

Design setup using Caravel_user_project

Prerequisites

To follow this lesson, you need a working linux system with docker installed and started. The instruction to setup the environment is introduced in Lesson 2.1

When you complete that lesson. You can come back here.

Caravel User Project need python3 virtual environment package that can be installed by this command:

```
$ sudo apt-get install python3-venv
```

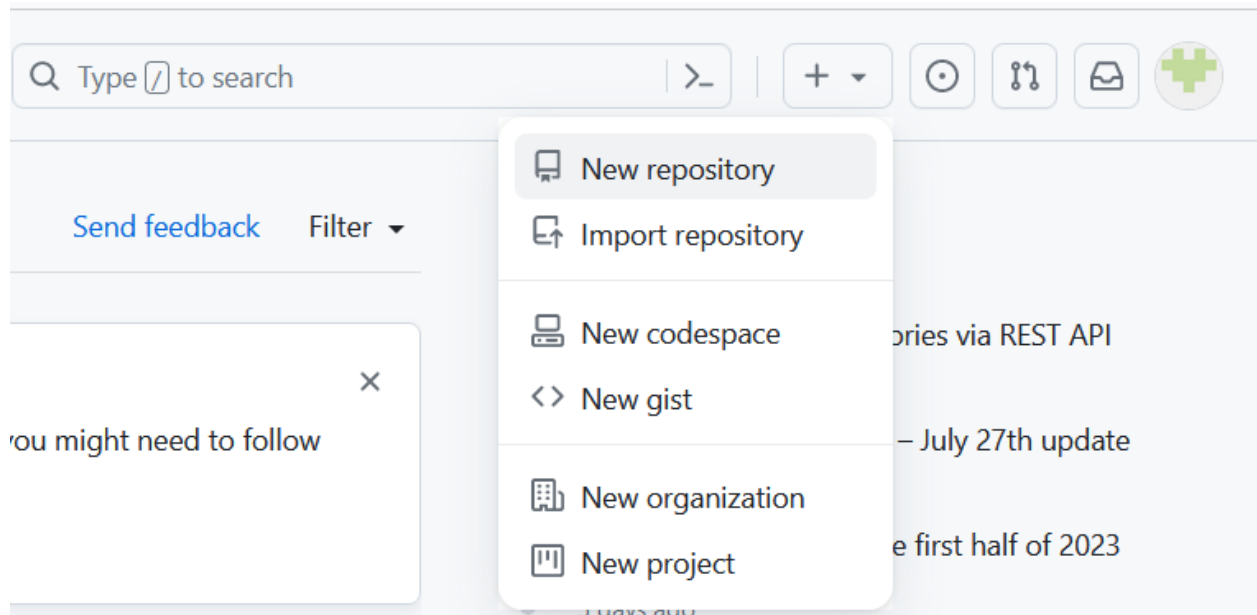
Introduction

In this lesson, we will learn how to use caravel_user_project to harden our design and integrate it into the caravel_user_project so that it can be fabricated using Caravel Test Harness.

It is recommended to have a github account with the proper setup so that you can checkout and push the change to github. However, it is optional, you can skip the start with the OPTIONAL at the beginning in this tutorial

(OPTIONAL) Create a github repository

1. First, we create a repository on github to store our code. This can be done by going to <https://github.com> and log in with your account credentials. After that you can select the menu to create a new repository.



2. In the create new repository page, you will enter the information and select if your repository is public or private. Press 'Create repository' when done.

Create a new repository

A repository contains all project files, including the revision history. Already have a project repository elsewhere? [Import a repository.](#)

Required fields are marked with an asterisk ().*

Owner * Repository name *

 duyhieubui ▾ /

✔ caravel_uniccas_example is available.

Great repository names are short and memorable. Need inspiration? How about **super-potato** ?

Description (optional)

- ☒  **Public**
Anyone on the internet can see this repository. You choose who can commit.
- ☐  **Private**
You choose who can see and commit to this repository.

Initialize this repository with:

- ☐ **Add a README file**
This is where you can write a long description for your project. [Learn more about READMEs.](#)

Add .gitignore

▾

- When your setup is done, you will see the instruction to add files to your new created repository. Please remember the path to your repository because we will need it later.


caravel_uniccas_example
Public

 Pin
  Unwatch 1
  Fork 0
  Star 0


Set up GitHub Copilot
 Use GitHub's AI pair programmer to autocomplete suggestions as you code.


Invite collaborators
 Find people using their GitHub username or email address.

Quick setup — if you've done this kind of thing before

 Set up in Desktop
 or
  HTTPS
  SSH



Get started by [creating a new file](#) or [uploading an existing file](#). We recommend every repository include a [README](#), [LICENSE](#), and [.gitignore](#).

