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# ThoughtSpot Administration Guide

*Release 6.0*

*December, 2019*

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# Introduction to administration

**Summary:** This guide covers all topics of special interest to application administrators.

This guide provides information for application administrators, or users with [administrative access privileges](#) [See page 7].

Before addressing the major components of this guide, we recommend that you familiarize yourself with the general top-level [architecture](#) [See page 10] of the ThoughtSpot service.

Administrators are responsible for many facets of the ThoughtSpot service. They are most frequently in charge of these common processes:

- [Installation and setup of ThoughtSpot](#) [See page 19]
- [Loading and managing data](#) [See page 85]
- [Managing users and groups](#) [See page 161]
- [Security](#) [See page 192]
- [System administration](#) [See page 237]
- [Backup and Restore](#) [See page 0]

Additionally, administrators are often involved in the following workflows:

- [Data modeling](#) [See page 271]
- [Using worksheets](#) [See page 320] to simplify search
- [Using views](#) [See page 363] for ‘stacked’ search; note that starting with Release 5.2, you can accomplish some aspects of search stacking by using the `IN` keyword [See page 0].
- [Beta Enabling SearchIQ](#) [See page 363], ThoughtSpot’s natural language search.
- [Managing scheduled jobs](#) [See page 409]
- [Monitoring system health](#) [See page 414]
- [Troubleshooting](#) [See page 441]

# Sign-in credentials for administration

**Summary:** You must have administrative access to perform various administrative tasks.

You can access ThoughtSpot through SSH at the command prompt, and from a Web browser.

## Administrative access

Each ThoughtSpot cluster has three default users. Contact your ThoughtSpot support team to get the passwords.

Type	Username	Description
Shell user	admin	<p>For work that requires <code>sudo</code> or <code>root</code> privileges</p> <p>Not for application login</p> <p>Logs for this user are in <code>/usr/local/scaligent/logs</code> directory</p>
Shell user	thoughtspot	<p>For command-line work that does not <code>sudo</code> or <code>root</code> privileges</p> <p>Can use <code>tsload</code>, <code>tql</code>, and check the cluster status</p> <p>Not for application login</p> <p>Logs for this user are in <code>/tmp</code> directory</p>
Application user	tsadmin	Access through a Web browser

Both the `admin` [See page 7] and `thoughtspot` [See page 7] user can SSH into the cluster. After authenticating, either user can use and all of the following utilities:

- `tscli` [See page 0]; `thoughtspot` [See page 7] user cannot use commands that require `sudo` or `root` privileges
- `tsload` [See page 0]
- `tql` [See page 142]

## SSH to the appliance

To perform basic administration such as checking network connectivity, starting and stopping services, and setting up email, log in remotely as the Linux administrator user “admin”. To log in with SSH from any machine, you can use the command shell or a utility like Putty.

In the following procedure, replace <hostname\_or\_IP> with the hostname or IP address of a node in ThoughtSpot. The default SSH port (22) will be used.

1. Log in to a client machine and open a command prompt.
2. Issue the SSH command, specifying the IP address or hostname of the ThoughtSpot instance:

```
ssh admin@<hostname_or_IP>
```

3. Enter the password for the admin user.

## Sign in to the ThoughtSpot application

To set up and explore your data, access the ThoughtSpot application from a standard Web browser, using a username and password.

Before accessing ThoughtSpot, you need the following:

- The Web address (IP address or server name) for ThoughtSpot
- A network connection
- A Web browser
- A username and password for ThoughtSpot

ThoughtSpot supports the following Web browsers:

**Firefox**

68.x, 69.x, and later

**Chrome**

76.x, 77.x, and later

**Internet Explorer**

11.x, and later

**Edge**

44.x, and later

**Safari**

13.x, and later

 **Tip:** We support, but do not recommend, the use of the Internet Explorer.

Depending on your environment, you can experience performance or UI issues.

To sign in to ThoughtSpot from a browser, follow these steps:

1. Open the browser and type in the Web address for ThoughtSpot:

`http://<hostname_or_IP>`

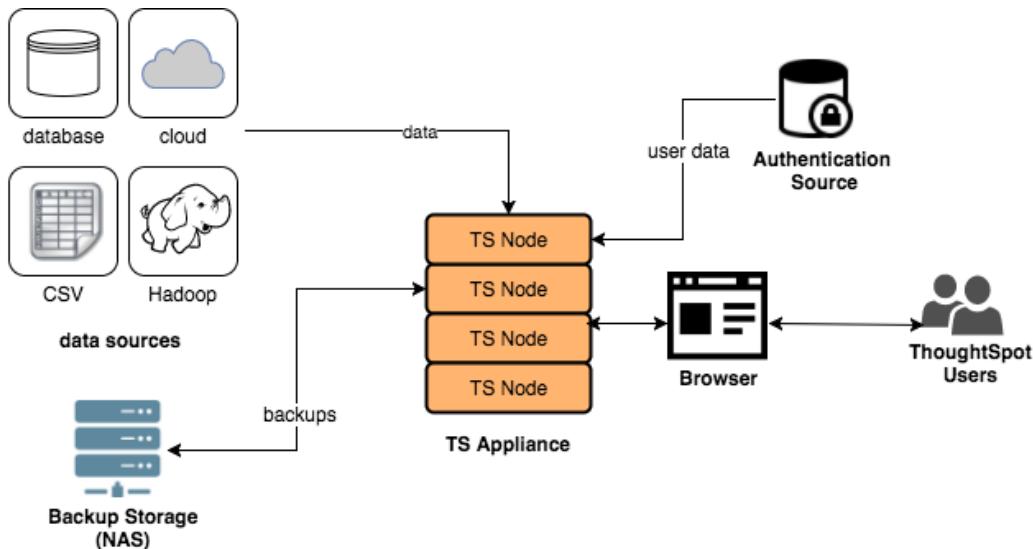
2. Enter your username and password, and click **Sign in**.

# Architecture components

**Summary:** To implement ThoughtSpot it is important to understand where it sits within your overall analytics architecture and how it provides data to end users.

ThoughtSpot consists of a cluster of one or more nodes, acting together to provide analytic answers to business questions. As such, there are only a few integration points with ThoughtSpot on your network.

The major components in a ThoughtSpot cluster are:



ThoughtSpot can handle a wide variety of different data sources. ThoughtSpot does all analysis against data in memory to help achieve fast results across millions and billions of records of data. ThoughtSpot caches the data in order to process it.

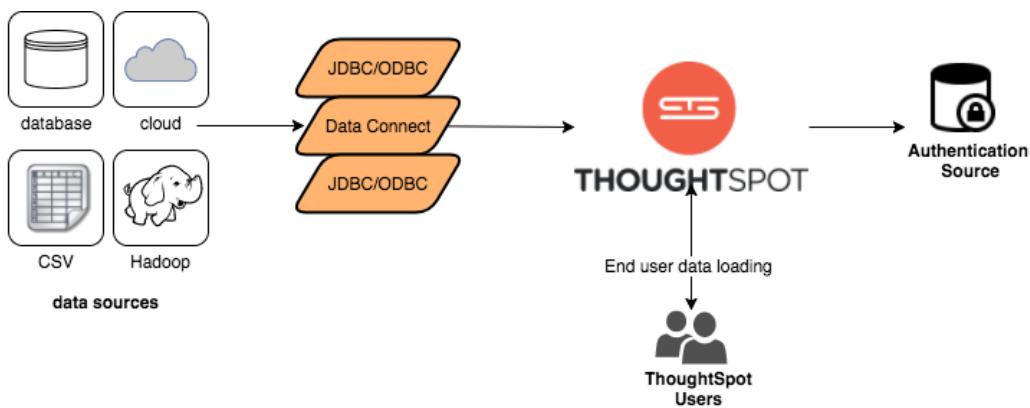
The ThoughtSpot appliance can be a physical appliance that ThoughtSpot ships, one or more AWS instances that are clustered together, or one or more VMware instances that are clustered together. From an external interface, regardless of the appliance type, the appliance appears to be a single instance.

For authentication (logging in), some source of user information is required. These define the login requirements and access control groups. Users must access the data from a supported browser to view saved content, or perform search-based analytics. Finally, it is recommended that you have some sort of networked attached storage for storing backups in case of hardware failure.

# Data Caching

**Summary:** ThoughtSpot does all analysis against data in memory to help achieve fast results across millions and billions of records of data.

ThoughtSpot caches data as relational tables in memory. The tables can be sourced from different data sources and joined together. ThoughtSpot has several approaches for getting data into the cluster.



## JDBC and ODBC Drivers

ThoughtSpot provides a JDBC and ODBC driver that can be used to write data to ThoughtSpot. This is useful for customers who already have an existing ETL process or tool, and want to extend it to populate the ThoughtSpot cache.

JDBC and ODBC drivers are appropriate under the following circumstances:

- have an ETL load, such as Informatica, SSIS, and so on
- have available resources to create and manage ETL
- have smaller daily loads

## tsload

You can use the `tsload` command line tool to bulk load delimited data with very high throughput.

Finally, individual users can upload smaller (< 50MB) spreadsheets or delimited files.

We recommend the tsload approach in the following cases:

- initial data load
- JDBC or ODBC drivers are not available
- there are large recurring daily loads
- for higher throughput; this can add I/O costs

## Choosing a Data Caching Strategy

The approach you choose depends on your environment and data needs. There are, of course, tradeoffs between different data caching options.

Many implementations use a variety of approaches. For example, a solution with a large amount of initial data and smaller daily increments might use tsload to load the initial data, and then use the JDBC driver with an ETL tool for incremental loads.

# Authentication

**Summary:** ThoughtSpot provides LDAP/AD, SAML, and ThoughtSpot login to authenticate users.

ThoughtSpot provides three ways to authenticate users LDAP/AD, SAML, and ThoughtSpot login. In general, ThoughtSpot recommends that you use LDAP/AD or SAML if possible since ThoughtSpot provides only basic authentication with no restrictions on passwords, timeouts, failed logins, etc.

The following table shows each of the options and the items to consider for each.

SAML	LDAP/AD	ThoughtSpot
<ul style="list-style-type: none"> <li>• Use SAML for single sign-on authentication.</li> <li>• Can redirect from ThoughtSpot to SAML logins.</li> <li>• Recommended for portal integration.</li> <li>• Option to sync users and groups if stored in LDAP/AD.</li> </ul>	<ul style="list-style-type: none"> <li>• Configuration.</li> <li>• Users authenticate against LDAP or AD.</li> <li>• Option to sync users and groups with ThoughtSpot to manage group membership.</li> </ul>	<ul style="list-style-type: none"> <li>• User created and managed in ThoughtSpot.</li> <li>• No enterprise password control (expiration, password strength, etc.).</li> <li>• Only recommended when SAML and LDAP are not options.</li> </ul>

All users and groups must be known to ThoughtSpot. If you are using LDAP/AD or SAML and don't create users in ThoughtSpot, a user is created when the user first logs in. However, this user is assigned to the `All` group and can only see content available for all users.

Groups are the primary way that security is managed. Groups are not automatically created. You can create groups and users manually or you must automate the assignment from a source system.

ThoughtSpot has an assignment script that works with most LDAP / AD stores. It also has public APIs that you can use to sync users and groups between source systems and your ThoughtSpot appliance.

# Data and object security

ThoughtSpot provides many features for protecting data.

## Object Security

Object security controls what content users see within ThoughtSpot. Objects are tables, columns in tables, worksheets, pinboards, and saved answers.

Users gain access to objects when an object owner shares access with them. Owners can share with individual users or with entire groups, giving access to everyone within that group. Objects may be shared with edit or view-only options. A user can automatically share objects with anyone else in the groups to which they belong. This has implications on setting up privileges, and on applying row-level security.

### Permissive Security Mode

The default Permissive Security mode of ThoughtSpot means that when someone shares an object with you, you can see all the data it uses, regardless of explicit permissions to the parent object data. You can see a shared pinboard without having access to its underlying worksheet or table.

### Advanced Security Mode

ThoughtSpot's Advanced Security mode is opposite of the default permissive mode. Unless the user has explicit permissions to the entire stack of parent objects, they cannot see the data in the child object. For example, in a shared pinboard, you can see data only if you have explicit permissions to the relevant columns of the parent worksheet. Similarly, you can only see the data in a worksheet to which you have access if you have explicit permissions to its parent table object.

Work with your ThoughtSpot support team to enable the Advanced Security Mode on the relevant clusters.

## Row level security (RLS)

Row level security controls what data a user can see in each shared piece of content. Even if a user has access to a worksheet, they can only see rows from the tables they have permission to see.

RLS applies at the table level, so it automatically extends to all worksheets, saved answers, and pinboards based on that table, every time. Also, in queries where there are tables with table filters, all joins are always enforced to avoid accidentally allowing users access to data they shouldn't see.

RLS requires three things:

- A table filter with a column (possibly in a joined table) that can be used to determine who can see a row, such as account id or tenant id.
- A group that can be associated with the row of data by name. For example, if the column is `account_id` and has values of `1`, `2`, `3`, users can be assigned to groups `group_1`, `group_2`, `group_3` and then only see their data.
- Users must be assigned to the group. If they are not assigned to a group that has access, they do not see any data.

Administrative users can always see all rows of data because RLS does not apply to them.

RLS supports a hierarchy of groups, which makes it possible to grant access to some users across multiple groups.

Keep in mind that users within a group can share with one another. If you put everyone in your organization into the same group for RLS, they can share with anyone in the company.

## Column level security (CLS)

Column level security lets users see certain columns in a table, but not other columns. This can be accomplished by sharing a limited set of columns in a table with specific users or groups.

Because someone can share with anyone in the same group, they can potentially share restricted columns. For example, if a *Human Resources* repository has a column with salary information, and it appears in a worksheet, any *Human Resources* group member could create an answer with visible salary information and mistakenly share with someone outside of *Human Resources*. That 'outside' person now has access to the salary information. In such cases, we recommend that you work with your ThoughtSpot support team to enable the Advanced Security Mode on the relevant clusters.

## System privileges

System privileges refer to what a user can do in ThoughtSpot. For example, can they upload or download data or share with all users. These privileges are defined on a group level and inherit downwards. So, if Group A had child groups Group B and Group C, then any privilege given to Group A is also available to Group B and Group C. What this often means is that separate sets of groups are required to manage privileges.

# Performance considerations

**Summary:** Make sure you understand the performance considerations in your installation.

ThoughtSpot configuration and licensing varies by memory availability. Other considerations also impact the performance of your solution. Because some solutions perform better than others, think about the following issues before implementation.

Each node in a ThoughtSpot cluster performs ideally when it has less than 250GB of data and fewer than 0.25 billion total rows of data. For more complex schemas, we recommend even fewer rows of data per node for optimal performance. To reduce the total amount of data and rows of data, you can limit the data range to the relevant years or months, or combine long and narrow tables into wider tables when possible.

## Data Boundaries

Total rows in a result of a join can have an impact on performance. In general, we recommend that you have fewer than 10 billion rows in a many-to-many join. Also, consider these boundaries:

Description	Boundary
Maximum number of rows that can be downloaded	10M (default: 1M)
Size in CSV format	250GB per node
Total number of rows across all tables	250GB per node
Many-to-Many (Generic) join cardinality	2.5B per node
Load frequency	Once every hour

## Worksheet Boundaries

Worksheets must have less than 1000 columns. For aggregated worksheets, follow these guidelines:

- Number of columns should be less than 50

- Number of rows should be less than 10 millions

You can use an ETL process to circumvent these limitations. Speak with ThoughtSpot Customer Support to learn more.

## Aggregated Worksheets and Joins

To join an aggregated worksheet with a base table, you must configure your installation to allow this behavior.

- The aggregated worksheet cannot use more than 5 component tables.
- The number of rows in the final aggregated worksheet cannot be greater than 1000.

## Chasm Trap Worksheets

For chasm trap scenarios where two or more fact tables join through a shared dimension, we recommend the following boundaries:

Description	Boundary
Maximum number of fact tables in a worksheet	5
Maximum number of shared dimensions	2
Maximum number of rows in a <i>non</i> co-sharded shared dimension table of chasm trap	1B
Maximum number of rows in a co-sharded shared dimension table of chasm trap	1B

## Row-level Security Boundaries

Maximum number of unique RLS rules with search data suggestions should not exceed 15K.

## Scheduled Pinboards

For ideal performance of scheduled pinboards, do not exceed 50 scheduled pinboard jobs.

# About installation and upgrades

**Summary:** As administrator, you are responsible for setting up and configuring ThoughtSpot. This guide explains how. It will also assist you in troubleshooting some common problems, finding additional resources, and contacting ThoughtSpot.

Your ThoughtSpot application software is already installed for you in a ThoughtSpot appliance. This is true for both physical and virtual appliances.

The ThoughtSpot software is updated by ThoughtSpot Support. ThoughtSpot Support will contact you to schedule an update when one becomes available.

As administrator, you are responsible for setting up and configuring ThoughtSpot. This guide explains how. It will also assist you in troubleshooting some common problems, finding additional resources, and contacting ThoughtSpot.

## Display your current configuration

To perform the setup and configuration, you must first learn how to [gain administrative access \[See page 7\]](#).

1. Log into the ThoughtSpot cluster as the `admin` user.
2. Use the `tscli feature` subcommand to display your current configuration.

ACTION	NAME	STATUS	CONFIGUR
	Firewall	Disabled	
	Saml	Disabled	
	Ldap	Disabled	
	CustomBranding	Disabled	
	CustomBrandingFontCustomization	Disabled	
	DataConnect	Disabled	
	RLS	Enabled	
	Callhome	Enabled	
	SSHTunnel	Enabled	
	Fileserver	Disabled	

## Related information

The following tasks are also available:

- [Set your locale \[See page 22\]](#)
- [Test connectivity between nodes \[See page 24\]](#)
- [Set up a fiscal calendar year \[See page 27\]](#)
- [Integrate LDAP \[See page 44\]](#)
- [Set up monitoring \[See page 56\]](#)
- [Configure support services \[See page 58\]](#)
- [Network ports \[See page 64\]](#)
- [Configure load balancing and proxies \[See page 76\]](#)

*About installation and upgrades*

- Customize look and feel [See page 80]
- Add the Slack integration [See page 84]

# Set your ThoughtSpot locale

**Summary:** You can change the language displayed in the application.

By default, the language that ThoughtSpot UI displays depends on the system locale. It is simple to change it using the **Profile** interface.

The **Language** selection specifies more than just the language: it sets the locale, which controls both the language choice and standard data formats for date and number. So, if you set French as the default locale in your profile settings, the interface updates to reflect this. Be sure to refresh your browser page.

For example, in the United States the number format for large numbers uses the comma thousands separator and a period decimals separator, and looks like this: `xxx,xxx.xx`. In most European countries, they use the reverse notation, with comma decimals separator and period thousands separator, like this: `xxx.xxx,xx`.

In addition to American English (`en-US`), ThoughtSpot supports the following locales:

Locale	Language
<code>da-DK</code>	Dansk
<code>de-DE</code>	Deutsche
<code>en-AU</code>	English (Australia)
<code>en-CA</code>	English (Canada)
<code>en-GB</code>	English (United Kingdom)
<code>en-US</code>	English (United States)
<code>es-US</code>	Español (latín)
<code>es-ES</code>	Español (España)
<code>fr-CA</code>	Français (Canada)
<code>fr-FR</code>	Français (France)
<code>it-IT</code>	Italiano

Locale	Language
<i>nl-NL</i>	Nederland (beta)
<i>nb-NO</i>	Norsk
<i>pt-BR</i>	Português (Brazil)
<i>pt-PT</i>	Português (Portugal)
<i>fi-FI</i>	Suomi
<i>sv-SE</i>	Svenska
<i>zh-CN</i>	中文(简体)
<i>ja-JP</i>	日本語

ThoughtSpot translates keywords, operators, and error messages. See the [keyword reference for all supported languages \[See page 0\]](#).

ThoughtSpot *DOES NOT* translate formulas, or metadata entered by the user. For example, if you name a visualization ‘Quarterly Sales’ in any variant of English and subsequently change the locale to a variant of French, the visualization remains ‘Quarterly Sales’ and does not become ‘Ventes trimestrielles’.

# Test network connectivity between nodes

**Summary:** Verify your network is properly configured for the application.

This procedure tests the network connectivity between all ThoughtSpot nodes, and to the LAN. If you can perform these steps successfully, the network settings on ThoughtSpot are correct.

1. Log in to the Linux shell using SSH.
2. Ping each of the other nodes in the cluster.
3. Ping another machine that exists outside of the cluster, for example, a machine that you will use to stage data to be loaded.

If you cannot perform these tests successfully, there is a problem with the network setup. If the tests fail, check [Network connectivity issues \[See page 448\]](#).

## Set the relay host for SMTP (email)

**Summary:** ThoughtSpot uses emails to send critical notifications to ThoughtSpot Support. A relay host for SMTP traffic routes the alert and notification emails coming from ThoughtSpot through an SMTP email server.

### Configure using tscli

Set up SMTP rules to send critical email notifications to ThoughtSpot Support.

#### Set up the relay Host

To set up a relay host:

1. Log in to the Linux shell using SSH.
2. Issue the setup command, providing the IP address of the relay host:

```
$ tscli smtp set-relayhost <IP_address>
```

3. Verify your settings:

```
$ tscli smtp show-relayhost
```

4. Verify that email is working.

#### Configure an email to receive alerts

ThoughtSpot sends alerts to the email address specified during installation. If no email address was entered, no alerts are sent. You should add an email to receive alerts by issuing:

```
$ tscli monitoring set-config --email <your_email>
```

To send to multiple emails, provide a comma-separated list with no spaces.

### Verify the relay with an email

Check if the email settings are working properly by using this procedure.

1. Log in to the Linux shell using SSH.
2. Try sending an email to yourself by issuing:

```
$ echo | mail -s Hello <your_email>
```

3. If you receive the email at the address(es) you supplied, email is working correctly.

# Set up custom calendars

**Summary:** With a custom calendar, you can choose when the year, quarter, or week starts, and search using date-related keywords.

You can create custom calendars for different purposes within your company, including:

- Retail calendars, like 4-4-5, 4-5-4, or 5-4-4
- Fiscal calendars, where the year or quarter starts on a different date each year
- Pharmaceutical calendars, where the week runs from Friday through Thursday
- Calendars in different languages

## Options

In a custom calendar, you can set the following:

- The starting date of a year
- The starting dates of quarters
- The starting day of the week
- The words used for the days of the week, months and quarters

## Search features

You can use your custom calendar to search the following ways:

- Using date keywords, like `this quarter` and `q3`
- Using [date formulas with the `fiscal` option specified \[See page 0\]](#)
- Overriding the calendar used in the search bar by typing your custom calendar's name

## Limitations

- Maximum scope of the date dimension is 90 years
- Maximum length of a calendar year is 12 months

## Setting up a custom calendar

To set up a custom calendar for your cluster, you must do the following:

1. Enable the custom calendar feature.
2. Generate a calendar template.
3. Edit the calendar template.
4. Add the custom calendar to your cluster.

### Enable the custom calendar feature

To enable the custom calendar feature for your cluster, contact [ThoughtSpot Support \[See page 0\]](#).

### Generate a calendar template

Using a calendar template as your starting point ensures that you use a format that is compatible with ThoughtSpot.

To generate a calendar template, do the following:

1. SSH as admin into your ThoughtSpot cluster: `ssh admin@<cluster-ip-address or hostname>`.
2. Run the `tscli calendar generate` command using the following syntax:

```
tscli calendar generate --name <calendar_name> --start_date <MM/DD/YYYY> --
end_date <MM/DD/YYYY> --username tsadmin
```

```
Example: tscli calendar generate --name my_calendar --start_date 07/01/2019
--end_date 06/30/2020 --username tsadmin
```

This generates a calendar template file in .csv format. In the previous example:  
**my\_calendar.csv**.

3. Exit your SSH session.

## Edit the calendar template

To use the template you generated as your custom calendar, some editing is required.

1. Download the .csv file to your computer using following syntax:

```
scp admin@<cluster-ip-address>:/home/admin/<calendar_name>.csv /<Local  
directory on your computer>/.
```

Example (on Mac OS): `scp admin@172.18.144.217:/home/admin/my_calendar.csv  
/Users/john.smith/Desktop/.`

2. Open the .csv file in a text editor or spreadsheet program and edit the file to ensure the date and quarter columns are formatted correctly:
  - The Date column must use the format: **MM/DD/YYYY**. No other formats are supported.
  - The Quarter column must display the correct quarter number for each day of the year.

**❶ Note:** By default, a generated calendar displays quarter numbers based on the Gregorian calendar (which starts on January 1st). If your custom calendar begins any other date, you must adjust the quarter numbers to align with your calendar. For example: If your custom calendar begins on April 1st, the calendar would incorrectly show April, May and June as quarter 2. You would need to correct this to indicate those months are quarter 1 and correct the subsequent months to have the correct quarter.

- (Optional) To enhance searchability, ThoughtSpot recommends adding a “Q” before each quarter number. Example: **Q1**. If adapting the calendar to different language, use the appropriate letter in place of “Q”.
- Make any other changes needed to the calendar (like translating months or days into a different language.)

Example calendar with the fiscal year beginning on April 1:

date	day_of_week	month	quarter	year	day_number_of_week	week_number_of_month	week_number_of_quarter	week_number_of_year	is_weekend
4/1/19	monday	april	Q 1	2019	1	1	1	1	FALSE
4/2/19	tuesday	april	Q 1	2019	2	1	1	1	FALSE
4/3/19	wednesday	april	Q 1	2019	3	1	1	1	FALSE
4/4/19	thursday	april	Q 1	2019	4	1	1	1	FALSE
4/5/19	friday	april	Q 1	2019	5	1	1	1	FALSE
4/6/19	saturday	april	Q 1	2019	6	1	1	1	TRUE
4/7/19	sunday	april	Q 1	2019	7	2	1	1	TRUE
4/8/19	monday	april	Q 1	2019	1	2	2	2	FALSE
4/9/19	tuesday	april	Q 1	2019	2	2	2	2	FALSE
4/10/19	wednesday	april	Q 1	2019	3	2	2	2	FALSE
4/11/19	thursday	april	Q 1	2019	4	2	2	2	FALSE
4/12/19	friday	april	Q 1	2019	5	2	2	2	FALSE
4/13/19	saturday	april	Q 1	2019	6	2	2	2	TRUE
4/14/19	sunday	april	Q 1	2019	7	3	2	2	TRUE
4/15/19	monday	april	Q 1	2019	1	3	3	3	FALSE
4/16/19	tuesday	april	Q 1	2019	2	3	3	3	FALSE
4/17/19	wednesday	april	Q 1	2019	3	3	3	3	FALSE

- Save your calendar template as a UTF-encoded .csv file with UNIX line breaks.

**Note:** Saving the file with UNIX line breaks, ensures there are no carriage returns (^M characters) in the file which prevent you from using your calendar in ThoughtSpot. Microsoft Excel, for example, adds carriage returns. The easiest way to remove carriage returns is to open your .csv file in a text editor, and save it as a .csv with UNIX line breaks.

## Add the custom calendar to your cluster

To use your edited calendar template as a custom calendar, you must upload it to your cluster and use it to create a calendar in ThoughtSpot.

- Upload the .csv file to your ThoughtSpot cluster using the following syntax:

```
scp /<Local directory on your computer>/<calendar_template_name>.csv
admin@<cluster-ip-address>:/home/admin/
```

Example (on Mac OS): `scp /Users/john.smith/Desktop/my_calendar.csv`

```
admin@172.18.144.217:/home/admin
```

- SSH as admin into your ThoughtSpot cluster: `ssh admin@<cluster-ip-address or hostname> .`

3. Run the `tscli calendar create` command using the following syntax:  
`tscli calendar create --file_path /home/admin/<calendar_template_name>.csv --name <calendar_name> --username tsadmin`

Example: `tscli calendar create --file_path /home/admin/my_calendar.csv --name my_calendar --username tsadmin`

(Optional) Set a custom calendar as the default calendar for your cluster

To set your custom calendar as the default calendar for your cluster, contact [ThoughtSpot Support \[See page 0\]](#).

## Setting a worksheet, table or view to use your custom calendar

If you don't set your custom calendar as the default for your cluster, you must do the following to use your calendar:

1. Sign in to your ThoughtSpot cluster and click **DATA**.
2. On the DATA page, click the name of a worksheet, table or view in which you want to use your custom calendar.
3. Under COLUMN NAME, find a column that uses the DATE or DATE\_TIME data type where you want to use your custom calendar and scroll right until you see the CALENDAR TYPE column.

**Note:** The column must use the DATE or DATE\_TIME data type.

4. In the CALENDAR TYPE column for the column(s) you chose, double-click the existing calendar name, and then select your custom calendar.
5. Click **Save Changes**.

Now, date-related searches in the selected worksheet, table or view use your custom calendar.

# Configure internal authentication

**Summary:** Many organizations don't use LDAP or active directory for user authentication. In other scenarios, some users are not in LDAP and are created only in ThoughtSpot. In such cases, you can choose to authenticate users against ThoughtSpot internal authentication.

Many organizations don't use LDAP or active directory for user authentication. In other scenarios, some users are not in LDAP and are created only in ThoughtSpot. In such cases, you can choose to authenticate users against ThoughtSpot internal authentication.

**Note:** Before the user logs into ThoughtSpot, the user must exist in ThoughtSpot. This is independent of the authentication mechanism.

If you have been using ThoughtSpot with users you created manually, and you now want to transition to LDAP, please [contact ThoughtSpot Support \[See page 0\]](#). They can assist you in migrating existing users to their LDAP equivalents. <!--

## Configure internal authentication

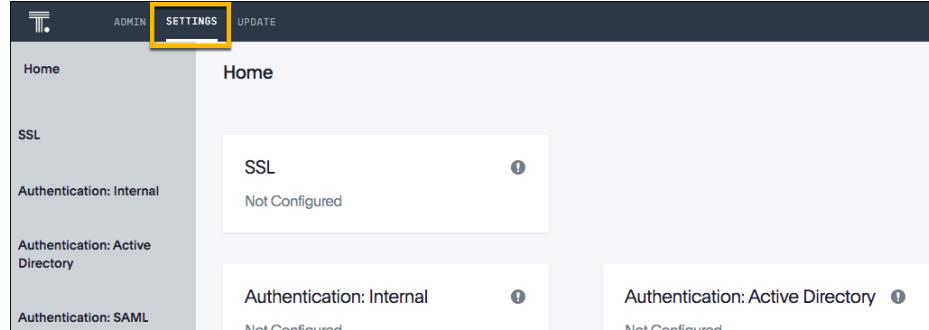
To authenticate users using ThoughtSpot internal who are not available in the LDAP or AD system:

1. Log into ThoughtSpot from a browser.
2. Click the **Admin** menu on the top navigation bar.

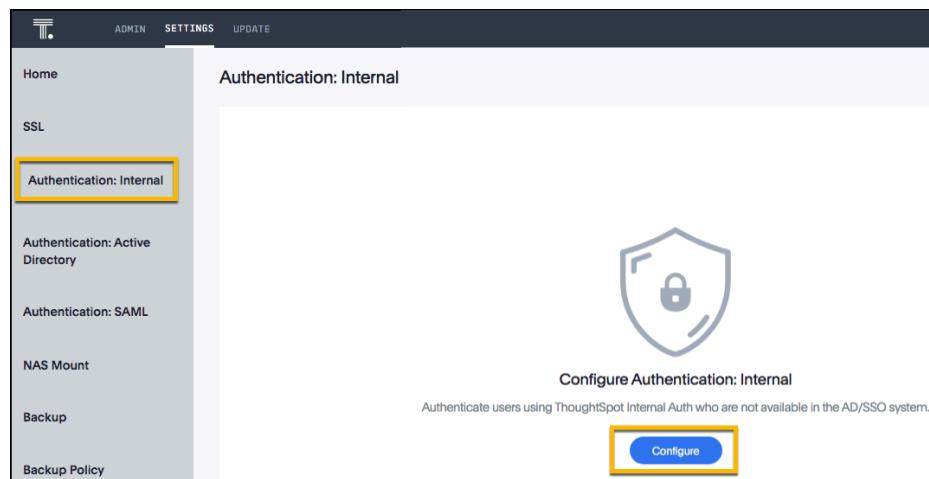


This opens the ThoughtSpot Management Console.

3. Click **Settings** menu on the top navigation bar.



4. In the Settings panel, click **Authentication: Internal** and then **Configure** option.



5. Choose **Enable** under Authentication: Internal option. If you want to disable the internal authentication, configure AD or LDAP first, and then select **Disable** and save the configuration.

The screenshot shows the 'Edit Authentication: Internal' dialog box. It contains a message about authenticating users not available in Active Directory or SSO. Below is a section for 'Authentication: Internal \*' with two radio buttons: 'Enable' (selected) and 'Disable'. At the bottom are 'Cancel' and 'Save' buttons, with 'Save' highlighted with a yellow box.

*Configure internal authentication*

6. Click **Save** to configure the internal authentication. ->

# Configure SSL

**Summary:** Secure socket layers (SSL) provide authentication and data security when sending data to and from ThoughtSpot.

You can use SSL to enable both HTTP and LDAP data security.

## About SSL

Companies usually secure applications that access data. To use SSL with ThoughtSpot, you must use your company's own SSL certificate. The certificate is issued for each domain or service. If you plan to use SSL for both HTTP(S) and LDAP(S), you must have two separate certificates.

If you do not have an SSL certificate, there are options:

- Check with your IT department if they have an SSL certificate you can use.
- Obtain the certificate from an issuing authority.
- Disable SSL and loose the security it provides. Use the following command:

```
tscli ssl off
```

ThoughtSpot works with a wide variety of SSL types, from a wide variety of vendors.

## Required ports

To use SSL, the following ports must be open:

- 443
- 80

## Configure SSL for web traffic

**Note:** Do not use a passphrase when creating certificates.

To verify if you're prompted to specify a passphrase, invoke the command `openssl rsa -check`

`-in pk.key`. If the answer is ‘yes’, remove the passphrase to use the key.

To add SSL and enable HTTPS in ThoughtSpot, obtain the [SSL certificate chain \[See page 36\]](#) and the [private key \[See page 36\]](#).

### SSL certificate chain

The SSL certificate chain must be in `.PEM` format. This is an `X.509v3` file that contains ASCII (Base64) armored data, packed between `BEGIN` and `END` directives. It can be a bundle of certificates.

### Private key

The private key must be in compatible `.PEM` format. It cannot be password or passphrase protected.

## Configure SSL using tscli

Follow these instructions to install the SSL certificate using tscli:

1. Use the instructions from the certifying authority where you obtained the certificate.

This is usually sent to you by email, or available for download.

2. Copy the certificate and key files to ThoughtSpot:

```
$ scp <key> <certificate> admin@<IP_address>:<certificate-path>
```

3. Log into the Linux shell using SSH.

4. Change to the directory where you copied the files:

```
$ cd <certificate-path>
```

5. To install the certificate, issue the `tscli` command:

```
$ tscli ssl add-cert <key> <certificate>
```

6. To test that the certificate is correctly installed, [log into the ThoughtSpot application \[See page 0\]](#).

You should see that the application's URL begins with `https://`.

### Set the recommended TLS version

There are a couple of security vulnerabilities due to SSL certificates supporting older versions of TLS (Transport Layer Security). This procedure shows you how to set the recommended TLS version to avoid these vulnerabilities.

The PCI (Payment Card Industry) Data Security Standard and the FIPS 140-2 Standard require a minimum of TLS v1.1 and recommends TLS v1.2.

ThoughtSpot supports SSL v3, TLS v1.0, and TLS v1.1 for backwards compatibility. However, the recommended version is TLS v1.2. Therefore, to set the recommended TLS version:

1. Enable your web browser to support TLS v1.2. This can be done in your browser's advanced settings.
2. Log in to the Linux shell using SSH..
3. Issue the following command:

```
tscli ssl set-min-version 1.2
```

This will block all usage of older versions.

### Configuration string for load balancers

When enabling SSL support on a load balancer's server-side SSL client profile, use the following list of ciphers to ensure compatibility between the load balancer and ThoughtSpot.

```
EECDH+AESGCM:EDH+AESGCM:AES256+EECDH:AES256+EDH
```

The following ciphers are currently supported:

```
| TLSv1.2:  
|   ciphers:  
|     TLS_DHE_RSA_WITH_AES_128_GCM_SHA256 - strong  
|     TLS_DHE_RSA_WITH_AES_256_CBC_SHA - strong  
|     TLS_DHE_RSA_WITH_AES_256_CBC_SHA256 - strong  
|     TLS_DHE_RSA_WITH_AES_256_GCM_SHA384 - strong  
|     TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 - strong  
|     TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA - strong  
|     TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384 - strong  
|     TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 - strong  
|   compressors:  
|     NULL  
|_  least strength: strong
```

You can retrieve these from the ThoughtSpot web server (not against the load balancer) by running the

following command on any ThoughtSpot node: `nmap --script ssl-enum-ciphers -p 443`

`<ThoughtSpot_node_IP_address>` You must ensure that your load balancer supports these ciphers.

# Configure SAML

**Summary:** You can use the Security Assertion Markup Language (SAML) to authenticate users.

ThoughtSpot enables you to use the Security Assertion Markup Language (SAML) to authenticate user.

You can set up SAML using the management console or through the shell on ThoughtSpot using a `tscli`-based configurator. It is configured to work using service provided by an Identity Provider (IDP).

## Configuration prerequisites

Before you configure SAML, collect the following information:

- ThoughtSpot service address [See page 39]
- Service port [See page 39]
- Unique service name [See page 0]
- Skew time in seconds [See page 40]
- IDP Metadata XML File [See page 40]
- Automatically add SAML users to Thoughtspot [See page 40]
- Also use ThoughtSpot internal authentication [See page 40]

### ThoughtSpot service address

DNS name of the load balancer *front-end* for multi-node ThoughtSpot clusters, or of ThoughtSpot *server* for single-node ThoughtSpot cluster.

### Service port

Service port for ThoughtSpot instance, typically TCP/443.

### Unique service name

The unique key ThoughtSpot uses to identify IDP service. Set by the ThoughtSpot Support Team.

The key has the following format: `urn:thoughtspot:callosum:saml`.

### Skew time in seconds

Allowed skew time for authentication, or the duration after authentication response is rejected and sent back from the IDP.

Usually set to `3600` seconds.

### IDP Metadata XML File

This file is provided by the IDP. The absolute path to the `idp-meta.xml` file is needed for one-time configuration.

### Automatically add SAML users to Thoughtspot: (yes/no)

If you choose ‘yes’, then new users will be automatically created in ThoughtSpot. If ‘no’, then SAML users will be added in ThoughtSpot upon first successful SSO login.

### Also use ThoughtSpot internal authentication: (y/n)

If ‘y’, then ThoughtSpot local/internal users (including local administrative users) will still be authenticated outside the scope of SSO.

## Configure SAML using tscli

**Note:** The configuration persists across updates to newer releases of ThoughtSpot.

To set up SAML on ThoughtSpot for user authentication, follow these steps:

1. Log into the Linux shell using SSH.

2. Run the `saml configure` command to launch the interactive SAML configuration:

```
tscli saml configure
```

3. Complete the configurator prompts with the information you collected in [Configuration prerequisites \[See page 39\]](#).
4. When the configuration completes, open a browser and navigate to the ThoughtSpot login page. It should show the SSO option.

# Enable Active Directory based access

**Summary:** ThoughtSpot supports enabling Active Directory (AD) based access individually on each node where the commands are run.

## Enable Active Directory based access on a ThoughtSpot node

ThoughtSpot supports enabling Active Directory (AD) based access individually on each node where the commands are run. There is no provision to enable AD access for the whole cluster with a single command. To enable AD access on a cluster, you need to run these commands on each individual node and on any additional nodes added to the cluster.

The command to enable system AD user access is:

```
tscli sssd enable --user <USER> --domain <DOMAIN>
```

You will then be prompted for password credentials.

**Note:** The user must have permission to join a computer or VM to the domain.

## Set sudoers AD Group on a local node

Just like enabling AD based access on a node, setting `sudo` AD group applies only on the node where the command is run, and is not set for the whole cluster.

The command to allow `sudo` permissions for AD group:

```
tscli sssd set-sudo-group <ACTIVE_DIRECTORY_GROUP_NAME>
```

## Clear sudoers AD Group on a local node

Clearing `sudo` AD group only applies on the node where command is run, and is not set for the whole cluster.

The command to clear `sudo` permissions for the AD group:

```
tscli sssd clear-sudo-group <ACTIVE_DIRECTORY_GROUP_NAME>
```

## Disable AD based access on a local node

Currently ThoughtSpot supports disabling AD based access individually on each node where the commands are run. There is no provision to disable AD access for the whole cluster with a single command. To disable AD access on a cluster, run these commands on each individual node and any additional nodes added to the cluster.

Command to disable system AD user access is:

```
tscli sssd disable
```

**ⓘ Note:** Running this command will also remove the AD group from sudoers list.

## Related Information

- [sssd \[See page 0\]](#) in the `tscli` command reference

# About LDAP integration

**Summary:** You authenticate users against an LDAP server.

Some companies use LDAP (Lightweight Directory Access Protocol) to manage user authentication.

Using LDAP provides security and makes user management more centralized. You can choose to authenticate users against an LDAP server, against ThoughtSpot, or both.

ThoughtSpot supports both anonymous and non-anonymous LDAP integration. Non-anonymous LDAP binding is more rigorous than anonymous authentication, but it should help you track what your users are querying and keep a log trace for auditing purposes.

If you have been using ThoughtSpot with users you created manually, and you now want to transition to LDAP, please contact ThoughtSpot Support. They can assist you in migrating existing users to their LDAP equivalents.

ThoughtSpot supports LDAP with [Active Directory \[See page 45\]](#).

# Configure authentication through Active Directory

**Summary:** ThoughtSpot enables you to set up integration with LDAP using Active Directory. After successful setup, you can authenticate users against a secure LDAP server.

## Configuration prerequisites

Before you configure ThoughtSpot for Active Directory, collect the following information:

- URL [See page 45]
- Domain name [See page 45]
- Search base [See page 46]
- SSL [See page 46]
- Automatically add LDAP or AD users in ThoughtSpot? [See page 46]
- Also use ThoughtSpot internal authentication? [See page 46]

### URL

Required to connect to Active Directory.

For example, `ldap://ad.yourdomain.local:389` or `ldap://ad.yourdomain.local:636`

### Domain name

Default domain under which users who want to be authenticated against Active Directory reside. When a user logs in with a username, the default domain is added to the username before sending it to the LDAP server. If users reside in multiple sub-domains, you can still designate one of them as the default.

Authentication against multiple domains is not supported.

Users who don't belong to the default domain must explicitly qualify their username when they log in.

For example: `username@ad.yourdomain.local`

## Search base

LDAP search base. The scope of searching user information, like *email* and *Display name*, within AD.

## SSL

If you want to use SSL, you must obtain the SSL certificate from an issuing authority.

If AD servers are behind a load balancer, you must procure the SSL certificate to identify ThoughtSpot to the load balancer. The communication after the load balancer is non-secure. ThoughtSpot does not support a scenario where multiple AD servers provide their own SSL certificates.

## Automatically add LDAP or AD users in ThoughtSpot? (yes/no)

If you choose ‘yes’, new users are automatically created within ThoughtSpot when successfully authenticated against AD. ThoughtSpot doesn’t cache passwords for AD-authenticated users.

If you choose ‘no’, users have to be manually created with a dummy password as a placeholder in ThoughtSpot before they can log in. The username you specify when creating the LDAP-authenticated user manually in ThoughtSpot has to be domain qualified, for example:

`username1@ad.yourdomain.local`.

In order to log in to ThoughtSpot, the user has to exist in ThoughtSpot independent of whether that user is authenticated against AD or against ThoughtSpot’s internal authentication.

## Also use ThoughtSpot internal authentication? (yes/no)

If you choose ‘yes’, ThoughtSpot will first attempt to authenticate the user against AD. If that attempt fails, it will then attempt to authenticate the user as an internal/local ThoughtSpot user. If either of these succeed, then the user is successfully logged in. This is useful in scenarios where some users are not in AD and are created only in ThoughtSpot.

## Configure LDAP using tscli

You do not have to create a user called `tsadmin` on your LDAP server. Internal authentication can be used for `tsadmin`. To configure AD based authentication, follow these steps:

1. Log in to the Linux shell using SSH.
2. Run the command to configure AD authentication:

```
$ tscli ldap configure
```

3. Answer the prompts using the information you collected under **Before you begin** section. For example:

```
Choose the LDAP protocol:  
[1] Active Directory  
Option number: 1  
Configuring Active Directory  
URL to connect to Active Directory. (Example: ldap://ad.yourdomain.local:389): ldaps://ad.yourdomain.local:636  
Default domain (Example: ldap.thoughtspot.com): yourdomain.local  
Use SSL (LDAPS) (y/n): n  
LDAP search base (Example: cn=Users): cn=Users,ou=organit,dc=youdomain,dc=local  
Automatically add LDAP users in ThoughtSpot (y/n): y  
Also use ThoughtSpot internal authentication (y/n): y
```

4. If you are using SSL, [add the SSL certificate for AD \[See page 48\]](#).
5. If you want to remove the AD configuration, issue the following command:

```
$ tscli ldap purge-configuration
```

# Add the SSL certificate for LDAP

## **Summary:** Install the certificate to support LDAPS

When you set up LDAP, you specified whether or not to use SSL for LDAP (LDAPS). If using SSL, you must install the LDAP SSL certificate. Before you can add the SSL certificate, you must [Configure LDAP for Active Directory \[See page 45\]](#).

You must have the SSL certificate before you start. For more information on obtaining an SSL certificate, see [Configure SSL \(secure socket layers\) \[See page 35\]](#).

To add the SSL certificate for LDAP:

1. Follow the instructions from your certifying authority to obtain the certificate. This is usually sent by email or available for download.
2. Copy the certificate to ThoughtSpot:

```
$ scp <certificate> admin@<IP_address>:<path>
```

3. Log in to the Linux shell using SSH.
4. Change directories to where you copied the certificate:

```
$ cd <path>
```

5. Run the command to configure SSL for LDAP, designating an alias for this certificate using the `<name>` parameter:

```
$ tscli ldap add-cert <name> <certificate>
```

## Test the LDAP configuration

**Summary:** This procedure allows you to test the LDAP connection you created.

After configuring LDAP, you can test to make sure it is working by issuing a command.

1. Log in to the Linux shell using SSH.
2. Issue the LDAP testing command, supplying the information for the LDAP server you configured, as in this example:

```
$ ldapsearch -x -h 192.168.2.61 -p 389 -D "testuser@laptop.thoughtspot.com" -W -b "dc=ldap,dc=thoughtspot,dc=company" cn
```

3. Supply the LDAP password when prompted.
4. If the connection works, you can see a confirmation message.

# Sync users and groups from LDAP

**Summary:** Use this procedure to synchronize your ThoughtSpot system with an LDAP server.

Before synchronizing users and groups, you need this information:

- IP address and port of the server where your ThoughtSpot instance is running. This hostport is needed in the following format `http(s)://<host>:<port>` or `http(s)://<domain>`.
- Administrator login username and password for your ThoughtSpot instance.
- URL of the LDAP server, or hostport.

For example, `ldap://192.168.2.48:389`

- Login username and password for the LDAP system.

An example username would be `moo_100@ldap.thoughtspot.com`

- Distinguished Name (DN) for the base to start searching for users in the LDAP system.

For example, `DC=ldap,DC=thoughtspot,DC=com`

- Location of the Python synchronization script, in case you want to modify it or create your own: `/usr/local/scaligent/release/callosum/utilities/ldap_sync_python_api/syncUsersAndGroups.py`

There are two ways for you to fetch users and groups from LDAP and populate them into your ThoughtSpot system:

- Run the synchronization script in interactive mode, which will walk you through the process (shown here).
- Create your own Python script by using the ThoughtSpot Python APIs. If you need details on the Python APIs, contact ThoughtSpot Support. If you choose this method, you can run the script periodically using a cron job.

To run the LDAP sync script in interactive mode:

1. Log in to the Linux shell using SSH.

- Run the command to start the script:

```
python syncUsersAndGroups.py interactive
```

- Answer the prompts using the information you collected above. For example:

```
Complete URL of TS server in format "http(s)://<host>:<port>": http://10.77.145.24:8088
Disable SSL authentication to TS server (y/n): y
Login username for ThoughtSpot system: admin
Login password for ThoughtSpot system: 12345
Complete URL of server where LDAP server is running in
format ldap(s)://<host>:<port>: ldap://192.168.2.48:389
Login username for LDAP system: moo_100@ldap.thoughtspo
t.com
Login password for LDAP system: 12345
Syncs user and groups between LDAP and TS systems (y/
n): y
Delete entries in ThoughtSpot system that are not curre
ntly in LDAP tree being synced (y/n): n
Distinguished name for the base to start searching grou
ps in LDAP System: DC=ldap,DC=thoughtspot,DC=com
Scope to limit the search to (choice number)
0:base Searching only the entry at the base DN
1:one Searching all entries on level under the base DN
- but not including the base DN
2:tree Searching of all entries at all levels under an
d including the specified base DN: 2
```

```
Filter string to apply the search to: (|(CN=TestGroupAl
pha)(CN=TestGroupBeta))
```

Answering this prompt is optional. If left blank, the default value of '(CN=\*)' will be used.

```
Apply sync recursively, i.e. Iterates through group mem
bers and creates member groups, users and relationships
in a recursive way. (y/n): n
```

This prompt is asking if you would like to include group members even if they do not belong to the current sub tree that is being synced.

4. Alternatively, to input your own shorthand script commands:

Issue the Python script commands, supplying all this information, following this format example:

```
python syncUsersAndGroups.py script \
--ts_hostport <ts_hostport> \
--disable_ssl \
--ts_uname <ts_username> \
--ts_pass <ts_password> \
--ldap_hostport '<ldap_hostport>' \
--ldap_uname '<ldap_username>' \
--ldap_pass '<ldap_password>' \
--sync \
--purge \
--basedn 'DC=ldap,DC=thoughtspot,DC=com' \
--filter_str '(|(CN=TestGroupAlpha)(CN=TestGroupBeta))' \
--include_nontree_members
```

The bottom half of the preceding command targets sub trees under the DC called TestGroupAlpha and TestGroupBeta, and iterates through them recursively to create-sync users, groups, and their relationships in the ThoughtSpot system. It also deletes any other entities created in the ThoughtSpot system from this LDAP system that are not currently being synced.

#### syncUsersAndGroups.py command-line switches

The following table provides a description of each command-line switch available for the `syncUsersAndGroups` python script.

Switch	Description
<code>--ts_hostport &lt;ts_hostport&gt;</code>	ThoughtSpot cluster host port. Default port is 8088.

--disable_ssl	Controls the communication between the sync script and the ThoughtSpot cluster. It disables SSL communications between the script and the cluster ONLY, and prevents the need to provide SSL certs during the script execution in order to create users and groups.
--ts_uname	ThoughtSpot cluster username. The <code>admin</code> user is usually used.
--ts_pass	ThoughtSpot cluster password.
--ldap_hostport	AD/LDAP server port that is queried. Default is 389.
--ldap_uname	Username for the LDAP/AD server.
--ldap_pass <ldap_pass--word>	Password for the LDAP/AD server.
--sync	Syncs users and groups which match the <code>basedn</code> and <code>filter_str</code> queries to your ThoughtSpot cluster.
--purge	Purges any users that exist in ThoughtSpot, but not in AD.
--basedn	Place in the directory that will be searched for users.
--filter_str	Further filters results from your base DN.
--include_nontree_members	Includes group members from LDAP/AD even if they do not belong to the current subtree that is being synced.

# Configure NAS file system

**Summary:** Some operations, like backup, restore, and data loading, require either reading or writing very large files. You can mount a network attached storage (NAS) file system to support these operations. Your NAS storage can be in the drive format you choose.

## About NAS mount

ThoughtSpot enables you to mount a NAS file system for storing or accessing large files. The file system will be mounted at the same location on each node in the cluster automatically. When any node is restarted, the file system will be mounted again automatically, if it can be found.

When supplying a directory for writing or reading a backup, you can specify the a new mount point within `/export` as the directory to use. Likewise, you can stage data there for loading. It is best to have 2 separate NAS volumes, individually dedicated to data loads and backups.

Backups are written by the Linux user `admin`. If that user does not have permission to write to the NAS file system, you can write the backups to a disk (for example `/export/sdc1`, `/export/sdd1`, `/export/sde1`, or `/export/sdf1`) and then set up a cron job that executes as root user and copies the backup to the NAS device every night, then deletes it from the directory.

Do not send the periodic backups or stage files on `/export/sdb1` since it is a name node. It is used internally by Hadoop Distributed File System (HDFS) and if this drive fills up, it can cause serious problems. Do not allow backups or data files to accumulate on ThoughtSpot. If disk space becomes limited, the system will not function normally.

## Mount NAS using tscli

To mount a NAS file system using the tscli, follow these steps:

1. Log in to the Linux shell using SSH.
2. Mount the directory to the file system by issuing the appropriate command:
  - Example for an NFS (Network File System) directory:

```
tscli nas mount-nfs --server storageservername.firebaseio.yourdomain.net  
    --path_on_server <path> /tsdev-backup --mount_point /export/BACKUPS/  
    --options vers=<version>,sec=<security scheme>,<OPTIONS>
```

**Note:** Other command-line options are available to forward to the command (default: noexec).

- Example for a CIFS (Common Internet File System) directory:

```
tscli nas mount-cifs --server storageservername.firebaseio.yourdomain.net  
    --path_on_server /tsdev-backup --mount_point /export/BACKUPS/  
    --username 'avtprdweutspotdev' --uid 1001 --gid 1001 --options 'vers=3.0'
```

**Note:** Other command-line options are available to forward to the mount.cifs command (default: noexec).

3. Use the mounted file system by referring to its mount point.
4. When you are finished with it, you can optionally unmount the NAS file system:

```
tscli nas unmount --dir <directory>
```

# Set up monitoring

**Summary:** Setting up monitoring is a one time operation.

To configure monitoring of your cluster, set up the frequency of heartbeat and monitoring reports and an email address to receive them.

1. Log in to the Linux shell using SSH.
2. Issue the `tscli` command to set up monitoring:

```
tscli monitoring set-config  
  --email <email>  
  --heartbeat_interval <heartbeat_interval>  
  --report_interval <report_interval>
```

The parameters are:

- `--email <email>` is a comma separated list (no spaces) of email addresses where the cluster will send monitoring information.
- `--heartbeat_interval <heartbeat_interval>` is the heartbeat email generation interval in seconds. Must be greater than 0.
- `--report_interval <report_interval>` sets the cluster report email generation interval in seconds. Must be greater than 0.

3. To view your settings and verify that they have been applied, issue:

```
tscli monitoring show-config
```

You should see information like:

**Monitoring Configuration:**

Alert Email: dev-alerts@thoughtspot.com

Heartbeat Interval: 900 sec

Report Interval: 21600 sec

4. After the heartbeat interval has passed, check your email to verify that emails are being delivered.
5. If you don't receive any emails, [verify that email is working \[See page 26\]](#).

# Configure support services

**Summary:** There are several configurations you can set up in your installation to ensure your company's support from ThoughtSpot works smoothly.

## Set up a reverse tunnel for support

You can set up a reverse tunnel to allow ThoughtSpot Support to get access to your ThoughtSpot instance, to perform support-related activities. This setup is scalable, more secure, and a much simpler alternative to using a virtual meeting room.

Granting remote support access can streamline troubleshooting activities, because it enables your support agent to work directly on your computer from a secure setting. The remote tunnel enables SSH and HTTP access to your ThoughtSpot instance by ThoughtSpot Support. This access can be granted and revoked easily, so you can enable it for a troubleshooting session, and then disable it again. Before doing this procedure, make sure your company's security policies allow reverse tunneling.

**Note:** Before you set up a reverse tunnel, open port 22 in your firewall outgoing rules to whitelist `tunnelrelay.thoughtspot.com`.

## Using remote support with tscli

To enable remote support, follow these steps:

1. [Contact ThoughtSpot \[See page 0\]](#) and open a support ticket for making the appropriate reverse tunnel settings on our end. Provide the cluster name of the cluster for which you want to enable remote support.
2. After the ticket is completed, continue with the remaining steps in this procedure to make the settings on your side.
3. Log into the Linux shell using SSH.
4. Issue the command to configure the destination for the remote tunnel.

You only need to do this one time, when you are enabling the tunnel for the very first time.

After that, this setting persists when you start and stop the remote tunnel.

```
$ tscli support set-remote --addr tunnelrelay.thoughtspot.com --user ubuntu
```

5. Test that the setting is configured:

```
$ tscli support show-remote
```

6. Enable the remote tunnel:

```
$ tscli support start-remote
```

7. Contact ThoughtSpot [See page 0] and test the setup with your ThoughtSpot Support contact.

8. After your remote session with ThoughtSpot Support is over, turn the remote tunnel off until you need to use it again:

```
$ tscli support stop-remote
```

You can repeat the steps to start and stop the remote tunnel as needed for future support operations.

9. Ensure that the remote tunnel is disabled:

```
$ tscli support show-remote
```

## Configure a secure file server

ThoughtSpot Support uses a secure file server to distribute new releases and to access your logs and troubleshooting files. You must also use a secure server connection to enable the optional performance statistics collection.

Before uploading files to the secure file server, obtain your user name and password for logging into the secure file server. You can get these from ThoughtSpot Support.

Configuring the connection to the file server is a one-time operation. You do not have to reconfigure the connection unless your password changes. Note that you can do a one time override of the user and password you used to configure the connection. This is done by passing a different user and password on the command line when uploading or downloading a file.

To configure the connection to the secure file server, follow these steps:

1. Log in to the Linux shell using SSH.
2. Issue the command to configure the file server:

```
$ tscli fileserver configure --user <user_name> [--password <password>]
```

If you do not supply the `--password` parameter, you are prompted to enter it.

## Call home with cluster usage data

“Call home” data is metadata and usage data from your ThoughtSpot cluster. This data allows ThoughtSpot’s Support team to troubleshoot your cluster. They use the data to see basic usage information over time for your ThoughtSpot instance. ThoughtSpot’s “call home” functionality intermittently sends a call home bundle of statistics to a ThoughtSpot S3 server through HTTPS. The data is encrypted at rest on the server.

By default, call home is enabled on your cluster. You can disable call home in by doing the following:

1. Log into the ThoughtSpot server as `admin` user.
2. Use the `tscli` command to disable.

```
$ tscli callhome disable
```

## Designate a support contact

A support contact person can answer your questions about data and search at your company. If the person can't answer your system and software-related questions, that person should submit the questions to ThoughtSpot Support. The designated support contact should have an available email and phone number.

To designate the custom support contact, follow these steps:

1. Log into the Linux shell using SSH.
2. Issue the `tscli` command to set the email address:

```
$ tscli support set-admin-email <email_address>
```

3. Issue the `tscli` command to set the phone number:

```
$ tscli support set-admin-phone <phone_number>
```

4. If you need to reset both of these to the default (ThoughtSpot Support), issue these commands:

```
$ tscli support rm-admin-email  
$ tscli support rm-admin-phone
```

## Manage the feedback contact

Users in ThoughtSpot may be asked for feedback for new or BETA features in the system. By default, feedback goes directly to ThoughtSpot support.

Alternatively, and especially in cases of using ThoughtSpot in embedded mode, you can send feedback to someone in your company.

Your designated feedback contact should have an available email. To designate the custom feedback contact, follow these steps:

1. Log into the Linux shell using SSH.
2. To set the feedback email address, issue this command:

```
$ tscli support set-feedback-email <email_address>
```

3. Verify the email address is set:

```
$ tscli support show-feedback-email
```

To reset the email to the default (ThoughtSpot support), issue this command:

```
$ tscli support rm-feedback-email
```

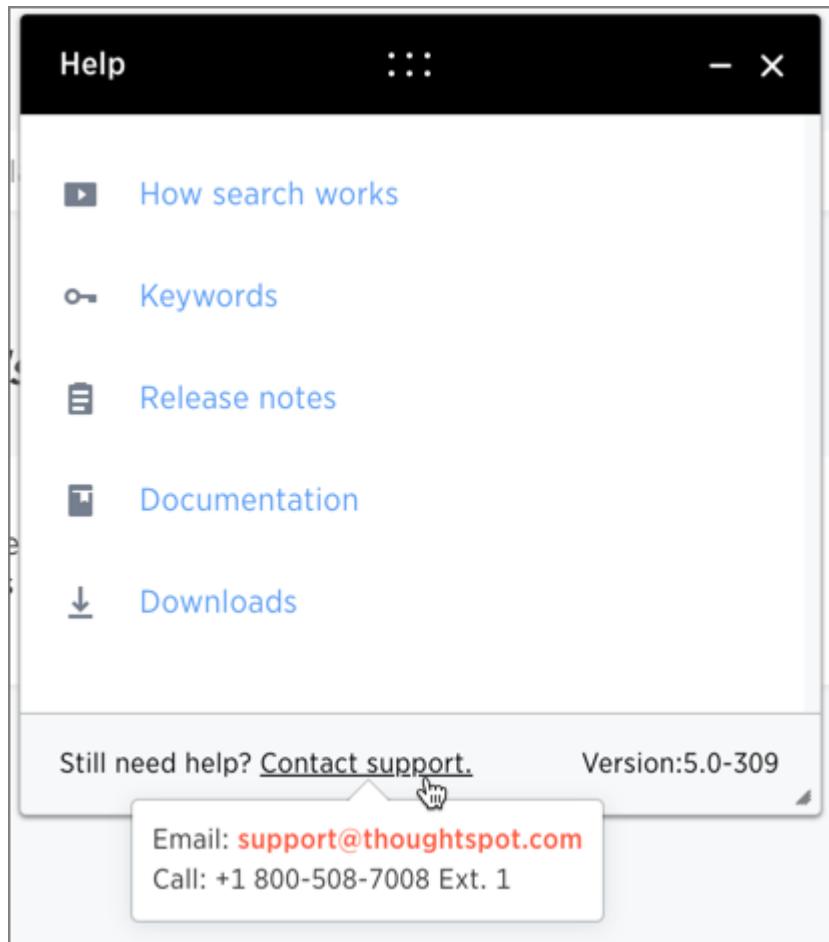
You can also choose not to send feedback on your system. Issue this command:

```
$ tscli support set-feedback-email ''
```

## How users find your company's support contact

After you set the custom support contact information, your users can see it in the following parts of ThoughtSpot:

- In the Help Center, when a user selects **Contact Support**.



- In error messages, when a user selects **What Happened?**

# Network policies

**Summary:** Lists the required ports, protocols and policies for an installation.

For regular operations and debugging, there are some ports you must keep open to network traffic from end users. Another list of ports must be open for intracluster traffic, and for inbound and outbound access to the cluster. ICMP v4 is used for checking the health of the cluster.

## Required ports for operations and debugging

The following ports must be open for requests from your user population. There are two main categories: operations and debugging.

Port	Protocol	Service Name	Direction	Source	Destination	Description
22	SSH	SSH	bidirectional	Administrators IP addresses	All nodes	Secure shell access. Also used for scp (secure copy).
80	HTTP	HTTP	bidirectional	All users IP addresses	All nodes	Hypertext Transfer Protocol for website traffic.
443	HTTPS	HTTPS	bidirectional	All users IP addresses	All nodes	Secure HTTP.
12345	TCP	Simba	bidirectional	Administrators IP addresses	All nodes	Port used by ODBC and JDBC drivers when connecting to ThoughtSpot.
2201	HTTP	Orion master HTTP	bidirectional	Administrator IP addresses	All nodes	Port used to debug the cluster manager.
2101	HTTP	Oreo HTTP	bidirectional	Administrator IP addresses	All nodes	Port used to debug the node daemon.
4001	HTTP	Falcon worker HTTP	bidirectional	Administrator IP addresses	All nodes	Port used to debug the data cache.

Port	Protocol	Service Name	Direction	Source	Destination	Description
4251	HTTP	Sage master HTTP	bidirectional	Administrator IP addresses	All nodes	Port used to debug the search engine.

## Required ports for cluster communication

This reference lists the potential ports to open when setting up your security group.

### Required ports for intracluster operation

Static ports are used for communication between services within the cluster. ThoughtSpot recommends that you open all ports within a cluster. This is not required, but it will ensure that cluster communication works properly if additional ports are used in a future software release.

If your organization does not allow you to open all ports, make sure you open the required intracluster ports listed in the following table. In addition, a number of ports are dynamically assigned to services, which change between runs. The dynamic ports come from the range of ports that are dynamically allocated by Linux (20K+).

Port	Protocol	Service Name	Direction	Source	Dest.	Description
80	TCP	nginx	inbound	All nodes	All nodes	Primary app HTTP port (nginx)
443	TCP	Secure nginx	inbound	All nodes	All nodes	Primary app HTTPS port (nginx)
2100	RPC	Oreo RPC port	bidirectional	All nodes	All nodes	Node daemon RPC
2101	HTTP	Oreo HTTP port	bidirectional	Admin IP addresses and all nodes	All nodes	Node daemon HTTP

<b>Port</b>	<b>Protocol</b>	<b>Service Name</b>	<b>Direction</b>	<b>Source</b>	<b>Dest.</b>	<b>Description</b>
2181	RPC	Zookeeper servers listen on this port for client connections	bidirectional	All nodes	All nodes	Zookeeper servers listen on this port for client connections
3181	RPC	Zookeeper servers listen on this port for client connections	bidirectional	All nodes	All nodes	Zookeeper servers listen on this port for client connections
4181	RPC	Zookeeper servers listen on this port for client connections	bidirectional	All nodes	All nodes	Zookeeper servers listen on this port for client connections
2200	RPC	Orion master RPC port	bidirectional	All nodes	All nodes	Internal communication with the cluster manager
2201	HTTP	Orion master HTTP port	bidirectional	Admin IP addresses and all nodes	All nodes	Port used to debug the cluster manager
2205	TCP	Cluster update service TCP port	bidirectional	All nodes	All nodes	Internal communication with the cluster manager
2210	RPC	Cluster stats service RPC port	bidirectional	All nodes	All nodes	Internal communication with the stats collector
2211	HTTP	Cluster stats service HTTP port	bidirectional	Admin IP addresses and all nodes	All nodes	Port used to debug the stats collector
2230	RPC	Callosum stats collector RPC port	bidirectional	All nodes	All nodes	Internal communication with the BI stats collector

Port	Protocol	Service Name	Direction	Source	Dest.	Description
2231	HTTP	Callosum stats collector HTTP port	bidirectional	Admin IP addresses and all nodes	All nodes	Port used to debug the BI stats collector
2240	RPC	Alert manager	bidirectional	All nodes	All nodes	Port where alerting service receives alert events
2241	RPC	Alert manager	bidirectional	All nodes	All nodes	Port where alerting service receives alert events
2888	RPC	Ports used by Zookeeper servers for communication between themselves	bidirectional	All nodes	All nodes	Ports used by Zookeeper servers for communication between themselves
3181	RPC	Ports used by Zookeeper servers for communication between themselves	bidirectional	All nodes	All nodes	Ports used by Zookeeper servers for communication between themselves
3888	RPC	Ports used by Zookeeper servers for communication between themselves	bidirectional	All nodes	All nodes	Ports used by Zookeeper servers for communication between themselves
4000	RPC	Falcon worker RPC port	bidirectional	All nodes	All nodes	Port used by data cache for communication between themselves
4001	HTTP	Falcon worker HTTP port	bidirectional	Admin IP addresses and all nodes	All nodes	Port used to debug the data cache
4002	HTTP	Falcon worker HTTP port	bidirectional	Admin IP addresses and all nodes	All nodes	Port used to debug the data cache

<b>Port</b>	<b>Protocol</b>	<b>Service Name</b>	<b>Direction</b>	<b>Source</b>	<b>Dest.</b>	<b>Description</b>
4003	RPC	Falcon worker RPC port	bidirectional	All nodes	All nodes	Port used by data cache for communication between themselves
4004	RPC	Falcon worker RPC port	bidirectional	All nodes	All nodes	Port used by data cache for communication between themselves
4021	RPC	Sage metadata service port (exported by Tomcat), Callousum services like meta-data services, meta-data-dependency service, scheduling service, session-less service, spotiq service	bidirectional	All nodes	All nodes	Port where search service contacts meta-data service for metadata
4181	RPC	Ports used by Zookeeper servers for communication between themselves	bidirectional	All nodes	All nodes	Ports used by Zookeeper servers for communication between themselves
4201	HTTP	Sage auto complete server HTTP interface port	bidirectional	Admin IP addresses and all nodes	All nodes	Port used to debug the search service
4231	HTTP	Sage index server HTTP port	bidirectional	Admin IP addresses and all nodes	All nodes	Port used to debug the search service
4232	RPC	Sage index server metadata subscriber port	bidirectional	All nodes	All nodes	Port used for search service internal communication
4233	RPC	Sage index server RPC port	bidirectional	All nodes	All nodes	Port used for search service internal communication

<b>Port</b>	<b>Protocol</b>	<b>Service Name</b>	<b>Direction</b>	<b>Source</b>	<b>Dest.</b>	<b>Description</b>
4241	HTTP	Sage auto complete server HTTP port	bidirectional	Admin IP addresses and all nodes	All nodes	Port used to debug the search service
4242	RPC	Sage auto complete server RPC port	bidirectional	All nodes	All nodes	Port used for search service internal communication
4243	RPC	Sage auto complete server metadata subscriber port	bidirectional	All nodes	All nodes	Port used for search internal communication
4244	RPC	Sage auto complete server metadata subscriber port	bidirectional	All nodes	All nodes	Port used for search internal communication
4245	RPC	Sage auto complete server metadata subscriber port	bidirectional	All nodes	All nodes	Port used for search internal communication
4243	RPC	Sage auto complete server metadata subscriber port	bidirectional	All nodes	All nodes	Port used for search internal communication
4251	RPC	Sage master RPC port	bidirectional	All nodes	All nodes	Port used for search service internal communication
4405	RPC	Diamond (graphite) port	bidirectional	All nodes	All nodes	Port used for communication with monitoring service
4406	RPC	Diamond (graphite) port	bidirectional	All nodes	All nodes	Port used for communication with monitoring service
4500	RPC	Trace vault service RPC port	bidirectional	All nodes	All nodes	Trace collection for ThoughtSpot services
4501	HTTP	Trace vault service HTTP port	bidirectional	Admin IP addresses and all nodes	All nodes	Debug trace collection

Port	Protocol	Service Name	Direction	Source	Dest.	Description
4851	RPC	Graphite manager RPC port	bidirectional	All nodes	All nodes	Communication with graphite manager
4852	HTTP	Graphite manager HTTP port	bidirectional	Admin IP addresses and all nodes	All nodes	Debug graphite manager
4853	RPC	Elastic search stack (ELK) manager RPC port	bidirectional	All nodes	All nodes	Communication with log search service
4853	HTTP	Elastic search stack (ELK) manager HTTP port	bidirectional	Admin IP addresses and all nodes	All nodes	Debug log search service
9200	RPC	Elastic search (ELK)	bidirectional	All nodes	All nodes	Communication with log search service
5021	RPC	Callosum services like meta-data services, medata-dependency service, scheduling service, session-less service, spotiq service	bidirectional	All nodes	All nodes	Port where search service contacts meta-data service for metadata
5432	Postgres	Postgres database server port	bidirectional	All nodes	All nodes	Communication with Postgres database
6021	RPC	Callosum services like meta-data services, medata-dependency service, scheduling service, session-less service, spotiq service	bidirectional	All nodes	All nodes	Port where search service contacts meta-data service for metadata
7021	RPC	Callosum services like meta-data services, medata-dependency service, scheduling service, session-less service, spotiq service	bidirectional	All nodes	All nodes	Port where search service contacts meta-data service for metadata

Port	Protocol	Service Name	Direction	Source	Dest.	Description
8020	RPC	HDFS namenode server RPC port	bidirectional	All nodes	All nodes	Distributed file system (DFS) communication with clients
8021	RPC	Callosum services like meta-data services, metadata-dependency service, scheduling service, session-less service, spotiq service	bidirectional	All nodes	All nodes	Port where search service contacts metadata service for metadata
8080	HTTP	Tomcat	bidirectional	All nodes	All nodes	BI engine communication with clients
8081	HTTP	Callosum/Tomcat status	bidirectional	All nodes	All nodes	BI engine communication with clients
8787	HTTP	Periscope (UI) service HTTP port	bidirectional	All nodes	All nodes	Administration UI back end
8888	HTTP	HTTP proxy server (tinyproxy)	bidirectional	All nodes	All nodes	Reverse SSH tunnel
11211	Memcached	Memcached server port	bidirectional	All nodes	All nodes	BI engine cache
12345	ODBC	Simba server port	bidirectional	All nodes	All nodes	Port used for ETL (extract, transform, load)
8480	HTTP	HDFS journalnode server HTTP port	bidirectional	All nodes	All nodes	Debug DFS metadata
8485	HTTP	HDFS journalnode server HTTP port	bidirectional	All nodes	All nodes	Debug DFS metadata
50070	HTTP	HDFS namenode server HTTP port	bidirectional	All nodes	All nodes	Debug DFS metadata
50090	HTTP	HDFS secondary namenode server HTTP port	bidirectional	All nodes	All nodes	Debug DFS metadata
50075	HTTP	HDFS datanode server HTTP port	bidirectional	All nodes	All nodes	Debug DFS data

Port	Protocol	Service Name	Direction	Source	Dest.	Description
50010	HTTP	HDFS datanode server HTTP port	bidirectional	All nodes	All nodes	Debug DFS data
50020	HTTP	HDFS datanode server HTTP port	bidirectional	All nodes	All nodes	Debug DFS data
7000	TCP	Cassandra KV store database	bidirectional	All nodes	All nodes	Debug DFS data
7001	TCP	Cassandra	bidirectional	All nodes	All nodes	Debug DFS data
9042	HTTP	Munshi server impression service, Cassandra	bidirectional	All nodes	All nodes	Debug DFS data
9160	TCP	Cassandra	bidirectional	All nodes	All nodes	Debug DFS data
4010	HTTP	Falcon moderator	bidirectional	All nodes	All nodes	Debug DFS data
4011	HTTP	Falcon moderator	bidirectional	All nodes	All nodes	Debug DFS data
20123 - 32768	TCP (dynamic)	Dynamic port in this range used for various services and ancillary services like atlas, caffeine, call-home, callosum, falcon, monitoring, munshi server, nlp, object_search, postgres, sage UBR, spo-tiq snapshot, timely	All nodes	Services		
5270	TCP	Cluster monitoring service (ELK)	bidirectional	All nodes	All nodes	Services
5271	TCP	Cluster monitoring service (ELK)	bidirectional	All nodes	All nodes	Services
5601	TCP	Kibana UI (ELK)	bidirectional	All nodes	All nodes	Services
6311	TCP	R service	bidirectional	All nodes	All nodes	Services
8008	TCP	Video recorder	bidirectional	All nodes	All nodes	Services

Port	Protocol	Service Name	Direction	Source	Dest.	Description
9090	TCP	Timely	bidirectional	All nodes	All nodes	Services
	ICMPv4	Used for health check of cluster nodes	bidirectional	All nodes	All nodes	Services

### Required ports for inbound and outbound cluster access

ThoughtSpot uses static ports for inbound and outbound access to the cluster.

