

# Database Systems on Modern CPU Architectures

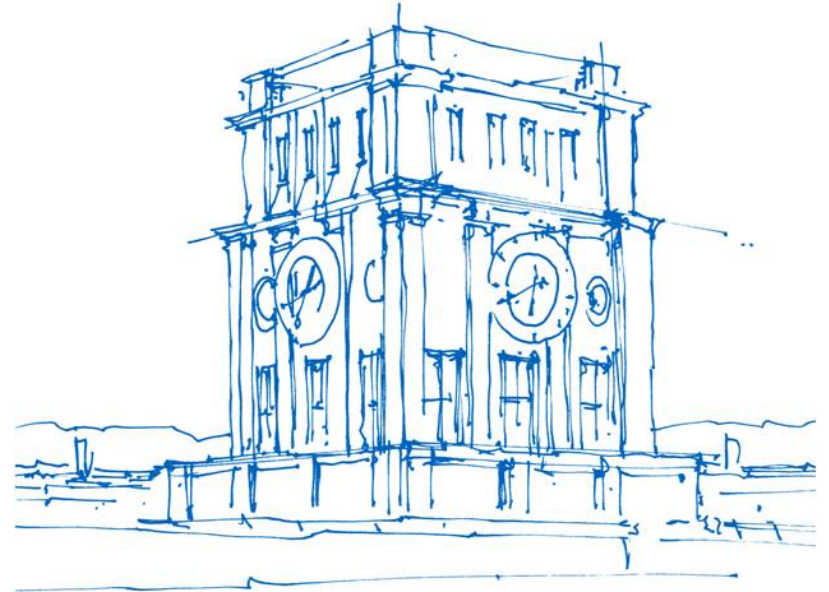
Philipp Fent, André Kohn

Technical University Munich

Chair for Database Systems

fent@in.tum.de

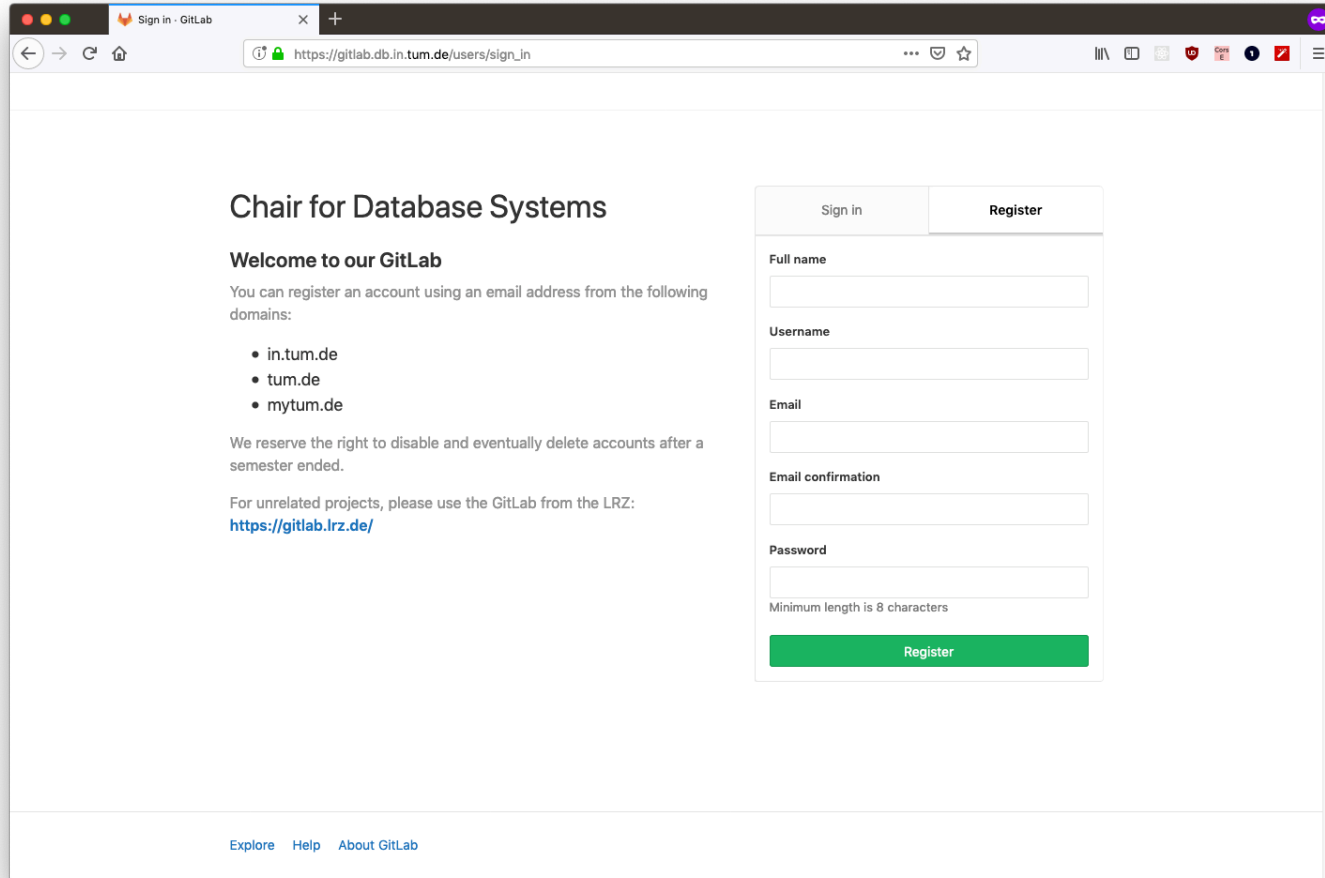
kohna@in.tum.de



*Uhrenturm der TUM*

# Organisation

- Lecture + Tutorial: Tuesdays from 14:00 –17:00.
- Programming assignments every 2 weeks starting now.
- Announcements on website & **Mattermost**.
- Assignments managed via **GitLab (CI)**. (Due Tuesdays at 14:00)
- No teams.
- Bonus System:
  - 0.3 / 0.4 grade bonus on final exam. ( $\geq 75\%$  of all points)
  - **9 points** for correct implementation of assignments.
  - **1 points** for code quality per assignment. (Linter green == 1 Points)



Sign in - GitLab

https://gitlab.db.in.tum.de/users/sign\_in

## Chair for Database Systems

### Welcome to our GitLab

You can register an account using an email address from the following domains:

- in.tum.de
- tum.de
- mytum.de

We reserve the right to disable and eventually delete accounts after a semester ended.

