Drawing UML Class Diagram by using `pgf-umlcd`

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Abstract

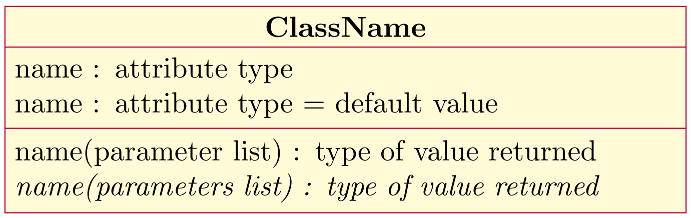
`pgf-umlcd` is a LaTeX package for drawing UML Class Diagrams. As stated by its name, it is based on a very popular graphic package `PGF/TikZ`. This document presents the usage of `pgf-umlcd` and collects some UML class diagrams as examples. `pgf-umlcd` can be downloaded from http://code.google.com/p/pgf-umlcd/.

Contents

1 Basics

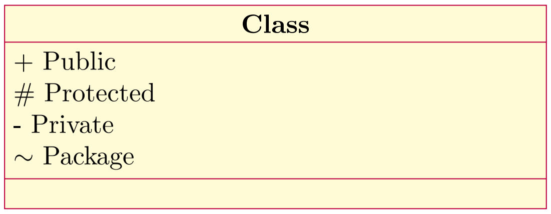
1.1 Class with attributes and operations

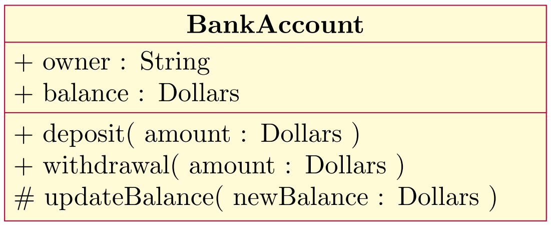
Note: If you don't want to show empty parts in the diagrams, please use `simplified` option, e.g. `\usepackage[simplified]{pgf-umlcd}`.


ClassName
name : attribute type
name : attribute type = default value
name(parameter list) : type of value returned
name(parameters list) : type of value returned

```
\begin{tikzpicture}
  \begin{class}[text width=8cm]{ClassName}{0,0}
    \attribute{name : attribute type}
    \attribute{name : attribute type = default value}

    \operation{name(parameter list) : type of value
        returned}
    % virtual operation
    \operation[0]{name(parameters list) : type of
        value returned}
  \end{class}
\end{tikzpicture}
```

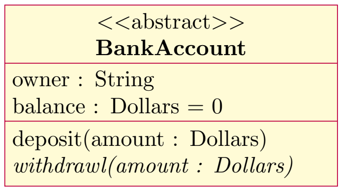
1.1.1 Visibility of attributes and operations



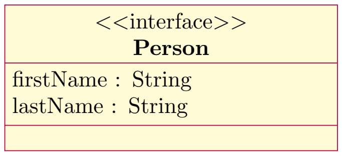

BankAccount
+ owner : String
+ balance : Dollars
+ deposit(amount : Dollars)
+ withdrawal(amount : Dollars)
# updateBalance(newBalance : Dollars)

```
\begin{tikzpicture}%[show background grid]
    \begin{class}[text width=7cm]{Class}{0,0}
    \attribute{+ Public}
    \attribute{\# Protected}
    \attribute{- Private}
    \attribute{$\sim$ Package}
  \end{class}

  \begin{class}[text width=7cm]{BankAccount}{0,-3}
    \attribute{+ owner : String}
    \attribute{+ balance : Dollars}

    \operation{+ deposit( amount : Dollars )}
    \operation{+ withdrawal( amount : Dollars )}
    \operation{\# updateBalance( newBalance : Dollars
        )}
  \end{class}
\end{tikzpicture}
```

1.1.2 Abstract class and interface

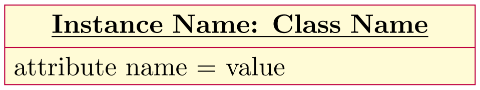


```
\begin{tikzpicture}
  \begin{abstractclass}[text width=5cm]{BankAccount
      }{0,0}
    \attribute{owner : String}
    \attribute{balance : Dollars = 0}

    \operation{deposit(amount : Dollars)}
    \operation[0]{withdrawl(amount : Dollars)}
  \end{abstractclass}
\end{tikzpicture}
```



