Information Integration
Chapter 2. Federated Databases (REST & Web Model)

SIA & SDBIS

Web Model: Web Views and REST Views

Oracle APEX Platform and ORDS Services

Case Study (Review)

- Data Sources
  - SQL: Oracle DB Database 12c/18c/19c/21c,
  - SQL: PostgreSQL 9/10/12,
  - CSV/XLSx: Local FileSystem, Virtual File System (FTP)
  - XML: Local FileSystem or (Web)REST Data Services
  - JSON: Local FileSystem or (Web)REST Data Services

- Data source Access Model
  - External Tables
  - Remote Views
    - SQL Remote Views
    - XML Remote Views
    - REST Remote Views
  - Local Tables (ETL)

- Integration Model
  - Consolidation Views
  - Analytical Views

- Web Model:
  - ORDS REST Views,
  - APEX Reports and Charts

2.2 Architecture and components FDB

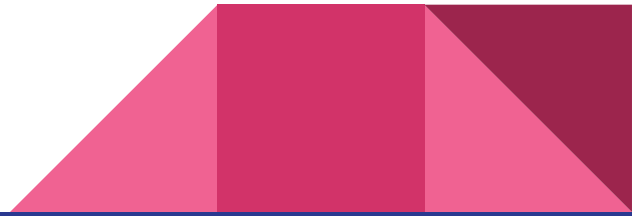
- 2.2.1 Federated Database System Concept
- 2.2.2 Data Source Model and Access Components
- 2.2.3 Integration and Analytical Model
- **2.2.4 Integration Web Model**

2.2.4 Integration Web Model with Oracle ORDS & APEX

- 1. Installation of Oracle ORDS and APEX (on ORDS Platform)
  - Install and config ORDS
  - Enable APEX on ORDS-Service as Web Listener.
- 2. REST Data Service Model with ORDS
  - Create REST Services (ORDS) from Oracle Database
    - REST Data Views with ORDS Services
  - Create REST Data Services with APEX
    - REST Data Services with SQL Queries.
- 3. Web Model with Oracle APEX
  - Reporting Pages for Analytical Views
    - Interactive Reports
    - Chart Reports.

1. Installation of ORDS Platform and APEX Environment

- ORDS Platforms is the APEX runtime.
- If only the REST Services were needed then:
  - (1a) Install and configure ORDS Platform (standalone mode)
- If both APEX and ORDS services are needed then:
  - (1b) Install and configure APEX into Oracle Database
  - (1a) Install and configure ORDS Platform (standalone mode)
  - (1c) Run APEX on ORDS Platform (standalone mode)



(1a) Install and configure **ORDS** platform

- a1) Create/define ORDS HOME directory, e.g. %ORDS_HOME% could be D:\ORDS
- a2) Create/define ORDS configuration directory, e.g. D:\ORDS\config
- a3) Download Oracle REST Data services (aka ORDS) kit form OTN-link and unzip the file into %ORDS_HOME%:
- a4) **First install** and run **ords** app from ORDS_HOME/bin and follow command line instructions:
  - Change current directory to %ORDS_HOME% directory:
    - CD %ORDS_HOME%/bin (replace %ORDS_HOME% with actual ORDS path)
  - `ords --config %ORDS_HOME%/config install`
    - `e.g.: ords --config ../config install`
- a5) **Launch** ORDS runtime in standalone mode:
  - **`ords --config %ORDS_HOME%/config serve`**
    - **`e.g. ords --config ../config config`**

ORDS Interactive Install Log (1)

```
Oracle REST Data Services - Interactive Install

  Enter a number to select the database connection type to use
    [1] Basic (host name, port, service name)
    [2] TNS (TNS alias, TNS directory)
    [3] Custom database URL
  Choose [1]:
  Enter the database host name [localhost]:
  Enter the database listen port [1521]:
  Enter the database service name [XEPDB1]:
  Provide database user name with administrator privileges.
    Enter the administrator username: SYS
  Enter the database password for SYS AS SYSDBA:
```

ORDS Interactive Install Log (2)

```
Retrieving information.
  Enter a number to update the value or select option A to Accept and Continue
    [1] Connection Type: Basic
    [2] Basic Connection: HOST=localhost PORT=1521 SERVICE_NAME=XEPDB1
           Administrator User: SYS AS SYSDBA
    [3] Database password for ORDS runtime user (ORDS_PUBLIC_USER): <generate>
    [4] Additional Feature: Database Actions
    [5] Configure and start ORDS in Standalone Mode: Yes
    [6]    Protocol: HTTP
    [7]       HTTP Port: 8080
    [8]   APEX static resources location:
    [A] Accept and Continue - Create configuration and Upgrade ORDS in the database
    [Q] Quit - Do not proceed. No changes
  Choose [A]: A
```

Install and configure ORDS platform: DEBUG

- Optional - IF the ORDS installation fail or some other problems:
  - to re-configure server
    - `ords --config %ORDS_HOME%/config config`
      - `e.g. ords --config ../config config`
  - to run a second installation - if the first install will fail
    - Uninstall:
      - `ords --config %ORDS_HOME%/config uninstall`
    - Re-install:
      - `ords --config %ORDS_HOME%/config install`
- Finally re-launch ORDS runtime in standalone mode:
  - `ords --config %ORDS_HOME%/config serve`
    - `e.g. ords --config ../config config`

(1b) Install and configure **APEX** into the Oracle Database

- b1) Download APEX from OTN Link
- b2) Unzip APEX kit into a dedicated folder (e.g D:\) so that %APEX_HOME% could be D:\apex
  - (the apex-latest.zip contains an internal *apex folder*)
- b3) Run installation procedure scripts:
  - CD %APEX_HOME% - replace APEX_HOME with the actual apex path.
  - Run apex installation SQL scripts from SQLPLUS /nolog.

(1b) Install and configure APEX into Oracle Database

- b3) Run installation procedure scripts from SQLPLUS
  - 1) Connect to SQLPLUS
    - sqlplus /nolog
    - connect sys as sysdba
    - (for Oracle CDB context switch to a PDB)
      - ALTER SESSION SET container = XEPDB1;
  - 2) Run installation script
    - @apexins SYSAUX SYSAUX TEMP /i/
  - 3) Set APEX admin account credentials
    - @apxchpwd
      - Username(default): ADMIN
  - 4) Unlock and update Oracle APEX_PUBLIC_USER use account:
    - ALTER USER APEX_PUBLIC_USER ACCOUNT UNLOCK;

(1b) Install and configure APEX into Oracle Database

- b3) Run installation procedure scripts from SQLPLUS
  - 5) Enable APEX REST services for ORDS integration (to enable REST data schema and/or structure from APEX REST module) by running the @apex_rest_config script
    - Run @apex_rest_config
  - 6) Set APEX static resource directory (with images) for ORDS integration
    - Open and edit ORDS platform configuration file %ORDS_HOME%/config/global/***settings.xml***
    - Add the following configuration line (replace %APEX_HOME% with actual apex directory, e.g. D:\apex):
      - <entry key="standalone.static.path">%APEX_HOME%/images/</entry>

(1c) Run Oracle APEX on ORDS Platform

- Launch ORDS platform in standalone mode:
  - ords --config %ORDS_HOME%/config serve
    - `e.g.: ords --config ../config config`
  - ORDS path (from generic URL http://localhost:8080/ords/)
    - http://localhost:8080/ords/_/landing
- APEX URLs from ORDS (default port: 8080):
  - http://localhost:8080/ords/apex
  - http://localhost:8080/ords/apex_admin
- See 3.1 section (from this tutorial) to configure an Workspace and a developer APEX user to access APEX development mode.

Problems with installation and configuration of ORDS and APEX

- ORDS Platform Installation “problematic” steps:
  - Setup configuration location [Enter the location to store configuration data]
    - [%ORDS_HOME%]\config
  - If the installation home is in a CDB Context (Container Database Context is default for 18c, 19c, 21c) then ORDS must be installed in a pluggable-database and not in the main container, then in the step:
    - Enter the Database Service Name: enter PDB container name (e.g. XEPDB1)
  - APEX URL from ORDS (default port: 8080):
    - http://localhost:8080/ords/apex

Installation Guide Latest

Problems with installation and configuration of ORDS and APEX

- APEX Installation problems
  - If the installation home is in a CDB Context (Container Database Context is default for 18c, 19c, 21c) then APEX (and ORDS) must be installed in a pluggable-database and not in the main container: launch SQL*PLUS with SYS user and switch to a pluggable db:

```
sqlplus /nolog
connect sys as sysdba
ALTER SESSION SET container = XEPDB1;
```

- Check Oracle Service ORCL (Oracle Instance) to be started in OS Services console.

Installation Guide Latest

Problems with installation and configuration of ORDS and APEX

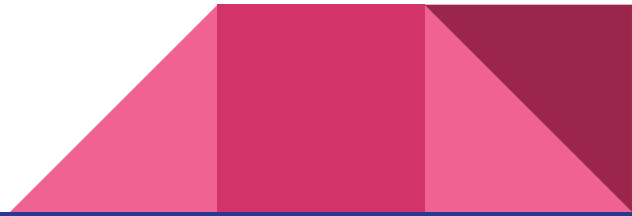
- APEX on ORDS Installation problems
  - Remember APEX user password
  - Check APEX users - check if status is OPEN and not expired:
    - APEX_PUBLIC_USER
      - ALTER USER APEX_PUBLIC_USER ACCOUNT UNLOCK;
      - ALTER USER APEX_PUBLIC_USER ACCOUNT IDENTIFIED BY *new_password*;
    - APEX_REST_PUBLIC_USER
    - ORDS_PUBLIC_USER
  - Check configuration file: %ORDS_HOME%/config/global/settings.xml
    - <entry key="standalone.http.port">8080</entry>
    - <entry key="standalone.context.path">/ords</entry>
    - <entry key="standalone.static.path">%APEX_HOME%/images/</entry>

2. WEB REST Data Service Model with ORDS

- Oracle REST Data Services (ORDS) for Oracle Database
  - REST Data Views with ORDS Services
  - REST Data Services with APEX (first see section 3.1)
    - REST Data Services with SQL Queries

Create REST Services from Oracle Database (ORDS)

