COBALT Developer's Guide

JV Roig
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[This manual is incomplete and is a work in progress.

Always check for the latest copy of the manual from http://cobalt.jvroig.com]

Preface

In the Information Age, companies live and die by the quality of their data, information, and the reports and decision-making generated from collected information.

All these – from data collection to production of metrics for decision-making – depend on the quality of the processes and business software used by the company. Crappy systems collect crappy data, which in turn produce crappy information, which then result in crappy reports and metrics, finally ending with crappy decision-making.

We can't have that. And this is where Cobalt steps in.

Cobalt gives developers a better way to work – a faster, more reliable way to develop business applications.

Cobalt is a business framework designed to give the internal software development team of a company the tools to create secure business-oriented information systems very fast, and completely take over redundant parts of software development.

The Cobalt mantra is ***"Reasonable defaults over endless customization"***. Cobalt does not bog you down with too much configuration. Every Cobalt system is good to go right after being baked by the Cobalt code generator, allowing you to rapidly prototype new systems or additional modules for existing projects.

This manual is meant to get you started with Cobalt, and show you a better path to successful development of internal business software.

Good luck and have fun!

Conventions Used

Fonts

When a word / phrase / label refers to something specific in a code (such as a function or object), or an object in the UI (such as a specific button or other form control), or the name of a database, table, or field being discussed, it appears **`like this`**, to emphasize that the particular word / phrase / label refers to a specific entity in code, database, or UI. For example:

- Please click the **`Submit`** button. (Refers to an element in the UI)
- Imagine a table, **`branch`**, with three fields: **`branch_id`**, **`branch_name`**, and **`branch_description`**. (All instances of the special bold font refer to database objects)
- **`ucwords()`** is used to transform field names to field labels. (Refers to a PHP function)

When a word / phrase is meant as a *value* instead of an object, it appears *`like this`*. This means the word / phrase is something you should type in a box, or choose from a list, or a command you should enter in a terminal or command line interface. For example:

- If on the same machine as Cobalt, then this is simply "*`localhost`*". (Refers to text that you should type in a textbox)
- in Linux, this would be through a command similar to: *`chmod 0777 /path/to/Projects`* (Refers to a command to enter in a terminal / CLI)

Message Boxes

Various message boxes are used, depending on what kind of information they provide.

> **Warning!**
> This is a Warning Box. These boxes are meant to give you a heads up on potential problems you may encounter, tell you stuff you shouldn't do (and why).

> This is a Tip/Note Box. It is used for emphasizing good practices, handing out tips regarding the topic, and occasionally also for clarifying certain concepts or presenting side notes.

```
Code:
This is a Code Box. Normally, that means these boxes contains actual code (PHP
code or SQL Code), but I also often use them as an ASCII-art drawing board of
sorts to simulate terminal / console / CLI output.
```

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Chapter 1: Cobalt Overview

What is Cobalt?

Cobalt is a web-based code generator and framework using PHP and MySQL designed for creating multi-user, administrative, business-oriented web applications (and little else).

It is a code generator, so it is capable of producing a complete working system based on the information you feed it (data dictionary and a few miscellaneous data for certain special cases and fine-tuning).

It is also a framework. This means it contains a set of classes, functions and core files that allow you to create applications much easier and faster than if you were to start from scratch.

Cobalt was previously known as "SCV2". The name "SCV2" stands for "SYNERGY Core, Version 2", as it was originally intended to be a much-needed improvement to the original SYNERGY Core which I made circa 2005-2006 for a school management system. But as I worked on it, it started to become a lot more than just an overhaul of the SYNERGY Core, eventually becoming the code generator and framework that it is now.

The basic idea behind Cobalt is this: redundant development tasks (like creating "add/edit/delete/view" modules, or CRUD) should be done automatically so that we can have more efficient use of our time. Instead of spending 70% of our time working on redundant parts of the system, we should just spend a minimal amount of time on them by letting a code generator do most of the redundant work for us. This way, we focus most of our energies on the really important parts of system development: the system design, special modules, and the reports.

Cobalt as a Code Generator

Cobalt's most visible feature is a code generator that reads your database metadata (data dictionary) and makes assumptions regarding what kind of form controls you will most likely need based on the data types it finds.

After pointing it to your database (supplying necessary information such as the host name, database name, username, password), you can then ask it to import the tables (that is, the metadata). After the import is finished, you can generate a complete system that has a basic but production-ready Add/Edit/Delete/View interface per table. By default, the generated system also includes the following components:

- Login/logout module
- User management

- User passport management (ACL-based user privilege management, with RBAC emulation)
- Module control (allows the system admin to turn modules on or off)
- User links (system modules) and passport groups (module grouping) management
- Security Monitor (comprehensive audit trail)
- Change Skin (UI theme management) and Change Password modules for users

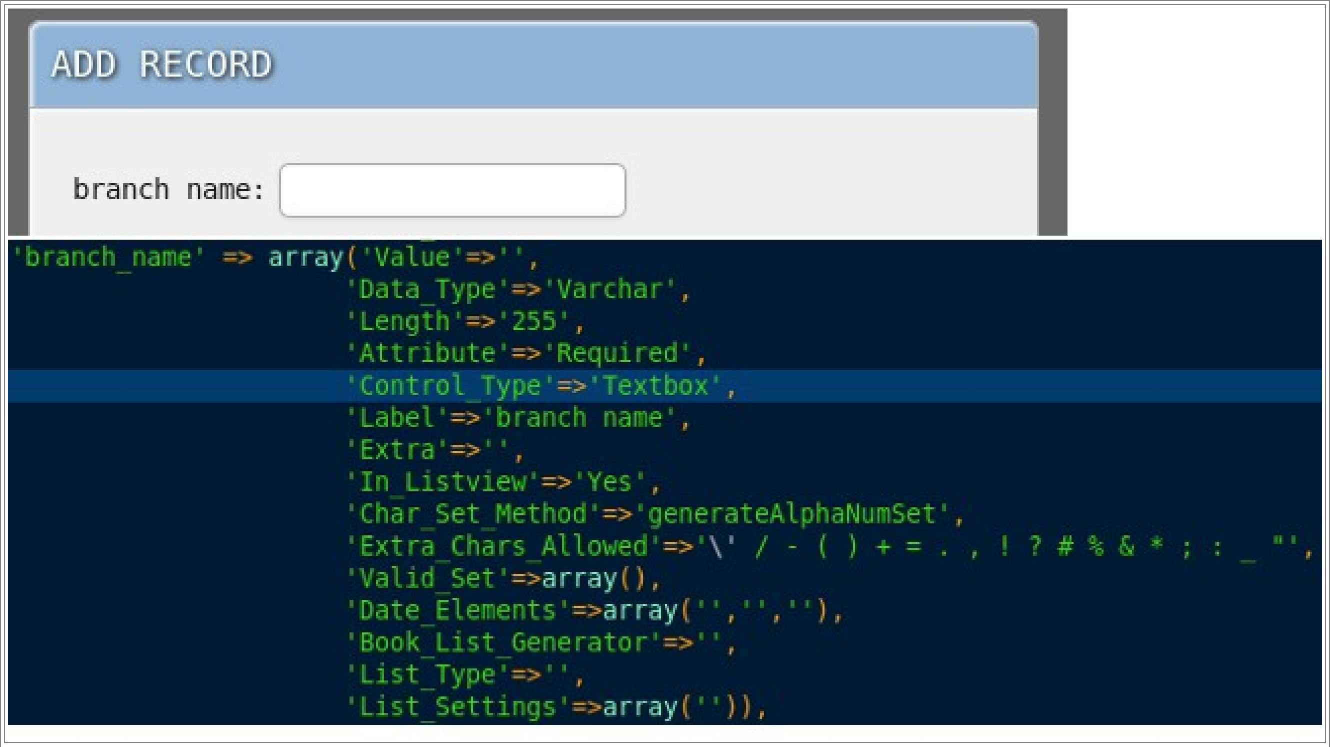
These components will be discussed in more detail in **Chapter 2: The Cobalt Code Generator.**

These default components result in a complete, fully-functioning system, from login to logout, along with powerful system administration features.

Cobalt as a Framework

Cobalt's framework is meant to simplify the life of a business application developer. Cobalt (the framework) is model-driven, in that the data dictionary file of each table controls most of the behavior of the created modules, and simple changes in the data dictionary file can result in significant modifications of the modules, without requiring much actual re-programming.

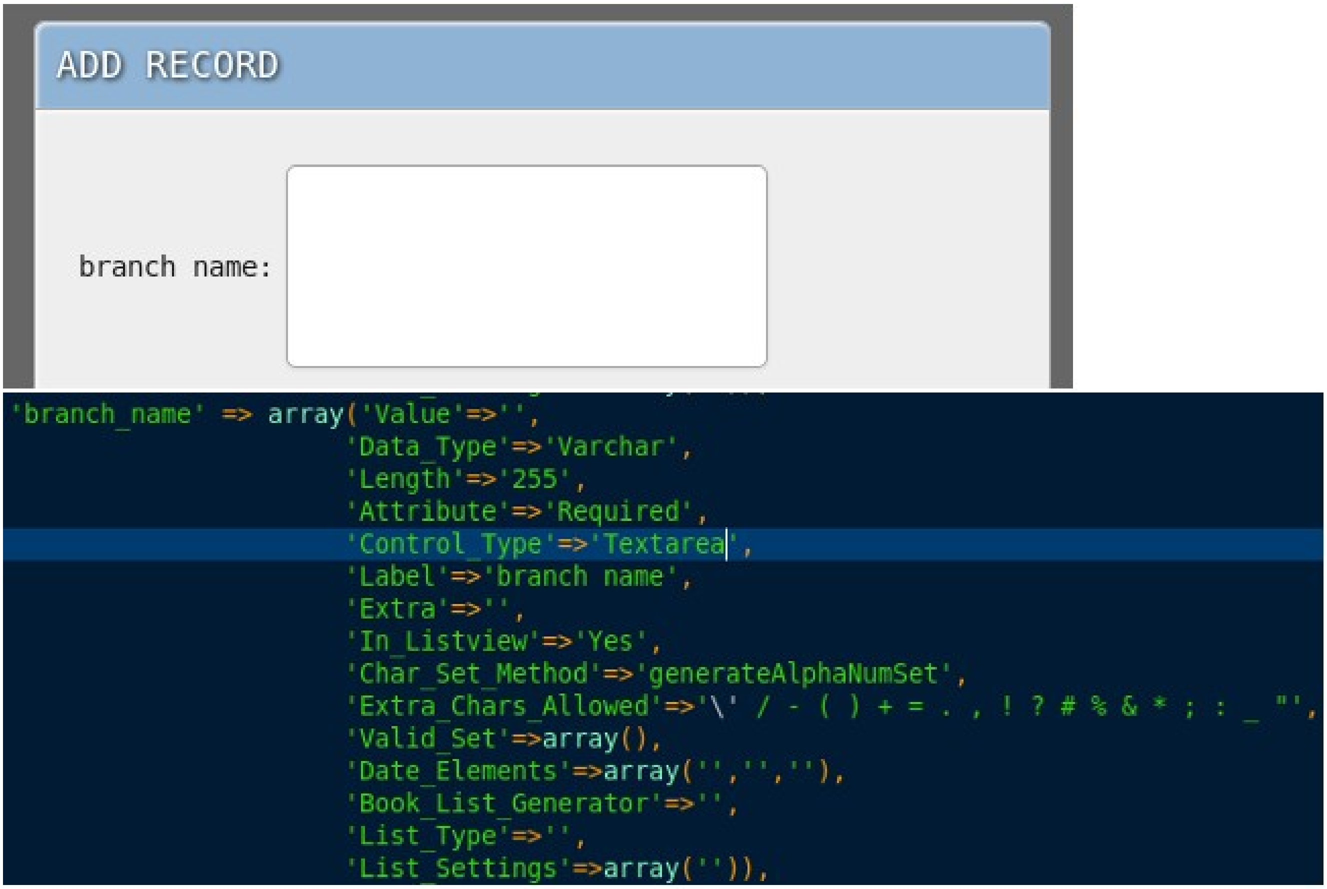
For example, let's say you have a table called `branch`, and it has a field called `branch_name` (among others). Refer to Figure 1 for a screenshot and a peek at the source code.



```
'branch_name' => array('Value'=>'',
                       'Data_Type'=>'Varchar',
                       'Length'=>'255',
                       'Attribute'=>'Required',
                       'Control_Type'=>'Textbox',
                       'Label'=>'branch name',
                       'Extra'=>'',
                       'In_Listview'=>'Yes',
                       'Char_Set_Method'=>'generateAlphaNumSet',
                       'Extra_Chars_Allowed'=>'\' / - ( ) + = . , ! ? # % & * ; : _ "',
                       'Valid_Set'=>array(),
                       'Date_Elements'=>array('','',''),
                       'Book_List_Generator'=>'',
                       'List_Type'=>'',
                       'List_Settings'=>array('')),
```

Figure 1: A form control field (above) and the data dictionary code behind it (below).

Let's forget for the moment that a textbox is indeed the perfect control type for data entry of branch names. What if we wanted to use a textarea instead? Figure 1 shows that the **`Control_Type`** of **`branch_name`** is set to “*`Textbox`*”. We simply have to change this to “*`Textarea`*” to effect the change we desire (see Figure 2).

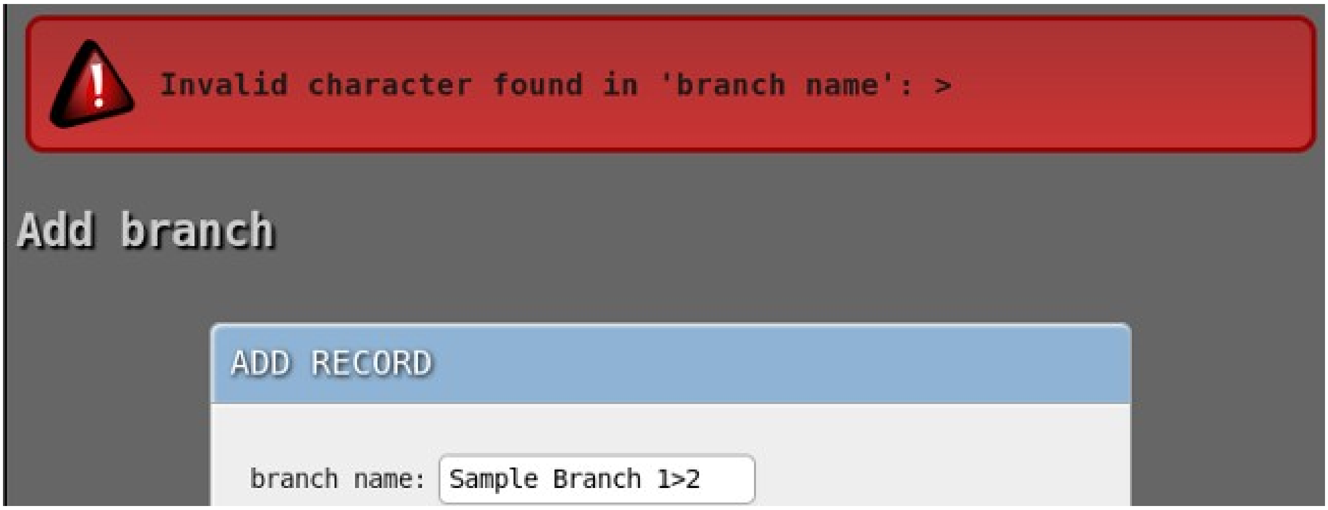


```
'branch_name' => array('Value'=>'',
                       'Data_Type'=>'Varchar',
                       'Length'=>'255',
                       'Attribute'=>'Required',
                       'Control_Type'=>'Textarea',
                       'Label'=>'branch name',
                       'Extra'=>'',
                       'In_Listview'=>'Yes',
                       'Char_Set_Method'=>'generateAlphaNumSet',
                       'Extra_Chars_Allowed'=>'\' / - ( ) + = . , ! ? # % & * ; : _ "',
                       'Valid_Set'=>array(),
                       'Date_Elements'=>array('','',''),
                       'Book_List_Generator'=>'',
                       'List_Type'=>'',
                       'List_Settings'=>array('')),
```

Figure 2: Result of modifying the "Control_Type" element to "Textarea"

That was very simple, wasn't it? There wasn't any real programming involved – just changing a value in one array element (which is actually part of a larger multi-dimensional array that makes up the data dictionary for the table; we'll get to that in more detail in **Chapter 3: The Cobalt Framework**).

Let's take a different example, one that captures more complicated behavior. (For this new example, we effectively undo the change to a textarea, and we are back to a regular textbox for the “branch_name” field.) Cobalt-generated modules already have a default (and very loose) filtering in place, allowing alphanumeric input, plus a host of special characters. This can be seen in the elements **`arr_charset_Method`** and **`Extra_Chars_Allowed`** (both Figure 1 and Figure 2 show this). “*`generateAlphaNumSet`*” in **`arr_charset_Method`** means the acceptable character set for the input will be alphanumeric (letters and numbers), while the **`Extra_Chars_Allowed`** element lists all other characters that should also be allowed (separated by spaces; note that the first entry, a single quote, is escaped because it is the same as the delimiter used). If a character that is not a letter, number, or any of the extra chars listed is entered as input, an error message will alert the user that an invalid character was detected upon submission. In this case, the greater-than symbol (>) is an invalid character, since it is not alphanumeric, and is not listed in **`Extra_Chars_Allowed`**. Attempting to submit a branch name with the greater-than symbol will trigger the aforementioned error message (Figure 3).

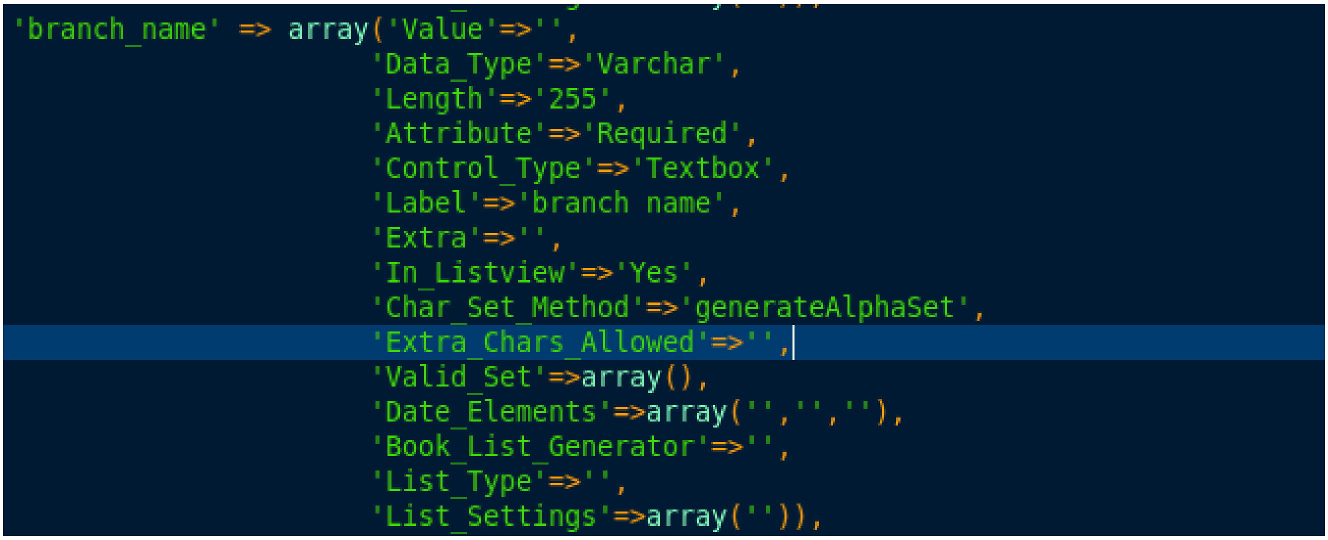


Invalid character found in 'branch name': >

branch name: Sample Branch 1>2

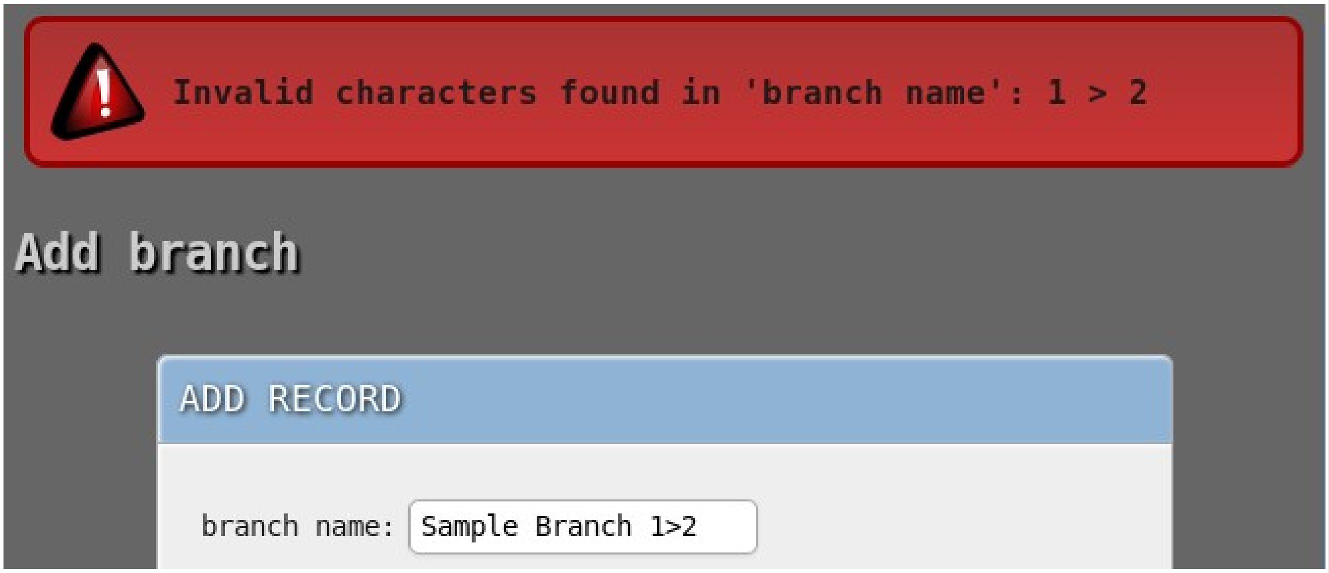
Figure 3: Error message triggered by submission of input with invalid character(s).

What if we actually wanted branch names to only accept letters? Modifying the character filter to accomplish this is easy: adjust the **`arr_charset_Method`** to "*`generateAlphaSet`*", then set the **`Extra_Chars_Allowed`** element to blank (Figure 4 shows the modifications, Figure 5 the result).



```
'branch_name' => array('Value'=>'',
                      'Data_Type'=>'Varchar',
                      'Length'=>'255',
                      'Attribute'=>'Required',
                      'Control_Type'=>'Textbox',
                      'Label'=>'branch name',
                      'Extra'=>'',
                      'In_Listview'=>'Yes',
                      'Char_Set_Method'=>'generateAlphaSet',
                      'Extra_Chars_Allowed'=>'',
                      'Valid_Set'=>array(),
                      'Date_Elements'=>array('','',''),
                      'Book_List_Generator'=>'',
                      'List_Type'=>'',
                      'List_Settings'=>array('')),
```

Figure 4: Modifications to "arr_charset_Method" and "Extra_Chars_Allowed" values, to allow only letters as valid input.



Invalid characters found in 'branch name': 1 > 2

Add branch

ADD RECORD

branch name: Sample Branch 1>2

Figure 5: After the modifications in Figure 4, numbers have also become invalid input.

That's all it took to change the input filter: modifying the values of two elements. It's hardly a programming challenge.

There are a lot more things possible to accomplish just by modifying the data dictionary code. This kind of power and flexibility in the data dictionary is what makes the Cobalt framework a boon to business application developers – it takes little effort to accomplish some of the most common tasks that need to be accomplished, be it setting the proper form control types, or input filters (and this is not just limited to character filters – even the max length, required fields, or even a whitelist of acceptable values can all be set quite easily through the data dictionary code).

Aside from the data dictionary structure, the Cobalt framework also has other components that provide powerful and convenient tools for developers. We'll go through them all in detail in Chapter 3.

A Specialized Framework+Code Generator for the Enterprise

Cobalt is a very specialized framework and code generator meant for business application development.

By "specialized", I mean that Cobalt isn't a general purpose framework to create PHP applications and web services. Instead, Cobalt is meant to create administrative web apps that follow a specific style - the style that Cobalt makes them. I guess that means you can say that Cobalt is a highly opinionated software. This makes Cobalt suffer in flexibility/adaptability - but the trade-off is that it makes you extremely more productive when you use it for its intended purpose of creating multi-user, administrative web apps (online enrollment and school management system, accounting, asset management, inventory, human resources, and local government information systems are just a few examples of what Cobalt has been used to create).

As a specialized framework for the enterprise, Cobalt offers a well-polished, production-ready set of automatically generated modules and framework components that are a must for enterprise use:

- Fine-grained user privilege system that is very flexible and easily modified
- Built-in security features protecting against common attack vectors for the web:
  - Cross-Site Request Forgery (CSRF or XSRF)
  - SQL Injection
  - Session Fixation
  - Cross-Site Scripting (XSS)
- A password system that does not store user passwords in cleartext, and instead uses cryptographically-strong password hashing algorithms with key stretching to hash passwords, combined with a per user salt. Number of rounds for the stretching is easily configurable to balance performance and security, and keep up with increases in available computing power.
- Use of cryptographically-secure PRNG for the creation of form keys and password salts.
- Comprehensive audit trail that logs each user's actions (modules visited, buttons clicked) and all queries that get executed. The exhaustiveness of the logging mechanism is easily modified. By default, clicking links (modules) and buttons, as well as all queries (except for SELECT queries) are logged.
- Built-in data filtering and validation for user input (allowed characters, allowed values, max length, and required field,)
- Data validation and character set classes to make custom data filtering easier, or override the default data filtering in place when needed.

If all you want is to create a photo gallery on your personal website, or maybe create your own simple blog, Cobalt will get you nowhere. This is not to say that Cobalt will be worthless; it can still save you a little time (on the administrative aspects of your site/blog) . But you won't feel the power that Cobalt affords you in terms of productivity if a photo gallery or a blog is what you are after.

Getting Started

This section contains instructions for setting up a Cobalt development environment. If you already have PHP installed, you can skip the Prerequisites section.

Prerequisites

To get started with Cobalt, you'll need a working webserver (with PHP support) and MySQL.

In Windows (XP, Vista, 7), the easiest and fastest way to achieve this is to download XAMPP for

Windows from Apache Friends (http://www.apachefriends.org).

In Linux, XAMPP is also an option (Apache Friends also has an XAMPP package for Linux), but installing a webserver with PHP support is usually as easy as a single command for most Linux distributions ("`yum install httpd php`" or "`apt-get httpd php`").

System Requirements

Any modern computer made within the last 7 years (2005 onwards) should be more than capable of supporting Cobalt.

The slowest machine that has ever run Cobalt is an old MSI netbook I used to have (MSI Wind U100, with an Atom N270 processor and 1GB RAM). This is a pretty slow machine, but it handles Cobalt and Cobalt-based apps just fine (for development purposes only), on both Windows XP and Linux (Fedora).

Also, I sometimes use a laptop powered by an AMD V105 processor (single core, 1.2GHz) and 2GB of RAM to develop and debug Cobalt itself from time to time, as well as to develop, test, and present a few Cobalt-based apps.

Unless your dev system is significantly slower than either of these two machines, your system should have no problem with Cobalt development.

As for Operating System requirements, there are none. As long as your favorite OS supports some sort of webserver with PHP, you are good to go.

Installation

1. Download the latest Cobalt package from http://cobalt.jvroig.com.
2. Unzip/extract the contents of the Cobalt package into your webroot. (Your webroot differs depending on your platform. In XAMPP for Windows, this is the *xampp\htdocs* folder. In XAMPP for Linux, this is */opt/lampp/htdocs*. For httpd in Fedora, this is */var/www/html*.)
3. A folder named "**`cobalt`**" should now exist in your webroot. Inside this folder is a file named "**`cobalt.sql`**". We need that to create the Cobalt database.
4. Create a new database named "*`cobalt`*".
5. Import the contents of "**`cobalt.sql`**" into the **`cobalt`** database. The **`cobalt`** database should have 15 tables once the import is successful.
6. Open up your web browser (Google Chrome and Mozilla Firefox are recommended), and go to "*`http://localhost/cobalt`*".
7. If you see the Project screen (Create New Project and Choose Existing Project) and don't see a "FATAL ERROR" message, congratulations! You have successfully installed Cobalt and are ready to start creating applications.

