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Erlang SOLUTIONS

Erlang e-learning

Automatic Assessment of Erlang Code

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Is this talk a sales pitch?

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About Erlang e-learning

- Learn anytime, anywhere
  - No temporal constraints
  - No geographical constraints
  - No economic constraints
- Enhanced face-to-face training
- Asynchronous learning
- Knowledge Transfer Partnership (KTP)

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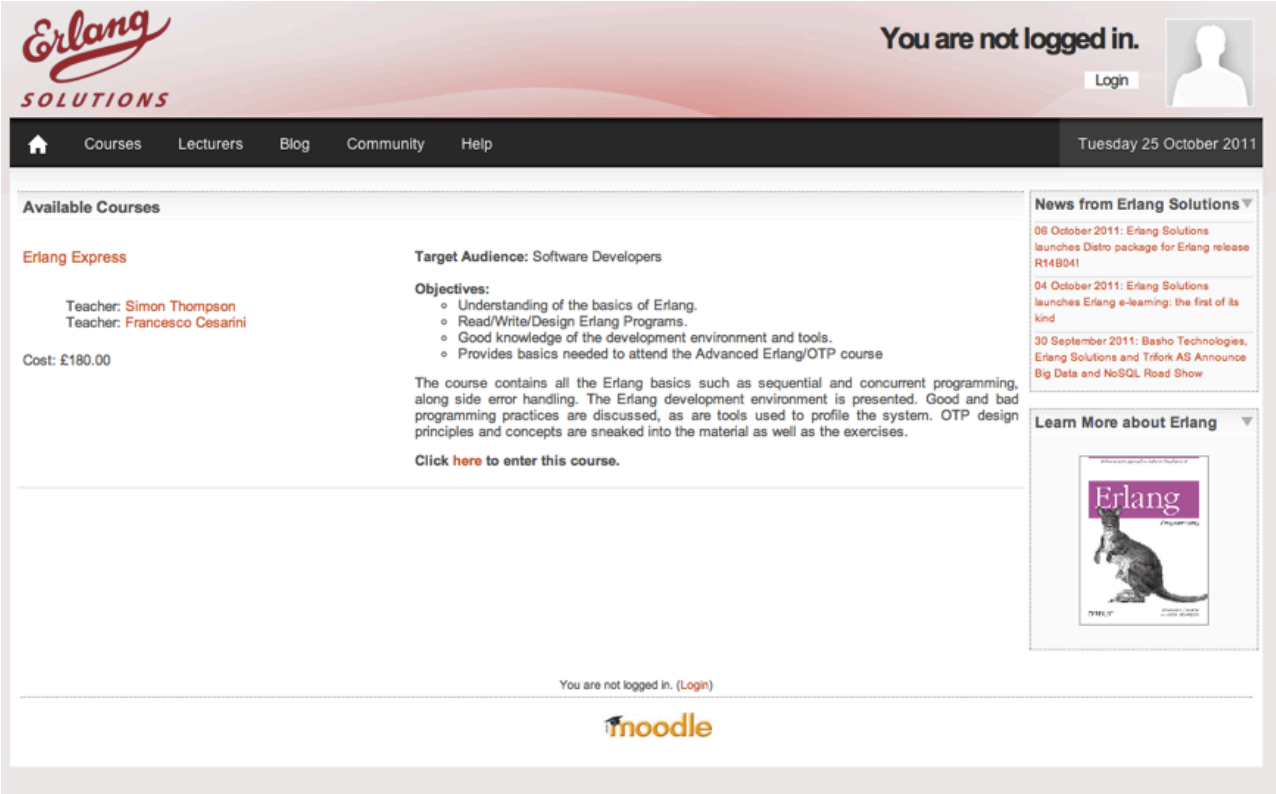
What is Erlang e-learning?



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The Feedback Tool

WHAT?

Automatic assessment of Erlang programming exercises

WHY?

