

Homework File

by

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This document provides the requirements and design details of the assignments from the Fall 2025 section of SSW590.

Table 1: Document Update History

Date	Updates
10/15/2025	Updates (SS): <ul style="list-style-type: none">Added chapter on How to compile Latex with all the packages, documenting all the steps and solutions to troubleshooting issues encountered.(Chapter 12).
10/14/2025	Updates (GC): <ul style="list-style-type: none">Added chapter on SSL research for overleaf and how to add SSL certificates using docker. (Chapter 11).
10/08/2025	Updates (JB&GC&TU): <ul style="list-style-type: none">Updated passwords (Chapter 2) with new information to allow user access to Bugzilla and course-related servicesUpdated hosts (Chapter 4) with new information to allow user access to Bugzilla and course-related services
10/06/2025	Overleaf on Digital Ocean (SS): <ul style="list-style-type: none">Added Overleaf Chapter (Chapter 10) and detailed steps I took to get Overleaf community edition running on a portDetailed my troubleshooting efforts to fix issues I ran into
10/04/2025	Bugzilla on Digital Ocean (SS): <ul style="list-style-type: none">Added Bugzilla Chapter (Chapter 9) and detailed steps I took to get Bugzilla running on a port
09/29/2025	LaTeX Docker (GC): <ul style="list-style-type: none">Added LaTeX Docker (Chapter 8) with description of writing done and Docker file code changed.
09/29/2025	Website Refactor (GC&JB&TU&SS): <ul style="list-style-type: none">Added section on Website refactoring (Chapter 7) with updated JavaScript code and UML Class Diagram for ColorController class.

Table 1: Document Update History

Date	Updates
09/29/2025	AWS Deployment (SS): <ul style="list-style-type: none"> • Followed instructions to deploy Two button app on AWS, troubleshooting issues and documented steps in detail in (Chapter 7) • Included link for successfully deployed website
09/17/2025	Project Proposal (GC&JB&TU&SS): <ul style="list-style-type: none"> • Added Project Proposal (Chapter 6) with description (section 6.1)
09/10/2025	Linux Commands (GC&JB&TU&SS): <ul style="list-style-type: none"> • Added LinuxCommands (Chapter 5) demonstrating bash command output and solution to Linux ProblemSet
09/09/2025	Introduction and Setup (GC&JB&TU&SS): <ul style="list-style-type: none"> • Updated the course introduction (Chapter 1) and Glossary
09/03/2025	Hosts (GC&JB&TU&SS): <ul style="list-style-type: none"> • Created a Hosts chapter and add a long table with names of hosts you will be configuring for your development environment (Chapter 4).
09/03/2025	Kanban Setup (GC&JB&TU&SS): <ul style="list-style-type: none"> • Added Kanban Setup chapter. (Chapter 3).
09/03/2025	Passwords (GC&JB&TU&SS): <ul style="list-style-type: none"> • Added Passwords chapter (Chapter 2). • Added a table with user/password/server rules.

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Chapter 1

Introduction

– Justin Baumann, Gianna Cerbone, Thomas Ung, Spurthi Setty

SSW-590: DevOps Principles and Practices (Fall 2025) teaches the culture, principles, and tools behind modern DevOps. It covers software lifecycles, configuration management, automated testing, code infrastructure, monitoring, and containerization. It allows students to apply these in AWS with Docker through a hands-on service implementation, tying DevOps practices back to core software engineering life-cycle concepts.

Chapter 2

Passwords

– Justin Baumann, Gianna Cerbone, Thomas Ung, Spurthi Setty

Created a rule that is our own and included hints to what the passwords are while not listing the passwords.

User	root
Password	REDACTED
Server	167.99.54.162
Hint	SSH/root account on DigitalOcean. Password follows Anchor+SiteCode+Policy — long, mixed-case, includes digits and a special character.

User	admin
Password	REDACTED
Server	167.99.54.162:8080
Hint	Service admin user for Bugzilla. Password begins with “admin” and ends with a short numeric pattern.

User	ssetty2@stevens.edu
Password	REDACTED
Server	167.99.54.162:8090
Hint	Overleaf web app login. Hint: friendly English word (capitalized) + 4-digit number + one special character.

Chapter 3

Kanban Setup

– Justin Baumann, Gianna Cerbone, Thomas Ung, Spurthi Setty

3.1 Kanban Setup

This is the order of operations executed to set up a Kanban board in Atlassian JIRA.

1. Go to Atlassian and select Kanban.
2. Name your first project. We named ours SSW590.
3. Select types of work needed. We selected task and story.
4. Track work using status states including: To Do, In Progress, In Review, Done.
5. Select Finish.
6. Share with team members.

Chapter 4

Hosts

– Justin Baumann, Gianna Cerbone, Thomas Ung

Host Name	DigitalOcean Ubuntu Server
IP Address	167.99.54.162
Operating System	Ubuntu 22.04 (64-bit)
Specifications	2 GPUs, 8 GB RAM
Purpose	Main server hosting Docker and Overleaf instance. Used for testing deployments and connecting with GitHub for project credit setup.
Access Method	SSH via <code>ssh root@167.99.54.162</code>
Security Notes	Root password stored separately; SSH keys recommended. Docker containers isolated and managed manually.

Chapter 5

Linux Commands

– Justin Baumann, Gianna Cerbone, Thomas Ung, Spurthi Setty

5.1 Linux Bash Commands

Below is a screenshot of the Linux commands that were run.

```
gcerb@Gianna:~$ mkdir -p ~/lx-test && cd ~/lx-test
gcerb@Gianna:~/lx-test$ printf "alpha\nbeta\nGamma\ngamma\nbeta\n" > words.txt
gcerb@Gianna:~/lx-test$ printf "id,name,dept\n1,Ada,EE\n2,Linus,CS\n3,Grace,EE\n4,Dennis,CS\n" > people.csv
gcerb@Gianna:~/lx-test$ printf "INFO boot ok\nWARN disk low\nERROR fan fail\nINFO shutdown\n" > sys.log
gcerb@Gianna:~/lx-test$ dd if=/dev/zero of=blob.bin bs=1K count=48 status=none
gcerb@Gianna:~/lx-test$ mkdir -p src/lib tmp archive
gcerb@Gianna:~/lx-test$ printf "one two three four\n" > src/file1.txt
gcerb@Gianna:~/lx-test$ printf "two three four five\n" > src/file2.txt
gcerb@Gianna:~/lx-test$ ln -s src/file1.txt link-to-file1
ln: failed to create symbolic link 'link-to-file1': File exists
gcerb@Gianna:~/lx-test$ touch -t 202401020304 old.txt
```

Figure 5.1: Screenshot of Linux Bash commands executed.

