Embedded Systems

NXP

University Course

Alex Cuhureanu

- **Bio:**
  - SW developer for over 7 years in NXP where I am developing software for an Integrated Development Environment named S32Design Studio.
  - Java, Maven, Jenkins, GIT, C/C++

- **Topics covered in this course:**
  - V-Model/Requirements
  - Virtual Machine Environment Setup
  - Process | Git, IDE Setup, Compile and Flash the Hello World Project
  - How Hardware and Software are Linked
  - Lights Node
  - Review and Exercises

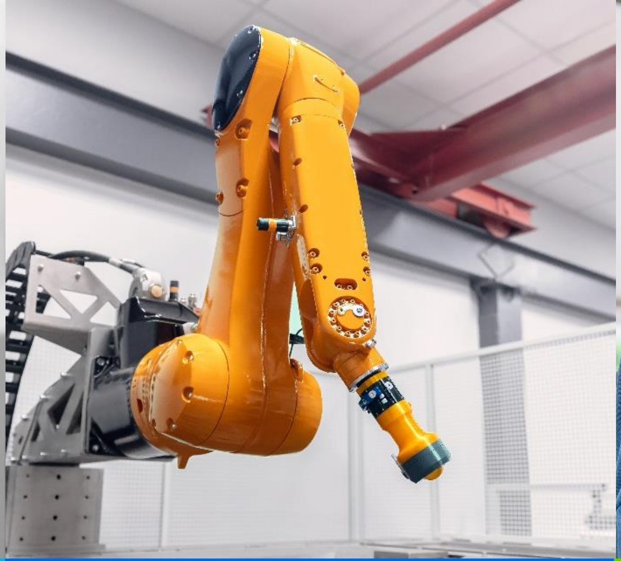
Ramona Dragulin

- **Bio:**
  - SW developer in System Tools department where I am developing software for an Integrated Development Environment named S32Design Studio.
  - Java , Maven, Python, C++ to implement S32DS.
- **Topics covered in this course:**
  - Process | Git, IDE Setup, Compile and Flash the Hello World Project
  - Architecture (UML) | Virtual Machine Environment Setup
  - RGB | Hands-on Lab (no module – just the dev board)
  - Brakes Node
  - Review and Exercises

A smarter world starts with NXP

We design purpose-built, rigorously tested technologies that enable devices to sense, think, connect and act intelligently to improve people's daily lives.

Automotive


Industrial & IoT

Mobile

Smart Home

Smart City

Communication Infrastructure

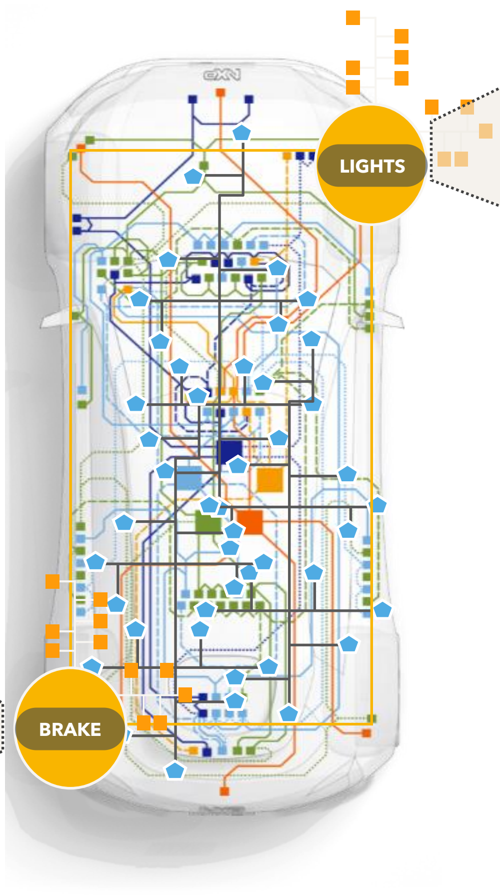
Ground RULES

- There are no stupid questions!
- Please be respectful to your colleagues
- If you need to go to the bathroom, take a phone call, or take a small break you do not need to ask permission, just leave without disturbing
- Please interrupt me at any time during my presentation if you want to ask questions
- Please tell me if I am going too fast or too slowly
- The goal of this event is for you to understand the basic concepts, it is not for me to go through everything I have prepared
- One big break from 12pm to 1pm for lunch
- We will have small breaks that we can agree on

Course Contents

General topics, Courses & Labs

REPLI-CAR NETWORK



LIGHTS CONTROL NODE
Replicate Body Control Module behavior
· Actuate lights (headlamps, turn indicators), horn and washer pump based on input controller from HMI
· Communications with other nodes: HMI, PCM, Brake, Steering, Comfort

BRAKE CONTROL NODE
Replicate Brake Control Module behavior
· brake actuation and brake lamp indication based on input controller from HMI
· Communications with other nodes: HMI, PCM, BCM

V-Model

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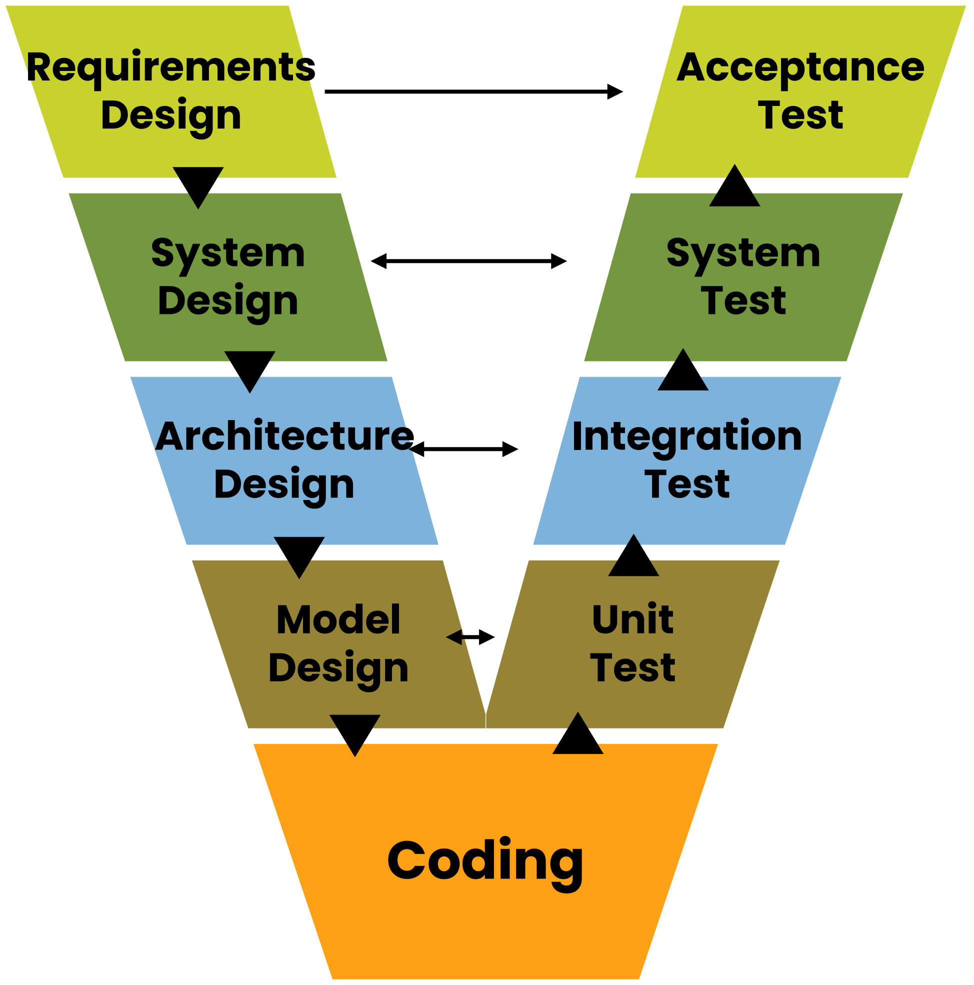
The V-MODEL



- Known as **verification** and **validation** model
- It is similar to waterfall model that follows a sequential path of execution of processes
- Devised by the late Paul Rook in 1980s, V-model was targeting the **improvement of software development**
- It is a **step-by-step process** in which the next phase begins only after the completion of the present phase
- If this model is used to test a product, there is an **assurance** that the final product developed will be **of high quality**

Phases of V-Model – Verification phase

The verification phase of V-model includes:

- **Business requirement** analysis is the stage of having a **detailed communication with the customer** so that it gets easier **to understand his/her exact requirements**.
- **System design** stage involves **understanding and detailing out the entire hardware and communication setup** for the product being developed. System test design can also be planned at this stage
- **Architectural design** stage involves **understanding the technical and financial feasibility of the product before it is actually developed**. The focus is to understand the data transfer that will take place between internal and external modules
- **Module design** stage focuses on **designing a detailed plan for the internal modules** of the system. Also known as low-level design, it is important to ensure that the design is compatible with other modules in system architecture and other external systems

Phases of V-Model – CODING phase

- During this phase, the actual **coding** of the system modules is taken up
- On the basis of system and architectural requirements of the program, the best suitable programming language is selected using which the coding is done at par with the coding guidelines and standards; the code is then reviewed and optimized to ensure the delivery of best performing product

Phases of V-Model – Verification phase

During this phase, the product undergoes various forms of testing.

- **Unit testing** is conducted at an early stage so that the bugs are eliminated at the starting stages of product development
- **Integration testing** is done to check whether there is a valid and proper communication within the internal modules of the system
- **System testing** enables the testing of the entire system and to ensure if the internal modules communicate effectively with the external systems
- **Acceptance testing** is done to test a product in the user's environment and to check if it's compatible with the other systems available in the environment

Requirements Engineering

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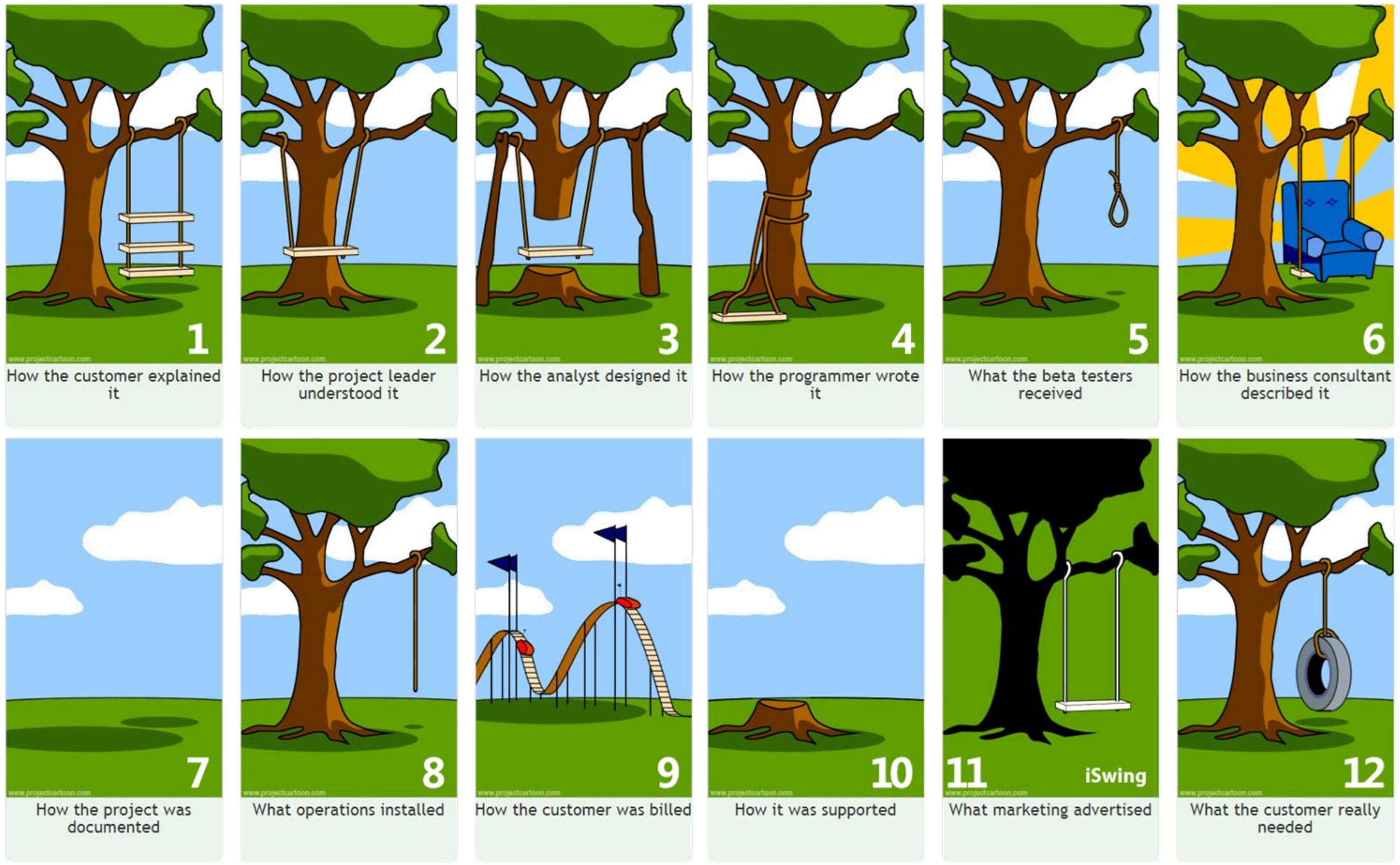
What is requirements engineering?


