

Package ‘asa’

December 26, 2025

Title AI Search Agent for Large-Scale Research Automation

Version 0.1.0

Description Provides an LLM-powered research agent for performing AI search tasks at large scales. Uses a ReAct (Reasoning + Acting) agent pattern with web search capabilities via DuckDuckGo and Wikipedia. Implements DeepAgent-style memory folding for context management. The agent is built on 'LangGraph' and supports multiple LLM backends including 'OpenAI', 'Groq', and 'xAI'.

URL <https://github.com/cjerzak/asa-software>

BugReports <https://github.com/cjerzak/asa-software/issues>

Depends R (>= 4.0.0)

License GPL-3

Encoding UTF-8

Imports reticulate (>= 1.28), jsonlite, rlang, digest

Suggests testthat (>= 3.0.0), knitr, rmarkdown, future, future.apply

VignetteBuilder knitr

RoxygenNote 7.3.3

Config/testthat.edition 3

SystemRequirements Python (>= 3.11), Conda, Tor (optional, for anonymous searching)

NeedsCompilation no

Author Connor Jerzak [aut, cre] (ORCID: <<https://orcid.org/0000-0003-1914-8905>>)

Maintainer Connor Jerzak <connor.jerzak@gmail.com>

Contents

asa-package	3
.build_trace	4
.close_http_clients	5
.create_agent	5
.create_http_clients	6
.create_llm	6
.create_research_config	7
.create_research_graph	7

.create_tools	7
.extract_fields	8
.extract_json_from_trace	8
.extract_json_object	8
.extract_response_text	9
.get_extdata_path	9
.get_local_ip	9
.get_python_path	10
.handle_response_issues	10
.import_python_packages	10
.import_research_modules	10
.invoke_memory_folding_agent	11
.invoke_standard_agent	11
.is_initialized	11
.normalize_schema	11
.parse_json_response	12
.process_research_results	12
.resume_research	12
.run_research	12
.run_research_with_progress	13
.save_checkpoint	13
.stop_validation	13
.validate_asa_agent	14
.validate_asa_response	14
.validate_asa_result	14
.validate_build_backend	15
.validate_build_prompt	15
.validate_choice	15
.validate_conda_env	16
.validate_configure_search	16
.validate_consistency	17
.validate_dataframe	17
.validate_initialize_agent	18
.validate_logical	18
.validate_positive	19
.validate_process_outputs	19
.validate_proxy_url	19
.validate_range	20
.validate_required	20
.validate_research_inputs	21
.validate_run_agent	21
.validate_run_task	21
.validate_run_task_batch	22
.validate_s3_class	22
.validate_string	23
.validate_string_vector	23
as.data.frame.asa_enumerate_result	24
as.data.frame.asa_result	24
asa_agent	25
asa_enumerate	25
asa_enumerate_result	28
asa_response	29

asa_result	30
build_backend	30
build_prompt	31
check_backend	32
clean_whitespace	33
configure_search	33
configure_search_logging	34
decode_html	35
extract_agent_results	36
extract_search_snippets	36
extract_search_tiers	37
extract_urls	38
extract_wikipedia_content	38
format_duration	39
get_agent	39
get_tor_ip	40
initialize_agent	40
is_tor_running	42
json_escape	43
print.asa_agent	43
print.asa_enumerate_result	44
print.asa_response	44
print.asa_result	45
print2	45
process_outputs	46
reset_agent	46
rotate_tor_circuit	47
run_agent	47
run_agent_batch	48
run_task	49
run_task_batch	50
safe_json_parse	51
summary.asa_agent	52
summary.asa_enumerate_result	52
summary.asa_response	53
summary.asa_result	53
truncate_string	54
write_csv.asa_enumerate_result	54

Index**55****Description**

The `asa` package provides an LLM-powered research agent for performing AI search tasks at large scales using web search capabilities.

The agent uses a ReAct (Reasoning + Acting) pattern implemented via LangGraph, with tools for searching DuckDuckGo and Wikipedia. It supports multiple LLM backends (OpenAI, Groq, xAI) and implements DeepAgent-style memory folding for managing long conversations.

Main Functions

- `build_backend`: Set up the Python conda environment
- `initialize_agent`: Initialize the search agent
- `run_agent`: Run the agent with a custom prompt
- `run_task`: Run a structured task with the agent
- `run_task_batch`: Run multiple tasks in batch

Configuration

The package requires a Python environment with LangChain and related packages. Use `build_backend` to create this environment automatically.

For anonymous searching, the package can use Tor as a SOCKS5 proxy. Install Tor via `brew install tor` (macOS) and start it with `brew services start tor`.

Author(s)

Maintainer: Connor Jerzak <connor.jerzak@gmail.com> ([ORCID](#))

See Also

Useful links:

- <https://github.com/cjerzak/asa-software>
- Report bugs at <https://github.com/cjerzak/asa-software/issues>

.build_trace

Build Trace from Raw Response

Description

Build Trace from Raw Response

Usage

```
.build_trace(raw_response)
```

.close_http_clients *Close HTTP Clients*

Description

Safely closes the synchronous httpx client to prevent resource leaks. This is called automatically by reset_agent() and when reinitializing.

Usage

```
.close_http_clients()
```

Details

Note: We no longer create or manage async clients from R (R-CRIT-001 fix). LangChain manages its own async client lifecycle internally.

Value

Invisibly returns NULL

.create_agent *Create the LangGraph Agent*

Description

Create the LangGraph Agent

Usage

```
.create_agent(  
  llm,  
  tools,  
  use_memory_folding,  
  memory_threshold,  
  memory_keep_recent  
)
```

Arguments

llm	LLM instance
tools	List of tools
use_memory_folding	Whether to use memory folding
memory_threshold	Messages before folding
memory_keep_recent	Messages to keep

`.create_http_clients` *Create HTTP Client for API Calls*

Description

Creates a synchronous httpx client for LLM API calls. Note: We intentionally do NOT create an async client. LangChain/OpenAI SDK creates its own async client internally when needed (for async operations). This avoids R-CRIT-001 where async client cleanup was unreliable from R since `aclose()` requires an async context.

