B4A business graphic generator

Disclaimer

Conventions

Commands syntax, instructions in programming language and examples are with font `COURIER NEW`. The optional parties of syntactic explanation are contained between `[square parentheses]`, alternatives are separated by `|` and the variable parties are in *`italics`*; the default values are underlined.

Contents table

1 Data presentation

The visualization of data by charts is a way to make a phenomenon more understandable, provided that we choose an appropriate chart and, for some type, we don't aspect a precise correspondence.

A chart can have one or more set of numeric data that can be viewed as one coordinate being the other an implicit progressive number corresponding to an enumeration or a temporal instants[1].

Some charts can accept multiple set of data that can be drawn together if these have a compatible scale.

Two non homogeneous set can be arranged in point chart where the point generated by the first set become a bubble which dimensions is proportional to the corresponding data on the second set.

If we have a set of partitioned data or, it is the same thing, a set of percentage the best display can be a Pie or a Ring Chart.

This brief examination above does not exhaust, of course, all the possible charts or variations, however it is sufficient to illustrate the program developed.

Chart	Type of data	
Area	Set or sets with same scale	Values from linear phenomena
Bar	Set or sets with same scale	Temporal or enumeration data
Bubble	Sets whit different scale	Bubble instead of point proportional to second set
Line	Set or sets with same scale	Values from phenomena usually taken at fixed point
Delta	Couple of set of same scale	Difference from two set
Pie, Ring	Partition of data	Partition of set, a possible second set creates variable slices
Point	Set or sets with same scale	Values from phenomena usually taken at fixed point
Venn	Two or three values	two sets and their intersection

Table 1: Charts and sets of data

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[1] We exclude the Cartesian charts where the data are point of plane.

2   Chart

The purpose of the program is to generate Business Charts; they can be bar, line(s), set(s) of points, area, pie or ring and Venn.

Charts can have, depending of type, some attributes for enhance the choice, in the Gallery there are some example.

2.1   Create chart

The script `Chart.bas` is an activity module; the chart is generate by a delayed call with one parameter:

```
CallSubDelayed2(Charts,"Chart",param)
```
`param` contains the chart description.

2.1.1   Save chart

When a chart has been created in menu of activity there is an option for save a chart in `png` or `jpeg` format. It is also saved a `.txt` file containing the string from which the chart has been generated.

2.2   Informal syntax

The creation of a chart is based on a description where the objects that compose it are followed by their properties with the possibly value(s); if properties has multiple values, for example a list of colors or labels, these must be enclosed in apostrophes.

The order of objects is not important; however in case of multiple type of charts some properties are taken from the first chart.

Below the use of punctuation and special characters.

2.2.1   Apostrophes

Apostrophes enclose a list of values.

```
Color 'transparent orange'
```

2.2.2   Asterisk

Asterisk marks a lack of data in some charts: `Point` chart, `Line` chart, `Bubble` chart `Scatter` chart (the possibly third set).

2.2.3   Comma

Comma parts set of data attribute when they are formed by more than one word or value.

```
Data 'Min Max' '8 7 9 8 7 9 12,12 10 16 14 8 15 16'
labels 'first day,second third'
```

This is applied to data, titles and labels.

☞ if the last item contains space it must be followed by comma otherwise the words are considered different values.

2.2.4   Semicolon

Semicolon are used for separate multiple chart.

2.2.5   Spaces

Spaces parts objects, properties and values.

```
Chart Area color Silver Border ...
```

2.2.6   % parameter placeholder

In labels and titles it is possible use placeholders which are replaced when the Chart is generated:

`%date`	date of day
`%chart`	chart name
`%nnnnn`	character whose ASCII value is *nnnn*l (from 2 to 5 digits)
`%d`	Name of days of three letters, in local language
`%days`	Name of days, in local language
`%m`	Name of months of three letters, in local language
`%months`	Name of months, in local language
`%`	In pie and ring chart shows the percentage of slice or percentage in the label
`%v`	In pie, ring and Venn chart shows the value of slice or the value on label

Table 2: Placeholders

2.3   Chart

```
chart chartType [color backgroundColor|gradient] [border]
chartType Area|AreaBar|Bar|Bubble|Delta|hBar|Line|Pie|Point|Ring|
Scatter|Venn
```

For each type of chart are indicated the possible accepted properties.