For unrelated projects, please use the GitLab from the LRZ:  
<https://gitlab.lrz.de/>

Sign in Register

Full name

Username

Email

Email confirmation

Password

Minimum length is 8 characters

Register

[Explore](#) [Help](#) [About GitLab](#)

Database Systems on Modern CPU Architectures - ModernDBs - 2019 > Details

## D Database Systems on Modern CPU Architectures - ModernDBs - 2019

Group | [Request Access](#)

Programming assignments for the lecture [Database Systems on Modern CPU Architectures](#).


**Subgroups and projects** Shared projects Archived projects

Search by name  Last created

**A group is a collection of several projects.**

If you organize your projects under a group, it works like a folder.

You can manage your group member's permissions and access to each project in the group.



← Collapse sidebar

Database Systems on Modern CPU Architectures - ModernDBs - 2019 > Details

Your request for access has been queued for review.

**D Database Systems on Modern CPU Architectures - ModernDBs - 2019** Withdraw Access Request

Group | [Withdraw Access Request](#)


Programming assignments for the lecture [Database Systems on Modern CPU Architectures](#).

**Subgroups and projects** Shared projects Archived projects

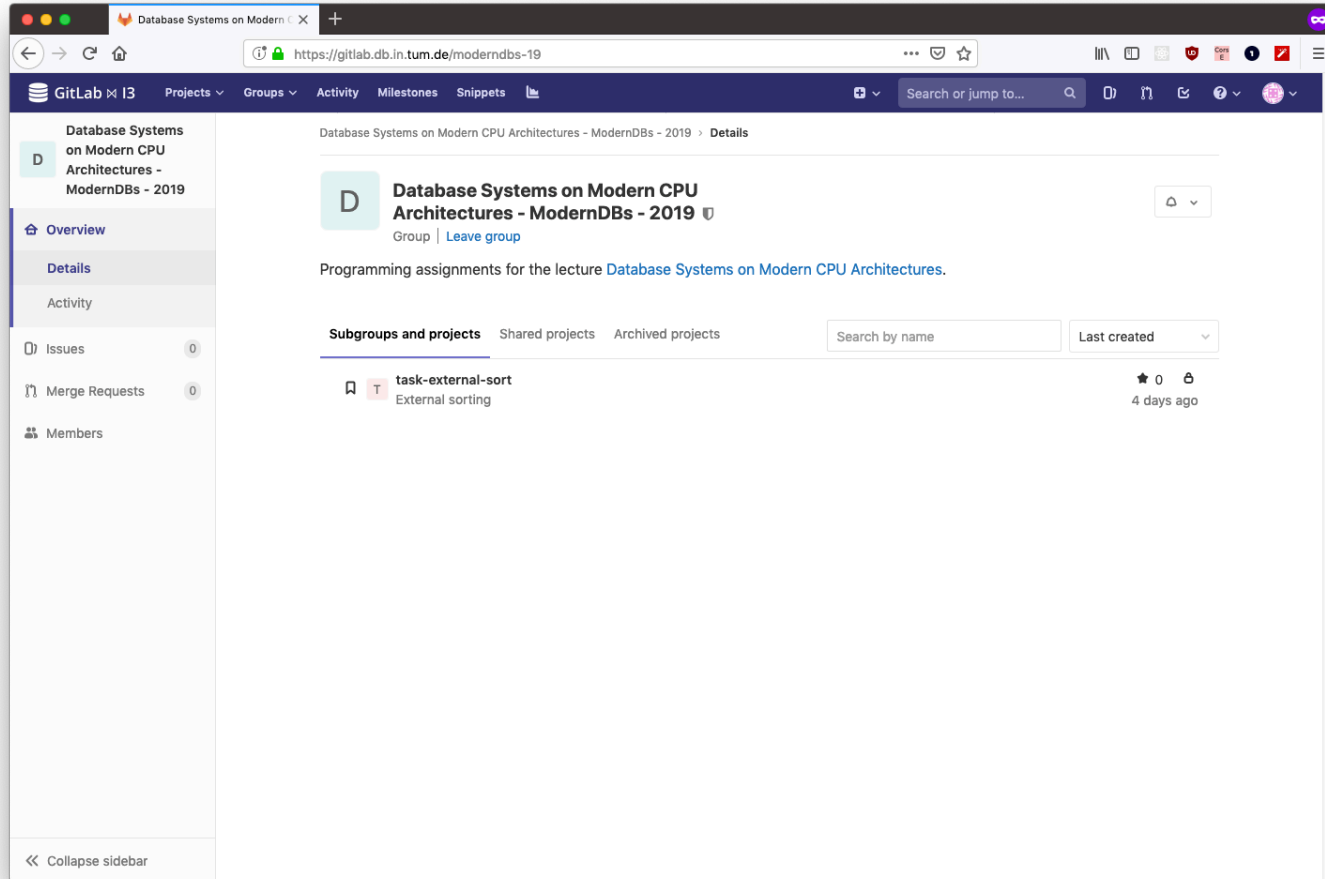
**A group is a collection of several projects.**

If you organize your projects under a group, it works like a folder.

You can manage your group member's permissions and access to each project in the group.



← Collapse sidebar



The screenshot shows a web browser window displaying a GitLab group page. The browser's address bar shows the URL `https://gitlab.db.in.tum.de/moderndbs-19`. The GitLab navigation bar at the top includes the logo, the text 'GitLab 13', and menu items for 'Projects', 'Groups', 'Activity', 'Milestones', and 'Snippets'. A search bar is also present.

The left sidebar contains a breadcrumb trail: 'Database Systems on Modern CPU Architectures - ModernDBs - 2019'. Below this are navigation links for 'Overview', 'Details' (which is highlighted), 'Activity', 'Issues' (with a count of 0), 'Merge Requests' (with a count of 0), and 'Members'. At the bottom of the sidebar is a 'Collapse sidebar' button.

