



## Expert Advisors Users Guide

- Review
- Programming language MetaQuotes Language II (MQL II)
- Step-By-Step Creation of Simple Expert
- Features of Writing Experts
- Features of Writing Custom Indicators and User Functions
- Technical Indicators

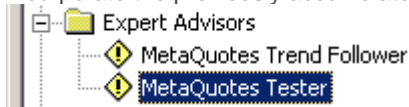
Expert Advisors are used to automate the trading process and relieve the trader of the routine functions of continuous market monitoring. Many professional traders employ multiple trading systems enabling them to operate in diverse markets and under a variety of environments. Usually they write and test their trading strategies in the well-known analytical packages, such as Strategy runner, MetaStock or TradeStation.

With FXDirectDealer expert advisor there is a way, whereby you can link the signals generated by the trading systems with your real account, and link them in such a way as to be able to track and manage your open positions, placed orders and stops at any given moment.

**What is an Expert Advisor?** It is a mechanical trading system (MTS) written in specialized language “MetaQuotes Language II (MQL II)” and linked to a particular chart. An Expert Advisor is able not only to notify the trader of the trading opportunities, but also to automatically make deals in the trading account, sending them directly to the trading server. Like most IT systems, Expert Advisors supports the testing of strategies with historical data, with the trade entry/exit points being represented on the charts. Furthermore, the executable code of the Expert Advisor is stored separately from its source text – this arrangement guarantees the concealment (if necessary) of the logic used by the trader from prying eyes.

Writing your own Expert Advisor is very easy: to do it, you don't need to be a professional programmer; you only need to learn to use a very simple language – the MQL II. Even if the user is not able to write the rules for his Expert Advisor on his own, he can always engage an acquaintance of his with decent programming skills, who most likely won't need more than an hour to master the rules and write the program.

There is a great variety of trading strategies developed by numerous traders for StrategyRunner, MetaStock and TradeStation. Most of these are easily translated into the MQL II language, which allows the user to incorporate the previously accumulated experience.



FXDirectDealer stores Expert Advisors as **\*.MQL** (source text) and **\*.EXP** (executable code) files in **/Experts** subdirectory of the root directory of the program. A trader may have an unlimited number of Expert Advisors which can be easily managed through the Navigator window. Procedure of creating the custom Expert Advisors and linking them to the trade terminal is described in detail in the FXDirectDealer User Guide.

### MetaQuotes Language II (MQL II)

**MetaQuotes Language II** is used to write custom Expert Advisors to automate the trading process management and implement the trader's own strategies. MetaQuotes Language II is easy to learn, use and

set up. MQL II language includes a large number of variables used to control the current and past quotes, principal arithmetic and logical operations and features main built-in indicators and commands used for opening and controlling of the positions. In its syntax the language is similar to the EasyLanguage developed by TradeStation Technologies, Inc., but it also features some specific characteristics.

The programming code is written using the **MetaEditor** advisor text editor, which is capable of highlighting different structures of MQL II language in different colors, thus helping the user through the text of the expert system. Comments start with the // symbol (double slash). Comments can also be marked with the 'slash-asterisk' – 'asterisk-slash' pair (/ \* comments \*/ , as in "C" programming language). The built-in editor highlights comments in gray color.

```

Trailing Stop.mql
vars : cnt(0),first(0);

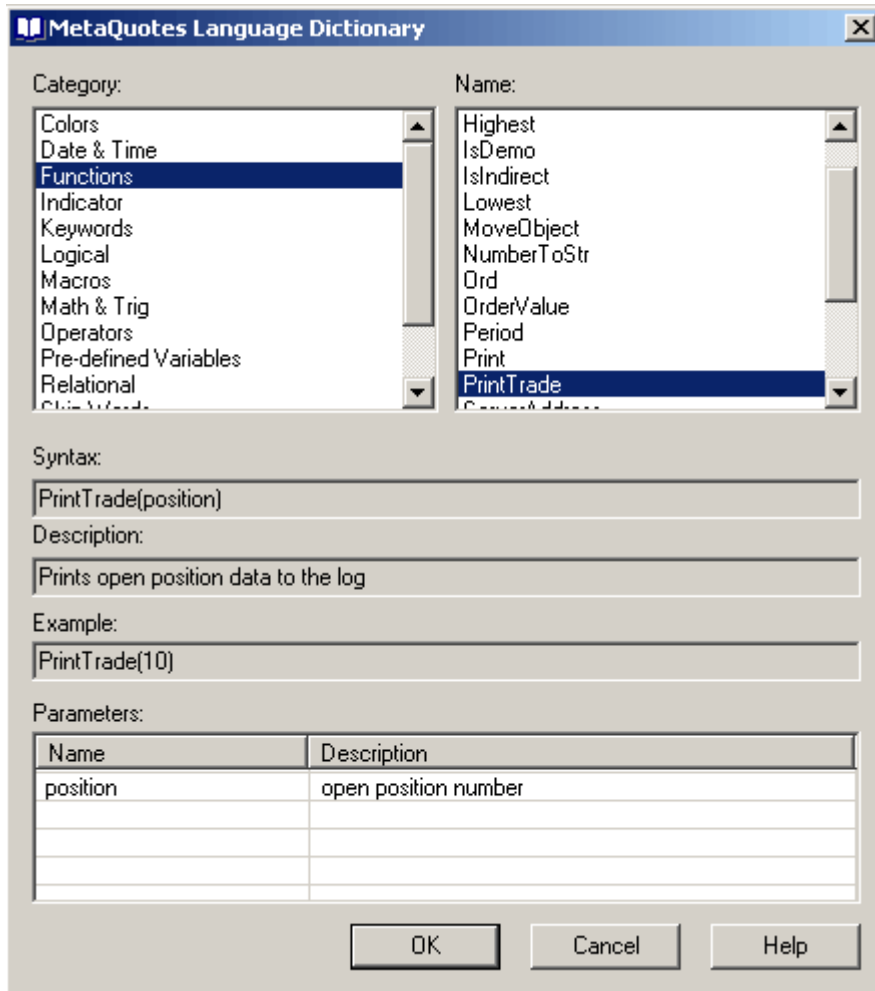
if TrailingStop<5 then ( print("Invalid trailing stop"); Exit: );
/* Проверим ранее открытые позиции.
   Трейлинг стоп работает через модификацию Stop Loss. */
for cnt=1 to TotalTrades
begin
// это длинная позиция?
If Ord(cnt,VAL_TYPE)=OP_BUY then // длинная позиция

```

To set up and control his operational strategy, a trader maintains a log-file holding information about the generated signals, variables output and the results of executed trades. Expert Advisor logs are kept in the **/logs/YYYYMMDD.log** file in the FXDirectDealer folder. The current log may be accessed directly from lower "Terminal" window ("Journal" tab).

Time	Message
2002.10.24 12:42:19	Expert: 'Trailing Stop' loaded [1 uservar, 3 vars, 1 strings, 3 ini, 121 exe]
2002.10.24 12:42:03	Expert: 'Account Information' loaded [0 uservar, 0 vars, 8 strings, 0 ini, 23 exe]
2002.10.24 12:42:03	Expert: 'Trailing Stop' loaded [1 uservar, 3 vars, 1 strings, 3 ini, 121 exe]
2002.10.24 12:40:16	Expert: 'Trailing Stop' loaded [0 uservar, 2 vars, 1 strings, 0 ini, 121 exe]
2002.10.24 12:21:55	MetaTrader 2.11 started
2002.10.24 12:21:55	Expert: 'Account Information' loaded [0 uservar, 0 vars, 8 strings, 0 ini, 23 exe]
2002.10.24 12:21:54	Expert: compiling 'Trailing Stop'...
2002.10.24 12:21:54	Expert: old version[200] of 'Trailing Stop'
2002.10.24 12:21:54	Expert: compiling 'MACD Sample'...
2002.10.24 12:21:54	Expert: old version[200] of 'MACD Sample'
2002.10.24 12:21:54	Expert: compiling 'Trend Follower.mql'...
2002.10.24 12:21:54	Expert: compiling 'The Reversal Bar.mql'...
2002.10.24 12:21:54	Expert: compiling 'Account Information.mql'...

To access the directory system of the MQL II language, the **MetaQuotes Language Dictionary** window is called, either by pressing the **Dictionary** button or from the **Tools** menu. The short manual contains the functions split by categories; operations, reserved words etc., and enables the user to get the description of each element used by the language.



### 1. Main language structures

As any other language, MQL II has a set of main components constituting its basic structure. These components have to be organized and arranged in a particular way, so as to represent proper statements and expressions.

Main object of the language is the data, which may be of 3 types: numerical, logical or string. All the **numerical** values take the "double" format. **Logical data** may take "True" or "False" values. A **string** is a range of characters marked with apostrophes. A character string is also called a text string. Data may be contained in the variables of appropriate types or be represented directly in the source text of the program.

A MetaQuotes Language statement is a complete instruction. Statements may contain reserved words, operators, data, variables, expressions or punctuation symbols and always end with a semicolon. **Reserved words** are the predefined words with specific or special meaning. **Operators** are the symbols designating specific operations on the data, variables and (or) expressions. **Variables** are used to hold numerical, string or logical data. **Expression** is a combination of reserved words, variables, data and operators having as a result a value of one of the 3 types used in the language: numerical, logical or character string. **Punctuation symbols** are used to represent expressions, define parameters, divide words or rearrange the sequence of computations.

### 2. Punctuation symbols

Character	Name	Description
;	semicolon	Ends an instruction in MetaQuotes Language II.
( )	parentheses	Group the values in an expression to change the order of calculation. Mark the parameters in functions and initializing expressions in the descriptions of variables. Mark the initializing values for variables and arrays in the variable description section.
,	comma	Divides the parameters when the functions are called. Divides the variables in

		the variable description section. Divides the numbers in the description of the array lengths. Divides the indices for accessing the array elements.
:	colon	Is used in the variable description section to start the variable list.
" "	quotation marks	Mark a text (character) string.
[]	square brackets	Mark the numbers to specify the array length. Mark numbers (indices) for accessing a particular element of an array. Mark the number of the period for accessing the historical data.
{ }	curly brackets	Serve as operator brackets. May be used instead of <b>begin-end</b> . Isolate a range of instructions into a block.
/* */	comment brackets	Mark the comments.
//	double slash	Specify the start of a single-string comment.

### 3. Operators

Operators are divided into 5 groups: assignment operators, string operators, mathematical operators, relative operators and logical operators.

#### 3.1. Assignment operator

The assignment operator '=' (the "equal" sign) is used to assign specific values (numerical, string or logical, depending on the variable type) to variables. The assigned value may be a result of an expression.

Example:

```
Variable: Counter(0);
...
Counter = Counter + 1;
```

As a result, the "Counter" variable will take the value 1. Values may also be assigned to array elements.

#### 3.2. String operator

To manipulate text strings, only one operator can be used: '+' (the "plus" sign). It is used to join two strings.

Example:

```
Variable: String(" ");
...
String = "some_" + "text";
```

As a result, the "String" variable will contain the "some text" text string. Joining strings with numerical and logical values is also permitted. In the latter case the numerical and/or logical values, before joining, will be transformed into the string type. Example:

```
String = "string" + 1;
```

As a result, the "String" variable will contain the "string1" text string. Operands may be not only values, but also the variables of corresponding types holding such values, as well as expressions which, after they are executed, produce such values.

#### 3.3. Mathematical operators

Four main mathematical operations: addition – '+' ("plus" sign); subtraction – '-' ("minus" sign); multiplication – '\*' (**asterisk**); **division** – '/' (slash) – are used in the mathematical expressions to calculate the numerical values. Examples of mathematical expressions:

```
( Ask + Bid ) / 2 , High[1] + 20 * Point
```

#### 3.4. Relative operators

Relative operators are used to compare two values of the same type. The first value is compared with the second, resulting in logical values "true" or "false", "less than" – '<' (left bracket); greater than – '>' (right bracket); "equal to" – '=' ("equal" sign); "not equal to" – '<>'; "less than or equal to" – '<='; "greater than or equal to" – '>='.

The logical values obtained as a result of a relative expression are used in the control structures of MetaQuotes Language II. Example:

```
If Free Margin < 1000 then exit;
```

The text strings are compared in lexicographic order, i.e. "aaa" string is considered less than string "zzz".

When logical values are compared, one should keep in mind that numerical value of the logical value "True" is 1, while the numerical value of the logical value "False" is 0.

#### 3.5. Logical operators

Logical operators enable the user to combine logical values. The logical OR – '|' (vertical line, or broken bar); logical AND – '&' (ampersand); logical NOT – '!' (exclamation mark). Logical operators have corresponding reserved words OR, AND, NOT. Example:

```
If FreeMargin > 100 and FreeMargin < 1000 then print( "Free margin is ", FreeMargin );
```

Note that, while "OR" and "AND" operations are dyadic, that is, they operate with two values, the "NOT" operation is one-place, that is, it applies to a single value only. Example:

```
Variable: Condition1( True );
```

...  
 Condition1 = FreeMargin >= 1000;  
 If not Condition1 then exit;

Below are the tables of results of logical operations.

Value1	Value2	Value1 OR Value2
True	True	True
True	False	True
False	True	True
False	False	False
Value1	Value2	Value1 AND Value2
True	True	True
True	False	False
False	True	False
False	False	False
Value1	Value2	NOT Value1
True		False
False		True

#### 4. Reserved words

MetaQuotes Language II uses several groups of reserved words.

##### Logical operations

AND, NOT, OR.

##### MQL II commands

Array, Begin, Break, Continue, Define, Downto, Else, End, Exit, For, If, Input, Then, To, Variable, While.

Reserved words defining the structure of commands of the language are also called "keywords".

##### Built-in functions

Abs, AccName, AccountName, Alert, ArcCos, ArcSin, ArcTan, Ceil, CloseOrder, Comment, Cos, CurTime, Day, DayOfWeek, DelArrow, DeleteOrder, DelGlobalVariable, DelObject, Exp, FileClose, FileDelete, FileOpen, FileReadNumber, FileReadString, FileSeek, FileSize, FileTell, FileWrite, Floor, GetGlobalVariable, GetIndexValue, GetIndexValue2, GetTickCount, Highest, Hour, iAC, iAD, iADX, iADXEx, iAlligator, iAO, iATR, iBands, iBandsEx, iBearsPower, iBullsPower, iBWMFI, iCCI, iCCIEx, iCustom, iDeMarker, iEnvelopes, iForce, iFractals, iGator, ilchimoku, iMA, iMAEx, iMACD, iMACDEx, iMFI, iMom, iMomEx, iOBV, iOsMA, iRSI, iRSIEx, iRVI, iSAR, iSTO, iWPR, IsDemo, IsFileEnded, IsFileLineEnded, IsGlobalVariable, IsIndirect, IsTesting, IsTradeAllowed, LastTradeTime, Log, Lowest, MarketInfo, Max, Min, Minute, Mod, ModifyOrder, Month, MoveObject, Normalize, NumberToStr, Ord, OrderValue, Period, Pow, Print, PrintTrade, Return, Rand, Round, Seconds, ServerAddress, SetArrow, SetDebugMode, SetGlobalVariable, SetIndexValue, SetIndexValue2, SetLoopCount, SetObjectText, SetOrder, SetText, Sin, Sqrt, Strand, StrToTime, Symbol, Tan, TimeDay, TimeDayOfWeek, TimeHour, TimeMinute, TimeMonth, TimeSeconds, TimeToStr, TimeToStrEx, TimeYear, UserFunction, Year.

