Internship at the Cyber Innovation Hub

Cybersecurity in Operational Technologies

Hyb Arloesedd Seiber
Cyber Innovation Hub

FONDATION RENNES 1
Progresser Innover Entreprendre

iut Lannion


Kirkwall
Elgin
Portree
Inverness
HEBRIDES
SCOTLAND
Aberdeen
Dundee
St Andrews
Stirling
Edinburgh
Glasgow
United Kingdom
Newcastle upon Tyne
Sligo
Leeds
Dundalk
Drogheda
Galway
Ireland
Dublin
Liverpool
Manchester
Limerick
Kilkenny
Birmingham
Norwich
Dingle
Tralee
Waterford
Cyber Innovation Hub
Cambridge
Killarney
Cork
Oxford
London
Bristol
Cardiff
Exeter
Bournemouth
Plymouth
English Channel
Rouen


Kirkwall
Elgin
Portree
Inverness
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SCOTLAND
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Dundee
St Andrews
Stirling
Edinburgh
Glasgow
United Kingdom
Newcastle upon Tyne
Sligo
Leeds
Dundalk
Drogheda
Galway
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Dublin
Liverpool
Manchester
Limerick
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Dingle
Tralee
Waterford
Cyber Innovation Hub
Cambridge
Killarney
Cork
Oxford
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Bristol
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Bournemouth
Plymouth
English Channel
Rouen

7 Avril 2025

7 Avril 2025 ⟶ 13 Juin 2025

10 semaines

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10 semaines

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Cybersécurité dans les technologies opérationnelles

10 semaines

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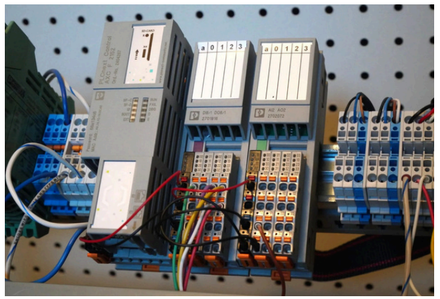
Cybersécurité dans les technologies opérationnelles



I - Host Organization & Problematic

II - Existing Situation, Tasks & Difficulties

I - Host Organization & Problematic

III - Tools, Gantt Planning & Personal Organization

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II - Existing Situation, Tasks & Difficulties

IV - The 3 main projects

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Legal Status: **Non-profit**

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Name: **Cyber Innovation Hub**

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Mission: **Transform the South Wales into a leading cybersecurity cluster by 2030**

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Size: **12-16 employees**

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Products & services: **OT consultancy, trainings and testbeds**

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Divisions:

- **Commercials**
- **Operations**
- **Strategy**
- **Delivery (Mine)**

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- Commercials
- Operations
- Strategy
- Delivery (Mine)

Delivery Team: **6 members, led by Vijay**

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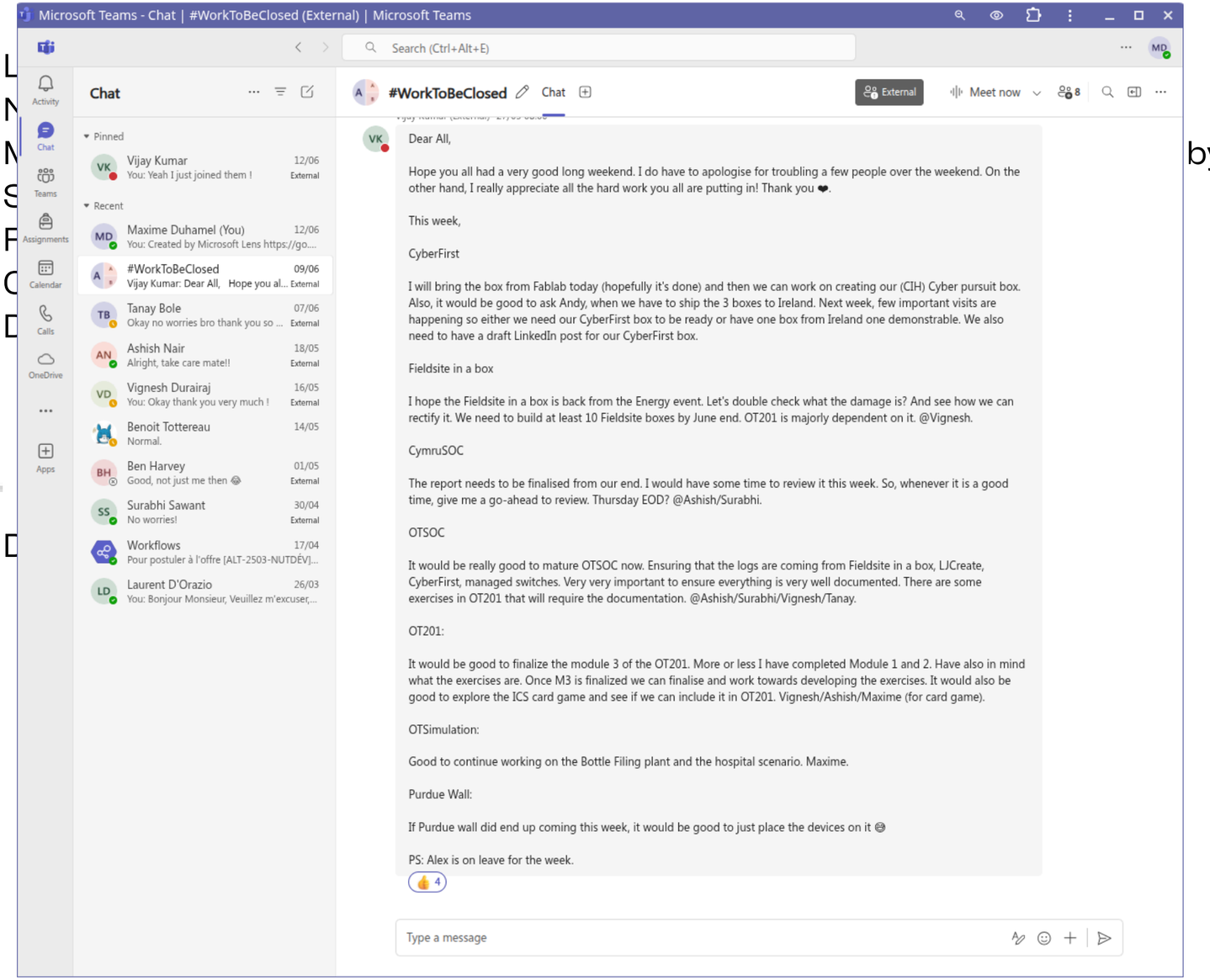

by 2030

30

How can the CIH simulate realistic cyberattack environments to efficiently train teams in defense and incident response?

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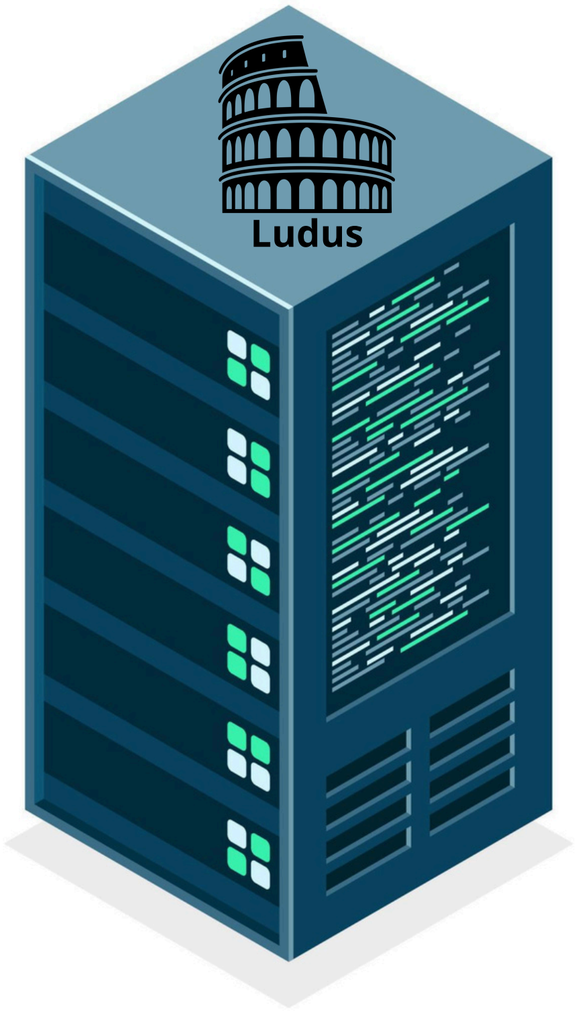
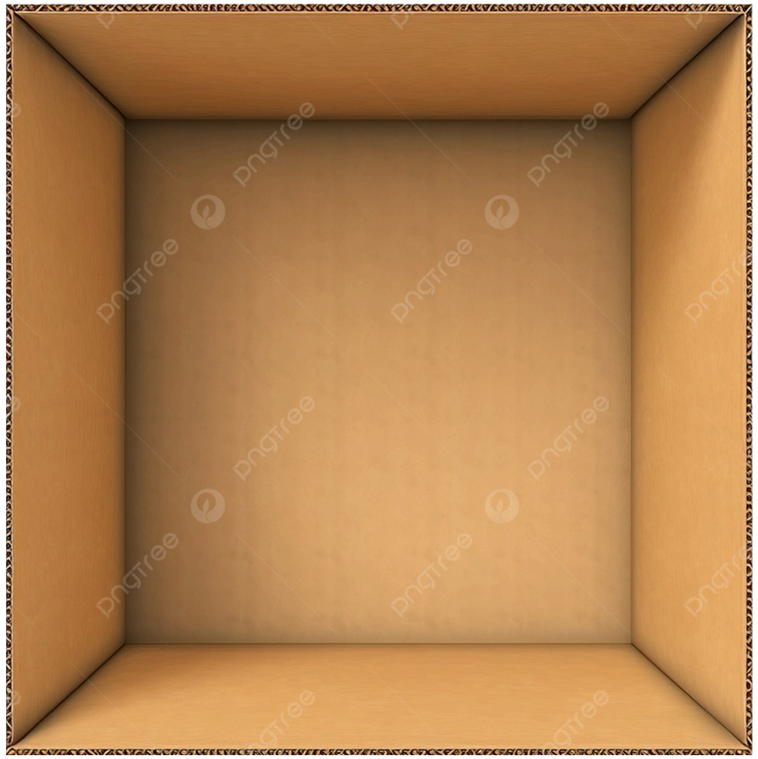

Ludus



Your computer
(physical machine)

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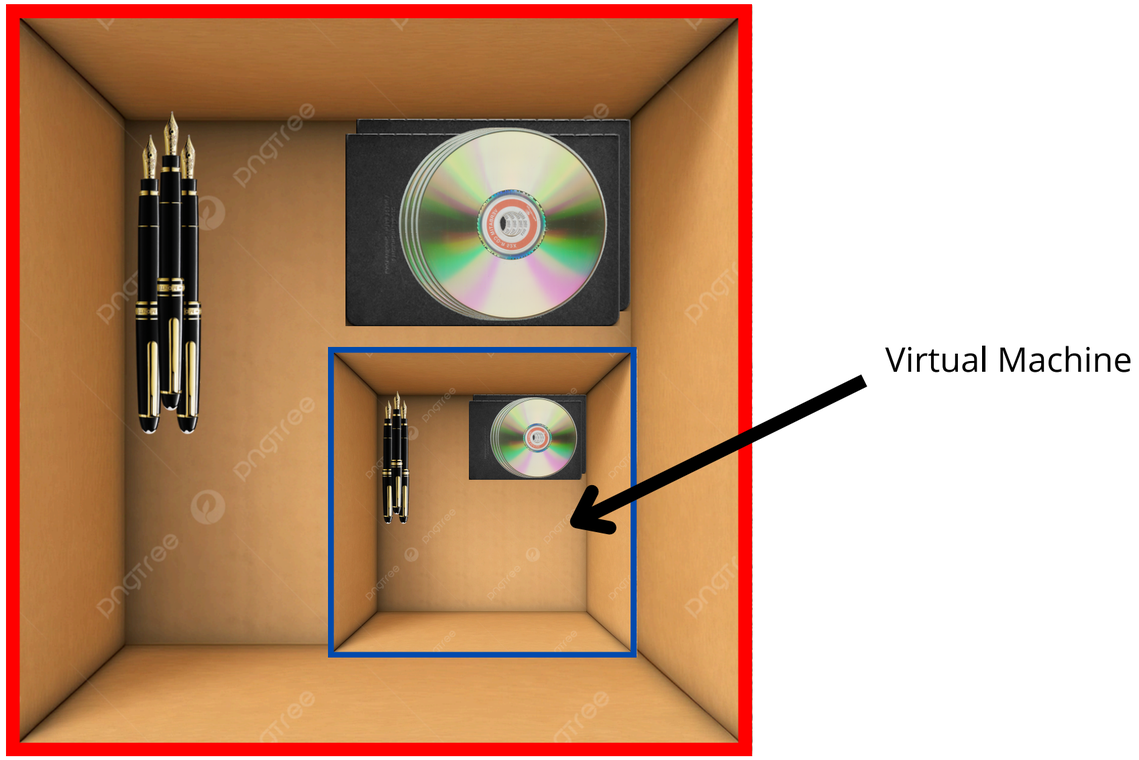
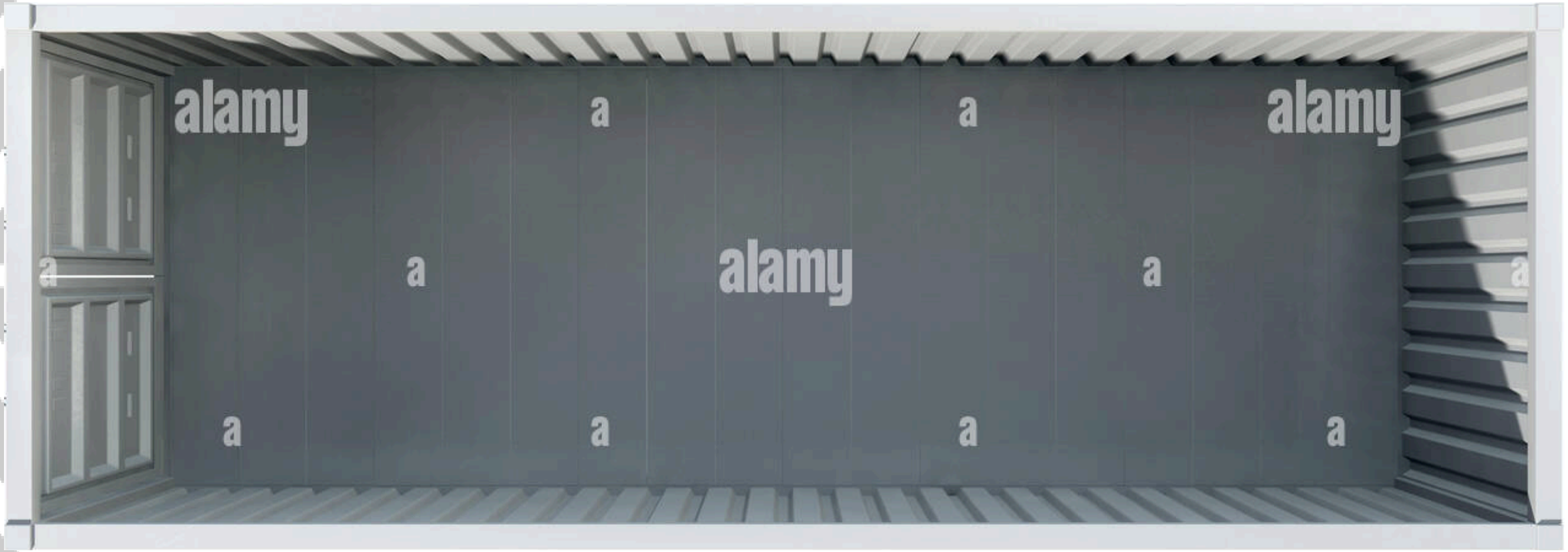


Virtual Machine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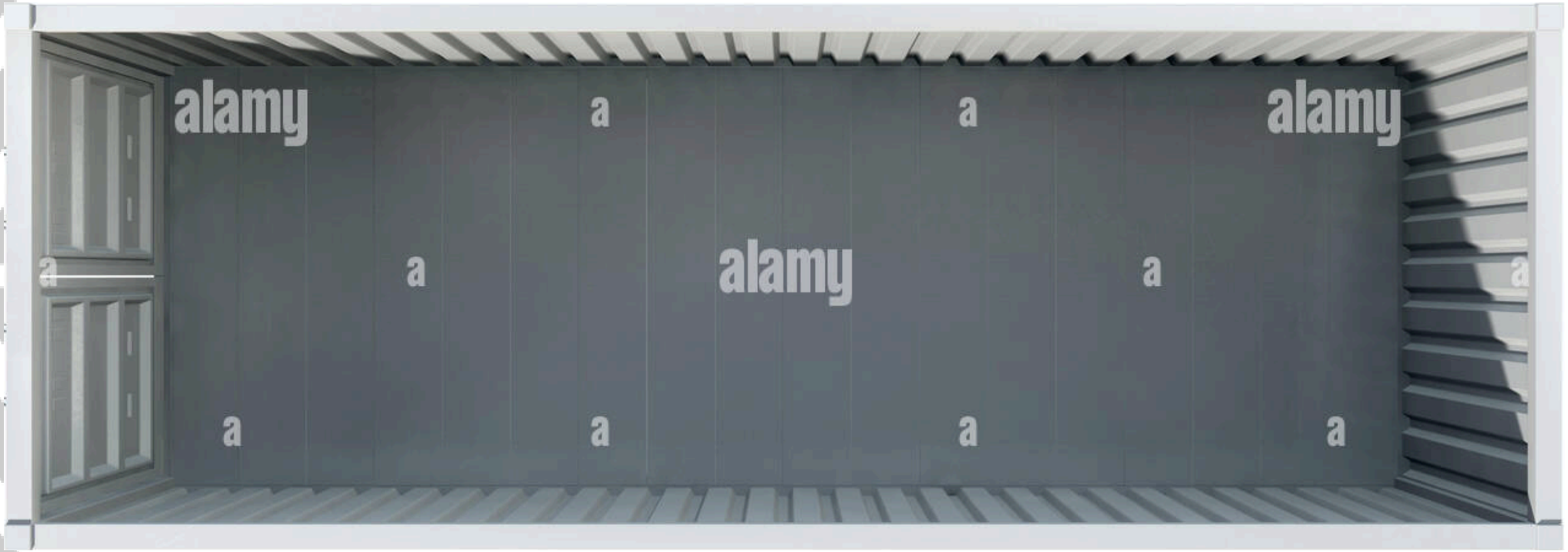
User 1 User 2 User 3



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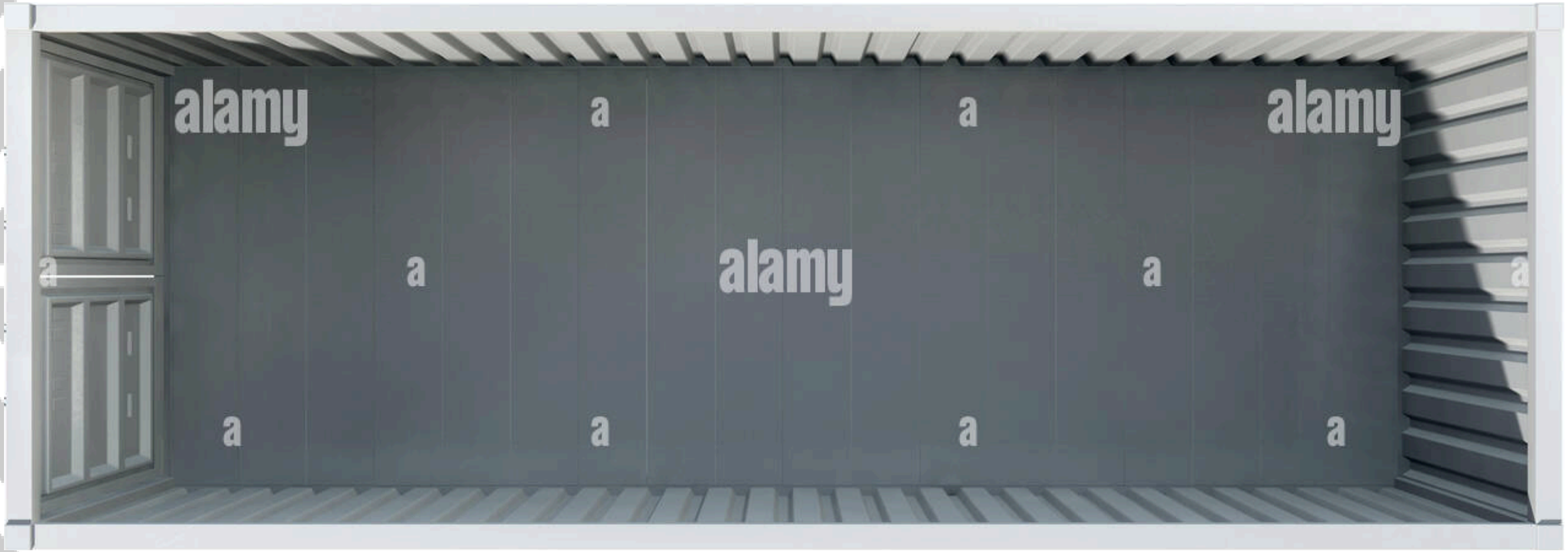
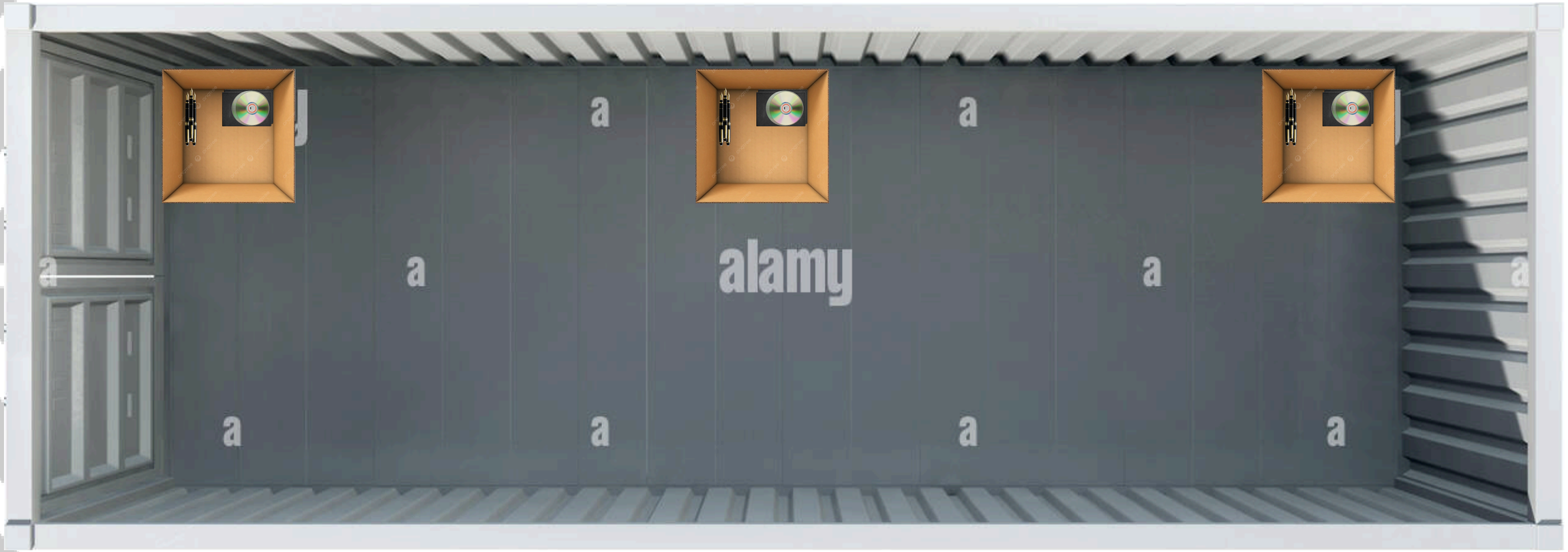


Virtual Machine 1

User 1 User 2 User 3



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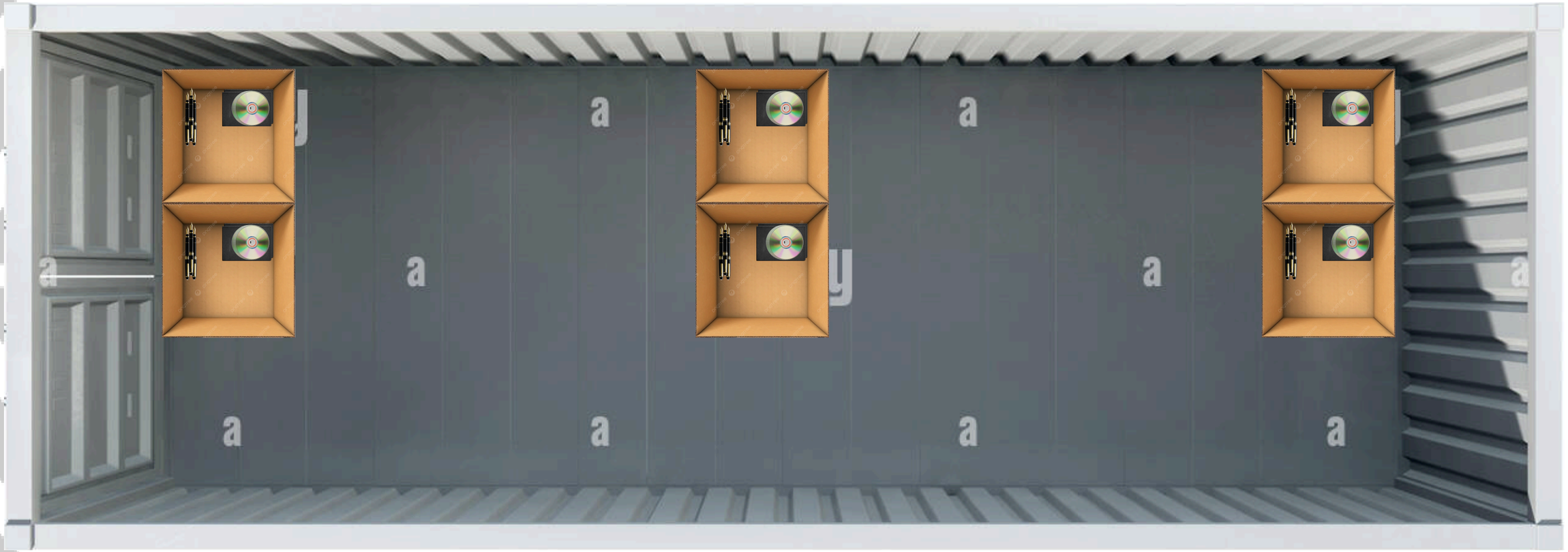