Port	Protocol	Service Name	Direction	Source	Dest.	Description
22	SCP	SSH	bidirectional	ThoughtSpot Support	All nodes	Secure shell access.
80	HTTP	HTTP	bidirectional	ThoughtSpot Support	All nodes	Hypertext Transfer Protocol for website traffic.
443	HTTPS	HTTPS	bidirectional	ThoughtSpot Support	All nodes	Secure HTTP.
12345	TCP	Simba	bidirectional	ThoughtSpot Support	All nodes	Port used by ODBC and JDBC drivers when connecting to ThoughtSpot.
2049	TCP	NFS: In case one needs to mount NFS share on TS node.	bidirectional	ThoughtSpot Support	All nodes	Port used by NFS.
123	UDP	NTP service	bidirectional	ThoughtSpot Support	All nodes	Port used by NTP service.

Port	Protocol	Service Name	Direction	Source	Destination	Description
443	TCP	HTTPS	outbound	All nodes	208.83.110.20	For transferring files to thoughtspot.egnyte.com.

Port	Protocol	Service Name	Direction	Source	Destination	Description
443	TCP	HTTPS	outbound	All nodes	For transferring product usage data to mixpanel cloud.	outbound
443	TCP	HTTPS	outbound	All nodes	je8b47jfif.execute-api.us-east-2.amazonaws.com s3.us-west-1.amazonaws.com s3-us-west-1.amazonaws.com s3.dualstack.us-west-1.amazonaws.com	For transferring monitoring data to InfluxCloud. (Given address will resolve to point to AWS instances).
25 or 587	SMTP	SMTP or Secure SMTP	outbound	All nodes and SMTP relay (provided by customer)	All nodes	Allow outbound access for the IP address of whichever email relay server is in use. This is for sending alerts to ThoughtSpot Support.
389 or 636	TCP	LDAP or LDAPS	outbound	All nodes and LDAP server (provided by customer)	All nodes	Allow outbound access for the IP address of the LDAP server in use.

### Required ports for IPMI (Intelligent Platform Management Interface)

ThoughtSpot uses static ports for out-of-band IPMI communications between the cluster and ThoughtSpot support.

Port	Protocol	Service Name	Direction	Source	Dest.	Description
80	HTTP	HTTP	bidirectional	ThoughtSpot Support	All nodes	Hypertext Transfer Protocol for website traffic.
443	TCP	S-HTTP	bidirectional	ThoughtSpot Support	All nodes	IPMI GUI and for HTML5-based IPMI console access.

<b>Port</b>	<b>Protocol</b>	<b>Service Name</b>	<b>Direction</b>	<b>Source</b>	<b>Dest.</b>	<b>Description</b>
623	UDP	Serial-over-LAN	bidirectional	ThoughtSpot Support	All nodes	IPMI GUI and for HTML5-based IPMI console access.

## Related information

[EC2 Best Practices \[See page 0\]](#)

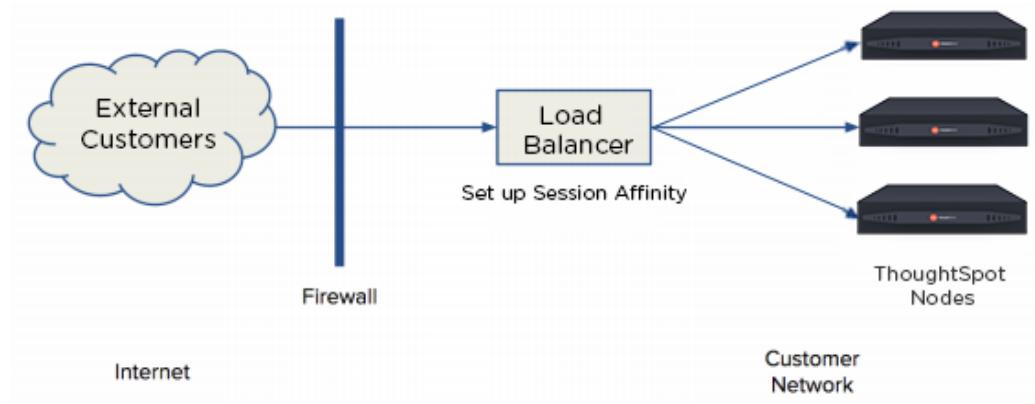
# Configure load balancing and proxies

**Summary:** A load balancer is needed in front of a server group in order to direct traffic to individual servers in a way that maximizes efficiency.

Here are some of the best practices and guidelines for a typical implementation with ThoughtSpot. Your experience may differ depending on your environment and preference.

## Load balance across ThoughtSpot nodes

The following shows a network architectural diagram which includes a load balancer for ThoughtSpot nodes.



The load balancer is an appliance in your infrastructure that routes traffic automatically to nodes to provide failover. You can also place a load balancer or proxy in front of the ThoughtSpot appliance if you'd like external network users to access the system.

The best way to load balance across all ThoughtSpot nodes in a cluster is to map one domain name (FQDN) to all the IPs in the cluster in a round robin fashion.

For example, if you want to use a DNS server based load balancing, then you can define multiple “A” resource records (RR) for the same name.

Below is an example of how you could set that up

```
thoughtspot.customer.com IN A 69.9.64.11  
thoughtspot.customer.com IN A 69.9.64.12  
thoughtspot.customer.com IN A 69.9.64.13  
thoughtspot.customer.com IN A 69.9.64.14
```

The example indicates that IP addresses for the domain thoughtspot.customer.com are 69.9.64.11, 69.9.64.12, 69.9.64.13, and 69.9.64.14.

## Session Affinity

Session Affinity refers to directing requests to the same application server for the time it takes to complete a task.

In order for session affinity to work on ThoughtSpot, HTTPS (an SSL certificate) has to be installed on the load balancer level. If it is installed outside of the load balancer, session affinity may not occur and the ThoughtSpot system will fail.

## Web proxies

You can access ThoughtSpot through any standard web proxy server. Web proxies are fairly universal regardless of the application they are proxying. However, ThoughtSpot doesn't use any new protocols, like SPDY or HTTP/2, which may have a dependency on the proxy. Instead, ThoughtSpot is commonly placed behind a web HTTP/HTTPS proxy.

Additionally, the proxy can round robin across multiple nodes in the ThoughtSpot backend. You can essentially use the web proxy as a load balancer. Therefore, your session will carry over if the proxy round robins between the ThoughtSpot backends as long as the URL doesn't change.

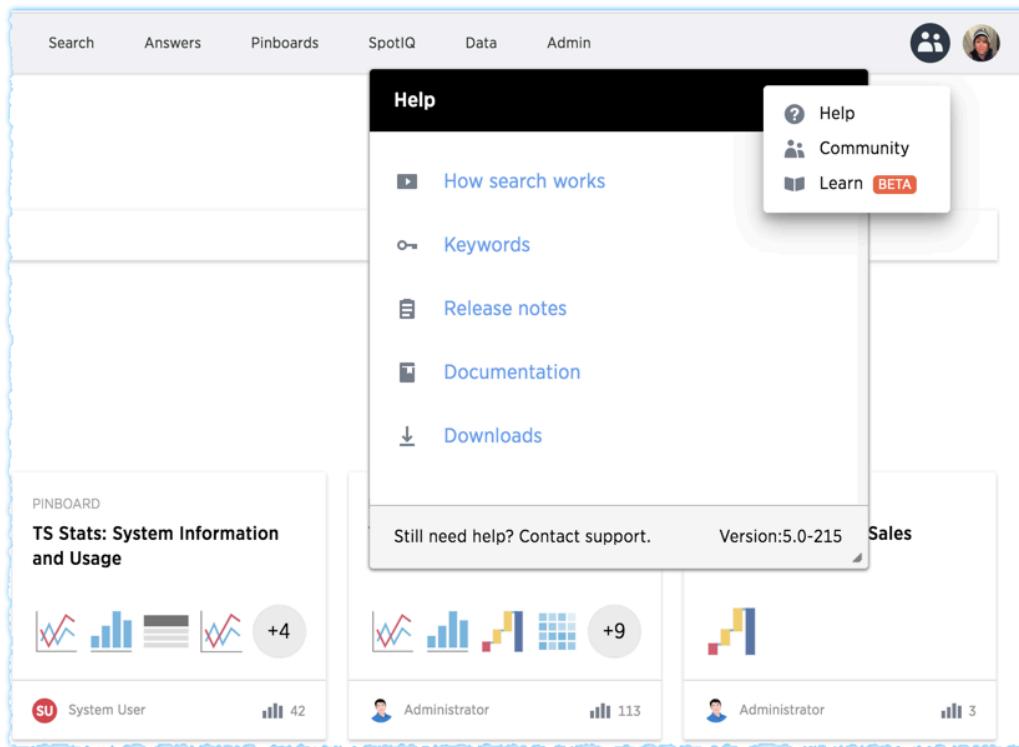
# Customize ThoughtSpot Help

**Summary:** You customize ThoughtSpot Help to be specific to your data, examples, and documentation.

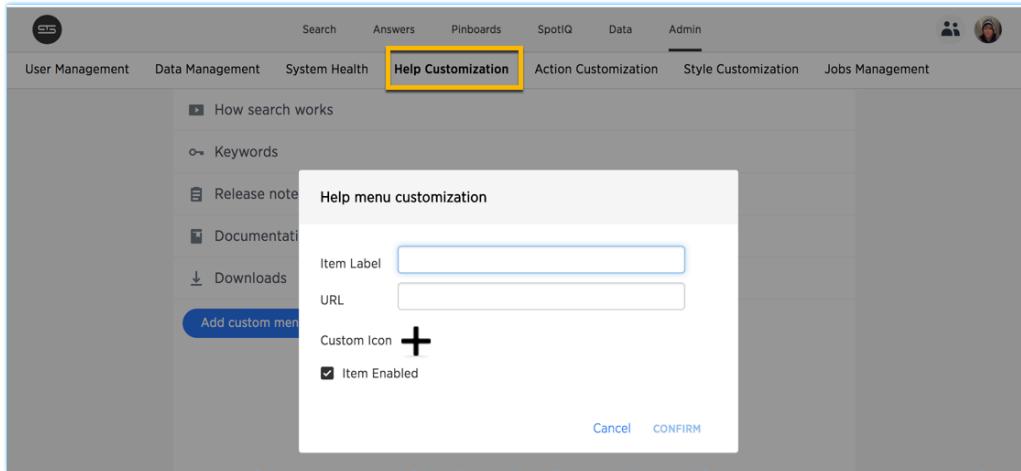
You can customize the Help for your ThoughtSpot application to tailor it to your organization.

Configuring these Help settings sets system-wide defaults for all your users.

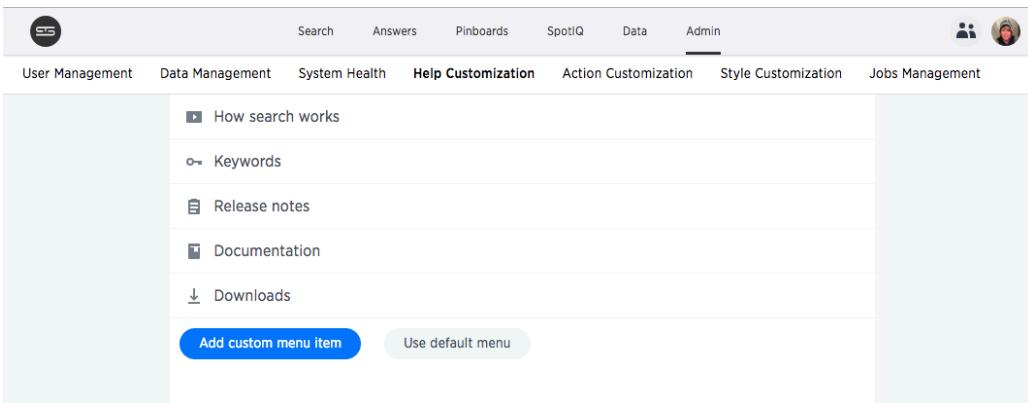
When your ThoughtSpot users click the Help icon, they see a list of links.



As an administrator, you can add your own links to this list. This allows you to include documentation specific to your company, such as information about the data available in ThoughtSpot, where to get support internally, or company-specific training.



You can also edit existing links, change icons, or remove items from the help listing altogether.



# Customize look and feel

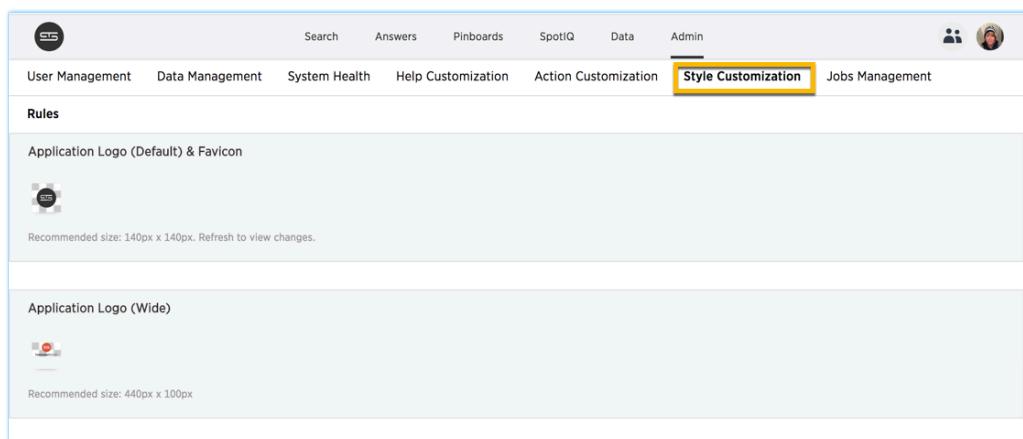
**Summary:** You can brand the ThoughtSpot application for your company.

You can customize the look and feel of the ThoughtSpot application for your company. Configuring these settings sets system-wide defaults for all your users.

Style customization is enabled by default. You can configure your cluster to disable this functionality. Contact [support@thoughtspot.com](mailto:support@thoughtspot.com) [See page 0] for information about disabling this feature.

## Where to customize styles

A user with administrative rights can view and access the customization on the **Admin** page.



Use the **Style Customization** page to access the configuration settings.

## General guidelines for customization

Your changes take effect either immediately or with browser refresh. You can revert your changes by using the **Reset** button which displays when your cursor moves to the right of any setting.



The following table lists the style customizations you can configure.

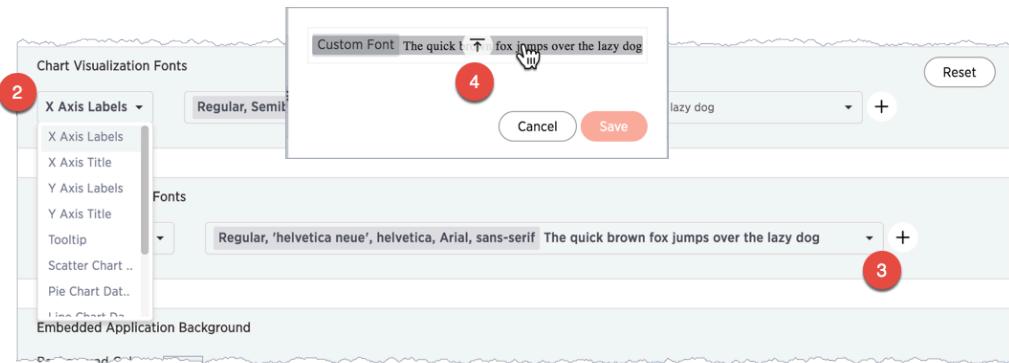
Setting	Description
<b>Application Logo (Default) &amp; Favicon</b>	Sets a default application and favicon logo. This should be 140 pixels square.
<b>Application Logo (Wide)</b>	This logo should be 440 x 100 pixels.
<b>Chart Visualization Fonts</b>	Set a font for chart labels. You can specify any Web Open Font Format ('WOFF') file.
<b>Table Visualization Fonts</b>	Set a font for table labels. You can specify any Web Open Font Format ('WOFF') file.
<b>Embedded Application Background</b>	Set the background for an embedded ThoughtSpot instance. This is only used if you are embedding ThoughtSpot in another application.
<b>Chart Color Palettes</b>	Set the default palette for all charts. To set a value, however over a color value and enter a HEX value or select one from the chart. Individual users can still customize their own chart colors. They can use the **Reset colors** option on a chart to clear their changes.
<b>Footer text</b>	Define a footer to appear with the ThoughtSpot application.
<b>Page title</b>	Sets the title for the browser tab.

## How to specify fonts

You can set your systems default fonts by specifying either or both of the **Chart Visualization Fonts** and **Table Visualization Fonts** values. To set this values, your font must be defined in a Web Open Font Format ( WOFF ) file.

Changes to chart and table defaults apply only to charts and features created *after* you configure a value. If you change table fonts, older tables retain their previous fonts. Some settings can be overridden on a per-object level. Users cannot configure their own defaults.

To set a new font:



1. Make sure you have a WOFF file available for your font.
2. Select the label you want to change.
3. Click the + button.

The system displays the **Custom Font** dialog.

4. Click the **Custom Font** field.

The system displays the file finder.

5. Add the `WOFF` file you want.

The file appears in the font dialog

6. Click **Save** to change the font.

## How to specify the behavior of clickable links in data

There is a system-wide setting which determines what happens when a user clicks on a link within the data. When your data includes URLs, they display as clickable links in ThoughtSpot tables. By default, clicking on a link opens the URL in a separate tab. But there is a system-wide setting that can be changed to open the links within the context in which they appear.

Changing this setting opens the links:

Link type	Opens in
Link in search result table in ThoughtSpot	Same browser tab as ThoughtSpot application
Link in table embedded in an iFrame	Same iFrame that contains the table
Link in full ThoughtSpot application embedded in an iFrame	Same iFrame that contains the application

# Slack integration

Working with ThoughtSpot, you can configure your installation to work with Slack. Users can use the integration, called **Spot**, to make queries or view charts. Any users with administrative rights can apply a `spot` sticker to specific objects. Then, the object is available through Slack.

The first time a user messages Spot, it returns a login link for ThoughtSpot. After logging in, the user's Slack and ThoughtSpot accounts are connected. Actions a user makes from Slack are tied to the user's permissions and authorization.

## Spot workflow for administration

Here are the high level steps:

1. Work with [support@thoughtspot.com](mailto:support@thoughtspot.com) [See page 0] to install the Spot Slack bot on your cluster.
2. Log into ThoughtSpot.
3. Label answers, pinboards, and other objects with the spot sticker.
4. Start Spot Bot.
5. Register Spot bot with your company's Slack instance.
6. Register your Spot Slack account to ThoughtSpot.

## Related Information

Relevant `tscli` commands are [here](#) [See page 0], but these will not work until Spot is enabled by ThoughtSpot Support. Support will work with you to install Spot, and then provide the rest of the workflow to you, including `tscli` command usage.

# Load and manage data

The fastest and easiest way to load a new table is by importing it using the Web browser. This is best for one time data loads of small tables which do not have complex relationships to other tables. This method is limited to tables that are under 50 MB (megabytes) in size.

Using ThoughtSpot Loader, you can script recurring loads and work with multi-table schemas.

If your data already exists in another database with the schema you want to use in ThoughtSpot, you can pull the schema and data in using the ODBC or JDBC driver.

These are the methods you can use to load data, along with the benefits of each method:

Method	Description	Benefits
Connect to external databases [See page 0]	Use the ThoughtSpot Embrace to read directly from the external databases.	Easy way to set up and enable the connection between ThoughtSpot and external databases. Users can send live query to the external databases, without having to replicate data again in ThoughtSpot for analysis.
Load data from the ThoughtSpot UI [See page 88]	Use the ThoughtSpot Web interface to upload an Excel or CSV (comma separated values) file from your local machine.	Easy way to do a one-time data load of a small file (under 50MB). End users can upload their own data and explore it quickly.
Import with the ThoughtSpot Loader (tsload) [See page 142]	Use TSQL and tsload to load data directly into the back end database that ThoughtSpot uses.	Best way to load large amounts of data or a schema with multiple tables. Can be scripted and used for recurring data loads, such as monthly sales results or daily logs. Can be integrated with an ETL solution for automation.
Use the ODBC/JDBC driver to connect to ThoughtSpot	Use the ODBC or JDBC client with your ETL tool. For information, see the ThoughtSpot Data Integration Guide.	Make use of an established ETL process and tool(s). Connect to ThoughtSpot using third party tools like SSIS. You don't need to define a schema to accept the data load.

If you're uploading data through the Web interface, you can use a native Excel file. If you want to use a CSV (comma separated values) or delimited file, or you are loading using ThoughtSpot Loader, you must [create CSV files with the data to be loaded \[See page 89\]](#) first.

**Tip:** End users will almost always work with worksheets and data they upload.

## Related Information

- [Load CSV files with the UI \[See page 88\]](#)
- [Append data through the UI \[See page 0\]](#)
- [Schema planning concepts \[See page 100\]](#)
- [Overview of schema building \[See page 119\]](#)
- [Import CSV files with tsload \[See page 142\]](#)
- [How to view a data schema \[See page 94\]](#)

# Configure casing

**Summary:** You can set the type of case sensitivity you would like to see reflected in the ThoughtSpot display.

Before you load your data, you should consider the type of casing you would like your data to reflect.

The case sensitivity for source data strings is preserved in the display. So, the visual display of results is identical to the input case that is loaded.

**Note:** The casing will remain lowercase in other parts of the application, such as when you ask a question or filter.

It is important to note that string casings aren't applied globally, but by column. So datasets will have different string casings as long as they're in different columns. Tables that are already compacted will keep their lowercase format. In these cases, to get the specific string case that you want, you would have to truncate related tables and reload them.

To take advantage of case configuration, you need to have ThoughtSpot Support enable it on your cluster for you. In addition, title casing should be disabled for string casing to properly work.

# Load CSV files with the UI

**Summary:** The simplest way to load data is to upload a CSV or Excel file from the ThoughtSpot Web interface.

Loading data through the Web browser is recommended for smaller tables (under 50MB) with simple relationships between them. This method is recommended for small, one time data loads. Using this method, the data schema is created for you automatically.

Any user who belongs to a group that has the privilege **Has administration privileges** or **Can upload user data** can upload their own data from the browser.

Your data should be in a CSV (comma separated values) before you load it. A CSV file is a text file made up of data fields separated by a delimiter and optionally enclosed with an enclosing character. If your data contains multiple tables, you can have a separate CSV for each table.

## Formatting the CSV

Your ETL (extract, transform, load) process will typically generate CSV files. You can also create a CSV file from a Microsoft Excel spreadsheet by opening the spreadsheet in Excel, choosing **Save As** and selecting CSV.

A CSV file contains a delimiter that marks the separation between fields in the data. The delimiter is usually comma, but it can be any character. The file also contains fields optionally enclosed with double quotes. Use these guidelines when creating the CSV file:

- If the CSV contains column headers, they must match the column names in the database exactly.
- Often a `|` (pipe) or tab is used as the delimiter, because it may be less likely to occur within the data values.
- When a field contains a double quote, it must be escaped with the character specified in the escape character argument in `ts load`.
- When a field contains the delimiter, the field must be enclosed in double quotes.

ThoughtSpot supports a wide range of date and timestamp formats [See page 0] in the CSV file. Blank values in user uploaded CSV files are interpreted as NULL values. These include the values (case insensitive):

- `NULL`
- `\N`
- `NA`
- `N/A`
- `[space]`

If you are appending data to an existing schema or table, columns in the CSV file must be in the same order as defined in the target table.

If you are loading a fact table that joins to dimension tables, you must load the fact table first, and then the dimension tables. The joining key must be a single column of unique values in the dimension table. `NULL` values in the fact table cannot be joined.

## Create a CSV file

The first step in loading data is to obtain or create one or more CSV files that contain the data to be

loaded into ThoughtSpot. CSV is a common format for transferring data between databases.

ThoughtSpot requires this format.

Most applications such as Microsoft Excel or Google Sheets can output CSV formatted files. If your source is an Excel spreadsheet or Google Sheet:

1. Save, export, or download the file in CSV format. The exact procedure you use will depend on the source application.
2. Review the file's format before uploading it to ThoughtSpot.

Your source data may be in another database. If this is the case, your company's ETL (extract, transform, load) process will typically generate CSV files. If your source is another database:

3. Connect to the source database.
4. Extract each table you wish to import into ThoughtSpot as a CSV file.

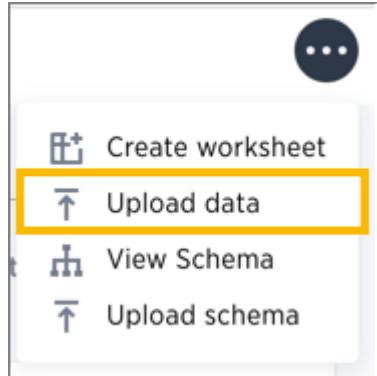
The column delimiter should be a `,` (comma), `|` (pipe), or tab.

For general information about CSV files and the rules for creating them, see the [Comma-separated\\_values \[See page 0\]](#) on Wikipedia.

## Load the CSV File

Any user who belongs to a group that has the privilege **Has administration privileges** or **Can upload user data** can upload their own data from the browser. To load the CSV or Excel file into ThoughtSpot:

1. Log into ThoughtSpot from a browser.
2. Click **Data**, on the top navigation bar.
3. Click the ellipses icon  , in the upper right corner, and select **Upload Data**.



4. Upload the CSV or Excel file by doing one of these options:
  - a. Click **Browse your files** and select the file.
  - b. Drag and drop the file into the drop area.
5. Answer the question **Are the column names already defined in the file header?**
6. Answer the question **Are the fields separated by?** Click **Next**.

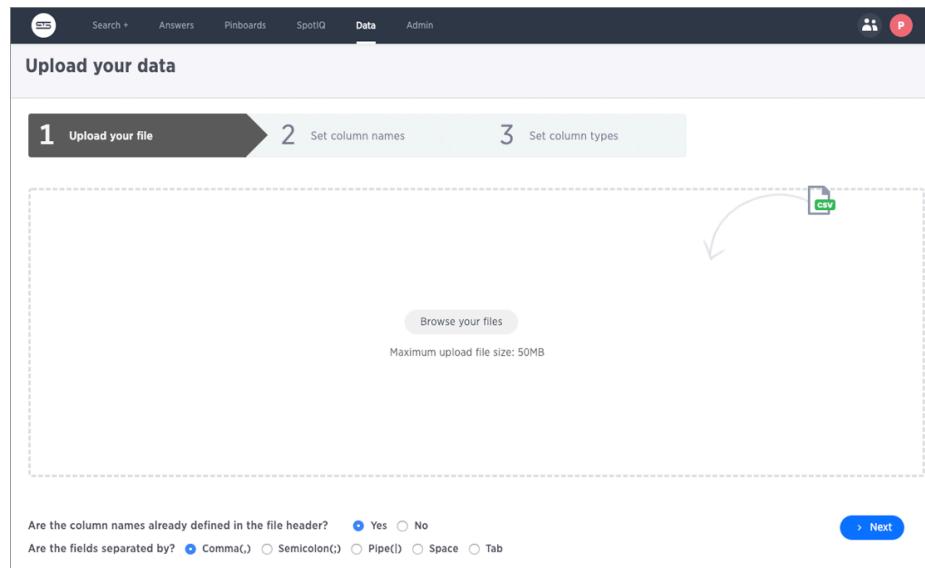
7. Click the column header names to change them to more useful names, if you'd like. Click **Next**.

8. Review the automatically generated data types for each column, and make any changes you want.

There are four data types: Text, Integer, Decimal, and Date.

9. Click **Import**.

When an upload is complete, the system reports the results and offers you some further actions.



- Click **Link to Existing Data** if you want to link the data you uploaded to the data in another table or worksheet.
- Click **Search** if you want to begin a new search.
- Click **Auto analyze** if you want to use the SpotIQ feature to find insights in your new data.

## Append to an existing table

You can append data to your existing system tables through the ThoughtSpot application, even if the tables were initially loaded using `ts load`. The CSV file must have the same structure as the table it is being loaded into, including number and type of columns, in the same order as the target table.

To append data into ThoughtSpot:

1. Log in to ThoughtSpot from a browser.
2. Click **Data** on the top navigation bar.



3. Click the name of the table you would like to append data to.
4. Click the **Load Data** button.

A screenshot of the ThoughtSpot table details page for 'ThoughtSPORT\_Product\_Dimension'. The table has 5 rows and 10 columns. The columns are: COLUMN NAME, DESCRIPTION, DATA TYPE, COLUMN TYPE, ADDITIVE, AGGREGATION, HIDDEN, SYNONYMS, and INDEX TYPE. The 'Load Data' button is highlighted with a red box in the top right corner of the table view.

5. Upload the CSV or Excel file by doing one of these options:
  - Click **Browse your files** and select the file.
  - Drag and drop the file into the drop area.
6. Answer the question **Are the column names already defined in the file header?**.
7. For the question **Do you want to append to the existing data or overwrite it?**, select **Append**.
8. Answer the question **Are the fields separated by?**, and click **Next**.
9. Click **Upload**.
10. Click **Link to existing data** if you want to link the data you uploaded to the data in another

table or worksheet. Or click **Ask a question** if you want to begin a new search.

# How to view a data schema

**Summary:** Use the schema viewer to see tables and worksheets and their relationships.

ThoughtSpot has a ##Schema Viewer\*\* through which you can examine the database schema. It is interactive and configurable, so you can see the level of detail that is relevant to your work.

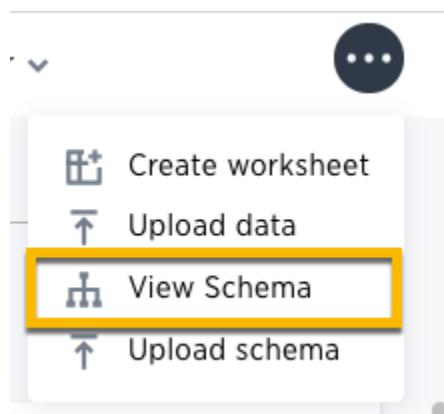
You must have **Admin** privileges to use the **Schema Viewer**.

## Accessing the Schema Viewer for all objects

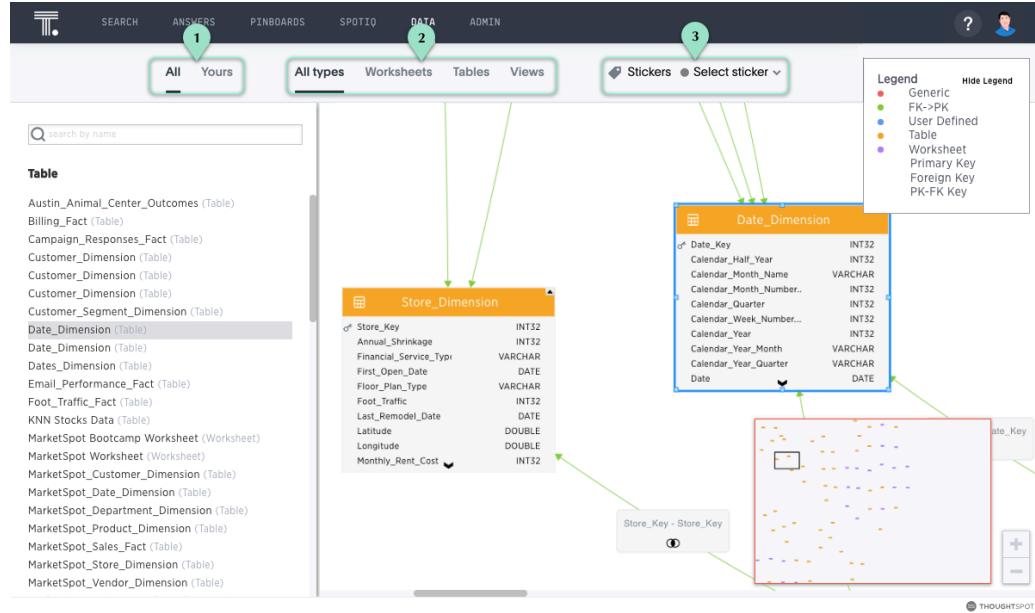
1. Click the **Data** tab in the top menu.



2. Click the ellipses icon, ..., and select **View Schema**.



1. When the schema appears, you can see that you can control the visible part of the schema.



#### Legend Action

1. See either All (Default), or Yours.
2. See either All types (Default), Worksheets, Tables, or Views.
3. Select artifacts tagged with stickers.

1. The list of tables, worksheets, and imported data on the left changes as you select the various filters. The schema view focus changes in tandem.
2. To center the view panel on a specific table, worksheet, or view, click that object.

You can also drag the objects around in the viewer to position them better.

## Accessing Schema Viewer for a single worksheet, table, or view

You can now see the schema for each object for tables, worksheets, or views.

1. Click the **Data** tab in the top menu.



2. Select from the list of the possible objects:

**Legend Action**

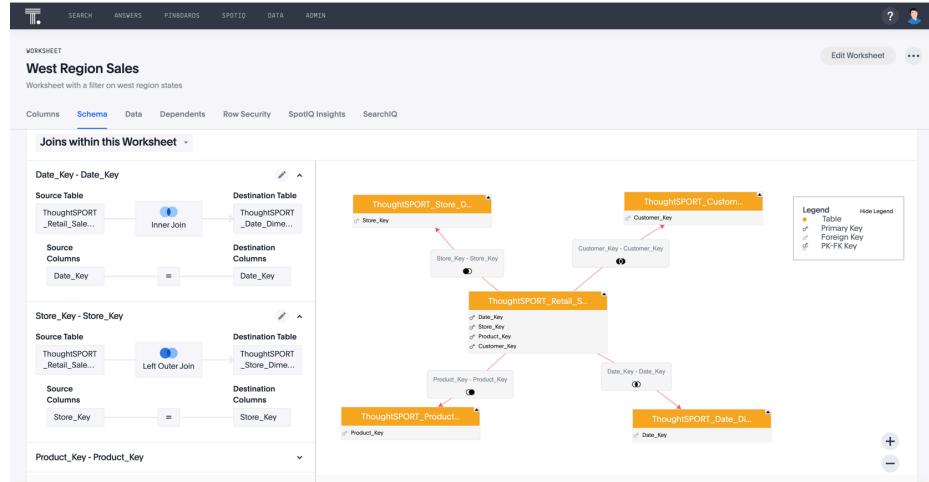
1. See either All (Default), or Yours.
2. See either All types (Default), Worksheets, Tables, or Views.
3. Select artifacts tagged with stickers.

3. From the list of objects, select one. Here, we selected the worksheet *West Regional Sales*.

4. At the top of the worksheet, click the **Schema** tab.

COLUMN NAME	DESCRIPTION	DATA TYPE	COLUMN TYPE	ADDITIVE	AGGREGATION	HIDDEN
Sales	Click to edit	DOUBLE	MEASURE	<input checked="" type="radio"/> YES	SUM	<input type="radio"/> NO
Gross Margin	Click to edit	DOUBLE	MEASURE	<input checked="" type="radio"/> YES	SUM	<input type="radio"/> NO
Quantity	Click to edit	INT32	MEASURE	<input checked="" type="radio"/> YES	SUM	<input type="radio"/> NO
POS Transaction Nu...	Click to edit	INT32	ATTRIBUTE	<input checked="" type="radio"/> YES	SUM	<input type="radio"/> NO
Date	Click to edit	DATE	ATTRIBUTE	<input type="radio"/> NO	NONE	<input type="radio"/> NO
Latitude	Click to edit	DOUBLE	ATTRIBUTE	<input type="radio"/> NO	NONE	<input type="radio"/> NO
Longitude	Click to edit	DOUBLE	ATTRIBUTE	<input type="radio"/> NO	NONE	<input type="radio"/> NO
Store City	Click to edit	VARCHAR	ATTRIBUTE	<input type="radio"/> NO	NONE	<input type="radio"/> NO

5. The join information and the schema for the worksheet appear.



## Why use the Schema Viewer

You can use the Schema Viewer to discover the following information:

- What is the relationship between two tables?
- What tables make up this worksheet, and how are they joined?

The schema viewer shows joins between tables, join directionality, and join type.

## How the Schema Viewer shows joins

You can use the Schema Viewer to review your schema and ensure that it was modeled using best practices. For example, joins appear in different colors to distinguish their type:

- Red is used for generic relationships
- Green is used for primary key/foreign key joins

When viewing a worksheet, you can also see what joins connect the tables: the inner, left outer, right outer, or full outer joins

A good rule to follow is “Keep it Green”. This means that you can get better results from PK/FK joins rather than from using generic relationships. You should only use generic relationships when the tables being joined have a many-to-many rather than a PK/FK structure. If you find tables that have been joined

using a generic relationship, but could have used a PK/FK join, you should drop the relationship and create a PK/FK join instead. To do this, you need to use the ALTER TABLE...DROP RELATIONSHIP statement in TSQL. Then use ALTER TABLE...ADD FOREIGN KEY to create the PK/FK join.

## Worksheet view

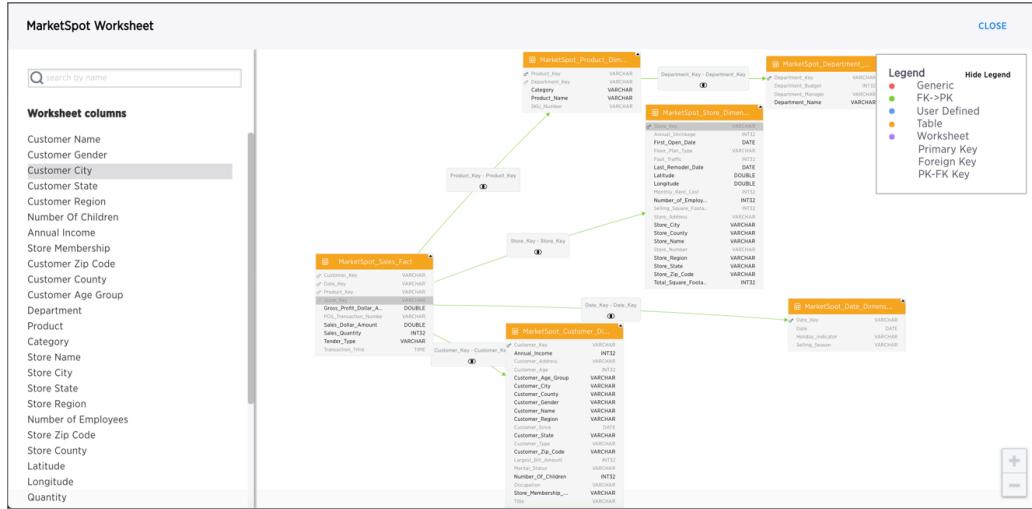
Worksheets are often based on more than one table. The worksheet schema will show schemas for the tables behind the worksheet, as well as the joins between tables *that were created as a part of the worksheet*.

Click a worksheet, to see it in the Schema Viewer. If the schema view is not showing the schema behind the worksheet, double click the tab on the top right of the worksheet object.

The screenshot shows the ThoughtSpot Data interface. At the top, there are tabs for All, Yours, All types, Worksheets, Tables, and Views. The Worksheets tab is selected. Below the tabs is a search bar labeled "search by name". A sidebar on the left lists various worksheets, including "MarketSpot Bootcamp Worksheet (Worksheet)" and "MarketSpot Worksheet (Worksheet)". The main area displays the schema for the "MarketSpot Worksheet". It shows a table with columns: Annual Income (INT32), Category (VARCHAR), Customer Age Group (VARCHAR), Customer City (VARCHAR), Customer County (VARCHAR), Customer Gender (VARCHAR), Customer Name (VARCHAR), Customer Region (VARCHAR), Customer State (VARCHAR), and Customer Zip Code (VARCHAR). A yellow box highlights the title "MarketSpot Worksheet". To the right of the schema, there is a legend titled "Legend" which includes entries for Generic, FK->PK, User Defined, Table, Worksheet, Primary Key, Foreign Key, and PK-FK Key. A red box highlights the "Worksheet" entry in the legend. The bottom right corner of the interface has a "THOUGHTSPOT" logo.

The worksheet view shows the following information:

- All tables in the worksheet, and the relationships between these tables.
- Source columns for all columns of a worksheet.
- Keys and definitions for each relationship, as well as join paths and types.
- Columns that are derived from formulas.
- Correct join paths for newly created chasm trap worksheets. Chasm trap worksheets created prior to ThoughtSpot version 4.4 do not show the correct join paths.



## Related Information

- [Worksheet joins \[See page 341\]](#)
- [Modify joins within a worksheet \[See page 345\]](#)
- [Change the schema using TQL \[See page 132\]](#)
- [Constraints \[See page 106\]](#)

# Schema planning concepts

**Summary:** Considerations in creating a schema for the ThoughtSpot Loader.

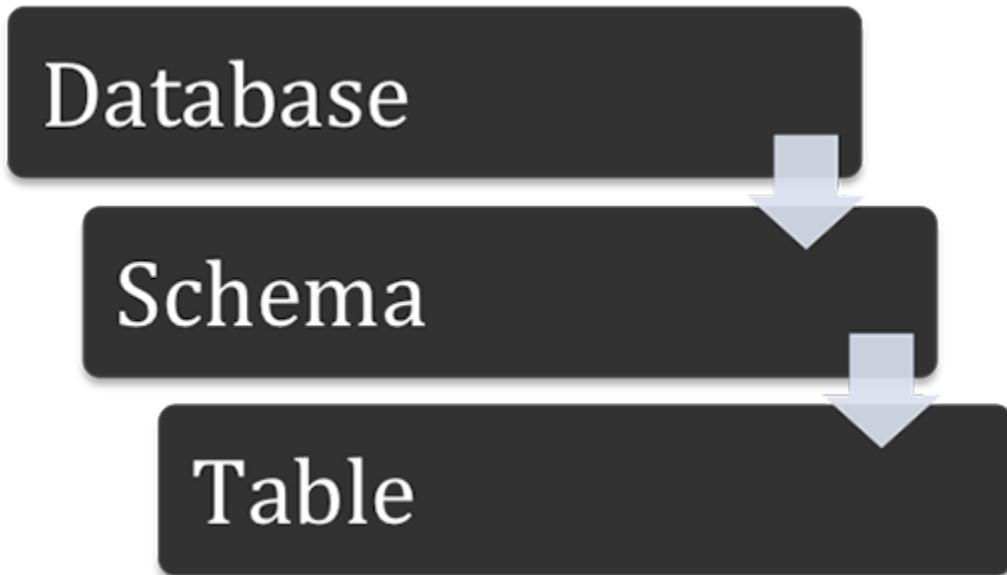
Before you can load data with ThoughtSpot Loader, you must create a schema to receive it, using the SQL command line interface (TQL).

The TQL syntax is similar to the SQL used in other relational databases, but with some important differences. Use DDL (data definition language) to create the schema into which you can load the data. We recommend combining all DDL statements into a single script for creating the schema.

Before writing your TQL script, you need to understand some basic ThoughtSpot concepts.

## About databases and schemas

ThoughtSpot organizes objects in a hierarchical namespace. Databases contain schemas, which contain tables.



ThoughtSpot can contain one or more databases, and each database can have multiple schemas. If you do not specify a schema, the default schema (`falcon_default_schema`) is used automatically. This makes it easier to add tables to the database without the need to explicitly create a schema.

If you do create an additional schema, you must refer to its objects using the syntax

`< schemaname>.< objectname >` . If you do not qualify the schema when referencing its objects, the default schema (`falcon_default_schema`) will always be assumed.

By default, ThoughtSpot creates an internal database to host tables corresponding to data that is imported by users from a Web browser.

## Review the structure of your data

The schema you create to hold the data needs to be a good fit for your data. First, familiarize yourself with the tables you want to load, and understand their structure. Make note of this information for each table:

- The column names and data types
- Type of table (fact or dimension)
- Primary key column(s)
- The size of the table on disk
- Any other tables it can be joined with (foreign keys)

Here's what you must take into account in your TQL for creating each table, based on these properties:

Table type	Table size	To be joined with	Schema recommendations
Fact	Any	Small dimension table(s)	Sharded. Foreign key references the primary key in the dimension table.
Fact	Any	Large dimension table(s)	Sharded on the same distribution key as the dimension table it will be joined with. Foreign key references the primary key in the dimension table.
Fact	Any	Another fact table	Sharded on the same distribution key as the fact table it will join with. Many-to-many relationship defines how the tables will be joined.
Dimension	under 50MB	Fact table(s)	Replicated (not sharded). Has a primary key.

Table type	Table size	To be joined with	Schema recommendations
Dimension	over 50MB	Fact table(s)	Distributed dimension table, sharded on the same distribution key as the fact table it will be joined with. Primary key must be the same as the distribution key.

## Where to go next

- [Data types \[See page 103\]](#)

ThoughtSpot supports the common data types. Compare these with the data types you want to load, and do any necessary conversion ahead of loading the data.

- [Constraints \[See page 106\]](#)

Constraints include primary keys, foreign keys, and relationships. Relationships allow you to create a generic relationship for use when you want to join tables that don't have a primary key/foreign key relationship.

- [Sharding \[See page 110\]](#)

For the best performance, you should split (or shard) very large tables across nodes. If you have a large dimension table, you might choose to co-shard it with the fact table it will be joined with.

- [Chasm traps \[See page 116\]](#)

In a complex schema, you may have a fact table with no relationship to another fact table, except that each contains a foreign key to a shared dimension table. This is known as a chasm trap, and ThoughtSpot can handle it!

# Data types

**Summary:** ThoughtSpot supports the common data types.

Before you import data, compare the data types you want to load with these supported data types.

Then, convert your data before loading it. Typically, you would export the data, transform it to meet these type rules, and then load the data. This is known as an extract-transform-load process.

## Supported data types

The tables you create to receive the data must have the same number of columns and data types as the data you will be loading. Choose a data type for each column from the list of supported data types:

Data	Supported data types	Details
Character	VARCHAR(*n*)	Specify the maximum number of characters, as in VARCHAR(255). The size limit is 1GB for VARCHAR values.
Floating point	DOUBLE or FLOAT	DOUBLE is recommended. DOUBLE has a range of 1.7E +/- 308 (15 digits).
Boolean	BOOL	Can be true or false.
Integer	INT or BIGINT	INT holds 32 bits. BIGINT holds 64 bits. INT has a range of -2,147,483,648 to 2,147,483,647. BIGINT range is -9,223,372,036,854,775,808 to 9,223,372,036,854,775,807.
Date or time	DATE , DATETIME , TIMESTAMP , TIME	DATETIME , TIMESTAMP , and TIME are stored at the granularity of seconds. TIMESTAMP is identical to DATETIME , but is included for syntax compatibility.

**⚠ Warning:** There is a 1GB limitation on the number of characters for VARCHAR. If you have any VARCHAR data that exceeds this limit, the entire load will fail.

## Geographical data types

For geographical data types, use VARCHAR. For latitude and longitude, you can use either `VARCHAR` or `DOUBLE`. After loading the data, designate it as a geographical data type when you [Edit the system-wide data model \[See page 275\]](#). Wherever abbreviations or codes are used, they are the same as what the USPS (United States Postal Service) recognizes.

These data types can be designated as geographical data, which enables them to be visualized using the Geo chart types:

- Countries, for example:
  - United States
    - `long_name` : United States
    - `name_sort` : United States of America
    - `abbreviation` : U.S.A.
    - `adm0_a3` : USA
    - `adm0_a3_is` : USA
    - `adm0_a3_us` : USA
    - `admin` : United States of America
    - `brk_a3` : USA
    - `brk_name` : United States
    - `formal_en` : United States of America
    - `iso_a2` : US
    - `iso_a3` : USA
    - `iso_n3` : 840
  - `COUNTY` for counties in the United States, for example:
    - santa clara county
    - pike county, ohio
    - pike county, OH
  - `STATE_PROVINCE` for states in the United States, for example:
    - `name` : California
    - `US_Postal_Service_abbreviation` : CA

- `LATITUDE` which must be used with `LONGITUDE`, for example:
  - 37.421023
  - 1.282911
- `LONGITUDE` which must be used with `LATITUDE`
  - 122.142103
  - 103.848865
- `ZIP_CODE` for zip codes in the United States
  - `po_name` : MT MEADOWS AREA
  - `ZIP` : “00012”
  - `zip2` : 12
- Other Sub-nation Regions which are administrative regions found in countries other than the United States, for example:
  - bremen
  - normandy
  - west midlands

**⚠ Important:** You cannot upload your own custom boundaries.

# Constraints

**Summary:** Constraints allow you to build relationships and join tables.

Constraints include primary keys, foreign keys, and relationships. Relationships allow you to create a generic relationship for use when you want to join tables that don't have a primary key/foreign key relationship.

## Primary keys

When a primary key is selected for a table, it impacts data loading behavior. When a new row is added:

- If another row already exists with same primary key, it is updated with the values in the new row.
- If a row with the same primary key does not exist already, the new row is inserted into the table.

This behavior is referred to as “upsert” because it does an `INSERT` or an `UPDATE`, depending on whether a row with the same primary key already exists.

Note that ThoughtSpot does not check for primary key violations across different shards of the table. Therefore, you need to shard the table on the primary key columns if you require this “upsert” behavior.

## Foreign key relationships

Foreign key relationships tell ThoughtSpot how two tables can be joined. These relationships are only used for joining the tables, and not for referential integrity constraint checking.

The directionality of primary key - foreign key relationships is important. The foreign key relationship is defined on the fact table and references the primary key(s) in the dimension table. So you can think of the fact table as the source and the dimension table as the target. In the schema viewer, notice that the arrow that represents a PK/FK join points to the dimension table.

If you use primary and foreign keys, when users search the data from the search bar, tables are automatically joined. For example, assume there are two tables:

- revenue, which is a fact table
- region, which is a dimension table

There is a foreign key on the fact table on `regionid` which points to the id in the region dimension table. When a user types in “revenue by region”, the two tables will be joined automatically.

Foreign keys have to match the primary key of the target table they refer to. So if there are multiple columns that make up the primary key in the target table, the foreign key must include all of them, and in the same order.

## Generic relationships (many-to-many)

You may have a schema where there is a fact table that you want to join with another fact table. If there isn't a primary key/foreign key relationship between the tables, you can use many-to-many to enable this. You can do this by using the RELATIONSHIP syntax to add a link between them, that works similarly to the WHERE clause in a SQL join clause.

**Note:** Using generic relationships is not a best practice. In cases where you have two fact tables you want to join, it is better to find a way to create a bridge table between them, so you have a chasm trap. Look at your two fact tables to see if they share some common data that you could use to create a dimension table between them. For example a date or product dimension could be used to join an inventory fact table with a sales fact table. This is best done in your ETL process, before bringing the data into ThoughtSpot.

**Note:** A many-to-many implementation does not protect from over counting in some searches. If you plan to use it, make sure your searches don't include aggregation or count searches that will count one value multiple times, because it satisfies the join condition for multiple rows.

This is a special kind of relationship, that applies to specific data models and use cases. For example, suppose you have a table that shows wholesale purchases of fruits, and another table that shows retail fruit sales made, but no inventory information. In this case, it would be of some use to see the wholesale purchases that led to sales, but you don't have the data to track a single apple from wholesale purchase through to sale to a customer.

In a many-to-many relationship, the value(s) in a table can be used to join to a second table, using an equality condition (required) and one or more range conditions (optional). These conditions act like the WHERE clause in a SQL JOIN clause. They are applied using AND logic, such that all conditions must be met for a row to be included.

To use a many-to-many relationship, you need to follow a few rules:

- There must be one equality condition defined between the two tables.
- Each table must be sharded on the same key that will be used for the equality condition.
- There can optionally be one or more range conditions defined.

This example shows the TQL statements that create the two fact tables and the relationship between them.

```
TQL> CREATE TABLE "wholesale_buys" (
    "order_number" VARCHAR(255),
    "date_ordered" DATE,
    "expiration_date" DATE,
    "supplier" VARCHAR(255),
    "fruit" VARCHAR(255),
    "quantity" VARCHAR(255),
    "unit_price" DOUBLE
) PARTITION BY HASH (96) KEY ("fruit");

TQL> CREATE TABLE "retail_sales" (
    "date_sold" DATE,
    "location" VARCHAR(255),
    "vendor" VARCHAR(255),
    "fruit" VARCHAR(255),
    "quantity" VARCHAR(255),
    "sell_price" DOUBLE
) PARTITION BY HASH (96) KEY ("fruit");

TQL> ALTER TABLE "wholesale_buys" ADD RELATIONSHIP WITH "retail_sales" AS "wholesale_buys"."fruit" = "retail_sales"."fruit" and ("wholesale_buys"."date_ordered" < "retail_sales"."date_sold" and "retail_sales"."date_sold" < "wholesale_buys"."expiration_date");
```

# Sharding

**Summary:** Sharding partitions very large tables into smaller, faster, more easily managed parts called data shards.

ThoughtSpot tables can be replicated or sharded. Replicated tables exist in their entirety, the complete data set, on each node. Sharded tables consist of a single data set divided into multiple tables or shards. The shards have identical schemas but different sets of data.

## When to use sharding

By default, ThoughtSpot tables are replicated, you must explicitly shard tables. Sharding your tables impacts the total amount of memory used by the table as well as its performance.

For example, you might shard a large table of sales data. So, you could divide a single sales table into shards each of which contains only the data falling within a single year. These shards are then distributed across several nodes. Requests for sales data are dispersed both by the year and the location of the shard in the node cluster. No single table or node is overloaded, and so the performance of a query and the system load are both improved.

To optimize ThoughtSpot performance, you should *shard* very large fact tables whenever possible. If you have a large dimension table, you might choose to shard it along with the fact table it is joined with. Sharding both the fact and dimension table is known as *co-sharding*.

### Table sizes and sharding recommendations

Number of rows per shard	5-10 million
Maximum	10 million rows per shard
Maximum number of shards	~ 80% of CPU cores

## Example

Number of rows in table	1.1 billion
CPUS in cluster	256
HASH (128)	~50% of total CPUs
	8.6 million rows per shard

## How to shard

Sharding is a type partitioning and is sometimes called *Horizontal partitioning*. The term sharding is particular to situations where data is distributed not only among tables but across nodes in a system. To create a sharded table add the add `PARTITION BY HASH ( )` clause to your `CREATE TABLE` statement.

```
TQL> CREATE TABLE ...
...PARTITION BY HASH (96) KEY ("customer_id");
```

The `HASH` parameter determines the number of shards and the `KEY` parameter the sharding key. The recommended number of shards depends upon the number of nodes in your cluster:

Number of Nodes	Number of Shards
1	32
2	64
3	96
4-12	128
13-24	256
25-36	384

Number of Nodes	Number of Shards
37-48	512
49-60	640
61-72	768

If you omit the `PARTITION BY HASH` statement or if the `HASH` parameter is 1 (one), the table is unsharded. This also means the table physically exists in its entirety on each node.

If you want to use the primary key for sharding, specify that the table is to be partitioned by `HASH` on the primary key, as in this example:

```
TQL> CREATE TABLE "supplier" (
    "s_suppkey" BIGINT,
    "s_name" VARCHAR(255),
    "s_address" VARCHAR(255),
    "s_city" VARCHAR(255),
    "s_phone" VARCHAR(255),
    CONSTRAINT PRIMARY KEY ("s_suppkey")
) PARTITION BY HASH (96) KEY ("s_suppkey");
```

The system does not use primary keys as sharding keys by default. If you specify the `PARTITION BY HASH` statement with a `HASH` greater than 1 (one) *but omit the `KEY` parameter* ThoughtSpot shards the table randomly. This is not recommended; avoid this by always ensuring you specify the `KEY` parameter with a `HASH` greater than 1 (one).

## How to choose a shard key

When you shard a large table, you select a *shard key* from the table. This key exists in every shard. You can use any data type that is valid for use as the primary key as the shard key. Choosing a shard key plays an important role in the number of shards and the size of any single shard.

A shard key should contain a value that has a good distribution (roughly the number of rows with each value in that column). This value is typically part of the primary key, but it can include other columns. For example:

```

CREATE TABLE "sales_fact"
  ("saleid" int,
   "locationid" int,
   "vendorid" int,
   "quantity" int,
   "sale_amount" double,
   "fruitid" int,
   CONSTRAINT
   PRIMARY KEY("saleid, vendorid"))
PARTITION BY HASH(96)
KEY ("saleid");

```

Notice the shard key contains the `saleid` value that is also part of the primary key. When creating a shard key use these guidelines.

- Include one or more values of the table's primary key in the shard key.

This prevents scenarios where the data with the same primary key ends up in different shards and nodes because the shard key changed.

- If you expect to join two tables that are both sharded, make sure both tables use the same shard key.

This guideline ensures better join performance. So, for example, if you have two tables and the primary keys are:

`PRIMARY KEY("saleid, vendorid") on A` `PRIMARY KEY("saleid, custerid") on B`

You should use `saleid` for your shared key when you shard both table A and B.

- Choose a shard key so that the data is distributed well across the keys.

For example, suppose the table you want to shard has a primary key made up of `saleid`, `custid`, and `locationid`. If you have 10K sales but 400 locations, and 2000 customers, you would not want to use the `locationid` in your shard key if 5k sales were concentrated in just 2 locations. The result would be data in fewer shards and degrade your performance. Instead, your shard key may be `custid`, and `locationid`.

- Choose a shard key that results in a wide variety of keys.

For example, suppose the table you want to shard has a primary key made up of `saleid`, `productid`, and `locationid`. Suppose the table has 10K sales, 40 locations, and 200 products. If the sales are evenly distributed across locations you would not want to use the `locationid` in your shard key. Instead, `saleid` and `productid` would be the better choice as it results in a wider variety of keys.

As mentioned in the previous section, it is possible to simply use the primary key as a shard key. It isn't a good idea to use shard keys outside of the primary key. The reason is that it, with a non-primary shard key, it is possible to get two versions of a record if the shard key for a record changes, but the primary key doesn't. A second version results because, in the absence of a unique shard key, the system creates a secondary record rather than doing a SQL MERGE (`upsert`).

## Sharded dimension tables

In a typical schema, you'd have a sharded fact table with foreign keys to small dimension tables. These small dimension tables are replicated in their entirety and distributed on every node. This works best where dimension tables under 50MB in size.

If you have a large dimension table, replicating it and distributing it can impact the performance of your ThoughtSpot System. In this case, you want to shard the dimension tables and distribute it the same way as the fact table it joins to.

When sharding both a fact and its dimension table (known as co-sharding) keep in mind the guidance for creating a shard key. Only shard dimension tables if the dimension table is large (over 50MB) and the join between the fact and dimension tables use the same columns. Specifically, the tables must:

- be related by a primary key and foreign key
- be sharded on the same primary key/foreign key
- have the same number of regions (or shards)

If these requirements are met, ThoughtSpot automatically co-shards the tables for you. Co-sharded tables are always joined on the sharding key. Data skew can develop if a very large proportion of the rows have the same sharding key.

This example shows the `CREATE TABLE` statements that meet the criteria for sharding both a fact table and its dimension table:

```
TQL> CREATE TABLE products_dim (
    "id" int,
    "prod_name" varchar(30),
    "prod_desc" varchar(100),
    PRIMARY KEY ("id")
)
PARTITION BY HASH (96) KEY ("id")
;

TQL> CREATE TABLE retail_fact (
    "trans_id" int,
    "product_id" int,
    "amount" double,
    FOREIGN KEY ("product_id") REFERENCES products_dim ("id")
)
PARTITION BY HASH (96) KEY ("product_id")
;
```

If a dimension table is joined to multiple fact tables, all of the fact tables must be sharded in the same way as the dimension table. Self-joins are not supported.

## Joining two sharded fact tables

You can also join two sharded fact tables with different shard keys, this is known as *non co-sharded* tables. It may take a while to join two tables sharded on different keys since a lot of data redistribution is required. Therefore, ThoughtSpot recommends that you use a common shard key for two fact tables.

You are not limited by the column connection or relationship type.

# Chasm traps

**Summary:** A chasm trap occurs when two many-to-one joins converge on a single table.

In a complex schema, you may have a fact table with no relationship to another fact table, except that each contains a foreign key to a shared dimension table. This is known as a chasm trap, and ThoughtSpot can handle it!

## Understand how chasm traps occur

A fact table, just as it sounds, stores facts about your business. If you are selling apples, the sales fact table has facts about these apples.

SaleID	AppleTypeID	StoreID	Units Sold
4	55	2	12
8	34	33	3
10	09	09	1

Dimension tables describe the attributes that are interesting to analyze. For example, the apple table might look like this.

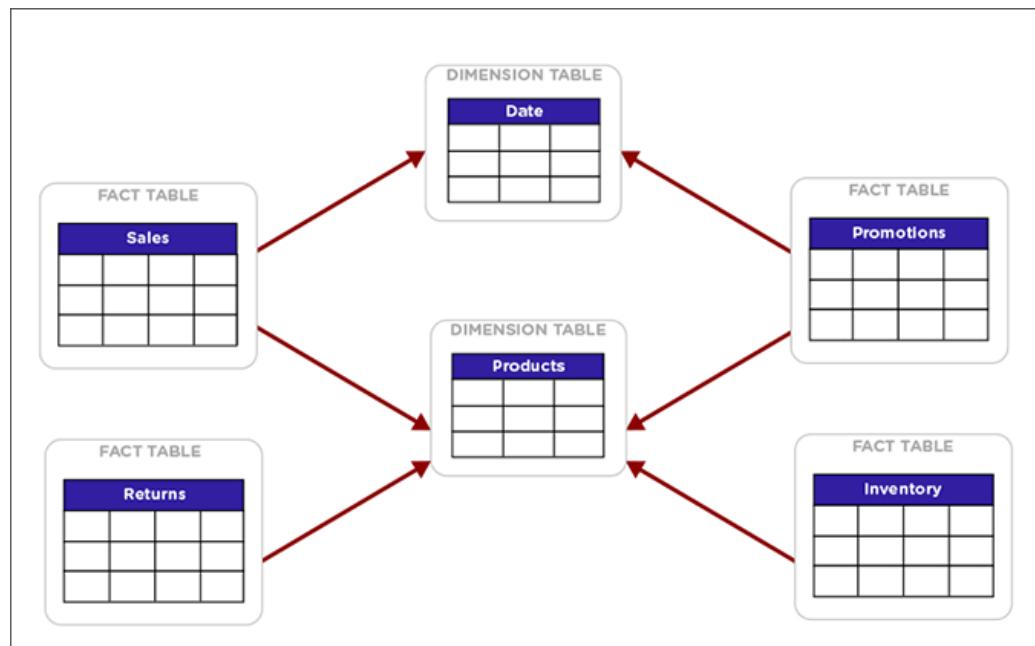
AppleTypeID	Color	Name	Use
55	Red	Red Delicious	Snack
34	Green	Granny Smith	Cooking
09	Yellow	Golden	Snack

As you can imagine, in a business you might have several fact tables that access dimension tables. So, an apple business may record waste as well as sales.

TimeID	AppleTypeID	StoreID	Units Wasted
4	55	2	2
8	34	33	43
10	09	09	11

Both the sales and waste tables are facts that reference the apple dimension table.

A chasm trap in a data schema can introduce problems of over counting if you join the two fact tables through their shared dimension table. This diagram shows a typical complex schema with several tables that are related over a chasm trap:



Examples of use cases where a chasm trap could occur when attribution analysis compare campaign data with purchase data, where all they have in common is that both contain a customer identifier that is a foreign key to a customer dimension table. Chasm traps also occur, for example, in cost of sales analysis when wholesale orders data is only related to the retail sales data through a shared products dimension table.

In many databases, joining tables across a chasm trap creates a *Cartesian product* or *cross join*. That is each row from the first fact table is joined to each row from the second table. A Cartesian product causes over counting when computing counts and aggregates. ThoughtSpot protects you from this kind of over counting.

There are still just a few things to look out for when using a schema that contains chasm traps:

- The tables should be joined to the dimension table by an equi-join (a primary key/foreign key relationship). They cannot be joined using a range of values.
- Review the column setting called [Attribution Dimension \[See page 307\]](#). You may need to change this setting if some of the columns in the shared dimension table should not be used for attribution when combining fact tables.
- Tables that will be joined across a chasm trap do not have to be co-sharded. They will be joined appropriately automatically in the most efficient way.

## Chasm trap limitations

Join information in **What am I Looking At?** does not appear for searches on a worksheet containing a chasm trap or on base tables that are related over a chasm trap.

# Overview of schema building

**Summary:** Before you can load data into ThoughtSpot, you must build a database schema to receive it.

You can build a schema by writing a SQL script that creates the objects in your schema. ThoughtSpot provides the ThoughtSpot SQL Command Line (TQL) for creating, viewing, and managing a schema using SQL. Your script can use any statements that are supported in ThoughtSpot SQL Command Line (TQL). The TQL syntax is similar to the SQL used in other relational databases, but with some important differences.

You can use DDL (data definition language) to create the schema into which you can load the data. We recommend placing all your DDL statements into a single script for creating the schema.

## Upload the script through the browser

You can upload an your SQL script directly through the browser in the ThoughtSpot application. You can edit the script or add to it right within the browser, too. The steps to build a schema through the browser are:

1. [Write a SQL script to create the schema \[See page 123\]](#)
2. [Import a schema \(use the SQL editor\) \[See page 130\]](#)

## Use TQL on the SQL command line

You can choose to run your SQL script within the Linux shell instead. You can run TQL in interactive command line mode, or you can write a script and use TQL to run it. The SQL syntax in ThoughtSpot is called TQL for ThoughtSpot SQL. The ThoughtSpot SQL Command Line (TQL) runs in an interactive mode. To invoke TQL Log in to the Linux shell using SSH and type `tql`. At the prompt, type `h` or `help` to see a list of supported commands.

The steps to build a schema using TQL include:

1. [Connect to the database with the ThoughtSpot SQL Command Line \(TQL\) \[See page 121\].](#)
2. [Write a SQL script to create the schema \[See page 123\].](#)

3. Type your SQL commands on the command line, terminating each command with a semicolon (;).

Commands can span multiple lines. ThoughtSpot supports a limited number of SQL commands, plus some custom SQL extensions. For example, you can specify the number of shards and the distribution key as part of the CREATE TABLE syntax. A full list of supported SQL in TQL is available in the [TQL reference \[See page 0\]](#).

## Where to go next

- [Connect with TCL and create a schema \[See page 121\]](#)

Having examined the structure of the data to be loaded and become familiar with the ThoughtSpot SQL Command Line (TQL), you are now ready to create the schema.

- [Write a SQL script to create the schema \[See page 123\]](#)

Using a SQL script to create your schema is a recommended best practice. This makes it easier to adjust the schema definitions and recreate the schema quickly, if needed.

- [Schema creation examples \[See page 125\]](#)

These examples demonstrate the steps involved in creating a schema using the ThoughtSpot SQL Command Line (TQL). After the schema is created, you can load data into it with ThoughtSpot Loader.

- [Upload and run a SQL script\) \[See page 130\]](#)

You can run a SQL script to create your database schema through the browser, without having to log in to the shell on the ThoughtSpot instance. You can edit the script and run it directly in the browser to create the schema.

# Connect with TQL and create a schema

To perform administrative tasks directly in the database, you will use the ThoughtSpot SQL Command Line (TQL). TQL supports many, but not all, common SQL commands.

## Connect with TQL

Before connecting with TQL, you need:

- Access to your ThoughtSpot instance Linux shell from a client machine.
- The administrator OS login.

To connect to TQL:

1. Log in to the Linux shell using SSH.
2. Invoke TQL:

```
$ tql  
TQL>
```

3. Enter your SQL command, followed by a semicolon ( ; ).

## Enter a SQL script

Having examined the structure of the data to be loaded and become familiar with the ThoughtSpot SQL Command Line (TQL), you are now ready to create the schema.

This method is a good way to get familiar with TQL and how to create database objects, but when creating a schema in a production system, you will most likely [Write a SQL script to create the schema \[See page 123\]](#).

To create the schema directly in TQL:

1. [Connect to the database with the ThoughtSpot SQL Command Line \(TQL\) \[See page 121\]](#).
2. If the database you will be using does not exist, create it now:

```
TQL> CREATE DATABASE my_database;
```

3. Connect to the database:

```
TQL> USE my_database;
```

4. If you wish to use a schema other than the default one, create it now:

```
TQL> CREATE SCHEMA my_schema;
```

5. Issue a `CREATE TABLE` command for each table you will create, using the information in [Plan the schema \[See page 100\]](#).

**Tip:** Foreign key declaration within a `CREATE TABLE` will show the table created even if there are problems with the foreign key. Therefore, it is good practice to also issue a separate `ALTER TABLE ADD CONSTRAINT FOREIGN KEY` command.

# How to write a SQL script

**Summary:** Using a SQL script to create your schema is a recommended best practice. This makes it easier to adjust the schema definitions and recreate the schema quickly, if needed.

The schema creation script is a text file that contains all the SQL commands to create your schema.

Comments should be enclosed in the comment tags /\* and \*/.

Enclose all object names (schema, table, and column) in double quotes and any column values in single quotes in your scripts. Object names that are also reserved words in SQL, or that contain special characters (any character other than alphanumeric or \_ ), must be surrounded by double quotes. If you see the error message “Error parsing SQL. Check SQL input.”, you should check for object names without double quotes in your script.

If you are working in a schema other than the default schema, object names must be fully qualified, as in  
"`<schema_name>`".`<object_name>`".

If your schema includes constraints to define relationships between tables (foreign key, or the RELATIONSHIP syntax), it is recommended that your script first creates all the tables, and then at the end, creates the relationships between them using the ADD CONSTRAINT syntax. This makes it easier to troubleshoot the script and make changes.

If TQL is run using the flag `--allow_unsafe`, your statements will always execute without this warning. Note that when running TQL from a script, you must decide what behavior you want if the script contains changes that affect dependent objects. If you want the script to run even if objects with dependencies are affected, run it using this flag, for example:

```
cat safest_script_ever.sql | tql --allow_unsafe
```

1. Open a new file in a text editor.
2. Type in the command to create the database, if it does not already exist:

```
CREATE database <db_name>;
```

3. Type in the command to specify the database to use:

```
USE database <db_name>;
```

4. Type in the command to create the schema, if you don't want to use the default schema:
5. Type in each of the CREATE TABLE statements, with its column definitions, primary key constraints, and sharding specification (if any).
6. At the end of your script, optionally type in the ALTER TABLE statements to add foreign keys to use in joining the tables.
7. Save the file.
8. Run the script using one of these methods:
  - Import a schema (use the SQL editor) [See page 130].
  - Log in to the shell [See page 8], copy your script to your ThoughtSpot instance using scp, and pipe it to TQL:

```
$ cat create-schema.sql | tql
```

# Schema creation examples

**Summary:** Simple examples that illustrate how to use the TQL and the ThoughtSpot Loader.

These examples demonstrate the steps involved in creating a schema using the ThoughtSpot SQL Command Line (TQL). After the schema is created, you can load data into it with ThoughtSpot Loader.

