



CAPRI Introduction

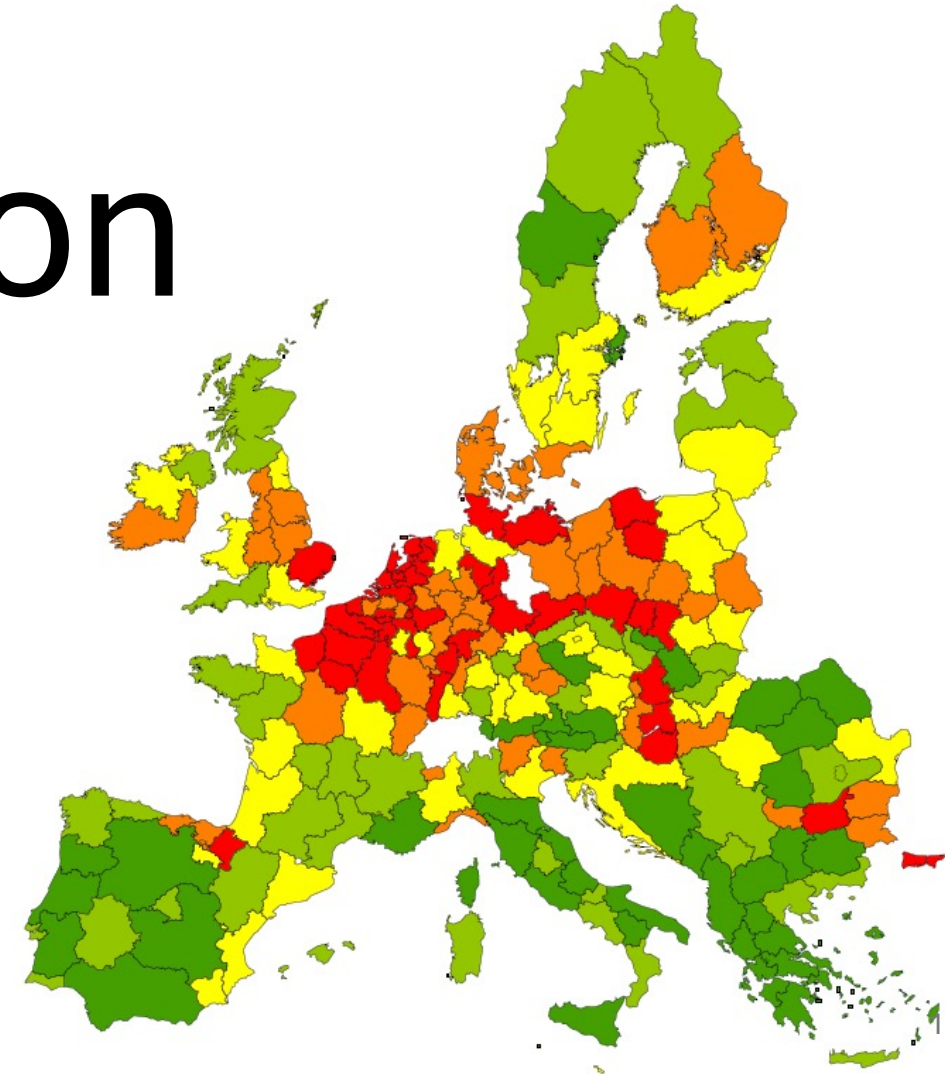
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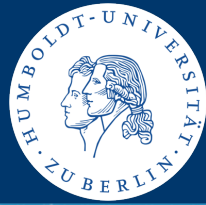
Dr. Torbjörn Jansson

Swedish University of Agricultural Sciences, Uppsala





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1. Setting up the System

More information in CAPRI Modelling System Documentation (Britz, 2014):
<https://www.capri-model.org/lib/exe/fetch.php?media=docs:capri-documentation.pdf>

- **Setting up the System**
- **Structure of CAPRI**
- **CAPRI Graphical User Interface (GUI)**
 - Start the GUI
 - Adjust the settings
 - Tasks in the GUI
- **Running Your First Simulation**
 - Scenario Settings
 - Run a Policy Scenario
 - Run a Policy Reform Scenario
 - Run Scenarios Without the Market Model

CAPRI Environment Setup Guide

using a zip(tar) file from the stick

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This guide walks you through setting up the CAPRI environment using Docker and connecting to it via Visual Studio Code. Before you begin, ensure **Docker Desktop** is installed. **Windows users** may need to restart after installation or even install updates. (how to see also [Link](#) – Option B)

01

Check Your System & Download the Correct Image

CAPRI Docker images come in two versions — download the one matching your processor:

- **Mac:** Apple menu → About This Mac → Chip/Processor. "Intel" = AMD64; "Apple M1/M2/M3/M4" = ARM64.
- **Windows:** Start → System Information → System Type. "x64-based PC" = AMD64 (most common); "ARM64-based PC" = ARM64.
- **Linux:** Run `uname -m` in Terminal. `x86_64` = AMD64; `aarch64` = ARM64.

Copy the correct file: `capri_v8-arm64.tar` (ARM64) or `capri_v8-amd64.tar` (AMD64) from the stick.