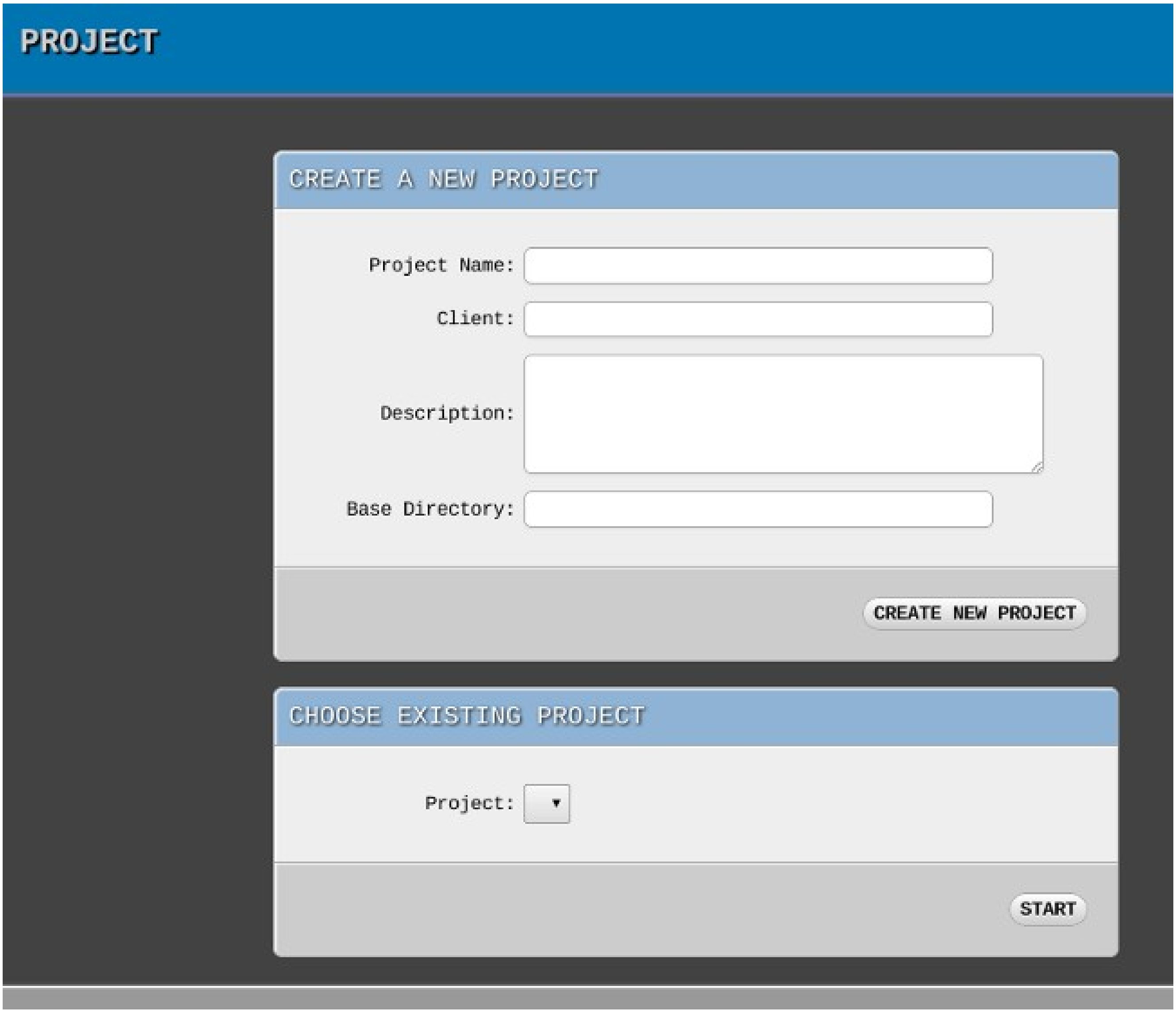
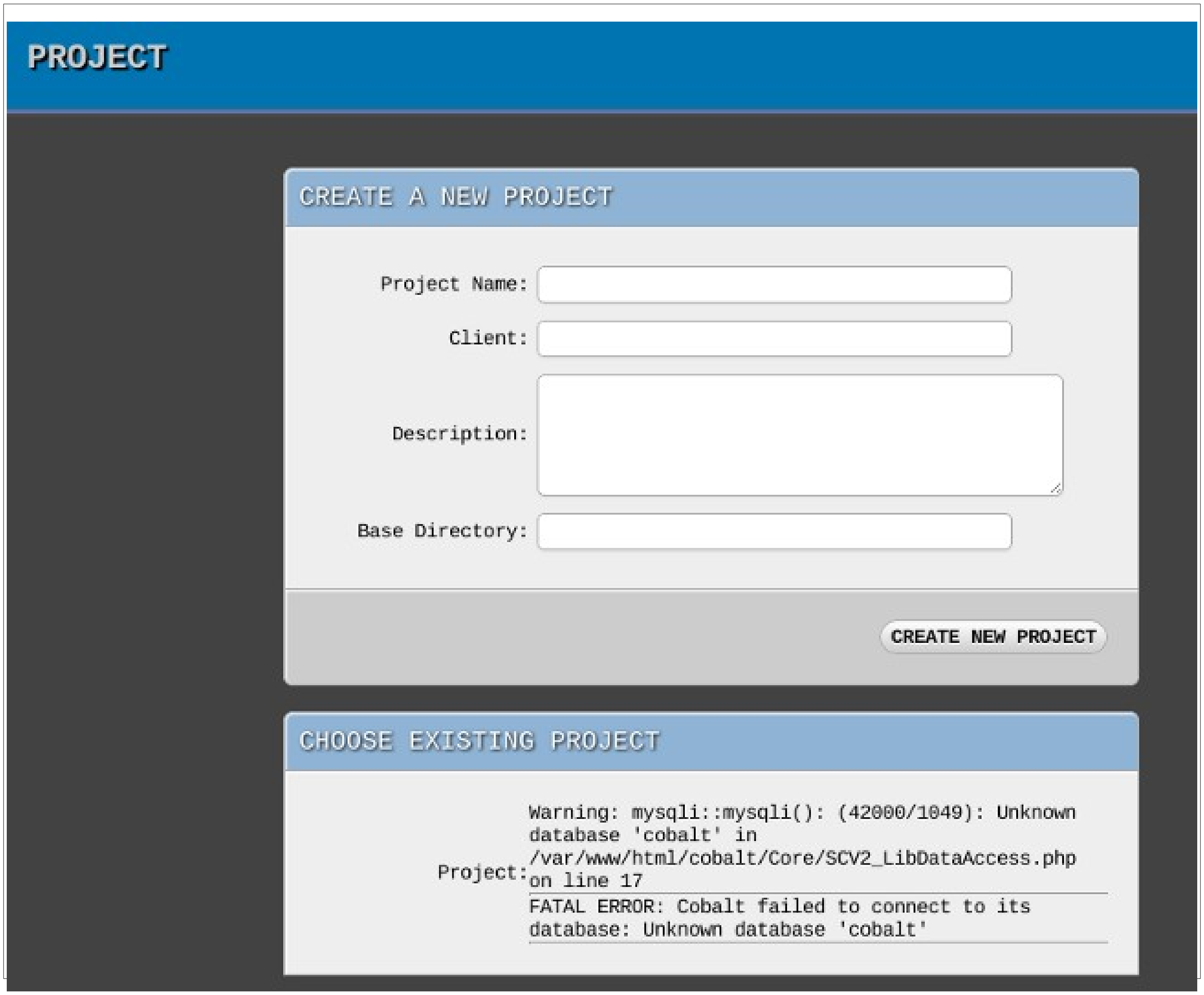


Figure 6: The project screen of a successful install – no "FATAL ERROR" messages can be seen.



```
Warning: mysqli::mysqli(): (42000/1049): Unknown
database 'cobalt' in
/var/www/html/cobalt/Core/SCV2_LibDataAccess.php
on line 17
FATAL ERROR: Cobalt failed to connect to its
database: Unknown database 'cobalt'
```

Chapter 2: The Cobalt Code Generator

Generator Concept

The code generator is the most visible feature of Cobalt. How it works can be summarized as follows:

- Point Cobalt to your database.
- Tell Cobalt to import the tables in the database.
- Tell Cobalt to generate a complete system based on the metadata it collected.

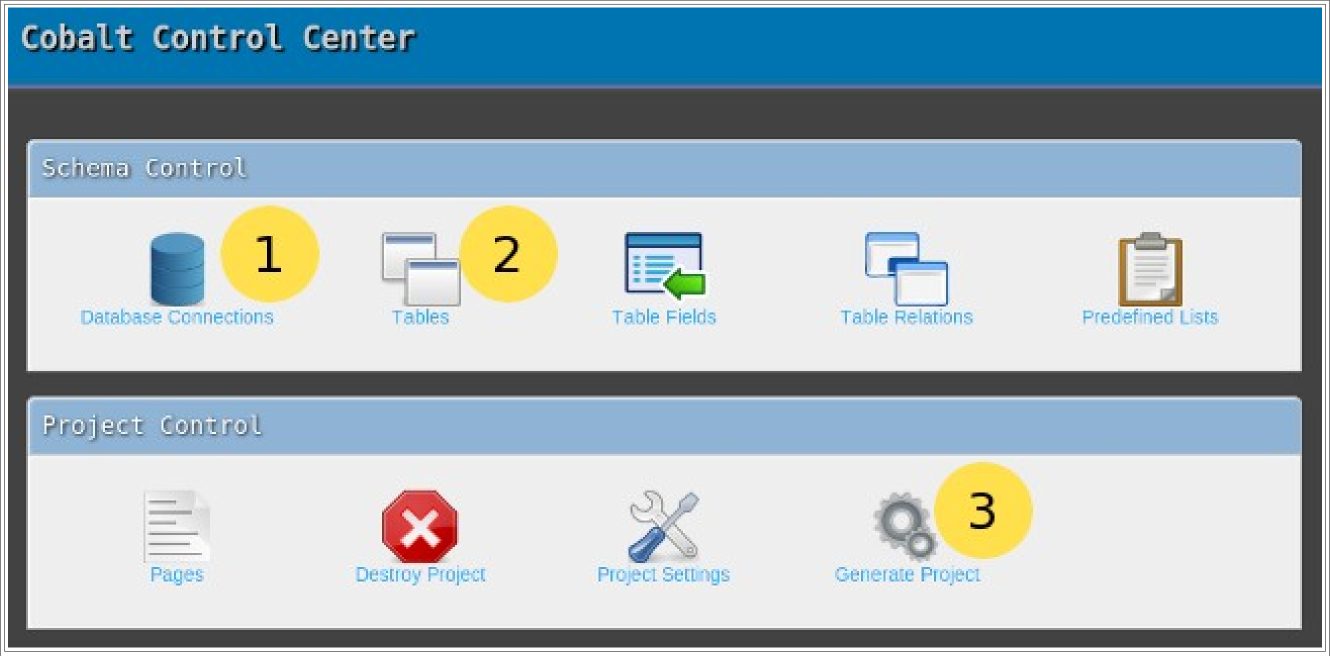


Figure 8: The Cobalt code generator. 1.) Supply database connection information to Cobalt. 2.) Import tables from your database into Cobalt. 3.) Generate the project.

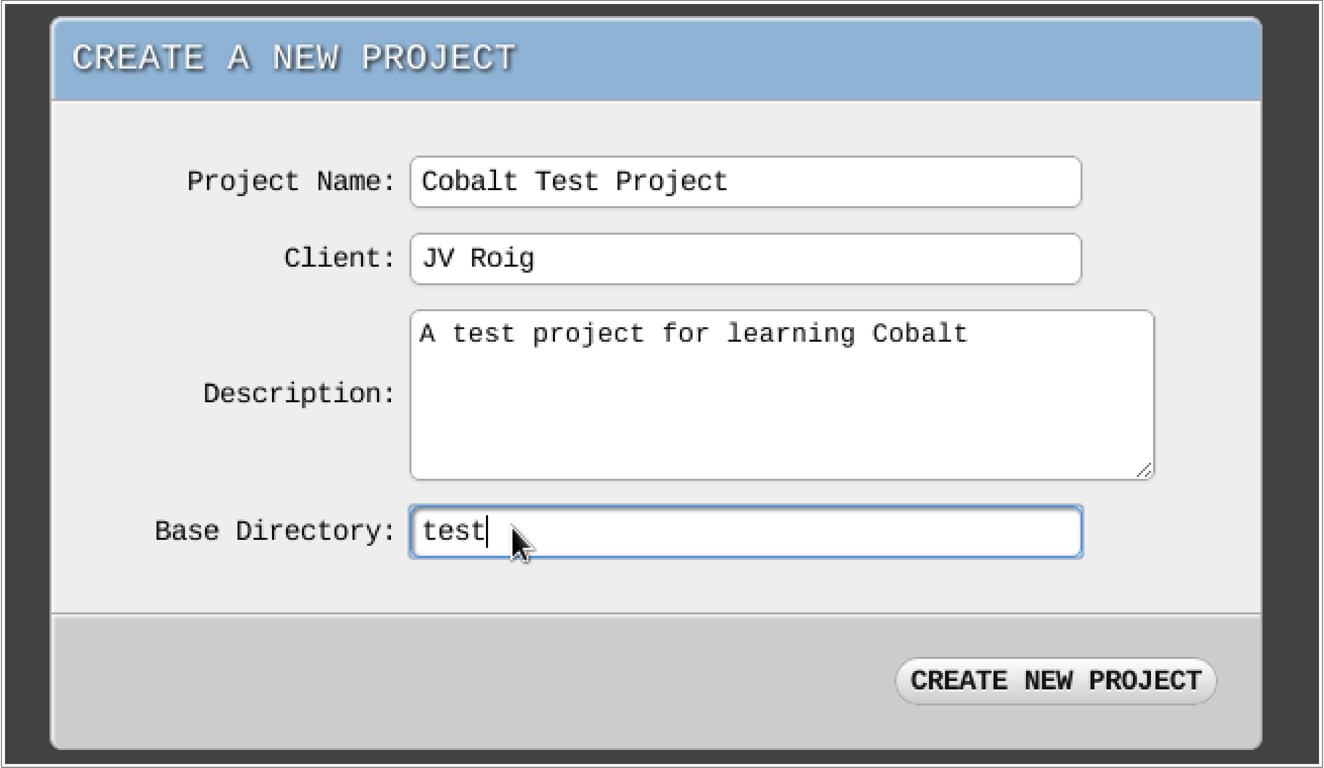
While this effectively summarizes the concept behind the Cobalt code generator, this in no way covers the extent of what the code generator can accomplish, or the fine-tuning you can make before the code generator starts creating the project. This simply shows the basic principle behind the code generator: *let it read your database metadata, then let it create a base system based on the metadata.*

Starting a New Project

Your Cobalt experience starts with the Choose Project screen (refer to the last portion of **Chapter 1**, *Installation* section).

Naturally, having no projects in Cobalt yet, all you can actually do at this point is to *create a new project*:

- `Project name` – what you want your new project to be named
- `Client` – your client or customer for this project (or simply yourself if you are just learning)
- `Description` – a brief description of the project
- `Base Directory` – name of the main folder/directory that will contain the entire project.



Project Name: Cobalt Test Project

Client: JV Roig

Description: A test project for learning Cobalt

Base Directory: test

Figure 9: The Create a New Project box.

`Project name` is important because that will be prominently displayed in the resulting system: login screen, header, and browser window title.

`Client` has no use beyond mere project information, and has no bearing on the resulting system.

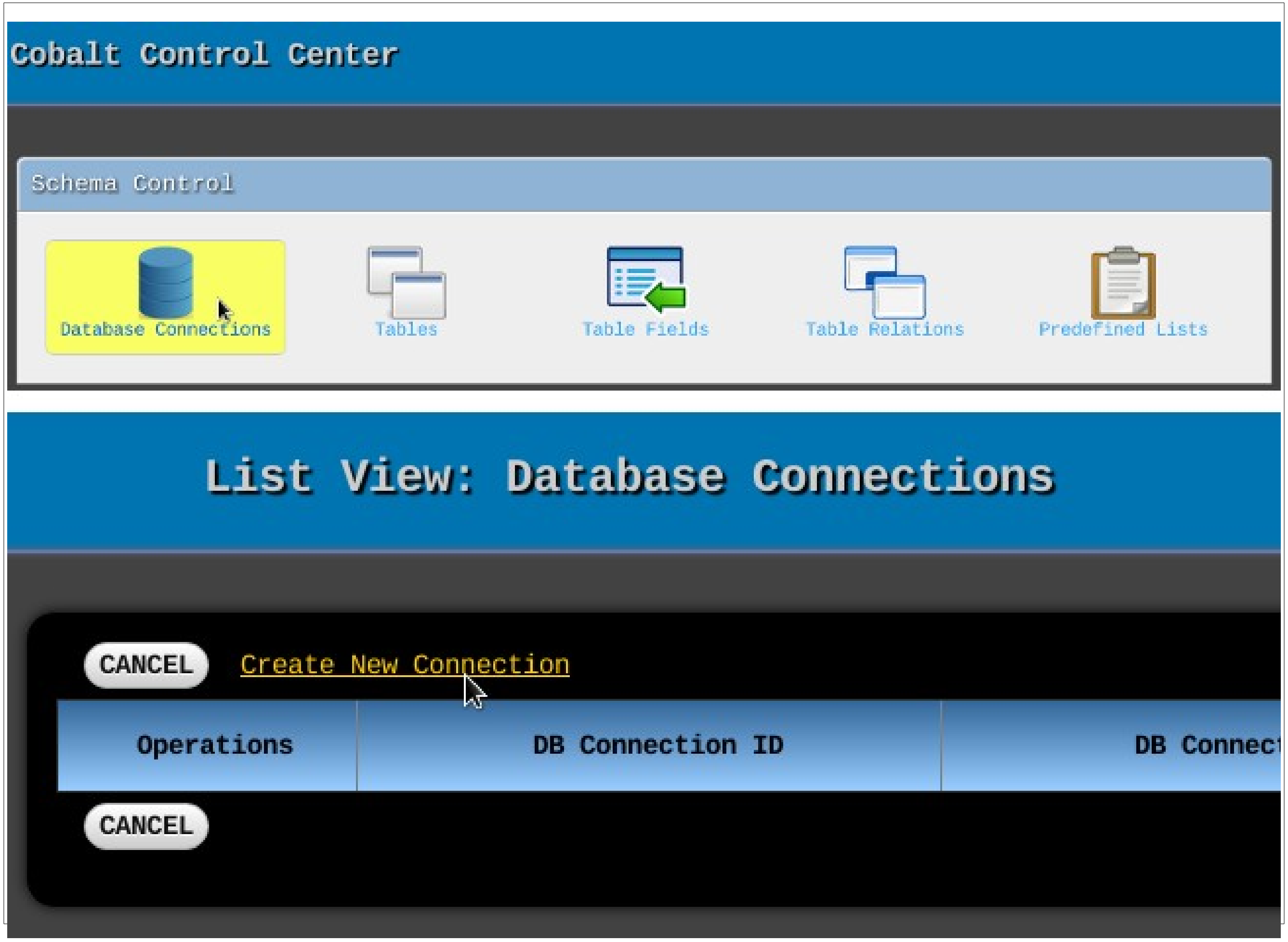
`Description` also has no functional bearing on the project, so this is non-critical. However, the text you specify here will be displayed in the "About" screen of the generated system.

`Base Directory` is the most important of all the information requested here. This will be what is placed in your webroot, therefore also how your project will be accessed through the URL. For example, if you put "*test*" here, then a folder named **test** will be created and all project files and subdirectories will be created inside that folder, and accessing the system through your browser can be done with "*localhost/test*".

Point Cobalt to the Database

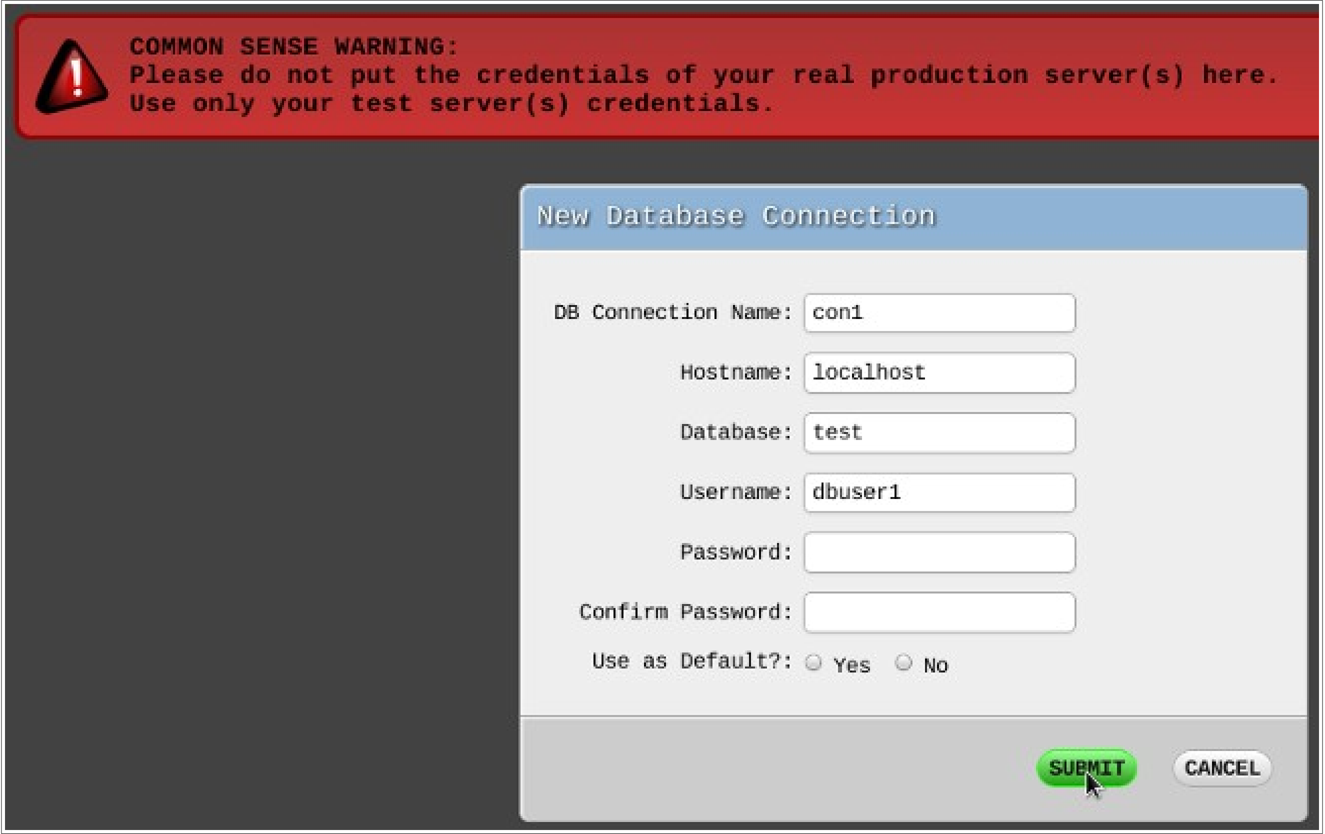
Pointing Cobalt to the database simply means supplying database connection information to Cobalt, so that the code generator can connect to your database and read your database metadata.

From the Cobalt Control Center, click **Database Connections**, then **Create New Connection**.



A read-only database user connection will suffice – you don't need to supply root/admin access information, and in fact it is not recommended that you use anything but a read-only ("safe") user account for Cobalt, for security reasons, if you actually make Cobalt connect to a production (live) server.

In most cases, however, you are probably connecting to a database that is also being ran by your own dev machine. In such a scenario, feel free to not bother creating a read-only database user for Cobalt. As long as the credentials (host, username, password) you give to Cobalt aren't actual live production server credentials, it's fine.



COMMON SENSE WARNING:
Please do not put the credentials of your real production server(s) here.
Use only your test server(s) credentials.

New Database Connection

DB Connection Name: con1

Hostname: localhost

Database: test

Username: dbuser1

Password:

Confirm Password:

Use as Default?: ○ Yes ○ No

Figure 11: Pointing Cobalt to your database

The information you will need to supply are the following:

- **`DB Connection Name`** – just any label you want to identify this database connection, such as "*`connection 1`*" or "*`con1`*" or "*`Accounting DB`*".
- **`Hostname`** – the hostname or IP address of the database server. If on the same machine as Cobalt, then this is simply "*`localhost`*".
- **`Database`** – the name of the database you want Cobalt to scan.
- **`Username`** – database account that Cobalt should use to access the database.
- **`Password`** – the password for the database account you want Cobalt to use. Can be blank to accommodate a developer's local dev environment where the local database has a default account with no password.

- `Confirm password` – retyping the password just to make sure you didn't make a typo, since the password field is not human readable.
- `Use as Default` – this only matters for projects that have more than one database. You can completely ignore this if your project only has one database involved. If your project has multiple databases, then you need to choose one to set as default. This default database connection will not affect your code generation activities; it will simply use the default connection information as the information in the base class for database connections.

After supplying all the requested information to make a successful database connection, you can continue adding more database connections (if your project has multiple databases). Cobalt supports a practically-unlimited number of database connections per project, so just add connections as needed.

Tell Cobalt to Import the Tables in the Database

From the Cobalt Control Center, click `Tables`, then click `Import Tables`. (Figure 12)

You will be greeted by the Import Tables screen. (Figure 13). Choose the database connection you want to use, then click `Submit`.

Cobalt will show you a list of all the tables found using the specified database connection. (Figure 14). All checked tables will be imported. You may uncheck tables as you see fit.

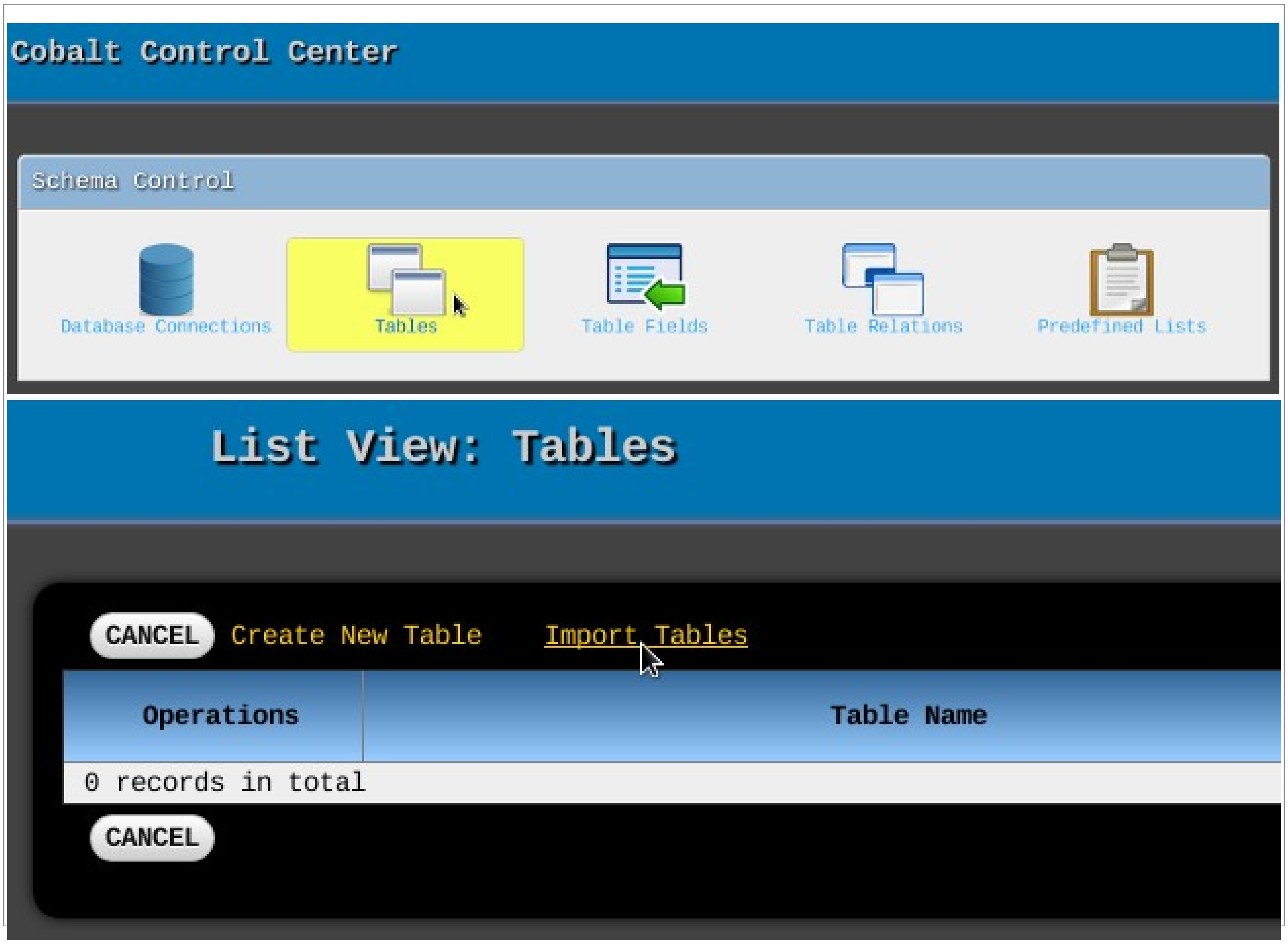
The `Folder / Subdirectory` field is used to tell Cobalt that the module files that will be generated for the particular table should be placed in a folder inside the base directory (therefore, a subdirectory), with the folder name corresponding to the text you type in the `Folder / Subdirectory` field.

For example, if you indicate "*stockkeeping_modules*" as the subdirectory for tables `branch`, `branch_type`, and `item` (these are just imaginary table names for our hypothetical project for the purposes of this example), and assuming our base directory is "`test`", then Cobalt will place all module files for `branch`, `branch_type`, and `item` in "*test/stockkeeping_modules*".

If left blank, Cobalt will simply place all created modules for that table inside the base directory. Following our example above, had we left the field blank for the three tables mentioned, then all their module files would simply be located inside the "`test`" directory.

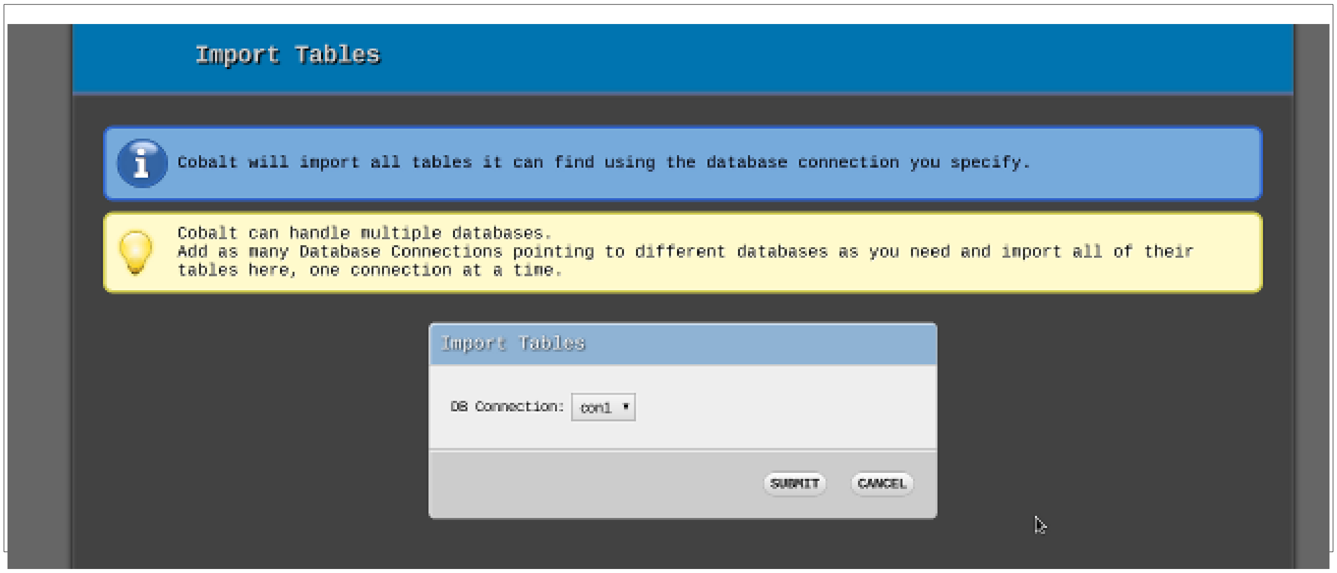
Click `Submit` when you are done checking/unchecking tables and specifying their subdirectories.

