

RĪGAS TEHNISKĀ UNIVERSITĀTE

Datorzinātnes un informācijas tehnoloģijas fakultāte

3.praktiskais darbs

mācību priekšmetā

“Pēcrelāciju datu bāzes sistēmas(DB2)”

**XML datu bāzes sistēmas.**

Izstrādāja: Viktors Stepičevs

III.kurss RDBD0, 4.grupa, 191RDB100

Pārbaudīja: Prof. J. Eiduks

**2021./22/māc.gads**

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# **Darba uzdevumi**

1. Ar izvēlētu XML redaktoru jāizveido divi XML dokumenta faili un tiem atbilstošie shēmu faili.  
2. XMLType tipa tabulu izveidošana:  
1) binārā veidā bez shēmas un ar shēmu. Tagad šis XML datu glabāšanas veids ir galvenais (sākot ar Oracle 11.2 versiju).  
2) strukturētā jeb relāciju – objektu (object – relational) veidā ar shēmu (bez shēmas nav domāts variants). Lai to izdarītu, jāveic XML redaktorā iegūtās shēmas anotēšana.

To var izdarīt Oracle datu bāzes sistēmā un un arī ALTOVA XMLSpy redaktorā. Šī punkta izpilde nav obligāta, bet ja izpildīsiet, papildus atzīmei tiks pielikti 1.5 punkti.  
3. Datu ievade izveidotajās tabulās (tekstveida, lielo objektu BLOB un SQL\*Loader izmantošana).  
4. XMLTable vaicājumu izpilde (2 vaicājumi).  
5. XMLQuery vaicājumu izpilde (4 vaicājumi).  
6. XMLCast vaicējumu izpilde (2 vaicājumi)  
7. XML datu izvadīšana relāciju datu veidā.  
8. Relāciju datu izvadīšana XML datu formātā.  
9. Secinājumi (kas labs, kas slikts, kas noskaidrots, XML izmantošanas iespēju izvērtējums).

# **Anotācija**

Darbā tiks apskatītas XML un datu bāzes sistēmu saistības pamatjēdzieni, XML struktūras glābāšanas veidi, kā arī vairākas SQL iebūvētās XML funkcijas. XML dokumenti un shēmas tika izstrādātas ar ALTOVA XMLSpy redaktoru, bet datu bāze pilnība tika izstrādāta Oracle SQL Developer vidē.

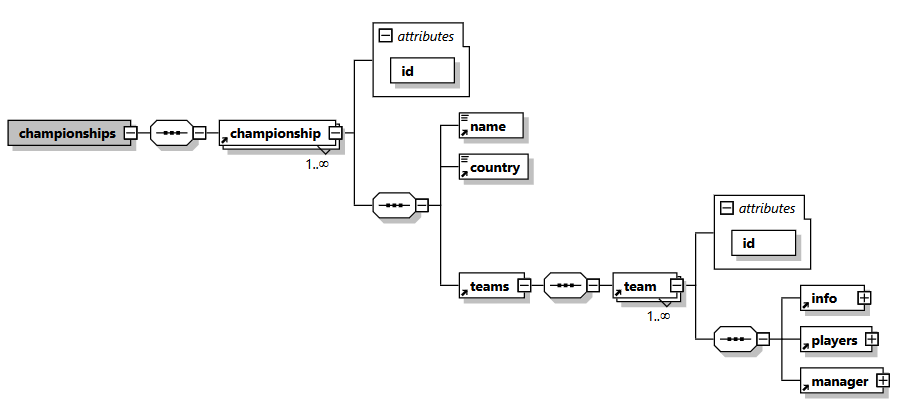
# **XML dokumentu failu un shēmu izveide**

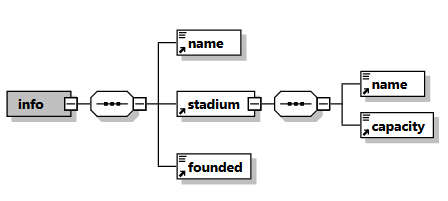
Pirms uzsākot pildīt darba uzdevumus, pirmais ko ir jāizdara ir XML redaktora instalēšana. Darba izstrādei es izvēlējos ALTOVA XMLSpy redaktoru, ar kuru palīdzību tiks izstrādāti divi XML dokumentu faili un tiem atbilstošie shēmu faili. Runājot par darba novirzi, kā ierasts paliku pie tās pašas tematikas kā iepriekšējos darbos – futbola komandas.

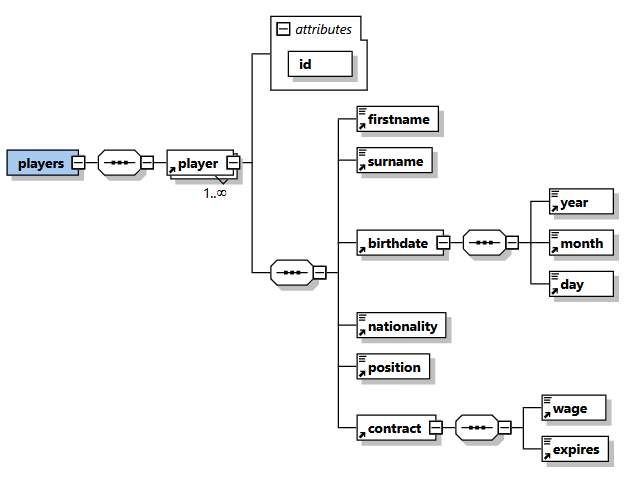
Kā arī minēju, darba gaitā tika izstrādāti divi XML dokumenta faili Championships un Seasons, un tiem atbilstošas shēmas Championships\_Schema un Seasons\_Schema. Dokuments Championships būtībā glāb līdzīgo informāciju, ka datu bāze manā pagājušajā darbā – informācija par 6 komandām no 3 dažādām valstīm, kur katrai ir iezīmēti 3 spēlētāji un viens treneris, savukārt, failā Seasons varētu būt atrasta informācija par komandu spēlēm savā starpā, atspoguļojot iegūtus vārtus, bumbas kontroles procentu un sitienu daudzumu, arī ņēmot vērā, ka komandas savā starpā čempionātā spēlē mājās un viesos. Dati par spēlēm tika atspoguļoti ar 2 gadu periodiku. Pabeidzot definēt visas iezīmēs, ALTOVA XMLSpy redaktorā ir iespēja aplūkot datu “grid” tabulas versiju. Šeit es ievietoju tikai pamata iezīmju attēlojumu, jo izvirzot shēmu plašāk, diez vai bildē kaut kas salasāms, bet pamata informācija ir redzama, ka iezīmē <championships> iekšā ir trīs “bērnu” <champioship> iezīmes ar atribūtu id, kurās katra satur informāciju par 2 komandām. Darba XML dokumenti un shēmas ir pieejamas darba pielikumos.

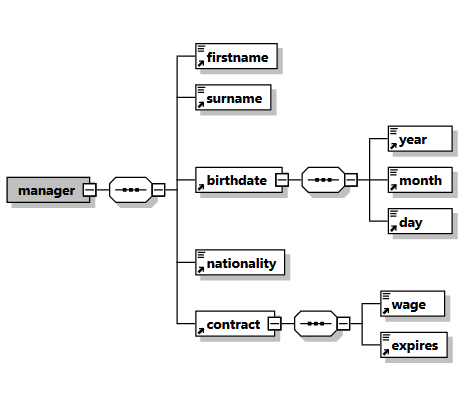


ALTOVA XMLSpy vidē arī ir iespēja uzģenerēt savam XML dokumentam attiecīgo shēmu. Uzģenerējot shēmu, ar shēmas attēlojuma nodaļu ir iespējams iegūt strukturētu faila diagrammu.

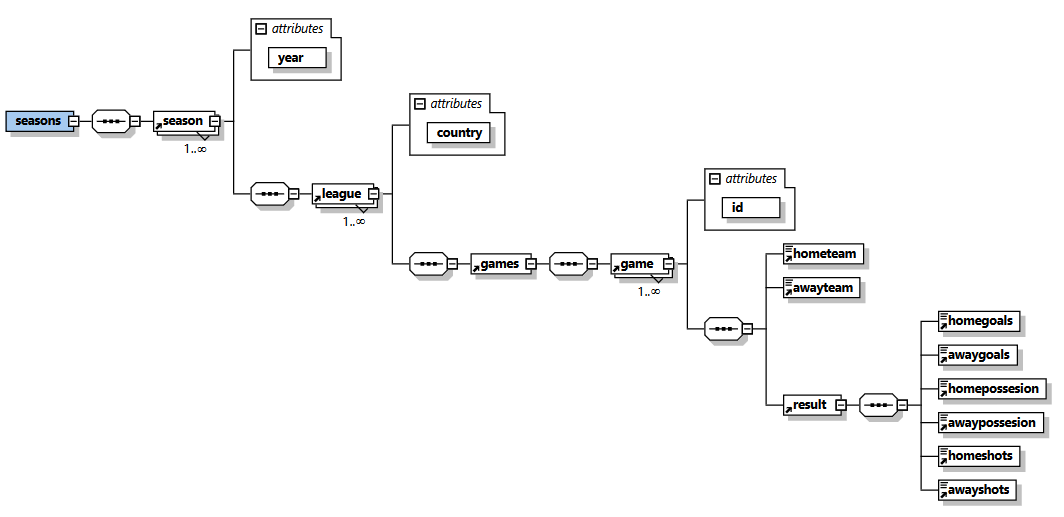
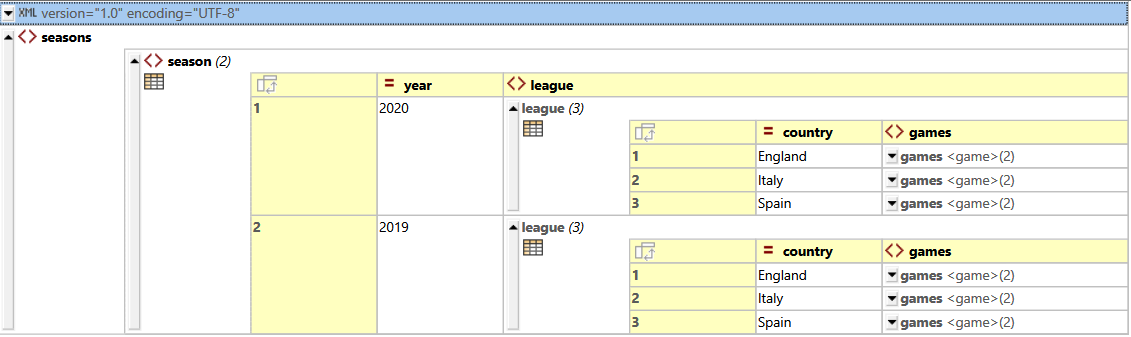








Savukārt, līdzīgs attēlojums ir pieejams arī Seasons dokumentam.



