

Package ‘AIGRA’

June 3, 2026

Title Agentic Item Generation, Review, and Analysis

Version 0.1.1

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Description Provides tools for validating, generating, reviewing, reporting, and visualising assessment item generation workflows. The package supports tabular item-bank templates, item-bank validation, 'Python'-backed agentic generation workflows, multimodal diagram generation, quality summaries, and 'HTML' reporting. External artificial intelligence services and related 'API' calls require user-supplied credentials and are not called during package checks. The workflow is informed by automatic item generation methods described by Gierl and Haladyna (2013, ISBN:9780415897518) and evidence-centered assessment design described by Mislevy et al. (2003) <doi:10.1002/j.2333-8504.2003.tb01908.x>.

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Encoding UTF-8

Imports graphics, grid, reticulate, utils, grDevices,

Suggests base64enc, png, readxl, rmarkdown, writexl

Config/roxygen2/version 8.0.0

NeedsCompilation no

Repository CRAN

Date/Publication 2026-06-03 13:10:21 UTC

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`aigra_apply_diagram_agent`*Apply AIGRA Diagram Agent to generated results*

Description

Inspects generated items and automatically sets `diagram_required` and `diagram_prompt` when a visual diagram is likely needed.

Usage

```
aigra_apply_diagram_agent(result, overwrite_prompt = FALSE)
```

Arguments

`result` A data frame returned by AIGRA.
`overwrite_prompt` If TRUE, replace existing diagram prompts.

Value

Updated result data frame.

`aigra_backend_path` *Get AIGRA backend path*

Description

Returns the configured AIGRA Python backend path.

Usage

```
aigra_backend_path()
```

Details

AIGRA first checks the active session configuration. If no backend has been set in the current R session, it checks the `AIGRA_BACKEND_PATH` environment variable.

Value

Backend path as a character string.

aigra_build_diagram_prompt

Build a safe diagram prompt from an item stem

Description

Build a safe diagram prompt from an item stem

Usage

```
aigra_build_diagram_prompt(  
  stem,  
  option_A = "",  
  option_B = "",  
  option_C = "",  
  option_D = ""  
)
```

Arguments

stem	Item stem.
option_A	Option A.
option_B	Option B.
option_C	Option C.
option_D	Option D.

Value

A diagram-generation prompt.

aigra_build_diagram_prompt_from_row

Build a diagram prompt from a result row

Description

Build a diagram prompt from a result row

Usage

```
aigra_build_diagram_prompt_from_row(result, row = 1)
```

Arguments

result	A data frame returned by AIGRA.
row	Row number.

Value

A diagram prompt.

aigra_create_sample_source_diagrams

Create source diagrams for the AIGRA multimodal template

Description

Create source diagrams for the AIGRA multimodal template

Usage

```
aigra_create_sample_source_diagrams(diagram_dir)
```

Arguments

diagram_dir	Directory where source diagram PNG files should be saved.
-------------	---

Value

Named character vector of diagram paths.

aigra_detect_diagram_required

Detect whether an item likely requires a diagram

Description

Uses rule-based visual triggers in the item stem, topic, objective, and options.

Usage

```
aigra_detect_diagram_required(stem, topic = "", objective = "", options = "")
```

Arguments

stem	Item stem.
topic	Optional topic.
objective	Optional objective.
options	Optional option text.

Value

TRUE or FALSE.

aigra_example_item_bank

Get path to bundled AIGRA example item bank

Description

Get path to bundled AIGRA example item bank

Usage

aigra_example_item_bank()

Value

Path to the bundled example CSV item bank.

aigra_find_uv

Find uv executable

Description

Find uv executable

Usage

aigra_find_uv()

Value

Path to uv executable.