Feedback to students in mass courses

Increase the quality of distance learning

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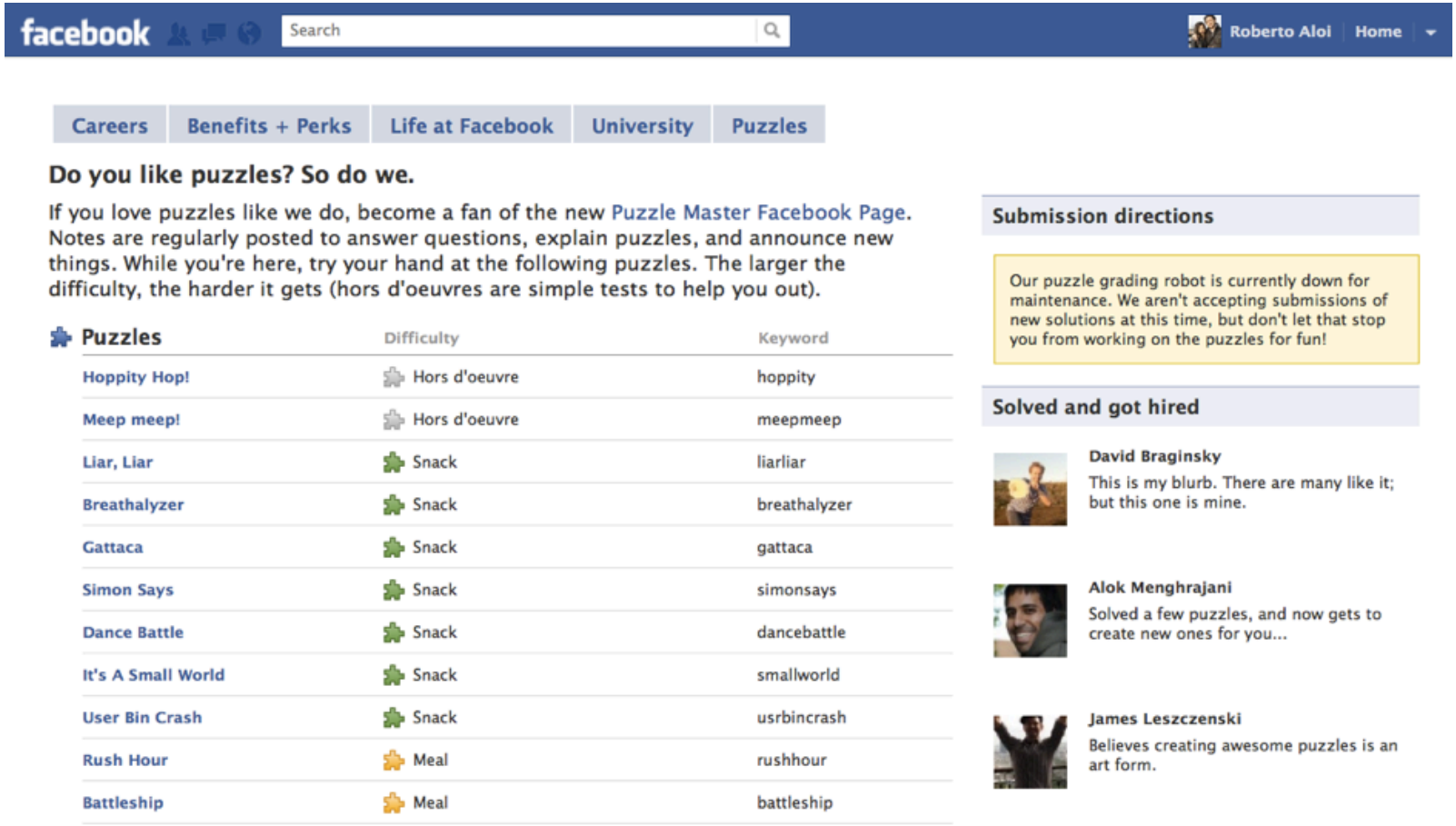
Facebook Puzzles



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Project Euler

Project Euler.net

Problems

1 2 3 4 5 6 7 8 Go to Problem:

ID	Description / Title	Solved By
1	Add all the natural numbers below one thousand that are multiples of 3 or 5.	175941
2	By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms.	145772
3	Find the largest prime factor of a composite number.	105970
4	Find the largest palindrome made from the product of two 3-digit numbers.	98000
5	What is the smallest number divisible by each of the numbers 1 to 20?	110234
6	What is the difference between the sum of the squares and the square of the sums?	112072
7	Find the 10001st prime.	94009
8	Discover the largest product of five consecutive digits in the 1000-digit number.	83207
9	Find the only Pythagorean triplet, $\{a, b, c\}$, for which $a + b + c = 1000$.	83159
10	Calculate the sum of all the primes below two million.	75516
11	What is the greatest product of four adjacent numbers on the same straight line in the 20 by 20 grid?	57370
12	What is the value of the first triangle number to have over five hundred divisors?	50393
13	Find the first ten digits of the sum of one-hundred 50-digit numbers.	56992
14	Find the longest sequence using a starting number under one million.	54997

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The Project Euler Flow

Problem 1

05 October 2001

If we list all the natural numbers below 10 that are multiples of 3 or 5, we get 3, 5, 6 and 9. The sum of these multiples is 23.

Find the sum of all the multiples of 3 or 5 below 1000.

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The Project Euler Flow

```
#include <iostream>

using namespace std;

int main()
{

  const long long NUM = 1000;
  long long res = 0;

  for (int i = NUM - 1; i > 1; i--)
      if ( ( i % 3 == 0 ) || ( i % 5 == 0 ) )
      {
         res += i;
         cout << i << "   ";
      }

  cout << "A soma dos números é: " << res << "\n";

  cout << "Pressione qualquer tecla para continuar";
  cin.get();
  return 0;

}
```

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The Project Euler Flow

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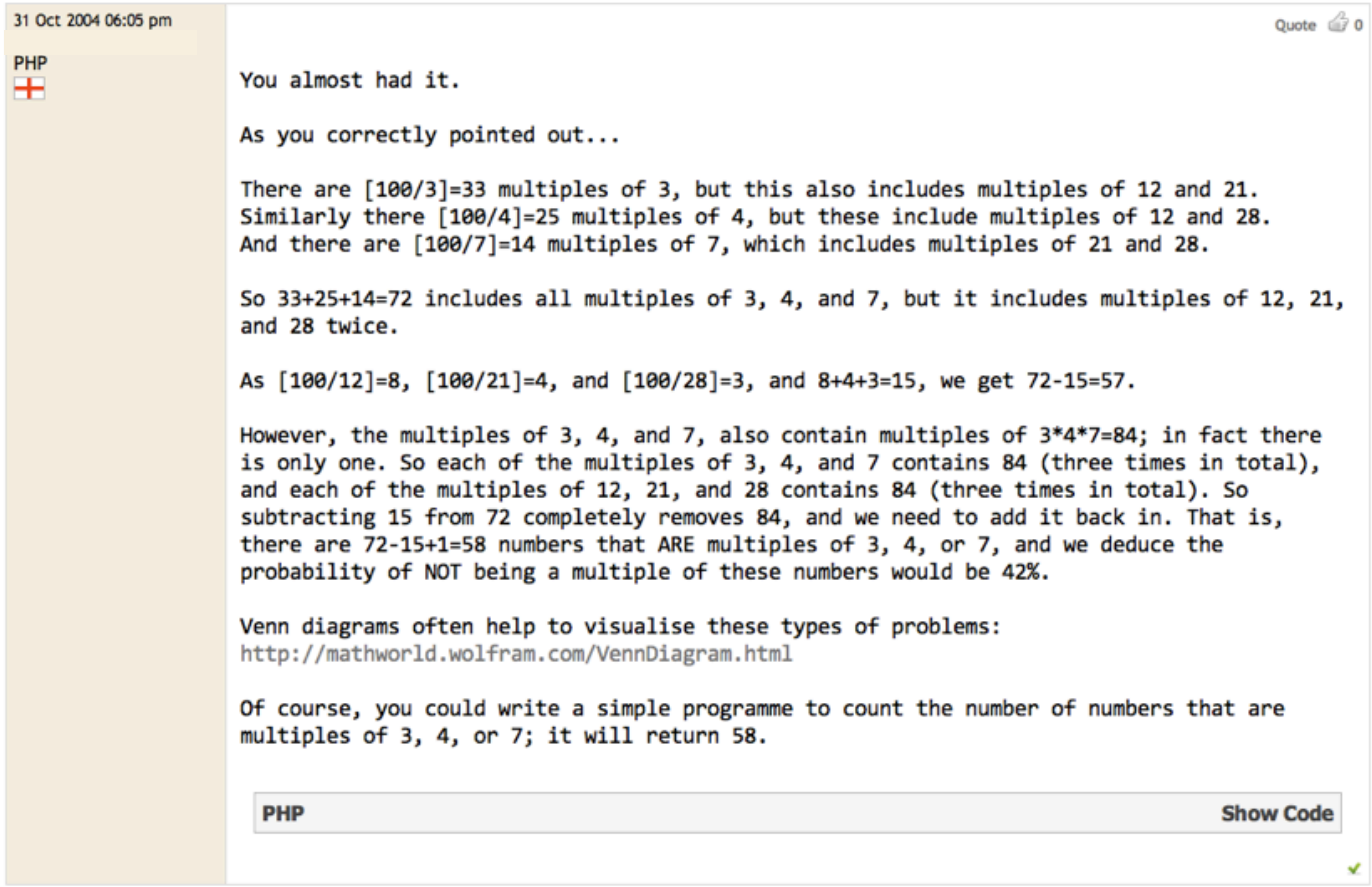
The Project Euler Flow



