
-

#####

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<style> body { font-family: "Open Sans", "DejaVu Sans", sans-serif; } </style>

1.

#####, ## # ##### ## ## ##### ## ##
#####, #####¹ ## #####².

#####, ##### ## ##### #####
#####. ##### ## #, ##### ## #
#. ##### ## "#####". ## #, ## #
#, ## # # #, #####-#####
####. ## # # ##### (Turbo) #, #
#. ##### # # # # #
C++, Java ## C#.

- ### ## #####, ##### ## - #, #, #####³, ##### ...
- ### ## ##### ## ## #,
- ### # #####,
- ### # ## #, ## ## ## # # # # #.

#, ##### Free
Pascal Compiler, <http://freepascal.org/> . ## # IDE (#####,
Debugger, ##### # #, #####
Lazarus <http://lazarus.freepascal.org/> . ##### ## # Castle Game Engine,
<https://castle-engine.io/> , ##### # 3D # 2D # #, #####
(Windows, Linux, macOS,
Android, iOS, Nintendo Switch; ##### # # WebGL).

#-##### #, ##### #
#. ## # # #

¹ ##### = Unit

² ##### = Generics

³ ##### = Interface


```

procedure MyProcedure(const A: Integer);
begin
    WriteLn('A + 10 е: ', A + 10);
end;

function MyFunction(const S: string): string;
begin
    Result := S + 'низове се управляват автоматично';
end;

var
    X: Single;
begin
    WriteLn(MyFunction('Забележка: '));
    MyProcedure(5);

    // Делението с "/" винаги дава резултат float,
    // използвайте "div" за целочислено делене
    X := 15 / 5;
    WriteLn('X сега е: ', X); // научна нотация
    WriteLn('X сега е: ', X:1:2); // 2 десетични знака
end.

```

```

## ## ##### ## ## ##, ##### ## #####
##### Result. ##### ## ##### ##### Result, #####
##### # ##### ##### #####.

```

```

function MyFunction(const S: string): string;
begin
    Result := S + 'нещо';
    Result := Result + ' още нещо!';
    Result := Result + ' и още!';
end;

```

```

##### ## ## ##### (MyFunction # #####
#####) #####, ## ## #####. ## ## ##
##### # ## ##, ## ## "#####", ##### ##
# ##### ## #####. ##### Result
#####, ##### ## ##### ## #####.

```

```

##### ## ## ## ##### ## ## ##
#####. ## ##### ## ##, ##

```

```
    Result := Count;
end;

begin
    Count := 10;
    CountMe; // функцията се изпълнява но резултата ѝ се игнорира, Count
сега е 11
    MyCount := CountMe; // резултата от функцията се използва, MyCount става
равно на Count, което сега е 12
end.
```

2.3. ##### (if)

```
##### if .. then ### if .. then .. else ## ## #####
###, ##### # #####. ## ## C-#####
#####, # ##### ## # ##### # #####.
```

```
var
    A: Integer;
    B: boolean;
begin
    if A > 0 then
        DoSomething;

    if A > 0 then
        begin
            DoSomething;
            AndDoSomethingMore;
        end;

    if A > 10 then
        DoSomething
    else
        DoSomethingElse;

    // еквивалентно на горното
    B := A > 10;
    if B then
        DoSomething
    else
        DoSomethingElse;
end;
```

(###) ##### ##-#####
#####. ##### ## ## ##### ## #####
#####, ## ## ##### ## ## #####.

#####:

```
var
  A, B: Integer;
begin
  if A = 0 and B <> 0 then ... // НЕКОРЕКТЕН пример
```

#####, ### ##### #####
and # ##### #: (0 and B). ##### #
#, ##### #. #####
=, ##### # A = (0 and B). ##### #
"type mismatch" ##### # ##
A = (0 and B) # ##### 0.

