EPI architecture: Brane

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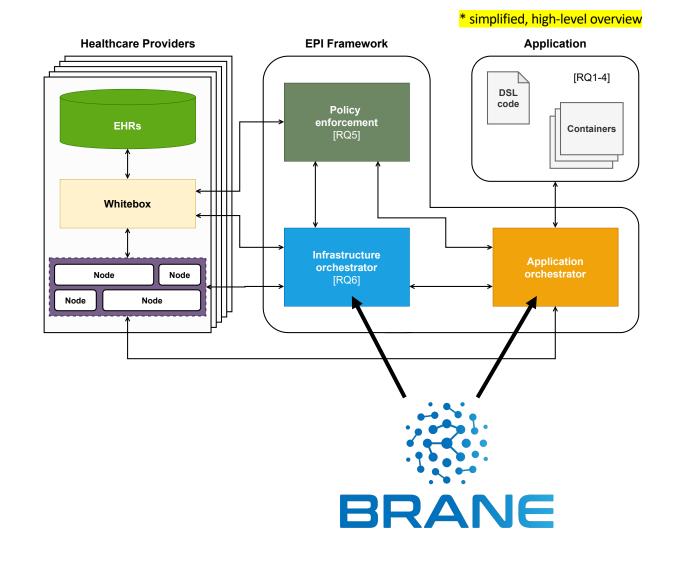


https://mns-research.nl

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Current features

1. Packaging

- Create self-contained and reusable building blocks.
- Code, Web APIs and Workflows.
- Export and import packages.
- <u>Automatically convert</u> for the container runtime on the <u>target infrastructure</u>.

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🛞 Brane			Q Search
The Brane Framework	Web AF	Pls	=
DEMONSTRATIONS	Build package	s targeting (RESTful) Web APIs.	
LOFAR	••• • • < >	e docs.brane-framework.org/package-builders/code	ۍ 🗘 🛞 🕹
GETTING STARTED	Brane		Q Search
Installation			
Testbed	The Brane Framework	Code	=
Quickstart		Build packages based on arbitrary code.	=
	DEMONSTRATIONS	build packages based on arbitrary code.	
PROGRAMMING			
Bakery	GETTING STARTED	To build a package based on arbitrary code, you must explicitly can execute the code. The configuration file needs to be in the	
BraneScript	Installation Testbed	on this page, and is conventionally called container.yml . The container.yml and con	
	Quickstart >		
PACKAGE BUILDERS		<pre>\$ brane build container.yml</pre>	۵ ا
Code	PROGRAMMING		
Web APIs	Bakery BraneScript		
Workflows		Specification ∂	
	PACKAGE BUILDERS	Brane's specification to explicitly describe arbitrary code is cal	led explicit container usage (ECU).
	Code Web APIs	The following sections document the properties of an ECU do	cument.
	Workflows	Root-level	
		These root-level fields are for metadata and package-wide opt	ions.
		Field Required Description	
		name Yes Will be used as the name	e of the package.
		version Yes Will be used as the versi	on of the package.
		description No Will be used as the desc	ription of the package.
		kind Yes Specifies the kind of page	skage.
		base No Sets the image base for	the package.
		contributors No Lists the contributors to	this package.
		environment No Lists the environment va	riables for this package.
		dependencies No Lists the system dependence	lencies for this package.
		files No Lists the files that need	to be included in this package.
-			
Powered by GitBook	Powered by GitBook	Urrently, there is only one kind of package: compute.	

Current features

2. Composition

• Two DSLs for different users, <u>BraneScript</u> for multi-site:

<pre>// Brings the relevant functions into scope import distributed_dl;</pre>
<pre>let world_size := 3;</pre>
<pre>on "node1" { // The master service is running on node 1 let master := startMaster(world_size); master.waitUntilStarted();</pre>
<pre>// After the master service is ready, workers // are started, in parallel, on nodes 2 and 3 parallel [on "node2" { let wl := startWorker(world_size, 1, master.address);</pre>
<pre>w1.waitUntilDone(); }, on "node3" { let w2 := startWorker(world_size, 2, master.address);</pre>
<pre>w2.waitUntilDone(); }];</pre>
<pre>// Let the application run until completion master.waitUntilDone(); }</pre>