## Simple schema creation example

The example creates a database (`tpch`) with two tables (`customer`, `transaction`). The example does not create a schema explicitly. So it will use the default schema (`falcon_default_schema`).

In this example:

- The table `customer` has a primary key called `customer_id`. The table `customer_transactions` has a primary key called `transaction_id`.
- The `customer` table is unsharded.
- The `customer_transactions` table is sharded into 96 shards using the `transaction_id` column.
- Both tables have referential integrity on `customer_id`.

```
$tql

TQL> CREATE DATABASE tpch;

TQL> USE tpch;

TQL> CREATE TABLE customer (
    name  VARCHAR(100),
    address VARCHAR(255),
    zipcode INT,
    customer_id INT,
    CONSTRAINT PRIMARY KEY (customer_id)
);

TQL> CREATE TABLE customer_transactions (
    transaction_id INT,
    customer_id INT,
    amount DOUBLE,
    transaction_date DATETIME,
    CONSTRAINT PRIMARY KEY (transaction_id),
    CONSTRAINT FOREIGN KEY (customer_id) REFERENCES
    customer(customer_id)
) PARTITION BY HASH (96) KEY (transaction_id);
```

## More complex schema creation example

The example uses a custom schema called sample\_schema to hold the tables. Because of this, every table reference has to be schema qualified.

```
$ tql

TQL> CREATE DATABASE "sample_db";

TQL> USE "sample_db";

TQL> CREATE SCHEMA "sample_schema";

TQL> CREATE TABLE "sample_schema"."customer" (
    "c_custkey" BIGINT,
    "c_name" VARCHAR(255),
    "c_address" VARCHAR(255),
    "c_city" VARCHAR(255),
    "c_nation" VARCHAR(255),
    "c_region" VARCHAR(255),
    "c_phone" VARCHAR(255),
    CONSTRAINT PRIMARY KEY ("c_custkey")
);

TQL> CREATE TABLE "sample_schema"."supplier" (
    "s_suppkey" BIGINT,
    "s_name" VARCHAR(255),
    "s_address" VARCHAR(255),
    "s_city" VARCHAR(255),
    "s_nation" VARCHAR(255),
    "s_region" VARCHAR(255),
    "s_phone" VARCHAR(255),
```

```
CONSTRAINT PRIMARY KEY ("s_suppkey")  
);  
  
TQL> CREATE TABLE "sample_schema"."lineorder" (  
    "lo_orderkey" BIGINT,  
    "lo_linenumber" BIGINT,  
    "lo_custkey" BIGINT,  
    "lo_partkey" BIGINT,  
    "lo_suppkey" BIGINT,  
    "lo_orderdate" DATE,  
    "lo_orderpriority" VARCHAR(255),  
    "lo_shipppriority" VARCHAR(255),  
    "lo_quantify" BIGINT,  
    "lo_extendprice" BIGINT,  
    "lo_ordtotalprice" BIGINT,  
    "lo_discount" BIGINT,  
    "lo_commitdate" DATE,  
    CONSTRAINT PRIMARY KEY ("lo_orderkey","lo_linenumber"),  
    CONSTRAINT FOREIGN KEY ("lo_custkey") REFERENCES "sample_sche  
ma"."customer" ("c_custkey"),  
    CONSTRAINT FOREIGN KEY ("lo_suppkey") REFERENCES "sample_sche  
ma"."supplier" ("s_suppkey")  
) PARTITION BY HASH (96) KEY (lo_orderkey);
```

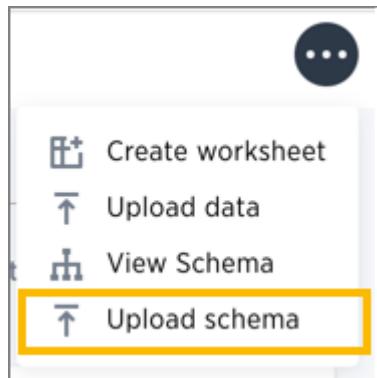
# Upload and run a SQL script

**Summary:** Importing a schema through the Web browser makes it possible to run your SQL script without needing to have a Linux login.

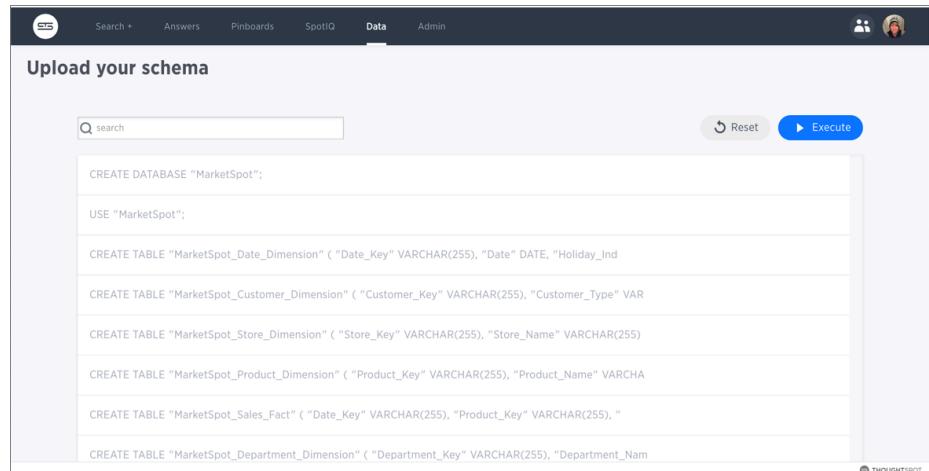
You can run a SQL script to create your database schema through the browser, without having to log in to the shell on the ThoughtSpot instance. You can edit the script and run it directly in the browser to create the schema. You can use this capability in any of these ways:

- [Create the SQL script ahead of time](#) [See page 123], and use the browser to run it.
- Use the editor to type your SQL directly into the browser.
- Use the browser SQL interface as an interactive SQL editor, for example to test an existing script or make changes to an existing schema.

1. Log into ThoughtSpot from a browser.
2. Click **Data**, on the top navigation bar.
3. Click the ellipses icon  , and select **Upload schema**.



4. Drag and drop your SQL file into the browser, or choose **Browse Your Files** to locate it.
5. You're now in the SQL editor. Use it to view your script and make any changes.



The screenshot shows the ThoughtSpot Data interface. At the top, there are navigation links: Search, Answers, Pinboards, SpotIQ, Data (which is underlined), and Admin. On the far right, there are user icons. Below the navigation bar, the title "Upload your schema" is displayed. A search bar with the placeholder "search" is located above a code editor area. The code editor contains several lines of SQL script:

```
CREATE DATABASE "MarketSpot";
USE "MarketSpot";
CREATE TABLE "MarketSpot_Date_Dimension" ( "Date_Key" VARCHAR(255), "Date" DATE, "Holiday_Ind"
CREATE TABLE "MarketSpot_Customer_Dimension" ( "Customer_Key" VARCHAR(255), "Customer_Type" VAR
CREATE TABLE "MarketSpot_Store_Dimension" ( "Store_Key" VARCHAR(255), "Store_Name" VARCHAR(255)
CREATE TABLE "MarketSpot_Product_Dimension" ( "Product_Key" VARCHAR(255), "Product_Name" VARCHA
CREATE TABLE "MarketSpot_Sales_Fact" ( "Date_Key" VARCHAR(255), "Product_Key" VARCHAR(255), "
CREATE TABLE "MarketSpot_Department_Dimension" ( "Department_Key" VARCHAR(255), "Department_Nam
```

At the bottom right of the code editor, there is a "THOUGHTSPOT" logo.

6. When ready, run your script by clicking the **Execute** button.
7. If there are any errors, correct them and run the script again.

# How to change a schema

**Summary:** After you've created a schema and loaded data, you may find yourself wishing you'd set things up a little differently. You can make changes to the schema, such as changing the primary key, relationships to other tables, and sharding.

Making changes to a schema after data has been loaded and users have created worksheets or pinboards on the tables requires care, so that you don't lose the relationship between the objects created in ThoughtSpot and the underlying tables. If you follow the procedures here, your tables will retain their relationships to the objects created on top of them.

**Tip:** Always take a snapshot of your database before making any schema changes. This snapshot allows you to revert back to the prior state if you make an error, or something doesn't work as you expected after the schema change.

## Change the primary key for a table

Use this procedure to change the primary key for a table. But use it with caution, particularly if you are changing to a primary key for which values are not unique.

You can change the primary key of a table without having to `TRUNCATE` it first and reload the data. However, changing the primary key could result in data deletion. This is because of the upsert behavior which is applied when multiple rows have the same primary key. This is very important to understand ahead of time, if you are considering changing to a primary key for which values are not unique.

To change the primary key, first remove any existing primary key, and then define a new one (if any). You do not have to truncate the tables to do this operation beginning in version 3.2. Any dependent objects (pinboards or worksheets) will remain intact.

To change the primary key of a table:

1. [Create a manual snapshot \[See page 254\]](#).
2. [Connect to the database with the ThoughtSpot SQL Command Line \(TQL\) \[See page 121\]](#).
3. Drop the existing primary key (if any), by issuing a command like this example:

```
TQL> ALTER TABLE "cart"  
    DROP CONSTRAINT  
    PRIMARY KEY;
```

Dropping a primary key can impact existing worksheets, answers, and pinboards. The system warns you if dropping a primary key impacts other objects. To continue, use the `--allow_unsafe` flag.

4. Add a new primary key, if desired:

```
TQL> ALTER TABLE "cart"  
    ADD CONSTRAINT  
    PRIMARY KEY ("owner_id");
```

5. Test that any dependent objects (pinboards, worksheets, etc.) are still working correctly.
6. Delete the snapshot you created earlier using the command:

```
tscli snapshot delete <name>
```

## Change a relationship between tables

Use this procedure to remove a relationship between tables or define a new one. This operation works for both kinds of relationships: foreign key or generic relationship.

To change a relationship between two tables, first remove any existing relationship, and then define the new relationship (if any). You do not have to truncate the tables to do this operation. Any dependent objects (pinboards or worksheets) will remain intact.

To change the relationship between tables:

1. [Create a manual snapshot \[See page 254\]](#).
2. [Connect to the database with the ThoughtSpot SQL Command Line \(TQL\) \[See page 121\]](#).
3. Issue the command to drop the existing relationship

Before dropping a relationship TQL checks for and then warns of any dependent objects. To continue with the drop any way, use the `--allow_unsafe` flag. The following examples illustrate several different types of drop operations.

Drop a foreign key by name, if it was given a name when it was defined:

```
TQL> ALTER TABLE  
      "sales_fact"  
      DROP CONSTRAINT  
      "FK_P0_number";
```

Drop a relationship by name, if it was given a name when it was defined:

```
TQL> ALTER TABLE "fruit_dim"  
      DROP RELATIONSHIP "REL_dates";
```

Drop the foreign key relationship explicitly, if it doesn't have a name, by referencing the two tables that are joined. This drops all foreign keys between the two tables:

```
TQL> ALTER TABLE "shipments"  
      DROP CONSTRAINT  
      FOREIGN KEY "orders";
```

Drop all generic relationships between two tables:

```
TQL> ALTER TABLE "wholesale_buys"  
      DROP RELATIONSHIP  
      WITH "retail_sales";
```

4. Define a new relationship, if you want to, using `ALTER TABLE...ADD CONSTRAINT...`
5. Test that any dependent objects (pinboards, worksheets, etc.) are still working correctly.
6. Delete the snapshot you created earlier using the command:

```
tscli snapshot delete <name>
```

## Change sharding on a table

You can change the sharding on a table or remove it altogether (creating a replicated table) using this procedure. This procedure preserves the data within the table.

This procedure reshards a table. This is also called redistributing or repartitioning. You can use this method to reshuffle a table without losing its data or metadata. This means that worksheets and pinboards built on top of the table will continue to work.

You can use these steps to do any of these operations:

- shard a table that was previously replicated.
- change a replicated table to a sharded table.
- change the number of shards to use for a sharded table.

To change the sharding on a table:

1. [Create a manual snapshot \[See page 254\]](#).
2. [Connect to the database with the ThoughtSpot SQL Command Line \(TQL\) \[See page 121\]](#).
3. Issue the command to change the sharding using this syntax:

```
TQL> ALTER TABLE <table>
      [SET DIMENSION | SET FACT
      [PARTITION BY HASH
      [<shards>]]
      [KEY(<column>)]]
```

For example:

- To make a sharded table into a dimension table (replicated on every node), use:

```
ALTER TABLE "products"
  SET DIMENSION;
```

- To make a dimension table into a sharded (fact) table or change the number of shards, use:

```
ALTER TABLE "sales"
  SET FACT PARTITION BY HASH (96)
  KEY ("productID");
```

4. Test that any dependent objects (pinboards, worksheets, etc.) are still working correctly.

5. Delete the snapshot you created earlier using the command:

```
tscli snapshot delete <name>
```

# Convert column data type

**Summary:** You can convert the data in a column from one data type to another by issuing a TQL command.

There are some details you should be aware of when doing a data type conversion.

## Data type conversion behavior

When converting from one data type to another, any values that can not be converted will be set to NULL. If errors occur during data type conversion, the operation is aborted. However, you may choose to force the conversion despite the errors. You can start TQL in allow\_unsafe mode to continue with the data conversion, at your own risk, of course! To start TQL in unsafe mode, issue this command:

```
tql --allow_unsafe
```

Multiple columns of a single table can be converted using a single TQL command. The behavior is transactional. So for example, you would issue a command like this example:

```
ALTER TABLE products
    MODIFY COLUMN product_id int,
    MODIFY COLUMN supplier VARCHAR(4);
```

Also note that changing data type has implications on the primary key and sharding enforcement. For example, changing the data type of a column that is part of the sharding key would lead to a redistribution of data. Then imagine that the sharding key column contained the text values `00100`, `0100`, and `100`, which all map to same integer value. If this type of a column is changed from a `VARCHAR` to an `INT`, then it would be subject to the upsert behavior on primary keys. So, in this example, only one of the three rows would be preserved.

Be aware that data type conversion will preserve the data in the underlying database table, but there is no guarantee that any objects built on top of it (worksheets or pinboards) will be preserved. This is because you might make a data type change that makes a chart built on top of the table invalid (for example a growth chart would be invalidated if the date column it depends on were changed to a varchar column).

## Supported data type conversions

In general, the data type conversions that make logical sense are supported. But there are a few nuances you should be aware of:

- When you convert from `INT` to `BOOL`, zero is converted to false, and all non-zero values are converted to true.
- When you convert from `BOOL` to `INT`, true gets converted to 1, and false gets converted to 0.
- When you convert from `DOUBLE` to `INT`, the value gets rounded.
- When you convert from `INT` to `DOUBLE`, the value gets rounded.
- When you convert from `DATETIME` to `DATE`, the date part of value is preserved and the time part is dropped.
- When you convert from `DATE` to `DATETIME`, the time gets added as `00:00:00`. The date part of the value is preserved.
- When you convert from `DATETIME` to `TIME`, the time part of the value is preserved.
- Conversion from `TIME` to `DATETIME` is not supported.

## Date and time conversions

Some data type conversion require a format string. These include:

- conversion from `DATE` / `TIME` / `DATETIME`
- conversion to `DATE` / `TIME` / `DATETIME`

For these types of conversions, you can use a special syntax using `parsinghint` and the date format specifications supported in the [strftime library function \[See page 0\]](#).

For the example, first create a table with a timestamp stored as a `VARCHAR`:

```
CREATE TABLE fruit_sales  
  (time_of_sale VARCHAR(32));  
  
INSERT INTO fruit_sales  
  VALUES ('2015-12-29 13:52:39');
```

Now, convert the column from a `VARCHAR` to `DATETIME`, using the format `%Y-%m-%d %H:%M:%S`:

```
ALTER TABLE fruit_sales  
  MODIFY COLUMN time_of_sale DATETIME  
  [parsinghint="%Y-%m-%d %H:%M:%S"]
```

Finally, convert the column back to `VARCHAR`:

```
ALTER TABLE fruit_sales  
  MODIFY COLUMN time_of_sale VARCHAR(32);
```

## String to boolean conversions

String to boolean conversions have format strings, too. You can use `parsinghint` as you do for date and time conversions. You can choose among these approaches:

**OPTION 1: Specify string values for both true and false.** Any non-matching values get converted to null. In this example, “100” gets converted to true, and “0” gets converted to false. “-1” gets converted to null.

```
ALTER TABLE db  
  MODIFY COLUMN s bool [parsinghint="100_0"];
```

**OPTION 2: Specify a string value for true.** Any non-matching value gets converted to false. In this example, “100” gets converted to true, “-1” and “0” get converted to false.

```
ALTER TABLE db
    MODIFY COLUMN s bool [parsinghint="100_"];
```

**Option 3: Specify a string value for false.** Any non-matching value get converted to true. In this example, “-1” and “100” get converted to true, and “0” gets converted to false.

```
ALTER TABLE db
    MODIFY COLUMN s bool [parsinghint="_0"];
```

## String to boolean conversions

When converting from a string to a boolean, you must specify a string for true and false. By default, a string to boolean conversion generates `true` for `true`, `false` for `false`.

```
ALTER TABLE db
    MODIFY COLUMN b varchar(32);
```

But you may override the default strings that get generated by using `parsinghint`, as in this example:

```
ALTER TABLE db
    MODIFY COLUMN b varchar(32) [parsinghint="tr_fa"];
```

## Change the Data Type of a Column

When you issue the TQL command to convert a column from one data type to another, the conversion is handled automatically. However, you must ensure that any visualizations built on top of the table display correctly.

You should always take a snapshot of your database before making any schema changes. This will allow you to revert back to the prior state if you make an error, or something doesn’t work as you expected after the schema change.

When changing a data type in an existing table, be aware that answers and pinboards created on top of that table (or worksheets that include it) may change. This is because charts and aggregations depend upon the data type. So for example changing from `INTEGER` to `VARCHAR` could break charts that used the numeric data type `INTEGER` to calculate an average or a total. Because of this, use caution, and check all dependent objects before and after changing the data type, to ensure that they display as intended.

To change the data type of a column:

1. [Connect to the database with the ThoughtSpot SQL Command Line \(TQL\) \[See page 121\].](#)
2. Issue the command to change the data type using this syntax:

```
TQL> ALTER TABLE <table>
      MODIFY COLUMN <column> <new_data_type>;
```

For example:

```
ALTER TABLE fact100
  MODIFY COLUMN product_id int;
```

# Import CSV files with `tsload`

**Summary:** The `tsload` command is a common way to import data from a CSV file.

Use ThoughtSpot Loader (`tsload`) to load data from a CSV text file into an existing table in ThoughtSpot. ThoughtSpot Loader (`tsload`) is a common way to import data. When using `tsload`, you can load larger datasets and make the loading process repeatable through scripting. The `tsload` command accepts flags that enable you to specify column and row separators, date or timestamp formats, null value representations, and similar parameters. Many of these options have defaults that you can override.

Before importing data, you need to [Build the schema \[See page 119\]](#).

To use ThoughtSpot Loader, type the command `tsload` followed by the appropriate flags. You can see the list of the flags it accepts in the [ThoughtSpot Loader flag reference \[See page 0\]](#) or by issuing `tsload --help`.

`tsload` supports both full and incremental data loads. For incremental loads, an upsert (insert or update) is performed. If an incoming row has the same primary key as an existing row, it updates the existing row with the new values.

You can integrate `tsload` into your ETL environment for more automated data loads. Most ETL tools provide the ability to write target data into files and support scripted post-transformation actions that can include loading data into ThoughtSpot. This procedure describes manually loading data, but the `tsload` commands could be saved as a script:

1. Log in to the Linux shell using SSH.
2. Change to the directory where your CSV files are staged.
3. Use the following syntax to invoke `tsload`, specifying the appropriate flags and your data source file:

```
$ tsload --target_database=my_database  
        --target_table=my_table --alsologtostderr  
        --empty_target --source_file=my_file.csv --v 1  
        --field_separator="separator_char"
```

This example imports the CSV file `ssbm_customer.csv` into the table CUSTOMER:

```
$ tsload --target_database=SAMPLE_DB  
        --target_table=CUSTOMER --alsologtostderr  
        --empty_target --source_file=ssbm_customer.csv  
        --v 1 --field_separator "|"
```

4. After the processing begins, you can see messages that indicate the progress, and then two summary messages after the load is complete.

```

Started processing data row
Source has 32 data rows, ignored row count 0
Waiting for rows to commit...(please wait)

Source summary
-----
Data source: ssbm_customer.csv
Source data format: csv
Header row?: no
Tokenizer Options: escape_char: "" field
d_separator: "|" enclosing_char: "\\""
Date format: %Y%m%d
Date time format: %Y%m%d %H:%M:%S
Flexible mode?: no

Load summary
-----
Target table: CUSTOMER
Should empty target?: yes
Status: Successful
Rows total: 32
Rows successfully loaded: 30
Rows failed to load: 0
Rows duplicate/omitted: 2
% of Rows successfully loaded: 93.75 %
Load Rate (MB/s): 0.00 MB/s
Load Rate (Rows/s): 3.53 Rows/s
Start time (Wallclock): Tue Jan 29 09:09:07
End time (Wallclock): Tue Jan 29 09:09:08
Total load time = 1.13 seconds = 0.02 minutes = 0.00 hours
Data size = 50 bytes = 0.06 KB = 0.00 MB

```

5. In the load summary, be sure to check the **Rows duplicate/omitted** number. This indicates the number of rows (if any) that were omitted from loading because they did not satisfy the table constraints. A common cause of this would be a duplicate primary key. If any rows were omitted, review your CSV file, make the required adjustments, and then load it again.
6. After correctly loading your file, repeat this process to load data from any additional CSV files.

## Loading data from an AWS S3 bucket

If you have data in .csv format stored in an AWS bucket, you can load it directly to ThoughtSpot.

### (5.3.1 and later) Assigning S3 read-only role to your EC2 instance

If your cluster is running 5.3.1 or later, you can assign an S3 read-only role to your ThoughtSpot EC2 instance(s) so the instance(s) can access the S3 bucket from which you want to load the data. This eliminates the need to enter the AWS S3 credentials when loading your data. For details, see: [Using an IAM Role to Grant Permissions to Applications Running on Amazon EC2 Instances \[See page 0\]](#) in Amazon's AWS documentation.

**Note:** If you are using S3 for persistent storage, and assigned the `ec2rolewithfulls3access` IAM role to your instance, you do not need to complete this step.

To load data from an AWS S3 bucket, do the following:

1. Log in to the Linux shell of your AWS instance using SSH.
2. Use the following syntax to invoke `tsload`, specifying the appropriate flags and your data source file:

```
$ tsload --source_file "/aws/default/<my_file_in_aws>"  
        --target_database "<my_database_in_ThoughtSpot>"  
        --target_table "<my_table_in_the_database_in_ThoughtSpo  
t>"
```

This example imports the CSV file `teams.csv` into the table `teams` in the database `temp`:

```
$ tsload --source_file "/aws/default/teams.csv"  
        --target_database "temp" --target_table "teams"
```

3. After running the `tsload` command, you are prompted to enter additional AWS S3 information:

- AWS S3 bucket name

- AWS S3 region
- AWS S3 credentials (accesskey;secret\_key)\*
- AWS S3 root (prefix for S3 object search path)

Optionally, these four pieces of information can be inserted at the beginning of the command (in step 2), using the following flags:

- `--aws_s3_bucket_name "<bucket name>"`
- `--aws_s3_region_name "<region name>"`
- `--aws_s3_credentials "<credentials>" *`
- `--aws_s3_root "<search path>"`

**Note:** \*AWS S3 credentials is not used in the 5.3.1 release, if an S3 read-only role is assigned to your instance.

4. After the processing begins, progress messages appear, and then source and load summary messages after the load is complete.

## Loading data from a GCP GCS bucket

If you have data in .csv format stored in a GCS bucket, you can load it directly to ThoughtSpot.

### Assigning GCS read-only role to your GCP instance

You can assign a read-only role to your ThoughtSpot GCP instance(s) so the instance(s) can access the GCS bucket from which you want to load the data. This eliminates the need to enter the GCP GCS credentials when loading your data. For details, refer to the storage setting detailed in the GCP [Create an instance \[See page 0\]](#) section.

**Note:** If you are using GCS for persistent storage, you already assigned the *Set access for each API scope* to your instance, and specified *Full* storage access, so you do not need to complete this step.

## Create the database and table

1. Log in to the Linux shell of your GCP instance using SSH.
2. Invoke TQL:

```
$ tql
```

```
TQL>
```

3. Create the database:

```
TQL> CREATE DATABASE temp;
```

4. Connect to the database:

```
TQL> USE temp;
```

5. Create the table

```
TQL> create table teams (id int, name VARCHAR(255));  
TQL> exit;
```

To load data from an GCP GCS bucket, do the following:

- Use the following syntax to invoke `tsload`, specifying the appropriate flags and your data source file:

```
$ tsload --source_file /gs/default/team.csv
--target_database temp
--target_table teams
--gs_bucket_name "my_gcs_bucket"
--has_header_row 2>/dev/null

$ Header row read successfully
    Source has 2 data rows, has header row, ignored row count 0
        Waiting for rows to commit...(please wait)
        Source summary
-----
        Data source:                  /gs/default/team.csv
        Source data format:          csv
        Header row?:                 yes
        Tokenizer Options:           escape_char: "" field_se
parator: "," enclosing_char: "\" null_value: "(null)" t
railing_field_separator: false
        Date format:                 %Y%m%d
        Date time format:           %Y%m%d %H:%M:%S
        Flexible mode?:            no
        Load summary
-----
        Target table:                teams
        Should empty target?:      no
        Status:                      Successful
        Rows total:                  2
        Rows successfully loaded:   2
        Rows failed to load:       0
        % of Rows successfully loaded: 100.00 %
        Load Rate (MB/s):          0.00 MB/s
        Load Rate (Rows/s):         1.13 Rows/s
        Start time (Wallclock):     Wed Oct 30 23:30:11
        End time (Wallclock):       Wed Oct 30 23:30:13
        Total load time = 1.78 seconds = 0.03 minutes = 0.00
hours
        Data size = 19 bytes = 0.02 KB = 0.00 MB
```

Verify the table contents

1. Invoke TQL:

```
$ tql
```

```
TQL>
```

2. Connect to the database:

```
TQL> USE temp;
```

3. Show the table data:

```
TQL> select * from teams;
```

Table contents are displayed:

id	name
1	sameer
2	sandeep

# Use a script to load data

**Summary:** Learn how to load one or files in bulk with a script.

If you need to load data from multiple CSV files, create a script to automate the process. You can also use a similar script to automate recurring data feeds.

## Understand how to create a script

The data loading script is a text file that contains all the calls to `tsload` for loading the data from your CSV files.

The example script shown here uses the `cat` command to read the data file, and pipes it to `tsload`. When creating and testing your script, you may wish to replace each `cat` with `cat -10`, to load only the first ten lines of each file. This allows you to quickly run a test of your script. When the test succeeds for all the data files, you can then remove each `-10`, so the complete files will load when you run the script again.

1. Log in to the Linux shell using SSH.
2. Navigate to the directory that contains your CSV files and open a new file in a text editor.
3. Type in the commands to load the data.

This example shows commands to load three files:

```
cat Players.csv | tsload
  --target_database baseball --target_table "players"
  --empty_target --field_separator ","
  --max_ignored_rows 10 --bad_records_file bad_record
s.txt
  --has_header_row --alsologtostderr --null_value ""

cat AllstarFull.csv | tsload
  --target_database baseball --target_table "allstarfu
ll"
  --empty_target --field_separator ","
  --max_ignored_rows 10 --bad_records_file bad_record
s.txt
  --has_header_row --alsologtostderr --null_value ""

cat Appearances.csv | tsload
  --target_database baseball --target_table "appearanc
es"
  --empty_target --field_separator ","
  --max_ignored_rows 10 --bad_records_file bad_record
s.txt
  --has_header_row --alsologtostderr --null_value ""
```

4. Save the file.

5. Run the script:

```
$ ./load_baseball_data.sh
```

## Loading data efficiently

If you have a very large data file that takes a long time to load, you can reduce the load time by splitting it up into multiple files and loading them in parallel using multiple invocations of `tsload`. If the size of any of your data files is greater than 50 million rows, running `tsload` in parallel can reduce the load time significantly.

- Split up your large data file into multiple smaller files.
- Stage the data files in a location accessible to the node on which you run the script. Usually, you can use an [NAS mounted file system](#) [See page 54].

- Create a script to load the files in the following example.
- Run the script to load the files. You will make your script multi-threaded by invoking multiple loader threads (between 1 and 5 are recommended).

To optimize the load time even further, determine what the bottleneck is and adjust your process accordingly. If the disk I/O for reading the data files is the bottleneck, you can stage the data files on separate NAS mounted file systems and reference them accordingly in your script. If the CPU on the machine you're using to run the load script is the bottleneck, you can split the load script into the same number of parts as you have nodes in your ThoughtSpot instance, place one script on each node, and run them in parallel. Make sure the other nodes are able to access the data files where they are staged. Running the load script on separate nodes will put the data on all the nodes, just as when you run the script on a single node. Running the script on all the nodes at the same time just lets you take advantage of CPU power of each node for hashing data files.

For example, suppose you have 30 days of data in 30 files, one for the data collected on each day. Each day's data file contains 10 million rows, for a total of 300 million rows of data. You want to load the whole month of data. For this example we'll have 5 loader processes, each one handling 6 days of data. Here is a sample script you could use to load the data files in parallel:

```
/* Script load_script.sh, loads 30 days of data in parallel */

#!/bin/bash

pidlist=""

cat day1.csv day2.csv day3.csv day4.csv day5.csv day6.csv | tsload
--target_database sales --target_table SALES_FACT --max_ignore
d_rows 10
--bad_records_file ./SALES_FACT.bad --date_format %Y-%m-%d
--date_time_format "%Y-%m-%d %H:%M:%S" --source_data_format del
imited
--field_separator "|" --null_value "" --enclosing_character
"\\""
--boolean_representation 1_0 &

pidlist="$pidlist $" &

cat day7.csv day8.csv day9.csv day10.csv day11.csv day12.csv | tsload
--target_database sales --target_table SALES_FACT --max_ignore
d_rows 10
--bad_records_file ./SALES_FACT.bad --date_format %Y-%m-%d
--date_time_format "%Y-%m-%d %H:%M:%S" --source_data_format del
imited
--field_separator "|" --null_value "" --enclosing_character
"\\""
--boolean_representation 1_0 &

pidlist="$pidlist $" &

cat day13.csv day14.csv day15.csv day16.csv day17.csv day18.cs
v | tsload
--target_database sales --target_table SALES_FACT --max_ignore
d_rows 10
--bad_records_file ./SALES_FACT.bad --date_format %Y-%m-%d
--date_time_format "%Y-%m-%d %H:%M:%S" --source_data_format del
imited
--field_separator "|" --null_value "" --enclosing_character
"\\""
--boolean_representation 1_0 &

pidlist="$pidlist $" &
```

```
cat day19.csv day20.csv day21.csv day22.csv day23.csv day24.cs  
v | tsload  
--target_database sales --target_table SALES_FACT --max_ignore  
d_rows 10  
--bad_records_file ./SALES_FACT.bad --date_format %Y-%m-%d  
--date_time_format "%Y-%m-%d %H:%M:%S" --source_data_format del  
imited  
--field_separator "|" --null_value "" --enclosing_character  
"\\"  
--boolean_representation 1_0 &  
  
pidlist="$pidlist $" &  
  
cat day25.csv day26.csv day27.csv day28.csv day29.csv day30.cs  
v | tsload  
--target_database sales --target_table SALES_FACT --max_ignore  
d_rows 10  
--bad_records_file ./SALES_FACT.bad --date_format %Y-%m-%d  
--date_time_format "%Y-%m-%d %H:%M:%S" --source_data_format del  
imited  
--field_separator "|" --null_value "" --enclosing_character  
"\\"  
--boolean_representation 1_0 &  
  
pidlist="$pidlist $" &  
  
wait $pidlist
```

Call your script using a command like:

```
nohup bash ./load_script.sh > master_log.txt &  
  
tail -f master_log.txt
```

Constructing your script in this way will execute all the commands in the background, and output to the file `master_log.txt`. You can see a running status as the commands in the script execute. After the script completes, you can check the log file for detailed information, such as the number of rows that loaded successfully.

# Delete a data source

**Summary:** How to prepare for and delete a data source using the ThoughtSpot application.

There are two separate ways to delete a data source, through the browser or [through TQL](#) [See page 159] describes the dependency checking that occurs when deleting or changing a table using TQL.

When you want to delete a data source, you first need to handle any dependent objects that have been built on top of it. You can easily see these dependencies, and choose how to handle them before deleting the data source.

## Check data source dependencies

You can see all of the dependencies for any data source (worksheet or table) on the **Data** page.

To view dependent objects for a data source:

1. Click **Data** on the top navigation bar.
2. Click the name of the data source whose dependencies you want to view.
3. Click **Dependents**.

You will see a list of the names of the dependent objects (worksheets and pinboards), and the columns they use from that data source. You can use this information to determine the impact of changing the structure of the data source or to see how widely it is used.

The screenshot shows a 'WORKSHEET' titled 'Sporting Goods Retail Worksheet' under the 'ThoughtSPORT worksheet' category. The 'Dependents' tab is selected. A table displays the following data:

COLUMN NAME	DEPENDENT NAME	TYPE
Age Group	Total Sales by Depar..	View
Date	Top 100 Products M..	View
Product Name	Top 100 Products M..	View
Department	Total Sales by Depar..	View
Sales	Total Sales by Depar..	View
Customer City	Customer Location	Answer
Customer Name	Customer Location	Answer

( showing rows 1-0 of 27 )

4. Click a dependent object to modify or delete it.

If you want to remove the dependency by modifying the dependent object, you must remove all search terms or columns that refer back to the data source you are trying to delete.

5. When all dependencies have been removed, you will be able to go back and delete the data source.

## Delete a data source

You can delete data sources from the browser, as long as they were not created by an administrator through `tsload`.

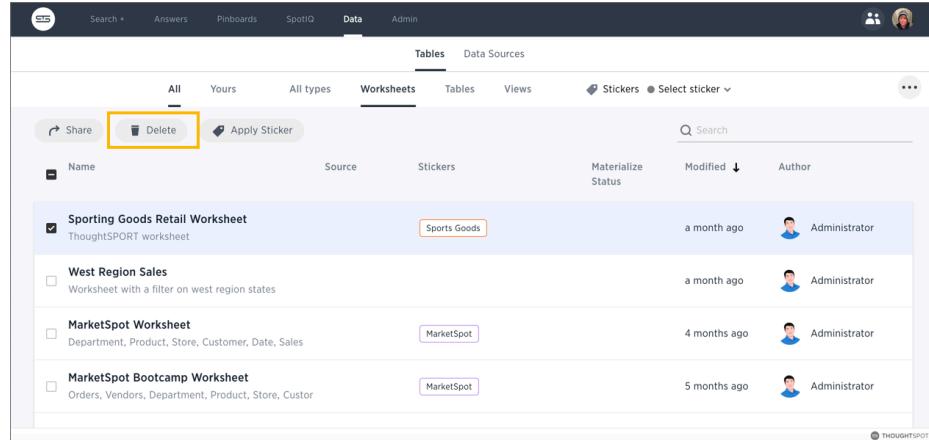
You can delete data sources from the browser if they were created in the browser. These types of data sources include:

- Data imported from the browser.
- Worksheets.

ThoughtSpot checks for dependencies whenever you try to delete a table or worksheet.

1. Click **Data** on the top navigation bar.
2. Check the box next to the name of the data source you want to delete.
3. Click the delete icon.

## Delete a data source



The screenshot shows the ThoughtSpot Data Sources interface. At the top, there are tabs for 'Tables' and 'Data Sources'. Below that, a search bar and filter options like 'All', 'Yours', 'All types', 'Worksheets' (which is selected), 'Tables', 'Views', 'Stickers', and 'Select sticker'. A 'Share' button is also present. The main area lists data sources with columns for 'Name', 'Source', 'Stickers', 'Materialize Status', 'Modified', and 'Author'. One row is selected, and its details are shown in a tooltip: 'Sporting Goods Retail Worksheet' (ThoughtSPORT worksheet), Source: Sports Goods, Modified: a month ago, Author: Administrator. The 'Delete' button in the toolbar is highlighted with a yellow box.

Name	Source	Stickers	Materialize Status	Modified	Author
Sporting Goods Retail Worksheet ThoughtSPORT worksheet	Sports Goods			a month ago	Administrator
West Region Sales Worksheet with a filter on west region states				a month ago	Administrator
MarketSpot Worksheet Department, Product, Store, Customer, Date, Sales	MarketSpot			4 months ago	Administrator
MarketSpot Bootcamp Worksheet Orders, Vendors, Department, Product, Store, Custor	MarketSpot			5 months ago	Administrator

4. If you attempt to delete a data source with dependent objects, the operation will be blocked.

You will see a list of dependent objects with links.

## Cannot delete

The following object(s) depend on "Sporting Goods Retail Worksheet". You must delete them to delete "Sporting Goods Retail Worksheet".

- [Sales by Store - Last 30 Days](#) (Answer)
- [Shopping Trend of Members vs Non-Members](#) (Answer)
- [Sales Breakdown by Mode of Payment](#) (Answer)
- [Moving Sum of All Sales - Last 30 days](#) (Answer)
- [Pivot Example](#) (Answer)
- [Sales Trend by Day of Week](#) (Answer)
- [Customer Location](#) (Answer)
- [Customer Footprint and Sales by Region](#) (Answer)
- [Sales by Region, State and Year](#) (Answer)
- [Low Inventory](#) (Answer)
- [Monthly Department Sales Analysis](#) (Answer)
- [Sales for Last Month](#) (Answer)
- [Product & Department Sales Group Sum](#) (Answer)
- [Margin vs Sales Analysis](#) (Answer)
- [Sales by Age Group, Gender and Product Category](#) (Answer)
- [Racquet Sales](#) (Answer)
- [Sales by Quarter](#) (Answer)
- [Average Sales - Weekday vs Weekend](#) (Answer)
- [Vicky's Sales Data](#) (Answer)
- [Sales Per Customer for Outerwear by State](#) (Answer)

OK

5. Click a dependent object to modify or delete it.

If you want to remove the dependency by modifying the dependent object, you must remove all search terms or columns that refer back to the data source you are trying to delete.

6. When all dependencies have been removed, you will be able to go back and delete the data source.

# Delete or change a table in TQL

**Summary:** You can delete a data source in the web browser or using ThoughtSpot SQL Command Line (TQL).

When you enter a TQL statement, the system warns you of possible dependency consequences with a prompt asking if you'd like to proceed. This should make you feel safe issuing TQL commands, even commands like dropping a table.

If TQL is run using the flag `--allow_unsafe`, your statements will always execute without this warning. Note that when running TQL from a script, you will need to decide what behavior you want if the script contains changes that affect dependent objects. If you want the script to run even if objects with dependencies are affected, run it using this flag, for example:

```
cat safest_script_ever.sql | tql --allow_unsafe
```

If you do not run the script using the flag, it will fail if any of its commands might cause problems with dependent objects.

TQL actions with possible dependency consequences include:

- Change, add, or remove a primary key.
  - When changing or adding a primary key, if the key in question is not unique in the data it may cause deletion of rows, because of upserts occurring when duplicate primary keys are found.
  - When changing or removing a primary key, incoming foreign key relationships will be broken.
- Change a column datatype.
- Add a relationship or foreign key.
- Drop a relationship or foreign key constraint.
- Change or add a sharding key.
- Drop a table, schema, or database.

When issuing one of the previous commands, you will see a warning message similar to this:

```
TQL> ALTER TABLE table1
      DROP CONSTRAINT PRIMARY KEY;

WARNING: This operation will break the Foreign Key relationship "products"
with table "sales", which will break 34 user-visible visualizations and
2 Worksheets. We recommend taking a snapshot before performing
this operation.

Do you wish to proceed? (yes/no).
```

# Understand groups and privileges

**Summary:** Creating groups and assigning users to them makes privilege management easier.

Before people can log in and use ThoughtSpot, you need to create a username, a password, and a membership in one or more groups for them.

This page describes manual creation of users, groups, and privileges, but you can also manage users through [LDAP \[See page 44\]](#) or SAML. For information on setting up SAML authentication, see the *ThoughtSpot Application Integration Guide*.

## Privileges and groups

Privileges determine what kinds of actions users are allowed to do. You assign privileges to groups. Then, you create users and assign them to groups. This is how you grant users access to different capabilities in ThoughtSpot.

Each group includes a set of privileges for its users. The privileges a group has determine the actions that its members are allowed to do. If a user belongs to more than one group, they will have the highest level of the privileges from all the groups they belong to. Plan your groups so that you can use them to assign a common set of privileges to multiple users. Good planning will pay off in ease of administration and a better search experience.

There is a default group called **All**, which includes every user in ThoughtSpot. When you create a new user, they will be added to the **All** group automatically. You cannot delete the **All** group or remove members from it.

You can also have a hierarchy of groups. That is, groups can belong to (that is, be children of) other groups. When using group hierarchies, permissions are inherited from the parent group. So if you're a member of a sub-group, you would automatically have the privileges of the parent group.

## List of privileges

Here are the different privileges, and the capabilities they enable:

Privilege	Description
<b>Can administer ThoughtSpot</b>	Can manage Users and Groups and has view and edit access to all data. Users with this privilege can also download a saved answer.
<b>Can upload user data</b>	Can upload their own data from the application's <b>Data</b> page using <b>Actions &gt; Upload data</b> .
<b>Can download data</b>	Can download data from search results and pinboards.
<b>Can share with all users</b>	Can see the names of and share with users outside of the groups the user belongs to. Members of groups with this privilege can also share with groups marked as <b>NOT SHAREABLE</b> .
<b>Can manage data</b>	Can create worksheets and views. Note that to edit a worksheet or a view created by another user, you must have the **Edit** permission on that object, and it must be shared with you.
<b>Can use experimental features</b>	Can access trial and experimental features that ThoughtSpot makes available to early adopters.
<b>Can invoke Custom R Analysis</b>	Can access R scripts to further explore search answers. Includes options to invoke R scripts on visualizations, create and share custom scripts, and share the results of R analysis as answers and pinboards.
<b>Can schedule pinboards</b>	Can create pinboard schedules and edit their own scheduled jobs.
<b>Has SpotIQ privilege</b>	Can use the SpotIQ feature. If this privilege is not enabled for the user, they can still see "Did you know" SpotIQ insights on the ThoughtSpot home page.
<b>Can administer and bypass RLS</b>	<p>Users in groups with this privilege (directly or through group inheritance):</p> <ul style="list-style-type: none"> <li>• Are exempt from row-level security (RLS) rules.</li> <li>• Can add/edit/delete existing RLS rules.</li> <li>• Can check or uncheck Bypass RLS on a worksheet.</li> </ul> <p>Your installation configuration may enable or disable the availability of this privilege. By default, it is enabled. Administrators or groups with the privilege <b>Can administer ThoughtSpot</b> can grant this privilege.</p>

Typically, the **ALL** group has a common set of privileges applies such as the **Can upload user data** and/or **Can download data** privileges.

Privileges are additive, meaning that if a user belongs to more than one group, they will have the highest level of privileges from among the groups they are a member of. They are also inherited from the parent, so that a sub-group gets all the same privileges of its parent, all the way up the group hierarchy.

If you add the privilege **Has administration privileges** to a group, note that all users in that group will be able to see all the data in ThoughtSpot. Administrators can see all data sources, and [Row level security \[See page 219\]](#) does not apply to them.

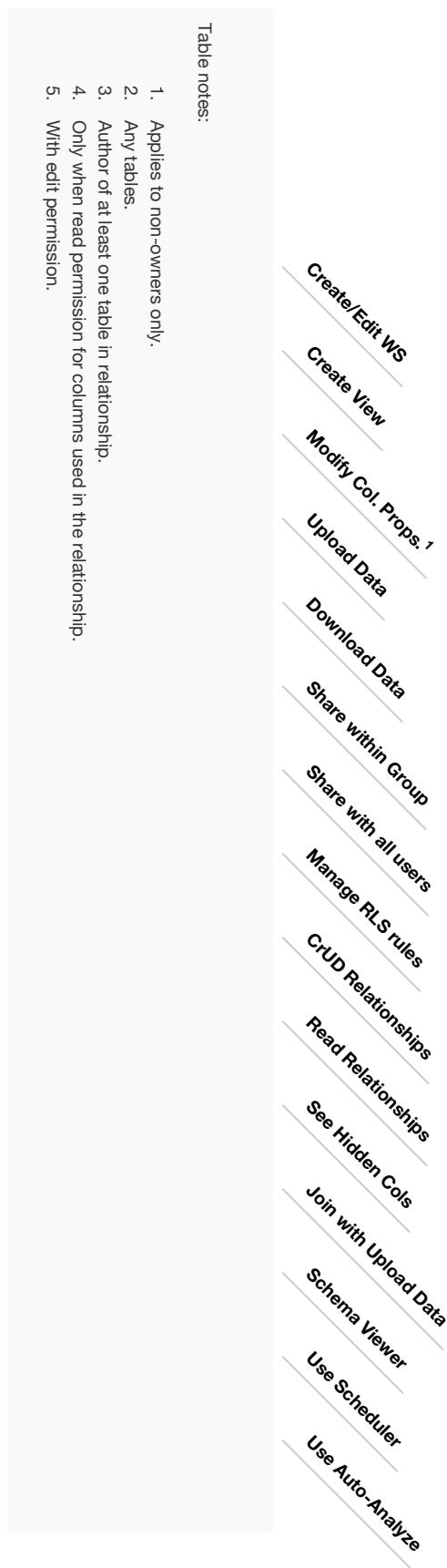
Permissions to see and edit tables, worksheets, and pinboards are set when you share them with users and groups, as described in the topic [Data security \[See page 201\]](#).

The following table shows the intersection of user privilege and ability:

	Create/Edit WS	Create View	Modify Col. Props. <sup>1</sup>	Upload Data	Download Data	Share within Group	Share with all users	Manage RLS rules	CrUD Relationships	Read Relationships	See Hidden Cols	Join with Upload Data	Schema Viewer	Use Scheduler	Use Auto-Analyze
Can administer ThoughtSpot	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Can upload user data	N	N	N	Y	N	Y	N	Y <sup>3</sup>	Y <sup>4</sup>	Y	Y	Y	Y	Y	Y
Can download data	N	N	N	N	Y	Y	N	N	Y <sup>4</sup>	N	N	N	N	N	N
Can manage data	Y	Y	Y	Y	N	Y	N	N	Y <sup>4</sup>	Y <sup>4</sup>	Y <sup>5</sup>	Y	N	N	N
Can share with all users	N	N	N	N	N	Y	Y	N	Y <sup>4</sup>	Y <sup>4</sup>	N	N	N	N	N
Has SpotIQ privilege	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y
Can Administer and By-pass RLS	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
None	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N

Table notes:

1. Applies to non-owners only.
2. Any tables.
3. Author of at least one table in relationship.
4. Only when read permission for columns used in the relationship.
5. With edit permission.



## Related information

- [Add a group and set security privileges \[See page 167\]](#)
- [Add a user \[See page 181\]](#)

# Create, edit, or delete a group

**Summary:** ThoughtSpot has intuitive and powerful user group management for assigning privileges, user selection, multi-tier subgroups, default Pinboard assignment, and emailing.

Before adding users, create the groups to which they belong. Each group includes a set of privileges for its users.

## Create a group

To create a group and add privileges for the group, follow these steps:

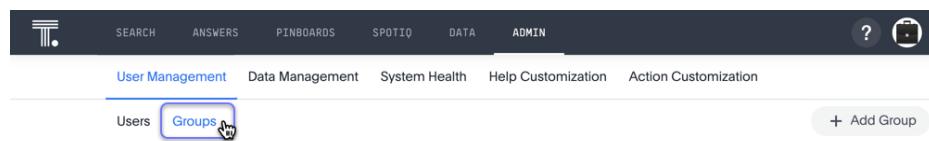
1. Log into ThoughtSpot from a browser.
2. Click the **Admin** icon, on the top navigation bar.



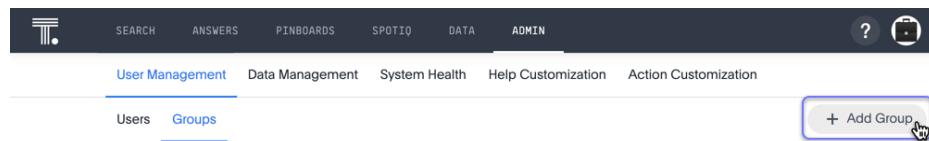
3. In the **Admin** panel, click **User Management**.



4. In the **User Management** section, click **Groups**.



5. Click the **+ Add Group** button on the upper right-hand side of the list of groups.



- In the **Add a new group** modal, enter the details for the new group:

Field	Description
<b>Group name</b>	Enter a unique name for the group.
<b>Display name</b>	Name of the group as it appears in ThoughtSpot.
<b>Sharing visibility</b>	Indicate whether objects can be shared with this group. When set to <b>SHAREABLE</b> , this group is an option in the <b>Share</b> dialog.
<b>Description</b>	Optionally, enter a description.
<b>Privileges</b>	Check the <a href="#">privileges [See page 161]</a> you want to grant to the group. If you add the privilege <b>Has administration privileges</b> to a group, all users in that group can see all the data in ThoughtSpot. Administrators can always see all data sources, and <a href="#">Row level security [See page 219]</a> does not apply to them.

- You can also add [Groups \[See page 169\]](#) (these would be the subgroups of the group you are editing), [Users \[See page 170\]](#). Also, see [Default Pinboards \[See page 0\]](#).
- Click **Add** to create the group.

## Default Pinboards

You cannot add default Pinboards to a new user group. You must create it first, and then edit it to add default Pinboards. See [Edit a group > Default Pinboards \[See page 173\]](#).

### Add a new group

Group name *	Sales EMEA
Display name *	Sales EMEA
Sharing visibility *	SHARABLE
Description	
Privileges	<input type="checkbox"/> Can administer ThoughtSpot <input checked="" type="checkbox"/> Can upload user data <input checked="" type="checkbox"/> Can download data <input type="checkbox"/> Can share with all users <input type="checkbox"/> Can manage data <input type="checkbox"/> Can use experimental features <input type="checkbox"/> Can invoke Custom R Analysis <input type="checkbox"/> Has SpotIQ privilege <input type="checkbox"/> Can administer and bypass RLS

\* Required field

**Select default pinboards** *i*

Steps to setup default pinboards for this group:

1. Create this group
2. Share existing or new Pinboards with this group
3. Edit this group and assign default Pinboards

**Cancel** **ADD**

## Groups

Follow these steps to assign subgroups to the group:

1. Click the **Groups** tab.
2. Select the groups you want to add in the list by clicking the box next to the group name.
3. You can also use **Search** to find groups by name.

### Add a new group

Group name \* Sales EMEA

Display name \* Sales EMEA

Sharing visibility \* SHARABLE

Description

Privileges

- Can administer ThoughtSpot
- Can upload user data
- Can download data
- Can share with all users
- Can manage data
- Can use experimental features
- Can invoke Custom R Analysis
- Has SpotIQ privilege
- Can administer and bypass RLS

No Groups in Group

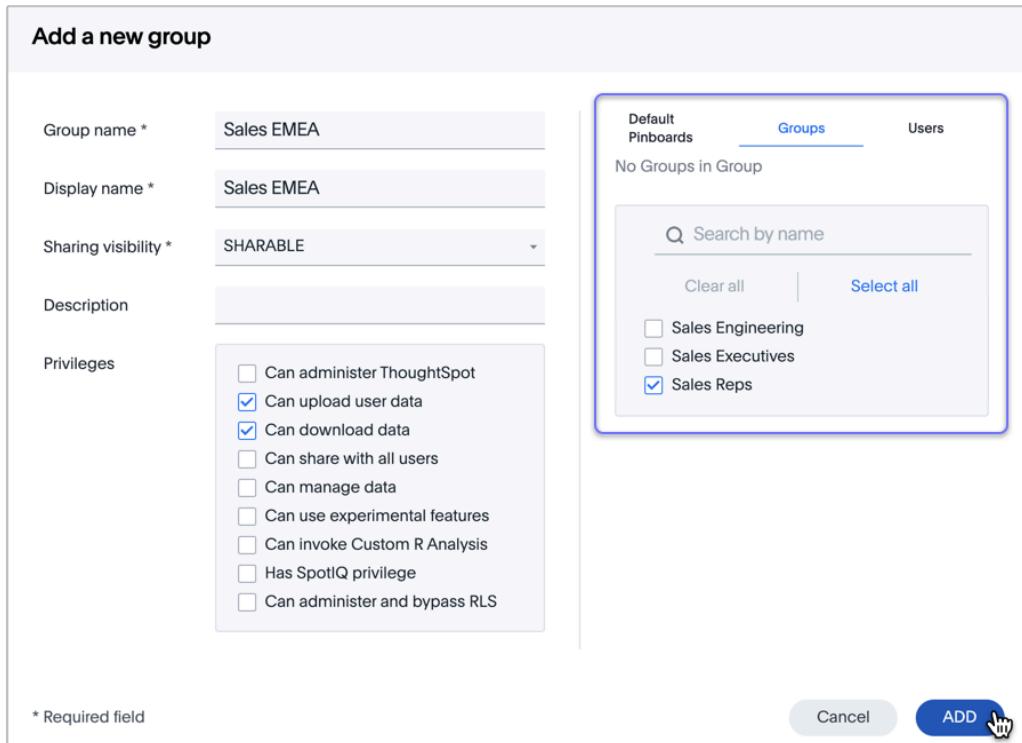
Search by name

Clear all | Select all

- Sales Engineering
- Sales Executives
- Sales Reps

\* Required field

Cancel ADD 



## Users

Follow these steps to assign users to the group:

1. Click the **Users** tab.
2. Select the users you want to add in the list by clicking the box next to the user name.
3. You can also use **Search** to find users by name.

### Add a new group

Group name *	Sales EMEA
Display name *	Sales EMEA
Sharing visibility *	SHARABLE
Description	
Privileges	<input type="checkbox"/> Can administer ThoughtSpot <input checked="" type="checkbox"/> Can upload user data <input checked="" type="checkbox"/> Can download data <input type="checkbox"/> Can share with all users <input type="checkbox"/> Can manage data <input type="checkbox"/> Can use experimental features <input type="checkbox"/> Can invoke Custom R Analysis <input type="checkbox"/> Has SpotIQ privilege <input type="checkbox"/> Can administer and bypass RLS

Default Pinboards      Groups      Users

No Groups in Group

Q Search by name

Clear all       Select all

- Sales Engineering
- Sales Executives
- Sales Reps

\* Required field

Cancel ADD

## Edit a group

After adding a group, you can edit its settings to add or revoke privileges. The new settings apply to all group members.

To edit an existing group, follow these steps:

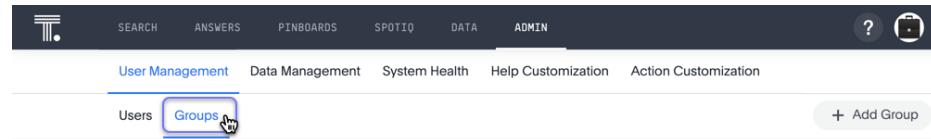
1. Log into ThoughtSpot from a browser.
2. Click the **Admin** icon, on the top navigation bar.



3. In the **Admin** panel, click **User Management**.



4. In the **User Management** section, click **Groups**.



5. Find the group you want to edit in the list, and click its name.

If you don't immediately see the name of the group, try searching for it.

A screenshot of the ThoughtSpot Admin interface showing the Groups list. The top navigation and tabs are identical to the previous screenshot. A search bar at the top of the list area contains the text 'Manage'. Below the search bar is a table with four columns: Display Name, Name (with an upward arrow), Created At, and Default pinboards. Two rows of data are visible:

Display Name	Name ↑	Created At	Default pinboards
M Manage Data	Manage Data	3 years ago	0
P Product Management	Product Management	3 years ago	3

The 'Manage Data' row has a blue box around it, indicating it is selected or being edited.

6. You can change the [Group name](#) [See page 168], [Display name](#) [See page 168], [Sharing visibility](#) [See page 0], [Description](#) [See page 168], and the selected [Privileges](#) [See page 168].

Here, we added the *Can manage data* privilege.

**Edit group**

Group name *	Sales EMEA
Display name *	Sales EMEA
Sharing visibility *	SHARABLE
Description	
Privileges	<input type="checkbox"/> Can administer ThoughtSpot <input checked="" type="checkbox"/> Can upload user data <input checked="" type="checkbox"/> Can download data <input type="checkbox"/> Can share with all users <input checked="" type="checkbox"/> Can manage data <input type="checkbox"/> Can use experimental features <input type="checkbox"/> Can invoke Custom R Analysis <input type="checkbox"/> Has SpotIQ privilege <input type="checkbox"/> Can administer and bypass RLS

Select default pinboards *i*

Search by name

- AE Pinboard
- Activity Dashboard
- Campaign Dashboard
- Deal Flow Analysis
- Demo - Customer Sales Metrics
- Free Trial Usage Analysis
- Marketing Attribution
- Marketing Demand Generation
- Marketing Funnel

\* Required field Cancel **Update** 

You can also make changes to the [Default Pinboards \[See page 173\]](#), [Groups \[See page 174\]](#) (these would be the subgroups of the group you are editing), [Users \[See page 175\]](#), or [Email \[See page 176\]](#).

7. Make your changes, and click **Update**.

## Default Pinboards

To assign default pinboards to groups, follow these steps:

1. Create a group, or choose an existing group. Note its name.
2. In the **Pinboards** interface, find the correct Pinboards, and share them with this group. See [Share a Pinboard \[See page 211\]](#).
3. Open the Group for editing. See [Edit a group \[See page 171\]](#).
4. Click the **Default Pinboards** tab.
5. From the list of shared Pinboards, select 1-3 default Pinboards in the list by clicking the box next to the Pinboard name.

6. You can also use **Search** to find Pinboards by name.
7. Click **Update** to save changes.

## Groups

When editing a group, keep in mind that only subgroups or possible subgroups appear in the list of groups. The **No Groups in Group** only indicates there are no children in this group's hierarchy. Do not underestimate the importance of the parent(s) of the group, because each group inherits the privileges of each of its parent groups.

Follow these steps to change subgroups of the group:

1. Click the **Groups** tab.
2. Select the groups you want to add in the list by clicking the box next to the group name.
3. You can also use **Search** to find groups by name.
4. Deselect the groups you want to remove from the list by clearing the box next to the group name.
5. Click **Update** to save changes.

### Edit group

Group name \* Sales EMEA

Display name \* Sales EMEA

Sharing visibility \* SHARABLE

Description

Privileges

- Can administer ThoughtSpot
- Can upload user data
- Can download data
- Can share with all users
- Can manage data
- Can use experimental features
- Can invoke Custom R Analysis
- Has SpotIQ privilege
- Can administer and bypass RLS

\* Required field

Cancel Update

Default Pinboards Groups Users Email

No Groups in Group

Search by name

Clear all Select all

Sales Engineering  
 Sales Executives  
 Sales Reps

## Users

Follow these steps to change the users of the group:

1. Click the **Users** tab.
2. Select the users you want to add in the list by clicking the box next to the user name.
3. You can also use **Search** to find users by name.
4. Deselect the users you want to remove from the list by clearing the box next to the user name.
5. Click **Update** to save changes.

### Edit group

Group name \* Sales EMEA

Display name \* Sales EMEA

Sharing visibility \* SHARABLE

Description

Privileges

- Can administer ThoughtSpot
- Can upload user data
- Can download data
- Can share with all users
- Can manage data
- Can use experimental features
- Can invoke Custom R Analysis
- Has SpotIQ privilege
- Can administer and bypass RLS

\* Required field

Default Pinboards Groups **Users** Email

11 Users in Group

Search by name

Clear all | Select all

- user\_sharing\_82
- user\_sharing\_83
- user\_sharing\_84
- user\_sharing\_85
- user\_sharing\_86
- user\_sharing\_87
- user\_sharing\_88
- user\_sharing\_89
- user\_sharing\_9
- user\_sharing\_90
- user\_sharing\_91

Cancel Update

## Email

You can configure groups so that users receive a *welcome email* that introduces them to ThoughtSpot, and initiates the onboarding process.

Follow these steps to configure group-wide emails:

1. Click the **Email** tab.
2. Under **Resend welcome email**, select either either *All users* or *New users*.
3. Enter optional text for the email. Here, we added “Welcome!”
4. To send the email immediately, click **Send**.
5. To test the email, click “Test welcome email”
6. Click **Update** to save changes.

The screenshot shows the 'Edit group' interface. On the left, there are fields for Group name (Sales EMEA), Display name (Sales EMEA), Sharing visibility (SHARABLE), and a Description field. Under Privileges, several checkboxes are listed: Can administer ThoughtSpot, Can upload user data (checked), Can download data (checked), Can share with all users, Can manage data, Can use experimental features, Can invoke Custom R Analysis, Has SpotIQ privilege, and Can administer and bypass RLS.

On the right, the 'Email' tab is selected. It displays a 'Resend welcome email' section with two radio button options: 'All users' (unchecked) and 'New users' (checked). Below this is a text area containing 'Welcome!' followed by a 'Send' button and a 'Test welcome email' link. A numbered callout (1-5) highlights specific elements: 1 points to the 'New users' radio button, 2 points to the 'Email' tab header, 3 points to the 'Welcome!' text area, 4 points to the 'Send' button, and 5 points to the 'Test welcome email' link.

\* Required field

Cancel      Update

## Deleting groups

To delete existing groups, follow these steps:

1. Log into ThoughtSpot from a browser.
2. Click the **Admin** icon, on the top navigation bar.

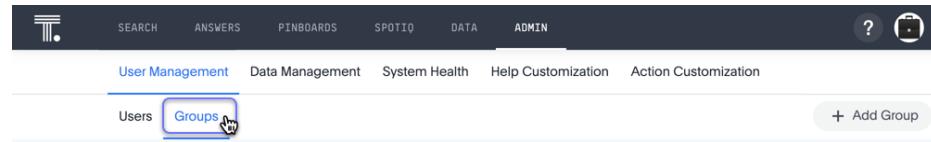


3. In the **Admin** panel, click **User Management**.



4. In the **User Management** section, click **Groups**.

Create, edit, or delete a group



5. Select the groups you plan to delete by clicking the box next to the group name.

If you don't immediately see the name of the group, try searching for it.

A screenshot of the ThoughtSpot Admin interface showing the Groups page. The search bar at the top contains the text 'Manage'. The table below lists two groups: 'Manage Data' and 'Product Management'. The 'Manage Data' row is highlighted with a blue border. The columns are labeled 'Display Name', 'Name ↑', 'Created At', and 'Default pinboards'. The 'Manage Data' row shows values: 'Manage Data', '3 years ago', and '0'. The 'Product Management' row shows values: 'Product Management', '3 years ago', and '3'. A 'Default pinboards' column is also present.

6. Click **Delete**.

A screenshot of the ThoughtSpot Admin interface showing the Groups page. Two groups, 'Experimental Feature' and 'Cloud Control', are selected for deletion, indicated by a blue selection box around their rows. The 'Delete' button is highlighted with a blue border. The table has columns for 'Display Name', 'Name', 'Created At', and 'Default pinboards'. The 'Experimental Feature' row shows values: 'ExperimentalFeature', '3 months ago', and '0'. The 'Cloud Control' row shows values: 'CloudControl', '8 months ago', and '0'. A search bar at the top right contains 'Search'.

## List group members

When browsing through users or subgroups, you can often see only a limited list. To check for other users, search for the name of a specific user or subgroup.

## Add multiple users to a group

To add multiple users to a group, you must be on the **Users** interface. Follow these steps:

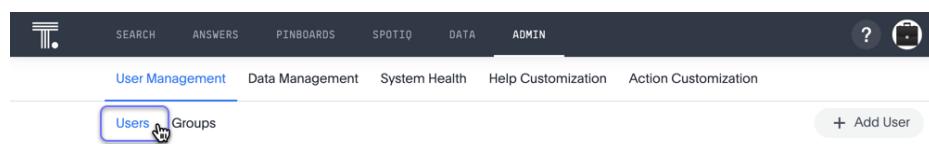
1. Log into ThoughtSpot from a browser.
2. Click the **Admin** icon, on the top navigation bar.



3. In the **Admin** panel, click **User Management**.

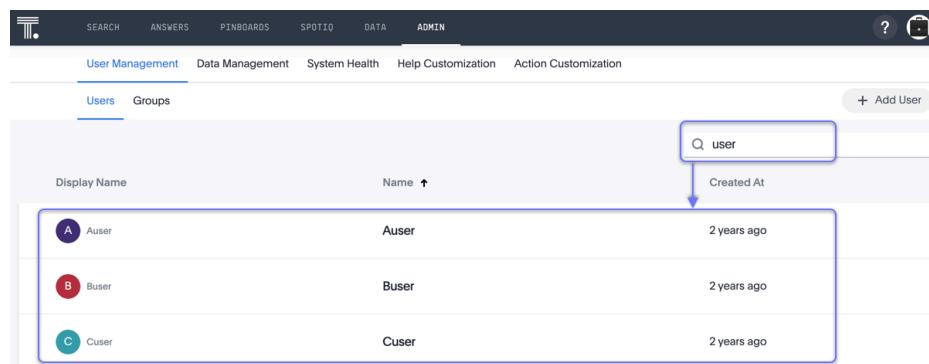


4. In the **User Management** section, click **Users**.



5. Select the names of users you plan to add to groups by clicking the box next to the user name.

If you don't immediately see the user name, try searching for it.



6. Click the **Add Users to Groups** button on the top of the list of users.

The screenshot shows the ThoughtSpot Admin interface with the 'User Management' tab selected. Under the 'Groups' tab, a modal window titled 'Add users to groups' is displayed. Inside the modal, there is a list of users: Auser, Buser, and Cuser. Each user has a checkbox next to their name. The checkbox for 'Auser' is checked. There is also a 'Display Name' field and a search bar at the top of the modal.

7. In the **Add Users to Groups** interface, select the groups by clicking the box next to the group name.
8. Click **Add**.

The screenshot shows the 'Add users to group' modal. At the top, it says 'Add users to group'. Below that is a search bar labeled 'Search by name'. A list of groups is shown with checkboxes next to them. The checkboxes for 'Cloud Control' and 'Customer Service' are checked. At the bottom right of the modal, there is a blue 'ADD' button with a hand cursor icon pointing to it. There is also a 'Cancel' button at the bottom left.

# Create, edit, or delete a user

**Summary:** For each unique person who accesses ThoughtSpot, you must create a user account. When you create a user manually in ThoughtSpot, you continue to manage that user in ThoughtSpot.

You can create users directly in ThoughtSpot, or import users and user groups through LDAP or similar protocols.

For users who have access through LDAP, the LDAP installation manages all user information.

## Create a user in ThoughtSpot

This procedure demonstrates how to create a user manually. When you create a user, you can specify the *username* [See page 183], *display name* [See page 183], *sharing visibility* [See page 183], the *password* [See page 183], *email* [See page 183], whether they get a *welcome email* [See page 183] and its *text* [See page 0], and assign *group* [See page 184] memberships. The user inherits privileges and permissions directly from the group assignments.

Note that all users automatically belong to the group **All**.

To create a new user and assign that user to groups, follow these steps:

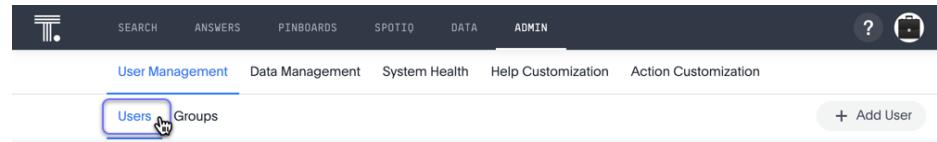
1. Log into ThoughtSpot from a browser.
2. Click the **Admin** icon, on the top navigation bar.



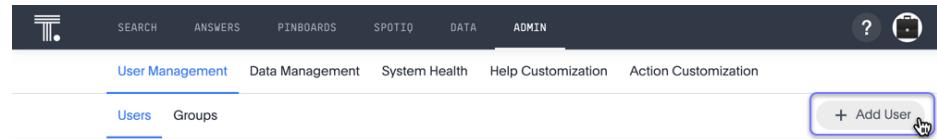
3. In the **Admin** panel, click **User Management**.



4. In the **User Management** section, click **Users**.



- Click the + Add User button on the upper right-hand side of the list of users.



- In the Add a new user interface, enter the details for the new user:

**Add a new user**

Username *	Auser
Display name *	Auser
Sharing visibility *	SHARABLE
Change password *	*****
Confirm password *	*****
Email *	auser@thoughtspot.com
<input checked="" type="checkbox"/> Send a welcome email Welcome!	
<input type="button" value="Cancel"/> <input style="background-color: #0070C0; color: white; font-weight: bold;" type="button" value="ADD"/>	

\* Required field

**Groups**

6 Groups assigned to User

Search by name

Manage Data  
 Marketing  
 Marketing Demo  
 Sales Demo  
 Sales Development  
 Sales Directors  
 Sales EMEA  
 Sales Engineering  
 Sales Executives

Field	Required?	Description
-------	-----------	-------------

<b>Username</b>	Yes	A login name for the user. Usernames must be unique and lowercase.
		If you are using Active Directory to authenticate users, and your LDAP configuration requires users to be created manually (they are not created automatically in ThoughtSpot upon authentication), the username you specify has to be domain-qualified ( <code>username@ldap.thoughtspot.com</code> ), and you must enter a dummy password.
<b>Display name</b>	Yes	A unique name for the user (usually their first and last name).
<b>Sharing visibility</b>	Yes	Indicate whether objects can be shared with this user. When set to <b>SHAREABLE</b> , this user is an option in the <b>Share</b> dialog.
<b>Change password</b>	Yes	A password.
<b>Confirm password</b>	Yes	Enter the password again.
<b>Email</b>	Yes	The user's email address. ThoughtSpot uses this for notification when another user shares something with them, for onboarding, for the <b>Ask an Export</b> feature, and others.  Note that during cluster configuration, the domain is specified. ThoughtSpot does not accept emails outside this domain.
<b>Send a welcome email</b>	No	When checked, this option ensures that the new user receives a welcome email.
<b>Email message text</b>	No	Enter text of the optional welcome email here.

**Groups**      Recommended      Select the groups for the user.

Note that if you add the user to a group that has the privilege **Has administration privileges**, they can see all the data in ThoughtSpot.

When you create a new user, the groups they belong to define the following attributes for the user:

- **Privileges:** the actions they can perform, defined when you [Add a group and set security privileges \[See page 167\]](#).
- **Permissions:** the data they can access and view, defined when you consider [Data security \[See page 201\]](#).

Administrators can see all data sources, and [Row level security \[See page 219\]](#) does not apply to them.

7. Click **Add** to create the user.

Note that this process of identifying the user's needs contributes to a robust onboarding process. See [Onboarding users \[See page 0\]](#).

## Edit an existing user

As an administrator, you can edit a user account, and change the user's groups. You can also help users by resetting their password, and evaluating their onboarding experience to ensure they receive the best possible introduction to relevant information in ThoughtSpot.

To edit an existing user, follow these steps:

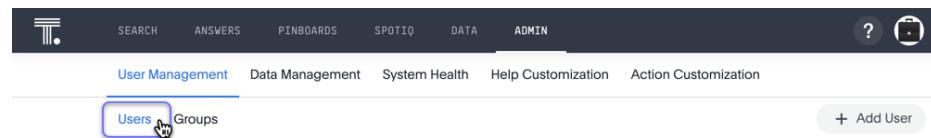
1. Log into ThoughtSpot from a browser.
2. Click the **Admin** icon, on the top navigation bar.



3. In the **Admin** panel, click **User Management**.

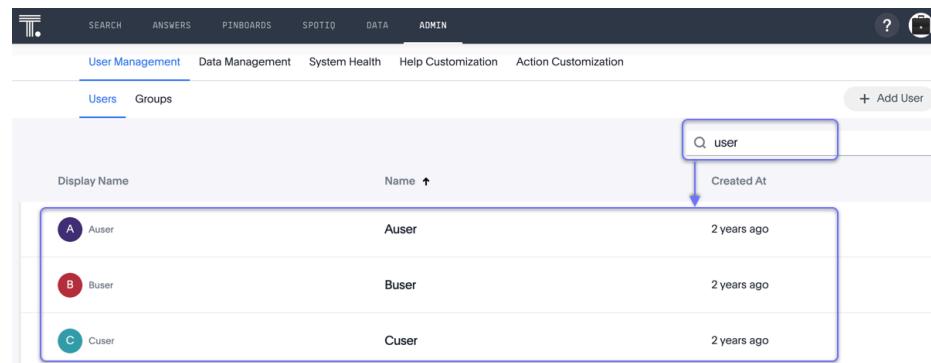


4. In the **User Management** section, click **Users**.



5. Click the username in the list to open the **Edit User** interface.

If you don't immediately see the username you plan to edit, try searching for it.