> It is recommended that you do not leave the **Folder / Subdirectory** field blank for real projects, otherwise the base directory will get cluttered with lots of files really fast. Cobalt creates 6 module files per table, so even with a low number of tables in a project (such as ten to fifteen tables), your base directory will be cluttered with lots of mostly unrelated module files, making it harder to locate files you are looking to open for editing.



List View: Tables

Operations	Table Name
0 records in total	



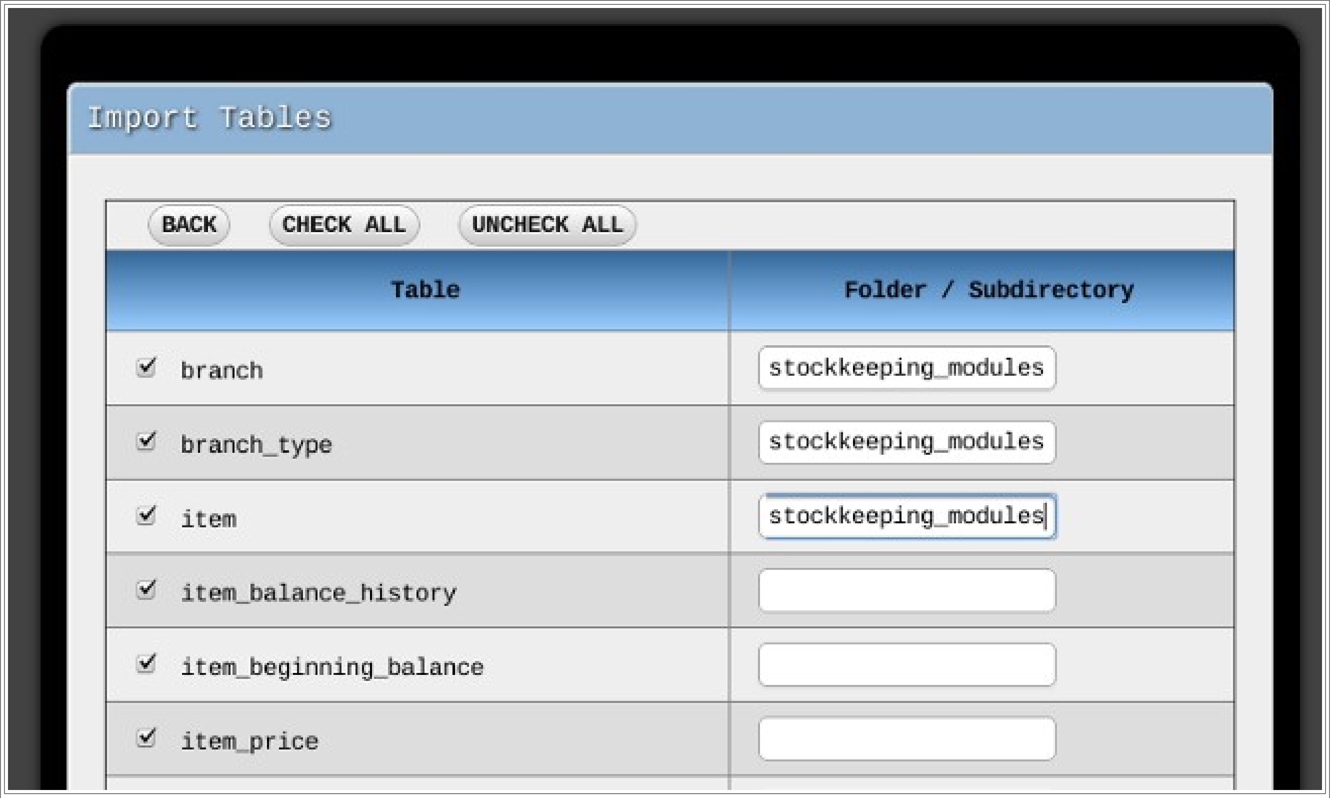
Import Tables

Cobalt will import all tables it can find using the database connection you specify.

Cobalt can handle multiple databases.
Add as many Database Connections pointing to different databases as you need and import all of their tables here, one connection at a time.

Import Tables

DB Connection: con1



Import Tables

Table	Folder / Subdirectory
☑ branch	stockkeeping_modules
☑ branch_type	stockkeeping_modules
☑ item	stockkeeping_modules
☑ item_balance_history	
☑ item_beginning_balance	
☑ item_price	

Figure 14: Importing Tables: Choosing tables and indicating subdirectories for their modules.

Tell Cobalt to Generate a Complete System

From the Cobalt Control Center, click `Generate Project`. (Figure 15)

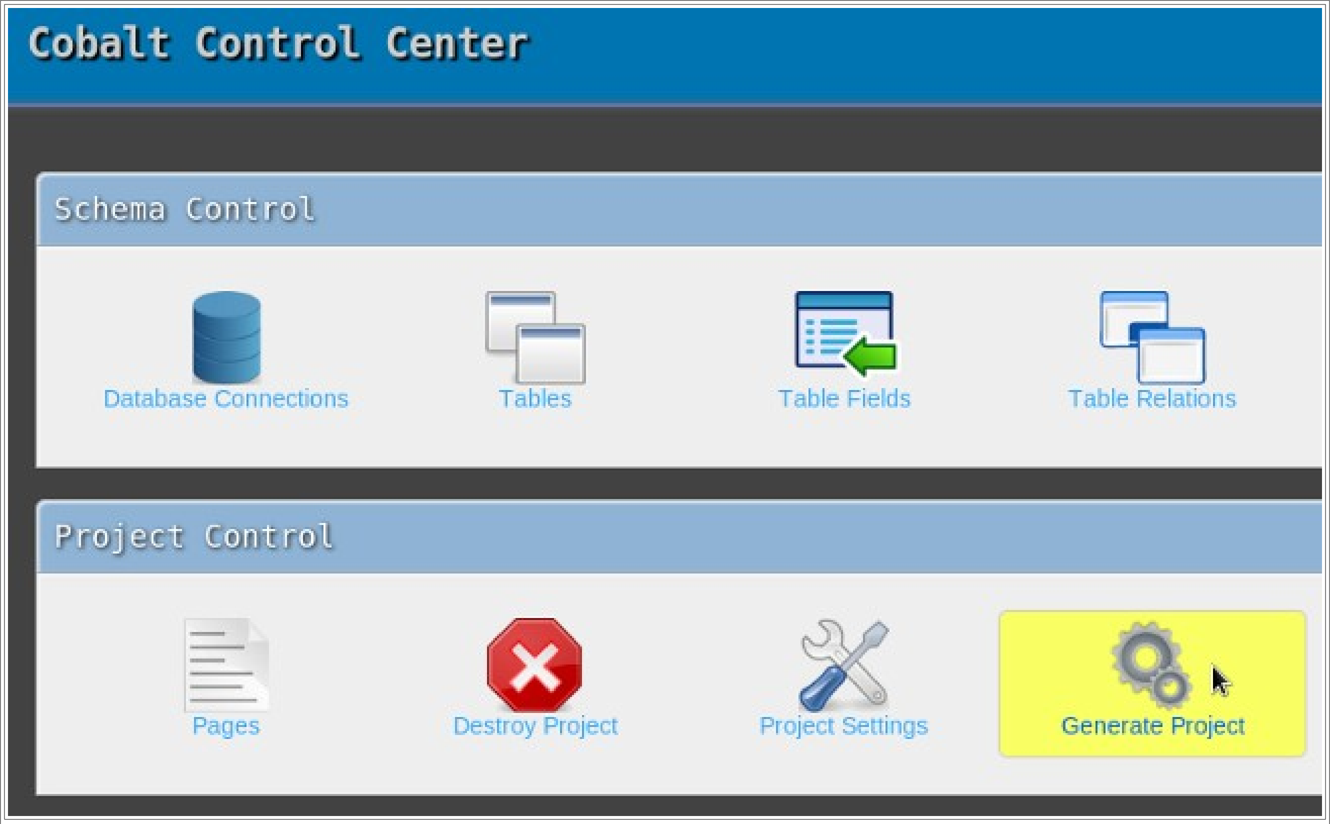


Figure 15: Generating the System: From the Cobalt Control Center, click "Generate Project"

You will find yourself in the Generate Project screen. You'll find a table with three columns:

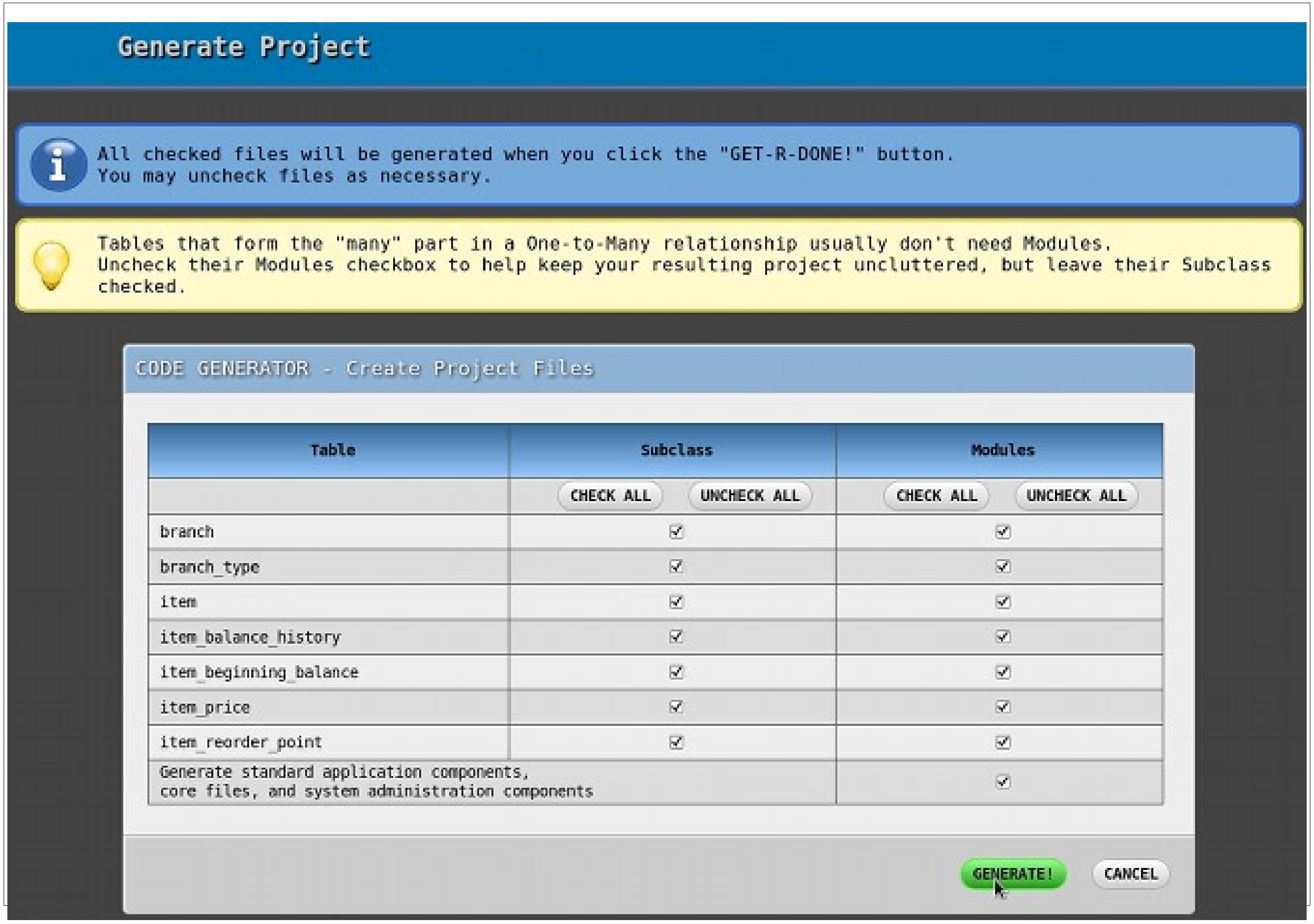
- Column 1 lists the tables you asked Cobalt to import earlier, plus the option to generate a complete system (standard application components, core files, system administration)
- Column 2 contains the subclass checkbox of each table – if checked, Cobalt will create the data dictionary file, data abstraction subclass, and HTML subclass for the corresponding table. Remember the data dictionary file demonstration from Chapter 1? This is what creates it.
- Column 3 contains the modules checkbox of each table – if checked, Cobalt will create add / edit / delete / view / report modules for the corresponding table. These modules rely on the subclasses for operation.

The final checkbox ("Generate standard application components, core files, and system administration components") tells Cobalt to create not just individual subclasses and modules, but instead create a complete, cohesive system by generating the following components:

- Login/logout module

- Control Center (the home page for each user, listing all their available modules)
- Change Skin (UI theme management) and Change Password modules for users
- User management
- User passport management (ACL-based user privilege management, with RBAC emulation)
- Module control (allows the system admin to turn modules on or off)
- User links (system modules) and passport groups (module grouping) management
- Security Monitor (comprehensive audit trail)

At this point, you don't need to bother about unchecking items, you just want to click the `Generate!` button. (Figure 16)



Generate Project

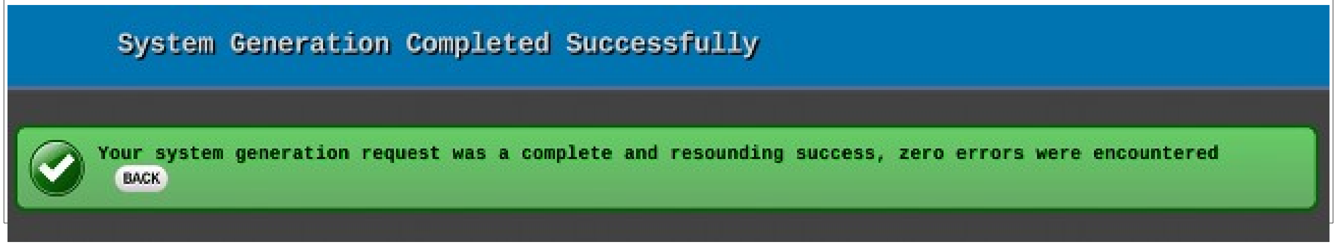
All checked files will be generated when you click the "GET-R-DONE!" button.
You may uncheck files as necessary.

Tables that form the "many" part in a One-to-Many relationship usually don't need Modules. Uncheck their Modules checkbox to help keep your resulting project uncluttered, but leave their Subclass checked.

CODE GENERATOR - Create Project Files

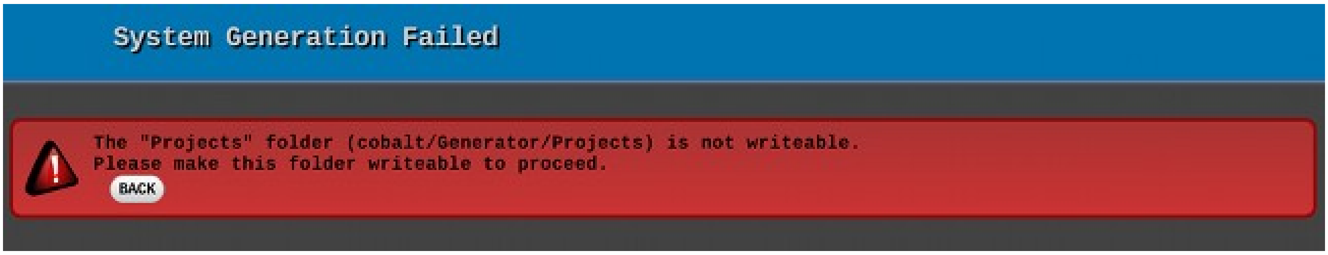
Table	Subclass	Modules
	CHECK ALL UNCHECK ALL	CHECK ALL UNCHECK ALL
branch	☑	☑
branch_type	☑	☑
item	☑	☑
item_balance_history	☑	☑
item_beginning_balance	☑	☑
item_price	☑	☑
item_reorder_point	☑	☑
Generate standard application components, core files, and system administration components		☑

If everything succeeds, you'll be greeted by a success screen. (Figure 17)


System Generation Completed Successfully

Your system generation request was a complete and resounding success, zero errors were encountered

Depending on your platform (especially if it is a Linux distribution), you may have to modify the permissions of the `Projects` folder (*"cobalt/Generator/Projects"*) so that Cobalt can create your base directory and project files inside the `Projects` folder. If this is the case, Cobalt alerts you with the System Generation Failed screen instead of the success screen. (Figure 18)


System Generation Failed

The "Projects" folder (cobalt/Generator/Projects) is not writeable.
Please make this folder writeable to proceed.

Figure 18: System Generation Failed: You need to change the permissions of the cobalt/Generator/Projects folder so that Cobalt can write in it.

Fixing this error is easy, just make sure the `Projects` folder is writeable by PHP. You don't really have to worry about restricting write access to only PHP, though. Since Cobalt is installed on your dev machine (not on a server of any importance), you can simply make the Projects folder world-writeable (in Linux, this would be through a command similar to: *`chmod 0777 /path/to/Projects`*).

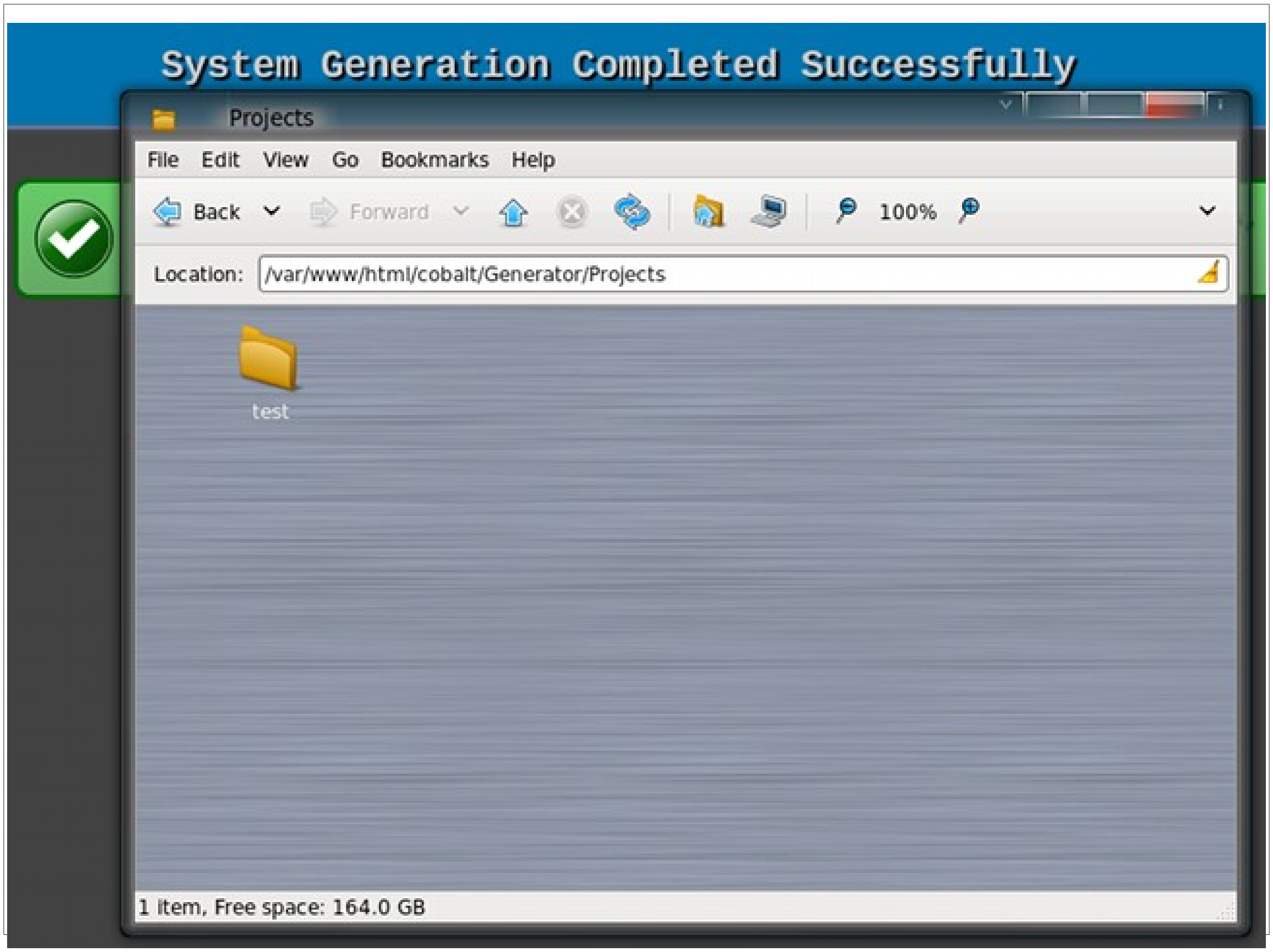
After updating the folder permissions to allow Cobalt write access, click the **`Back`** button then click **`Generate!`** again. You should see the success screen now.

That's it – you've just generated a Cobalt system in those few steps. All you have to do now is start up that new system.

Starting a Newly-Generated System

Now that Cobalt has generated a new system for you, you just have to transfer the files to your webroot, then load the framework tables into your database.

To transfer the files to your webroot, go to Cobalt's `Projects` folder (*"cobalt/Generator/Projects"*). After a successful system generation, the `Projects` folder should now contain a folder named after the base directory you specified for your project. Just cut-and-paste that into your webroot.

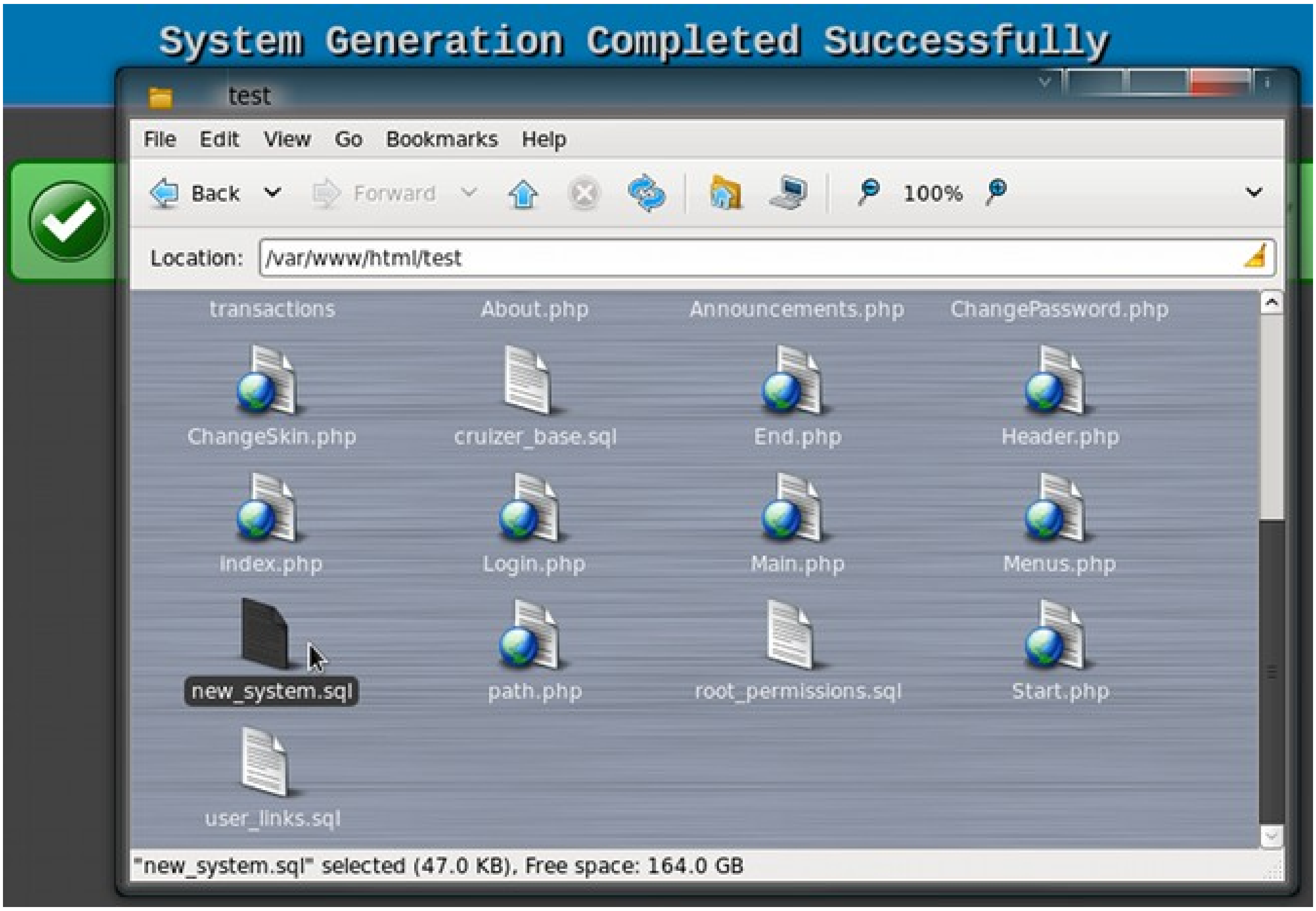

System Generation Completed Successfully
Projects
File Edit View Go Bookmarks Help
Back
Forward
100%
Location: /var/www/html/cobalt/Generator/Projects
test
1 item, Free space: 164.0 GB

All that's left now is to load the framework tables into your database. Remember the last checkbox in the Generate Project screen, the option that says “Generate standard application components, core files, and system administration components”? We need the framework tables to make those components work.

To make this happen, Cobalt also generated an SQL file called `new_system.sql` which contains a bunch of SQL commands to create the framework tables, including table records specific to your project (module names and permissions). You can find this inside your project's base directory (Figure 20). Import that file into your database. After a successful import, you'll find that you have 11 new tables, namely:

- person
- system_log
- system_settings
- system_skins

- user
- user_links
- user_passport
- user_passport_groups
- user_role
- user_role_links
- user_types



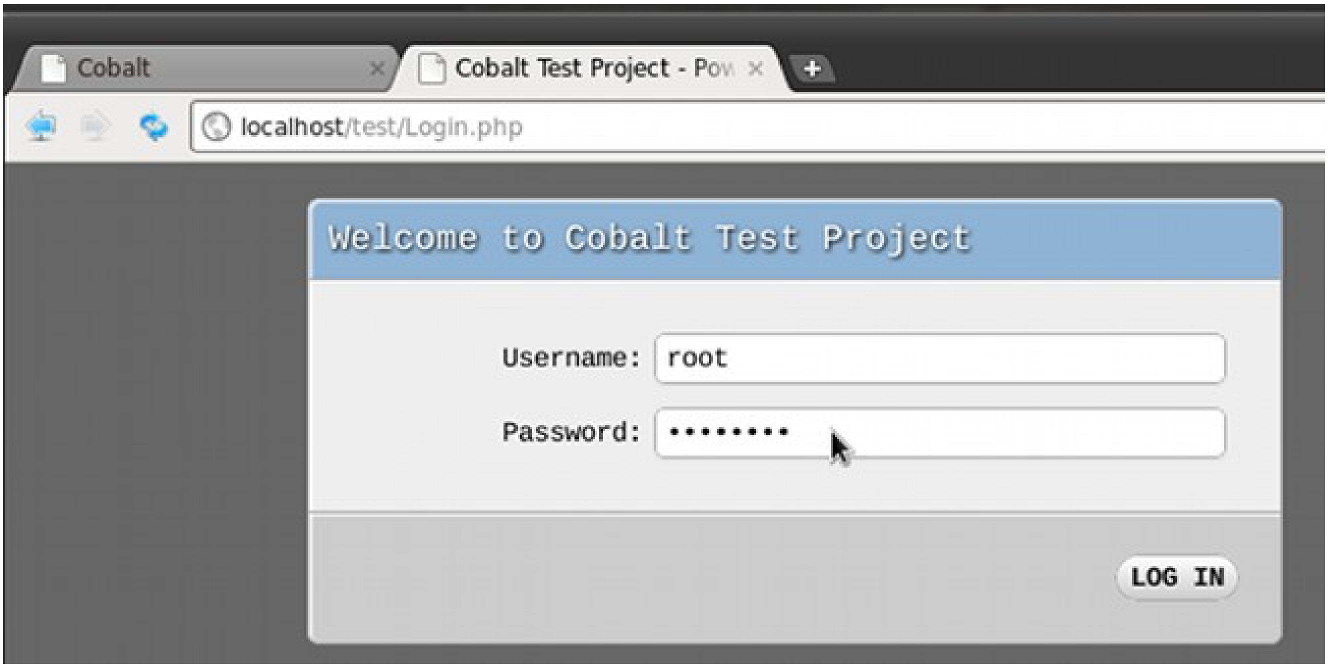
"new_system.sql" selected (47.0 KB), Free space: 164.0 GB

Figure 20: The "new_system.sql" file can be found inside the base directory of your project.

With the project files copied to your webroot and the framework tables imported into your database, you can now login to your new system and try it out. Open a new tab or browser window, and accessing the system through the URL "`localhost/<base directory>`". For example, if your base directory is “`test`”, then the URL to access the generated system is “`localhost/test`”.

You should be greeted by a login screen (Figure 21). It will say “`Welcome to <Project Name>`”. In our example, we put “Cobalt Test Project”, so our login screen in Figure 21 says “`Welcome to Cobalt Test Project`”.

The default (and only) user is `root`, and the password is “`password`”.