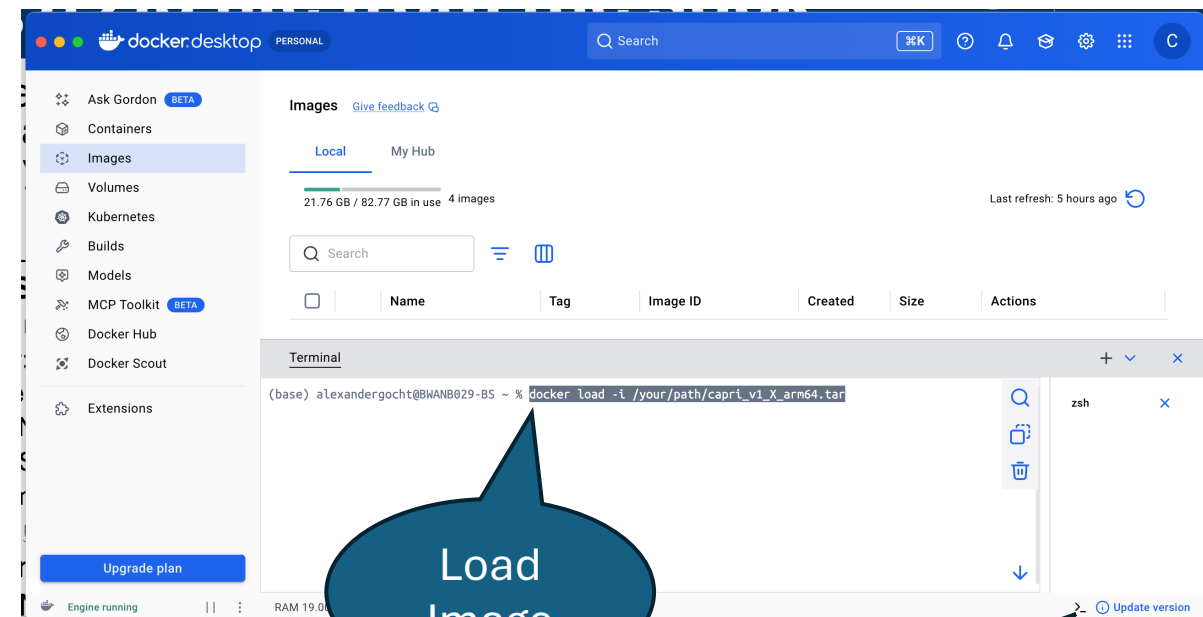
02

Load the Docker Image

Open your terminal (Command Prompt/PowerShell on Windows; Terminal on Mac/Linux) and run the appropriate command, replacing `/your/path/` with the actual folder where you saved the file:

- **AMD64:** `docker load -i /your/path/capri_v1_X_amd64.tar`
- **ARM64:** `docker load -i /your/path/capri_v1_X_arm64.tar`

Press Enter. This may take a few minutes. On success, the terminal will confirm: Loaded image: `capri_v1_X_XXX64` X=use the highest number



CAPRI Environment Setup Guide

using a zip file from the stick



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03

Either open Docker Desktop and navigate to terminal (see slide before).

Click Run to launch the container. Link the license file. Run the image by

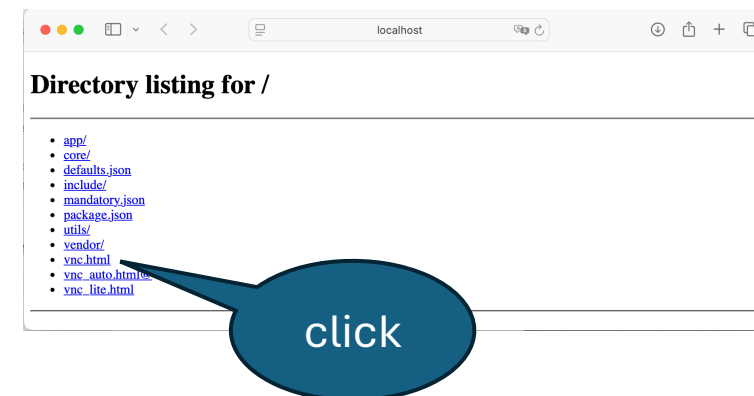
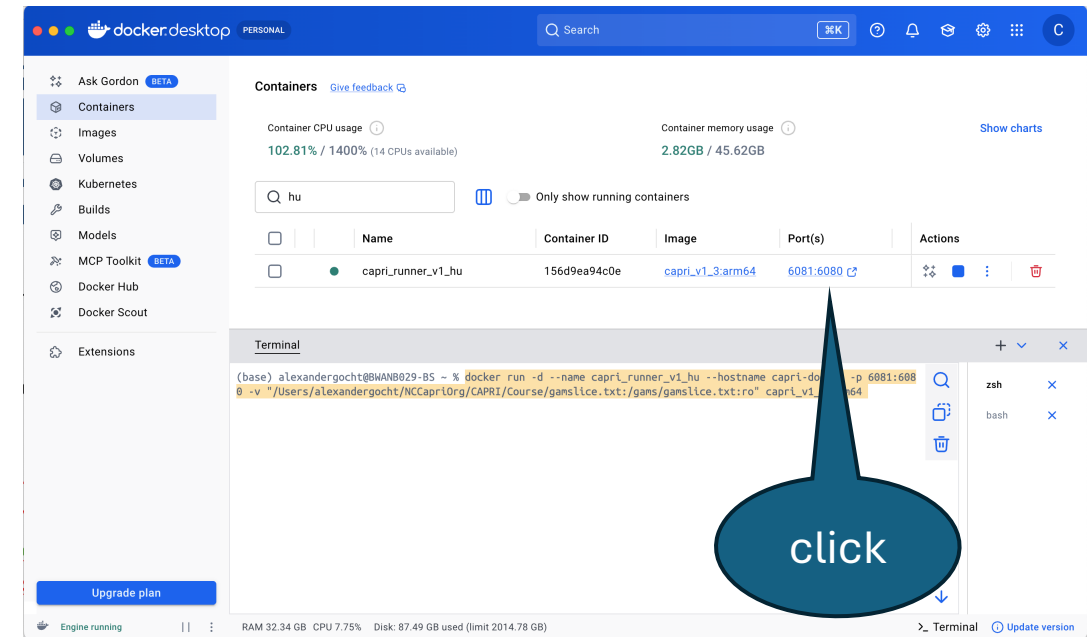
```
docker run -d --name capri_runner_v1 --hostname capri-docker -p 6080:6080 -v "/Users/alexandergocht/NCCapriOrg/CAPRI/Course/gamslice.txt :/gams/gamslice.txt:ro" capri_v1_3:amd/arm64
```

04

Access the CAPRI GUI. Open any web browser (Chrome, Firefox, Safari) and navigate to:

<http://localhost:6080/vnc.html> and click on [vnc.html](#)

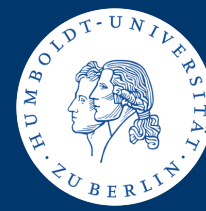
The CAPRI Graphical User Interface will load in your browser, and you are ready to use the software.



