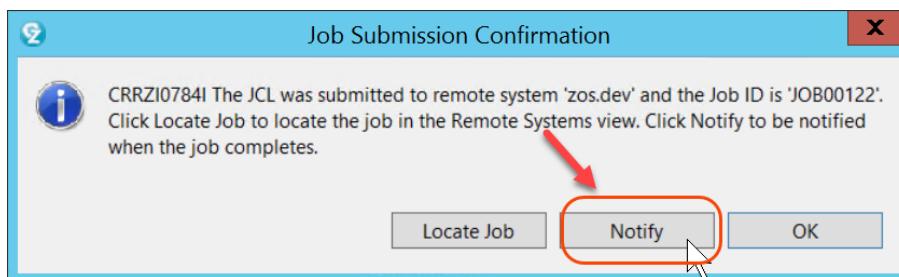
2.3.1 ► Using *Remote System View* (on top and right), scroll up to locate the file **pot01run.jcl** under **Local/Local Files/ADF\_POT/empot01** and **double click** to edit.



### 2.3.2 ► Right click on the JCL being edited and select Submit to → zos.dev

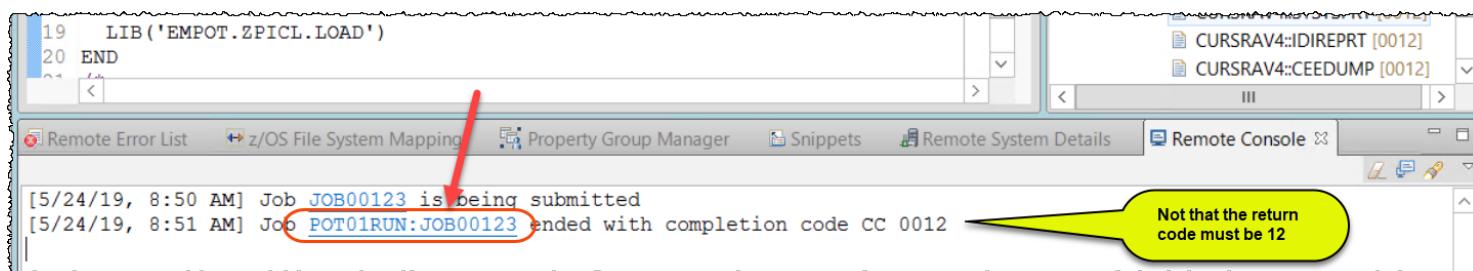


### 2.3.3 ► When the dialog pop up appears, click Notify. This allows you to be notified when the execution is ended.



### 2.3.4 Under *Remote Console*, you will be notified when execution is completed.

► Once the execution ends, **click on the link POT01RUN:JOB00xxx**  
(where 00xxx is a number) to point to the Job output. This number vary depending on z/OS.



2.3.5 ► Under **Remote Systems** view scroll down, expand **JES > Retrieved Jobs > POT01RUN:JOB00xxx** and **double click CURSRAV4::IDIREPRT** step and you will see the *Fault Analyzer* report showing an **OCB ABEND**. Your mission is to fix that bug.

**Tip:** If there is no jobs under “Retrieved Jobs”, is because you did not click on link as stated at 2.3.4. You can also see this output once you right click on “My Jobs” under **JES** and select **Refresh**.

The screenshot shows the IBM z/OS Management Console interface. On the left, a code editor window displays a fault analysis report. The report includes the following text:

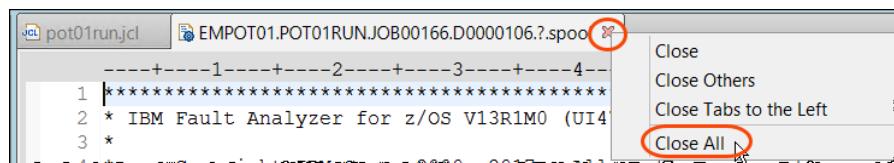
```

1 -----
2 * IBM Fault Analyzer for z/OS V13R1M0 (UI47734 2017/06/01)
3 *
4 * Copyright IBM Corp. 2000, 2017. All rights reserved.
5 ****
6
7 JOBNAME: POT01RUN SYSTEM ABEND: OCB           SOW1    2021/04/02 09:09:34
8
9
10 <H1> I B M   F A U L T   A N A L Y Z E R   S Y N O P S I S
11
12
13 A system abend OCB occurred in module DB2REGI program DB2REGI at offset X'F9C'.
14
15 A program-interruption code 000B (Decimal-Divide Exception) is associated with
16 this abend and indicates that:
17
18     The divisor was zero in a signed decimal division.
19
20 The cause of the failure was program DB2REGI in module DB2REGI. The COBOL
21 source code that immediately preceded the failure was:
22
23     Source
24     Line #
25 -----

```

The line "A system abend OCB occurred in module DB2REGI program DB2REGI at offset X'F9C'" is highlighted with a red oval. The Remote Systems tree on the right shows the path: JES > Retrieved Jobs > POT01RUN:JOB00147 [CC 0012] > CURSRAV4::IDIREPRT. Red arrows labeled 1 and 2 point to the "IDIREPRT" node and the "Close All" option in the context menu respectively.

2.3.6 ► Close all the opened editors using **Ctrl + Shift + F4**, Or right click on the and choose **Close all**.



### Section 3. Use Fault Analyzer to identify the cause of the ABEND

You will now take advantage of **IBM Fault Analyzer** (that is part of Application Delivery Foundation- ADF) to verify the cause of the ABEND.

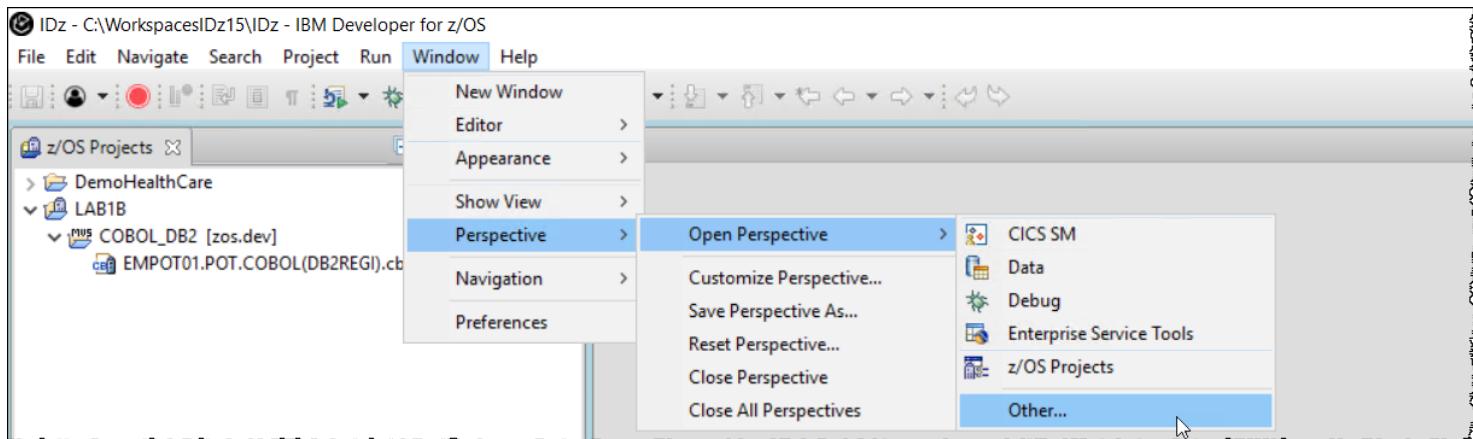
#### What is IBM Fault Analyzer for z/OS?

 **IBM Fault Analyzer for z/OS** helps developers analyze and fix system and application failures for CICS, WebSphere MQ, IMS and DB2 environments. When an application ends abnormally, Fault Analyzer is automatically engaged, gathering real-time information about the event and its environment at the time of failure.

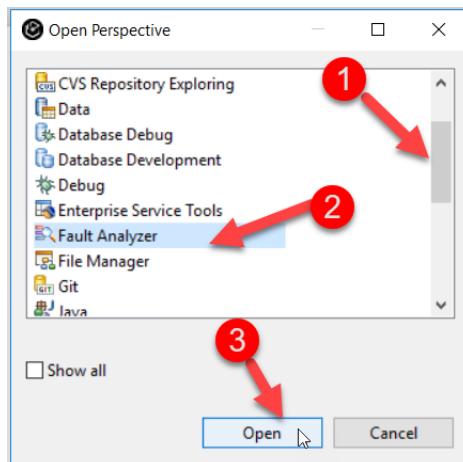
This helps the development team to identify the cause, analyze what went wrong and resolve the problem in a more timely and efficient manner to avoid costly interruptions that could jeopardize application schedules and outcomes.

### 3.1 Using Fault Analyzer perspective

3.1.1 ►| Open the **Fault Analyzer** perspective using **Window > Perspective > Open Perspective > Other...**

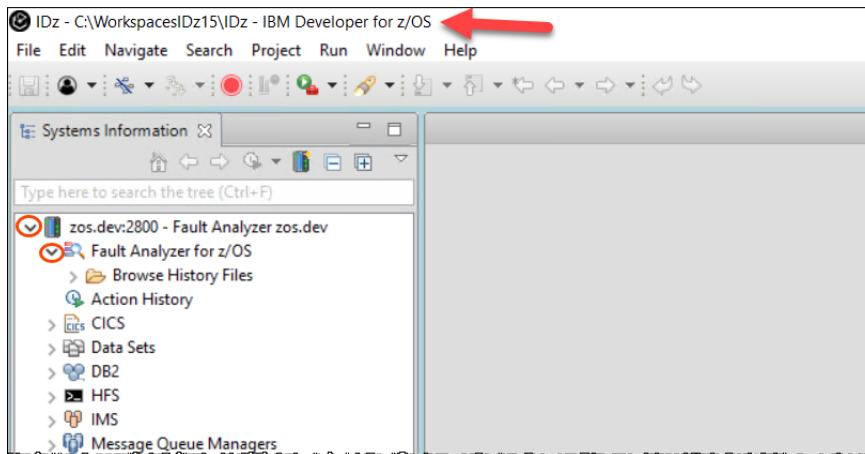


3.1.2 ►| Scroll down, select **Fault Analyzer** and click **Open**

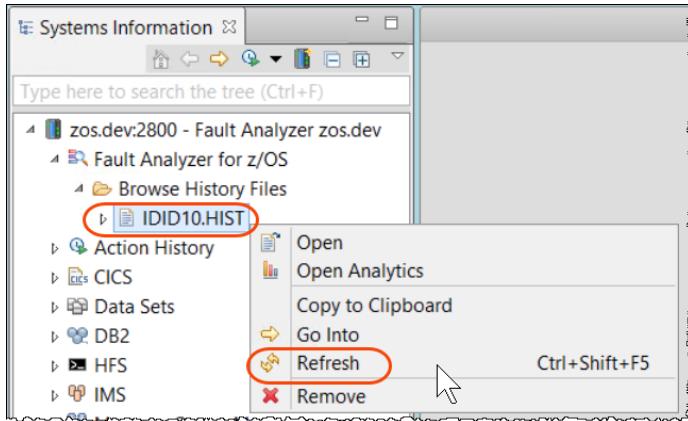


3.1.3 ►| Under **Systems Information** view (on left) be sure that **Fault Analyzer for z/OS** is expanded

**TIP:** If you do not have this entry, it is because you are using a wrong IDz workspace. Please contact the instructor.



- 3.1.4 ► Right click **Fault Analyzer for z/OS** and select **Refresh**  
 ► Expand **Browse History File**. You will see the folder **IDID10.HIST**  
 ► Right click **IDID10.HIST** and select **Refresh** (or **Ctrl + Shift + F5**)



- 3.1.5 ► If you get a *Sign on* dialog for *Fault Analyzer* use empot01 credentials and click **OK**  
 You see a list of *FAULT\_IDs* on the z/OS system that you are connected to...

The screenshot shows the 'Systems Information' interface. The left pane displays the system tree. A red arrow points from the 'IDID10.HIST' folder in the tree view down to the corresponding row in a table on the right. The right pane shows a table titled 'ZOS.DEV : 2800/IDID10.HIST' with the following data:

FAULT_ID	JOB/TRAN	USER_ID	SYS/JOB	ABEND	I_ABEND	JOB_ID	JOBNAME
F00302	POT01RUN	EMPOT01	S0W1	S0CB	S0CB	JOB00123	POT01RUN
F00282	HCMA	IBMUSER	CICSTS53	4038	4038	STC00045	CICSTS53

3.1.6 ► On the **ZOS.DEV:2800/IDID10.HIST** view locate the latest job name **POT01RUN** and **double click** on it. You will see the report being downloaded from the z/OS to your Windows client. The report below will be displayed

The screenshot shows the IBM Fault Analyzer interface. The left pane displays a tree view of the system information, including 'zos.dev:2800 - Fault Analyzer zos.dev' and various sub-options like 'Browse History Files' and 'IDID10.HIST'. The right pane shows the content of the 'ZOS.DEV:2800/IDID10.HIST(F00353)-Report'. The report header includes copyright information for IBM Corp. 2000, 2017. It details a system abend (OCB) in the POT01RUN job, which occurred in the DB2REGI program at offset X'F9C'. The fault was a decimal divide exception (000B). Below the report, there is a table showing fault details:

FAULT_ID	JOB/TRAN	USER_ID	SYS/JOB	ABEND	I_ABEND	JOB_ID	JOBNAME	USERNAME
> F00353	POT01RUN	EMPOT01	S0W1	S0CB	S0CB	JOB00212	POT01RUN	
F00352	HCMA	IBMUSER	CICSTS53	4038	4038	STC00044	CICSTS53	

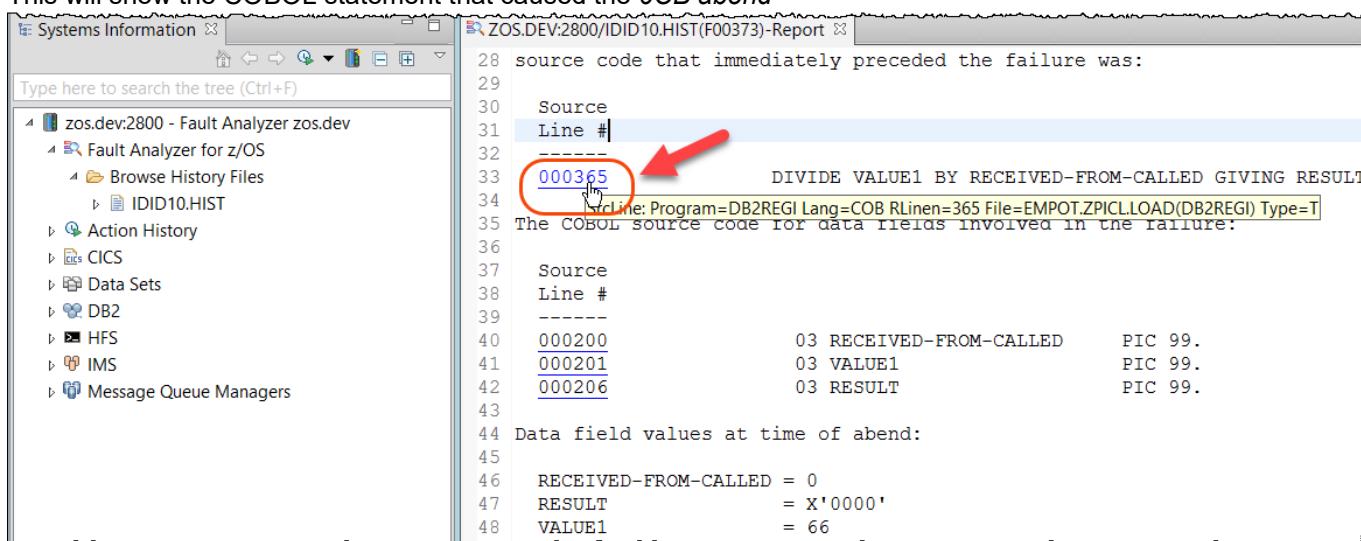
3.1.7 ► Scroll the report down and you will see that the field **RECEIVED-FROM-CALLED** used on the division has "0". So the abend is because of a divide by zero.

► Also notice that there are other tabs on this panel (like Event Details, Abend Information, etc.). You may try those tabs to get more information about the abend.

The screenshot shows the COBOL source code for the DB2REGI program. The code includes a DIVIDE statement and a section for data field values at the time of the abend. Red annotations highlight the 'RECEIVED-FROM-CALLED' field in the source code and its value ('0') at the time of the abend. Red arrows point from these annotations to the corresponding sections in the report. The report also includes tabs for Main Report, Event Details, Abend Information, System-Wide Information, and Miscellaneous.

### 3.1.8 ► Using the *Main Report* view Click on the link **000365**

This will show the COBOL statement that caused the *OCB abend*



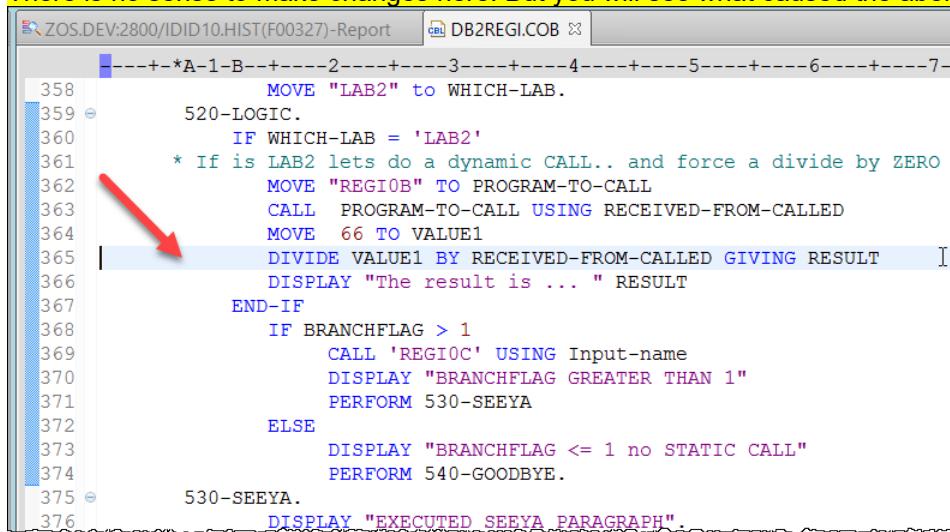
```

28 source code that immediately preceded the failure was:
29
30 Source
31 Line #
32 -----
33 000365          DIVIDE VALUE1 BY RECEIVED-FROM-CALLED GIVING RESULT
34 *Line: Program=DB2REGI Lang=COB RLinen=365 File=EMPOT.ZPCLLOAD(DB2REGI) Type=T
35 The COBOL source code for data fields involved in the failure:
36
37 Source
38 Line #
39 -----
40 000200          03 RECEIVED-FROM-CALLED      PIC 99.
41 000201          03 VALUE1                  PIC 99.
42 000206          03 RESULT                  PIC 99.
43
44 Data field values at time of abend:
45
46 RECEIVED-FROM-CALLED = 0
47 RESULT              = X'0000'
48 VALUE1              = 66

```

### 3.1.9 The program editor shows the line with the statement that is causing the abend.

Notice that this is NOT the COBOL source code. This what is on the "minidump" downloaded by Fault Analyzer. There is no sense to make changes here. But you will see what caused the abend.

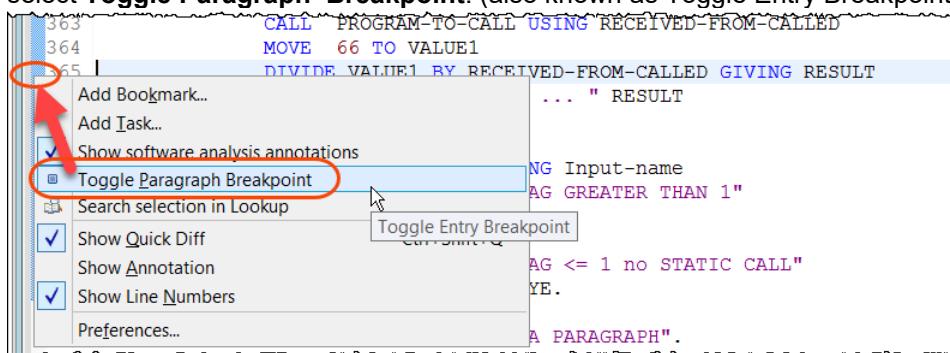


```

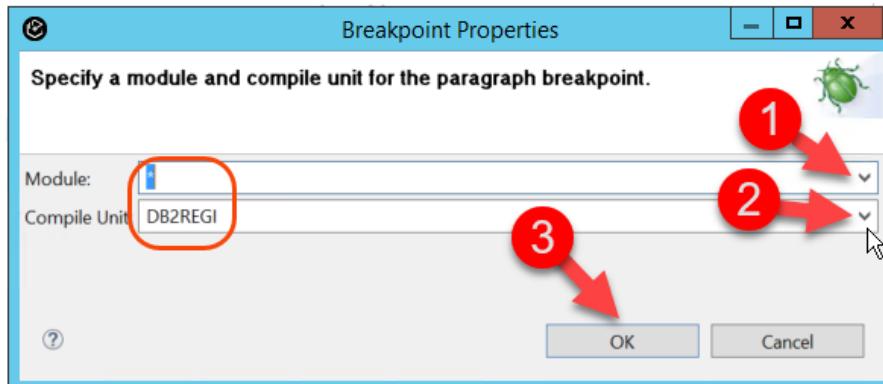
-----*A-1-B-----2-----3-----4-----5-----6-----7-
358      MOVE "LAB2" to WHICH-LAB.
359 520-LOGIC.
360      IF WHICH-LAB = 'LAB2'
361      * If is LAB2 lets do a dynamic CALL.. and force a divide by ZERO
362      MOVE "REGIOB" TO PROGRAM-TO-CALL
363      CALL PROGRAM-TO-CALL USING RECEIVED-FROM-CALLED
364      MOVE 66 TO VALUE1
365      DIVIDE VALUE1 BY RECEIVED-FROM-CALLED GIVING RESULT I
366      DISPLAY "The result is ... " RESULT
367  END-IF
368      IF BRANCHFLAG > 1
369      CALL 'REGIOC' USING Input-name
370      DISPLAY "BRANCHFLAG GREATER THAN 1"
371      PERFORM 530-SEEYA
372  ELSE
373      DISPLAY "BRANCHFLAG <= 1 no STATIC CALL"
374      PERFORM 540-GOODBYE.
375 530-SEEYA.
376      DISPLAY "EXECUTED SEEYA PARAGRAPH".

```

### 3.1.10 ► On line 365, right-click in the ruler area (the blue line on left) and select **Toggle Paragraph Breakpoint**. (also known as Toggle Entry Breakpoint)



3.1.11 ► On the Breakpoint Properties dialog use drop down to select \*, and select or type **DB2REGI** as Compile Unit and click **OK**



### What is *Toggle Paragraph Breakpoint*?



Toggle Paragraph Breakpoint provides the ability to set paragraph breakpoints prior to starting a debug session. Because these breakpoints are set using the original source files, they persist between debug sessions.

On previous versions, breakpoints could only be set at the level of the generated program listing files.

This allows a more natural edit, compile and debug workflow on the original source files.

3.1.12 ► Scroll up a bit. The *Toggle Paragraph Breakpoint* is set at the **520-LOGIC** paragraph. This break point may optionally be used when debugging the COBOL code.

```

ZOS.DEV:2800/IDID10.HIST(F00327)-Report DB2REGI.COB
-----A-1-B-----2-----3-----4-----5-----6-----7-----8
      MOVE "LAB2" to WHICH-LAB.
  359  520-LOGIC.
      IF WHICH-LAB = 'LAB2'
  361  * If is LAB2 lets do a dynamic CALL.. and force a divide by ZERO
      MOVE "REGI0B" TO PROGRAM-TO-CALL
      CALL PROGRAM-TO-CALL USING RECEIVED-FROM-CALLED
      MOVE 66 TO VALUE1
  365  |   DIVIDE VALUE1 BY RECEIVED-FROM-CALLED GIVING RESULT
      DISPLAY "The result is ... " RESULT
  366  END-IF
  367  IF BRANCHFLAG > 1
  368      CALL 'REGI0C' USING Input-name
  369      DISPLAY "BRANCHFLAG GREATER THAN 1"
  370      PERFORM 530-SEEYA
  371
  372  ELSE
  373      DISPLAY "BRANCHFLAG <= 1 no STATIC CALL"
  374      PERFORM 540-GOODBYE.
  375  530-SEEYA.

```

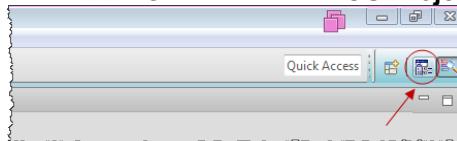
3.1.13 ► Close all opened editors using **CTRL+ Shift + F4**.  
Or just click on the of each opened editor.

## Section 4. Using the IBM z/OS Debugger for a temporary fix

You will use the Debug to verify the ABEND and make a runtime fix.

### 4.1 Submit the JCL to invoke the Debug

- 4.1.1 ► Go back to the z/OS Projects Perspective by clicking on the icon below on the right corner.



- 4.1.2 ► Using Remote System View, scroll up to locate the file **pot01db.jcl** under **Local/Local Files/ADF\_POT/empot01** and double click to edit..

The screenshot shows the Eclipse IDE interface. On the left is the JCL editor window titled "pot01db.jcl" containing the following JCL code:

```

1 //POT01DB JOB,
2 // MSGCLASS=H,MSGLEVEL=(1,1),TIME=1440,REGION=70M,COND=(16,LT)
3 ///* ZPICL Debug
4 //CURSRAV4 EXEC PGM=IKJEFT01,DYNAMNBR=20
5 //STEPLIB DD DSN=EMPOT01.POT.LOAD,DISP=SHR
6 //          DD DSN=EMPOT.ZPICL.LOAD,DISP=SHR
7 //          DD DISP=SHR,DSN=IBMUSER.VER1.SEQAMOD
8 //          DD DISP=SHR,DSN=IBMUSER.VER1.SEQAUTH
9 //          DD DSN=DSNB10.SDSNLOAD,DISP=SHR
10 //         DD DSN=DSNB10.DBDBG.RUNLIB.LOAD,DISP=SHR
11 //         DD DISP=SHR,DSN=FKE910.SFEKAUTH
12 //         DD DISP=SHR,DSN=EQAE10.SEQAMOD
13 //SYSPRINT DD SYSOUT=*
14 //SYSOUT   DD SYSOUT=*
15 //SYSTSPRT DD SYSOUT=*
16 //SYSTSIN  DD *
17 TSOLIB ACTIVATE DA('DSNB10.SDSNLOAD')
18 DSN SYSTEM(DBDBG)
19 RUN PROGRAM(DB2REGI) PLAN(DB2REGI) -
20 LIB('EMPOT.ZPICL.LOAD')
21 END
22 /*
3 //***** Launch Debug Tool
4 //CEEOPTS DD *
5     TEST(,,DBM)
6 /*

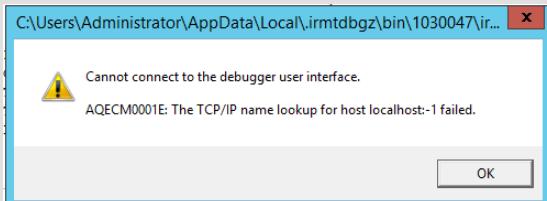
```

A yellow callout bubble points to the line "3 //\*\*\*\*\* Launch Debug Tool" with the text "Notice the debug options here". Two red arrows point to the file "pot01db.jcl" in the "Local/Local Files/ADF\_POT/empot01" folder in the "Remote Systems" view on the right.

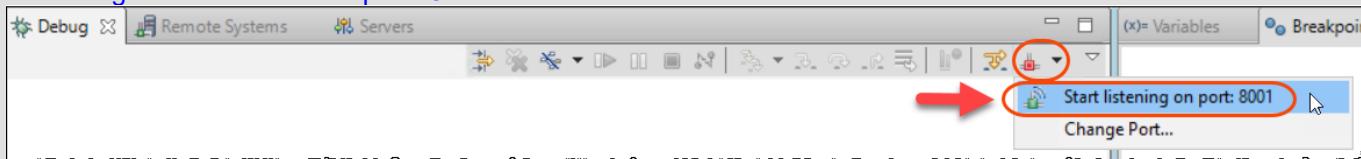
- 4.1.3 ► Right click on the JCL being edited and select **Submit to > zos.dev**

The screenshot shows a context menu for the JCL editor. The "Submit to" option is highlighted with a blue box and a cursor, and "zos.dev" is selected from the dropdown menu. Other options in the menu include Undo, Revert File, Save, Open Declaration, Show in Remote Systems View, Open With, Show In, Cut, Compare With, Replace With, and Preferences... .

**Do you have a connection error like below?**



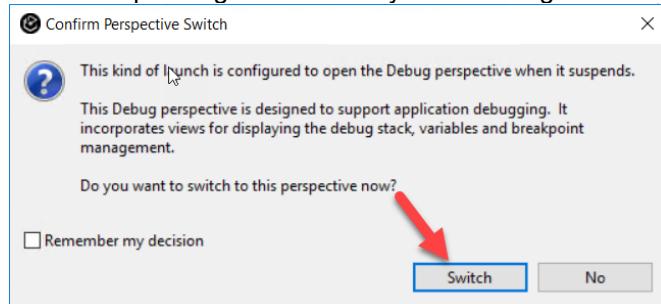
This may happen if your IDz is not listening to the z/OS. To fix that Open the **Debug perspective** (**Windows > Perspective > Open perspective > Debug**) click as below and select **Start listening on port 8001**. The listening icon will turn green Submit again as shown on step 4.1.3



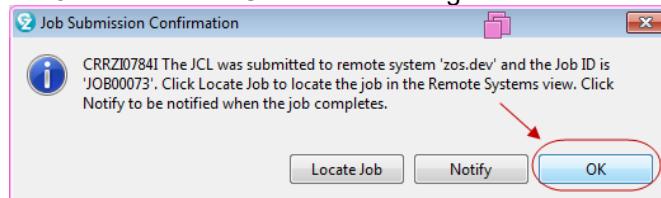
4.1.4 Once the job starts the z/OS debug will "talk" with you. Notice that the communication will be via the IDz connection (RSE), you don't need to specify IP addresses. This may work even when firewalls are in place.

► Click **Switch** to open the *Debug Perspective*

Notice: Depending how fast are you the dialogs order here could be different.

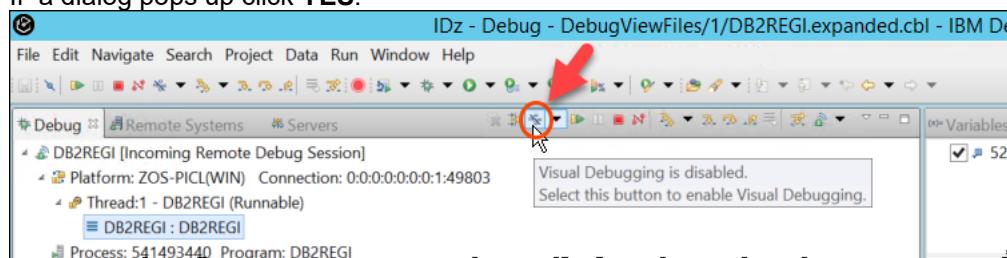


4.1.5 ► Also click **OK** for this dialog below



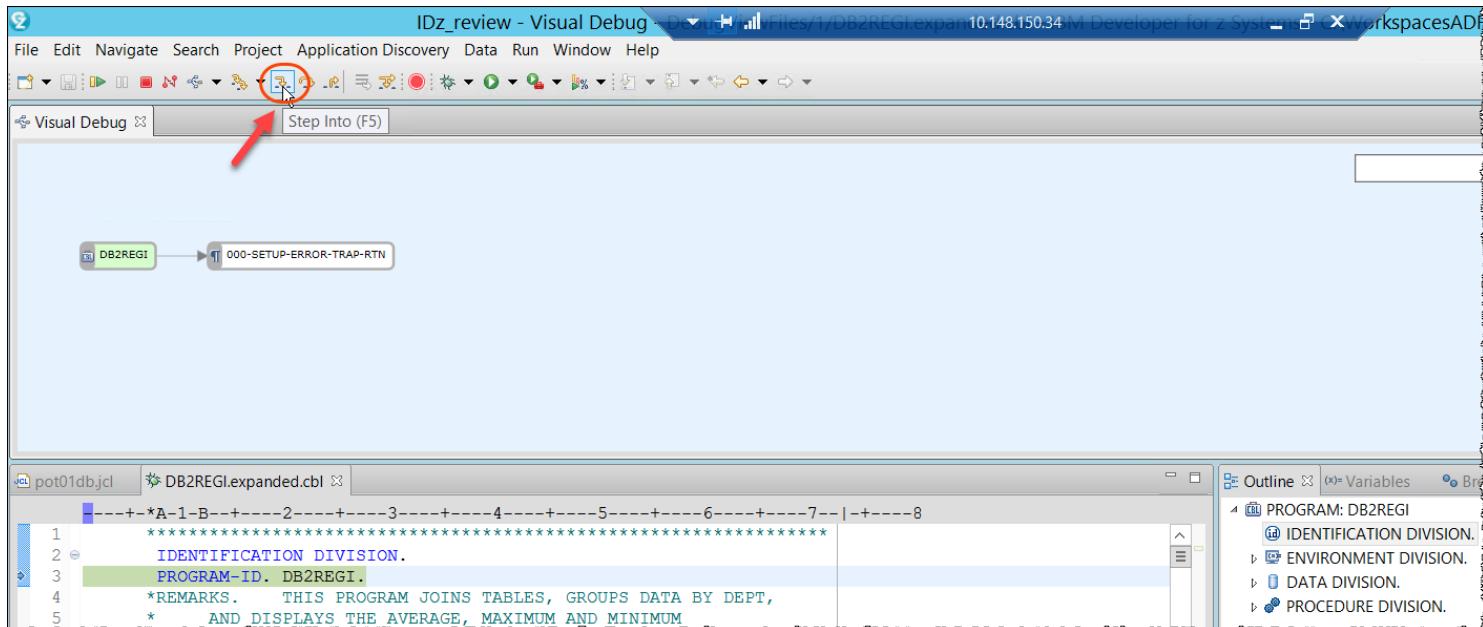
4.1.6 Using the *Debug perspective*:

► Click the icon to enable Visual Debugging which shows the **Visual Debug** view. If a dialog pops up click **YES**.



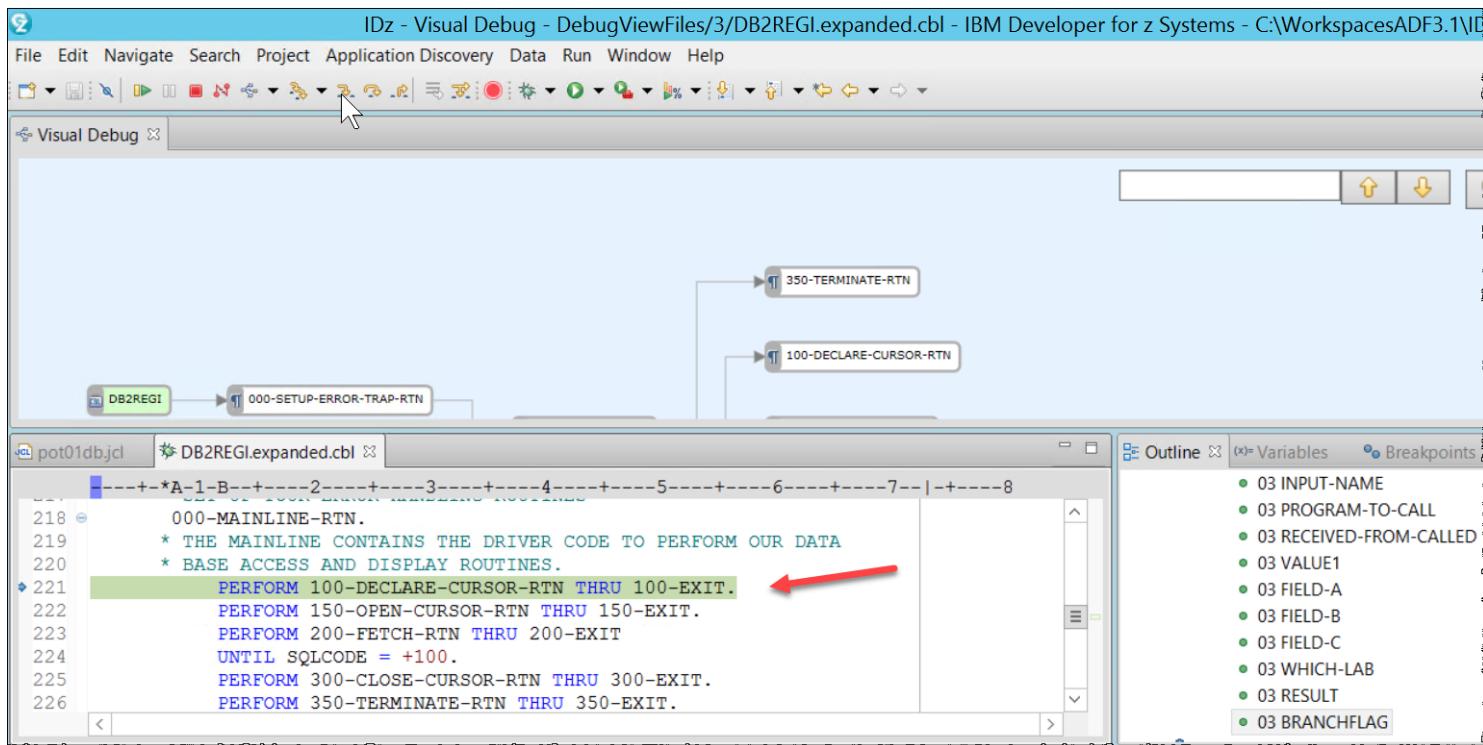
#### 4.1.7 The Visual Debug view show the paragraphs being executed (in the top)

▶ Click the icon  or F5 (Step into) to execute first line of code.



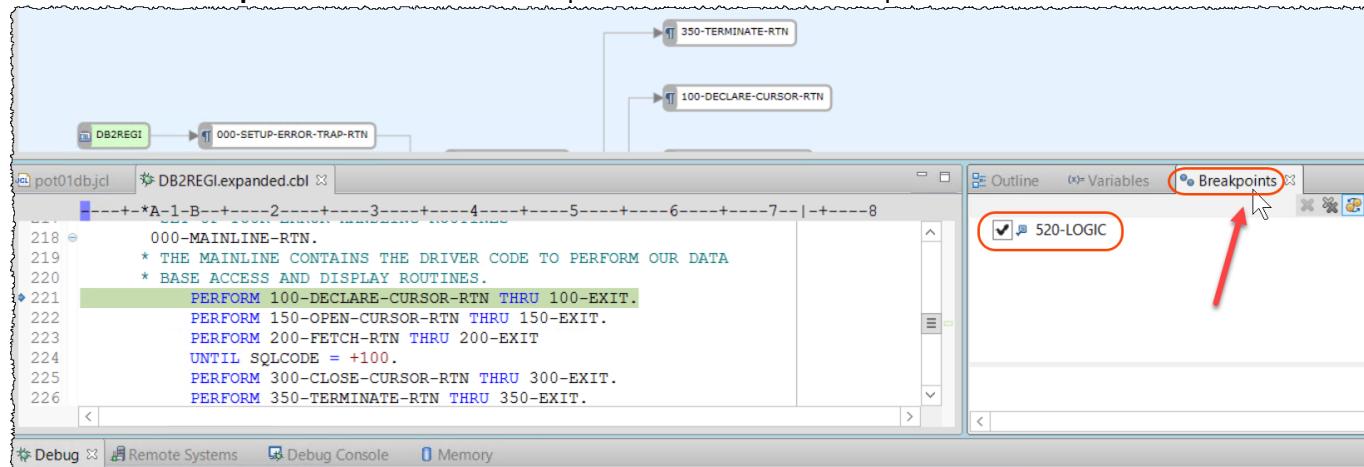
#### 4.1.8 The execution will stop at the statement that will execute

`PERFORM 100-DECLARE-CURSOR-RTN THRU 100-EXIT`



4.1.9 On the step 3.1.10 when using the *Fault Analyzer*, you created a *paragraph breakpoint* even without having the execution started. This is handy since it will show the area that needs to be debugged..

▶ Click on **Breakpoints** tab to see this breakpoint created before on step 3.1.10.



## What is the Visual Debugging?

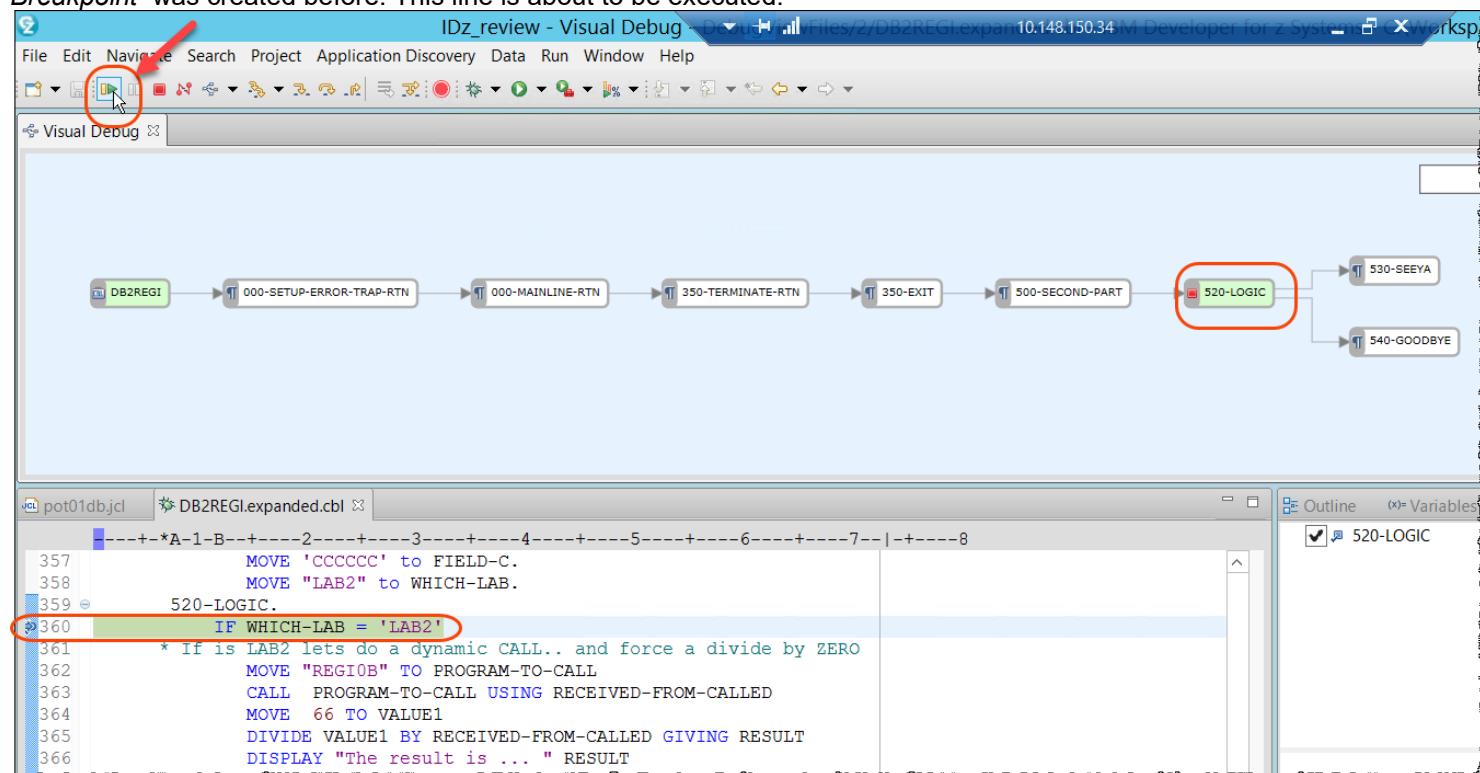


Visual debugging allows you to interact with your COBOL or PL/I debug session using the program control flow diagram.

With this diagram, you can visualize the stack trace, set breakpoints, and run to a selected call path. In COBOL, the stack trace represents the paragraph call chain.

In PL/I, the stack trace represents the procedure call chain.

4.1.10 ▶ Click on or press **F8** and notice that the execution will stop on line 360 since a *Paragraph Entry Breakpoint* was created before. This line is about to be executed.



4.1.11. As you verified using Fault Analyzer, the abend occurred on line 365 where you had a divide by zero (see step 3.1.10). Now you will add a breakpoint on this line and change the values to avoid the abend.

► On the COBOL editor move the mouse to the **blue column** on left and **double click** on the line 365 DIVIDE VALUE1 BY RECEIVED-FROM-CALLED GIVING RESULT to create a breakpoint.

The screenshot shows the RAD interface with the COBOL editor open. The code is as follows:

```

358      MOVE "LAB2" to WHICH-LAB.
359  520-LOGIC.
360  IF WHICH-LAB = 'LAB2'
361    * If LAB2 lets do a dynamic CALL.. and force a divide by ZERO
362    MOVE "REGI0B" TO PROGRAM-TO-CALL
363    CALL PROGRAM-TO-CALL USING RECEIVED-FROM-CALLED
364    MOVE 66 TO VALUE1
365    DIVIDE VALUE1 BY RECEIVED-FROM-CALLED GIVING RESULT
366    DISPLAY "The result is ... " RESULT

```

The line 365 is highlighted in green. A red arrow points to the blue margin column on line 365, indicating where to double-click to set a breakpoint.

4.1.12 Notice that a small circle is shown on the left of line 365 and also a breakpoint is displayed on the Breakpoint view

The screenshot shows the Breakpoints view in the RAD interface. The list contains two entries:

- Line [DB2REGL.expanded.cbl:365]
- 520-LOGIC

4.1.13 ► Continue by clicking on or using F5 until you will see that a program named REGI0B is called and this program is returning a value of 0.

The screenshot shows the Visual Debug perspective in the RAD interface. The toolbar has a 'Step Into (F5)' button highlighted with a red arrow. The COBOL editor below shows the code for REGI0B:

```

6      * This will cause an error when this value is used in a division
***** Data Division.
7      Working-Storage Section.
8      Linkage Section.
9      01 Recvd-Parms.
10     05 In-value          Pic 99.
11
12 Procedure Division using Recvd-Parms.
13
14 Move 0 to In-value.
15
16

```

A red arrow points to the line 'Move 0 to In-value.'

- 4.1.14 ① Click on or press F8.

The execution will stop at the breakpoint that you created (line 365). .

- ② Move the cursor to RECEIVED-FROM-CALLED variable and click to see the 00 value..  
 (Tip: under the cloud instance the behavior may act different and you may need to click on the editor area before moving the mouse to that field).

```

File Edit Navigate Search Project Application Discovery Data Run Window Help
Visual Debug
File pot01db.jcl DB2REGI.expanded.cbl
----+*A-1-B----2----3----4----5----6----7----8
362 MOVE "REGIOB" TO PROGRAM-TO-CALL
363 CALL PROGRAM-TO-CALL USING RECEIVED-FROM-CALLED
364 MOVE 66 TO VALUE1
365 DIVIDE VALUE1 BY RECEIVED-FROM-CALLED GIVING RESULT
366 DISPLAY "The result is ... " RESULT
367 END-IF
368 IF BRANCHFLAG > 1
369   CALL 'REGI0C' USING Input-name
370   DISPLAY "BRANCHFLAG GREATER THAN 1"
371   PERFORM 530-SEEYA
  
```

- 4.1.15 ① Click the Variables tab (right ) and ② verify that RECEIVED-FROM-CALLED is 00.

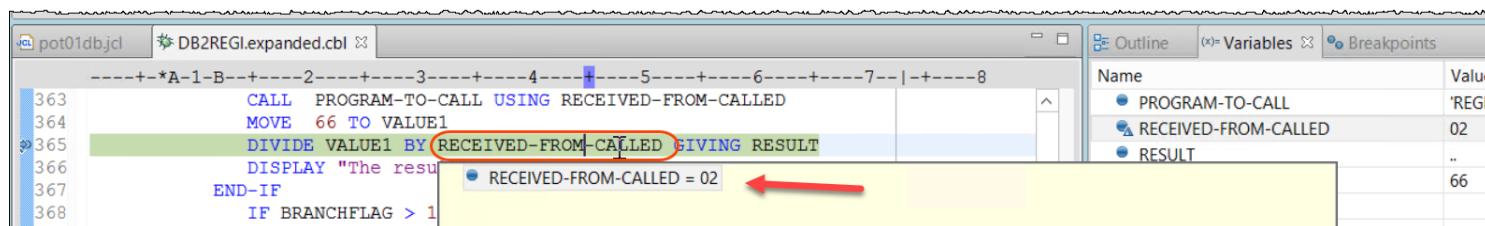
Name	Value
PROGRAM-TO-CALL	'REGIOB'
RECEIVED-FROM-CALLED	00
RESULT	..
VALUE1	66

- 4.1.16 This is the abend cause. You must change the value to something different than 0.

- Click on RECEIVED-FROM-CALLED value of 00 and modify to 2, just overtyping and press enter.

Name	Value
PROGRAM-TO-CALL	'REGIOB'
RECEIVED-FROM-CALLED	02
RESULT	..
VALUE1	66

4.1.17 ► Again, move the cursor to **RECEIVED-FROM-CALLED** variable and now see the value **02**.  
 (Tip: under the cloud instance the behavior may act different and you may need to click on the editor area before moving the mouse to that field).



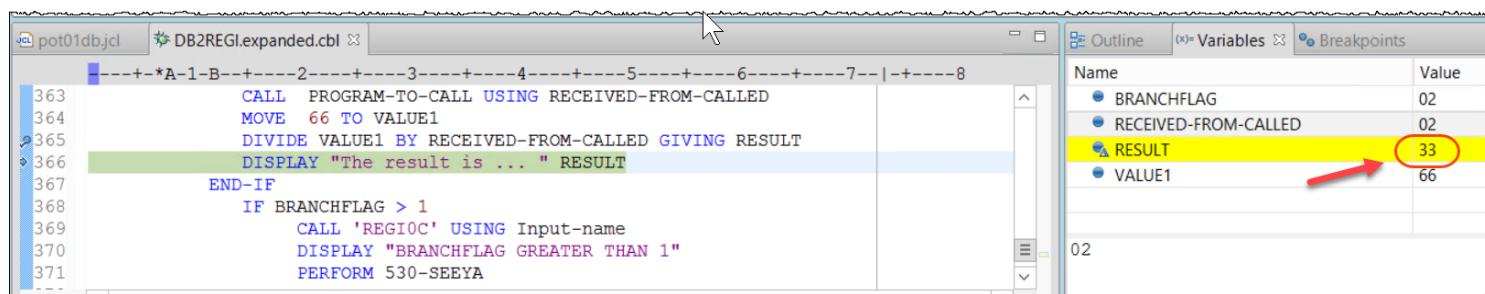
```

JCL pot01dbjcl DB2REGI.expanded.cbl
-----+-----+-----+-----+-----+-----+-----+-----+
363      CALL PROGRAM-TO-CALL USING RECEIVED-FROM-CALLED
364      MOVE 66 TO VALUE1
365      DIVIDE VALUE1 BY RECEIVED-FROM-CALLED GIVING RESULT
366      DISPLAY "The resu
367      END-IF
368      IF BRANCHFLAG > 1
369      CALL 'REGI0C' USING Input-name
370      DISPLAY "BRANCHFLAG GREATER THAN 1"
371      PERFORM 530-SEEEYA
-----+-----+-----+-----+-----+-----+-----+-----+

```

Name	Value
PROGRAM-TO-CALL	REGI0C
RECEIVED-FROM-CALLED	02
RESULT	..
BRANCHFLAG	02
RECEIVED-FROM-CALLED	02
RESULT	33
VALUE1	66

4.1.18 ► Click the icon (Step into) or press **F5** to see the next line being executed  
 This time the divide by 2 give you a result of **33**.



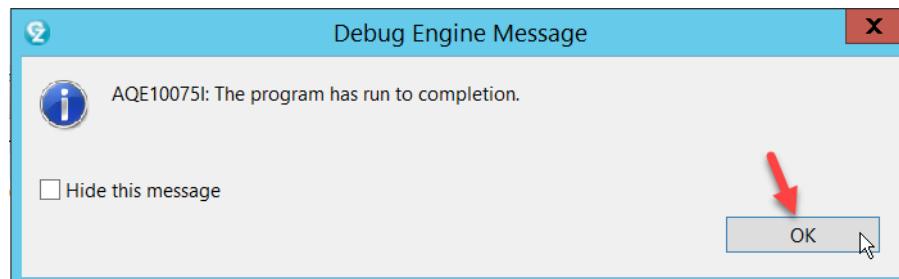
```

JCL pot01dbjcl DB2REGI.expanded.cbl
-----+-----+-----+-----+-----+-----+-----+-----+
363      CALL PROGRAM-TO-CALL USING RECEIVED-FROM-CALLED
364      MOVE 66 TO VALUE1
365      DIVIDE VALUE1 BY RECEIVED-FROM-CALLED GIVING RESULT
366      DISPLAY "The result is ... " RESULT
367      END-IF
368      IF BRANCHFLAG > 1
369      CALL 'REGI0C' USING Input-name
370      DISPLAY "BRANCHFLAG GREATER THAN 1"
371      PERFORM 530-SEEEYA
-----+-----+-----+-----+-----+-----+-----+-----+

```

Name	Value
BRANCHFLAG	02
RECEIVED-FROM-CALLED	02
RESULT	33
VALUE1	66

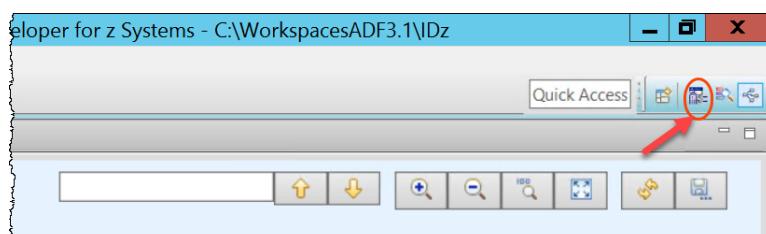
4.1.19 ► Click on (or F5) few times  
 ► and **Resume** (F8) when you are satisfied so the program will execute until the end.



4.1.20 ► Click **OK** to close the dialog above.

To fix this bug definitely you will modify the program **REGI00B** that is returning 0 to be used in a division.  
 You will do that later. For now, optionally you can play again with the Debugger and use the Visual Debugger.  
 Or continue after the optional steps.

4.1.21 ► Go back to the **z/OS Projects Perspective** by clicking on the icon the top right corner.



## 4.2 (OPTIONAL) Using the Visual Debugger for Stack pattern breakpoints

If you are not running late and interested on this subject, execute the steps below, otherwise jump to 4.3

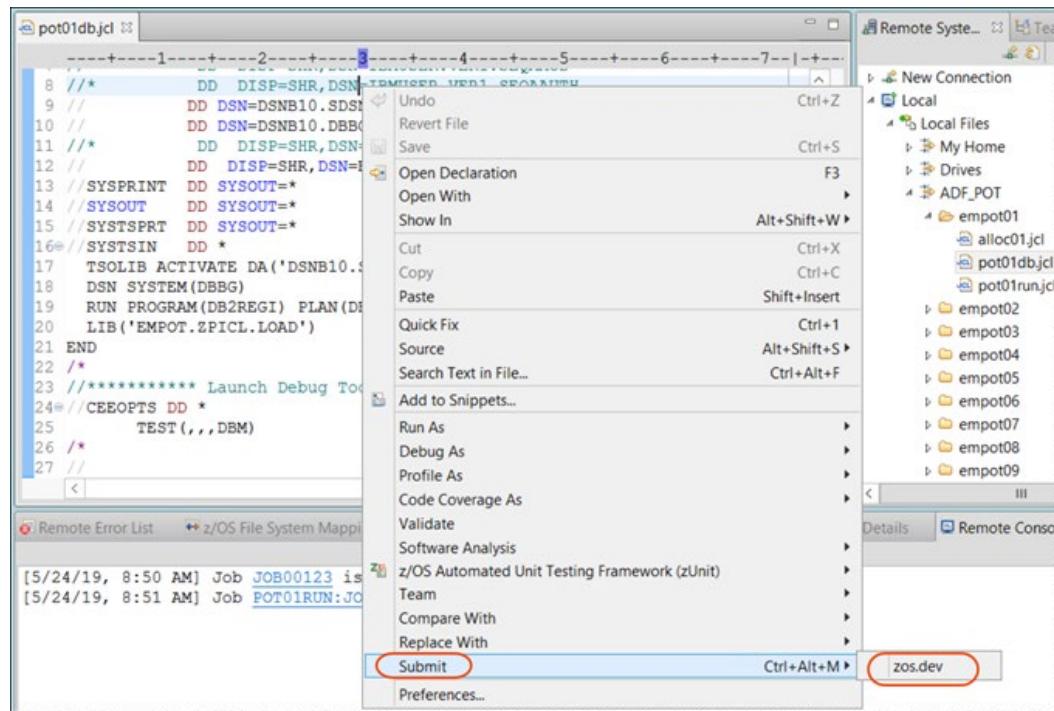
### Stack pattern breakpoint



A stack pattern breakpoint is a special type of conditional breakpoint. With this feature, you can specify that you only want to stop at a location when the current stack trace contains a predefined stack pattern.

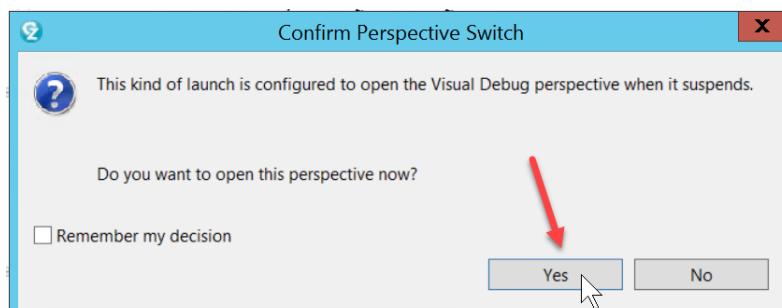
Visual debugging supports a stack pattern integration feature, which allows you to select a connected path from the program control flow diagram and set a stack pattern breakpoint using the selected path as a stack pattern.

#### 4.2.1 ► (Optional) Right click on the JCL being edited and select Submit > zos.dev

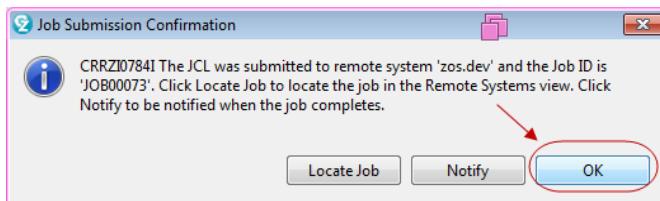


#### 4.2.2 (Optional) Once the job starts the z/OS debug will “talk” with you.

► Click Yes to open the Visual Debug Perspective  
(depending on the z/OS the order here could be the next step first).



4.2.3 ► (Optional) Also click **OK** for this dialog below

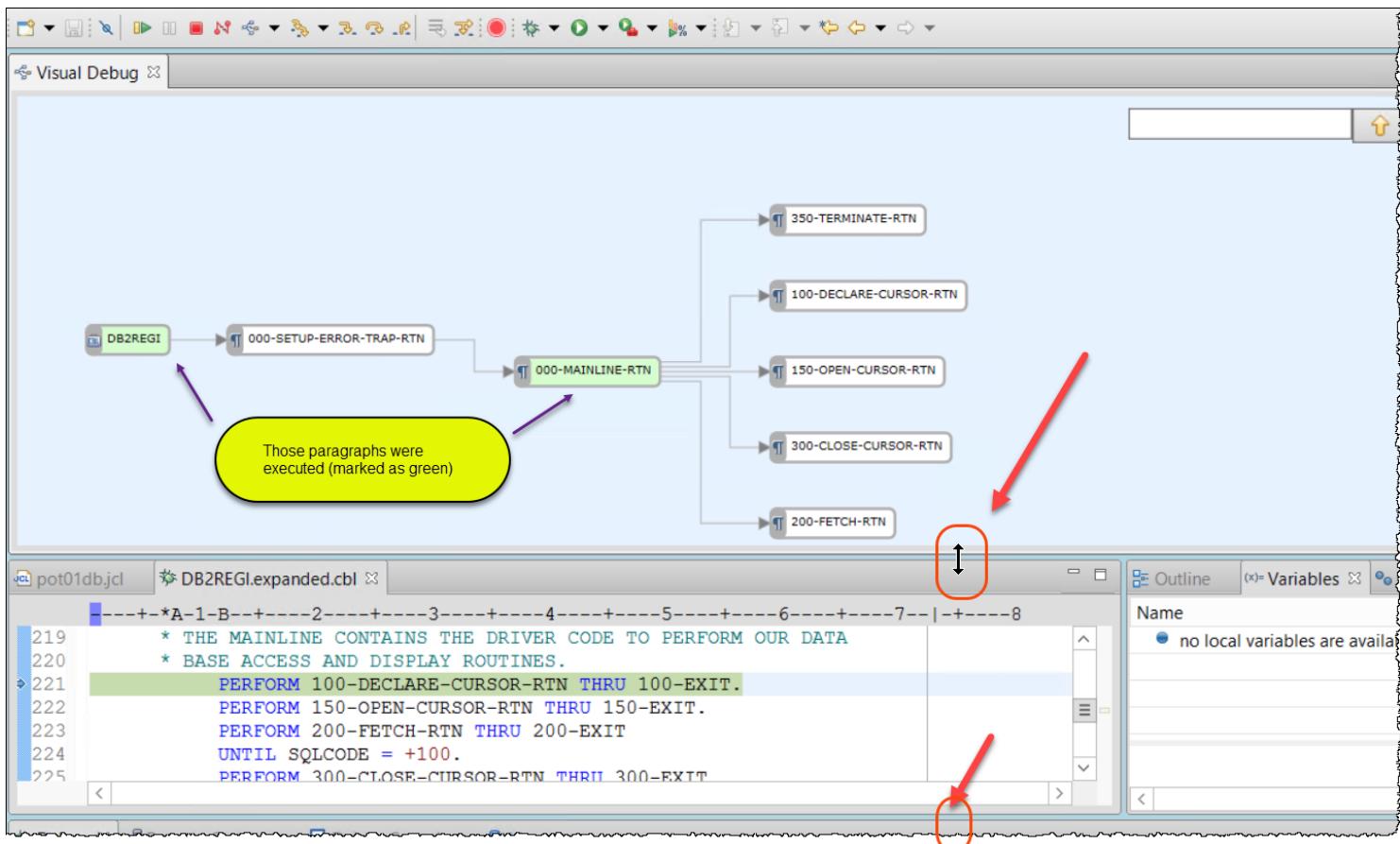


4.2.4 (Optional) Using the **Visual Debug** perspective:

► Click on icon (or Press **F5**)



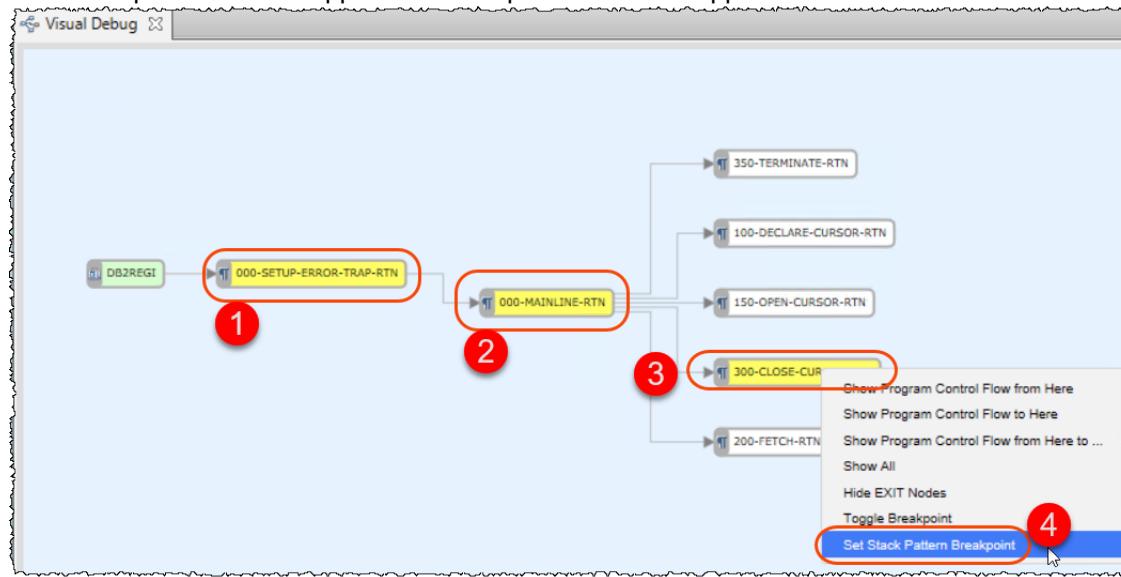
4.2.5 ► (Optional) Resize the **Visual Debug** view and you will notice that the paragraphs executed are marked as green



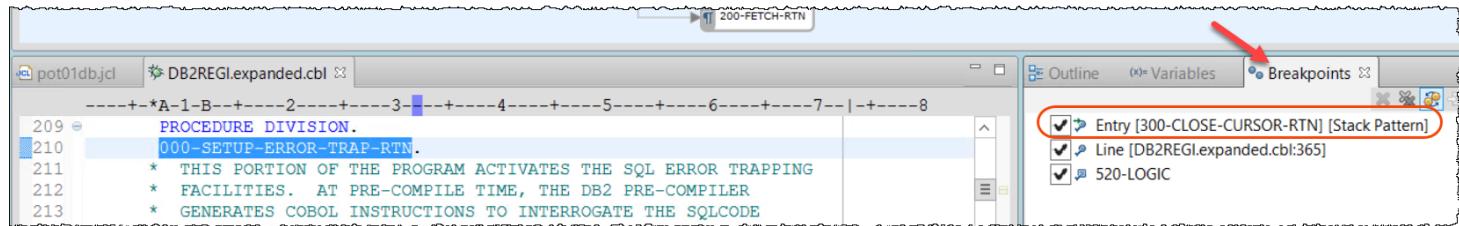
4.2.6 ► (Optional) Using the *Visual Debug* view, scroll down

► Press **CTRL** Key and select the 3 paragraphs as shown below, right click and choose **Set Stack Pattern Breakpoint**

This breakpoint that will happen when the path selected happens.

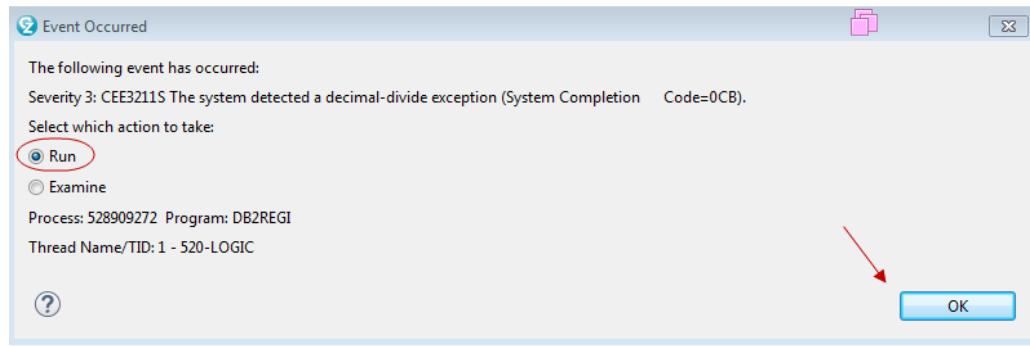


4.2.7 ► (Optional) Click on **Breakpoints** view and you will see this breakpoint created.



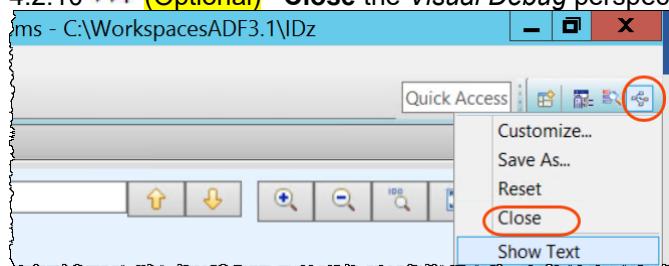
4.2.8 ► (Optional) Click on (or press **F8**) few times to resume the execution

4.2.9 ► (Optional) Select **Run** and click **OK** to continue

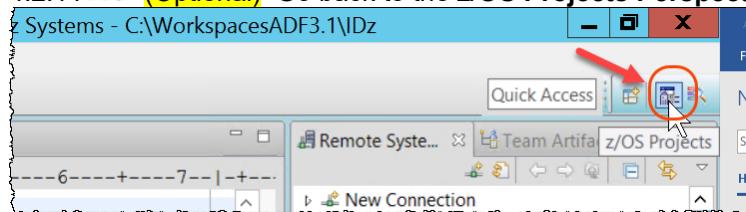


Notice – This breakpoint did not happen since the execution did not execute the 3 selected paragraphs.

4.2.10 ► (Optional) Close the Visual Debug perspective.



4.2.11 ► (Optional) Go back to the **z/OS Projects Perspective** by clicking on the icon in the top right corner.



### 4.3 Accessing the z/OS JES

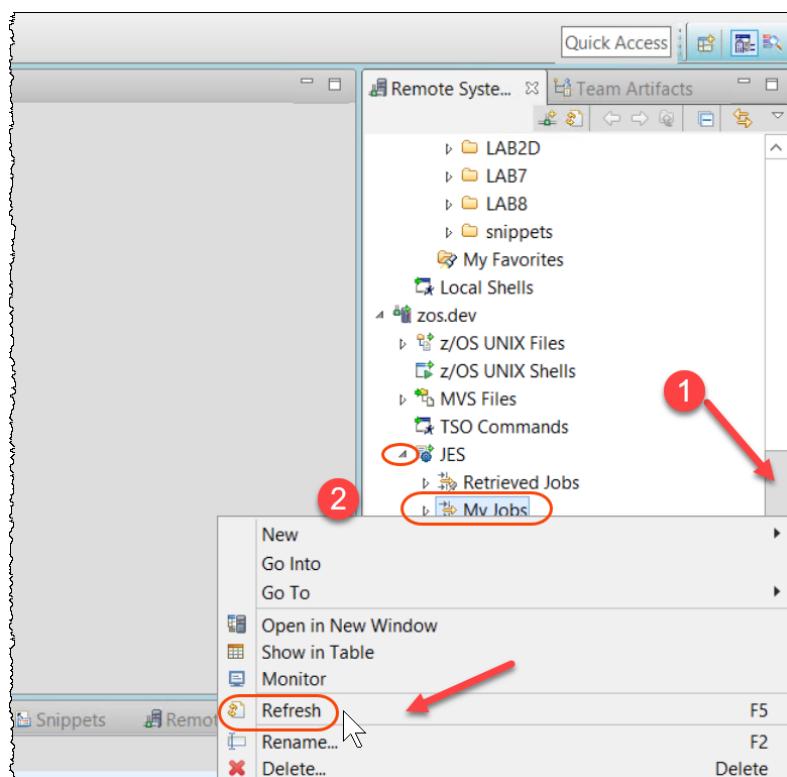
On ISPF many people use SDSF for this activity.

You will use the Job Monitor subsystem part of the host components.

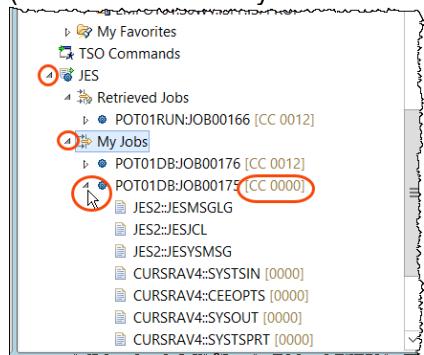
4.3.1 ► Use **Ctrl + Shift + F4** to close all opened editors. Do not save any changes.

Or just click on the of each opened editor.

4.3.2 ► Using the *Remote Systems* view scroll down, expand JES right click on **My Jobs** and select **Refresh**



**4.3.3 ►| Expand My Jobs and the Job **POT01DB:JOB00xxx** that has the CC 0000  
(it will be the latest if you did not make the optional step)**



**4.3.4 ►| On Remote Systems view, double click on the **POT01DB:JOB00xxx**, that has the CC 0000**

The 'Remote Systems' view shows a list of jobs. The job 'POT01DB:JOB00175 [CC 0000]' is selected and highlighted with a red circle. A red arrow points from this selection to the 'JOB LOG' window on the left, which displays the job log for 'POT01DB:JOB00175'. The log output includes details about the job's execution, such as system statistics and step definitions.

**4.3.5 ►| Scroll down to see the various JOB steps. Notice that a small report has been printed.**

The 'Remote Systems' view shows a list of jobs. The job 'POT01DB:JOB00175 [CC 0000]' is selected and highlighted with a red circle. A red arrow points from this selection to the 'JOB LOG' window on the left. Another red arrow labeled '2' points to the bottom of the 'JOB LOG' window, indicating where to scroll down to see more steps. The 'JOB LOG' window displays the detailed steps and output of the selected job.

4.3.6 ► Close all opened editors. (**Ctrl + Shift + F4**). Click **No** if asked to save changes. Or just click on the of each opened editor.

## Section 5. Modify the COBOL code to fix the bug

You will work with a z/OS member using the editor and now we will be working with the assets located on the z/OS remote system.

**What z/OS remote assets you will work with?**

This is a batch program that reads DB2. In addition, this program does a Dynamic call to another COBOL program named **REGI0B**.

```

DB2REGI.cbl

-----+*A-1-B---+---2---+---3---+---4---+---5---+---6---+---7---+
234      500-SECOND-PART.
235      MOVE 2 TO BRANCHFLAG.
236      MOVE 'AAAAAA' to FIELD-A.
237      MOVE 'BBBBBB' to FIELD-B.
238      MOVE 'CCCCCC' to FIELD-C.
239      MOVE "LAB2" to WHICH-LAB.
240
241      520-LOGIC.
242      IF WHICH-LAB = 'LAB2'
243      * If is LAB2 lets do a dynamic CALL.. and force a divide by ZERO
244      MOVE "REGI0B" TO PROGRAM-TO-CALL
245      CALL PROGRAM-TO-CALL USING RECEIVED-FROM-CALLED
246      MOVE 66 TO VALUE1
247      DIVIDE VALUE1 BY RECEIVED-FROM-CALLED GIVING RESULT
248      DISPLAY "The result is ... " RESULT
END-IF

```

### 5.1 Using the Editor with z/OS COBOL programs

Before fixing the code let's explore some editor capabilities on the main DB2 COBOL program.

5.1.1 ► Using the z/OS Projects perspective and the z/OS Projects view, **double click** on **EMPOT01.POT.COBOL(DB2REGI)** to open the file using the editor.

```

z/OS Projects
  LAB1B
  COBOL_DB2 [zos.dev]
    EMPOT01.POT.COBOL(DB2REGI).cbl

DB2REGI.cbl

-----+*A-1-B---+---2---+---3---+---4---+---5---+---6---+
1 IDENTIFICATION DIVISION.
2   PROGRAM-ID. DB2REGI.
3
4   *REMARKS. THIS PROGRAM JOINS TABLES, GROUPS DATA BY DEPT.
5   * AND DISPLAYS THE AVERAGE, MAXIMUM AND MINIMUM
6   * HOURS, AND PERFORMANCE EVALUATION BY DEPT.
7   * Modified by Regi to add DEAD CODE - Jan/2-14
8   * Modified by Regi to added test if -204 - Mar/2015
9
10  ENVIRONMENT DIVISION.
11    CONFIGURATION SECTION.
12    SOURCE-COMPUTER. IBM-370.
13    OBJECT-COMPUTER. IBM-370.
14    DATA DIVISION.
15    WORKING-STORAGE SECTION.
16    * CODE THE NECESSARY DB2 INCLUDE STATEMENTS HERE

```

5.1.2 ► Click on the **Outline** tab (bottom and left) to see the *Outline* view.

► Using the editor, browse the program and notice that the contents of the *Outline* view are synchronized with the COBOL source code and vice versa.

► Click on the **PROCEDURE DIVISION**. Notice that you can navigate using the *Outline* view.

The screenshot shows the z/OS Studio interface with the COBOL editor open. The left pane displays the project structure under 'z/OS Projects'. The main editor window shows a COBOL program named 'DB2REGI.cbl'. The code includes sections for IDENTIFICATION, ENVIRONMENT, DATA, and PROCEDURE DIVISION. The 'Outline' tab is selected in the bottom-left corner. A red arrow highlights the 'PROCEDURE DIVISION' entry in the outline, which corresponds to the highlighted section in the main editor window.

```

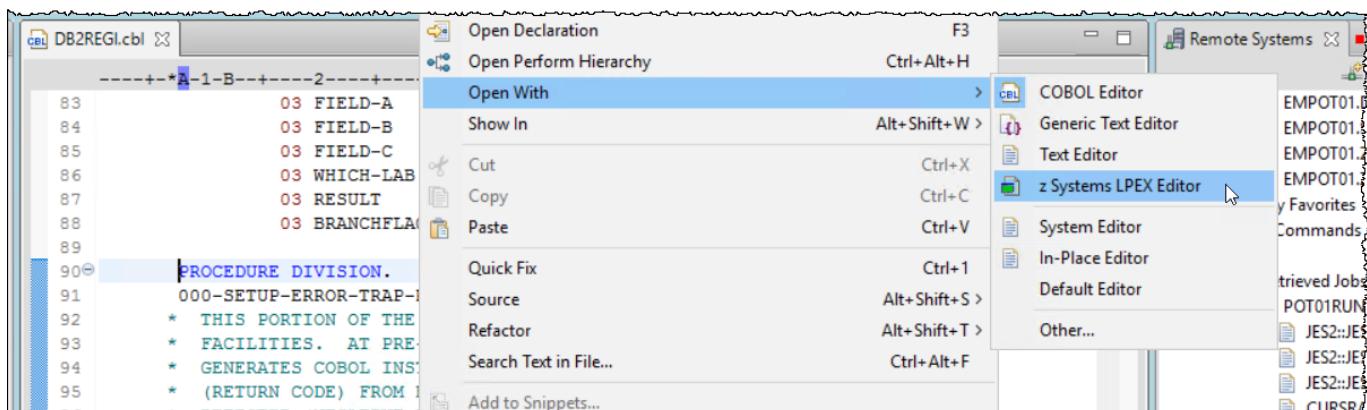
85      03 FIELD-C          PIC X(6).
86      03 WHICH-LAB        PIC X(4).
87      03 RESULT            PIC 99.
88      03 BRANCHFLAG       PIC 99.

89
90*
91  PROCEDURE DIVISION.
92    000-SETUP-ERROR-TRAP-RTN.
93      * THIS PORTION OF THE PROGRAM ACTIVATES THE SQL ERROR TRAPPING
94      * FACILITIES. AT PRE-COMPILATION TIME, THE DB2 PRE-COMPILER
95      * GENERATES COBOL INSTRUCTIONS TO INTERROGATE THE SQLCODE
96      * (RETURN CODE) FROM EACH CALL. IF A SQLERROR CONDITION IS
97      * DETECTED (NEGATIVE RETURN CODE), EXECUTION WILL BRANCH TO THE
98      * 999-ERROR-TRAP-RTN TO DISPLAY AN APPROPRIATE ERROR MSG.
99      * SET UP YOUR ERROR HANDLING ROUTINES
100     000-MAINLINE-RTN.
101     * THE MAINLINE CONTAINS THE DRIVER CODE TO PERFORM OUR DATA
102     * BASE ACCESS AND DISPLAY ROUTINES.
103     PERFORM 100-DECLARE-CURSOR-RTN THRU 100-EXIT.

```

5.1.3 If you prefer the ISPF editor, you might use another IDz editor called "LPEX editor".

► To switch the editor, right click on the program and select **Open with > z Systems LPEX Editor**



5.1.4 ► Note that the column on left are similar as the prefix area of the ISPF editor..

You may type commands to add lines etc..

Like **I** to insert a line, **d** to delete, **m** to move, etc. **Try it.**

The screenshot shows the COBOL editor with the cursor positioned at the beginning of line 000090. A red circle highlights the 'I' character, indicating an insertion point. The code in the editor is identical to the one shown in the previous screenshot.

```

000081  03 PROGRAM-TO-CALL   PIC X(07).
000082  03 RECEIVED-FROM-CALLED  PIC 99.
000083  03 VALUE1             PIC 99.
000084  03 FIELD-A            PIC X(6).
000085  03 FIELD-B            PIC X(6).
000086  03 FIELD-C            PIC X(6).
000087  03 WHICH-LAB          PIC X(4).
000088  03 RESULT              PIC 99.
000089  03 BRANCHFLAG         PIC 99.

000090*
000091  PROCEDURE DIVISION.
000092    000-SETUP-ERROR-TRAP-RTN.
000093    * THIS PORTION OF THE PROGRAM ACTIVATES THE SQL ERROR TRAPPING

```

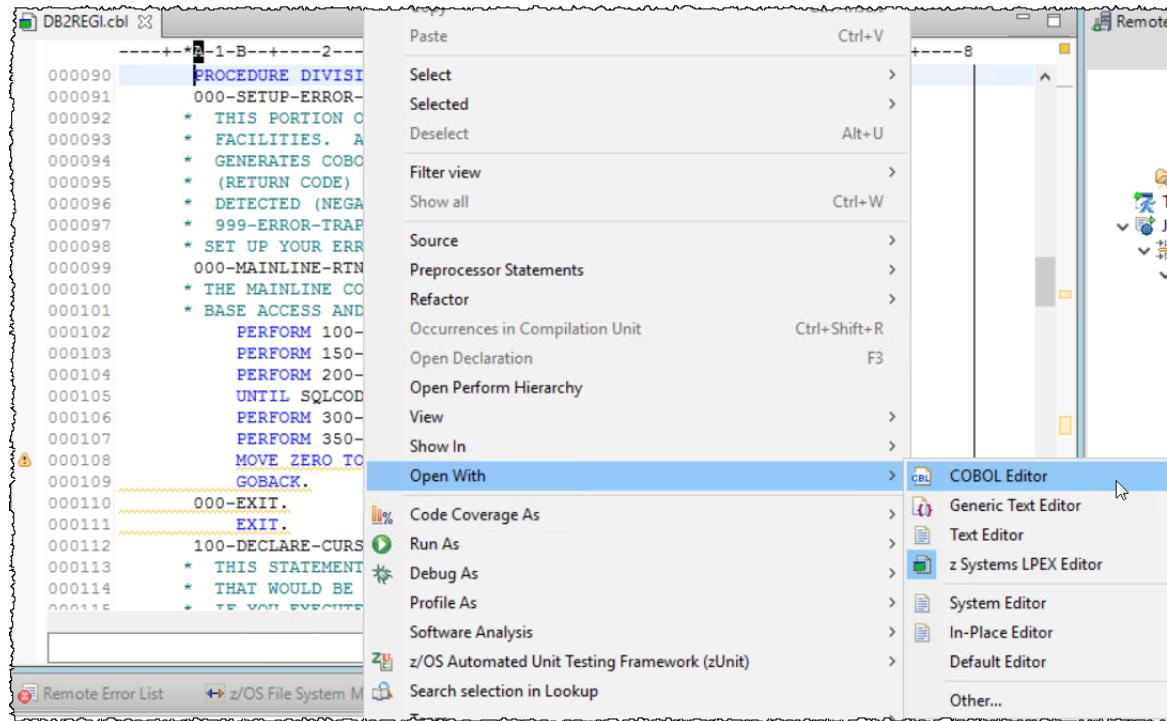
### 5.1.5 Switch back to **COBOL editor** (since the screen captures uses the COBOL editor)

► Right click on the program and select **Open with > COBOL Editor**

Click **No** for saving changes.

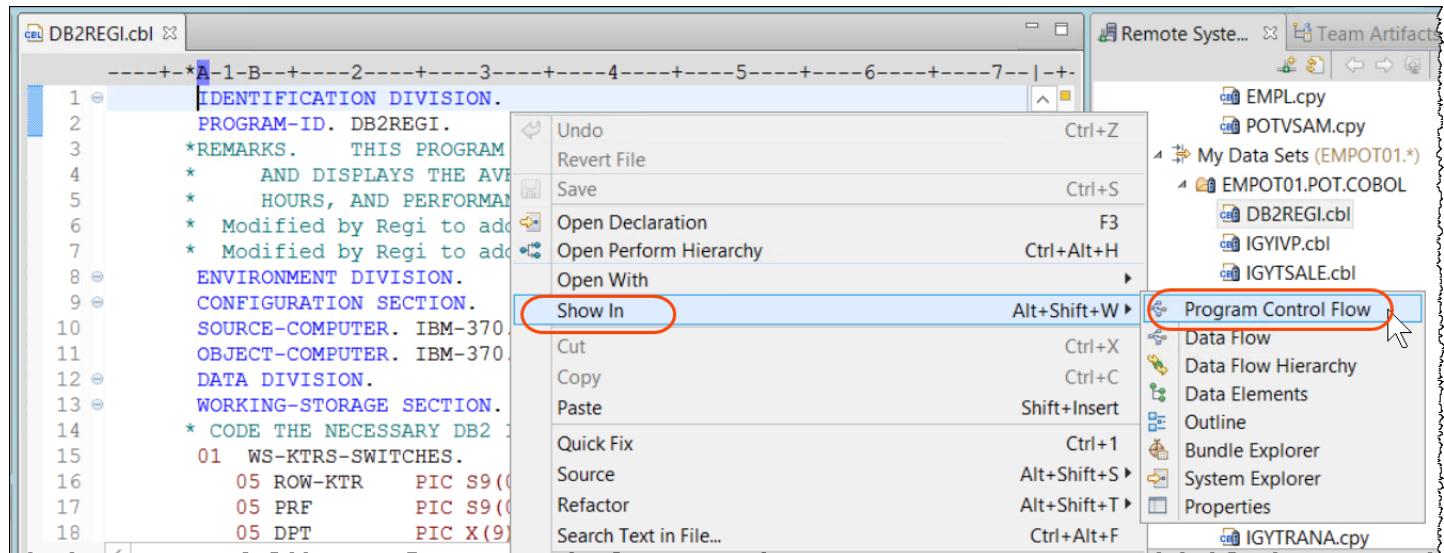
This editor is more like the Java Editor and gives you more capabilities. When you see all advantages, probably you will prefer this editor than the ISPF like editor (LPEX)..

Please keep this program opened as we will work on it later.



### 5.1.6 Let's see the program in more details..

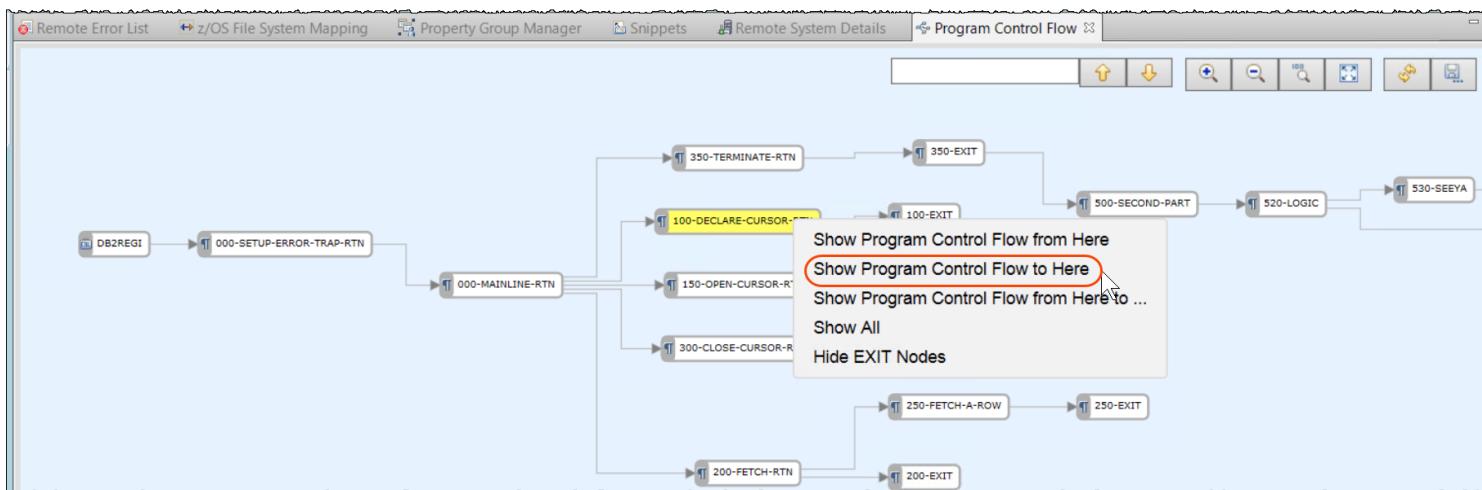
► Right click on the editor and select **Show In → Program Control Flow**



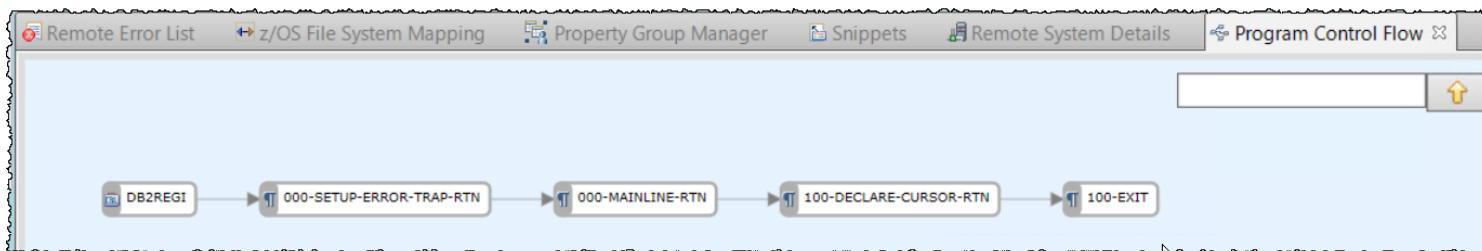
5.1.7 See the results under *Program Control Flow* view.

► Double click “**Program Control Flow**” title to have a bigger diagram (full page).

► Right-click on **100-DECLARE-CURSOR-RTN** box and select **Show Program Flow Control to here**.



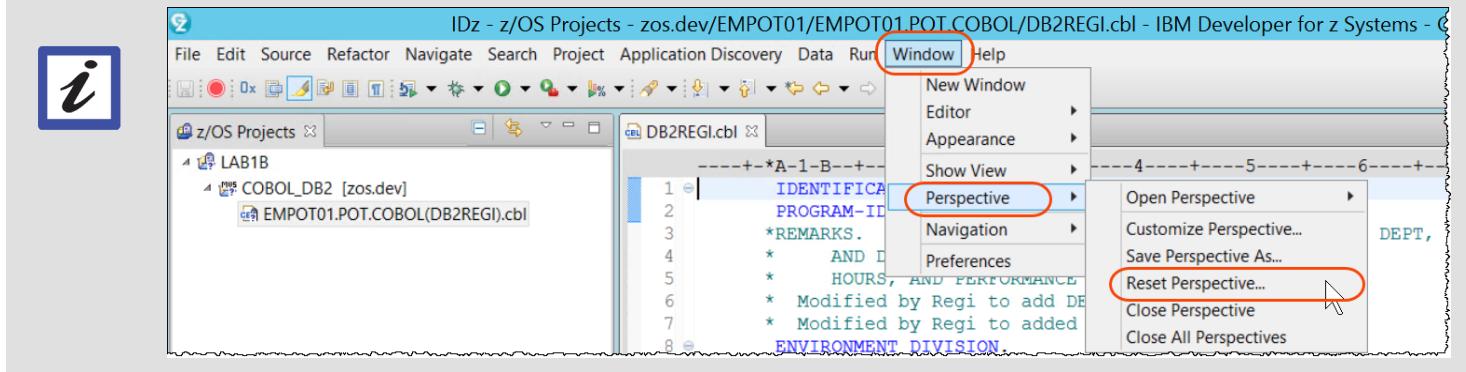
5.1.8 It shows the path to reach this paragraph.. Nice uh? That helps with extremely complex diagrams



**The perspectives are not the same as here? Got confused with the opened views?**

At any time, you may restore the perspective to the default. You may need that when you did mistakes and closed views you should not.

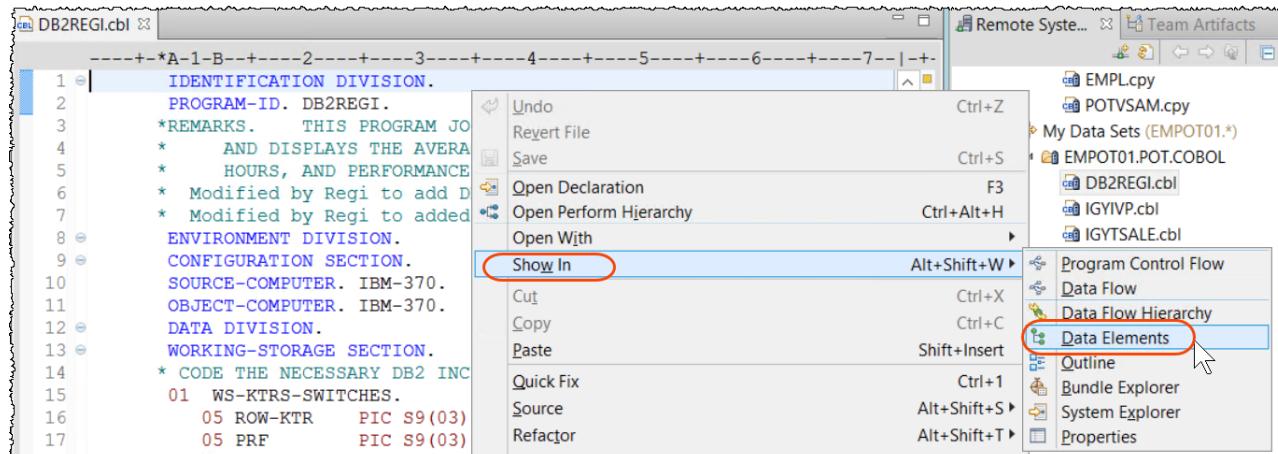
Just select **Windows > Perspective > Reset Perspective...** as below:



5.1.9 ► Double click "Program Control Flow" title to have the diagram smaller.

► Right click again on the editor and select

Show In → Data Elements



5.1.10 ► On Data Elements view, resize the view, scroll down and right click on RECEIVED-FROM-CALLED and select Occurrences in Compilation Unit

Name	Level	Top-level Item	Declaration	Declared In	Line Number	References	Item Type
PRF	5	WS-KTRS-SWITCHES	PIC S9(03)	DB2REGI.cbl	17	0	Data
PROGRAM-TO-CALL	3	WORK-FIELDS	PIC X(07)	DB2REGI.cbl	80	2	Data
PROJ	10	EMPL	PIC X(2)	EMPLcpy	46	0	Data
RECEIVED-FROM-CALLED	3	WORK-FIELDS	PIC 99	DB2REGI.cbl	81	2	Data
RESULT			PIC 99	DB2REGI.cbl	87	2	Data
ROW-KTR			PIC S9(03)	DB2REGI.cbl	16	3	Data
ROW-MSG				DB2REGI.cbl	61	1	Data
ROW-STAT			PIC Z99	DB2REGI.cbl	64	1	Data

5.1.11 ► Double click on line 246. It will show in the line that is abending.

Notice the colors. When the variable is referenced, it is blue and when it is modified is brown.

'RECEIVED-FROM-CALLED' - 3 matches in compilation unit of 'DB2REGI.cbl'

- DB2REGI.cbl (3 matches)
  - 241 03 RECEIVED-FROM-CALLED PIC 99.
  - 244 CALL PROGRAM-TO-CALL USING RECEIVED-FROM-CALLED
  - 246 DIVIDE VALUE1 BY RECEIVED-FROM-CALLED GIVING RESULT

You need to fix the called program named **REGI0B** that is returning 0 on this variable as seen before with Fault Analyzer.

### Exploring Data Flow

This capability is cool. *Program data flow* provides a graphical and hierarchical view of the data flow within a COBOL program. You can use this feature to examine how a data element is populated, modified, or written elsewhere.

5.1.12 ► Double click on line 81. It will show where *RECEIVED-FROM-CALLED* is defined.

```

DB2REGI.cbl
-----+-----+-----+-----+
78      01 WORK-FIELDS.
79          03 INPUT-NAME          Pic x(30).
80          03 PROGRAM-TO-CALL    PIC X(07).
81          03 RECEIVED-FROM-CALLED PIC 99. RECEIVED-FROM-CALLED
82          03 VALUE1              PIC 99.
83          03 FIELD-A             PIC X(6).
84          03 FIELD-B             PIC X(6).
85          03 FIELD-C             PIC X(6).
86          03 WHICH-LAB           PIC X(4).
87          03 RESULT               PIC 99.
88          03 BRANCHFLAG          PIC 99.
89
90  PROCEDURE DIVISION.
91  000-SETUP-ERROR-TRAP-RTN.
92  * THIS PORTION OF THE PROGRAM ACTIVATES THE SQL ERROR TRAPPING
93  * FACILITIES. AT PRE-COMPILATE TIME, THE DB2 PRE-COMPILER
94  * GENERATES COBOL INSTRUCTIONS TO INTERROGATE THE SQLCODE
95  * (RETURN CODE) FROM EACH CALL. IF A SQLERROR CONDITION IS
96  * DETECTED (NEGATIVE RETURN CODE), EXECUTION WILL BRANCH TO THE
97  * 999-ERROR-TRAP-RTN TO DISPLAY AN APPROPRIATE ERROR MSG.
98  * SET UP YOUR ERROR HANDLING ROUTINES
99  000-MAINLINE-RTN.
100 * THE MAINLINE CONTAINS THE DRIVER CODE TO PERFORM OUR DATA
101 * BASE ACCESS AND DISPLAY ROUTINES.
102     PRRDRBY... 100  PRRDRBY... 100  PRRDRBY... 100  PRRDRBY...
103

```

5.1.13 ► Select **PROGRAM-TO-CALL** (on line 80) double clicking on it, right click and select **Show In > Data Flow**. (the options order can differ from the screen capture here).

5.1.14 ► Move the cursor to the line between REGI0B and 03 PROGRAM-TO-CALL.

► Clicking in this line shows the program statement where "REGI0B" is moved to PROGRAM-TO-CALL.

The screenshot shows the Rational Developer for System z interface. At the top is the DB2REGI.cbl editor window displaying COBOL code. In the middle is the Data view, which contains a diagram of data structures. A red arrow points from the cursor in the editor to a node in the Data view labeled "REGI0B". The Data view also shows other nodes like "01 WORK-FIELDS". The bottom of the interface has various toolbars and tabs.

```

240      520-LOGIC.
241      IF WHICH-LAB = 'LAB2'
242      * If is LAB2 lets do a dynamic CALL.. and force a divide by ZERO
243      MOVE "REGI0B" TO PROGRAM-TO-CALL
244      CALL PROGRAM-TO-CALL USING RECEIVED-FROM-CALLED
245      MOVE 66 TO VALUE1
246      DIVIDE VALUE1 BY RECEIVED-FROM-CALLED GIVING RESULT
247      DISPLAY "The result is ... " RESULT
248      END-IF
249      IF BRANCHFLAG > 1
250          CALL 'REGI0C' USING Input-name
251          DISPLAY "BRANCHFLAG GREATER THAN 1"

```

5.1.15 ► Close all opened editors if still opened. (**CTRL + Shift + F4**)

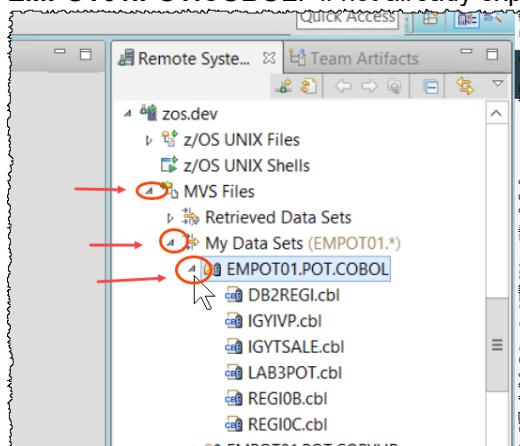
Or just click on the of each opened editor.

## 5.2 Fixing the program REGI0B

You need to fix the called program named REGI0B that is returning 0 on this variable as seen before with Fault Analyzer and the debugger.

This program is on your **PDS EMPOT01.POT.COBOL**.

5.2.1 ► Using Remote Systems view scroll back, expand **MVS Files**, **My Data Sets** and **EMPOT01.POT.COBOL**. if not already expanded.



**5.2.4 ► Double click on the program REGI0B.cbl to edit it.**

```

1 | Identification Division.
2 | Program-ID. "REGI0B".
3 | ****
4 | * This program is called.
5 | * It returns a value (0)
6 | * This will cause an error when this value is used in a division
7 | ****
8 | Data Division.
9 | Working-Storage Section.
10| Linkage Section.
11| 01 Recvd-Parms.
12|     05 In-value      Pic 99.
13|
14| Procedure Division using Recvd-Parms.
15|     Move 0 to In-value.
16|     Goback.

```

**5.2.5 ► Move the cursor after the **In-value** and press **enter** to add a blank line**

```

1 | Identification Division.
2 | Program-ID. "REGI0B".
3 | ****
4 | * This program is called.
5 | * It returns a value (0)
6 | * This will cause an error when this value is used in a division
7 | ****
8 | Data Division.
9 | Working-Storage Section.
10| Linkage Section.
11| 01 Recvd-Parms.
12|     05 In-value      Pic 99.
13|
14| Procedure Division using Recvd-Parms.
15|     Move 0 to In-value.
16|     Goback.

```

**5.2.6 You can now take advantage of the **editor content assist...****

► On the column 12 as shown below, type **m** and press **Ctrl + Space**

**5.2.7 ► Select the statement **MOVE** (you can use the mouse double click or select and press enter)**

```

Linkage Section.
01 Recvd-Parms.
05 In-value      Pic 99.

Procedure Division using Recvd-Parms.
Move 0 to In-value.
m
  1
  2
    MERGE
    MOVE
    MULTIPLY
    MULTIPLY - NOT ON SIZE ERROR - END-MULTIPLY
    MULTIPLY - ON SIZE ERROR - END-MULTIPLY
    MULTIPLY - ON SIZE ERROR - NOT ON SIZE ERROR - END-M

```

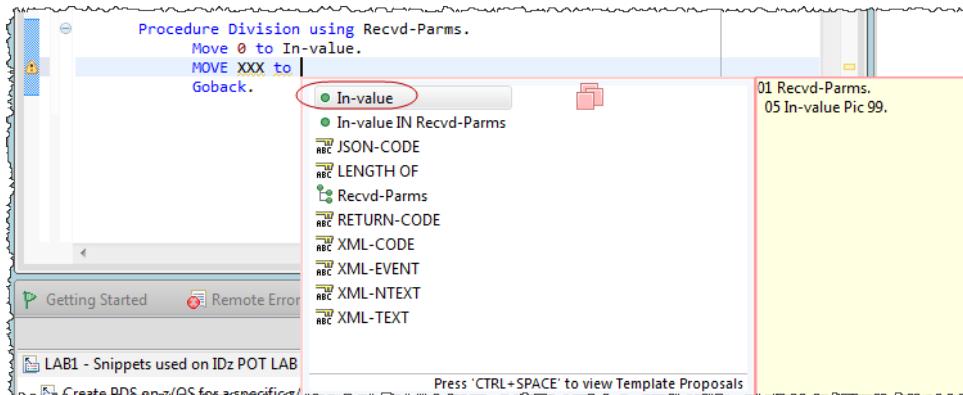
**5.2.8 ► Type “XXX to”**

```

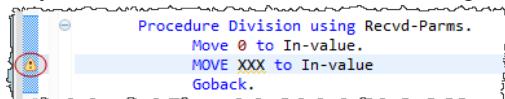
Procedure Division using Recvd-Parms.
Move 0 to In-value.
MOVE XXX to
Goback.

```

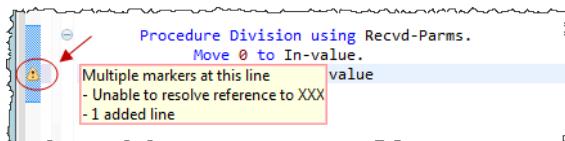
5.2.9 ►| Press **Ctrl + Space** to list the variables and select **In-value**.  
 Notice that variables could be defined in copybooks.



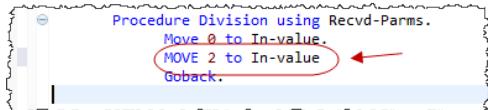
A yellow mark shows that something is wrong.



5.2.10 ►| Move the cursor to the yellow mark to see what the error is.  
 You are finding this error without using the z/OS compilation. If you were using ISPF you would see that only after submitting this JOB to the z/OS COBOL compiler.  
 Productivity and z/OS CPU saving. You are using the power of the smart editor.



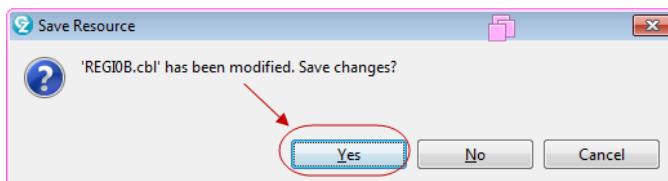
5.2.11 ►| Change from **XXX** to **2** as below. Note that the icon will go away.



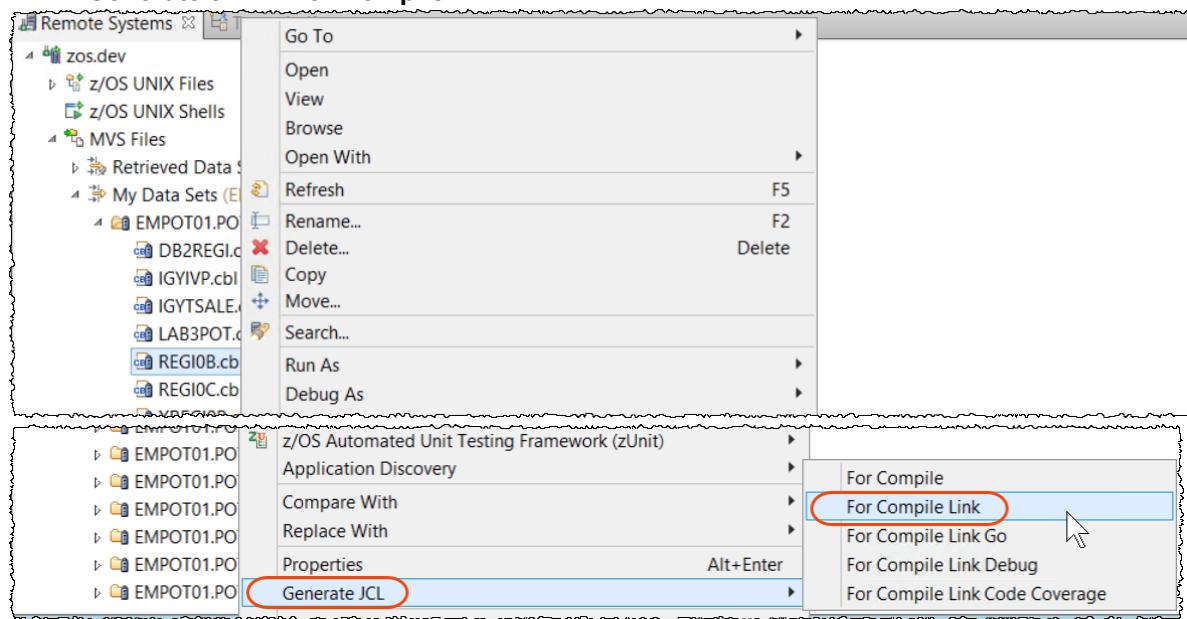
### 5.3 Compile and link REGI0B.

You need to compile and link the program that you just changed. You could use a JCL or let IDz generate a JCL for you. Once you have a Property Group associated to the COBOL code a JCL file could be generated on the fly when you need it. You have associated the property Group at step 7.2.1 above.

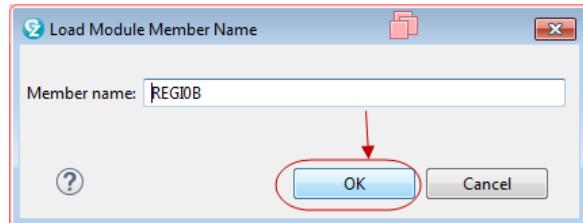
5.3.1 ►| Click **Ctrl + Shift + F4** to close the editors. Or just left click on the of each opened editor.  
 ►| Click **Yes** to Save Changes.



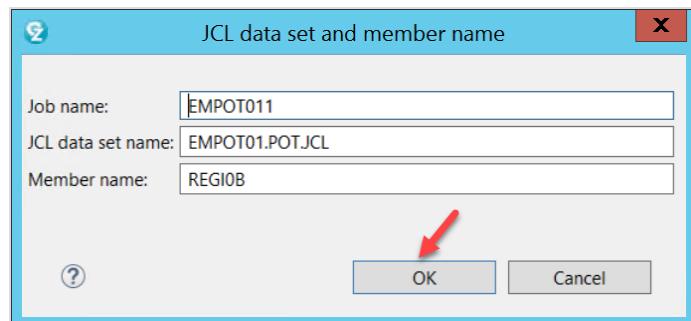
5.3.2 ► Using the Remote Systems view right click on **REGI0B.cbl** and select **Generate JCL > For Compile Link**.



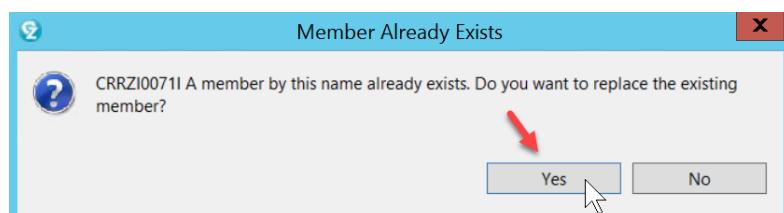
5.3.3 ► Accept the default member name and click **OK**



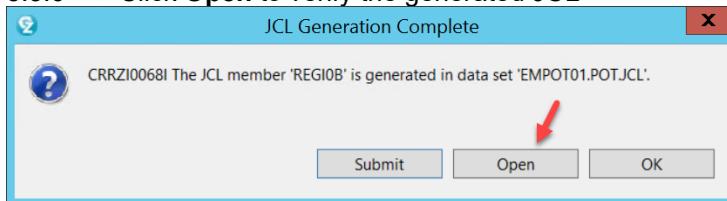
5.3.4 ► Accept the default and click **OK**



5.3.5 ► Click **Yes** if the member already exists



5.3.6 ► Click **Open** to verify the generated JCL



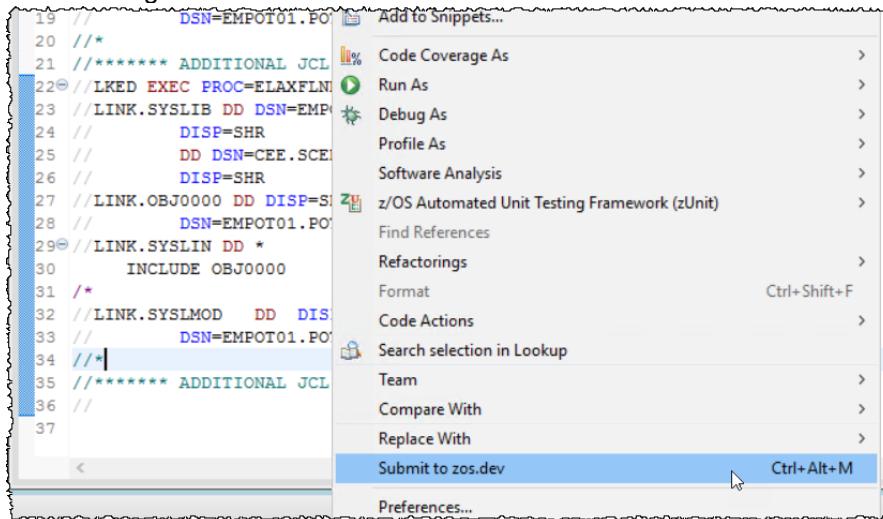
5.3.7 ► Scroll down and notice that the *Load module* will be created on the PDS: **EMPOT01 . POT . LOAD**.

```

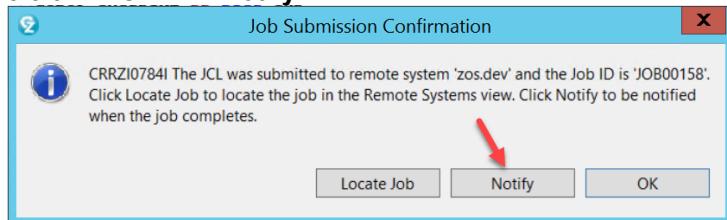
14 //      DD DISP=SHR,
15 //      DSN=EMPOT.ZPICL.COPYLIB
16 //COBOL.SYSXMLSD DD DUMMY
17 //COBOL.SYSIN DD DISP=SHR,
18 //      DSN=EMPOT01.POT.COBOL (REGI0B)
19 //*
20 //***** ADDITIONAL JCL FOR COMPILE HERE *****
21 //LKED EXEC PROC=ELAXFLNK
22 //LINK.SYSLIB DD DSN=EMPOT01.POT.OBJ,
23 //      DISP=SHR
24 //      DD DSN=CEE.SCEELKED,
25 //      DISP=SHR
26 //LINK.OBJ0000 DD DISP=SHR,
27 //      DSN=EMPOT01.POT.OBJ (REGI0B)
28 //LINK.SYSLIN DD *
29     INCLUDE OBJ0000
30 /*
31 //LINK.SYSLMOD DD DISP=SHR,
32 //      DSN=EMPOT01.POT.LOAD (REGI0B)
33 //*
34 //***** ADDITIONAL JCL FOR LINK HERE *****
35 /

```

5.3.8 ► Right click on the JCL and click **Submit to zos.dev**



5.3.9 ► Click on **Notify**.



### 5.3.10 You MUST have 000 as return code.

▶▶ Click on **EMPOT011:JOB00xxx**

```

20 //***** ADDITIONAL JCL FOR COMPILE HERE *****
21 //LKED EXEC PROC=ELAXFLNK
22 //LINK.SYSLIB DD DSN=EMPOT01.POT.OBJ,
   DTCP-SUB
  
```

[5/28/19, 10:34 AM] Job **JOB00158** is being submitted  
[5/28/19, 10:34 AM] Job **EMPOT01:JOB00158** ended with completion code CC 0000

### 5.3.11 ▶▶ Expand **EMPOT01:JOB00xxx** and verify the results double clicking on **LKED:LINK:SYSPRINT**.

▶▶ Scroll down and verify that the load module **REGI0B** invoked by your DB2 COBOL program is now created in **EMPOT01.POT LOAD**.

```

298 SAVE OPERATION SUMMARY:
299
300 MEMBER NAME      REGI0B
301 LOAD LIBRARY    EMPOT01.POT LOAD
302 PROGRAM TYPE    PROGRAM OBJECT (FORMAT 3)
303 VOLUME SERIAL   C2DBAR
304 DISPOSITION     ADDED NEW
305 TIME OF SAVE    09.33.57 MAY 28, 2019
306
307
308 SAVE MODULE ATTRIBUTES:
309
310 AC             000
311 AMODE          31
312 COMPRESSION    NONE
313 DC             NO
314 EDITABLE        YES
315 EXCEEDS 16MB   NO
316 EXECUTABLE     YES
317 LONGPARM       NO
318 MIGRATABLE     NO
  
```

**REGI0B** is now on  
EMPOT01.POT LOAD

File Browser (right side):

- Remote System... Team Artifacts
- My Favorites TSO Commands
- JES Retrieved Jobs
  - EMPOT01:JOB00158 [CC 0000]
    - JES2:JESMSGLG
    - JES2:JESJCL
    - JES2:JESYSMSG
    - LKD:LINK:SYSLIN [0000]
    - LKD:LINK:SYSPRINT [0000]
  - POT01RUN:JOB00123 [CC 0012]

### 5.3.10 ▶▶ Use **Ctrl + Shift + F4** to close all editors.

Or just click on the of each opened editor

## 5.4 Execute the COBOL/DB2 program

On this step, you will explore some capabilities of the JCL editor and modify the JCL for execution.

5.4.1 ► Using Remote System View, scroll back to locate the file `pot01run.jcl` under the folder `Local/Local Files/ADF_POT/empot01` and double click to edit..

```

//POT01RUN JOB ,
// MSGCLASS=H,MSGLEVEL=(1,1),TIME=1440,REGION=70M,COND=(16,LT)
///* ZPICL Debug
//CURSRAV4 EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB DD DSN=EMPOT01.POT.LOAD,DISP=SHR
// DD DSN=EMPOT.ZPICL.LOAD,DISP=SHR
///* DD DISP=SHR,DSN=IBMUSER.VER1.SEQAMOD
///* DD DISP=SHR,DSN=IBMUSER.VER1.SEQAUTH
// DD DSN=DSNB10.SDSNLOAD,DISP=SHR
// DD DSN=DSNB10.DBDBG.RUNLIB.LOAD,DISP=SHR
// DD DISP=SHR,DSN=FEK910.SFEKAUTH
//SYSPRINT DD SYSOUT=*
//SYSOUT DD SYSOUT=*
//SYSTSPRT DD SYSOUT=*
//SYSTSIN DD *
TSOLIB ACTIVATE DA('DSNB10.SDSNLOAD')
DSN SYSTEM(DBDBG)
RUN PROGRAM(DB2REGI) PLAN(DB2REGI) -
LIB('EMPOT.ZPICL.LOAD')
END
/*

```

5.4.2 Notice on bottom left corner the same *Outline* view that you have for the COBOL program.  
It will help to navigate on large JCL members.

► Expand CURSRAV4 EXEC PGM= and click on STEPLIB

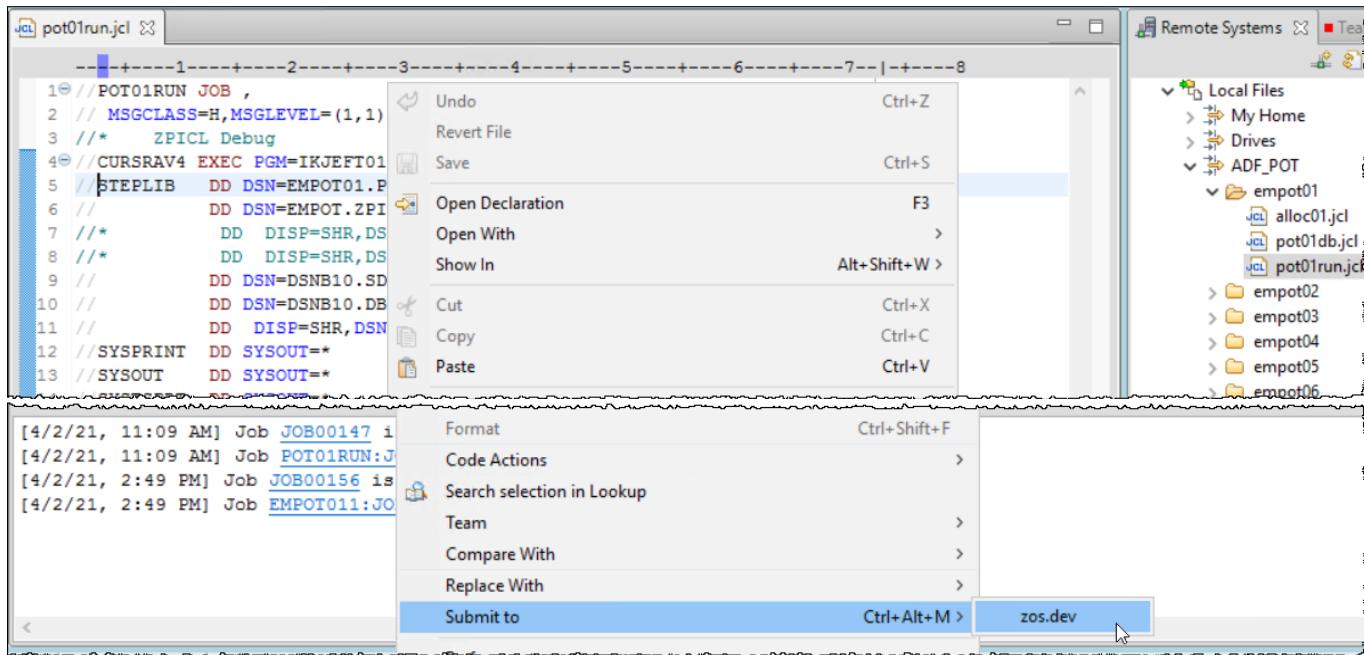
5.4.3 ► Notice that your PDS where REG10B is created is already on the STEPLIB.

```

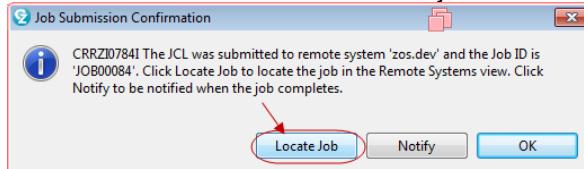
//POT01RUN JOB ,
// MSGCLASS=H,MSGLEVEL=(1,1),TIME=1440,REGION=70M,COND=(16,LT)
///* ZPICL Debug
//CURSRAV4 EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB DD DSN=EMPOT01.POT.LOAD,DISP=SHR
// DD DSN=EMPOT.ZPICL.LOAD,DISP=SHR
///* DD DISP=SHR,DSN=IBMUSER.VER1.SEQAMOD
///* DD DISP=SHR,DSN=IBMUSER.VER1.SEQAUTH
// DD DSN=DSNB10.SDSNLOAD,DISP=SHR
// DD DSN=DSNB10.DBDBG.RUNLIB.LOAD,DISP=SHR
// DD DISP=SHR,DSN=FEK910.SFEKAUTH
//SYSPRINT DD SYSOUT=*
//SYSOUT DD SYSOUT=*
//SYSTSPRT DD SYSOUT=*
//SYSTSIN DD *
TSOLIB ACTIVATE DA('DSNB10.SDSNLOAD')
DSN SYSTEM(DBDBG)
RUN PROGRAM(DB2REGI) PLAN(DB2REGI) -
LIB('EMPOT.ZPICL.LOAD')
END
/*

```

#### 5.4.4 ► Right click and select Submit to > zos.dev

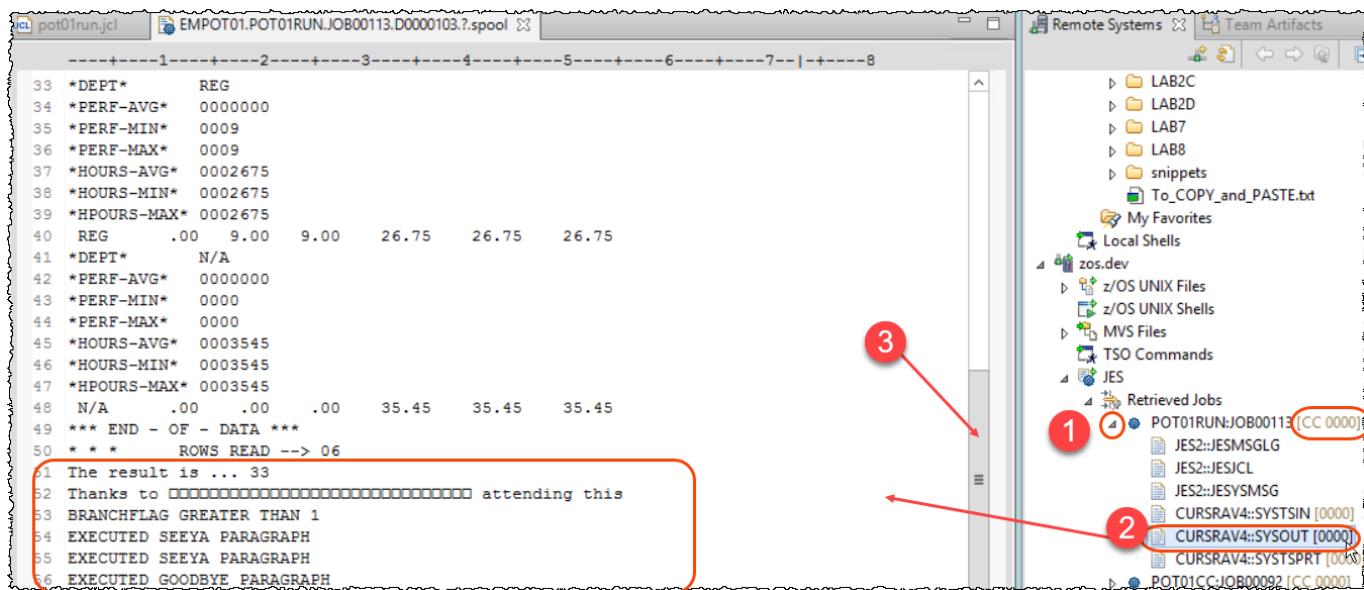


#### 5.4.5 ► Click on Locate Job. The job submitted will be shown under JES folder under Remote Systems view



#### 5.4.6 You MUST have the return code 0000 and the bug will be corrected.

► Using Remote Systems view, verify the results double expanding POT01RUN:JOB00xxxx (where 00xxxx can be any number) and clicking on CURSRAV4:SYSOUT. Now you MUST have 000 as return code  
Tip: You may need to refresh Retrieved Jobs to see it go from active to finished



5.4.7 ► Use **Ctrl + Shift + F4** to close all editors. Or just click on the of each opened editor

#### What have you done so far?

You used **Fault Analyzer** to identify why the program was abending.

