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# GlideQuery

## An expressive API with an emphasis on safety

**Peter Bell**
Senior Software Engineer

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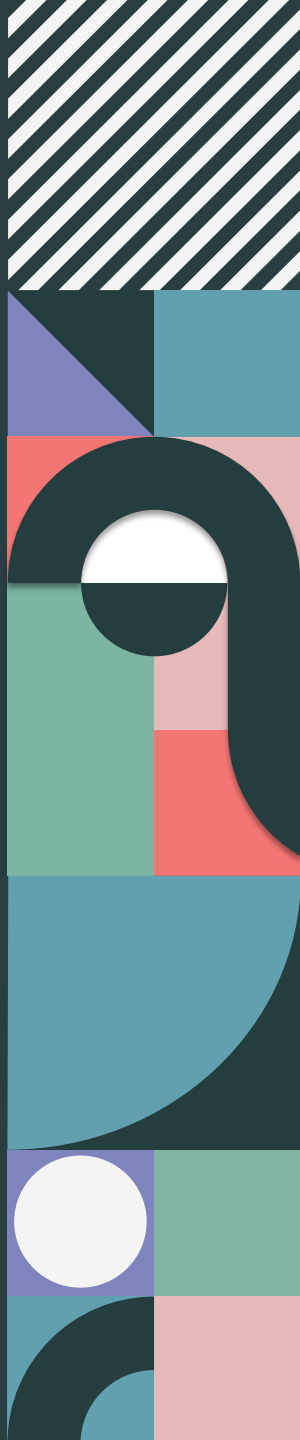

ServiceNow speakers

# Speaker introduction

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**Name:** Peter Bell

**Title:** Senior Software Engineer

**Function:** SAM and COVID-19 Emergency Response development

**Company:** ServiceNow

**Experience/expertise:** 15 years in the software industry using .NET, Go, JavaScript, Elixir, and the Now platform.

**Achievements:** Designed and implemented GlideQuery for use in the ITAM (and beyond) organization. Developed code linting tools to improve code quality in ITAM.

**Current projects:** Developing apps to improve state and private organizations response to the COVID-19 outbreak.

**Company bio:** I love cycling, baseball, software, and my family. Writing software tools to improve software development is my passion.



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# What is GlideQuery?

Server-side API for querying data

Written in 100% JavaScript (global Script Include)

Uses GlideRecord behind the scenes

Started as a side project, but is now being used in production in Orlando and Paris



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# GlideQuery Principles

**Fail Fast**


**Be JavaScript**


**Expressive**



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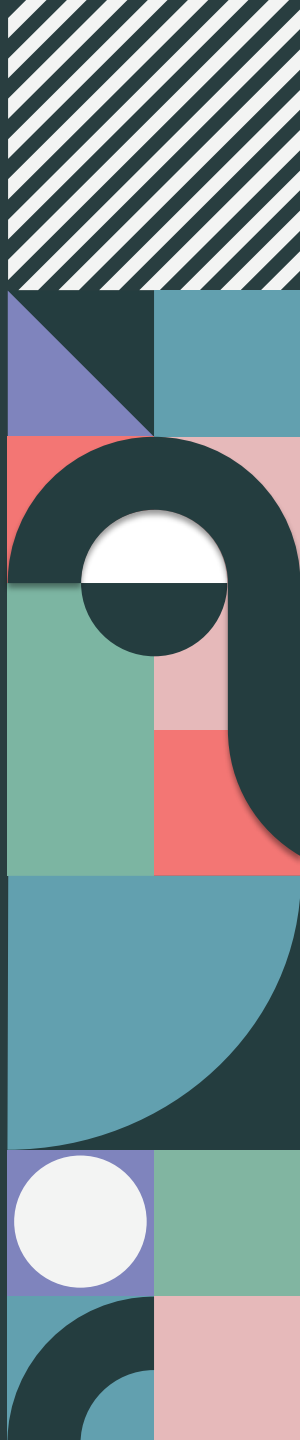
# Fail Fast

## Improving the feedback loop



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# Field checking

```
var gr = new GlideRecord('task')
gr.addQuery('closed_date', '<', ‘2016-01-01');
gr.query();
gr.deleteMultiple();
```



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# Field checking

```
var gr = new GlideRecord('task')
gr.addQuery('closed_date', '<', ‘2016-01-01');
gr.query();
gr.deleteMultiple();

// EVERY task deleted! 😨
```



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# Field checking

```
new GlideQuery('task')
    .where('closed_date', '<', '2016-01-01')
    .del();

// Error: Unknown field 'closed_date' in table 'task'. Known fields:
// [
//     "parent",
//     "made_sla",
//     "watch_list",
//     "closed_at",
//     ...
```