CAPRI Environment Setup Guide using a zip file from the stick



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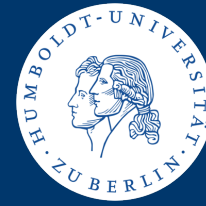
05

Click on Connect, and you should see a batch execution form and the yellow CAPRI Graphical User Interface (GUI)

The image shows a remote desktop session. On the left, the CAPRI GUI is visible, featuring a yellow-themed interface with a sidebar menu containing 'CAPRI worksteps' (Installation, Build database, Generate baseline, Run scenario, Disaggregate Results, Tests and Reporting) and 'CAPRI tasks' (Create result and restart directory structure). A 'Settings' dialog box is open, showing options for 'Shared mode', 'View only', 'Clip to window', 'Scaling mode' (set to 'Remote resizing'), and 'Advanced' settings. The main window displays a 'Batch execution' form with fields for 'Batch file to execute' (set to `./batchfiles/build_database2020_and_baseline.txt`) and 'Directory for expref files'. Below the form are checkboxes for 'Generate EXP and REF files for HTML documentation', 'Only compile the GAMS programs', and 'Send email notification'. At the bottom of the form are buttons for 'Start', 'Stop after end of current process', 'Stop now', 'Kill current process', and 'Open HTML report'. The terminal window shows the output of the CAPRI execution, including the CAPMOD title 'Balance global trade flows and market balances in the final year for SOYA', GAMS version 3.17R, and a table of iteration results. The table shows an infeasible solution due to a reduced gradient.

Iter	Phase	Ninf	Infeasibility	RGmax	NSB	Step	InItr	MX	OK
0	0			7.2918225953E+04					(Input point)
1	0			7.2918225953E+04					(After pre-processing)
2	0			9.182218113E+01					(After scaling)
51	1	24	2.3408155455E+01	8.9E-01	SS	1.0E+00		8	T T
54	1	3	1.5083436210E+00	0.0E+00				10	

NOVNC logo and a 'Connect' button are visible on the right side of the screen.



To comfortably view, edit, and save project files inside the running CAPRI environment, connect VS Code directly to the Docker container using the **Dev Containers** extension.

1

Prepare VS Code

Ensure **Visual Studio Code** is installed and open it. Look for the green >< icon in the **very bottom-left corner** of the VS Code window (Open a Remote Window) and click it. From the menu that appears at the top, select **Attach to Running Container**.

2

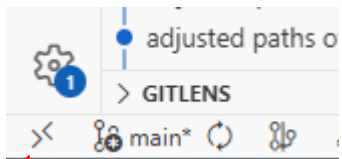
Connect to the CAPRI Container

After clicking **Attach to Running Container**, a list of your active Docker containers will appear. Select the CAPRI container — it typically has a randomly generated name (e.g., focused_turing) next to the capri_v8 image name. A new VS Code window will open, connected directly to the inside of your Docker container.

3

Open Your Working Directory

In the new VS Code window, click **Open Folder** in the Explorer pane (or go to **File** → **Open Folder**). Type /app/ into the path bar and click **OK**. All your project files will appear on the left side of the screen.



Important Note on Saving Your Work: Changes saved in VS Code are saved *inside the running container* and are persistent as long as you use that specific container. However, they do not alter the original .tar image file downloaded in Part 1. Back up your up your /app/ directory contents if you plan to delete the container entirely.



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2. Structure of CAPRI

More information in CAPRI Modelling System Documentation (Britz, 2014):
<https://www.capri-model.org/lib/exe/fetch.php?media=docs:capri-documentation.pdf>

Outline: Structure of CAPRI

A. Technical implementation

B. Physical organization of files and folders

C. Logical organization of CAPMOD.gms

D. Exercises

(... and NOT how the economic model is structured in terms of equations and variables)

- CAPRI worksteps
- Installation
 - Build database
 - Generate baseline
 - Run scenario
 - Disaggregate Results
 - Tests and Reporting

- CAPRI tasks
- Define scenario
 - Run scenario with market model
 - Run scenario without market model
 - Test alternative market model
 - Run scenario only with market model
 - Disagg_Scenario

General settings Modules and algorithm Reporting Algorithmic settings Debug options

CAPRI General settings

Scenario description

Dir:

..

Files:

cap_after_2014/ref

Years

Base year 2017

Aggregation file defaulta

Scenario group NoGroup

Simulation years

2004 2005 2006 2007 2008 2009 2010
 2011 2012 2013 2014 2015 2016 2017
 2018 2019 2020 2021 2022 2024 2025
 2030 2035 2040 2045 2050 2055 2060
 2065 2070 2075 2080 2085

