Dru Documentation

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CHAPTER 1

What is Dru?

Dru is a platform that enables the researchers focused on the analysis of blockchain an easier start. It consists from a block engine that maintains the blocks database in sync with the blockchain of a cryptocurrency and a querying engine that offers its API to run the analyses. The results of each query are stored and are easily accessible for reducing time of reproducing them.

CHAPTER 2

Which blockchains are currently supported by Dru?

Dru is designed in such a way that each blockchain client using standard RPC calls should be supported. Nevertheless, the development and testing focused especially on Zcash, since the development process was supported by the Zcash Foundation. For details see *Funding*.

CHAPTER 3

Dru's components

Dru consists from two components: block-engine and the endpoints provider. These two together provide all the functionalities of the project, yet if you want to use the blocks database in a different manner than for network science analyses, you can only clone and use the block-engine component. However, this documentation covers the whole environment consisting from both components.

CHAPTER 4

Where would I find the sources of Dru?

Dru is an open source project and can be found here: https://github.com/bergplace/Dru. The lincense details are to be found in *Licenses* page. If you are interested in using only the block-engine (see above), its project page is located here: https://github.com/bergplace/block-engine.

CHAPTER 5

OK, I'm am insterested in using Dru, what's next?

Great! Please have a look at the *Getting started* guide.

5.1 Getting started

5.1.1 Firstly, test Dru using our instance

Before installing Dru in your environment, we highly encourage you to evaluate its capabilities using a Zcashe instance provided by us. This would help you to understand how it operares and how to query its API endpoints. To do so, visit the *Dru instance* section. But if you decided to install Dru locally, continue with the instructions provided in this section.

5.1.2 Where to install Dru?

Dru can be thought as of an engine that provides its clients with answers on blockchain-related queries. As such, it can be run on your local computer, but bear in mind that if the blockchain of a chosen cryptocurrency is large, you need to be equipped with enough hardware (especially RAM). Apart from that, some of the queries can be computationally complex, so this is another factor to consider. This is why it is suggested to have Dru installed on either a server or a workstation that is always on and has enough resources. This will create a typical client-server architecture and many researchers will have the opportunity to use Dru at the same time and gain access to already computed queries' results. Nevertheless, this is not a necessity and you can install Dru on your local computer.

5.1.3 Installing Dru

Installing docker

Dru runs in the Docker environment. Before continuing with installing Dru, please make sure that you have Docker CE and Docker Compose installed. The following guide shows how to install Docker CE: https://docs.docker.com/install/ and this one describes the installation process of Docker Compose: https://docs.docker.com/compose/install/

Cloning the repository

If you have Docker CE installed, you can proceed to cloning the Dru repository:

```
git clone https://github.com/bergplace/Dru.git
```

Note, that the Docker compose file provided by Dru has version 3.3 and as such it requires Docker in version 17.06.0 or above. For more details on compatibility, please visit this webpage: https://docs.docker.com/v17.09/compose/compose-file/

Creating the configuration

Next, use the default configuration file as a template for your Dru instance configuration:

```
cd Dru
cp dru.conf.default dru.conf
```

Then, edit the dru.conf to suite your needs according to the *Configuration* section.

5.1.4 Starting Dru

When you prepared the configuration file, you are ready to start Dru. But before have a look also at all make targets by issuing the following command:

```
make help
```

Most likely, you will want to start Dru in the following manner:

```
make start
```

It is worth to know that Dru also offers the `make test` directive that loads only first 7,000 of blocks and lets to test the whole environment without downloading the whole blockchain. All make targets are described in the *Make targets* section.

5.1.5 Using Dru

When Dru runs for the first time, it imports all blockchain blocks information into its MongoDB instance. This will take some time and you can see the progress using the following make target:

```
make logs
```

Nevertheless, as soon as some blocks are in MongoDB, you can communicate with the endpoints.