Usage

```
.create_http_clients(proxy, timeout)
```

Arguments

<code>proxy</code>	Proxy URL or NULL
<code>timeout</code>	Timeout in seconds

Value

A list with 'sync' client (async is NULL, letting LangChain manage it)

`.create_llm` *Create LLM Instance*

Description

Create LLM Instance

Usage

```
.create_llm(backend, model, clients, rate_limit)
```

Arguments

<code>backend</code>	Backend name
<code>model</code>	Model identifier
<code>clients</code>	HTTP clients (for OpenAI)
<code>rate_limit</code>	Requests per second

.create_research_config

Create Research Configuration

Description

Create Research Configuration

Usage

.create_research_config(max_workers, max_rounds, budget, stop_policy, sources)

.create_research_graph

Create Research Graph

Description

Create Research Graph

Usage

.create_research_graph(agent, config_dict)

.create_tools

Create Search Tools

Description

Create Search Tools

Usage

.create_tools(proxy)

Arguments

proxy Proxy URL or NULL

.extract_fields *Extract Specific Fields from Response*

Description

Extract Specific Fields from Response

Usage

```
.extract_fields(text, fields)
```

Arguments

text	Response text
fields	Character vector of field names to extract

.extract_json_from_trace *Extract JSON from Agent Traces*

Description

Internal function to extract JSON data from raw agent traces.

Usage

```
.extract_json_from_trace(text)
```

Arguments

text	Raw trace text
------	----------------

Value

Parsed JSON data as a list, or NULL if no JSON found

.extract_json_object *Extract JSON Object from Text*

Description

Extract JSON Object from Text

Usage

```
.extract_json_object(text)
```

Arguments

text	Response text
------	---------------

.extract_response_text

Extract Response Text from Raw Response

Description

Extract Response Text from Raw Response

Usage

.extract_response_text(raw_response, backend)

.get_extdata_path

Get External Data Path

Description

Returns the path to the package's external data directory.

Usage

.get_extdata_path(filename = NULL)

Arguments

filename Optional filename within extdata directory

Value

Character string with the path

.get_local_ip

Get Local IP Address (Cross-Platform)

Description

Returns the local IP address for use with Exo backend. Works on Windows, macOS, and Linux.

Usage

.get_local_ip()

Value

Character string with the local IP address, or "127.0.0.1" on failure.

`.get_python_path` *Get Package Python Module Path*

Description

Returns the path to the Python modules shipped with the package.

Usage

`.get_python_path()`

Value

Character string with the path to inst/python

`.handle_response_issues` *Handle Response Issues (Rate Limiting, Timeouts)*

Description

Handle Response Issues (Rate Limiting, Timeouts)

Usage

`.handle_response_issues(trace, verbose)`

`.import_python_packages` *Import Required Python Packages*

Description

Import Required Python Packages

Usage

`.import_python_packages()`

`.import_research_modules` *Import Research Python Modules*

Description

Import Research Python Modules

Usage

`.import_research_modules()`

.invoke_memory_folding_agent
Invoke Memory Folding Agent

Description

Invoke Memory Folding Agent

Usage

.invoke_memory_folding_agent(python_agent, prompt, recursion_limit)

.invoke_standard_agent
Invoke Standard Agent

Description

Invoke Standard Agent

Usage

.invoke_standard_agent(python_agent, prompt, recursion_limit)

.is_initialized *Check if ASA Agent is Initialized*

Description

Check if ASA Agent is Initialized

Usage

.is_initialized()

Value

Logical indicating if the agent has been initialized

.normalize_schema *Normalize Schema Input*

Description

Normalize Schema Input

Usage

.normalize_schema(schema, query, verbose)

```
.parse_json_response    Parse JSON Response
```

Description

Parse JSON Response

Usage

```
.parse_json_response(response_text)
```

Arguments

response_text Response text from agent

```
.process_research_results
      Process Research Results
```

Description

Process Research Results

Usage

```
.process_research_results(result, schema_dict, include_provenance)
```

```
.resume_research      Resume Research from Checkpoint
```

Description

Resume Research from Checkpoint

Usage

```
.resume_research(checkpoint_file, verbose)
```

```
.run_research        Run Research (Non-Streaming)
```

Description

Run Research (Non-Streaming)

Usage

```
.run_research(graph, query, schema_dict, config_dict)
```

.run_research_with_progress
Run Research with Progress Updates

Description

Run Research with Progress Updates

Usage

```
.run_research_with_progress(  
    graph,  
    query,  
    schema_dict,  
    config_dict,  
    checkpoint_file,  
    verbose  
)
```

.save_checkpoint *Save Checkpoint*

Description

Save Checkpoint

Usage

```
.save_checkpoint(result, query, schema_dict, config_dict, checkpoint_file)
```

.stop_validation *Stop with Formatted Validation Error*

Description

Creates a standardized error message with Got/Fix sections.

Usage

```
.stop_validation(param_name, requirement, actual = NULL, fix = NULL)
```

Arguments

param_name	Name of the parameter that failed validation
requirement	What the parameter should be
actual	What was actually received (optional, auto-formatted)
fix	Actionable fix suggestion

`.validate_asa_agent` *Validate S3 Constructor: asa_agent*

Description

Validate S3 Constructor: asa_agent

Usage

```
.validate_asa_agent(python_agent, backend, model, config)
```

`.validate_asa_response`
 Validate S3 Constructor: asa_response

Description

Validate S3 Constructor: asa_response

Usage

```
.validate_asa_response(  
    message,  
    status_code,  
    raw_response,  
    trace,  
    elapsed_time,  
    fold_count,  
    prompt  
)
```

`.validate_asa_result` *Validate S3 Constructor: asa_result*

Description

Validate S3 Constructor: asa_result

Usage

```
.validate_asa_result(prompt, message, parsed, raw_output, elapsed_time, status)
```

`.validate_build_backend`

Validate build_backend() Parameters

Description

Validate build_backend() Parameters

Usage

```
.validate_build_backend(conda_env, conda, python_version)
```

`.validate_build_prompt`

Validate build_prompt() Parameters

Description

Validate build_prompt() Parameters

Usage

```
.validate_build_prompt(template)
```

`.validate_choice`

Validate Choice from Set

Description

Validate Choice from Set

Usage

```
.validate_choice(x, param_name, choices)
```

Arguments

x Value to check

param_name Name for error message

choices Valid choices

`.validate_conda_env` *Validate Conda Environment Name*

Description

Validate Conda Environment Name

Usage

```
.validate_conda_env(x, param_name)
```

Arguments

x	Value to check
param_name	Name for error message

`.validate_configure_search`
 Validate configure_search() Parameters

Description

Validate configure_search() Parameters

Usage

```
.validate_configure_search(  
    max_results,  
    timeout,  
    max_retries,  
    retry_delay,  
    backoff_multiplier,  
    captcha_backoff_base,  
    page_load_wait,  
    inter_search_delay,  
    conda_env  
)
```

`.validate_consistency` *Validate Logical Consistency Between Parameters*

Description

Validate Logical Consistency Between Parameters

Usage

```
.validate_consistency(condition, message, fix)
```

Arguments

condition	Condition that must be TRUE
message	Error message if condition is FALSE
fix	How to fix the issue