`aigra_generate_diagram`*Generate a single AIGRA diagram from a prompt*

Description

Generate a single AIGRA diagram from a prompt

Usage

```
aigra_generate_diagram(  
    prompt,  
    output_path,  
    provider = "gemini",  
    model = "gemini-2.5-flash-image",  
    size = "1024x1024"  
)
```

Arguments

<code>prompt</code>	Diagram prompt.
<code>output_path</code>	Output PNG path.
<code>provider</code>	Image provider.
<code>model</code>	Image model.
<code>size</code>	Image size.

Value

Output path.

`aigra_generate_diagram_fallback`*Generate a diagram with fallback image models*

Description

Tries multiple image-generation models in order until one succeeds.

Usage

```
aigra_generate_diagram_fallback(
    prompt,
    output_path,
    provider = "gemini",
    models = c("gemini-2.5-flash-image", "gemini-3.1-flash-image-preview",
              "gemini-3-pro-image-preview"),
    size = "1024x1024"
)
```

Arguments

prompt	Diagram prompt.
output_path	Output PNG path.
provider	Image provider.
models	Character vector of model names to try in order.
size	Image size.

Value

Output path.

aigra_generate_items *Generate and review assessment items*

Description

Runs the AIGRA Python backend pipeline to generate, solve, review, and export assessment items.

Usage

```
aigra_generate_items(
    pdf_path = NULL,
    target_language = "English",
    n_clones = 1,
    max_items = 1,
    provider = "gemini",
    model = "gemini-3.1-pro-preview",
    source_language = "Russian",
    review_language = "English",
    subject = "Physics",
    exam = "Kazakhstan UNT",
    read_csv = TRUE
)
```

Arguments

pdf_path	Path to source item-bank PDF. Defaults to backend data/Kz.pdf.
target_language	Language for generated items.
n_clones	Number of clones per source item.
max_items	Maximum number of source items to process.
provider	LLM provider. Currently usually "groq".
model	LLM model name.
source_language	Language of the source item bank.
review_language	Language for review comments.
subject	Subject name.
exam	Examination name.
read_csv	If TRUE, returns the latest CSV output as a data frame.

Value

A data frame if read_csv is TRUE; otherwise invisibly returns latest CSV path.

```
aigra_generate_multimodal_tabular_items
```

Generate multimodal items from a tabular item bank

Description

Runs item generation and diagram generation in one workflow.

Usage

```
aigra_generate_multimodal_tabular_items(
  file_path,
  provider = "gemini",
  model = "gemini-3.1-pro-preview",
  image_provider = "gemini",
  image_model = "gemini-3-pro-image-preview",
  source_language = "English",
  target_language = "English",
  subject = "General",
  exam = "AIGRA Multimodal Item Bank",
  n_clones = 1,
  max_items = NULL,
  max_images = NULL,
  write_reports = TRUE,
  include_key = TRUE,
  only_accepted = TRUE
)
```

Arguments

file_path	Path to CSV or Excel item bank.
provider	Text-generation provider.
model	Text-generation model.
image_provider	Image-generation provider.
image_model	Image-generation model.
source_language	Source item language.
target_language	Target generated item language.
subject	Subject name.
exam	Exam or item-bank name.
n_clones	Number of clones per item.
max_items	Maximum source items to process. Use NULL for all.
max_images	Maximum diagrams to generate. Use NULL for all generated rows.
write_reports	If TRUE, writes quality and administration HTML reports.
include_key	If TRUE, include answer key in administration HTML.
only_accepted	If TRUE, administration HTML includes only ok/edited rows.

Details

Text-only items are generated normally. Items that require diagrams are processed through the Source Diagram Agent and Clone Diagram Agent.

Value

A list containing result, result_with_diagrams, report_path, admin_file, and student_file.

aigra_generate_result_diagrams

Generate diagrams for rows in an AIGRA result

Description

Generates diagram images for result rows and returns the updated data frame with diagram_path, diagram_prompt, image_provider, and image_model columns.