The main content area shows the group details for 'Database Systems on Modern CPU Architectures - ModernDBs - 2019'. It includes a group icon 'D', the group name, and a 'Leave group' link. Below this, there is a text block: 'Programming assignments for the lecture [Database Systems on Modern CPU Architectures](#).' A section titled 'Subgroups and projects' contains a search bar and a dropdown menu set to 'Last created'. A single project is listed: 'task-external-sort' with the description 'External sorting', 0 stars, and a lock icon, created '4 days ago'.

Database Systems on Modern CPU Architectures - ModernDBs - 2019 > task-external-sort > Details

**task-external-sort** Project ID: 1335

Star 0 Fork 0 Clone

MIT License 1 Commit 1 Branch 0 Tags 0 Bytes Files

External sorting

public/task-exte... task-external-sort / +

external sort Philipp Fent authored 4 days ago 41476ea0

[README](#)
[Add CHANGELOG](#)
[Add CONTRIBUTING](#)
[CI/CD configuration](#)

Name	Last commit	Last update
bench	external sort	4 days ago
cmake	external sort	4 days ago
include	external sort	4 days ago
src	external sort	4 days ago
test	external sort	4 days ago
tools	external sort	4 days ago
vendor	external sort	4 days ago

Fork project · Database System X +

https://gitlab.db.in.tum.de/moderndbs-19/task-external-sort/forks/new

GitLab 13 Projects Groups Activity Milestones Snippets

Search or jump to...

**T** task-external-sort

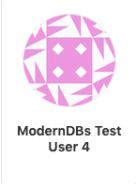
- Project
- Repository
- Issues 0
- Merge Requests 0
- CI / CD
- Operations
- Registry
- Wiki
- Snippets
- Members

Database Systems on Modern CPU Architectures - ModernDBs - 2019 > task-external-sort > Fork project

### Fork project

A fork is a copy of a project. Forking a repository allows you to make changes without affecting the original project.

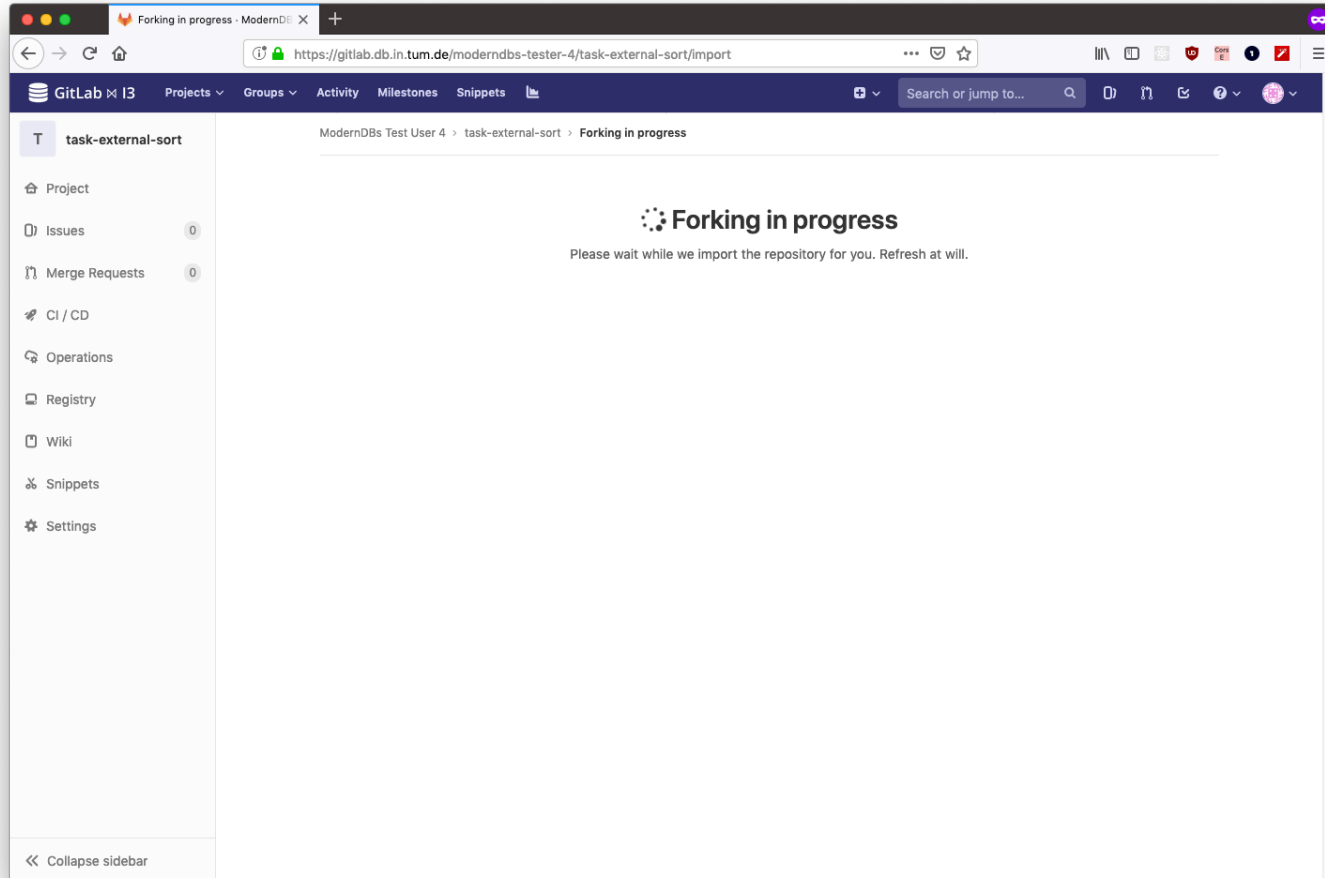
Select a namespace to fork the project



ModernDBs Test User 4

← Collapse sidebar





The screenshot shows a web browser window with the URL `https://gitlab.db.in.tum.de/moderndbs-tester-4/task-external-sort/import`. The page title is "Forking in progress - ModernDB". The main content area displays a large heading "Forking in progress" with a circular loading icon to its left. Below the heading, a message reads: "Please wait while we import the repository for you. Refresh at will." The left sidebar contains a navigation menu with the following items: "task-external-sort" (selected), "Project", "Issues" (0), "Merge Requests" (0), "CI / CD", "Operations", "Registry", "Wiki", "Snippets", and "Settings". At the bottom of the sidebar, there is a "Collapse sidebar" button.