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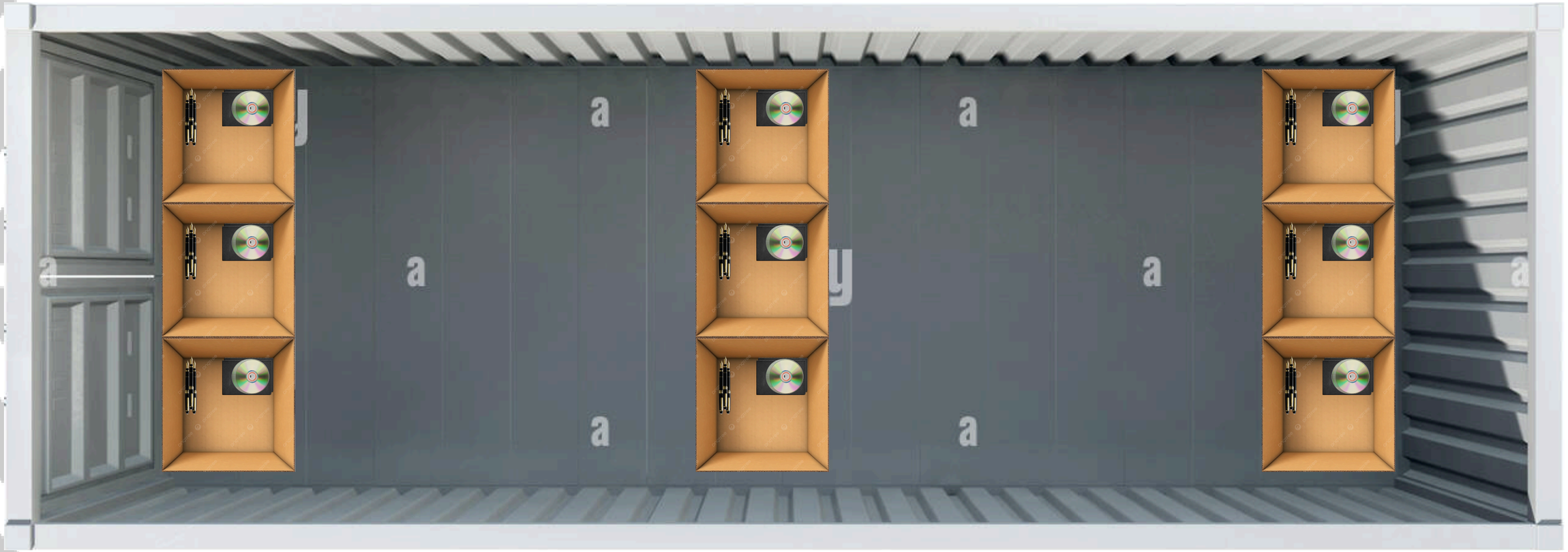

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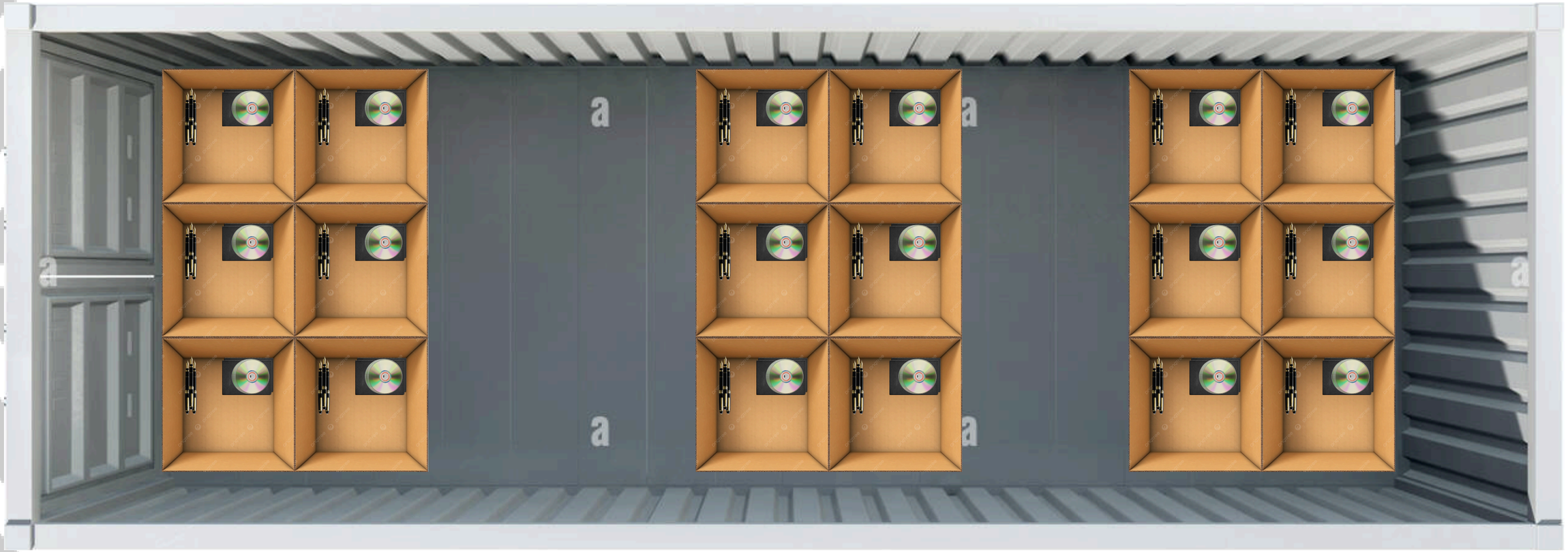

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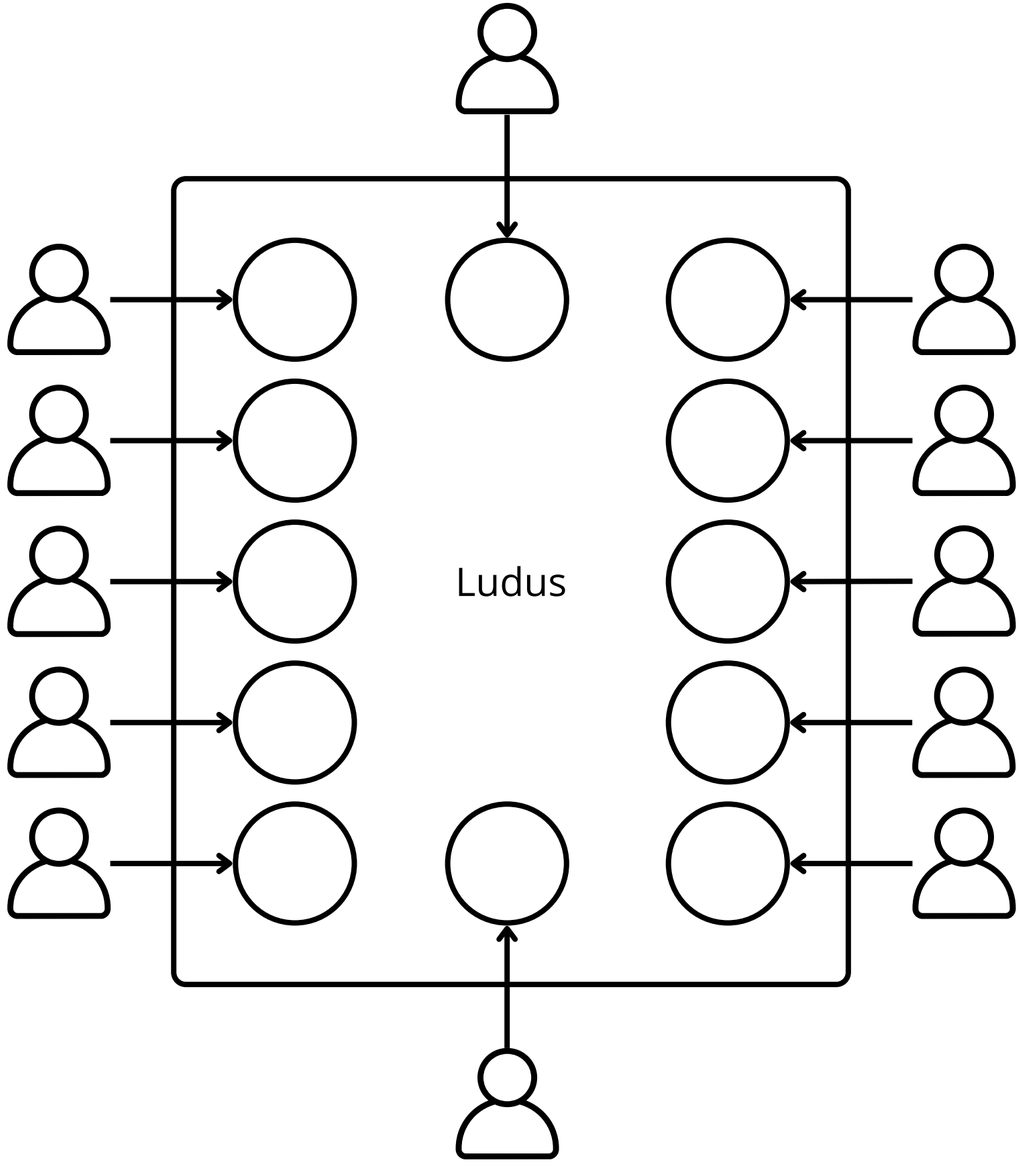
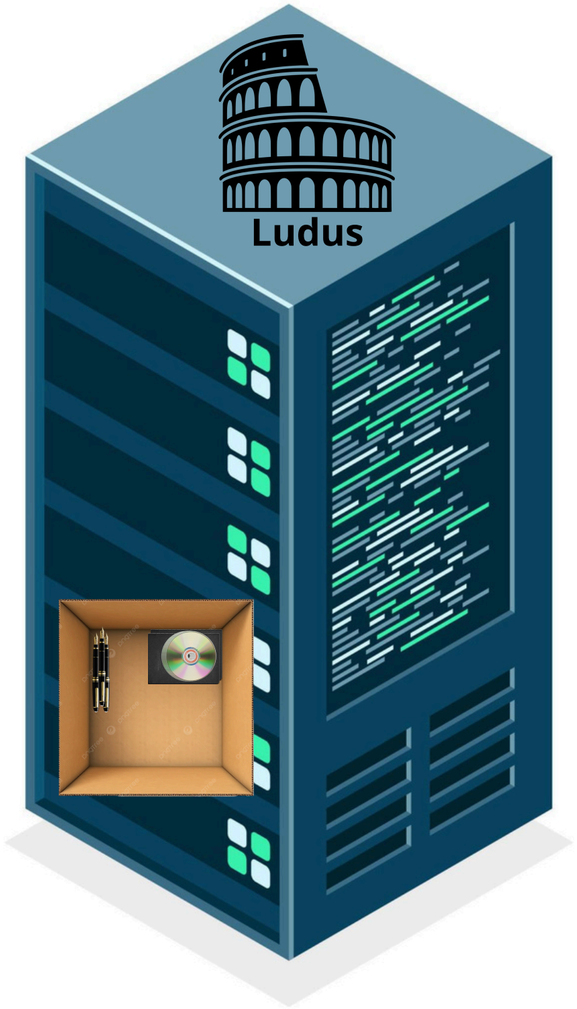

Ludus



1 - Installing and configuring the simulations

2 - Deploying and managing the ranges

3 - Documenting the processes

II - Existing Situation, Tasks & Difficulties

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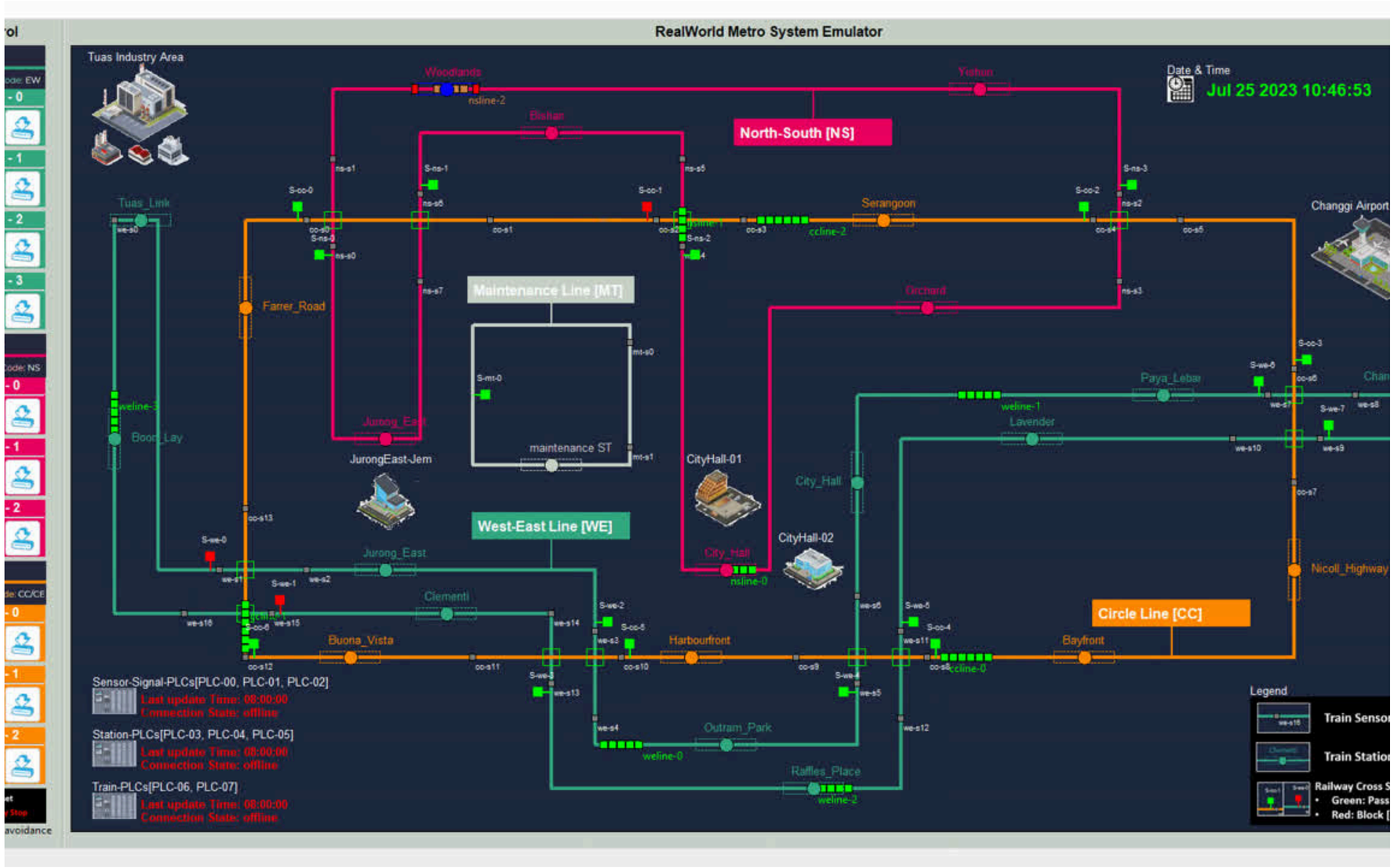

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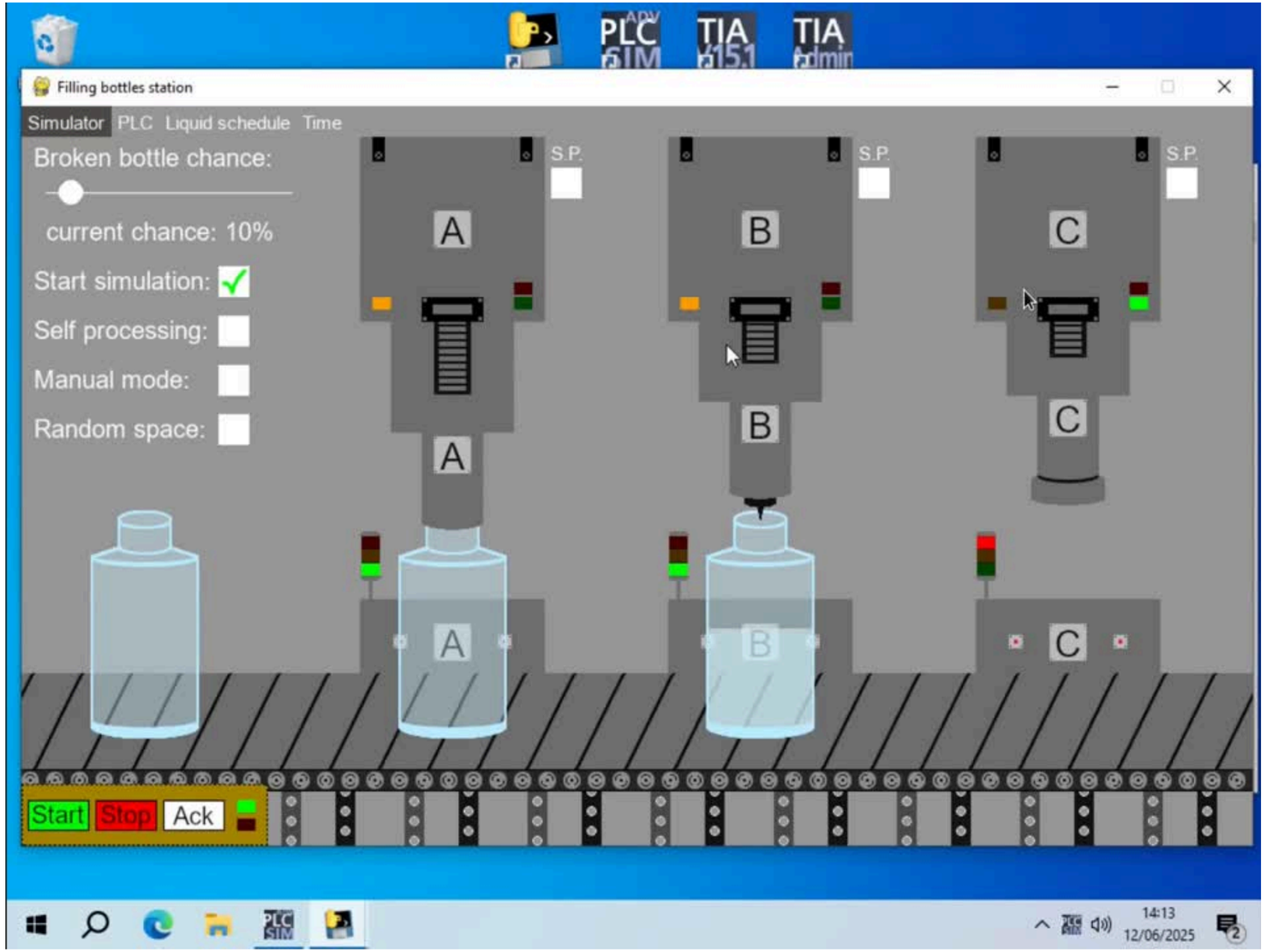

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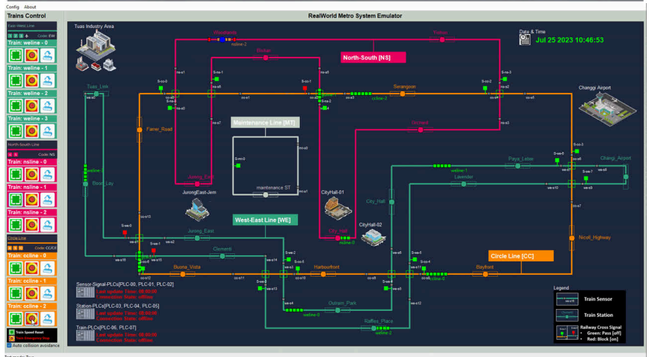

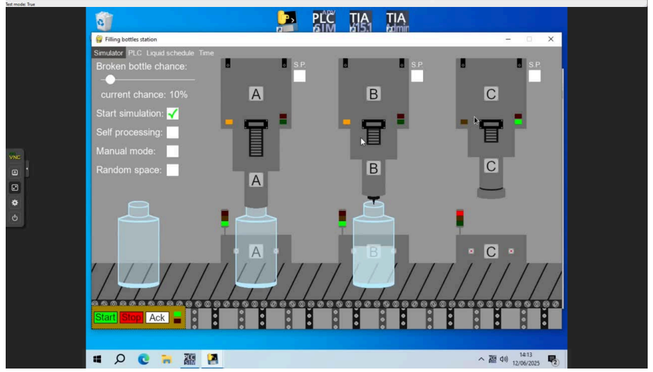

Replicate **real-world industrial systems** in a **controlled environment**

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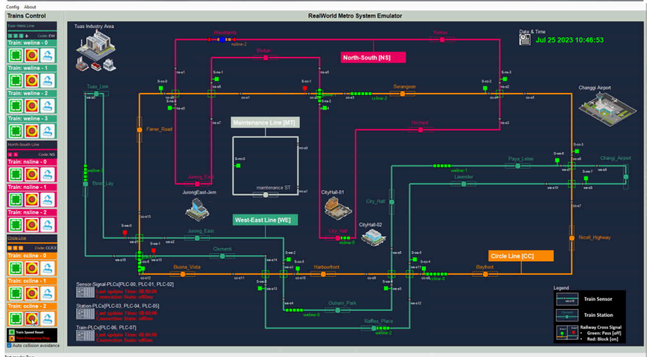

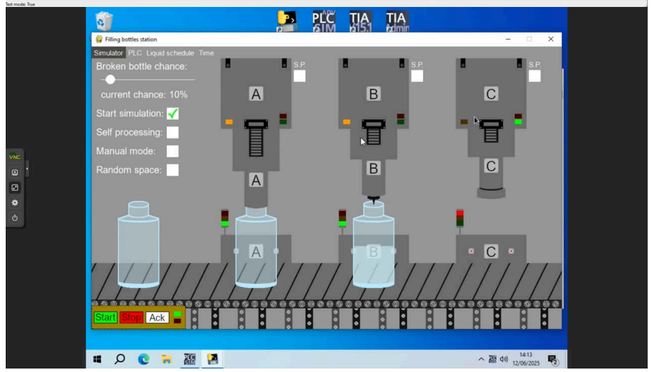

Replicate **real-world industrial systems** in a **controlled environment**

Steep **learning curve**

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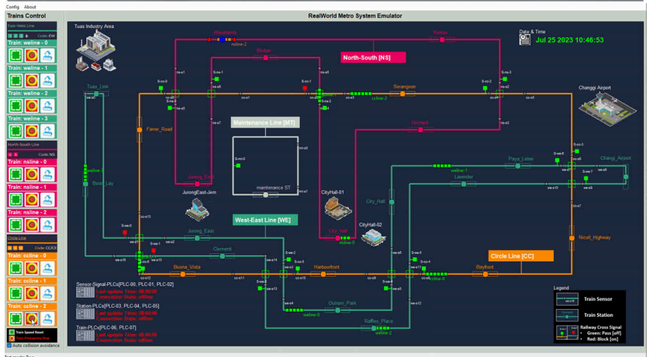

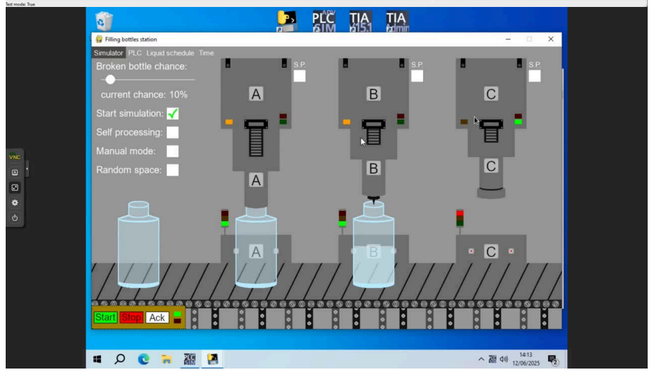

Replicate **real-world industrial systems** in a **controlled environment**

Steep **learning curve**

Searching for **solutions online**, **asking colleagues** and **experimenting** until I found what worked

1 - Installing and configuring the simulations

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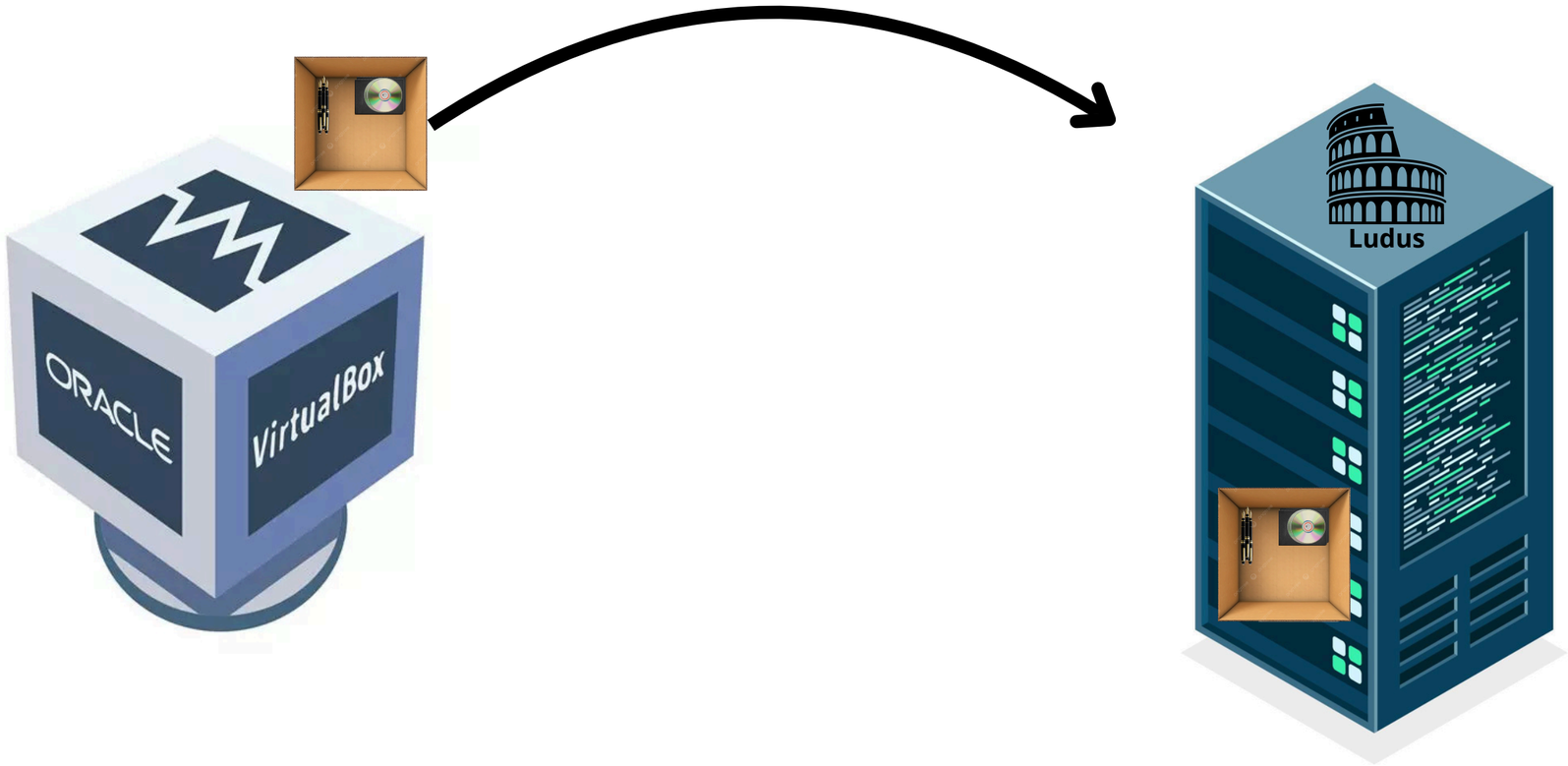
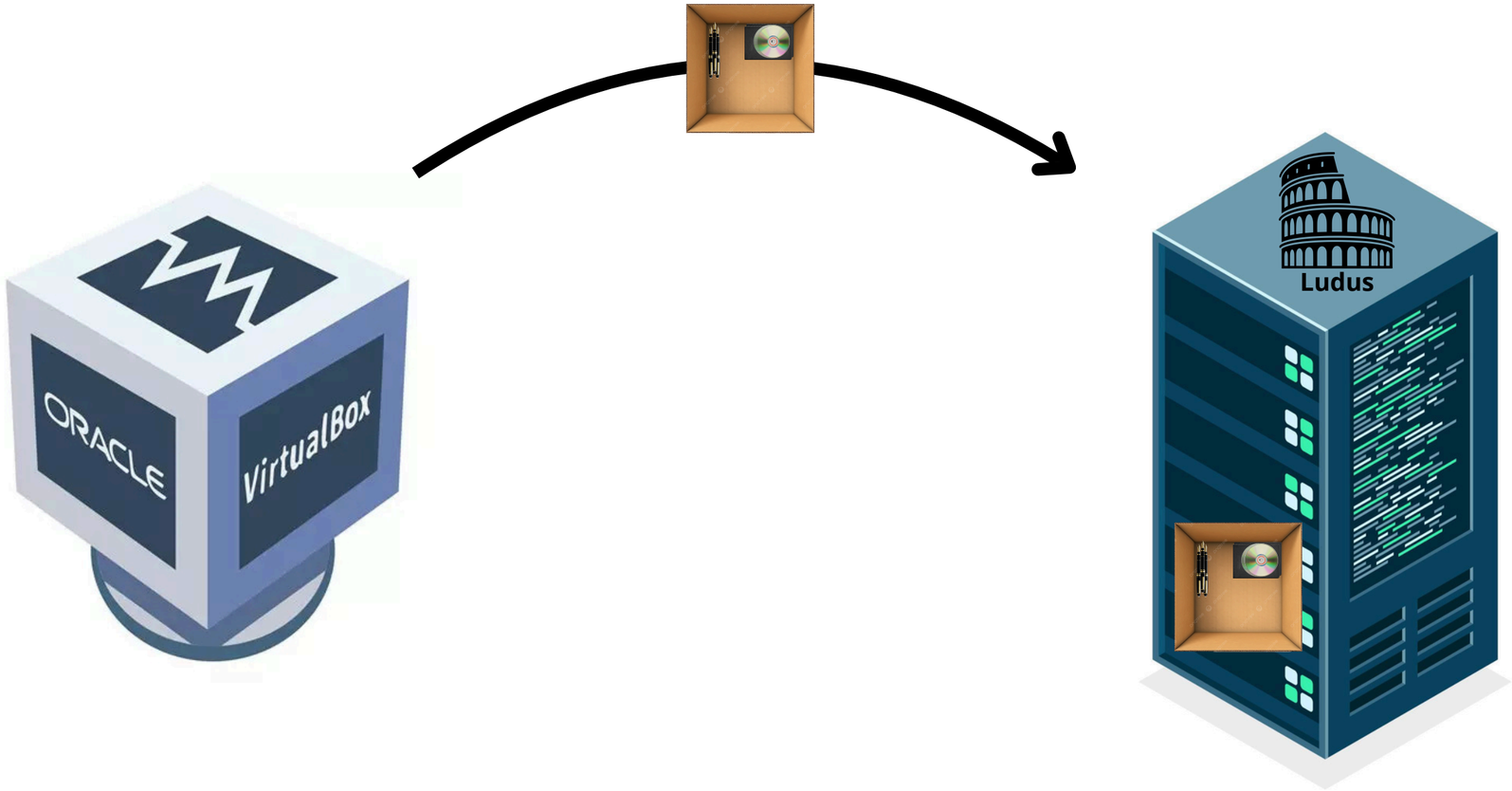