31 Oct 2004 06:05 pm

PHP

Quote 0

You almost had it.

As you correctly pointed out...

There are [100/3]=33 multiples of 3, but this also includes multiples of 12 and 21.
Similarly there [100/4]=25 multiples of 4, but these include multiples of 12 and 28.
And there are [100/7]=14 multiples of 7, which includes multiples of 21 and 28.

So 33+25+14=72 includes all multiples of 3, 4, and 7, but it includes multiples of 12, 21, and 28 twice.

As [100/12]=8, [100/21]=4, and [100/28]=3, and 8+4+3=15, we get 72-15=57.

However, the multiples of 3, 4, and 7, also contain multiples of 3*4*7=84; in fact there is only one. So each of the multiples of 3, 4, and 7 contains 84 (three times in total), and each of the multiples of 12, 21, and 28 contains 84 (three times in total). So subtracting 15 from 72 completely removes 84, and we need to add it back in. That is, there are 72-15+1=58 numbers that ARE multiples of 3, 4, or 7, and we deduce the probability of NOT being a multiple of these numbers would be 42%.

Venn diagrams often help to visualise these types of problems:
http://mathworld.wolfram.com/VennDiagram.html

Of course, you could write a simple programme to count the number of numbers that are multiples of 3, 4, or 7; it will return 58.

PHP Show Code

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SUMMATIVE ASSESSMENT

Measure the level of success or proficiency that has been obtained at the end of an instructional unit, by comparing it against some standard or benchmark

vs

FORMATIVE ASSESSMENT

Serving to form something, especially having a profound and lasting influence on a person's development

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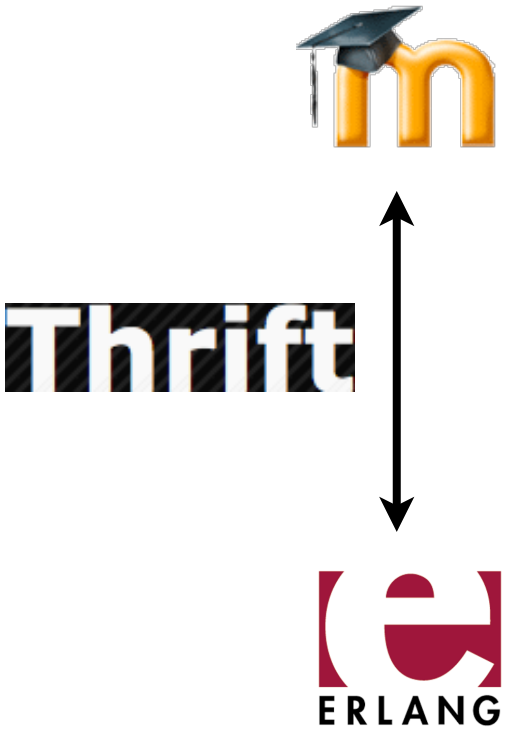
What kind of feedback?