##### Predefined user variables (user-defined variables)

Lots, StopLoss, TakeProfit, TrailingStop.

##### Predefined variables of the trading terminal

AccNum, AccountNumber, Ask, Balance, Bars, Bid, Close, Credit, Equity, FreeMargin, High, Low, Margin, Open, Point, PriceAsk, PriceBid, PriceHigh, PriceLow, PriceTime, Time, TotalProfit, TotalTrades, Volume.

##### Predefined parameters of built-in functions (macros)

MODE\_CLOSE, MODE\_DETAILS, MODE\_EMA, MODE\_FILE, MODE\_FIRST, MODE\_GATORJAW, MODE\_GATORLIPS, MODE\_GATORTEETH, MODE\_HIGH, MODE\_KIJUNSEN, MODE\_LWMA, MODE\_LOW, MODE\_LOWER, MODE\_MAIN, MODE\_MINUSDI, MODE\_OPEN, MODE\_PLUSDI, MODE\_SECOND, MODE\_SENKOUSPAN, MODE\_SENKOUSPANA, MODE\_SENKOUSPANB, MODE\_SIGNAL, MODE\_SMA, MODE\_SMMA, MODE\_STOPLOSS, MODE\_TAKEPROFIT, MODE\_TENKANSEN, MODE\_TIME, MODE\_UPPER, MODE\_VALUES, MODE\_VOLUME, OBJ\_FIBO, OBJ\_HLINE, OBJ\_SYMBOL, OBJ\_TEXT, OBJ\_TRENDLINE, OBJ\_VLINE, OP\_BUY, OP\_BUYLIMIT, OP\_BUYSTOP, OP\_SELL, OP\_SELLLIMIT, OP\_SELLSTOP, PRICE\_CLOSE, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN, PRICE\_OPEN, PRICE\_TYPICAL, PRICE\_WEIGHTED, SEEK\_CUR, SEEK\_END, SEEK\_SET, STYLE\_SOLID, STYLE\_DASH, STYLE\_DOT, STYLE\_DASHDOT, STYLE\_DASHDOTDOT, SYMBOL\_ARROWDOWN, SYMBOL\_ARROWUP, SYMBOL\_CHECKSIGN,

SYMBOL\_STOPSIGN, SYMBOL\_THUMBSDOWN, SYMBOL\_THUMBSUP, TIME\_DATE, TIME\_MINUTES, TIME\_SECONDS, VAL\_CLOSEPRICE, VAL\_CLOSETIME, VAL\_COMMENT, VAL\_COMMISSION, VAL\_LOTS, VAL\_OPENPRICE, VAL\_OPENTIME, VAL\_PROFIT, VAL\_STOPLOSS, VAL\_SWAP, VAL\_SYMBOL, VAL\_TAKEPROFIT, VAL\_TICKET, VAL\_TYPE.

Actually, the above reserved words are macros, i.e. the syntax analyzer replaces them with numerical values. Macros were introduced to simplify the process of writing the function calls for the user: more convenient and mnemonically significant words can be used instead of the numerical values of parameters of some functions. The same applies to the names of colors.

### Colors

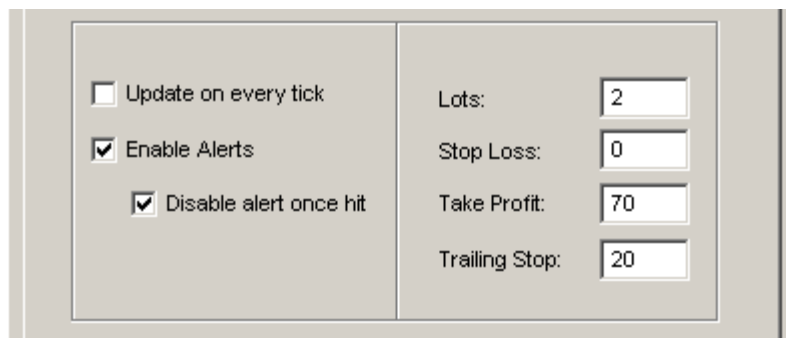
AliceBlue, AntiqueWhite, Aqua, Aquamarine, Azure, Beige, Bisque, Black, BlanchedAlmond, Blue, BlueViolet, Brown, BurlyWood, CadetBlue, Chartreuse, Chocolate, Coral, CornflowerBlue, Cornsilk, Crimson, Cyan, DarkBlue, DarkCyan, DarkGoldenrod, DarkGray, DarkGreen, DarkKhaki, DarkMagenta, DarkOliveGreen, DarkOrange, DarkOrchid, DarkRed, DarkSalmon, DarkSeaGreen, DarkSlateBlue, DarkSlateGray, DarkTurquoise, DarkViolet, DeepPink, DeepSkyBlue, DimGray, DodgerBlue, FireBrick, FloralWhite, ForestGreen, Fuchsia, Gainsboro, GhostWhite, Gold, Goldenrod, Gray, Green, GreenYellow, Honeydew, HotPink, IndianRed, Indigo, Ivory, Khaki, Lavender, LavenderBlush, LawnGreen, LemonChiffon, LightBlue, LightCoral, LightCyan, LightGoldenrod, LightGreen, LightGrey, LightPink, LightSalmon, LightSeaGreen, LightSkyBlue, LightSlateGray, LightSteelBlue, LightYellow, Lime, LimeGreen, Linen, Magenta, Maroon, MediumAquamarine, MediumBlue, MediumOrchid, MediumPurple, MediumSeaGreen, MediumSlateBlue, MediumSpringGreen, MediumTurquoise, MediumVioletRed, MidnightBlue, MintCream, MistyRose, Moccasin, NavajoWhite, Navy, OldLace, Olive, OliveDrab, Orange, OrangeRed, Orchid, PaleGoldenrod, PaleGreen, PaleTurquoise, PaleVioletRed, PapayaWhip, PeachPuff, Peru, Pink, Plum, PowderBlue, Purple, Red, RosyBrown, RoyalBlue, SaddleBrown, Salmon, SandyBrown, SeaGreen, Seashell, Sienna, Silver, SkyBlue, SlateBlue, SlateGray, Snow, SpringGreen, SteelBlue, Tan, Teal, Thistle, Tomato, Turquoise, Violet, Wheat, White, WhiteSmoke, Yellow, YellowGreen.

All the reserved words are case-insensitive, i.e. they may be written in lower as well as in upper case.

#### 4.1. Predefined user variables

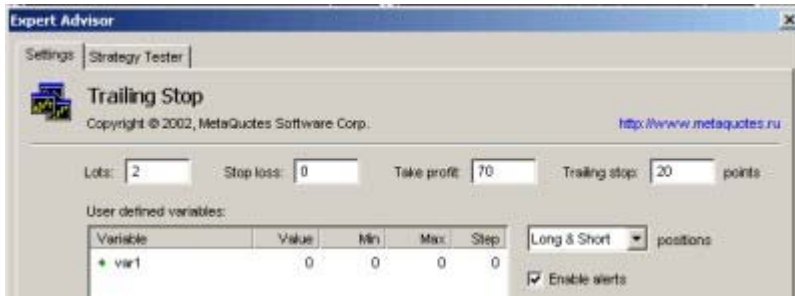
It is often necessary to change certain parameters in an already written Expert Advisor which affect its operation. In order to avoid manual editing of the Advisor code and its critical variables each time such changes are made, an approach similar to that used in the MetaQuotes system was applied: four parameters were taken out to the "Properties" table (Menu **Files of the MetaEditor – Properties... – "Processing" tab**) of the Expert Advisor:

- **Lots** – number of lots;
- **StopLoss** – Stop Loss level in points;
- **TakeProfit** – Take Profit level in points;
- **TrailingStop** – Trailing Stop level in points.



<input type="checkbox"/> Update on every tick	Lots: <input type="text" value="2"/>
<input checked="" type="checkbox"/> Enable Alerts	Stop Loss: <input type="text" value="0"/>
<input checked="" type="checkbox"/> Disable alert once hit	Take Profit: <input type="text" value="70"/>
	Trailing Stop: <input type="text" value="20"/>

Initial values of these variables may be entered through the "Properties" table of the Expert Advisor or changed in a special settings dialog box ("Settings" tab) called by pressing **F7** or via the menu (**Charts – Expert Advisors – Properties**). These variables can't be modified from the programme.



## 4.2. Command structures of MetaQuotes Language II

### 4.2.1. Variables declaration and description

Storage of the temporary data in the process of calculation requires the use of variables. The variables are described in the very beginning of the programme using reserved words **Variable**, **Array**, **Define** and **Input**. It is allowed to use these words in plural, i.e. **Variables**, **Arrays**, **Defines** and **Inputs**. One of these words always starts the variable declaration statement. The difference between these words is the following: "variable" describes simple variables, "array" describes arrays, "define" describes additional user-defined variables which similar to the predefined user variables, may be modified via the "Settings" dialog box i.e. from the outside. However unlike the predefined variables the user variables may be changed in the process of calculation within the programme. "Input" describes variables used as input parameters for user functions or custom indicator programs.

Variable declaration syntax:

```
Variable : Name( InitialValue );
```

where:

- "Name" is the name of the variable;
- "InitialValue" is the initial value of the variable.

The initial value defines the type of the variable – numerical, string or logical.

Example of declaration of a numerical variable:

```
Variable : Counter( 0 );
```

Example of declaration of a string variable:

```
Variable : String1( "some string" );
```

Example of declaration of a logical variable:

```
Variable : MyCondition( false );
```

Array declaration syntax:

```
Array : ArrayNameLength( InitialValue );
```

where the array length is denoted by one or several (up to four) numbers – number[, number [, number [, number]]].

In MetaQuotes Language II arrays may be of one-, two-, three- or four-element lengths. In general terms, an array is a set of variables positioned in a row one after the other which may be accessed by using the same name – the array name – and giving the sequential number (numbers) of the element in an array. Arrays are convenient for holding sequences of data of the same type. A good example of arrays is the historical data of the trading terminal, such as **Close**, **Open**, **High**, **Low**, **Volume**. These data are accessed as a single-element array. For example, **Close[ 5 ]** is the value of **Close** five periods back. Example of a two-element array may be a simple table where the first measurement is the rows and the second measurement – the columns. Example:

```
Array : MyTable10, 5 ( 0 ); // a 10 rows by 5 columns table
```

...

```
print( MyTable2, 4 ); // print the fourth element in the second row
```

Arrays may contain values of any type – numerical, string or logical, however, it should be of the type, the initial value of which was specified when the array was declared.

Additional user-defined variable declaration syntax:

```
Define : Name( InitialNumber );
```

where:

- "Name" is the name of the variable;
- "InitialNumber" is the Initial numerical value of the variable.

It should be noted that the additional user-defined variables may be of numerical type only. As already mentioned above, the user-defined variables may be modified during the calculation process of the programme. Such modifications will only apply in the current session of the Expert Advisor, until the particular Expert Advisor is deleted from the chart or the operation of the customer terminal ends. When the new session of the Expert Advisor starts, the values of the user-defined variables will be initialized anew.

Note that initialization of the all variables ("Inputs", "Variables", "Defines", "Arrays") is passed one time only at the first launch of an expert adviser. If you want so that some variable has a specified value at each launch then assign such value explicitly. For example:

```
Variable : cnt( 0 );
cnt = 0; // variable assignment at each launch
```

#### 4.2.2. EXIT statement

The **Exit** statement breaks the operation of the Expert Advisor. It is the so-called pre-scheduled termination of the programme.

#### 4.2.3. IF-THEN conditional statement

The **If-Then** conditional statement makes it possible to control the sequence of execution of the Expert Advisor instructions. This statement may be written in different ways. Syntax:

```
if Condition then Statement;
```

or

```
if Condition then begin
    Statement;
    ...
    Statement;
end;
```

where:

- "Condition" is a logical expression taking the values "True" or "False";
- "Statement" is any instruction of the MetaQuotes Language II.

Operator brackets **Begin – End** may be replaced with curly brackets { }. The conditional statement can be used to branch the programme. To achieve this, an additional keyword **Else** is used. Syntax:

```
if Condition then Statement1 else Statement2;
```

or

```
if Condition
then
begin
Statement;
...
Statement;
end
else
begin
Statement;
...
Statement;
end;
```

or

```
if Condition
then
begin
Statement;
...
Statement;
end
else Statement;
```

or

```
if Condition then Statement;
else
begin
Statement;
...
Statement;
end;
```

It is possible to use nested conditional statements. In general terms, statement may be represented by any legitimate instruction of MetaQuotes Language II, except for variable declarations, because, strictly speaking, a variable declaration is not an executable statement.

#### 4.2.4. The WHILE loop

The **While** loop ensures execution of statements contained in the loop body as many times as the loop condition holds true. A loop may be terminated ahead of schedule using the **Break** statement. An iteration may be stopped using the **Continue** statement. This statement causes the start of the next iteration of the loop, i.e. the statements coming after **Continue** and down to the end of the loop body are not executed in this iteration. It is reasonable to use **Break** and **Continue** in a conditional statement. Syntax:

```
while Condition begin
Statement;
[break;][continue;]
...
end;
```

where:

- "Condition" is the loop execution condition – a logical expression calculated before each iteration of the loop and taking "True" or "False" value;
- "Statement" is any instruction of the MetaQuotes Language II.

Operator brackets **Begin – End** denote the loop body and may be replaced by curly brackets { }. **Break** and **Continue** statements are not obligatory.

Example:

```
Counter = 1;
while Counter <= Bars
begin
print( CloseCounter – 1 );
Counter = Counter + 1;
end;
```

This example illustrates a loop which is going to be executed a **Bars** times, or, if **Bars** is 0, not once.

#### 4.2.5. The FOR loop

The **For** loop ensures execution of statements contained in the loop body a specific number of times. Syntax:

```
for NumberVariable = InitialValue to|downto LimitValue
begin
Statement;
[break;][continue;]
...
end;
```

where:

- "NumberVariable" is the variable of the loop which, after each iteration, will either increase or decrease by one (depending on the use of the keywords **To** or **Downto**);
- "InitialValue" is the initial numerical value of the loop variable;
- "Statement" is any instruction of the MetaQuotes Language II.
- "To" or "Downto" specify an increase of the loop variable by 1 ("To") or its decrease by 1 ("Downto");

- "LimitValue" is the marginal numerical value of the loop variable;

The operator brackets **Begin – End** denote the loop body and may be replaced by curly brackets { }. **Break** and **Continue** statements are not obligatory. Example:

```
for Counter = 1 to 10 begin
  if Counter > Bars then break;
  print( CloseCounter );
end;
```

This example illustrates a loop which may be executed 10 times. However, if the **Bars** value is less than 10, the loop breaks earlier, i.e. the loop is executed **Bars** times.

#### 4.2.6. The BREAK statement

The **Break** statement ensures an early termination of a **For** loop or a **While** loop. The previous example illustrates not only the operation of the loop, but also the use of the **Break** statement. The **Break** statement may not be used outside of the loop body. Loops may be nested, and the **Break** statement terminates only the loop which is closest to it. In other words, a statement breaking an internal loop doesn't break the external loop as well.

