

PW-pipeline

PathWay pipeline using GWAS summary statistics, named analogously after FM-pipeline I have implemented.

INTRODUCTION

Pathway analysis becomes an important element in GWAS. Broadly, it involves SNP annotation, such as Variant Effect Predictor (VEP), gene analysis such as VEGAS2, and gene set analysis. Visualisation of a particular region has been facilitated with LocusZoom, while network(s) from pathway analysis via [gephi](#) or [Cytoscape](#), which uses genes and a collection of edges, directed or undirected, to build a network. Aspects to consider include part or all databases, individual level genotype data vs GWAS summary statistics, computing speed, with and without tissue enrichment.



diagram from Cytoscape/GeneMANIA

INSTALLATION

This pipeline involves several software for pathway analysis using GWAS summary statistics, as shown below,

Full name

Meta-Analysis Gene-set Enrichment of variant Associations

Multi-marker Analysis of GenoMic Annotation

Abbreviation

MAGENTA

MAGMA

Reference

Segre, et al. (2010)

de Leeuw, et al. (2015)

Pathway SCoring Algorithm	PASCAL	Lamparter, et al. (2016)
Data-Driven Expression Prioritized Integration for Complex Traits	DEPICT	Pers, et al.(2015)

The full functionality of the pipeline requires availability of individual software for pathway analysis, which should fulfil their requirements, e.g., [Matlab](#) for MAGENTA, PLINK. It is useful to install [XpdfReader](#) or [ImageMagick](#) to produce Excel workbook. By default [Sun grid engine](#) is used but this can be any other mechanism such as [GNU parallel](#) [note with its `--env` to pass environment variables]. As usual, [R](#) is required.

The pipeline itself can be installed from GitHub in the usual way.

```
git clone https://github.com/jinghuazhao/PW-pipeline
```

USAGE

The pipeline requires users to specify both software and database to be used. It is possible that a given database can be used for several software when appropriate. The beginning of the main program, [pwp.sh](#), is as follows,

```
## software flags: 1=enable
# DEPICT
export depict=1
export number_of_threads=5
export p_threshold=0.00000005
export nr_repitions=200
export cutoff_type=fdr
export pvalue_cutoff=0.00001
# MAGENTA
export magenta=0
export min_gs_size=5
export max_gs_size=2000
# MAGMA
export magma=0
# PASCAL
export pascal=0

## database (magenta, c2, msigdb, depict_discretized, depict), multiple
precision, result collection
export _db=depict
export mp=0
export collection_only=0

## Environmental variables
export PW_location=/genetics/bin/PW-pipeline
export MAGENTA=/genetics/bin/MAGENTA_software_package_vs2_July2011
export MAGMA=/genetics/bin/MAGMA
export PASCAL=/genetics/bin/PASCAL
export DEPICT=/genetics/bin/depict/src/python
```

```

export PLINK_EXECUTABLE=/genetics/bin/plink-1.9

export MSigDB=/genetics/src/MSigDB/msigdb_v6.0_GMTs
export c2_db=$MSigDB/c2.all.v6.0.entrez.gmt
export msigdb_db=$MSigDB/msigdb.v6.0.entrez.gmt
export
depict_discretized=$PASCAL/resources/genesets/depict_discretized_cutoff3.2.gmt

export R_LIBS=/genetics/bin/R:/usr/local/lib64/R/library
export
LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/usr/local/lib64/R/lib:/genetics/data/software/lib
export
PATH=/genetics/bin/anaconda2/bin:/genetics/bin:/usr/local/bin:$PATH:/genetics/data/software/bin
export PYTHONPATH=/genetics/bin/anaconda2/lib/python2.7/site-packages:$PYTHONPATH

```

The syntax is

```
bash pwp.sh <input file>
```

Input

The input will be GWAS summary statistics described at <https://github.com/jinghuazhao/SUMSTATS> **in that order without the header**,

Output

The output will be available from individual directories named after the software you choose, and optionally in case all software are used the output can also be an Excel workbook containing combined results.

For DEPICT databases, it is possible to call [netowrk_plot.py](#) to generate network diagram and perform cluster analysis.

EXAMPLES

The `bmi.txt` and `ST4` from <https://github.com/jinghuazhao/SUMSTATS> can be called as follows,

```
pwp.sh bmi.txt
```

and

```
pwp.sh ST4 &
```

ADDITIONAL TOPICS

The [wiki page](#) contains the following information,

- [Databases](#)
- [Features](#)
- [Tissue and network plots](#)
- [Result collection](#)

You can make changes to the configuration files for each software in their own directories. See also [software-notes](#) on how to set up VEGAS2, as in [vegas2v2.sh](#).

RELATED LINKS

- [BioGRID](#): an interaction repository with data compiled through comprehensive curation efforts.
- [Osprey](#): Network Visualization System.
- [GeneMANIA](#): Imports interaction networks from public databases from a list of genes with their annotations and putative functions.
- [rGREAT](#): Client for GREAT Analysis
- [VisANT](#): Visual analyses of metabolic networks in cells and ecosystems.

ACKNOWLEDGEMENTS

The work drives from comparison of software performances using our own GWAS data. The practicality of a common DEPICT database to all software here was due to PASCAL developer(s). At the end of our implementation it came to our attention that similar effort has been made, e.g., [DEPICT-pipeline](#) and other adaptations.

SOFTWARE AND REFERENCES

DEPICT ([GitHub](#))

Pers TH et al.(2015) Biological interpretation of genome-wide association studies using predicted gene functions. Nat Commun. 6:5890. doi: 10.1038/ncomms6890.

MAGENTA

Segre AV, et al (2010). Common Inherited Variation in Mitochondrial Genes Is Not Enriched for Associations with Type 2 Diabetes or Related Glycemic Traits. PLoS Genet. 12;6(8). pii: e1001058. doi: 10.1371/journal.pgen.1001058

MAGMA

de Leeuw C, et al. (2015) MAGMA: Generalized Gene-Set Analysis of GWAS Data. PLoS Comput Biol. 11(4): e1004219. doi: 10.1371/journal.pcbi.1004219

PASCAL ([GitHub](#))

Lamparter D, et al. (2016) Fast and Rigorous Computation of Gene and Pathway Scores from SNP-Based Summary Statistics. PLoS Comput Biol. 2016 Jan 25;12(1):e1004714. doi: 10.1371/journal.pcbi.1004714

VEGAS2 (Versatile Gene-based Association Study)

Liu JZ, et al. (2010). A versatile gene-based test for genome-wide association studies. *Am J Hum Genet* 87:139–145.