`.validate_dataframe` *Validate Data Frame with Required Columns*

Description

Validate Data Frame with Required Columns

Usage

```
.validate_dataframe(x, param_name, required_cols = NULL)
```

Arguments

x	Value to check
param_name	Name for error message
required_cols	Required column names (optional)

```
.validate_initialize_agent  
    Validate initialize_agent() Parameters
```

Description

Validate initialize_agent() Parameters

Usage

```
.validate_initialize_agent(  
    backend,  
    model,  
    conda_env,  
    proxy,  
    use_memory_folding,  
    memory_threshold,  
    memory_keep_recent,  
    rate_limit,  
    timeout,  
    verbose  
)
```

```
.validate_logical      Validate Boolean
```

Description

Validate Boolean

Usage

```
.validate_logical(x, param_name)
```

Arguments

x	Value to check
param_name	Name for error message

.validate_positive *Validate Positive Number*

Description

Validate Positive Number

Usage

```
.validate_positive(x, param_name, allow_zero = FALSE, integer_only = FALSE)
```

Arguments

x	Value to check
param_name	Name for error message
allow_zero	Allow zero values (default: FALSE)
integer_only	Require integer values (default: FALSE)

.validate_process_outputs *Validate process_outputs() Parameters*

Description

Validate process_outputs() Parameters

Usage

```
.validate_process_outputs(df, parallel, workers)
```

.validate_proxy_url *Validate URL Format (SOCKS5 Proxy)*

Description

Validate URL Format (SOCKS5 Proxy)

Usage

```
.validate_proxy_url(x, param_name)
```

Arguments

x	Value to check (NULL is valid = no proxy)
param_name	Name for error message

`.validate_range` *Validate Range*

Description

Validate Range

Usage

```
.validate_range(x, param_name, min = NULL, max = NULL)
```

Arguments

x	Value to check (must already be validated as numeric)
param_name	Name for error message
min	Minimum allowed value (optional)
max	Maximum allowed value (optional)

`.validate_required` *Validate Required Argument Presence*

Description

Validate Required Argument Presence

Usage

```
.validate_required(x, param_name)
```

Arguments

x	Value to check
param_name	Name for error message

```
.validate_research_inputs
```

Validate Research Inputs

Description

Validate Research Inputs

Usage

```
.validate_research_inputs(  
    query,  
    schema,  
    output,  
    max_workers,  
    max_rounds,  
    budget,  
    stop_policy,  
    sources,  
    checkpoint_dir,  
    resume_from  
)
```

```
.validate_run_agent      Validate run_agent() Parameters
```

Description

Validate run_agent() Parameters

Usage

```
.validate_run_agent(prompt, agent, recursion_limit, verbose)
```

```
.validate_run_task       Validate run_task() Parameters
```

Description

Validate run_task() Parameters

Usage

```
.validate_run_task(prompt, output_format, agent, verbose)
```

```
.validate_run_task_batch  
    Validate run_task_batch() Parameters
```

Description

Validate run_task_batch() Parameters

Usage

```
.validate_run_task_batch(  
    prompts,  
    output_format,  
    agent,  
    parallel,  
    workers,  
    progress  
)
```

```
.validate_s3_class      Validate S3 Class
```

Description

Validate S3 Class

Usage

```
.validate_s3_class(x, param_name, expected_class)
```

Arguments

x	Value to check
param_name	Name for error message
expected_class	Expected S3 class name

.validate_string *Validate Non-Empty String*

Description

Validate Non-Empty String

Usage

```
.validate_string(x, param_name, allow_empty = FALSE, allow_na = FALSE)
```

Arguments

x	Value to check
param_name	Name for error message
allow_empty	Allow empty strings (default: FALSE)
allow_na	Allow NA values (default: FALSE)

.validate_string_vector *Validate Character Vector (Non-Empty)*

Description

Validate Character Vector (Non-Empty)

Usage

```
.validate_string_vector(x, param_name, min_length = 1L)
```

Arguments

x	Value to check
param_name	Name for error message
min_length	Minimum required length (default: 1)

```
as.data.frame.asa_enumerate_result  
Convert asa_enumerate_result to Data Frame
```

Description

Convert asa_enumerate_result to Data Frame

Usage

```
## S3 method for class 'asa_enumerate_result'  
as.data.frame(x, ...)
```

Arguments

x	An asa_enumerate_result object
...	Additional arguments (ignored)

Value

The data data.frame from the result

```
as.data.frame.asa_result  
Convert asa_result to Data Frame
```

Description

Convert asa_result to Data Frame

Usage

```
## S3 method for class 'asa_result'  
as.data.frame(x, ...)
```

Arguments

x	An asa_result object
...	Additional arguments (ignored)

Value

A single-row data frame

<code>asa_agent</code>	<i>Constructor for asa_agent Objects</i>
------------------------	--

Description

Creates an S3 object representing an initialized ASA search agent.

Usage

```
asa_agent(python_agent, backend, model, config)
```

Arguments

<code>python_agent</code>	The underlying Python agent object
<code>backend</code>	LLM backend name (e.g., "openai", "groq")
<code>model</code>	Model identifier
<code>config</code>	Agent configuration list

Value

An object of class `asa_agent`

<code>asa_enumerate</code>	<i>Multi-Agent Research for Open-Ended Queries</i>
----------------------------	--

Description

Performs intelligent open-ended research tasks using multi-agent orchestration. Decomposes complex queries into sub-tasks, executes parallel searches, and aggregates results into structured output (data.frame, CSV, or JSON).

Usage

```
asa_enumerate(
  query,
  schema = NULL,
  output = c("data.frame", "csv", "json"),
  max_workers = 4L,
  max_rounds = 8L,
  budget = list(queries = 50L, tokens = 200000L, time_sec = 300L),
  stop_policy = list(target_items = NULL, plateau_rounds = 2L, novelty_min = 0.05,
    novelty_window = 20L),
  sources = list(web = TRUE, wikipedia = TRUE, wikidata = TRUE),
  pagination = TRUE,
  progress = TRUE,
  include_provenance = FALSE,
  checkpoint = TRUE,
  checkpoint_dir = tempdir(),
  resume_from = NULL,
```

```

    agent = NULL,
    backend = "openai",
    model = "gpt-4.1-mini",
    conda_env = "asa_env",
    verbose = TRUE
)

