



Факультатив

по курсу  
«Программные  
средства  
САПР»

Занятие 1

Вводное занятие

```
if (fabs_parr < 1e-7 * fabs_delta || fabs_parr == 0) { std::cout << "OK\n";  
return 0;  
}  
// Вычисляем значения x и y  
for (value_i i = 0; i < g_vector.elements.size(); ++i)  
g_vector.elements[i] = dotProduct(x, y);  
for (value_i i = 0; i < g_vector.elements.size(); ++i)  
g_vector.elements[i] = dotProduct(x, y);  
// Вычисляем значения x и y  
for (value_i i = 0; i < x.size(); ++i)  
x[i] = 0.0;  
for (value_i i = 0; i < x.size(); ++i)  
for (value_i j = 0; j < x.size(); ++j)  
x[i][j] = 0.0;  
// Вычисляем значения x и y  
for (value_i i = 0; i < g_vector.elements.size(); ++i) {  
g_vector.elements[i] = 0.0;  
g_vector.elements[i] = 0.0;  
}
```



# Среда разработки на C++

The screenshot displays the Microsoft Visual Studio IDE interface. The main window shows the source code for `main.cpp` in the `main()` function scope. The code is as follows:

```
1  #include <iostream>
2
3  int main() {
4      setlocale(LC_CTYPE, "rus");
5
6      std::cout << "ПКМС рулит!" << std::endl;
7
8      return EXIT_SUCCESS;
9  }
```

The Solution Explorer on the left shows the project structure for `test_Console`, including `References`, `External Dependencies`, `Header Files`, `Resource Files`, and `Source Files` (containing `main.cpp`).

The Output window at the bottom shows the build process:

```
Show output from: Build
1>----- Rebuild All started: Project: test_Console, Configuration: Debug Win32 -----
1>main.cpp
1>test_Console.vcxproj -> C:\Users\TopGun\Documents\Visual Studio 2017\Projects\test_Console\Debug\test_Console.exe
===== Rebuild All: 1 succeeded, 0 failed, 0 skipped =====

+++++
+++          Please consider donating to VSColorOutput          +++
+++          http://mike-ward.net/donate/          +++
+++          (this message can be turned off in the settings panel)          +++
+++++
```

The status bar at the bottom indicates "Rebuild All succeeded" and shows the current cursor position at Line 1, Column 1, Character 1.



# Создание проекта (1)

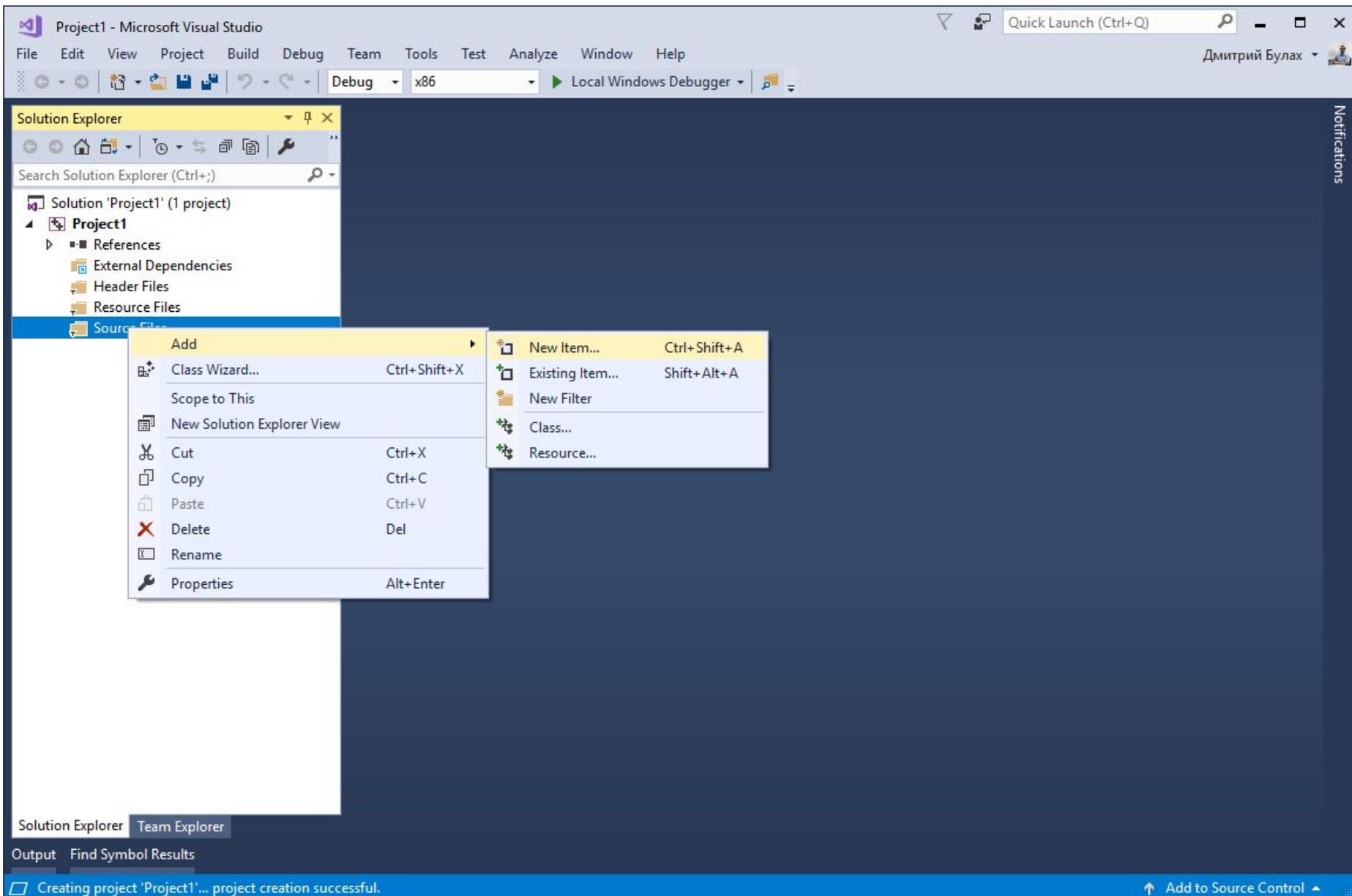
The screenshot displays the Microsoft Visual Studio IDE with a new console application project named 'ConsoleApplication1'. The Solution Explorer on the left shows the project structure, including 'ConsoleApplication1' with subfolders for 'References', 'External Dependencies', 'Header Files' (containing 'pch.h'), 'Resource Files', and 'Source Files' (containing 'ConsoleApplication1.cpp' and 'pch.cpp'). The main code window shows the source code for 'ConsoleApplication1.cpp' with the following content:

```
1 // ConsoleApplication1.cpp : This file contains the 'main' function. Program execution begins here.
2 //
3
4 #include "pch.h"
5 #include <iostream>
6
7 int main()
8 {
9     std::cout << "Hello World!\n";
10 }
11
12 // Run program: Ctrl + F5 or Debug > Start Without Debugging menu
13 // Debug program: F5 or Debug > Start Debugging menu
14
15 // Tips for Getting Started:
16 // 1. Use the Solution Explorer window to add/manage files
17 // 2. Use the Team Explorer window to connect to source control
18 // 3. Use the Output window to see build output and other messages
19 // 4. Use the Error List window to view errors
20 // 5. Go to Project > Add New Item to create new code files, or Project > Add Existing Item to add existing code files to the project
21 // 6. In the future, to open this project again, go to File > Open > Project and select the project file.
```

The status bar at the bottom shows 'Ready', 'Ln 10', 'Col 1', 'Ch 1', 'INS', and 'Add to Source Control'.



## Создание проекта (2)



The screenshot displays the Microsoft Visual Studio interface during the creation of a project. The Solution Explorer on the left shows a project named 'Project1' with the following structure:

- Solution 'Project1' (1 project)
  - Project1
    - References
    - External Dependencies
    - Header Files
    - Resource Files
    - Source Files

The 'Add' context menu is open over the 'Source Files' folder, showing the following options:

- Add
  - Class Wizard... (Ctrl+Shift+X)
  - Scope to This
  - New Solution Explorer View
  - Cut (Ctrl+X)
  - Copy (Ctrl+C)
  - Paste (Ctrl+V)
  - Delete (Del)
  - Rename
  - Properties (Alt+Enter)

The 'Add' menu is also open, showing the following options:

- New Item... (Ctrl+Shift+A)
- Existing Item... (Shift+Alt+A)
- New Filter
- Class...
- Resource...