# **XMLType tipa tabulu izveidošana un datu ievade tabulās**

Uzsākot darbu ar izveidotājiem failiem Oracle SQL Developer, vispirms, lai tiktu klāt visiem darbā izmantotājiem failiem ir jādefinē direktoriju, kurā tie atrodas.



## **Binārais glabāšanas veids bez shēmas**

Tātad, vispirms tika izveidota XMLTYPE tabula Championships\_Bin ar vienkāršo CREATE TABLE vaicājumu. Gadījuma, kad tabulai nav norādīta XML dokumenta shēma un glabāšanas opcijas, pēc noklusējuma dati tiks glabāti kā binārs XML.



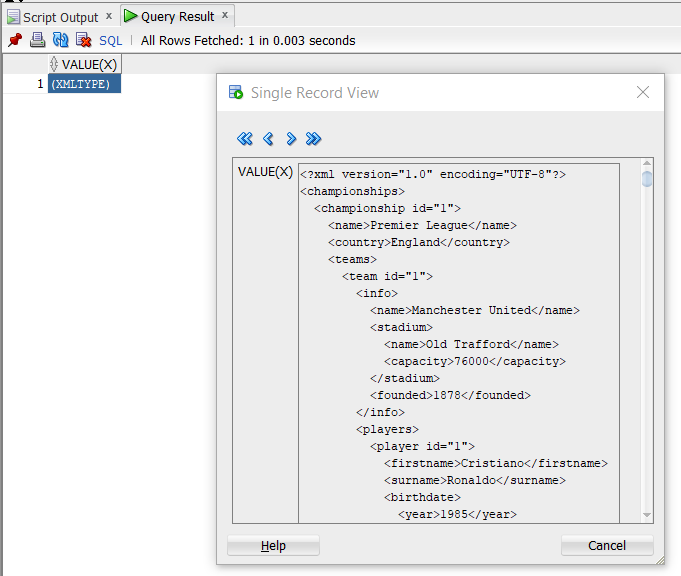
Šajā tabulā dati tika ievadīti ar INSERT INTO palīdzību, pielietojot XMLTYPE, ievietojot datus tieši no izveidotājā XML dokumenta, norādot direktoriju, faila nosaukumu un simbolu formātu.

**INSERT INTO Championships\_Bin VALUES(XMLTYPE(Bfilename('XML\_DIR', 'Championships.xml'),nls\_charset\_id('AL32UTF8')));**

Rezultātā izvadot tabulas vērtību, ir redzams, ka iekšā atrodas (XMLTYPE), kuru vērtību apskatoties ir redzams Championships XML fails.

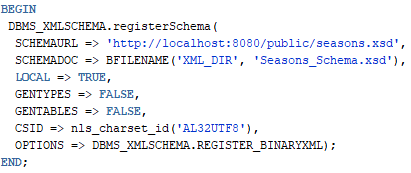
**SELECT VALUE(x)**

**FROM Championships\_Bin x;**



## **Binārais glabāšanas veids ar shēmas**

Pirmkārt, lai strādātu tālāk ir jādefinē XML faila shēmu binārai glabāšanai datu bāzes sistēmā.



Pēc shēmas anotēšanas, tālāk tika izveidota tabulas Seasons\_Bin, kurai tika norādīta XML faila shēma. To ir iespējams izdarīt kā ar XMLSCHEMA un ELEMENT iebūvēto funkciju konstrukciju(ko izmantošu vēlāk), kā arī izmantojot tikai ELEMENT, pielietojot XPointer notāciju, shēmas norādē specificējot saknes elementu.



Šajā tabulā datus es ievadīju tekstveidā, ievadot XML failu tieši datu bāzēs sistēmā. Ņemot vēra 4000 teksta simbolu ierobežojumu, faila saturu es sadalīju pa gadiem, ievadot tos ka divus atsevišķus ierakstus.