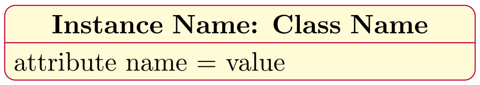
```
\begin{tikzpicture}%[show background grid]
  \begin{interface}{Person}{0,0}
    \attribute{firstName : String}
    \attribute{lastName : String}
  \end{interface}
\end{tikzpicture}
```

1.1.3 Object

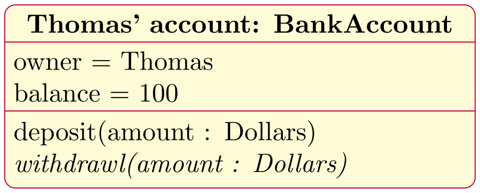


```
\begin{tikzpicture}
  \begin{object}[text width=6cm]{Instance Name: Class
       Name}{0,0}
    \attribute{attribute name = value}
  \end{object}
\end{tikzpicture}
```

Note: Object with rounded corners and methods are used in German school for didactic reasons. You get the rounded corners with `\usepackage[school]{pgf-umlcd}`. If you need both in one document you can switch it with `\switchUmlcdSchool`



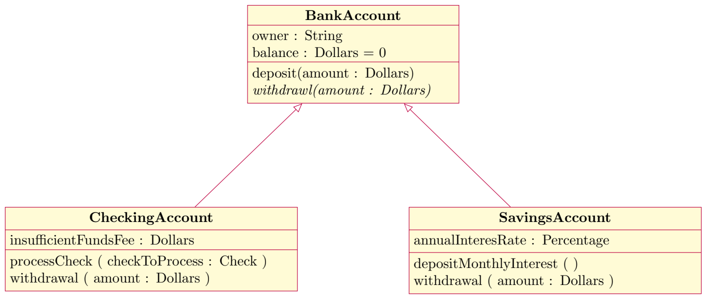
```
\begin{tikzpicture}
  \begin{object}[text width=6cm]{Instance Name: Class
       Name}{0,0}
    \attribute{attribute name = value}
  \end{object}
\end{tikzpicture}
```


Thomas' account: BankAccount
owner = Thomas
balance = 100
deposit(amount : Dollars)
withdrawl(amount : Dollars)

```
\begin{tikzpicture}
  \begin{object}[text width=6cm]{Thomas' account:
      BankAccount}{0,0}
    \attribute{owner = Thomas}
    \attribute{balance = 100}

    \operation{deposit(amount : Dollars)}
    \operation[0]{withdrawl(amount : Dollars)}
  \end{object}
\end{tikzpicture}
```