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# Choice checking

```
var gr = new GlideRecord('task');
gr.addQuery('approval', 'not_requested');
gr.query();

while (gr.next()) {
   doSomething(gr.assigned_to, gr.description);
}

// no results 🤔
```



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# Choice checking

```
var tasks = new GlideQuery('task')
    .where('approval', 'not_requested')
    .select('assigned_to', 'description')
    .forEach(doSomething);


// Error: Invalid choice 'not_requested' for field 'approval' (table 'task'). // Allowed values:
// [
//     "not requested",
//     "requested",
//     "approved",
//     "rejected"
// ]
```



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# Type checking

```
var gr = new GlideRecord('task');
gr.addQuery('priority', '<', 'V');
gr.addQuery('location.country', 'United Kingdom');
gr.query();

while (gr.next()) {
   sendNotification(gr);
}
```



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# Type checking

```
new GlideQuery('task')
    .where('priority', '<', 'V')
    .orWhere('location.country', 'United Kingdom')
    .select('assigned_to')
    .forEach(sendNotification)

// Unable to match value 'V' with field 'priority' in
// table 'task'. Expecting type 'integer'
```



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# Business Rule update/insert checks

```
var entitlementGr = new GlideRecord('alm_license');
entitlementGr.addQuery('sys_id', entitlement.sys_id);
entitlementGr.setValue('end_date', '2016-04-15');
entitlementGr.setValue('start_date', '2020-04-15');
entitlementGr.update(); // business rule will reject update

// code keeps running...
```


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# Business Rule update/insert checks

```
new GlideQuery('alm_license’)
   .where('sys_id', entitlement.sys_id)
   .update({
      end_date: '2016-04-15’,
      start_date: '2020-04-15’,
   });

// {
//    message: 'Failure to update table',
//    table: 'alm_license',
//    lastGlideError: 'Operation against file 'alm_license' was aborted by
//       Business Rule 'Check for valid date range^011783713750200044e0bfc8bcbe5d81'.
//       Business Rule Stack:Check for valid date range',
//    changes: {
//       end_date: '2016-04-15',
//       start_date: '2020-04-15'
//    }
// }
```



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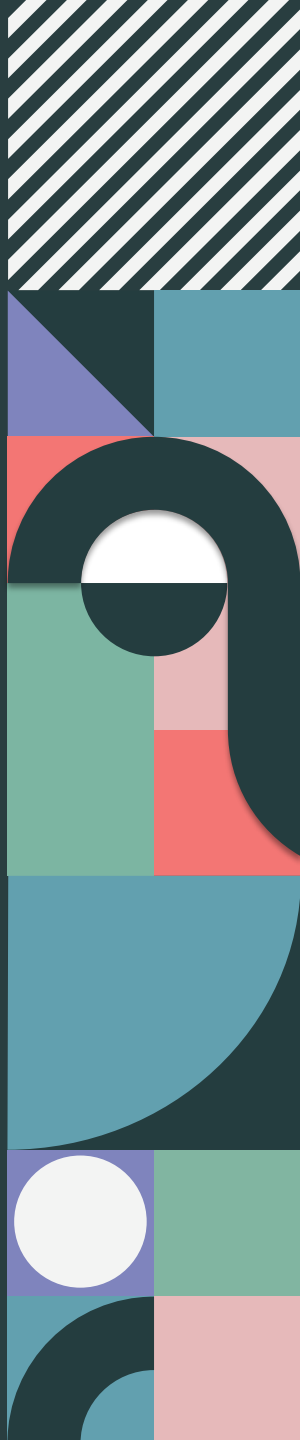
# Be JavaScript

## Isolation from Java



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# Stringly-typed values

```
var userGr = new GlideRecord('sys_user');
userGr.addQuery('first_name', 'Fred');
userGr.query();

if (userGr.next()) {
   gs.log(userGr.first_name)           // "Fred"
   gs.log(userGr.first_name === 'Fred'); // false (wut?)
   gs.log(typeof (userGr.first_name));   // "object"
}
```



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# Stringly-typed values

```
var gr = new GlideRecord('task');
gr.query();

while (gr.next()) {
   if (gr.getValue('active')) {
      sendEmail(gr.assigned_to);
   } else {
      gr.setValue('active', false);
      gr.update();
   }
}
```



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# Stringly-typed values

```
var gr = new GlideRecord('task');
gr.query();

while (gr.next()) {
   if (gr.getValue('active')) { // “0” always truthy
      sendEmail(gr.assigned_to);
   } else {
      gr.setValue('active', false);
      gr.update();
   }
}
```



