eulerAPE

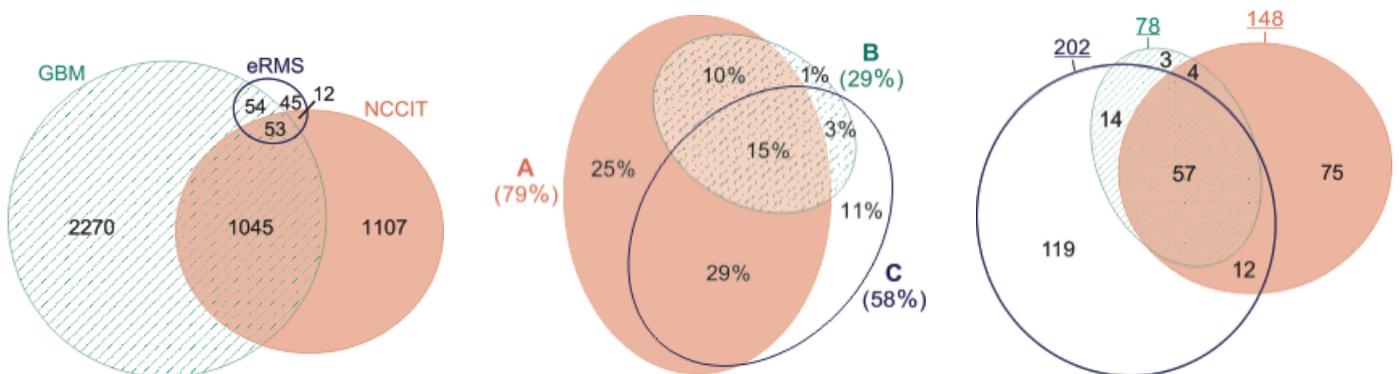## Drawing Area-Proportional Euler and Venn Diagrams using Ellipses

This is the first automatic area-proportional Euler diagram drawing tool that uses ellipses. It generates an exact diagram for most of the cases, and when it fails, the best diagram obtained through the hill climbing search is displayed, together with the inaccuracy values for each region. Formal evaluation demonstrates that in contrast to various methods that use either circle or polygons, accurate and intuitive Venn diagrams can be drawn for most random 3-set data using ellipses, which like circles are smooth and have good continuity. Other formal evaluation is being carried out to investigate how well it can handle data sets with regions whose area has to be zero. More work is being carried out to improve the design and features of future releases. Thus, any feedback is greatly appreciated. It is currently restricted to three curves, but later on, it will be extended to handle more curves. Please acknowledge *eulerAPE* whenever used.

eulerAPE for real-world data: *click on the image to view the diagram published in the journal article that discussed this real-world data*

New improved version: eulerAPE v3

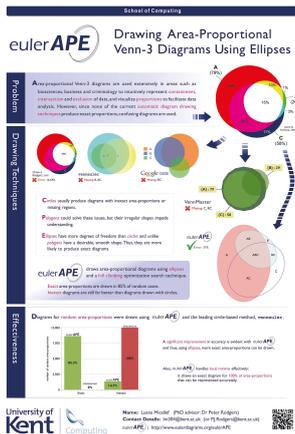This page is dedicated to the latest version, eulerAPE v3. Previous versions are available at: v2, v1.

The drawing algorithm of eulerAPE v3 has been improved. Minor changes to the interface have been made.

As in eulerAPE v2,

- diagrams can be exported in png and svg formats
  or in eld format to reveal the properties of the ellipses in the diagram,
- black and white images of the generated diagrams can be produced,
- region areas saved in a file (.els) or computed from a diagram in a file (.eld) can be loaded.

Also, eulerAPE v3 is:

- locale-independent,
- support command-line execution,
- fully tested on both Windows and Mac OS X.

The Pacific Northwest National Laboratory (PNNL) mentions euler*APE* on their Venn Diagram Plotter webpage, as an improved method for drawing area-proportional Venn diagrams with three curves.

Currently, euler*APE* is being used for various application areas, such as health, medicine, bioinformatics, proteomics, genomics, biophysics, life sciences, brain and mind sciences, statistics, marketing, classification and database queries.

euler*APE* v2 was selected for participation in the ACM Student Research Competition (SRC) at the 2012 Grace Hopper Celebration (poster to the left).