#####:

```
var
  A, B: Integer;
begin
  if (A = 0) and (B <> 0) then ...
```

#. ##### (short-circuit evaluation). #####:

```
if MyFunction(X) and MyOtherFunction(Y) then...
```

- ##### #, ## ##### MyFunction(X).
- ### MyFunction(X) ##### false, ##### #
(##### # false and каквото_и_да_е # false),
MyOtherFunction(Y) #####.
- ##### # or #####. #####, ## # true
(##### # true), #####.
- ##### # #####, #####

```
if (A <> nil) and A.IsValid then...
```

#####, #### A # nil. ##### nil # ##
(##### # #####). ##### null
pointer # #####.

2.5. ##### (case)

case .. of .. end.

```
case SomeValue of
  0: DoSomething;
  1: DoSomethingElse;
  2: begin
    IfItsTwoThenDoThis;
    AndAlsoDoThis;
  end;
  3..10: DoSomethingInCaseItsInThisRange;
  11, 21, 31: AndDoSomethingForTheseSpecialValues;
  else DoSomethingInCaseOfUnexpectedValue;
end;
```

else # ##### (# ##### # default # C-#####
#####). ##### else ##
#####.

C-##### # ##### switch, ##
(fall-through) ## ##.
#####. ## # ##### # ##
break. ## ##### -#####
case, #####.

2.6. #####, ##### #

#####, ##### ##
enums # #####:)

type


```

type
  TAnimalKind = (akDuck, akCat, akDog);
  TAnimals = set of TAnimalKind;
var
  A: TAnimals;
begin
  A := [];
  A := [akDuck, akCat];
  A := A + [akDog];
  A := A * [akCat, akDog];
  Include(A, akDuck);
  Exclude(A, akDuck);
end;

```

2.7. ##### (for, while, repeat, for .. in)

```

{$mode objfpc}{$H+}{$J-}
{$R+} // включена проверка на диапазона - подходящо за дебъг
var
  MyArray: array [0..9] of Integer;
  I: Integer;
begin
  // инициализация
  for I := 0 to 9 do
    MyArray[I] := I * I;

  // показване
  for I := 0 to 9 do
    WriteLn('Квадрата е ', MyArray[I]);

  // прави същото като горното
  for I := Low(MyArray) to High(MyArray) do
    WriteLn('Квадрата е ', MyArray[I]);

  // прави същото като горното
  I := 0;
  while I < 10 do
  begin
    WriteLn('Квадрата е ', MyArray[I]);
    I := I + 1; // или "I += 1", или "Inc(I)"
  end;

  // прави същото като горното
  I := 0;

```

```
##### for I in .. do .. # ##### # foreach # ##### #####  
## #####. ## ## # ##### # ##### # #####:
```

- ##### # (#####).
- ##### #:

```
var  
  AK: TAnimalKind;  
begin  
  for AK in TAnimalKind do...
```

- #####:

```
var  
  Animals: TAnimals;  
  AK: TAnimalKind;  
begin  
  Animals := [akDog, akCat];  
  for AK in Animals do ...
```

- # ##### # #####, #####, #####
TObjectList or TFPGObjectList.

```
{ $mode objfpc } { $H+ } { $J- }
```

```
uses  
  SysUtils, FGL;
```

```
type  
  TMyClass = class  
    I, Square: Integer;  
  end;  
  TMyClassList = specialize TFPGObjectList<TMyClass>;
```

```
var  
  List: TMyClassList;  
  C: TMyClass;  
  I: Integer;  
begin  
  List := TMyClassList.Create(true); // true = притежава елементите си  
  try  
    for I := 0 to 9 do  
      begin  
        C := TMyClass.Create;
```

-

```
C.I := I;
C.Square := I * I;
List.Add(C);
end;

for C in List do
  WriteLn('Квадрата на ', C.I, ' е ', C.Square);
finally
  FreeAndNil(List);
end;
end.
```

#####, #####

#####. #####

:)