#### 4.2.7. The CONTINUE statement

The **Continue** statement terminates the iteration of the loop ahead of schedule and starts the execution of the next iteration from the beginning of the loop body. In other words, the statements following the **Continue** are ignored. Example:

```
for Counter = 1 to 10 begin
```

```
  ...
  if Counter > Bars then continue;
  print( Close[ Counter ] );
```

```
  ...
end;
```

This example illustrates a loop which will be executed exactly 10 times. However, the value **Close[ Counter ]** will be printed not more than **Bars** times. The "..." represents other MetaQuotes Language II statements.

### 4.3. Predefined variables of the trading terminal

For greater convenience of the user, some variables of the trading terminal may be accessed from the Expert Advisor.

- **AccountNumber** – the account number (synonym **AccNum**);
- **Ask** – the "Ask" price (synonym of the variable **PriceAsk**);
- **Balance** – value of the balance of the trading account;
- **Bars** – number of the bars on the chart – a very important variable showing the degree of filling of the chart with data;
- **Bid** – the "Bid" price (synonym of the variable **PriceBid**);
- **Close** – the "Close" price;
- **Credit** – credit advanced;
- **Equity** – status of account, including the unrealized profit;
- **FreeMargin** – value of the "Free Margin" of the trading account – also used to check the availability of funds on the account;
- **High** – maximum price over a period;
- **Low** – minimum price over a period;
- **Margin** – funds used to support the open positions;
- **Open** – the Open price;
- **Point** – value of a single point for the current financial instrument (on which the Expert Advisor runs at the moment), for example, for USD/JPY – 0.01, for USD/CHF – 0.0001 etc;
- **PriceAsk** – current "Ask" price as shown in the "Market Watch" window (synonym of the variable **Ask**);
- **PriceBid** – current "Bid" price as shown in the "Market Watch" window (synonym of the variable **Bid**);

- **PriceHigh** – maximum "Ask" price over the current 24-hour period (value from the "Market Watch" window);
- **PriceLow** – minimum "Bid" price over the current 24-hour period (value from the "Market Watch" window);
- **PriceTime** – current time as shown in the "Market Watch" window;
- **Time** – bar time if the price chart;
- **TotalProfit** – total unrealized profit for all the open positions;
- **TotalTrades** – total number of open positions and delayed orders in the trading terminal;
- **Volume** – volume (number of the ticks over a period).

It should be noted that **Close, Open, High, Low, Volume, Time** are arrays of historical data (seriesarrays) and allow access of such data over the past periods.

#### 4.4. Built-in functions

MetaQuotes Language II offers a number of functions for the most diverse uses. These include technical indicators, trading functions, time functions, mathematical and trigonometric functions, data conversion and output functions, etc.

- **Abs( nExpression )** – returns the absolute value (module) of the specific numerical value.  
Parameter: numerical value.
- **AccountName** – returns a text string containing the user name (synonym of **AccName**).
- **Alert(...)** – produces a dialog screen containing user-defined data.  
Any non-zero number of parameters is possible.
- **ArcCos( nExpression )** – returns a number representing arccosine of "nExpression" in the range – $\pi/2$  to  $\pi/2$  radians.  
Parameter: numerical value in the range –1 to 1.
- **ArcSin( nExpression )** – returns a number representing arcsine of "nExpression" in the range – $\pi/2$  to  $\pi/2$  radians.  
Parameter: numerical value in the range –1 to 1.
- **ArcTan( nExpression )** – returns a number representing arctangent of "nExpression" in the range – $\pi/2$  to  $\pi/2$  radians.  
Parameter: numerical value in the range –1 to 1.
- **Ceil( nExpression )** – returns a number representing the smallest closest integer which is equal or greater than the specified numerical value.  
Parameter: numerical value.
- **CloseOrder( order, lots, price, slippage, color )** – position closing.  
Parameters:  
"order" – number of order for the open position;  
"lots" – number of lots;  
"price" – preferred closing price;  
"slippage" – value of the maximum price slippage;  
color – color of the cross on the chart.
- **Comment(...)** – produces user-defines data in the left upper corner of the chart.  
Any non-zero number of parameters is possible.
- **Cos( nExpression )** – calculates and returns the cosine of the numerical value, representing the angle expressed in radians.  
Parameter: numerical value.
- **CurTime** – returns the number of seconds having passed since 0 hours, January 1, 1970.
- **Day** – returns the sequential number of the current day of the month.
- **DayOfWeek** – returns the sequential number of the current day of the week. 1 – Sunday, 2 – Monday, ... , 7 – Saturday.
- **DelArrow( time, price )** – deleting of previously placed pictografic symbol from the chart.  
Parameters:  
"time" – time reference point on the chart;  
"price" – price reference point on the chart;

**Note!** If pass zero as parameters time and price then **all** the pictografic symbols will be removed from the chart. If pass zero as one of parameters (time or price) then such parameter will not be checked and only non-zero parameter will be compared for deleting.

- **DeleteOrder( order )** – deleting of the previously placed delayed order.  
Parameter:  
"order" – number of the order of the delayed position.
- **DelGlobalVariable( name )** – deleting of the specified global variable.  
Parameter:  
"name" – text string containing global variable name.
- **DelObject( name, time, price, time\_precision, price\_precision )** – deleting of the named object created by the **MoveObject** function.  
Parameters:  
"name" – text string with object's name (empty string means any object);  
"time" – one of time reference points on the chart (zero value means any time);  
"price" – one of price reference point on the chart (zero value means any price);  
"time\_precision" – deviation from the time value;  
price\_precision – deviation from the price value.  
  
**Note!** If empty name passed then one of possible reference points will be checked in boundaries time-time\_precision — time+time\_precision, price-price\_precision — price+price\_precision for deleting a some object with any name.
- **Exp( nExpression )** – returns a number representing the exponent of the specified numerical value.  
Parameter: numerical value.
- **FileDelete( filename )** – deletes a specified file. If the file earlier was opened, then it should be closed, other was deleting will be failed.  
Parameter : "filename" – text string containing a specified file name.
- **FileClose( filehandle )** – closes a specified file.  
Parameter: "filehandle" – file identification code received from the **FileOpen** function.
- **FileOpen( filename, delimiter )** – opens a specified file in the 'Experts' directory and returns the numerical value that identifying opened file (file handle).  
Parameters:  
"filename" – text string containing a specified file name. There is 'Comma Separated Values' (CSV) file because data output by **FileWrite** function is symbolical (text) but not binary and separated with specified delimiter;  
"delimiter" – data delimitation symbol. May be passed as numerical value or as text string containing one symbol only.
- **FileReadNumber( filehandle )** – returns numerical value read from current position of the specified file. The file pointer is increased by the number of bytes actually read.  
Parameter: "filehandle" – file identification code received from the **FileOpen** function.
- **FileReadString( filehandle )** – returns text string read from current position of the specified file. The file pointer is increased by the number of bytes actually read.  
Parameter: "filehandle" – file identification code received from the **FileOpen** function.
- **FileSeek( filehandle, offset, origin )** – sets new read/write file position.  
Parameters:  
"filehandle" – file identification code received from the **FileOpen** function.  
"offset" – numeric value of the offset relatively of file begin (SEEK\_SET), current file position (SEEK\_CUR) or end of file (SEEK\_END).  
"origin" – one of 3 values – SEEK\_SET, SEEK\_CUR or SEEK\_END.
- **FileSize( filehandle )** – returns size of the specified file.  
Parameter: "filehandle" – file identification code received from the **FileOpen** function.
- **FileTell( filehandle )** – returns current read/write file position.  
Parameter: "filehandle" – file identification code received from the **FileOpen** function.
- **FileWrite( filehandle, ... )** – outputs specified data to the specified file into current position. **Print** function analog. Output data are separated with delimitation symbol specified at file open. After output the file pointer is increased by the number of bytes actually write and in the most of cases passed to the end of file.  
Parameters:  
"filehandle" – file identification code received from the **FileOpen** function.  
"data" – comma separated list of any output data.
- **Floor( nExpression )** – returns a number representing the greatest next integer equal to or smaller than the specified numerical value.  
Parameter: numerical value.

- **GetGlobalVariable( name )** – returns numerical value of defined global variable. If defined global variable does not exist then will return 0 and in the system journal will appear an error message.  
Parameter: "name" – text string containing global variable name.
- **GetIndexValue( shift )** – returns numeric value of the specified element from the primary data array of the current custom indicator. There is specific custom indicator function.  
Parameter: "shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **GetIndexValue2( shift )** – returns numeric value of the specified element from the secondary data array of the current custom indicator. There is specific custom indicator function.  
Parameter: "shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **GetTickCount** – operating system's function returns the number of milliseconds that have elapsed since the system was started. Difference between 2 GetTickCount values allows to estimate expert adviser's processing speed.
- **Highest( type, beginbar, periods )** – returns the shift of the maximum value of **Open, Low, High, Close** or **Volume** (depending on the "type" parameter) over the specified number of periods.  
Parameters:  
"type" – a returned variable, may take one of the following values: MODE\_OPEN, MODE\_LOW, MODE\_HIGH, MODE\_CLOSE, MODE\_VOLUME  
"beginbar" – a shift showing the bar, relative to the current bar, that the data should be taken from.  
"periods" – number of periods (in direction from beginbar to the current bar) on which the calculation is carried out.
- **Hour** – returns the sequential number of the current hour within the 24-hour period.
- **iAC( shift )** – accelerator-decelerator oscillator.  
Parameter: "shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iAD( shift )** – accumulation-distribution indicator.  
Parameter: "shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iADX( period, mode, shift )** – index of the average directed motion.  
Parameters:  
"period" – number of periods for calculation;  
"mode" – data type may take one of the following values: MODE\_MAIN (main indicator), MODE\_PLUSDI (line +DI), MODE\_MINUSDI (line -DI);  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iADXEx( period, applied\_price, mode, shift )** – index of the average directed motion (extended function).  
Parameters:  
"period" – number of periods for calculation;  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price, (H+L)/2), PRICE\_TYPICAL (typical price, (H+L+C)/3), PRICE\_WEIGHTED (weighted close, (H+L+C+C)/4).  
"mode" – data type may take one of the following values: MODE\_MAIN (main indicator), MODE\_PLUSDI (line +DI), MODE\_MINUSDI (line -DI);  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iAlligator( jaw\_period, jaw\_shift, teeth\_period, teeth\_shift, lips\_period, lips\_shift, ma\_method, applied\_price, mode, shift )** – Bill Williams' alligator.  
Parameters:  
"jaw\_period" – calculating period of the 'gator jaw' line (usually 13);  
"jaw\_shift" – forward shift of the 'gator jaw' line (usually 8);  
"teeth\_period" – calculating period of the 'gator teeth' line (usually 8);  
"teeth\_shift" – forward shift of the 'gator teeth' line (usually 5);  
"lips\_period" – calculating period of the 'gator lips' line (usually 5);  
"lips\_shift" – forward shift of the 'gator lips' line (usually 3);  
"ma\_method" – moving average method may take one of following values: MODE\_SMA (simple moving average), MODE\_EMA (exponential moving average), MODE\_SMMA (smoothed moving average), MODE\_LWMA (linear weighted moving average);  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price, (H+L)/2), PRICE\_TYPICAL (typical price, (H+L+C)/3), PRICE\_WEIGHTED (weighted close, (H+L+C+C)/4).

"mode" – data source may take one of the following values: MODE\_GATORJAW ('blue' balance line), MODE\_GATORTEETH ('red' balance line), MODE\_GATORLIPS ('green' balance line);  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.

- **iAO( shift )** – awesome oscillator.  
Parameter: "shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iATR( period, shift )** – indicator of the average true interval.  
Parameters:  
"period" – number of periods for calculation;  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iBands( period, deviation, mode, shift )** – Bollinger band indicator.  
Parameters:  
"period" – number of periods for calculation;  
"deviation" – deviation;  
"mode" – may take one of the following values: MODE\_MAIN (main line, slipping), MODE\_LOW (lower border), MODE\_HIGH (upper border);  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iBandsEx( period, deviation, bands\_shift, applied\_price, mode, shift )** – Bollinger band indicator (extended function).  
Parameters:  
"period" – number of periods for calculation;  
"deviation" – deviation;  
"bands\_shift" – forward or backward shift for calculated values;  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price,  $(H+L)/2$ ), PRICE\_TYPICAL (typical price,  $(H+L+C)/3$ ), PRICE\_WEIGHTED (weighted close,  $(H+L+C+C)/4$ ).  
"mode" – may take one of the following values: MODE\_MAIN (main line, slipping), MODE\_LOW (lower border), MODE\_HIGH (upper border);  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iBearsPower( period, applied\_price, shift )** – bears power indicator.  
Parameters:  
"period" – number of periods for calculation;  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price,  $(H+L)/2$ ), PRICE\_TYPICAL (typical price,  $(H+L+C)/3$ ), PRICE\_WEIGHTED (weighted close,  $(H+L+C+C)/4$ ).  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iBullsPower( period, applied\_price, shift )** – bulls power indicator.  
Parameters:  
"period" – number of periods for calculation;  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price,  $(H+L)/2$ ), PRICE\_TYPICAL (typical price,  $(H+L+C)/3$ ), PRICE\_WEIGHTED (weighted close,  $(H+L+C+C)/4$ ).  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iBWMFI( shift )** – market facilitation index.  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iCCI( period, shift )** – commodity channel index.  
Parameters:  
"period" – number of periods for calculation;  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iCCIEx( period, applied\_price, shift )** – commodity channel index (extended function).  
Parameters:  
"period" – number of periods for calculation;  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price,  $(H+L)/2$ ), PRICE\_TYPICAL (typical price,  $(H+L+C)/3$ ), PRICE\_WEIGHTED (weighted close,  $(H+L+C+C)/4$ ).  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iCustom( name [, parameter1 [,parameter2, ...]], mode, shift )** – custom indicator.  
Parameters:  
"name" – text string containing custom indicator program name;  
"parameter1", "parameter2", ... – numeric input parameters (if needed);  
"mode" – may take one of the following values: MODE\_FIRST (value from the primary data array),

MODE\_SECOND (value from the secondary data array);

"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.

Custom indicator program is a simple expert adviser written on the MQL II and passed translation (**Verify** button in the MetaEditor). Parameters for this program are passed in the same sequence as they are listed in the 'Inputs' section. Only numerical values can be passed as parameters! For the preparation of the primary and secondary (if needed) data arrays of the custom indicator are to be used **SetIndexValue** and **SetIndexValue2** functions. It is impossible to use some trade functions, custom indicator or user function call functions in the custom indicator.