Assuming that the Dru instance is installed on your localhost, you can try to test the environment by querying the API for a block. To do so, use your REST client (e.g. web browser) and make the following query:

```
http://localhost:8000/api/get_blocks/0/0
```

This call will return a JSON object that contains the URL to the actual result (result_url). If you follow this URL, you will get another JSON that contains the status of the query in the field "status". If the results are already available, they will be in the "data" field.

If you are running Dru for Zcash, this call return the Zcash genesis block.

If everything worked well, you can continue using Dru. For the documentation of all Dru API endpoints, see *API endpoints* section. Otherwise, if you'll encounter any problems, please have a look at Dru logs by running the command `make logs`. If you won't find anything helpful, try to look for support using the *Support* section.

5.1.6 Stopping Dru

When you wish to stop Dru instance, issue the following command:

```
make stop
```

5.2 Configuration

5.2.1 Preparing the configuration file

The default configuration file of Dru is `dru.default.conf`. First, create a copy of this file and name it `dru.conf`. Below the descriptions of the configuration directives are presented.

5.2.2 Configuration directives

Below are the configuration directives with the possible values described. The first one or the only one is the default value.

Web server section

`debug=false|true`

Puts Dru in debug mode, not suitable for regular use, when dru is in debug mode it will return debug information in case of error.

`web_host=localhost|ip_address`

Which address the web server will be bound to.

`web_enable_ssl=false|true`

Should Dru also provide TLS-secured version of the API?

`web_ssl_key_path=./web/conf/placeholder.key`

Path to the private key file used for TLS. If you do not have any certificate, we recommend obtaining one from Let's Encrypt free certificates provider.

`web_ssl_cert_path=./web/conf/placeholder.cert`

Path to the certificate file used for TLS.

Data section

`mongo_dir=~/dru-data/mongo`

The path for mongo database containing blocks. Space requirements for this database depends on the size of blockchain and can be quite large.

`postgres_dir=~/dru-data/pg`

The path for Postgres database containing supplementary information for Dru.

`task_results_dir=~/dru-data/task-results/`

The path for storing the tasks' results.

`zcash_dir=~/dru-data/zcash`

The path where given cryptocurrency blockchain is stored.

`rabbit_dir=~/dru-data/rabbit`

The path for RabbitMQ-related files.

Cryptocurrency node section

For security reasons, if possible, use separate cryptocurrency client (node) for the purpose of Dru. Definitely do not use any node that has funds on its wallets.

`use_docker_zcash_node=true|false`

Should Dru use encapsulated docker node or the node installed locally?

`docker_zcash_node_test_mode=false|true`

If this option is enabled, Dru will load only 7,000 of blocks instead of the whole blockchain. Helpful for debugging.

`cryptocurrency=zcash`

Which cryptocurrency blockchain should Dru load - zcash by default, but any other cryptocurrency compliant with Bitcoin RPC should be supported.

`cryptocurrency_rpc_port=8232`

At which port the node is listening for RPC calls.

`cryptocurrency_rpc_username=user`

The RPC username to contact the node.

`cryptocurrency_rpc_password=pass`

The RPC password to contact the node.

Credentials section

`web_admin_username=admin`

The username of the web server administrator. The webserver admin portal is located at `/admin` URL.

`web_admin_password=pass`

The password of the web server administrator.

`mongo_admin_username=admin`

The Mongo server admin username.

`mongo_admin_password=pass`

The Mongo server admin password.

`mongo_readonly_username=user`

The Mongo server read-only username.

`mongo_readonly_password=pass`

The Mongo server read-only password.

`postgres_username=postgres`

The administrator username of the Postgres server.

`postgres_password=postgres`

The administrator password of the Postgres server.

Misc section

`tx_address_cache_limit=1000000`

The above directive controle the cache size for tx addresses. Higher values make initial load of data faster at the cost of memory usage.

`sendgrid_username=user`

If you want to send e-mail statuses over Sendgrid, provide its username.

`sendgrid_password=changeme`

If you want to send e-mail statuses over Sendgrid, provide its password.

