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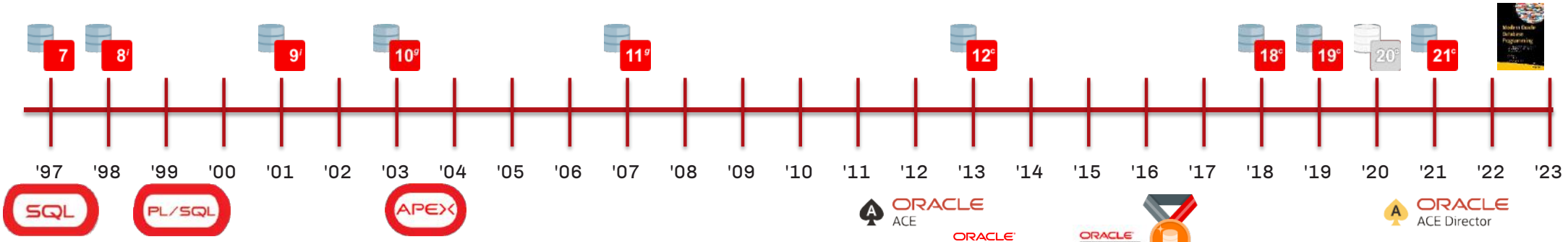
http://blog.bar-solutions.com

About me...



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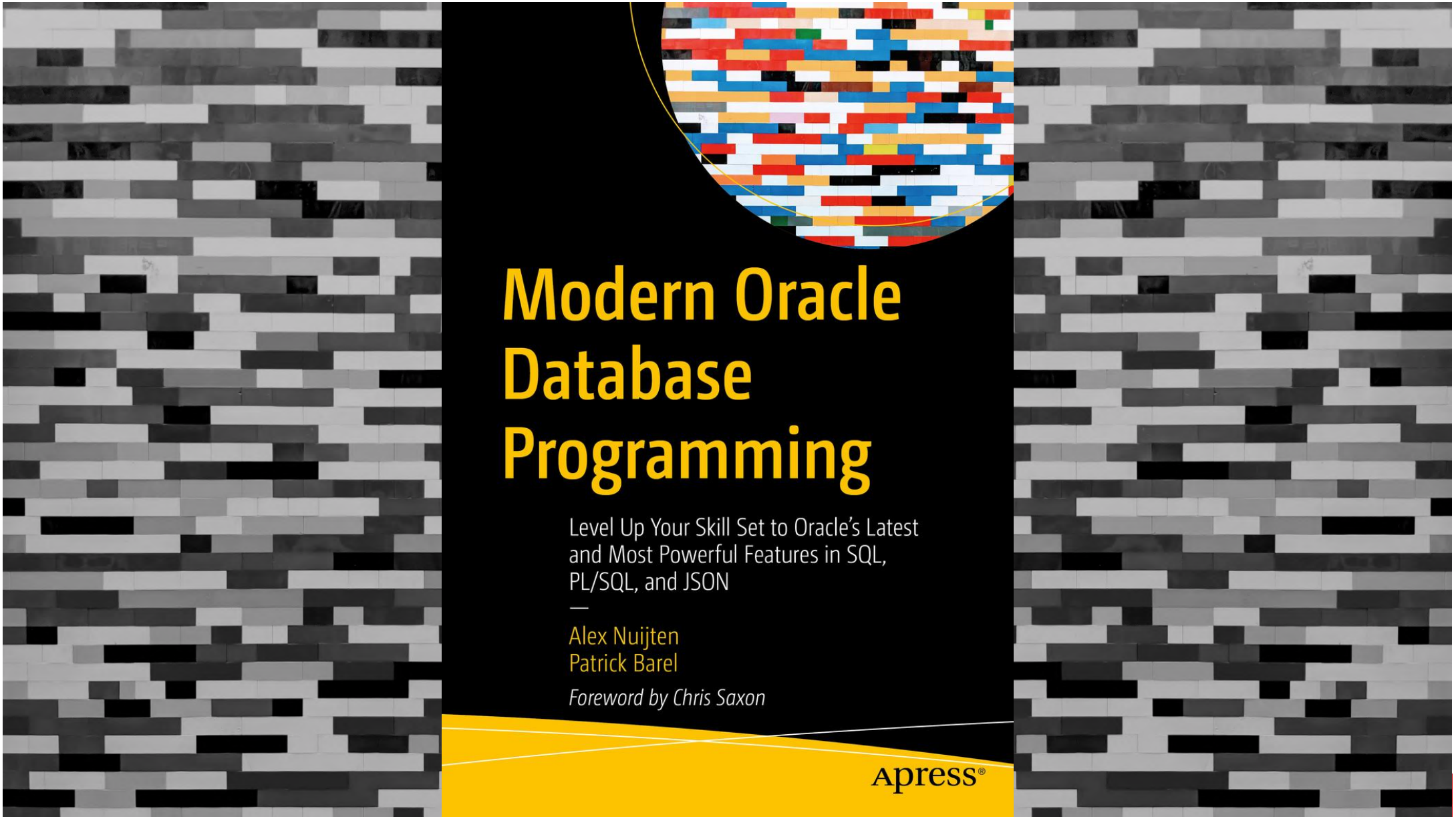
Modern Oracle Database Programming
Level Up Your Skill Set to Oracle's Latest and Most Powerful Features in SQL, PL/SQL, and JSON
Alex Nuijten
Patrick Barel
Foreword by Chris Saxon
Apress®

Contact me...

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Patrick Barel

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Sharing of reliable knowledge
Supporting the various user groups and individuals

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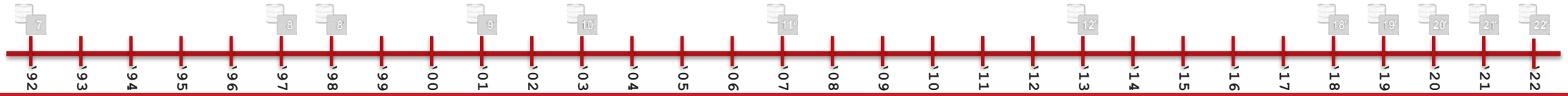
A collection's a collection
No matter how small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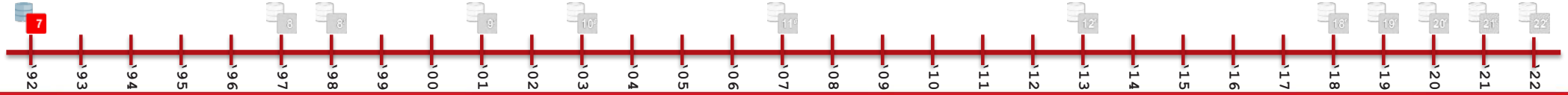
Oracle 7


PL/
SQL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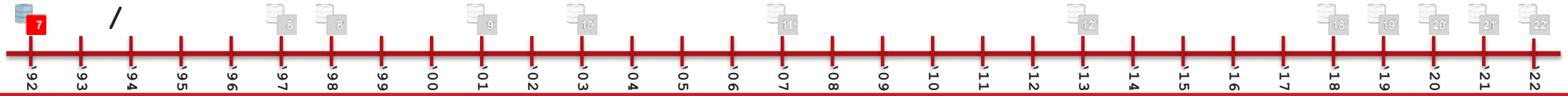
Oracle 7

```
declare
   type    names_pt is table of varchar2(30) index by binary_integer;
   l_names names_pt;
   l_indx  binary_integer;
begin
   -- fill up the collection
   l_names(1)                    := 'Hooly';
   l_names(42)                   := 'Heddy';
   l_names(10)                   := 'Hilder';
   l_names(l_names.count + 1)    := 'Holy';
   l_names(-1)                   := 'Haley';
   -- display the contents of the collection
   l_indx := l_names.first;
   while l_indx is not null loop
     dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
     l_indx := l_names.next(l_indx);
   end loop;
end;
/
```



Oracle 7

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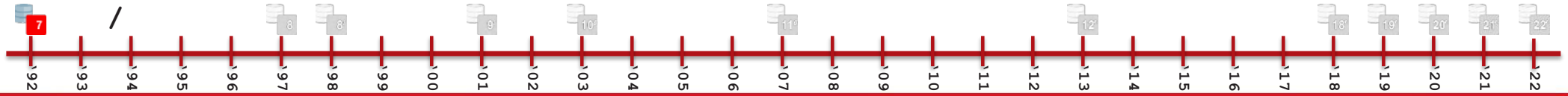
  end loop;
end;
/
```



Oracle 7

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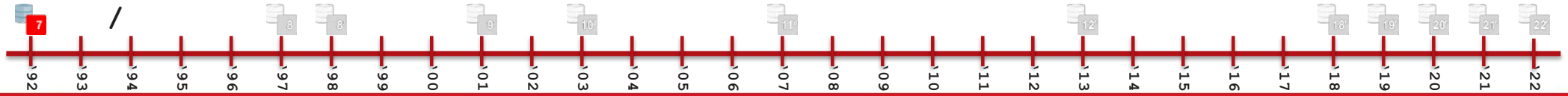
    l_indx := l_names.next(l_indx);
  end loop;
end;
/
```

1	Hooly



Oracle 7

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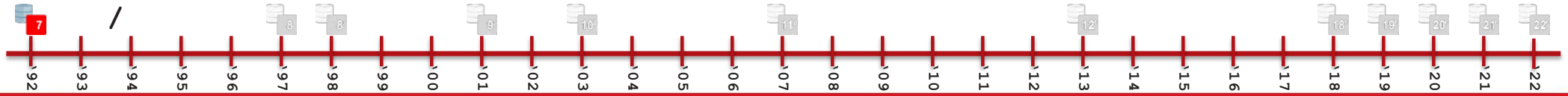
  end loop;
end;
/
```

1	Hooly

42	Heddy



Oracle 7

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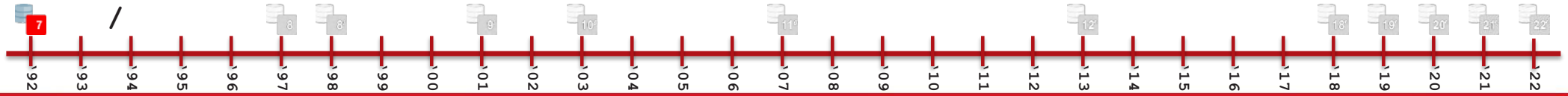
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
end;
/
```

