
Oracle DB 23c
For the APEX Developer
Roel Hartman

Roel Hartman 😎
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Oracle ACE Director

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Roel Hartman 😎
@RoelH

Director at APEX Consulting.
Oracle ACE Director.
Director at ODTUG.

Software developer/Programmer/Software engineer · The Netherlands
roelhartman.blogspot.com · Born June 10, 1965 · Joined March 2007

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Oracle Database 23c

App Simple

SQL Domains

Schema Level Privileges

Real-time SQL Plan Management

JSON Schema

Read-Only Per-PDB Standby

Property Graphs

Microservice Support

JSON / Relational Duality

AI Vector Search

True Cache

SQL Firewall

Priority Transactions

Globally Distributed Database

Rolling Patching

JS Stored Procedures

Developer Role

Shrink Tablespace

Boolean Datatype

Few Changes for SQL in Oracle Database 23c

Boolean Datatype

```
SQL> alter table oehr_employees
  2  add ( on_holiday boolean default false not null)
  3* /

Table OEHR_EMPLOYEES altered.
```

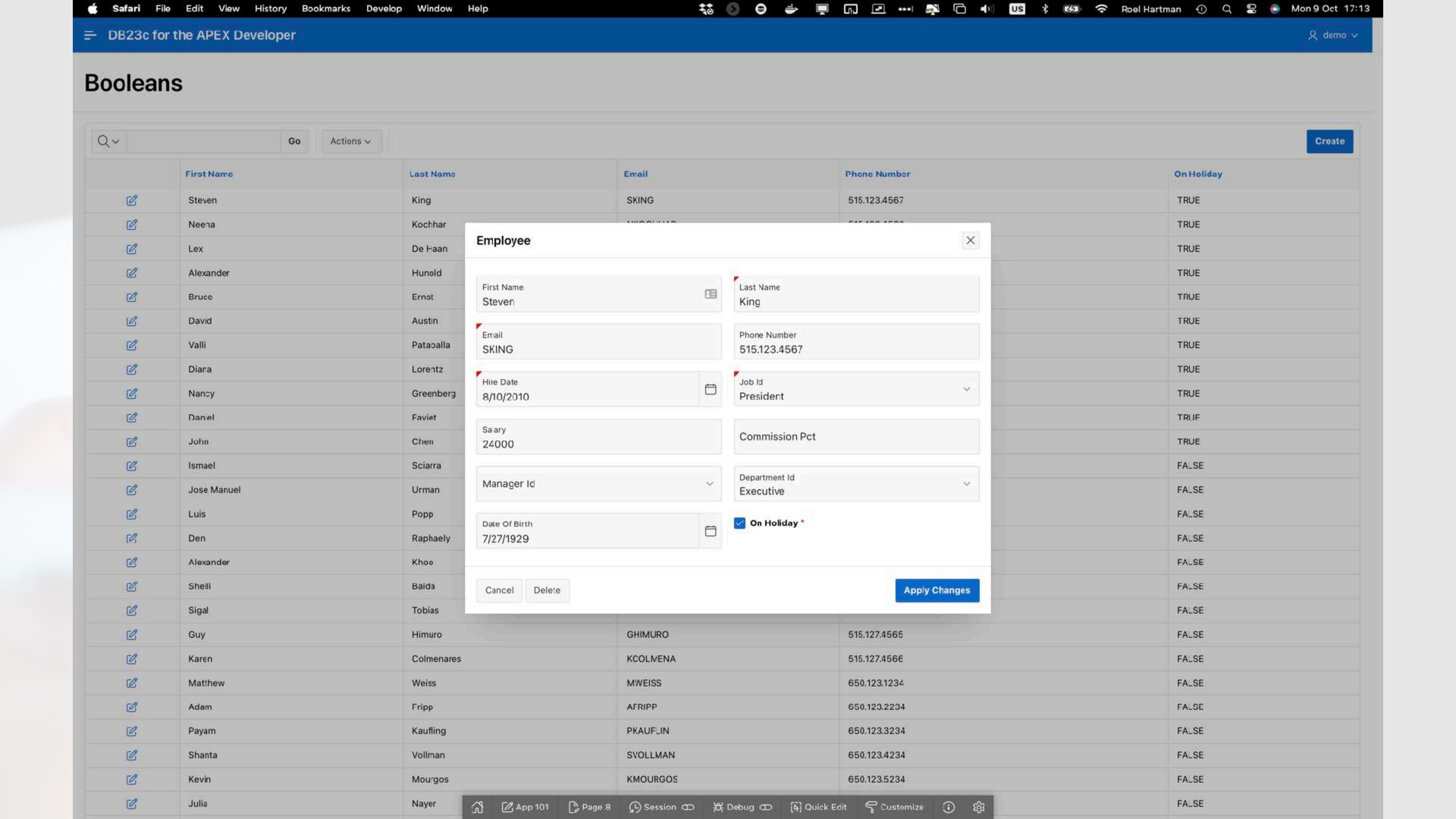
```
SQL> update oehr_employees
  2  set on_holiday = true
  3  where employee_id <= 110
  4* /

11 rows updated.
```

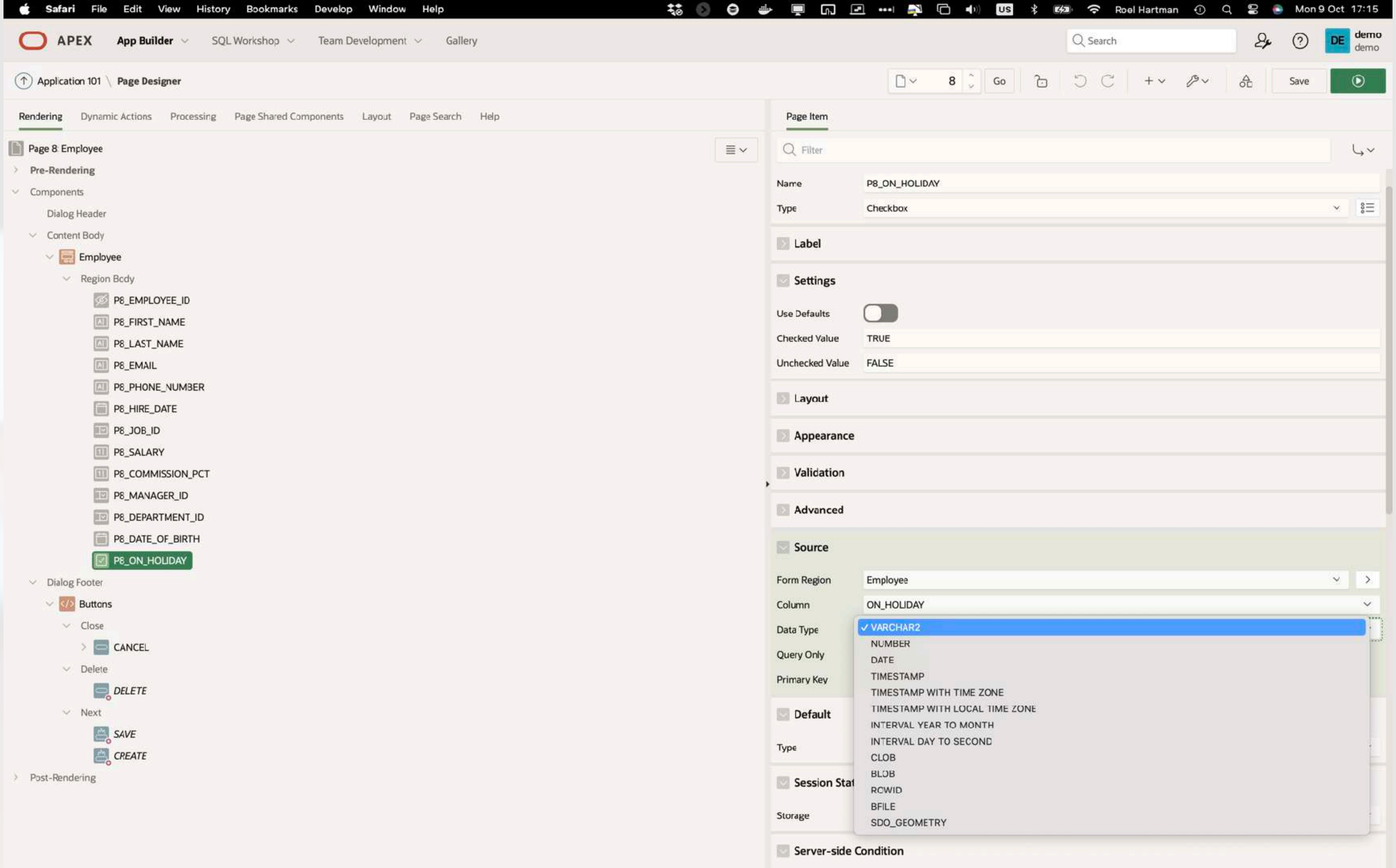
```
SQL> select count(*)
  2  from oehr_employees
  3  where on_holiday
  4* /

  COUNT(*)
__________
        11
```

Booleans

Go Actions Create

First Name	Last Name	Email	Phone Number	On Holiday
Steven	King	SKING	515.123.4567	TRUE
Neena	Kochhar	NKOCHHAR	515.123.4568	TRUE
Lex	De Haan	LDEHAAN	515.123.4569	TRUE
Alexander	Hunold	AHUNOLD	590.423.4567	TRUE
Bruce	Ernst	BERNST	590.423.4568	TRUE
David	Austin	DAUSTIN	590.423.4569	TRUE
Valli	Pataballa	VPATABAL	590.423.4560	TRUE
Diana	Lorentz	DLORENTZ	590.423.5567	TRUE
Nancy	Greenberg	NGREENBE	515.124.4569	TRUE
Daniel	Faviet	DFAVIET	515.124.4169	TRUE
John	Chen	JCHEN	515.124.4269	TRUE
Ismael	Sciarra	ISCIARRA	515.124.4369	FALSE
Jose Manuel	Urman	JMURMAN	515.124.4469	FALSE
Luis	Popp	LPOPP	515.124.4567	FALSE
Den	Raphaely	DRAPHEAL	515.127.4561	FALSE
Alexander	Khoo	AKHOO	515.127.4562	FALSE
Shelli	Baida	SBAIDA	515.127.4563	FALSE
Sigal	Tobias	STOBIAS	515.127.4564	FALSE
Guy	Himuro	GHIMURO	515.127.4565	FALSE
Karen	Colmenares	KCOLMENA	515.127.4566	FALSE
Matthew	Weiss	MWEISS	650.123.1234	FALSE
Adam	Fripp	AFRIPP	650.123.2234	FALSE
Payam	Kaufling	PKAUFLIN	650.123.3234	FALSE
Shanta	Vollman	SVOLLMAN	650.123.4234	FALSE
Kevin	Mourgos	KMOURGOS	650.123.5234	FALSE
Julia	Nayer			FALSE


Safari File Edit View History Bookmarks Develop Window Help
Roel Hartman Mon 9 Oct 17:13
DB23c for the APEX Developer
demo
Booleans
Go
Actions
Create
First Name
Last Name
Email
Phone Number
On Holiday
Steven King SKING 515.123.4567 TRUE
Neena Kochhar TRUE
Lex De Haan TRUE
Alexander Hunold TRUE
Bruce Ernst TRUE
David Austin TRUE
Valli Pataballa TRUE
Diana Lorentz TRUE
Nancy Greenberg TRUE
Daniel Faviet TRUE
John Chen TRUE
Ismael Sciarra FALSE
Jose Manuel Urman FALSE
Luis Popp FALSE
Den Raphaely FALSE
Alexander Khoo FALSE
Shelli Baida FALSE
Sigal Tobias FALSE
Guy Himuro GHIMURO 515.127.4565 FALSE
Karen Colmenares KCOLMENA 515.127.4566 FALSE
Matthew Weiss MWEISS 650.123.1234 FALSE
Adam Fripp AFRIPP 650.123.2234 FALSE
Payam Kaufling PKAUFLIN 650.123.3234 FALSE
Shanta Vollman SVOLLMAN 650.123.4234 FALSE
Kevin Mourgos KMOURGOS 650.123.5234 FALSE
Julia Nayer FALSE
Employee
First Name
Steven
Last Name
King
Email
SKING
Phone Number
515.123.4567
Hire Date
8/10/2010
Job Id
President
Salary
24000
Commission Pct
Manager Id
Department Id
Executive
Date Of Birth
7/27/1929
On Holiday *
Cancel
Delete
Apply Changes
App 101
Page 8
Session
Debug
Quick Edit
Customize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APEX
App Builder
SQL Workshop
Team Development
Gallery
Search
DE
demo
demo
Application 101 \ Page Designer
8
Go
Save
Rendering
Dynamic Actions
Processing
Page Shared Components
Layout
Page Search
Help
Page 8: Employee
Pre-Rendering
Components
Dialog Header
Content Body
Employee
Region Body
P8_EMPLOYEE_ID
P8_FIRST_NAME
P8_LAST_NAME
P8_EMAIL
P8_PHONE_NUMBER
P8_HIRE_DATE
P8_JOB_ID
P8_SALARY
P8_COMMISSION_PCT
P8_MANAGER_ID
P8_DEPARTMENT_ID
P8_DATE_OF_BIRTH
P8_ON_HOLIDAY
Dialog Footer
Buttons
Close
CANCEL
Delete
DELETE
Next
SAVE
CREATE
Post-Rendering
Page Item
Filter
Name
P8_ON_HOLIDAY
Type
Checkbox
Label
Settings
Use Defaults
Checked Value
TRUE
Unchecked Value
FALSE
Layout
Appearance
Validation
Advanced
Source
Form Region
Employee
Column
ON_HOLIDAY
Data Type
Query Only
Primary Key
VARCHAR2
NUMBER
DATE
TIMESTAMP
TIMESTAMP WITH TIME ZONE
TIMESTAMP WITH LOCAL TIME ZONE
INTERVAL YEAR TO MONTH
INTERVAL DAY TO SECOND
CLOB
BLOB
ROWID
BFILE
SDO_GEOMETRY
Default
Type
Session Stat
Storage
Server-side Condition