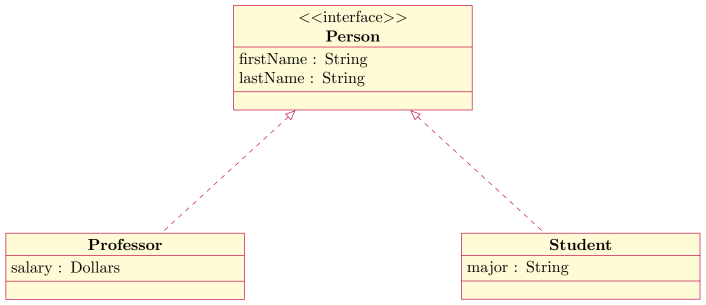
1.2 Inheritance and implement

1.2.1 Inheritance


BankAccount
owner : String
balance : Dollars = 0
deposit(amount : Dollars)
withdrawl(amount : Dollars)
CheckingAccount
insufficientFundsFee : Dollars
processCheck (checkToProcess : Check)
withdrawal (amount : Dollars)
SavingsAccount
annualInteresRate : Percentage
depositMonthlyInterest ( )
withdrawal (amount : Dollars)

```
\begin{tikzpicture}
  \begin{class}[text width=5cm]{BankAccount}{0,0}
    \attribute{owner : String}
    \attribute{balance : Dollars = 0}

    \operation{deposit(amount : Dollars)}
    \operation[0]{withdrawl(amount : Dollars)}
  \end{class}

  \begin{class}[text width=7cm]{CheckingAccount
      }{-5,-5}
    \inherit{BankAccount}
    \attribute{insufficientFundsFee : Dollars}

    \operation{processCheck ( checkToProcess : Check
        )}
    \operation{withdrawal ( amount : Dollars )}
  \end{class}

  \begin{class}[text width=7cm]{SavingsAccount}{5,-5}
    \inherit{BankAccount}
    \attribute{annualInteresRate : Percentage}

    \operation{depositMonthlyInterest ( )}
    \operation{withdrawal ( amount : Dollars )}
  \end{class}

\end{tikzpicture}
```

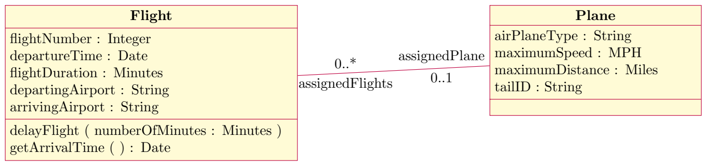
1.2.2 Implement an interface



```
\begin{tikzpicture}%[show background grid]
  \begin{interface}{Person}{0,0}
    \attribute{firstName : String}
    \attribute{lastName : String}
  \end{interface}

  \begin{class}{Professor}{-5,-5}
    \implement{Person}
    \attribute{salary : Dollars}
  \end{class}

  \begin{class}{Student}{5,-5}
    \implement{Person}
    \attribute{major : String}
  \end{class}
\end{tikzpicture}
```

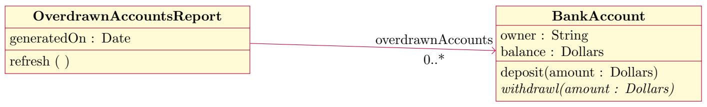
1.3 Association, Aggregation and Composition

1.3.1 Association



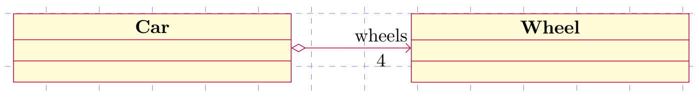
```
\begin{tikzpicture}
  \begin{class}[text width=7cm]{Flight}{0,0}
    \attribute{flightNumber : Integer}
    \attribute{departureTime : Date}
    \attribute{flightDuration : Minutes}
    \attribute{departingAirport : String}
    \attribute{arrivingAirport : String}

    \operation{delayFlight ( numberOfMinutes :
        Minutes )}
    \operation{getArrivalTime ( ) : Date}
  \end{class}

  \begin{class}{Plane}{11,0}
    \attribute{airPlaneType : String}
    \attribute{maximumSpeed : MPH}
    \attribute{maximumDistance : Miles}
    \attribute{tailID : String}
  \end{class}

  \association{Plane}{assignedPlane}{0..1}{Flight
      }{0..*}{assignedFlights}

\end{tikzpicture}
```

1.3.2 Unidirectional association



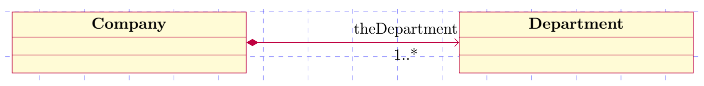
```
\begin{tikzpicture}
  % \draw[help lines] (-7,-6) grid (6,0);

  \begin{class}[text width=6cm]{
      OverdrawnAccountsReport}{0,0}
    \attribute{generatedOn : Date}

    \operation{refresh ( )}
  \end{class}

  \begin{class}{BankAccount}{12,0}
    \attribute{owner : String}
    \attribute{balance : Dollars}

    \operation{deposit(amount : Dollars)}
    \operation[0]{withdrawl(amount : Dollars)}
  \end{class}

  \unidirectionalAssociation{OverdrawnAccountsReport
      }{overdrawnAccounts}{0..*}{BankAccount}

\end{tikzpicture}
```