You used the **Debugger** to temporarily fix the error caused by the called program REGI0B.

You used IDz to change the program REGI0B to return other value than zero.

You compiled and linked REGI0B creating another version on your load library.

You executed again the JOB but now using the REGI0B that you created and verified that the abend is gone.



## Section 6. Using the Code coverage

Code coverage analyzes a running program and generates a report of statements that were executed, compared to the total number of executable lines.

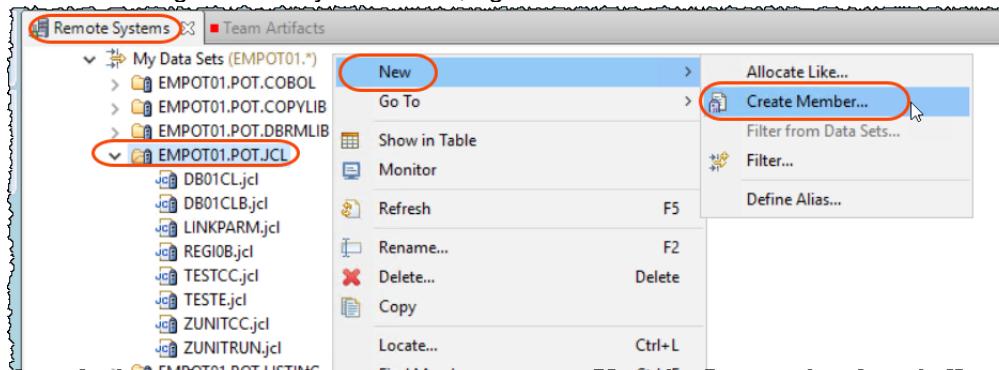
Developer for z Systems Host Utilities provides two ways to invoke Code coverage in batch mode, A sample JCL procedure, to process a single program run, and a set of scripts to start and stop a permanently active Code coverage collector that can process multiple program runs.

You can run code coverage for any application you can debug. You can generate code coverage reports that you can view in the workbench or save the results to your file system for future analysis. We will show a simple batch mode invocation.

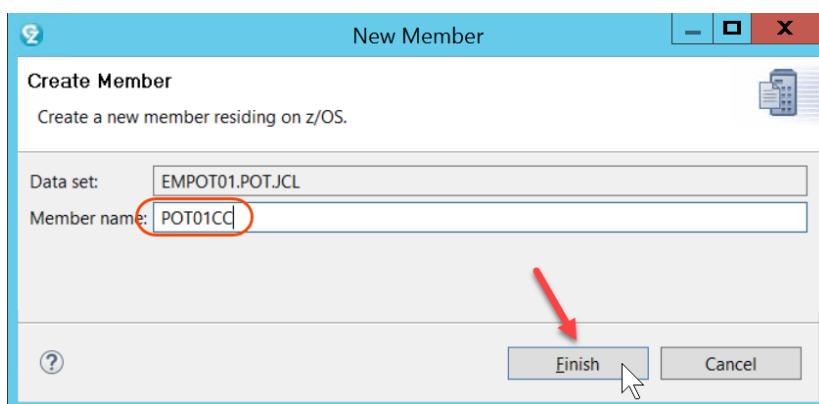
### 6.1 Creating a JCL to run the code coverage

You will create a JCL file to run Code Coverage

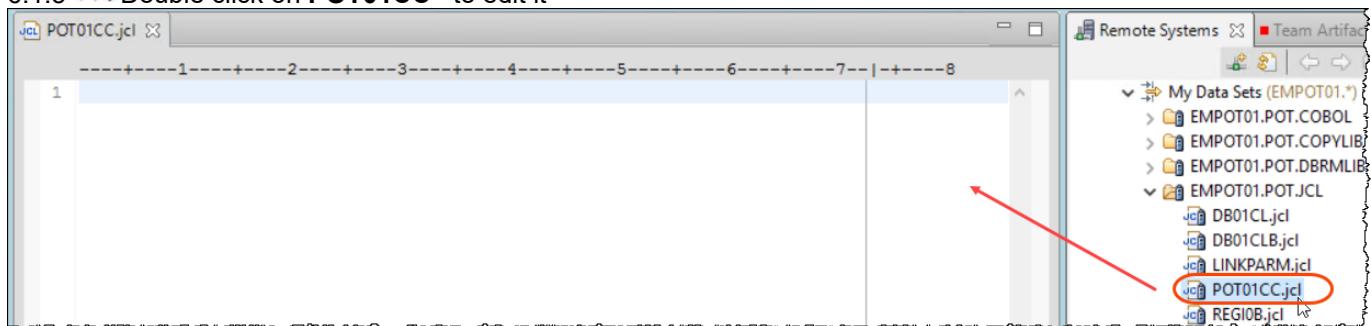
6.1.1 ► Using Remote Systems view, right click on **EMPOT01.POT.JCL** and select **New > Create Member...**



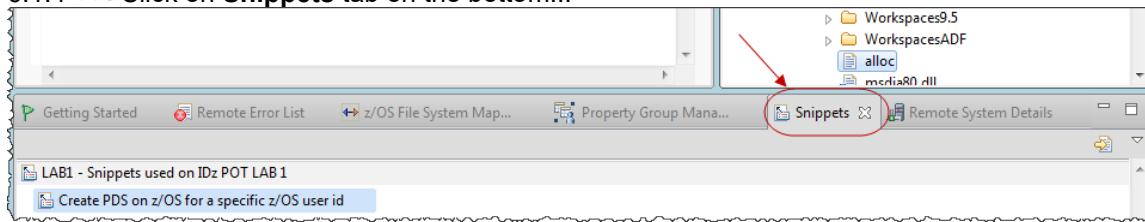
6.1.2 ► Name it as **POT01CC** and click **Finish**



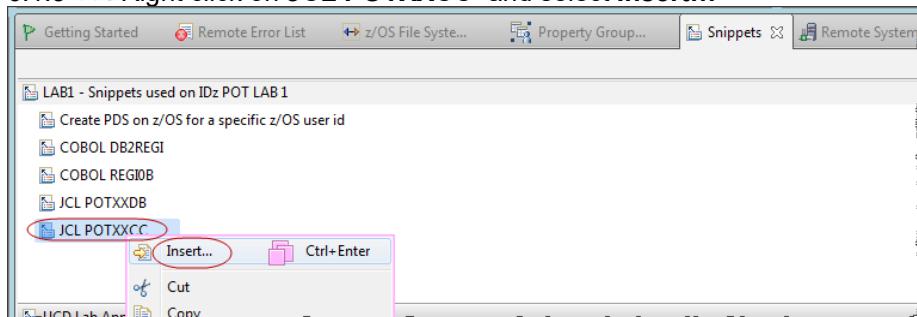
6.1.3 ► Double click on **POT01CC** to edit it



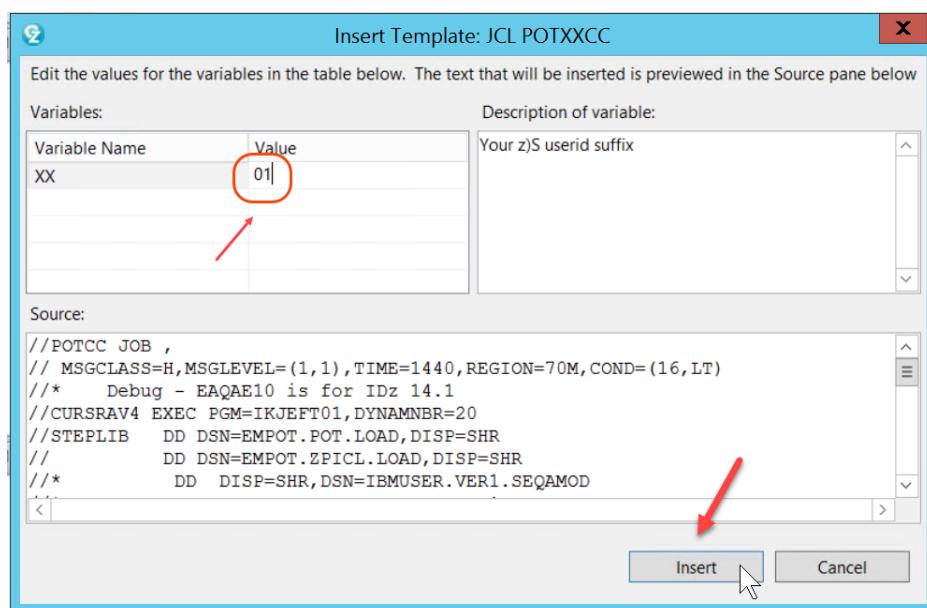
6.1.4 ► Click on **Snippets** tab on the bottom...



6.1.5 ► Right click on **JCL POTXXCC** and select **Insert...**



6.1.6 ► When the *Insert* dialog opens, type **01** in the **Value** and click **Insert**



6.1.7 . Notice that the Snippets variables will be replaced.

► Use **Ctrl + S** to save the changes.

```

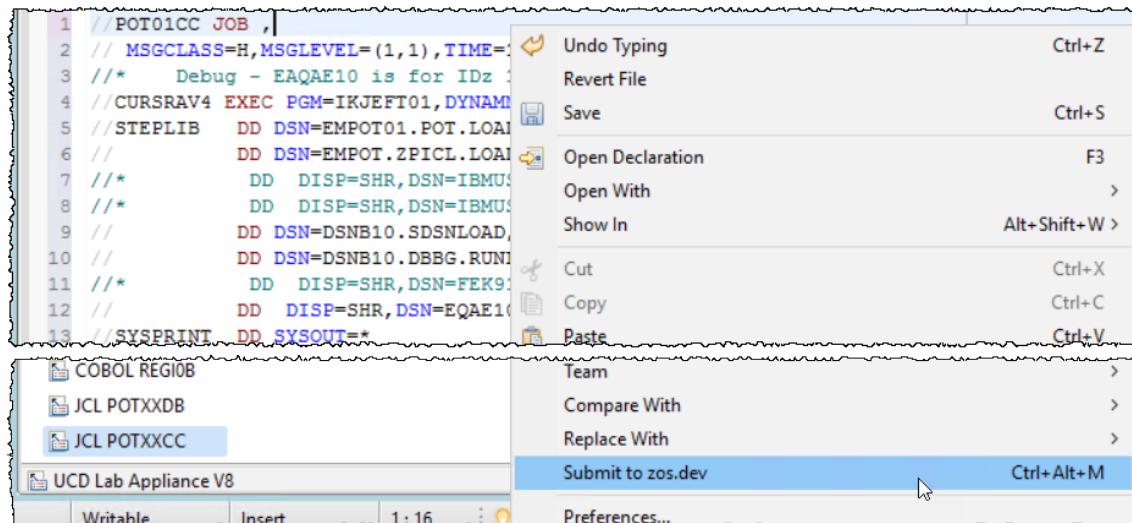
1 //POT01CC JOB ,
2 // MSGCLASS=H,MSGLEVEL=(1,1),TIME=1440,REGION=70M,COND=(16,LT)
3 /* Debug - EAQAE10 is for IDz 14.1
4 //CURSRAV4 EXEC PGM=IKJEFT01,DYNAMNBR=20
5 //STEPLIB DD DSN=EMPOT01.POT LOAD,DISP=SHR
6 // DD DSN=EMPOT.ZPICL.LOAD,DISP=SHR
7 /**
8 /**
9 // DD DSN=DSNB10.SDSNLOAD,DISP=SHR
10 // DD DSN=DSNB10.DBDBG.RUNLIB.LOAD,DISP=SHR
11 /**
12 // DD DISP=SHR,DSN=FEK910.SFEKAUTH
13 //SYSPRINT DD SYSOUT=*
14 //SYSOUT DD SYSOUT=*
15 //SYSTSPRT DD SYSOUT=*
16 //SYSTSIN DD *
17 TSOLIB ACTIVATE DA('DSNB10.SDSNLOAD')
18 DSN SYSTEM(DBDBG)
19 RUN PROGRAM(DB2REGI) PLAN(DB2REGI) -

```

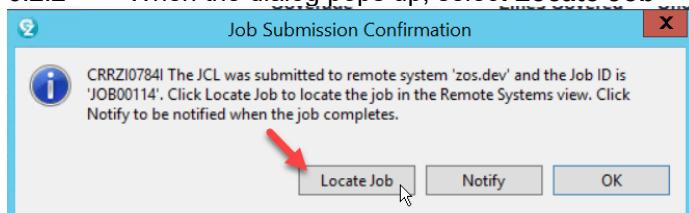
## 6.2 Submit the JCL for z/OS execution

You will now execute the fixed batch COBOL/DB2 on z/OS

6.2.1 ► Right click on the JCL being edited and select **Submit to zos.dev**



6.2.2 ► When the dialog pops up, select **Locate Job**



6.2.3 The code coverage report will be created. You can see that this test covered only **73%** of your program

► Click on **Code Coverage Results tab**

Name	Coverage	Lines Covered	Uncovered Lines	Total
DB2REGI.DB2REGI.cob	69%	61	27	
DB2REGI.REGI0C.cob	100%	9	0	
REGI0B.REGI0B.cob	100%	3	0	
<b>Summary (Elapsed time: 0.718 sec)</b>	<b>73%</b>	<b>73</b>	<b>27</b>	

Code coverage report for 'DB2REGI\_2021\_04\_16\_131035\_0684', analyzed Apr 16, 2021 1:10:35 PM

Export      Files      Modules

Off On Show below : 80 % Refresh      ?

Remote Error List z/OS File System Mapping Property Group Manager Snippets Remote System Details **Code Coverage Results**

Compiled Code Coverage Workspace Results Status Coverage Level Analyzed Date Additional Info

DB2REGI\_2021\_04\_16\_131035\_0684 73% Line Apr 16, 2021 1:10:35 PM CRRDG7202

6.2.4 ► Click on **DB2REGI.DB2REGI.cob**

Name	Coverage	Lines Covered	Uncovered Lines	Total
DB2REGI.DB2REGI.cob	69%	61	27	

6.2.5 ► Scroll down move the mouse to the colored green and red bars and you will see the lines executed in **green** and the lines not executed in **Red**.

```

332 EXIT.
333 350-TERM-RTN.
334 MOVE ROW-KTR TO ROW-STAT.
335 DISPLAY ROW-MSG.
336 350-EXIT.
337 * EXIT.
338 GO TO 500-SECOND-PART.
339 999-ERROR-TRAP-RTN.
340 ****
341 * ERROR TRAPPING ROUTINE FOR NEGATIVE SQLCODES *
342 ****
343 Lines 343-351 not covered. **** WE HAVE A SERIOUS PROBLEM HERE ****.
344 999-ERROR-TRAP-RTN'.
345 MULTIPLY SQLCODE BY -1 GIVING SQLCODE.
346 DISPLAY 'SQLCODE ==> ' SQLCODE.
347 DISPLAY SQLCA.
348 DISPLAY SQLERRM.
349 EXEC SQL WHENEVER SQLERROR CONTINUE END-EXEC.
350 EXEC SQL ROLLBACK WORK END-EXEC.
351 *
352 500-SECOND-PART.
353 MOVE 2 TO BRANCHFLAG.
354 MOVE 'AAAAAA' to FIELD-A.
355 MOVE 'BBBBBB' to FIELD-B.
356 MOVE 'CCCCCC' to FIELD-C.

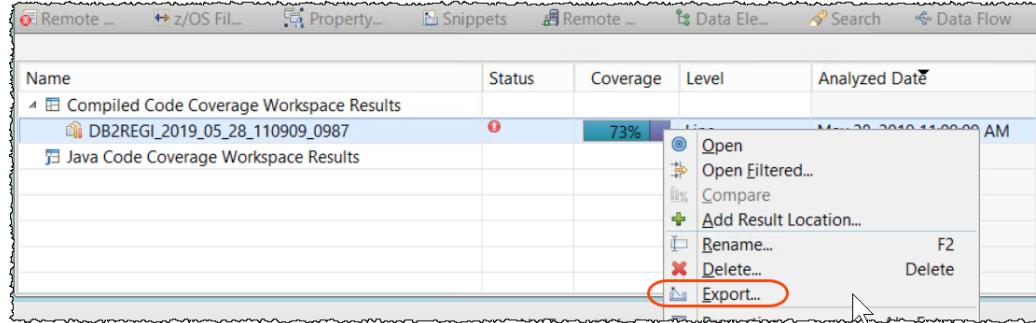
```

As you can see the error routine on the picture above is not tested..

Imagine how bad if you go to production and never test this condition ....

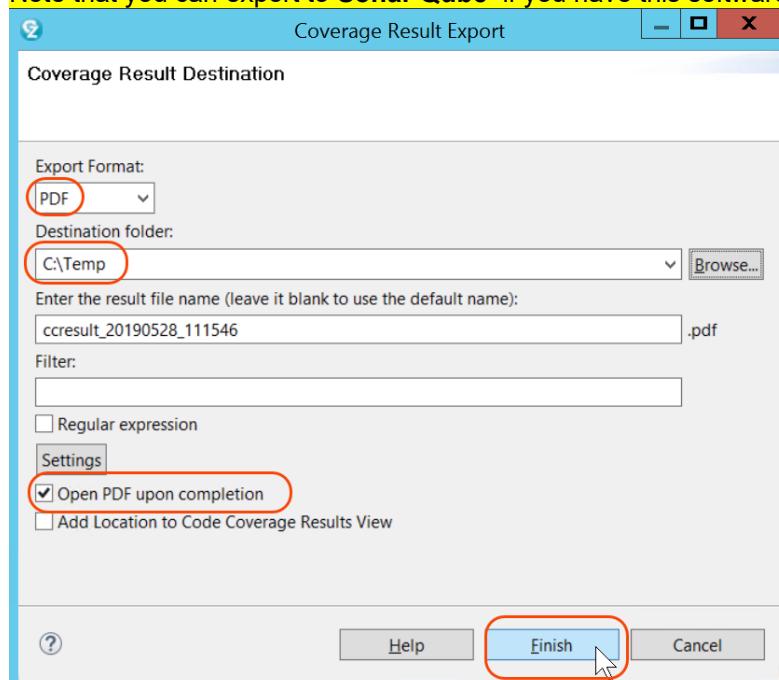
6.2.6 ► You could also create a PDF report as documentation or export this data to other products (like ADDI or SonarQube )

Right click on the results and select Export ..



6.2.7 ► Select PDF, C:\Temp, Open PDF upon completion and Finish.

Note that you can export to Sonar Qube if you have this software.



6.2.8 A PDF report will be generated.

Overall Summary		Code Coverage Summary	
Total Number of Files: 3		File Coverage: 100%	
Total Number of Functions: 24		Function Coverage: 88%	
Total Number of Lines: 100		Line Coverage: 73%	
Total Number of Statements: 100		Statement Coverage: 73%	

6.2.8 ► Close all editors pressing Ctrl + Shift + F4 Or just click on the ✕ of each opened editor.

## Section 7. (Optional) Executing SQL statements when editing the program.

IDz can be installed with Data studio that is very helpful when working with a Database.

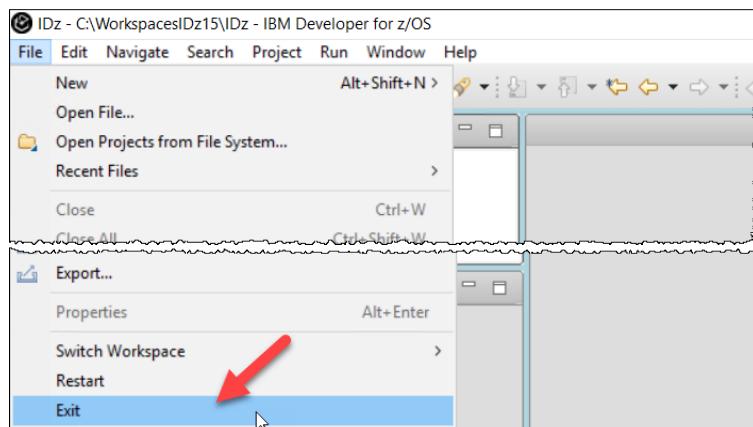
Data Studio is a foundational offering that includes support for key tasks across the data management lifecycle, including administration, application development, and query tuning.

### 7.0 Starting IDz version 14 and connect to z/OS

**When we created this lab Data studio could be installed only on IDz V 14. So for this section you will use IDz Version 14 instead of IDz version 15. Notice that Data Studio is a free plugin.**

7.0.1 Before starting IDz version 14, you must close IDz version 15 to save some memory on your windows client.

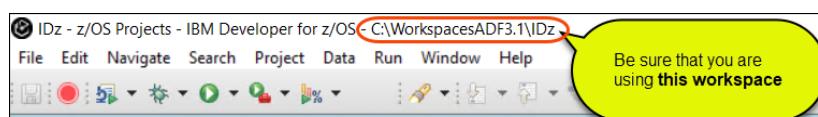
► Click on **File > Exit**



7.0.2 Start **IBM Developer for z Systems version 14**

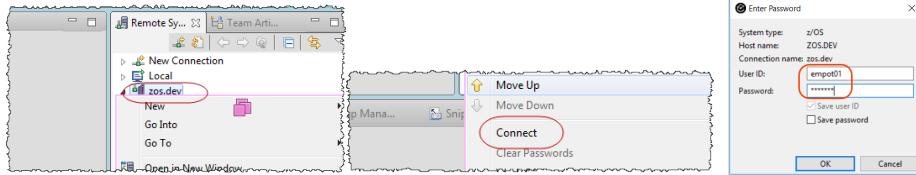
► Using the windows desktop double click on **IDz 14.2.4** icon.

**IMPORTANT** -> This icon will start an eclipse workspace that has already some definitions required for this lab.  
PLEASE DO NOT start IDz using other way than this icon.



### 7.0.3 To Connect to the z/OS system:

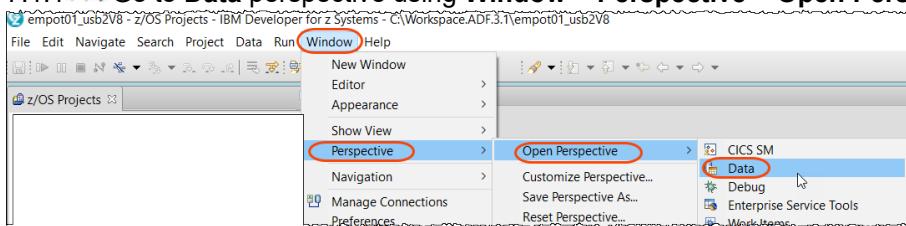
- ▶▶ Using the **Remote Systems** view, right-click on **zos.dev** and select **Connect** .
- ▶▶ Use **empot01** and password **empot01**



## 7.1 Creating a connection to the DB2 on z/OS

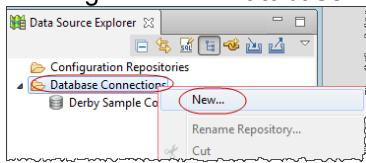
You will need to have authorization to connect to the DB2. Now you will use **IBMUSER** as a new z/OS ID

### 7.1.1 ▶▶ Go to Data perspective using Window > Perspective > Open Perspective > Data

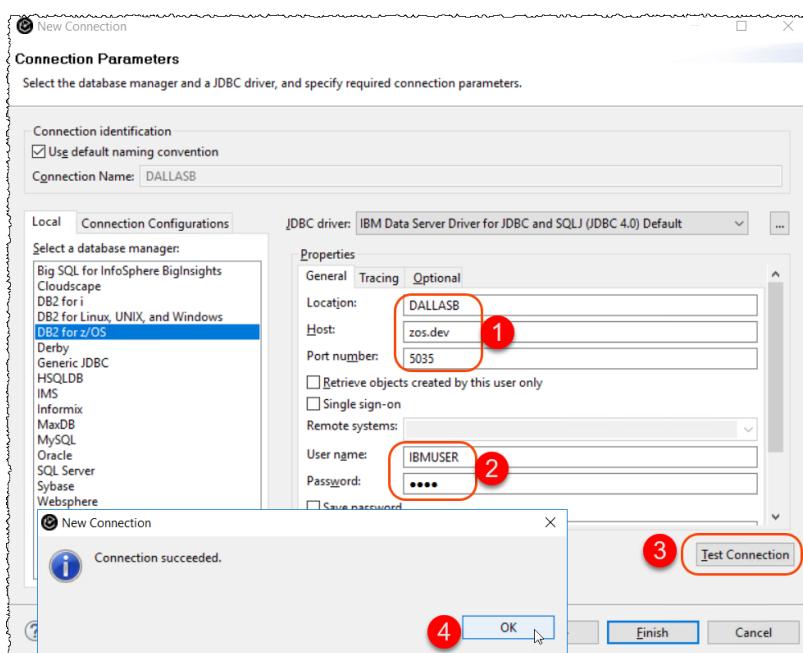


### 7.1.2 Using the Data Source Explorer view, create a new z/OS DB2 connection:

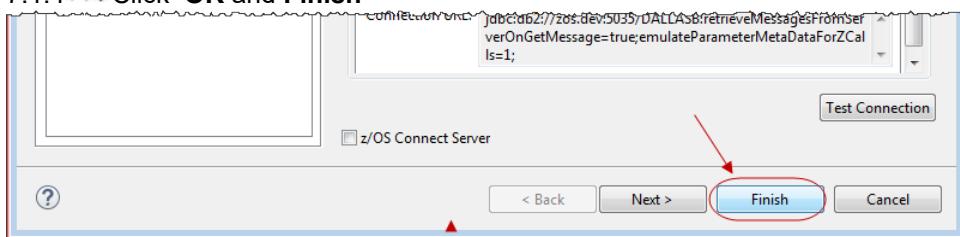
- ▶▶ Right click on **Database Connections** and select **New..**



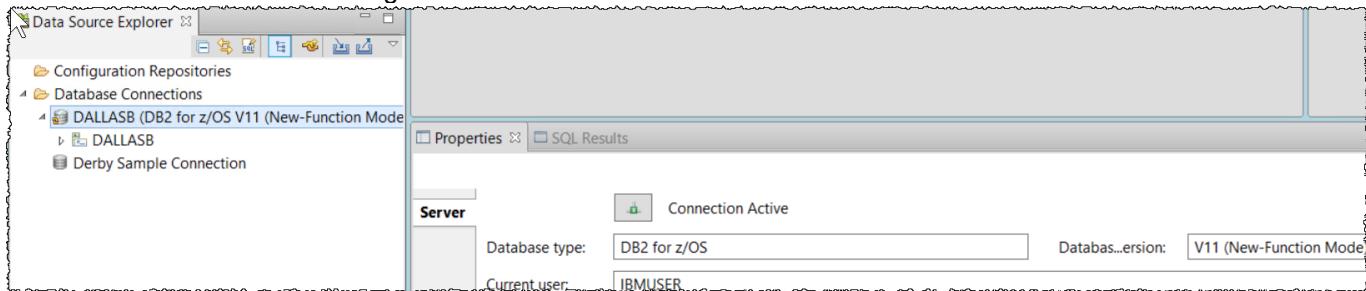
### 7.1.3 ▶▶ Select **DB2 for z/OS**, use **Location** as **DALLASB**, Host is **zos.dev** and port is **5035** , **IBMUSER** and password **SYS1** Click **Test Connection** to be sure you can successfully connect to the DB2.



#### 7.1.4 ► Click OK and Finish



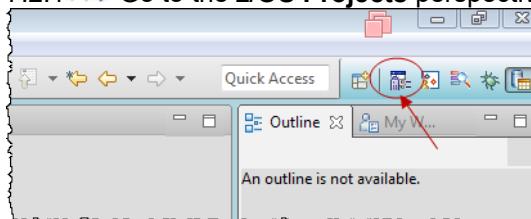
The connection is created. You could see tables, modify contents etc..  
But we want to focus on the integration of DB2 and the COBOL/DB2 editor.



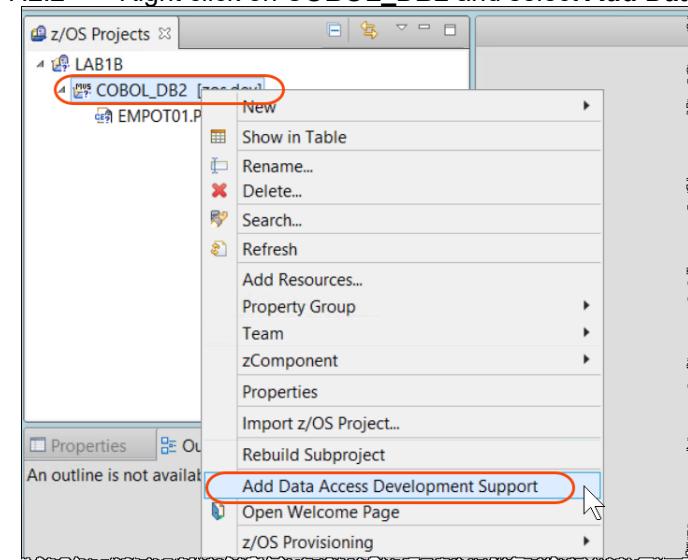
## 7.2 Running a SQL query from COBOL program

You will need to have authorization to run the queries.

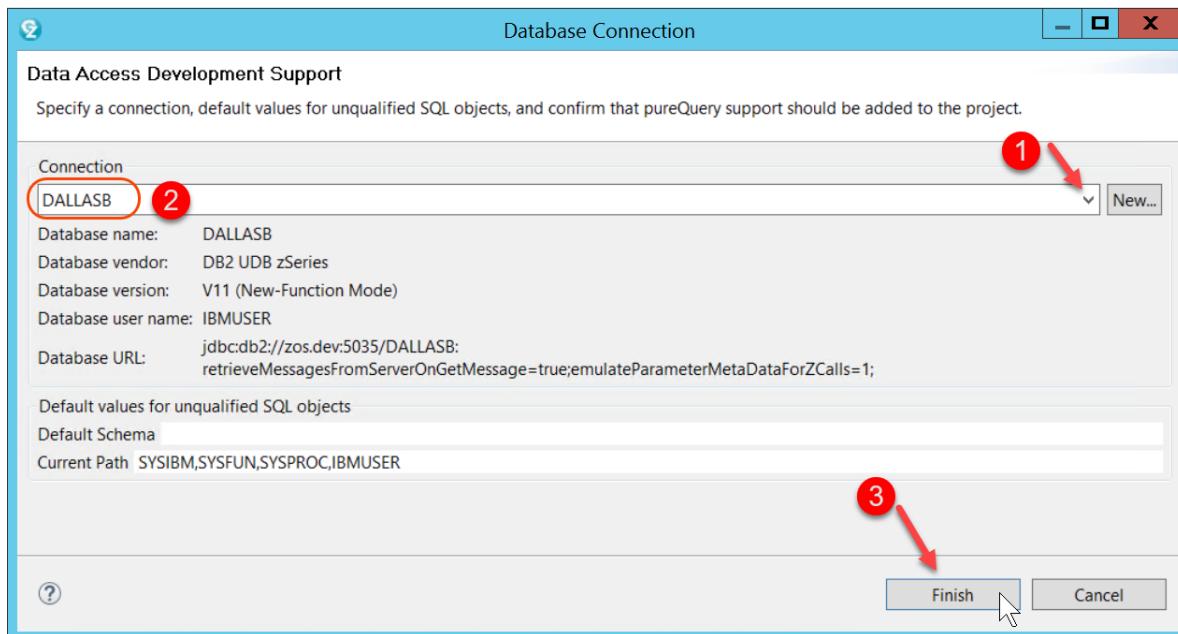
#### 7.2.1 ► Go to the z/OS Projects perspective



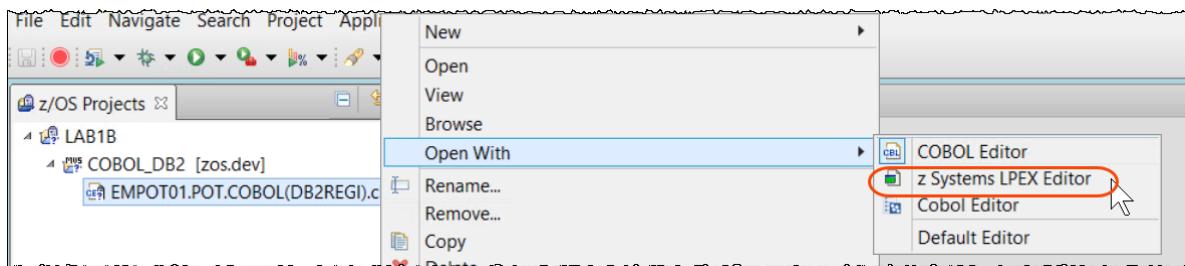
#### 7.2.2 ► Right click on COBOL\_DB2 and select Add Data Access Development Support



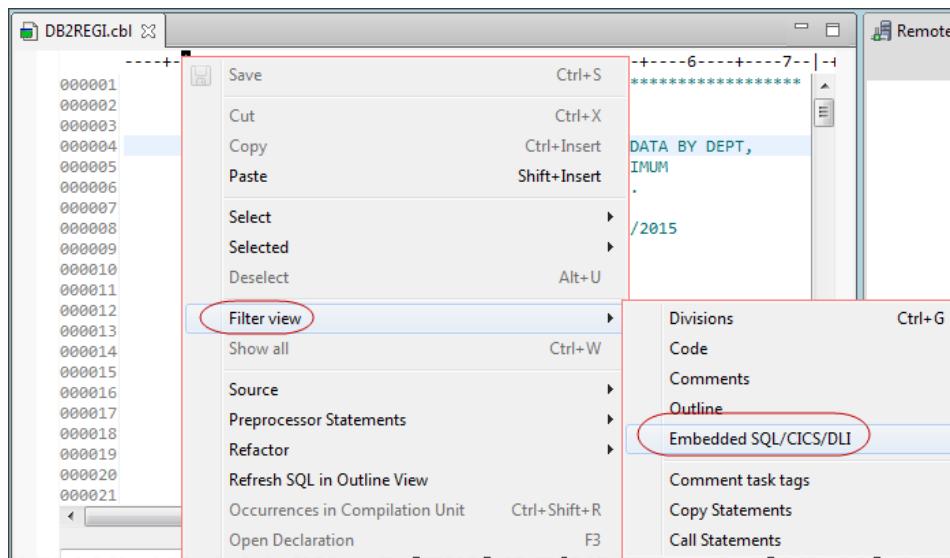
7.2.3 ► Select the connection created **DALLASB** and click **Finish**



7.2.4 ► Right click on program **DB2REGI.cbl** and select **Open With > z Systems LPEX editor**



7.2.5 ► Right click and select **Filter View > Embedded SQL/CICS/DLI**



7.2.6 ► Highlight the SQL statements as shown right click and choose Run SQL

The screenshot shows the DB2REGL.cbl editor window. A context menu is open over a block of SQL code. The menu items include Paste, Shift+Insert, Select, Selected, Deselect, Filter view, Show all, Source, Preprocessor Statements, Refactor, Tune SQL, Run SQL (which is circled in red), Refresh SQL in Outline View, Occurrences in Compilation Unit, Open Declaration, Open Perform Hierarchy, and View.

```

-----+*A-1-B-----2-----+---3---+---4-----
* 000030      EXEC SQL INCLUDE SQLCA END-EXEC.
 000068      EXEC SQL INCLUDE DIAGCODE END-EXEC.
 000069      EXEC SQL INCLUDE EMPL END-EXEC.
* 000070      EXEC SQL INCLUDE CUST1 END-EXEC.
 000121      EXEC SQL
 000122      DECLARE C1 CURSOR FOR
 000123      SELECT DEPT, MIN(PERF), MAX(
 000124          MIN(HOURS), MAX(HOURS), AVG(
 000125              FROM RBAROSA.EMPL E, RBAROSA.PAY P
 000126              WHERE E.NBR = P.NBR
 000127      * AND PERF > :PERF
 000128          GROUP BY DEPT
 000129      END-EXEC.
* 000130      EXEC SQL OPEN C1
 000131      END-EXEC.
 000187      EXEC SQL FETCH C1 INTO
 000188          :DEPT-TBL:DEPT-NULL,

```

7.2.7 ► Click as below and you will have the query results

The screenshot shows the DB2REGL.cbl editor window with the results of the executed query displayed in a results grid. The results grid has columns labeled DEPT, 2, 3, 4, 5, 6, and 7. The data rows are:

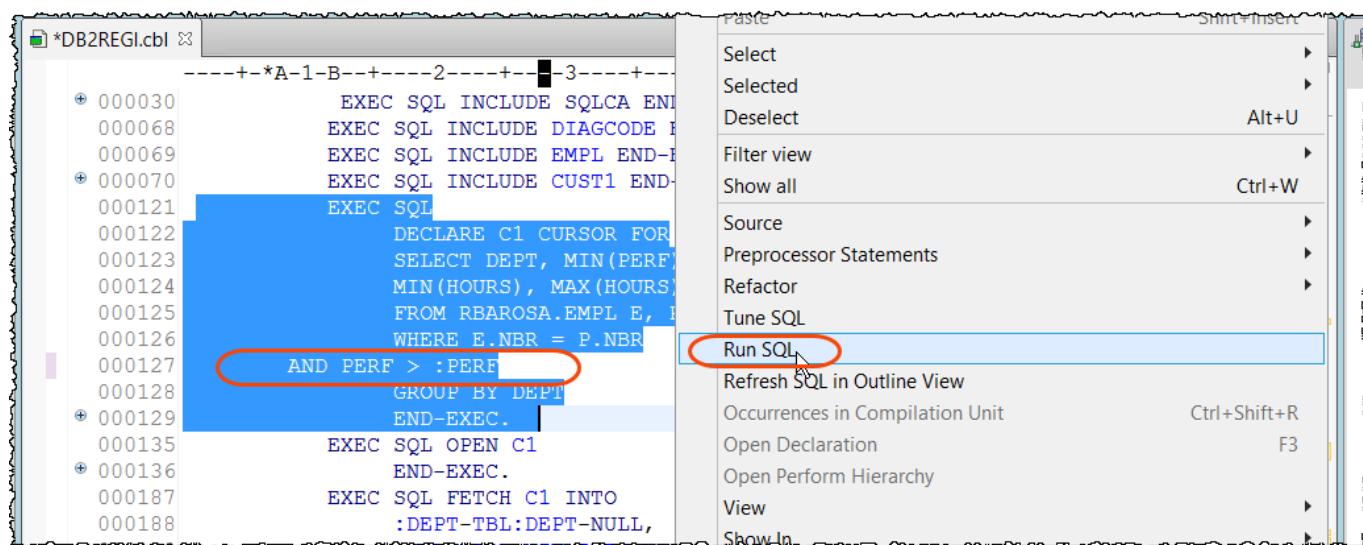
	DEPT	2	3	4	5	6	7
1	ACC	8	8	8	15.99	15.99	15.9900...
2	FIN	3	9	5	8.89	32.45	22.6966...
3	MKT	1	3	1	13.23	32.41	22.8200...
4	R&D	1	1	1	NULL	NULL	NULL
5	REG	9	9	9	26.75	26.75	26.7500...
6	NULL	0	0	0	35.45	35.45	35.4500...

Numbered callouts indicate the following steps:

- 1: Points to the status bar message "Sucess SELECT D... 8/12/19, ... DALLASB".
- 2: Points to the "Result1" tab in the results grid.

### 7.2.8 Modifying the SQL query..

► Remove the COBOL comment (\*) from the line 127,  
**Select the SQL statements again right click and choose Run SQL**

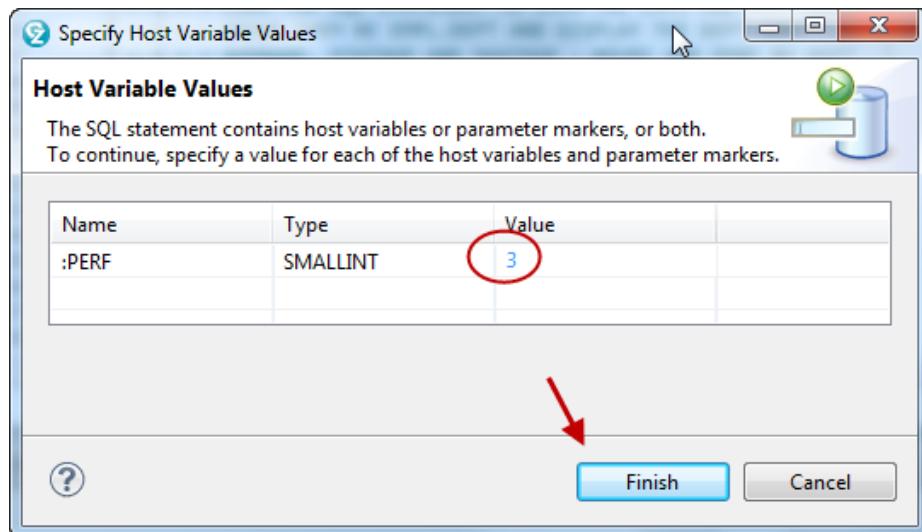


```

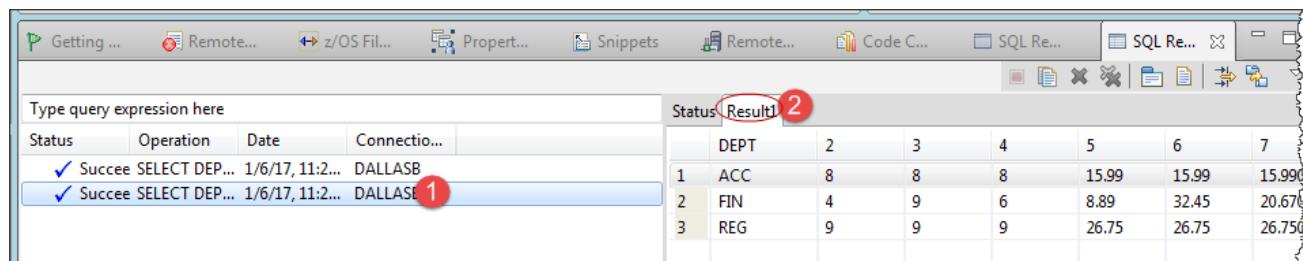
*DB2REGL.cbl
-----+-----+-----+-----+-----+
+ 000030      EXEC SQL INCLUDE SQLCA END-EXEC.
+ 000068      EXEC SQL INCLUDE DIAGCODE END-EXEC.
+ 000069      EXEC SQL INCLUDE EMPL END-EXEC.
+ 000070      EXEC SQL INCLUDE CUST1 END-EXEC.
000121      EXEC SQL
000122      DECLARE C1 CURSOR FOR
000123      SELECT DEPT, MIN(PERF)
000124      MIN(HOURS), MAX(HOURS)
000125      FROM RBAROSA.EMPL E,
000126      WHERE E.NBR = P.NBR
000127      AND PERF > :PERF
000128      GROUP BY DEPT
000129      END-EXEC.
+ 000135      EXEC SQL OPEN C1
+ 000136      END-EXEC.
000187      EXEC SQL FETCH C1 INTO
:DEPT-TBL:DEPT-NULL,
000188

```

### 7.2.9 ► Specify a value like 3 and click Finish



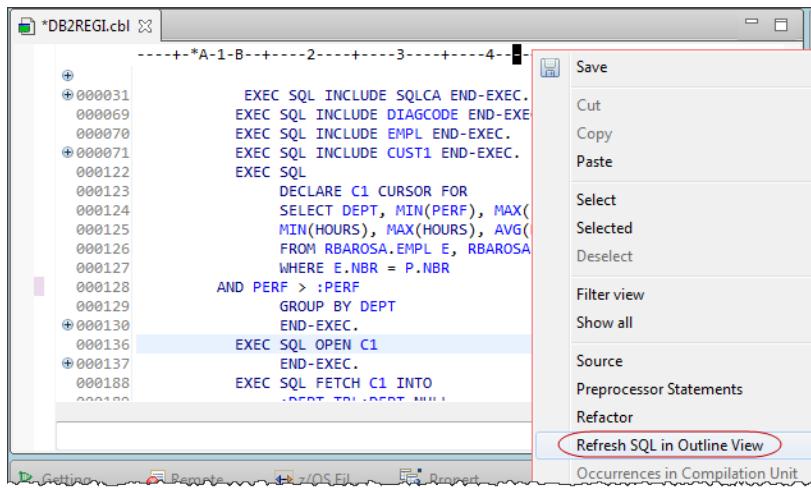
### 7.2.10 The new results now will be:



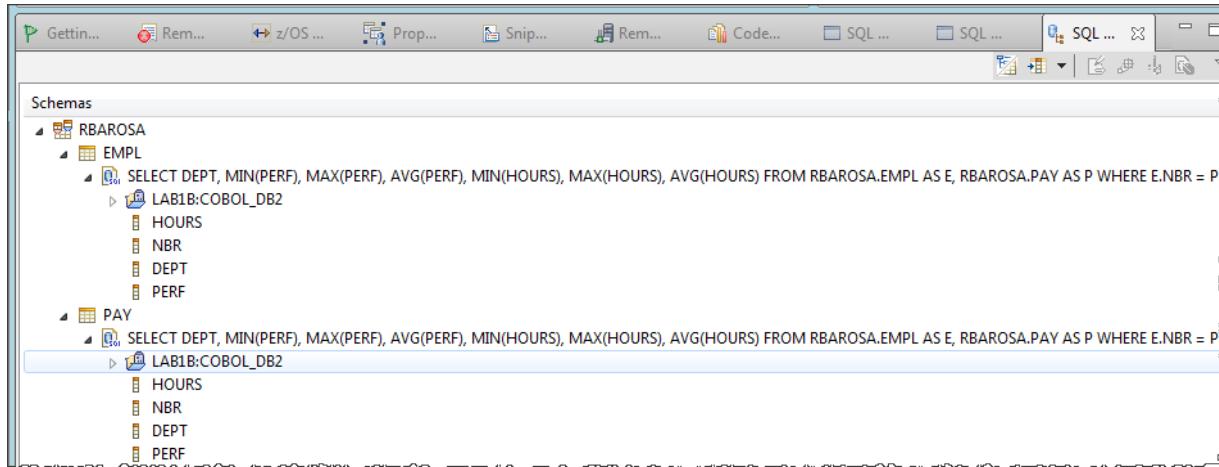
DEPT	2	3	4	5	6	7
1 ACC	8	8	8	15.99	15.99	15.99
2 FIN	4	9	6	8.89	32.45	20.67
3 REG	9	9	9	26.75	26.75	26.75

## 7.3 Using the SQL Outline view

### 7.3.1 Without selecting any statement, right click and select Refresh SQL in Outline View

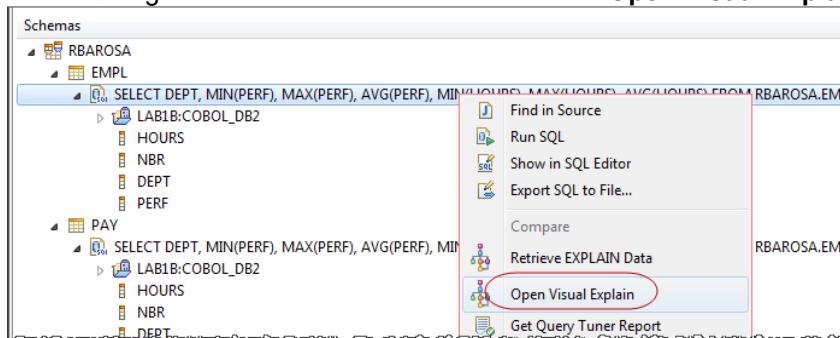


### 7.3.2 Using SQL Outline View, expand RBAROSA, EMPL, PAY and the SQL statements and you will have more details as below

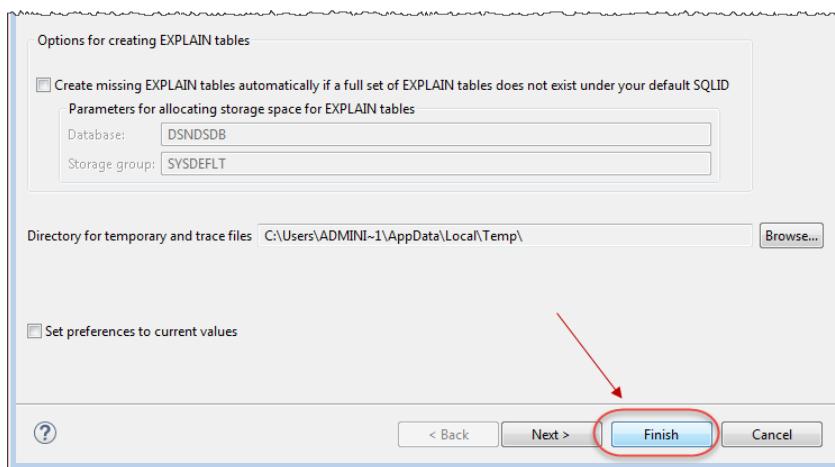


## 7.4 Using SQL Visual Explain

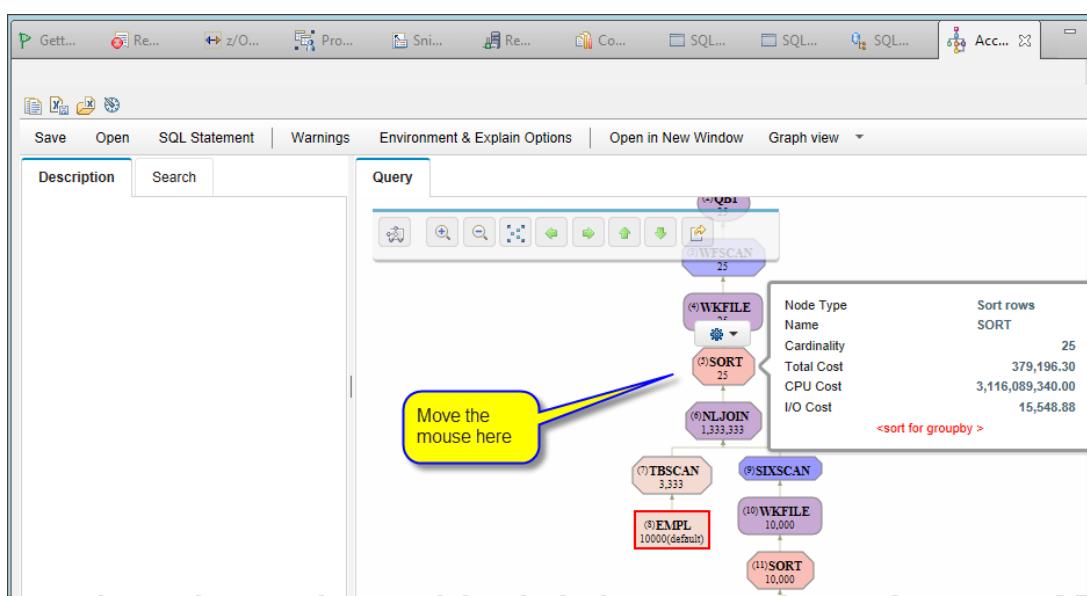
### 7.4.1 Right click on the first Select and choose Open Visual Explain



7.4.2 ► Click **Finish**. A new report view (Access Plan Diagram) will be generated in the bottom of the screen...

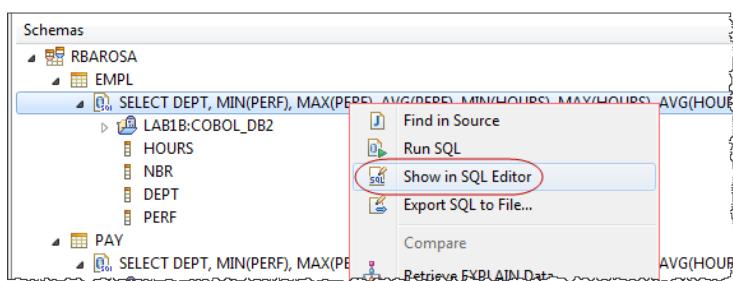


7.4.3 ► Double click on the tab to have a bigger view.  
You will have the report below to work with the SQL explain

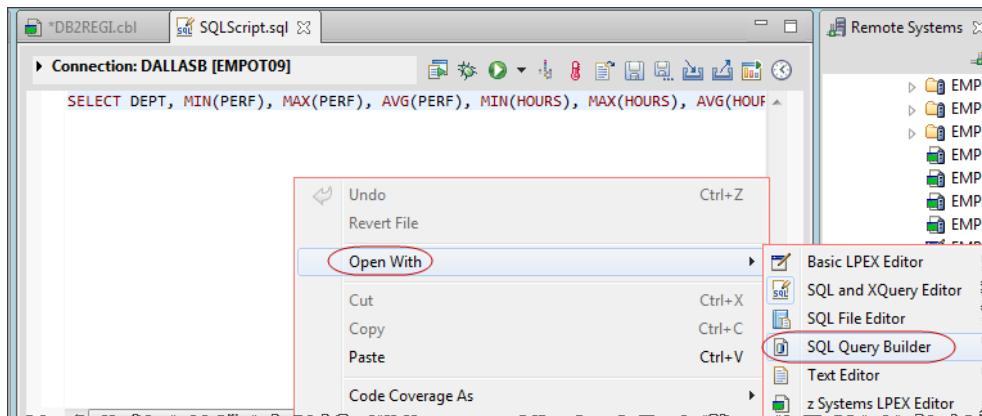


## 7.5 Reverse engineer the Query

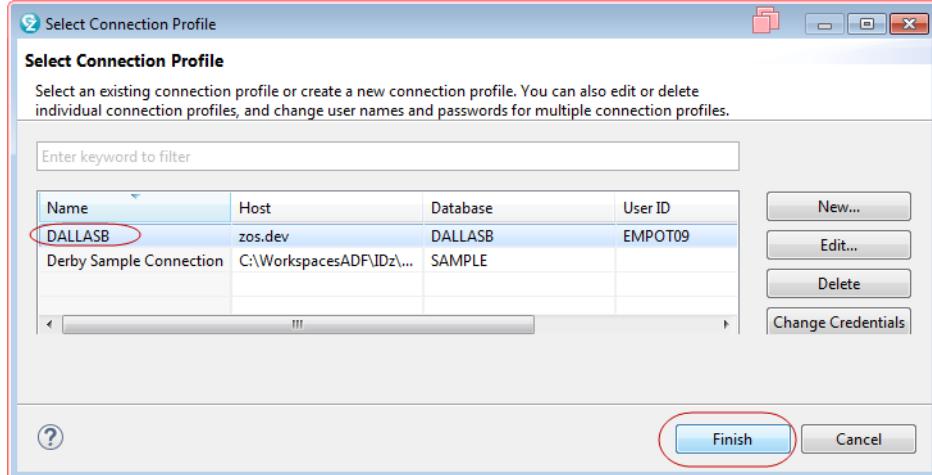
7.5.1 ► Using the SQL Outline view, right click on the Select and choose **Show in SQL Editor**



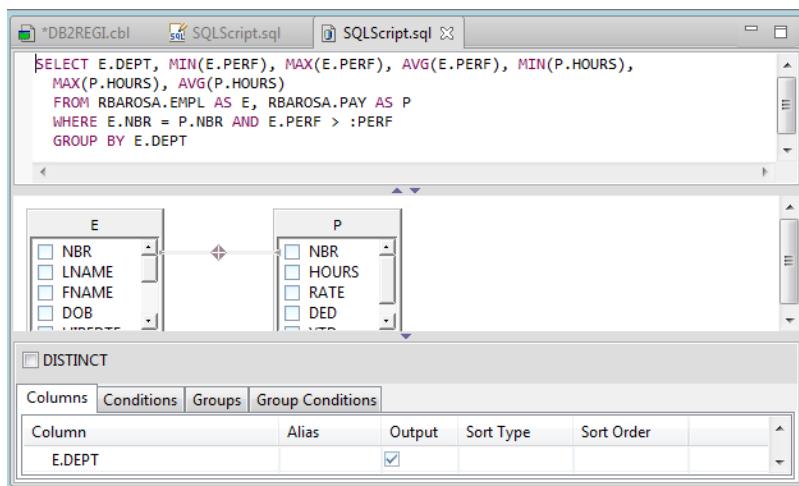
### 7.5.2 ► When opened,.. select Open With > SQL Query Builder



### 7.5.3 ► Choose DALLASB and click Finish



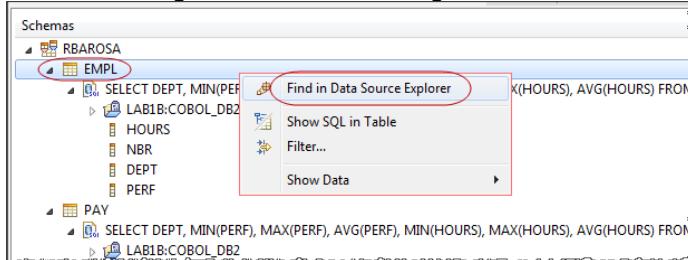
### 7.5.4 Now we have the graphical editor



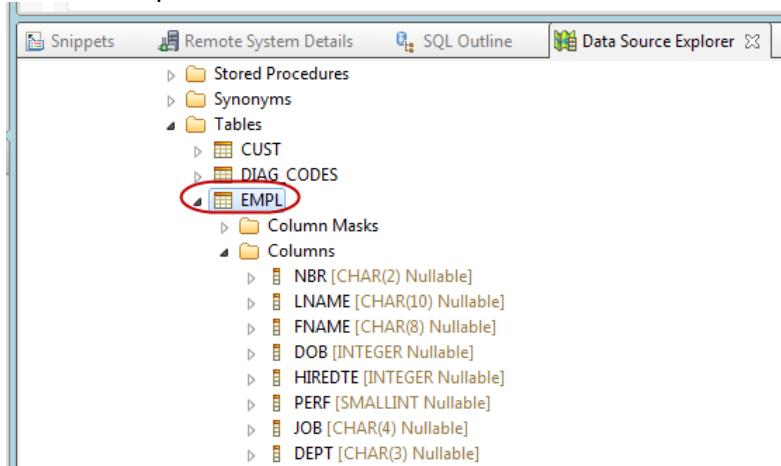
### 7.5.5 ► You might use this graphical editor to make changes on SQL statements. Notice that the changes reflects on the COBOL code..

## 7.6 Displaying DB2 table content

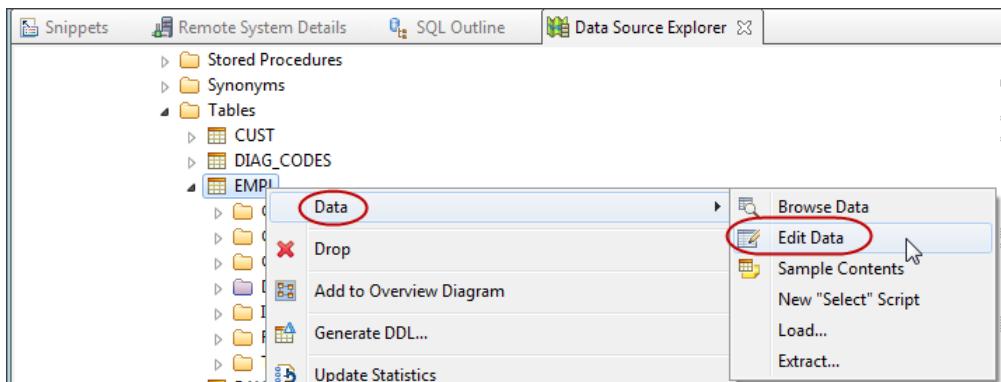
### 7.6.1 ► Using SQL Outline view, right click on EMPL and select Find Data Source Explorer



### 7.6.2 ► Expand Tables and EMPL

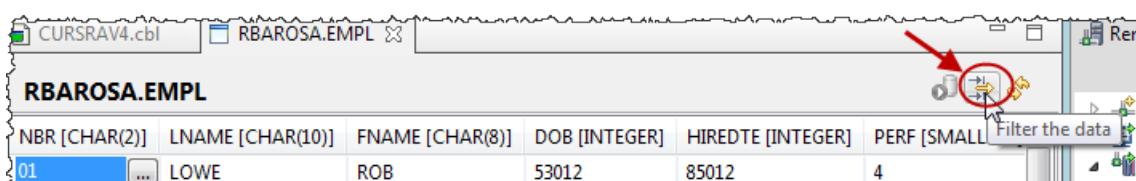


### 7.6.3 ► Right click on EMPL and select Data > Edit Data

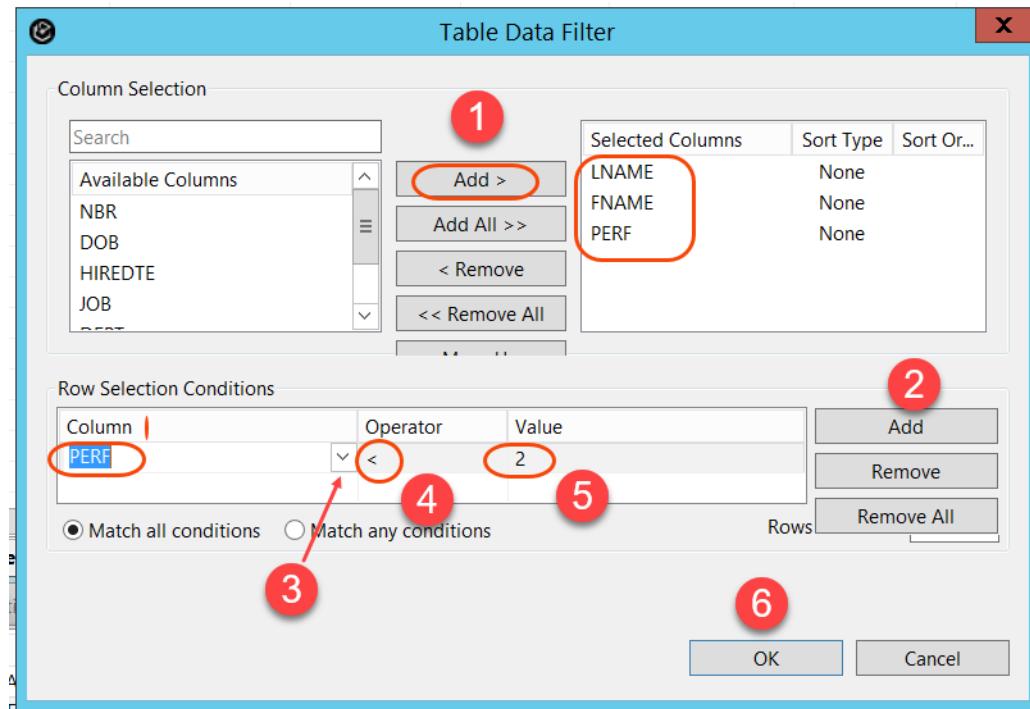


### Filtering data results.

### 7.6.4 ► Click Filter the data icon



7.6.5 ► On the *Table Data Filter* dialog, using **Add >** button, select **LNAME**, **FNAME** and **PERF**. Using the **second Add** button, use the pull down and select **EMPL.PERF** for *Column*, **<** as *Operator* and type **2** as *Value*.



7.6.6 ► Clicking **OK** you will get the results below:

The screenshot shows the DB2REGI.cbl editor displaying the results of the filtered query. The results are as follows:

	LNAME [CHAR(10)]	FNAME [CHAR(8)]	PERF [SMALLINT]
1	MOORE	ROGER	1
2	LANCASTER	BURT	1
3	BLAIR	LINDA	1
4	MOORE	ROGER	1
5	MOSTEL	ZERO	0
6	LANCASTER	BURT	1
7	BLAIR	LINDA	1
8			0
<new row>			

Connection : DALLASB      Showing all 8 rows [Change SQL results view options](#)

7.6.7 ► Close all editors pressing **Ctrl + Shift + F4**. Or just click on the of each opened editor

► Say **NO** to saving the COBOL program.

## Section 8. (Optional) Using File Manager

ADFz may optionally have the File Manager (FM) plugin installed. FM works with a broad spectrum of z/OS files and data bases, including VSAM, IAM, and QSAM files, PDS and libraries, DB2 and IMS databases, HFS files, OAM files, CICS queues, MQ queues, and tapes.

File Manager provides powerful formatted editors and viewers, and also provides a full complement of on-line and batch utilities to copy, extract, and load data, to create files and databases, compare and print, and many other utility functions.

File Manager has a conventional 3270 interface that can be accessed from TSO or CICS. here is also an eclipse GUI interface that is available on ADFz.

File Manager has many capabilities we will explore just few examples on this optional lab.

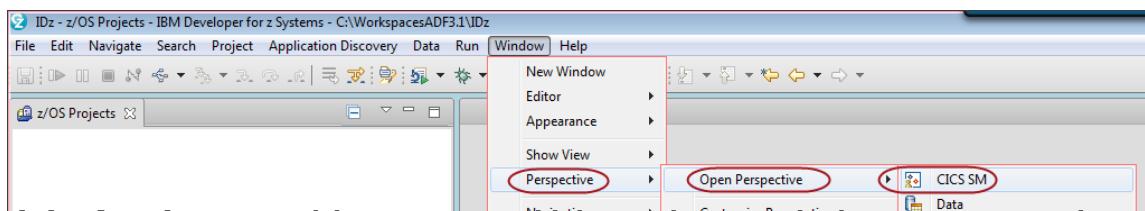
**Note that this exercise could be also done with either IDz version 14 or version 15.** Here we are using version 14, but instructions will be the same.

### 8.1 Verify that you are connected to the PDTTOOLS Common components

On step, 3.1 you have used the PDTTOOLS Common Components. Let's be sure that you are still connected.

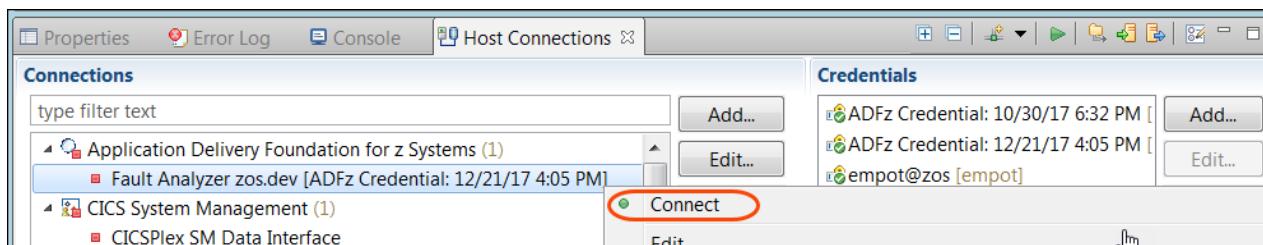
8.1.1 ► Go to **CICS SM** perspective using

**Window > Perspective> Open Perspective > CICS SM**  
(If CICS SM is not shown click **Other** and find **CICS SM**)



8.1.2 ► Click on **Host Connections** tab (bottom) and verify that **Application Delivery Foundation for z Systems** has a green icon:

If it is not green you must connect it. **Right click and select Connect**



### 8.2 Using View Load Module utility

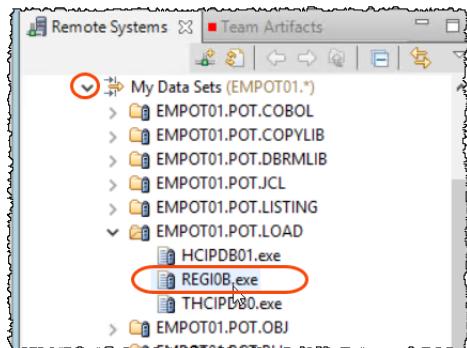
You can use the **View Load Module** utility function to print a list of the symbols (CSECTs, common sections, entry points, and ZAPs) in a load module. You also could compare load modules, using the Compare wizard.

This page details the mapping of fields to batch parameters and miscellaneous notes. For the full description of each parameter, refer to the [IBM File Manager Users Guide and Reference](#).

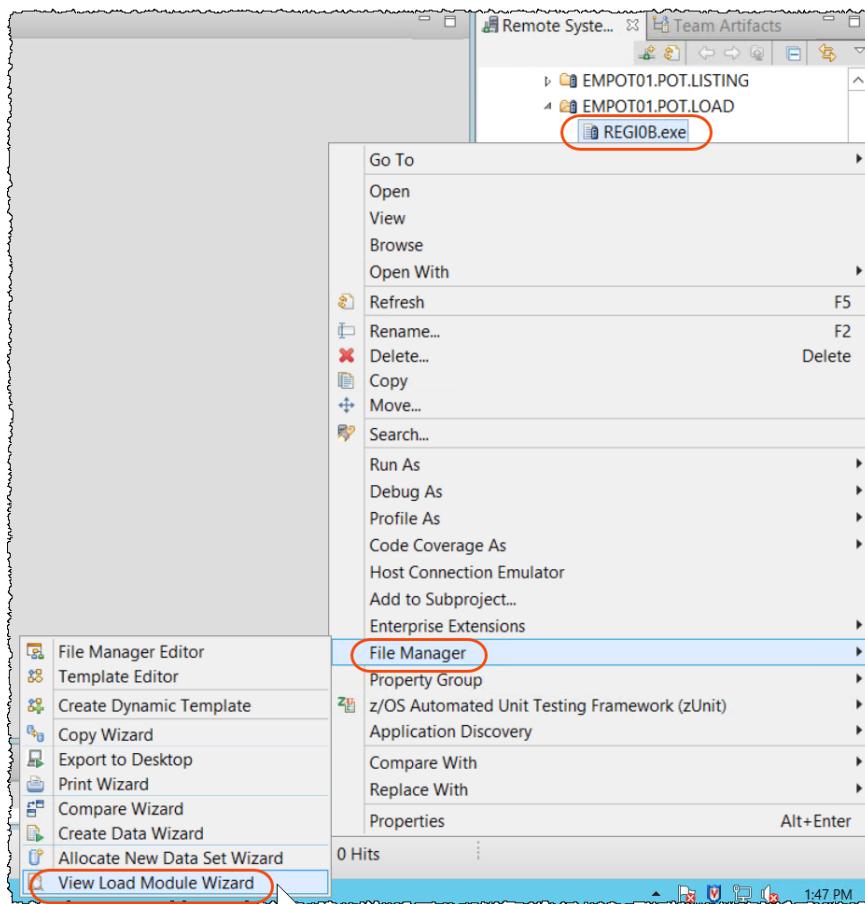
8.2.1 ► Go to **z/OS Projects** perspective clicking on the upper top right icon as below



8.2.2 ► Using Remote System view on the right, expand **MVS Files**, **My Data Sets** and **EMPOT01.POT.LOAD** and you should see the load module **REGI0B.exe** that you created before..

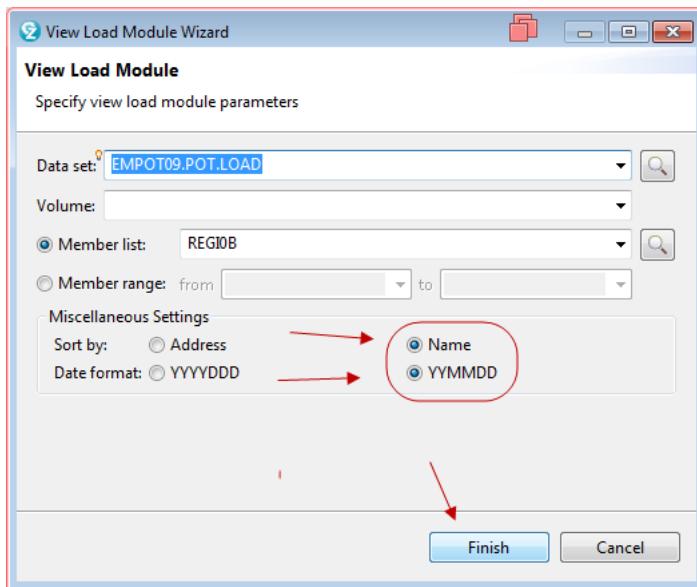


8.2.3 ► Right click on **REGI0B.exe** and select **File Manager** and **View Load Module Wizard**.



► If you get a *Sign on* dialog for *Fault Analyzer* use **empot01** credentials and click **OK**

8.2.4 ► Select **Name** to sort by name and **YYMMDD** to show the date on this format and click **Finish**.



8.2.5 The result is below..

► Scroll down and you may find interesting the date and time that this module was linked as well other information. You also could compare load modules.

```

000018 0
000019 Load Module Information
000020
000021 Load Library EMPOT01.POT.LOAD
000022 Load Module REGI0B
000023 Linked on 19/05/28 at 10:33:32 by PROGRAM BINDER 5695-PMB V2R2
000024 EPA 000000 Size 000142C TTR 000005 SSI AC 00 AM
000025
000026 Name Type Address Size Class A/RMODE Compiler 1
000027 -----
000028 -PRIVATE PC 0000000 0000008 C_@PPA2 ANY/ANY
000029 -PRIVATE PC 0000000 0000004 C_@CSINIT ANY/ANY
000030 -PRIVATE PC 0000000 0000084 C_WSA ANY/ANY
000031 CEEARLU SD 0000718 00000B8 B_TEXT MIN/ANY PL/X 390 V2R4
000032 CEEBETBL SD 00004C0 0000028 B_TEXT MIN/ANY HIGH-LEVEL AS
000033 CEEBINT SD 0000710 0000008 B_TEXT MIN/ANY PL/X 390 V2R4
000034 CEELLLST SD 00006B0 000005C B_TEXT MIN/ANY HIGH-LEVEL AS
000035 CEELLIST LD 00006C0 000004C B_TEXT 31/ANY PL/X 390 V2R4
000036 CEEBPIRA SD 00007D0 00002A0 B_TEXT

```

**Notice:** The date that is shown is when your REGI0B module was created and will be different from what is shown on your report.

8.2.6 ► Close the edited file. Can use **CTRL + Shift + F4** to close all opened editors. Or just click on the of each opened editor

## 8.3 Working with z/OS data sets

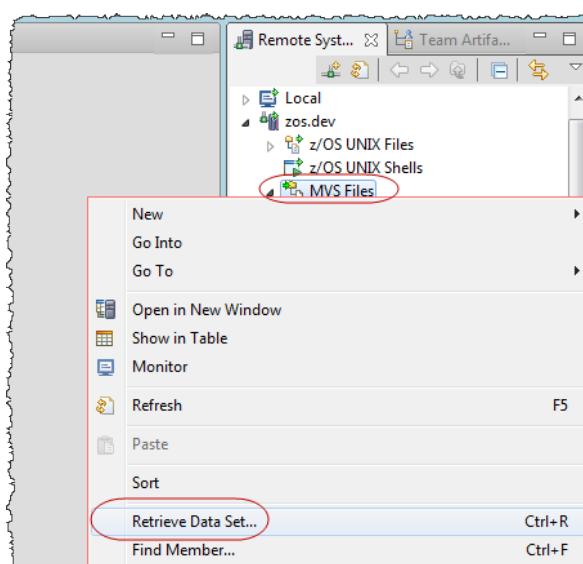
In this section, you will open a variable blocked sequential dataset in the editor or viewer, using a copybook as a layout.

You will use the very basic features of the editor, including navigating a file, we will not cover finding data in a file, changing data, inserting, deleting and sorting records.

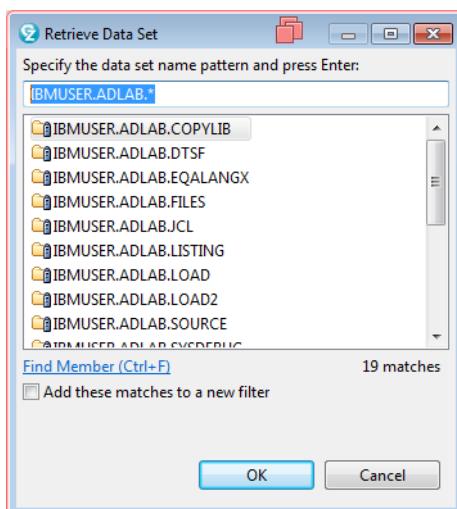
8.3.1 Before you start mapping the dataset using a COBOL COPYBOOK, let us copy the copybook that maps the file to your PDS.

► Using the *Remote Systems* view, right click on **MVS Files** and select **Retrieve Data Set** ....

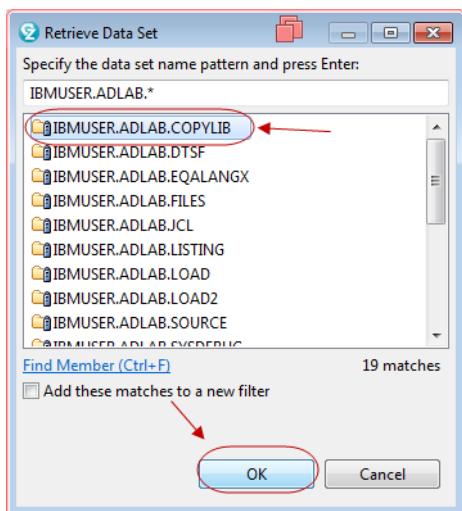
This is equivalent at the TSO 3.4 function.



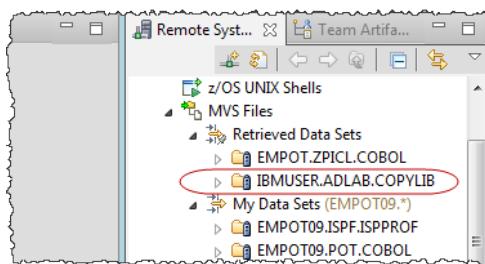
8.3.2 ► Type **IBMUSER.ADLAB.\*** and press **Enter**.



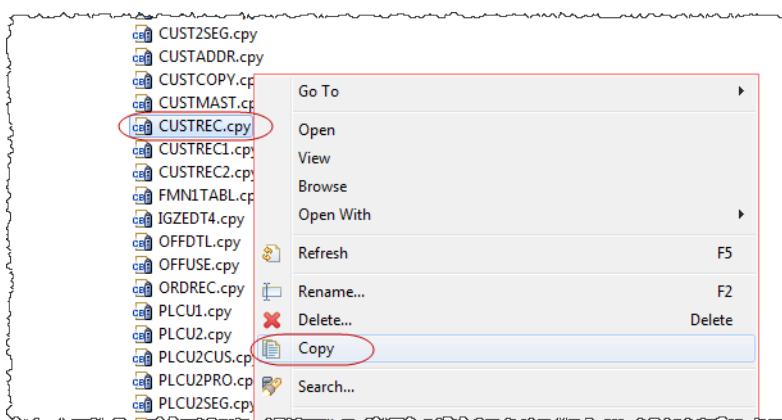
8.3.3 ► Select **IBMUSER.ADLAB.COPYLIB** and click **OK**.



8.3.4 The data set will be under *Retrieved Data Sets*.

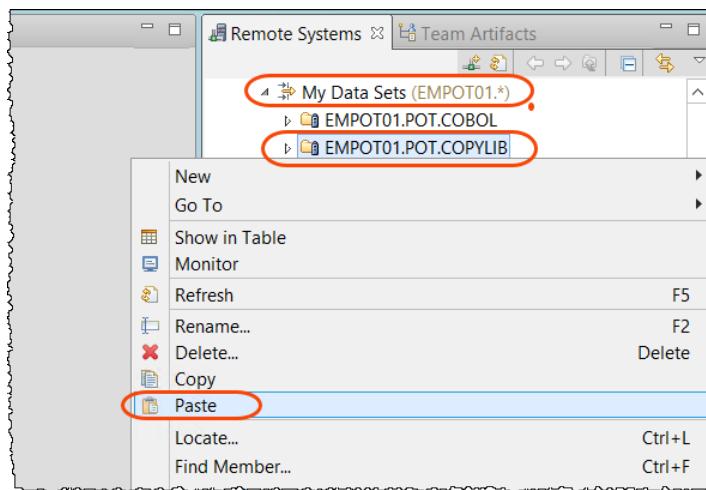


8.3.5 ► Expand **IBMUSER.ADLAB.COPYLIB**, right click on **CUSTREC.cpy** and select **Copy**. You want to copy this member to your PDS.

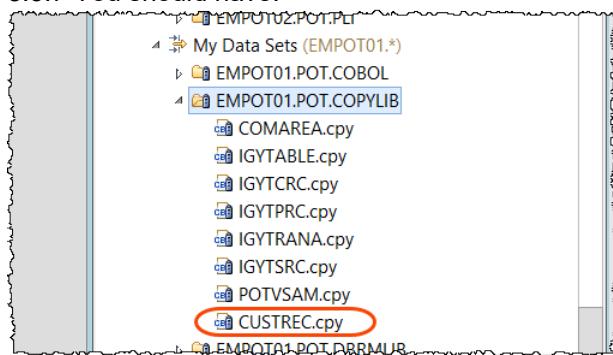


8.3.6 ➡ Navigate to **My Data Sets**, right click on **EMPOT01.POT.COPYLIB** and select **Paste**

If this member is already there select **Overwrite**



8.3.7 You should have:



8.3.8 ➡ Double click on **CUSTREC.cpy** to edit it.

This copybook is the file layout of the file that you will see later. Note than some fields are COMP-3.

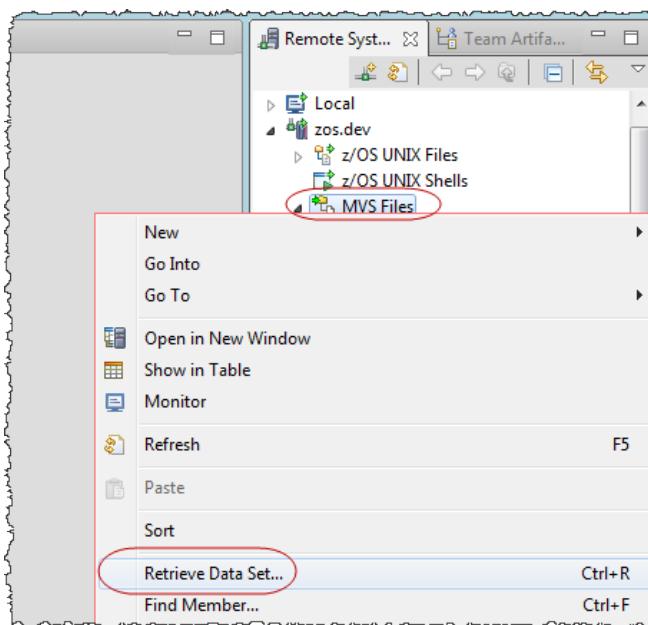
```

*** ++++++1-B-----2-----3-----4-----5-----6-----7-----8
1  *+
2  * Sample COBOL Copybook for IBM PD Tools Workshops
3  *
4  * The sample data described by this copybook
5  *      is <USERID>.ADLAB.CUSTFILE
6  *** ++++++1-B-----2-----3-----4-----5-----6-----7-----8
7 01 CUST-REC.
8    05 CUSTOMER-KEY.
9      10 CUST-ID          PIC X(5).
10     10 REC-TYPE         PIC X.
11    05 NAME              PIC X(17).
12    05 ACCT-BALANCE      PIC S9(7)V99  COMP-3.
13    05 ORDERS-YTD        PIC S9(5)   COMP.
14    05 ADDR              PIC X(20).
15    05 CITY              PIC X(14).
16    05 STATE              PIC X(02).
17    05 COUNTRY            PIC X(11).
18    05 MONTH             PIC S9(7)V99  COMP-3  OCCURS 12.
19    05 OCCUPATION         PIC X(30).
20    05 NOTES              PIC X(120).
21    05 LAB-DATA-1         PIC X(05)

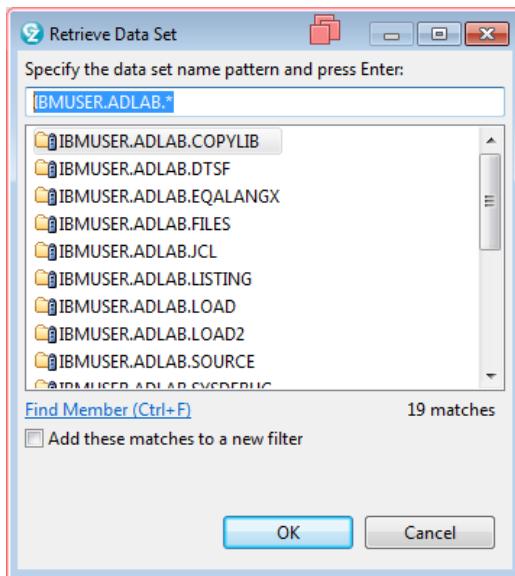
```

8.3.9 ► To see the data set, using the *Remote Systems* view, right click on **MVS Files** and select **Retrieve Data Set** ....

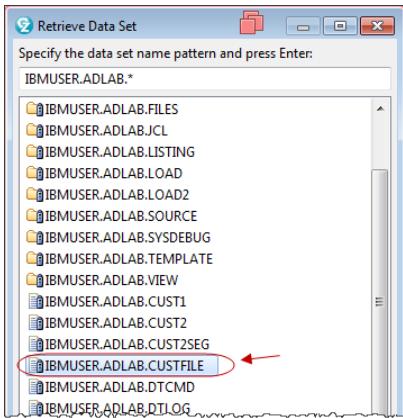
This is equivalent at the TSO 3.4 function.



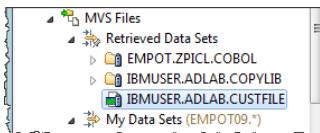
8.3.10 ► Type **IBMUSER.ADLAB.\*** and press **Enter**.



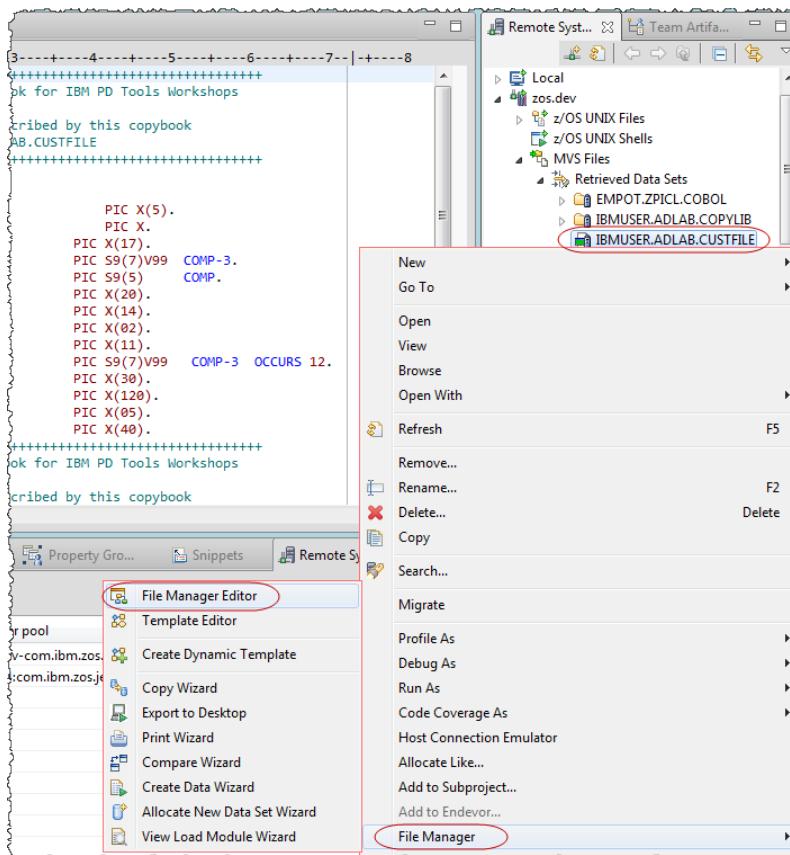
8.3.11  Scroll down, select **IBMUSER.ADLAB.CUSTFILE** and click **OK**.



8.3.12 The data set will be under *Retrieved Data Sets*.

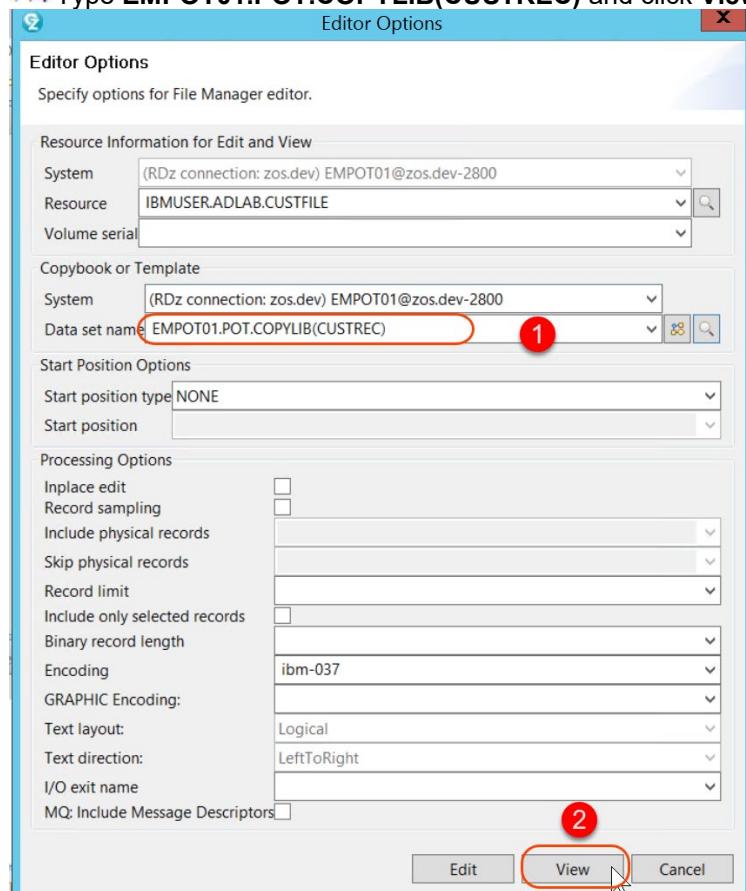


8.3.13  Right click on **IBMUSER.ADLAB.CUSTFILE** and select **File Manager -> File Manager Editor**. You want to map this file against the COBOL COPYBOOK that you copied.



8.3.14 On *Data set name* you will use the PDS and member that you have copied the COPYBOOK.

► Type **EMPOT01.POT.COPYLIB(CUSTREC)** and click **View**.



8.3.15 The file record is displayed (type A) in formatted mode.

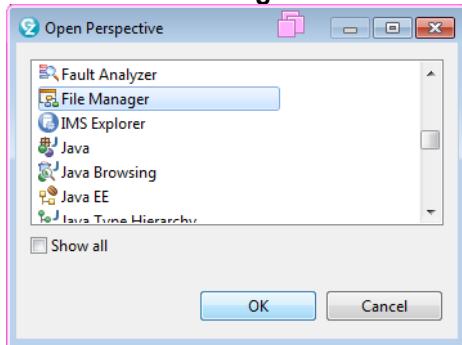
The screenshot shows the IBM Data Explorer interface. On the left, a data grid displays records from the 'CUSTREC' copybook. The columns are labeled: CUST-ID, REC-TYPE, NAME, ACCT-BALANCE, ORDERS-YTD, and ADD. The data includes records for customers like Graham, Holly, Moore, Adeline, etc. On the right, a file tree shows the structure of the 'EMPOT03.POT.COPYLIB' library, including various copybook members like COMAREA.cpy, IGYTABLE.cpy, etc. Below the file tree, there are sections for 'My Favorites', 'TSO Commands', 'JES', and 'Retrieved Jobs'.

	CUST-ID	REC-TYPE	NAME	ACCT-BALANCE	ORDERS-YTD	ADD
1	03115	A	Graham, Holly	254.53	1	310
2	05580	A	Moore, Adeline	498.95	3	470
3	06075	A	Dubree, Dustin	192.98	1	922
4	06927	A	Buchs, Jillian	99.99	0	41
5	07008	A	Houston, Roger	296.97	1	411
6	07025	A	Marx, Audrey	450.51	2	90
7	11204	A	Ness, Luke	513.06	3	516

8.3.16 We can see more details using the File manager perspective.

►► Select Window > Perspective > Open Perspective > Other...

►► Select File Manager and click OK



►► Click on the record #1.

Notice that the field **ACCT-BALANCE** that is **COMP-3** and **ORDERS-YTD** that is **COMP** are correctly displayed.

	CUST-ID	REC-TYPE	NAME	ACCT-BALANCE	ORDERS-YTD	ADDR	CITY	STATE	COUNTRY
1	03115	A	Graham, Holly	254.53		1 3100 Oaktree Ct	Raleigh	NC	USA
2 CO...									
3 CO...									
4	05580	A	Moore, Adeline	498.95	3	4700 S. Syracuse	Denver	CO	USA
5 CO...									
6 CO...									
7 CO...									
8	06075	A	Dubree, Dustin	192.98	1	9229 Delegate's Row	Indianapolis	IN	USA
9	06927	A	Buchs, Jillian	99.99	0	41 Avendale Drive	Carlisle	PA	USA
10	07008	A	Houston, Roger	296.97	1	4111 Northside PkWay	Atlanta	GA	USA
11	07025	A	Marx, Audrey	450.51	2	90 South Cascade	Boulder	CO	USA
12 C...									
13 C...									
14 C...									

Field	Picture	Type	Start	Length	Data
CUST-ID	X(5)	AN	1	5	03115
REC-TYPE	X	AN	6	1	A
NAME	X(17)	AN	7	17	Graham, Holly
ACCT-B...	S9(7)V99	FD	24	5	254.53
ORDERS...	S9(5)	BI	29	4	1
ADDR	X(20)	AN	33	20	3100 Oaktree Ct
CITY	X(14)	AN	53	14	Raleigh
STATE	X(02)	AN	67	2	NC
COUNTRY	X(11)	AN	69	11	USA

You may have to scroll down this view to see the formatted field names.

Also notice that there are two views of the data. The multiple record view appears at the top by default, and the single record view appears at the bottom and displays only one record at a time.

If you select (click) a record in the multiple-record view that record displays in the single record view.

#### 8.3.16 ➡ Click on the record #2 and verify the new layout (CONTACT-REC)..

The screenshot shows the CBL CUSTREC.cpy editor interface. At the top, there is a toolbar with various icons. Below the toolbar is a navigation bar with 'TOP' selected. The main area contains a table with 14 rows of customer data. Row 2 is highlighted with a red box and labeled '2 CONTACT-R'. A red arrow points from this row to the single-record view below. The single-record view is titled 'Layout CONTACT-REC' and shows the details for the second record. It includes a table with columns: Field, Picture, Type, Start, Length, and Data. The data for the second record is as follows:

Field	Picture	Type	Start	Length	Data
CUST-ID	X(5)	AN	1	5	03115
REC-TYPE	X	AN	6	1	B
NAME	X(17)	AN	7	17	Graham, Holly
DESCRIPTION	X(10)	AN	24	10	Home Phone
CONTACT-INFO	X(20)	AN	34	20	112-555-6736

#### 8.3.17 ➡ Click on the Layout pull-down in the editor and select CONTACT-REC. As you see, you can work with multiple layouts.

The screenshot shows the CBL CUSTREC.cpy editor interface. The layout dropdown menu is open, and 'CONTACT-REC' is selected. A red box highlights the 'CONTACT-REC' option in the dropdown menu. A red arrow points from the 'CONTACT-REC' option to the single-record view below. The single-record view is titled 'Layout CONTACT-REC' and shows the details for the second record. It includes a table with columns: Field, Picture, Type, Start, Length, and Data. The data for the second record is as follows:

Field	Picture	Type	Start	Length	Data
CUST-ID	X(5)	AN	1	5	03115
REC-TYPE	X	AN	6	1	B
NAME	X(17)	AN	7	17	Graham, Holly
DESCRIPTION	X(10)	AN	24	10	Home Phone
CONTACT-INFO	X(20)	AN	34	20	112-555-6736

8.3.18 You now can see that records 2 and 3 are displayed (type B and C) in formatted mode.

	CUST-ID	REC-TYPE	NAME	DESCRIPTION	CONTACT-INFO
1	CUST-...				
2	03115	B	Graham, Holly	Home Phone	112-555-6736
3	03115	C	Graham, Holly	Cell Phone	135-555-2338
4	CUST-...				
5	05580	B	Moore, Adeline	Work Phone	161-555-4024
6	05580	C	Moore, Adeline	Home Phone	221-555-7598
7	05580	D	Moore, Adeline	Cell Phone	138-555-2410
8	CUST-...				
9	CUST-...				
10	CUST...				
11	CUST...				
12	07025	B	Marx, Audrey	Cell Phone	232-555-7244
13	07025	C	Marx, Audrey	Home Phone	240-555-4245
14	07025	D	Marx, Audrey	Work Phone	232-555-8753

8.3.19 ►► Right click on the editor and verify that there are many options.

►► Click on **Switch Mode**

Context menu options:

- Compare With
- Switch Mode (highlighted)
- Page Up
- Page Down
- Page Left
- Page Right
- Copy Records
- Find/Replace
- Locate Column
- Sort Records
- Hex on/off
- Show Options
- Exclude Records
- Reset Excludes
- Save Records
- SaveAs Records
- Validate
- Software Analysis
- Team
- Replace With

8.3.20 The multiple-record view display is changed to character mode. In character mode, the data is not formatted according to the fields in layout.

The screenshot shows the CBL CUSTREC.cpy editor window. The data is displayed in character mode, where field boundaries are not respected. A red circle highlights the 'CHARACTER' button at the bottom left of the interface.

8.3.21 ► On the lower view notice the **View Mode** options.  
Use the drop down and select **Dump Mode**:

The screenshot shows the CONTACT-REC layout editor. The 'View Mode' dropdown menu is open, showing options: Single Mode, Dump Mode, DB2 Single Mode, Structure Mode, and Unstructured Mode. 'Dump Mode' is selected and highlighted with a red box. A red arrow points from the 'View Mode' dropdown to the menu.

The screenshot shows the CONTACT-REC layout editor in dump mode. It displays binary data as hex values. The data shown includes offsets +0, +10, +20, and +30, with corresponding hex values F0, F5, F5, F8, F0, C4, D4, 96, 96, 99, 85, 6B, 40, C, 0, 5, 5, etc.

There are lots of capabilities here.. You can try play a bit, but due to time constrains we will not cover all.

8.3.22 ► Use **Ctrl + Shift + F4** to close all opened editors.

## 8.4 Working with templates

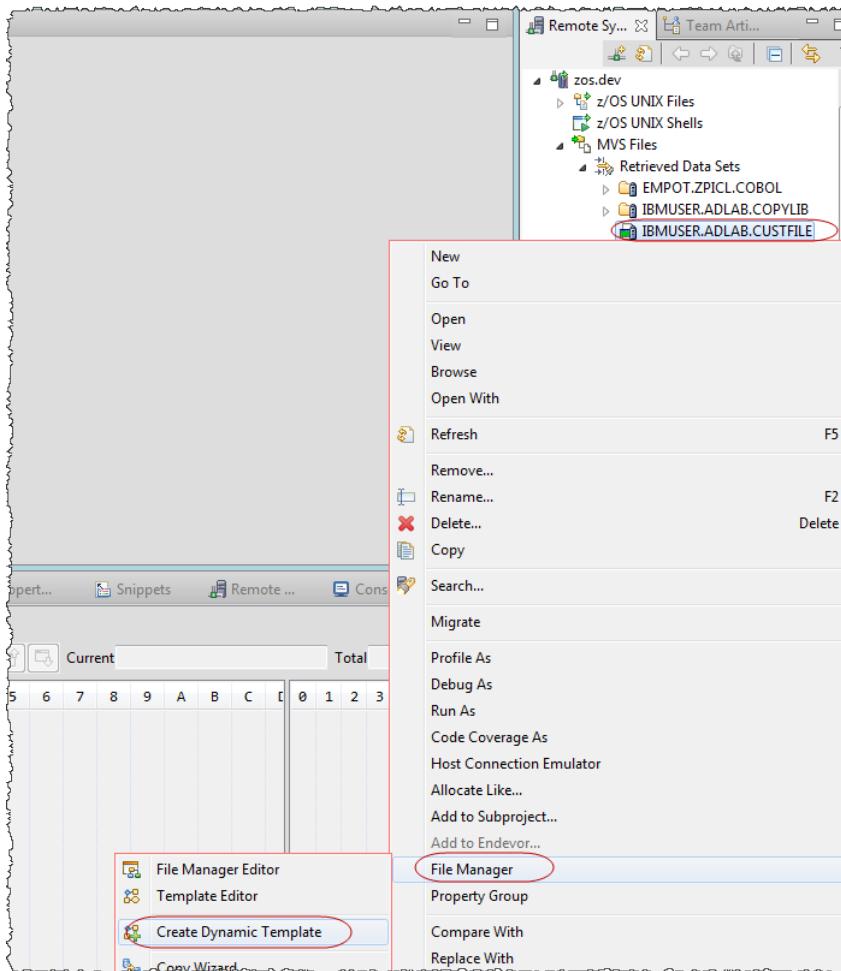
When you use the File Manager editor or viewer, you can specify a layout in the form of either a copybook or a template. If you specify a copybook, the editor/viewer can display records formatted according to the fields in the copybook. While a copybook defines the record layout, it cannot be used to select only a subset of records. A template, like a copybook, also has fields and defines the record layout. In addition, in a template you can specify:

- Record selection criteria (so that only the selected records will display)
- Field selection (so that only selected fields will display)
- Formatting of individual fields (for example, to always display a certain field in hexadecimal)
- And other formatting and data manipulation settings

You can use an existing copybook as the basis for a new template. All of the fields in the copybook are copied into the new template, and then you save the template. Templates are stored in PDS or library data sets. After you have saved a template, you can re-use it again whenever you need it. Templates can be used by other File Manager utilities other than just the editor and viewer.

For example, if you have a template that selects records, you can use it with the File Manager copy utility, and only the selected records will be copied.

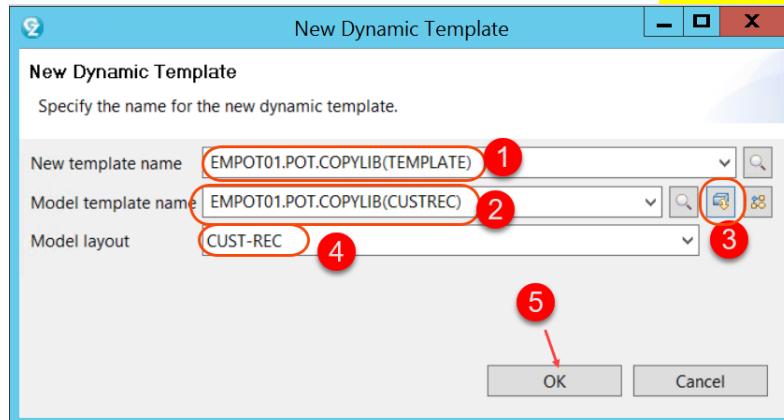
8.4.1  Go back to **z/OS Projects** Perspective and using *Remote Systems Explorer* view, right click **IBMUSER.ADLAB.CUSTFILE** file and select **File Manager -> Create Dynamic Template**



8.4.2 ► As New template name type **EMPOT01.POT.COPYLIB(TEMPLATE)**

► For Model template name type **EMPOT01.POT.COPYLIB(CUSTREC)** and click on icon (Load model template).

► Be sure that **CUST-REC** is selected and click **OK**. If an overwrite message appears, click **YES**.



8.4.3 On the *File Manager Template Editor* you will add a selection criteria.

You will select all customers that have the ACCT-BALANCE **bigger than 100** and we want to display only **CUST-ID**, **NAME** and **ACCT-BALANCE**.

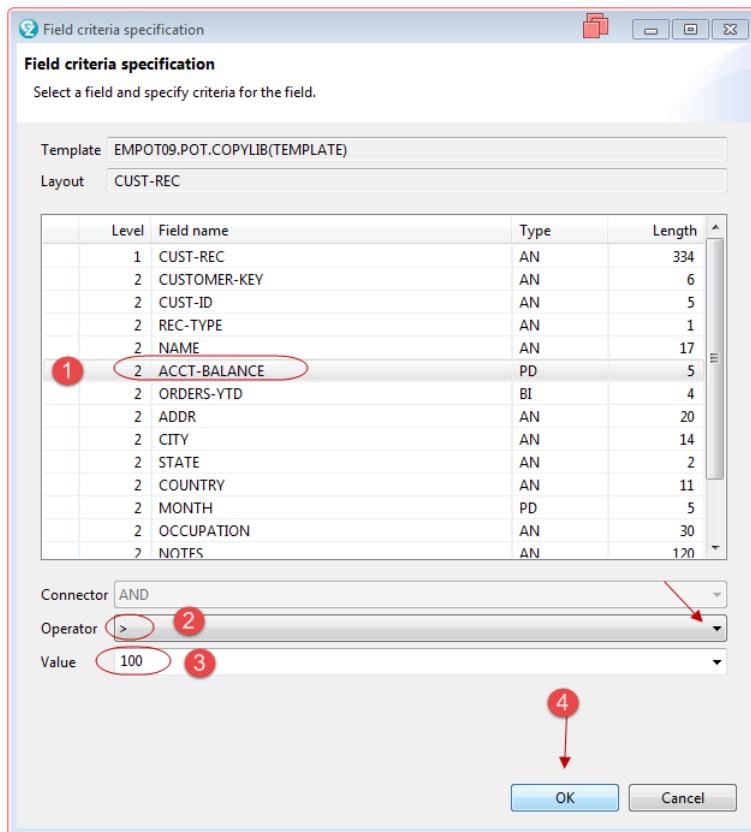
► 1 On **Selection criteria** click on the icon

► 2 Using **By-Field Criteria Builder** click on the icon

The screenshot shows the 'File Manager Template Editor' interface. The main window displays a layout for 'CUST-REC'. In the 'Selection criteria' section, there is a grid icon (step 1). Below it, the 'By-Field Criteria Builder' section has its own toolbar with a plus sign icon (step 2). A red arrow points from the 'Selection criteria' toolbar to the 'By-Field Criteria Builder' toolbar.

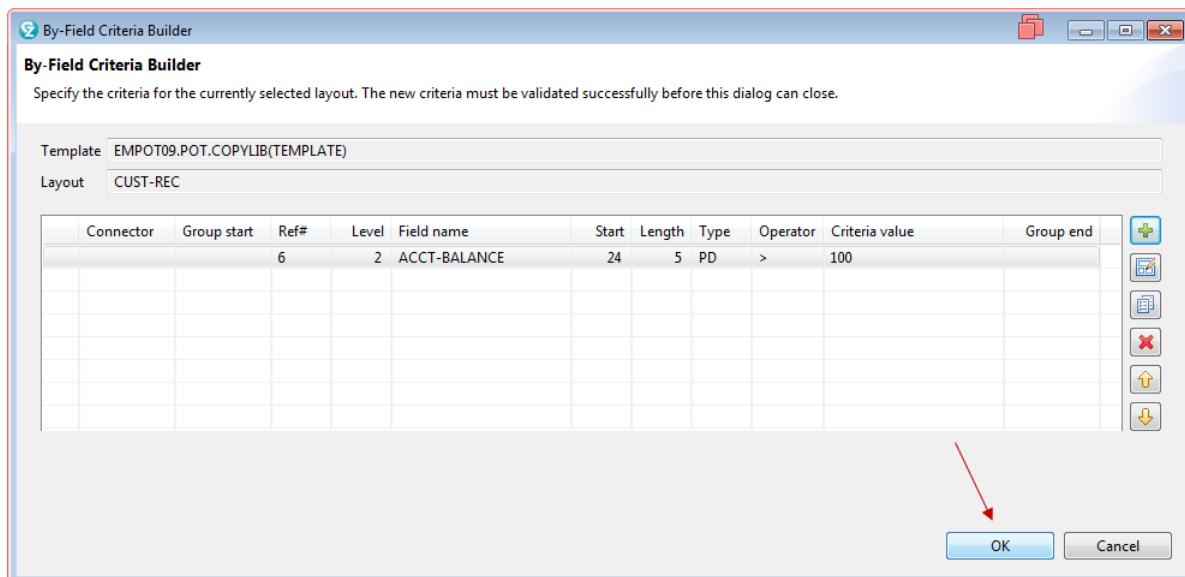
8.4.4 1 On the *Field criteria specification* select **ACCT-BALANCE**

2 On the *Operator* using the drop down select **>** and 3 on the *Value* type **100** and 4 click **OK**.



8.4.5 The result is shown below..

Click **OK**



8.4.6 ► Using the column **Selected** double-click on the boxes

① CUST-ID, ② NAME and ③ ACCT-BALANCE.

► Click **OK**.

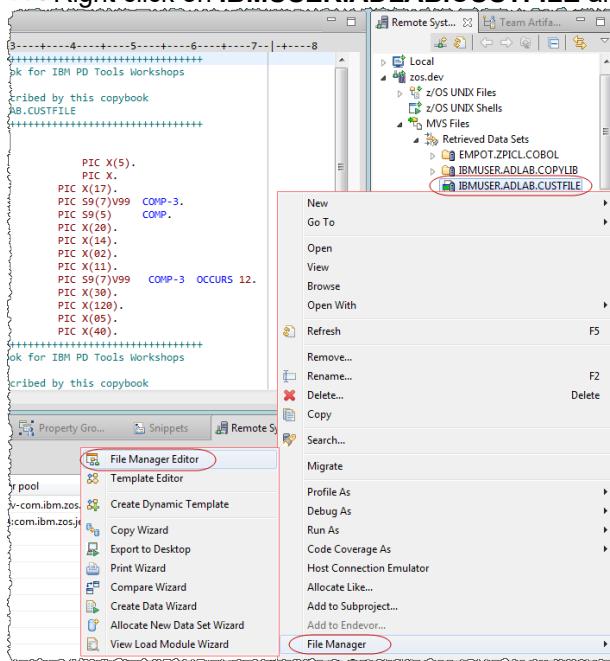
The template is created. At any time, you can edit and modify it.

The screenshot shows the 'File Manager Template Editor' window for creating a COBOL layout. The title bar indicates the connection is to 'zos.dev' and the file is 'EMPOT01.POT.COPYLIB(YTEMPLAT)'. The main area displays a table of fields with columns for Sequence, Hold, Selected, Level, Name, Additional Clause, Picture, Type, Start, Length, and REDEFINES Criteria. The 'Selected' column is circled in red with numbers 1, 2, and 3 corresponding to the fields CUST-ID, NAME, and ACCT-BALANCE. A red arrow labeled 4 points to the 'OK' button at the bottom right of the dialog.

Sequence	Hold	Selected	Level	Name	Additional Clause	Picture	Type	Start	Length	REDEFINES Crit...
1			1	CUST-REC			Alphanumeric	1	334	
2			2	CUSTOMER-KEY			Alphanumeric	1	6	
3	1	<input checked="" type="checkbox"/>	2	CUST-ID			Alphanumeric	1	5	
4			2	REC-TYPE			Alphanumeric	6	1	
5			2	NAME			Alphanumeric	7	17	
6		<input checked="" type="checkbox"/>	2	ACCT-BALANCE			Packed decimal	24	5	
7			2	ORDERS-YTD			Binary	29	4	
8			2	ADDR			Alphanumeric	33	20	
9			2	CITY			Alphanumeric	53	14	
10			2	STATE			Alphanumeric	67	2	
11			2	COUNTRY			Alphanumeric	69	11	
12			2	MONTH			Packed decimal	80	5	
13			2	OCCUPATION			Alphanumeric	140	30	
14			2	NOTES			Alphanumeric	170	120	
15			2	LAB-DATA-1			Alphanumeric	290	5	
16			2	LAB-DATA-2			Alphanumeric	295	40	

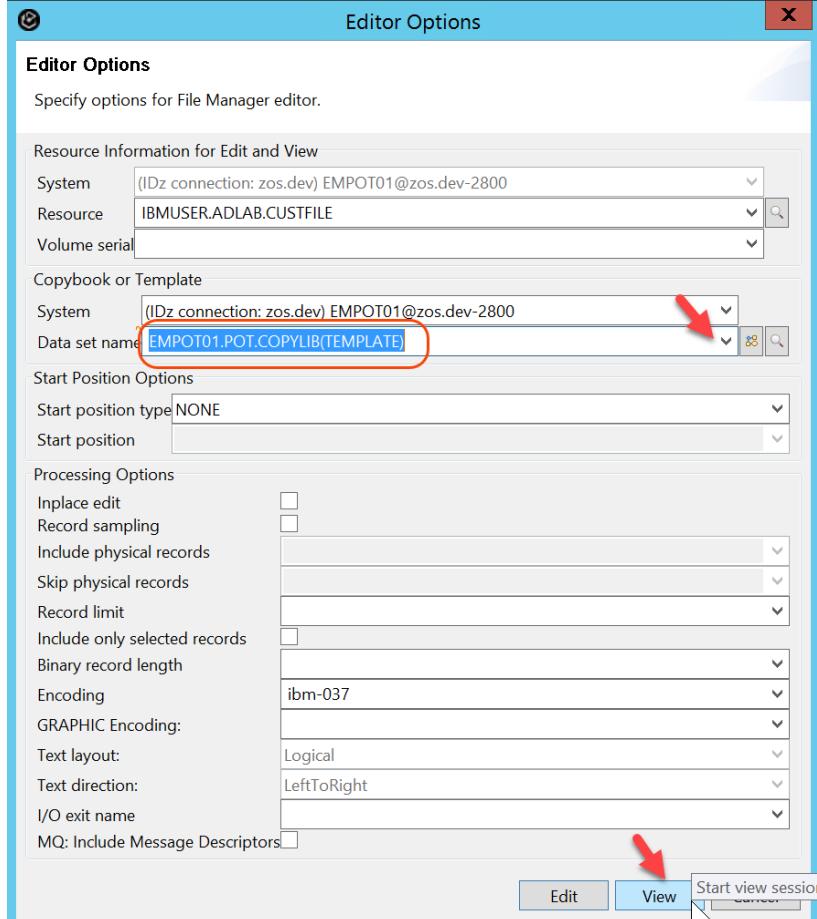
8.4.7 Now that the template is created you can use against the data set.

► Right click on IBMUSER.ADLAB.CUSTFILE and select File Manager -> File Manager Editor.



8.4.8 ► On Data set name type the Template that you have created.

Type **EMPOT01.POT.COPYLIB(TEMPLATE)** (or use the drop down) and click **View**.



#### 8.4.9 You should have the results below..

Notice that only 3 fields are displayed and all have account balance higher than 100.

The screenshot shows the Rational Developer for z/OS (RDz) interface. On the left, there is a data editor titled 'RDz connection: zos.dev' showing a table with columns CUST-ID, NAME, and ACCT-BALANCE. The data includes rows for customers 1 through 14, with names like Graham, Holly, Moore, Adeline, etc., and account balances ranging from 19298 to 25453. Below this editor is another titled 'Layout CUST-REC' showing field definitions for CUST-ID, NAME, and ACCT-BALANCE. On the right, there is a 'Remote System Det...' browser window displaying a hierarchical view of datasets on the 'zos.dev' system, including 'z/OS UNIX Files', 'z/OS UNIX Shells', and 'MVS Files' sections.

	CUST-ID	NAME	ACCT-BALANCE
1	03115	Graham, Holly	25453
2 CONTA...			
3 CONTA...			
4	05580	Moore, Adeline	49895
5 CONTA...			
6 CONTA...			
7 CONTA...			
8	06075	Dubree, Dustin	19298
9	06927	Buchs, Jillian	9999
10	07008	Houston, Roger	29697
11	07025	Marx, Audrey	45051
12 CONT...			
13 CONT...			
14 CONT...			

Field	Picture	Type	Start	Length	Data
CUST-ID		AN	1	5	03115
NAME		AN	7	17	Graham, Holly
ACCT-BALANCE		PD	24	5	25453

File manager had much more capabilities. But at least you had an idea how it works with z/OS datasets

#### 8.4.10 ➔ Use **Ctrl + Shift + F4** to close all editors. Or just click on the ✕ of each opened editor

**Congratulations!** You have completed the Lab.

# LAB 2D -(OPTIONAL) z/OS Connect EE Toolkit : Create an API from Catalog Manager Application ( EGUI )

Created by Wilbert, updated April 12 2021 by Regi



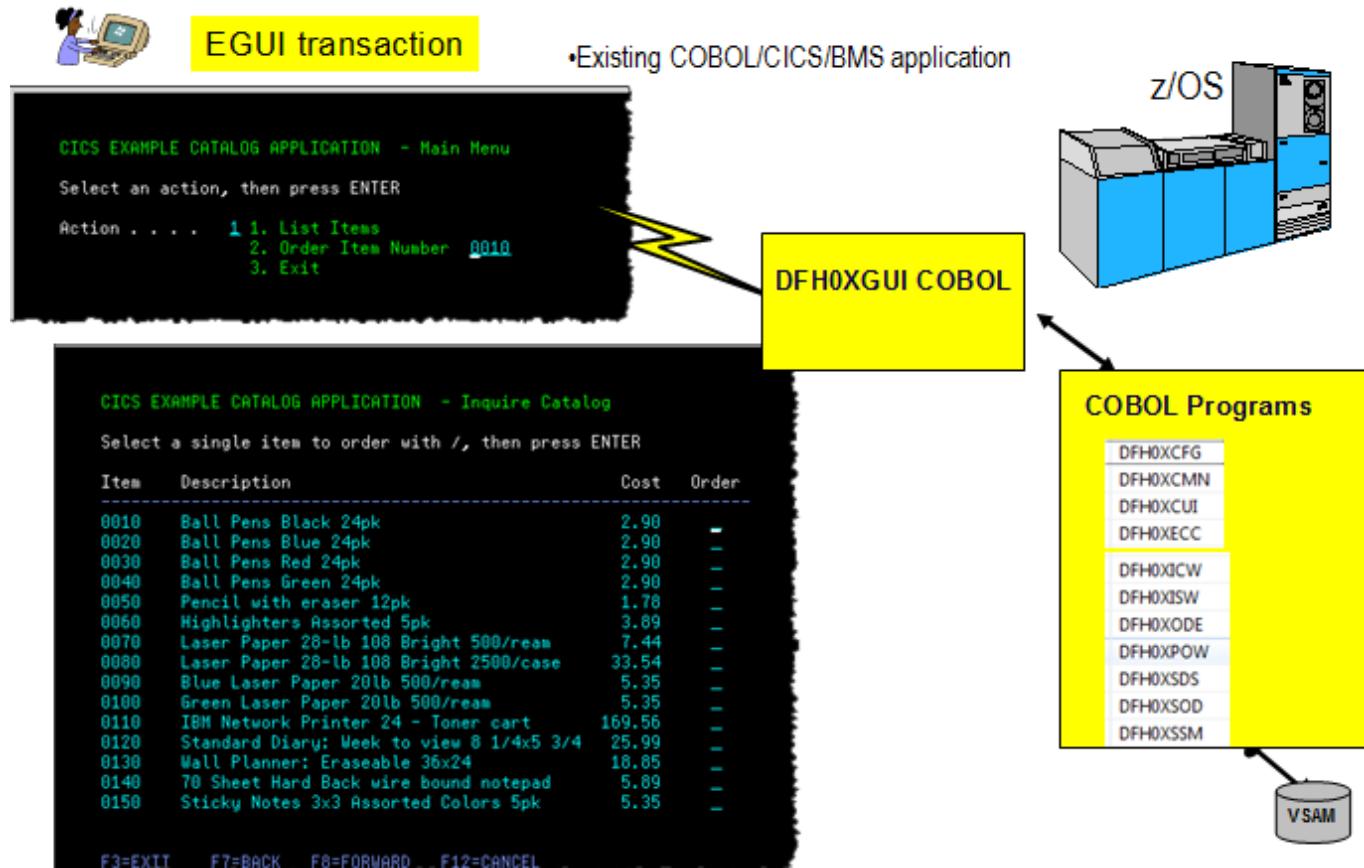
## Acknowledgments:

We would like to thank the original authors of this exercises:  
Aymeric Affouard, Eric Phan, Paul Pilotto & Nigel Williams.

## Overview of development tasks

In this lab you will go through the process of creating an API that allows REST clients to access the application.  
The different steps of the lab are:

1. Create your team services using the z/OS Connect EE API Toolkit
2. Create your team API using the z/OS Connect EE API Editor
3. Test your team API using a REST client:





Each time you see a symbol it means that you have to “do” something on your computer – not merely read the document.

## **z/OS Connect EE**

IBM z/OS Connect EE provides a framework that enables z/OS based programs and data to participate fully in the new API economy for mobile and cloud applications. It provides REST API access to z/OS subsystems, such as CICS, IMS, WebSphere MQ, DB2, and Batch.