10	Hilder

1	Hooly
42	Heddy



Oracle 7

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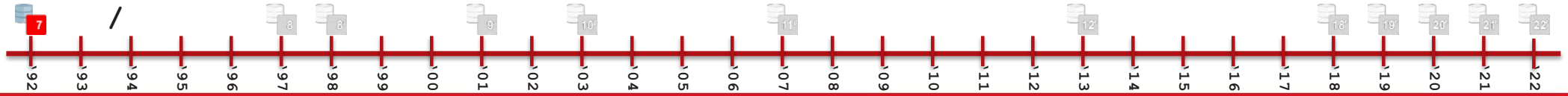
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
end;
/
```

4	Holy

1	Hooly
10	Hilder
42	Heddy



Oracle 7

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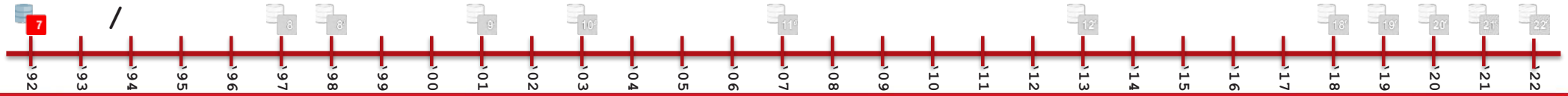
  while l_indx is not null loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
end;
/
```

-1	Haley

1	Hooly
4	Holy
10	Hilder
42	Heddy



Oracle 7

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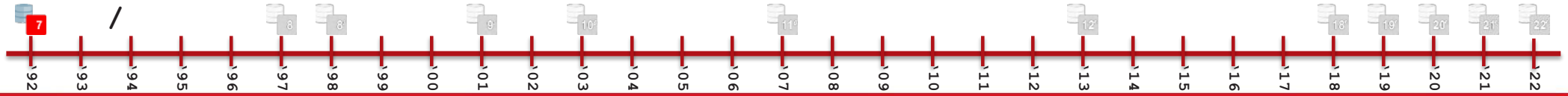
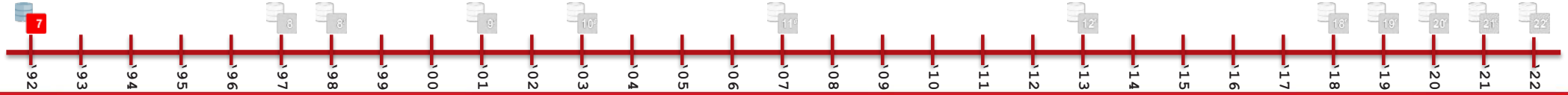
    l_indx := l_names.next(l_indx);
  end loop;
end;
/
```

-1	Haley
1	Hooly
4	Holy
10	Hilder
42	Heddy



Oracle 7


C:\ORANT\BIN\PLUS33.exe
SQL*Plus: Release 3.3.2.0.2 - Production on Fri Jan 31 08:57:05 2020
Copyright (c) Oracle Corporation 1979, 1994. All rights reserved.
Connected to:
Oracle7 Workgroup Server Release 7.3.2.2.1 - Production Release
PL/SQL Release 2.3.2.2.0 - Production
SQL>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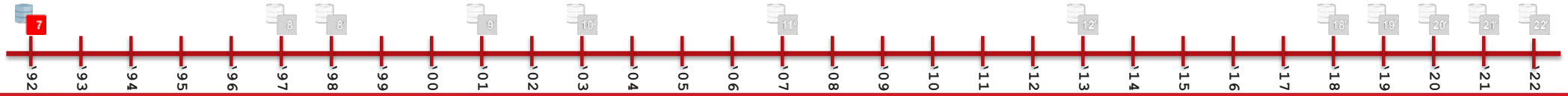
Oracle 7

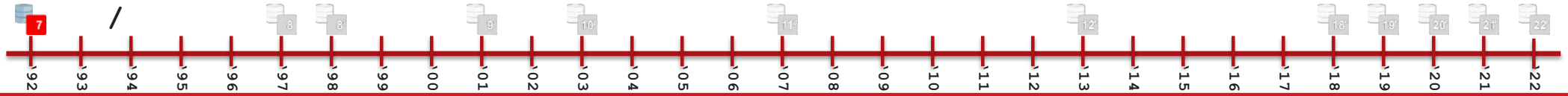
```
prompt create the RelationTypes table
create table RelationTypes(
  Type number(2)
, Name varchar2(16)
)
/
prompt create the NedMcDodd table
create table NedMcDodd(
  ID        number(4)
, Firstname varchar2(32)
, Lastname  varchar2(32)
, Type      number(2)
)
/
```



```
prompt add the Relation Types to the table
begin
 insert into RelationTypes(Type, Name) values (10, 'Relative');
 insert into RelationTypes(Type, Name) values (12, 'Wife');
 insert into RelationTypes(Type, Name) values (15, 'Son');
 insert into RelationTypes(Type, Name) values (18, 'Daughter');
 insert into RelationTypes(Type, Name) values (20, 'Friend');
 insert into RelationTypes(Type, Name) values (30, 'Enemy');
 commit;
end;
/
prompt add the characters to the NedMcDodd table
begin
 -- Relative
 insert into NedMcDodd(ID, Firstname, Lastname, Type) values (1010, 'Sally', 'O''Malley', 12);
 insert into NedMcDodd(ID, Firstname, Lastname, Type) values (1020, 'JoJo', 'McDodd', 15);
 insert into NedMcDodd(ID, Firstname, Lastname, Type) values (1030, 'Hooly', 'McDodd', 18);
 insert into NedMcDodd(ID, Firstname, Lastname, Type) values (1040, 'Hedy', 'McDodd', 18);
 insert into NedMcDodd(ID, Firstname, Lastname, Type) values (1050, 'Helen', 'McDodd', 18);
 insert into NedMcDodd(ID, Firstname, Lastname, Type) values (1060, 'Heather', 'McDodd', 18);
 insert into NedMcDodd(ID, Firstname, Lastname, Type) values (1070, 'Hildy', 'McDodd', 18);
```

Oracle 7

```
declare
  cursor c_names is
    select n.firstname from NedMcDodd n where n.type = 18;
  type    names_pt is table of varchar2(30) index by binary_integer;
  l_names names_pt;
begin
  -- fill up the collection by selecting from the table
  open c_names;
  loop
    fetch c_names into l_names(l_names.count + 1);
    exit when c_names%notfound;
  end loop;
  close c_names;
  -- display the contents of the collection
  for l_indx in l_names.first .. l_names.last loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```



Oracle 7

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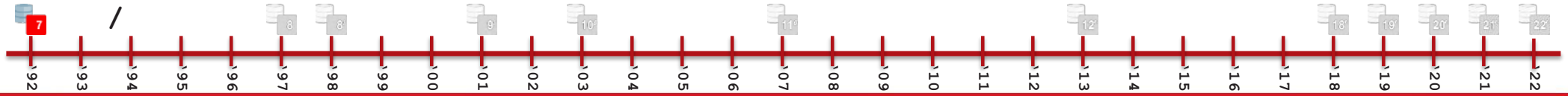
  -- display the contents of the collection
  for l_indx in l_names.first .. l_names.last loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```



Oracle 7

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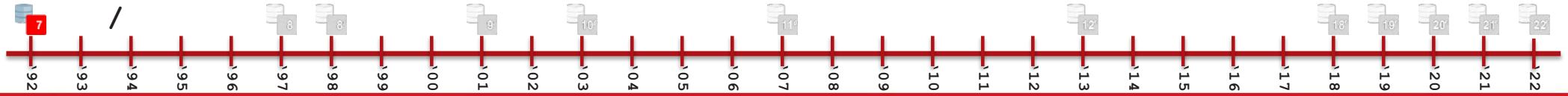
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```

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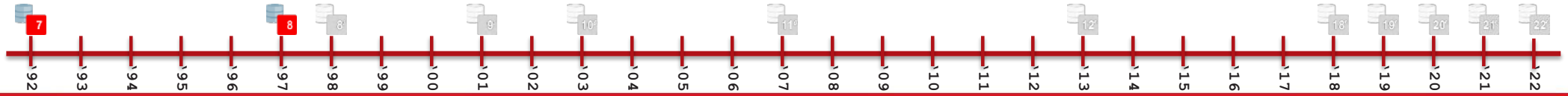
Oracle 8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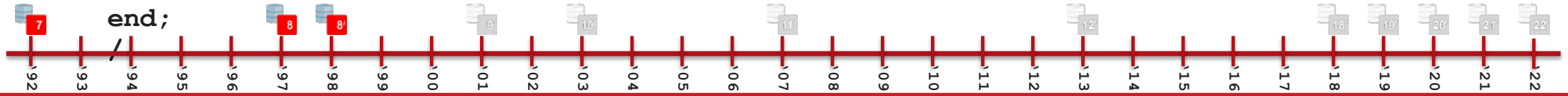
Oracle 8*i*

```
declare
   type    names_nt is table of varchar2(30);
   l_names names_nt;
begin
   -- initialize the collection
   l_names := names_nt();
   -- extend the collection
   l_names.extend(5); -- make room for 5 items right away
   -- fill up the collection
   l_names(1) := 'Haley';
   l_names(5) := 'Heddy';
   l_names(4) := 'Hilder';
   l_names(2) := 'Hooly';
   l_names(3) := 'Holy';
   -- display the contents of the collection
   for l_indx in l_names.first .. l_names.last loop
     dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
   end loop;
end;
/
```



Oracle 8*i*

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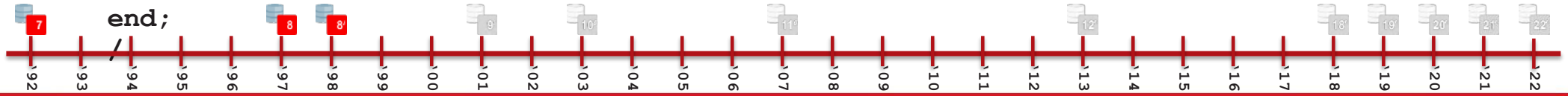
     dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
   end loop;
end;
/
```



Oracle 8*i*

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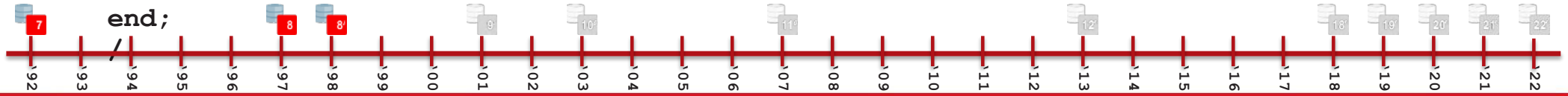
  for l_indx in l_names.first .. l_names.last loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```

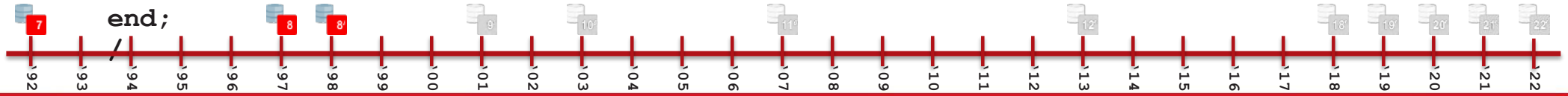
1	
2	
3	
4	
5	



Oracle 8*i*