Welcome to Cobalt Test Project

Username: root

Password: •••••••••

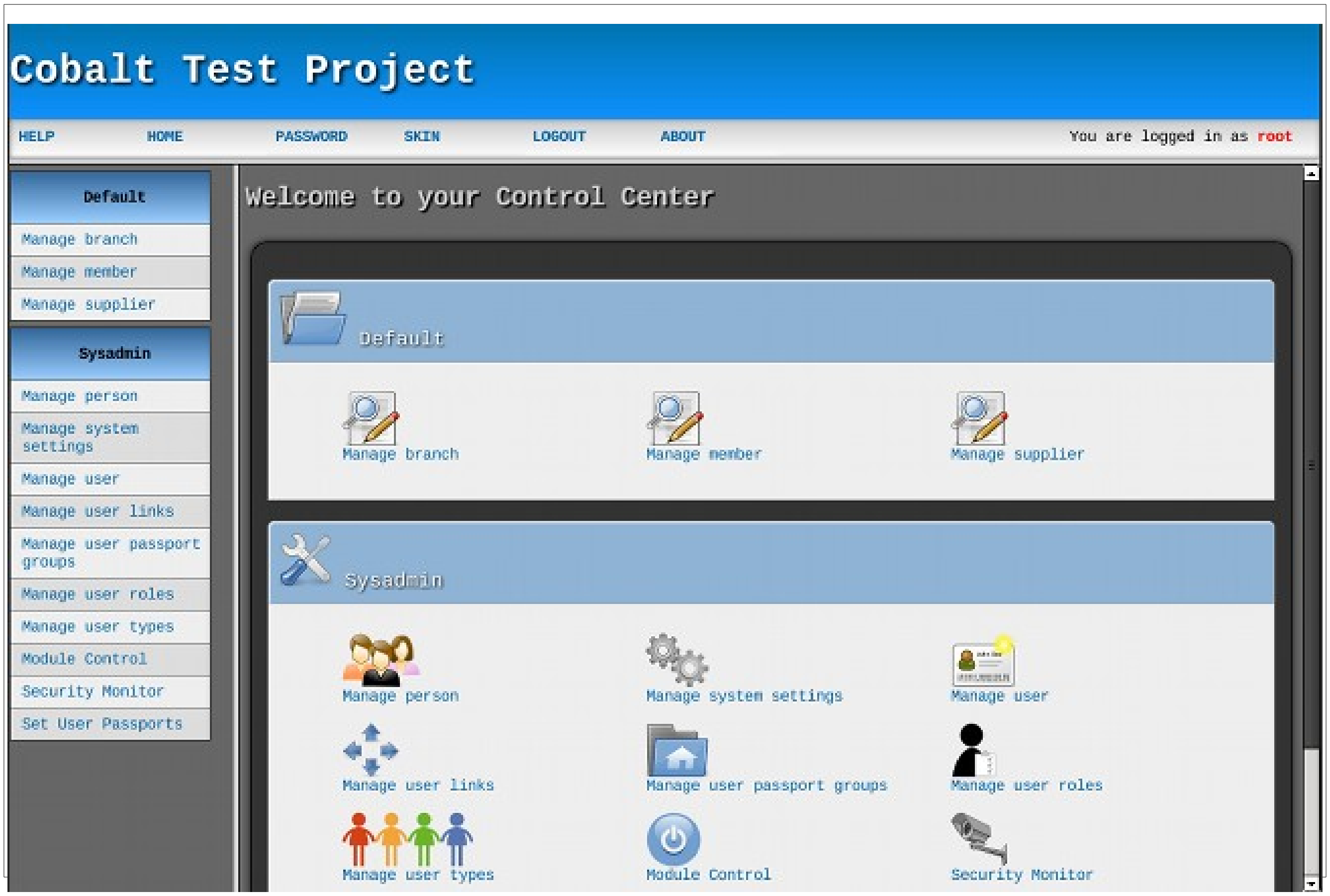
Figure 21: Login screen of the generated system. Default username is "root", with the password "password".

Login successfully and you should reach your Control Center (this is what Cobalt calls each user's landing page / home page). From your Control Center, you can see all module groups you can access (by default for the root user, you have two groups available: “Default”, which contains all modules made from the tables you imported into Cobalt, and “Sysadmin”, which contains all system administration modules).

You'll find that your project name is again displayed very prominently, this time as the header.

There is also a sidebar on the left for quick access to modules. This sidebar is on a different frame so no matter what module you are currently in, this sidebar remains and you can quickly transfer to a different module without having to go back to your Control Center each time.

This ends the **Generator Concept** section. As mentioned from the start, that concept is as simple as this: *let it read your database metadata, then let it create a base system based on the metadata.*



Automatically-Generated System Components

Back in Chapter 1, in the section titled “**Cobalt as a Code Generator**”, we briefly mentioned the following components as being automatically created for us:

- Login/logout module
- User management
- User passport management (ACL-based user privilege management, with RBAC emulation)
- Module control (allows the system admin to turn modules on or off)
- User links (system modules) and passport groups (module grouping) management
- Security Monitor (comprehensive audit trail)
- Change Skin (UI theme management) and Change Password modules for users

We'll go through them in more detail one by one.

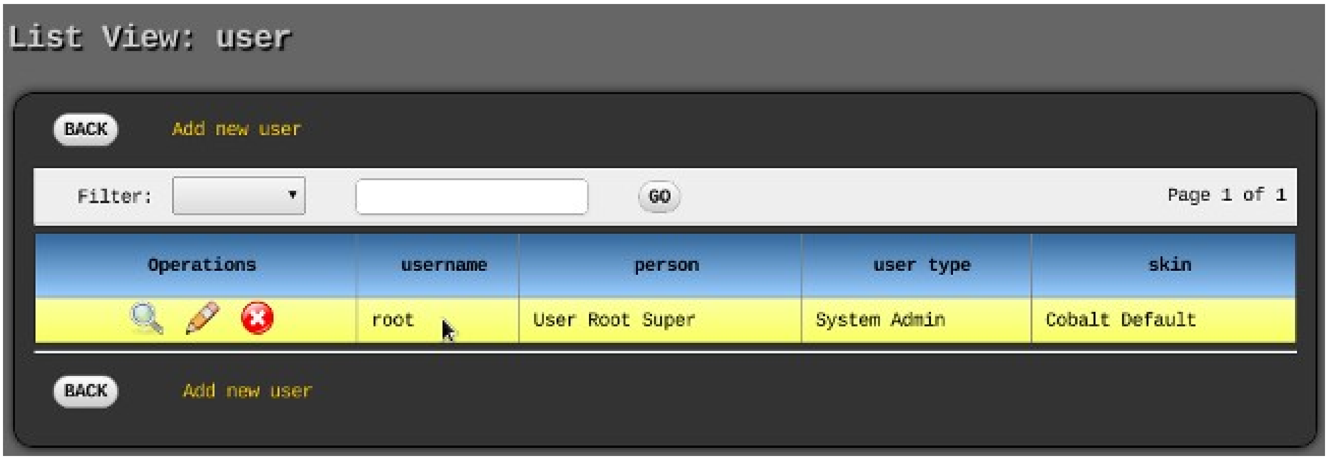
Login/Logout Module

We've already seen this in action: our introduction into the newly-generated system started with meeting the login screen.

Cobalt creates this login screen for us (paired with the logout mechanism, accessed through the header menu bar option helpfully marked “LOGOUT”).

Figure 21 shows the login screen, while the logout option can be seen in the header menu of Figure 22.

User Management

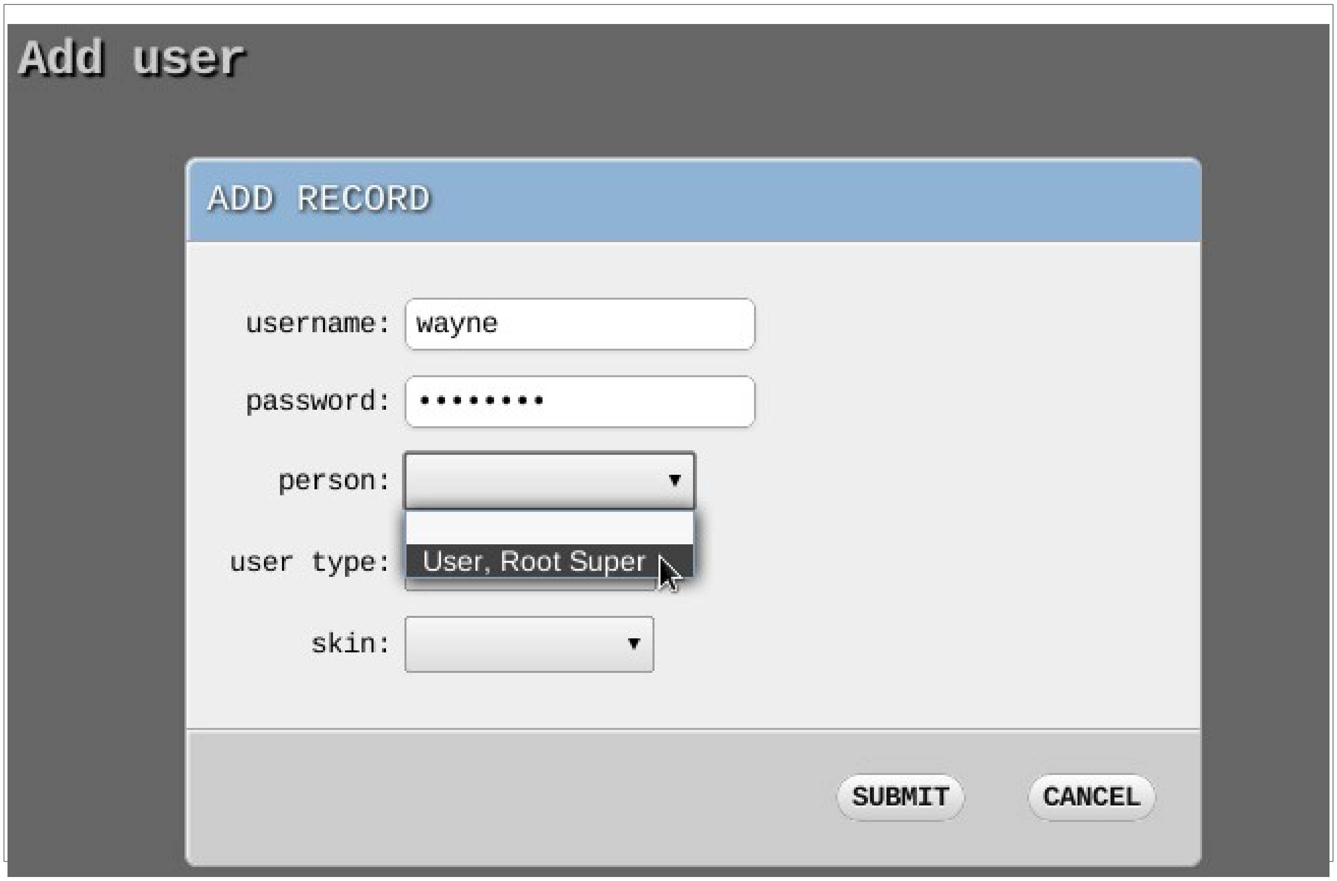


Operations	username	person	user type	skin
🔍 ✏ ✖	root	User Root Super	System Admin	Cobalt Default

Figure 23: User management provided by Cobalt.

Cobalt provides user management as part of the default package. You can add/edit/delete/view users through the user management modules, accessed by clicking the `Manage user` icon in your Control Center under the Sysadmin group. Alternatively, you can also find the `Manage user` link in the sidebar on the left, listed under the Sysadmin group.

Each user needs to be connected to a person (Figure 24). Most often this is an employee of the company, but depending on the type of project you are working on or your setting, this person can also be a different entity – for example, a student in an academic setting, a customer if your system provides customers direct access to certain features or functionality, or a supplier if your system provides suppliers access to certain modules related to their service to the company.


Add user

ADD RECORD

username: wayne

password: ••••••••

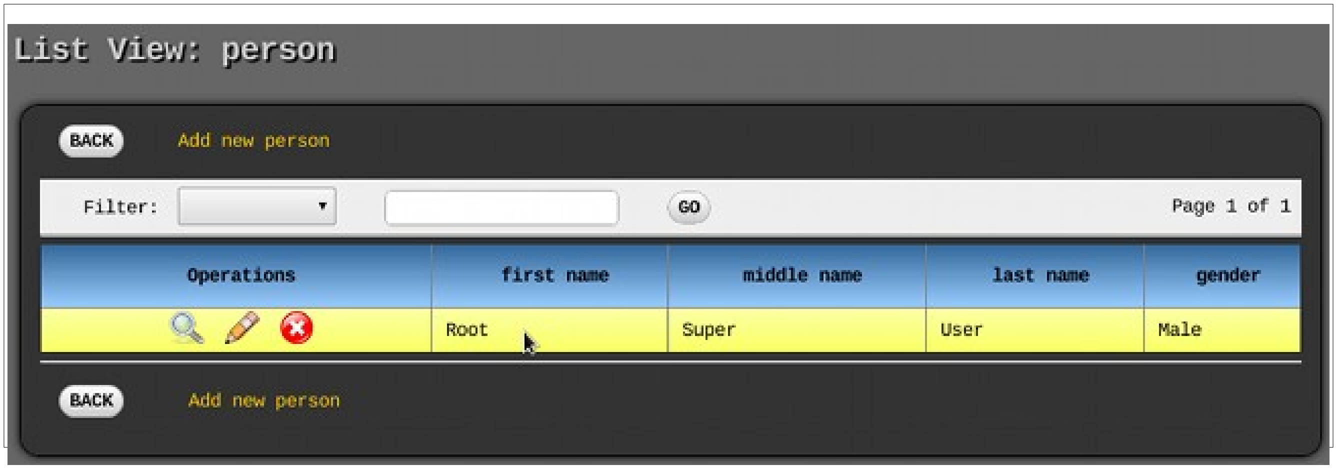
person:

User, Root Super

user type:

skin:

To add a new person into the database, access the `Manage person` link in your Control Center or sidebar under the “Sysadmin” group.


List View: person

Filter:

Page 1 of 1

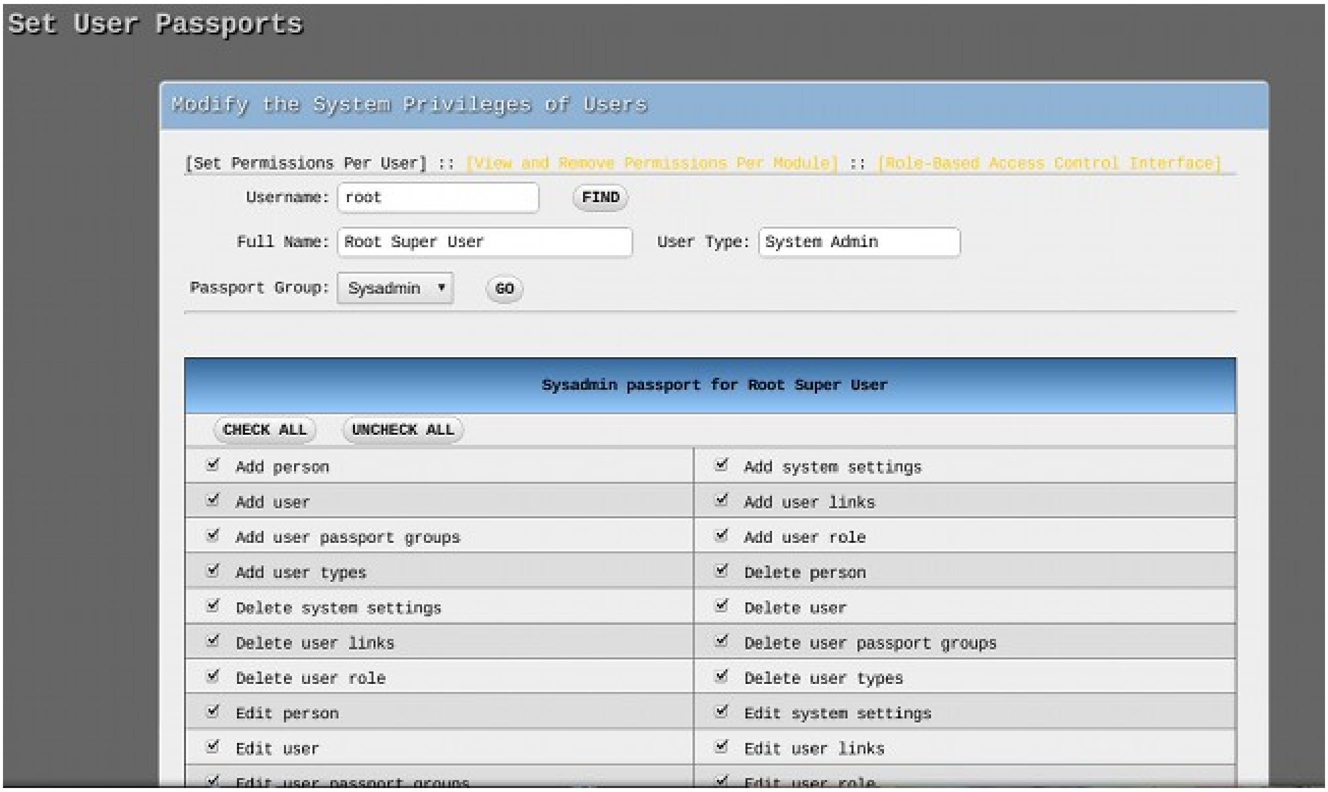
Operations	first name	middle name	last name	gender
	Root	Super	User	Male

Cobalt creates a `person` table as the default repository of all persons to become users (along with the person management modules you accessed through the `Manage person` link). You can override this behavior later (effectively obsoleting the `person` table). For example, if your project encompasses the

Human Resources department, you most certainly already have a table for employees. You can use that table as the repository for persons to become users, instead of the `person` table that Cobalt offers you by default. However, we'll need to learn more about the framework itself to get this done, so we'll need to finish Chapter 3 first before attempting to do so.

User Passport Management

In Cobalt, the permissions or access privileges of the users of the system are defined through the passport system. The main interface for the passport system can be accessed through the `Set User Passports` link in your Control Center or sidebar under the Sysadmin group.



Set User Passports

Modify the System Privileges of Users

[Set Permissions Per User] :: [View and Remove Permissions Per Module] :: [Role-Based Access Control Interface]

Username: root

Full Name: Root Super User User Type: System Admin

Passport Group: Sysadmin

Sysadmin passport for Root Super User	
☑ Add person	☑ Add system settings
☑ Add user	☑ Add user links
☑ Add user passport groups	☑ Add user role
☑ Add user types	☑ Delete person
☑ Delete system settings	☑ Delete user
☑ Delete user links	☑ Delete user passport groups
☑ Delete user role	☑ Delete user types
☑ Edit person	☑ Edit system settings
☑ Edit user	☑ Edit user links
☑ Edit user passport groups	☑ Edit user role

Figure 26: The Cobalt Passport System: check or uncheck modules as necessary to define what a user can do in the system.

Cobalt's passport system is an access control list (ACL)-based permission system. In essence, there is a list of all modules in the system for each user, and you can specify (through a checkbox) whether they can access a specific module or not. Cobalt defines a “module” as a single, atomic functionality that can be assigned to users; therefore, the “Add User” module is different from the “Edit User” module, although we often think of them as just parts of a greater “User” module. This simplifies the concept of “modules” and allows the passport system to be very fine-grained. Just by checking/unchecking the appropriate checkboxes in a user's passport, you can define his system privileges quickly.

The most basic permission is the "`Manage [table name]`" permission. For all intents and purposes, the "Manage" links are the "View" permission, allowing nothing but viewing – no adding, editing, or deleting. For example, let's take the "`Manage user`" permission. If you assign this to a user, the user will see the **`Manage user`** icon in his Control Center and the **`Manage user`** link in his sidebar, both under the Sysadmin group, and he will be granted access to the List View module.

If he has other related permissions as well (such as "`Add user`", "`Edit user`", and "`Delete user`"), he will be able to see links to these modules inside the List View module. Edit and Delete links are found in the Operations column. The Add link can be found at the top of the List View table, and another link at the bottom.

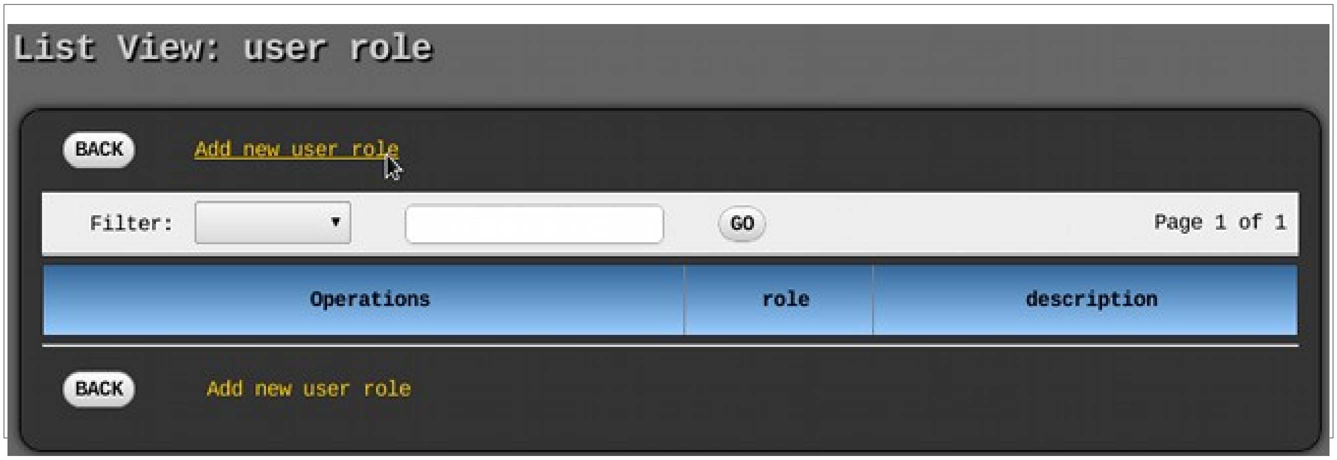
However, if the user only has the "`Manage user`" link checked, but the rest of the related permissions are left unchecked, he will not see any Add, Edit, or Delete links.

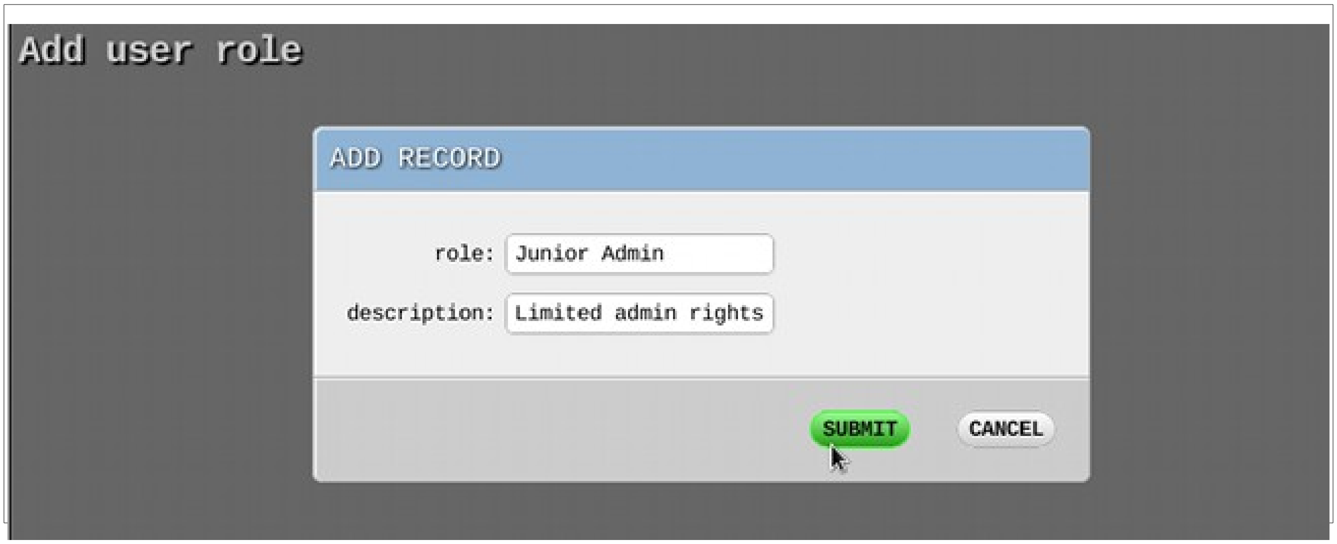
As expected, if you provide a user the "Add" permission for a particular set of modules, but forget to assign them the "Manage" link for that set of modules, he won't be able to see his desired module in the Control Center or sidebar. Since the "Manage" permissions are the "View" permissions, it makes no sense for a user to be able to add, edit, or delete records without actually being allowed to view records.

Managing permissions solely through the basic ACL interface can be very redundant. Since each new user will have to be defined a passport, you (assuming you are the system administrator) may find yourself having to check little checkboxes repeatedly as users are added into the system. This kind of tediousness is avoided by a role-based permission system or RBAC (role-based access control); unfortunately, RBAC is much less flexible than ACL (read: does not support fine-grained permissions per user).

Despite being completely ACL-based, Cobalt mitigates this tediousness by providing RBAC emulation:

- Go to **`Manage user roles`**, either through the Control Center or sidebar, under Sysadmin.
- Click "**`Add new user role`**". (Figure 27)
- Enter a role name and description. (Figure 28)
- Click **`Submit`**.
- Your newly named role should now be visible in the table. Click **`Role Permissions`** under the Operations column. (Figure 29)
- Define as many permissions for this role as you want. For example, if you want to issue 10 permissions to this new role, input "`10`" into the textbox labeled "**`Change # of items to:`**" and click **`Go`**. (Figure 30)

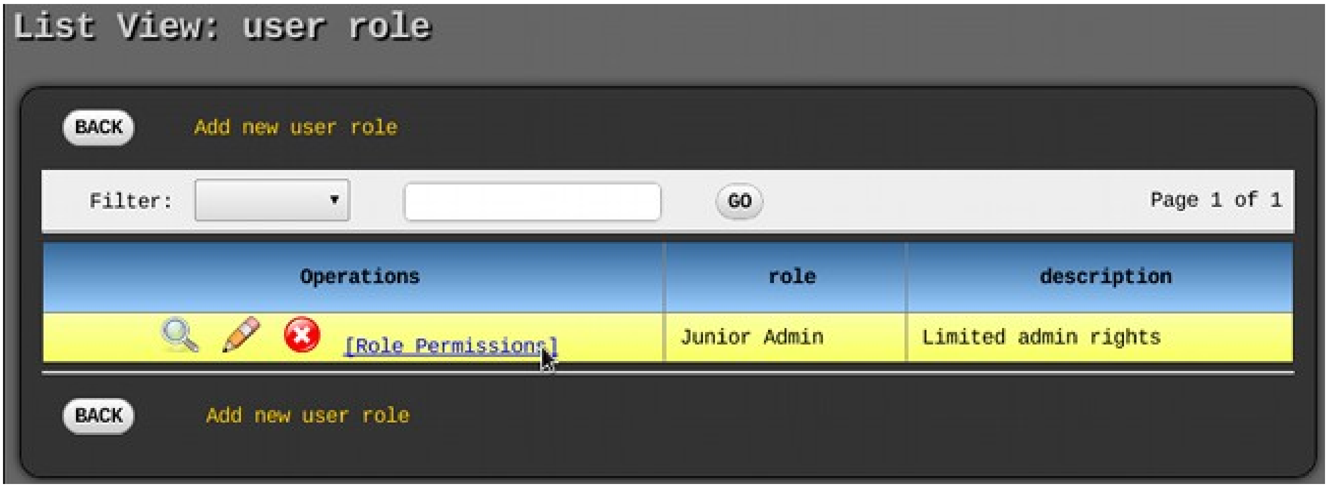




role: Junior Admin

description: Limited admin rights

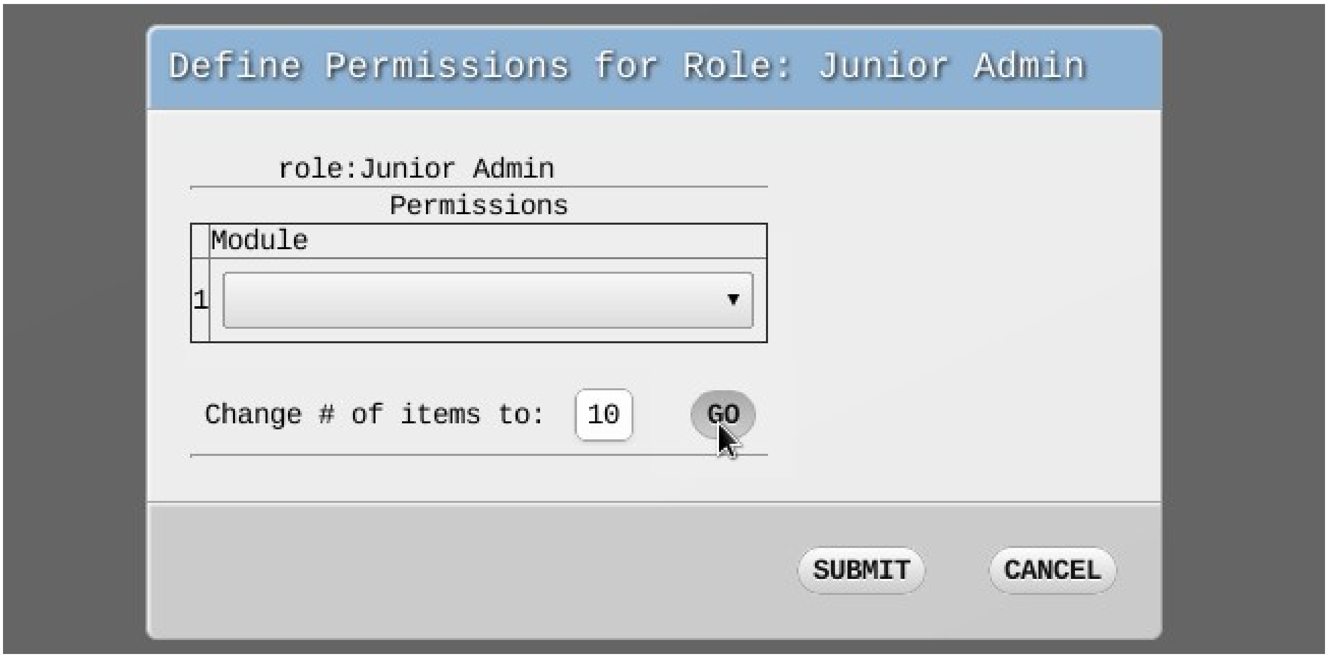
- Choose the permissions you want from the drop-down lists.
- When you are done assigning all the permissions for the role, click `Submit`.
- Go to `Set User Passports`, either through the Control Center or sidebar, under Sysadmin.
- Click the `Role-Based Access Control Interface` link (top right). (
- Instead of defining the user's permission by manipulating lots of little checkboxes, you now define or re-define the user's permission by assigning a role (or roles). The role you just created will be visible in the drop-down list labeled `Role`.