```

Arguments

query	Character string describing the research goal. Examples: "Find all current US senators with their state, party, and term end date"
schema	Named character vector defining the output schema. Names are column names, values are R types ("character", "numeric", "logical"). Use NULL or "auto" for LLM-proposed schema.
output	Output format: "data.frame" (default), "csv", or "json".
max_workers	Maximum number of parallel search workers (default: 4).
max_rounds	Maximum research iterations (default: 8).
budget	Named list with resource limits: <ul style="list-style-type: none"> queries: Maximum search queries (default: 50) tokens: Maximum LLM tokens (default: 200000) time_sec: Maximum execution time in seconds (default: 300)
stop_policy	Named list with stopping criteria: <ul style="list-style-type: none"> target_items: Stop when this many items found (NULL = unknown) plateau_rounds: Stop after N rounds with no new items (default: 2) novelty_min: Minimum new items ratio per round (default: 0.05) novelty_window: Window size for novelty calculation (default: 20)
sources	Named list controlling which sources to use: <ul style="list-style-type: none"> web: Use DuckDuckGo web search (default: TRUE) wikipedia: Use Wikipedia (default: TRUE) wikidata: Use Wikidata SPARQL for authoritative enumerations (default: TRUE)
pagination	Enable pagination for large result sets (default: TRUE).
progress	Show progress bar and status updates (default: TRUE).
include_provenance	Include source URLs and confidence per row (default: FALSE).
checkpoint	Enable auto-save after each round (default: TRUE).
checkpoint_dir	Directory for checkpoint files (default: tempdir()).
resume_from	Path to checkpoint file to resume from (default: NULL).
agent	An initialized <code>asa_agent</code> object. If NULL, uses the current agent or creates a new one with specified backend/model.
backend	LLM backend if creating new agent: "openai", "groq", "xai", "openrouter".
model	Model identifier if creating new agent.
conda_env	Conda environment name (default: "asa_env").
verbose	Print status messages (default: TRUE).

Details

The function uses a multi-agent architecture:

1. **Planner**: Decomposes query into facets and identifies authoritative sources
2. **Dispatcher**: Spawns parallel workers for each facet
3. **Workers**: Execute searches using DDG, Wikipedia, and Wikidata
4. **Extractor**: Normalizes results to match schema
5. **Deduper**: Removes duplicates using hash + fuzzy matching
6. **Stopper**: Evaluates stopping criteria (novelty, budget, saturation)

For known entity types (US senators, countries, Fortune 500), Wikidata provides authoritative enumerations with complete, verified data.

Value

An object of class `asa_enumerate_result` containing:

- `data`: `data.frame` with results matching the schema
- `status`: "complete", "partial", or "failed"
- `stop_reason`: Why the search stopped
- `metrics`: List with rounds, `queries_used`, `novelty_curve`, `coverage`
- `provenance`: If `include_provenance=TRUE`, source info per row
- `checkpoint_file`: Path to checkpoint if saved

Checkpointing

With `checkpoint=TRUE`, state is saved after each round. If interrupted, use `resume_from` to continue from the last checkpoint:

```
result <- asa_enumerate(query, resume_from = "/path/to/checkpoint.rds")
```

Schema

The schema defines expected output columns:

```
schema = c(name = "character", state = "character", party = "character")
```

With `schema = "auto"`, the planner agent proposes a schema based on the query.

See Also

[run_task](#), [initialize_agent](#)

Examples

```

## Not run:
# Find all US senators
senators <- asa_enumerate(
  query = "Find all current US senators with state, party, and term end date",
  schema = c(name = "character", state = "character",
             party = "character", term_end = "character"),
  stop_policy = list(target_items = 100),
  include_provenance = TRUE
)
head(senators$data)

# Find countries with auto schema
countries <- asa_enumerate(
  query = "Find all countries with their capitals and populations",
  schema = "auto",
  output = "csv"
)

# Resume from checkpoint
result <- asa_enumerate(
  query = "Find Fortune 500 CEOs",
  resume_from = "/tmp/asa_enumerate_abc123.rds"
)
## End(Not run)

```

asa_enumerate_result *Constructor for asa_enumerate_result Objects*

Description

Creates an S3 object representing the result of an enumeration task.

Usage

```
asa_enumerate_result(
  data,
  status,
  stop_reason,
  metrics,
  provenance = NULL,
  plan = NULL,
  checkpoint_file = NULL,
  query = NULL,
  schema = NULL
)
```

Arguments

data	data.frame containing the enumeration results
status	Result status: "complete", "partial", or "failed"

stop_reason	Why the enumeration stopped (e.g., "target_reached", "novelty_plateau")
metrics	List with execution metrics (rounds, queries_used, etc.)
provenance	Optional data.frame with source information per row
plan	The enumeration plan from the planner agent
checkpoint_file	Path to saved checkpoint file
query	The original enumeration query
schema	The schema used for extraction

Value

An object of class `asa_enumerate_result`

`asa_response`

Constructor for `asa_response` Objects

Description

Creates an S3 object representing an agent response.

Usage

```
asa_response(  
    message,  
    status_code,  
    raw_response,  
    trace,  
    elapsed_time,  
    fold_count,  
    prompt  
)
```

Arguments

message	The final response text
status_code	Status code (200 = success, 100 = error)
raw_response	The full Python response object
trace	Full text trace of agent execution
elapsed_time	Execution time in minutes
fold_count	Number of memory folds performed
prompt	The original prompt

Value

An object of class `asa_response`

asa_result*Constructor for asa_result Objects*

Description

Creates an S3 object representing the result of a research task.

Usage

```
asa_result(prompt, message, parsed, raw_output, elapsed_time, status)
```

Arguments

<code>prompt</code>	The original prompt
<code>message</code>	The agent's response text
<code>parsed</code>	Parsed output (list or NULL)
<code>raw_output</code>	Full agent trace
<code>elapsed_time</code>	Execution time in minutes
<code>status</code>	Status ("success" or "error")

Value

An object of class `asa_result`

build_backend*Build the Python Backend Environment*

Description

Creates a conda environment with all required Python dependencies for the asa search agent, including LangChain, LangGraph, and search tools.

Usage

```
build_backend(conda_env = "asa_env", conda = "auto", python_version = "3.13")
```

Arguments

<code>conda_env</code>	Name of the conda environment (default: "asa_env")
<code>conda</code>	Path to conda executable (default: "auto")
<code>python_version</code>	Python version to use (default: "3.13")

Details

This function creates a new conda environment and installs the following Python packages:

- langchain_groq, langchain_community, langchain_openai
- langgraph
- ddgs (DuckDuckGo search)
- selenium, primp (browser automation)
- beautifulsoup4, requests
- fake_headers, httpx
- pysocks, socksio (proxy support)

Value

Invisibly returns NULL; called for side effects.

