SIMPLIFY DATABASE CODE WITH utPLSQL

Philipp Salvisberg
4th May 2022

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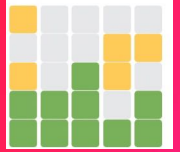
PHILIPP SALVISBERG

SENIOR PRINCIPAL CONSULTANT

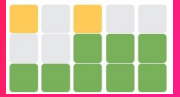
- Database centric development
- Model Driven Software Development
- Author of free SQL Developer Extensions PL/SQL Unwrapper, db* CODECOP, utPLSQL, plscope-utils, oddgen and Bitemp Remodeler

Wordle 208 3/6

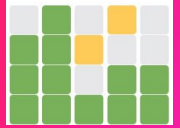
Wordle 209 5/6



Wordle 210 3/6



Wordle 211 4/6



Wordle 212 3/6

WORDLE

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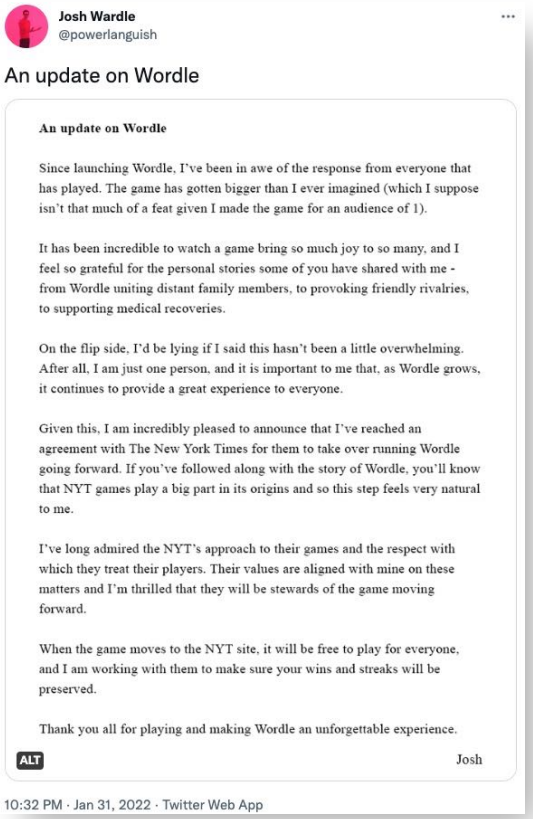
4 INVENTOR

Josh Wardle
[@powerlanguish](#)

https://www.powerlanguage.co.uk/wordle/



Josh Wardle
@powerlanguish

An update on Wordle

An update on Wordle

Since launching Wordle, I've been in awe of the response from everyone that has played. The game has gotten bigger than I ever imagined (which I suppose isn't that much of a feat given I made the game for an audience of 1).

It has been incredible to watch a game bring so much joy to so many, and I feel so grateful for the personal stories some of you have shared with me - from Wordle uniting distant family members, to provoking friendly rivalries, to supporting medical recoveries.

On the flip side, I'd be lying if I said this hasn't been a little overwhelming. After all, I am just one person, and it is important to me that, as Wordle grows, it continues to provide a great experience to everyone.

Given this, I am incredibly pleased to announce that I've reached an agreement with The New York Times for them to take over running Wordle going forward. If you've followed along with the story of Wordle, you'll know that NYT games play a big part in its origins and so this step feels very natural to me.

I've long admired the NYT's approach to their games and the respect with which they treat their players. Their values are aligned with mine on these matters and I'm thrilled that they will be stewards of the game moving forward.

When the game moves to the NYT site, it will be free to play for everyone, and I am working with them to make sure your wins and streaks will be preserved.

Thank you all for playing and making Wordle an unforgettable experience.

ALT

Josh

10:32 PM · Jan 31, 2022 · Twitter Web App

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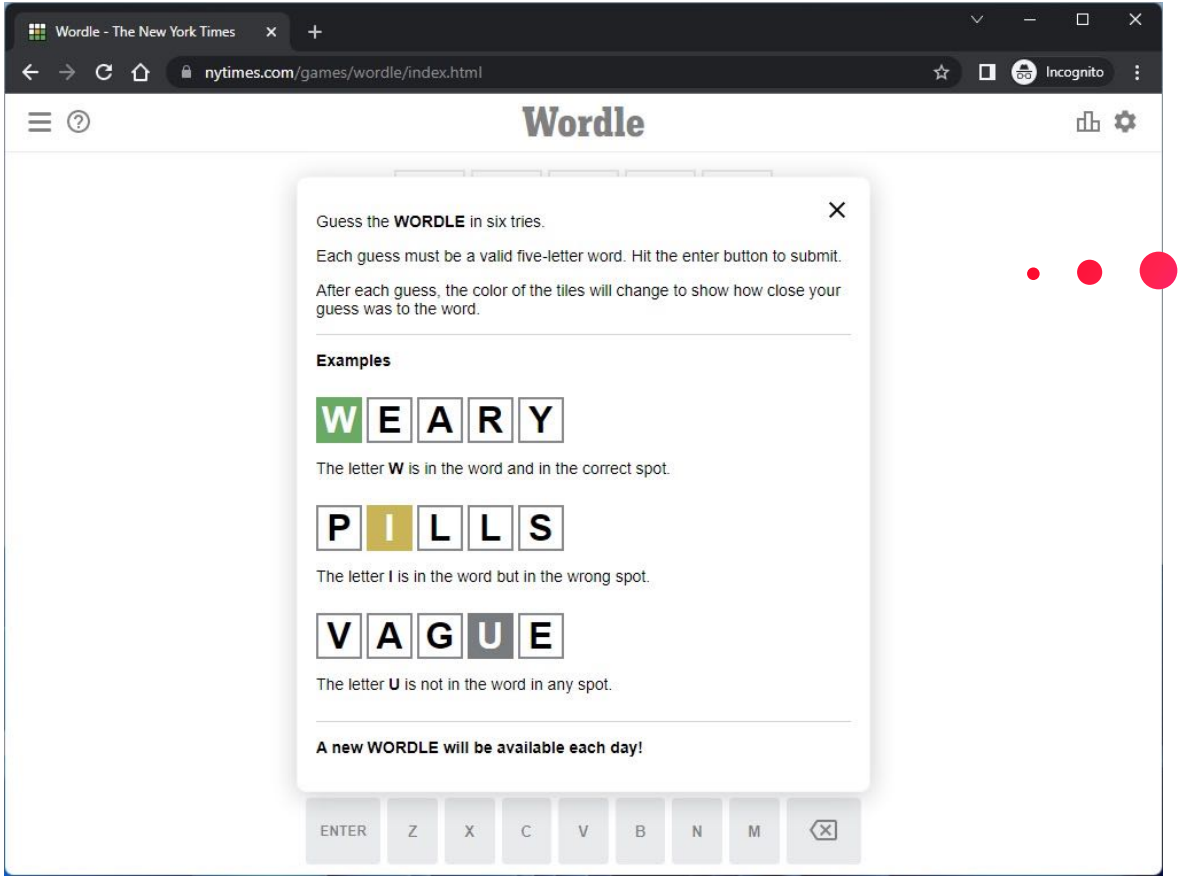
5 RULES