6. In the **Edit User** interface, edit the basic user information.

You can change the [username \[See page 183\]](#), [display name \[See page 183\]](#), [sharing visibility \[See page 183\]](#), [passwords \[See page 183\]](#), and [user's email \[See page 183\]](#).

**Edit User**

Username *	Auser
Display name *	Auser
Sharing visibility *	SHARABLE
Change password	
Confirm password	
Email *	auser@thoughtspot.com

**Groups**  
6 Groups assigned to User

Search by name

<input type="checkbox"/> Manage Data
<input type="checkbox"/> Marketing
<input type="checkbox"/> Marketing Demo
<input checked="" type="checkbox"/> Sales Demo
<input checked="" type="checkbox"/> Sales Development
<input checked="" type="checkbox"/> Sales Directors
<input checked="" type="checkbox"/> Sales EMEA
<input checked="" type="checkbox"/> Sales Engineering
<input checked="" type="checkbox"/> Sales Executives

[Preview onboarding](#)

\* Required field

You can also [Preview onboarding \[See page 186\]](#), and make changes to the [Groups \[See page 187\]](#) assigned to the user.

7. Click **Update**.

### Preview onboarding

You can click **Preview onboarding** to evaluate this user's first experience with ThoughtSpot. After previewing the user's default data source and Pinboards, you may choose to change the [Group \[See page 0\]](#) assignments.

### Edit User

Username *	Auser
Display name *	Auser
Sharing visibility *	SHARABLE
Change password	
Confirm password	
Email *	auser@thoughtspot.com

\* Required field

**Groups**

6 Groups assigned to User

Search by name

Clear all | Select all

Manage Data  
 Marketing  
 Marketing Demo

Sales Demo  
 Sales Development  
 Sales Directors  
 Sales EMEA  
 Sales Engineering  
 Sales Executives

Preview onboarding 

Cancel Update

## Groups

Follow these steps to change the user's groups:

1. Click the **Groups** tab.
2. Select the groups you want to add in the list by clicking the box next to the group name.
3. You can also use **Search** to find groups by name.
4. Deselect the groups you want to remove from the list by clearing the box next to the group name.
5. Click **Update** to save changes.

### Edit User

Username \* Auser

Display name \* Auser

Sharing visibility \* SHARABLE

Change password

Confirm password

Email \* auser@thoughtspot.com

\* Required field

**Groups**  
7 Groups assigned to User

Search by name

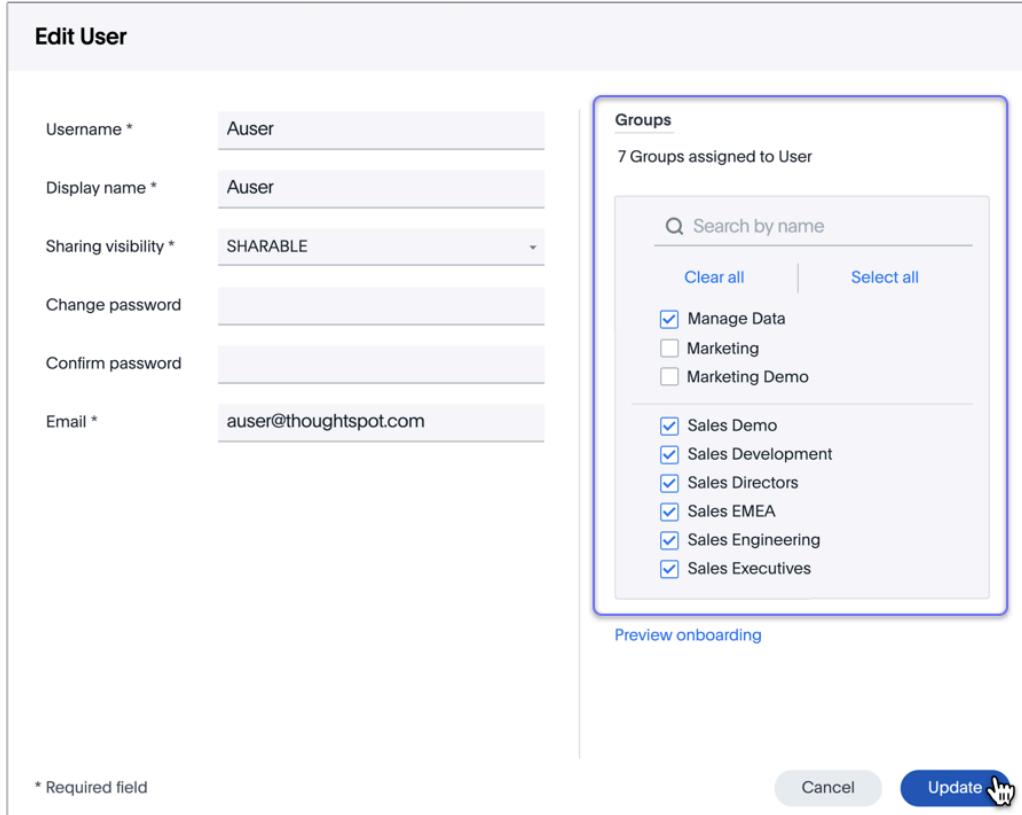
Clear all | Select all

Manage Data  
 Marketing  
 Marketing Demo

Sales Demo  
 Sales Development  
 Sales Directors  
 Sales EMEA  
 Sales Engineering  
 Sales Executives

Preview onboarding

Cancel **Update** 



## Delete users

To delete users, follow these steps:

1. Log into ThoughtSpot from a browser.
2. Click the **Admin** icon, on the top navigation bar.

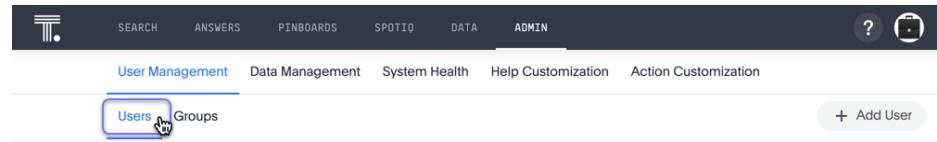


3. In the **Admin** panel, click **User Management**.



4. In the **User Management** section, click **Users**.

Create, edit, or delete a user



5. Select the users you plan to delete by clicking the box next to the username.

If you don't immediately see the username you plan to delete, try searching for it.

Display Name	Name ↑	Created At
A Auser	Auser	2 years ago
B Buser	Buser	2 years ago
C Cuser	Cuser	2 years ago

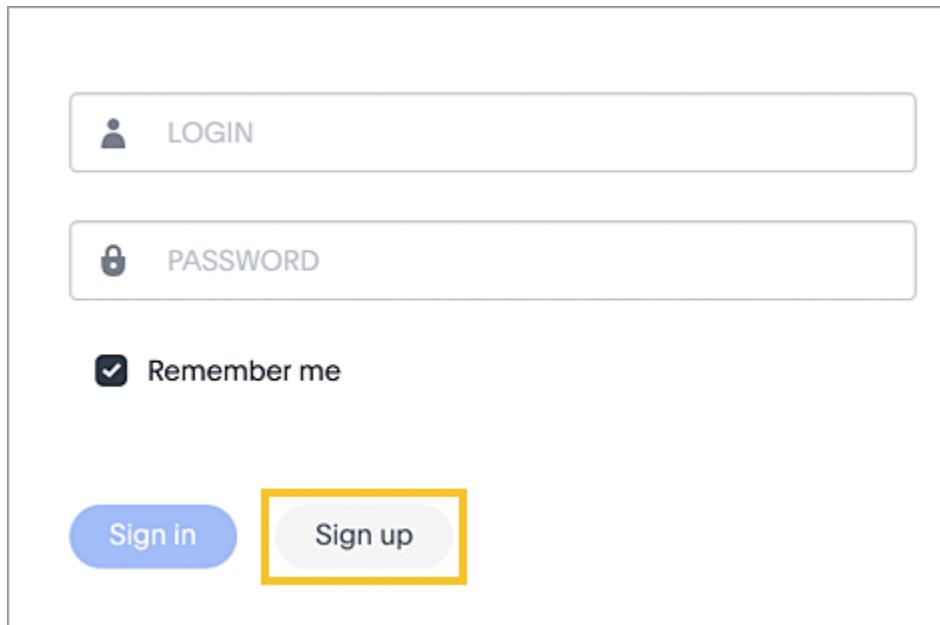
6. Click **Delete**.

Display Name	Name ↑	Created At
A Auser	Auser	2 years ago
B Buser	Buser	2 years ago
C Cuser	Cuser	2 years ago

# Allow users to sign up

You can allow people in your organization to sign up for ThoughtSpot by clicking a button on the sign-in page.

You do this by providing them with the ThoughtSpot sign-up URL. When they go to this URL, they see the sign-up button.



When a person clicks the sign-up button, they go to a sign-up page that you've already set up outside of ThoughtSpot. This can be any page you want to use for registering new users.

## Create the ThoughtSpot sign-up URL

Follow this syntax for creating the URL:

```
https://<your-thoughtspot-URL>/?signUpEnabled=true&signUpButtonLink=https://<your-sign-up-page-URL>
```

Example:

```
https://thoughtspot.mycompany.com/?signUpEnabled=true&signUpButtonLink=https://signup.mycompany.com/thoughtspot
```

## Customize the sign-up button text

By default, the button text is ‘Sign up’, but you have the option to change it. To do that, you add the ‘signUpButtonText’ parameter to the URL and include the custom text you want. If the text contains spaces, you must replace each space with a percent sign and the number 20 (%20). For example, if you wanted the button text to be ‘Request Account’, you would use ‘Request%20Account’.

Follow this syntax for creating the URL with custom button text:

```
https://<your-thoughtspot-URL>/?signUpEnabled=true&signUpButtonText=<your-sign-up->&signUpButtonLink=https://<your-sign-up-page-URL>
```

Example:

```
https://thoughtspot.mycompany.com/?signUpEnabled=true&signUpButtonText=Request%20Account&signUpButtonLink=https://thoughtspot
```

## Display the sign-up button by default

If you want to display the sign-up button on the ThoughtSpot sign-in page without using the special sign-up URL, contact ThoughtSpot support.

# Overview of security features

There are several aspects of security, including access and permissions, data security and privacy, and security from an IT perspective.

- [System Security \[See page 193\]](#) refers to audit logs and security policies.
- [Data Security \[See page 201\]](#) refers to which users can see which data in the ThoughtSpot application, and includes:
  - [Users and Groups \[See page 161\]](#)
  - [Privileges \[See page 161\]](#)
  - [Table and columns sharing \[See page 207\]](#)
  - [Row level security \[See page 219\]](#)
  - [Worksheet sharing \[See page 209\]](#)
  - [Pinboard sharing \[See page 211\]](#)
- Network Security refers to ports for external traffic and traffic within the cluster. Some ports must remain open for handling network requests from outside the ThoughtSpot instance. To see a list of network ports that must remain open to outside traffic, and for inter-cluster communication, review the information in [Network ports \[See page 64\]](#).

# System security tools and processes

**Summary:** System security refers to audit logs and security policies.

ThoughtSpot includes a number of management tools, monitoring applications, and automated processes to support system security. System security includes managing access and privileges, audit logs, security policies, and Linux OS installed package updates.

## Audit logs

There are several ways you can view audit log information in ThoughtSpot. You can see recent events in the Control Center or view more detailed audit logs using tscli. Administrators can view audit logs of configuration changes users have made to ThoughtSpot in these ways:

- Monitor events from the [Control Center \[See page 439\]](#).
- Generate audit log reports through the `tscli` command.

You can access an audit log of cluster events through tscli. You can also access information on cluster updates, configurations, data loading and metadata events.

Use the `tscli event list` command to return an audit list of events from the cluster. The syntax is:

```
tscli event list
[--include <all|config|notification>]
[--since <hours,minutes,days>
 | --from <yyyymmdd-HH:MM>
 --to <yyyymmdd-HH:MM>]
[--detail]
[--summary_contains
<'string1'| 'string2' ...>]
[--detail_contains
<'string1'| 'string2' ...>]
[--attributes
<key1='value1'| 
key2='value2' ...>]
```

Optional parameters are:

Parameter	Description
--include	Specifies the type of events to include, and can be <code>all</code> , <code>config</code> , or <code>notification</code> .
--detail	Returns the events in a detail format rather than a tabular summary, which is the default.
--summary_contains <'string1'   'string2' ...>	Specifies a string to check for in the event summary. Enclose strings in single quotes, and separate multiple strings with <code> </code> . Events that match all specified strings will be returned.
--detail_contains <'string1'  'string2' ...>	Specifies a string to check for in the detail. Enclose strings in single quotes, and separate multiple strings with <code> </code> (pipe symbol). Events that match all specified strings will be returned.
--attributes <key1='value1' &pipe; key2='value2' ...>	Specifies attributes to match as key=value pairs. Separate multiple attributes with <code> </code> (pipe symbol). Events that match all specified key/value pairs will be returned. Put single quotes around the value(s).

And a time window made up of either:

- `--since <hours,minutes,days>` is a time in the past for where the event audit begins, ending at the present time. Specify a human readable duration string, e.g. `4h` (4 hours), `30m` (30 minutes), `1d` (1 day).

Or both:

- `--from <yyyymmdd-HH:MM>` is a timestamp for where to begin the event audit. It must be of the form: `yyyymmdd-HH:MM`.
- `--to <yyyymmdd-HH:MM>` is a timestamp for where to end the event audit. It must be of the form: `yyyymmdd-HH:MM`.

To get audit logs:

1. Log in to the Linux shell using SSH.
2. Issue the `tscli event list` command, with the desired parameters, for example:

```
$ tscli event list
  --include config
  --since 24 hours
```

## Security policies

Security policies are the principles and processes ThoughtSpot uses in development to ensure a product that conforms to security standards. Security policies ensure a secure product with each release. When a release is in development, each build is tested using Qualys Network Security and Vulnerability Management Suite. Issues and vulnerabilities are fixed proactively, based on the results.

The ThoughtSpot Engineering and ThoughtSpot Support teams are notified of Common Vulnerabilities and Exposures (CVEs), so they can patch OS packages proactively as well. You can view installed packages along with their version numbers at any time, in order to see if you require an update to ThoughtSpot.

Whenever a CVE is identified, and an OS package needs to be updated, the next patch release will include the patch or update. You can view installed Linux packages at any time, along with the version numbers of the installed packages.

## Third-party security software for security, governance, and monitoring of ThoughtSpot

You can install supported [third-party security and monitoring software \[See page 196\]](#) on a ThoughtSpot cluster.

# About third-party security and monitoring software

**Summary:** You can install third-party software for security, governance, and monitoring of ThoughtSpot.

In addition to the ThoughtSpot monitoring and security features, some companies require specific additional third-party software to comply with their internal IT policies. This allows them to support all of their systems with a common set of security and management tools.

For example, you may wish to accomplish some security and monitoring tasks with your own third-party software. These tasks include things like pushing alerts, events, forensics, audit trails, insights, etc. from ThoughtSpot to your own local monitoring systems.

## Supported third-party software

ThoughtSpot supports installation of the following third-party software on the ThoughtSpot instance:

- Qualys Qualys is a widely used technical vulnerabilities and security compliance scanning tool. For more information about Qualys, see the [Qualys documentation \[See page 0\]](#).
- SNMP (Simple Network Management Protocol) SNMP is an industry standard protocol used for monitoring network traffic and alert events.
- Splunk You can install Splunk rsyslog and use it to forward ThoughtSpot logs to Splunk. For more information about Splunk, see the [Splunk documentation \[See page 0\]](#).

### Install third-party software

For details on how to install third-party software, see: [Installing third-party security and monitoring software \[See page 199\]](#)

## What is not supported

When installing and configuring third-party software on a ThoughtSpot cluster, follow the following guidelines to avoid interfering with cluster operations:

- Avoid making any direct changes to any files outside of the /home directory.
- Do not remove existing SSH keys or authorized keys from /home/admin/.ssh
- Excessive resource usage, e.g. CPU, disk, memory, processes, etc.
- Killing any system or ThoughtSpot services, or causing node reboots.

Do not change any system wide configuration which may affect ThoughtSpot, such as:

- Network, e.g. IP addresses, DNS resolution
- Storage, e.g. removing existing mount points, removing drives
- Security, e.g. selinux

## Qualys

Qualys is supported for scanning of ThoughtSpot clusters for security vulnerabilities.

## SNMP Traps

ThoughtSpot has a built-in alerting service that can also be used to send SNMP traps. Many third-party monitoring systems share the common standard of using SNMP traps, and you can take advantage of those capabilities with ThoughtSpot.

ThoughtSpot supports SNMP for read only. So for example, you can read the IP address of the cluster, but not change it using SNMP.

See the [Alert code reference \[See page 0\]](#) for details.

## Splunk rsyslog

ThoughtSpot monitoring and alerting logs are written to standard locations in the file system. This allows you to use rsyslog to collect them and send them to Splunk.

Here are some links to help you learn where various logs are written in ThoughtSpot:

- [Monitoring logs \[See page 414\]](#)
- [Audit logs \[See page 193\]](#)
- [Alert code reference \[See page 0\]](#)

# Installing third-party security and monitoring software

**Summary:** You can install third-party software for security, governance, and monitoring of ThoughtSpot.

This procedure shows how to install supported [third-party security and monitoring software](#) [See page 196] on a ThoughtSpot cluster:

## To install third-party software

1. Log in to the Linux shell using SSH.
2. Issue the `tscli ansible checkout` command, specifying a temporary directory, for example:

```
$ tscli ansible checkout  
Checking out playbooks successfully in /tmp/111895937.
```

3. Switch to the temporary directory that was created.

```
$ cd /tmp/111895937
```

4. In the temporary directory, save or edit the playbooks and modules.

If you want to create a global ordering between playbooks, name them in alphabetical order, e.g. 10.first.yml, 20.second.yml, etc. You can also specify the order line by line in order.txt within the same directory.

5. Commit your changes. This command will validate the playbook first, and then apply it.

Use the `-local` flag if you want to commit the change only to local storage on the local node. Otherwise, push it will go to centralized storage, and your changes will apply to all nodes in the cluster.

- To apply your changes globally to all nodes in the cluster, issue the command:

```
$ tscli ansible commit
```

- To apply your changes on the local node only, issue the command:

```
$ tscli ansible commit --local
```

This commits your changes. If there is a problem with the configuration, you will see an error message in standard output.

# Data security

**Summary:** Data security refers to which users can see which data in the ThoughtSpot application.

Sharing and security privileges govern what data a user can access and what they can do with the data. Admins can use privileges to regulate access to information and provide a personalized user experience.

## Users, groups, and privileges

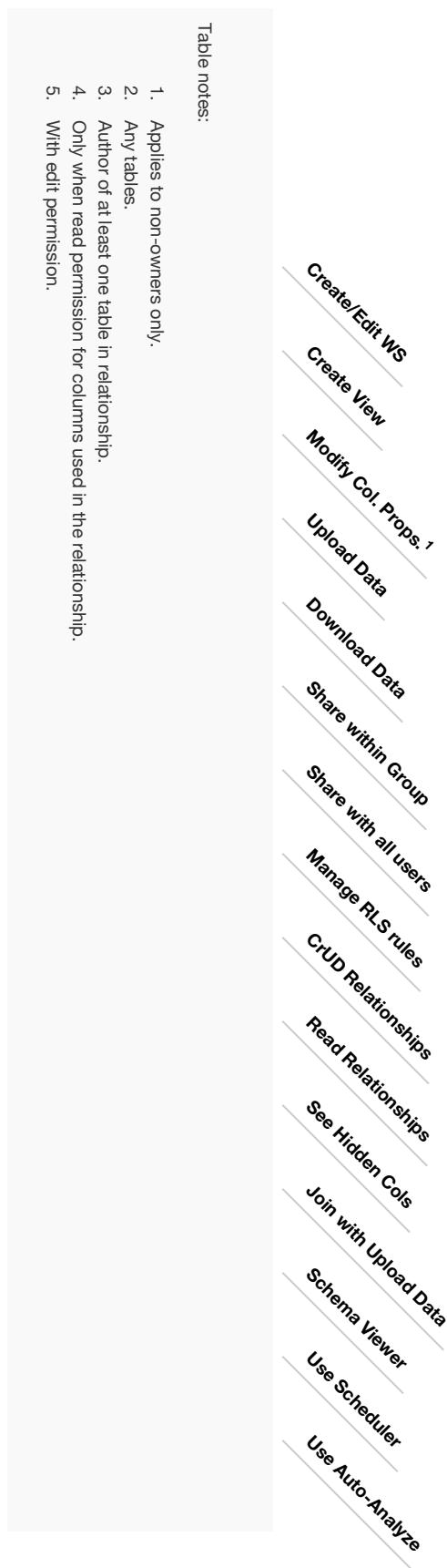
Data security applies to users and groups. Users can be managed [manually \[See page 161\]](#) or through [LDAP \[See page 44\]](#). Each user can have membership in one or more groups. Admins can make security settings that determine what users are allowed to do in ThoughtSpot. These settings are applied at the group level.

The following table shows the intersection of user privilege and ability:

	Create/Edit WS	Create View	Modify Col. Props. <sup>1</sup>	Upload Data	Download Data	Share within Group	Share with all users	Manage RLS rules	CrUD Relationships	Read Relationships	See Hidden Cols	Join with Upload Data	Schema Viewer	Use Scheduler	Use Auto-Analyze
Can administer ThoughtSpot	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Can upload user data	N	N	N	Y	N	Y	N	Y <sup>3</sup>	Y <sup>4</sup>	Y	Y	Y	Y	Y	Y
Can download data	N	N	N	N	Y	Y	N	N	Y <sup>4</sup>	N	N	N	N	N	N
Can manage data	Y	Y	Y	Y	N	Y	N	N	Y <sup>4</sup>	Y <sup>4</sup>	Y <sup>5</sup>	Y	N	N	N
Can share with all users	N	N	N	N	N	Y	Y	N	Y <sup>4</sup>	Y <sup>4</sup>	N	N	N	N	N
Has SpotIQ privilege	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y
Can Administer and Bypass RLS	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
None	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N

Table notes:

1. Applies to non-owners only.
2. Any tables.
3. Author of at least one table in relationship.
4. Only when read permission for columns used in the relationship.
5. With edit permission.



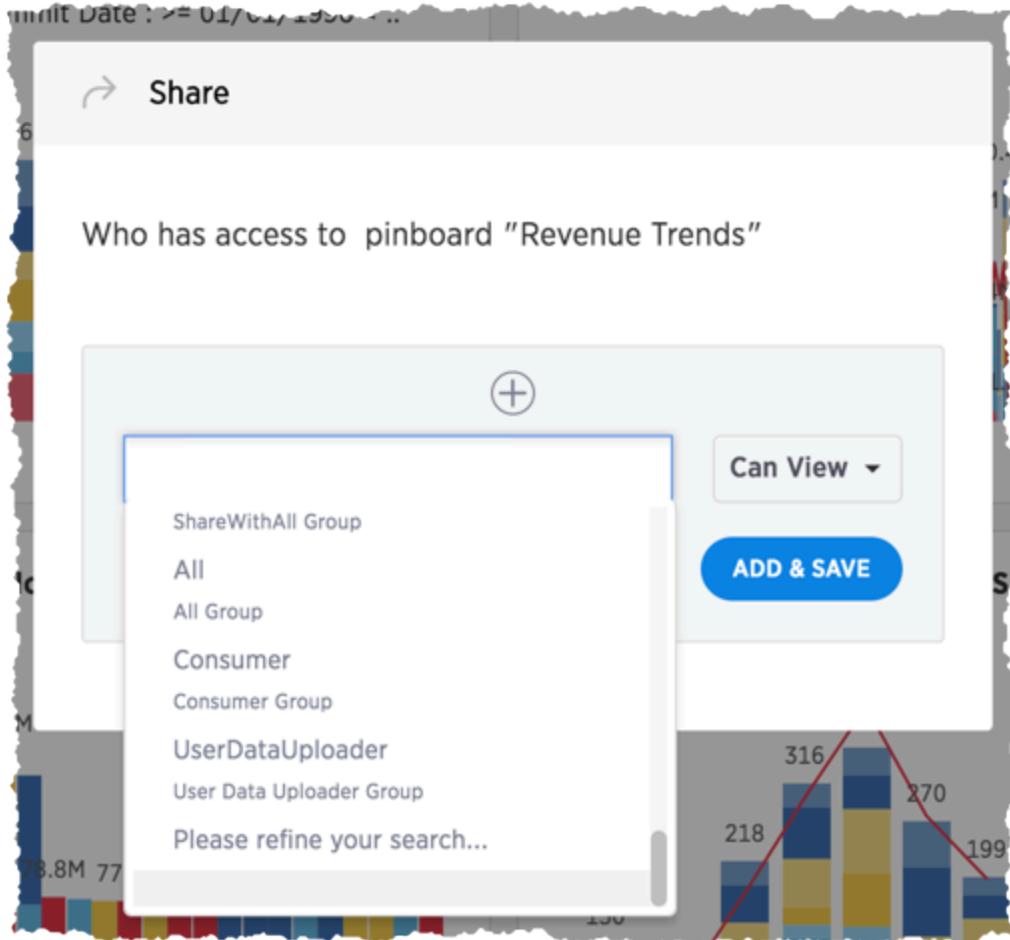
## Security model for sharing objects

You can share with groups and with individual users. Sharing of tables can be defined at the table, column, or row level. This provides flexibility in modeling your data security policy. Security and sharing settings apply to several different types of objects, each of which has its own security default settings and rules.

Object type	Description	Default security model
Tables	The source data tables that have been loaded using ThoughtSpot Loader.	Administrator users have access to source tables. They can share a table with other users or groups. See [Share tables and columns](share-source-tables.html#)
Columns	The columns in the source data tables that have been loaded using ThoughtSpot Loader.	Administrator users have access to columns in the source tables. They can share selected columns with other users or groups. See [Share tables and columns](share-source-tables.html#)
Rows	The rows in the source data tables that have been loaded using ThoughtSpot Loader.	All rows in the source tables are shared with all users by default.
Imported data	Data that was imported using a Web browser.	Only the user who imported the data (and any user with administrator privileges) has access to it by default. They can share a table (or selected columns) with other users or groups. See [Share tables and columns](share-source-tables.html#)
Worksheets	A worksheet created using a Web browser.	Only the creator of the worksheet (and any user with administrator privileges) has access to it by default. They can share a worksheet with other users or groups. See [Share worksheets](share-worksheets.html)
Pinboards	A pinboard of saved search results.	Anyone who can view a pinboard can share it. See [Share a pinboard](share-pinboards.html)

## Understanding SHAREABLE

When you share an object, only the users and groups that have **SHAREABLE** set for the **Sharing visibility** option appear on the dialog.



Only users in the **Administrators** group or users with **Admin** privileges can share with groups marked as **NOT SHAREABLE**. Members of a group with **Can share with all users** authorization can also share with groups marked as **NOT SHAREABLE**.

Users in groups marked **NOT SHAREABLE** cannot share objects among themselves. In multi-tenant scenarios, admins can create groups that bring together portions of two non-share groups so that they can share. For example, the members of group C can share even if they belong to other groups that cannot.

## Row level security

ThoughtSpot includes robust row level security, which allows you to filter all objects users see based on conditions you set at the level of row values in base data tables.

You may find it useful to create groups for RLS. To prevent these groups from appearing in the **Share** dialog, create a **NOT SHAREABLE** group with a single user and an RLS group with another single user (1-to-1).

## Related information

- [Revoke access \(unshare\) \[See page 216\]](#)
- [Row level security \[See page 219\]](#)

# Share tables and columns

**Summary:** You can share an entire table, or only some of its columns.

By default, when data is loaded using the ThoughtSpot Loader, ODBC, or JDBC, it is only visible to administrators. Data imported from a Web browser is visible to administrators and the user who uploaded it. Administrators and owners can share **Can View** or **Can Edit** privileges on tables with other users, who can further share them with others.

## Permissive or strict sharing

Use caution when sharing tables, because any objects created from them will have dependencies on the tables and their underlying structure. Objects created from tables can include worksheets, answers, and pinboards. This means that if a user wants to drop or modify a table, any object that depends upon it must be edited or removed first, to remove the dependency.

For this reason, it is a best practice to only grant the **Edit** permission on tables to a small number of users. If you want to prevent shares from also revealing the columns regardless of where it appears (worksheets, answers, and pinboards), you can ask ThoughtSpot Customer Support to enable a stricter behavior.

## How to share

Share a table or imported data by following these steps:

1. Click **Data** in the top navigation bar.
2. Click **Tables**.

Name	Source	Stickers	Materialize Status	Modified	Author
ThoughtSPORT_Date_Dimension	Sports Goods		a month ago		Administrator Super-User
MarketSpot_Sales_Fact	MarketSpot		a month ago		Administrator Super-User

3. Select one or more tables to share, and click the **Share** icon.
4. Select **Entire Table** or **Specific Columns**.

Name	Source	Stickers	Materialize Status	Modified	Author
Austin_Animal_Center_Outcomes			3 months ago		vicky
fruit_sales_4.4			4 months ago		victoria

5. If you selected **Specific Columns**, select the column to share.
6. Click **+** and select the users and groups with whom you want to share.
7. Configure the level of access by selecting from the dropdown list. You can select:
  - **Can View** to provide read-only access. This enables viewing the table data and defining worksheets on the table.
  - **Can Edit** to allow modification. This enables renaming, modifying, or deleting the entire table and adding or removing its columns.
8. Click **Add and Save**.
9. Click **Done**.

# Share worksheets

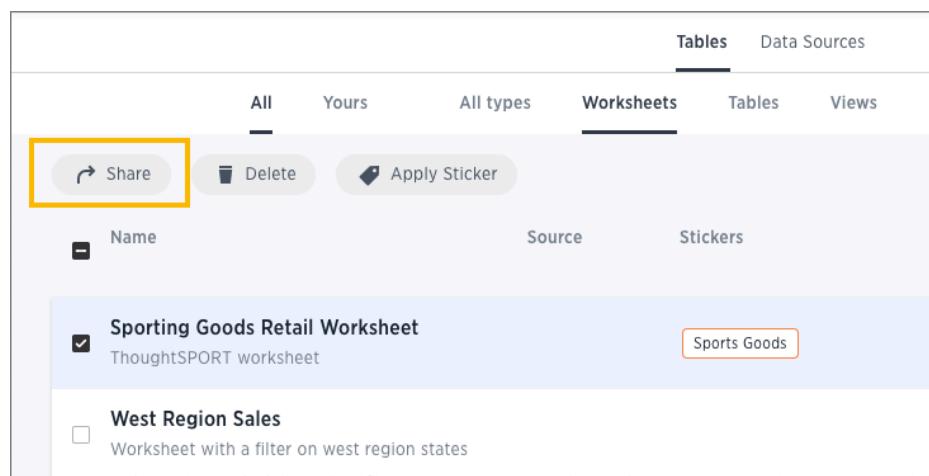
**Summary:** You can share worksheets with users or with groups.

Sharing a worksheet allows users to select it as a data source and search it.

When you share a worksheet, all of its columns are shared. Sharing a worksheet does not share the underlying tables. If you want to share the underlying tables, see [Share tables and columns \[See page 207\]](#). A worksheet can be shared by the owner of the worksheet, or by an administrator. Users can start searching a worksheet as soon as the worksheet is shared with them.

To share a pinboard:

1. Click **Data** on the top navigation bar and choose **Worksheets**.
2. Select one or more worksheets to share, and click the **Share** icon.



3. Click **+ Add users or groups** and select users or groups that you want to share with.

Share

Who has access to worksheet "Sporting Goods Retail Wor.."

M	Mike Mike	Can Edit	x
V	victoria victoria	Can View	x
SH	scott Scott Holden	Can Edit	x
ThoughtSPORT	ThoughtSPORT ThoughtSPORT	Can View	x
N	nathan Nathan	Can View	x
basic	basic	Can View	x

+ **DONE**

The screenshot shows a 'Share' dialog box. At the top, it says 'Who has access to worksheet "Sporting Goods Retail Wor.."'. Below this is a table listing six entries. Each entry consists of a small icon, a name, a role selection dropdown, and a delete 'x' icon. The entries are: 1. Mike (Can Edit), 2. victoria (Can View), 3. scott (Can Edit), 4. ThoughtSPORT (Can View), 5. nathan (Can View), and 6. basic (Can View). At the bottom of the table is a large grey button with a plus sign and the word 'DONE' in blue.

4. Configure the level of access by selecting from the dropdown list. You can select:
  - **Can View** to provide read-only access. Enables viewing the worksheet and searching on it.
  - **Can Edit** to allow modification. Enables renaming, modifying filters, or deleting the worksheet and adding or removing its columns. To add columns to a worksheet a user needs access to the underlying table.
5. Click **Add and Save**.
6. Click **Done**.

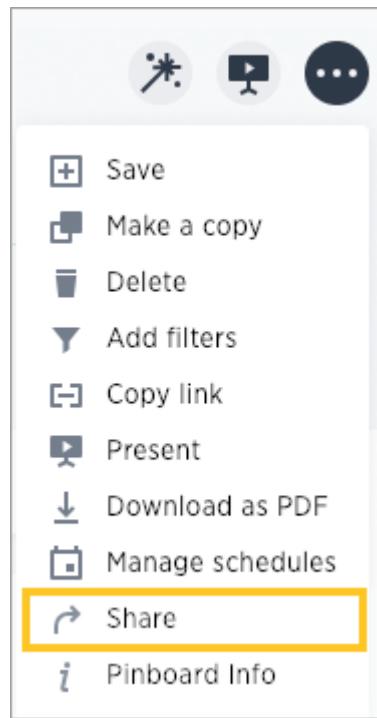
# Share a pinboard

**Summary:** Whenever you view a pinboard you have the option of sharing it with others.

When you share a pinboard what you are really sharing is a live link to the pinboard, when you click **Share with....** So whenever someone else views it, they will see the most recently saved version with the most recent data. You do not have to be an administrator or the owner to share saved pinboards. Any user can share them, based on the access levels the user has.

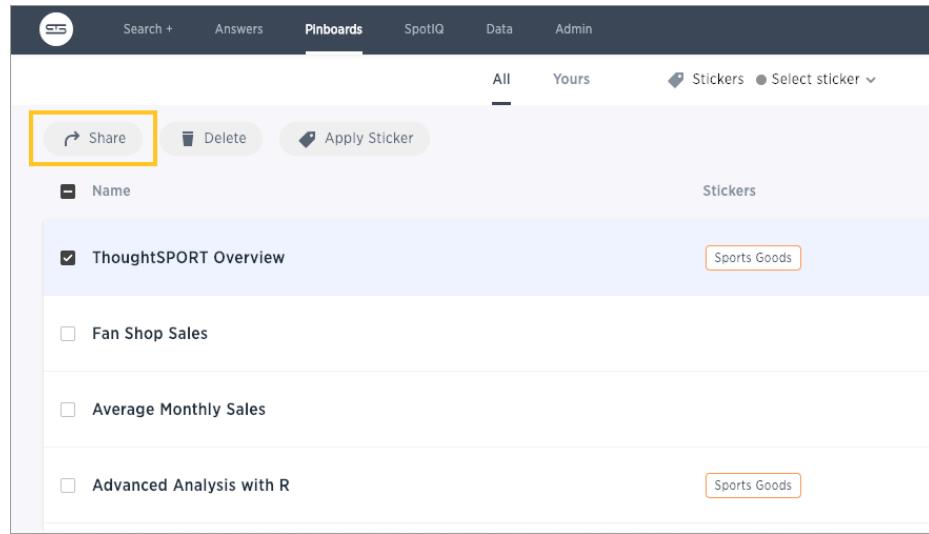
To share a pinboard:

1. Configure it to look as it must appear when shared.
2. From within a pinboard, click the ellipses icon  , and select **Share**.



Alternatively, select the pinboard you want to share from the list of pinboards and click **Share**.

(The profile picture or avatar for the owner of each pinboard is shown in the list.)



3. Click the plus (+) at the bottom of the Share dialog, and select users or groups with whom you want to share.

The screenshot shows the 'Share' interface for a pinboard titled "ThoughtSPORT Overview". It lists six users and groups with their current access level and edit options:

User/Group	Access Level	Edit Option
marco	Can Edit	<input type="button" value="x"/>
victoria	Can View	<input type="button" value="x"/>
ThoughtSPORT	Can View	<input type="button" value="x"/>
basic	Can View	<input type="button" value="x"/>
nathan	Can Edit	<input type="button" value="x"/>
vicky	Can View	<input type="button" value="x"/>

A modal dialog is open at the bottom, allowing for new sharing:

- A text input field contains "antony X".
- An access dropdown next to it is set to "Can View".
- Buttons for "CANCEL" and "ADD" are visible.

4. Configure the level of access by selecting from the dropdown next to each user or group.

Available options are based on your own access level. For example, if you have only **View** access, you will not have an option to share as **Edit**. You can select:

- **Can View** to provide read-only access. If the person doesn't have access to the underlying data, they can only view a shared pinboard. If they change anything on the pinboard, their changes are not saved. In order to persist the changes, the user would need to make a copy of the modified pinboard.

- **Can Edit** to allow modification. Enables renaming or deleting the shared pinboard.

If a person with edit privileges modifies a shared pinboard, their changes will be saved to it.

5. Click **Add** to save your changes, then click **Done**.

The screenshot shows the 'Share' interface for a pinboard titled 'ThoughtSPORT Overview'. It lists six users and their access levels:

User	Access Level
victoria	Can View
ThoughtSPORT	Can View
basic	Can View
nathan	Can Edit
vicky	Can View
antony	Can View

At the bottom left is a '+' button, and at the bottom right is a 'DONE' button.

# Security for SpotIQ functions

SpotIQ is a feature in ThoughtSpot that automatically generates insights into system data. The feature works on all the data in your system, search queries, saved answers, and pinboards. Because SpotIQ uses the same data security model as other data in the system, there is no need to build a new schema or security model to support it.

SpotIQ automatically generates insights into data when a user requests them. These requests can be run immediately or users can schedule regular analysis. SpotIQ requests for insights can put additional load on your system depending on the amount of data being analyzed and how frequently users make use of it.

Users are required to have the **Has Spot IQ privilege** to use this feature. Users without this privilege cannot view insights unless the users that generated the insights add them to a pinboard and share the pinboard with others.

You may want to restrict access to a subset of your users or even to a subset of your managers. To restrict access to this feature:

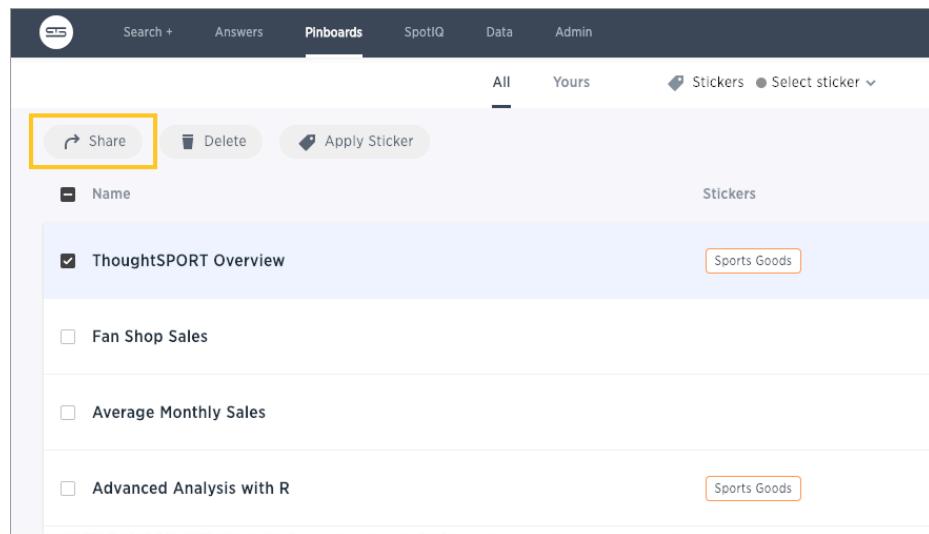
1. Create a group called **SpotIQUsers**.
2. Grant this group **Has Spot IQ privilege**.
3. Enable users to this group.

# Revoke access (unshare)

You may need to revoke access to an object (table, worksheet, or pinboard) that you have previously shared. Unsharing an object is very similar to sharing it.

To unshare one or more objects:

1. Go to the area where the object(s) you want to unshare is located. From the top menu bar:
  - If the object is a table or worksheet, click **Data**.
  - If the object is a pinboard, click **Pinboards**.
  - If the object is an answer, click **Answers**.
2. Find the object(s) in the list, and check the corresponding box(es).
3. Click the **Share** icon.



The screenshot shows the ThoughtSpot Pinboards interface. At the top, there is a navigation bar with icons for Search +, Answers, Pinboards (which is the active tab), SpotIQ, Data, and Admin. Below the navigation bar, there are filters for All, Yours, Stickers, and a Select sticker dropdown. A toolbar below the filters includes a Share button (highlighted with a yellow box), a Delete button, and an Apply Sticker button. The main area displays a list of pinboards. The first pinboard, "ThoughtSPORT Overview", has a checked checkbox next to its name and is associated with a "Sports Goods" sticker (also highlighted with a yellow box). The other three pinboards in the list ("Fan Shop Sales", "Average Monthly Sales", and "Advanced Analysis with R") have unchecked checkboxes and are not associated with any stickers.

4. Click the X next to the users and groups that you want to remove from sharing.

Share

Who has access to pinboard "ThoughtSPORT Overview"

 victoria victoria	Can View	x
 ThoughtSPORT ThoughtSPORT	Can View	x
 basic basic	Can View	x
 nathan Nathan	Can Edit	x
 vicky vicky	Can View	x
 marco marco	Can Edit	x

+ 

DONE

5. Click **Save**, and then click **Done**.

## Share

Who has access to pinboard "ThoughtSPORT Overview"

 victoria victoria	Can View ▾	x
 ThoughtSPORT ThoughtSPORT	Can View ▾	x
 basic basic	Can View ▾	x
 nathan Nathan	Can Edit ▾	x
 vicky vicky	Can View ▾	x

+ DONE

# About row level security (RLS)

**Summary:** Using row level security, you can restrict data that appears in search results and pinboards by group.

Row level security (RLS) allows you to restrict a group's access to table row data. You do this by creating a *rule* that associates a filter with a group. When a group member searches, views an answer, or otherwise works with data, ThoughtSpot evaluates the rules and prevents the display of the restricted data. Users see only the data they are permitted to see.

## How does RLS impact user interactions?

The security rules apply to objects shared with users individually or through groups they are a member of. The rules restrict the visible data when users:

- view a table
- view a worksheet derived from the table
- search for data in the worksheet or table
- view answers from restricted data — either that they've created or that were shared with them
- interact with pinboards from restricted data — either that they've created or that were shared with them

Search suggestions also fall under row-level security. If a user would not have access to the row data, then values from the row do not appear in **Search** suggestions.

## Why use RLS?

RLS allows you to set up flexible rules that are self-maintaining. An RLS configuration can handle thousands of groups. There are several reasons you might want to use row level security:

Reason	Example

Hide sensitive data from groups who should not see it.	In a report with customer details, hide potential customers (those who have not yet completed their purchase) from everyone except the sales group.
Filter tables to reduce their size, so that only the relevant data is visible.	Reduce the number of rows that appear in a very large table of baseball players, so that players who are no longer active are not shown except to historians.
Enable creation of a single pinboard or visualization, which can display different data depending on the group who is accessing it.	Create one sales pinboard that shows only the sales in the region of the person who views it. This effectively creates a personalized pinboard, depending on the viewer's region.

## Related information

- To continue learning about RLS, see [How rule-based RLS works \[See page 221\]](#).
- **Search** suggestions relies on compile indices to present suggestions to users from your data. See [Manage suggestion indexing \[See page 293\]](#) to learn how to configure suggestions.

# How rule-based RLS works

**Summary:** Use rule-based RLS to restrict a group's access to data.  
Users see only accessible row data.

Row level security works at the group level and is configured on tables. A table's RLS rules also apply to any objects with data from that table. So, searches, answers, worksheets, and pinboards that rely on a table's data fall under RLS rules.

## Worksheet queries and RLS

You cannot set RLS rules on worksheets, only on tables. However, administrators can disable RLS on worksheets that are derived from tables with RLS rules. After RLS rules are disabled, users with access to the worksheet can see all its data.

By default, worksheet queries only take into account RLS rules on tables whose columns appear in the query. Other related tables that may underly the worksheet are ignored. This means that not all RLS rules on underlying tables are applied when a user queries a worksheet.

You can configure a stricter application of RLS rules to take into account RLS rules from all the tables underlying the worksheet. This is recommended if you have key dimension tables that worksheets rely on but that are not necessarily regularly accessed through query. To do this, contact ThoughtSpot Customer Support.

## Privileges that allow users to set, or be exempt from, RLS

Users in the **Administrators** group or with the **Has administration privilege** have full access to everything in the system. As a result:

- Row level security does not apply to them.
- They can create, edit, and delete RLS rules.
- They can also disable RLS rules on individual worksheets.

If your installation has enabled the **Can Administer and Bypass RLS** privilege, administrators can also grant **Can Administer and Bypass RLS** to groups. Members of groups with **Can Administer and Bypass RLS**:

- Are exempt from row-level security (RLS) rules.
- Can add/edit/delete existing RLS rules.
- Can check or uncheck Bypass RLS on a worksheet.

This behavior is true regardless of whether the privilege is from a direct group membership or indirect (through a group hierarchy).

## Examples of RLS rules

An RLS rule evaluates against two system variables:

Function	Description	Examples
ts_groups	Returns a list of all the groups the current logged in user belongs to. For any row, if the expression evaluates to true for any of the groups, the user can see that row.	ts_groups = 'east'
ts_username	Returns the user with the matching name.	ts_username != 'mark'

ThoughtSpot filters a table's rows by evaluating a rule against the authenticated user.

A rule is an expression that returns a boolean, `TRUE` or `FALSE`. If the rule evaluates to `TRUE`, a user can see that row. If the rule evaluates to `FALSE` for the user, then the user cannot view the data and instead they see the message `No data to display`.

Rule expression can be implicit or explicit. And rules may or may not contain logic. A simple implicit RLS rule has the format:

`COLUMN_FILTER = ts_groups`

An example of an explicit rule that contains logic would be:

`if ( COLUMN_FILTER ) then true else false`

Rules can also reference tables other than the table you are securing.

Consider a simple RLS rule example. Your company has `vendor-purchase` table such as:

DATE	VENDOR	AMOUNT
12/11/39..	zendesk	116.00
12/11/39..	getquik com ca	289.70
12/11/39..	ikea	113.91
12/11/39..	costco	274.43
12/11/39..	waiters wheels pa	66.52
12/11/39..	waiters whee	76.49
12/11/39..	chipotle	175.33

You want to give your vendors the ability to see trends in company purchases. You give vendor personnel access to ThoughtSpot *and* add them to self-titled vendor groups. So, all users from the Starbucks vendor are in the `Starbucks` group and all users from `round table` are in the `Round Table` group. Then, you set a **Row security** on the `vendor-purchase` table as follows:

```
VENDOR = ts_groups
```

Only users in `Starbucks` group see `starbucks` data and so forth. Rules ignore case inconsistencies and spaces are evaluated so `round table` in the data matches the `Round table` group but not a group named `RoundTable`.

Rules can be simple or they can incorporate logic such as `if/then` rules. For example, vendors should see their own data but your accounts payable group needs to see all the vendor data:

```
VENDOR = ts_groups or 'Accounts Payable' = ts_groups
```

This rule continues to work as you add data from new vendor or team members to `Accounts Payable`. In this way, a well-written rule is *self maintaining*, meaning you don't have to revisit the rule as your system changes.

You can also create rules that reference tables other than the table you are securing. For example, if you have a `sales` table and `store` dimension table, you can use attributes from the `store` table to secure the `sales` table.

## Multiple rules and multiple group membership

You can define multiple rules on table. In this case, ThoughtSpot treats the rules as additive. That is, they are applied using an `OR` operator. If any of the rules evaluate to `true` for a user on a row, that row's data is visible.

If a user is a member of multiple groups, the user can see all the rows that are visible to all of their groups. The most permissive policy is used.

Members of groups with **Can Administer and Bypass RLS** are exempt from row-level security (RLS) rules. This is true regardless of whether the group membership is direct or indirect (through a group hierarchy).

## Best practices for using Rule-Based Row Level Security

Use these best practices for Rule-Based Row Level Security:

- Use **Share** as the first level of data access.

Non-administrative users and groups have no way to access any data without first having it shared with them. So, only share what you need.

When you share, share worksheets. This is a general best practice. Worksheets simplify the data environment for end users; they only need to choose among a few sources, rather than many tables. Also, one worksheet can also combine data from several tables.

- Set row level security wherever you want to keep data secure.

It is always a possibility that a particular search only includes data from a single table, and a user will see something they shouldn't. So, protect your data by setting row level security wherever you want to keep data secure.

- Explicitly grant access for users that should see all rows.

As soon as you define a rule on a table for one group, you prevent access by all others outside of that group hierarchy. Subsequent rules should specifically add groups that need access.

- Keep in mind that multiple rules on a table are additive with `or`.

If you are concerned with security, start with very limited access. Then, expand the access as needed.

- Keep rules simple.

Complex rules can impact the system performance. So, err on the side of simple rules rather than complex rules with a lot of logic.

## Related information

- To learn the procedure you follow for setting a rule, [Set RLS rules \[See page 226\]](#)
- For a list of operators and functions you can use to build RLS rules see [Row level security rules reference \[See page 0\]](#).
- For information on bypassing rules on a worksheet, see [Change inclusion, join, or RLS for a worksheet \[See page 339\]](#).

# Set row level security rules

**Summary:** Explains the process for setting RLS rules.

When rule-based row level security (RLS) is set, it prevents users from seeing data they shouldn't in tables and the objects derived from them. You must have administrative rights on ThoughtSpot to set RLS rules.

Before you create a rule, make sure you have read [How rule-based RLS works \[See page 221\]](#).

## Create a rule on a table

You can set RLS rules *only* on tables. To set up rule-based row level security, do the following:

1. Click **Data**, and double-click a table.
2. Click **Row security**.
3. Click **+ Add row security**.

The screenshot shows the ThoughtSpot interface for managing row-level security. At the top, there's a navigation bar with 'SYSTEM TABLE' and a back arrow, followed by the table name 'Fruit\_Cart\_Large'. Below the navigation are tabs for 'Columns', 'Data', 'Relationships', 'Dependents', and 'Row security', with 'Row security' being the active tab. A callout box highlights the '+ Add row security' button. Below this, there's a section titled 'Example' with an illustration of a person holding a pencil. It explains how to type an expression to apply data from a column to a group, giving an example for 'EastSales' and 'WestSales' groups. A code snippet 'concat(region, "Sales") = ts\_groups' is shown. Further down, there's a 'Groups' section listing 'EastSales' and 'WestSales', and a 'This table' section showing a table with columns 'Customer' and 'Region', containing rows for 'ABC' (East) and 'XYZ' (West).

The system displays the Rule Builder.

Enter Rule name

start typing your formula here

Rule Assistant

Cancel Save

You define row level security by creating an expression that gets evaluated for every row and group combination. This powerful feature can be used with up to thousands of groups.

4. Open the Rule Builder.
5. Give your rule a name.
6. Enter an expression for your rule.

The rule gets evaluated against an authenticated user for every row and group combination. If the rule evaluates to true, the user can't see that row's data. Use the variable **ts\_groups** to refer to the group name.

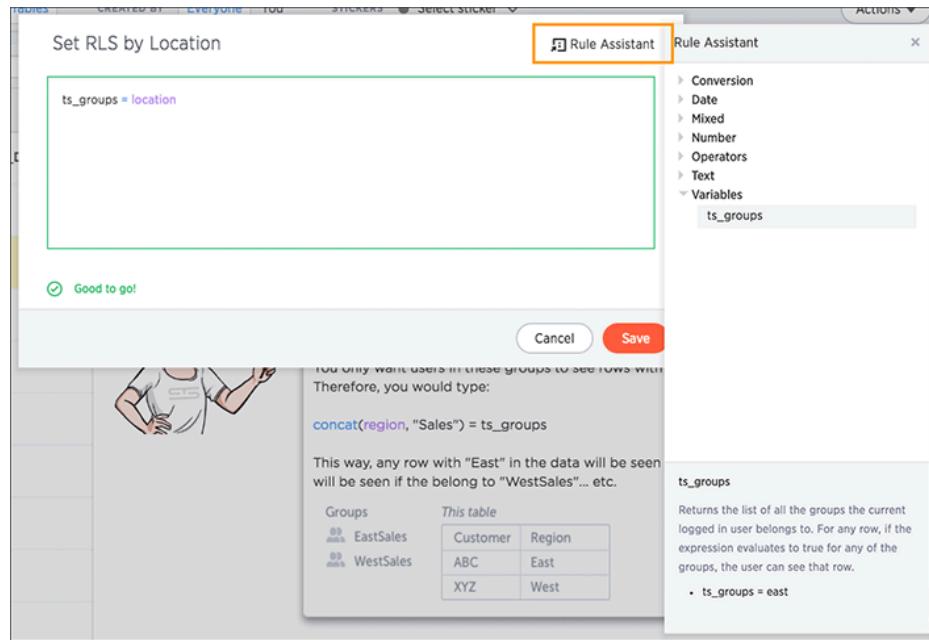
Set RLS by Location

ts\_groups = location

Good to go!

Rule Assistant

You can see a list of available operators by clicking on **Rule Assistant**.



As you type, ThoughtSpot suggests formula syntax, variables, and column names. If you can't remember the exact column name or variable you want to use, the suggestions can help.

When your expression is valid, a green indicator appears at the bottom of the Rule Builder.

7. Click **Save**.

The rule you created is listed in the rules. You can edit the rule or add more rules by clicking **+ Add**.

## Test your rule with restricted and unrestricted users

To test your rule, log in as users in different groups. Search within the table for data both that you test user can and can't access. Make sure your test users are seeing the appropriate rows.

## Related information

- Administrators can bypass the RLS rules set on a the table at the worksheet level. See how to “[Change inclusion, join, or RLS for a worksheet \[See page 339\]](#)” in this documentation for more information.
- For a list of operators and functions you can use to build RLS rules see [Row level security rules reference \[See page 0\]](#).

# ThoughtSpot Lifecycle

**Summary:** This topic covers security processes for the entire lifecycle of a ThoughtSpot deployment from development, release, installation, upgrades, to software patching.

## Overview

A ThoughtSpot deployment consists of the following high level software systems:

- Operating System (OS) and software packages installed on the OS
- Third-party software
- ThoughtSpot application services (binaries and configuration)

### Operating System

All ThoughtSpot physical appliances, virtual machines (VMs) and public cloud images come pre-installed with CentOS 7. The [CentOS \[See page 0\]](#) distribution of Linux is owned by [RedHat \[See page 0\]](#) and closely tracks versions of RedHat Enterprise Linux (RHEL).

ThoughtSpot uses the minimal install of CentOS 7 with the addition of a few software packages (e.g. Python) needed for ThoughtSpot operations. The most notable change to the installation is to the Linux kernel, which is sourced from the current long term stable kernel version instead of the default included in CentOS 7 (kernel-lt package). To list all the installed packages, see [Checking Package Versions \[See page 232\]](#).

### Third-Party Software (Middleware)

Third party software used includes Java, Boost C++ libraries, Google protocol buffers, etc. These are software components necessary for operation of the ThoughtSpot application. ThoughtSpot only uses software licensed for distribution.

## Development and Release Process

ThoughtSpot releases its software as a tarball containing all the ThoughtSpot application (binaries and configuration), third-party software, and an operating system image. Installation or update using this release tarball on appliances, VMs, or cloud instances updates each of these components.

### Operating System

Building the operating system image including software packages is a multi-step process:

1. Begin with the set of packages in the base OS image and our added packages.
2. Configure all installation to only use official public RedHat repositories.
3. For each package, install the current stable version including any security patches.
4. Bring up the image on all supported platforms for stability and performance testing along with the ThoughtSpot application stack. Success criteria: no OS impact on stability or performance.
5. Scan the Operating System and ThoughtSpot application stack using Qualys scans with additional modules enabled: Vulnerability Management, Web App Scanning.
6. Review all vulnerabilities found. Success criteria is zero severity 4+ vulnerabilities.
7. Assuming all above testing and exit criteria are met, the OS image is considered qualified.

### Third-Party Software

Third-party software is periodically sourced from the upstream distribution of each software component. Unlike OS and ThoughtSpot application, this changes less frequently and on an as needed basis, when any new security vulnerability or stability issue is discovered in the library. The list of all third-party software as well as licensing details are here.

## ThoughtSpot Application

ThoughtSpot follows industry standard best practices for writing robust software. Every code change is reviewed by at least one engineer. Our engineering team consists of senior engineers from Enterprise software and web companies.

ThoughtSpot uses a small number of proven programming languages powering some of the largest enterprises in the world. ThoughtSpot tracks stability, performance, and reliability of our software and services aggressively. The ThoughtSpot platform is trusted by dozens of global F2000 organizations.

### *Protection of Source Code*

Source code is private and not shared publicly, e.g. all distribution to customers is in binary or minified format to discourage reverse engineering.

### *Automated Tools*

We use automated tools and infrastructure like Jenkins, Kubernetes, AWS, partnering with the teams behind these systems so as to adopt best practices. For example, all our automation runs through Jenkins, which is managed by CloudBees (the company behind Jenkins) using an enterprise license with regular security patching, and so on. We upgrade our automation tools regularly.

### *Independent Testing*

Independent testing is done outside of the product team by pre sales and post sales before promoting to production. Some areas are tested by third party testers.

### Security Hardening

Starting 4.5.1.5, we have also taken specific steps to incorporate most of CIS standard recommendations towards hardening.

## Installation and Upgrade Process

ThoughtSpot is installed or updated from a release tarball which contains the ThoughtSpot application (binaries and configuration), third-party software, and Operating System image.

### Operating System Image Installation

Installing ThoughtSpot on any node (VM, cloud instance, appliance) automatically updates the operating system and required packages on the node. No Internet or repository access is required for this, the update is applied directly from the release tarball.

Specifically, all nodes running ThoughtSpot are required to have two root partitions on their boot drive of which one of them is booted from at any given time. During installation or update, the Operating System image contained in the release tarball is copied into the second currently-unused root partition and the system switches to it through a reboot.

### Checking OS Package Versions

The following command run from any ThoughtSpot node will indicate versions of all installed packages:

```
rpm -qa
```

### Upgrades

ThoughtSpot patches the Operating System at the time of upgrades. The exact same process used during installation is also applied during upgrades. The previous OS image on a node gets replaced by the new image carried in the release tarball.

Only some releases may patch the Operating System, not all. Typically, all major and minor releases (e.g. 4.4, 4.5, 4.5.1, 5.0) upgrade OS patches, whereas only some patch releases (e.g. 4.4.1.4) contain OS patches.

## Distributed Clusters and Failure Handling

On distributed clusters, individual nodes receive the OS image from the release tarball individually.

Initially, the new image is deployed on a single node only. When that node is deemed healthy following the update and a rich set of tests, the image is made available to remaining nodes in the cluster.

If a node fails to patch, then ThoughtSpot support will modify the upgrade workflow to either retry the patching or skip and exclude the node.

## Third-Party Software

Installation or upgrade of ThoughtSpot deployments automatically upgrades all third-party software to the version included in the release tarball.

## Security Scanning and Patching Process

The ThoughtSpot Security team continuously scans security bulletins for new vulnerabilities discovered in included OS packages (e.g., Linux Kernel, libc) and third party software (e.g., Java). Additionally, weekly scans are done for all release branches using Qualys with the following additional modules enabled: Vulnerability Management, Web App Scanning. The security scans discover vulnerabilities at all layers: OS, third-party software, as well as ThoughtSpot application binaries and configuration. Additionally, ThoughtSpot periodically scans all source code for third-party software as well as ThoughtSpot's proprietary code base for vulnerabilities or unsafe usage using SourceClear.

After a critical new vulnerability is found (severity 4 or 5), ThoughtSpot includes the corresponding patch in the next patch release for all supported release branches. Consult ThoughtSpot documentation or support to find out if you are on an active or supported release branch.

After a new patch release with a critical security vulnerability is available, customers are encouraged to upgrade their deployment quickly.

## Latency

We recommend customers to wait for the next regular release for receiving security patches. However, should a critical vulnerability be discovered in the interim, ThoughtSpot can push out a new patch release containing the required patches, if available upstream.

ThoughtSpot targets a three week or less cadence for generating patch releases for all supported release branches. Timeline for the new release and patching depends on availability of the patch upstream (e.g., not all vulnerabilities in Linux are immediately fixed) and qualification (ThoughtSpot qualifies each build on each supported cloud and on-prem platform). If a fix is unavailable upstream at the moment, customers and ThoughtSpot support can work together to identify potential workarounds.

# Storage Security

## Encryption at Rest

- On-prem: Not supported yet
- Cloud: Supported on [AWS \[See page 0\]](#), [GCP \[See page 0\]](#), [Azure \[See page 0\]](#)

## Secure Erase

[Current erase guide \[See page 0\]](#)

# Encryption of data in transit within a cluster

## Overview

ThoughtSpot supports encryption of data in transit within a cluster (traffic flowing between multiple nodes in a cluster). Encryption in transit within the cluster is primarily needed for cloud deployments of ThoughtSpot. This is accomplished using IPSec.

IPSec operates in two modes: tunnel mode and transport mode. ThoughtSpot recommends using **transport mode** to set up IPSec for encrypting in-transit data.

Note: While IPSec provides additional security, it also reduces network bandwidth between nodes.

ThoughtSpot supports IPSec encryption using strongSwan (an open-source IPSec-based VPN solution for Linux and other UNIX based operating systems).

Summary:

1. Use IPSec in Transport mode for host-to-host IPSec communication.
2. Use the strongSwan package.
3. Use AES-GCM for ESP protocol (since it provides authenticated encryption and provides better network bandwidth).

Note: IPSec is supported in ThoughtSpot software versions starting from 4.5.1.4

## Deployment

1. **Enabling IPSec:** Run following command on any ThoughtSpot node after cluster has been configured and right built has been deployed: `# tscli ipsec enable`.
2. **Disabling IPSec:** Run following command on any node of the cluster: `# tscli ipsec disable`.
3. **Checking status of IPSec:** Run following command on any node of the cluster `# tscli ipsec status`.
4. IPSec configuration and settings are NOT persistent across cluster backup/restore and will have to be re-enabled.

5. **Adding a node in an IPSec enabled cluster:** IPSec settings are automatically configured across nodes as nodes get added to a ThoughtSpot cluster that has IPSec enabled.
6. **Removing a node in IPSec enabled cluster:** IPSec settings are not impacted when nodes get removed from a ThoughtSpot cluster that has IPSec enabled. If any failure occurs during node removal, IPSec would need to re-enabled by using the following command: `tscli ipsec enable .`
7. **Manually enable/disable IPSec on a single node(if any IPSec related failure occurs on that node):**

Manually enable and start strongSwan:

```
sudo systemctl enable strongswan  
sudo systemctl start strongswan
```

Manually stop and disable strongSwan:

```
sudo systemctl stop strongswan  
sudo systemctl disable strongswan
```

Note: You can check `/etc/strongswan/ipsec.conf` and `/etc/strongswan/ipsec.secrets` on each node to verify that they are consistent across all nodes.

## Firewall configuration

The following ports must be open between nodes to allow IPSec encryption:

- UDP port 500 (for IKE)
- UDP port 4500 (for IPSec over IDP)
- IP Protocol 50 (ESP)

# System administration

System administration includes applying upgrades, backing up and restoring the cluster, snapshotting, and adding or removing nodes.

## Administration tools

Use these tools to perform administrative actions:

- [tscli \[See page 0\]](#): an administrative command line interface.
- [tsload \[See page 0\]](#): a command for loading data directly into the database.
- [TQL \[See page 0\]](#): a command line SQL interface to interact with databases.

# Send logs when reporting problems

You can generate a log bundle which you can then send to ThoughtSpot Support or you can send logs direct to your administrator.

## Generate log bundle

Before you can send a log bundle to ThoughtSpot Support, you must [Connect to the ThoughtSpot Support file server \[See page 58\]](#). This is a one-time setup operation.

To generate a log bundle:

1. Log in to the Linux shell using SSH.
2. Issue the command to generate the log bundle:

```
tscli callhome generate-bundle  
--d <directory> --since <num_of_daysd>
```

**Note:** Don't forget to include `d` after your specified number of days. For example, `30d`.

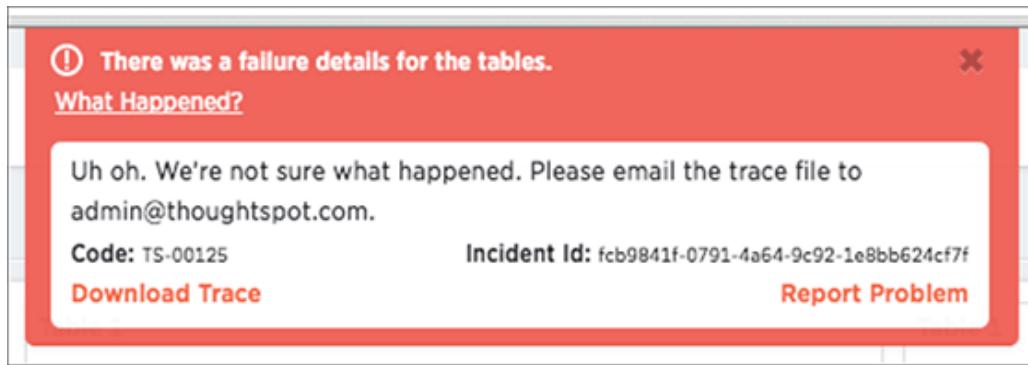
3. Change directories to the directory where you wrote the log bundle.
4. Issue the command to send the log bundle to ThoughtSpot Support:

```
tscli fileserver upload  
--file_name <file>  
--server_dir_path <path>
```

## Send a log to the administrator

Alternately, you can easily send log files directly to your administrator with a single click. When ThoughtSpot encounters a problem, a red bar displays in the browser with an error message. You can use the **Report Problem** option to complete this task.

Click **Report Problem** in the bottom right corner of the error message.



The logs will be sent to your administrator as an email attachment from your email account. Your administrator then has the option to followup with ThoughtSpot, if necessary.

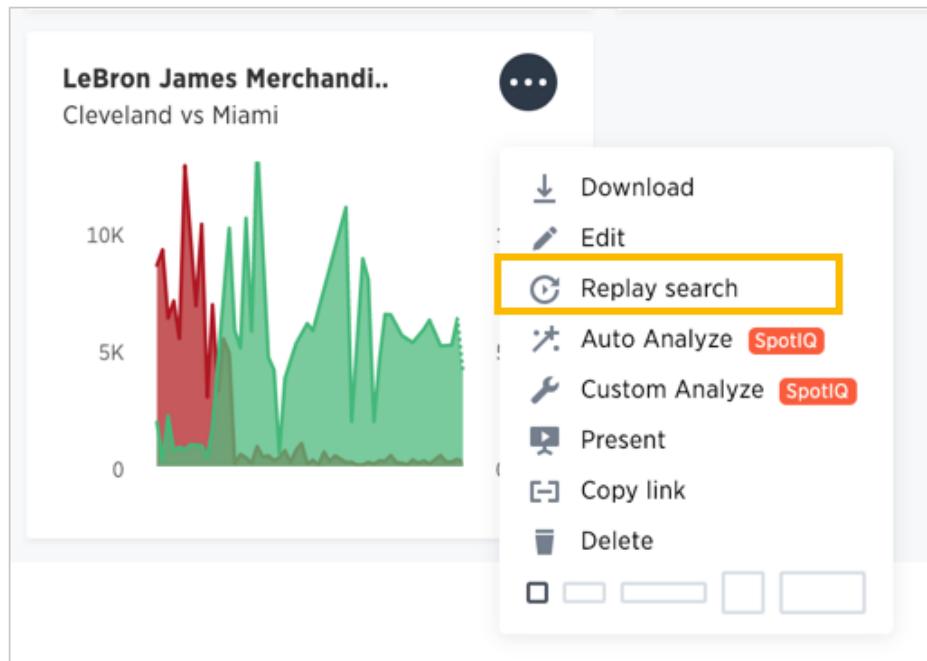
## Set up recording for Replay Search

**Summary:** You can use the recording to create training for your users on how to search your own data.

Recording a search replay requires administrator privileges and a Firefox browser. You must override some of your browser security settings in order to use the ThoughtSpot application to make the recording. This is a one time setup operation. If you do not wish to do this, you can replay the search and record it using QuickTime, Camtasia, or another screen cam recording tool.

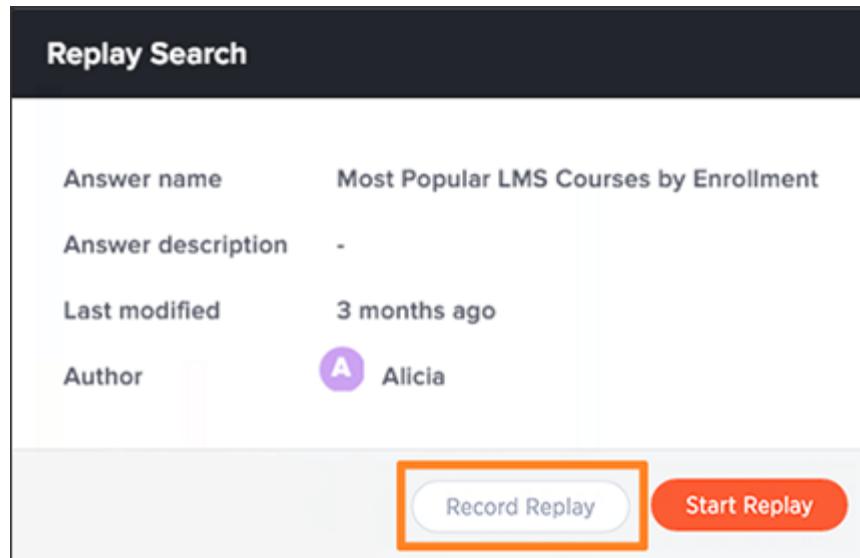
To record a search replay using ThoughtSpot:

1. While viewing a chart or table in ThoughtSpot, click the **Replay Search** icon.



2. Click the **Record Replay** button.

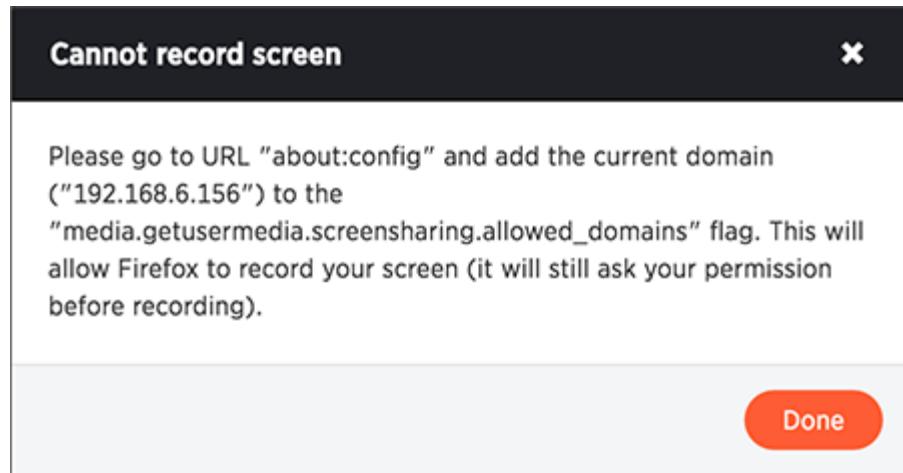
If you do not see the button, you must log in as a user with administrator privileges.



A message will display, showing a URL and a domain or an IP address.

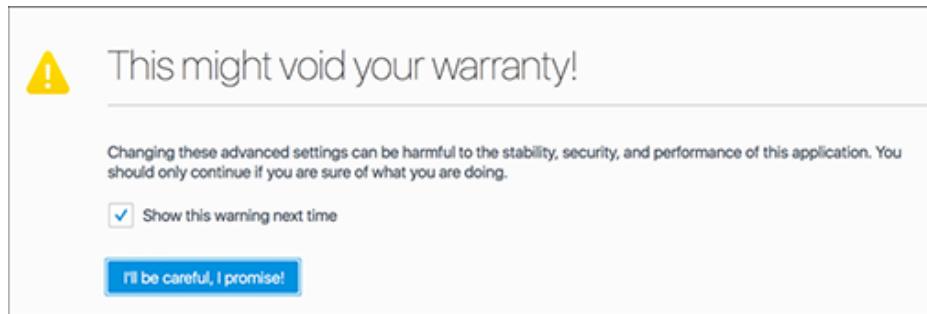
3. Make note of both of these items.
4. Open a new browser tab and go to the URL shown in the message (for example, "about:config").