The status bar at the bottom indicates: 'Creating project 'Project1'... project creation successful.'



# Создание проекта (3)

The screenshot displays the Visual Studio 2017 'New Project' dialog box. The 'Project type' is set to 'Visual C++', and the 'Subtype' is 'Windows Desktop'. The 'Project name' is 'pssapr\_superlab\_01'. The 'Location' is 'C:\Users\p\Documents\Visual Studio 2017\Projects\pssapr\_superlab\_01'. The 'Solution name' is 'pssapr\_superlab\_01'. The 'Project type' is 'Visual C++', and the 'Subtype' is 'Windows Desktop'. The 'Project name' is 'pssapr\_superlab\_01'. The 'Location' is 'C:\Users\p\Documents\Visual Studio 2017\Projects\pssapr\_superlab\_01'. The 'Solution name' is 'pssapr\_superlab\_01'. The 'Project type' is 'Visual C++', and the 'Subtype' is 'Windows Desktop'. The 'Project name' is 'pssapr\_superlab\_01'. The 'Location' is 'C:\Users\p\Documents\Visual Studio 2017\Projects\pssapr\_superlab\_01'. The 'Solution name' is 'pssapr\_superlab\_01'.

The Windows File Explorer window shows the project files for 'pssapr\_superlab\_01' in the 'Documents\Visual Studio 2017\Projects' folder. The files are:

Имя	Дата изменения	Тип	Размер
Debug	22.10.2019 8:42	Папка с файлами	
main.cpp	22.10.2019 8:42	C++ Source	1 КБ
pssapr_superlab_01.sln	22.10.2019 8:41	Microsoft Visual S...	2 КБ
pssapr_superlab_01.vcxproj	22.10.2019 8:42	VC++ Project	8 КБ
pssapr_superlab_01.vcxproj.filters	22.10.2019 8:42	VC++ Project Filte...	1 КБ
pssapr_superlab_01.vcxproj.user	22.10.2019 8:41	Per-User Project O...	1 КБ



# Создание проекта (4)

The image shows two overlapping windows from Visual Studio 2017. The background window is the 'New Project' dialog, and the foreground window is a Windows Explorer showing the project directory.

**New Project Dialog:**

- Left sidebar: 'Installed' > 'Visual C++' > 'Windows Desktop' is selected.
- Main list: 'Windows Console Application', 'Dynamic-Link Library (DLL)', and 'Static Library' are visible.
- Right pane: 'Type: Visual C++' and a description: 'A wizard that can be used to configure a custom application or library that runs on Windows.'

**Windows Explorer:**

- Path: < Visual Studio 2017 > Projects > pssapr\_superlab\_01 > pssapr\_superlab\_01 >
- Files and folders listed:

Имя	Дата изменения	Тип	Размер
Debug	22.10.2019 8:45	Папка с файлами	
main.cpp	22.10.2019 8:45	C++ Source	1 КБ
pssapr_superlab_01.vcxproj	22.10.2019 8:45	VC++ Project	8 КБ
pssapr_superlab_01.vcxproj.filters	22.10.2019 8:45	VC++ Project Filte...	1 КБ
pssapr_superlab_01.vcxproj.user	22.10.2019 8:45	Per-User Project O...	1 КБ

At the bottom of the Explorer window, it says 'Элементов: 5' (5 items).



# Открытие других проектов

Configuration: Active(Debug) Platform: Active(Win32) Configuration Manager...

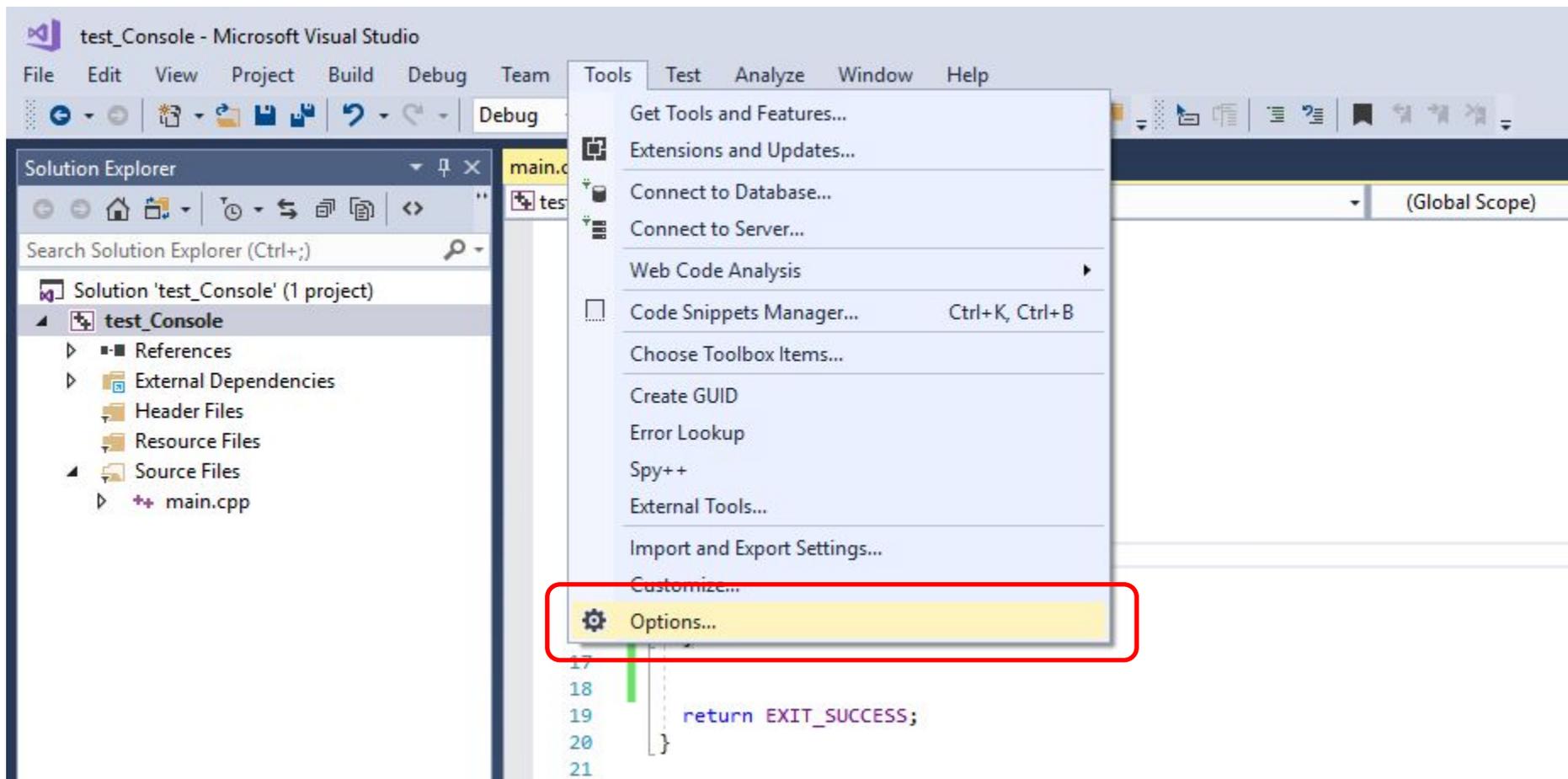
- Configuration Properties
  - General
  - Debugging
  - VC++ Directories
    - C/C++
    - Linker
    - Manifest Tool
    - XML Document Generator
    - Browse Information
    - Build Events
    - Custom Build Step
    - Code Analysis

General	
Target Platform	Windows 10
Windows SDK Version	10.0.17763.0
Output Directory	10.0.17134.0
Intermediate Directory	8.1
Target Name	<inherit from parent or project defaults>
Target Extension	.exe
Extensions to Delete on Clean	*.cdf;*.cache;*.obj;*.obj.enc;*.ilk;*.ipdb;*.iobj;*.resources;*.tlb;*.tli;*.t...
Build Log File	\$(IntDir)\$(MSBuildProjectName).log
Platform Toolset	Visual Studio 2017 (v141)
Enable Managed Incremental Build	No
Project Defaults	
Configuration Type	Application (.exe)
Use of MFC	Use Standard Windows Libraries
Character Set	Use Unicode Character Set
Common Language Runtime Support	No Common Language Runtime Support
.NET Target Framework Version	
Whole Program Optimization	No Whole Program Optimization
Windows Store App Support	No