ORACLE
VirtualBox
Ludus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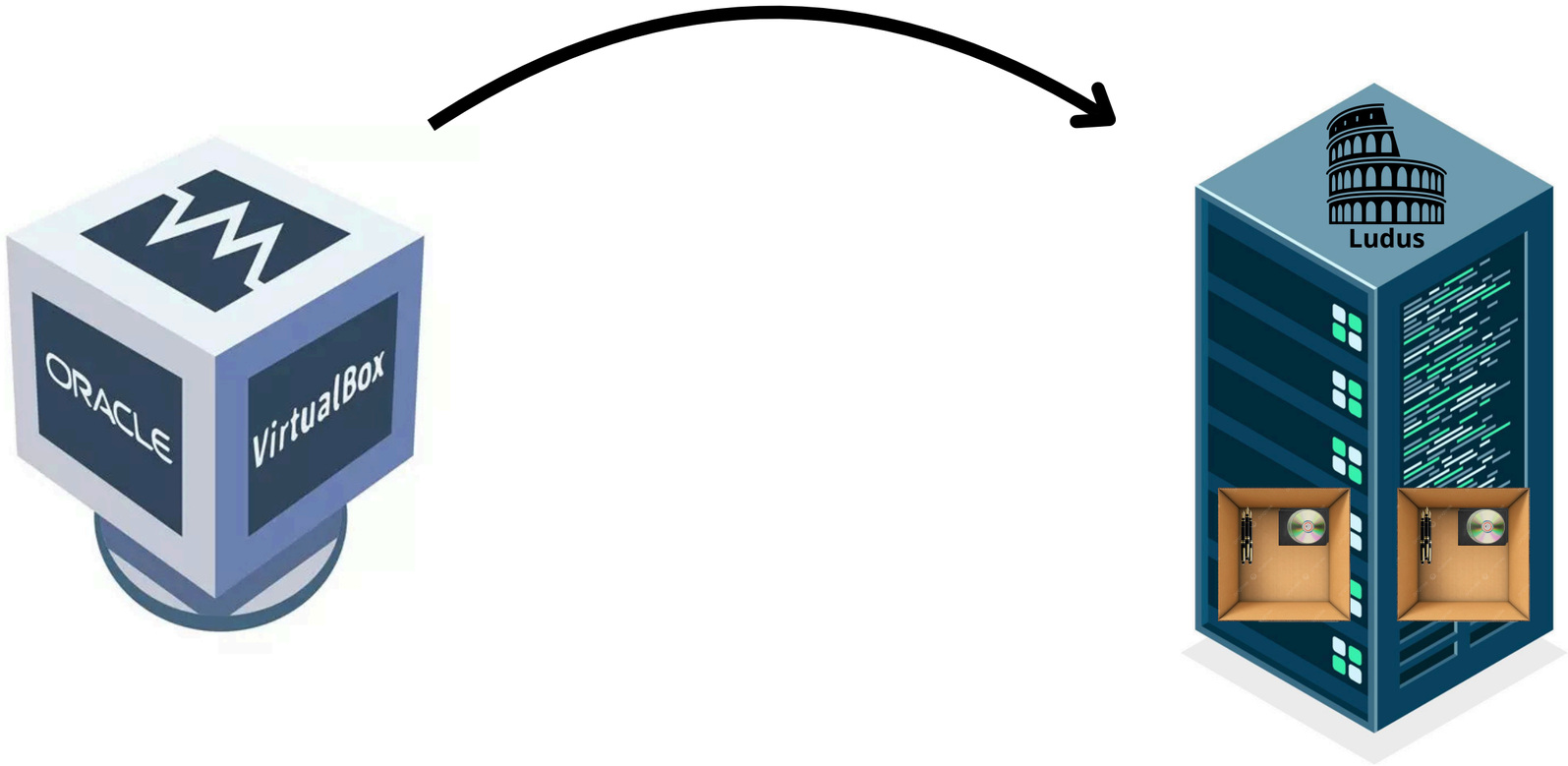
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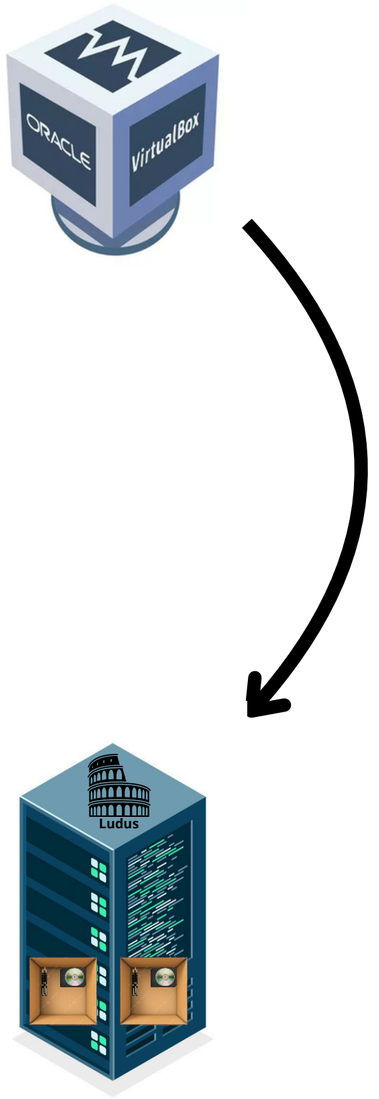
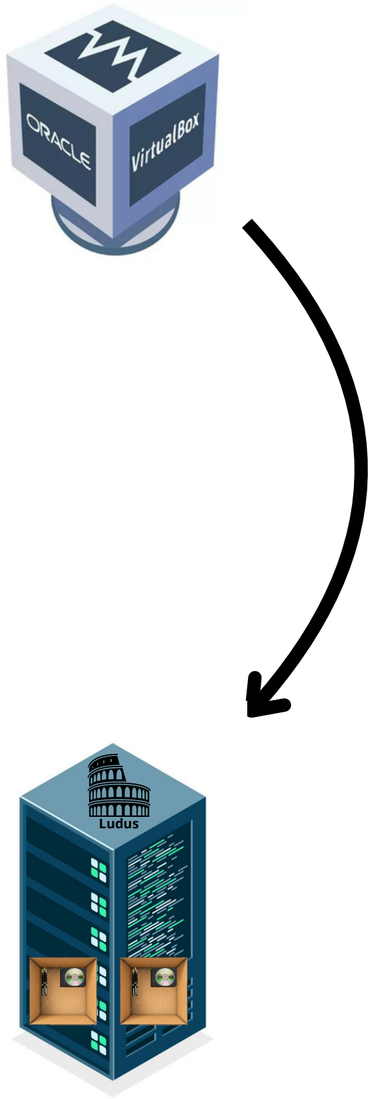


Ensure the range could be **easily duplicated** for different users



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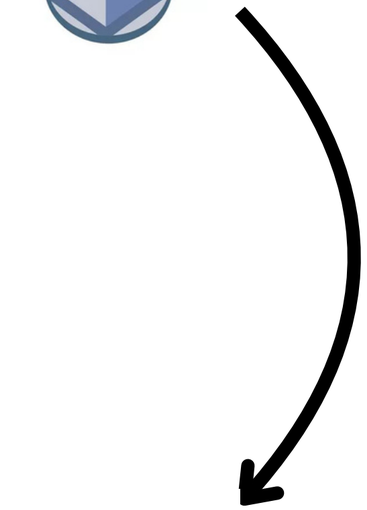
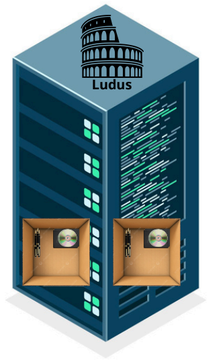
Time-consuming, especially when dealing with large files or complex network topologies





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Time-consuming, especially when dealing with large files or complex network topologies

Even **small configurations** could cause **big problems**, leading to hours of debugging

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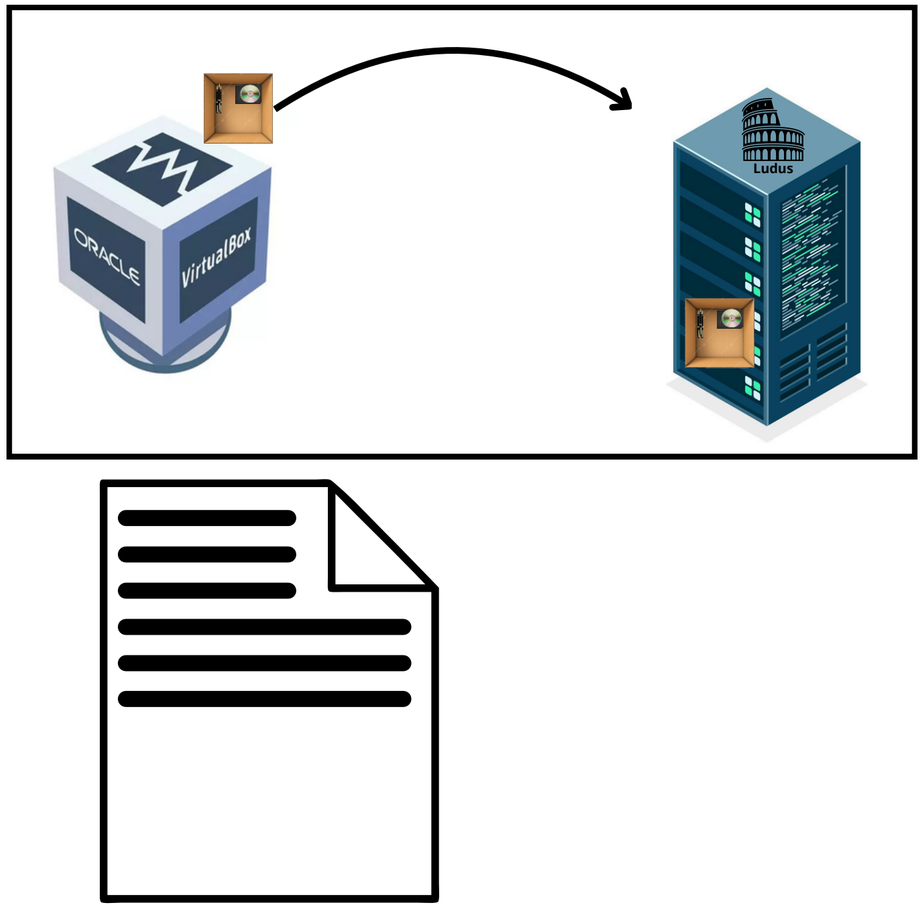
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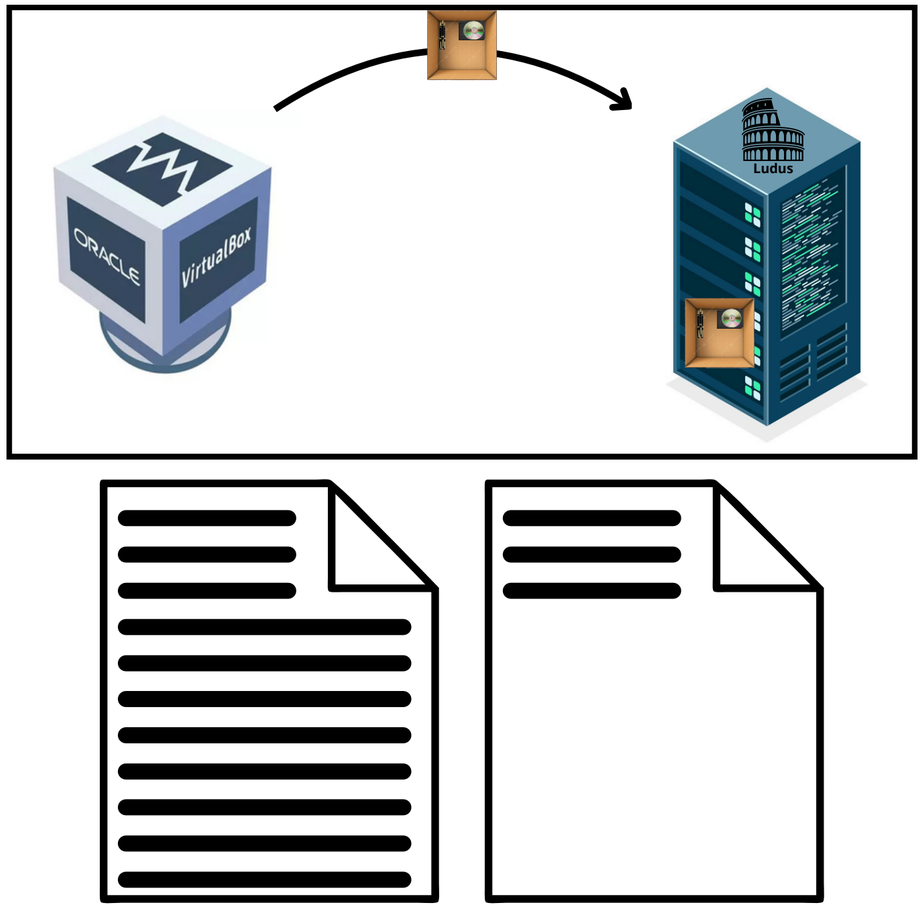
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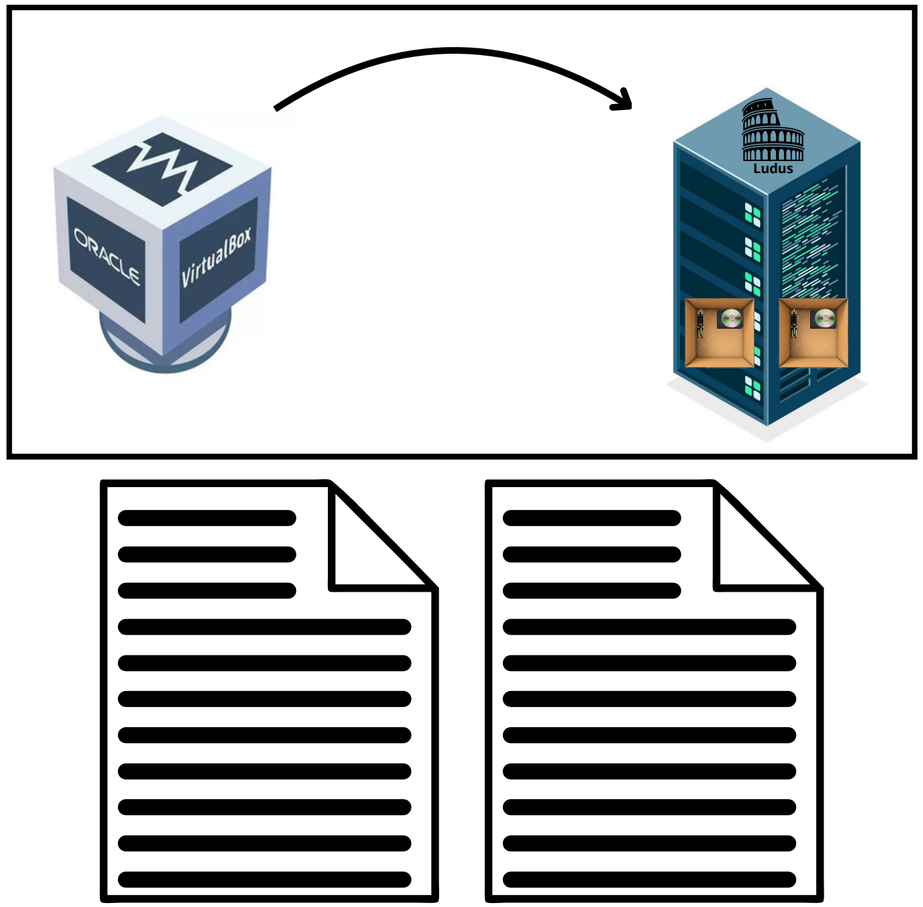
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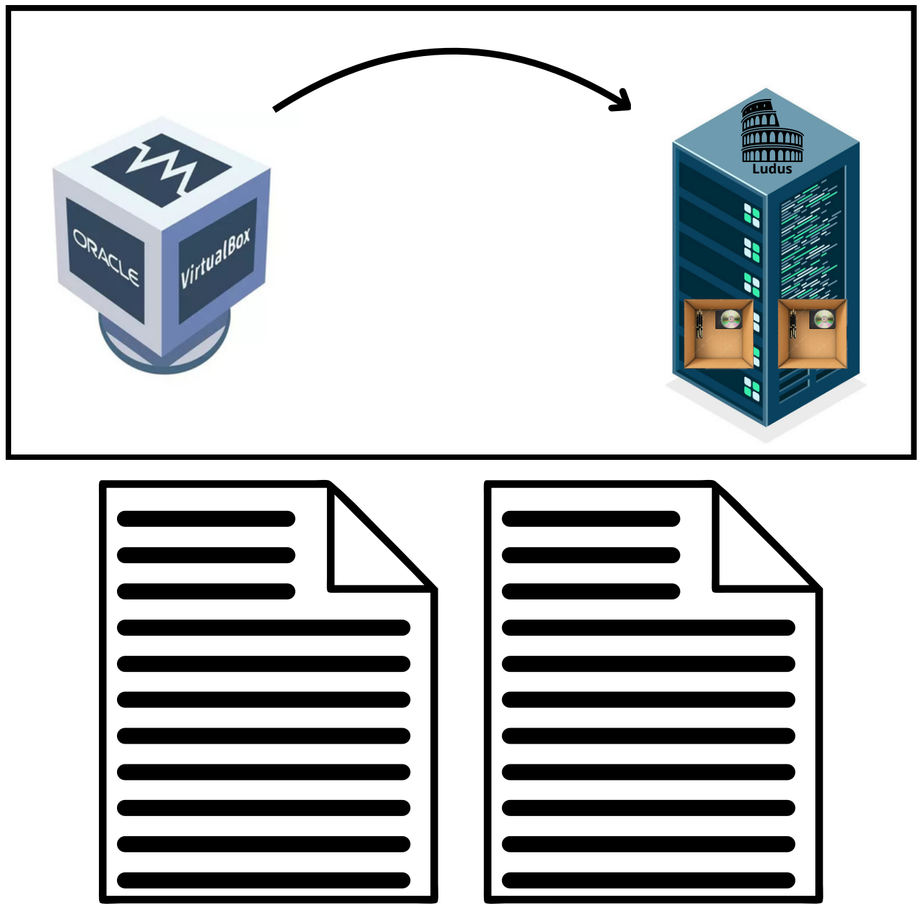
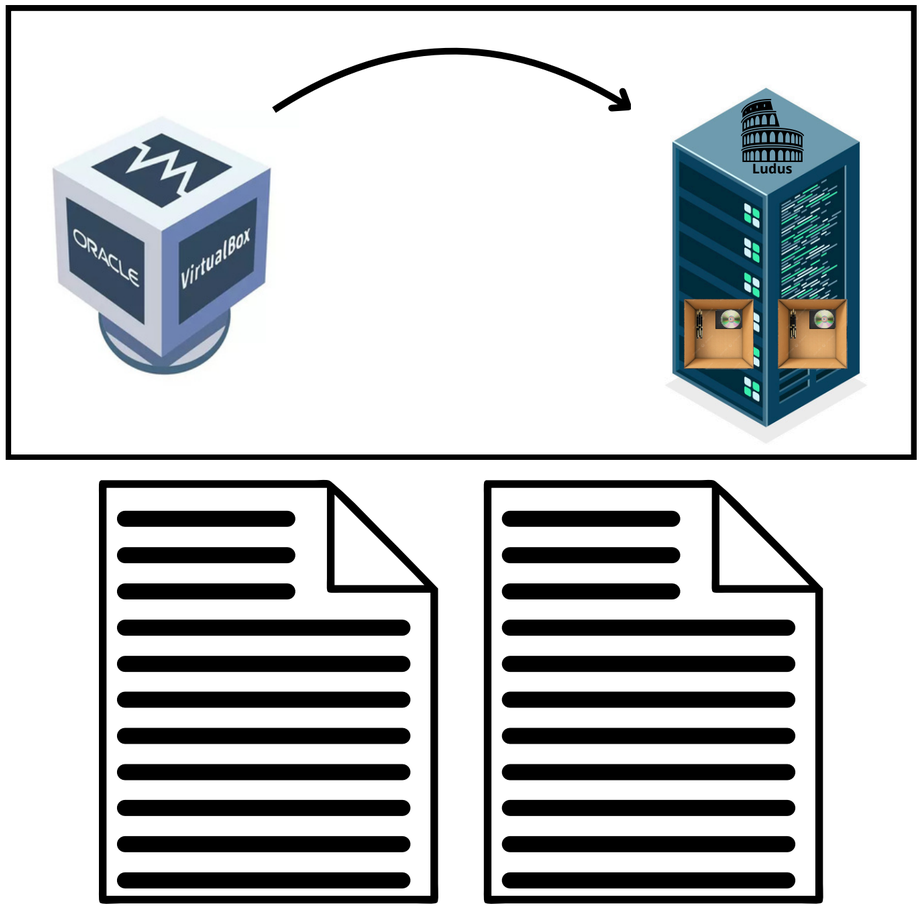


Anyone on the team could **easily replicate** what I had done



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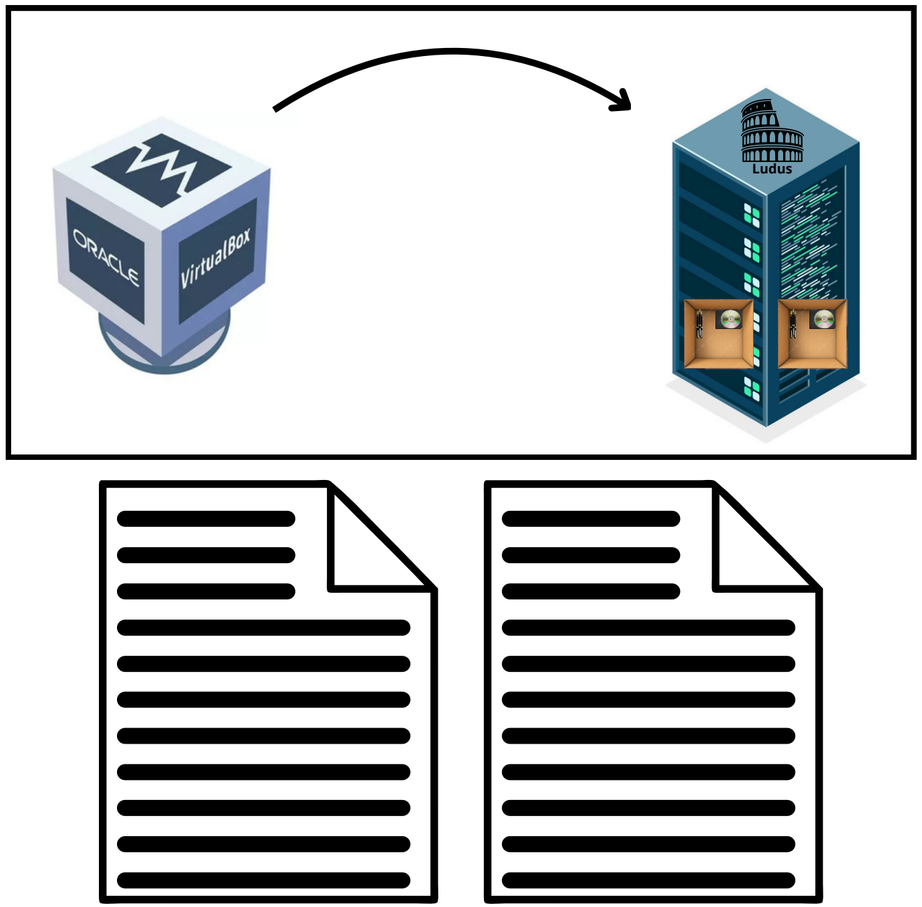
The amount of **time and focus** it required



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The amount of **time and focus** it required

Hard to stay motivated, particularly when I had **to repeat processes**

1 - Installing and configuring the simulations

2 - Deploying and managing the ranges

3 - Documenting the processes

1 - Installing and configuring the simulations

2 - Deploying and managing the ranges

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Bonus - Others


Backdoors
&Breaches

II - Existing Situation, Tasks & Difficulties

Bonus - Others

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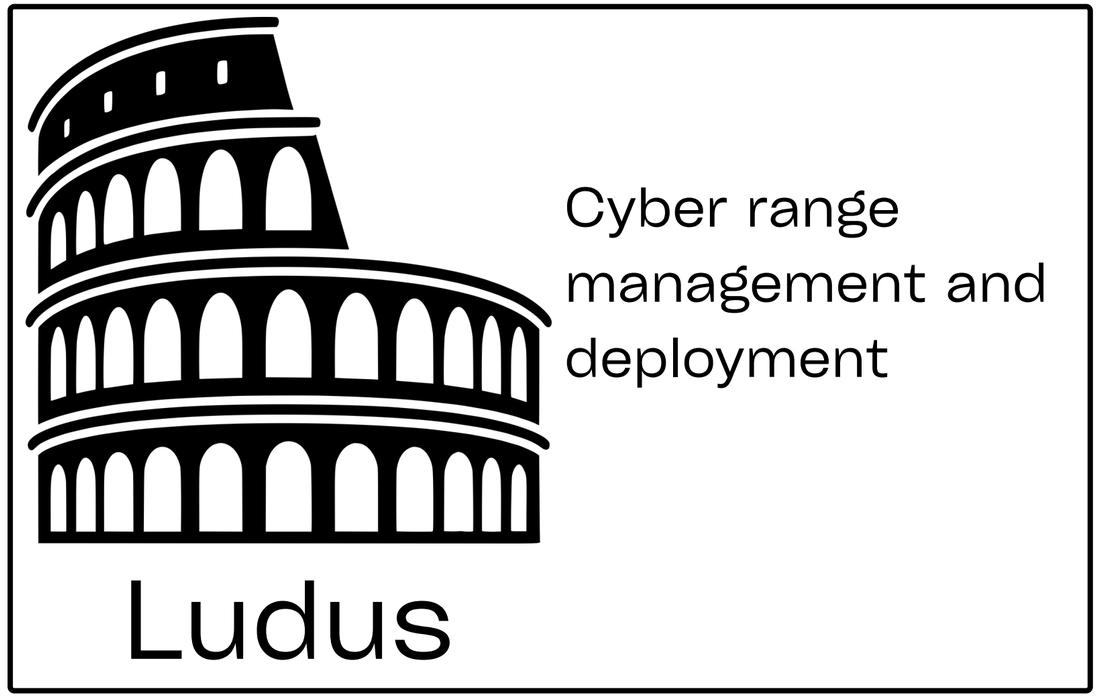
III - Tools, Gantt Planning & Personal Organization