Depending on which browser and version you are using, you may need to access the browser configurations through a menu or by typing in a different URL. Check your own browser help section for information on how to access the browser configuration settings, if necessary.



You may see a message warning that you are about to override the browser settings.

5. If you trust yourself, click “I'll be careful, I promise!”.

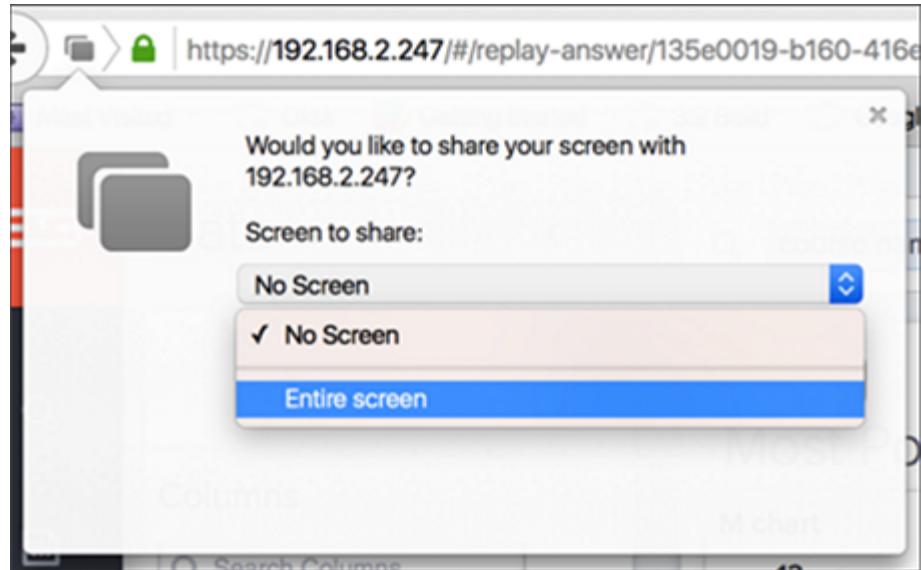


6. Find the setting for **media.getusermedia.screensharing.allowed\_domains**, and add the domain used by ThoughtSpot.

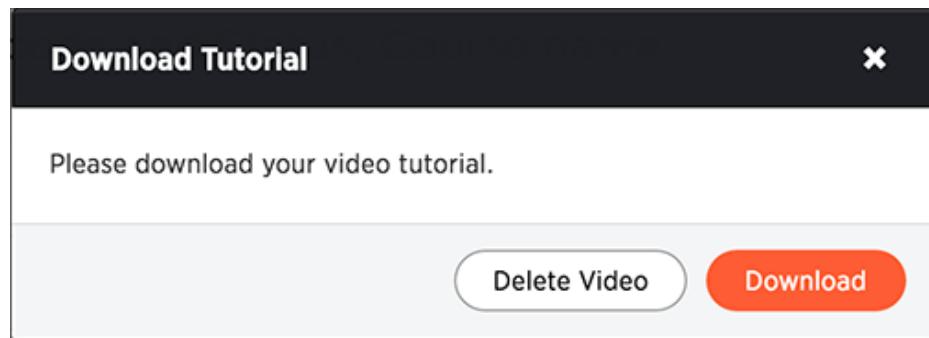
This domain will be the same one you made note of from the **Cannot record screen** message.

media.getusermedia.agc_enabled	default	boolean	false
media.getusermedia.audiocapture.enabled	default	boolean	false
media.getusermedia.browser.enabled	default	boolean	true
media.getusermedia.noise	default	integer	1
media.getusermedia.noise_enabled	default	boolean	true
media.getusermedia.playout_delay	default	integer	10
media.getusermedia.screensharing.allow_on_old_platforms	default	boolean	false
media.getusermedia.screensharing.allowed_domains	default	string	webex.com,*.webex.com,ciscospark.com,*
media.getusermedia.screensharing.enabled	default	boolean	true
media.gmp-gmpopenh264.abi	user set	string	x86_64-gcc3-u-i386-x86_64
media.gmp-gmpopenh264.lastUpdate	user set	integer	1454453226

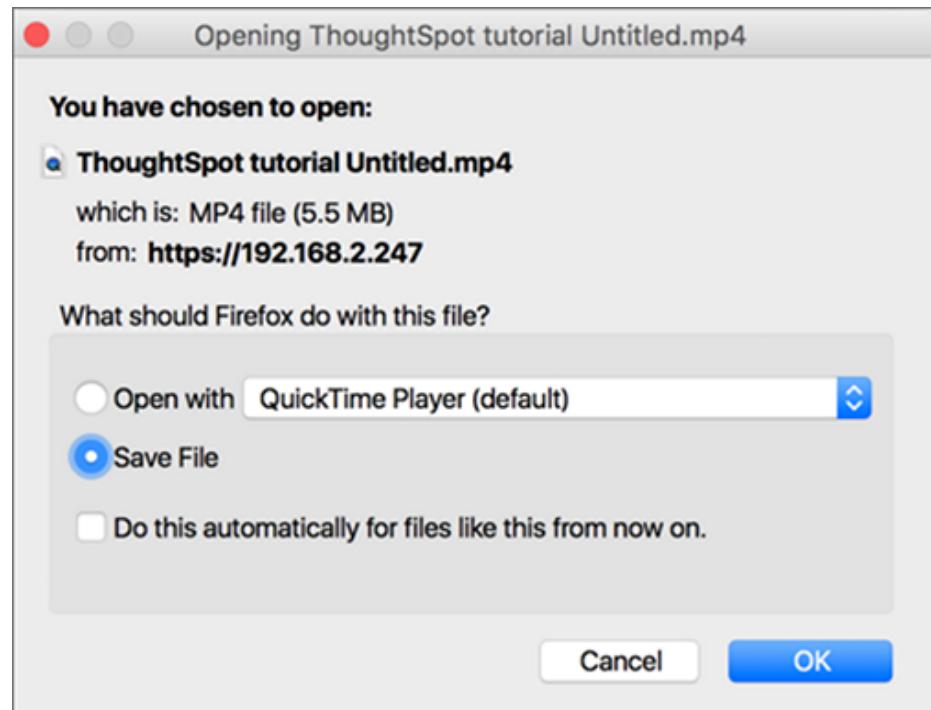
7. If you see a message asking if you'd like to share your screen with the IP address or domain name of ThoughtSpot, select **Entire screen**.



8. When the search replay has been recorded, you can see a confirmation. Select **Download**.



9. Save the recording on your computer by selecting **Save File** and clicking **OK**.



# Upgrade a cluster

ThoughtSpot is installed or updated from a release tarball which contains the ThoughtSpot application (binaries and configuration), third-party software, and Operating System image. Third party softwares are licensed software components necessary for operation of the ThoughtSpot application. These include Java, Boost C++ libraries, Google protocol buffers, and so on.

ThoughtSpot patches the Operating System at the time of upgrades. The exact same process used during installation is also applied during upgrades. The previous OS image on a node gets replaced by the new image carried in the release tarball.

**ⓘ Note:** ThoughtSpot Support will contact you to schedule an update when a minor or major upgrade becomes available.

# Understand the backup strategies

**Summary:** Consider the strategies for backing up your ThoughtSpot cluster.

## Snapshots

A snapshot is a point-in-time image of your running cluster. Snapshots are both taken on and restored to a cluster while it is running. Each cluster has a periodic snapshot configuration enabled by default. This configuration instructs the system to periodically take snapshots. Creation of a snapshot takes about 20 seconds. After creation, a snapshot persists on disk in the cluster's HDFS.

You can also create a snapshot manually. You should create a snapshot before making any changes to the environment, loading a large amount of new data, or changing the structure of a table. A snapshot may only be restored to the same cluster on which it was taken. The cluster software release version must match the snapshot release version.

If you need to move data between clusters or restore to a cluster that was updated to a new release, contact ThoughtSpot Support.

## Backups

A backup is a procedure that stores a snapshot outside of a ThoughtSpot cluster. Backups are stored in a directory on a local or network file system. You can store all of the data associated with a snapshot or a portion of that data or only metadata. There is no default configuration enabled for backing up a cluster. You can configure on yourself or you can take backups manually. Backing up periodically protects your company from losing data and/or user work.

You can use a backup to restore a cluster to a prior state, a differently configured appliance, or move the backup from an appliance to a virtual cluster or vice versa.

## Offline backup cluster

The most robust strategy for backup and recovery requires having a backup cluster offline that is kept in sync with the production cluster. Then, if the production cluster fails, the backup cluster can be drafted to take its place with minimal loss of work and disruption to operations.

Details on this architecture and instructions on setting it up are available in the ThoughtSpot Disaster Recovery Guide, which you can request from ThoughtSpot.

## Choosing a strategy

Depending on your situation and your goals, you can choose to use either a snapshot or a backup. This table should help you decide:

	Snapshot	Backup
<b>Purpose</b>	Restore to a cluster to particular point in time.	<ul style="list-style-type: none"><li>• Restore a cluster to a prior state.</li><li>• Move a cluster to a different appliance.</li><li>• Move a cluster to VM appliance.</li><li>• Removing a node.</li><li>• Restoring to a cluster that runs a different release from the one where the backup was taken.</li></ul>
<b>Storage</b>	In the cluster's HDFS	Outside the cluster on either local or NAS disk.
<b>Advantages</b>	<ul style="list-style-type: none"><li>• Can be taken on, or restored to, a running cluster</li><li>• Fastest create and restore</li></ul>	<ul style="list-style-type: none"><li>• Very stable.</li><li>• Can be used to recover from data loss or corruption, even if the cluster is destroyed.</li><li>• Can be typed as <i>full</i>, <i>light-weight</i>, or <i>dataless</i>.</li></ul>

<b>Limitations</b>	<ul style="list-style-type: none"><li>Include all data, state, and metadata created between snapshot create and restore.</li><li>Lost if the HDFS name node fails, if you lose multiple disks, or if the entire cluster is destroyed</li><li>Can be restored only to the cluster where they are taken</li></ul>	<ul style="list-style-type: none"><li>Require deleting the existing cluster first.</li><li>You are responsible for validating your backup configuration as viable for restoring a cluster.</li><li>Best practice recommends you to maintain multiple backups.</li><li>Typically, very large in memory size.</li></ul> <p>&lt;/ul&gt; &lt;/td&gt; &lt;/tr&gt; &lt;/table&gt;</p> <p>You should never restore from a snapshot or backup yourself. Contact ThoughtSpot Support for help.</p>
--------------------	---	---

# Understand backup/snapshot schedules

**Summary:** Explains how schedules and gives examples.

You can schedule periodic snapshots and backups. For snapshots, ThoughtSpot comes configured with a strongly recommended periodic snapshot policy. For backups, there is no such policy but you may want to create one or several of your own configurations. This section helps to understand existing schedules and how to configure new schedules.

## Configuration format

ThoughtSpot uses a [protocol buffer \[See page 0\]](#) configuration file to hold snapshot and backup policies. There are slight differences between the configuration of snapshots and backups. You can read more about these later. However, the file format defines a `schedule` structure which is the same for both snapshots and backups. The following example shows the `schedule` format:

```
schedule {  
    period {  
        number: integer  
        unit: MINUTE | HOUR | DAY  
    }  
    retention_policy {  
        bucket {  
            time {  
                number: integer  
                unit: MINUTE | HOUR | DAY  
            }  
            capacity: integer  
        }  
    }  
    offset_minutes_from_sunday_midnight: integer  
}
```

The `schedule` has the following components:

period	Specifies the frequency in the chosen unit . You can specify the unit as MINUTE , HOUR , or DAY .
retention_policy	Specifies retention intervals. Retention is on a first-in-first-out (FIFO) basis. So, the oldest result is always discarded. You can specify the unit as MINUTE , HOUR , or DAY . You can specify multiple retention buckets and they can have different retention policies.
offset_minutes_from_sunday_midnight	Determines the minute within the hour you'd like execution to start. Setting this to zero is equivalent to midnight.

## Work through an example schedule

In this section, you work through an example schedule. This is a working example that is the actual default snapshot schedule set on every ThoughtSpot instance.

```
schedule {
    period {
        number: 1
        unit: HOUR
    }
    retention_policy {
        bucket {
            time {
                number: 1
                unit: HOUR
            }
            capacity: 3
        }
        bucket {
            time {
                number: 4
                unit: HOUR
            }
            capacity: 2
        }
    }
    offset_minutes_from_sunday_midnight: 0
}
```

Under this policy, a snapshot is taken every hour starting at midnight. You can see that by combining the `period` of 1 hour with the midnight offset of 0.

```
schedule {  
    period {  
        number: 1  
        unit: HOUR  
    }  
    ...  
}  
offset_minutes_from_sunday_midnight: 0  
}
```

Using this frequency, a total of 24 snapshots are taken in a day.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	...	24
---	---	---	---	---	---	---	---	---	----	----	----	----	----	-----	----

If you were to specify a `number` of 2, the frequency changes. The first execution would start at midnight but subsequent executions would happen every 2 hours as shown here:

2	4	6	8	10	12	14	...	24
---	---	---	---	----	----	----	-----	----

You use the `retention_policy` to control how many snapshots are kept. In this example, the first bucket retains a snapshot every three hours.

```
retention_policy {  
    bucket {  
        time {  
            number: 1  
            unit: HOUR  
        }  
        capacity: 3  
    }  
    ...  
}
```

At the beginning of the fourth hour, the system discards the snapshot from the first hour. This is in accordance with FIFO behavior. Therefore, this retention bucket contains snapshots from hours 2, 3, and 4.

1D	2R	3R	4R	5	6	7	8	9	10	11	12	13	14	...	24
----	----	----	----	---	---	---	---	---	----	----	----	----	----	-----	----

The second bucket retains the snapshot taken at four hour intervals.

```
retention_policy {  
    ...  
    bucket {  
        time {  
            number: 4  
            unit: HOUR  
        }  
        capacity: 2  
    }  
}
```

It retains two of these four-hour-interval snapshots at any one time. By hour 9 during the day, you have the snapshots from hour 4 and hour 8 in this second bucket.

1	2	3	4R	5	6	7	8R	9	10	11	12	13	14	...	24
---	---	---	----	---	---	---	----	---	----	----	----	----	----	-----	----

Consider what you will have in the first bucket in hour 9? The first bucket has the snapshots from hour 9, 8, and 7.

At the end of the day, in the first bucket, you can have 22, 23, and 24th snapshot. While in the second bucket, you will have the 20th hour and the 24th hour snapshots.

1	...	12	13	14	15	16	17	18	19	20R	21	22R	23R	24R
---	-----	----	----	----	----	----	----	----	----	-----	----	-----	-----	-----

What if you changed the `period` frequency to every 2 hours? What would you have retained in your buckets at hour 24?

1	...	12	14	16	18R	20R	22R	24R
---	-----	----	----	----	-----	-----	-----	-----

As you can see, when defining a policy it can be helpful to graphically represent the frequency you configure. Then, determine which time blocks are important to retain before determining your retention bucket.

# Work with snapshots

**Summary:** A snapshot is a point-in-time image of your running cluster. You can use a snapshot to restore the cluster to a specific point in time. In this section, we describe how to work with the default snapshot configuration that is enabled on every cluster, and how to make manual snapshots.

To work with snapshots, use the `tscli` command line interface.

**Warning:** Backups rely on the snapshot system, so you must never disable the periodic snapshot system. If you disable periodic snapshots and enable periodic backups, the backups either fail or use an outdated snapshot.

## Create a manual snapshot

You must create a snapshot before making any changes to the environment, loading a large amount of data, or changing the structure of a table. ThoughtSpot supports up to 20 manual snapshots. You must clear them to create new snapshots. To delete a snapshot, contact [ThoughtSpot Support \[See page 0\]](#).

ThoughtSpot generates a snapshot in approximately 20 seconds, depending on the size of the cluster. To restore from a snapshot, contact [ThoughtSpot Support \[See page 0\]](#).

**Note:** During an upgrade, all snapshots from the previous version of ThoughtSpot become manual snapshots.

### Create a snapshot using tscli

To create a snapshot using the `tscli`, follow these steps:

1. Log into the Linux shell using SSH.
2. Create a snapshot, specifying its name and the reason for creating it.

Note that snapshot names must not exceed 44 characters.

```
$ tscli snapshot create <name> <reason> <ttl>
```

3. Check that the snapshot was created successfully by checking the directory listing:

```
$ tscli snapshot ls
```

## Configure periodic snapshots with snapshot policy

Each ThoughtSpot cluster automatically makes periodic snapshots based on its default snapshot policy.

The default snapshot policy is enabled for every cluster. You can display the current policy for periodic snapshots. You can change this policy.

### View snapshot policy

To view your current periodic snapshot policy, follow these steps:

1. Log into the Linux shell using SSH.
2. Enter `tscli snapshot-policy show` command to view the policy.

In the following example, the policy starts at midnight on Sunday. It retains the snapshots from the previous three 4-hour intervals, and two snapshots from two of the previous 4-hour intervals. Here, ThoughtSpot retains 7 periodic snapshots overall. For detailed information about understanding the schedule, see [Understand backup/snapshot schedules \[See page 249\]](#).

```
$ tscli snapshot-policy show
schedule {
    period {
        number: 1
        unit: HOUR
    }
    retention_policy {
        bucket {
            time {
                number: 1
                unit: HOUR
            }
            capacity: 3
        }
        bucket {
            time {
                number: 4
                unit: HOUR
            }
            capacity: 4
        }
        bucket {
            time {
                number: 1
                unit: DAY
            }
            capacity: 4
        }
        bucket {
            time {
                number: 1
                unit: WEEK
            }
            capacity: 2
        }
    }
    offset_minutes_from_sunday_midnight: 0
}
enabled: true
```

### Update the snapshot policy

Do not change the default policy, unless it is recommended by [ThoughtSpot Support \[See page 0\]](#).

**Note:** Your policy must hold no more than 20 snapshots at any time. Exceeding this number impacts cluster performance.

To update your current periodic snapshot policy, follow these steps:

1. Log in to the Linux shell using SSH.
2. Enter `tscli snapshot-policy update`.
3. In the editor, make changes to the current policy, and save them.

You cannot delete the snapshot policy. However, you can either disable or enable it.

### Disable the snapshot policy

To disable your current periodic snapshot policy, follow these steps:

1. Log into the Linux shell using SSH.
2. Enter `tscli snapshot-policy disable`.

### Enable the snapshot policy

To enable a specific periodic snapshot policy, follow these steps:

1. Log into the Linux shell using SSH.
2. Enter `tscli snapshot-policy enable`.

# Understand backup modes

A backup is a procedure that stores a snapshot outside of a ThoughtSpot cluster. You can use a backup to restore a cluster to a prior state, a differently configured appliance, or move it to from an appliance to a virtual cluster or vice versa. Other advanced administrative operations also use backups.

You can create a manual backup or configure an automated, periodic backup. A backup stores snapshot outside of a ThoughtSpot cluster. For manual backups, the system creates a backup using the named snapshot you specify. For periodic backups, the system uses the most recent snapshot to create the backup.

**⚠ Warning:** You should never disable the periodic snapshot system as backups rely on it. For example, if you have disabled the periodic snapshots system and periodic backups are enabled, then the periodic backup may use a very outdated snapshot or it may fail all together.

Backups are usually stored on a [NAS \(network attached storage\) file system](#) [See page 54] but you can store them on a local disk as well. When creating a backup, ThoughtSpot copies a release tarball and several supporting files to a disk you specify. Storing these supporting files takes about 10 GB of extra space beyond the backup itself. The final backup image is smaller because these extra files are removed after the backup completes successfully. So, make sure you have enough disk space both to *take* a backup and store the result. Use the `tscli storage df` command to identify the amount of space available.

You can create a backup using one of three modes, full, lightweight or dataless.

## Full backups

Full backups are entire backups of the cluster with all data, whether loaded from the web interface or from `tsload`. This is the best mode for restoring a cluster and all your data. After a `FULL` backup is created, you can move them between clusters, even if the cluster configuration is different. Full backups can be as large as 20 GB in addition to the 5 GB of additional files. Some installations can exceed these limits, this is why it is important to test your backup configuration.

Before creating a manual backup or configuring automated backups, make sure there is enough disk space on the target disk. Consider an example, where you want to store three backups. If the backup itself takes 18GB, you need about  $18 + 5 = 23$  GB of free disk space. Don't forget that the backup size can grow over time, so you should occasionally check to ensure you are not in danger of running out of disk space to store backups.

## Lightweight backups

Lightweight backups contain everything that makes up a cluster so they contain the following:

- Cluster configuration (SSH, LDAP, etc.)
- In-memory data cache
- All data that is stored unencrypted in HDFS
- Data uploaded by users
- Metadata for the data store
- Users, groups and permissions
- Objects created by users (pinboards, worksheets, and formulas) with their shares and permissions.
- Data model and row-level security rules.

Data loaded through ThoughtSpot Loader (`tsload`), ODBC/JDBC drivers, and Data Connect is excluded. The expectation is that data loaded by `tsload` is from external sources and so can be re-loaded after the cluster is restored. An exception is if these mechanisms were used to load data into tables that were first created through CSV import (that is, a user first loaded the tables using the GUI). In this case, the data, like the tables they were loaded into, are saved.

## Dataless backups

A dataless backup saves a backup of the schema (metadata), with no data. Dataless backups allow you to send a copy of your cluster metadata to ThoughtSpot Support for troubleshooting without compromising data security and privacy. The size of a dataless backup is usually within 10's of megabytes provided you do not have customized binaries.

When restoring from a dataless backup, you must supply the correct release tarball, since this type of backup does not include the software release.

# Create a manual backup

**Summary:** Learn how to manually create a backup.

ThoughtSpot enables you to manually create a backup to restore a cluster to a prior state or a differently configured appliance. You can also move the backup from an appliance to a virtual cluster or vice versa.

To restore a cluster from a backup, [contact ThoughtSpot Support \[See page 0\]](#).

You create a manual backup from an existing snapshot. So, you must identify an existing snapshot to use or take a new snapshot first. The time required to take a backup depends on the data size. Taking a backup does not take long, and happens in the background while the cluster is running.

## Using tscli

To manually create a backup using ThoughtSpot's command line interface, tscli:

1. Log in to the Linux shell using SSH.
2. Create a manual snapshot or find a snapshot you want to use. To find a snapshot you want to back up, use the following command:

```
$ tscli snapshot ls
```

```
-----
Name      : pre330
Reason    : pre3.3.0
Hdfs snapshot : pre330
Start     : Wed May 4 18:07:32 2016
End       : Wed May 4 18:08:23 2016
Size(Full) : 13.24 GB
Size(LW)   : 4.96 GB
Size(Dataless): 39.76 MB
```

```
-----  
...  
-----
```

3. Make sure you have enough room on the target disk.

In addition to the size of the snapshot, you must have 10 to 12 GB of disk space. This is because the process requires space for temporary files. You can use the `df` command to check disk size.

```
$ df -h
```

4. Create the backup, designating the [type of backup \[See page 258\]](#), the snapshot name, and a directory:

Choose the [mode of backup \[See page 258\]](#) you want to create, either full, lightweight, or dataless. The destination directory is created for you; do not specify an existing directory. The BASE value is the name of the backup.

```
$ tscli backup create [-h]
  [--mode {full|light|dataless}]
  [--type {full}]
  [--base snapshot_name]
  [--storage_type {local|nas}] [--remote]
  <name> <directory>
```

5. Check that the backup was created by listing all backups:

```
$ tscli backup ls
```

# Configure periodic backups

You can configure ThoughtSpot to backup automatically at specified times. The policy allows you to control the type, frequency, retention periods (first-in-first-out), and output location for a periodic backup.

A periodic backup uses the same steps as creating a backup manually. However, you do not have to specify a snapshot name, the system uses the most recent backup. You can backup to a local file system or [mount a NAS \(network attached storage\) file system \[See page 54\]](#) to hold the backup. A NAS is recommended. Make sure you have adequate space to store the number of backups you want to archive.

## Default policy format

The format for a policy includes the following:

```
name: "name_for_backup"
param {
    mode: FULL | DATALESS | LIGHTWEIGHT
    type: STANDALONE
}
schedule {
    period {
        number: integer
        unit: MINUTE | HOUR | DAY
    }
    retention_policy {
        time {
            number: integer
            unit: MINUTE | HOUR | DAY
        }
        capacity: integer
    }
}
offset_minutes_from_sunday_midnight: integer
}
directory: "NAME"
storage_type: NAS | LOCAL
```

## Before you begin

Before creating a policy, make sure you have read [Understand backup/snapshot schedules \[See page 249\]](#) for information on configuring a `schedule` element. In addition, you must specify:

Element	Description
mode	The backup mode. <code>FULL</code> backups are necessary for restoring a cluster. See <a href="#">Work with backups [See page 258]</a> for details on each backup mode.
type	Currently, only <code>STANDALONE</code> is supported.
directory	The location on the disk to place the backup.
storage_type	The type of storage you are using. <code>NAS</code> storage is recommended for <code>FULL</code> backups.

## Create a backup policy

Backups cannot start when another backup is still running. So, choose a reasonable frequency for the mode in your policy. For example, a `FULL` backup takes longer than a `DATALESS` backup. Consider the load on the system when configuring. Do not backup up when the system would experience a heavy load. For example, you may want to take `FULL` backups late in the evening or on weekends.

The retention system deletes the oldest stored backup and the corresponding snapshot on a first-in-first-out basis (FIFO). This means that if you set a bucket retention of 1 the system stores a single backup at any one time. The system deletes the older backup after the new full backup is successful. <!--

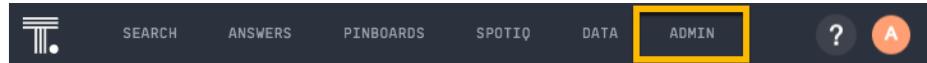
### Configure using Management Console

**Note:** The Management Console is now available in **beta** for customers with ThoughtSpot 5.3 or later. Please contact ThoughtSpot Support, if you want to try it.

To configure periodic backups using the admin UI:

1. Log into ThoughtSpot from a browser.

2. Click the **Admin** menu on the top navigation bar.



This opens the ThoughtSpot Management Console.

3. Click **Settings** menu on the top navigation bar.

A screenshot of the ThoughtSpot Management Console's Settings panel. The top navigation bar shows ADMIN, SETTINGS (highlighted with a yellow box), and UPDATE. The left sidebar lists Home, SSL, Authentication: Internal, Authentication: Active Directory, and Authentication: SAML. The main panel shows Home, SSL, Authentication: Internal, and Authentication: Active Directory, all marked as "Not Configured".

4. In the Settings panel, click **Backup Policy** and then **Configure** option.

A screenshot of the ThoughtSpot Management Console's Backup Policy configuration page. The top navigation bar shows ADMIN, SETTINGS (highlighted with a yellow box), and UPDATE. The left sidebar lists Home, SSL, Authentication: Internal, Authentication: Active Directory, Authentication: SAML, NAS Mount, Backup (with Backup Policy highlighted with a yellow box), and Snapshot. The main panel shows a server icon, the title "Configure Backup Policy", a description "Take manual and instant backup of your ThoughtSpot cluster.", a blue "Configure" button (highlighted with a yellow box), and a link "Get help on Backup Policy."

5. Update the backup policy details:

## Configure Backup Policy

**Backup Policy Name \***

**Location**

**NAS**

**Local**

**NAS Path \***

**Mode \***

**Directory Name \***  
The location on the disk to place the backup.

**Period \***

**Retention Policy \***

**Capacity:**

**Add Retention Policy**

**Cancel** **Save**

Field	Description
<b>Backup Policy Name</b>	Specify the name of the backup policy.
<b>Location</b>	Specify the backup location.
<b>NAS Path</b>	If you choose NAS, select the NAS path or configure a new NAS mount.

<b>Mode</b>	Select the backup mode. Allowed type are full , light weight or dataless .
<b>Directory Name</b>	Specify the location on the disk to place the backup.
<b>Period</b>	Specify the frequency in the chosen unit. Allowed unit types are Minutes, Hours, or Days.
<b>Retention Policy</b>	Specify the retention intervals in the chosen unit. Allowed unit types are Minutes, Hours, or Days. Retention is on a first-in-first-out (FIFO) basis. So, the oldest backup is always deleted after the new full backup is successful.
<b>Capacity</b>	Specify the retention capacity.  <b>Note:</b> You can add multiple retention buckets with different retention policies. Click <b>Add Retention Policy</b> to specify more policies.

6. Click **Save** to update the backup policy.

->

## Configure using tscli

To configure periodic backups using the tscli:

1. Log in to the Linux shell using SSH.
2. Find a directory with enough disk space to support the `retention_policy` number you configure.

You can use `df -h` to see free disk space and `tscli snapshot ls` to view existing snapshots and their size on disk.

3. Use the `tscli backup-policy create` command.

The command opens a `vi` editor for you to configure the backup policy.

4. Write and save the file to store your configuration.

By default, newly created policies are automatically enabled. To disable a policy, use the `tscli backup-policy disable` command.

5. Verify the policy using the `tscli backup periodic-config <name>` command.

## Doing more with backup

The following table lists some additional backup commands you can use.

To	Command
List present backup policies.	<code>tscli backup-policy ls</code>
Show a backup policy.	<code>tscli backup-policy show &lt;name&gt;</code>
Check the status of a policy.	<code>tscli backup-policy status &lt;name&gt;</code>
Change an existing policy.	<code>tscli backup-policy update &lt;name&gt;</code>
Disable or enable an existing policy.	<code>tscli backup-policy disable or enable</code>
Delete a policy	<code>tscli backup-policy delete &lt;name&gt;</code>

Finally, you can time a `crontab` job with your periodic backup configuration to move a backup to longer term storage. Simply create a `crontab` job that moves the backup to a location outside of the `directory` defined in the periodic schedule.

# About restore operations

When restoring to a running cluster where the ThoughtSpot software is not updated, we recommend that you use a snapshot. But in the case where you updated the cluster to a new release, if the configuration changed significantly, or when restoring to a different cluster, you must restore from a backup.

Restoring from backup require that you first delete the old cluster. Changes to a cluster that require restoring from a backup instead of a snapshot include:

- Removal of a node.
- Restoring to a different cluster from the one where the snapshot/backup was taken.
- Restoring to a cluster running a different release from the one where the snapshot/backup was taken.

You should never restore from a snapshot or backup yourself. To perform a restore from a snapshot or backup, contact ThoughtSpot Support.

# About data modeling

**Summary:** Modeling, tagging, and adding links between your data sources can make the data even easier to search.

Data modeling allows you to define metadata and other aspects of your data. For example, you can give data columns search friendly names or predefine how they can be explored and aggregated. Metadata include such information as **Column Names**, **Column Visibility**, **Column** and **Data Definition**, **Column Rank** and so forth.

When you load data, ThoughtSpot has defaults for data modeling metadata. After loading data, you can start searching your data without doing any data modeling, creating relationships, or tagging. However, since you know your data best, you can customize the modeling settings. Putting some thought into these will make the data even easier and more intuitive to search for your end users.

## User interfaces for modeling data

Data modeling is a very lightweight process compared to what you may have experienced in other tools. You can configure the model for an individual data table or you can view and configure all the system data using a modeling file. Editing the data model file requires that you have administrative privileges.

The model file contains a row for each column in your data set. It isn't unusual to have tens of thousand of rows in this file. This means that editing this file is equivalent to editing all the tables simultaneously. When you add new data to your system, this file expands to accommodate the new data columns you have added.

Both of these methods, have the same effect, they improve search. Moreover, while they have different effects of scale, they use the same mechanisms to accomplish these effects.

## Modeling topics

The following topics explain how to model your data:

- [Change a table's data model \[See page 273\]](#)

Explains how to make modeling settings for a table you've just loaded, or to make a quick change to existing settings.

- **[Edit the system-wide data model \[See page 275\]](#)**

Explains how to define a default data model to use for data system-wide.

- **[Data modeling settings \[See page 280\]](#)**

Explains the possible data model settings and their accepted values. These are the same for a table or the system.

- **[Link tables using relationships \[See page 310\]](#)**

Linked tables can be searched together or combined into a worksheet for easy searching.

Tables that have no relationship between their columns can not be combined in a single search.

- **[About stickers \[See page 316\]](#)**

You can create stickers to make it easier for people to find data sources and pinboards.

# Change a table's data model

**Summary:** You can adjust the data model for a newly loaded table.

To make modeling settings for a data source you've just loaded, or to make a quick change to existing settings, use the ThoughtSpot web interface. You can adjust the **Columns** settings from the data management listing.

You can change all the same data model settings here as in the model file. This method is easier and faster, unless you need to make many settings in bulk. In that case, [using the model file \[See page 275\]](#) is recommended.

## About data sources

You can change the data modeling settings for base **Tables**, **Worksheets**, and **Views** [\[See page 363\]](#). Worksheets will inherit the data modeling settings from the tables upon which they are based. However, if you make further changes to a base table *after* you've created worksheets on it, the new data model changes will not propagate up. You must make any new data model changes directly to the worksheets (if you want them).

## Change the data model for a data source

1. Click **Data** on the top navigation bar.
2. Click a data source you own or can edit.

Name	Source	Stickers	Materialize Status	Modified	Author
FoodDollarDataReal				47 minutes ago	P Plummer
ThoughtSPORT_Product_Dimension	Sports Goods			a month ago	AS Administrator Super-User
ThoughtSPORT_Retail_Sales_Fact	Sports Goods			a month ago	AS Administrator Super-User
MarketSpot_Vendor_Dimension	MarketSpot			a month ago	AS Administrator Super-User
ThoughtSPORT_Store_Dimension	Sports Goods			a month ago	AS Administrator Super-User
ThoughtSPORT_Customer_Dimension	Sports Goods			a month ago	AS Administrator Super-User

This brings up the **Columns** screen, where you can make your modeling settings.

3. Modify one or more column settings.

Descriptions of the possible settings are listed in [Data modeling settings \[See page 280\]](#).

4. Save your changes.

COLUMN NAME	DESCRIPTION	DATA TYPE	COLUMN TYPE	ADDITIVE	AGGREGATION	HIDDEN	SYNOMYS	INDEX TYPE
Product_Key	Click to edit	INT32	ATTRIBUTE	<input type="radio"/> NO	NONE	<input type="radio"/> NO	Click to edit	DONT_INDEX
Product_Name	Click to edit	VARCHAR	ATTRIBUTE	<input type="radio"/> NO	NONE	<input type="radio"/> NO	product	DEFAULT
SKU_Number	Click to edit	VARCHAR	ATTRIBUTE	<input type="radio"/> NO	NONE	<input type="radio"/> NO	Click to edit	DEFAULT
Department_Desc..	Click to edit	VARCHAR	ATTRIBUTE	<input type="radio"/> NO	NONE	<input type="radio"/> NO	Click to edit	DEFAULT
Category	Click to edit	VARCHAR	ATTRIBUTE	<input type="radio"/> NO	NONE	<input type="radio"/> NO	Click to edit	DEFAULT

( showing rows 1-5 of 5 )

5. To check your changes, use the **SEARCH** page to search for across the changed data.

## Related information

- [Data modeling settings \[See page 280\]](#)
- [Edit the system-wide data model \[See page 275\]](#)
- [Understand data sources \[See page 0\]](#)

# Edit the system-wide data model

**Summary:** Edit the modeling file to edit your data settings.

When you load data, ThoughtSpot uses defaults for data modeling metadata. You change these defaults using the data modeling file if you have access to the **ADMIN > Data Management** page. Editing this file allows you to view and edit all the system data columns. When you (or your users) add new data to your system, this file changes as it expands to accommodate new data columns.

**Tip:** If you just want to change a subset of your data, use the [Change a table's data model \[See page 273\]](#) instead.

## Overview of the modeling process

The data formats you use in your system are controlled by the modeling file, an Excel file. To make these changes you download the model file, change the model, and upload your changes back into the system.

In each row of the modeling file, all the data properties corresponding to a column from your data are listed. You can modify many of these properties by typing in the new value. Remember these important guidelines when editing the model file:

- Do not modify any value in a column which contains **DoNotModify** in the field under the column heading.
- Make sure to keep the file in the same format as it had when you downloaded it.

The model file contains a row for each column in your data set. It isn't unusual to have tens of thousands of rows in this file. You can change all or a subset of rows. You can edit the file to leave the heading rows and only those rows you want to change. This can make the file more convenient to work with.

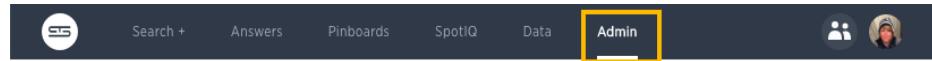
The model file must be saved as UTF-8 encoded. If your model file includes multi-byte characters, make sure you save it in the correct format or you won't be able to upload it after making your changes.

## Download the model file

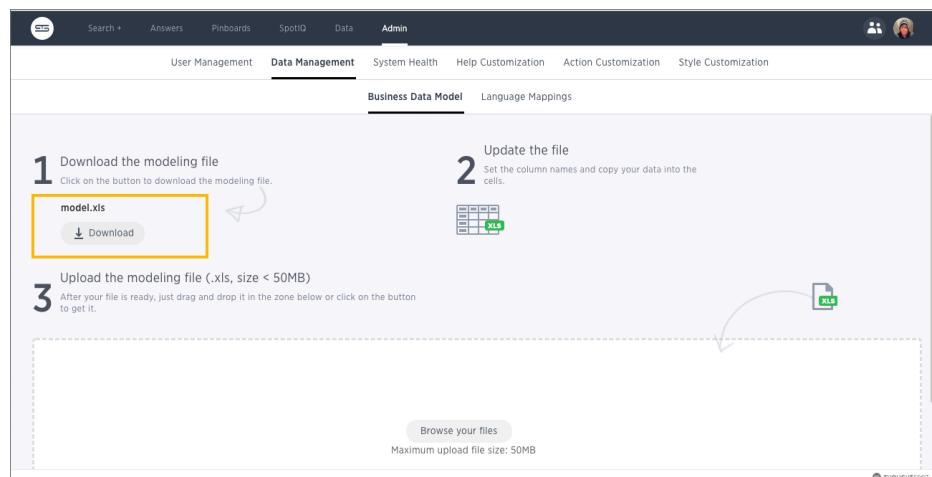
Before you can make changes to the model file, you need to download it. Then, you edit it using Microsoft Excel, vi/vim, or a similar text editing tool.

To obtain the model file:

1. Log in to ThoughtSpot from a browser as an Administrator user.
2. Click the **ADMIN** tab in the top navigation bar.



3. Click **Data Management**, then click **Business Data Model**.
4. Click **Download**.

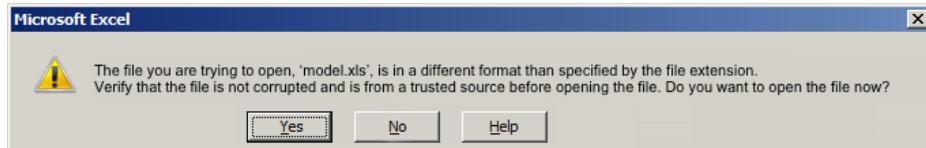


## Edit the file and change the settings

You can make changes to the settings using this procedure. To see a list of the changes you can make, see [Data modeling settings \[See page 280\]](#). You can edit any of the values in the model file, except for those where the words **DoNotModify** appear under the column header. To make changes in the model file:

1. Open the model file you downloaded ( `model.xls` ) in Excel, vi/vim, or a text editor.

If you are using Excel, you may see a warning message.



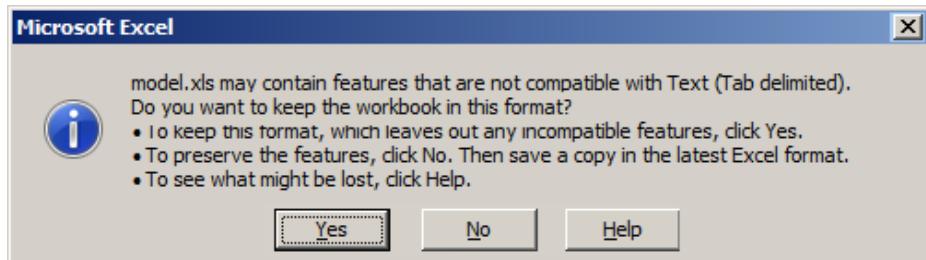
Click `YES` to proceed.

2. Find the column you want to modify.

Descriptions of the meanings of the columns are listed in [Data modeling settings \[See page 280\]](#).

3. Select the value you want to change.
4. Type in the new value.
5. After making all your changes, save the model file.

If you are using Excel, you will see a message. Click `YES` to save the file.



The model file must be saved as UTF-8 encoded. If your model file includes multi-byte characters, edit the file using vi or vim to ensure the file is saved in the correct format. Otherwise, you won't be able to upload it after making your edits.

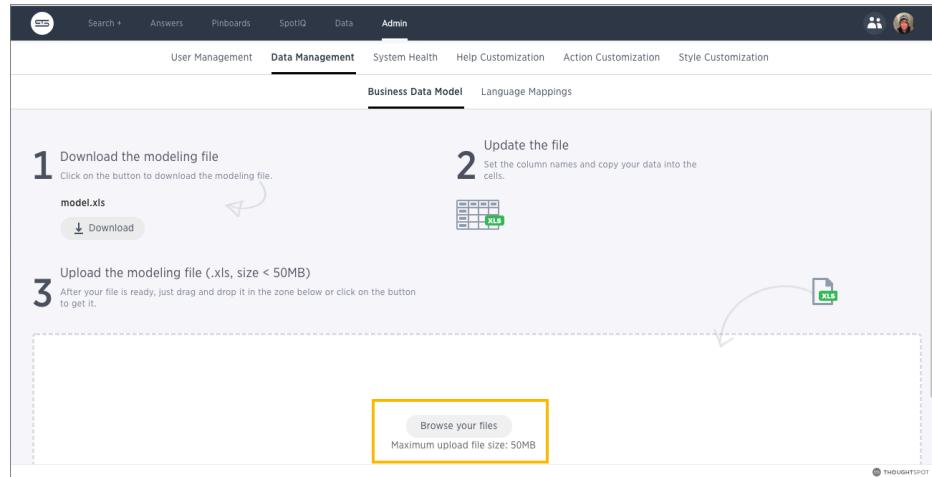
## Upload the edited file

After you have made changes to the modeling file, you must upload it back to ThoughtSpot before the changes will take effect. To upload the model file:

1. Log in to ThoughtSpot from a browser as an Administrator user.
2. Click **ADMIN**, on the top navigation bar.



3. Click **Data Management**, then click **Business Data Model**.
4. Click **Browse your files** to upload the model.xls file, or drag and drop it in the zone.



If you receive an error message upon uploading the file, check that it does not include any multi-byte characters (for example, Japanese or other multi-byte language characters). If it does, you must download the file again and make your edits using vi or vim.

If you choose to remove all the rows you have not changed from the model file before uploading it. If you upload a model file that includes only the changed rows, you won't lose any of the pre-existing model file settings. This is a good option if your model file is causing an error on upload, but you aren't sure where in the model file the problem is.

As soon as the file is uploaded, ThoughtSpot performs any necessary re-indexing for you automatically. Your new settings will be reflected within a few minutes.

## Related information

- [Data modeling settings \[See page 280\]](#)
- [Change a table's data model \[See page 273\]](#)

# Overview of data modeling settings

You can change these settings in two ways, both of which change the model. If you want to make a few small changes, you should make them in the ThoughtSpot application [See page 273]. If you want to make many changes [you should edit the modeling file \[See page 275\]](#). Whether you are changing data modeling settings using the modeling file or the Web interface, the settings and their accepted values are the same.

## Modeling settings

The following index includes mutable data modeling settings that you can apply to columns, both tables and worksheets.

Setting	Description
<a href="#">Column Name [See page 0]</a>	Sets the name of the column to be used in searches.
<a href="#">Description [See page 283]</a>	Adds a text description of what the column contains.
<a href="#">Data Type [See page 103]</a>	<b>Read only.</b> Shows the column's data type.
<a href="#">Column Type [See page 284]</a>	Sets the type of column, either ATTRIBUTE or MEASURE .
<a href="#">Additive [See page 285]</a>	Controls the type of aggregations that will be available for a column.
<a href="#">Aggregation [See page 285]</a>	Sets the default aggregation type for a column.
<a href="#">Hidden [See page 289]</a>	Sets the visibility of a column.
<a href="#">Synonyms [See page 289]</a>	Adds synonyms that can be used in the search bar to refer to a column.
<a href="#">SpotIQ Preference [See page 291]</a>	Excludes specified columns from SpotIQ analyses. By Default, all columns are included in SpotIQ.
<a href="#">Index Type [See page 293]</a>	Sets the type of index that will be created for a column.

Setting	Description
<a href="#">Geo Config [See page 299]</a>	Enables a column to be used in GeoMap visualizations.
<a href="#">Index Priority [See page 293]</a>	Changes the priority of a column in search suggestions.
<a href="#">Format Pattern [See page 301]</a>	Specifies the format to use for numeric values or dates that show in the column.
<a href="#">Currency Type [See page 305]</a>	Specifies the format of currencies in a column.
<a href="#">Attribution Dimension [See page 307]</a>	Only applies to tables that join over a <a href="#">Chasm Trap [See page 116]</a> . Designates whether the tables depend on this column for attribution.
<a href="#">Calendar Type [See page 27]</a>	Specifies what type of calendar a date type column uses. It can be Gregorian calendar (default), a fiscal calendar, or any custom calendar.
<a href="#">Entity Category [See page 404]</a>	Specifies how to categorize the data in the column: person, place, time, and so on. Important for configuring SearchIQ ( <b>Beta</b> ).
SearchIQ Enabled	Indicates if the column is enabled for SearchIQ. Note that SearchIQ is in <b>Beta</b> .

## Data modeling best practices

As a best practice, make any data modeling settings in the table when you will be creating multiple worksheets that use that table. This way, you won't have to make the same settings in each worksheet. The settings will be inherited when you create worksheets that uses columns from the table.

If you have settings that only apply in the context of a particular worksheet, make those settings in the worksheet rather than in the underlying table(s).

Note that if you make your settings at the table level, and then create a worksheet that uses columns from the table, the settings are inherited from the table at the point in time that the worksheet is created. If you then go back and change the settings at the table level, your changes will not be reflected in the worksheet.

If you want the worksheet to have the changes you made at the table level, you must drop those columns from the worksheet and re-add them. Then save the worksheet. At this point, the new settings will be used in the worksheet. Note that any saved answers or pinboards based on the worksheet may display differently because of your changes. For example, if you've changed the GeoMap setting from "None" to "Country", you will now see a map where before you might have seen a table.

## Related information

- [Model the data for searching \[See page 0\]](#)
- [Add a geographical data setting for a column \[See page 299\]](#)

# Set column name, description, and type

**Summary:** Modeling includes setting basic information for a data column such as its name, description, and type.

Basic information for a data column is its **NAME**, **DESCRIPTION**, and **TYPE**. All of these can influence how a user experiences your data. For example, the **DESCRIPTION** appears as a “tip” when a user hovers over a column. So it is the means for helping users understand where the data comes from.

## Change the column name

**Column Name (UI)/ColumnName** (model file) is the name that displayed to users for that column in ThoughtSpot. The column name is what users type to add that column to their search. Change the text that is shown for the column names in ThoughtSpot to make the names more meaningful to users.

The model file contains a row for each column in your data set. It isn’t unusual to have tens of thousand of rows in this file. You can change all or a subset of rows. You can edit the file to leave the heading rows and only those rows you want to change. This can make the file more convenient to work with.

The default is the name you gave the column when you defined the table in the database or imported the CSV file from the browser.

1. Find the column name you want to change.
2. Type in the new column name.
3. Save your changes.

## Change column description

**Description (UI)/ColumnDescription** (model file) an optional description for the corresponding column. You can provide a description for a specific column, to provide additional information for users about the data it contains. When a user hovers over the column, a tooltip will show this description.

To create a column description:

1. Find the column description you want to change.
2. Enter a new description.

3. Repeat for all columns where you want to add a description.
4. Save your changes.

## Change column type

**Column Type (UI)/ColumnType** (model file) describes the kind of data a column stores. This is set automatically upon defining the table, but in some cases, you may want to change the type. There are two types of columns:

- `ATTRIBUTE` contains a property, like name, address, or id number.
- `MEASURE` contains a numeric value that can be compared in a meaningful way using math, such as a count or measurement.

When a new table is created, the default column type is set according to the **Data Type (UI)/DataType** (model file) defined for each column. By default, columns with the numeric data types (`FLOAT`, `DOUBLE`, `INT`, or `BIGINT`) are assigned the type `MEASURE`. Columns with `VARCHAR`, `BOOL`, or date/time data types are assigned the type `ATTRIBUTE`.

Usually the default setting for column type works fine. But occasionally, you must change a `MEASURE` to an `ATTRIBUTE`. Examples of numeric values for which mathematical operations are not meaningful include:

- ID numbers
- Key values that are primarily used for joining tables
- Product number or SKU
- Sports team member jersey number
- Year, when separate from a date (e.g. 1999, 2000)

To change the column type:

1. Find the column type you want to change.
2. Change it to either `MEASURE` or `ATTRIBUTE`.
3. Save your changes.

## Related information

- [Model the data for searching \[See page 0\]](#)
- [Hide column or define a column synonym \[See page 289\]](#)

# Set ADDITIVE or AGGREGATION

**Summary:** You can allow aggregate on MEASURE columns and some ATTRIBUTE columns.

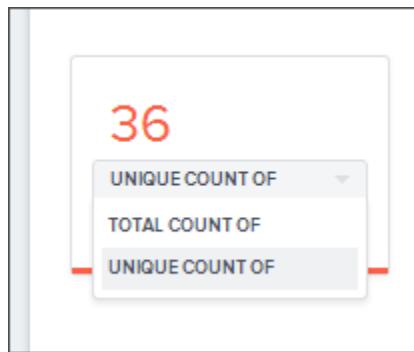
Aggregation is grouping many units or parts into a new value. In data, aggregation gathers multiple input values and calculates a summary value from them. You then use this aggregated value to do an analysis.

Every summary value results from a data aggregation function. An example aggregation function would be average or minimum. You can control how aggregation works in your data.

## Making an ATTRIBUTE column ADDITIVE

Your data may contain a column with a numeric data type that you have defined as an ATTRIBUTE rather than a MEASURE. For example, you may have ATTRIBUTE column with an INTEGER data type that represents age. Typically, these columns have an ADDITIVE setting of NO. Within a search result that contains data from this column, the options for each column on the left side of the screen includes:

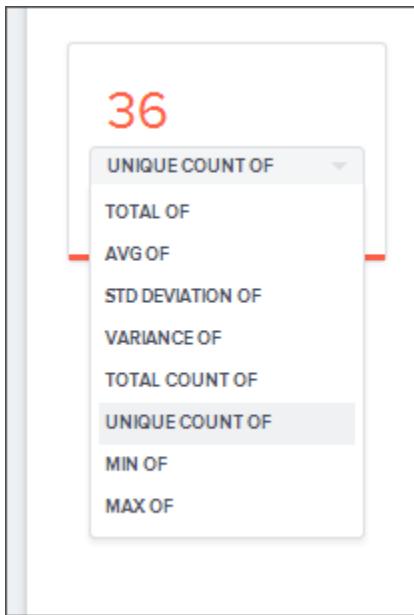
- UNIQUE COUNT OF
- TOTAL COUNT OF



To display extended aggregate view options, you must set ADDITIVE to YES on these ATTRIBUTE columns. This option is only possible on columns that have a numeric data type ( FLOAT , DOUBLE or INTEGER ) or a date data type ( DATE , DATETIME , TIMESTAMP , or TIME ). After you make this change, these additional view options area-charts offered:

- TOTAL OF

- **AVG OF**
- **STD DEVIATION OF**
- **VARIANCE OF**
- **TOTAL COUNT OF**
- **UNIQUE COUNT OF**
- **MIN OF**
- **MAX OF**



To change this setting:

1. Find the column whose **ADDITIVE** setting you want to change
2. Select the **ADDITIVE** toggle.
3. Change the value to one of these:
  - YES or NO, if using the Web interface.
  - TRUE or FALSE, if using the model file.
4. Save your changes.

## Change Aggregation

Both `MEASURE` columns and `ATTRIBUTE` columns support **AGGREGATION** operations. To aggregate a column without having to enter the aggregation type explicitly in your searches every time, you can set a default **Aggregation** for that column. Setting this default can make combining data more intuitive and faster.

`ATTRIBUTE` columns have **AGGREGATION(UI)/AggregationType** (model file) values with default aggregate type of **NONE**. You can change **AGGREGATION** to one of the supported aggregation types. To extend the available aggregation actions, set **ADDITIVE** on these columns to `YES` ( `TRUE` ).

Aggregate type	Description
<b>NONE</b>	Does no aggregation. This is the default for <code>ATTRIBUTE</code> type columns.
<b>SUM</b>	Adds the values together and returns the total. This is the default for <code>MEASURE</code> type columns.
<b>AVERAGE</b>	Calculates the average of all the values.
<b>MIN</b>	Calculates the minimum value.
<b>MAX</b>	Calculates the maximum value.
<b>STD_DEVIATION</b>	Calculates the standard deviation of all the values.
<b>VARIANCE</b>	Calculates the variance of all the values.
<b>COUNT</b>	Calculates the total number of values.
<b>COUNT_DISTINCT</b>	Calculates the total number of distinct values.

Keep in mind that not all `MEASURE` data should be aggregated. Consider a table containing data about athletes on a sports team. The data contains some numerical values, including points scored, salaries, and jersey numbers for each of the players. Because jersey number is an `INTEGER`, it would become a column of type `MEASURE` (not `ATTRIBUTE`). So it will aggregate, by default. But you may want to make its aggregation type **NONE** instead. This ensures that search results that include jersey number will not attempt to compare or aggregate those values in a way that is not meaningful.

To set this value.

1. Find the column whose default aggregation type you want to change
2. Select its **Aggregation**. If using the modeling file, use the **AggregationType** setting.
3. Select the new default aggregation type.
4. Save your changes.

## Related information

[Model the data for searching \[See page 0\]](#)

# Hide a column or define a synonym

**Summary:** Hide a column from users or make it easier to find by assigning a synonym.

You can hide columns from users in ThoughtSpot without dropping them from the database. It is common to hide a column when its data contains identifier columns that are used to join tables, but which do not have any meaning to users.

Alternatively, rather than hiding a column, you can make it easier to find by creating synonyms for it. This is helpful, for example, when different departments refer to the data using different terminology.

## Hide a column

As the number of columns in the dataset increases, the search experience requires more effort. Users have to navigate through larger numbers of columns to choose the correct one. There might also be some columns in the dataset that you don't want to expose to the users.

Change the **HIDDEN (UI)/Hide** (model file) setting to hide a column. By default, all columns in a data source appear in ThoughtSpot. To hide these columns, set the **HIDDEN** setting to `YES`.

1. Find the **HIDDEN (UI)/Hide** (model file) setting for a column.
2. Set its value to `YES`.
3. Save your changes.

## Create synonyms for a column

When users search a data source, they might try typing different words to try to retrieve a particular column. This could be due to different groups in your organization using different terms for the same data. Or maybe your users just intuitively use different words when searching for that item. Using synonyms allows them to access the data even if the term they choose isn't the same as the actual column name.

You can set column synonyms for columns in tables, user imported data, and worksheets. The returned table or chart uses the *actual column name*, but the search bar reflects the term the user typed in (the synonym).

To create a synonym for a column:

1. Find the column for which you want to add synonyms.
2. Select its **Synonyms**.
3. Enter a comma-separated list of the synonyms.

If a synonym is more than one word, enclose it in double quotes. If you are using the Web interface, you would type:

```
profit,"gross profit"
```

If you are using the model file, the list of synonyms must be enclosed in square brackets:

```
[profit, "gross profit"]
```

4. Save your changes.

## Related information

[Model the data for searching \[See page 0\]](#)

# Set columns to exclude from SpotIQ analyses

**Summary:** You can specify columns to exclude from SpotIQ analyses.

SpotIQ [See page 0] is a ThoughtSpot feature that provides users with insights about their data by automatically surfacing interesting characteristics (trends, correlations, outliers, and so on).

If you have access to tables, worksheets, and views for data modeling purposes, you can specify columns to exclude from SpotIQ analyses. By default, all columns are *included* in SpotIQ analyses.

## Exclude columns from SpotIQ analyses

To specify columns to exclude from SpotIQ analyses:

1. Click **Data** in the top menu, and choose **Tables**, **Worksheets**, or **Views** [See page 363].
2. Click the name of your data source.
3. On the **Columns** tab, find the COLUMN NAMES you want to exclude from SpotIQ analyses, and scroll to the right to find **SPOTIQ PREFERENCE**.
4. Use the drop-down menu to set the **SPOTIQ PREFERENCE** to **EXCLUDE** for each column you want to exclude.
5. Click **SAVE CHANGES** in the upper right.

## Include columns in SpotIQ analyses

By default, all columns are included in SpotIQ analyses.

If you have previously set some columns to EXCLUDE and you want to re-set these to be included, do the following.

1. Click **Data** in the top menu, and choose **Tables**, **Worksheets**, or **Views** [See page 363].

2. Click the name of your data source.
3. On the **Columns** tab, find the COLUMN NAMES you want to set back to include in SpotIQ analyses, and scroll to the right to find **SPOTIQ PREFERENCE**.
4. Use the drop-down menu to set the **SPOTIQ PREFERENCE** to **DEFAULT** for each column you want to include.
5. Click **SAVE CHANGES** in the upper right.

## Related information

- [SpotIQ tutorial \[See page 0\]](#)
- [Overview of data modeling settings \[See page 280\]](#)

# Manage suggestion indexing

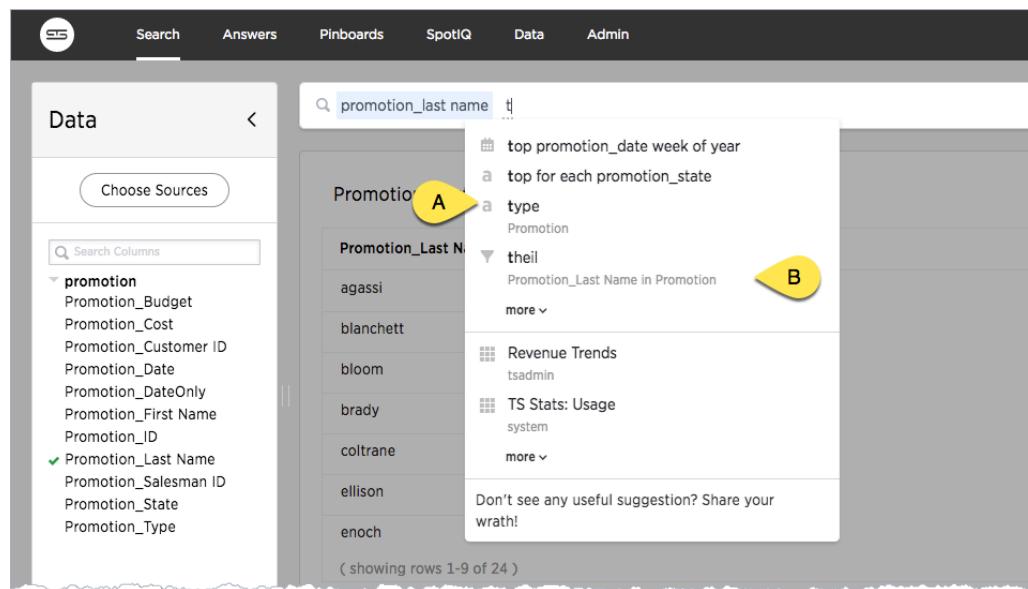
**Summary:** ThoughtSpot dynamically indexes Search bar suggestions for column names and values.

When a user searches in the **Search** bar, ThoughtSpot supplies the user with suggestions for column names and their column values. The **COLUMN NAME** and any **SYNONYMS** appear in **Search** suggestions. A column's **INDEX TYPE** controls whether and how ThoughtSpot suggests column values.

Additionally, ThoughtSpot uses a column's **INDEX PRIORITY** value to determine where to rank a column's name and values in the search suggestions. These values impact the dynamically calculated *usage based ranking (UBR)*,

## Example of Search suggestion behavior

The following example illustrates how searching for `promotion_last_name t` causes the system to suggest several ways of completing the `t` in the search:



The system is suggesting the synonym `type` (callout A) for a column in the `Promotion` table. It is also suggesting a value of `theil` (callout B) for the `Promotion_Last Name` column. If you look in the **Data > Tables** page, you can see that there is a `type` synonym for the `Promotion_Type` column which is using default indexing.

COLUMN NAME	AGGREGATION	HIDDEN	SYNOMYS	INDEX TYPE	GEO C...
Promotion_Type	NONE	<input checked="" type="checkbox"/> NO	Type	DEFAULT	None
Promotion_Date	NONE	<input checked="" type="checkbox"/> NO	Click to edit	DEFAULT	None
Promotion_Sales..	NONE	<input checked="" type="checkbox"/> NO	Click to edit	DEFAULT	None

Managing search suggestions through **INDEX TYPE** and **INDEX PRIORITY** is important. Properly configured suggestions can decrease “noise” in the suggestion list. Increasing the visibility of important columns is helpful for new or intermittent ThoughtSpot users.

## Understand the default indexing behavior

ThoughtSpot has a system default **INDEX TYPE** behavior for search suggestions. This system default is configured on your cluster and applies to all worksheets and tables. You can override this default behavior on a per-column basis.

The system behavior when the **INDEX TYPE** is **DEFAULT** is as follows:

- With two exceptions, the system indexes all columns using their **COLUMN NAME** value. The exceptions are columns with **COLUMN TYPE** of `MEASURE` and columns with **DATA TYPE** of `DATE`.
- Columns that contain data values with large amount of free-form strings, that is, a length is greater than 50 words, are indexed as `PREFIX_ONLY` by default.

**Warning:** If a column has a very large free text values, ThoughtSpot recommends you keep **DEFAULT** or set **DONT\_INDEX**. Other settings indexing on these values may generate confusing suggestions.

- Short strings (like a `firstname` column) are indexed using `PREFIX_AND_SUBSTRING` by default, which indexes both prefix and substrings.
- If a column is using has a *cardinality* – the number of unique column values – greater than 10 million, it is not indexed.

If a column's **INDEX TYPE** is *not* **DEFAULT** and the column's cardinality is greater than 30 million, ThoughtSpot does not index the column.

### High cardinality and performance

A column's cardinality can impact indexing. If you have a column with a very high cardinality and a very high number of rows, indexing these values can impact your ThoughtSpot performance. ThoughtSpot Support recommends you turn off indexing of primary key columns on extremely large tables (> 10 million rows) in your cluster.

High cardinality is relative to other considerations. In some cases, columns with fewer than 10 million rows but with columns containing long strings can cause performance problems with memory. If you have concerns or questions, your ThoughtSpot Customer Success Engineer can help you determine appropriate cardinality thresholds for your ThoughtSpot installation.

### Configure your own cluster defaults

If you need to, you can work with ThoughtSpot Support or your Customer Success Engineer to configure new cluster defaults.

## Override the system default on a column

You can change a column's **INDEX TYPE** in the **Data > Tables > Columns** page or in the **Index** value in the modeling file.

The values you can set for **INDEX TYPE** are:

Index type	Description
------------	-------------

DEFAULT	The default behavior applies to all ATTRIBUTE columns that are not DATE types. PREFIX_AND_SUBSTRING for short values and PREFIX_ONLY for long values and free-form text.
DONT_INDEX	Prevents indexing on the column values. The column doesn't appear in search suggestions.
PREFIX_AND_SUBSTRING	Allows full indexing such that prefix and sub-string search both work for the column values.
PREFIX_AND_WORD_SUBSTRING	Allows indexing such that only prefix search works for each word of a multi-word string, for the column values.
PREFIX_ONLY	Allows indexing such that only prefix search works for the column values.

Consider a column in which there are four values ThoughtSpot , Thought , Spot and ThoughtSpot . If you search for sp , depending on the setting for indexing, the column value search result suggestions will vary:

Index field value	Search bar suggestions
DEFAULT	ThoughtSpot , Spot and ThoughtSpot
DONT_INDEX	No suggestions.
PREFIX_AND_SUBSTRING	ThoughtSpot , Spot and ThoughtSpot
PREFIX_ONLY	Spot
PREFIX_AND_WORD_SUBSTRING	Spot and ThoughtSpot

To change a value in the application UI:

1. Open a worksheet or table from the **Data** page.
2. Find the column whose index type you want to modify.
3. Set its **INDEX TYPE**.
4. Save your changes.

If you are using the model file, locate the **Index** cell, and enter the **INDEX TYPE** you want to use.

## Change a column's suggestion priority

A column's **INDEX PRIORITY** determines the order or rank in which it and its values appear in the search dropdown.

The screenshot shows the ThoughtSpot interface with the following elements:

- Top Navigation Bar:** SEARCH, ANSWERS, PINBOARDS, SPOT IQ.
- Main Area:** A title "Data" with a back arrow, a "Choose Sources" button, and a search bar labeled "Search Columns".
- Search Dropdown:** A list of suggestions starting with "# latitude Zip\_Codes\_States", "# longitude Zip\_Codes\_States", "# zip\_code Zip\_Codes\_States", and "for state nj". There is also a "more" link at the bottom of the list.

By default, the **INDEX PRIORITY** value is set to `1` for all columns. You can push a column up in the order (increase the rank) by increasing its **INDEX PRIORITY** value. A higher value (like `2`) will cause the corresponding column and its values to appear higher up in the search dropdown than columns with lower value (like `1`).

The screenshot shows the ThoughtSpot Admin UI with the 'Tables' tab selected. A table named 'zip\_code' is highlighted. The 'Columns' tab is active, showing the following data:

COLUMN NAME	ONFIG	INDEX PRIORITY	FOR
zip_code		1	Click
latitude		10	Click
longitude		1	Click
city		1	Click
state		1	Click
county		1	Click

You should only use numbers between 1-10 in the **INDEX PRIORITY** field. Use a value between 8-10 for important columns to improve their search ranking. Use 1-3 for low priority columns.

To change a value in the application UI:

1. Open a worksheet or table from the **Data** page.
2. Find the column whose index type you want to modify.
3. Change the **INDEX PRIORITY** to a number between 1 and 10.
4. Save your changes.

If you are using the model file, locate the **Index** cell, and enter the priority you want to use.

## Related information

- [Model the data for searching \[See page 0\]](#)
- [Usage based rankings \(UBR\) \[See page 0\]](#).

# Add a geographical data setting

Certain attribute columns that contain location data can be used to create GeoMaps. ThoughtSpot supports Latitude, Longitude, Zip Code, US States, US Counties, Countries, and select international sub-nation regions.

You can designate a column as `Geo` by editing the **GEO CONFIG** column in the table **Columns** page.

You cannot edit the geo configuration column information in the `model.xls` file.

## Guidelines for geographic columns

Columns that can be designated as `Geo` columns need to contain text ( `VARCHAR` ) data unless they contain latitude/longitude data. Latitude and longitude columns can contain numeric data ( `DOUBLE` ) or text.

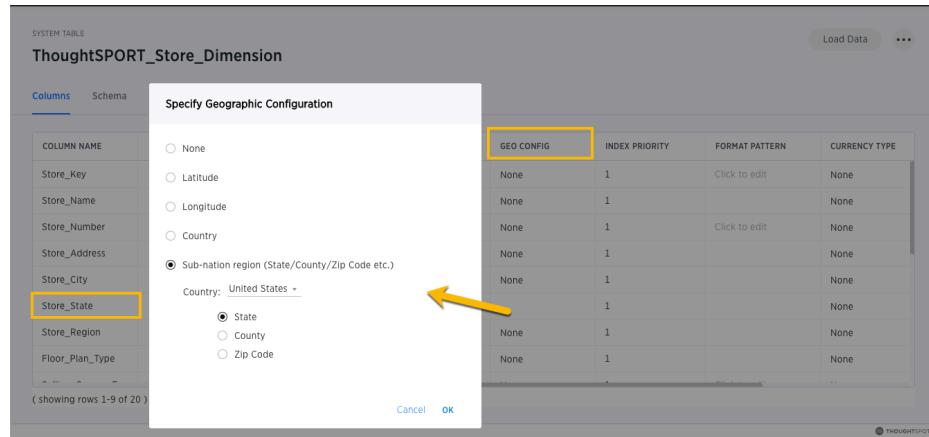
If you are using a column with the data type `DOUBLE` for latitude and longitude, you will also need to change the following settings for those columns:

- set **Column Type** to `ATTRIBUTE`
- set **Additive** to `NO`
- set **Aggregation Type** to `NONE`

For information these settings, see [Set ADDITIVE or AGGREGATION \[See page 285\]](#).

## How to edit geographic columns

1. Find the **GEO CONFIG** for the column that contains the geographical data.
2. Select the column to display the **Specify Geographic Configuration** dialog.



3. Change the value to the appropriate **GEO CONFIG**, depending on the kind of geo data the column contains.

If your data includes latitude and/or longitude columns that are stored as a numeric data type (`DOUBLE`), make these changes for those columns:

- a. Change the **Type** to `ATTRIBUTE`.
  - b. Change **ADDITIVE** to `NO / FALSE`.
- 
4. Save your changes.

## Supported geo maps

For a complete list of supported geo maps in ThoughtSpot, refer to: [Geo Map Reference \[See page 0\]](#)

## Related information

[Model the data for searching \[See page 0\]](#)

# Set number, date, and currency formats

**Summary:** Explains how to set key formats for column values.

You can set number, date, and currency display formats. These formats define how these value types display in tables and charts.

## Number formats

You can set a format for how numbers are displayed in tables and charts. For example, you can display numbers with a different number of digits after the decimal point, based on the data modeling setting

**Format Pattern.** You can use any of the supported number formats for delimiters and number of digits to show using [Java Decimal Notation \[See page 0\]](#). Currency symbols are not supported.

The system has default values which are:

#,### For integer data types INT and BIGINT . As you can see, these can only contain numbers, alpha characters are not permitted.

#,###.00 for decimal data types DOUBLE and FLOAT .

These are some examples of formats you can use:

Stored Value	Format Pattern	Display Value
12345.6789	#,##0.##	12,345.68
12345.6789	#,##0.###	12,345.679
12345.6789	#,##0.00000	12,345.68
12345.6789	#,##0	12,345
12345.6789	#,##0.00	12,345.68
12345	#,##0.##	12,345
12345	#,##0.00	12,345.00

You can change the date format used to display a column's values [for a single table \[See page 273\]](#) or, by editing the data model, for [the entire ThoughtSpot instance \[See page 275\]](#). Editing the data model file requires that you have administrative privileges.

1. Decide if the change is for a table or the entire instance.
2. Find the **Format Pattern** for the column.

This is either a column in a single table or a column in the data modeling file.

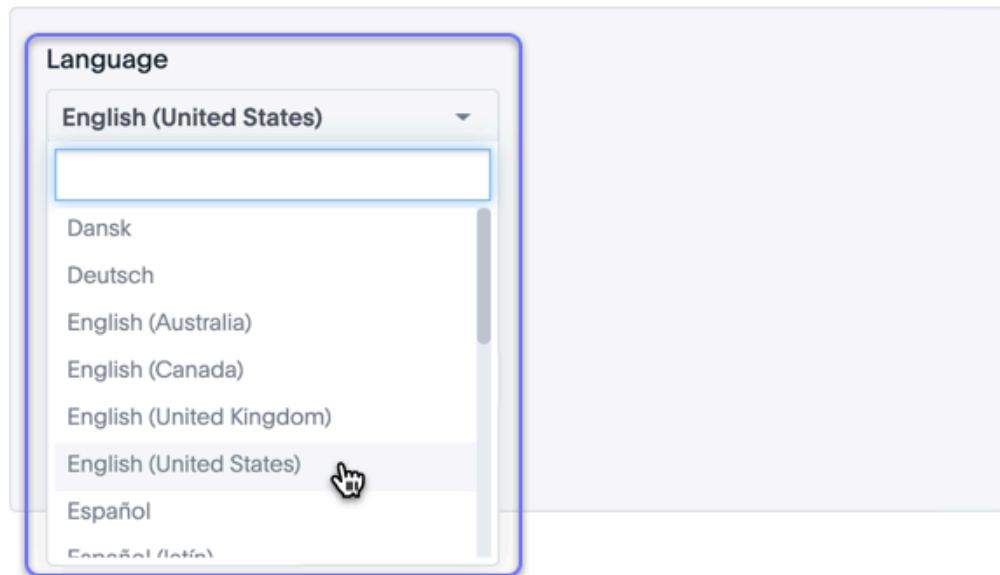
3. In the column, enter the format you want to use.
4. Save your changes.

If you are using a data-modeling file you must upload the new file to your installation.