Usage

```
aigra_generate_result_diagrams(
  result,
  output_dir = NULL,
  provider = "gemini",
  model = "gemini-2.5-flash-image",
  rows = NULL,
  only_required = TRUE,
  force = FALSE,
  max_images = 1,
  overwrite = FALSE
)
```

Arguments

result	A data frame returned by AIGRA.
output_dir	Directory for generated images.
provider	Image provider.
model	Image model.
rows	Optional row numbers to process.
only_required	If TRUE, process only rows where diagram_required is true.
force	If TRUE, generate even when diagram_required is false or missing.
max_images	Maximum number of images to generate.
overwrite	If TRUE, overwrite existing image files.

Value

Updated result data frame.

```
aigra_generate_result_diagrams_auto
```

Generate diagrams using the AIGRA Diagram Agent

Description

Applies the Diagram Agent, then generates diagrams for rows marked as requiring diagrams.

Usage

```
aigra_generate_result_diagrams_auto(
  result,
  provider = "gemini",
  model = "gemini-3-pro-image-preview",
  rows = NULL,
  max_images = 3,
  overwrite = FALSE
)
```

Arguments

result	A data frame returned by AIGRA.
provider	Image provider.
model	Image model.
rows	Optional row numbers to process.
max_images	Maximum number of images to generate.
overwrite	If TRUE, overwrite existing image files.

Value

Updated result data frame with diagram paths.

aigra_generate_tabular_items

Generate items from a tabular item bank

Description

Runs the AIGRA generation, solver, critic, and export pipeline using a CSV or Excel item bank.

Usage

```
aigra_generate_tabular_items(
  file_path,
  provider = "gemini",
  model = "gemini-3.1-pro-preview",
  source_language = "English",
  target_language = "English",
  review_language = "English",
  subject = "General",
  exam = "Item Bank",
  n_clones = 1,
  max_items = NULL,
  output_dir = NULL,
  read_csv = TRUE
)
```

Arguments

file_path	Path to CSV or Excel item bank.
provider	LLM provider, such as "gemini", "openai", "groq", or "anthropic".
model	Provider model name.
source_language	Language of the source item bank.

target_language	Language for generated items.
review_language	Language for review comments.
subject	Subject name.
exam	Examination or item-bank name.
n_clones	Number of clones per source item.
max_items	Maximum number of valid source items to process. Use NULL to process all valid items.
output_dir	Optional output directory.
read_csv	If TRUE, returns the CSV output as a data frame.

Value

A data frame if read_csv is TRUE; otherwise invisibly returns the CSV path.

aigra_image_models *List supported AIGRA image models*

Description

Returns the image model registry known to AIGRA. This function is CRAN-safe and does not call external APIs or require the Python backend.

Usage

```
aigra_image_models(provider = NULL)
```

Arguments

provider Optional image provider, such as "gemini" or "openai".

Value

Supported image models.

aigra_latest_csv *Get latest AIGRA CSV output path*

Description

Get latest AIGRA CSV output path

Usage

```
aigra_latest_csv()
```

Value

Path to latest CSV output.

aigra_latest_output *Get latest AIGRA CSV output path*

Description

Get latest AIGRA CSV output path

Usage

```
aigra_latest_output()
```

Value

Path to the latest AIGRA CSV output.

aigra_list_outputs *List AIGRA output files*

Description

Lists generated CSV and JSONL files from the backend output directory.

Usage

```
aigra_list_outputs()
```

Value

A data frame of output files.

aigra_localize_diagram_prompts
Localize AIGRA diagram prompts

Description

Adds a language instruction to diagram prompts so generated diagrams use the target language for visible labels.

Usage

```
aigra_localize_diagram_prompts(result, target_language = "English")
```

Arguments

result	A data frame returned by AIGRA.
target_language	Target language for visible diagram text labels.

Value

Updated result data frame.

aigra_multimodal_template_items
Create AIGRA multimodal template items

Description

Create AIGRA multimodal template items

Usage

```
aigra_multimodal_template_items(diagram_dir = NULL, create_diagrams = TRUE)
```

Arguments

diagram_dir	Directory where source diagrams are stored or should be created.
create_diagrams	If TRUE, creates sample source diagram PNG files.