- Syntactic
- Logical
- Stylistic

Let's not re-invent the wheel!

- Compiler
- Dialyzer
- Wrangler
- EUnit
- QuickCheck / PropEr
- Tracer

Behind the Scenes




```
$ft = new Feedbacktool();
$job = new FTJob();
[...]
$job_id = $ft->compute($job);
```

```
compute(Job) ->
    [...]
    JobId.
```

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Sand-boxing

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Sand-boxing

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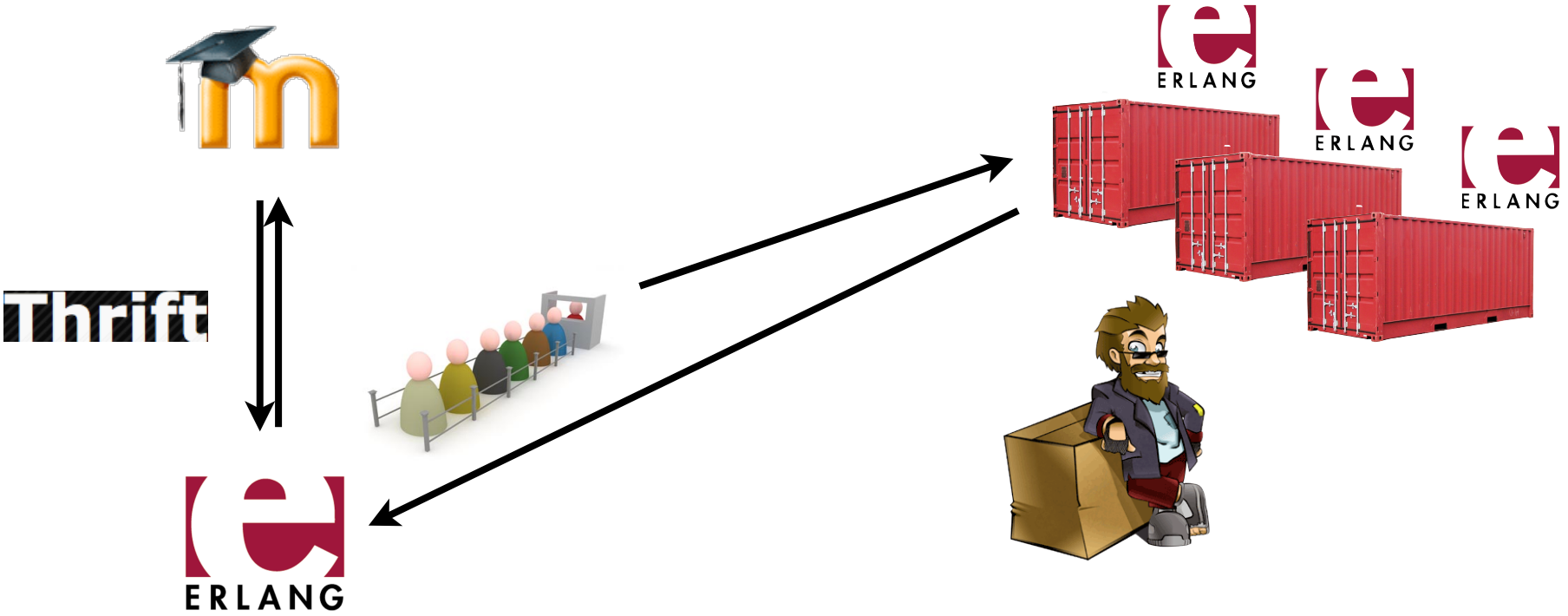
Sand-boxing



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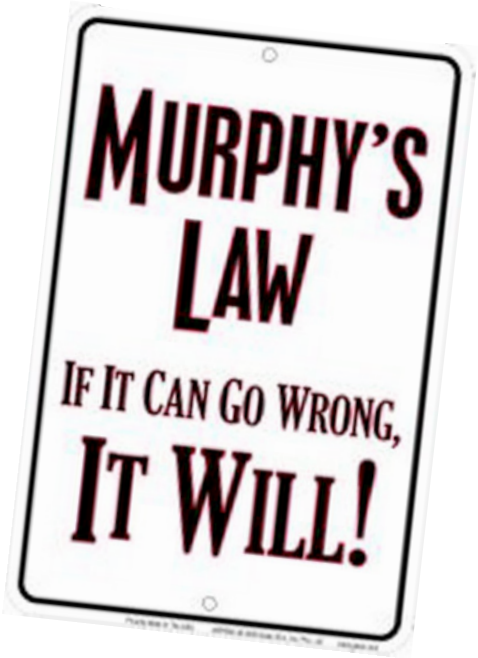
DEMO TIME