**INSERT INTO Seasons\_Bin VALUES(XMLTYPE(**

**'<?xml version="1.0" encoding="UTF-8"?>**

**<seasons>**

**<season year="2020">**

**<league country="England">**

**<games>**

**<game id="1">**

**<hometeam>Manchester United</hometeam>**

**<awayteam>Liverpool</awayteam>**

**<result>**

**<homegoals>3</homegoals>**

**<awaygoals>2</awaygoals>**

**<homepossesion>45</homepossesion>**

**<awaypossesion>55</awaypossesion>**

**<homeshots>9</homeshots>**

**<awayshots>11</awayshots>**

**</result>**

**</game>**

**<game id="2">**

**<hometeam>Liverpool</hometeam>**

**<awayteam>Manchester United</awayteam>**

**<result>**

**<homegoals>0</homegoals>**

**<awaygoals>0</awaygoals>**

**<homepossesion>61</homepossesion>**

**<awaypossesion>39</awaypossesion>**

**<homeshots>8</homeshots>**

**<awayshots>4</awayshots>**

**</result>**

**</game>**

**</games>**

**</league>**

**<league country="Italy">**

**<games>**

**<game id="3">**

**<hometeam>AC Milan</hometeam>**

**<awayteam>Juventus</awayteam>**

**<result>**

**<homegoals>1</homegoals>**

**<awaygoals>1</awaygoals>**

**<homepossesion>48</homepossesion>**

**<awaypossesion>52</awaypossesion>**

**<homeshots>2</homeshots>**

**<awayshots>9</awayshots>**

**</result>**

**</game>**

**<game id="4">**

**<hometeam>Juventus</hometeam>**

**<awayteam>AC Milan</awayteam>**

**<result>**

**<homegoals>2</homegoals>**

**<awaygoals>0</awaygoals>**

**<homepossesion>45</homepossesion>**

**<awaypossesion>55</awaypossesion>**

**<homeshots>7</homeshots>**

**<awayshots>3</awayshots>**

**</result>**

**</game>**

**</games>**

**</league>**

**<league country="Spain">**

**<games>**

**<game id="5">**

**<hometeam>Real Madrid</hometeam>**

**<awayteam>FC Barcelona</awayteam>**

**<result>**

**<homegoals>3</homegoals>**

**<awaygoals>1</awaygoals>**

**<homepossesion>60</homepossesion>**

**<awaypossesion>40</awaypossesion>**

**<homeshots>8</homeshots>**

**<awayshots>5</awayshots>**

**</result>**

**</game>**

**<game id="6">**

**<hometeam>FC Barcelona</hometeam>**

**<awayteam>Real Madrid</awayteam>**

**<result>**

**<homegoals>1</homegoals>**

**<awaygoals>0</awaygoals>**

**<homepossesion>52</homepossesion>**

**<awaypossesion>48</awaypossesion>**

**<homeshots>7</homeshots>**

**<awayshots>7</awayshots>**

**</result>**

**</game>**

**</games>**

**</league>**

**</season>**

**</seasons>**

**'**

**));**

**INSERT INTO Seasons\_Bin VALUES(XMLTYPE(**

**'<seasons>**

**<season year="2019">**

**<league country="England">**

**<games>**

**<game id="7">**

**<hometeam>Manchester United</hometeam>**

**<awayteam>Liverpool</awayteam>**

**<result>**

**<homegoals>1</homegoals>**

**<awaygoals>2</awaygoals>**

**<homepossesion>41</homepossesion>**

**<awaypossesion>59</awaypossesion>**

**<homeshots>3</homeshots>**

**<awayshots>9</awayshots>**

**</result>**

**</game>**

**<game id="8">**

**<hometeam>Liverpool</hometeam>**

**<awayteam>Manchester United</awayteam>**

**<result>**

**<homegoals>1</homegoals>**

**<awaygoals>1</awaygoals>**

**<homepossesion>65</homepossesion>**

**<awaypossesion>35</awaypossesion>**

**<homeshots>10</homeshots>**

**<awayshots>4</awayshots>**

**</result>**

**</game>**

**</games>**

**</league>**

**<league country="Italy">**

**<games>**

**<game id="9">**

**<hometeam>AC Milan</hometeam>**

**<awayteam>Juventus</awayteam>**

**<result>**

**<homegoals>1</homegoals>**

**<awaygoals>0</awaygoals>**

**<homepossesion>50</homepossesion>**

**<awaypossesion>50</awaypossesion>**

**<homeshots>5</homeshots>**

**<awayshots>9</awayshots>**

**</result>**

**</game>**

**<game id="10">**

**<hometeam>Juventus</hometeam>**

**<awayteam>AC Milan</awayteam>**

**<result>**

**<homegoals>0</homegoals>**

**<awaygoals>0</awaygoals>**

**<homepossesion>53</homepossesion>**

**<awaypossesion>47</awaypossesion>**

**<homeshots>6</homeshots>**

**<awayshots>6</awayshots>**

**</result>**

**</game>**

**</games>**

**</league>**

**<league country="Spain">**

**<games>**

**<game id="11">**

**<hometeam>Real Madrid</hometeam>**

**<awayteam>FC Barcelona</awayteam>**

**<result>**

**<homegoals>1</homegoals>**

**<awaygoals>1</awaygoals>**

**<homepossesion>41</homepossesion>**

**<awaypossesion>59</awaypossesion>**

**<homeshots>4</homeshots>**

**<awayshots>5</awayshots>**

**</result>**

**</game>**

**<game id="12">**

**<hometeam>FC Barcelona</hometeam>**

**<awayteam>Real Madrid</awayteam>**

**<result>**

**<homegoals>0</homegoals>**

**<awaygoals>2</awaygoals>**

**<homepossesion>63</homepossesion>**

**<awaypossesion>37</awaypossesion>**

**<homeshots>8</homeshots>**

**<awayshots>7</awayshots>**

**</result>**

**</game>**

**</games>**

**</league>**

**</season>**

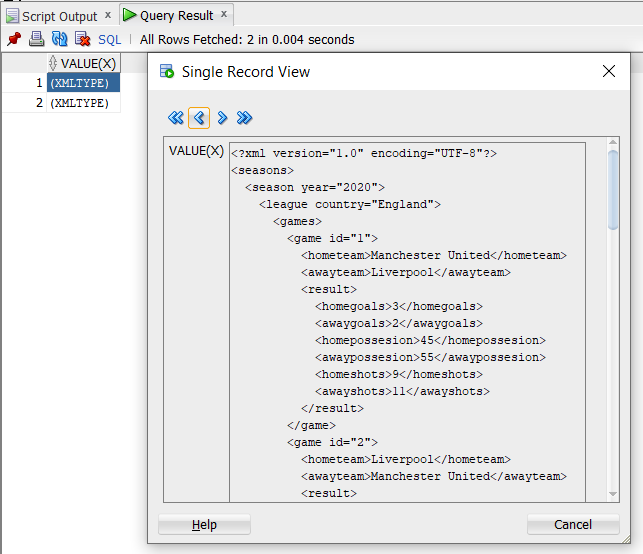
**</seasons>**

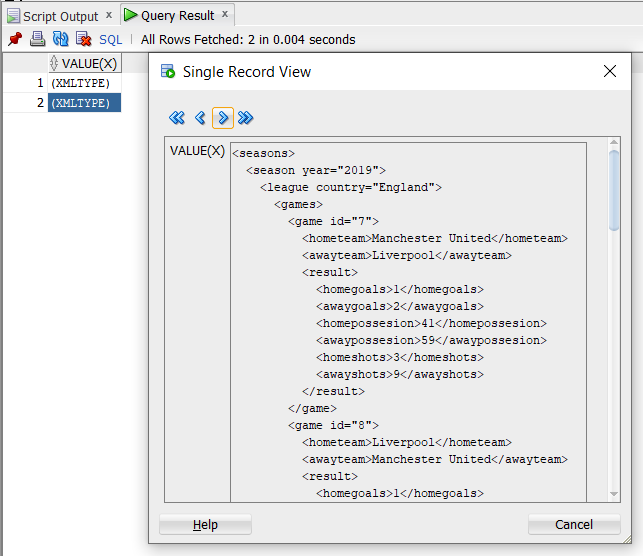
**'**

**));**

**SELECT VALUE(x)**

**FROM Seasons\_Bin x;**





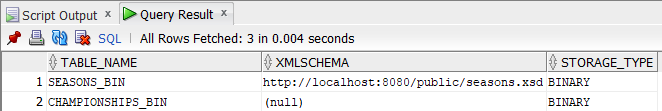
Lai pārbaudītu, vai izveidotās tabulas tieši tika izveidotās ar bināro glabāšanas tipu tika palaists sekojošais vaicājums.

**SELECT x.TABLE\_NAME, x.XMLSCHEMA, x.STORAGE\_TYPE**

**FROM USER\_XML\_TABLES x**

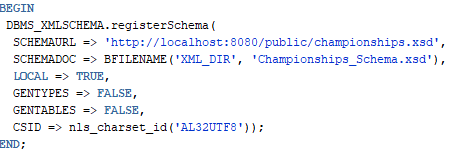
**ORDER BY x.TABLE\_NAME DESC;**

Kā arī un ir redzams, tabulu STORAGE\_TYPE ir binary, kā ari Seasons\_Bin tabulai ir norādīta XML shēma, bet tabulai Championships\_Bin – nav.



## **Strukturētais glabāšanas veids**

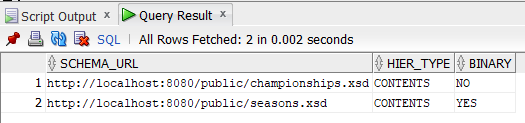
Tātad, tagad ir jādefinē shēma strukturētajam glabāšanas veidam. Būtībā, tas tika panākts izdzēšot OPTIONS parametru, kur bija specificēts glabāšanas tips.



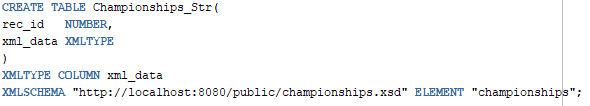
Lai apskatītu shēmas tipus tika izdarīts sekojošais vaicājums.

**SELECT SCHEMA\_URL, HIER\_TYPE, BINARY**

**FROM USER\_XML\_SCHEMAS;**



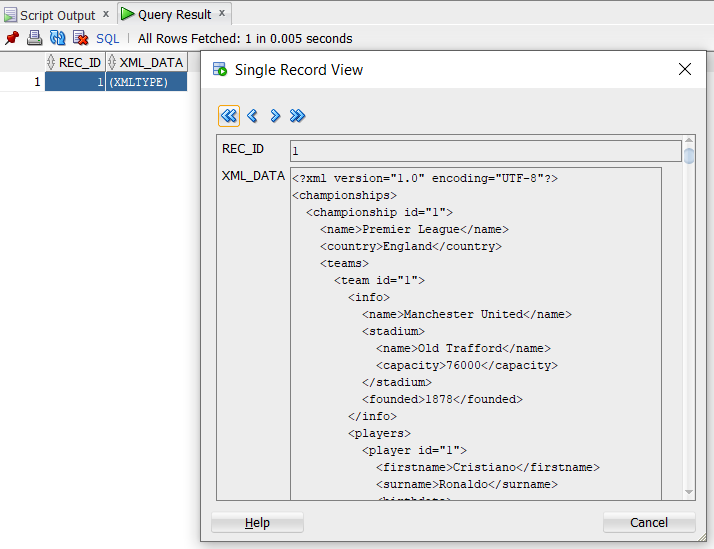
Tālāk, uz definētās shēmas pamata tika izveidota tabula ar XMLType tipa kolonu Championships\_Str. Līdzīgi Championships\_Bin tabulai dati tika ievietoti tieši no XML dokumenta.



**INSERT INTO Championships\_Str VALUES(1, XMLTYPE(BFILENAME('XML\_DIR', 'Championships.xml'),nls\_charset\_id('AL32UTF8')));**

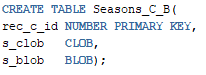
**SELECT x.\***

**FROM Championships\_Str x;**



## **Tabula ar lielo objektu kolonam**

Tālāk tika izveidota tabula Seasons\_C\_B ar CLOB un BLOB lieliem objektiem. CLOB ir Character Large Object, kas ir domāts lieliem tekstiem vai teksta dokumentiem, bet BLOB ir Binary Large Object kas ir piemērots multimediju datiem.

Tātad, tabulā dati tika ievietoti izmantojot SQL\*Loader palīdzību, līdzīgi ka tas arī bija pirmā darbā. Tika izveidoti command un data teksta faili. Command fails norada uz datu failu, kas satur tabulā ievadītus datus, norāda kurā tabulā tiks ievadīti dati un kolonu sadalīšanas simbols. Lai viss strādātu korekti, visiem izmantotiem failiem ir jābūt zem vienas direktorijas. Dati tiek ievietoti palaižot Command Prompt tajā mapē un norādot izmantoto lietotāju un command faila nosaukumu.