ModernDBs Test User 4 / task-external-sort

https://gitlab.db.in.tum.de/moderndbs-tester-4/task-external-sort

GitLab 13 Projects Groups Activity Milestones Snippets

Search or jump to...

**task-external-sort** You won't be able to pull or push project code via SSH until you add an SSH key to your profile [Don't show again](#) [Remind later](#)

ModernDBs Test User 4 > task-external-sort > Details

The project was successfully forked.

**task-external-sort** Project ID: 1339 🔒 ★ Star 0 🍴 Fork 0 📄 Clone

MIT License 1 Commit 1 Branch 0 Tags 0 Bytes Files

External sorting

Forked from Database Systems on Modern CPU Architectures - ModernDBs - 2019 / task-external-sort

public/task-exter... task-external-sort / +

History Find file Web IDE

**external sort**  
Philipp Fent authored 4 days ago 41476ea0

[README](#)
[Add CHANGELOG](#)
[Add CONTRIBUTING](#)
[Add Kubernetes cluster](#)
[CI/CD configuration](#)

Name	Last commit	Last update
bench	external sort	4 days ago
cmake	external sort	4 days ago
include	external sort	4 days ago
src	external sort	4 days ago

Repository Issues 0 Merge Requests 0 CI / CD Operations Registry Wiki Snippets Settings

⏪ Collapse sidebar

Chair for Database Systems

https://db.in.tum.de/teaching/ss19/moderndbds/?lang=en

Seminar - Modern Database Systems

Oberseminar AG: Forschung im Datenbankbereich

Large-Scale Machine Learning

Systems Programming in C++

Mining Massive Datasets

Oberseminar: Data Mining and Machine Learning

› Winter Term 2018/19

› Summer Term 2018

› Winter Term 2017/18

› Summer Term 2017

› Winter Term 2016/17

› Summer Term 2016

› Winter Term 2015/16

› Sommersemester 2015

› Wintersemester 2014/15

› Sommersemester 2014

› Wintersemester 2013/14

Previous Semesters

› Datenbanksysteme: Eine Einführung (Book)

Theses and Assistant Positions

Contact

Directions

### Prerequisites

- Grundlagen der Informatik
- *Grundlagen Datenbanksysteme (GDB)* (IN0008)

### Organization

- First Lecture: Tuesday, April 23th 2019
- Lecture + Exercises: 2pm – 5pm
- Room: 0001, ZEI-Seminarraum (5414.EG.001)
- [GitLab](#)
- [Mattermost](#)

### Literature

- Theo Härder, Erhard Rahm. *Datenbanksysteme: Konzepte und Techniken der Implementierung*. Springer, Berlin; 2nd ed.
- Hector Garcia-Molina, Jeff Ullman, Jennifer Widom. *Database Systems: The Complete Book*
- D. E. Knuth. *The Art of Computer Programming Volume III*
- Joseph M. Hellerstein, Michael Stonebraker, James Hamilton. *Architecture of a Database System*

### Lecture Slides

- [Introduction](#)
- [Storage](#)
- [Access Paths](#)
- [Set-Oriented Processing](#)
- [Algebraic Operators](#)
- [Code Generation, Parallelism](#)
- [Main-Memory Databases](#)
- [Additional slides on storage](#)

