GGIG
GAMS Graphical Interface Generator

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Why GUIs for economic models?

- Steer the applications with a known Touch & Feel – reduce need to know details about software and specific implementation
- Exploit the results – often not nicely supported by the modeling languages
- GUI development supports a good structure of the applications themselves
Some history

- Graphical User Interfaces (GUI) to steer economic simulation models exist at the institute for food and resource economics since the 70ties:
  - Already for terminals to connect to mainframe
  - Sequence of dialogues (one dialogue = one full screen page)
  - Supported where text fields
Some history

Table file services ------------------------- SPBL ------------------------- Rename entries

Please enter key selection

Region       ( 3 ch.) => NL
            Rename =>
Sub-region   ( 2 ch.) => 00
            Rename =>
Current year ( 2 ch.) => 60 : 88
            Rename =>
Periodicity  ( 2 ch.) => 00
            Rename =>
Base year    ( 2 ch.) => NN
            Rename =>
Type         ( 4 ch.) => COMC
            Rename => XXXC
Model area   ( 1 ch.) => S
            Rename =>

Enter= ok  1= Help  3= Quit  4= Exit  11= Save/Load
Some history

- First GUI of CAPRI based on C/FORTRAN
Some history

- 1999: Mapping tool in Java
Some history

- Since CAP-STRAT (2001-2004), CAPRI GUI in Java
- Use of the CAPRI exploitation tools
  - e.g. in Multi-Commodity model for Benin (BenImpact) and Drâa valley river basin model (mid of nineties)
  - by staff members when at OECD, FAO …
  - Table definitions in XML allowed to port functionality of CAPRI GUI (tables, maps, graphics …) to other models’ outputs

=> Same idea now for model steering
What is the GAMS Graphical Interface Generator (GGIG)?

- Compiled Java code
- which generate from a XML based text file (no Java programming needed)
  - a Graphical User Interface
  - with user operable controls such as check boxes, selection lists, tables
  - which translate the settings of these control into GAMS/R code in a include file
  - which can start GAMS/R programs, shows the log in a window
- allows to exploit the results stored in GDX files, explore them as tables, graphics, maps
Why GGIG

- No Java programming needed to generate or modify a GUI:
  - Interfaces efficient also for smaller projects
  - Easy to add options
  - Interface portable also to other platforms where GAMS and Java are running, such as MACs

- Some useful utilities accessible
Why GGIG: GAMS side

- Supports **structured programming** in GAMS:
  - Clear **distinction** between **user input** and **processing code**
  - "**One entry point**" strategy via include file to define **run specific settings** including definition of **counterfactuals**

- **No manual edits in GAMS** to change settings

- **Meta information** (who, when, what) automatically generated as a GAMS set

- **GAMS code** can still be run without the interface
Why GGIG

- Functionality of CAPRI GUI ported to other projects
  - distribute maintenance costs
  - existing utilities from CAPRI GUI become available: code documentation in HTML, exploitation tools, GDX Viewer, batch execution, equation and variable viewer ...
  - common touch & feel, especially important for the exploitation tools
Why GGIG

- Full functionality of CAPRI exploitation tools:
  - Based on **pre-defined views** stored in XML
  - **Tables**: pivot, select, show differences, statistics and outlier detection, hyperlinks to other tables, hide/show empty rows …
  - **Maps**: different classification options, shapefile converter
  - **Graphs**: many types
  - In-built **machine-learning package**
  - Clipboard exports of tables, maps and graphs, e.g. to EXCEL or Word
  - Links to chapter in pdf-files possible
  - …
Where is GGIG currently used

- DairyDyn with Bernd Lengers
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- RegCge stand-alone
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- Latest CAPRI version, which includes the regional CGEs, spatial down-scaling to 1x1 km scales, farm types …
GGIG further use

- GTAPinGAMS
- FADNTOOL user interface (extension to run R-scripts included)
- Spatial poultry model from NTM-Impact
- Recursive-dynamic model for markets of forestry products
- Sector model for Norway
- Agent Based Model for structural change (uses controls/exploitation part with odel running in Java)
Basic functioning of GGIG

- GGIG Controls and Settings definition file
- GAMS include file
- GAMS project code
- GGIG Control Generator
- Project specific GUI
- GAMS executable
- Exploitation tools
- Meta data
- Numerical results