Contents

- Downloads
- Getting Started
- Running euler*APE*: *in 3 steps*
- Running euler*APE*: *reference guide*
- Running euler*APE*: *from the command-line*
- Licensing Terms
- Other Drawing Tools – *you might be interested in*

Downloads

file	executable / source	comments	date
eulerAPE_3.0.0.jar	executable	the executable to run euler*APE* v3.0.0 on Windows or Mac OS X (not tested on other operating systems)	Nov 18, 2013
eulerAPE_3.0.0_src.zip	source	the source code for euler*APE* v3.0.0	Nov 18, 2013

Ideal screen resolution: 1290 × 740 or better

NOTE: when you download any of these files, you are agreeing to euler*APE*'s Licensing Terms
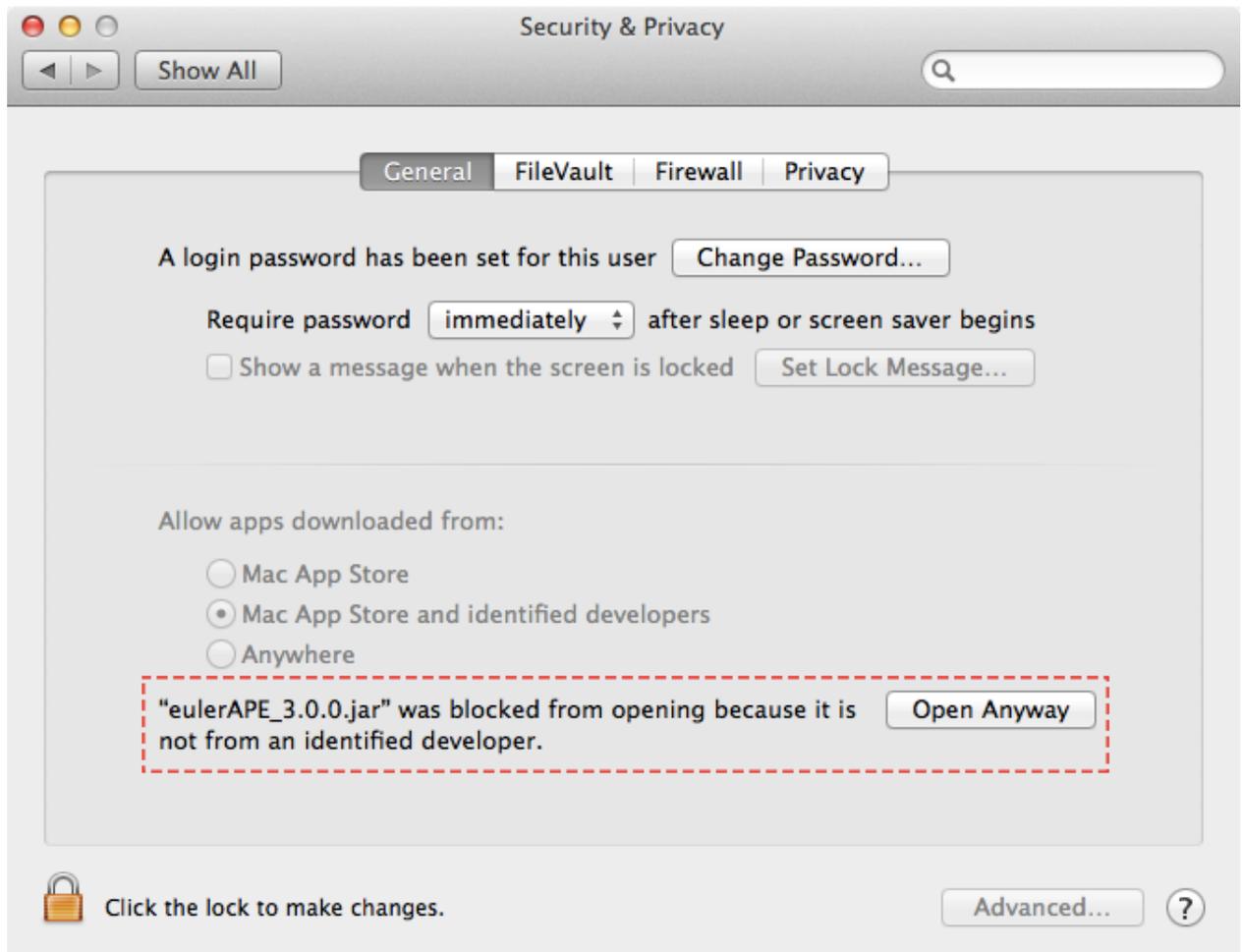
Getting Started

1. Download and install Java version 6.0 or greater. on your machine.
2. Download eulerAPE_3.0.0.jar.
3. Double click on the downloaded eulerAPE_3.0.0.jar to run euler*APE*.

Running on Mac OS X and getting the following message?