5.2 Linux Problem Set

A) Navigation & File Ops

1. `pwd`
2. `ls -A1`
3. `[-d tmp] && cp -v src/file1.txt tmp/`
4. `mv -v --preserve=timestamps old.txt archive/`
5. `touch notes.md` (only if not exists: `test -e notes.md ||`
(continued) `touch notes.md`)
6. `du -sh src`

B) Viewing & Searching

```
7. nl sys.log
8. grep 'ERROR' sys.log
9. tr '[:upper:]' '[:lower:]' < words.txt | tr -c '[:alnum:]' '[\n*]' |
(continued) sort -u | wc -l
10. grep -i '^g' words.txt
11. head -n 2 people.csv
12. tail -n 3 -f sys.log
```

C) Text Processing

```
13. cut -d',' -f2 people.csv | tail -n +2
14. sort -f words.txt | uniq
15. sed -i.bak 's/three/3/g' src/*
16. wc src/*.txt
```

D) Permissions & Ownership

```
17. chmod 700 tmp/
18. chmod -R g+x src/lib
19. stat -c "%a" src/file2.txt
20. chattr +a notes.md
```

E) Links & Find

```
21. test -L link-to-file1 && readlink -f link-to-file1
22. find . -type f -size +40k
23. find tmp/ -type f -mmin -10 -exec ls -lh {} +
```

F) Processes & Job Control

```
24. pstree -p
25. sleep 120 & echo $!
26. pkill -TERM -u "$USER" sleep
27. ps -eo pid,comm,%mem --sort=-%mem | head -n 6
```

G) Archiving & Compression

```
28. tar -czf src.tgz src/
29. tar -tzf src.tgz
30. tar -xzf src.tgz -C tmp src/file2.txt
```

H) Networking & System Info

```
31. ss -ltnp
32. ip route show default
```

33. `uname -srm`

34. `last -n 5`

I) Package & Services (Debian/Ubuntu)

35. `dpkg -s coreutils | grep Version`

36. `apt-cache search ripgrep`

37. `systemctl is-active cron`

J) Bash & Scripting

38. `for f in src/*.txt; do echo "$f: $(cat "$f")"; done`

39. `awk -F',' ' $3=="CS" && NR>1 {print > "cs.txt"}' people.csv`

40. `export X=42; echo $X; unset X`

Chapter 6

Project Proposal

– Justin Baumann, Gianna Cerbone, Thomas Ung, Spurthi Setty

6.1 Project Proposal

6.1.1 Project Title: QuackOps User Interface

The QuackOps Senior Design project has the following mission statement: To develop an autonomous drone delivery system that uses AI for navigation and visual target recognition, and to provide fast, contactless, and efficient on-campus delivery of goods and food.

To aid in the QuackOps Senior Design project, our team will help in developing the graphic user interface with computer vision, AI, and real time updating components from the data gathered by the QuackOps drone. Our contribution will be the web based dashboard that allows users to define delivery parameters, track the drone's location in real time, manage geofences, and monitor fleet health and compliance logs. Our main focus will be the software and user centered interface using DevOps techniques and skills learned in class.

We will be using Jira KANBAN for task tracking and distribution. Github for source control. CI/CD Actions within GitHub is what we are considering for testing as it is implemented directly into GitHub. Our team needs to make sure that the interface is modular and can be integrated with whatever we are using to get the drone data and can also be able to communicate with the drone in some way. For this part - we will need to think about the drone project extensively and keep both projects intertwined.

Chapter 7

AWS Deployment

– Justin Baumann, Gianna Cerbone, Thomas Ung, Spurthi Setty

7.1 Overview

These instructions are for a Windows machine, assuming Docker and AWS CLI are already installed and an AWS account has been created. These are step-by-step instructions to:

1. Configure AWS CLI with IAM Identity Center (SSO).
2. Push a Docker container image to Amazon Elastic Container Registry (ECR).
3. Deploy the container image to AWS App Runner.

7.2 Set up Environment

1. Ensure that Docker Desktop is installed and open the application
2. Open command prompt and navigate to the directory which contains the Dockerfile for the color button app.
3. Verify installation of AWS CLI by running the following in your command prompt

```
aws --version
```

You should get an output something like

```
aws-cli/2.15.54 Python/3.11.8 Windows/10 exe/AMD64
```

7.3 Set up IAM Identity Center

1. Login into you AWS Console
2. Navigate to IAM Identity Center, and click enable
3. On the left hand menu, click on Users and then the Add User button on the top right

4. Enter the specified username, email and Name. I created a user with the following information
 - username: spurthi
 - email: spurthi.setty@gmail.com
 - Display name: Spurthi Setty
5. Click on next - no need to fill out additional information or add the user to a group
6. Select your preferred method of creating a password, I used a one time code, and set up 2FA with my Microsoft authenticator app.
7. Follow instructions to verify your email for your user
8. In your user, click on the tab for AWS Accounts, and then the button called Assign Accounts
9. Click on Create permissions set → predefined → Administrator Access
10. Assign the access for your user and wait for the confirmation message
11. Go back to AWS → IAM Identity Center → Settings. Here you should see a AWS access portal URL. This is your SSO Start URL for the next section. For me it was

`https://d-906629391d.awsapps.com/start`

7.4 Configure AWS CLI with SSO

1. Run the following command

`aws sso login`
2. You will be prompted to enter a series of inputs, here are the values to provide
 - SSO session name: my-sso (or any name)
 - SSO start URL: `https://d-906629391d.awsapps.com/start` (or whatever you AWS Access portal URL is)
 - SSO region: us-east-1
 - SSO registration scopes: (blank)
3. The browser will open the url, and the command prompt will also provide the URL to an SSO authorization page.
4. Enter the username and password on the page for the user you created in the previous section.
5. You will then be asked to input a 6 digit code on your browser from your command prompt, or asked to confirm the code.
6. Approve any permissions and you should get a confirmation message that your request has been approved.
7. You can now close this tab from your browser

8. Confirm you have successfully logged in by running the following command

```
aws sts get-caller-identity
```

9. Ensure that you are logged in as the user you created with administrator access. If you are not, then try the sso command again. An example of the expected output for the previous step is

```
{
  "UserId": "AROAW4ZMTTNJFUQ2BGYAX:spurthi",
  "Account": "474150574930",
  "Arn":
    ↪ "arn:aws:sts::474150574930:assumed-role/AWSReservedSSO_AdministratorAccess_67ee4a
}
```

7.5 Set Environment Variables (Windows CMD)

Run the following commands, adjusting names and values as needed. The `AWS_ACCOUNT_ID` should correspond to the value for account in the previous step. The `CONTAINER_PORT` should correspond to whatever port is specified in your Dockerfile.

```
set AWS_REGION=us-east-1
set AWS_ACCOUNT_ID=474150574930
set ECR_REPO=color-buttons-app
set IMAGE_TAG=v1
set CONTAINER_PORT=3000
set APP_NAME=my-apprunner-app
```

7.6 Create an ECR repository

1. Run the following command to describe and create an ECR repository

```
aws ecr describe-repositories --repository-names %ECR_REPO% --region
↪ %AWS_REGION% >NUL 2>&1 || ^
aws ecr create-repository --repository-name %ECR_REPO%
↪ --image-scanning-configuration scanOnPush=true --region %AWS_REGION%
```

2. The output should look something like this

```
{
  "repository": {
    "repositoryArn":
      ↪ "arn:aws:ecr:us-east-1:474150574930:repository/color-buttons-app",
    "registryId": "474150574930",
    "repositoryName": "color-buttons-app",
    "repositoryUri":
      ↪ "474150574930.dkr.ecr.us-east-1.amazonaws.com/color-buttons-app",
    "createdAt": "2025-09-29T21:43:04.517000-04:00",
    "imageTagMutability": "MUTABLE",
  }
}
```

```

    "imageScanningConfiguration": {
      "scanOnPush": true
    },
    "encryptionConfiguration": {
      "encryptionType": "AES256"
    }
  }
}