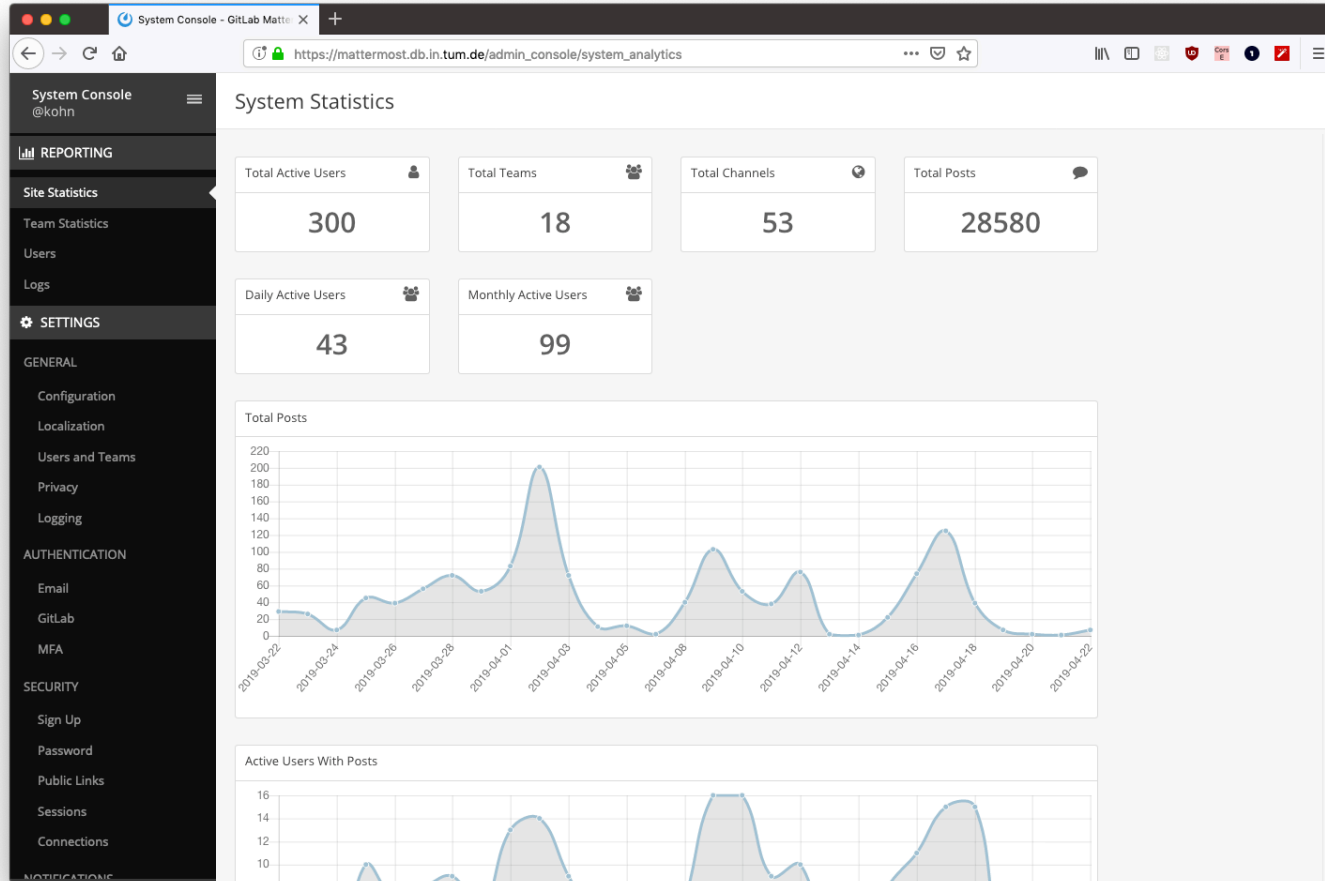
### Programming Assignments

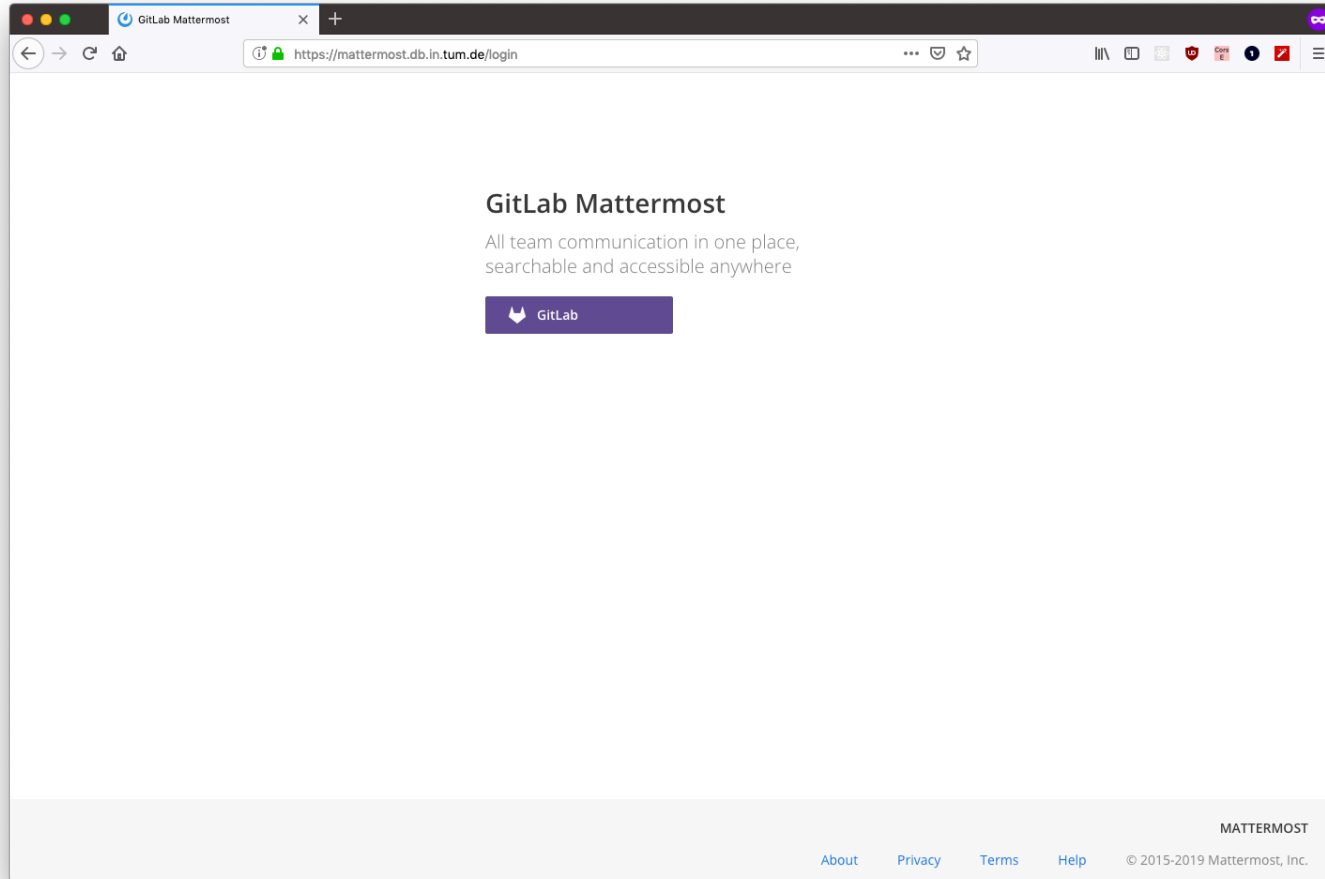
- Programming homework includes implementing the concepts learned in the lecture in C++, previous systems programming experience recommended
- The assignments are managed via our [GitLab](#)
- Please join us on [Mattermost](#)