### Profile-based number formatting

Number formatting is set by default based on your ThoughtSpot profile's **Preferred locale** setting. You can set this value to accommodate your geographic locations.

## Preferences



For example, if you are using ThoughtSpot in the US, the number formatting should look like this:

xxx,xxx.xx . And in Europe, it should look like this: xxx,xxx,xx .

## Date formats

**Format Pattern (UI)/ Format Pattern (model file)** formats for how dates are displayed in tables and charts. For example, you can display dates in a standard European or US format based on the data modeling setting **Format Pattern**. These are some examples of formats you can use:

Format mask	Description
YYYY or yyyy	four digit year such as 2017
YY or yy	last two digits of year such as 17
M	month with no leading zero 1 - 12
MM	Two digit month 01 - 12
MMM	Three letter month such as Jan
D	Day of year without a leading zero 0 - 365
DD	Day of year with up to one leading zero 01 - 365
DDD	Day of year with up to two leading zeroes 001 - 365
d	Day of month with no leading zero 1 - 31
dd	Two digit day of month 01 - 31
HH	Two digit 24 hour representation of hour 00 - 23
hh	Two digit 12 hour representation of hour 01 - 12
H	24 hour representation of hour with no leading zero 0 - 23
h	12 hour representation of hour with no leading zero 1 - 12
mm	Minutes 00 - 59
m	Minutes with no leading zero 0 - 59
ss	Seconds 00 - 59
s	Seconds with no leading zero 0 - 59

Format mask	Description
a	AM/PM indicator

Valid delimiters include most non-alphabet characters. This includes but is not limited to:

- \ (forward slash)
- / (backward slash)
- | (pipe symbol)
- : (colon)
- - (dash)
- \_ (underscore)
- = (equal sign)

Examples of valid format masks you can produce for display are as follows:

- MM/dd/yyyy
- MMM
- DD/MM/yyyy
- MM/dd/yyyy HH:mm
- DD/MM/yyyy HH:mm

To change the date format used to display a column's values for a single table [See page 273] or, by editing the data model, for the entire ThoughtSpot instance [See page 275].

1. Decide if the change is for a table or the entire instance.
2. Find the **Format Pattern** for the column.

This is either a column in a single table or a column in the data modeling file.

3. In the column, enter the format you want to use.
4. Save your changes.

If you are using a data-modeling file you must upload the new file to your installation.

## Set currency type

You can set a format for how currencies display in tables and charts when using the ThoughtSpot Data API or embedding. For example, you can display currencies in a standard European Euro or US Dollar format, based on the data modeling setting **Currency Type**.

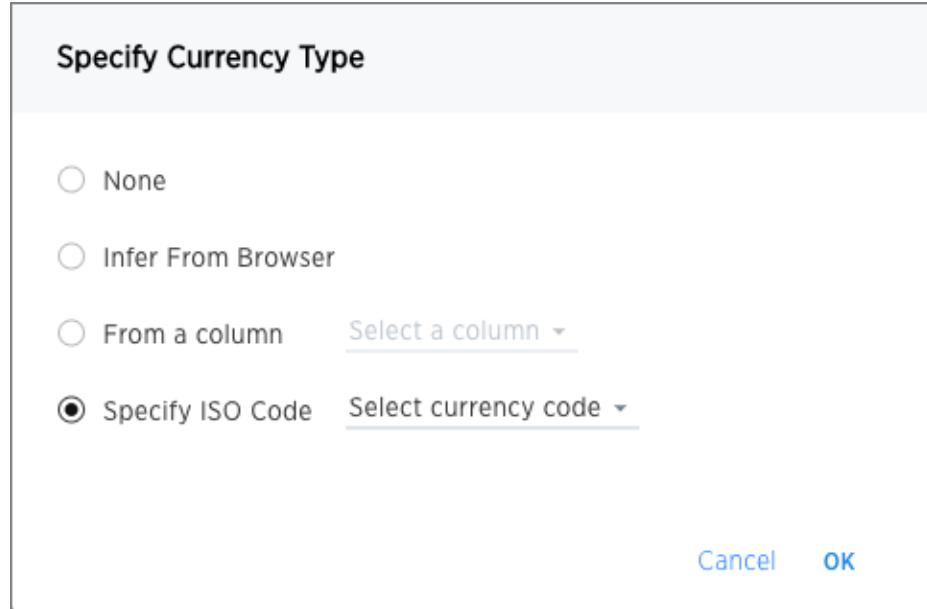
You can change the currency format used to display a column's values [for a single table \[See page 273\]](#).

When you specify the currency type of your data in the **Columns** settings, your currency data will only display the correct format and currency code in the embedded use case. Currency specific symbols are available in the non-embedded use case as well, but they are not localized.

All users are treated as if they are in `en-US` locale unless they are in embed mode and their browser configuration tells ThoughtSpot that they are in some other locale. For example, `100 Polish Zloty` appears as `100zŁ` to a user in Poland, but without localization enabled, it appears as `PLN 100`.

This subtle difference can be seen when you use the REST API. See the ThoughtSpot Application Integration Guide for more information on the API.

1. Find the **Currency Type** for the column whose display format you want to change.
2. Click it to open the **Specify Currency Type** menu.



3. Select one of the following ways you would like to change the format.

Option	Description
Infer From Browser	Your currency data will be modeled upon the locale of your browser setting.
From a column	Your currency data will be modeled upon the existing currency information in the selected column. This option is disabled if there is no VARCHAR column to choose from.
Specify ISO Code	Your currency data will be modeled upon your selection from the available currency code choices.

4. Click **Ok** to save your changes.

## Related information

[Model the data for searching \[See page 0\]](#)

# Change the Attribution Dimension

**Summary:** The **“Attribution Dimension”** setting applies only to tables that are related through a chasm trap. If your schema does not include these, you can ignore this setting.

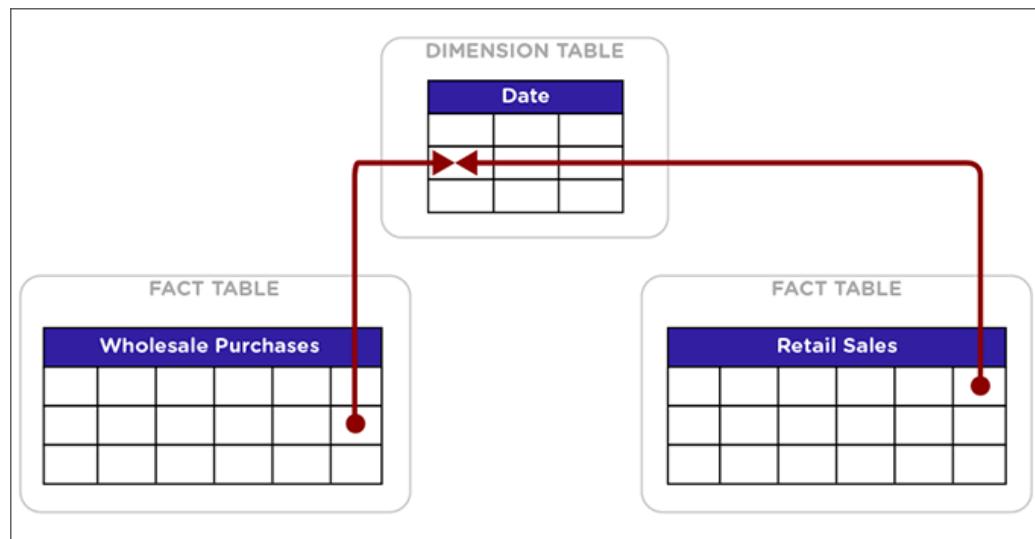
The **Attribution Dimension** setting only applies to tables that join over a Chasm Trap [See page 116]. By default, the attribution dimension setting will be set to `YES`, but you can override that by setting the column’s attribution dimension property to `N0`, as described here.

## Understand chasm traps and attribute dimension

In the classic chasm trap, two fact tables are related through a shared dimension table. When the two fact tables are joined, the shared column(s) in the dimension table are used to attribute rows in one fact table to match with rows in the other fact table.

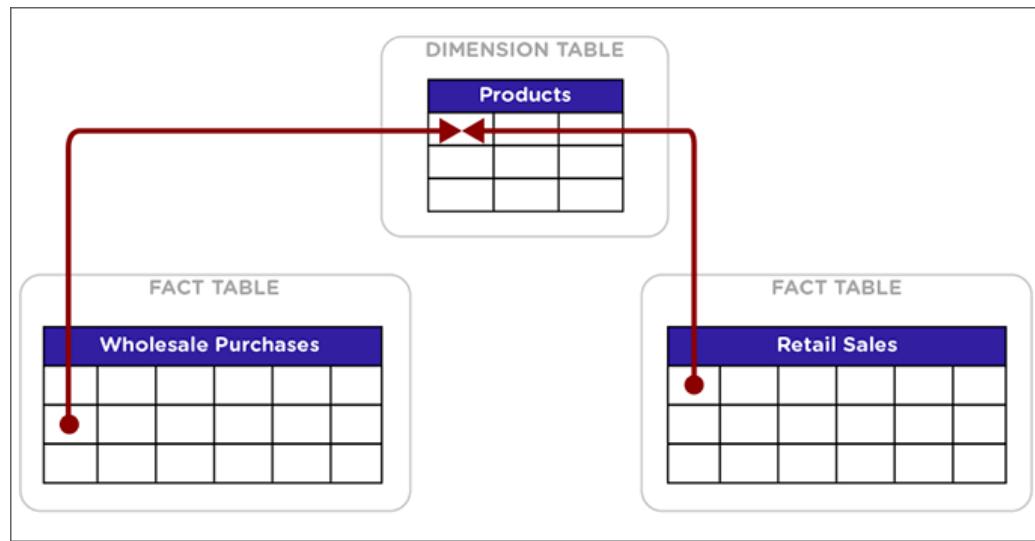
Usually, all goes well using this method. But sometimes an incorrect or illogical attribution can result. This can happen because the column chosen is not meaningful for performing this attribution. If you are seeing unexpected results in searches that include tables across a chasm trap, this setting is for you.

Below is an example of a column that is not an attribution dimension. Suppose you have two fact tables, Wholesale Purchases and Retail Sales, that share a common dimension Date.



In this example, the date column in the Date dimension should not be used for attribution, since unrelated rows in both of the fact tables could share the same row in the Date table. Why? Because if Sally bought oranges wholesale on April 25, 2005 and made a retail sale of apples on the same day, there is no logical relationship between those two events. Combining the two events using the date they share will not create any meaningful information.

If matching rows in two fact tables over a chasm trap depends on the values in a column contained in a dimension table, that column is known as an attribution dimension.



In this example, the Product ID column in the Products dimension table is an attribution dimension. For rows where the Product ID in the Wholesale Purchases and in the Retail Sales tables is a match, those rows are logically related in a meaningful way. They can be combined in charts and reports to produce a logical, expected outcome.

## How to set attribute dimension

You cannot configure this setting in the model file. You can only configure it on a table-by-table basis. To designate a column as not being an attribution dimension (not producing any meaningful attribution across a chasm trap):

1. Find the column that is not an attribution dimension.
2. Select its **Attribution Dimension**.
3. Set the value to `N0`. If you're using the modeling file, set it to **FALSE**.
4. Save your changes.

## Related information

[Model the data for searching \[See page 0\]](#)

# Link tables using relationships

You can link tables by creating relationships between their columns. Linked tables can be searched together or combined into a worksheet for easy searching. Tables that have no relationship between their columns can not be combined in a single search.

There are two ways to create relationships between tables:

1. [Create a constraint using TQL. \[See page 106\]](#)
2. [Create a relationship through the web interface. \[See page 311\]](#)

The two methods create the same kind of relationship both from an end user perspective and an administrative perspective. When creating a relationship between two tables, the columns that form the link must be the exact same data type. For example, a column of type `INT32` to another `INT32` column.

Both types of relationships exist within the database. You can also generate a script in TQL that contains all relationships, both the ones created in the web interface and the ones created in TQL.

Relationships created through either method can be managed either in TQL or by going to the [Relationships](#) page when viewing data in the **Date Modeling** section in the ThoughtSpot application. You can view, modify, or delete relationships in either place.

You may create relationships using a mixture of TQL and the web interface, but the relationships you create cannot form a circular relationship, or “cycle”. If you attempt to create a relationship that would complete a cycle, you will see a message stating that the relationship could not be added because it conflicts with another existing relationship.

# Join a table or view to another data source

**Summary:** Learn how to define joins between a table or view and another table, view, or worksheet

Joining a table or view to another table, view, or worksheet creates a relationship that allows them to be searched together. Choose a column to join on that both tables contain (e.g. employee ID or product key). This process creates a [generic join \[See page 106\]](#) between the table or view and the other table, view, or worksheet on the column you specify.

If you want to create a primary key/foreign key relationship, you need to use [TSQL \[See page 106\]](#) rather than the web interface.

You must have either the [Can administrator ThoughtSpot](#) or the [Can manage data](#) privilege [See page 161] to create a join relationship. If you're not an administrator, you also need edit permissions on the table, view, or worksheet.

When creating a join between the columns in two data sources, the linked columns must have the same data type, with the same meaning. That is, they must represent the same data. Normally, you can make this kind of link from a fact table column to a column in a dimension table that uniquely identifies a logical entity in your data such as Employee ID for a person, Product ID for a product, or Date Key for a specific date in a date lookup table.

To create a relationship through the Web interface:

1. To find your table or view, click **Data** in the top menu, and choose **Tables** or **Views**.
2. Click the name of your table or view.
3. Click **Schema**. You will see the list showing existing joins.
4. Click the **+ Add Join** button on the upper right side of the screen.

The screenshot shows the ThoughtSpot interface for the LINEORDER schema. At the top, there are navigation links: Search, Answers, Pinboards, SpotIQ, Data, Admin, and a user icon. Below the navigation is a header for 'SYSTEM TABLE LINEORDER'. The main area has tabs for Columns, Schema (which is selected), Data, Profile, Dependents, Row Security, and SpotIQ Insights. Under the Schema tab, there's a 'Joins' section. It shows a diagram for an 'Inner Join' between the 'LINEORDER' table (Source Table) and the 'PART' table (Destination Table). The join condition is 'Lineorder PartKey = PART PartKey'. A yellow box highlights the '+ Add Join' button in the top right of this section. Other buttons include 'View Schema' and icons for edit and delete.

5. Use the **Map source to destination** dialog to choose the destination table, view, or worksheet you want to join to.

The screenshot shows the 'Add Join' dialog. The title is 'Add Join' and the sub-section is 'Map Source to Destination'. It says 'Use the form below to map your selected table to a destination table and select specific columns to join.' On the left, 'Source Table' is set to 'LINEORDER'. Below it, 'Source Columns' is set to 'Select Column' with a '+ Add Column' button. An arrow points from the source to the destination. On the right, 'Destination Table' is shown with a 'Select Table' dropdown. A yellow box highlights this dropdown. It contains a search bar 'Search table name' and a list of tables: 'Users', 'SUPPLIER', 'PRODUCTS', 'Tax', and 'Revenue'.

6. Choose the columns you want to join on from the table or view (source) and destination table, view, or worksheet. Click **Next**.

Add Join

Map Source to Destination

Use the form below to map your selected table to a destination table and select specific columns to join.

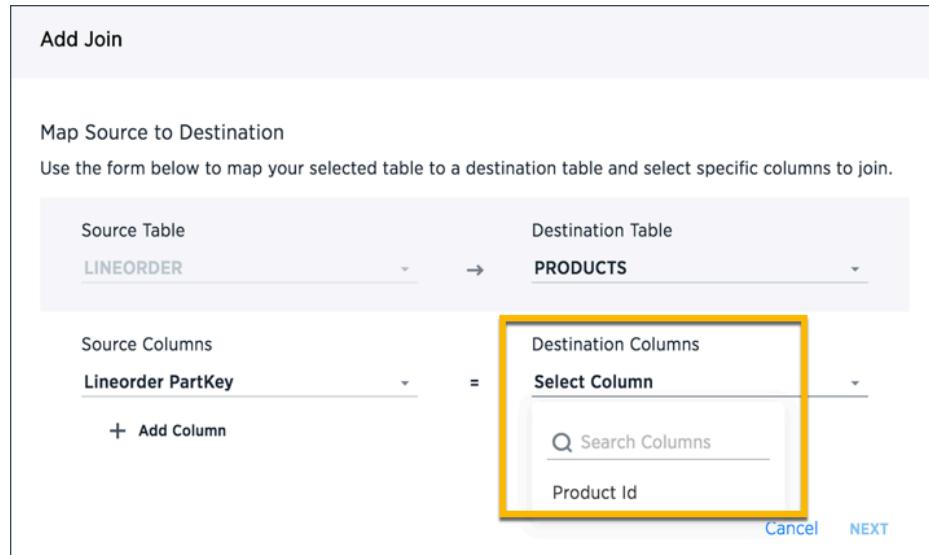
Source Table	Destination Table
LINEORDER	PRODUCTS

Source Columns      Destination Columns

Lineorder PartKey      Select Column

+ Add Column      Product Id

Cancel      NEXT



7. Give your join a name and description and click **ADD JOIN**.

8. Repeat these steps until all the joins you want to make have been created.

After creating the join, you may change its name and description by clicking the edit icon. If you want to change the data source or column being joined, you must delete the join and create a new one.

## Related Information

- Constraints [See page 106]

# Delete a relationship

**Summary:** You can delete relationship (link) between tables through the application or TQL.

You must have either the **Can administrator ThoughtSpot** or the **Can manage data** privilege [See page 161] to delete a relationship. If you're not an administrator, you also need edit permissions on the table, view, or worksheet.

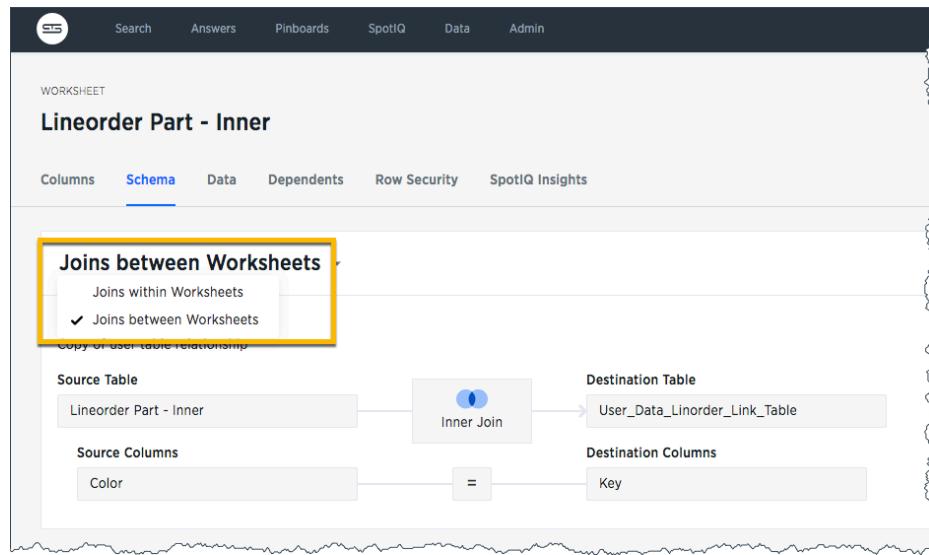
If you created a relationship (join or link) between tables using the Web interface, you can also delete it from the Web interface. But if the relationship was created using TQL, you must also use TQL to delete it.

To delete a relationship using TQL [See page 132], use an `ALTER TABLE...DROP CONSTRAINT...` or `ALTER TABLE...DROP RELATIONSHIP...` statement.

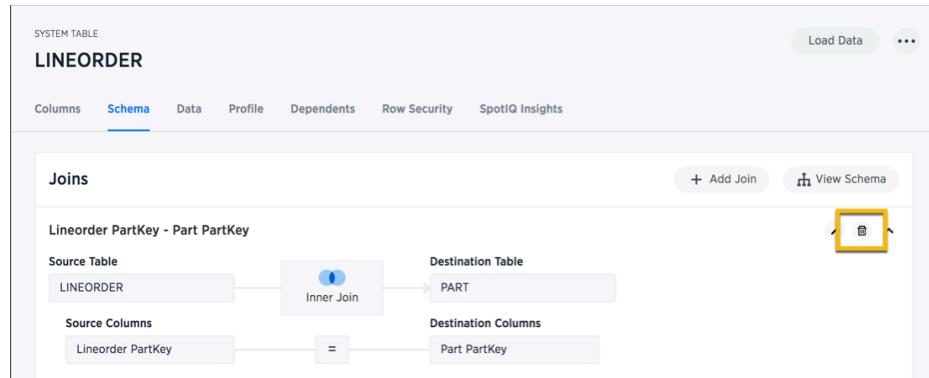
To delete a relationship from the Web interface:

1. Click **Data** on the top navigation bar.
2. Click the name of the data source you from which you want to remove the relationship.
3. Click **Schema**. You will see the list showing existing joins.

If this is a worksheet, you must click **Joins within worksheets** and choose **Joins between worksheets**.



4. Find the relationship you want to delete, and click the **Delete icon**.



5. Repeat these steps until all the joins you want to remove have been deleted.

## Related Information

- [Constraints \[See page 106\]](#)

# About stickers

**Summary:** Stickers enable you to create categories for classification of objects, including pinboards, answers, data sources, and worksheets.

You can create stickers to make it easier for people to find data sources and pinboards. Stickers are global in scope. This means that everyone can see the stickers and use them to tag objects. They can also filter lists of objects by sticker. Stickers are often used to designate subject areas, such as sales, HR, and finance, but you can use them any way you like.

Keep in mind these permissions when working with stickers:

- Only administrators can create stickers.
- Anyone can apply a sticker.
- Anyone can filter by a sticker.

## Create a sticker

Only administrator users can create stickers. Anyone can apply the stickers you create, or use them as filters when selecting from a list of sources or pinboards.

To create a sticker:

1. Navigate to the **Manage Data** or **Pinboards** screen using the icons in the top navigation bar.
2. Choose the currently selected sticker, scroll to the bottom of the list, and click **+ Add**.

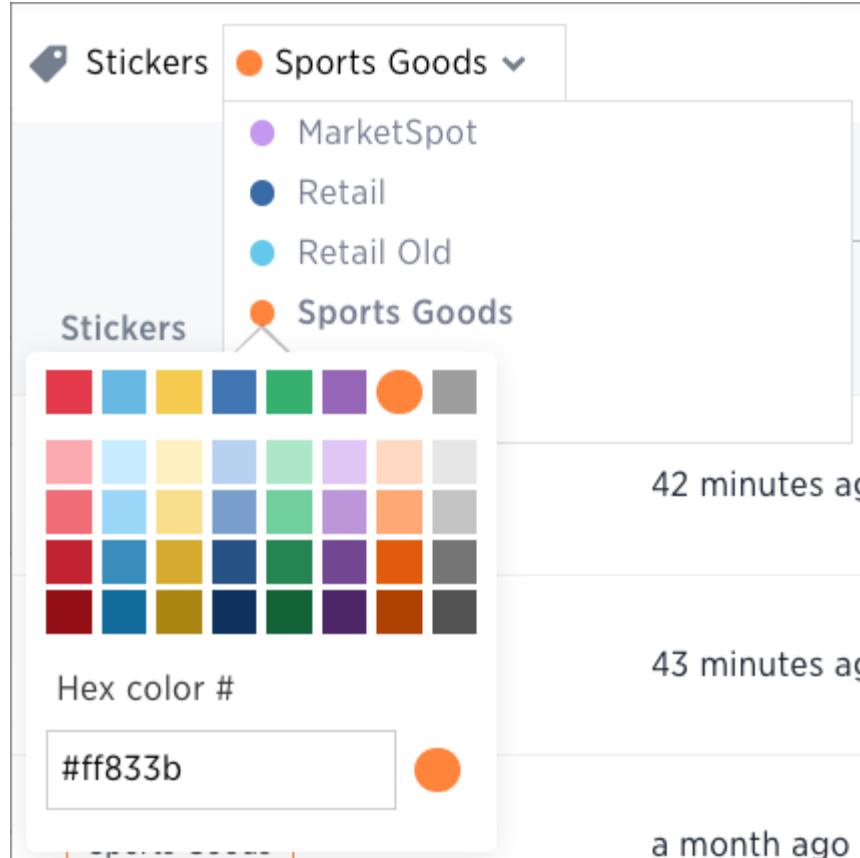
The screenshot shows a list of stickers. At the top right, there is a dropdown menu for 'Sports Goods' with a red box around the '+ Add' button. Below the dropdown, there is a list of four items:

Name	Stickers	Time Ago
ThoughtSPORT Overview	Sports Goods	9 minutes ago
Advanced Analysis with R	Sports Goods	9 minutes ago
ThoughtSPORT Analysis Overview of Advanced Formulas in Thoughtspot	Sports Goods	a month ago
Comparative Analysis	Sports Goods	a month ago

3. Type the name for the new sticker.
4. You can change the name of a sticker by clicking the edit icon next to its name.

The screenshot shows a context menu for a sticker. The 'Edit name' option is highlighted with a red box. The menu also includes 'Remove sticker' and other options like 'MarketSpot', 'Retail', 'Retail Old', and 'Sports Goods'.

5. You can change the color of a sticker by clicking the color circle next to its name.

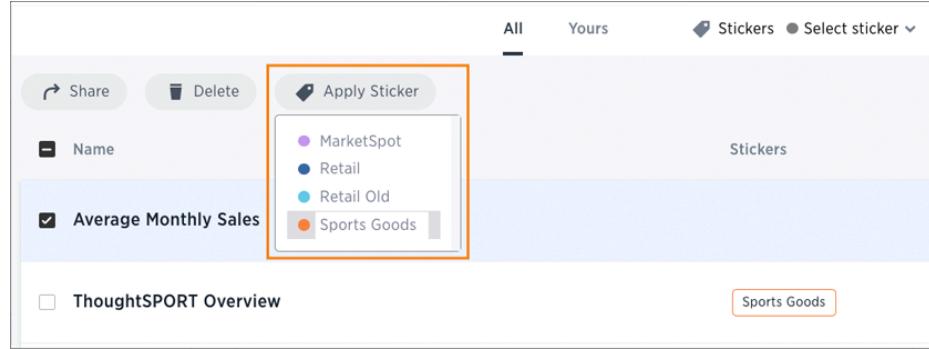


## Apply a sticker

Only administrators create stickers, but anyone with edit privileges can tag an object with a sticker.

To tag an object with a sticker:

1. From the top menu, choose Answers, Pinboards, or Data.
2. Find the item(s) you want to tag in the list, and check the box next to its name.
3. Click the apply sticker icon and choose one from the list. You can apply as many stickers as you like to an object.



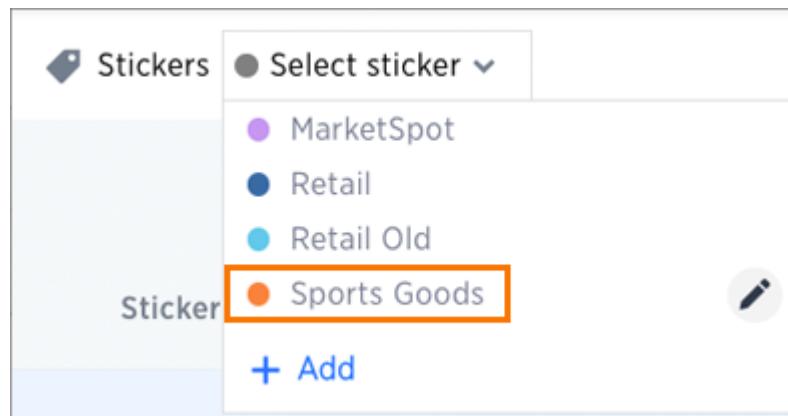
## Filter by stickers

Whenever you are selecting objects from a list, you can filter by sticker to find what you're looking for.

Anyone can use stickers to filter lists of pinboards or data sources. You can also filter by sticker when selecting data sources.

To filter by sticker:

1. From the top menu, choose **Answers**, **Pinboards**, or **Data**.
2. Click **Select sticker**, and select the name of the sticker you want to filter by.



# Create and use worksheets

**Summary:** Worksheets are flat tables created by joining columns from a set of one or more tables or imported datasets.

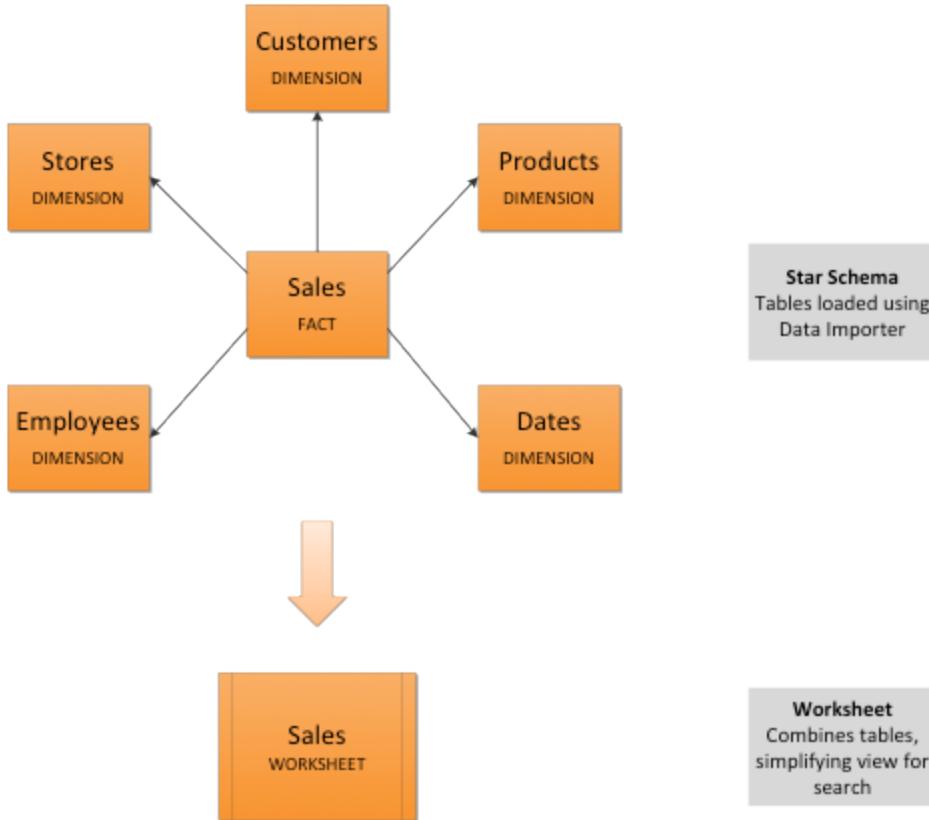
After modeling the data, create worksheets to make searching easier. For example, a sales executive might need to search for information about retail sales. The required data could be contained in several tables (sales, customers, products, stores, etc.), with foreign key relationships between them. An administrator who is familiar with the data model can create a retail sales worksheet, that combines all of the related fact and dimension tables into a single, easy-to-use view, and share it with the sales executive. This provides access to the data without requiring an understanding of how it is structured.

## Guidelines for worksheets

Users are often unfamiliar with tables and how they are related to one another. A worksheet groups multiple related tables together in a logical way. You might use a worksheet for these reasons:

- To pre-join multiple tables together.
- To give a user or group access to only part of the underlying data.
- To include a derived column using a formula.
- To rename columns to make the data easier to search.
- To build in a specific filter or aggregation.
- To give users a filtered set of data to search.

Typically, you create one worksheet for each set of fact and dimension tables. For example, you may have a sales fact table and an inventory fact table. Each of these fact tables shares common dimensions like date, region, and store. In this scenario, you would create two worksheets: sales and inventory. The following diagram depicts the workflow for creating the sales worksheet.



The process for creating a worksheet is:

1. Decide which tables to use for the worksheet.
2. Create a new worksheet.
3. Add sources (tables) to the worksheet.
4. Choose the [worksheet join rule \[See page 337\]](#).
5. Select the columns to include.
6. Optionally [modify the join types \[See page 345\]](#) within the worksheet.
7. Optionally [create formulas \[See page 329\]](#).
8. Optionally [create worksheet filters \[See page 332\]](#).
9. Save the worksheet.

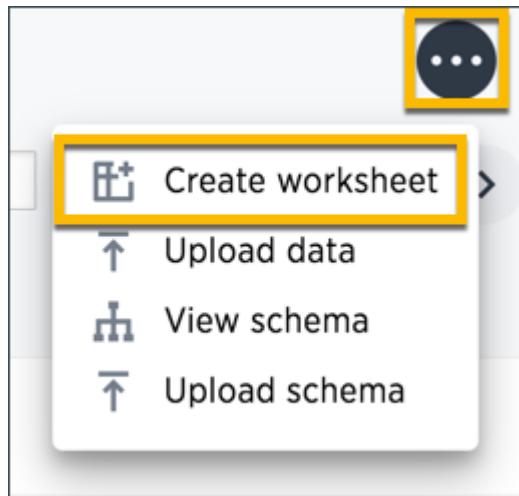
10. Share the worksheet with groups or users [See page 209].

## Create a worksheet

Create a worksheet to make the data easy for users to search. This process includes adding a new worksheet, after which you will choose the data sources to include in it.

To create a new worksheet:

1. Click **Data**, on the top navigation bar.
2. Click the ellipses icon  , and select **Create worksheet**.

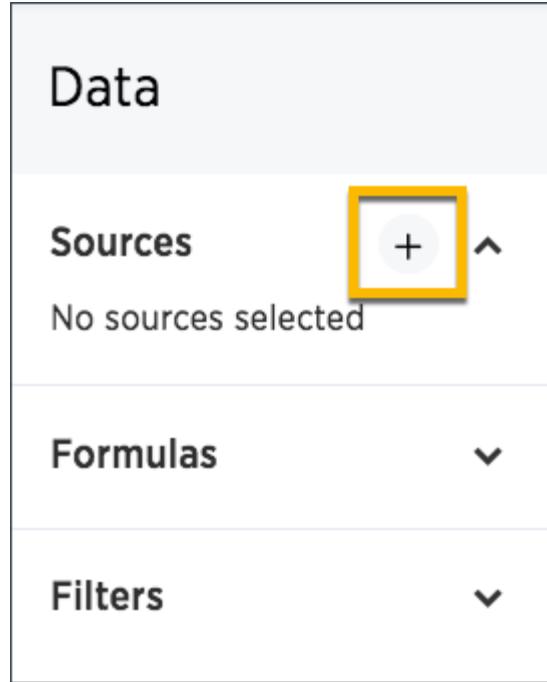


## Add sources and columns to a worksheet

After creating a worksheet, you need to add the sources that contain the data. Sources is another name for tables. The sources you choose are typically related to one another by foreign keys.

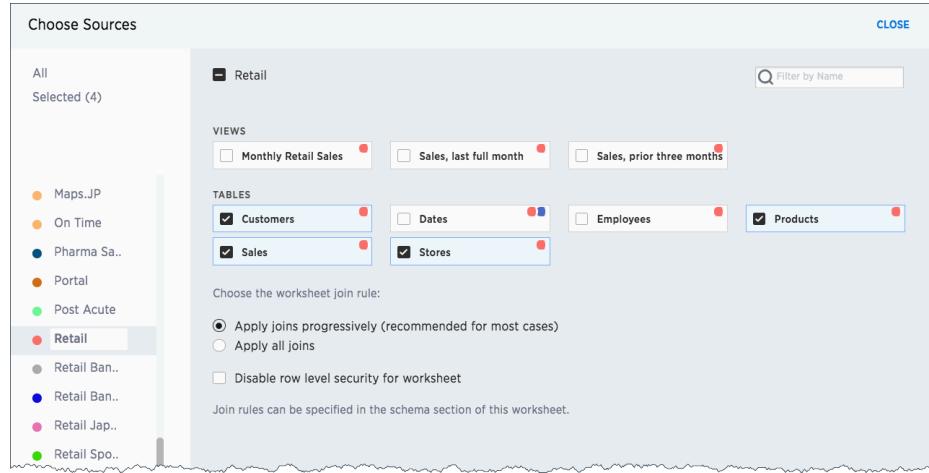
To add the sources to the worksheet:

1. Click the + icon.



2. Check the box next to each of the sources you want to include in the worksheet.

Note that the list of sources only shows the data sources on which you have view or edit privileges.



3. If you want to see what the data inside the sources looks like, click **Explore all data**.
4. Choose the [worksheet join rule \[See page 337\]](#).

5. If you want to disable [Row Level Security \[See page 221\]](#), for this worksheet, check the checkbox to disable it.
6. Click **CLOSE** to save your changes.
7. Expand the table names under **Columns** and select the columns to add to the worksheet, by doing any of the following:
  - a. To add all of the columns from a table, click the table name and click **+ Add Columns**.
  - b. To add a single column, double-click its name.
  - c. To add multiple columns, Ctl+click each column you want to add and click **+ Add Columns**.

Note that after you add a column, non-related tables (those without a primary/foreign key relationship) become hidden. If you are working with two tables that should be related, but are not, you can [add a relationship between them \[See page 310\]](#).

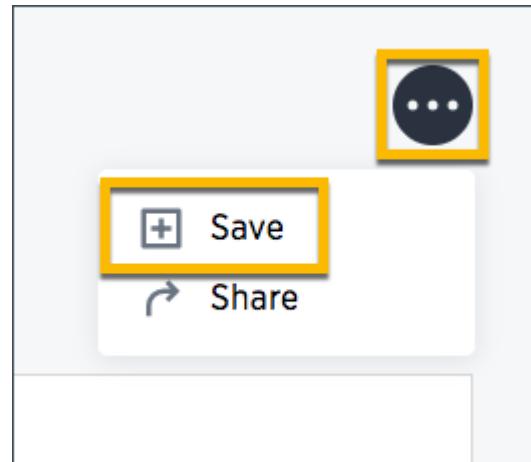
8. (Optional) [modify the join types \[See page 345\]](#) within the worksheet.
9. (Optional) [create formulas \[See page 329\]](#).
10. (Optional) [create worksheet filters \[See page 332\]](#).
11. Click the ellipses icon  , and select **Save**.
12. In the Save Worksheet window, enter a name and description for your worksheet and click **SAVE**.
13. (Optional) Click each column name and enter a more user-friendly name for searching. You can tab through the list of columns to rename them quickly.

14. (Optional) If you want to add a prefix to the name of several columns, select them, click the **Add prefix** button, and type in the prefix.

The screenshot shows the ThoughtSpot Data interface. On the left, there's a sidebar titled 'Data' with a 'Sources' section containing a search bar and a list of data types: 'Customers', 'Products', 'Sales', 'Date Key', 'Product Key', 'Store Key', 'Promotion Key', 'Customer Key', and 'Employee Key'. The main workspace is titled 'Untitled' and contains a table with the following data:

	name	gender	city	age
	Seth Z. Moore	Male	Volga	27

15. Click the ellipses icon , and select **Save**.



16. Share your worksheet [See page 209], if you want other people to be able to use it.

## Where to go next

- [How the worksheet join rule works \[See page 337\]](#)

Use the worksheet join rule to specify when to apply joins when a search is done on a worksheet. You can either apply joins progressively, as each search term is added

(recommended), or apply all joins to every search.

# Edit or rename worksheet

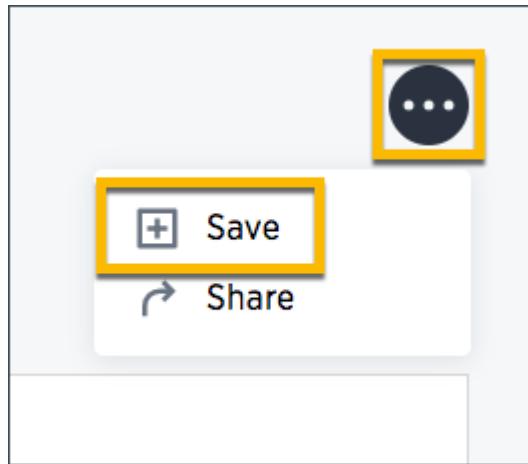
**Summary:** A worksheet can be edited by anyone with the proper permissions.

If you created a worksheet, or you have edit permissions on it, you can make changes such as adding sources and columns, adding or editing formulas, changing relationships, and changing column names. You can also rename a worksheet or change its description.

## Edit a worksheet

To edit a worksheet:

1. Click **Data** on the top navigation bar.
2. Click the name of the worksheet you want to edit.
3. Click the **Edit** button in the upper-right side of the screen.
4. Make your changes to the worksheet.
5. Click the ellipses icon  , and select **Save**.



## Rename a worksheet or table

You can change a worksheet or table name from the ThoughtSpot application.

To change the name of a worksheet or table:

1. Click **Data**, on the top navigation bar.
2. Find the worksheet or table you want to rename and click its name.
3. Click the current name, and enter a new name.

## Related information

- [Change the join rule for a worksheet \[See page 339\]](#)
- [Add joins between a worksheet and other data \[See page 341\]](#)
- [Modify table joins within a worksheet \[See page 345\]](#)

# Create a formula in a worksheet

**Summary:** You can define formulas and use them to create derived columns in worksheets.

You create formulas by combining standard functions and operators, column names, and constant values.

Anyone who can create a worksheet can add a formula to it. Formulas are not reusable; the formula you create is associated only with the worksheet it belongs to. A complete list of available formulas and examples of each is available in the [Formula function reference \[See page 0\]](#).

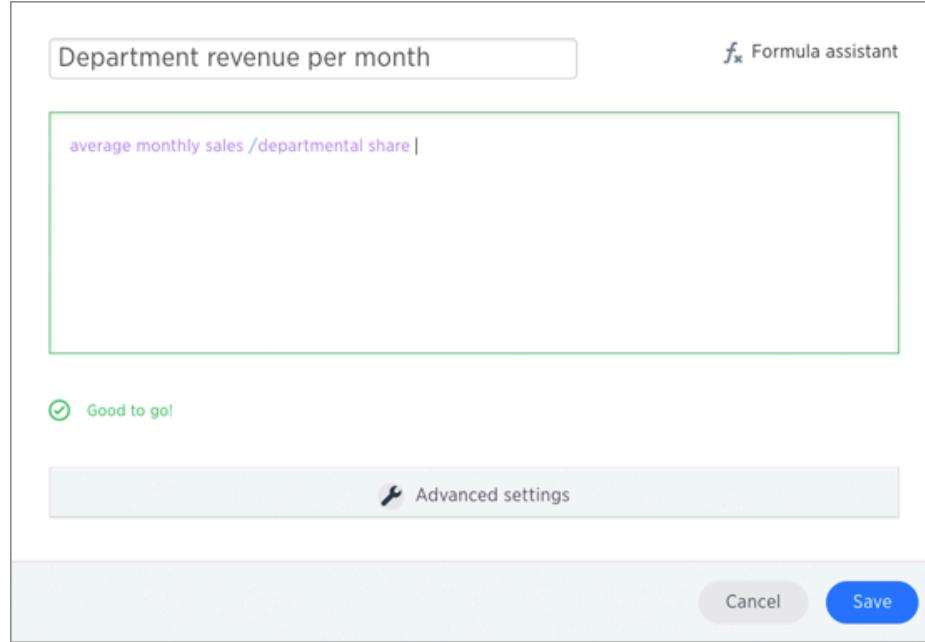
You can create a formula in a worksheet by using the Formula Builder. When you do this, the result of the formula gets added to the worksheet as a column. Use these steps to create a formula:

1. Create a new worksheet, or edit an existing one.
2. Click the + button next to **Formulas**.

The screenshot shows the ThoughtSpot Formula Builder interface. On the left, there's a sidebar titled 'Data' with a 'Choose Sources' button and a 'Search Columns' input field. Below that is a list of columns under 'fruit\_for\_help': Date, Fruit, Location, Price per fruit (\$), Quantity sold, Total sale, and Vendor. There's also a section for 'fruit\_sales'. At the bottom of the sidebar is a '+ Add Columns' button. On the right, the main area has a header 'fruit for help' with 'Delete' and 'Add prefix' buttons. Below that is a table titled 'Formulas' with a single row: 'average quantity sold' with value 'N/A'. Then there's another section for 'fruit\_for\_help' with rows for Date ('05/13/FY 2013'), Fruit ('apples'), Location ('the bronx'), Price per fruit (\$) ('3.00'), Quantity sold ('11'), Total sale ('16.50'), and Vendor ('ray ratliff'). At the bottom of the main area is a '+ Create a new formula' button.

d

3. Type your formula in the Formula Builder.

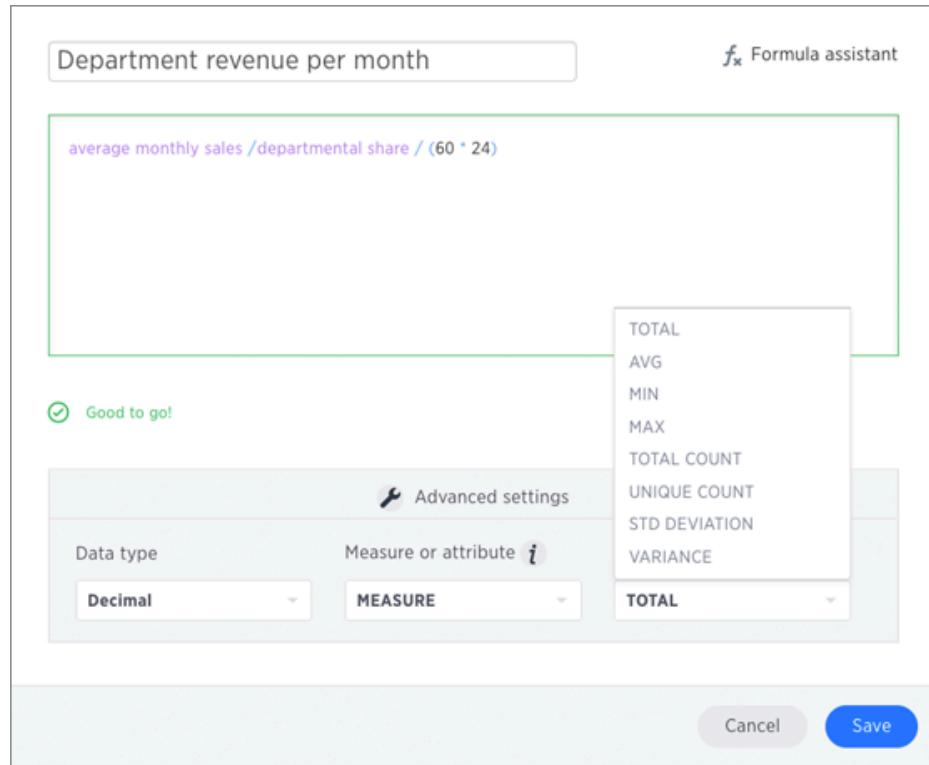


**Note:** Formulas elements are color coded by type and can include the formula operators and functions (blue), the names of columns (purple), and/or constants (black).

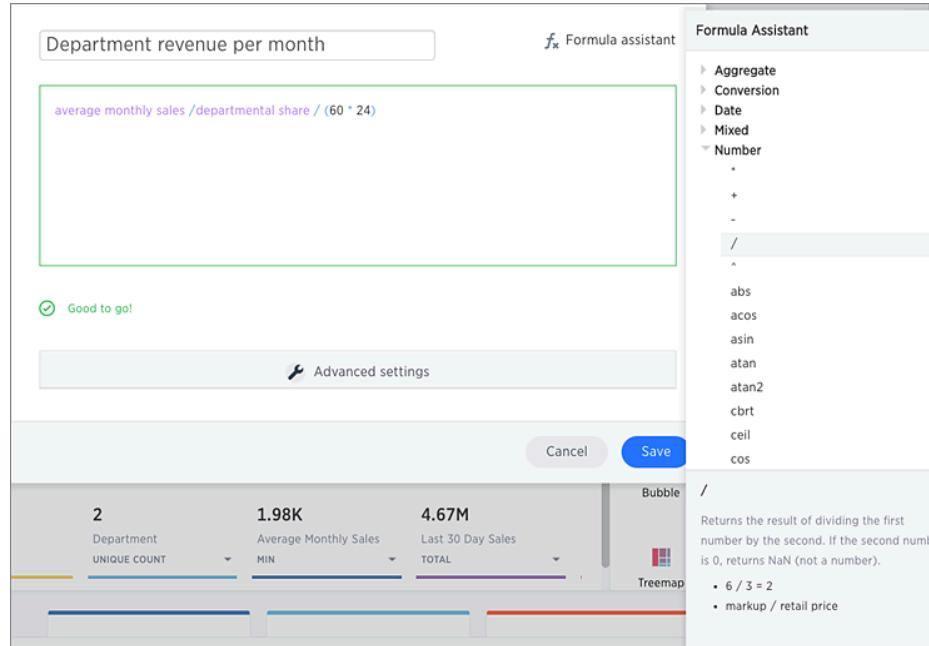
4. If you want to change what your formula returns, use the **Advanced settings**.

Depending on your formula, you may be able to change:

- Data type
- ATTRIBUTE or MEASURE
- Aggregation type



5. You can see a list of formula operators with examples by clicking on **Formula Assistant**.



6. Name the formula by clicking on its title and typing the new name. Click **Save**.

# Add a filter to a worksheet

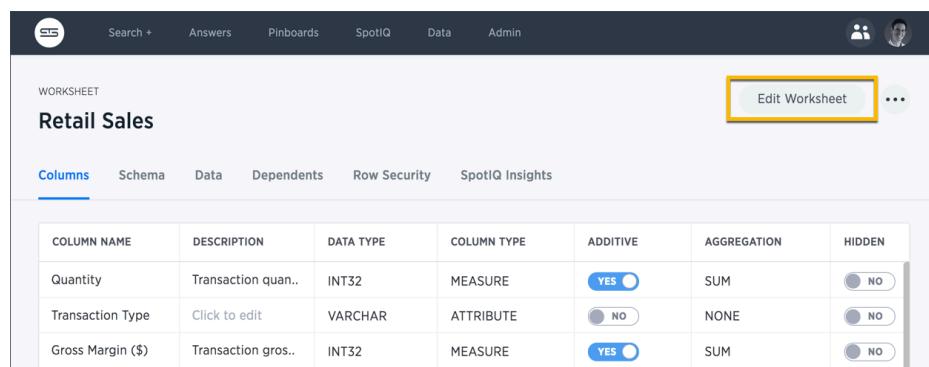
**Summary:** You can add filters to a worksheet to limit the data users can access from the worksheet.

Beginning in ThoughtSpot version 5.0, you can add filters to a worksheet to limit the data it contains.

This is useful when you have underlying tables that store more data than is necessary for the types of analyses the worksheet is intended for. You can also use worksheet filters to provide data security, when you want different groups of users to be able to see different data without relying on row level security.

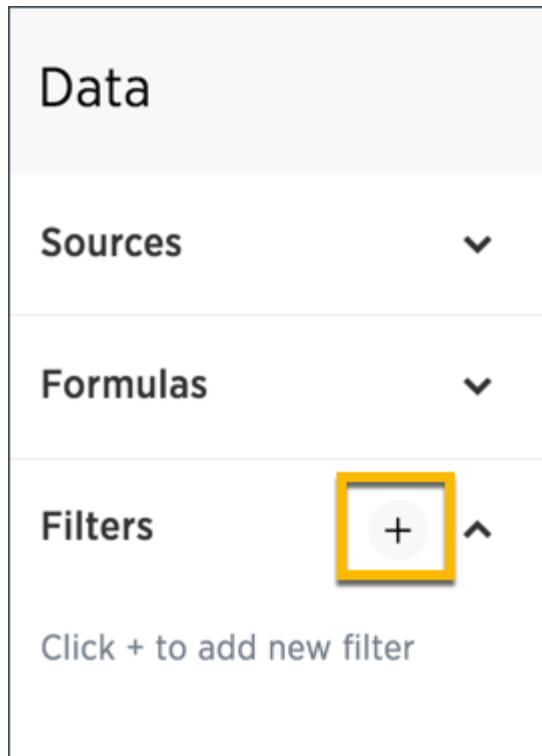
To add a filter to a worksheet:

1. Click **Data** in the top menu bar, find your worksheet, and click its name.
2. Click the **Edit Worksheet** button.



The screenshot shows the ThoughtSpot worksheet editor interface. At the top, there's a navigation bar with icons for Search +, Answers, Pinboards, SpotIQ, Data, and Admin. On the far right, there are user profile icons. Below the navigation bar, the title 'WORKSHEET' is followed by 'Retail Sales'. To the right of the title is a button labeled 'Edit Worksheet' with a yellow border, which is the target of the first step in the list. Further to the right is a three-dot menu icon. Below the title, there are tabs for 'Columns', 'Schema', 'Data', 'Dependents', 'Row Security', and 'SpotIQ Insights', with 'Columns' being the active tab. The main area displays a table with four rows of data. The columns are: COLUMN NAME, DESCRIPTION, DATA TYPE, COLUMN TYPE, ADDITIVE, AGGREGATION, and HIDDEN. The data rows are: 1. Quantity, Transaction quan.., INT32, MEASURE, YES (selected), SUM, NO (selected). 2. Transaction Type, Click to edit, VARCHAR, ATTRIBUTE, NO (selected), NONE, NO (selected). 3. Gross Margin (\$), Transaction gros.., INT32, MEASURE, YES (selected), SUM, NO (selected).

3. Click **Filters** on the left menu and click **+**.



4. Choose the column you want to filter on.

### Filter - Choose a column

Search Columns

**Customers**

- Occupation
- Marital Status
- Number Of Children
- Largest Bill Amount
- Customer Region
- Customer City
- Customer Name
- Customer State
- Annual Income
- Customer County
- Customer Zip Code

**Dates**

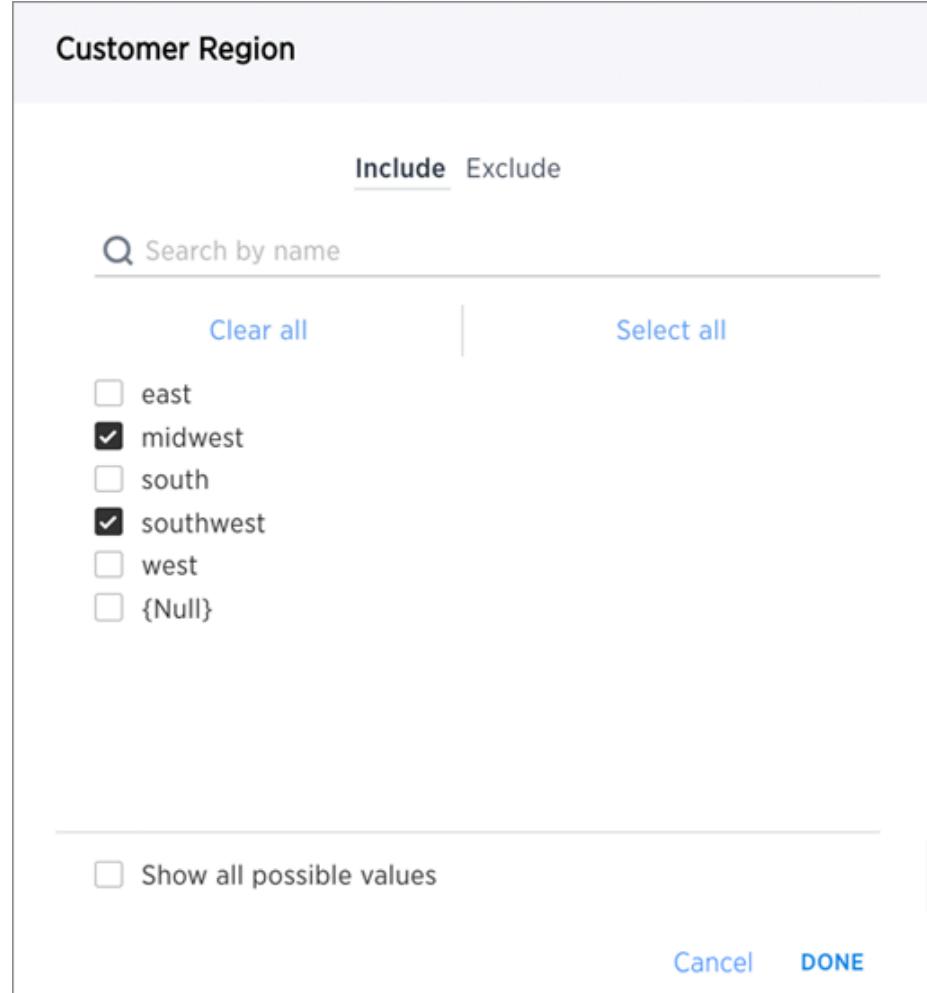
- Weekday Indicator

**Products**

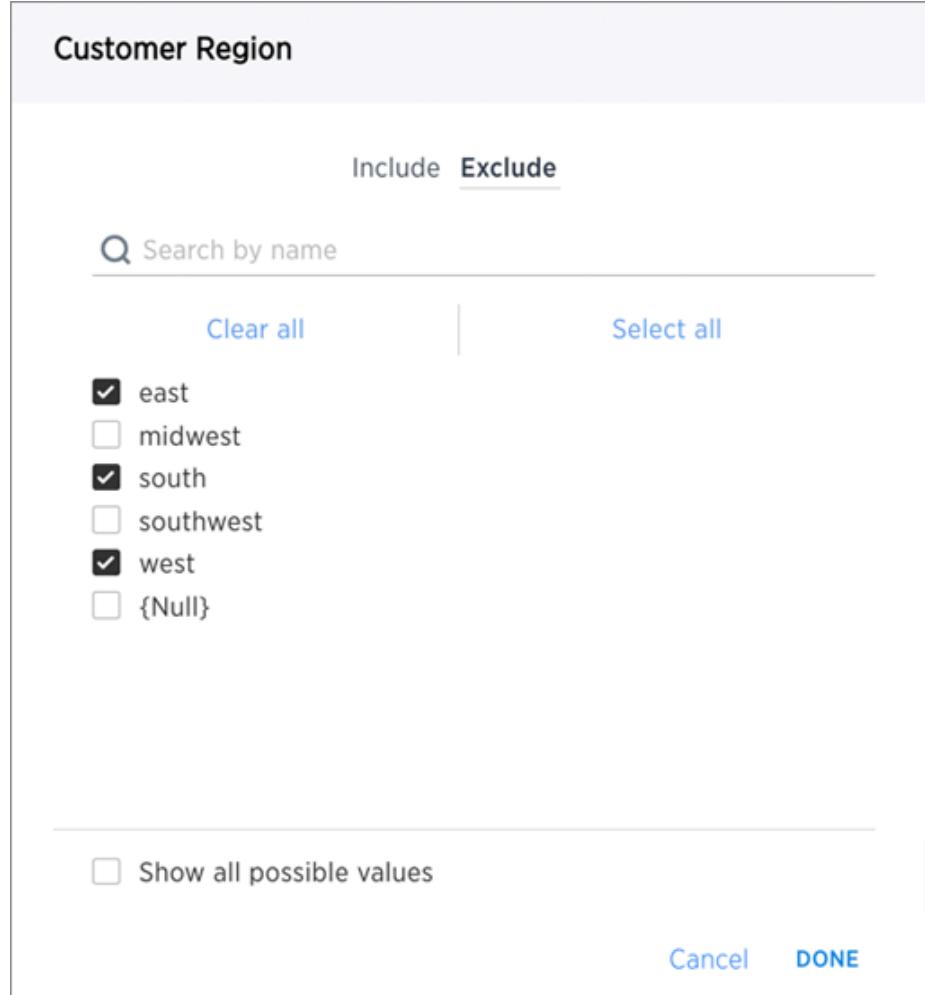
- Department
- Diet Type
- Product Name
- Category

[CANCEL](#)

5. Select the values to include in your answer.



6. If you want to exclude values, click **Exclude** and choose values to exclude.



7. Click **ADD FILTER**.

If there are too many values, you can use the filter search bar to find the ones you want.

# How the worksheet join rule works

Use the worksheet join rule to specify when to apply joins when a search is done on a worksheet. You can either apply joins progressively, as each search term is added (recommended), or apply all joins to every search.

## Understand progressive joins

Often, a worksheet includes several dimension tables and a fact table. With progressive joins, if your search only includes terms from the fact table, you can see all of the rows that satisfy your search. But as you add terms from dimension tables, the total number of rows shown may be reduced, as the joins to each dimension table are applied. It works like this:

- If you choose **Apply joins progressively (recommended for most cases)**, joins are only applied for tables whose columns are included in the search.
- If you choose **Apply all joins**, all possible joins are applied, regardless of which tables are included in the search.

When using **Apply joins progressively**, the number of rows in a search using the worksheet depends on which tables are part of the search. The worksheet acts like a materialized view. This means that it contains the results of a defined query in the form of a table. So if a particular dimension table is left out of the search, its joins are not applied.

## Rule-Based Row Level Security (RLS) with worksheets

With Rule-Based RLS, you need to protect every table that contains any sensitive data. To do this, you can grant access by creating explicit row level security rules on each of the underlying tables which contain data that row level security should apply to.

When creating the row level security rules for a table that's part of a worksheet, you aren't limited to referencing only the columns in that table. You can specify columns from other tables in the worksheet as well, as long as the tables are joined to the table you're creating the rule on. Then, when creating a worksheet on top of them, the behavior is consistent regardless of the worksheet join rule you choose. Users will never be able to see data they should not, regardless of what their search contains.

Imagine you have a worksheet that contains a `Sales` fact table, and `Customer` and `Product` dimensions that are joined on `Customer SSN` and `Product Code` columns. In order to secure the `Sales` table, you can use `Customer Name` from the `Customer` column to create a row level security rule.

## How joins are applied with chasm traps

When working with worksheets and row level security, you need to understand how joins are applied. This is particularly important with chasm trap schemas. For chasm trap schemas, if row level security is only set on one of the tables, people could see data they should not see if the scope of their search does not include that table. (this protects them from having people see the wrong things if they have chasm trap).

For chasm trap *worksheets*, progressive and non-progressive joins do not apply. There is an entirely different methodology for how worksheet joins on a chasm trap schema work with row level security. So you can safely ignore that setting.

# Change the join rule or RLS setting for a worksheet

**Summary:** As long as you have permissions to edit a worksheet, you can always go into it and set a different join or RLS rule.

If you find that the charts and tables built on a worksheet contain a large number of null values (which display as {blank} in the web browser), you can fix this by changing the [internal joins \[See page 345\]](#) for the worksheet.

If you have the **Can administer ThoughtSpot** privilege or the **Can manage data** plus edit privilege on a worksheet, you can edit the worksheet and change its RLS or other key settings.

## Change/configure a worksheet

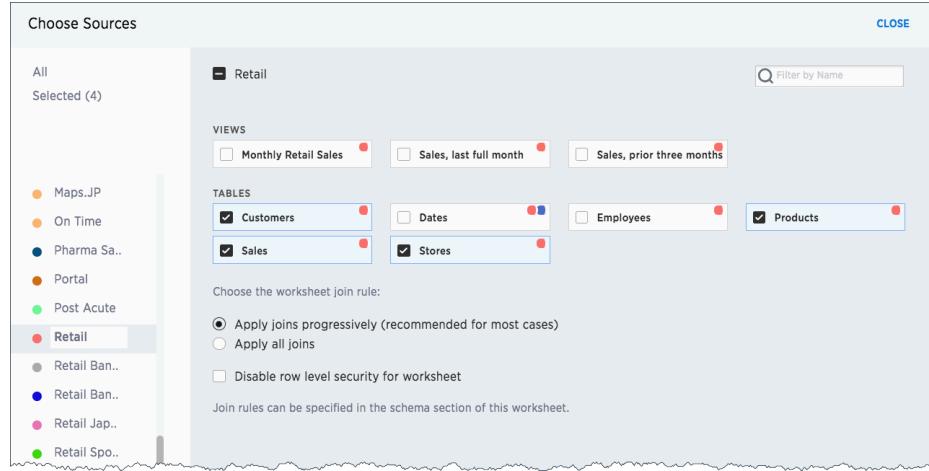
Before working through this procedure, make sure you are familiar with how the following affect data:

- [internal worksheet joins \[See page 345\]](#)
- [worksheet join rule \[See page 337\]](#)
- [row level security \(RLS\) \[See page 226\]](#)

To configure these values for a worksheet:

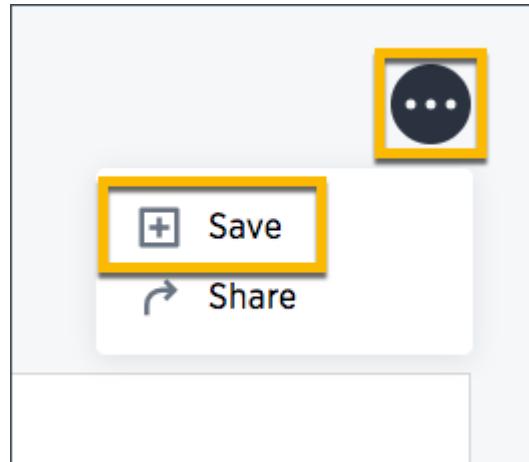
1. Click **Data** on the top navigation bar and then on **Worksheets**.
2. Click the name of the worksheet you want to edit from the list.
3. Click the **Edit Worksheet** button in the upper right hand side of the screen.
4. Click the **+** icon next to **Sources**.
5. Scroll to the bottom of the page.
6. Configure the worksheet join rule and RLS setting as needed.

Change the join rule or RLS setting for a worksheet



7. Click **CLOSE**.

8. Click the ellipses icon , and select **Save**.



# Join a worksheet to another data source

**Summary:** Learn how to define joins between a worksheet and a table or view

Joining a worksheet to a table or view creates a relationship that allows them to be searched together.

Choose a column to join on that both data sources contain (e.g. employee ID or product key). This process creates a [generic join \[See page 106\]](#) between the worksheet and the table or view on the column you specify.

Note that creating a [foreign key relationship \[See page 106\]](#) is preferred over a generic relationship in most cases, except for when you need to do a range join. Foreign key relationships perform better and protect users from overcounting upon aggregation.

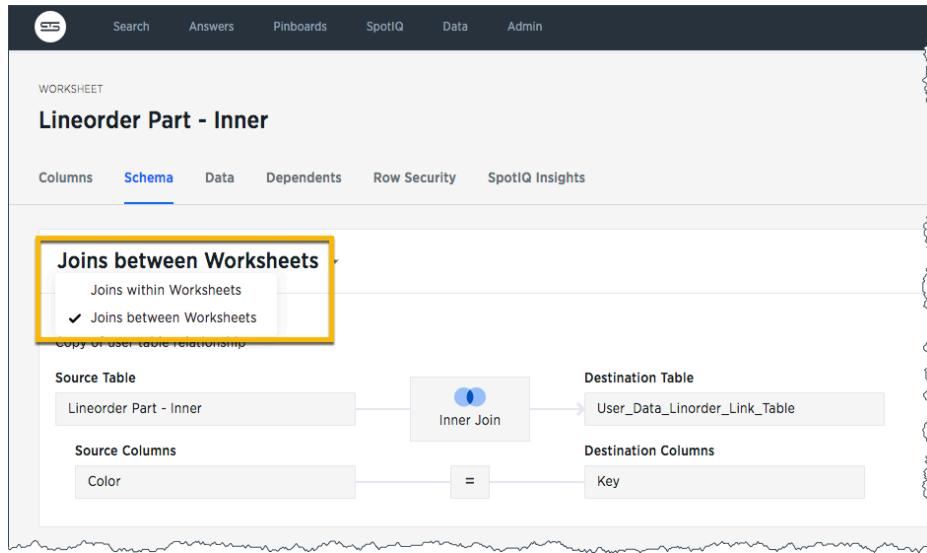
You must have either the **Can administer ThoughtSpot** privilege or the **Can manage data** privilege to create a join relationship. If you're not an administrator, you also need edit permissions on the table, view, or worksheet.

When creating a join between the columns in two data sources, the columns being linked must have the same data type, with the same meaning. That is, they must represent the same data.

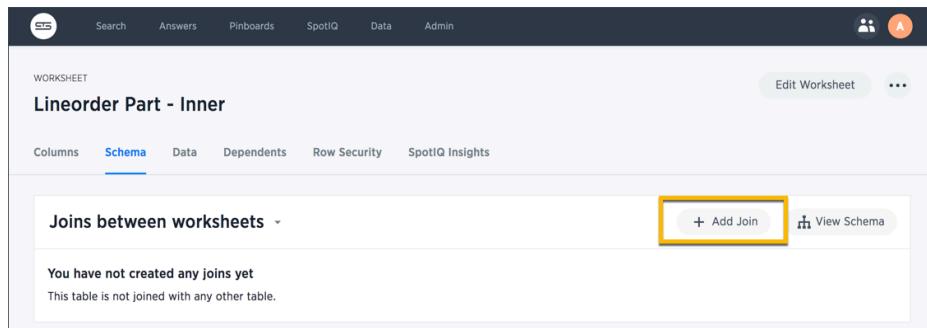
To create a relationship through the Web interface:

1. To find your worksheet, click **Data** in the top menu, and choose **Worksheets**.
2. Click the name of your worksheet.
3. Click **Schema**. You will see the list showing existing joins within the worksheet.
4. To view the joins between the worksheet and other data sources, click **Joins within worksheets** and choose **Joins between worksheets**.

Join a worksheet to another data source



5. Click the **+ Add Join** button on the upper right side of the screen.



6. Use the **Map source to destination** dialog to choose the destination table or view you want to join to.

Add Join

Map Source to Destination

Use the form below to map your selected table to a destination table and select specific columns to join.

Source Table Lineorder Part - Inner	→	Destination Table User_Data_Linorder_Link_Table
Source Columns Select Column	=	Search table name User_Data_Linorder_Link_Table User_Data_Transactions
+ Add Column		

Cancel    **NEXT**

7. Choose the columns you want to join on from the worksheet (source) and destination data source. Click **Next**.

Add Join

Map Source to Destination

Use the form below to map your selected table to a destination table and select specific columns to join.

Source Table Lineorder Part - Inner	→	Destination Table User_Data_Linorder_Link_Table
Source Columns Commit Date	=	Destination Columns Select Column
+ Add Column		Search Columns Created Updated

Cancel    **NEXT**

8. Give your join a name and description and click **ADD JOIN**.

9. Repeat these steps until all the joins you want to make have been created.

After creating the join, you may change its name and description by clicking the edit icon. If you want to change the data source or column being joined, you must delete the join and create a new one.

## Related Information

- Constraints [See page 106]

# Modify joins within a worksheet

**Summary:** Learn how to change the join type between the tables within a worksheet

When you create a worksheet, you select a [join rule \[See page 337\]](#). The join rule works together with the joins defined within the worksheet determine how the tables that make up the worksheet are joined, and how those joins behave when searching on the worksheet.

Starting with ThoughtSpot version 5.0, you are not limited to just one join rule for the entire worksheet.

You can define different types of joins for each join between tables in a worksheet. By default, each of these individual table joins uses an inner join. But you can override this at the individual join level.

You must have either the **Can administer ThoughtSpot** privilege or the **Can manage data** privilege to modify joins within worksheets.

## Modify a join

To modify the join types within a worksheet, follow these steps:

1. Click the **Data** tab in the top menu.

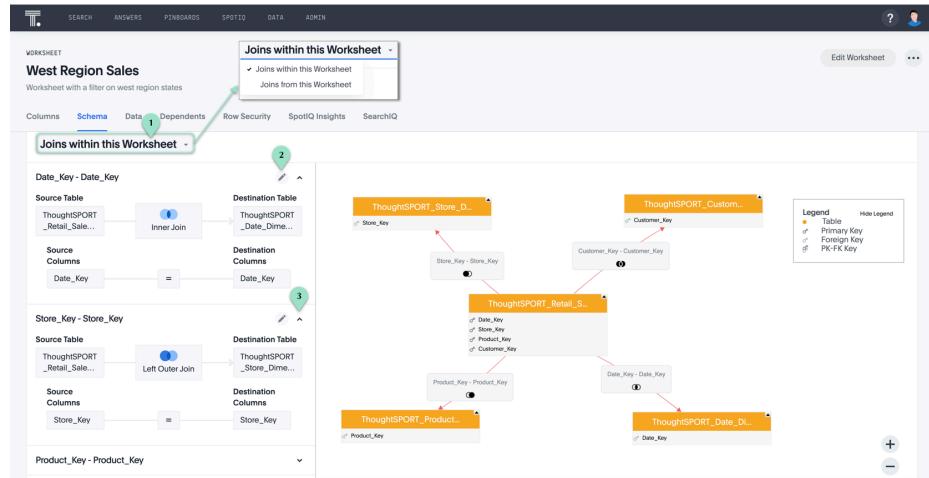


2. Select **Table**, and then select **Worksheets**.
3. Click the name of the worksheet. Here, we selected the worksheet *West Regional Sales*.
4. At the top of the worksheet, click the **Schema** tab.