```

3. Confirm that the ECR was created by checking it on your AWS console under Elastic Container Registry

7.7 Build, Tag, and Push Docker Image

1. Login to docker by running the following command

```

aws ecr get-login-password --region %AWS_REGION% | docker login
↪ --username AWS --password-stdin
↪ %AWS_ACCOUNT_ID%.dkr.ecr.%AWS_REGION%.amazonaws.com

```

You should get a message that Login succeeded

2. Build your Docker container by running the following command

```
docker build --platform linux/amd64 -t %ECR_REPO%:%IMAGE_TAG% .
```

If successful, your terminal should look something like

```
[+] Building 1.3s (10/10) FINISHED          docker:desktop-linux
```

3. Tag it to your ECR by running the following command

```

docker tag %ECR_REPO%:%IMAGE_TAG%
↪ %AWS_ACCOUNT_ID%.dkr.ecr.%AWS_REGION%.amazonaws.com/%ECR_REPO%:%IMAGE_TAG%

```

4. Push your docker container by running the following command

```

docker push
↪ %AWS_ACCOUNT_ID%.dkr.ecr.%AWS_REGION%.amazonaws.com/%ECR_REPO%:%IMAGE_TAG%

```

If successful, you should see these Images populate in your AWS console within this ECR

5. Verify that the image is pushed by running the following command

```

aws ecr describe-images --repository-name %ECR_REPO% --region
↪ %AWS_REGION% --query "imageDetails[0].imageTags"

```

The output should look like this, with whatever you specified the image tag as:

```

[
  [
    "v1"
  ]
]

```

7.8 Create App Runner ECR Access Role

1. Create the role:

```
aws iam create-role --role-name AppRunnerECRAccessRole
↪ --assume-role-policy-document
↪ "{ \"Version\": \"2012-10-17\", \"Statement\": [{ \"Effect\": \"Allow\", \"Principal\": { \"Service\": \"apprunner.amazonaws.com\" }, \"Action\": \"iam:PassRole\" } ] }
```

2. Attach the policy:

```
aws iam attach-role-policy --role-name AppRunnerECRAccessRole --policy-arn
↪ arn:aws:iam::aws:policy/service-role/AWSAppRunnerServicePolicyForECRAccess
```

3. Save the role ARN in an environment variable:

```
set
↪ ACCESS_ROLE_ARN=arn:aws:iam::%AWS_ACCOUNT_ID%:role/AppRunnerECRAccessRole
```

7.9 Deploy with App Runner

1. Create the App Runner service:

```
aws apprunner create-service ^
--service-name %APP_NAME% ^
--region %AWS_REGION% --profile default ^
--source-configuration
↪ "{ \"AuthenticationConfiguration\": { \"AccessRoleArn\": \"%ACCESS_ROLE_ARN%\" }, \"ImageRepository\": { \"RepositoryUri\": \"%ECR_REPO_URI%\" } }" ^
--instance-configuration "{ \"Cpu\": \"1 vCPU\", \"Memory\": \"2 GB\" }"
```

7.10 Verify Service and Get URL

1. Check the service status and retrieve the URL:

```
aws apprunner list-services --region %AWS_REGION% --profile default ^
--query
↪ "ServiceSummaryList[?ServiceName=='%APP_NAME%'].[ServiceArn,Status,ServiceUrl]" ^
--output table
```

2. You can also get the URL by going to AWS App Runner in your console, and clicking the url in the default domain. Here is the App Runner service URL for when I set it up:

<https://8fjyjsrizv.us-east-1.awsapprunner.com/>

You can also access it here: <https://8fjyjsrizv.us-east-1.awsapprunner.com/>

7.11 Website Refactor

To improve maintainability and follow object-oriented design principles, we refactored the JavaScript for the two-buttons application into a class-based design. The `ColorController` class encapsulates all button logic.

7.11.1 Updated JavaScript Code

```
class ColorController {
  constructor(blueBtnId, redBtnId) {
    this.blueBtn = document.getElementById(blueBtnId);
    this.redBtn = document.getElementById(redBtnId);
    this.attachEvents();
  }

  attachEvents() {
    this.blueBtn.addEventListener('click', () => this.setBlue());
    this.redBtn.addEventListener('click', () => this.setRed());
  }

  setBlue() {
    document.body.style.backgroundColor = 'blue';
  }

  setRed() {
    document.body.style.backgroundColor = 'red';
  }
}

document.addEventListener('DOMContentLoaded', () => {
  new ColorController('blueBtn', 'redBtn');
});
```

7.11.2 UML Class Diagram

The UML diagram in Figure 7.1 illustrates the structure of the `ColorController` class.

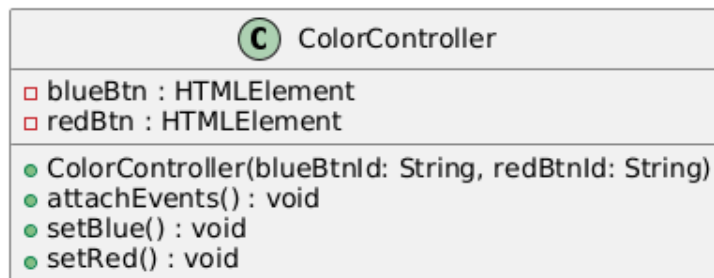


Figure 7.1: UML Class Diagram for the ColorController class

Chapter 8

LaTeX Docker

– Justin Baumann, Gianna Cerbone, Thomas Ung, Spurthi Setty

8.1 Overview

This chapter demonstrates building a Docker container that compiles LaTeX documents with TeX Live, similar to how Overleaf runs builds.

8.2 Dockerfile

```
FROM ubuntu:22.04
RUN apt-get update && apt-get install -y \
    texlive-latex-recommended texlive-latex-extra \
    texlive-fonts-recommended latexmk python3-pip \
    && rm -rf /var/lib/apt/lists/*
RUN pip install pygments
WORKDIR /work
ENTRYPOINT
→ ["latexmk", "-pdf", "-interaction=nonstopmode", "-halt-on-error", "-shell-escape"]
```

8.3 Build and Run

```
# build the image
docker build -t latex-texlive .

# run to compile example.tex into a PDF
docker run --rm -v %cd%:/work latex-texlive example.tex
```

Chapter 9

Bugzilla

– Spurthi Setty

9.1 Setting Up Bugzilla in Docker on DigitalOcean

This section documents the detailed procedure for setting up Bugzilla using Docker on a DigitalOcean Ubuntu 22.04 Droplet. The setup uses Docker Compose with two services: a MariaDB database and an Apache-based Bugzilla application container.

9.1.1 Environment Setup

1. **Create the Droplet:** - OS: Ubuntu 22.04 LTS - Size: 2 vCPUs, 4 GB RAM (recommended minimum)
- Note the public IP address (e.g., 167.99.54.162).