2.3.1   Chart properties

Properties	Syntax	Note
`background`	`Background graphicFile`	
`border`	`border`	
`color`	`Color color|gradient`	see par. 2.4 Color
`sorted`	`sorted`	The data of first set is ordered; the order of the labels and any other sets are modified on the basis of the ordering of the first set of data.

Table 3: Chart properties

2.3.2   Area

Is a line chart with color filled below.

☞ A strip area is obtained by two sets where the color of the first set is transparent.

2.3.3   Bar

Properties	Syntax	Note
`overlap`	`overlap n`	For multiple set of data: *n* is percentage of overlap; if negative is distance from bars.
`stacked`	`stacked`	the bars are lined up instead of being flanked.

2.3.4   Areabar

A collage of bars i.e. there is no space from every set of bars.

2.3.5 Horizontal Bar

Only for one set of data. The `X` axis is not drawn.

2.3.6 Bubble

Point chart where the second set of data is used to create circles around the point whit the radius proportional to the data.

☞ `Y` axis is determinate by the first data set.

2.3.7 Delta

Used to visualize differences between two data-sets in form of vertical segments where the first color is used if the second value is greater of the first, otherwise is used the second color.

2.3.8 Line

One or more sets of points connected by segments.

Properties	Syntax	Note
smooth	smooth	

2.3.9 Map `(experimental)`

Properties	Syntax	Note
limits	Limits '*Left Top Right Bottom*'	

`Map` chart show a chart without axis and an image in background. For this chart must be supplied two set of numeric values where the first set of data are the values of abscissa (`X` axis), the second are the values of ordinate (`Y` axis). A possible third set generates a bubble proportional to the data itself with the value written below the point. The labels, if they exist, are written on the point.

2.3.10 Pie and Ring

Round graphics, every slice is proportional to a value.

Properties	Syntax	Note
explode	explode n|'n_1 [n_2 ...]'	ex. `explode '1 3'`
slice	slice *degree*	Not completed pie or ring, ex: `slice 180` (half pie)
show	show <u>%</u>|%v	For the label surrounding the slice, a string that can contain `%v` or `%` which will be substitute by the slice value or by the percentage respectively.
inside	Inside %|%v	Same as above, but values inside the slice

2.3.11 Scatter

Create a point chart in Cartesian coordinates, the first set of data are the values of abscissa (`X` axis), the second are the values of ordinate (`Y` axis).

☞ If there is a third set of data, it is generated a bubble proportionate to the data itself with the value written below the point.

2.3.12 Venn

This is limited to two or three values i.e. two set and his intersection. If the values are two the second value must be less of the first one.

2.4 Color

Color can affects some chart component

```
Color color(s)|gradient
```

Color affects the preceding object that are: `Chart`, `Title`, `Data`, `Xaxis`. `Yaxis`.

color can be one of symbolic name possibly followed by a transparency value or a hexadecimal value:

```
color := nameColor [transparency]|[x|X]AARRGGBB
transparency = from 0 to 255
nameColor := aqua, black, blue, cyan, gray, green, magenta, lightgray,
teal, white, transparent, olive, orange, red, silver, crimson, purple.
```

The hexadecimal value can be without the alpha value, in this case the default alpha value is `FF` that is complete opacity, for example `xFFFF` is the opaque cyan color.

For `chart` background *Color* is two colors possibly followed by gradient direction:

```
color₁ color₂ [TOP_BOTTOM|RIGHT_LEFT |BOTTOM_TOP|LEFT_RIGHT]
```

2.5 Axis

```
xAxis|yAxis title [color color|'colorLabel colorAxis'
```

☞ color affects both `title` and the axis.

The default is `color 'black transparent'`

Ex. `yAxis Degree red`

2.6 Background

```
Background imageFile
```

This can be used for `Map` charts or for give a custom background to a chart.

If the **imageFile** doesn't contains a folder, this is assumed to be `File.DirAssets`.

2.7 Data

```
Data [dataTitle(s)] dataSet(s)
dataTitle      title(s) for numeric set(s) separated by comma.
dataSet        a set of numeric values, sets are separated by , (comma).
Data 'Minimum Maximum' '6 8 9 13 -4 7 4, 8 10 14 10 12 7 11'
```

2.7.1 Lack of data

Data can be omitted for `bar`, `point` and `line` charts.

An `*` means a data omitted; in case of multiple sets a set can be shorter i.e. without use of `*`; see an example in gallery.