- **iDeMarker( period, shift )** – DeMark indicator.  
Parameters:  
"period" – number of periods for calculation;  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iEnvelopes( period, ma\_method, deviation, applied\_price, mode, shift )** – envelopes indicator.  
Parameters:  
"period" – number of periods for calculation;  
"ma\_method" – moving average method may take one of following values: MODE\_SMA (simple moving average), MODE\_EMA (exponential moving average), MODE\_SMMA (smoothed moving average), MODE\_LWMA (linear weighted moving average);  
"deviation" – deviation percent;  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price, (H+L)/2), PRICE\_TYPICAL (typical price, (H+L+C)/3), PRICE\_WEIGHTED (weighted close, (H+L+C+C)/4).  
"mode" – can take one of values: MODE\_UPPER (upper band value), MODE\_LOWER (lower band value).  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iForce( period, ma\_method, applied\_price, shift )** – force indicator.  
Parameters:  
"period" – number of periods for calculation;  
"ma\_method" – moving average method may take one of following values: MODE\_SMA (simple moving average), MODE\_EMA (exponential moving average), MODE\_SMMA (smoothed moving average), MODE\_LWMA (linear weighted moving average);  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price, (H+L)/2), PRICE\_TYPICAL (typical price, (H+L+C)/3), PRICE\_WEIGHTED (weighted close, (H+L+C+C)/4).  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iFractals( mode, shift )** – fractals. If zero value returned then no any fractal presented.  
Parameters:  
"mode" – can take one of values: MODE\_UPPER (upper line values), MODE\_LOWER (lower line values).  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iGator( jaw\_period, jaw\_shift, teeth\_period, teeth\_shift, lips\_period, lips\_shift, ma\_method, applied\_price, mode, shift )** – gator oscillator.  
Parameters:  
"jaw\_period" – calculating period of the 'gator jaw' line (usually 13);  
"jaw\_shift" – forward shift of the 'gator jaw' line (usually 8);  
"teeth\_period" – calculating period of the 'gator teeth' line (usually 8);  
"teeth\_shift" – forward shift of the 'gator teeth' line (usually 5);  
"lips\_period" – calculating period of the 'gator lips' line (usually 5);  
"lips\_shift" – forward shift of the 'gator lips' line (usually 3);  
"ma\_method" – moving average method may take one of following values: MODE\_SMA (simple moving average), MODE\_EMA (exponential moving average), MODE\_SMMA (smoothed moving average), MODE\_LWMA (linear weighted moving average);  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price, (H+L)/2), PRICE\_TYPICAL (typical price, (H+L+C)/3), PRICE\_WEIGHTED (weighted close, (H+L+C+C)/4).  
"mode" – data source may take one of the following values: MODE\_UPPER (absolute difference between 'blue' and 'red' lines), MODE\_LOWER (negative absolute difference between 'red' and 'green' lines);  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **Ichimoku( tenkan\_sen, kijun\_sen, senkou\_span\_b, mode, shift )** – Ichimoku Kinko Hyo.  
Parameters:  
"tenkan\_sen" – Tenkan Sen period (usually 9);  
"kijun\_sen" – Kijun Sen period (usually 26);

"senkou\_span\_b" – Senkou SpanB period (usually 52);

"mode" – data source may take one of the following values: MODE\_TENKANSEN, MODE\_KIJUNSEN, MODE\_SENKOUSPANA, MODE\_SENKOUSPANB, MODE\_CHINKOUSPAN;

"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.

- **iMA( period, mode, shift )** – moving average indicator.  
Parameters:  
"period" – number of periods for calculation;  
"mode" – mode of calculation, which may take one of the following values: MODE\_SMA, MODE\_EMA, MODE\_WMA.  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iMAEx( period, ma\_shift, applied\_price, ma\_method, shift )** – moving average indicator (extended function).  
Parameters:  
"period" – number of periods for calculation;  
"ma\_shift" – forward or backward shift of the calculated values;  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price, (H+L)/2), PRICE\_TYPICAL (typical price, (H+L+C)/3), PRICE\_WEIGHTED (weighted close, (H+L+C+C)/4).  
"ma\_method" – moving average method may take one of following values: MODE\_SMA (simple moving average), MODE\_EMA (exponential moving average), MODE\_SMMA (smoothed moving average), MODE\_LWMA (linear weighted moving average);  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iMACD( fast\_ema\_period, slow\_ema\_period, signal\_period, mode, shift )** – moving averages convergence/divergence indicator.  
Parameters:  
"fast\_ema\_period" – number of periods for calculation of the 'fast' moving average (usually 12);  
"slow\_ema\_period" – number of periods for calculation of the 'slow' moving average (usually 26);  
"signal\_period" – number of periods for calculation of the 'signal' moving average (usually 9);  
"mode" – source of data, may take one of the following values: MODE\_MAIN (main indicator), MODE\_SIGNAL (signal line);  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iMACDEx( fast\_ema\_period, slow\_ema\_period, signal\_period, applied\_price, mode, shift )** – moving averages convergence/divergence indicator (extended function).  
Parameters:  
"fast\_ema\_period" – number of periods for calculation of the 'fast' moving average (usually 12);  
"slow\_ema\_period" – number of periods for calculation of the 'slow' moving average (usually 26);  
"signal\_period" – number of periods for calculation of the 'signal' moving average (usually 9);  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price, (H+L)/2), PRICE\_TYPICAL (typical price, (H+L+C)/3), PRICE\_WEIGHTED (weighted close, (H+L+C+C)/4).  
"mode" – source of data, may take one of the following values: MODE\_MAIN (main indicator), MODE\_SIGNAL (signal line);  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iMFI( period, shift )** – money flow index.  
Parameters:  
"period" – number of periods for calculation;  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iMom( period, shift )** – momentum indicator.  
Parameters:  
"period" – number of periods for calculation;  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iMomEx( period, applied\_price, shift )** – momentum indicator (extended function).  
Parameters:  
"period" – number of periods for calculation;  
"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price, (H+L)/2), PRICE\_TYPICAL (typical price, (H+L+C)/3), PRICE\_WEIGHTED (weighted close, (H+L+C+C)/4).  
"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- **iOBV( shift )** – on balance volume indicator.  
Parameter: "shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.

- iOsMA( fast\_ema\_period, slow\_ema\_period, signal\_period, applied\_price, shift )** – moving averages of oscillator.

Parameters:

"fast\_ema\_period" – number of periods for calculation of the 'fast' moving average (usually 12);

"slow\_ema\_period" – number of periods for calculation of the 'slow' moving average (usually 26);

"signal\_period" – number of periods for calculation of the 'signal' moving average (usually 9);

"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price, (H+L)/2), PRICE\_TYPICAL (typical price, (H+L+C)/3), PRICE\_WEIGHTED (weighted close, (H+L+C+C)/4).

"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- iRSI( period, shift )** – relative strength index.

Parameters:

"period" – number of periods for calculation;

"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- iRSIEx( period, period2, applied\_price, mode, shift )** – relative strength index (extended function).

Parameters:

"period" – number of periods for calculation;

"period2" – number of periods for calculation of the second line;

"applied\_price" – price to which calculation will be applied: PRICE\_CLOSE, PRICE\_OPEN, PRICE\_HIGH, PRICE\_LOW, PRICE\_MEDIAN (median price, (H+L)/2), PRICE\_TYPICAL (typical price, (H+L+C)/3), PRICE\_WEIGHTED (weighted close, (H+L+C+C)/4).

"mode" – source of data, may take one of the following values: MODE\_FIRST (main indicator), MODE\_SECOND (second line);

"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- iRVI( period, mode, shift )** – relative vigor index.

Parameters:

"period" – number of periods for calculation;

"mode" – source of data, may take one of the following values: MODE\_MAIN (main indicator), MODE\_SIGNAL (signal line);

"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- iSAR( step, maximum, shift )** – parabolic SAR.

Parameters:

"step" – increment, usually 0.02;

"maximum" – maximum value, usually 0.2.
- iSTO( %Kperiod, %Dperiod, slowing, method, mode, shift )** – "stochastic oscillator" indicator.

Parameters:

"%Kperiod" – %K line period;

"%Dperiod" – %D line period;

"slowing" – slowing value;

"method" – method of calculation, may take one of the following values: MODE\_SMA (simple average), MODE\_EMA (exponential), MODE\_WMA (weighted);

"mode" – source of data, may take one of the following values: MODE\_MAIN (main indicator line), MODE\_SIGNAL (signal indicator line);

"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- iWPR(period, shift)** – Williams percentage range indicator.

Parameters:

"period" – number of periods for calculation;

"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.
- IsDemo** – returns logical value "True" if the Expert Advisor runs on a training account. Otherwise returns "False" value.
- IsFileEnded( filehandle )** – returns logical value 'True' if end of the specified file during the read reached..

Parameter: "filehandle" – file identification code received from the **FileOpen** function.
- IsFileLineEnded( filehandle )** – returns logical value 'True' if end of line ('carriage return' or 'line feed') symbol during the read reached.

Parameter: "filehandle" – file identification code received from the **FileOpen** function.
- IsGlobalVariable( name )** – returns logical value 'True' if the specified global variable exists. Or 'False' otherwise.

Parameter: "name" – text string containing global variable name.

- **IsIndirect** – returns logical value 'True' if the specified instrument is calculated using the reverse method. Otherwise returns "False" value.
- **IsTesting** – returns logical value 'True' if expert advisor launched for testing. Or 'False' otherwise.
- **IsTradeAllowed** – returns logical value 'True' if checkbox "allow live trading" in expert advisor's properties is checked. Or 'False' otherwise.
- **LastTradeTime** – returns a number representing the time of execution of the most recent trade (**SetOrder**, **DelOrder**, **CloseOrder**, **ModifyOrder**) in seconds having passed since 0 hours, January 1, 1970.
- **Log( nExpression )** – returns a logarithm of the specified positive numerical value.  
Parameter: positive numerical value.
- **Lowest( type, beginbar, periods )** – returns the shift of the least value of **Open**, **Low**, **High**, **Close** or **Volume** (depending on the "type" parameter) over a specific number of periods.  
Parameters:  
"type" – may take one of the following values: MODE\_OPEN, MODE\_LOW, MODE\_HIGH, MODE\_CLOSE, MODE\_VOLUME;  
"beginbar" – a shift showing the bar, relative to the current bar, that the data should be taken from;  
"periods" – number of periods (in direction from beginbar to the current bar) on which the calculation is carried out.
- **MarketInfo( symbol, mode )** – returns one of specified values from the "Market Watch" window.  
Parameters:  
"symbol" – the financial instrument short name of which information is needed;  
"mode" – type of returned data can take one of the values: MODE\_HIGH, MODE\_LOW, MODE\_BID, MODE\_ASK, MODE\_TIME.
- **Max( nExpression1, nExpression2 )** – returns maximal value of two specified numeric values.
- **Min( nExpression1, nExpression2 )** – returns minimal value of two specified numeric values.
- **Minute** – returns the sequential number of the current minute in the hour.
- **Mod( nExpression1, nExpression2 )** – returns an integer representing the remainder of division of one numerical value by another one.  
Parameters: numerical value1, numerical value2.
- **ModifyOrder( order, price, stoploss, takeprofit, color )** – modification of characteristics for the previously opened position or a delayed order.  
Parameters:  
"order" – number or order of the opened or delayed position;  
"price" – new price (only for a pending orders!);  
"stoploss" – new stop loss level;  
"takeprofit" – new profit-taking level;  
"color" – color of the pictogram on the chart.
- **Month** – returns the sequential number of the current month.
- **MoveObject( name, type, time, price, time2, price2 [,color [,weight [, style]]] )** – moving or creation of a named object.  
Parameters:  
"name" – name of the object in a text string form;  
"type" – object type, may take one of the following values: OBJ\_HLINE (horizontal line), OBJ\_VLINE (vertical line), OBJ\_TRENDLINE (trend line), OBJ\_SYMBOL (setting a pictogram), OBJ\_TEXT (text string), OBJ\_FIBO (Fibonacci retracement);  
"time" – first chart reference point by time;  
"price" – first chart reference point by price;  
"time2" – second chart reference point by time;  
price2 – second chart reference point by price;  
  
Optional parameters:  
"color" – object's color;  
"weight" – line weight in pixels (values from 1 to 5 are allowed);  
"style" – line style, may take one of values: STYLE\_SOLID, STYLE\_DASH, STYLE\_DOT, STYLE\_DASHDOT, STYLE\_DASHDOTDOT.

**Note:** both reference points are used for trend lines and Fibonacci retracement. For text string or for pictographical symbol is used second reference point only, first reference point is ignored. For any horizontal line is used 'price2' value only. For vertical line – 'time2' value.

- **Normalize( number, precision )** – returns numeric value rounded to the specified precision.  
Parameters:  
"number" – specified numerical value;  
"precision" – precision format, number of digits after the decimal point.
  - **NumberToStr( number, precision )** – returns text string with the specified numerical value transformed into the specified precision format. The function used to produce numerical values with other precision format than 4 digits after the decimal point.  
Parameters:  
"number" – specified numerical value;  
"precision" – precision format, number of digits after the decimal point.
  - **OrderValue( position, mode )** – returns one of the specified values of the order.  
Parameters:  
"position" – position of the order in the trading terminal list, starting from 1;  
"mode" – type of the returned data, may take one of the following values: VAL\_TICKET (order number), VAL\_OPENTIME (order opening time), VAL\_TYPE (order type), VAL\_LOTS (number of requested lots), VAL\_SYMBOL (name of the instrument, in form of a text string), VAL\_OPENPRICE (opening price), VAL\_STOPLOSS (stop loss level), VAL\_TAKEPROFIT (take profit level), VAL\_CLOSEPRICE (closing price), VAL\_COMMISSION (commission amount), VAL\_SWAP (amount of rollover fees for the position rollover), VAL\_PROFIT (amount of profit of the trade), VAL\_COMMENT (comment on the particular position in form of a text string), VAL\_CLOSETIME (order closing time).
  - **Ord** – same as in **OrderValue**.
  - **Period** – returns the number of minutes defining the used period.
  - **Pow( nBaseExpression, nExponentExpression )** – returns the number produced by raising the "nBaseExpression" number to the "nExponentExpression" power, given as parameters.  
Parameters: numerical value1, numerical value2.
  - **Print(...)** – prints the data defined by the user into the system log.  
Any non-zero number of parameters possible.
  - **PrintTrade( position )** – stores the details of a particular position in the log.  
Parameter: "position" – number of an opened position in the trading terminal.
  - **Rand** – returns a generated pseudorandom number.  
Before using this function, pseudorandom number generator should be set to initial position using the **Srand** function. If the pseudorandom number generator is to be used, it is set into the initial position once, at the start of the programme.
  - **Round( nExpression )** – returns a number representing a specified numerical value rounded to the closest integer.  
Parameter: a numerical value.
  - **Seconds** – returns the sequential number of the current second in the minute.
  - **ServerAddress** – returns the server IP-address in form of a text string.
  - **SetArrow( time, price, symbol, color )** – setting the pictographic symbol on the chart.  
Parameters:  
"time" – chart reference point by time;  
"price" – chart reference point by price;  
"symbol" – numerical value of the symbol from the Wingdings font set;  
"color" – pictogram color.
  - **SetDebugMode( mode )** – sets debug info output mode.  
Parameter: "mode" – debug info output mode can take one of values: MODE\_FILE (output to file; all the debug info as well as printed data will output into the separate log-file EXPERT\_NAME.log), MODE\_VALUES (output all the variables values after expert advisor processing), MODE\_TIME (output expert advisor's elapsed time, executed instructions count, remaining stack size), 0 (all the set modes cancellation); Modes can be combined one with other with the adding it's values (for example: MODE\_FILE + MODE\_VALUES + MODE\_TIME).
- Note!** This function still not working.
- **SetGlobalVariable( name, value )** – sets specified numerical value to the specified global variable.  
If the specified global variable does not exist then it will be created. Global variables are accessible to any expert advisor. Global variables are kept in the 'gvariables.dat' file. If some global variable will not used in the period of 2 weeks then this one will be deleted automatically.