Last simulation year 2050

Regions

Countries

Regional breakdown NUTS2

FAOSTAT updated to 2021 Non-default FAO trade matrix vintage

FAO trade matrix vintage (determines FAOregions) FAO_trade_matrix_1986_2021

Compile GAMS

Start GAMS

Stop GAMS

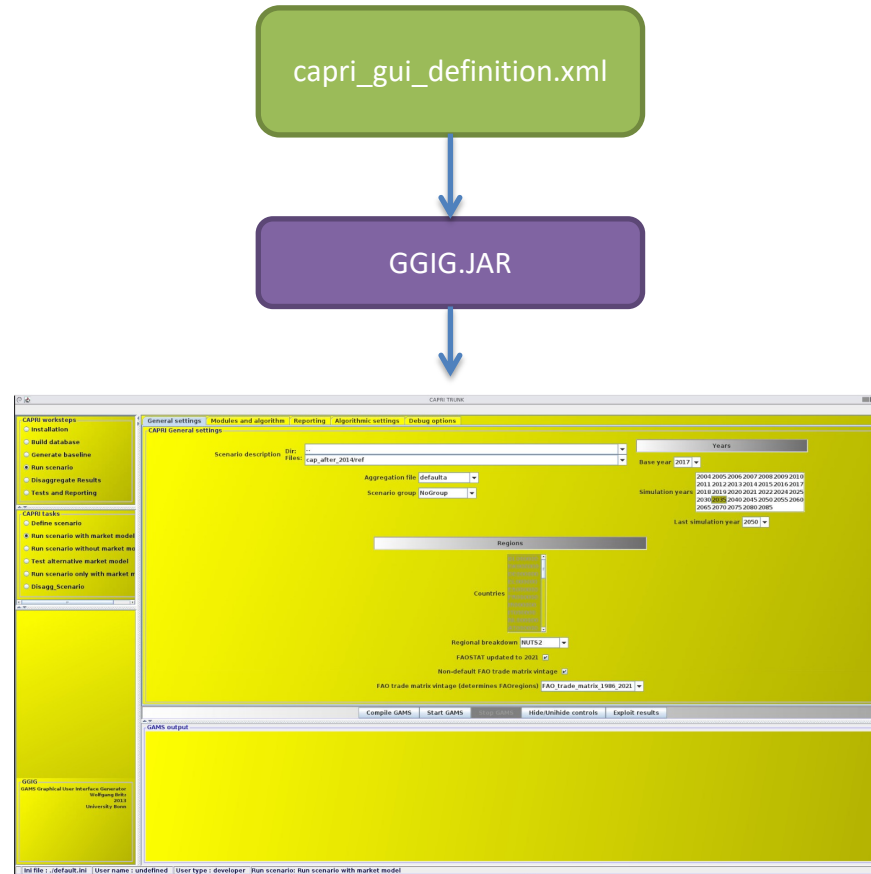
Hide/Unihide controls

Exploit results

GAMS output

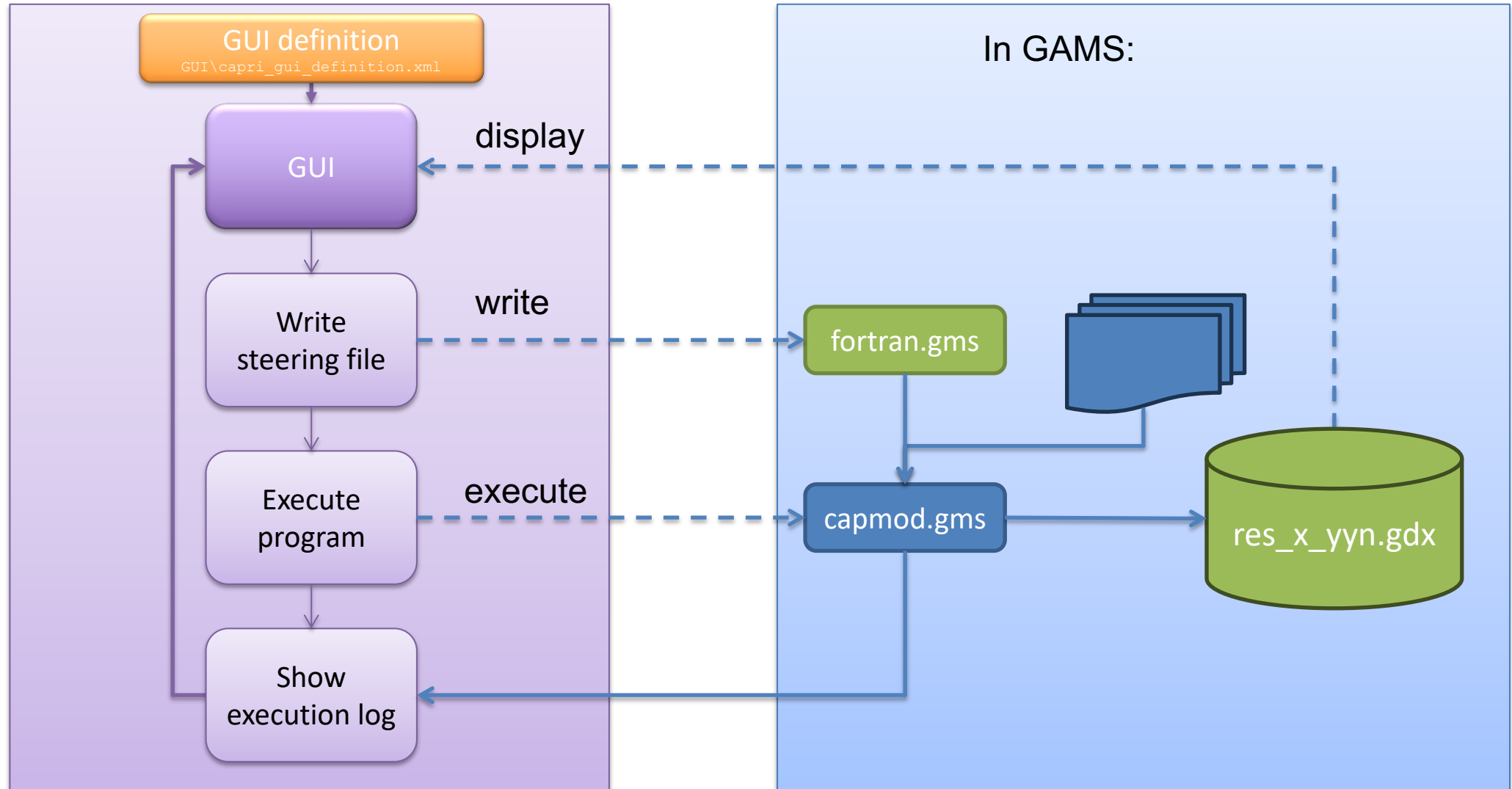
GGIG
 GAMS Graphical User Interface Generator
 Wolfgang Britz
 2013
 University Bonn