...or create a new repository on the command line

```

echo "# caravel_uniccas_example" >> README.md
git init
git add README.md
git commit -m "first commit"
git branch -M main
git remote add origin git@github.com:duyhieubui/caravel_uniccas_example.git
git push -u origin main
    
```



...or push an existing repository from the command line

```

git remote add origin git@github.com:duyhieubui/caravel_uniccas_example.git
git branch -M main
git push -u origin main
    
```



...or import code from another repository
 You can initialize this repository with code from a Subversion, Mercurial, or TFS project.

 Import code

- It is a good practice to set up an ssh key to access github. You can follow the instructions in [this tutorial](#) or [this videos](#)

Clone the repository and run the setup

- Next, we create a directory for the run by using this command:

```
$ cd $HOME
$ mkdir -p unic-cass/caravel_tutorial
$ cd unic-cass/caravel_tutorial
```

```
cass@DESKTOP-QIE8PTM:~$ cd $HOME
cass@DESKTOP-QIE8PTM:~$ mkdir unic-cass/caravel_tutorial
cass@DESKTOP-QIE8PTM:~$ cd unic-cass/caravel_tutorial
cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial$
```

- Download the source code with the correct release/tag. In this tutorial, we will use the latest release tag of Caravel which is mpw-9d as follows:

```
$ git clone -b mpw-9d https://github.com/efabless/caravel_user_project \
  caravel_uniccas_example
```

```

cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial$ git clone -b mpw-9d https://github.com/efabless/caravel
_user_project caravel_uniccas_example
Cloning into 'caravel_uniccas_example'...
remote: Enumerating objects: 4856, done.
remote: Counting objects: 100% (969/969), done.
remote: Compressing objects: 100% (522/522), done.
remote: Total 4856 (delta 524), reused 791 (delta 393), pack-reused 3887
Receiving objects: 100% (4856/4856), 258.17 MiB | 2.52 MiB/s, done.
Resolving deltas: 100% (2646/2646), done.
Note: switching to 'a3201027228081638766628f64f0ad0e094d3a13'.

You are in 'detached HEAD' state. You can look around, make experimental
changes and commit them, and you can discard any commits you make in this
state without impacting any branches by switching back to a branch.

If you want to create a new branch to retain commits you create, you may
do so (now or later) by using -c with the switch command. Example:

    git switch -c <new-branch-name>

Or undo this operation with:

    git switch -

Turn off this advice by setting config variable advice.detachedHead to false

Updating files: 100% (141/141), done.
cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial$

```

3. Next, we have to change the directory to the caravel_uniccas_example directory

```
$ cd caravel_uniccas_example
```

```

cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial$ cd caravel_uniccas_example
cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccas_example$ git remote rename origin upstream

```

4. (optional) Next, we will rename the original git url into an upstream so that we can edit the file and push it into our own git repository

```

$ git remote rename origin upstream
$ git remote add origin git@github.com:duyhieubui/caravel_uniccas_example.git

```

You should replace my github with your created repository using the ssh URI that you created in the previous part.

5. (optional) We create a new branch so that it will not interfere with the original one

```
$ git checkout -b unic-cas
```

```

cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccas_example$ git remote rename origin upstream
cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccas_example$ git add remote origin git@github
b.com:duyhieubui/caravel_uniccas_example.git
fatal: pathspec 'remote' did not match any files
cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccas_example$ git remote add origin git@github
b.com:duyhieubui/caravel_uniccas_example.git
cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccas_example$ git checkout -b uniccas
Switched to a new branch 'uniccas'
cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccas_example$

```

6. (optional) we now can push the source code into our own repository and start changing it

```
$ git push -u origin unic-cas
```

```

cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccas_example$ git push -u origin uniccas
The authenticity of host 'github.com (140.82.121.4)' can't be established.
ED25519 key fingerprint is SHA256:+DiY3wvV6TuJJhpZisF/zLDA0zPMSvHdkr4UvC0qU.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Please type 'yes', 'no' or the fingerprint: yes
Warning: Permanently added 'github.com' (ED25519) to the list of known hosts.
Enter passphrase for key '/home/cass/.ssh/id_rsa':
Enter passphrase for key '/home/cass/.ssh/id_rsa':
Enumerating objects: 3503, done.
Counting objects: 100% (3503/3503), done.
Delta compression using up to 16 threads
Compressing objects: 100% (1488/1488), done.
Writing objects: 100% (3503/3503), 164.12 MiB | 679.00 KiB/s, done.
Total 3503 (delta 1889), reused 3477 (delta 1879), pack-reused 0
remote: Resolving deltas: 100% (1889/1889), done.
remote: warning: See https://gh.io/lfs for more information.
remote: warning: File gds/user_project_wrapper.gds is 52.23 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File mag/user_proj_example.mag is 84.12 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File spi/lvs/user_project_wrapper.spice is 63.08 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File mag/user_project_wrapper.mag is 80.16 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File spi/lvs/user_project_wrapper.spice is 63.08 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File mag/user_project_wrapper.mag is 80.16 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File mag/user_project_wrapper.mag is 80.10 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File mag/user_project_wrapper.mag is 80.10 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File mag/user_project_wrapper.mag is 80.16 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File gds/user_project_wrapper.gds is 51.29 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File mag/user_project_wrapper.mag is 82.05 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File gds/user_proj_example.gds is 50.68 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File gds/user_project_wrapper.gds is 51.27 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: File mag/user_project_wrapper.mag is 80.10 MB; this is larger than GitHub's recommended maximum file size of 50.00 MB
remote: warning: GH001: Large files detected. You may want to try Git Large File Storage - https://git-lfs.github.com.
To github.com:duyhieubui/caravel_uniccas_example.git
* [new branch]      uniccas -> uniccas
Branch 'uniccas' set up to track remote branch 'uniccas' from 'origin'.
cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccas_example$