Parameters:

"name" – text string containing global variable name;  
"value" – specified numerical value.

- **SetIndexValue( shift, value )** – sets specified numeric value to the specified primary data array's element of the current custom indicator. There is custom indicator program' specific function.

Parameters:

"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.

"value" – numeric value to set.

- **SetIndexValue2( shift, value )** – sets specified numeric value to the specified secondary data array's element of the current custom indicator. There is custom indicator program' specific function.

Parameters:

"shift" – shift relative to the current bar (number of periods back), where the data is to be taken from.

"value" – numeric value to set.

- **SetLoopCount( count )** – sets limitation quantity of executed instructions. This function allows to limit the performance time of the expert advisor. Value 1000000 is used by default. Special value 0 allows to turn off the control of the quantity of executed instructions, however in purposes of an infinite loop protection the expert advisor will not work more than one second.

Parameter: "count" – limitation quantity of executed instructions.

- **SetObjectText( name, time, price, symbol, color )** – assign a text string to a specified object of OBJ\_TEXT type.

Parameters:

"name" – object name;

"text" – specified text;

"font" – font name;

"size" – font size;

"color" – text color.

- **SetOrder( operation, lots, price, slippage, stoploss, takeprofit, color )** – main function used to open a position or set a delayed order.

Parameters:

"operation" – type of operation, may take the following values: OP\_BUY (opening the buying position), OP\_SELL (opening the selling position), OP\_BUYLIMIT, OP\_SELLLIMIT, OP\_BUYSTOP, OP\_SELLSTOP (putting the delayed order);

"lots" – number of lots;

"price" – preferred closing price of the trade;

"slippage" – maximum price slippage for OP\_BUY and OP\_SELL operations;

"stoploss" – Stop Loss level;

"takeprofit" – Profit Taking level;

"color" – color of the arrow put on the chart when the function is called.

- **SetText( time, price, string, color )** – put a text string on the chart in the specified position.

Parameters:

"time" – chart reference point by time;

"price" – chart reference point by price;

"string" – text string;

"color" – text color.

- **Sin( nExpression )** – calculates and returns the sine of the numerical value representing the angle in radians.

Parameter: numerical value.

- **Sqrt( nExpression )** – calculates and returns the square root of the specified positive numerical value.

Parameter: positive numerical value.

- **Srand( initial\_value )** – sets the pseudorandom number generator to the initial position. If the generator is to be used, it is set into the initial position once, at the start of the programme. The best value to be used for initial setting is the number returned by the **Time** function – in this case the randomness of the sequence generation is increased.

Parameter: positive numerical value.

- **StrToTime( DateTimeString )** – returns numeric time value, converted from text string such as "yyyy.mm.dd hh:mi"

Parameter: date and(or) time as string.

**Note:** strings as "yyyy.mm.dd hh:mi", "yyyy.mm.dd", "hh:mi" are allowed. Missing data (date or time) assumes current date or current time.

- **Symbol** – returns a text string with the name of the financial instrument the Expert Advisor is running on.
- **Tan( nExpression )** – calculates and returns the tangent of a numerical value representing an angle in radians.  
Parameter: numerical value.
- **TimeDay( Time )** – returns sequential day number in the month of the specified time value.  
Parameter: positive numerical value.
- **TimeDayOfWeek( Time )** – returns sequential day number in the week of the specified time value.  
1 – sunday, 2 – monday, ... , 7 – saturday.  
Parameter: positive numerical value.
- **TimeHour( Time )** – returns sequential hour (from 0 to 23) number in the day of the specified time value.  
Parameter: positive numerical value.
- **TimeMinute( Time )** – returns sequential minute (from 0 to 59) number in the hour of the specified time value.  
Parameter: positive numerical value.
- **TimeMonth( Time )** – returns sequential month number in the year of the specified time value.  
Parameter: positive numerical value.
- **TimeSeconds( Time )** – returns sequential second (from 0 to 59) number in the minute of the specified time value.  
Parameter: positive numerical value.
- **TimeToStr( Time )** – returns text string of "yyyy.mm.dd hh:mi" type, produced from the specified numerical value representing the number of seconds having passed since 0 hours, January 1, 1970.  
  
Parameter: positive numerical value.
- **TimeYear( Time )** – returns the number of the year of the specified time value.  
Parameter: positive numerical value.
- **UserFunction( name [, parameter1 [,parameter2, ...]] )** – calls for execution specified MQL II – program (user function).  
Parameters:  
"name" – user function name;  
"parameter1", "parameter2", ... – numeric parameters (if needed).

User function program is a simple expert adviser written on the MQL II and passed translation (**Verify** button in the MetaEditor). Parameters for this program are passed in the same sequence as they are listed in the 'Inputs' section. Only numerical values can be passed as parameters! For the returning of some value is to be used **Return** function. UserFunction function returns the same value that was set by the **Return** function in the user function program. **Return** function is specific for the user function program.

- **Year** – returns the number of the current year.

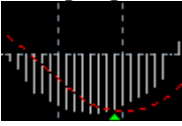
### Step-By-Step Creation of Simple Expert

- Review
- Programming language MetaQuotes Language II (MQL II)
- Step-By-Step Creation of Simple Expert
- Features of Writing Experts
- Features of Writing Custom Indicators and User Functions
- Technical Indicators

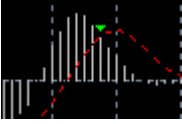
Let's try to create an Expert Advisor running on the standard MACD indicator, with the profit-taking capability, supporting trailing stops and using most safeguards for secure operation. In the example given below the trade is done by opening and controlling a single position.

Trading principles:

- **Long (BUY) entry** – MACD indicator is below zero, goes upwards and is crossed by the "Signal Line" going downwards.



- **Short (SELL) entry** – MACD indicator is above zero, goes downwards and is crossed by the "Signal Line" going upwards.



- **Long exit** – by execution of the take profit limit, by execution of the trailing stop or when MACD crosses its "Signal Line" (MACD is above zero, goes downwards and is crossed by the "Signal Line" going upwards).
- **Short exit** – by execution of the take profit limit, by execution of the trailing stop or when MACD crosses its "Signal Line" (MACD is below zero, goes upwards and is crossed by the "Signal Line" going downwards).

**Important note:** to exclude insignificant changes of the MACD indicator (small 'hillocks' on the chart) from our analysis, we introduce an additional measure of controlling the size of the plotted 'hillocks' as follows: the indicator size should be at least 5 units of the minimum price ( $5 \cdot \text{Point}$ , which for USD/CHF = 0.0005 and for USD/JPY = 0.05).



[enlarge](#)

#### Step I: Writing the Expert Advisor description



Point the mouse pointer on the **Expert Advisors** section of the "Navigator" window, press the right button of the mouse and select "**Create a new Expert**" command in the appearing menu. The "Initializing Wisard" of the Expert Advisor will ask you to enter certain data. In the appearing window we write the name (**Name**) of the Expert Advisor – "MACD Sample", the author (**Author**) – indicate your name, the link (**Link**) – a link to your website, in the notes (**Notes**) – "Test example of an MACD-based Expert Advisor".

#### Step II: Creating the primary structure of the programme

Code of the test Expert Advisor will only occupy several pages, but even such volume is often difficult to grasp, especially in view of the fact that we are not professional programmers – otherwise we wouldn't need this description at all, right? :)

To get some idea of the structure of a standard Expert Advisor, let's take a look at the description given below:

1. Initial data checks
  - check the chart, number of bars on the chart
  - check the values of external variables: Lots, S/L, T/P, T/S
2. Setting the internal variables for quick data access
3. Checking the trading terminal – is it void? If yes, then:
  - checks: availability of funds on the account etc...
  - is it possible to take a long position (BUY)?
    - » open a long position and exit
  - is it possible to take a short position (SELL)?
    - » open a short position and exit
  - exiting the Expert Advisor...
4. Control of the positions previously opened in the cycle
  - if it is a long position
    - » should it be closed?
    - » should the trailing stop be reset?
  - if it is a short position
    - » should it be closed?
    - » should the trailing stop be reset?

It turned out to be relatively simple, with only 4 main blocks.

Now let's try to generate pieces of code step by step for each section of the structural scheme:

#### 1. Initial data checks

This piece of code usually migrates from one Expert Advisor to another with minor changes – it is a practically standard block of checks:

```
If Bars<200 Then Exit; // the chart has less than 200 bars – exit
If TakeProfit<10 Then Exit; // wrong takeprofit parameters
```

#### 2. Setting the internal variables for quick data access

In the programme code it is very often necessary to access the indicator values or handle the computed values. To simplify the coding and speed up the access, the data is initially nested within the internal variables.

```
MacdCurrent=iMACD(12,26,9,0,MODE_MAIN); // MACD value on the current bar
MacdPrevious=iMACD(12,26,9,1,MODE_MAIN); // MACD value on the previous bar
SignalCurrent=iMACD(12,26,9,0,MODE_SIGNAL); // Signal Line value on the current bar
SignalPrevious=iMACD(12,26,9,1,MODE_SIGNAL); // Signal Line value on the previous bar
MaCurrent=iMA(MATrendPeriod,MODE_EMA,0); // moving average value on the current bar
MaPrevious=iMA(MATrendPeriod,MODE_EMA,1); // moving average value on the previous bar
```

Now, instead of the monstrous notation of **iMACD(12,26,9,MODE\_MAIN,0)** we can simply write in the program text **MacdCurrent**. All the variables used by the Expert Advisor will have to be preliminarily described, according to the MetaQuotes Language II description. Therefore we insert the description of these variables at the beginning of the programme:

```
var: MacdCurrent(0), MacdPrevious(0), SignalCurrent(0), SignalPrevious(0);
var: MaCurrent(0), MaPrevious(0);
```

MetaQuotes Language II also introduces the concept of additional user-defined variables which may be set from outside the programme, without any interference with the source source text of the Expert Advisor programme. This feature allows added flexibility. Variable **MATrendPeriod** is a user-defined variable of this very type. So, we insert the description of this variable in the beginning of the programme.

```
defines: MATrendPeriod(56);
```

#### 3. Checking the trading terminal – is it void? If yes, then:

In our Expert Advisor we only use the current positions and don't handle the delayed orders.

However, to be on the safe side, let's introduce a check of the trading terminal for previously placed orders:

```
If TotalTrades < 1 then // no opened orders identified {
```

- **Checks: availability of funds on the account etc...**  
Before analyzing the market situation it is advisable to check the status of your account to make sure that there are free funds for opening a position.

```
If FreeMargin < 1000 then Exit; // no funds – exit
```

- **is it possible to take a long position (BUY)?**  
Condition of entry into the long position: MACD is below zero, goes upwards and is crossed by the Signal Line going downwards. This is how we describe it in MQL II (note that we operate on the indicator values which were previously saved in the variables):

```
If MacdCurrent < 0 and MacdCurrent > SignalCurrent and
    MacdPrevious < SignalPrevious and // a cross-section exists
    Abs(MacdCurrent) > (MACDOpenLevel*Point) and // the indicator plotted a decent 'hillock'
    MaCurrent > MaPrevious then // 'bull' trend
    {
    SetOrder(OP_BUY,Lots,Ask,3,0,Ask+TakeProfit*Point,RED); // executing
    Exit; // exiting, since after the execution of a trade
    // there is a 10-second trading timeout
    };
```

Above we mentioned the method of additional monitoring of the size of the plotted 'hillocks'. **MACDOpenLevel** variable is a user-defined variable which may be changed without interfering with the programme text, to ensure greater flexibility. In the beginning of the programme we insert a description of this variable (as well as the description of the variable used below).

```
defines: MACDOpenLevel(3), MACDCloseLevel(2);
```

- **is it possible to take a short position (SELL)?**  
Condition of entry of a short position: MACD is above zero, goes downwards and is crossed by the Signal Line going upwards. The notation is as follows:

```
If MacdCurrent > 0 and MacdCurrent < SignalCurrent and
    MacdPrevious > SignalPrevious and MacdCurrent > (MACDOpenLevel*Point) and
    MaCurrent < MaPrevious then
    {
    SetOrder(OP_SELL,Lots,Bid,3,0,Bid-TakeProfit*Point,RED); // executing
    Exit; // exiting
    };
Exit; // no new positions opened – just exit
};
```

#### 4. Control of the positions previously opened in the cycle

```
for cnt=1 to TotalTrades
    {
    if OrderValue(cnt,VAL_TYPE)<=OP_SELL and // is it an open position?
    OrderValue(cnt,VAL_SYMBOL)=Symbol then // position from "our" chart?
    {
```

**Cnt** is the cycle variable which is to be described at the beginning of the programme as follows:

```
var: Cnt(0);
```

- if it is a long position:

```
If OrderValue(cnt,VAL_TYPE)=OP_BUY then // long position opened
```

{

- **Should it be closed?**

Condition for exiting a long position: MACD is crossed by its Signal Line, MACD being above zero, going downwards and being crossed by the Signal Line going upwards.

```
    If MacdCurrent > 0 and MacdCurrent < SignalCurrent and
      MacdPrevious > SignalPrevious and MacdCurrent > (MACDCloseLevel*Point) then
    {
      CloseOrder(OrderValue(cnt,VAL_TICKET),OrderValue(cnt,VAL_LOTS),Bid,3,Violet); Exit; // exit
    };
```

- **should the trailing stop be reset?**

We set the trailing stop only in case the position already has a profit exceeding the trailing stop level in points, and in case the new level of the stop is better than the previous.

If TrailingStop > 0 then // if trailing stops are used

```
{
  If (Bid-OrderValue(cnt,VAL_OPENPRICE))>(Point*TrailingStop) then
  {
    If OrderValue(cnt,VAL_STOPLOSS)<(Bid-Point*TrailingStop) then
    {
      ModifyOrder(OrderValue(cnt,VAL_TICKET),OrderValue(cnt,VAL_OPENPRICE),
        Bid-Point*TrailingStop,OrderValue(cnt,VAL_TAKEPROFIT),Red);
      Exit
    };
  };
};
```

- **if it is a short position:**

```
    else // otherwise it is a short position
    {
```

- **should it be closed?**

Condition for exiting a short position: MACD is crossed by its Signal Line, MACD being below zero, going upwards and being crossed by the Signal Line going downwards.

```
    If MacdCurrent<0 and MacdCurrent>SignalCurrent and
      MacdPrevious(MACDCloseLevel*Point) then
    { \ CloseOrder(OrderValue(cnt,VAL_TICKET),OrderValue(cnt,VAL_LOTS),Ask,3,Violet);
      Exit; // exit };
```

- **should the trailing stop be reset?**

We set the trailing stop only in case the position already has a profit exceeding the trailing stop level in points, and in case the new level of the stop is better than the previous.

```
    If TrailingStop>0 then // the user has put a trailing stop in his settings
      { // so, we set out to check it
        If (OrderValue(cnt,VAL_OPENPRICE)-Ask)>(Point*TrailingStop) then
        {
          If OrderValue(cnt,VAL_STOPLOSS)=0 or
            OrderValue(cnt,VAL_STOPLOSS)>(Ask+Point*TrailingStop) then
          {
            ModifyOrder(OrderValue(cnt,VAL_TICKET),OrderValue(cnt,VAL_OPENPRICE),
              Ask+Point*TrailingStop,OrderValue(cnt,VAL_TAKEPROFIT),Red)
            Exit;
```

```

    };
    };
    };
    // end. Closing all the curly bracket which remain open
    };
    };
    };

```

So, following this step-by-step procedure, we have written our Expert Advisor...