Examples

```
## Not run:  
# Create the default environment  
build_backend()  
  
# Create with a custom name  
build_backend(conda_env = "my_asa_env")  
  
## End(Not run)
```

build_prompt

Build a Task Prompt from Template

Description

Creates a formatted prompt by substituting variables into a template.

Usage

```
build_prompt(template, ...)
```

Arguments

template	A character string with placeholders in the form {variable_name}
...	Named arguments to substitute into the template

Value

A formatted prompt string

Examples

```
## Not run:
prompt <- build_prompt(
  template = "Find information about {{name}} in {{country}} during {{year}}",
  name = "Marie Curie",
  country = "France",
  year = 1903
)

## End(Not run)
```

<code>check_backend</code>	<i>Check Python Environment Availability</i>
----------------------------	--

Description

Checks if the required Python environment and packages are available.

Usage

```
check_backend(conda_env = "asa_env")
```

Arguments

<code>conda_env</code>	Name of the conda environment to check
------------------------	--

Value

A list with components:

- `available`: Logical, TRUE if environment is ready
- `conda_env`: Name of the environment checked
- `python_version`: Python version if available
- `missing_packages`: Character vector of missing packages (if any)

Examples

```
## Not run:
status <- check_backend()
if (!status$available) {
  build_backend()
}

## End(Not run)
```

clean_whitespace	<i>Clean Whitespace</i>
------------------	-------------------------

Description

Normalizes whitespace in a string by collapsing multiple spaces and trimming leading/trailing whitespace.

Usage

```
clean_whitespace(x)
```

Arguments

x	Character string
---	------------------

Value

Cleaned string

configure_search	<i>Configure Python Search Parameters</i>
------------------	---

Description

Sets global configuration values for the Python search module. These values control timeouts, retry behavior, and result limits.

Usage

```
configure_search(  
    max_results = NULL,  
    timeout = NULL,  
    max_retries = NULL,  
    retry_delay = NULL,  
    backoff_multiplier = NULL,  
    captcha_backoff_base = NULL,  
    page_load_wait = NULL,  
    inter_search_delay = NULL,  
    conda_env = "asa_env"  
)
```

Arguments

max_results	Maximum number of search results to return (default: 10)
timeout	HTTP request timeout in seconds (default: 15)
max_retries	Maximum retry attempts on failure (default: 3)
retry_delay	Initial delay between retries in seconds (default: 2)

```

backoff_multiplier
    Multiplier for exponential backoff (default: 1.5)
captcha_backoff_base
    Base multiplier for CAPTCHA backoff (default: 3)
page_load_wait  Wait time after page load in seconds (default: 2)
inter_search_delay
    Delay between consecutive searches in seconds (default: 0.5)
conda_env      Name of the conda environment (default: "asa_env")

```

Value

Invisibly returns a list with the current configuration

Examples

```

## Not run:
# Increase timeout for slow connections
configure_search(timeout = 30, max_retries = 5)

# Get more results
configure_search(max_results = 20)

# Add delay between searches to avoid rate limiting
configure_search(inter_search_delay = 2.0)

## End(Not run)

```

configure_search_logging
Configure Python Search Logging Level

Description

Sets the logging level for the Python search module. This controls how much diagnostic output is produced during web searches.

Usage

```
configure_search_logging(level = "WARNING", conda_env = "asa_env")
```

Arguments

level	Log level: "DEBUG", "INFO", "WARNING" (default), "ERROR", or "CRITICAL"
conda_env	Name of the conda environment (default: "asa_env")

Details

Log levels from most to least verbose:

- DEBUG: Detailed diagnostic information for debugging
- INFO: General operational information
- WARNING: Indicates something unexpected but not an error (default)
- ERROR: Serious problems that prevented an operation
- CRITICAL: Very serious errors

Value

Invisibly returns the current logging level

Examples

```
## Not run:  
# Enable verbose debugging output  
configure_search_logging("DEBUG")  
  
# Run a search (will show detailed logs)  
result <- run_task("What is the population of Tokyo?", agent = agent)  
  
# Disable verbose output  
configure_search_logging("WARNING")  
  
## End(Not run)
```

decode_html

Decode HTML Entities

Description

Converts HTML entities to their character equivalents.

Usage

```
decode_html(x)
```

Arguments

x	Character string with HTML entities
---	-------------------------------------

Value

Decoded string

`extract_agent_results` *Extract Structured Data from Agent Traces*

Description

Parses raw agent output to extract search snippets, Wikipedia content, URLs, JSON data, and search tier information. This is the main function for post-processing agent traces.

Usage

```
extract_agent_results(raw_output)
```

Arguments

<code>raw_output</code>	Raw output string from agent invocation (the trace field from an <code>asa_response</code> object)
-------------------------	--

Value

A list with components:

- `search_snippets`: Character vector of search result content
- `search_urls`: Character vector of URLs from search results
- `wikipedia_snippets`: Character vector of Wikipedia content
- `json_data`: Extracted JSON data as a list (if present)
- `search_tiers`: Character vector of unique search tiers used (e.g., "primp", "selenium", "ddgs", "requests")

Examples

```
## Not run:
response <- run_agent("Who is the president of France?", agent)
extracted <- extract_agent_results(response$trace)
print(extracted$search_snippets)
print(extracted$search_tiers) # Shows which search tier was used

## End(Not run)
```

`extract_search_snippets`

Extract Search Snippets by Source Number

Description

Extracts content from Search tool messages in the agent trace.

Usage

```
extract_search_snippets(text)
```

Arguments

text Raw agent trace text

Value

Character vector of search snippets, ordered by source number

Examples

```
## Not run:  
snippets <- extract_search_snippets(response$trace)  
  
## End(Not run)
```

extract_search_tiers *Extract Search Tier Information*

Description

Extracts which search tier was used from the agent trace. The search module uses a multi-tier fallback system:

- primp: Fast HTTP client with browser impersonation (Tier 0)
- selenium: Headless browser for JS-rendered content (Tier 1)
- ddgs: Standard DDGS Python library (Tier 2)
- requests: Raw POST to DuckDuckGo HTML endpoint (Tier 3)

Usage

```
extract_search_tiers(text)
```

Arguments

text Raw agent trace text

Value

Character vector of unique tier names encountered (e.g., "primp", "selenium", "ddgs", "requests")

Examples

```
## Not run:  
tiers <- extract_search_tiers(response$trace)  
print(tiers) # e.g., "primp"  
  
## End(Not run)
```

extract_urls*Extract URLs by Source Number*

Description

Extracts URLs from Search tool messages in the agent trace.

Usage

```
extract_urls(text)
```

Arguments

text Raw agent trace text

Value

Character vector of URLs, ordered by source number

Examples

```
## Not run:  
urls <- extract_urls(response$trace)  
  
## End(Not run)
```

extract_wikipedia_content*Extract Wikipedia Content*

Description

Extracts content from Wikipedia tool messages in the agent trace.