1.3.3 Aggregation



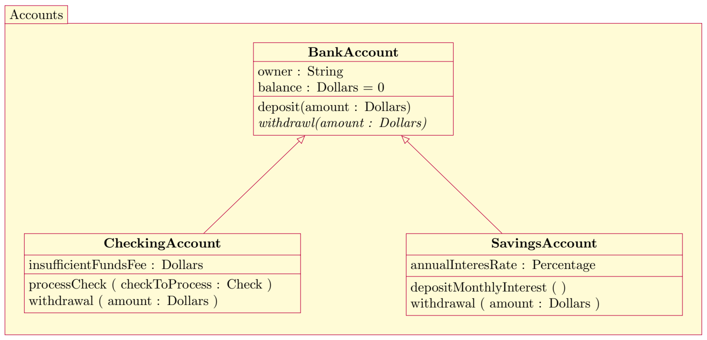
```
\begin{tikzpicture}[show background grid]
  \begin{class}{Car}{0,0}
  \end{class}

  \begin{class}{Wheel}{7.5,0}
  \end{class}

  \aggregation{Car}{wheels}{4}{Wheel}

\end{tikzpicture}
```

1.3.4 Composition



```
\begin{tikzpicture}[show background grid]
  \begin{class}{Company}{0,0}
  \end{class}

  \begin{class}{Department}{10,0}
  \end{class}

  \composition{Company}{theDepartment}{1..*}{
     Department}

\end{tikzpicture}
```