The z/OS Connect EE API toolkit is an Eclipse-based workstation tool that you install into IBM Explorer for z/OS to create services and REST APIs for accessing z/OS resources. In the API toolkit, you can create two types of projects: service projects and API projects

### **Section 1 – Create and configure a z/OS Connect Service Project**

You will now create a z/OS Connect EE Service project and use the COBOL copybook to create a service. This copybook was identified as a candidate to invoke an API from the existing EGUI transaction.

To create the z/OS Connect EE Service you need to use the “z/OS Connect Enterprise Edition” perspective

#### **1.1 Create the z/OS Connect service project**

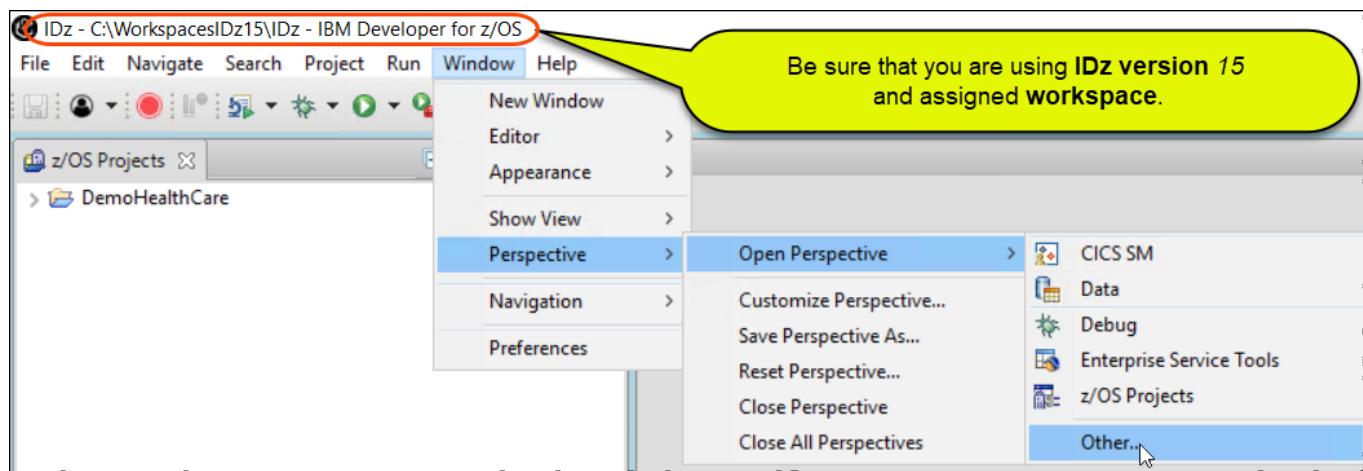
##### **1.1.1 Start IBM Developer for z Systems version 15 if not already started**

Using the desktop double click on **IDz V15** icon. Verify that the message indicates that it is Version **15.0.1**.

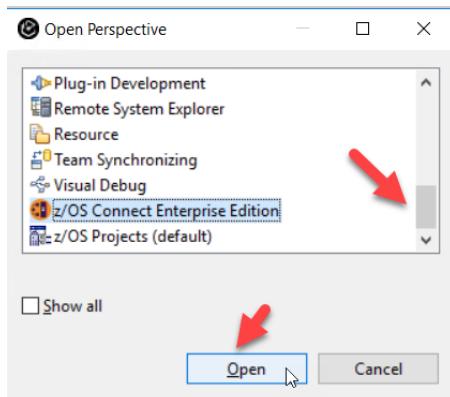
**IMPORTANT** -> This icon will start an eclipse workspace that has already some definitions required for this lab.  
PLEASE DO NOT start IDz using other way than this icon.



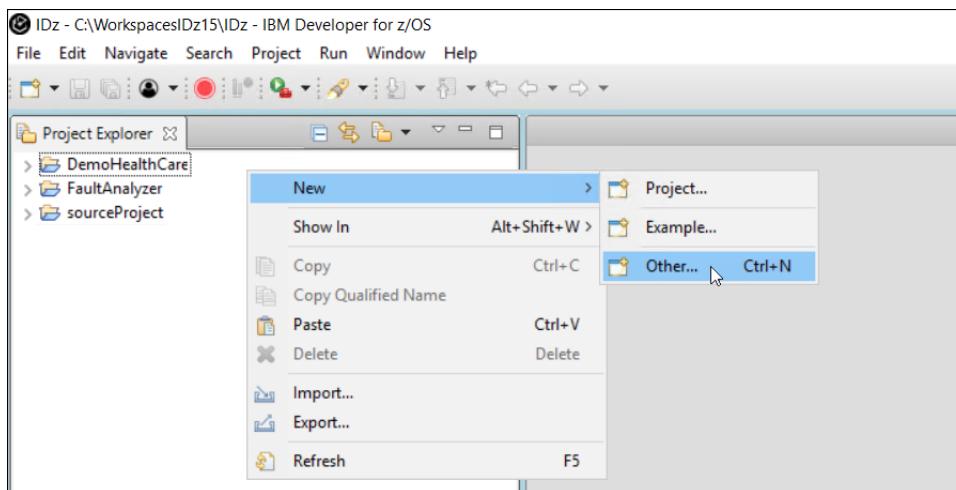
##### **1.1.2 Open the z/OS Projects perspective by selecting Window > Perspective > Open Perspective > Other...**



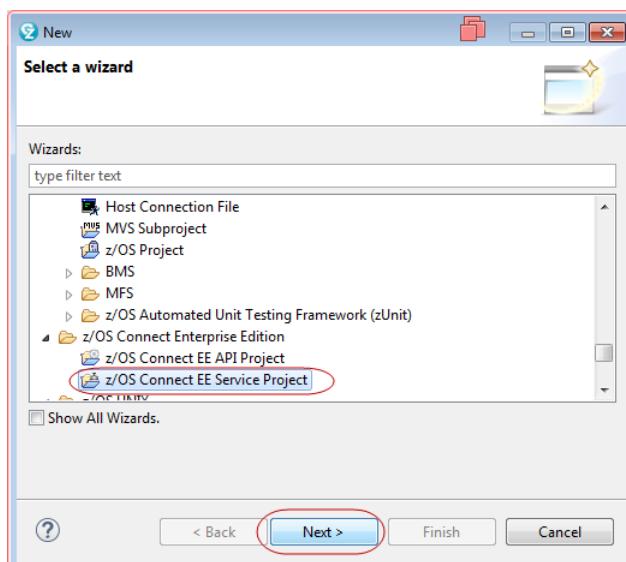
1.1.3 ➡ Scroll down, select **z/OS Connect Enterprise Edition** and click **Open**



1.1.4 ➡ Using the *Project Explorer* view, right click on the blank space and select **New > Other..**



1.1.5 Scroll down, select **z/OS Connect EE Service Project** and click **Next**.

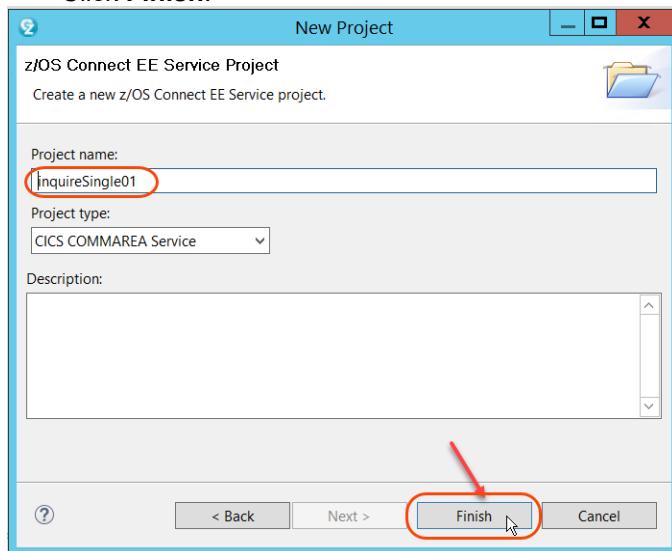


1.1.6 ► Fill in the Project name, this name will be the name of the service.

Use **inquireSingle01**

We know from the Application Discovery lab that the project should be based on a CICS Commarea

► Click **Finish**.

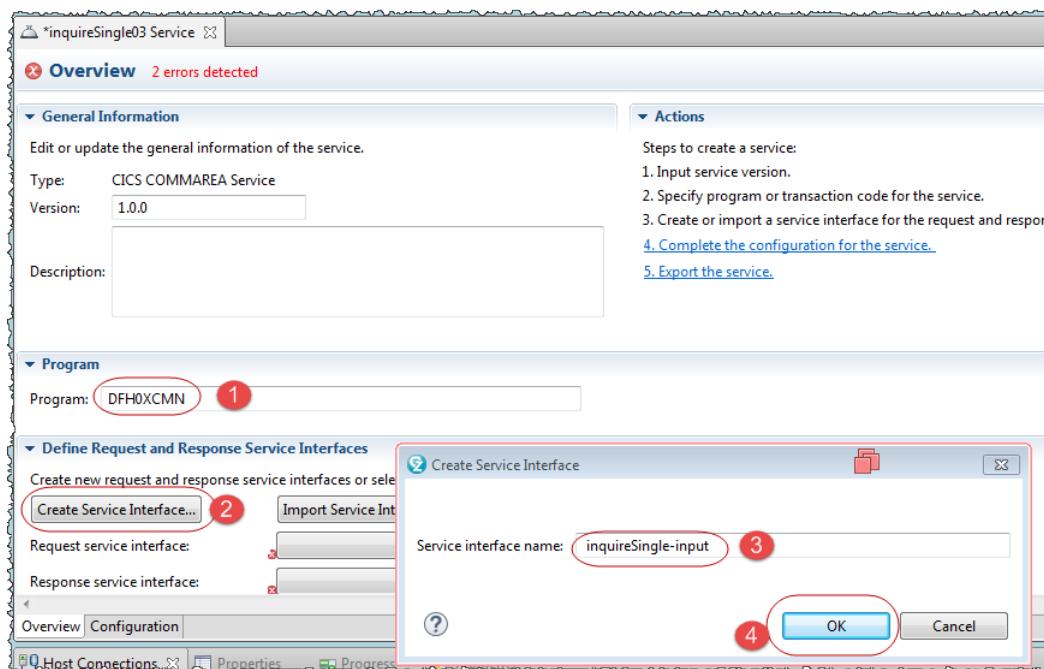


## 1.2 Service configuration

Once the project is created, there are 4 steps to perform: specify the CICS program to call, import copybook, define service interfaces and specify the IPIC connection reference

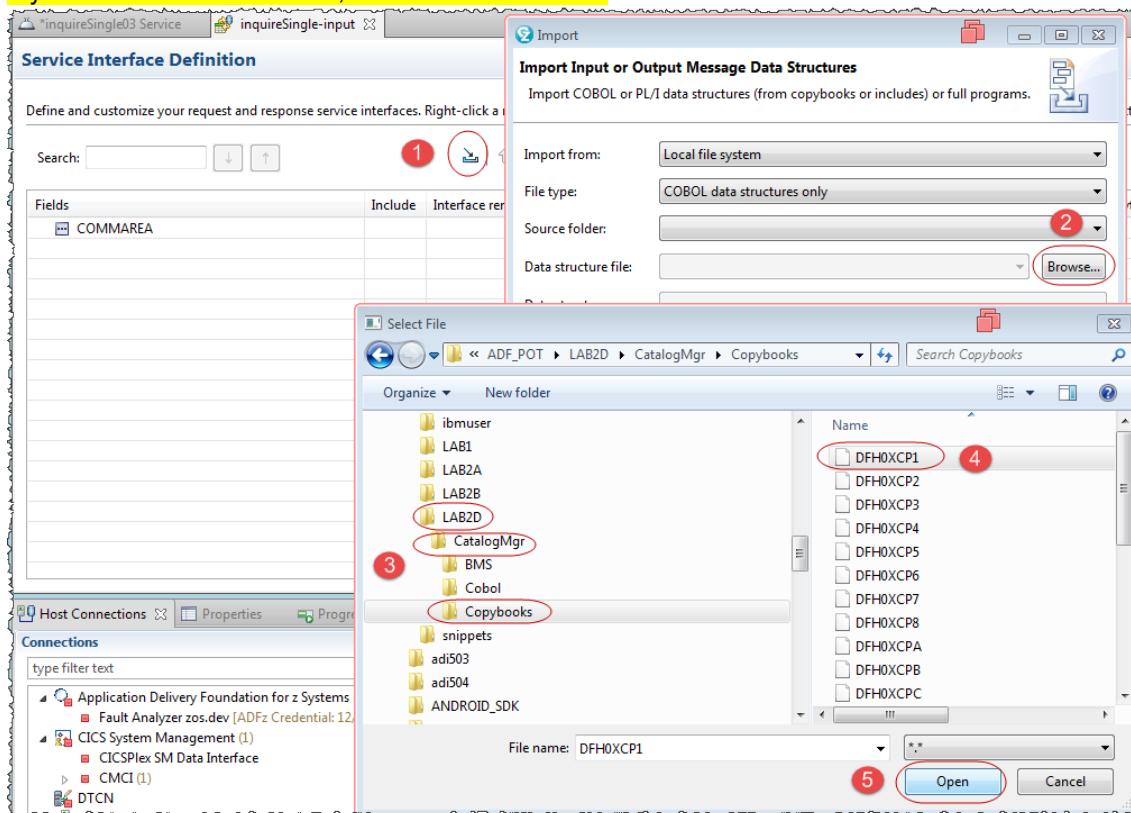
1.2.1 ► Fill in the Program information. the program name **DFH0XCMN** (where 0 is number zero).

► Click on **Create Service Interface...** and call it **inquireSingle-input** and click **OK**

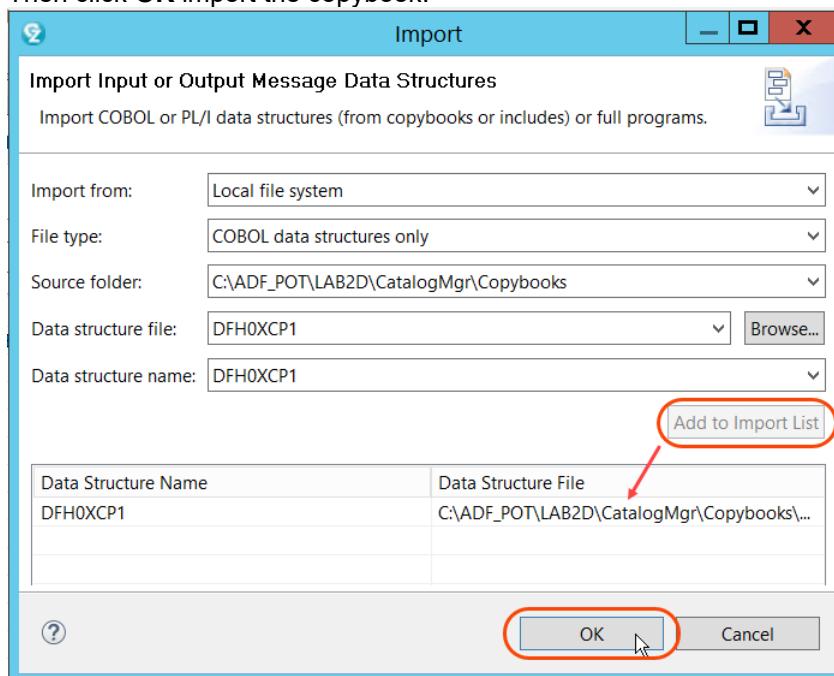


1.2.2 You will arrive in the Service Interface Definition window and you need to Import the copybook **DFH0XCP1**.

- Click on icon  and using the **Browse..** button navigate to **c:\ADF\_POT\LAB2D\CatalogMgr\Copybooks\DFH0XCP1** and click **Open**.  
**If you DO not find this folder, contact the instructor.**



- 1.2.3 ► With "DFH0XCP1" specified as the Data structure name, click on **Add to Import List**. Then click **OK** import the copybook.



### 1.2.4 ►| Expand the data structure to get a better view of the different fields

The screenshot shows the 'Service Interface Definition' interface with the title bar 'inquireSingle03 Service' and 'inquireSingle-input'. The main area displays a table titled 'Fields' with columns: Fields, Include, Interface rename, Default Field Value, Data Type, Field Length, and Start Byte. The table lists various fields from the 'COMMAREA' and 'DFH0XCP1' structures, such as CA\_REQUEST\_ID, CA\_RETURN\_CODE, CA\_RESPONSE\_MESSAGE, and CA\_REQUEST\_SPECIFIC. Most fields have their 'Include' checkbox checked. The 'Default Field Value' column shows values like 'CA\_REQUEST\_ID', 'DECIMAL', 'CHAR', etc. The 'Data Type' column includes CHAR, DECIMAL, STRUCT, ARRAY, and others. The 'Field Length' and 'Start Byte' columns provide specific details for each field.

Fields	Include	Interface rename	Default Field Value	Data Type	Field Length	Start Byte
COMMAREA						
DFH0XCP1						
CA_REQUEST_ID	<input checked="" type="checkbox"/>	CA_REQUEST_ID		CHAR	6	1
CA_RETURN_CODE	<input checked="" type="checkbox"/>	CA_RETURN_CODE		DECIMAL	2	7
CA_RESPONSE_MESSAGE	<input checked="" type="checkbox"/>	CA_RESPONSE_MESSAGE		CHAR	79	9
CA_REQUEST_SPECIFIC (Redefined)	<input checked="" type="checkbox"/>	CA_REQUEST_SPECIFIC		CHAR	911	88
CA_INQUIRE_REQUEST redefines CA_REQ	<input type="checkbox"/>	CA_INQUIRE_REQUEST		STRUCT	911	88
CA_LIST_START_REF	<input type="checkbox"/>	CA_LIST_START_REF		DECIMAL	4	88
CA_LAST_ITEM_REF	<input type="checkbox"/>	CA_LAST_ITEM_REF		DECIMAL	4	92
CA_ITEM_COUNT	<input type="checkbox"/>	CA_ITEM_COUNT		DECIMAL	3	96
CA_INQUIRY_RESPONSE_DATA (Redefined)	<input type="checkbox"/>	CA_INQUIRY_RESPONSE_DATA		CHAR	900	99
CA_CAT_ITEM redefines CA_INQUIRY,	<input type="checkbox"/>	CA_CAT_ITEM		ARRAY	900	99
CA_INQUIRE_SINGLE redefines CA_REQ	<input type="checkbox"/>	CA_INQUIRE_SINGLE		STRUCT	911	88
CA_ITEM_REF_REQ	<input type="checkbox"/>	CA_ITEM_REF_REQ		DECIMAL	4	88
FILL_0	<input type="checkbox"/>	FILL_0		DECIMAL	4	92
FILL_1	<input type="checkbox"/>	FILL_1		DECIMAL	3	96
CA_SINGLE_ITEM	<input type="checkbox"/>	CA_SINGLE_ITEM		STRUCT	60	99
FILL_2	<input type="checkbox"/>	FILL_2		CHAR	840	159
CA_ORDER_REQUEST redefines CA_REQ	<input type="checkbox"/>	CA_ORDER_REQUEST		STRUCT	911	88
CA_USERID	<input type="checkbox"/>	CA_USERID		CHAR	8	88
CA_CHARGE_DEPT	<input type="checkbox"/>	CA_CHARGE_DEPT		CHAR	8	96
CA_ITEM_REF_NUMBER	<input type="checkbox"/>	CA_ITEM_REF_NUMBER		DECIMAL	4	104
CA_QUANTITY_REQ	<input type="checkbox"/>	CA_QUANTITY_REQ		DECIMAL	3	108
FILL_3	<input type="checkbox"/>	FILL_3		CHAR	888	111

For the **inquireSingle-input** service, define a mapping that:

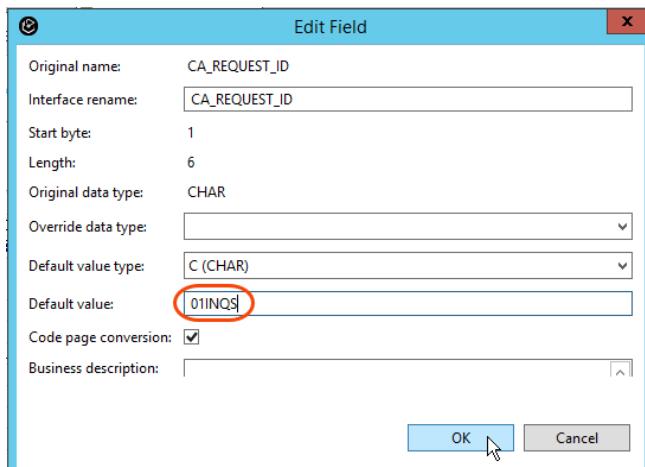
1.2.5 You will exclude **CA\_REQUEST\_ID** and assign the default value **01INQS**  
(Identified at the Application Discovery Lab)

►| To assign a default value to a field, right-click the field, then choose **Edit field**,

The screenshot shows the 'Service Interface Definition' interface with the same table structure. A context menu is open over the 'CA\_REQUEST\_ID' row. The menu items are: 'Edit field' (highlighted with a red circle) and 'Exclude field from interface'.

Fields	Include	Interface rename	Default Field Value	Data Type
COMMAREA				
DFH0XCP1				
CA_REQUEST_ID	<input checked="" type="checkbox"/>	CA_REQUEST_ID	<input type="button" value="Edit field"/>	CHAR
CA_RETURN_CODE	<input checked="" type="checkbox"/>	CA_RETURN_CODE		DECIMAL
CA_RESPONSE_MESSAGE	<input checked="" type="checkbox"/>	CA_RESPONSE_MESSAGE	<input type="checkbox"/> Exclude field from interface	CHAR
CA_REQUEST_SPECIFIC (Redefined)	<input checked="" type="checkbox"/>	CA_REQUEST_SPECIFIC		CHAR

1.2.6 ►| Specify **01INQS** as default value and click **OK**



1.2.7 ► To exclude **CA\_REQUEST\_ID** you need to uncheck the include box.

Fields	Include	Interface rename	Default Field Value
COMMAREA			
DFH0XCP1			
CA_REQUEST_ID	<input type="checkbox"/>	CA_REQUEST_ID	01INQS
CA_RETURN_CODE	<input checked="" type="checkbox"/>	CA_RETURN_CODE	
CA_RESPONSE_MESSAGE	<input checked="" type="checkbox"/>	CA_RESPONSE_MESSAGE	
CA_REQUEST_SPECIFIC (Redefined)	<input checked="" type="checkbox"/>	CA_REQUEST_SPECIFIC	

1.2.8 You will also exclude **CA\_RETURN\_CODE**, **CA\_RESPONSE\_MESSAGE** (these are response fields). Also will exclude **CA\_REQUEST\_SPECIFIC** (this field is redefined by **CA\_INQUIRE\_SINGLE**)

► To exclude you need to uncheck the include box.

Fields	Include	Interface rename	Default Field Value
COMMAREA			
DFH0XCP1			
CA_REQUEST_ID	<input type="checkbox"/>	CA_REQUEST_ID	01INQS
CA_RETURN_CODE	<input type="checkbox"/>	CA_RETURN_CODE	
CA_RESPONSE_MESSAGE	<input type="checkbox"/>	CA_RESPONSE_MESSAGE	
CA_REQUEST_SPECIFIC (Redefined)	<input type="checkbox"/>	CA_REQUEST_SPECIFIC	
CA_INQUIRE_REQUEST redefines CA_REQ	<input type="checkbox"/>	CA_INQUIRE_REQUEST	
CA_LIST_START_REF	<input type="checkbox"/>	CA_LIST_START_REF	

1.2.9 You will include **CA\_ITEM\_REF\_REQ** that is under **CA\_INQUIRE\_SINGLE**. This field allow to specify which item information to retrieve.

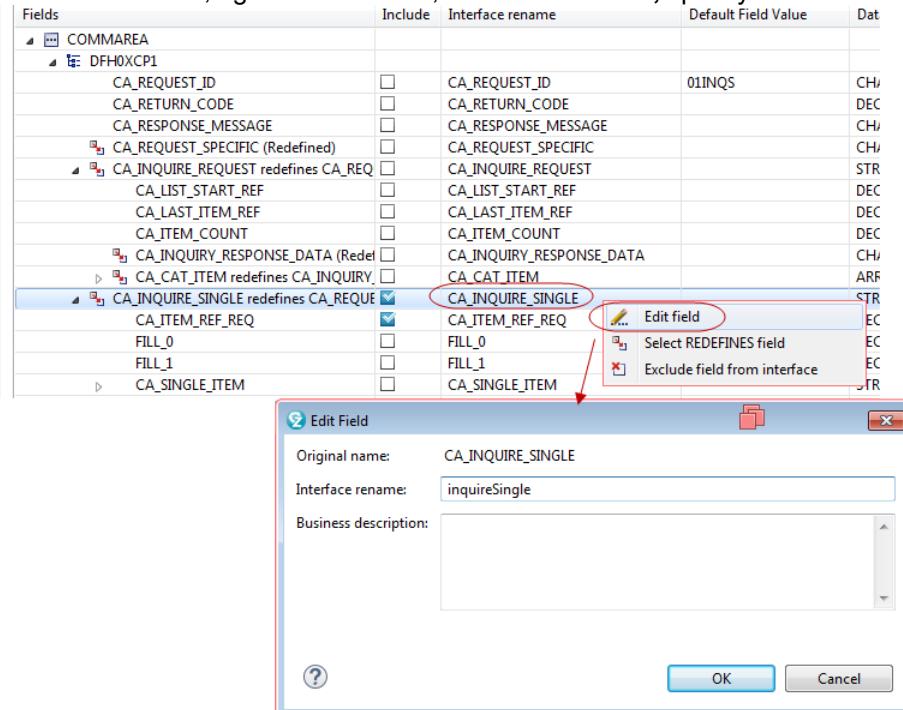
► Check the include box of **CA\_ITEM\_REF\_REQ**.

Fields	Include	Interface rename	Default Field Value	Data Type
COMMAREA				
DFH0XCP1				
CA_REQUEST_ID	<input type="checkbox"/>	CA_REQUEST_ID	01INQS	CHAR
CA_RETURN_CODE	<input type="checkbox"/>	CA_RETURN_CODE		DECIM
CA_RESPONSE_MESSAGE	<input type="checkbox"/>	CA_RESPONSE_MESSAGE		CHAR
CA_REQUEST_SPECIFIC (Redefined)	<input type="checkbox"/>	CA_REQUEST_SPECIFIC		CHAR
CA_INQUIRE_REQUEST redefines CA_REQ	<input type="checkbox"/>	CA_INQUIRE_REQUEST		STRUCT
CA_LIST_START_REF	<input type="checkbox"/>	CA_LIST_START_REF		DECIM
CA_LAST_ITEM_REF	<input type="checkbox"/>	CA_LAST_ITEM_REF		DECIM
CA_ITEM_COUNT	<input type="checkbox"/>	CA_ITEM_COUNT		DECIM
CA_INQUIRY_RESPONSE_DATA (Redefined)	<input type="checkbox"/>	CA_INQUIRY_RESPONSE_DATA		CHAR
CA_CAT_ITEM redefines CA_INQUIRY	<input type="checkbox"/>	CA_CAT_ITEM		ARRAY
CA_INQUIRE_SINGLE redefines CA_REQ	<input checked="" type="checkbox"/>	CA_INQUIRE_SINGLE		STRUCT
CA_ITEM_REF_REQ	<input checked="" type="checkbox"/>	CA_ITEM_REF_REQ		DECIM
FILL_0	<input type="checkbox"/>	FILL_0		DECIM
FILL_1	<input type="checkbox"/>	FILL_1		DECIM
CA_SINGLE_ITEM	<input type="checkbox"/>	CA_SINGLE_ITEM		STRUCT
FILL_2	<input type="checkbox"/>	FILL_2		CHAR

1.2.10 It is also a good idea to rename the fields that are exposed by the service interface .

► Rename the **CA\_INQUIRE\_SINGLE** as **inquireSingle**,

To rename a field, right-click the field, choose **Edit field**, specify a different interface rename and click **OK**.



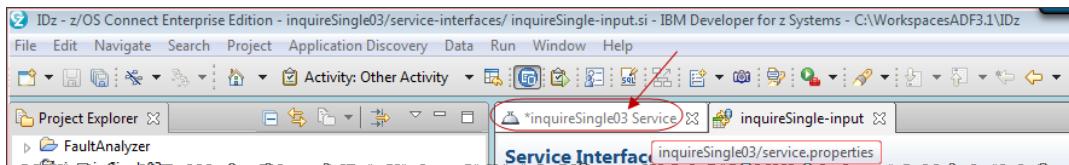
► Rename the **CA\_ITEM\_REF\_REQ** field as **itemID** (follow the lower/upper case letters)

1.2.11 ► Your service interface should look similar to the mapping below

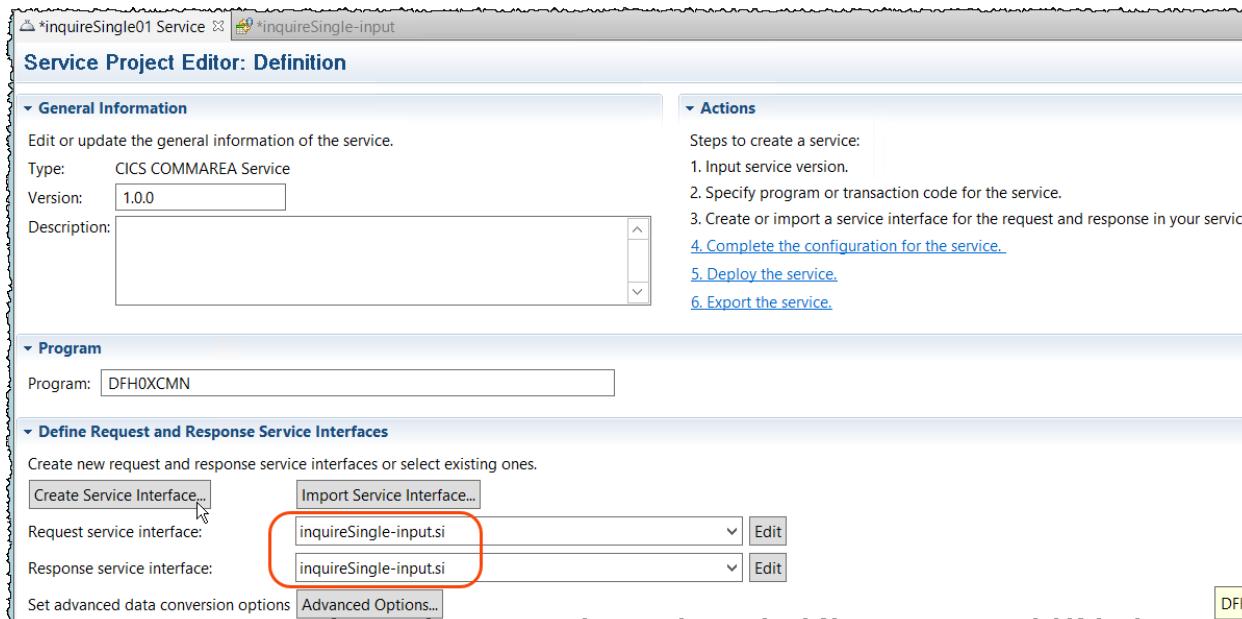
► Save the service interface (**CTRL S**)

The screenshot shows the 'Service Interface Definition' tool. The 'inquireSingle03 Service' tab is active. The 'inquireSingle-input' tab is visible at the top. The main area displays the 'Fields' table. The 'CA\_INQUIRE\_SINGLE' field has been renamed to 'inquireSingle'. The 'CA\_ITEM\_REF\_REQ' field has been renamed to 'itemID'. Other fields like 'CA\_REQUEST\_ID', 'CA\_RETURN\_CODE', etc., remain as they were. The table includes columns for 'Fields', 'Include', 'Interface rename', 'Default Field Value', 'Data Type', and 'Field Length'.

1.2.12 ► Go back to the **inquireSingle01** Service tab clicking on it



1.2.13 Note that the service interface you just defined is used for request and response

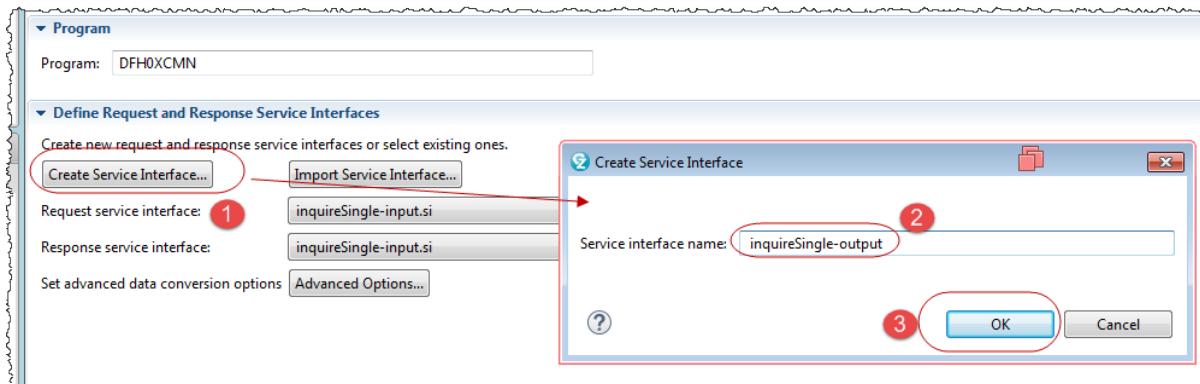


Let's create a new service interface for the output: **inquireSingle-output**.

1.2.14 In the new service interface, you will need to:

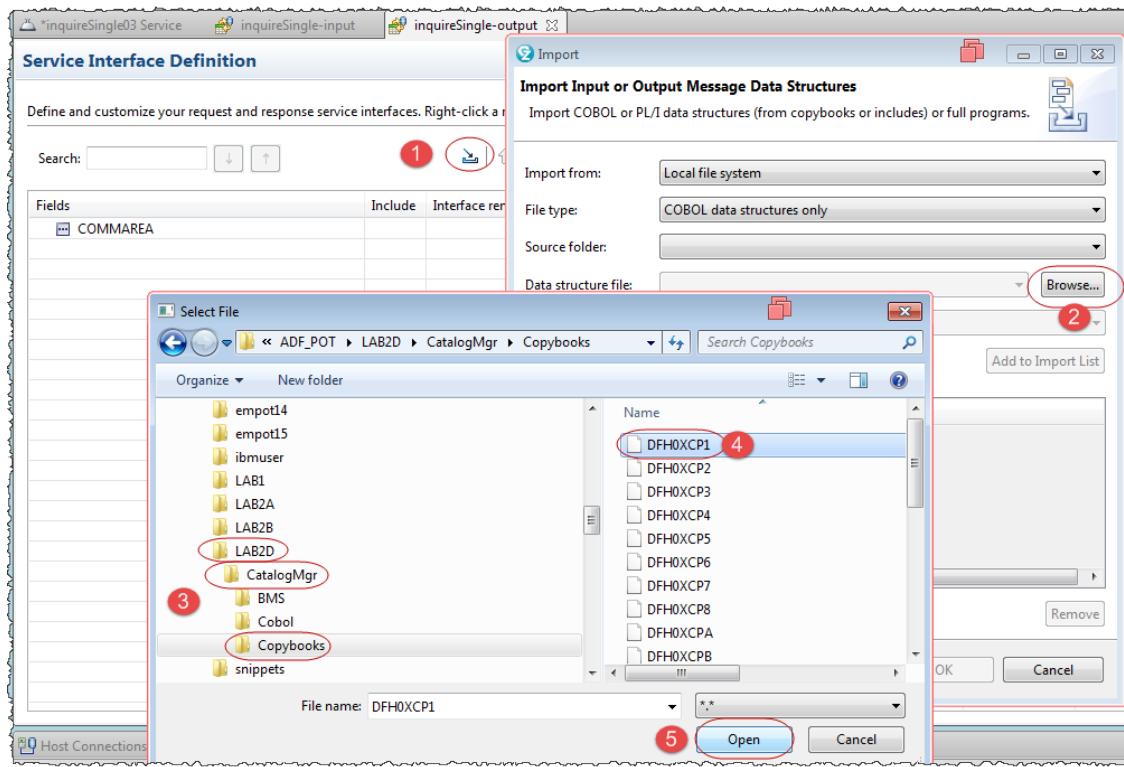
- Import the **DFH0XCP1** copybook
- Include and exclude fields
- Optionally rename exposed fields to give names that make more sense

► Click on **Create Service Interface**, call it **inquireSingle-output** and click **OK**

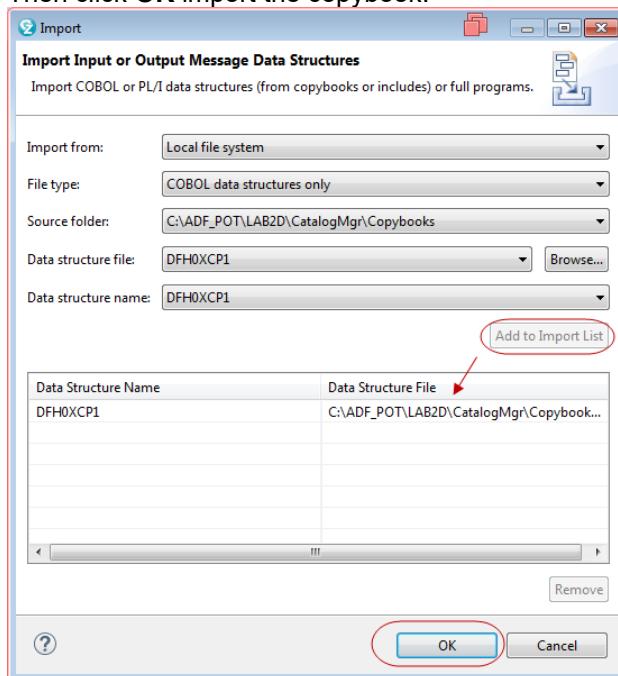


1.2.15 You will arrive in the Service Interface Definition window and you need to Import again the copybook **DFH0XCP1**.

► Click on icon click on source folder to select the value already entered there and using the **Browse..** button navigate to **c:\ADF\_POT\LAB2D\CatalogMgr\Copybooks\DFH0XCP1** and click **Open**.



1.2.16 ► With "DFH0XCP1" specified as the Data structure name, click on **Add to Import List**. Then click **OK** import the copybook.



### 1.2.17 ► Expand the data structure to get a better view of the different fields

Fields	Include	Interface rename	Default Field Value	Data Type	Field Length	Start Byte
COMMAREA						
DFH0XCP1						
CA_REQUEST_ID	<input checked="" type="checkbox"/>	CA_REQUEST_ID		CHAR	6	1
CA_RETURN_CODE	<input checked="" type="checkbox"/>	CA_RETURN_CODE		DECIMAL	2	7
CA_RESPONSE_MESSAGE	<input checked="" type="checkbox"/>	CA_RESPONSE_MESSAGE		CHAR	79	9
CA_REQUEST_SPECIFIC (Redefined)	<input checked="" type="checkbox"/>	CA_REQUEST_SPECIFIC		CHAR	911	88
CA_INQUIRE_REQUEST redefines CA_REQ	<input type="checkbox"/>	CA_INQUIRE_REQUEST		STRUCT	911	88
CA_LIST_START_REF	<input type="checkbox"/>	CA_LIST_START_REF		DECIMAL	4	88
CA_LAST_ITEM_REF	<input type="checkbox"/>	CA_LAST_ITEM_REF		DECIMAL	4	92
CA_ITEM_COUNT	<input type="checkbox"/>	CA_ITEM_COUNT		DECIMAL	3	96

For the **inquireSingle-output** service, define a mapping that:

### 1.2.18 Excludes CA\_REQUEST\_ID and CA\_REQUEST\_SPECIFIC

► To exclude you need to uncheck the include box.

Fields	Include	Interface rename	Default Field Value	Data Type
COMMAREA				
DFH0XCP1				
CA_REQUEST_ID	<input type="checkbox"/>	CA_REQUEST_ID		CHAR
CA_RETURN_CODE	<input checked="" type="checkbox"/>	CA_RETURN_CODE		DECIMAL
CA_RESPONSE_MESSAGE	<input checked="" type="checkbox"/>	CA_RESPONSE_MESSAGE		CHAR
CA_REQUEST_SPECIFIC (Redefined)	<input type="checkbox"/>	CA_REQUEST_SPECIFIC		CHAR
CA_INQUIRE_REQUEST redefines CA_REQ	<input type="checkbox"/>	CA_INQUIRE_REQUEST		STRUCT
CA_LIST_START_REF	<input type="checkbox"/>	CA_LIST_START_REF		DECIMAL
CA_LAST_ITEM_REF	<input type="checkbox"/>	CA_LAST_ITEM_REF		DECIMAL
CA_ITEM_COUNT	<input type="checkbox"/>	CA_ITEM_COUNT		DECIMAL

### 1.2.19 Include CA\_INQUIRE\_SINGLE, only the high level record. and CA\_SINGLE\_ITEM

► To include you need to check the include box.

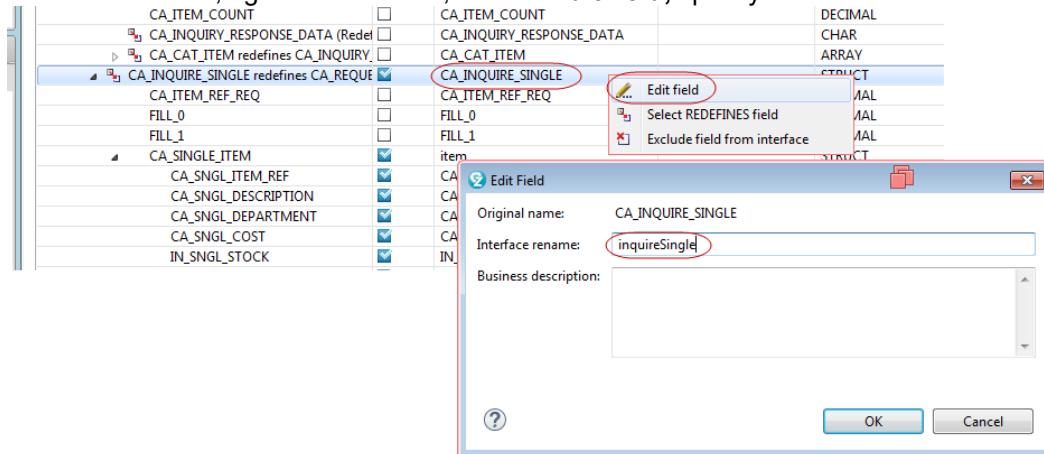
Fields	Include	Interface rename	Default Field Value	Data Type	Field L
COMMAREA					
DFH0XCP1					
CA_REQUEST_ID	<input type="checkbox"/>	CA_REQUEST_ID		CHAR	6
CA_RETURN_CODE	<input checked="" type="checkbox"/>	CA_RETURN_CODE		DECIMAL	2
CA_RESPONSE_MESSAGE	<input checked="" type="checkbox"/>	CA_RESPONSE_MESSAGE		CHAR	79
CA_REQUEST_SPECIFIC (Redefined)	<input type="checkbox"/>	CA_REQUEST_SPECIFIC		CHAR	911
CA_INQUIRE_REQUEST redefines CA_REQ	<input type="checkbox"/>	CA_INQUIRE_REQUEST		STRUCT	911
CA_LIST_START_REF	<input type="checkbox"/>	CA_LIST_START_REF		DECIMAL	4
CA_LAST_ITEM_REF	<input type="checkbox"/>	CA_LAST_ITEM_REF		DECIMAL	4
CA_ITEM_COUNT	<input type="checkbox"/>	CA_ITEM_COUNT		DECIMAL	3
CA_INQUIRY_RESPONSE_DATA (Redefine)	<input type="checkbox"/>	CA_INQUIRY_RESPONSE_DATA		CHAR	900
CA_CAT_ITEM redefines CA_INQUIRY	<input type="checkbox"/>	CA_CAT_ITEM		ARRAY	900
CA_INQUIRE_SINGLE redefines CA_REQ	<input checked="" type="checkbox"/>	CA_INQUIRE_SINGLE		STRUCT	911
CA_ITEM_REF_REQ	<input type="checkbox"/>	CA_ITEM_REF_REQ		DECIMAL	4
FILL_0	<input type="checkbox"/>	FILL_0		DECIMAL	4
FILL_1	<input type="checkbox"/>	FILL_1		DECIMAL	3
CA_SINGLE_ITEM	<input checked="" type="checkbox"/>	CA_SINGLE_ITEM		STRUCT	60
CA_SNGL_ITEM_REF	<input checked="" type="checkbox"/>	CA_SNGL_ITEM_REF		DECIMAL	4
CA_SNGL_DESCRIPTION	<input checked="" type="checkbox"/>	CA_SNGL_DESCRIPTION		CHAR	40
CA_SNGL_DEPARTMENT	<input checked="" type="checkbox"/>	CA_SNGL_DEPARTMENT		DECIMAL	3
CA_SNGL_COST	<input checked="" type="checkbox"/>	CA_SNGL_COST		CHAR	6
IN_SNGL_STOCK	<input checked="" type="checkbox"/>	IN_SNGL_STOCK		DECIMAL	4
ON_SNGL_ORDER	<input checked="" type="checkbox"/>	ON_SNGL_ORDER		DECIMAL	3
FILL_2	<input type="checkbox"/>	FILL_2		CHAR	840
CA_ORDER_REQUEST redefines CA_REQ	<input type="checkbox"/>	CA_ORDER_REQUEST		STRUCT	911
CA_USERID	<input type="checkbox"/>	CA_USERID		CHAR	8

1.2.20 The best practice is to rename the fields to better expose the service interface..  
**But if you are running late or don't want to spend time here just jump to 1.2.22**

(Optional) Rename the fields that are exposed by the service interface .

► Rename the **CA\_INQUIRE\_SINGLE** as **inquireSingle**,

To rename a field, right-click the field, choose **Edit field**, specify a different interface rename and click **OK**.



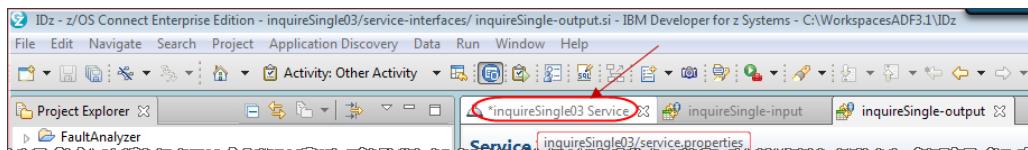
1.2.21 ► (Optional) Rename the **CA\_RETURN\_CODE** as **resultCode**, **CA\_RESPONSE\_MESSAGE** as **responseMessage** **CA\_SINGLE\_ITEM** as **item**, **CA\_SNGL\_ITEM\_REF** as **itemID**, **CA\_SNGL\_ITEM\_DESCRIPTION** as **description**, **CA\_SNGL\_ITEM\_DEPARTMENT** as **department**, **CA\_SNGL\_COST** as **cost**, **IN\_SNGL\_STOCK** as **stock** and **ON\_SNGL\_ORDER** as **onOrder**

► Your service interface should look similar to the mapping below

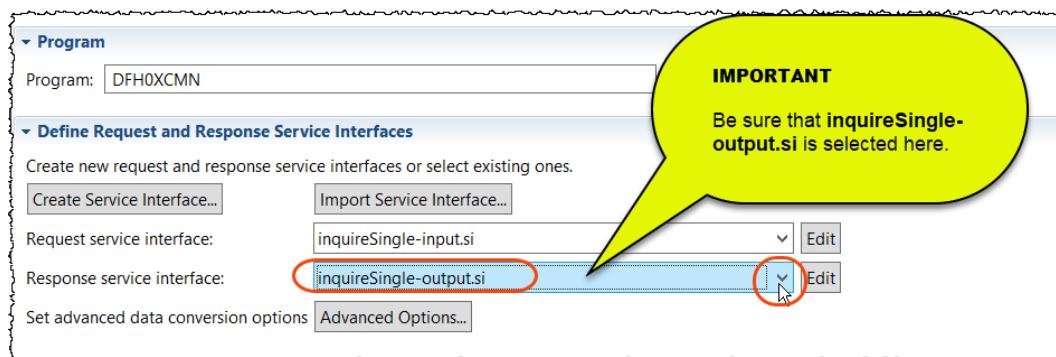
Fields	Include	Interface rename	Default Field Value	Data Type	Field Length
COMMAREA					
DFH0XCP1					
CA_REQUEST_ID	<input type="checkbox"/>	CA_REQUEST_ID		CHAR	6
CA_RETURN_CODE	<input checked="" type="checkbox"/>	resultCode		DECIMAL	2
CA_RESPONSE_MESSAGE	<input checked="" type="checkbox"/>	responseMessage		CHAR	79
CA_REQUEST_SPECIFIC (Redefined)					
CA_INQUIRE_REQUEST redefines CA_REQ					
CA_LIST_START_REF					
CA_LAST_ITEM_REF					
CA_ITEM_COUNT					
CA_INQUIRY_RESPONSE_DATA (Redef)					
CA_CAT_ITEM redefines CA_INQUIRY.					
CA_INQUIRE_SINGLE redefines CA_REQ	<input checked="" type="checkbox"/>	inquireSingle		STRUCT	911
CA_ITEM_REF_REQ					
FILL_0					
FILL_1					
CA_SINGLE_ITEM	<input checked="" type="checkbox"/>	item		STRUCT	60
CA_SNGL_ITEM_REF	<input checked="" type="checkbox"/>	itemID		DECIMAL	4
CA_SNGL_DESCRIPTION	<input checked="" type="checkbox"/>	description		CHAR	40
CA_SNGL_DEPARTMENT	<input checked="" type="checkbox"/>	department		DECIMAL	3
CA_SNGL_COST	<input checked="" type="checkbox"/>	cost		CHAR	6
IN_SNGL_STOCK	<input checked="" type="checkbox"/>	stock		DECIMAL	4
ON_SNGL_ORDER	<input checked="" type="checkbox"/>	onOrder		DECIMAL	3
FILL_2					
CA_ORDER_REQUEST redefines CA_REQ					
CA_USERID					

1.2.22 ► Save the **inquireSingle-output** service interface (**CTRL S**)

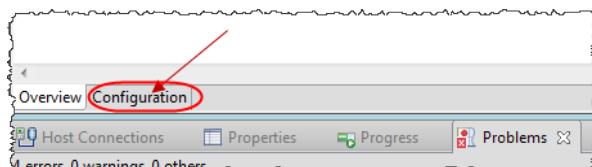
1.2.23 ► Go back to the **inquireSingle01 Service** tab by clicking on it



1.2.24 ► Click on the second drop down ("Response service interface") and select **inquireSingle-output.si**

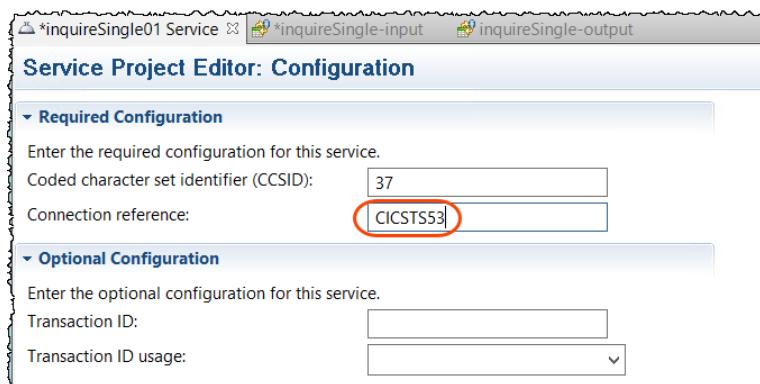


1.2.25 ► On the **inquireSingle Service** tab, switch to the "Configuration" part by clicking the sub-tab (bottom of the window).



1.2.26 ► Type **CICSTS53** for the **Connection reference**

This connection name is a logical name that represents the IPIC connection to a CICS region.



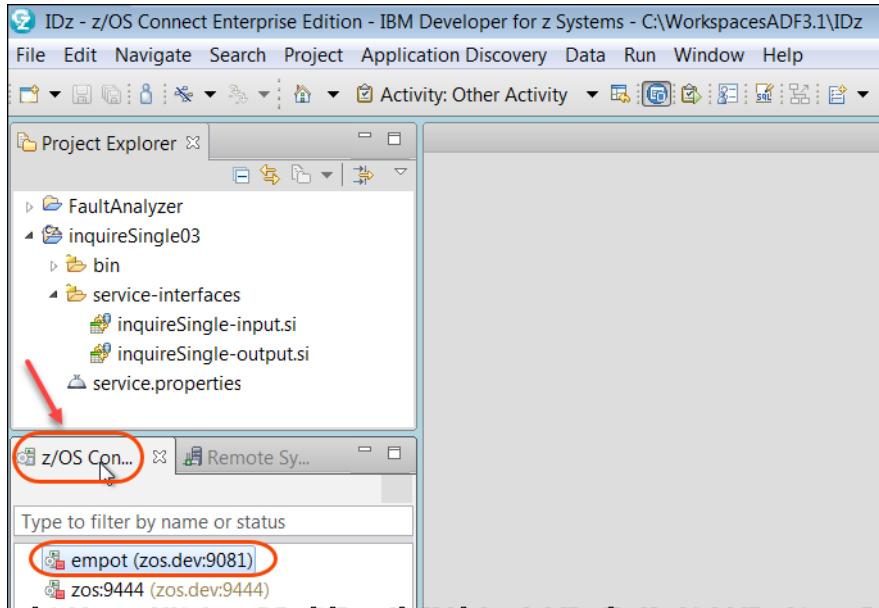
1.2.27 ► Save the service interface (**CTRL S**)

1.2.28 ► Use **Ctrl + Shift + F4** to close all opened editors

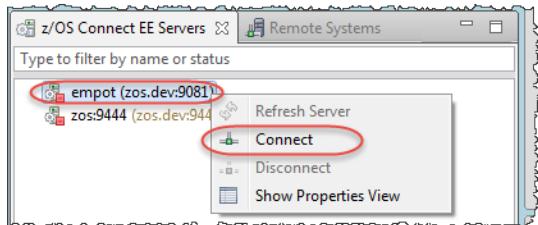
## 1.3 Connecting to a z/OS Connect EE server

You will connect to the z/OS Connect EE server to deploy the service.

1.3.1 ► Still using the *z/OS Connect Enterprise Edition* perspective click on **z/OS Connect EE Servers** view.  
You should see the connection **zos.dev:9081** already defined



1.3.2 ► Right click **empot(zos.dev:9081)** and select **Connect**.



### In case of connection errors...

If you have errors during the connection it could be because z/OS connect is not running.  
Call the instructor.

**Instructor:** use the z/OS master console or SDSF DA and verify that you have the **BBGZANGL** and **BAQSTRT** started tasks running.

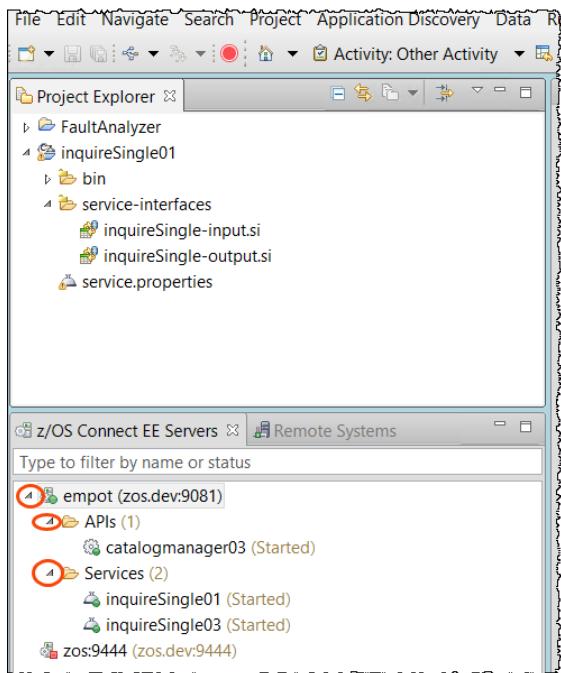
If not: issue a **S BBGZANGL**, then **S BAQSTRT**

For BAQSTRT, make sure you see the message "The server server1 is ready to run a smarter planet"



```
Launching Server30 (z/OS Connect 03.00.00, WebSphere Application Server 7.0.0.
YAUDIT  " CWWKE0001I: The server server30 has been launched.
YAUDIT  " BAQR7000I: z/OS Connect API package catalogmanager03 installed succe
YAUDIT  " BAQR0000I: z/OS Connect Enterprise Edition version 3.0.0.0 (20170602)
YAUDIT  " BAQR7043I: z/OS Connect EE service archive inquireSingle03 installed
YAUDIT  " CWWKF0015I: The server has the following interim fixes active in the
YAUDIT  " CWWKF0012I: The server installed the following features: Yssl-1.0, a
YAUDIT  " CWWKF0011I: The server server30 is ready to run a smarter planet
YAUDIT  " CWWKT0016I: web application available (default_host): http://cloud.p
```

1.3.3 ► Using z/OS Connect EE Servers view on left/bottom, expand **empot/API** and **-Services** and you should see something similar to the following screen capture below.  
(it will depend on how many services and APIs have already been deployed there).



## 1.4 Deploying the Service to z/OS Connect

You can deploy your service to the server directly from the API toolkit if the server connection is already properly configured.

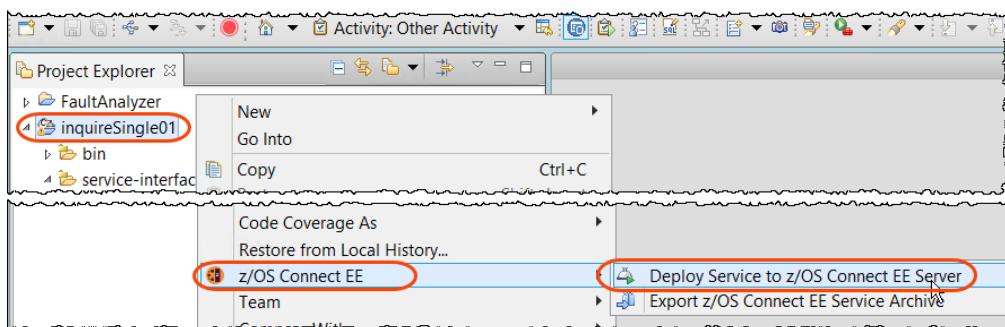


### Automatic Deploy versus Manual deploy

Depending on the level of the z/OS Connect EE V3 installed you could do the Automatic deploy.

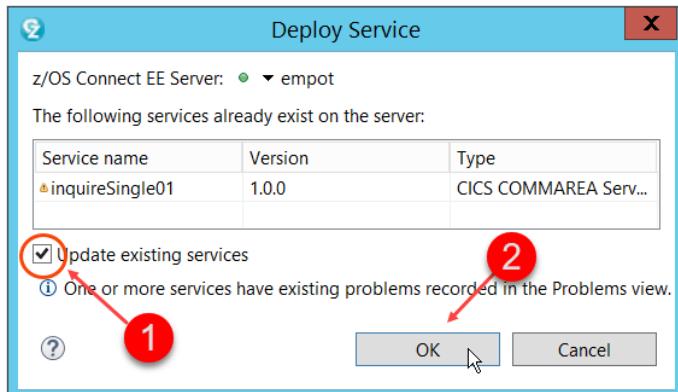
1.4.1 We will deploy the service to the z/OS Connect EE server.

► Using *Project Explorer* view, right-click on the project **inquireSingle01**, then **z/OS Connect EE > Deploy Service to z/OS Connect EE Server**.



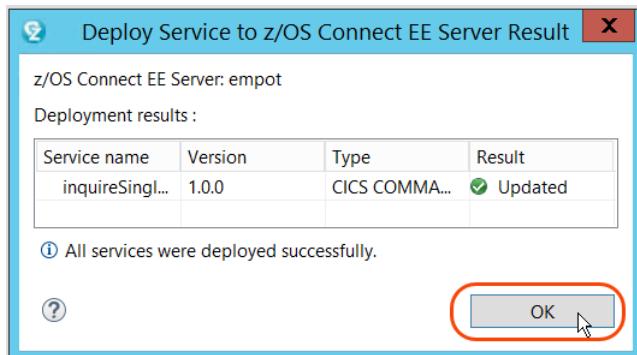
1.4.2 You will get the following *Deploy Service* dialog.

► Check **Update existing services** and click **OK**.



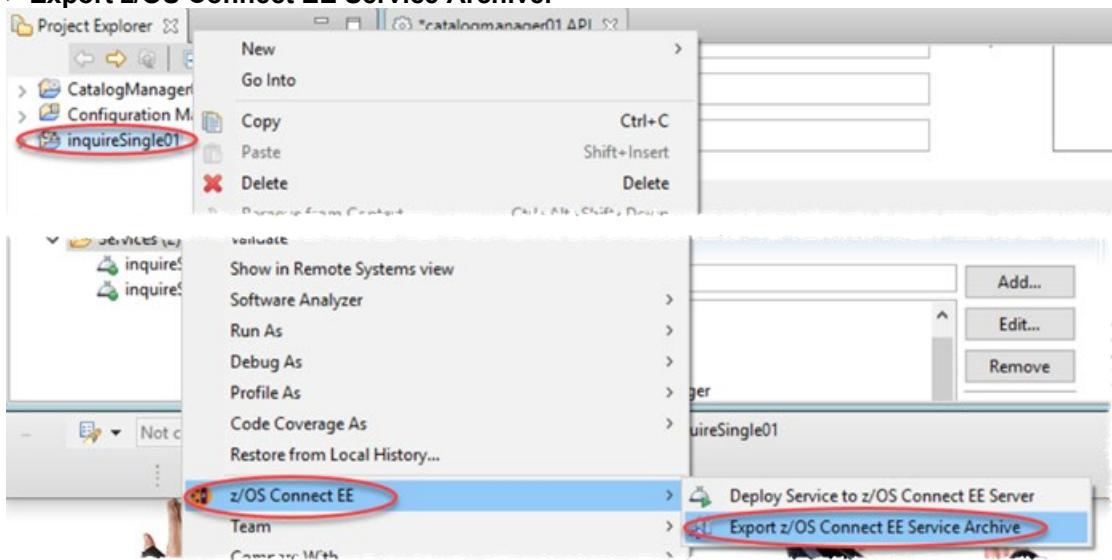
1.4.3 You will get the *Deploy Service ... Result* dialog. The result could be “Created” or “Updated”.

► Click **OK**.

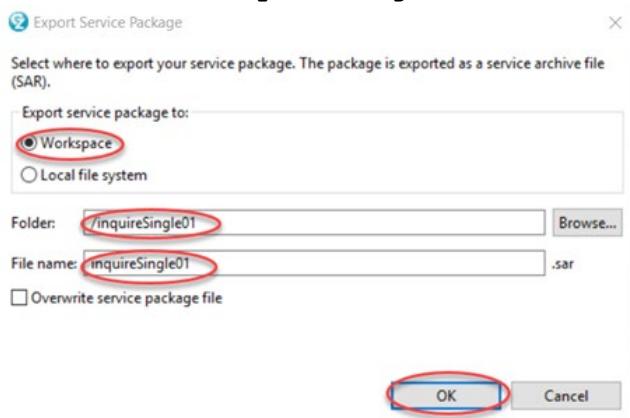


1.4.4 You will now export the service archive file for use in the next section.

► Using the *Project Explorer* view, right-click on the project **inquireSingle01**, then **z/OS Connect EE** > **Export z/OS Connect EE Service Archive**.



- In the *Export Service Package* dialog, select **Workspace** as the export target, with `/inquireSingle01` as the *Folder* and `inquireSingle01` as the *File name*. Click **OK**.

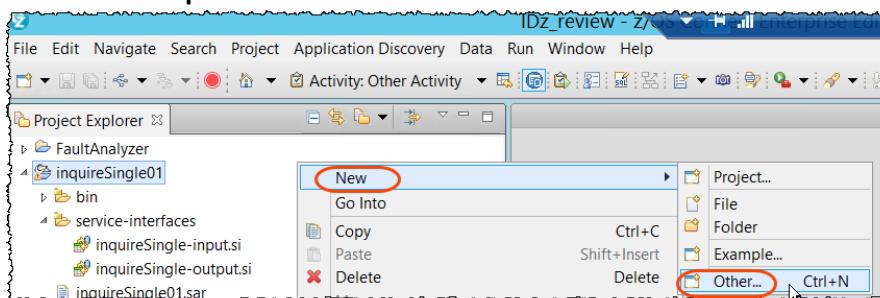


## Section 2 – Create and configure a z/OS Connect API Project

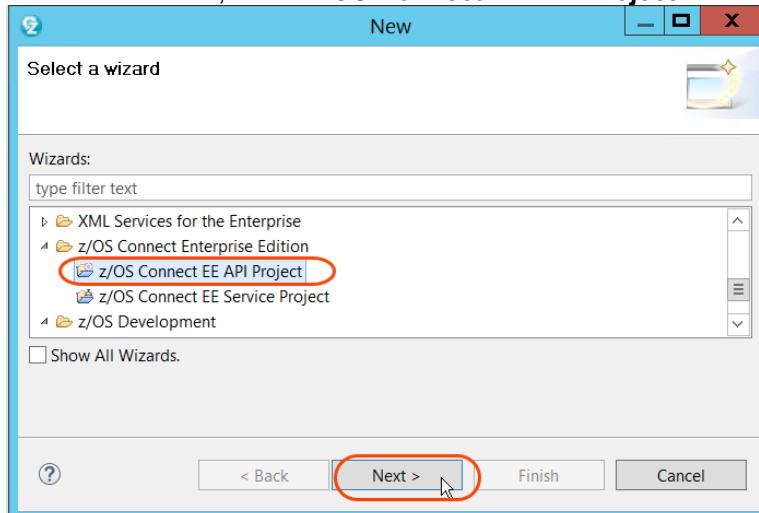
In this step, you will create and API to invoke a z/OS Connect Service created before.

### 2.1 Create the z/OS Connect API project and import the service

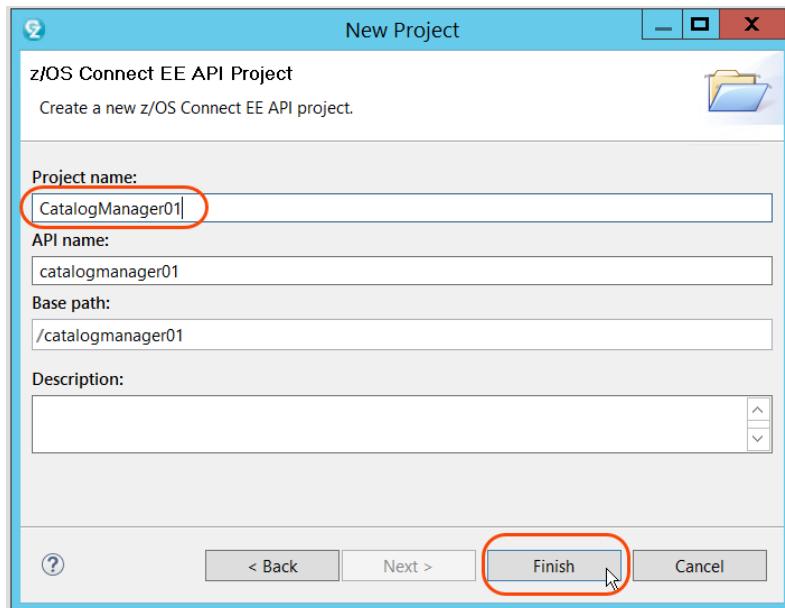
- 2.1.1. ► Still under *z/OS Connect Enterprise Edition* perspective and using the *Project Explorer* view, right click on the blank space and select **New > Other..**



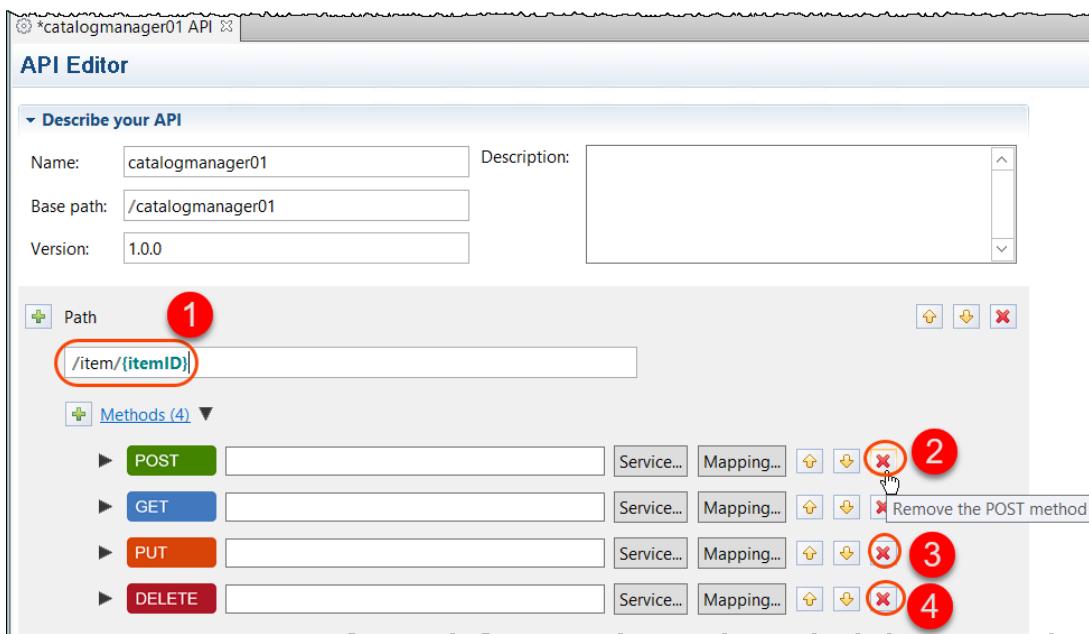
- 2.1.2. Scroll down, select **z/OS Connect EE API Project** and click **Next**



- 2.1.3 ► Fill in the Project name, this name will be the name of the API in lowercase.  
 Use **CatalogManager01**  
 ► Click **Finish**.

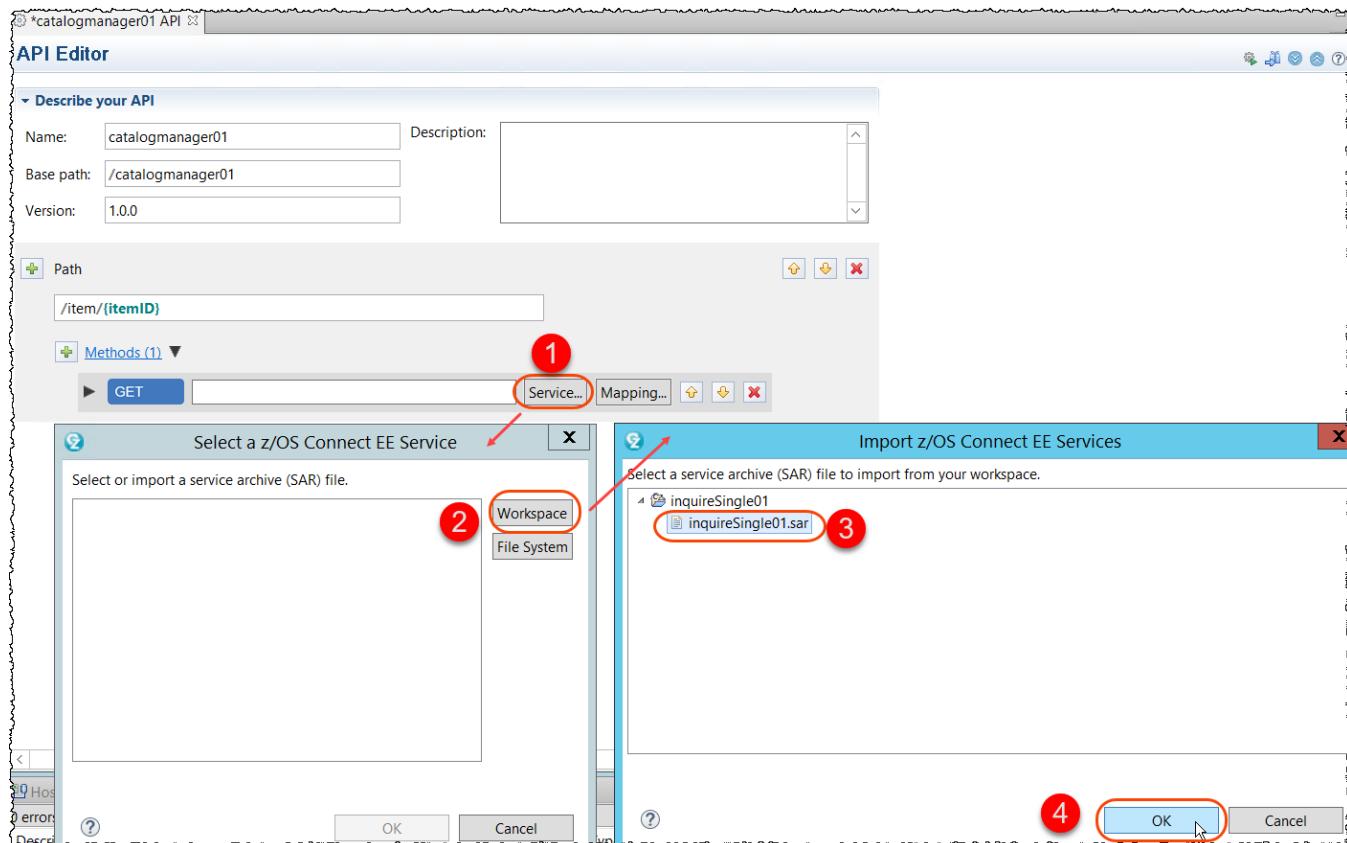


- 2.1.4 You will arrive in the z/OS Connect EE API Editor  
 ► in Path specify **/item/{itemID}**  
 Tip: (itemID was the interface renamed on step 1.2.10)  
 ► You want only GET a value from the service. Use the icon to delete the methods **POST**, **PUT** and **DELETE**



- 2.1.5 ► Click **OK** for the dialogs confirming the delete.

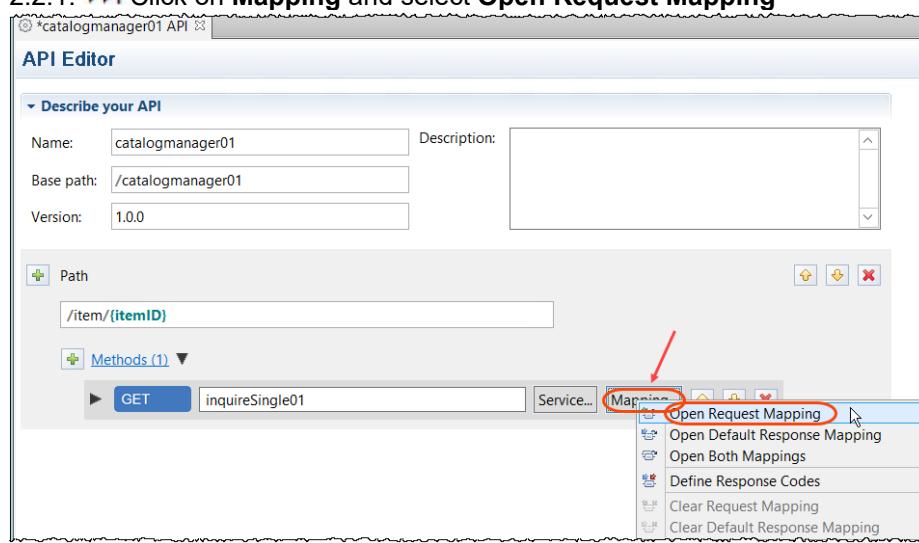
- 2.1.6 ► Click on **Service...** button and on **Select a z/OS Connect EE Service** click **Workspace** button.  
 Navigate to your Service Project and find the SAR file ( **inquireSingle01.sar** ) that you exported before and  
 ► Click **OK** three times.



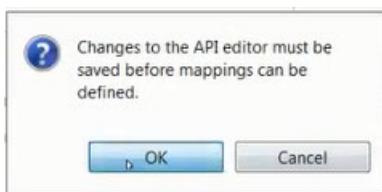
## 2.2 Mapping the API to the service

Now we need to do the mappings

- 2.2.1. ► Click on **Mapping** and select **Open Request Mapping**

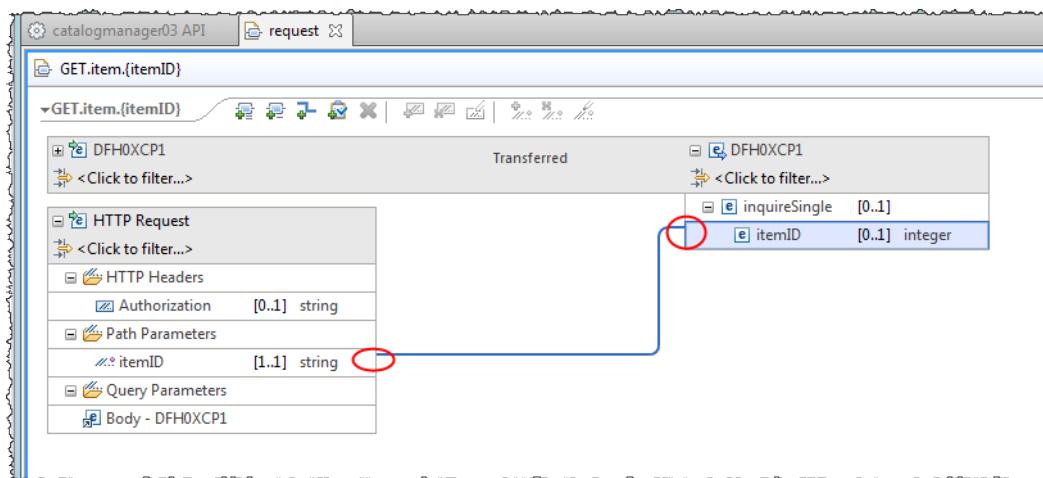


2.2.2 ► A dialog will ask for save the changes. Click **OK** to save it..

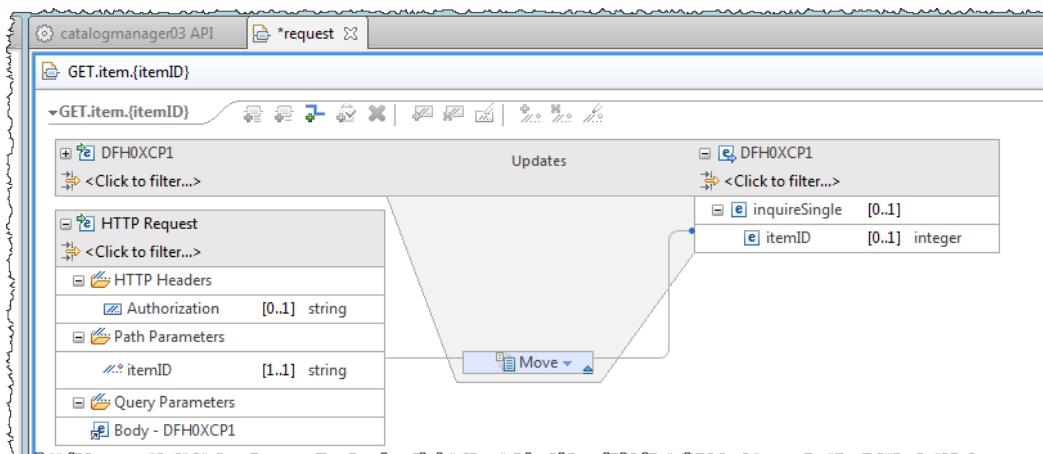


2.2.3 The Mapping editor opens

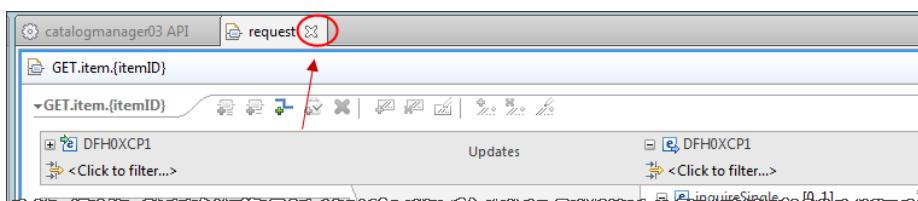
► Expand **inquireSingle** on right.  
Use the mouse to drag **itemID** and drop to **itemID** under **Path Parameters**



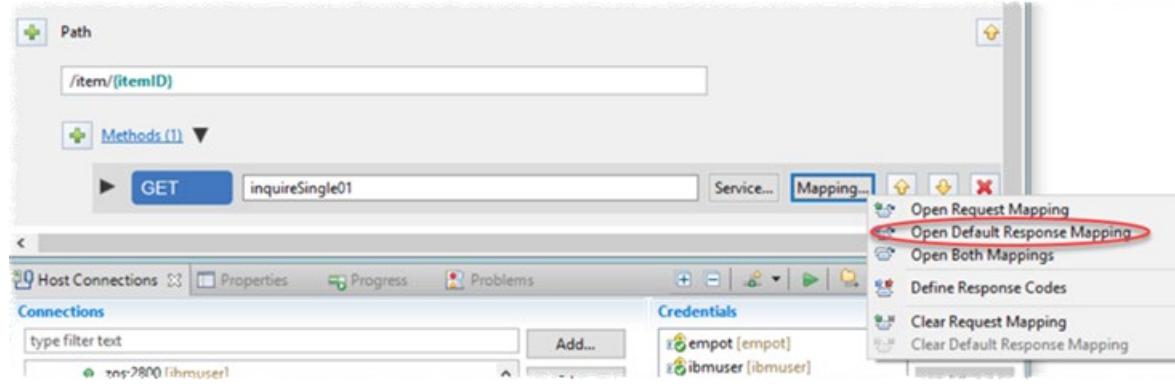
It shows as:



2.2.4 ► Use **Ctrl + S** to save this mapping and **close** this mapping editor



2.2.5 ➡ Back to API editor click on **Mapping...** and select **Open Default Response Mapping**



2.2.6 ➡ On the response expand the fields that we will map on the left and on the right. We could map each one as we did, but we can keep as is so it will do an **implicit mappings** and **maps everything**. It will save time.

2.2.7 ➡ Use **Ctrl + Shift + F4** to close all editors

## Section 3 – Deploy the API

In this step, you would deploy the API to z/OS Connect EE Server. Your API may only contain a single path, but for an initial experience with the API Editor and the APIs deployment, it is sufficient.

### 3.1 Deploy API to z/OS

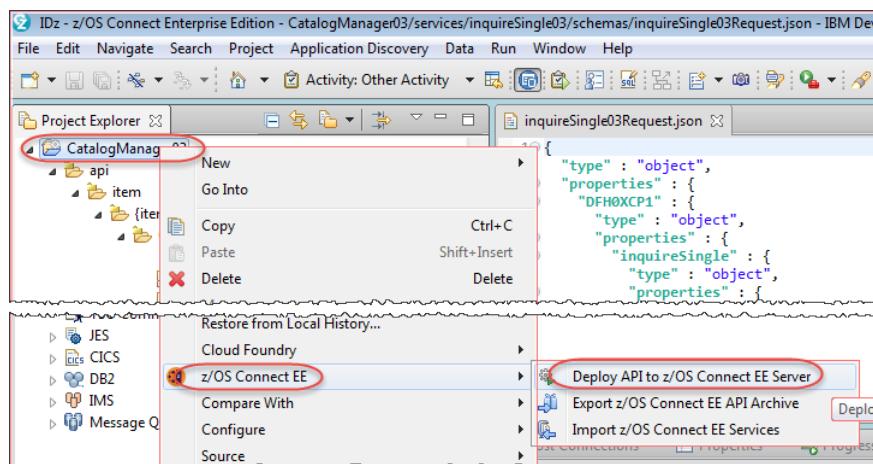
- 3.1.1. Still under *z/OS Connect Enterprise Edition* perspective and using the *Project Explorer* view, fully expand the **CatalogManager01** project and double click on **inquireSingle01Request.json**. You can see the json request created

```

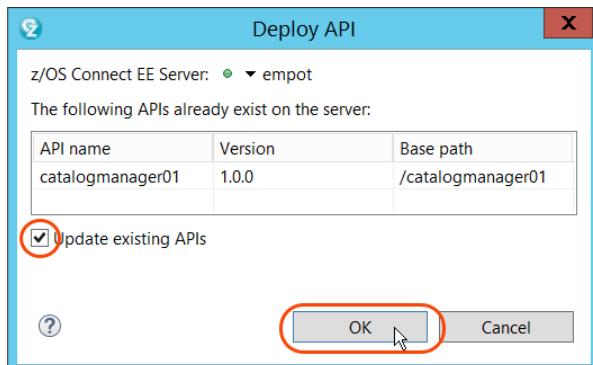
File Edit Navigate Search Project Application Discovery Data Run Window Help
Activity: Other Activity
Project Explorer
CatalogManager01
  api
    item
      {itemID}
        GET
          mapping.xml
          requestmap
          response.map
  api-docs
  services
    inquireSingle01
      files
      schemas
        inquireSingle01Request.json
        inquireSingle01Response.json
        manifest.yml
  package.xml
  FaultAnalyzer
  inquireSingle01Request.json
1: {
2:   "type" : "object",
3:   "properties" : {
4:     "DFH0XCP1" : {
5:       "type" : "object",
6:       "properties" : {
7:         "inquireSingle" : {
8:           "type" : "object",
9:           "properties" : {
10:             "itemID" : {
11:               "minimum" : 0,
12:               "maximum" : 9999,
13:               "type" : "integer"
14:             }
15:           }
16:         }
17:       }
18:     }
19:   }
20: }
21:

```

- 3.1.2. To deploy this API, right click on **CatalogManager01** and select *z/OS Connect EE -> Deploy API to z/OS Connect EE Server*

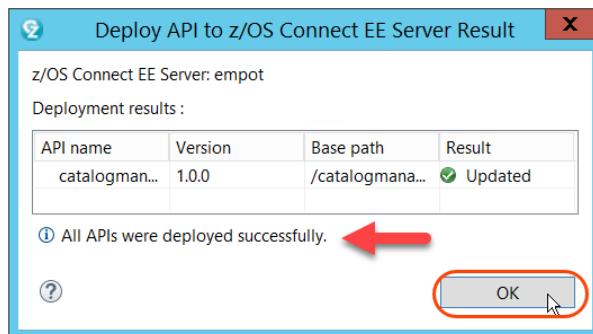


3.1.3 ➡ Select Update existing APIs and click **OK**

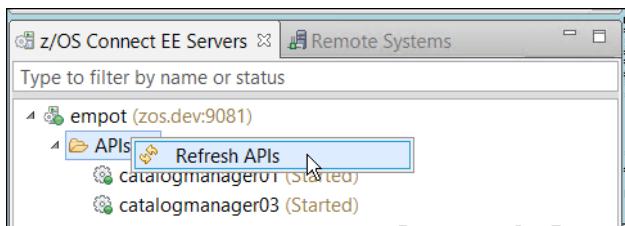


3.1.4 ➡ Once deployed, the result is displayed

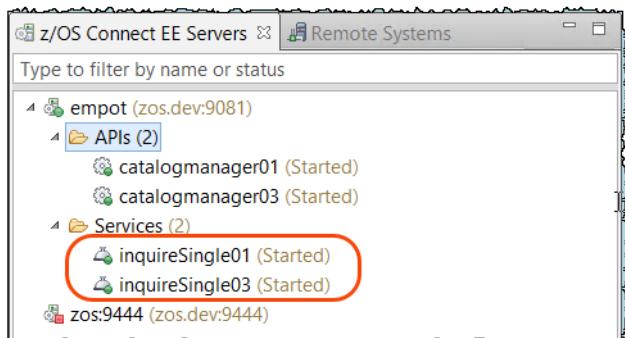
Check that “*All APIs were deployed successfully*” then click on **OK**:



3.1.5 ➡ Using the *z/OS Connect EE Servers* view (left bottom), right click on **APIs** and select **Refresh APIs**.



3.1.6 You should see the list of APIs already deployed to the *z/OS Connect EE Server*



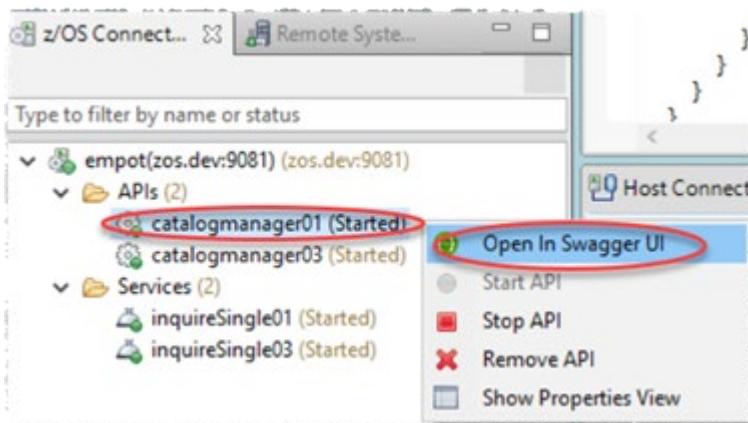
## Section 4 – Testing deployed API using Swagger

In this step, you will test the deployed API using Swagger.

Swagger is the world's largest framework of API developer tools for the OpenAPI Specification(OAS), enabling development across the entire API lifecycle, from design and documentation, to test and deployment.

### 4.1 Invoking Swagger to test the API

- 4.1.1. ► Using the z/OS Connect EE Servers view, right click on the API **catalogmanager01** that you deployed and select **Open In Swagger UI**.



4.1.2. It will open the Swagger UI inside IDz.

- Click on **catalogmanager01** to see the **GET API**



You will see:



#### 4.1.3 ► Click GET /items/{itemID}

You will see the description for the operation: the elements to send for the request and the format of the response. Test your inquire single operation by filling in the itemID (**10, 20, 30, ..., 210**), then click “**Try it out!**”.

**catalogmanager01**

Show/Hide | List Operations | Expand O:

**catalogmanager01**

**GET** /item/{itemID}

Response Class (Status 200)  
OK

Model Example Value

```
{
  "DFH0XCP1": {
    "returnCode": 0,
    "department": 0,
    "cost": "string",
  }
}
```

Response Content Type application/json

Parameters

Parameter	Value	Description	Parameter Type	Data Type
Authorization			header	string
itemID	10		path	string

Try it out!

[ BASE URL: /catalogmanager01 , API VERSION: 1.0.0 ]

#### 4.1.4 ►| Scroll down and check the results

The screenshot shows the Postman interface with two tabs open: 'inquireSingle03Request.json' and 'catalogmanager03.json'. In the 'catalogmanager03.json' tab, the 'itemID' parameter is set to '10' (highlighted with a red circle and arrow). Below it, the 'Authorization' header is empty. A 'Try it out!' button is visible. The 'Curl' section contains the command: `curl -X GET --header 'Accept: application/json' 'http://zos.dev:9081/catalogmanager03/item/10'`. The 'Request URL' is `http://zos.dev:9081/catalogmanager03/item/10`. The 'Request Headers' section shows: `{ "Accept": "application/json" }`. The 'Response Body' section displays the JSON response:

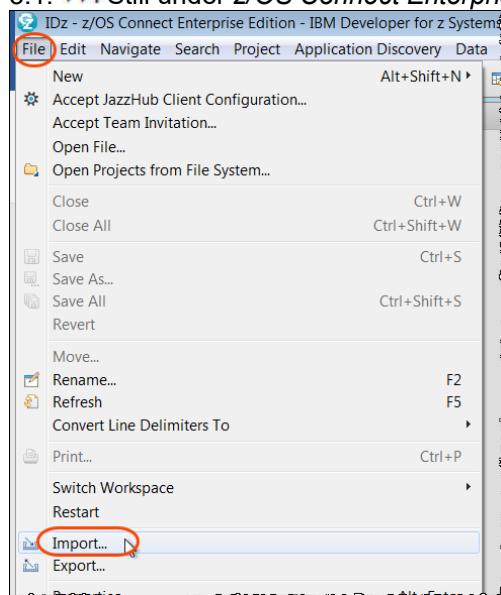
```
{
  "DFH0XCP1": {
    "responseMessage": "RETURNED ITEM: REF =0010",
    "returnCode": 0,
    "inquireSingle": {
      "item": {
        "stock": 5,
        "itemID": 10,
        "department": 10,
        "description": "Ball Pens Black 24pk",
        "onOrder": 0,
        "cost": "002.90"
      }
    }
  }
}
```

#### 4.1.5 ►| Use Ctrl + Shift + F4 to close all opened editors.

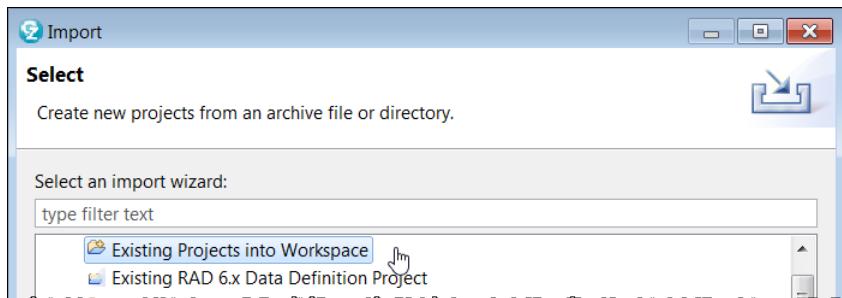
## Section 5 –(OPTIONAL) Import the solution

In case you did not complete the lab you can import a solution for an userid (empot03). Even if you are other user id this solution will work for you.

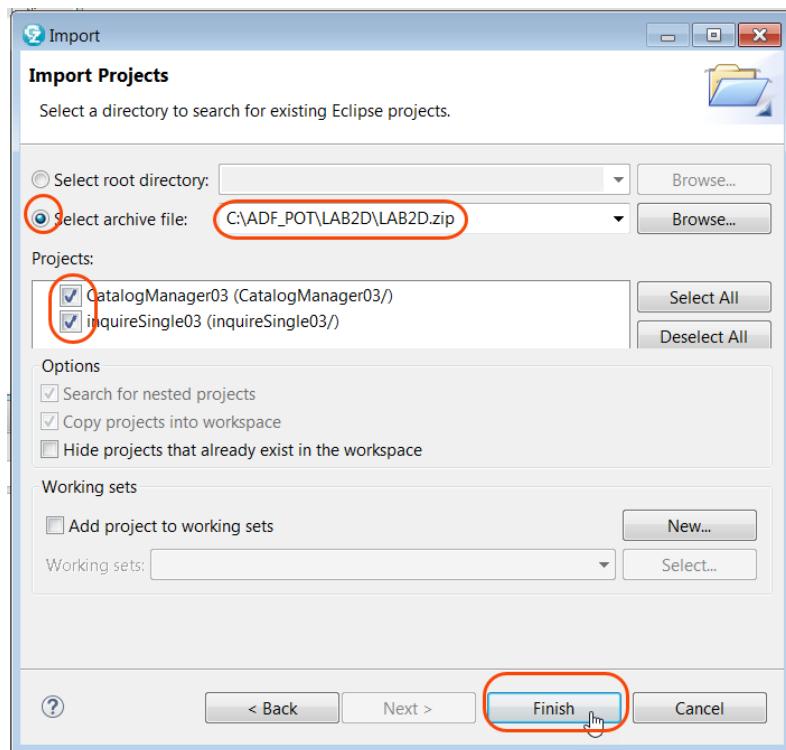
#### 5.1. ►| Still under z/OS Connect Enterprise Edition perspective select File > Import...



5.2.  **Select Existing Projects into Workspace** and click **Next**



5.3.  **Select archive file** and use Browse to find the exported version **LAB2D.zip** and select **CatalogManager03** and **inquireSingle03** Click **Finish**



5.4.  Proceed to item 1.4.1 to deploy the Service to z/OS and then go to Section 3 to deploy the API.I

# LAB 5 (OPTIONAL) Create UrbanCode Deploy infrastructure and deploy to z/OS

Updated April 12 2021 by Regi. (Reviewed by Wilbert Kho)

## Abstract:

You will create and deploy an existing COBOL CICS application using UrbanCode Deploy to z/OS

This Lab has 3 parts.

### Part 1 – Create the UrbanCode Deploy application infrastructure.

In this section, you will design the actual deployment process; you need to prepare the application infrastructure in UrbanCode Deploy (UCD). First, you will create a component and add component version, then you will define resources and map them to an environment, and finally you will create an application and add environment and component to it.

### Part 2 - Create the UrbanCode Deploy deployment processes.

On this part you will create a deployment process for your component and the application process that uses the component process to deploy the component.

### Part 3 – Deploy the application to z/OS CICS

On this part you will deploy the Application to the z/OS CICS.



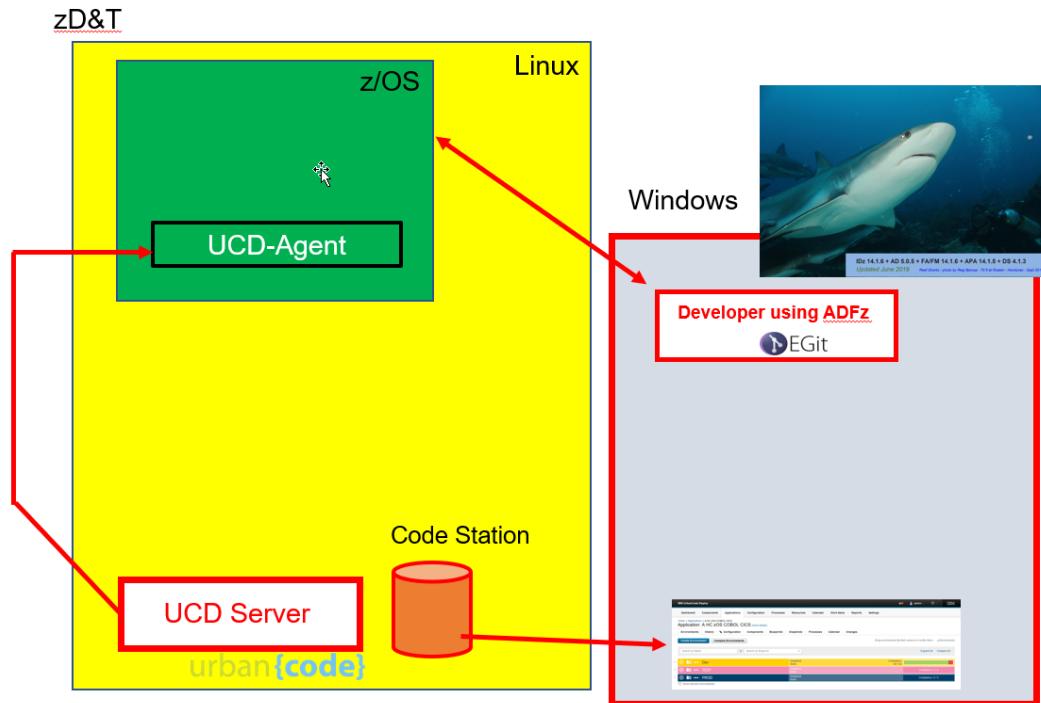
Each time you see the symbol ➡ it means that you have to “do” something on your computer – not merely read the document.

## Lab Architecture and proposed scenario

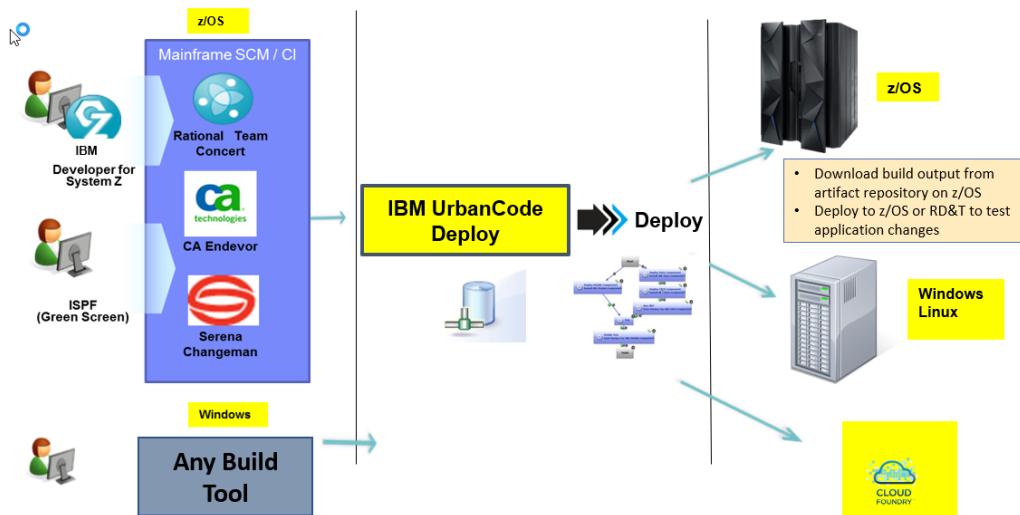
The architecture used in this lab consists of.

1. The **z/OS Server** running on the ZDT that has CICS running and the UCD z/OS agent.
2. The **UrbanCode Deploy Server** that is running on Linux and on the same machine that has the z/OS (ZDT)

Below the architecture of each cloud instance



Below is a picture that describes UCD:

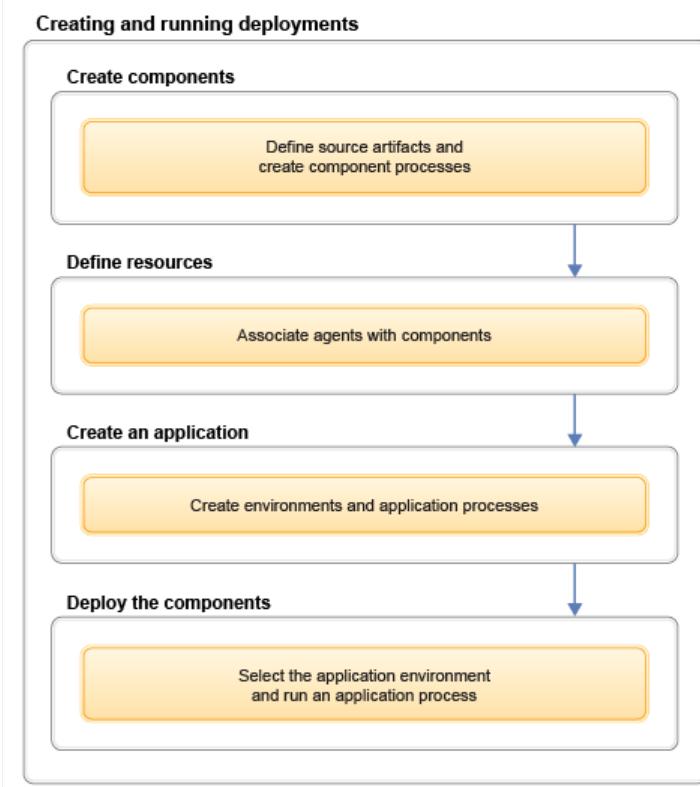


## PART 1 – Create the UrbanCode application infrastructure

In this section, you will design the actual deployment process; you need to prepare the application infrastructure in UCD.

First, you will create a component and add component version, then you will define resources and map them to an environment, and finally you will create an application and add environment and component to it

The main steps are as follows:



Task 1 – Logon to UCD server running on Linux and verify that the UrbanCode agents are running

You will now connect to the UrbanCode Deploy (UCD) server running on a LINUX (same Linux that ZDT is running) and that each student have access to it

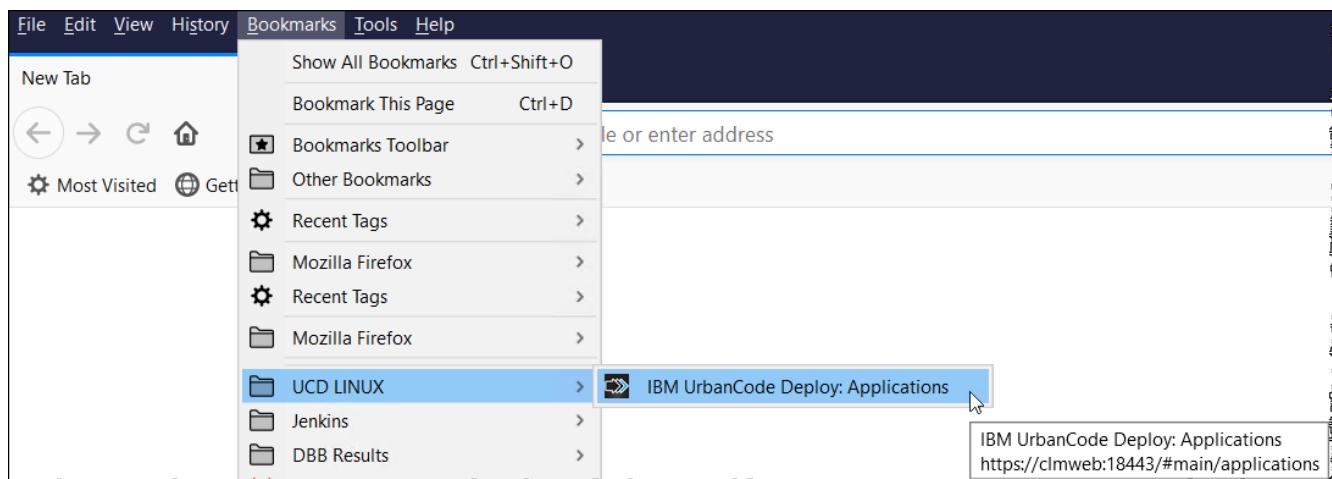
Here you will verify the UCD agents that the UCD server has access to.

You will use the user id **empot02** and password **empot02**. Remember that here the Userid and password is **lower case**.

1.1  Start the Firefox browser to go to UCD server on Linux You can use the icon on the base of your screen Move the mouse to the base of your screen if you do not see this bar



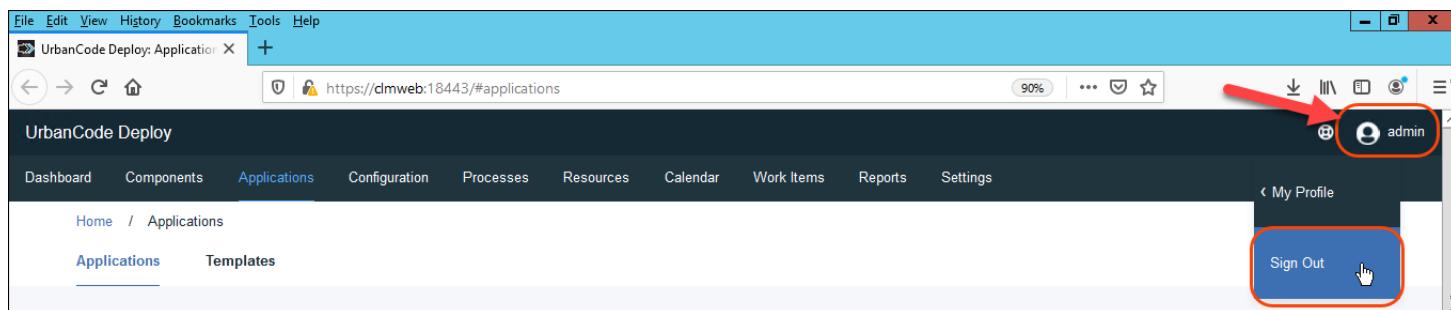
 Look for the **bookmark** below



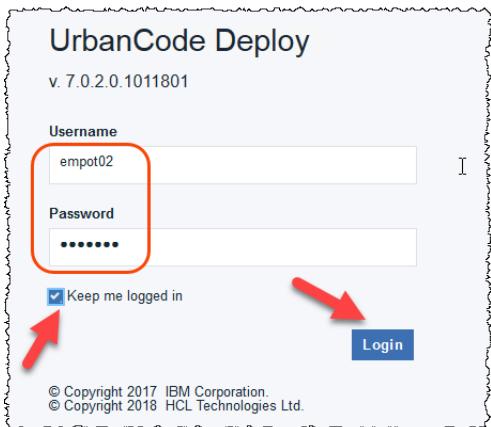
Or use: <https://clmweb:18443/>

1.2. **If you are already logged on**, you must first logoff and logon with your right user id.

 Click on **admin** (or whatever user id is logged in) and select **Sign Out**



- 1.3.  Login with **empot02** and password **empot02**  
 Remember that this is case sensitive here and lower case



UrbanCode Deploy  
v. 7.0.2.0.1011801

Username  
empot02

Password  
\*\*\*\*\*

Keep me logged in

Login

© Copyright 2017 IBM Corporation.  
© Copyright 2018 HCL Technologies Ltd.

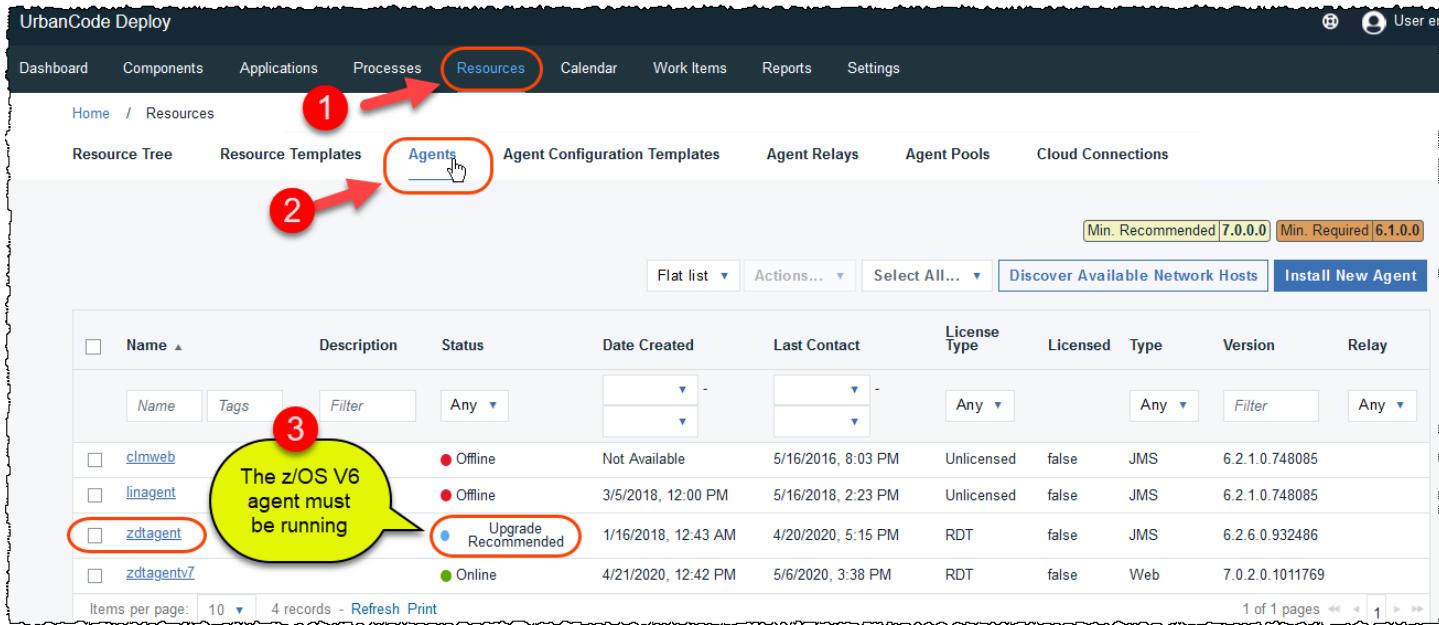
- 1.4.  Verify that the UCD agents are running Th by clicking **Resources > Agents**.

There are 2 running UCD agents on our z/OS.

- One is version 6 (**zdtagent**) identified by the blue icon 
- The other is v7 (**zdtagentv7**) identified by the green icon 

Notice a warning recommending an upgrade of the v6 agent This UCD version 6 agent will point to our DEV environment (CICSTS53).

On this lab you will use only the z/OS V6 agent (**zdtagent**)



UrbanCode Deploy

Dashboard Components Applications Processes **Resources** Calendar Work Items Reports Settings

Home / Resources

Resource Tree Resource Templates **Agents** Agent Configuration Templates Agent Relays Agent Pools Cloud Connections

Flat list Actions... Select All... Discover Available Network Hosts Install New Agent

Name	Description	Status	Date Created	Last Contact	License Type	Licensed	Type	Version	Relay
clmweb		● Offline	Not Available	5/16/2016, 8:03 PM	Unlicensed	false	JMS	6.2.1.0.748085	
linagent		● Offline	3/5/2018, 12:00 PM	5/16/2018, 2:23 PM	Unlicensed	false	JMS	6.2.1.0.748085	
<b>zdtagent</b>		● Offline	1/16/2018, 12:43 AM	4/20/2020, 5:15 PM	RDT	false	JMS	6.2.6.0.932486	
zdtagentv7		● Online	4/21/2020, 12:42 PM	5/6/2020, 3:38 PM	RDT	false	Web	7.0.2.0.1011769	

Items per page: 10 4 records - Refresh Print 1 of 1 pages

## Task 2 – Create a UCD component

Components are groups of deployable artifacts that make up an application. You will later create your UCD application named “**J02Mortgage**” that will include only one component that you will create here.



### UCD: What is a Component?

A component is a logical representation of deployable artifact along with user-defined processes that operate on them. The physical artifacts are specified in a Component Version. A component has one or more component versions. Each component version has one or more files.

In UrbanCode Deploy, components represent deployable items along with user-defined processes that operate on them. Deployable items, or artifacts, can be files, PDS members, images, databases, etc. In our example, component will include **PDS** members **J02CMORT** and **J02MPMT**.



### z/OS: What is a PDS?

A partitioned data set or PDS consists of a *directory* and *members*. The directory holds the address of each member, or “file”, and thus makes it possible for programs or the operating system to access each member directly. Each member, however, consists of sequentially stored records.

Partitioned data sets are often called *libraries*. Programs, or other content, are stored as members of partitioned data sets. Generally, the operating system loads the members of a PDS into storage sequentially, but it can access members directly when selecting a program for execution.

A PDS also contains a directory. The directory contains an entry for each member in the PDS with a reference (or pointer) to the member. Member names are listed alphabetically in the directory, but members themselves can appear in any order in the library. The directory allows the system to retrieve a particular member in the data set.

2.1 ► On the **Components** page, click **Create Component**:

2.2 Provide values for the required fields on the **Create Component** dialog.

- Specify component Name as **J02Mortgage**  
(Be careful since the name is case sensitive).
- Select **MVSCOMPONENT** in the **Template** field (Templates serve as models for various groups of resources. MVSCOMPONENT template, preinstalled with UCD, includes basic z/OS deploy processes and other z/OS related settings)
- Scroll down and click **Save**.

**UCD: What is a Component Template?**

A component template, stores component processes and properties so you can create components from them; template-based components inherit the template's properties and process.

Create Component ⓘ

Name \*  1

Description  3

Teams  
Team 02 x

Component Template  
MVSCOMPONENT 2

Template Version  
Always Use Latest

Component Type  
z/OS

High Level Qualifier Length  
0

ucd.repository.host

Use the system's default version import agent/tag.

Import new component versions using a single agent.

Import new component versions using any agent with the specified tag.

Cleanup Configuration

Inherit Cleanup Settings 4

Run Process after a Version is Created

2.3 The component **J02Mortgage** is created

Dashboard Components Applications Processes Resources Calendar Work Items Reports Settings

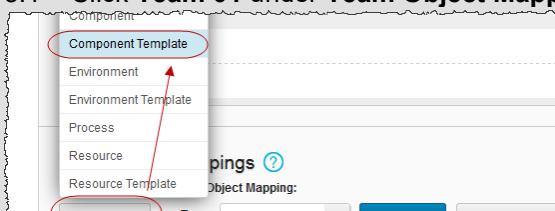
Home / Components / J02Mortgage Component: J02Mortgage Show details

Dashboard Usage Configuration Calendar Versions Processes Changes

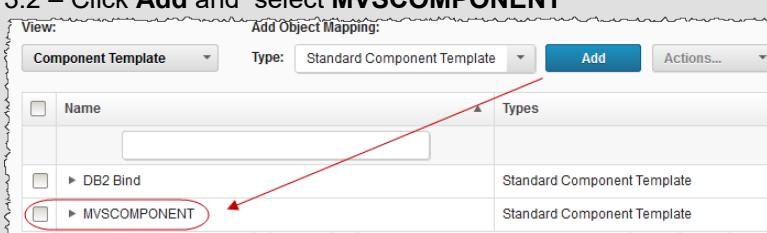
**The MVSCOMPONENT is not in the drop down?**  
 Your UCD server must have this template defined there. If NOT call the instructor..

1. Logon ad **admin/admin**
2. Click **Settings > Teams (under Security)**
3. For EACH team perform as below.

**3.1 – Click Team 01 under Team Object Mappings/View: select Component Template**



**3.2 – Click Add and select MVSCOMPONENT**



### Task 3 – Create a ship list file and z/OS component version

The z/OS **ship list file** specifies which files from the build to include in the new component version to deploy. You must create a ship list file before you run z/OS deployment tools.

Ship list files are XML files that contain a list of files to be deployed on z/OS. For more information, refer to the UCD documentation:

[http://www.ibm.com/support/knowledgecenter/SS4GSP\\_6.2.6/com.ibm.udeploy.doc/topics/zos\\_shiplistfiles.html](http://www.ibm.com/support/knowledgecenter/SS4GSP_6.2.6/com.ibm.udeploy.doc/topics/zos_shiplistfiles.html)

To create a ship list file for the component to be deployed you could use many ways, including ISPF.  
 To make this easy you will use IDZ.

**3.1 Start IBM Developer for z Systems version 15 if it is not already started**

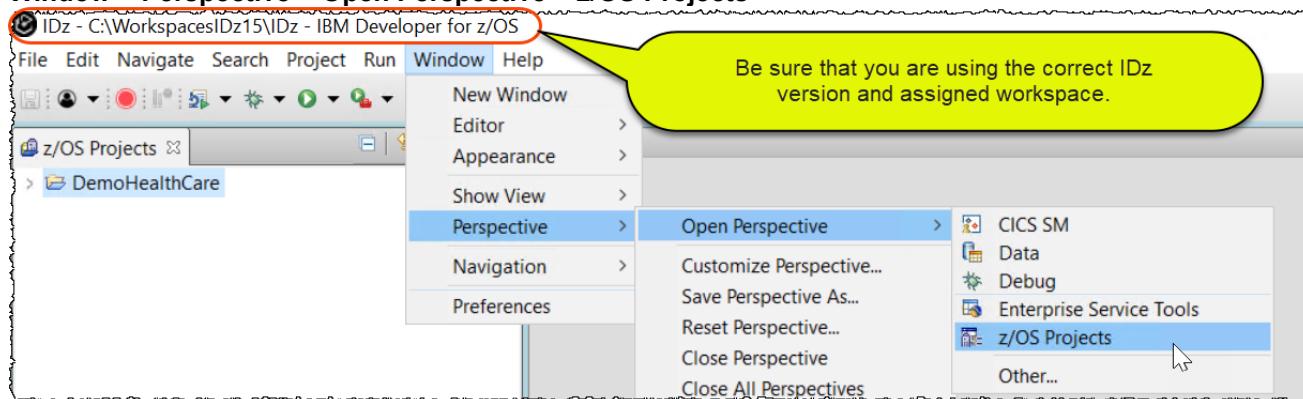
►► Using the desktop double click on **IDz V15** icon.

►► Verify that the message indicates that it is Version **15.0.1**

**IMPORTANT ->** This icon will start an eclipse workspace that has already some definitions required for this lab.  
 PLEASE DO NOT start IDz using other way than this icon.

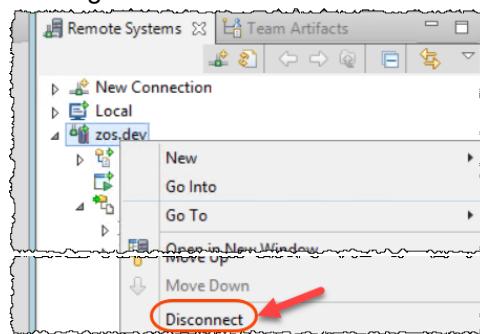


3.2  Open the **z/OS Projects** perspective by selecting  
**Window > Perspective > Open Perspective > z/OS Projects**

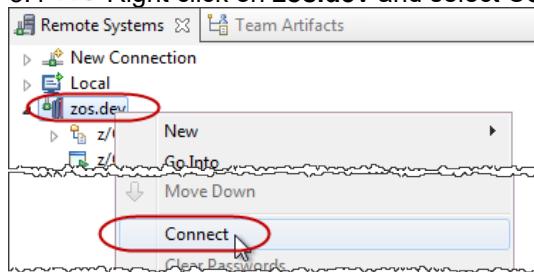


3.3 If you used userid **empot01** before you need to disconnect. Your new userid now will be **empot02**.

 Right click on **zos.dev** and select **Disconnect**

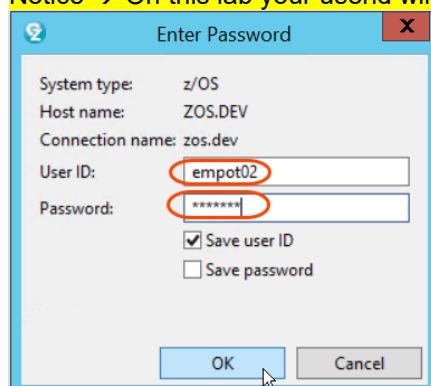


3.4  Right click on **zos.dev** and select **Connect**

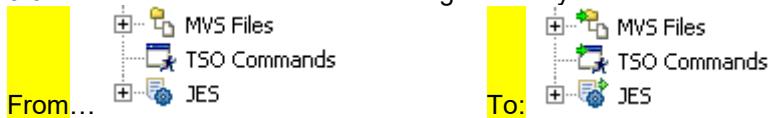


3.5  Type **empot02** as userid (might be already there) and **empot02** as password.  
 Click **OK** to connect to z/OS.

Notice → On this lab your userid will be **empot02** (not empot01 used in previous labs)



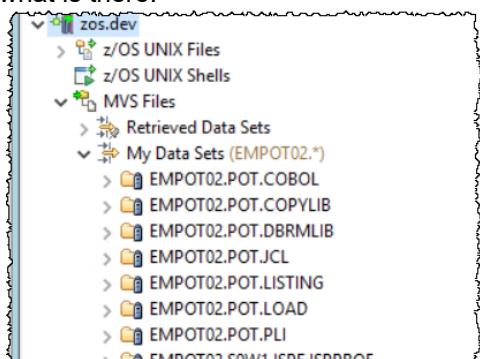
3.6 Notice that the folder icons changed once you are connected to z/OS. A small green arrow is added.,,



3.7 ► Expand MVS Files and My Data Sets to see all your MVS data sets

Note that you do not have the same PDSs shown below (EMPOT02.\*) this is just an example..

Depending on which ID you are using you may have no data sets, the IDs are reused and we have no control what is there.



You are connected to a z/OS remote system. Now you will create a Ship List and submit JCL to create the executables to be deployed.

3.8 You now can create the UCD ship list. An XML file that has the list of the load modules that will be deployed. This xml could be created from an SCM build tool like RTC, Endevor etc..

For this lab we will create it manually..