Checklist
Yes
No

SQL Domains

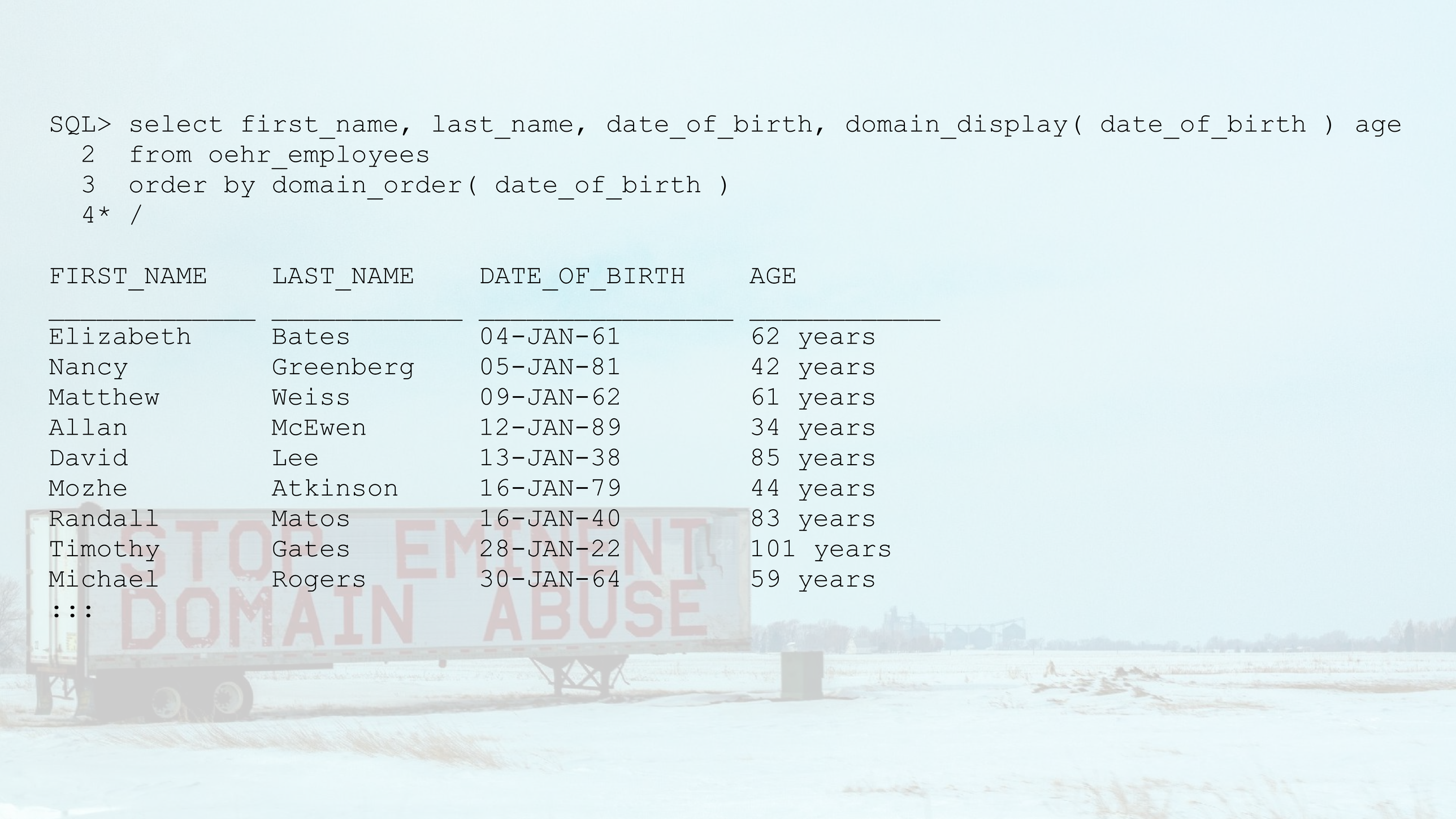
- Email address
- Credit card no.
- Zip code
- Birthday

```
SQL> create domain birth_date as date
2  constraint birth_date_only check ( birth_date = trunc ( birth_date ) )
3  display floor ( months_between ( sysdate, birth_date ) / 12 ) || ' years'
4  order to_char( birth_date, 'MM-DD')
5* /

Domain BIRTH_DATE created.
```

```
SQL> alter table oehr_employees add ( date_of_birth birth_date )
2* /


Table OEHR_EMPLOYEES altered.
```

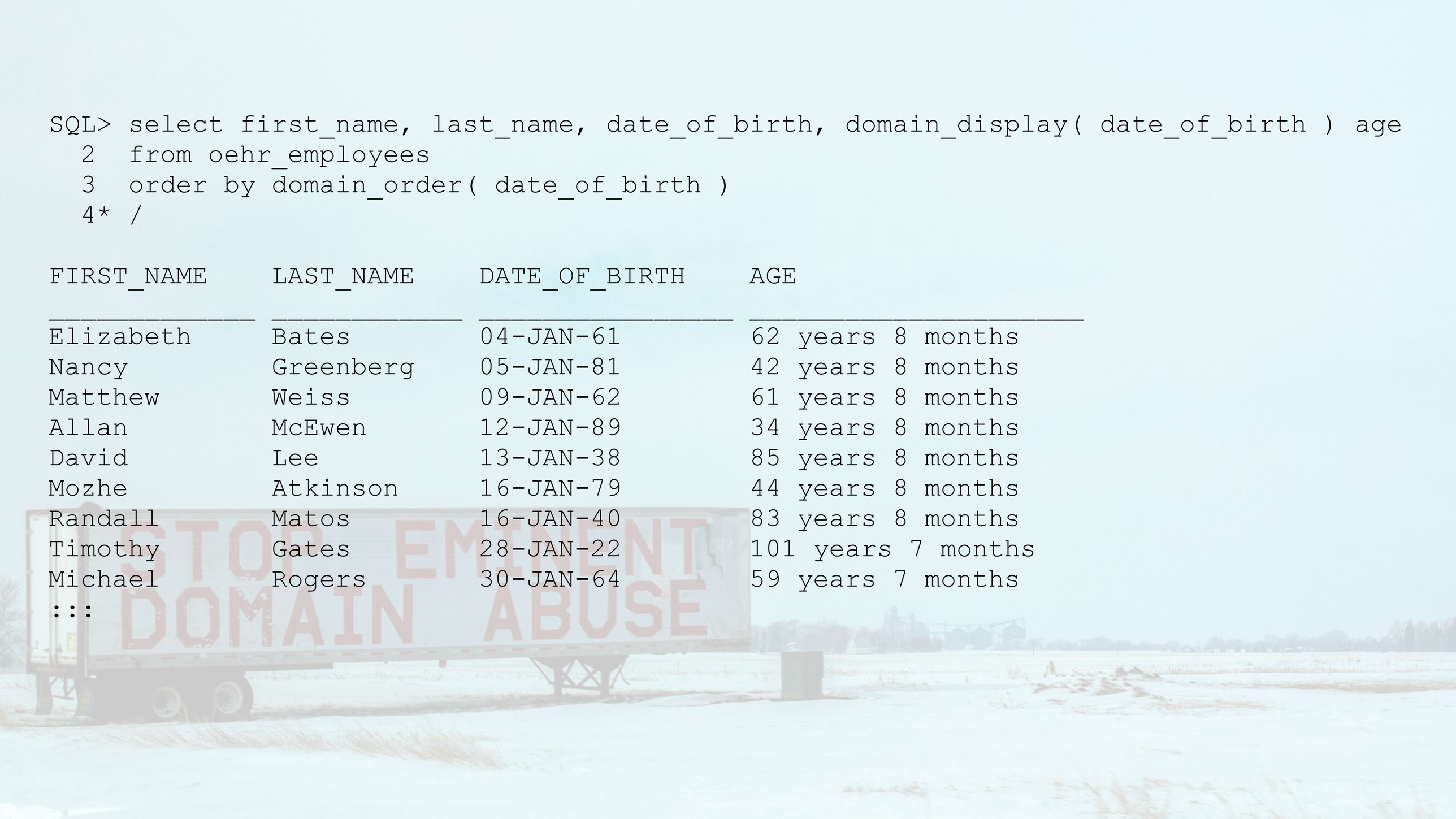
```
SQL> declare
  2    l_birth_date date;
  3  begin
  4    for emp in ( select * from oehr_employees) loop
  5      select to_date(trunc(dbms_random.value(to_char(date'1920-01-01','J')
  6                                            ,to_char(date'1999-12-31','J'))),'J')
  7      into   l_birth_date;
  8      update oehr_employees
  9      set date_of_birth = l_birth_date
 10      where employee_id = emp.employee_id;
 11    end loop;
 12  end;
 13* /

PL/SQL procedure successfully completed.
```

```
SQL> select first_name, last_name, date_of_birth, domain_display( date_of_birth ) age
  2  from oehr_employees
  3  order by domain_order( date_of_birth )
  4* /

FIRST_NAME     LAST_NAME      DATE_OF_BIRTH      AGE
______________ ______________ __________________ ____________
Elizabeth      Bates          04-JAN-61          62 years
Nancy          Greenberg      05-JAN-81          42 years
Matthew        Weiss          09-JAN-62          61 years
Allan          McEwen         12-JAN-89          34 years
David          Lee            13-JAN-38          85 years
Mozhe          Atkinson       16-JAN-79          44 years
Randall        Matos          16-JAN-40          83 years
Timothy        Gates          28-JAN-22          101 years
Michael        Rogers         30-JAN-64          59 years
:::
```

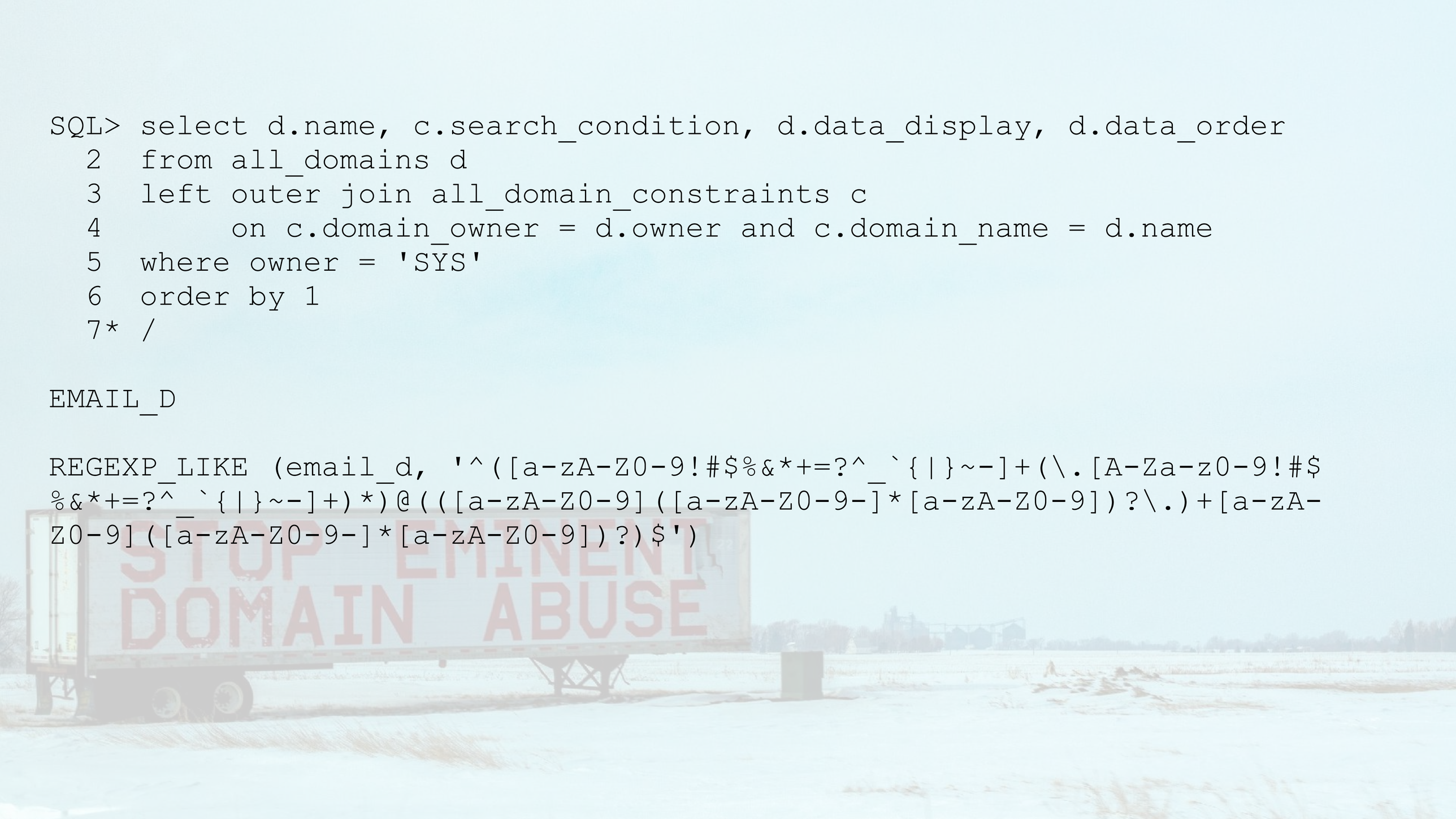


```
SQL> alter domain birth_date
  2    modify display
  3      floor ( months_between ( sysdate, birth_date ) / 12 ) || ' years ' ||
  4      mod ( floor ( months_between ( sysdate, birth_date ) ), 12 ) || ' months'
  5* /

Domain BIRTH_DATE altered.
```

```
SQL> select first_name, last_name, date_of_birth, domain_display( date_of_birth ) age
  2  from oehr_employees
  3  order by domain_order( date_of_birth )
  4* /

FIRST_NAME     LAST_NAME      DATE_OF_BIRTH     AGE
______________ ______________ _________________ ____________________________
Elizabeth      Bates          04-JAN-61         62 years 8 months
Nancy          Greenberg      05-JAN-81         42 years 8 months
Matthew        Weiss          09-JAN-62         61 years 8 months
Allan          McEwen         12-JAN-89         34 years 8 months
David          Lee            13-JAN-38         85 years 8 months
Mozhe          Atkinson       16-JAN-79         44 years 8 months
Randall        Matos          16-JAN-40         83 years 8 months
Timothy        Gates          28-JAN-22         101 years 7 months
Michael        Rogers         30-JAN-64         59 years 7 months
:::
```



```
SQL> select d.name, c.search_condition, d.data_display, d.data_order
  2  from all_domains d
  3  left outer join all_domain_constraints c
  4       on c.domain_owner = d.owner and c.domain_name = d.name
  5  where owner = 'SYS'
  6  order by 1
  7* /

EMAIL_D

REGEXP_LIKE (email_d, '^([a-zA-Z0-9!#$%&*+=?^_`{|}~-]+(\.[A-Za-z0-9!#$
%&*+=?^_`{|}~-]+)*)@(([a-zA-Z0-9]([a-zA-Z0-9-]*[a-zA-Z0-9])?\.)+[a-zA-
Z0-9]([a-zA-Z0-9-]*[a-zA-Z0-9])?)$')
```