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# JavaScript values

```
var taskGa = new GlideAggregate('task');
taskGa.addAggregate('COUNT');
taskGa.query();
taskGa.next();
var numRows = taskGa.getAggregate('COUNT'); // returns a string


var numRows = new GlideQuery('task').count(); // return a number :)

// true: 10 > 2
// false: '10' > '2'
```



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# JavaScript values

```
new GlideQuery('task')
    .whereNotNull('parent')
    .selectOne('description', 'active', 'parent.urgency')
    .get()

// {
//     "sys_id": "8b9ac8badba52200a6a2b31be0b8f5eb",
//     "description": null,
//     "active": true,
//     "parent": {
//         "urgency": 3
//     }
// }
```



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# Java Stracktraces

(sys_script_include.2f331e7d73912300bb513198caf6a711.script; line 145):
org.mozilla.javascript.gen.sys_script_include_2f331e7d73912300bb513198caf6a711_script_4210._c_raise_11(sys_script_include.2f331e7d73912300bb513198caf6a711.script:145)
org.mozilla.javascript.gen.sys_script_include_2f331e7d73912300bb513198caf6a711_script_4210.call(sys_script_include.2f331e7d73912300bb513198caf6a711.script)
org.mozilla.javascript.ScriptRuntime.doCall2(ScriptRuntime.java:2651)
org.mozilla.javascript.ScriptRuntime.doCall(ScriptRuntime.java:2590)
org.mozilla.javascript.optimizer.OptRuntime.call1(OptRuntime.java:32)
org.mozilla.javascript.gen.sys_script_include_4e115aed73512300bb513198caf6a749_script_2574._c_checkField_25(sys_script_include.4e115aed73512300bb513198caf6a749.script:333)
org.mozilla.javascript.gen.sys_script_include_4e115aed73512300bb513198caf6a749_script_2574.call(sys_script_include.4e115aed73512300bb513198caf6a749.script)
org.mozilla.javascript.ScriptRuntime.doCall2(ScriptRuntime.java:2651)
org.mozilla.javascript.ScriptRuntime.doCall(ScriptRuntime.java:2590)
org.mozilla.javascript.optimizer.OptRuntime.callN(OptRuntime.java:52)
org.mozilla.javascript.gen.sys_script_include_d52b3c8a08013300fa9b4300d8d67a76_script_2477._c_executePlan_14(sys_script_include.d52b3c8a08013300fa9b4300d8d67a76.script:142
)
org.mozilla.javascript.gen.sys_script_include_d52b3c8a08013300fa9b4300d8d67a76_script_2477.call(sys_script_include.d52b3c8a08013300fa9b4300d8d67a76.script)
org.mozilla.javascript.ScriptRuntime.doCall2(ScriptRuntime.java:2651)
org.mozilla.javascript.ScriptRuntime.doCall(ScriptRuntime.java:2590)
org.mozilla.javascript.optimizer.OptRuntime.callN(OptRuntime.java:52)
org.mozilla.javascript.gen.sys_script_include_d52b3c8a08013300fa9b4300d8d67a76_script_2477._c_executeSelectQuery_35(sys_script_include.d52b3c8a08013300fa9b4300d8d67a76.s
cript:383)
org.mozilla.javascript.gen.sys_script_include_d52b3c8a08013300fa9b4300d8d67a76_script_2477.call(sys_script_include.d52b3c8a08013300fa9b4300d8d67a76.script)
org.mozilla.javascript.ScriptRuntime.doCall2(ScriptRuntime.java:2651)
org.mozilla.javascript.ScriptRuntime.doCall(ScriptRuntime.java:2590)
org.mozilla.javascript.optimizer.OptRuntime.callN(OptRuntime.java:52)
org.mozilla.javascript.gen.sys_script_include_d52b3c8a08013300fa9b4300d8d67a76_script_2477._c_createQuerySession_27(sys_script_include.d52b3c8a08013300fa9b4300d8d67a76.sc
ript:312)