12'972
accepted words

2'309
used as solution

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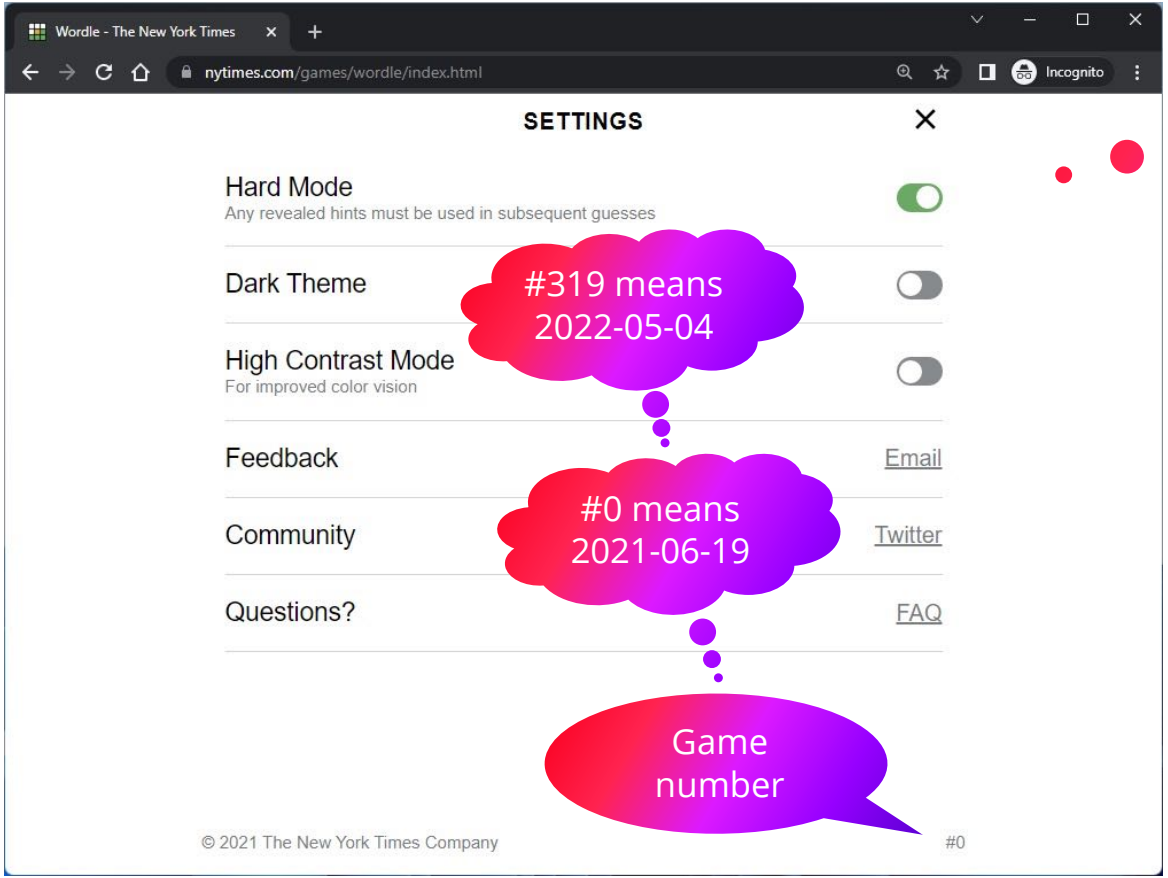
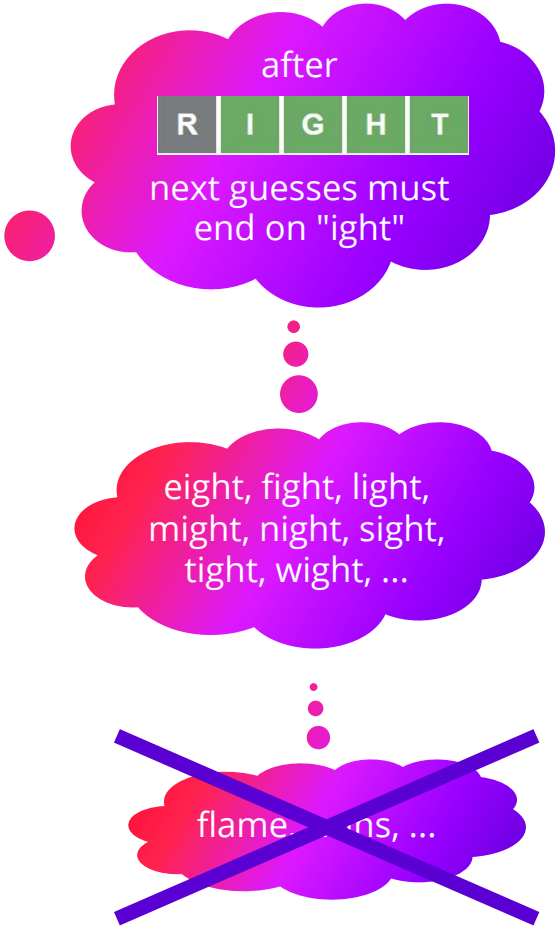
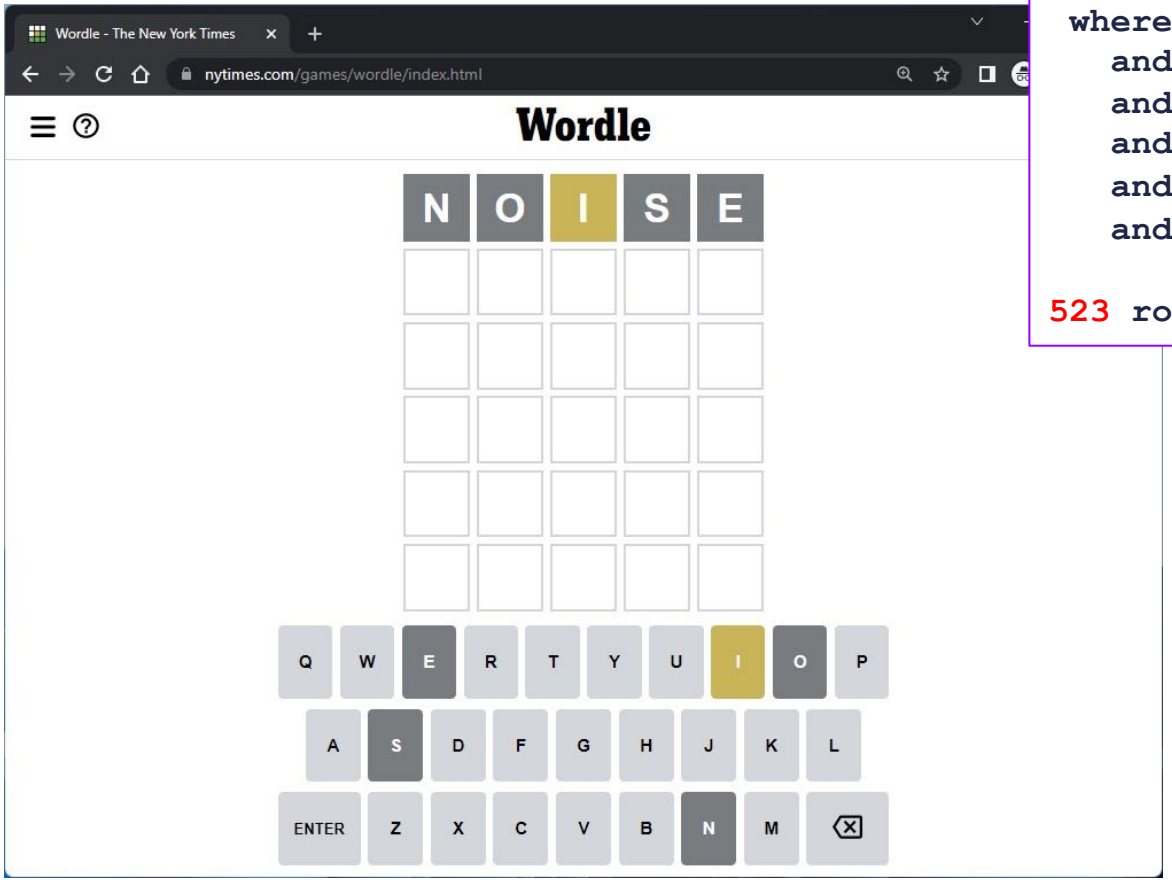
6 SETTINGS