**Windows SDK Version**  
Version of Targeted Platform

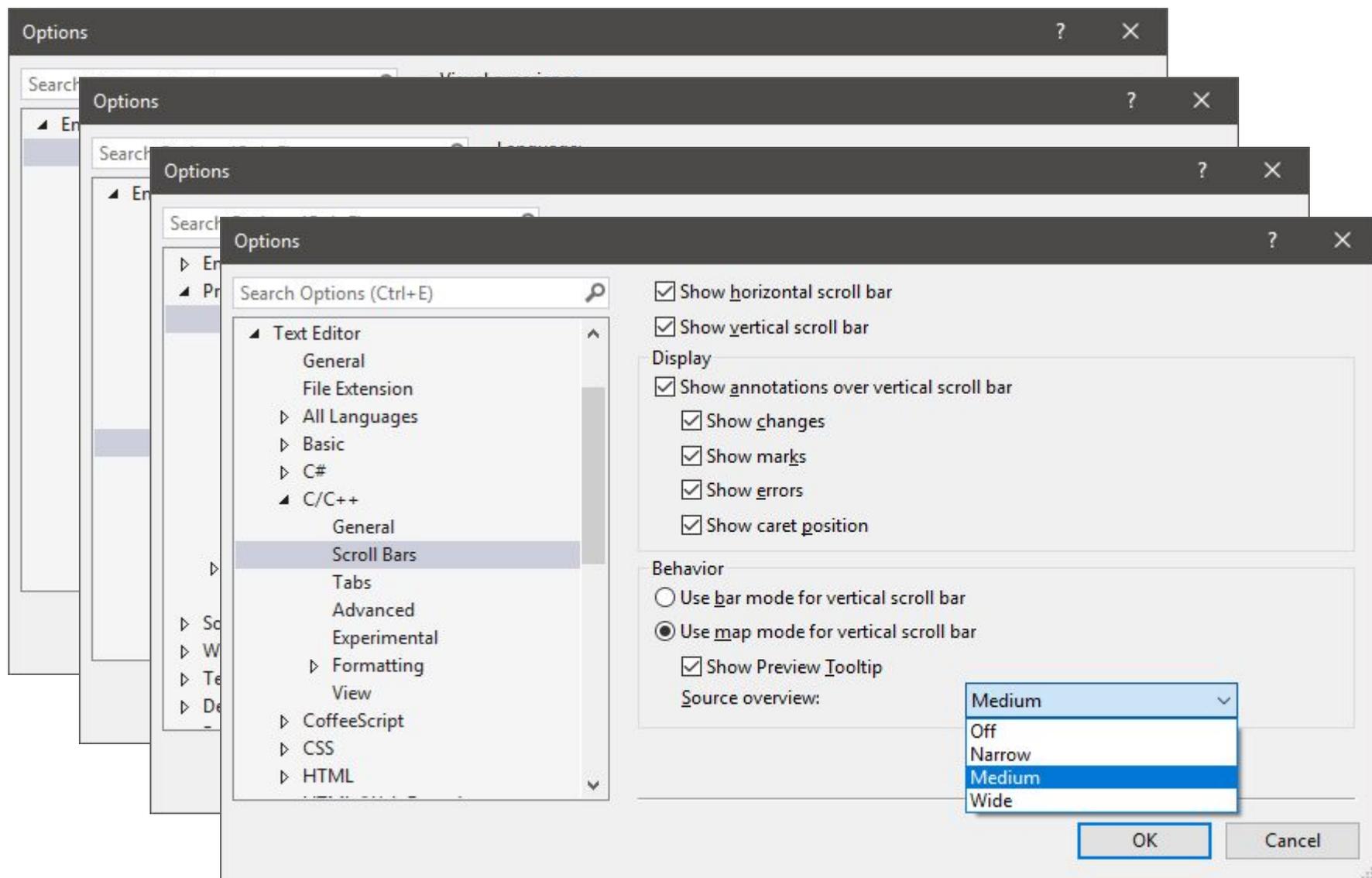
OK Отмена Применить

# Настройка параметров среды для комфортной работы



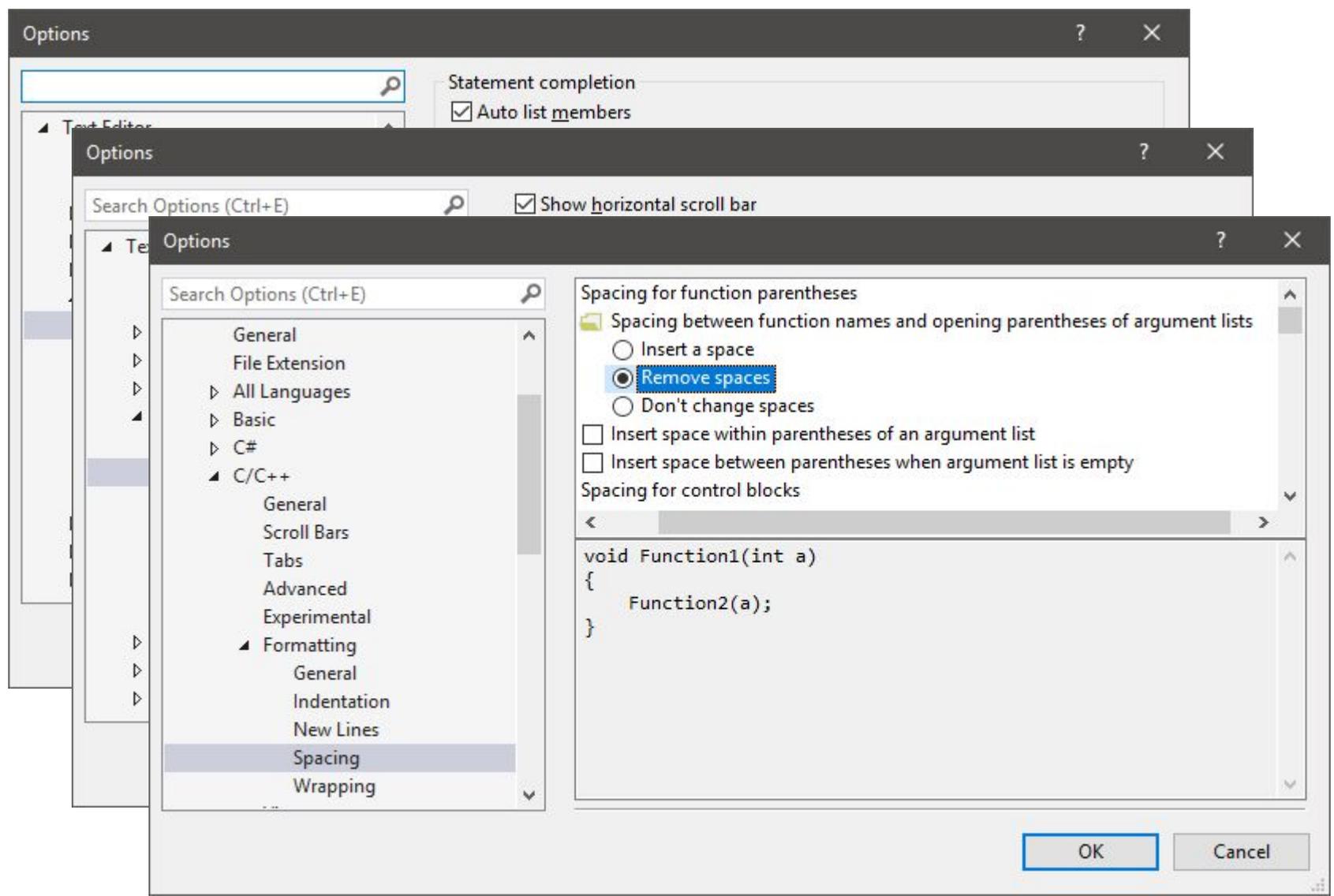


# Параметры среды





# Параметры редактора кода





# Отображение таблицы

```
main.cpp  ▢ ×
test_Console
1  #include <iostream>
2  #include <vector>
3  using namespace std;
4
5  int get_max_element(vector<int> &v) {
6  }
7
8
9  int main() {
10  setlocale(LC_CTYPE, "rus");
11
12  vector<int> v;
13  for (size_t i = 0; i < 1000; ++i)
14  v.push_back(i);
15
16  return EXIT_SUCCESS;
17  }
18
```

```
C:\Users\TopGun\Documents\Visual Studio 2017\Proje
#include <iostream>
#include <vector>
using namespace std;

int get_max_element(vector<int> &v) {
}

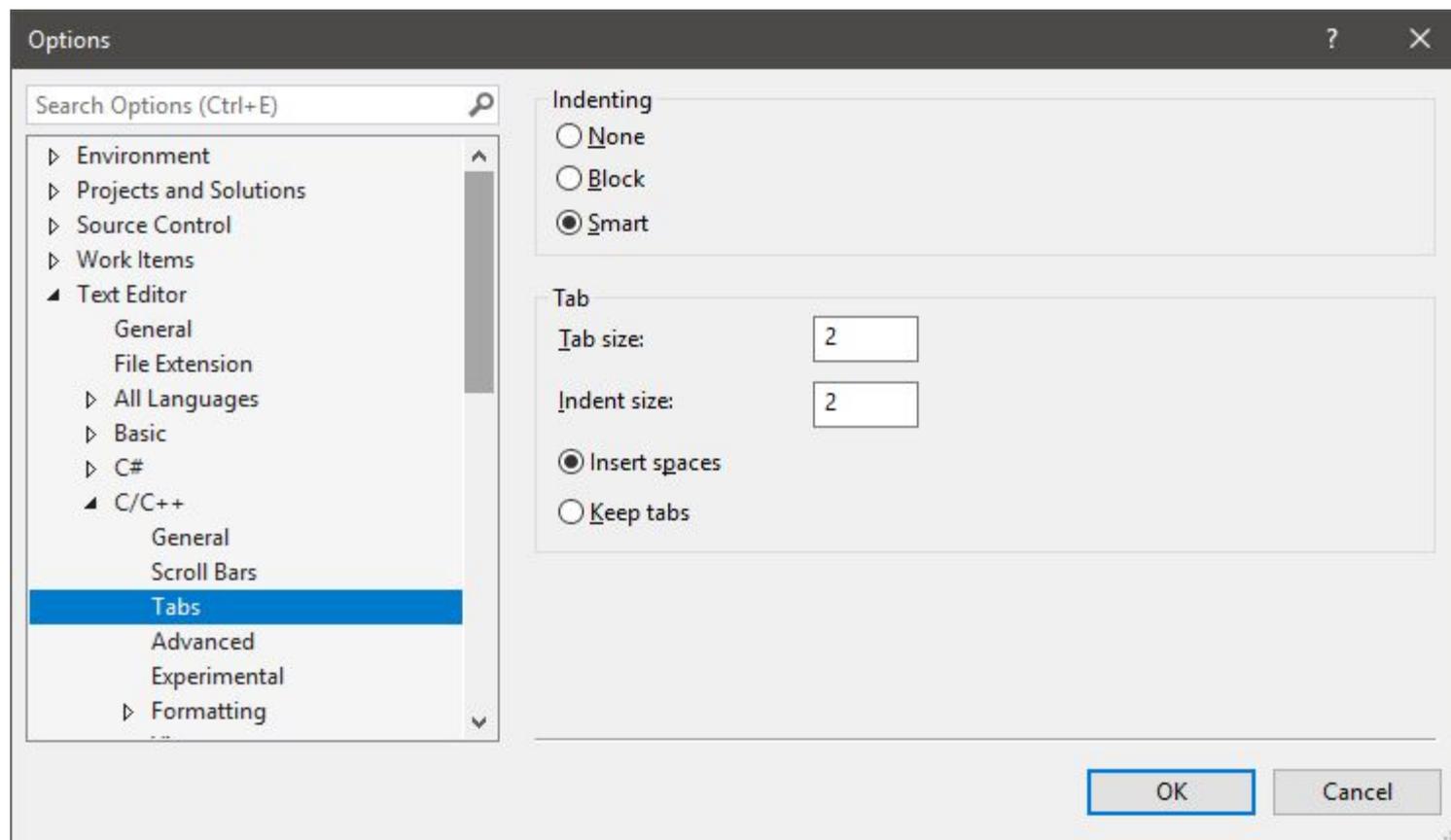
int main() {
    setlocale(LC_CTYPE, "rus");

    vector<int> v;
    for (size_t i = 0; i < 1000; ++i)
        v.push_back(i);

    return EXIT_SUCCESS;
}
```



# Настройка табуляции в MS Visual Studio 2017





# Плагины для Visual Studio 2017 (1)

marketplace.visualstudio.com/items

VisualStudio | Marketplace Sign in

Visual Studio > Tools > VSColorOutput



## VSColorOutput

Mike Ward - Ann Arbor |  $\pm$  362,310 installs | ★★★★★ (140) | Free

Color output for build and debug windows

Download

Overview | Q & A | Rating & Review

VS 2017: use version 2.6.4 Categories

**Output**

Show output from: **Build**

```