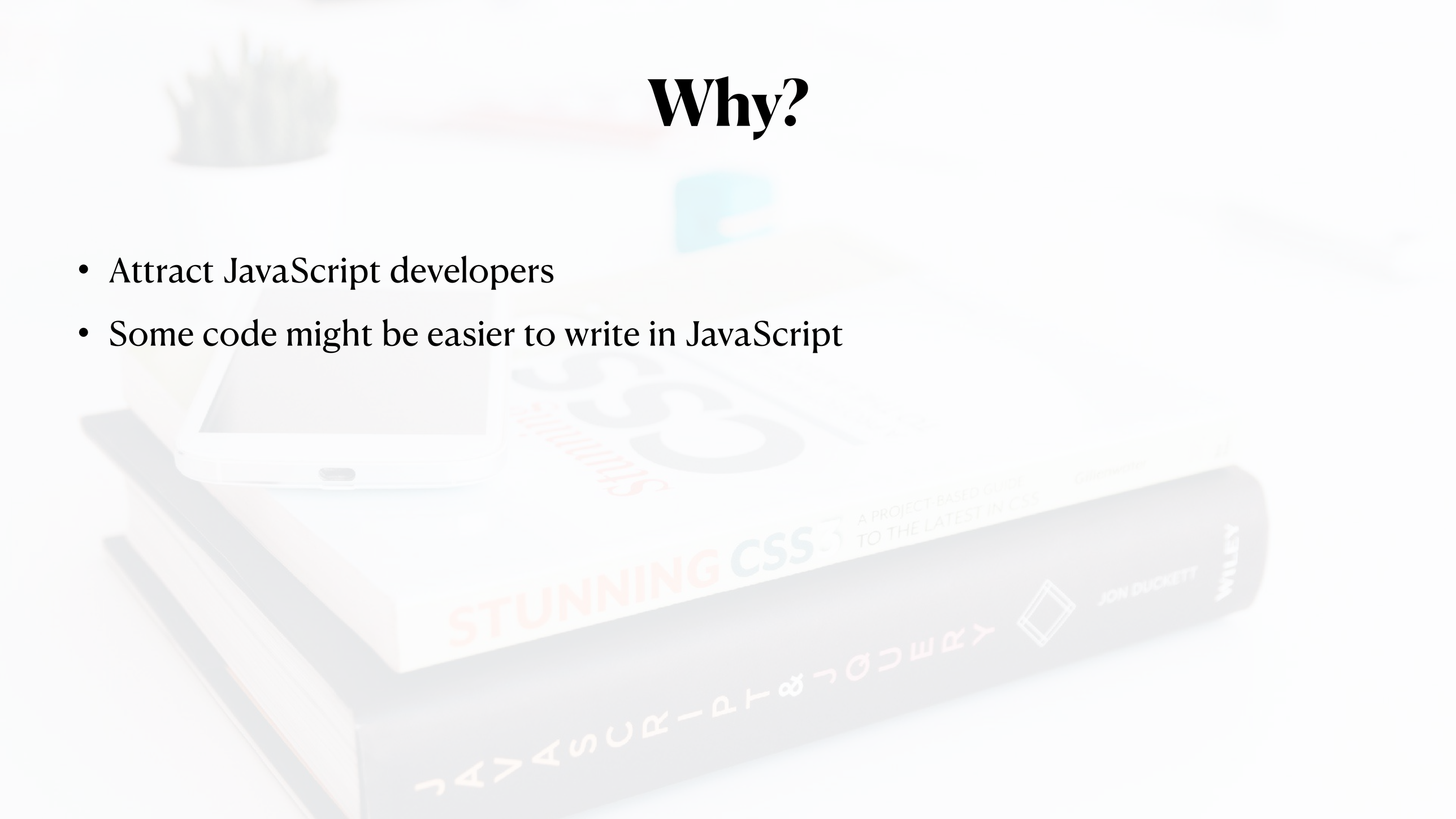



STOP EMINENT
DOMAIN ABUSE

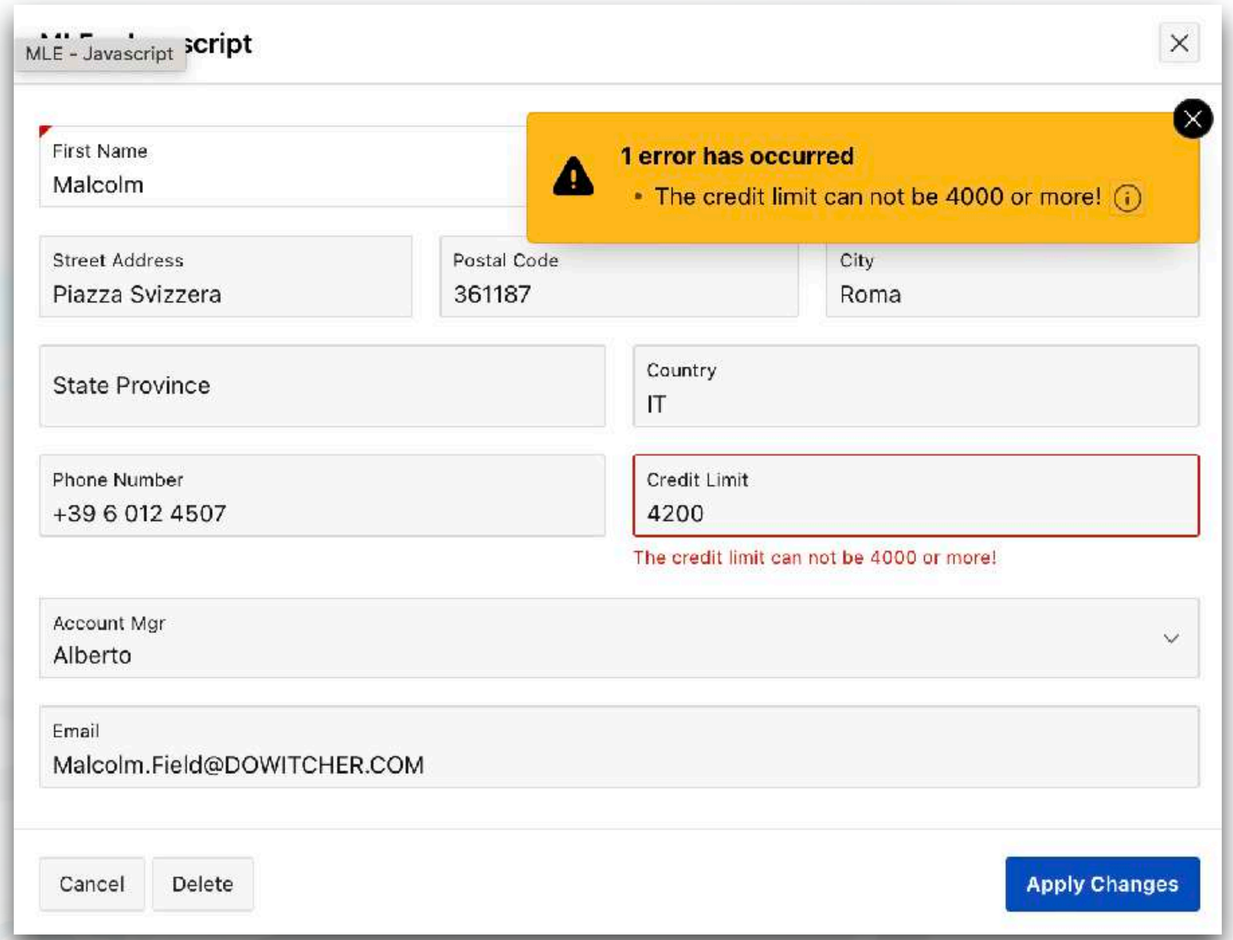
JavaScript / MLE

Why?

- Attract JavaScript developers
- Some code might be easier to write in JavaScript




Validation
Editable Region
- Select -
Type
Expression
Language
JavaScript (MLE)
JavaScript Expression
apex.env.P4_CREDIT_LIMIT < 4000
Always Execute


MLE - Javascript
First Name
Malcolm
1 error has occurred
The credit limit can not be 4000 or more!
Street Address
Piazza Svizzera
Postal Code
361187
City
Roma
State Province
Country
IT
Phone Number
+39 6 012 4507
Credit Limit
4200
The credit limit can not be 4000 or more!
Account Mgr
Alberto
Email
Malcolm.Field@DOWITCHER.COM
Cancel
Delete
Apply Changes

Why?

- Attract JavaScript developers
- Some code is easier to write in JavaScript
- Reuse code already written in JavaScript

validatorjs / validator.js Public

Sponsor Notifications Fork 2.2k Star 21.8k

Code Issues 153 Pull requests 155 Actions Projects Wiki Security 1 Insights

master 3 branches 152 tags Go to file Code

SimranSiddiqui feat(isMobilePhone): Added the regex for Malawi en-MW (#... b958bd7 on Aug 18 2,221 commits

.github	chore: add note about providing a reference in PR template (#2161)	7 months ago
src	feat(isMobilePhone): Added the regex for Malawi en-MW (#2267)	last month
test	feat(isMobilePhone): Added the regex for Malawi en-MW (#2267)	last month
.babelrc	ES module for webpack tree shaking (#1015)	4 years ago
.eslintrc.json	chore: upgrade to babel 7 (#915)	5 years ago
.gitignore	removed local changes	2 years ago
.nycrc	chore: setup github actions (#1606)	2 years ago
CHANGELOG.md	13.11.0	last month
LICENSE	Bump	5 years ago
README.md	feat(isMobilePhone): Added the regex for Malawi en-MW (#2267)	last month
SECURITY.md	docs: add a security policy (#1861)	last year
bower.json	chore: setup github actions (#1606)	2 years ago
build-browser.js	fix: npm installation error (#1697)	2 years ago
jsconfig.json	Migrate to ES6	7 years ago
package.json	fix(isDate): Timezone Offset Fix (#2257)	last month

README.md

validator.js

About

String validation

javascript sanitization node validation input validator validations validate hacktoberfest sanitize

Readme
MIT license
Security policy
Activity
21.8k stars
227 watching
2.2k forks
Report repository