…and a lot more


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# GlideQuery stacktrace

```
Error: Unknown field 'las_name' in table 'sys_user'. Known fields:
[
   "country",
   "calendar_integration",
   ...
]
----- STACK TRACE -----
at [global] 'Schema' [sys_script_include:4e115aed73512300bb513198caf6a749]:333 (checkField)
at [global] 'GlideQueryEvaluator' [sys_script_include:d52b3c8a08013300fa9b4300d8d67a76]:142 (executePlan)
at [global] 'GlideQueryEvaluator' [sys_script_include:d52b3c8a08013300fa9b4300d8d67a76]:383 (executeSelectQuery)
at [global] 'GlideQueryEvaluator' [sys_script_include:d52b3c8a08013300fa9b4300d8d67a76]:312 (createQuerySession)
at [global] 'GlideQueryEvaluator' [sys_script_include:d52b3c8a08013300fa9b4300d8d67a76]:330 (selectOne)
at [global] 'GlideQuery' [sys_script_include:864c9ebf73631300bb513198caf6a721]:250 (selectOne)
at [sn_sam_saas] 'Sam Spend Transaction Import' [sys_transform_script:749c202cb1813300fa9bc2e917496ad9]:2 (runTransformScript)
at [sn_sam_saas] 'Sam Spend Transaction Import' [sys_transform_script:749c202cb1813300fa9bc2e917496ad9]:1
at [global]'SamSpendImportTransactionUtil' [sys_script_include:13c2664477603300edfc0ff9ba106153]:225 (anonymous)
at [global] 'SamSpendImportTransactionUtil' [sys_script_include:13c2664477603300edfc0ff9ba106153]:50 (anonymous)
at [global] 'SamSpendTransactionImportJob' [sys_script_include:544fe4b677a13300edfc0ff9ba10611e]:6 (anonymous)
at [global] 'AssetManagementBaseJob' [sys_script_include:545738685383130099 61ddeeff7b1296]:123 (anonymous)
at [sn_sam_saas] 'SAM - Import Spend Transactions' [sysauto_script:61847fe04c603300fa9bb64c2b491dac]:2 (anonymous)
at [sn_sam_saas] 'SamSpendLogUtil' [sys_script_include:1c47710d7c013300fa9b2451daf591b5]:41 (anonymous)
at [sn_sam_saas] 'SAM - Import Spend Transactions' [sysauto_script:61847fe04c603300fa9bb64c2b491dac]:1
-----------------------------
```



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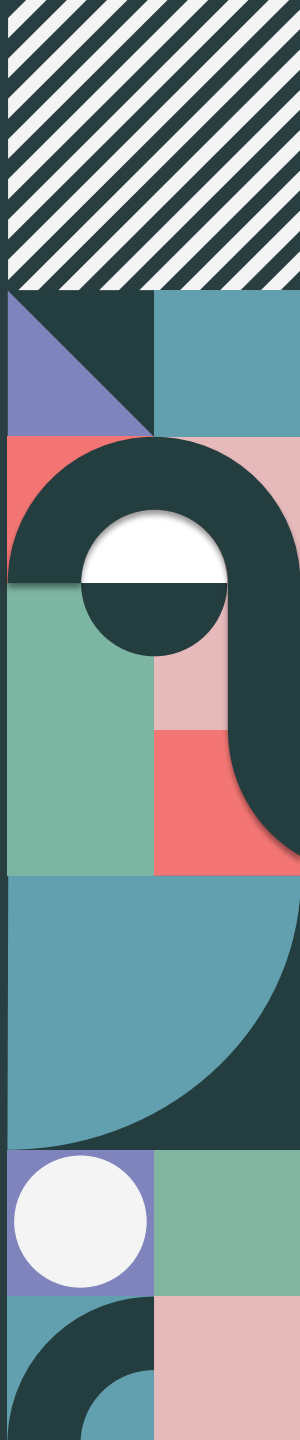
# Expressive

Do more with less



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# Reading data

## Stream

- Used for reading multiple records
- Returned by select()
- Is lazily evaluated
- Common Stream methods:
  - map
  - flatMap
  - forEach
  - reduce
  - some/any

## Optional

- Used for reading a single record
- Returned by selectOne(), insert(), and update()
- Is considered “empty” if a record isn’t found by query
- Common Optional methods:
  - get [throws if empty]
  - map
  - isEmpty
  - isPresent
  - ifPresent
  - orElse


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# map and forEach

```
new GlideQuery('sys_user')
    .whereNotNull('name')
    .select('name')
    .map(function (user) { return user.name.toUpperCase(); })
    .forEach(gs.log);

// LUCIUS BAGNOLI
// JIMMIE BARNINGER
// MELINDA CARLETON
// JEWEL AGRESTA
// ...
```



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# some and every

```
var hasOnlyShortDescriptions = new GlideQuery('task')
    .whereNotNull('description')
    .select('description')
    .every(function (t) { return t.description.length < 10; });

var hasLongDescriptions = new GlideQuery('task')
    .whereNotNull('description')
    .select('description')
    .some(function (t) { return t.description.length > 1000; });
```