COLUMN NAME	DESCRIPTION	DATA TYPE	COLUMN TYPE	ADDITIVE	AGGREGATION	HIDDEN
Sales	Click to edit	DOUBLE	MEASURE	<input checked="" type="radio"/> YES <input type="radio"/>	SUM	<input checked="" type="radio"/> NO <input type="radio"/>
Gross Margin	Click to edit	DOUBLE	MEASURE	<input checked="" type="radio"/> YES <input type="radio"/>	SUM	<input checked="" type="radio"/> NO <input type="radio"/>
Quantity	Click to edit	INT32	MEASURE	<input checked="" type="radio"/> YES <input type="radio"/>	SUM	<input checked="" type="radio"/> NO <input type="radio"/>
POS Transaction Nu...	Click to edit	INT32	ATTRIBUTE	<input checked="" type="radio"/> YES <input type="radio"/>	SUM	<input checked="" type="radio"/> NO <input type="radio"/>
Date	Click to edit	DATE	ATTRIBUTE	<input type="radio"/> NO <input checked="" type="radio"/>	NONE	<input checked="" type="radio"/> NO <input type="radio"/>
Latitude	Click to edit	DOUBLE	ATTRIBUTE	<input type="radio"/> NO <input checked="" type="radio"/>	NONE	<input checked="" type="radio"/> NO <input type="radio"/>
Longitude	Click to edit	DOUBLE	ATTRIBUTE	<input type="radio"/> NO <input checked="" type="radio"/>	NONE	<input checked="" type="radio"/> NO <input type="radio"/>
Store City	Click to edit	VARCHAR	ATTRIBUTE	<input type="radio"/> NO <input checked="" type="radio"/>	NONE	<input checked="" type="radio"/> NO <input type="radio"/>

5. The join information and the schema for the worksheet appear.

- The schema representation includes the join type.
- You can see the list of *Joins within the worksheet*, which include all joins between the underlying tables, both created using TQL [See page 106] and created in the browser [See page 311].
- The fact table is always on the left side of the join, and it appears on the left side.

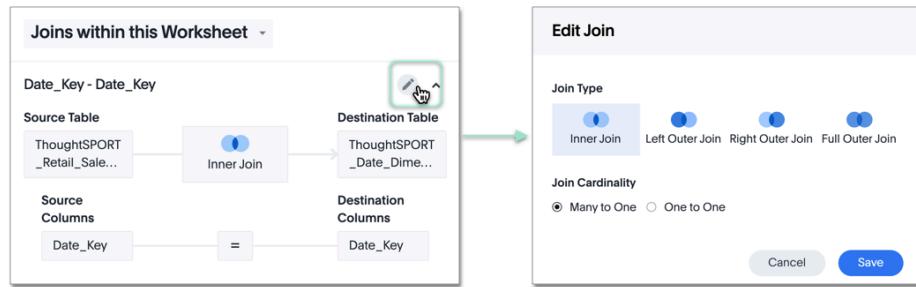


Note the available actions for the join view.

#### Legend Action

- See either *Join within this Worksheet (Default)*, or *Joins from this Worksheet*.

2. Click the pencil icon to edit the join.
3. Click the up arrow icon to collapse the join detail.
6. Select the join you plan to modify, and click the **Edit** (pencil) icon next to it.
7. In the **Edit Join** window modal, make the necessary changes:



- Under **Join Type**, select one of *Inner Join*, *Left Outer Join*, *Right Outer Join*, or *Full Outer Join*.
- Under **Join Cardinality**, select either *Many to One*, or *One to One*.

Click **Save**.

## Related Information

- [Join rule \[See page 337\]](#)
- [Create joins using TQL \[See page 106\]](#)
- [Create join relationships in the browser \[See page 311\]](#)

# Delete a worksheet or table

**Summary:** When you try to delete a worksheet or table, you can see a message listing any dependent objects that must be removed first.

ThoughtSpot checks for dependencies whenever you try to remove a table or worksheet. A list of dependent objects appears, and you can click them to delete them or remove the dependency. Then, you can remove the table or worksheet.

To delete a worksheet or table:

1. Click **Data**, on the top navigation bar.
2. Find the worksheet or table you want to remove in the list, and check the box next to its name.
3. Click the **Delete** icon.

Tables				Data Sources
All	Yours	All types	Worksheets	Tables
<input type="button" value="Delete"/>	<input type="button" value="Share"/>	<input type="button" value="Apply Sticker"/>		
NAME	DESCRIPTION	SOURCE		
<input type="checkbox"/> Udemy_user_progr..		Imported		
<input type="checkbox"/> Udemy_user_cours..		Imported		
<input checked="" type="checkbox"/> Udemy_user_activi..		Imported		
<input checked="" type="checkbox"/> Udemy Worksheet				

If you are attempting to delete a data source with dependent objects, the operation will be blocked. You will see a warning, with a list of dependent objects with links.

4. Click the link for an object to modify or delete it.

When all its dependencies are removed, you will be able to delete the data source.

## Cannot delete

The following object(s) depend on "Sporting Goods Retail Worksheet". You must delete them to delete "Sporting Goods Retail Worksheet".

- [Sales by Store - Last 30 Days](#) (Answer)
- [Shopping Trend of Members vs Non-Members](#) (Answer)
- [Sales Breakdown by Mode of Payment](#) (Answer)
- [Moving Sum of All Sales - Last 30 days](#) (Answer)
- [Pivot Example](#) (Answer)
- [Sales Trend by Day of Week](#) (Answer)
- [Customer Location](#) (Answer)
- [Customer Footprint and Sales by Region](#) (Answer)
- [Sales by Region, State and Year](#) (Answer)
- [Low Inventory](#) (Answer)
- [Monthly Department Sales Analysis](#) (Answer)
- [Sales for Last Month](#) (Answer)
- [Product & Department Sales Group Sum](#) (Answer)
- [Margin vs Sales Analysis](#) (Answer)
- [Sales by Age Group, Gender and Product Category](#) (Answer)
- [Racquet Sales](#) (Answer)
- [Sales by Quarter](#) (Answer)
- [Average Sales - Weekday vs Weekend](#) (Answer)
- [Vicky's Sales Data](#) (Answer)
- [Sales Per Customer for Outerwear by State](#) (Answer)

OK

5. You can also click the name of a worksheet or table and then click **Dependents**, to see a list of dependent objects with links.

The **Dependents** list shows the names of the dependent objects (worksheets and pinboards), and the columns they use from that source. You can use this information to determine the impact of changing the structure of the data source or to see how widely used it is. Click a dependent object to modify or delete it.

Delete a worksheet or table

WORKSHEET

## Sporting Goods Retail Worksheet

ThoughtSPORT worksheet

[Edit Worksheet](#) [...](#)

Columns Schema Data **Dependents** Row Security SpotIQ Insights

COLUMN NAME	DEPENDENT NAME	TYPE
Age Group	<a href="#">Total Sales by Depar..</a>	View
Date	<a href="#">Top 100 Products M..</a>	View
Product Name	<a href="#">Top 100 Products M..</a>	View
Department	<a href="#">Total Sales by Depar..</a>	View
Sales	<a href="#">Total Sales by Depar..</a>	View
Customer City	<a href="#">Customer Location</a>	Answer
Customer Name	<a href="#">Customer Location</a>	Answer

( showing rows 1-0 of 27 )

THOUGHTSPOT

# Migrate or restore Worksheets

**Summary:** You can export an entire ThoughtSpot worksheet in a flat-file format. After optional modification, you can migrate it to a different cluster, or restore it to the same cluster.

In ThoughtSpot, you can download Worksheets to a flat file in `yaml` format, modify the file, and subsequently upload this file either to the same cluster, or to a different cluster. This mechanism supports several scenarios that you may encounter:

- **Migrating from a development environment to a production environment** by downloading the file from the development cluster and uploading the same file into the production cluster
- **Implementing metadata changes outside ThoughtSpot UI**, such as replacing the underlying tables for the entire table, or replacing a single column from one table with a column in another table
- **Making bulk changes**, such as mass renaming of objects defined by the worksheets, and managing duplicates

## Prerequisites

You must have **Edit** permissions for the worksheet.

## Export Worksheet

To export a worksheet, follow these steps:

1. Click **Data** on the top navigation bar.
2. Click the name of the worksheet you want to edit.
3. Click the ellipses  (more options) menu in the upper-right side of the screen.
4. From the menu, select **Export Worksheet**.

Here, we are downloading the *Sales* worksheet.

COLUMN NAME	DESCRIPTION	DATA TYPE	COLUMN TYPE	ADDITIVE	AGGREGATION	HIDDEN
Account ID	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO
Account Name	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO
Opportunity ID	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO
Opportunity Name	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO
Project Active Flag	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO
Project Customer S...	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO
Project End Date	Click to edit	DATE	ATTRIBUTE	(radio) NO	NONE	(radio) NO
Project ID	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO
Project Manager ID	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO
Project Name	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO

125 rows total

5. The worksheet downloads into your default directory.

You can access the downloaded `*.yaml` file, named for your worksheet either through the file system manager, or by clicking on the name of the downloaded file in the left bottom corner of your Internet browser.

COLUMN NAME	DESCRIPTION	DATA TYPE	COLUMN TYPE	ADDITIVE	AGGREGATION	HIDDEN	SYNOMYS	SPOTIC
Account ID	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO	Click to edit	DEFA
Account Name	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO	Click to edit	DEFA
Opportunity ID	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO	Click to edit	DEFA
Opportunity Name	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO	Click to edit	DEFA
Project Active Flag	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO	Click to edit	DEFA
Project Customer S...	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO	Click to edit	DEFA
Project End Date	Click to edit	DATE	ATTRIBUTE	(radio) NO	NONE	(radio) NO	Click to edit	DEFA
Project ID	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO	Click to edit	DEFA
Project Manager ID	Click to edit	VARCHAR	ATTRIBUTE	(radio) NO	NONE	(radio) NO	Click to edit	DEFA

125 rows total

Sales.yaml

## Working with the Worksheet yaml file

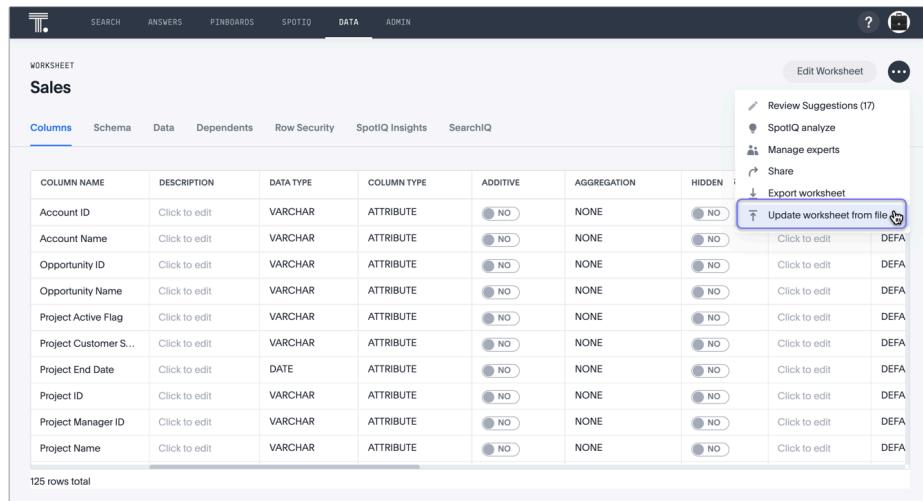
You can change the yaml file that represents the Worksheet by editing its content. See [YAML Worksheet specification](#) [See page 355] for the full syntax of the YAML file.

## Update a Worksheet

To update an existing worksheet, follow these steps:

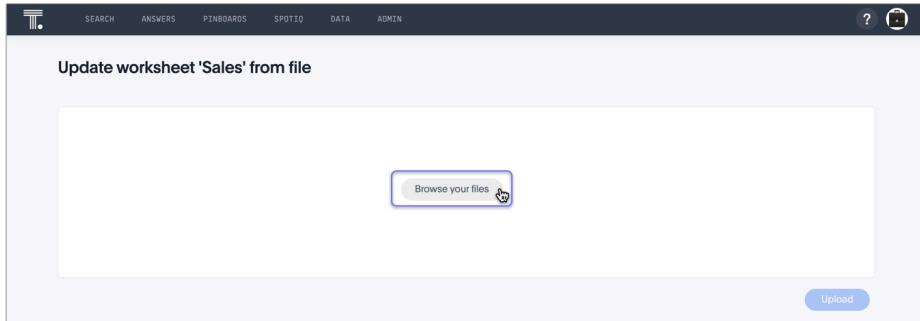
1. Click **Data** on the top navigation bar.
2. Click the name of the worksheet you want to edit.
3. Click the ellipses  (more options) menu in the upper-right side of the screen.
4. From the menu, select **Update Worksheet from file**.

Here, we are uploading the edited Sales worksheet.



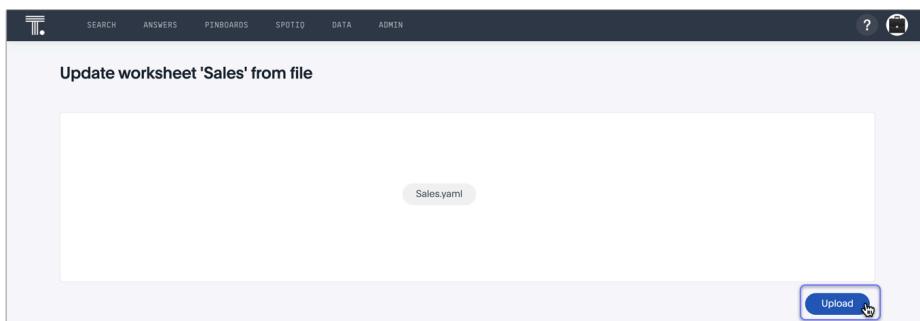
The screenshot shows the ThoughtSpot worksheet editor interface. At the top, there's a navigation bar with tabs: SEARCH, ANSWERS, PINBOARDS, SPOTIQ, DATA, and ADMIN. Below the navigation bar, the title 'WORKSHEET' and 'Sales' are displayed. Underneath the title, there are several tabs: Columns (which is selected), Schema, Data, Dependents, Row Security, SpotIQ Insights, and SearchIQ. The main area contains a table with 12 columns, each with a 'Click to edit' link. To the right of the table is a vertical sidebar with various options: Review Suggestions (17), SpotIQ analyze, Manage experts, Share, Export worksheet, and Update worksheet from file. The 'Update worksheet from file' option is highlighted with a blue box and a cursor icon pointing at it.

5. In the upload interface, click **Browse your files**.



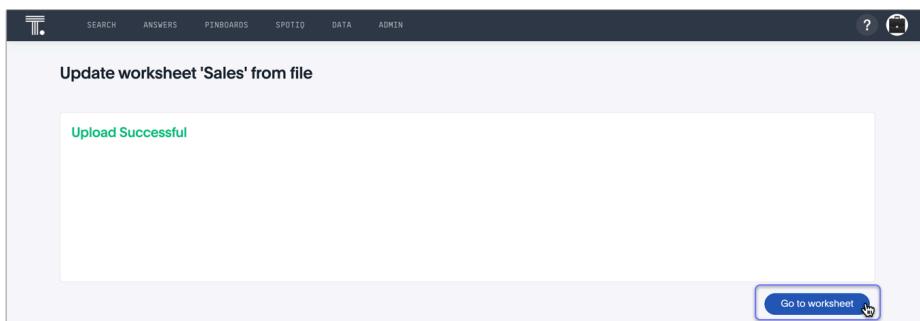
6. In your file system, find and select the YAML file.

7. In the **Update worksheet** interface, click **Upload**.



8. If you constructed the Worksheet file correctly, the **Upload Worksheet** interface displays an *Upload successfull* message.

9. To examine the updated Worksheet, click **Go to Worksheet**.



## Related Information

- [Worksheet YAML specification \[See page 355\]](#)

# Worksheet YAML specification

**Summary:** ThoughtSpot worksheet specification may be exported as a YAML file, modified, and imported into the same or different cluster.

To work with Scriptable Worksheets in ThoughtSpot, you can download Worksheets to a flat file in `yaml` format, modify it, and subsequently upload this file either to the same cluster, or to a different cluster.

## Syntax of the Worksheet YAML file

The YAML file for Scriptable Worksheets has a specific syntax.

See the [Parameters \[See page 358\]](#) section for details about the keywords used in this example.

```

worksheet [See page 0]:
  name [See page 0]: <worksheet_name>
  description [See page 0]: |-
    This is a multi-line description of the worksheet
    Description line 2
  tables [See page 0]:
  - name [See page 0]: <table_name_1>
  - [alias [See page 0]] : <table_alias>
  - [fqn [See page 0]] : <GUID_of_table_name>
  - name [See page 0]: <table_name_2>
  - name [See page 0]: <table_name_3>
  joins:
  - name [See page 0]: <join_name_1>
    source [See page 0]: <source_table_name>
    destination [See page 0]: <destination_table_name>
    type [See page 0]: [RIGHT_OUTER | LEFT_OUTER | INNER | OUTE
R]
    is_one_to_one [See page 0]: [ false | true ]
  - ...
  table_paths [See page 0]:
  - id [See page 0]: <table_path_name_1>
    table [See page 0]: <table_name_1>
    join_path [See page 0]:
    - join [See page 0]join:
      - <join_name_1>
  - id [See page 0]: <table_path_name_2>
    table [See page 0]: <table_name_2>
    join_path [See page 0]:
    - {}
  - id [See page 0]: <table_path_name_3>
    table [See page 0]: <table_name_3>
    join_path [See page 0]:
    - join [See page 0]:
      - <join_name_1>
    - join [See page 0]:
      - <join_name_2>
      - <join_name_3>
    - join [See page 0]:
      - <join_name_4>
      - <join_name_5>
      - <join_name_6>
  formulas [See page 0]:
  - name [See page 0]: <formula_name_1>
    expr [See page 0]: <formula_definition_1>
    [id]: <unique_identifier>

```

```

- name [See page 0]: <formula_name_2>
  expr [See page 0]: <formula_definition_2>
- name [See page 0]: <formula_name_3>
  expr [See page 0]: <formula_definition_3>
worksheet_columns [See page 0]:
- name [See page 0]: <column_name_1>
  description [See page 0]: <column_description>
  formula_id [See page 0]: <formula_name_1>
  properties [See page 0]:
    column_type [See page 0]: [ MEASURE | ATTRIBUTE ]
    aggregation [See page 0]: [ SUM | COUNT | AVERAGE | MAX
      | MIN |
        COUNT_DISTINCT | NONE | STD_DEVIATION | VA
      RIANCE]
    index_type [See page 0]: [ DONT_INDEX | DEFAULT | PREFI
      X_ONLY |
        PREFIX_AND_SUBSTRING | PREFIX_AND_WORD_SUBS
      TRING ]
    is_hidden [See page 0]: [ true | false ]
    index_priority [See page 0] : <index_priority>
  synonyms [See page 0] :
    <synonym_1>
    <synonym_2>
  is_attribution_dimension [See page 0] : [true | false]
  is_additive [See page 0] : [ true | false ]
  calendar [See page 0] : [ default | calendar_name ]
  format_pattern [See page 0] : <format_pattern_string>
  currency_type [See page 0] :
    is_browser : true
    OR
    column : <column_name>
    OR
    iso_code : <valid_ISO_code>
geo_config [See page 0] :
  latitude : true
  OR
  longitude : true
  OR
  country : true
  OR
  region_name:
  - country : <name_supported_country>
  - region_name : <region_name_in_UI>
name [See page 0]: <column_name_2>
description [See page 0]: <column_description>

```

```
formula_id [See page 0]: <formula_name_2>
...
properties [See page 0]:
  is_bypass_rls [See page 0]: [ true | false ]
  join_progressive [See page 0]: [ true | false ]
```

## Parameters of Worksheet YAML file

### aggregation

The default aggregation of the worksheet column

Aggregation options depend on the data type.

Possible values: SUM , COUNT , AVERAGE , MAX , MIN , COUNT\_DISTINCT , NONE , STD\_DEVIATION , and VARIANCE

Default: SUM

### alias

An alternate name for the table

### calendar

Specifies the calendar used by a date column

Can be the Gregorian calendar ( default ), a fiscal calendar, or any custom calendar.

See [Set up a custom calendar \[See page 27\]](#)

### column\_type

The type of data the column represents

Possible values: MEASURE or ATTRIBUTE

Default: MEASURE

### currency\_type

The source of currency type

One of:

- is\_browser : true infer the currency data from the locale of your browser
- column : <column\_name> extracts the currency information from a specified column
- iso\_code : <valid\_ISO\_code> applies currency based on the ISO code; see [ISO 4217 Currency Codes \[See page 0\]](#)

See [Set currency type \[See page 305\]](#)

### description

The text that describes an object: a worksheet , a worksheet\_column , and so on.

### destination

Name of destination table or view of the join

### expr

The definition of the formula

### **format\_pattern**

The format pattern string that controls the display of a number, date, or currency column

See [Set number, date, and currency formats \[See page 301\]](#)

### **formula\_id**

The `id` of the formula that defines the worksheet column

### **formulas**

The list of formulas in the worksheet

Each formula is identified by `name`, the `expr` (expression), and an optional `id` attribute.

### **fqn**

A GUID for the table name

### **geo\_config**

Specifies the geographic information of a column

One of:

- `latitude : true` for columns that specify the latitude
- `longitude : true` for columns that specify the longitude
- `country : true` for columns that specify the country
- `region_name` for specifying a region in a country

Uses two paired parameters:

- `country: <country_name>`
- `region_name: <region_name_in_UI>`, which can be State, Postal Code, District, and so on.

See [Add a geographical data setting \[See page 299\]](#)

### **id**

Specifies the id of an object, such as `table_paths`, `formula`.

### **index\_priority**

A value (1-10) that determines where to rank a column's name and values in the search suggestions

ThoughtSpot prioritizes columns with higher values.

See [Change a column's suggestion priority \[See page 297\]](#).

### **index\_type**

The indexing option of the worksheet column

Possible values: `DONT_INDEX`, `DEFAULT` (see [Understand the default indexing behavior \[See page 294\]](#)), `PREFIX_ONLY`, `PREFIX_AND_SUBSTRING`, and `PREFIX_AND_WORD_SUBSTRING`

Default: `DEFAULT`

See [Index Type Values \[See page 295\]](#)

### **is\_additive**

Controls extended aggregate options for attribute columns

For attribute columns that have a numeric data type ( `FLOAT`, `DOUBLE`, or `INTEGER` ) or a date data type ( `DATE`, `DATETIME`, `TIMESTAMP`, or `TIME` )

Possible values: `true` or `false`

Default: `true`

See [Making an ATTRIBUTE column ADDITIVE \[See page 285\]](#)

### **is\_attribution\_dimension**

Controls if the column is an attribution dimension

Used in managing chasm traps.

Possible values: `true` by default, `false` to designate a column as not producing meaningful attributions across a chasm trap

Default: `true`

See [Change the attribution dimension \[See page 307\]](#)

#### **is\_bypass\_rls**

Specifies if the worksheet supports bypass of Row-level security (RLS)

Possible values: `true` or `false`

Default: `false`

See [Privileges that allow users to set, or be exempt from, RLS \[See page 221\]](#)

#### **is\_hidden**

The visibility of the column

Possible values: `true` to hide the column, `false` not to hide the column

Default: `false`

See [Hide a column \[See page 289\]](#)

#### **is\_one\_to\_one**

Specifies the cardinality of the join

Possible values: `true`, `false`

Default: `false`

#### **join**

Specific join, used in defining higher-level objects, such as table paths

Defined as `name` within `joins` definition

#### **join\_path**

Specification of a composite join as a list of distinct `join` attributes

These `join` attributes list relevant joins, previously defined in the `joins`, by name.

Default: `{}`

#### **join\_progressive**

Specifies when to apply joins on a worksheet

Possible values: `true` when joins are applied only for tables whose columns are included in the search, and `false` for all possible joins

Default: `true`

See [How the worksheet join rule works \[See page 337\]](#)

#### **joins**

List of joins between tables and views, used by the worksheet

Each join is identified by `name`, and the additional attributes of `source`, `destination`, `type`, and `is_one_to_one`.

#### **name**

The name of an object. Applies to `worksheet`, `table`, `join`, `formula`, and so on.

#### **properties**

The list of properties of the worksheet column

Each column can have the following properties, depending on its definition: `column_type`, `aggregation`, `index_type`, `is_hidden`, `index_priority`, `synonyms`, `is_attribution_dimension`, `is_additive`, `calendar`, `format_pattern`, `currency_type`, and `geo_config`.

**source**

Name of source table or view of the join

**synonyms**

Alternate names for the column, used in search

See [Create synonyms for a column \[See page 289\]](#)

**table**

Specific table, used in defining higher-level objects, such as table paths

Defined as `name` within `tables` definition

**table\_paths**

The list of table paths

Each table path is identified by the `id`, and additional attributes of `table` and `join_path`.

**tables**

List of tables used by the worksheet

Each table is identified by `name`.

**type**

Join type

Possible values: `LEFT_OUTER` for left outer join, `RIGHT_OUTER` for right outer join, `INNER` for inner join, `OUTER` for full outer join

Default: `RIGHT_OUTER`

**worksheet**

Top-level container for all object definitions within the worksheet

**worksheet\_columns**

The list of columns in the worksheet

Each worksheet is identified by `name`, `description`, `formula_id`, and `properties`.

## Limitations of working with Worksheet YAML files

There are certain limitations to the changes you can apply be editing a Worksheet through YAML.

- Formulas and columns can either have a new name, or a new expression. You cannot change both, unless migrating or updating the worksheet two times.
- It is not possible to reverse the join direction in the YAML script.
- It is not possible to include Worksheet filters in the YAML script.

## Related Information

- Migrate or restore Worksheets [See page 351]

# Understand views

**Summary:** If you want to search on top of another search, try saving your search as a view. Then, you can use the saved view as a data source for a new search.

## Introduction to views

**Note:** Prior to ThoughtSpot version 5.0, Views were known as Aggregated Worksheets. When you upgrade to version 5.0 or later versions, any pre-existing Aggregated Worksheets will be converted to Views for you automatically. The functionality remains the same, but the name has changed.

You may have noticed that when you do a search on a data source, ThoughtSpot is only able to aggregate one column by one other column. Because of this, you may come across searches you can't do in one pass, because they are essentially nested queries. But you can create the equivalent of nested queries using a view, which is an answer that you have saved for the purpose of building other searches on top of it.

You can use a view just like any other data source. You can even link it to other sources by defining a relationship. When you save an answer as a view, and then use it as a source in a new search, it is similar to doing a nested query in SQL, only much easier to create.

To create a view, you must belong to a group that has the privilege **Can administer ThoughtSpot** or **Can manage data**. If you are not able to create views, contact your administrator and request the **Can manage data** privilege.

## View workflow

Suppose you have created a search on the sales fact table that shows the top ten Sales Reps by revenue for the first quarter. Then you want to do some further investigations on that set of data, like ranking them by how much they discounted a specific product using data from the orders fact table. Unless you save your first answer as a view, certain explorations like this won't be possible. If you want to do this, here are the steps at a high level:

1. Create the first search, and save it as a view [See page 366].
2. Create relationships [See page 311] or define joins [See page 106] to connect your view with any other data sources you need.
3. Create a new search that includes your view and the other sources you linked with it.
4. You may want to [create a new worksheet \[See page 320\]](#) that includes all these data sources.

Creating a worksheet will make it easier for people to search using your view and any related tables.

## Best practices for using views

Only users with the **Can administrator ThoughtSpot** or the **Can manage data** privilege [See page 161] can create views and link them. Users that create views should keep in mind best practices for creating a worksheet and the boundaries around the final worksheet size.

**Note:** Views do not support row level security, so all users of a view will be able to see all the data it contains.

To be able to join a view with a base table, your installation must be configured to allow this. The view cannot have more than 5 tables involved, and the number of rows in the view cannot be greater than 1000.

The order of the objects being linked (joined) matters, this is because joins are directional. The table or view with the foreign key needs to occur in the first (left) position. The table or view with the primary key should be in the second (right) position.

For the best performance, views should have 50 or fewer columns and no more than 10 million rows. Exceeding these boundaries can make your view slow. You can remedy this by materializing it.

You can use an ETL (extract, transform, load) process to circumvent these limitations.

## Related Information

- [More view scenario examples \[See page 370\]](#)
- [Save a search as a view \[See page 366\]](#)
- [Constraints \[See page 106\]](#)
- [Materialized views \[See page 372\]](#)

# Save a search as a view

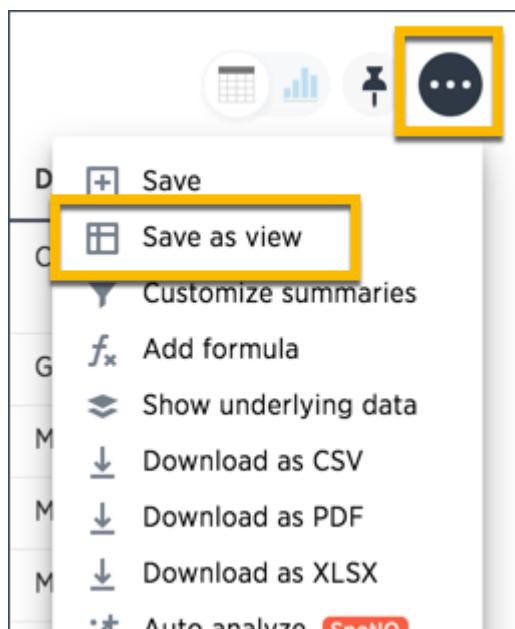
**Summary:** If you want to search on top of another search, try saving your search as a view. Then, you can use the saved view as a data source for a new search.

This procedure walks you through creating a view from a search. To create a view from a search:

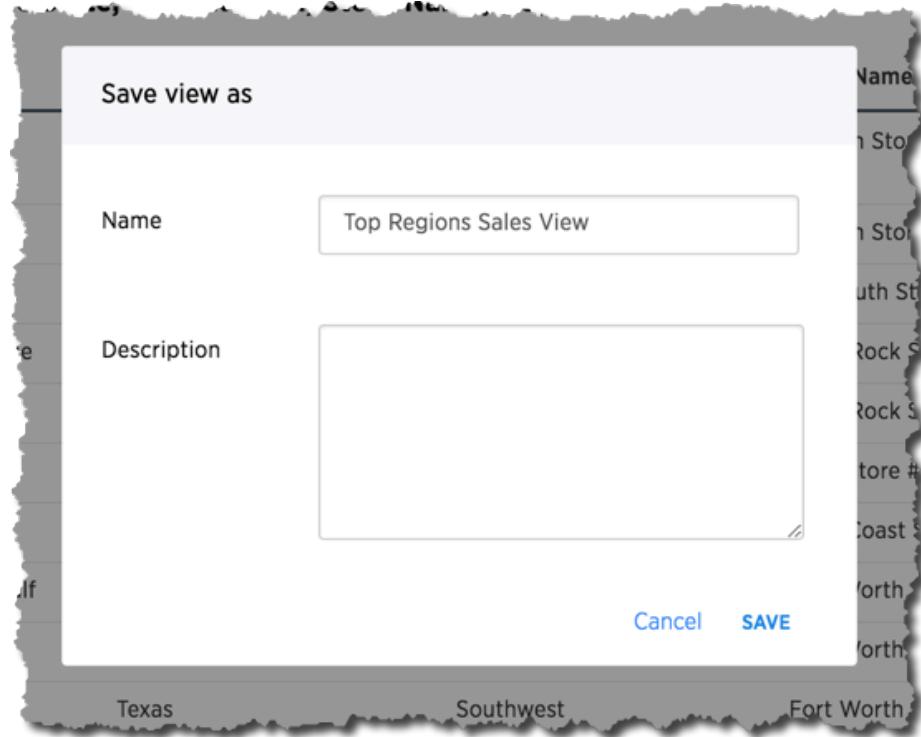
1. Start a new search, or edit an existing visualization from a pinboard.

Any filters or aggregations created during this search will be reflected in the view.

2. Make any changes to the visualization that you want in your saved view (change aggregation level, filters, etc.)
3. Click the ellipses icon  , and **Save as view**.



4. Give the view a name and save it.



5. [Link \[See page 311\]](#) your view to any other data source, or [define joins \[See page 106\]](#).

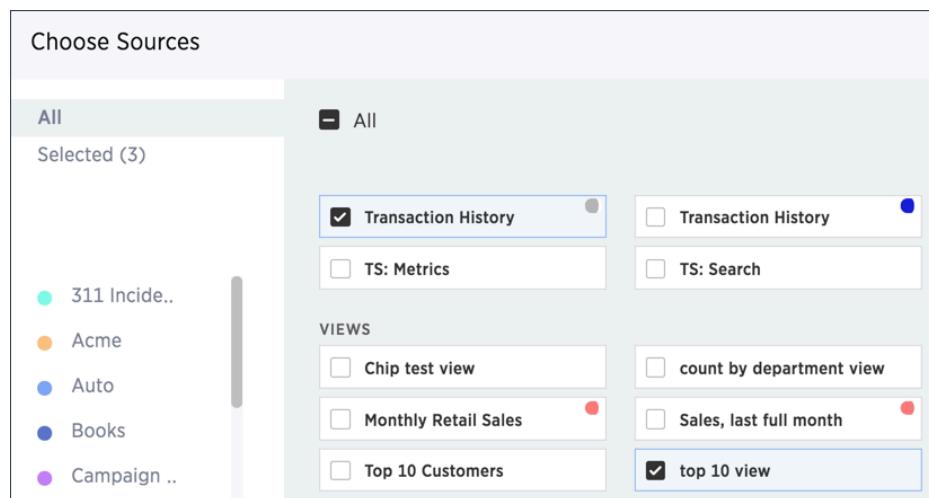
At this point the view has been saved, but you may also want to [materialize the view \[See page 372\]](#), to improve its performance when searching.

# Create a search from a view

**Summary:** After creating a view, you can select it and search its data.

After creating a view and linking it to related data, you're ready to create your new search. To do a search on the view, along with any data sources you linked:

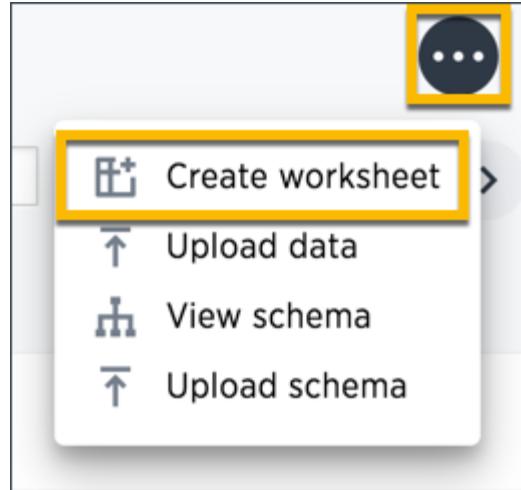
1. Click the search icon, and select **Data Source**. Choose your linked sources.



2. Do a search using columns from the linked sources.
3. Test the result, to make sure it's what you expect.

If your search shows no data found or doesn't look right to you, it is possible that one of the links between your sources was made on the incorrect column. Check the relationships you created and try linking using a different column, to see if that gives the expected search results.

4. When you have the expected answer, you can create a worksheet to make it easier for you and other people to use. To do this, click **Data**.
5. Click the ellipses icon , and select **Create worksheet**.



6. Choose your view and any other tables it is linked to using **Choose Sources**.
7. You may need to rename some columns appropriately for searching.
8. Save the worksheet and share it with the appropriate users and groups.

# View example scenarios

**Summary:** It's not always easy to know when you need to use a view, but these are some common scenarios.

Here are three common examples of when you would want to use a view.

## Example 1

Search a filtered subset

Let's say you have a table with all the sales transactions for each customer. You want to find high value customers (those who have spent a certain amount of money in the last year). Then you want to do some further analysis on these high value customers, like the count by region. Here you essentially need to sum up the sales per customer, filter by that sum to get the top customers, and then do a count, making it two levels of aggregation. A single search can do only one level of aggregation.

However, a search can calculate the initial sum and filter within it to get the highest value customers. Then you can save that result as a view. Joining the view to some other tables, like the customer dimension, allows you to do the count and other similar analyses using the view along with the other tables.

## Example 2

Cohort analysis

This example is similar to the previous example, except that it involves a more complex filter, called a cohort. You might create a search to find customers who bought product A, but did not buy product B.

First, you would have to perform searches for total sales by customer for both A and B, and create views for both. Then join these two views back in an outer join looking for conditions where the A and B join values are null.

This example could also be solved in a single search by using [conditional formulas \[See page 0\]](#) to determine the desired group (or cohort) of customers as defined by their buying behavior, and then doing the analysis on this group. But the performance will be better if you do this using a view, and then [materialize the view \[See page 372\]](#).

## Example 3

Combining aggregated sources

If you do a lot of your analysis in the aggregate, like at the quarterly level, you may be challenged when trying to combine this aggregated data from different sources. For example, you may want to combine three different quarterly views from SalesForce - Pipeline, Bookings, and Sales Activity to create a comprehensive analysis of each region's performance. Joining the quarterly views together in a worksheet enables you to do this type of analysis easily.

## Example 4

Lightweight data transformation

You may have a table with separate columns for people's first name and last name. You could use a concat formula to create a single column with first name, a space, and last name. But using this formula could make performance slow, since that column would always be calculated on the fly when searching. In this case, creating a view using the concatenate formula and materializing it will improve performance when searching this data.

# About materialized views

**Summary:** You can materialize a view to improve its performance.

## Introduction to materialized views

Views can become slow as your data volume and the number of views stacked on top of one another grow. This happens because when doing a search, each view is computed on the fly. To improve the performance of a view, you can materialize it. Materializing pre-computes the view and stores it in memory, just like a table. You can expect a materialized view to be three to six times faster than a view that is not materialized, on average.

To materialize a view, you must have the [Can administer ThoughtSpot](#) privilege [See page 161].

**Note:** The number of materialized views you can create is limited to 50, because materialized views take up space in memory.

**Note:** Row Level Security does not apply to materialized views. All users will see the same data when using the materialized view as a data source.

These are the operations you can do on a view:

- [Materialize a view](#) [See page 375] to improve performance,
- [Dematerialize a view](#) [See page 381] to save space, or
- [Refresh a view](#) [See page 383] to synchronize its data with the latest data load to the underlying tables.
- Check the status of a view.

After materializing, a view can have one of three statuses. You can see the status of a view by selecting **Data**, clicking on **Views**, and finding your view in the list. The status is shown next to the name of your view.

## Materialization status

[See page 373]

These are the statuses a view can have:

Status	Description	Action
Queued	View is waiting to be materialized.	Click <b>Update status</b> .
In Progress	View is being materialized.	Click <b>Update status</b> . Wait for materialization to finish.
Materialized	View has been materialized into memory.	You can now search the materialized view.
Stale	View has become out of sync with the data in the tables that make it up, usually due to an incremental data load.	Refresh the view by clicking <b>Refresh Data*</b> .
Unknown	View status could not be determined.	Click <b>Update status</b> .
Error	An error occurred.	Refresh the view by clicking <b>Refresh Data*</b> . Optionally run a report.

\* You will only have the option to refresh data if you have the **Can administrator ThoughtSpot** privilege [See page 161] privilege.

## Freshness of data

Your view can become stale, if it isn't refreshed when the data in the tables used to create it is updated.

There are two ways to refresh the data:

- Manually refresh data in a view [See page 383]
- Refresh the view on a schedule [See page 385]

Here are some conditions that could lead to a view becoming stale:

- Changes to the view definition

- Changes to the fields used in the view
- Changes to the join relationships used in the view
- Change to formulas in the view
- Change the datatypes in the underlying tables

## Related Information

- [Understand views \[See page 363\]](#)
- [Save a search as a view \[See page 366\]](#)
- [Materialize a view \[See page 375\]](#)

# Materialize a view

**Summary:** Learn how to materialize a view to improve its performance.

To improve the performance of a view, you can materialize it. This operation computes the data for the view and stores it in memory, just like a table. You can expect a 3-6 times performance improvement on a materialized view over a view that is not materialized. However, materialized views take up space in memory, so weigh the tradeoffs and benefits of materializing a view ahead of time.

**Note:** Row Level Security does not apply to materialized views. All users will see the same data when using the materialized view as a data source.

To materialize a view:

1. To find your view, click **Data** in the top menu, and choose **Views**.
2. Click the name of your view.
3. Click **Schema**.
4. If needed, [add joins \[See page 311\]](#).
5. Under **Materialization**, click **Materialize**.

## Materialization

When a view is materialized, all the data of the view is saved in memory to improve query performance. [Learn more](#)

Materialization Status

Not Materialized

[Materialize](#)

6. Fill in the details for [primary key](#) [See page 106], sharding key, and number of shards [See page 110].

## Materialize View

These settings are important for optimizing performance on a large materialized view. If you do not set them, the view will be replicated on every node of your cluster. [Learn more.](#)

Primary Key (Optional)

Select keys

Sharding Key (Optional)

Select keys

Number of shards

Number of shards

[Cancel](#) [MATERIALIZE](#)

**Note:** If you do not fill in the sharding details, the view will be replicated on every node of your cluster. If you're not sure what to fill in, ask your ThoughtSpot administrator, or follow the links in this step to learn more about sharding.

7. Click **Materialize**.
8. In the **Schedule data updates** dialog, select an option for **Repeats** (Monthly, Weekly, or Daily).

**Schedule Data Updates**

Please specify a schedule to refresh view data.

Repeats  Daily Weekly Monthly

If you don't want to set a schedule now, choose **Setup later** and skip to Step 11.

9. Fill in the schedule details:

**Schedule Data Updates**

Please specify a schedule to refresh view data.

Repeats  on  at

10. Click **Update**.

11. You can see the status of the materialization as it progresses. Click **Update status** to refresh it.

## Materialization

When a view is materialized, all the data of the view is saved in memory to improve query performance. [Learn more](#)

Materialization Status

! In Progress [Update Status](#)

Update Schedule: **None**

[Dematerialize](#) [Show Details](#)

12. When it says **Materialized** your materialized view is ready for search.

## Materialization

When a view is materialized, all the data of the view is saved in memory to improve query performance. [Learn more](#)

Materialization Status

✓ Materialized

Data Last Updated: 11/06/2018 10:10 AM

Update Schedule: **None**

[Dematerialize](#) [Show Details](#)

If after some time, the status has not changed to **Materialized**, check the [list of statuses \[See page 373\]](#) and corresponding actions to take.

## Related Information

- [Understand views \[See page 363\]](#)
- [Save a search as a view \[See page 366\]](#)
- [About materialized views \[See page 372\]](#)
- [Constraints \[See page 106\]](#)
- [Sharding \[See page 110\]](#)

# Dematerialize a view

**Summary:** Learn how to dematerialize a view to free up space.

To free up space in your cluster, you can dematerialize views that were materialized but are no longer regularly used. This operation leaves the view intact, but removes the precomputed data which has been stored in memory. After dematerializing a view, you can expect searches on the view to take longer, but you will have more space available in memory.

To dematerialize a view:

1. To find your materialized view, click **Data** in the top menu, and choose **Views**.
2. Click the name of your view.
3. Click **Schema**.
4. Under **Materialization**, click **Dematerialize**.

## Materialization

When a view is materialized, all the data of the view is saved in memory to improve query performance. [Learn more](#)

Materialization Status

 Materialized

Data Last Updated: 11/06/2018 10:10 AM  
Update Schedule: None

[Dematerialize](#) [Show Details](#)

You will see a warning message that the data in the view will be removed from memory. Click **Remove** to confirm.

5. You can see the status of the dematerialization as it progresses. Click **Update status** to refresh it.

Remember that at this point your view is still searchable. It just isn't materialized into memory.

If you want to remove the view altogether, you still need to delete the view.

## Related Information

- [Understand views \[See page 363\]](#)
- [Materialize a view \[See page 375\]](#)

# Refresh a materialized view

**Summary:** You can refresh a view manually, so that its data matches the data in the underlying tables.

Materialized views can get out of sync with their underlying data. If the status of a view is **Stale**, you must refresh the view manually to sync it with the table.

Note that until it is refreshed, the view remains searchable.

To refresh a view manually, follow these steps:

1. To find your view, click **Data** in the top menu, and choose **Views**.
2. Click **Schema**.
3. In the **Materialization** panel, notice that the **Status** is *Stale*.
4. Next to the *Stale* status, click **Refresh Data**.

## Materialization

When a view is materialized, all the data that makes up the view is stored in memory to improve query performance. [Learn more](#)

**Status**

! **Stale** [Refresh Data](#) 🕒

Data Last Updated: 08/27/2019 01:23 PM  
Update Schedule: **None**

[Dematerialize](#) [Show Details](#)

## Related Information

- [Understand views \[See page 363\]](#)
- [About materialized views \[See page 372\]](#)

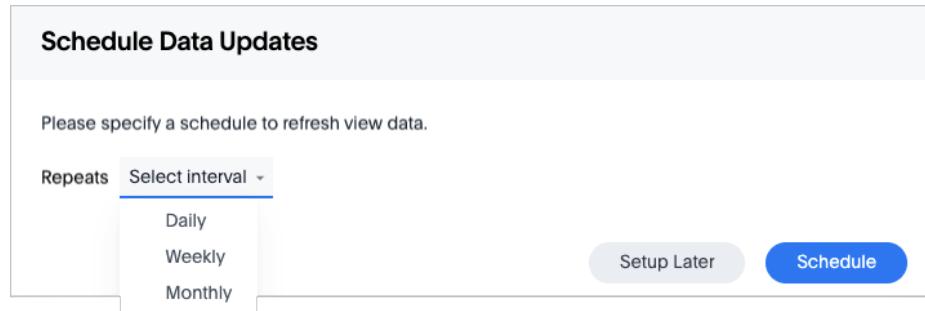
# Schedule materialization refresh on a view

**Summary:** Learn how to schedule materialization refresh of a view to keep it in sync with the data that makes it up.

To keep the data in a view up-to-date, you can schedule periodic refreshes from the underlying table(s).

To schedule materialization of a view:

1. To find your view, click **Data** in the top menu, and choose **Views**.
2. Click the name of your view.
3. Click **Schema**.
4. Under **Materialization**, click the link next to **Update Schedule**.
5. In the **Schedule Data Updates** dialog, select an option for **Repeats** (Monthly, Weekly, or Daily).



6. Fill in the schedule details:

**Schedule Data Updates**

Please specify a schedule to refresh view data.

Repeats  on  at  :  hours

7. Click **Schedule**.

**Note:** Refresh works only if it is scheduled in the refresh window set for the cluster (default: 8:00 PM - 4:00 AM). Only the start time of the refresh window is configurable using the flag `orion.materializationConfig.refreshWindowStartTime` which can be set to values such as 12:00PM or 01:00AM etc. Example: To set the cluster window from 2:00 AM to 10:00 AM you can set the flag as `orion.materializationConfig.refreshWindowStartTime "02:00AM"`.

## Related Information

- Understand views [See page 363]
- Save a search as a view [See page 366]
- About materialized views [See page 372]

# Enable SearchIQ

**Summary:** Enable SearchIQ to provide natural language search for some or all of your users.

**Note: SearchIQ is in Beta**

- SearchIQ is only available in English.
- The feature is off by default; to enable it, contact [ThoughtSpot Support](#) [See page 0].
- You must have the **Can use experimental features** permission.

SearchIQ is a different search experience that understands more natural, speech-like search language than the original ThoughtSpot search or [Search+](#) [See page 0]. For example, you can search for `What was my top selling product last month?`, instead of having to type `top 1 product by sales last month`. You can also speak your search using the voice-to-text capability of your operating system.

Users can easily [teach SearchIQ their language](#) [See page 0] as they use it. Over time, SearchIQ gets smarter about how to interpret terms that don't come directly from keywords, column names, or data values. In order to give it time to learn, the best practice recommendation is to enable SearchIQ for a small group of users initially. Over time you can roll it out to larger groups as SearchIQ learns what your users search for the most.

To enable SearchIQ on a ThoughtSpot instance:

1. Call ThoughtSpot Support and ask them to turn on SearchIQ for your ThoughtSpot instance.
2. Grant the **Can use experimental features** privilege to any group that should have access to the SearchIQ search experience.

**Edit group**

Group name *	Retail West
Display name *	Retail West
Sharing visibility *	SHARABLE
Description	
Privileges	<input type="checkbox"/> Can administer ThoughtSpot <input checked="" type="checkbox"/> Can upload user data <input checked="" type="checkbox"/> Can download data <input type="checkbox"/> Can share with all users <input checked="" type="checkbox"/> Can manage data <input checked="" type="checkbox"/> Can use experimental features <input type="checkbox"/> Can invoke Custom R Analysis <input checked="" type="checkbox"/> Has Spot IQ privilege <input type="checkbox"/> Can administer and bypass RLS

\* Required field

Manage Groups Manage Users

No Groups in Group

Search by name

Clear all Select all

- Administrator
- Marketing
- Retail East
- SpotIQ
- ThoughtSPORT
- basic

Cancel UPDATE

**Note:** Because the SearchIQ search experience is very different from the original ThoughtSpot search experience, you should give your new users some orientation on it, so they know what to expect.

## Related information

- [About SearchIQ \[See page 0\]](#)
- [Use SearchIQ \[See page 0\]](#)
- [Teach SearchIQ your language \[See page 0\]](#)

# Optimize SearchIQ

**Summary:** For SearchIQ to work well, you must enable, optimize, and enable it on the data source.

SearchIQ is in Beta.

**Note:** SearchIQ is turned off by default, you can have ThoughtSpot Support enable it for you.

SearchIQ is only available in English.

SearchIQ is a search experience that understands a more natural, speech-like search language. Contrast it with the [original ThoughtSpot search \[See page 0\]](#). For example, you can search for *What was my top selling product last month?*, instead of typing *top 1 product by sales last month*. You can also speak your search using the voice-to-text capability of your operating system.

Data source owners must enable SearchIQ for their data sources, and then optimize the data source so users get better results. These are the primary steps for enabling and optimizing SearchIQ:

1. [Enable columns for SearchIQ \[See page 391\]](#)
2. [Add Experts for SearchIQ \[See page 397\]](#)
3. [Train SearchIQ \[See page 400\]](#)

## Prerequisites

- SearchIQ is turned off by default; ask your administrator to enable it.
- You must be a member of a group that has the **Can use experimental features** permission.

## Enable Columns

See [Enable Columns for SearchIQ \[See page 391\]](#).

## Add Experts

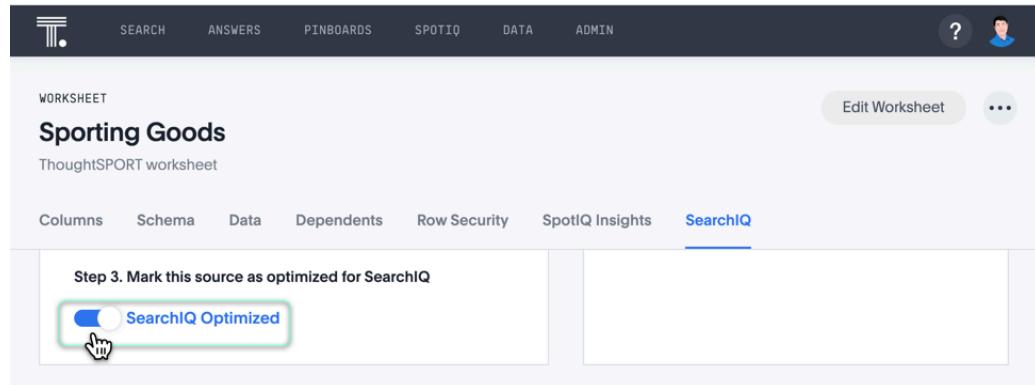
See [Add Experts for SearchIQ \[See page 397\]](#).

## Train SearchIQ

See Train SearchIQ [See page 400].

## Mark the source as optimized for SearchIQ

After you finish training SearchIQ on your data source, click the **Data** tab, navigate to the data source, select its **SearchIQ** tab, scroll to the bottom left corner, and finally turn on the setting for **SearchIQ Optimized**.



## How does SearchIQ work for end Users

After you finish training SearchIQ on the Dataset, we recommend that you share with the users a list of the questions you used for training SearchIQ, the names of columns and their descriptions, common synonyms, and some guidance on how to ask a question.

Remember that users who experience SearchIQ see only the columns that SearchIQ knows.

## Related information

- [About SearchIQ \[See page 0\]](#)
- [Use SearchIQ \[See page 0\]](#)
- [Teach SearchIQ your language \[See page 0\]](#)

# Enable Columns for SearchIQ

**Summary:** Let us discuss how to enable SearchIQ for the columns of the data source.

SearchIQ is in Beta.

**Note:** SearchIQ is turned off by default, you can have ThoughtSpot Support enable it for you.

SearchIQ is only available in English.

Before enabling columns, keep in mind these points, and other in-product guidelines:

- Enable no more than fifteen (15) columns for SearchIQ.
- Enable at most one (1) date column.
- Column names should not contain more than 3 words.
- Name the columns well, by optimizing for business users. For example, use *Opportunity Cost* and avoid `opp_cst`.
- Avoid indexing descriptive columns, ones that contain more than seven (7) words, or contain values with stop words, such as *is*, *are*, *the*, *what*, and so on). See the [Stop Words \[See page 0\]](#) reference for the full list of stop words.
- For columns that represent formulas with categorical values, set the **Indexing Type** to `PREFIX_AND_SUBSTRING`.

To enable columns in a worksheet for SearchIQ, follow these steps:

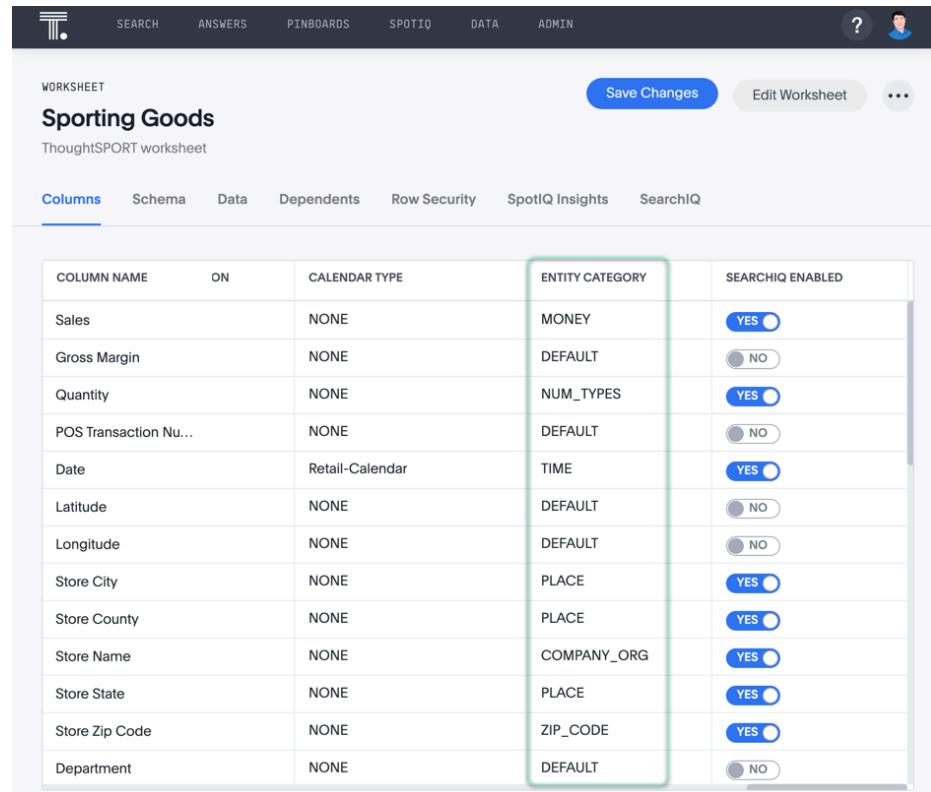
1. Click **Data** on top navigation bar.
2. Click **Tables**.
3. Click **Worksheets**.
4. Select and open the worksheet you want to enable for SearchIQ.
5. Scroll to the far right, until you see the **SearchIQ Enabled** attribute.

Set it to Yes for each column enabled for SearchIQ.

COLUMN NAME	ON	CALENDAR TYPE	ENTITY CATEGORY	SEARCHIQ ENABLED
Sales	NONE	DEFAULT	<input checked="" type="checkbox"/> YES	
Gross Margin	NONE	DEFAULT	<input type="radio"/> NO	
Quantity	NONE	DEFAULT	<input checked="" type="checkbox"/> YES	
POS Transaction Nu...	NONE	DEFAULT	<input type="radio"/> NO	
Date	Retail-Calendar	DEFAULT	<input checked="" type="checkbox"/> YES	
Latitude	NONE	DEFAULT	<input type="radio"/> NO	
Longitude	NONE	DEFAULT	<input type="radio"/> NO	
Store City	NONE	DEFAULT	<input checked="" type="checkbox"/> YES	
Store County	NONE	DEFAULT	<input checked="" type="checkbox"/> YES	
Store Name	NONE	DEFAULT	<input checked="" type="checkbox"/> YES	
Store State	NONE	DEFAULT	<input checked="" type="checkbox"/> YES	
Store Zip Code	NONE	DEFAULT	<input checked="" type="checkbox"/> YES	
Department	NONE	DEFAULT	<input type="radio"/> NO	

6. Change the **Entity Category** for the columns you marked **SearchIQ Enabled**, from *default* to one that accurately describes the column.

See Set Entity Categories [See page 404]. The category options are *default*, *person*, *replace*, *time*, *money*, *product*, *zip\_code*, *lat\_long*, *company\_org*, and *num\_types*.



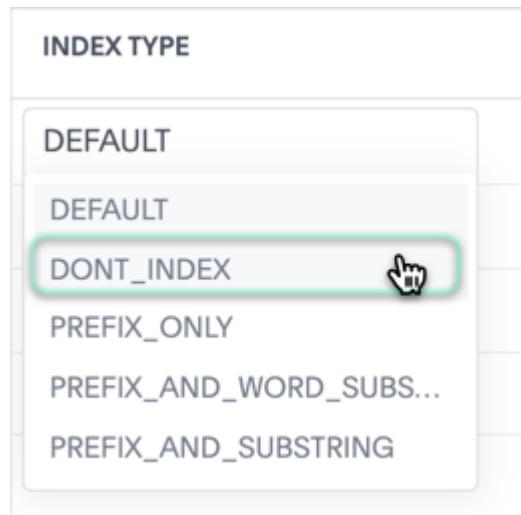
COLUMN NAME	ON	CALENDAR TYPE	ENTITY CATEGORY	SEARCHIQ ENABLED
Sales	NONE	MONEY	<input checked="" type="radio"/> YES	
Gross Margin	NONE	DEFAULT	<input type="radio"/> NO	
Quantity	NONE	NUM_TYPES	<input checked="" type="radio"/> YES	
POS Transaction Nu...	NONE	DEFAULT	<input type="radio"/> NO	
Date	Retail-Calendar	TIME	<input checked="" type="radio"/> YES	
Latitude	NONE	DEFAULT	<input type="radio"/> NO	
Longitude	NONE	DEFAULT	<input type="radio"/> NO	
Store City	NONE	PLACE	<input checked="" type="radio"/> YES	
Store County	NONE	PLACE	<input checked="" type="radio"/> YES	
Store Name	NONE	COMPANY_ORG	<input checked="" type="radio"/> YES	
Store State	NONE	PLACE	<input checked="" type="radio"/> YES	
Store Zip Code	NONE	ZIP_CODE	<input checked="" type="radio"/> YES	
Department	NONE	DEFAULT	<input type="radio"/> NO	

7. Add **Synonyms** for all columns you marked **SearchIQ Enabled**, simply by typing them in the appropriate cell. See [Add common synonyms \[See page 289\]](#) for more information.

The screenshot shows the 'Sporting Goods' worksheet configuration page. At the top, there are tabs for Columns, Schema, Data, Dependents, Row Security, SpotIQ Insights, and SearchIQ. The 'Columns' tab is selected. Below the tabs is a table with columns: COLUMN NAME, ADDITIVE, AGGREGATION, HIDDEN, SYNONYMS, and SPOTIQ PREFERENCE.

COLUMN NAME	ADDITIVE	AGGREGATION	HIDDEN	SYNONYMS	SPOTIQ PREFERENCE
Sales	<input checked="" type="radio"/> YES	SUM	<input type="radio"/> NO	purchases, sale...	DEFAULT
Gross Margin	<input checked="" type="radio"/> YES	SUM	<input type="radio"/> NO	Click to edit	DEFAULT
Quantity	<input checked="" type="radio"/> YES	SUM	<input type="radio"/> NO	amount, volume	DEFAULT
POS Transaction Nu...	<input checked="" type="radio"/> YES	SUM	<input type="radio"/> NO	Click to edit	DEFAULT
Date	<input type="radio"/> NO	NONE	<input type="radio"/> NO	when, year	DEFAULT
Latitude	<input type="radio"/> NO	NONE	<input type="radio"/> NO	Click to edit	DEFAULT
Longitude	<input type="radio"/> NO	NONE	<input type="radio"/> NO	Click to edit	DEFAULT
Store City	<input type="radio"/> NO	NONE	<input type="radio"/> NO	location, where	DEFAULT
Store County	<input type="radio"/> NO	NONE	<input type="radio"/> NO	county, where	DEFAULT
Store Name	<input type="radio"/> NO	NONE	<input type="radio"/> NO	name of store	DEFAULT
Store State	<input type="radio"/> NO	NONE	<input type="radio"/> NO	state, where	DEFAULT
Store Zip Code	<input type="radio"/> NO	NONE	<input type="radio"/> NO	zipcode, zip, wh...	DEFAULT
Department	<input type="radio"/> NO	NONE	<input type="radio"/> NO	Click to edit	DEFAULT

8. Change the **Index Type** to `DONT_INDEX` for columns when they must be excluded from indexing. We recommend excluding a column when it is descriptive in nature, =contains a large amount of text, has [stop words](#) [See page 0], or for a variety of similar reason. See [Turn off indexing](#) [See page 293].



This prevents SearchIQ from scanning through large amounts of text to understand what user asked. Note that searches on text fields that use the `contains` keyword still work.

WORKSHEET

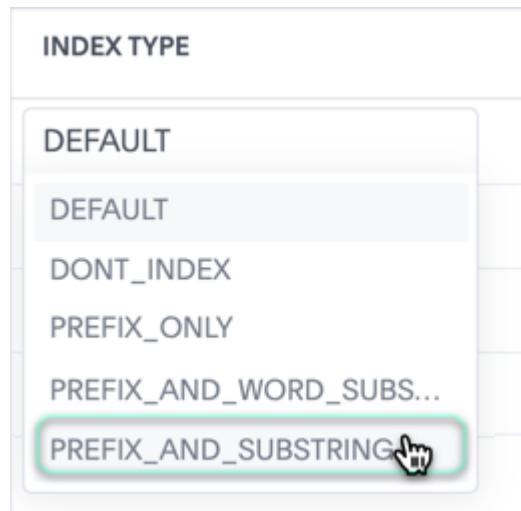
## Sporting Goods

ThoughtSPORT worksheet

**Columns** Schema Data Dependents Row Security SpotIQ Insights SearchIQ

COLUMN NAME	INDEX TYPE	GEO CONFIG	INDEX PRIORITY
Share of Total Yearly Sales	DONT_INDEX	None	1
Sales Per Customer	DONT_INDEX	None	1
Sales	DEFAULT	None	1
Quantity	DEFAULT	None	1
Product Name	PREFIX_AND_SUBSTRING	None	1
POS Transaction Number	DEFAULT	None	1
Number of Children	DEFAULT	None	1
Net Margin	DEFAULT	None	1
Months Since Launch	DEFAULT	None	1
Margin Percentage	DONT_INDEX	None	1
Longitude	DEFAULT	Longitude	1
Latitude	DEFAULT	Latitude	1
Income Bracket	PREFIX_AND_SUBSTRING	None	1

- Change the **Index Type** for columns that represent formulas with categorical values to **PREFIX\_AND\_SUBSTRING**. See [Turn off indexing \[See page 293\]](#).



COLUMN NAME	INDEX TYPE	GEO CONFIG	INDEX PRIORITY
Share of Total Yearly Sales	DONT_INDEX	None	1
Sales Per Customer	DONT_INDEX	None	1
Sales	DEFAULT	None	1
Quantity	DEFAULT	None	1
Product Name	PREFIX_AND_SUBSTRING	None	1
POS Transaction Number	DEFAULT	None	1
Number of Children	DEFAULT	None	1
Net Margin	DEFAULT	None	1
Months Since Launch	DEFAULT	None	1
Margin Percentage	DONT_INDEX	None	1
Longitude	DEFAULT	Longitude	1
Latitude	DEFAULT	Latitude	1
Income Bracket	PREFIX_AND_SUBSTRING	None	1

10. Rename the columns to have names that are shorter (maximum three words), and easier for business users to understand.



11. Click **Save Changes**.

# Add Experts for SearchIQ

**Summary:** It is useful to identify experts who can help with SearchIQ.

SearchIQ is in Beta.

**Note:** SearchIQ is turned off by default, you can have ThoughtSpot Support enable it for you.

SearchIQ is only available in English.

While not completely necessary, we recommend that you add Experts to the datasource. These people in your organization know a great deal about the data, and can help you train SearchIQ. They are also the individuals who can assist business users in validating the answers they receive as a result of both regular Search and SearchIQ. You can learn more about that by reading about our [Ask an expert \[See page 0\]](#) feature.

To specify the experts for the datasource, follow these steps:

1. Click the ellipsis icon at the top right corner, and select **Manage Experts**.

The screenshot shows the ThoughtSpot interface with a 'Sporting Goods' worksheet selected. At the top right, there is a modal window titled 'Manage Experts'. This modal contains several options: 'Review Suggestions (2)', 'SpotIQ analyze', 'Manage Experts' (which is highlighted with a green box and a cursor pointing to it), and 'Share'. Below the modal, the worksheet table is visible, showing columns like 'COLUMN NAME', 'ATTRIBUTION DIMENSION', 'CALENDAR TYPE', 'ENTITY CATEGORY', and 'SEARCHIQ ENABLED'. Each row in the table has a 'YES' or 'NO' button next to the 'SEARCHIQ ENABLED' column.

COLUMN NAME	ATTRIBUTION DIMENSION	CALENDAR TYPE	ENTITY CATEGORY	SEARCHIQ ENABLED
Sales	<input checked="" type="radio"/> YES	NONE	MONEY	<input checked="" type="radio"/> YES
Gross Margin	<input checked="" type="radio"/> YES	NONE	DEFAULT	<input type="radio"/> NO
Quantity	<input checked="" type="radio"/> YES	NONE	NUM_TYPES	<input checked="" type="radio"/> YES
POS Transaction Nu...	<input checked="" type="radio"/> YES	NONE	DEFAULT	<input type="radio"/> NO
Date	<input checked="" type="radio"/> YES	Retail-Calendar	TIME	<input checked="" type="radio"/> YES
Latitude	<input checked="" type="radio"/> YES	NONE	DEFAULT	<input type="radio"/> NO
Longitude	<input checked="" type="radio"/> YES	NONE	DEFAULT	<input type="radio"/> NO
Store City	<input checked="" type="radio"/> YES	NONE	PLACE	<input checked="" type="radio"/> YES
Store County	<input checked="" type="radio"/> YES	NONE	PLACE	<input checked="" type="radio"/> YES
Store Name	<input checked="" type="radio"/> YES	NONE	COMPANY_ORG	<input checked="" type="radio"/> YES

2. In the **Manage Experts** window modal, you may see existing experts. Add more users and groups, and click **Add**.

## Manage Experts

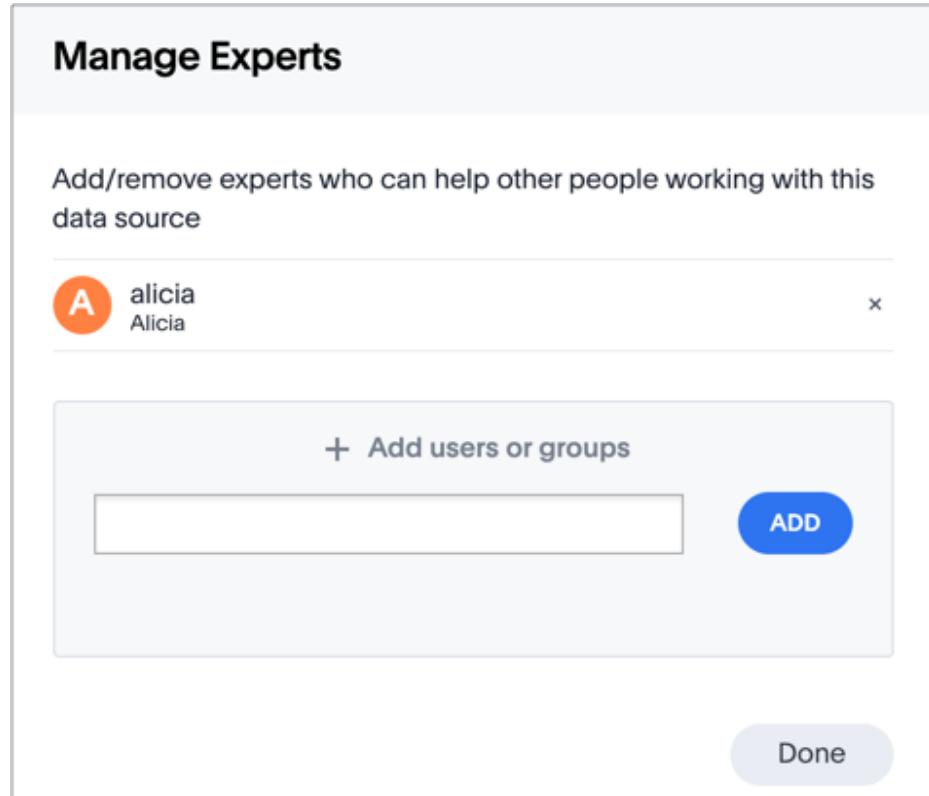
Add/remove experts who can help other people working with this data source

 alicia Alicia	x
--	---

+ Add users or groups

ADD

Done



3. After you finish adding experts, click **Done**.

## Manage Experts

Add/remove experts who can help other people working with this data source

A alicia  
Alicia

x

R Roza  
Roza

x

S sean  
Sean

x

+ Add users or groups

Done



# Train SearchIQ

**Summary:** Training SearchIQ ensures a good natural language search experience.

SearchIQ is in Beta.

**Note:** SearchIQ is turned off by default, you can have ThoughtSpot Support enable it for you.

SearchIQ is only available in English.

There are two complementary paths for optimizing SearchIQ to understand natural language search, [Data Modeling \[See page 400\]](#) and [Language Modeling \[See page 0\]](#). Also, consider the the [Training Examples \[See page 401\]](#)

## Data modeling settings

Add experts to the data source [\[See page 0\]](#) to enable the [Ask an Expert \[See page 0\]](#) workflow. This supplies users with another path to getting an answer when they get stuck.

## Language modeling

We bundle SearchIQ with a set of pre-defined templates that help it understand natural language, and return the best possible answers. You can also add your own templates for each data source, and teach it new language interpretations:

Teach SearchIQ using a saved SearchIQ answer

See [Teach SearchIQ your language \[See page 0\]](#).

1. Select a saved answer.
2. Click one of the drop-down phrases that shows how SearchIQ interprets the search terms, and click **Teach**.

## Use new searches to teach SearchIQ

We recommend that you train SearchIQ by performing at least 50 natural language searches. This teaches SearchIQ how to map common questions to relevant entities. Use points described in [Teach SearchIQ \[See page 0\]](#) for any unexpected answers.

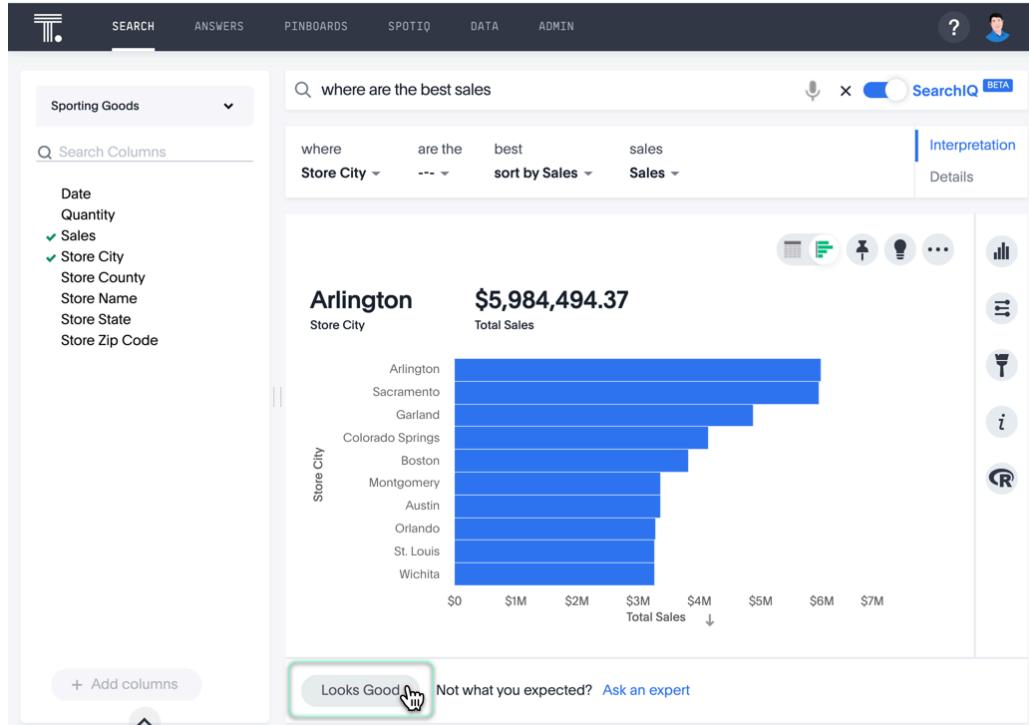
- For best results, use simple and short queries.
- Ask questions that contain only exact column names or their synonyms.
- Use exact values for filtering.
- Use keywords. See [Keywords \[See page 0\]](#).
- Use stopwords. See [Stop Words \[See page 0\]](#).