Generating a GUI

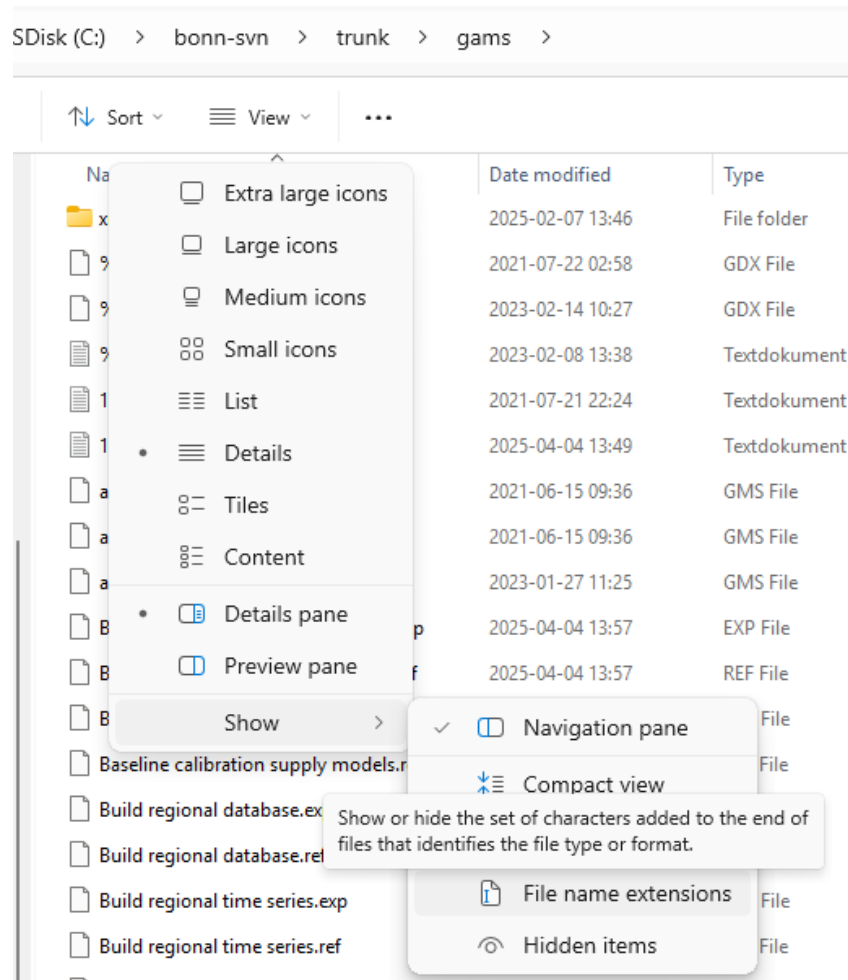


- The GUI is generic
- XML-files define
 - Controls to display
 - Programs to run
 - Reports (views)
- This “is” not CAPRI
- It is difficult to use CAPRI without it!
- The engine under the hood is a set of GAMS programs