1
How the customer explained it
2
How the project leader understood it
3
How the analyst designed it
4
How the programmer wrote it
5
What the beta testers received
6
How the business consultant described it
7
How the project was documented
8
What operations installed
9
How the customer was billed
10
How it was supported
11
iSwing
What marketing advertised
12
What the customer really needed
www.projectcartoon.com

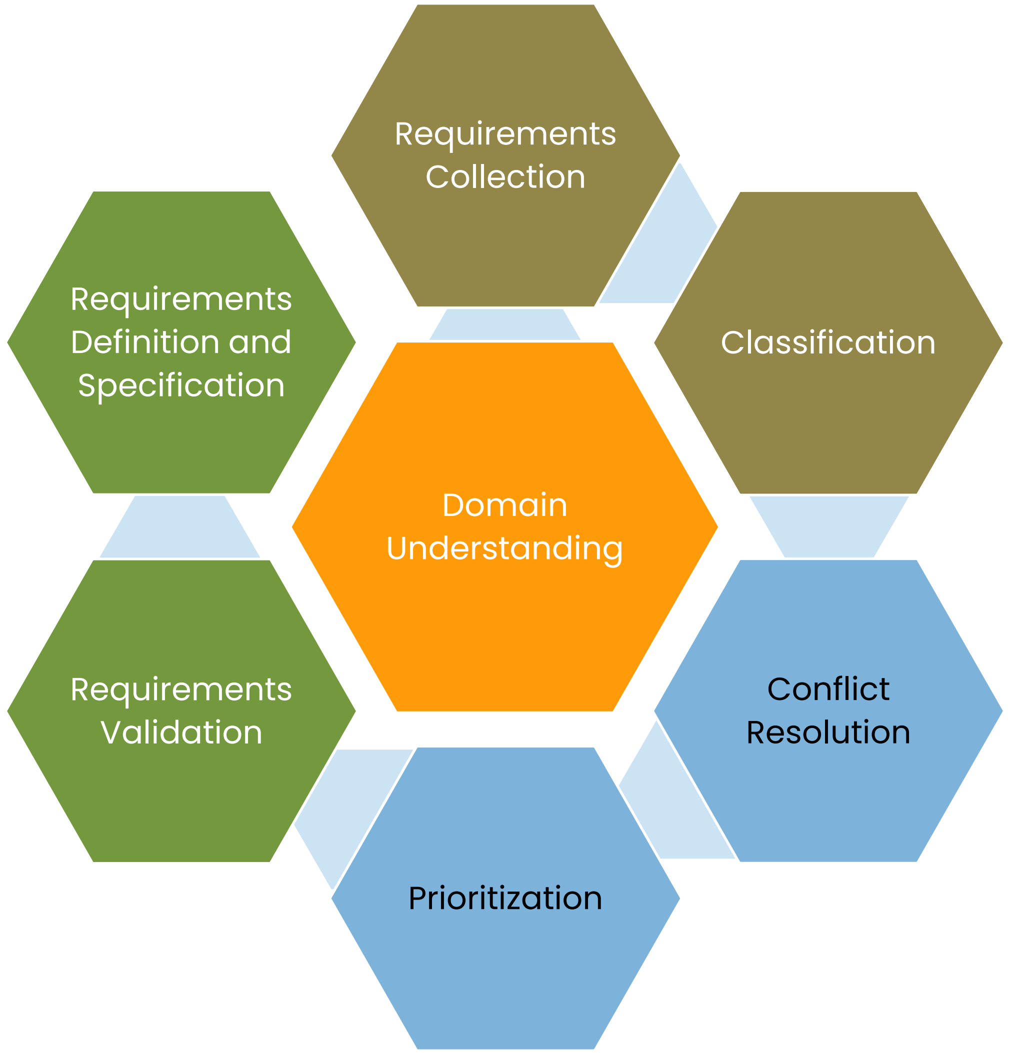
What is requirements engineering?

- **Requirements Engineering** (RE) is the **process of discovering, analyzing, documenting and validating** the requirements of the system
- Each software development process goes through the phase of requirements engineering
- The processes used for RE vary widely depending on the application domain, the people involved and the organization developing the requirements

Requirements engineering – Problems of requirements analysis

- Stakeholders **don’t know what they really want**
- Stakeholders **express** requirements **in their own terms**
- Different stakeholders may have **conflicting requirements**
- Organizational and political factors may **influence the** system **requirements**
- The **requirements change** during the analysis process.
- New **stakeholders may emerge** and the business environment change

The requirements analysis process



Process activities & Viewpoint-oriented elicitation

- **Process activities**:
  - Domain understanding
  - Requirements collection
  - Classification
  - Conflict resolution
  - Prioritization
  - Requirements checking

- **Viewpoint-oriented elicitation**:
  - Stakeholders represent different ways of looking at a problem or problem viewpoints
  - This multi-perspective analysis is important as there is no single correct way to analyze system requirements

Requirements validation

- **Validation**
    - Concerned with **demonstrating** that the **requirements define the system** that the customer really wants
    - **Requirements error costs are high**, so validation is very important
    - Fixing a requirements error after delivery may cost up to 100 times the cost of fixing an implementation error

- Requirements **management** is **the process of managing changing requirements** during the requirements engineering process and system development
    - **Requirements** are inevitably **incomplete and inconsistent**
    - **New requirements** emerge during the process as business needs change and a better understanding of the system is developed
    - Different viewpoints have **different requirements** and these are **often contradictory**

Enduring and volatile requirements

- **Enduring requirements**
  - Stable requirements derived from the core activity of the customer organization. E.g. a hospital will always have doctors, nurses, etc. May be derived from domain models
- **Volatile requirements**
  - Requirements which change during development or when the system is in use. In a hospital, requirements derived from health-care policy

Writing Good Requirements

- A good requirement states something that is **necessary, verifiable**, and **attainable**.
  - **Need**. If there is a doubt about the necessity of a requirement, then ask: What is the worst thing that could happen if this requirement were not included? If you do not find an answer of any consequence, then you probably do not need the requirement.
  - **Verification**. As you write a requirement, determine how you will verify it.
  - **Attainable**. To be attainable, the requirement must be technically feasible and fit within budget, schedule, and other constraints.
  - **Clarity**. Each requirement should express a single thought, be concise, and simple. It is important that the requirement not be misunderstood – it must be unambiguous.

- *Simple sentences will most often suffice for a good requirement.*

Writing Good Requirements - Use of terms

- In a specification, there are terms to be avoided and terms that must be used in a very specific manner. Authors need to understand the use of shall, will, and should:
  - **Requirements** use **shall**
  - **Statements** of fact use **will**
  - **Goals** use **should**.
- These are standard usage of these terms. You will confuse everyone if you deviate from them. **All shall statement (requirements) must be verifiable**, otherwise, compliance cannot be demonstrated.
- Terms such as **are**, **is**, **was**, and **must** *do not belong in a requirement*. They may be used in a descriptive section or in the lead-in to a requirements section of the specification.
- There are several terms to be avoided in writing requirements, because they confuse the issue and can cost you money, e.g.: support, but not limited to, etc., and/or

Writing Good Requirements - Use of terms

- The word **support** is often used incorrectly in requirements. Support is a proper term if you want a structure to support 50 pounds weight. It is incorrect if you are stating that the system will support certain activities.
  - **WRONG:** The system **shall support the training coordinator** in defining training scenarios.
  - **RIGHT:** The system **shall provide input screens for defining training scenarios.** The system shall provide automated training scenario processes.
- The terms **but not limited to**, and **etc**. are put in place because the person writing the requirements suspects that more may be needed than is currently listed. *Using these terms will not accomplish what the author wants and can backfire.*

Writing Good Requirements – Structure/grammar

- Requirements **should be easy to read and understand**. The requirements in a system specification are either for the system or its next level (e.g.: subsystem). Each requirement can usually be written in the format:
  - The System **shall provide …**
  - The System **shall be capable of…**
  - The System **shall weigh…**
  - The Subsystem #1 **shall provide …**
  - The Subsystem #1 **shall interface with…**
- *Note: The name of your system and the name of each subsystem appear in these locations. If you have a complex name, please use the acronym, or your document will have many unneeded pages just because you have typed out a long name many times*

Writing Good Requirements – Structure/grammar

- Each of these beginnings is followed by **what** the System or Subsystem shall do.
- Each should generally be followed by **a single predicate**, not by a list.
- Requirement statements **should not be complicated** by explanations of operations, design, or other related information. This non-requirement information should be provided in an introduction to a set of requirements or in rationale.
- You can accomplish two things by rigorously sticking to this format:
  - First, you avoid the **Subject Trap**.
  - Second, you will **avoid bad grammar** that creeps into requirements when authors get creative in their writing

Writing Good Requirements – Structure/grammar - Subject trap

- A set of requirements might be written that reads as follows:
  - The **guidance and control subsystem** shall provide control in six degrees of freedom.
  - The **guidance and control subsystem** shall control attitude to 2+/- 0.2 degrees.
- The **subject trap** is created because **the author has defined a guidance and control subsystem**. Controlling attitude and rate is a **system** problem; it requires not only a guidance and control subsystem *but also a propulsion subsystem to achieve these attitudes and rates*. The requirements should be **written from the system perspective**, as follows:
  - The **system** shall provide six degrees of freedom control.
  - The **system** shall control attitude to 2 +/- 0.2 degrees.

Writing Good Requirements – Structure/grammar - Bad grammar

- **Bad grammar** → reader will misinterpret what is stated.
- Avoid it by **writing requirements as bullet charts**. When the content is agreed upon a good writer can convert the information into a sentence for the specification.
- **Authors will also try to put all that they know in a single sentence**. This results in a long complex sentence that probably contains more than one requirement. Bullet charts or one good editor can alleviate this problem.

Writing Good Requirements – Verifiable

- Requirements may be unverifiable for several reasons. The following discusses the most common reason: use of **ambiguous terms** – because they are subjective (different meanings to different people).
- **Avoid these words**:
  - Minimize / Maximize
  - Rapid
  - User-friendly
  - Easy
  - Sufficient
  - Adequate
  - Quick

Requirements Exercises

References

nxp.com

References

- Ian Sommerville, *Software Engineering* (International Computer Science Series), 22 Aug. 2000
- *Writing Good Requirements*, https://spacese.spacegrant.org/uploads/Requirements-Writing/Writing%20Good%20Requirements.pdf
- IEEE Guide for Developing System Requirements Specifications , https://www2.seas.gwu.edu/~mlancast/cs254/IEE_STD_1233-_Requirements_Spec.pdf

Overview of the change management process

Change/Feature/Bug Requests, Implementation (Coding), Review, Branch, Commit, PullRequest, Testing

Introduction in CHANGE MANAGEMENT PROCESS

The change management process refers to the stages involved in any change management strategy and its implementation. Having a strategy and steps helps transformations become successful and ensure that all factors are considered.

At a glance, the change management process breaks down into the following five steps:

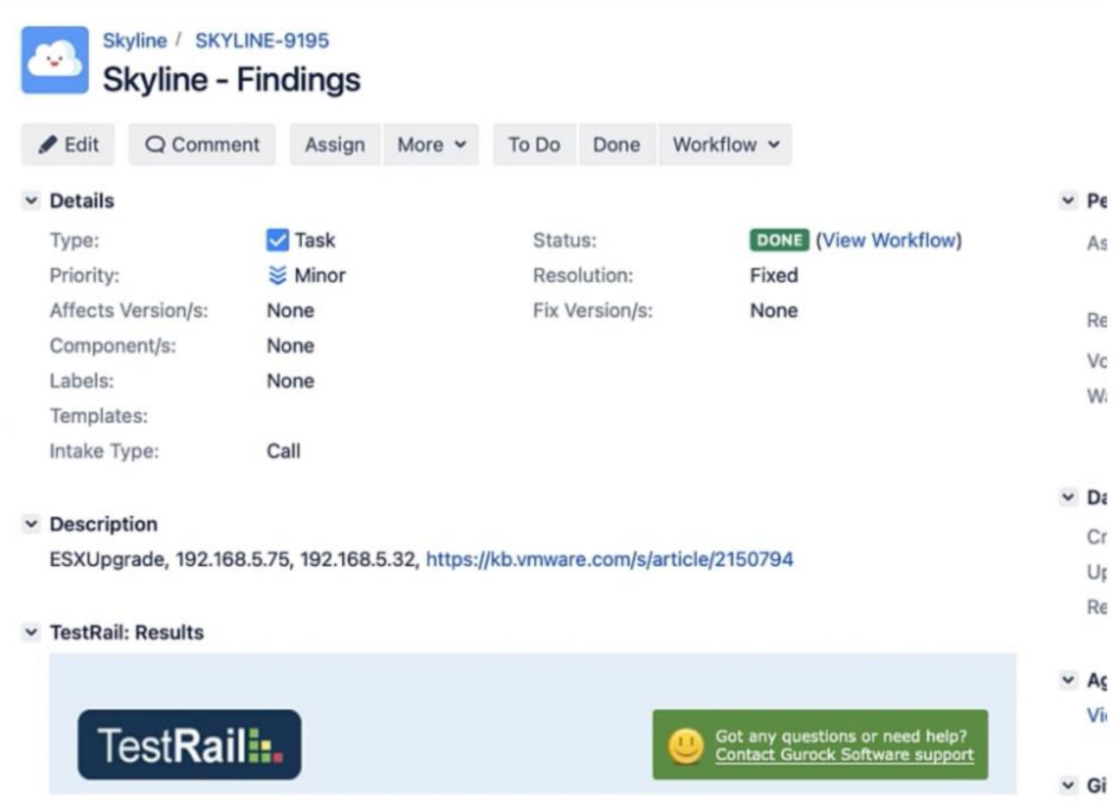
1. Prepare for change.
2. Create a vision for change.
3. Implement changes.
4. Embed and solidify changes.
5. Review and analyze.

Introduction in Jira

What Is Jira?

Jira is a software application developed by the Australian software company Atlassian that allows teams to track issues, manage projects, and automate workflows.

Jira is based on four key concepts: *issue*, *project*, *board*, and *workflow*.