Releases 11

13.11.0 Latest
on Aug 4

+ 10 releases

Sponsor this project

opencollective.com/validatorjs

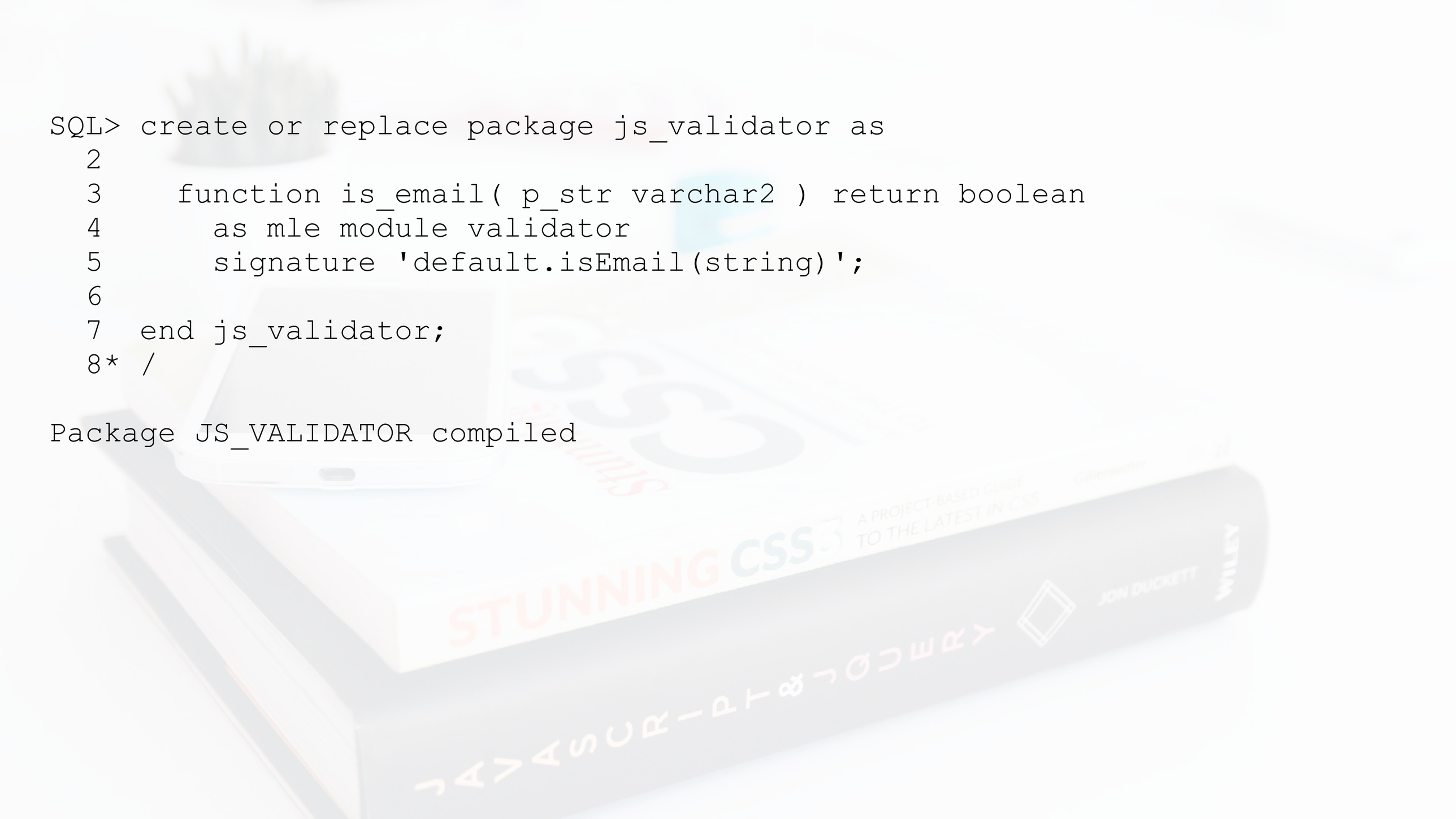
Packages

No packages published

```
curl -Lo validator.min.js https://cdn.jsdelivr.net/npm/validator@latest/+esm

SQL> create directory if not exists javascript_src_dir
  2  as '/opt/oracle/oradata/oradir'
  3* /

Directory JAVASCRIPT_SRC_DIR created.
```

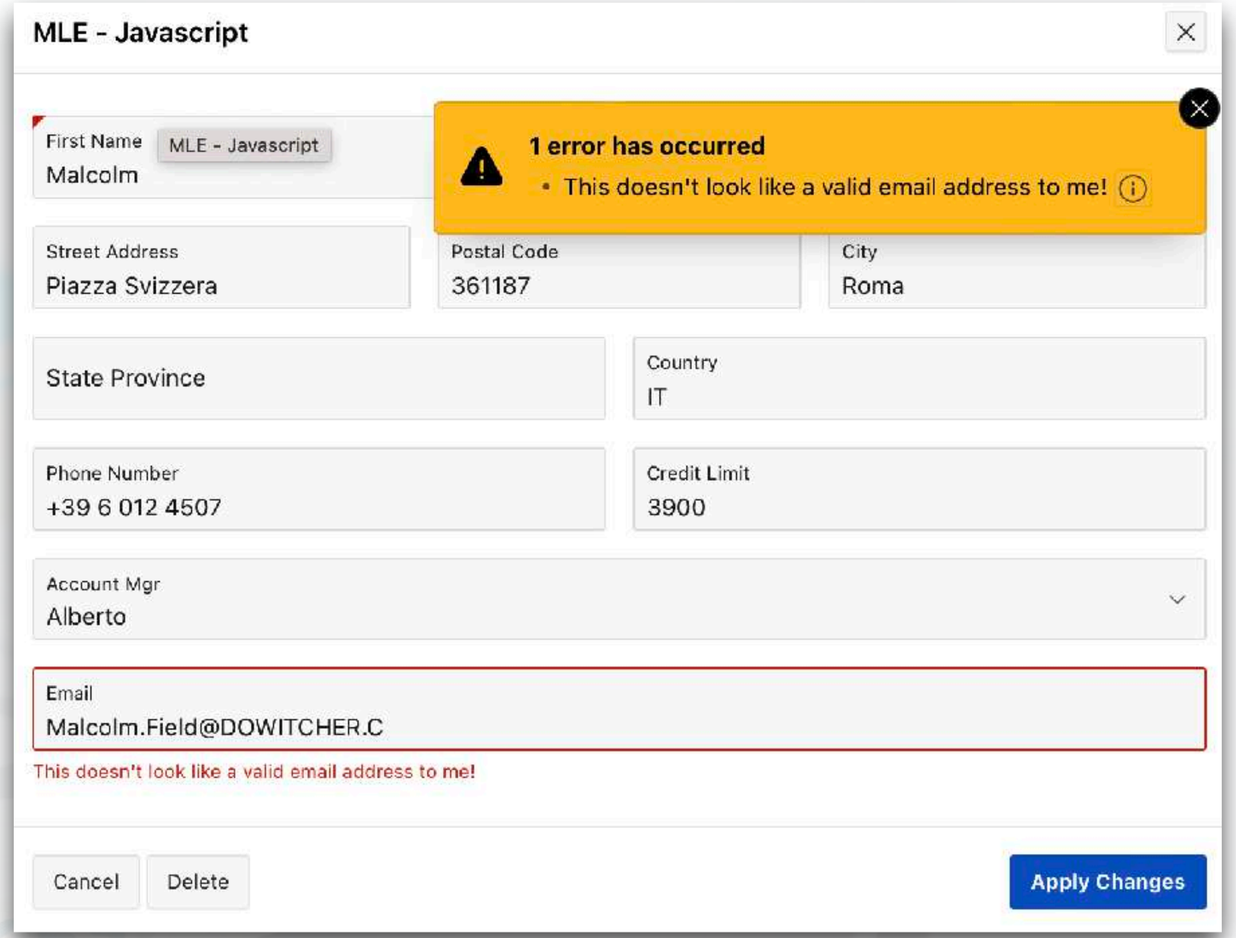
```
SQL> create mle module if not exists validator
  2  language javascript
  3  using bfile (javascript_src_dir, 'validator.min.js');
  4* /

PL/SQL procedure successfully completed.

SQL> select module_name, language_name
  2  from user_mle_modules
  3* /

MODULE_NAME          LANGUAGE_NAME
____________________ ____________________
EXAMPLE_MODULE       JAVASCRIPT
VALIDATOR            JAVASCRIPT
```

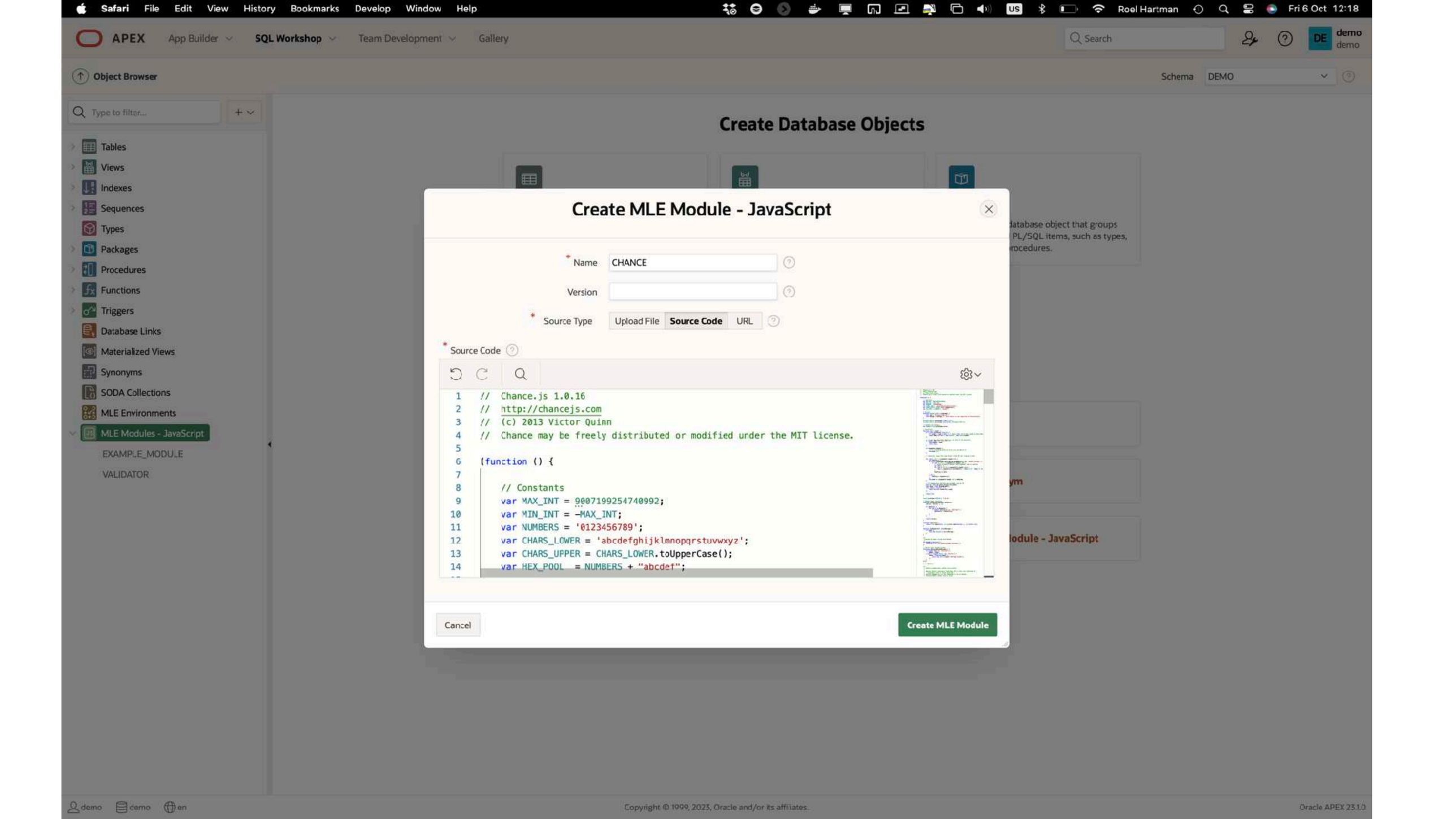
```
SQL> create or replace package js_validator as
  2
  3    function is_email( p_str varchar2 ) return boolean
  4      as mle module validator
  5      signature 'default.isEmail(string)';
  6
  7  end js_validator;
  8* /

Package JS_VALIDATOR compiled
```



```
SQL> select js_validator.is_email('roel@apexconsulting.nl')
  2* /

   JS_VALIDATOR.IS_EMAIL('ROEL@APEXCONSULTING.NL')
_________________________________________________
                                                1

SQL> select js_validator.is_email('roel@apexconsulting.n')
  2* /

   JS_VALIDATOR.IS_EMAIL('ROEL@APEXCONSULTING.N')
_________________________________________________
                                                0
```


Validation
Editable Region
- Select -
Type
Expression
Language
PL/SQL
PL/SQL Expression
js_validator.is_email(:P4_CUST_EMAIL)
Always Execute


MLE - Javascript
First Name
MLE - Javascript
Malcolm
1 error has occurred
This doesn't look like a valid email address to me!
Street Address
Piazza Svizzera
Postal Code
361187
City
Roma
State Province
Country
IT
Phone Number
+39 6 012 4507
Credit Limit
3900
Account Mgr
Alberto
Email
Malcolm.Field@DOWITCHER.C
This doesn't look like a valid email address to me!
Cancel
Delete
Apply Changes