- Oracle REST Services (ORDS) into Oracle Database: publishing REST Data Views with ORDS Services
  - Enable REST services for Oracle schema with ORDS.ENABLE_SCHEMA
  - Enable SQL-Table/View as REST-Resource with ORDS.ENABLE_OBJECT



Publish SQL-View as REST Resource

STEP_1: http://localhost:8080/ords/fdbo/invoices_agg/

```
BEGIN
    ORDS.ENABLE_SCHEMA(p_enabled => FALSE);
    ORDS.drop_rest_for_schema();
    commit;
END;
/
```

```
BEGIN

    ORDS.ENABLE_SCHEMA(p_enabled => TRUE,
                       p_schema => 'FDBO',
                       p_url_mapping_type => 'BASE_PATH',
                       p_url_mapping_pattern => 'fdbo',
                       p_auto_rest_auth => FALSE);


    commit;

END;
/
```

Publish SQL.View as REST Resource
STEP_2: http://localhost:8080/ords/fdbo/invoices_agg/

```
BEGIN

    ORDS.ENABLE_OBJECT(p_enabled => TRUE,
                       p_schema => 'FDBO',
                       p_object => 'INVOICES_AGG_VIEW',
                       p_object_type => 'VIEW',
                       p_object_alias => 'invoices_agg',
                       p_auto_rest_auth => FALSE);

    commit;

END;
/
```

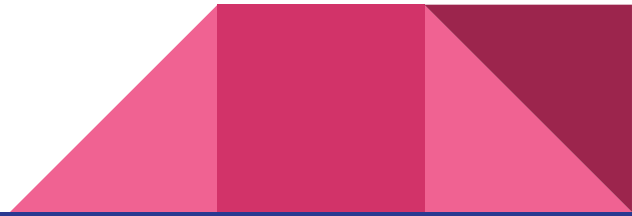
URL(endpoint) for a RESTful Resource

- ORDS base URL
  - `http://localhost:8080/ords`
- Schema context
  - `/fdbo`
- Object alias
  - `/invoices_agg`

`http://localhost:8080/ords/fdbo/invoices_agg/`

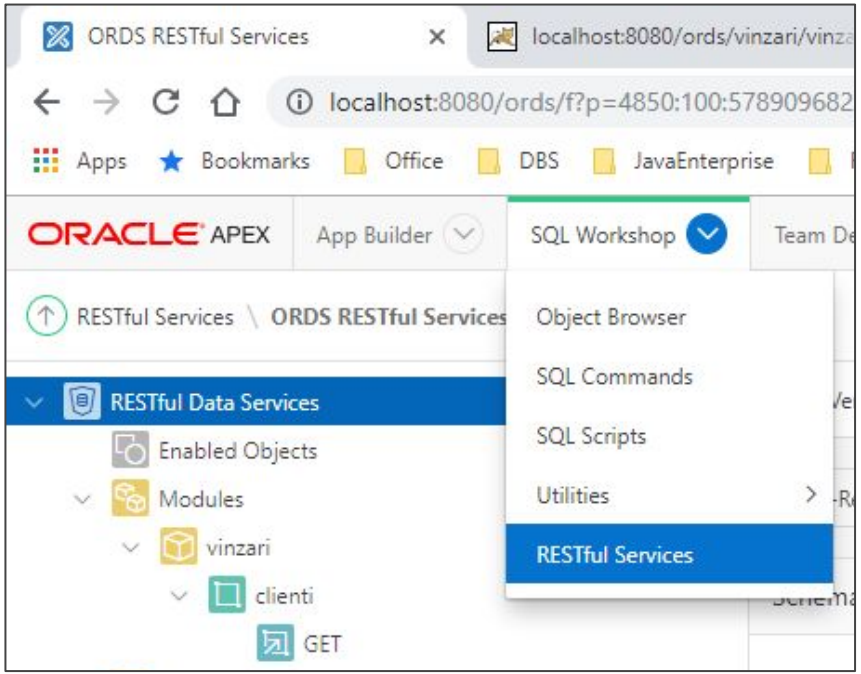
Create REST Data Services from APEX

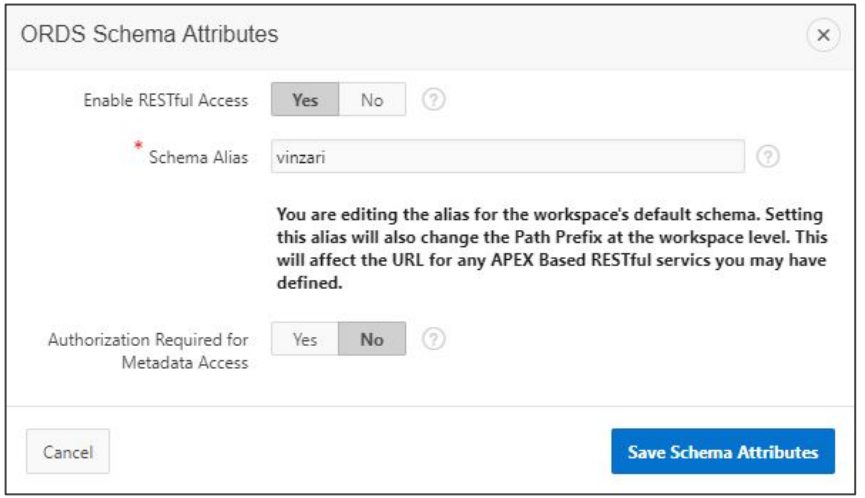
- Enable Restful Services
- Create REST Data Services with APEX from (local) SQL-Queries
- (Optional) REST Enabled SQL option of APEX