Command faila saturs:

**LOAD DATA**

**INFILE 'data.txt'**

**INTO TABLE Seasons\_C\_B TRUNCATE**

**fields terminated by "|"**

**(**

**rec\_c\_id,**

**xml\_file FILLER,**

**picture\_file FILLER,**

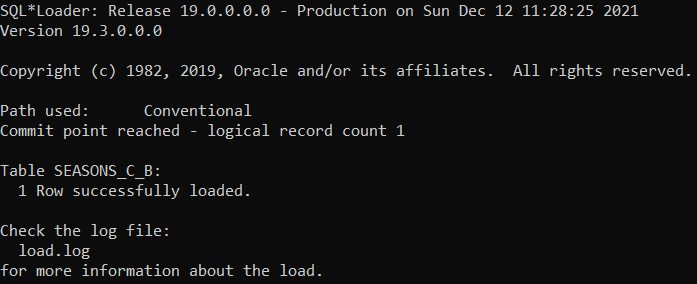
**s\_clob LOBFILE(xml\_file) TERMINATED BY EOF,**

**s\_blob LOBFILE(picture\_file) TERMINATED BY EOF**

**)**

Datu faila saturs:

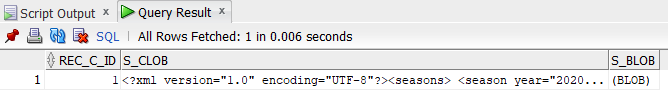
**1|Seasons.xml|ball.jpg**

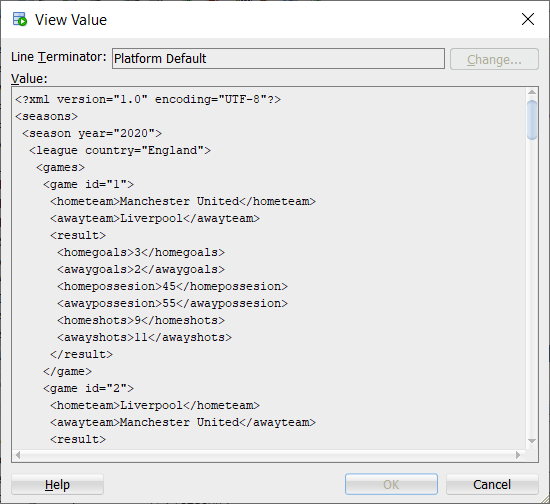


Izvadot informāciju ir redzams, ka kolona s\_clob iekšā tiešam satur Seasons.xml failu, bet s\_blob kolona BLOB objektu.

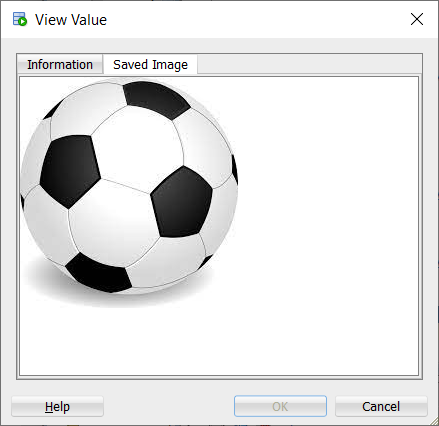
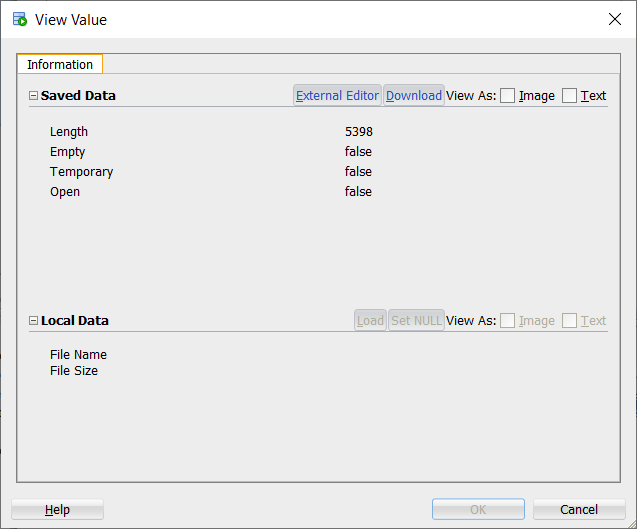
**SELECT a.\***

**FROM Seasons\_C\_B a;**





Atvērot rediģēšanas režīmu ir iespējams izvēlēties attēlošanas režīmu, savukārt pie View As izvēlējoties Image, ievietotu attēlu ir iespējams apskatīt datu bāzes sistēmā.

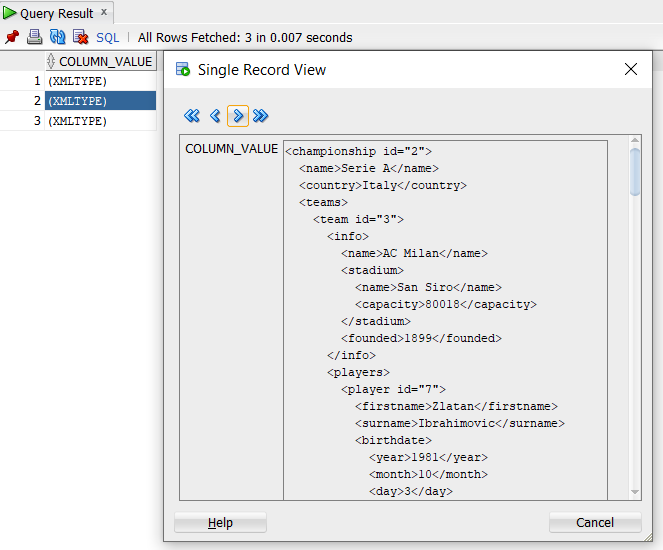


# **XMLTable vaicājumu izpilde**

Tātad, būtībā XMLTable funkcija jēdzīgi atbilst XPath izteiksmei. Noteicot ceļu pēc iezīmju nosaukumiem ir iespējams aplūkot objektus, kuri atrodas zem tā ceļa.

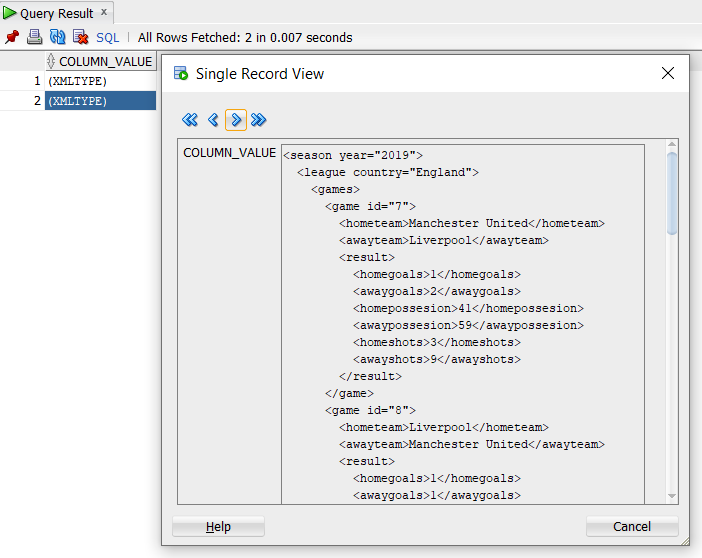
**SELECT c.COLUMN\_VALUE**

**FROM Championships\_Bin obj, XMLTable('/championships/\*' PASSING obj.OBJECT\_VALUE)c;**



**SELECT s.COLUMN\_VALUE**

**FROM Seasons\_Bin obj, XMLTable('/seasons/\*' PASSING obj.OBJECT\_VALUE)s;**



Ar XMLTable klauzulas COLUMNS palīdzību attiecīgi norādītājām ceļam ir iespējams sadalīt nosacītus datus un atspoguļot tos relāciju veidā. Sekojošajā vaicājumā tiek izvadīti visi spēlētāji no visām komandām.

**SELECT c.\***

**FROM Championships\_Bin, XMLTable('/championships/championship/teams/team/players/player'**

**PASSING OBJECT\_VALUE**

**COLUMNS Name VARCHAR2(50) PATH 'firstname',**

**Surname VARCHAR2(50) PATH 'surname',**

**Wage NUMBER PATH 'contract/wage',**

**Expires NUMBER PATH 'contract/expires') c;**



# **XMLQuery vaicājumu izpilde**

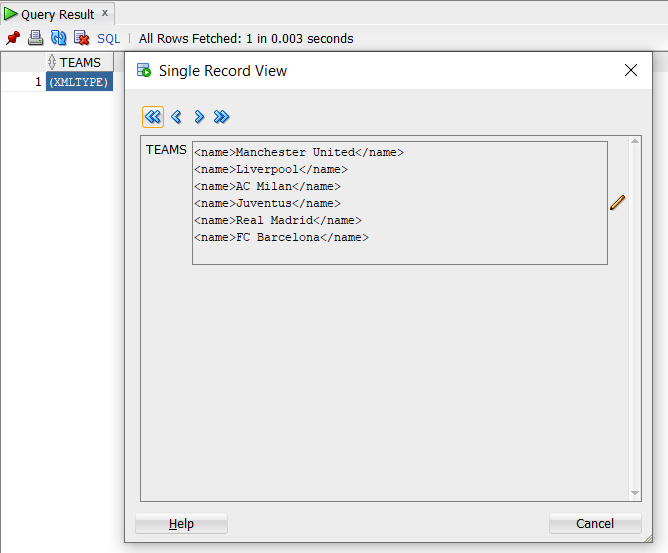
Ar XMLQuery funkcijas palīdzību tiešā veidā ir iespējāms izvilkt mezglus, kuri atbilst XPath izteiksmei.

Ar nākamo vaicājumu tika iegūti visi komandu nosaukumi.

**SELECT XMLQuery('/championships/championship/teams/team/info/name' PASSING OBJECT\_VALUE RETURNING CONTENT)**

**AS Teams**

**FROM Championships\_Bin;**



Izmantojot XQuery konstrukciju ar sekojošo vaicājumu tika iegūts spēlētāju uzvārds, norādot viņa vārdu.

