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External Language Stored Procedures

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Example: Non Trivial Sorting

Requirements:

Sort by first vowel (pig-latin)

Options:

- 1) Ignore it: Sort on the client.
- 2) Rewrite in existing UDF/SP framework.
- 3) Somehow use existing business logic in the server.

Ideal Select:

```
SELECT name, email
FROM accounts
WHERE ?
ORDER BY pig_latin(name)
LIMIT ?, ?
```

```
1 package org.example.mysql.udf;
2
3 public class PigLatin {
4
5     public static String toPigLatin(String english) {
6         if (english == null) {
7             return null;
8         }
9         boolean allUpper = allUpper(english);
10
11         String[] words = english.split(" ");
12
13         StringBuffer pigLatin = new StringBuffer();
14
15         for (int i = 0; i < words.length; i++) {
16             pigLatin.append(
17                 pigLatinizeWord(words[i], allUpper));
18             pigLatin.append(" ");
19         }
20
21         return pigLatin.toString().trim();
22     }
23 }
```

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Demo of Java Stored Procedures

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Perl Stored Procedures

Perl stored routines are declared in standard Perl modules.

```
CREATE PROCEDURE test.PperlPrimes1(top_limit INT)
LANGUAGE Perl    NO SQL    DYNAMIC RESULT SETS 1
EXTERNAL NAME 'MyUDFExample::testprimes';
```

```
CALL test.PperlPrimes1(50);
```

What works:
IN/OUT parameters.
Dynamic SQL with
DBD::mysql
Result sets from
hashes and arrays.

```
83 sub testprimes($)
84 {
85     my ($max_param)= @_;
86     # code from http://timjoh.com/calculate-prime-numbers-with-perl/
87
88     # The array where the primes will be stored
89     my @primes = (2);
90     # The maximum number of iterations
91     my $max = int $max_param;
92     # The starting iteration
93     my $i = 2;
94     # Whether the current loop is to be broken
95     my $b = 1;
96     # Start the loop
97     while ($i < $max) {
98         my $n;
```

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Demo of Perl Stored Procedures

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Server Impact

Minimal parser changes

Extends existing stored procedure implementation

Very minor change to system tables

Recursion handling

Refactor Protocol handling for inline embedded SQL

Client library: extended to support inline dynamic SQL

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The Internals: How it works

“External Language” implementations are a type of MySQL plug-in

Summary of plug-in interface

`foo_udf_plugin_init` - initialize the plugin

`foo_udf_find` - get a handle to routine

`foo_udf_execute` - call your routine

`foo_udf_release` - cleanup routine handle

`foo_udf_plugin_deinit` - tear down plugin

Callback interface for storing/retrieving values from the server

The Internals: How it works (part 2)

```
1 struct st_mysql_callback
2 {
3     /* store with idx == -1 for function results */
4     int store_null(int idx);
5     int store_integer(int idx, long long nr, char unsigned_val);
6     int store_string(int idx, const char *str, int length,
7                     struct charset_info_st *cs);
8     int store_double(int idx, double nr, int precision);
9
10    int val_null(int idx);
11    long long val_integer(int idx);
12    double val_double(int idx);
13    const char *val_string(int idx, char *str, int *length,
14                          struct charset_info_st **cs);
15
16    int row_field(const char *title, int field_type,
17                int size, int precision);
18    int row_prepare();
19    int row_send();
20    int row_send_eof();
21 };
22
```


Extensibility: The Sky is the Limit

Not just for Perl and Java...

Can be used as a replacement to the MySQL UDF API for user-defined extensions.

Example: XML-RPC

```
mysql> create function xml_get_state(id int) returns text
      -> no sql language xmlrpc external name
      -> 'xmlrpc://betty.userland.com/RPC2;examples.getStateName';
Query OK, 0 rows affected (0.00 sec)
```

```
mysql> select xml_get_state(40);
+-----+
| xml_get_state(40) |
+-----+
| South Carolina    |
+-----+
1 row in set (0.42 sec)
```

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Tour of XML-RPC Plug-in Source

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Security and Limitations

Basic user Create/Execute control by GRANT/REVOKE statements

Specific language plugins are responsible for their own sandboxes

No support for aggregate functions yet

Not yet delivered an 'adaptor' for legacy UDF support

Plugins run in-process with MySQL daemon

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The future

Code available today

<https://code.launchpad.net/~starbuggers/mysql/mysql-5.1-wl820>

Planned:

- * Feature preview binaries to download
- * Type 2 Connector/J Driver
- * Legacy UDF adaptor
- * Fenced plugin adaptor
- * Additional languages: LUA, Ruby, Python...

Pipe-dreams?

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Questions?

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