Safari File Edit View History Bookmarks Develop Window Help
Roel Hartman Fri 6 Oct 12:18
APEX App Builder SQL Workshop Team Development Gallery
Search
DE demo demo
Object Browser
Schema DEMO
Type to filter...
Tables
Views
Indexes
Sequences
Types
Packages
Procedures
Functions
Triggers
Database Links
Materialized Views
Synonyms
SODA Collections
MLE Environments
MLE Modules - JavaScript
EXAMPLE_MODULE
VALIDATOR
Create Database Objects
Create MLE Module - JavaScript
Name CHANCE
Version
Source Type Upload File Source Code URL
Source Code
// Chance.js 1.0.16
// http://chancejs.com
// (c) 2013 Victor Quinn
// Chance may be freely distributed or modified under the MIT license.
(function () {
// Constants
var MAX_INT = 9007199254740992;
var MIN_INT = -MAX_INT;
var NUMBERS = '0123456789';
var CHARS_LOWER = 'abcdefghijklmnopqrstuvwxyz';
var CHARS_UPPER = CHARS_LOWER.toUpperCase();
var HEX_POOL = NUMBERS + "abcdef";
Cancel
Create MLE Module
demo demo en
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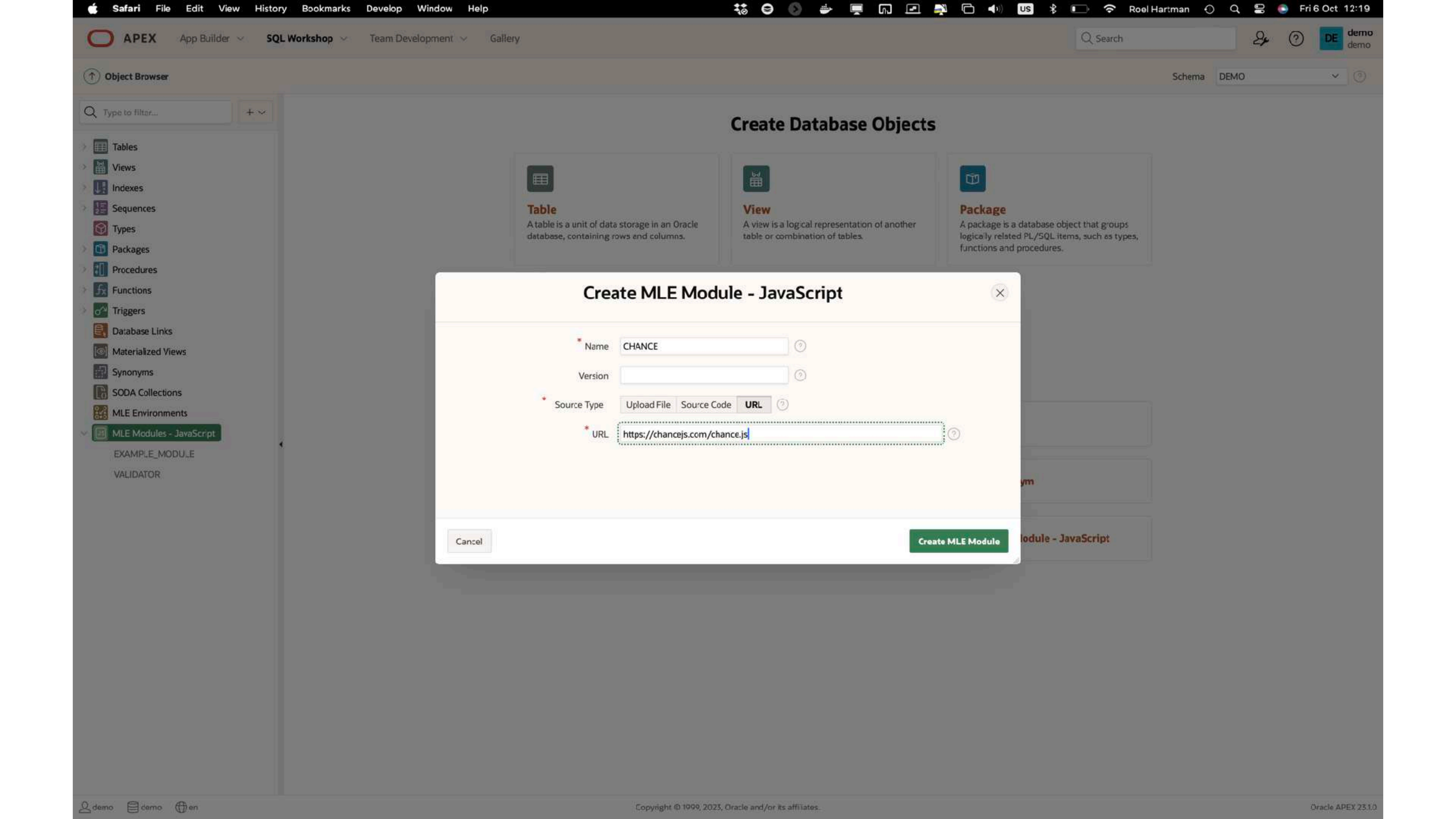
Oracle APEX 23.1.0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Fri 6 Oct 12:19
APEX
App Builder
SQL Workshop
Team Development
Gallery
Search
DE
demo
demo
Object Browser
Schema
DEMO
Type to filter...
Tables
Views
Indexes
Sequences
Types
Packages
Procedures
Functions
Triggers
Database Links
Materialized Views
Synonyms
SODA Collections
MLE Environments
MLE Modules - JavaScript
EXAMPLE_MODULE
VALIDATOR
Create Database Objects
Table
A table is a unit of data storage in an Oracle database, containing rows and columns.
View
A view is a logical representation of another table or combination of tables.
Package
A package is a database object that groups logically related PL/SQL items, such as types, functions and procedures.
Create MLE Module - JavaScript
Name
CHANCE
Version
Source Type
Upload File
Source Code
URL
URL
https://chancejs.com/chance.js
Cancel
Create MLE Module
demo
demo
en
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Oracle APEX 23.1.0

PL/SQL code successfully compiled (10:19:58)

Type to filter...

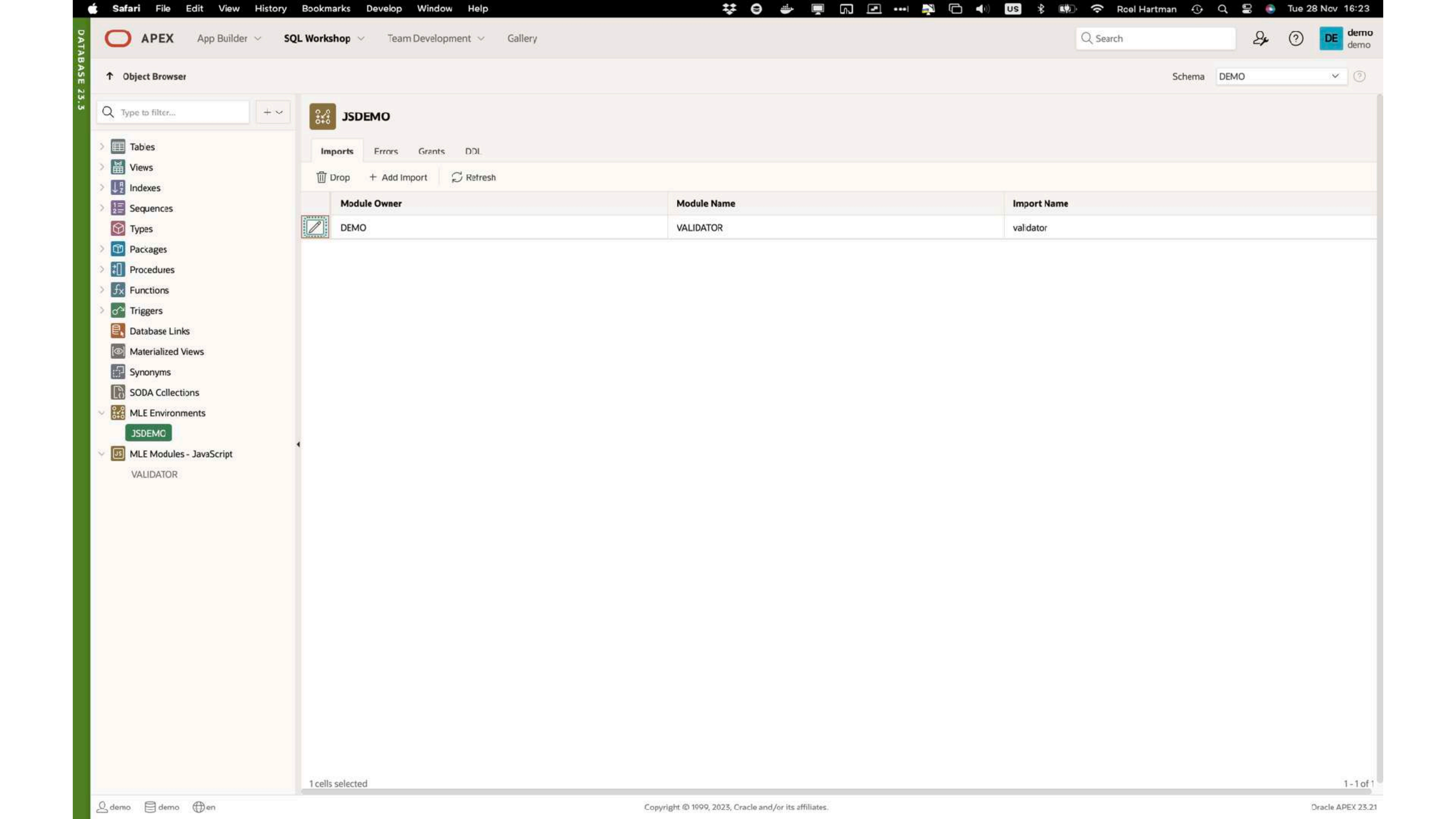
- Tables
- Views
- Indexes
- Sequences
- Types
- Packages
- Procedures
- Functions
- Triggers
- Database Links
- Materialized Views
- Synonyms
- SODA Collections
- MLE Environments
- MLE Modules - JavaScript
  - CHANCE
  - EXAMPLE_MODULE
  - VALIDATOR

CHANCE

Code Grants

Download Save and Compile Drop Refresh

```
1  //  Chance.js 1.0.16
2  //  http://chancejs.com
3  //  (c) 2013 Victor Quinn
4  //  Chance may be freely distributed or modified under the MIT license.
5
6  (function () {
7
8      // Constants
9      var MAX_INT = 9007199254740992;
10     var MIN_INT = -MAX_INT;
11     var NUMBERS = '0123456789';
12     var CHARS_LOWER = 'abcdefghijklmnopqrstuvwxyz';
13     var CHARS_UPPER = CHARS_LOWER.toUpperCase();
14     var HEX_POOL  = NUMBERS + "abcdef";
15
16     // Errors
17     function UnsupportedError(message) {
18         this.name = 'UnsupportedError';
19         this.message = message || 'This feature is not supported on this platform';
20     }
21
22     UnsupportedError.prototype = new Error();
23     UnsupportedError.prototype.constructor = UnsupportedError;
24
25     // Cached array helpers
26     var slice = Array.prototype.slice;
27
28     // Constructor
29     function Chance (seed) {
30         if (!(this instanceof Chance)) {
31             if (!seed) { seed = null; } // handle other non-truthy seeds, as described in issue #322
32             return seed === null ? new Chance() : new Chance(seed);
33         }
34
35         // if user has provided a function, use that as the generator
36         if (typeof seed === 'function') {
37             this.random = seed;
38             return this;
39         }
40
41         if (arguments.length) {
42             // set a starting value of zero so we can add to it
43             this.seed = 0;
```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DATABASE 23.3
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demo
demo
Object Browser
Schema
DEMO
Type to filter...
Tables
Views
Indexes
Sequences
Types
Packages
Procedures
Functions
Triggers
Database Links
Materialized Views
Synonyms
SODA Collections
MLE Environments
JSDEMO
MLE Modules - JavaScript
VALIDATOR
JSDEMO
Imports
Errors
Grants
DDL
Drop
Add Import
Refresh
Module Owner
Module Name
Import Name
DEMO
VALIDATOR
validator
1 cells selected
1 - 1 of 1
demo
demo
en
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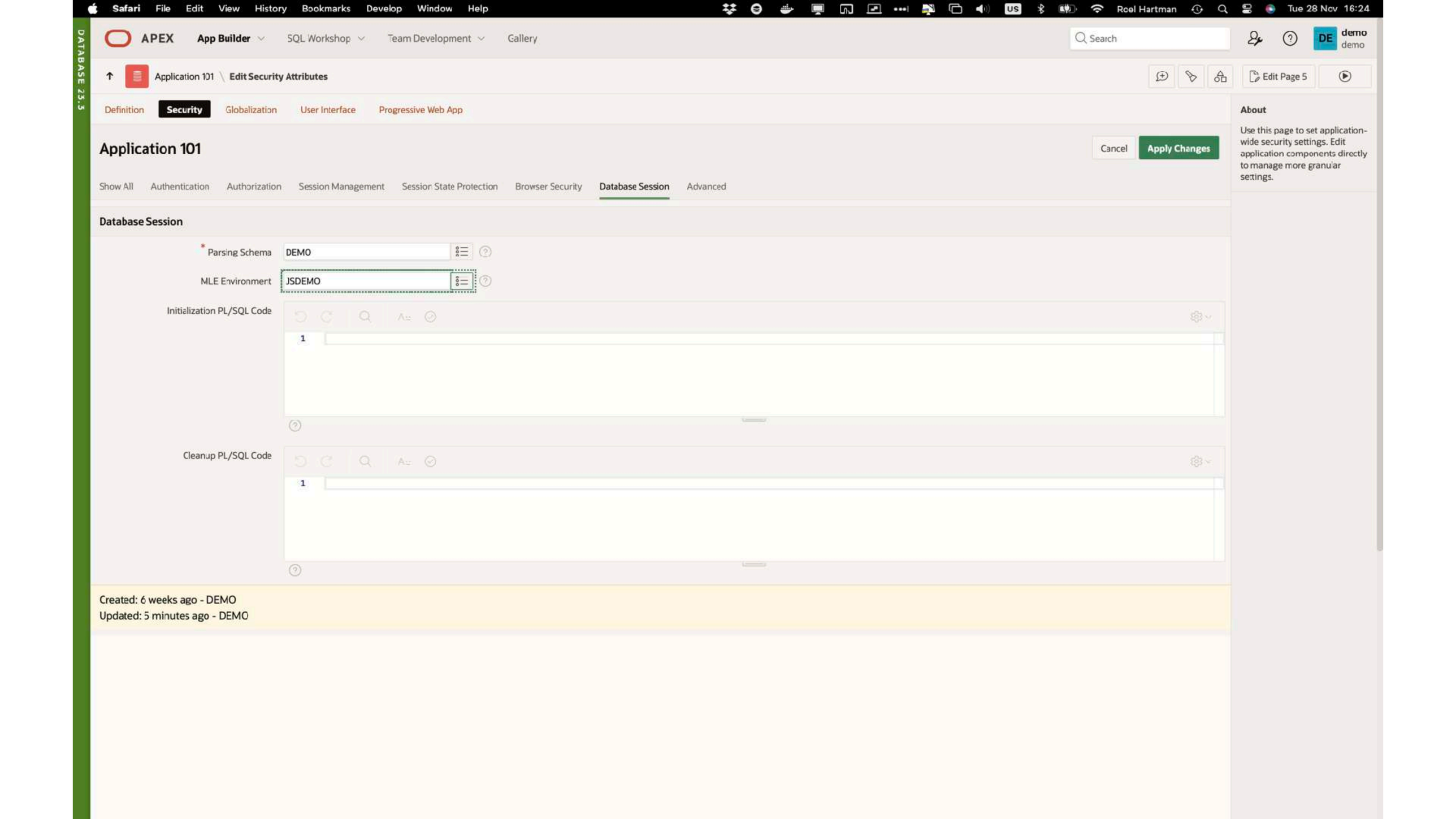
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DATABASE 23.3
APEX
App Builder
SQL Workshop
Team Development
Gallery
Search
DE
demo
demo
Application 101
Edit Security Attributes
Edit Page 5
Definition
Security
Globalization
User Interface
Progressive Web App
Application 101
Cancel
Apply Changes
Show All
Authentication
Authorization
Session Management
Session State Protection
Browser Security
Database Session
Advanced
Database Session
Parsing Schema
DEMO
MLE Environment
JSDEMO
Initialization PL/SQL Code
1
Cleanup PL/SQL Code
1
Created: 6 weeks ago - DEMO
Updated: 5 minutes ago - DEMO
About
Use this page to set application-wide security settings. Edit application components directly to manage more granular settings.