Wordle - The New York Times
nytimes.com/games/wordle/index.html
Incognito
SETTINGS
Hard Mode
Any revealed hints must be used in subsequent guesses
Dark Theme
High Contrast Mode
For improved color vision
Feedback
Email
Community
Twitter
Questions?
FAQ
© 2021 The New York Times Company
#0
#319 means 2022-05-04
#0 means 2021-06-19
Game number


after
R I G H T
next guesses must end on "ight"
eight, fight, light, might, night, sight, tight, wight, ...
flame ns, ...

7 FIRST GUESS




```
select word
  from words
 where word not like '__i__'
   and instr(word, 'i', 1, 1) > 0
   and word not like '%n%'
   and word not like '%o%'
   and word not like '%s%'
   and word not like '%e%';

523 rows selected.
```

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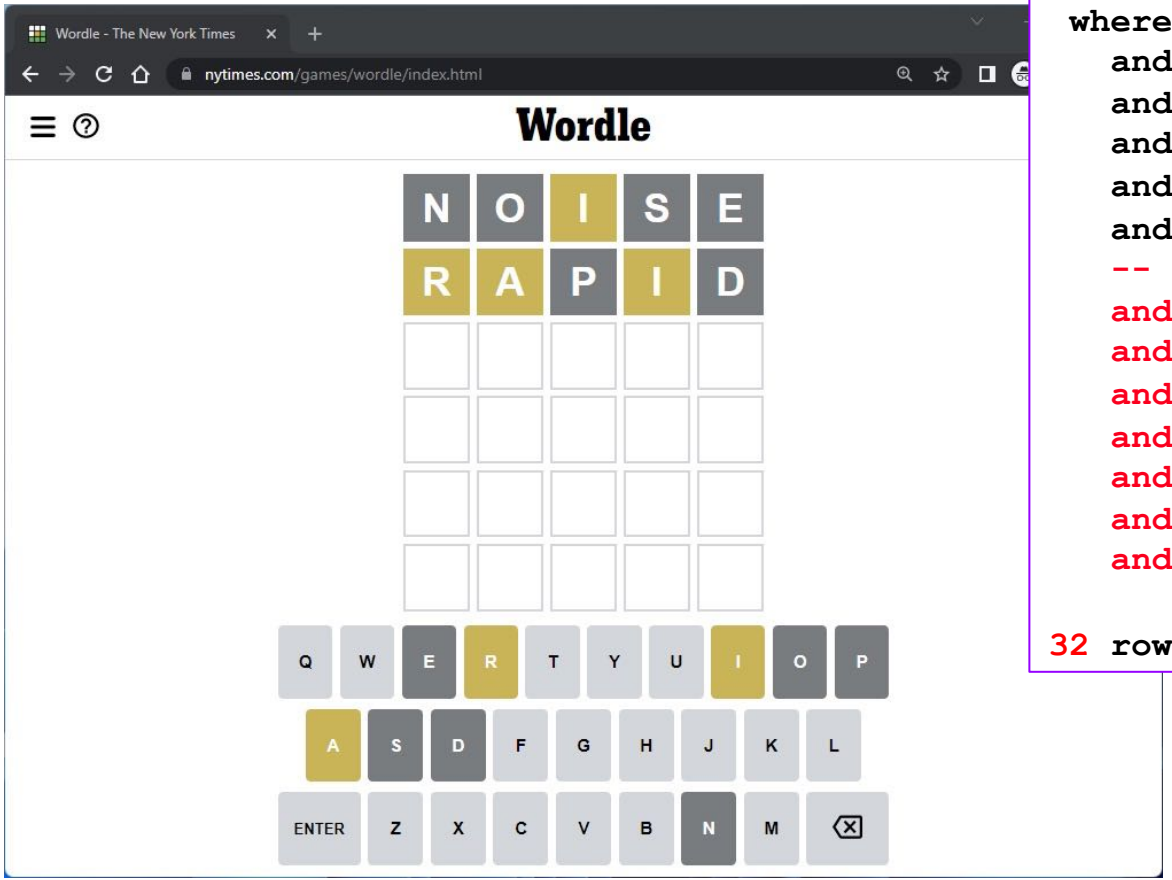
8 SECOND GUESS




```
select word
  from words
 where word not like '__i__'
   and instr(word, 'i', 1, 1) > 0
   and word not like '%n%'
   and word not like '%o%'
   and word not like '%s%'
   and word not like '%e%'
   -- second guess
   and word not like 'r____'
   and word not like '_a___'
   and word not like '___i_'
   and instr(word, 'r', 1, 1) > 0
   and instr(word, 'a', 1, 1) > 0
   and word not like '%p%'
   and word not like '%d%';

32 rows selected.
```