1>----- Build started: Project: test_Console, Configuration: Debug Win32 -----
1>main.cpp
1>c:\users\topgun\documents\visual studio 2017\projects\test_console\main.cpp(8): error C2065: 'cout': undeclared identifier
1>c:\users\topgun\documents\visual studio 2017\projects\test_console\main.cpp(8): error C2065: 'endl': undeclared identifier
1>Done building project "test_Console.vcxproj" -- FAILED.
===== Build: 0 succeeded, 1 failed, 0 up-to-date, 0 skipped =====

+++++
+++          Please consider donating to VSColorOutput          +++
+++          http://mike-ward.net/donate/          +++
+++          (this message can be turned off in the settings panel)          +++
+++++
  
```

Output Find Symbol Results

Ready

Succeeded	VSColorOutput\VSColorOutput - copied (Debug Any CPU)
Succeeded	Tests\tests.cppproj (Debug Any CPU)
Time Elapsed 00:00:03.03	

### More Info

Version 2.6.7  
Released on 24.12.2011, 18:48:33  
Last updated 16.10.2019, 17:13:02  
Publisher Mike Ward - Ann Arbor

The default patterns will color build errors in red, warnings in yellow/gold and successful build messages in green.



# Плагины для Visual Studio 2017 (2)

test\_Console - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Debug x86 Local Windows Debugger

Solution Explorer

main.cpp

```
1 #include <iostream>
2 using namespace std;
3
4 int main() {
5     setlocale(LC_CTYPE, "rus");
6
7     return EXIT_SUCCESS;
8 }
9
```

КОГДА ЖАН-ЛЮК ПИКАР  
ВИДИТ МОЙ КОД...