2.8. #####,

```
## ##### # #####, ##### Write ##
WriteLn. ##### # #####.
```

```
##### "#####" ##### # #####. ## ##### #####
##### # ## ##### ##### #####. #####
## ##### # ##### # ##### # ##### #
##### # ##### # ##### # #####.
```

```
WriteLn('Hello world!');
WriteLn('Може да отпечатате цяло число: ', 3 * 4);
WriteLn('Може да разширите полето на цяло число: ', 666:10);
WriteLn('Може да отпечатате число с плаваща запетая: ', Pi:1:4);
```

```
## ## ##### # ## # ##, ##### LineEnding
(## FPC RTL). (Castle Game Engine ##### #-#####
NL.) ##### # ##### # #####, ##
#####
```

```
WriteLn('One line.\nSecond line.');// НЕКОРЕКТЕН пример
```

```
## #####, ##### # ## # ##. ## #####:
```

```
WriteLn('Първи ред.' + LineEnding + 'Втори ред.');
```


3. ##### (Unit-#)

Unit-### ##### ## ##### (#####, ##### ## ##
#####), ## ##### unit-# # #####. ## ## ##### ##
#####. ##### interface,
unit-
implementation ##### # ##### ##
#####. ##### unit-# MyUnit ### myunit.pas (#####
.pas).

```

{$mode objfpc}{$H+}{$J-}
unit MyUnit;
interface

procedure MyProcedure(const A: Integer);
function MyFunction(const S: string): string;

implementation

procedure MyProcedure(const A: Integer);
begin
    WriteLn('A + 10 е равно на: ', A + 10);
end;

function MyFunction(const S: string): string;
begin
    Result := S + 'низове се управляват автоматично';
end;

end.
```

myprogram.lpr (lpr
= Lazarus program file; # Delphi ##### .dpr). ##### ##

.pas ## ## ## ## .pp ## unit-# ## ##
.pas ## unit-# # .lpr ## FPC/Lazarus #####.

unit ### ## uses :

```

{$mode objfpc}{$H+}{$J-}

program MyProgram;
```

uses

MyUnit;

begin

WriteLn(MyFunction('Забележка: '));

MyProcedure(5);

end.

Unit-# ##### ## ##### initialization # finalization.
 ##### # ##### ## ##### #####
 ##### — #####.

{\$mode objfpc}{\$H+}{\$J-}

unit initialization_finalization;

interface

implementation

initialization

WriteLn('Hello world!');

finalization

WriteLn('Goodbye world!');

end.

3.1. Unit-#, ##### ##

unit #### ## ##### unit. ##### unit #### ## ## ##### #
 ##### interface ### ##### # ##### implementation. ##### ##
 ## ##### (#####,...) ## ##### ##
 ##### ## ##### unit. ##### # ##-##### , #.#. ### #####
 unit #### # ##### implementation, ##### ##### # ##.

{\$mode objfpc}{\$H+}{\$J-}

unit AnotherUnit;

interface

uses Classes;

{ Типът (клас) "TComponent" е дефиниран в unit Classes.

Поради тази причина трябва да използваме uses Classes; по-горе. }

procedure DoSomethingWithComponent(**var** C: TComponent);

implementation

uses SysUtils;

procedure DoSomethingWithComponent(**var** C: TComponent);

begin

{ Процедурата FreeAndNil е дефинирана в unit SysUtils.

Тъй като го използваме само в реализацията а не в интерфейсната част,
достатъчно е да използваме uses SysUtils; в секция "implementation". }

FreeAndNil(C);

end;

end.

unit-# # #####
unit-# ## ## #####
interface. ##### ## ## #, ## ## "#####"
unit, ##### ## ## "#####"
unit-#, ##### ## ##. #####

Makefile ## #####

#####.

unit-# ## ##
implementation. ##### unit A
B # ## interface # ## unit B
unit A # ## implementation.