### Step III: Assembling the resulting code of the programme

Let's open the Expert Advisor settings (using a button or a line in the **Properties...** menu). We are offered a window in which we have to define the external settings of the working parameters:

Let's assemble all the code from the previous section:

```

    defines: MACDOpenLevel(3),MACDCloseLevel(2);
    defines: MATrendPeriod(56);
    var: MacdCurrent(0),MacdPrevious(0),SignalCurrent(0),SignalPrevious(0);
    var: MaCurrent(0),MaPrevious(0);
    var: cnt(0);
    // initial data checks
    // it is important to make sure that the Expert Advisor runs on a normal chart and that
    // the user has correctly set the external variables (Lots, StopLoss,
    // TakeProfit, TrailingStop)
    // in our case we only check the TakeProfit
    If Bars<200 or TakeProfit<10 then Exit; // less than 200 bars on the chart
    // to simplify and speed up the procedure, we store the necessary
    // indicator data in temporary variables
    MacdCurrent = iMACD(12,26,9,0,MODE_MAIN);
    MacdPrevious = iMACD(12,26,9,1,MODE_MAIN);
    SignalCurrent = iMACD(12,26,9,0,MODE_SIGNAL);
    SignalPrevious= iMACD(12,26,9,1,MODE_SIGNAL);
    MaCurrent = iMA(MATrendPeriod,MODE_EMA,0);
    MaPrevious = iMA(MATrendPeriod,MODE_EMA,1);
    // now we have to check the status of the trading terminal.
    // we are going to see whether there are any previously opened positions or orders.
    If TotalTrades<1 then
    {
    // there are no opened orders
    // just to be on the safe side, we make sure we have free funds on our account.
    // the "1000" value is taken just as an example, usually it is possible to open 1 lot
    If FreeMargin<1000 then Exit; // no money – we exit

    // checking for the possibility to take a long position (BUY)
    If MacdCurrent<0 and MacdCurrent>SignalCurrent and
    MacdPrevious<SignalPrevious and Abs(MacdCurrent)>(MACDOpenLevel*Point) and
    MaCurrent>MaPrevious then
    {
    SetOrder(OP_BUY,Lots,Ask,3,0,Ask+TakeProfit*Point,RED); // executing
    Exit; // exiting, since after the execution of a trade
    // there is a 10-second trading timeout
    };

```

```

// checking for the possibility of taking a short position (SELL)
// If MacdCurrent>0 and MacdCurrent<SignalCurrent and
MacdPrevious>SignalPrevious and MacdCurrent>(MACDOpenLevel*Point) and
MaCurrent<MaPrevious then
{
SetOrder(OP_SELL,Lots,Bid,3,0,Bid-TakeProfit*Point,RED); // executing
Exit; // exiting
};

// here we completed the check for the possibility of opening new positions.
// no new positions were opened and we simply exit the programme using the Exit command, as
// there is nothing to analyze
Exit;
};

// we come over to an important part of the Expert Advisor – the control of open positions
// it is important to enter the market correctly, but it is even more important to exit it...'
for cnt=1 to TotalTrades
{
if OrderValue(cnt,VAL_TYPE)<=OP_SELL and // is this an open position? OP_BUY or OP_SELL
OrderValue(cnt,VAL_SYMBOL)=Symbol then // does the instrument match?
{
If OrderValue(cnt,VAL_TYPE)=OP_BUY then // long position opened
{
// we check – maybe, it's already time to close it?
If MacdCurrent>0 and MacdCurrent<SignalCurrent and
MacdPrevious>SignalPrevious and MacdCurrent>(MACDCloseLevel*Point) then
{
CloseOrder(OrderValue(cnt,VAL_TICKET),OrderValue(cnt,VAL_LOTS),Bid,3,Violet);
Exit; // exiting
};
// we check – maybe, we already may or it's already time to set a trailing stop?
If TrailingStop>0 then // the user has put a trailing stop in his settings
{ // so, we set out to check it
If (Bid-OrderValue(cnt,VAL_OPENPRICE))>(Point*TrailingStop) then
{
If OrderValue(cnt,VAL_STOPLOSS)<(Bid-Point*TrailingStop) then
{
ModifyOrder(OrderValue(cnt,VAL_TICKET),OrderValue(cnt,VAL_OPENPRICE),
Bid-Point*TrailingStop,OrderValue(cnt,VAL_TAKEPROFIT),Red);
Exit;
};
};
};
}
else // otherwise it is a short position
{
// we check – maybe, it's already time to close it?
If MacdCurrent<0 and MacdCurrent>SignalCurrent and
MacdPrevious<SignalPrevious and Abs(MacdCurrent)>(MACDCloseLevel*Point) then
{
CloseOrder(OrderValue(cnt,VAL_TICKET),OrderValue(cnt,VAL_LOTS),Ask,3,Violet);
Exit; // exiting
};
// we check – maybe, we already may or it's already time to set a trailing stop?
If TrailingStop>0 then // the user has put a trailing stop in his settings
{
// so, we set out to check it
If(OrderValue(cnt,VAL_OPENPRICE)-Ask)>(Point*TrailingStop) then
{
If OrderValue(cnt,VAL_STOPLOSS)=0 or
OrderValue(cnt,VAL_STOPLOSS)>(Ask+Point*TrailingStop) then
{

```



- Features of Writing Experts
- Features of Writing Custom Indicators and User Functions
- Technical Indicators

Writing and testing experts in FXDirectDealer trading system has a number of features.

- Before opening a position it is necessary to check if there is any free money at the account. If there is not enough money at the account the operation of opening a position will end unsuccessfully. And at the same time, when being tested the **FreeMargin** value must necessarily be above 1000 because when being tested one lot price makes 1000.

```
If FreeMargin < 1000 Then Exit; // no money – exit
```

- After having opened, closed or changed a position or after having deleted a pending order (i.e., after having used any of the following commands: **SetOrder**, **CloseOrder**, **ModifyOrder** or **DeleteOrder**), it is recommended to finish the expert program using the **Exit** instruction, as after completing the operation a 10-seconds-timeout begins which is used for processing trading operations. But for all that, this 10-seconds-timeout does not function during the testing (it is possible to process several operations one after another), and, if one does not finish the expert running by executing the **Exit** instruction after having completed the operation, the testing results can differ from those of the real expert trading.

```
SetOrder(OP_SELL,Lots,Bid,3,0,Bid-TakeProfit*Point,RED); // execute
Exit; // exit
```

To prevent a possibility of processing several trade operations with an interval of less than 10 seconds during the testing it is also possible to check before processing the next operation that no less than 10 seconds have passed after completing the last trade operation.

```
// check that the current time is more than the time taken for
// completing the last trade operation more than 10 seconds
If CurTime > LastTradeTime + 10 Then Begin
SetOrder(OP_SELL,Lots,Bid,3,0,Bid-TakeProfit*Point,RED); // execute
Exit;
End;
```

- The admittance for historical data can be obtained using indexing predefined variables **Open**, **Close**, **High**, **Low**, and **Volume**. Index in this case is the number of periods necessary to be counted back.

```
// if Close at the last bar is less than Close at the bar before last
If Close[1] < Close[2] Then Exit;
```

- Experts testing in FXDirectDealer trading system supports 4 models.
  - **OHLC points** (Open/High/Low/Close). When testing an expert only Open, High, Low, Close prices are used. This model of testing is the quickest one. But the results of the testing can differ from those of the real expert trading.
  - **Every spread/2 points**. When testing an expert the candle development having the "spread/2"(usually 2) points step is simulated.
  - **Every 1 point**. When testing an expert the candle development having the 1 point step is simulated. This model of testing is the slowest one. But the results of the testing are identical with those of the real expert trading (when keeping the 10 seconds interval between completing trading operations).
- When writing and testing an expert, like testing any other program, it is sometimes necessary to display some additional debugging information. The MQL II language gives a number of opportunities to display such information.
  - The Alert function displays a dialogue box containing data defined by the user.

```
Alert("Free margin is ", FreeMargin);
```

- The **Comment** function shows the data defined by the user in the upper left corner of the chart. The "\n" char sequence is used for line feed.

```
Comment("Free margin is ", FreeMargin, "\nEquity is ", Equity);
```

- The **Print** function prints data defined by the user in the log file.

```
Print("Total trades are ", TotalTrades, "; Equity is ", Equity, "; Credit is ", Credit);
```

- The **PrintTrade** function prints data of selected trade position in the log-file.

```
PrintTrade(1);
```

- When testing an expert the test results are stored in files having ".log" extension in a subdirectory of the "logs"-directory where you have already installed your FXDirectDealer trading system. When you often test experts do not forget to delete log files periodically as they can have a size of several megabytes.
- It occurs that it is necessary to perform a large preparatory work before the experts start working. This work is so large that the expert will close forcedly with the error of loop detected. (It is necessary to note that the expert runs with each price tick and may not work long). But you can perform the preparatory work, for example, initialization of any array, in several movements. For example, in this way:

```
var: cnt(0), initvalue(0);
    array: arr[6000](0);
SetLoopCount( 50000 ); // for example only. Illustrates an initialization in 3 times
    If initvalue <=6000 Then Begin
        print( "beginning from ", initvalue );
        For cnt = initvalue To 6000 Begin // initialization loop
            arr[cnt] = cnt;
        // strongly recommended last instruction in the initialization loop as follow
            initvalue = cnt + 1;
        End;
        print( "stopped with ", initvalue, " -- initialization is complete." );
    End
    Else print( "initialization is complete" );
```

If it is necessary to initialize several arrays you should use several variables. For example, "initvalue", "initvalue2", "initvalue3", etc.

- How to assess the beginning of the next bar? (This is necessary to know that the previous bar has just been formed.) There are several ways:

```
Variable: prevbars(0);...
If prevbars = Bars Then exit;
    prevbars = Bars;
    ...
```

This method can sometimes fail when spooling the history. I.e., the number of bars has changed, and the "previous" bar has not been formed yet. In this case, it is possible to complicate checking the difference between values being equal to 1.

The next way is based on the fact that the value of **Volume** is formed on the base of the number of ticks having come for each bar, and the first tick means that the value of the bar being newly formed the **Volume** value is equal to 1:

```
If Volume > 1 Then exit;
```

...

This method can fail when price ticks come too intensively. As a matter of fact, the processing of the price ticks coming is performed in a separate traffic. And if this traffic is occupied during the next tick coming, this coming tick will not be processed to prevent overloading the computing power! In this case, it is possible to complicate the checking using storage of the previous **Volume** value.

The third way is based on the bar opening time:

```
Variable: prevtime(0);
```

```
...
```

```
If prevtime = Time Then exit;  
prevtime = Time;
```

```
...
```

This method is the most effective. It will work under any conditions.

- An example of working with the file is given below:

```
vars : handle(0), cnt1(0), cnt2(0), position(0), size(0);  
vars : string(""), number(0);  
  
handle = FileOpen( "test", ",");  
print( "file size is ", FileSize( handle ) );  
size = 0;  
while not IsFileEnded( handle ) begin  
string = FileReadString( handle );  
number = FileReadNumber( handle );  
// lines counting  
if IsFileLineEnded( handle ) then size = size + 1;  
end;  
print( "file has ", size, " lines" );  
if size < 20 then begin  
cnt2 = 0;  
for cnt1 = size to 19 begin  
FileWrite(handle, "teststring"+cnt1, cnt1+1);  
cnt2 = cnt2 + 1;  
size = size + 1;  
if cnt2 = 5 then break;  
end;  
print( "there are ", cnt2, " lines added" );  
print( "file size is ", FileSize( handle ) );  
end;  
position = FileSeek( handle, 0, SEEK_SET );  
// file reading from begin  
for cnt1=1 to size begin  
print( FileReadString( handle ), ":", FileReadNumber( handle ) );  
If IsFileEnded( handle ) then break;  
end;  
FileClose(handle);
```

Here are several explanations to the code. The file will be opened first, then the line-by-line reading should be performed. It is presumed that the structure of each line of the file consists of one text variable and one numeric variable. If the number of lines being counted is less than 20 the next portion of 5 lines will be added. Since the pointer of the current position of reading-recording is at the end of the file after the lines have been counted, the recording of the next record will be made to the end of the file, after that the pointer of the current position will be moved to the end of the file. If the record should be done to the end of the file immediately after it has been opened it is necessary to use the following function:

```
position = FileSeek( handle, 0, SEEK_END );
```

after that the data should be stored in the file.

In the second part of the code the reading of records from the file will be conducted from its very beginning.

### **Features of Writing Custom Indicators and User Functions**

- Review
- Programming language MetaQuotes Language II (MQL II)
- Step-By-Step Creation of Simple Expert
- Features of Writing Experts
- Features of Writing Custom Indicators and User Functions
- Technical Indicators

Writing user indicators and functions in FXDirectDealer trading system has a number of features, as well:

- Parameters to be taken into consideration for user indicators and functions should be described in the **Inputs** section and be of numeric data type.

```
Inputs: nPeriod(13),nDeviation(0.1),nAccountedBars(300);
```

- Parameters will be sent to the function of custom indicator calculation in the order in which they are described. For example, call the custom indicator having the parameters listed above will appear as follows:

```
iCustom( "SomeIndicator", 13, 0.1, 300, MODE_FIRST, 0 );
```

- Strictly speaking, parameters should not be necessarily sent to the function. If the function does not have an **Inputs** section it is no use to send the parameters. Or one can use the initial values being applied for describing parameters. For example, call the same custom indicator without parameters will appear as follows:

```
iCustom( "SomeIndicator", MODE_FIRST, 0 );
```

This means that those values will be used which are stored in variables described in the **Inputs** section, i.e. 13, 0.1 and 300.