Executing GAMS from the GUI

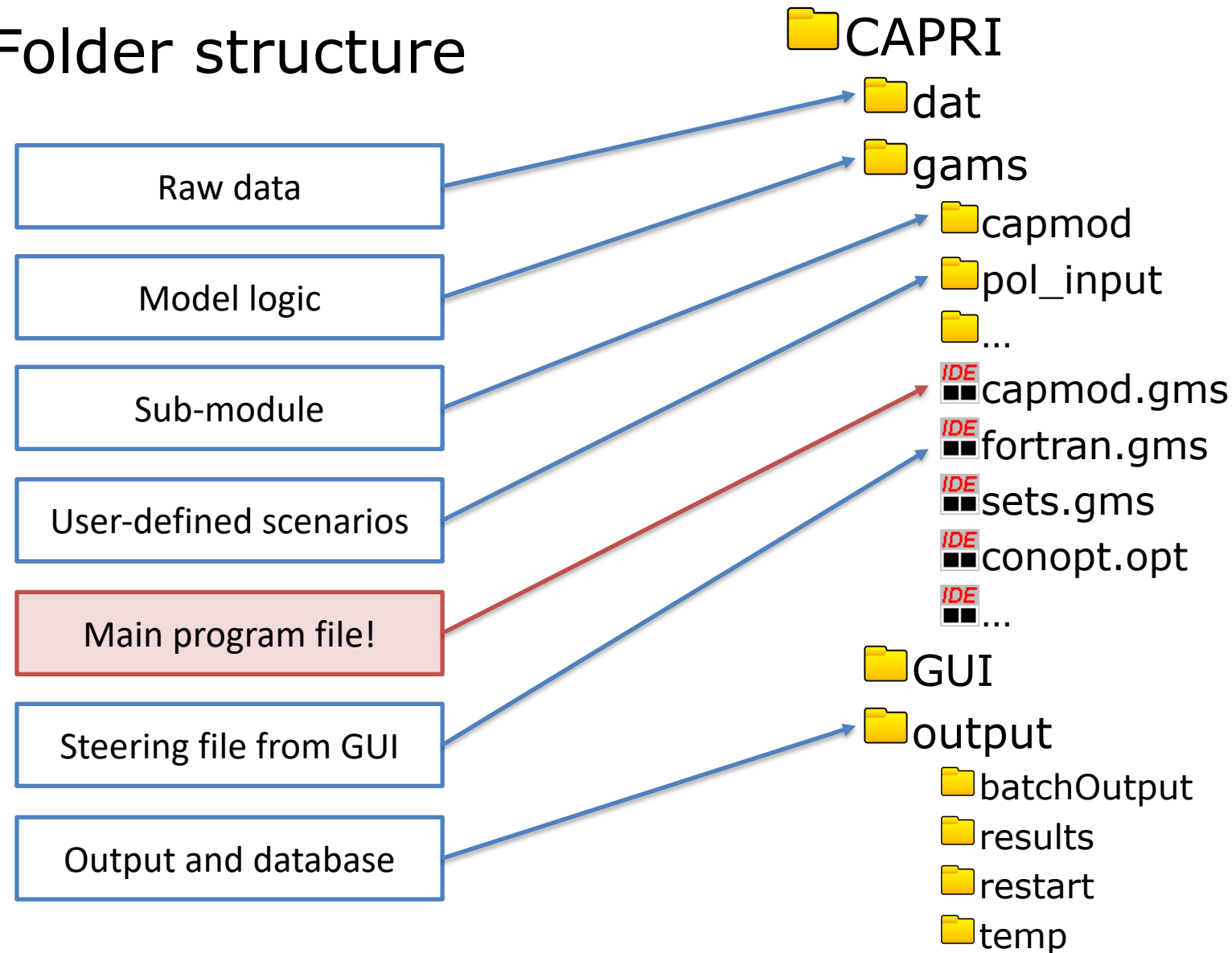


File types

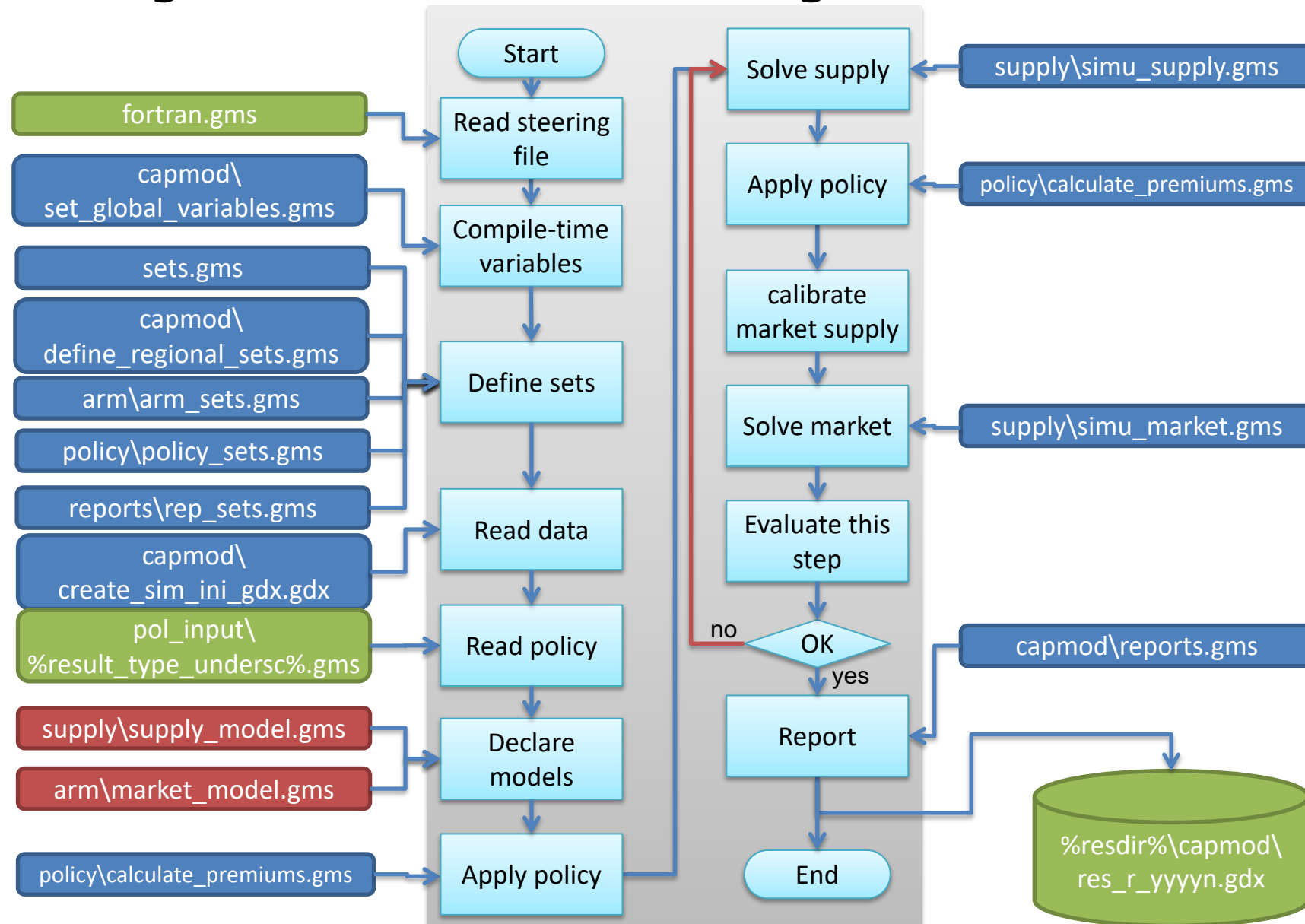


File suffix	Content type
.GMS	Model code in the language GAMS. Plain text file.
.GDx	Gams Data eXchange. Input or output data for GAMS. Binary file.
.LST	Program log from GAMS, containing compilation information and some program output.
.OPT	GAMS file that contains instructions (OPTions) for the model solver(s). Variations op1, op2, ...
.XML	Extended Markup language. Textfiles with instructions for the GUI.
.XLSX	Microsoft Excel files. Some raw data comes in this format.
.PDF	Portable Document Format. Mostly model documentation.
.BAT, .CMD	Windows command files, used to execute pre-defined windows commands
...	GAMS internal .ref, .exp, .lxi, .log, ...

Folder structure



Program flow of CAPMOD.gms



Exercise 1: Open and inspect sets.gms

sets.gms contains the definitions of many set elements in CAPRI. It is a good place to look if you wonder what some abbreviation means.

a) Open "*sets.gms*" and find out what the set element "UVAG" means.

b) Find at least three *sets* where this element is a member.



Exercise 2: Locating and inspecting the iteration loop in capmod.gms

- a) Find the places where the iteration loop starts and ends in **capmod.gms**
 - a) Start line nr: _____
 - b) End line nr: _____

- b) In which line is simu_supply included?
Answer: _____

- c) In which line is simu_market included?
Answer: _____

Exercise 3: The GUI definition files

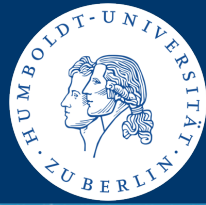
Check what GUI does when running a scenario:

- a) Open "**capri_gui_definition.xml**" (use a text editor)
- b) Search for "<name>Run scenario without market"
- c) Also check the value of "<gamsFile>" _____
- d) Also check the value of "<incfile>" _____
- e) Also check the value of "<resdir>" _____
- f) Look a few lines below at "<gdxSymbol>" _____