2.8 Labels

```
Labels labelsList
```
Ex: `labels '%months'`
```
    labels '2015 2016 2017 2018'
```

☞ Labels are usually associated with a value, however if they are less than the points they are distributed regularly.

☞ In the `Map` charts the `labels` are written next to the points highlighted on the map.

2.9 Maximum, minimum

`[maximum|minimum]` *n*
set `maximum` and `minimum` for `Y` axis.

For `Scatter` and `Map` chart s `Limits` (-> 2.10 Limits) manage both axis.

2.10 Limits

```
Limits 'Left Top Right Bottom'
```
Limits is a possible parameter for `Scatter` and `Map` charts.

2.11 Title

```
title title [color color|Black [backgroundColor]] [align CENTER|
RIGHT|LEFT]
```
ex.   `Title 'Gas consumption' color 'magenta gray' align left`

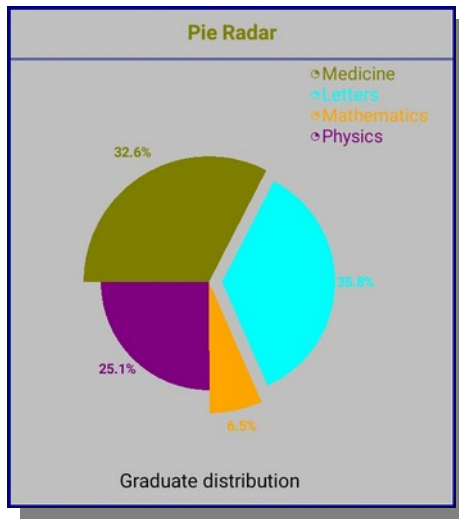The default of title color is `Black`.

2.12 My be in future

mirror bar
Multiple Horizontal bars
Multiple titles
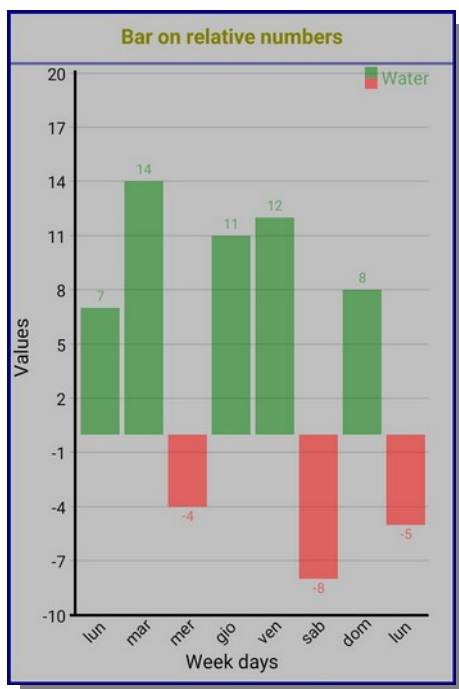Value suffix for example `%d5` first five days, `%month3-7`
Logarithmic scale

3   Gallery

Pie chart with one slice exploded and a second set of data.

```
Chart Pie color 'Silver' Border labels
'Medicine Letters Mathematics Physics'
Data 'Graduate distribution' '100 110 20
77,6.8 4.1 7.9 3.1' Color 'Olive aqua
orange purple' Title 'Pie Radar' color
Olive Align CENTER explode '2' show '%'
```