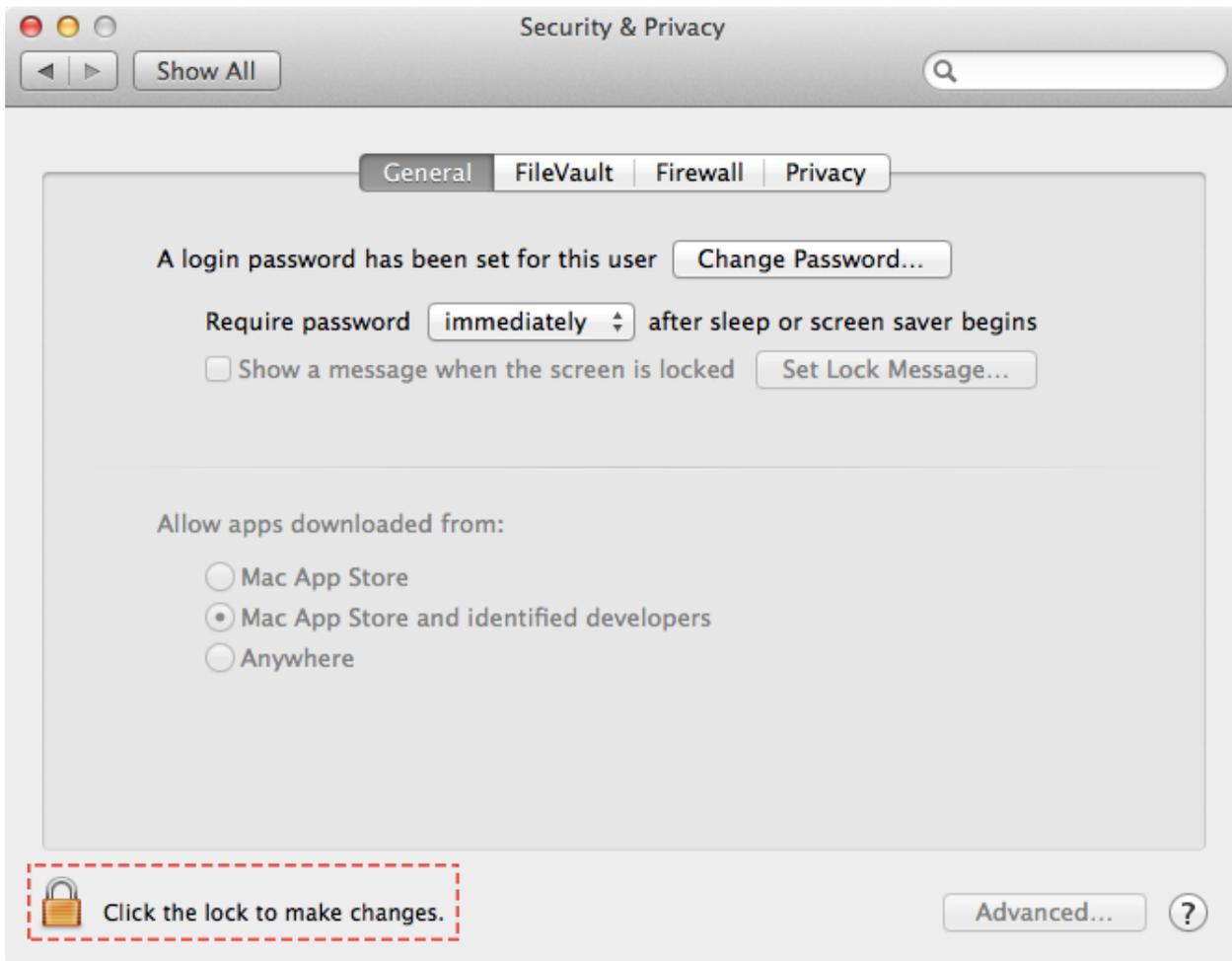Open **System Preferences** and go to **Security & Preferences**.