5.3 Make targets

These are the most general make targets. In order to see all of them, please refer to the content of the Makefile.

```
make help
```

Shows the help message.

```
make start
```

Starts Dru in the regular production mode using `dru.default.conf` as the initial configuration file. Before starting, verify configuration settings in this file.

```
make test
```

Starts Dru in the testing mode. This includes running the Travis tests as well as importing only first 7000 blocks. For details on the test configuration, please see `dru.test.conf`.

```
make restart
```

Restarts Dru.

```
make fuzz
```

Starts the "fuzz" tests, calling multiple Dru endpoints with variety of parameters. This allows to verify whether Dru's endpoints are working properly. Before starting, please make sure that the `URL` directive in `test/fuzz.py` points to the right server.

```
make html
```

Generates the webpages (index, mail registration etc.).

In order to see some more detailed targets that build the ones described above, have a look at `Makefile` content itself.

5.4 API endpoints

```
def get_blocks(start_height, end_height)
```

Returns the list of blocks for a given range of blocks' heights. The returned JSON can be used for further processing if none of the endpoints is suitable for performing the requested analysis. Note that this endpoint returns whole blocks, no attributes are stripped.

```
def get_blocks_reduced(start_height, end_height)
```

Returns the list of blocks for a given range of blocks' heights, yet with limited fields.

The returned fields are the following:

- height
- time
- transaction id
- input addresses (or coinbase)
- output addresses
- value

As such, this is a limited version of `get_blocks` endpoint.

The returned JSON can be used for further processing if none of the endpoints is suitable for performing the requested analysis.

```
def get_edges(start_height, end_height)
```

Returns the list of edges blocks for a given range of blocks' heights. These edges can be easily imported into graph-processing libraries.

Fields returned:

- source address
- destination address
- value of the transactions
- block height
- block time

```
def get_degree(start_height, end_height, mode)
```

Returns the list of addresses and the value of degree corresponding to them.

The graph is created from the blocks in the range [start_height, end_height].

The graph will be built as directed, but using mode all variants of the measure can be computed:

- all - total degree of the node

- in - in-degree of the node
- out - out-degree

```
def get_degree_by_block(start_height, end_height, address, mode)
```

Returns the list of addresses and the value of degree corresponding to them. The graph is created from the blocks in the range [start_height, end_height]. This variant computes the degree in each block separately. The graph will be built as directed, but using mode all variants of the measure can be computed:

- all - total degree of the node
- in - in-degree of the node
- out - out-degree

```
def get_degree_max(start_height, end_height, mode)
```

Returns the list of addresses and the value of degree corresponding to them. The graph is created from the blocks in the range [start_height, end_height]. The graph will be built as directed, but using mode all variants of the measure can be computed:

- all - total degree of the node
- in - in-degree of the node
- out - out-degree

```
def get_betweenness(start_height, end_height, directed)
```

Returns the list of addresses and the value of betweenness corresponding to them. The graph is created from the blocks in the range [start_height, end_height]. The graph can be built either as directed or undirected. Note: as all shortest paths have to be computed, this operation is time-consuming. Use with care.

```
def get_betweenness_max(start_height, end_height, directed)
```

Returns the address and the value of betwenneess in the graph created The graph is created from the from the blocks in the range [start_height, end_height]. The graph can be built either as directed or undirected. Note: as all shortest paths have to be computed, this operation is time-consuming. Use with care.

```
def get_closeness(start_height, end_height, directed)
```

Returns the list of addresses and the value of closeness corresponding to them. The graph is created from the from the blocks in the range [start_height, end_height]. The graph can be built either as directed or undirected.

```
def get_closeness_max(start_height, end_height, directed)
```

Returns the address and the value of the closeness in the graph. The graph is created from the from the blocks in the range [start_height, end_height]. The graph can be built either as directed or undirected.

```
def get_transitivity(start_height, end_height)
```

Returns the nodes' clustering coefficient in the graph. The graph is created from the blocks in the range [start_height, end_height] For global clustering coefficient value, use for get_transitivity_global.

```
def get_transitivity_global(start_height, end_height)
```