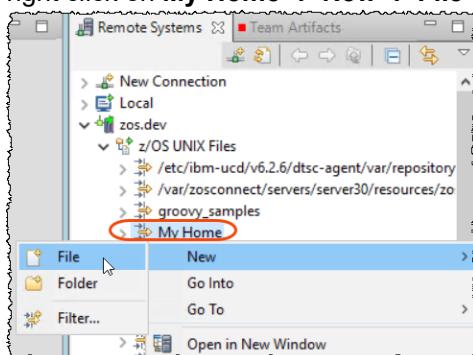
#### What is the Ship list file?

The ship list file specifies which files from the build to include in the new component version to deploy. You must create a ship list file before you run the IBM® z/OS® deployment tools.

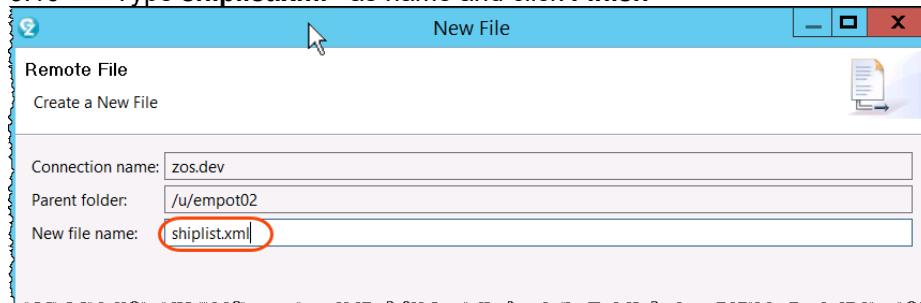


Ship list files are XML files that contain a list of files. The container type that is used to identify partitioned data set (PDS) resources is PDS and the resource type is **PDSmember**. You can use an asterisk (\*) as a wildcard for the resource name, if you want all members in a partitioned data set (PDS) to be included in a package. Typically, you write a script that works with your build engine to create a ship list file from the build output.

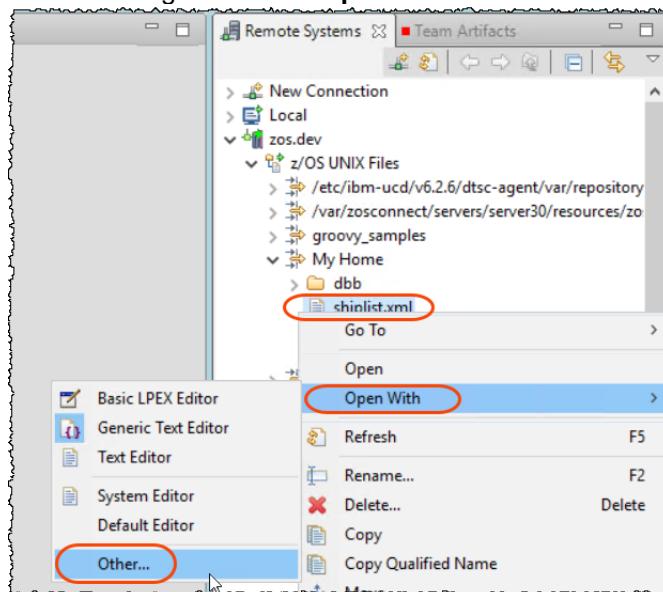
3.9 ► Using the Remote Systems view (on top right), expand z/OS UNIX Files, right click on **My Home** → **New** → **File**



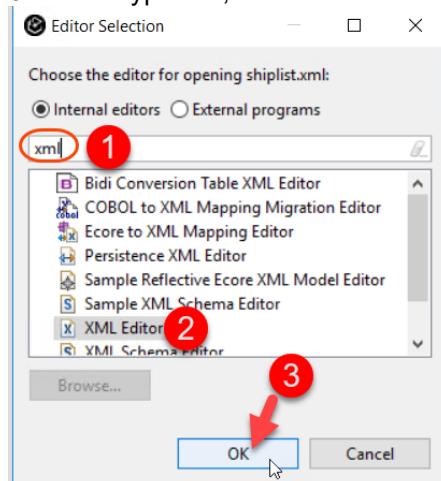
3.10 ► Type **shiplist.xml** as name and click **Finish**



3.11 ► Right click on **shiplist.xml** and select it to edit, or right click and select **Open With Other...**



3.12 ► Type **xml**, select **XML Editor** and click **OK**.



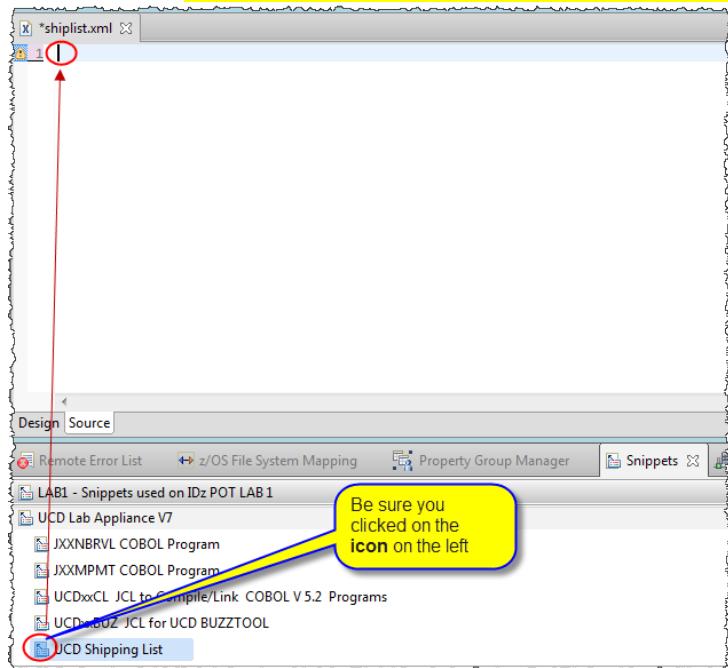
3.13 ► Click on **Source** tab



3.14 ► Click on **Snippets** tab on the bottom.

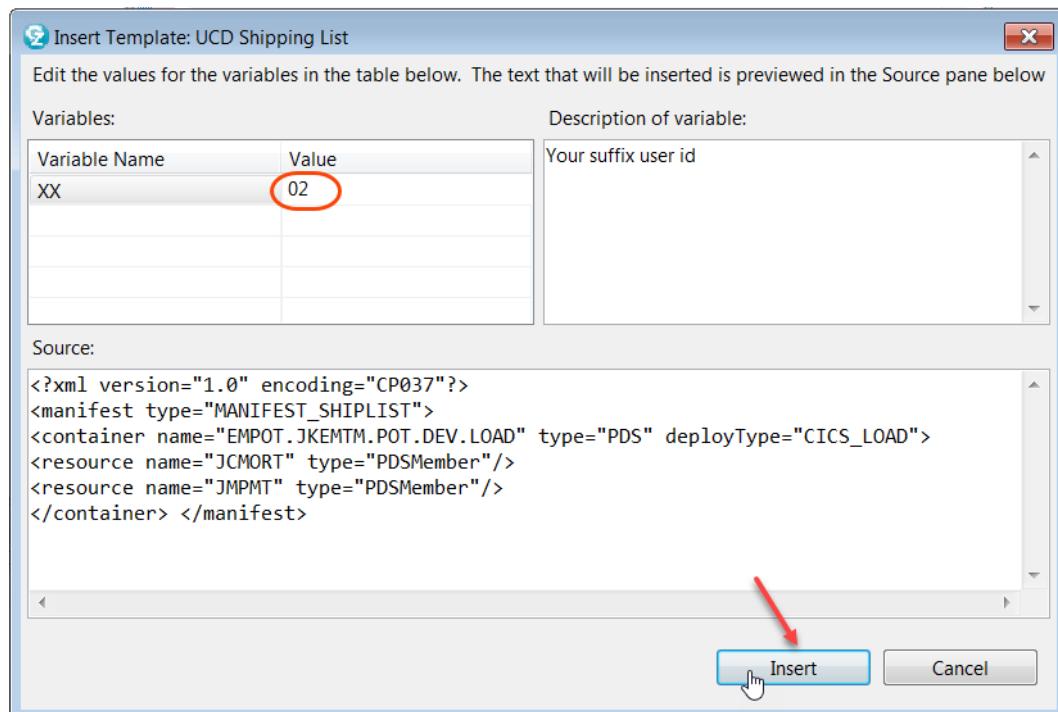
► Scroll down and use the **UCD Shipping List** snippets to drag and drop to the **FIRST position** of the file

**IMPORTANT:** You must click on the icon  to be able to drag/drop

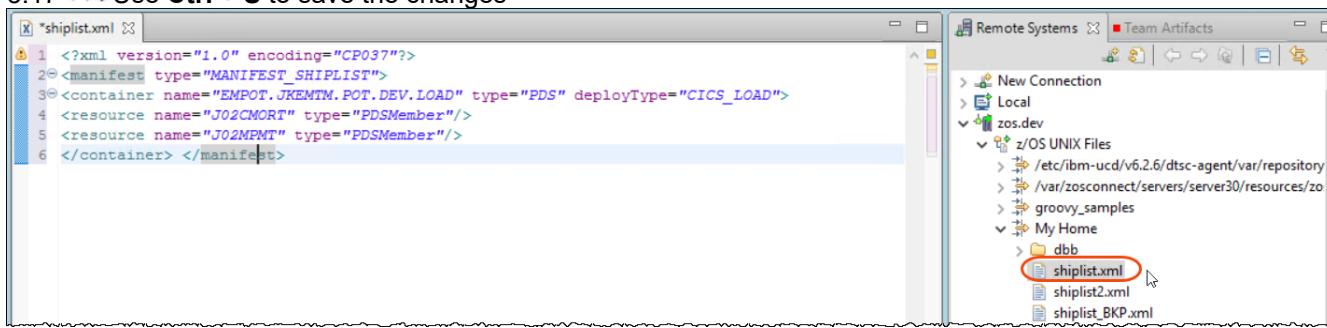


3.15 ► When the dialog opens type **02** ..

3.16 ► Click **Insert** to insert the lines. Notice that the variables are replaced



### 3.17 ►| Use Ctrl + S to save the changes



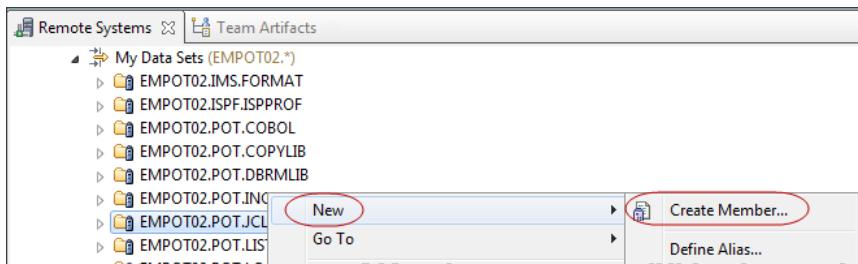
## Task 4 - Create the UCD component version from JCL

On this task, you will now use the z/OS UCD tool named “BUZTOOL” to create a version of the modules that need to be deployed. The UCD Toolkit installed on z/OS used the UCD Client to communicate to the UCD server.

In this lab the UCD code station on z/OS is kept in the USS Files or on UCD server (installation decision).

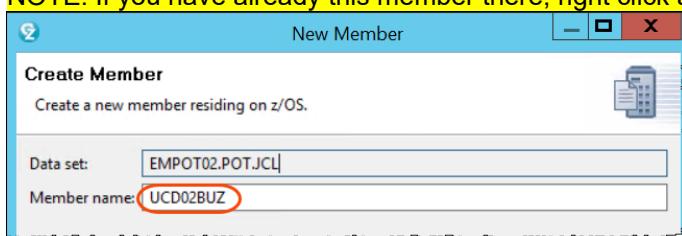
### 4.1 ►| Using Remote System view, expand **My Data Sets**, right click on **EMPOT02.POT.JCL** and create a member .

If you don't have this PDS call the instructor.

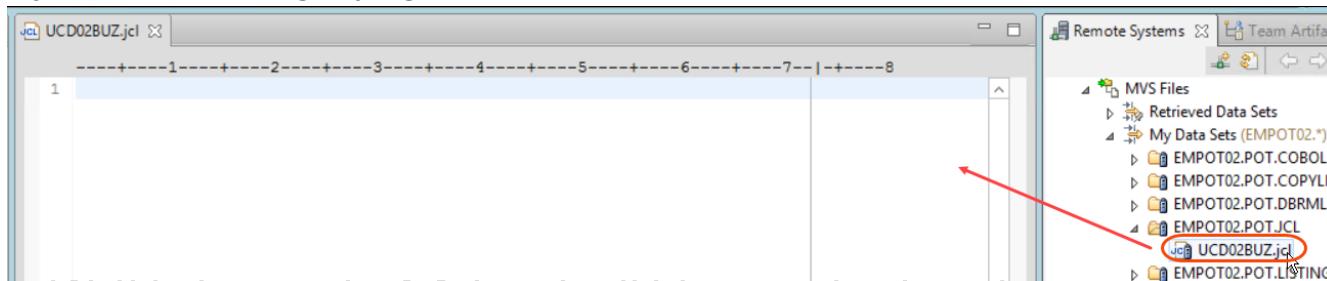


### 4.2 ►| Name it **UCD02BUZ** and click **Finish**

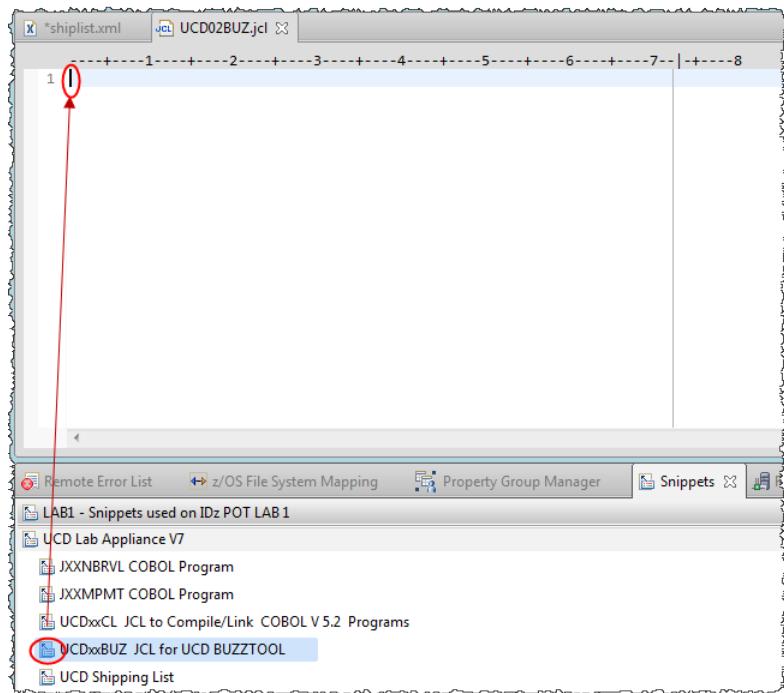
NOTE: If you have already this member there, right click and delete it.



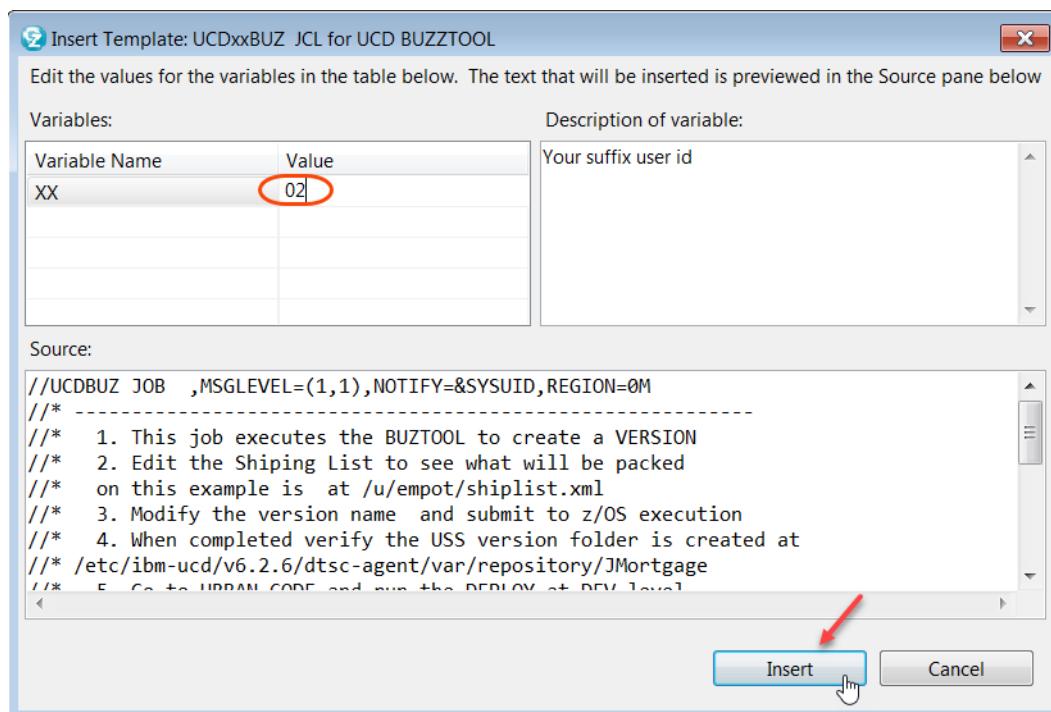
### 4.3 ►| Double click on **UCD02BUZ** to edit.



- 4.4 ►| Use the UCDxxBUZ snippets to drag and drop to the **FIRST POSITION** of the file  
**IMPORTANT:** You must click on the icon  to be able to drag/drop



- 4.5 ►| When the dialog opens type **02**. ..  
 ►| Click **Insert** to insert the lines. Note that the variables are replaced



This job uses the **buztool createzosversion** command to create the component version.

4.6 ► Scroll down and understand the parameters passed to the BUZTOOL

```

1 //UCD02BUZ JOB ,MSGLEVEL=(1,1),NOTIFY=&SYSUID,REGION=0M
2 /*
3 /* 1. This job executes the BUZTOOL to create a VERSION
4 /* 2. Edit the Shiping List to see what will be packed
5 /* on this example is at /u/empot02/shiplist.xml
6 /* 3. Modify the version name and submit to z/OS execution
7 /* 4. When completed verify the USS version folder is created
8 /* /etc/ibm-ucd/v6.2.6/dtsc-agent/var/repository/J02Mortgage
9 /* 5. Go to URBAN CODE and run the DEPLOY at DEV level
10 /*
11 //BUZTOOL EXEC PGM=BPXBATCH,REGION=0M
12 //STDOUT DD SYSOUT=*
13 //STDERR DD SYSOUT=*
14 //STDPARM DD *
15 SH /etc/ibm-ucd/v6.2.6/dtsc-agent/bin/buztool.sh createzosversion
16     "-c" "J02Mortgage"
17     "-s" "/u/empot02/shiplist.xml"
18     "-v" "yyyyymmdd"
19 /*
20 /* yyyyymmdd will be the name of your version
21 */

```

Possible arguments for the buztool **createzosversion** command

Parameter	Required	Description
-c	true	The name of the component in IBM UrbanCode Deploy. The component name can contain only letters, numbers, and spaces.
-v	false	The name of the version to create. If a version is not specified, a version name is generated from the current time stamp. The version name can contain only letters, numbers, and spaces.
-s	true	The location of the ship list file.
-verb	false	To display a trace log, set this parameter to true.

4.7 ► Name a version for this component:

Modify from "yyyyymmdd" to today's date in the format of **year, month and day**

Example: I used **20180709**. This version name must be unique for this component to avoid errors of being already created on the code station.

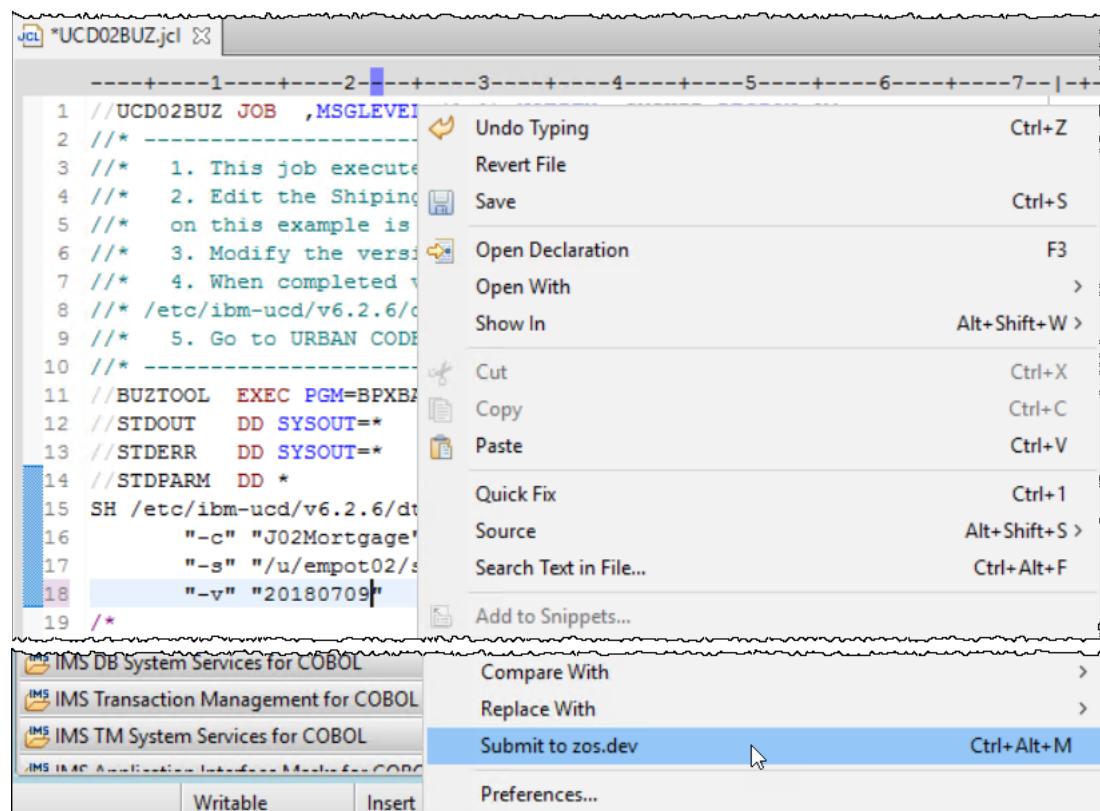
```

14 //STDPARM DD *
15 SH /etc/ibm-ucd/v6.2.6/dtsc-agent/bin/buztool.sh createzosversion
16     "-c" "J02Mortgage"
17     "-s" "/u/empot02/shiplist.xml"
18     "-v" "20180709"

```

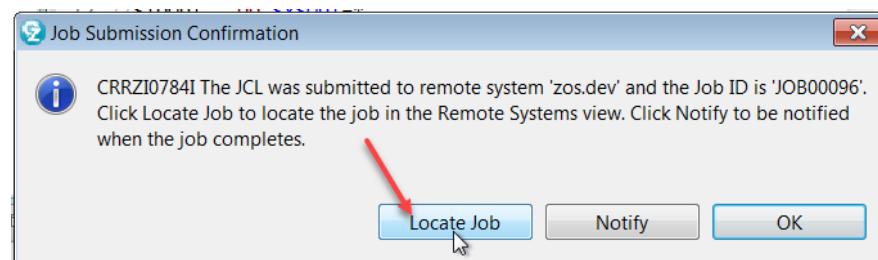
4.8 ►| Use **Ctrl + S** to save

►| Right click on the editor and select **Submit to zos.dev**



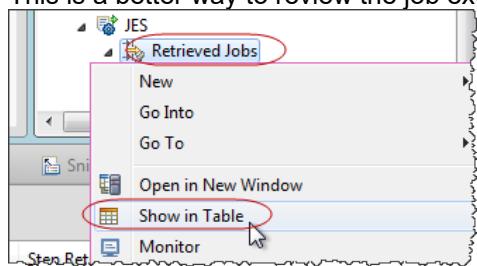
**You do not find the option Submit?...**

Be sure you are using the correct editor. Either LPEX or JCL editors will provide this capability when right clicking. Be sure you pasted the content on line 1 and column 1. If you still don't see, you can right click on the editor content and select **Open with → Other -> JCL Editor** and try again..

4.9 ►| Click **Locate Job** to get the job results

This job may take as long as 1 or 2 minutes.. Remember that your z/OS instance on cloud has limited power resources and is very slow.

4.10 ► On the right under *Remote System* view right click on **Retrieve Jobs** and select **Show in Table**. This is a better way to review the job execution



4.11 ► Use the refresh icon to see the job being executed. Once execution is completed you must have a *User Return Code*

Resource	Job ID	Job Name	Job Own...	Job Entr...	Return C...	Return In...	System ...	User Ret...	Return S...	Queue P...
UCD02BUZ:JOB0...	JOB00096	UCD02B...	EMPOT02	2018/07...	CC 0000	NORMAL		000	COMPLE...	10

The return code **must be 0** and the version must be created on UCD Server

4.12 ► Double click and scroll down to see the results

```

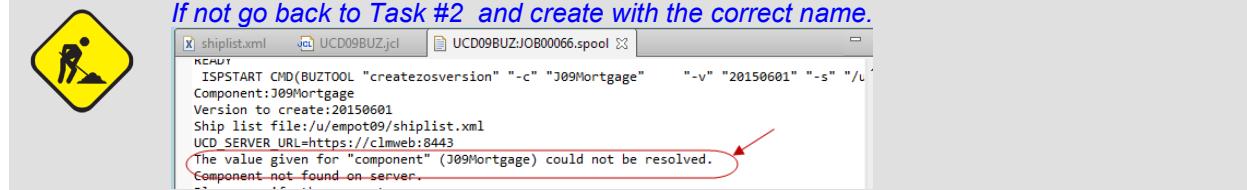
58      "-s" "/u/empot02/shiplist.xml"
59      "-v" "20180709"
60 zOS toolkit config : /etc/ibm-ucd/v6.2.6/dtsc-agent/ (6.2.6,2017
61 zOS toolkit binary : /etc/ibm-ucd/v6.2.6/dtsc-agent/ (6.2.6,2017
62 zOS toolkit data set : BUZ626 (6.2.6,20170907-0249)
63 Reading parameters:
64 ....Command : createzosversion
65 ....Component : J02Mortgage
66 ....Version : 20180709
67 ....Shiplist file : /u/empot02/shiplist.xml
68 Verifying version
69 ....Repository location : /etc/ibm-ucd/v6.2.6/dtsc-agent/var/repos
70 Pre-processing shiplist:
71 ....Shiplist after processing : /etc/ibm-ucd/v6.2.6/dtsc-agent/var/
72 Packaging data sets:
73 ....Location to store zip : /etc/ibm-ucd/v6.2.6/dtsc-agent/var/repos
74 ....Zip name : package.zip
75 ....EMPTO.JKEMTM.POT.DEV.LOAD.bin
76 ....Elapsed time for data set package or deploy operation : 1.6954
77 Create version and store package:
78 ....Version artifacts stored to UCD server CodeStation
79 ....Version:20180709 created
80 Elapsed time 24.0 seconds.
81 FSUM1006 A shell was not specified. Processing continues using the
82

```

4.13 ► Use **Ctrl + Shift + F4** to close all editors.

**Errors like the one below?**

*Be sure that you have created the component with the correct name (mixed case letters). If not go back to Task #2 and create with the correct name.*

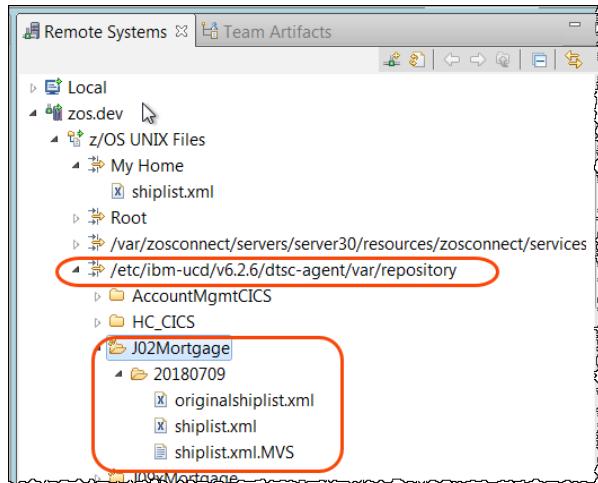


#### 4.14 (Optional)

► Under **z/OS UNIX Files** navigate to the filter  
**/etc/ibm-ucd/v6.2.6/dtsc-agent/var/repository**

Expand **J02Mortgage** to see the UCD metadata.

Notice that the zip file is located on the UCD CODE STATION on Linux (not on z/OS).



#### 4.15 ► Close or minimize IDz, you will not need any more on this lab.

Notice that during version creating process, the **BUZTOOL** communicates with your UCD server to obtain component information and to store version artifacts. If component version was created successfully, you can verify version information using UCD server interface.

#### 4.16 ► Now Using the UCD browser, click Components -> J02Mortgage

The screenshot shows the 'Components' tab in the IBM UrbanCode Deploy interface. The top navigation bar includes 'Dashboard', 'Components' (which is highlighted with a red circle labeled 1), 'Applications', 'Processes', 'Resources', 'Calendar', 'Work Items', 'Reports', and 'Settings'. Below the navigation bar, there are summary statistics: Failed Version Import (0), Importing Version (0), No Version (1), Successful (0), and No Artifact (0). There are buttons for 'Create Component', 'Import Components', 'Actions...', and 'Flat list...'. The main area displays a table of components:

	Name	Latest Import	Latest Version	Template	Description	Created
<input type="checkbox"/>	Component Name					
<input type="checkbox"/>	AccountMgmtCICS		work_item_287.20180608-0223530451	MVSCOMPONENT	Component used on PDTOLS demo	6/24/2015, 7 PM
<input type="checkbox"/>	HC_CICS		20180627-031937	MVSCOMPONENT	zMobile Health Care Appl - COBOL CICS assets	12/14/2017, 4:51 PM
<input type="checkbox"/>	HCMobileWindows7	Windows	V02 - HC for demo deploy		HC Mobile appl for Windows7	12/14/2017, 4:51 PM
<input type="checkbox"/>	J02Mortgage		20180709	MVSCOMPONENT		7/9/2018, 6:1 PM

4.17 ► Click , ① Versions and the ② version that you created (yyyyymmdd ).

Version	Statuses	Type	Created By	Date
20180709	Statuses	Any	admin	7/9/2018, 9:52 PM
testeRegi		Incremental	admin	7/9/2018, 9:28 PM

4.18 ► Click **Show Details**. You can verify that the repository is on UCD Server Code Station (on Linux, not z/OS USS Files)

UrbanCode Deploy

Components

Version: 20180709

Created By: admin  
Created On: 5/2/2020, 4:05 PM  
Repository Type: CodeStation  
Links: add remove

4.19 ► Expand **EMPOT.JKEMT.POT.DEV.LOAD** and you should be able to see the list load modules that are packaged and stored in the Code Station (from the JCL that you submitted before). Optionally the Code Station could be on the z/OS under USS folders.

In our example the Code Station is on the UCD server (LINUX):

Name	Artifact Type	Deploy Type	Inputs
EMPOT.JKEMT.POT.DEV.LOAD	[PDS,ADD]	CICS_LOAD	
J02CMORT		CICS_LOAD	
J02MPMT		CICS_LOAD	

## Task 5 - Create UCD Resources

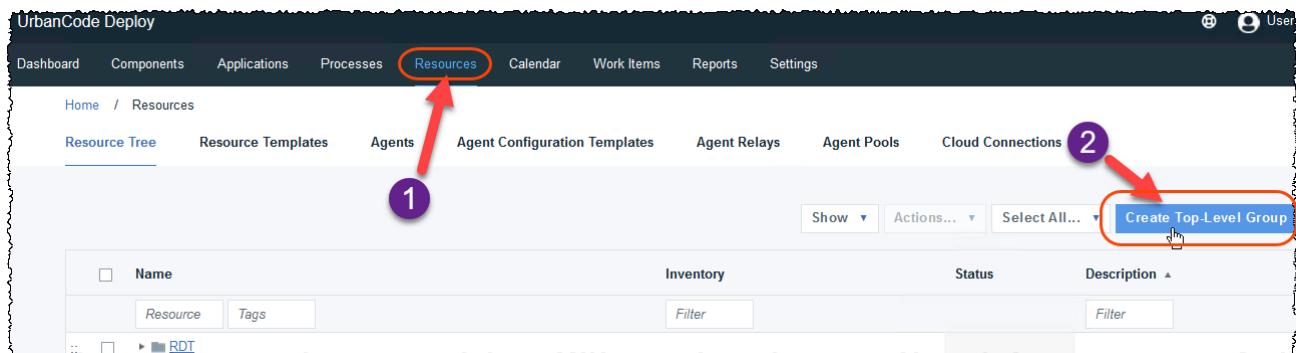
On this task you will create the UCD resources that is a user-defined construct.



### UCD : What is a resource?

A resource is a logical deployment target that typically resolves to an agent and a user-defined construct that is based on the architectural model of UCD. Resources can contain other resources in a hierarchical tree structure (called also resource groups or folders) to represent complex targets. Resources are assigned to environments.

5.1 ► On the **Resources** tab, click **Create Top-Level Group**:



5.2 ► Type **zOS Resource Group 02** and click **Save**.

**Create Resource**

Name\*  
zOS Resource Group 02

Include Agents Automatically

Description

Teams  
Team 02 x

Default Impersonation

Default impersonation can be configured here. Any steps which do not specify their own impersonation settings will fall back to the settings provided here.

Cancel Save

You should have:

Resource Tree	Resource Templates	Agents	Agent Configuration Templates	Agent Relays	Agent Pools	Cloud Connections
:: <input type="checkbox"/> RDT :: <input type="checkbox"/> zOS Resource Group 02						

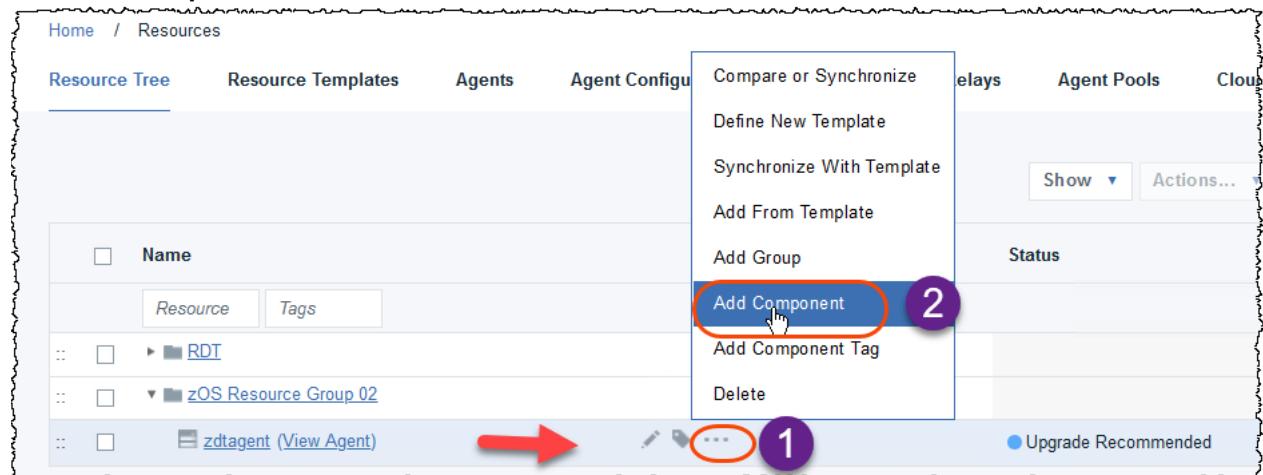
5.3 ► Move the mouse to **ZOS Resource Group**, click the **...** (three dots) and using the drop-down menu click **Add Agent**:



5.4 ► In the **Agent** drop down dialog, select **zdtagent** and click **Save**

The screenshot shows the 'Create Resource' dialog box. The 'Agent' dropdown is set to 'zdtagent' and is circled in purple. The 'Name' field contains 'zdtagent'. There is a 'Description' field, a checked 'Inherit Teams From Parent' checkbox, a 'Teams' section with 'Team 02' selected, and an unchecked 'Default Impersonation' checkbox. A note at the bottom states: 'Default impersonation can be configured here. Any steps which do not specify their own impersonation settings will fall back to the settings provided here.' A red arrow points to the 'Save' button at the bottom right.

- 5.5 ► In the row **zdtagent**, click the ... (three dots) and using the drop-down menu click **Add Component**:



- 5.6 ► Select the component created earlier (**J02Mortgage**) and click **Save**.

**Create Resource**

**Component\***  
J02Mortgage

**Name\***  
J02Mortgage

**Description**

Inherit Teams From Parent

**Teams**  
Team 02

Default Impersonation

Default impersonation can be configured here. Any steps which do not specify their own impersonation settings will fall back to the settings provided here.

**Role Properties: J02Mortgage**

Property	Description	Value	Actions
No properties are available on this role.			

Refresh Print

Cancel Save

You should have:

The screenshot shows the 'Resource Tree' section of the UrbanCode Deploy interface. At the top, there are tabs for 'Resource Tree', 'Resource Templates', 'Agents', 'Agent Configuration Templates', 'Agent Relays', 'Agent Pools', and 'Cloud Groups'. Below the tabs is a search bar with 'Show' and 'Actions...' buttons. The main area displays a tree view of resources under 'zOS Resource Group 02', with 'zdagent (View Agent)' and 'J02Mortgage (View Component)' highlighted by a red box.

## Task 6 - Create an UrbanCode Application

On this task you will create an UCD application.

Applications are responsible for bringing together all the components that must be deployed together.

**UCD : What is a UCD Application?**

Application is a module the contains the following elements:

- Components to be deployed
- Environments target and the resources to deploy the application.
- A process definition (note that application process runs on the server while component process runs on agent)
- Properties

**UCD: Properties**

Properties can be set in UCD for many different things, including components, environments, processes, and applications. You can also set global properties for the system.

You can refer to a property by scope:  
    \${p:scope/propertyName} for example: \${p:environment/DBconnect}

or without scope:  
    \${p:propertyName}

You define objects (Application, component, process, resource, etc) properties in the object's Configuration Tab of UCD browser interface.

For more details, refer to the full documentation on Properties:  
[http://www-01.ibm.com/support/knowledgecenter/SS4GSP\\_6.2.6/com.ibm.udeploy.reference.doc/topics/ud\\_properties.html](http://www-01.ibm.com/support/knowledgecenter/SS4GSP_6.2.6/com.ibm.udeploy.reference.doc/topics/ud_properties.html)

6.1 ► On the Applications tab, click Create Application:

The screenshot shows the 'Applications' tab selected in the navigation bar. Below the navigation bar, there are two buttons: 'Applications' and 'Templates'. At the bottom right of the screen, there is a blue 'Create Application' button with a red arrow pointing to it.

6.2 ► Provide the value for the **Name** field in the **Create Application** dialog  
Name it **J02Mortgage COBOL** and click **Save**

The screenshot shows the 'Create Application' dialog box. The 'Name' field is filled with 'J02Mortgage COBOL' and has a red oval around it. In the 'Teams' section, 'Team 02' is listed with a delete icon next to it. Below that, the 'Application Template' is set to 'None' and the 'Notification Scheme' is also 'None'. At the bottom, there is a checkbox labeled 'Enforce Complete Snapshots' which is unchecked. To the right of the checkbox are two buttons: 'Cancel' and 'Save', with a red arrow pointing to the 'Save' button.

The result should be:

The screenshot shows the application details page for 'J02Mortgage COBOL'. The title 'Application: J02Mortgage COBOL' is highlighted with a red oval. Below the title, there are several tabs: Environments, History, Configuration, Components, Blueprints, Snapshots, Processes, Calendar, and Changes. The 'Environments' tab is currently selected. On the left side, there is a search bar with 'Search by Name' and 'Search by Blueprint' options, and a checkbox for 'Show Inactive Environments'. Below the search bar, a message says 'No Environments Found'. To the right, there is a blue button labeled 'Create Environment'.

## Task 7 - Create environment

On this task you will create The UCD environment that is a user-defined collection of resources that hosts an UCD application.

When you create an environment, you map resources to it that define where the parent application can run deployments.

### UCD : What is a UCD Application Environment?

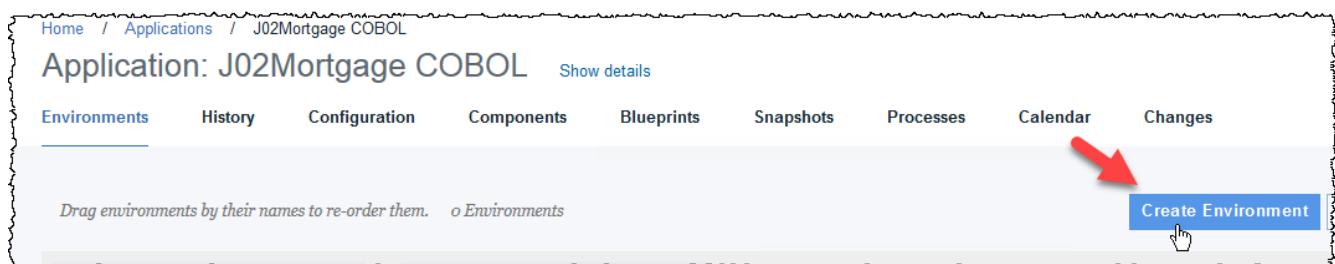


An environment is the application's mechanism for bringing together components with the agent that deploys them. Environments are typically modeled on some stage of the software project lifecycle, such as development, test, or production.

When you create an environment, you map resources to it and the application components that will be deployed.

You can also define environment specific properties.

7.1 ➔ Click Create Environment:



7.2 ➔ Provide the value for the Name field in the Create Environment dialog (for example, **Test**), choose a color, and click **Save**:

The screenshot shows the 'Create Environment' dialog box. It has fields for 'Name\*' (with 'Test' entered and circled with a purple '1'), 'Description' (empty), 'Blueprint' (dropdown menu), 'Teams' (list with 'Team 02 x'), 'Require Approvals' (checkbox), 'Exempt Processes' (text input 'None'), 'Lock Snapshots' (checkbox), 'Require Snapshot' (checkbox), and a 'Color' picker (a grid of colored squares with a yellow square highlighted and circled with a purple '2'). At the bottom are 'Cancel' and 'Save' buttons, with 'Save' being circled with a purple '3' and a red arrow pointing to it.

7.3 ► Click the environment name (**Test** in our example) to open environment properties:

The screenshot shows the 'Environments' tab selected in the top navigation bar. Below it, a list of environments is displayed with a yellow background. The environment named 'Test' is circled with a red arrow. Other environments listed include 'RDT', 'zOS Resource Group 02', 'zdtagent', and 'J02Mortgage'. A 'Create Environment' button is visible in the top right corner.

7.4 ► Click Add Base Resources:

The screenshot shows the 'Resources' tab selected in the top navigation bar. In the top right, there is a blue button labeled 'Add Base Resources' with a red arrow pointing to it. Below the button is a table header with columns: Name, Inventory, Status, and Description.

7.5 ► Expand zOS Resource Group 02, select Component **J02Mortgage**: and click Save:

**Note:** In order for a component to be deployed by an application, it must be added to the application and also mapped to an agent-type resource. A component that is added to an application but not mapped to an agent resource, cannot be deployed by that application.

Similarly, a component that is mapped to an agent resource but not added to an application, cannot be deployed by that application.

The screenshot shows the 'Add Resource to Environment' dialog box. In the list of resources, the 'J02Mortgage' component under 'zdtagent' is checked (indicated by a red circle with number 1). In the bottom right corner, there is a 'Save' button with a red arrow pointing to it (indicated by a purple circle with number 2).

You now must have:

Name	Inventory	Status	Description
zOS Resource Group 02 / zdtagent (View Agent) / J02Mortgage	Filter	Filter	

## PART 2 - Create the UrbanCode deployment processes.

On this part you will you create a deployment process for your component and the application process that uses the component process to deploy the component.

Processes are automated tasks that run on agents.

There are three types of processes:



- **Generic processes** run outside the context of components or applications. Not used on this lab.
- **Application processes** run within the context of applications. In many cases, application processes call component processes. For example, an application process can call the component processes that deploy those components.
- **Component processes** run tasks on a single component, such as deploying it, uninstalling it, or running configuration tasks on it.

### Task 8 - Create a components process

A component process is a succession of commands that are called steps. Steps can manipulate files, run system commands, set properties, pass information to other steps, and run programs. Steps are provided by automation plug-ins. Processes are designed with the drag-and-drop process editor where you drag plug-in steps onto the design editor and configure them as you go. Several plug-ins come with the product and others are available, which work with many different types of software. In this lab you use z/OS plug-ins. A component can have any number of processes defined for it, but a component must have at least one process.

In this task you create a deployment process for your component. Later, you create an application process that uses the component process to deploy the component.

We are going to create a **component process** for this example. This process will automate deployment of the new version of our **J02Mortgage COBOL** application.

8.1 ► Click on tab **Components**, find the component created earlier (**J02Mortgage**) and click on it

The screenshot shows the 'Components' tab selected in the top navigation bar. Below the navigation, there are two tabs: 'Components' (which is highlighted) and 'Templates'. A red arrow points from the text above to the 'Components' tab. A purple circle labeled '1' is placed over the 'Components' tab. Another purple circle labeled '2' is placed over the row for the 'J02Mortgage' component in the list, which is circled in red.

Name	Latest Import	Latest Version	Template	Description	Created	By
AccountMgmtCICS	20180627-1257160725	MVSCOMPONENT	Component used on PDTOOLS demo	6/24/2015, 7:55 PM	admin	
HC_CICS	20200130-124347	MVSCOMPONENT	zMobile Health Care Appl - COBOL CICS assets	12/14/2017, 4:51 PM	admin	
HCMobileWindows7	V02 - HC for demo deploy		HC Mobile appl for Windows7	12/14/2017, 4:51 PM	admin	
<b>J02Mortgage</b>	20180709	MVSCOMPONENT		5/6/2020, 5:04 PM	User empt0 (empt02)	

8.2 ► Click the **Processes** tab

The screenshot shows the 'Processes' tab selected in the top navigation bar of the 'J02Mortgage' component details page. A red circle highlights the 'Processes' tab. A blue button labeled 'Create Process' is visible on the right. The main area displays a table of processes:

Process	Description
<a href="#">Deploy (MVSCOMPONENT)</a>	Deploy data sets. Version artifacts are fetched from code station located in the same z/OS.
<a href="#">Deploy - get artifacts from CodeStation (MVSCOMPONENT)</a>	Deploy data sets. Version artifacts are fetched from UrbanCode Deploy server CodeStation.
<a href="#">Deploy - get artifacts using FTP (MVSCOMPONENT)</a>	Deploy data sets. Version artifacts are fetched from code station using FTP
<a href="#">Remove all versions (MVSCOMPONENT)</a>	Remove all versions in an environment including the backup created during version deployment. Use this process when you want to start next round of development with a clean environment. Audit history is available even if versions have been removed from the environment.
<a href="#">Remove redundant versions (MVSCOMPONENT)</a>	Remove redundant versions in an environment. Redundant versions are these versions which are replaced completely by later deployed versions.
<a href="#">Remove redundant versions with manual verification (MVSCOMPONENT)</a>	Remove redundant versions in an environment. Redundant versions are these versions which are replaced completely by later deployed versions.
<a href="#">Sample JCL submission process (MVSCOMPONENT)</a>	This process demonstrates usage of the JCL submission steps.
<a href="#">Uninstall (MVSCOMPONENT)</a>	Uninstall a version and restore the backup data sets

You will notice that there is a small collection of processes that was created automatically for your component (**Deploy**, **Remove all versions**, **Uninstall**, and so on). Remember that those processes were created from a template.

These processes can be used by themselves to perform simple tasks or can be used as starting points for more complex processes.

We will next create our deployment process. We could slightly simplify this task by reusing the existing process called **Deploy**. However, for the purposes of this example, we are going to create a brand new one.

8.3 ► Click **Create Process** button to get started.



8.4 ► Enter Process Name (**Deploy JKE to CICS**)

Leave all other options at their default values and click **Save**:

The screenshot shows a 'Create Process' dialog box. It has several input fields: 'Name\*' (with 'Deploy JKE to CICS' entered), 'Description' (empty), 'Process Type\*' (set to 'Deployment'), 'Inventory Status\*' (set to 'Active'), 'Default Working Directory\*' (containing the placeholder `\${p:resource/work.dir}/\${p:component.name}`), and 'Required Role' (empty). At the bottom, there are 'Cancel' and 'Save' buttons. A red arrow points to the 'Save' button, which is circled with a purple marker labeled '2'. Another purple marker labeled '1' is placed over the 'Name' input field.

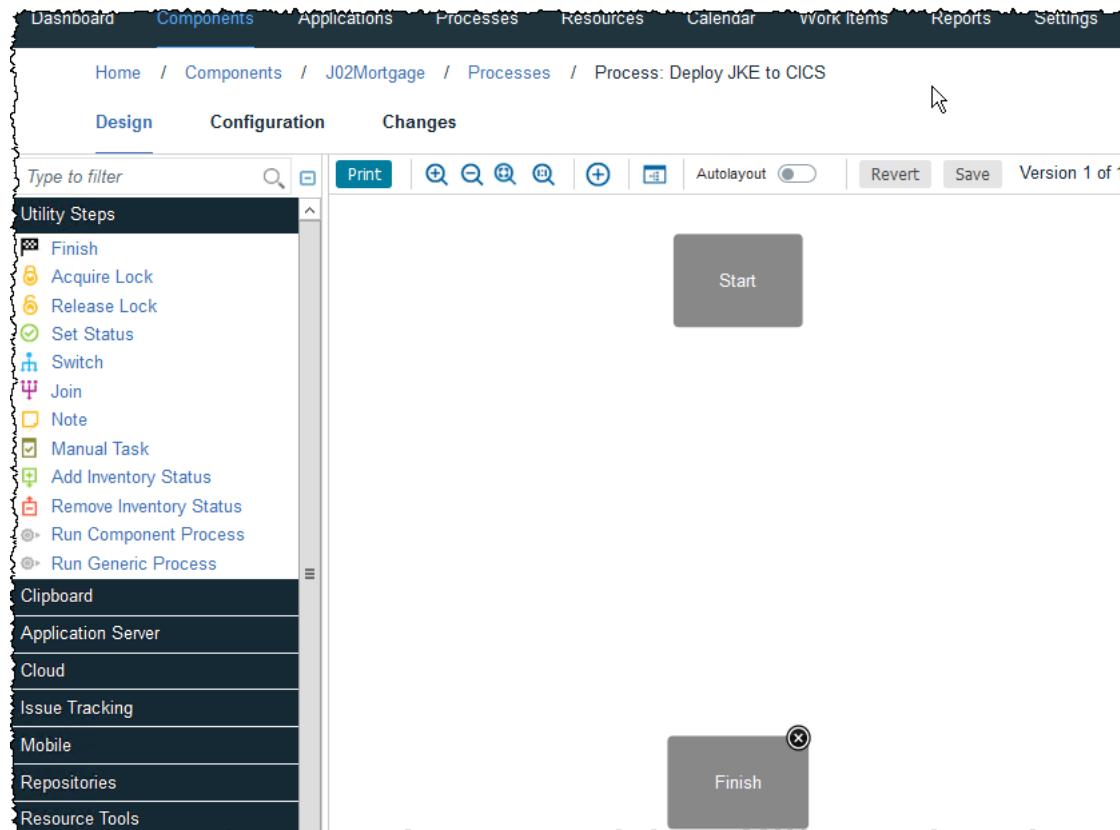
### 8.5 The Process Editor will open.

Here, you can organize the steps of a process, specify their properties, and connect them to each other.

As usual, you can refer to UCD documentation for detailed information on editing processes.

If you have internet access you can go to the link below for more details::

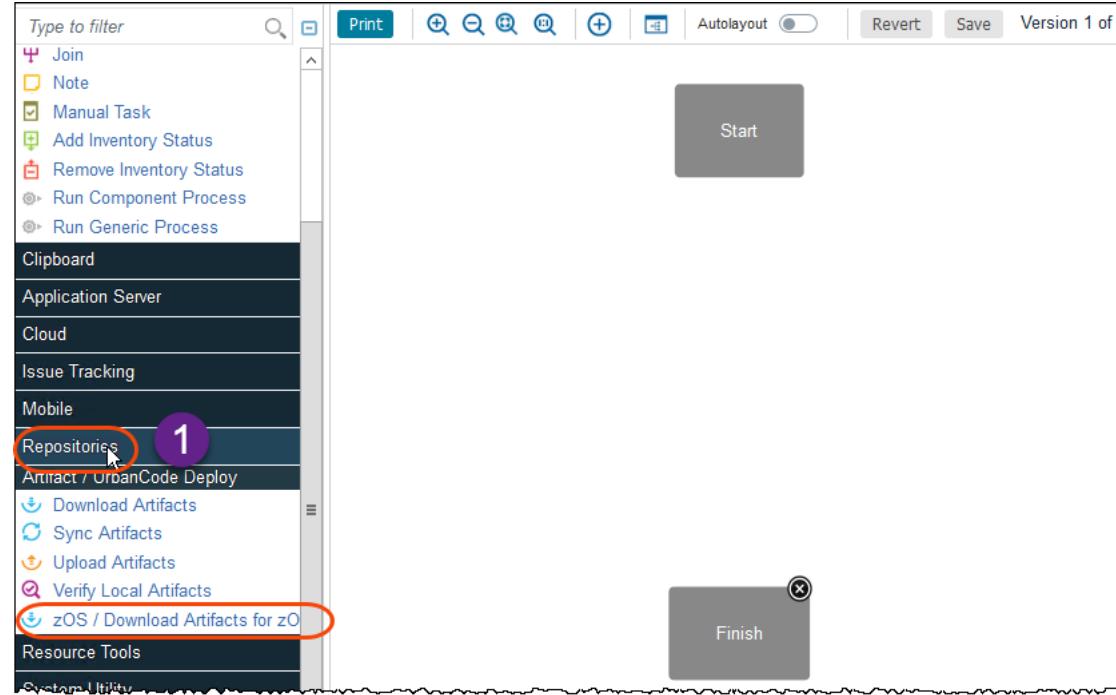
[https://www.ibm.com/support/knowledgecenter/SS4GSP\\_7.0.2/com.ibm.udesigner.doc/topics/comp\\_workflow.html](https://www.ibm.com/support/knowledgecenter/SS4GSP_7.0.2/com.ibm.udesigner.doc/topics/comp_workflow.html)



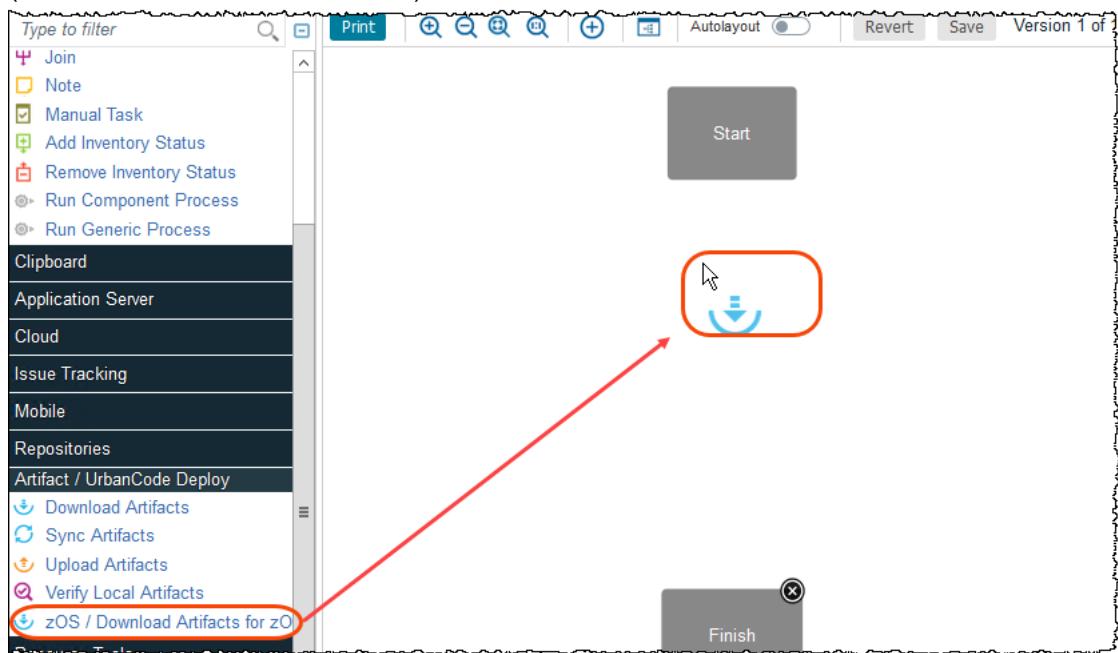
8.6 We are going to create a simple process for updating an existing CICS application.

- On the left hand side of the editor you will find an extensive **Palette** of process steps.
- Scroll down and expand **Repositories**.

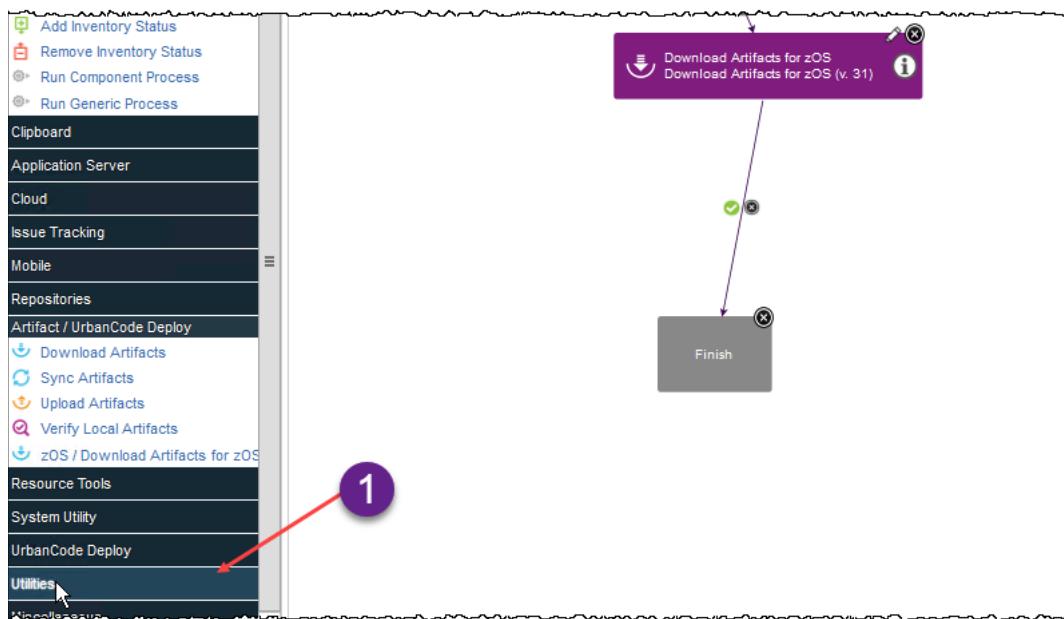
First you are going to use the step **zOS /Download Artifacts for zOS**:



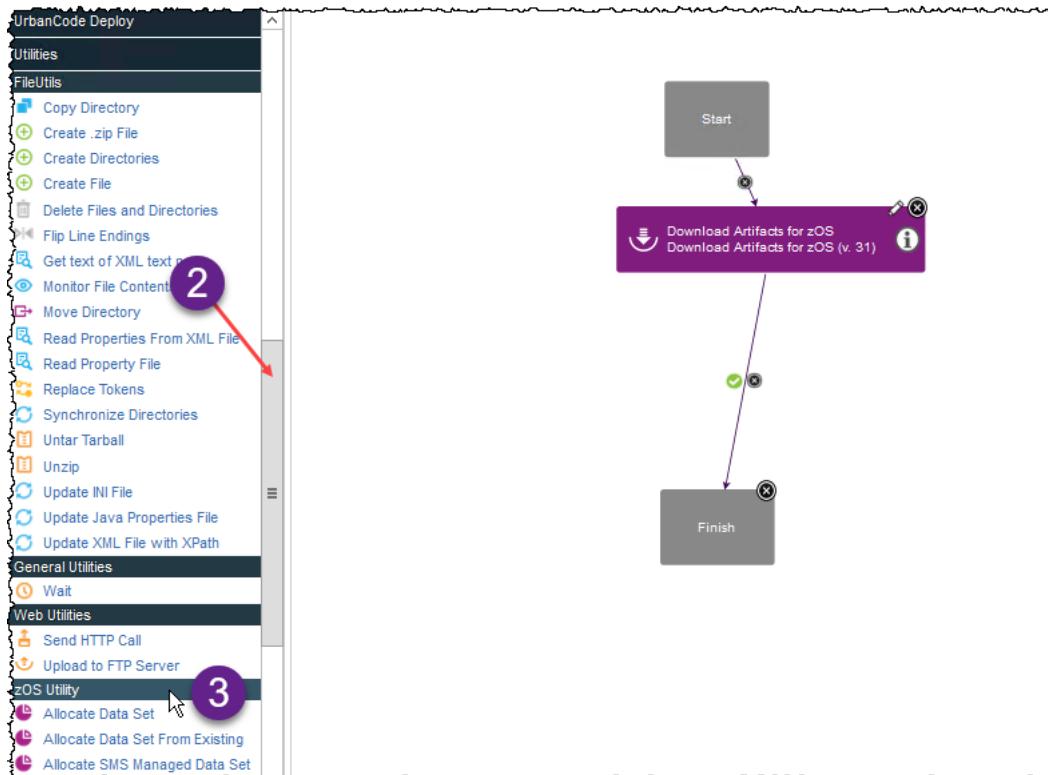
8.7 ► Drag and drop the first step, **zOS /Download Artifacts for zOS**, onto the design space (somewhere under the **Start** block).



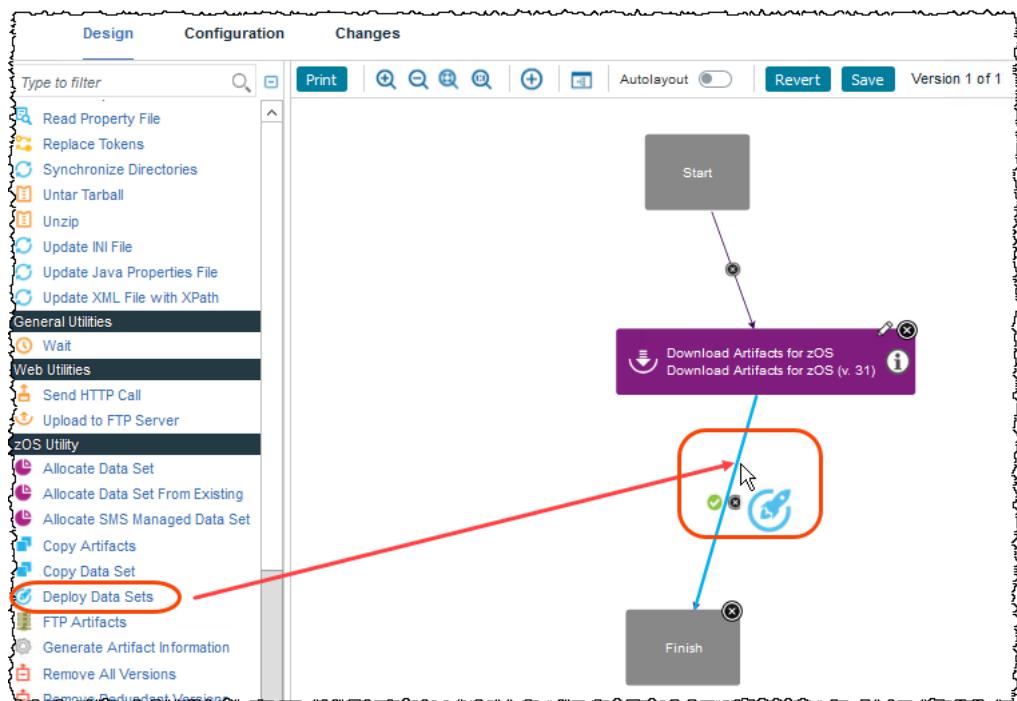
8.8 ► 1 Using the Design palette on left expand **Utilities**, clicking on it



► 2 Scroll down and 3 expand **zOS Utility**: The **Deploy Datasets** step will also be needed to load component artifacts from the z/OS repository and to bring them into z/OS work area for later deploy.



8.9 ► Scroll down and drag the **Deploy Data Sets** step onto the line that connects to the *Finish* as below



#### Properties

Properties can be set in UCD for many different things, including components, environments, processes, and applications. You can also set global properties for the system.

You can refer to a property by scope:

`${p:scope/propertyName}`

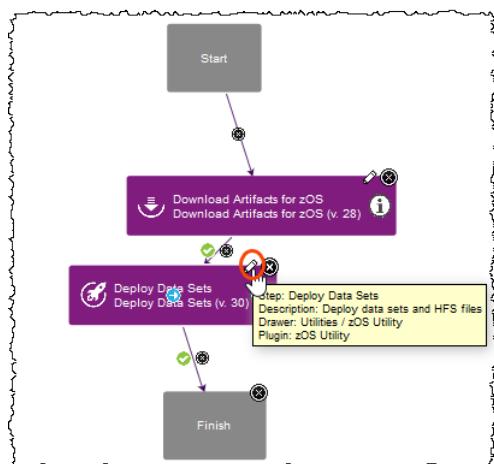
or without scope:

`${p:propertyName}`

For more details, refer to the full documentation on Properties:

[http://www-01.ibm.com/support/knowledgecenter/SS4GSP\\_6.1.1/com.ibm.udeploy.reference.doc/topics/ud\\_properties.html](http://www-01.ibm.com/support/knowledgecenter/SS4GSP_6.1.1/com.ibm.udeploy.reference.doc/topics/ud_properties.html)

8.10 ► Click on the pencil icon ☰ on **Deploy Data Sets** to change the UCD properties for this step.

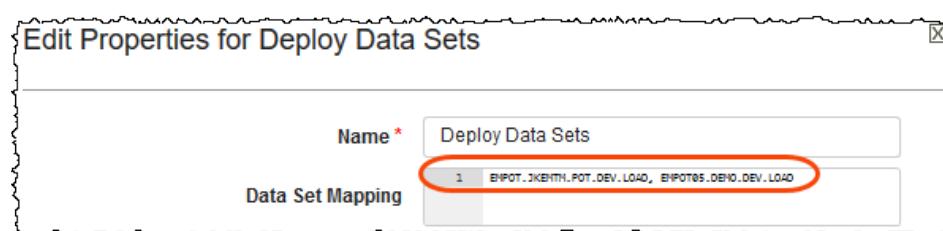
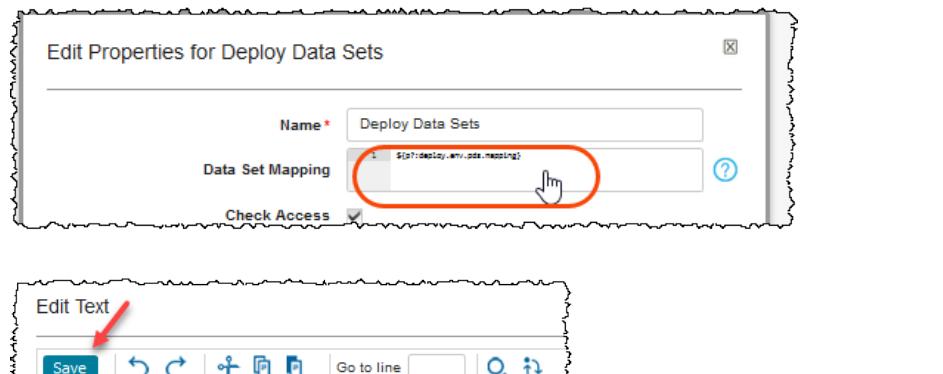


8.11 ► Enter the value for the *Data Set Mapping* property:  
**EMPOT.JKEMTM.POT.DEV.LOAD, EMPOT05.DEMO.DEV.LOAD**

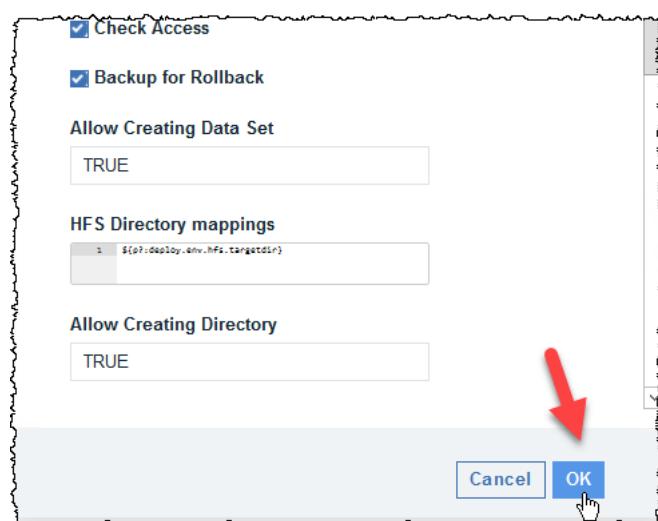
**Data Set Mapping** specifies which PDS members packaged with the component to deploy, and where to deploy them.

A mapping rule should follow format "From PDS, To PDS":

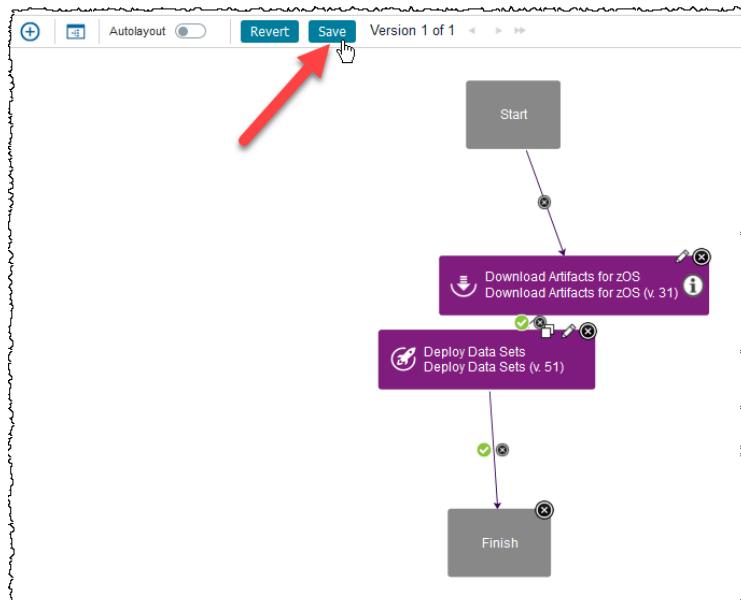
We could have that as variable but we will fix here to save time.



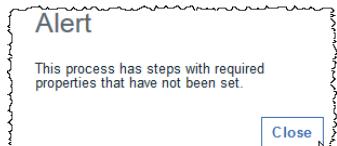
8.12 ► Click **OK** to save the properties updated



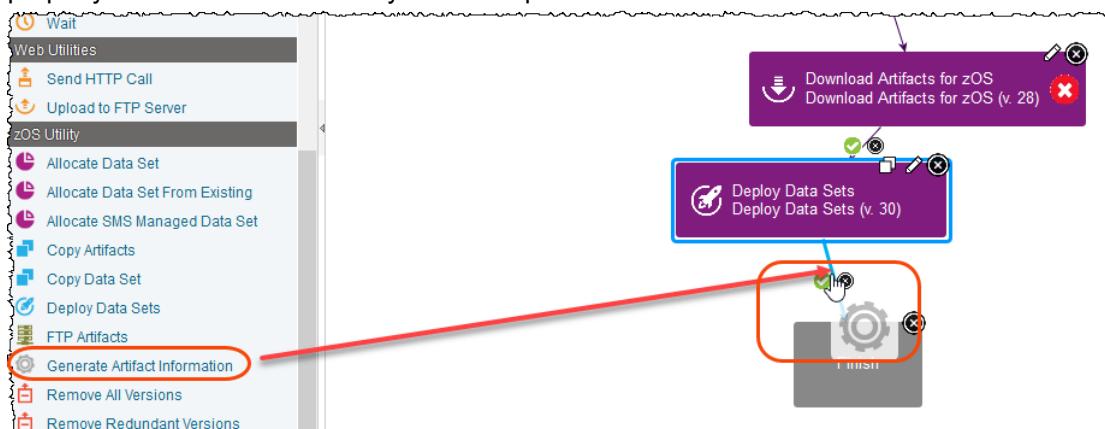
8.13 ► Click the **Save** button to save what you had done so far.



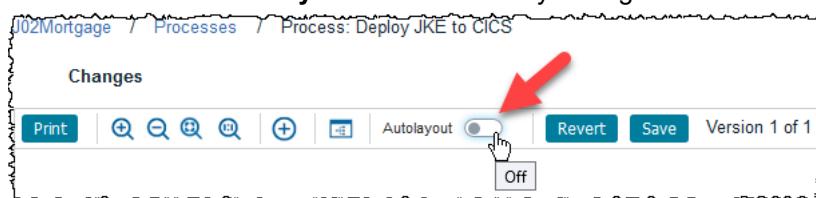
8.14 ► If there is a warning about missing property ignore it, we will fix that later.



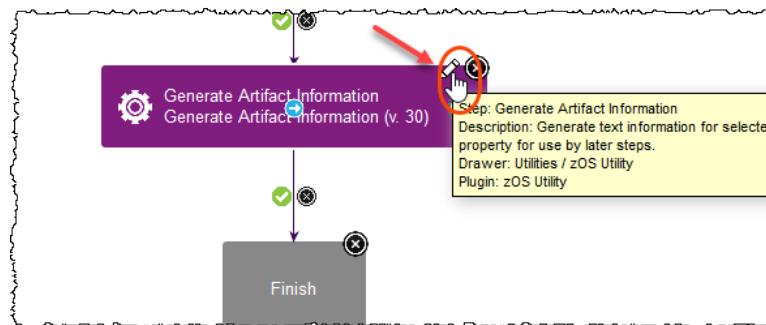
8.15 ► Scroll down on left pallet and drag and drop **Generate Artifact Information** on the line before Finish. You will need to specify a list of the load modules that CICS needs to do the *Newcopy*. This step generate text information for selected version artifacts. Information is put to output property 'text' to be consumed by a later step



8.16 ► Click on **Autolayout** to have the layout organized



- 8.17 ►| Click on the pencil icon  on **Generate Artifact Information** to change the UCD properties for this step.



- 8.18 ►| ① Change from *Generate Artifact Information* to **Generate Program List** (must respect upper/lower case and spaces)

- | ② Add **CICS\_LOAD** to *Deploy Type Filter*  
►| ③ Scroll down to add another property

Edit Properties for Generate Artifact Information

Name\* 1

For Each\*

Order By\*

Container Name Filter

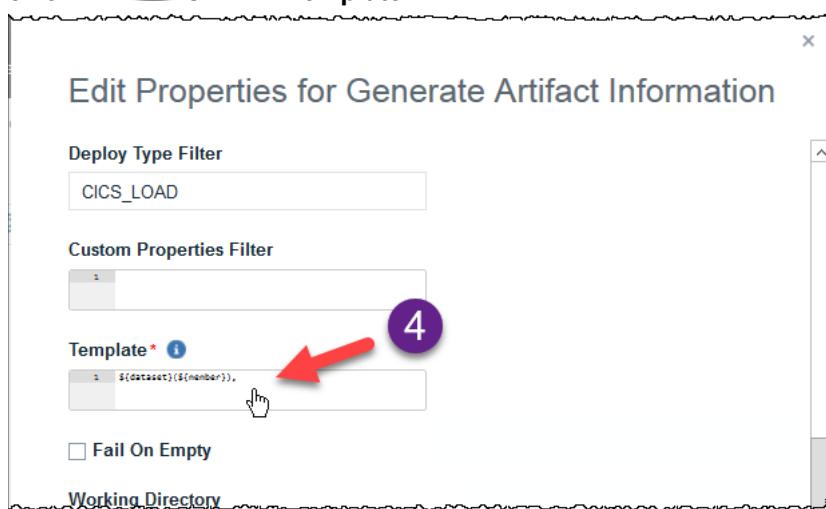
Target Data Set Name Filter

Resource Name Filter

Deploy Type Filter 2

3 

8.19 ► 4 Click on **Template**



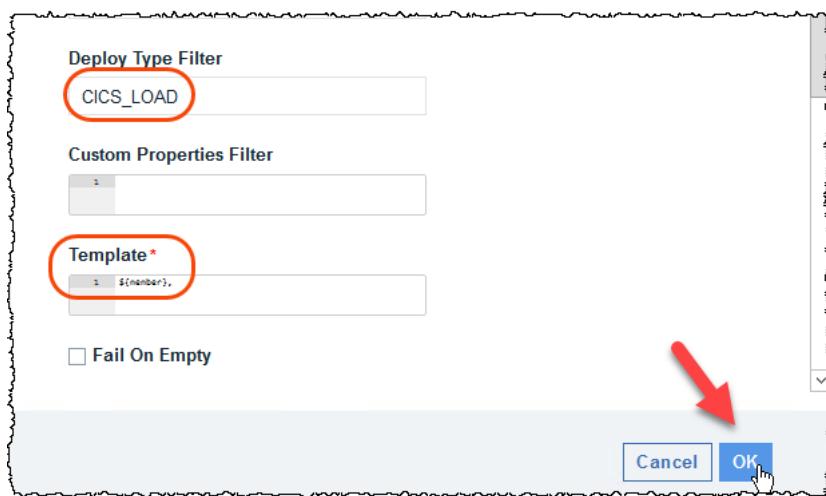
► Change the value from “  
\${dataset} (\${member}) ,” to  **\${member},**

**IMPORTANT ➔ Be sure that you add a , (comma) after the \${member},**

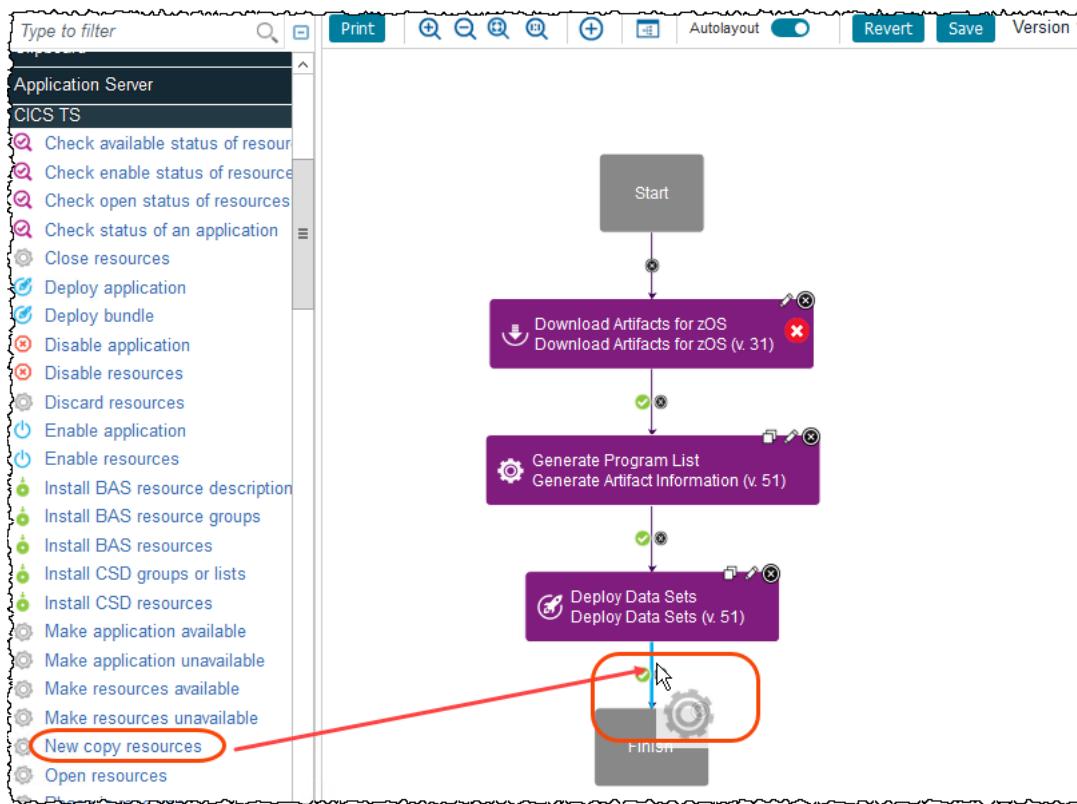


► Click **Save** to save the modified value

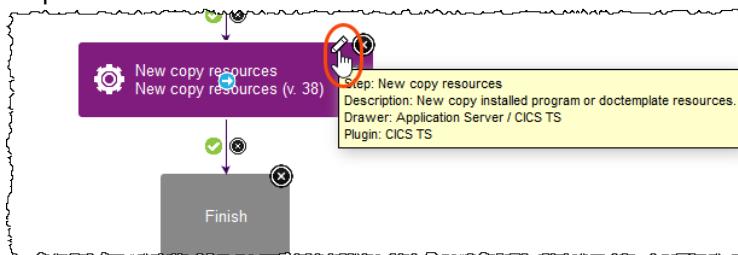
8.20 ► Click **OK** to close the dialog



- 8.21 ►► On the Palette (left side) expand **Application Server** (scroll up) and **CICS TS**.  
 ►► Drag and drop **New copy resources** to the line that connects to the *Finish* box..

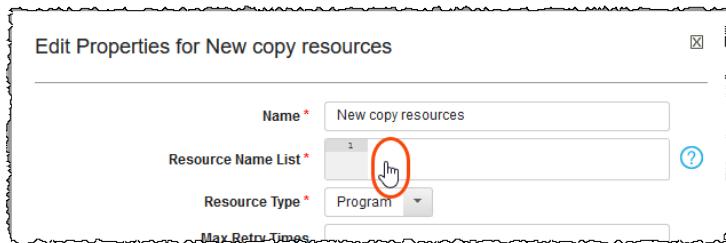


- 8.22 ►► Click on the pencil icon ► on **New copy resources** to change the UCD properties for this step.

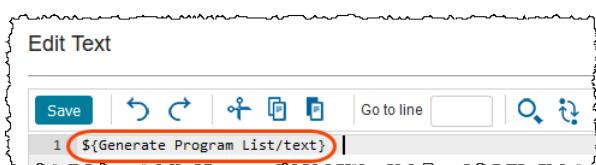


8.23 You need to specify a list of the load modules that CICS needs to do the *Newcopy*.

►| Click on Resource Name List

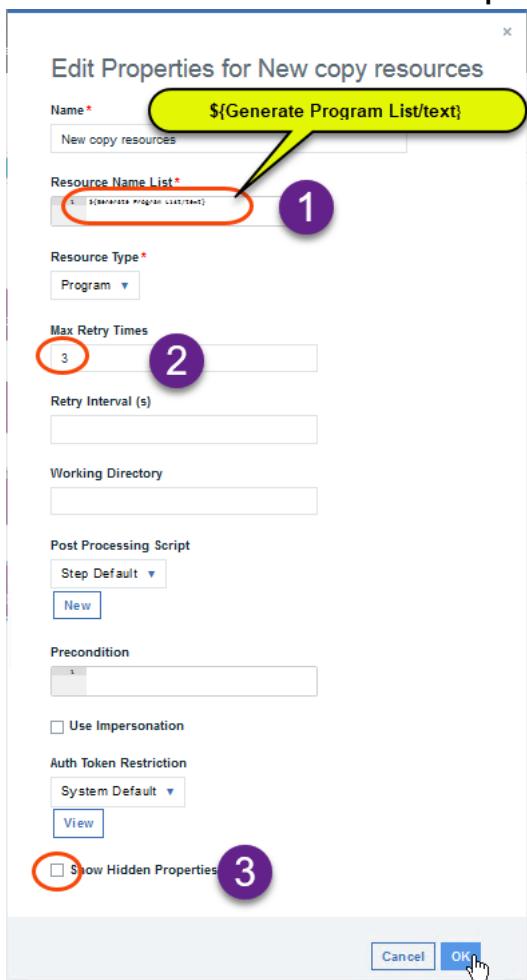


►| Type  **\${Generate Program List/text}** (This is the step name that you created on 8.18) and click **Save**



►| Type 3 for Max Retry Times

►| Scroll down and click **Show Hidden properties**.



8.24 Scroll down to see those properties that need to be filled. Later we will do that at the **Test** level

Edit Properties

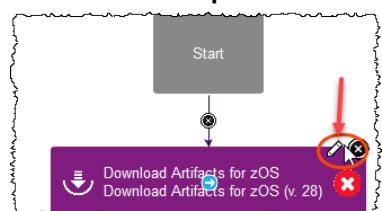
Show Hidden Properties

Host *	<input type="text" value="\${p:cics.host}"/>
Port *	<input type="text" value="\${p:cics.cmcpo}"/>
CICSPlex	<input type="text" value="\${p?:cics.cicsplex}"/>
Scope	<input type="text" value="\${p?:cics.scope}"/>
Username	<input type="text" value="\${p?:cics.username}"/>
Password	<input type="password" value="*****"/>
Enable SSL	<input type="text" value="\${p?:cics.ssl}"/>
Keystore Location	<input type="text" value="\${p?:cics.kslocation}"/>
Keystore Type	<input type="text" value="\${p?:cics.kstype}"/>
Keystore Password	<input type="password" value="*****"/>
Truststore Location	<input type="text" value="\${p?:cics.tslocation}"/>
Truststore Type	<input type="text" value="\${p?:cics.tstype}"/>
Truststore Password	<input type="password" value="*****"/>

▶ Click **OK** to save it

8.25 You still need to fix a warning on first step (see the icon ).

▶ Click on the pencil icon on **Download Artifacts for zOS** to possibly change the properties.



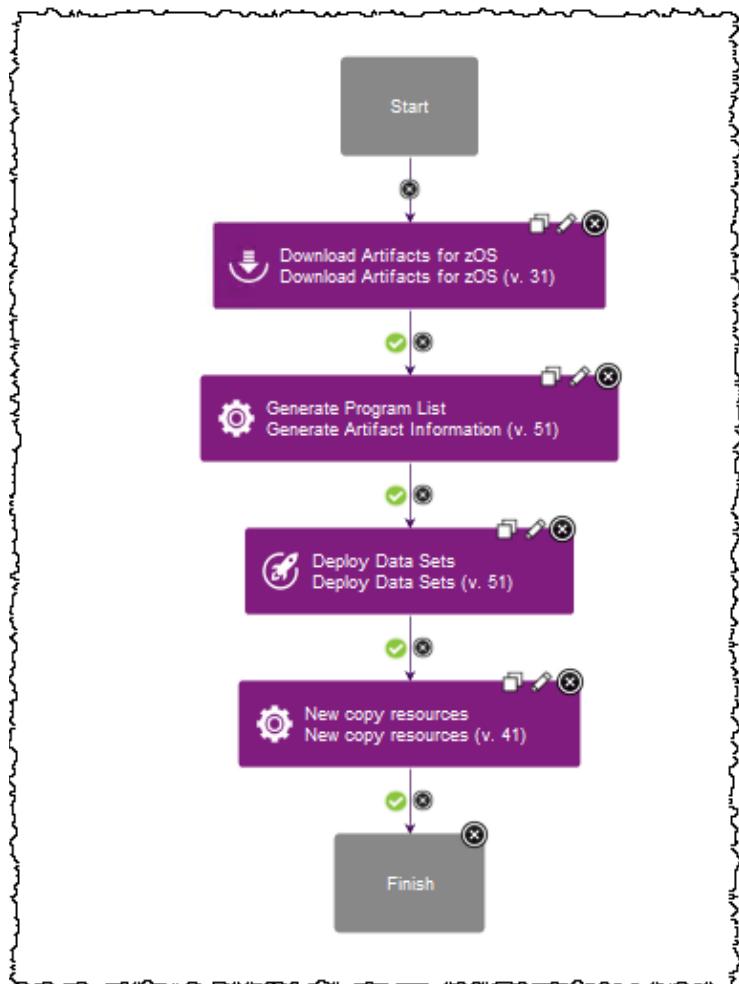
8.26 ▶ No changes are required here and click **OK**

Edit Properties for Download Artifacts for zOS

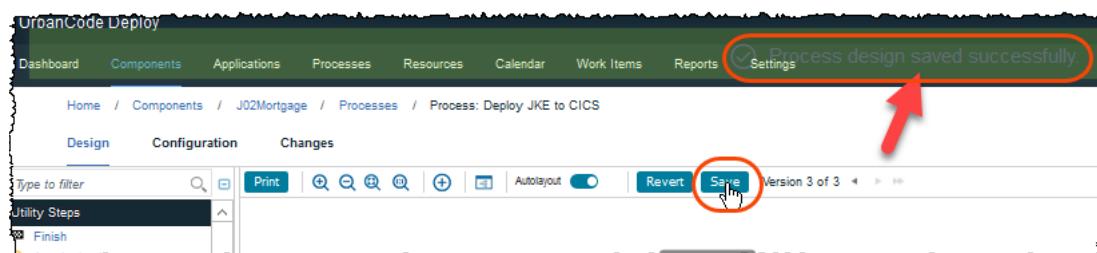
Name *	<input type="text" value="Download Artifacts for zOS"/>
Directory Offset *	<input type="text" value="."/>
Working Directory	<input type="text"/>
Post Processing Script	<input type="button" value="Step Default"/> <input type="button" value="New"/>
Precondition	<input type="text" value="1"/>
Use Impersonation	<input type="checkbox"/>
Show Hidden Properties	<input type="checkbox"/>

**OK** **Cancel**

8.27 The final result should look similar to this:



8.28 ► Finally, click the **Save** button located in the upper left portion of the process editor to save the process:



A message will indicate that the process is saved.

## Task 9 - Create an application process

Application processes direct underlying component processes and orchestrate multi-component deployments. An application process, like a component process, consists of steps that are configured with the process editor.

In this task, you create an application process that installs the UCD application defined .

- 9.1 ► Go to Applications page, select your application (**J02 Mortgage - COBOL**),

Name	Template	Description
A HC zOS COBOL CICS		Deploy the HC application to CICS - No DB2 Binding
Account Management CICS and Worklight (LINUX)		Used in PDTTOOLS demo
J02 Mortgage zOS and Worklight		J02 CICS + JKE Mobile
<b>J02Mortgage COBOL</b>		
JKE Emulator		

- 9.2 ► Click Components tab and click Add Component:

- 9.3 ► Select your UCD component created previously (**J02Mortgage**) and click Save:

9.4 ► Click the Processes tab and click **Create Process**:



9.5 ► Give a name to your process, like **Deploy J02 to CICS** and click **Save**:

**Create an Application Process**

Name\*  
Deploy J02 to CICS (1)

Description

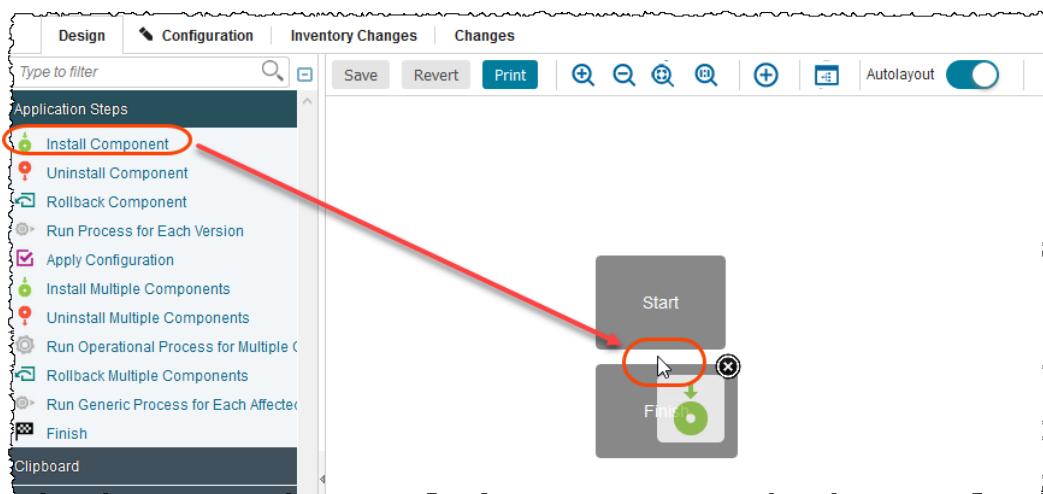
Inventory Management\*  
Automatic

Offline Agent Handling\*  
Check Before Execution

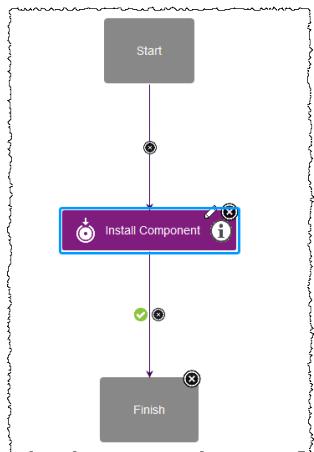
Required Role (2)

Cancel Save

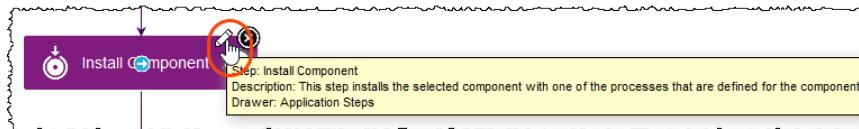
9.6 ► Find **Install Component...** step in the Design Palette, and drag it onto the space between *Start* and *Finish* boxes.



9.7 The result will be as below:

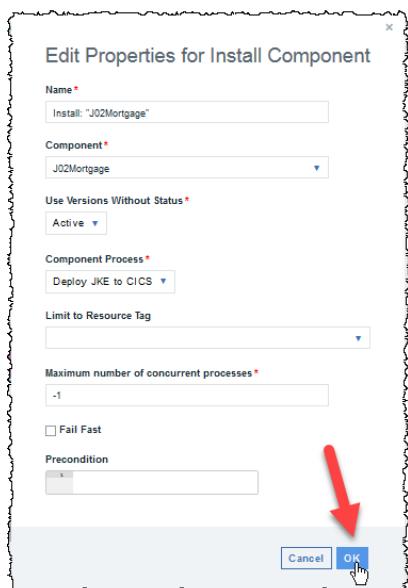


9.8 ► Click on the pencil icon 🖍 on **Install Component** to possibly change the properties

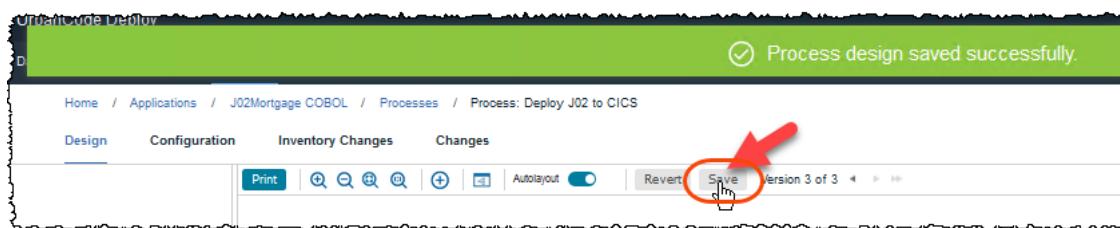


9.9 Notice that the properties of this step are pre filled for you.

► Click OK:



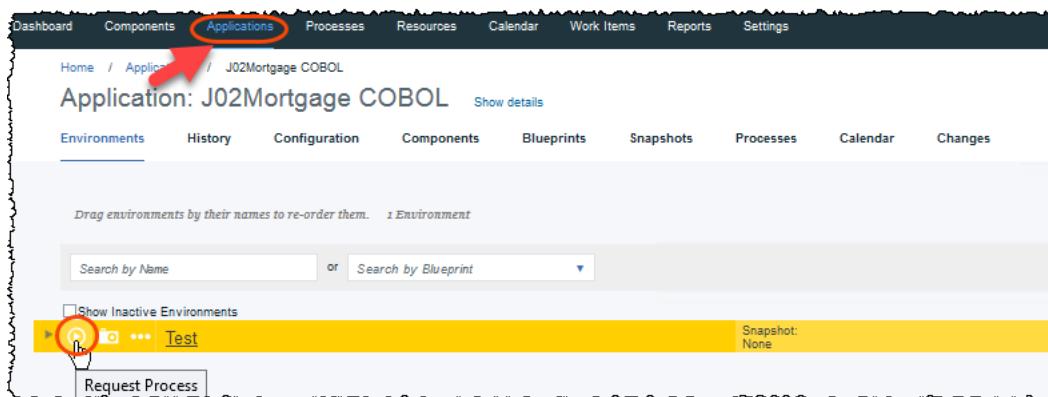
9.10 ► Click Save



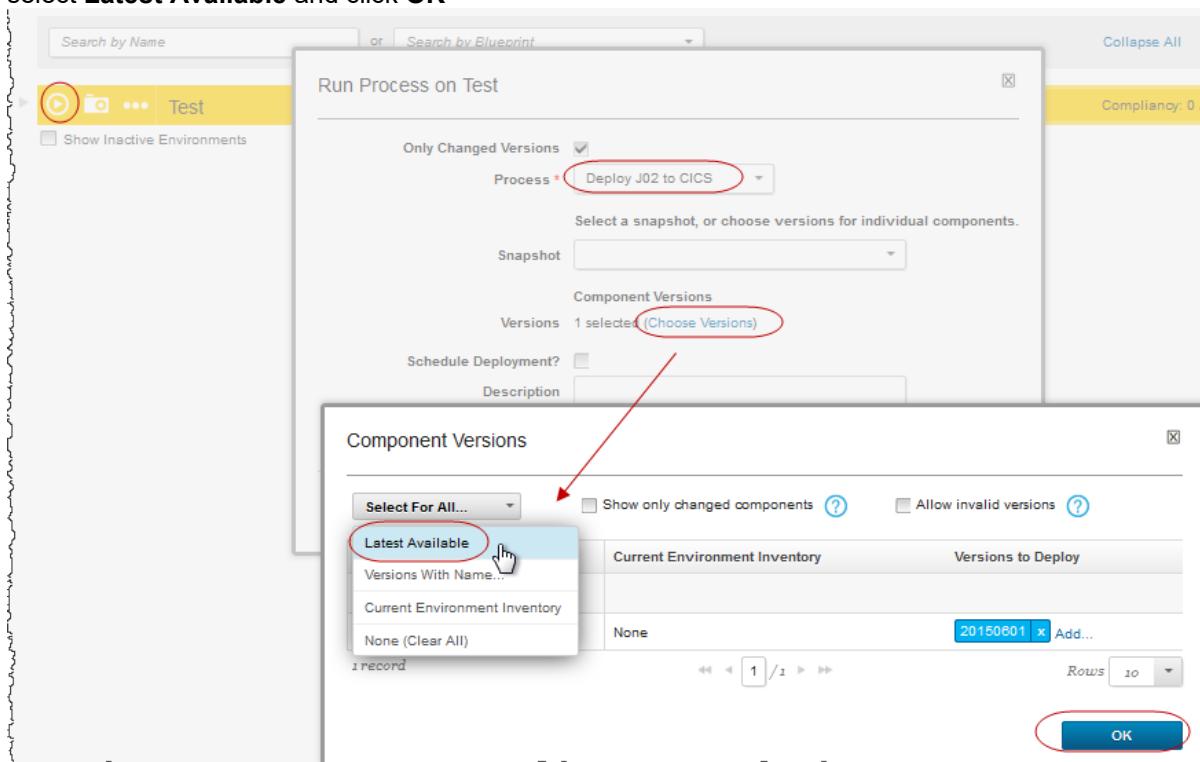
## Task 10 – Environment properties configuration

On the task 7 you created the **Test** environment. For this lab we have just one environment, but usually we have few environments. Example the **Test** environment could reflect the Test LPAR and **Prod** environment that would reflect other LPAR. Each environment may have different values used on the deploy. Example the CICS test environment uses port 30090, the prod environment uses port 30091, etc.. Those values in our lab were not yet defined and you will see errors when trying to deploy the application for **Test** environment..

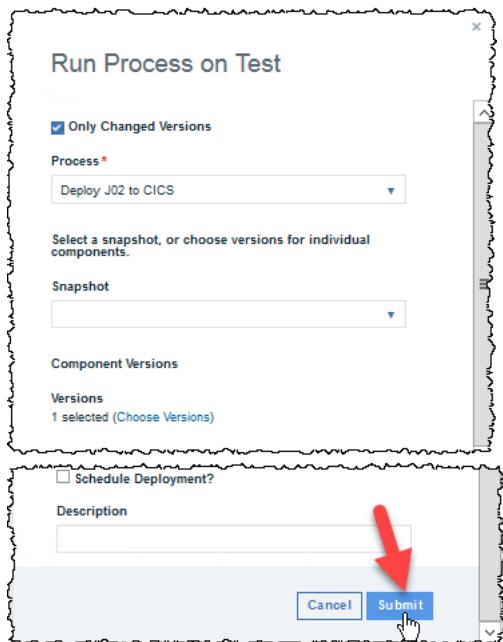
- 10.1 ➡ Go to Application > J02 Mortgage COBOL and click the icon  on **Test** environment



- 10.2 ➡ Select the Process Deploy J02 to CICS , click Choose Versions, click Select For All.. select Latest Available and click OK



10.3 ► When the dialog below is shown click **Submit**



The Deploy process start, but it will fail as you see soon..

10.4 ► Click **Expand all** on the far right

Step	Progress	Start Time	Duration	Status
► 1. Install: "J02Mortgage"	0 / 1	4:57:55 PM	0:00:49	Running
Total Execution	0 / 1	4:57:55 PM	0:00:49	Running

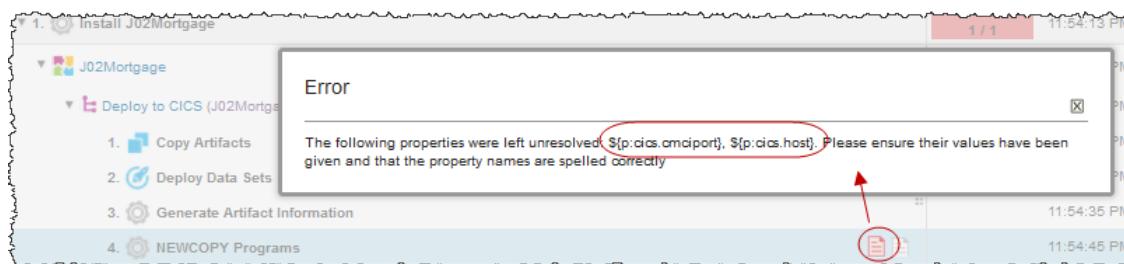
10.5 ► Click the icon ► to expand all steps being executed

Step	Progress	Start Time	Duration	Status
▼ 1. Install: "J02Mortgage"	0 / 1	5:00:49 PM	0:00:06	Running
▼ J02Mortgage	0 / 1	5:00:49 PM	0:00:06	Running
► Deploy JKE to CICS (J02Mortgage 20180709)	0 / 1	5:00:49 PM	0:00:06	Running
1. Download Artifacts for zOS	0 / 1	5:00:50 PM	0:00:08	Running
2. Deploy Data Sets				Not Started
3. Generate Program List				Not Started
4. New copy resources				Not Started
Total Execution	0 / 1	5:00:49 PM	0:00:06	Running

### 10.6 ► Click on Error Log icon

Step		Progress	Start Time	Duration	Status
v 1.	Install: "J02Mortgage"	1 / 1	1:11:20 PM	0:03:12	● Failed
	J02Mortgage	1 / 1	1:11:20 PM	0:03:12	● Failed
	Deploy JKE to CICS (J02Mortgage_20180709)				
1.	Download Artifacts for zOS		1:11:20 PM	0:03:12	● Failed
2.	Generate Program List		1:12:35 PM	0:00:35	● Success
3.	Deploy Data Sets		1:13:11 PM	0:01:21	● Success
4.	New copy resources		1:14:31 PM	0:00:00	● Failed
Total Exec	(CICS TS v. 4.1.20181207-0633)	Error Log	1 / 1	1:11:20 PM	0:03:12

### 10.7 ► See the properties missing and close the dialog



10.8 We could add properties at various levels.. In our example let's make the variables at the Environment level. The missing properties are:

**cics.cmciport** and **cics.host**.

10.9 To add the properties..

### ► Click Applications > J02 Mortgage COBOL > Test

### 10.10 ► Select Configuration > Environment properties and click Add Property

10.11 ► Add the property **cics.cmciport** with value **1490** and click **Save**

Add Property

Name\*  
cics.cmciport

Description

Secure

Value  
1490

Cancel Save

10.12 ► Add the property **cics.host** with value **10.1.1.2** and click **Save**

Add Property

Name\*  
cics.host

Description

Secure

Value  
10.1.1.2

Batch Edit Add Property

1

2

3

4

Cancel Save

10.13 ► Using the **Add Property** button

add the property **cics.userid** with the value **empot02** (your userid)

10.14 ► Also add the property **cics.password** with the value **empot02**.

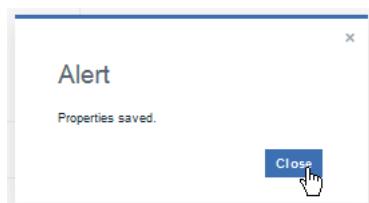
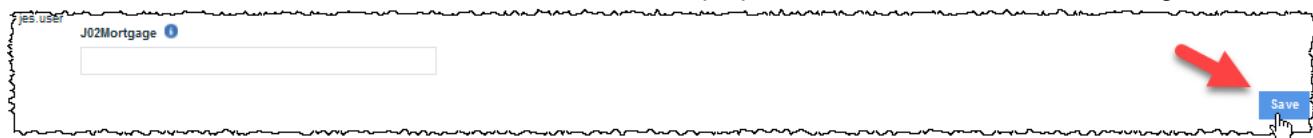
In the real world you will not add the password here and will use other secure way to authenticate., also

In the Edit Property dialog, you can check the secure box and this will hide (secure) the password..

When complete:

Name	Value	Description	Actions
cics.cmciport	1490		Edit Delete
cics.host	10.1.1.2		Edit Delete
cics.password	empot02		Edit Delete
empot02	empot02		Edit Delete

- 10.15 ► Scroll down and click **Save** to save the defined properties and **Close** to close the dialog.



## PART 3 – Deploy the application to z/OS CICS

On this part you will deploy the Application to the z/OS CICS.

To deploy the components in the application, you must run the application process on the specified environment. We created only one environment named **Test**, you will deploy this environment.

### Task 11 – Run an application process

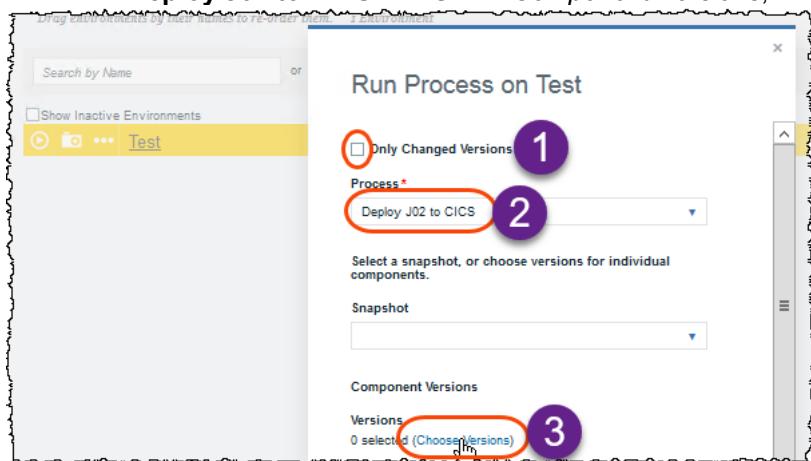
You are now ready to test our deployment process.

- 11.1 ► Click the Applications tab and then click **J02 Mortgage COBOL**

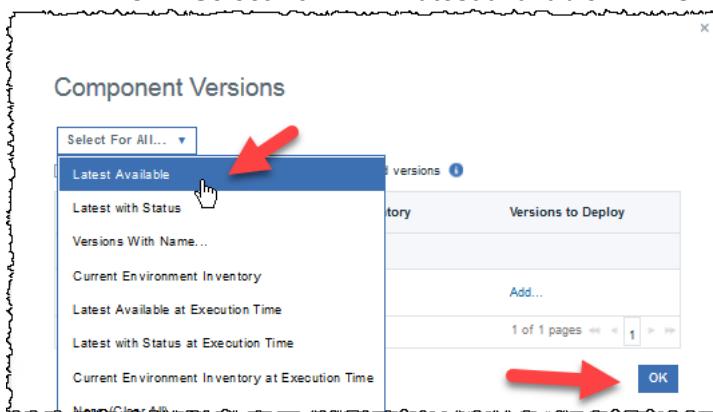
Name	Template	Description	Created
A HC zOS COBOL CICS		Deploy the HC application to CICS - No DB2 Binding	12/14/2017, 4:51 PM
Account Management CICS and Worklight (LINUX)		Used in PDTTOOLS demo	8/18/2015, 11:02 PM
J02 Mortgage zOS and Worklight		J02 CICS + JKE Mobile	12/16/2014, 1:38 PM
<b>J02Mortgage COBOL</b>			5/8/2020, 8:37 AM
JKE Emulator			12/15/2014, 8:17 PM

- 11.2 ► Under Test environment click the Request Process

- 11.3 ► In the **Run Process** window, un-select **Only Changed Versions**, in the **Process**, select the **Deploy J02 to CICS** and Under **Component Versions**, click **Choose Versions**

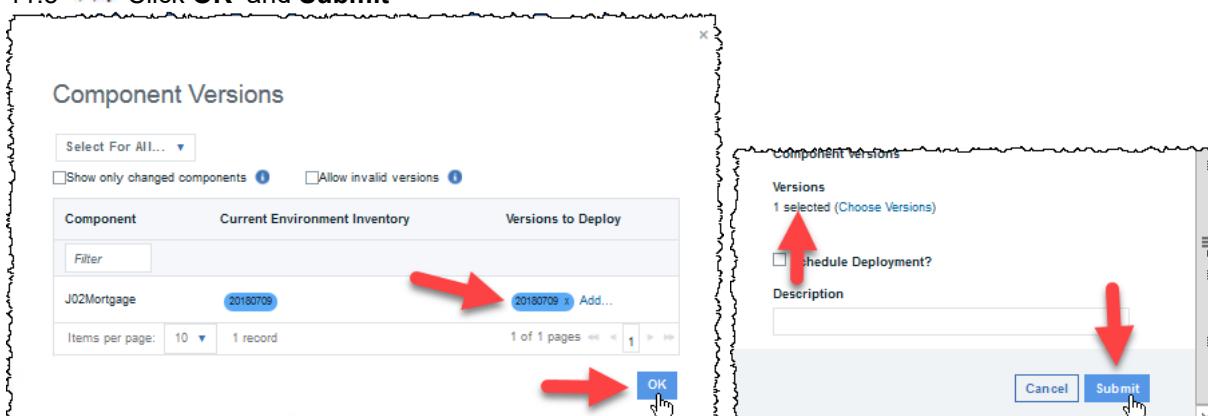


- 11.4 ► Click **Select For All > Latest available** click **OK**



Make sure that the version that you created on PART 1 of the lab is selected for **J02Mortgage**. If you do not select a version, that component is not deployed.

- 11.5 ► Click **OK** and **Submit**



The web page shows you the progress of the application process request. From this page, you can watch as the processes run. The following figure shows the application process partially completed. The application component process is finished and the other two component processes are running.

11.6 ► Click **Expand All** and expand **Deploy JKE to CICS** to see all steps and WAIT the deploy...

Application Process Request: J02 Mortgage COBOL [\(show details\)](#)

Log	Properties	Manifest	Configuration Changes	Inventory Changes																																													
<b>Execution</b> <div style="display: flex; justify-content: space-between;"> <span><b>Pause</b></span> <span><b>Cancel</b></span> <span><b>Download All Logs</b></span> </div> <table border="1"> <thead> <tr> <th>Step</th> <th>Progress</th> <th>Start Time</th> <th>Duration</th> <th>Status</th> </tr> </thead> <tbody> <tr> <td>▼ 1. Install: "J02Mortgage"</td> <td>0 / 1</td> <td>5:32:19 PM</td> <td>0:00:48</td> <td>Running</td> </tr> <tr> <td>▼ J02Mortgage</td> <td>0 / 1</td> <td>5:32:19 PM</td> <td>0:00:48</td> <td>Running</td> </tr> <tr> <td>  ▼ Deploy JKE to CICS (J02Mortgage 20180709)</td> <td>0 / 1</td> <td>5:32:19 PM</td> <td>0:00:48</td> <td>Running</td> </tr> <tr> <td>    1. Download Artifacts for zOS</td> <td>0 / 1</td> <td>5:32:20 PM</td> <td>0:00:35</td> <td>Success</td> </tr> <tr> <td>    2. Deploy Data Sets</td> <td>0 / 1</td> <td>5:32:56 PM</td> <td>0:00:12</td> <td>Running</td> </tr> <tr> <td>    3. Generate Program List</td> <td>0 / 1</td> <td></td> <td></td> <td>Not Started</td> </tr> <tr> <td>    4. New copy resources</td> <td>0 / 1</td> <td></td> <td></td> <td>Not Started</td> </tr> <tr> <td>Total Execution</td> <td>0 / 1</td> <td>5:32:19 PM</td> <td>0:00:48</td> <td>Running</td> </tr> </tbody> </table>					Step	Progress	Start Time	Duration	Status	▼ 1. Install: "J02Mortgage"	0 / 1	5:32:19 PM	0:00:48	Running	▼ J02Mortgage	0 / 1	5:32:19 PM	0:00:48	Running	▼ Deploy JKE to CICS (J02Mortgage 20180709)	0 / 1	5:32:19 PM	0:00:48	Running	1. Download Artifacts for zOS	0 / 1	5:32:20 PM	0:00:35	Success	2. Deploy Data Sets	0 / 1	5:32:56 PM	0:00:12	Running	3. Generate Program List	0 / 1			Not Started	4. New copy resources	0 / 1			Not Started	Total Execution	0 / 1	5:32:19 PM	0:00:48	Running
Step	Progress	Start Time	Duration	Status																																													
▼ 1. Install: "J02Mortgage"	0 / 1	5:32:19 PM	0:00:48	Running																																													
▼ J02Mortgage	0 / 1	5:32:19 PM	0:00:48	Running																																													
▼ Deploy JKE to CICS (J02Mortgage 20180709)	0 / 1	5:32:19 PM	0:00:48	Running																																													
1. Download Artifacts for zOS	0 / 1	5:32:20 PM	0:00:35	Success																																													
2. Deploy Data Sets	0 / 1	5:32:56 PM	0:00:12	Running																																													
3. Generate Program List	0 / 1			Not Started																																													
4. New copy resources	0 / 1			Not Started																																													
Total Execution	0 / 1	5:32:19 PM	0:00:48	Running																																													

If the process runs successfully, the request shows that each component process is finished, as in the following figure:

Execution

Start	Progress	Status	Duration	End
6:08:25 PM	1 / 1	Success	0:02:23	6:10:49 PM
<div style="display: flex; justify-content: space-between;"> <span><b>Repeat Request</b></span> <span><b>Download All Logs</b></span> <span><b>Expand All</b></span> <span><b>Collapse All</b></span> </div>				
Step	Progress	Start Time	Duration	Status
▼ 1. Install: "J02Mortgage"	1 / 1	6:08:25 PM	0:02:23	Success
▼ J02Mortgage	1 / 1	6:08:25 PM	0:02:23	Success
▼ Deploy JKE to CICS (J02Mortgage 20180709)	1 / 1	6:08:25 PM	0:02:23	Success
1. Download Artifacts for zOS	1 / 1	6:08:25 PM	0:00:40	Success
2. Deploy Data Sets	1 / 1	6:09:06 PM	0:00:45	Success
3. Generate Program List	1 / 1	6:09:52 PM	0:00:27	Success
4. New copy resources	1 / 1	6:10:19 PM	0:00:29	Success
Total Execution	1 / 1	6:08:25 PM	0:02:23	Success

11.7 ► Click on **Output Log** to see the CICS Programs NEWCOPY executed.

Output Log

37 2020/05/08 20:51:10.758 GMT BUZCP0006I Connected to "10.1.1.2:1490". CICS TS version: 050300.
38 2020/05/08 20:51:17.893 GMT BUZCP0037I Perform NEWCOPY Operation.
39 2020/05/08 20:51:18.904 GMT BUZCP0024I NEWCOPY PROGRAM "J02CMORT" succeeded.
40 2020/05/08 20:51:19.202 GMT BUZCP0024I NEWCOPY PROGRAM "J02MORT" succeeded.
41 2020/05/08 20:51:19.714 GMT BUZCP0028I Summary: 2 NEWCOPY request(s) succeeded, 0 NEWCOPY request(s) failed.
42

11.8 ► Close the web browser

## Task 12 – Verifying the Deploy results at z/OS CICS

The z/OS components are unique for each student, so you can see the code that you deployed to CICS.

### 12.1 ►| Use the 3270 emulator

Go to the windows desktop and **double click the 3270 emulation icon**



### 12.2 Verify the CICS application. L cicsts53

►| Type **I cicsts53** (I is L lower case)

```

z/OS V2R2 PUT1606 / RSU1607                               IP Address = 10.1.1.1
                                                               VTAM Terminal = SC0TCP01

          Application Developer System

          // 0000000 SSSSS
          // 00    00 SS
zzzzzz // 00    00 SS
zz // 00    00 SSSS
zz // 00    00      SS
zzzzzz // 0000000 SSSS

System Customization - ADCD.Z22C.*


====> Enter "LOGON" followed by the TSO userid. Example "LOGON IBMUSER" or
====> Enter L followed by the APPLID
====> Examples: "L TSO", "L CICSTS52", "L CICSTS53", "L IMS13", "L IMS14"
l cicsts53
Mn   H
24/011

```

### 12.3 ►| Authenticate using your id **empot02** and password **empot02**

```

          Signon to CICS                                APPLID CICSTS53

WELCOME TO CICS TS 5.3

Type your userid and password, then press ENTER:
        Userid . . . empot02      Groupid . . . _____
        Password . . . _           Language . . . _
        New Password . . .

DFHCE3520 Please type your userid.
F3=Exit
Mn   A
11/033

```

12.4 ► Type the transaction **J02P**.



12.5 ► Type **00** on Length of Loan in Years. Note that the error message.

```
Session A - [24 x 80]
File Edit View Communication Actions Window Help
Host: zos.dev Port: 23 LU Name:
JKE MORTGAGE CALCULATOR

Amount of Loan: 1000
Length of Loan in Years: 00
Interest Rate: 5

Press F3 to quit or Enter to calculate loan
Press PF9 to see companies that can match or beat this rate

Monthly Payment: 7.91

LOAN TERM MUST BE BETWEEN 1 AND 40 YEARS

MA A 01/001
Connected to remote server/host zos.dev using LU
```

**Congratulations!** You completed the lab.

## LAB 6B – (OPTIONAL) Using IBM zUnit to Unit Test a COBOL CICS/DB2 application using Remote assets (60 minutes)

Updated March 23, 2021 by Regi – Created by Regi/Wilbert



### Acknowledgments:

We would like to thank the following for their assistance:  
Suman Gopinath & Nathan Cassata.

This lab will take you through the steps of using the automated unit testing ([zUnit](#)) capabilities of [IBM Developer for z](#) (IDz) to create a unit test case for a COBOL CICS/DB2 program. This enables the testing of just a single program within a CICS transaction without the need to run the whole transaction. This is done by stubbing out CICS calls, enabling the program to be tested without a CICS environment and without the need to deploy to CICS after a code change. This enables a developer to test early without impacting other developers that share the same CICS environment.

In this lab you will record interaction with a COBOL CICS/DB2 program (program under test) and import the recorded data into the unit test case generation process. You will build and run the unit test, make a change to the CICS COBOL program, and rerun the unit test.

## Overview of development tasks

To complete this tutorial, you will perform the following tasks:

- 1. Get familiar with the application using the 3270 terminal**  
→ You will start a 3270 emulation and execute a transaction named **HCAZ** to become familiar with the Application that you will be recording.
- 2. Import a z/OS project**  
→ You will import a z/OS project with the required resources added to the project.
- 3. Record interaction with the application.**  
→ You will record an interaction with the COBOL CICS/DB2 program.
- 4. Generate, build and run the unit test**  
→ You will compile and link-edit the generated unit test program, followed by running the unit test.
- 5. Modify the program and rerun the unit test**  
→ You will modify the program under test, rerun the unit test, and observe the failure of the test case.
- 6. Run the unit test from a batch JCL .**  
→ You will run the unit test from a Batch JCL and observe a similar test case result.

## Section 1. Get familiar with the application using the 3270 terminal

You will start a 3270 emulation and execute a transaction named **HCAZ** to become familiar with the Application that you will be interacting with.

### 1.1 Connect to z/OS and emulate a CICS 3270 terminal

You will use IDz to emulate a 3270 terminal to run the CICS transaction.

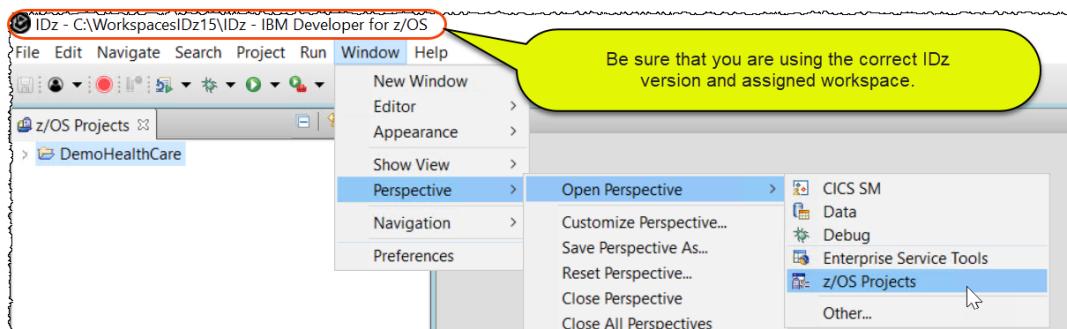
1.1.1 Start *IBM Developer for z Systems version 15* if it is not already started

- Using the desktop double click on **IDz V15 icon**.
- Verify that the message indicates that it is Version **15.0.1**

**IMPORTANT** -> This icon will start an eclipse workspace that has already some definitions required for this lab. PLEASE DO NOT start IDz using other way than this icon.