1 - Tools and programming languages

2 - Gantt diagram

3 - Personal Organisation

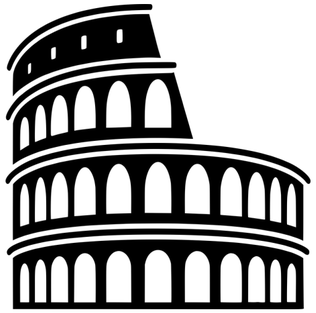

Cyber range
management and
deployment
Ludus

Ludus

Cyber range
man
depl

Local virtual machine management and simulation

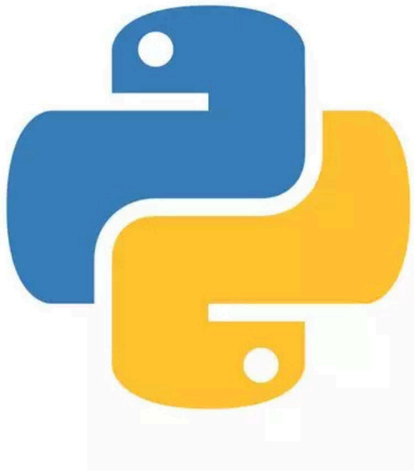
VirtualBox



Ludus

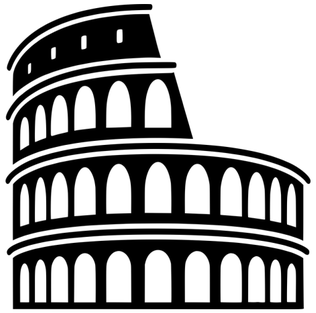
Cyber range
man
depl

Local virtual



Very easy and complete programming language used in most projects

Python



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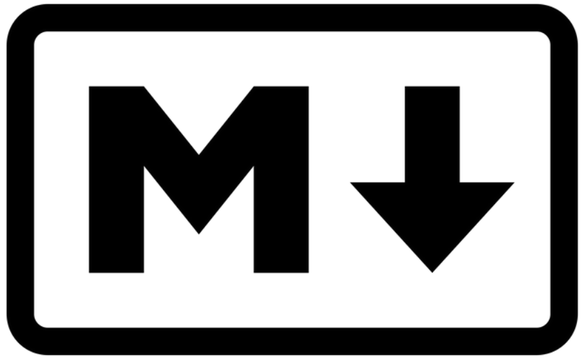
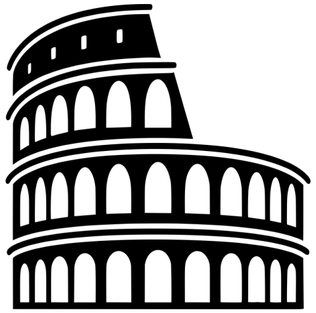


Format documentation before converting into Sphinx

Markdown



Ludus

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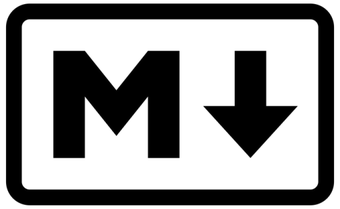
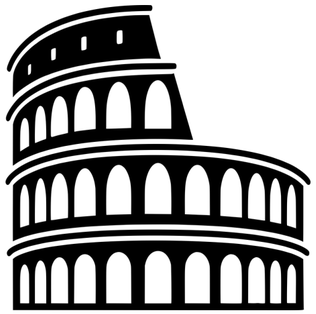
Internal Communication

Teams



Markdown

F
d
b
c
Sphinx



Ludus

Cyber range
man
depl

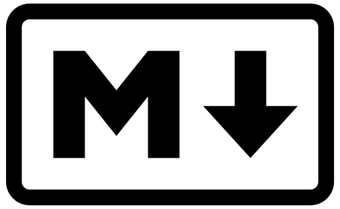
Local virtual

Very easy and complete programming language used in most projects

n

To save, keep track of and share my modifications to projects

Github



Markdown

F
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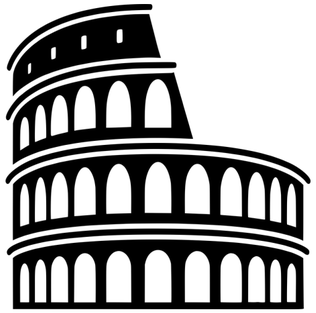
Sphinx

Teams

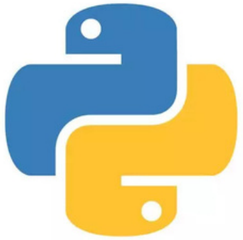


Ludus

Cyber range management and deployment

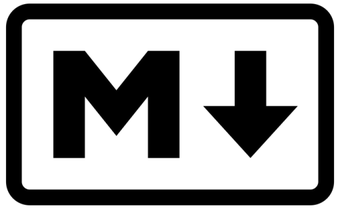
VirtualBox

Local virtual machine management and simulation



Python

Very easy and complete programming language used in most projects



Markdown

Format documentation before converting into Sphinx

Teams

Internal Communication

Github

To save, keep track of and share my modifications to projects

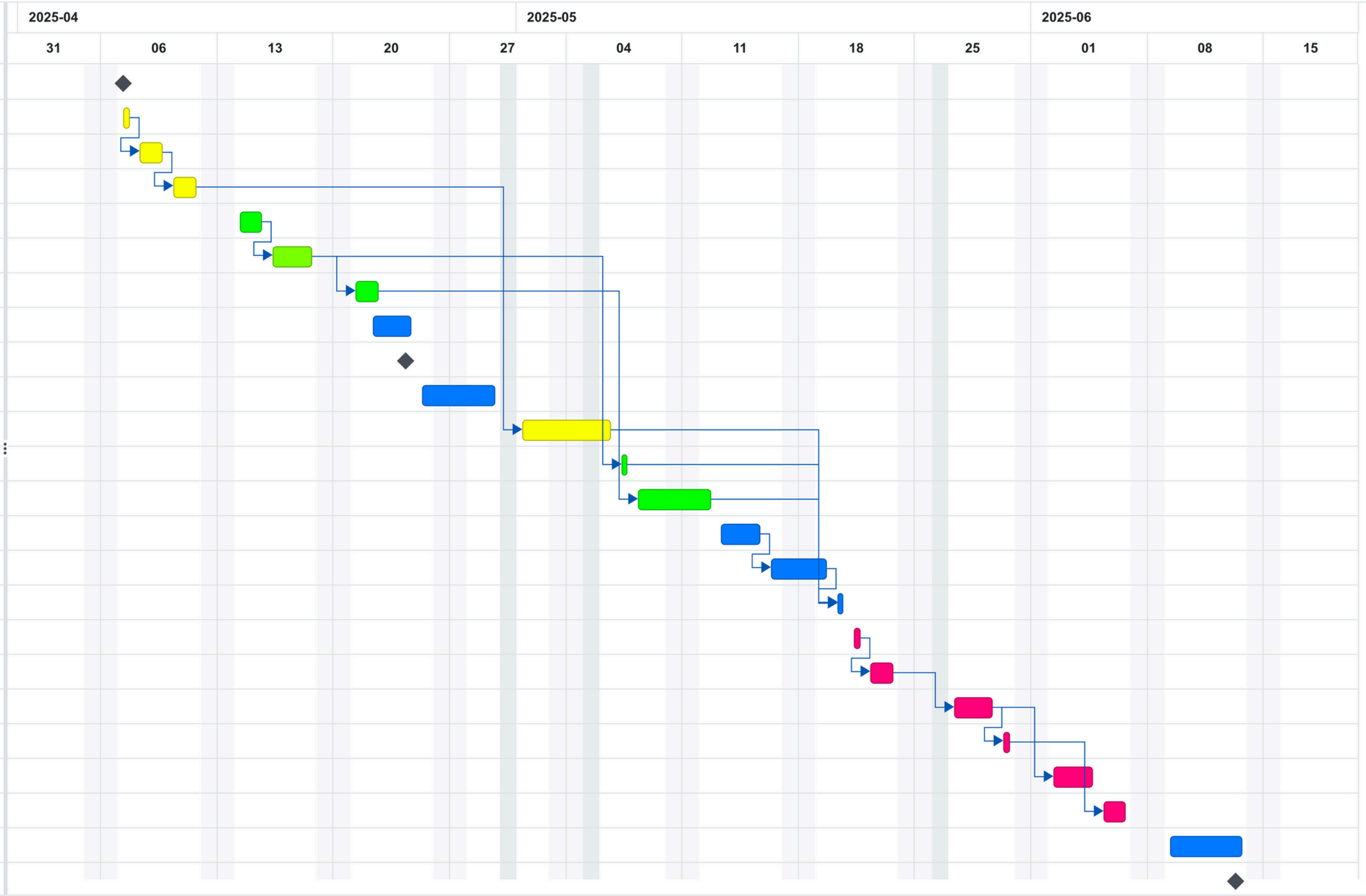
III - Tools, Gantt Planning & Personal Organization

1 - Tools and programming languages

2 - Gantt diagram

3 - Personal Organisation

ID	Task Name
22	First Day
1	Exploring the GRFICS project
2	Understand how Ludus works
3	Configure the GRFICS project in the Ludus
5	Understand the Metro Railway project
6	Implement an attack in the Metro Railway
8	Install the Metro railway in the Ludus
20	Create videos to present the GRFICS and Met…
23	Visit from DSIT
19	Set up a multi-instances VLC Controller
4	Document how I installed the GRFICS project …
7	Document how to attack the Metro Railway
9	Document how I installed the Metro Railway p…
10	Reinstall a new Ludus in an empty server
11	Document the installation of the Ludus
12	Merge all the documentations in one file
13	Understand the Bottle Filling project
14	Install the Bottle Filling project to make it work
15	Configure the PLC in the Bottle Filling project t…
17	Install the Bottle Filling project in the Ludus
16	Document the configuration of the PLC in the …
18	Document the installation of the Bottle Filling p…
21	Prepare this presentation
24	Last day



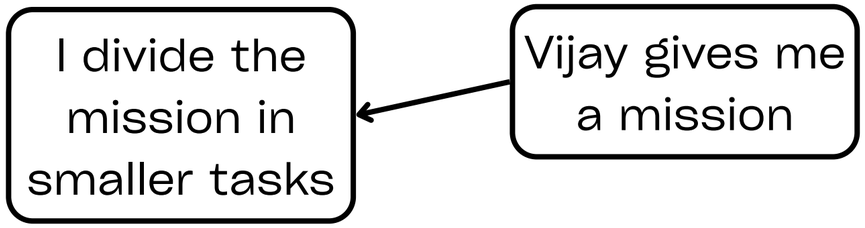
III - Tools, Gantt Planning & Personal Organization

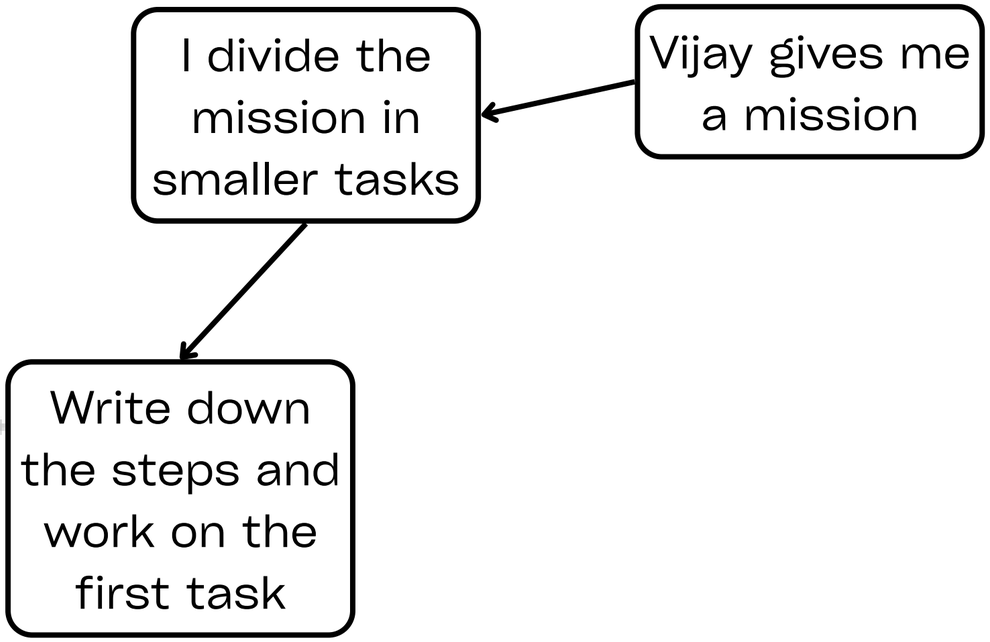
1 - Tools and programming languages

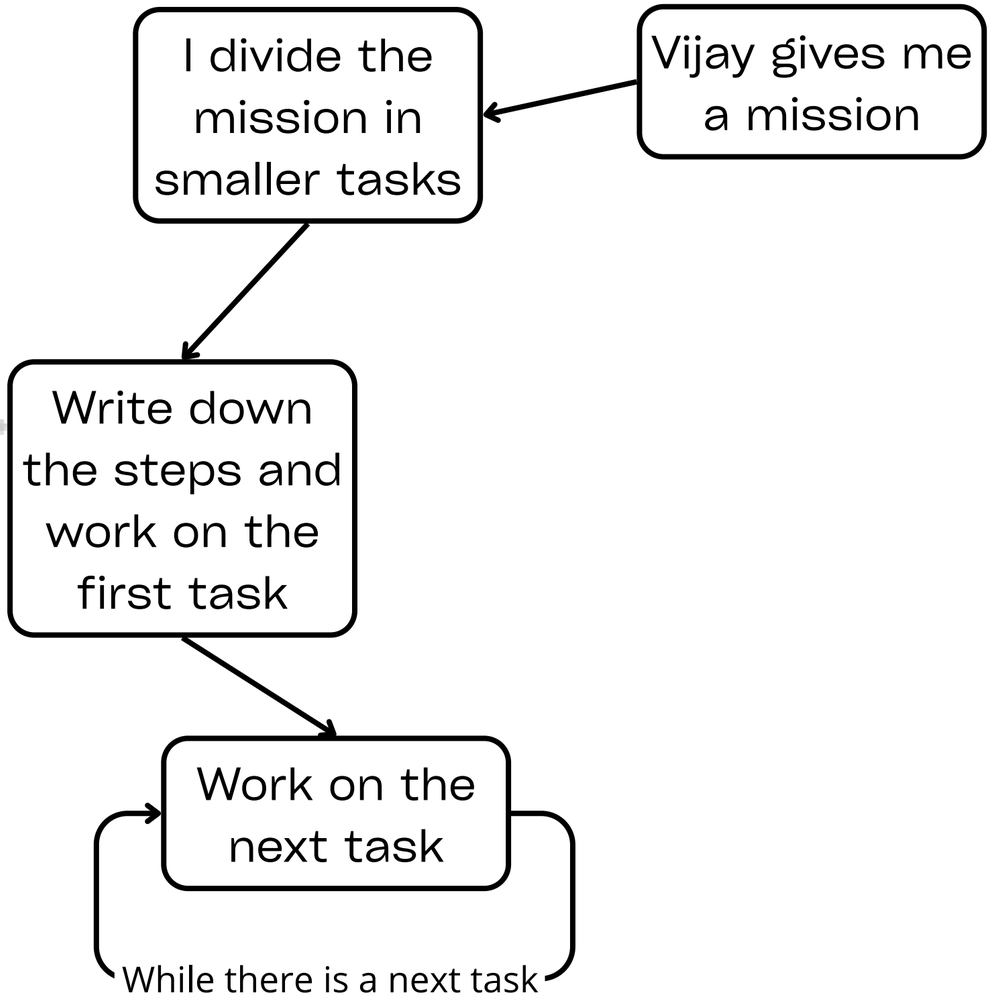
2 - Gantt diagram

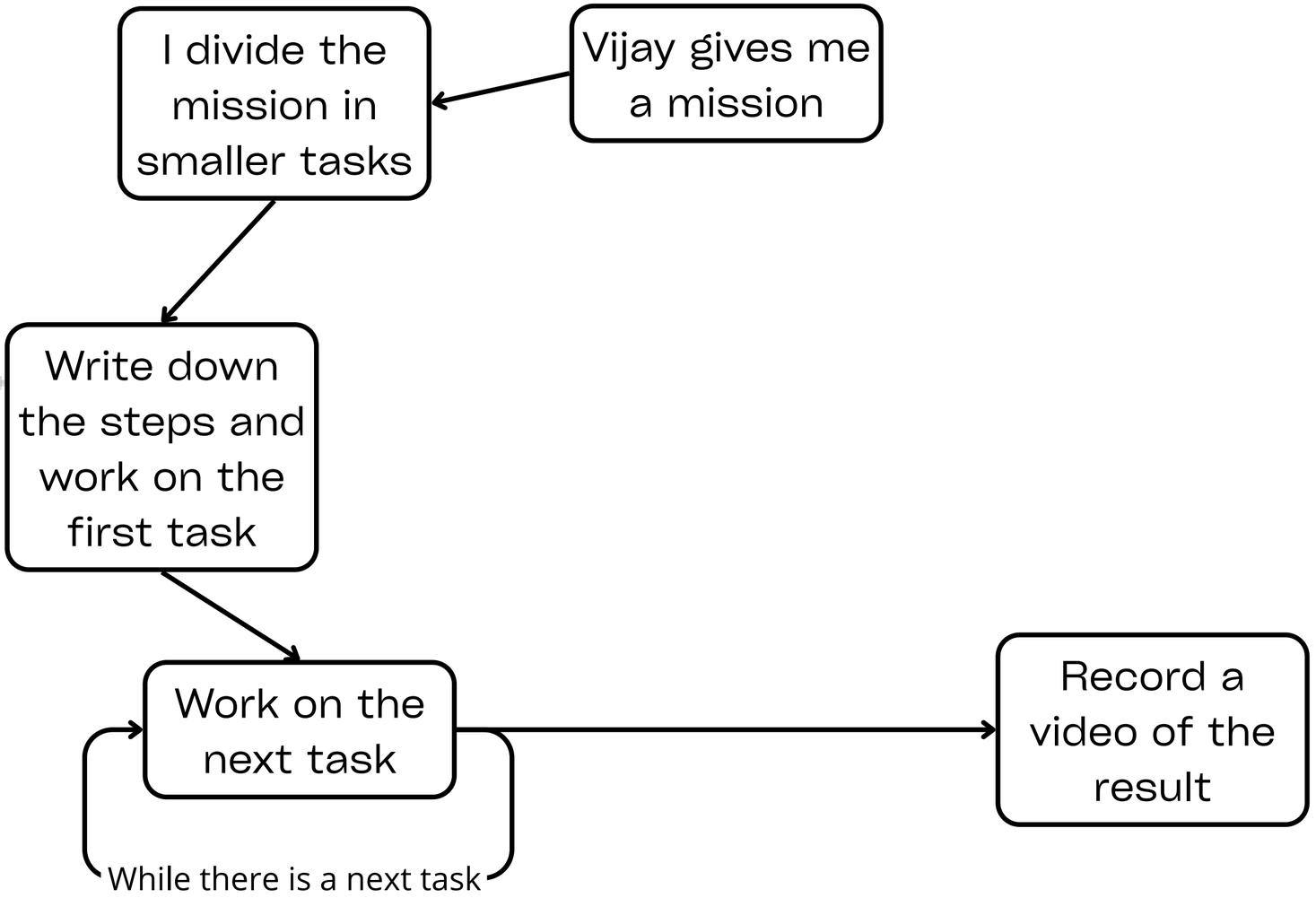
3 - Personal Organisation

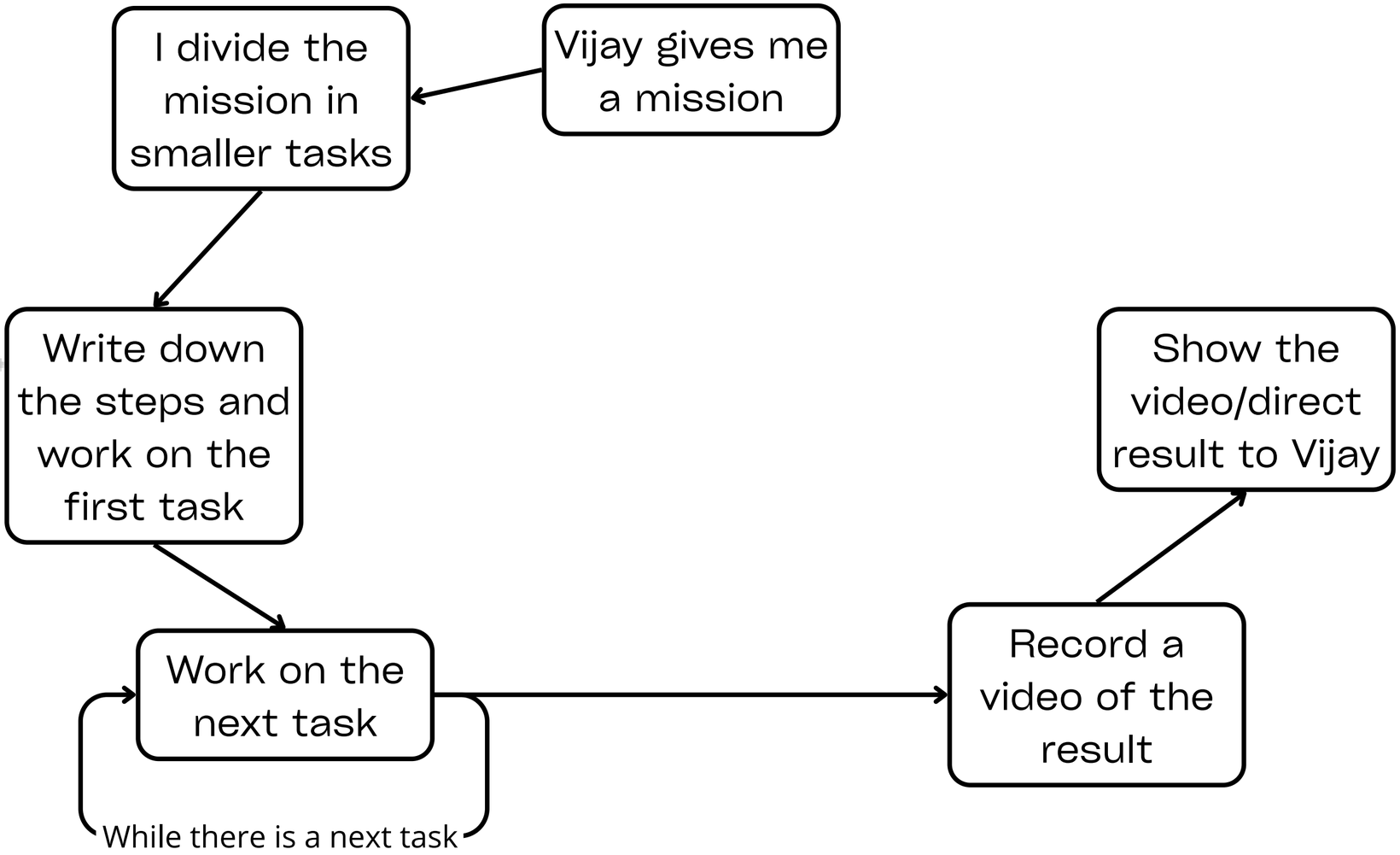
Vijay gives me
a mission

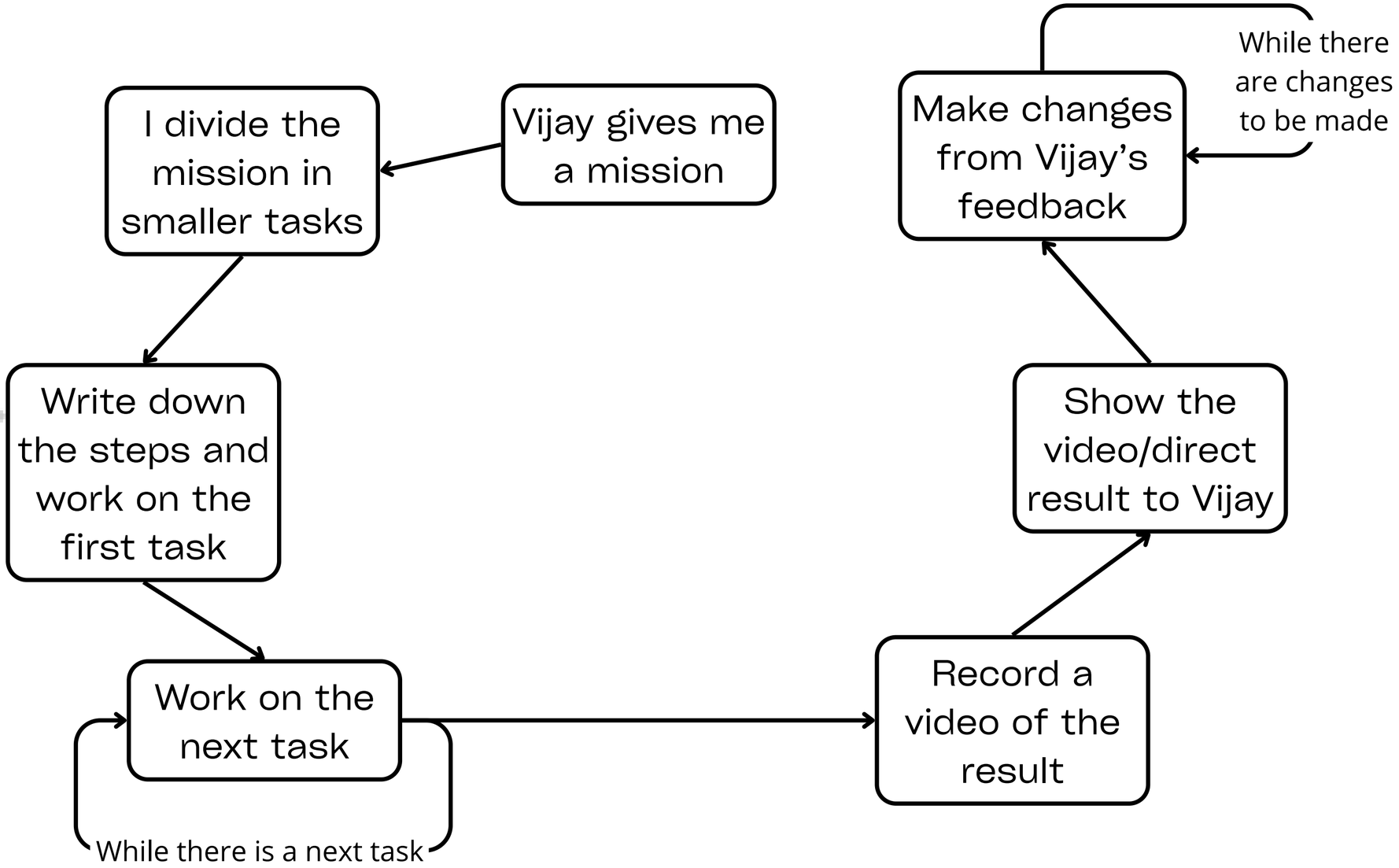

I divide the mission in smaller tasks
Vijay gives me a mission

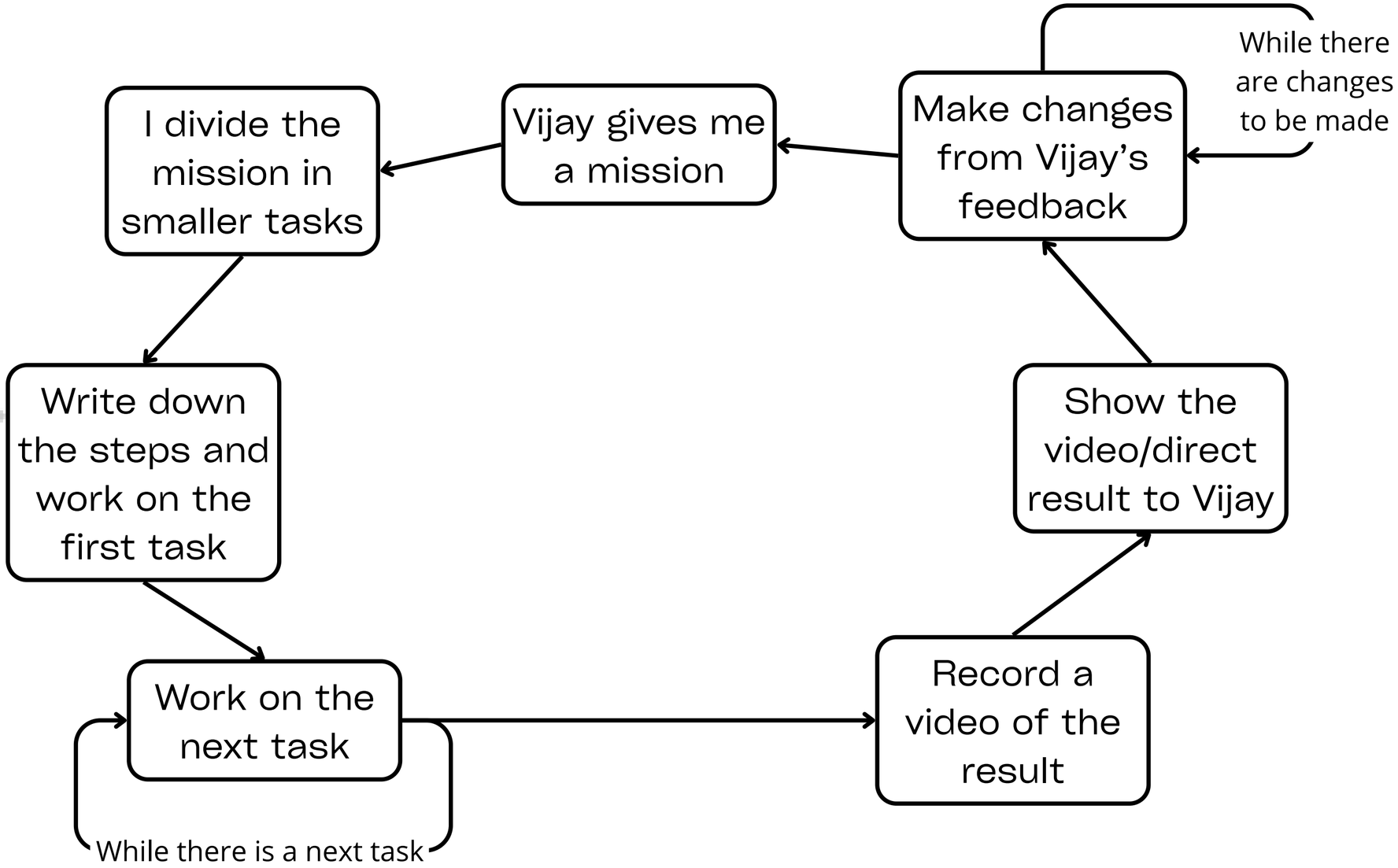

I divide the mission in smaller tasks
Vijay gives me a mission
Write down the steps and work on the first task