Usage

```
extract_wikipedia_content(text)
```

Arguments

text Raw agent trace text

Value

Character vector of Wikipedia snippets

Examples

```
## Not run:  
wiki <- extract_wikipedia_content(response$trace)  
  
## End(Not run)
```

format_duration	<i>Format Time Duration</i>
-----------------	-----------------------------

Description

Formats a numeric duration (in minutes) as a human-readable string.

Usage

```
format_duration(minutes)
```

Arguments

minutes	Numeric duration in minutes
---------	-----------------------------

Value

Formatted string

get_agent	<i>Get the Current Agent</i>
-----------	------------------------------

Description

Returns the currently initialized agent, or NULL if not initialized.

Usage

```
get_agent()
```

Value

An asa_agent object or NULL

Examples

```
## Not run:  
agent <- get_agent()  
if (is.null(agent)) {  
  agent <- initialize_agent()  
}  
  
## End(Not run)
```

<code>get_tor_ip</code>	<i>Get External IP via Tor</i>
-------------------------	--------------------------------

Description

Retrieves the external IP address as seen through Tor proxy.

Usage

```
get_tor_ip(proxy = "socks5h://127.0.0.1:9050")
```

Arguments

<code>proxy</code>	Tor proxy URL
--------------------	---------------

Value

IP address string or NA on failure

Examples

```
## Not run:
ip <- get_tor_ip()
message("Current Tor IP: ", ip)

## End(Not run)
```

<code>initialize_agent</code>	<i>Initialize the ASA Search Agent</i>
-------------------------------	--

Description

Initializes the Python environment and creates the LangGraph agent with search tools (Wikipedia, DuckDuckGo). The agent can use multiple LLM backends and supports DeepAgent-style memory folding.

Usage

```
initialize_agent(
  backend = "openai",
  model = "gpt-4.1-mini",
  conda_env = "asa_env",
  proxy = "socks5h://127.0.0.1:9050",
  use_memory_folding = TRUE,
  memory_threshold = 4L,
  memory_keep_recent = 2L,
  rate_limit = 0.2,
  timeout = 120L,
  verbose = TRUE
)
```

Arguments

backend	LLM backend to use. One of: "openai", "groq", "xai", "exo", "openrouter"
model	Model identifier (e.g., "gpt-4.1-mini", "llama-3.3-70b-versatile")
conda_env	Name of the conda environment with Python dependencies
proxy	SOCKS5 proxy URL for Tor (default: "socks5h://127.0.0.1:9050"). Set to NULL to disable proxy.
use_memory_folding	Enable DeepAgent-style memory compression (default: TRUE)
memory_threshold	Number of messages before folding triggers (default: 4)
memory_keep_recent	Number of recent messages to preserve after folding (default: 2)
rate_limit	Requests per second for rate limiting (default: 0.2)
timeout	Request timeout in seconds (default: 120)
verbose	Print status messages (default: TRUE)

Details

The agent is created with two tools:

- Wikipedia: For looking up encyclopedic information
- DuckDuckGo Search: For web searches with a 4-tier fallback system (PRIMP -> Selenium -> DDGS library -> raw requests)

Memory folding (enabled by default) compresses older messages into a summary to manage context length in long conversations, following the DeepAgent paper.

Value

An object of class `asa_agent` containing the initialized agent and configuration.

API Keys

The following environment variables should be set based on your backend:

- OpenAI: OPENAI_API_KEY
- Groq: GROQ_API_KEY
- xAI: XAI_API_KEY
- OpenRouter: OPENROUTER_API_KEY

OpenRouter Models

When using the "openrouter" backend, model names must be in provider/model-name format.
Examples:

- "openai/gpt-4o"
- "anthropic/cllaude-3-sonnet"
- "google/gemma-2-9b-it:free"
- "meta-llama/llama-3-70b-instruct"

See <https://openrouter.ai/models> for available models.

See Also

[run_agent](#), [run_task](#)

Examples

```
## Not run:
# Initialize with OpenAI
agent <- initialize_agent(
  backend = "openai",
  model = "gpt-4.1-mini"
)

# Initialize with Groq and custom settings
agent <- initialize_agent(
  backend = "groq",
  model = "llama-3.3-70b-versatile",
  use_memory_folding = FALSE,
  proxy = NULL # No Tor proxy
)

# Initialize with OpenRouter (access to 100+ models)
agent <- initialize_agent(
  backend = "openrouter",
  model = "anthropic/clause-3-sonnet" # Note: provider/model format
)

## End(Not run)
```

is_tor_running	<i>Check if Tor is Running</i>
----------------	--------------------------------

Description

Checks if Tor is running and accessible on the default port.

Usage

```
is_tor_running(port = 9050L)
```

Arguments

port	Port number (default: 9050)
------	-----------------------------

Value

Logical indicating if Tor appears to be running

Examples

```
## Not run:  
if (!is_tor_running()) {  
  message("Start Tor with: brew services start tor")  
}  
  
## End(Not run)
```

json_escape

Clean Text for JSON Output

Description

Escapes special characters in text for safe inclusion in JSON strings.

Usage

```
json_escape(x)
```

Arguments

x	Character string to escape
---	----------------------------

Value

Escaped string

print.asa_agent

Print Method for asa_agent Objects

Description

Print Method for asa_agent Objects

Usage

```
## S3 method for class 'asa_agent'  
print(x, ...)
```

Arguments

x	An asa_agent object
...	Additional arguments (ignored)

Value

Invisibly returns the object

print.asa_enumerate_result

Print Method for asa_enumerate_result Objects

Description

Print Method for asa_enumerate_result Objects

Usage

```
## S3 method for class 'asa_enumerate_result'  
print(x, n = 6, ...)
```

Arguments

x	An asa_enumerate_result object
n	Number of data rows to preview (default: 6)
...	Additional arguments (ignored)

Value

Invisibly returns the object

print.asa_response

Print Method for asa_response Objects

Description

Print Method for asa_response Objects

Usage

```
## S3 method for class 'asa_response'  
print(x, ...)
```

Arguments

x	An asa_response object
...	Additional arguments (ignored)

Value

Invisibly returns the object

print.asa_result	<i>Print Method for asa_result Objects</i>
------------------	--

Description

Print Method for asa_result Objects

Usage

```
## S3 method for class 'asa_result'  
print(x, ...)
```

Arguments

x	An asa_result object
...	Additional arguments (ignored)

Value

Invisibly returns the object

print2	<i>Print Utility</i>
--------	----------------------

Description

Wrapper around cat for consistent output formatting.