1.1.2 ► Open the **z/OS Projects** perspective by selecting **Window > Perspective > Open Perspective > z/OS Projects**

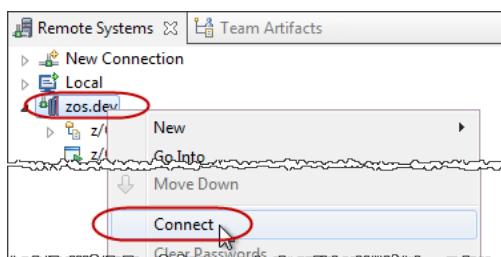


1.1.3 You will use userid **empot01**.

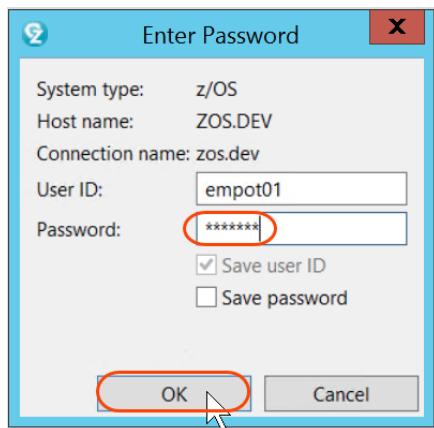
If you are connected as empot01, jump to step 1.1.5 Otherwise.

- Using *Remote Systems* view, right click on **zos.dev** and select **Connect**

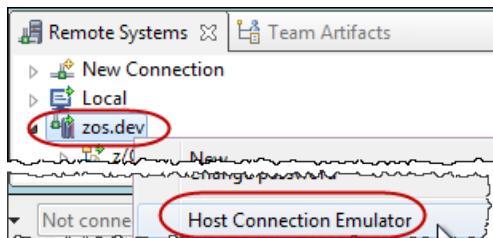
(You also may need to disconnect first)



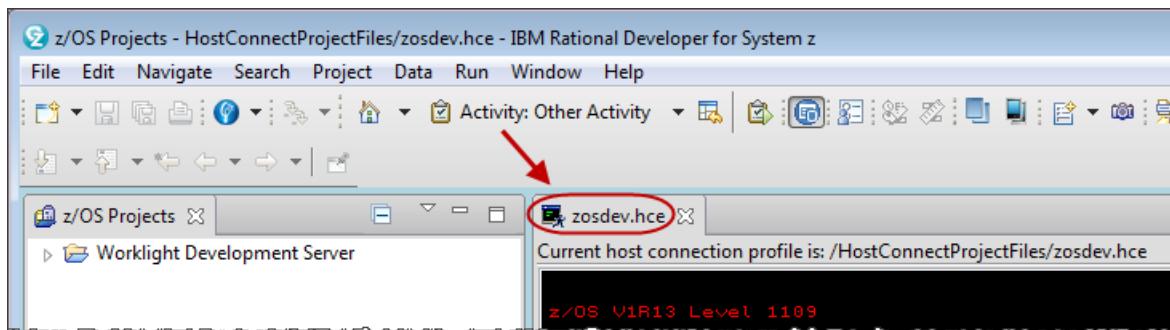
- 1.1.4 ► Type **empot01**as userid and **empot01** as password.  
 The userid and password can be any case; don't worry about having it in UPPER case.  
 Click **OK** to connect to z/OS.



- 1.1.5 ► Using the *Remote Systems* view, right click on **zos.dev** and select **Host Connection Emulator**.



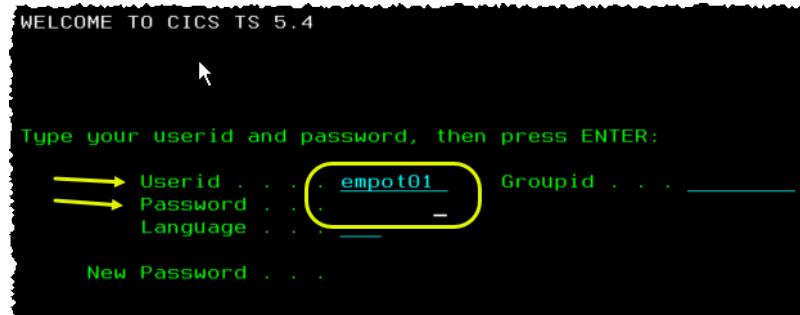
- 1.1.6 ► Since you will need more space, **double-click** on the **zos.dev.hce** title



- 1.1.7 ► Type **I cicsts54**. (where "I" is the lower case of letter "L") and press **Enter key**.



1.1.8 ► Logon using your z/OS user id and password (**empot01**) and press **Enter**.



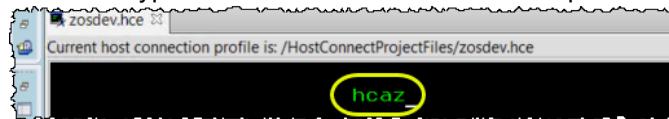
1.1.9 The sign-on message is displayed



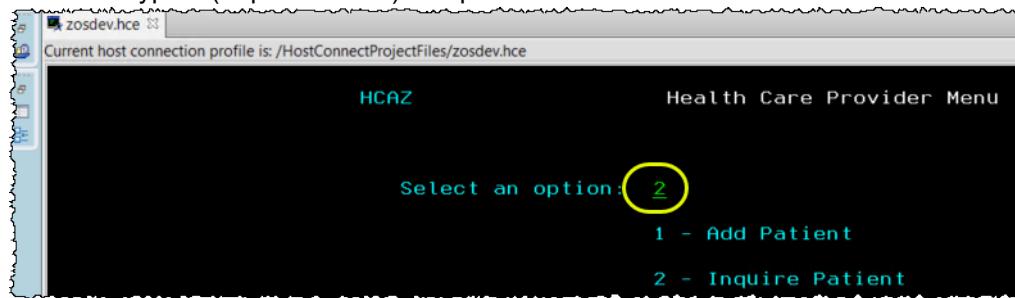
## 1.2 Run CICS transaction HCAZ

You should now be in the z/OS CICS region named C/CSTS54. This is the CICS instance where you will make the recording of your interaction.

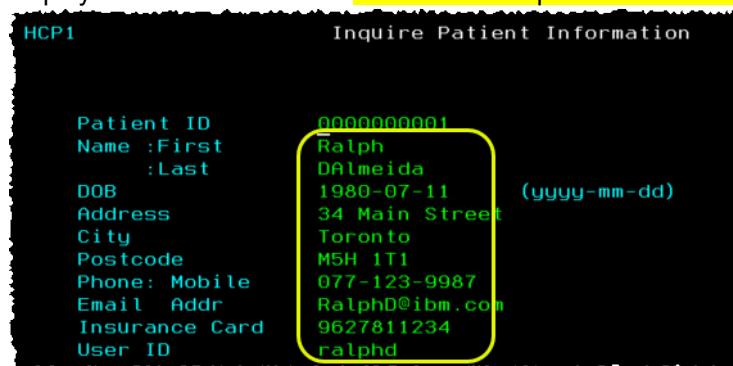
1.2.1 ► Type the CICS transaction **hcaz** and press the **Enter** key.



1.2.2 ► Type **2** (Inquire Patient) and press **Enter** .

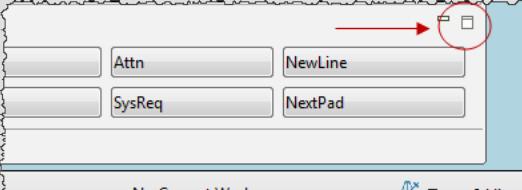


1.2.3 ► Type **1** for Patient ID and press Enter. The program will read the patient from a DB2 table and display the customer details. Remember the patient first name: **Ralph**

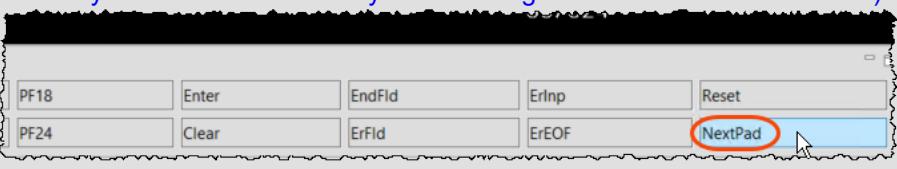


**IF you need to use functions like Clear or Reset**

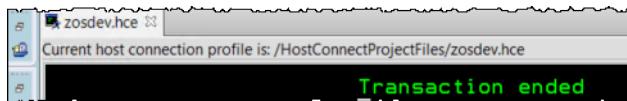
If you need to use the **clear** function use the key **Esc**.  
Also you may look in the right lower corner, select this icon . This will display possible keys, including the clear button.



You may also use the Reset key after clicking NextPad

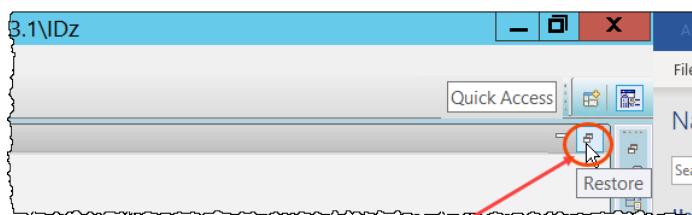


1.2.4 Press **F3** to end the application.



1.2.5 Close the terminal emulation clicking on → . Or pressing **CTRL + Shift + F4**.

1.2.6 You may need to restore the **z/OS Projects** perspective by clicking on the icon on top right:



#### What have you done so far?

You emulated a 3270 terminal using IBM Developer for System z.

You also executed the CICS transaction **HCAZ** and verified a simple interaction with the Hospital application. The objective here was to show the code that you will update.

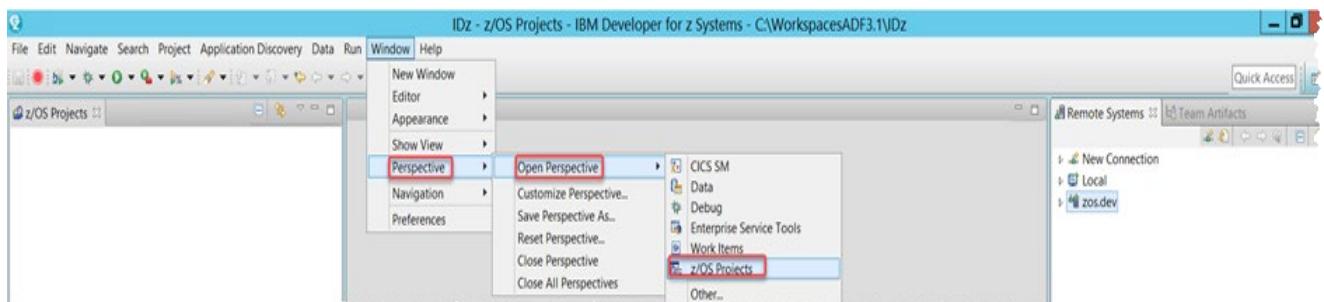
## Section 2 – Import a z/OS project

You will import a z/OS Project that contains the resources needed to generate a unit test program for a COBOL CICS application.

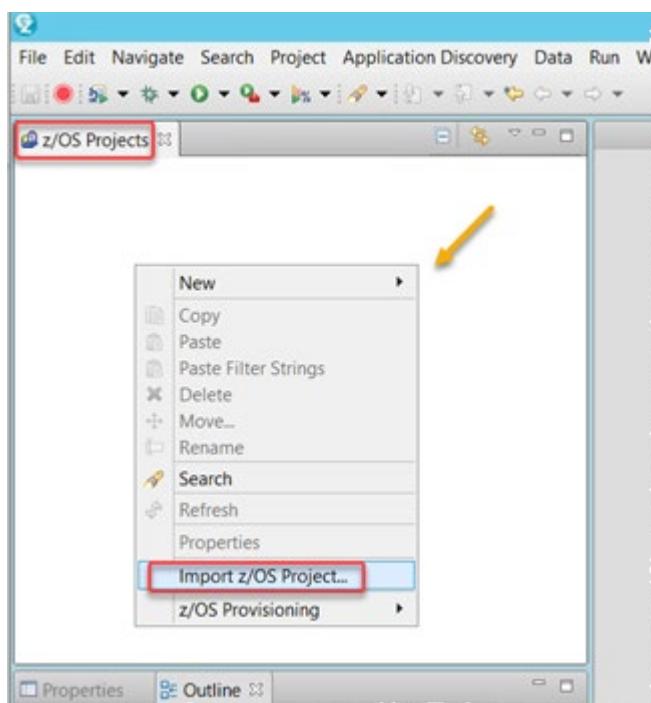
## 2.1 Importing the LAB6B z/OS Project

The Hospital Application used in this lab has its source code in a *PDS* that's been added to a *z/OS Project*. You must be connected to the *zos.dev* system (see step 1.1).

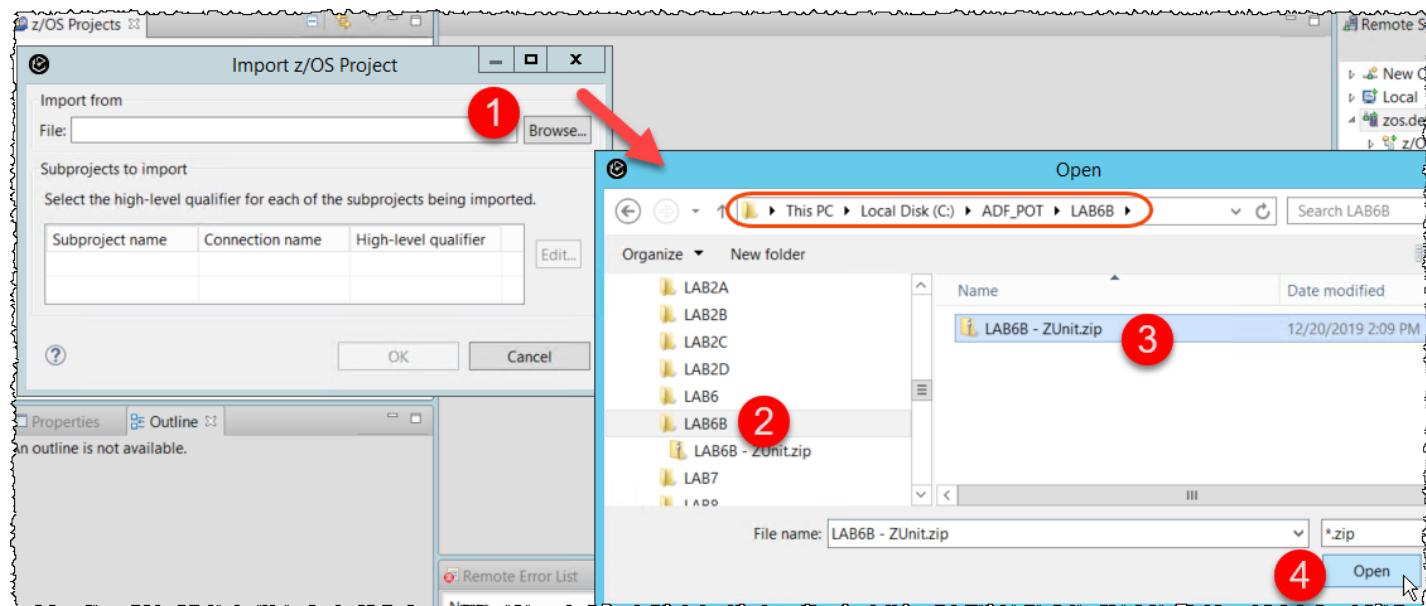
- 2.1.1 ► If not already in the *z/OS Projects* perspective, open the ***z/OS Projects*** perspective by selecting **Window > Perspective > Open Perspective > z/OS Projects**



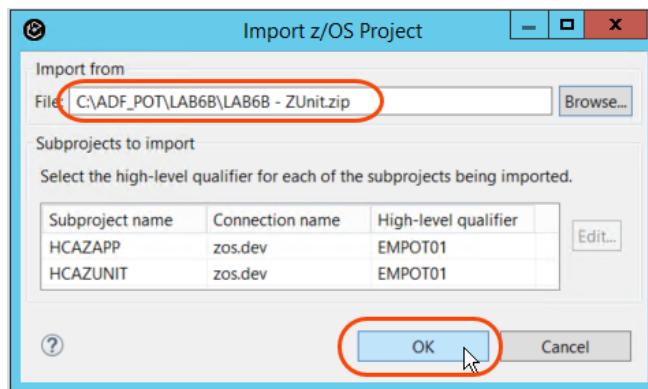
- 2.1.2 ► Using the ***z/OS Projects*** view on top left, position the cursor anywhere in the view. Right mouse click and select the **Import z/OS Project** action.



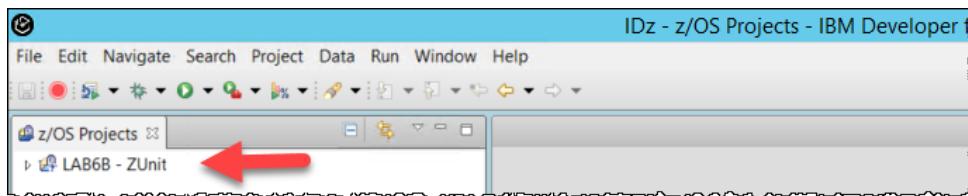
2.1.3 ► In the **Import z/OS Project** dialog, click the **Browse** button, navigate to **C:\ADF\_POT\LAB6B** and select **LAB6B - ZUnit.zip**. Click **Open**.



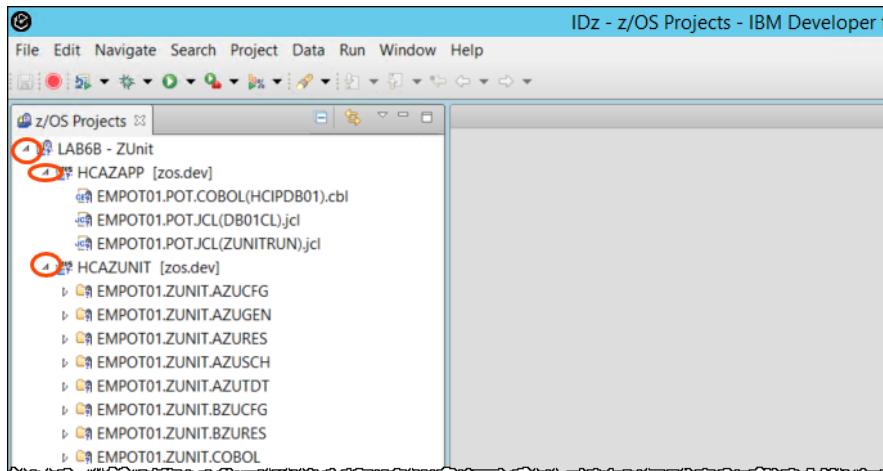
2.1.4 ► In the dialog that opens, click **OK**.



You should see something like this in your z/OS Projects view:



2.1.5 ► Expand the nodes by left clicking on the icon ▶ as shown below:.



## Section 3 – Record data interaction using the CICS application.

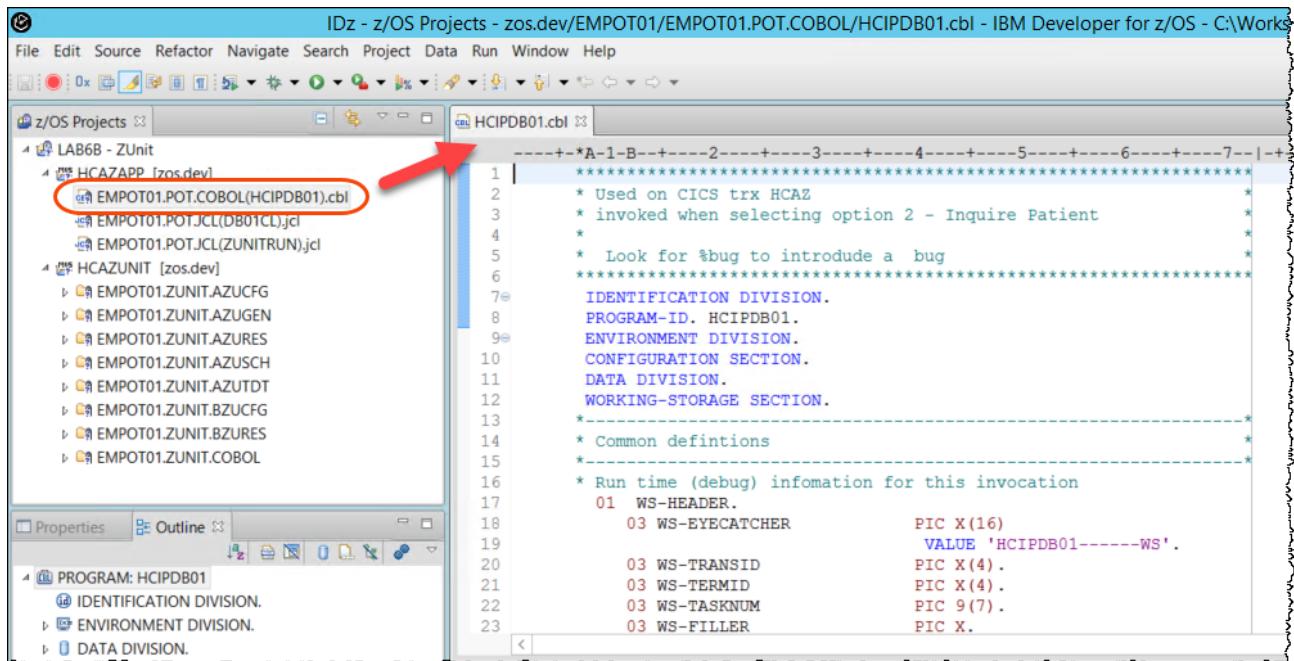
Using IDz you will record the interaction with the COBOL/DB2 program that reads a patient from a DB2 table.

### 3.1 Understanding the COBOL program that reads from DB2 table

The COBOL code that reads the patient from the DB2 tables is the program **HCIPDB01**

3.1.1 ► Using z/OS Projects view double click **EMPOT01.POT.COBOL(HCIPDB01).cbl** under **HCAZAPP**.

This is the program that you will update later on.



3.1.2 ► Using the Outline view on left expand **PROCEDURE DIVISION** and click on **GET-PATIENT-INFO**. This is where the patient data is read from the DB2 table. Later on you will introduce a bug in this program..

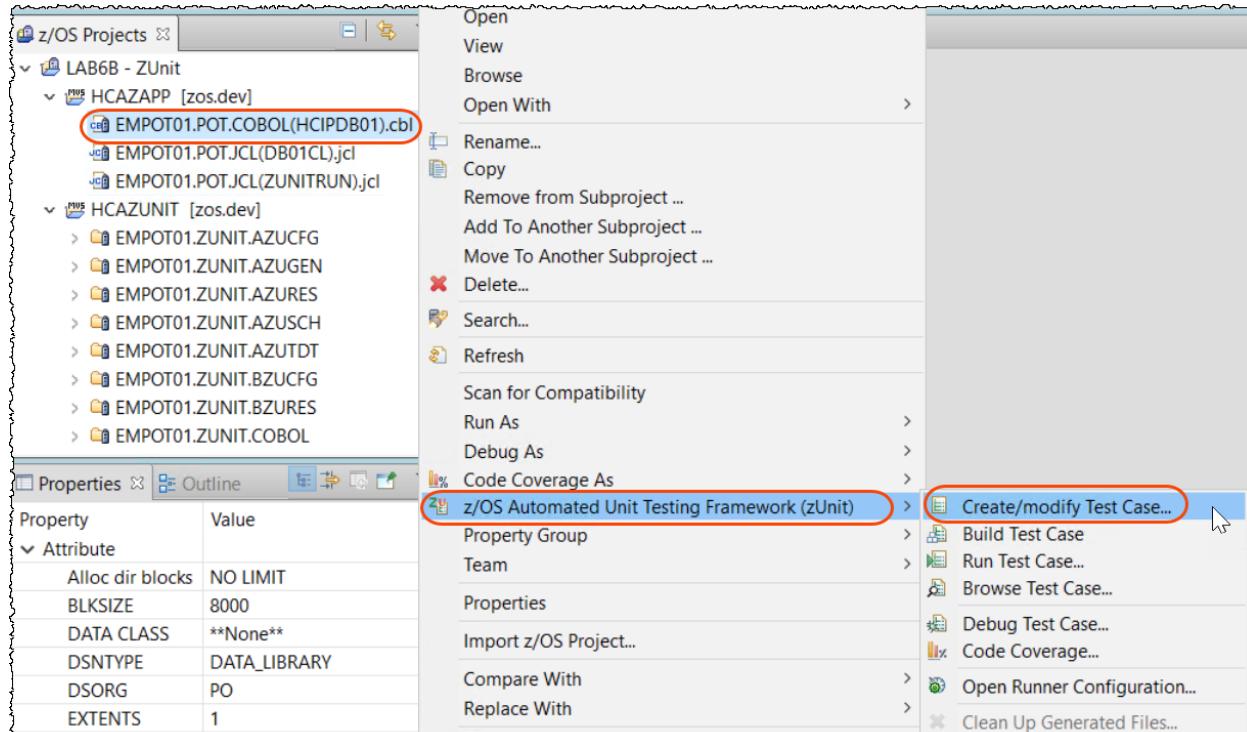
```

109      * END PROGRAM and return to caller
110      *
111      MAINLINE-END.
112      EXEC CICS RETURN END-EXEC.
113      MAINLINE-EXIT.
114      EXIT.
115
116      GET-PATIENT-INFO.
117      EXEC SQL
118          SELECT FIRSTNAME,
119              LASTNAME,
120              DATEOFBIRTH,
121              insCardNumber,
122              ADDRESS,
123              CITY,
124              POSTCODE,
125              PHONEMOBILE,
126              EMAILADDRESS,
127              USERNAME
128          INTO :CA-FIRST-NAME,
129              :CA-LAST-NAME,
130              :CA-DOB,
131              :CA-INS-CARD-NUM,

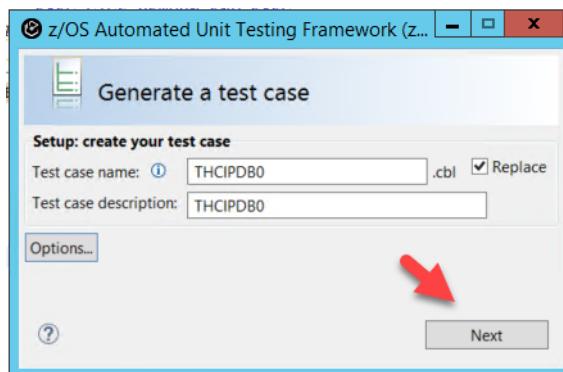
```

### 3.2 Recording the COBOL program that sends the message

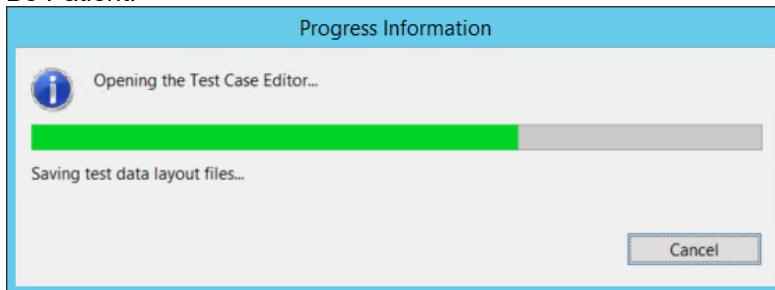
3.2.1 ► To start the recording, right click on **EMPOT01.POT.COBOL(HCIPDB01).cbl** and select **z/OS Automated Unit Testing Framework (zUnit)**-> **Create/modify Test Case..**



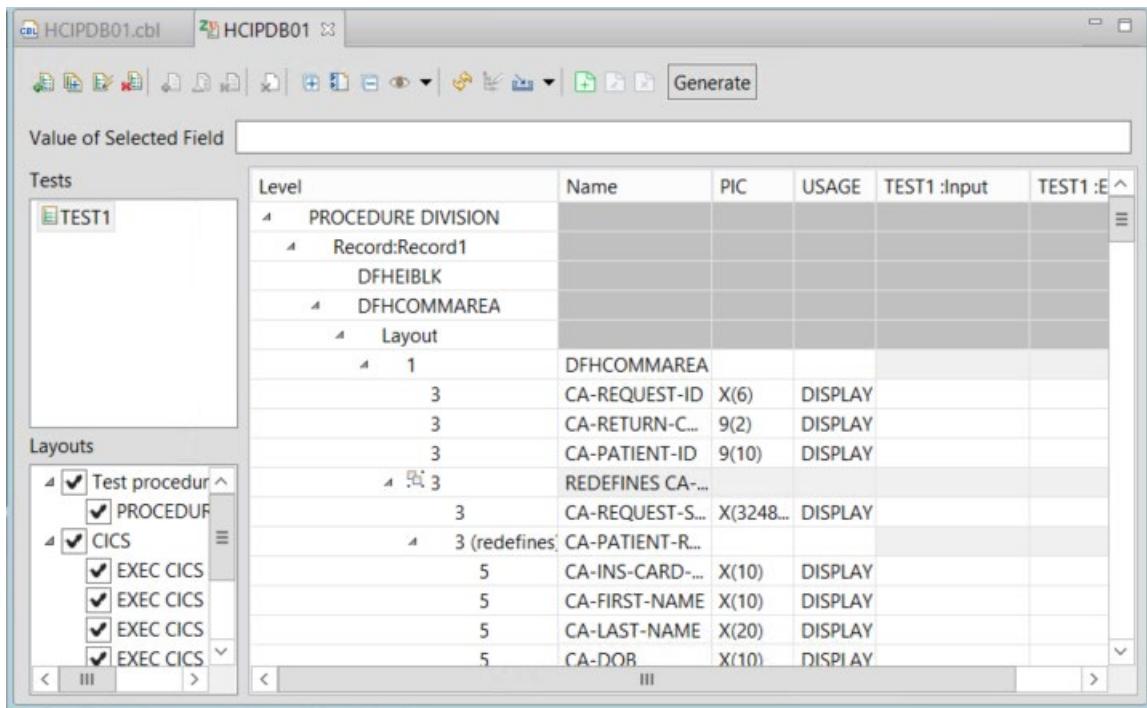
3.2.2 ► This opens a dialog where you can name your test case. Accept the auto-generated name and click **Next**.



3.2.3 This operation may take a while since members are being created on z/OS PDS **EMPOT01.ZUNIT.\***. Be Patient!



3.2.4 This will open the **Test Case Editor**, as shown below. TEST1 may or may not be on your screen. If TEST1 is there you will delete on next step.



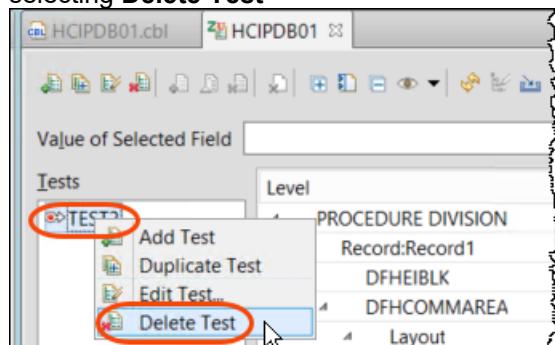
## Understanding the test case editor

- The bottom left box summarizes all the input output variable structures – In this example, the program has a COMMAREA exchanged via the PROCEDURE DIVISION, five EXEC CICS statements and one EXEC SQL statement.
- The COMMAREA and the CICS statements are also accompanied by the CICS DFHEIBLK variables. To see those values you must select the icon



The variables that are returned by the program are the output from the program logic that a developer should be checking

- 3.2.5 ► Since we will be recording the test data, delete the **TESTx** entry (if it exists) by right clicking and selecting **Delete Test**



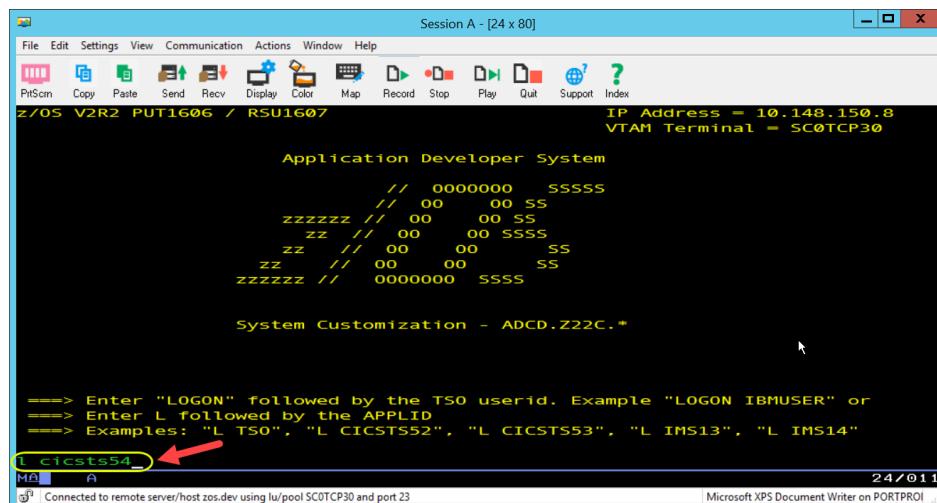
Notice that on section 1 we used the IDz emulator and now you will use the IBM PCOM emulator. Any 3270 emulator can be used.. We just show here a different way to emulate a 3270 terminal.

- 3.2.6 ► Bring up a 3270 terminal emulator clicking on the **host emulator icon** on the Windows task bar.



This opens the host emulator.

- 3.2.7 ► Type **I cicsts54**. (where I is L lower case) and press **Enter key** or the **right Ctrl key**.

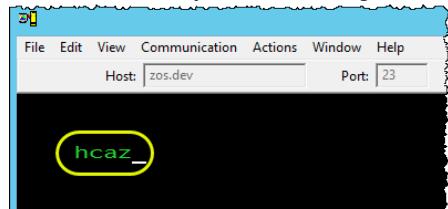


- 3.2.8 ► Sign on using **empot01** as the userid and **empot01** as the password.

Type your userid and password, then press ENTER:

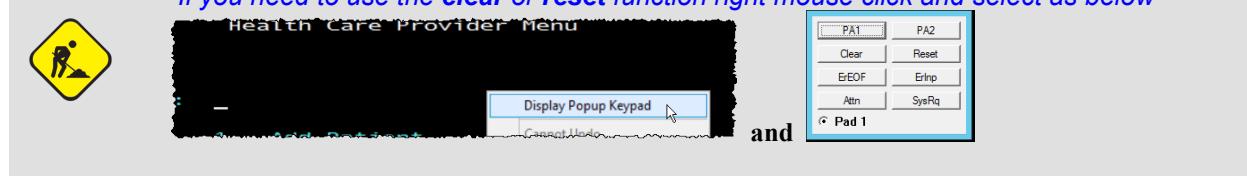
Userid . . .	<b>empot01</b>	Groupid . . .
Password . . .	_____	
Language . . .	_____	

- 3.2.9 ► Once you see the sign-on is complete message, enter **hcaz** and press the right **Ctrl** key.



#### IF you need to use functions like Clear or Reset

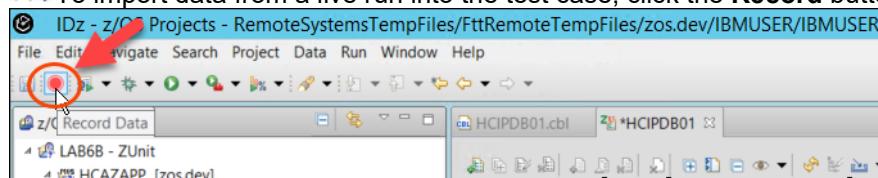
If you need to use the clear or reset function right mouse click and select as below



You are now ready to start recording and import data into the test case editor.

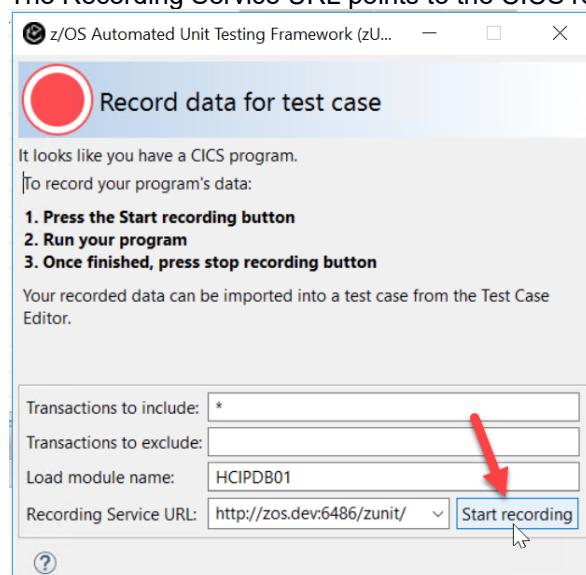
- 3.2.10 ► Minimize the terminal emulator and go back to IDz dialog.

► To import data from a live run into the test case, click the **Record** button on the IDz toolbar.

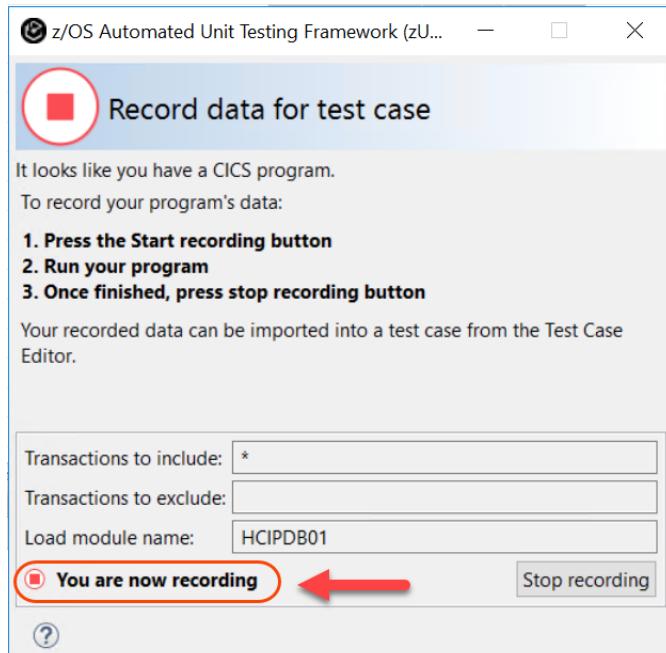


- 3.2.11 ► In the dialog that comes up, click on **Start recording**.

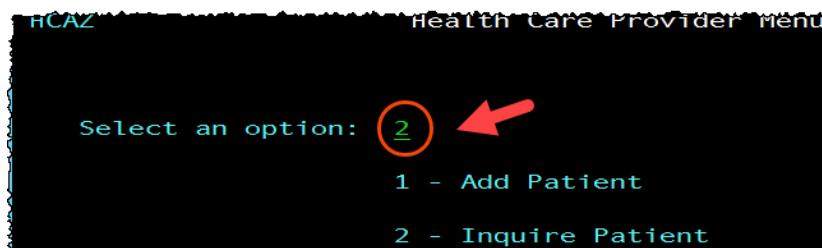
The Recording Service URL points to the CICS region where the live run is recorded.



3.2.12 When recording is turned on, the message “**You are now recording**” appears.



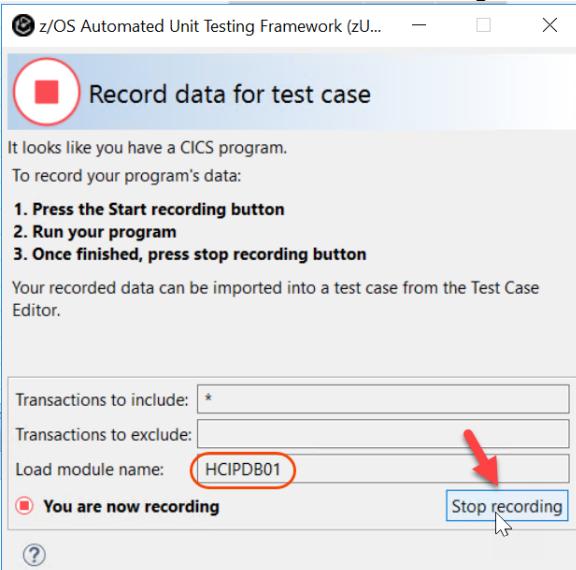
3.2.13 ► Switch to the 3270 terminal emulator (that is minimized), type **2** (Inquire Patient) and press **enter**.



3.2.14 ► Type **1** and press **enter**

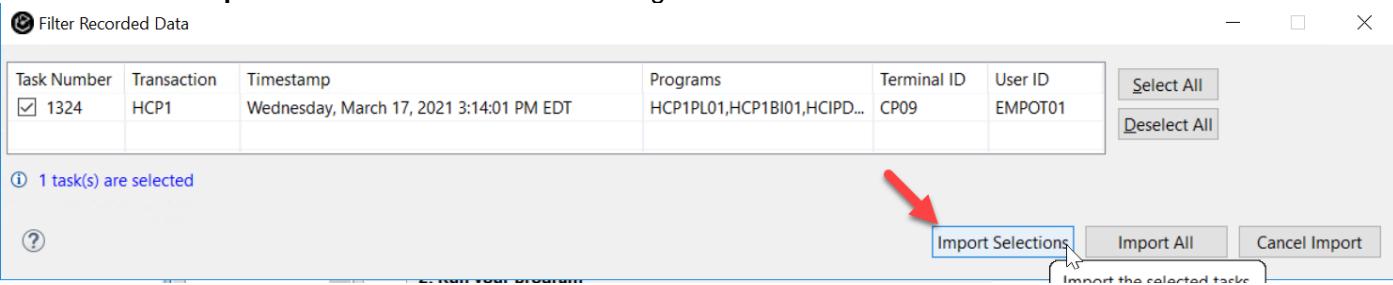


3.2.15 ►| Switch back to IDz minimizing the 3270 screen and click **Stop recording**.



The dialog Filter Recorded Data is displayed.

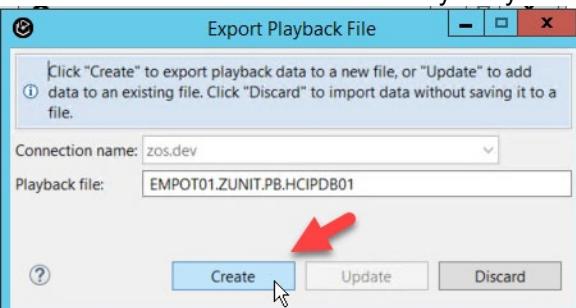
3.2.16 ►| Click **Import Selections** to dismiss the dialog.



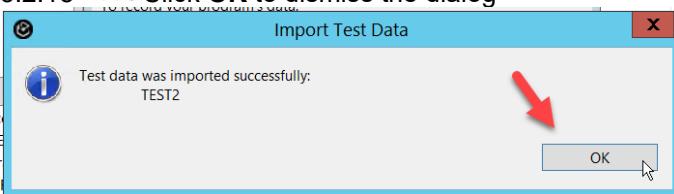
3.2.17 ►| Change the *Playback file* to **EMPOT01.ZUNIT.PB.HCIPDB01** (instead of **EMPOT05**)

►| Click **Create** to export playback data to a z/OS data set

Notice – In case this has been already run you must select **Update** instead.



3.2.18 ►| Click **OK** to dismiss the dialog



3.2.19 ► Double click on the **Hcipdb01** title to enlarge the view.

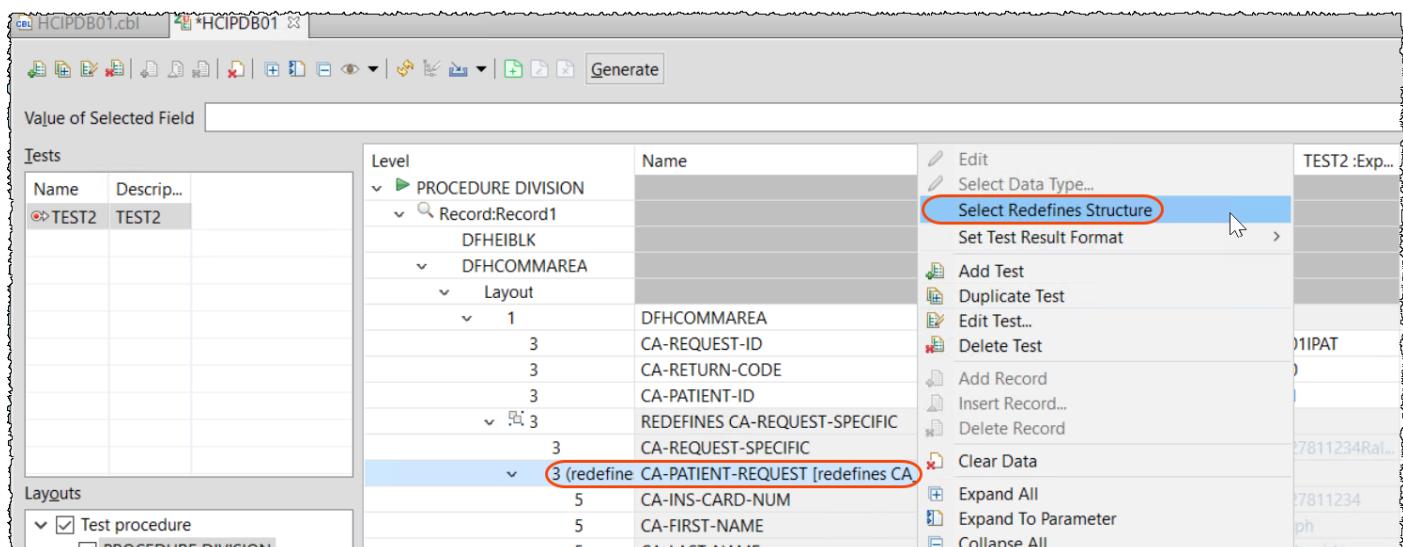


3.2.20 You now see a new test created in the editor and populated with the values from the live run. Also you may notice that this program has many redefines.

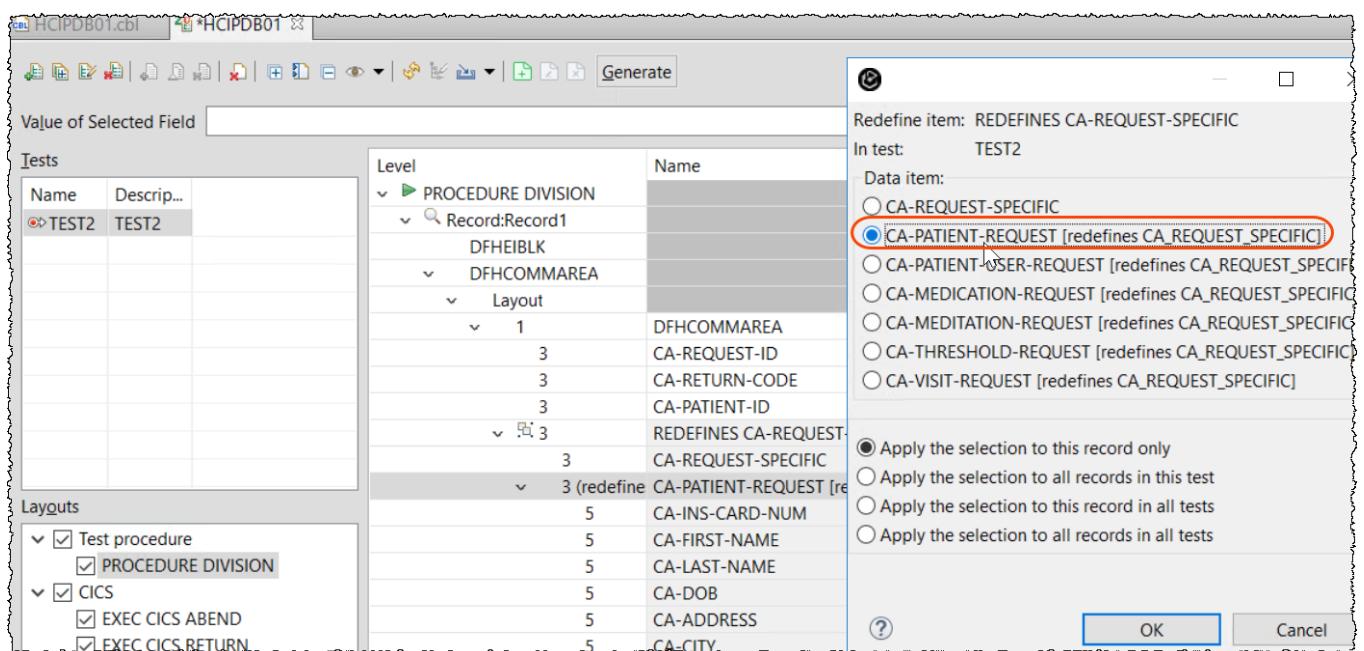
You need to identify which is the area being used on this program execution. In our example is the “CA-PATIENT-REQUEST” area being redefined.

► Find “(redefines) CA-PATIENT-REQUEST” (the first REDEFINES).

Right click on it and click **Select Redefines Structure**



3.2.21 ► Select CA-PATIENT-REQUEST and click OK



3.2.22 Notice that now the patient data recorded is displayed at the new redefines selected.

Level	Name	PIC	USAGE	TEST2 :Inp...	TEST2 :Exp...
1	DFHCOMMAREA				
3	CA-REQUEST-ID	X(6)	DISPLAY	01PAT	<input type="button" value="9627811234Ralph"/>
3	CA-RETURN-CODE	9(2)	DISPLAY	0	<input type="button" value="0"/>
3	CA-PATIENT-ID	9(10)	DISPLAY	1	<input type="button" value="1"/>
3	REDEFINES CA-REQUEST-SPECIFIC	X(3248...)	DISPLAY		
5	CA-PATIENT-REQUEST [redefines CA_QUE...				
5	CA-INS-CARD-NUM	X(10)	DISPLAY		<input type="button" value="9627811234Ralph"/>
5	CA-FIRST-NAME	X(10)	DISPLAY		<input type="button" value="Ralph"/>
5	CA-LAST-NAME	X(20)	DISPLAY		<input type="button" value="DALmeida ..."/>
5	CA-DOB	X(10)	DISPLAY		<input type="button" value="1980-07-11"/>
5	CA-ADDRESS	X(20)	DISPLAY		<input type="button" value="34 Main Stre..."/>
5	CA-CITY	X(20)	DISPLAY		<input type="button" value="Toronto ..."/>
5	CA-POSTCODE	X(10)	DISPLAY		<input type="button" value="M5H 1T1"/>
5	CA-PHONE-MOBILE	X(20)	DISPLAY		<input type="button" value="077-123-998..."/>
5	CA-EMAIL-ADDRESS	X(50)	DISPLAY		<input type="button" value="RalphD@ibm.c..."/>
5	CA-USERID	X(10)	DISPLAY		<input type="button" value="ralphd"/>

3.2.23 ► Press **Ctrl+S** to save any changes. Notice this save takes a while since values are saved on z/OS

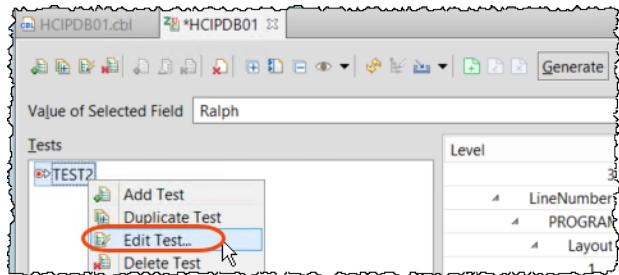
3.2.24 You now see a new test created in the editor and populated with the values from the live run.

► Scroll down the editor and notice the data displayed on the screen that was captured..

- 3.2.25 ► ① Select **EXEC SQL SELECT INTO (PATIENT)**to position the data layout for this statement.
- ② Use the scroll bar to scroll down until the end,
- ③ Click on **Ralph** . and notice that value is displayed on the line ④ ”

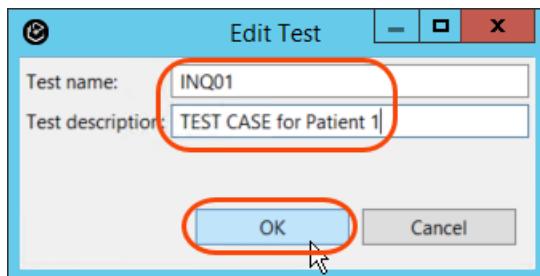
Level	Name	PIC	USAGE	TEST2 :Inp...	TEST2 :Exp...
1	HCAZERRS	X(8)	DISPLAY		
3	CA-ERROR-MSG				
3	FILLER	X(9)	DISPLAY		
3	CA-DATA	X(90)	DISPLAY		
4	EXEC SQL SELECT INTO [PATI				
4	Record:Record1				
4	LineNumber=117				
4	INTO				
5	CA-FIRST-NAME	X(10)	DISPLAY	Ralph	<input type="button" value="Ralph"/>
5	CA-LAST-NAME	X(20)	DISPLAY	DALmeida	<input type="button" value="DALmeida ..."/>
5	CA-DOB	X(10)	DISPLAY	1980-07-11	<input type="button" value="1980-07-11"/>
5	CA-INS-CARD-...	X(10)	DISPLAY	9627811234	<input type="button" value="9627811234Ralph"/>
5	CA-ADDRESS	X(20)	DISPLAY	34 Main Street ...	<input type="button" value="34 Main Stre..."/>
5	CA-CITY	X(20)	DISPLAY	Toronto	<input type="button" value="Toronto ..."/>
5	CA-POSTCODE	X(10)	DISPLAY	M5H 1T1	<input type="button" value="M5H 1T1"/>
5	CA-PHONE-M...	X(20)	DISPLAY	077-123-998...	<input type="button" value="077-123-998..."/>
5	CA-EMAIL-AD...	X(50)	DISPLAY	RalphD@ibm.c...	<input type="button" value="RalphD@ibm.c..."/>
5	CA-USERID	X(10)	DISPLAY	ralphd	<input type="button" value="ralphd"/>
4	WHERE				
3	DB2-PATIENT-ID	S9(9)	BINARY	1	
3	SQLCA				

3.2.26 ► Right click on **TEST2** and select **Edit Test**



3.2.27 It is a good practice give a name for the test case.

► Use a name like **INQ01** and a description like "**TEST CASE for Patient 1**". Click **OK**



3.2.28 ► Press **Ctrl+S** to save any changes.

3.2.29 ► Double click again on the **HCIPDB01** title to shrink the view.

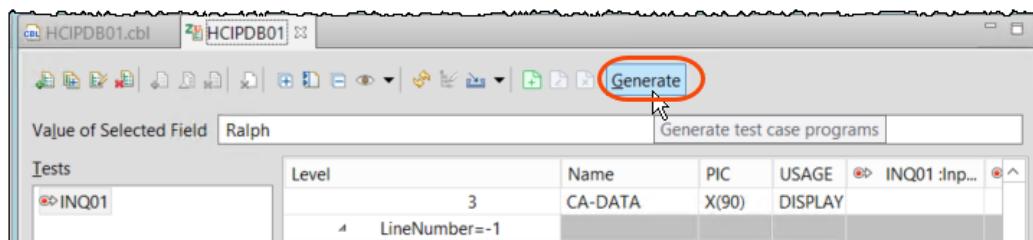


## Section 4. Generate, build and run the unit test.

You will generate, build, and run the unit test.

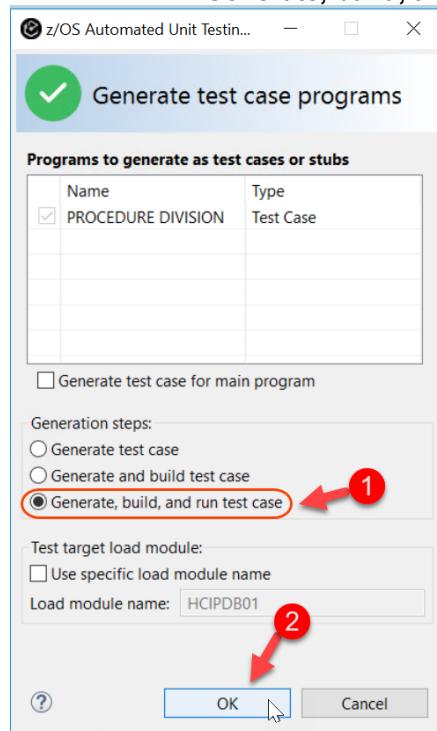
### 4.1 Generating, building and running the test case program.

4.1.1 ► Now that the expected input and output values have been set in the test case editor from the recorded run, click on **Generate** to generate the test case program.



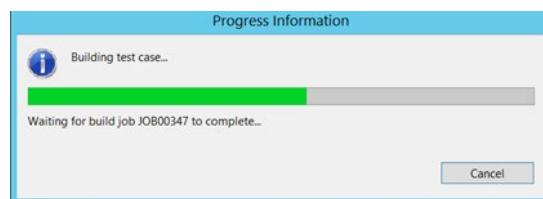
On the **Generate test case programs** dialog,

#### 4.1.2 ► Select **Generate, build, and run test case** and then click **OK**.

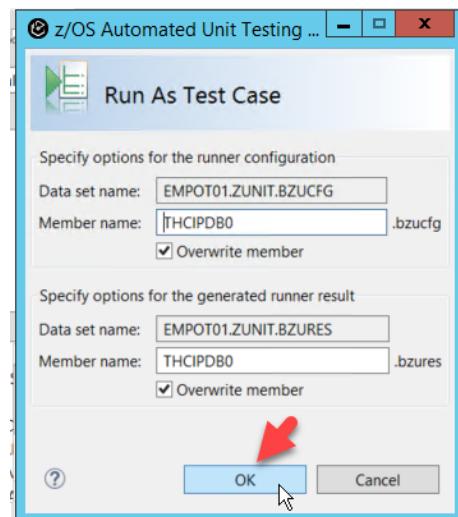


A **Progress information** dialog on the building will open.

This generation will take a while and a job is submitted to z/OS for execution. The COBOL test cases programs were compiled/link edited and are ready to run.



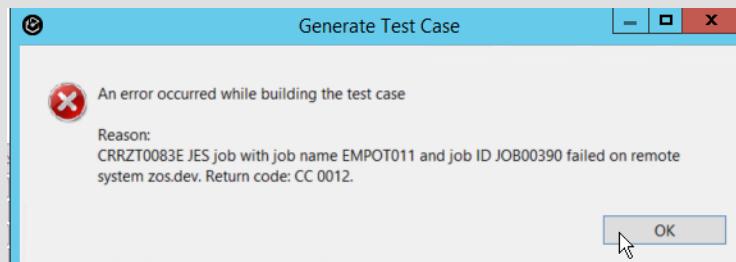
#### 4.1.3 ► Once the building is complete, a **Run As Test Case** dialog will open, click **OK** to continue.



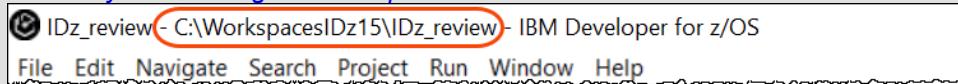
4.1.4 ► A Job Submission dialog opens, click **Notify** to be notified of job completion.



### #1. Had a return code 12 as below?



*You might be using a wrong IDz Workspace...  
Be sure you are using the workspace below and IDz V 15.0.1*



*Call the instructors and*

*1. Close all opened editors.*

*2. Delete the data set EMPOT01.ZUNIT.PB.HCIPDB01 and go back to record and try again*

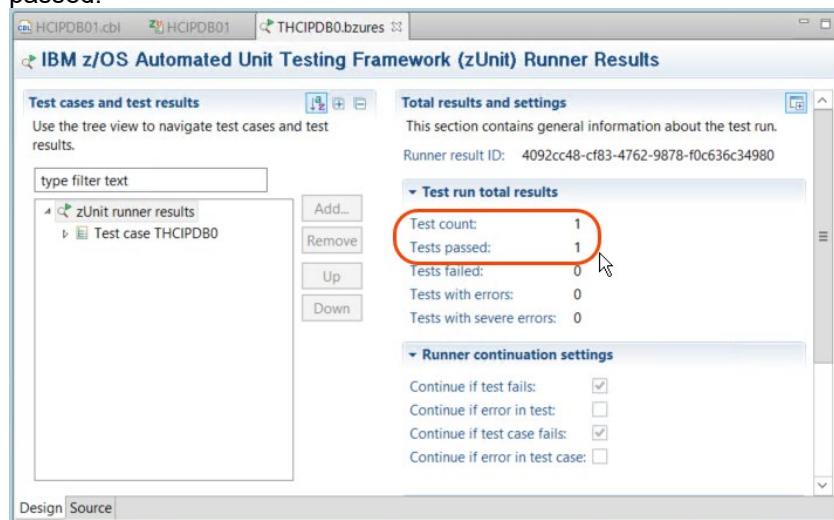
### #2. Had a “strange Test fail” ?

*Call the instructor..*

*1. Delete the data set EMPOT01.ZUNIT.PB.HCIPDB01*

*2. All members from EMPOT01.ZUNIT.\* need to be deleted and the record started again.*

4.1.5 Once the unit test run has completed, the results screen is displayed showing test cases ran and passed.



You have now created a test case with data imported from a recorded run and have been successful in testing a CICS program without the need of a CICS environment.

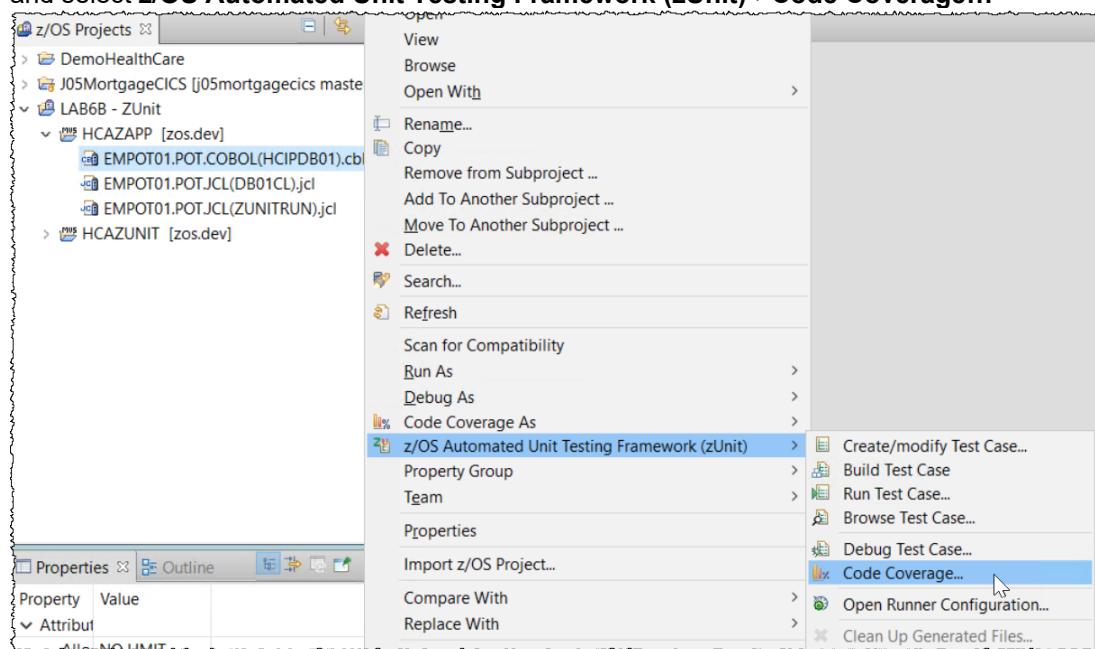
- 4.1.6 ►| Use **Ctrl + Shift + F4** to close all opened editors.

## 4.2 Running zUnit test case with Code Coverage

Code coverage analyzes a running program and generates a report of lines that are executed, compared to the total number of executable lines. Sometimes you need to be sure that your test is covering all capabilities of your program and that you are having the correct test cases.

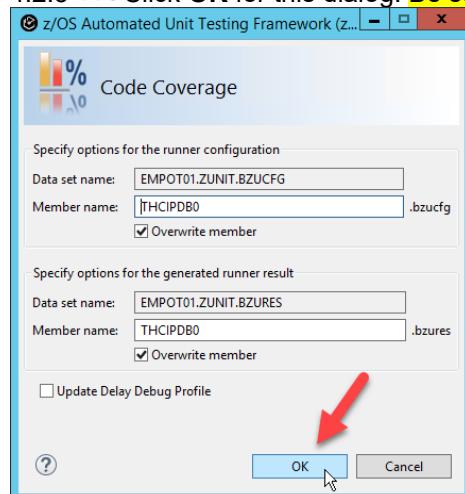
Notice that you are doing the code coverage using a batch job without need to have CICS and DB2 active, what is very handy..

- 4.2.1 ►| Right click on **EMPOT01.POT.COBOL(HCIPDB01).cbl** and select **z/OS Automated Unit Testing Framework (zUnit)->Code Coverage...**



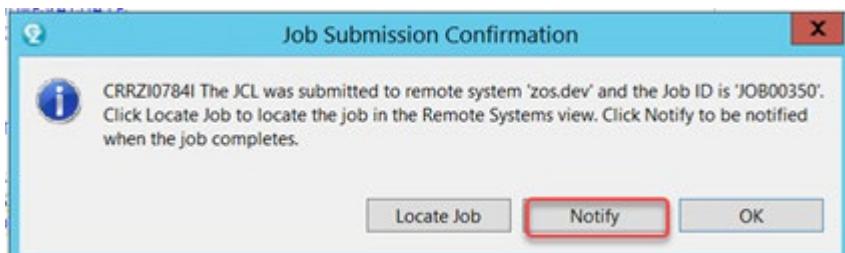
- | If you get a message that files are updated click **Yes** to continue

- 4.2.3 ►| Click **OK** for this dialog. Be sure that *Update Delay Debug Profile* is **NOT** checked.

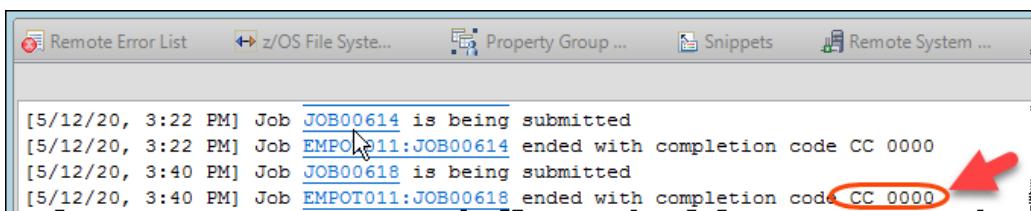


#### 4.2.4 A Job Is submitted for batch execution..

- Click **Notify** on the Job Submission Confirmation dialog.

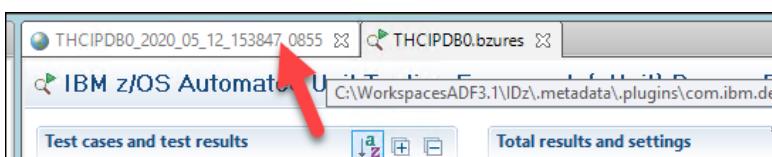


- Make sure the job completes with completion code of **0**.



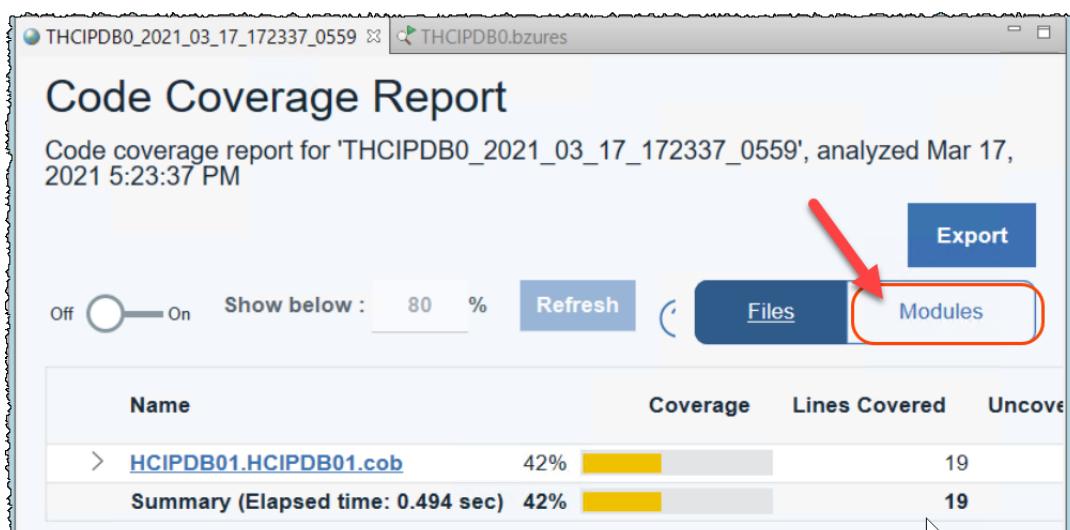
#### 4.2.5 Once again the zUnit Results are displayed and the Test passed.

- Click on **THCIPDB0\_yyyy\_mm\_dd\_xxxxxxx** tab to see the *Code Coverage report*



#### 4.2.6 The code coverage report shows all COBOL programs executed for this specific test case. It shows the coverage of the COBOL programs generated for zUnit to perform the test as well our *HCIPDB01* COBOL program..

- Since we are just interested in the code coverage of program being tested click on **Modules**:

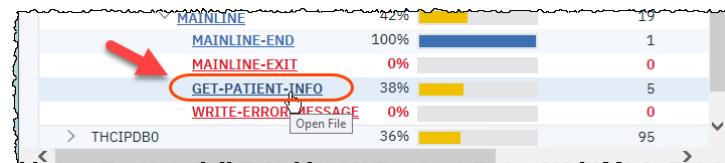


4.2.7 ► Expand the nodes as below to see the COBOL paragraphs.

Notice that **GET-PATIENT-INFO** has 38% of coverage and that **WRITE-ERROR-MESSAGE** was not covered at all on this test case.



4.2.8 ► Click on **GET-PATIENT-INFO** to see more details



4.2.9 ► Scroll down and move the mouse to the colored areas on left.

The lines covered by this test case are in **green** and the lines not covered are in **red**.

Also from the previous image we can see the `WRITE-ERROR_MESSAGE` paragraph is not covered at all.

The screenshot shows a COBOL source code editor with the file `HCIPDB01.HCIPDB01.cob` open. The code includes several paragraphs like `MAINLINE`, `MAINLINE-END`, `MAINLINE-EXIT`, `GET-PATIENT-INFO`, and `WRITE-ERROR-MESSAGE`. A yellow speech bubble labeled "lines covered" points to the green highlighted area around line 259. A red arrow points to the red highlighted area around line 262. A red box highlights the message "Lines 259-266 not covered." The code listing is as follows:

```

247      :CA-ADDRESS,
248      :CA-CITY,
249      :CA-POSTCODE,
250      :CA-PHONE-MOBILE,
251      :CA-EMAIL-ADDRESS,
252      :CA-USERID
253      FROM PATIENT
254      WHERE PATIENTID = :DB2-PATIENT-ID
255      END-EXEC.
256      Evaluate SQLCODE
257      When 0
258      MOVE '00' TO CA-RETURN-CODE
259      Lines 259-266 not covered. 00
260      MOVE '01' TO CA-RETURN-CODE
261      When -913
262      MOVE '01' TO CA-RETURN-CODE
263      When Other
264      MOVE '90' TO CA-RETURN-CODE
265      PERFORM WRITE-ERROR-MESSAGE
266      EXEC CICS RETURN END-EXEC
267      END-Evaluate.
268      * #bug -- the line below will introduce a BUG

```

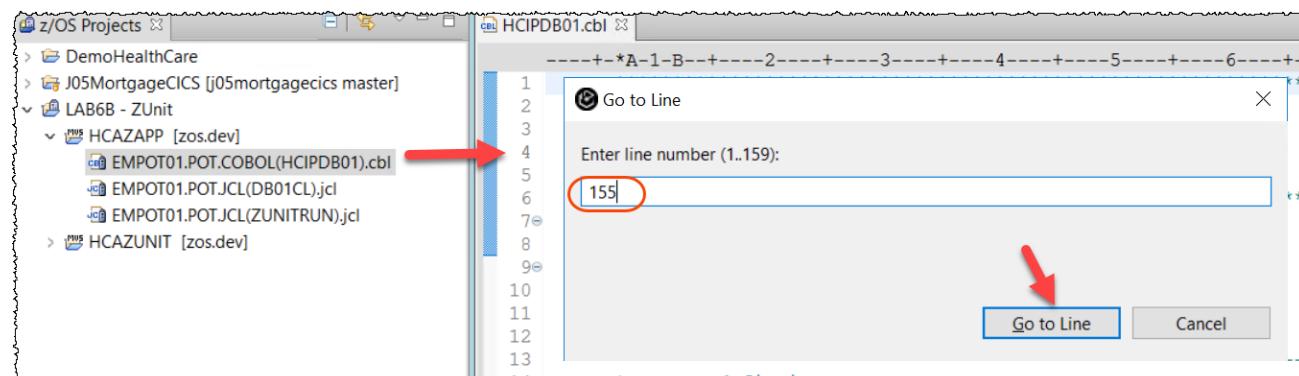
4.2.10 From this report we can see that the test cases created for this program are not sufficient ..  
The developer could go back to the test cases editor (step 3.2.19 above) and manually add test cases that cover other paragraphs. Due the lack of time we will not cover that here, but if you have extra time you can try it. Ask the instructor for guidance.

## Section 5. Introduce a bug in the program and rerun the unit test.

Using IDz you will modify the program and introduce a bug. Then you will rerun the unit test created in the previous section.

### 5.1 Modifying the program and introduce a bug

- 5.1.1 ► On IDz, close all active windows by pressing **Ctrl+Shift+F4**
- Open **EMPOT01.POT.COBOL (HCIPDB01).cbl** by double clicking on it in the z/OS Projects view.
- 5.1.2 ► On the editor, go to line 155 by pressing **Ctrl+L** and entering **155** and clicking **Go to Line**.



- 5.1.3 ► Change the line 155 removing the \* from the statement that moves “BAD NAME”,  
► Press **Ctrl+S** to save the changes.

```

-----+*A-1-B---+---2---+---3---+---4---+---5---+---6---+---7---+---8
138      FROM PATIENT
139      WHERE PATIENTID = :DB2-PATIENT-ID
140      END-EXEC.
141      Evaluate SQLCODE
142      When 0
143          MOVE '00' TO CA-RETURN-CODE
144      When 100
145          MOVE '01' TO CA-RETURN-CODE
146      When -913
147          MOVE '01' TO CA-RETURN-CODE
148      When Other
149          MOVE '90' TO CA-RETURN-CODE
150          PERFORM WRITE-ERROR-MESSAGE
151          EXEC CICS RETURN END-EXEC
152      END-Evaluate.
153      * %bug -- the line below will introduce a BUG
154      *
155      MOVE "BAD NAME" to CA-FIRST-NAME
156      *
157      EXIT.
158      *

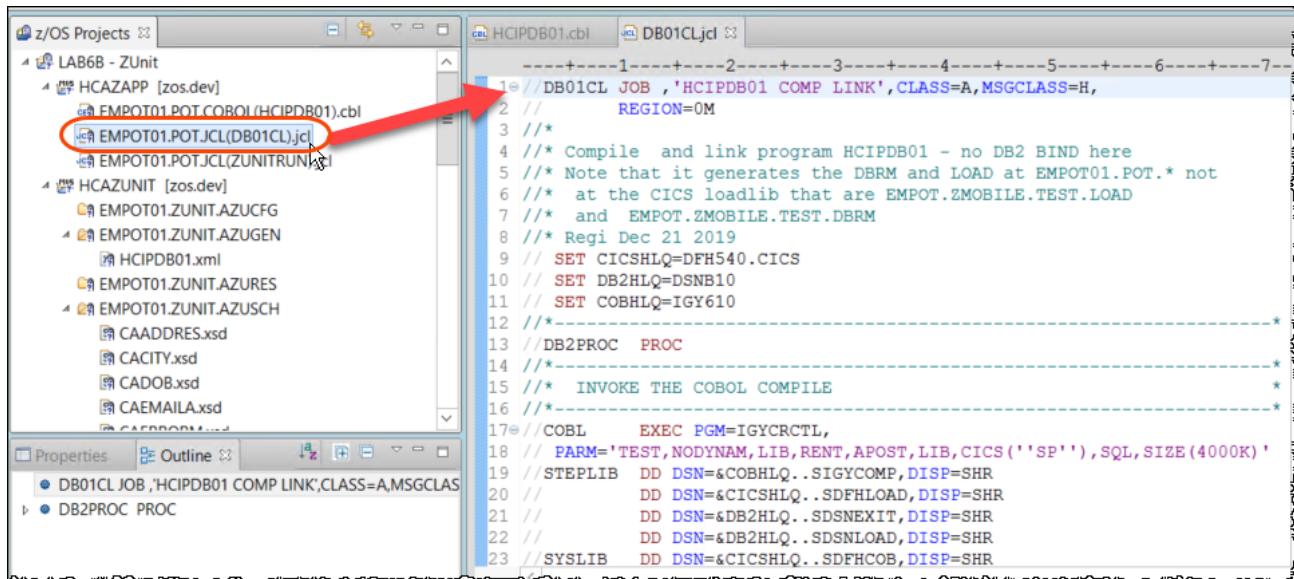
```

## 5.2 Rebuilding the changed program without deploying to CICS

### 5.2.1 ► On the z/OS Projects view, double click **EMPOT01.POT.JCL (DB01CL).jcl**, to edit .

This JCL will compile and link the changed COBOL program *HCIPDB01* using a working PDS to store the load module.

Notice that DB2 bind is not necessary since DB2 SQL calls will be intercepted when running the generated zUnit test cases.



```

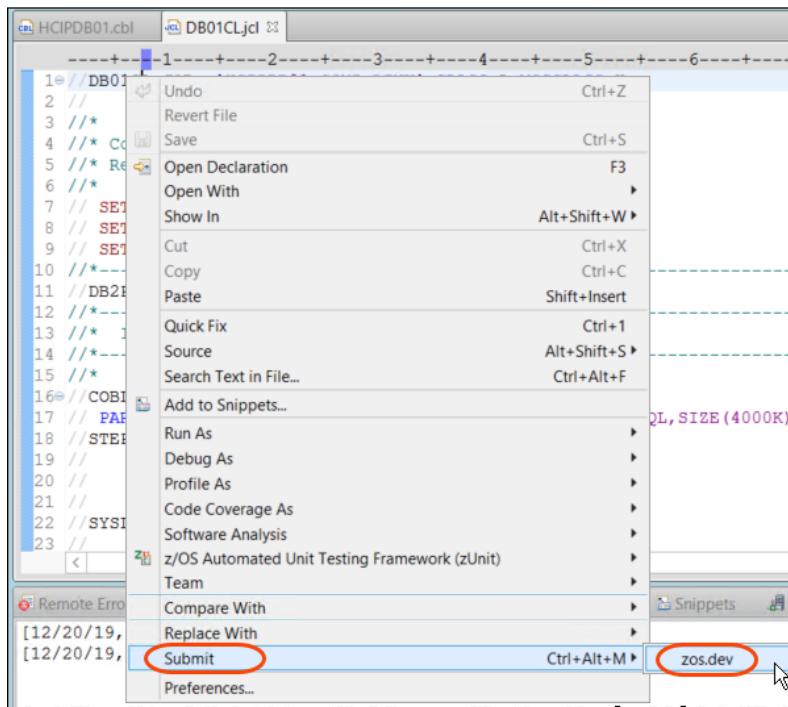
z/OS Projects : LAB6B - ZUNIT
  HCAZAPP [zos.dev]
    EMPOT01.POT.COBOL(HCIPDB01.cbl)
      EMPOT01.POT.JCL(DB01CL.jcl) (highlighted with a red circle)
      EMPOT01.POT.JCL(ZUNITRUNK) &1
  HCAZUNIT [zos.dev]
    EMPOT01.ZUNIT.AZUCFG
    EMPOT01.ZUNIT.AZUGEN
    HCIPDB01.xml
    EMPOT01.ZUNIT.AZURES
  EMPOT01.ZUNIT.AZUSCH
    CAADDRES.xsd
    CACITY.xsd
    CADOB.xsd
    CAEMAILA.xsd
    CAEMAILX.xsd

Properties : Outline
  DB01CL JOB , 'HCIPDB01 COMP LINK', CLASS=A, MSGCLAS
  DB2PROC PROC

HCIPDB01.cbl : DB01CL.jcl
1 //DB01CL JOB , 'HCIPDB01 COMP LINK', CLASS=A, MSGCLAS=H,
2 // REGION=0M
3 /**
4 //** Compile and link program HCIPDB01 - no DB2 BIND here
5 //** Note that it generates the DBRM and LOAD at EMPOT1.POT.* not
6 //** at the CICS loadlib that are EMPOT.ZMOBILE.TEST.LOAD
7 //** and EMPOT.ZMOBILE.TEST.DBRM
8 //** Regi Dec 21 2019
9 // SET CICSHLQ=DFH540.CICS
10 // SET DB2HLQ=DSNB10
11 // SET COBHLQ=IGY610
12 /**
13 //DB2PROC PROC
14 /**
15 /**
16 /**
17 //COBL EXEC PGM=IGYCRCTL,
18 // PARM='TEST,NODYNAM,LIB,RENT,APOST,LIB,CICS(''SP''),SQL,SIZE(4000K)'
19 //STEPLIB DD DSN=&COBHLQ..SIGYCOMP,DISP=SHR
20 // DD DSN=&CICSHLQ..SDFHLOAD,DISP=SHR
21 // DD DSN=&DB2HLQ..SDSNEXIT,DISP=SHR
22 // DD DSN=&DB2HLQ..SDSNLOAD,DISP=SHR
23 //SYSLIB DD DSN=&CICSHLQ..SDFHCOB,DISP=SHR

```

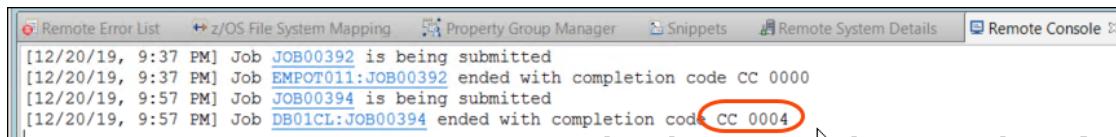
### 5.2.2 ► Right click and select submit > zos.dev to submit this job for execution



5.2.3 ➡ Click **Notify** on the Job Submission Confirmation dialog.

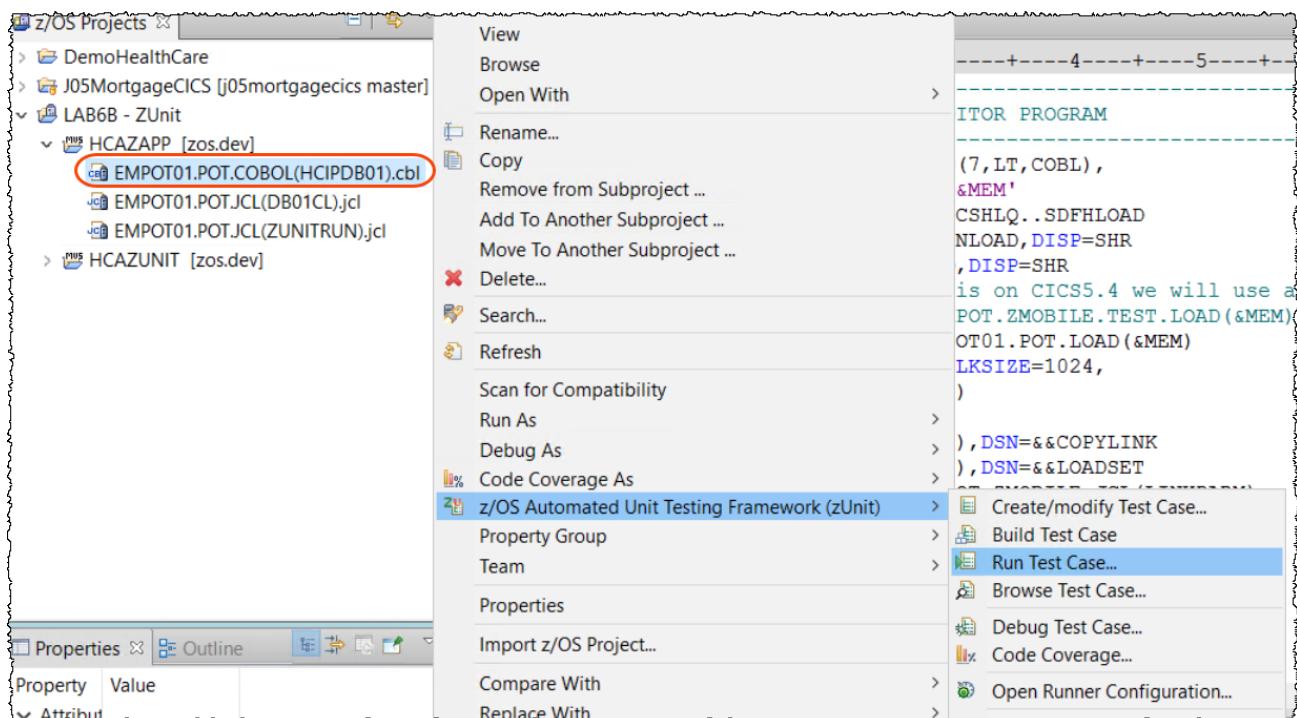


Make sure the job completes with completion code of 4.

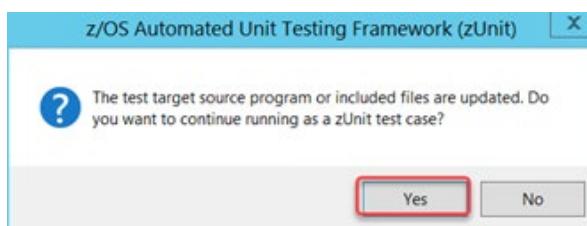


## 5.3 Rerunning the test case

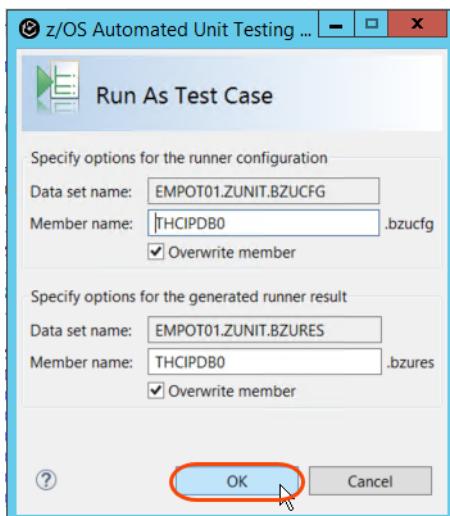
5.3.1 ➡ On the z/OS Projects view, select **EMPOT01.POT.COBOL(HCIPDB01).cbl**, right mouse click, and select the **z/OS Automated Unit Testing Framework (zUnit)->Run Test Case..** action.



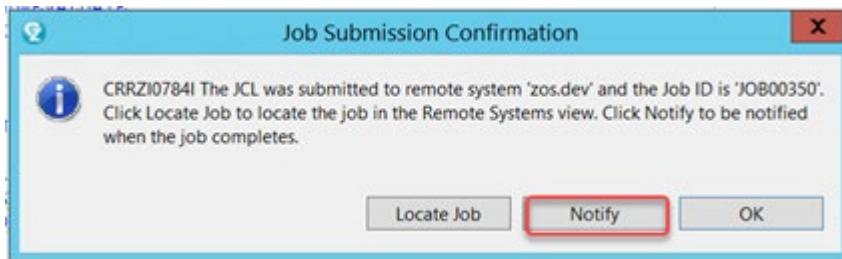
5.3.2 ➡ Click **Yes** to the following dialog to continue running the test case.



5.3.3 ► Click **OK** to the **Run As Test Case** dialog.



5.3.4 ► Click **Notify** on the Job Submission Confirmation dialog.

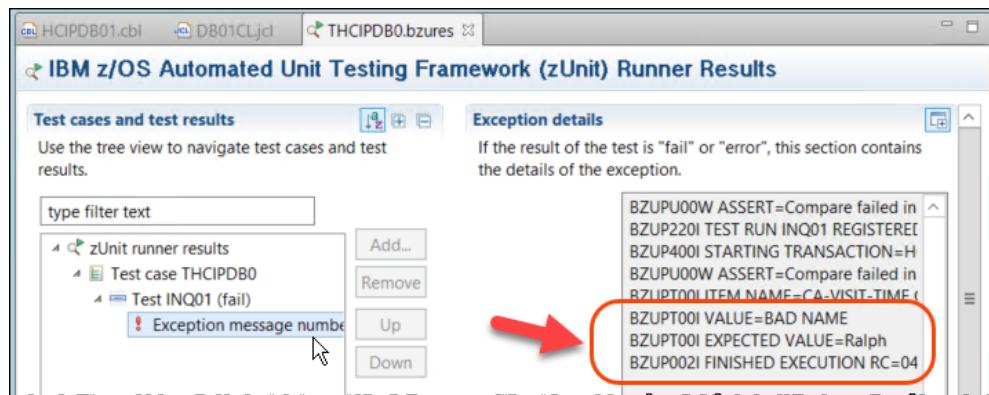


5.3.5 When the test run completes, the test results will be displayed, and it showed 1 test was ran and it failed.

► Click **Test case THCIPDB0**. The failure is expected because the expected value of the error message is different from the actual value.

Test case ID	e30e513c-140b-4176-b4f1-0b497de49f44
Module name	THCIPDB0
Test case name	THCIPDB0
Result	fail
Test count	1
Tests passed	0
Tests failed	1
Tests with errors	0
Tests with severe errors	0

5.3.6 ►| Expand **Test case THCIPDB0, Test INQ01 (fail)** and click **Exception message number** to verify the value received versus the expected value and verify the failure



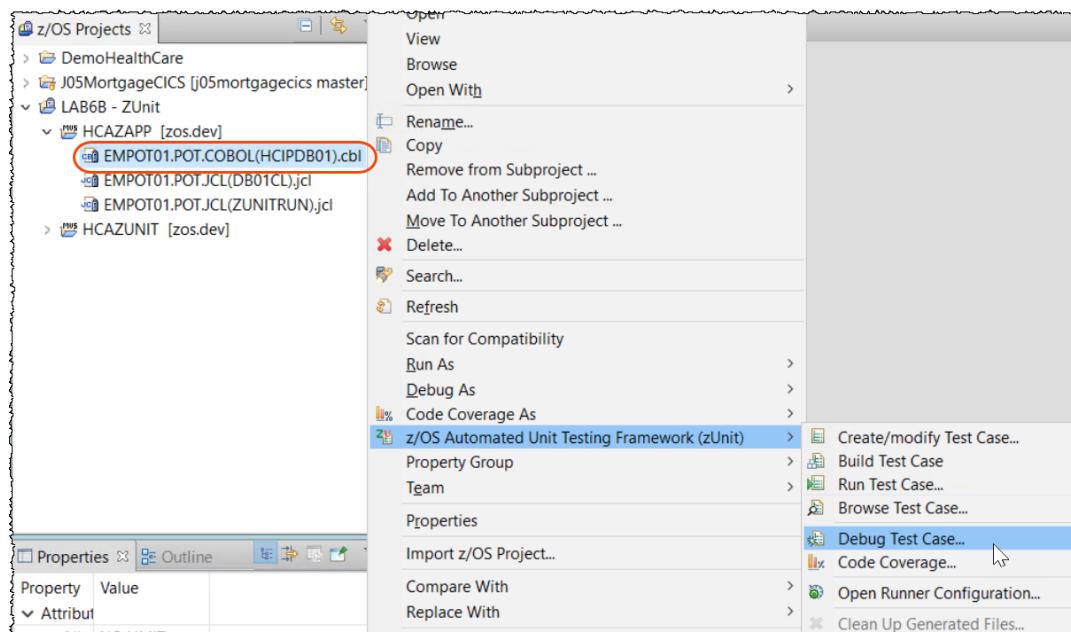
## 5.4 Running zUnit test case with debugging

The Debug dialog will debug the test case. Note that will debug the zUnit programs, the generated COBOL and also the COBOL program that you are testing. Below one example.

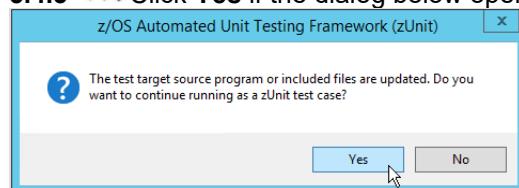
**Notice that you are debugging a batch job without need to have CICS and DB2 active, what is very handy.**

5.4.1 ►| Close all active windows by pressing **Ctrl+Shift+F4**

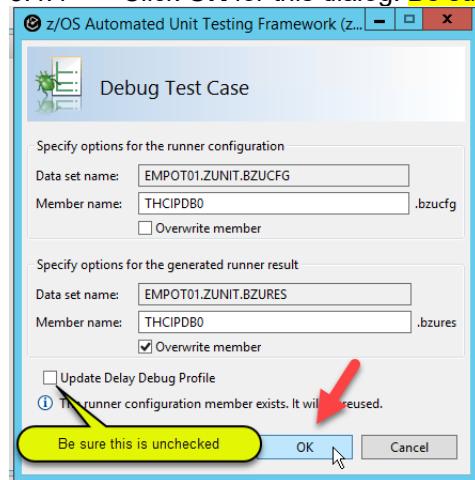
5.4.2 ►| Right click on **EMPOT01.POT.COBOL(HCIPDB01).cbl** and select **z/OS Automated Unit Testing Framework (zUnit) > Debug Test Case...**



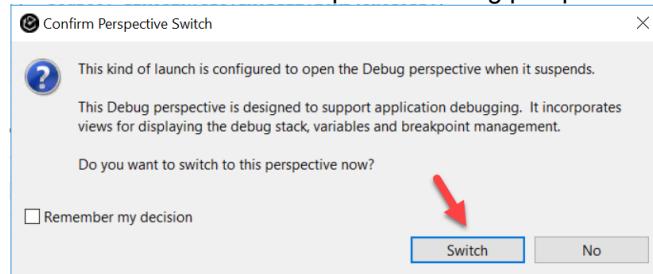
5.4.3 ►| Click **Yes** if the dialog below opens



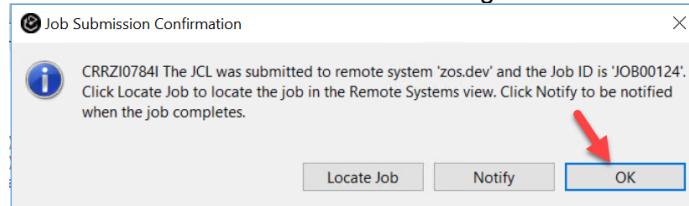
5.4.4 ► Click OK for this dialog. Be sure that Update Delay Debug Profile is un-checked.



5.4.5 ► Click Switch to open the debug perspective.

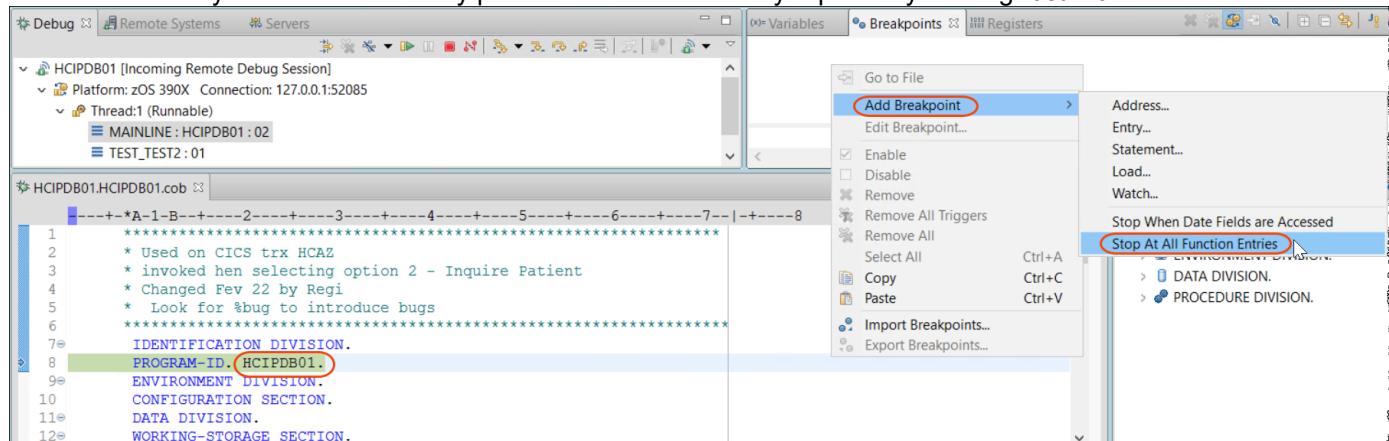


5.4.6 ► Click OK to dismiss this dialog

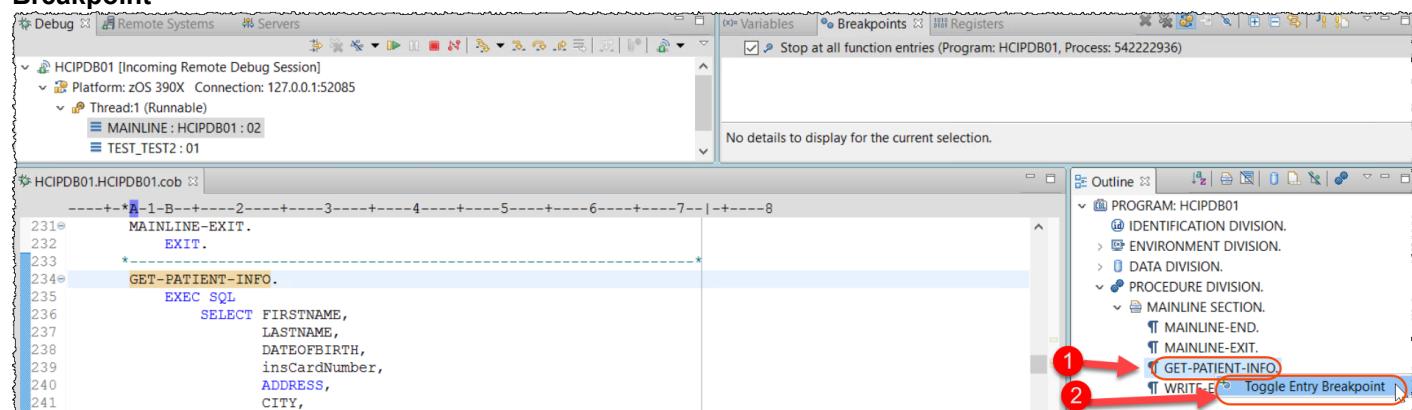


5.4.7 Notice that the first program being debugged is the program that you introduced the bug. (**Hcipdb01**)  
The execution is stopped BEFORE that program starts. You can add some breakpoints before running.

► Using the Breakpoints view, right click and select **Add Breakpoints > Stop At All Functions Entries**. This would allow you to reach the entry point of the source files by repeatedly clicking resume.



**5.4.8 ► Using the Outline view to navigate to **GET-PATIENT-INFO** and right click and select **Toggle Entry Breakpoint****



**5.4.9 A breakpoint is created on the **EXEC SQL SELECT** statement. When the program runs it will stop there.**

```

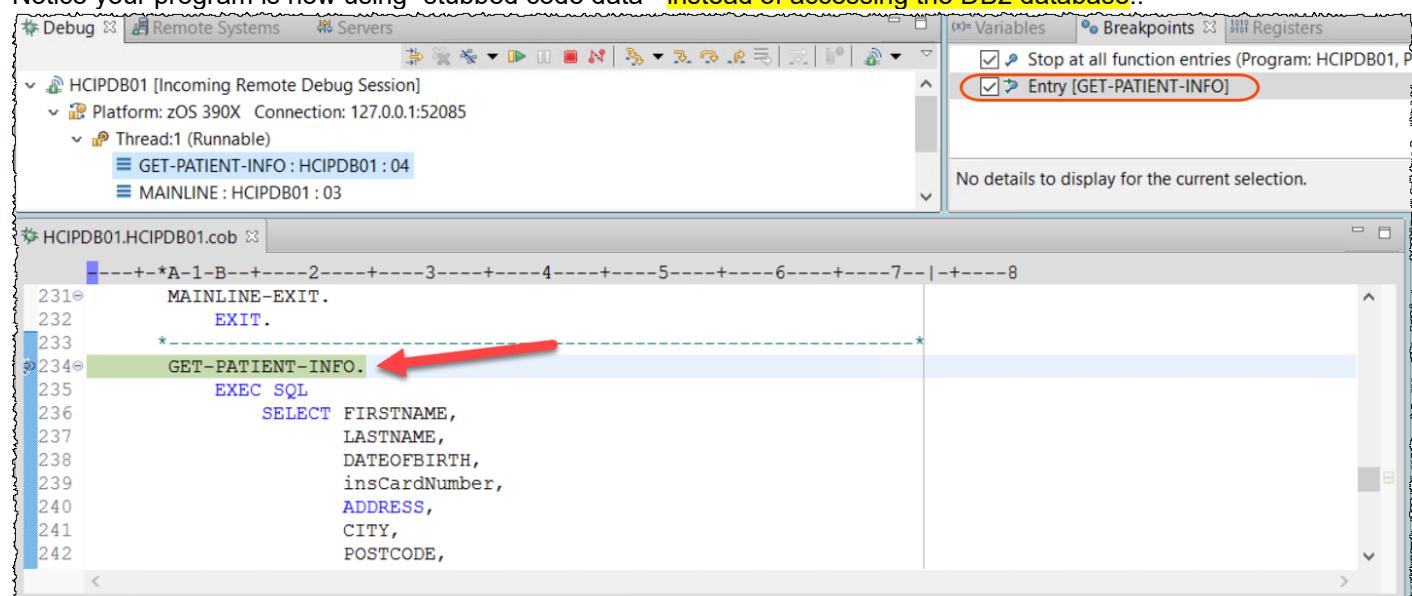
Hcipdb01.Hcipdb01.cob
-----+*A-1-B-----2-----3-----4-----+
231* MAINLINE-EXIT.
232   EXIT.
233 *
234* GET-PATIENT-INFO.
235   EXEC SQL
236     SELECT FIRSTNAME,
237       LASTNAME,
238       DATEOFBIRTH,
239       insCardNumber,
240       ADDRESS,
241       CITY,
242

```

**5.4.10 ► Click on icon ➤ or press F8 to resume. the execution**



**5.4.11 The execution will halt at the **SQL SELECT** statement due the breakpoint you added.  
Notice your program is now using “stubbed code data” instead of accessing the DB2 database..**



5.4.12 ► Click on icon or press F5 to Step Into the code until you find the statement below.

► Move the mouse to : DB2-PATIENT-ID and see its contents

Again, notice that we get DB2 data without going to the database, but using the stub recorded earlier (Play Back file).

```

-----+*A-1-B---2---+---3---+---4---+---5---+---6---+---7---|+---8
      FROM PATIENT
      WHERE PATIENTID = :DB2-PATIENT-ID
      END-EXEC.
Evaluate SQLCODE
When 0
  MOVE '00' TO CA-RET
When 100
  MOVE '01' TO CA-RET
When -913
  MOVE '01' TO CA-RET
When Other
  MOVE '90' TO CA-RET

```

5.4.13 ► Keep clicking on icon or press F5 to Step Into the code until you see the bug that you had introduced.

► You also can see the BUG that you introduced. Move the mouse to CA-FIRST-NAME to see the field content (**Ralph**), which will be replaced by "**BAD NAME**".

```

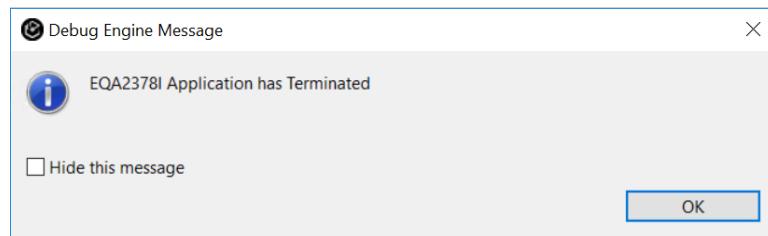
-----+*A-1-B---2---+---3---+---4---+---5---+---6---+---7---|+---8
      END-Evaluate.
      * %bug -- the line below will introduce a BUG
      *
      MOVE "BAD NAME" to CA-FIRST-NAME
      *
      EXIT.
      *
      *COPY HCERRSPD.
      *
      *=====
      * Procedure to write error m
      *   message will include Dat
      *   Medication Id and SQLCOD

```

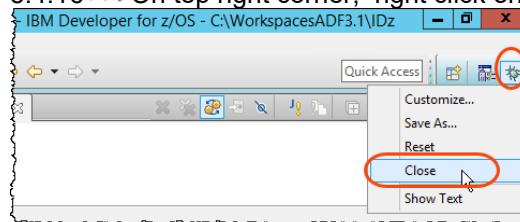
5.4.14 ► Click on icon or press **F8** to resume.. Or if you prefer keep clicking on *Step Into*.



5.4.15 ► You will see that the debug ends when you have the dialog below. Click **OK**



5.4.16 ► On top right corner, right click on icon and select **Close** to close the debug perspective



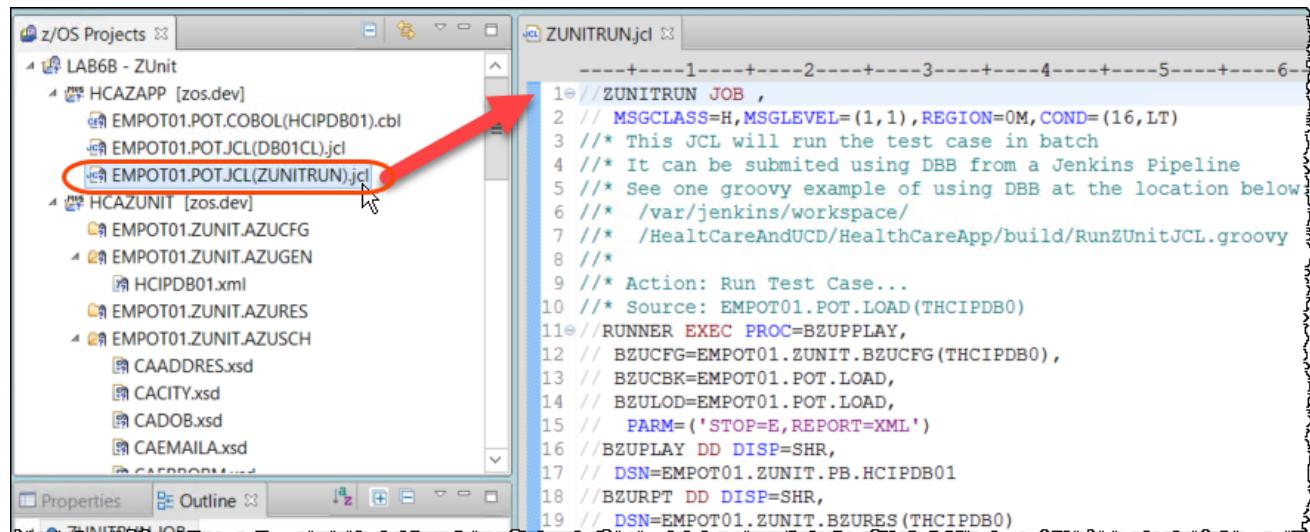
## Section 6. Run the unit test from a batch JCL.

Once a test case has been generated and built, it can be executed using a batch run via JCL. This would enable it to be ran as part of an automated process or pipeline..

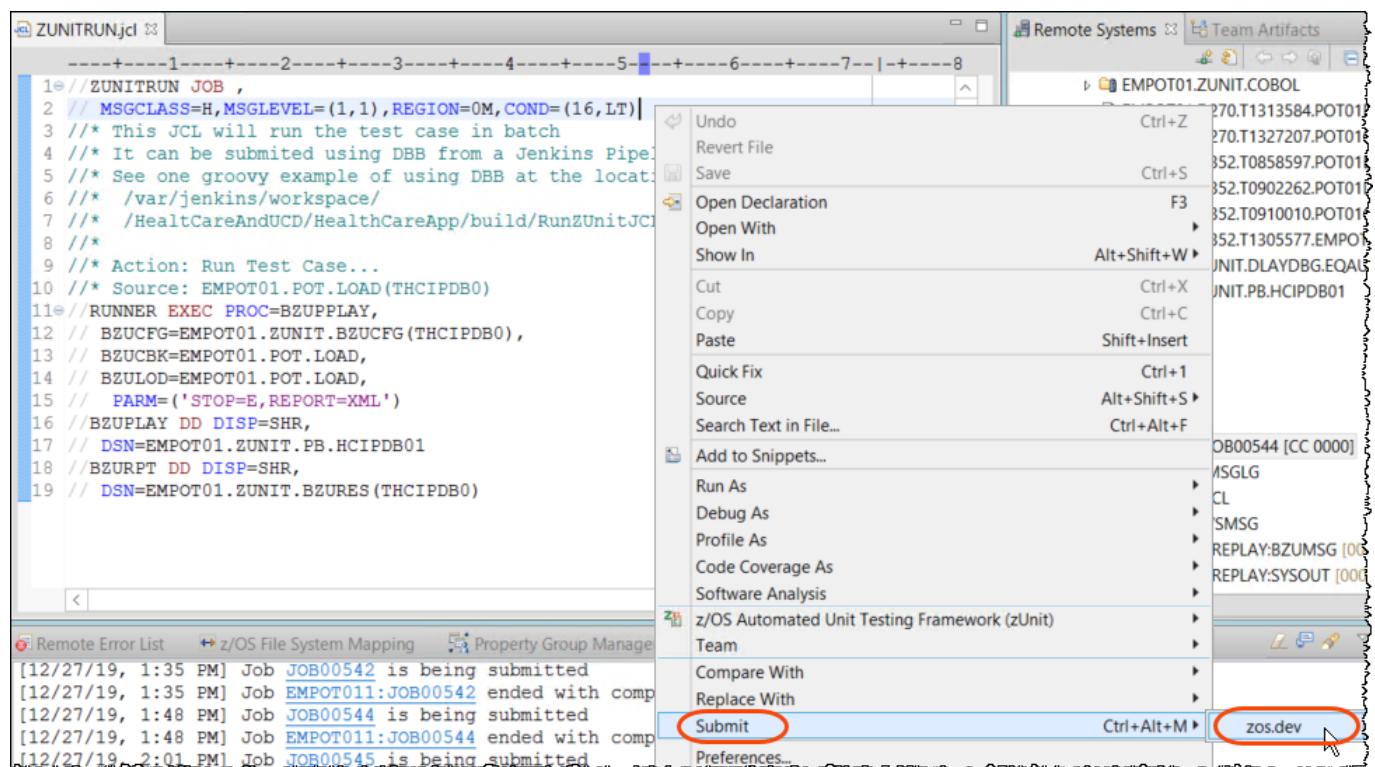
### 6.1 Running the unit test from a batch JCL

6.1.1 ► Close any active windows by pressing **Ctrl+Shift+F4**.

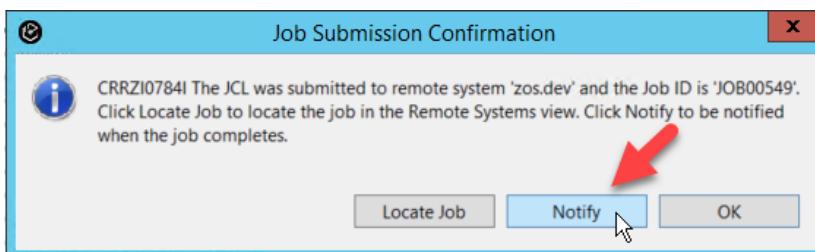
6.1.2 ► On the IDz z/OS Projects view, double click **EMPOT01.POT.JCL(ZUNITRUN).jcl** to open it. This JCL will run the test case that you created using a batch job.



6.1.3 ► Right click the editor and select **Submit > zos.dev**.

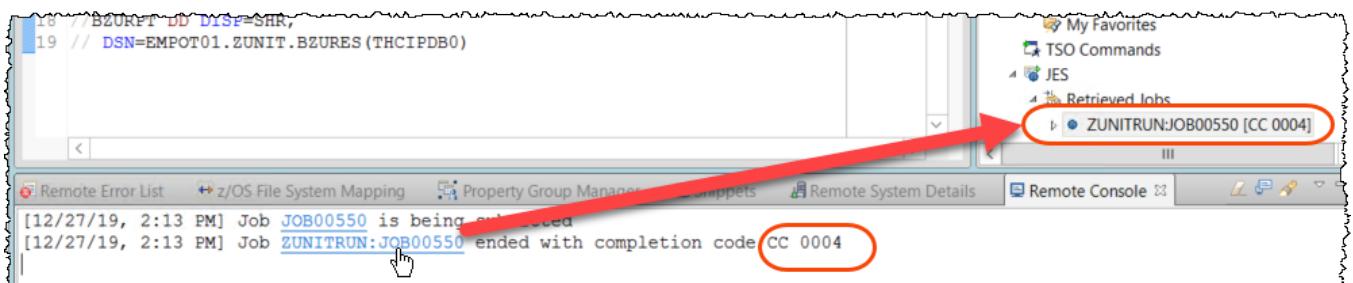


6.1.4 ► Click **Notify** on the Job Submission Confirmation dialog.



6.1.5 You MUST have **004** as return code.

► Click on **ZUNITRUN:JOB00xxx**



6.1.6 ► Expand **ZUNITRUN:JOB00xxx** and verify the results double clicking on **RUNNER:REPLAY:SYSOUT**.

The screenshot shows the Rational Developer for z/OS interface. On the right, the 'Remote Systems' view displays a tree structure under 'JES'. The 'Retrieved Jobs' section contains a job named 'ZUNITRUN:JOB00183 [CC 0004]'. Under this job, several output files are listed, with 'RUNNER:REPLAY:SYSOUT' circled in red. On the left, the 'Team Artifacts' view shows the contents of this file, displaying test log output. Another red arrow points from the 'RUNNER:REPLAY:SYSOUT' entry in the tree to the corresponding log output in the artifact view.

```

1 TEST_INQ01 STARTED...
2 CALL HCIPDB01
3 DB2_INPT ...
4 DB2_OUTP ...
5 CICS_OE08_HCIPDB01 CHECK VALUES...
6 EXEC CICS RETURN X'0000' L=00227
7 AREA ALLOCATED FOR RECORD COUNT:00000048
8 CICS_OE08_HCIPDB01 SUCCESSFUL.
9 ****
10 AZU2001W THE TEST "INQ01" FAILED DUE TO AN ASSERTION.
11 AZU1101I COMPARE FAILED IN PROCEDURE DIVISION.
12 DATA ITEM NAME : CA-FIRST-NAME OF CA-PATIENT-REQUEST OF DFHCOMMAREA
13 VALUE : BAD NAME
14 EXPECTED VALUE: Ralph
15 ****
16 TEST_INQ01 SUCCESSFUL.
17

```

6.1.7 This JCL could be executed using DBB and part of a Jenkins Pipeline.  
You may see an example of a groovy script used by DBB at the USS file below:  
/var/jenkins/workspace/HealtCareAndUCD/HealthCareApp/build/ RunZUnitJCL.groovy

► Under **zos.dev** and **z/OS UNIX Files** look for filter **groovy\_samples**

The screenshot shows the Rational Developer for z/OS interface. On the right, the 'Remote Systems' view displays a tree structure under 'zos.dev'. It shows 'z/OS UNIX Files' containing a 'groovy\_samples' directory. Inside 'groovy\_samples', there is a file named 'RunZUnitJCL.groovy'. Another 'RunZUnitJCL.groovy' file is located directly under 'z/OS UNIX Files'. On the left, the 'Team Artifacts' view shows the contents of the 'RunZUnitJCL.groovy' file from 'z/OS UNIX Files', which is a Groovy script for running zUnit tests.

```

import com.ibm.dbb.build.CopyToHFS
import com.ibm.dbb.build.DBBConstants
import com.ibm.dbb.build.JCLEExec
//*****
5 * Changed Dec 27, 2019 by Regi
6 * The following sample shows how to use JCLExec API to execute a ZUnit and
7 * display the results in the console.
8 * This sample assumes that user has setup the ZUnit and a JCL to execute the
9 * ZUnit.
10 * This sample requires:
11 *   1. The data set contains the JCL.
12 *   2. The data set contains the output of the Zunit result.
13 * Sample output:
14 *   Running ZUnit in JCL 'IBMUSER.ZUNIT.JCL(ZUNIDB01)'
15 *   The JCL Job completed with Max-RC CC 0004
16 * **** Module [J05CMORT] ****
17 * zUnit Test Runner 2.0.0.1 started at 2019-11-06T13:57:22.885...
18 * Test count: 1
19 * Tests passed: 1
20 * Tests failed: 0
21 * Tests in error: 0
22 *
23 ****
24
25/* DBB_CONF must be set for running JCLExec */
26/* def confDir = System.getenv("DBB_CONF") */
27/* added by regi - was above statement only before */
28def confDir = "/var/dbb/1.0.7/conf"
29
30/* The data set contains the Zunit JCL */
31/* For example: IBMUSER.ZUNIT.JCL */
32def jcldataset = "IBMUSER.ZUNIT.JCL"

```

Notice that this capability allows to invoke zUnit using pipelines like Jenkins.

**Congratulations!** You have completed the Lab.

---

## LAB 6C – (OPTIONAL) Using IBM zUnit to Unit Test a COBOL CICS/DB2 application using Local assets (60 minutes)

Updated March 26, 2021 by Regi –(reviewed by Wilbert Kho)

This lab will take you through the steps of using the automated unit testing ([zUnit](#)) capabilities of [IBM Developer for z](#) (IDz) to create a unit test case for a COBOL CICS/DB2 program. This enables the testing of just a single program within a CICS transaction without the need to run the whole transaction. This is done by stubbing out CICS calls, enabling the program to be tested without a CICS environment and without the need to deploy to CICS after a code change. This enables a developer to test early without impacting other developers that share the same CICS environment.

In this lab you will record interaction with a COBOL CICS/DB2 program (program under test) and import the recorded data into the unit test case generation process. You will build and run the unit test, make a change to the CICS COBOL program, and rerun the unit test.

The main difference between this lab and the LAB 6B is that here we will use local projects on IDz and IBM DBB (Dependency Based Build) instead of JCL to compile the COBOL programs.

### Overview of development tasks

To complete this tutorial, you will perform the following tasks:

1. **Get familiar with the application using the 3270 terminal**  
→ You will start a 3270 emulation and execute a transaction named **HCAZ** to become familiar with the Application that you will be recording.
2. **Record interaction with the application.**  
→ You will record an interaction with the COBOL CICS/DB2 program.
3. **Generate, build and run the unit test**  
→ You will compile and link-edit the generated unit test program, followed by running the unit test.
4. **Introduce a bug in the program and rerun the unit test**  
→ You will modify the program under test, rerun the unit test, and observe the failure of the test case.
5. **Run the unit test from a batch JCL .**  
→ You will run the unit test from a Batch JCL and observe a similar test case result.

## Section 1. Get familiar with the application using the 3270 terminal

You will start a 3270 emulation and execute a transaction named **HCAZ** to become familiar with the Application that you will be interacting with.

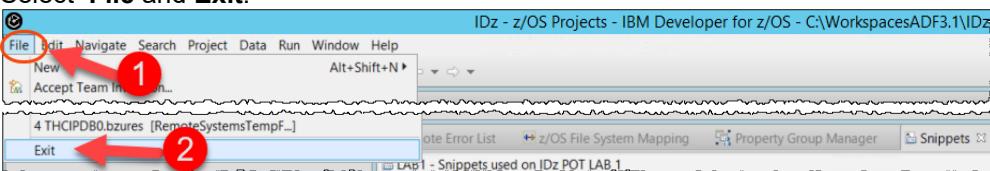
### 1.1 Connect to z/OS and emulate a CICS 3270 terminal

You will use IDz to emulate a 3270 terminal to run the CICS transaction.

1.1.0 This Lab will use **IDz Version 15**, on the previous labs you probably have used the IDz Version 14. Before you start this version, you must close IDz version 14.

► If IDz version 14 used on other labs is running, you must close it:

Select **File and Exit**.



1.1.1 Start *IBM Developer for z Systems version 15*

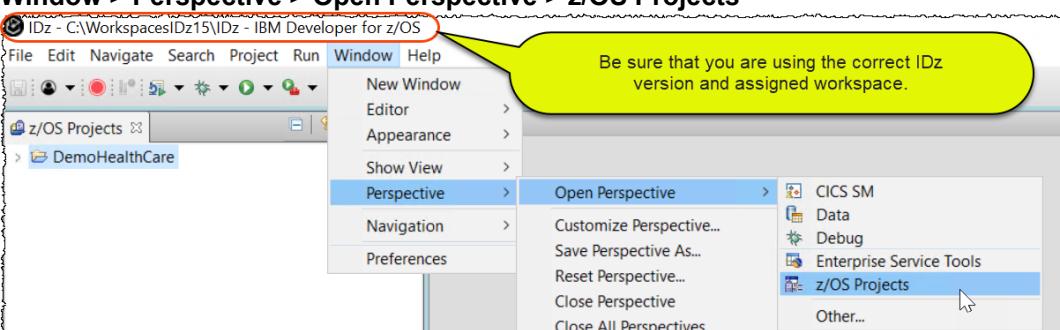
► Using the desktop double click on **IDz V15** icon.

► Verify that the message indicates that it is Version **15.0.1**

**IMPORTANT** -> This icon will start an eclipse workspace that has already some definitions required for this lab. PLEASE DO NOT start IDz using other way than this icon.



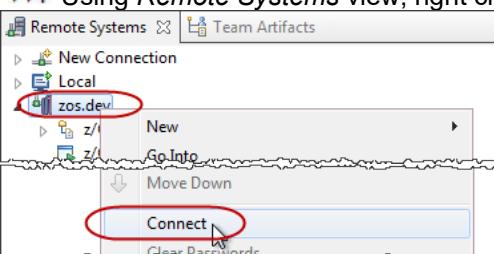
1.1.2 ► Open the **z/OS Projects** perspective by selecting **Window > Perspective > Open Perspective > z/OS Projects**



1.1.3 On this lab you will use userid **ibmuser**.

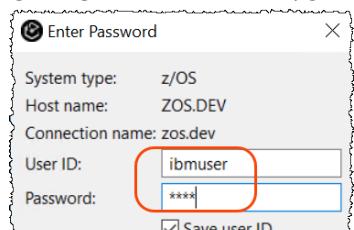
If you are connected as **ibmuser**, jump to step 1.1.5 Otherwise.

► Using **Remote Systems** view, right click on **zos.dev** and select **Connect**

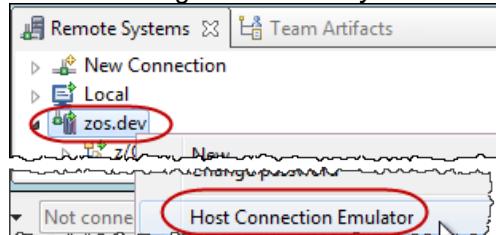


1.1.4 ► Type **ibmuser** as userid and **sys1** as password.