- What is the difference between the function of custom indicator calculation and a simple user function? It is defined by the methods of call. The function of custom indicator is called once when recalculation of the whole array of price data. The simple user function is called during the expert program working, i.e. with each tick. The function of custom indicator calculation has access to two arrays storing the results of calculation with the help of functions named **SetIndexValue**, **SetIndexValue2**, **GetIndexValue**, **GetIndexValue2**. And the simple user function has access to these arrays with the help of **iCustom** function. The function of custom indicator calculation can not call trading functions and functions of call of user functions. User function should be finished with the call of the **Return** function in order to send the value calculated to the expert-caller.
- There is a special value of index array which means the absence of data, it is 0. If zero value is significant in any of the custom indicators, it is necessary to use a very small value, for example, 0.00000001. It is necessary to note that when displaying the custom indicators in the pop-up prompts, the accuracy of 4 signs after the dot in decimal fraction will be used. Indicator placed in the price chart can not have negative data as they can not be displayed in any case. That is why negative values of the indicator placed in the price chart will also be considered as special ones. (The features of use of special values of custom indicators being placed in the price chart are discussed below.)
- The values of the variables in the function of custom indicator calculation, and the data arrays with the results of custom indicator calculation will be initialized at the first run of the indicator, and at the period or instrument change at the chart. It means, all values will be stored between initializations! When custom indicator is programmed in a proper and accurate way it is possible to provide the possibility of calculation of only last, not calculated values, data arrays of the indicator. An example of an indicator of a simple moving average:

```
/*[[
    Name := SimpleMA
    Author := Copyright (c) 2003, MetaQuotes Software Corp.
    Link := http://www.metaquotes.ru/
    Separate Window := No
    First Color := Red
    First Draw Type := Line
    Use Second Data := No
    ]*/
Inputs : MAPeriod(13);
Variables : shift(0), cnt(0), loopbegin(0), first(True), prevbars(0), sum(0);
    SetLoopCount(0);
    // initial checkings
    If MAPeriod < 1 Then Exit;
```

```

// check for additional bars loading or total reloading
If Bars < prevbars Or Bars-prevbars>1 Then first = True;
    prevbars = Bars;
    If first Then Begin
//loopbegin prevent counting of counted bars exclude current
    loopbegin = Bars-MAPeriod-1;
    If loopbegin < 0 Then Exit; // not enough bars for counting
        first = False;
        End;

// moving average
loopbegin = loopbegin+1; // current bar is to be recounted too
For shift = loopbegin Downto 0 Begin
    sum = 0;
    For cnt = 0 To MAPIperiod-1 Begin
        sum = sum + Close[shift+cnt];
    End;
    SetIndexValue(shift,sum/MAPeriod);
loopbegin = loopbegin-1; // prevent to previous bars recounting
End;

```

Explanations for the code. In the first variable after initialization the **True** value is stored. As soon as the indicator runs for the first time the check of the first variable will be conducted and the value of the loopbegin variable will be established on the assumption that the cycle would run from the data beginning. When the cycle is running the **loopbegin** variable is modified and contains in fact the value of the index of the last value calculated in the indicator array. In the case of "loop detected", the indicator expert will stop its work. But the first variable is established in **False**, it means that at the next start the **loopbegin** variable will not be established at the beginning of the indicator array. It means that the new calculation will be continued from the point where the previous calculation has been made. At the end, all the bars will be calculated. But if we need to recalculate the indicator value at the current bar with the coming of each new quote we modify the **loopbegin** variable before the cycle starts, increasing it by 1 to realize at least 1 cycle iteration.

If the historical data were spooled (**Refresh Chart**) or reloaded (**Erase and Refresh Chart**) the condition of the comparing of the current number of bars with the previous number of those would allow us to recalculate indicator on all data.

- Custom indicator function can be called not only from the expert program, but also from the "Navigator" window when selecting **Custom Indicator**. In this connection, there are several features of designing such a program. An example of the "Envelopes" indicator:

```

/*[[
    Name := Envelopes
    Author := Copyright (c) 2003, MetaQuotes Software Corp.
    Link := http://www.metaquotes.net/
    Notes := Sample Custom Indicator program
    Separate Window := No
    First Color := Blue
    First Draw Type := Line
    Use Second Data := Yes
    Second Color := Red
    Second Draw Type := Line
]]*/

Inputs : nPeriod(13),nDeviation(0.1),nAccountedBars(300);
Vars : CurrentBar(0),shift(0),i(0),sum(0),UpperBand(0),LowerBand(0),BeginBar(0);
    Vars : prevBars(0);

    If prevBars = Bars Then Exit;
        prevBars = Bars;
        SetLoopCount(0);

BeginBar = Bars - nAccountedBars;

```

```

If BeginBar < 0 then BeginBar = 0;
For CurrentBar = 0 To BeginBar-1 Begin
    shift = Bars-1-CurrentBar;
    SetIndexValue(shift, 0);
    SetIndexValue2(shift, 0);
End;

For CurrentBar = BeginBar To Bars-1 Begin
    shift = Bars - 1 - CurrentBar;
    If CurrentBar < nPeriod-1 Then Begin;
        SetIndexValue(shift, 0);
        SetIndexValue2(shift, 0);
        Continue;
    End;

    sum = 0;
    For i=0 To nPeriod-1 Begin
        sum = sum + Close[shift+i];
    End;
    sum = sum / nPeriod;
    UpperBand = sum * (1 + nDeviation/100);
    LowerBand = sum * (1 - nDeviation/100);
    SetIndexValue(shift, UpperBand);
    SetIndexValue2(shift, LowerBand);
End;

```

As you can see the "Experts Wizard" creates the description of custom indicator differing from the description of the expert program.

**Separate Window := No** – means that the indicator chart will be developed in the same window where the price chart is developed. If the values calculated with the custom indicator differ from the current prices very much, the indicator chart must be shown in a separate window.

**Draw Type := Line** – means that the indicator chart will be developed as a line. It is also possible to develop a histogram (**Histogram**) or to show a separate symbol (**Symbol**; in this case, the symbol will be set as a number defining the position of the symbol in the "Wingdings" table. For example, **First Symbol := 217**).

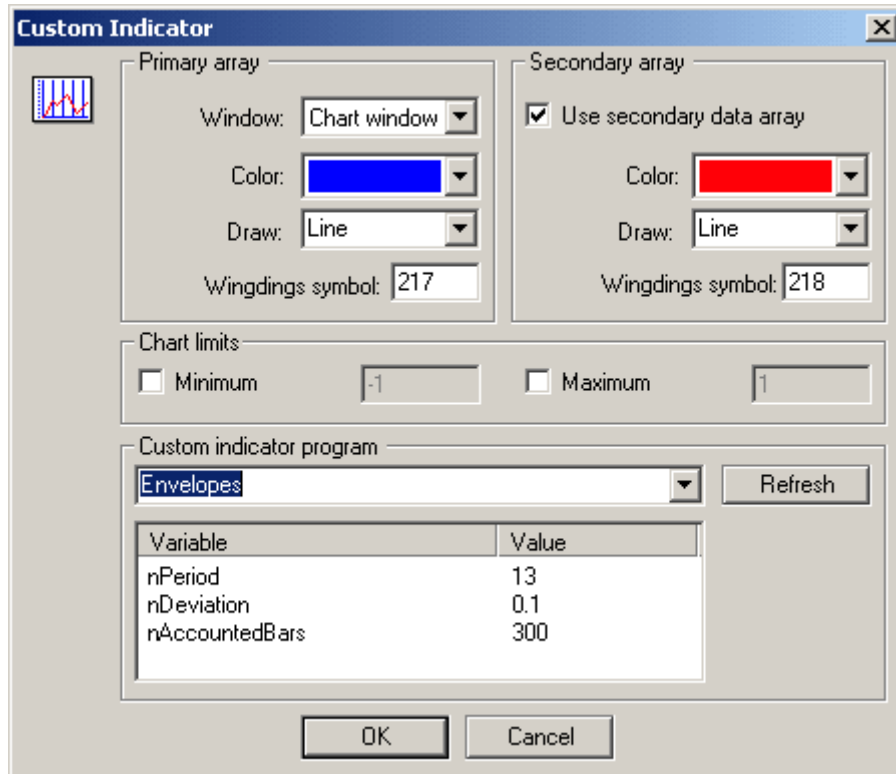
**Use Second Data := Yes** – means that the indicator calculation results in 2 charts, and not the only one (another example: MACD histogram and signal line). **First Color**, **First Draw Type** and **First Symbol** belong to the first indicator chart, the **Second Color**, **Second Draw Type** and **Second Symbol** belong to the second one.

If the indicator is shown in a separate window and the limiting values of the minimum and/or maximum are known beforehand, these limiting values can be defined to accelerate the displaying and, in some case, to make the displaying more beautiful (this especially concerns histograms). Experts Master will, for example, design it, as follows:

Minimum Chart Limits := -1.000000

Maximum Chart Limits := 1.000000

All parameters listed and made with the Expert Master help in quick setting of Custom Indicator.



- As it was mentioned above, the user expert chart can be displayed as a histogram. There is a feature of displaying the histogram in the price chart window. Both data arrays of the Custom Indicator participate in the process of histogram displaying. The line will be drawn at the chart from the first value to the second corresponding one. If the first value is more than the second one the line will be drawn with the first color. Otherwise, it will be drawn with the second color. This feature can be used when coloring the bars with different colors.

```

/*[[
    Name := ColoredBars
    Author := Copyright (c) 2003, MetaQuotes Software Corp.
    Link := http://www.metaquotes.net/
    Notes := Sample Custom Indicator program
    Separate Window := No
    First Color := Blue
    First Draw Type := Histogram
    Use Second Data := Yes
    Second Color := Pink
    Second Draw Type := Histogram
]]*/

Variables : CurrentBar(0),shift(0),nBWMFI(0),prevBWMFI(0),value1(0),value2(0);
SetLoopCount(0);
For CurrentBar = 0 To Bars-1 Begin
    shift = Bars-1-CurrentBar;
    nBWMFI = (High[shift] - Low[shift]) / Volume[shift];
    If CurrentBar < 1 Then Begin
        SetIndexValue(shift, 0);
        SetIndexValue2(shift, 0);
        prevBWMFI = nBWMFI;
    Continue;
    End;

```

```

        value1           =           0;
        value2           =           0;
    If nBWMFI > prevBWMFI and Volume[shift] < Volume[shift+1] Then Begin
        value1           =           High[shift];
        value2           =           Low[shift];
        End;
    If nBWMFI < prevBWMFI and Volume[shift] > Volume[shift+1] Then Begin
        value1           =           Low[shift];
        value2           =           High[shift];
        End;
        SetIndexValue(shift,           value1);
        SetIndexValue2(shift,          value2);
    prevBWMFI           =           nBWMFI;
End;

```

The example given above illustrates coloring the bars in "Bill Williams" style. If necessary, it is possible to prepare another program of custom indicator to color bars with two other colors corresponding with other conditions.

- The features of special values processing were mentioned above which had been less or equal to 0 and concerned the "line" custom indicators placed in the price chart. 0 means the absence of data. The line will be plotted between points having positive values. A negative value means the end of the previous line. I.e., lines can be interrupted. As an illustration of the "absence of data" an example of the "ZigZag" indicator is given below which plots lines between local price extremes.

```

        /*[[
        Name := ZigZag
        Author := Copyright (c) 2003, MetaQuotes Software Corp.
        Link := http://www.metaquotes.ru
        Separate Window := No
        First Color := Blue
        First Draw Type := Line
        Use Second Data := No
        ]*/

        Inputs: depth(12),deviation(5),backstep(3);
        Variables : shift(0),lasthigh(-1),lastlow(-1),lasthighpos(0),lastlowpos(0);
        Variables : val(0),back(0),res(0);
        Variables : curlow(0),curhigh(0);

        SetLoopCount(0);
        lasthigh=-1;
        lastlow=-1;

        for shift = Bars-300 downto 0
        {
        //-- low
        val=Low[Lowest(MODE_LOW,shift+depth-1,depth)];
        if val==lastlow then val=0
        else
        {
        lastlow=val;
        if (Low[shift]-val)>(deviation*Point) then val=0
        else
        {
        for back=1 to backstep
        {
        res=GetIndexValue(shift+back);
        if res!=0 and res>val then SetIndexValue(shift+back,0);
        };
        };
        };
        };
        };

```

```

    };
    SetIndexValue(shift,val);
    //-- high
val=High[Highest(MODE_HIGH,shift+depth-1,depth)];
    if val==lasthigh then val=0
    else
    {
        lasthigh=val;
        if (val-High[shift])>(deviation*Point) then val=0
        else
        {
            for back=1 to backstep
            {
                res=GetIndexValue2(shift+back);
                if res!=0 and res<val then SetIndexValue2(shift+back,0);
            };
        };
        SetIndexValue2(shift,val);
    };

    // final cutting
    lasthigh=-1; lasthighpos=-1;
    lastlow=-1; lastlowpos=-1;

    for shift = Bars-300 downto 0
    {
        curlow=GetIndexValue(shift);
        curhigh=GetIndexValue2(shift);
        if curlow == 0 & curhigh == 0 then continue;
        //--
        if curhigh!=0 then
        {
            if lasthigh>0 then
            {
                if lasthigh<curhigh then SetIndexValue2(lasthighpos,0)
                else SetIndexValue2(shift,0);
            };
        };
        //--
        if lasthigh<curhigh then
        {
            lasthigh=curhigh;
            lasthighpos=shift;
        };
        lastlow=-1;
    };
    if curlow!=0 then
    {
        if lastlow>0 then
        {
            if lastlow>curlow then SetIndexValue(lastlowpos,0)
            else SetIndexValue(shift,0);
        };
    };
    //--
    if curlow<lastlow | lastlow<0 then
    {
        lastlow=curlow;
        lastlowpos=shift;
    };
    lasthigh=-1;
    };
};

```

```

for shift = Bars-300 downto 0
{
res=GetIndexValue2(shift);
if res!=0 then SetIndexValue(shift,res);
};

```

As a result, the indicator given above fills the first indicator data array with the extreme values. The values between extremes are zero values. The lines are drawn between extremes (i.e., between positive values).

- As an illustration of symbols displaying in defining the position of the price chart a program of the simplest calculation of "Bill Williams" fractals is given below:

```

/*[[
Name := Fractals
Author := Copyright (c) 2003, MetaQuotes Software Corp.
Link := http://www.metaquotes.net/
Notes := Sample Custom Indicator program
Separate Window := No
First Color := Blue
First Draw Type := Symbol
First Symbol := 217
Use Second Data := Yes
Second Color := Red
Second Draw Type := Symbol
Second Symbol := 218
]]*/

Variable : value(0),CurrentBar(0), price(0);

SetLoopCount(0);
For CurrentBar = 0 To Bars-1 Begin
If CurrentBar < 2 Or CurrentBar >= Bars-2 Then Begin
SetIndexValue(CurrentBar, 0);
SetIndexValue2(CurrentBar, 0);
Continue;
End;

value = 0;
price = High[CurrentBar];
If price>High[CurrentBar+1] and price>High[CurrentBar+2] and
price>High[CurrentBar-1] and price>High[CurrentBar-2]
then value = price;
SetIndexValue(CurrentBar, value);

value = 0;
price = Low[CurrentBar];
If price<Low[CurrentBar+1] and price<Low[CurrentBar+2] and
price<Low[CurrentBar-1] and price<Low[CurrentBar-2]
then value = price;
SetIndexValue2(CurrentBar, value);
End;

```

A user function example. Before using the function, it is necessary to be sure that it has been successfully translated, and that there is a corresponding exp-file in the expert catalogue.

```

/*[[
Name := UserFunc
Author := Copyright (c) 2003, MetaQuotes Software Corp.
Link := http://www.metaquotes.ru/
]]*/

```

```
Input : parameter(0);  
print( "Input parameter is ", parameter );  
return( parameter );
```

User Function call sample:

```
Variable: ReturnValue(0);  
ReturnValue = UserFunction( "UserFunc", Close );  
print( "Return value is ", ReturnValue );
```

- It must be noted that the **overflow of custom indicators, improperly written user functions can slow down the functioning of the client terminal!**

### Technical Indicators

- Review
- Programming language MetaQuotes Language II (MQL II)
- Step-By-Step Creation of Simple Expert
- Features of Writing Experts
- Features of Writing Custom Indicators and User Functions
- Technical Indicators

**Indicator** is a result of mathematical calculations on the basis of price and/or volume indexes. The values obtained are used for prediction of price changes. There is a large amount of developed technical indicators in the world, some of them are represented in FXDirectDealer:

- Accumulation/Distribution;
- ADX;
- Average True Range;
- Bollinger Bands;
- Commodity Channel Index;
- DeMarker;
- Elder-rays;
- Envelopes;
- Force Index;
- Ichimoku Kinko Hyo;
- MACD;
- Market Facilitation Index;
- Momentum;
- Money Flow Index;
- Moving Average;
- Moving Average of Oscillator;
- On Balance Volume;
- Parabolic SAR;

### Accumulation/Distribution (A/D)

**Accumulation/Distribution** is an indicator which is determined by the price and volume changing. The volume represents the weighting factor at the price changing: the larger the factor (volume) is, the more significant the contribution of the price changing (for the given period of time) to the indicator's value is. The indicator was developed by Larry Williams and represents the accumulation of the difference between all movements upward (accumulation) during the days, when the price has arisen by the closing point, and downward (distribution) during the days, when the price has fallen by the closing point.