I divide the mission in smaller tasks
Vijay gives me a mission
Write down the steps and work on the first task
Work on the next task
While there is a next task


I divide the mission in smaller tasks
Vijay gives me a mission
Write down the steps and work on the first task
Work on the next task
While there is a next task
Record a video of the result


I divide the mission in smaller tasks
Vijay gives me a mission
Write down the steps and work on the first task
Work on the next task
While there is a next task
Record a video of the result
Show the video/direct result to Vijay


Vijay gives me a mission
I divide the mission in smaller tasks
Write down the steps and work on the first task
Work on the next task
While there is a next task
Record a video of the result
Show the video/direct result to Vijay
Make changes from Vijay's feedback
While there are changes to be made


While there are changes to be made
Make changes from Vijay's feedback
Vijay gives me a mission
I divide the mission in smaller tasks
Write down the steps and work on the first task
Work on the next task
While there is a next task
Record a video of the result
Show the video/direct result to Vijay

I - Host Organization & Problematic

II - Existing Situation, Tasks & Difficulties

III - Tools, Gantt Planning & Personal Organization

IV - The 3 main projects

V - Current VS Initial situation, Technical & Human Assessment

IV - The 3 main projects

1 - GRFICS

2 - Cardiff Metro Emulator

3 - Bottle Filling Plant

IV - The 3 main projects

1 - GRFICS

IV - The 3 main projects

1 - GRFICS

Graphical Realism Framework for Industrial Control Simulation

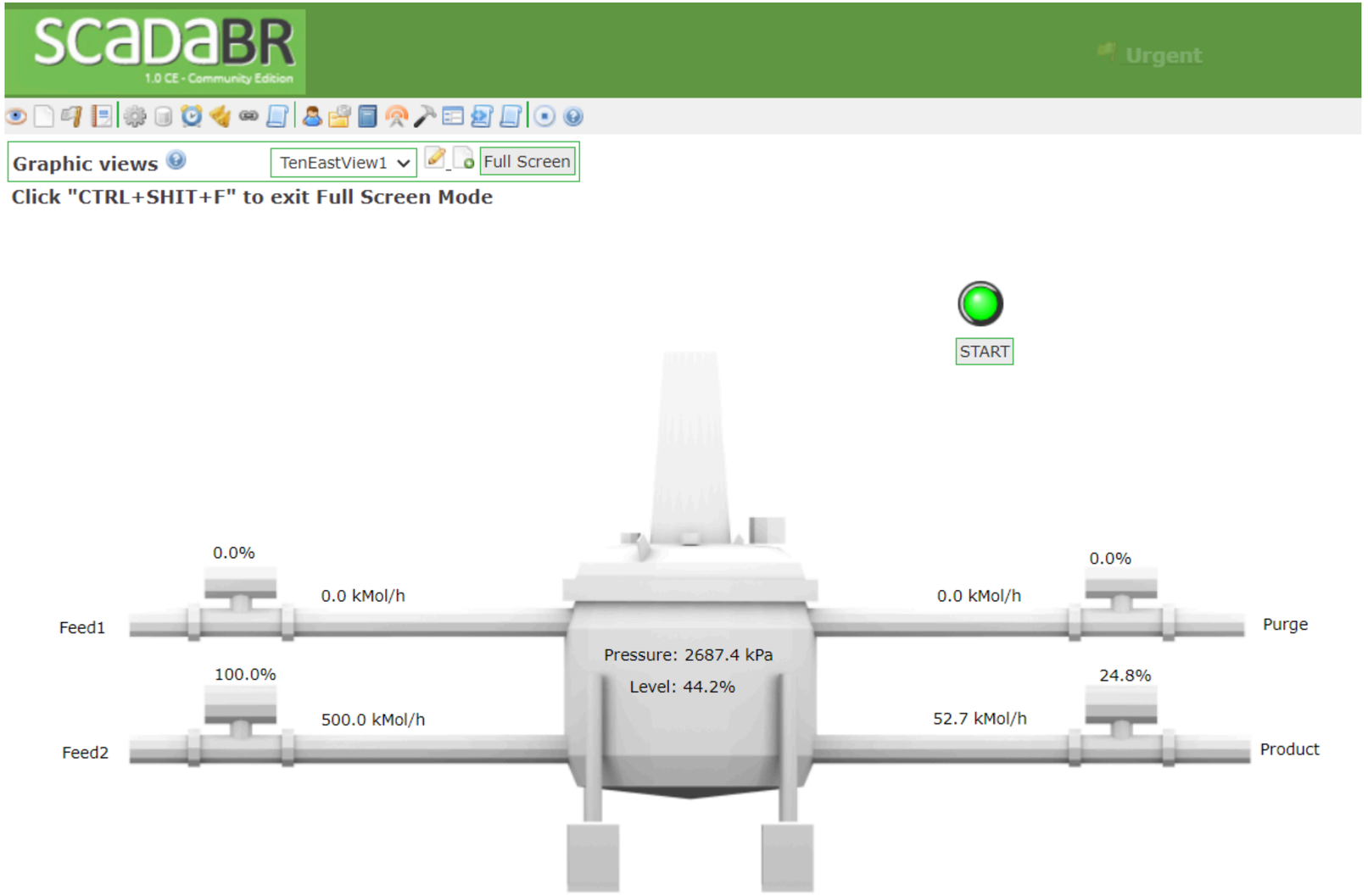
IV - The 3 main projects

1 - GRFICS (Chemical Plant)

IV - The 3 main projects

1 - GRFICS (Chemical Plant)

IV - The 3 main projects
1 - GRFICS (Chemical Plant)

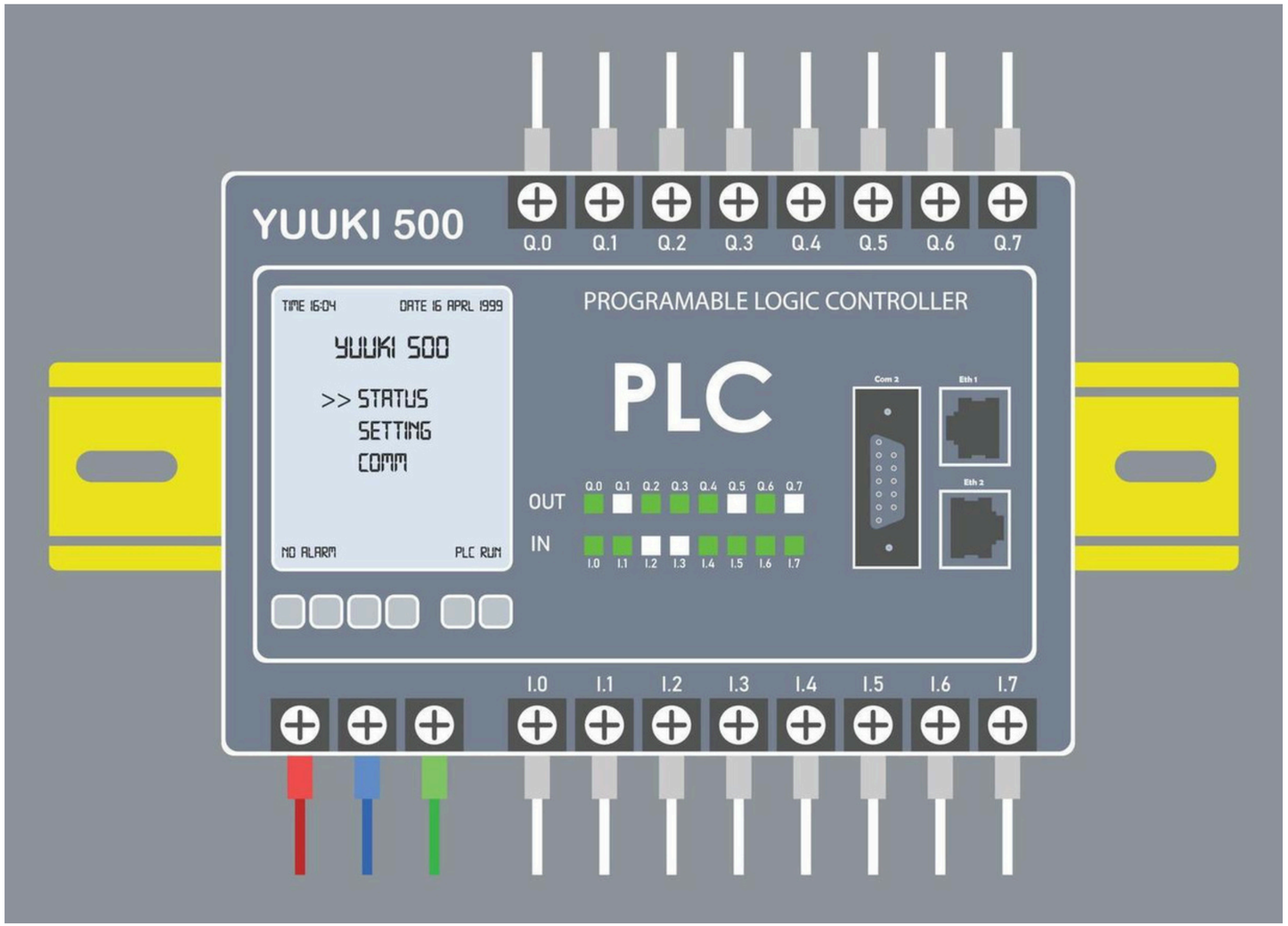


IV - The 3 main projects

1 - GRFICS (Chemical Plant)

IV - The 3 main projects

1 - GRFICS (Chemical Plant)



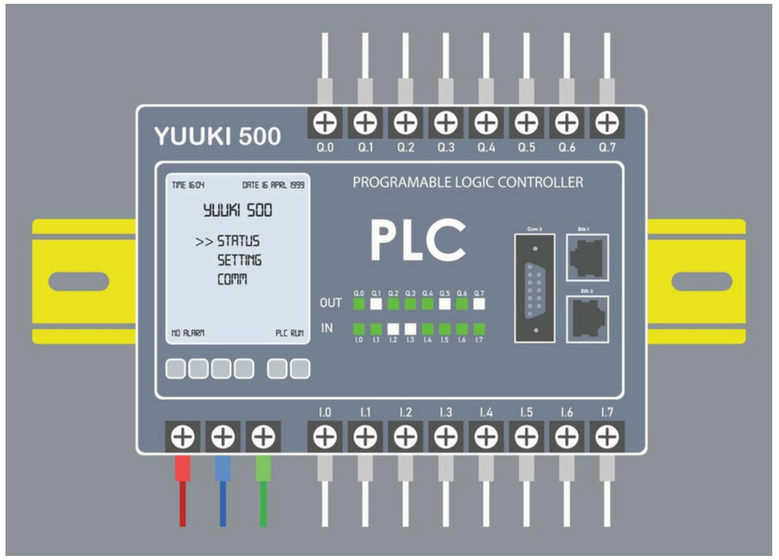
PLC = Programmable Logic Controller

IV - The 3 main projects

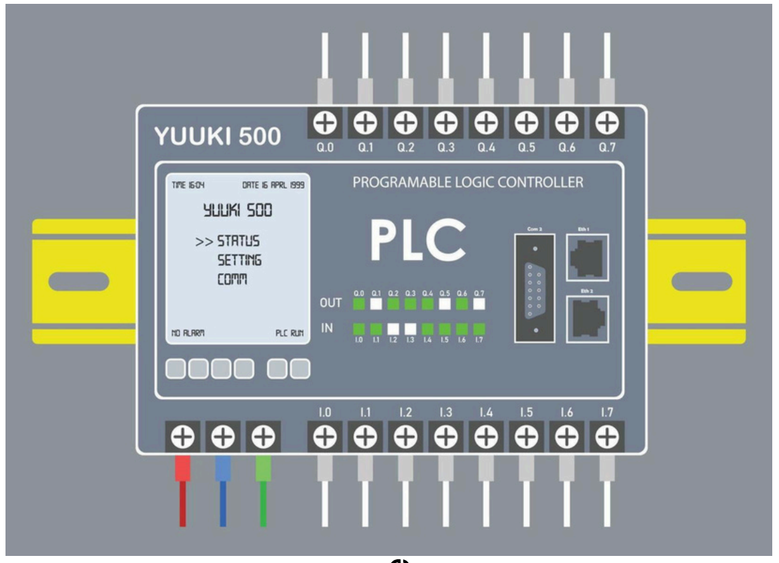
1 - GRFICS (Chemical Plant)

IV - The 3 main projects
1 - GRFICS (Chemical Plant)

IV - The 3 main projects
1 - GRFICS (Chemical Plant)

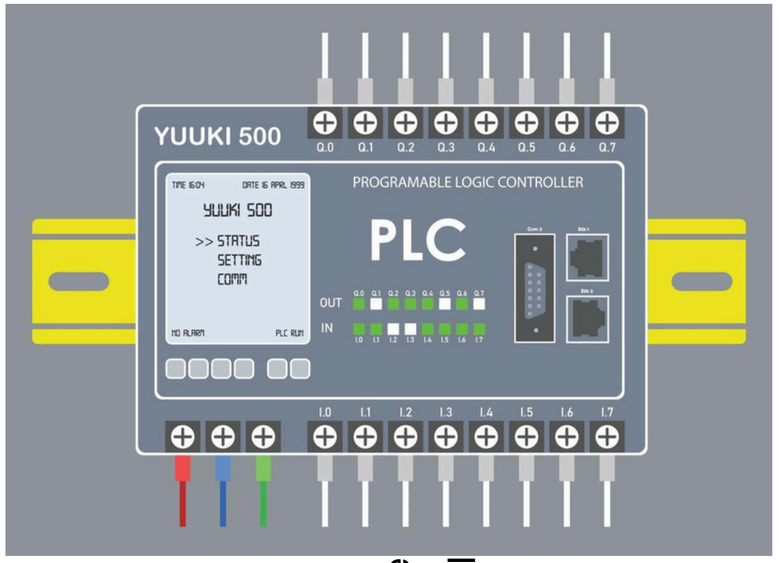


IV - The 3 main projects
1 - GRFICS (Chemical Plant)

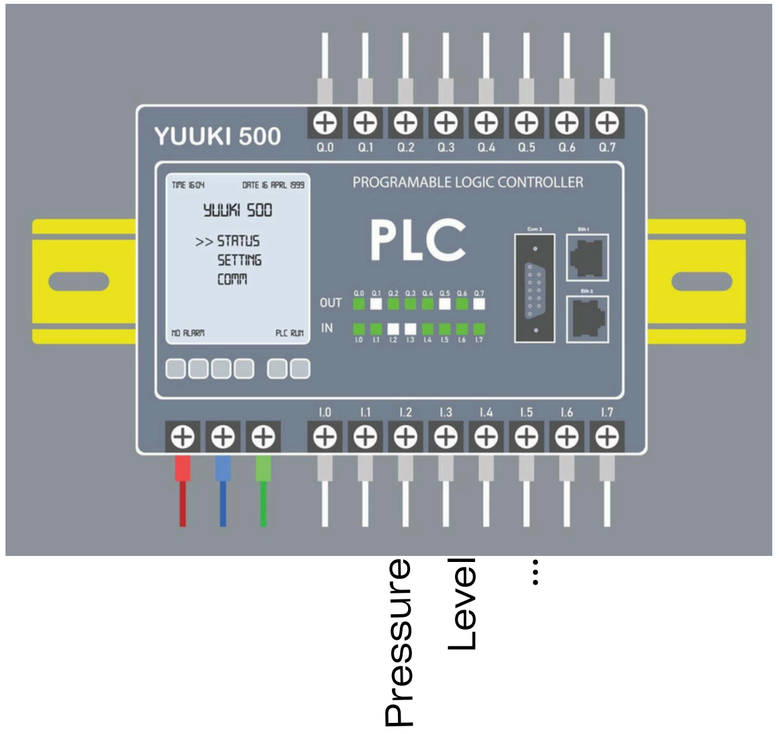


Pressure

IV - The 3 main projects
1 - GRFICS (Chemical Plant)



IV - The 3 main projects
1 - GRFICS (Chemical Plant)



IV - The 3 main projects
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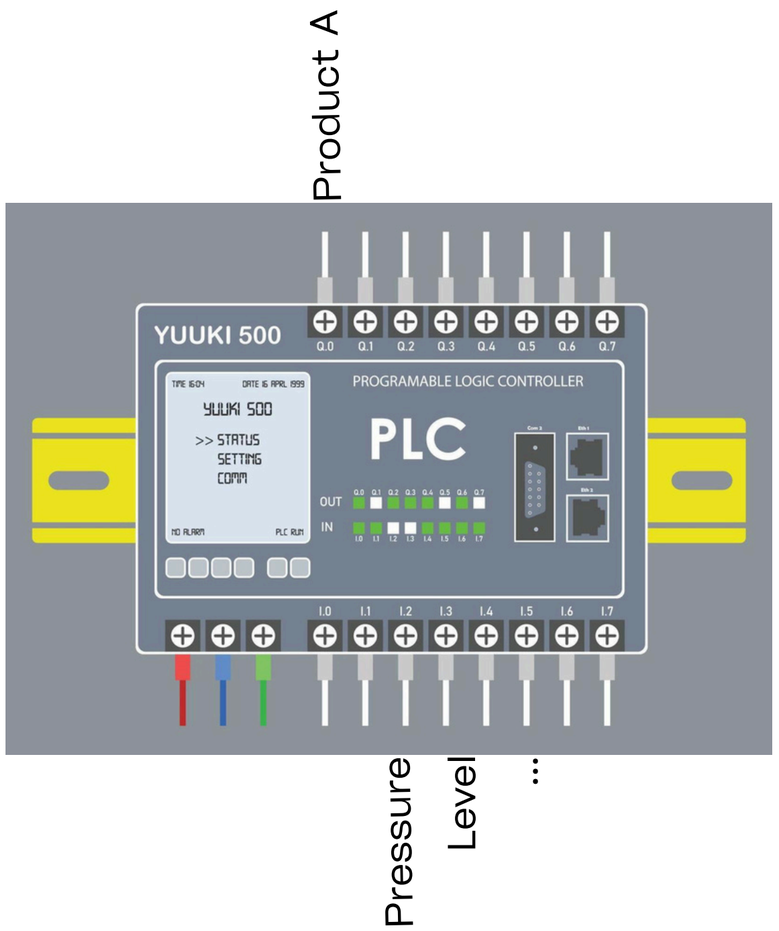

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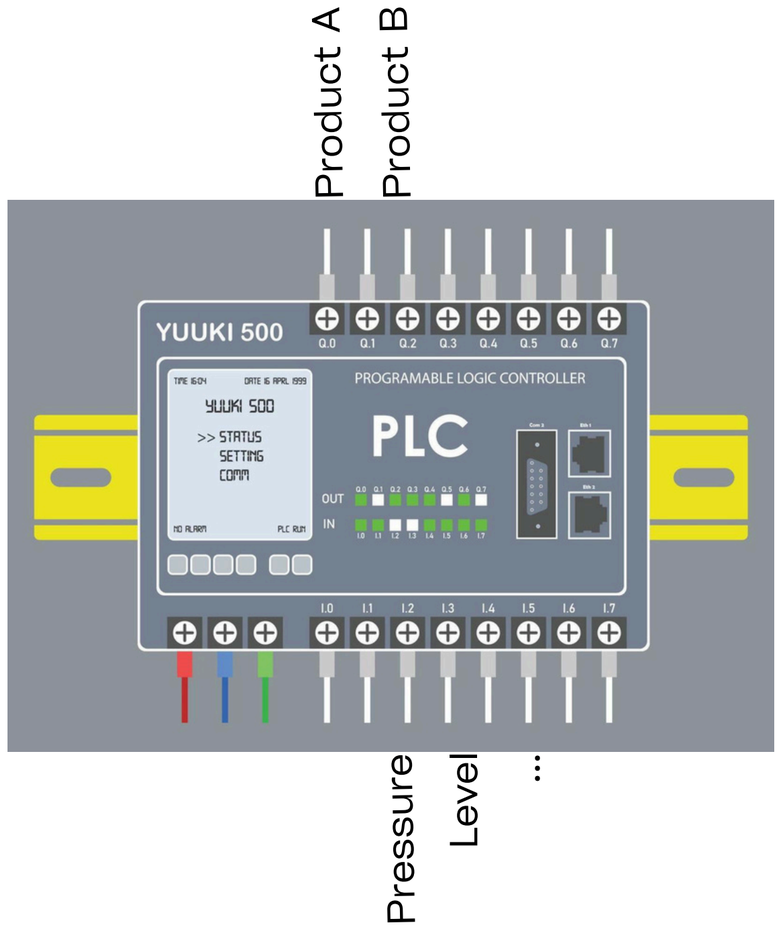
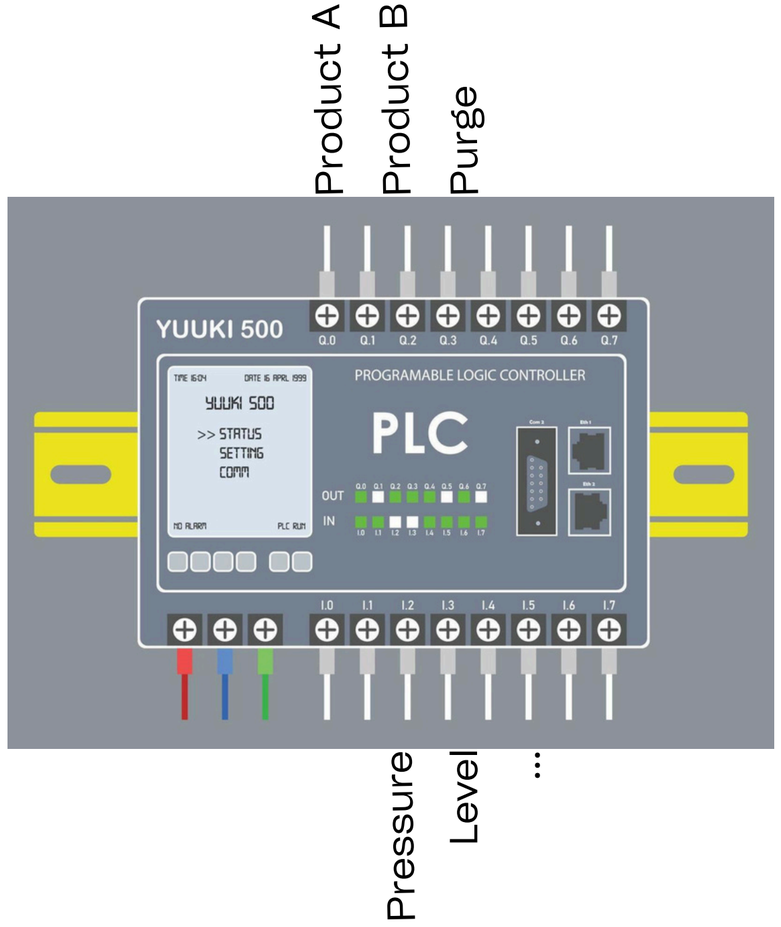


IV - The 3 main projects
1 - GRFICS (Chemical Plant)



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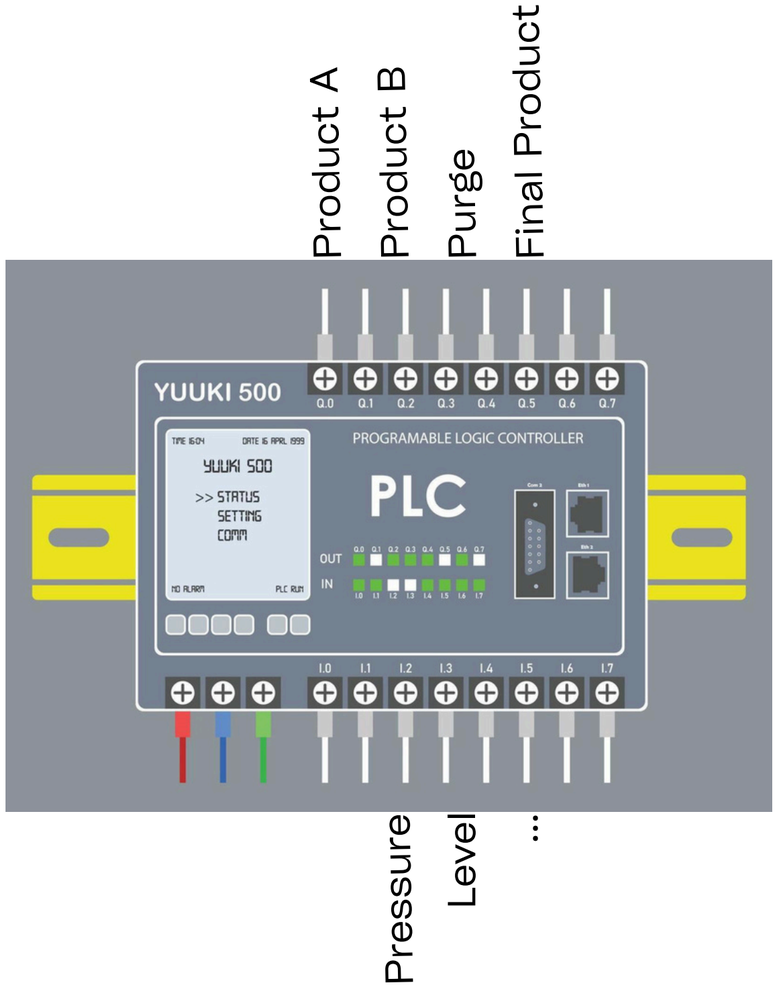