Pick your validation language

```
js_validator.is_email(:P4_CUST_EMAIL)
```

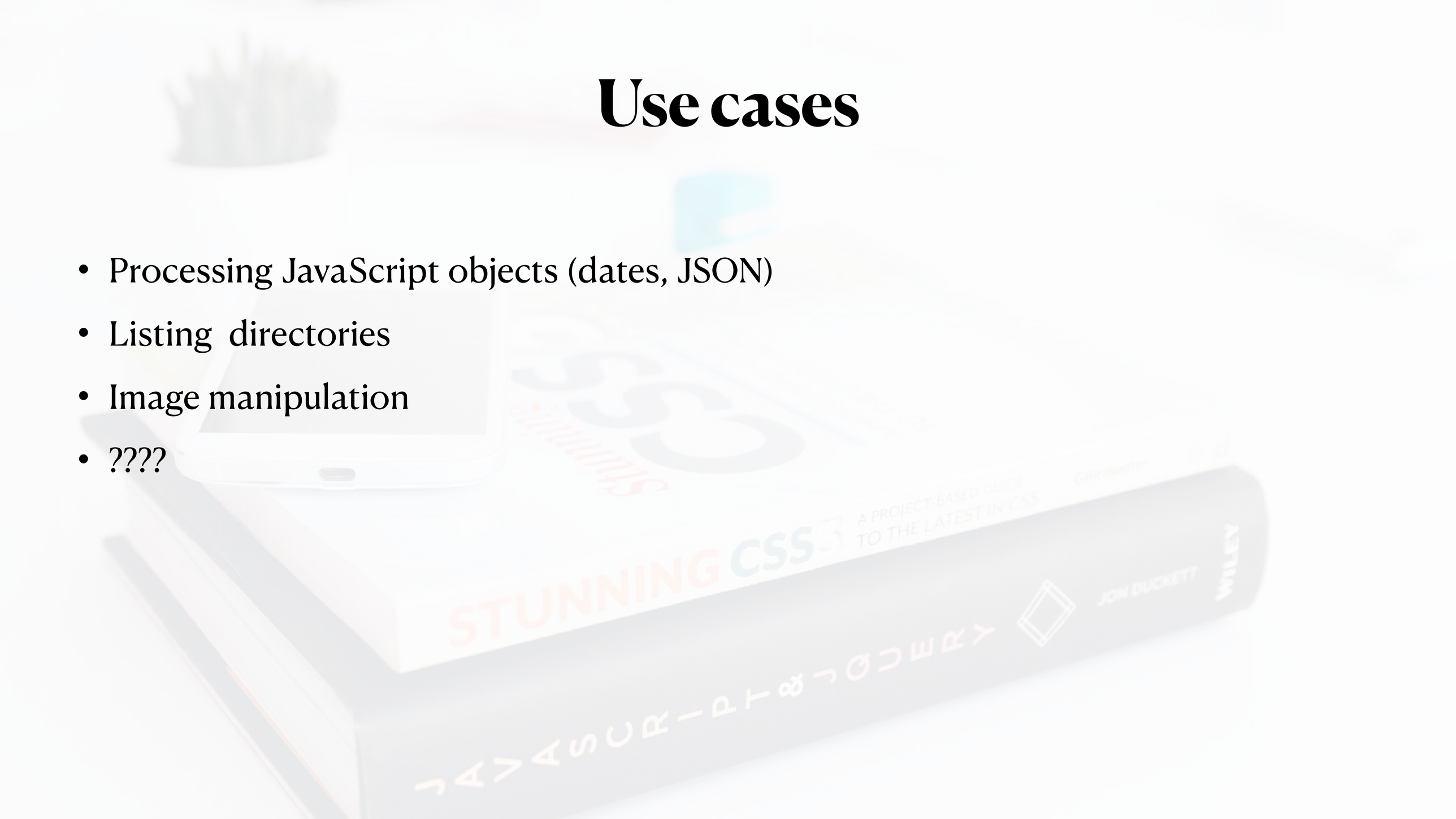
```
(await import ("validator")).default.isEmail(apex.env.P4_CUST_EMAIL)
```

Why?

- Attract JavaScript developers
- Some code is easier to write in JavaScript
- Reuse code already written in JavaScript
- Some code can’t be written - or is hard(er) to write - in PL/SQL

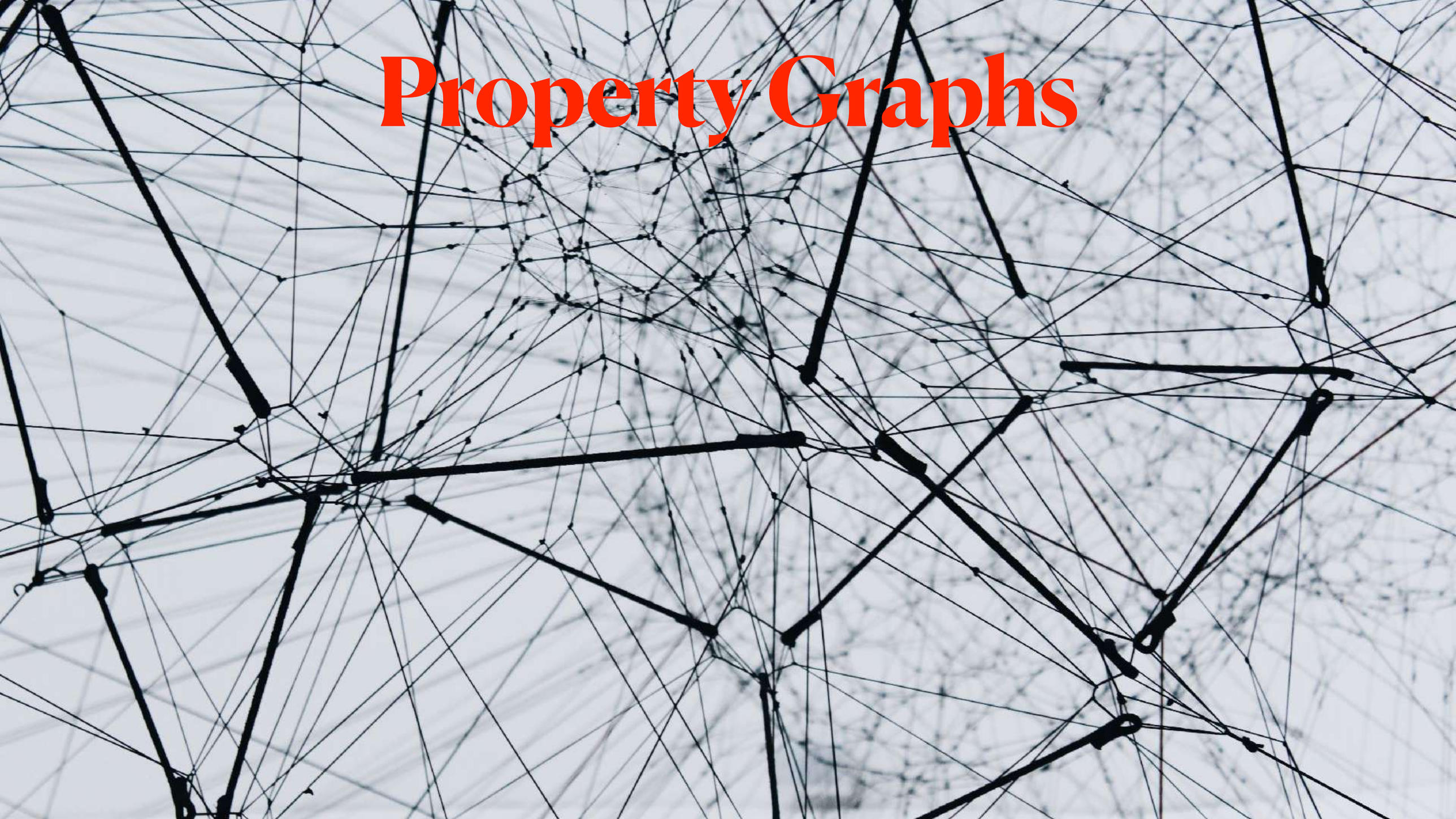
Use cases

- Processing JavaScript objects (dates, JSON)
- Listing directories
- Image manipulation
- ????