Details

Type:	Task	Status:	DONE (View Workflow)
Priority:	Minor	Resolution:	Fixed
Affects Version/s:	None	Fix Version/s:	None
Component/s:	None		
Labels:	None		
Templates:			
Intake Type:	Call		

Description

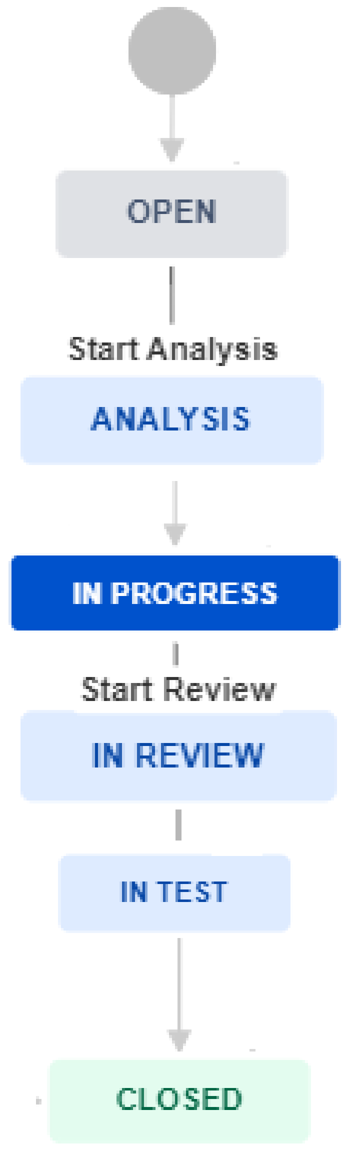
ESXUpgrade, 192.168.5.75, 192.168.5.32, https://kb.vmware.com/s/article/2150794

TestRail: Results

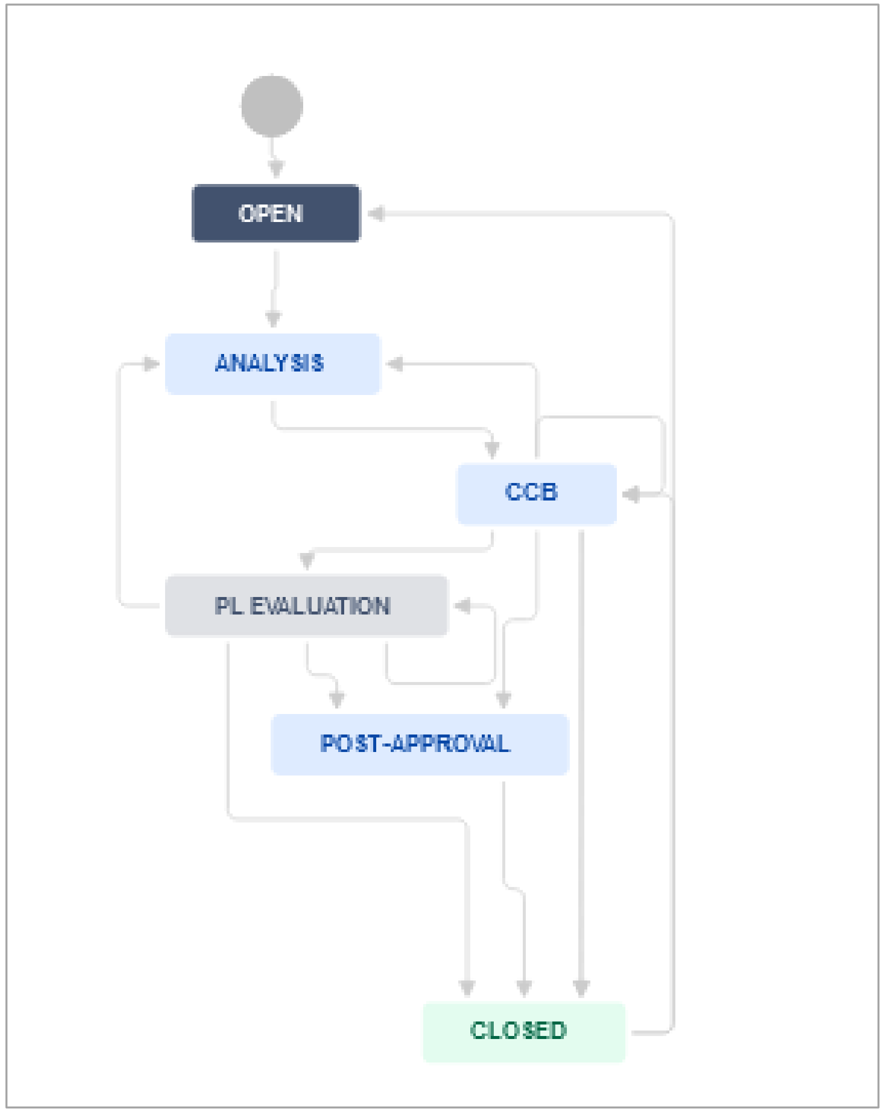
TestRail
Got any questions or need help?
Contact Gurock Software support

Simple schema

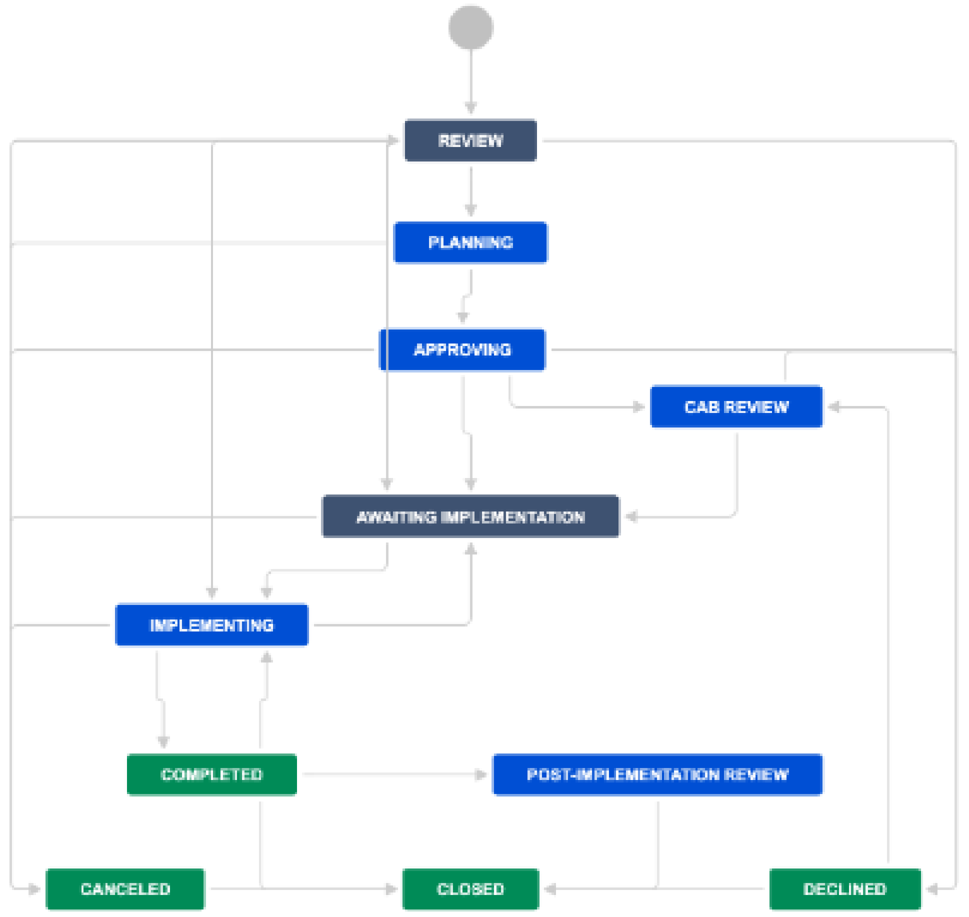
Jira Implementation Workflow



Change request flow



Jira Implementation Workflow



Support Tools

Jira, Git, Bitbucket

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Log-in using Windows credentials

What can you do in Jira:

- ❖Plan and track several types of activities like tasks, sub-tasks, bugs, new- features, inquiries
- ❖Plan and track releases
- ❖Use queries (predefined or define your own)
- ❖Use the predefined Jira Reports
- ❖Visualize Jira project status
- ❖Integrate Jira with Git and PullRequest

JIRA

Story points

1, 1 , 2, 3 ,5 , 8, 13…..

JIRA

Story points

- 1 story point - 0.5 day
- 2 story points - 1 day
- 3 story points - 2 days
- 5 story points - 1 week
- 8 story points - 2 weeks
- 13 story points - 3 weeks (maximum)
- Tasks bigger than 13 points must be divided in smaller tasks

Repo from GitHub

Working with Git

Command Line Interface

https://git-scm.com/downloads

Used in MCAL and OS projects

https://gerrit.googlesource.com/git-repo/

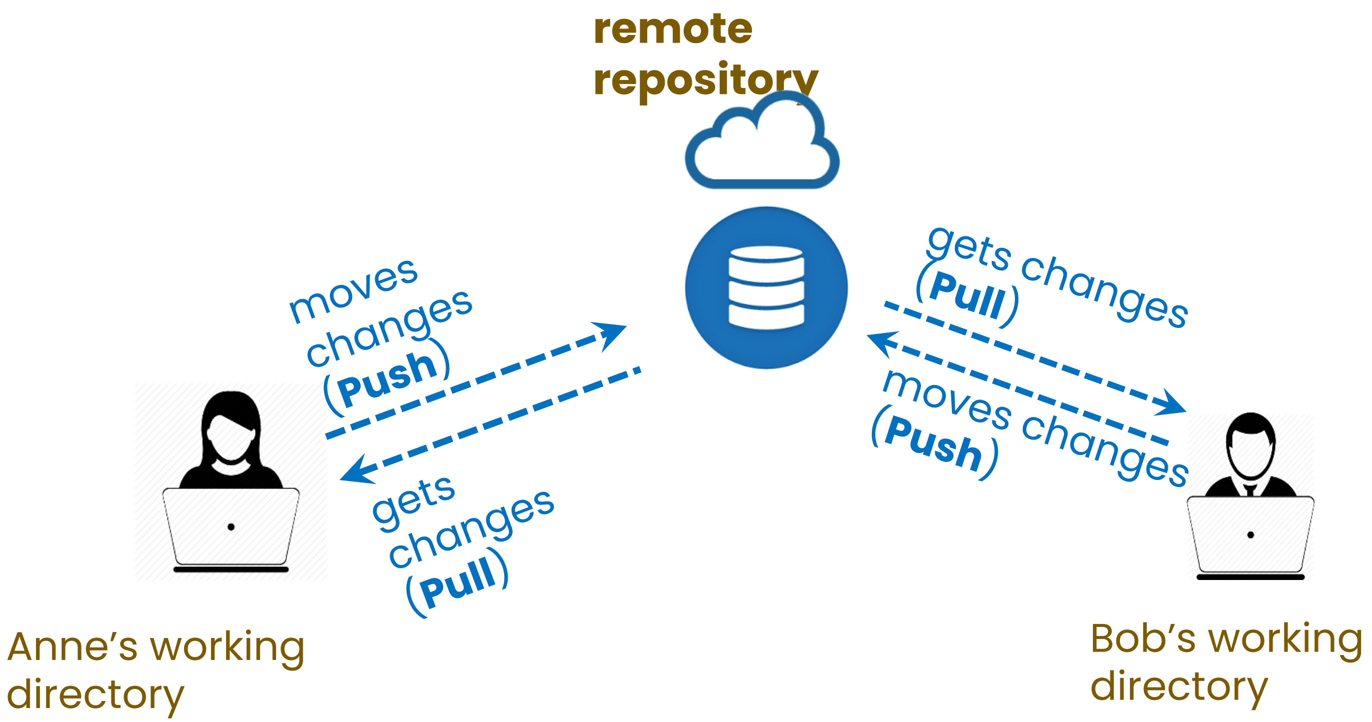
Source Tree GUI Client

https://www.sourcetreeapp.com/download/

https://bitbucket.sw.nxp.com/dashboard

NXP remote repo servers

Centralized Version Control System



Working with Git BASH & Source Tree

Main steps using Git Bash and Source Tree.

1. **Clone the project repo. One time operation.**
2. **Create a branch from the JIRA ticket**
3. **Pull the branch**
4. **Checkout the branch**
5. **Add/update a source files**
6. **Commit the change**
7. **Pull the changes from remote repo**
8. **Push your change to remote repo, in the feature/ bugfix branch**
9. **Add a tag o the last commit form the feature/bugfix branch and push the tag**
10. **Merge the feature/bugfix branch to the official branch through BitBucket Pull Request**

Git setup on git bash

Syntax highlighting:

```
git config --global color.ui auto
```

Introduce yourself:

```
git config --global user.name “Name“
git config --global user.email email
```

Check your settings:

```
git config --list
```

Or check a specific key’s configuration

```
git config <key>
```

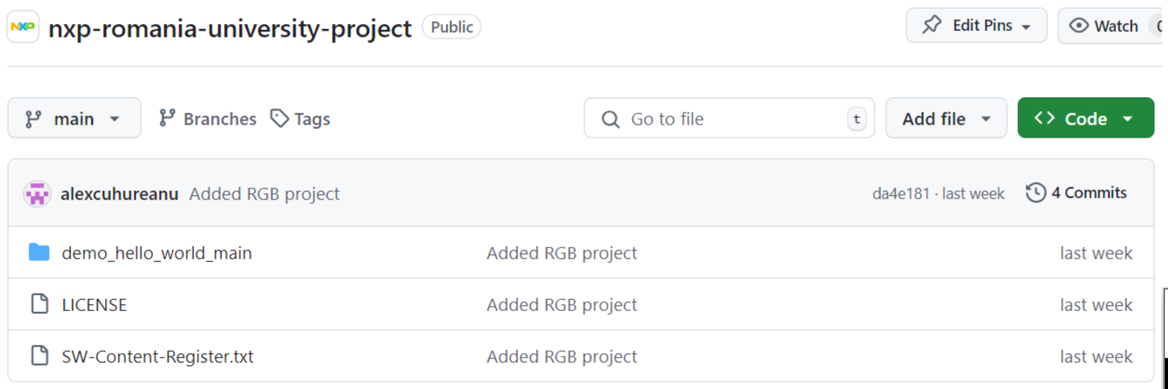
e.g. Make a clone:

```
git clone …..
```

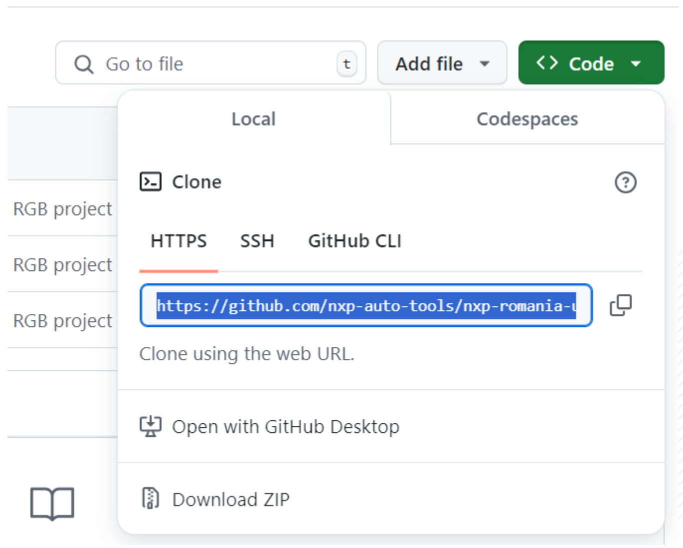
[Git ducation]