```
declare
  type    names_nt is table of varchar2(30);
  l_names names_nt;
begin
  -- initialize the collection
  l_names := names_nt();
  -- extend the collection
  l_names.extend(5); -- make room for 5 items right away
  -- fill up the collection
  l_names(1) := 'Haley';
  l_names(5) := 'Heddy';
  l_names(4) := 'Hilder';
  l_names(2) := 'Hooly';
  l_names(3) := 'Holy';
  -- display the contents of the collection
  for l_indx in l_names.first .. l_names.last loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```

1	Haley
2	
3	
4	
5	



Oracle 8*i*

```
declare
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  l_names.extend(5); -- make room for 5 items right away
  -- fill up the collection
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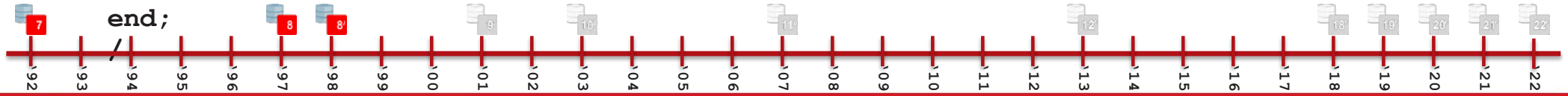
  l_names(5) := 'Heddy';
  l_names(4) := 'Hilder';
  l_names(2) := 'Hooly';
  l_names(3) := 'Holy';
  -- display the contents of the collection
  for l_indx in l_names.first .. l_names.last loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```

1	Haley
2	
3	
4	
5	Heddy



Oracle 8*i*

```
declare
  type    names_nt is table of varchar2(30);
  l_names names_nt;
begin
  -- initialize the collection
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  -- extend the collection
  l_names.extend(5); -- make room for 5 items right away
  -- fill up the collection
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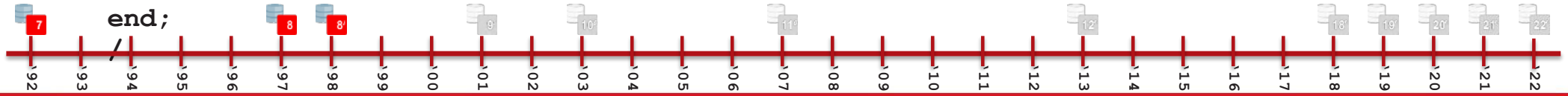
  l_names(5) := 'Heddy';
  l_names(4) := 'Hilder';
  l_names(2) := 'Hooly';
  l_names(3) := 'Holy';
  -- display the contents of the collection
  for l_indx in l_names.first .. l_names.last loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```

1	Haley
2	
3	
4	Hilder
5	Heddy



Oracle 8*i*

```
declare
  type    names_nt is table of varchar2(30);
  l_names names_nt;
begin
  -- initialize the collection
  l_names := names_nt();
  -- extend the collection
  l_names.extend(5); -- make room for 5 items right away
  -- fill up the collection
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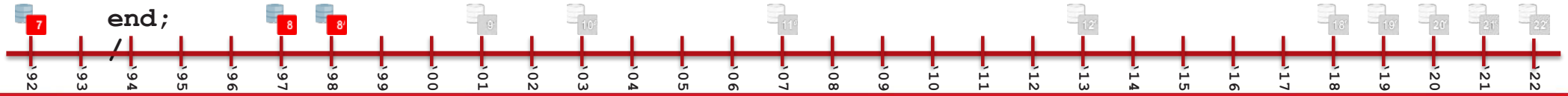
  l_names(5) := 'Heddy';
  l_names(4) := 'Hilder';
  l_names(2) := 'Hooly';
  l_names(3) := 'Holy';
  -- display the contents of the collection
  for l_indx in l_names.first .. l_names.last loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```

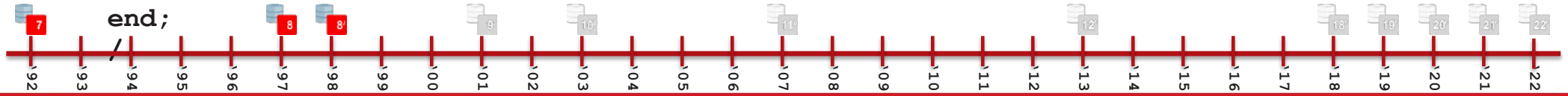
1	Haley
2	Hooly
3	
4	Hilder
5	Heddy



Oracle 8*i*

```
declare
  type    names_nt is table of varchar2(30);
  l_names names_nt;
begin
  -- initialize the collection
  l_names := names_nt();
  -- extend the collection
  l_names.extend(5); -- make room for 5 items right away
  -- fill up the collection
  l_names(1) := 'Haley';
  l_names(5) := 'Heddy';
  l_names(4) := 'Hilder';
  l_names(2) := 'Hooly';
  l_names(3) := 'Holy';
  -- display the contents of the collection
  for l_indx in l_names.first .. l_names.last loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```

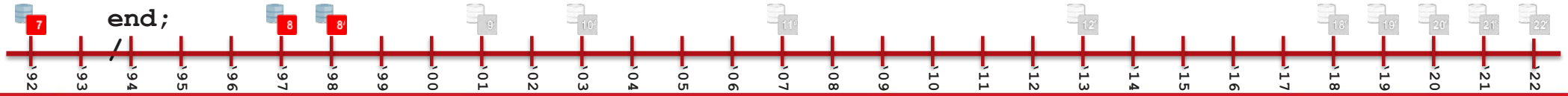
1	Haley
2	Hooly
3	Holy
4	Hilder
5	Heddy



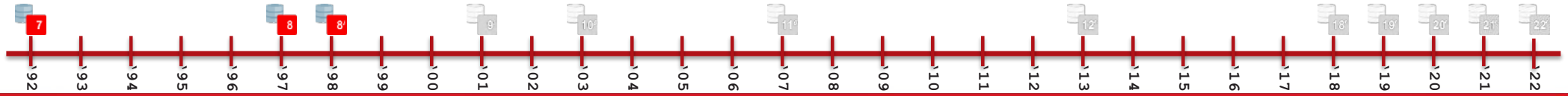
Oracle 8*i*

```
declare
  type    names_nt is table of varchar2(30);
  l_names names_nt;
begin
  -- initialize the collection
  l_names := names_nt();
  -- extend the collection
  l_names.extend(5); -- make room for 5 items right away
  -- fill up the collection
  l_names(1) := 'Haley';
  l_names(5) := 'Heddy';
  l_names(4) := 'Hilder';
  l_names(2) := 'Hooly';
  l_names(3) := 'Holy';
  -- display the contents of the collection
  for l_indx in l_names.first .. l_names.last loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```

1	Haley
2	Hooly
3	Holy
4	Hilder
5	Heddy

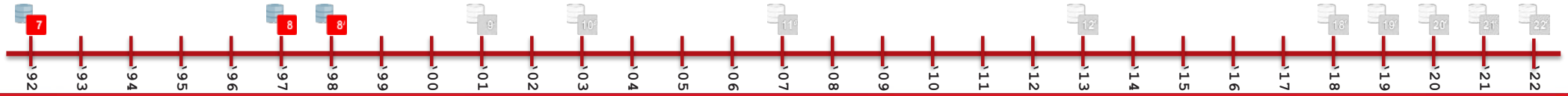


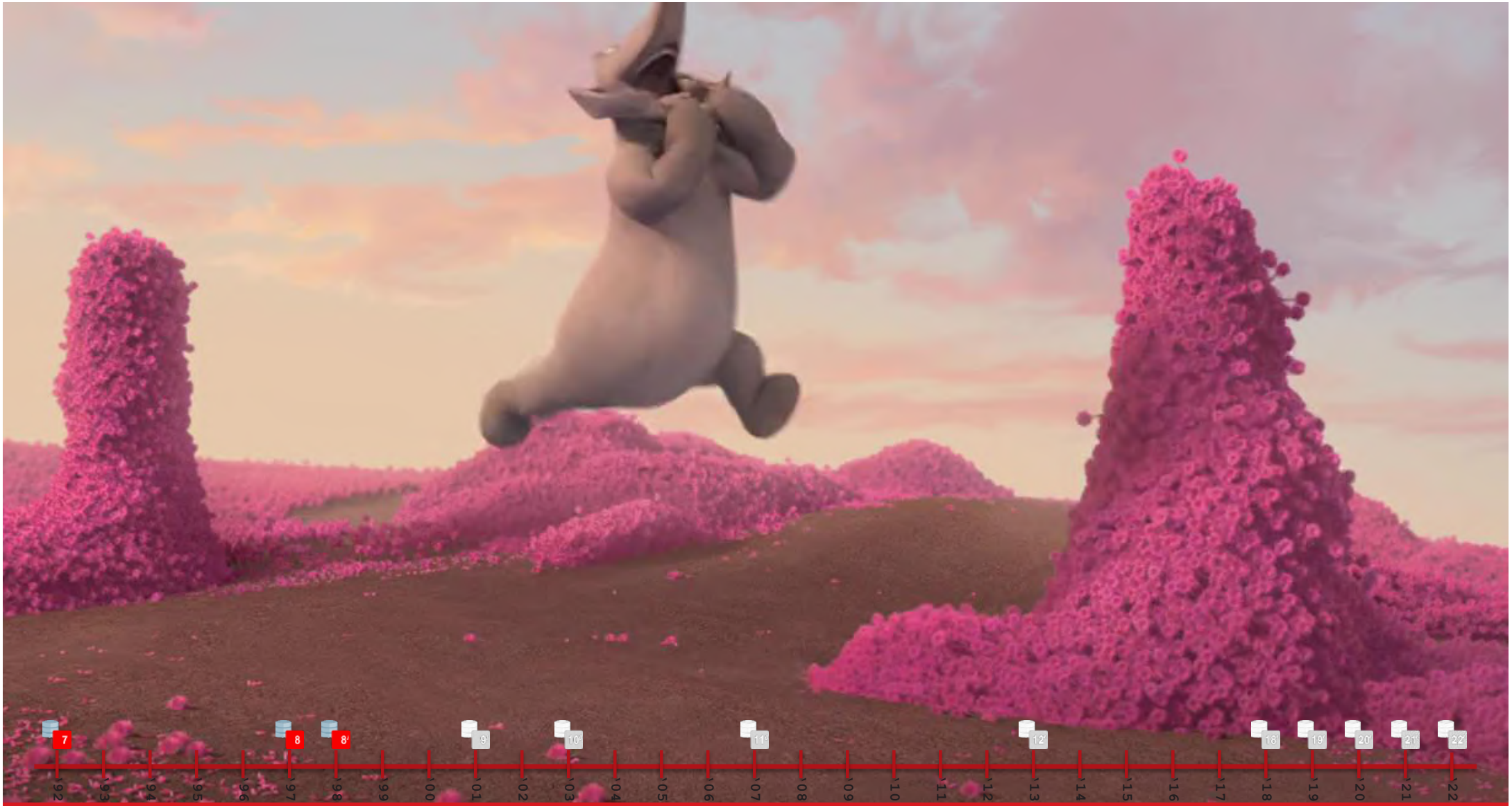
```
declare
  cursor c_names is
    select n.firstname from NedMcDodd n where n.type = 18;
  type    names_ibi is table of varchar2(30) index by binary_integer;
  l_names names_ibi;
begin
  -- fill up the collection by selecting from the table
  open c_names;
  fetch c_names bulk collect into l_names;
  close c_names;
  -- display the contents of the collection
  for l_indx in l_names.first .. l_names.last loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```



```
declare
  cursor c_names is
    select n.firstname from NedMcDodd n where n.type = 18;
  type    names_ibi is table of varchar2(30) index by binary_integer;
  l_names names_ibi;
begin
  -- fill up the collection by selecting from the table
  open c_names;
  fetch c_names bulk collect into l_names;
  close c_names;
  -- display the contents of the collection
  for l_indx in 1 .. l_names.count loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
  end loop;
end;
/
```