Returns the clustering coefficient of the graph created from the blocks in the range [start_height, end_height]. This value is global for the graph. For node-level clustering coefficient, use get_transitivity.

```
def get_diameter(start_height, end_height, directed)
```

Returns the diameter of the graph created from the blocks in the range [start_height, end_height]. The graph can be considered as directed or undirected.

```
def get_density(start_height, end_height, directed, loops)
```

Returns the density of the graph created from the blocks in the range [start_height, end_height]. The graph can be considered as directed or undirected.

```
def are_connected(start_height, end_height, address1, address2, directed)
```

Returns true/false information whether two addresses are connected within a given range of blocks. If any of these addresses does not exist in the graph, None will be returned.

```
def get_transactions_value(start_height, end_height, address1, address2)
```

Returns the count and total value of transactions between two addresses in the graph. The graph is created from the blocks in the range [start_height, end_height]. If any of these addresses does not exist in the graph, None will be returned.

```
def get_zcash_tx_types_count(start_height, end_height):
```

The returned dictionary contains the blocks' heights accompanied by the following: block time and number of shielded-shielded, shielded-transaparent, transparent-shielded, transparent-transparent transactions. For details on transactions' types, see: https://z.cash/technology/

5.5 Dru instance

Thanks to the support of Zcash Foundation. we host an instance of Dru synced with Zcash blockchain.

It is available until withdrawing (not earlier than 2021-12-31) at the following addresses:

SSL-enabled, recommended:

https://dru.bergplace.org

non-SSL, not recommended:

http://dru.bergplace.org

For instance, if you want to test the API, you might be willing to get the edges of the first 11 blocks of Zcash blockchain:

https://dru.bergplace.org/api/get_edges/0/10

For more details on available endpoints, see *API endpoints*.

In case of any problems, please look for *Support*.

5.6 Changelog

5.6.1 Unreleased

Added:

- wait-for-it.sh script to celery & web containers for waiting for postgres to start
- endpoint get_zcash_tx_types_count for counting transparent/shielded transactions

Changed:

- update python-igraph to version 0.8.0
- update psycopg2 to psycopg2-binary and bump from 2.7.7 to 2.8.4
- update fuzz test URL to localhost to not to hit the demo instance
- reduce fuzz test intensity

Fixed:

- fix endpoints computing transivitity, now they work only with simplified undirected graphs

5.6.2 1.0.0 - 2019-08-19

First public release.

5.7 Source code

The source code of the Dru project is available at the GutHub repository: https://github.com/bergplace/Dru

The licenses of the software are described here: *Licenses*.

If you are interested in collaboration regarding the project, just *Contact us*.

5.8 Authors

Dru is being actively developed by BERG - Blockchain Exploration Research Group.

5.8.1 Project manager

Radosław Michalski

5.8.2 Core developers

The core developers of the project are the following:

Marcin Pieczka

Radosław Michalski

Wojciech Puchta

Weronika Mrugała

5.8.3 Your contribution?

If you want to work on the project, feel free to do so by contributing to the Dru repository: https://github.com/bergplace/Dru. If you think of some long-term commitment, please *Contact us*.

5.9 Funding

The development of Dru in years 2018 and 2019 has been funded by the Zcash Foundation. within the Zcash Foundation Grant Programme. This also applies to one year hosting of a *Dru instance*.

5.10 Licenses

Dru is licensed with GNU GPL v3 and the block-engine is licensed with MIT license. The text of both is provided below.

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5.11.1 Github issues

If you believe the Dru code has some flaws, the easiest way is to let us know is to create an issue in the Dru repository: https://github.com/bergplace/Dru/issues

5.11.2 E-mail

Another option is contacting us by email.

5.11.3 IRC

You can also reach us using IRC at Freenode (channels #dru or #bergplace).

5.12 Contact us

The project is maintained by BERG - Blockchain Exploration Research Group.

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