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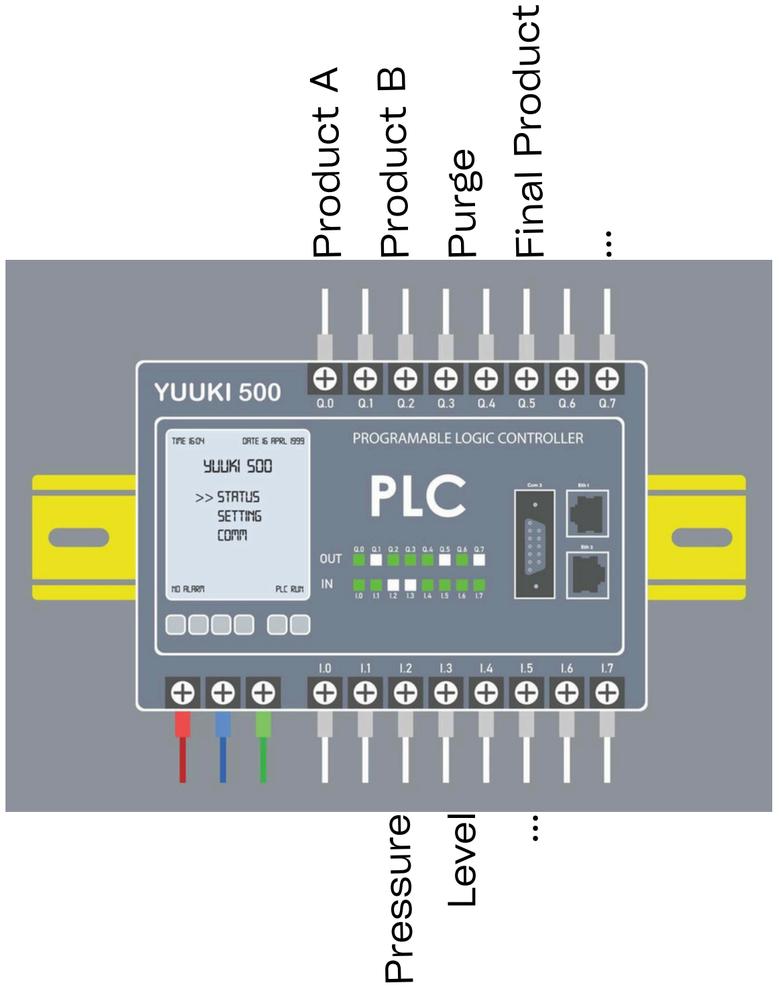

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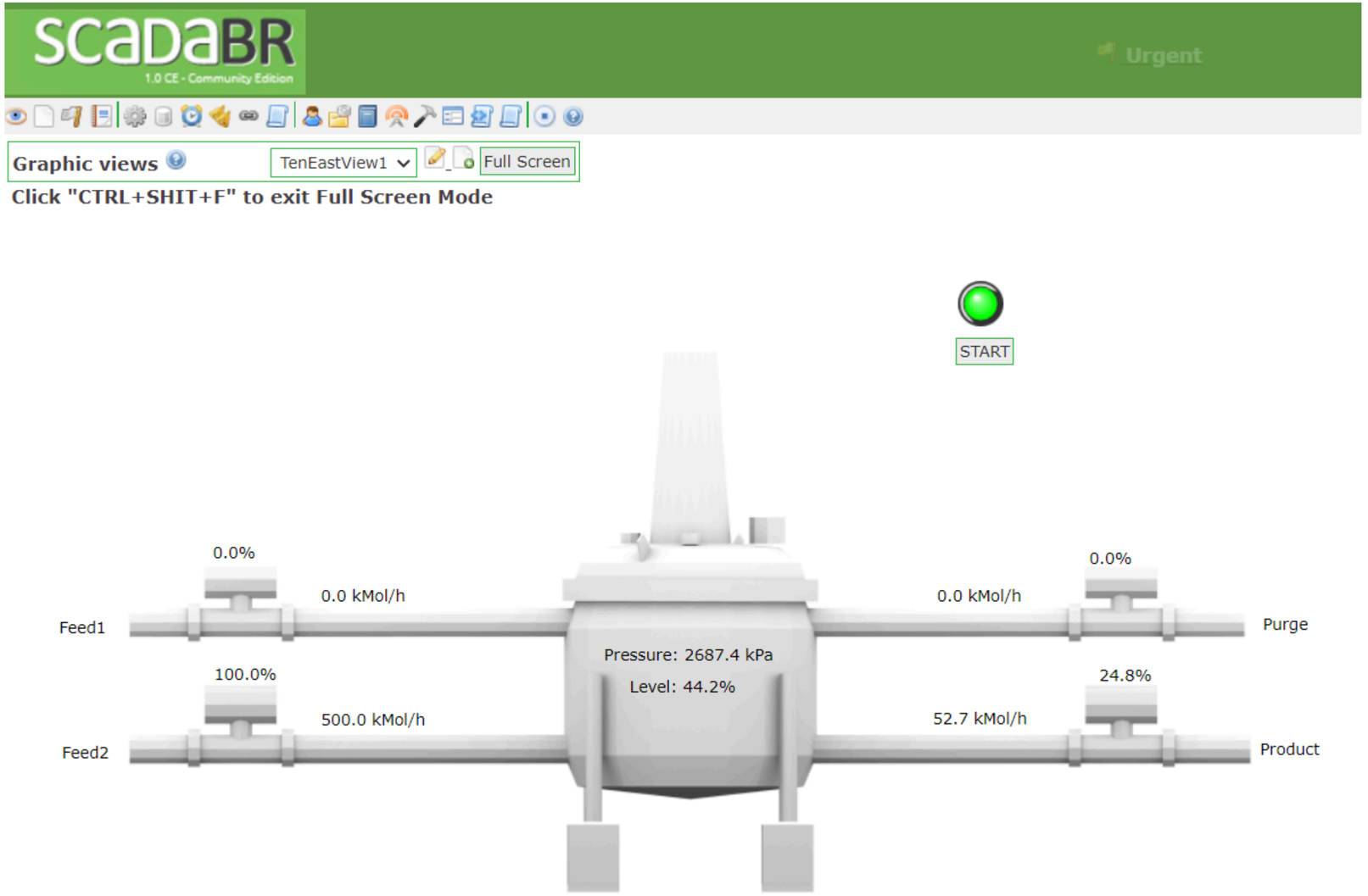


IV - The 3 main projects
1 - GRFICS (Chemical Plant)

My work:

My work:

- Understand the project

My work:

- Understand the project
- Install it

My work:

- Understand the project
- Install it
- Make it work locally

My work:

- Understand the project
- Install it
- Make it work locally
- Understand how it can be attacked

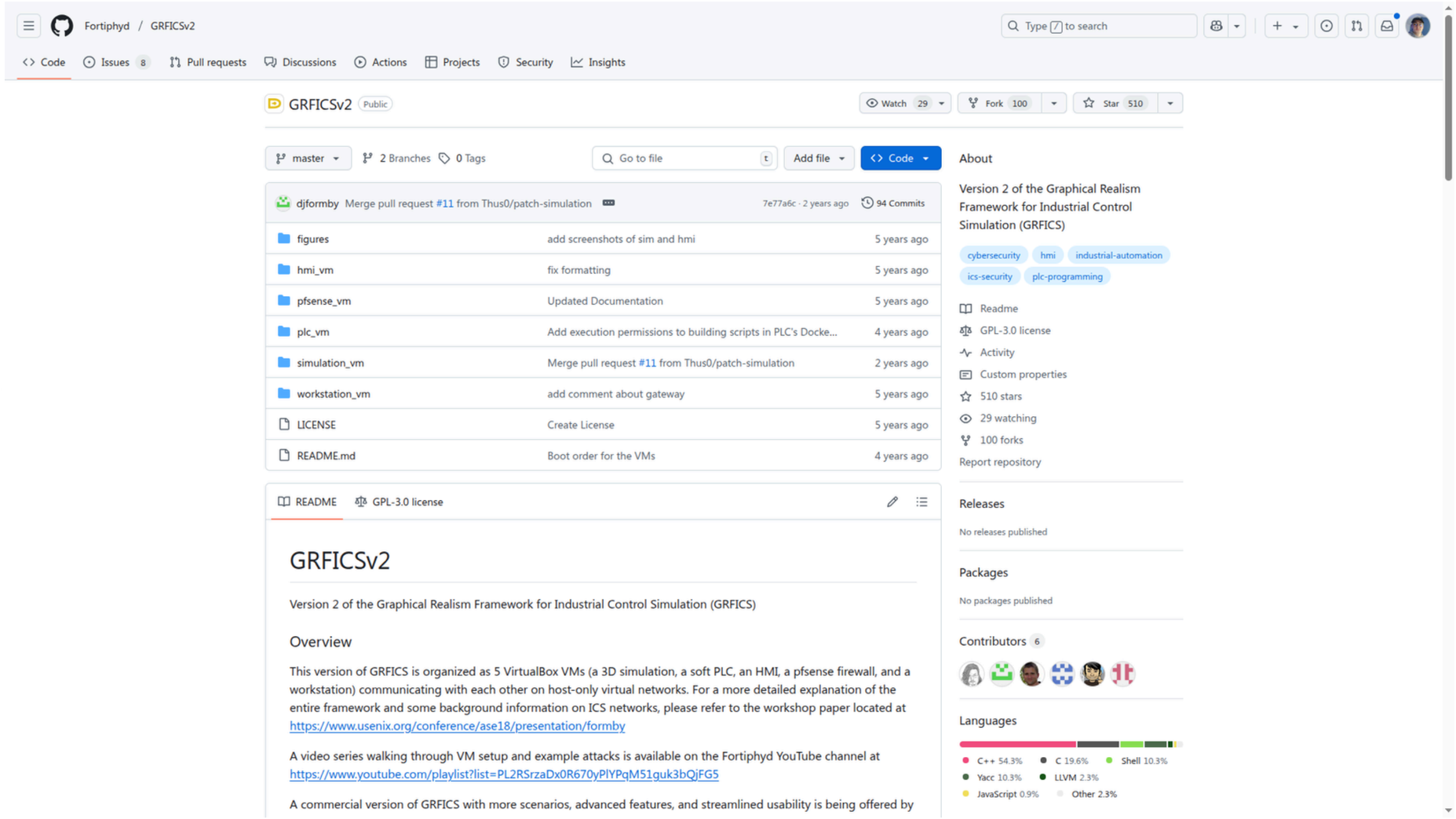
My work:

- Understand the project
- Install it
- Make it work locally
- Understand how it can be attacked
- Export it to the Ludus

My work:

- Understand the project
- Install it
- Make it work locally
- Understand how it can be attacked
- Export it to the Ludus
- Make it duplicable

IV - The 3 main projects
1 - GRFICS (Chemical Plant)



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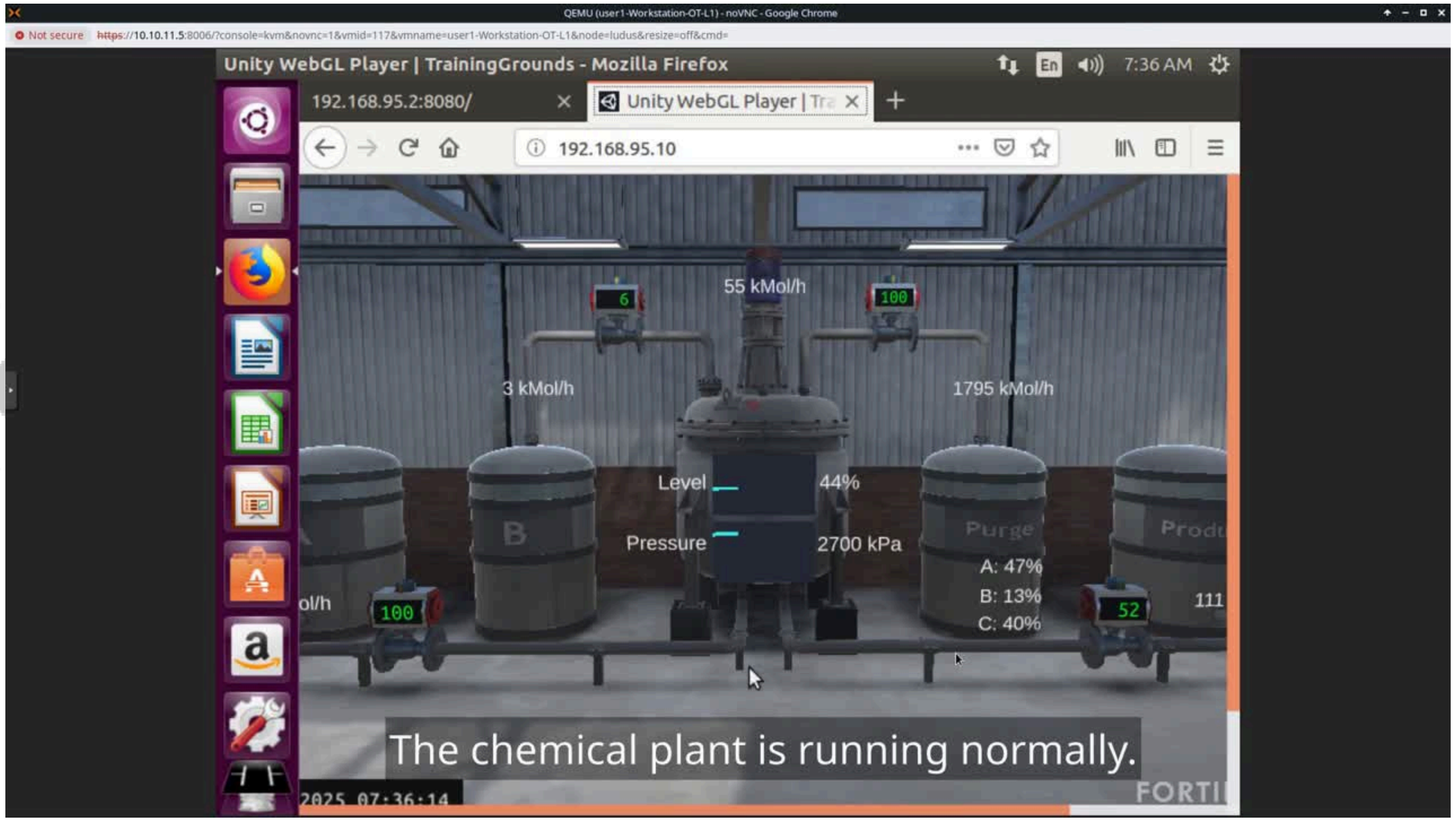

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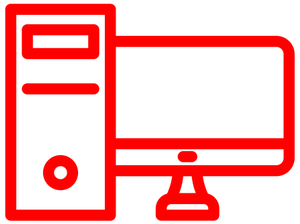
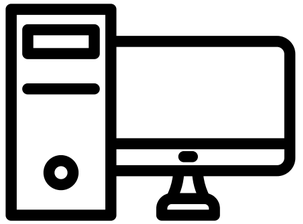
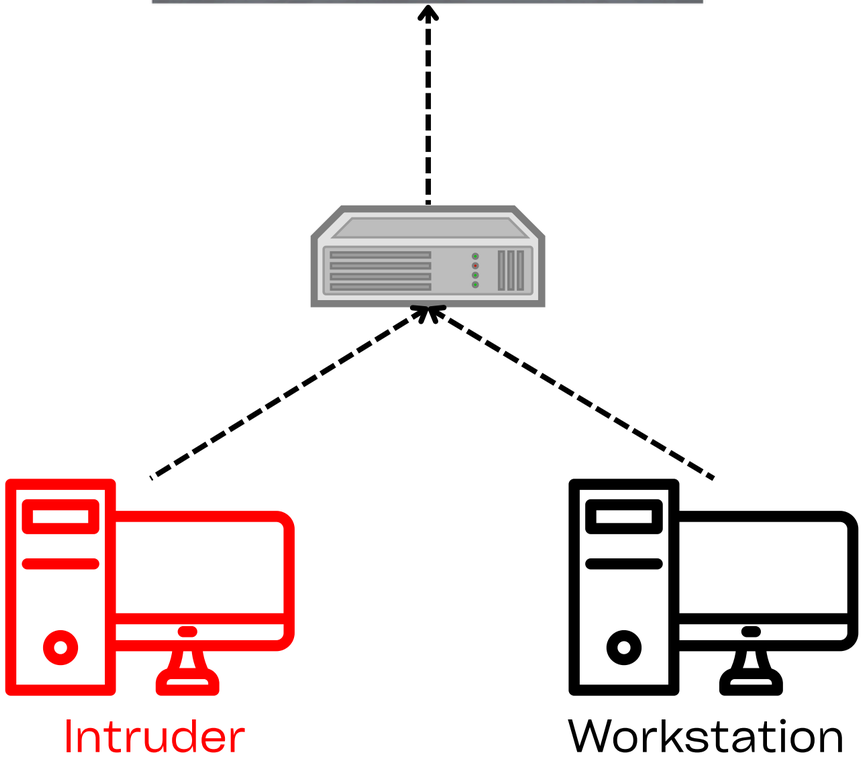


Intruder

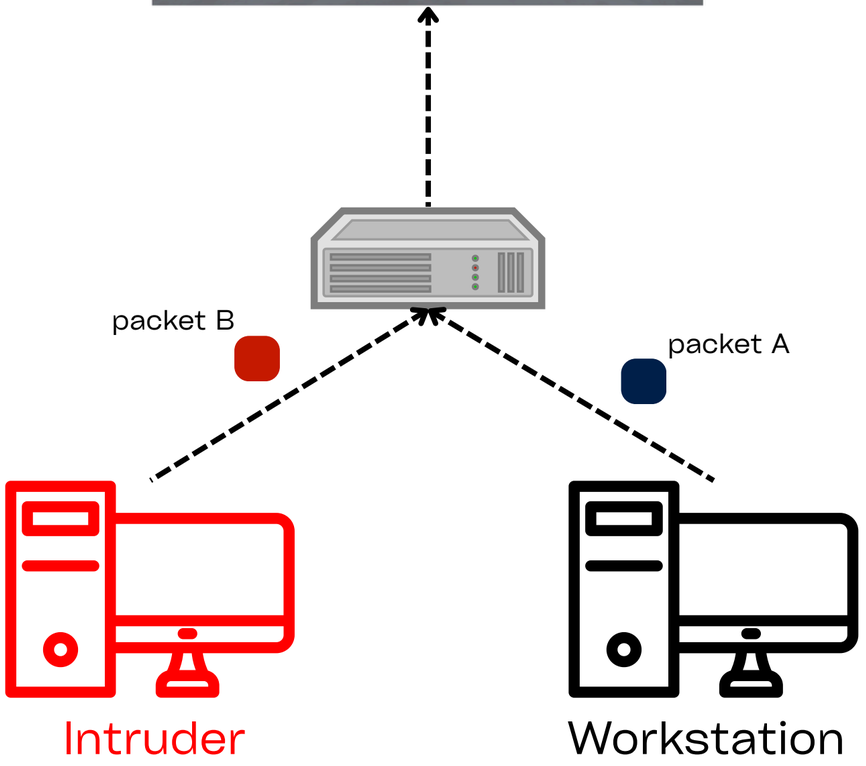


Workstation

IV - The 3 main projects
1 - GRFICS (Chemical Plant)



IV - The 3 main projects
1 - GRFICS (Chemical Plant)



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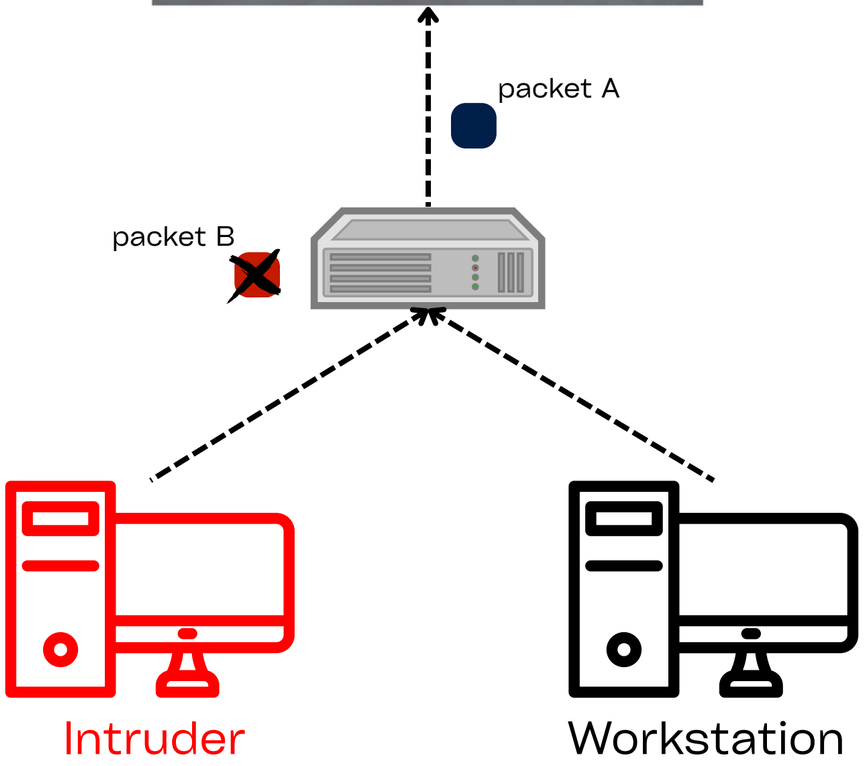

IV - The 3 main projects
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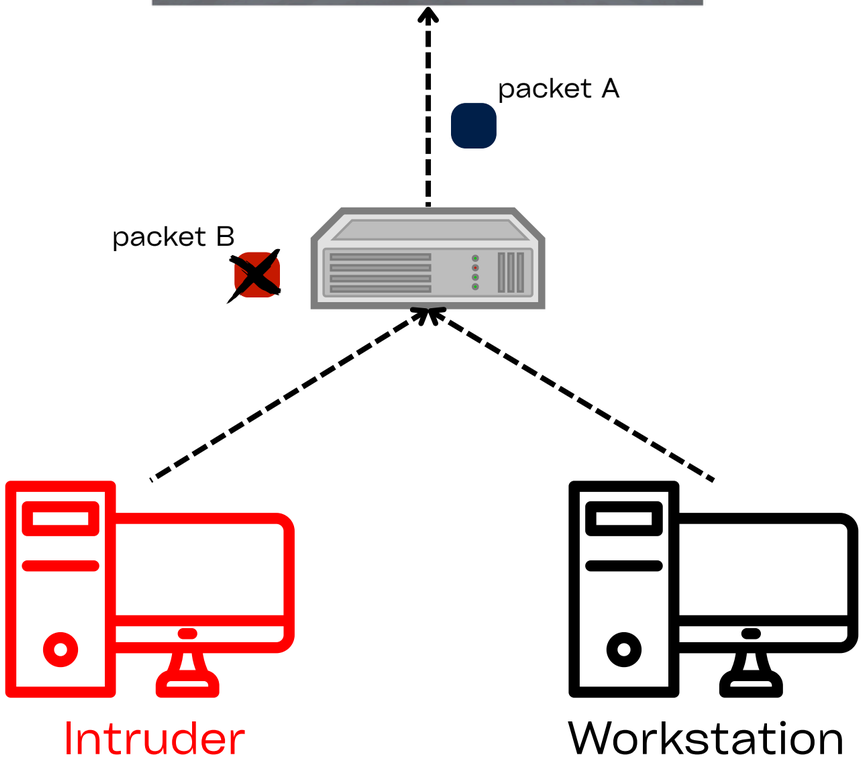


Benefits

Benefits

Already installed, so no direct benefit for the CIH

Benefits

Already installed, so no direct benefit for the CIH

I understood what the CIH was working on

Benefits

Already installed, so no direct benefit for the CIH

I understood what the CIH was working on

Get hands-on practice on the Ludus

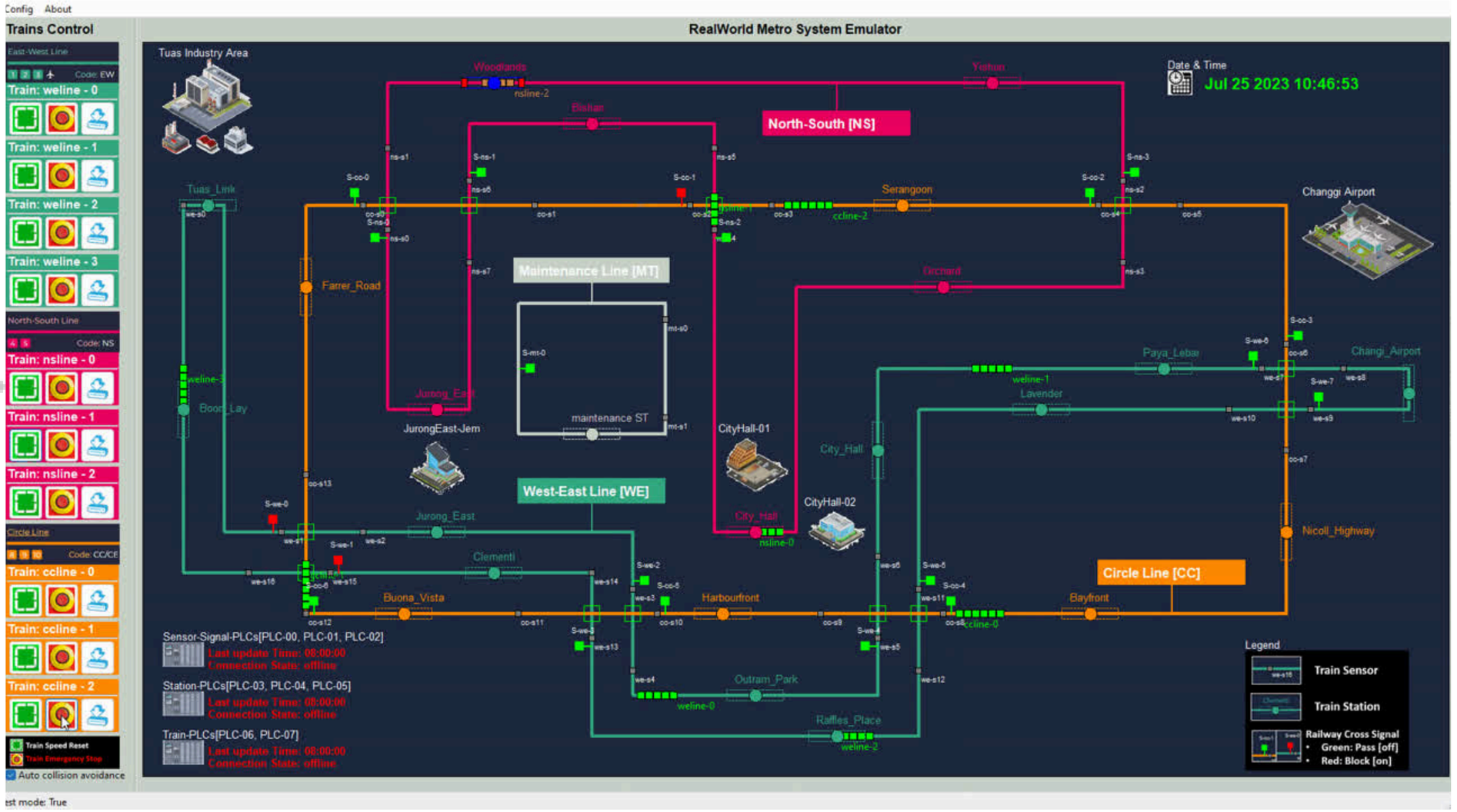
IV - The 3 main projects

1 - GRFICS (Chemical Plant)