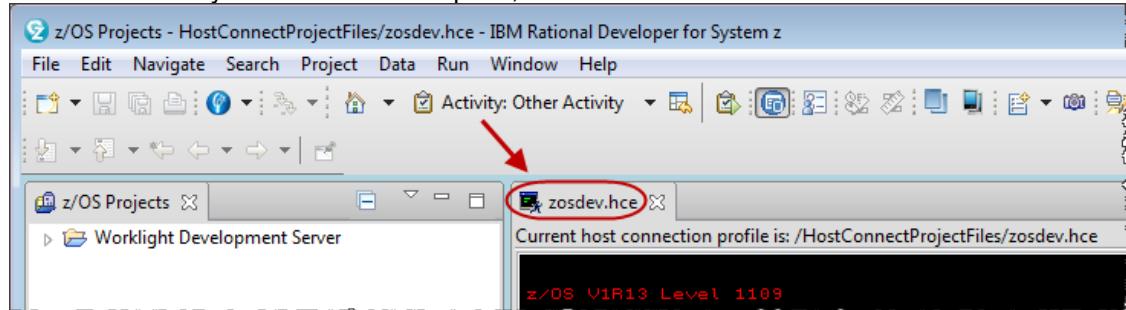
The userid and password can be any case; don't worry about having it in UPPER case.  
Click **OK** to connect to z/OS.



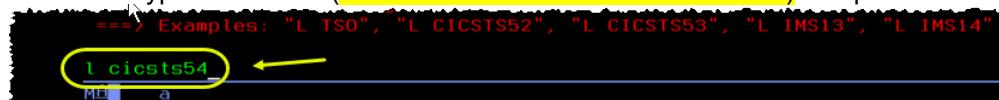
1.1.5 ► Using the **Remote Systems** view, right click on **zos.dev** and select **Host Connection Emulator**.



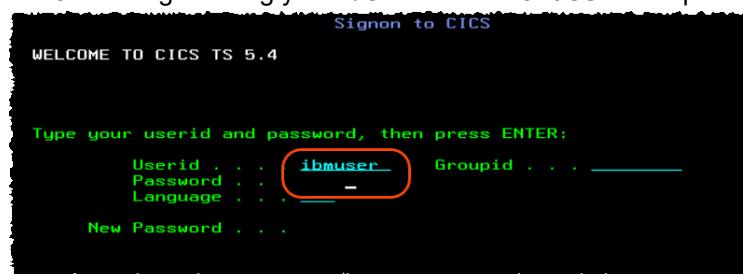
1.1.6 ► Since you will need more space, **double-click** on the **zos.dev.hce** title



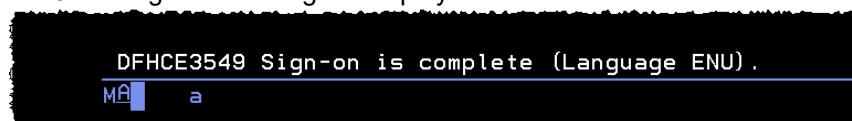
1.1.7 ► Type **I cicsts54**. (where "I" is the lower case of letter "L") and press **Enter** key.



1.1.8 ► Logon using your z/OS user id **ibmuser** and password **sys1** and press **Enter**.



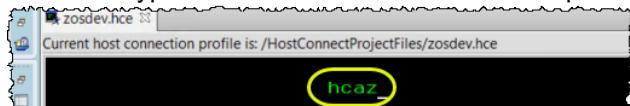
1.1.9 The sign-on message is displayed



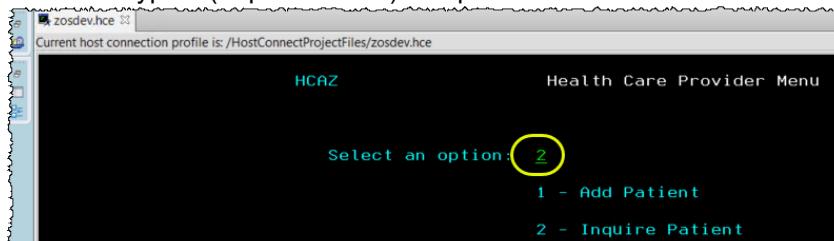
## 1.2 Run CICS transaction HCAZ

You should now be in the z/OS CICS region named *CICSTS54*. This is the CICS instance where you will make the recording of your interaction.

- 1.2.1 ► Type the CICS transaction **hcaz** and press the **Enter** key.



- 1.2.2 ► Type **2** (Inquire Patient) and press **Enter**.



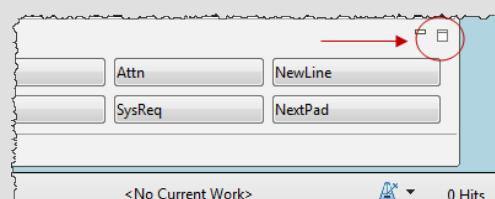
- 1.2.3 ► Type **1** for Patient ID and press Enter. The program will read the patient from a DB2 table and display the customer details. Remember the patient first name: **Ralph**



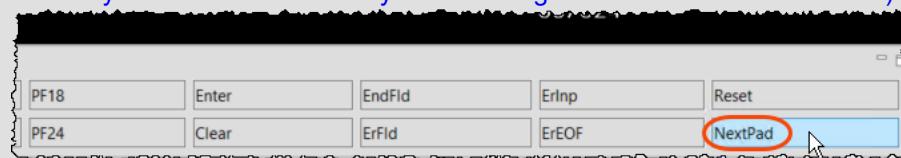
### IF you need to use functions like Clear or Reset

If you need to use the *clear* function use the key **Esc**.

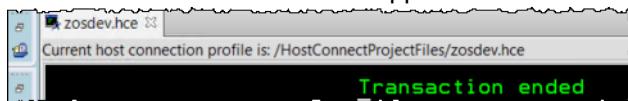
Also you may look in the right lower corner, select this icon . This will display possible keys, including the clear button.



You may also use the Reset key after clicking NextPad

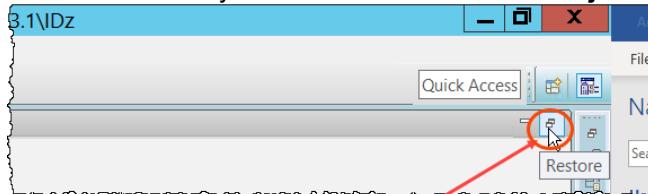


1.2.4 ► Press **F3** to end the application.



1.2.5 ► Close the terminal emulation clicking on → . Or pressing **CTRL + Shift + F4**.

1.2.6 ► You may need to restore the **z/OS Projects** perspective by clicking on the icon on top right:



#### What have you done so far?

You emulated a 3270 terminal using IBM Developer for System z.

You also executed the CICS transaction **HCAZ** and verified a simple interaction with the Health Care application. The objective here was to show the code that you will update.

## Section 2 – Record data interaction using the CICS application.

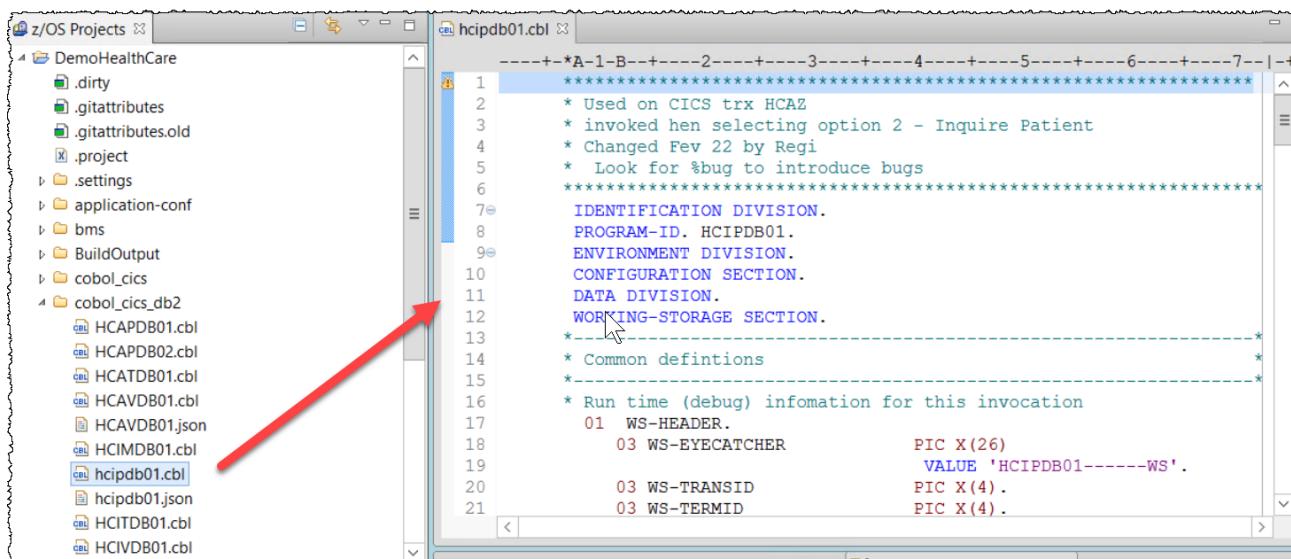
Using IDz you will record the interaction with the COBOL/DB2 program that reads a patient from a DB2 table.

### 2.1 Understanding the COBOL program that reads from DB2 table

The COBOL code that reads the patient from the DB2 tables is the program **HCIPDB01**

2.1.1 ► Using **z/OS Projects** view, expand **DemoHealthCare**  
double click on **hcipdb01.cbl** under **DemoHealthCare/cobol\_cics\_db2**.

This is the program that you will update later on. The name is lower case to make it easier to find it 😊 .



2.1.2 ► Using the Outline view on left expand **PROCEDURE DIVISION** and click on **GET-PATIENT-INFO**. This is where the patient data is read from the DB2 table. Later on you will introduce a bug in this program..

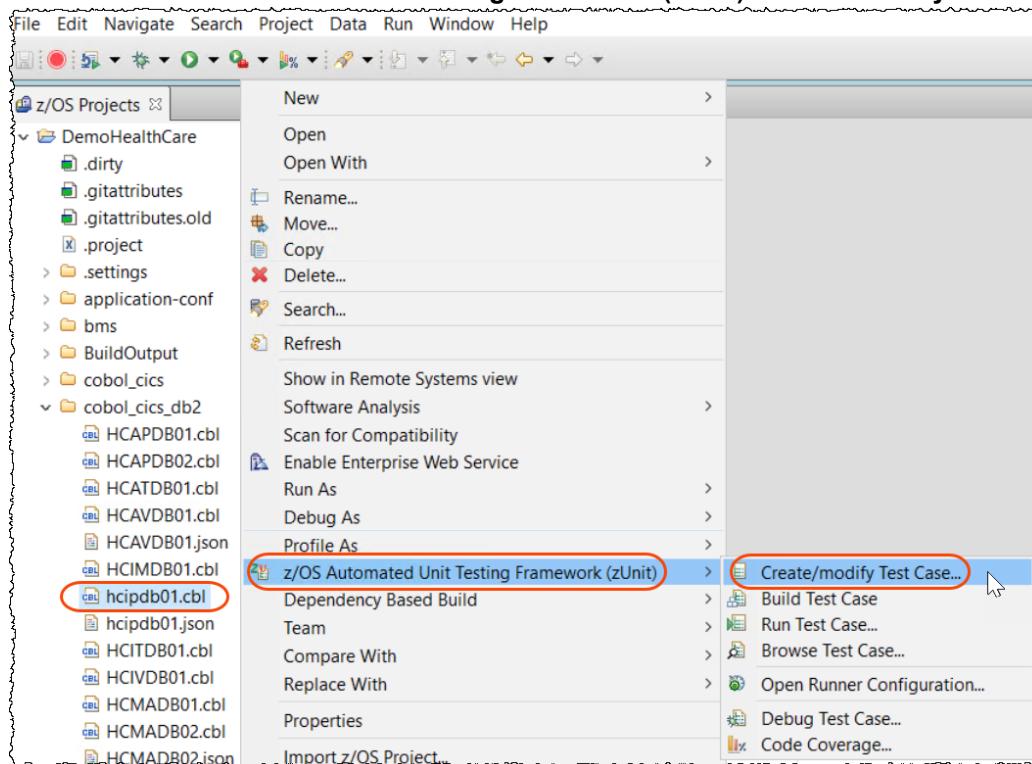
```

111          *-----+-----+-----+-----+
112          *-----+-----+-----+-----+
113          MAINLINE-END.
114          EXEC CICS RETURN END-EXEC.
115          MAINLINE-EXIT.
116          EXIT.
117          *-----+-----+-----+-----+
118          GET-PATIENT-INFO.
119          EXEC SQL
120          SELECT FIRSTNAME,
121          LASTNAME,
122          DATEOFBIRTH,
123          insCardNumber,
124          ADDRESS,
125          CITY,
126          POSTCODE,
127          PHONEMOBILE,
128          EMAILADDRESS,
129          USERNAME
130          INTO :CA-FIRST-NAME,
131          :CA-LAST-NAME,
132          :CA-DOB,
133

```

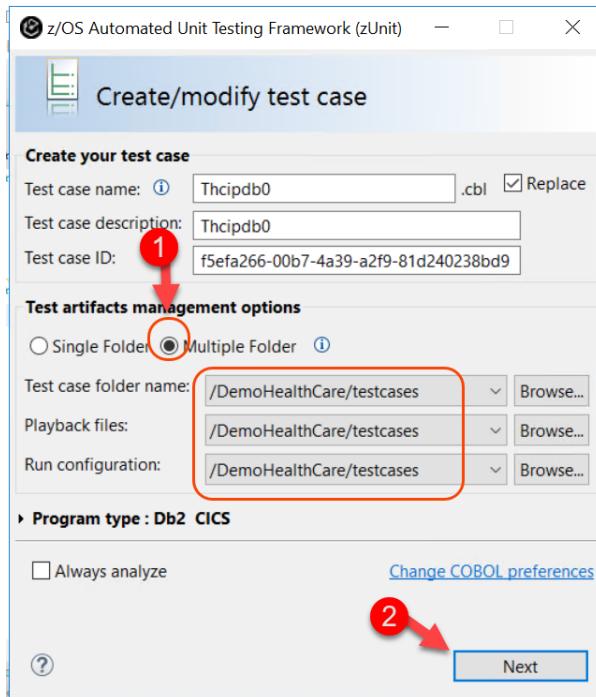
## 2.2 Recording the COBOL program that sends the message

2.2.1 ► To start the recording, right click on **hcipdb01.cbl** and select **z/OS Automated Unit Testing Framework (zUnit)>Create/modify Test Case..**



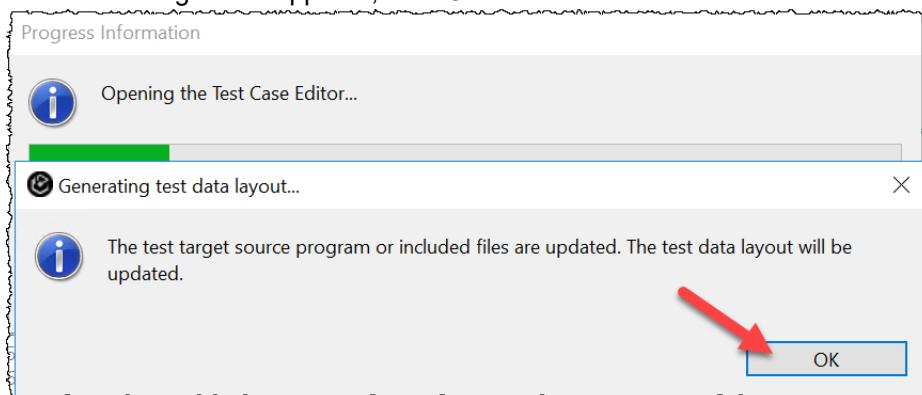
2.2.2 This opens a dialog where you can name your test case.

► Click on **Multiple Folder**, verify that the generated assets will be under **/DemoHealthCare/testcases** and click **Next**.

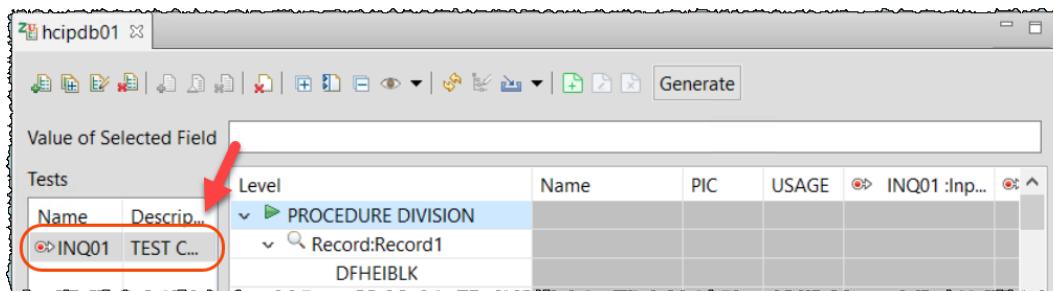


2.2.3 This operation will generate the test data layout on the local workspace.

► If the dialog below appears, click **OK**.

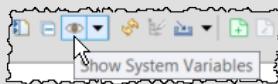


2.2.4 This will open the **Test Case Editor**, as shown below. **INQ01** may or may not be on your screen. If **INQ01** is there you will delete on next step.



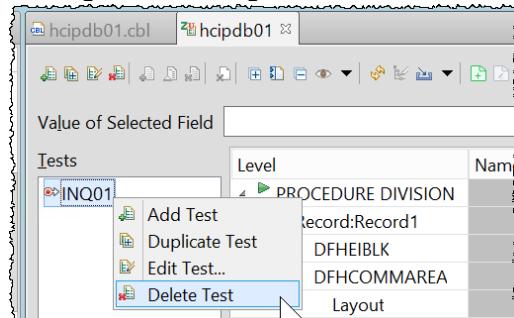
**Understanding the test case editor**

- The bottom left box summarizes all the input output variable structures – In this example, the program has a COMMAREA exchanged via the PROCEDURE DIVISION, five EXEC CICS statements and one EXEC SQL statement.
- The COMMAREA and the CICS statements are also accompanied by the CICS DFHEIBLK variables. To see those values you must select the icon



The variables that are returned by the program are the output from the program logic that a developer should be checking

2.2.5 ► Since we will be recording the test data, delete the INQ01 or any other entry (if it exists) by right clicking and selecting **Delete Test**



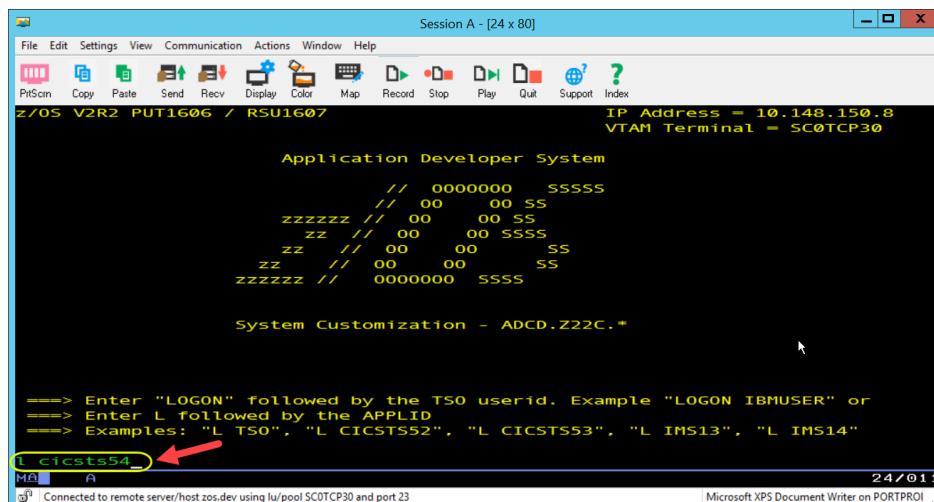
Notice that on section 1 we used the IDz emulator and now you will use the IBM PCOM emulator. Any 3270 emulator can be used.. We just show here a different way to emulate a 3270 terminal.

2.2.6 ► Bring up a 3270 terminal emulator clicking on the **host emulator icon** on the Windows task bar.



This opens the host emulator.

2.2.7 ► Type **I cicsts54**. (where I is L lower case) and press **Enter key** or the **right Ctrl key**.



2.2.8 ►| Sign on using **ibmuser** as the userid and **sys1** as the password.

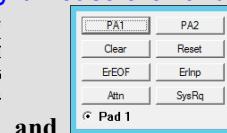
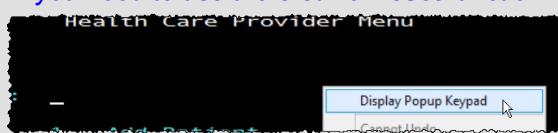


2.2.9 ►| Once you see the sign-on is complete message, enter **hcaz** and press the right **Ctrl** key.



**IF you need to use functions like Clear or Reset**

*If you need to use the clear or reset function right mouse click and select as below*

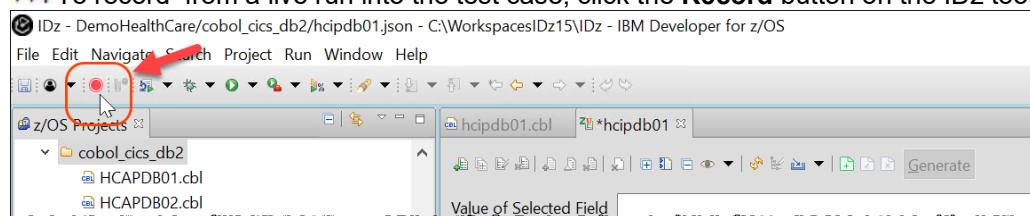


and

You are now ready to start recording and import data into the test case editor.

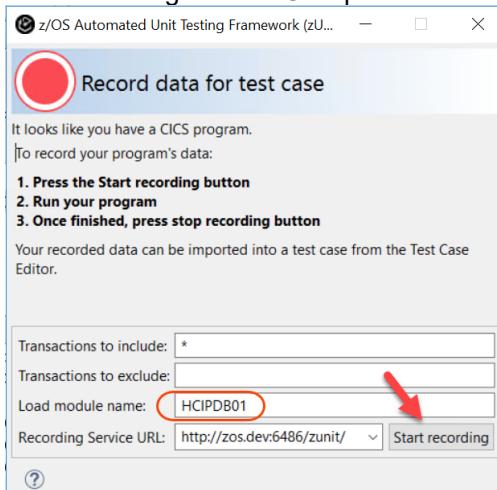
2.2.10 ►| Minimize the terminal emulator and go back to IDz dialog.

►| To record from a live run into the test case, click the **Record** button on the IDz toolbar.

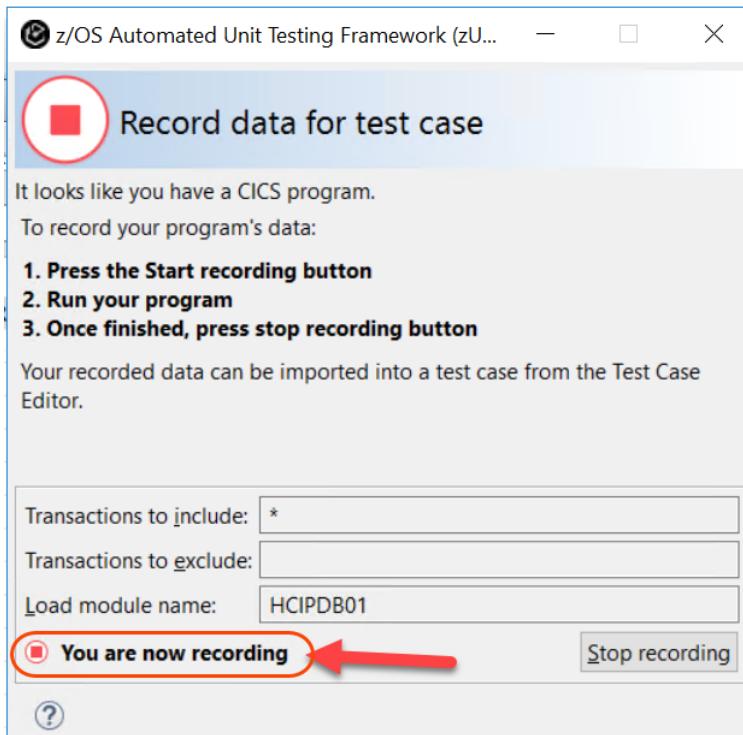


2.2.11 ►| In the dialog that comes up, click on **Start recording**.

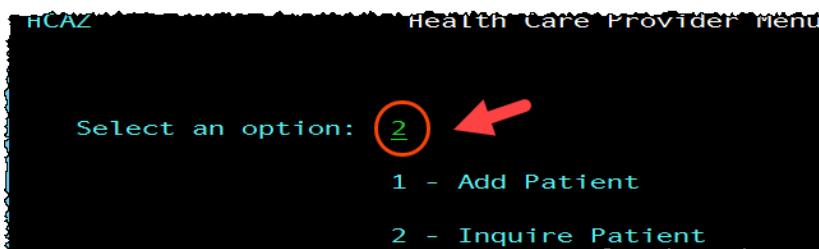
The Recording Service URL points to the CICS region where the live run is recorded.



2.2.12 When recording is turned on, the message “**You are now recording**” appears. Verify that the Load module **Hcipdb01** is the one being recorded.



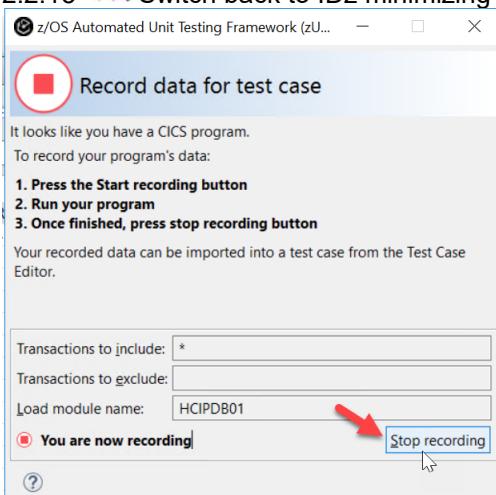
2.2.13 ► Switch to the 3270 terminal emulator (that is minimized), type **2** (Inquire Patient) and press **enter**. In case your transaction is not running just type **HCAZ** again.



2.2.14 ► Type **1** and press **enter**

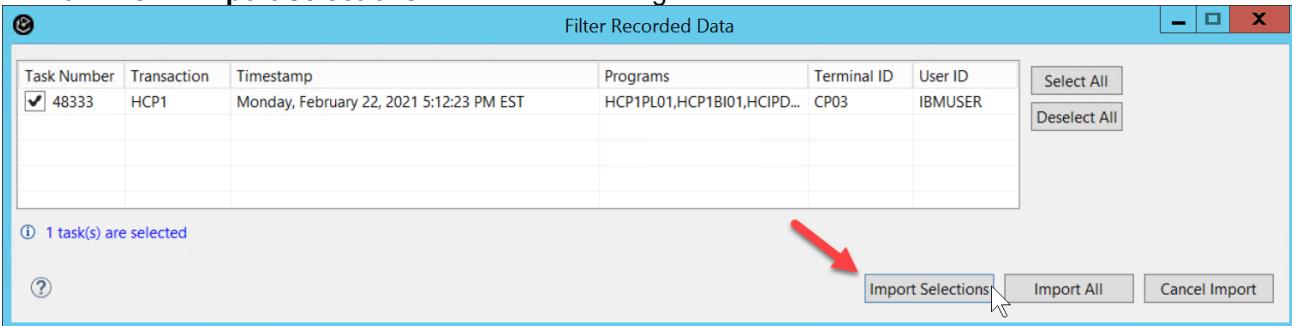


2.2.15 ►| Switch back to IDz minimizing the 3270 screen and click **Stop recording**.



The dialog *Filter Recorded Data* is displayed.

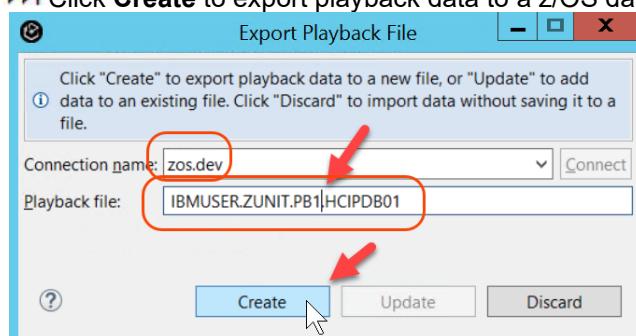
2.2.16 ►| Click **Import Selections** to dismiss the dialog.



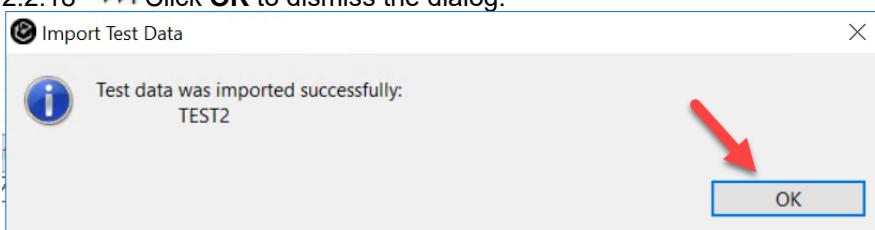
2.2.17 ►| Using drop down select the **zos.dev** as Connection name

►| **IMPORTANT ->** Modify the Playback file name to **IBMUSER.ZUNIT.PB1.HCIPDB01**

►| Click **Create** to export playback data to a z/OS data set



2.2.18 ►| Click **OK** to dismiss the dialog.



2.2.19 ► Double click on the **hcipdb01** title to enlarge the view.  
In case by mistake you close this editor will need to go back to step 2.2.1



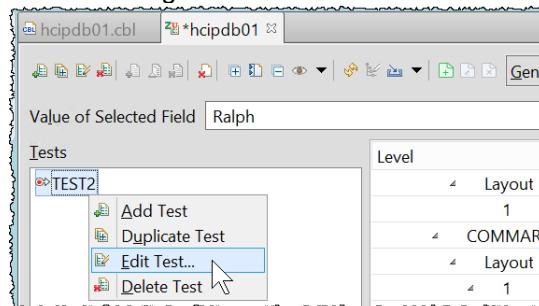
2.2.20 You now see a new test created in the editor and populated with the values from the live run.  
► Scroll down the editor and notice the data displayed on the screen that was captured..

Level	Name	PIC	USAGE	TEST2 : Inp...	TEST2 : Exp...
5	CA-HOW-OFTEN	X(20)	DISPLAY	87	RalphD...@ibm.com
5	CA-ADDITION...	X(3235...)	DISPLAY		
4	3 (redefines CA-THRESHOL...				
5	CA-HR-THRES...	X(10)	DISPLAY	9627811234	Ralph
5	CA-BP-THRESH...	X(10)	DISPLAY		DAlmeida
5	CA-MS-THRES...	X(10)	DISPLAY		1980-07-11
5	CA-ADDITION...	X(3245...)	DISPLAY		34 Main Street ...
4	3 (redefines CA-VISIT-REQU...				
5	CA-VISIT-DATE	X(10)	DISPLAY	9627811234	Ralph
5	CA-VISIT-TIME	X(10)	DISPLAY		DAlmeida
5	CA-HEART-RATE	X(10)	DISPLAY		
5	CA-BLOOD-PR...	X(10)	DISPLAY		
5	CA-MENTAL-S...	X(10)	DISPLAY		
5	CA-ADDITION...	X(3243...)	DISPLAY		
4	EXEC CICS ABEND	line=81			
4	Record:Record1				
	DFHEIBLK				
	LineNumber=81				
4	EXEC CICS RETURN	line=97,112,151			

2.2.21 ► 1 Click on **EXEC SQL SELECT INTO (PATIENT)** to position the data layout for this statement.  
2 Use the scroll bar to **scroll down** until the end,  
3 Click on **Ralph** . and notice that value is displayed on the line 4

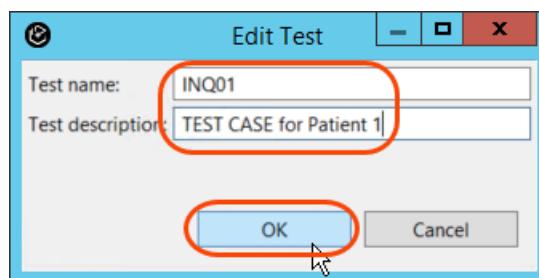
Level	Name	PIC	USAGE	TEST2 : Inp...	TEST2 : Exp...
1	HCAZERRS	X(8)	DISPLAY		
4	COMMAREA				
4	Layout				
4	1				
3	CA-ERROR-MSG				
3	FILLER	X(9)	DISPLAY		
3	CA-DATA	X(90)	DISPLAY		
4	EXEC SQL SELECT INTO [PATI	line=117			
4	Record:Record1				
4	LineNumber=117				
4	INTO				
5	CA-FIRST-NAME	X(10)	DISPLAY	Ralph	3
5	CA-LAST-NAME	X(20)	DISPLAY	DAlmeida	
5	CA-DOB	X(10)	DISPLAY	1980-07-11	
5	CA-INS-CARD...	X(10)	DISPLAY	9627811234	
5	CA-ADDRESS	X(20)	DISPLAY	34 Main Street ...	
5	CA-CITY	X(20)	DISPLAY	Toronto	
5	CA-POSTCODE	X(10)	DISPLAY	M5H 1T1	
5	CA-PHONE-M...	X(20)	DISPLAY	077-123-9987	
5	CA-EMAIL-AD...	X(50)	DISPLAY	RalphD@ibm.c...	
5	CA-USERID	X(10)	DISPLAY	ralphd	
4	WHERE				
3	DB2-PATIENT-ID	S9(9)	BINARY	1	
	SQLCA				

2.2.23 ► Right click on **TEST2** and select **Edit Test**



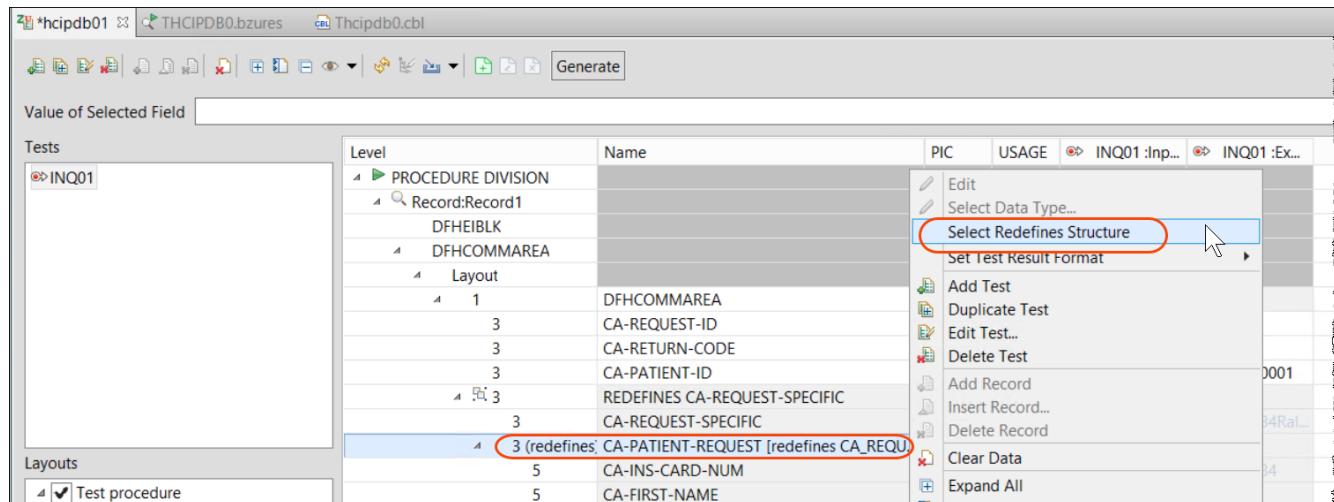
2.2.24 It is a good practice give a name for the test case.

► Use a name like **INQ01** and a description like “**TEST CASE for Patient 1**”: . Click **OK**

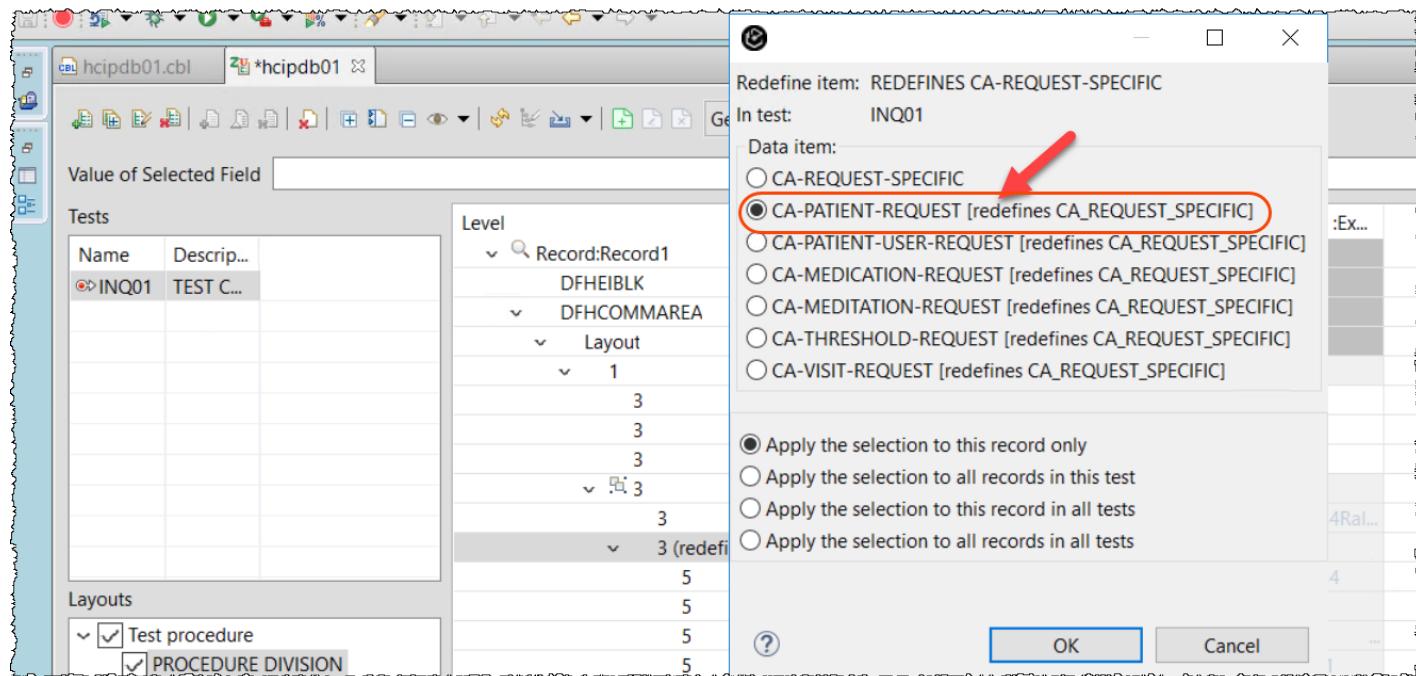


2.2.25 You may notice that this program has many redefines. You may need to identify which is the area being used on this program execution. In our example is the “inquiry patient” area being redefined.

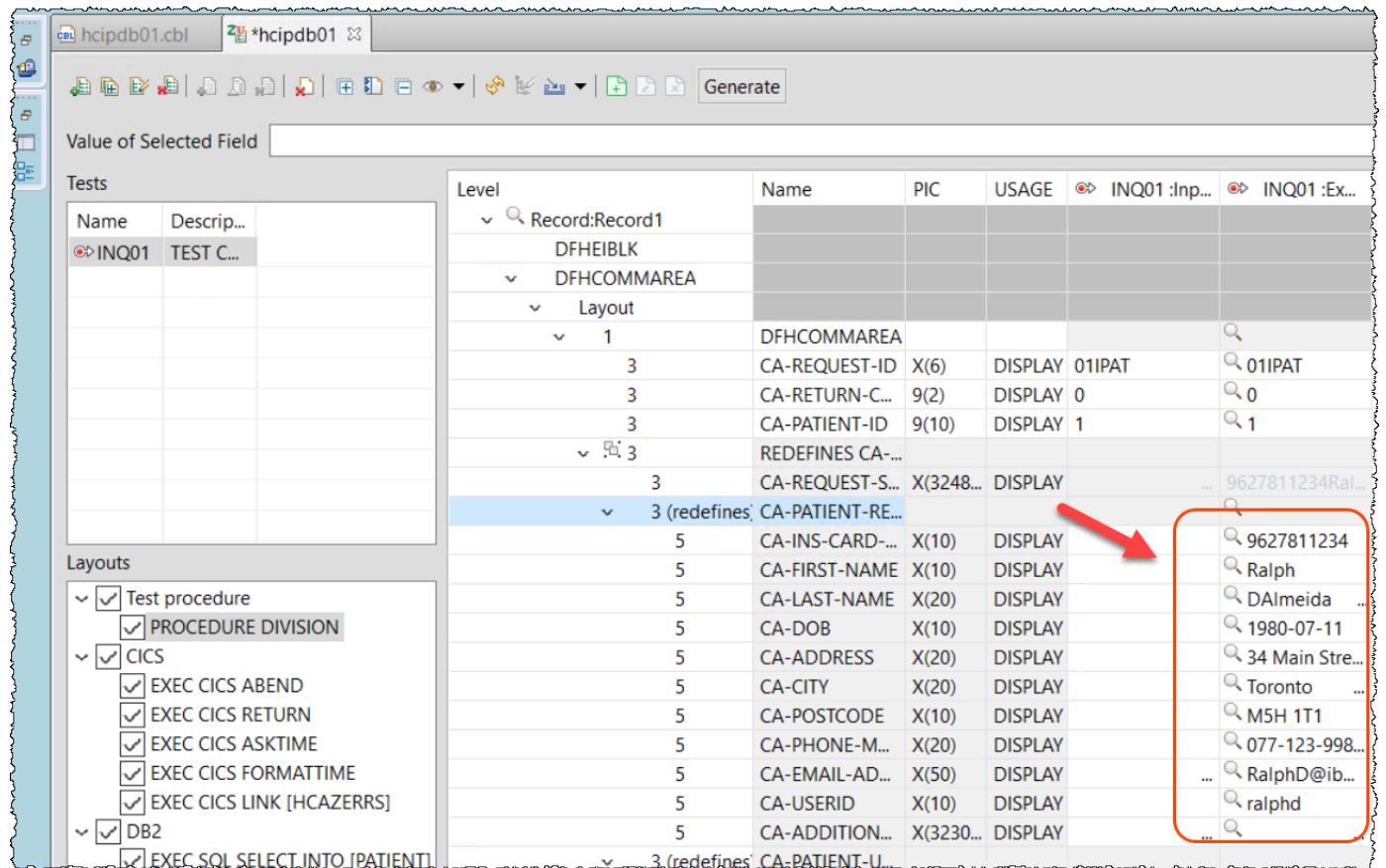
► Scroll up until you find “**(redefines) CA-PATIENT-REQUEST**” (the first REDEFINES). Right click on it and click **Select Redefines Structure**



2.2.26 Select CA-PATIENT-REQUEST and click OK



2.2.27 Notice that now the patient data recorded is displayed at the new redefines selected.



2.2.28 ►| Press **Ctrl+S** to save any changes.

2.2.29 ►| Double click again on the **hcipdb01** title to shrink the view.  
In case by mistake you close this editor will can re-execute the step 2.2.1

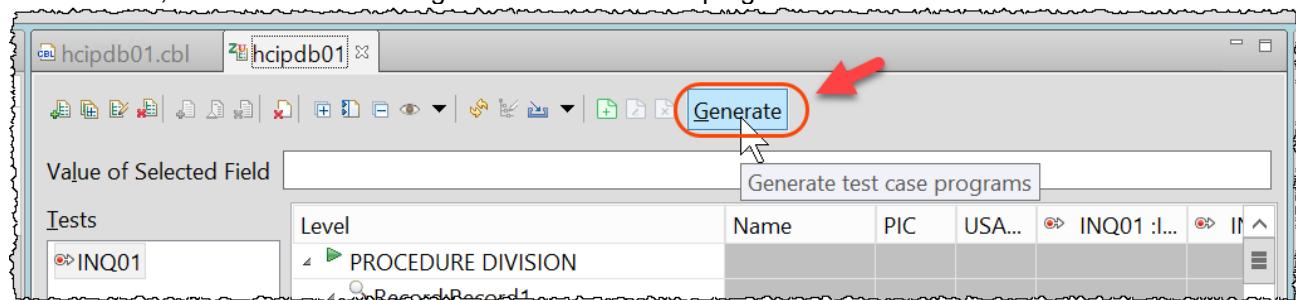


## Section 3. Generate, build, and run the unit test.

You will generate, build, and run the unit test for the test case created.

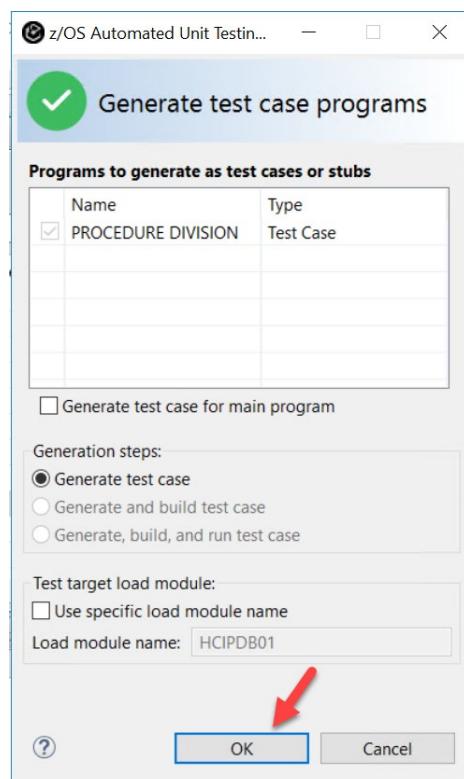
### 3.1 Generating the test case program.

3.1.1 ►| Now that the expected input and output values have been set in the test case editor from the recorded run, click on **Generate** to generate the test case program.



On the **Generate test case programs** dialog,

3.1.2 ►| Click **OK**.



3.1.3 The COBOL program that will run the test case is generated under the folder *testcases*.

► Expand **testcases** and double click on **Thcipdb0.cbl** to verify the generated program.

Notice that in fact **9 COBOL programs** were generated from this test case . This can be seen on the **Outline** view. You could navigate to each program if time allows, note that **NONE** of these programs will require **CICS** or **DB2** to be executed. All will be executed in batch using JCL.

The screenshot shows the IBM Rational Application Developer interface. In the top left, the 'z/OS Projects' view lists several files and folders, including 'HCMADB01.cbl', 'HCMADB02.cbl', 'HCMADB02.json', 'copybook', 'jcl', 'Jenkinsfile', 'Jenkinsfile\_No\_tests', 'Jenkinsfile3', 'O.dirty', 'O.project', 'testcases', '.gitignore', 'hcipdb01.bzucfg', 'hcipdb01.plbck', 'Thcipdb0.cbl', and 'WAZI/readme'. A red circle highlights 'Thcipdb0.cbl' in the 'testcases' folder. A red arrow points from the 'Properties' tab at the bottom left to the 'Outline' tab at the bottom right. The 'Outline' tab displays a list of generated COBOL programs: 'PROGRAM: TEST\_INQ01', 'PROGRAM: BZU\_TEST', 'PROGRAM: BZU\_INIT', 'PROGRAM: BZU\_TERM', 'PROGRAM: EVALOPT', 'PROGRAM: GTMEMRC', 'PROGRAM: AZU\_GENERIC\_CICS', 'PROGRAM: AZU\_GENERIC\_DB2', and 'PROGRAM: CICS\_OE08\_HCIPDB01'. The main editor window shows the source code for 'Thcipdb0.cbl', which includes comments like 'PROCESS NODLL, NODYNAM, TEST (NOSEP), NOCICS, NOSQL, PGMN (LU)', 'PRODUCT: IBM DEVELOPER FOR Z/OS', and 'PROGRAM: ENTERPRISE COBOL ZUNIT TEST CASE FOR DYNAMIC RUNNER'.

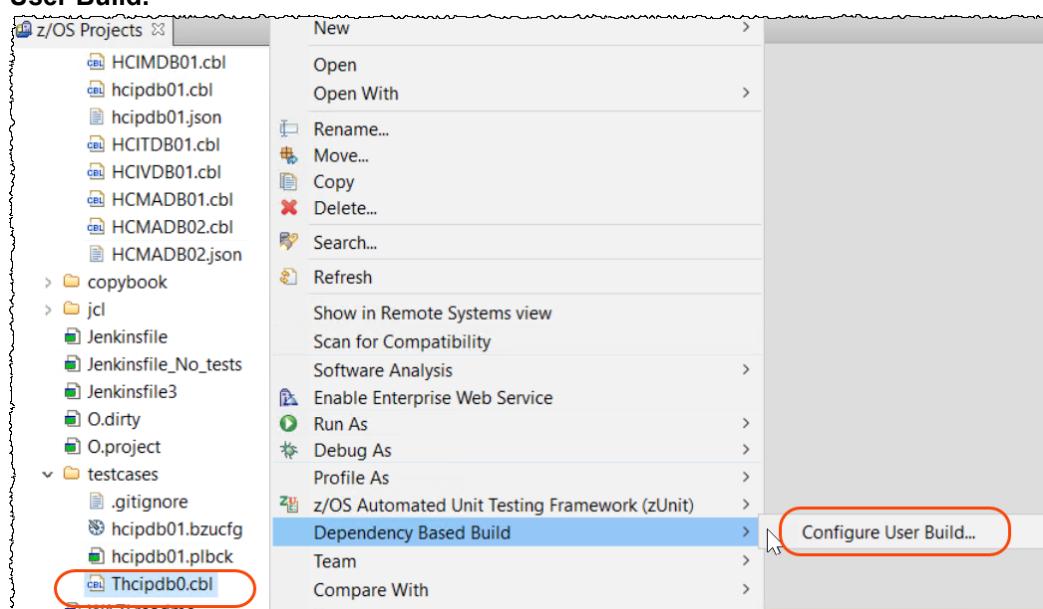
### 3.2 Building the generated test case programs using IBM DBB .

The 6 generated COBOL programs need to be compiled/link edited to be executed. This must be done on z/OS using the COBOL compiler.

To make this easier we will use the IBM DBB. We provided the required framework to make this possible. But note that this could be done using any other way, including via JCL normal compilation.

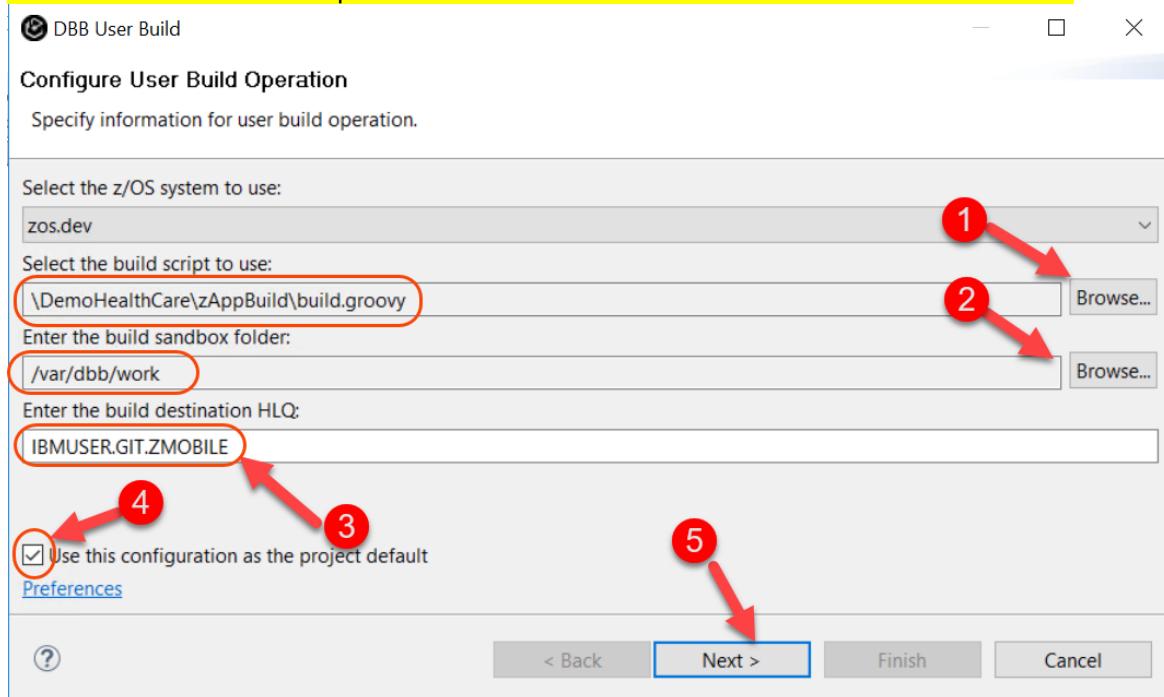
3.2.1 ► Use **Ctrl + Shift + F4** to close all opened editors.

3.2.2 ► Right click on **Thcipdb0.cbl** (under *testcases*) and select **Dependency Based Build > Configure User Build**.



3.2.3 ► Those values could be already there, otherwise use the **Browse...** buttons to specify the values as below. As build destination HLQ use **IBMUSER.GIT.ZMOBILE**, select **Use this configuration as the project default** and click **Next**

Notice that the COBOL compiler on z/OS will use datasets **IBMUSER.GIT.ZMOBILE.xxxx**

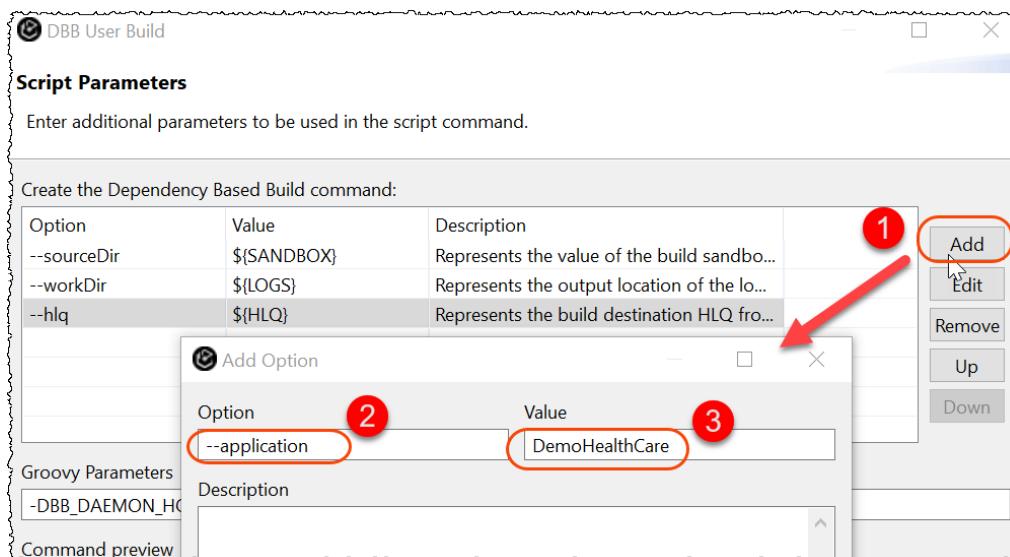


3.2.4 ► Click **Next** Twice

3.2.5 On dialog **Script Parameters**, if the “**--application**” and “**--debug**” are not there you must add  
► Otherwise skip to 3.2.7

In case you need to add **--application**.

► Click **Add** to insert **--application** and **DemoHealthCare** (mixed case) and click **OK**



### 3.2.6 In case you need to add --debug.

► Click Add to insert **--debug** and click OK

Verify that the options below were inserted. Notice that there is an “**--**” before each option.

Create the Dependency Based Build command:

The screenshot shows a table for defining build options. A modal window titled 'Add Option' is open, showing a row with 'Option' set to '--debug'. A red circle labeled '1' points to the 'Add' button in the top right of the main dialog. A red circle labeled '2' points to the 'Option' field in the 'Add Option' modal.

Option	Value	Description
--sourceDir	`\${SANDBOX}	Represents the value of the build sandbox from...
--workDir	`\${LOGS}	Represents the output location of the log folder f...
--hlq	`\${HLQ}	Represents the build destination HLQ from the fir...
--application	DemoHealthCare	

### 3.2.7 Groovy Parameters should be already there.

► In case you need to add Groovy Parameters. On **Groovy Parameters** type

(or copy/paste from C:\ADF\_POT\LAB6C\LAB6C\_Copy\_Paste.txt)

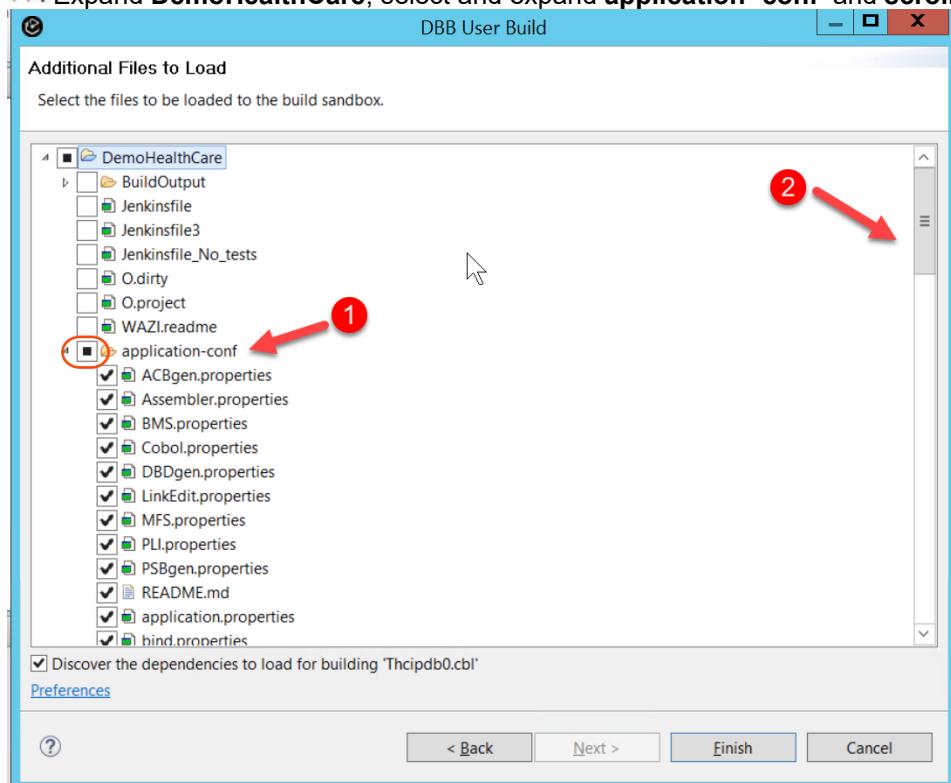
**-DBB\_DAEMON\_HOST 127.0.0.1 -DBB\_DAEMON\_PORT 8080**

► Click Next

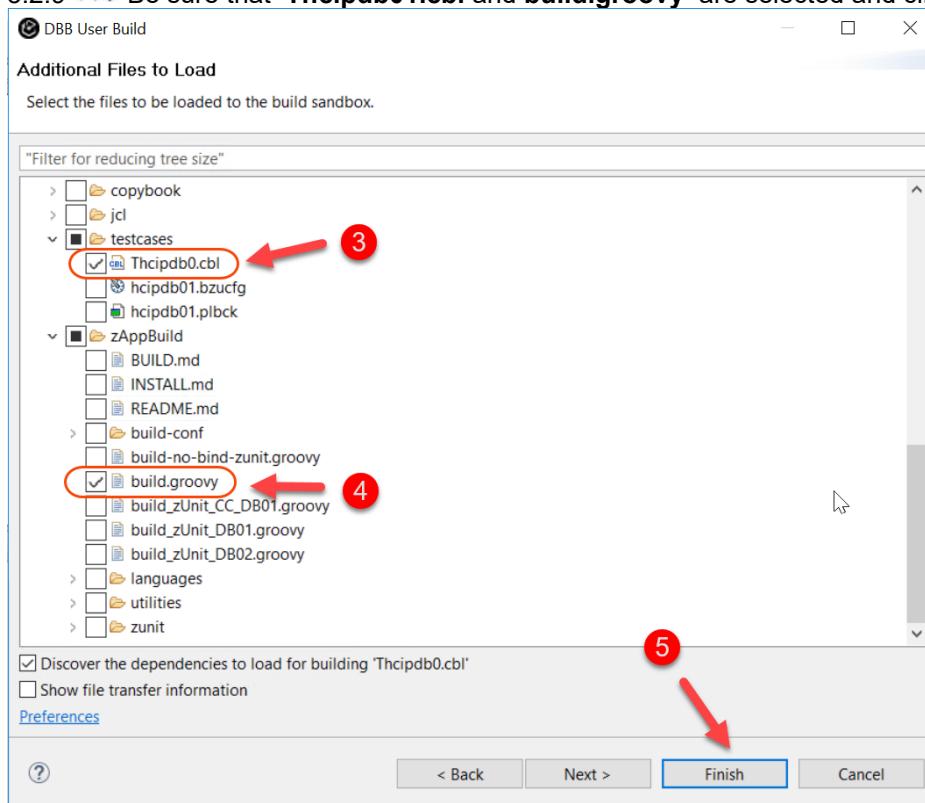
The screenshot shows the 'DBB User Build' dialog. The 'Script Parameters' section contains a table with rows for --sourceDir, --workDir, --hlq, --application (DemoHealthCare), and --debug. A red circle labeled '1' is on the --debug row. The 'Groovy Parameters' section contains the text '-DBB\_DAEMON\_HOST 127.0.0.1 -DBB\_DAEMON\_PORT 8080' in a red-outlined box. A red circle labeled '2' is on this text. A red circle labeled '3' points to the 'Next >' button at the bottom. The 'Command preview' section shows the full command: '-DBB\_DAEMON\_HOST 127.0.0.1 -DBB\_DAEMON\_PORT 8080'.

### 3.2.8 You need to move the assets to z/OS UNIX Files

► Expand DemoHealthCare, select and expand application -conf and scroll down

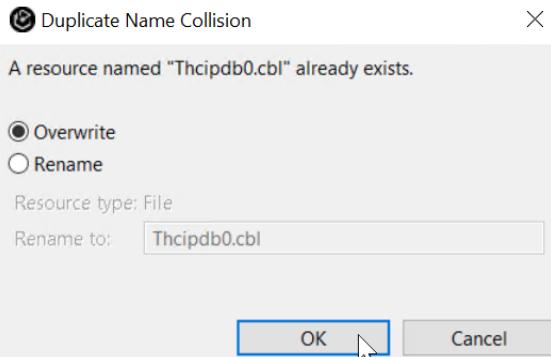


### 3.2.9 ► Be sure that Thcipdb0.cbl and build.groovy are selected and click Finish

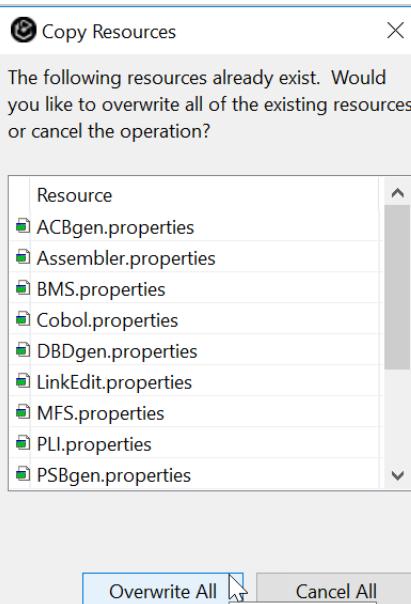


3.2.9 Those assets were once already moved to the z/OS UNIX files and will overwrite the old copies.

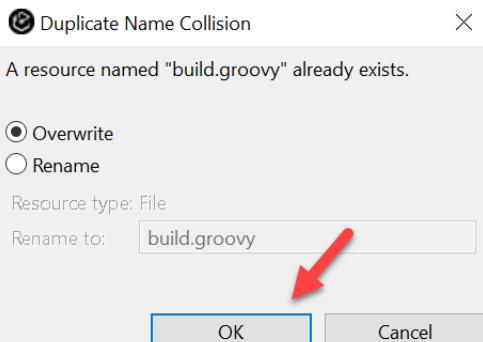
▶ Click OK



▶ Click Overwrite All



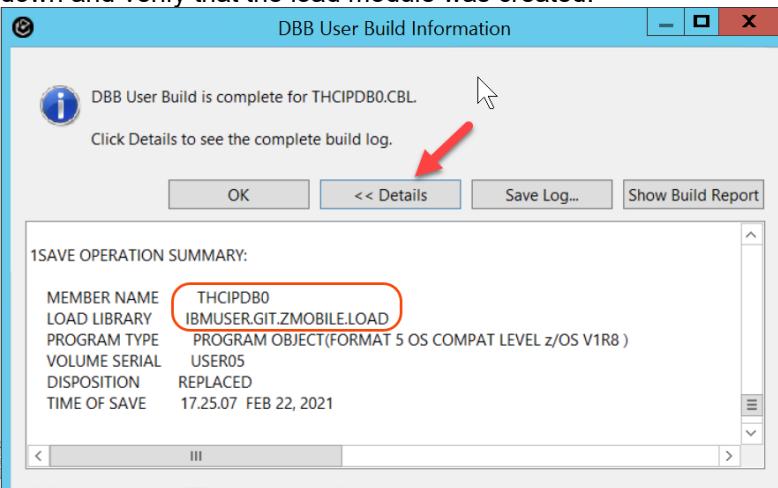
▶ Click OK



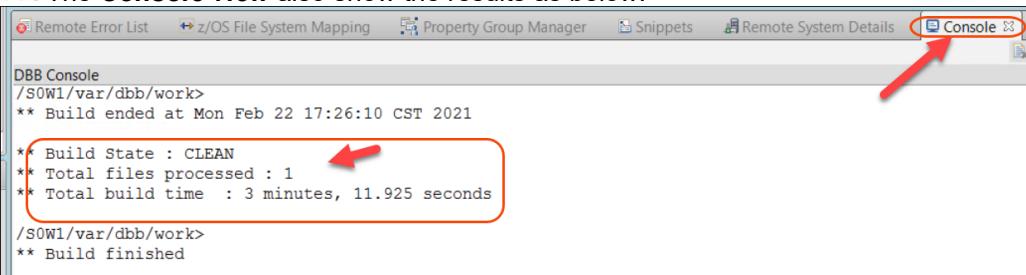
The assets will be moved to **z/OS UNIX Files** and the **build.groovy** will start.  
You can see log on **Console** view.

3.2.10 This operation will compile, and link 9 generated COBOL programs and it may take up to 2 minutes. When it starts you can see the **Console view** opening in the bottom.

► When finished the dialog below will be displayed and you can click on **Details** and **OK** after you scroll down and verify that the load module was created.



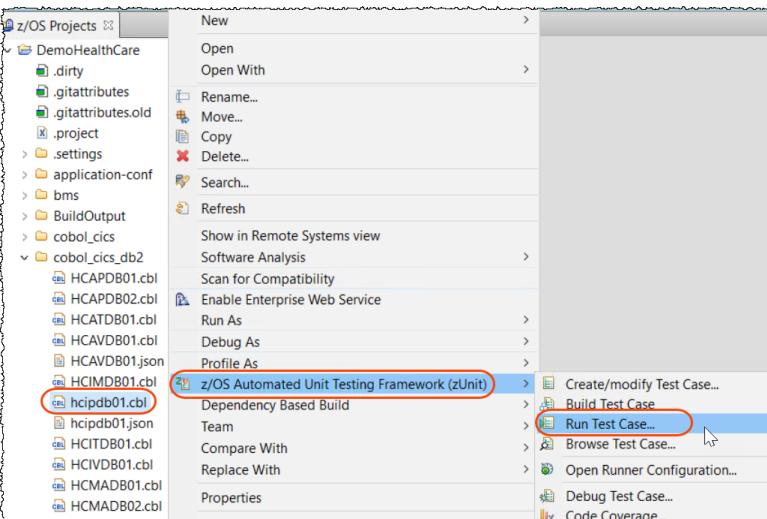
► The **Console view** also show the results as below:



### 3.3 Running the test case,

Once you have the test cases load module created you can run the test case against the COBOL program. Since you did not make changes to the program the return code must be zero and all tests should pass.

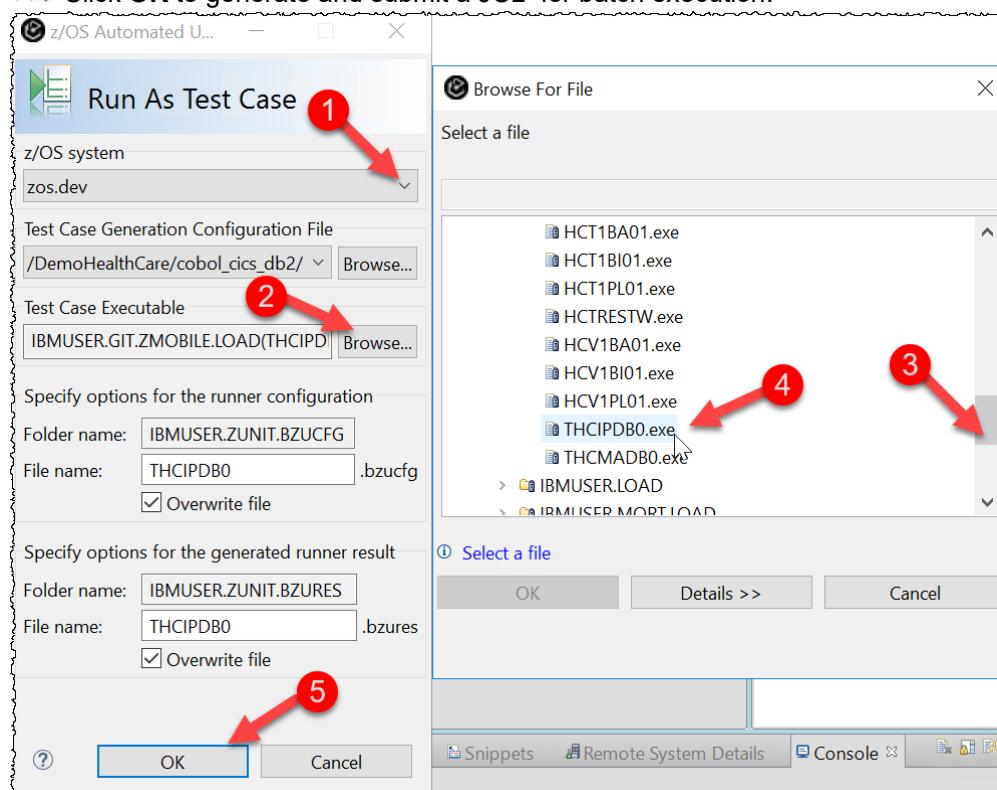
3.3.1 ► Using z/OS Projects view, scroll up, right click on **hcipdb01.cbl** and select **z/OS Automated Unit Testing Framework (zUnit)->Run Test Case...**



3.3.2 ► Select **zos.dev** and use the **Browse** button to select the PDS and load module where the test case was created.

You will find the PDS **IBMUSER.GIT.ZMOBILE.LOAD (THCIPDB0)** under **My Data Sets ..**

► Click **OK** to generate and submit a JCL for batch execution.

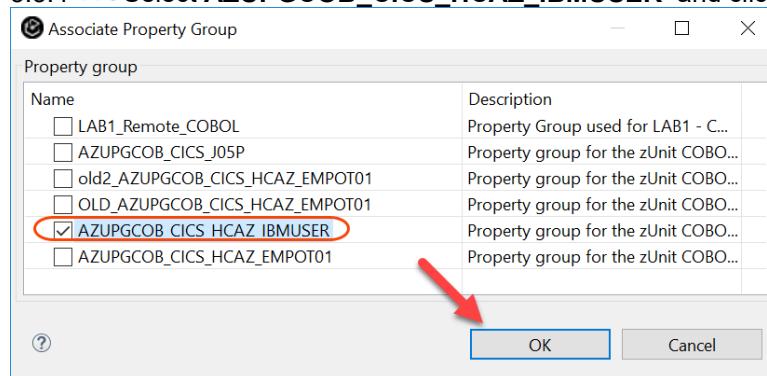


3.3.3 The *Missing Property Group* dialog will prompt.

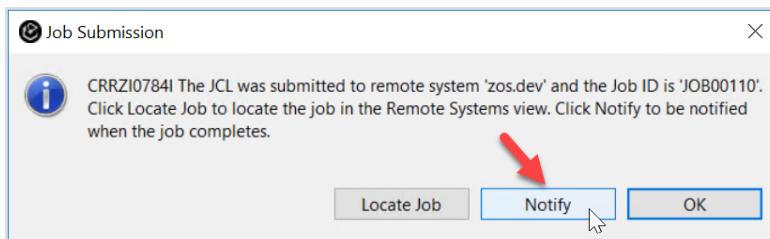
► Click **Associate an existing property group**



3.3.4 ► Select **AZUPGCOB\_CICS\_HCAZ\_IBMUSER** and click **OK**



3.3.5 ► A Job Submission dialog opens, click **Notify** to be notified of job completion.



3.3.6 Once the unit test run has completed, the results screen is displayed showing test cases ran and passed.

**Test cases and test results**  
Use the tree view to navigate test cases and test results.  
type filter text

**Total results and settings**  
This section contains general information about the test run.  
Runner result ID: 4092cc48-cf83-4762-9878-f0c636c34980

**Test run total results**

Test count:	1
Tests passed:	1
Tests failed:	0
Tests with errors:	0
Tests with severe errors:	0

**Runner continuation settings**

Continue if test fails:	<input checked="" type="checkbox"/>
Continue if error in test:	<input type="checkbox"/>
Continue if test case fails:	<input checked="" type="checkbox"/>
Continue if error in test case:	<input type="checkbox"/>

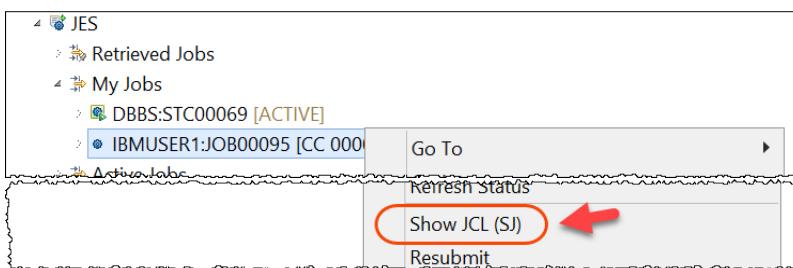
You have now created a test case with data imported from a recorded run and have been successful in testing a CICS program without the need of a CICS and DB2 environment.

3.3.7 ► Use **Ctrl + Shift + F4** to close all opened editors.

## 3.4 Verify the JCL submitted

To see the JCL submitted on the previous execution

3.4.1 ► Using **Remote Systems** view on right, under **JES** expand **My Jobs**, right click on the last executed and select **Show JCL (SJ)**



3.4.2 ► The job submitted will be displayed. You could save it in a PDS member and use it when want to run the test cases for this program.

As you see there is no CICS or DB2 environments in that execution.

```

JOB00092.jcl
----+---1---+---2---+---3---+---4---+---5---+---6---+---7---| +---+
1 //IBMUSER1 JOB ,
2 // MSGCLASS=H,MSGLEVEL=(1,1),REGION=0M,COND=(16,LT)
3 /* Action: Run Test Case...
4 /* Source: IBMUSER.GIT.ZMOBILE.LOAD(THCIPDB0)
5 //      SET FELJOB=ZUNITGO
6 // RUNNER EXEC PROC=BZUPPLAY,
7 // BZUCFG=IBMUSER.ZUNIT.BZUCFG(THCIPDB0),
8 // BZUCBK=IBMUSER.GIT.ZMOBILE.LOAD,
9 // BZULOD=IBMUSER.GIT.ZMOBILE.LOAD,
10 // PRM='STOP=0,REPORT=XML'
11 //REPLAY.BZUPLAY DD DISP=SHR,
12 // DSN=IBMUSER.ZUNIT.PB1.HCIPDB01
13 //REPLAY.BZURPT DD DISP=SHR,
14 // DSN=IBMUSER.ZUNIT.BZURES(THCIPDB0)
15 //STEPLIB DD
16 //      DD DSN=IBMUSER.LOAD,DISP=SHR
17 //      DD DSN=IBMUSER.GIT.ZMOBILE.LOAD,DISP=SHR
18

```

3.4.3 ► Use **Ctrl + Shift + F4** to close all opened editors.

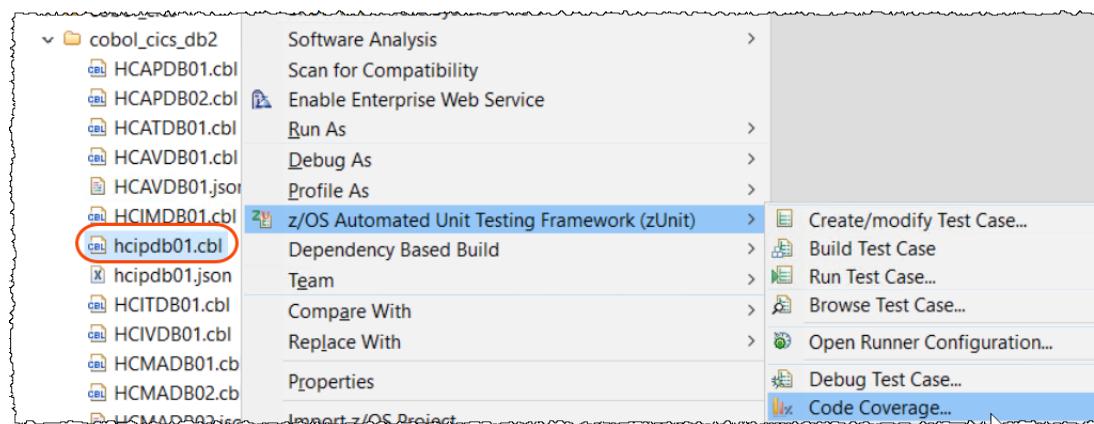
## 3.5 Running zUnit test case Code Coverage

Code coverage analyzes a running program and generates a report of lines that are executed, compared to the total number of executable lines. Sometimes you need to be sure that your test is covering all capabilities of your program and that you are having the correct test cases.

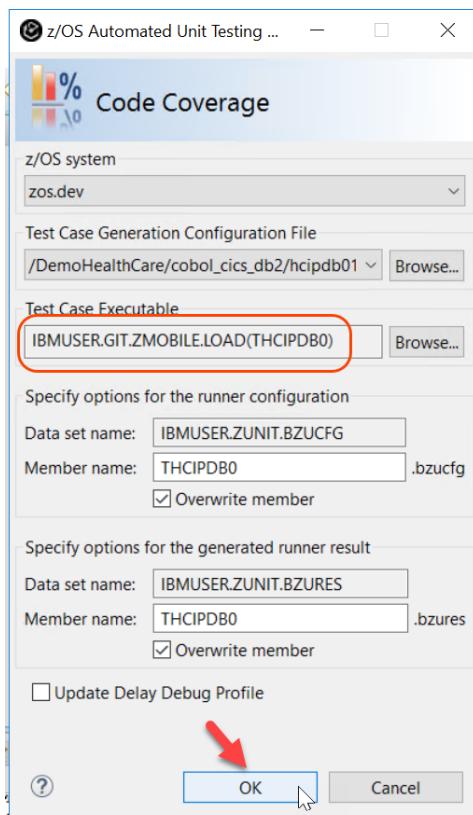
Notice that you are doing the code coverage using a batch job without need to have CICS and DB2 active, which is very handy..

3.5.1 ZUnit also provides the capability to run the test case using Code coverage or Debug.

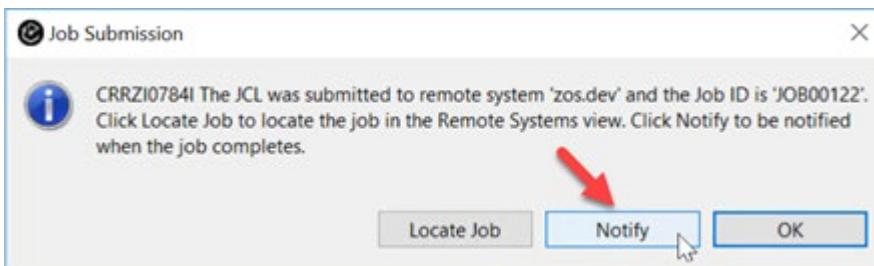
► Right click **hcipdb01.cbl** and select **zUnit > Code Coverage....**



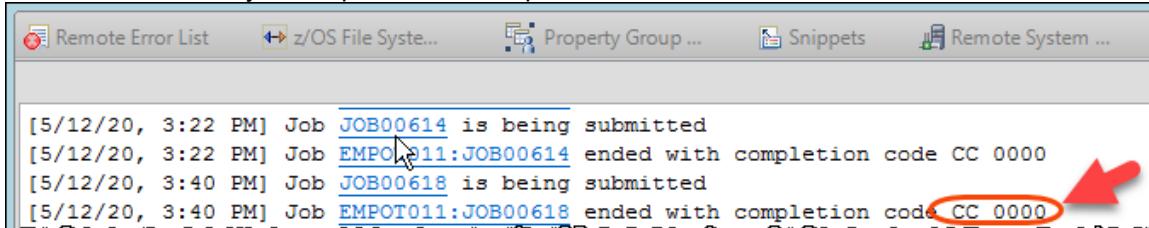
3.5.2 ► Click **OK** to generate and submit a JCL for batch execution.



3.5.3 ► Click **Notify** on the Job Submission Confirmation dialog.



3.5.4 Make sure the job completes with completion code of **0000**.



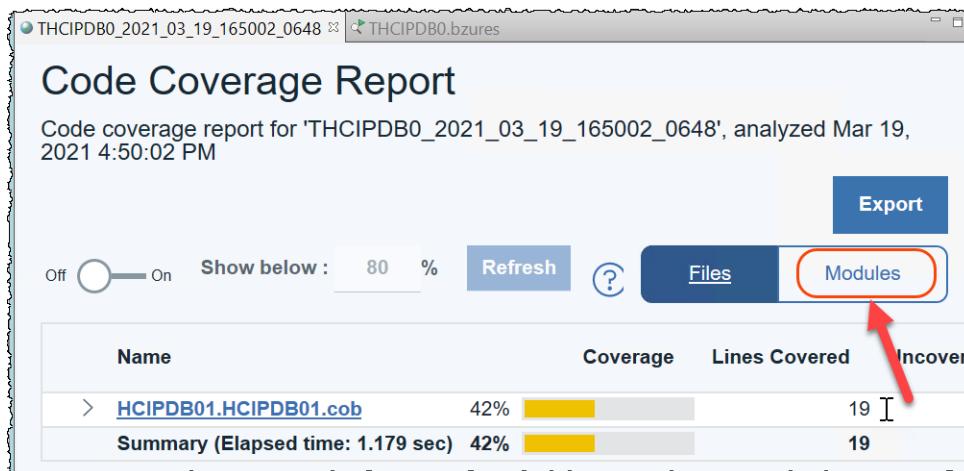
3.5.5 The code coverage report shows all COBOL programs executed for this specific test case.

► Click on title **THCIPDB0\_yyyy\_mm\_dd\_xxxxxxx** to see the Code coverage report



3.5.6 This code coverage report shows the coverage of the COBOL programs generated for zUnit to perform the test as well our *HCIPDB01* COBOL program..

► Since we are just interested in the code coverage of program being tested click on **Modules**:

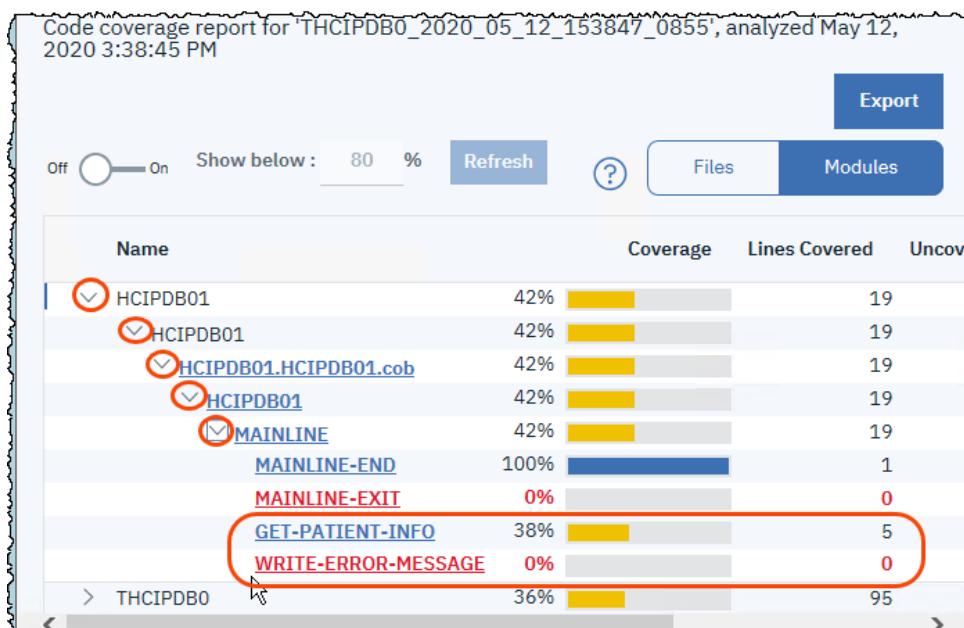


The screenshot shows a browser window titled "THCIPDB0\_2021\_03\_19\_165002\_0648" with the URL "THCIPDB0.bzures". The main title is "Code Coverage Report" and it states "Code coverage report for 'THCIPDB0\_2021\_03\_19\_165002\_0648', analyzed Mar 19, 2021 4:50:02 PM". Below the title are buttons for "Export", "Off" (radio button), "On", "Show below : 80 %", "Refresh", a help icon, and tabs for "Files" (selected) and "Modules". The "Modules" tab has a red arrow pointing to it. A table follows:

Name	Coverage	Lines Covered	Uncov.
> <a href="#">HCIPDB01.HCIPDB01.cob</a>	42%	19	
<b>Summary (Elapsed time: 1.179 sec)</b>	<b>42%</b>	<b>19</b>	

3.5.7 ► Expand the nodes as below to see the COBOL paragraphs.

Notice that **GET-PATIENT-INFO** has 38% of coverage and that **WRITE-ERROR-MESSAGE** was not covered at all on this test case.

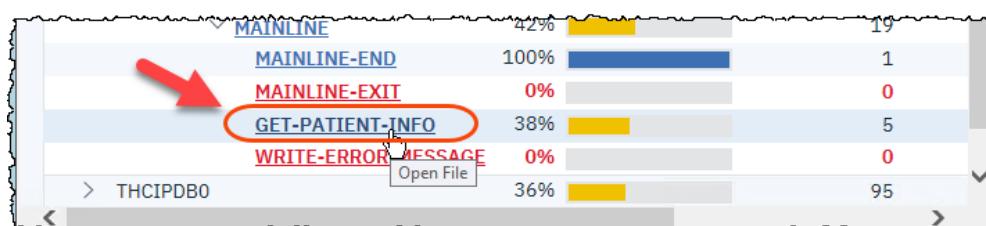


The screenshot shows the same interface after expanding the "HCIPDB01" node. The "Modules" tab is still selected. The expanded tree shows:

- HCIPDB01
  - HCIPDB01
    - HCIPDB01.HCIPDB01.cob
    - HCIPDB01
      - MAINLINE
      - MAINLINE-END
      - MAINLINE-EXIT
      - GET-PATIENT-INFO (highlighted with a red box)
      - WRITE-ERROR-MESSAGE (highlighted with a red box)

A red box highlights the "GET-PATIENT-INFO" and "WRITE-ERROR-MESSAGE" rows in the coverage table, which show 38% and 0% coverage respectively.

3.5.8 ► Click on **GET-PATIENT-INFO** to see more details



The screenshot shows the expanded "HCIPDB01.HCIPDB01.cob" node with the "MAINLINE-END" and "MAINLINE-EXIT" nodes collapsed. A red arrow points to the "GET-PATIENT-INFO" row, which is highlighted with a red box. The "WRITE-ERROR-MESSAGE" row is also highlighted with a red box. The coverage table shows:

MAINLINE	42%	19
MAINLINE-END	100%	1
MAINLINE-EXIT	0%	0
<b>GET-PATIENT-INFO</b>	<b>38%</b>	<b>5</b>
WRITE-ERROR-MESSAGE	0%	0

### 3.5.9 ► Scroll down and move the mouse to the colored areas on left.

The lines covered by this test case are in **green** and the lines not covered are in **red**.

Also from the previous image we can see the WRITE-ERROR\_MESSAGE paragraph is not covered at all.  
(you may have different values than the screen capture below).

```

THCIPDB0_2021_03_19_165002_0648 THCIPDB0.bzures HCIPDB01.HCIPDB01.cob
-----+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---8---+
252 :CA-POSTCODE,
253 :CA-PHONE-MOBILE,
254 :CA-EMAIL-ADDRESS,
255 :CA-USERRID
256 FROM PATIENT
257 WHERE PATIENTID = :DB2-PATIENT-ID
258 END-EXEC.
259 Evaluate SQLCODE
260 When 0
261     MOVE '00' TO CA-RETURN-CODE
262     .... '01' TO CA-RETURN-CODE
263 When -913
264     MOVE '01' TO CA-RETURN-CODE
265 When Other
266     MOVE '90' TO CA-RETURN-CODE
267     PERFORM WRITE-ERROR-MESSAGE
268     EXEC CICS RETURN END-EXEC
269 END-Evaluate.
270 * %bug2 -- the line below will introduce a BUG
271 *-----*
272 *      IF DB2-PATIENT-ID = 1
273

```

### 3.5.10 From this report we can see that the test cases created for this program are not sufficient ..

The developer could go back to the test cases editor (step 2.2.20 above) and manually add test cases that cover other paragraphs. Due the lack of time we will not cover that here, but if you have extra time you can try it. Ask the instructor for guidance.

### 3.5.11 We also saved the JCL showed on step 3.4.2 and added the information to run the code coverage.

This JCL can be found at [jc1/HCIPCC.jcl](#)

► Double click on [jc1/HCIPCC.jcl](#) and verify this JCL. You could just submit this JCL to run the test case and the Code Coverage.

```

z/OS Projects HCIPCC.jcl
BuildOutput
cobol_cics
cobol_cics_db2
copybook
jcl
  HCIPCC.jcl (highlighted)
  HCIPDBG.jcl
  HCIPZRUN.jcl
  ZUDBDB01.jcl
  ZUDBDB02.jcl
  ZUNITCC.jcl
  ZUNITRUN.jcl
  ZURUDB02.jcl
Jenkinsfile
Jenkinsfile_No_tests
Jenkinsfile3
O.dirty

-----+---1---+---2---+---3---+---4---+---5---+---6---+
1 // HCIPCC JOB ,
2 // MSGCLASS=H,MSGLEVEL=(1,1),REGION=0M,COND=(16,LT)
3 ///* Action: Code Coverage...
4 ///* Source: IBMUSER.GIT.ZMOBILE.LOAD(THCIPDB0)
5 // RUNNER EXEC PROC=BZUPPLAY,
6 // BZUCFG=IBMUSER.ZUNIT.BZUCFG(THCIPDB0),
7 // BZUCBK=IBMUSER.GIT.ZMOBILE.LOAD,
8 // BZULOD=IBMUSER.GIT.ZMOBILE.LOAD,
9 // PARM=( 'STOP=E,REPORT=XML')
10 //CEEOPTS DD *
11 TEST (ALL,,PROMPT,DBMDT%IBMUSER:*)
12 ENVAR(
13 "EQA_STARTUP_KEY=CC,THCIPDB0,cclevel=LINE,testid=THCIPDB0")
14 /*
15 //BZUPLAY DD DISP=SHR,
16 // DSN=IBMUSER.ZUNIT.PB1.HCIPDB01
17 //BZURPT DD DISP=SHR,
18 // DSN=IBMUSER.ZUNIT.BZURES(THCIPDB0)
19

```

## Section 4. Introduce a bug in the program and rerun the unit test.

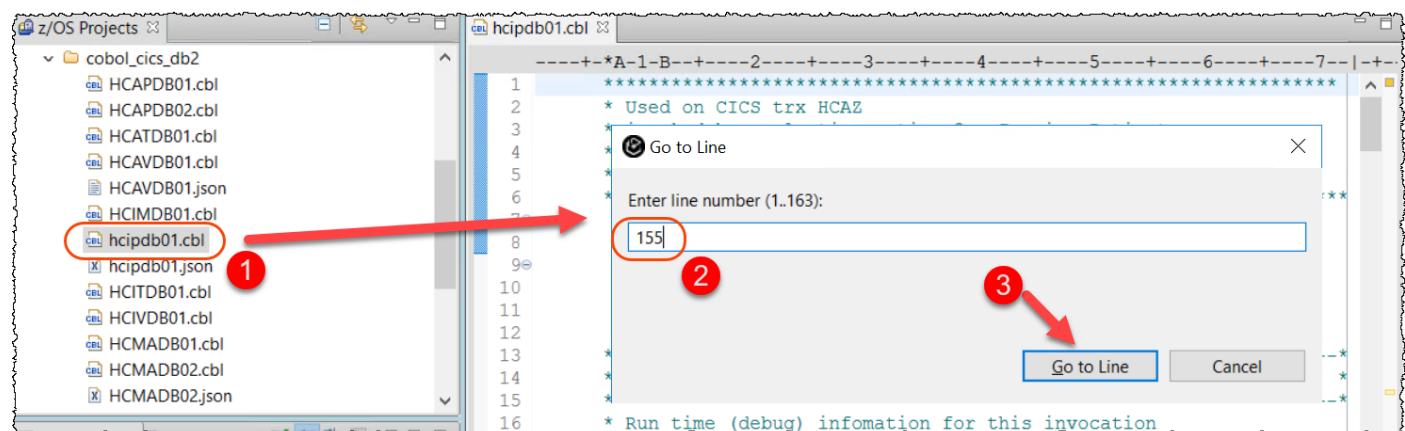
Using IDz you will modify the program and introduce a bug. Then you will rerun the unit test created in the previous section.

### 4.1 Modifying the program and introduce a bug

4.1.1 ► On IDz, close all active windows by pressing **Ctrl+Shift+F4**

► Open **hcipdb01.cbl** under **cobol\_cics\_db2** by double clicking on it in the z/OS Projects view.

4.1.2 ► On the editor, go to line 155 by pressing **Ctrl+L** and entering **155** and clicking **Go to Line**



4.1.3 ► Change the lines 156, 157 and 158 removing the \* from the statement that moves "BAD NAME",  
Tip -> Could use **Source > Toggle Comment** also **DO NOT** change line 159.

► Press **Ctrl+S** to save the changes. and **Ctrl + Shift + F4** to close all editors.

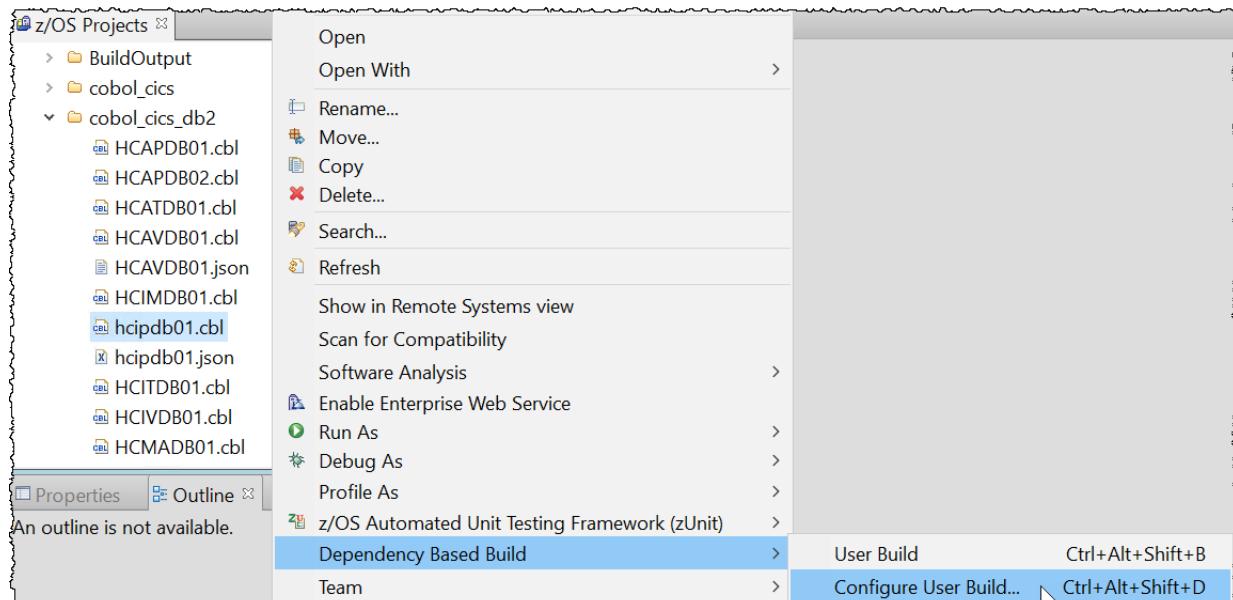
```

141      END-EXEC.
142          Evaluate SQLCODE
143              When 0
144                  MOVE '00' TO CA-RETURN-CODE
145              When 100
146                  MOVE '01' TO CA-RETURN-CODE
147              When -913
148                  MOVE '01' TO CA-RETURN-CODE
149              When Other
150                  MOVE '90' TO CA-RETURN-CODE
151                  PERFORM WRITE-ERROR-MESSAGE
152                  EXEC CICS RETURN END-EXEC
153          END-Evaluate.
154          * %bug2 -- the line below will introduce a BUG
155          *
156          IF DB2-PATIENT-ID = 1
157              MOVE "BAD NAME" to CA-FIRST-NAME
158          END-IF
159          * MOVE "02" to CA-NEWFIELD
160          *
161          EXIT.
162          *
163          COPY HCERRSPD.

```

## 4.2 Rebuilding the changed program without deploying to CICS using DBB

- 4.2.1 ► On the z/OS Projects view, right click on **hcipdb01.cbl** and select **Dependency Based Build > Configure User Build...**



- 4.2.2 ► If the values are not populated, use the Browse button and specify the values below and click **Next** 3 times

**DBB User Build**

**Configure User Build Operation**

Specify information for user build operation.

Select the z/OS system to use:  
zos.dev

Select the build script to use:  
\\DemoHealthCare\\zAppBuild\\build.groovy

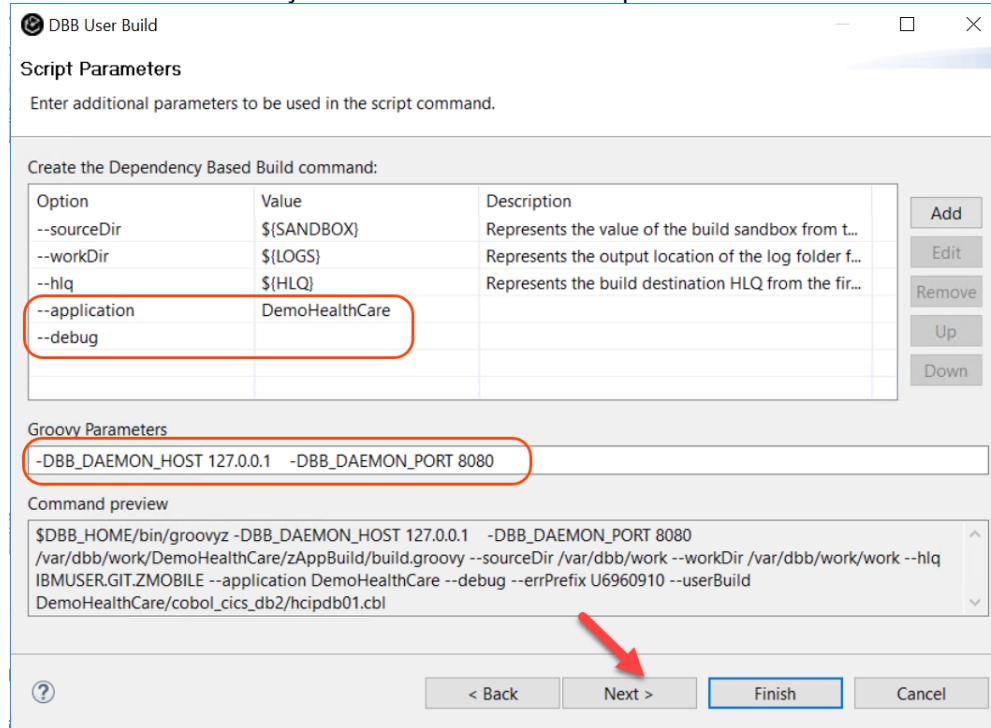
Enter the build sandbox folder:  
/var/dbb/work

Enter the build destination HLQ:  
IBMUSER.GIT.ZMOBILE

Use this configuration as the project default  
[Preferences](#)

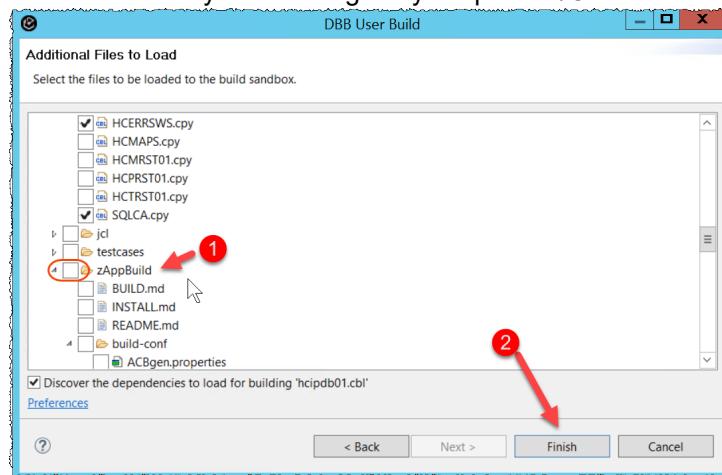
? < Back Next > Finish Cancel

**4.2.3 ➡ Be sure that you have the values below specified and click **Next****

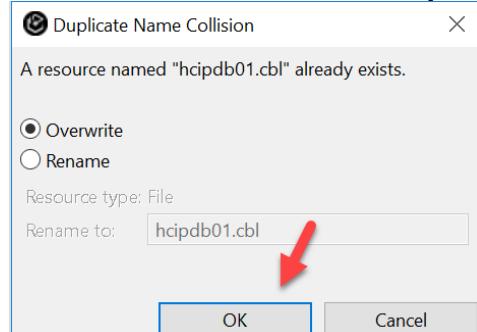


**4.2.4 ➡ Expand **DemoHealthCare**, Un-select **zAppBuild** and click **Finish** .**

You have already moved all groovy scripts to z/OS before when compiled the Test case program.

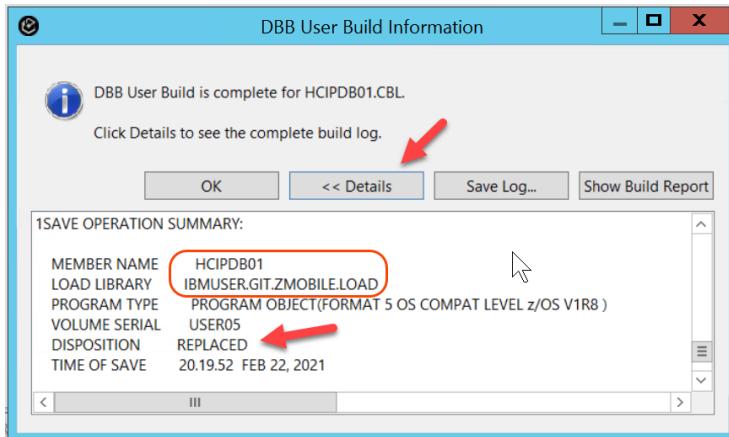


**4.2.5 ➡ Overwrite the code already on z/OS as the example below**

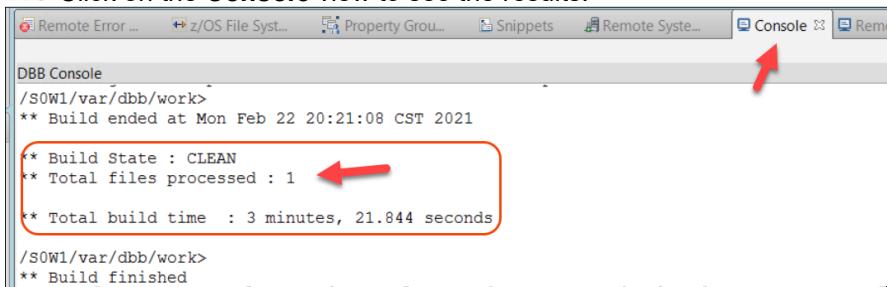


4.2.6 This operation may take up to 2 minutes When finished the dialog below will be displayed.

► Click on **Details** and **OK** after you verified that the load module was replaced.



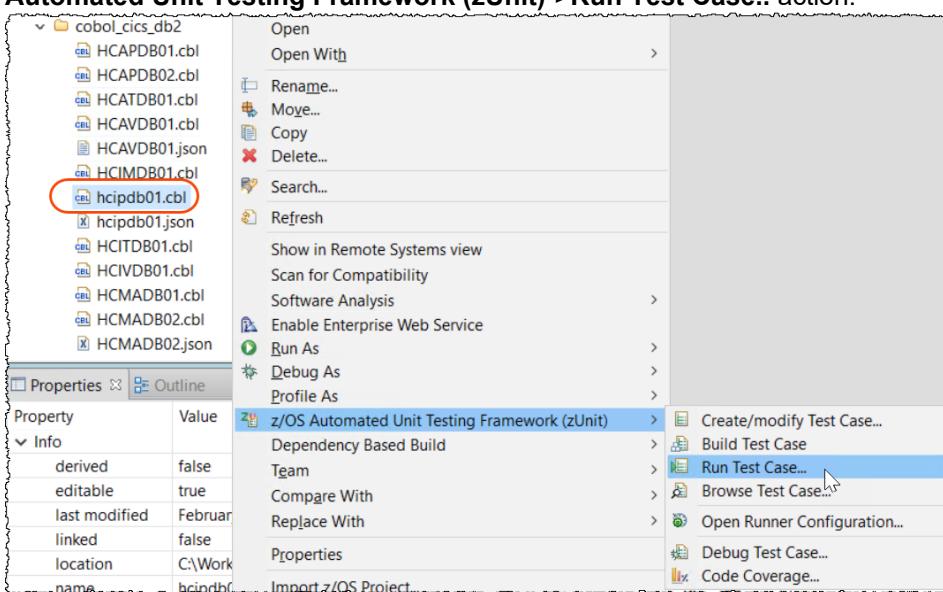
► Click on the **Console** view to see the results:



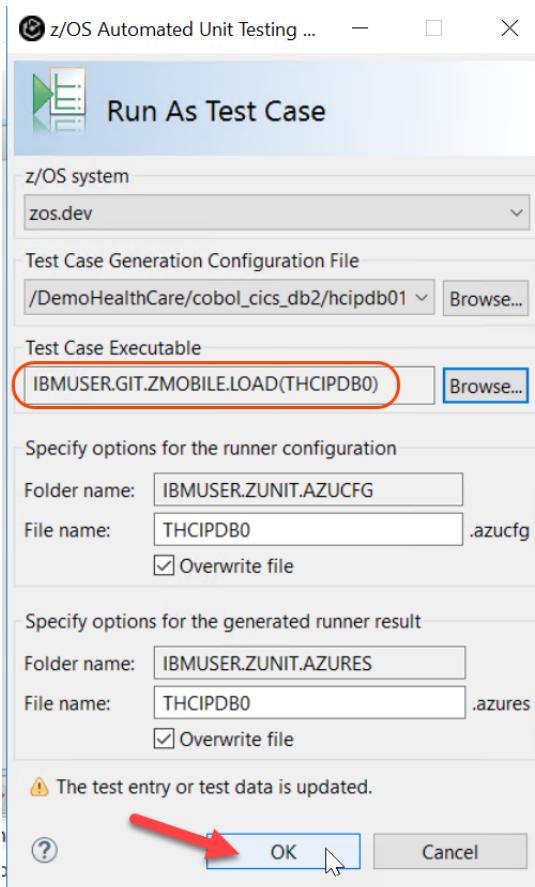
## 4.3 Running the test case again

Since we introduced a bug, now the test case must fail.

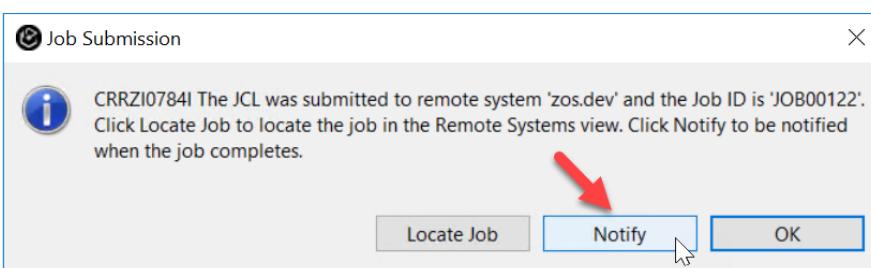
4.3.1 ► On the z/OS Projects view, select **hcipdb01.cbl**, right mouse click, and select the **z/OS Automated Unit Testing Framework (zUnit)**->**Run Test Case..** action.



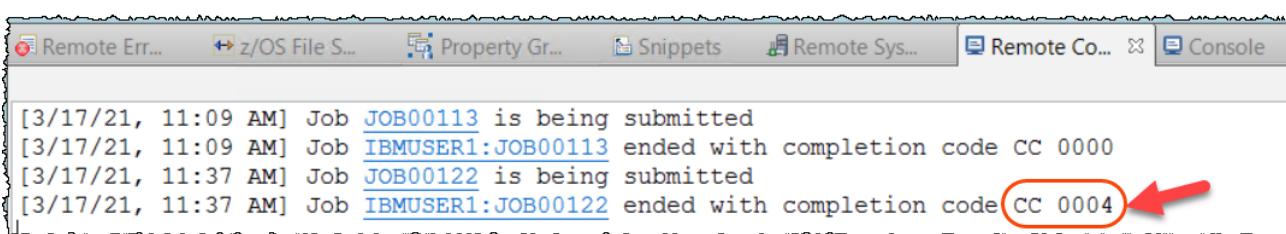
4.3.2 ► Be sure that the test case load module **IBMUSER.GIT.ZMOBILE LOAD(THCIPDB0)** is selected and click **OK** to submit the execution via JCL.



4.3.3 ► Click **Notify** on the Job Submission Confirmation dialog.



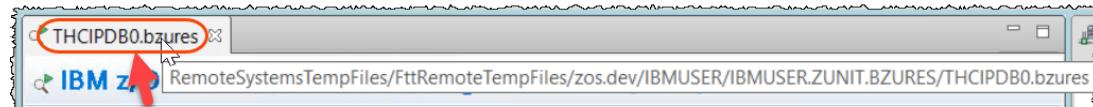
4.3.4 ► Notice that now you have a completion code of **0004** instead of 0000.



4.3.5 When the test run completes, the test results will be displayed, and it showed 1 test was ran and it failed.

► Click **Test case THCHIPDB0**. The failure is expected because the expected value of the error message is different from the actual value.

4.3.6 ► Double click on title **THCHIPDB0.bzures** to maximize the windows and better check the results



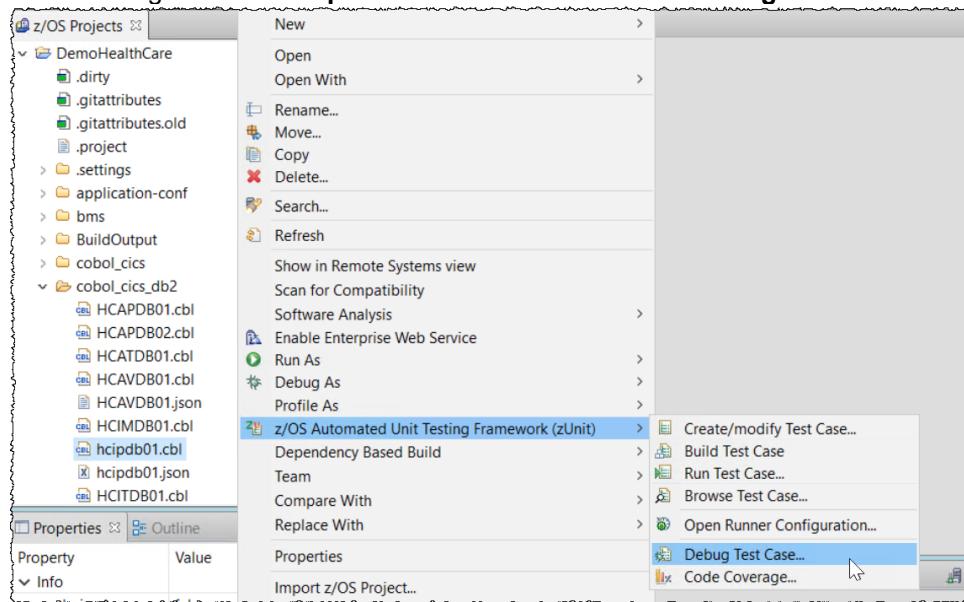
4.3.7 ► Expand **Test case THCHIPDB0, Test INQ01 (fail)** and click **Exception message number** to verify the value received versus the expected value and verify the failure

## 4.4 Running zUnit test case with debugging

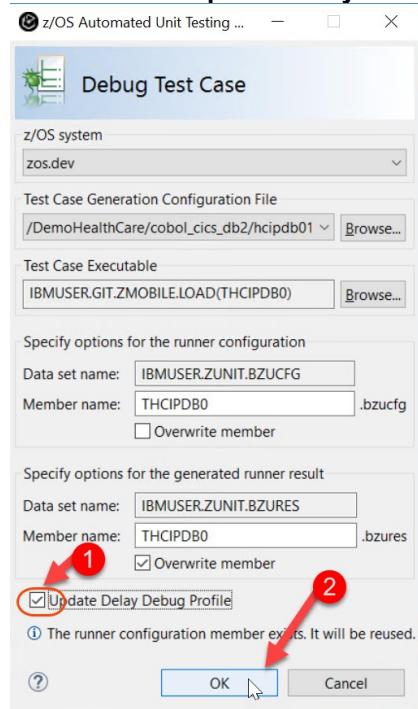
The Debug dialog will debug the test case. Note that will debug the zUnit programs, the generated COBOL and also the COBOL program that you are testing. Below one example. **Notice that you are debugging a batch job without need to have CICS and DB2 active, which is very handy.**

4.4.1 ➡ Close all active windows by pressing **Ctrl+Shift+F4**

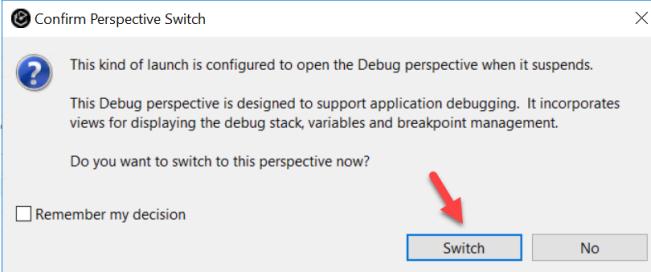
4.4.2 ➡ Right click on **hcipdb01.cbl** and select **zUnit → Debug Test Case ...**



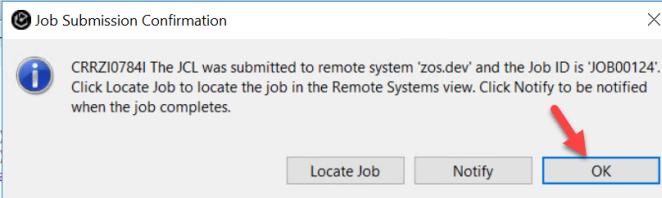
4.4.3 ➡ Click **Update Delay Debug Profile** and click **OK**



#### 4.4.4 Click **Switch** to open the debug perspective.



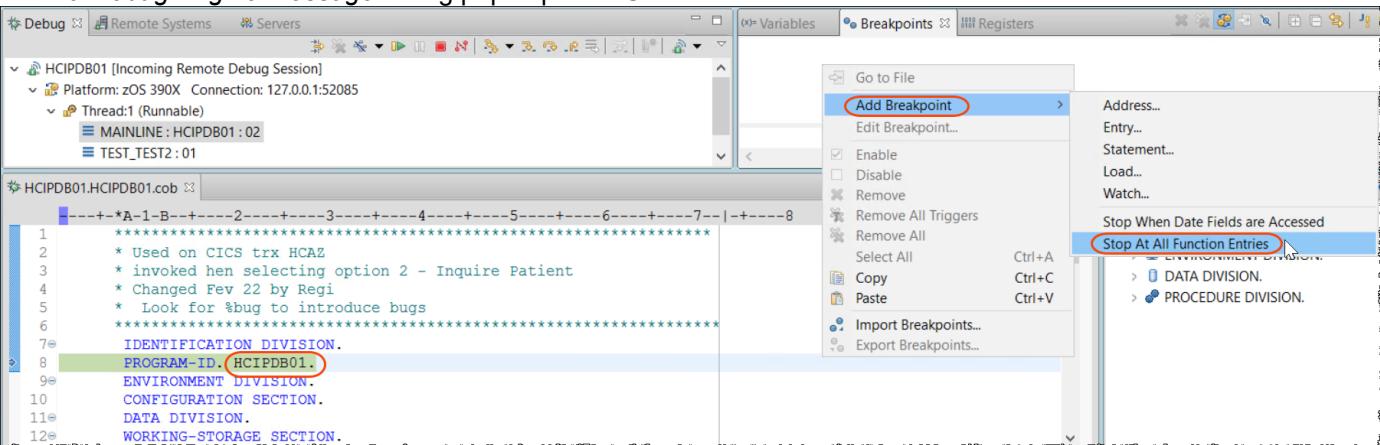
#### 4.4.5 Click **OK** to dismiss this dialog



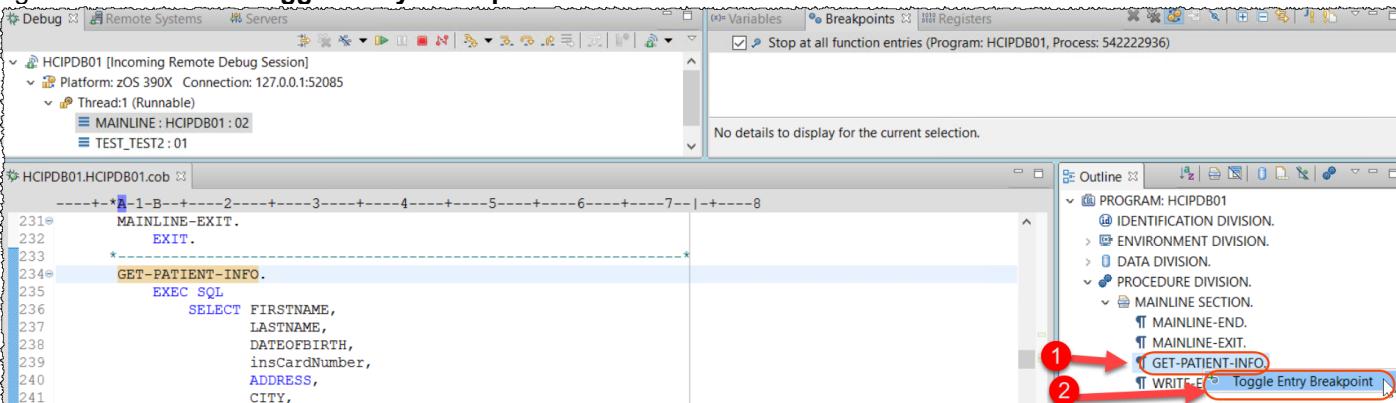
4.4.6 Notice that the first program being debugged is the program that you introduced the bug. (**HCIPDB01**)  
The execution is stopped BEFORE that program starts. You can add some breakpoints before running.

 Using the Breakpoints view, right click and select **Add Breakpoints > Stop At All Functions Entries**. This would allow you to reach the entry point of the source files by repeatedly clicking *resume*.

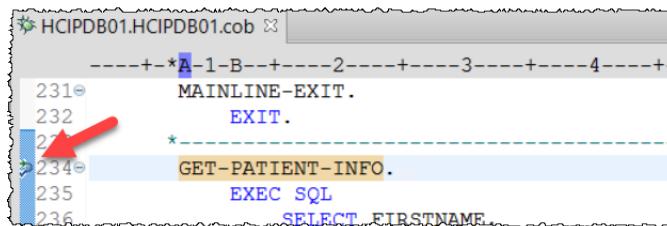
 If a **Debug Engine Message** dialog pops up click **OK**



#### 4.4.7 Using the Outline view to navigate to **GET-PATIENT-INFO**, right click and select **Toggle Entry Breakpoint**



4.4.8 A breakpoint is created on the **EXEC SQL SELECT** statement. When the program runs it will stop there.

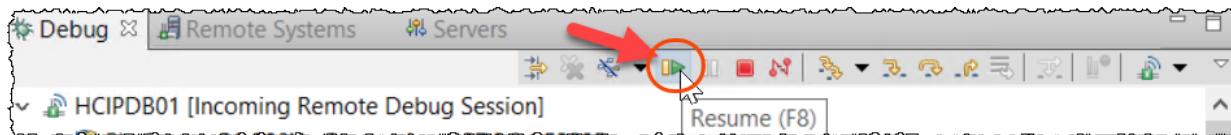


```

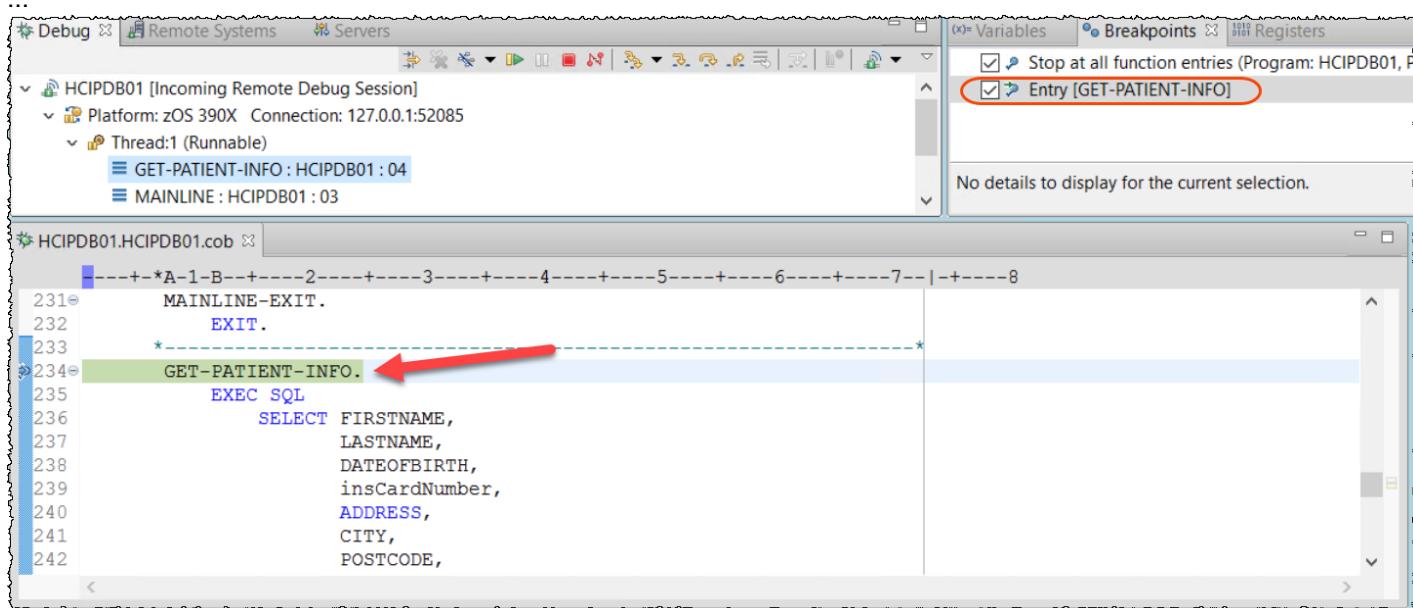
HCPDB01.HCPDB01.cob
-----+---+---+---+---+---+---+---+
231*   MAINLINE-EXIT.
232      EXIT.
233*
234* GET-PATIENT-INFO.
235      EXEC SQL
236      SELECT FIRSTNAME.