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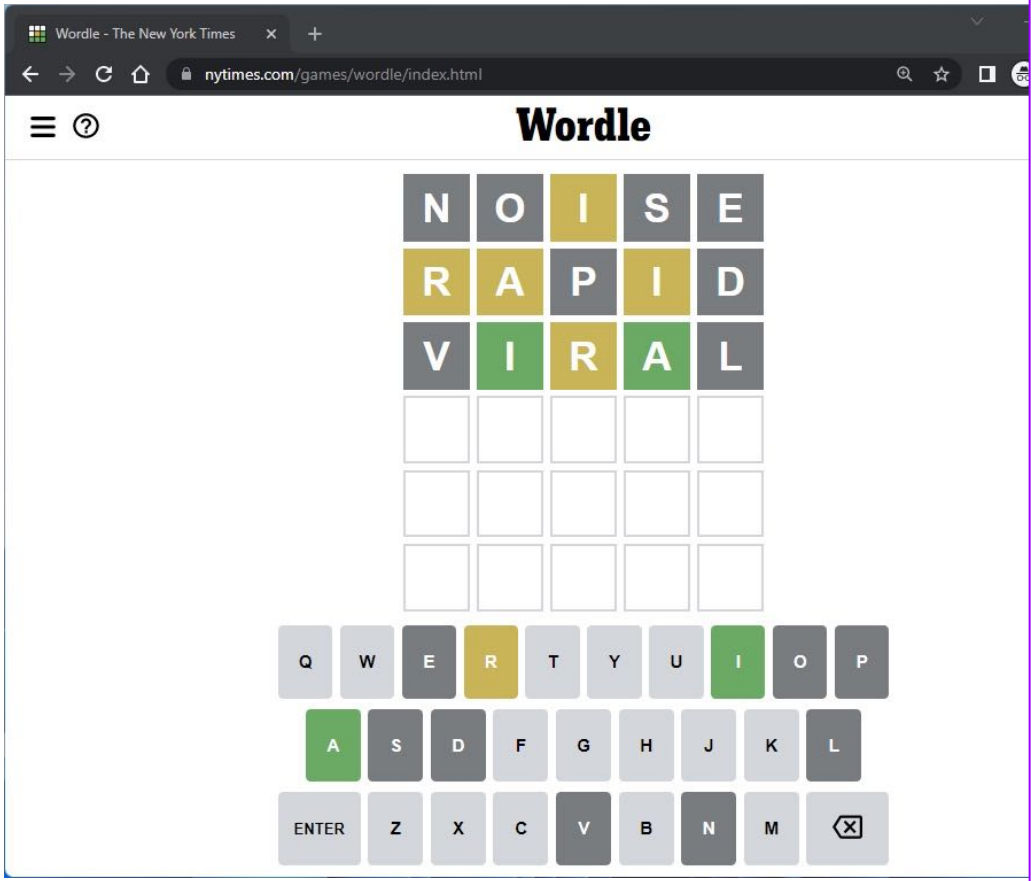
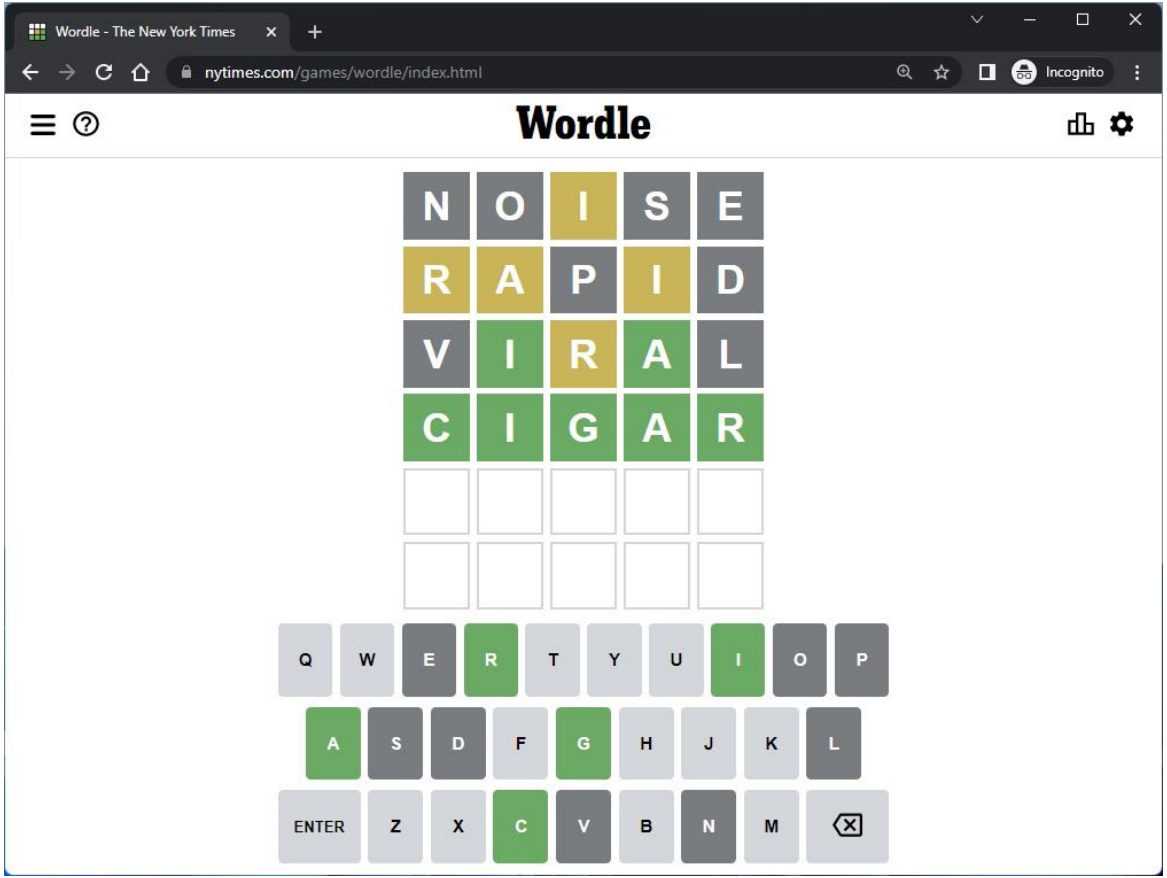
9 THIRD GUESS




```
select word
  from words
 where word not like '__i__'
   and instr(word, 'i', 1, 1) > 0
   and word not like '%n%'
   and word not like '%o%'
   and word not like '%s%'
   and word not like '%e%'
   -- second guess
   and word not like 'r____'
   and word not like '_a___'
   and word not like '___i_'
   and instr(word, 'r', 1, 1) > 0
   and instr(word, 'a', 1, 1) > 0
   and word not like '%p%'
   and word not like '%d%'
   -- third guess
   and word like '_i_a_'
   and word not like '__r__'
   and word not like '%v%'
   and word not like '%l%';

2 rows selected.
```