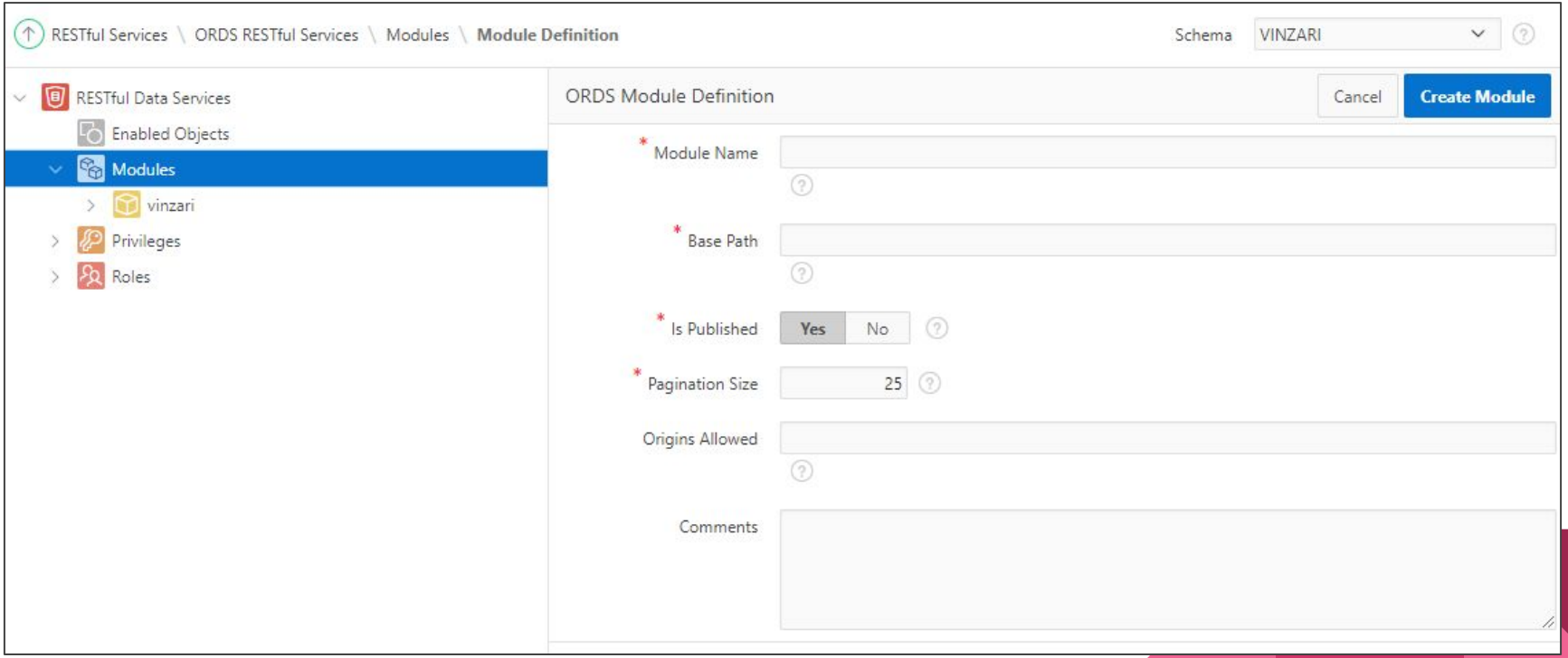
APEX Restful Services

- Enable APEX support from APEX SQL Workshop module and RESTful Services Option

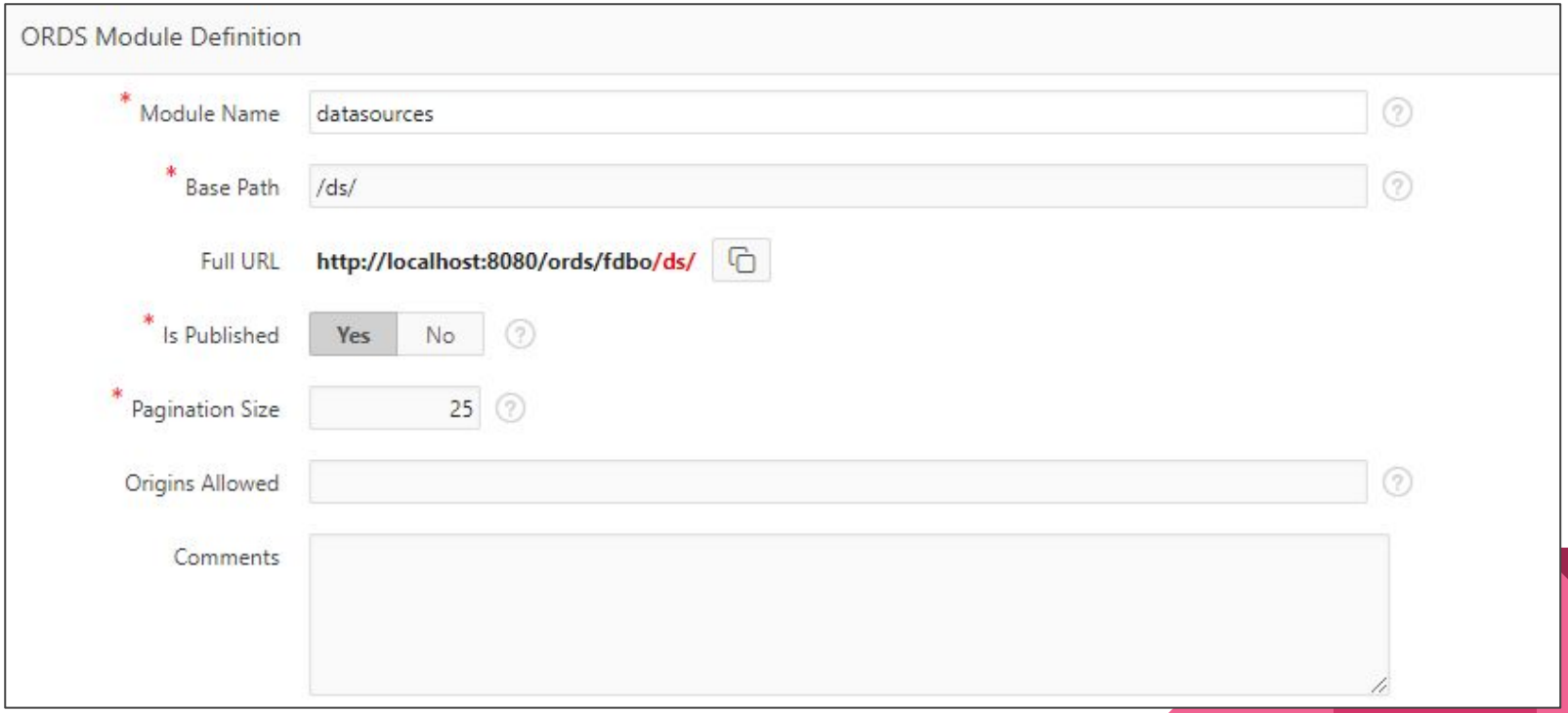




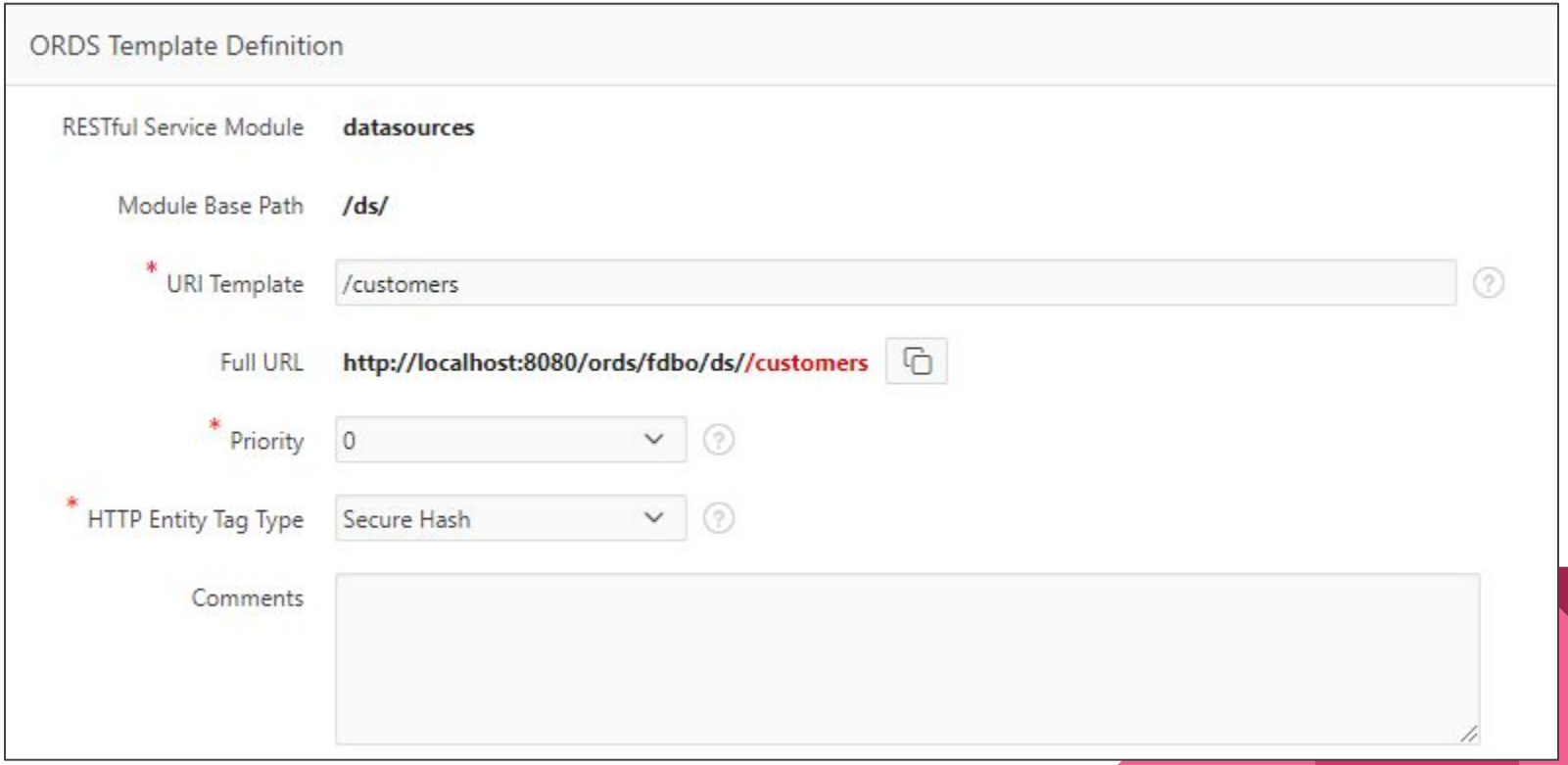
APEX Restful Services



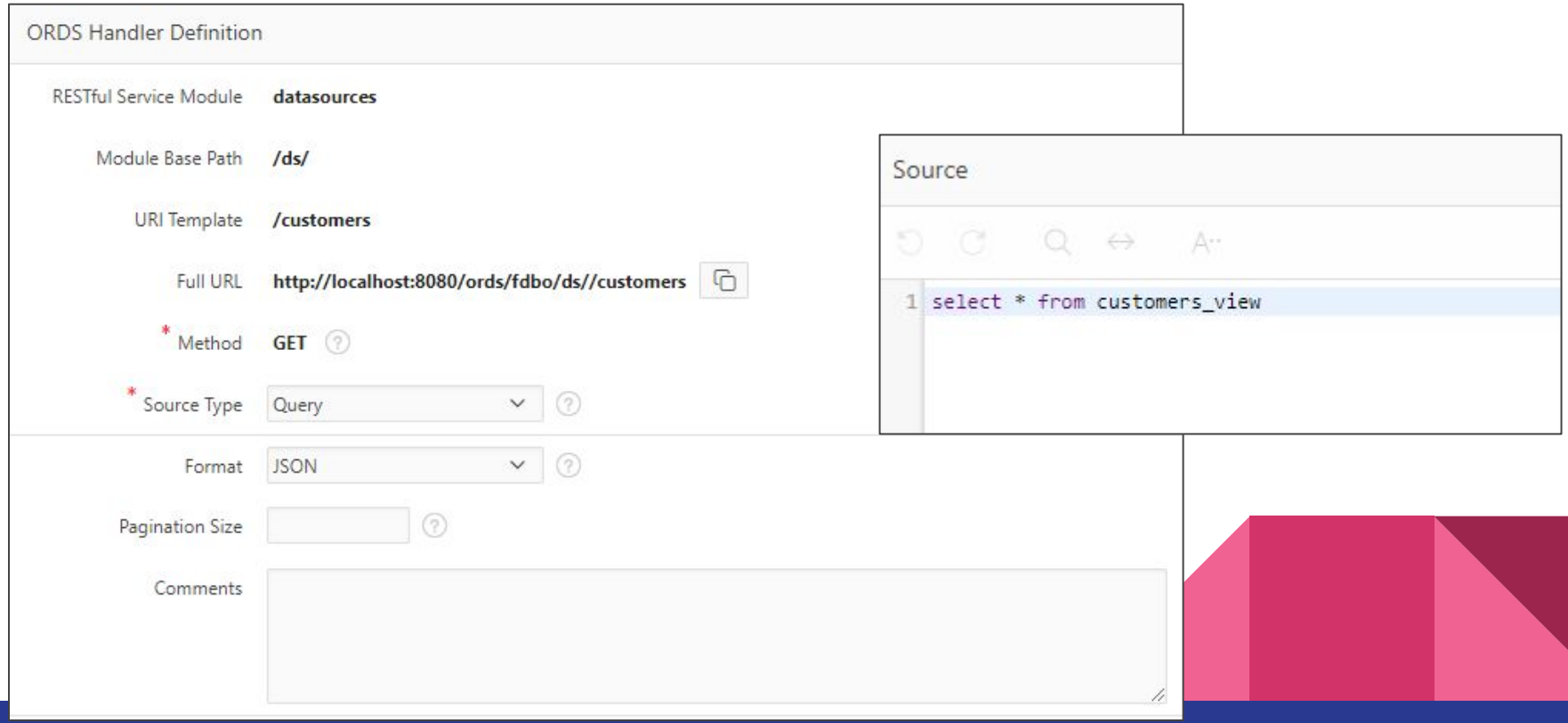
Step_1: Create Module definition



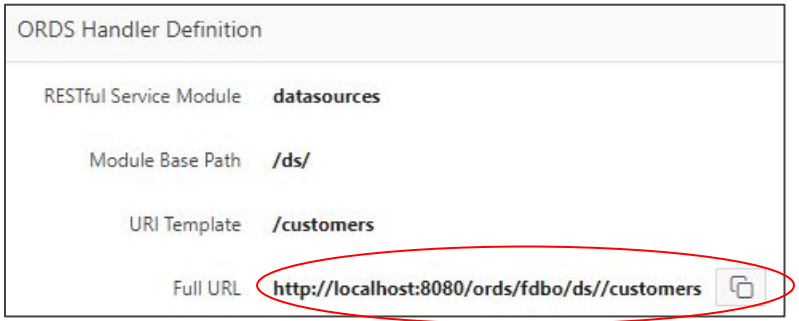
Step_2: Create Template definition

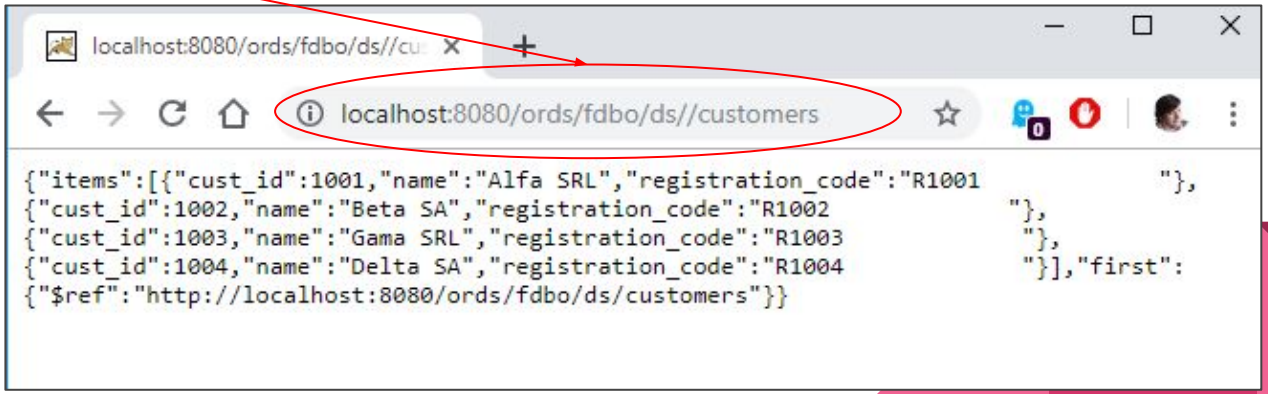


Step_3: Create Handler definition with Source Type Query



Step_3: Access REST Data Services URL





CASE STUDY: Oracle REST Data Services

Case Study: Oracle REST Data Services Configuration from SQL Developer

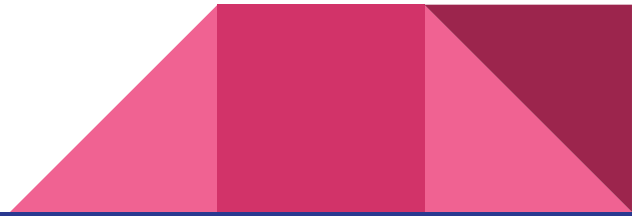
- SQL Script Examples:
  - 32_FDBO_REST_WebViews.sql

3. Oracle APEX Web Model

- Workspace management in Admin Mode