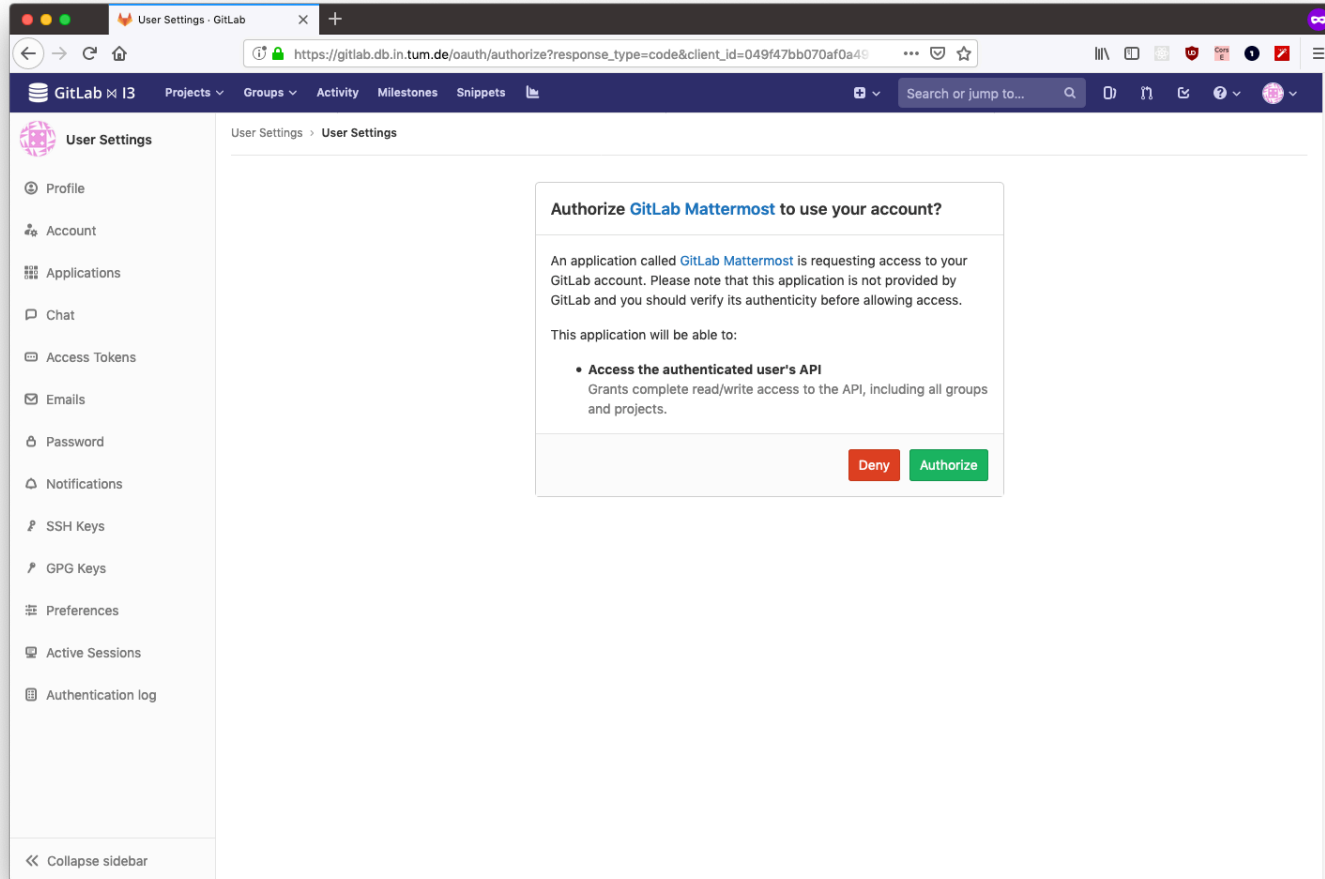
To get the bonus, please include your name (as displayed in TUMonline) and your matriculation number in the README.md file of at least one project in the following format:

```
Name: Lastname, Firstname
Matriculation number: 01xxxxxx
```

© TUM 2009 - 2018 Datenschutzerklärung Impressum







The screenshot shows a web browser window with the URL `https://gitlab.db.in.tum.de/oauth/authorize?response_type=code&client_id=049f47bb070af0a40`. The page title is "User Settings - GitLab". The navigation bar includes "Projects", "Groups", "Activity", "Milestones", and "Snippets". The left sidebar is titled "User Settings" and contains the following menu items: Profile, Account, Applications, Chat, Access Tokens, Emails, Password, Notifications, SSH Keys, GPG Keys, Preferences, Active Sessions, and Authentication log. The main content area is titled "User Settings > User Settings" and displays an authorization prompt:

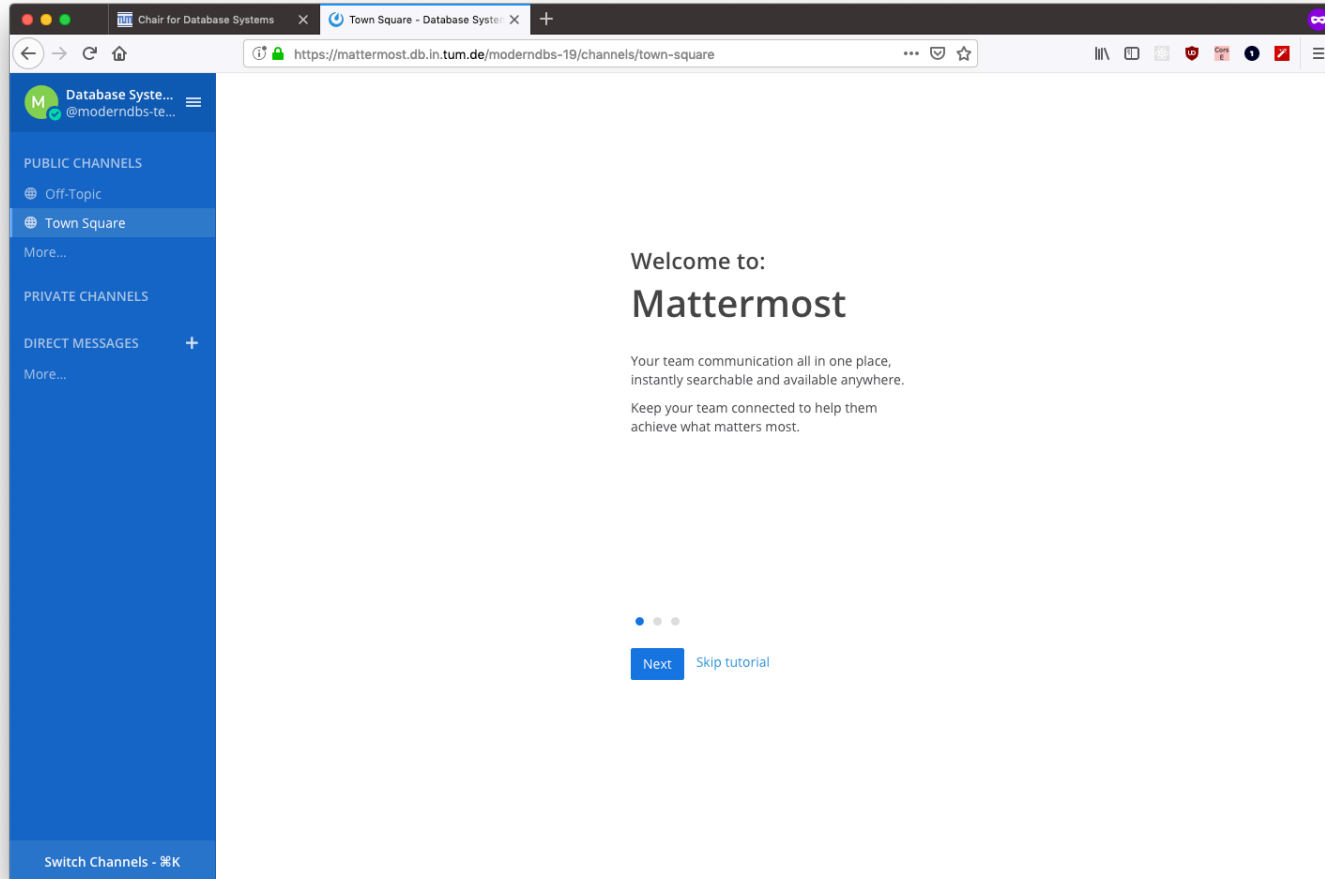
**Authorize GitLab Mattermost to use your account?**