When SearchIQ returns a satisfactory table or chart, remember to click the **Looks Good** button to provide the necessary feedback.

## Training Examples for SearchIQ

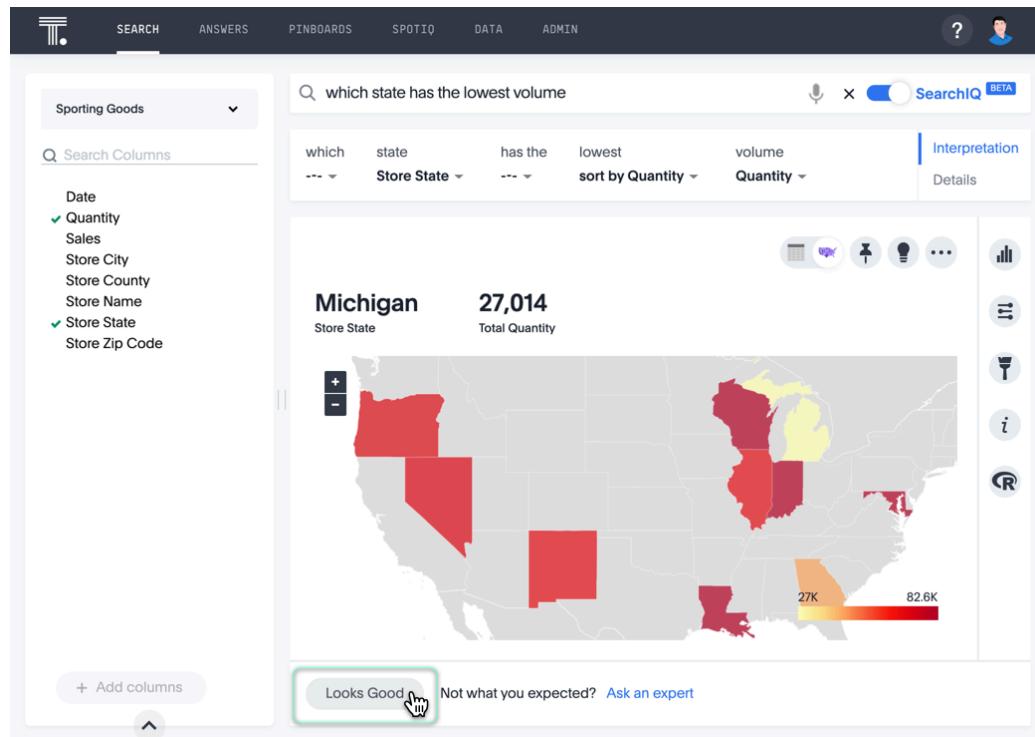
### **Example 1: where are the best sales**

In this example, the query returned a very good answer, by interpreting *where* as *Store City* and *best* as *sort by Sales*. The chart **Looks Good**, and this is valuable feedback for training SearchIQ.



### Example 2: which state has the lowest volume

In this example, the query returned a very good answer, by interpreting *lowest* as *sort by Quantity* and *volume* as *Quantity*. This chart also **Looks Good**, and provides valuable feedback for training SearchIQ.



# Set entity categories for SearchIQ

**Summary:** Entity categories help describe the column content, and assist SearchIQ in interpreting natural language queries.

**Note: SearchIQ is in Beta**

- SearchIQ is only available in English.
- The feature is off by default; to enable it, contact [ThoughtSpot Support](#) [See page 0].
- You must have the **Can use experimental features** permission.

Entity categories specify how to categorize the data in the column, by entity type. By default, `ENTITY_TYPE` is not set. Entity categories support [SearchIQ](#) [See page 0] so that when you type a natural question, ThoughtSpot better knows how to interpret it. For example, if you ask “who are the top performers?” ThoughtSpot will first choose columns set with `PERSON` from which to return answers. If you ask “when was the movie Jurassic Park released?”, columns set to `TIME` will be used to answer the “when” part of the question, and so forth.

If you have access to tables and worksheets for data modeling purposes, you can specify entity categories for their columns. This lets you designate that column as representing a person, place, or thing. So then when a user asks “Which”, “Who”, or “Where”, an appropriate response can more easily be found in the data.

If you’re not sure how to change the data modeling settings, see the [Overview of data modeling settings](#) [See page 280].

## About Entity Categories

These are the available Entity Categories:

Category	Description
PERSON	Contains data that represents a person, relevant to questions about “who?”
PLACE	Contains data that represents a location, relevant to questions about “where?”

Category	Description
TIME	Contains data that represents a date or time, relevant to questions about “when?”
PRODUCT	Contains data that represents a product
ZIP_CODE	Contains zip code data, relevant to questions like “where?” or “what zip code?”
LAT_LONG	Contains data that represents geographical positioning, relevant to questions like “where?”
COMPANY_ORG	Contains data that represents a company or organization
NUM_TYPES	Contains numerical data

## Set Entity Categories

To specify entity categories:

1. Click **Data** in the top menu, and choose **Tables or Worksheets**.
2. Click the name of your table or worksheet.
3. On the **Columns** tab, find the COLUMN NAMES for which you want to specify entity categories, and scroll to the right to find **ENTITY CATEGORY**.
4. Use the drop-down menu to set the **ENTITY CATEGORY** to the type you want.
5. Click **SAVE CHANGES** in the upper right.

## Related information

- [SearchIQ \[See page 0\]](#)
- [Overview of data modeling settings \[See page 280\]](#)

# Edit the SearchIQ mappings

**Summary:** In SearchIQ, you can change the language mappings established earlier, during initial configuration.

**Note: SearchIQ is in Beta**

- SearchIQ is only available in English.
- The feature is off by default; to enable it, contact [ThoughtSpot Support](#) [See page 0].
- You must have the **Can use experimental features** permission.

When a user types a term in the SearchIQ search bar, SearchIQ interprets what the user means through language mappings. Users can teach their language to SearchIQ using [Teach SearchIQ your language](#) [See page 0].

As an administrator, you can see and change these language mappings by editing the mappings file.

You can access the mappings file if you are in the Administrator group, because then you can have access to the **ADMIN > Data Management** page. You can download the mappings file there. This allows you to view and edit all the language mappings users made, in bulk.

## Overview of the mapping process

The language mappings in SearchIQ are controlled by a CSV (comma separated values) file called the mapping file. The mapping file is saved with an .xls file extension, so you can open and edit it using Excel. To make these changes you will download the mapping file, change the mappings, and upload your changes back into the system.

In each row of the mapping file, you will see a natural language search term, that is mapped to a search keyword, or something that occurs in the data (like a column name or value). You can use the mapping file to remove mappings that have been made in error. Remember these important guidelines when editing the Mappings file:

- Do not delete rows from the file. Instead, type “True” in the **Delete Y/N** column for any mapping you want to delete.
- Make sure to keep the file in the same format as it had when you downloaded it.

The model file contains a row for each natural language mapping a user has created using the Teach feature of SearchIQ. It isn't unusual to have tens of thousand of rows in this file.

## Download the mapping file

Before you can make changes to the mapping file, you need to download it. Then, you edit it using Microsoft Excel, vi/vim, or a similar text editing tool.

To obtain the model file:

1. Log in to ThoughtSpot from a browser as an Administrator user.
2. Click **ADMIN** in the top navigation bar.
3. Click **Data Management**, then click **Language Mappings**.
4. Click **Download**.

## Edit the file and change the settings

You can delete any of the mappings in the file. To delete a mapping:

1. Open the model file you downloaded ( `mappings.xls` ) in Excel, vi/vim, or a text editor.

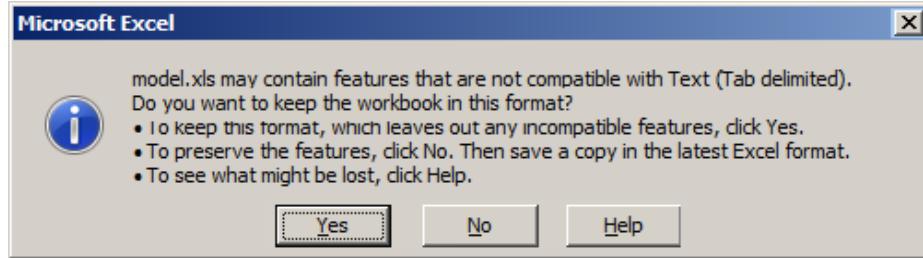
If you are using Excel, you may see a warning message similar to this.



Click **YES** to proceed.

2. Find the row for which you want to delete the mapping.
3. Find the **Delete Y/N** column.
4. Type **True** in the corresponding cell.
5. After making all your changes, save the model file.

If you are using Excel, you will see a message similar to this one. Click **YES** to save the file.



The mapping file must be saved as UTF-8 encoded. If your mapping file includes multi-byte characters, edit the file using vi or vim to ensure the file is saved in the correct format.

Otherwise, you won't be able to upload it after making your edits.

## Upload the edited file

After you have made changes to the mapping file, you must upload it back to ThoughtSpot before the changes will take effect. To upload the mapping file:

1. Log in to ThoughtSpot from a browser as an Administrator user.
2. Click **ADMIN**, on the top navigation bar.
3. Click **Data Management**, then click **Language Mappings**.
4. Click **Browse your files** to upload the mappings.xls file, or drag and drop it in the zone.

If you receive an error message upon uploading the file, check that it does not include any multi-byte characters (for example, Japanese or other multi-byte language characters). If it does, you must save it as UTF-8 encoded. You may need to download the file again and make your edits using vi or vim.

As soon as the file is uploaded, your new settings will be reflected within a few minutes.

## Related information

- [Teach SearchIQ your language \[See page 0\]](#)

# Job management (scheduled pinboards)

**Summary:** All jobs on your cluster will appear on the Jobs Management page. You can also view jobs for individual pinboards under the pinboard Actions dropdown.

The **Jobs Management** page found on the **Admin** section in the ThoughtSpot web application allows you to create and manage jobs, namely scheduled pinboards. Scheduled pinboards should help with preparing for recurrent meetings, when reviewing the same pinboard is necessary. They should also be useful when you have metrics you want to monitor at a consistent interval, like daily or monthly sales targets.

You can get pinboards emailed to you on a regular basis and do analysis offline. This introduces an additional format for you to consume and share pinboards with others, including those who don't have a ThoughtSpot account.

Contact ThoughtSpot Support if scheduled pinboards is not enabled on your cluster, or you can run the command `tscli scheduled-pinboards` to enable it yourself.

## Scheduled pinboard creators

Administrators and users with can schedule pinboard privilege can schedule and manage pinboard jobs. These scheduled pinboard creators must have at least edit-only and view-only rights to the pinboard they want to share.

**⚠ Warning:** It is recommended that admins carefully choose who to give can schedule pinboard privilege to, since there is a possible security hole where a user with limited access can get a pinboard email with all access data.

## Row level security

The scheduled pinboards respect row level security rules. This means if the recipients are users in ThoughtSpot, then they can only see data based on their own access to the pinboard. If the user does not have at least view-only access to the pinboard, then they will not see anything in the email. However, if the recipients are from outside of the cluster, then they will have access to the dataset of the pinboard based on the sender's permissions.

## Scheduled pinboard formats

The pinboard visualizations are attached to the scheduled email as CSV or PDF files. Saved configurations such as pinboard filters are applied to the attachments. Refer to the table to see how the pinboard data is represented in each file format.

CSV	PDF
The CSV file gets data only for table visualizations.	The PDF file gets data for all visualizations.
The email has n CSV attachments, where there are n table visualizations in the pinboard.	The email has only one attachment file, which includes every visualization on its own page.
Table visualizations have all data rows that they're supposed to have.	Table visualizations include only the first 100 rows.
In the case of a corrupted pinboard: no email is sent. An error message indicating failure to export data is visible on the Admin Jobs Management page.	In the case of a corrupted pinboard: the PDF attachment has empty/error screenshots.
In the case of a corrupted visualization: an email with the visualizations whose data can be exported is sent. An error message indicating visualization export error is visible on the Jobs Management page.	In the case of a corrupted visualization: the PDF attachment has empty/error slots for the corrupted visualizations.

The size of each email is limited to 25 MB, which matches most email services size limitations.

And the total number of recipients for a scheduled pinboard job cannot exceed the default of 1000.

## Related information

For information on creating a pinboard, see the [Schedule a pinboard job \[See page 0\]](#).

# Scheduled pinboards management

**Summary:** You can manage all scheduled pinboards on the Jobs Management page under Admin.

Users who are not admins, but have can schedule pinboard privilege, can only view pinboard schedules they've created. You can select specific jobs and choose to pause, resume, edit, or delete them. You can have up to 50 scheduled jobs on your cluster at time. Contact ThoughtSpot Support if you'd like to increase this limit.

The screenshot shows the ThoughtSpot Admin interface. At the top, there is a navigation bar with links: Search +, Answers, Pinboards, SpotIQ, Data, Admin (which is highlighted with a yellow box), User Management, Data Management, System Health, Help Customization, Action Customization, Style Customization, and Jobs Management (which is also highlighted with a yellow box). Below the navigation bar is a search bar labeled 'Search'. The main content area displays a table with columns: Name, Status, Recipient, Created, and Author. A single row is visible, showing 'Test Schedule' in the Name column, 'Paused' in the Status column (indicated by a double vertical bar icon), '2 Recipients' in the Recipient column, 'a year ago' in the Created column, and a user profile icon in the Author column. The entire screenshot is framed by a thin gray border.

## Bulk actions

Select the scheduled pinboards and use the **Delete**, **Resume**, and **Pause** buttons to perform these bulk actions. Deleting a pinboard will also delete any schedules linked to it.

## Job statuses

Clicking on the row of a job will open a detailed view of every generated update of that job. You can see the start and end times of the job, as well as the status. Clicking on a job will show more information about the status updates.

User Management Data Management Sy > email limit csv				
		STARTED AT	ENDED AT	STATUS
<input type="checkbox"/>	NAME	6 minutes ago	5 minutes ago	<span>Success</span>
<input type="checkbox"/>	<a href="#">sc email_limit.pdf</a>	11 minutes ago	10 minutes ago	<span>Failed</span>
<input type="checkbox"/>	<a href="#">sc email_limit.csv</a>	16 minutes ago	15 minutes ago	<span>Success</span>
<input type="checkbox"/>	<a href="#">sc test</a>	21 minutes ago	20 minutes ago	<span>Success</span>
<input type="checkbox"/>	<a href="#">sc max_jobs_test</a>	26 minutes ago	25 minutes ago	<span>Success</span>
<input type="checkbox"/>	<a href="#">sc header</a>			
<input type="checkbox"/>	<a href="#">sc 10.14 rls.pdf</a>			
<input type="checkbox"/>	<a href="#">sc 10.14 rls</a>			
<input type="checkbox"/>	<a href="#">sc delete_creator.pdf</a>			
<input type="checkbox"/>	<a href="#">sc delete_creator</a>			
Job started at 10/14/FY 2017 14:20:00 Scheduled updates generated as expected.				
Generating updates as stephanie@thoughtspot.int. SUCCESS: Create update for visualization t3 (1) of pinboard big table in format csv. SUCCESS: Create update for visualization CITY, NAME, NATION, PHONE, REGION, SUPKEY (2) of pinboard big table in format csv. SUCCESS: Create update for visualization t2 (3) of pinboard big table in format csv. SUCCESS: Create update for visualization ADDRESS, CATEGORY, CUSTKEY, MKTSEGMENT (4) of pinboard big table in format csv. SUCCESS: Create update for visualization t1 (5) of pinboard bin table in format csv.				

User Management Data Management Sy > email limit pdf				
		STARTED AT	ENDED AT	STATUS
<input type="checkbox"/>	NAME	2 minutes ago	N/A	<span>Running</span>
<input type="checkbox"/>	<a href="#">sc email_limit.pdf</a>	7 minutes ago	3 minutes ago	<span>Failed</span>
<input type="checkbox"/>	<a href="#">sc email_limit.csv</a>	12 minutes ago	11 minutes ago	<span>Failed</span>
<input type="checkbox"/>	<a href="#">sc test</a>	22 minutes ago	17 minutes ago	<span>Failed</span>
<input type="checkbox"/>	<a href="#">sc max_jobs_test</a>	27 minutes ago	25 minutes ago	<span>Failed</span>
<input type="checkbox"/>	<a href="#">sc header</a>			
<input type="checkbox"/>	<a href="#">sc 10.14 rls.pdf</a>			
<input type="checkbox"/>	<a href="#">sc 10.14 rls</a>			
<input type="checkbox"/>	<a href="#">sc delete_creator.pdf</a>			
<input type="checkbox"/>	<a href="#">sc delete_creator</a>			
Job started at 10/14/FY 2017 14:20:00 Error Code: 12700 Incident Id: f1cf72ad-c0c6-4017-be26-88becc4f5fb9 Error Message: Error in generating scheduled update. Error Code: 12708 Details: Pdf for pinboard big table could not be generated. Error Code: FOOLSCAP_4017-be26-88becc4f5fb9 Error Message: Foolscap returned partial success. Failing request.				
Generating updates as stephanie@thoughtspot.int. FAILURE: Create update for pinboard big table in format pdf. FAILURE: Send scheduled update				

## Pinboard links

Click the scheduled pinboard name link to jump to a Edit schedule page, where you can edit the schedule configurations.

You can also click the pinboard link provided in the scheduled pinboard emails to jump to the pinboard in ThoughtSpot. In order to have the link direct you to the correct URL, you must first configure front end host and port access. Contact ThoughtSpot Support to configure these settings.

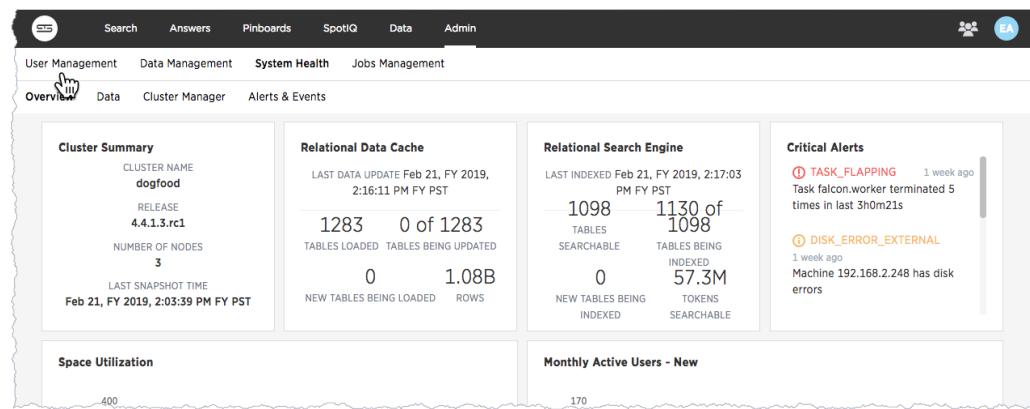
# Introduction to monitoring

System monitoring tools in ThoughtSpot include an **Admin > System Health** page and system logs.

Additionally, ThoughtSpot provides several worksheets and out-of-the-box system monitoring pinboards. From these worksheets, you can create your own custom visualizations and pinboards. This page introduces these features and directs you towards more detailed information.

## System Health center

The ThoughtSpot application includes a **System Health** center, for easy monitoring of usage, alerts, events and general cluster health. You view the System Health Center by choosing the **Admin** icon and then selecting **System Health**.



Only users with administrative privileges can view the **System Health** center. However, administrative users can present to others the information that displays in the **System Health** center.

Administrators can also create their own, custom boards that reflect system data in ways that are meaningful to specific departments or groups. For more information, see the following documentation:

- [Health Overview board \[See page 416\]](#)
- [Data board \[See page 429\]](#)
- [Cluster Manager board \[See page 432\]](#)
- [Alerts and Events board \[See page 432\]](#)
- [System worksheets \[See page 437\]](#)
- [System pinboards \[See page 439\]](#)

Much of the data presented by these boards is also available through `tscli` commands [See page 0].

## Log files

Many of the administration commands output logging information to log files. The logs get written into the fixed directory `/export/logs`, with a sub-directory for each subsystem. The individual log directories are the following:

- `/export/logs/orion`
- `/export/logs/oreo`
- `/export/logs/hadoop`
- `/export/logs/zookeeper`

You can also view [additional topics that also touch on [log files \[See page 0\]](#)] throughout the documentation.

## System monitoring notifications

You can configure ThoughtSpot to send emails to addresses you specify with monitoring reports and a cluster heartbeat. Follow these steps to [Set up monitoring \[See page 56\]](#).

# Overview board

The **Overview** pinboard summarizes essential information about your cluster and its users. Choose **Admin > System Health > Overview** to see this pinboard.

## Understand system boards and pinboards

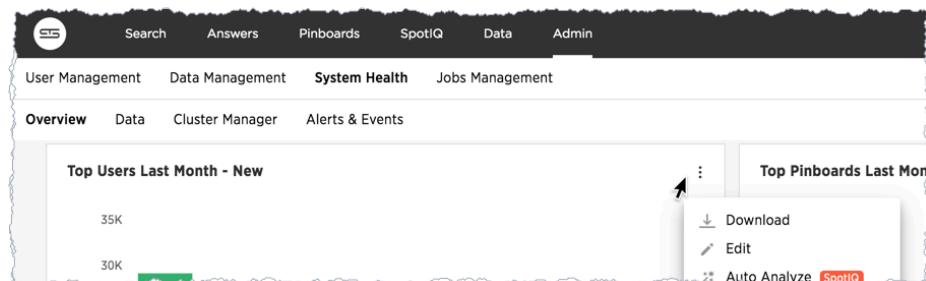
The **Overview** page includes system panels and standard ThoughtSpot [answers \[See page 416\]](#). The system charts are generated in real time and rely on internal system data. The answers rely on underlying system worksheets which are available to ThoughtSpot administrators. The information in these worksheets is updated hourly from internal tables that collect monitoring statistics.

Each answer has a menu. You can present or copy the links to the system charts. The answers have a subset of the ThoughtSpot answer menu. You can use the menu to do additional actions such as download the answer or present information about your ThoughtSpot cluster. While you can interact with and change the search, you cannot save changes to the underlying query.

You can also interact with the answers, drilling into them to explore the detail as with any other pinboard answer.

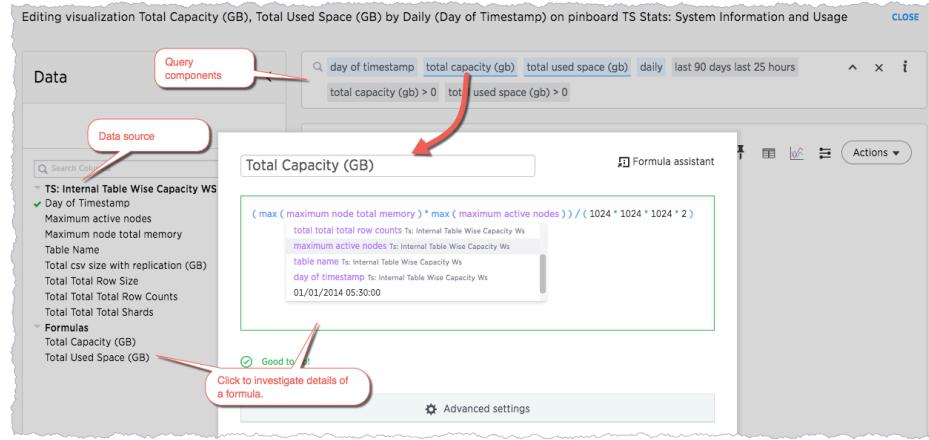
To find out how a particular answer was created, do the following:

1. Select **Edit** from the panel menu.



This displays a **Search** bar.

2. Investigate the components of the search as you would normally.



## Cluster Summary

This system panel contains basic information about your cluster. The **NUMBER OF NODES** is the number of installed nodes. This doesn't reflect the active nodes which may be more or less.

This summary includes the **LAST SNAPSHOT TIME** it reflects whether regular snapshots of your cluster are collected. This value should update regularly in real time. If you do not see it change or empty, you should check your cluster snapshot policy using the `tscli` command:

```
$ tscli snapshot-policy show
schedule {
    period {
        number: 1
        unit: HOUR
    }
    retention_policy {
        bucket {
            time {
                number: 1
                unit: HOUR
            }
            capacity: 3
        }
        bucket {
            time {
                number: 4
                unit: HOUR
            }
            capacity: 2
        }
    }
    offset_minutes_from_sunday_midnight: 0
}
enabled: false
```

You can see this policy is disabled, which is a problem. Production clusters should enable the default snapshot policy. When you show or enable the snapshot policy, you can see your `tscli` command reflected in the **Configuration Events** panel on this same page.

#### Display the features used in a cluster configuration

1. Log into the ThoughtSpot cluster as the `admin` user.
2. Use the `tscli feature` subcommand to display your current configuration.

\$ tscli feature get-all-config			
ACTION	NAME	STATUS	CONFIGUR
	Firewall	Disabled	
	Saml	Disabled	
	Ldap	Disabled	
	CustomBranding	Disabled	
	CustomBrandingFontCustomization	Disabled	
	DataConnect	Disabled	
	RLS	Enabled	
	Callhome	Enabled	
	SSHTunnel	Enabled	
	Fileserver	Disabled	

## Relational Data Cache

This section reports real-time information about tables in your cluster. Worksheet data is not included.

Value	Description
<b>TABLES LOADED</b>	Number of currently loaded tables.
<b>TABLES BEING UPDATED</b>	Number of table loads in-progress.
<b>NEW TABLES BEING LOADED</b>	Number of tables being loaded for the first time.

Value	Description
<b>ROWS</b>	Number of rows combined across all tables in ThoughtSpot.

## Relational Search Engine

Value	Description
<b>TABLES SEARCHABLE</b>	Tables that are indexed and can be searched.
<b>TABLES BEING INDEXED</b>	Total of in-progress table indexing.
<b>NEW TABLES BEING INDEXED</b>	Total of first-time, in-progress table indexing.
<b>TOKENS SEARCHABLE</b>	Number of <b>tokens</b> [See page 416] of all table (combined) indexed in ThoughtSpot.

## Critical Alerts

Displays critical and warning alerts. This includes when an alert was generated and from which service and machine. Administrators can get a custom report by issuing a `tscli alert list` on the appliance:

```
tscli alert list --since 4w
```

The critical alerts you can encounter in this display are the following:

- `TASK_FLAPPING`

```
Msg: Task {{.Service}}.{{.Task}} terminated {{._actual_num_occurrences}}
times in last {{._earliest_duration_str}}
```

This alert is raised when a task is crashing repeatedly. The service is evaluated across the whole cluster. So, if a service crashes 5 times in a day across all nodes in the cluster, this alert is generated.

- OREO\_TERMINATED

**Msg:** Oreo terminated on machine {{.Machine}}

This alert is raised when the Oreo daemon on a machine terminates due to an error. This typically happens due to an error accessing Zookeeper, HDFS, or a hardware issue.

- HDFS\_DISK\_SPACE

**Msg:** HDFS has less than {{.Perc}}% space free

Raised when a HDFS cluster is low on total available disk space.

- ZK\_INACCESSIBLE

**Msg:** Zookeeper is not accessible

Raised when Zookeeper is inaccessible.

- PERIODIC\_BACKUP\_FLAPPING

**Msg:** Periodic backup failed {{.\_actual\_num\_occurrences}} times in last {{.\_earliest\_duration\_str}}

This alert is raised when a periodic backup failed repeatedly.

- PERIODIC\_SNAPSHOT\_FLAPPING

**Msg:** Periodic snapshot failed {{.\_actual\_num\_occurrences}} times in last {{.\_earliest\_duration\_str}}

This alert is raised when periodic snapshot failed repeatedly.

- APPLICATION\_INVALID\_STATE\_EXTERNAL

**Msg:** {{.Service}}.{{.Task}} on {{.Machine}} at location {{.Location}}

Raised when Application raises invalid state alert.

The possible alert types are `CRITICAL`, `WARNING`, `ERROR`, and `INFO`. For a full reference, see the [Alert code reference \[See page 0\]](#).

## Space Utilization

The **Space Utilization** chart is one of the available charts for you to use when checking the cluster overview. This line chart displays the total capacity and estimated used capacity over time.



The x-axis is by time and the y-axis measures the size in GB. You can zoom in and see daily or hourly utilization data. So, in the **Space Utilization** chart above, the green line shows the amount of capacity in use in the system, while the red line shows the total capacity. An increase in the red line at the end of a time period indicates the addition of extra hardware, resulting in increased capacity.

The query for this answer is the following:

```
day of timestamp  
total capacity (gb)  
total used space (gb)  
daily  
last 90 days last 25 hours  
total capacity (gb) > 0  
total used space (gb) > 0
```

The chart relies on the `TS: Internal Table Wise Capacity WS` worksheet. It tracks total used space, which consists of raw uncompressed data, including replication.

## Monthly Active Users

This chart shows the number of active users in the system over the last four months, and during the current month. An active user is defined as a user who has logged in at least one time in the defined time interval, in this case months.

The query for this answer is the following:

```
monthly  
last 4 months this month  
active users  
user != {null}
```

This query relies on the `TS: BI server` worksheet.

## Monthly Ad-hoc Searches

Number of ad-hoc searches (queries) issued per month. An ad-hoc query is defined as any search or change to a search that builds a new answer (result). An ad-hoc search can also be generated through SpotIQ or another UI/API interaction.

ThoughtSpot considers all of the following as ad-hoc searches (queries):

- User edits tokens (boxed terms) in the search bar.
- User opens an existing saved answer and makes changes to tokens in the search bar.

- User opens an existing saved pinboard, edits a visualization, and makes change to the search tokens.
- Searches initiated by an API call for data with runtime filters

It is not considered a search (query) in this context if a user opens an existing saved aggregated worksheet and makes changes to its underlying query.

The query for this answer is the following:

```
ad-hoc search
user action = 'answer_pinboard_context' 'answer_saved' 'answe
r_unsaved'
monthly
last 4 months this month
```

This answer relies on data from the `TS: BI Server` worksheet.

## Monthly Pinboard Views

Number of times a saved pinboard is viewed by a user. These scenarios are considered pinboard views:

- User opens an existing saved pinboard.
- User opens an embedded pinboard from a URL.
- Pinboard data is accessed using the an API.

These scenarios are not considered pinboard views:

- A user opens SpotIQ tab pinboards.
- A user opens admin tab pinboards.
- The system loads a pinboard on the homepage.
- The system loads the ‘learn how to use ThoughtSpot’ pinboard.

The query underlying this answer is:

```
pinboard views
user action = 'pinboard_embed_view' 'pinboard_tspublic_no_runti
me_filter' 'pinboard_tspublic_runtime_filter' 'pinboard_view'
monthly
last 4 months this month
```

The query uses the `TS: BI Server` data source.

## Top Users Last Month

This answer shows the top ThoughtSpot users ranked by number of actions the users performed in the last 30 days. The possible user actions include:

<code>answer_unsaved</code>	User makes a change to tokens in the search bar.
<code>answer_saved</code>	User opens an existing saved answer and makes changes to tokens in the search bar.
<code>answer_pinboard_context</code>	User opens an existing saved pinboard, edits a context viz and makes a change to tokens in the search bar.
<code>answer_aggregated_worksheet</code>	User opens an existing saved aggregated worksheet and makes changes to tokens in the search bar.
<code>answer_upgrade</code>	Requests made for the sole purpose of upgrade.
<code>pinboard_view</code>	User opens an existing saved pinboard.
<code>pinboard_filter</code>	User adds, removes or applies values to a pinboard filter.
<code>pinboard_ad_hoc</code>	User drills down in a pinboard viz.
<code>data_chart_config</code>	Request for new data being generated following a chart config change.
<code>data_show_underlying_row</code>	Request to show underlying data for a data row(s).
<code>data_export</code>	Request to export data.

pinboard_tspublic_runtime_filter	Request to TSPublic/pinboarddata with runtime filters.
answer_aggregated_worksheet_save	User updates aggregated worksheet.
answer_add_new_filter	User adds a filter using the UI.
data_show_underlying_viz	Request to show underlying data for a data row(s).
answer_view	User opens an existing, saved answer.
answer_viz_context_view	User opens an existing saved pinboard, edits a context viz.
pinboard_insight_view	User opens SpotIQ tab pinboards.
pinboard_admin_view	User opens admin tab pinboards.
pinboard_embed_view	User opens embed pinboard from a URL.
pinboard_homepage_view	On loading of homepage pinboard.
pinboard_learn_view	On loading learn pinboard.
pinboard_tspublic_no_runtime_filter	Request to TSPublic/pinboard data without runtime filters.

The query underlying this answer is:

```
top 10
ranked by user actions
user action != 'invalid'
user != {null}
user
last 30 days today
```

The query uses the `TS: BI Server` data source.

## Top Pinboards Last Month

This answer shows the top ThoughtSpot users ranked by number of pinboard actions the user performed in the last 30 days. The possible user actions include:

- User opens an existing saved pinboard ('pinboard\_view').

- User opens an embedded pinboard from a URL ('pinboard\_embed\_view').
- Pinboard data is accessed using an API ('pinboard\_tspublic\_no\_runtime\_filter' or 'pinboard\_tspublic\_runtime\_filter').

The query underlying this answer is:

```
top 10
ranked by pinboard views
user action = 'pinboard_embed_view' 'pinboard_tspublic_no_runtime_filter' 'pinboard_tspublic_runtime_filter' 'pinboard_view'
pinboard != {null}
pinboard
last 30 days today
```

The query uses the `TS: BI Server` data source.

## Configuration Events

This system answer displays recent events that changed the configuration of the system. This panel displays configuration events related to:

**Cluster Configuration** Reports configuration actions from the `'tscli'` and `'tql'` commands.

**Metadata Management** Events related to metadata such as column names, column visibility, column and data definition, column rank and so forth.

**User Management** Events related to creating, updating, or adding new users and groups.

For a more detailed list, including the user that issued a command, you can use the `tscli event list` command. Administrators can `ssh` into the cluster and specify a time period or even a type of command to include.

## About deprecated boards

There are a number of deprecated boards on this page. They are there to support older installations that relied on them. New installations, should not use or rely on deprecated boards. Older installations that have used these boards in some way, should use the new boards and remove any dependencies.

## Related information

`tscli logs` command [See page 0]

# Data board

The **Data** page shows all the stored tables with details on the last update time, time taken for auto-indexing, number of rows, and so forth.

Table Information		
DATABASE	USER SCHEMA	NAME
FalconUserDataDataBase	FalconUserDataSch..	USERDATA-a6c0991e-462d
FalconUserDataDataBase	FalconUserDataSch..	USERDATA-96a40275-7427
FalconUserDataDataBase	FalconUserDataSch..	USERDATA-bcda2191-cd6c
FalconUserDataDataBase	FalconUserDataSch..	USERDATA-9dc1bfc7-2d27
FalconUserDataDataBase	FalconUserDataSch..	USERDATA-29546f4d-84ac
thoughtspot_analytics	falcon_default_sche..	candidates
FalconUserDataDataBase	FalconUserDataSch..	USERDATA-4343525d-261b
FalconUserDataDataBase	FalconUserDataSch..	USERDATA-0694fd57-fadf-
FalconUserDataDataBase	FalconUserDataSch..	USERDATA-51435761-0aac
FalconUserDataDataBase	FalconUserDataSch..	USERDATA-0fb9daec-5230
dw	falcon_default_sche..	fact_lead_transitions
FalconUserDataDataBase	FalconUserDataSch..	USERDATA-12b3cf23-0de5

( showing rows 1 - 14 of 913. )

You can click a column name to sort by table name. This table information is based on an underlying system data, you can present it or copy the link, but you cannot access the underlying query.

## Database Status

The **Database Status** column can have the following possible values:

Status	Meaning
READY	The data has been loaded.
IN PROGRESS	The data is still being loaded.
STALE	The data is not up to date.
ERROR	The table is invalid. Call Customer Support.

## Replication Status

The **Replicated** column indicates if the table has been replicated or sharded. This can be used in conjunction with the **Total Shards** column to see how your data is distributed.

If the table is replicated on a multi node system, the **Used Capacity (MB)** column will indicate the total space used on all nodes. a 10MB table replicated on a 4 node system will show 40MB used capacity for example.

## Search Status

The **Search Status** column can have the following possible values:

Status	Meaning
READY	The data is up to date and searchable.
NOT READY	The data is not ready to be searched.
DELETING INDEX	The table has already been deleted, but the index still exists due to the latency between the database and search engine.
INDEXING DISABLED	Either too many tokens exist in a column for it to be indexed, or indexing has been disabled manually.

Status	Meaning
CREATING INDEX	The index is being created.
UPDATING INDEX	A change has been made to indexing or the data, and the index is being updated to reflect it.

# Cluster Manager board

The **Cluster Manager** section show detailed information about a cluster including latency over time, snapshot status, installed release, node functions, and logs.

Cluster Details	
PROPERTY	CONTENT
Cluster Name	dclone-316
Cluster ID	dflid
Release	3.2.20160208_fa1495
Last Update Time	Feb 08, 2016 08:12:35 am PST
Zookeeper Servers	192.168.6.154.2181,192.168.6.155.2181,192.168.6.156.2181
HDFS Name Nodes	192.168.6.154.8020,192.168.6.155.8020
Cluster Alert Email	
Periodic Snapshot ...	disabled

( showing rows 1 - 8 of 8 )

List of Snapshots		
TIME	NAME	REASON
Feb 08, 2016 08:02:25 am PST	pre_1_2_20160208_fa1495...	Automatic pre update snapshot
Feb 07, 2016 08:49:55 pm PST	pre_3_2_20160207_fb14881...	Automatic pre update snapshot
Feb 07, 2016 06:58:48 pm PST	pre_3_2_20160207_647fbf...	Automatic pre update snapshot
Feb 07, 2016 01:20:18 pm PST	pre_3_2_20160207_3cfaed...	Automatic pre update snapshot
Feb 06, 2016 08:33:58 pm PST	pre_1_2_20160206_e473465...	Automatic pre update snapshot
Feb 06, 2016 09:04:42 am PST	pre_3_2_20160206_d9f3fb...	Automatic pre update snapshot
Feb 05, 2016 02:29:42 pm PST	pre_3_2_20160205_40742ed...	Automatic pre update snapshot
Feb 05, 2016 01:08:41 pm PST	pre_3_2_20160205_a0942ed...	Automatic pre update snapshot

( showing rows 1 - 10 of 20 )

Cluster Logs		
TIME	TYPE	RELEASE
Feb 08, 2016 08:12:35 am PST	UPDATE	3.2.20160208_fa1495
Feb 07, 2016 09:01:10 pm PST	UPDATE	3.2.20160207_fb14881
Feb 07, 2016 07:10:17 pm PST	UPDATE	3.2.20160207_e473465
Feb 07, 2016 01:31:03 pm PST	UPDATE	3.2.20160207_3cfaed
Feb 06, 2016 08:45:01 pm PST	UPDATE	3.2.20160206_e473465
Feb 06, 2016 09:15:50 am PST	UPDATE	3.2.20160206_d9f3fb
Feb 05, 2016 02:39:17 pm PST	UPDATE	3.2.20160205_40742ed
Feb 04, 2016 12:10:29 pm PST	UPDATE	3.2.20160204_221fb80

( showing rows 1 - 11 of 21 )

Average Latency Last 2 Weeks (sec)

0.0    0.2    0.4    0.6    0.8    1.0

Any Duration [sec] Avg Total [sec]

Jan 24 Jan 25 Jan 26 Jan 27 Jan 28 Jan 29 Jan 30 Jan 31 Feb 01 Feb 02 Feb 03 Feb 04 Feb 05 Feb 06

Daily (Timestamp) for 2016

Only the **Average Latency Last 2 Weeks (sec)** panel contains a standard ThoughtSpot visualization.

The other visualizations rely on internal queries that are not accessible. You can, however, **Present** or **Copy link** on them.

## Cluster Details

The fields on this visualization has the following meaning:

Field	Description
<b>Cluster Name</b>	The name of the cluster defined at installation time.
<b>Cluster ID</b>	The ID of the cluster set at installation time.
<b>Last Update Time</b>	Last time the cluster was updated.
<b>Release</b>	Version of the current release.
<b>Zookeeper Servers</b>	IP addresses of the Zookeeper servers.

<b>HDFS Name Nodes</b>	Control nodes for Hadoop Distributed File System (HDFS).
------------------------	--

## Cluster Logs

The fields on this visualization has the following meaning:

Field	Description
<b>Time</b>	A timestamp indicating when an action occurred.
<b>Type</b>	Type of action.
<b>Release</b>	Identifies the full release number.

You can also use the `tscli logs` command to review log data from your cluster.

## List of Snapshots

This visualization shows the snapshots *and the backups* taken on the cluster. The fields on this visualization has the following meaning:

Field	Description
<b>Time</b>	A timestamp indicating when a snapshot or backup happened occurred.
<b>Name</b>	Name of the snapshot file. These files are stored in the `/usr/local/scaligent/backup` directory on your cluster.
<b>Reason</b>	Identifies the reason the snapshot/backup was created. You should see several period snapshots if your cluster is configured properly. You may also see evidence here of manual backups. For example, you should be sure your cluster is backed up before major events such as upgrades. Email <a href="mailto:sup-port@thoughtspot.com">sup-port@thoughtspot.com</a> [See page 0] if you don't see evidence your cluster is periodically creating snapshots.
<b>Size</b>	Size of the backup in gigabytes.

## Average Latency Last 2 Weeks (sec)

This visualization relies on the `TS: BI Server` worksheet to display the average database latency over the last 15 days. The database latency measures how long it takes for a search to return data from ThoughtSpot - this does not include the time taken to send the answer back to the client, it measures internal processing time. You can use the visualization menu to drill down to its underlying query:

```
average datacache (sec)
average total (sec)
daily
last 15 days
for database latency (us) > 0
```

## Related information

`tscli logs` command [See page 0]

# Alerts and Events board

The **Alerts and Events** section shows notifications, alerts, and an audit trail of cluster configuration changes.

Configuration Events	
<b>ClusterConfiguration</b>	3 minutes ago
tscli service add-javaopt tomcat.tomcat D orion.customBrandingFontCustomization..	
<b>ClusterConfiguration</b>	3 minutes ago
tscli service add-javaopt tomcat.tomcat D orion.customBrandingEnabled true	
<b>ClusterConfiguration</b>	1 hour ago
tscli service add-javaopt tomcat.tomcat D orion.defaultQuarterStartMonth 2	
<b>ClusterConfiguration</b>	2 hours ago
tscli service delete-javaopt tomcat.tomcat D orion.defaultQuarterStartMonth	
<b>ClusterConfiguration</b>	2 hours ago
tscli etl enable-lw --username priyanka.shriram@thoughtspot.com --admin_username..	

## Alerts

The fields on this answer have the following meaning:

Field	Description
<b>Time</b>	When the alert was sent.
<b>Type</b>	The ID of the event.
<b>Message</b>	The text of the alert message.

For a full reference of possible alerts, see the [Alert code reference \[See page 0\]](#).

## Configuration Events

This system answer displays recent events that changed the configuration of the system. This list can contain the same types of information available on the **Admin System Health > Overview** page. This answer displays the **Time**, the **User** that performed the action, and a **Summary** of the action.

## Notification events

This answer displays notifications of data loads. The display the **Time**, the **User** that performed the action, and a **Summary** of the action. Notifications are kept for 90 days before being discarded.

## Related information

[Alert code reference \[See page 0\]](#)

# System worksheets

Most of the monitoring information in **System Health** are sourced from system worksheet which administrators can view, but not modify. The underlying tables are protected system tables that cannot be accessed directly. However, administrators can create new, custom monitoring reports from the worksheets.

## List the system worksheets

To list the system worksheets:

1. Go to the **Data** tab.
2. Choose **All** and **Worksheets**.
3. Enter `TS:` in the search field.

The screenshot shows the ThoughtSpot interface with the 'Data' tab selected. Under the 'Tables' section, the 'Worksheets' tab is active. A search bar at the top right contains the text 'Q TS:'. Below the search bar is a table with columns: Name, Source, Stickers, Materialize Status, Modified, and Author. The table lists four entries:

Name	Source	Stickers	Materialize Status	Modified	Author
TS: BI Server				11 months ago	SU System User
TS: Search				a year ago	SU System User
TS: Database				2 years ago	SU System User
TS: Service Resources				2 years ago	SU System User

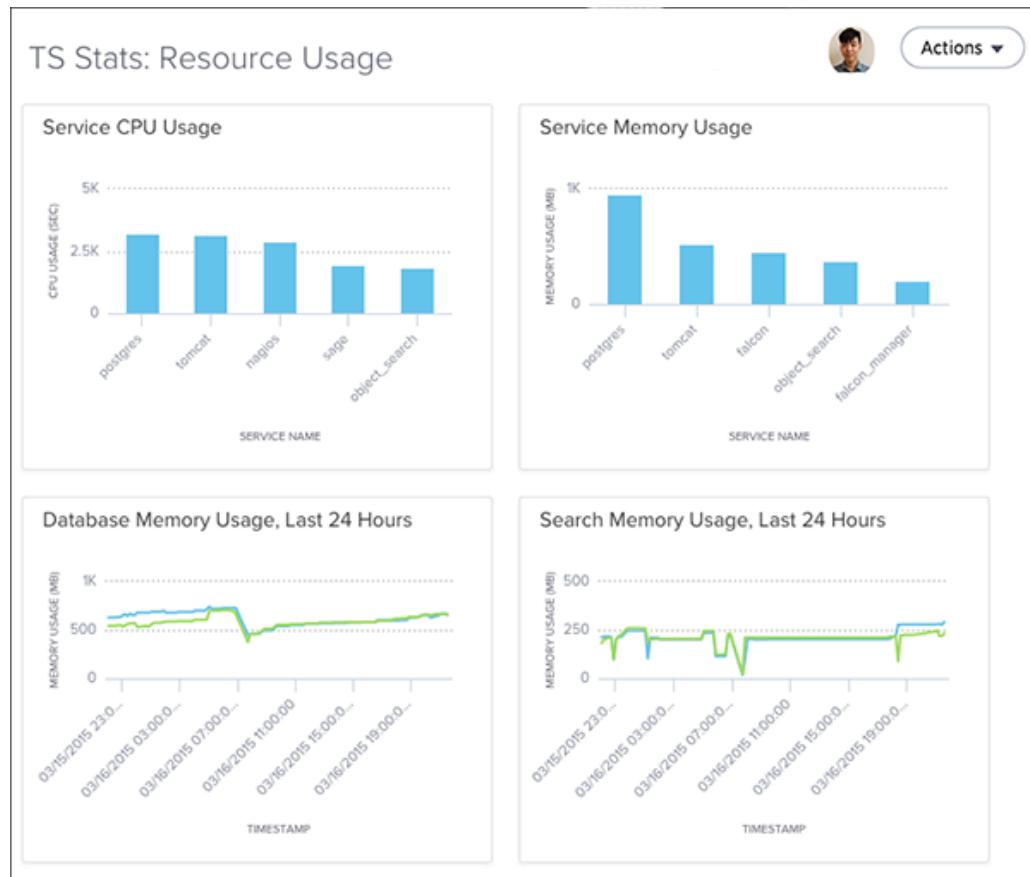
## Summary of the worksheets

Worksheet	Description
TS: BI Server	Contains data related to the systems associated with underlying the ThoughtSpot BI server. This includes database latency, browser clients, size of responses, and more.
TS: Database	Contains information related to the database cache and queries run on the database. For example, you could use this worksheet to see data on the query errors returned by the database.

TS: Internal Capacity WS	Describes cluster memory capacity by node over time.
TS: Internal Table Wise Capacity WS	Describes memory capacity by node, table name, shard count, and CSV replication over time.
TS: Metrics	Contains metrics by cluster and host over time.
TS: Search	Contains data related to the number of searches (queries) run in the system. This contains information such as uptime, host, and timestamps.
TS: Service Resources	Contains data related to cluster nodes including page faults, memory usage, memory failures, and more.
TS: Table Info	Describes the named tables by timestamp, row count, row shards, and row size.
TS: Table Row Counts	Describes the named tables by timestamp and row count.
TS: Table Row Counts and Shards	Describes the named tables by timestamp, row count, row shards, and row size.
TS: Table Row Size	Describes the named tables by timestamp and row size.
TS: Table Shards	Describes the named tables by timestamp and shard count.

# System pinboards

There are several system monitoring pinboards in ThoughtSpot that provide answers for system status and resource usage questions. The information in these pinboards are updated hourly from internal data sources that collect monitoring statistics.



Only users with administrative privilege can view the monitoring pinboards. They are based on worksheets, which administrators can view, but not modify. However, you can create new monitoring pinboards from the worksheets.

## List system pinboards

To list these system pinboards:

1. Go to the **Pinboards** tab.
2. Choose **All**.

3. Enter `TS:` in the search field.

Name	Stickers	Modified	Author
ThoughtSPORT Overview	Sports Goods	3 days ago	Administrator
Fan Shop Sales	Sports Goods	6 days ago	Administrator
Advanced Analysis with R	Sports Goods	3 weeks ago	Administrator

## Summary of system pinboards

Pinboard	Description
Learn how to use ThoughtSpot	Contains search replays created in the system.
TS Stats: Alert Detail	Combines alerts, notification events, and configuration events boards.
TS Stats: Cluster Detail	Contains cluster details, logs, snapshots, and latency data.
TS Stats: System Information and Usage	Replicates the **Admin > System Health > Overview** page.
TS Stats: Latency Visualizations	Latency on servers and <b>impression [See page 439]</b> counts. This data comes from the 'TS: BI Server' worksheet.
TS Stats: Table Status	Replicates the **Data** board.

## About deprecated boards

The deprecated boards (`TS status: Usage - Deprecated` and `TS StaTS: Queries -- Deprecated`) are there to support older installations. New installations, should not use or rely on deprecated boards. Older installations that have used these boards in some way, should use the new boards and remove any dependencies.

# About troubleshooting

The information here provides very basic troubleshooting. For more detailed troubleshooting, [Contact ThoughtSpot \[See page 0\]](#).

- [Get your configuration and logs \[See page 442\]](#)

For troubleshooting on specific incidents or cluster problems, getting a log bundle can help.

- [Upload logs to ThoughtSpot Support \[See page 446\]](#)

- [Network connectivity issues \[See page 448\]](#)

If network connectivity to and from ThoughtSpot is not working, try using these steps to find and correct the issue.

- [Check the timezone \[See page 449\]](#)

ThoughtSpot comes configured with the timezone where it is to be installed.

- [Browser untrusted connection error \[See page 450\]](#)

If you are not using a SSL certificate for authentication, users will see an untrusted connection error in their browser when accessing ThoughtSpot. The error looks slightly different depending upon the Web browser being used.

- [Characters not displaying correctly \[See page 451\]](#)

Your CSV files are more likely to load smoothly if they are encoded with UTF-8. If you're having problems with some characters rendering incorrectly, you can convert the files to UTF-8 encoding before loading the data.

- [Clear the browser cache \[See page 452\]](#)

You might occasionally see unexpected behavior that is due to the Web browser caching information from ThoughtSpot. In this case, clearing the browser cache and reloading the page should resolve the problem.

- [Cannot open a saved answer that contains a formula \[See page 455\]](#)

- [Data loading too slowly \[See page 458\]](#)

Some tables may take an unusually long time to load due to a high data version issue. This issue normally arises when ThoughtSpot completes an upgrade or the system is recovering after a crash.

- [Search results contain too many blanks \[See page 459\]](#)

If you find that your search results contain too many blanks when your data source is a worksheet, there is a simple adjustment you can make to fix this.

# Get your configuration and logs

For troubleshooting on specific incidents or cluster problems, two things are important. Understanding your current configuration and getting a log bundle.

## Check your configuration

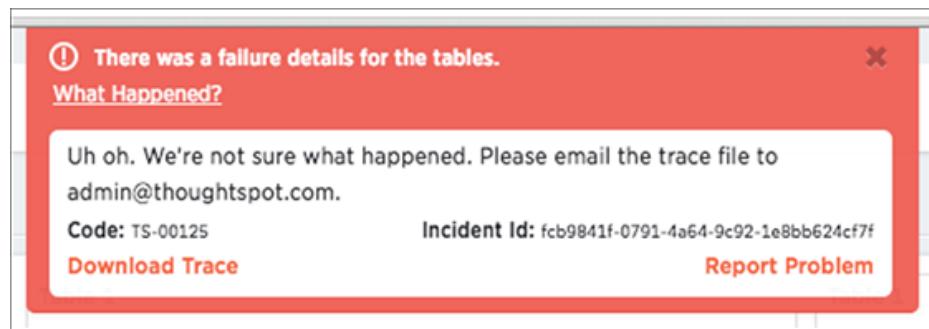
1. Log into the ThoughtSpot cluster as the `admin` user.
2. Use the `tscli feature` subcommand to display your current configuration.

\$ tscli feature get-all-config			
ACTION	NAME	STATUS	CONFIGUR
	Firewall	Disabled	
	Saml	Disabled	
	Ldap	Disabled	
	CustomBranding	Disabled	
	CustomBrandingFontCustomization	Disabled	
	DataConnect	Disabled	
	RLS	Enabled	
	Callhome	Enabled	
	SSHTunnel	Enabled	
	Fileserver	Disabled	

## How to get logs

There are two ways to get logs:

- When ThoughtSpot encounters a problem, a red bar displays in the browser with an error message. You can click **What Happened?** in the error message for more details. To download related logs, click **Download Trace**. Send the logs as an email attachment to the support contact that is provided. Clicking **Report Problem** will also send the logs as an email attachment to your administrator.



- You can generate a log bundle using the `tscli logs collect` command if you are comfortable with Linux. The command lets you specify which logs to collect and from what time periods.

Usage for this command is:

```
tscli logs collect
  --include <selector | glob>
  [--exclude <selector | glob>]
  [--since <hours,minutes,days>
   | --from <yyyymmdd-HH:MM>
   --to <yyyymmdd-HH:MM>]
  [--out <path>]
  [--maxsize <size_in_MB_or_GB>]
  [--sizeonly]
```

The full list of all selectors is:

- `all` collects all of the logs listed from the system and the ThoughtSpot application.
  - `system` collects all system logs, e.g. syslog, upstart, mail logs, etc.
  - `ts` collects all logs from the ThoughtSpot application. This includes falcon, sage, orion core (cluster management), etc.
  - `orion` collects all orion logs including cluster management, hdfs, zookeeper, etc.
- Detailed syntax and options are listed in the [tscli command reference \[See page 0\]](#).

## Examples

Here are some examples of usage for the command `tscli logs collect`:

To collect all logs from the past day to the default location ( `/tmp/logs.tar.gz` ):

```
$ tscli logs collect --include all --since 1d
```

In this example, `all` is a selector for all the available logs.

In most cases, you can probably use the selector `ts` to only capture logs for the ThoughtSpot application:

```
$ tscli logs collect --include ts --since 2d
```

For debugging cluster management issues, use a command like this one, which collects logs for system and orion from the past 2 hours. The output is written to `/tmp/debug.tar.gz` as specified using `--out`:

```
$ tscli logs collect --include system,orion --since 2h --out /tmp/debug.tar.gz
```

This command collects logs from a specific time window:

```
$ tscli logs collect --include system,orion --from 20150520-1  
2:00 --to 20150522-12:30
```

Advanced usage alert! You can also use `--include` and `--exclude` to specify filesystem paths as a glob pattern. This works like the Linux `find(1)` command. Pass all the entries in `--include` starting with `/` to `find(1)`, and all entries in `--exclude` which are not selectors to `find(1)` using the `-not -path` flag.

```
$ tscli logs collect --include system,orion --exclude *hadoo  
p*,*zookeeper* --since 2h
```

The above command collects all system and all orion logs, but excludes hadoop (hdfs) and zookeeper logs. See [Upload logs to ThoughtSpot Support \[See page 446\]](#) about using a secure file sever to collect log files or other files needed for troubleshooting. You can easily send log files to this file serve directly from the ThoughtSpot instance.

# Upload logs to ThoughtSpot Support

ThoughtSpot Support uses a secure file sever to collect log files or other files needed for troubleshooting. You can easily send log files to this file serve directly from the ThoughtSpot instance.

## Metrics collection

ThoughtSpot collects the diagnostic information from your system on an ongoing basis: there is no time needed to collect diagnostic information after a problem is reported. These metrics allow for:

- Our support team can begin working to remediate any issue with you immediately.
- Metrics provides direct visibility to the ThoughtSpot team on your system's limits. Therefore, our Support team can proactively identify critical threshold issues and work to prevent failures. Metrics also help reduce SLA times as the team can debug much faster.
- ThoughtSpot can tune search algorithms by studying search history and schema.
- ThoughtSpot analyzes expensive and complex query patterns to look for performance optimizations.

Finally, the metrics pipeline allows ThoughtSpot to identify application-use patterns that contribute to performance bottlenecks with specific browsers and help your team prevent or alleviate them.

## Other log uploads

Before you can upload a file to the secure file server:

1. [Configure the connection to the file server \[See page 58\].](#)
2. Obtain the directory path on the file server.

The server directory path for uploading a file is formatted like this example: `/Shared/support/<customer_name>`. If you do not know the customer name, [contact ThoughtSpot Support \[See page 0\]](#).

You can upload files directly to the file server using this procedure:

1. Log in to the Linux shell using SSH.
2. Navigate to the directory where the file to be uploaded is located.
3. Issue the command to upload the file, specifying the file name and directory path:

```
$ tscli fileserver upload --file_name <file> --server_directory_path <path>
```

When your upload succeeds, you will see a confirmation message.

# Network connectivity issues

If network connectivity to and from ThoughtSpot is not working, try using these steps to find and correct the issue.

To troubleshoot network connectivity for ThoughtSpot:

1. Make sure that the network cables are connected correctly.
2. Check that the network cable is connecting the nodes to the network switch.
3. Try replacing the cable with a cable from a known working system to rule out a bad cable or switch connectivity issues.
4. Make sure the eth0 interface is connected to the network by issuing: `ethtool eth0` The port that's currently connected will have "link detected" in the last line of the output.
5. If the networking settings have been reconfigured, reboot each of the nodes.

# Check the timezone

ThoughtSpot comes configured with the timezone where it is to be installed. Data is imported based on the timezone of the node from which `tsload` or `tql` is run. To see the timezone your ThoughtSpot node is running under, log into the server as the `thoughtspot` user and run the `date` command:

```
[thoughtspot@ts.server etc]$ date  
Tue Feb 20 09:07:04 PST 2018
```

To see the current timezone used by the ThoughtSpot application, choose **Admin > Cluster Manager** and review the **Cluster Details**:

Cluster Details	
Property	Content
Cluster Name	local
Cluster ID	local
Release	dev
Last Update Time	Feb 16, 2018, 4:14:31 AM PST
Zookeeper Servers	172.18.248.8:2181
HDFS Name Nodes	172.18.248.8:8020

The timezones should match.

Sometimes the timezone that is listed by `date` is not the active timezone for the ThoughtSpot application and the application needs to be reset. If you need to change the timezone, [contact ThoughtSpot Support \[See page 0\]](#) and they will change the timezone for you. You may need to change the timezone if you move the server between data centers.

# Browser untrusted connection error

If you are not using a SSL certificate for authentication, users will see an untrusted connection error in their browser when accessing ThoughtSpot. The error looks slightly different depending upon the Web browser being used.

ThoughtSpot uses secure HTTP (the HTTPS protocol) for communication between the browser and ThoughtSpot. By default there is no SSL certificate for authentication. This must be added by the site administrator. If the site administrator has not added the certificate, the browser warns the user.

Browser	Warning
Google Chrome	The site's security certificate is not trusted!
Mozilla Firefox	This Connection is Untrusted

If you see the warning message, choose one of the following options:

- Ask the site administrator to install the certificate.
- Ask the site administrator to turn off SSL using this command in the shell on the ThoughtSpot instance:

```
$ tscli ssl off
```

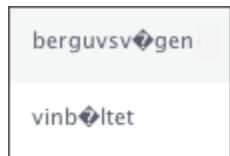
- You can choose to ignore the message, and access ThoughtSpot without SSL.

# Characters not displaying correctly

Your CSV files are more likely to load smoothly if they are encoded with UTF-8. If you're having problems with some characters rendering incorrectly, you can convert the files to UTF-8 encoding before loading the data.

You might see unexpected characters in your data, especially characters whose ASCII values are at the high and low end of possible values. Some examples of characters that can appear incorrectly are: æ, ñ, ä, í, ö.

If this happens, your data will look like this:



Instead of displaying correctly like this:



To encode your data as UTF-8:

1. On Windows, open your CSV file in Notepad. Save the file as CSV with the Unicode option.
2. On Linux or MacOS, issue a command like:

```
$ iconv -f -t UTF-8 <in_file>.csv > <out_file>.csv
```

3. Reload the data.
4. Attempt to import it again.

## Clear the browser cache

You might occasionally see unexpected behavior that is due to the Web browser caching information from ThoughtSpot. In this case, clearing the browser cache and reloading the page should resolve the problem. You can usually resolve these situations by clearing the browser cache:

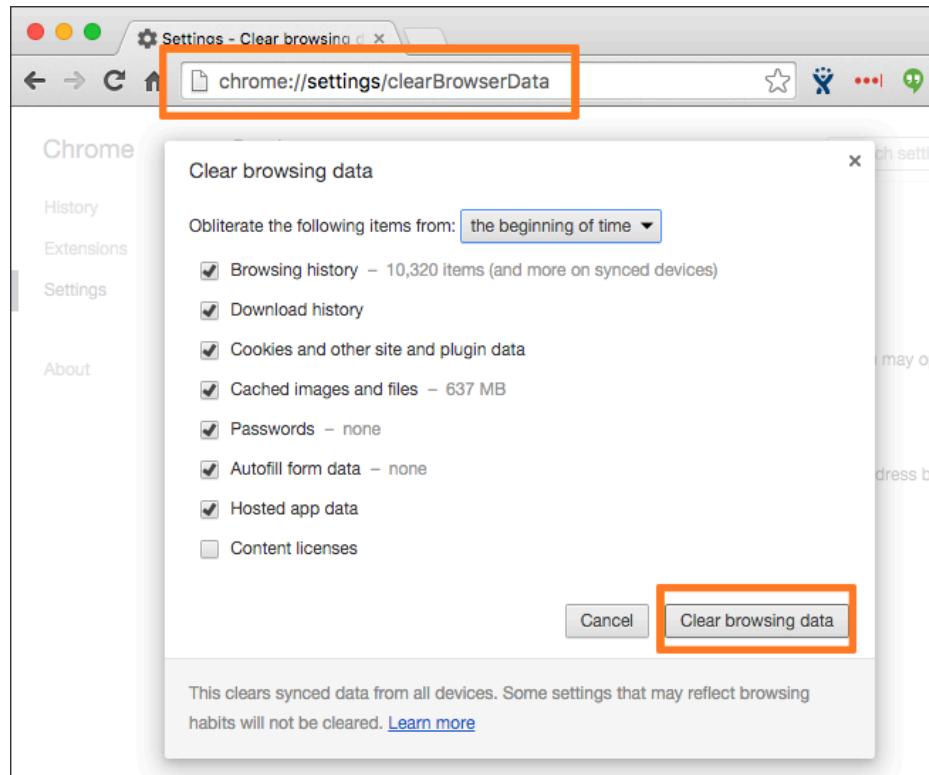
- During a ThoughtSpot session, the browser suddenly displays a white screen and reloading does not fix the problem. This is due to a self-signed SSL certificate that has timed out during the session.
- When accessing the Help Center, you see a login screen. This is due to a problem during automatic authentication in the Help Center, after which the bad login gets cached by the browser.

To resolve any of these situations, clear the browser cache:

1. Clear the browser cache.

This works a little differently on individual browser versions and operating systems. For example, when using Chrome, to get to the browser cache settings, navigate to:

```
chrome://settings/clearBrowserData
```

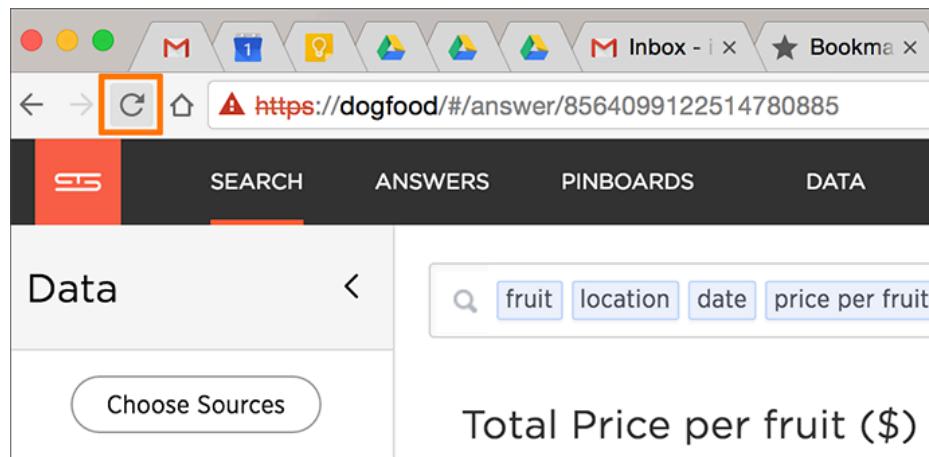


2. Click **Clear browsing data**.

This is the name of the button on Chrome. The name may vary slightly on other browsers.

3. Reload the page.

For example, on Chrome you would click the **Reload** icon:



*Clear the browser cache*

Now the problem should be fixed, and the page will appear as expected.

# Cannot open a saved answer that contains a formula

When working with formulas, keep in mind the data types they return. You may occasionally see unexpected results, or even be unable to open a saved answer, due to problems with data types and formulas.

In this scenario, “data type” refers the data type as defined in the column definition when creating the schema (INT, TIMESTAMP, VARCHAR, etc.).

When you define a formula, both the data type it returns is set automatically. This can lead to problems, if you build another formula that uses the output of the first formula as input. This can be hard to understand, so an example will be helpful.

Suppose you have created a worksheet that contains a formula called “weekday” defined as:

```
day_of_week(date)
```

The output of that formula is the day of the week (Monday, Tuesday, etc.) returned as a text string (VARCHAR, ATTRIBUTE).

Then suppose you create an answer using the worksheet as a source. And in the answer, you create another formula on top of the formula column in the worksheet. This formula is supposed to return the day of the week that is two days after the given day of the week:

```
weekday + 2
```

In this case, you have effectively created a formula on top of another formula. This works fine, so long as the data types in the worksheet formula can work in the answer formula. If not, you may not be able to save the answer, or open it after it has been saved. Here, the second formula you created does not work, because it is invalid. It is trying to subtract a number from a text string.

If you encounter this issue, you must open the worksheet and edit its formula so that it returns the type expected by the formula that was built on top of it. In this case, a numeric data type.

You must change the underlying worksheet column to use day\_number\_of\_week instead of day\_of\_week. This is because day\_number\_of\_week returns a numeric data type.

Here are the steps to resolve an issue like this:

1. Open the underlying worksheet that contains the formula whose output data type you need to change.
2. Click the formula name to edit the formula.

The screenshot shows the ThoughtSpot Data Editor interface. On the left, the 'Data' panel displays a list of available sources: 'Udemy\_user\_activity\_report', 'Udemy\_user\_course\_activi..', and 'Udemy\_user\_progress\_rep..'. Below this is a 'Formulas' section containing a single formula named 'weekday', which is highlighted with a red box. On the right, the 'Udemy Worksheet' panel shows a table with data from the 'Udemy\_user\_activity\_report' source. The table has three columns: 'date joined', 'date last visit', and 'minutes video watched'. The data rows include: date joined (FY 2016-08-27 17:00:00), date last visit (FY 2017-05-18 17:13:47), minutes video watched (1,159.00). There are also several other columns and rows in the table, such as 'number of courses assigned' (0), 'number of courses complet..' (0), 'number of days used' (41), etc.

<input type="checkbox"/> date joined	FY 2016-08-27 17:00:00	FY 20
<input type="checkbox"/> date last visit	FY 2017-05-18 17:13:47	FY 20
<input type="checkbox"/> minutes video watched	1,159.00	1,159.
<input type="checkbox"/> number of courses assigned	0	0
<input type="checkbox"/> number of courses complet..	0	0
<input type="checkbox"/> number of days used	41	41
<input type="checkbox"/> number of modules compl..	153	153
<input type="checkbox"/> number of courses enrolled	15	15
<input type="checkbox"/> number of courses started	13	13
<input type="checkbox"/> email	anirudh@thoughtspot.com	anirud
<input type="checkbox"/> first name	anirudh	anirud
<input type="checkbox"/> last name	{Blank}	{Blank}

3. In the Formula Builder, modify the formula, so that it returns the expected data type.

There are data type conversion formulas available to make this easier. To view them and their syntax, open the **Formula Assistant**, and expand the section called **Conversion**.

The screenshot shows the ThoughtSpot Formula Assistant interface. A search bar at the top contains the text "weekday". Below it, a list of functions is shown, with "day\_number\_of\_week" highlighted in blue. A tooltip for "day\_number\_of\_week" is displayed on the right, containing the following text:

Returns the number (1-7) of the day in a week from the given date with 1 being Monday and 7 being Sunday.

Examples:

- `day_number_of_week ( 01/30/2015 ) = 6`
- `day_number_of_week ( shipped )`

At the bottom left of the interface, there is a green checkmark icon followed by the text "Formula is valid".

4. Make your changes, and saving the formula by clicking **Save**.
5. Save the worksheet by clicking **Save**.
6. Now you will be able to open the answer that was created on top of the worksheet.

# Data loading too slowly

Some tables may take an unusually long time to load due to a high data version issue. This issue normally arises when ThoughtSpot completes an upgrade or the system is recovering after a crash.

The data version is the number of loads that have been historically applied to a table. Every completed load increments the version number of the table by one. ThoughtSpot would need to process each version of the table during restoration, which could increase the time it takes to build the table.

There are a few steps you can take to check for a high data version issue and fix it. To improve data loading speed, run the following command to find the number of tables that are building and their names

```
tscli cluster status --mode table
```

You may notice that a few small tables are taking up a lot of time to be built. This could simply be due to the deceptively large size of the table. There is also the chance it could be due to a high data version issue. To determine if this is a high data version issue, check the size of the table by running the following command:

```
echo 'show statistics for server;' | tql
```

If there is a large number of rows in the table, go on to shard the table. If the table has a small number of rows, then the slow loading speed is caused by a high data version issue, and you do not have to shard the table. Use the compact table functionality to trim the table down to its actual size:

```
tql> compact table <table name>;
```

# Search results contain too many blanks

If you find that your search results contain too many blanks when your data source is a worksheet, there is a simple adjustment you can make to fix this.

If you find that the charts and tables built on a worksheet contain a large number of null values (which display as {blank} in the web browser), you can fix this by changing the [inclusion rule \[See page 0\]](#) for the worksheet.

An inclusion rule that specifies **Exclude Empty Rows (Inner Join)** will reduce the number of null values in the result. Imagine a worksheet that includes data about a retail grocery store. There are rows in the worksheet from these source tables:

Table Name	Description
sales	Fact table with sales made per product per store.
products	Dimension table with information about every product.
stores	Dimension table with information about every store.

When creating the worksheet, suppose you choose **Include Empty Rows (Left Outer Join)** for the inclusion rule and **Progressive Joins** for the join rule. In this case, if you type “product name” in your search, you can see a list of all the products that exist. Suppose you then add “store name” to your search. You will see a lot of null ({blank}) values in the result. This happens because the columns “store name” and “product name” are joined through the fact table, “sales”. So for every product that has never been sold in a particular store, you can see {blank} in the “store name” column. This may be what you want to see, in which case, you can leave the worksheet as is, and choose **Exclude** for the {blank} values in your table or chart, whenever you don’t want to see them.

However, in many cases, including all the {blank} values could confuse end users. So if you encounter this problem, you can [edit the worksheet, and change the inclusion rule \[See page 339\]](#) to **Exclude Empty Rows (Inner Join)**. Now when searching for “store name” and “product name” on the worksheet, users will not be overwhelmed by null values. They’ll only see the rows where a particular product has been sold in a particular store.