100 %

Ready Ln 9 Col 2 Ch 2 INS Add to Source Control



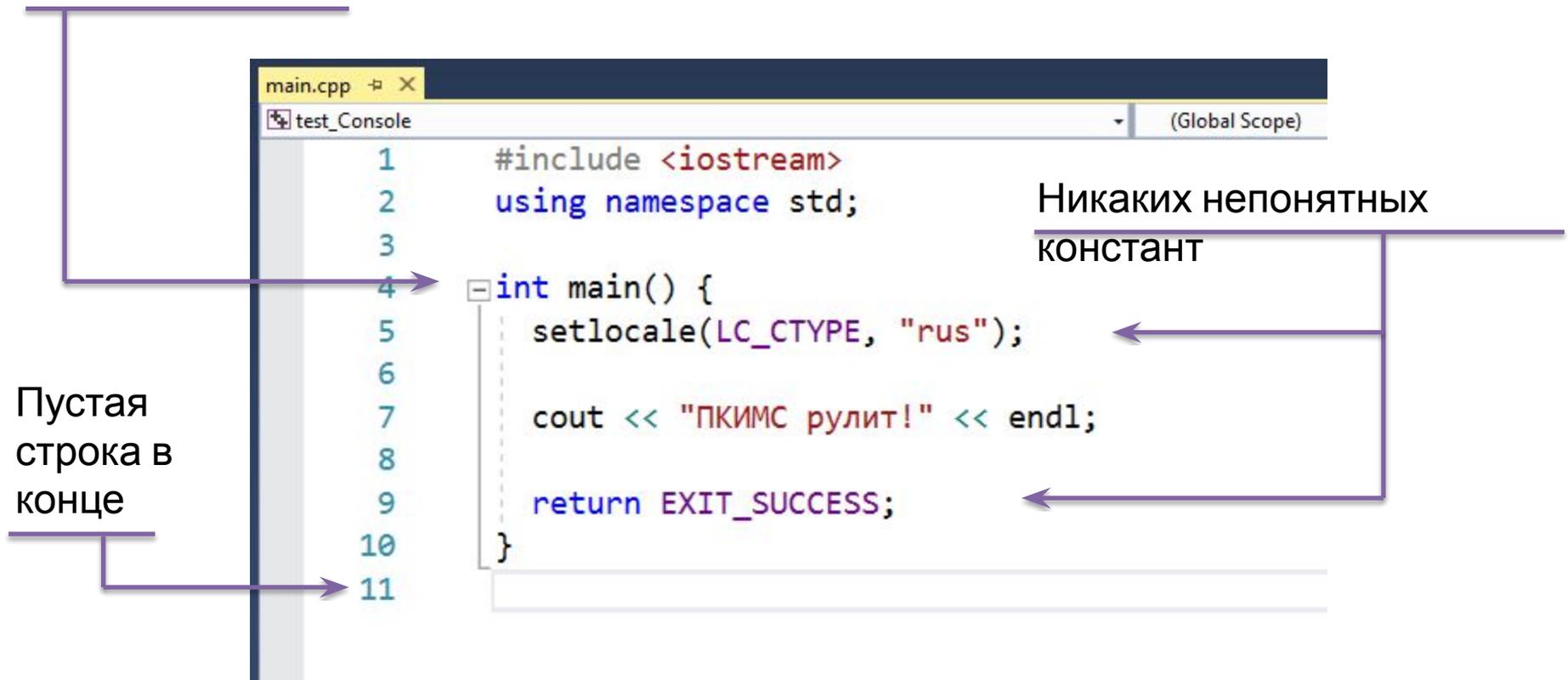
# Разработка кода: функция main (1)

Никаких void main

```
main.cpp [X]
test_Console (Global Scope)
1  #include <iostream>
2  using namespace std;
3
4  int main() {
5      setlocale(LC_CTYPE, "rus");
6
7      cout << "ПКМС рулит!" << endl;
8
9      return EXIT_SUCCESS;
10 }
11
```

Никаких непонятных  
констант

Пустая  
строка в  
конце





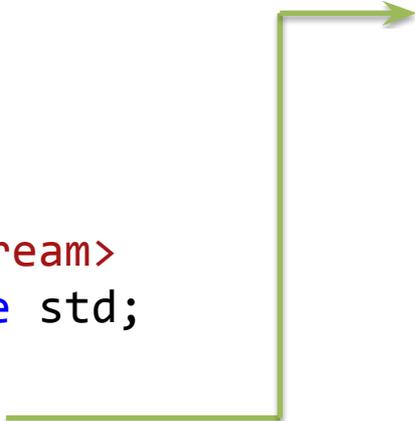
## Разработка кода: функция main (2)

```
#include <iostream>
using namespace std;

int main() {
    setlocale(LC_CTYPE, "rus");

    cout << "ПКИМС рулит!" <<
endl;

    return EXIT_SUCCESS;
}
```



```
int main(int argc, char *argv[]) {
    setlocale(LC_CTYPE, "rus");
```



## Функция setlocale (1)

```
#include <stdio.h>
#include <locale.h>

int main(int argc, char *argv[]) {
    //setlocale(LC_NUMERIC, "rus");

    printf("%f\n", 3.1415);

    return 0;
}
```

```
C:\WINDOWS\system32\cmd.exe
3.141500
Для продолжения нажмите любую клавишу . . .
```



## Функция setlocale (2)

```
#include <stdio.h>
#include <locale.h>

int main(int argc, char *argv[]) {
    setlocale(LC_NUMERIC, "rus");

    printf("%f\n", 3.1415);

    return 0;
}
```

C:\WINDOWS\system32\cmd.exe  
3,141500  
Для продолжения нажмите любую клавишу . . .



## Форматирование кода: 1TBS, K&R

```
bool gate::t_plus() {
    bool changed = false;
    for (size_t i = 0; i < outs.size(); ++i) {
        if (outs[i]->value != outs_temp[i]) {
            outs[i]->value = outs_temp[i];
            changed = true;
        }
    }
    return changed;
}
```



## Форматирование кода: BSD

```
bool gate::t_plus()
{
    bool changed = false;
    for (size_t i = 0; i < outs.size(); ++i)
    {
        if (outs[i]->value != outs_temp[i])
        {
            outs[i]->value = outs_temp[i];
            changed = true;
        }
    }
    return changed;
}
```



## Форматирование кода: Whitesmith

```
bool gate::t_plus()
{
    bool changed = false;
    for (size_t i = 0; i < outs.size(); ++i)
    {
        if (outs[i]->value != outs_temp[i])
        {
            outs[i]->value = outs_temp[i];
            changed = true;
        }
    }
    return changed;
}
```



## Форматирование кода: что кроме отступов? (1)

```
int numberOfprocessors = 4;
```

```
int NumberOfProcessors = 4;
```

```
int numberOfProcessors = 4;
```

```
int number_of_processors = 4;
```

```
int nProcessors = 4;
```

```
int m_Processors = 4;
```

```
int *p_val = NULL;
```

```
int* p_val = NULL;
```



## Форматирование кода: что кроме отступов? (2)

```
switch (N) {  
    case 1:  
        cout << "1" << endl;  
        break;  
    case 2:  
        cout << "2" << endl;  
        break;  
}
```

```
if (N == 4) {  
    cout << "OK";  
}  
else {  
    cout << "He  
OK";  
}
```

```
switch (N) {  
    case 1:  
        cout << "1" << endl;  
        break;  
    case 2:  
        cout << "2" << endl;  
        break;  
}
```

```
if( N==4 ) {  
    cout << "OK";  
} else {  
    cout << "He  
OK";  
}
```



## Работа с переменными

```
int n1 = 4131;
```

```
unsigned int n2 = 4131;
```

```
unsigned long int n3 = 4131;
```

```
const unsigned long int n4 = 4131;
```

```
static unsigned long int n4 = 4131;
```

——

если переменная  
объявлена локально

```
extern unsigned long int n5;
```

——

если переменная  
объявлена глобально



# Локальные переменные (1)

```
#include <iostream>
using namespace std;

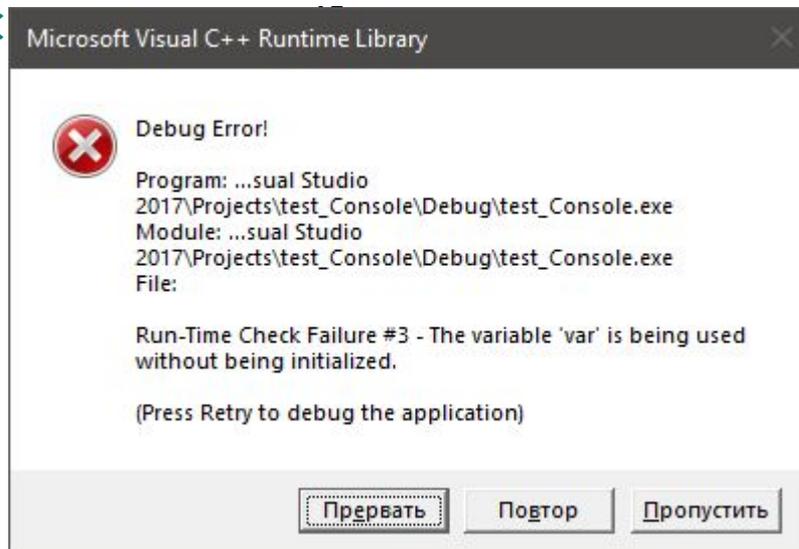
void func() {
    int var;
    cout << "(1) Variable = " <
    cout << "Enter value : ";
    cin >> var;
    cout << "(2) Variable = " <
}

int main() {

    func();
    func();

    return EXIT_SUCCESS;
}
```

```
C:\WINDOWS\system32\cmd.exe
(1) Variable = -858993460
Enter value : 5
(2) Variable = 5
(1) Variable = -858993460
Enter value : 4
(2) Variable = 4
Для продолжения нажмите любую клавишу . . .
```