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Things fail...
... so do automatic tools

- Manually monitor selection of solutions
  - Identify common error patterns
  - Incrementally improve automatic feedback
- "Ask the teacher" button
- Traditional forums

This was the student's perspective

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The Teacher's Perspective

- Invent an exercise (or use an existing one)
- Write a solution for it
- Write tests for your solution
- Plug it into the Feedback Tool
- Configure

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Invent an exercise

"Write a '*create*' module which contains a function named '*create*' which takes an integer *N* as an input and returns a list of the format:

```
[1,2,..,N-1,N]
```

Add to the same module a second function, named '*reverse_create*', which returns a list of the format:

```
[N,N-1,..,2,1]
```

You may not use the `lists:reverse/1` function."

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Write a Solution for It...

```
-module(create).
-export([create/1, reverse_create/1]).
create(0) -> [];
create(N) ->
    create_acc(N, []).
create_acc(0, Result) -> Result;
create_acc(N, Result) ->
    create_acc(N - 1, [N|Result]).

reverse_create(0) -> [];
reverse_create(N) ->
    reverse_create_acc(N, 1, []).

reverse_create_acc(N, M, Result) when N + 1 =:= M  -> Result;
reverse_create_acc(N, M, Result) ->
    reverse_create_acc(N, M + 1, [M|Result]).
```

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...And the tests for it.

```
-module(create_tests).

-include_lib("eqc/include/eqc.hrl").
-include_lib("eunit/include/eunit.hrl").

[...]

prop_create() ->
    ?FORALL(I, int(),
      ?IMPLIES(I =/= 0,
        begin
            N = abs(I),
            lists:seq(1,N) =:= create:create(N)
        end)).
```

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Plug it into the Feedback Tool

```
-module(test_create).
-behaviour(ft_adapter).
-include_lib("ft_worker/include/ft_lib.hrl").
-export([test_it/1, compile_required/0]).

test_it(_Options) ->
    TestSuite = ft_lib:eunit(create_tests, []),
    [build_message(TestCase) || TestCase <- TestSuite#testsuite.testcases].

compile_required() ->
    [{"create_tests.erl", []}].

% Internal function
build_message(TC) ->
    ft_lib:build_message(TC).
```

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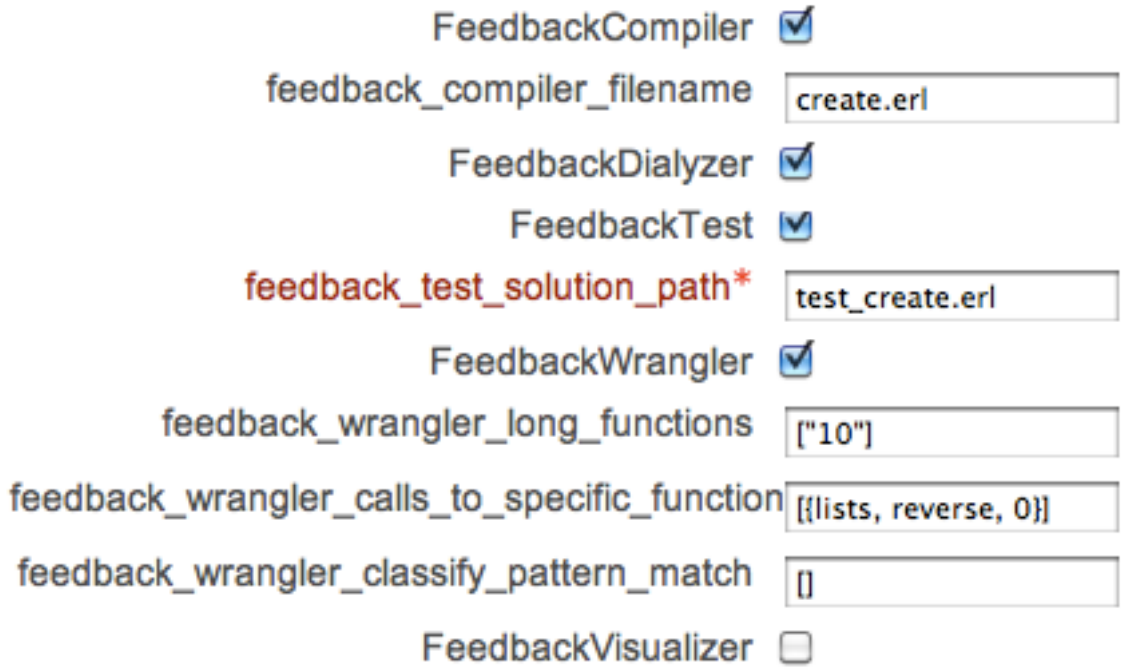
Configure