Usage

```
print2(...)
```

Arguments

...	Arguments passed to cat
-----	-------------------------

process_outputs	<i>Process Multiple Agent Outputs</i>
-----------------	---------------------------------------

Description

Processes a data frame of raw agent outputs, extracting structured data.

Usage

```
process_outputs(df, parallel = FALSE, workers = 10L)
```

Arguments

df	Data frame with a 'raw_output' column containing agent traces
parallel	Use parallel processing
workers	Number of workers

Value

The input data frame with additional extracted columns: search_count, wiki_count, and any JSON fields found

reset_agent	<i>Reset the Agent</i>
-------------	------------------------

Description

Clears the initialized agent state, forcing reinitialization on next use. Also closes any open HTTP clients to prevent resource leaks.

Usage

```
reset_agent()
```

Value

Invisibly returns NULL

rotate_tor_circuit	<i>Rotate Tor Circuit</i>
--------------------	---------------------------

Description

Requests a new Tor circuit by restarting the Tor service.

Usage

```
rotate_tor_circuit(method = c("brew", "systemctl", "signal"), wait = 12L)
```

Arguments

method	Method to restart: "brew" (macOS), "systemctl" (Linux), or "signal"
wait	Seconds to wait for new circuit (default: 12)

Value

Invisibly returns NULL

Examples

```
## Not run:  
rotate_tor_circuit()  
  
## End(Not run)
```

run_agent	<i>Run the ASA Agent with a Custom Prompt</i>
-----------	---

Description

Invokes the search agent with an arbitrary prompt, returning the full agent trace and response. This is the low-level function for running the agent; for structured task execution, use [run_task](#).

Usage

```
run_agent(prompt, agent = NULL, recursion_limit = NULL, verbose = FALSE)
```

Arguments

prompt	The prompt to send to the agent
agent	An <code>asa_agent</code> object from initialize_agent , or NULL to use/create the default agent
recursion_limit	Maximum number of agent steps (default: 100 for memory folding, 20 otherwise)
verbose	Print status messages (default: FALSE)

Value

An object of class `asa_response` containing:

- `message`: The final response text
- `status_code`: 200 for success, 100 for error
- `raw_response`: The full Python response object
- `trace`: Full text trace of agent execution
- `elapsed_time`: Execution time in minutes
- `fold_count`: Number of memory folds (if memory folding enabled)

See Also

[initialize_agent](#), [run_task](#)

Examples

```
## Not run:
# Run with a custom prompt
agent <- initialize_agent()
result <- run_agent(
  prompt = "Who was the 44th president of the United States?",
  agent = agent
)
print(result$message)

## End(Not run)
```

run_agent_batch

Run Agent in Batch Mode

Description

Runs the agent on multiple prompts, optionally in parallel.

Usage

```
run_agent_batch(
  prompts,
  agent = NULL,
  parallel = FALSE,
  workers = 4L,
  progress = TRUE
)
```

Arguments

<code>prompts</code>	Character vector of prompts
<code>agent</code>	An <code>asa_agent</code> object
<code>parallel</code>	Use parallel processing (requires <code>future.apply</code> package)
<code>workers</code>	Number of parallel workers (default: 4)
<code>progress</code>	Show progress bar (default: TRUE)

Value

A list of asa_response objects

Examples

```
## Not run:  
prompts <- c(  
  "What is the population of Tokyo?",  
  "What is the population of New York?"  
)  
results <- run_agent_batch(prompts, agent)  
  
## End(Not run)
```

run_task*Run a Structured Task with the Agent*

Description

Executes a research task using the AI search agent with a structured prompt and returns parsed results.

Usage

```
run_task(prompt, output_format = "text", agent = NULL, verbose = FALSE)
```

Arguments

<code>prompt</code>	The task prompt or question for the agent to research
<code>output_format</code>	Expected output format. One of: "text" (raw response), "json" (parse as JSON), or a character vector of field names to extract
<code>agent</code>	An asa_agent object from initialize_agent , or NULL to use the currently initialized agent
<code>verbose</code>	Print progress messages (default: FALSE)

Details

This function provides a high-level interface for running research tasks. For simple text responses, use `output_format = "text"`. For structured outputs, use `output_format = "json"` or specify field names to extract.

Value

An object of class asa_result with components:

- `prompt`: The original prompt
- `message`: The agent's response text
- `parsed`: Parsed output (if `output_format` specified)
- `raw_output`: Full agent trace
- `elapsed_time`: Execution time in minutes
- `status`: "success" or "error"

See Also

[initialize_agent](#), [run_agent](#), [run_task_batch](#)

Examples

```
## Not run:
# Initialize agent first
agent <- initialize_agent(backend = "openai", model = "gpt-4.1-mini")

# Simple text query
result <- run_task(
  prompt = "What is the capital of France?",
  output_format = "text",
  agent = agent
)
print(result$message)

# JSON structured output
result <- run_task(
  prompt = "Find information about Albert Einstein and return JSON with
            fields: birth_year, death_year, nationality, field_of_study",
  output_format = "json",
  agent = agent
)
print(result$parsed)

## End(Not run)
```

run_task_batch

Run Multiple Tasks in Batch

Description

Executes multiple research tasks, optionally in parallel.

Usage

```
run_task_batch(
  prompts,
  output_format = "text",
  agent = NULL,
  parallel = FALSE,
  workers = 4L,
  progress = TRUE
)
```

Arguments

- | | |
|----------------------------|--|
| <code>prompts</code> | Character vector of task prompts, or a data frame with a 'prompt' column |
| <code>output_format</code> | Expected output format (applies to all tasks) |
| <code>agent</code> | An asa_agent object |

parallel	Use parallel processing
workers	Number of parallel workers
progress	Show progress messages

Value

A list of asa_result objects, or if prompts was a data frame, the data frame with result columns added

Examples

```
## Not run:  
prompts <- c(  
  "What is the population of Tokyo?",  
  "What is the population of New York?",  
  "What is the population of London?"  
)  
results <- run_task_batch(prompts, agent = agent)  
  
## End(Not run)
```

safe_json_parse *Safe JSON Parse*

Description

Attempts to parse JSON, returning NULL on failure.