- Create Starter Web Application in Development Mode
- Analytical Reports with Interactive Grids
- Analytical Charts

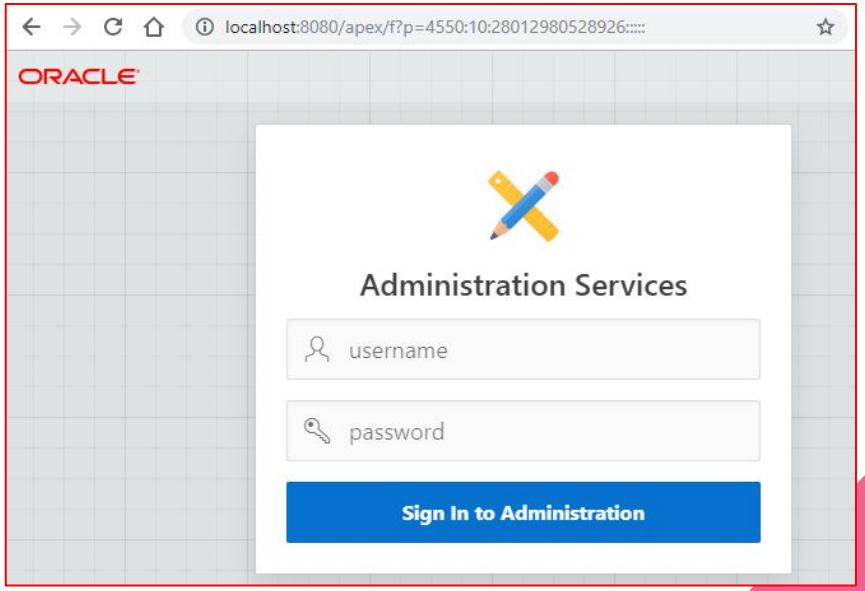
3.1 Workspace management in Admin Mode

- Prerequisites
  - Existing database schema: FDBO



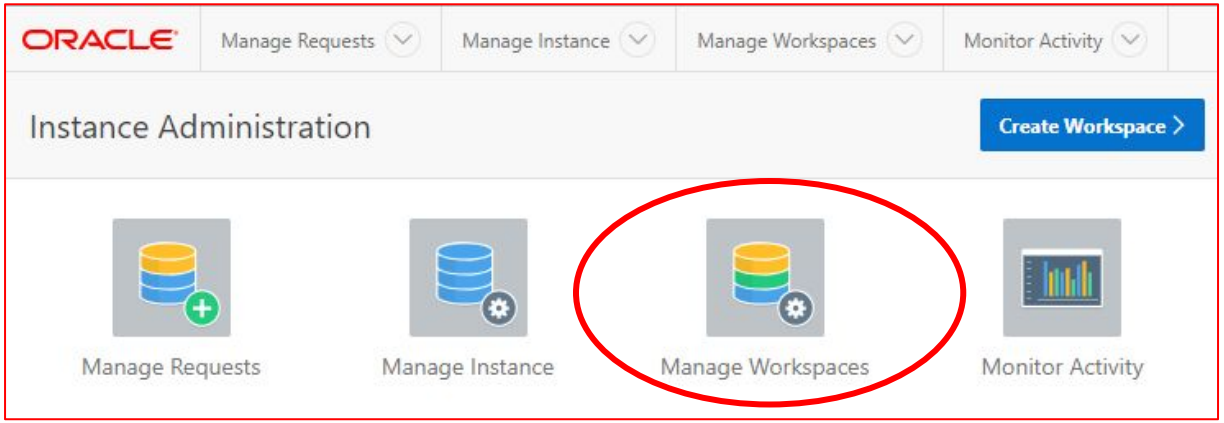
ADMIN Mode: Instance Administration

- Login page from URL: http://localhost:8080/apex/apex_admin] requires:
  - administration account username: admin;
  - password settled with *apxchpwd* script (see previous slides).



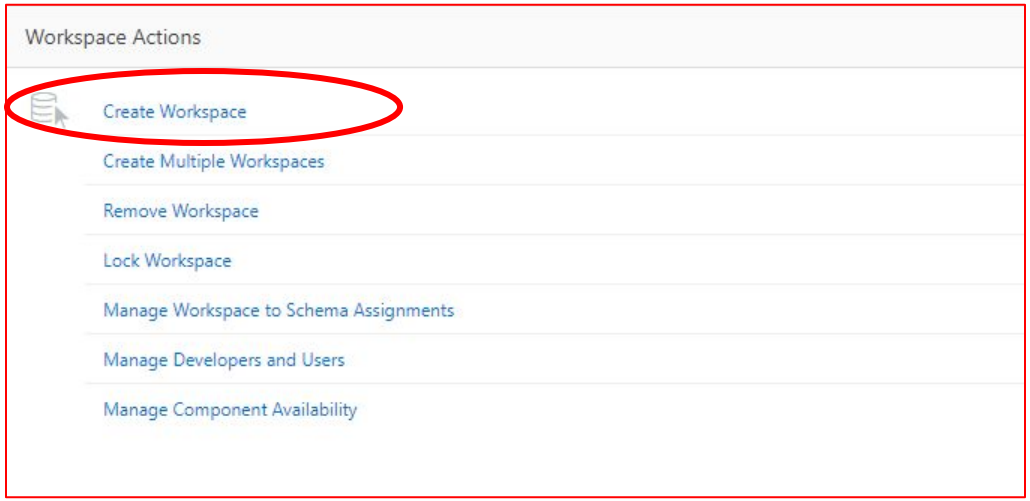
Apex Instance Administration

- The necessary settings in order to activate the “Development Mode” will be made from *Manage Workspace* option.



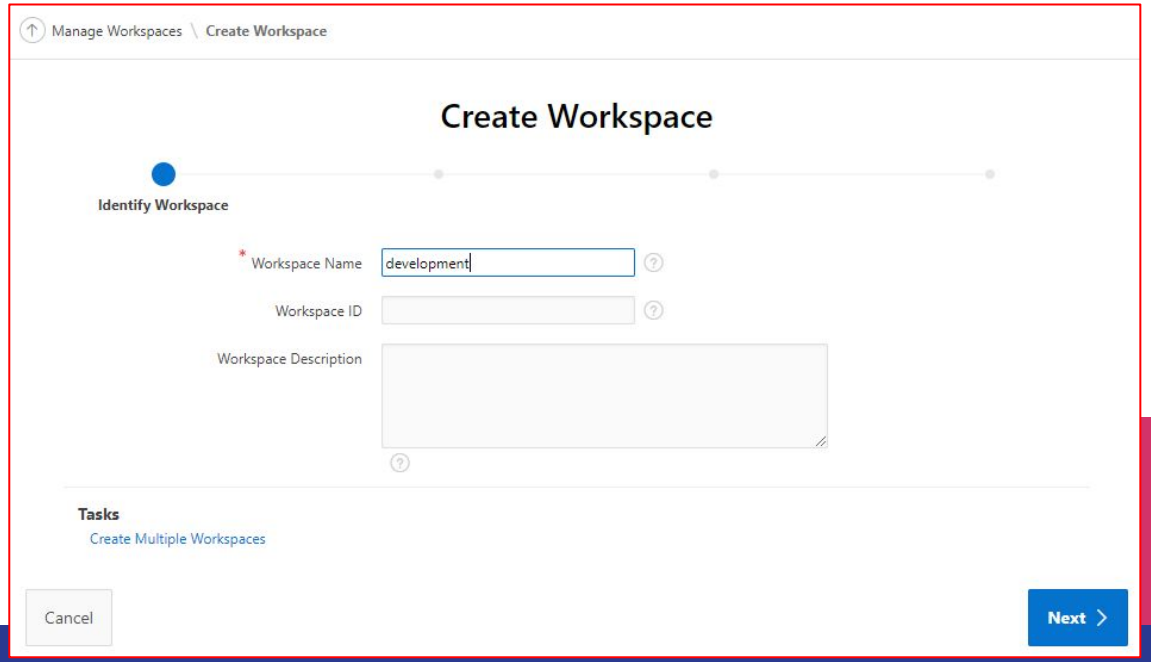
Apex Instance Administration

- From *Manage Workspace* page the *Create Workspace* flow has to be started.