# Локальные переменные (2)

The screenshot shows the Visual Studio IDE in Debug mode. The Disassembly window is open to the `func(void)` function in `main.cpp`. The assembly code is as follows:

```
00DB5CBC lea edi,[ebp-0D8h]
00DB5CC2 mov ecx,3Ch
00DB5CC7 mov eax,0CCCCCCCCh
00DB5CCC rep stos dword ptr es:[edi]
00DB5CCE mov byte ptr [ebp-0D1h],0
00DB5CD5 mov ecx,offset _7483FD32_main@cpp (0DBF027h)
00DB5CDA call @__CheckForDebuggerJustMyCode@4 (0DB1276h)
int var;
cout << "(1) Variable = " << var << endl;
00DB5CDF cmp byte ptr [ebp-0D1h],0
00DB5CE6 jne func+45h (0DB5CF5h)
00DB5CE8 push 0DB5DE8h
00DB5CED call __RTC_UninitUse (0DB10AAh)
00DB5CF2 add esp,4
00DB5CF5 mov esi,esp
00DB5CF7 push offset std::endl<char,std::char_traits<char> > (0DB141Ah)
00DB5CFC mov edi,esp
00DB5CFE mov eax,dword ptr [var]
00DB5D01 push eax
00DB5D02 push offset string "(1) Variable = " (0DB9BE4h)
00DB5D07 mov ecx,dword ptr [_imp_?cout@std@@3V?$basic_ostream@DU?$char_traits@D@std@@@
00DB5D0D push ecx
```

Two lines of assembly are highlighted with red boxes: `mov eax,0CCCCCCCCh` and `call __RTC_UninitUse (0DB10AAh)`.

The Watch window shows a variable `var` of type `int` with the value `0xCCCCCCCCh`.

The Autos window shows the current state of registers:

Name	Value	Type
ECX	00DBF027	
EBP	001AF950	

The Call Stack window shows the current call stack:

Name	Language
test_Console.exelfunc() Line 6	C++
test_Console.exelmain() Line 15	C++
[External Code]	
[Frames below may be incorrect and/or missing, no symbols loaded for kernel32.dll]	Un...



# Локальные переменные (3)

test\_Console (Debugging) - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Process: [0x2B2C] test\_Console.exe Thread: [0x2284] Main Thread Stack Frame: func

Disassembly main.cpp

Address: func(void)

Viewing Options

```
00A15CBC lea edi,[ebp-0CCh]
00A15CC2 mov ecx,33h
00A15CC7 mov eax,0CCCCCCCCh
00A15CCC rep stos dword ptr es:[edi]
00A15CCE mov ecx,offset _7483FD32_main@cpp (0A1F027h)
00A15CD3 call __CheckForDebuggerJustMyCode@4 (0A11276h)
int var = 0xCCCCCCCC;
00A15CD8 mov dword ptr [var],0CCCCCCCCh
cout << "(1) Variable = " << var << endl;
00A15CDF mov esi,esp
00A15CE1 push offset std::endl<char,std::char_traits<char> > (0A1141Ah)
00A15CE6 mov edi,esp
00A15CE8 mov eax,dword ptr [var]
00A15CEB push eax
00A15CEC push offset string "(1) Variable = " (0A19BE4h)
00A15CF1 mov ecx,dword ptr [_imp_cout@std@@3V?$basic_ostream@DU?$char_traits@D@std@@@
00A15CF7 push ecx
00A15CF8 call std::operator<<<std::char_traits<char> > (0A11208h)
00A15CFD add esp,8
00A15D00 mov ecx,eax
00A15D02 call dword ptr [_imp_std::basic_ostream<char,std::char_traits<char> >::opera
00A15D08 cmp edi,esp
```

Watch 1

Name	Value	Type
var	0xCCCCCCCC	int

Нет вызова функции

Autos

Name	Value	Type
ECX	00A1F027	
EBP	003EF8D4	
EDI	003EF8D4	
ES	002B	

Call Stack

Name	Lang
test_Console.exe!func() Line 5	C++
test_Console.exe!main() Line 15	C++
[External Code]	
[Frames below may be incorrect and/or missing, no symbols loaded for kernel32.dll]	Un...

Autos Locals

Call Stack Breakpoints Exception Settings Command Window Immediate Window Output

Ready Add to Source Control



# Локальные переменные (4) : Debug vs Release

The screenshot shows the Visual Studio IDE with a C++ console application named 'test\_Console'. The code in 'main.cpp' is as follows:

```
1 #include <iostream>
2 using namespace std;
3
4 void func() {
5     int var;
6     cout << "(1) Variable = " << var << endl;
7     cout << "Enter value : " << endl;
8     cin >> var;
9     cout << "(2) Variable = " << var << endl;
10 }
11
12 int main() {
13
14     func();
15     func();
16
17     return EXIT_SUCCESS;
18 }
19
```

The program is being debugged in Release mode. The Output window shows the following output:

```
C:\WINDOWS\system32\cmd.exe
(1) Variable = 464423
Enter value : 4
(2) Variable = 4
(1) Variable = 4
Enter value : 7
(2) Variable = 7
Для продолжения нажмите любую клавишу . . .
```

The second call to 'func()' shows that the variable 'var' has been reset to 4, demonstrating that local variables are not preserved between function calls in Release mode.

Below the first output, there is another screenshot of the program's output:

```
C:\WINDOWS\system32\cmd.exe
(1) Variable = 1983760699
Enter value : 9
(2) Variable = 9
(1) Variable = 9
Enter value : 10
(2) Variable = 10
Для продолжения нажмите любую клавишу . . .
```

This second output shows that the variable 'var' is again reset to 9, further demonstrating that local variables are not preserved between function calls in Release mode.



## Углубляемся в переменные – подсчёт числа вызовов

```
#include <iostream>
using namespace std;

void func() {
    int var = ???;
    cout << "Функция вызвана " << var << " раз" << endl;
}

int main() {
    setlocale(LC_CTYPE, "rus");

    func();
    func();

    return EXIT_SUCCESS;
}
```



# Глобальные переменные

```
#include <iostream>
using namespace std;

int numOfCalls;
```

```
void func() {
    cout << "Функция вызвана " << ++numOfCalls << " раз" << endl;
}
```

```
int main() {
    setlocale(LC_CTYPE, "rus");

    func();
    func();

    return EXIT_SUCCESS;
}
```

```
C:\WINDOWS\system32\cmd.exe
Функция вызвана 1 раз
Функция вызвана 2 раз
Для продолжения нажмите любую клавишу . . .
```



# Статические переменные

```
#include <iostream>
using namespace std;

void func() {
    static int numOfCalls = 0;
    cout << "Функция вызвана " << ++numOfCalls << " раз" << endl;
}

int main() {
    setlocale(LC_CTYPE, "rus");

    func();
    func();

    return EXIT_SUCCESS;
}
```

```
C:\WINDOWS\system32\cmd.exe
Функция вызвана 1 раз
Функция вызвана 2 раз
Для продолжения нажмите любую клавишу . . .
```



## Как реализованы статические переменные?

```
#include <iostream>
using namespace std;

int A;

void func() {
    static int B = 0;
    int C = 0;

    cout << "A : " << &A << endl;
    cout << "B : " << &B << endl;
    cout << "C : " << &C << endl;
}

int main() {
    setlocale(LC_CTYPE, "rus");

    func();

    return EXIT_SUCCESS;
}
```

```
C:\WINDOWS\system32\cmd.exe
A : 00F2C150
B : 00F2C154
C : 003FF648
Для продолжения нажмите любую клавишу . . .
```

```
C:\WINDOWS\system32\cmd.exe
A : 00F2C150
B : 00F2C154
C : 008FFBE8
Для продолжения нажмите любую клавишу . . .
```



## Переменные, указатели и ссылки (1)

```
#include <iostream>
using namespace std;

int main() {
    setlocale(LC_CTYPE, "rus");

    int var = 4131;
    cout << var << endl;
    var = 4132;
    cout << var << endl;

    return EXIT_SUCCESS;
}
```

```
C:\WINDOWS\system32\cmd.exe
4131
4132
Для продолжения нажмите любую клавишу . . .
```



## Переменные, указатели и ссылки (2)

```
#include <iostream>
using namespace std;

int main() {
    setlocale(LC_CTYPE, "rus");

    int var = 4131;
    cout << var << endl;

    int *p_var = &var;

    cout << p_var << endl;
    cout << *p_var << endl;

    return EXIT_SUCCESS;
}
```

```
C:\WINDOWS\system32\cmd.exe
4131
004FFEB0
4131
Для продолжения нажмите любую клавишу . . .
```