**SELECT XMLQuery(**

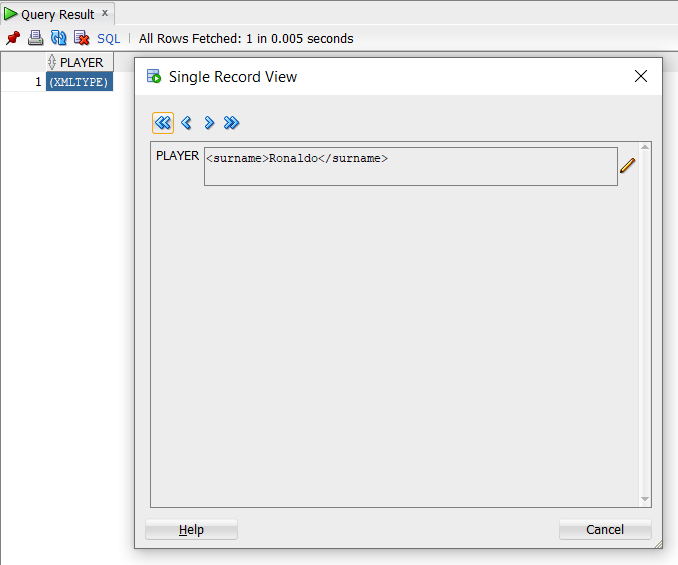
**'for $i in /championships/championship/teams/team/players/player**

**where $i/firstname = "Cristiano"**

**return $i/surname'**

**PASSING OBJECT\_VALUE RETURNING CONTENT) AS Player**

**FROM Championships\_Bin;**



Nākamais vaicājums izvada uzvārdus tiem spēlētājiem, kuriem atalgojums ir lielāks par 250000 un ņemot vērā, ka championship id atribūta vērtība ir 1, savukārt tas nozīmē, ka spēlētāji ir tika no pirmās līgās.

**SELECT XMLQuery(**

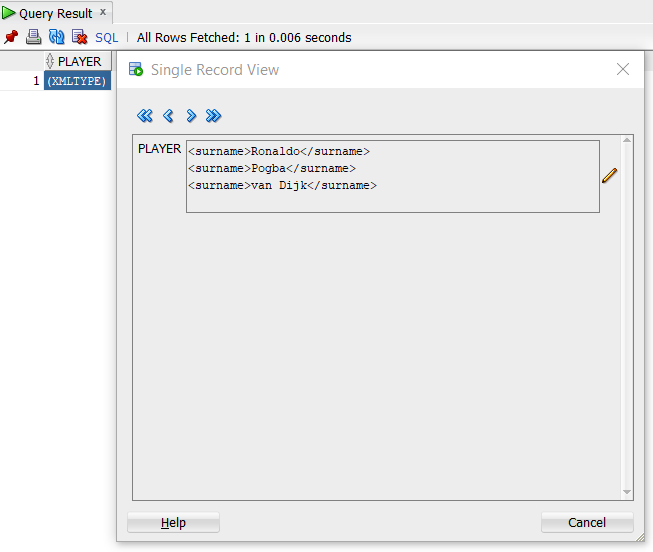
**'for $i in /championships/championship[@id="1"]/teams/team/players/player**

**where $i/contract/wage > "250000"**

**return $i/surname'**

**PASSING OBJECT\_VALUE RETURNING CONTENT) AS Player**

**FROM Championships\_Bin;**



Sekojošais vaicājums papildus iezīmē <shots> atgriež cik vārtu ir ieguvusi komanda Manchester United spēlējot mājās.

**SELECT XMLQuery(**

**'for $i in /seasons/season/league/games/game**

**where $i/hometeam = "Manchester United"**

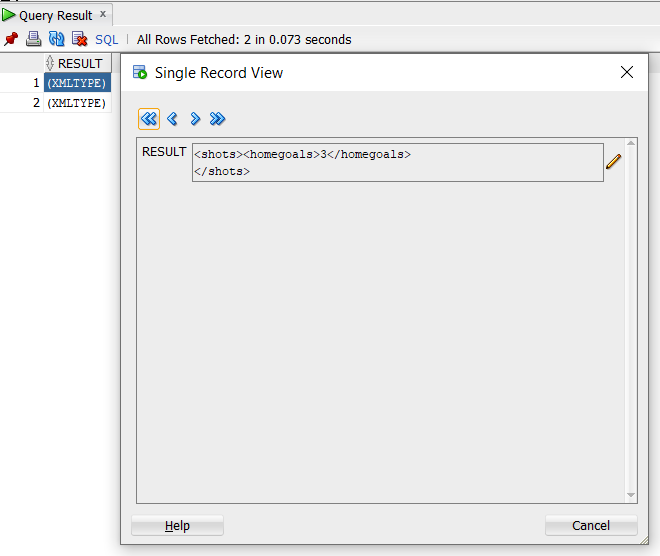
**return <shots>**

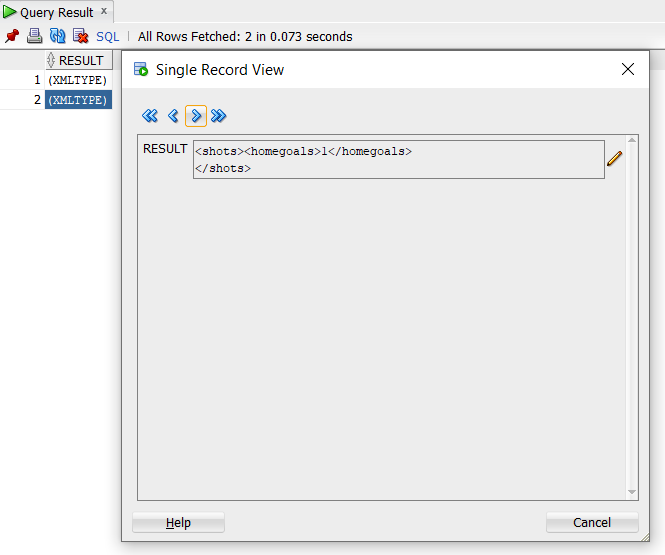
**{$i/result/homegoals}**

**</shots>'**

**PASSING OBJECT\_VALUE RETURNING CONTENT) Result**

**FROM Seasons\_Bin;**





# **XMLCast vaicājumu izpilde**

XMLCast tipa vaicājums būtībā palīdz iegūt “reālas” XMLQuery vaicājuma rezultātus, izvadot datus tieši izveidotājā kolonā. Nākamajos divos vaicājumos esmu pārtaisījis 2 vaicājumus no iepriekšējas nodaļās.

**SELECT XMLCast(XMLQuery(**

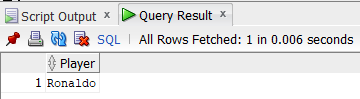
**'for $i in /championships/championship/teams/team/players/player**

**where $i/firstname = "Cristiano"**

**return $i/surname'**

**PASSING OBJECT\_VALUE RETURNING CONTENT) AS VARCHAR2(100))"Player"**

**FROM Championships\_Bin;**



**SELECT XMLCast(XMLQuery(**

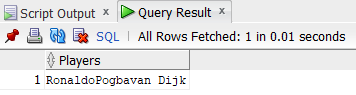
**'for $i in /championships/championship[@id="1"]/teams/team/players/player**

**where $i/contract/wage > "250000"**

**return $i/surname'**

**PASSING OBJECT\_VALUE RETURNING CONTENT)AS VARCHAR(100))"Players"**

**FROM Championships\_Bin;**

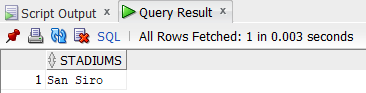


# **XML datu izvadīšana relāciju datu veidā**

Būtībā, ar extractValue funkcijas palīdzību ir iespējams iegūt un izvadīt datus relāciju veidā no XML struktūras. Sekojošais vaicājums izvada stadionu komandai ar atribūta id vērtību 3.

**SELECT extractValue(OBJECT\_VALUE, '/championships/championship/teams/team[@id="3"]/info/stadium/name') AS Stadiums**

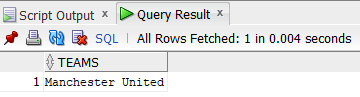
**FROM Championships\_Bin;**



Nākamais vaicājums atrod komandas nosaukumu, kura tika dibināta 1878. gadā.

**SELECT extractValue(OBJECT\_VALUE, '/championships/championship/teams/team/info[founded=1878]/name') AS Teams**

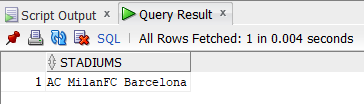
**FROM Championships\_Bin;**



Gadījumā, ja pēc definētiem ierobežojumiem rezultāta būs divas vai vairākās vērtības, tad tie tiks izvadīti secīgi vienā rindā.

**SELECT extractValue(OBJECT\_VALUE, '/championships/championship/teams/team/info[founded=1899]/name') AS Stadiums**

**FROM Championships\_Bin;**



# **Relāciju datu izvadīšana XML datu formātā**

Lai panāktu visu izdarīto iepriekšējā nodaļā, bet citā virzienā vispirms, lai iegūtu datus transformēšanai ir jāizveido relācijas tabulu un jāievada tā datus.