3.2. ##### # ##### unit-#

unit-# ## ##

#####. # ## "#####"
uses , #####
unit-#.

unit-# ## ##
unit-# ## ## ## MyUnit.MyIdentifier. ##
##

```
uses Graphics, GoogleMapsEngine;
```

21

```
uses GoogleMapsEngine;

procedure ShowColor(const Color: TColor);
begin
    // WriteLn(ColorToString(Color));
end;

end.
```

```
# unit Graphics (## Lazarus LCL) ## ##### TColor. ## #####
## ## ##### unit, ## ## ## ## ##
##### ShowColor, ## ## ## ## ## interface.
##### # ## unit GoogleMapsEngine ##### TColor.
##### ## ## ## ## implementation, ## ## ## ##
##### TColor ## ## implementation. ##### ## ##
unit, ##### ## ## ## ## ##:
```

```
{$mode objfpc}{$H+}{$J-}
unit UnitUsingColors;
```

```
// НЕКОРЕКТЕН пример
// Ето какво "вижда" компилатора когато се опитва да компилира предишното
```

```
interface

uses Graphics;

procedure ShowColor(const Color: Graphics.TColor);

implementation

uses GoogleMapsEngine;

procedure ShowColor(const Color: GoogleMapsEngine.TColor);
begin
    // WriteLn(ColorToString(Color));
end;

end.
```

```
##### ## ## ## ## ## — ##### ## ## ## implementaton
## ## ## ## TColor ## unit Graphics. ## ## ## ## ##
##### GoogleMapsEngine # ## ## interface ##### Graphics. ## ##
```

unit-# UnitUsingColors #####
#####.

```
{ $mode objfpc } { $H+ } { $J- }  
unit UnitUsingColors;  
  
interface  
  
uses Graphics;  
  
procedure ShowColor(const Color: TColor);  
  
implementation  
  
uses GoogleMapsEngine;  
  
procedure ShowColor(const Color: Graphics.TColor);  
begin  
    // WriteLn(ColorToString(Color));  
end;  
  
end.
```

3.3. ##### unit

unit # ##
unit,
#####.

unit-#. # "#####" ##### unit ##
#####.

unit.

```
{ $mode objfpc } { $H+ } { $J- }  
unit MyUnit;  
  
interface  
  
uses Graphics;  
  
type
```

```
{ Представи TColor от unit Graphics като TMyColor. }
TMyColor = TColor;

{ Алтернативно, представи го под същото име.
  Квалифицирай типа с името на unit-а, в противен случай ще изглежда,
  че типа се позовава сам на себе си "TColor = TColor" в дефиницията. }
TColor = Graphics.TColor;
```

const

```
{ Може така да представите и константи от друг unit. }
clYellow = Graphics.clYellow;
clBlue = Graphics.clBlue;
```

implementation

end.

#####

#####

#####

8.2, „Callbacks (#####

#####

#####⁴, #####

unit,

#####.

#####

(unit-level properties), ##### 4.3, „#####“.

4.

4.1.

(classes).

#####:

- ##### (fields) (#####
- ##### (methods) (#####

⁴##### = wrappers

end;

procedure TMyClassDescendant.MyVirtualMethod;

begin

 WriteLn('TMyClassDescendant shows MyInt + 20: ', MyInt + 20);

end;

var

 C: TMyClass;

begin

 C := TMyClass.Create;

try

 C.MyVirtualMethod;

finally

 FreeAndNil(C);

end;

 C := TMyClassDescendant.Create;

try

 C.MyVirtualMethod;

finally

 FreeAndNil(C);

end;

end.

#####, ## ##
 ## ## virtual. ##
 ##### override, # ##
 #####. ## ##
 ##### reintroduce (#####
 #####).

 ## is. ## ##
 ##### as.

{ \$mode objfpc } { \$H+ } { \$J- }

program is_as;

uses

 SysUtils;

type

 TMyClass = **class**

```

    procedure MyMethod;
end;

TMyClassDescendant = class(TMyClass)
    procedure MyMethodInDescendant;
end;

procedure TMyClass.MyMethod;
begin
    WriteLn('MyMethod');
end;

procedure TMyClassDescendant.MyMethodInDescendant;
begin
    WriteLn('MyMethodInDescendant');
end;

var
    Descendant: TMyClassDescendant;
    C: TMyClass;
begin
    Descendant := TMyClassDescendant.Create;
    try
        Descendant.MyMethod;
        Descendant.MyMethodInDescendant;

        { Descendant има цялата функционалност, която се очаква от
          TMyClass, така че това присвояване е OK }
        C := Descendant;
        C.MyMethod;

        { Това не може да сработи, тъй като TMyClass не дефинира този метод }
        //C.MyMethodInDescendant;
        if C is TMyClassDescendant then
            (C as TMyClassDescendant).MyMethodInDescendant;

    finally
        FreeAndNil(Descendant);
    end;
end.
```

```

##### X as TMyClass, ##### ## ##### ## #####
TMyClass(X). ##### # #-##### ## #####, ## ##### ## ## #####
## ##### ## ## X ## ## ##### ## TMyClass.
##### ## ## ##### TMyClass(X), ##### ## ## # #####
```