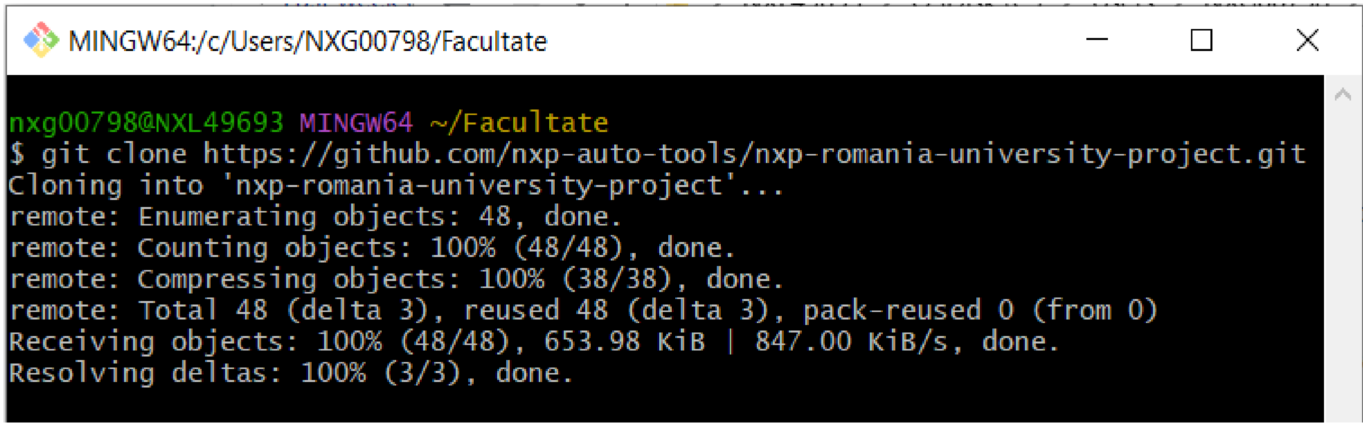
GitHub

Git Bash



demo_hello_world_main	Added RGB project	last week
LICENSE	Added RGB project	last week
SW-Content-Register.txt	Added RGB project	last week





```
nxg00798@NXL49693 MINGW64 ~/Facultate
$ git clone https://github.com/nxp-auto-tools/nxp-romania-university-project.git
Cloning into 'nxp-romania-university-project'...
remote: Enumerating objects: 48, done.
remote: Counting objects: 100% (48/48), done.
remote: Compressing objects: 100% (38/38), done.
remote: Total 48 (delta 3), reused 48 (delta 3), pack-reused 0 (from 0)
Receiving objects: 100% (48/48), 653.98 KiB | 847.00 KiB/s, done.
Resolving deltas: 100% (3/3), done.
```

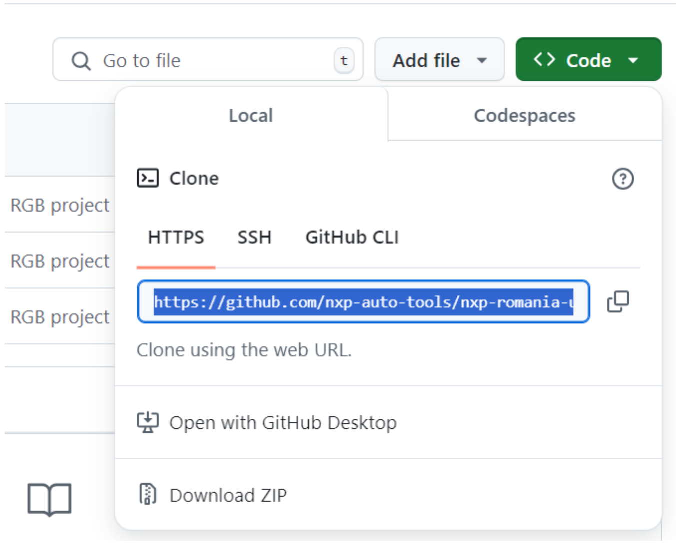
| Clone a repository

Cloning a repo

Someone else's repository can be located on their local file system or on a remote machine accessible via HTTP, HTTPS, SSH, etc.

To clone the repo onto your local machine:

```
git clone <url>
```



https://github.com/nxp-auto-tools/nxp-romania-

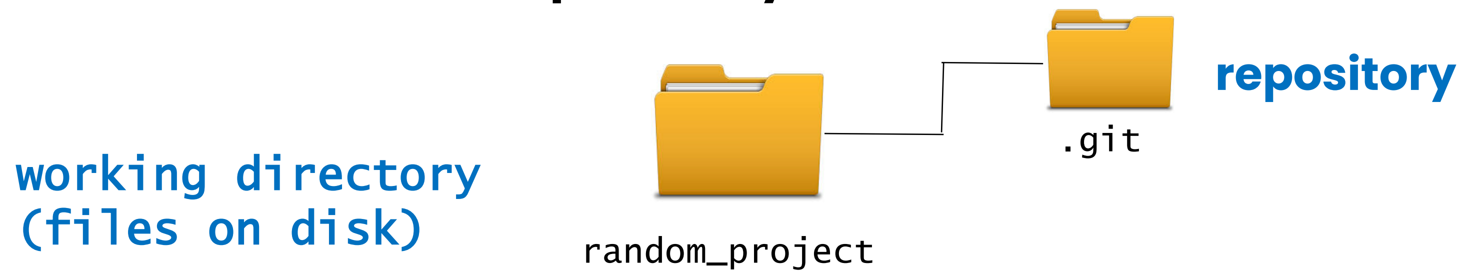
Clone using the web URL.

e.g. using SSH protocol:

```
git clone https://github.com/NXP/*repo*.git
```

SSH uses public-key authentication, so you'll have to generate one

Repository status



Now, you can notice a .git directory in the initialized project directory (is hidden).
Deleting it will turn your project into a normal unmanaged collection of files

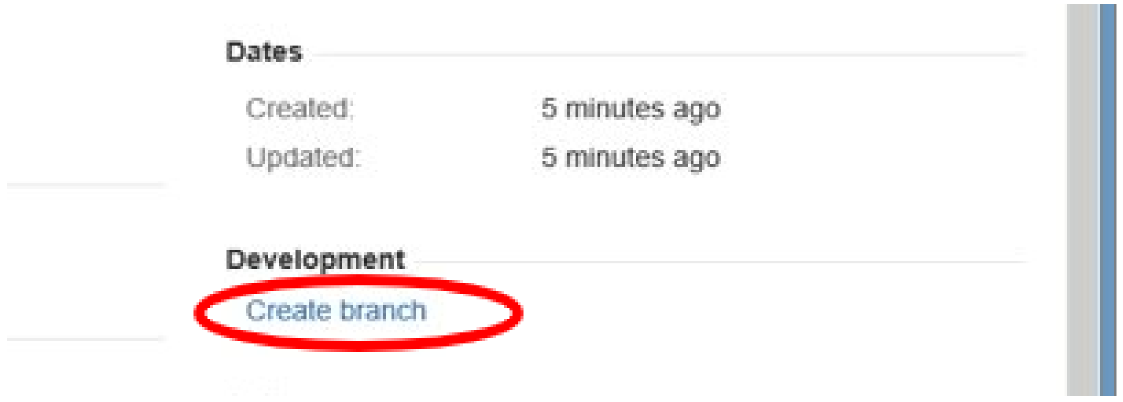
Next, you'll want to see the status of the repository:

```
git status
```

Output:

```
On branch master

Initial commit

nothing to commit (create/copy files and use "git add" to
track)
```