10 FOURTH GUESS



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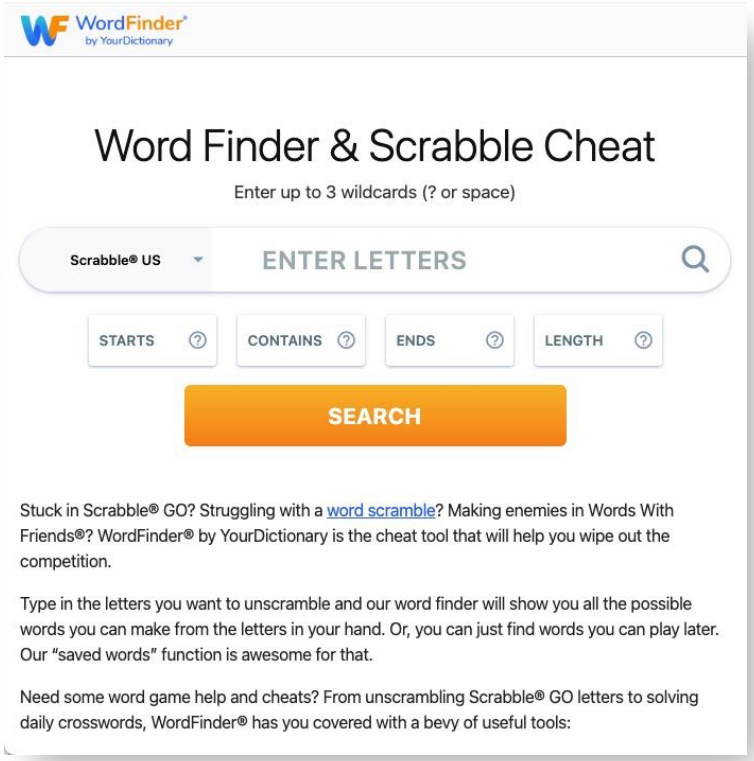
COMMON WORDLE HELPER

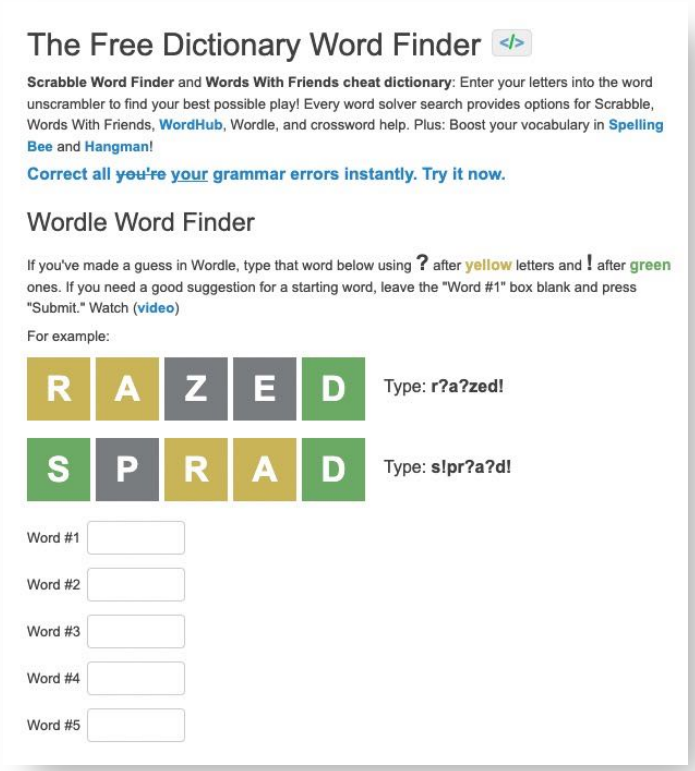
WORD FINDER BY YourDictionary



Limited Search Features

Source: https://wordfinder.yourdictionary.com/

THE FREE DICTIONARY WORD FINDER



Excellent Search Features

Different Word List

Source: https://www.thefreedictionary.com/Word-Finder.htm#Wordle

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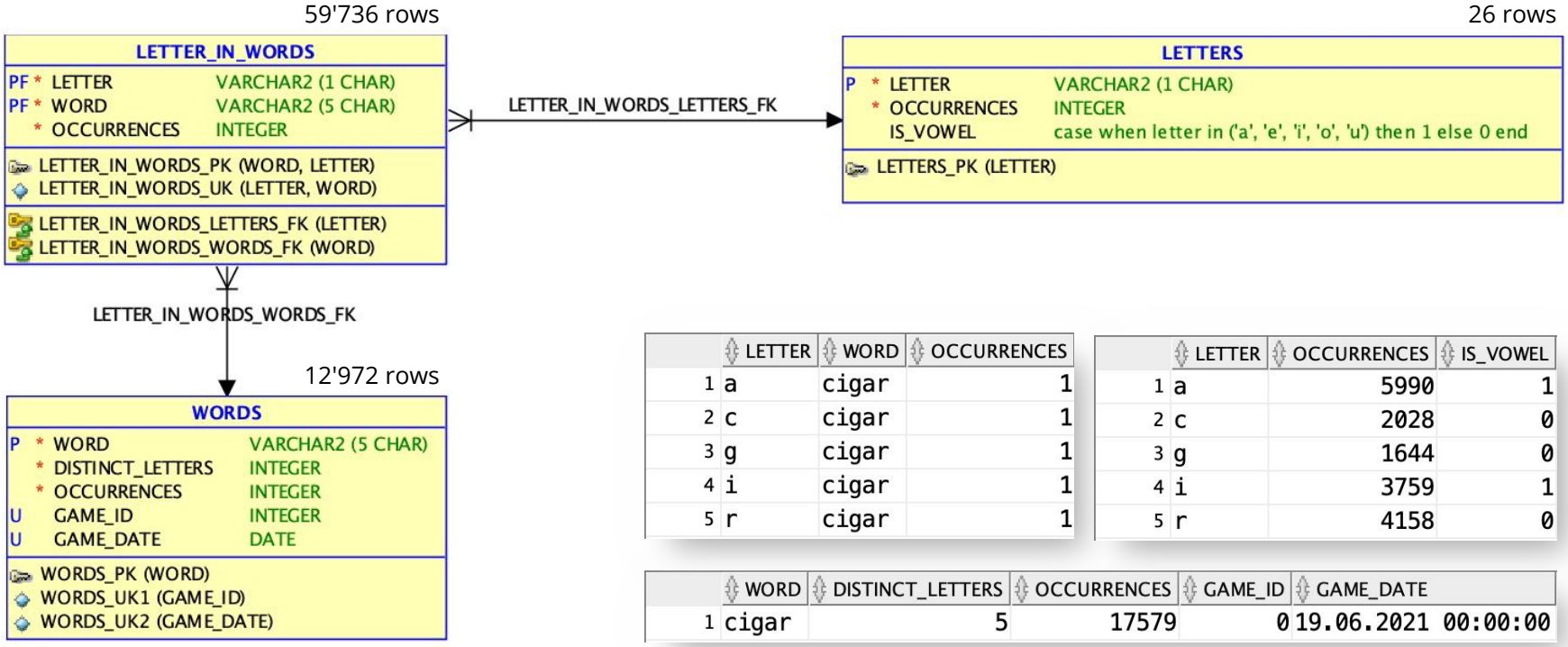
ORACLE DATABASE WORDLE HELPER