List View: user role

Operations	role	description
[Role Permissions]	Junior Admin	Limited admin rights

Figure 29: Your newly created role is visible in the table after submitting. Click the "Role Permissions" link to define permissions for the new role.



Define Permissions for Role: Junior Admin

role:Junior Admin

Permissions

	Module
1	

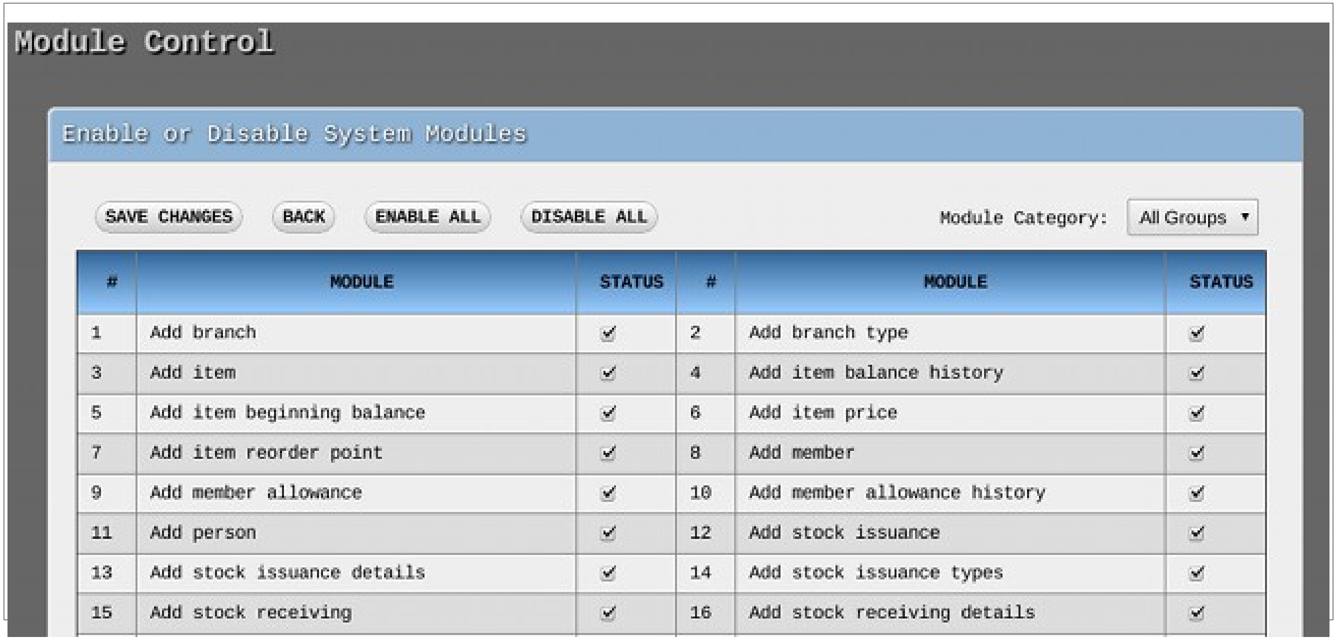
Change # of items to: 10

Figure 30: Defining role permissions. To change the number of modules assigned to the role, enter the number you need in the textbox labeled "Change # of items to", then click "Go"..

- After choosing a role from the list, the permissions associated with that role is shown to you. Click **`Assign`** to give all the listed permissions to the user.
- There is an **`Exclusive Role`** checkbox beside the role list. If you check this, Cobalt will make sure the user is assigned only the permissions in this role by deleting all existing permissions the user has before assigning the permissions associated with the role you are about to assign.

Take note that Cobalt does not actually store the roles you assign for a user. Cobalt is completely ACL-based, so this RBAC-emulation is just an interface for system admins to be able to assign permissions to new users more efficiently. If you update the permissions for a role (adding or removing some permissions for that role), users you previously assigned the role to will not be affected. You will have to modify their passports individually, either by re-assigning exclusively the newly modified role, or through the standard ACL interface; which way is more efficient or applicable depends on the changes to the permissions. For minor changes, you will almost always end up using the standard ACL interface because the user passport can be modified very quickly.

Module Control



Module Category: All Groups

#	MODULE	STATUS	#	MODULE	STATUS
1	Add branch	☑	2	Add branch type	☑
3	Add item	☑	4	Add item balance history	☑
5	Add item beginning balance	☑	6	Add item price	☑
7	Add item reorder point	☑	8	Add member	☑
9	Add member allowance	☑	10	Add member allowance history	☑
11	Add person	☑	12	Add stock issuance	☑
13	Add stock issuance details	☑	14	Add stock issuance types	☑
15	Add stock receiving	☑	16	Add stock receiving details	☑

There are cases when a module or a set of modules need to be off limits to everyone, such as functionality that are only used periodically or follows a strict schedule (for example, a business module that needs to be inaccessible during cut-off periods, or the enrollment module of a school during non-enrollment periods), or when the affected modules are undergoing maintenance.

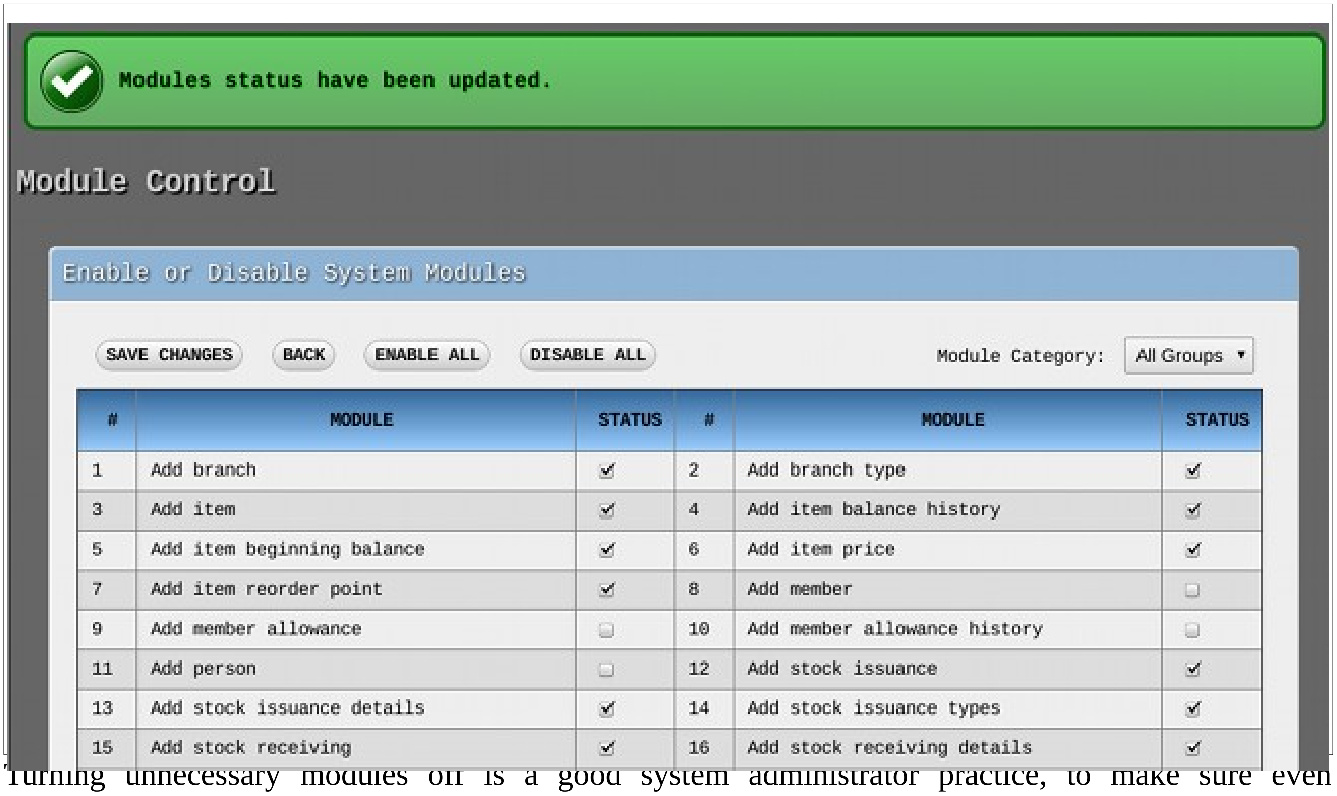
Technically, you could achieve this through the passport system, but that would be very tedious – you'd have to go through each user's passport setting and uncheck the affected modules, only to go through all of them again. System admins will find that hell.

To mitigate this, Cobalt provides a module control interface that allows you to turn modules off and on again at will. As seen in Figure 31, all system modules are listed with a checkbox beside them, quite similar to the standard ACL interface for setting user passports. Uncheck modules that you want to turn off, then click `Save Changes` when you are done. You should see a success message. (Figure 32)

To turn them on again, just check the appropriate checkboxes, then click `Save Changes`.

When a module is turned off, it behaves as if it was removed from the passport of each user. Users will not be able to access the module or even see the module at all (whether in the Control Center or sidebar, or in the appropriate List View module). Even `root`, the default super administrator account, will not have access to the module.

When a module is turned on again, it behaves as if it was re-assigned to all appropriate users (simply because we did not actually remove the module from anybody's passport).



Modules status have been updated.

Module Control

Enable or Disable System Modules

#	MODULE	STATUS	#	MODULE	STATUS
1	Add branch	☑	2	Add branch type	☑
3	Add item	☑	4	Add item balance history	☑
5	Add item beginning balance	☑	6	Add item price	☑
7	Add item reorder point	☑	8	Add member	□
9	Add member allowance	□	10	Add member allowance history	□
11	Add person	□	12	Add stock issuance	☑
13	Add stock issuance details	☑	14	Add stock issuance types	☑
15	Add stock receiving	☑	16	Add stock receiving details	☑

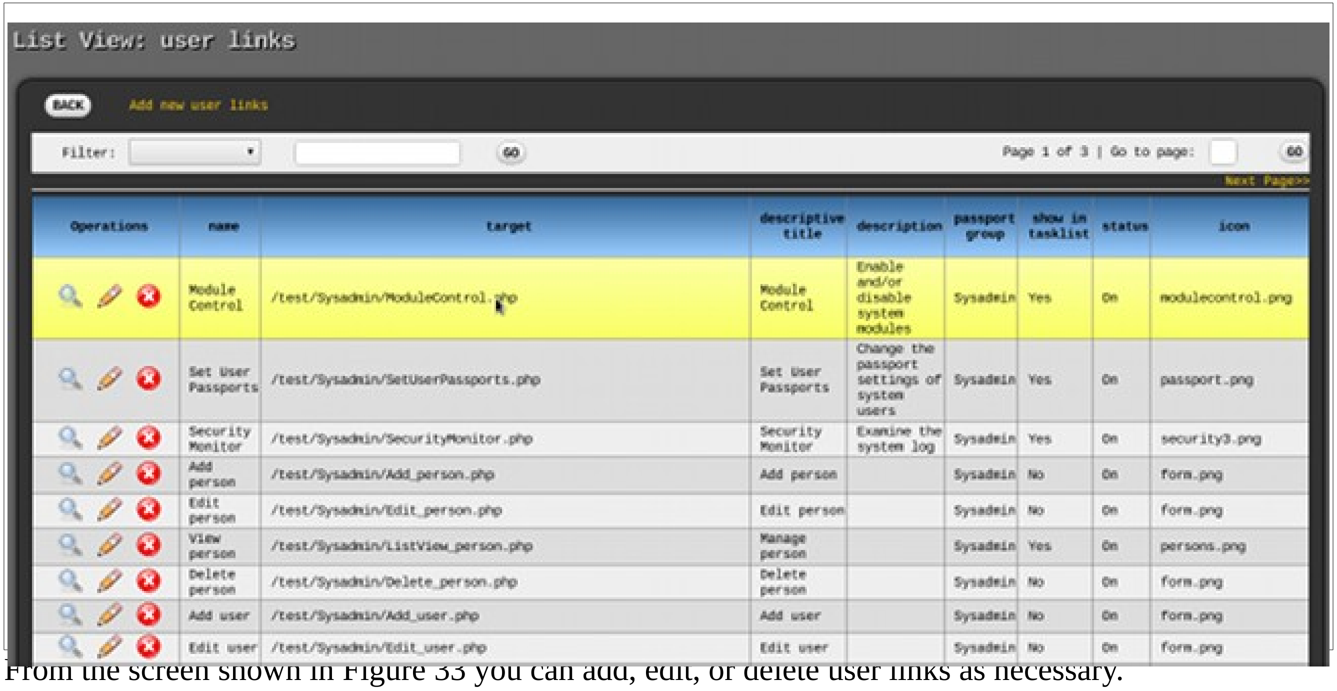
Turning unnecessary modules off is a good system administrator practice, to make sure even completely-innocent and accidental use of such modules do not happen outside of the supposed activation periods. It is absolutely recommended to turn off a module that is currently under maintenance, to make sure no unforeseen side effects will not even have a chance to be triggered.

User Links and Passport Groups Management

Cobalt uses the term “user links” to describe system modules, since system modules most often look like normal web links to the user – accessed through a hyperlink.

Cobalt provides a way for devs or system admins to maintain this table of user links, to make any necessary changes, such as renaming a module (a very likely use case, especially if the default name provided by Cobalt is not very pretty or “user friendly”, since it is simply based on the relevant table name), or adding a new user link (such as for a newly-developed module that did not come from the Cobalt code generator), or deleting user links that are obsolete or not needed.

From your Control Center or sidebar, under the Syadmin group, click **`Manage user links`**.



List View: user links

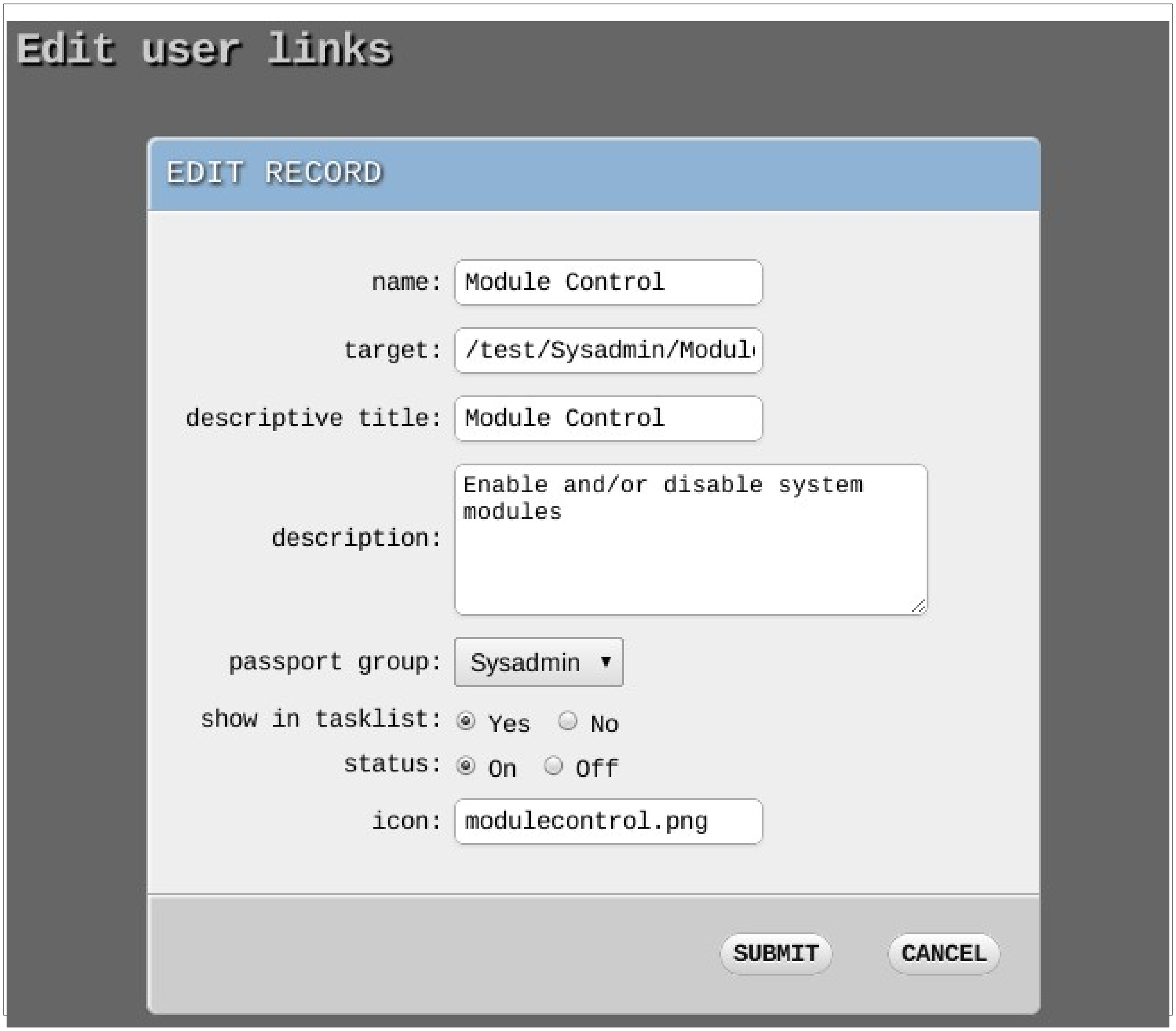
Page 1 of 3 | Go to page:

Operations	name	target	descriptive title	description	passport group	show in tasklist	status	icon
🔍 ✎ ✖	Module Control	/test/Sysadmin/ModuleControl.php	Module Control	Enable and/or disable system modules	Sysadmin	Yes	On	modulecontrol.png
🔍 ✎ ✖	Set User Passports	/test/Sysadmin/SetUserPassports.php	Set User Passports	Change the passport settings of system users	Sysadmin	Yes	On	passport.png
🔍 ✎ ✖	Security Monitor	/test/Sysadmin/SecurityMonitor.php	Security Monitor	Examine the system log	Sysadmin	Yes	On	security3.png
🔍 ✎ ✖	Add person	/test/Sysadmin/Add_person.php	Add person		Sysadmin	No	On	form.png
🔍 ✎ ✖	Edit person	/test/Sysadmin/Edit_person.php	Edit person		Sysadmin	No	On	form.png
🔍 ✎ ✖	View person	/test/Sysadmin/ListView_person.php	Manage person		Sysadmin	Yes	On	persons.png
🔍 ✎ ✖	Delete person	/test/Sysadmin/Delete_person.php	Delete person		Sysadmin	No	On	form.png
🔍 ✎ ✖	Add user	/test/Sysadmin/Add_user.php	Add user		Sysadmin	No	On	form.png
🔍 ✎ ✖	Edit user	/test/Sysadmin/Edit_user.php	Edit user		Sysadmin	No	On	form.png

From the screen shown in Figure 33 you can add, edit, or delete user links as necessary.

Notice that the sixth column, **`passport group`**, contains either “*`Sysadmin`*” or “*`Default`*”. This is the field that contains the label for the module groups that you've seen in the Control Center and in the sidebar.

Try adding a new link (click “**`Add new user links`**”) or editing an existing link (the pencil icon beside a record), and you will see that the form control (data entry) for passport group is a drop-down list. (Figure 34). This drop-down list contains only “*`Sysadmin`*” and “*`Default`*”, but don't worry, the passport groups themselves are customizable – you are not stuck with “*`Sysadmin`*” and “*`Default`*” forever.



Edit user links

EDIT RECORD

name: Module Control

target: /test/Sysadmin/Modul

descriptive title: Module Control

description: Enable and/or disable system modules

passport group: Sysadmin ▾

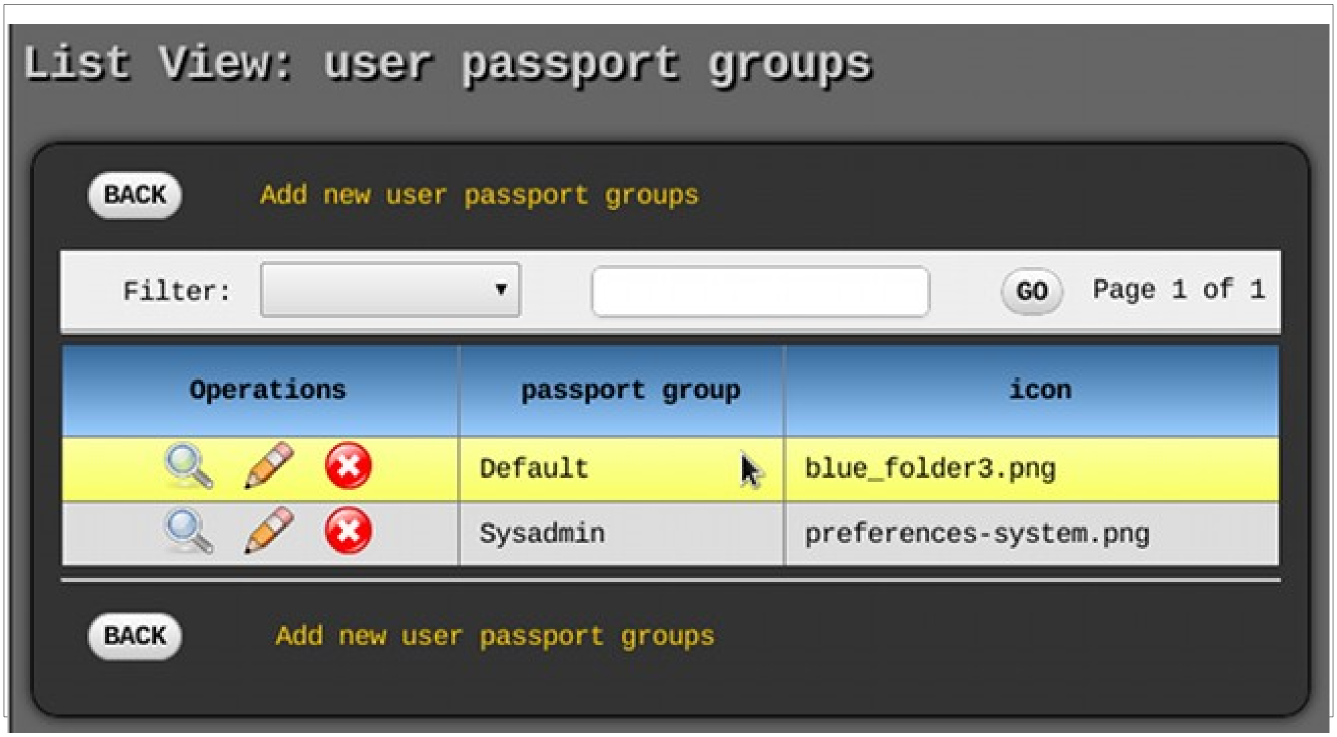
show in tasklist: ● Yes ○ No

status: ● On ○ Off

icon: modulecontrol.png

To customize your passport groups (make new ones, rename or remove old ones, etc), click `Manage user passport groups` from your Control Center or sidebar.

From the “List view: user passport groups” screen, you can customize your passport groups by adding, editing, and deleting passport groups. When you are done creating new groups, renaming existing groups, and/or deleting old groups, your changes will be reflected in the user links modules. Your new groups will become part of the values in the `passport group` drop-down lists in the Add and Edit modules of user links, and if you renamed “Default” (perhaps to something more suitable and fitting to your project, such as “Logistics” or “Accounting”), you will see that all modules previously classified as “Default” will now be classified as the new group name.



List View: user passport groups

Operations	passport group	icon
🔍 ✎ ✖	Default	blue_folder3.png
🔍 ✎ ✖	Sysadmin	preferences-system.png

Security Monitor

By default, Cobalt logs a huge amount of system events:

- Each module access of a user.
- Every database query (SQL) that happens (except for SELECT statements).

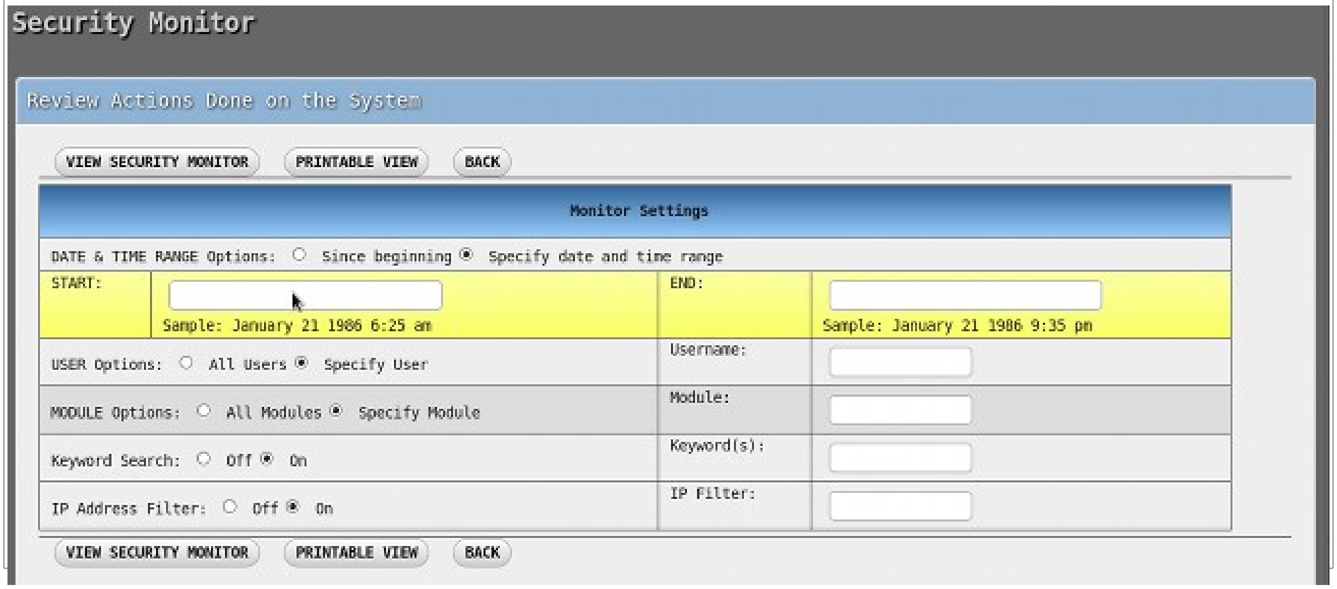
Cobalt provides a way to conveniently view these logs along with some optional filtering options through the Security Monitor module. From your Control Center or sidebar, click **`Security Monitor`**.

To view the log without any filter, choose the following options:

- **`DATE & TIME RANGE:`** *`Since beginning`*
- **`USER:`** *`All Users`*
- **`MODULE:`** *`All Modules`*
- **`Keyword Search:`** *`Off`*
- **`IP Address Filter:`** *`Off`*

After setting those options, click **`View Security Monitor`**. Cobalt will show you the log entries that match your filters (in this case, no filter at all) in what resembles a standard Cobalt “list view” screen, complete with pagination. (Figure 37)

If you want the log result in printable form, click `Printable View` instead. (Figure 38)



Monitor Settings

DATE & TIME RANGE Options: ○ Since beginning ● Specify date and time range

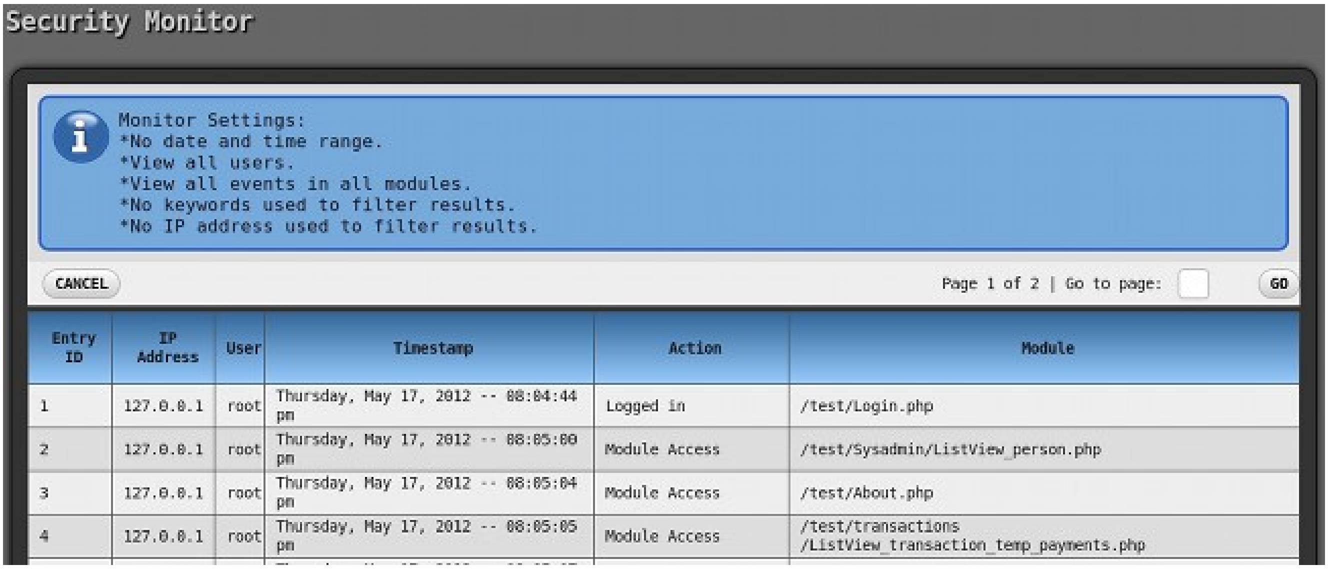
START: Sample: January 21 1986 6:25 am | END: Sample: January 21 1986 9:35 pm

USER Options: ○ All Users ● Specify User | Username:

MODULE Options: ○ All Modules ● Specify Module | Module:

Keyword Search: ○ Off ● On | Keyword(s):

IP Address Filter: ○ Off ● On | IP Filter:

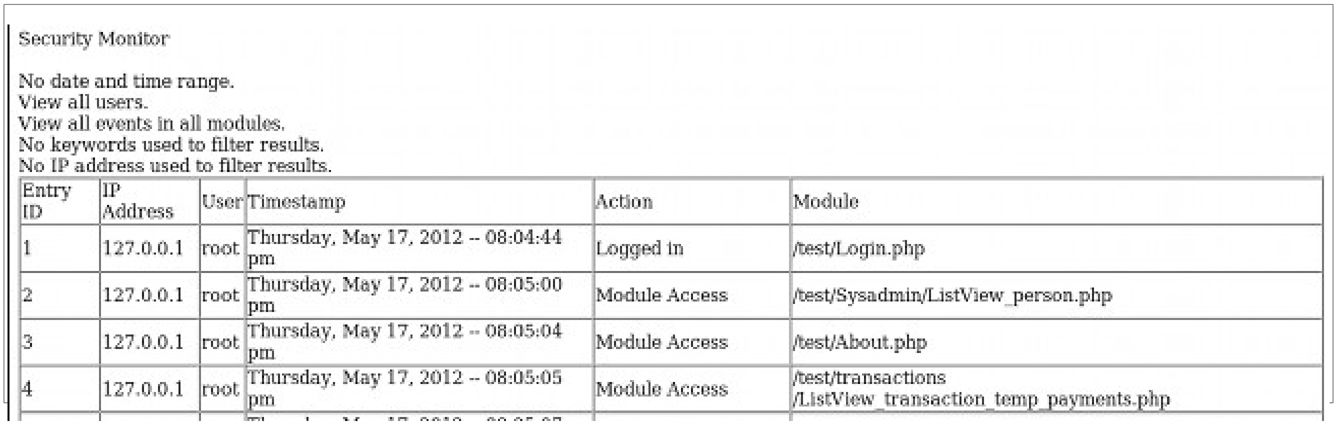


Monitor Settings:
*No date and time range.
*View all users.
*View all events in all modules.
*No keywords used to filter results.
*No IP address used to filter results.