Value

A data frame containing multimodal sample items.

aigra_outputs	<i>List AIGRA output files</i>
---------------	--------------------------------

Description

List AIGRA output files

Usage

```
aigra_outputs(pattern = "aigra(_tabular)?_results_.*\\.\\.(csv|jsonl)$")
```

Arguments

pattern File-name pattern.

Value

A data frame of output files.

aigra_output_dir	<i>AIGRA output directory</i>
------------------	-------------------------------

Description

AIGRA output directory

Usage

```
aigra_output_dir()
```

Value

Path to the backend output directory.

aigra_parse_items *Parse assessment items from a PDF*

Description

Parses a supported assessment-item PDF through the AIGRA Python backend and returns a data frame of source items.

Usage

```
aigra_parse_items(  
    pdf_path = NULL,  
    source_language = "Russian",  
    subject = "Physics",  
    exam = "Kazakhstan UNT"  
)
```

Arguments

pdf_path	Path to the source item-bank PDF. Defaults to backend data/Kz.pdf.
source_language	Language of the source item bank.
subject	Subject name.
exam	Examination name.

Value

A data frame of parsed assessment items.

aigra_parse_tabular_items
Parse tabular item bank

Description

Parses a CSV or Excel item bank directly from the supplied file path.

Usage

```
aigra_parse_tabular_items(  
    file_path,  
    source_language = "English",  
    subject = "General",  
    exam = "Item Bank"  
)
```

Arguments

file_path	Path to CSV or Excel item bank.
source_language	Default source language if the file does not contain source_language.
subject	Default subject if the file does not contain subject.
exam	Default exam name if the file does not contain exam.

Value

A data frame of parsed assessment items.

aigra_plot_diagram *Plot an AIGRA diagram image*

Description

Plot an AIGRA diagram image

Usage

```
aigra_plot_diagram(image_path)
```

Arguments

image_path	Path to a PNG image.
------------	----------------------

Value

Invisibly returns the image path.

aigra_plot_summary *Plot AIGRA output quality summary*

Description

Creates a simple bar chart of item review statuses in an AIGRA output.

Usage

```
aigra_plot_summary(data = NULL)
```

Arguments

data	Optional AIGRA output data frame. If NULL, reads the latest CSV output.
------	---

Value

Invisibly returns the status table used for plotting.

aigra_print_summary *Print an AIGRA quality summary*

Description

Prints a compact quality summary for an AIGRA output.

Usage

```
aigra_print_summary(data = NULL)
```

Arguments

data Optional AIGRA output data frame. If NULL, reads the latest CSV output.

Value

Invisibly returns the summary list.

Examples

```
result <- data.frame(  
  status = c('ok', 'edited', 'reject'),  
  solver_matches_key = c(TRUE, TRUE, FALSE),  
  stringsAsFactors = FALSE  
)  
aigra_print_summary(result)
```

aigra_print_validation

Print tabular item-bank validation results

Description

Print tabular item-bank validation results

Usage

```
aigra_print_validation(validation)
```

Arguments

validation Validation result returned by [aigra_validate_tabular_items\(\)](#).

Value

Invisibly returns the validation object.

Examples

```
validation <- list(  
  summary = list(file = 'items.csv', rows = 1, issue_count = 0),  
  valid = TRUE,  
  missing_required_columns = character(),  
  unknown_columns = character(),  
  issues = data.frame()  
)  
aigra_print_validation(validation)
```

aigra_python_info *Show AIGRA Python environment information*

Description

Show AIGRA Python environment information

Usage

```
aigra_python_info(backend_path = NULL)
```

Arguments

backend_path Path to the AIGRA_BACKEND folder.

Value

A list with Python environment information.