Create a branch from the JIRA ticket

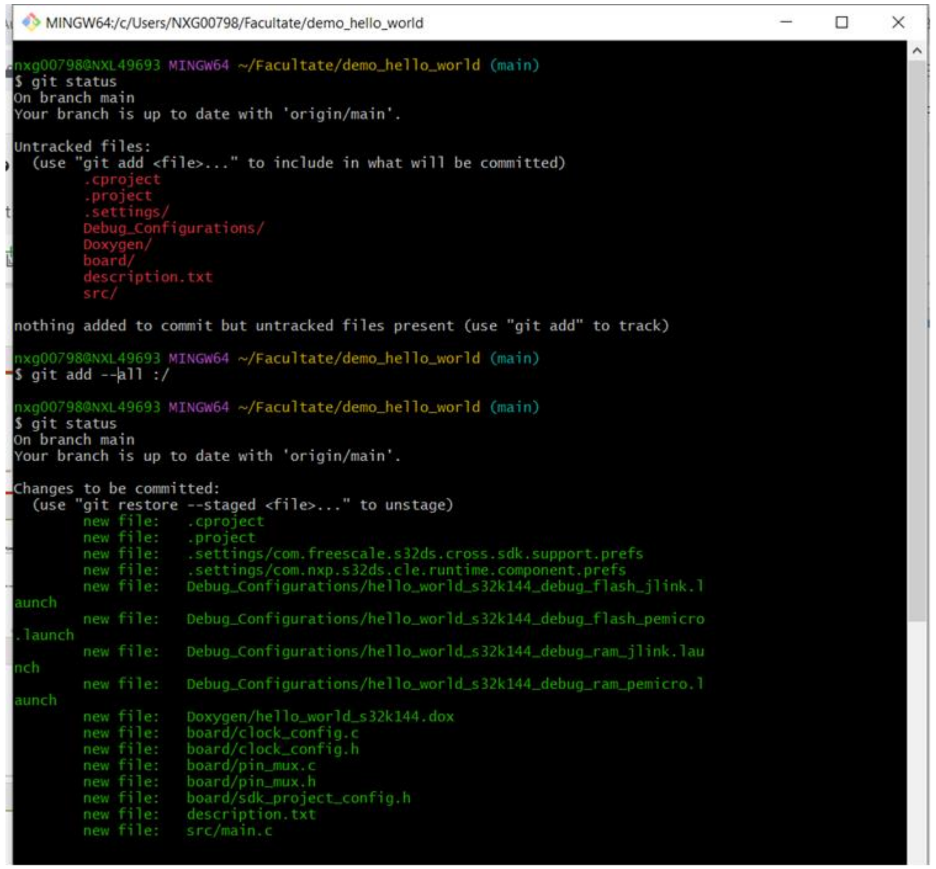


Dates

Created:	5 minutes ago
Updated:	5 minutes ago

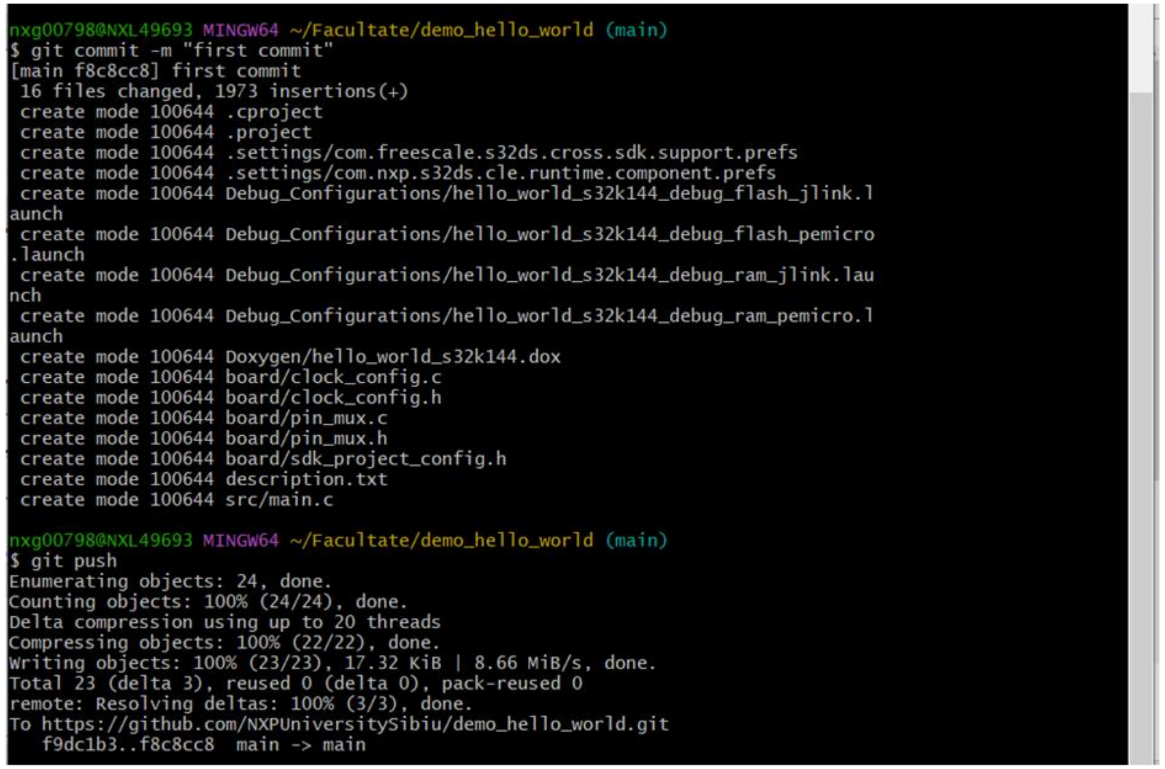
Development

| Commit your changes

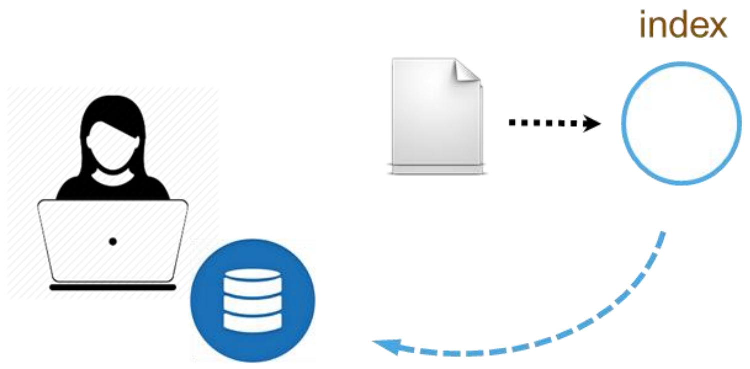


MINGW64:/c/Users/NXG00798/Facultate/demo_hello_world

```
nxg00798@NXL49693 MINGW64 ~/Facultate/demo_hello_world (main)
$ git status
On branch main
Your branch is up to date with 'origin/main'.

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        .cproject
        .project
        .settings/
        Debug_Configurations/
        Doxygen/
        board/
        description.txt
        src/

nothing added to commit but untracked files present (use "git add" to track)

nxg00798@NXL49693 MINGW64 ~/Facultate/demo_hello_world (main)
$ git add --all :/

nxg00798@NXL49693 MINGW64 ~/Facultate/demo_hello_world (main)
$ git status
On branch main
Your branch is up to date with 'origin/main'.

Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        new file:   .cproject
        new file:   .project
        new file:   .settings/com.freescale.s32ds.cross.sdk.support.prefs
        new file:   .settings/com.nxp.s32ds.cle.runtime.component.prefs
        new file:   Debug_Configurations/hello_world_s32k144_debug_flash_jlink.l
aunch
        new file:   Debug_Configurations/hello_world_s32k144_debug_flash_pemicro
.launch
        new file:   Debug_Configurations/hello_world_s32k144_debug_ram_jlink.lau
nch
        new file:   Debug_Configurations/hello_world_s32k144_debug_ram_pemicro.l
aunch
        new file:   Doxygen/hello_world_s32k144.dox
        new file:   board/clock_config.c
        new file:   board/clock_config.h
        new file:   board/pin_mux.c
        new file:   board/pin_mux.h
        new file:   board/sdk_project_config.h
        new file:   description.txt
        new file:   src/main.c
```



```
nxg00798@NXL49693 MINGW64 ~/Facultate/demo_hello_world (main)
$ git commit -m "first commit"
[main f8c8cc8] first commit
 16 files changed, 1973 insertions(+)
 create mode 100644 .cproject
 create mode 100644 .project
 create mode 100644 .settings/com.freescale.s32ds.cross.sdk.support.prefs
 create mode 100644 .settings/com.nxp.s32ds.cle.runtime.component.prefs
 create mode 100644 Debug_Configurations/hello_world_s32k144_debug_flash_jlink.l
aunch
 create mode 100644 Debug_Configurations/hello_world_s32k144_debug_flash_pemicro
.launch
 create mode 100644 Debug_Configurations/hello_world_s32k144_debug_ram_jlink.lau
nch
 create mode 100644 Debug_Configurations/hello_world_s32k144_debug_ram_pemicro.l
aunch
 create mode 100644 Doxygen/hello_world_s32k144.dox
 create mode 100644 board/clock_config.c
 create mode 100644 board/clock_config.h
 create mode 100644 board/pin_mux.c
 create mode 100644 board/pin_mux.h
 create mode 100644 board/sdk_project_config.h
 create mode 100644 description.txt
 create mode 100644 src/main.c

nxg00798@NXL49693 MINGW64 ~/Facultate/demo_hello_world (main)
$ git push
Enumerating objects: 24, done.
Counting objects: 100% (24/24), done.
Delta compression using up to 20 threads
Compressing objects: 100% (22/22), done.
Writing objects: 100% (23/23), 17.32 KiB | 8.66 MiB/s, done.
Total 23 (delta 3), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (3/3), done.
To https://github.com/NXPUniversitySibiu/demo_hello_world.git
   f9dc1b3..f8c8cc8  main -> main
```



Committing files

Committing the snapshot

```
git commit -m "Added the module definitions and functionalities"
```

-m flag prevents the additional editor window message to pop up.

Your message should, however, be explicit enough to others.
To exit and save contents, hit Esc and then, enter :wq.

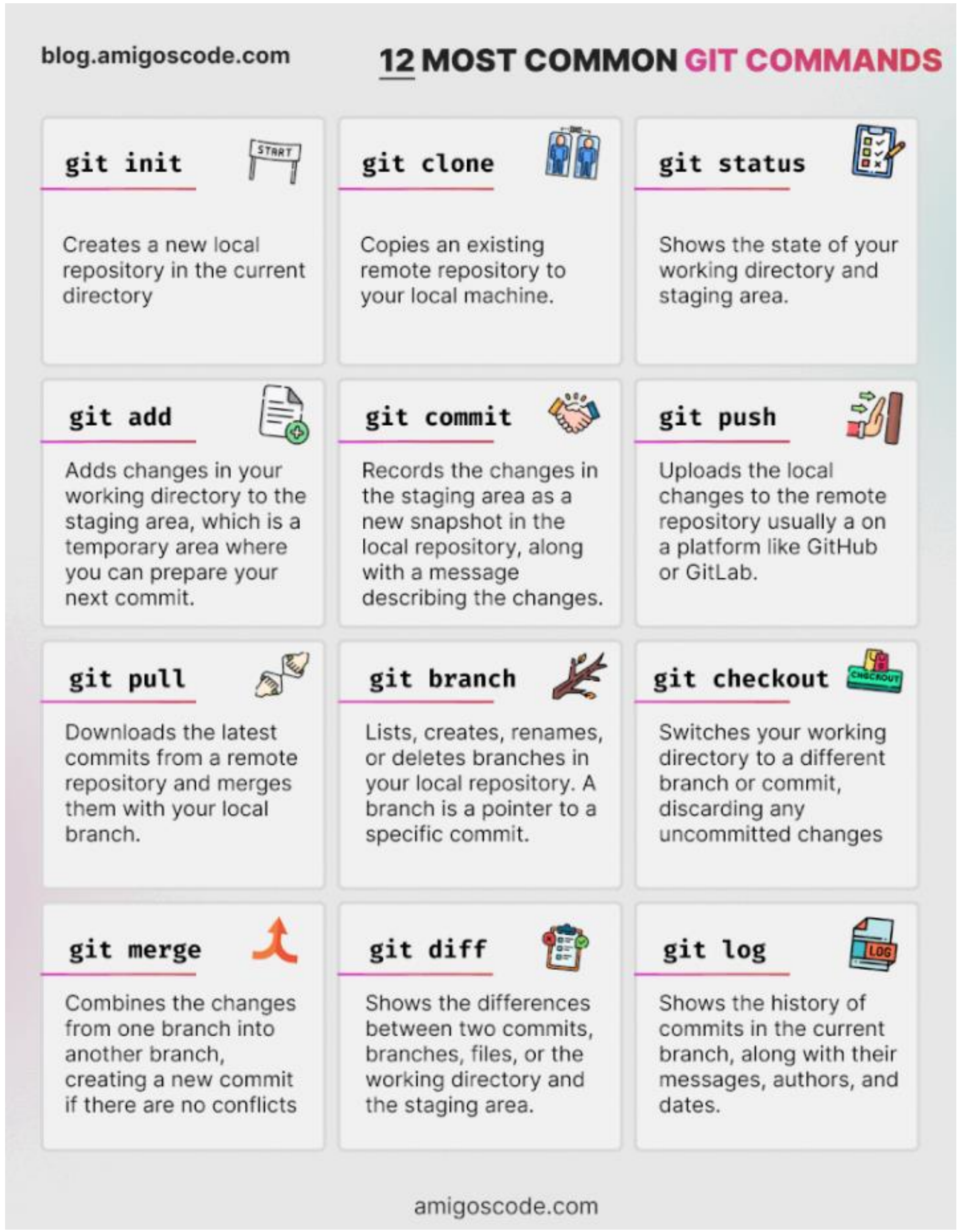
Note that git status only shows the uncommitted changes.
If you run it after a commit, it will show that you have no more files to commit.
(only if you don't add new files in your working directory in the meantime)

Checkout <branch>

```
git checkout <branch-name>
```

To return to the current (default) branch – master (restores current files in index and working directory):

```
git checkout master
```



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12 MOST COMMON GIT COMMANDS

`git init`

Creates a new local repository in the current directory

`git clone`

Copies an existing remote repository to your local machine.

`git status`

Shows the state of your working directory and staging area.

`git add`

Adds changes in your working directory to the staging area, which is a temporary area where you can prepare your next commit.

`git commit`

Records the changes in the staging area as a new snapshot in the local repository, along with a message describing the changes.

`git push`

Uploads the local changes to the remote repository usually a on a platform like GitHub or GitLab.

`git pull`

Downloads the latest commits from a remote repository and merges them with your local branch.

`git branch`

Lists, creates, renames, or deletes branches in your local repository. A branch is a pointer to a specific commit.

`git checkout`

Switches your working directory to a different branch or commit, discarding any uncommitted changes

`git merge`

Combines the changes from one branch into another branch, creating a new commit if there are no conflicts

`git diff`

Shows the differences between two commits, branches, files, or the working directory and the staging area.

`git log`

Shows the history of commits in the current branch, along with their messages, authors, and dates.

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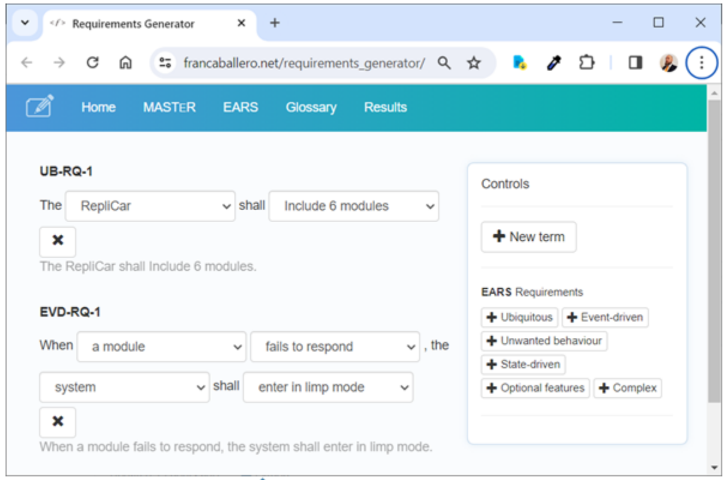
Conclusion



Requirements Generator

francaballero.net/requirements_generator/

Home MASTER EARS Glossary Results

UB-RQ-1

The RepliCar shall Include 6 modules

The RepliCar shall Include 6 modules.

EVD-RQ-1

When a module fails to respond, the system shall enter in limp mode

When a module fails to respond, the system shall enter in limp mode.

Controls

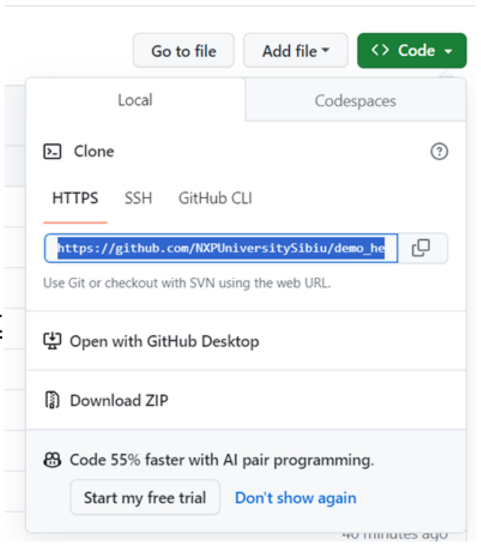
+ New term

EARS Requirements

+ Ubiquitous + Event-driven + Unwanted behaviour + State-driven + Optional features + Complex

GitBash

Clone the project repo



Go to file | Add file | Code

Local | Codespaces

Clone

HTTPS SSH GitHub CLI

```
https://github.com/NXPUniversitySibiu/demo_he
```

Use Git or checkout with SVN using the web URL.

Open with GitHub Desktop

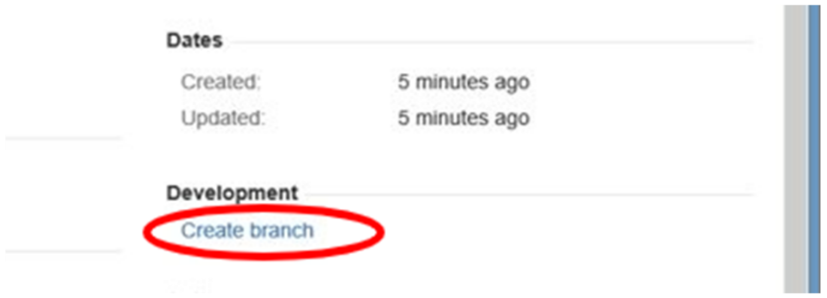
Download ZIP

Code 55% faster with AI pair programming.

Start my free trial | Don't show again

Working

Jira



Dates

Created:	5 minutes ago
Updated:	5 minutes ago

Development

Create branch

GitBash

- git status
- git add
- git commit
- Git push

- PR
- Merge

Jira

ENVIRONMENT SET-UP

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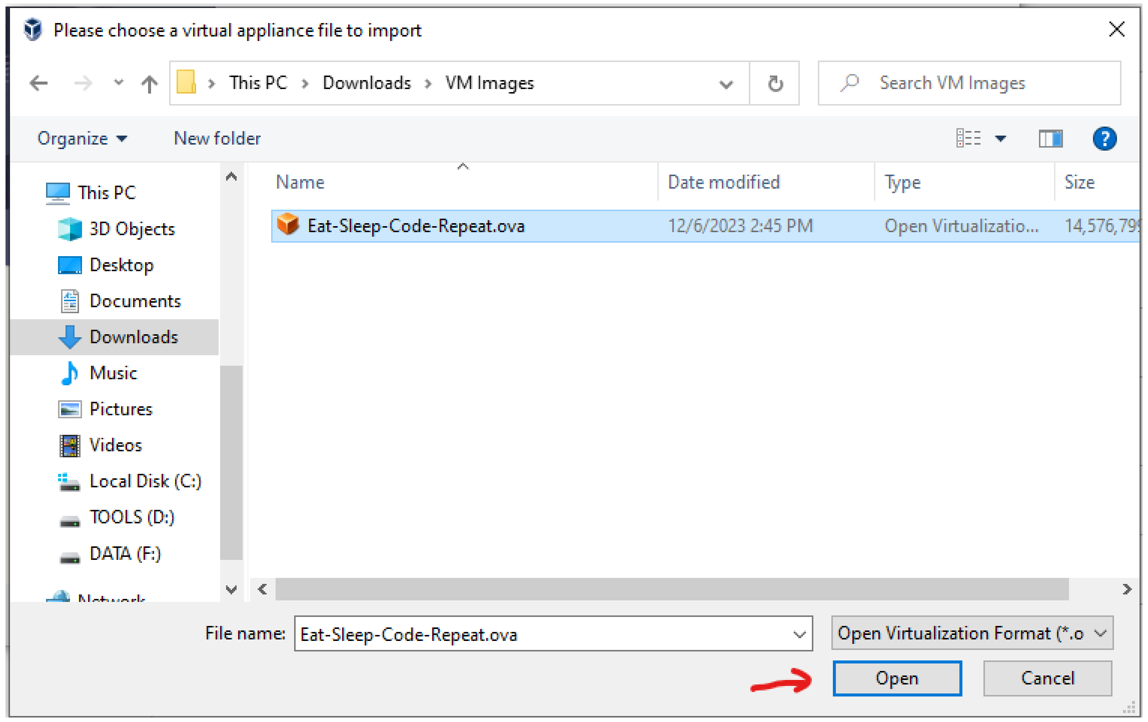
Install VirtualBox

- Prerequisites
  - 40 GB free space on disk
  - Enable Virtualization. If is disabled, please search on google the procedure specific for your own laptop (e.g. search on google *How to Enable Virtualization on HP Latitude xxx*) - Usually this is activated by default on most models.
- Install VirtualBox - v7 is required
- Download VM image - **Eat-Sleep-Code-Repeat.ova**