Page 1 of 2 | Go to page:

Entry ID	IP Address	User	Timestamp	Action	Module
1	127.0.0.1	root	Thursday, May 17, 2012 -- 08:04:44 pm	Logged in	/test/Login.php
2	127.0.0.1	root	Thursday, May 17, 2012 -- 08:05:00 pm	Module Access	/test/Sysadmin/ListView_person.php
3	127.0.0.1	root	Thursday, May 17, 2012 -- 08:05:04 pm	Module Access	/test/About.php
4	127.0.0.1	root	Thursday, May 17, 2012 -- 08:05:05 pm	Module Access	/test/transactions /ListView_transaction_temp_payments.php

Figure 37: The Security Monitor results screen. It shows you the settings you chose and the results, with pagination if the results exceed the page limit (default = 50 entries per page)



Security Monitor

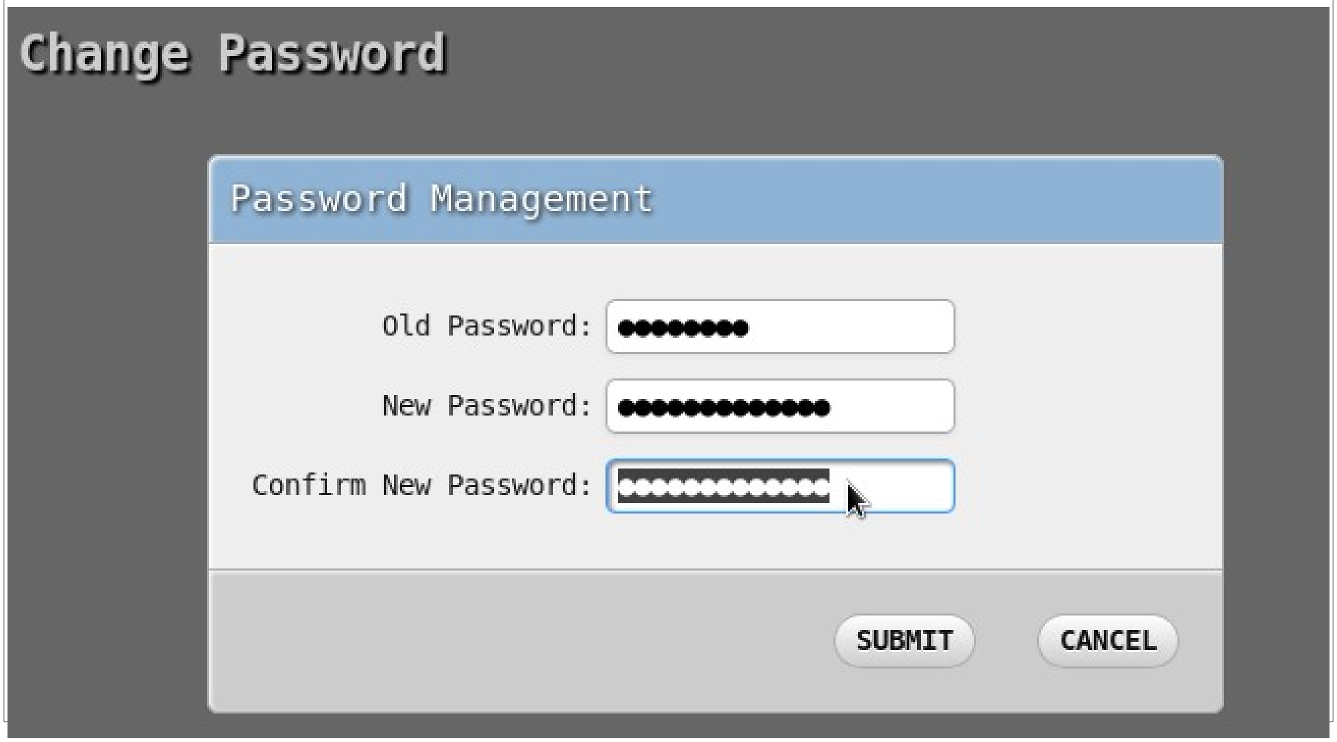
No date and time range.
View all users.
View all events in all modules.
No keywords used to filter results.
No IP address used to filter results.

Entry ID	IP Address	User	Timestamp	Action	Module
1	127.0.0.1	root	Thursday, May 17, 2012 -- 08:04:44 pm	Logged in	/test/Login.php
2	127.0.0.1	root	Thursday, May 17, 2012 -- 08:05:00 pm	Module Access	/test/Sysadmin/ListView_person.php
3	127.0.0.1	root	Thursday, May 17, 2012 -- 08:05:04 pm	Module Access	/test/About.php
4	127.0.0.1	root	Thursday, May 17, 2012 -- 08:05:05 pm	Module Access	/test/transactions /ListView_transaction_temp_payments.php

You can use any combination of options to filter your log search. Take note of the following behaviors:

- **`DATE & TIME RANGE:`** Follow the format in the example to make sure Cobalt understands what you mean. The **`strtotime()`** function is used to evaluate the date and time, which understands most date strings, but the farther you deviate from the sample format, the more likely it becomes that your date and time range will be misinterpreted.
- **`USER:`** The user filter takes your supplied username and searches for an exact match.
- **`MODULE:`** The module filter takes your supplied module string, and searches for entries whose module field contains the module string, not necessarily an exact match. Whatever you supply is enclosed in %...%. Searching for “*`Login.php`*” will match “*`/test/Login.php`*”, which makes filtering for modules easier – even though Cobalt records the full path of the module (starting from webroot), you only actually need to supply the filename of the module. As long as all modules have unique names (they should), you don't need to bother about supplying the full path from the webroot.
- **`Keyword Search:`** The keyword search filters only the **`Action`** field. Whatever you supply is enclosed in %...%. Combine this with your ability to customize log messages with keywords of your choosing, and you can filter for actions you want to monitor very easily just by supplying the unique keywords you give to certain actions / functions of the system.
- **`IP Address Filter:`** You can supply a full IP address, or a partial IP address. Whatever you supply is enclosed in %...%. Take note that it is possible for the IP address column to contain two addresses separated by a colon. In these cases, that means Cobalt detected that a proxy server was used, so the IP address of the proxy and the client was logged. The first IP address is the client IP, while the second one is the IP address of the proxy. It is also possible for the first IP address (the one before the colon) to actually contain multiple IP addresses separated by commas.

Change Password



Change Password

Password Management

Old Password: ●●●●●●●●

New Password: ●●●●●●●●●●●●●●

Confirm New Password: ●●●●●●●●●●●●●●

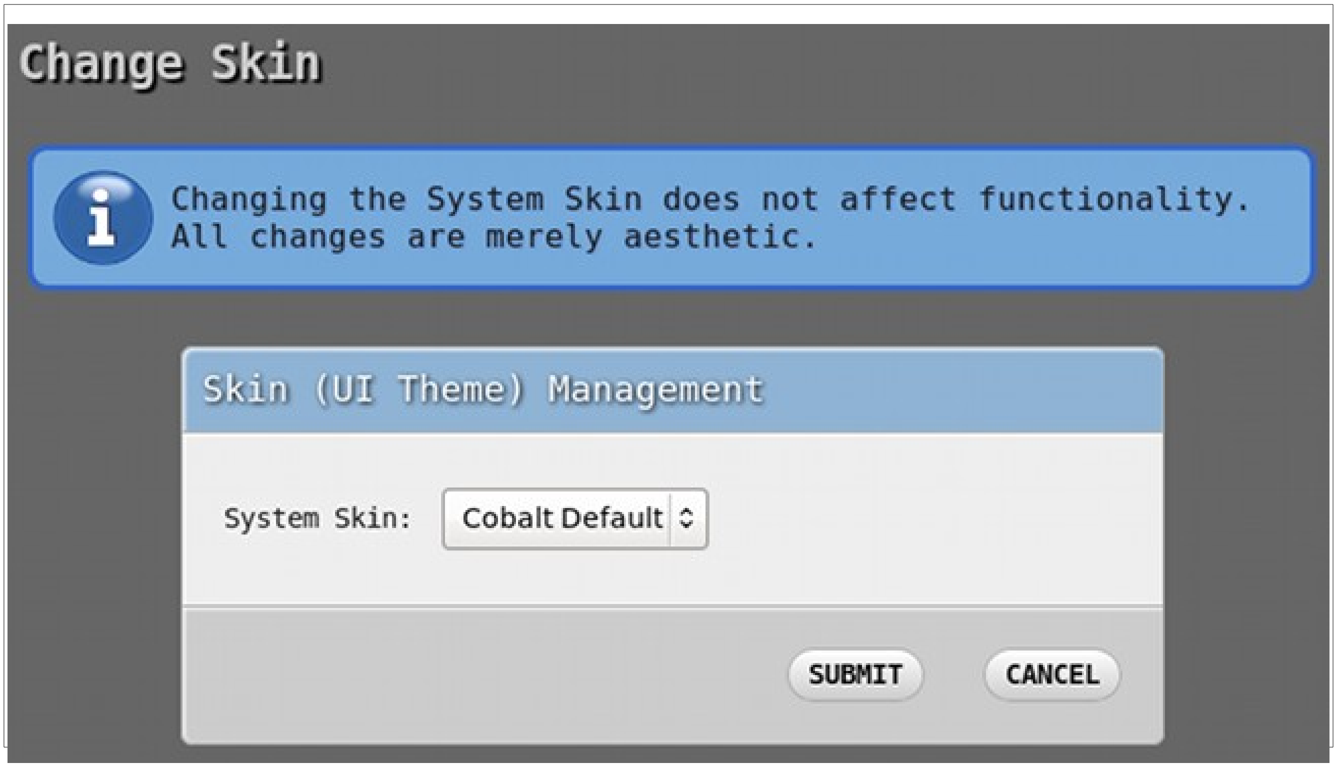
Cobalt provides a way for all users to change their passwords as they desire. From the header menu, click **`PASSWORD`** to access the Change Password module.

This functions as most password changing modules do:

- Supply your old password first, to verify that the request to change password is legitimate.
- Type in your new password twice to prevent accidental typing errors turning your password into a mystery.
- Click **`Submit`** to finish, or **`Cancel`** if you change your mind and don't want to change your password at this time.

Cobalt will show you a success message if everything went well. Otherwise, Cobalt will show you an error message, telling you exactly what you need to fix (for example, the old password you typed does not match your existing password, or the new passwords don't match each other).

Change Skin



Change Skin

Changing the System Skin does not affect functionality.
All changes are merely aesthetic.

Skin (UI Theme) Management

System Skin: Cobalt Default

Cobalt sports a “skinnable” / theme-able user interface (UI). Users can change the UI theme to suit their preferences (darker, lighter, preferred color scheme, etc) by accessing the Change Skin module and choosing from the available system skins.

To access the Change Skin module, click **`SKIN`** from the header menu.

The *`Cobalt Default`* skin uses a lot of advanced CSS to give a more presentable and user-friendly UI (rounded corners, shadows, and highlighting of rows and buttons upon mouseover). Those running on slow machines may feel that the UI is slow or takes too much CPU power. If so, choose the *`Cobalt Minimal`* skin for a simpler, faster UI.

```
Changing the system skin does not affect functionality.
All changes are merely aesthetic.
```

Fine-Tuning Your Project

Unless your project is a very simple one, the output of Cobalt's code generator will not fit your needs without some fine-tuning. This includes:

- Assigning a different control type to a field, instead of the one assigned by Cobalt.
- Assigning a list of acceptable values for a certain field.
- Changing the labels for each field.
- Changing the attribute of a field to become optional instead of required.
- Adding relationship information between tables.

The code generator interface allows you to make these modifications so that the resulting system is closer to your actual desires.

You can also do all these modifications outside of the code generator interface, by modifying the data dictionary code of relevant modules as necessary (we tackled this a bit in Chapter 1). In fact, more fine-tuning is possible through data dictionary code modification than through the code generator interface.

> Take note that there is a certain advantage to doing as much fine-tuning as possible through the code generator before generating the project: you can regenerate the project at any time, and your fine-tuning will remain. If you did all fine-tuning through data dictionary code modification, all these modifications will not persist if you regenerate the project.

Assigning a Different Control Type to a Field

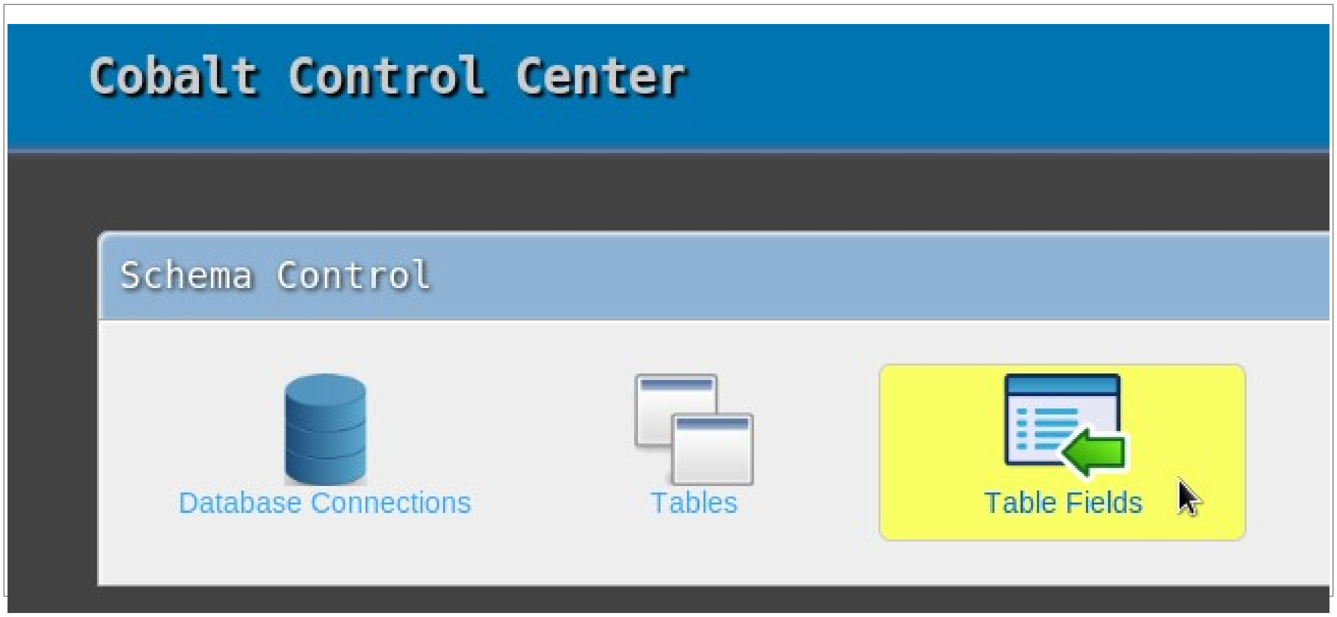
The default control type assigned by Cobalt to a field is based on the data type Cobalt detected for that field. The only exception here are fields named “remarks” or “description”, to which Cobalt automatically assigns a textarea as the default control type.

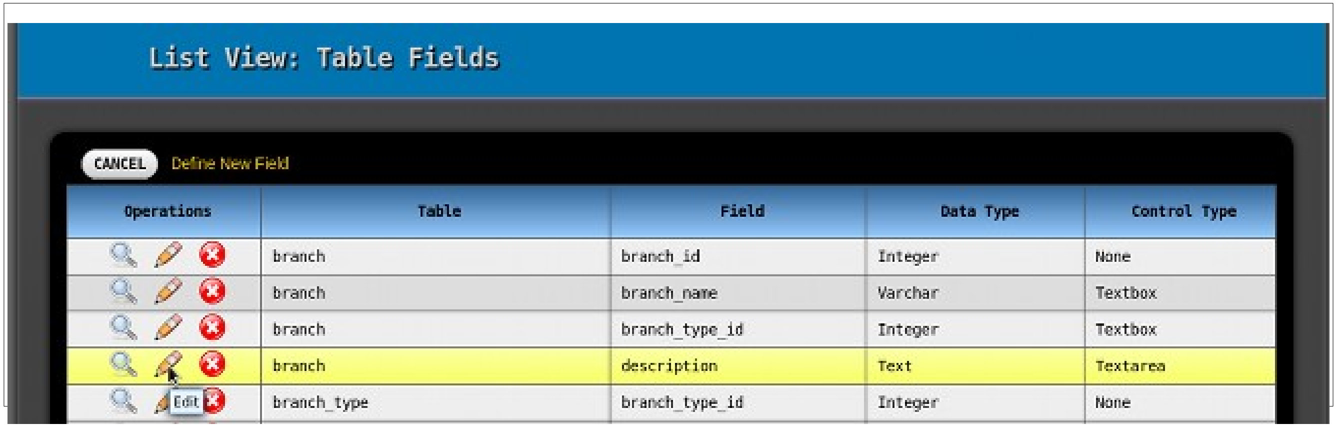
In cases where you feel Cobalt's default choice for the control type of a field isn't optimal, you can override Cobalt's choice and assign a different control type.

From the Cobalt Control Center, click **`Table Fields`**. (Figure 41)

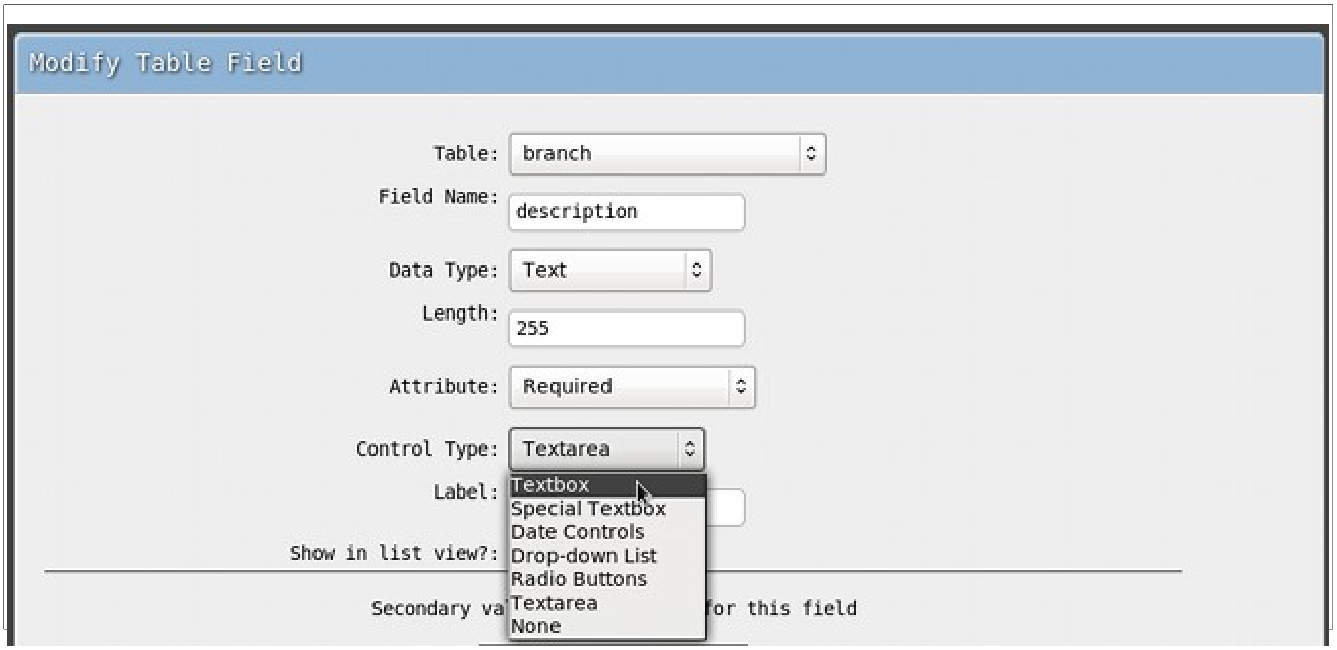
You should now find yourself in the List View: Table Fields screen. This page lists all the fields in all the tables that Cobalt imported. The entries are arranged in alphabetical order per table.

Find the field you want to modify, then click the pencil icon beside it under the Operations column. This will bring you to the Edit Table Field screen.





Operations	Table	Field	Data Type	Control Type
	branch	branch_id	Integer	None
	branch	branch_name	Varchar	Textbox
	branch	branch_type_id	Integer	Textbox
	branch	description	Text	Textarea
	branch_type	branch_type_id	Integer	None



Modify Table Field

Table: branch

Field Name: description

Data Type: Text

Length: 255

Attribute: Required

Control Type: Textarea

As illustrated in Figure 43, click the Control Type drop-down list, then choose the new control type you want for the field.

Warning!
The "Special Textbox" control type is currently unsupported. It's a feature that is currently still under development. Don't use it. Currently, choosing it results in the same thing as choosing "None".

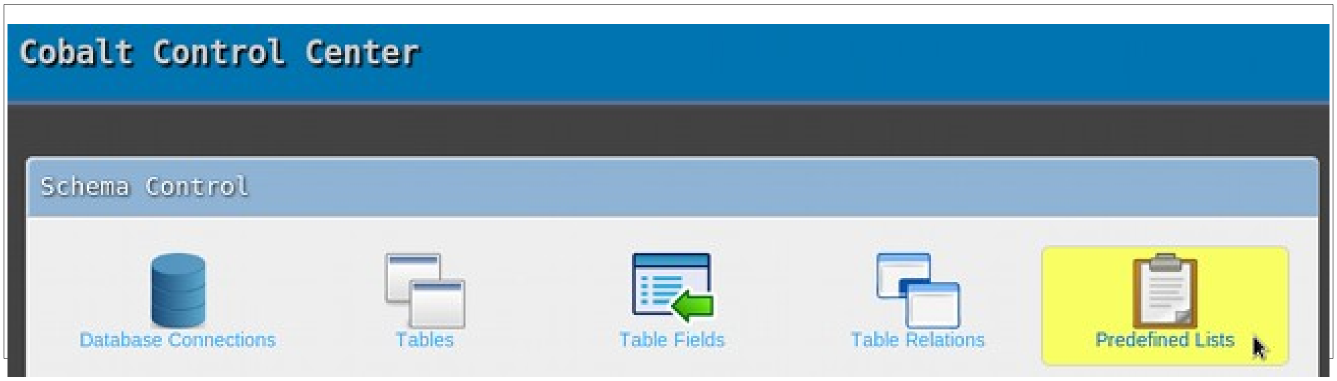
For the moment, disregard the other options available. Let's just focus on choosing a new control type. Click **`Submit`** when you are done choosing a new control type.

Assigning a List of Acceptable Values for a Certain Field.

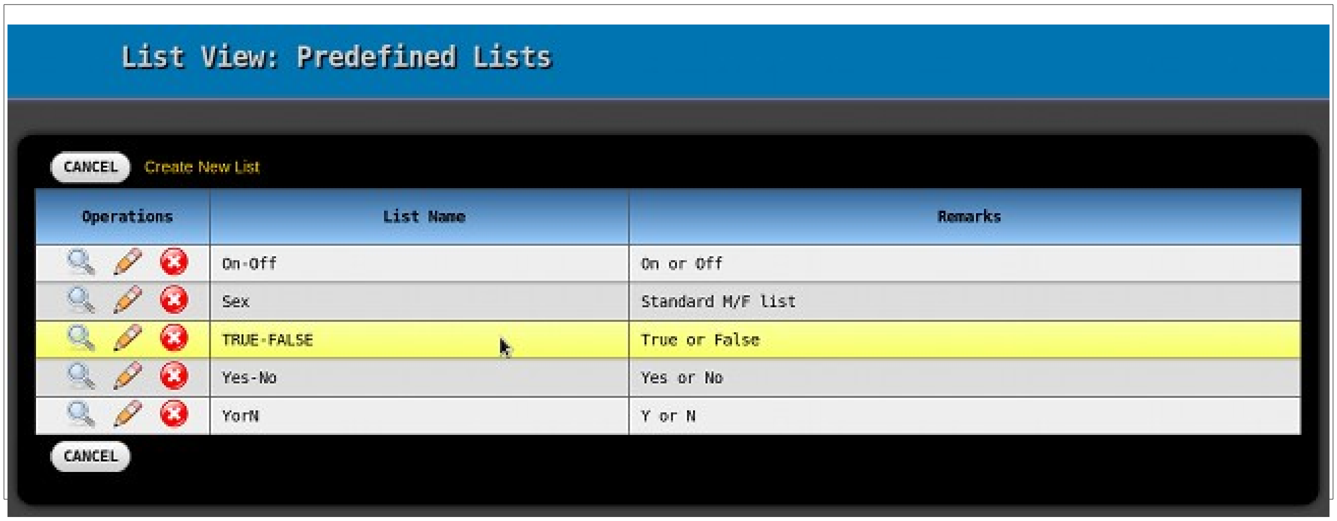
If you chose either *`Drop-down List`* or *`Radio Buttons`*, you need to tell Cobalt the data source, otherwise the resulting drop-down list or radio buttons will have no options for the user.

Cobalt keeps lists of values you can assign to fields having a drop-down list or radio button as their control type. These lists of values are called **`predefined lists`**.

To see the available predefined lists, click **`Predefined Lists`** from the Cobalt Control Center. (Figure 44)



You should now find yourself in the List View: Predefined Lists page. (Figure 45)



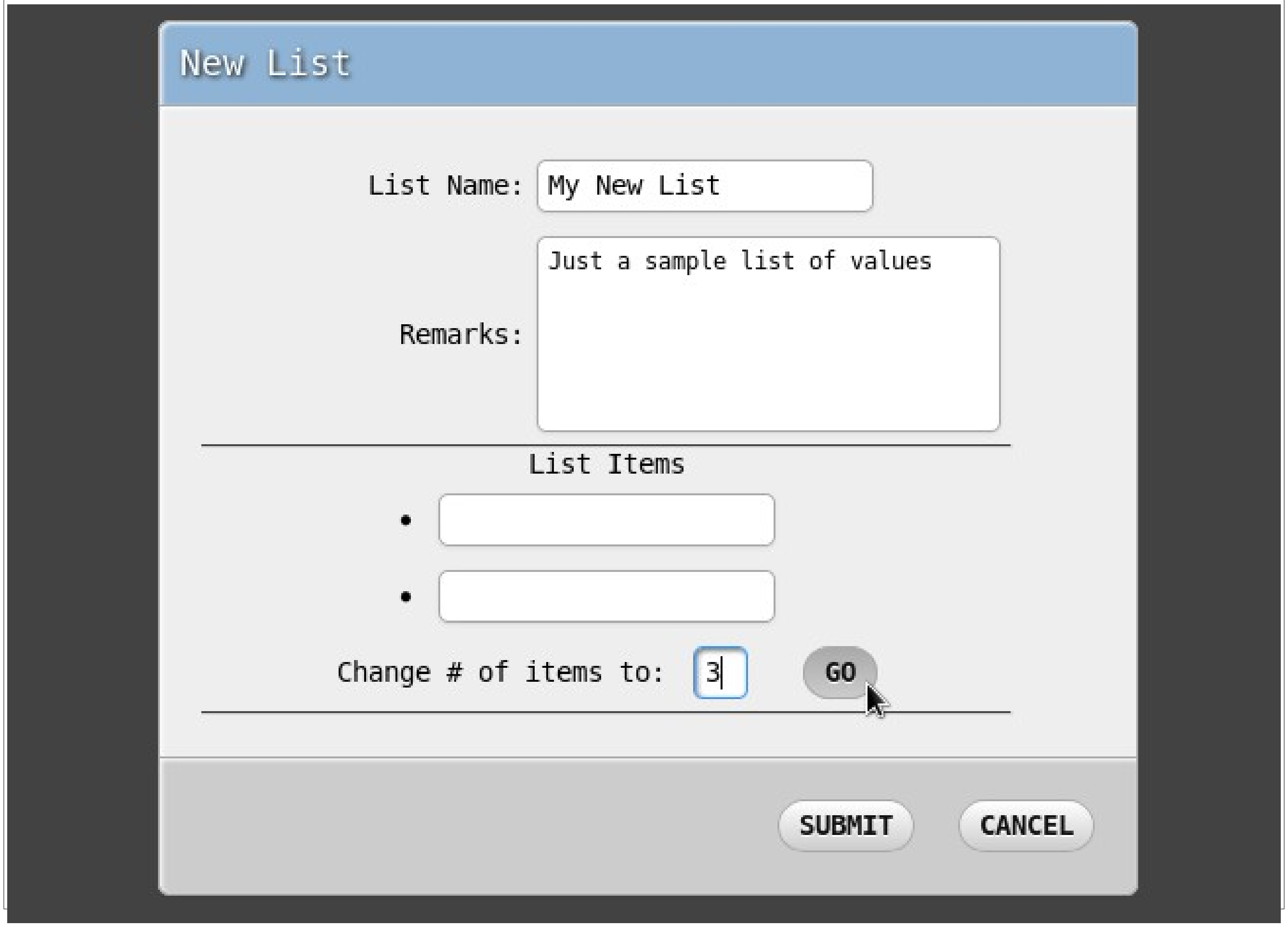
Operations	List Name	Remarks
	On-Off	On or Off
	Sex	Standard M/F list
	TRUE-FALSE	True or False
	Yes-No	Yes or No
	YorN	Y or N

From here, you can see the default predefined lists that Cobalt ships with. You can freely modify them (for example, adding items to the list or modifying the existing items) by clicking the Edit button (pencil icon) beside the list you are interested in.