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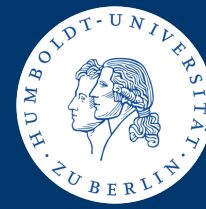
3. CAPRI Graphical User Interface (GUI)

More information in CAPRI Modelling System Documentation (Britz, 2014):
<https://www.capri-model.org/lib/exe/fetch.php?media=docs:capri-documentation.pdf>

CAPRI Graphical User Interface (GUI)



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The screenshot displays the CAPRI GUI interface. The main window is titled "CAPRI TRUNK" and contains several tabs: "General settings", "Modules and algorithm", "Reporting", "Algorithmic settings", and "Debug options". The "General settings" tab is active, showing the following configuration:

- Scenario description:** Dir: .., Files: cap_after_2014/ref
- Aggregation file:** defaulta
- Scenario group:** NoGroup
- Base year:** 2017
- Simulation years:** A list of years from 2004 to 2085, with 2035 selected.
- Last simulation year:** 2050
- Regions:** A list of regions including AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IL, IN, IT, JP, KR, LT, LU, LV, NL, NO, PL, PT, RO, RU, SE, SI, SK, TR, US, ZA.
- Countries:** A list of countries including AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IL, IN, IT, JP, KR, LT, LU, LV, NL, NO, PL, PT, RO, RU, SE, SI, SK, TR, US, ZA.
- Regional breakdown:** NUTS2
- FAOSTAT updated to 2021:**
- Non-default FAO trade matrix vintage:**
- FAO trade matrix vintage (determines FAOregions):** FAO_trade_matrix_1986_2021

At the bottom of the main window, there are buttons for "Compile GAMS", "Start GAMS", "Stop GAMS", "Hide/Unhide controls", and "Exploit results". Below this is a "GAMS output" section, which is currently empty. In the bottom left corner, there is a "GGIG" logo and text: "GAMS Graphical User Interface Generator, Wolfgang Britz, 2013, University Bonn". At the very bottom of the window, a status bar shows: "Ini file : ./default.ini | User name : undefined | User type : developer | Run scenario: Run scenario with market model".



- Hands-on:
 - Settings
 - Text Editor
 - GDX Viewer
 - ...



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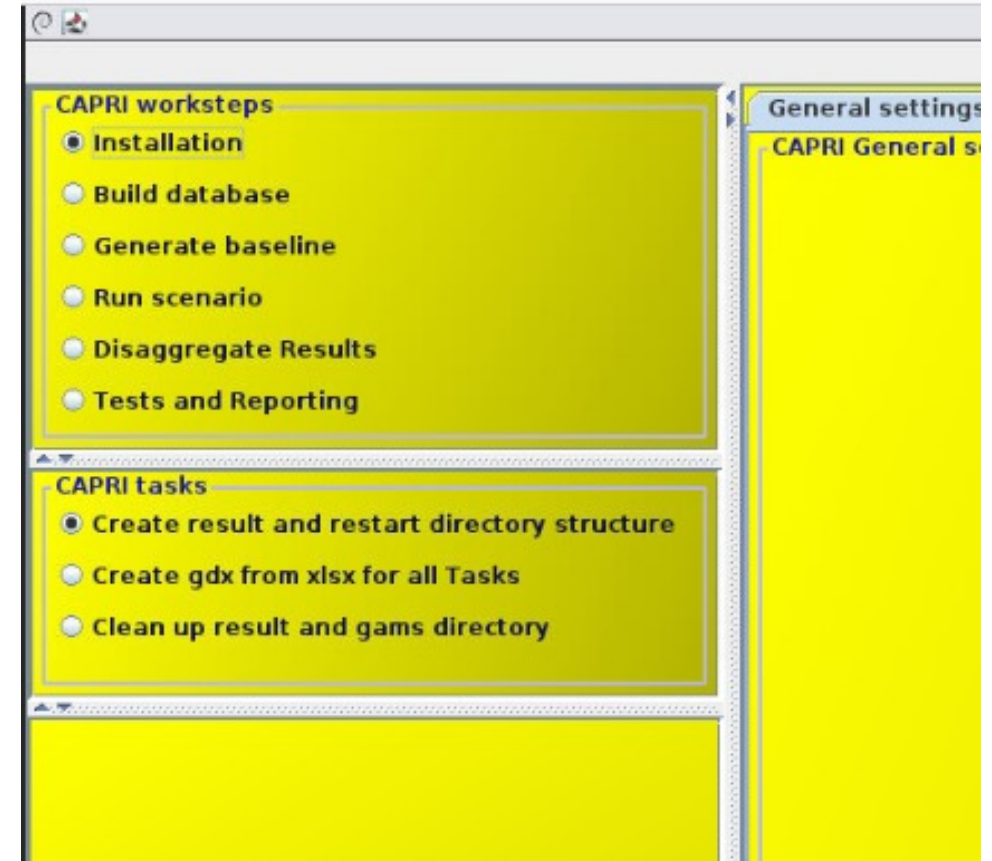
Work Steps and Tasks in GUI

Tasks in the GUI

- the work steps you will see in the GUI depends on your chosen user type

5 different Work steps,
each with specific Tasks

(we will only focus on the Run Scenarios step)