Densely filled, starting at 1




7
8
8'
9
10
11
12
18
19
20
21
22
92
93
94
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96
97
98
99
00
01
02
03
04
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06
07
08
09
10
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12
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15
16
17
18
19
20
21
22

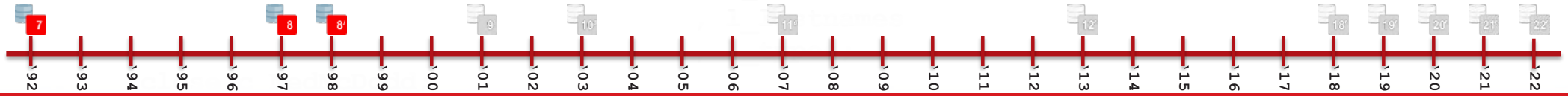
```
declare
  c_limit constant number := 4;
  cursor c_names is select n.firstname from NedMcDodd n where n.type = 18;
  type names_ibi is table of varchar2(30) index by binary_integer;
  l_names names_ibi;
begin
  open c_names;
  loop
    fetch c_names bulk collect into l_names limit c_limit;
    if l_names.count > 0 then -- display the contents of the collection
      for l_indx in l_names.first .. l_names.last loop
        dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
      end loop;
    end if;
    exit when l_names.count < c_limit;
  end loop;
  close c_names;
end;
/
```

Oracle 8*i*

```
declare
   type id_ibi         is table of NedMcDodd.id%type         index by binary_integer;
   type firstname_ibi  is table of NedMcDodd.firstname%type  index by binary_integer;
   type lastname_ibi   is table of NedMcDodd.lastname%type   index by binary_integer;
   type type_ibi       is table of NedMcDodd.type%type       index by binary_integer;

   cursor c_NedMcDodd is
   select n.id, n.firstname, n.lastname, n.type
     from NedMcDodd n where n.type in (12, 15, 18);

   l_ids         id_ibi;
   l_firstnames  firstname_ibi;
   l_lastnames   lastname_ibi;
   l_types       type_ibi;
begin
   open c_NedMcDodd;
   fetch c_NedMcDodd bulk collect into l_ids
                                     , l_firstnames
```

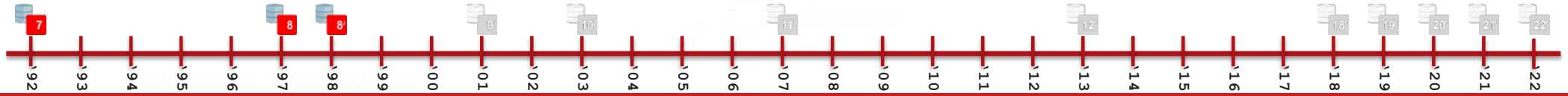


Oracle 8*i*

```
declare
  type id_ibi        is table of NedMcDodd.id%type        index by binary_integer;
  type firstname_ibi is table of NedMcDodd.firstname%type index by binary_integer;
  type lastname_ibi  is table of NedMcDodd.lastname%type  index by binary_integer;
  type type_ibi      is table of NedMcDodd.type%type      index by binary_integer;

  cursor c_NedMcDodd is
  select n.id, n.firstname, n.lastname, n.type
    from NedMcDodd n where n.type in (12, 15, 18);

  l_ids        id_ibi;
  l_firstnames firstname_ibi;
  l_lastnames  lastname_ibi;
  l_types      type_ibi;
begin
  open c_NedMcDodd;
  fetch c_NedMcDodd bulk collect into l_ids
                                    , l_firstnames
```

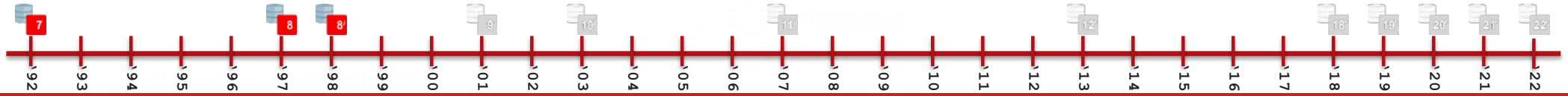


Oracle 8*i*

```
declare
  type id_ibi         is table of NedMcDodd.id%type         index by binary_integer;
  type firstname_ibi  is table of NedMcDodd.firstname%type  index by binary_integer;
  type lastname_ibi   is table of NedMcDodd.lastname%type   index by binary_integer;
  type type_ibi       is table of NedMcDodd.type%type       index by binary_integer;

  cursor c_NedMcDodd is
  select n.id, n.firstname, n.lastname, n.type
    from NedMcDodd n where n.type in (12, 15, 18);

  l_ids         id_ibi;
  l_firstnames  firstname_ibi;
  l_lastnames   lastname_ibi;
  l_types       type_ibi;
begin
  open c_NedMcDodd;
  fetch c_NedMcDodd bulk collect into l_ids
                                    , l_firstnames
```

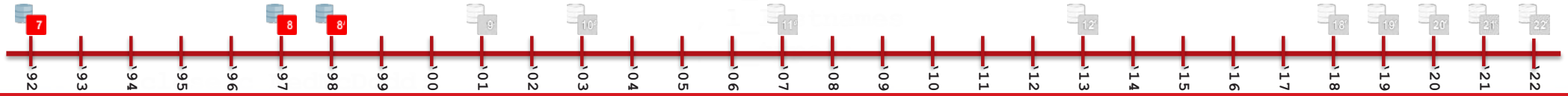


Oracle 8*i*

```
declare
  type id_ibi         is table of NedMcDodd.id%type         index by binary_integer;
  type firstname_ibi  is table of NedMcDodd.firstname%type  index by binary_integer;
  type lastname_ibi   is table of NedMcDodd.lastname%type   index by binary_integer;
  type type_ibi       is table of NedMcDodd.type%type       index by binary_integer;

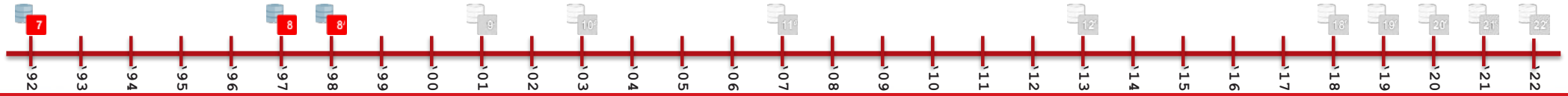
  cursor c_NedMcDodd is
  select n.id, n.firstname, n.lastname, n.type
    from NedMcDodd n where n.type in (12, 15, 18);

  l_ids         id_ibi;
  l_firstnames  firstname_ibi;
  l_lastnames   lastname_ibi;
  l_types       type_ibi;
begin
  open c_NedMcDodd;
  fetch c_NedMcDodd bulk collect into l_ids
                                    , l_firstnames
```



Oracle 8*i*

```
  l_ids         id_ibi;
  l_firstnames firstname_ibi;
  l_lastnames   lastname_ibi;
  l_types       type_ibi;
begin
  open c_NedMcDodd;
  fetch c_NedMcDodd bulk collect into l_ids
                                    , l_firstnames
                                    , l_lastnames
                                    , l_types;
  close c_NedMcDodd;
  dbms_output.put_line('Number of relatives :'||l_ids.count);
  for indx in l_ids.first .. l_ids.last loop
    dbms_output.put_line('Relative('||l_ids(indx)||') : '||l_firstnames(indx));
  end loop;
end;
/
```



Oracle 8*i*

```
create or replace type Names_NT as table of varchar2(32)
/

create or replace package McDodd as
  function Daughters return Names_nt;
  function Relatives(type_in in number) return Names_nt;
end;
/

create or replace package body McDodd as
  function Daughters return Names_nt
  is
    l_Daughters Names_NT;
  begin
    l_Daughters := Names_NT();
    l_Daughters.extend(2);
    l_Daughters(1) := 'Hooly';
    l_Daughters(2) := 'Holy';
```

Oracle 8*i*

```
create or replace type Names_NT as table of varchar2(32)
/

create or replace package McDodd as
  function Daughters return Names_nt;
  function Relatives(type_in in number) return Names_nt;
end;
/

create or replace package body McDodd as
  function Daughters return Names_nt
  is
    l_Daughters Names_NT;
  begin
    l_Daughters := Names_NT();
    l_Daughters.extend(2);
    l_Daughters(1) := 'Hooly';
    l_Daughters(2) := 'Holy';
```