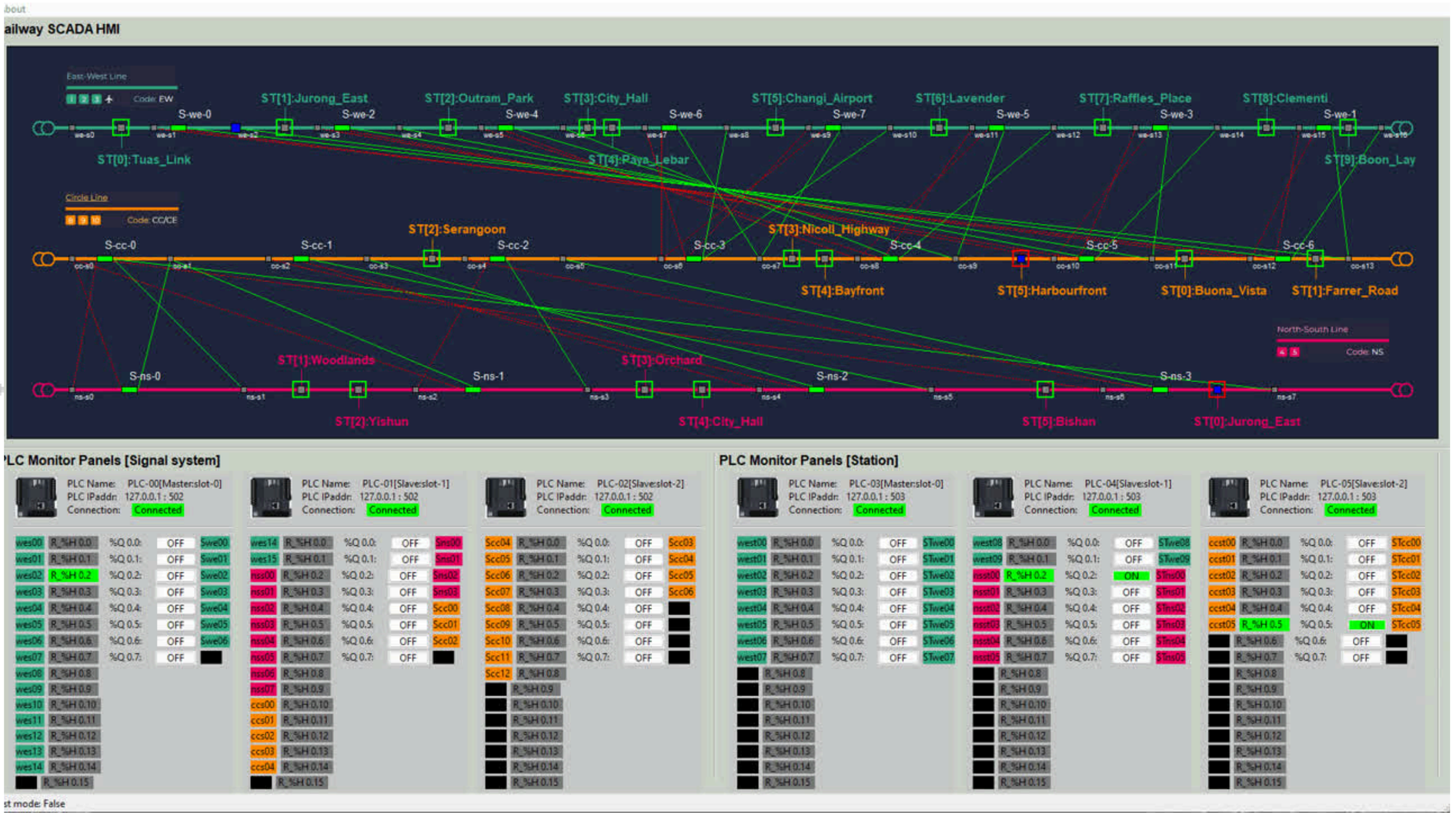
2 - Cardiff Metro Emulator

3 - Bottle Filling Plant

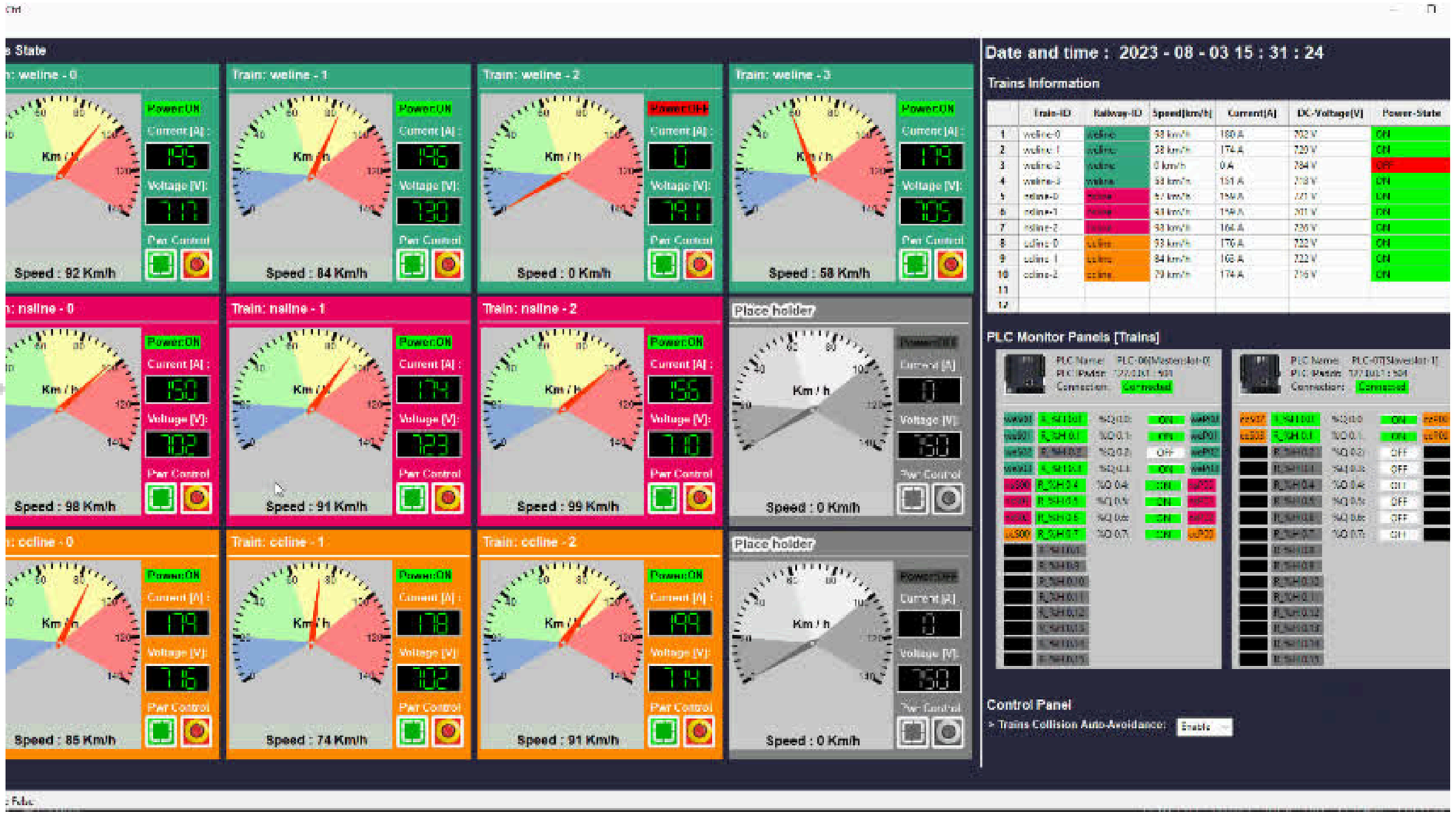
IV - The 3 main projects
2 - Cardiff Metro Emulator



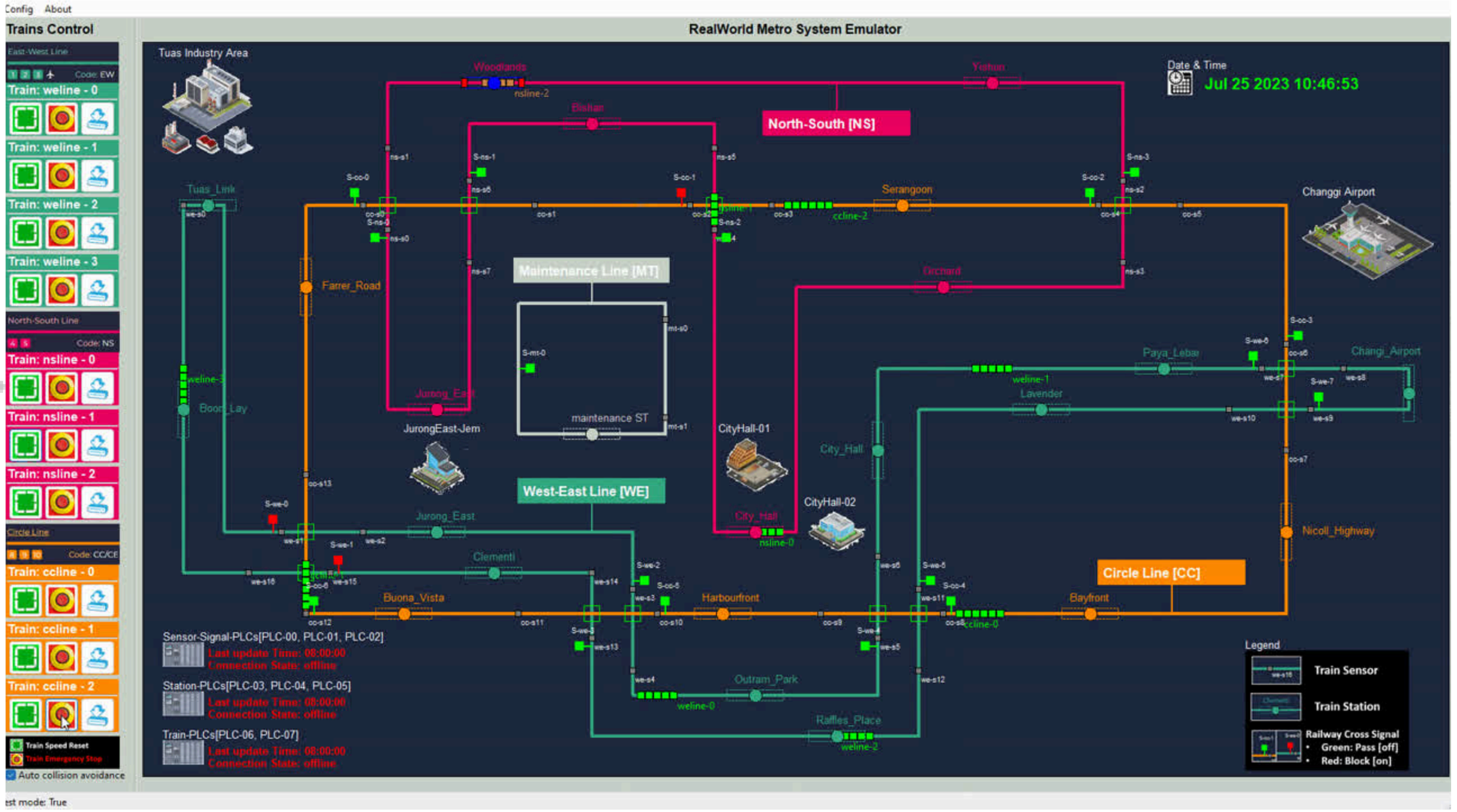
IV - The 3 main projects
2 - Cardiff Metro Emulator



IV - The 3 main projects
2 - Cardiff Metro Emulator



IV - The 3 main projects
2 - Cardiff Metro Emulator



My work:

- Understand the project
- Install it
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- Understand how it can be attacked
- Export it to the Ludus
- Make it duplicable

My work:

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- Install it
- Make it work locally
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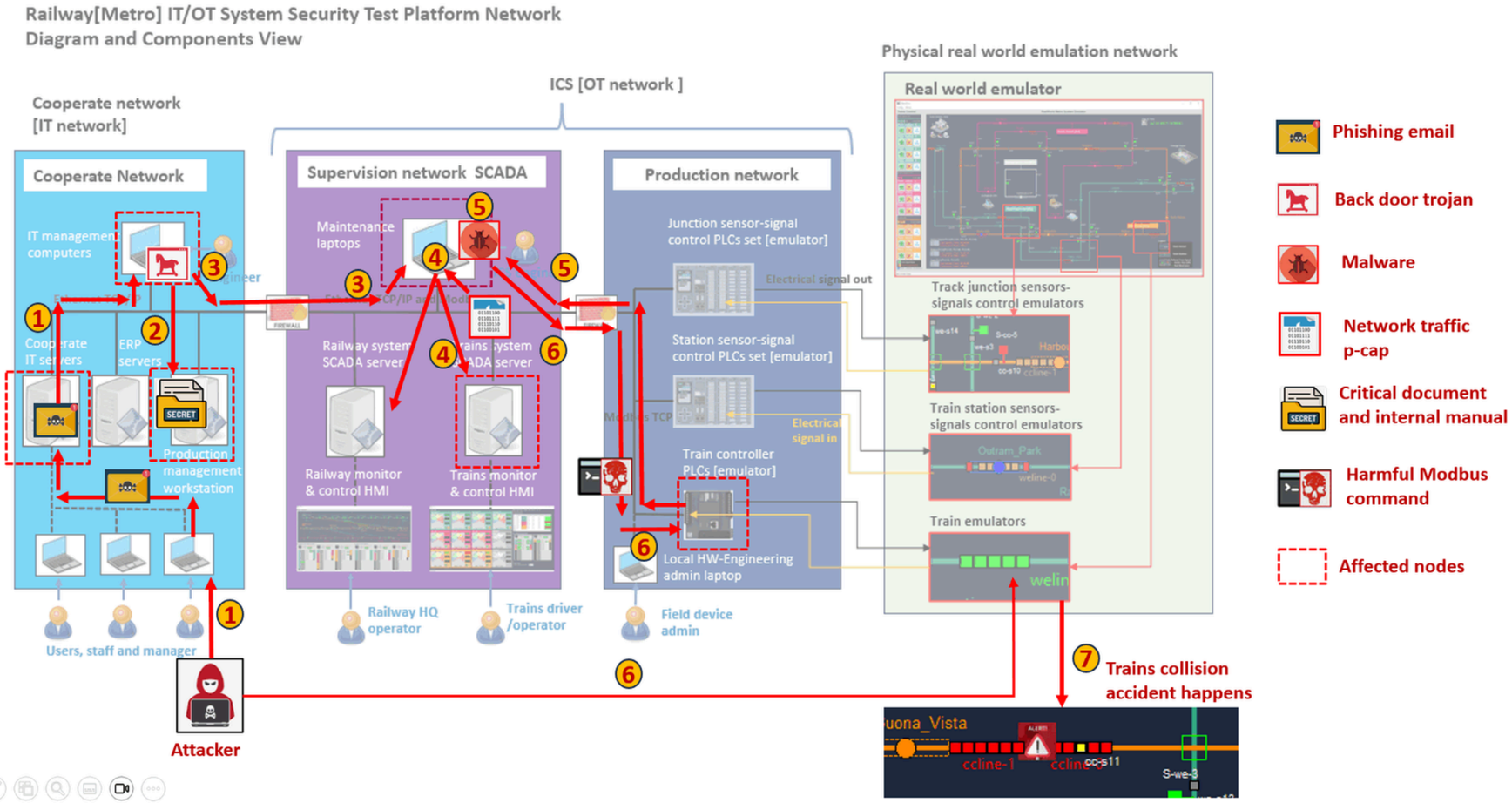
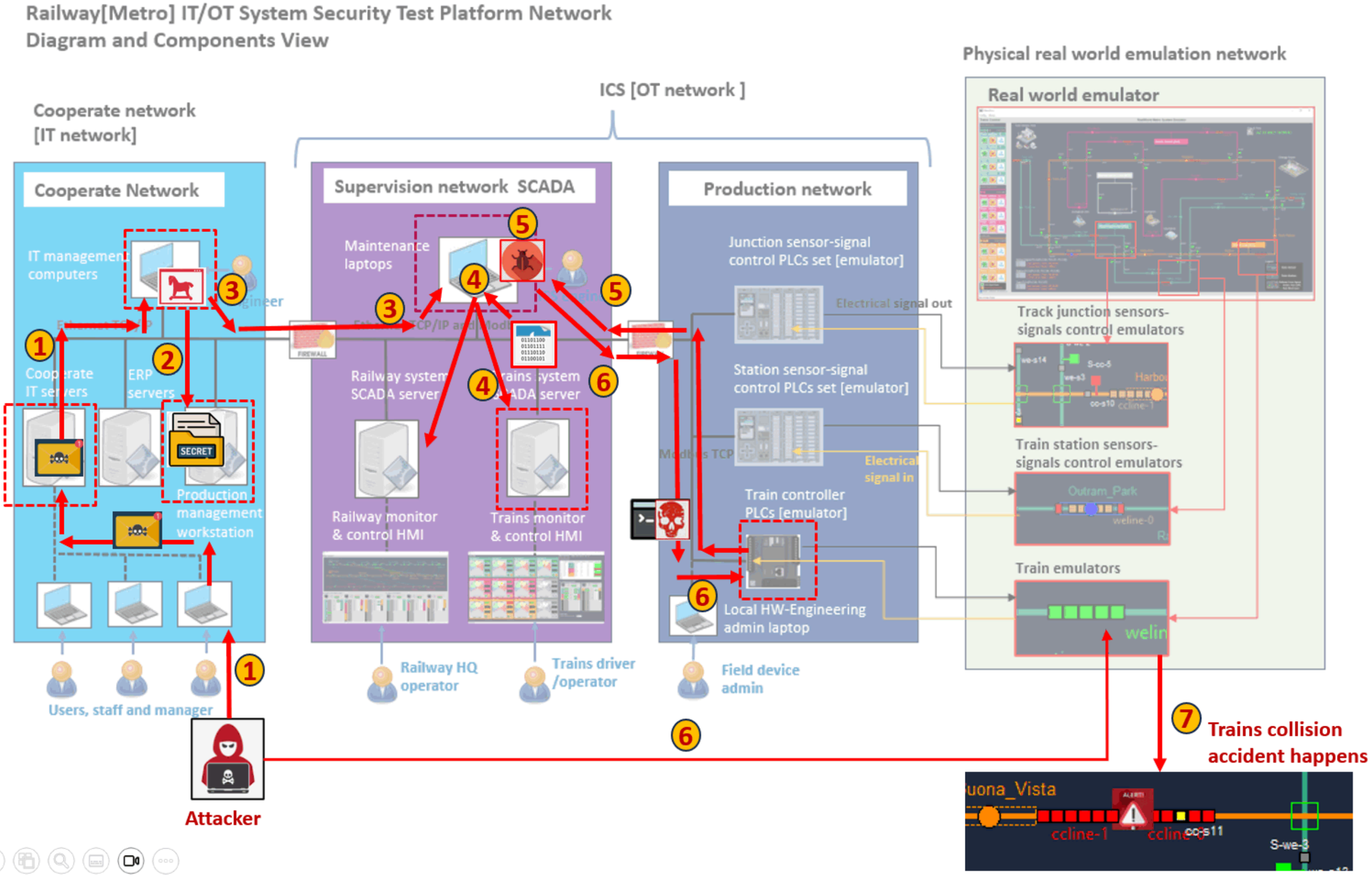
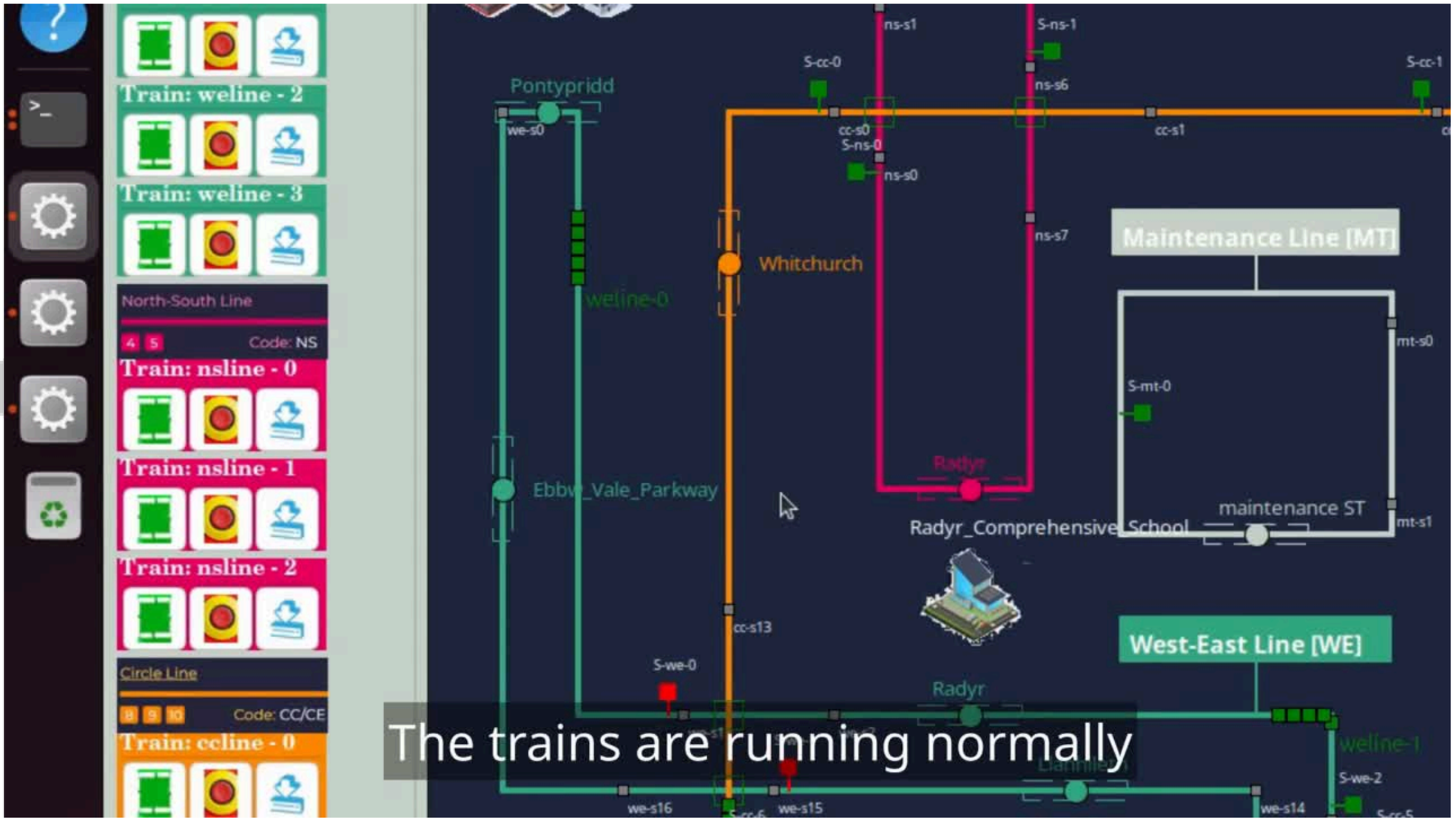
Attack Scenario 1: False command injection attack via phishing email and Backdoor Trojan



Attack Scenario 1: False command injection attack via phishing email and Backdoor Trojan




Train: weline - 2
Train: weline - 3
North-South Line
Code: NS
Train: nsline - 0
Train: nsline - 1
Train: nsline - 2
Circle Line
Code: CC/CE
Train: ccline - 0
Pontypridd
we-s0
weline-0
Whitchurch
Ebbw_Vale_Parkway
Radyr
Radyr_Comprehensive_School
ns-s1
S-ns-1
S-cc-0
S-cc-1
ns-s6
cc-s0
cc-s1
S-ns-0
ns-s0
ns-s7
Maintenance Line [MT]
mt-s0
S-mt-0
maintenance ST
mt-s1
cc-s13
S-we-0
West-East Line [WE]
Radyr
weline-1
S-we-2
we-s16
we-s15
we-s14
The trains are running normally

IV - The 3 main projects

1 - GRFICS (Chemical Plant)

2 - Cardiff Metro Emulator

3 - Bottle Filling Plant

IV - The 3 main projects

3 - Bottle Filling Plant

2 main problems:

2 main problems:

- The PLC should be programmed using ladder logic

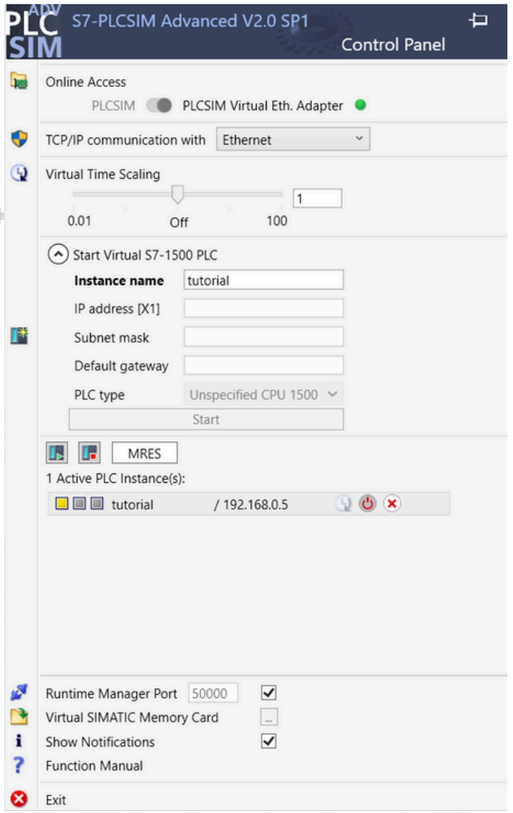
2 main problems:

- The PLC should be programmed using ladder logic
- The PLC program was not explicitly explained