Eat-Sleep-Code-Repeat.ova - Google Drive

Import Image into VirtualBox

- Start VirtualBox
- Go to **File->Import Appliance…** menu (Ctrl+I)
- Browse and select the downloaded **Eat-Sleep-Code-Repeat.ova**

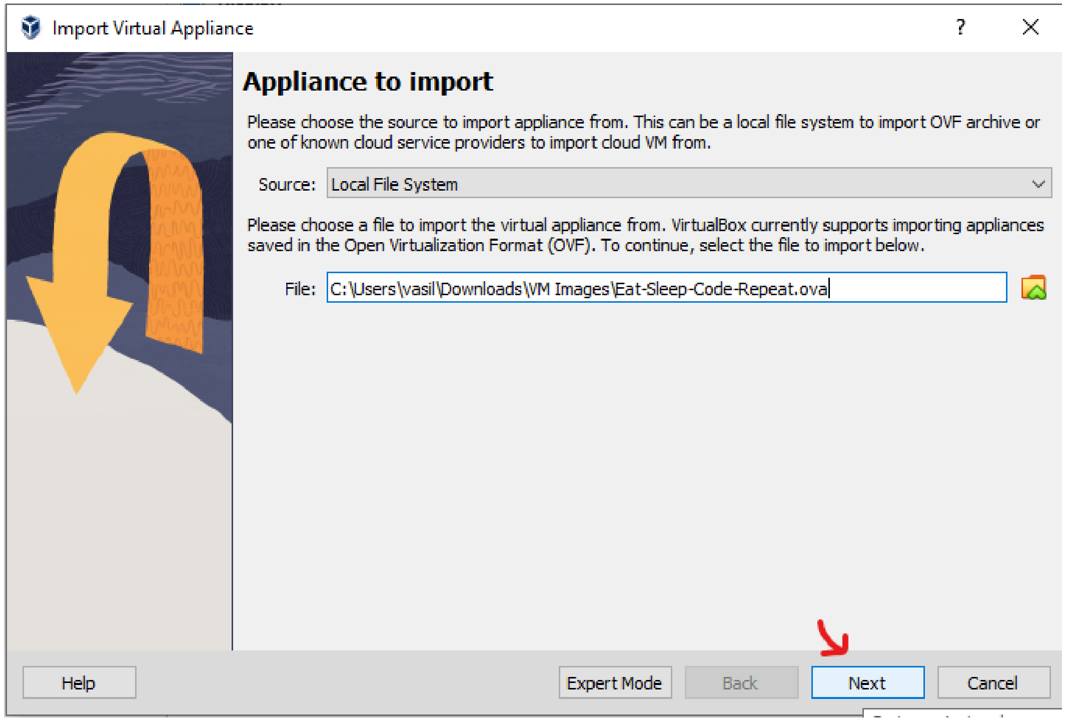

Please choose a virtual appliance file to import

This PC › Downloads › VM Images

Name	Date modified	Type	Size
Eat-Sleep-Code-Repeat.ova	12/6/2023 2:45 PM	Open Virtualizatio...	14,576,79

File name: Eat-Sleep-Code-Repeat.ova

Open Virtualization Format (*.o


Import Virtual Appliance

Appliance to import

Please choose the source to import appliance from. This can be a local file system to import OVF archive or one of known cloud service providers to import cloud VM from.

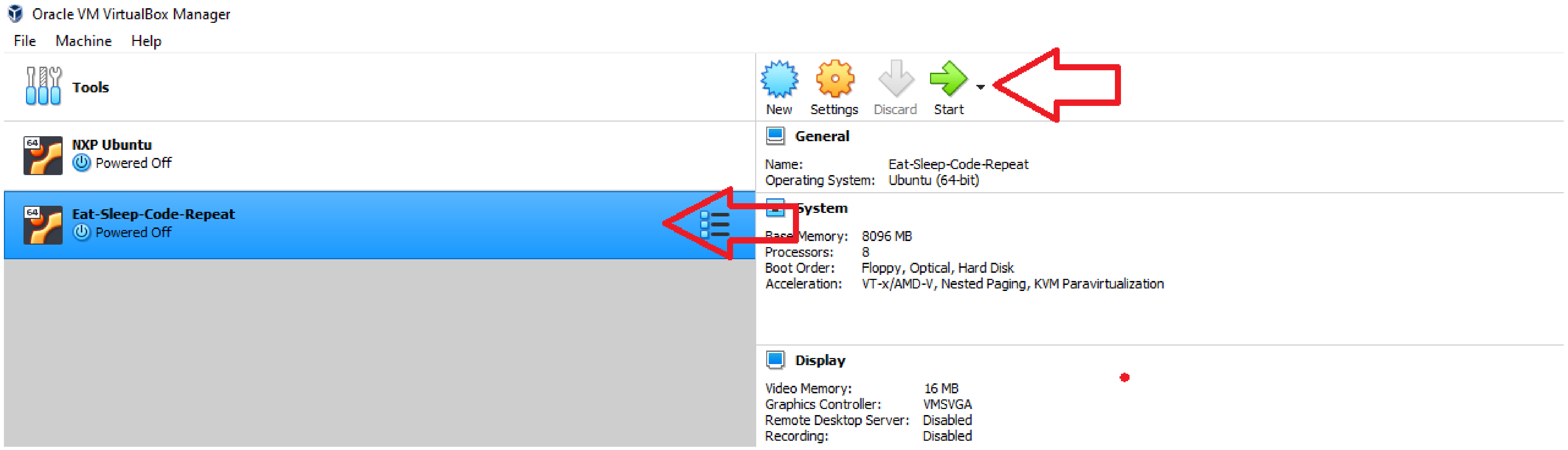
Source: Local File System

Please choose a file to import the virtual appliance from. VirtualBox currently supports importing appliances saved in the Open Virtualization Format (OVF). To continue, select the file to import below.

File: C:\Users\vasil\Downloads\VM Images\Eat-Sleep-Code-Repeat.ova

Import Image into VirtualBox

- Select Eat-Sleep-Code-Repeat and then press **Start** button
- Default username: **student**
- Default password: **student**

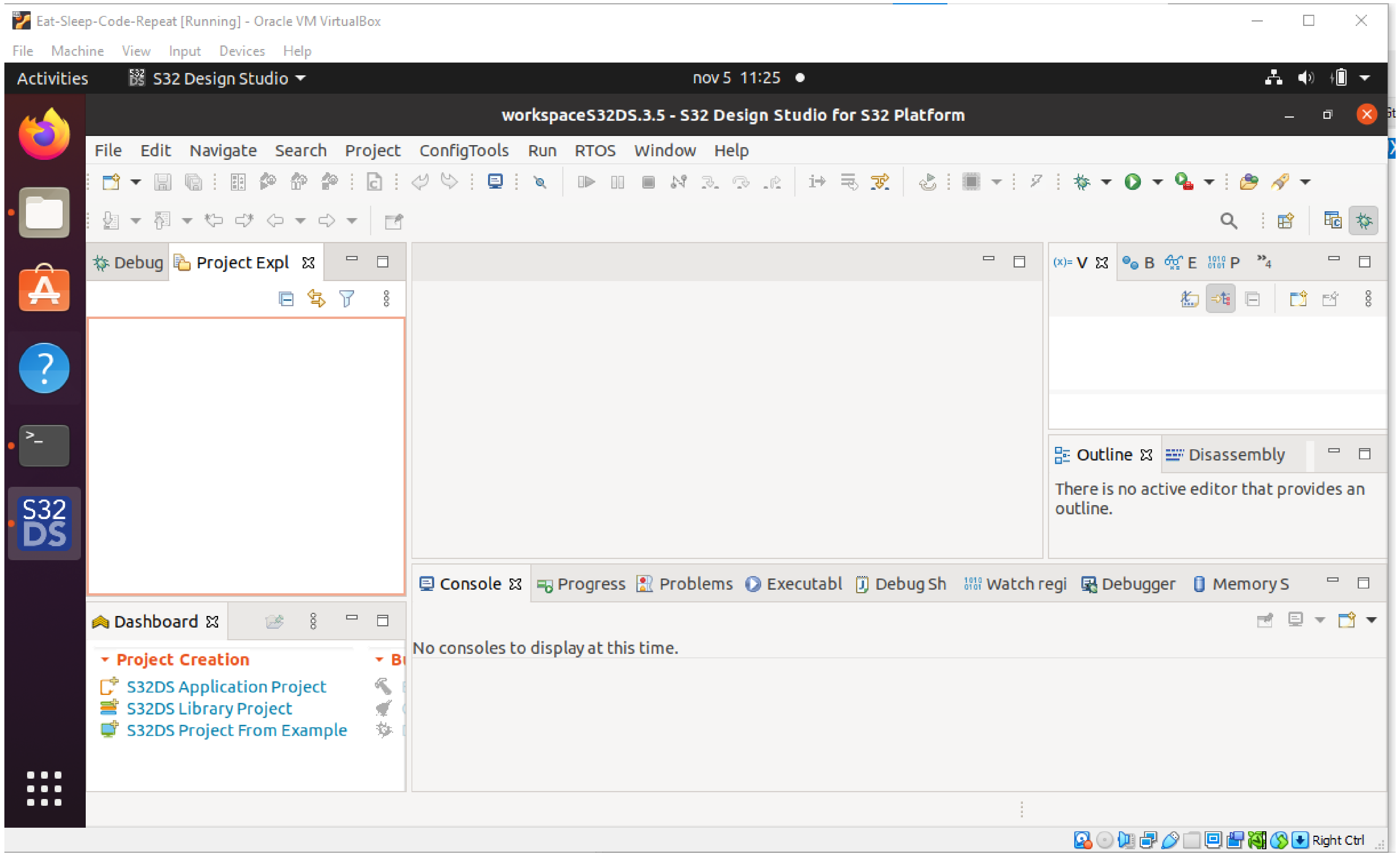


Name: Eat-Sleep-Code-Repeat
Operating System: Ubuntu (64-bit)

Base Memory: 8096 MB
Processors: 8
Boot Order: Floppy, Optical, Hard Disk
Acceleration: VT-x/AMD-V, Nested Paging, KVM Paravirtualization

Video Memory: 16 MB
Graphics Controller: VMSVGA
Remote Desktop Server: Disabled
Recording: Disabled

Import Image into VirtualBox


Eat-Sleep-Code-Repeat [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities
S32 Design Studio
nov 5 11:25
workspaceS32DS.3.5 - S32 Design Studio for S32 Platform
File Edit Navigate Search Project ConfigTools Run RTOS Window Help
Debug
Project Expl
Outline
Disassembly
Console
Progress
Problems
Executabl
Debug Sh
Watch regi
Debugger
Memory S
Dashboard
Project Creation
S32DS Application Project
S32DS Library Project
S32DS Project From Example
Right Ctrl

There is no active editor that provides an outline.

No consoles to display at this time.

Activate S32DS

- Start **S32 Design Studio for S32 Platform 3.5**
- Open terminal in ***/home/student/NXP/S32DS.3.5***
- *sudo ./s32ds.sh*
- Design : Product Download : Files
- If it asks for an activation code, ask for it!

How Hardware and Software are Linked

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What is Hardware and Software?

Hardware

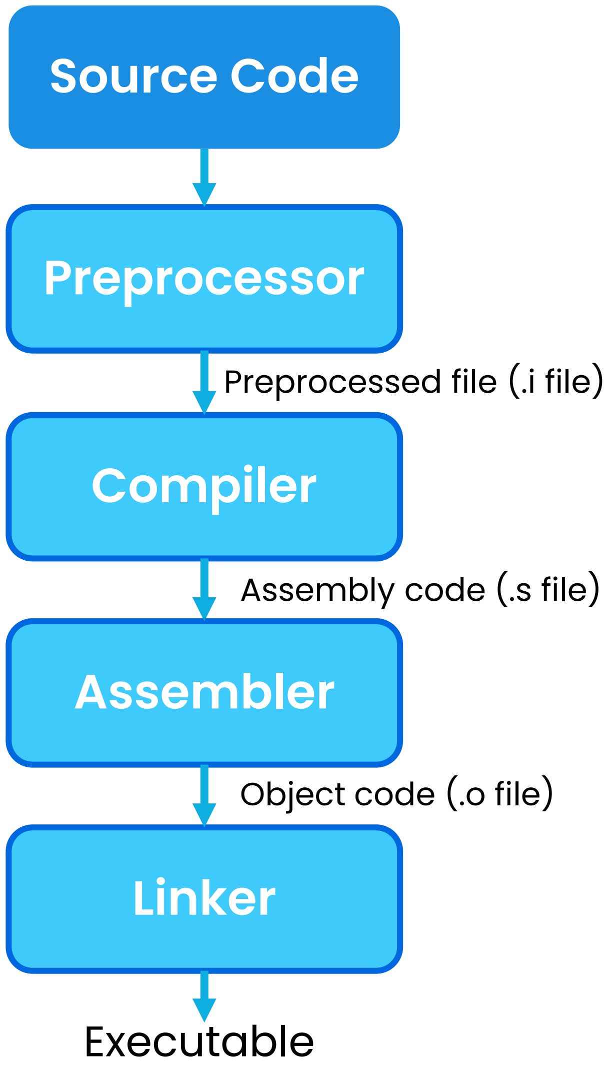
Hardware refers to the physical, tangible components of a computing system or electronic device. It includes all mechanical, electronic, and electric part that form the foundation of the system's functionality. Essentially, hardware is everything you can touch and see in a computer or device.

Software

Software refers to the set of instructions, programs and data that run on hardware, guiding it to perform specific tasks. Unlike hardware, software is intangible; it cannot be physically touched but it plays a crucial role in controlling and managing the hardware.