Oracle 8*i*

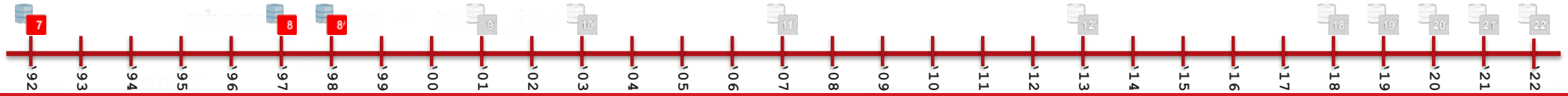
```
create or replace type Names_NT as table of varchar2(32)
/

create or replace package McDodd as
  function Daughters return Names_nt;
  function Relatives(type_in in number) return Names_nt;
end;
/

create or replace package body McDodd as
  function Daughters return Names_nt
  is
    l_Daughters Names_NT;
  begin
    l_Daughters := Names_NT();
    l_Daughters.extend(2);
    l_Daughters(1) := 'Hooly';
    l_Daughters(2) := 'Holy';
```

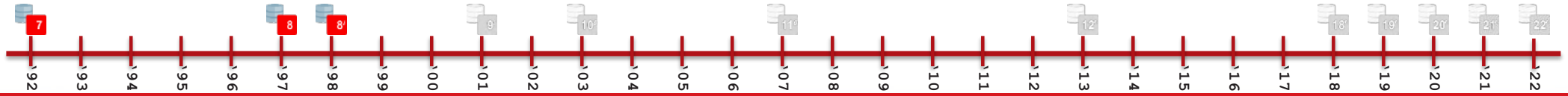
Oracle 8*i*

```
create or replace package body McDodd as
  function Daughters return Names_nt
  is
    l_Daughters Names_NT;
  begin
    l_Daughters := Names_NT();
    l_Daughters.extend(2);
    l_Daughters(1) := 'Hooly';
    l_Daughters(2) := 'Holy';
    return l_Daughters;
  end;
  function Relatives(type_in in number) return Names_nt
  is
    l_Names Names_NT;
  begin
    select n.firstname
      bulk collect into l_Names
      from NedMcDodd n
```



Oracle 8*i*

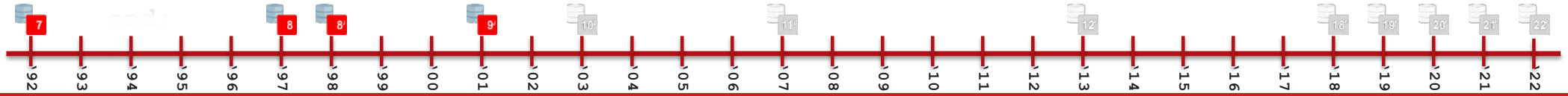
```
  function Relatives(type_in in number) return Names_nt
  is
    l_Names Names_NT;
  begin
    select n.firstname
      bulk collect into l_Names
      from NedMcDodd n
     where n.type = type_in;
    return l_Names;
  end;
end;
/
select column_value from table(cast (McDodd.Daughters() as Names_nt))
/
select column_value from table(cast (McDodd.Relatives(20) as Names_nt))
/
```



Oracle 9*i*

```
declare
   type names_aa is table of varchar2(30) index by varchar2(10);

   l_names names_aa;
   l_indx  varchar2(10);
begin
   -- fill up the collection
   l_names('Hooly')  := 'One';
   l_names('Heddy')  := 'Two';
   l_names('Hilder') := 'Three';
   l_names('Holy')   := 'Four';
   l_names('Haley')  := 'Five';
   -- display the contents of the collection
   l_indx := l_names.first;
   while l_indx is not null loop
     dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
     l_indx := l_names.next(l_indx);
   end loop;
end;
```

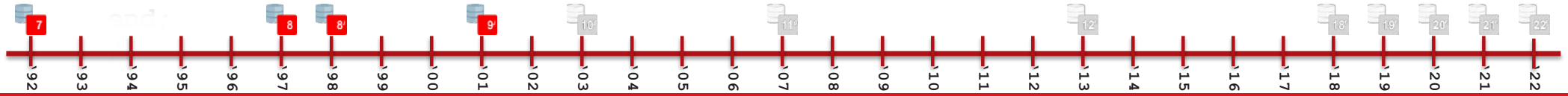


Oracle 9*i*

```
declare
   type names_aa is table of varchar2(30) index by varchar2(10);

   l_names names_aa;
   l_indx  varchar2(10);
begin
   -- fill up the collection
   l_names('Hooly')  := 'One';
   l_names('Heddy')  := 'Two';
   l_names('Hilder') := 'Three';
   l_names('Holy')   := 'Four';
   l_names('Haley')  := 'Five';
   -- display the contents of the collection
   l_indx := l_names.first;
   while l_indx is not null loop
     dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
     l_indx := l_names.next(l_indx);
   end loop;
end;
```

Hooly	One

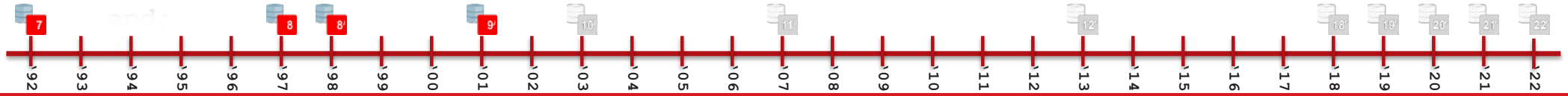


Oracle 9*i*

```
declare
  type names_aa is table of varchar2(30) index by varchar2(10);

  l_names names_aa;
  l_indx  varchar2(10);
begin
  -- fill up the collection
  l_names('Hooly')  := 'One';
  l_names('Heddy')  := 'Two';
  l_names('Hilder') := 'Three';
  l_names('Holy')   := 'Four';
  l_names('Haley')  := 'Five';
  -- display the contents of the collection
  l_indx := l_names.first;
  while l_indx is not null loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
end;
```

Heddy	Two	Hooly	One

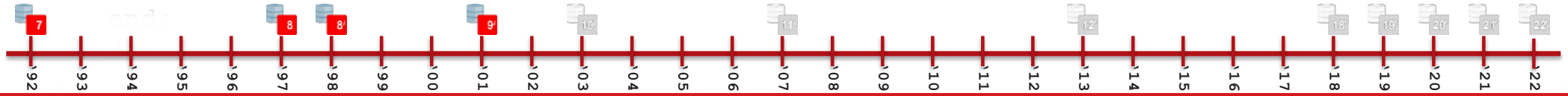


Oracle 9*i*

```
declare
  type names_aa is table of varchar2(30) index by varchar2(10);

  l_names names_aa;
  l_indx  varchar2(10);
begin
  -- fill up the collection
  l_names('Hooly')  := 'One';
  l_names('Heddy')  := 'Two';
  l_names('Hilder') := 'Three';
  l_names('Holy')   := 'Four';
  l_names('Haley')  := 'Five';
  -- display the contents of the collection
  l_indx := l_names.first;
  while l_indx is not null loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
```

Heddy	Two
Hilder	Three
Hooly	One



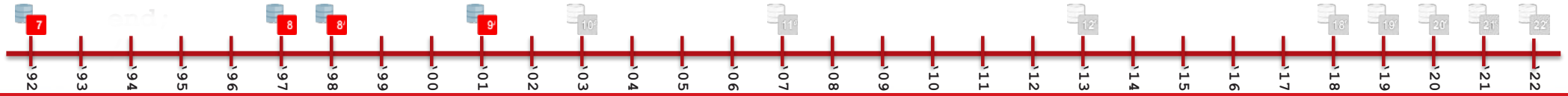
Oracle 9*i*

```
declare
  type names_aa is table of varchar2(30) index by varchar2(10);

  l_names names_aa;
  l_indx  varchar2(10);
begin
  -- fill up the collection
  l_names('Hooly')  := 'One';
  l_names('Heddy')  := 'Two';
  l_names('Hilder') := 'Three';
  l_names('Holy')   := 'Four';
  l_names('Haley')  := 'Five';
  -- display the contents of the collection
  l_indx := l_names.first;
  while l_indx is not null loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
end;
```

Holy	Four

Heddy	Two
Hilder	Three
Hooly	One



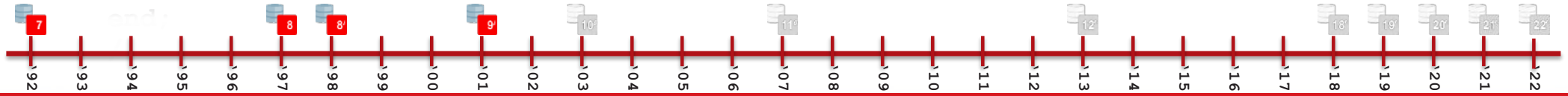
Oracle 9*i*

```
declare
  type names_aa is table of varchar2(30) index by varchar2(10);

  l_names names_aa;
  l_indx  varchar2(10);
begin
  -- fill up the collection
  l_names('Hooly')  := 'One';
  l_names('Heddy')  := 'Two';
  l_names('Hilder') := 'Three';
  l_names('Holy')   := 'Four';
  l_names('Haley')  := 'Five';
  -- display the contents of the collection
  l_indx := l_names.first;
  while l_indx is not null loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
end;
```

Haley	Five

Heddy	Two
Hilder	Three
Holy	Four
Hooly	One

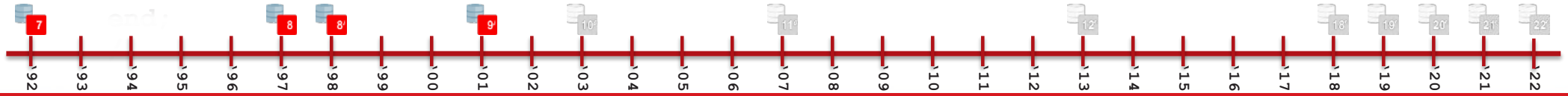


Oracle 9*i*

```
declare
  type names_aa is table of varchar2(30) index by varchar2(10);

  l_names names_aa;
  l_indx  varchar2(10);
begin
  -- fill up the collection
  l_names('Hooly')  := 'One';
  l_names('Heddy')  := 'Two';
  l_names('Hilder') := 'Three';
  l_names('Holy')   := 'Four';
  l_names('Haley')  := 'Five';
  -- display the contents of the collection
  l_indx := l_names.first;
  while l_indx is not null loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
end;
```