Apex Instance Administration

- The assisted process flow (working as an wizard) will guide you through a sequence of steps.
- *The first step* requires the name for the new development workspace.

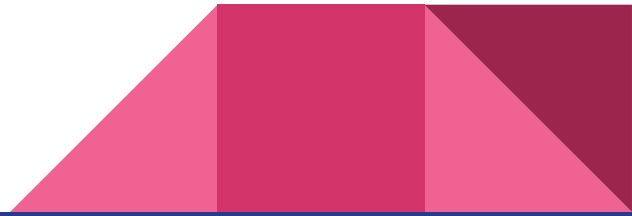


Create Workspace Workflow
Step-by-step Sequence

Step #	Parameter (field)	Value
Step 1 *Identify workspace*	Workspace name	*fdbo*
Step 2 *Identify schema*	Re-use existing schema?	*Yes*
	Schema name	*fdbo*
Step 3 *Identify administrator*	Administrator username	*developer*
	Administrator password	*********
	Email	*developer@org.com*
Step 4 *Confirm request*	Create Workspace	*action*

3.2 Create Starter Web Application in Development Mode

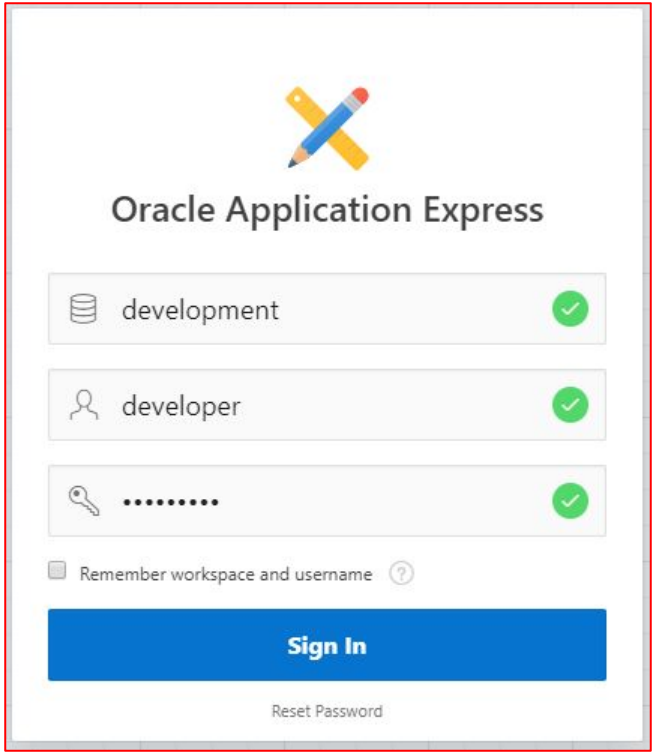
- Prerequisites
  - Existing database schema: FDBO
  - Existing workspace: FDBO
  - Existing admin/dev user in workspace: developer



APEX Development Mode

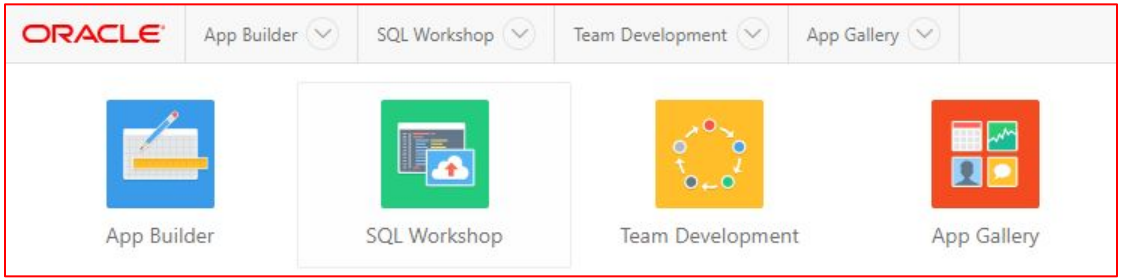
- The home page [http://localhost:8080/apex] accessible from web browser starts with a login dialog where has to be entered:
  - Development workspace name: *fdbo*
  - Development workspace username: *developer*
  - Developer user password: *developer*

http://localhost:8080/apex



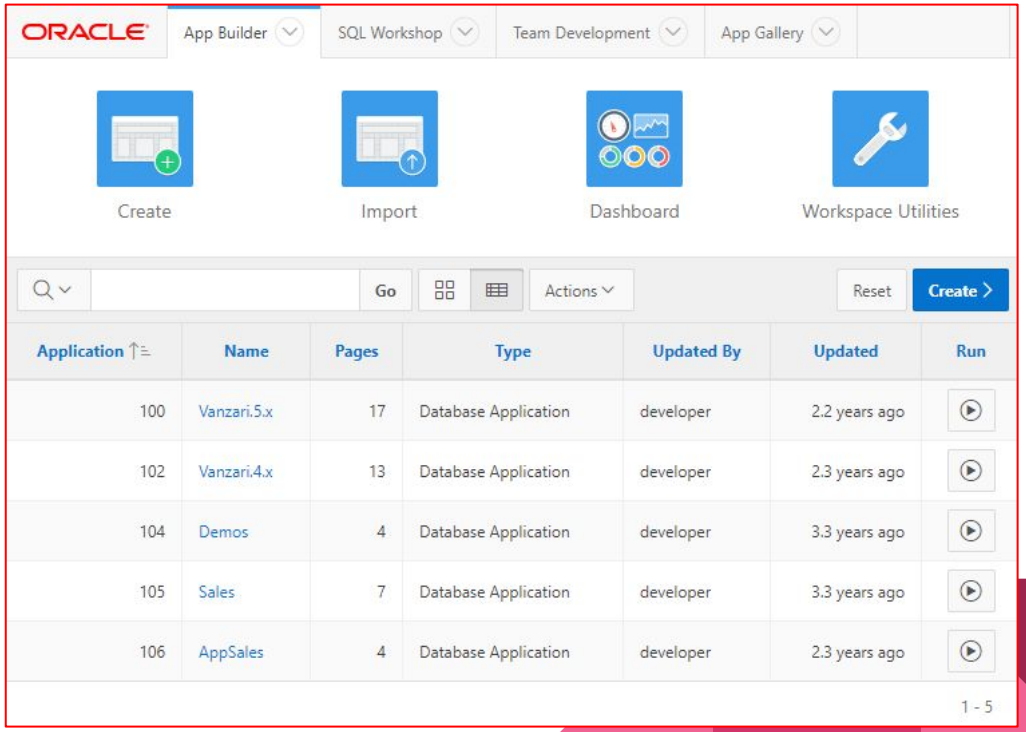
Apex Development

- The starting page for *developer* user (which also owns the administrator role of the workspace) will display several sections (and menus) for: APEX-apps creation, database SQL object creation, teamwork coordination and APEX-apps administration.
- Application Builder module allows the access to the actual declarative and visual development environment.



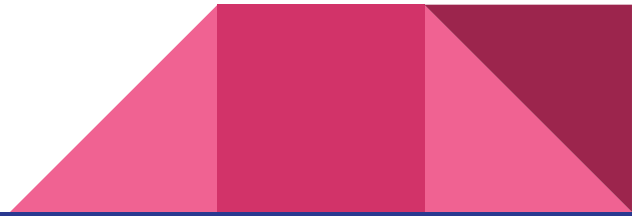
Apex Development

- *Create* button of the Application Builder will start the creational flow guided by the corresponding wizard through the step-by-step sequence that will finally conclude with the first application containing the default login and start pages.



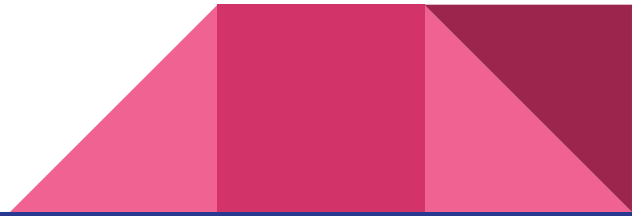
3.3 APEX Analytical Reports

- Prerequisites
  - Existing database schema: FDBO
  - Existing workspace: FDBO
  - Existing admin/dev user in workspace: developer
  - Existing starter application.
- APEX Region Types useful for analytical applications:
  - Classic Report
  - Interactive Report (legacy)
  - **Interactive Grid**.



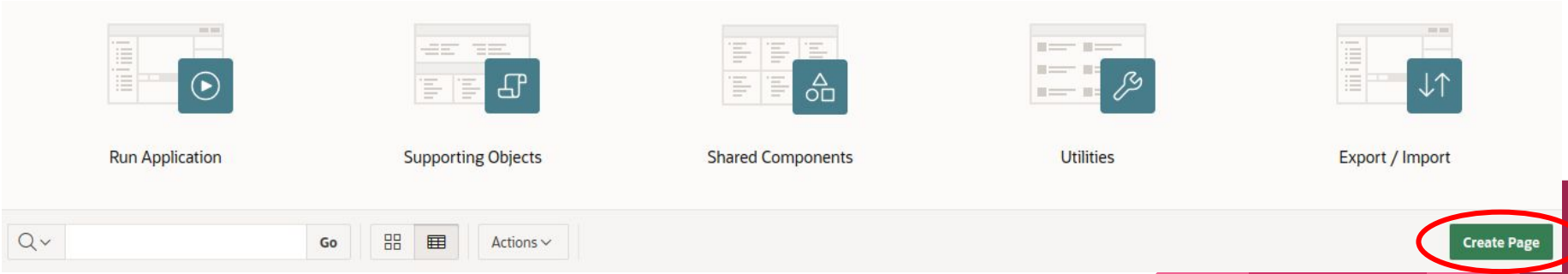
APEX Web Model

- Define and Analytical Application with:
  - Integration/consolidation view reports
  - OLAP Dimensional view reports
  - OLAP Factual view reports
  - Analytical Pages
    - OLAP Aggregation View Reports
    - Other Analytical Query Reports and charts.