15 DATA MODEL



	LETTER	WORD	OCCURRENCES
1	a	cigar	1
2	c	cigar	1
3	g	cigar	1
4	i	cigar	1
5	r	cigar	1

	LETTER	OCCURRENCES	IS_VOWEL
1	a	5990	1
2	c	2028	0
3	g	1644	0
4	i	3759	1
5	r	4158	0

	WORD	DISTINCT_LETTERS	OCCURRENCES	GAME_ID	GAME_DATE
1	cigar	5	17579	0	19.06.2021 00:00:00

16 FIRST GUESS

```
SQL> set pagesize 1000
SQL> set linesize 250
SQL> exec wordle.set_hard_mode

PL/SQL procedure successfully completed.

SQL> exec wordle.set_ansiconsole

PL/SQL procedure successfully completed.

SQL> select * from wordle.play(0, 'noise');

Result Sequence
--------------------------------------------------------------------------------
N O I S E

suggestions:

trail
tapir
grail
tidal
diary
plait
flair
frail
acrid
rapid

14 rows selected.

SQL>
```

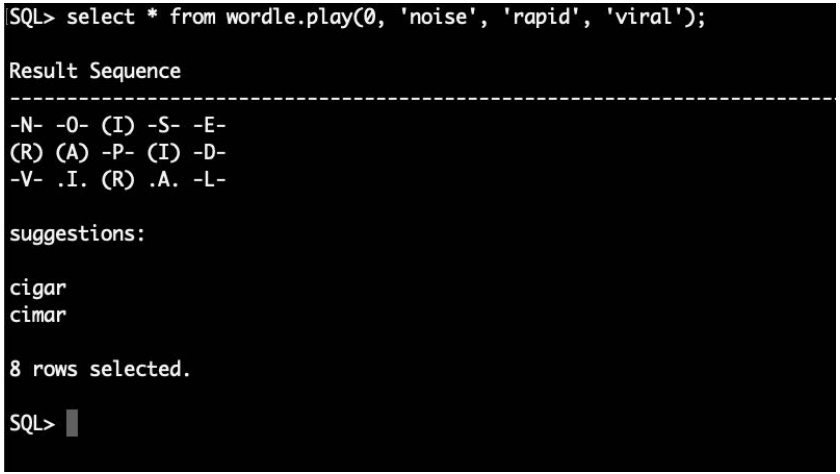
```
SQL> set pagesize 1000
SQL> set linesize 250
SQL> exec wordle.set_hard_mode

PL/SQL procedure successfully completed.

SQL> exec wordle.set_ansiconsole(false)

PL/SQL procedure successfully completed.

SQL> select * from wordle.play(0, 'noise');

Result Sequence
--------------------------------------------------------------------------------
-N- -O- (I) -S- -E-

suggestions:

trail
tapir
grail
tidal
diary
plait
flair
frail
acrid
rapid

14 rows selected.

SQL>
```

17 SECOND GUESS

```
SQL> select * from wordle.play(0, 'noise', 'rapid');

Result Sequence
--------------------------------------------------------------------------------
N  O  I  S  E
R  A  P  I  D

suggestions:

viral
cigar
vicar
tiara
circa
liart
urali
hilar
airth
libra

15 rows selected.

SQL>
```

```
SQL> select * from wordle.play(0, 'noise', 'rapid');

Result Sequence
--------------------------------------------------------------------------------
-N- -O- (I) -S- -E-
(R) (A) -P- (I) -D-

suggestions:

viral
cigar
vicar
tiara
circa
liart
urali
hilar
airth
libra

15 rows selected.

SQL>
```

18 THIRD GUESS



19 FOURTH GUESS

```
SQL> select * from wordle.play(0, 'noise', 'rapid', 'viral', 'cigar');

Result Sequence
--------------------------------------------------------------------------------
N O I S E
R A P I D
V I R A L
C I G A R

Bravo! You completed Wordle 0 4/6

6 rows selected.

SQL>
```

```
SQL> select * from wordle.play(0, 'noise', 'rapid', 'viral', 'cigar');

Result Sequence
--------------------------------------------------------------------------------
-N- -O- (I) -S- -E-
(R) (A) -P- (I) -D-
-V- .I. (R) .A. -L-
.C. .I. .G. .A. .R.

Bravo! You completed Wordle 0 4/6

6 rows selected.

SQL>
```

utPLSQL

utPLSQL

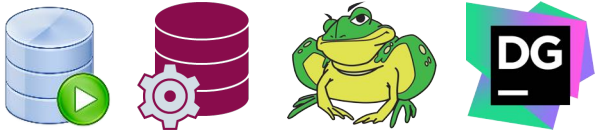
Core Testing Framework

- Schema in the database
- No repository
- Annotation based tests

ORACLE DATABASE

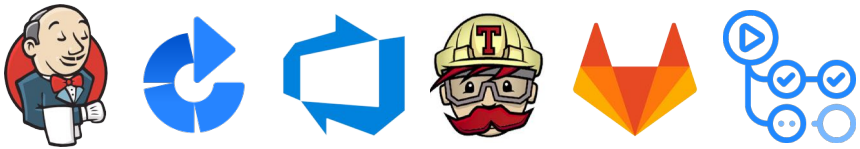
Development

- Realtime Reporter
- Code Coverage, Code Templates, etc.