An application called **GitLab Mattermost** is requesting access to your GitLab account. Please note that this application is not provided by GitLab and you should verify its authenticity before allowing access.

This application will be able to:

- **Access the authenticated user's API**  
Grants complete read/write access to the API, including all groups and projects.

At the bottom of the prompt are two buttons: "Deny" (red) and "Authorize" (green).



Chair for Database Systems

Town Square - Database Systems

https://mattermost.db.in.tum.de/modernpbs-19/channels/town-square

Database Systems  
@modernpbs-te...

PUBLIC CHANNELS

- Off-Topic
- Town Square
- More...

PRIVATE CHANNELS

DIRECT MESSAGES +

More...

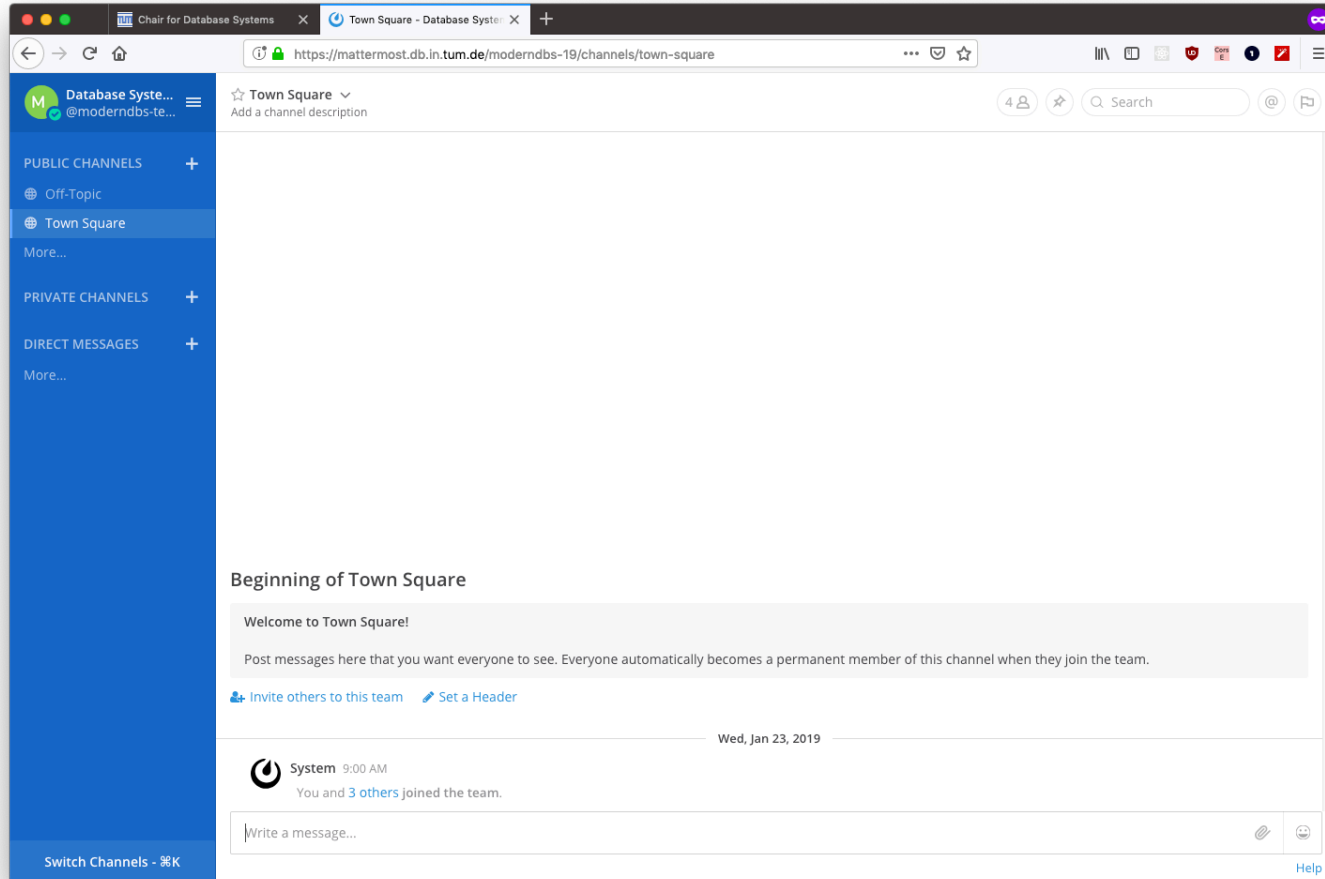
Switch Channels - ⌘K

## Welcome to: Mattermost

Your team communication all in one place,  
instantly searchable and available anywhere.