GDX

User input
Basic concepts: Worksteps and tasks

- **Work step: selection of task**

  ![Workstep Diagram]

  ```xml
  <workstep>
    <name>Data base compilation</name>
    <pdflink>..\doc\VtapInGams with a GUI.pdf#Data base generation</pdflink>
    <tasks>
      <task>Convert FlexABB to GDX</task>
      <task>Convert GTAPABB to GDX</task>
      <task>Filter out small values</task>
      <task>Split up products and sectors</task>
    </tasks>
  </workstep>
  
  ![Tasks Diagram]
  
  ```xml
  <task>
    <name>Simulation</name>
    <pdflink>..\doc\VtapInGams with a GUI.pdf#Running the scenario</pdflink>
    <gamsFile>mrtncp.gms</gamsFile>
    <incFile>model\mrtncp_inc</incFile>
    <curDir>model\</curDir>
    <regionDim>0</regionDim>
    <dim5Dim>1</dim5Dim>
    <productDim>2</productDim>
    <activityDim>3</activityDim>
    <sectorDim>4</sectorDim>
    <originsDim>4</originsDim>
    <dim7Dim>5</dim7Dim>
    <versionDim>5</versionDim>
    <scenarioDim>6</scenarioDim>
    <resdir>run</resdir>
    <gdxSymbol>p_results.gdx</gdxSymbol>
    <filename>-gdx$</filename>
  </task>
  ```
Basic concepts: TASK

- name
- gamsfile: the file called, e.g. capmod(.gms)
- incFile: the name of the include file
- resdir: where to search for results
- filemask: regex to find file in resdir
- gdxSymbol: name of symbol with results
- regionDim ...: position of logical dimensions in gdxSymbol
- filters: control e.g. to select regions, years when exploiting scenarios
- userLevels: to hide tasks
Basic concepts: controls

- **type**: checkbox, slider, table, singlelist, multilist ..
- **title**: description seen by user
- **options**: what the user can chose
- **gamsname**: $setglobal gamsname ...
- **tasks**: which tasks use the controls
- **disable**: if true, control is blocked
- **userLevlsl**: to hide tasks
- some more special settings such as selection groups, tooltips, pdf links, dependencies with other controls, style options ...
Example: introduce a check box

Ini file

```xml
<control>
  <Type>checkBox</Type>
  <Title>Allow for endogenous reduction of max milk yield</Title>
  <Value>true</Value>
  <gamsName>mlkRed</gamsName>
  <tasks>Single farm run, Calculate MACs, Experiments dairy</tasks>
  <dependsOn>Farm branches: Dairy</dependsOn>
</control>
```

Interface

- Name of global from ini file
- Setting from interface based on user input

GAMS

```gams
$SETGLOBAL mlkRed true

All settings stored as textual information in s_META set
```

```gams
SET s_META /

'Allow for reduction of max milk yield' 'true'
```
Further functionalities

- SVN support
Further functionalities

- Editable menu items to send e-mail and open web pages
- Utility to build documentation of GAMS code in HTML
Further functionalities

- Batch execution
Further functionalities

- Build scenario file from code snippets
Further functionalities

- Filters for scenario selections resp. in GDX cube
Exploitation tools

- A relatively simple report generator for on-line views based on XML
- Support pivots, sorting, adding statistics, manual selection, relative/absolute differences to user chosen items …
- Larger sets of graph type (bar / line / pie charts, histograms, scatter plots …)
- Colored maps, flow maps
- Link to Machine Learning Package
- Export to clipboard and various file formats (GAMS, CSV, XLS, DBF …)
Exploitation tools, tables

<table>
<thead>
<tr>
<th># of sectors</th>
<th>11.00</th>
</tr>
</thead>
<tbody>
<tr>
<td># of factors</td>
<td>5.00</td>
</tr>
<tr>
<td># of regions</td>
<td>10.00</td>
</tr>
<tr>
<td>Model type</td>
<td>CBS</td>
</tr>
<tr>
<td># of equations</td>
<td>13332.00</td>
</tr>
<tr>
<td># of variables</td>
<td>13332.00</td>
</tr>
<tr>
<td># Iterations</td>
<td>4.00</td>
</tr>
<tr>
<td># seconds solution time</td>
<td>0.20</td>
</tr>
<tr>
<td>Lab Market</td>
<td>sluggish</td>
</tr>
<tr>
<td>sld Market</td>
<td>sluggish</td>
</tr>
<tr>
<td>capital Market</td>
<td>sluggish</td>
</tr>
<tr>
<td>res Market</td>
<td>sluggish</td>
</tr>
<tr>
<td>Ind Market</td>
<td>sluggish</td>
</tr>
</tbody>
</table>

**Sector overview [0]**

<table>
<thead>
<tr>
<th>Region</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Res</td>
<td></td>
</tr>
<tr>
<td>Mining and Extraction</td>
<td></td>
</tr>
<tr>
<td>Grains and Crops</td>
<td>Livestock and Meat Products</td>
</tr>
<tr>
<td>Total output</td>
<td>116626.70</td>
</tr>
<tr>
<td>Output taxes</td>
<td>1986.06</td>
</tr>
<tr>
<td>Total intermediate</td>
<td>64336.36</td>
</tr>
<tr>
<td>Total intermediate</td>
<td>836.61</td>
</tr>
<tr>
<td>Total factor taxes</td>
<td>4854.85</td>
</tr>
<tr>
<td>Total factor demand</td>
<td>44671.32</td>
</tr>
<tr>
<td>Total intermediate</td>
<td>64336.36</td>
</tr>
<tr>
<td>Grains and Crops</td>
<td>747.09</td>
</tr>
<tr>
<td>Livestock and Meat Products</td>
<td>688.74</td>
</tr>
<tr>
<td>Mining and Extraction</td>
<td>2968.29</td>
</tr>
<tr>
<td>Processed Food</td>
<td>1273.83</td>
</tr>
<tr>
<td>Textiles and Clothing</td>
<td>641.68</td>
</tr>
<tr>
<td>Light Manufacturing</td>
<td>7675.46</td>
</tr>
<tr>
<td>Heavy</td>
<td>17305.07</td>
</tr>
</tbody>
</table>
Exploitation tools, graphs
Exploitation tools, maps and schemers
Summary of GGIG

- Relatively easy to use tool to build an interface on a GAMS/R based model
- Powerful exploitation possibilities
- Benefits from 15 years developments for CAPRI