## Переменные, указатели и ссылки (3)

```
#include <iostream>
using namespace std;

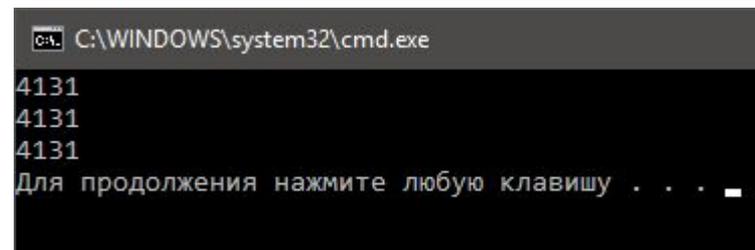
int main() {
    setlocale(LC_CTYPE, "rus");

    int var = 4131;
    cout << var << endl;

    int &var_ref = var;

    cout << var << endl;
    cout << var_ref << endl;

    return EXIT_SUCCESS;
}
```



```
C:\WINDOWS\system32\cmd.exe
4131
4131
4131
Для продолжения нажмите любую клавишу . . .
```



# Массивы

The screenshot shows the Visual Studio IDE during a debug session. The main window displays the source code of `main.cpp` with the following content:

```

1  #include <iostream>
2  using namespace std;
3
4  int main() {
5      setlocale(LC_CTYPE, "rus");
6
7      int mas[10] = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10};
8
9      cout << mas[2] << endl;
10     cout << *(mas + 2);
11
12     return EXIT_SUCCESS;
13 }
14

```

The **Watch 1** window shows the state of the `mas` array:

Name	Value	Type
mas	0x008ffbe4 {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}	int[10]
[0]	1	int
[1]	2	int
[2]	3	int
[3]	4	int
[4]	5	int
[5]	6	int

The **Memory 1** window shows the memory address `0x008FFBE4` and its contents:

```

Address: 0x008FFBE4
0x008FFBE4 01 00 00 00 02 00 00 00 03 00 .....
0x008FFBEE 00 00 04 00 00 00 05 00 00 00 .....
0x008FFBF8 06 00 00 00 07 00 00 00 08 00 .....
0x008FFC02 00 00 09 00 00 00 0a 00 00 00 .....
0x008FFC0C cc cc cc cc 49 a6 f1 18 28 fc M...I|c.(b
0x008FFC16 8f 00 be 2e 1b 00 01 00 00 00 U.s.....
0x008FFC20 b0 60 99 00 98 92 99 00 84 fc 0`m..`m..b
0x008FFC2A 8f 00 27 2d 1b 00 d9 a6 f1 18 U.'-.Ш|c.
0x008FFC34 b6 13 1b 00 b6 13 1b 00 00 d0 9...9...P
0x008FFC3E 7b 00 00 00 00 00 00 00 00 00 {.....
0x008FFC48 00 00 00 00 00 00 00 00 00 00 .....
0x008FFC52 00 00 00 00 00 00 00 00 00 00 .....
0x008FFC5C 00 00 00 00 84 c5 1b 00 90 c5 .....E..hE
0x008FFC66 1b 00 00 00 00 00 30 fc 8f 00 .....0bU.

```

The **Autos** window shows the current state of local variables:

Name	Value	Type
mas	0x008ffbe4 {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}	int[10]
mas[2]	3	int

The **Call Stack** window shows the current call stack:

Name	Lang
test_Console.exe!main() Line 12	C++
[External Code]	
[Frames below may be incorrect and/or missing, no symbols loaded for kernel32.dll]	Un...



# Структуры

The screenshot displays the Microsoft Visual Studio IDE with the following components:

- Disassembly Window:** Shows the source code for `main.cpp` in the `main()` function. The code defines a `SomeObject` struct and initializes it in `main`.
- Watch Window:** Displays the contents of the `obj` variable, showing its fields: `type` (0), `posX` (10), `posY` (10), `isColored` (true), `isSelected` (false), `isVisible` (true), `name` ("fig1"), and `scale` (1.00000000).
- Memory Window:** Shows the memory address `0x010FFE18` and its contents, including the string "fig1" and other data.
- Autos Window:** Shows the `obj` variable in the current scope.
- Output Window:** Shows the debug output, including system messages about loaded DLLs.

```
#include <iostream>
using namespace std;

struct SomeObject {
    int type;
    int posX;
    int posY;
    bool isColored;
    bool isSelected;
    bool isVisible;
    char name[8];
    float scale;
};

int main() {
    setlocale(LC_CTYPE, "rus");

    SomeObject obj = { 0, 10, 10, true, false, true, "fig1", 1.0f };

    return EXIT_SUCCESS;
}
```

Name	Value	Type
obj	{type=0 posX=10 posY=10 ...}	SomeObj...
type	0	int
posX	10	int
posY	10	int
isColored	true	bool
isSelected	false	bool
isVisible	true	bool
name	0x010ffe27 "fig1"	char[8]
scale	1.00000000	float

Address	0x010FFE18
0x010FFE18	00 00 00 00 0a 00 00 00 0a 00 .....
0x010FFE22	00 00 01 00 01 66 69 67 31 00 ....fig1.
0x010FFE2C	00 00 00 cc 00 00 80 3f cc cc ...М..Ъ?ММ
0x010FFE36	cc cc 2b cb ea 6c 50 fe 0f 01 ММ+лк1Пр...
0x010FFE40	be 2e 0a 00 01 00 00 00 b0 60 s.....°
0x010FFE4A	26 00 98 92 26 00 ac fe 0f 01 &..'&.-ю..
0x010FFE54	27 2d 0a 00 bb cb ea 6c b6 13 '-..»лк1лј.
0x010FFE5E	0a 00 b6 13 0a 00 00 b0 e9 00 ..ј.....°й.
0x010FFE68	00 00 00 00 00 00 00 00 00 00 .....
0x010FFE72	00 00 00 00 00 00 00 00 00 00 .....
0x010FFE7C	00 00 00 00 00 00 00 00 00 00 .....



# Структуры: битовые поля

The screenshot displays the Microsoft Visual Studio IDE during a debugging session. The main window shows the disassembly of the `main` function in `main.cpp`. The code defines a `SomeObject` struct with two `char` members: `colorBorder` and `colorFill`. The `main` function sets the locale to "rus" and initializes `obj` with `COLOR_WHITE` and `COLOR_GREEN`.

The **Watch 1** window shows the state of the `obj` variable:

Name	Value	Type
obj	{colorBorder=1 '\x1' colorFill=3 '\x3'}	SomeObj...
colorBorder	1 '\x1'	char
colorFill	3 '\x3'	char

The **Memory 1** window shows the memory address `0x00FEF9AF` containing the binary representation of the struct: `31 cc cc cc cc c8 f9 fe 00 be`.

The **Autos** window shows the `obj` variable with the value `{colorBorder=1 '\x1' colorFill=3 '\x3'}`.

The **Output** window shows the debug output, including system messages about loading DLLs.



## Объединения (1)

```
#define TYPE_CHAR    0
#define TYPE_BOOL    1
#define TYPE_INT     2
#define TYPE_FLOAT   3
#define TYPE_DOUBLE  4
```

```
struct MegaDataType {
    int    type;
    char   valChar;
    bool   valBool;
    float  valFloat;
    double valDouble;
};
```

```
MegaDataType mdt;
mdt.type = TYPE_BOOL;
mdt.valBool = false;

...

float x = 0.0f;
if (mdt.type == TYPE_FLOAT)
    x = mdt.valFloat;
```



## Объединения (2)

```
#define TYPE_CHAR    0
#define TYPE_BOOL    1
#define TYPE_INT     2
#define TYPE_FLOAT   3
#define TYPE_DOUBLE  4
```

```
union Data {
    char    valChar;
    bool    valBool;
    float   valFloat;
    double  valDouble;
};
```

```
struct MegaDataType {
    int    type;
    Data   data;
};
```

```
MegaDataType mdt;
mdt.type = TYPE_BOOL;
mdt.data.valBool = false;
```

```
float x = 0.0f;
if (mdt.type == TYPE_FLOAT)
    x = mdt.data.valFloat;
```