Usage

```
safe_json_parse(x)
```

Arguments

x	JSON string
---	-------------

Value

Parsed R object or NULL

summary.asa_agent *Summary Method for asa_agent Objects*

Description

Summary Method for asa_agent Objects

Usage

```
## S3 method for class 'asa_agent'  
summary(object, ...)
```

Arguments

object	An asa_agent object
...	Additional arguments (ignored)

Value

Invisibly returns a summary list

summary.asa_enumerate_result
 Summary Method for asa_enumerate_result Objects

Description

Summary Method for asa_enumerate_result Objects

Usage

```
## S3 method for class 'asa_enumerate_result'  
summary(object, ...)
```

Arguments

object	An asa_enumerate_result object
...	Additional arguments (ignored)

Value

Invisibly returns a summary list

summary.asa_response *Summary Method for asa_response Objects*

Description

Summary Method for asa_response Objects

Usage

```
## S3 method for class 'asa_response'  
summary(object, show_trace = FALSE, ...)
```

Arguments

object	An asa_response object
show_trace	Include full trace in output
...	Additional arguments (ignored)

Value

Invisibly returns a summary list

summary.asa_result *Summary Method for asa_result Objects*

Description

Summary Method for asa_result Objects

Usage

```
## S3 method for class 'asa_result'  
summary(object, ...)
```

Arguments

object	An asa_result object
...	Additional arguments (ignored)

Value

Invisibly returns a summary list

truncate_string	<i>Truncate String</i>
-----------------	------------------------

Description

Truncates a string to a maximum length, adding ellipsis if truncated.

Usage

```
truncate_string(x, max_length = 100, ellipsis = "...")
```

Arguments

x	Character string
max_length	Maximum length
ellipsis	String to append when truncated

Value

Truncated string

write_csv.asa_enumerate_result	<i>Write asa_enumerate_result to CSV</i>
--------------------------------	--

Description

Write asa_enumerate_result to CSV

Usage

```
write_csv.asa_enumerate_result(x, file, include_provenance = FALSE, ...)
```

Arguments

x	An asa_enumerate_result object
file	Path to output CSV file
include_provenance	Include provenance as additional columns
...	Additional arguments passed to write.csv

Value

Invisibly returns the file path

Index

* **internal**

- .build_trace, 4
- .close_http_clients, 5
- .create_agent, 5
- .create_http_clients, 6
- .create_llm, 6
- .create_research_config, 7
- .create_research_graph, 7
- .create_tools, 7
- .extract_fields, 8
- .extract_json_from_trace, 8
- .extract_json_object, 8
- .extract_response_text, 9
- .get_exdata_path, 9
- .get_local_ip, 9
- .get_python_path, 10
- .handle_response_issues, 10
- .import_python_packages, 10
- .import_research_modules, 10
- .invoke_memory_folding_agent, 11
- .invoke_standard_agent, 11
- .is_initialized, 11
- .normalize_schema, 11
- .parse_json_response, 12
- .process_research_results, 12
- .resume_research, 12
- .run_research, 12
- .run_research_with_progress, 13
- .save_checkpoint, 13
- .stop_validation, 13
- .validate_asa_agent, 14
- .validate_asa_response, 14
- .validate_asa_result, 14
- .validate_build_backend, 15
- .validate_build_prompt, 15
- .validate_choice, 15
- .validate_conda_env, 16
- .validate_configure_search, 16
- .validate_consistency, 17
- .validate_dataframe, 17
- .validate_initialize_agent, 18
- .validate_logical, 18
- .validate_positive, 19
- .validate_process_outputs, 19
- .validate_proxy_url, 19
- .validate_range, 20
- .validate_required, 20
- .validate_research_inputs, 21
- .validate_run_agent, 21
- .validate_run_task, 21
- .validate_run_task_batch, 22
- .validate_s3_class, 22
- .validate_string, 23
- .validate_string_vector, 23
- asa-package, 3
- clean_whitespace, 33
- decode_html, 35
- format_duration, 39
- json_escape, 43
- print2, 45
- safe_json_parse, 51
- truncate_string, 54
- .build_trace, 4
- .close_http_clients, 5
- .create_agent, 5
- .create_http_clients, 6
- .create_llm, 6
- .create_research_config, 7
- .create_research_graph, 7
- .create_tools, 7
- .extract_fields, 8
- .extract_json_from_trace, 8
- .extract_json_object, 8
- .extract_response_text, 9
- .get_exdata_path, 9
- .get_local_ip, 9
- .get_python_path, 10
- .handle_response_issues, 10
- .import_python_packages, 10
- .import_research_modules, 10
- .invoke_memory_folding_agent, 11
- .invoke_standard_agent, 11
- .is_initialized, 11
- .normalize_schema, 11
- .parse_json_response, 12
- .process_research_results, 12

.resume_research, 12
 .run_research, 12
 .run_research_with_progress, 13
 .save_checkpoint, 13
 .stop_validation, 13
 .validate_asa_agent, 14
 .validate_asa_response, 14
 .validate_asa_result, 14
 .validate_build_backend, 15
 .validate_build_prompt, 15
 .validate_choice, 15
 .validate_conda_env, 16
 .validate_configure_search, 16
 .validate_consistency, 17
 .validate_dataframe, 17
 .validate_initialize_agent, 18
 .validate_logical, 18
 .validate_positive, 19
 .validate_process_outputs, 19
 .validate_proxy_url, 19
 .validate_range, 20
 .validate_required, 20
 .validate_research_inputs, 21
 .validate_run_agent, 21
 .validate_run_task, 21
 .validate_run_task_batch, 22
 .validate_s3_class, 22
 .validate_string, 23
 .validate_string_vector, 23

as.data.frame.asa_enumerate_result, 24
 as.data.frame.asa_result, 24
 asa (asa-package), 3
 asa-package, 3
 asa_agent, 25
 asa_enumerate, 25
 asa_enumerate_result, 28
 asa_response, 29
 asa_result, 30

build_backend, 4, 30
 build_prompt, 31

check_backend, 32
 clean_whitespace, 33
 configure_search, 33
 configure_search_logging, 34

decode_html, 35

extract_agent_results, 36
 extract_search_snippets, 36
 extract_search_tiers, 37

extract_urls, 38
 extract_wikipedia_content, 38

format_duration, 39

get_agent, 39
 get_tor_ip, 40

initialize_agent, 4, 27, 40, 47–50
 is_tor_running, 42

json_escape, 43

print.asa_agent, 43
 print.asa_enumerate_result, 44
 print.asa_response, 44
 print.asa_result, 45
 print2, 45
 process_outputs, 46

reset_agent, 46
 rotate_tor_circuit, 47
 run_agent, 4, 42, 47, 50
 run_agent_batch, 48
 run_task, 4, 27, 42, 47, 48, 49
 run_task_batch, 4, 50, 50

safe_json_parse, 51
 summary.asa_agent, 52
 summary.asa_enumerate_result, 52
 summary.asa_response, 53
 summary.asa_result, 53

truncate_string, 54

write_csv.asa_enumerate_result, 54