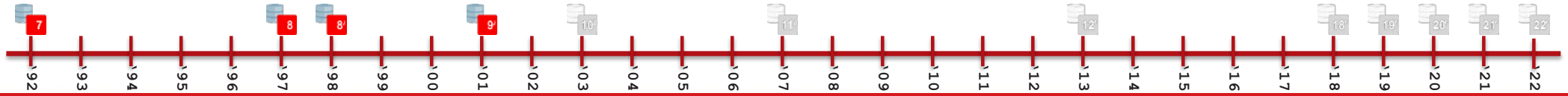
Haley	Five
Heddy	Two
Hilder	Three
Holy	Four
Hooly	One



Oracle 9*i*

```
  l_names names_aa;
  l_indx  varchar2(10);
begin
  -- fill up the collection
  l_names('Hooly')  := 'One';
  l_names('Heddy')  := 'Two';
  l_names('Hilder') := 'Three';
  l_names('Holy')   := 'Four';
  l_names('Haley')  := 'Five';
  -- display the contents of the collection
  l_indx := l_names.first;
  while l_indx is not null loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
end;
/
```

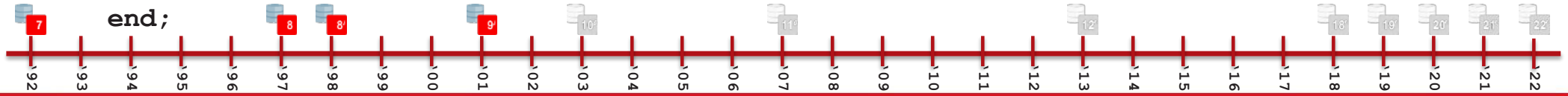
Haley	Five
Heddy	Two
Hilder	Three
Holy	Four
Hooly	One



Oracle 9*i*

```
declare
   type NedMcDodd_aa is table of NedMcDodd%rowtype index by binary_integer;

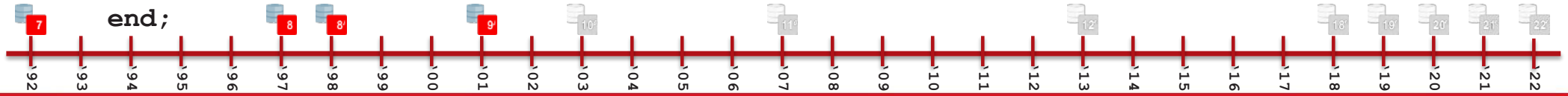
  cursor c_NedMcDodd
  is
  select n.id, n.firstname, n.lastname, n.type
    from NedMcDodd n
   where n.type in (12, 15, 18);
  l_NedMcDodds NedMcDodd_aa;
begin
  open c_NedMcDodd;
  fetch c_NedMcDodd bulk collect into l_NedMcDodds;
  close c_NedMcDodd;
  dbms_output.put_line('Number of relatives :'||l_NedMcDodds.count);
  for indx in l_NedMcDodds.first .. l_NedMcDodds.last loop
    dbms_output.put_line('Relative('||l_NedMcDodds(indx).id||') : ' ||
                                      l_NedMcDodds(indx).firstname);
  end loop;
end;
```



Oracle 9*i*

```
declare
   type NedMcDodd_aa is table of NedMcDodd%rowtype index by binary_integer;

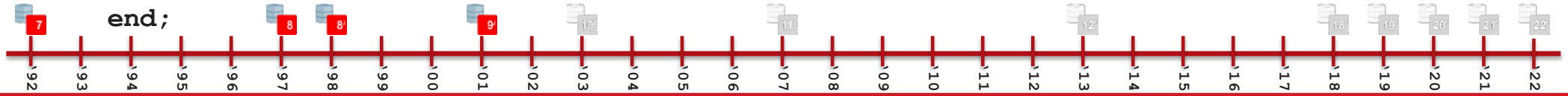
   cursor c_NedMcDodd
   is
   select n.id, n.firstname, n.lastname, n.type
     from NedMcDodd n
    where n.type in (12, 15, 18);
   l_NedMcDodds NedMcDodd_aa;
begin
   open c_NedMcDodd;
   fetch c_NedMcDodd bulk collect into l_NedMcDodds;
   close c_NedMcDodd;
   dbms_output.put_line('Number of relatives :'||l_NedMcDodds.count);
   for indx in l_NedMcDodds.first .. l_NedMcDodds.last loop
     dbms_output.put_line('Relative('||l_NedMcDodds(indx).id||') : ' ||
                                       l_NedMcDodds(indx).firstname);
   end loop;
end;
```



Oracle 9*i*

```
declare
  type NedMcDodd_aa is table of NedMcDodd%rowtype index by binary_integer;

  cursor c_NedMcDodd
  is
  select n.id, n.firstname, n.lastname, n.type
    from NedMcDodd n
   where n.type in (12, 15, 18);
  l_NedMcDodds NedMcDodd_aa;
begin
  open c_NedMcDodd;
  fetch c_NedMcDodd bulk collect into l_NedMcDodds;
  close c_NedMcDodd;
  dbms_output.put_line('Number of relatives :'||l_NedMcDodds.count);
  for indx in l_NedMcDodds.first .. l_NedMcDodds.last loop
    dbms_output.put_line('Relative('||l_NedMcDodds(indx).id||') : ' ||
                                      l_NedMcDodds(indx).firstname);
  end loop;
end;
```



Oracle 9*i*

```
create or replace type Names_NT as table of varchar2(32)
/

create or replace package McDodd as
  function Daughters return Names_NT pipelined;
  function Relatives(type_in in number) return Names_NT pipelined;
end;
/

create or replace package body McDodd as
  function Daughters return Names_NT pipelined
  is
    l_row NedMcDodd.Firstname%type;
  begin
    l_row := 'Hooly';
    pipe row(l_row);
    l_row := 'Holy';
    pipe row(l_row);
```

Oracle 9*i*

```
create or replace type Names_NT as table of varchar2(32)
/

create or replace package McDodd as
  function Daughters return Names_NT pipelined;
  function Relatives(type_in in number) return Names_NT pipelined;
end;
/

create or replace package body McDodd as
  function Daughters return Names_NT pipelined
  is
    l_row NedMcDodd.Firstname%type;
  begin
    l_row := 'Hooly';
    pipe row(l_row);
    l_row := 'Holy';
    pipe row(l_row);
```

Oracle 9*i*

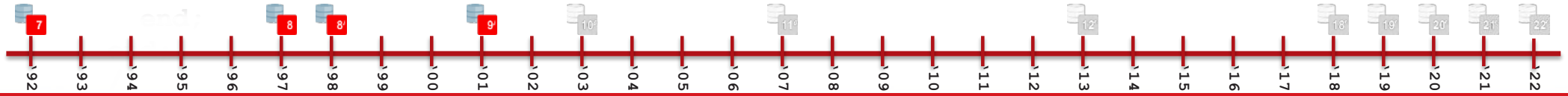
```
create or replace type Names_NT as table of varchar2(32)
/

create or replace package McDodd as
  function Daughters return Names_NT pipelined;
  function Relatives(type_in in number) return Names_NT pipelined;
end;
/

create or replace package body McDodd as
  function Daughters return Names_NT pipelined
  is
    l_row NedMcDodd.Firstname%type;
  begin
    l_row := 'Hooly';
    pipe row(l_row);
    l_row := 'Holy';
    pipe row(l_row);
```

Oracle 9*i*

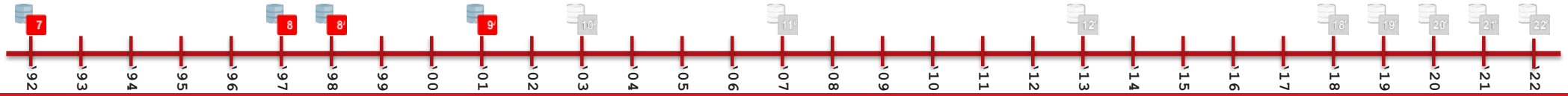
```
create or replace package body McDodd as
  function Daughters return Names_NT pipelined
  is
    l_row NedMcDodd.Firstname%type;
  begin
    l_row := 'Hooly';
    pipe row(l_row);
    l_row := 'Holy';
    pipe row(l_row);
    return;
  end;
  function Relatives(type_in in number) return Names_NT pipelined
  is
  begin
    for l_row in (select n.firstname from NedMcDodd n where n.type = type_in) loop
      pipe row(l_row.firstname);
    end loop;
    return;
```



Oracle 9*i*

```
  function Relatives(type_in in number) return Names_NT pipelined
  is
  begin
    for l_row in (select n.firstname from NedMcDodd n where n.type = type_in) loop
      pipe row(l_row.firstname);
    end loop;
    return;
  end;
end;
/
```

```
select * from table(McDodd.Daughters)
/
select * from table(McDodd.Relatives(20))
/
```



Oracle 9*i*

```
clear screen
set serveroutput on size unlimited

drop table FatMcDodd
/

prompt create a big fat table
create table FatMcDodd as select * from NedMcDodd where 1=2
/
begin
  for indx in 1 .. 10000 loop
    insert into FatMcDodd select * from NedMcDodd;
  end loop;
  commit;
end;
/
select count(*) from FatMcDodd
/
```

Oracle 9*i*

```
  end loop;
  commit;
end;
/
select count(*) from FatMcDodd
/

set timing on
declare
  l_id FatMcDodd.id%type;
begin
  for rec in (select * from FatMcDodd) loop
    l_id := rec.id;
  end loop;
end;
/
set timing off
```

```
PL/SQL procedure successfully completed
Executed in 4.453 seconds
```

Oracle 9*i*

```
declare
  l_id FatMcDodd.id%type;
begin
  for rec in (select * from FatMcDodd) loop
    l_id := rec.id;
  end loop;
end;
/
set timing off
```

```
PL/SQL procedure successfully completed
Executed in 1.235 seconds
```

Oracle 9*i*

```
declare
  cursor c_FatMcDodd
  is
  select * from FatMcDodd;
  type t_FatMcDodd is table of FatMcDodd%rowtype index by pls_integer;
  lFatMcDodd t_FatMcDodd;
  l_id FatMcDodd.id%type;
begin
  open c_FatMcDodd;
  loop
    fetch c_FatMcDodd bulk collect into lFatMcDodd limit 10000;
    exit when lFatMcDodd.count = 0;
    for indx in lFatMcDodd.first .. lFatMcDodd.last loop
      l_id := lFatMcDodd(indx).id;
    end loop;
  end loop;
end;
/
```

Oracle 10g

```
clear screen
set serveroutput on size unlimited

drop table FatMcDodd
/

prompt create a big fat table
create table FatMcDodd as select * from NedMcDodd where 1=2
/
begin
  for indx in 1 .. 10000 loop
    insert into FatMcDodd select * from NedMcDodd;
  end loop;
  commit;
end;
/
select count(*) from FatMcDodd
/
```