2. **Update and Install Docker:**

```
sudo apt update && sudo apt upgrade -y
sudo apt install docker.io docker-compose -y
sudo systemctl enable docker
sudo systemctl start docker
docker --version
docker compose version
```

3. **Verify Docker Installation:**

```
docker --version
docker compose version
```

9.1.2 Deploying Bugzilla via Docker Compose

1. **Create Directory Structure:**

```
mkdir -p /opt/bugzilla
cd /opt/bugzilla
```

2. **Create the Docker Compose File:**

```
version: '3'
services:
  db:
    image: mariadb:10.6
    restart: always
    environment:
      MYSQL_ROOT_PASSWORD: root
      MYSQL_DATABASE: bugzilla
      MYSQL_USER: bugs
      MYSQL_PASSWORD: bugs
    volumes:
      - bugzilla_db_data:/var/lib/mysql

  bugzilla:
    image: bugzilla/bugzilla-dev:latest
    restart: always
    ports:
      - "8080:80"
    depends_on:
      - db
    volumes:
      - bugzilla_data:/var/www/html/bugzilla

volumes:
  bugzilla_db_data:
  bugzilla_data:
```

3. Start the Containers:

```
docker compose up -d
docker ps
```

The Bugzilla service listens on port 8080 on the host, mapped to port 80 inside the container.

9.1.3 Configuring Bugzilla Inside the Container

1. Access the Running Container:

```
docker exec -it bugzilla-bugzilla-1 bash
```

2. Create and Configure the Database:

```
mysql -uroot -e "CREATE DATABASE IF NOT EXISTS bugzilla CHARACTER SET
↪ utf8mb4;"
mysql -uroot -e "CREATE USER 'bugs'@'localhost' IDENTIFIED BY 'bugs';"
mysql -uroot -e "GRANT ALL PRIVILEGES ON bugzilla.* TO 'bugs'@'localhost';
↪ FLUSH PRIVILEGES;"
```

3. Set Up Bugzilla Configuration:

```
cd /var/www/html/bugzilla
cat > localconfig <<'CONF'
$db_driver = 'mysql';
$db_host   = 'localhost';
$db_name   = 'bugzilla';
$db_user   = 'bugs';
$db_pass   = 'bugs';
$webservergroup = 'apache';
$urlbase = 'http://167.99.54.162:8080/bugzilla/';
CONF
chown -R apache:apache .
```

4. Initialize Bugzilla:

```
perl checksetup.pl
```

The script validates Perl modules, initializes the database schema, and generates the `params.json` configuration file.

9.1.4 Resolving Apache Configuration and Permissions

1. Fix Permissions:

```
chown -R apache:apache /var/www/html/bugzilla
chmod -R 755 /var/www/html/bugzilla
```

2. Replace the Default Apache Configuration:

```
rm -f /etc/httpd/conf.d/welcome.conf
cat >/etc/httpd/conf.d/bugzilla-root.conf <<'CONF'
ServerName 127.0.0.1
DocumentRoot "/var/www/html/bugzilla"

<Directory "/var/www/html/bugzilla">
    Options +ExecCGI +FollowSymLinks
    AllowOverride All
    Require all granted
    AddHandler cgi-script .cgi
</Directory>

DirectoryIndex index.cgi
CONF
```

3. Restart Apache (no systemd available):

```
pkill -f httpd || true
/usr/sbin/httpd -DFOREGROUND &
```

9.1.5 Testing and Verification

1. Verify Local Connectivity:

```
curl -I http://127.0.0.1/bugzilla/
```

Expect either HTTP/1.1 200 OK or 302 Found (index.cgi).

2. Verify Host Mapping:

```
curl -I http://127.0.0.1:8080/
```

3. Access the Web Interface:

```
http://167.99.54.162:8080/
```

Log in with:

```
admin@example.com / admin123
```

9.1.6 Troubleshooting Notes

- **403 Forbidden Error:** Fixed by defining explicit `Require all granted` and enabling CGI execution in Apache config.
- **500 Internal Server Error:** Caused by missing `params.json`; running `perl checksetup.pl` regenerates it.
- **Apache Startup Errors:** If logs are missing, recreate them:

```
mkdir -p /var/log/httpd  
touch /var/log/httpd/error_log /var/log/httpd/access_log  
chown -R apache:apache /var/log/httpd
```

- **Testing Without Browser:** Use:

```
curl -I http://127.0.0.1/bugzilla/
```

9.1.7 Final Result

Bugzilla was successfully deployed and is accessible at:

<http://167.99.54.162:8080/>

This configuration persists through container restarts, with all data stored in Docker volumes defined in the Compose file.

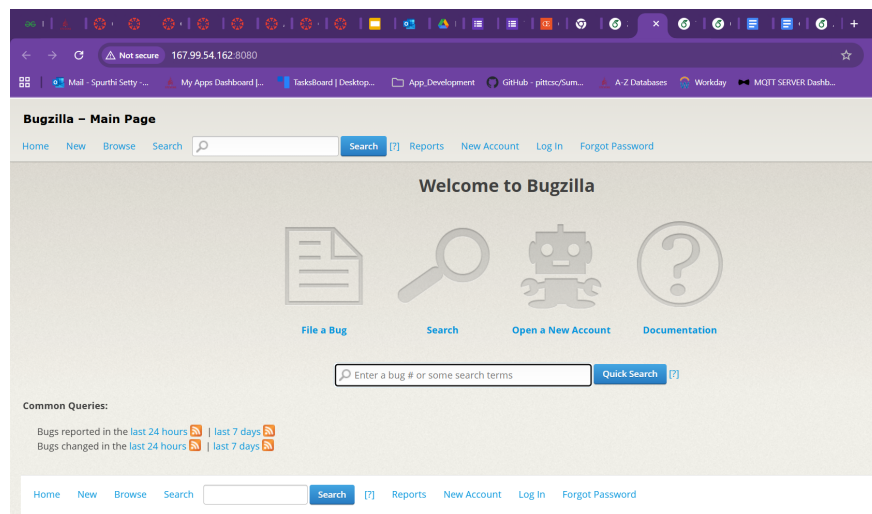


Figure 9.1: Screenshot of bugzilla working at <http://167.99.54.162:8080/>

Chapter 10

Overleaf

– Spurthi Setty

10.1 How to compile this chapter

Add to your preamble and compile with shell-escape to enable minted:

```
\usepackage{xcolor}
\usepackage{minted}
\setminted{fontsize=\small,breaklines=true}
% Compile with: latexmk -pdf -shell-escape main.tex
```

10.2 Context

We deployed **Overleaf Community Edition** on an existing DigitalOcean droplet that already served another site on <http://167.99.54.162:8080>. To avoid port conflicts, Overleaf was mapped to port 8090.