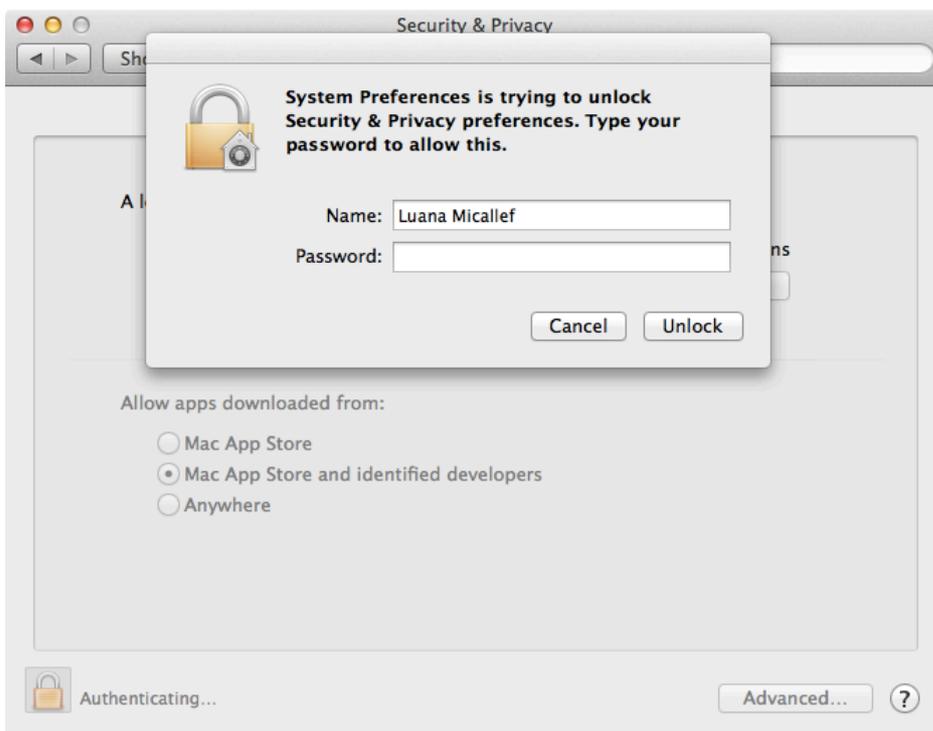If you get a message like the one in the red, dashed box below

click on **Open Anyway** and then click on **Open** when you get the following.
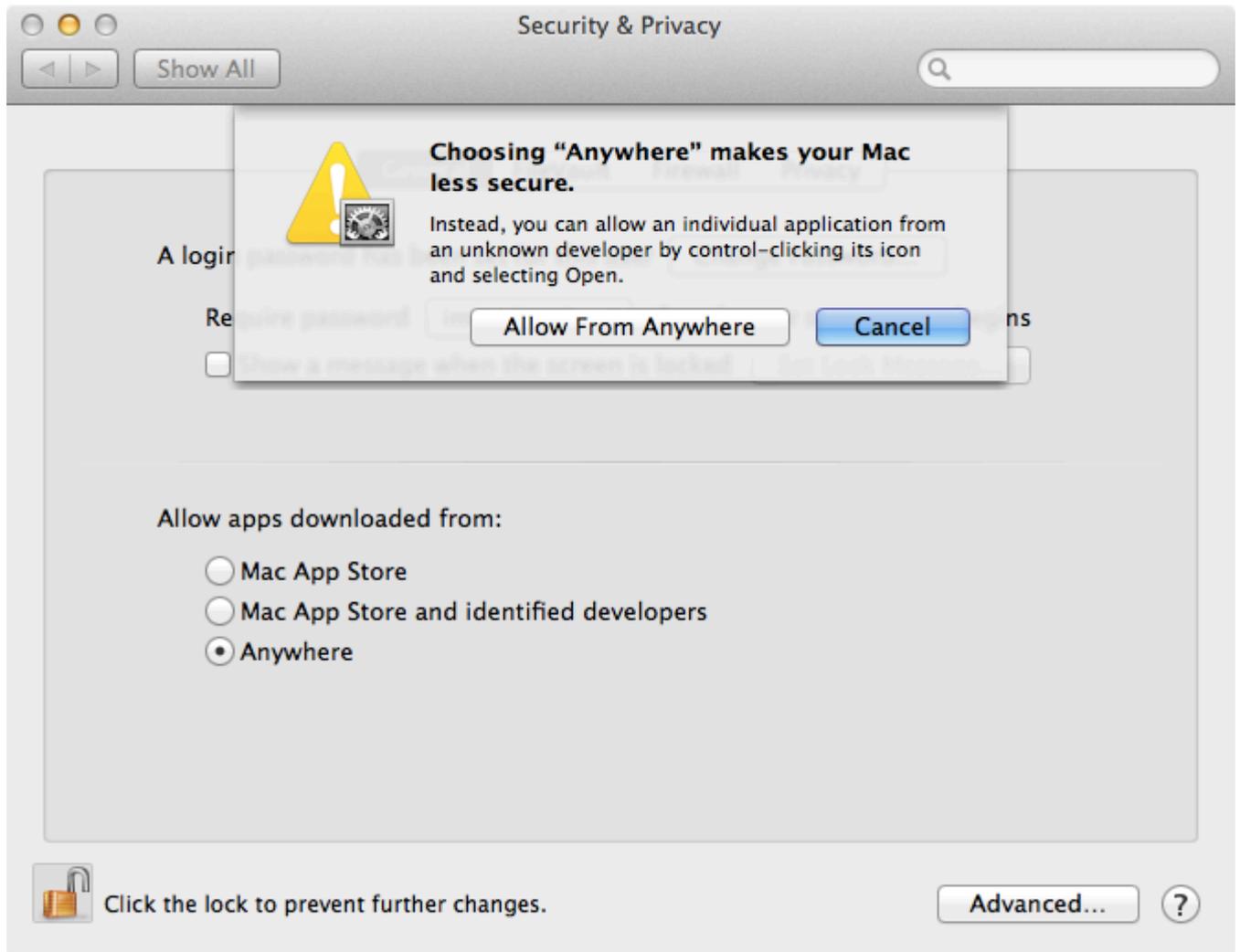
Else, click on the lock in the bottom left corner, marked with a red, dashed box below