Oracle 10g

```
  end loop;
  commit;
end;
/
select count(*) from FatMcDodd
/

set timing on
declare
  l_id FatMcDodd.id%type;
begin
  for rec in (select * from FatMcDodd) loop
    l_id := rec.id;
  end loop;
end;
/
set timing off
```

```
PL/SQL procedure successfully completed
Executed in 0.701 seconds
```

Oracle 10g

```
declare
  l_id FatMcDodd.id%type;
begin
  for rec in (select * from FatMcDodd) loop
    l_id := rec.id;
  end loop;
end;
/
set timing off
```

```
PL/SQL procedure successfully completed
Executed in 0.581 seconds
```

Oracle 10g

```
declare
  cursor c_FatMcDodd
  is
  select * from FatMcDodd;
  type t_FatMcDodd is table of FatMcDodd%rowtype index by pls_integer;
  lFatMcDodd t_FatMcDodd;
  l_id FatMcDodd.id%type;
begin
  open c_FatMcDodd;
  loop
    fetch c_FatMcDodd bulk collect into lFatMcDodd limit 10000;
    exit when lFatMcDodd.count = 0;
    for indx in lFatMcDodd.first .. lFatMcDodd.last loop
      l_id := lFatMcDodd(indx).id;
    end loop;
  end loop;
end;
/
```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Oracle 10g

```
create or replace package McDodd as
  type Names_NT is table of NedMcDodd.firstname%type;
  function Daughters return McDodd.Names_NT pipelined;
  function Relatives(type_in in number) return McDodd.Names_NT pipelined;
end;
/

create or replace package body McDodd as
  function Daughters return McDodd.Names_NT pipelined
  is
    l_row NedMcDodd.firstname%type;
  begin
    l_row := 'Hooly';
    pipe row(l_row);
    l_row := 'Holy';
    pipe row(l_row);
    return;
  end;
```

Oracle 10g

```
create or replace package McDodd as
  type Names_NT is table of NedMcDodd.firstname%type;
  function Daughters return McDodd.Names_NT pipelined;
  function Relatives(type_in in number) return McDodd.Names_NT pipelined;
end;
/

create or replace package body McDodd as
  function Daughters return McDodd.Names_NT pipelined
  is
    l_row NedMcDodd.firstname%type;
  begin
    l_row := 'Hooly';
    pipe row(l_row);
    l_row := 'Holy';
    pipe row(l_row);
    return;
  end;
```

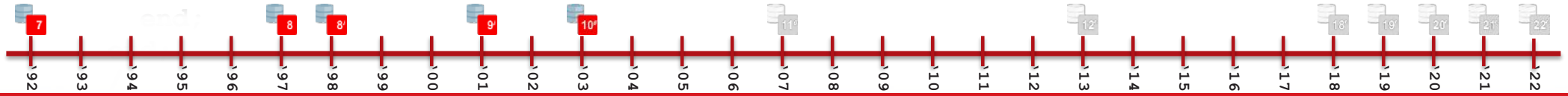
Oracle 10g

```
create or replace package McDodd as
  type Names_NT is table of NedMcDodd.firstname%type;
  function Daughters return McDodd.Names_NT pipelined;
  function Relatives(type_in in number) return McDodd.Names_NT pipelined;
end;
/

create or replace package body McDodd as
  function Daughters return McDodd.Names_NT pipelined
  is
    l_row NedMcDodd.firstname%type;
  begin
    l_row := 'Hooly';
    pipe row(l_row);
    l_row := 'Holy';
    pipe row(l_row);
    return;
  end;
```

Oracle 10g

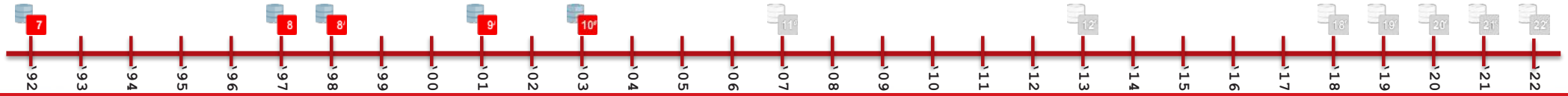
```
create or replace package body McDodd as
  function Daughters return McDodd.Names_NT pipelined
  is
    l_row NedMcDodd.firstname%type;
  begin
    l_row := 'Hooly';
    pipe row(l_row);
    l_row := 'Holy';
    pipe row(l_row);
    return;
  end;
  function Relatives(type_in in number) return McDodd.Names_NT pipelined
  is
  begin
    for l_row in (select n.firstname from NedMcDodd n where n.type = type_in) loop
      pipe row(l_row.firstname);
    end loop;
    return;
```



Oracle 10g

```
  function Relatives(type_in in number) return McDodd.Names_NT pipelined
  is
  begin
    for l_row in (select n.firstname from NedMcDodd n where n.type = type_in) loop
      pipe row(l_row.firstname);
    end loop;
    return;
  end;
end;
/
```

```
select * from table(McDodd.Daughters)
/
select * from table(McDodd.Relatives(20))
/
```

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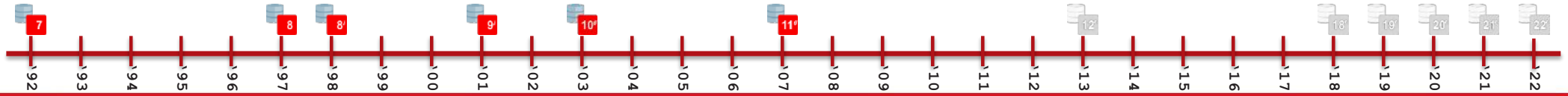
Oracle 11g

```
create or replace package McDodd as
  type Daughters_NT is table of NedMcDodd.firstname%type;
end;
/

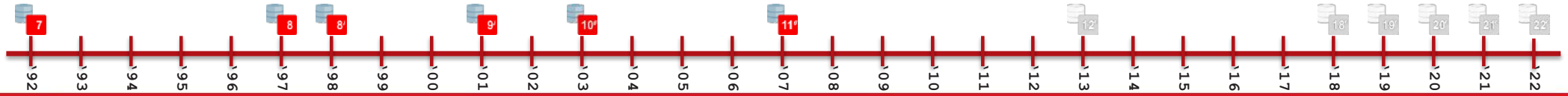
declare
  Daughters McDodd.Daughters_NT;
begin
  Daughters := McDodd.Daughters_NT();
  Daughters.extend(2);
  Daughters(1) := 'Hooly';
  Daughters(2) := 'Holy';
  for i in (select n.firstname from NedMcDodd n where n.type = 18
              and n.firstname not in (select * from table(Daughters))) loop
    dbms_output.put_line(i.firstname);
  end loop;
end;
/
```



Oracle 11g

```
create or replace
  type Daughters_NT as table of varchar2(32)
/

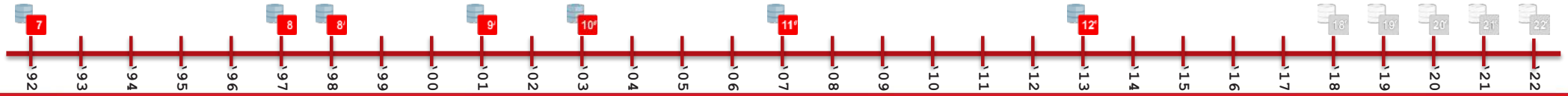

declare
  Daughters Daughters_NT;
begin
  Daughters := Daughters_NT();
  Daughters.extend(2);
  Daughters(1) := 'Hooly';
  Daughters(2) := 'Holy';
  for i in (select n.firstname from NedMcDodd n where n.type = 18
                and n.firstname not in (select * from table(Daughters))) loop
    dbms_output.put_line(i.firstname);
  end loop;
end;
/
```



Oracle 12c

```
create or replace package McDodd as
  type Daughters_NT is table of NedMcDodd.firstname%type;
end;
/

declare
  Daughters McDodd.Daughters_NT;
begin
  Daughters := McDodd.Daughters_NT();
  Daughters.extend(2);
  Daughters(1) := 'Hooly';
  Daughters(2) := 'Holy';
  for i in (select n.firstname from NedMcDodd n where n.type = 18
              and n.firstname not in (select * from table(Daughters))) loop
    dbms_output.put_line(i.firstname);
  end loop;
end;
/
```

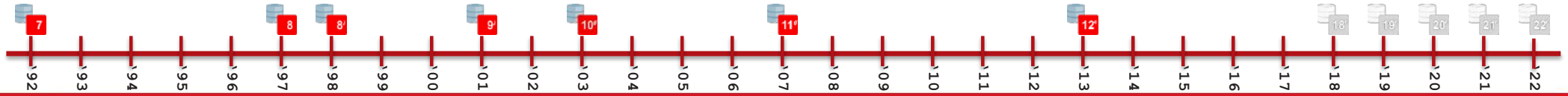


Oracle 12c

```
create or replace package McDodd as
  type Daughters_AA is table of NedMcDodd.firstname%type index by pls_integer;
end;
/

declare
  Daughters McDodd.Daughters_AA;
begin


  Daughters(1) := 'Hooly';
  Daughters(2) := 'Holy';
  for i in (select n.firstname from NedMcDodd n where n.type = 18
              and n.firstname not in (select * from table(Daughters))) loop
    dbms_output.put_line(i.firstname);
  end loop;
end;
/
```

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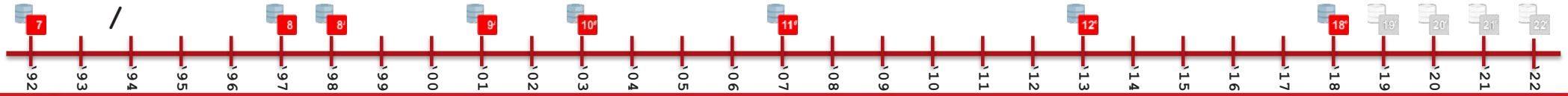
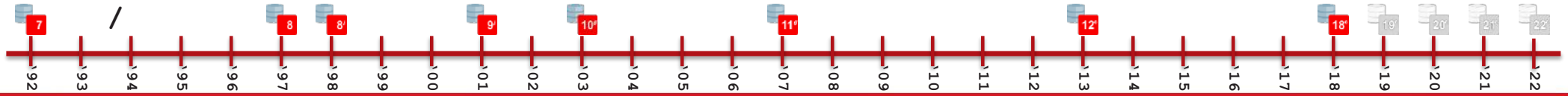
Oracle 18c

```
declare
  type    names_aa is table of varchar2(30) index by binary_integer;
  l_names names_aa;
  l_indx  binary_integer;
begin
  -- fill up the collection
  l_names(1)                   := 'Hooly';
  l_names(42)                  := 'Heddy';
  l_names(10)                  := 'Hilder';
  l_names(l_names.count + 1)   := 'Holy';
  l_names(-1)                  := 'Haley';
  -- display the contents of the collection
  l_indx := l_names.first;
  while l_indx is not null loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
end;
/
```