This indicator gives rather infrequent signals forming divergence with the price at the critical breaks of tendencies.



### ADX (Average Directional Movement Index)

**Average Directional Movement Index (ADX)** is the indicator developed by Wells Wilder for measuring the intensity of market trend. When calculating ADX the values of indicators of ordered motions are used (+DI and -DI). It is considered that if ADX goes up and exceeds 15 the trend is observed in the market.



### Average True Range (ATR)

**Average True Range (ATR)** is the indicator of volatility of the market. It was introduced by Wells Wilder in his book *New Concepts of Technical Trading Systems*, and since then the indicator is applied as a constituent of many other indicators and trading systems.

ATR often reaches high values in the market foundations after sheer fall in prices caused with panic selling. Low values of the indicator often correspond with long periods of horizontal movement being observed in the market summits and during the consolidation time. It can be interpreted by the same rules as other volatility indicators. The principle of prediction with the help of this indicator is formulated as follows: the higher the value of the indicator is, the more probable the trend change is; the lower this value is, the weaker the trend orientation is.



### Bollinger Bands

**Bollinger Bands** are similar to moving average envelopes. The difference between them consists in that the margins of envelopes are positioned above and below the moving average curve at the fixed distance expressed as percentage, whereas the margins of Bollinger Bands are based on distances equal to a certain amount of standard deviations. Inasmuch as the value of the standard deviation depends on volatility, the bands regulate their own width: it increases when the market is unstable, and decreases during more stable periods.

Bollinger Bands are usually plotted in the price chart, but they can also be plotted in the indicator chart. All mentioned below concerns the bands plotted in price charts. Like in the case of envelope moving averages, the Bollinger Bands interpretation is based on that it is inherent to the prices to stay in the range of highest and lowest margins of the band. A distinctive feature of Bollinger Bands is their variable width determined with the volatility of prices. In the periods of significant price changes (i.e., of high volatility), the bands become wider giving space to prices. In the economic glut periods (i.e., of low volatility) the bands become narrow keeping the prices in the range of their margins.

Bollinger Bands features:

- Price leaps usually happen after band narrowing corresponding with the volatility decrease.
- If prices exceed the range of the band the continuation of the current tendency should be predicted.
- If the peaks and troughs outside the band are followed by peaks and troughs inside of the band, the turn of the tendency is possible.
- Price movement having started from one of the band margins usually reaches the opposite margin. The latter observation is useful for predicting price guideposts.



### Commodity Channel Index (CCI)

**Commodity Channel Index (CCI)** measures the deviation of the commodity price from its average statistical price. High values of the index point out that the price is unusually high being compared with the average one, and low values show that the price is too low. In spite of its name, the CCI can be applied for any financial instrument, and not only for the wares.

There are two basic techniques of using CCI:

- **For finding the divergences.**  
The divergence appears when the price reaches a new maximum, and CCI can not grow above the previous maximums. This classical divergence is normally followed by the price correction.
- **As an indicator of overbuying/overselling.**  
CCI usually varies in the range of +/-100. Values above +100 inform about overbuying state (and about a probability of correcting decay), and the values below 100 inform about the overselling state (and about a probability of correcting increase).



### DeMarker

The **DeMarker** indicator registers the regions of price depletion which usually coincide with the peaks and troughs of prices. The indicator varies between 0 and 1. When indicator is below the 0.3 point, the price turn upward is to be expected. When the indicator is above 0.7, the price turn downward is to be expected.



### Elder-rays

The **Elder-rays** combine the properties of trend following indicators and oscillators. They use exponential moving average indicator (**EMA**, the best period is 13) as a tracing indicator. The oscillators reflect the power of bulls and bears. To plot the Elder-rays three charts should be used: on one side, the price chart and EMA will be plotted, on two other sides bulls power oscillator (**Bulls Power**) and bears power oscillator (**Bears Power**) will be plotted.

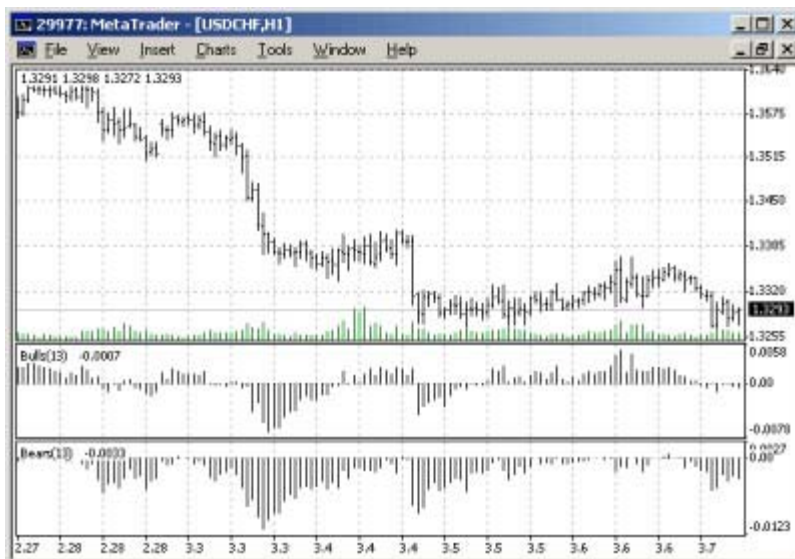
Elder-rays are used both individually and together with other methods. If using them individually, one should take into account that the EMA slope determines the trend movement, and position should be opened in its direction. Bulls and bears power oscillators are applied for defining the moment of positions opening/closing. The following positions should be opened:

- **Buy, if:**
  1. there is an increasing trend (determined with the EMA movement);
  2. the Bears Power oscillator is negative, but increasing at the same time;
  3. the last peak of the Bulls Power oscillator is higher than the previous one;
  4. the Bears Power oscillator increases after the Bulls divergence.

At the positive values of the Bears Power oscillator, it is better to keep back.

- **Sell, if:**
  1. there is a decreasing trend (determined with the EMA movement);
  2. the Bulls Power oscillator is positive, but decreases gradually;
  3. the last trough of the Bulls Power oscillator is lower than the previous one;
  4. the Bulls Power oscillator decreases leaving the Bears' divergence.

Do not open short positions when the Bulls Power oscillator is negative.  
Divergence between the Bulls and Bears Power and prices is the best time for trading.



### Envelopes

The **Envelopes** are formed with two moving averages one of which is shifted upward and another one is shifted downward. The selection of optimum relative number of band margins shifting is determined with the market volatility: the higher the latter is, the stronger the shift is. Envelopes define the upper and the lower margins of the price range.

- **Signal to sell** appears when the price reaches the upper margin of the band;
- **Signal to buy** appears when the price reaches the lower margin.



### Force Index

The **Force Index** was developed by Alexander Elder. This index measures the Bulls Power at each increase, and the Bulls Power at each decrease. It connects the basic elements of market information: price trend, its drops, and volumes of transactions. This index can be used as it is, but it is better to approximate it with the help of moving average. Approximation with the help a short moving average (the author proposes to use 2 intervals) contributes to finding the best opportunity to open and close positions. If the approximations is made with long moving average (period 13), the index shows the tendencies and their changes.

- It is better to buy when the forces become minus (fall below zero) in the period of indicator increasing tendency;

- The force index signals the continuation of the increasing tendency when it increases to the new peak;
- The signal to sell comes when the index becomes positive during the decreasing tendency;
- The force index signals the Bears Power and continuation of the decreasing tendency when the index falls to the new trough.



### Ichimoku Kinko Hyo

**Ichimoku Kinko Hyo** is predefined to characterize the market trend, support and opposition levels, and to generate signals of buying and selling. This indicator works best at week and day charts.

When defining the dimension of parameters, four time intervals of different length are used. The values of individual lines composing this indicator are based on these intervals:

- **Tenkan-sen** shows the average price value during the first time interval defined as the sum of maximum and minimum within this time, divide by two.
- **Kijun-sen** shows the average price value during the second time interval.
- **Senkou Span A** shows the middle of the distance between two previous lines shifted forwards by the value of the second time interval.
- **Senkou Span B** shows the average price value during the third time interval shifted forwards by the value of the second time interval.

**Chinkou Span** shows the closing price of the current candle shifted backwards by the value of the second time interval. The distance between the Senkou lines is hatched with another color and called 'cloud'. If the price is between these lines, the market should be considered as non-trend, and then the cloud margins form the support and opposition levels. If the price is above the cloud, its upper line forms the first support level, and the second line forms the second support level. If the price is below cloud, the lower line forms the first opposition level, and the upper one forms the second level. If the "Chinkou Span" line traverses the price chart in the bottom-up direction it is signal to buy. If the "Chinkou Span" line traverses the price chart in the top-down direction it is signal to sell. "Kijun-sen" is used as an indicator of the market movement. If the price is higher than this indicator, the prices will probably continue to increase. When the price traverses this line the further trend changing is possible.

Another kind of using the "Kijun-sen" is giving signals. Signal to buy is generated when the "Tenkan-sen" line traverses the "Kijun-sen" in the bottom-up direction. Top-down direction is the signal to sell. "Tenkan-sen" is used as an indicator of the market trend. If this line increases or decreases, the trend exists. When it goes horizontally, it means that the market has come into the channel.



### Moving Average Convergence/Divergence (MACD)

**Moving Average Convergence/Divergence (MACD)** is the dynamic indicator following the tendency. It shows the ratio between two moving averages of the price.

The **MACD** is developed as the difference between two exponential moving averages (**EMA**) having periods of 12 and 26 days. To define the best opportunities for buying or selling clearly, the so called signal line will be plotted in the MACD chart: it is the 9-days-moving-average of the indicator.

MACD is the most effective under conditions when the market swings with high amplitude in trading. The most frequently used signals of MACD are intersections, overbuying/overselling states and divergences.



### Market Facilitation Index (BW MFI)

**BW MFI (Bill Williams Market Facilitation Index)** is the indicator which shows the change of price for 1 tick. Absolute values of the indicator do not mean anything as they are, only indicator changes have sense. Bill Williams emphasizes the interchanging of MFI and volume:

- **MFI increases and volume increases** – this points out that:
  1. the number of players coming into the market increases (volume increases),
  2. the new coming players open positions in the direction of bar development, i.e., the movement has begun and picks up speed.
- **MFI falls and volume falls.** It means the market participants are not interested anymore.

- **MFI increases, but the volume falls.** It is most likely, that the market is not supported with the volume from clients, and the price is changing due to traders' (brokers and dealers) "on the floor" speculations.
- **MFI falls, but the volume increases.** This is the battle between bulls and bears where the volume of buying and selling is large, but movements of the price itself are insignificant as a result of powers being approximately equal. One of the fighting parties (buyers against sellers) will win. Usually, the break of such a bar lets you know if this bar determines the continuation of the trend or annuls the trend. Bill Williams calls such bar "curtsying".



### Momentum

The **Momentum** indicator measures the value of the commodity price change during a certain period.

These are the basic methods of use this indicator:

- **As an oscillator following the tendency,** like MACD. In this case, the **signal to buy** appears if the indicator makes trough and begins to grow; the **signal to sell** appears if it comes up to its peak and turns downwards. To define the turning points of the indicator it is better to use its short moving average.

The extremely high or low values of the "Momentum" indicator presume that the current tendency will continue. So, if the indicator reaches the extremely high values and then turns downwards, the coming price increasing should be expected. But, in any case, one should not open/close position before the prices confirm the signal of the indicator.

- **As a leading indicator.** This method is based on the presuming that the final phase of upward tendency is usually accompanied with sheer price increase (since everybody believes that it will continue), and the closing of the bears' market is usually accompanied with sheer fall in prices (since everybody seeks after leaving the market). This happens very often in this way, but it is still a too sweeping generalization.



### Money Flow Index (MFI)

**MFI (Money Flow Index)** is an indicator showing the intensity the money is invested in a commodity or taken out of it. Forming and interpreting this indicator are similar to those of RSI, the only difference is that the MFI takes volume into consideration, as well.

When analyzing the MFI the following should be taken into account:

- **divergences between indicator and price movement.** If prices increase and MFI falls (or vice versa), the probability of price turning is very high.
- **MFI values higher than 80 and lower than 20** signalizes respectively about potential peak or foundation of the market.



### Moving Average (MA)

The **Moving Average (MA)** indicator is the most frequently used indicator in technical analysis. The moving average line will be plotted directly in the price movement chart. The moving average is calculated with a certain predefined period. The shorter the period is, the higher the probability of false signals is. The longer the period is, the weaker the sensibility of the moving average is.

Moving average variants:

- Simple Moving Average;
- Exponential Moving Average;
- Smoothed Moving Average;
- Linear Weighted Moving Average.



#### Moving Average of Oscillator

**Moving Average of Oscillator** is, in general case, the difference between the oscillator and the smoothing of oscillator. In this case, the basic line of MACD is used as an oscillator, and the signal line of MACD is used for smoothing.



#### On Balance Volume (OBV)

**On Balance Volume (OBV)** indicator connects the volume and the price change accompanying the given volume. The sense of this indicator, developed by Josef Granville, is simple. If the closing price of the current bar is higher than that of the previous bar, the value of the volume of the current bar will be added to the previous value of OBV, if the closing price of the current bar is lower than that of the previous bar, the volume will be taken from the previous value of OBV.

Signals given by OBV are better to be used as confirming, these signals are more likely secondary in the importance being compared with those of oscillators or tendency indicators, though, nevertheless, OBV like oscillators gives a strong signal of turn at the divergence with the price. Moreover, the increase of OBV up to a new maximum or its decrease to the new minimum confirm the power of bulls or bears and gives the signal of increase or decrease respectively.



### Parabolic SAR

The **Parabolic SAR** indicator is plotted on the price chart. This indicator is similar to moving average in its sense, but the difference is that the "Parabolic SAR" moves with much more acceleration. This indicator is often used as a line of moving stop-signal.

The Parabolic SAR defines the points at which one should leave the market excellently. Long positions should be closed when the price falls below SAR line, and the short ones should be closed when the price increases above SAR line.

If you have a long position opened (i.e., the price is above SAR line), the SAR line will move upwards independent on that in which direction the prices move. The value of the SAR line shift depends on the value of price movement.