**Bar with relative numbers.**

```
Chart Bar color 'Silver' Border labels
'%d lun' Data 'Water' '7 14 -4 11 12 -8 8
-5' Color 'x7F007F00 red 127' Title 'Bar
on relative numbers' color Olive Align
CENTER XAxis 'Week days' YAxis 'Values';
```
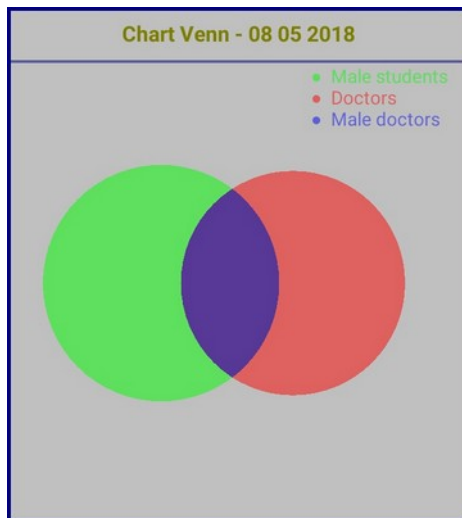
**Venn chart**

```
Chart Venn color 'Silver' Border labels
'Male students, Doctors, Male doctors,'
Data 'Graduates' '100 90 30' Color 'green
127 red 127 blue 127' Title 'Chart %chart
- %date' color Olive Align CENTER
```
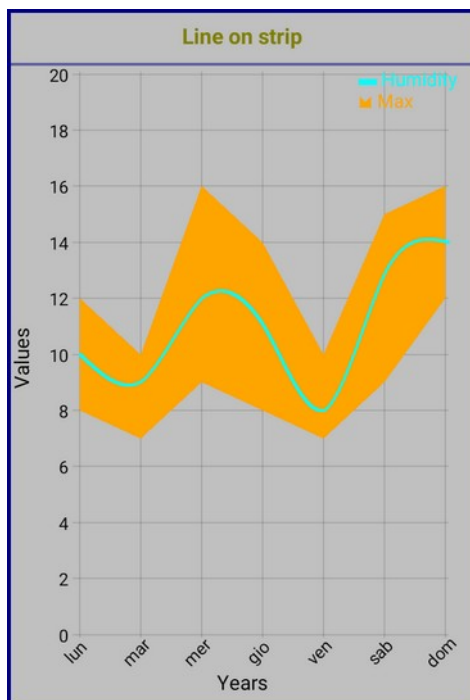

Strip with smoothed line inside.

```
Chart Area color 'Silver' Border labels
'%d' Data 'Min,Max' '8 7 9 8 7 9 12,12
10 16 14 10 15 16' Color 'transparent
orange' Title 'Line on strip' color
Olive Align CENTER XAxis 'Years' YAxis
'Values';Chart Line data Humidity '10 9
12 11 8 13 14' color aqua smooth
```
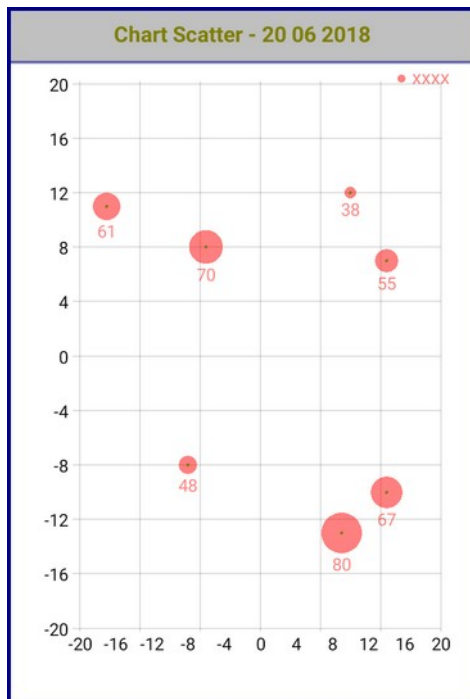
Scatter chart with bubbles

```
Chart Scatter color 'White' Border
labels '' Data 'xxxx' '-6 9 14 -8 14 10
-17,8 -13 7 -8 -10 12 11,70 80 55 48 67
38 61' Color 'red 127' Title 'Chart
%chart - %date' color 'Olive Silver'
Align CENTER XAxis '' YAxis '';
```
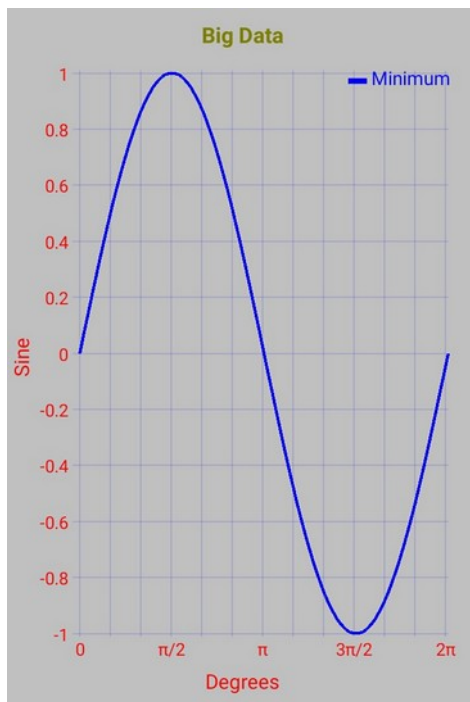


```
Chart Line color 'Silver'  labels '0
%960/2 %960 3%960/2 2%960' Data
'Minimum,Maximum' '0 0.07 0.139 0.208
0.276 0.342 0.407 0.469 0.53 0.588 0.643
0.695 0.743 0.788 0.829 0.866 0.899
0.927 0.951 0.97 0.985 0.995 0.999 0.999
0.995 0.985 0.97 0.951 0.927 0.899 0.866
0.829 0.788 0.743 0.695 0.643 0.588 0.53
0.469 0.407 0.342 0.276 0.208 0.139 0.07
0 -0.07 -0.139 -0.208 -0.276 -0.342 -
0.407 -0.469 -0.53 -0.588 -0.643 -0.695
-0.743 -0.788 -0.829 -0.866 -0.899 -
0.927 -0.951 -0.97 -0.985 -0.995 -0.999
-0.999 -0.995 -0.985 -0.97 -0.951 -0.927
-0.899 -0.866 -0.829 -0.788 -0.743 -
0.695 -0.643 -0.588 -0.53 -0.469 -0.407
-0.342 -0.276 -0.208 -0.139 -0.07 -0 '
Color 'blue red' Title 'Big Data' color
Olive Align CENTER yAxis 'Sine' color
'red transparent' xAxis 'Degrees' color
'red transparent'
```