Brane		Q Search
The Brane Framework	Brane	Script =
DEMONSTRATIONS	A C-like pro	gramming language with advanced multi-site constructs.
LOFAR	••• • • < >	🗊 🖻 🔒 docs.brane-framework.org/programming/bakery Č 🕚 🖞
GETTING STARTED	Brane	Q Search
Testbed	The Brane Framework	Bakery
Quickstart	DEMONSTRATIONS	An intuitive domain-specific language for end-users.
PROGRAMMING	LOFAR	
Bakery	GETTING STARTED	Bakery is a high-level DSL for writing scientific applications. It has been designed such that Bakery code is intuitive to write and easy to reason about . This is beneficial for maintainability, but also makes Bakery
BraneScript	Installation	accessible for users with limited programming experience. The two main features of Bakery are its type safety and sentence-like statements.
PACKAGE BUILDERS	Quickstart >	sarety and semence-like statements.
Code	PROGRAMMING	Type safety ⊘
Web APIs	Bakery BraneScript	All variables must have an associated type. Based on these types, the Bakery type system is able to
Workflows	PACKAGE BUILDERS	identify type errors early during development. For instance: passing text to a function when a number is expected. This prevents certain errors during runtime and improves the development productivity.
	Code	Bakery has six built-in types , arrays, and supports custom types, i.e. objects:
	Web APIs	Type Description
	Workflows	Boolean represents logical true or false.
		Directory holds the location of a directory.
		File holds the location of a file.
		Integer number without a decimal part (64-bit)
		Real number with a decimal part (64-bit)
		String unicode text (UTF-8)
		The Boolean , Integer , Real , and String types have their own representations:
		<pre>1 true // boolean 2 false // boolean 3 10000 // Integer 4 10.00 // Real 5 "Sun" // String</pre>
		The Directory and File types are created as objects, where the file paths are URLs:
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Listing 4: A deep learning application in the BraneScript DSL.

Current features

3. Deployment

- <u>Locally</u>, optionally with simulated VM, HPC, Kubernetes nodes.
- <u>Single-site</u>, on a Kubernetes cluster.
- <u>Multi-site</u>, centralized installation with external compute nodes.

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Brane		Q Search	
The Brane Framework	Installa	ation	
DEMONSTRATIONS	Install depend	lencies and setup a Brane instance.	
LOFAR	••• 🗉 < >	0 🖞 docs.brane-framework.org/getting-started/testbed C 🛈 🗘	
GETTING STARTED	Brane	Q Search	
Installation			
Testbed	The Brane Framework	Testbed ≡	
Quickstart	DEMONSTRATIONS	Set up a local testbed (simulation) with a VM node, Kubernetes cluster, and a Slurm cluster.	
PROGRAMMING	LUAR		
Bakery BraneScript	GETTING STARTED	This page contains instructions on how to setup a local testbed (simulation) with three different types of compute resources: a VM node, a Kubernetes cluster, and a Slurm cluster (HPC). Each of these compute resources uses a different container runtime: Docker, container.d, and Singularity respectivly.	
	Testbed	The configuration is are added to the infra.yml and secrets.yml files (see the installation page).	
PACKAGE BUILDERS	Quickstart >	The configuration is are added to the infra.ymc and secrets.ymc files (see the installation page).	
Code	PROGRAMMING	A complete testbed configuration is available in the ./contrib/config directory.	
Web APIs	Bakery	A complete testade communication to an analysis in the typenter hap contributions.	
Workflows	BraneScript		
	PACKAGE BUILDERS	VM node	
	Code		
	Web APIs	We can use the machine where Brane is running to simulate a VM node, no additional setup is required:	
	Workflows	<pre>locations: </pre>	
		(i) This configuration is already present in the ./contrib/config/infra-local-vm.yml file.	
		Kubernetes cluster	
		To simulate a Kubernetes cluster, we make use of kind (Kubernetes in Docker). The first step is to install kind. Either by following the instructions from the kind documentation, or by using an automated script:	
Powered by GitBook		\$ make install-kind	
*	Powered by GitBook	Now we can create a new kind cluster:	

Web Service and Cloud-based Systems (MSc)

- As part of the MSc WSCB course student teams have used the Brane framework to implement various ML pipelines (Kaggle challenges)
 - <u>Result</u>: multiple resuable "community" packages on GitHub.