```

4.4.9  Click on icon  or press **F8** to resume. the execution



4.4.10 The execution will halt at the **SQL SELECT** statement due the breakpoint you added. Notice your program is now using “stubbed code data” instead of accessing the DB2 database..



The screenshot shows the IBM Rational Application Developer interface. The top navigation bar includes 'Debug', 'Remote Systems', and 'Servers'. The left pane displays a tree structure for 'HCIPDB01 [Incoming Remote Debug Session]' under 'Platform: zOS 390X' with 'Thread:1 (Runnable)' expanded, showing 'GET-PATIENT-INFO : HCIPDB01 : 04' and 'MAINLINE : HCIPDB01 : 03'. The right pane has tabs for 'Variables', 'Breakpoints', and 'Registers'. The 'Breakpoints' tab is active, showing a checkbox for 'Stop at all function entries (Program: HCIPDB01, Function: Entry [GET-PATIENT-INFO])' which is checked. Below this, it says 'No details to display for the current selection.' The bottom pane shows the COBOL source code 'HCPDB01.HCPDB01.cob' with the following lines:

```

-----+---+---+---+---+---+---+---+
231*   MAINLINE-EXIT.
232      EXIT.
233*
234* GET-PATIENT-INFO.
235      EXEC SQL
236      SELECT FIRSTNAME,
237          LASTNAME,
238          DATEOFBIRTH,
239          insCardNumber,
240          ADDRESS,
241          CITY,
242          POSTCODE,

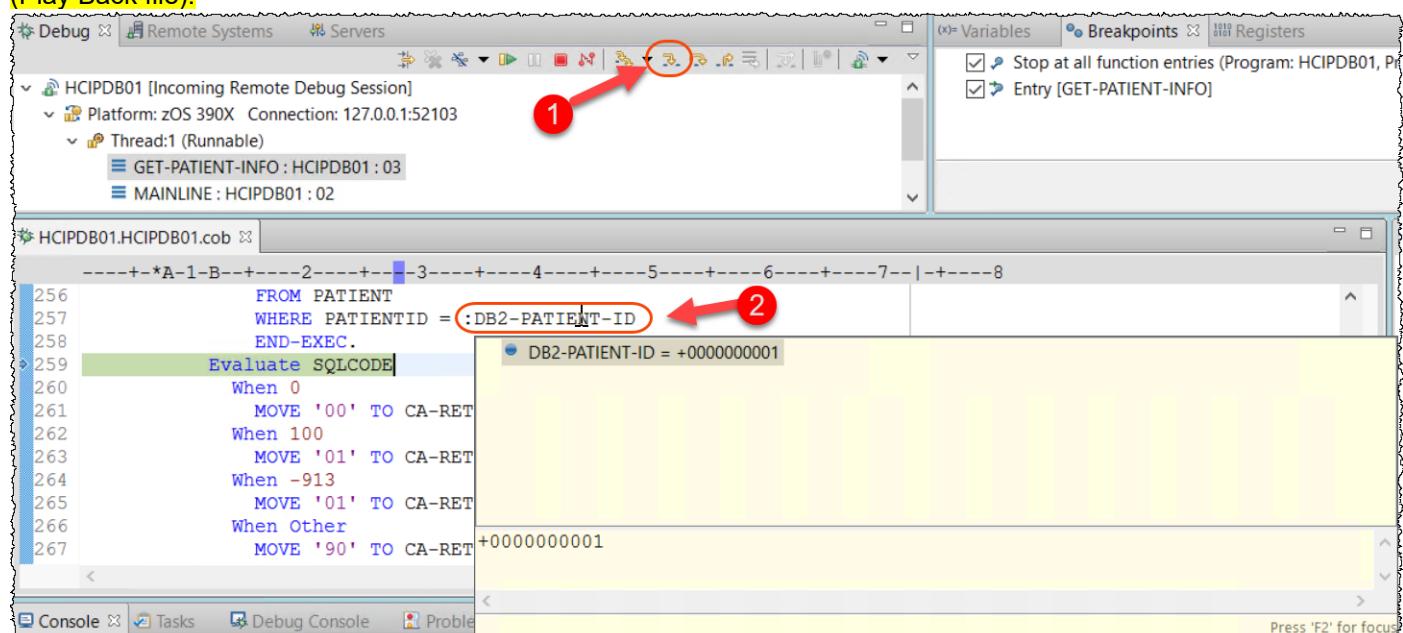
```

A red arrow points to the line '234\* GET-PATIENT-INFO.'

4.4.11 ► Click on icon or press F5 to Step Into the code until you find the statement below.

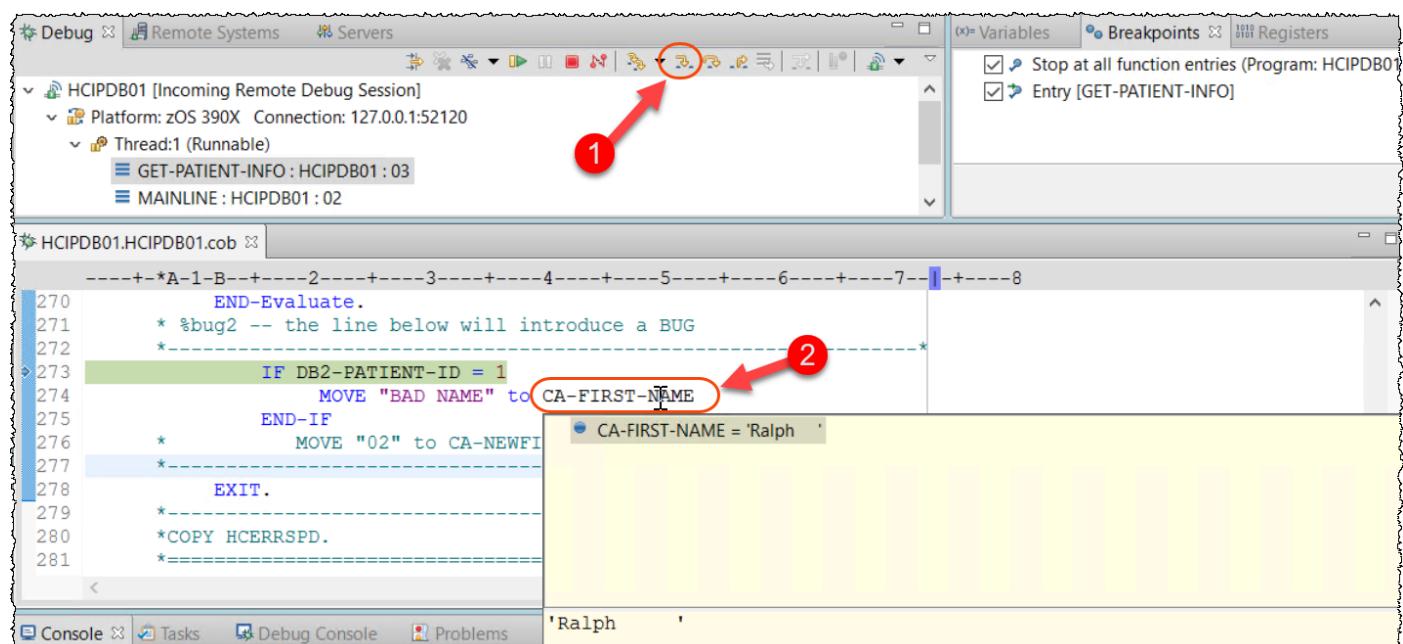
► You can move the mouse to : DB2-PATIENT-ID and see its contents

Again, notice that we get DB2 data without going to the database, but using the stub recorded earlier (Play Back file).



4.4.12 ► Keep clicking on icon or press F5 to Step Into the code until you see the bug that you had introduced.

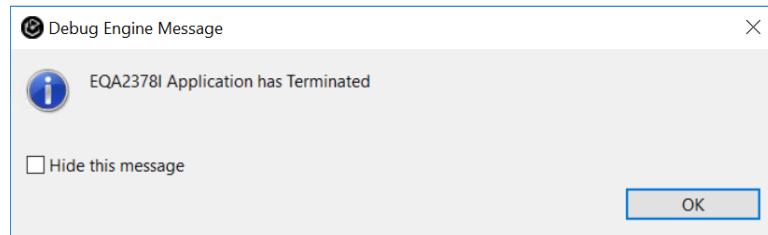
► You also can see the BUG that you introduced. Move the mouse to CA-FIRST-NAME to see the field content (**Ralph**), which will be replaced by **"BAD NAME"**.



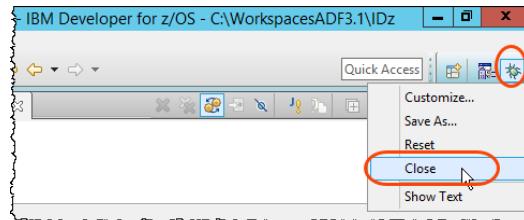
4.4.13 ► Click on icon or press **F8** to resume.. Or if you prefer keep clicking on *Step Into*.



4.4.14 ► You will see that the debug ends when you have the dialog below. Click **OK**



4.4.15 ► On top right corner, right click on icon and select **Close** to close the debug perspective



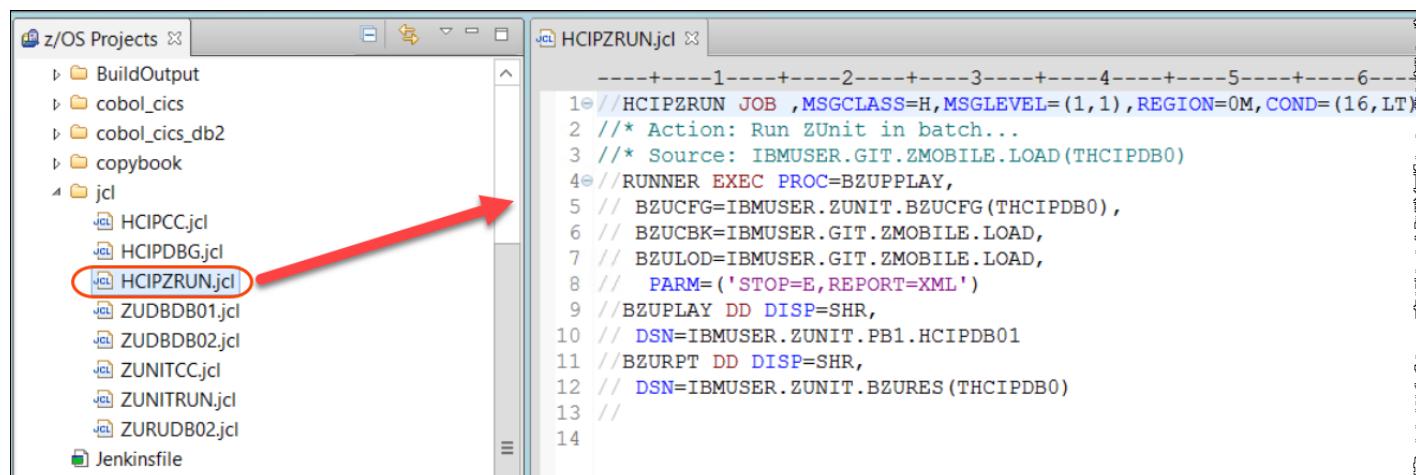
## Section 5. (Optional) Run the unit test from a batch JCL.

Once a test case has been generated and built, it can be executed using a batch run via JCL. This would enable it to be ran as part of an automated process or pipeline..

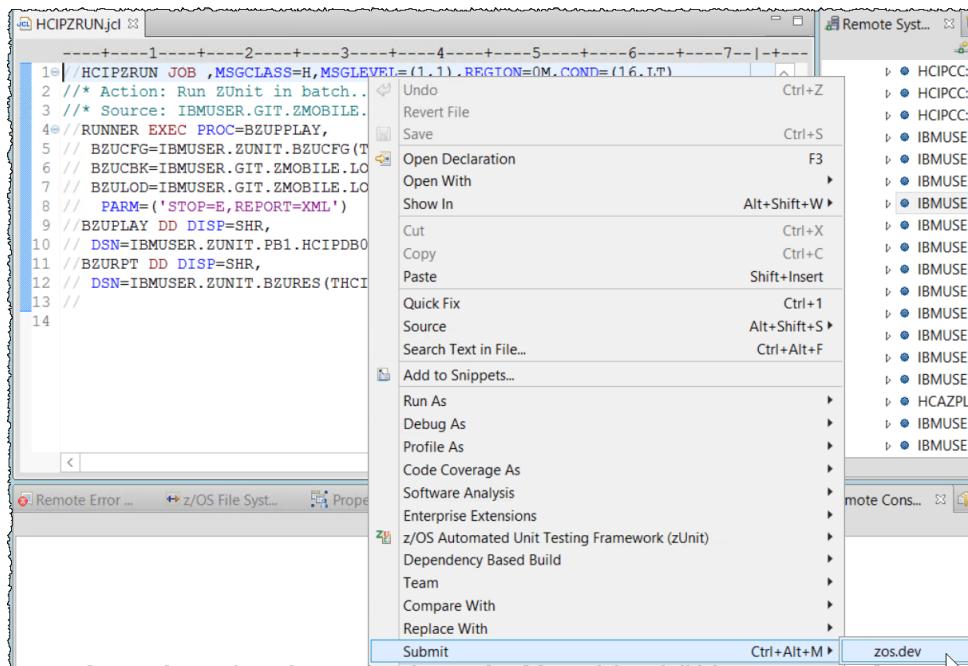
### 5.1 Running the unit test from a batch JCL

5.1.1 ► Close any active windows by pressing **Ctrl+Shift+F4**.

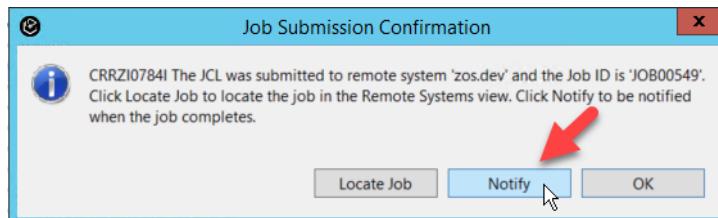
5.1.2 ► On the IDz z/OS Projects view, double click **HCIPZRUN.jcl** to open it. This JCL will run the test case that you created using a batch job.



5.1.3 ► Right click the editor and select **Submit > zos.dev**.

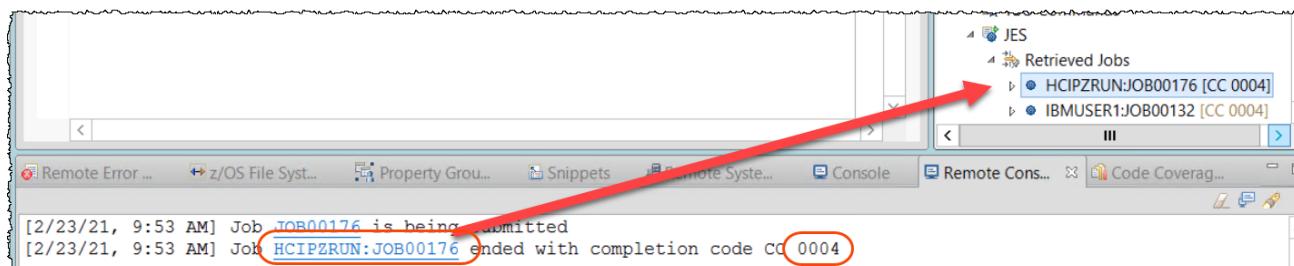


5.1.4 ► Click **Notify** on the Job Submission Confirmation dialog.



5.1.5 You **MUST** have **0004** as return code.

► Click on **HCIPZRUN:JOB00xxx**



5.1.6 ► Expand **HCIPZRUN:JOB00xxx** and verify the results double clicking on **RUNNER:REPLAY:SYSOUT**.

```

HCIPZRUN.jcl IBMUSER.HCIPZRUN.JOB00103.D0000104?.spool
-----1-----2-----3-----4-----5-----6-----7-----8-----
1 TEST_INQ01 STARTED...
2 CALL HCIPDB01
3 DB2_INPT ...
4 DB2_OUTP ...
5 CICS_OE08_HCIPDB01 CHECK VALUES...
6 EXEC CICS RETURN X'0000' L=00230
7 AREA ALLOCATED FOR RECORD COUNT:00000048
8 CICS_OE08_HCIPDB01 SUCCESSFUL.
*****AZU2001W THE TEST "INQ01" FAILED DUE TO AN ASSERTION.
11 AZU1101I COMPARE FAILED IN PROCEDURE DIVISION.
12 DATA ITEM NAME : CA-FIRST-NAME OF CA-PATIENT-REQUEST OF DFHCOMMAREA
13 VALUE          : BAD NAME
14 EXPECTED VALUE: Ralph
*****TEST_INQ01 SUCCESSFUL.
15
16
17

```

5.1.7 This JCL could be executed using DBB as part of a Jenkins Pipeline.

You may see an example of a groovy script used by DBB at the USS file below:

/var/jenkins/workspace/HealtCareAndUCD/HealthCareApp/build/\_RunZUnitJCL.groovy

► Under **zos.dev** and **z/OS UNIX Files** look for filter **groovy\_samples**

```

RunZUnitJCL.groovy
import com.ibm.dbb.build.CopyToHFS
import com.ibm.dbb.build.DBBConstants
import com.ibm.dbb.build.JCLExec
// ****
5 * Changed Dec 27, 2019 by Regi
6 * The following sample shows how to use JCLExec API to execute a ZUnit and
7 * display the results in the console.
8 * This sample assumes that user has setup the ZUnit and a JCL to execute the
9 * ZUnit.
10 * This sample requires:
11 *   1. The data set contains the JCL.
12 *   2. The data set contains the output of the ZUnit result.
13 * Sample output:
14 *   Running ZUnit in JCL 'IBMUSER.ZUNIT.JCL(ZUNIDB01)'
15 *   The JCL Job completed with Max-RC CC 0004
16 *   ***** Module [J05CMORT] *****
17 * zUnit Test Runner 2.0.0.1 started at 2019-11-06T13:57:22.885...
18 * Test count: 1
19 * Tests passed: 1
20 * Tests failed: 0
21 * Tests in error: 0
22 *
23 ****
24
25 /* DBB_CONF must be set for running JCLExec */
26 /* def confDir = System.getenv("DBB_CONF") */
27 /* added by regi - was above statement only before */
28 def confDir = "/var/dbb/1.0.7/conf"
29
30 /* The data set contains the ZUnit JCL */
31 /* For example: IBMUSER.ZUNIT.JCL */
32 def jclDataset = "IBMUSER.ZUNIT.JCL"

```

Notice that this capability allows you to invoke zUnit using pipelines like Jenkins.

**Congratulations!** You have completed the Lab.

## LAB 7 – Using IBM Dependency Based Build with Git, Jenkins and UCD on z/OS (60 minutes)

Updated Mar 26 2021 by Regi., (Reviewed by Wilbert)

This lab will take you through the steps of using [IBM Dependency Based Build](#) (DBB) along with [Git](#), [Jenkins](#) and [UrbanCode Deploy](#) (UCD) on z/OS.

On this lab you will modify an existing COBOL/CICS application stored in Git.

You will use **IDz** (which is part of the **ADFz** "package") to change the code and perform a personal test for later delivery and commit to *Git* and then use *Jenkins* for the final build and continuous delivery.

The updated code will be deployed to CICS using *UrbanCode Deploy* (UCD)

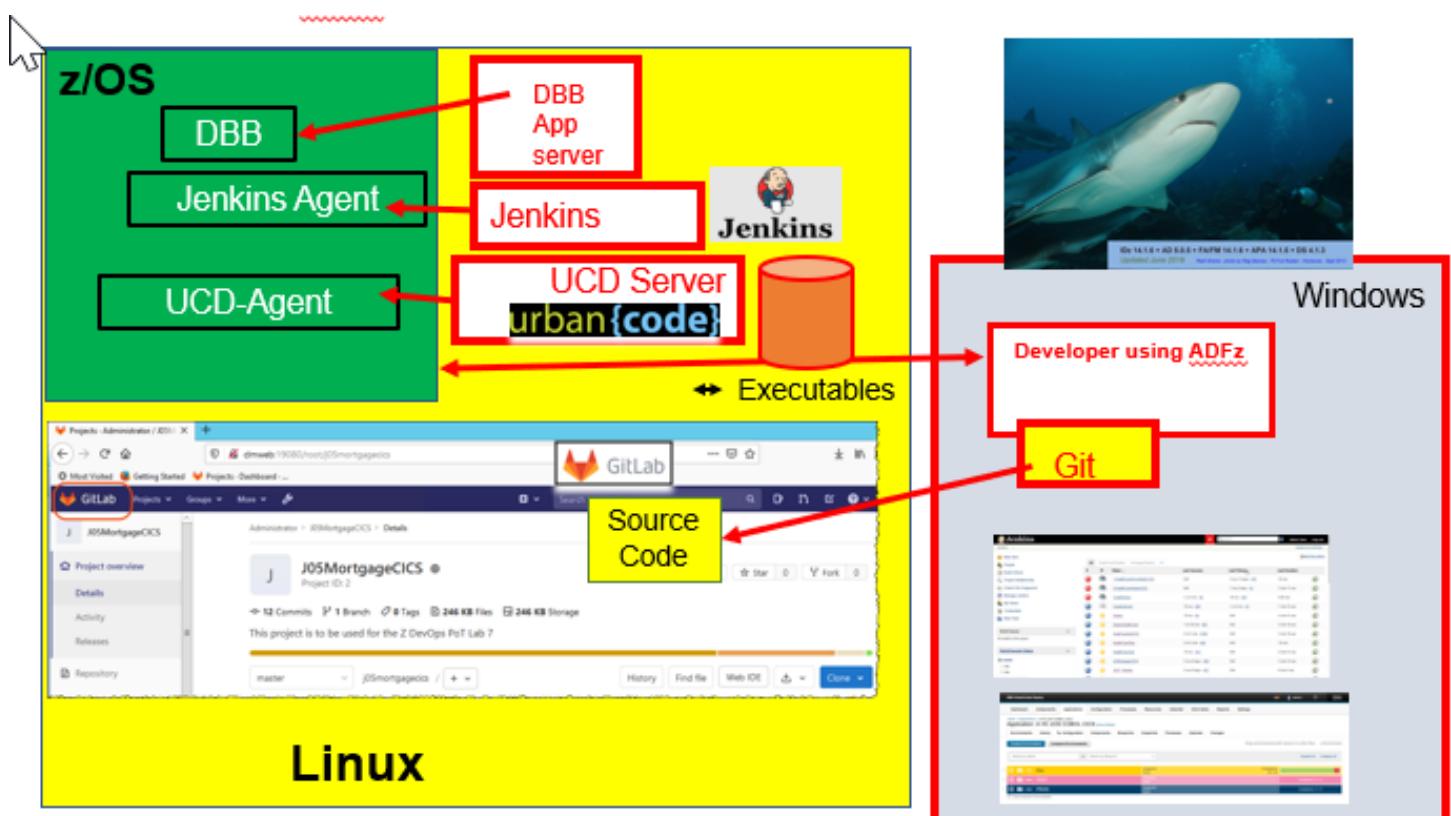
The process would be similar for a PL/I program or IMS instead of CICS.

More about DBB [https://www.ibm.com/support/knowledgecenter/SS6T76\\_1.1.0/welcome.html](https://www.ibm.com/support/knowledgecenter/SS6T76_1.1.0/welcome.html)

The environment used on this Lab is pictured below.

Note that we have few “servers” running on Linux like **UCD server**, **Jenkins**, **DBB Application Server**.  
Also the **Git Repository** is on Linux.

The z/OS has many other running tasks including **CICS**, **DB2**, **DBB code** and agents that interact with the Linux servers.



## Overview of development tasks

To complete this tutorial, you will perform the following tasks:

1. **Get familiar with the application using the 3270 terminal**  
→ You will start a 3270 emulation and execute a transaction named **J05P** to become familiar with the Application that you intend to modify.
2. **Load the source code from Git to the local IDz workspace**  
→ You will load the COBOL code that is stored on Linux to your windows client to be modified.
3. **Modify the COBOL code using IDz.**  
→ Using *IDz* you will modify the COBOL code to have a different message in a *C/ICS* dialog.
4. **Use IDz DBB User Build to compile/bind and perform personal tests.**  
→ You will compile and link the modified code using the *DBB User Build* Function. When complete you will run the code using *C/ICS* for a personal test and verify that the change is correctly implemented.
5. **Push and Commit the changed code to Git .**  
→ You will commit the changes to *Git*.
6. **Use Jenkins with Git plugin to build all the modified code committed to Git.**  
→ You will use Jenkins pipeline to build the new changed code and push the executables to be deployed using *UCD*.  
Note that this step makes a build of all code committed to Git, while on step 4 only the selected COBOL program was built.
7. **Use Jenkins and UCD plugin to deploy results and test the CICS transaction again**  
→ You will verify the results after the final deploy to *C/ICS* using *UCD*
8. **(Optional) Understanding DBB Build Reports**  
→ You will understand the reports generated by *DBB* during the build.

### What is Git and DBB ?

**Git** is an open Source Code Management tool that is very popular in the distributed world.

In early 2017, Rocket Software ported Git into the mainframe – with the necessary checks to handle EBCDIC to UTF-8 conversions and vice-versa.

In Q3 2017, IBM released an Open Beta of **Dependency Based Build (DBB)**. DBB provides a build tool that provides the build framework, dependency understanding, and tracking for builds run on z/OS. This build system is not dependent on any SCM or Continuous integration automation tool. In this lab, we use DBB to build our z/OS COBOL source code which resides in the distributed Git Repositories.

DBB is part of IBM Developer for Z Systems EE (Enterprise Edition) or ADFz and was announced on March 13, 2018.



### GitHub vs. Bitbucket vs. GitLab ?

More at: <https://stackshare.io/stackups/bitbucket-vs-github-vs-gitlab>

**GitHub**, **Bitbucket**, and **GitLab** are code collaboration and version control tools offering repository management. They each have their share of fans, though **GitHub** is by far the most used of the three.

Of the three, only **GitLab** is open source, though all three support open source projects. For that reason we are using **GitLab** in this lab, but the steps would be exactly the same if using other tools.

**GitHub** offers free public repositories; **Bitbucket** also offers free private repositories; **GitLab** offers a Community Edition which is entirely free

## Section 1. Get familiar with the application using the 3270 terminal

You will start a 3270 emulation and execute a transaction named J05P to become familiar with the Application that you intend to update.

**Tip** → Use the notepad and edit **C:\ADF\_POTILAB7** to copy/paste values if you don't want to type).

### 1.1 Connect to z/OS and emulating a CICS 3270 terminal

#### 1.1.1 Start *IBM Developer for z Systems version 15* if it is not already started

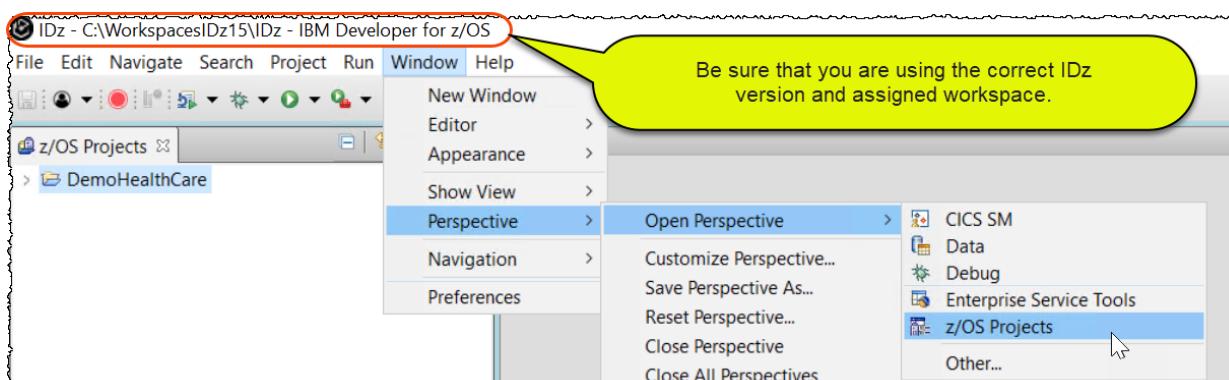
► Using the desktop double click on **IDz V15** icon.

► Verify that the message indicates that it is Version **15.0.1**

**IMPORTANT** -> This icon will start an eclipse workspace that has already some definitions required for this lab.  
PLEASE DO NOT start IDz using other way than this icon.



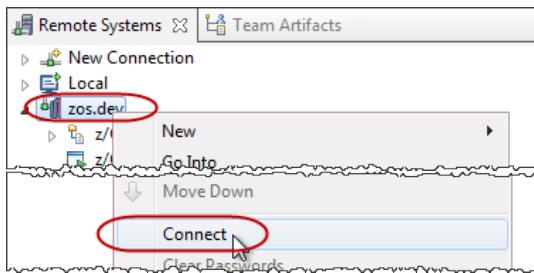
#### 1.1.2 ► Open the **z/OS Projects** perspective by selecting **Window > Perspective > Open Perspective > z/OS Projects**



#### 1.1.3 On other labs you used userid **empot01** or **ibmuser**.

Your new userid now will be **empot05**.

1.1.4 ► Right click on **zos.dev** and select **Connect**. If you are already connected, you may Disconnect first.



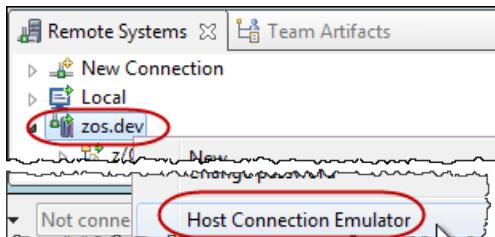
1.1.5 ► Type **empot05** as userid and **empot05** as password.

The userid and password can be any case; don't worry about having it in UPPER case.  
Click **OK** to connect to z/OS.

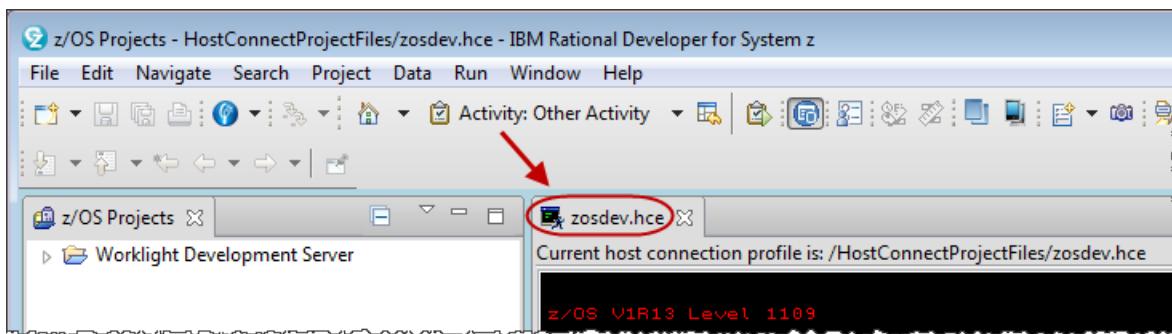
**Notice → On this lab your userid will be empot05 (not empot01 used in previous labs)**



1.1.6 ► Using the *Remote Systems* view, right click on **zos.dev** and select **Host Connection Emulator**.



1.1.7 ► Since you will need more space, **double-click** on the **zosdev.hce** title



1.1.8 ► Type **I cicsts53**. (where "I" is the lower case of letter "L") and press **Enter key**.

```
==> Examples: "L TSO", "L CICSTS52", "L CICSTS53", "L IMS13", "L IMS14"
l cicsts53_
24/011
```

1.1.9 ► Logon using **empot05** and password **empot05** and press **Enter**.

```
Signon to CICS
WELCOME TO CICS TS 5.3

Type your userid and password, then press ENTER:
--> Userid . . . empot05      Groupid . . .
--> Password . . . -          Language . . .
--> New Password . . .

MA a
```

1.1.10 The sign-on message is displayed

```
DFHCE3549 Sign-on is complete (Language ENU).
MA a
```

## 1.2 Run CICS transaction J05P

You should now be in the z/OS CICS region named *C/CSTS53*. This is the CICS instance where you will make the program changes.

1.2.1 ► Type the CICS transaction **j05p** and press the **Enter key**.

```
zosdev.hce x
Current host connection profile is: /HostConnectProjectFiles/zosdev.hce
j05p
```

1.2.2 ► Press **enter** to see the monthly payment for the default data .

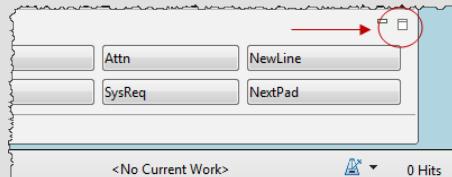
```
JKE MORTGAGE CALCULATOR

Amount of Loan: 1000
Length of Loan in Years: 10
Interest Rate: 5

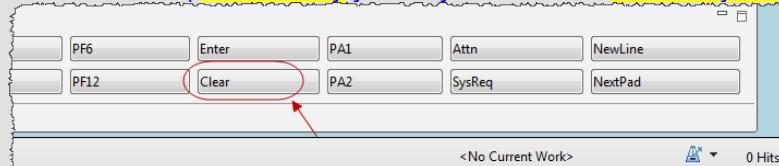
Press F3 to quit or Enter to calculate loan
Press PF9 to see companies that can match or beat this rate

Monthly Payment: 10.61
```

You may need to use the **clear** key. If the clear button is not displayed, look in the right lower corner, select this icon  . This will display possible keys, including the clear button.



**Click on Clear ( If necessary you may also use the Reset key after clicking NextPad )**



1.2.3 ► Press **F1** key and verify the message displayed “**INVALID KEY PRESSED**” .

Your mission will be modifying the COBOL program that send this message.

Your new message must be “**YYYYMMDD - INVALID KEY PRESSED**” .

Where **YYYYMMDD** will be the today's date.

```
JKE MORTGAGE CALCULATOR

Amount of Loan:      1000
Length of Loan in Years: 10
Interest Rate:        5

Press F3 to quit or Enter to calculate loan
Press PF9 to see companies that can match or beat this rate

Monthly Payment:      10.61

INVALID KEY PRESSED.
```

1.2.4 ► Press **F3** to end the application.

```
zosdev.hce ✘
Current host connection profile is: /HostConnectProjectFiles/zosdev.hce
END OF TRANSACTION - THANK YOU
```

1.2.5 ► Close the terminal emulation clicking on  →  . Or pressing **CTRL + Shift + F4**.

#### What have you done so far?

You emulated a 3270 terminal using IBM Developer for System z.

You also executed the CICS transaction **J05P** and verified a simple interaction with the Mortgage application. The objective here was to show the code that you will update.

## Section 2 – Load the source code from Git to the local IDz workspace

You will load the COBOL code that is stored on Linux to your Windows client to be modified.

### 2.1 Cloning the Git Repository

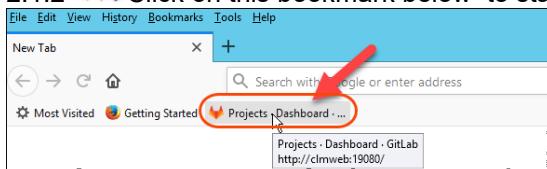
The Mortgage Application used in this lab has its source code in a *Git Repository* that is on Linux system. You must connect to the Git Repository and clone the Git project into the IDz. This brings the source code into your IDz workspace for edits and build. *GitLab* is open source and for that reason we are using *GitLab* in this lab. This lab would work also if using GitHub or Bitbucket.

#### 2.1.1 Before cloning the Git repository, you should visualize the code stored at GitLab.

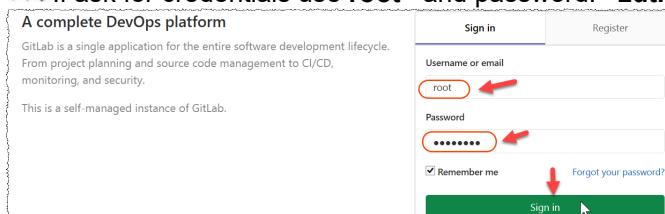
► Start a browser clicking in the icon in the bottom of your screen



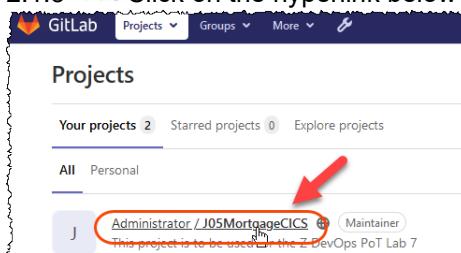
#### 2.1.2 ► Click on this bookmark below to start *GitLab*. The URL used is <http://clmweb:19080/>



► If asked for credentials use **root** and password: **zdtlinux**

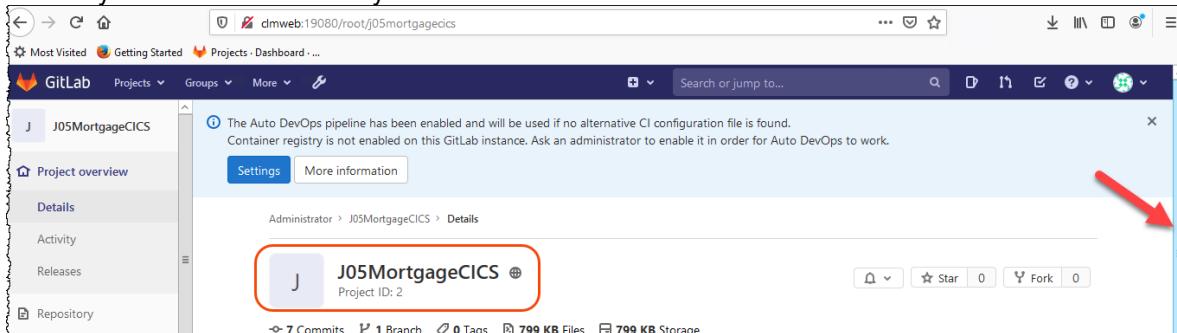


#### 2.1.3 ► Click on the hyperlink below to see the **J05MortgageCICS** repository. Be patient this may take a while...



#### 2.1.4 ► Scroll down and you find the **J05MortgageCICS** repository.

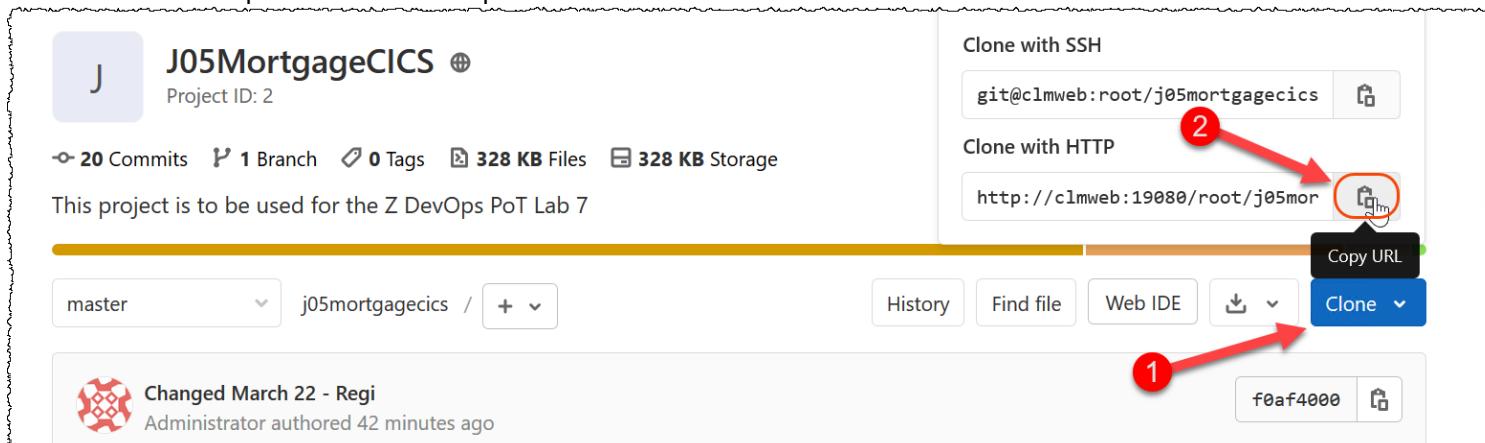
You may browse the content if you want. The source code to be used on this lab is there



2.1.5 In order to clone it at your window desktop you could use **HTTP** or **SSH**.

Since **SSH** is blocked in our environment we need to use **HTTP**.

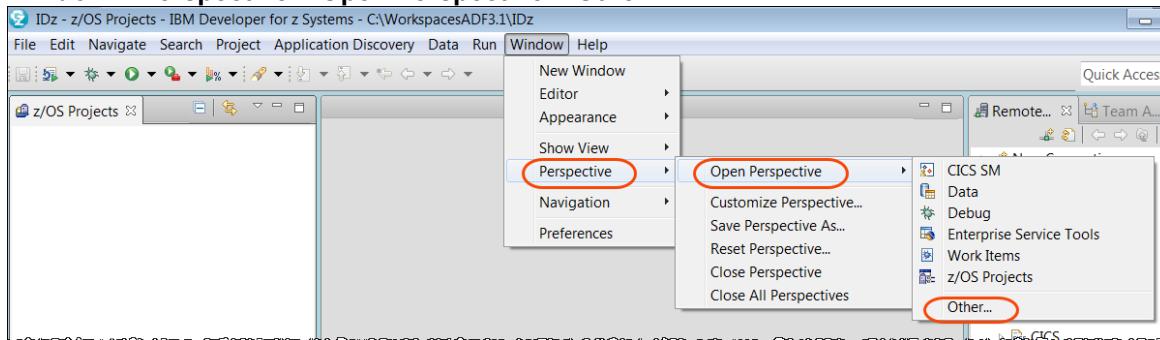
- ▶ 1 Click on **Clone** (the blue button) and 2 in the icon  to **copy the URL**.  
This value will be kept in the windows clipboard.



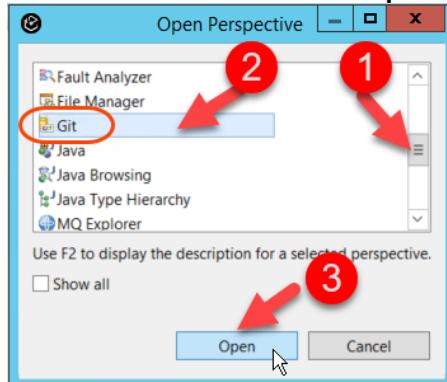
2.1.6 ▶ Go back to IDz using the icon that is on the base of your screen:



2.1.7 ▶ Open the **Git** perspective by selecting  
**Window > Perspective > Open Perspective > Other...**



2.1.8 ▶ Select **Git** and click **Open**

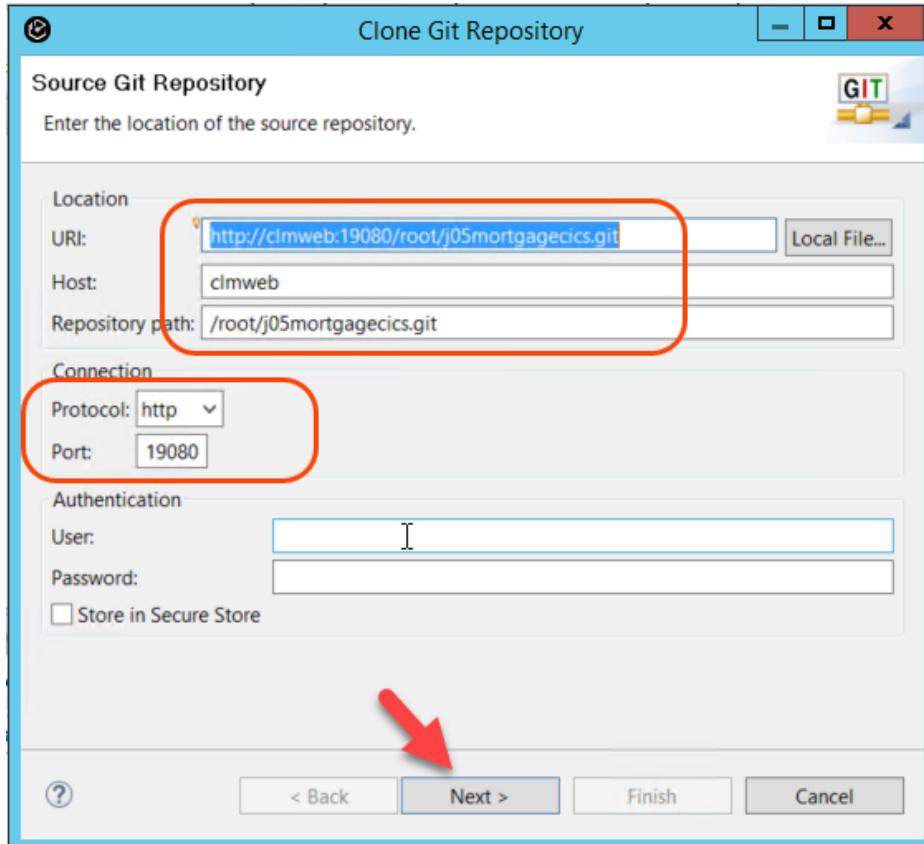


- 2.1.9 ► In the *Git Repositories* tab, click on the hyperlink to ‘Clone a Git repository’.



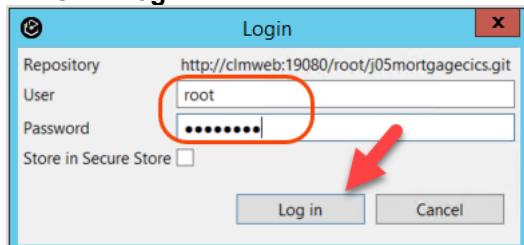
- 2.1.9 ► The values copied from the web page (copy URL) will be shown in the Clone Git Repository.  
Tip: In case you don't see it, got back to the page and copy it again (steps 2.1.1-2.1.5 above).

► Click **Next**



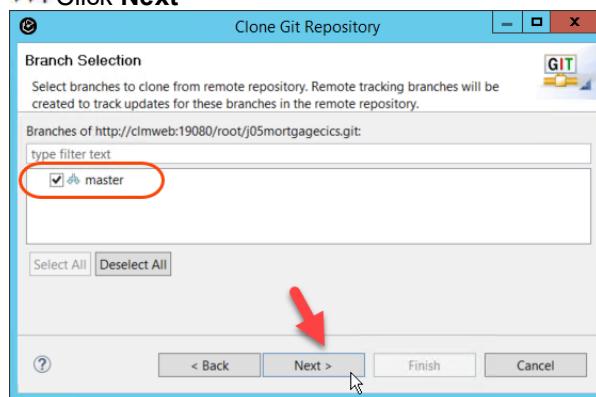
- 2.1.10 If a dialog asks for login the credentials are a user user: **root** and password **zdtlinux**

► Click **Log in**



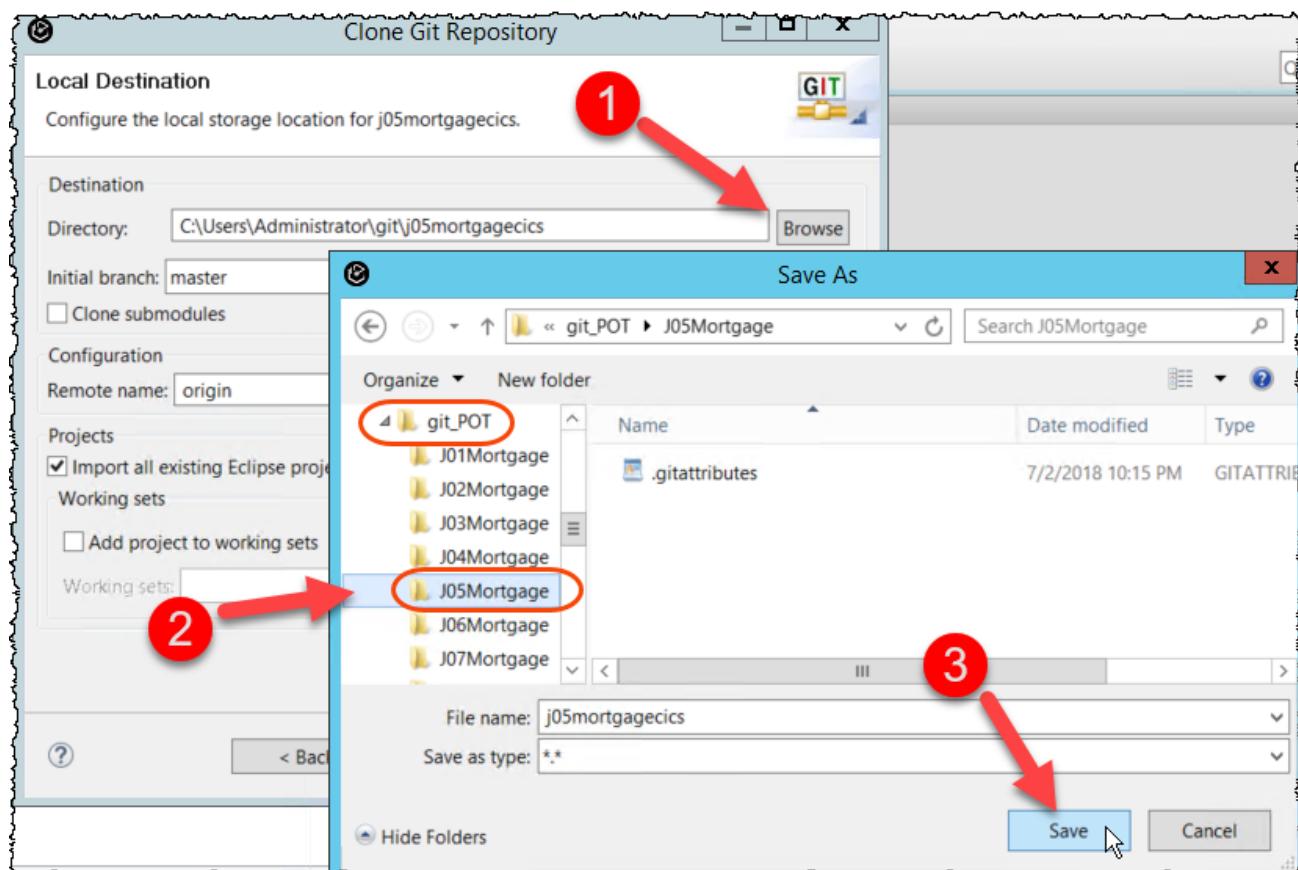
2.1.11 We have only one branch named master.

▶▶ Click Next



2.1.12 We will clone the repository on your local windows and import to be shown on IDz

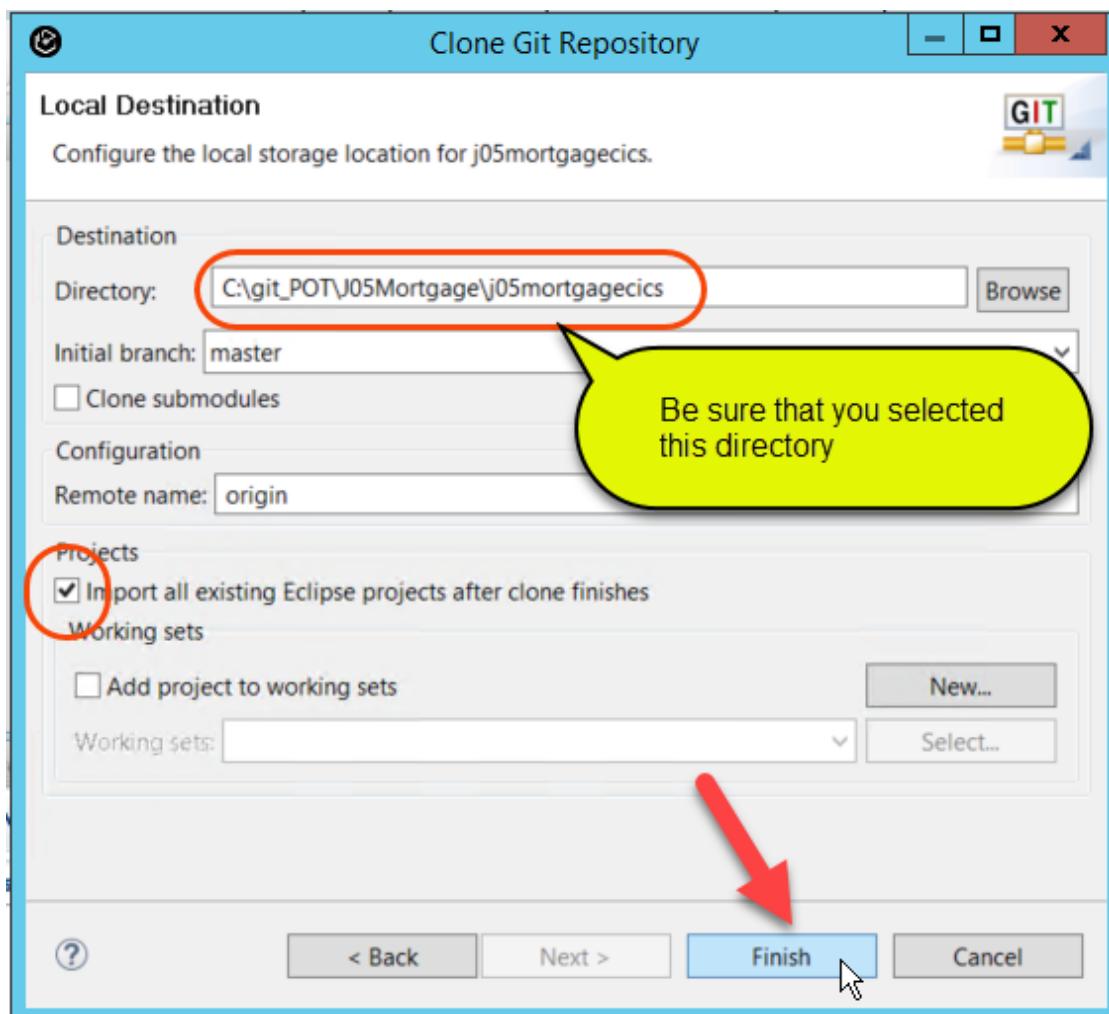
- 1 ▶▶ Use **Browse** button to select the directory **C:\git\_POT\J05Mortgage** (on left).
- 2 ▶▶ Click folder **J05Mortgage** on left
- 3 ▶▶ Click **Save**



2.1.13 The *Directory* now should point to C:\git\_POT\J05Mortgage\j05mortgagetcics

► Be sure that you selected **Import all existing Eclipse projects after clone finishes**

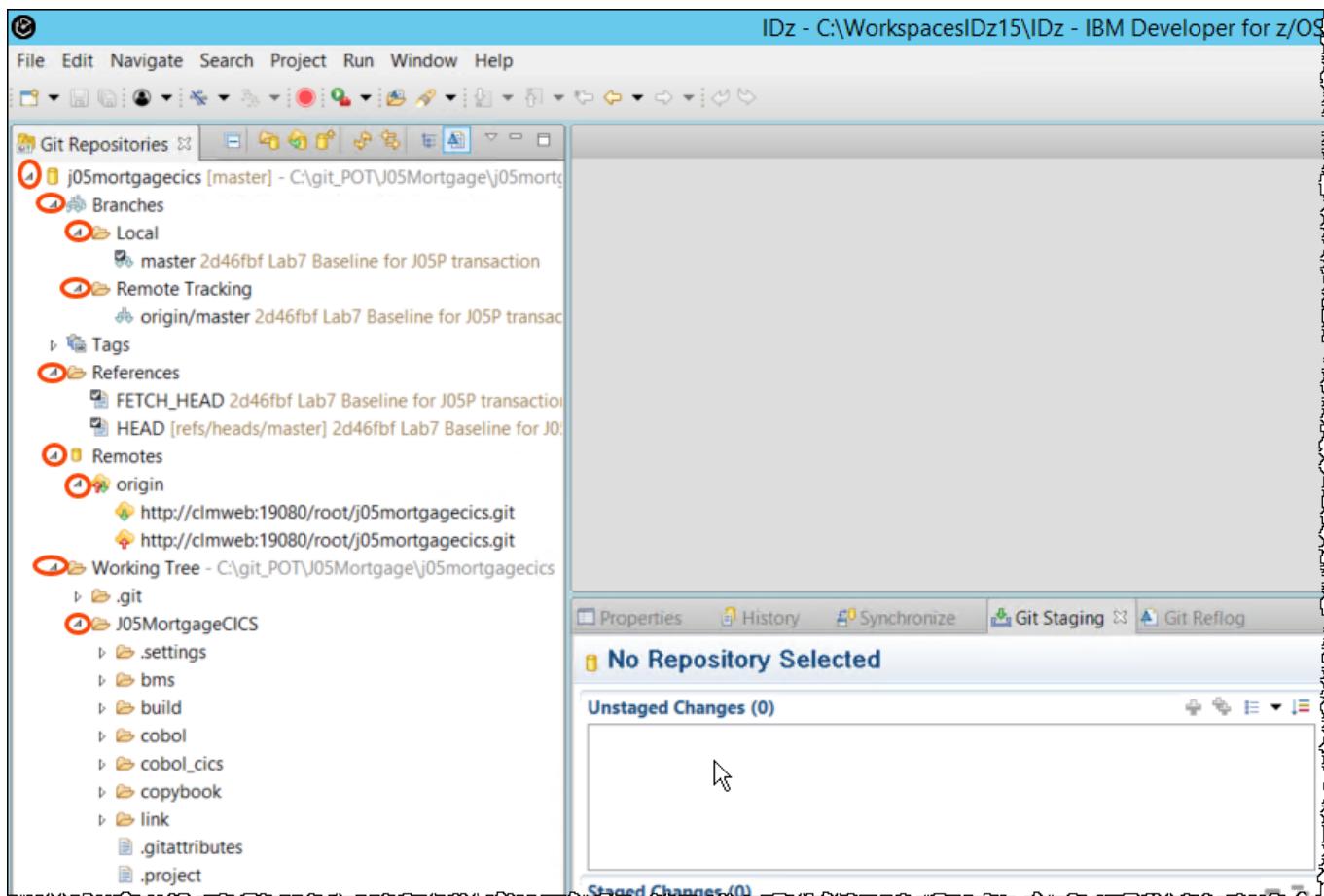
► Click **Finish**



2.1.14 The Mortgage Application will be cloned from the Remote master repository and will appear in the *Git Repositories* view.



2.1.15 **Expand the nodes** by left clicking on the icon as shown below:

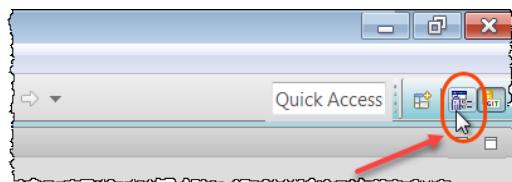


## 2.2 Verify the code cloned using z/OS projects perspective

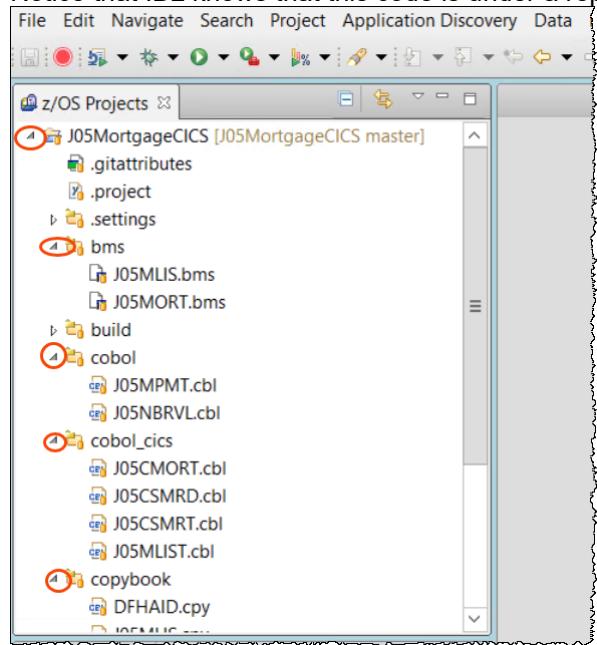
The z/OS projects perspective is the IDz perspective that developers use to work with the source code.

Notice that you have cloned the project at your local workstation but later you will need to connect to z/OS to be able to compile and build your programs.

2.2.1 **Switch to the z/OS Projects perspective** clicking on icon on the top right corner



2.2.2 ► Expand the project **J05MortgageCICS** clicking on icon ▶ and see the source code loaded  
 Notice that IDz knows that this code is under a repository and the yellow decorator on the icon 📁 indicates that.



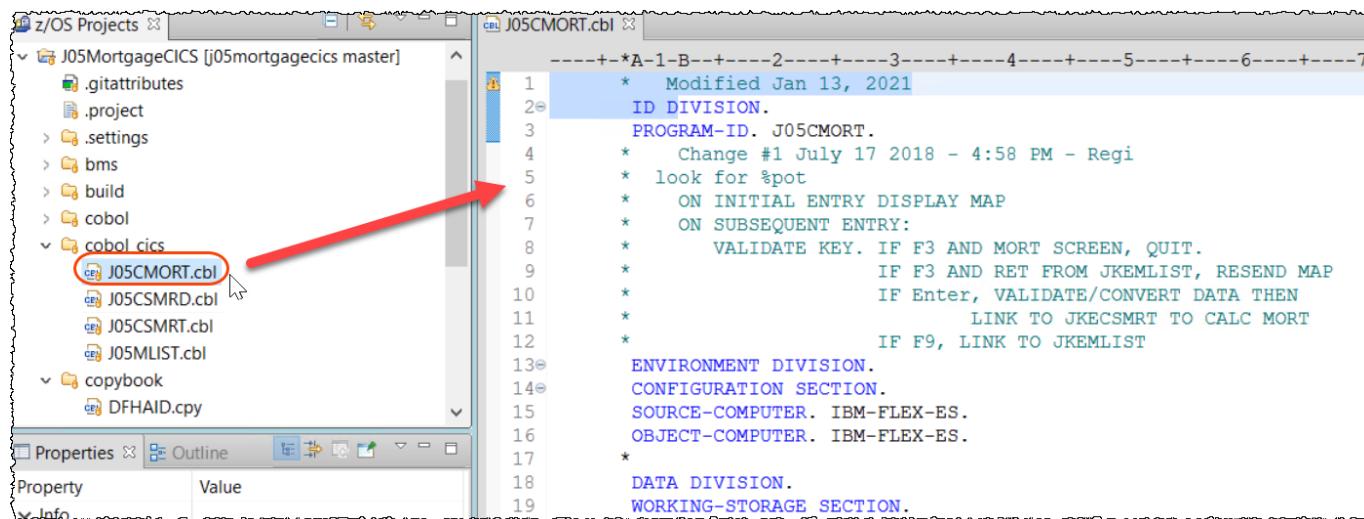
## Section 3 –Modify the COBOL code using IDz.

Using IDz you will modify the COBOL to have a different message in a CICS dialog.  
 You will replace the message “**INVALID KEY PRESSED**” when pressing F1 by another message:  
**“YYYYMMDD - INVALID KEY PRESSED”**.

### 3.1 Edit and modify the code that send the message

The COBOL code to be modified is the program **J05CMORT** that is under the folder **cobol\_cics**.

3.1.1 ► Using z/OS Projects view double click **J05CMORT** under **cobol\_cics**  
 This is the program that you will update



3.1.2 ►| Use **Ctrl + f** to find the “%pot” on line 137 (second Find hit). You will modify the line 141..

J05CMORT.cbl

```

131 * Process Enter Key to calculate the loan amount
132     PERFORM A100-PROCESS-MAP
133     END-IF
134     WHEN OTHER
135 * Invalid key
136     MOVE LOW-VALUES TO JKEMENUO
137 * %pot - below is the message to be changed -
138 * Replace YYYYMMDD Example: 20180712 *
139 *
140     MOVE 'INVALID KEY PRESSED.' TO MSGERRO
141     MOVE 'INVALID KEY PRESSED.' TO MSGERRO
142     SET SEND-DATAONLY TO TRUE
143     PERFORM A300-SEND-MAP
144     END-EVALUATE
145     EXEC CICS
146         RETURN TRANSID(EIBTRNID)
147         COMMAREA(W-COMMUNICATION-AREA)
148         LENGTH(W-COMAREA-LENGTH)
149     END-EXEC.
150

```

Find/Replace

Find: %pot (1)

Replace with:

Direction: Forward Scope: All

Options: Case sensitive (unchecked), Wrap search (checked), Whole word (unchecked), Incremental (unchecked), Regular expressions (unchecked)

Buttons: Find (2), Replace/Find, Replace, Replace All, Close

3.1.3 ►| Close the find dialog and modify the line 141

From

MOVE 'INVALID KEY PRESSED.' TO MSGERRO

To

MOVE 'YYYYMMDD - INVALID KEY PRESSED.' TO MSGERRO

Where **YYYYMMDD** is the today's date.. Example, I changed to **20190529..**

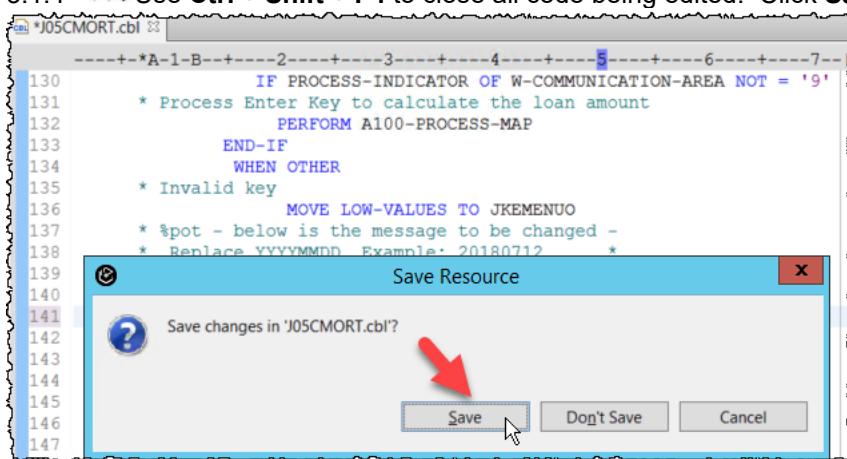
J05CMORT.cbl

```

129 WHEN EIBAID = DFHENTER
130     IF PROCESS-INDICATOR OF W-COMMUNICATION-AREA NOT = '9'
131 * Process Enter Key to calculate the loan amount
132     PERFORM A100-PROCESS-MAP
133     END-IF
134     WHEN OTHER
135 * Invalid key
136     MOVE LOW-VALUES TO JKEMENUO
137 * %pot - below is the message to be changed -
138 * Replace YYYYMMDD Example: 20180712 *
139 *
140     MOVE 'INVALID KEY PRESSED.' TO MSGERRO
141     MOVE '20190529 - INVALID KEY PRESSED.' TO MSGERRO
142     SET SEND-DATAONLY TO TRUE
143     PERFORM A300-SEND-MAP
144     END-EVALUATE
145     EXEC CICS
146         RETURN TRANSID(EIBTRNID)
147         COMMAREA(W-COMMUNICATION-AREA)

```

3.1.4 ►| Use **Ctrl + Shift + F4** to close all code being edited. Click **Save** to save the modified code.

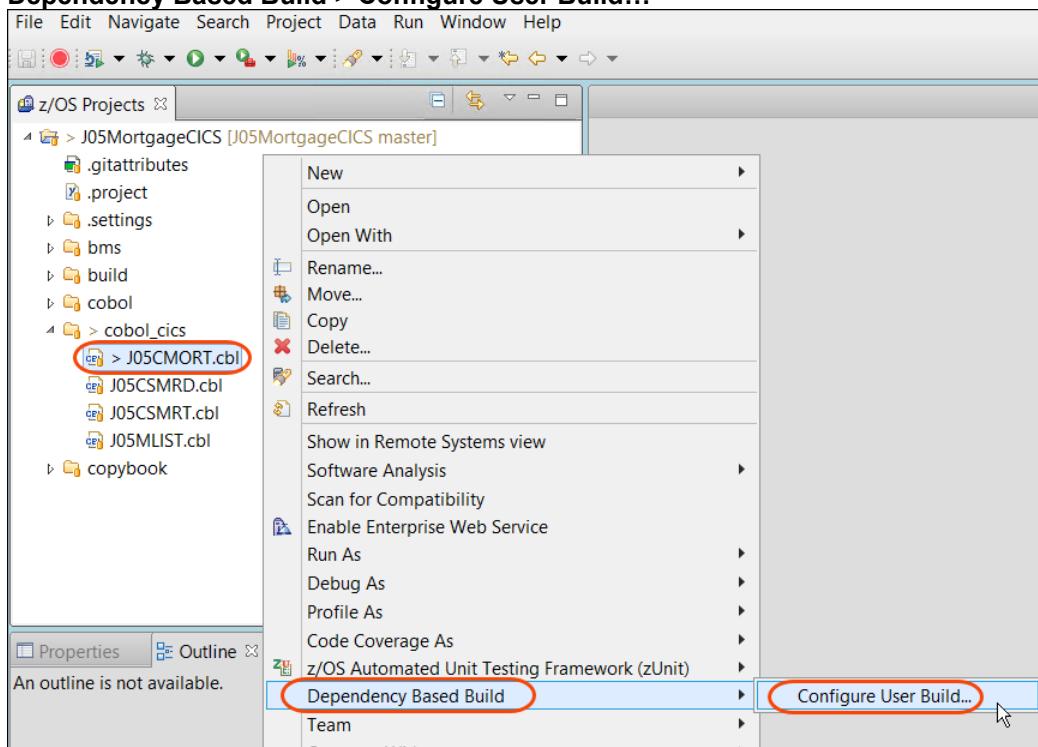


## Section 4. Use IDz DBB User Build to compile/bind and perform personal tests.

You will compile and link the modified code using the DBB User Build function. When complete you will run the code using CICS for a personal test and verify that the change is correctly implemented.

### 4.1 Using Dependency Based Building option

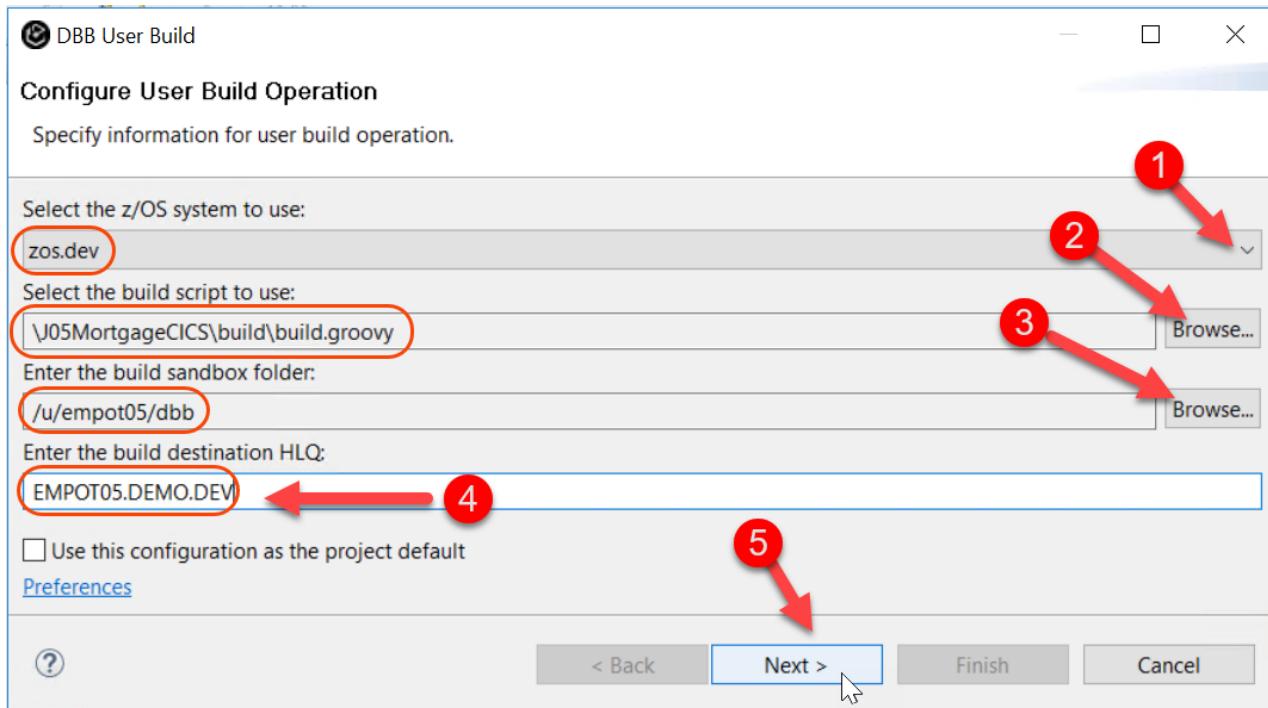
4.1.1 ►| Under **z/OS Projects** view right click **J05CMORT** and select **Dependency Based Build > Configure User Build...**



4.1.2 ► Be sure that those values are already assigned for the build, otherwise use the **Browse** button and select the values as below

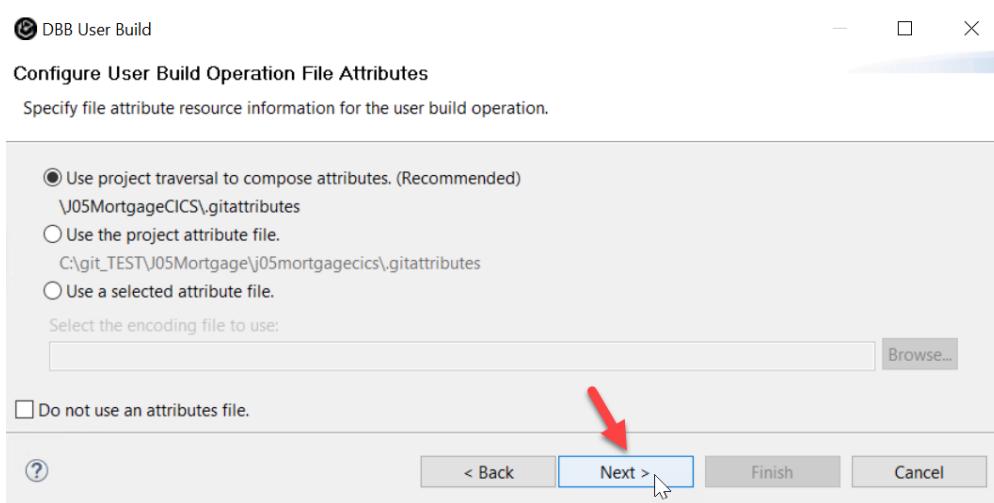
(Tip → Use the notepad and edit `c:\ADF_POT\LAB7\LAB7_Copy_Paste.txt` if want to copy/paste).

- 1 z/OS system: `zos.dev`
- 2 Build script : `\J05MortgageCICS\build\build.groovy` (use **Browse the local workspace**)
- 3 Build sandbox : `/u/empot05/dbb` (Use **Browse**, expand **MyHome**, click **dbb** and **OK**)
- 4 Build destination HLQ: `EMPOT05.DEMO.DEV` (must type)
- 5 ► Click **Next**

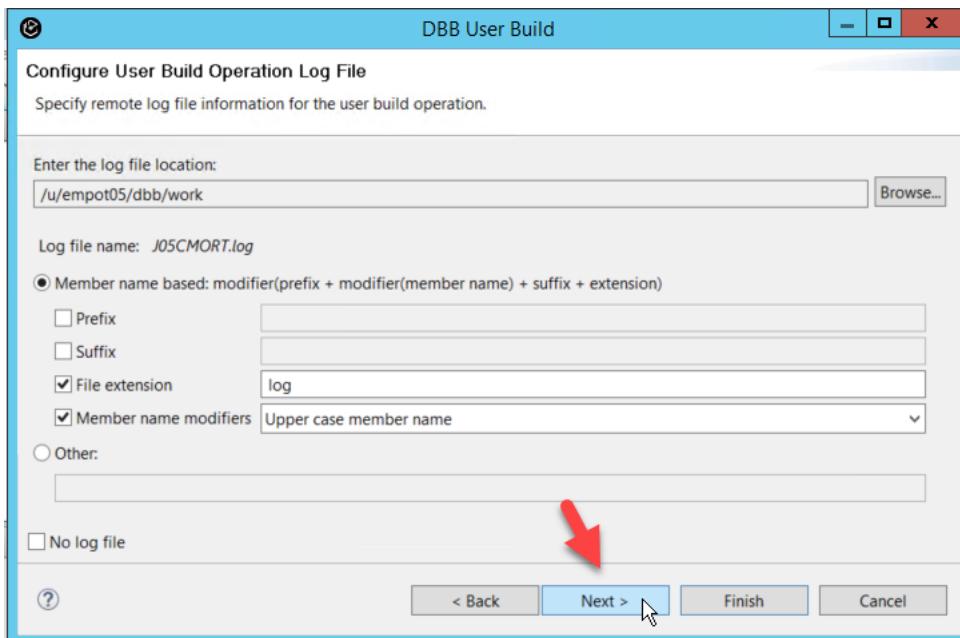


4.1.3 ► On *Configure User Build Operation File Attributes* click **Next**

The `.gitattributes` have the information to translate from *UTF-8* to *EBCIDIC* when moving the code to z/OS.



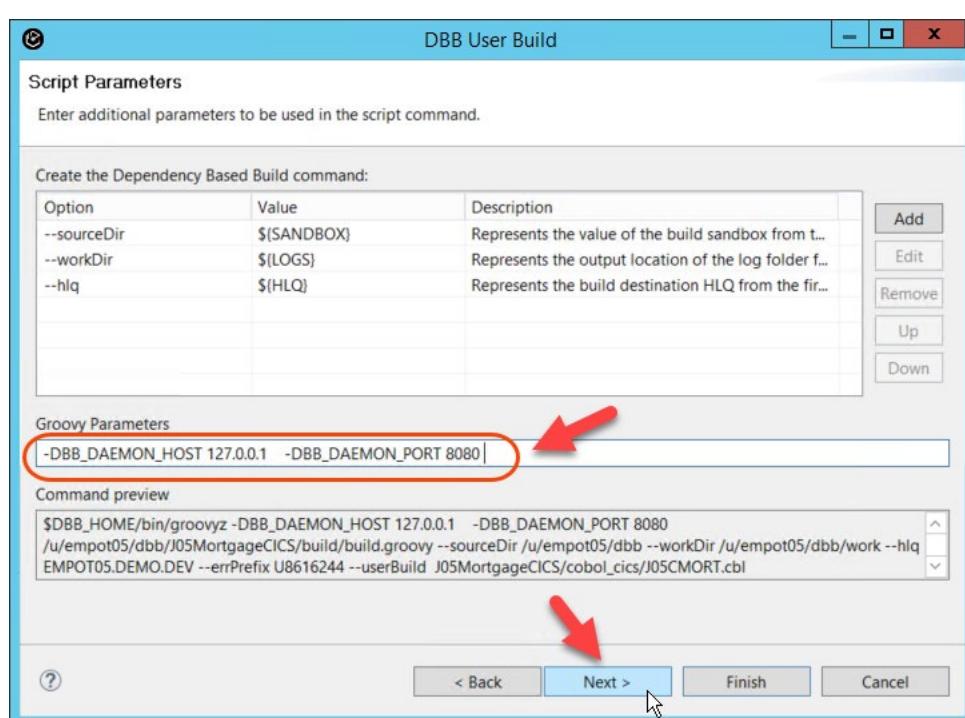
4.1.4 ►| On *Configure User Build Operation Log File* click **Next**  
 You will use the default values.



4.1.5 ►| On *Groovy Parameters* type :  
**-DBB\_DAEMON\_HOST 127.0.0.1 -DBB\_DAEMON\_PORT 8080**  
 and click **Next**.

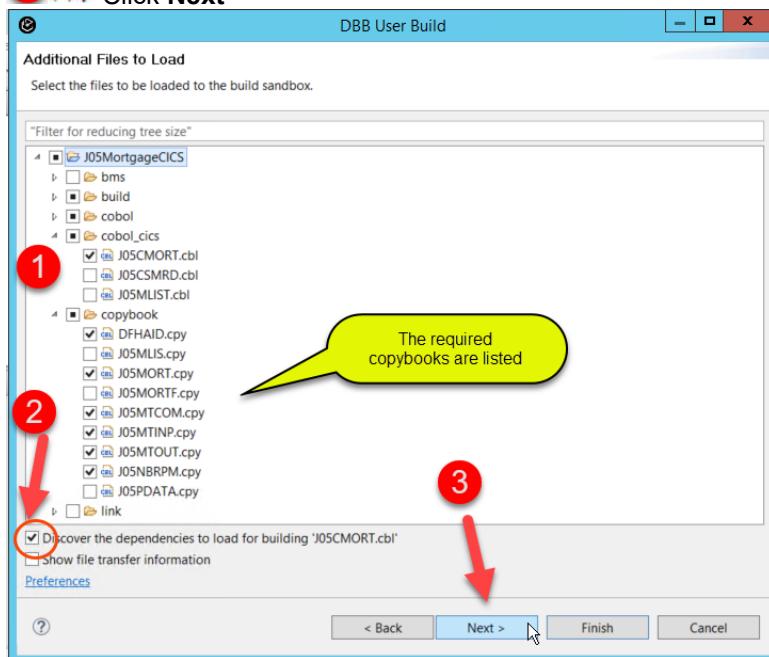
(Tip → Use the notepad and edit **c:\ADF\_POT\LAB7\LAB7\_Copy\_Paste.txt** if want to copy/paste).

This will use the DBB build manager started task to improve the build performance..  
 Notice the preview of the commands that will be execute at the z/OS by the DBB toolkit.

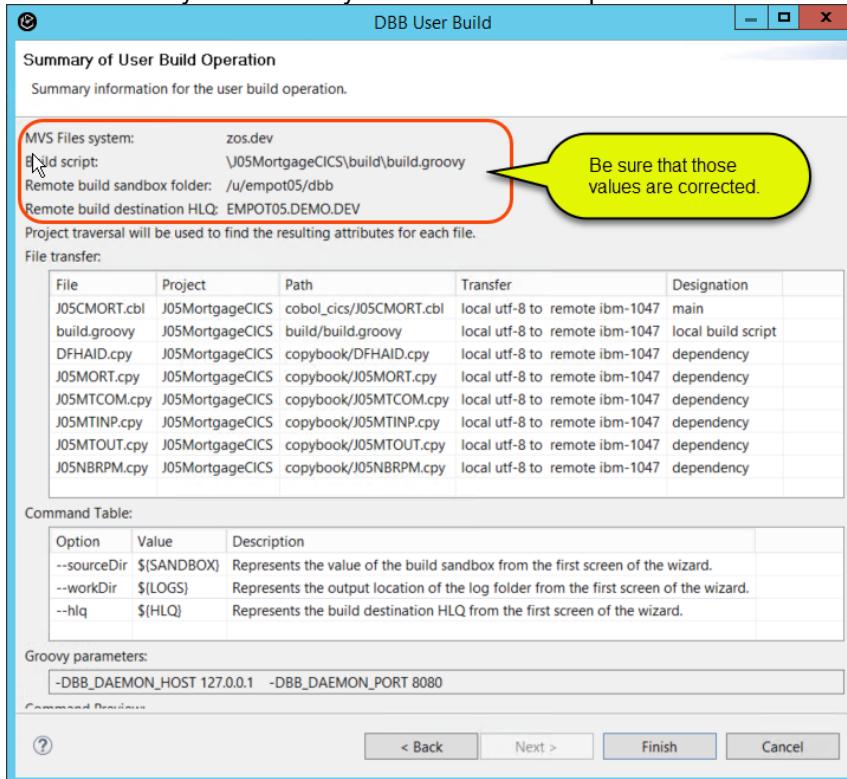


4.1.6 The selected files will be moved from your local workspace to a z/OS USS directory and the execution of the groovy scripts will interact with the DBB framework that will invoke the compiler, linkage editor, etc..

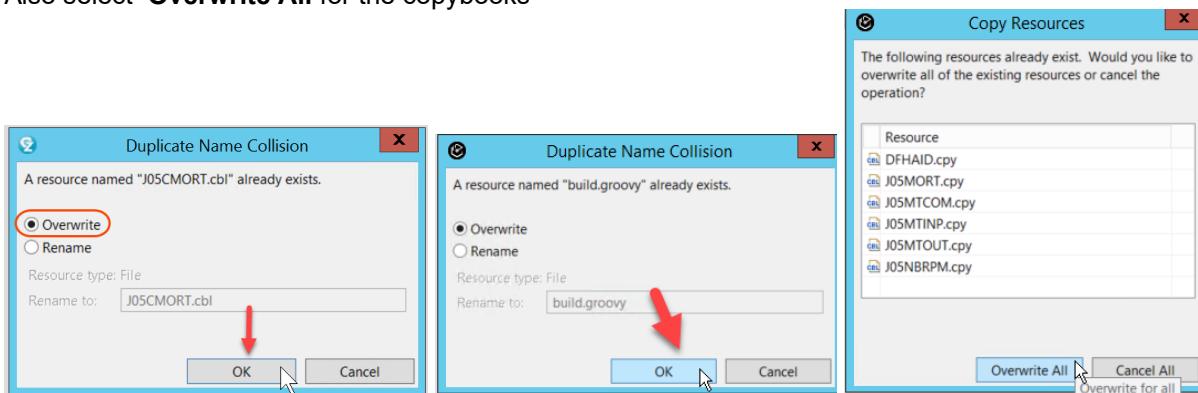
- 1 ►► Expand J05Mortgage CICS and the **cobol\_cics** and **copybook** directories
- 2 ►► Since you will also need the related copybooks for a clean compile be sure that “**Discover the dependencies to load for building J05CMORT.cbl**“ is selected (automatically checked).
- 3 ►► Click Next



4.1.7 ►► Verify the summary of the User Build Operation and click **Finish**



4.1.8 ► If the dialogs below pops up select **Overwrite** and click **OK**  
Also select **Overwrite All** for the copybooks



The DBB User build will be running and the messages will be shown at the Console view..

The execution will start, and this will take a while ( 2 to 3 Minutes) . **Time for a quick break.**

4.1.9 When complete you will have the message below:

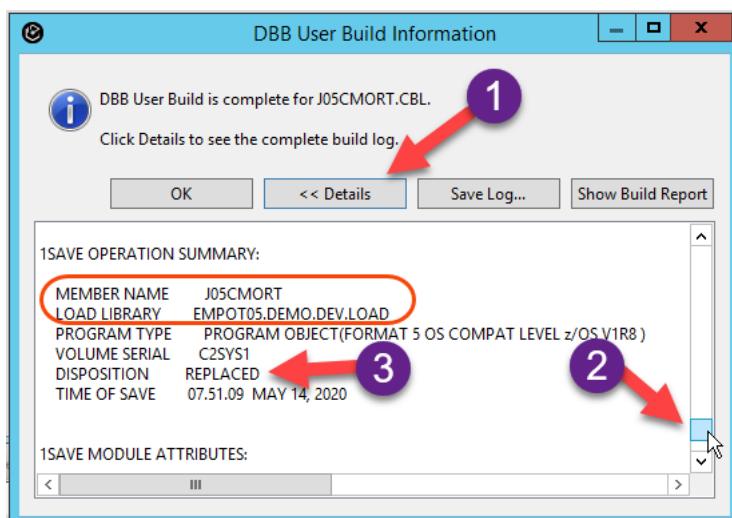
► Click **Details**



## 4.2 Verify the DBB User Build results

4.2.1 ► After clicking **Details >>** scroll down and verify that a new load module name **J05CMORT** was replaced on the dataset **EMPOT05.DEMO.DEV.LOAD**

► Click **OK** to close this dialog.



- 4.2.2 ► Verify at the Condole view that the Build State should show a **CLEAN** build.

```

Remote Error List z/OS File System Mapping Property Group Manager Snippets Remote System Details Console
DBB Console
** Build State : CLEAN ←
** Total files processed : 1
** Total build time : 44.516 seconds
/u/empot05/dbb>
** Build finished
/u/empot05/dbb>

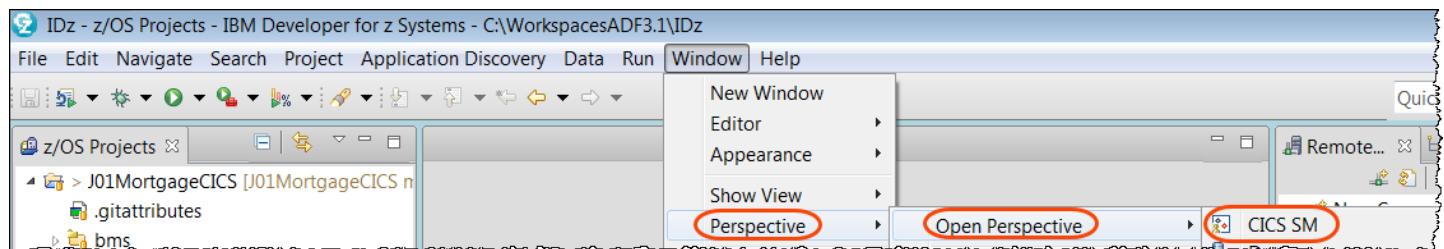
```

## 4.3 Issuing a CICS New copy

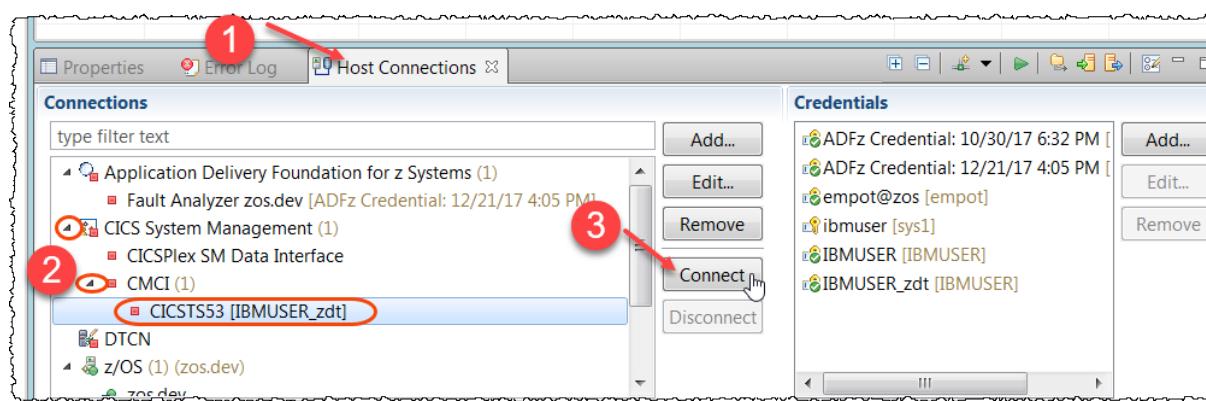
- 4.3.1 At this point you may test your new load module. But since this is a CICS system you will need to make a CICS NEWCOPY. Let's use IDz and CICS Explorer to do that.

Notice that the new copy could be done by the Groovy scripts, but I want to show CICS Explorer nice capabilities here..

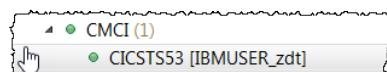
- Open the CICS SM perspective selecting Window > Perspective > Open Perspective > CICS SM



- 4.3.2 ► Click on tab Host Connections on the bottom, expand the CICS System Management, CMCI, select CICSTS53 and click on Connect



- 4.3.3 The red dot will turn green once is connected to CICS



4.3.4 ① ► On top left expand **CICSTS53** and click on **CICSTS53 (CICSTS53)**.

② ► Click on the **Programs** tab.

Since the filter is already made for "Name = J05\*" " you should see the list below:

The screenshot shows the IBM Developer for z Systems interface. The title bar reads "IDz - CICS SM - IBM Developer for z Systems - C:\Workspaces\ADF3.1\IDz". The menu bar includes File, Edit, Search, Application Discovery, Data, Operations, Window, Help. The toolbar has various icons for file operations. The left pane is the "CICSplex Explorer" showing a tree structure with "CICSTS53 (1/1)" expanded, revealing "Systems" and "CICSTS53 (CICSTS53)". A red circle with number 1 is around "CICSTS53 (CICSTS53)". The right pane is titled "Regions Tasks Programs ISC/MRO Connections Terminals Local Files Local Transactions". The "Programs" tab is selected, indicated by a red circle with number 2. The sub-tab "Programs" is also highlighted. The main area displays a table titled "CNX0211I Context: CICSTS53. Resource: PROGRAM. 8 (filtered,sorted) records collected at May 29, 2019, 8:36:17 AM". The table columns are Region, Name, Status, Use Count, Concurrent Use C..., Language, Share Status, and CEDF Status. The data rows are as follows:

Region	Name	Status	Use Count	Concurrent Use C...	Language	Share Status	CEDF Status
CICSTS53	J05CMORT	ENABLED	3	0	COBOL	PRIVATE	CEDF
CICSTS53	J05CSMRD	ENABLED	0	0	COBOL	PRIVATE	CEDF
CICSTS53	J05CSMRT	ENABLED	1	0	COBOL	PRIVATE	CEDF
CICSTS53	J05MLIS	ENABLED	0	0	NOTAPPLIC	PRIVATE	NOTAPPLIC
CICSTS53	J05MLISD	ENABLED	0	0	COBOL	PRIVATE	CEDF
CICSTS53	J05MLIST	ENABLED	0	0	COBOL	PRIVATE	CEDF
CICSTS53	J05MORT	ENABLED	3	0	NOTAPPLIC	PRIVATE	NOTAPPLIC
CICSTS53	J05MPMT	ENABLED	1	0	COBOL	PRIVATE	CEDF

4.3.5 ► Right click on **J05CMORT** and select **New Copy** as the example below

The screenshot shows the "Programs" table with the row for "J05CMORT" selected. A context menu is open over this row, with "New Copy" highlighted. Other options in the menu include Open, Phase In, Add Quick Filter, Copy (with Ctrl+C), Discard, Delete, and Enable. The table columns are Region, Name, Status, Use Count, Concurrent Use C..., and Language. The data rows are the same as in the previous screenshot.

4.3.6 ► Select OK

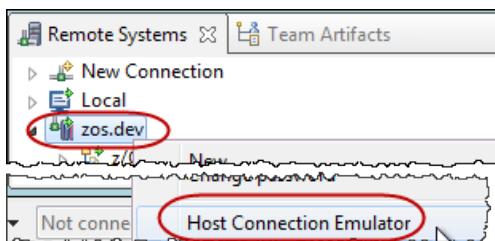
The screenshot shows the "Perform Operation" dialog box. The title is "Perform NEWCOPY Operation". It states "NEWCOPY operation will be performed on 1 item in the execution queue". The "Action Summary" section shows "Name: NEWCOPY" and "Parameters: J05CMORT". At the bottom are "OK" and "Cancel" buttons, with a red arrow pointing to the "OK" button.

4.3.7 Let's start the 3270 emulation again ..

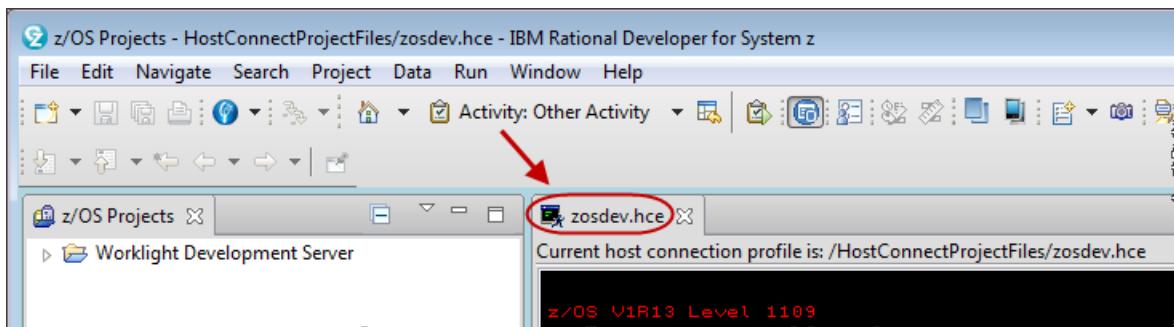
► Go to the **z/OS Projects** perspective

The screenshot shows the Eclipse IDE interface. The title bar says "IDz - CICS SM - IBM Developer for z Systems - C:\Workspaces\ADF3.1\IDz". The quick access bar at the top has several icons. The "z/OS Projects" icon is highlighted with a red circle. Below the quick access bar are tabs for "Local Files" and "Local Transactions".

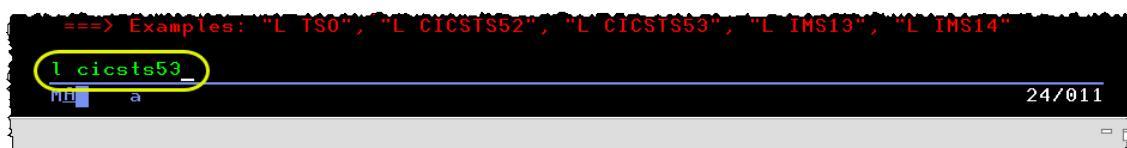
4.3.8 ► Using the *Remote Systems* view, right click on **zos.dev** and select **Host Connection Emulator**.



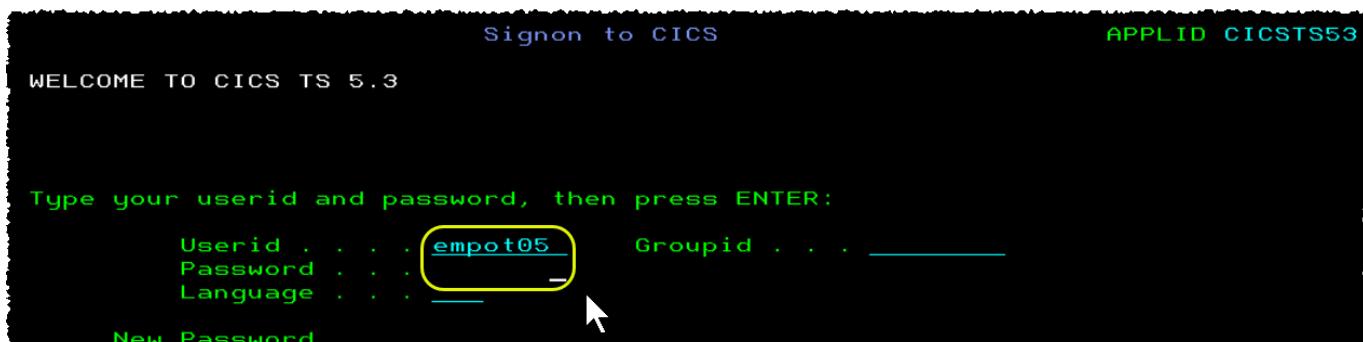
4.3.9 ► Since you will need more space, **double-click** on the **zos.dev.hce** title



4.3.10 ► Type **I cicsts53**. and press **Enter**.



4.3.11 ► Logon using **empot05** and password **empot05** and press **Enter**.



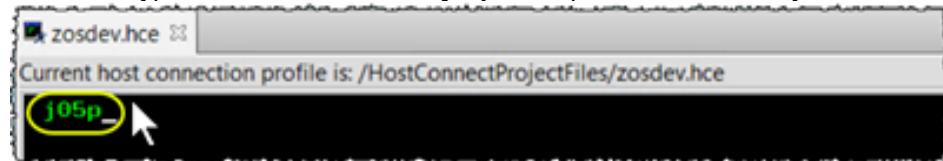
4.3.12 The sign-on message is displayed



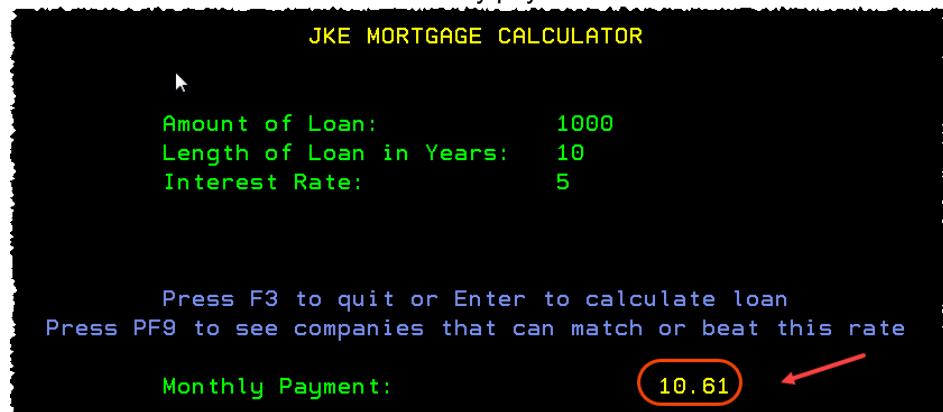
## 4.4 Running *j05p* CICS transaction

You should now be on the z/OS CICS region named *CICSTS53*. This is the CICS instance where you made the program changes.

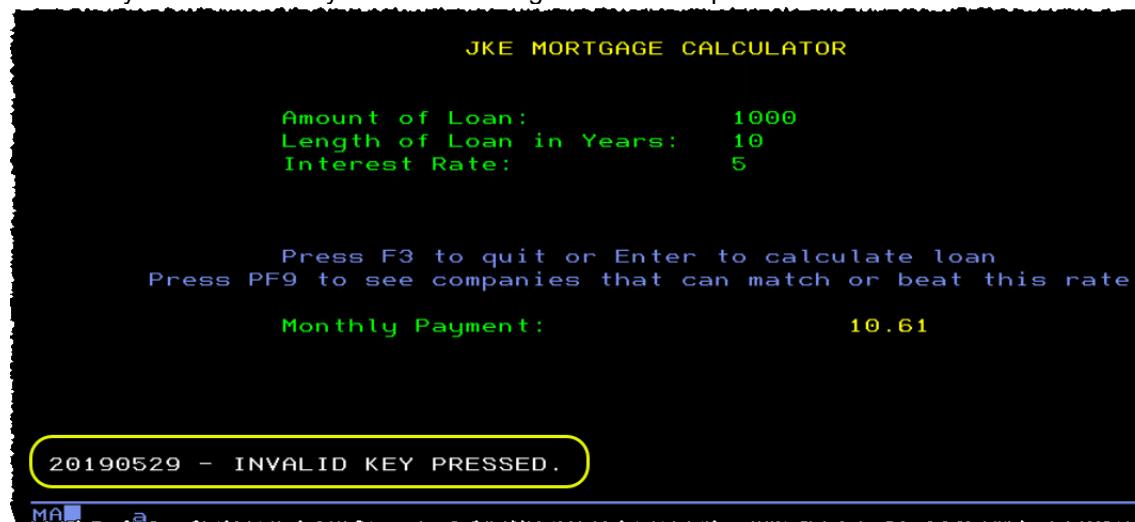
- 4.4.1 ► Type the CICS transaction **j05p** and press the **Enter** key.



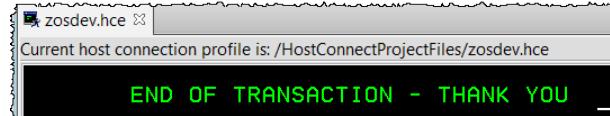
- 4.4.2 ► Press **enter** to see the monthly payment for the default data .



- 4.4.3 ► Press **F1** key and verify the message displayed  
This was your mission. As you see the change has been implemented.



- 4.4.4 ► Press **F3** to end the CICS transaction.



- 4.4.5 ► Use **Ctrl + Shift + F4** to close the terminal emulation.

## Section 5. Push and Commit the changed code to Git.

Using IDz you will commit the changes you made to Git and later perform the final building and deploy using Jenkins and UCD.

### 5.1 Using IDz with the Git plugin to compare the change versus original

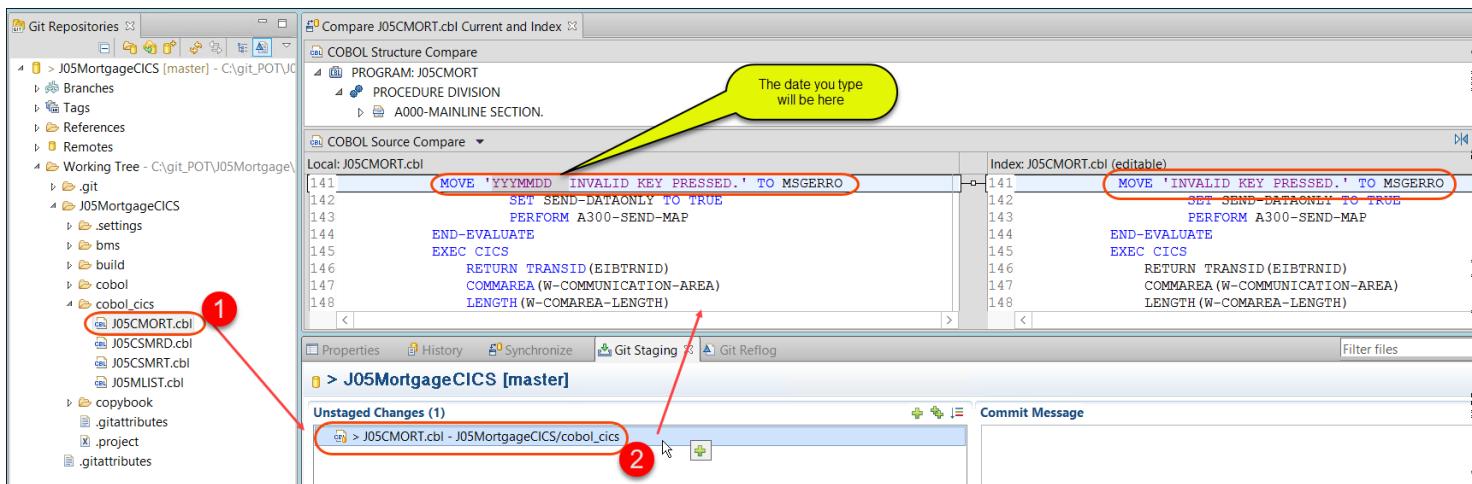
5.1.1 ► Switch to the **Git Perspective** selecting the icon on top and right



5.1.2 ► ① Expand the nodes and click on the program **J05CMORT.cbl** that you have modified. Notice that the changed program is listed in the *Git Staging* view...

► ② Double click on the **J05CMORT.cbl** that is listed under **Unstaged Changes** and noticed the comparison among the program that you updated versus the one that is in the Git repository.

You will need to commit the changes to the Git repository to make a final build later.

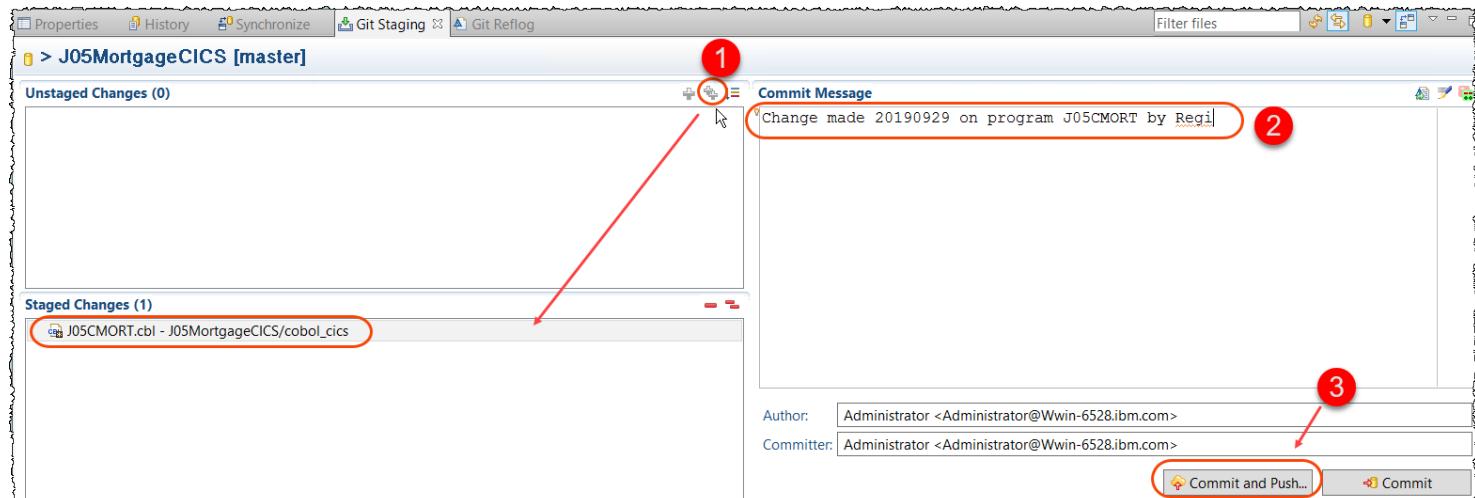


5.1.3 ► Use **Ctrl + Shift + F4** to close the editors.

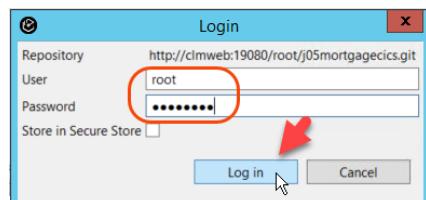
## 5.2 Push and Commit the changes to Git

### 5.2.1 ► Using Git Staging view ,

- 1 Click on the icon 
- 2 Write a commit message like: **Change made yyyymmdd on program J05CMORT by your name**
- 3 Click **Commit and Push ...**

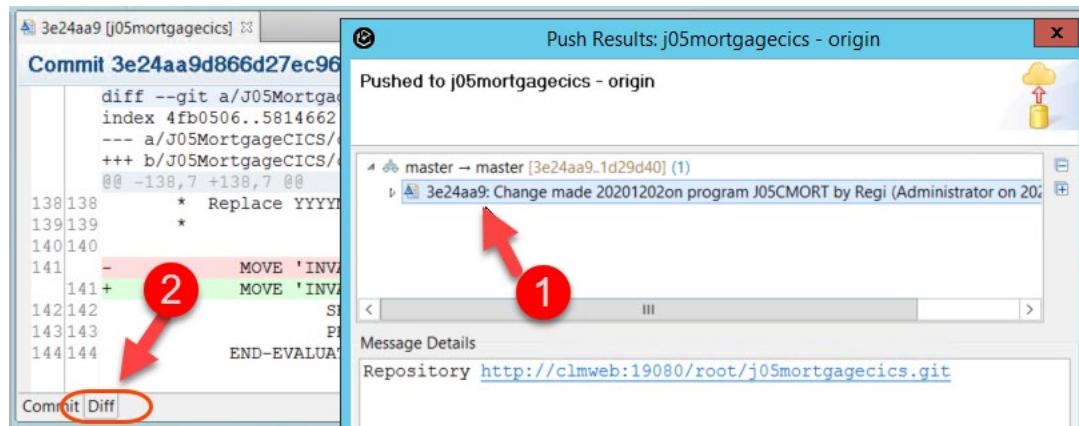


### 5.2.2 ► For login credentials use **root** and password **zdtlinux** and click **Log in**



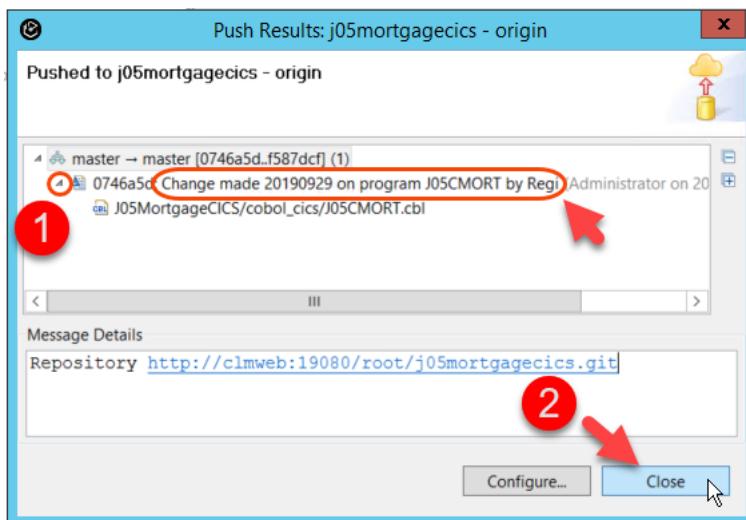
### 5.2.3 To see the changes you committed to Git:

► Double click on **Git hash string** and select **Diff** tab



5.2.4 ► Verify that the commit was successful and click **Close**

► Also use **Ctrl + Shift + F4** to close any opened editor



5.2.5 ► To see this changes in **GitLab** use the **Firefox browser** and do a **Refresh (F5)** (details how to get the link at 2.1.1).

Projects - Administrator / J05Mmortgagecics

Administrator > J05MortgageCICS > Details

J05MortgageCICS Project ID: 2

3 Commits 1 Branch 0 Tags 604 KB Files 604 KB Storage

This project is to be used for the Z DevOps PoT Lab 7

master j05mortgagecics / +

Change made 20190929 on program J05CMORT by Regi  
Administrator authored 15 minutes ago

Name	Last commit
..	
<a href="#">J05CMORT.cbl</a>	Change made 20190929 on program J05CMORT by Regi
<a href="#">J05CSMRD.cbl</a>	Lab7 Baseline for J05P transaction
<a href="#">J05MLIST.cbl</a>	Lab7 Baseline for J05P transaction

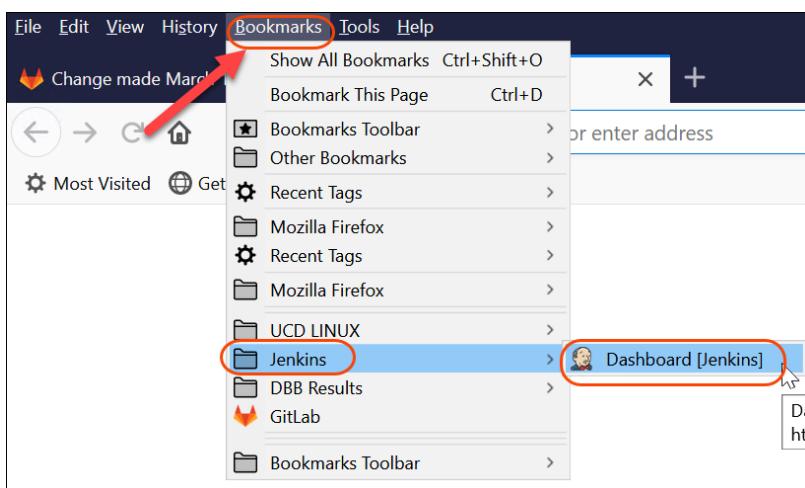
## Section 6. Use Jenkins with Git plugin to build all the modified code committed to Git.

At this point the changed code is delivered into the Git repository that is on Linux. You will use Jenkins pipeline to build the new changed code and push the executables to be deployed using UCD.

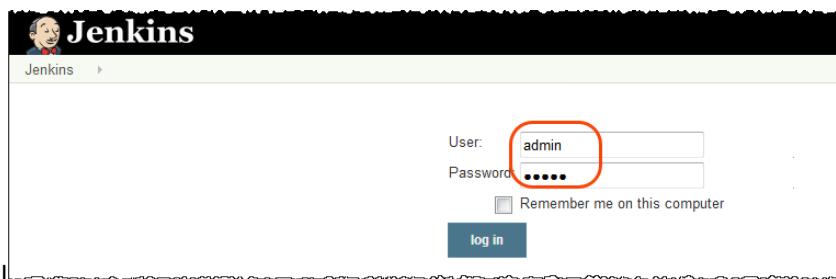
Note that this step makes a build of all code committed to Git, while on Section 4 only the selected COBOL program was built.

### 6.1 Logon to Jenkins using a Web Browser

#### 6.1.1 Using the **Bookmarks** click on **Jenkins > Dashboard**



#### 6.1.4 If required type the user **admin** and password **admin** (lowercase) and click **log in**.



## 6.2 Starting the Jenkins Pipeline

6.2.1 The homepage lists all of the Jenkins jobs and pipelines.

► Scroll down and click on the hyperlink for the project **J05P\_Pipeline** that represents your CICS application.

Icon	Pipeline Name	Last Build	Duration	Result	Build Time
Sun	J04P_Pipeline	1 yr 4 mo - #6	N/A	27 min	
Sun	J04PDeploy	1 yr 4 mo - #4	N/A	8 min 36 sec	
Red Circle	J05_Pipeline_Zunit	N/A	2 mo 10 days - #1	9 min 8 sec	
Red Circle	J05_Zunit_Stage	N/A	2 mo 9 days - #6	2 min 21 sec	
Sun	J05MortgageCICS	2 mo 10 days - #12	N/A	8 min 47 sec	
Sun	<b>J05P_Pipeline</b> 2	7 mo 13 days - #12	N/A	9 min 27 sec	
Sun	J05PDeploy	7 mo 13 days - #11	N/A	3 min 52 sec	
Sun	J05PDeploy_Test	2 mo 10 days - #1	N/A	4 min 24 sec	
Sun	J06MortgageCICS	1 yr 4 mo - #4	N/A	16 min	

6.2.2 This opens the **J05P\_Pipeline** view. This pipeline has been designed with two stages:

1 – **Stage 1** builds ONLY the changed code from Git. This is an example of a **Build pipeline**.

2 – **Stage 2** deploys the changes into CICS Development Region (Dev) using UrbanCode Deploy (UCD).  
This is an example of a **Delivery pipeline**.

This pipeline is a simplistic form of an actual delivery pipeline. Any other activity such as, test cases, code reviews, batch job runs, rexx scripts, table queries and other manual tasks that are currently being carried out in a shop before code is moved to QA (or any other region) can be built into a pipeline.

► Click on **Build Now** on the left.

**IMPORTANT :** This Jenkins Build will take at least **14 Minutes** since the cloud instances are slow compared to a real environment.

If you are running late and don't want to wait 14 minutes, you can see a build done already (example **Building #36**) or just read the steps described here.

6.2.3 ① Notice that the new build has appeared under **Build History** indicating the currently started Pipeline.

② The **Stage View** also shows a new line with an in-progress bar.

### 6.3 Checking the results

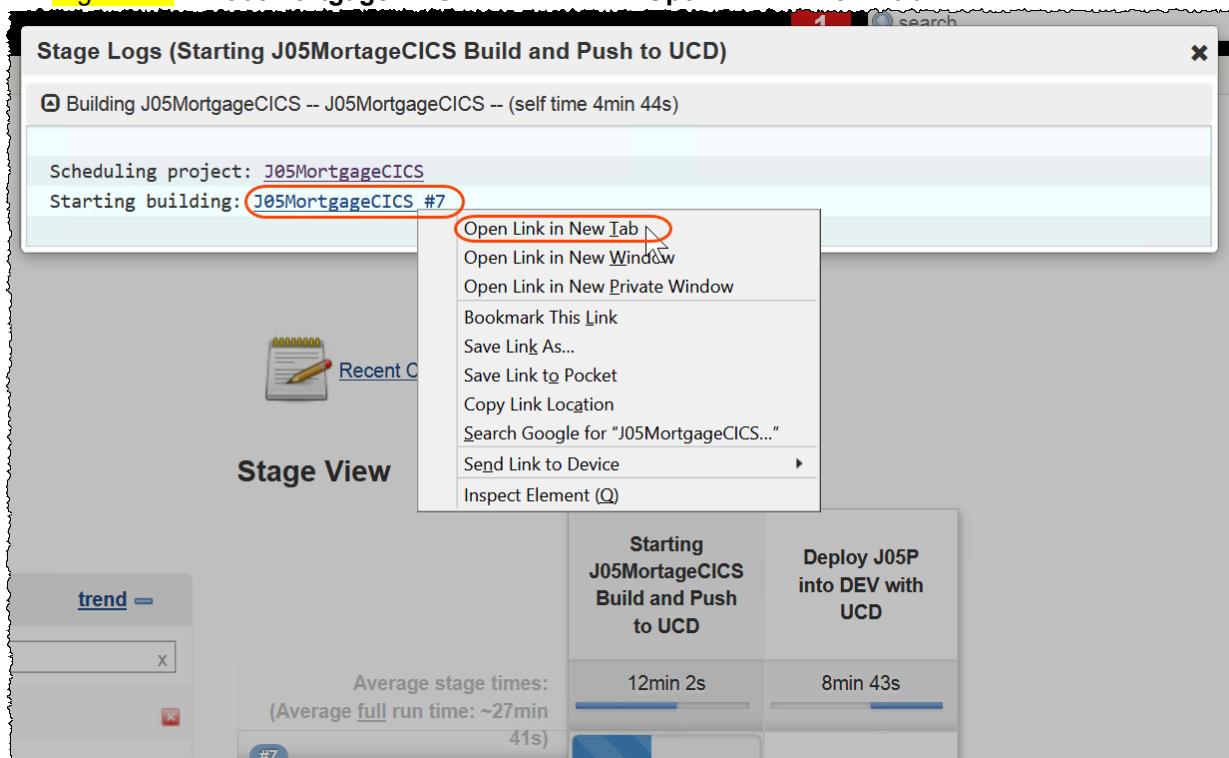
6.3.1 Since this z/OS is running in a small processor in the cloud, this activity may take 10 or more minutes, but you don't need to wait to be completed to check the results.

You can follow what is going on as described below ..

▶ Click as shown in the blue area ① and then click on Logs ②.

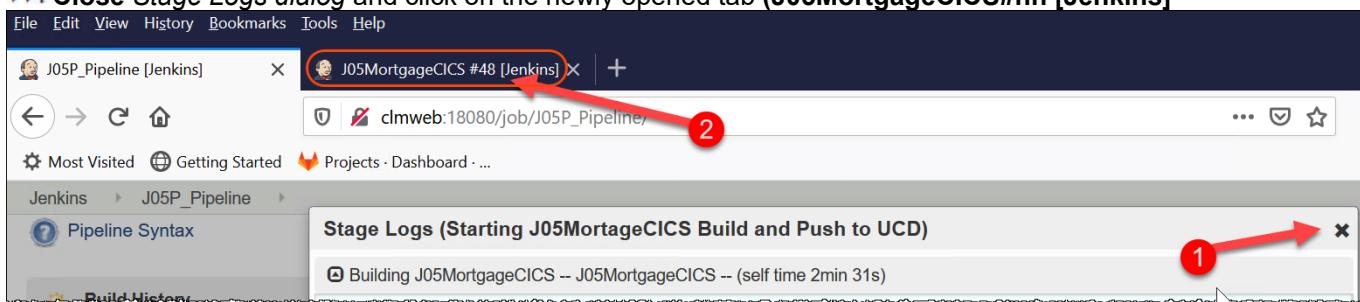
6.3.2 The dialog *Stage Logs* will open.