Horizontal (sorted) bar

```
Chart HBar color 'Silver' Border labels
'FIAT Renault Volvo Hyunday Seat Tata
Citroen' Data 'Van sold' '17 14 14 21 23
28 25' Color 'Blue 127' Title
'Horizontal Bar - %date' color 'Olive
Silver' Align CENTER XAxis 'Quantity
(thousand)' YAxis 'Factory';sorted
```
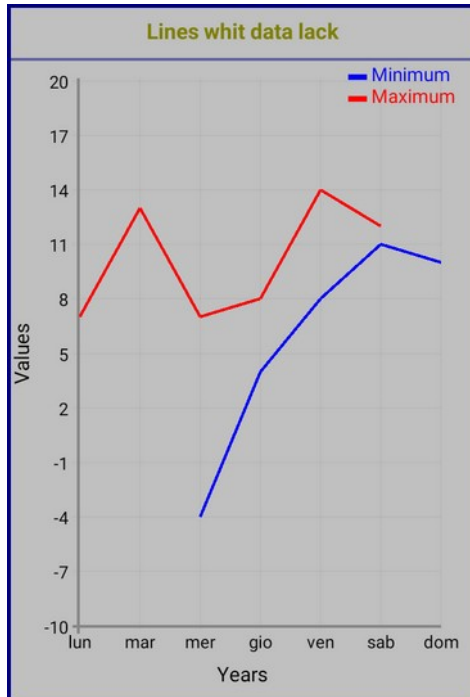

Lines whit data lack

```
Chart Line color 'Silver' Border labels
'%d' Data 'Minimum,Maximum' '* * -4 4 8
11 10, 7 13 7 8 14 12' Color 'blue red'
Title 'Lines whit data lack' color
'Olive Silver' Align CENTER XAxis Years
YAxis Values;
```

4 Technical reference

4.1 The Sand Box

This program has the purpose to discover how create charts.

4.2 Structures

4.2.1 Types

```
data
      chartType
      Name          ' data name
      color         ' color for data (not applicable to pie and ring)
      color2        ' second color, for negative value of relative bar
      data()        ' set of data
      hasData()     ' if data exists
      labels()      ' labels for item data
      Minimum       ' minimum found
      Maximum       ' maximum found
      slice         ' angle in grade for non complete pie or ring
      maxDataLabelWidth ' maximum width of labels of item data
      maxLabelWidth     ' maximum width data description
      intervalX   ' point distance
```

4.2.2 Array

4.2.3 Lists

aColors   charts color

4.2.4 Maps

	key	value
itemsMap	*parameter*	Value of parameter

4.2.4.1 Colors map

	key	value	
colorsMap	colorName	RGB and alfa value	contains some name of colors
objectsColorMap	objectName (*)		contains colors of the object

(*) contains also `label_[xaxis|yaxis]` and `fg_title` (background color).