Test Automation

- Command Line Client
- Maven Plugin
- Various Reporters



22 TEST DECLARATION

```
create or replace package test_suite as
   --%suite

   --%test
   procedure test_case;
end test_suite;
```

--%suite(<description>)
--%suitepath(<path>)
--%tags(<tag>[,...]
--%displayame(<description>)
--%beforeall([...])
--%afterall([...])
--%beforeeach([...])
--%aftereach([...])
--%rollback(manual)
--%disabled(<reason>)
--%context
--%endcontext

--%displayname(<description>)
--%test(<description>)
--%tags(<tag>[,...]
--%throws(<exception>[,...])
--%beforeall
--%afterall
--%beforeeach
--%aftereach
--%beforetest([...])
--%aftertest([...])
--%rollback(manual)
--%disabled(<reason>)

23 TEST IMPLEMENTATION

```
create or replace package body test_suite as
   procedure test_case is
      c_actual   sys_refcursor;
      c_expected sys_refcursor;
   begin
      -- arrange
      wordle.set_ansiconsole(false);
      -- act (solution is cigar)
      open c_actual for select column_value from wordle.play(0, 'noise', 'rapid', 'viral') where rownum <= 3;
      -- assert
      open c_expected for
         select '-N- -O- (I) -S- -E-' as column_value from dual union all
         select '(R) (A) -P- (I) -D-' from dual;
      ut.expect(c_actual).to_equal(c_expected).unordered;
   end test_case;
end test_suite;
```

Matcher:

be_between, be_empty, be_false, be_greater_than, be_greater_or_equal, be_less_or_equal, be_less_than, be_like, be_not_null, be_null, be_true, contain, **equal**, have_count, match

Extended options for refcursor, object type, JSON, nested table and varray:

- include(<items>)
- exclude(<items>)
- **unordered**
- join_by(<items>)

24 TEST RUN

```
set serveroutput on size unlimited
exec ut.run('test_suite')
```

List of ...
schema
[schema.]**package**[.procedure]
[schema]:suitepath[.context][.procedure]

Optionally extended by ...
, a_tags => 'includeTag, -excludeTag[, ...]'

```
test_suite
  test_case [.024 sec] (FAILED - 1)

Failures:

  1) test_case
      Actual: refcursor [ count = 3 ] was expected to equal: refcursor [ count = 2 ]
      Diff:
      Rows: [ 1 differences ]
      Extra:    <COLUMN_VALUE>-V- .I. (R) .A. -L-</COLUMN_VALUE>
      at "WH.TEST_SUITE.TEST_CASE", line 14 ut.expect(c_actual).to_equal(c_expected).unordered;

Finished in .026307 seconds
1 tests, 1 failed, 0 errored, 0 disabled, 0 warning(s)
```

HOW TO SIMPLIFY CODE WITH utPLSQL

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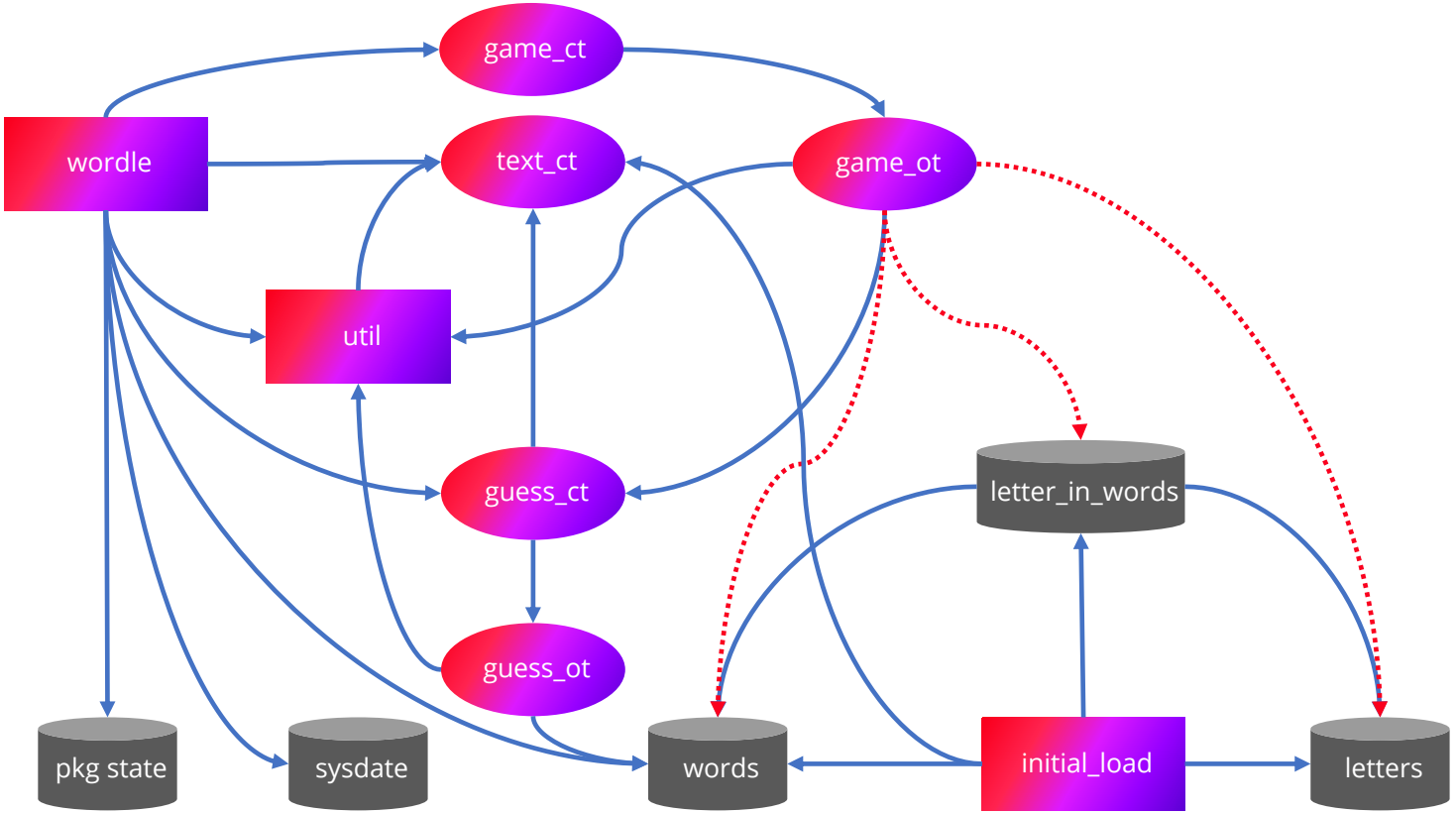
26 BE AWARE OF DEPENDENCIES AND THEIR STATES



27 API TEST

```
procedure set_hard_mode is
   c_actual   sys_refcursor;
   c_expected sys_refcursor;
begin
   -- act
   wordle.set_hard_mode(true);
   -- assert (solution is banal)
   open c_actual for
      select text
        from (select rownum as row_num, column_value as text
                from wordle.play(201, 'abcde', 'annal', 'noise'))
       where row_num < 7 or row_num = 8;
   open c_expected for
      select 'reduced input due to the following errors:' as text from dual union all
      select '- abcde is not in word list.' from dual union all
      select '- noise does not contain letter A (2 times).' from dual union all
      select '- noise''s letter #3 is not a N.' from dual union all
      select '- noise''s letter #4 is not a A.' from dual union all
      select '- noise''s letter #5 is not a L.' from dual union all
      select '(A) -N- .N. .A. .L.' from dual;
   ut.expect(c_actual).to_equal(c_expected);
end;
```

Relies on existing data and --%beforeeach

What do we want to test?