**CREATE TABLE Teams(**

**team\_name VARCHAR2(30),**

**player\_surname VARCHAR2(30),**

**manager\_surname VARCHAR2(30)**

**);**

**INSERT INTO Teams VALUES('Manchester United', 'Ronaldo', 'Rangnick');**

**INSERT INTO Teams VALUES('Liverpool', 'Salah', 'Klopp');**

**INSERT INTO Teams VALUES('AC Milan', 'Ibrahimovic', 'Pioli');**

**INSERT INTO Teams VALUES('Juventus', 'Locatelli', 'Allegri');**

SQL ir vairākās iebūvētas funkcijas, ar kuru palīdzību ir iespējams izveidot XML struktūru un pielīdzināt tabulas kolonu vērtības XML glabāšanas struktūrām. Ar funkcijas xmlElement() palīdzību tika definēts XML elements “team” no relāciju team\_name tabulas Teams kolonas. Tālāk, ar xmlAttributes() elementam ”team” tika definēt atribūts name, kurš arī un glabā komandas nosaukums. Pēc tām, ar xmlForest() funkcijas palīdzību tika definēti divi “bērnu” elementi “player” un manager, kuru satur informāciju no relācijas tabulas kolonam player\_surname un manager\_surmane attiecīgi.

**SELECT xmlElement("team",**

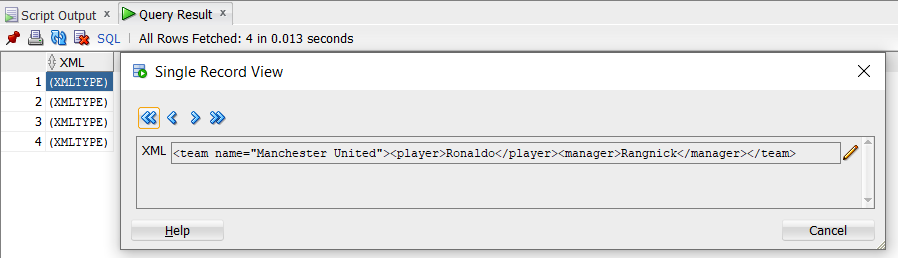
**xmlAttributes(t.team\_name AS "name"),**

**xmlForest(t.player\_surname AS "player"),**

**xmlForest(t.manager\_surname AS "manager")**

**).EXTRACT('/\*') AS XML**

**FROM Teams t;**



# **Secinājumi**

Analizējot sava darba gaitu un rezultātu, kopumā es varu teikt, ka izpildīt visus darba uzdevumus man veiksmīgi sanāca. Pirms darba uzsākšanas es biju zināju pamata lietas saistītās ar XML sintaksi un struktūru, bet savā prakse pielietot XML valodu kombinācijā ar datu bāzes sistēmu man pienācas pirmo reizi.

Pēc paveikta darba runājot par grūtībām un problēmam, vairāk tās bija saistītas ar XML vālodas īpašībam, kā piemērām definējot XMLQuery struktūras vaicājumus sākumā pielietoju FOR, WHERE klauzulas ar lielo burtu, kas rezultējā izpildes kļūdā, jo XML valoda ir “case-sensitive”. Tādās kļūdas ir diezgan grūti atrast, jo it kā viss ir kārtībā un visam ir jāstrādā, bet atrisināt tādās problēmas var tikai mācoties un detalizētāk analizējot konspektus. Runājot par apskatītiem glābāšanas veidiem tika apskatīti binārais veids ar shēmu un bez, kā arī strukturētais glābāšanas veids. Galvenā strukturēta glābāšanas veida priekšrocības ir ātrdarbība, bet binārājam glābāšanas veidam ir efektivitāte, jo piemērām ir iespējāms aprakstīt vairākās shēmas vienas tabulas ietvaros, un tātad ar tiem savstārpēji darboties. Par jaunumiem runājot, arī esmu apskatījis lielo objektu CLOB un BLOB darbības principu, arī ievietojot un atvērot bildi datu bāzēs sistēmā.

Butībā, darbs man aizņēma mazāk laika nekā iepriekšējais, bet dēļ tā, kā gadījās tāda situācija, ka aizkavējos ar iepriekšējo darbu, darboties un apskatit šo tematu es arī uzsāku vēlāk, par ko es arī atvainojos. Kopumā, izpildot šo darbu es noteikti esmu ieguvis jaunas prasmes, uz kuru pamatā man būs vieglāk arī darboties nākotnē.

# **Literatūra**

1. Prof. J. Eiduks. Lekciju konspekti priekšmetā “Pēcrelāciju datu bāzes sistēmas (DB2)”
2. <https://datubaze.wordpress.com/>
3. <https://docs.oracle.com/database/121/ADXDB/toc.htm>

# **Pielikumi**

## **Darba izmantotas datu bāzes SQL kods**

CREATE OR REPLACE DIRECTORY XML\_DIR AS 'C:\Users\testdb\Desktop\3. pr\XML';

------------------------Binara tabula bez shemas--------------------------------

CREATE TABLE Championships\_Bin OF XMLTYPE;

INSERT INTO Championships\_Bin VALUES(XMLTYPE(Bfilename('XML\_DIR', 'Championships.xml'),nls\_charset\_id('AL32UTF8')));

CREATE TABLE Seasons\_C\_B(

rec\_c\_id NUMBER PRIMARY KEY,

s\_clob CLOB,

s\_blob BLOB);

SELECT x.TABLE\_NAME, x.XMLSCHEMA, x.STORAGE\_TYPE

FROM USER\_XML\_TABLES x

ORDER BY x.TABLE\_NAME DESC;

SELECT x.TABLE\_NAME, x.XMLSCHEMA, x.STORAGE\_TYPE

FROM USER\_XML\_TABLES x;

SELECT a.\*

FROM Seasons\_C\_B a;

SELECT VALUE(x)

FROM Championships\_Bin x;

--------------------------------------------------------------------------------

------------------------Shemu definejums----------------------------------------

BEGIN

DBMS\_XMLSCHEMA.registerSchema(

SCHEMAURL => 'http://localhost:8080/public/championships.xsd',

SCHEMADOC => BFILENAME('XML\_DIR', 'Championships\_Schema.xsd'),

LOCAL => TRUE,

GENTYPES => FALSE,

GENTABLES => FALSE,

CSID => nls\_charset\_id('AL32UTF8'));

END;

BEGIN

DBMS\_XMLSCHEMA.registerSchema(

SCHEMAURL => 'http://localhost:8080/public/seasons.xsd',

SCHEMADOC => BFILENAME('XML\_DIR', 'Seasons\_Schema.xsd'),

LOCAL => TRUE,

GENTYPES => FALSE,

GENTABLES => FALSE,

CSID => nls\_charset\_id('AL32UTF8'),

OPTIONS => DBMS\_XMLSCHEMA.REGISTER\_BINARYXML);

END;

SELECT SCHEMA\_URL, HIER\_TYPE, BINARY

FROM USER\_XML\_SCHEMAS;

--------------------------------------------------------------------------------

------------------------Binara tabula ar shemu---------------------------------

CREATE TABLE Seasons\_Bin OF XMLTYPE

XMLTYPE STORE AS BINARY XML

ELEMENT "http://localhost:8080/public/seasons.xsd#seasons";

INSERT INTO Seasons\_Bin VALUES(XMLTYPE(

'<?xml version="1.0" encoding="UTF-8"?>

<seasons>

<season year="2020">

<league country="England">

<games>

<game id="1">

<hometeam>Manchester United</hometeam>

<awayteam>Liverpool</awayteam>

<result>

<homegoals>3</homegoals>

<awaygoals>2</awaygoals>

<homepossesion>45</homepossesion>

<awaypossesion>55</awaypossesion>

<homeshots>9</homeshots>

<awayshots>11</awayshots>

</result>

</game>

<game id="2">

<hometeam>Liverpool</hometeam>

<awayteam>Manchester United</awayteam>

<result>

<homegoals>0</homegoals>

<awaygoals>0</awaygoals>

<homepossesion>61</homepossesion>

<awaypossesion>39</awaypossesion>

<homeshots>8</homeshots>

<awayshots>4</awayshots>

</result>

</game>

</games>

</league>

<league country="Italy">

<games>

<game id="3">

<hometeam>AC Milan</hometeam>

<awayteam>Juventus</awayteam>

<result>

<homegoals>1</homegoals>

<awaygoals>1</awaygoals>

<homepossesion>48</homepossesion>

<awaypossesion>52</awaypossesion>

<homeshots>2</homeshots>

<awayshots>9</awayshots>

</result>

</game>

<game id="4">

<hometeam>Juventus</hometeam>

<awayteam>AC Milan</awayteam>

<result>

<homegoals>2</homegoals>

<awaygoals>0</awaygoals>

<homepossesion>45</homepossesion>

<awaypossesion>55</awaypossesion>

<homeshots>7</homeshots>

<awayshots>3</awayshots>

</result>

</game>

</games>

</league>

<league country="Spain">

<games>

<game id="5">

<hometeam>Real Madrid</hometeam>

<awayteam>FC Barcelona</awayteam>

<result>

<homegoals>3</homegoals>

<awaygoals>1</awaygoals>

<homepossesion>60</homepossesion>

<awaypossesion>40</awaypossesion>

<homeshots>8</homeshots>

<awayshots>5</awayshots>

</result>

</game>

<game id="6">

<hometeam>FC Barcelona</hometeam>

<awayteam>Real Madrid</awayteam>

<result>

<homegoals>1</homegoals>

<awaygoals>0</awaygoals>

<homepossesion>52</homepossesion>

<awaypossesion>48</awaypossesion>

<homeshots>7</homeshots>

<awayshots>7</awayshots>

</result>

</game>

</games>

</league>

</season>

</seasons>

'