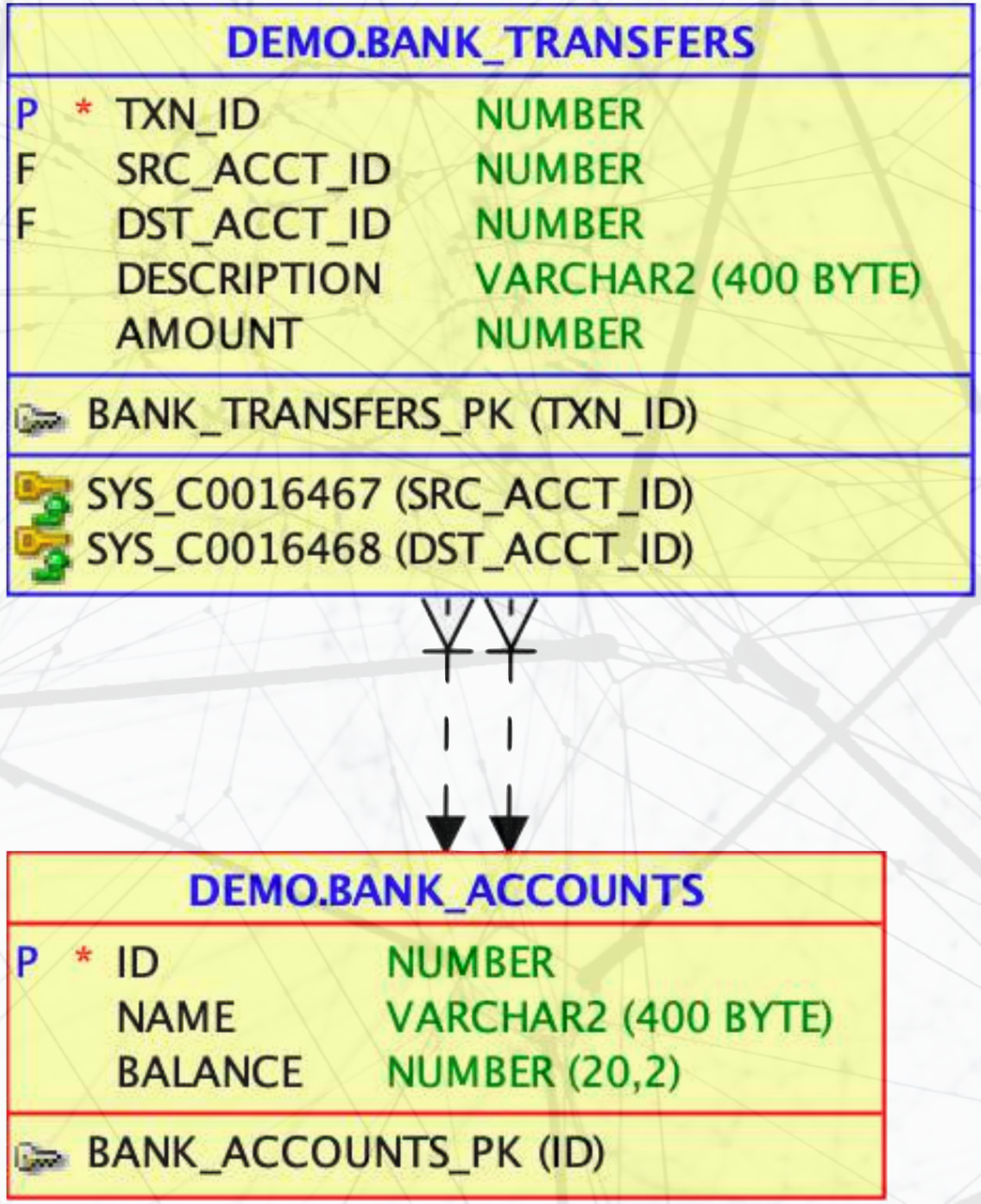

Stunning
CSS
STUNNING CSS3
A PROJECT-BASED GUIDE
TO THE LATEST IN CSS
Gillenwater
JAVASCRIPT & JQUERY
JON DUCKETT
WILEY

Property Graphs

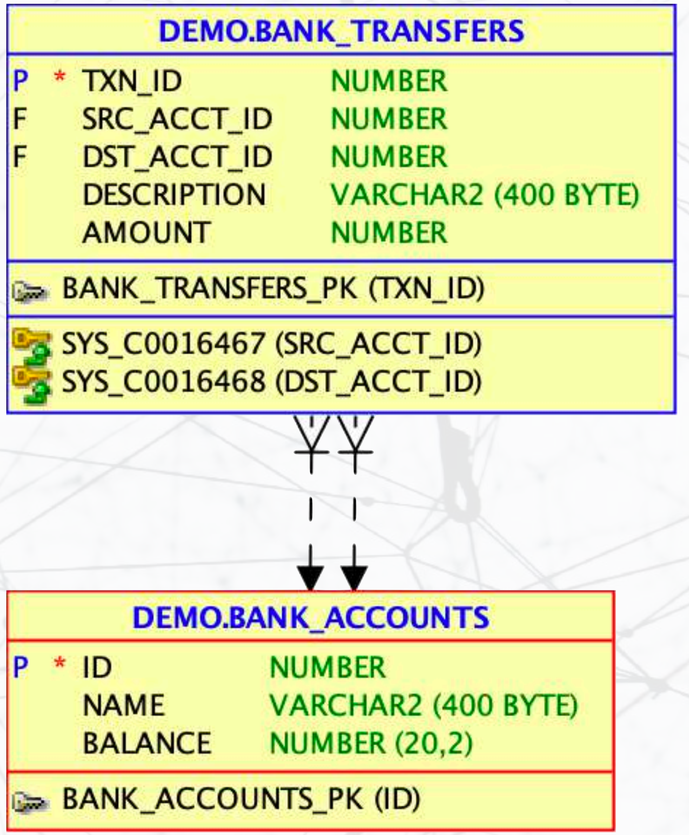


Use cases

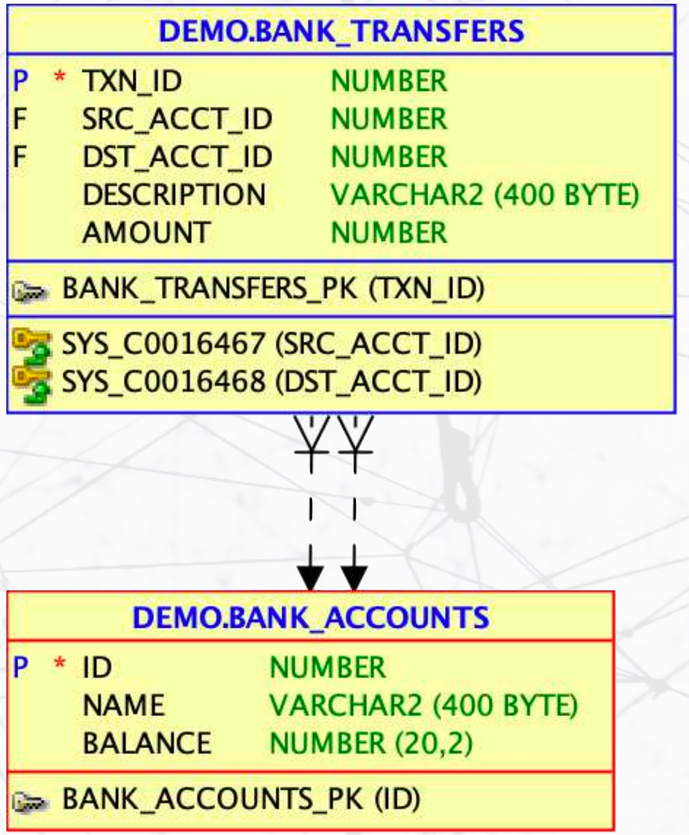
- (Recursive) relations
- Shortest path


DEMO.BANK_TRANSFERS
P * TXN_ID NUMBER
F SRC_ACCT_ID NUMBER
F DST_ACCT_ID NUMBER
DESCRIPTION VARCHAR2 (400 BYTE)
AMOUNT NUMBER
BANK_TRANSFERS_PK (TXN_ID)
SYS_C0016467 (SRC_ACCT_ID)
SYS_C0016468 (DST_ACCT_ID)
DEMO.BANK_ACCOUNTS
P * ID NUMBER
NAME VARCHAR2 (400 BYTE)
BALANCE NUMBER (20,2)
BANK_ACCOUNTS_PK (ID)

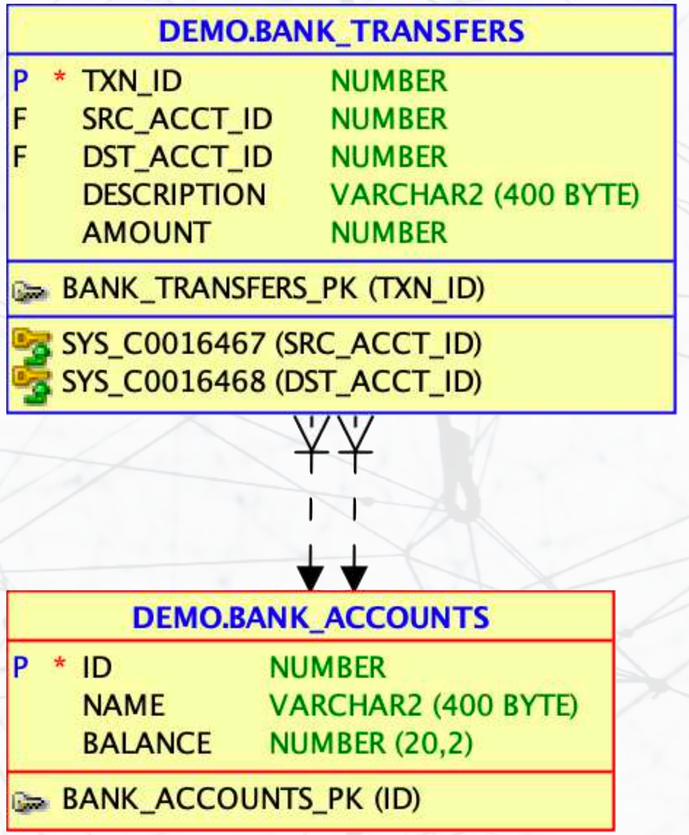
```
create property graph …
vertex tables (
  …
)
edge tables (
  …
)
```



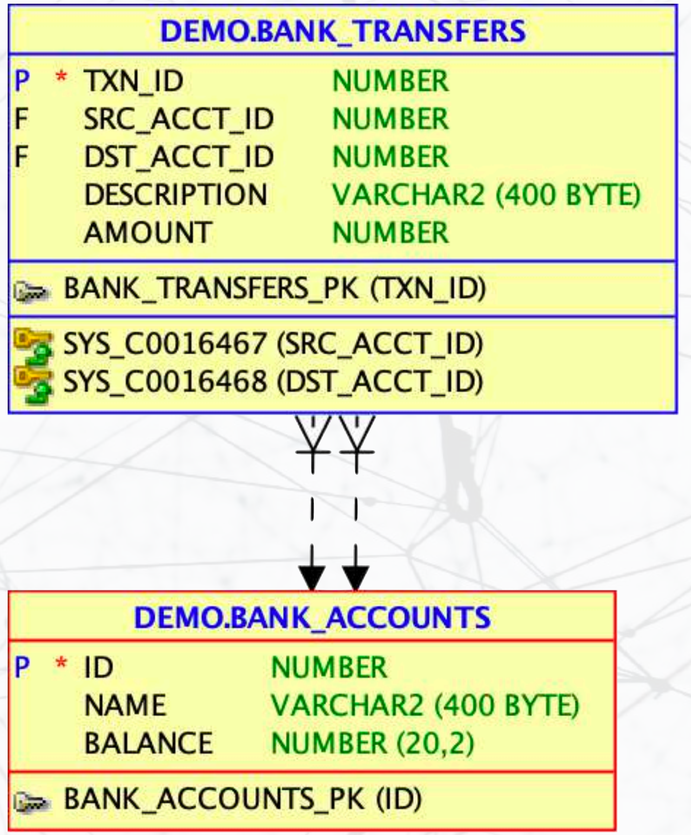
```
create property graph bank_graph
vertex tables (
  …
)
edge tables (
  …
)
```



```
create property graph bank_graph
vertex tables (
 bank_accounts
 key (id)
 properties( id, name, balance )
)
edge tables (
 …
)
```



```
create property graph bank_graph
vertex tables (
 bank_accounts
 key (id)
 properties( id, name, balance )
)
edge tables (
 bank_transfers
 key (txn_id)
 source key (src_acct_id) references bank_accounts(id)
 destination key(dst_acct_id)references bank_accounts(id)
 properties(src_acct_id, dst_acct_id, amount)
)
```



Top 5 incoming transfers

```
SQL> select acct_id,
  2         count(*) as num_transfers
  3  from graph_table ( bank_graph
  4       match (src is bank_accounts) - [trf is bank_transfers] -> (dst is bank_accounts)
  5       columns ( dst.id as acct_id )
  6     ) group by acct_id order by num_transfers desc
  7  fetch first 5 rows only
  8* /

   ACCT_ID    NUM_TRANSFERS
__________ _________________
       387                39
       934                39
       135                36
       534                32
       380                31

SQL>
```

```
SQL> select dst_acct_id, count(*) as num_transfers
  2  from bank_transfers
  3  group by dst_acct_id
  4  order by num_transfers desc
  5  fetch first 5 rows only
  6* /
```

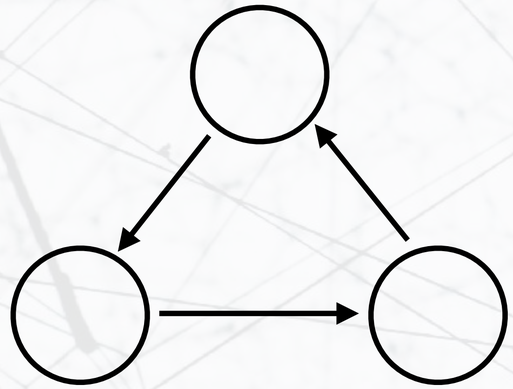
Top 5 incoming transfers

```
SQL> select acct_id,
  2         count(*) as num_transfers
  3  from graph_table ( bank_graph
  4  --       match (src is bank_accounts) - [trf is bank_transfers] -> (dst is bank_accounts)
  5           match (src) -> (dst)
  6           columns ( dst.id as acct_id )
  7       ) group by acct_id order by num_transfers desc
  8  fetch first 5 rows only
  9* /

   ACCT_ID    NUM_TRANSFERS
__________ _________________
       387                39
       934                39
       135                36
       534                32
       380                31

SQL>
```

```
SQL> select dst_acct_id, count(*) as num_transfers
  2  from bank_transfers
  3  group by dst_acct_id
  4  order by num_transfers desc
  5  fetch first 5 rows only
  6* /
```

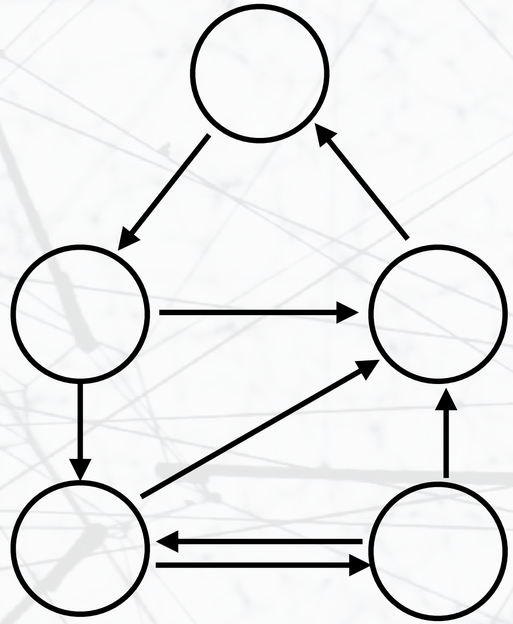
3 hops roundtrips

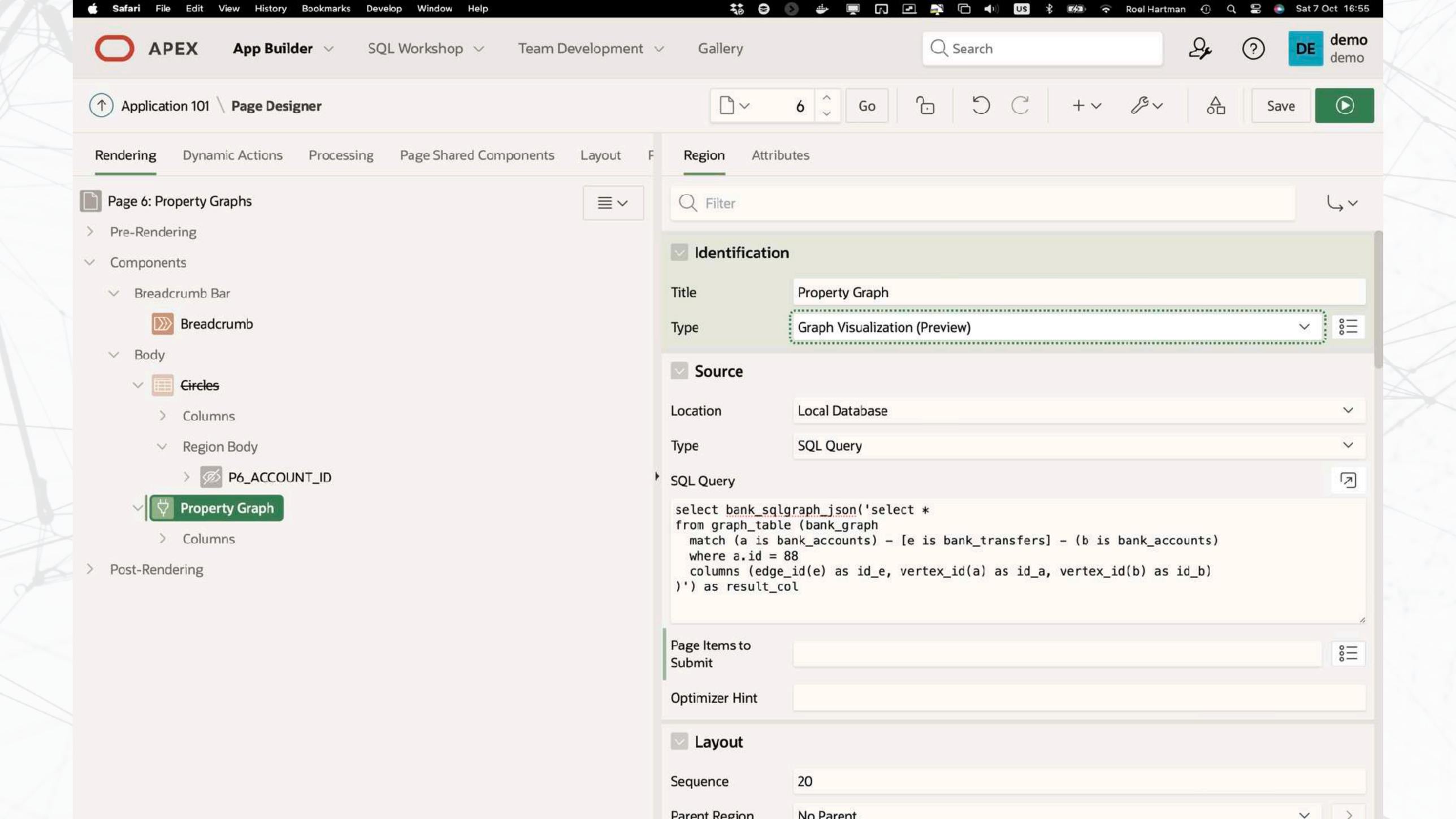
```
SQL> select acct_id, count(*) as chains
  2  from graph_table (bank_graph
  3    match (src) ->{3} (src)
  4    columns (src.id as acct_id)
  5  ) group by acct_id order by chains desc
  6  fetch first 5 rows only
  7* /

    ACCT_ID     CHAINS
___________ __________
        751          3
        534          3
        359          3
        918          3
        651          2
```