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Pressent Overlage Over		ription, website, or topics	Group 3's repo for the Web Services and Cloud-Based Systems course	A misbariest More nariose nara mala rate	u data utility package for Brane.
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Perfikulook use of workflow that is more consistent 21 days ago REAVE and update many consistent 21 days ago	Dataprocessor No. Bettogen put Dataprocessor is a brane package for manipulating data and using various statistical functions on this data. Think	es publiched	21 days ego mateure prediction erchestration last month brane	C README.md 105 days ago N C README.md 25 days ago N C Compilery.ml Mide oxfoloop name shake case 25 days ago	
branc, visualization, Spirite Added Ties for module (Initial commit) 25 days ago branc, visualization, Spirite Added Ties for module (Initial commit) 25 days ago deaministan Dann Vision	about packages such as Pandas and Numpy for Python. Currently only two functions are identified: Languages A function to read a cov and return one column of this cov Python. Ito	08_web_service_11.tar add the submission tars	liest month DI Readme 3 months ago	example_schema.json initial commit last month C	Contributors (a)
containerymit Minor change container version and update python script 26 days ago www.ample Addot files for module (initial contrib) 25 days ago	 A function that computes the average for each key in a dictionary. The keys are represented as a list and the values as well. 	O3_web_service_112ar add the submission turs O3_web_service_11ar update submission	3 months ago Releases 2 months ago No releases published	= ofsatuf md	SteliosRammos
requirements.txt add requirements 27 days age Languages use of workflow that is more consistent 27 days age	Installation If on Linux or MacOS first run:	READMEmd Update READMEmd Update READMEmd Migratifie fit problems with the multinode setup	25 days ago last month Packages	data-utils	andreibelos Bolos Andrei
Python 22 days ago Python 22 days ago	ched +x zur.py Otherwisether:	providson-microk8s.ah fit problems with the multinode setup fit README.md	last month No packages published	() types parage parage box to surpressed water?	Python 92.0% Maketile 0.0%
READWE.ind	brane buld container.yml brane publ dataprocessor 1.8.0	Uva.WSCBS2021	Contributors (2)	Features	
WSCBS2021 Visualization This is an example Brane package to explore data by visualization, using Matplotitic (Python package), it can group	Or install using the brane import function:	How to submit?	histm Kaliban	Currently, we only have a single feature: • Downcast data files, which makes sure that their data types per column are using the most efficient data type	
columns of CSVs and show a bar plot / pie chart of the number of occurrences. Furthermore a threshold is available to place values below a specific court, which will be merged in a group called "Others". NaN values can be dropped by setting the corresponding bookan.	brane inport lucasdepeus/braneProceesorkind ecu	Just create a text :	yəaani85	memory-wise.	
Import it as follows:	Usage average	tar czf archive.tar.gz folder_to_copy	Languages	Import directly from GitHub:	
<pre>\$ brane import dumnvinken/wecbu3921-visualization</pre>	input parameters are: • Keys: an array of keys in a dictionary	Assignment 5: Programming project (Due 4 Jun at 23:59)	Pythen 38.1% Jupyter Natabook 37.2%	brane import wars-2021/data-utils	
Platform types	 values an array that should equal the length of keys and should contain the values associated with the keys. Import dataprocessor; 	Canvas link Programming project Report	 Shell 10.4% Smarty 6.2% Java 2.2% HTML 1.6% Other 3.6% 	Requirements	
- Making - M	<pre>let key: = ("Ganda", "Canada", "United States of Americs"); let values := [100.0, 200.0, -50.0);</pre>	Presentation		• pandas • numpy	

Features in-development

Vantage6

- <u>Status</u>: working "light" integration (API calls).
- <u>Next</u>: a "deep" integration is under investigation.

• Network functions (RQ6)

- <u>Status</u>: working low-level implementation (Rust).
- <u>Next</u>: a high-level interface is under construction (Python).

Whitebox

- <u>Status</u>: gained insight in the technical operation of Whitebox.
- <u>Next</u>: adding a layer of indirection to Brane to support Whitebox.





Dissemination & adoption

• Paper submitted to the ReWorDS21 workshop (eScience 2021).

• Software development

- Best practices: https://guide.esciencecenter.nl
- Documentation and contributing guidelines.
- Continuous Integration (CI) and automated tests.
- Release cycle with long-term archiving on Zenodo.
- Publicly available on GitHub under the Apache-2.0 license.