));

INSERT INTO Seasons\_Bin VALUES(XMLTYPE(

'<seasons>

<season year="2019">

<league country="England">

<games>

<game id="7">

<hometeam>Manchester United</hometeam>

<awayteam>Liverpool</awayteam>

<result>

<homegoals>1</homegoals>

<awaygoals>2</awaygoals>

<homepossesion>41</homepossesion>

<awaypossesion>59</awaypossesion>

<homeshots>3</homeshots>

<awayshots>9</awayshots>

</result>

</game>

<game id="8">

<hometeam>Liverpool</hometeam>

<awayteam>Manchester United</awayteam>

<result>

<homegoals>1</homegoals>

<awaygoals>1</awaygoals>

<homepossesion>65</homepossesion>

<awaypossesion>35</awaypossesion>

<homeshots>10</homeshots>

<awayshots>4</awayshots>

</result>

</game>

</games>

</league>

<league country="Italy">

<games>

<game id="9">

<hometeam>AC Milan</hometeam>

<awayteam>Juventus</awayteam>

<result>

<homegoals>1</homegoals>

<awaygoals>0</awaygoals>

<homepossesion>50</homepossesion>

<awaypossesion>50</awaypossesion>

<homeshots>5</homeshots>

<awayshots>9</awayshots>

</result>

</game>

<game id="10">

<hometeam>Juventus</hometeam>

<awayteam>AC Milan</awayteam>

<result>

<homegoals>0</homegoals>

<awaygoals>0</awaygoals>

<homepossesion>53</homepossesion>

<awaypossesion>47</awaypossesion>

<homeshots>6</homeshots>

<awayshots>6</awayshots>

</result>

</game>

</games>

</league>

<league country="Spain">

<games>

<game id="11">

<hometeam>Real Madrid</hometeam>

<awayteam>FC Barcelona</awayteam>

<result>

<homegoals>1</homegoals>

<awaygoals>1</awaygoals>

<homepossesion>41</homepossesion>

<awaypossesion>59</awaypossesion>

<homeshots>4</homeshots>

<awayshots>5</awayshots>

</result>

</game>

<game id="12">

<hometeam>FC Barcelona</hometeam>

<awayteam>Real Madrid</awayteam>

<result>

<homegoals>0</homegoals>

<awaygoals>2</awaygoals>

<homepossesion>63</homepossesion>

<awaypossesion>37</awaypossesion>

<homeshots>8</homeshots>

<awayshots>7</awayshots>

</result>

</game>

</games>

</league>

</season>

</seasons>

'

));

SELECT x.TABLE\_NAME, x.XMLSCHEMA, x.STORAGE\_TYPE

FROM USER\_XML\_TABLES x;

SELECT VALUE(x)

FROM Seasons\_Bin x;

--------------------------------------------------------------------------------

------------------------Struktureta tabula--------------------------------------

CREATE TABLE Championships\_Str(

rec\_id NUMBER,

xml\_data XMLTYPE

)

XMLTYPE COLUMN xml\_data

XMLSCHEMA "http://localhost:8080/public/championships.xsd" ELEMENT "championships";

INSERT INTO Championships\_Str VALUES(1, XMLTYPE(BFILENAME('XML\_DIR', 'Championships.xml'),nls\_charset\_id('AL32UTF8')));

SELECT x.\*

FROM Championships\_Str x;

--------------------------------------------------------------------------------

SELECT c.COLUMN\_VALUE

FROM Championships\_Bin obj, XMLTable('/championships/\*' PASSING obj.OBJECT\_VALUE)c;

SELECT s.COLUMN\_VALUE

FROM Seasons\_Bin obj, XMLTable('/seasons/\*' PASSING obj.OBJECT\_VALUE)s;

SELECT c.\*

FROM Championships\_Bin, XMLTable('/championships/championship/teams/team/players/player'

PASSING OBJECT\_VALUE

COLUMNS Name VARCHAR2(50) PATH 'firstname',

Surname VARCHAR2(50) PATH 'surname',

Wage NUMBER PATH 'contract/wage',

Expires NUMBER PATH 'contract/expires')c;

--------------------------------------------------------------------------------

SELECT XMLQuery('/championships/championship/teams/team/info/name' PASSING OBJECT\_VALUE RETURNING CONTENT)

AS Teams

FROM Championships\_Bin;

SELECT XMLQuery(

'for $i in /championships/championship/teams/team/players/player

where $i/firstname = "Cristiano"

return $i/surname'

PASSING OBJECT\_VALUE RETURNING CONTENT) AS Player

FROM Championships\_Bin;

SELECT XMLQuery(

'for $i in /seasons/season/league/games/game

where $i/hometeam = "Manchester United"

return <shots>

{$i/result/homegoals}

</shots>'

PASSING OBJECT\_VALUE RETURNING CONTENT) Result

FROM Seasons\_Bin;

SELECT XMLQuery(

'for $i in /championships/championship[@id="1"]/teams/team/players/player

where $i/contract/wage > "250000"

return $i/surname'

PASSING OBJECT\_VALUE RETURNING CONTENT) AS Player

FROM Championships\_Bin;

--------------------------------------------------------------------------------

SELECT XMLCast(XMLQuery(

'for $i in /championships/championship/teams/team/players/player

where $i/firstname = "Cristiano"

return $i/surname'

PASSING OBJECT\_VALUE RETURNING CONTENT) AS VARCHAR2(100))"Player"

FROM Championships\_Bin;

SELECT XMLCast(XMLQuery(

'for $i in /championships/championship[@id="1"]/teams/team/players/player

where $i/contract/wage > "250000"

return $i/surname'

PASSING OBJECT\_VALUE RETURNING CONTENT)AS VARCHAR(100))"Players"

FROM Championships\_Bin;

--------------------------------------------------------------------------------

SELECT extractValue(OBJECT\_VALUE, '/championships/championship/teams/team[@id="3"]/info/stadium/name') AS Stadiums

FROM Championships\_Bin;

SELECT extractValue(OBJECT\_VALUE, '/championships/championship/teams/team/info[founded=1878]/name') AS Teams

FROM Championships\_Bin;

SELECT extractValue(OBJECT\_VALUE, '/championships/championship/teams/team/info[founded=1899]/name') AS Stadiums

FROM Championships\_Bin;

SELECT Home\_Team, Home\_Goals, Away\_Goals, Away\_Team

FROM

(SELECT extractValue(OBJECT\_VALUE, '/seasons/season/league/games/game[@id="1"]/hometeam') AS Home\_Team

FROM Seasons\_Bin),

(SELECT extractValue(OBJECT\_VALUE, '/seasons/season/league/games/game[@id="1"]/result/homegoals') AS Home\_Goals

FROM Seasons\_Bin),

(SELECT extractValue(OBJECT\_VALUE, '/seasons/season/league/games/game[@id="1"]/awayteam') AS Away\_Team

FROM Seasons\_Bin),

(SELECT extractValue(OBJECT\_VALUE, '/seasons/season/league/games/game[@id="1"]/result/awaygoals') AS Away\_Goals

FROM Seasons\_Bin);

--------------------------------------------------------------------------------

CREATE TABLE Teams(

team\_name VARCHAR2(30),

player\_surname VARCHAR2(30),

manager\_surname VARCHAR2(30)

);

INSERT INTO Teams VALUES('Manchester United', 'Ronaldo', 'Rangnick');

INSERT INTO Teams VALUES('Liverpool', 'Salah', 'Klopp');

INSERT INTO Teams VALUES('AC Milan', 'Ibrahimovic', 'Pioli');

INSERT INTO Teams VALUES('Juventus', 'Locatelli', 'Allegri');

SELECT xmlElement("team",

xmlAttributes(t.team\_name AS "name"),

xmlForest(t.player\_surname AS "player"),

xmlForest(t.manager\_surname AS "manager")

).EXTRACT('/\*') AS XML

FROM Teams t;

## **SQL\*Loader data file**

1|Seasons.xml|ball.jpg

## **SQL\*Loader command file**

INFILE 'data.txt'

INTO TABLE Seasons\_C\_B TRUNCATE

fields terminated by "|"

(

rec\_c\_id,

xml\_file FILLER,

picture\_file FILLER,

s\_clob LOBFILE(xml\_file) TERMINATED BY EOF,

s\_blob LOBFILE(picture\_file) TERMINATED BY EOF

)