4.3 Slicing

B4A canvas is relatively simple, it is not possible to draw arcs but only circles[2], then a slice can be obtained clipping an appropriate area, draw a circle and remove the clipping area. In the figure at right the dotted lines enclose the clipping area for obtain a slice[3]; $\overline{CB}$ is the radius **R**; the length of $\overline{AB}$ is $R*\tan(\alpha)$ so the length of $\overline{AC}$ is:

$$R*\sqrt{1+\tan(\alpha)^2}$$

Figure 1: Clip area

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[2]   In recent version of B4A a clip area can be set to a sector.
[3]   In the program the slice is created more than one if the slice is g
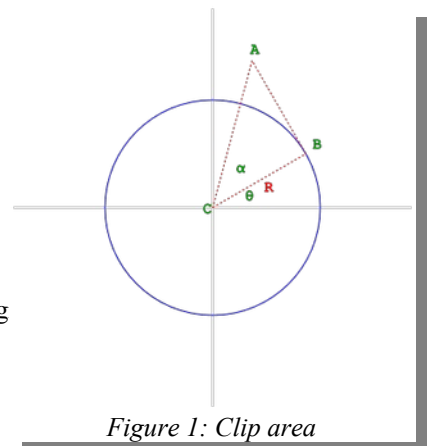
The clipping area needs point expressed in Cartesian coordinates, this means for point **B** to calculate the intersection of circle and the straight line of equation `y = tan(θ)*x` and the point **A** is the intersection of the lines:

- `y = tan(α+θ)*x`
- `y = (-1/ tan(θ))*x`

Instead with polar coordinates the task is much easier indeed the coordinates of the three points are:

- `C(0, 0)`
- `B(R, θ)`
- `A( ` $R*\sqrt{1+\tan(\alpha)^2}$ `, θ+α)`

which can be easy converted into Cartesian coordinates by the relations:

```
x = ρ * cos(φ)
y = ρ * sin(φ)
```

That is:

- `C(0, 0)`
- `B(R*cos(θ), R*sin(θ))`
- `A( ` $R*\sqrt{1+\tan(\alpha)^2}*\cos(\alpha+\theta)$ `, ` $R*\sqrt{1+\tan(\alpha)^2}*\sin(\alpha+\theta)$ `)`

4.4 The Venn diagram

The Venn Diagrams can be viewed as an analogical correspondence from number to graphic representation, like a pie chart where sectors are proportional to the relative percentage. In the Venn diagrams, therefore, this proportionality is only in the case of two sets and their intersection; for three sets the correspondence can be for all sets and their intersection two by two and not for their triple intersection; in some case the above proportionality aren't possible.

At the moment the package deals with two sets.

Let be **A**, **B** and **I** the values of three sets, where **I** is the dimension of intersection of **A** and **B**.

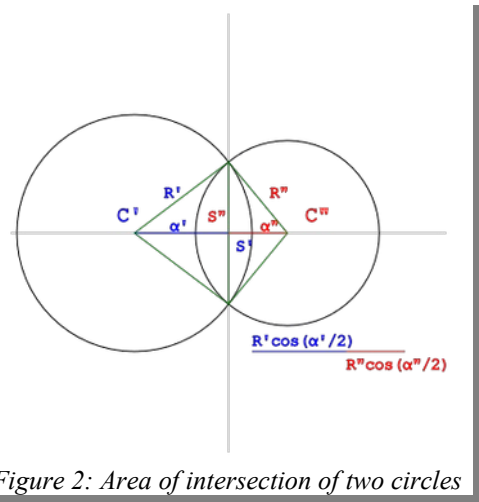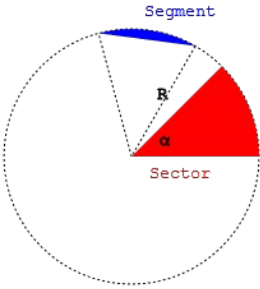In the figure at right **S'** and **S"** are the sectors of the two circles.

Figure 2: Area of intersection of two circles

The problem is to find a distance from the two centers so that **I = S' + S"**; this is accomplished by the **bisection method**:

1. we start with two values that are the minimum and the maximum possible of the distance: (0, R'+R"),
2. compute the medium value *d*,
3. use d for compute I_d,
4. if |I - I_d| < 0.0001 we ends with the result,
5. if not *d* substitute first limit if I_d < **I** otherwise *d* substitute second limit,
6. repeat from the point 2.