To change the number of items, enter the total number of items you want in the box labeled “*`Change # of items to`*”, and then click **`GO`**.

Warning!
The number you enter is **not** the number of *additional* textboxes. Rather, it is the **total number** of textboxes to display. If you enter a number that is less than the existing items in the list, the last few entries that exceed the new number will be removed.

You can also add a new predefined list into Cobalt. Click **`Create New List`** at the top of the table.



New List

List Name: My New List

Remarks: Just a sample list of values

List Items

-
-

Change # of items to: 3

Enter your preferred list name and a short description, then enter the items you want to appear in the list.

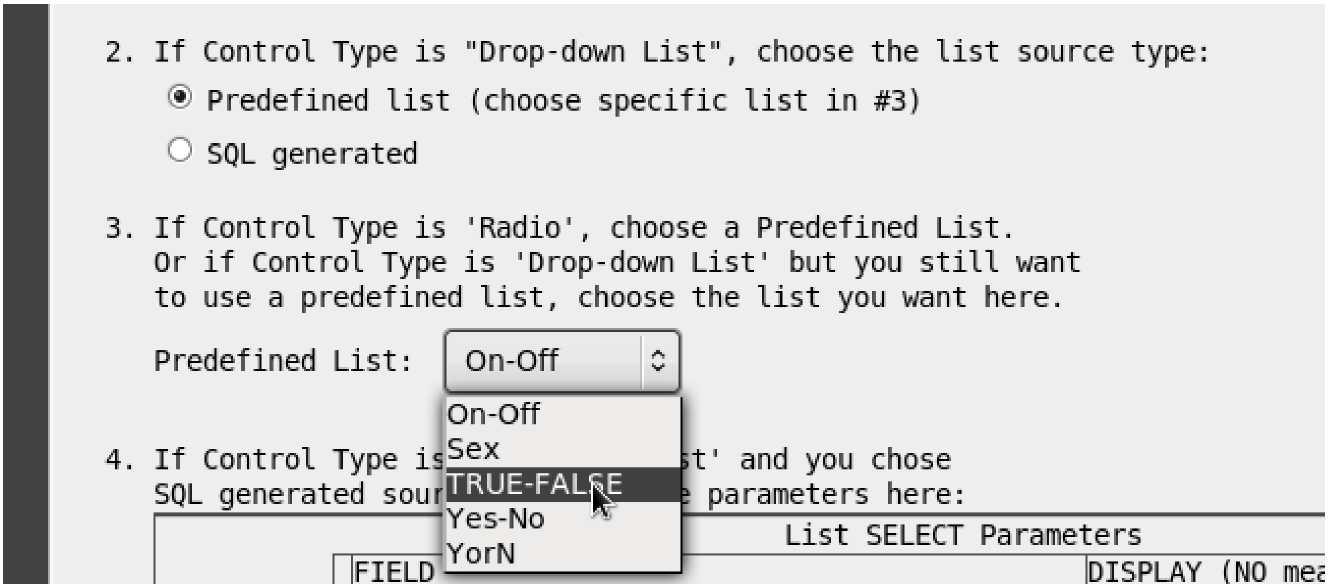
The variable number of textboxes for list items works exactly like described in the Edit screen. Input the total number of items you want in the small textbox labeled "*`Change # of items to`*" and click **`GO`**.

When you are done listing all the items you want, click **`Submit`**.

`Cobalt will not sort the list; the list items will appear in the order that you entered them. If you want the items to be ordered in a particular way, list them in that particular order.`

Now that you are finished creating and/or modifying predefined lists, you can now try assigning your new (or newly-modified) predefined list to fields that use radio buttons or drop-down lists as controls:

- From the Cobalt Control Center, click **`Table Fields`**, then the Edit button (pencil icon) beside the field you want to modify.
- Change the control type either to a drop-down list or radio button
- Scroll down to #2 of Additional Options, choose *`Predefined List`*. (This step is only necessary if you chose *`Drop-down List`* instead of *`Radio Buttons`*.)
- Choose the predefined list you want in #3 of Additional Options.
- Click **`Submit`**.



2. If Control Type is "Drop-down List", choose the list source type:

● Predefined list (choose specific list in #3)

○ SQL generated

3. If Control Type is 'Radio', choose a Predefined List.
Or if Control Type is 'Drop-down List' but you still want
to use a predefined list, choose the list you want here.

Predefined List: On-Off

4. If Control Type is ... st' and you chose
SQL generated sour ... e parameters here:

List SELECT Parameters

FIELD DISPLAY (NO mea

Figure 47: Assigning a predefined list to a field: Choose "Predefined List" in #2 of Additional Options, then the appropriate predefined list in #3.

`A particular predefined list can be assigned to multiple fields in different tables, or even multiple fields in the same table. Just repeat the steps above for each field you wish to assign a predefined list to.`

Changing the Label of a Field

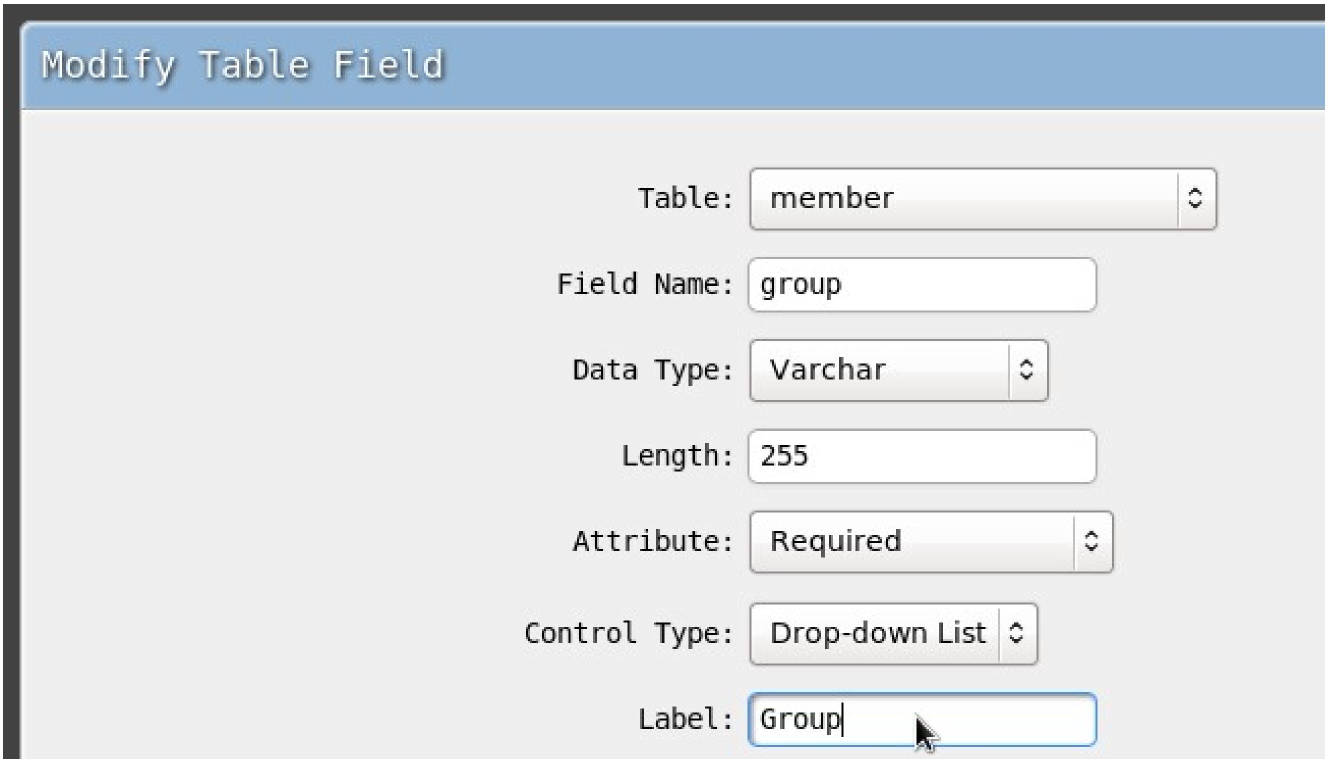
Cobalt derives the field label from field name itself, only cleaning it up a bit by replacing underscores with spaces, and attempting to capitalize it properly using PHP's **`ucwords()`** function (capitalizing the first letter of each word).

If your field name isn't very cryptic, the default label provided by Cobalt will usually suffice. For example, if your field is called “*employee_name*”, the resulting label would be “*Employee Name*”.

However, if your field name is a bit less structured than that, say, “*empname*”, then the default label would become “*Empname*”. This is far from ideal, but you may have no control over the field names (old database, existing project, you are not involved in the database design, etc). In this case, all you can really do is override the default labels Cobalt assigned.

To change the field label into something more appropriate, click **Table Fields** from the Cobalt Control Center, then the Edit button (pencil icon) beside the field whose label you wish to modify.

The **Label** textbox (below the **Control Type** drop-down list) contains the field label. Enter the new label you want here. (Figure 48)



Modify Table Field

Table: member

Field Name: group

Data Type: Varchar

Length: 255

Attribute: Required

Control Type: Drop-down List

Label: Group

Figure 48: Modifying the field label: Simply type the label you want in the "Label" textbox..

```
The field label has nothing to do with the variable name associated with the
control, or the field name included in SQL queries. The field label is completely
for display purposes only, as the column name in List View pages and the text
displayed beside the control in Add/Edit/Delete/View pages.
```

Changing the Field to Optional Instead of Required

By default, Cobalt makes all fields required instead of optional. This means the form will not submit until all fields are appropriately filled up. Attempting to submit a form with a blank required field will cause Cobalt to display an error message stating that it detected no value for the field that you left blank.

In case you are sure that a certain field should become optional, you can do this by modifying the **`Attribute`** drop-down list of the field and setting it to “*`None`*”.

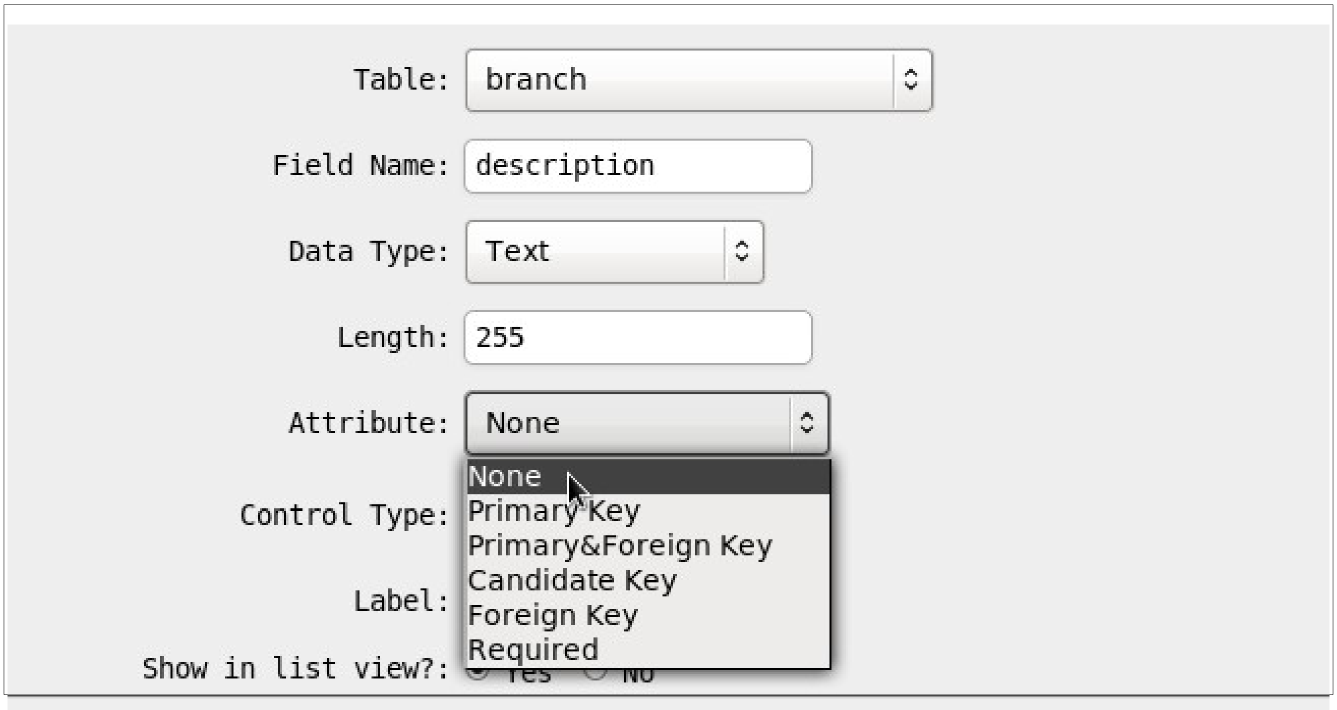


Table: branch

Field Name: description

Data Type: Text

Length: 255

Attribute: None

Control Type:

Label:

Show in list view?: ● Yes ○ No

Adding Relationship Information Between Tables: 1-1

For any non-trivial system you are working on, there's bound to be some relationship between tables, and these relationships affect how modules derived from the tables should work.

You can tell Cobalt about these relationships, and Cobalt will take these into account when generating the system for you.

There are 2 types of relationships between any two tables that Cobalt needs to know: one-to-one (1-1) relationships, and one-to-many (1-M) relationships.

To see how setting 1-1 relationships can affect the generated system, let's take the following example of a hypothetical **`branch`** table, with a 1-1 relationship with a hypothetical **`branch_type`** table:

```
Code:
branch (
    branch_id int,
    branch_name varchar(255),
    branch_type_id int,
    description varchar(255)
)

branch_type (
    branch_type_id int,
    branch_type_title varchar(255),
    description varchar(255)
)
```

The code box above shows the relevant details for our **branch** and **branch_type** tables. We've got a table of branches, and a separate table that stores the different branch types that branches could have. Although we show no foreign key constraints above, it's pretty easy to spot that what we actually want is for **branch** to be related with **branch_type** through the **branch_type_id** field:

```
Code:
branch (
    branch_type_id int <--------|
)                               |
                                |
branch_type (                   |
    branch_type_id int <--------|
)
```

We want the **branch_type_id** of **branch** to refer to values in the table **branch_type**. To tell Cobalt this relationship between branch and branch_type, click **Table Relations** from the Cobalt Control Center, then click **Define New Relationship** in the List View: Table Relations screen.

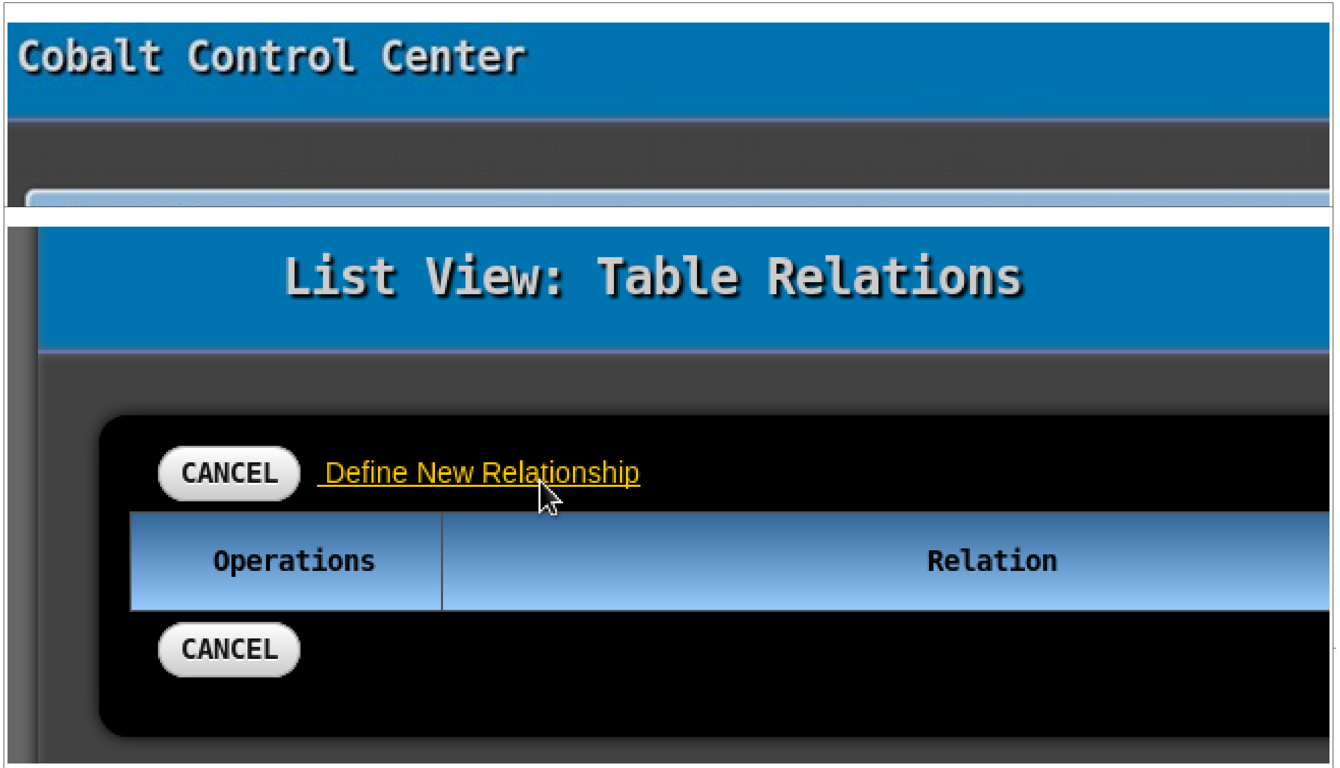
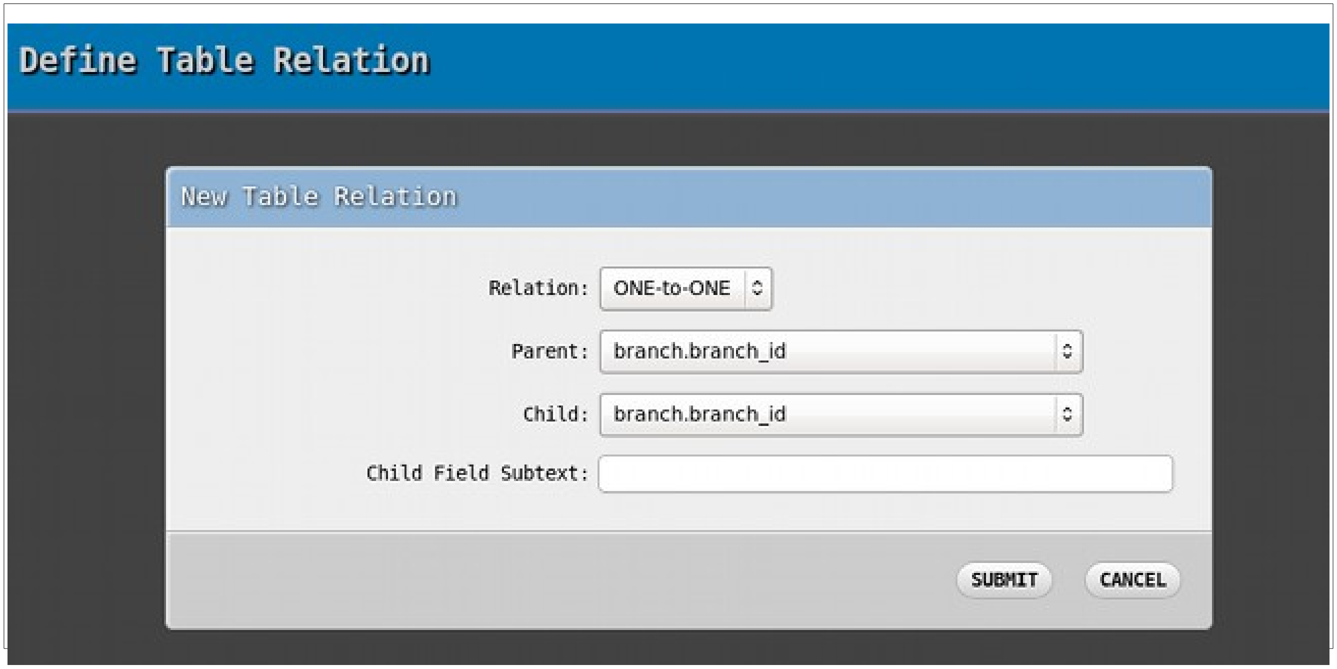


Figure 51: Click "Define New Relationship" to start telling Cobalt about a 1-1 or 1-M relationship.

You should now find yourself in the Define Table Relation screen. (Figure 52). From here, you set what kind of relationship you wish to define (1-1 or 1-M), and set the parent and child in the relationship.



Define Table Relation

New Table Relation

Relation: ONE-to-ONE

Parent: branch.branch_id

Child: branch.branch_id

Child Field Subtext:

In our hypothetical **branch** and **branch_type** relationship, it is a 1-1 relationship, and our parent is the **branch_type** table because it is the source of the data. It's not enough to just say what table is the parent and what table is the child, we also need to indicate what fields connect them, therefore setting the parent and child means choosing both the table AND field.

Let's review the relationship we want to tell Cobalt about:

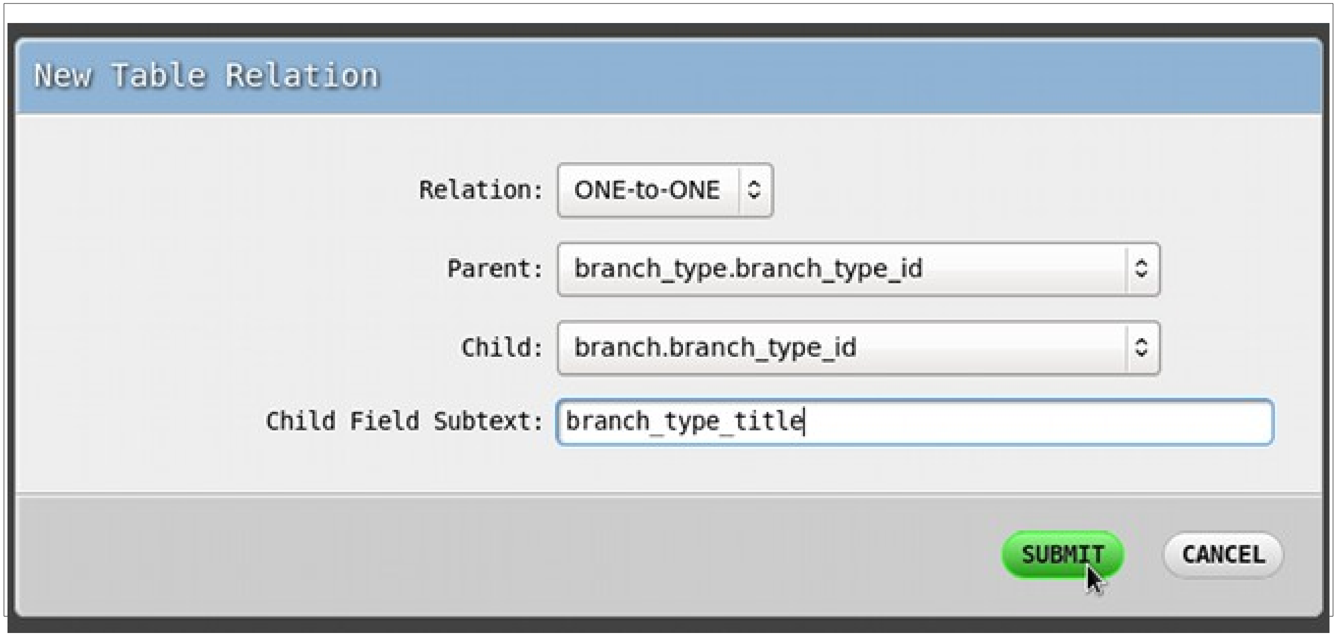
```
Code:
branch (
    branch_type_id int <--------| === This is the child, it refers to its parent
)                               |          table for valid values
                                |
branch_type (                   |
    branch_type_id int <--------| === This is the parent, source of data
)
```

From there, we get that the parent is **branch_type.branch_type_id**, while the child is **branch.branch_type_id**.

In 1-1 relationships, you don't actually want to use the child's foreign key for display purposes. For example, when our system displays the list of branches (we are just continuing our example using **branch** and **branch_type**), we want the list to actually show the type of branch (as text), not the branch type ID. The code box below simulates this to provide more clarity:

```
Code:
Sample values for branch_type table:
branch_type_id | branch_type_title   | Description
      1          Store + Warehouse     Branches that have their own warehouse
      2          Store Only            Branches that rely on central warehouse


(Below is what we don't want to see when listing branches)

branch_id | branch_name | branch_type
    1        Main Store        1
    2        Branch 1          1
    3        Branch 2          2


(Below is what we actually want to see)

branch_id | branch_name | branch_type
    1        Main Store    Store + Warehouse
    2        Branch 1      Store + Warehouse
    3        Branch 2      Store Only
```

For this purpose, you need to tell Cobalt what text you want it to substitute for the child's foreign key. In our example above, we want the **branch_type_title** as the substitute (replacement) for **branch.branch_type_id** when it comes to display purposes. To tell Cobalt about this text substitution, you enter "*branch_type_title*" in **Child Field Subtext** box. Figure 53 shows the complete information that Cobalt needs in order to understand the relationship we envision between the **branch** and **branch_type** tables.



New Table Relation

Relation: ONE-to-ONE

Parent: branch_type.branch_type_id

Child: branch.branch_type_id

Child Field Subtext: branch_type_title

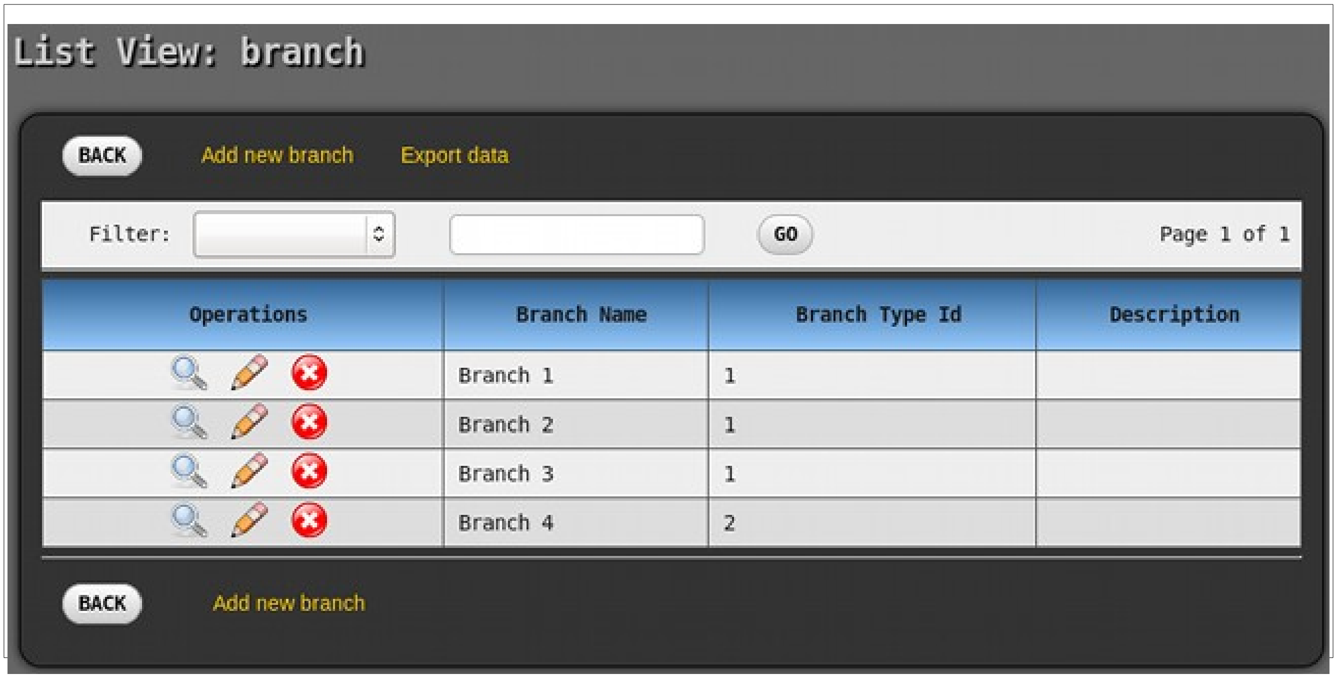
Clicking Submit finalizes the relationship, and Cobalt can generate a more-polished set of modules for the `branch` table, thanks to the relationship information you entered.

Figures 54 and 55 shows you how the List View and input form for branch would look like if no relationship information was given to Cobalt before generating the system.

Figures 56 and 57 shows you how the List View and input form for branch would look if the relationship information shown in Figure 53 was given to Cobalt before generating the system.