## **XML fails Championships**

<?xml version="1.0" encoding="UTF-8"?>

<championships>

<championship id="1">

<name>Premier League</name>

<country>England</country>

<teams>

<team id="1">

<info>

<name>Manchester United</name>

<stadium>

<name>Old Trafford</name>

<capacity>76000</capacity>

</stadium>

<founded>1878</founded>

</info>

<players>

<player id="1">

<firstname>Cristiano</firstname>

<surname>Ronaldo</surname>

<birthdate>

<year>1985</year>

<month>2</month>

<day>5</day>

</birthdate>

<nationality>Portugese</nationality>

<position>Forward</position>

<contract>

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<expires>2023</expires>

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</player>

<player id="2">

<firstname>Paul</firstname>

<surname>Pogba</surname>

<birthdate>

<year>1993</year>

<month>3</month>

<day>15</day>

</birthdate>

<nationality>French</nationality>

<position>Midfielder</position>

<contract>

<wage>340000</wage>

<expires>2022</expires>

</contract>

</player>

<player id="3">

<firstname>Bruno</firstname>

<surname>Fernandes</surname>

<birthdate>

<year>1994</year>

<month>9</month>

<day>8</day>

</birthdate>

<nationality>Portugese</nationality>

<position>Midfielder</position>

<contract>

<wage>210000</wage>

<expires>2025</expires>

</contract>

</player>

</players>

<manager>

<firstname>Ralf</firstname>

<surname>Rangnick</surname>

<birthdate>

<year>1958</year>

<month>6</month>

<day>26</day>

</birthdate>

<nationality>German</nationality>

<contract>

<wage>200000</wage>

<expires>2022</expires>

</contract>

</manager>

</team>

<team id="2">

<info>

<name>Liverpool</name>

<stadium>

<name>Anfield</name>

<capacity>53394</capacity>

</stadium>

<founded>1892</founded>

</info>

<players>

<player id="4">

<firstname>Virgil</firstname>

<surname>van Dijk</surname>

<birthdate>

<year>1991</year>

<month>7</month>

<day>8</day>

</birthdate>

<nationality>Dutch</nationality>

<position>Defender</position>

<contract>

<wage>260000</wage>

<expires>2025</expires>

</contract>

</player>

<player id="5">

<firstname>Mohamed</firstname>

<surname>Salah</surname>

<birthdate>

<year>1992</year>

<month>6</month>

<day>15</day>

</birthdate>

<nationality>Egyptian</nationality>

<position>Forward</position>

<contract>

<wage>235000</wage>

<expires>2023</expires>

</contract>

</player>

<player id="6">

<firstname>Allison</firstname>

<surname>Becker</surname>

<birthdate>

<year>1992</year>

<month>10</month>

<day>2</day>

</birthdate>

<nationality>Brazilian</nationality>

<position>Goalkeeper</position>

<contract>

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<expires>2027</expires>

</contract>

</player>

</players>

<manager>

<firstname>Jurgen</firstname>

<surname>Klopp</surname>

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<year>1967</year>

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<name>Serie A</name>

<country>Italy</country>

<teams>

<team id="3">

<info>

<name>AC Milan</name>

<stadium>

<name>San Siro</name>

<capacity>80018</capacity>

</stadium>

<founded>1899</founded>

</info>

<players>

<player id="7">

<firstname>Zlatan</firstname>

<surname>Ibrahimovic</surname>

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<position>Forward</position>

<contract>

<wage>205000</wage>

<expires>2022</expires>

</contract>

</player>

<player id="8">

<firstname>Olivier</firstname>

<surname>Giroud</surname>

<birthdate>

<year>1986</year>

<month>9</month>

<day>30</day>

</birthdate>

<nationality>French</nationality>

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<firstname>Fikayo</firstname>

<surname>Tomori</surname>

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<year>1997</year>

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<position>Defender</position>

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<firstname>Stefano</firstname>

<surname>Pioli</surname>

<birthdate>

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<nationality>Italian</nationality>

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<name>Allianz Stadium</name>

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<surname>Szczesny</surname>

<birthdate>

<year>1990</year>

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<day>18</day>

</birthdate>

<nationality>Polish</nationality>

<position>Goalkeeper</position>

<contract>

<wage>232000</wage>

<expires>2024</expires>

</contract>

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<player id="11">

<firstname>Leonardo</firstname>

<surname>Bonucci</surname>

<birthdate>

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</birthdate>

<nationality>Italian</nationality>

<position>Defender</position>

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<firstname>Manuel</firstname>

<surname>Locatelli</surname>

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</birthdate>

<nationality>Italian</nationality>

<position>Midfielder</position>

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<manager>

<firstname>Massimiliano</firstname>

<surname>Allegri</surname>

<birthdate>

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<nationality>Italian</nationality>

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<expires>2025</expires>

</contract>

</manager>

</team>

</teams>

</championship>

<championship id="3">

<name>La Liga</name>

<country>Spain</country>

<teams>

<team id="5">

<info>

<name>Real Madrid</name>

<stadium>

<name>Estadio Santiago Bernabeu</name>

<capacity>81044</capacity>

</stadium>

<founded>1902</founded>

</info>

<players>

<player id="13">

<firstname>Karim</firstname>

<surname>Benzema</surname>

<birthdate>

<year>1987</year>

<month>8</month>

<day>19</day>

</birthdate>

<nationality>French</nationality>

<position>Forward</position>

<contract>

<wage>320000</wage>

<expires>2023</expires>

</contract>

</player>

<player id="14">

<firstname>Vinicius</firstname>

<surname>Jr</surname>

<birthdate>

<year>2000</year>

<month>7</month>

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</birthdate>

<nationality>Brazilian</nationality>

<position>Forward</position>

<contract>

<wage>215000</wage>

<expires>2025</expires>

</contract>

</player>

<player id="15">

<firstname>Luka</firstname>

<surname>Modric</surname>

<birthdate>

<year>1985</year>

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</birthdate>

<nationality>Croatian</nationality>

<position>Midfielder</position>

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</contract>

</player>

</players>

<manager>

<firstname>Carlo</firstname>

<surname>Anchelotti</surname>

<birthdate>

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</birthdate>

<nationality>Italian</nationality>

<contract>

<wage>200000</wage>

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</contract>

</manager>

</team>

<team id="6">

<info>

<name>FC Barcelona</name>

<stadium>

<name>Camp Nou</name>

<capacity>99354</capacity>

</stadium>

<founded>1899</founded>

</info>

<players>

<player id="16">

<firstname>Gerard</firstname>

<surname>Pique</surname>

<birthdate>

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</birthdate>

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<player id="17">

<firstname>Marc-Andre</firstname>

<surname>ter Stegen</surname>

<birthdate>

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</birthdate>

<nationality>German</nationality>

<position>Goalkeeper</position>

<contract>

<wage>165000</wage>

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</contract>

</player>

<player id="18">

<firstname>Frenkie</firstname>

<surname>de Jong</surname>

<birthdate>

<year>1997</year>

<month>5</month>

<day>12</day>

</birthdate>

<nationality>Dutch</nationality>

<position>Midfielder</position>

<contract>

<wage>415000</wage>

<expires>2024</expires>

</contract>

</player>

</players>

<manager>

<firstname>Xavi</firstname>

<surname>Hernandez</surname>

<birthdate>

<year>1980</year>

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</birthdate>

<nationality>Spanish</nationality>

<contract>

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<expires>2024</expires>

</contract>

</manager>

</team>

</teams>

</championship>

</championships>

## **XML faila Championships atbilstoša shēma**

<?xml version="1.0" encoding="UTF-8"?>

<!-- W3C Schema generated by XMLSpy v2022 (x64) (http://www.altova.com) -->

<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">

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<xs:enumeration value="Fikayo"/>

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<xs:enumeration value="Gerard"/>

<xs:enumeration value="Jurgen"/>

<xs:enumeration value="Karim"/>

<xs:enumeration value="Leonardo"/>

<xs:enumeration value="Luka"/>

<xs:enumeration value="Manuel"/>

<xs:enumeration value="Marc-Andre"/>

<xs:enumeration value="Massimiliano"/>

<xs:enumeration value="Mohamed"/>

<xs:enumeration value="Olivier"/>

<xs:enumeration value="Paul"/>

<xs:enumeration value="Ralf"/>

<xs:enumeration value="Stefano"/>

<xs:enumeration value="Vinicius"/>

<xs:enumeration value="Virgil"/>

<xs:enumeration value="Wojciech"/>

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<xs:enumeration value="Zlatan"/>

</xs:restriction>

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<xs:enumeration value="Estadio Santiago Bernabeu"/>

<xs:enumeration value="FC Barcelona"/>

<xs:enumeration value="Juventus"/>

<xs:enumeration value="La Liga"/>

<xs:enumeration value="Liverpool"/>

<xs:enumeration value="Manchester United"/>

<xs:enumeration value="Old Trafford"/>

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<xs:restriction base="xs:string">

<xs:enumeration value="Defender"/>

<xs:enumeration value="Forward"/>

<xs:enumeration value="Goalkeeper"/>

<xs:enumeration value="Midfielder"/>

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<xs:enumeration value="Klopp"/>

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<xs:enumeration value="Modric"/>

<xs:enumeration value="Pioli"/>

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<xs:enumeration value="Szczesny"/>

<xs:enumeration value="Tomori"/>

<xs:enumeration value="de Jong"/>

<xs:enumeration value="ter Stegen"/>

<xs:enumeration value="van Dijk"/>

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</xs:element>

<xs:element name="team">

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<xs:element ref="info"/>

<xs:element ref="players"/>

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</xs:schema>

## **XML fails Seasons**

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<seasons>

<season year="2020">

<league country="England">

<games>

<game id="1">

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<awayteam>Liverpool</awayteam>

<result>

<homegoals>3</homegoals>

<awaygoals>2</awaygoals>

<homepossesion>45</homepossesion>

<awaypossesion>55</awaypossesion>

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</games>

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<awayteam>Juventus</awayteam>

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</league>

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<game id="5">

<hometeam>Real Madrid</hometeam>

<awayteam>FC Barcelona</awayteam>

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<hometeam>FC Barcelona</hometeam>

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</game>

</games>

</league>

</season>

<season year="2019">

<league country="England">

<games>

<game id="7">

<hometeam>Manchester United</hometeam>

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</game>

<game id="8">

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</game>

</games>

</league>

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<hometeam>AC Milan</hometeam>

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</result>

</game>

</games>

</league>

</season>

</seasons>

## **XML faila Seasons atbilstoša shēma**

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</xs:element>

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