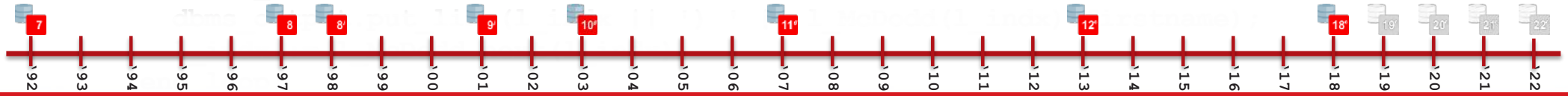
Oracle 18c

```
declare
  type    names_aa is table of varchar2(30) index by binary_integer;
  l_names names_aa;
  l_indx  binary_integer;
begin
  -- fill up the collection
  l_names := names_aa(1  => 'Hooly'
                     ,42 => 'Heddy'
                     ,10 => 'Hilder'
                     ,(l_names.count + 1)  => 'Holy'
                     ,-1 => 'Haley');
  -- display the contents of the collection
  l_indx := l_names.first;
  while l_indx is not null loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
end;
/
```



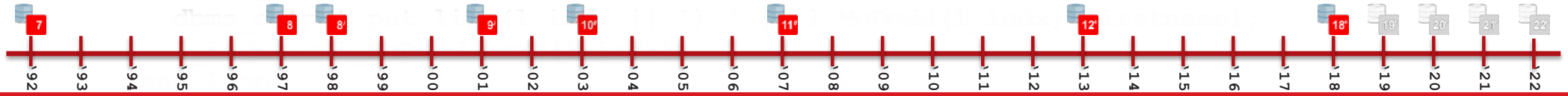
Oracle 18c

```
declare
  type McDodd_rec is record
  ( firstname varchar2(32)
  , type      number(2)
  );
  type McDodd_AA is table of McDodd_rec index by pls_integer;
  l_McDodd McDodd_AA;
  l_indx   pls_integer;
begin
  -- fill up the collection
  l_McDodd := McDodd_AA(1  => McDodd_rec(firstname => 'Hooly',  type => 18)
                       ,42 => McDodd_rec(firstname => 'Heddy',  type => 18)
                       ,10 => McDodd_rec(firstname => 'Hilder', type => 18)
                       ,4  => McDodd_rec(firstname => 'Holy',   type => 18)
                       ,-1 => McDodd_rec(firstname => 'Haley',  type => 18));
  -- display the contents of the collection
  l_indx := l_McDodd.first;
  while l_indx is not null loop
```

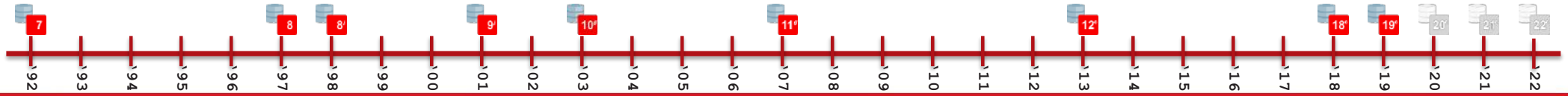


Oracle 18c

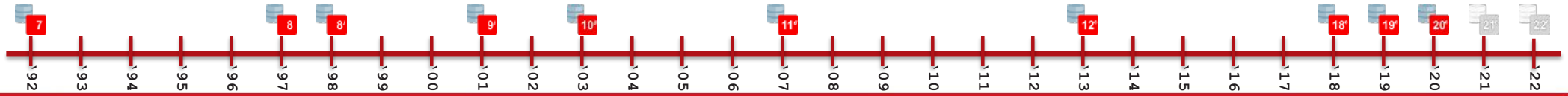
```
declare
  type McDodd_rec is record
  ( firstname varchar2(32)
  , type      number(2)
  );
  type McDodd_AA is table of McDodd_rec index by pls_integer;
  l_McDodd McDodd_AA;
  l_indx   pls_integer;
begin
  -- fill up the collection
  l_McDodd := McDodd_AA(1  => McDodd_rec(firstname => 'Hooly',  type => 18)
                       ,42 => McDodd_rec(firstname => 'Heddy',  type => 18)
                       ,10 => McDodd_rec(firstname => 'Hilder', type => 18)
                       ,4  => McDodd_rec(firstname => 'Holy',   type => 18)
                       ,-1 => McDodd_rec(firstname => 'Haley',  type => 18));
  -- display the contents of the collection
  l_indx := l_McDodd.first;
  while l_indx is not null loop
```



Oracle 19c

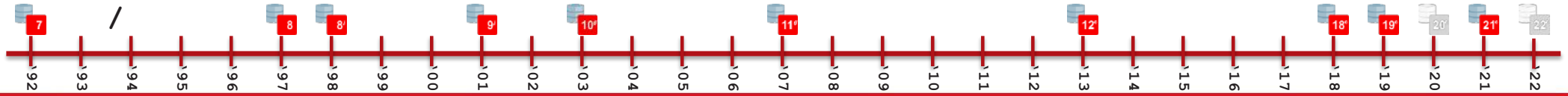

7
8
8i
9i
10g
11g
12c
18c
19c
20c
21c
22c
'92
'93
'94
'95
'96
'97
'98
'99
'00
'01
'02
'03
'04
'05
'06
'07
'08
'09
'10
'11
'12
'13
'14
'15
'16
'17
'18
'19
'20
'21
'22

Oracle 20c


7
8
8i
9i
10g
11g
12c
18c
19c
20c
21c
22c
'92
'93
'94
'95
'96
'97
'98
'99
'00
'01
'02
'03
'04
'05
'06
'07
'08
'09
'10
'11
'12
'13
'14
'15
'16
'17
'18
'19
'20
'21
'22

Oracle 21c

```
declare
  type    names_aa is table of varchar2(30) index by binary_integer;
  l_names names_aa;
  l_indx  binary_integer;
begin
  -- fill up the collection
  l_names(1)                   := 'Hooly';
  l_names(42)                  := 'Heddy';
  l_names(10)                  := 'Hilder';
  l_names(l_names.count + 1)   := 'Holy';
  l_names(-1)                  := 'Haley';
  -- display the contents of the collection
  l_indx := l_names.first;
  while l_indx is not null loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));
    l_indx := l_names.next(l_indx);
  end loop;
end;
/
```



Oracle 21c

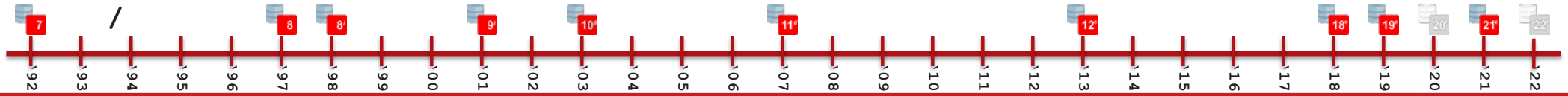
```
declare
  type    names_aa is table of varchar2(30) index by binary_integer;
  l_names names_aa;
  l_indx  binary_integer;
begin
  -- fill up the collection
  l_names(1)                    := 'Hooly';
  l_names(42)                   := 'Heddy';
  l_names(10)                   := 'Hilder';
  l_names(l_names.count + 1)    := 'Holy';
  l_names(-1)                   := 'Haley';
  -- display the contents of the collection

  for l_indx           in indices of l_names loop
    dbms_output.put_line(l_indx || ') ' || l_names(l_indx));

  end loop;
end;
/
```

```
-1) Haley
1) Hooly
4) Holy
10) Hilder
42) Heddy

PL/SQL procedure successfully completed
```



Oracle 21c

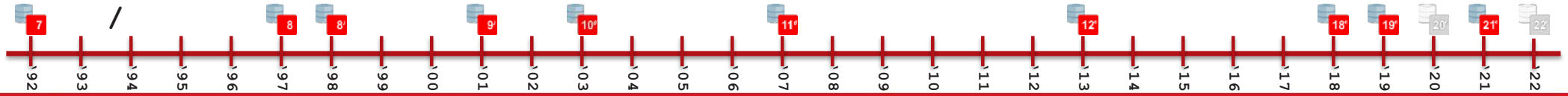
```
declare
  type    names_aa is table of varchar2(30) index by binary_integer;
  l_names names_aa;
  l_indx  binary_integer;
begin
  -- fill up the collection
  l_names(1)                    := 'Hooly';
  l_names(42)                   := 'Heddy';
  l_names(10)                   := 'Hilder';
  l_names(l_names.count + 1)    := 'Holy';
  l_names(-1)                   := 'Haley';
  -- display the contents of the collection

  for l_indx           in values  of l_names loop
    dbms_output.put_line(l_indx                              );

  end loop;
end;
/
```

```
Haley
Hooly
Holy
Hilder
Heddy

PL/SQL procedure successfully completed
```



Oracle 21c

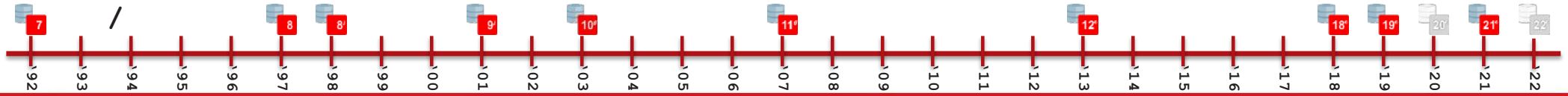
```
declare
  type    names_aa is table of varchar2(30) index by binary_integer;
  l_names names_aa;
  l_indx  binary_integer;
begin
  -- fill up the collection
  l_names(1)                    := 'Hooly';
  l_names(42)                   := 'Heddy';
  l_names(10)                   := 'Hilder';
  l_names(l_names.count + 1)    := 'Holy';
  l_names(-1)                   := 'Haley';
  -- display the contents of the collection

  for l_indx, l_value in pairs   of l_names loop
    dbms_output.put_line(l_indx || ') ' || l_value        );

  end loop;
end;
/
```

```
-1) Haley
1) Hooly
4) Holy
10) Hilder
42) Heddy

PL/SQL procedure successfully completed
```




This presentation was inspired by the movie
Dr. Seuss'
HORTON
HEARS A WHO!™
An animation done by:
Blue Sky™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Q&A