Examples

```
info <- aigra_python_info(backend_path = tempdir())  
is.list(info)
```

aigra_read_latest_csv *Read latest AIGRA CSV output*

Description

Read latest AIGRA CSV output

Usage

```
aigra_read_latest_csv()
```

Value

A data frame containing the latest AIGRA CSV output.

`aigra_read_latest_output`*Read latest AIGRA CSV output*

Description

Read latest AIGRA CSV output

Usage

```
aigra_read_latest_output()
```

Value

A data frame containing the latest AIGRA CSV output.

`aigra_repair_diagram_prompts`*Repair diagram prompts for diagram-dependent AIGRA results*

Description

Strengthens diagram prompts when a generated item requires a figure but the prompt is too vague for solving/review.

Usage

```
aigra_repair_diagram_prompts(result)
```

Arguments

`result` A data frame returned by AIGRA.

Value

Updated result data frame.

aigra_set_backend	<i>Set the AIGRA Python backend</i>
-------------------	-------------------------------------

Description

Connects the R package to the AIGRA Python backend.

Sets the path to the AIGRA Python backend.

Usage

```
aigra_set_backend(backend_path = NULL)
```

```
aigra_set_backend(backend_path = NULL)
```

Arguments

backend_path	Path to the AIGRA_BACKEND folder. If NULL, uses the AIGRA_BACKEND_PATH environment variable.
--------------	--

Value

Invisibly returns backend configuration.

Invisibly returns the normalized backend path.

aigra_show_result_diagram

Show a diagram from an AIGRA result row

Description

Show a diagram from an AIGRA result row

Usage

```
aigra_show_result_diagram(result, row = 1)
```

Arguments

result	A data frame returned by AIGRA.
row	Row number to display.

Value

Invisibly returns the image path.

aigra_status	<i>Check AIGRA backend status</i>
--------------	-----------------------------------

Description

Checks whether the R package can access the Python backend.

Usage

```
aigra_status(backend_path = NULL)
```

Arguments

backend_path Optional path to the AIGRA_BACKEND folder.

Value

A list containing backend path, Python path, Python version, and import status.

aigra_summarise_output	<i>Summarise an AIGRA output</i>
------------------------	----------------------------------

Description

Summarises the latest or supplied AIGRA CSV output.

Usage

```
aigra_summarise_output(data = NULL)
```

Arguments

data Optional AIGRA output data frame. If NULL, reads the latest CSV output.

Value

A list with quality counts and simple rates.

aigra_template_items *Create an AIGRA tabular item-bank template*

Description

Creates a sample item-bank data frame with the required columns for CSV/Excel-based AIGRA generation.

Usage

```
aigra_template_items()
```

Value

A data frame containing sample item-bank rows.

aigra_translate_diagram_prompts
Translate/localize AIGRA diagram prompts using an LLM

Description

This rewrites diagram prompts into the target language before image generation. Scientific symbols and units are preserved.

Usage

```
aigra_translate_diagram_prompts(  
    result,  
    target_language = "English",  
    provider = "gemini",  
    model = "gemini-3.1-pro-preview"  
)
```

Arguments

result	A data frame returned by AIGRA.
target_language	Target language for visible diagram labels.
provider	Text LLM provider.
model	Text LLM model.

Value

Updated result data frame.

aigra_use_backend *Use AIGRA backend*

Description

Backward-compatible alias for [aigra_set_backend\(\)](#).

Usage

```
aigra_use_backend(backend_path = NULL)
```

Arguments

backend_path Optional backend path. If NULL, uses AIGRA_BACKEND_PATH.

Value

Invisibly returns backend path.

aigra_validate_tabular_items
Validate a tabular AIGRA item bank

Description

Checks a CSV or Excel item bank before parsing or generation.

Usage

```
aigra_validate_tabular_items(file_path)
```

Arguments

file_path Path to CSV or Excel item bank.

Value

A list containing validation status, issues, and a summary.

