The Figure Class

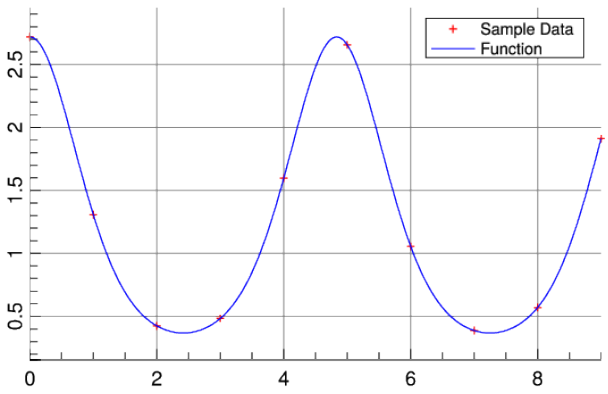
Basic plotting in C++

Contents

1 Opening example

This short example code will show, how the Figure class can be used.

```
# include <vector>
# include <Eigen/Dense>
# include <figure/figure.hpp>

int main()
{
  std::vector<double> x(10), y(10);
  for (int i = 1; i <= 10; ++i){
    x[i] = i; y[i] = std::exp(std::cos(0.2*i));
  }
  Eigen::VectorXd u = Eigen::VectorXd::LinSpaced(500, 1, 10),
                  v = ( (0.2*u.array()).cos().exp() ).matrix();
  mgl::Figure fig;
  fig.plot(x, y, " +r").label("Sample Data");
  fig.plot(u, v, "b").label("Function");
  fig.legend();
  fig.save("plot.eps");
  return 0;
}
```



2 Methods

2.1 grid

Definition:

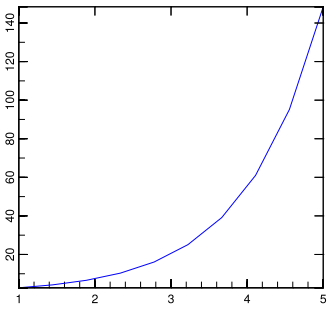
```
void grid( const bool& on = true,
           const std::string& gridType = "-",
           const std::string& gridCol = "h" )
```

Restrictions: None.

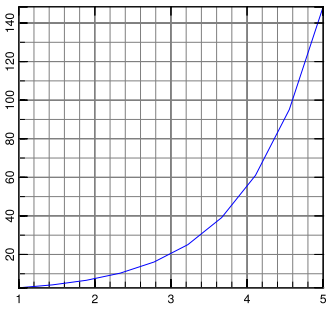
Examples:

```
mgl::Figure fig;
fig.plot(x, y);
fig.grid(false); // unset grid
fig.save("plot.eps");

mgl::Figure fig;
fig.plot(x, y);
fig.grid(true, "!", "h"); // gray fine mesh
fig.save("plot.eps");
```

Unset grid



Fine, grey grid



2.2 xlabel

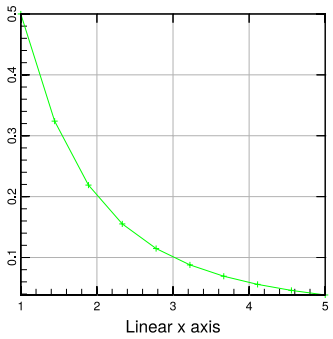
Definition:

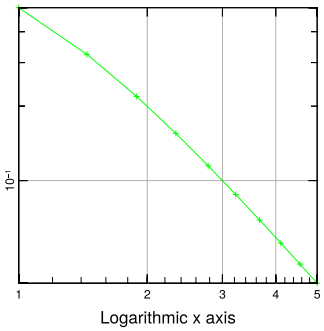
```
void xlabel( const std::string& label,
             const double& pos = 0 )
```

Restrictions: None.

Examples:

```
mgl::Figure fig;
fig.plot(x, y, "g+"); // 'g+' equals matlab/python '+-g'
fig.xlabel("Linear x axis");
fig.save("plot.eps");

mgl::Figure fig;
fig.xlabel("Logarithmix x axis"); // no restricitons on call order
fig.setlog(true, true);
fig.plot(x, y, "g+");
fig.save("plot.eps");
```





2.3 ylabel

Definition:

```
void ylabel( const std::string& label,
             const double& pos = 0 )
```

Restrictions: None.

Examples: See `xlabel`.

2.4 legend

Definition:

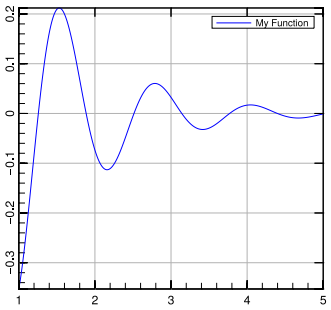
```
void legend( const double& xPos = 1,
             const double& yPos = 1 )
```

Restrictions: None.