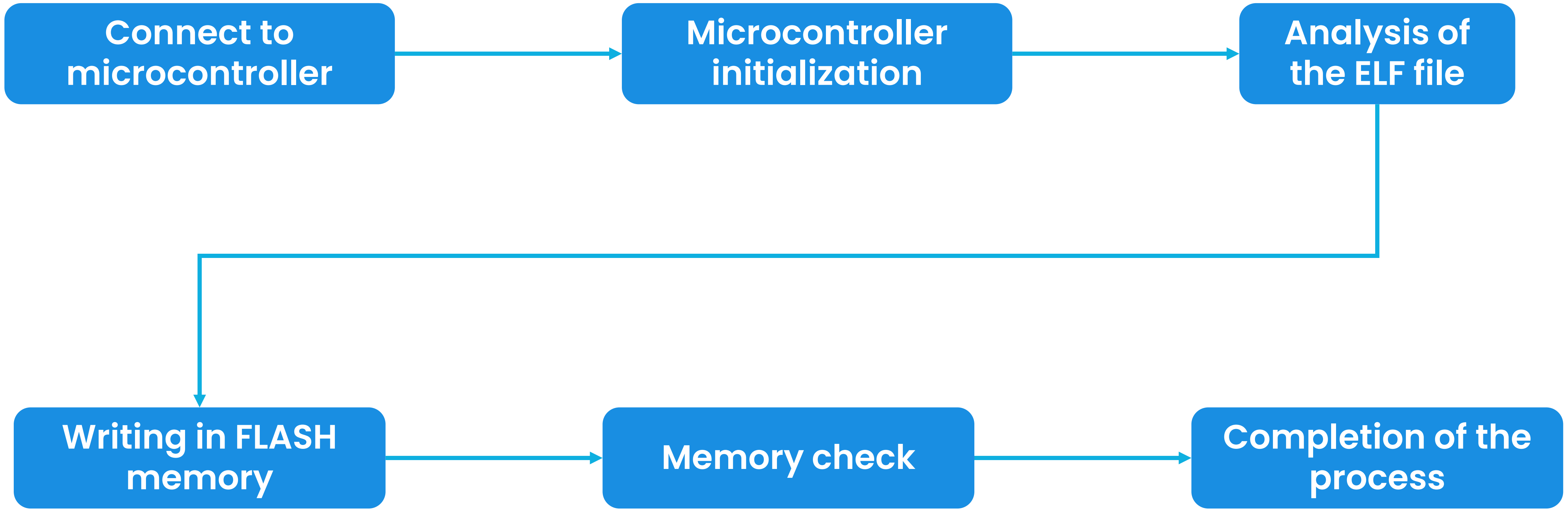
From source code to executable

Compiling



Writing to Flash memory

Flashing the microcontroller


Connect to microcontroller
Microcontroller initialization
Analysis of the ELF file
Writing in FLASH memory
Memory check
Completion of the process

S32K144 board ON VM

- **Set-up debug configuration & exercise**

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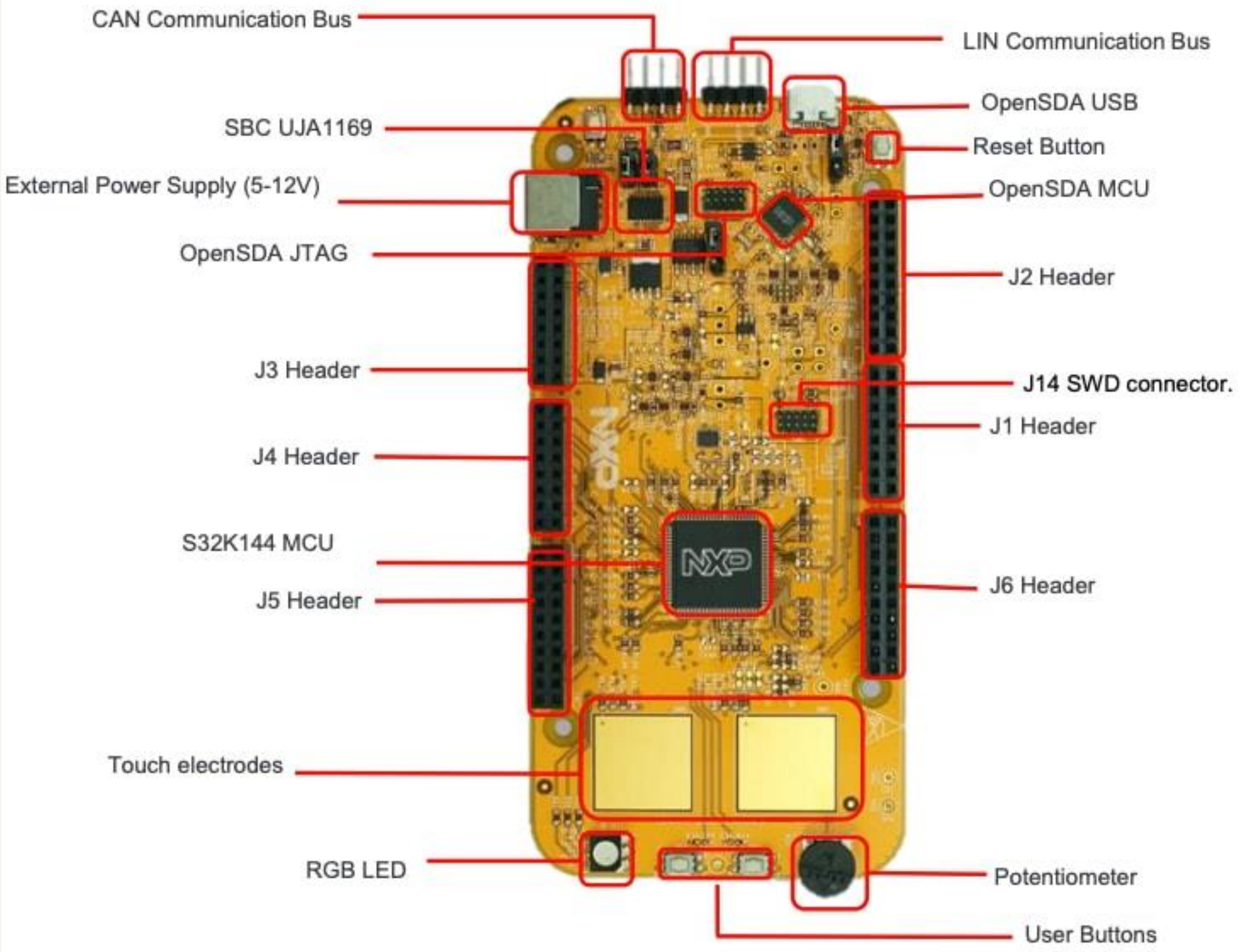
02

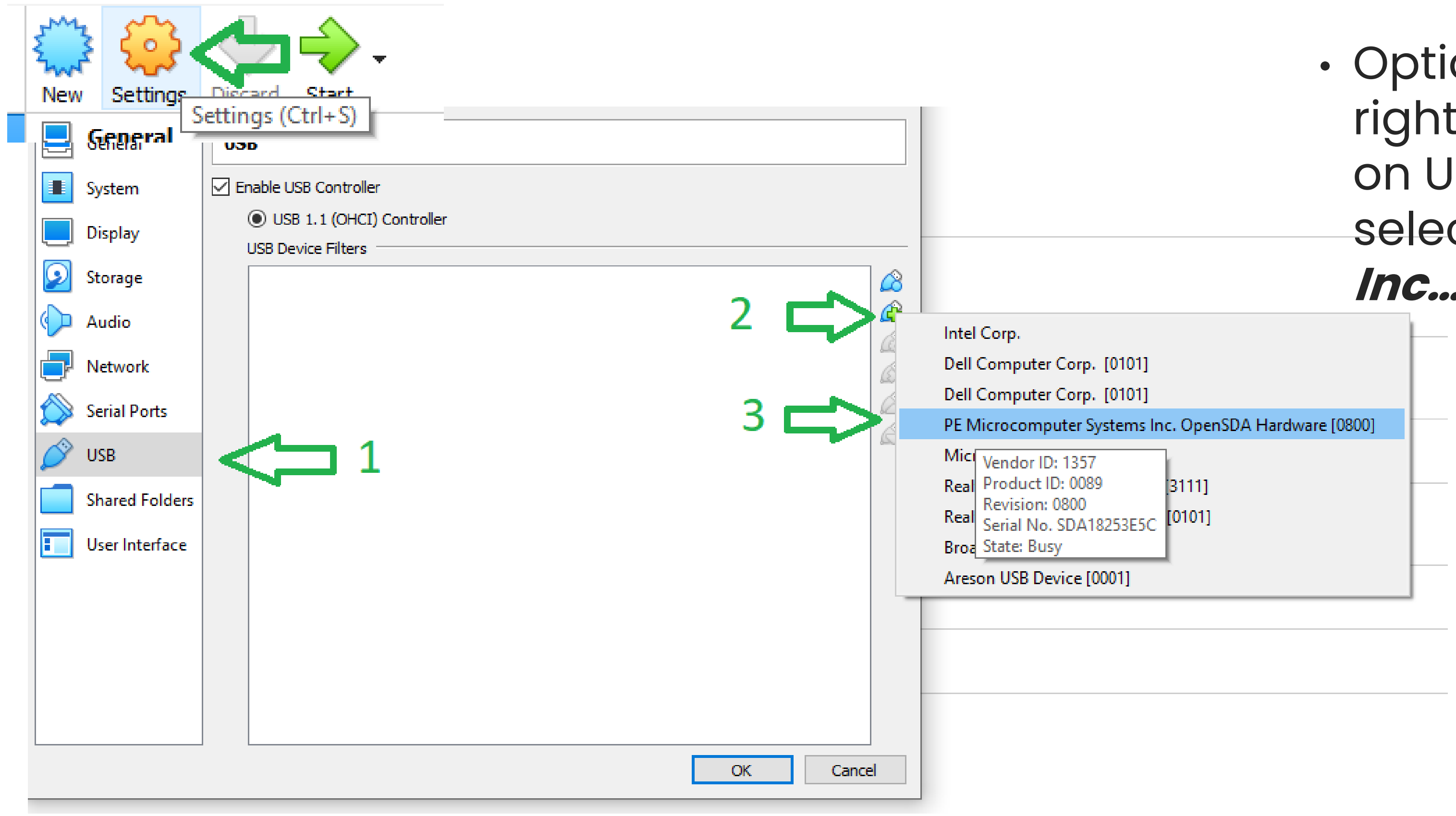
S32K144

Get to Know Your Evaluation Board

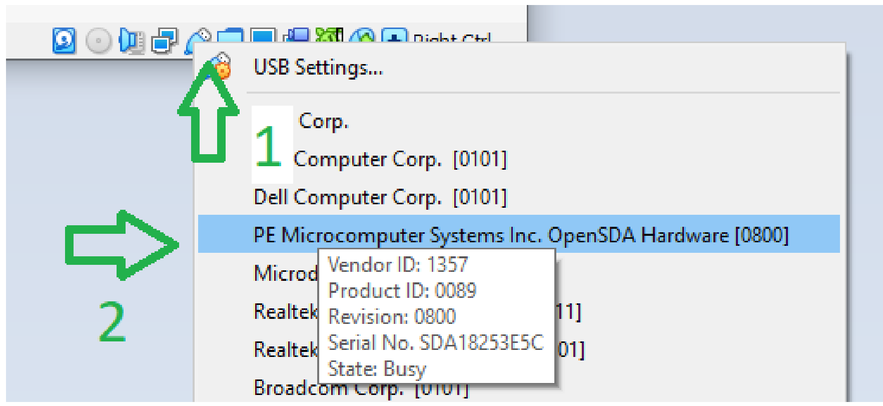


Attach Board to VM

- Option 1: With VM turned OFF, select the VM and click on **Settings** button or press **Ctrl+S** keys
- Select **USB** node then click on **Add new USB filter…** And from the list select ***PE Microcomputer Systems Inc.….*** device

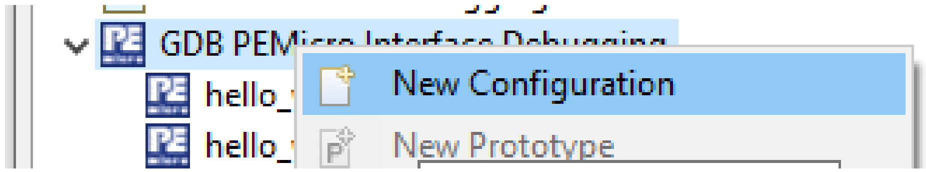


- Option 2: With VM running, from the right-bottom of the VM screen, right click on USB icon and select ***PE Microcomputer Systems Inc.….*** device from the list



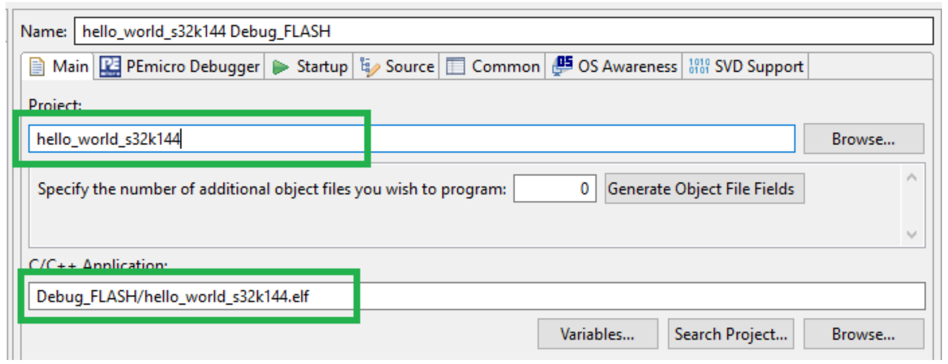
Create DEBUG Configuration

- Start ***S32 Design Studio for S32 Platform 3.5***
- Select **hello world** project
- Build project – click **Project > Build All (Ctrl+B)**
- Click **Run > Run** or **Run > Debug**.
- Expand ***GDB PEMicro Interface Debugging***
- If there is no entry like *{project_name}_Debug_FLASH* create a new configuration -> right click on ***GDB PEMicro Interface Debugging -> New Configuration***