The central point is to compute I_d that is the sum of the two segment area (see below Erreur : source de la référence non trouvée); for this we need the angles α' and α" that can be obtained by the (cosine theorem): `α'/2 = arccosine(R'² + R"² - d²/2*R'*R")` where `d` is the distance from the centers of circles.

	In the circle of radius R the red area is a Sector of angle α; the blue area is a Segment of circle.	
	Circle area	$R^2*\Pi$
	Sector area	$0.5*R^2*\alpha$
	Triangle area	$0.5*R^2\sin(\alpha)$
	Segment area	Sector area - Triangle Area $0.5*R^2*(\alpha-\sin(\alpha))$

4.5 Introduction to regular expressions

A regular expression is a string of characters used to search, check, extract part of text in a text; it has a cryptic syntax and here there is a sketch with a few examples.

The expression is formed with the characters to search in the text and control characters, among the latter there is a \ said *escape* used to introduce the control characters or categories of characters:

- **\ escape character**, for special characters (for example asterisk) or categories of characters:
  - ○ **\w** any alphabetical and numerical character, **\W** any non alphabetical and numerical character,
  - ○ **\s** *white space* namely. tabulation, line feed, form feed, carriage return, and space,
  - ○ **\d** any numeric digits, **\D** any non digit,
- **.** any character,
- **quantifiers**, they apply to the character(s) that precede:
  - ***** zero or more characters
  - **+** one or more characters
  - **?** zero or one character (means possibly)
  - **{n}, {n,}** and **{n,m}** respective exactly *n* characters, almost *n* characters and from *n* to *m* characters **.**

(...) what is between parentheses is memorized,

?=*pattern* checks if *pattern* exists,

[a-z] any letter from a to z included,

[a|b] a or b,

\b word boundary,

\$ (at the bottom),

^ (at start).

4.5.1 Examples

Regular expression used on B4A graphics machine	
`'(.*?)'|(\w+)`	separate tokens on space or apostrophe delimited (first those closed with apostrophe)
`\s*,\s*`	split token by comma

`([xX][0-9a-fA-F]+)|(\w+\s+\d+)|(\w+)|`
`(TOP_BOTTOM|RIGHT_LEFT|BOTTOM_TOP|`
`LEFT_RIGHT)`
	`X7f00Aff red 75 blue X8F007E green 45`
	`LEFT_RIGHT`

Other Regular expressions	
`^\s*$`	Empty string or with only white spaces
`aa+`	Find a sequence of two or more `a`, like `aa`, `aaa`,`....`
`(\w+)\s+(\w+)\s+(\w+)`	Find and memorize three consecutive words
`(\-[a-z])`	Find and memorize `minus` followed by one alphabetic character
`.(jpg|jpeg)$`	Controls file type jpg or jpeg
`^[a-zA-Z0-9._-]+@[a-zA-Z0-9.-]+\.[a-zA-Z]` `{2,4}$`	Control of mail address
`^\d+$`	Only integers
`((?=.*\d)(?=.*[a-z]+)(?=.*[\W]).{6,12})`	`(?=.*\d)` almost a digit from `0-9` `(?=.*[a-z])` almost one lowercase character `(?=.*[\W]+)` almost one special character `.` match anything with previous condition checking `{6,12}` length at least 8 characters and maximum 12
`^[-+]?\d{1,2}(\.\d{1,2})?$`	**Numeric values** `[-+]?` the sign is possible `\d{1,2}` one or two digits `(\.\d{1,2})?` It is possible to have a decimal point followed by one or two digits
`[aAbBcCdDeEfF\d]{8}`	8 hexadecimal digits

4.6 Some Unicode characters

Name	Decimal value	Symbol	Hexadecimal value
edit	#9998	✎	#x270E
delete	#10008	✘	#x2718
check	#10003	✓	#x2713
check bold	#10004	✔	#x2714
email	#9993	✉	#x2709
cross	#10006	✖	#x2716
dollar	#36	$	#x24
euro		€	#x20AC
pound		£	#xA3
white square		▢	#x25a2
	#9646	▮	#x25ae
	#9650	▲	#x25b2
	#9679	●	#x25cf
	#9644	▬	#25ac

5   History

Version 0.2.0   Support of data lack
Some errors amended
Some aesthetic improvements
Improvement in Venn diagram
Improvement in Sand box

Version 0.2.1   added `Map` chart
added background images
added `limits` useful for `Scatter` and `Map` charts