1. Installation work step

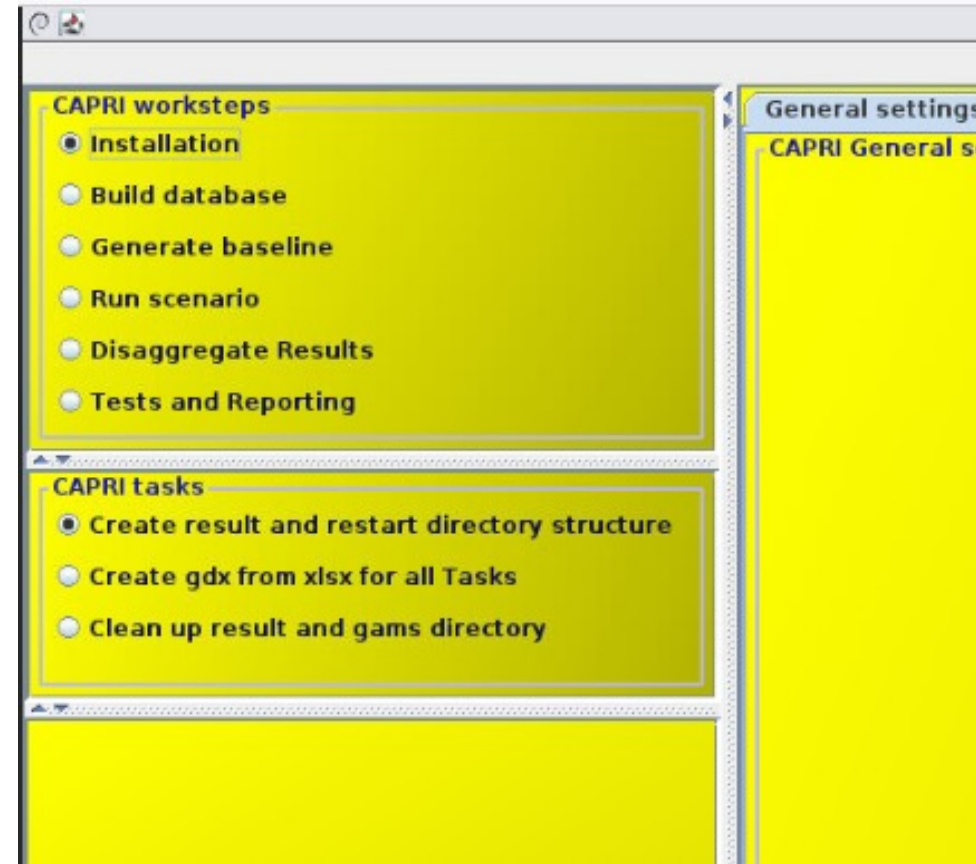
Only one task – **Create result and restart directory structure**

- The task generates the folder structure for your results
- Restart is generated for system testing purposes and is not of interest for this course
- This work step generates the CAPRI database

2. Build database work step

Harmonizes the data (on e.g., agricultural land use, production quantities and prices from FAOSTAT, EUROSTAT) to be a complete and consistent dataset

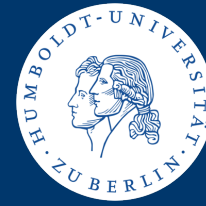
There is no need to run those two tasks because you already have result files in your CAPRI folder for this course.



Tasks in the GUI



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* But if you want to run CAPRI from scratch here are the steps:

- 1) Select the task “Create result and restart directory structure” and click **Compile GAMS**. (Normally you will get the message “Normal Completion” in the output window)
- 2) Then click **Start GAMS**, and wait for a “Normal Completion” again

Errors:

- If you can not see other work steps after Installation – restart GUI
- Check again that you have the correct JAVA and GAMS version
- Try to download CAPRI again and redo the installation process
- If it still doesn't work contact the course team.

The screenshot shows the CAPRI GUI with the following elements:

- Left Panel:** 'CAPRI worksteps' with 'Installation' selected, and 'CAPRI tasks' with 'Create result and restart directory structure' selected.
- Right Panel:** 'General settings' tab with 'Aggregation file' set to 'defaulta'.
- Buttons:** 'Compile GAMS', 'Start GAMS', 'Stop GAMS', and 'Hide/Unhide controls'.
- Terminal Window:** Shows the execution of the selected task, including file creation and directory structure setup. The output ends with 'Normal completion' and 'GAMS RC 0'.
- Footer:** 'GGIG GAMS Graphical User Interface Generator Wolfgang Brütz 2013 University Bonn' and system information like 'Ini file: ./default.ini', 'User name: undefined', and 'User type: developer'.

3. Generate Baseline work step

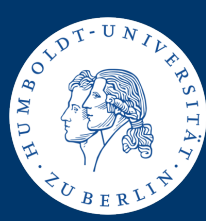
- A baseline projection for the chosen simulation year is generated based on a mix of trends, expert knowledge and automated checks that assures logical consistency. It is updated continuously and serves as the point of reference in our ex-ante analysis.
- You will not need to perform this work step – the baseline files are already included in the CAPRI database

4. Run Scenario work step

- In this work step the scenarios are simulated.
- This step is the focus of this course and will be described later

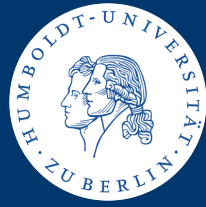
5. Tests and Reporting work step

- Here the results of the CAPRI model can be tested with regards to for example stability when using different computers. This is used by developers in a process of improving and identifying development needs of the model.



Exercise 6: Define a reference scenario, running the supply model

1. Start the Docker. Go to the workstep "Run scenario", task "Run scenario without market model". From the cap_after_2023 directory select the ref file.
2. Include an additional result type identifier under the Debug options!
3. Make sure that on "Modules and algorithm" the "non-Default reference scenario for carbon accounting" is selected –
res_2_1730cap_after_2023_refdefaulta
4. Select only one country (any), *base year 2017*, *simulation year 2035*, run! (click on Start GAMS)
5. Verify that a new *fortran.gms* was written in the *gams* folder.
 - 4.1 Find your scenario name in that file!
 - 4.2 Find "*\$setglobal countries*" and check that your country appears there
5. Look at the *output\results\capmod* folder to find the *gdx* file.



References

1. Britz, W., & Witzke, H. P. (2014). CAPRI Model Documentation 2014. University of Bonn. <https://www.capri-model.org/lib/exe/fetch.php?media=docs:capri-documentation.pdf>
2. CAPRI Course Overview page. <https://www.capri-model.org/ts/dokuwiki/doku.php?id=start>
3. European Commission. *Common Agricultural Policy (CAP) overview*. https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview_en
4. Jansson, T., Nordin, I., Wilhelmsson, F., Witzke, P., Manevska-Tasevska, G., & Weiss, F. (2021). *Coupled agricultural subsidies in the EU undermine climate efforts*. *Applied Economic Perspectives and Policy*, 43(4), 1503–1519. <https://doi.org/10.1002/aep.13092>