`aigra_write_admin_html`*Write an AIGRA administration HTML file*

Description

Creates a print-ready HTML file containing generated item stems, diagrams, response options, and an answer key.

Usage

```
aigra_write_admin_html(  
  result,  
  file = NULL,  
  title = "AIGRA Generated Assessment Items",  
  include_key = TRUE,  
  include_metadata = FALSE,  
  only_accepted = TRUE  
)
```

Arguments

<code>result</code>	A data frame returned by AIGRA, preferably after diagram generation.
<code>file</code>	Output HTML file. If NULL, writes to backend outputs folder.
<code>title</code>	Title shown at the top of the paper.
<code>include_key</code>	If TRUE, include answer key at the end.
<code>include_metadata</code>	If TRUE, show topic, section, and difficulty.
<code>only_accepted</code>	If TRUE, include only rows with status ok or edited.

Value

Path to the HTML file.

Examples

```
result <- data.frame(  
  original_id = 'ITEM001',  
  clone_stem = 'What is 2 + 3?',  
  opt_A = '4',  
  opt_B = '5',  
  opt_C = '6',  
  opt_D = '7',  
  correct_answer = 'B',  
  status = 'ok',  
  stringsAsFactors = FALSE  
)
```

```
html <- aigra_write_admin_html(
  result,
  file = tempfile(fileext = '.html'),
  include_key = TRUE,
  only_accepted = FALSE
)
file.exists(html)
```

aigra_write_multimodal_template_excel

Write an AIGRA multimodal Excel template

Description

Creates source diagram PNGs and writes a ready-to-run Excel item bank.

Usage

```
aigra_write_multimodal_template_excel(
  file = NULL,
  diagram_dir = NULL,
  overwrite = FALSE
)
```

Arguments

file	Output Excel file path.
diagram_dir	Directory for source diagram PNGs.
overwrite	If TRUE, overwrite the Excel file.

Value

Path to the Excel file.

aigra_write_report *Write an AIGRA HTML report*

Description

Writes a CRAN-safe local HTML report from an AIGRA result data frame. If diagram_path is present, generated diagrams are shown inline.

Usage

```
aigra_write_report(result = NULL, file = NULL, title = "AIGRA Quality Report")
```

Arguments

result	A data frame returned by AIGRA. If NULL, reads latest output.
file	Output HTML path. If NULL, writes to backend outputs folder.
title	Report title.

Value

Path to the report.

aigra_write_template_csv

Write an AIGRA CSV item-bank template

Description

Write an AIGRA CSV item-bank template

Usage

```
aigra_write_template_csv(file = "aigra_item_template.csv", overwrite = FALSE)
```

Arguments

file	Output CSV file path.
overwrite	If TRUE, overwrite an existing file.

Value

The normalized output file path.

aigra_write_template_excel

Write an AIGRA Excel item-bank template

Description

Write an AIGRA Excel item-bank template

Usage

```
aigra_write_template_excel(
  file = "aigra_item_template.xlsx",
  overwrite = FALSE
)
```

Arguments

file	Output Excel file path.
overwrite	If TRUE, overwrite an existing file.

Value

The normalized output file path.

ensure_aigra_python *Ensure 'AIGRA' 'Python' Environment*

Description

Creates or repairs the 'Python' virtual environment used by the 'AIGRA' backend.

Usage

```
ensure_aigra_python(
  backend_path = NULL,
  python_version = "3.11",
  force = FALSE,
  install_providers = TRUE,
  verbose = FALSE
)
```

Arguments

backend_path	Path to the 'AIGRA' backend folder. If NULL, the AIGRA_BACKEND_PATH environment variable is used.
python_version	'Python' version to use with 'uv'.
force	If TRUE, recreate the virtual environment.
install_providers	If TRUE, install provider packages.
verbose	If TRUE, show progress messages.

Value

A list with 'Python' environment information.

Examples

```
# This function creates or repairs a backend environment,
# so the example only inspects the function interface.
names(formals(ensure_aigra_python))
```

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