2 to 5 hops roundtrips

```
SQL> select acct_id, count(*) as chains
  2  from graph_table (bank_graph
  3    match (src) ->{2,5} (src)
  4    columns (src.id as acct_id)
  5  ) group by acct_id order by chains desc
  6  fetch first 5 rows only
  7* /

    ACCT_ID     CHAINS
___________ __________
         135         37
         387         34
         934         30
         640         28
         458         27
```

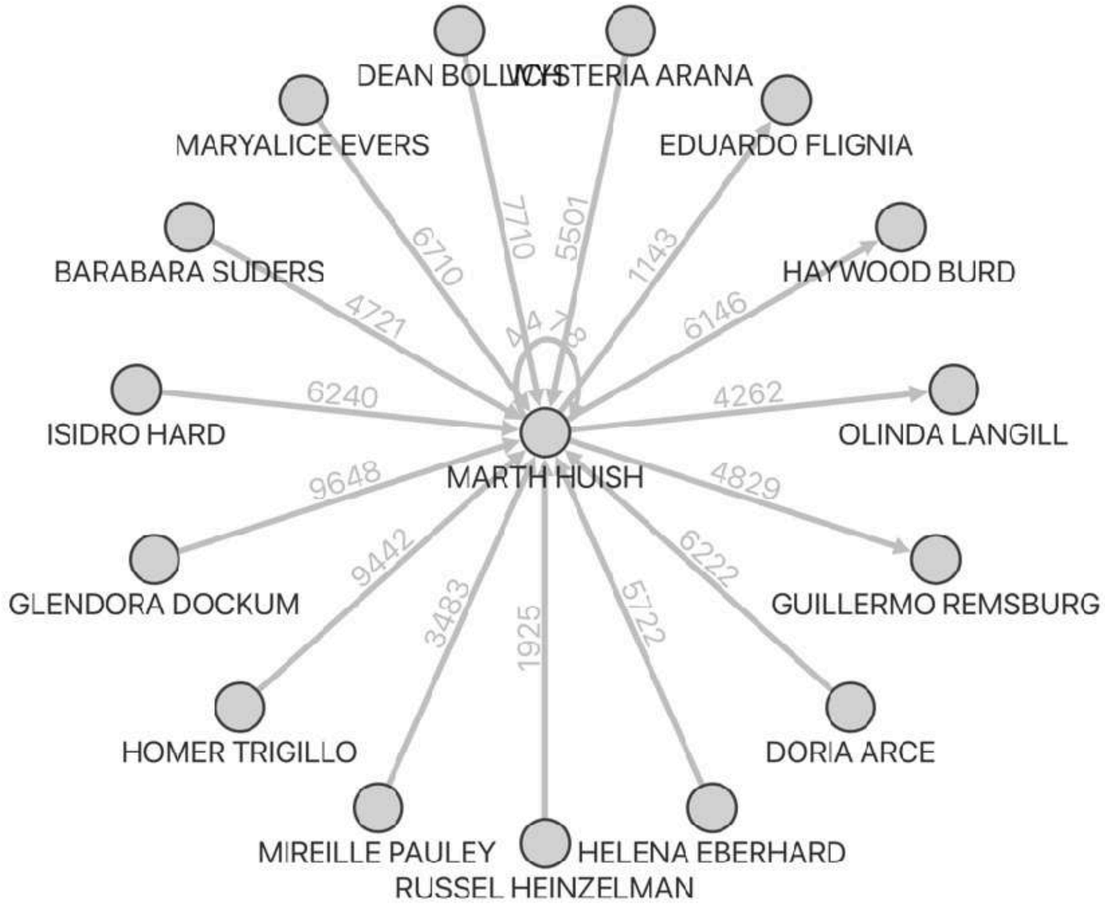



Safari File Edit View History Bookmarks Develop Window Help
Roel Hartman
Sat 7 Oct 16:55
APEX
App Builder
SQL Workshop
Team Development
Gallery
Search
DE
demo
demo
Application 101
Page Designer
6
Go
Save
Rendering
Dynamic Actions
Processing
Page Shared Components
Layout
Region
Attributes
Page 6: Property Graphs
Pre-Rendering
Components
Breadcrumb Bar
Breadcrumb
Body
Circles
Columns
Region Body
P6_ACCOUNT_ID
Property Graph
Columns
Post-Rendering
Filter
Identification
Title
Property Graph
Type
Graph Visualization (Preview)
Source
Location
Local Database
Type
SQL Query
SQL Query
select bank_sqlgraph_json('select *
from graph_table (bank_graph
match (a is bank_accounts) - [e is bank_transfers] - (b is bank_accounts)
where a.id = 88
columns (edge_id(e) as id_e, vertex_id(a) as id_a, vertex_id(b) as id_b)
)') as result_col
Page Items to Submit
Optimizer Hint
Layout
Sequence
20
Parent Region
No Parent

Home
SQL Domains
MLE - JavaScript
Property Graphs

Property Graphs

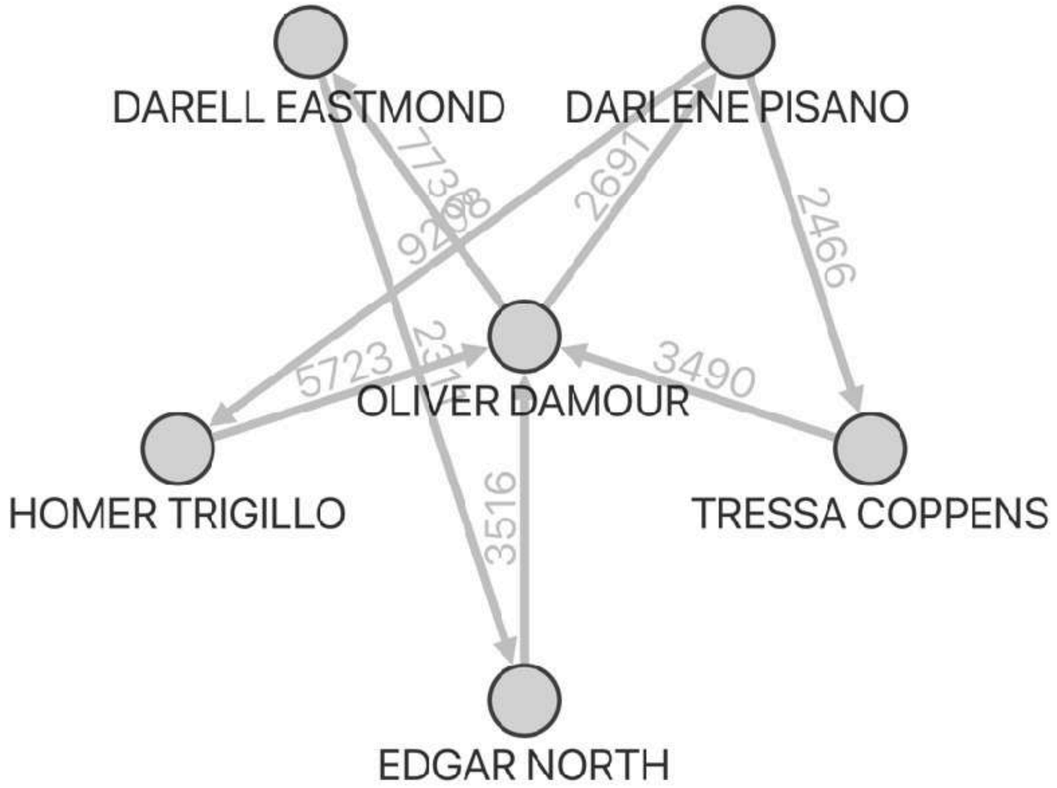
Property Graph



Home
Booleans
SQL Domains
MLE - JavaScript
Property Graphs
All Transactions
All Transactions to/from 88
Rounds to 751

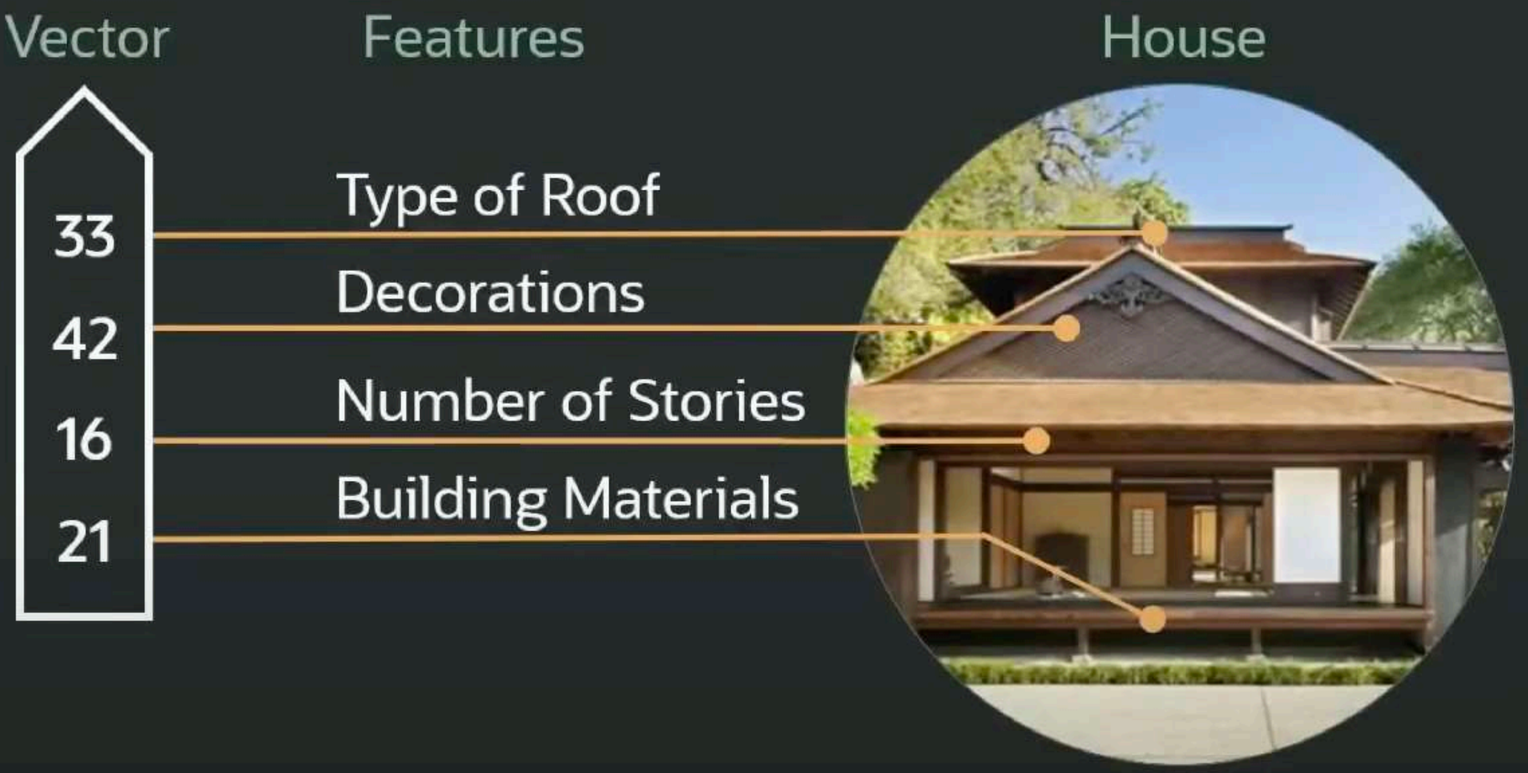
Property Graphs - rounds to 751

Property Graph



AI Vector Search

Example: the features for a house image could be



Each dimension represents a different feature of the house

The distance between the vectors is proportional to their semantic similarity

Oracle Database 23c can store vectors using a new vector data type

```
CREATE TABLE house_for_sale (house_id     number,
                             price        number,
                             city         varchar2(400),
                             house_photo  blob,
                             house_vector vector

);
```

Allows finding data that is semantically similar to an input

Find houses that are similar to this picture

```
SELECT   …
FROM     house_for_sale
ORDER BY vector_distance(house_vector, :input_vector);
```

Allows queries that combine AI vector search with business data about customers and products

Find houses that are similar to this picture and match the customer's preferred city and budget

```
SELECT …
FROM   house_for_sale
WHERE  price <= (SELECT budget      FROM customer …)
AND    city  in (SELECT search_city FROM customer …)
ORDER BY vector_distance(house_vector, :input_vector);
```

AI Vector Search

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