DIVIDE & CONQUER

29 REDUCE DEPENDENCIES (1)

```
procedure pattern_of_guess_annal_for_solution_banal is
   l_actual varchar2(5 char);
begin
   -- act
   l_actual := util.pattern(in_solution => 'banal', in_guess => 'annal');

   -- assert
   ut.expect(l_actual).to_equal('10222');
end;
```

30 REDUCE DEPENDENCIES (2)

```
procedure abcde_is_an_unknown_word is
   o_guess guess_ot;
begin
   -- act
   o_guess := guess_ot(
                 in_word            => 'abcde',
                 in_solution        => 'zzzzz',
                 in_previous_guess => null,
                 in_hard_mode       => 0
              );

   -- assert
   ut.expect(o_guess.errors.count).to_equal(1);
   ut.expect(o_guess.errors(1)).to_equal('abcde is not in word list.');
end;
```

31 REDUCE DEPENDENCIES (3)

```
procedure abcde_is_a_known_word is
   o_guess guess_ot;
begin
   -- arrange
   insert into words (word) values ('abcde');

   -- act
   o_guess := guess_ot(
                  in_word           => 'abcde',
                  in_solution       => 'zzzzz',
                  in_previous_guess => null,
                  in_hard_mode      => 0
              );

   -- assert
   ut.expect(o_guess.errors.count).to_equal(0);
end;
```

32 REDUCE DEPENDENCIES (4)

```
procedure revealed_hints_must_be_reused_in_hard_mode is
   o_first_guess  guess_ot;
   o_second_guess guess_ot;
begin
   -- arrange
   o_first_guess  := guess_ot(in_word => 'annal', in_solution => 'banal',
                        in_previous_guess => null, in_hard_mode => 1);
   -- act
   o_second_guess := guess_ot(in_word => 'noise', in_solution => 'banal',
                        in_previous_guess => o_first_guess, in_hard_mode => 1);
   -- assert
   ut.expect(anydata.convertcollection(o_second_guess.errors)).to_equal(
      anydata.convertcollection(
         text_ct(
            'noise does not contain letter A (2 times).',
            'noise''s letter #3 is not a N.',
            'noise''s letter #4 is not a A.',
            'noise''s letter #5 is not a L.'
         )
      )
   ).unordered;
end;
```

33 API TEST – REFACTORED

```
procedure set_hard_mode is
   l_actual integer;
begin
   -- act
   wordle.set_hard_mode(true);

   -- assert (solution is banal)
   select count(*) into l_actual
     from wordle.play(201, 'annal', 'noise')
    where column_value like '%errors%';
   ut.expect(l_actual).to_be_greater_or_equal(1);
end;
```

34 WHAT ABOUT TEST DOUBLES?

- Dummies
- Stubs
- Spies
- Mocks
- Fakes

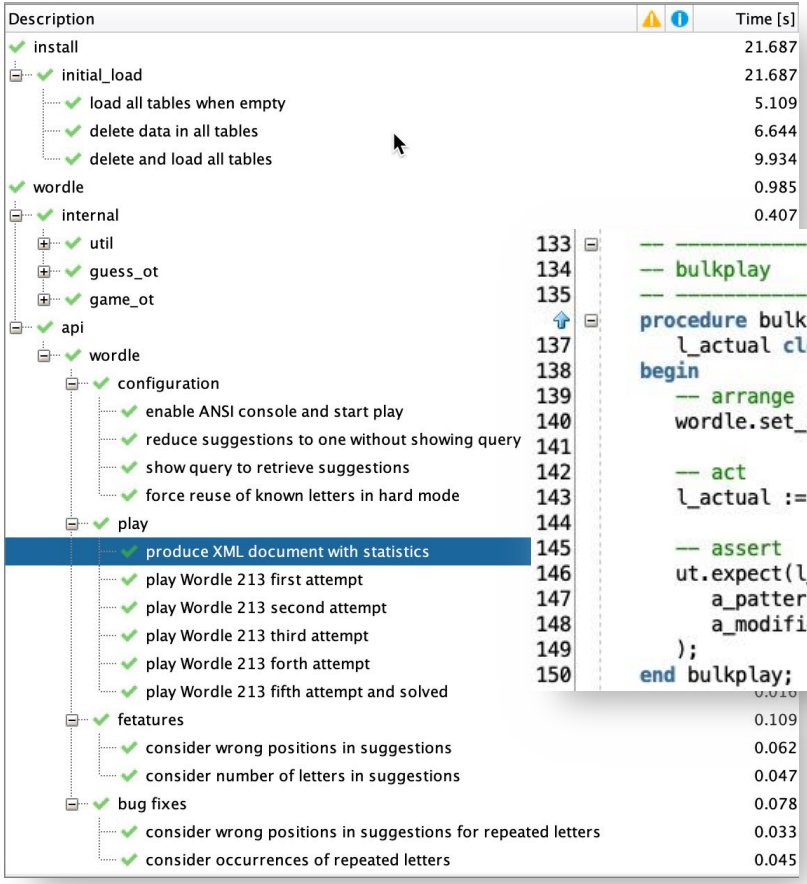
Source: Heidi Moneymaker, https://www.instagram.com/p/BlLm4tCBzyJ/

Requires usually a dedicated test schema

Missing frameworks

Good option for 3rd party system access

35 DEMO




```
133  -- ------------------------------------------------------------------------------
134  -- bulkplay
135  -- ------------------------------------------------------------------------------
136  procedure bulkplay is
137     l_actual clob;
138  begin
139     -- arrange
140     wordle.set_hard_mode(true);
141
142     -- act
143     l_actual := wordle.bulkplay(in_from_game_id => 867, in_to_game_id => 869).getstringval();
144
145     -- assert
146     ut.expect(l_actual).to_match(
147        a_pattern   => '^<bulkplay>.*<solved_games_percent>66.67</.*10 rows only',
148        a_modifiers => 'n'
149     );
150  end bulkplay;
```

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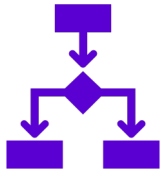
CORE MESSAGES

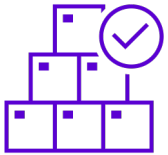
37 BY WRITING A utPLSQL TEST YOU ...

- Describe how to use a piece of software

- Reduce dependencies to make testing
  - simpler
  - faster
  - deterministic



- Simplify code



TOGETHER WE ARE #1 PARTNER FOR BUSINESSES TO HARNESS THE POWER OF DATA FOR A SMARTER LIFE

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