Create AR Page: Interactive Grid Container

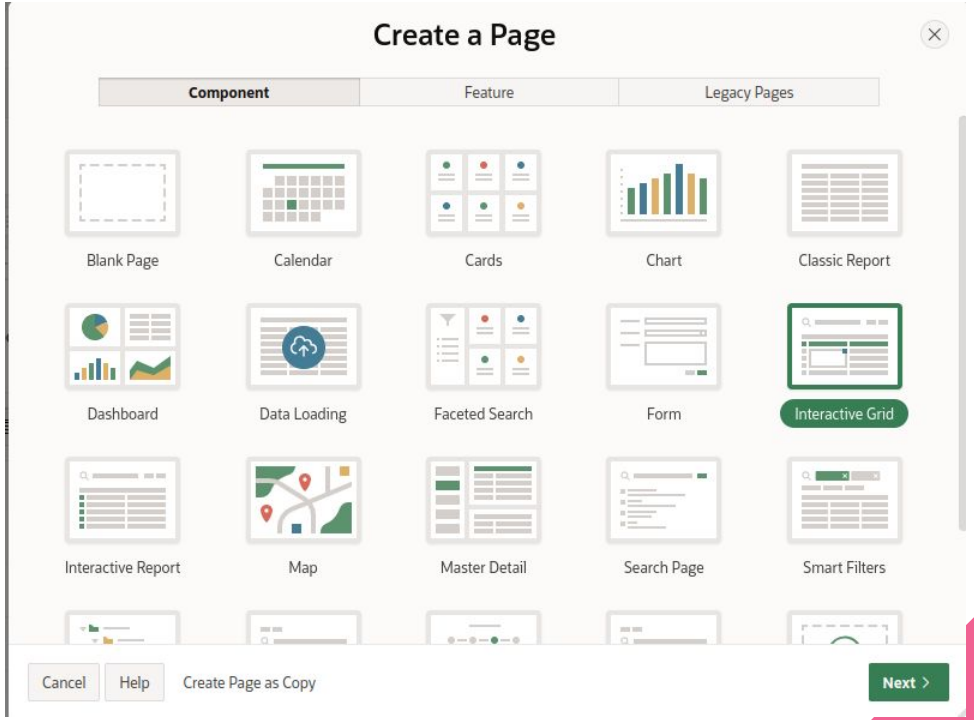
- Create New Page:
  - From APEX Application Builder
  - Select <Create Page> Action (button).



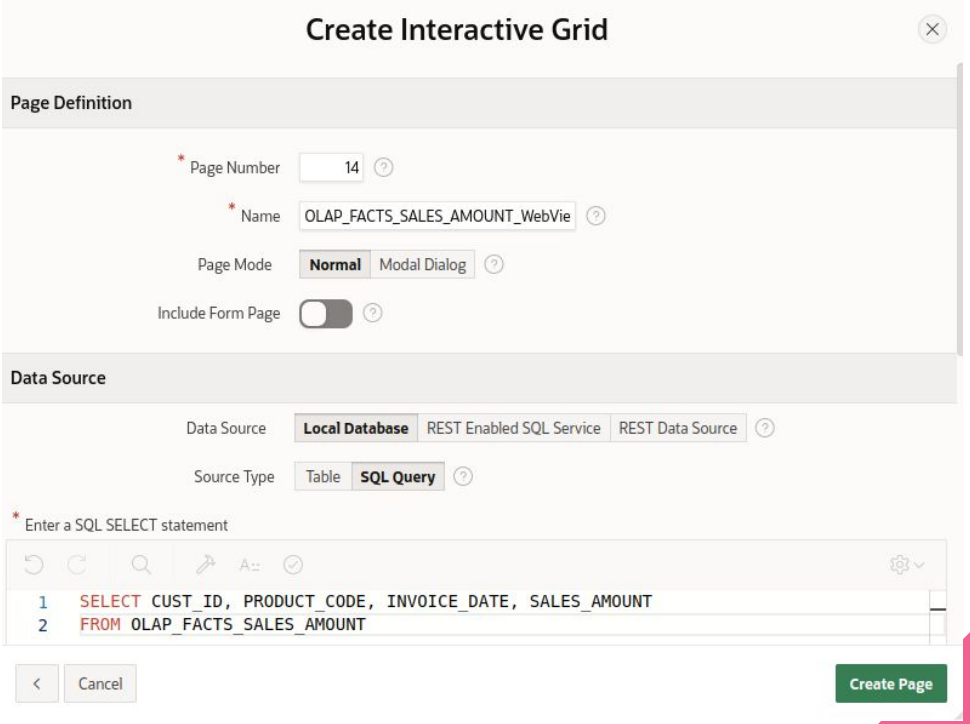
Create Page with Interactive Grid Workflow Step-by-step Sequence

Step #	Parameter (field)	Value
Step 1 *Select Page/Region Type*	Component	*Interactive Grid*
Step 2 *Create Interactive Grid*	Page Definition: Name	*OLAP_FACTS_SALES_AMOUNT_WebView*
	Data Source: Source Type	*SQL Query*
	Data Source: Enter SQL SELECT Statement	*SELECT CUST_ID, PRODUCT_CODE, INVOICE_DATE, SALES_AMOUNT FROM OLAP_FACTS_SALES_AMOUNT*
	Navigation: Parent Navigation Menu Entry	*Integration Web Views*
Step 4 *Confirm request*	Create Page	*Action <Create Page>*