#####, ## X # ##### ## TMyClass, ##### ## ## ##
is:

```
.....
if A is TMyClass then
  (A as TMyClass).CallSomeMethodOfMyClass;
// долното е малко по-бързо
if A is TMyClass then
  TMyClass(A).CallSomeMethodOfMyClass;
.....
```

4.3.

"#####" (##.##. syntax sugar - #####
#####, ##### ## ##### ## #####, ## #####
##-#####) ##:

1. ##### ## ##### ##### ##### (## ##### ## ## ##### # #####) ## ## ##
(getter) # ##### (setter). ##### ## ##### ##
(#####. ##### ## #####) ##### ##
#####;
2. ##### ## ##### ##### #####, ## ## # ##### ## #####. # ##### ## ##
#####.

type

```
TWebPage = class
private
  FURL: string;
  FColor: TColor;
  function SetColor(const Value: TColor);
public
  { Няма начин да се запише директно.
    Извикайте метода Load, например Load('http://www.freepascal.org/'),
    за да заредите страницата и да установите свойството. }
  property URL: string read FURL;
  procedure Load(const AnURL: string);
  property Color: TColor read FColor write SetColor;
end;
```

```
procedure TWebPage.Load(const AnURL: string);
begin
  FURL := AnURL;
  NetworkingComponent.LoadWebPage(AnURL);
```

end;

```
function TWebPage.SetColor(const Value: TColor);
begin
  if FColor <> Value then
  begin
    FColor := Value;
    // за пример: предизвиква обновяване всеки път при промяна на
    стойността
    Repaint;
    // пак за пример: осигурява, че някаква друга вътрешна инстанция,
    // като "RenderingComponent" (каквато и да е тя),
    // съдържа същата стойност за Color.
    RenderingComponent.Color := Value;
  end;
end;
```


#####, ## ##### ## ## ##### ##, #### ## ## ##### # ## ##
 ##### (#####) ## ##### ##. # #####
 #####, ##### Color ##### ## (setter SetColor. ## ##
 ##### Color ##### ##
 ##### FColor. ##### # ##-#####
 "#####" ##### ##. ##-##### ##, #### ##
 #####.

#####:

1. ##### ## ## ##### # ## (# ##### ## ##### ##
 ##### getter);
2. # ##### — ##### ## ## ##### # ## (# ##### ## #####
 ## ## ##### setter).

 ##### ## #####. #####, ## ## ##### Integer
 #####, ##### ## ##### ## ## Integer ## #####
 #####, ##### Integer.

#####, ## ##### "getter" # "setter" ## #####
 ##### # ##### ## ##### (#####)
 #####). ## # ##### ## ##, ##
 ## ## ##### ## ##-#####

-  ##### ##### ## ## ##### # ##### ####, ## #### unit. ##### ##### ##### ## ##### — ##### ##### #####, ## ##### # ##### ## ##### ##### ## *getter* # *setter*.



```
##### ##### ## #### ## ##### (### streaming components)
# #####. #####, ## ##### ## ##### ## #####
## ##### # ##### (stream, ##### ## #####), ## ##### ##### ##-##### ## ##
##### #####.
```



```

procedure TMyClass.MyMethod;
begin
    if Random > 0.5 then
        raise Exception.Create('Raising an exception!');
end;

var
    C: TMyClass;
begin
    Randomize;
    C := TMyClass.Create;
    try
        C.MyMethod;
    finally
        FreeAndNil(C);
    end;
end.

```

```

##### finally #####
##### Exit (##### / ##### / #####) Break
Continue (#####).