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The developer's Perspective

(extending the Feedback Tool)

- Implement a plugin back-end
- Implement a plugin front-end

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Implement a plugin back-end

```
-module(ftw_plugin).

-export([behaviour_info/1]).

behaviour_info(callbacks) ->
    [{do, 2}, {stop, 1}];
behaviour_info(_) ->
    undefined.
```

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Implement a plugin back-end

```
-module(feedback_custom).

-behaviour(ftw_plugin).

-include_lib("ft_util/include/feedbacktool_types.hrl").

-export([do/2, stop/1]).

-spec do([string()], [#fTOption{}]) ->
    {ok, #fTFeedback{}}.
do(Files, Options) ->
    Messages = messages(),
    Status = true,
    {ok, #fTFeedback{status = Status, messages = Messages}}.

-spec stop(term()) -> ok.
stop(_Reason) -> ok.
```

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Implement a plugin front-end

```
<?php

require_once("path/to/feedback_tool.php");

class FeedbackCustom
{

  private $code = '';

  public function FeedbackCustom($options = array()) {
  }

  public function render($message) {
      $this->code .= FeedbackTool::render($message);
  }

  public function terminate() {
  }

  public function getCode() {
      return $this->code;
  }

  public function supportedOptions() {
      return array();
  }
}
```

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The Wrangler Example

```
test() ->
    V = unnecessary_match,
    V.
```

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The Wrangler Example

```
unnecessary_match(SearchPaths) ->
   Funs=?FULL_TD_TU([?COLLECT(?T("Body@@, V@=Expr@, V@"),
                              {_File@,
                              wrangler_misc:start_end_loc(lists:nthtail(length(Body@@),
                              _This@))},
                              api_refac:type(V@) == variable andalso
                              length(api_refac:var_refs(V@))==1)],
                     SearchPaths),
   Res = [begin
              Msg = lists:flatten(
                      io_lib:format("This is an unnecessary match
                      expression at line ~p.",
                                    [Ln])),
              {Msg, [{file, File},
                     {line, integer_to_list(Ln)}]}
          end || {File, {{Ln, _}, _}}<-Funs],
   {ok, Res}.
```

Collect info from each template meeting the condition

Give a message for each instance

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The Wrangler Example

Options = [... , {unnecessary_match, []}, ...].

```
-module(feedback_wrangler).

-behaviour(ftw_plugin).

-include_lib("ft_util/include/feedbacktool_types.hrl").

-export([do/2, ... ]).

do(SearchPaths, Options) ->
    api_wrangler:start(),
    ...
    M = inspec_feedback_wrangler:do_code_inspection(SearchPaths, Options),
    api_wrangler:stop(),
    {ok, #fTFeedback{status   = true,
                     crash    = false,
                    type     = ?MODULE,
                     messages = build_messages(M)}}.

...

build_message(M) ->
    #fTFeedbackMessage{
                        ...
                        message = list_to_binary(Msg),
                        options = ...,
                        custom  = ...}.
```

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Future Improvements

- More augmented feedback
- More accurate tests
- Line numbers and visualizer
- Web-based IDE
- Cloud (Travis CI / Moebius)

Wish List

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- Kryzstof Rutka

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