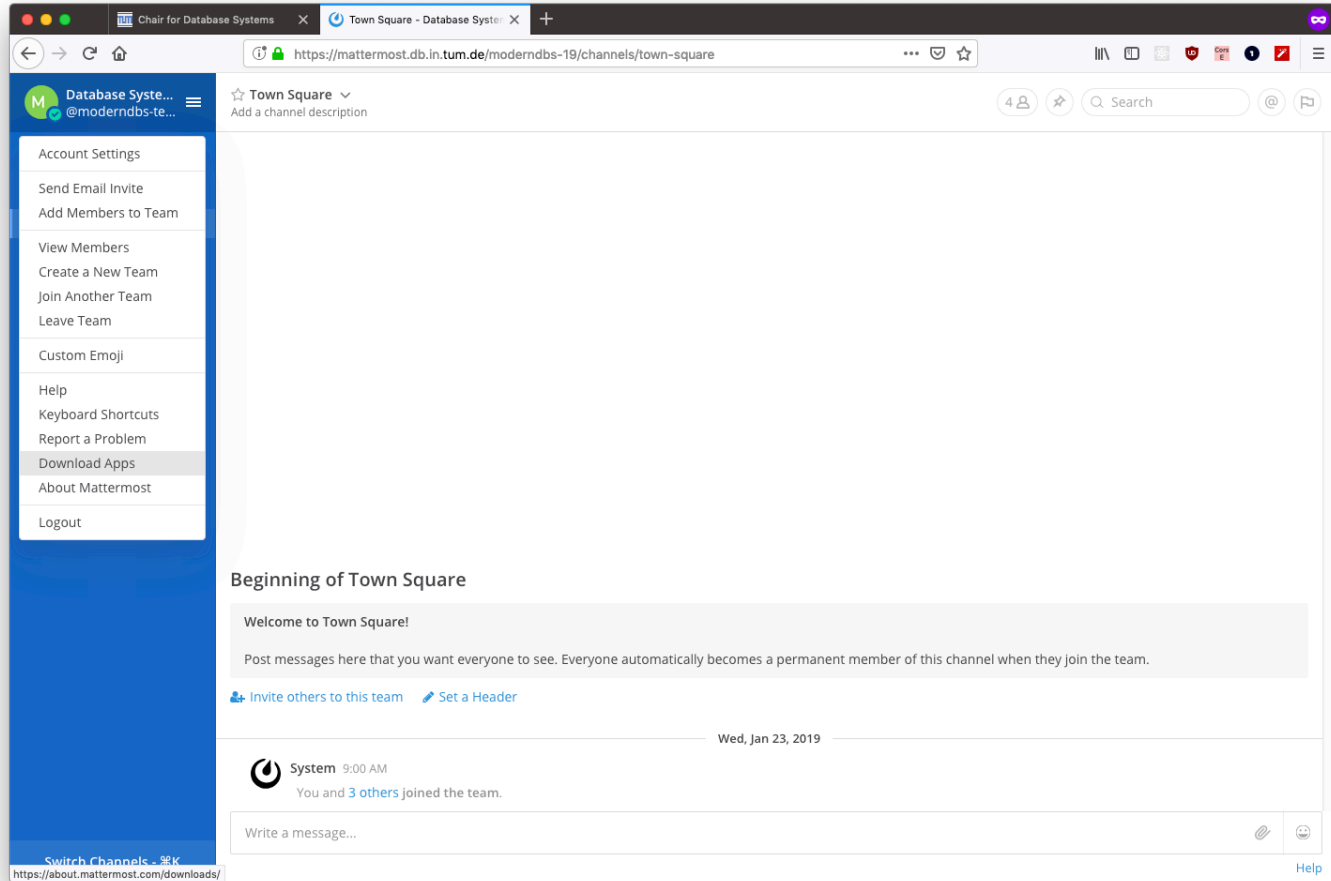
Keep your team connected to help them  
achieve what matters most.

Next Skip tutorial



The screenshot shows a web browser window with two tabs: 'Chair for Database Systems' and 'Town Square - Database System'. The address bar shows the URL `https://mattermost.db.in.tum.de/modernpbs-19/channels/town-square`. The interface is for a Mattermost channel named 'Town Square'. On the left, there is a blue sidebar with navigation options: 'PUBLIC CHANNELS' (with a plus sign), 'Off-Topic', 'Town Square' (selected), 'More...', 'PRIVATE CHANNELS' (with a plus sign), 'DIRECT MESSAGES' (with a plus sign), and 'More...'. At the bottom of the sidebar, it says 'Switch Channels - ⓂK'. The main content area shows the channel header 'Town Square' with a description 'Add a channel description'. Below this is a large white box with the text 'Beginning of Town Square' and 'Welcome to Town Square!'. It includes instructions: 'Post messages here that you want everyone to see. Everyone automatically becomes a permanent member of this channel when they join the team.' There are two links: 'Invite others to this team' and 'Set a Header'. A date separator 'Wed, Jan 23, 2019' is present. A system message from 'System' at 9:00 AM states 'You and 3 others joined the team.' At the bottom, there is a text input field 'Write a message...' with a 'Send' button (paper plane icon) and a 'Help' link.





The screenshot shows a web browser window with two tabs: "Chair for Database Systems" and "Town Square - Database System". The address bar shows the URL <https://mattermost.db.in.tum.de/modernpbs-19/channels/town-square>. The page title is "Town Square" with a dropdown arrow and the text "Add a channel description".

The left sidebar is blue and contains a menu with the following items:

- Account Settings
- Send Email Invite
- Add Members to Team
- View Members
- Create a New Team
- Join Another Team
- Leave Team
- Custom Emoji
- Help
- Keyboard Shortcuts
- Report a Problem
- Download Apps
- About Mattermost
- Logout

The main content area shows the channel header "Town Square" and a message:

**Beginning of Town Square**

Welcome to Town Square!

Post messages here that you want everyone to see. Everyone automatically becomes a permanent member of this channel when they join the team.

[Invite others to this team](#) [Set a Header](#)

Wed, Jan 23, 2019

**System** 9:00 AM  
You and 3 others joined the team.

At the bottom, there is a text input field "Write a message..." and a "Help" link.