```

```

### ##### 6, „#####“ ## #-#####

```

4.5.

```

##### # #####-#####, # #####
##### # ##### / ##### / #####.

```

```

##### # #:

```

public

```

##### # #####, # ##### unit-#.

```

private

```

##### # #####.

```

protected

```

##### # #####.

```

```

##### #-##### private # protected # #####.
##### # unit ##### # #####, #####
##### private protected. ##### # #####,
##### #-##### strict

```


private ### strict protected ## ## #####
#####. ##-##### ## # ##### # ##### 9.1, „##### # #####“.

#####, ## ##### public. #####
{M+}, ## #####
{M+}, ##### #####
TPersistent, ##### # ##### TComponent
(##### TComponent # ##### TPersistent). ## ##
published, ##### # public, ## #
##.

published (## ## ##

public, ## ## # ## ## ## ##
#####.

4.6.

##, ## ## ##, ## ##
TObject.

4.7. Self

Self (##) ## ## ##
##, ## ## ## ##. ## #
this ## C++, Java # #####.

4.8.

##, ## ##, ##
##. #
##-####, TMyClass2.MyOtherMethod ##### MyMethod, #####
TMyClass2.MyMethod.

```
{mode objfpc}{H+}{J-}
```

```
uses SysUtils;
```

```
type
```

```
  TMyClass1 = class
    procedure MyMethod;
  end;
```

```

TMyClass2 = class(TMyClass1)
  procedure MyMethod;
  procedure MyOtherMethod;
end;

procedure TMyClass1.MyMethod;
begin
  Writeln('TMyClass1.MyMethod');
end;

procedure TMyClass2.MyMethod;
begin
  Writeln('TMyClass2.MyMethod');
end;

procedure TMyClass2.MyOtherMethod;
begin
  MyMethod; // this calls TMyClass2.MyMethod
end;

var
  C: TMyClass2;
begin
  C := TMyClass2.Create;
  try
    C.MyOtherMethod;
  finally FreeAndNil(C) end;
end.

```

```

### ##### # # ##### # ##### #, ##### # ##### #
##### #. #####, ##### MyMethod # ##### #
TMyClass2, #####

```

- ##### TMyClass2.MyMethod.
- ### # # #, ##### TMyClass1.MyMethod.
- ### # # #, ##### TObject.MyMethod.
- ### # # #, ##### # # #.

```

#### # # ##### # ##### # # #
TMyClass2.MyMethod # #-##### #. ##### # #
TMyClass2.MyOtherMethod # # # TMyClass1.MyMethod.

```



```
begin
  Writeln('TMyClass1.MyMethod ', A);
end;

constructor TMyClass2.Create;
begin
  inherited Create; // this calls TMyClass1.Create
  Writeln('TMyClass2.Create');
end;

procedure TMyClass2.MyMethod(const A: Integer);
begin
  inherited MyMethod(A); // this calls TMyClass1.MyMethod
  Writeln('TMyClass2.MyMethod ', A);
end;

var
  C: TMyClass2;
begin
  C := TMyClass2.Create;
  try
    C.MyMethod(123);
  finally FreeAndNil(C) end;
end.
```

```
##### inherited #####
### # #####, ### #####:
#### # inherited; (##### inherited, #####
##### # #####, ##### # #####). ####
"##### ###, #####
#####".
```



```
# #####, ##### inherited ...; #####
## # inherited;.
```

```
##### 1: #### inherited; # #####
##### ### #####. ### ###
## (##### # ##### # const), #####
##### # #####
#####. #####:
```

```
procedure TMyClass2.MyMethod(A: Integer);
```

begin

```

writeln('TMyClass2.MyMethod начало ', A);
A := 456;
{ Това извиква TMyClass1.MyMethod with A = 456,
  независимо от стойността на A подадена на този метод
  (TMyClass2.MyMethod). }
inherited;
writeln('TMyClass2.MyMethod крайно ', A);
end;

```

2: ##### MyMethod (## "#####
 ## #####) ##### ## #####. ##### ##
 ##### ## # ##### #-####. ## inherited #####
 ##### ## # ##### ## ##. inherited #####, ##
 ##### ## # ##### # ##### # ##
 ## #####, ## # ## #####.