```

Run the setup

- Next, we need to set up two environment variables PDK_ROOT and OPENLANE_ROOT. This is needed during the setup because caravel_user_project use a specific version of Skywater 130nm PDK and a specific version of Openlane

```

$ export PDK_ROOT=$HOME/unic-cass/caravel_tutorial/pdks
$ export OPENLANE_ROOT=$HOME/unic-cass/caravel_tutorial/openlane

```

```

cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccass_example$ export PDK_ROOT=$HOME/unic-cass
/caravel_tutorial/pdks
cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccass_example$ export OPENLANE_ROOT=$HOME/unic
-cas/caravel_tutorial/openlane
cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccass_example$

```

8. Next, we need to download the required file for caravel to run by this command:

```
$ make setup
```

```

cass@DESKTOP-QIE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccass_example$ make setup
if [ -d "/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/caravel" ]; then\
    echo "Deleting existing /home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/caravel" && \
    rm -rf /home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/caravel && sleep 2;\
fi
echo "Installing caravel-lite.."
Installing caravel-lite..
git clone -b mpw-9d https://github.com/efabless/caravel-lite /home/cass/unic-cass/caravel_tutorial/caravel
_uniccass_example/caravel --depth=1
Cloning into '/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/caravel'...
remote: Enumerating objects: 573, done.
remote: Counting objects: 100% (573/573), done.
remote: Compressing objects: 100% (404/404), done.
remote: Total 573 (delta 174), reused 373 (delta 105), pack-reused 0
Receiving objects: 100% (573/573), 192.82 MiB | 2.13 MiB/s, done.
Resolving deltas: 100% (174/174), done.
Note: switching to 'ee5b3ee314a17f2d64cb850091d3f8e73711f284'.

You are in 'detached HEAD' state. You can look around, make experimental
changes and commit them, and you can discard any commits you make in this
state without impacting any branches by switching back to a branch.

If you want to create a new branch to retain commits you create, you may
do so (now or later) by using -c with the switch command. Example:

    git switch -c <new-branch-name>

Or undo this operation with:

    git switch -

Turn off this advice by setting config variable advice.detachedHead to false

Updating files: 100% (458/458), done.
export CARAVEL_ROOT=/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/caravel && make -f /home
/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/caravel/Makefile check-env
make[1]: Entering directory '/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example'
make[1]: Nothing to be done for 'check-env'.
make[1]: Leaving directory '/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example'
export CARAVEL_ROOT=/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/caravel && make -f /home
/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/caravel/Makefile install_mcw
make[1]: Entering directory '/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example'
if [ -d "/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/mgmt_core_wrapper" ]; then \
    echo "Deleting existing /home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/mgmt_core_w
rapper" && \
    rm -rf /home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/mgmt_core_wrapper && sleep 2; \
fi
Installing mcw-litex-vexriscv..
Cloning into '/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/mgmt_core_wrapper'...
remote: Enumerating objects: 837, done.
remote: Counting objects: 100% (837/837), done.
remote: Compressing objects: 100% (574/574), done.
remote: Total 837 (delta 330), reused 617 (delta 249), pack-reused 0
Receiving objects: 100% (837/837), 442.23 MiB | 1.11 MiB/s, done.
Resolving deltas: 100% (330/330), done.
Note: switching to 'f9b2483a8d3a70a2f938ce0f70fb32e100f1bf40'.

You are in 'detached HEAD' state. You can look around, make experimental
changes and commit them, and you can discard any commits you make in this
state without impacting any branches by switching back to a branch.

If you want to create a new branch to retain commits you create, you may
do so (now or later) by using -c with the switch command. Example:

    git switch -c <new-branch-name>

Or undo this operation with:

    git switch -

Turn off this advice by setting config variable advice.detachedHead to false