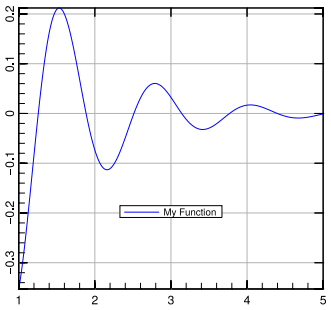
Examples:

```
mgl::Figure fig;
fig.plot(x0, y0).label("My Function");
fig.legend(); // 'activate' legend
fig.save("plot");

mgl::Figure fig;
fig.plot(x0, y0).label("My Function");
fig.legend(0.5, 0.25); // set position to (0.5, 0.25)
fig.save("plot");

mgl::Figure fig;
fig.plot(x0, y0).label("My Function");
fig.save("plot"); // legend won't appear as legend() hasn't been called
```

Default legend



Manual positioning



2.5 setlog

Definition:

```
void setlog( const bool& logx = false,
             const bool& logy = false,
             const bool& logz = false )
```

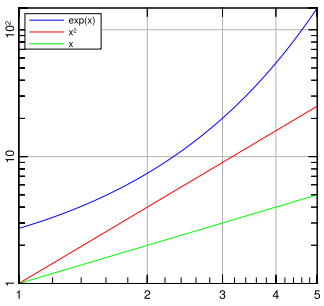
Restrictions: All plots will use the latest `setlog` options or default if none have been set.

Examples:

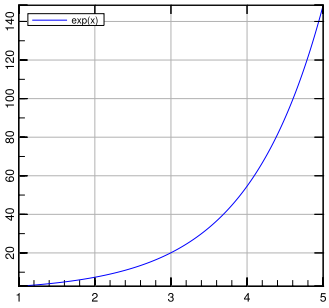
```
mgl::Figure fig;
fig.setlog(true, false); // -> semilogx
fig.plot(x0, y0);
fig.setlog(false, true); // -> semilogy
```

```
fig.plot(x1, y1);
fig.setlog(true, true); // -> loglog
fig.plot(x2, y2);
fig.save("plot.eps"); // ATTENTION: all plots will have been plotted in loglog-scale

mgl::Figure fig;
fig.plot(x, y);
fig.save("plot.eps"); // -> default (= linear) scaling
```

Multiple setlog calls



Default scaling



2.6 plot

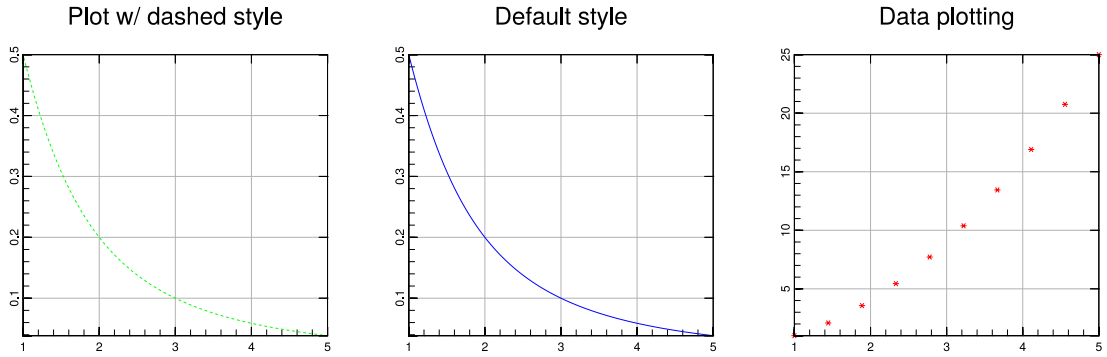
Definition:

```
template <typename yVector>
void plot( const yVector& y,
           const std::string& style = "" )

template <typename xVector, typename yVector>
void plot( const xVector& x,
           const yVector& y,
           const std::string& style = "" )
```

Restrictions: `xVector` and `yVector` must have a `size()` method, which returns the size of the vector and a `data()` method, which returns a pointer to the first element in the vector. Furthermore `x` and `y` must have same length.

Examples:

```
mgl::Figure fig;
fig.plot(x, y, "g;"); // green and dashed linestyle
fig.save("data.eps");

mgl::Figure fig;
fig.plot(x, y); // OK - style is optional
fig.save("data.eps");

mgl::Figure fig;
fig.plot(x, y, " *r", "Data w/ red dots"); // ' *r' equals matlab/python 'r*'
fig.save("data.eps");
```



2.7 plot3

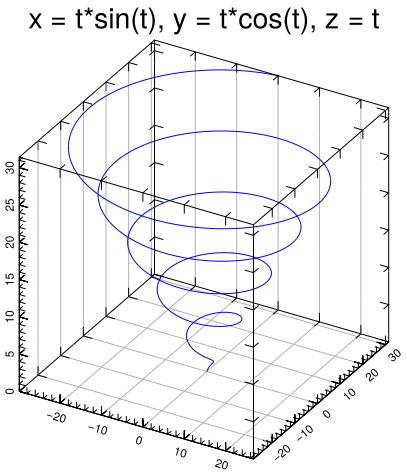
Definition:

```
template <typename xVector, typename yVector, typename zVector>
void plot3( const xVector& x,
            const yVector& y,
            const zVector& z,
            const std::string& style = "" )
```

Restrictions: Same restrictions as in `plot` for two vectors, extended to `zVector`.