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# Simple aggregation

```
var companyCount = new GlideQuery('core_company')
    .where('city', 'San Diego')
    .count(); // returns number


var maxReopenCount = new GlideQuery('incident')
    .where('priority', 3)
    .max('reopen_count') // returns Optional<number>
    .orElse(0);
```



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# More advanced aggregation

```
new GlideQuery('task')
   .where('active', true)
   .groupBy('priority')
   .aggregate('sum', 'reassignment_count')
   .having('sum', 'reassignment_count', '>', 4)
   .select()
   .toArray(10);

// [
//    {
//       group: {
//          priority: 1
//       },
//       sum: {
//          reassignment_count: 11
//       }
//    },
//    {
//       group: {
//          priority: 3
//       },
//       sum: {
//          reassignment_count: 6
//       }
//    },
//    ...
```



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# insert

```
new GlideQuery('sys_user')
    .insert({
        active: true,
        name: 'Bob Barker',
        city: 'Los Angeles'
    })
    .get();

// {
//     "sys_id": "f5bb5521d8c01010fa9b43ff0b914b62",
//     "active": true,
//     "name": "Bob Barker",
//     "city": "Los Angeles"
// }
```



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# delete

```
new GlideQuery('task')
    .where('priority', 5)
    .disableWorkflow() // disable business rules
    .deleteMultiple();
```



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# update

```
new GlideQuery('incident')
    .where('sys_id', id)
    .update({ priority: 1 });

new GlideQuery('incident')
    .where('priority', '>', 3)
    .updateMultiple({ order: 5 });
```



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# flags

```
new GlideQuery('sys_user')
    .select('company$DISPLAY')
    .forEach(doSomething);

var companies = new GlideQuery('core_company')
    .selectOne('market_cap', 'market_cap$CURRENCY_CODE')
    .get()

// {
//     "market_cap": 56496665.1258,
//     "market_cap$CURRENCY_CODE": "USD",
//     "sys_id": "004dc14611801010fa9b528c584f2659"
// },
```



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# Complex Queries

```
// active = true AND (priority = 1 OR severity = 1)
new GlideQuery('incident')
    .where('active', true)
    .where(new GlideQuery()
        .where('priority', 1)
        .orWhere('severity', 1))
    .select('description', 'assigned_to')
    .forEach(sendNotification);

// manager IS NULL OR (title = 'Vice President' AND state = 'CA')
new GlideQuery('sys_user')
    .whereNull('manager')
    .orWhere(new GlideQuery()
        .where('title', 'Vice President')
        .where('state', 'CA'))
    .select('name')
    .reduce(collectUsers);
```



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# Miscellaneous Topics

| | |
|---|---|
| 1 | Performance |
| 2 | Immutability and Reuse |
| 3 | Future work |



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# Performance

With business rules disabled

- GlideRecord Insert
  - 100 records: 829 ms median
- GlideRecord Reading
  - 1 record: 2ms median
  - 1,000 records: 86.5 ms median
  - 10,000 records: 842.5 ms median
- GlideQuery Insert
  - 100 records: 850 ms median (+2.5%)
- GlideQuery Reading (Stream)
  - 1 record: 3ms median (+1 ms)
  - 1,000 records: 90.5 ms median (+4.62%)
  - 10,000 records: 890 ms median (+5.64%)



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# Avoiding common perf mistakes

```
var gr = new GlideRecord('big_table');
gr.query(); // Should call gr.setLimit(1) first!

if (gr.next()) {
   doSomething(gr.getValue('column'));
}


// calls setLimit(1) automatically behind the scenes
new GlideQuery('big_table')
   .selectOne('column')
   .ifPresent(doSomething);
```



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# Avoiding common perf mistakes (cont.)

```
// reads all rows
var gr = new GlideRecord('big_table')
gr.query();
var count = gr.getRowCount();


// uses GlideAggregate... much faster
var count = new GlideQuery('big_table').count();
```



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# Immutability and reuse

```
var highPriorityTasks = new GlideQuery('task')
    .where('active', true)
    .where('priority', 1);

generateReport(highPriorityTasks);
notifyOwners(highPriorityTasks);
var avgReassignmentCount = highPriorityTasks
    .avg('reassignment_count')
    .orElse(0)


var userQuery = new GlideQuery('sys_user');
userQuery.orderBy('last_name'); // WARNING: Does nothing
```



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# Future work

- Allow opting out of field/choice checking
- Better join support
- Field casting
- Parsing encoded queries
- …what else?


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# Thank you

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