10.3 Prerequisites (Ubuntu 22.04/24.04)

```
# optional: install Docker Engine + compose plugin (if not present)
apt-get update -y
apt-get install -y ca-certificates curl gnupg lsb-release
install -m 0755 -d /etc/apt/keyrings
curl -fsSL https://download.docker.com/linux/ubuntu/gpg | gpg --dearmor -o /etc/apt/keyrings/d
chmod a+r /etc/apt/keyrings/docker.gpg
echo "deb [arch=$(dpkg --print-architecture) signed-by=/etc/apt/keyrings/docker.gpg] \
https://download.docker.com/linux/ubuntu $(lsb_release -cs) stable" \
| tee /etc/apt/sources.list.d/docker.list > /dev/null
apt-get update -y
apt-get install -y docker-ce docker-ce-cli containerd.io docker-buildx-plugin docker-compose-p
systemctl enable --now docker

# sanity
docker --version
```

```
docker compose version
```

10.4 Baseline deployment

10.4.1 Create working directory

```
mkdir -p /opt/overleaf  
cd /opt/overleaf
```

10.4.2 Open firewall

```
ufw allow OpenSSH  
ufw allow 8090/tcp  
ufw --force enable  
ufw status
```

10.4.3 Initial docker-compose.yml

We used sharelatex/sharelatex (the Overleaf CE image) with MongoDB and Redis. Note the **Overleaf-branded** env vars and the **new data path** /var/lib/overleaf.

```
services:  
  mongo:  
    image: mongo:6.0  
    restart: unless-stopped  
    volumes:  
      - overleaf_mongo_data:/data/db  
  
  redis:  
    image: redis:7  
    restart: unless-stopped  
    command: ["redis-server", "--appendonly", "yes"]  
    volumes:  
      - overleaf_redis_data:/data  
  
  sharelatex:  
    image: sharelatex/sharelatex:latest  
    container_name: sharelatex  
    restart: unless-stopped  
    depends_on:  
      - mongo  
      - redis  
    environment:  
      OVERLEAF_SITE_URL: "http://167.99.54.162:8090"  
      OVERLEAF_MONGO_URL: "mongodb://mongo:27017/sharelatex"  
      OVERLEAF_REDIS_HOST: "redis"  
    ports:
```



```

- "8090:80"
volumes:
- overleaf_app_data:/var/lib/overleaf

volumes:
  overleaf_mongo_data:
  overleaf_redis_data:
  overleaf_app_data:

```

10.4.4 Start the stack

```

cd /opt/overleaf
docker compose pull
docker compose up -d
docker compose ps

```

10.5 Issues encountered and exact fixes

Below are the exact errors we hit and the precise commands that resolved them on this host.

10.5.1 (A) Wrong image / registry hiccup

Symptom: Pull errors for ghcr.io/overleaf/overleaf (access denied/registry auth).

Fix: Switch to Docker Hub image sharelatex/sharelatex.

```

# if your compose ever referenced ghcr, replace it with Docker Hub image
sed -i 's#ghcr.io/overleaf/overleaf:latest#sharelatex/sharelatex:latest#' docker-compose.yml

```

10.5.2 (B) Legacy bind mount path: /var/lib/sharelatex

Symptom: Container logs show rebranding guard refusing to start due to old path.

Fix: Use the new path /var/lib/overleaf in the bind mount.

```

sed -i 's#/var/lib/sharelatex#/var/lib/overleaf#g' docker-compose.yml

```

10.5.3 (C) Legacy env var names: SHARELATEX_*

Symptom: 000_check_for_old_env_vars_5.sh refuses startup, listing SHARELATEX_MONGO_URL, SHARELATEX_REDIS_HOST, SHARELATEX_SITE_URL.

Fix: Rename to the Overleaf-branded variants.

```

sed -i -E 's/SHARELATEX_MONGO_URL/OVERLEAF_MONGO_URL/g; \
s/SHARELATEX_REDIS_HOST/OVERLEAF_REDIS_HOST/g; \
s/SHARELATEX_SITE_URL/OVERLEAF_SITE_URL/g' docker-compose.yml

```

```

# if you had a .env with legacy keys, update it too
sed -i 's/SHARELATEX_SITE_URL/OVERLEAF_SITE_URL/' .env 2>/dev/null || true

```

10.5.4 (D) Connection reset / app crash loop due to Mongo transactions

Symptom: Logs show: Transaction numbers are only allowed on a replica set member or mongos.

Cause: Overleaf 5+ expects MongoDB with transactions support (i.e., a replica set), even for a single node.

Fix: Run Mongo as a single-node replica set and update the connection string.

Step D1: Add override to enable replica set and connection string

```
cat > docker-compose.override.yml <<'YML'
services:
  mongo:
    command: ["mongod","--replSet","rs0","--bind_ip_all"]
  sharelatex:
    environment:
      OVERLEAF_MONGO_URL: "mongodb://mongo:27017/sharelatex?replicaSet=rs0"
YML
```

Step D2: Recreate the stack

```
docker compose down
docker compose up -d
```

Step D3: Initialize the replica set (one-time)

```
# try mongosh (6.x); fallback to legacy mongo shell if needed
docker exec overleaf-mongo-1 bash -lc \
  'mongosh --quiet --eval "rs.initiate({_id:\"rs0\", members:[{_id:0, host:\"mongo:27017\"}]})' \
  || docker exec overleaf-mongo-1 bash -lc \
  'mongo --quiet --eval "rs.initiate({_id:\"rs0\", members:[{_id:0, host:\"mongo:27017\"}]})'
```

Step D4: Verify replica set is healthy

```
docker exec overleaf-mongo-1 bash -lc 'mongosh --quiet --eval "rs.status().ok"' \
  || docker exec overleaf-mongo-1 bash -lc 'mongo --quiet --eval "rs.status().ok"'
# expect: 1
```

10.5.5 (E) Optional: tune kernel warning from Redis

```
# not required for functionality, but silences Redis warning
sysctl -w vm.overcommit_memory=1
echo 'vm.overcommit_memory=1' >> /etc/sysctl.conf
```

10.6 Verification commands we used

```
# container status
cd /opt/overleaf
docker compose ps
```

```
# app health (host)
curl -I http://localhost:8090
curl -sS http://localhost:8090/health_check || true

# service status inside the container (runit + port 80)
docker exec -it sharelatex bash -lc 'sv status nginx; sv status sharelatex; ss -tlnp | grep :8090'

# logs (when diagnosing)
docker compose logs --tail=200 sharelatex
```

10.7 Accessing the site

First-time admin setup (*Launchpad*): <http://167.99.54.162:8090/launchpad> After creating the admin, use the main URL: <http://167.99.54.162:8090>

10.8 Maintenance cheatsheet

```
# restart
cd /opt/overleaf
docker compose down
docker compose up -d

# upgrade images (occasional)
docker compose pull && docker compose up -d

# view logs
docker compose logs -f sharelatex

# backups of volumes (quick tar via busybox)
mkdir -p /opt/overleaf/backups
cd /opt/overleaf
for v in overleaf_app_data overleaf_mongo_data overleaf_redis_data; do
  docker run --rm -v ${v}:/data -v $(pwd)/backups:/backup busybox \
    tar czf /backup/${v}_$(date +%F).tar.gz /data
done
```

10.9 Final status

After applying fixes (B) path update, (C) env var rename to `OVERLEAF_*`, and (D) enabling a single-node Mongo replica set, Overleaf CE started cleanly and became reachable at <http://167.99.54.162:8090>. The `/launchpad` route was used to create the initial admin account.