SIEMENS

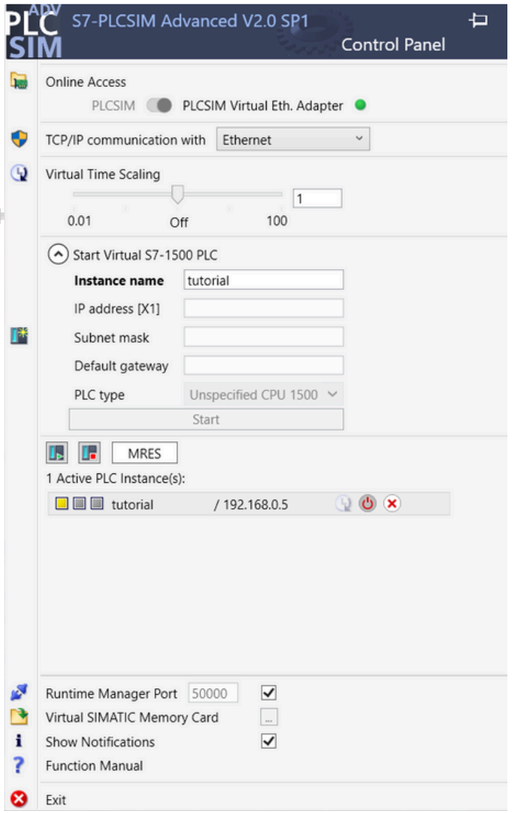
SIEMENS

PLC Simulator

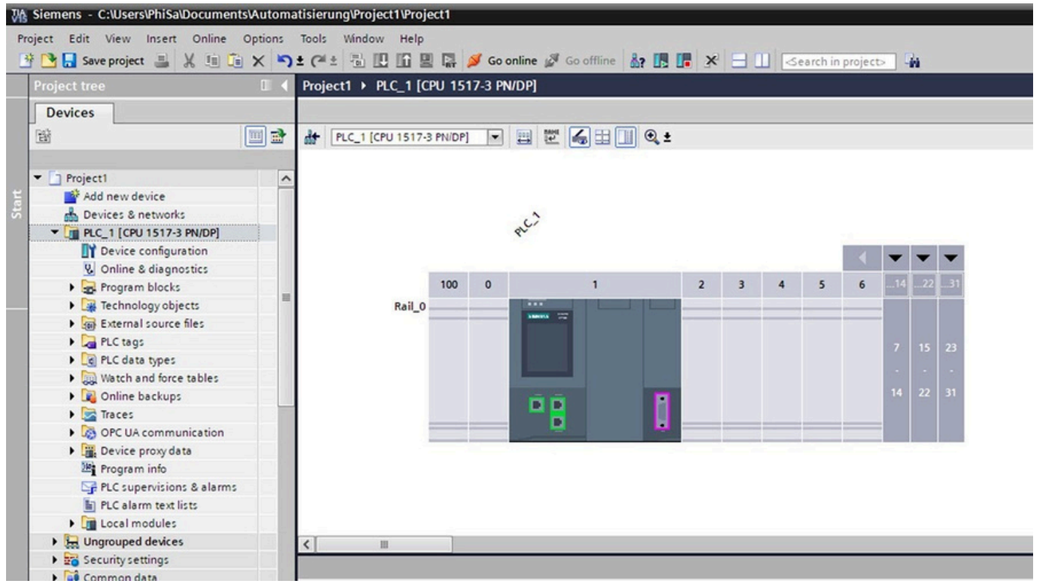


SIEMENS

PLC Simulator

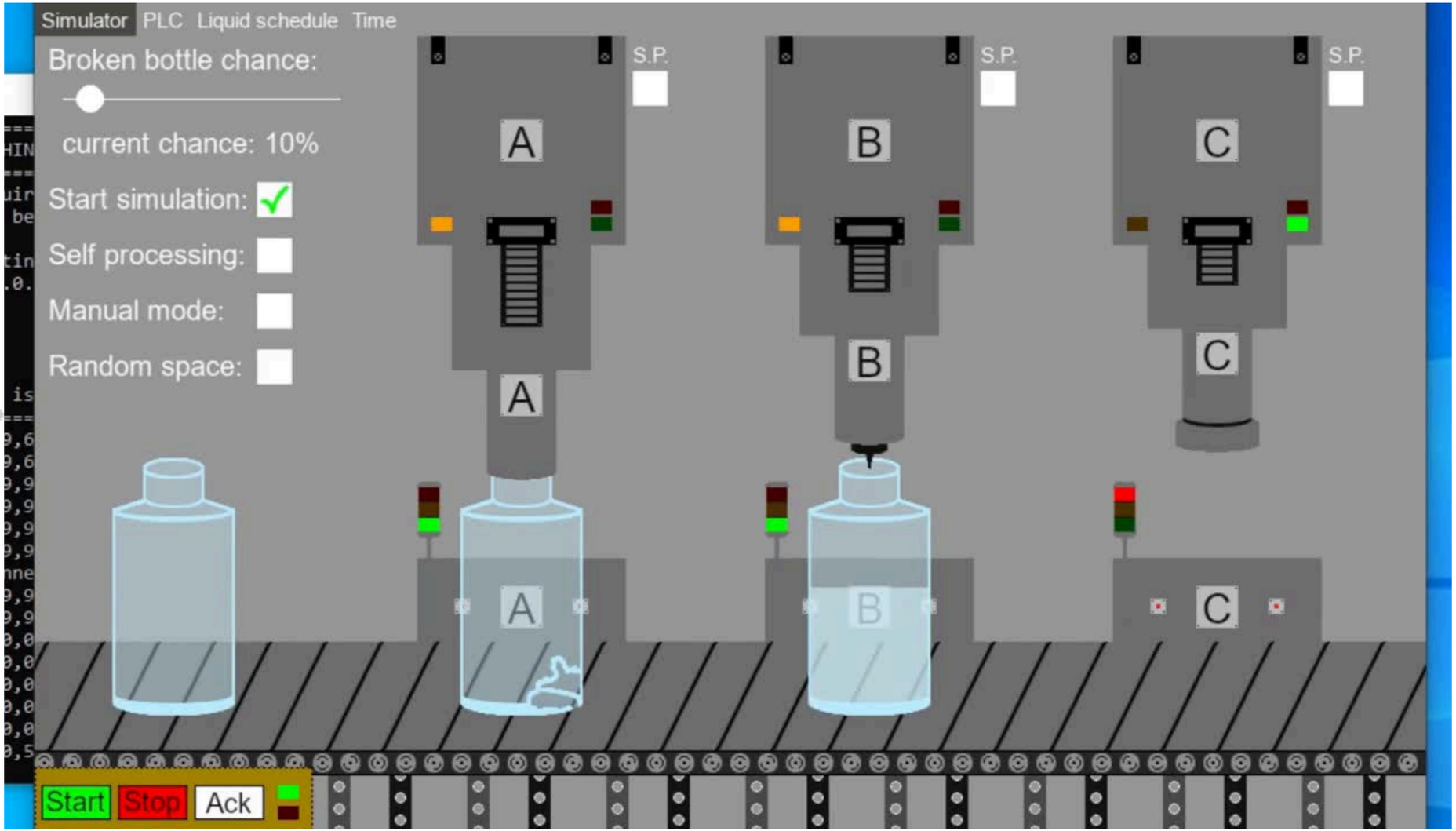


TIA Portal



IV - The 3 main projects

3 - Bottle Filling Plant



IV - The 3 main projects

3 - Bottle Filling Plant

Python = 170 lines

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Ladder logic = 7 days of 8 hours

IV - The 3 main projects

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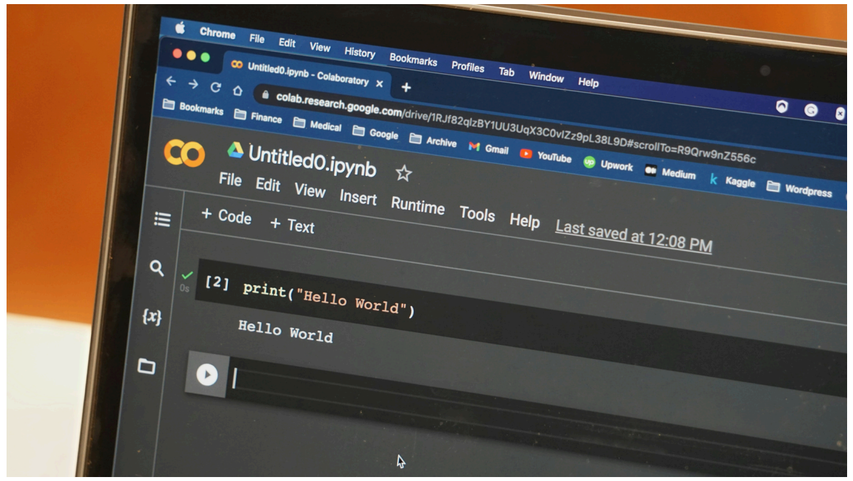
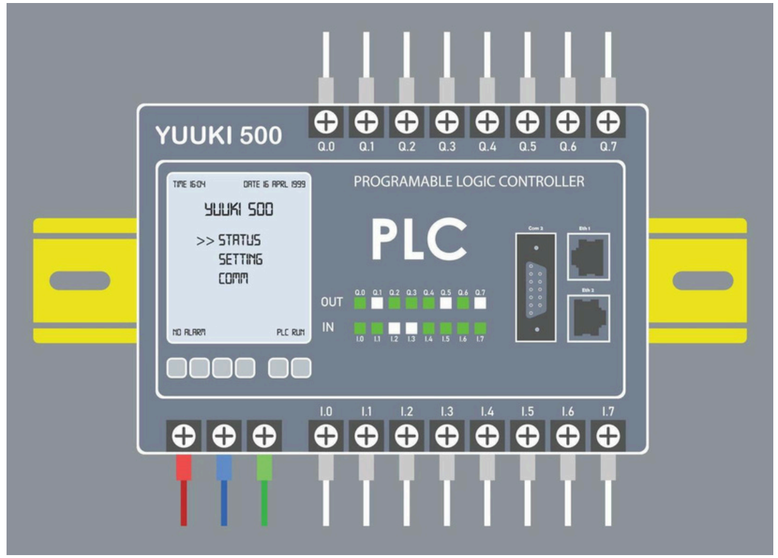


Ladder logic = 7 days of 8 hours

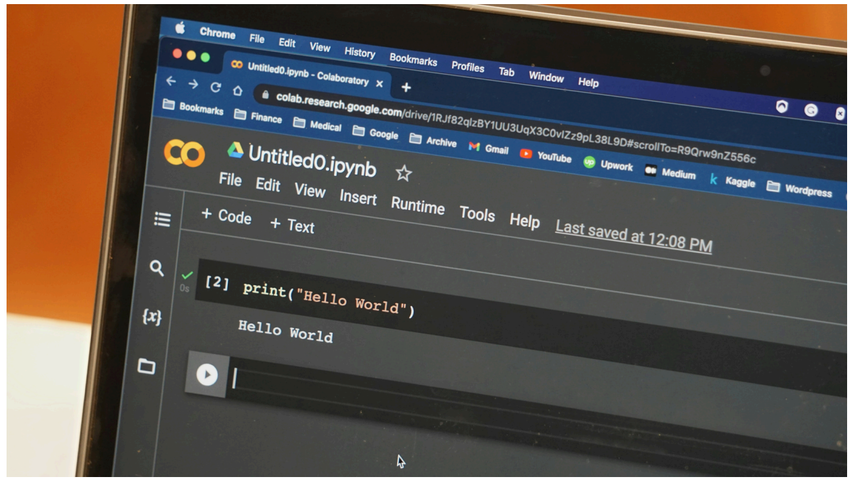


IV - The 3 main projects

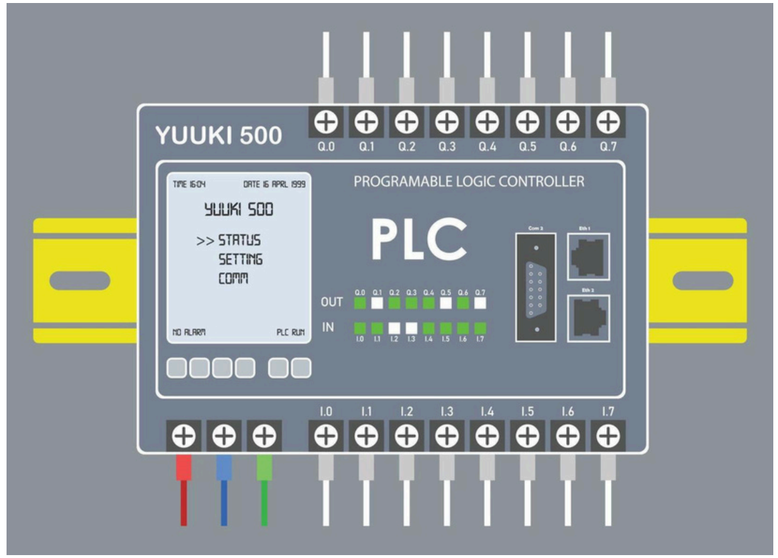
3 - Bottle Filling Plant

Python = 170 lines

Written programming language



Ladder logic = 7 days of 8 hours



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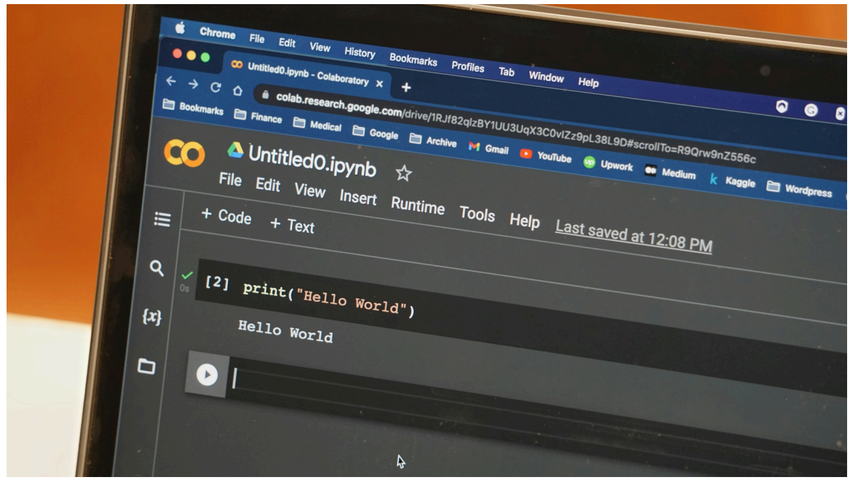
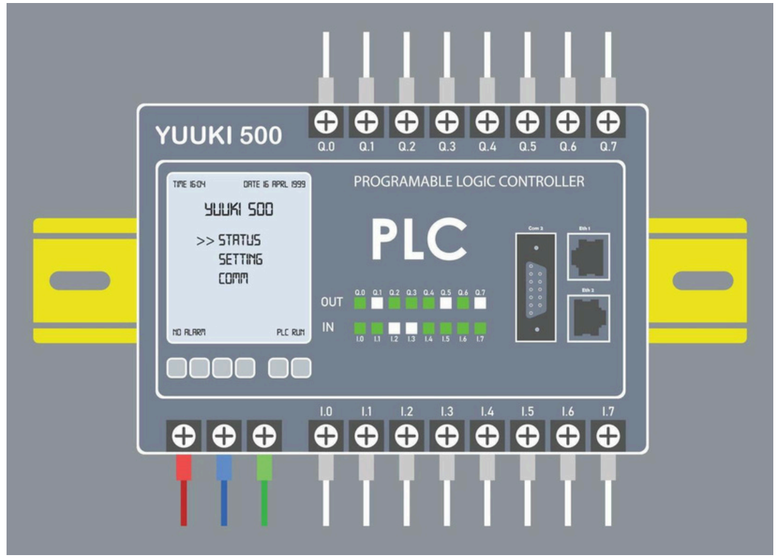


Ladder logic = 7 days of 8 hours

Visual programming language

Mainly conditions

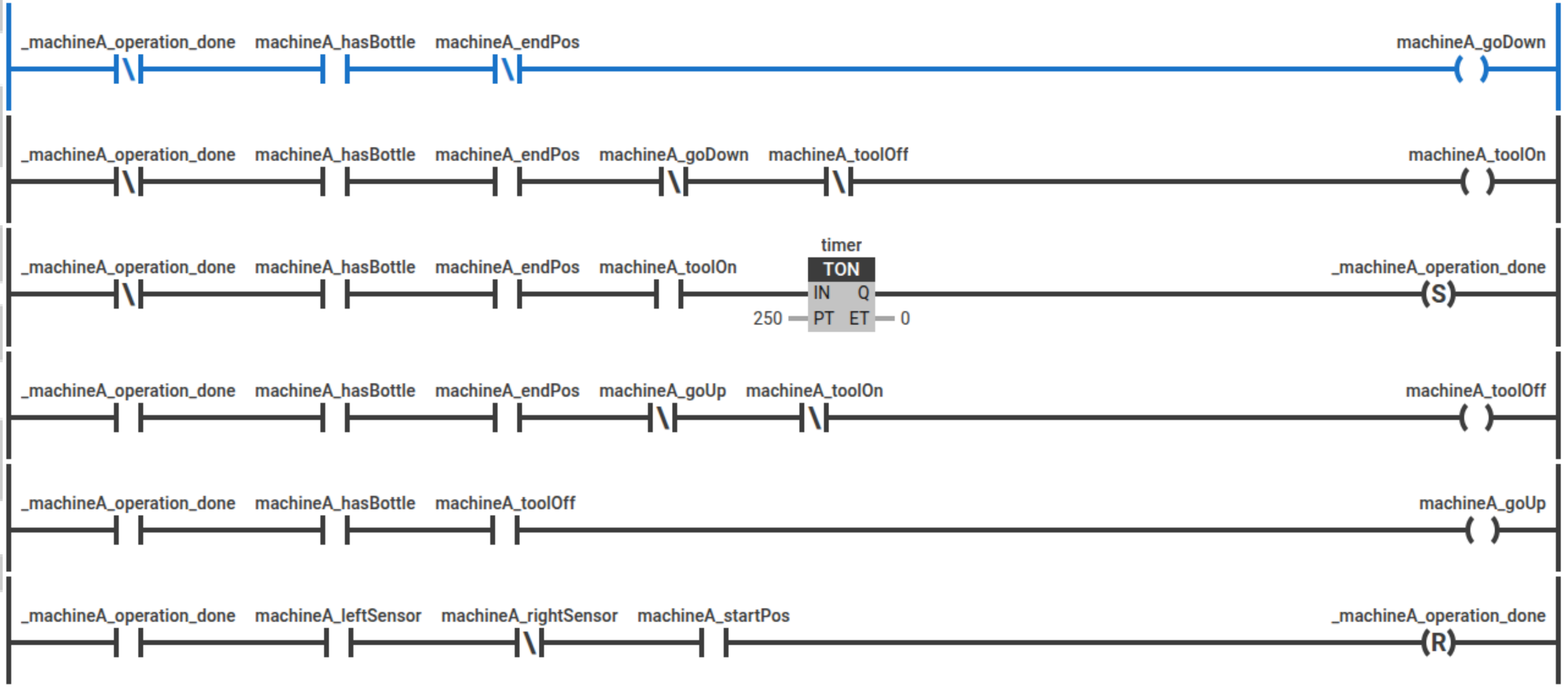


IV - The 3 main projects

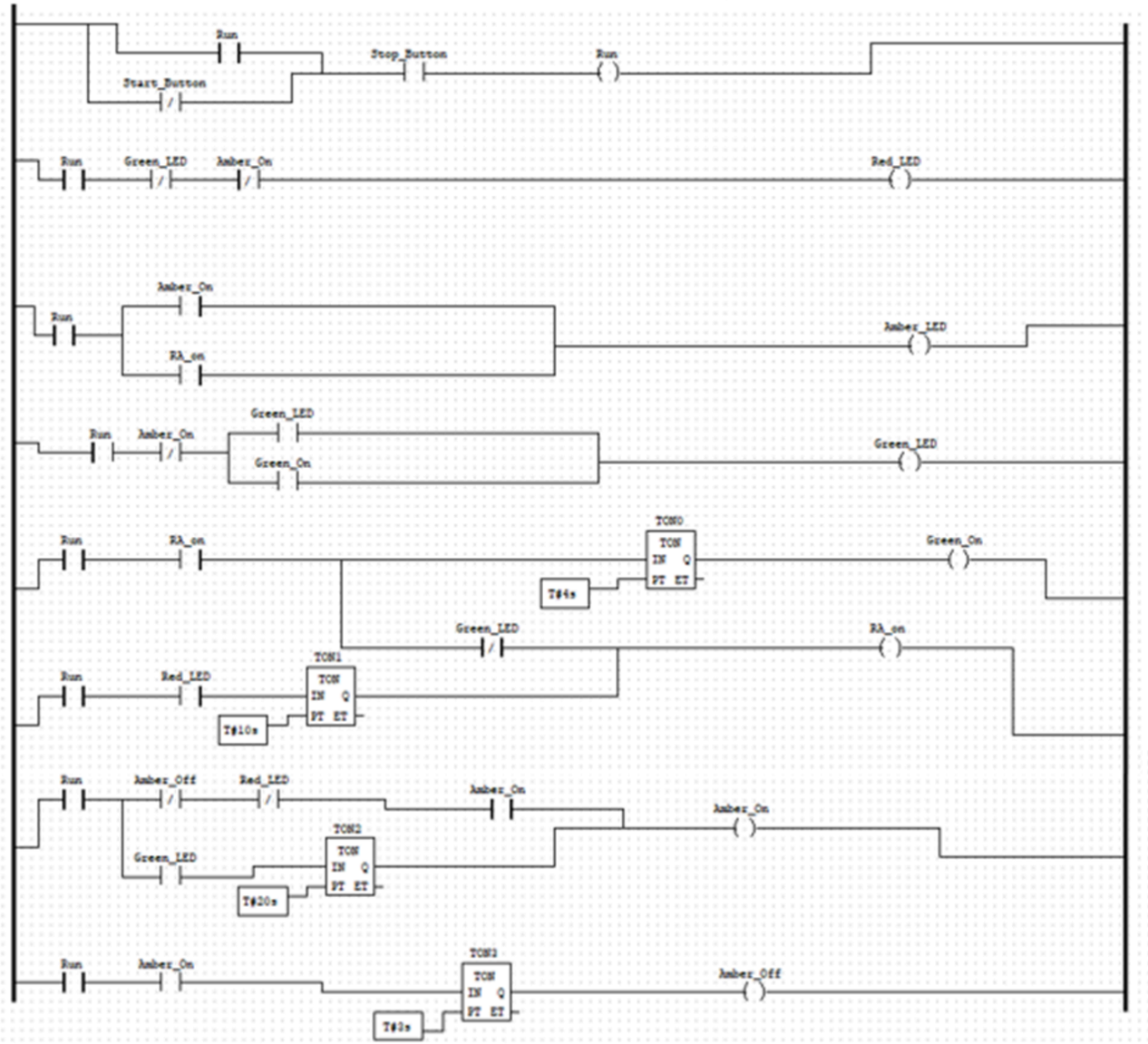
3 - Bottle Filling Plant

=


input_personInFront
input_doorIsClosing
input_doorIsClosed
output_openTheDoor


_machineA_operation_done
machineA_hasBottle
machineA_endPos
machineA_goDown
_machineA_operation_done
machineA_hasBottle
machineA_endPos
machineA_goDown
machineA_toolOff
machineA_toolOn
_machineA_operation_done
machineA_hasBottle
machineA_endPos
machineA_toolOn
timer
TON
IN
Q
250
PT
ET
0
_machineA_operation_done
S
_machineA_operation_done
machineA_hasBottle
machineA_endPos
machineA_goUp
machineA_toolOn
machineA_toolOff
_machineA_operation_done
machineA_hasBottle
machineA_toolOff
machineA_goUp
_machineA_operation_done
machineA_leftSensor
machineA_rightSensor
machineA_startPos
_machineA_operation_done
R

IV - The 3 main projects



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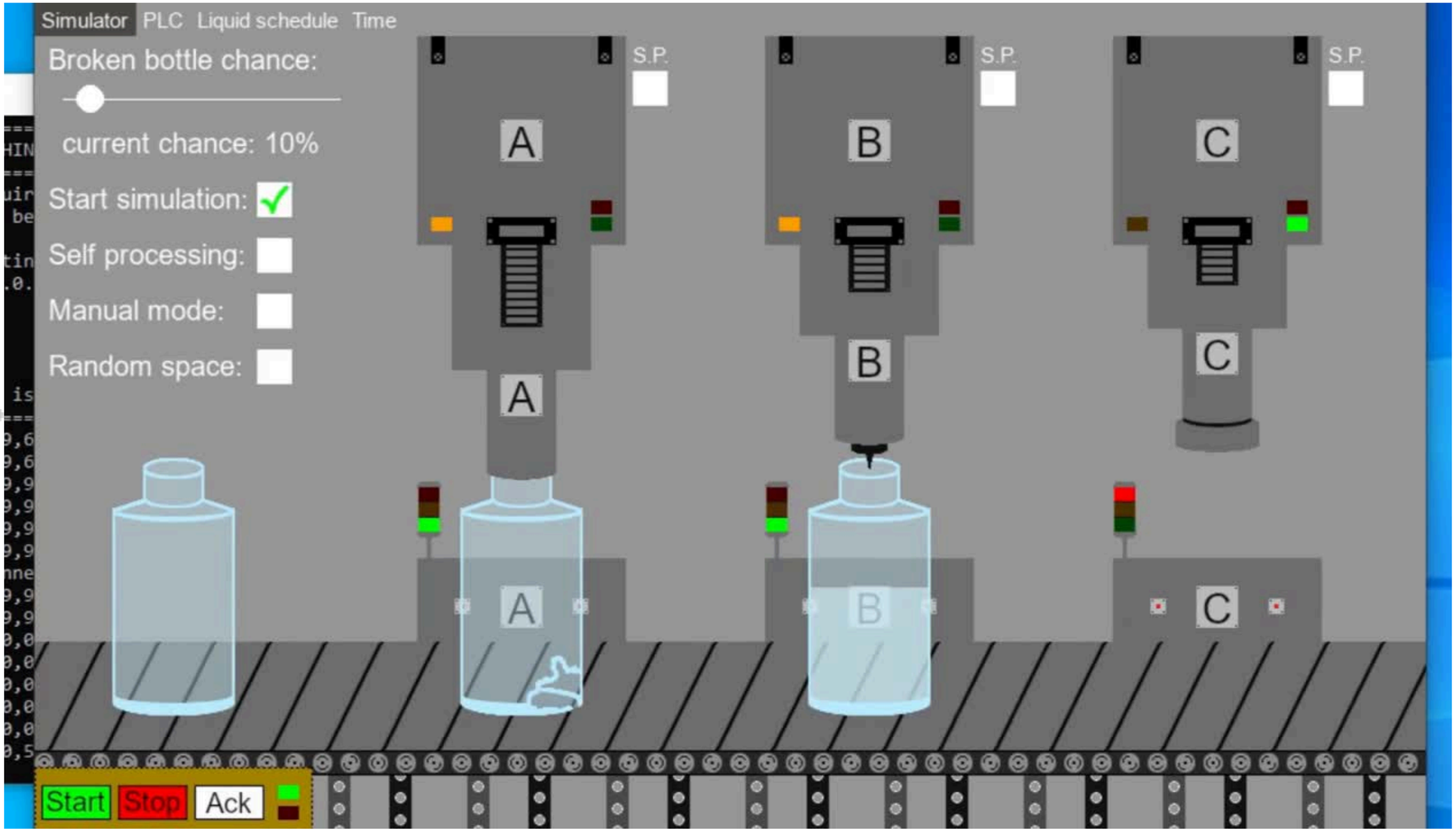

I - Host Organization & Problematic

II - Existing Situation, Tasks & Difficulties

III - Tools, Gantt Planning & Personal Organization

IV - The 3 main projects

V - Current VS Initial situation, Technical & Human Assessment

V - Current VS Initial situation, Technical & Human Assessment

Before

After

Before

1 simulation

After

3 simulations

V - Current VS Initial situation, Technical & Human Assessment

Before

1 simulation

No documentation

After

3 simulations

Documentation on:

- Ludus Installation
- Chemical Plant installation and utilisation
- Cardiff Metro Emulator installation and utilisation
- Bottle Filling Plant installation

V - Current VS Initial situation, Technical & Human Assessment

Before	After
1 simulation	3 simulations
No documentation	Documentation on: • Ludus Installation • Chemical Plant installation and utilisation • Cardiff Metro Emulator installation and utilisation • Bottle Filling Plant installation
No videos for presentations	Videos for: • Chemical Plant • Cardiff Metro Emulator • Bottle Filling Plant

V - Current VS Initial situation, Technical & Human Assessment

Before	After
1 simulation	3 simulations
No documentation	Documentation on: • Ludus Installation • Chemical Plant installation and utilisation • Cardiff Metro Emulator installation and utilisation • Bottle Filling Plant installation
No videos for presentations	Videos for: • Chemical Plant • Cardiff Metro Emulator • Bottle Filling Plant
No way to control the screen wall	A simple webpage to control all the screens

V - Current VS Initial situation, Technical & Human Assessment

Before	After
1 simulation	3 simulations
No documentation	Documentation on: • Ludus Installation • Chemical Plant installation and utilisation • Cardiff Metro Emulator installation and utilisation • Bottle Filling Plant installation
No videos for presentations	Videos for: • Chemical Plant • Cardiff Metro Emulator • Bottle Filling Plant
No way to control the screen wall	A simple webpage to control all the screens
No easy and educative way to approach cybersecurity	8 scenarios in the Backdoors&Breaches game

V - Current VS Initial situation, Technical & Human Assessment

Became comfortable with Virtual Machines

V - Current VS Initial situation, Technical & Human Assessment

Became comfortable with Virtual Machines

Learned how to install and use a Ludus server

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Cybersecurity knowledge expanded

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What is a PLC & how to program it with ladder logic

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What is a PLC & how to program it with ladder logic

Modbus command

Typical cyber-attacks & how to defend them

V - Current VS Initial situation, Technical & Human Assessment

Discovered people and a new culture

Discovered people and a new culture

Discovered the work environment in a new and modern company

V - Current VS Initial situation, Technical & Human Assessment

Discovered people and a new culture

Discovered the work environment in a new and modern company

Loved working with the whole team

V - Current VS Initial situation, Technical & Human Assessment

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Discovered the Cardiff city

V - Current VS Initial situation, Technical & Human Assessment

Discovered people and a new culture

Discovered the work environment in a new and modern company

Loved working with the whole team

Discovered the Cardiff city

Discovered what it is to live in a foreign country on my own

Cybersecurity in Operational Technologies

Final words

FONDATION RENNES 1
Progresser Innover Entreprendre

Hyb Arloesedd Seiber
Cyber Innovation Hub

iut Lannion