enter your Mac OS X account password

select **Anywhere** for *Allow apps downloaded from* and click on **Allow From Anywhere** when the warning message appears.

Finally click on the lock in the bottom left corner, close the **Security & Preferences** window, and try to run *eulerAPE* by double clicking on the downloaded eulerAPE_3.0.0.jar.

If you get the follow message box, click **Open** to run *eulerAPE*.

Running euler*APE*: *in 3 steps*

* the image below illustrates interface when run on Windows

Running euler*APE*: *reference guide*

* the images below illustrate interface when run on Windows and when the system locale is set to English

When euler*APE* starts, such a window opens:

To draw an area-proportional diagram, enter the area of every region or click on the **random** button to generate random region areas from a uniform distribution in the interval [1, 10000].
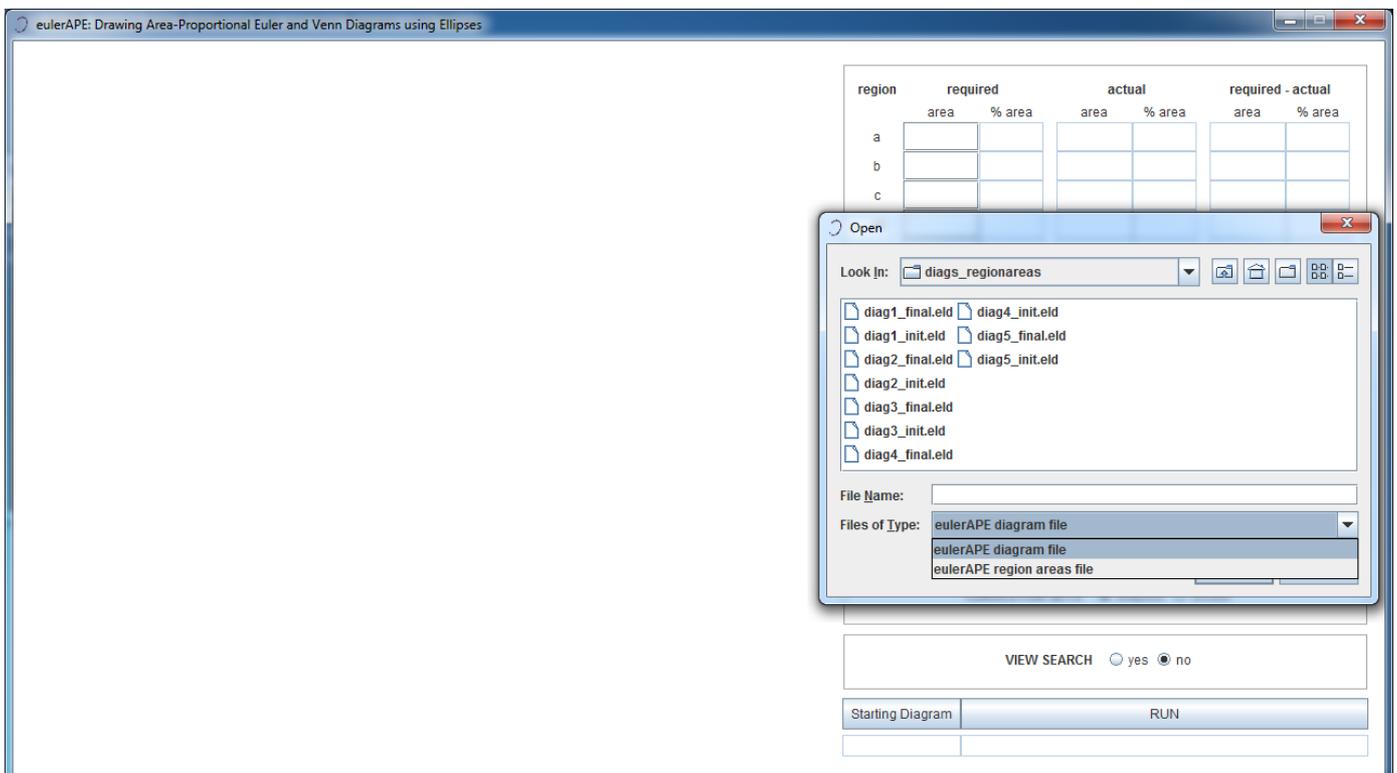

Alternatively, click on the **load** button and select a **.els** file ('*eulerAPE* region areas' file) or a **.eld** file ('*eulerAPE* diagram' file).