## ФУНКЦИИ В C++ (1)

```
#include <iostream>
using namespace std;
```

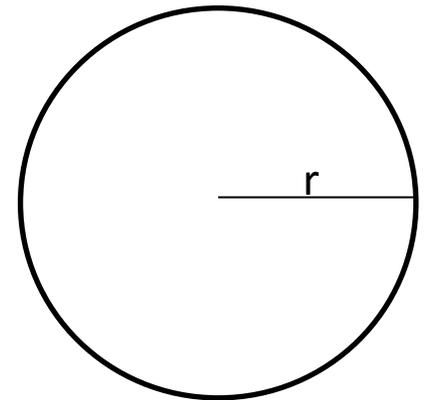
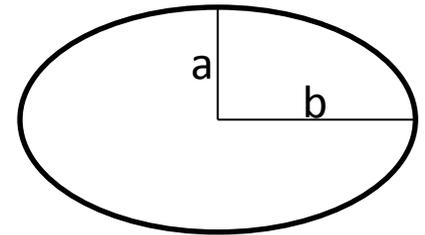
```
#define _USE_MATH_DEFINES
#include <math.h>
```

```
double get_ellipse_square(double a, double b) {
    return M_PI * a * b;
}
```

```
int main() {
    setlocale(LC_CTYPE, "rus");
```

```
    cout << get_ellipse_square(5, 6) << endl;
```

```
    return EXIT_SUCCESS;
}
```





# ФУНКЦИИ В C++ (2)

The screenshot shows the Visual Studio IDE with the following components:

- Menu:** File, Edit, View, Project, Build, Debug, Team, Tools, Test, Analyze, Window, Help.
- Toolbox:** Debug, x64, Local Windows Debugger.
- Solution Explorer:** Shows a project named 'Lytho1' with folders for Header Files, Resource Files, and Source Files. The 'MainFrame.cpp' file is selected.
- Code Editor:** Displays the implementation of the `MainFrame` class in `MainFrame.cpp`.
 

```

55 EVT_UPDATE_UI(IDM_VIEW_LOG,MainFrame::OnUpdateMenuUI_View_Log)
56 EVT_UPDATE_UI(IDM_FLOW_RUNTO,MainFrame::OnUpdateMenuUI_Flow_RunTo)
57 EVT_UPDATE_UI(IDM_FLOW_RESETSELECTED,MainFrame::OnUpdateMenuUI_Flow_ResetSelected)
58 // AUI events handlers
59 EVT_AUINOTEBOOK_PAGE_CHANGED(ID_AUI_FLOWWINDOWS,MainFrame::OnFlowWindowsPageChanged)
60 EVT_AUINOTEBOOK_PAGE_CLOSE(ID_AUI_FLOWWINDOWS,MainFrame::OnFlowWindowsPageClosing)
61 // Other handlers
62 EVT_CLOSE(MainFrame::OnClose)
63 wxEND_EVENT_TABLE()
64
65 MainFrame::MainFrame()
66 : wxFrame(nullptr,wxID_ANY,wxT("Lytho1 - v0.0.0.6"),wxDefaultPosition,wxSize(800,600)),
67
68
69 #if defined(_WXMSW_)
70 SetIcon(wxICON(appIcon));
71 #endif
72
73 auiManager.SetManagedWindow(this);
74
75 InitMenuBar();
76 InitToolBar();
77 InitStatusBar();
78 InitAui();
79
80 auiManager.Update();
81
82 Centre();
83
84
85 MainFrame::~MainFrame() {
86 auiManager.UnInit();
87 }
88
89 void MainFrame::UpdateFlowPage(size_t n) {
90 if (n >= p_nbFlow->GetPageCount())

```
- Notifications:** A vertical panel on the right side of the IDE.
- Status Bar:** Shows 'Ready', 'Ln 66', 'Col 13', 'Ch 13', 'INS', and window management icons.



## ФУНКЦИИ В C++ (3)

```
#include <iostream>
using namespace std;
```

```
int strlen(char *str) {
    int len = 0;
    while (str[++len]);
    return len;
}
```

```
int main() {
    setlocale(LC_CTYPE, "rus");

    cout << strlen("abc") << endl;

    return EXIT_SUCCESS;
}
```

```
int strlen(const char *str) {
    int len = 0;
    while (str[++len]);
    return len;
}
```



# Классы

```
class Object {
    int    type;
    int    posX, posY;
    bool   isColored, isSelected, isVisible;
    char   name[8];
    float  scale;
public:
    Object();
public:
    const char *get_name();
};

Object::Object() : type(0), posX(0), posY(0), isColored(true),
                  isSelected(false), isVisible(true), scale(1.0f) {
    memset(name, 0, sizeof(name));
}

const char *Object::get_name() {
    return name;
}
```



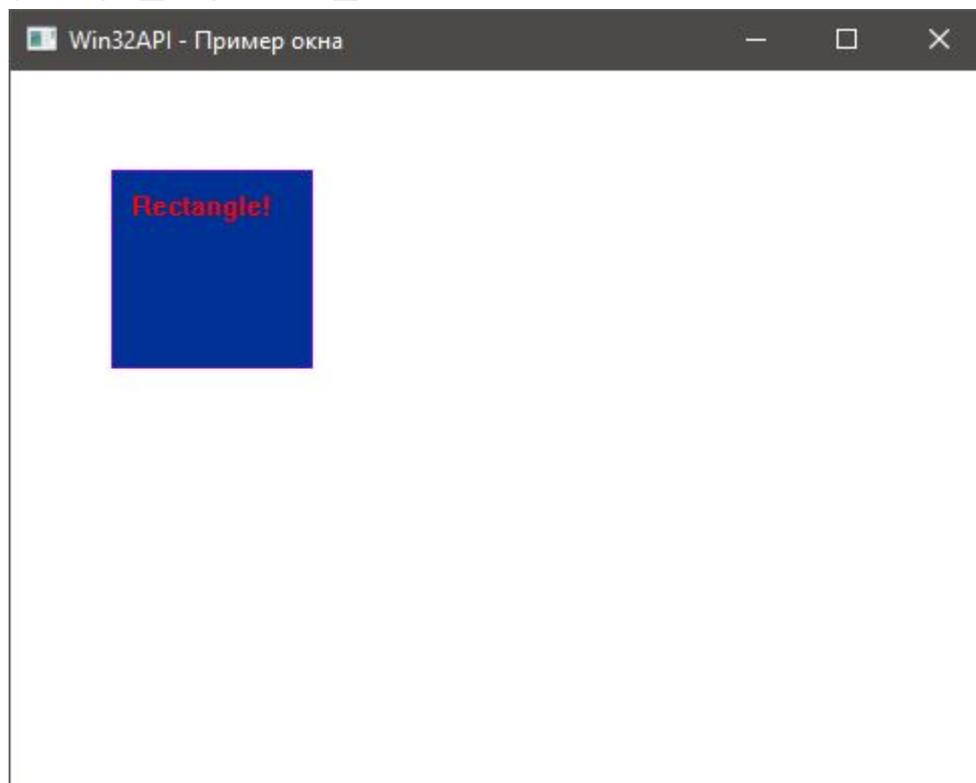
# Современный C++

- ключевое слово `nullptr`
- ключевое слово `auto`
- выражения инициализации в `if`
- лямбда-выражения



# Задание 1

Загружаем проект  
pssapr\_superlab\_01



## Задание

Реализовать следующую функциональность:

при клике правой кнопкой мыши по квадрату он должен последовательно менять свой цвет с синего на зелёный, затем на белый и снова на синий.



## Использование перечислимого типа (1)

```
int rectColor = 0;
```

```
case WM_RBUTTONDOWN:
```

```
    if(<проверка совпадения координат>) {
```

```
        ++rectColor;
```

```
        if(rectColor == 3)
```

```
            rectColor = 0;
```

```
        InvalidateRect(hWnd, NULL, TRUE);
```

```
        break;
```

```
    }
```



## Использование перечислимого типа (2)

```
switch (rectColor) {  
    case 0:  
        brush = CreateSolidBrush(RGB(0, 50, 150));  
        break;  
    case 1:  
        brush = CreateSolidBrush(RGB(0, 150, 50));  
        break;  
    case 2:  
        brush = CreateSolidBrush(RGB(250, 250, 250));  
        break;  
    default:  
        brush = CreateSolidBrush(RGB(250, 0, 0));  
        break;  
}
```



## Использование перечислимого типа (3)

```
enum RectColor {  
    rc_blue,  
    rc_green,  
    rc_white,  
};
```

```
RectColor rectColor = rc_blue;
```