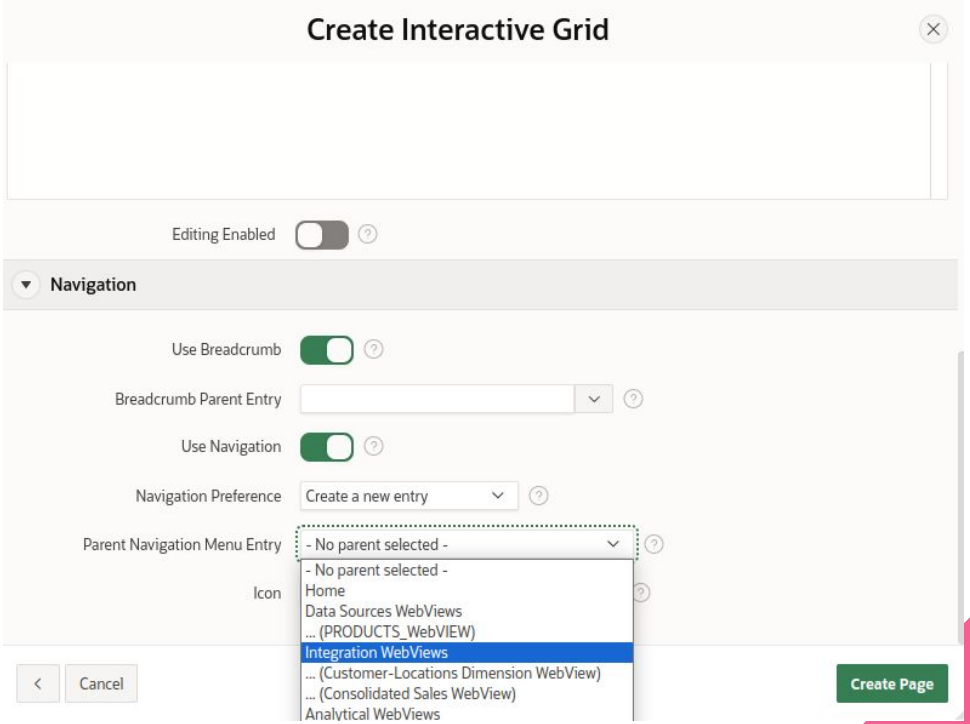
Step 1: Select Page/Region Type



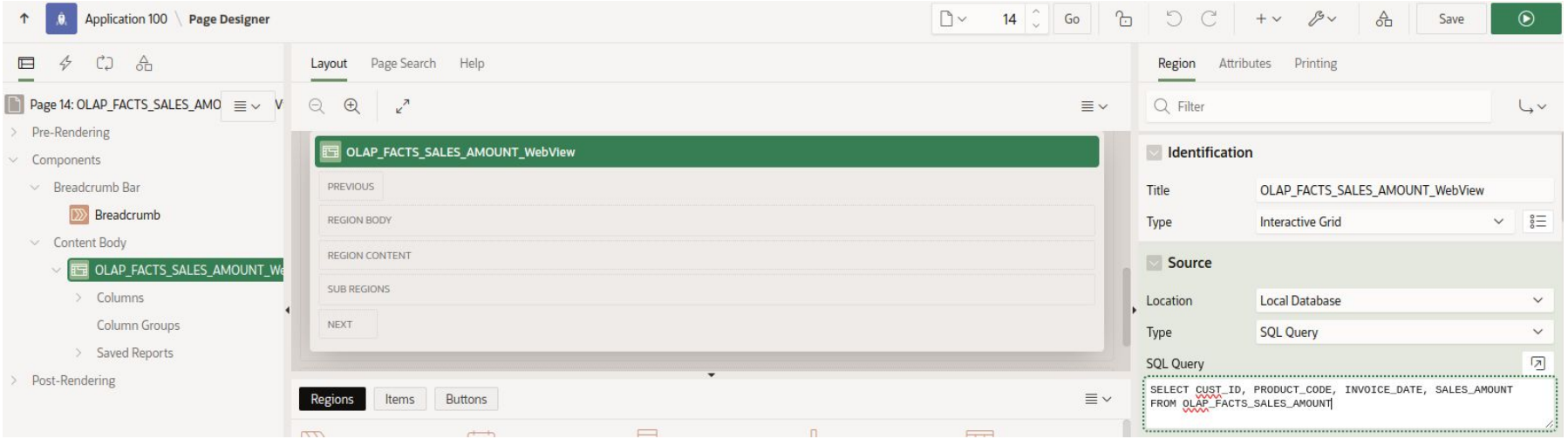
Step 2: Create Interactive Grid



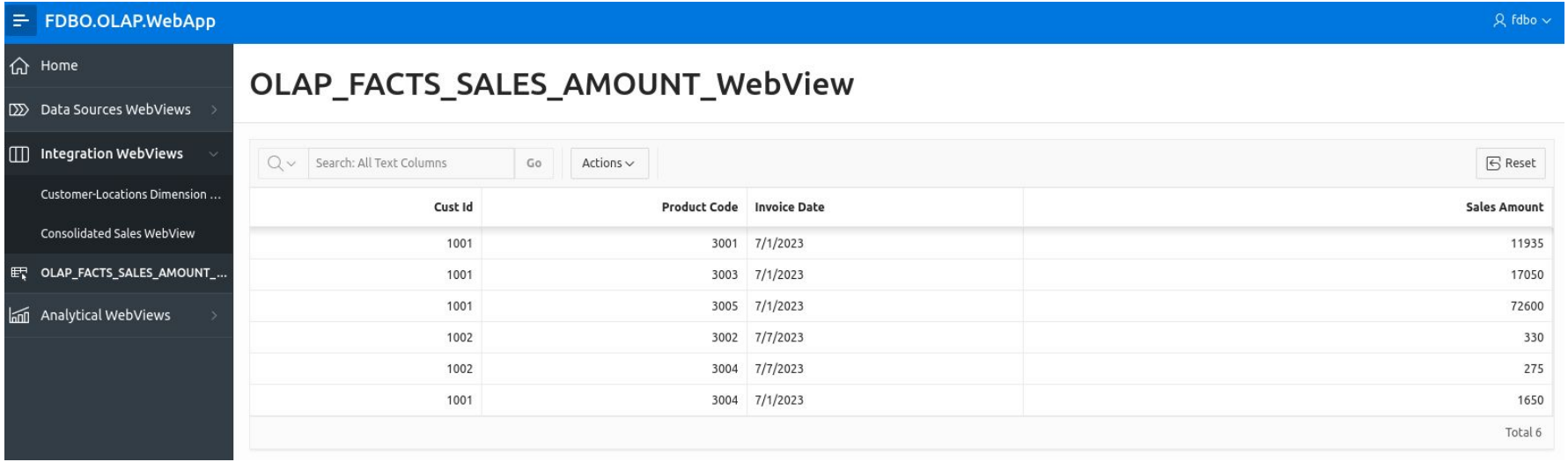
Step 2: Create Interactive Grid



Interactive Grid Page Designer



Interactive Grid Page Runtime



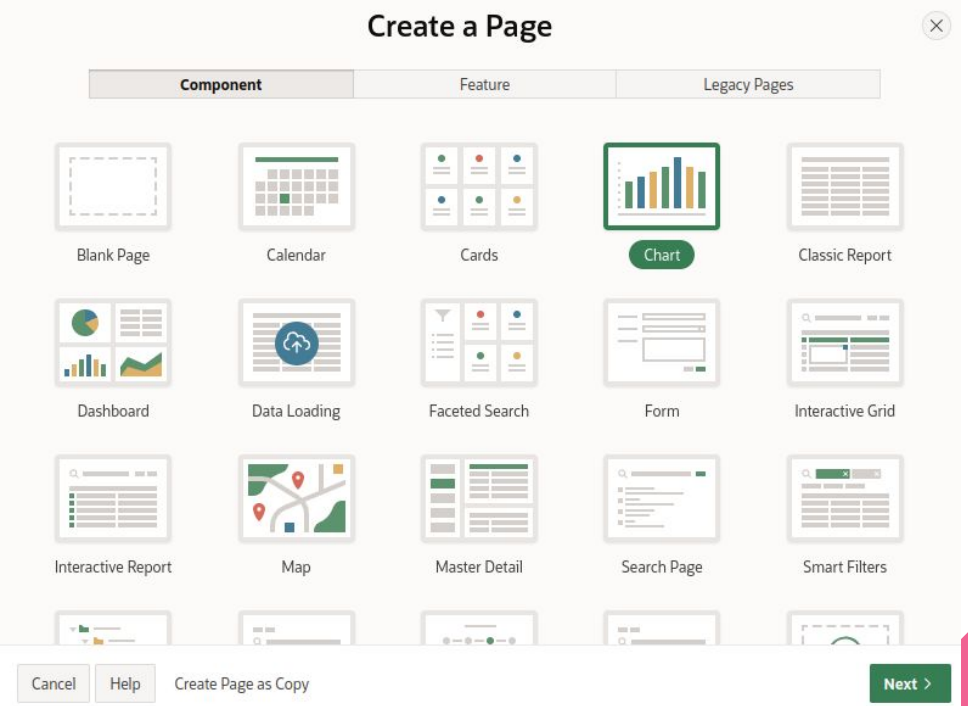
3.4 APEX Analytical Charts

- Prerequisites
  - Existing database schema: FDBO
  - Existing workspace: FDBO
  - Existing admin/dev user in workspace: developer
  - Existing starter application.
- APEX Region Types for analytical applications:
  - Chart.

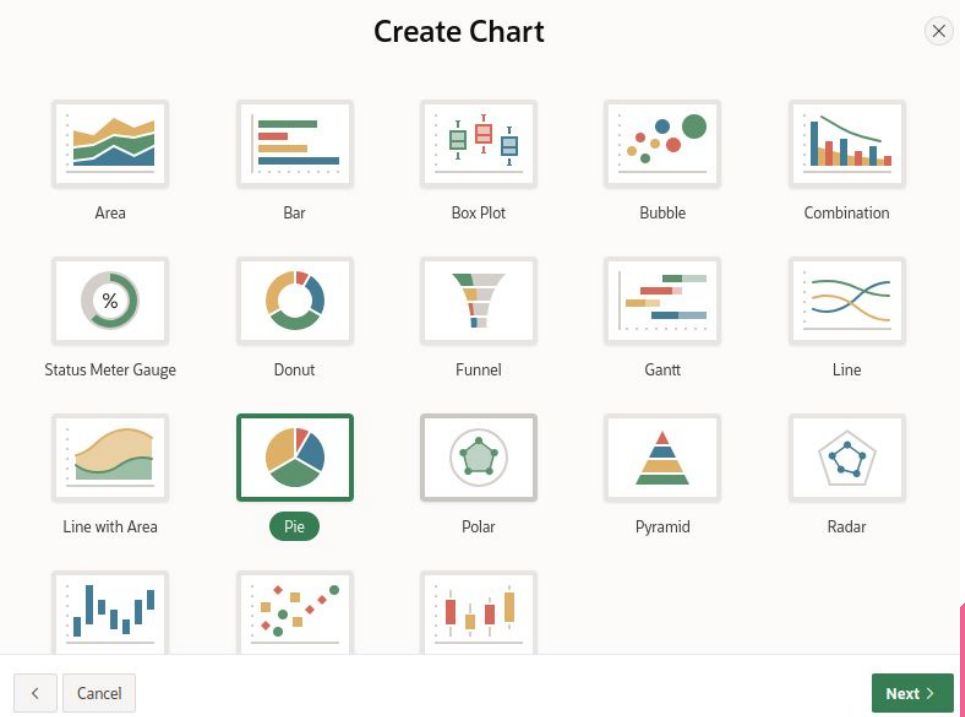
Create Page with Chart Workflow
Step-by-step Sequence

Step #	Parameter (field)	Value
Step 1 *Select Page/Region Type*	Component	*Chart*
Step 2 *Create Chart*	(Select Chart Type)	*Pie*
	Page Definition: Name	*SALES_CTG_PROD_ChartWebView*
	Data Source: Source Type	*SQL Query*
	Data Source: Enter SQL SELECT Statement	*SELECT prod_name, sales_amount FROM OLAP_VIEW_SALES_CTG_PROD WHERE prod_name NOT LIKE 'subtotal%' AND prod_name <> ' '*
	Navigation: Parent Navigation Menu Entry	*Analytical Web Views*
Step 4 *Confirm request*	Create Page	*Action <Create Page>*