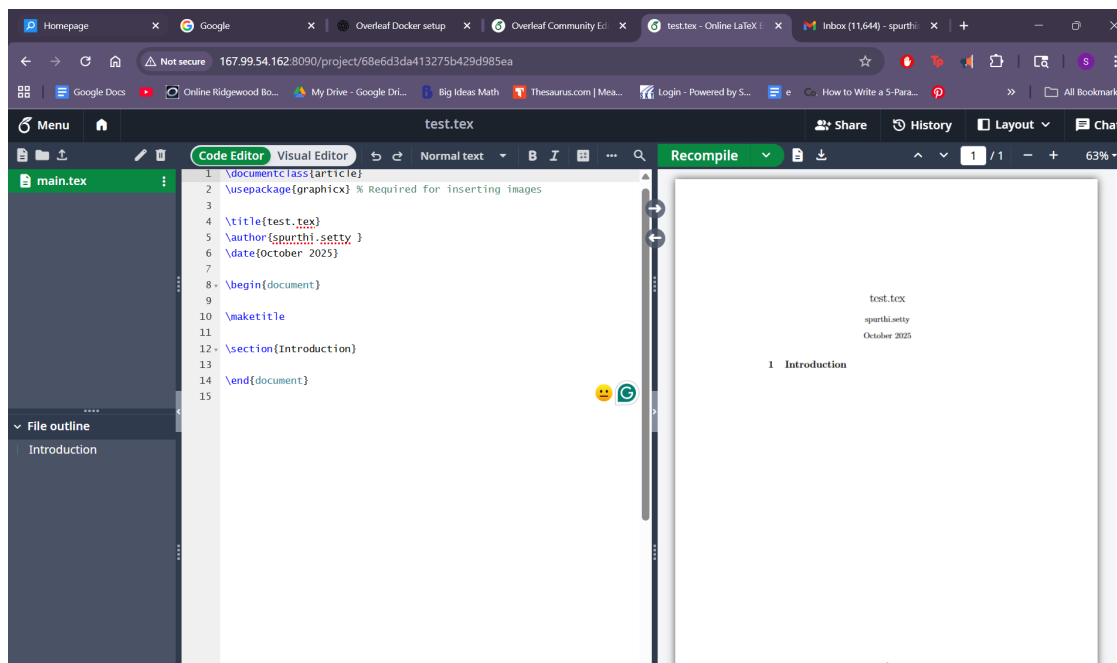


Figure 10.1: Screenshot of Compiled File at <http://167.99.54.162:8090>

10.10 Creating a New User Account

To create a new account manually from the administrator dashboard, follow these steps:

1. **Login as an administrator.** Open your Overleaf instance and sign in with your admin credentials.
2. **Open the Manage Users panel.** Click on your profile icon at the top right corner and select **Manage Users**.
3. **Register the new user.** In the user management form, enter the email address of the new user and click **Register**.
4. **Access the Set Password page.** Copy the Set Password URL generated for that user and paste it into your browser.
5. **Set a new password.** The page will prompt you to create a new password for the account. Enter the desired password and confirm it.
6. **Activate and log in.** After setting the password, click **Activate**. The user can now log in using the new credentials.

Chapter 11

SSL Research

– *Gianna Cerbone*

11.1 Overview

This chapter summarizes the research conducted on implementing SSL (Secure Sockets Layer) for Overleaf containers and images. The focus is on how to add SSL certificates, manage them using free services such as Let's Encrypt, and automate their renewal process. Let's Encrypt provides free certificates that expire every 90 days, making automated renewal a critical part of the configuration.

11.2 Architecture Considerations

In most deployments, Overleaf is hosted using Docker containers or the Overleaf Toolkit. The recommended approach is to run Overleaf behind a reverse proxy (commonly Nginx) that handles TLS termination. This means HTTPS traffic is decrypted at the proxy, which then forwards plain HTTP requests to the Overleaf application container.

Embedding SSL certificate management directly inside the Overleaf container is possible but discouraged. It adds unnecessary complexity and makes updates harder. Managing certificates at the proxy layer is simpler, more secure, and allows reuse of certificates for multiple services.

11.3 Using the Overleaf Toolkit with TLS Proxy Mode

For those using the Overleaf Toolkit, TLS support is already integrated. You can enable it by initializing the toolkit with:

```
bin/init --tls
```

This generates an Nginx configuration and placeholder certificates located in:

```
config/nginx/certs/overleaf_certificate.pem  
config/nginx/certs/overleaf_key.pem
```

Replace these placeholder files with your actual SSL certificate and key. The following settings can be configured in `config/overleaf.rc`:

```
NGINX_ENABLED=true
NGINX_CONFIG_PATH=config/nginx/nginx.conf
NGINX_HTTP_PORT=80
TLS_CERTIFICATE_PATH=config/nginx/certs/overleaf_certificate.pem
TLS_PRIVATE_KEY_PATH=config/nginx/certs/overleaf_key.pem
TLS_PORT=443
```

After modifying these settings, re-run:

```
bin/up
```

to recreate and restart the containers.

If an external proxy handles SSL termination, add the proxy IP address to:

```
OVERLEAF_TRUSTED_PROXY_IPS
```

so that Overleaf correctly interprets forwarded HTTPS requests.

11.4 Using an External Reverse Proxy

Another common approach is to use an external reverse proxy, such as Nginx or Traefik, to manage SSL and forward traffic to the Overleaf container. This approach simplifies certificate management and keeps the Overleaf image lightweight.

11.4.1 Advantages

- TLS configuration is isolated from the Overleaf container.
- Certificates can be easily renewed and reused for other services.
- Simplifies upgrades to Overleaf since SSL is handled separately.

11.4.2 Example Nginx Configuration

```
server {
    listen 80;
    server_name overleaf.example.com;

    location /.well-known/acme-challenge/ {
        root /var/www/acme-challenges;
    }

    location / {
        proxy_pass http://127.0.0.1:8000;
        proxy_http_version 1.1;
        proxy_set_header Upgrade $http_upgrade;
        proxy_set_header Connection "upgrade";
        proxy_set_header Host $host;
    }
}
```

```
        proxy_set_header X-Forwarded-Proto $scheme;
        proxy_set_header X-Real-IP $remote_addr;
    }
}

server {
    listen 443 ssl;
    server_name overleaf.example.com;

    ssl_certificate /etc/letsencrypt/live/overleaf.example.com/fullchain.pem;
    ssl_certificate_key /etc/letsencrypt/live/overleaf.example.com/privkey.pem;

    location / {
        proxy_pass http://127.0.0.1:8000;
        proxy_http_version 1.1;
        proxy_set_header Upgrade $http_upgrade;
        proxy_set_header Connection "upgrade";
        proxy_set_header Host $host;
        proxy_set_header X-Forwarded-Proto $scheme;
        proxy_set_header X-Real-IP $remote_addr;
    }
}
```

11.5 Using Let's Encrypt for Free SSL Certificates

Let's Encrypt offers free SSL certificates that are valid for 90 days. To generate and install one using `certbot`, run the following commands:

```
sudo apt install certbot python3-certbot-nginx
sudo certbot certonly --webroot -w /var/www/acme-challenges \
    -d overleaf.example.com
```

After the certificate is installed, configure automatic renewal:

```
sudo certbot renew --post-hook "systemctl reload nginx"
```

The renewal command can be added to a cron job or systemd timer to run periodically.

11.6 Renewal and Automation

Because Let's Encrypt certificates expire every three months, it is essential to automate the renewal process. Recommended best practices include:

- Schedule automatic renewals using `certbot renew`.
- Reload or restart the Nginx proxy after renewal to apply the new certificate.
- Test renewal scripts regularly using the `--dry-run` flag.
- Ensure that HTTP port 80 is available for ACME challenge responses.

11.7 Installing Certificates Inside the Container (Not Recommended)

While possible, installing and managing SSL certificates inside the Overleaf container is not recommended. This approach introduces additional maintenance complexity, such as updating trust stores, managing permissions, and triggering restarts on renewal.