Create DEBUG Configuration

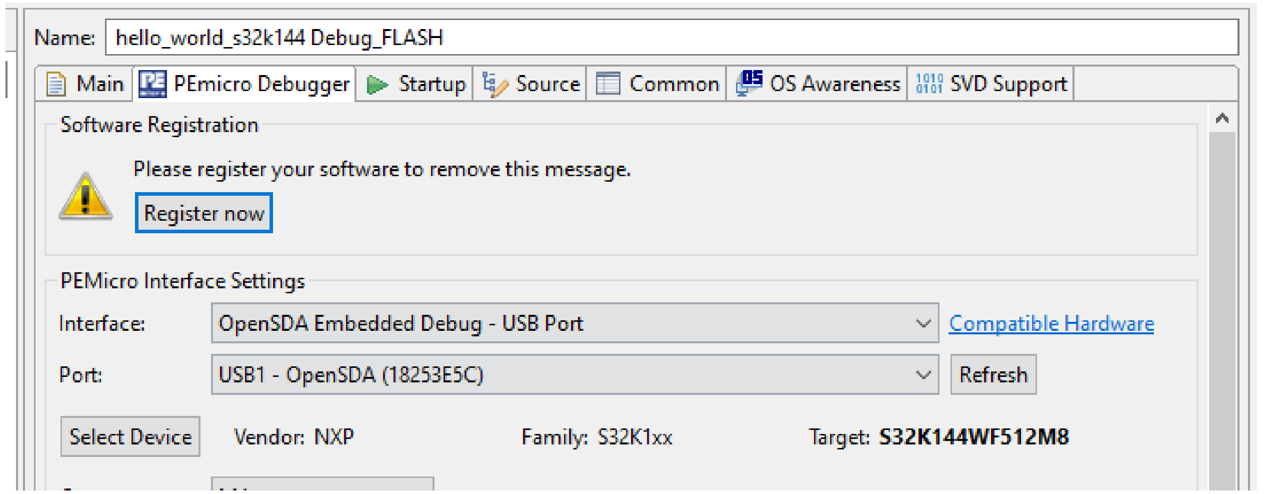
- In the **Main** tab select ***Project*** and *C/C++ Application*
- In the **Pemicro Debugger** tab set **Interface, Port**
- Click on ***Select Device*** and select ***S32K144WF512M8*** device


Name: hello_world_s32k144 Debug_FLASH

Project: hello_world_s32k144

Specify the number of additional object files you wish to program: 0

C/C++ Application: Debug_FLASH/hello_world_s32k144.elf


Name: hello_world_s32k144 Debug_FLASH

Software Registration

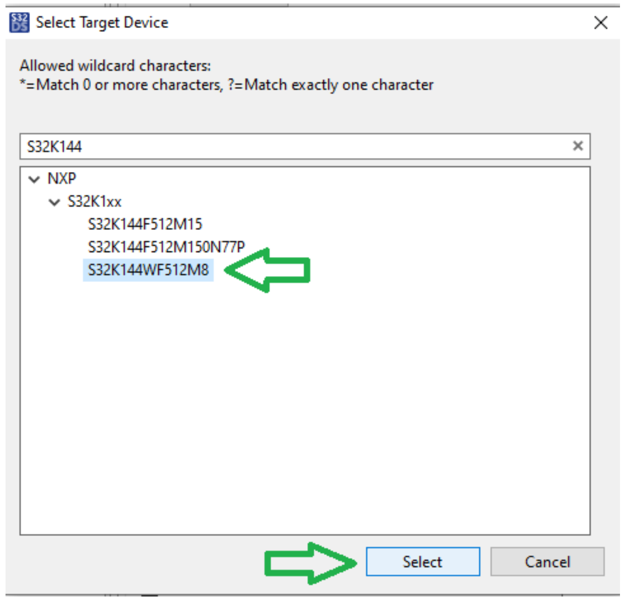
Please register your software to remove this message.

PEMicro Interface Settings

Interface: OpenSDA Embedded Debug - USB Port

Port: USB1 - OpenSDA (18253E5C)

Vendor: NXP Family: S32K1xx Target: S32K144WF512M8


Select Target Device

Allowed wildcard characters:
*=Match 0 or more characters, ?=Match exactly one character

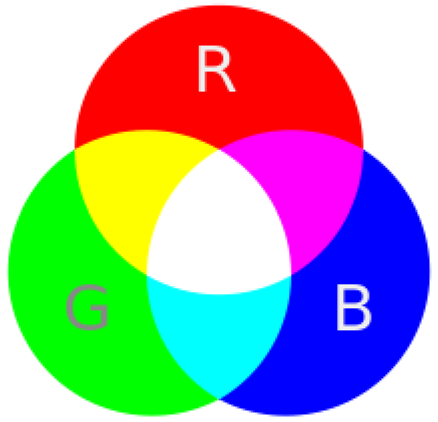
S32K144

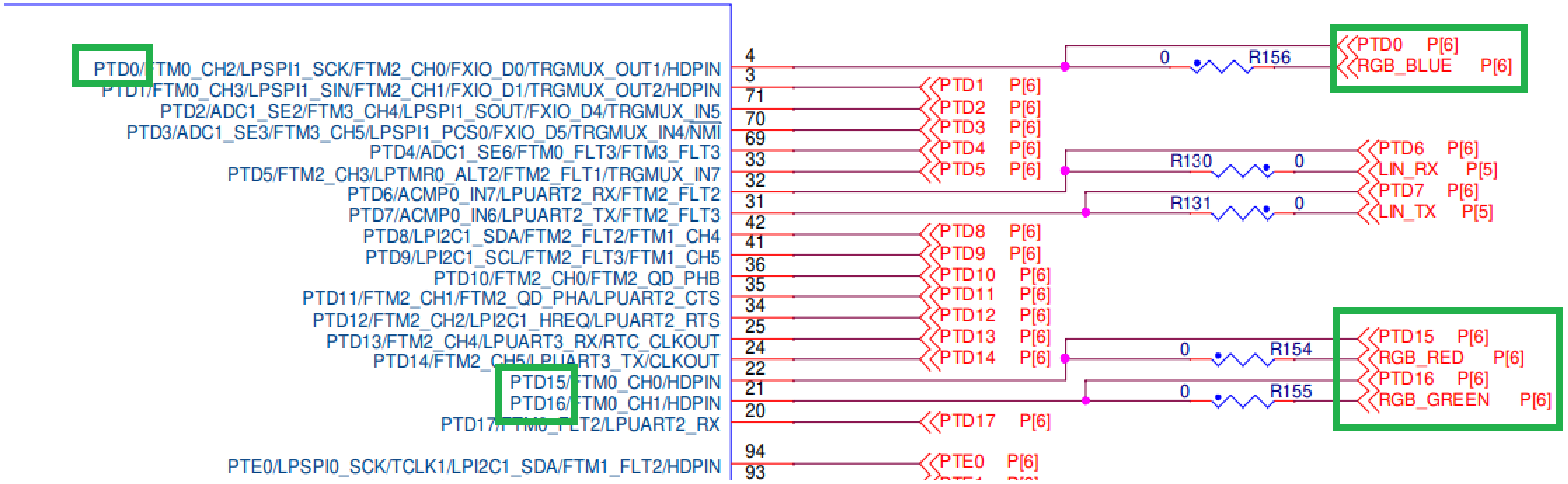
NXP
S32K1xx
S32K144F512M15
S32K144F512M150N77P
S32K144WF512M8

- Click on **Debug** button – the project will be flashed on board and the application will start to run on this.
- From this point, the Debug perspective will be opened and the execution will stop at the first line of **main** function – click **F8** to resume the code execution

Exercise: RED-YELLOW-BLUE

- The initial demo project will make the RGB LED to blink rapidly RED and GREEN colors
- Scope of this exercise is to make the RGB LED to blink on RED, YELLOW and BLUE

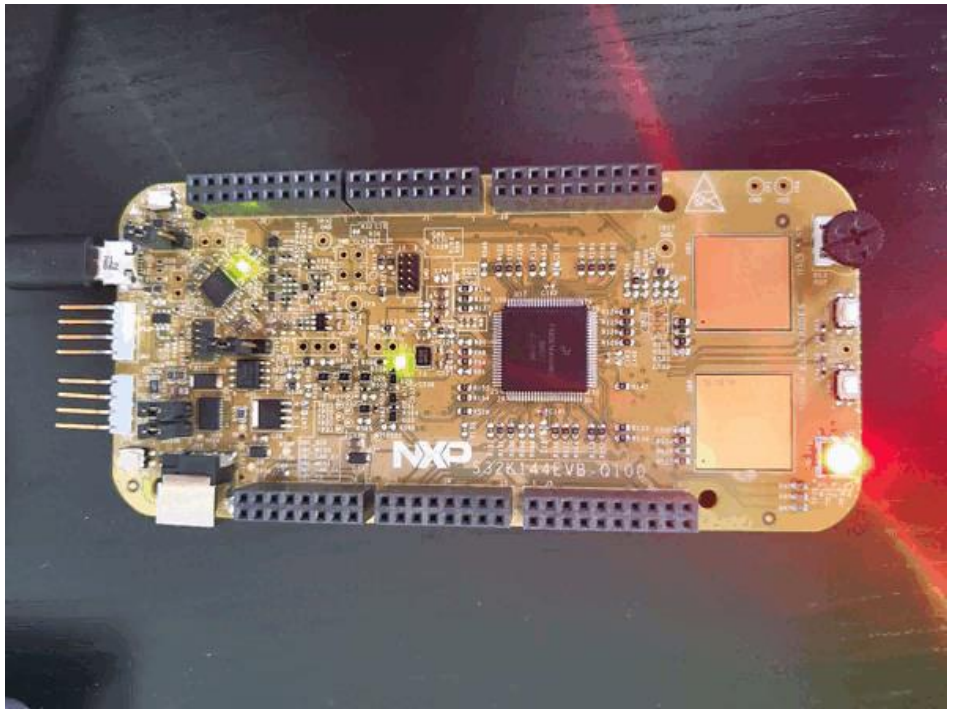



PTD0/FTM0_CH2/LPSPI1_SCK/FTM2_CH0/FXIO_D0/TRGMUX_OUT1/HDPIN
PTD1/FTM0_CH3/LPSPI1_SIN/FTM2_CH1/FXIO_D1/TRGMUX_OUT2/HDPIN
PTD2/ADC1_SE2/FTM3_CH4/LPSPI1_SOUT/FXIO_D4/TRGMUX_IN5
PTD3/ADC1_SE3/FTM3_CH5/LPSPI1_PCS0/FXIO_D5/TRGMUX_IN4/NMI
PTD4/ADC1_SE6/FTM0_FLT3/FTM3_FLT3
PTD5/FTM2_CH3/LPTMR0_ALT2/FTM2_FLT1/TRGMUX_IN7
PTD6/ACMP0_IN7/LPUART2_RX/FTM2_FLT2
PTD7/ACMP0_IN6/LPUART2_TX/FTM2_FLT3
PTD8/LPI2C1_SDA/FTM2_FLT2/FTM1_CH4
PTD9/LPI2C1_SCL/FTM2_FLT3/FTM1_CH5
PTD10/FTM2_CH0/FTM2_QD_PHB
PTD11/FTM2_CH1/FTM2_QD_PHA/LPUART2_CTS
PTD12/FTM2_CH2/LPI2C1_HREQ/LPUART2_RTS
PTD13/FTM2_CH4/LPUART3_RX/RTC_CLKOUT
PTD14/FTM2_CH5/LPUART3_TX/CLKOUT
PTD15/FTM0_CH0/HDPIN
PTD16/FTM0_CH1/HDPIN
PTD17/FTM0_FLT2/LPUART2_RX
PTE0/LPSPI0_SCK/TCLK1/LPI2C1_SDA/FTM1_FLT2/HDPIN
4
3
71
70
69
33
32
31
42
41
36
35
34
25
24
22
21
20
94
93
PTD0 P[6]
RGB_BLUE P[6]
R156
0
PTD1 P[6]
PTD2 P[6]
PTD3 P[6]
PTD4 P[6]
PTD5 P[6]
PTD6 P[6]
LIN_RX P[5]
PTD7 P[6]
LIN_TX P[5]
R130
R131
0
0
PTD8 P[6]
PTD9 P[6]
PTD10 P[6]
PTD11 P[6]
PTD12 P[6]
PTD13 P[6]
PTD14 P[6]
PTD15 P[6]
RGB_RED P[6]
PTD16 P[6]
RGB_GREEN P[6]
R154
R155
0
0
PTD17 P[6]
PTE0 P[6]

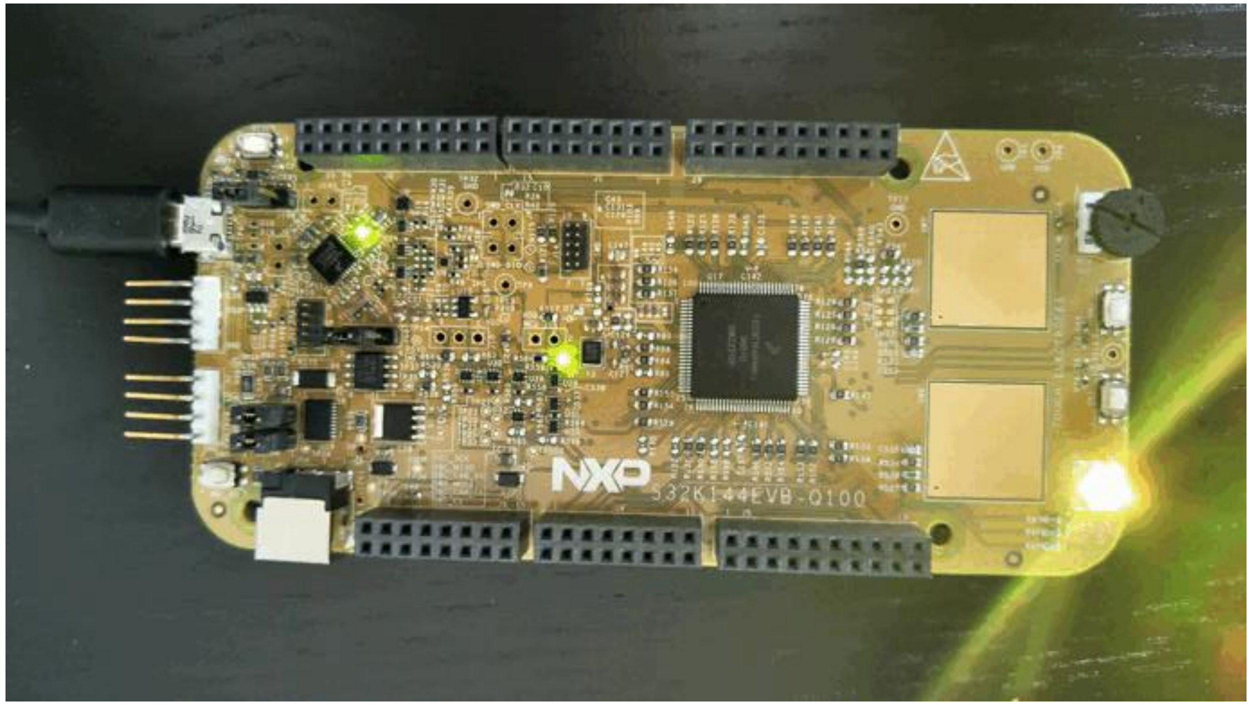
- RGB_BLUE – PTD0 ; RGB_RED – PTD15 ; RGB_GREEN – PTD16

Board pinout

Exercise: RED-YELLOW-BLUE



Before



Target result

Brighter Together

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