An **euler*APE* region areas** file with extension **.els**, such as [this example](#) (use a text editor to open or edit the file), defines the region areas to be loaded as follows:

```
//a | b | c | ab | ac | bc | abc
6416.46 | 3097.123 | 7012.0 | 1742.5 | 9634.67 | 267.0 | 7163.0
```
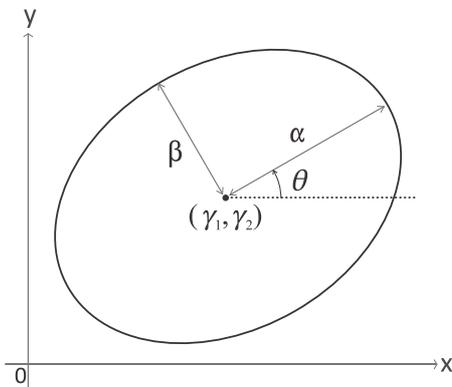
An **euler*APE* diagram** file with extension **.eld**, such as [this example](#) (use a text editor to open or edit the file), defines the properties of the ellipses in the diagram as follows:

```
DIAGRAM

ABSTRACTDESCRIPTION
0 a b c ab ac bc abc

ELLIPSES - label | semi-major axis | semi-minor axis | centre - x | centre - y | rotation |
a|52.0770762121543|57.12818461089164|2.891387939453125|0.003662109375|307.1356201171875|
b|42.17083337286026|34.68449741129755|12.592274634627673|34.713064198564346|74.014892578125|
c|48.55774377211602|59.11052662064727|27.344059440869614|-8.125|0.9979248046875|
```


The **label**, the semi-major axis α, the semi-minor axis β, the x-coordinate γ_1 and y-coordinate γ_2 of the centre (γ_1, γ_2), and the angle of rotation θ of the three ellipses must be defined (one line for each ellipse). The ellipses must be labelled as **a**, **b**, **c**.

If such a file is chosen, the region areas of the diagram in the file are computed and loaded. When euler*APE* diagram files are saved (as explained later), a .eld file is generated for both the initial and the final diagram in the search.

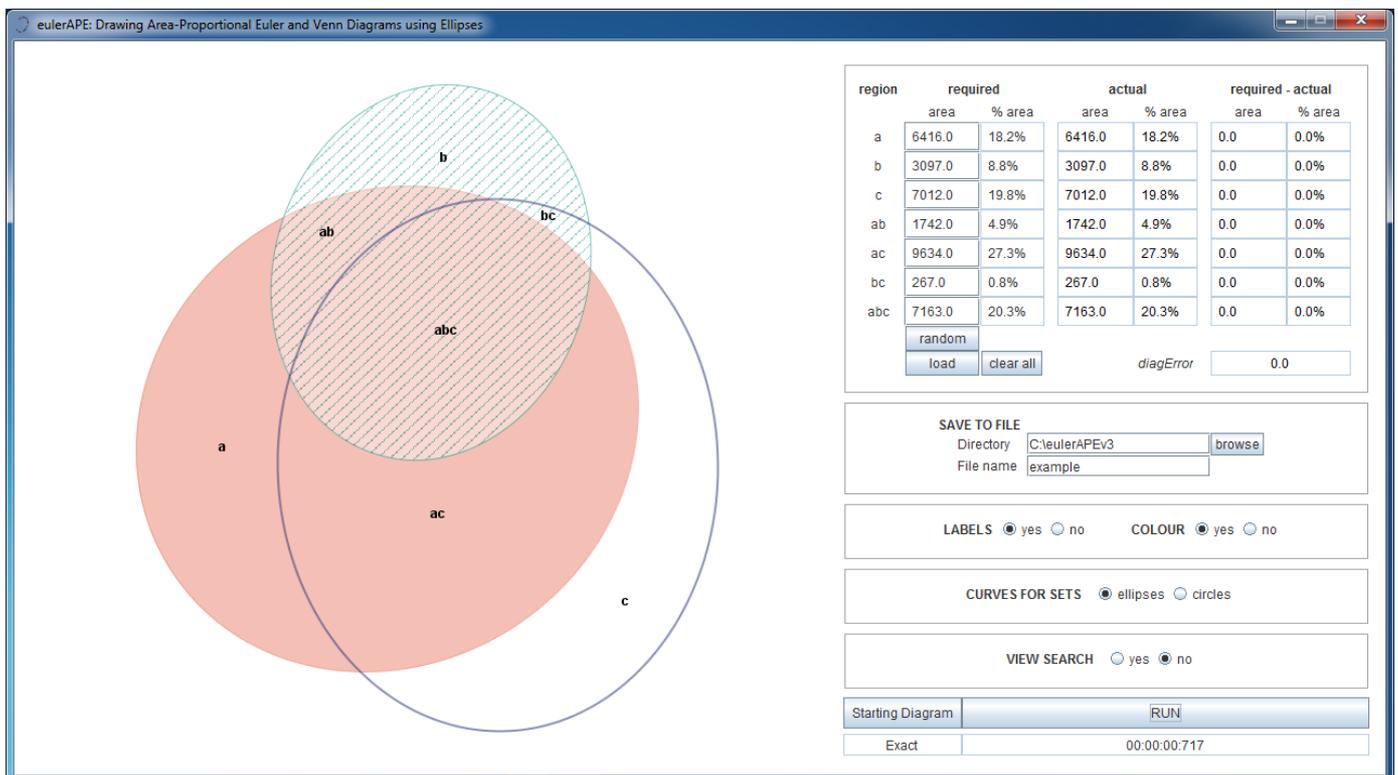To view the inital diagram that euler*APE* uses to start off the search process, click on the *Starting Diagram* button.