If necessary, certificates can be mounted as Docker volumes and renewed via a sidecar container running `certbot`. The containerized Overleaf application would then reload the updated certificates periodically.

11.8 Summary and Recommendations

- Use a reverse proxy such as Nginx to handle SSL termination.
- Use Let's Encrypt for free, automated SSL certificates that renew every 90 days.
- In the Overleaf Toolkit, enable TLS with `bin/init --tls` and replace the default certificates.
- If using an external proxy, ensure websockets and headers (`Upgrade`, `X-Forwarded-Proto`) are properly forwarded.
- Avoid embedding certificate management logic inside the Overleaf application container.

By following these practices, Overleaf can be securely deployed with HTTPS, using automated and renewable SSL certificates, ensuring both encrypted communication and reduced administrative overhead.

Chapter 12

Configuring Overleaf with Full LaTeX Package Support

– *Spurthi Setty*

12.1 Introduction

In order to compile LaTeX documents with advanced packages such as `tikz`, `pgfplots`, and `minted`, it is necessary to configure Overleaf’s self-hosted Docker environment with the full T_EX Live distribution. This chapter outlines the complete setup process, including Docker configuration, LaTeX package installation, troubleshooting missing packages, and environment adjustments to ensure Overleaf compiles documents without errors.

12.2 Setting Up Overleaf with Docker

We used the official `sharelatex/sharelatex` Docker image as a base and extended it with the full T_EX Live distribution to ensure comprehensive package support.

12.2.1 Directory Structure

All files were placed under:

`/opt/overleaf/`

Key files include:

- `Dockerfile` – to install `texlive-full`
- `docker-compose.yml` – to define Overleaf, MongoDB, and Redis services

12.2.2 Dockerfile

The Dockerfile extends the base image and installs T_EX Live:

```
FROM sharelatex/sharelatex:latest

USER root

RUN apt-get update && \
    apt-get install -y texlive-full && \
    apt-get clean && rm -rf /var/lib/apt/lists/*

ENV TEXMFROOT=/usr/share/texlive
ENV TEXMFVAR=$TEXMFROOT/texmf-var
ENV TEXMFSYSVAR=$TEXMFROOT/texmf-var
ENV TEXMFCONFIG=$TEXMFROOT/texmf-config
ENV TEXMFSYSCONFIG=$TEXMFROOT/texmf-config
ENV TEXMFLOCAL=$TEXMFROOT/texmf-local
ENV TEXMFDIST=$TEXMFROOT/texmf-dist
ENV TEXMFHOME=/root/texmf

RUN mktexlsr
```

12.2.3 docker-compose.yml

The Docker Compose configuration links Overleaf with MongoDB and Redis:

```
services:
  sharelatex:
    image: overleaf-fulltex
    container_name: sharelatex
    restart: unless-stopped
    ports:
      - "8090:80"
    environment:
      OVERLEAF_SITE_URL: "http://<YOUR_SERVER_IP>:8090"
      OVERLEAF_MONGO_URL: "mongodb://mongo/sharelatex"
      OVERLEAF_REDIS_HOST: "redis"
    volumes:
      - overleaf_app_data:/var/lib/overleaf

  mongo:
    image: mongo:6.0
    container_name: overleaf-mongo-1
    restart: unless-stopped
    volumes:
      - overleaf_mongo_data:/data/db
    command: ["mongod", "--replSet", "rs0", "--bind_ip_all"]
```

```
redis:
  image: redis:7
  container_name: overleaf-redis-1
  restart: unless-stopped
  command: ["redis-server", "--appendonly", "yes"]
  volumes:
    - overleaf_redis_data:/data

volumes:
  overleaf_app_data:
  overleaf_mongo_data:
  overleaf_redis_data:
```

12.2.4 Enabling MongoDB Replica Set

Overleaf requires MongoDB to support transactions, which are only available in replica sets. After container startup, we enabled the replica set manually:

```
docker exec -it overleaf-mongo-1 mongosh
> rs.initiate()
```

12.2.5 Building and Starting Containers

After creating the Dockerfile and docker-compose.yml, we built the custom image:

```
cd /opt/overleaf
docker build -t overleaf-fulltex .
```

Then started all services:

```
docker-compose up -d
```

12.2.6 Verifying Initial Package Availability

After building and starting the containers, we confirmed that LaTeX packages such as `tikz`, `pgfplots`, and `psfrag` were available by executing:

```
docker exec -it sharelatex kpsewhich tikz.sty
docker exec -it sharelatex kpsewhich pgfplots.sty
docker exec -it sharelatex kpsewhich psfrag.sty
```

If no path was returned, we updated the environment variables inside the container to point to the correct T_EX Live installation path and rebuilt the file name database with:

```
docker exec -it sharelatex mktexlsr
```

12.3 Troubleshooting Missing LaTeX Packages

After successfully deploying Overleaf with the full T_EX Live distribution, we encountered several missing package errors when attempting to compile a Cornell University thesis template. This section documents the systematic troubleshooting process used to identify and install missing LaTeX packages.

12.3.1 Initial Environment Configuration

Our Overleaf deployment consisted of three Docker containers running on an Ubuntu virtual machine hosted on Digital Ocean:

- `sharelatex` – Overleaf application server (image: `overleaf-fulltex`)
- `overleaf-mongo-1` – MongoDB 6.0 database
- `overleaf-redis-1` – Redis 7 cache server

The containers were accessible via port 8090 on the host machine at `http://167.99.54.162:8090`, running T_EX Live 2025.

12.3.2 Verifying Container Status

Before beginning troubleshooting, we verified that all containers were running properly:

```
docker ps
```

Expected output:

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS
7244bdc99c8a	overleaf-fulltex	"/sbin/my_init"	2 hours ago	Up 2 hours	0.0.0.0:8090->8090
9b8786881b61	redis:7	"docker-entrypoint.sh"	2 hours ago	Up 2 hours	6379/tcp
3f1ee20cf169	mongo:6.0	"docker-entrypoint.sh"	2 hours ago	Up 2 hours	27017/tcp

12.3.3 Sequential Package Installation

Missing Package: `psfrag`

The first compilation error indicated a missing `psfrag.sty` file:

```
! LaTeX Error: File `psfrag.sty' not found.
```

```
Type X to quit or <RETURN> to proceed,
or enter new name. (Default extension: sty)
```

```
Enter file name:
! Emergency stop.
```

We verified whether the package was already installed:

```
docker exec -it sharelatex tlmgr info psfrag
```

The output confirmed the package was installed, but the T_EX filename database needed updating:

```
docker exec -it sharelatex mktexlsr
```

We verified the package file location:

```
docker exec -it sharelatex find /usr/local/texlive -name "psfrag.sty"
```

Result: /usr/local/texlive/2025/texmf-dist/tex/latex/psfrag/psfrag.sty

Finally, we restarted the container:

```
docker restart sharelatex
```

Missing Package: fancyvrb

After resolving the psfrag issue, compilation failed with:

LaTeX Error: File `fancyvrb.sty' not found.

We installed the missing package directly:

```
docker exec -it sharelatex tlmgr install fancyvrb
docker exec -it sharelatex mktexlsr
```

Missing Package: algorithmic

The next compilation attempt failed at line 40:

```
! Emergency stop.
<read *>
```

```
l.40 \usepackage{algorithmic}^^M
```

The algorithmic package is part of the algorithms collection:

```
docker exec -it sharelatex tlmgr install algorithms
docker exec -it sharelatex mktexlsr
```

Missing Package: txfonts

Further compilation revealed a missing font package:

LaTeX Error: File `txfonts.sty' not found.