Step 1: Select Page/Region Type



Step 2: Create Chart: Select Chart Type



Step 2: Create Chart: Name and Data Source

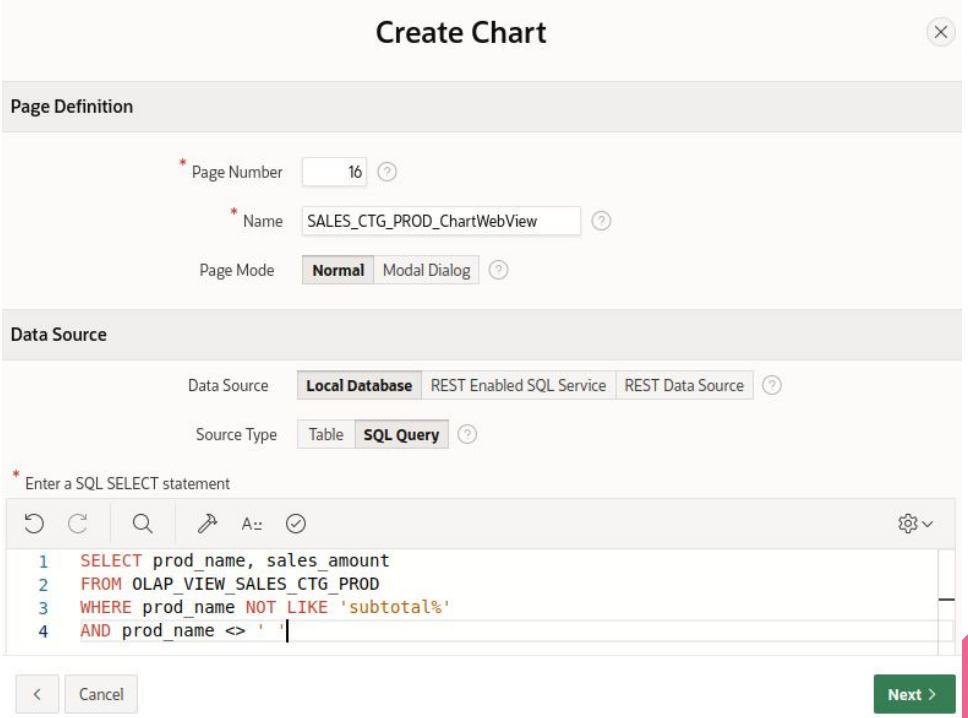


Chart Page Designer

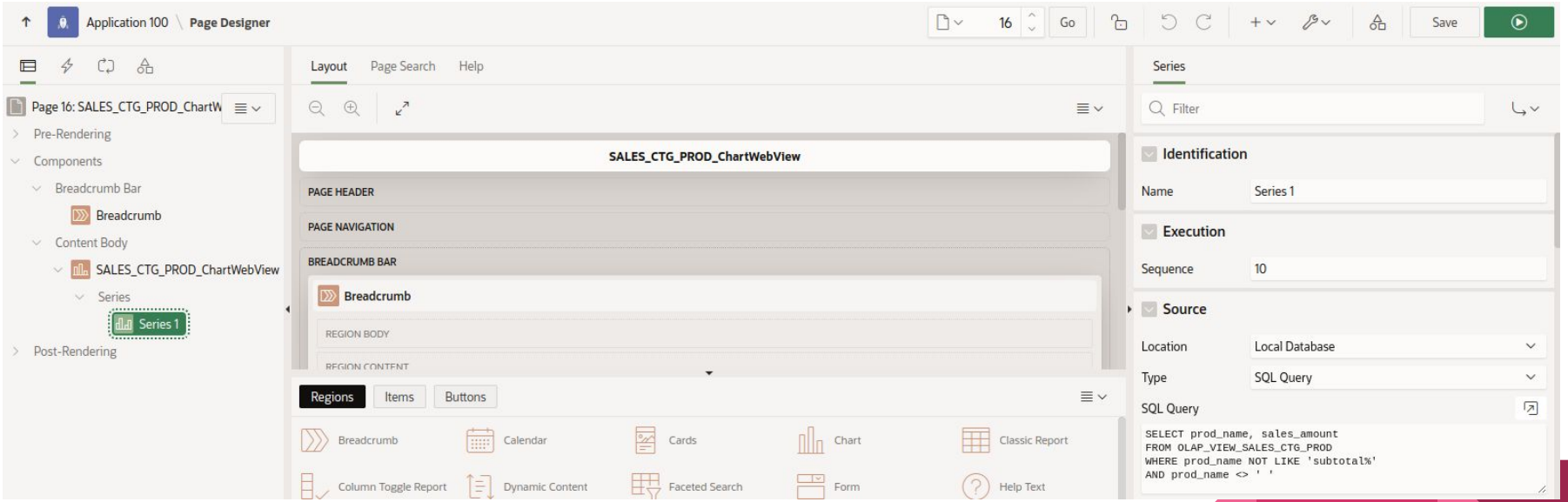
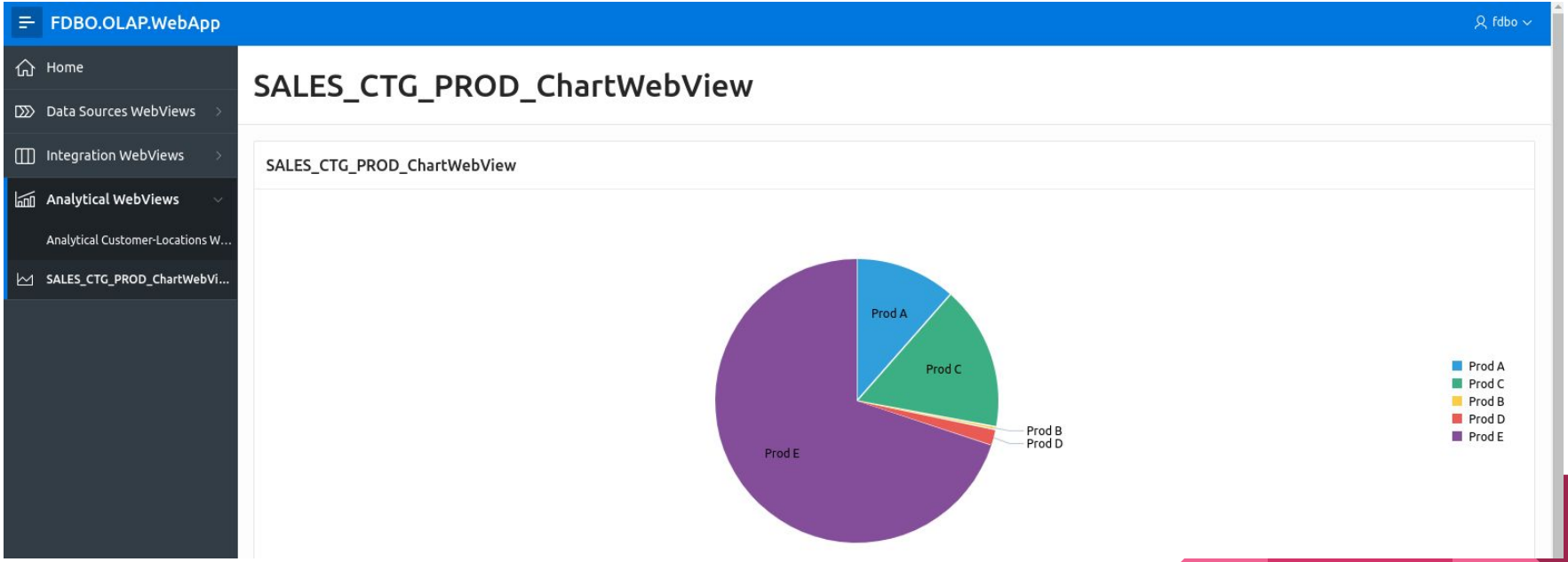


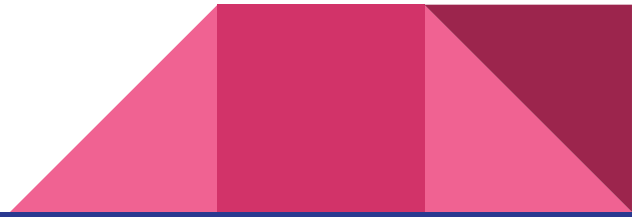
Chart Page Runtime



CASE STUDY: APEX Analytical Web View

Case Study: Oracle APEX Web Application Configuration from SQL Developer

- APEX workspace and application exported:
  - 32_WebApp.FDBO.OLAP_wks_ful.sql
  - 32_WebApp.FDBO.OLAP_f101.sql



Documentations

Oracle APEX Tutorials (advanced)

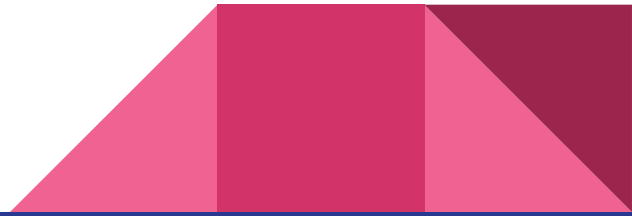
- Development Workflow: resource: see OracleAPEX-2-BaseWorkflows.PDF and OracleAPEX-3-AdvancedWorkflows.PDF documents, pay attention to:
  - Creation flow of STARTER App: default home page - *slide 9* from OracleAPEX-2-BaseWorkflows.PDF
  - Structure of Initial Navigational System - *slide 15* from OracleAPEX-2-BaseWorkflows.PDF
  - Report Creation Stage - *slide 13* from OracleAPEX-2-BaseWorkflows.PDF
  - Regions in APEX page REPORTS - *slide 31* from OracleAPEX-2-BaseWorkflows.PDF
  - Visual Chart Creation Workflow - *slide 30* from OracleAPEX-3-AdvancedWorkflows

Online Docs for Oracle APEX and ORDS

- APEX Web Reporting Pages for Analytical Views
  - Install APEX platform into Oracle Database
    - APEX Installation Guide
    - Uninstall apex: link_1, link_2
  - Interactive Reports
    - Tutorial Oracle APEX Interactive Reports
  - Chart Reports
    - Tutorial Oracle APEX Charts
- REST Data Views with ORDS Services
  - Install Oracle REST Services (ORDS) into Oracle Database
    - ORDS Installation Guide
  - Create REST Data Services with Oracle APEX
    - Tutorial APEX-REST Oracle Technology Network

Book Refs [Oracle APEX and ORDS]

- Edward Sciore, *Understanding Oracle APEX 20 Application Development: Think Like an Application Express Developer*, Apress, 2020
- Patrick Cimolini, *Oracle Application Express by Design*, Apress, 2017
- John Scott et al., *Expert Oracle Application Express*, Apress, 2015
- Francis Mignault, Luc Demanche, *Oracle Application Express Administration: For DBAs and Developers*, Apress, 2016



Other online Refs
[Oracle REST Data Services ORDS]

- https://blogs.oracle.com/apex/creating-a-crud-form-on-a-rest-service-with-apex-181
- https://www.oracle.com/webfolder/technetwork/tutorials/obe/db/apex/r51/restful_web_services/restful_web_services.htm
- https://www.oracle.com/technetwork/developer-tools/apex/downloads/index.html
- https://docs.oracle.com/database/apex-18.2/HTMIG/toc.htm
- https://docs.oracle.com/cd/E56351_01/doc.30/e87809/getting-started-with-RESTful-services.htm#AELIG90198
- https://blogs.oracle.com/apex/application-express-early-adopter:-rest-enabled-sql
- https://blogs.oracle.com/apex/application-express-early-adopter:-rest-enabled-sql
- https://oracle-base.com/articles/misc/oracle-rest-data-services-ords-rest-enabled-sql#enable-rest-enabled-sql

Deploy APEX and ORDS platform **on Tomcat Web Server**

- Run APEX on ORDS Platform with Tomcat 9 Web Server
  - Download and Apache Tomcat Web Server from apache-url - use 64-bit Windows version (or 32-bit according with your Windows System version).
  - Install Tomcat Server: unzip downloaded kit-file into a hosting folder %TOMCAT_HOME% (e.g D:\ApacheTomcat)
  - Copy ords.war file *after ORDS installation and configuration procedure* (1b):
    - From %ORDS_HOME% folder
    - To %TOMCAT_HOME%\webapps
  - Copy *images* folder
    - From %APACHE_HOME% folder
    - To %TOMCAT_HOME%\webapps
      - Rename folder as i
    - Start tomcat server by %TOMCAT_HOME%\bin\startup.bat script
    - Access APEX login page from http://localhost:8080/ords URL
- Installation procedure Documentation:
  - ORDS Installation Docs and Oracle APEX Docs