► Right click on **J05MortgageCICS #nn** and select **Open Link in New Tab**



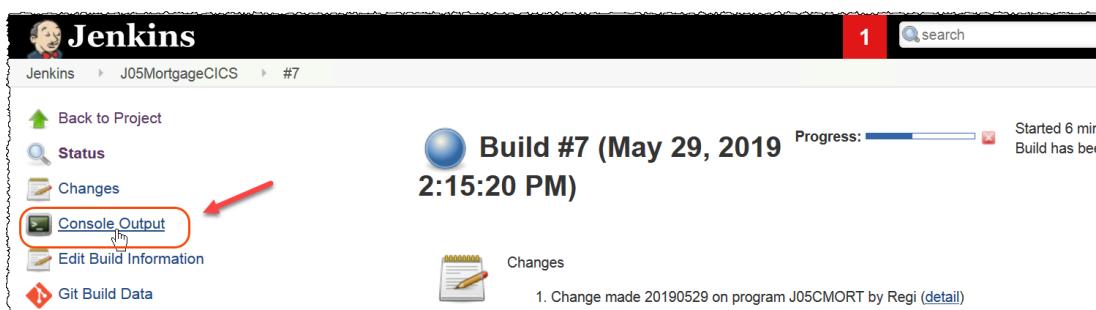
6.3.3 This opens a new Jenkins tab as shown below.

► Close *Stage Logs* dialog and click on the newly opened tab (**J05MortgageCICS#nn [Jenkins]**)



6.3.4 This opens the current running task for the first step of the J05Mortgage Application Build.

► Click on the **Console Output** to view the log.



6.3.5 The Console Output log of first pipeline shows the various Groovy scripts being executed. You need to understand what is going on. Below some explanation.

**IMPORTANT** → The Jenkins agent may take a while to start on z/OS.. BE PATIENT..

Notice that the comment that you added when you commit to Git is displayed.

This is what we call “smart building” since ONLY the modified code will be built.

```

Started by upstream project "J05P Pipeline" build number 24
originally caused by:
Started by user Admin User
Building remotely on zOSSlaveJ in workspace /var/jenkins/workspace/J05MortgageCICS
> /var/dbb/bin/git-jenkins.sh rev-parse --is-inside-work-tree # timeout=10
Fetching changes from the remote Git repository
> /var/dbb/bin/git-jenkins.sh config remote.origin.url git@clmweb:root/j05mortgagecics.git # timeout=10
Fetching upstream changes from git@clmweb:root/j05mortgagecics.git
> /var/dbb/bin/git-jenkins.sh --version # timeout=10
using GIT_ASKPASS to set credentials GitLab connection
> /var/dbb/bin/git-jenkins.sh fetch --tags --progress git@clmweb:root/j05mortgagecics.git +refs/heads/*:refs/remotes/*
Seen branch in repository origin/master
Seen 1 remote branch
> /var/dbb/bin/git-jenkins.sh show-ref --tags -d # timeout=10
Checking out Revision d7021bcc43533a5e85919f705663365367cec380 (origin/master)
> /var/dbb/bin/git-jenkins.sh config core.sparsecheckout # timeout=10
> /var/dbb/bin/git-jenkins.sh checkout -f d7021bcc43533a5e85919f705663365367cec380
Commit message: "Change made 20190929 on program J05CMORT by Regi"
> /var/dbb/bin/git-jenkins.sh rev-list --no-walk 167fd7a57b8659a93025b888fe8bea05df068af # timeout=10
[J05MortgageCICS] $ /var/dbb/groovy-2.4.12/bin/groovy -cp /var/dbb/lib/* /var/jenkins/workspace/J05MortgageCICS
/J05MortgageCICS/build/impacts.groovy --buildHash d7021bcc43533a5e85919f705663365367cec380 --sourceDir /var/jenkins
/workspace/J05MortgageCICS --workDir /var/jenkins/workspace/J05MortgageCICS/BUILD-35

```

### Your commit message is not what you expected?

Jenkins agent uses SSH to connect to GitLab on Linux. Since you are using the z/OS on cloud this SSH connection may fail and the code committed is not being considered.

this happens when the “known\_hosts” file located at “/u/ibmuser/.ssh” has a incorrect value. Each zOS instance must have a unique value and you need to generate new one.

You will need to delete known\_hosts file and create a new one to fix that issue.

The sequence to be done is:

1. Use the terminal emulation and type **L TSO**.
2. Logon as **IBMUSER** and password **SYS1**.
3. Go to OMVS using the option **6** and typing **OMVS**.
4. Execute the script typing **sshc.sh** if prompt for host authentication answer yes and press enter 3 times for the password.

If you cannot find this script, execute the statements below (this is the content of the script provided)

```

#This script will add Linux ip to known_hosts
echo -----
echo "--> This script will add Linux ip to known_hosts"
echo "--> Msg authenticity of host 'clmweb' can't be established will be displayed"
echo "--> When prompt yes/no answer yes"
echo "--> When prompt for password press enter 3 times"
echo -----
cd /u/ibmuser/.ssh
rm known_hosts
ssh clmweb

```

5. Exit OMVS and LOGOFF the TSO.

## 6.4 Understand the results

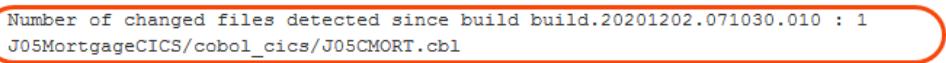
This task performs five sub-steps.

- ▶ Scroll down and locate the highlighted portions shown below from the build console output to know more about the build

### 6.4.1 Check out of code from Git Repositories based on the latest commit

```
Building remotely on zOSSlaveJ in workspace /var/jenkins/workspace/J05MortgageCICS
> /var/dbb/bin/git-jenkins.sh rev-parse --is-inside-work-tree # timeout=10
Fetching changes from the remote Git repository
> /var/dbb/bin/git-jenkins.sh config remote.origin.url git@clmweb:root/j05mortgagetcics.git # timeout=10
Fetching upstream changes from git@clmweb:root/j05mortgagetcics.git
> /var/dbb/bin/git-jenkins.sh --version # timeout=10
using GIT_ASKPASS to set credentials GitLab connection
> /var/dbb/bin/git-jenkins.sh fetch --tags --progress git@clmweb:root/j05mortgagetcics.git +refs/heads/*:refs/remotes/origin/*
Seen branch in repository origin/master
Seen 1 remote branch
> /var/dbb/bin/git-jenkins.sh show-ref --tags -d # timeout=10
Checking out Revision d7021bcc43533a5e85919f705663365367cec380 (origin/master) 
> /var/dbb/bin/git-jenkins.sh config core.sparsecheckout # timeout=10
> /var/dbb/bin/git-jenkins.sh checkout -f d7021bcc43533a5e85919f705663365367cec380
Commit message: "Change made 20190929 on program J05CMORT by Regi"
> /var/dbb/bin/git-jenkins.sh rev-list --no-walk 167fd7a57b8659a93025b888fe8bea05df068afb # timeout=10
[J05MortgageCICS] $ /var/dbb/groovy-2.4.12/bin/groovy -cp /var/dbb/lib/* /var/jenkins/workspace/J05MortgageCICS
```

### 6.4.2 An Impact Analysis to identify if any programs have been changed since the last build using DBB Impact scripts. The DBB application server that is installed on Linux keeps track of all builds.

```
** Impact analysis start at 20201202.080335.003 
** Searching for last successful build commit hash for build group J05MortgageCICS
Last successful build commit hash located. label : build.20201202.071030.010 , buildHash :
167fd7a57b8659a93025b888fe8bea05df068afb
** Executing Git command: git diff --name-only 167fd7a57b8659a93025b888fe8bea05df068afb
d7021bcc43533a5e85919f705663365367cec380
Number of changed files detected since build build.20201202.071030.010 : 1
J05MortgageCICS/cobol_cics/J05CMORT.cbl 
```

```
** Scan the changed file list to collect the latest dependency data
Scanning changed file J05MortgageCICS/cobol_cics/J05CMORT.cbl
** Store the dependency data in repository collection 'J05MortgageCICS'
HTTP/1.1 200 OK
** Creating build list by resolving impacted programs/files for changed files
Found build script mapping for J05MortgageCICS/cobol_cics/J05CMORT.cbl. Adding to build list.
** Writing buildlist to /var/jenkins/workspace/J05MortgageCICS/BUILD-35/buildlist.txt
** Impact analysis finished at Wed Dec 02 20:04:05 GMT 2020
** Total # build files calculated = 1
** Total analysis time : 30.138 seconds
[J05MortgageCICS] $ /var/dbb/groovy-2.4.12/bin/groovy -cp /var/dbb/lib/* /var/jenkins/workspace/J05MortgageCICS
/J05MortgageCICS/build/build.groovy --buildHash d7021bcc43533a5e85919f705663365367cec380 --sourceDir /var/jenkins
/workspace/J05MortgageCICS --workDir /var/jenkins/workspace/J05MortgageCICS/BUILD-35 --hlq EMPOT05.DEMO.DEV /var/jenkins
/workspace/J05MortgageCICS/BUILD-35/buildList.txt
```

6.4.3 **A dependency scan** to pick out all the dependencies of the changed programs, The DBB application server that is installed on Linux keeps track of all dependencies.

```
** Scan the changed file list to collect the latest dependency data
Scanning changed file J05MortgageCICS/cobol_cics/J05CMORT.cbl
** Store the dependency data in repository collection 'J05MortgageCICS'
HTTP/1.1 200 OK
** Creating build list by resolving impacted programs/files for changed files
Found build script mapping for J05MortgageCICS/cobol_cics/J05CMORT.cbl. Adding to bu
** Writing buildlist to /var/jenkins/workspace/J05MortgageCICS/BUILD-35/buildlist.txt
** Impact analysis finished at Wed Dec 02 20:04:05 GMT 2020
** Total # build files calculated = 1
** Total analysis time : 30.138 seconds
[J05MortgageCICS]$ ./var/dbb/groovy-2.4.12/bin/groovy -cp /var/dbb/lib/* /var/jenkins/workspace/J05MortgageCICS
```

This collection is  
on the DBB App  
Server

6.4.4 **A compile/link-edit** of the changed programs

```
** Invoking build scripts according to build order: Compile, LinkEdit, CobolCompile
* Building J05MortgageCICS/cobol_cics/J05CMORT.cbl using CobolCompile.groovy script
Copying /var/jenkins/workspace/J05MortgageCICS/J05MortgageCICS/cobol_cics/J05CMORT.cbl to
EMPOT05.DEMO.DEV.COBOLO(J05CMORT)
Resolving dependencies for file J05MortgageCICS/cobol_cics/J05CMORT.cbl and copying to EMPOT05.DEMO.DEV.COPYBOOK
Compiling and link editing program J05MortgageCICS/cobol_cics/J05CMORT.cbl
** Build finished at Wed Dec 02 20:06:21 GMT 2020
** Build State : CLEAN
** Total files processed : 1
** Total build time : 1 minutes, 23.097 seconds
[J05MortgageCICS]$
```

6.4.5 **Creation of a deployable binary version** of code that can be used by *UrbanCode Deploy* to deploy to the necessary environments. Here Jenkins is using the UCD plugin to store an executable version at UCD server for later deploy.

```

** Create version start at 20201202.080702.007
** Properties at startup:
  component -> J05MortgagePOT
  startTime -> 20201202.080702.007
  workDir -> /var/jenkins/workspace/J05MortgageCICS/BUILD-35
  buztoolPath -> /etc/ibm-ucd/v6.2.6/dtsc-agent/bin/buztool.sh
** Read build report data from /var/jenkins/workspace/J05MortgageCICS/BUILD-35/BuildReport.json
** Find deployable outputs in the build report
  EMPOT05.DEMO.DEV.LOAD(J05CMORT), LOAD
** Generate UCD ship list file
** Write ship list file to /var/jenkins/workspace/J05MortgageCICS/BUILD-35/shiplist.xml
** Create version by running UCD buztool
** Ignore > Error adding properties to version in UrbanCode Deploy server
/etc/ibm-ucd/v6.2.6/dtsc-agent/bin/buztool.sh createzosversion -c J05MortgagePOT -s /var/jenkins/workspace/J05MortgageCICS/BUILD-35/shiplist.xml -o /var/jenkins/workspace/J05MortgageCICS/BUILD-35/buztool.output
zos toolkit config : /etc/ibm-ucd/v6.2.6/dtsc-agent/ (6.2.6,20170906-2200)
zos toolkit binary : /etc/ibm-ucd/v6.2.6/dtsc-agent/ (6.2.6,20170906-2200)
zos toolkit data set : BUZ626 (6.2.6,20170907-0249)
Reading parameters:
....Command : createzosversion
....Component : J05MortgagePOT
....Generate version name : 20201202-200731
....Shiplist file : /var/jenkins/workspace/J05MortgageCICS/BUILD-35/shiplist.xml
....Output File:/var/jenkins/workspace/J05MortgageCICS/BUILD-35/buztool.output
Verifying version
....Repository location : /etc/ibm-ucd/v6.2.6/dtsc-agent/var/repository/J05MortgagePOT/20201202-200731
Pre-processing shiplist:
....Shiplist after processing :/etc/ibm-ucd/v6.2.6/dtsc-agent/var/repository/J05MortgagePOT/20201202-200731/shiplist.xml

```



Ignore the error message below. This does not impact the UCD version creation..

```

....Shiplist file : /var/jenkins/workspace/J05MortgageCICS/BUILD-35/shiplist.xml
....Output File:/var/jenkins/workspace/J05MortgageCICS/BUILD-35/buztool.output
Verifying version
....Repository location : /etc/ibm-ucd/v6.2.6/dtsc-agent/var/repository/J05MortgagePOT/20201202-200731
Pre-processing shiplist:
....Shiplist after processing :/etc/ibm-ucd/v6.2.6/dtsc-agent/var/repository/J05MortgagePOT/20201202-200731
/shiplist.xml
Packaging data sets:
....Location to store zip : /etc/ibm-ucd/v6.2.6/dtsc-agent/var/repository/J05MortgagePOT/20201202-200731
....Zip name : package.zip
....EMPOT05.DEMO.DEV.LOAD.bin
....Elapsed time for data set package or deploy operation : 5.073116
Post-processing package:
PackageManifest file post-processing completed.
Create version and store package:
....Error adding properties to version in UrbanCode Deploy server

```



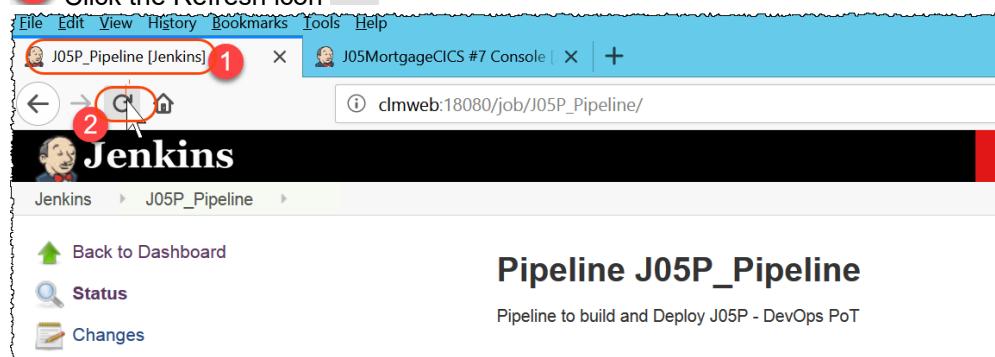

## Section 7. Use Jenkins and UCD plugin to deploy results and test the CICS transaction again

You will verify the results of the second stage (deploy using UCD) .

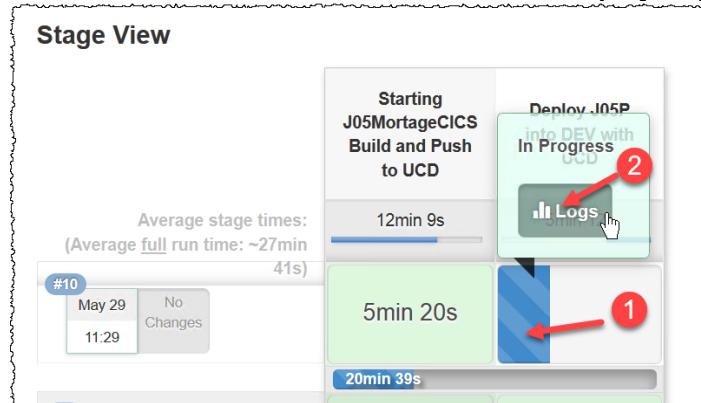
### 7.1 Checking the deploy results (second stage)

- 7.1.1 ► 1 Click on the previous browser tab **J05P\_Pipeline[Jenkins]**

- 2 Click the Refresh icon 

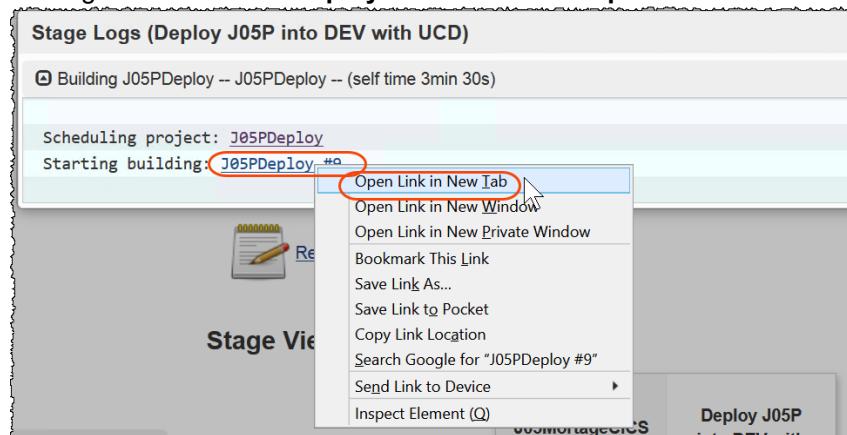


- 7.1.2 ► Click as show in the **blue area** of the Deploy stage 1 and then click on **Logs** 2.

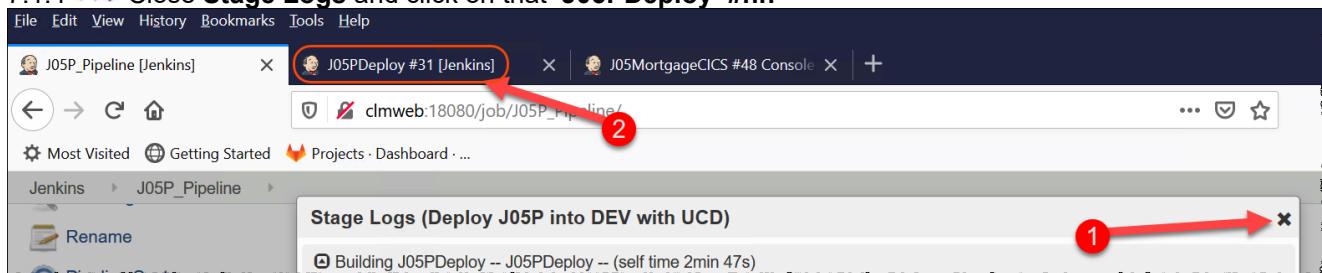


- 7.1.3 The dialog Stage Logs will open.

- Right click on **J05PDeploy #nn** and select **Open Link in New Tab**



7.1.4  Close Stage Logs and click on that J05PDeploy #nn



7.1.5  Click on the Console Output to view the logs.

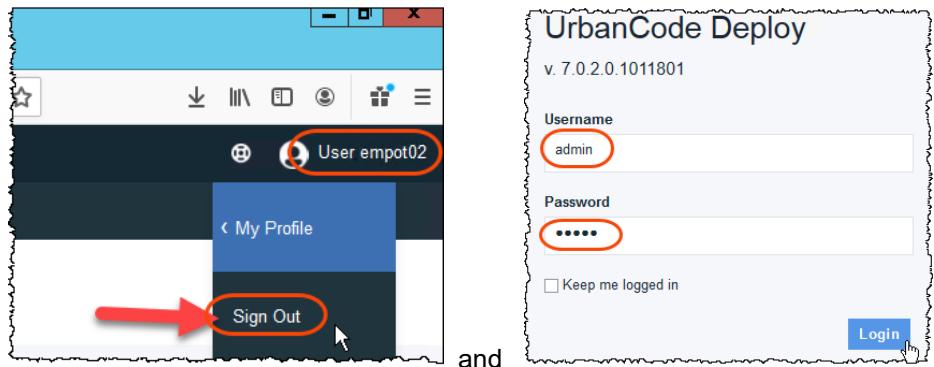
7.1.6 The Console Output log of second pipeline shows that the program that you delivered will be deployed to CICS Dev environment using UCD..

 You don't need to wait for the deploy finished. Go ahead and check UCD in action (step 7.2.1 below).

## 7.2 Checking UrbanCode Deploy logs

7.2.1  Start UCD console using the Bookmarks below

7.2.2 ► If you are not logged as **admin**, **Sign Out** and **Login** again using **admin** and password **admin** and click **Login**



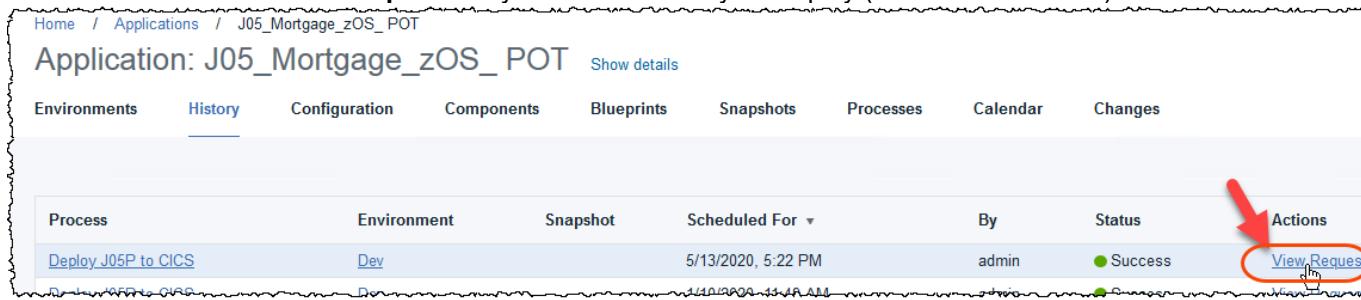
7.2.3 ► Click on **Applications** and find your application **J05\_Mortgage\_zOS\_POT** and click on it

► You will need to use the bottom to scroll to next page..

<input type="checkbox"/> Name	Template	Description
<input type="checkbox"/> J04 Mortgage zOS and Worklight		J04 CICS + JKE Mobile
<input type="checkbox"/> J04_Mortgage_zOS_POT		Deploy J04P for DevOps PoT
<input type="checkbox"/> J05 Mortgage zOS and Worklight		J05 CICS + JKE Mobile
<input type="checkbox"/> J05_Mortgage_zOS_POT		Deploy J05P for DevOps PoT
<input type="checkbox"/> J06 Mortgage zOS and Worklight		J06 CICS + JKE Mobile

7.2.4 ► Click on the **History** tab

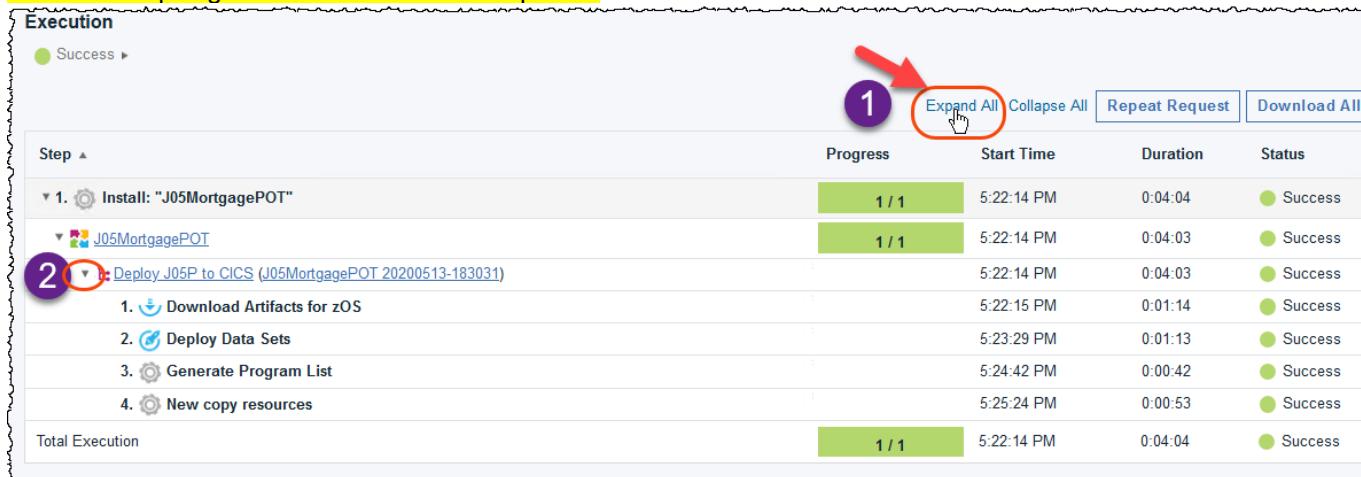
7.2.5  Click on the **View Request** entry that is related to your deploy (check the date/time)



Process	Environment	Snapshot	Scheduled For	By	Status	Actions
Deploy_J05P to CICS	Dev		5/13/2020, 5:22 PM	admin	Success	<a href="#">View Request</a>
Deploy_J05P to CICS	Dev		5/13/2020, 5:22 PM	admin	Success	<a href="#">View Request</a>

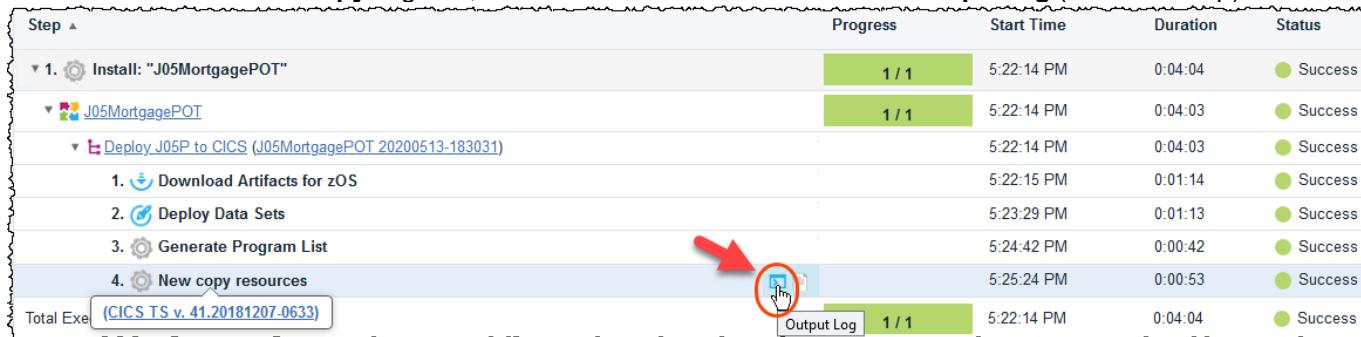
7.2.6  Click **Expand All** and expand the node as show in the #2 below

Once the step is green means that it is completed.



Step	Progress	Start Time	Duration	Status
1. Install: "J05MortgagePOT"	1 / 1	5:22:14 PM	0:04:04	Success
2. Deploy J05P to CICS (J05MortgagePOT 20200513-183031)	1 / 1	5:22:14 PM	0:04:03	Success
1. Download Artifacts for zOS		5:22:15 PM	0:01:14	Success
2. Deploy Data Sets		5:23:29 PM	0:01:13	Success
3. Generate Program List		5:24:42 PM	0:00:42	Success
4. New copy resources		5:25:24 PM	0:00:53	Success
Total Execution	1 / 1	5:22:14 PM	0:04:04	Success

7.2.7  Once the **New copy** is green, move the mouse as below and click **output log** (last UCD step)



Step	Progress	Start Time	Duration	Status
1. Install: "J05MortgagePOT"	1 / 1	5:22:14 PM	0:04:04	Success
J05MortgagePOT	1 / 1	5:22:14 PM	0:04:03	Success
Deploy J05P to CICS (J05MortgagePOT 20200513-183031)		5:22:14 PM	0:04:03	Success
1. Download Artifacts for zOS		5:22:15 PM	0:01:14	Success
2. Deploy Data Sets		5:23:29 PM	0:01:13	Success
3. Generate Program List		5:24:42 PM	0:00:42	Success
4. New copy resources	1 / 1	5:25:24 PM	0:00:53	Success
Total Exec	(CICS TS v. 4.1.20181207-0633)			

7.2.8 Notice that **J05CMORT** program was deployed to CICS Dev environment. and a CICS NEWCOPY was succeeded.

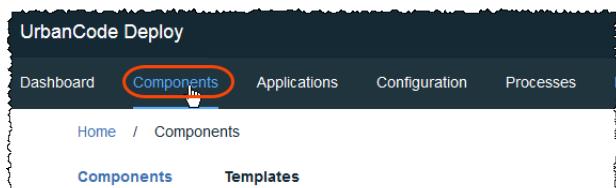
```

26 AGENT_HOME=/etc/ibm-ucd/v6.2.6/dtsc-agent
27 AH_AUTH_TOKEN=*****
28 AH_WEB_URL=https://ucdserver:18443
29 AUTH_TOKEN=*****
30 DS_AUTH_TOKEN=*****
31 DS_SYSTEM_ENCODING=IBM-1047
32 JAVA_OPTS=-Dfile.encoding=IBM-1047 -Dconsole.encoding=IBM-1047
33 PLUGIN_HOME=/etc/ibm-ucd/v6.2.6/dtsc-agent/var/plugins/com.ibm.ucd.plugin.cics_38_58e584b978e3fac6bb5320aa600d574e178448fc6
34 UD_DIALOGUE_ID=70e7cf54-db57-4993-a7f9-310c09585fc1
35 WE_ACTIVITY_ID=19982f24-80a5-4b63-a1ab-acbe4b5a1b8e
36
37 2019/05/29 16:39:38.977 GMT BUZCP0006I Connected to "10.1.1.2:1490". CICS TS version: 050300.
38 2019/05/29 16:39:43.618 GMT BUZCP0037I Perform NEWCOPY Operation.
39 2019/05/29 16:39:44.384 GMT BUZCP0024I NEWCOPY PROGRAM "J05CMORT" succeeded.
40 2019/05/29 16:39:44.517 GMT BUZCP0029I Summary: 1 NEWCOPY request(s) succeeded, 0 NEWCOPY request(s) failed.
41

```

7.2.9 You could verify the binaries generated by the build (LOADLIB) at the UCD Code station. You can have versions of executables stored under UCD.

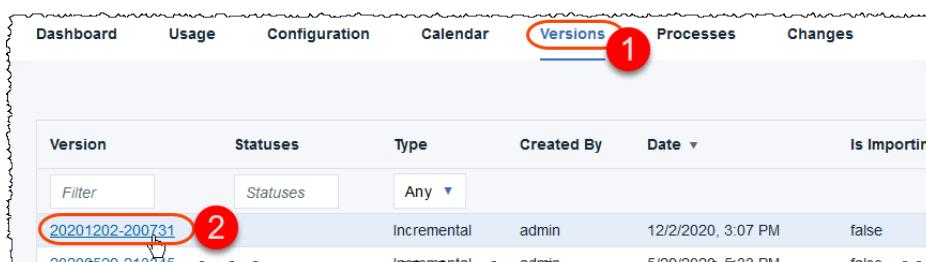
► Close the Output Log and click on **Components**



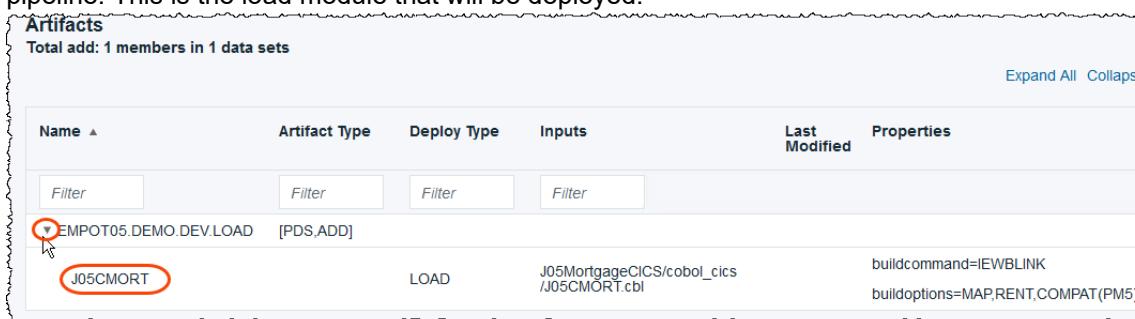
7.2.10 ► Scroll down and click on **J05MortgagePOT**



7.2.11 ► Click on **Versions** and the version created by your Jenkins run (it is a timestamp value)



7.2.12 ► Expand **EMPOT05.DEMO.DEV.LOAD** and you will see the load module created by the build on Jenkins pipeline. This is the load module that will be deployed.



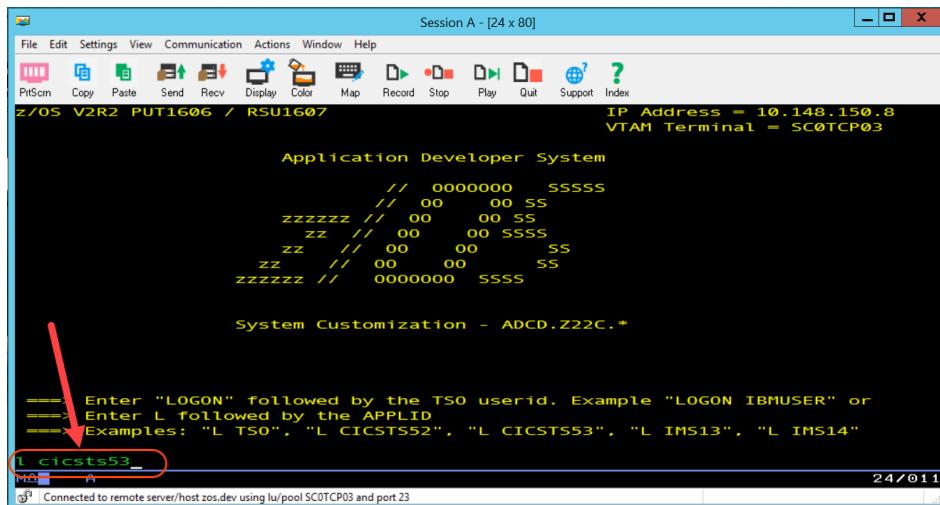
7.2.13 ► Minimize the browser if you will do the last optional step (#8) or close it.

### 7.3 Testing the CICS code deployed to Dev environment

7.3.1 ► Double click on the **3270 terminal emulator** that is on the Windows desktop

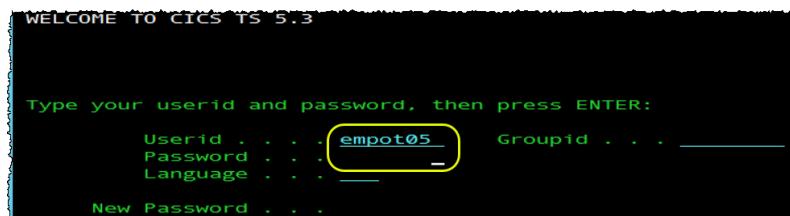


7.3.2 ► Type **I cicsts53.** ( I as logon) and press **Enter** key. ( **Ctrl** in some keyboards).



```
Session A - [24 x 80]
File Edit Settings View Communication Actions Window Help
PrtScrn Copy Paste Send Recv Display Color Map Record Stop Play Quit Support Index
z/OS V2R2 PUT1606 / RSU1607 IP Address = 10.148.150.8
VTAM Terminal = SC0TCP03
Application Developer System
      // 0000000 SSSSS
      // 00 00 SS
zzzzzz // 00 00 SSS
zz // 00 00 SSSS
zz // 00 00 SS
zzzzzz // 0000000 SSSS
System Customization - ACDZ.Z22C.*
==> Enter "LOGON" followed by the TSO userid. Example "LOGON IBMUSER" or
==> Enter L followed by the APPLID
==> Examples: "L TSO", "L CICSTS52", "L CICSTS53", "L IMS13", "L IMS14"
1 cicsts53
24/011
Connected to remote server/host zos.dev using lu/pool SC0TCP03 and port 23
```

7.3.3 ► Logon using your z/OS user id and password (**empot05/empot05**) and press **Enter** or **Ctrl**



```
WELCOME TO CICS TS 5.3

Type your userid and password, then press ENTER:
Userid . . . empot05 Groupid . . .
Password . . . Language . . .
New Password . . .

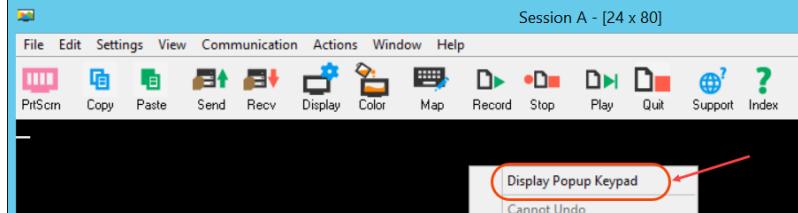
DFHCE3549 Sign-on is complete (Language ENU).
M A
```

7.3.4 The sign-on message is displayed

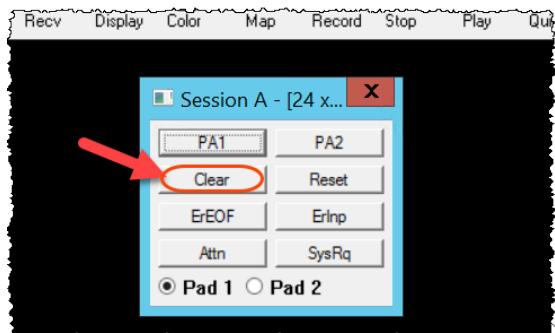


```
DFHCE3549 Sign-on is complete (Language ENU).
M A
```

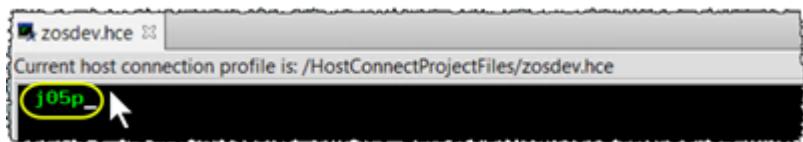
7.3.5 ► If you will need to use the **clear** key, right click and select **Display Popup Keypad**



and then select **Clear**



- 7.3.6 ➡ Type the CICS transaction **j05p** and press the **Enter** (or **Ctrl**) key.



- 7.3.7 ➡ Press **Enter** (or **Ctrl**) and then the **F1** key and verify the message displayed "YYYYMMDD - INVALID KEY PRESSED". This is your change correct?

```
JKE MORTGAGE CALCULATOR

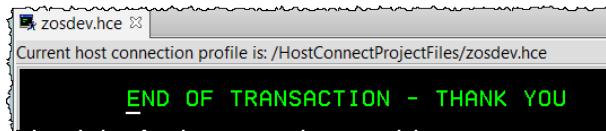
Amount of Loan: 1000
Length of Loan in Years: 10
Interest Rate: 5

Press F3 to quit or Enter to calculate loan
Press PF9 to see companies that can match or beat this rate

Monthly Payment: 10.61

20190529 - INVALID KEY PRESSED.
```

- 7.3.8 ➡ Press **F3** to end the CICS transaction.



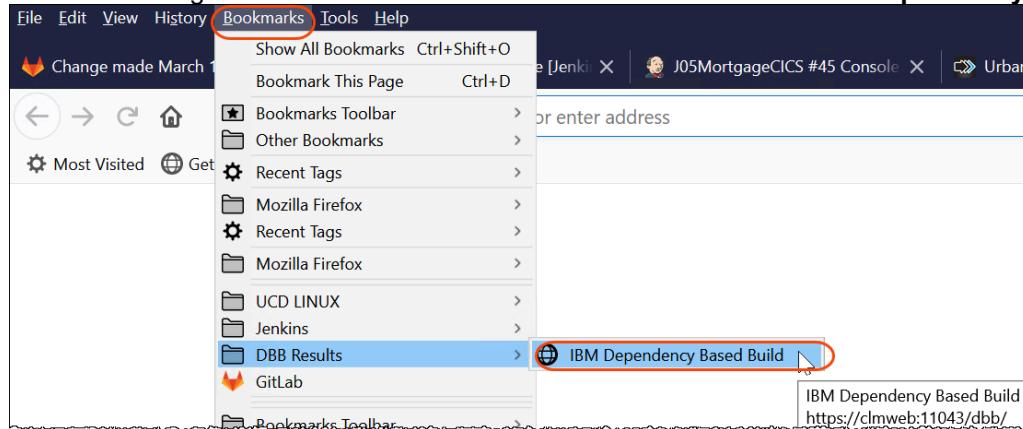
- 7.3.9 ➡ Close the terminal emulator.

## Section 8.(Optional) Understanding DBB Build Reports

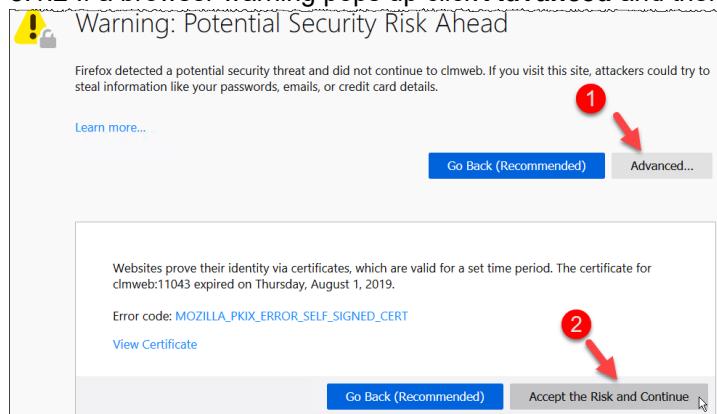
DBB has an application server (our is running on Linux) that capture the various build events. Here you will take a quick look of those reports.

### 8.1 Login to the DBB server using the browser

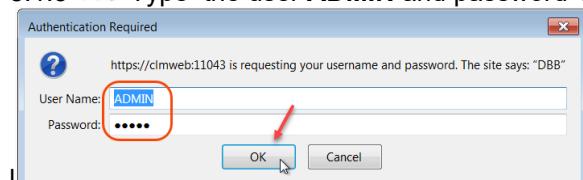
#### 8.1.1 Using the Browser Bookmarks click on DBB Results > IBM Dependency Based Build



#### 8.1.2 If a browser warning pops up click Advanced and then Accept the Risk and Continue.



#### 8.1.3 Type the user ADMIN and password ADMIN (uppercase) and click OK.



#### DBB Collections

In order to use the build dependency information collected by the *DependencyScanner* for dependency resolution and impact analysis, all scanned source files (both programs and dependency files) will need their resulting logical files stored in the DBB repository database as part of a dependency **Collection**.

A collection is a repository container for logical files. The scope of a collection is determined by the user but generally a collection contains all the logical files of a Git branch. This way the logical files in a collection can use the scanned file's relative path from the *sourceDir* as a unique identifier in the collection.

**Collections** themselves can have any name but it is recommended to use the name of the Git branch of the source files being scanned

Collection names must be unique in the DBB repository database and an error will occur when trying to create a collection that already exists. A good practice is to first check if the collection with that name already exists before creating it

## 8.2 Understand the DBB Collections

### 8.2.1 Click the Collections hyperlink and the collection name J05MortgageCICS

IBM

Collections Build Results

## DBB Collections

- [J01MortgageCICS](#)
- [HealthCareApp](#)
- [J03MortgageCICS](#)
- [J02MortgageCICS](#)
- [J04MortgageCICS](#)
- [J05MortgageCICS](#)
- [J06MortgageCICS](#)
- [J07MortgageCICS](#)
- [J08MortgageCICS](#)
- [J09MortgageCICS](#)

### 8.2.2 This opens the DBB Collection details..

▶ Scroll down and click the link for the program J05CMORT.

	lname	file	language	link
J05MLIS	J05MortgageCICS/bms/J05MLIS.bms	ASM	<a href="#">link</a>	
J05MORT	J05MortgageCICS/bms/J05MORT.bms	ASM	<a href="#">link</a>	
J05CSMRT	J05MortgageCICS/cobol/J05CSMRT.cbl	COB	<a href="#">link</a>	
J05MPMT	J05MortgageCICS/cobol/J05MPMT.cbl	COB	<a href="#">link</a>	
J05NBRVL	J05MortgageCICS/cobol/J05NBRVL.cbl	COB	<a href="#">link</a>	
<b>J05CMORT</b>	<b>J05MortgageCICS/cobol_cics/J05CMORT.cbl</b>	COB	<a href="#">link</a>	
J05CSMRD	J05MortgageCICS/cobol_cics/J05CSMRD.cbl	COB	<a href="#">link</a>	

This will show the COPY book dependencies for this program.

lname	category	library	link
DFHAID	COPY	SYSLIB	<a href="#">link</a>
J05MTCOM	COPY	SYSLIB	<a href="#">link</a>
J05NBRPM	COPY	SYSLIB	<a href="#">link</a>
<b>J05MORT</b>	<b>COPY</b>	<b>SYSLIB</b>	<b><a href="#">link</a></b>

## 8.3 Understand the Build Results

8.3.1 ► Click on the **Build Results** hyperlink, your collection name **J05MortgageCICS** and the build that you have just run (latest)

IBM Dependency Based Build

IBM

Collections **Build Results**

**DBB Build Results**

- J01MortgageCICS
- HealthCareApp
- J03MortgageCICS
- J02MortgageCICS
- J04MortgageCICS
- **J05MortgageCICS**
  - [build.20180807.083740.037](#)
  - [build.20180808.101018.010](#)
  - [build.20180809.033736.037](#)
  - [build.20180809.034610.046](#)
  - [build.20180810.044700.047](#)
  - [build.20180810.063341.033](#)
  - [build.20180829.031408.014](#)
  - [build.20190529.022144.021](#)
  - **[build.20190529.043258.032](#)**
- J06MortgageCICS

8.3.2 ► This opens the *DBB Build Results*.. Click the Build Report **view** to get details..

Field	Value
id	899
group	J05MortgageCICS
label	build.20190529.043258.032
Build Report	<a href="#">view</a> <span style="color: red;">←</span> <a href="#">view</a>
buildReportData	
state	2 (COMPLETE)
status	0 (CLEAN)
owner	ADMIN
permission	664
created	2019-05-29T16:32:54.026Z

8.3.3 ► This opens the *Build Report*.. Notice the load module created on this build  
You also may explore other hyperlinks. Click **Show dependencies**.

**Build Report**

Toolkit Version:

Version:	1.0.1
Build:	83.
Date:	31-May-2018 17:36:24

**Build Summary**

Number of files being built: 1

	File	Commands	RC	Data Sets	Outputs	Deploy Type	Logs
1	J05MortgageCICS/cobol_cics/J05CMORT.cbl <a href="#">Show Dependencies</a>	IGYCRCTL IEWBLINK	4 0	EMPOT05.DEMO.DEV.COBOL(J05CMORT)	EMPOT05.DEMO.DEV.LOAD(J05CMORT)	LOAD	J05CMORT.log

8.3.4 ► This opens the *Build Summary Report*.. Notice the files that are required for this build (dependencies)

**Build Summary**

Number of files being built: 1

	File	Commands	RC	Data Sets	Outputs	Logs
1	J05MortgageCICS/cobol_cics/J05CMORT.cbl <ul style="list-style-type: none"> <li>• J05MortgageCICS/copybook/DFHAID.cpy <a href="#">COPY</a></li> <li>• J05MortgageCICS/copybook/J05MTINP.cpy <a href="#">COPY</a></li> <li>• J05MortgageCICS/copybook/J05MTOUT.cpy <a href="#">COPY</a></li> <li>• J05MortgageCICS/copybook/J05MTCOM.cpy <a href="#">COPY</a></li> <li>• J05MortgageCICS/copybook/J05NBRPM.cpy <a href="#">COPY</a></li> <li>• J05MortgageCICS/copybook/J05MORT.cpy <a href="#">COPY</a></li> </ul> <a href="#">Hide Dependencies</a>	IGYCRCTL IEWBLINK	4 0	EMPOT05.DEMO.DEV.COBOL(J05CMORT)	EMPOT05.DEMO.DEV.LOAD(J05CMORT)	J05CMORT.log

8.3.5 ► Close the browser.

**Congratulations!** You have completed the Lab. .

# LAB 8 – Using Application Performance Analyzer (APA) (60 minutes)

Modified March 16 2021 by Regi,, (Reviewed by Wilbert Kho)

This lab will take you through the steps of using [Application Performance Analyzer \(APA\)](#) integrated with [Application Delivery Foundation for z \(ADFz\)](#).

On this lab you will measure an existing COBOL/DB2 program running in batch.

## **Overview of development tasks**

To complete this tutorial, you will perform the following tasks:

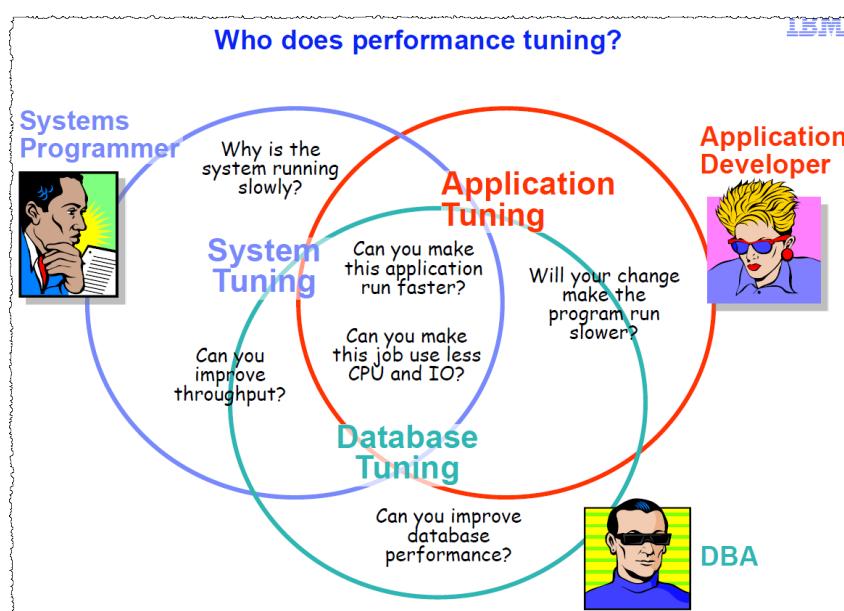
1. **Create a new observation request for a job that is not running yet**  
→ Using ADFz you will create an APA observation request.
2. **Run a sample batch job to collect performance data**  
→ You will submit a JCL that will execute a COBOL/DB2 batch program and will collect performance data.
3. **Review some of the reports created.**  
→ You will analyze some of the reports created.

### **What is APA (Application Performance Analyzer) ?**

IBM® Application Performance Analyzer for z/OS® measures and reports how applications use available resources. This tool helps you identify system constraints and improve application performance. The product's key functions allow users to maximize the performance of your existing applications and improve response time of online transactions and batch turnaround times.



The tool aids application design, development and maintenance cycles. It helps evaluate applications in the design phase, measure the impact of increased data volume or changes in business requirements, and generate historical reports to analyze performance trends.

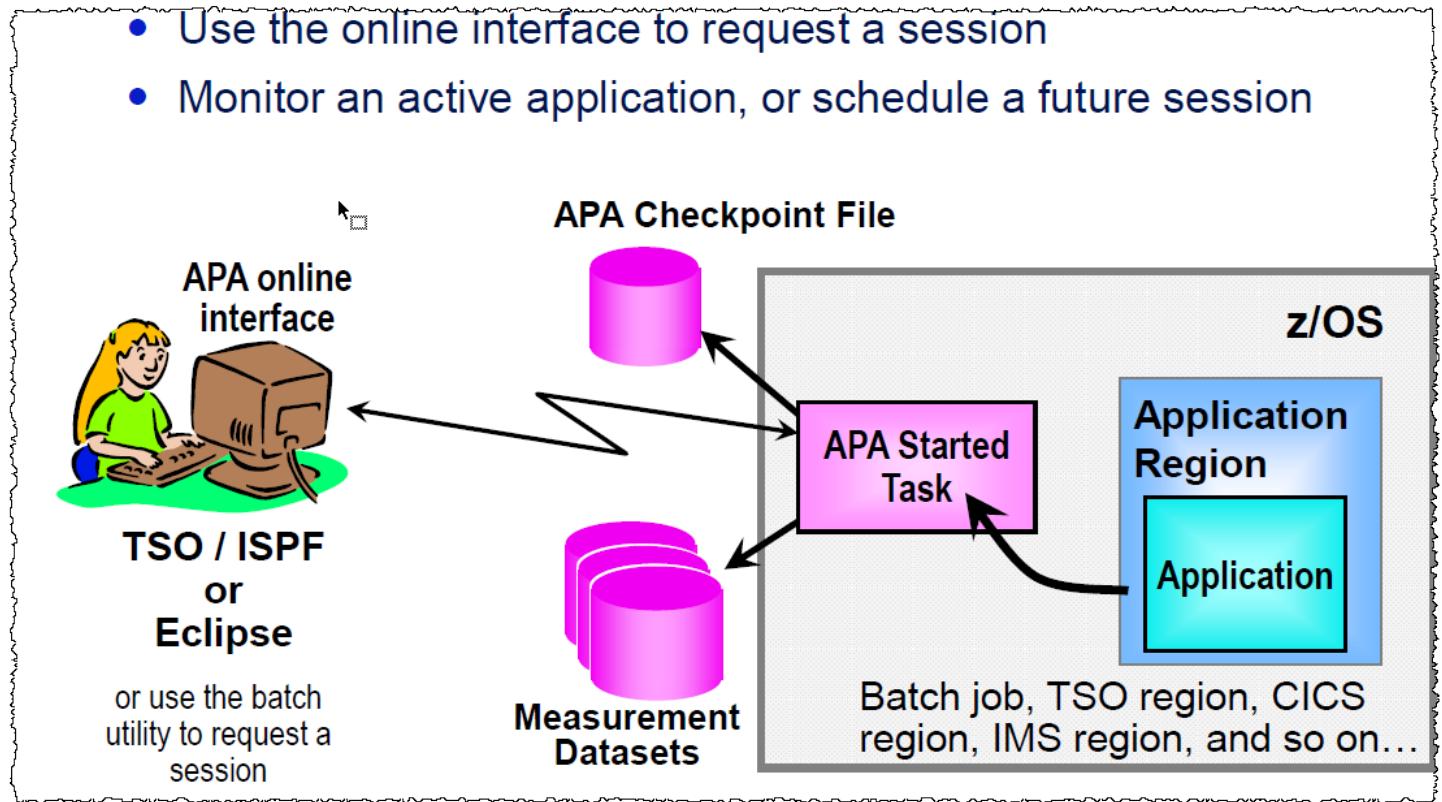


## Section 1. Create a new observation request for a job that is not running yet

For this lab you may use empot05 user id

You will create an **Application Analyzer Observation** for an existing program to be executed via JCL submission.

- Use the online interface to request a session
- Monitor an active application, or schedule a future session



### 1.1 Connect to the ADFz Common Components

There is a “Common components server” on the host system for Problem Determination Tools for z/OS. You must connect to it to access Application Performance Analyzer.

#### 1.1.1 Start IBM Developer for z Systems version 15

► Using the desktop double click on **IDz V15** icon.

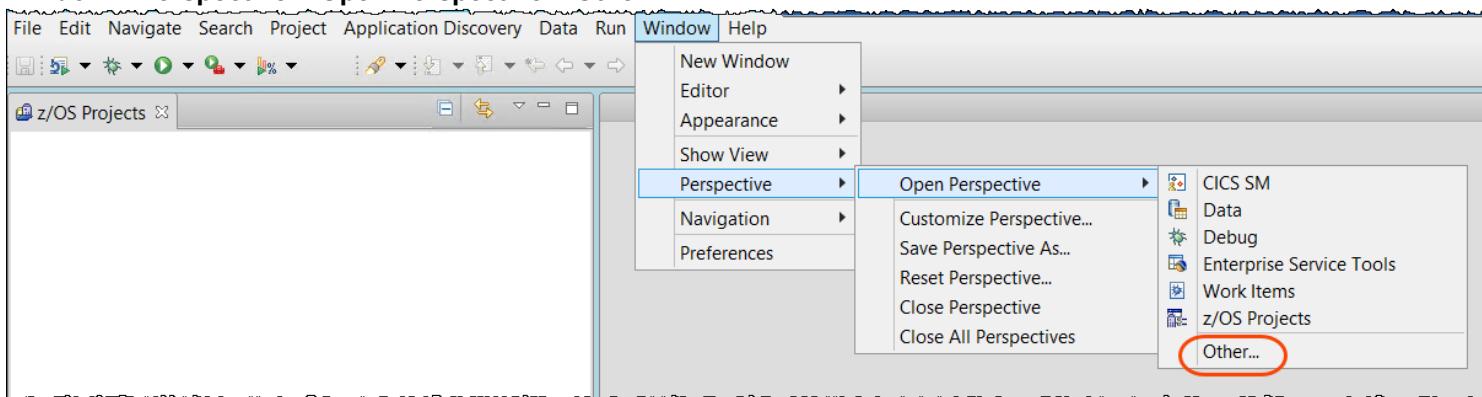
► Verify that the message indicates that it is Version 15.0.1

**IMPORTANT** -> This icon will start an eclipse workspace that has already some definitions required for this lab.  
PLEASE DO NOT start IDz using other way than this icon.

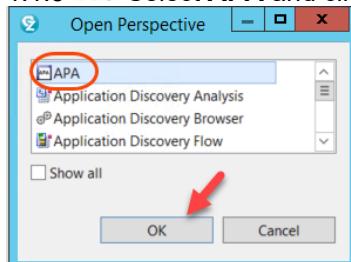


1.1.3 On other labs you may be used a different userid . Your new userid now will be **empot05**.

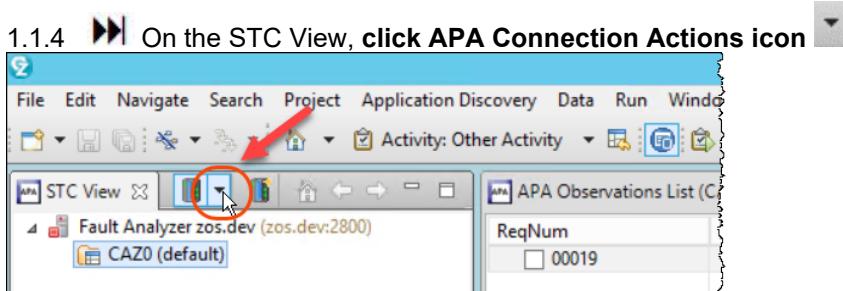
1.1.2 ►| Open the **APA** perspective by selecting  
**Window > Perspective > Open Perspective > Other..**



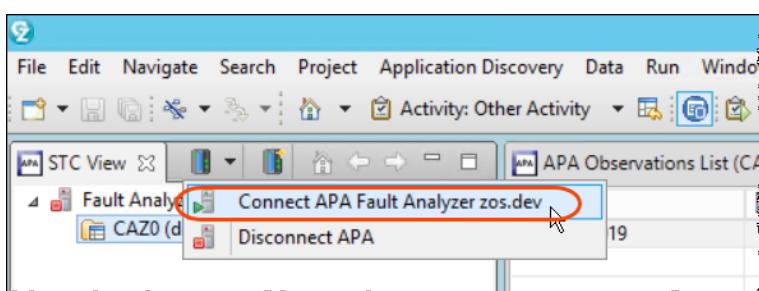
1.1.3 ►| Select **APA** and click **OK**



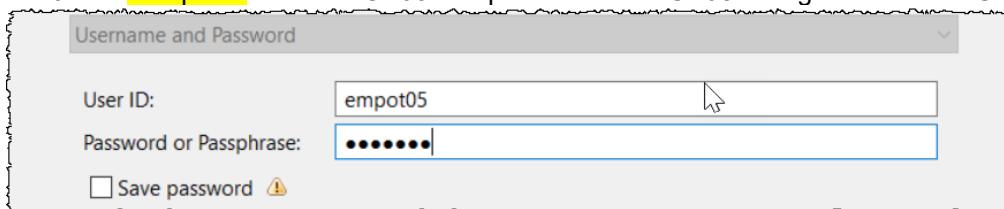
1.1.4 ►| On the STC View, click **APA Connection Actions icon**



1.1.5 ►| Then select **Connect APA Fault Analyzer zos.dev**



1.1.6 ►| If required use **EMPOT05** and password **EMPOT05** to sign in and click **OK**



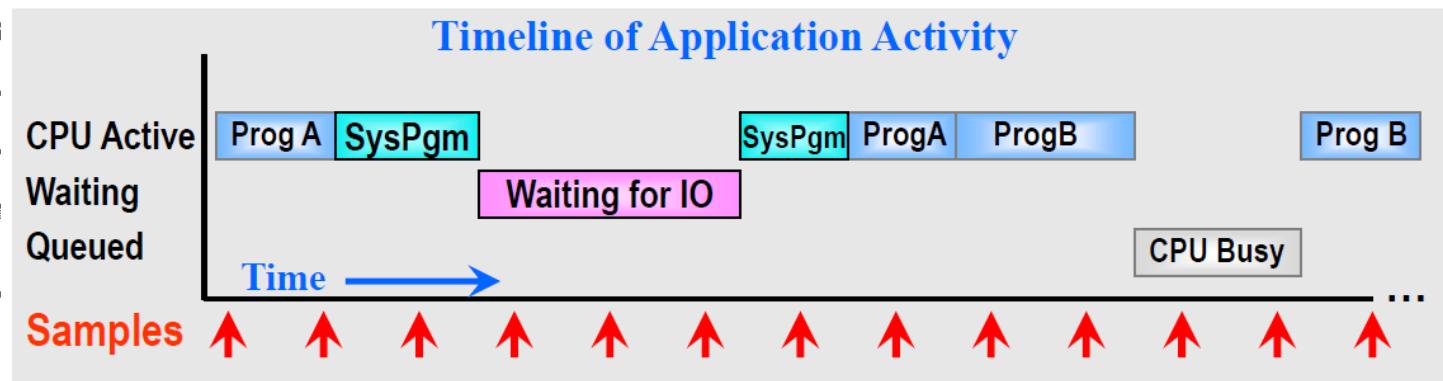
You will see some few pop-ups and this view will lose the focus once the connection succeeded.

## 1.2 Begin a new APA observation session

You will now prepare APA to collect information from the job that you will submit latter.  
You will collect 5000 samples in a duration of 1 minute (or less)

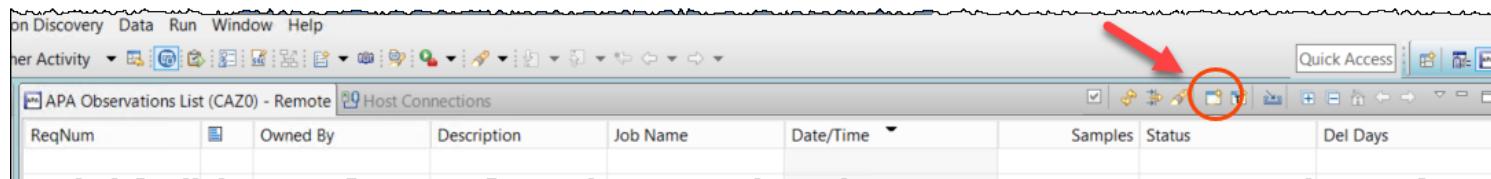
### ■ APA uses "Sampling"

- APA collects information at fixed intervals
- During each "sample", APA determines what the application is doing and why



- Collected data are stored in a measurement data set
- Samples are aggregated later, when you view APA reports

1.2.1 ► Click on the **New Observation** icon .



This will open the Schedule New Measurement dialog.

1.2.2 ► On *Job Name/Pattern* type **APA05**.

You will keep the number of samples as 5000 and duration 1 minute (defaults)

► Click **Submit**.

Schedule New Measurement

① Enter the measurement information and click 'Submit' to schedule.

Job Information		Options	Multi Steps	Active Jobs	Subsystems	Schedule	Sched Options
System	S0W1						
Job Name/Pattern	APA05		Get Active Jobs		ASID		
Inactive							
Step Specification							
Step Number	<input type="text"/>	Specify step number, program, step name or step name + proc step name. Use 'Multi Steps' tab to specify more than one step					
Program Name	<input type="text"/>						
Step Name	<input type="text"/>						
Proc Step Name	<input type="text"/>						
Description							
Number of Samples	5000	Measure to step end	<input type="checkbox"/>				
Duration (min:sec)	1:00	Delay by (secs)	<input type="text"/>				
Notify TSO User	<input type="text"/>	Retain file for (days)	30				
USS observations							
<input type="text"/> Max. 10							
<input style="width: 20px; height: 20px; vertical-align: middle;" type="button" value="?"/> <input style="margin-right: 10px;" type="button" value="Load"/> <input style="margin-right: 10px;" type="button" value="Preview"/> <input style="margin-right: 10px;" type="button" value="Cancel"/> <input style="margin-right: 10px;" type="button" value="Save"/> <input style="border: 2px solid red; border-radius: 10px; padding: 2px 10px;" type="button" value="Submit"/>							

1.2.3

Your new observation request has been added and APA is now waiting for your job to begin (*Sched*)

APA Observations List (CAZ0) - Remote		Host Connections									
Reqnum	Owned By	Description	Job Name	Date/Time	Samples	Status	Del Days	System			
00018	EMPOT05		APA05	Mar-16-2021 11:51	5,000	Sched	30	S0W1			

**What have you done so far?**



You created an APA observation request for a job that you will submit. This observation will collect up to 5000 samples in a duration of 1 minute.

## Section 2 – Run a sample batch job to collect performance data

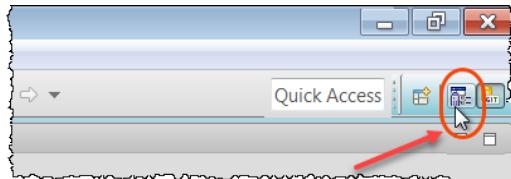
You will submit a COBOL/DB2 batch job named **APA05** and let APA collect performance data.

### 2.1 Connect to z/OS

To submit a job, you first need to connect to z/OS using your assigned user id.

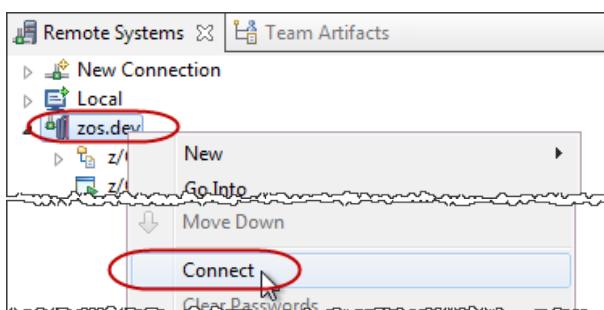
If you are already connected to z/OS using userid **empot05**, skip this and go to step 2.2.

- 2.1.1 ► Switch to the **z/OS Projects** perspective clicking on icon  on the top right corner



- 2.1.2 ► If you are connected using other userid than **empot05** (like **empot01**), you must disconnect first.

- Right click on **zos.dev** and select **Connect**



- 2.1.3 ► Type **empot05** as userid and **empot05** as password.

The userid and password can be any case; don't worry about having it in UPPER case.

Click **OK** to connect to z/OS.

Notice → On this lab your userid will be **empot05** (not empot01 used in Lab 1)

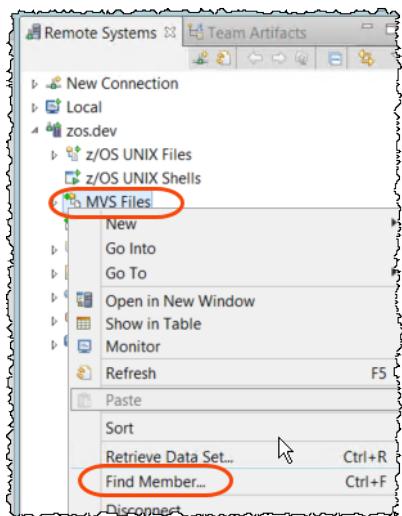


## 2.2 Find the JCL to be submitted

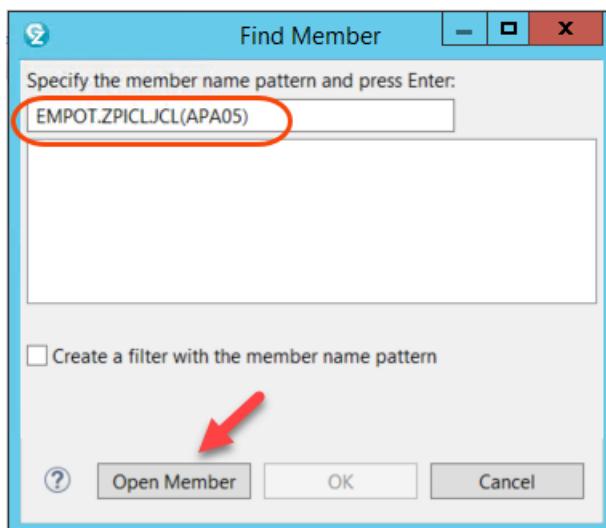
You will find a JCL that runs a COBOL/DB2 batch program.

There are multiple ways to find a job on z/OS. If you don't know in which PDS is your job you may use this technique below.

- 2.2.1 ► Right click on **MVS Files** and select **Find Member....**

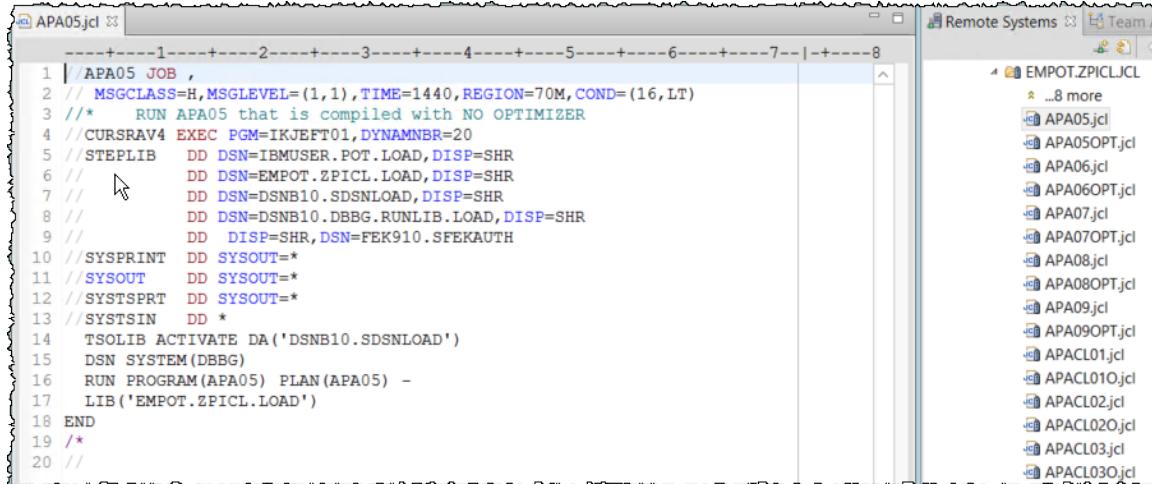


- 2.2.2 ► Type **EMPOT.ZPICL.JCL(APA05)** and click **Open Member**.



## 2.3 Submit the JCL to execute the COBOL/DB2 batch program

The member **APA05.jcl** will open and you must submit for execute on z/OS.

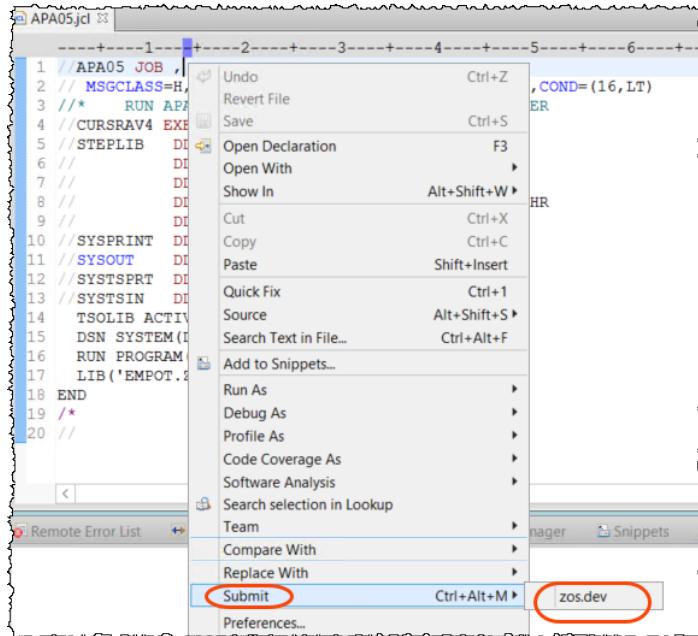


```

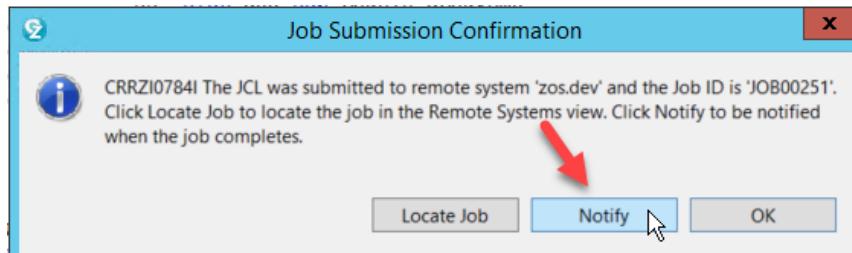
1 //> APA05 JOB ,
2 // MSGCLASS=H, MSGLEVEL=(1,1), TIME=1440, REGION=70M, COND=(16, LT)
3 ///* RUN APA05 that is compiled with NO OPTIMIZER
4 //CURSRAV4 EXEC PGM=IKJEFT01, DYNAMNBR=20
5 //STEPLIB DD DSN=IBMUSER.POT.LOAD, DISP=SHR
6 // DD DSN=EMPOT.ZPICL.LOAD, DISP=SHR
7 // DD DSN=DSNB10.SDSNLOAD, DISP=SHR
8 // DD DSN=DSNB10.DBBG.RUNLIB.LOAD, DISP=SHR
9 // DD DISP=SHR, DSN=FEK910.SFEKAUTH
10 //SYSPRINT DD SYSOUT=*
11 //SYSOUT DD SYSOUT=*
12 //SYSTSPPRT DD SYSOUT=*
13 //SYSTSIN DD *
14   TSOLIB ACTIVATE DA('DSNB10.SDSNLOAD')
15   DSN SYSTEM(DBBG)
16   RUN PROGRAM(APA05) PLAN(APA05) -
17   LIB('EMPOT.ZPICL.LOAD')
18 END
19 /*
20 //

```

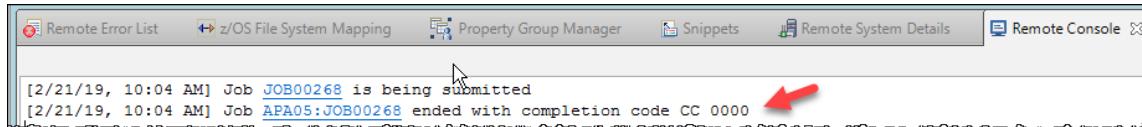
2.2.1 ➡ Right click in any place of the member being edited and select **Submit > zos.dev**



2.2.2 ➡ Click **Notify**. Note on Remote Console view that the job is being submitted



2.2.3 ► On the bottom you will see the Remote Console view. **The completion code must be 000.**  
If this is not the case call the instructor.



2.2.4 ► Use **Ctrl + Shift + F4** to close all opened editors.

### What have you done so far?



You created an APA observation request for a job that you have submitted.  
The observation collected less than 5000 samples since it run in less than 1 minute.

#### What information does Application Performance Analyzer provide?

- APA reports detailed information about:

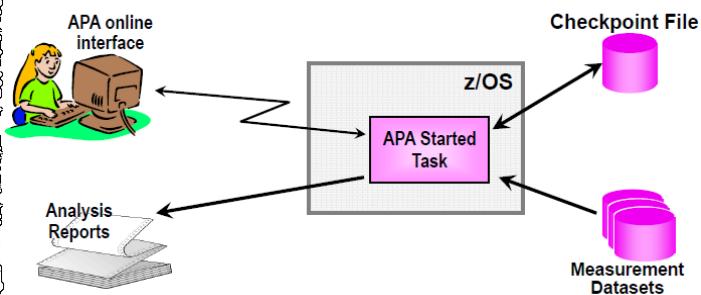
Category:	Sub-categories (partial list) :
CPU usage	by Module, by Statement, by Timeline, ...
WAIT time	by Module, Statement Attribution, ...
DB2	various Metrics by SQL stmt, Plan, Thread, ...
CICS	various Metrics by Txn and by Task, ...
IMS calls	by CPU Time, Call Service Time
DASD usage	by Device, by File, by Timeline, ...
HFS usage	by Device, by File, by Timeline, ...
MQ	by Queue, by Request, by Transaction ...
Storage	by Device, by Task, by Timeline, ...
And more	

## Section 3 – Review some of the reports created.

APA produces analysis reports. On this section you will explore some of the reports produced.  
Notice that you could print, create a PDF or export in XML format.

#### APA produces analysis reports

- View and print analysis reports
  - View sample file data from the APA online interface
  - Or print performance reports to SYSOUT or to a PDF file
  - Sample file data can also be written in XML format



### 3.1 Download the most recent APA observation reports

The reports can be seen using the APA perspective.

- 3.1.1 ➡ On top right corner click the icon  to switch to the APA perspective



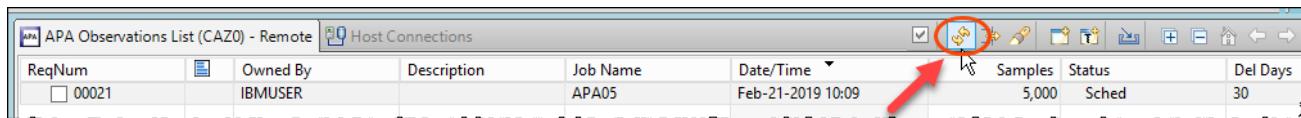
#### Observation Reports List Overview

The reports list is a 2-level tree-view. The first level (parent) rows represent the report category while the second-level (child) rows are for the individual reports.

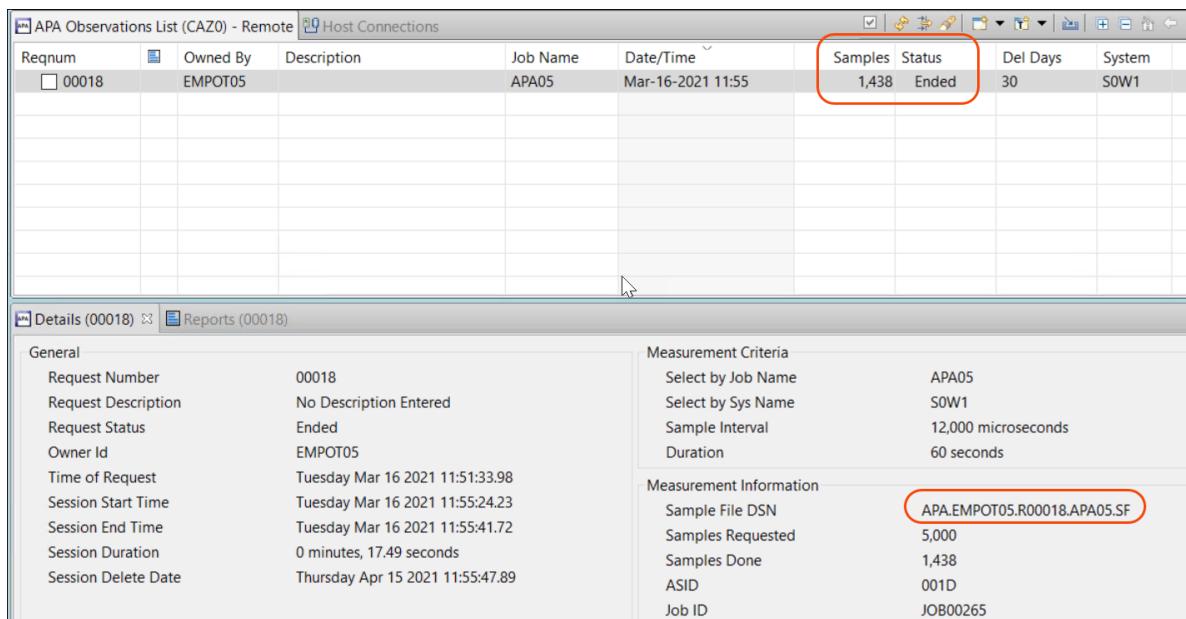
The category rows are for informational/organizational purposes only and result in no action if clicked (other than if the category is expanded). A sticky note icon  is displayed on each report row which has a sticky note.

For each report row that is selected (checkbox checked), a menu is available with a list of actions. Reference the Menu section of the Observations Reports List for details. If a report row is double-clicked a new Report View is opened. .

- 3.1.2 ➡ Click on the icon  to refresh the APA Observation List view



Notice that the Status change to **Ended** and also the *Details* view depicts information about the APA measurement. The name of the sample file ('APA.IBMUSER.xxx') shown below, circled in red, is displayed, which was automatically created by APA to hold the results of the observation session. This file is tied to the observation request. On your lab probably the owner will be EMPOT01 instead of IBMUSER shown on the screen captures..

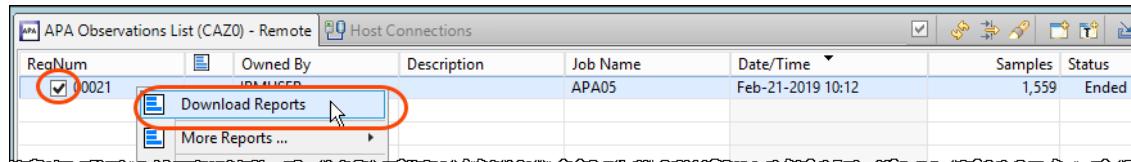


ReqNum	Owned By	Description	Job Name	Date/Time	Samples	Status	Del Days	System
00018	EMPOT05		APA05	Mar-16-2021 11:55	1,438	Ended	30	S0W1

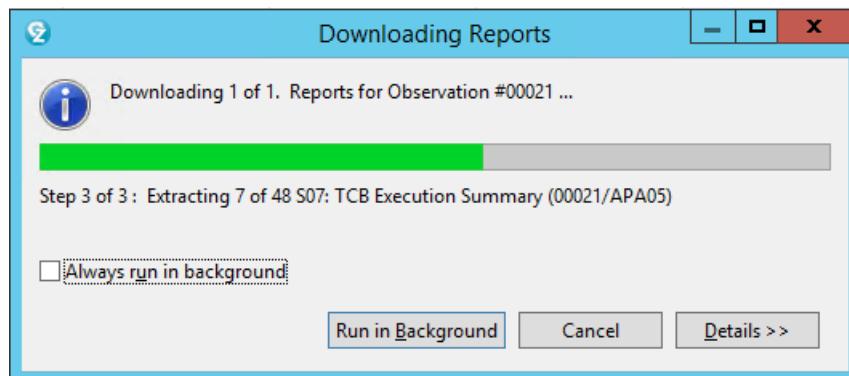
General		Measurement Criteria	
Request Number	00018	Select by Job Name	APA05
Request Description	No Description Entered	Select by Sys Name	S0W1
Request Status	Ended	Sample Interval	12,000 microseconds
Owner Id	EMPOT05	Duration	60 seconds
Time of Request	Tuesday Mar 16 2021 11:51:33.98	Measurement Information	
Session Start Time	Tuesday Mar 16 2021 11:55:24.23	Sample File DSN	APA.EMPOT05.R00018.APA05.SF
Session End Time	Tuesday Mar 16 2021 11:55:41.72	Samples Requested	5,000
Session Duration	0 minutes, 17.49 seconds	Samples Done	1,438
Session Delete Date	Thursday Apr 15 2021 11:55:47.89	ASID	001D
		Job ID	JOB00265

Notice that around 1,500 samples were collected instead of the 5,000 requested.  
 The reason is that the job duration was less than one minute requested (your value may be different).

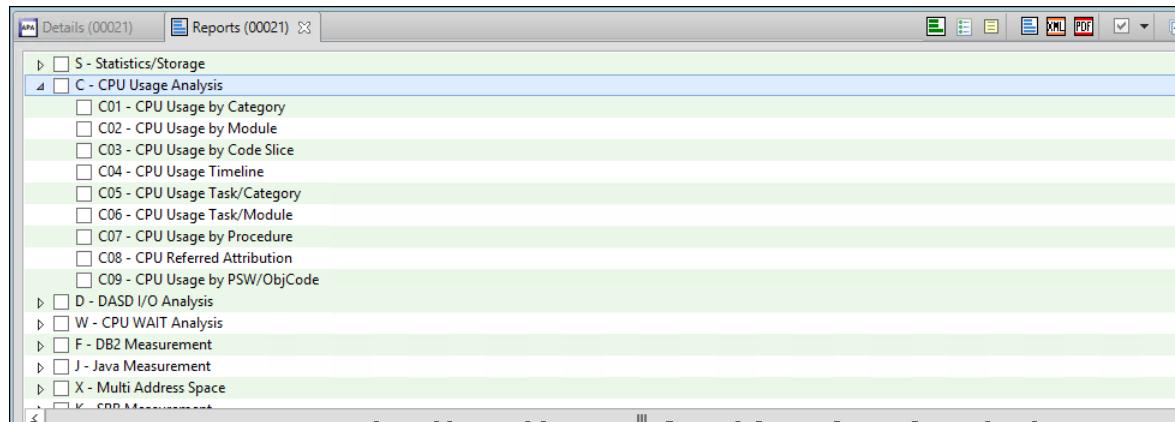
3.1.3 ➔ Click on the box (on left) to select the observation, **Right click** on observation and select **Download Reports**. This will download the created reports to your workspace.



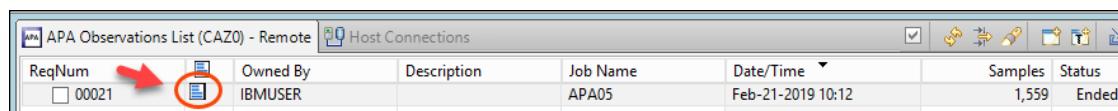
This operation may take a while, depending on your system, network, etc..



When completed you will have the *Reports* view populated.



Also notice that a sticky note is created on *APA Observation List* view.  
 At any point you can analyze any of the downloaded reports.



## 3.2 Analyzing the APA Measurement Profile report (S01)

The reports can be seen using the APA perspective. Each report category can be expanded. Let's start with the Statistics/Storage reports.

### COBOL/DB2 application used on this example

The COBOL/DB2 program source code used here is on the dataset **EMPOT.ZPICL.COBOL(APA05)**.

You may have access if interested on see the source code  
This program is compiled with **NOOPTIMIZE** option. It executes OPEN/FETCH/CLOSE on a small DB2 table 300 times:

```

000-LOOP-OPEN-FECH-CLOSE.
  MOVE 1 to IND.
  PERFORM 000-MAINLINE-RTN THRU 350-EXIT
          UNTIL IND = 300.

...
000-MAINLINE-RTN.

...
150-OPEN-CURSOR-RTN.
  EXEC SQL OPEN C1
  END-EXEC.
150-EXIT.
  EXIT.
250-FETCH-A-ROW.
  EXEC SQL FETCH C1 INTO
    :DEPT-TBL:DEPT-NULL,
    .....
  END-EXEC.
250-EXIT.
  EXIT.
300-CLOSE-CURSOR-RTN.
  EXEC SQL CLOSE C1 END-EXEC.
300-EXIT.
  EXIT.

350-EXIT.
  EXIT.

```

Also this program execute a COMPUTE statement 900,000 times as seen below:

```

502-LOOP.
  MOVE 1 to IND.
  PERFORM 504-ADD-COUNTER THRU 506-EXIT
          UNTIL IND = 900000.
504-ADD-COUNTER.
  MOVE FUNCTION CURRENT-DATE (1:8) TO WS-WORKING-DATE.
  COMPUTE WS-INTEGER-START-DATE =
    FUNCTION INTEGER-OF-DATE (WS-WORKING-DATE)
  COMPUTE IND = IND + 1.
506-EXIT.
  EXIT.
...

```



### 3.2.1 ➡ Expand the S reports above by clicking on the icon on the left of S - Statistics/Storage



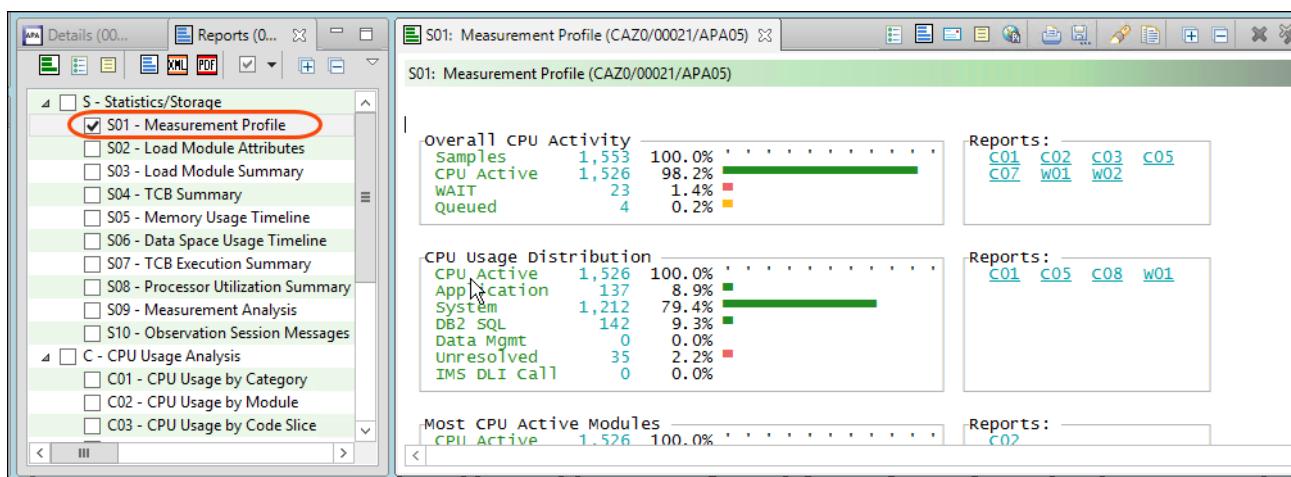
### 3.2.2 ► Double click on the S01 report. The Measurement Profile report is displayed.

This is a good report to examine first when analyzing a measurement. It provides an at-a-glance summary of various aspects of the measurement data and helps you choose which other reports to concentrate on. The first section of this report consists of a series of mini performance graphs illustrating various types of activity that was measured. This is followed by a section that reports measurement values.

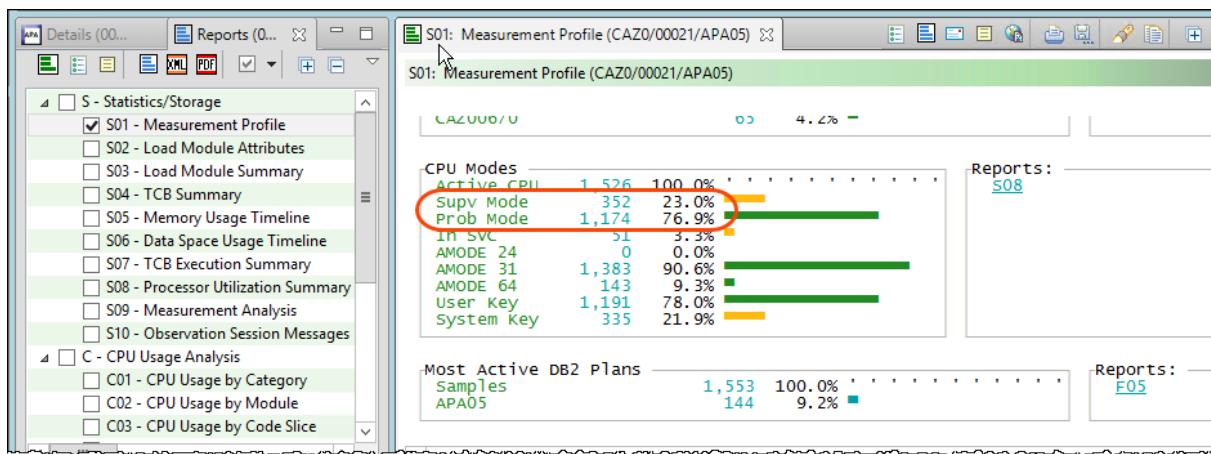
Remember that the actual statistics shown on your reports may be entirely different than the examples shown here. In the example below, the CPU was active for about 98.2% of the samples. An additional 1.4% of the samples show the application in a WAIT state, waiting for resources to become available.

Notice the box down. The CPU Usage Distribution uses the number from the CPU Active Samples to further define what occurred during the Observation Session.

In this case 8.9% was attributed to the Application (APA05 program) and 9.3 % was attributed to DB2 subsystem. While 79.4% was attributed to the Systems programs.



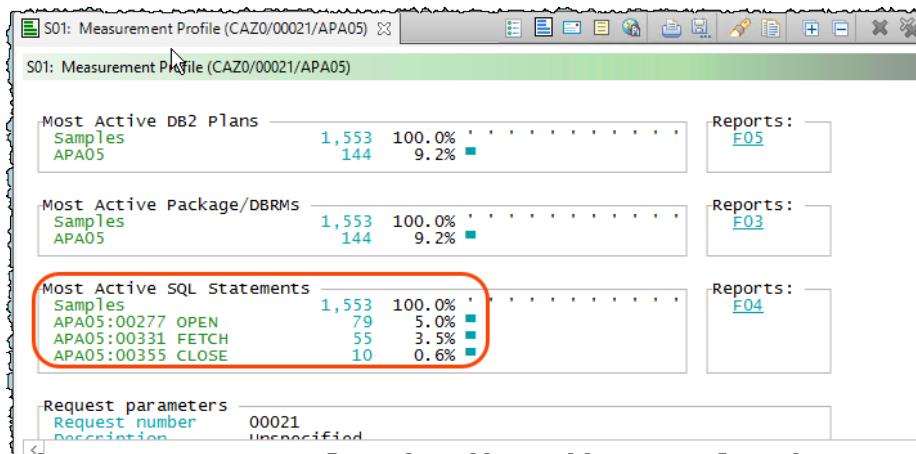
### 3.2.3 ► Scroll down to the remainder of the S01 report.



Notice that 76.9% of the samples observed occurred in **Problem Mode**, indicating that the application was a bit dependent upon code running in **Supervisor Mode**.

It also shows that this application ran mostly in AMODE 31(31 bit addressing mode), but 9.3% run in 64 bit addressing mode.

3.2.3  Scroll down to the remainder of the S01 report to see the CPU usage on the DB2 statements.



Notice that 5.0% of the DB2 CPU usage is on the SQL OPEN statement.

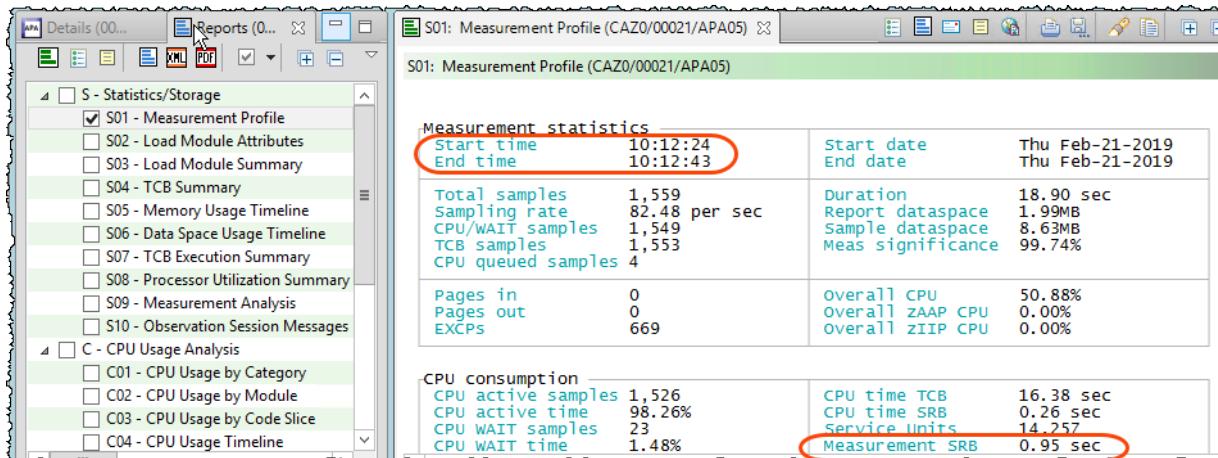
#### Usage of zIIP and zAAP processors



**Did You Know?** Usage of zIIP and zAAP processors used in many DB2 and IMS environments are shown by APA. These processors are included in the Number of CPUs count. The S08 Processor Utilization Summary provides a further breakdown of the CPU usage by the application. Specialty CPUs are reported on a separate line...

3.2.4  Scroll down to the bottom of the S01 report.

During monitoring, APA typically does not attach anything to the application in order to collect performance data. The run time of a monitored application should not be affected by APA. It does require CPU time in its own address space, and this is reported as the **Measurement SRB value** (0.95 sec).



### 3.3 Analyzing the APA Load Module Summary report (S03)

This report can be useful to find which compile options were used for the module creation.

3.3.1 Double click on the S03 report. The Load Module Summary report is displayed.

Module	Locn	Address	Count	size(bytes)	Attributes	DDName	Load Library
APA05	JPA	20458000	1	16,384		SYS00002	EMPOT.ZPICL.LOAD
CAZ00091	CSA	1D769458	1	31,656	RU RN		
CAZ00202	CSA	1D763C88	1	4,984	RU RN	STEPLIB	APA.SCAZAUTH
CAZ00650	CSA	1D73E490	1	2,688	RU RN		
CAZ00670	CSA	1D63BEF0	1	4,368			
CAZ00681	CSA	1D7261A0	1	15,968	RU RN	STEPLIB	APA.SCAZAUTH
CAZ00978	CSA	1D721FA8	1	4,184	RU RN	STEPLIB	APA.SCAZAUTH
CEEINIT	JPA	00072E10	1	45,552	RU RN	-LNKLST-	CEE.SCEERUN
CEEPLPKA	PLPA	05D48000	1	2,182,416			
COEMRETR	JPA	204221D8	1	7,720	RU RN		CEE.SCEELPA
CFLTCH	NHC	A1214110	1	1,688			

From here you can find that this program was loaded from the dataset EMPOT.ZPICL.LOAD.

3.3.2 Right click on APA05 and select Details

Module	Locn	Address	Count	size(bytes)	Attributes	DDName	Load Library
APA05	JPA	20458000	1	16,384		SYS00002	EMPOT.ZPICL.LOAD
CAZ00091	CSA	1D769458	1	31,656	RU RN		
CAZ00202	CSA	1D763C88	1	4,984	RU RN	STEPLIB	APA.SCAZAUTH
CAZ00650	CSA	1D73E490	1	2,688	RU RN		
CAZ00670	CSA	1D63BEF0	1	4,368			

You may find interesting information as seen below, like which COBOL version the program was compiled, the compile options (like NOOPT – NO Optimizer), etc.....

Module Information for APA05

- Load Address 20458000 to 2045BFFF
- Module Size 16,384
- Attributes NOREUS, NORENT
- Module Location JPA
- Loadlib DDNAME SYS00002
- Load Library **EMPOT.ZPICL.LOAD**

ESD Information for APA05

External	Offset	Length	Start Addr	End Addr
APA05	000000	8528	20458000	2045A14F

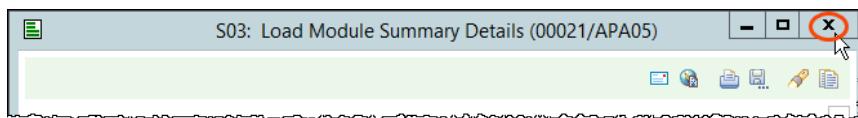
Entry Points: Compiled by COBOL V6.1 at 2019/01/09 14:21:11

```
+00000000 APA05
+00000000 APA05
```

Compile options:

```
ADV AFP(VOLATILE) QUOTE ARITH(COMPAT) NOAWO NOCICS NOCMPR2
NOCURR DATA(31) DBCS NODECK DISPSIGN(COMPAT) NODLL DP NODUMP
NODYNAM NOEXP NOFASTSRT HGPR(PRESERVE) INTDATE(ANSI) LIB LIST
NOMAP NOMDECK NONAME NONUM NUMCLS(PRIM) NUMPROC(NOPFD) OBJ
NOOFFSET NOOPT NOOPTFILE PGMNAME(CO) RENT RMODE(ANY) SEQ SIZE
SOURCE SQL SQLCCSID NOSSR NOSTGOPT NOTERM TEST(SOURCE)
NOTHREAD TRUNC(STD) NOVBREF NOWORD XP(XMLSS) XREF ZWB
```

3.3.3 ► Close the *Load Module Summary Details* clicking on the 

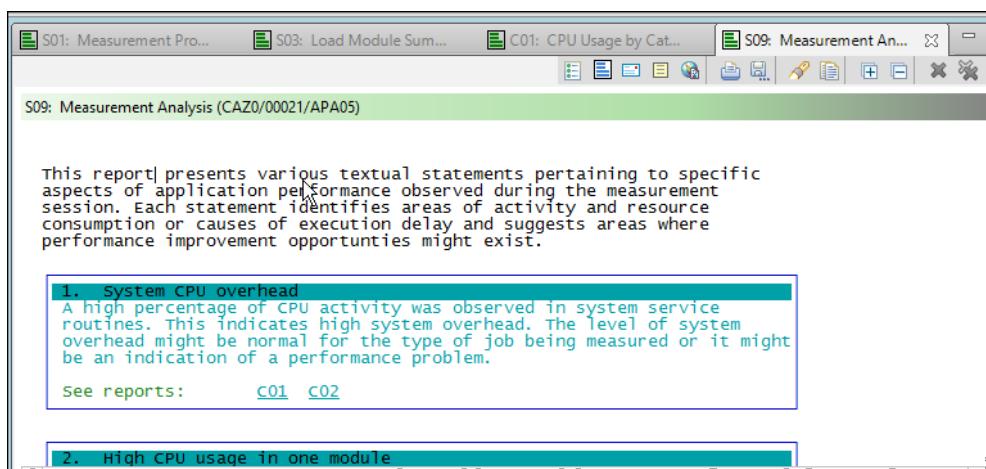


### 3.4 Measurement Analysis report (S09)

This report can be useful to see a summary of the results.

3.4.1 ► Double click on the **S09** report. The *Measurement Analysis* report is displayed.

This report shows aspects of application performance observed during the measurement session.



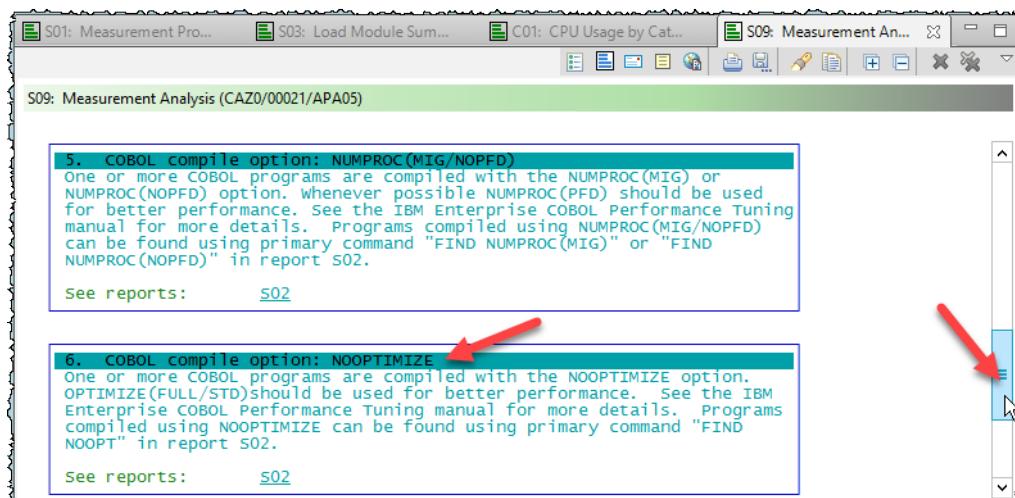
This report presents various textual statements pertaining to specific aspects of application performance observed during the measurement session. Each statement identifies areas of activity and resource consumption or causes of execution delay and suggests areas where performance improvement opportunities might exist.

**1. System CPU overhead**  
A high percentage of CPU activity was observed in system service routines. This indicates high system overhead. The level of system overhead might be normal for the type of job being measured or it might be an indication of a performance problem.

See reports: [C01](#) [C02](#)

**2. High CPU usage in one module**

3.4.2 ► Scroll down and verify the observations. One interesting one is the one that shows that the **COBOL** program was compiled with **NO OPTIMIZER** that could affect the performance.



**5. COBOL compile option: NUMPROC(MIG/NOPFD)**  
One or more COBOL programs are compiled with the NUMPROC(MIG) or NUMPROC(NOPFD) option. whenever possible NUMPROC(PFD) should be used for better performance. See the IBM Enterprise COBOL Performance Tuning manual for more details. Programs compiled using NUMPROC(MIG/NOPFD) can be found using primary command "FIND NUMPROC(MIG)" or "FIND NUMPROC(NOPFD)" in report S02.

See reports: [S02](#)

**6. COBOL compile option: NOOPTIMIZE**  
One or more COBOL programs are compiled with the NOOPTIMIZE option. OPTIMIZE(FULL/STD)should be used for better performance. See the IBM Enterprise COBOL Performance Tuning manual for more details. Programs compiled using NOOPTIMIZE can be found using primary command "FIND NOOPT" in report S02.

See reports: [S02](#)

TIP: Interested in execute this program again but compiled with OPTIMIZE(2)?

The JCL stored in **EMPOT.ZPICL.JCL (APA05OPT)** executes the SAME COBOL program, but compiled with **OPTIMIZE(2)**.

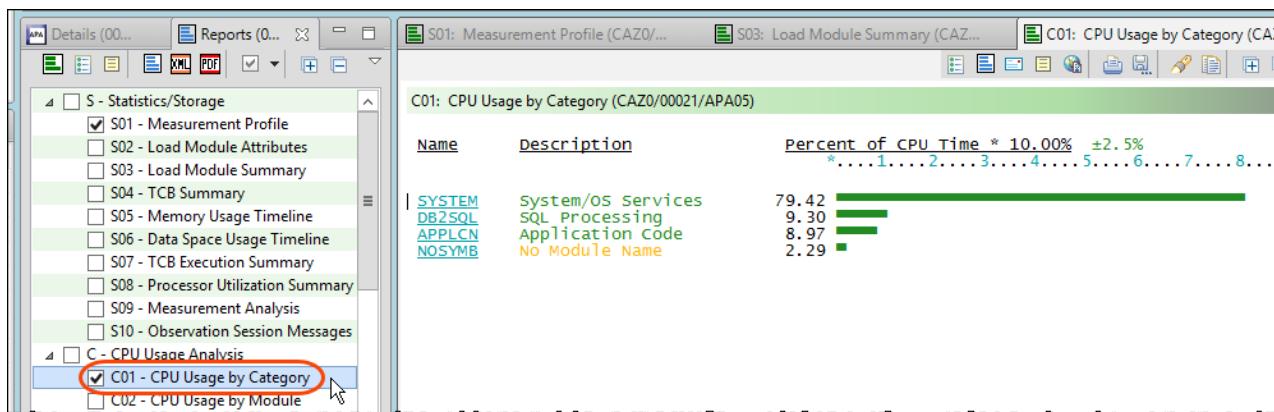
Once you finish this lab you may create another observation for this job and analyze the results... You will notice some CPU reduction...

### 3.5 Analyzing the APA CPU Usage by Category report (C01)

This report can be useful to find which compile options were used for the module creation.

3.5.1 ► Double click on the **C01** report. The *CPU Usage by Category* report is displayed.

The CPU Usage by Category shows the major collections of CPU activity with drill down capabilities to the Load Modules, CSECTS, and Program Source statements in each category.

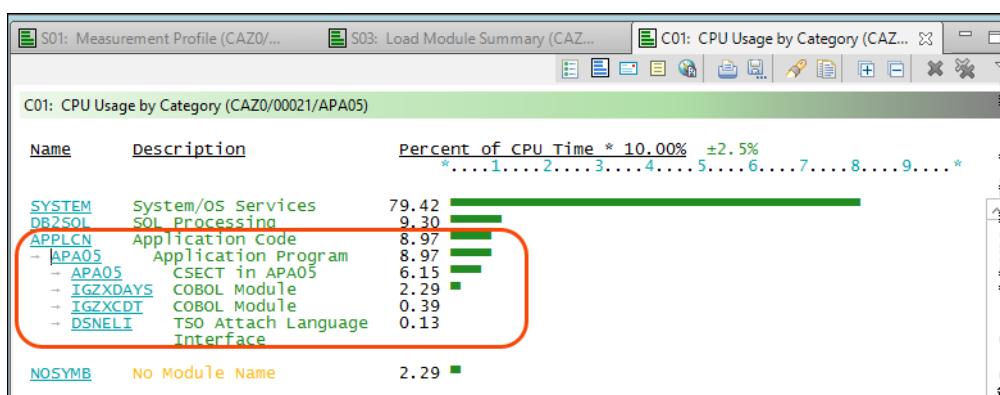


3.5.2 ► Click on the **APPLCN** collection to see the names of the Load Modules which appear in the sampling

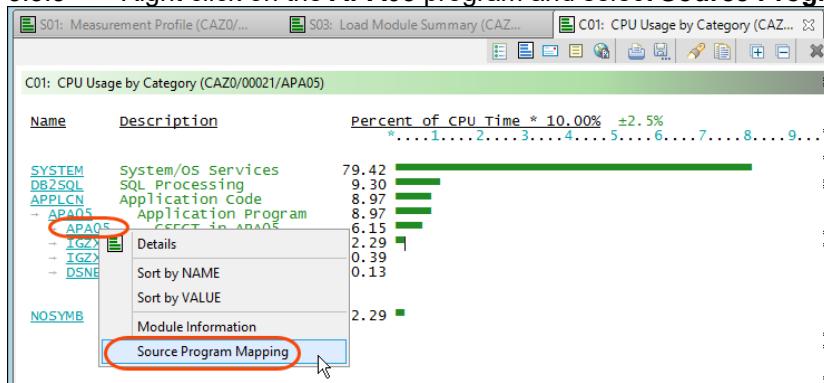
The only Load Module in the **APPLCN** collection is the **APA05** Load Module. In this example **APA05** consumed all of the CPU resource attributed to the **APPLCN** collection.

Since Load Modules can contain multiple programs or CSECTS which are link-edited together, expand the **APA05** program to reveal the individual programs that were observed during the Observation Session.

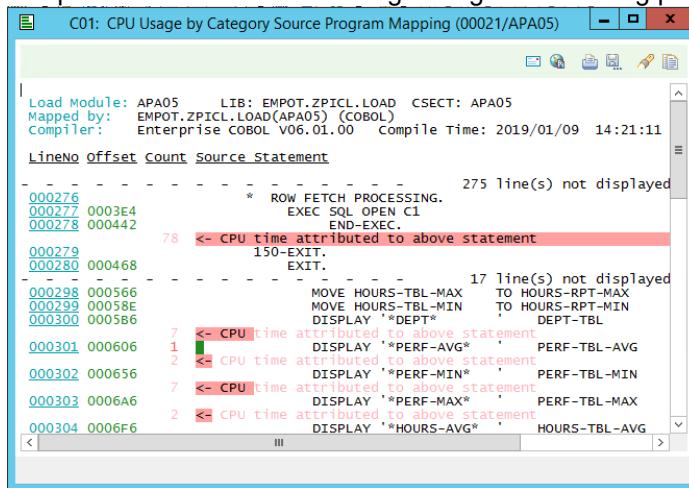
► Click on the **APA05** program to expand the information



### 3.5.3 ► Right click on the APA05 program and select Source Program Mapping

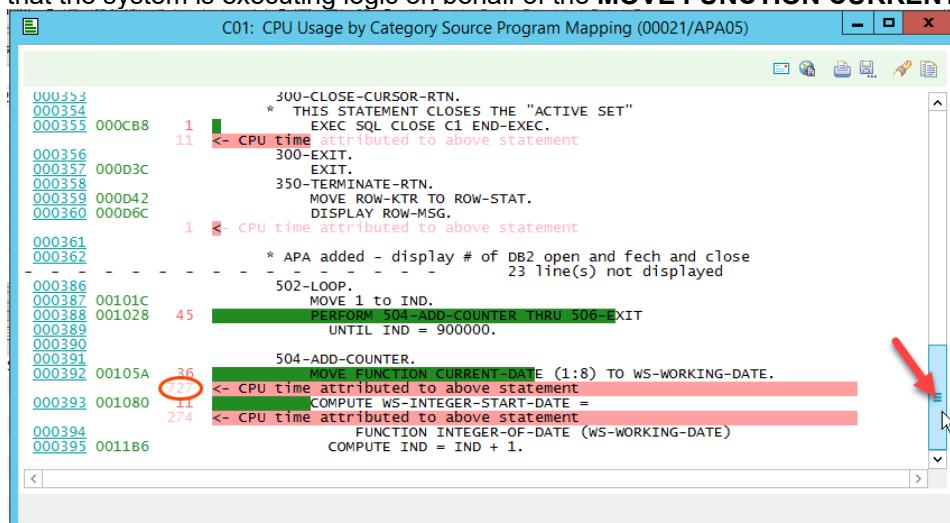


3.5.4 Some of the program source statements are displayed. The **Count** column indicates how many times APA sampled this statement executing during its monitoring process.



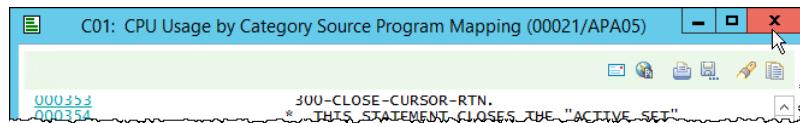
### 3.5.5 ► Scroll up to the end

APA also indicates when system level activity is taking place on behalf of a source statement. In this example, the Count column carries a high number and the statement under the **MOVE FUNCTION CURRENT-DATE** statement that the system is executing logic on behalf of the **MOVE FUNCTION CURRENT-DATE** statement.



Tip: A Possible performance improving here would define **WS-WORKING DATE** as packed or binary numeric?

3.5.6 Close the panel clicking on the

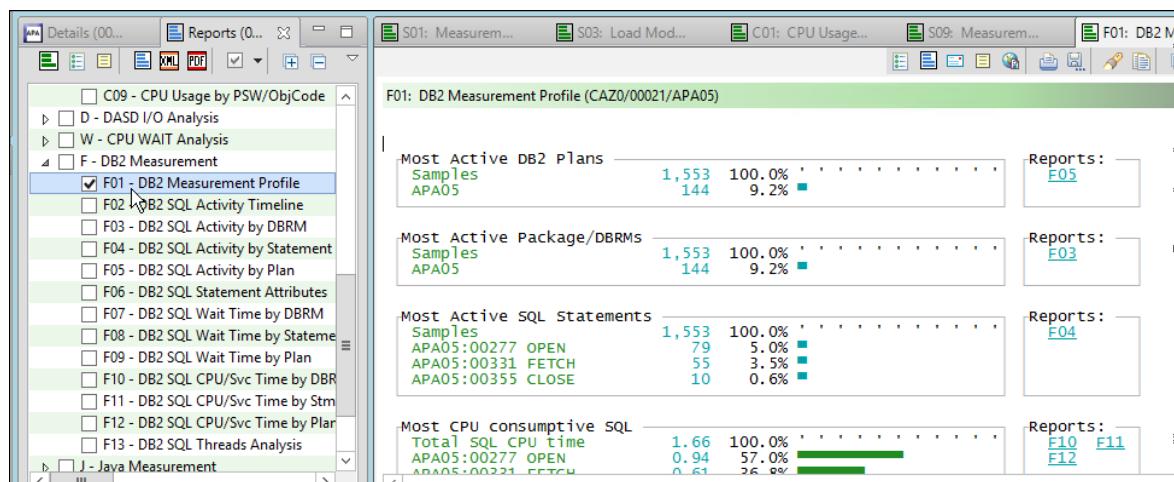


## 3.6 Analyzing the APA DB2 Measurement Profile report (F01)

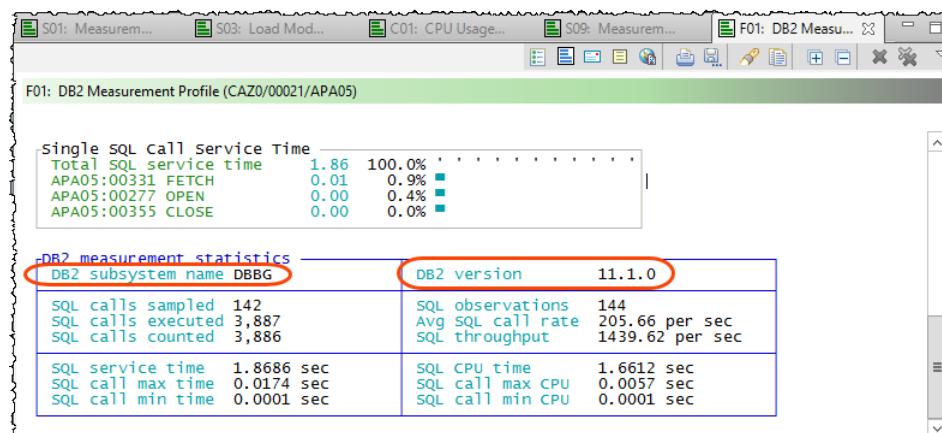
This is a good report to examine first when analyzing DB2 information. It provides an at-a-glance summary of various aspects of the measurement data and helps you choose which other reports to concentrate on. The first section of this report consists of a series of mini performance graphs illustrating various types of activity that was measured. This is followed by a section that reports measurement values.

3.6.1 Scroll down the Reports view and double click on the F01 report. The DB2 Measurement Profile report is displayed.

This report shows aspects of application performance observed during the measurement session



3.6.2 Scroll down the DB2 Measurement Profile Reports view and verify which DB2 level we used, the DB2 subsystem, etc.



### 3.7 Analyzing the APA DB2 Activity by Statement report (F04)

Use this report to see how time was consumed by SQL request processing. The percentage of time is reported by each SQL request.

3.7.1 ► Double click on the F04 report. The *DB2 SQL Activity by Statement* report is displayed. Notice that the Open statement used most of the resources on this example.

Seqno	Program	Stmt#	SQL Function	Percent of Time
S00003	APA05	277	OPEN	5.08
S00001	APA05	331	FETCH	3.54
S00002	APA05	355	CLOSE	0.64

3.7.2 ► Click S00003. You will see the details of this OPEN statement in the program **APA05**.

```

Seqno Program Stmt# SQL Function Percent of Time * 10.00% ±2.5%
*.....1.....2.....3.....4.....5.....6.....7.....8.....9.

S00003 APA05 277 OPEN 5.08
> DECLARE C1 CURSOR FOR SELECT DEPT , MIN ( PERF ) , MAX
> ( PERF ) , AVG ( PERF ) , MIN ( HOURS ) , MAX ( HOURS
> ) , AVG ( HOURS ) FROM RBAROSA . EMPL E , RBAROSA .
> PAY P WHERE E . NBR = P . NBR GROUP BY DEPT
S00001 APA05 331 FETCH 3.54
S00002 APA05 355 CLOSE 0.64

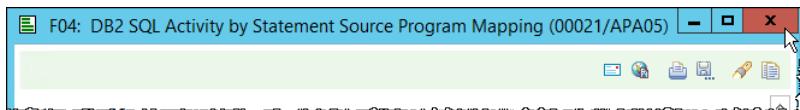
```

3.7.3 ► Right click S0003 and select **Source Program Mapping**

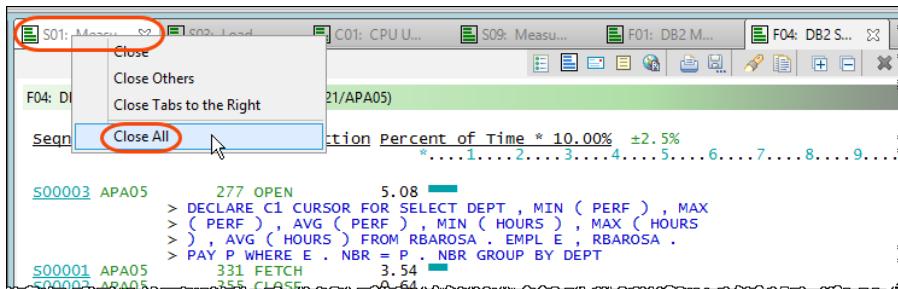
3.7.4 The reports shows where the **Open** is used in the program.

LineNo	Offset	Count	Source Statement
000268			267 line(s) not displayed
000269			WHERE E.NBR = P.NBR
000270			* AND PERF > :PERF
000271			GROUP BY DEPT
000272			END-EXEC.
000273	0003DE		100-EXIT.
000274			EXIT.
000275			150-OPEN-CURSOR-RTN.
000276			* THIS STATEMENT OPENS THE "ACTIVE SET" IN PREPARATION OF
000277	0003E4		* ROW FETCH PROCESSING.
000278	000442	79	EXEC SQL OPEN C1
000279			END-EXEC.
000280	000468		150-EXIT.
000281			EXIT.
000282			200-FETCH-RTN.
000283			* THIS PARAGRAPH SETS UP THE SQL PARAMETERS, PERFORMS THE
000284			* PARAGRAPH TO FETCH THE ROW, AND DISPLAYS THE RESULTS.
000285			* ----> HINT <--- USE ISPF EXCLUDE (XX) OR BLOCK COPY
			* FROM YOUR CURSOR DECLARE STATEMENT TO VERIFY PROPER

3.7.5 ► Close the panel clicking on the **x**



3.7.6 ► Right click on the **S01** Report view and select **Close All** to close all opened reports.



APA have more reports that you can view.. We just touched few of them.

**Congratulations!** You have completed the Lab.



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