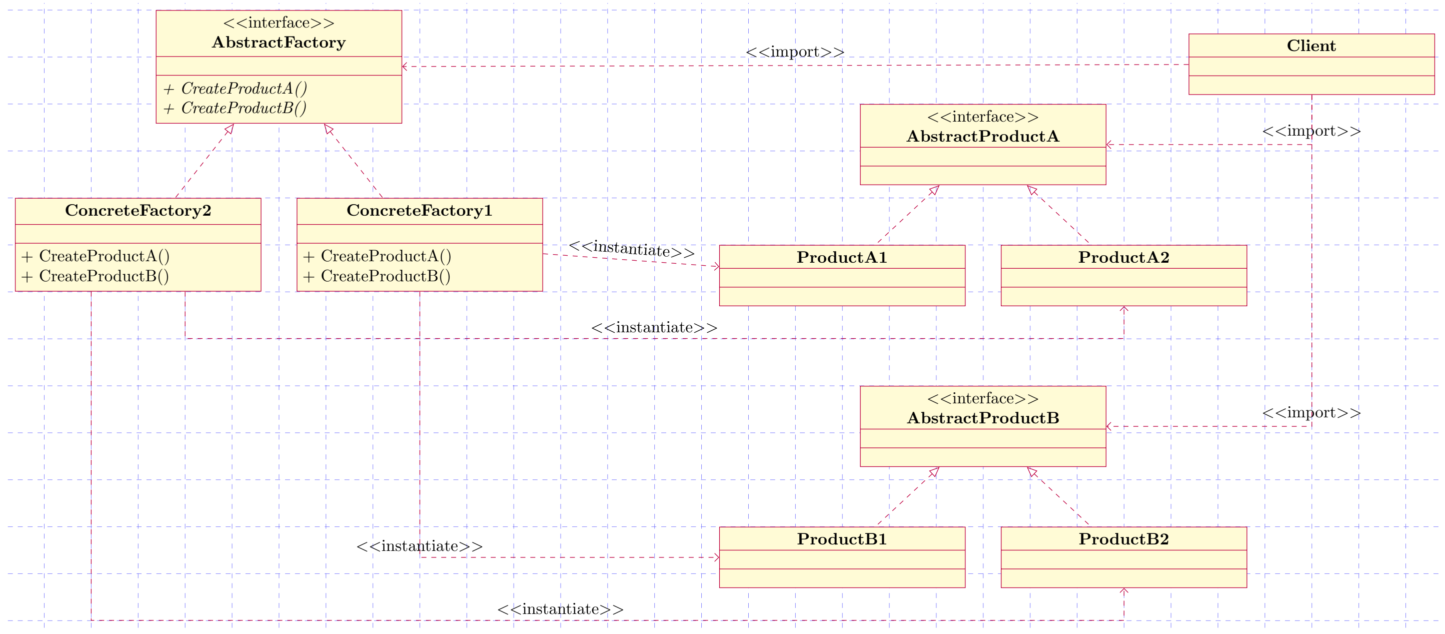
1.4 Package


Accounts
BankAccount
owner : String
balance : Dollars = 0
deposit(amount : Dollars)
withdrawl(amount : Dollars)
CheckingAccount
insufficientFundsFee : Dollars
processCheck (checkToProcess : Check)
withdrawal (amount : Dollars)
SavingsAccount
annualInteresRate : Percentage
depositMonthlyInterest ( )
withdrawal (amount : Dollars)

```
\begin{tikzpicture}
  \begin{package}{Accounts}
    \begin{class}[text width=5cm]{BankAccount}{0,0}
      \attribute{owner : String}
      \attribute{balance : Dollars = 0}

      \operation{deposit(amount : Dollars)}
      \operation[0]{withdrawl(amount : Dollars)}
    \end{class}

    \begin{class}[text width=7cm]{CheckingAccount
       }{-5,-5}
      \inherit{BankAccount}
      \attribute{insufficientFundsFee : Dollars}

      \operation{processCheck ( checkToProcess :
         Check )}
      \operation{withdrawal ( amount : Dollars )}
    \end{class}

    \begin{class}[text width=7cm]{SavingsAccount
       }{5,-5}
      \inherit{BankAccount}
      \attribute{annualInteresRate : Percentage}

      \operation{depositMonthlyInterest ( )}
      \operation{withdrawal ( amount : Dollars )}
    \end{class}
  \end{package}

\end{tikzpicture}
```

2 Examples

2.1 Abstract Factory



```
\begin{tikzpicture}[show background grid]
  \begin{interface}{AbstractFactory}{0,0}
    \operation[0]{+ CreateProductA()}
    \operation[0]{+ CreateProductB()}
  \end{interface}

  \begin{class}{ConcreteFactory2}{-3,-4}
    \implement{AbstractFactory}
    \operation{+ CreateProductA()}
    \operation{+ CreateProductB()}
  \end{class}

  \begin{class}{ConcreteFactory1}{3,-4}
    \implement{AbstractFactory}
    \operation{+ CreateProductA()}
    \operation{+ CreateProductB()}
  \end{class}

  \begin{interface}{AbstractProductA}{15,-2}
  \end{interface}

  \begin{class}{ProductA1}{12,-5}
    \implement{AbstractProductA}
  \end{class}

  \begin{class}{ProductA2}{18,-5}
    \implement{AbstractProductA}
  \end{class}

  \draw[umlcd style dashed line,->] (ConcreteFactory1) --node[above,
  sloped, black]{$<<$instantiate$>>$} (ProductA1);

  \draw[umlcd style dashed line,->] (ConcreteFactory2.south) ++
  (1,0) -- ++(0,-1) -- node[above, sloped,
  black]{$<<$instantiate$>>$} ++(20,0) -| (ProductA2);

  \begin{interface}{AbstractProductB}{15,-8}
  \end{interface}

  \begin{class}{ProductB1}{12,-11}
    \implement{AbstractProductB}
  \end{class}

  \begin{class}{ProductB2}{18,-11}
    \implement{AbstractProductB}
  \end{class}

  \draw[umlcd style dashed line,->] (ConcreteFactory1) |-node[above,
  sloped, black]{$<<$instantiate$>>$} (ProductB1);

  \draw[umlcd style dashed line,->] (ConcreteFactory2.south) ++
  (-1,0) -- ++(0,-7) -- node[above, sloped,
  black]{$<<$instantiate$>>$} ++(20,0) -| (ProductB2);

  \begin{class}{Client}{22,-0.5}
  \end{class}

  \draw[umlcd style dashed line,->] (Client) --node[above, sloped,
  black]{$<<$import$>>$} (AbstractFactory);

  \draw[umlcd style dashed line,->] (Client) |-node[above, sloped,
  black]{$<<$import$>>$} (AbstractProductA);

  \draw[umlcd style dashed line,->] (Client) |-node[above, sloped,
  black]{$<<$import$>>$} (AbstractProductB);
\end{tikzpicture}
```

3 Acknowledgements

Many people contributed to `pgf-umlcd` by reporting problems, suggesting various improvements or submitting code. Here is a list of these people: Martin Quinson, and Johannes Pieper.