Alternatively or consequently, start the search process by clicking on the **RUN** button. Before doing so:

1. **SAVE TO FILE**: select the directory and the file name where images (in png and svg formats) and details of the initial and final diagram will be saved locally (if required), once the search is over and a diagram is generated

2. **LABELS**: decide whether the shown and saved diagram should have labels

3. **COLOUR**: decide whether the shown and saved diagram should be coloured or black and white

4. **CURVES FOR SETS**: select 'ellipses' or 'circles' to draw the set curves

5. **VIEW SEARCH**: decide whether you would like to view the search process or not

During the search, a timer (hours : mins : secs : msecs) is displayed in the bottom right corner of the window.

Once it stops running, a note saying **Exact** or **Inexact** is displayed just below the *Starting Diagram* button, to indicate whether an accurate or inaccurate diagram has been generated with respect to the required region areas.
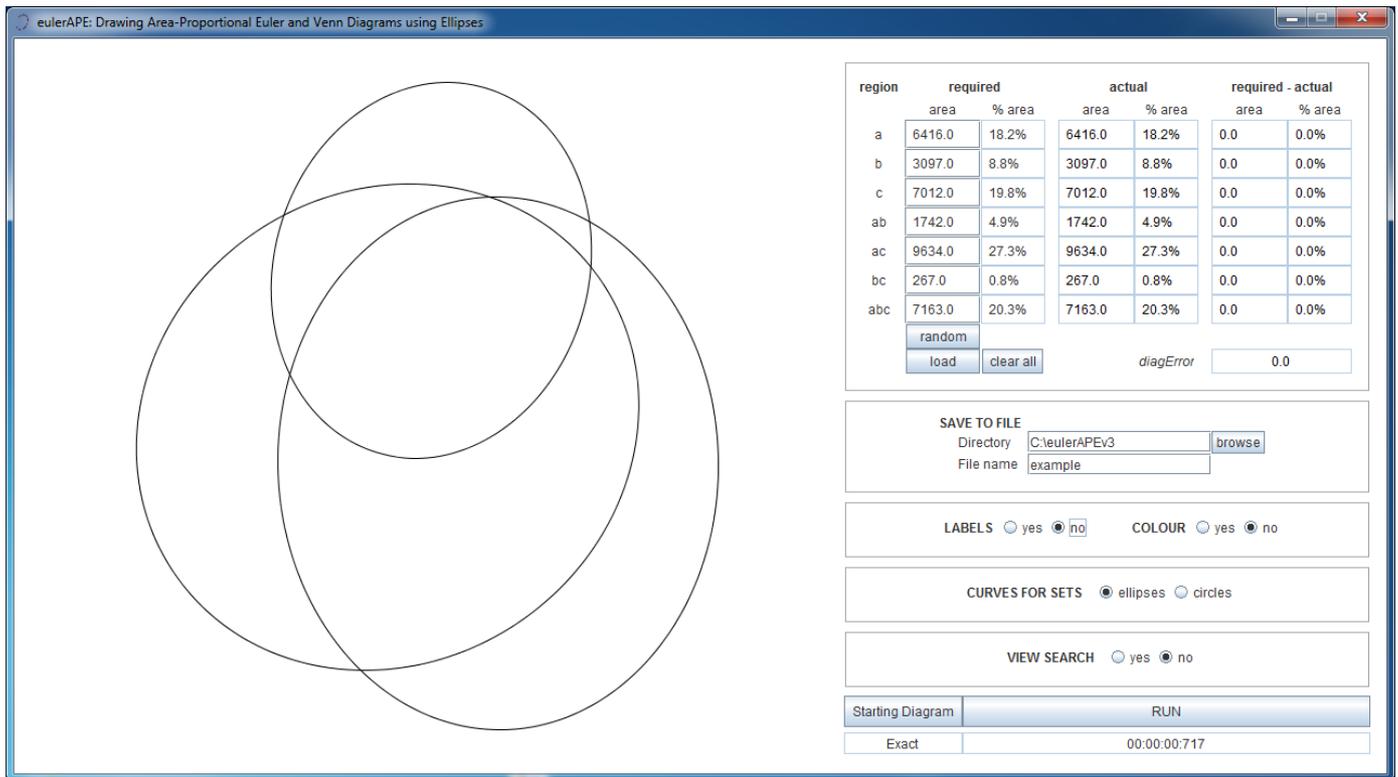