Examples:

```
mgl::Figure fig;
fig.plot3(x, y, z);
fig.save("trajectories.eps");
```



2.8 fplot

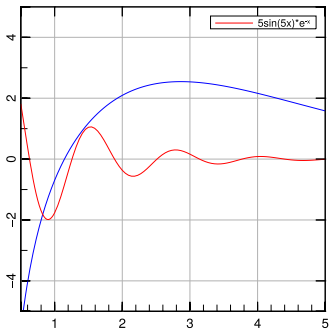
Definition:

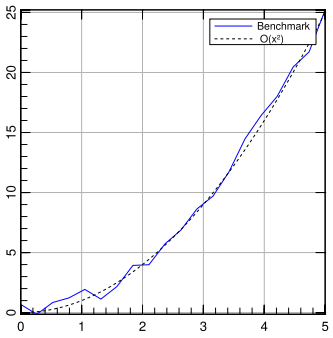
```
void fplot( const std::string& function,
            const std::string& style = "" )
```

Restrictions: None.

Examples:

```
mgl::Figure fig;
fig.fplot("(3*x^2 - 4.5/x)*exp(-x/1.3)");
fig.fplot("5*sin(5*x)*exp(-x)", "r").label("5sin(5x)*e^{-x}");
fig.ranges(0.5, 5, -5, 5); // be sure to set ranges for fplot!
fig.save("plot.eps");

mgl::Figure fig;
fig.plot(x, y, "b").label("Benchmark");
fig.fplot("x^2", "k;").label("\\ O(x^2)");
// here we don't set the ranges as it uses the range given by the x,y data
// and we use fplot to draw a reference line (O(x^2))
fig.save("runtimes.eps");
```





2.9 ranges

Definition:

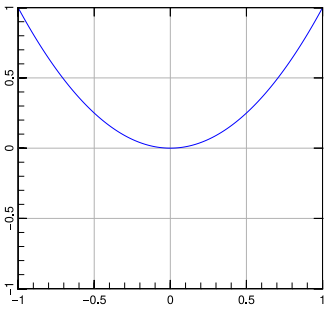
```
void ranges( const double& xMin,
             const double& xMax,
             const double& yMin,
             const double& yMax )
```

Restrictions: xMin $<$ xMax, yMin $<$ yMax and ranges must be > 0 for axis in logarithmic scale.

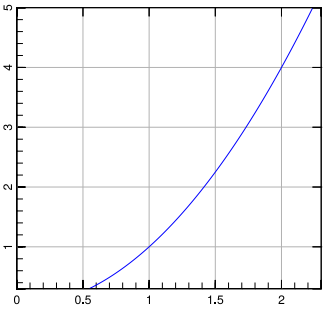
Examples:

```
mgl::Figure fig;
fig.ranges(-1,1,-1,1);
fig.plot(x, y, "b");
```

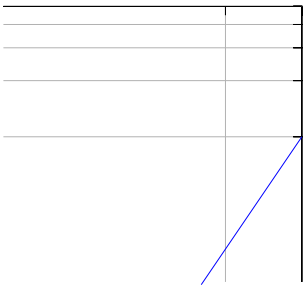
x = [-1, 1] y = [-1, 1]



x = [0, 2.3] y = [0.3, 5]



Negative axis values w/ logscaling



```
mgl::Figure fig;
fig.plot(x, y, "b");
fig.ranges(0, 2.3, 4, 5); // ranges can be called before or after 'plot'

mgl::Figure fig;
fig.ranges(-1, 1, 0, 5);
fig.setlog(true, true); // will run but MathGL will throw a warning
fig.plot(x, y, "b");
```

2.10 save

Definition:

```
void save( const std::string& file )
```

Restrictions: Supported file formats: `.eps` and `.png`.

Examples:

```
mgl::Figure fig;
fig.save("plot.eps"); // OK

mgl::Figure fig;
fig.save("plot"); // OK - will be saved as plot.eps

mgl::Figure fig;
fig.save("plot.png"); // OK - but needs -lpng flag!
```

2.11 title

Definition:

```
void title( const std::string& text )
```

Restrictions: None.

3 Line characteristics

Linecolors[a]:

blue	`b`
green	`g`
red	`r`
cyan	`c`
magenta	`m`
yellow	`y`
gray	`h`
green-blue	`l`
sky-blue	`n`
orange	`q`
green-yellow	`e`
blue-violet	`u`
purple	`p`

[a] Upper-case letters will give a darker version of the lower-case version.

Linestyles:

none	
solid	`-`
dashed	`;`
small dashed	`=`
long dashed	`|`
dotted	`:`
dash-dotted	`j`
small dash-dotted	`i`

None is used as follows: `" r*"` gives red stars w/o any lines

Linemarkers:

+	`+`
o	`o`
◇	`d`
·	`.`
△	`^`
▽	`v`
◁	`<`
▷	`>`
⊙	`#.`
⊞	`#+`
⊠	`#x`