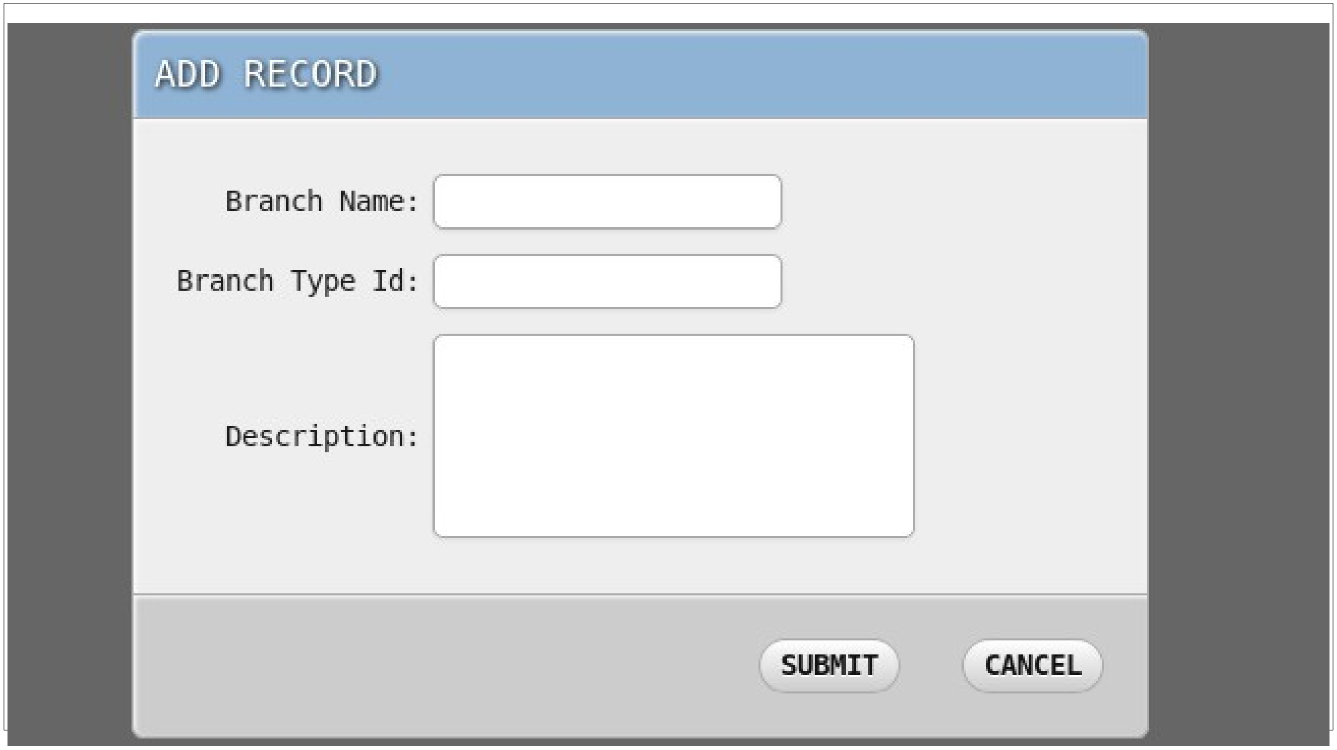
The difference between the two sets of screenshots is hard to miss:

- Figure 54 shows that the List View page displays the branch type ID (numbers, not very informative, not very user-friendly).
- In contrast, Figure 56 shows that the List View page displays the actual branch type title (text, immediately informative, user-friendly), since we defined **`Child Field Subtext`** of the relationship to be *`branch_type_title`*.
- Figure 55 shows that the Add module has a simple textbox as the control type, a very user-unfriendly way to ask for the branch type ID.
- In contrast, Figure 57 shows that the Add module has a drop-down list, whose options come from the contents of the **`branch_type`** table. This is a much-improved, user-friendly way to input the branch type.



List View: branch

Operations	Branch Name	Branch Type Id	Description
🔍 ✏ ❌	Branch 1	1	
🔍 ✏ ❌	Branch 2	1	
🔍 ✏ ❌	Branch 3	1	
🔍 ✏ ❌	Branch 4	2	

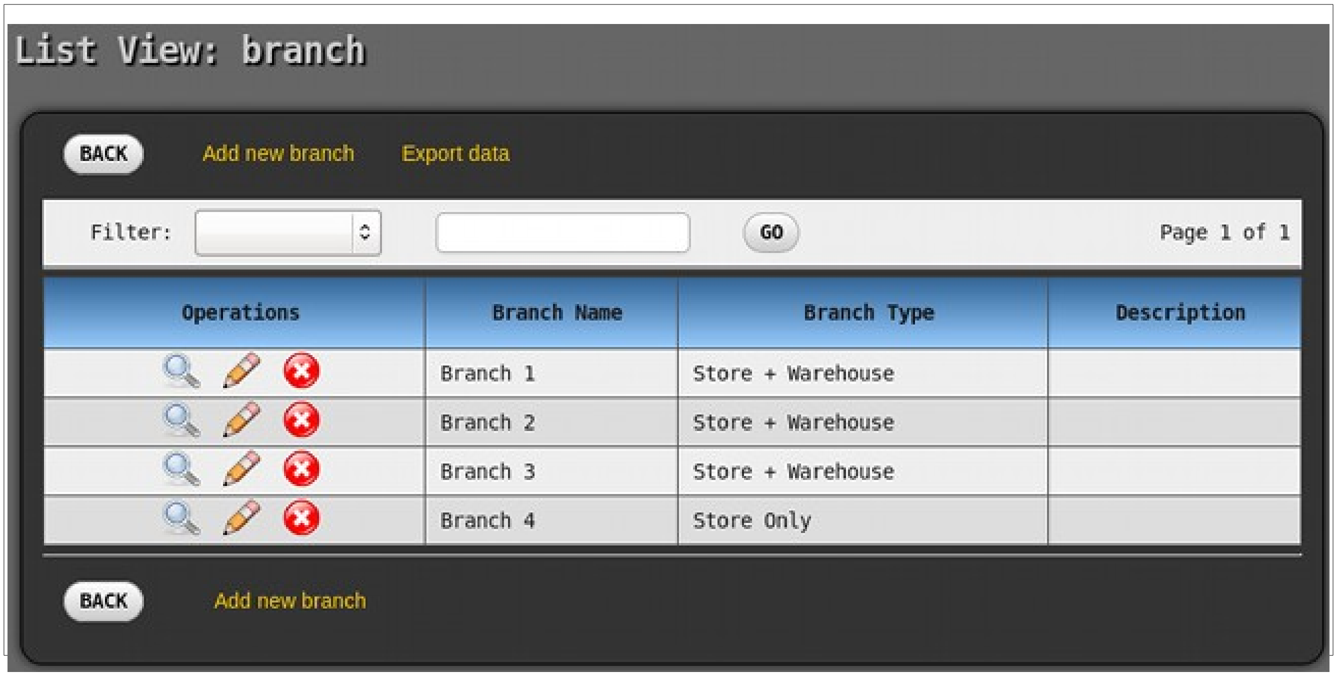


ADD RECORD

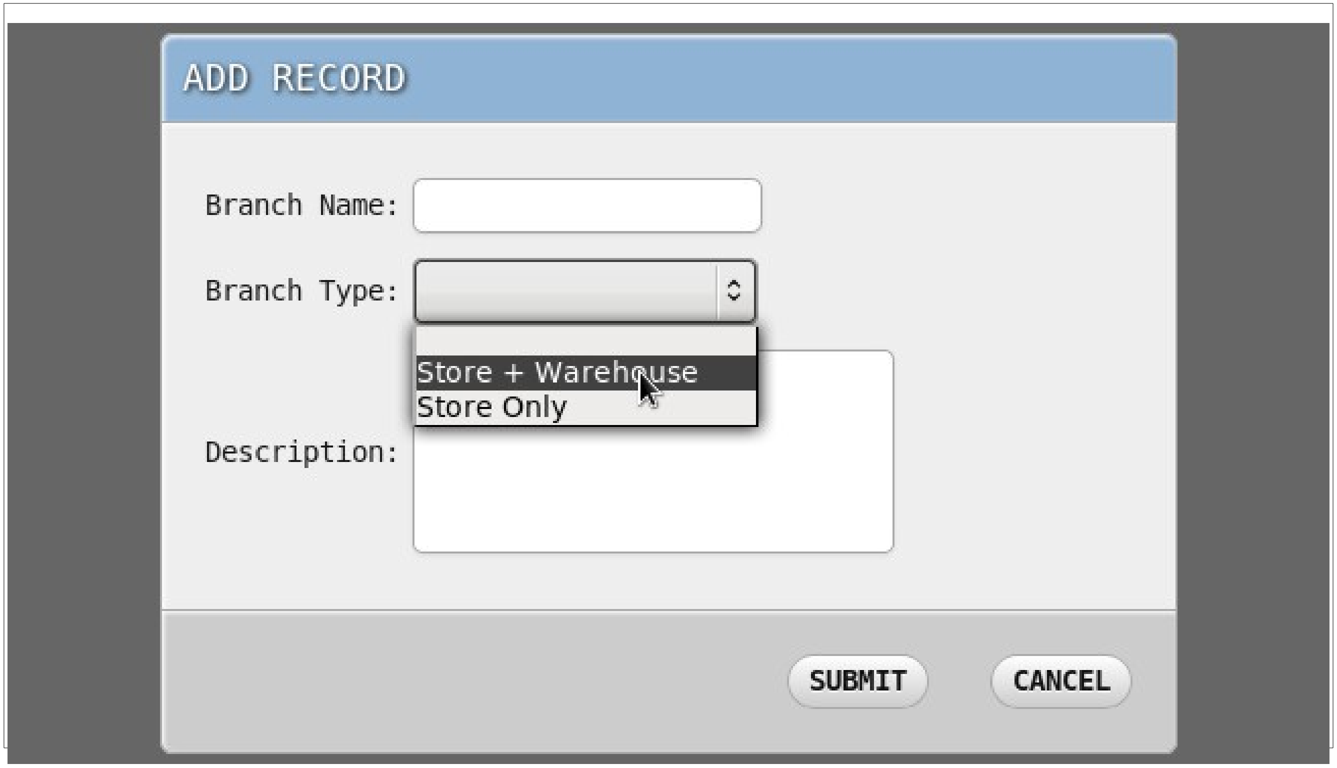
Branch Name:

Branch Type Id:

Description:



Operations	Branch Name	Branch Type	Description
🔍 ✎ ✖	Branch 1	Store + Warehouse	
🔍 ✎ ✖	Branch 2	Store + Warehouse	
🔍 ✎ ✖	Branch 3	Store + Warehouse	
🔍 ✎ ✖	Branch 4	Store Only	



Cobalt will implement these refinements when generating the system as long as you define the relationships first. It's a complete win – for very little effort, you can have Cobalt automatically make significant improvements to the generated modules. It's a no-brainer.

If you forgot to specify a relationship before generating the project, you can simply go back to the Cobalt Control Center, define the relationship, generate the project again, then overwrite the existing project that lacks the relationship refinements.

Warning!
The tip above works pefectly if you haven't modified any of the resulting project's code yet! If you've already modified certain parts of the project's source code, be careful not to overwrite the modified parts with "fresh" ones from the code generator. You'll lose a lot of good work that way, so be careful!

Adding Relationship Information Between Tables: 1-M

1-M table relationships instruct Cobalt to modify the input forms of the parent table to accommodate entry of a variable number of rows to the child table.

For example, let's say you have an `employee` table, and an `employee_skills` table, as described in the code box below:

Code:
```
employee (
    employee_id char(10),
    last_name varchar(255),
    first_name varchar(255),
    middle_name varchar(255)
)

employee_skills (
    employee_id char(10),
    auto_id int,     -- we probably want this as some auto-incrementing field
    skill` varchar(255)
)
```

It's easy enough to see that `employee` and `employee_skills` are related through each other's `employee_id` field. This isn't a 1-1 relationship, though. In this case, we probably designed these two tables so that we can store an employee's basic information and a list of his/her skills (there are many good reasons to have the skills in a separate table instead of being just a field, but let's not get into that right now).

In such a case, we say that the two tables form a 1-M relationship – that is, one record in `employee` is related to (or, you may say, "owns") multiple records in `employee_skills`. Here, "multiple" (like the "many" part in "one-to-many") can actually be any number, starting from zero to infinity.

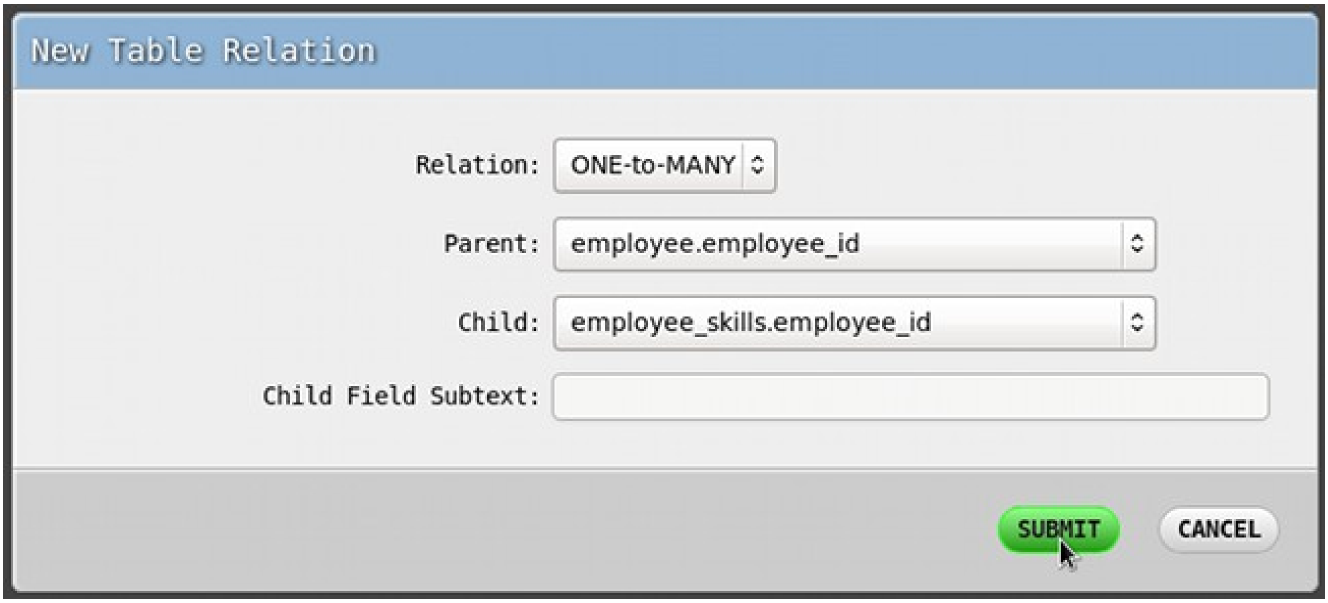
Just a side note: As far as the basic database design goes, we call these "1-M", although in an ERD you may see distinctions between a relationship that may have zero child records and a relationship that must have at least one child record. The distinction really isn't that important, because our sample structures above wouldn't really change at all.

Telling Cobalt about a 1-M relationship is slightly easier than a 1-1 relationship. It's still the same process, but this time you don't indicate a Child Field Subtext value. That makes sense because you don't really substitute anything in a 1-M relationship.

Our settings for the new relationship would be:

- **Relation:** *ONE-to-MANY*
- **Parent:** *employee.employee_id*
- **Child:** *employee_skills.employee_id*
- **Child Field Subtext:** (None; box is disabled for 1-M relationships)

The same information is illustrated in Figure 58.



New Table Relation

Relation: ONE-to-MANY

Parent: employee.employee_id

Child: employee_skills.employee_id

Child Field Subtext:

Figure 58: The input for "employee->employee_skills" 1-M relationship.

Chapter 3: The Cobalt Framework Reference

Framework vs the Code Generator

The Code Generator (see previous chapter) is meant to assist you in creating standard components for your system. In the grand scheme of things the utility of this component is a lot less than the Framework component of Cobalt, because in the entire development lifecycle of the project, you'll be spending most of your time working with the framework instead of the code generator.

The entire framework component is pre-packaged with the output of the code generator (unless you unchecked the `“Generate standard application components, core files, and system administration components”` checkbox before creating the project). You can find this framework inside “core” folder inside the base directory of your generated project.

The common roles of the Cobalt framework can be summarized as “Structure, Logic, Function, Control”

- Structure – provides an organized set of abstractions and components to help in code maintainability and extensibility.
- Logic – provides reasonable guides to help system developers implement system features and make design decisions.
- Function – provides convenience features, such as built-in components, classes and functions. to help developers accomplish common development tasks faster and with less code.
- Control – provides developers a way to easily extend, manage and adapt the framework as necessary as the requirements of the system or project change.

In the next sections, we'll go through each of the different components of the framework and go through each of their respective functionalities and settings.

global_config.php

This core file contains the global configuration settings of the system. Configurations that belong here are information that are true for every user, and will rarely change. The settings here are in the form of constants (using `define()` call) because they should never change during run time, and they should be globally accessible.

`global_config.php` defines the following constants:

- **`BASE_DIRECTORY`** – specifies the base directory. This is the name of the top-level folder/directory of the system, inside the server's webroot. If you rename your base directory in the file system for any reason, you will have to change this value to match it in order for your system to continue functioning as expected. Primarily, however, this configuration exists so that you can decouple your modules from the actual base directory name.
- **`FULLPATH_CORE`** – specifies the full filesystem path to the system's core folder.
- **`LOGIN_PAGE`** – specifies the webpath and filename of the login page.
- **`HOME_PAGE`** – specifies the webpath and filename of the home page (by default, this is the Control Center screen). Lots of modules will redirect to the home page upon hitting the **`cancel`** button, so this setting allows you to control where all those modules should redirect instead (if you so choose) by just changing a single value in a single location.
- **`INDEX_TARGET`** – specifies where the **`index.php`** files in each subdirectory of the system will redirect. By default, this defaults to Cobalt's parent frame (**`start.php`**). This setting will allow you to change the targets for every **`index.php`** file by just changing a single value in a single location.
- **`TMP_HYPERLINK_PATH`** – specifies the webpath to the directory where uploaded files and temporary files were written to. Using this constant, you can easily display, for example, a valid download link to a user for the file requested to be downloaded.
- **`TMP_DIRECTORY`** – specifies the full filesystem path to the directory where uploaded files and temporary files will be written to. This constant is used to be able to easily specify the full path where uploaded files will be saved.
- **`MULTI_BYTE_ENCODING`** – specifies the multi-byte encoding scheme for character sets that use more than one byte to encode a character. Unless you have a valid reason to do so, you should leave this at the default value of *`utf-8`*.
- **`TIMEZONE_SETTING`** – specifies the timezone setting (e.g., '*`Asia/Manila'`*) that the date and time functions of PHP will use. Cobalt will usually auto-detect the correct timezone so you generally do not have to change this value. However, auto-detection relies on your platform's timezone setting; if you did not configure the correct timezone in your operating system, then Cobalt will likely have detected the wrong timezone for you.
- **`DEBUG_MODE`** – *`TRUE`* or *`FALSE`* only; this determines if the system is considered to be running in “debug mode” or not. Debug mode means that Cobalt's error handler will output private portions of error messages (more specific details), which can greatly assist developers during development of the system. During production (go live / actual rollout), however, we usually do not want the private, specific portions of error messages to be displayed, as they most likely leak too much information to would-be attackers. Therefore, **`DEBUG_MODE`** should be set to *`FALSE`* once your system is in the live/production server.
- **`LOG_FILE`** – this is a soon-to-be-deprecated setting. Uncommenting this will allow you to have

file-based logging, aside from database-backed logging. File-based logging is harder to use, filter and sort, so this option is no longer recommended. Unless you have a very good reason to do so, leave this alone and commented out.

char_set_class.php

This core class is used to generate character sets for use in filtering. Various methods are provided to allow you a fast way to generate an array of characters according to your desired parameters.

Warning!
Note that this is completely different from *character set encoding*, which refers to how characters are encoded (such as ASCII, ISO-8859-01, or UTF-8) to be understood by systems that will read those characters.

Member: allowed_chars

(data type: array)

(default value: none – empty array)

This member will contain the resulting sets of characters created according to your use of the class.

Member: allow_space

(data type: boolean)

(default value: TRUE)

This member specifies whether the character set methods should include the space character into the resulting character set. By default, the space character is treated as “allowed”, therefore always included in character sets generated by this class.

Toggle this to *FALSE* if you want to generate a specific character set that does not include the space character.

Example:

```
require_once 'char_set_class.php'
$obj_charset = new char_set();
$obj_charset->generate_alphanum_set();
$arr_charset_1 = $obj_charset->allowed_chars; //Alphanumeric chars + space
$obj_charset->allow_space = FALSE;
$arr_charset_2 = $obj_charset->allowed_chars; //Alphanumeric chars, no space
```

Method: add_allowed_chars()

Parameters:

- **`$allow`** *(data type: string)* – the characters to add to the character set array, delimited by the space character.

Return value:

- None.

This appends extra characters into the character set. You normally do not have to invoke this manually, as it is normally employed as a helper function for the other methods. However, in cases where you have to incrementally add characters into the character set after specific operations, it is used just like ordinary methods.

Example:

```
require_once 'char_set_class.php'
$obj_charset = new char_set();
$obj_charset->generate_num_set();
$arr_charset_1 = $obj_charset->allowed_chars; //0 to 9 only, with space.
//... do something with this char set ...//
$obj_charset->add_allowed_chars('a b c');
$arr_charset_1 = $obj_charset->allowed_chars; //0 to 9, a-c, with space.
//... do something with this new char set...//
$obj_charset->add_allowed_chars('! ?');
$arr_charset_1 = $obj_charset->allowed_chars; //0 to 9, a-c, '!' and '?', w/space.
//... do something with this new char set with the two punctuation chars ...//
```

Method: generate_alphanum_set()

Parameters:

- **`$allow`** *(data type: string; Optional)* – if specified, the characters to add to the character set array, delimited by the space character.

Return value:

- None.

Creates an array composed of alphanumeric characters (0-9, A-Z, a-z).

If **`$this->allow_space`** is *`TRUE`* (default value), the space character is included in the resulting array.

If the optional parameter **`$allow`** is used, the characters (delimited by a space) supplied will be included in the resulting array.

Example:

```
require_once 'char_set_class.php'
$obj_charset = new char_set();

//This will contain A-Z, a-z, 0-9, and the space character.
$obj_charset->generate_alphanum_set();
$arr_charset_1 = $obj_charset->allowed_chars;

//This will contain A-Z, a-z, 0-9, but no space character.
$obj_charset->allow_space=FALSE;
$obj_charset->generate_alphanum_set();
$arr_charset_2 = $obj_charset->allowed_chars;

//This will contain A-Z, a-z, 0-9, space, and the
//following four punctuation marks: ! ? . ,
$obj_charset->allow_space=TRUE;
$obj_charset->generate_alphanum_set('! ? . ,');
$arr_charset_3 = $obj_charset->allowed_chars;
```

Method: generate_alpha_set()

Parameters:

- **`$allow`** *(data type: string; Optional)* – if specified, the characters to add to the character set array, delimited by the space character.

Return value:

- None.

Creates an array composed of alphabetic characters (A-Z, a-z).

If **`$this->allow_space`** is *`TRUE`* (default value), the space character is included in the resulting array.

If the optional parameter **`$allow`** is used, the characters (delimited by a space) supplied will be included in the resulting array.

Example:

```
require_once 'char_set_class.php'
```

```
$obj_charset = new char_set();

//This will contain A-Z and a-z, and the space character.
$obj_charset->generate_alpha_set();
$arr_charset_1 = $obj_charset->allowed_chars;

//This will contain A-Z and a-z, but no space character.
$obj_charset->allow_space=FALSE;
$obj_charset->generate_alpha_set();
$arr_charset_2 = $obj_charset->allowed_chars;

//This will contain A-Z, a-z, space, and the
//following four punctuation marks: ! ? . ,
$obj_charset->allow_space=TRUE;
$obj_charset->generate_alpha_set('! ? . ,');
$arr_charset_3 = $obj_charset->allowed_chars;
```

Method: generate_num_set()

Parameters:

- **`$allow`** *(data type: string; Optional)* – if specified, the characters to add to the character set array, delimited by the space character.

Return value:

- None.

Creates an array composed of numeric characters (0-9).

If **`$this->allow_space`** is *`TRUE`* (default value), the space character is included in the resulting array.

If the optional parameter **`$allow`** is used, the characters (delimited by a space) supplied will be included in the resulting array.

Example:

```
require_once 'char_set_class.php'
$obj_charset = new char_set();

//This will contain 0-9, and the space character.
$obj_charset->generate_num_set();
$arr_charset_1 = $obj_charset->allowed_chars;

//This will contain 0-9 only, no space character.
$obj_charset->allow_space=FALSE;
$obj_charset->generate_num_set();
```

```
$arr_charset_2 = $obj_charset->allowed_chars;

//This will contain A-Z, a-z, 0-9, space, and the
//following four punctuation marks: ! ? . ,
$obj_charset->allow_space=TRUE;
$obj_charset->generate_alphanum_set('! ? . ,');
$arr_charset_3 = $obj_charset->allowed_chars;
```

validation_class.php

This core class provides data validation functions to allow you to check if submitted input conforms to the expectations – for example, verifies that it contains only the allowed characters, or that it contains only the allowed values (a *whitelist* approach), or that it does not have any unwanted values (a *blacklist* approach).

Normally, you do not have to invoke methods from this class manually, as it is usually used indirectly and automatically by invoking the **`sanitize()`** method of your **`data abstraction subclass`**.

Member: validity

(data type: boolean)

(default value: FALSE)

This member will the final result of the validation routines done for a particular input. *`FALSE`* indicates invalid input, *`TRUE`* indicates the input conforms to expected or allowed values.

Member: error_message

(data type: string)

(default value: none – empty string)

If the validation routines end in *`FALSE`* (invalid input was detected), this member will contain the appropriate error message string, which you can then use to display an appropriate message to the screen or log. Otherwise, this member will remain empty.

Member: invalid_chars

(data type: array)

(default value: none – empty array)

If the validation routines end in *`FALSE`* (invalid input was detected), this member will contian all illegal characters (characters not found in the allowed character set) that the relevant validation routine found (**`check_char_set()`**).

If the validation routines end in `TRUE`, or if no allowed character set was specified, this member will remain empty.

Method: validate_data()

Parameters:

- **`$unclean`** *(data type: string)* – the input that needs to be validated.
- **`$type`** *(data type: string)* – specifies what data type **`$unclean`** is expected to be.
- **`$char_set`** *(data type: array; Optional)* – if specified, this sets the allowed characters that **`$unclean`** may have. Any character not included here that is found in **`$unclean`** will cause the validation to result in `FALSE`, and all such illegal characters will be added to the **`$invalid_chars`** array.
- **`$valid_set`** (*data type: array; Optional*) – if specified, this sets the possible values that will be used either as a blacklist (i.e., a list of unacceptable values) or a whitelist (i.e., a list of acceptable values).
- **`$whitelist`** (*data type: boolean; Optional*) – controls how $valid_set is interpreted. `TRUE` (default) means **`$valid_set`** will be treated as a whitelist, FALSE means **`$valid_set`** will be treated as a blacklist.

Return value:

- None.

`validate_data()` will perform necessary data validation depending on the value of **`$type`**.

`$char_set`, if supplied, contains the valid characters that the data may possess – anything else will mean the data will be considered invalid.

`$valid_set`, if supplied, contains a set of data, the use of which depends on the setting of **`$whitelist`**. If **`$whitelist`** is set to `TRUE` (it is by default), then **`$valid_set`** is considered to be a whitelist, meaning the only valid values for the submitted data should be in **`$valid_set`**, otherwise the data is regarded as invalid, whatever it is. On the other hand, if **`$whitelist`** is set to `FALSE`, then **`$valid_set`** is treated as a blacklist, meaning its contents represent invalid values - if the submitted data matches a value in **`$valid_set`**, then the submitted data is regarded as invalid.

Method: check_data_set()

Parameters:

- **`$unclean`** *(data type: string)* – the input that needs to be validated.

- `$valid_set` (*data type: array*) – the possible values that will be used either as a blacklist (i.e., a list of unacceptable values) or a whitelist (i.e., a list of acceptable values).
- `$whitelist` (*data type: boolean*) – controls how $valid_set is interpreted. *`TRUE`* (default) means `$valid_set` will be treated as a whitelist, FALSE means `$valid_set` will be treated as a blacklist.

Return value:

- None.

This function checks if the submitted data conforms to the defined whitelist or blacklist, as specified in `$valid_set` and `$whitelist`.

This method is automatically invoked by `validate_data()` if the `$valid_set` parameter was passed to `validate_data()`.

Upon success (`$unclean` was found in the whitelist or not found in the blacklist) this will set `$this->validity` to to *`TRUE`*. Otherwise, `$this->validity` will remain *`FALSE`* (default value) and `$this->error_message` will be appended with an appropriate error message fragment ('*`Invalid value submitted in: `*'). However, this error message is incomplete (hence, called a fragment), and the appropriate field name will have to be supplied to complete it. Higher-level abstractions deal with this complexity automatically (particularly the `sanitize()` method of your `data abstraction subclass`), so this is not something that developers will normally have to do manually, particularly in the use case of accepting form data and validating them.

Method: check_char_set()

Parameters:

- `$unclean` *(data type: string)* – the input that needs to be validated.
- `$char_set` (*data type: array*) – specifies the set of characters that `$unclean` is allowed to contain.

Return value:

- None.

This function checks if the submitted data contains only the specified allowed characters.

This method is automatically invoked by `validate_data()` if the `$char_set` parameter was passed to `validate_data()`.

Upon success (`$unclean` was found to contain only valid characers) this will set `$this->validity` to *`TRUE`*. Otherwise, **`$this->validity`** will remain *`FALSE`* (default value) and **`$this->invalid_chars`** will be filled with all the invalid characters found.

Method: check_if_null()

Parameters:

- **`$label`** *(data type: string)* – the label for the data to be inspected.
- **`$value`** (*data type: any*) – the data to be inspected

Return value:

- *(string)*: the error message. If all submitted data are not empty (success scenario), this will be an empty string,

This function accepts an arbitrary number of paramters, and these parameters will be treated as pairs. The first parameter in a pair is regarded as **`$label`**, while the second in the pair is regarded as **`$value`**.

This function checks if the submitted data (all **`$value`** parameters) are not empty or null. If one or more of the submitted data is found to be empty, this functon will return an error message saying *`“No value detected: $label”`*, where **`$label`** corresponds to the **`$label`** paried with the **`$value`** that was found to be empty.

This method is automatically invoked by higher-level abstractions and is not usually needed to be manually called in a module, particularly in the validation of submitted form data that is automatically done by Cobalt generated modules.

Example:

```
require_once 'validation_class.php'
$validator = new validation;

//Let's pretend that the following variables represent submitted form data, and
//not manually initialized variables.
$item = 'Shipping box';
$weight = '25kg';
$remarks = '';

//Assuming that all three submitted variables should not be blank:
$error_message = $validator->check_if_null('Item', $item);
$error_message .= $validator->check_if_null('Weight', $weight);
$error_message .= $validator->check_if_null('Remarks', $remarks);

//Since we set $remarks to empty, this will output
//”No value detected: Remarks”
echo $error_message;
```

```
//This function can actually accept multiple sets of parameters, so we
//can accomplish the same thing as above using this syntax:
$error_message = $validator->check_if_null('Item', $item,
                                           'Weight', $weight,
                                           'Remarks', $remarks);
echo $error_message;
//Output is still “No value detected: Remarks”;
```