We attempted to install the font package:

```
docker exec -it sharelatex tlmgr install txfonts helvetic times courier
docker exec -it sharelatex updmap-sys
docker exec -it sharelatex mktexlsr
```

However, after installation, a font error occurred:

```
dftex error: pdflatex (file utmb8a.pfb): cannot open Type 1 font
file for reading
```

==> Fatal error occurred, no output PDF file produced!

The `txfonts` package caused persistent font mapping issues. We resolved this by commenting out the package in the document preamble:

```
% Line 55 in itManual.tex
%\usepackage{txfonts}
```

For documents requiring Times-style fonts, a modern alternative can be used:

```
\usepackage{newtxtext,newtxmath}
```

To use this alternative, install the package first:

```
docker exec -it sharelatex tlmgr install newtx
docker exec -it sharelatex mktexlsr
```

12.3.4 Installing Complete Package Collections

Installing packages individually became inefficient as each compilation attempt revealed a new missing package. To avoid this iterative process, we installed comprehensive package collections.

We installed the `collection-latexextra` collection, which includes hundreds of commonly-used LaTeX packages:

```
docker exec -it sharelatex tlmgr install collection-latexextra
```

This collection includes packages such as:

- `fancyvrb` – Sophisticated verbatim text handling
- `algorithmic` – Algorithm typesetting
- `algorithm2e` – Alternative algorithm package
- `listings` – Source code formatting
- `tcolorbox` – Colored and framed text boxes
- `enumitem` – Customizable list environments
- And many others

After installation, we updated the filename database:

```
docker exec -it sharelatex mktexlsr
```

12.3.5 Compiler Configuration

Initial compilation used the latex compiler, which generates DVI output. This caused hyperref warnings:

Package hyperref Warning: You have enabled option `breaklinks'.
But driver `hdvips.def' does not support this.

We changed the compiler in the Overleaf web interface:

1. Navigate to **Menu** (top left corner)
2. Under **Settings**, locate **Compiler**
3. Change from LaTeX to **pdfLaTeX**
4. Click **Recompile**

This resolved the hyperref driver warnings and enabled direct PDF generation.

12.3.6 Document-Level Fixes

Header Height Adjustment

The fancyhdr package warned that the header height was too small:

Package fancyhdr Warning: \headheight is too small (14.45377pt):
Make it at least 26.14003pt.

We added the following line after `\usepackage{fancyhdr}` in the preamble:

```
\usepackage{fancyhdr}  
\setlength{\headheight}{27pt}
```

Hyperref Deprecated Options

We removed deprecated options from the hyperref package declaration. Original code:

```
\usepackage[pdfmark,  
breaklinks=true,  
colorlinks=true,  
citecolor=blue,  
linkcolor=blue,  
menucolor=black,  
pagecolor=black,  
urlcolor=blue  
{hyperref}
```

Updated code:

```
\usepackage[  
breaklinks=true,  
colorlinks=true,  
citecolor=blue,  
linkcolor=blue,  
urlcolor=blue  
{hyperref}
```

PDF Bookmark Unicode Warning

Line breaks (\\) in chapter or section titles cannot be included in PDF bookmarks. We used an optional argument for the PDF bookmark:

```
\chapter[Short Title for PDF]{Long Title \\ With Line Break}
```

12.3.7 Persistence of Installed Packages

Docker containers are ephemeral by design. Without additional steps, all installed packages would be lost when the container is restarted. After all packages were successfully installed, we committed the container to a new Docker image:

```
docker commit sharelatex overleaf-fulltex-complete
```

We then modified the `docker-compose.yml` file to reference the new image:

```
services:
  sharelatex:
    image: overleaf-fulltex-complete # Changed from overleaf-fulltex
    container_name: sharelatex
    # ... rest of configuration
```

After updating the configuration, we restarted the containers:

```
docker-compose down
docker-compose up -d
```

12.4 Final Working Configuration

After completing all troubleshooting steps and package installations, the Cornell thesis template compiled successfully without errors. Figure ?? shows the final working Overleaf instance with the successfully compiled document.

The deployment is accessible at:

<http://167.99.54.162:8090/project/68eed5f5ba6fdc86c648466b>

Key indicators of successful configuration include:

- All packages load without errors
- PDF compiles successfully with pdfLaTeX
- No missing package warnings
- Headers and footers render correctly
- Hyperlinks function properly in the PDF
- All bibliography and index features work as expected

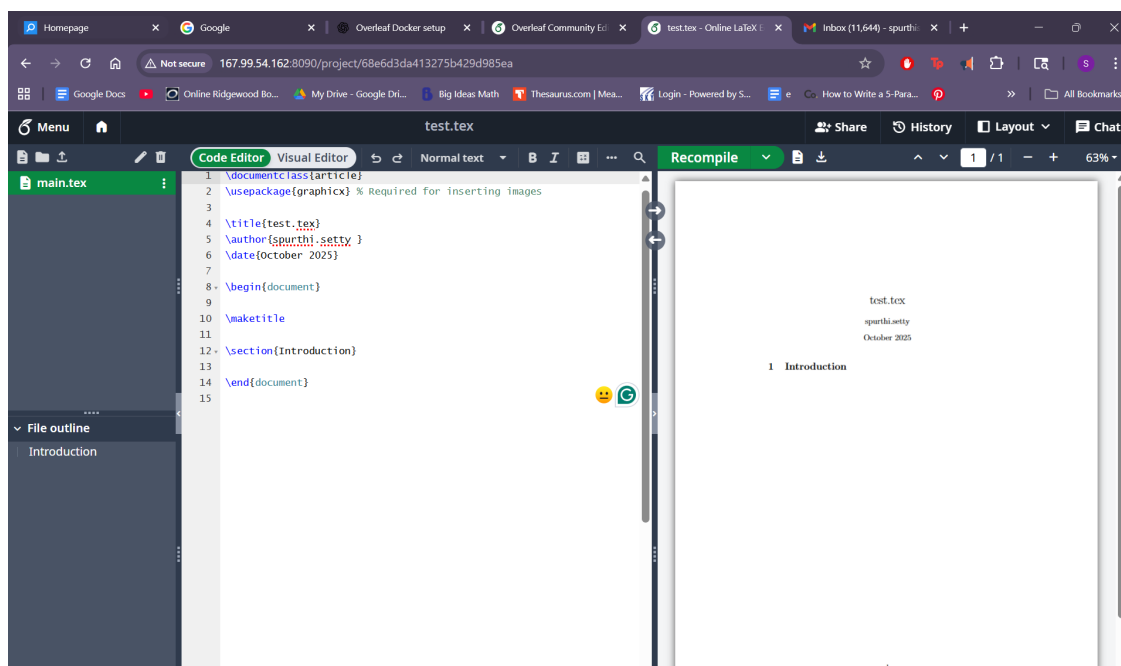


Figure 12.1: Successfully compiled template in Overleaf showing the PDF output, [URL:http://167.99.54.162:8090/project/68eed5f5ba6fdc86c648466b](http://167.99.54.162:8090/project/68eed5f5ba6fdc86c648466b)

Appendix A

Appendix

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