The accuracy of the generated diagram is measured by ***diagError***, which is displayed below the table of the required and actual region areas.

If R is the set of regions in the diagram,

$$diagError = max_{r \in R} \left| \frac{\text{required area of region } r}{\text{total area of the required diagram}} - \frac{\text{actual area of region } r}{\text{total area of the actual diagram}} \right|$$

An accurate, **Exact** diagram with respect to the required region areas is one with $diagError \leq 10^{-6}$.

At any point, you can show or hide **labels** and switch between **colour** and black and white mode. The diagram is saved after the search is completed and thus, for the desired visuals to be saved locally, these options have to be set before clicking on the **RUN** button.

To generate a diagram for a new set of region areas, click the **clear all** button and enter the areas manually, randomly or load them automatically from a file, as explained earlier.

Running euler*APE*: *from the command-line*

Open the **command prompt** and change the **current working directory** to the directory where eulerAPE_3.0.0.jar is saved.

Type in

```
java –Duser.language=xx –Duser.region=XX –jar eulerAPE_3.0.0.jar
```

where

- **xx** is the ISO 639 alpha-2 (or ISO 639-1) **language code** (e.g., it for Italian;
       codes available at http://www.loc.gov/standards/iso639-2/php/code_list.php)

- **XX** is the ISO 3166 alpha-2 (or ISO 3166-1) **country code** (e.g., IT for Italy;
       codes available at http://www.iso.org/iso/home/standards/country_codes/iso-3166-1_decoding_table.htm)

followed by the required options:

option	parameter	required	default
-i or **--input**	the path to a .els ('euler*APE* region areas') file, such as [this example](#) (use a text editor to open or edit the file) defining the region areas for which a diagram will be generated	yes	-
-o or **--output**	the path to the directory where the images (in png and svg formats) and the .eld ('euler*APE* diagram') file, such as [this example](#) (use a text editor to open the file) of the generated diagram will be saved	no	current working directory
-l or **--showlabels**	yes or no	no	yes
-c or **-- showincolour**	yes or no	no	yes
--curves	ellipses or circles	no	ellipses
-s or **--silent**	-	no	-

Example

```
java –Duser.language=it –Duser.region=IT –jar eulerAPE_3.0.0.jar
     -i "C:\regionareas.els"  -o "C:\eulerAPEv3_diagrams"
     -l yes  -c yes  --curves ellipses  -s
```

Licensing Terms

Please cite euler*APE* and provide a link to this page whenever you use euler*APE* and whenever you reuse or adapt any of the material provided on this page.

Other Drawing Tools - *you might be interested in*

eulerForce

The first method using a force-directed approach to automatically lay out Euler diagrams and to do so in relatively fast time.
http://www.eulerdiagrams.org/eulerForce

eulerGlyphs

The first automatic diagram drawing tool that draws area-proportional Euler diagrams, glyph representations and hybrid visualizations combining both Euler diagrams and glyphs.
http://www.eulerdiagrams.org/eulerGlyphs

For any questions, please contact Luana Micallef or Peter Rodgers (L.Micallef@kent.ac.uk; P.J.Rodgers@kent.ac.uk).

School of Computing
University of Kent
Canterbury, UK

University of Kent | Computing

Last updated: November 20, 2013