```

```

Updating files: 100% (761/761), done.
make[1]: Leaving directory '/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example'
realpath: /home/cass/unic-cas/caravel_tutorial/openlane: No such file or directory
cd openlane && make openlane
make[1]: Entering directory '/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/openlane'
if [ -d "/home/cass/unic-cas/caravel_tutorial/openlane" ]; then\
  echo "Deleting existing /home/cass/unic-cas/caravel_tutorial/openlane" && \
  rm -rf /home/cass/unic-cas/caravel_tutorial/openlane && sleep 2; \
fi
git clone https://github.com/The-OpenROAD-Project/OpenLane -b 2023.02.23 --depth=1 /home/cass/unic-cas/caravel_tutorial/openlane && \
  cd /home/cass/unic-cas/caravel_tutorial/openlane && \
  export OPENLANE_IMAGE_NAME=efabless/openlane:2023.02.23 && \
  export IMAGE_NAME=efabless/openlane:2023.02.23 && \
  make pull-openlane
Cloning into '/home/cass/unic-cas/caravel_tutorial/openlane'...
remote: Enumerating objects: 551, done.
remote: Counting objects: 100% (551/551), done.
remote: Compressing objects: 100% (478/478), done.
remote: Total 551 (delta 76), reused 291 (delta 24), pack-reused 0
Receiving objects: 100% (551/551), 10.84 MiB | 113.00 KiB/s, done.
Resolving deltas: 100% (76/76), done.
Note: switching to 'a35b64aa200c91e9eb7dde56db787d6b4c0eal2a'.

You are in 'detached HEAD' state. You can look around, make experimental
changes and commit them, and you can discard any commits you make in this
state without impacting any branches by switching back to a branch.

If you want to create a new branch to retain commits you create, you may
do so (now or later) by using -c with the switch command. Example:

    git switch -c <new-branch-name>

Or undo this operation with:

    git switch -

Turn off this advice by setting config variable advice.detachedHead to false

make[2]: Entering directory '/home/cass/unic-cas/caravel_tutorial/openlane'
Makefile:23: warning: undefined variable 'DOCKER_SWAP'
Makefile:26: warning: undefined variable 'DOCKER_MEMORY'
Makefile:42: warning: undefined variable 'ROUTING_CORES'
Makefile:84: warning: undefined variable 'STD_CELL_LIBRARY'
2023.02.23: Pulling from efabless/openlane
Downloading PyYAML-6.0.1-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (705 kB)
 705.5/705.5 kB 729.4 kB/s eta 0:00:00
Downloading requests-2.31.0-py3-none-any.whl (62 kB)
 62.6/62.6 kB 2.5 MB/s eta 0:00:00
Downloading certifi-2023.7.22-py3-none-any.whl (158 kB)
 158.3/158.3 kB 2.2 MB/s eta 0:00:00
Downloading charset_normalizer-3.2.0-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (201 kB)
 201.8/201.8 kB 2.0 MB/s eta 0:00:00
Downloading urllib3-2.0.4-py3-none-any.whl (123 kB)
 123.9/123.9 kB 2.4 MB/s eta 0:00:00
Installing collected packages: pcpp, commonmark, zstandard, urllib3, pyyaml, pygments, idna, click, charse
t-normalizer, certifi, rich, requests, volare
Successfully installed certifi-2023.7.22 charset-normalizer-3.2.0 click-8.1.6 commonmark-0.9.1 idna-3.4 pc
pp-1.30 pygments-2.15.1 pyyaml-6.0.1 requests-2.31.0 rich-12.6.0 urllib3-2.0.4 volare-0.9.2 zstandard-0.21
.0
./venv/bin/volare enable e6f9c8876da77220403014b116761b0b2d79aab4
Downloading default.tar.xz... 100% 0:00:00
Version e6f9c8876da77220403014b116761b0b2d79aab4 enabled for the sky130 PDK.
make[1]: Leaving directory '/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example'
Cloning into '/home/cass/unic-cass/caravel_tutorial/caravel_uniccass_example/dependencies/timing-scripts'..
remote: Enumerating objects: 692, done.
remote: Counting objects: 100% (155/155), done.
remote: Compressing objects: 100% (103/103), done.
remote: Total 692 (delta 95), reused 79 (delta 52), pack-reused 537
Receiving objects: 100% (692/692), 2.46 MiB | 164.00 KiB/s, done.
Resolving deltas: 100% (464/464), done.
Already up to date.
cass@DESKTOP-0TE8PTM:~/unic-cass/caravel_tutorial/caravel_uniccass_example$

```

9. Now we are done with the setup. We are ready to run the examples from caravel user project

What's next?

We have done the setup of the caravel user project. It is time to run some examples from the project. Please note that you need to set the `PDK_ROOT` and `OPENLANE_ROOT` to the correct directory so that we don't have to run the set up again. This can fasten the flow. In the next lesson, we will go through the process to harden a design and integrate it into the test harness.