4.9. #####, ##### #

#####. #### # ##### C++ # ##
 ##### ## Java.

#####, ##### ## ##
 ## ## # ##### ## ##, # ## ##
 ##### ## ##. ##### ##, ## # ##, ##
 ##### ## # #####, ## # ## TFruit, ## ##
 ## ##-##### TApple.

#####-##### #, ## #####-#####
 ##### # ##### ##### ##
 ##### ## ##### ## ##
 ##### ##. ##### ## # #####, ## ##
 ## #####. #####:

```

{$mode objfpc}{$H+}{$J-}
uses SysUtils;

type
  TFruit = class
    procedure Eat;
  end;

```

```

TApple = class(TFruit)
    procedure Eat;
end;

procedure TFruit.Eat;
begin
    Writeln('Изядохме плод');
end;

procedure TApple.Eat;
begin
    Writeln('Изядохме ябълка');
end;

procedure DoSomethingWithAFruit(const Fruit: TFruit);
begin
    Writeln('Имаме плод от клас ', Fruit.ClassName);
    Writeln('Ядем го:');
    Fruit.Eat;
end;

var
    Apple: TApple; // Забележка: тук също така може да декларирате "Apple:
    TFruit"
begin
    Apple := TApple.Create;
    try
        DoSomethingWithAFruit(Apple);
    finally FreeAndNil(Apple) end;
end.

```

#####

```

Имаме плод от клас TApple
Ядем го:
Изядохме плод

```

```

##### Fruit.Eat ##### TFruit.Eat
# ##### TFruit.Eat .

```

```

### ## #####, ##### ## ## ## #####:
##### Fruit.Eat, ##### Fruit ## #####
TFruit. ##### Eat ##### TFruit.###
TFruit ## #####, ##### # #####

```



```
Writeln('Изядохме ябълка');
end;
```

```
procedure DoSomethingWithAFruit(const Fruit: TFruit);
begin
    Writeln('Имаме плод от клас ', Fruit.ClassName);
    Writeln('Ядем го:');
    Fruit.Eat;
end;
```

```
var
    Apple: TApple; // Забележка: тук също така може да декларирате "Apple:
    TFruit"
begin
    Apple := TApple.Create;
    try
        DoSomethingWithAFruit(Apple);
    finally FreeAndNil(Apple) end;
end.
```

#####

```
Имаме плод от клас TApple
Ядем го:
Изядохме ябълка
```

```
##### , #####
##### (VMT), #####
#####
##### Eat , #####
# ##### Fruit , #
Eat #####
```

```
### ## override , ##
## #####
### ## , ## , ##
##### reintroduce . ## e ##-#####
##### override , ##
### ## , ##
```


5.

5.1.

#####. # #####
#####. #####
-gl -gh ## FPC ## ##### (### https://castle-engine.io/manual_optimization.php#section_memory).

#####. #####
(# ## #

###), ## #####
#####.

5.2.

FreeAndNil(A) ## unit SysUtils #####
A # nil, ## # — ## ##### (destructor) # ##
nil. #####.

#####:

```
if A <> nil then
begin
  A.Destroy;
  A := nil;
end;
```

FreeAndNil #####
nil ## A #####
— #####, ## "#####"
#####.

A.Free, #####:

```
if A <> nil then
  A.Destroy;
```

A (#), #####
nil.

nil. ##### A.Free #####
Free #####
"#####" # — #####
Self <> nil. ##### (#####
#####).

FreeAndNil(A) #####, #####
Free ##### Destroy. Castle
Game Engine #####. #####
nil, #####.

5.3.

(### -##### -
#####). #####
nil, #####
FreeAndNil(A).

#####:

```
uses SysUtils;
```

```
type
```

```
  TGun = class
```

```
  end;
```

```
  TPlayer = class
```

```
    Gun1, Gun2: TGun;
```

```
    constructor Create;
```

```
    destructor Destroy; override;
```

```
  end;
```

```
constructor TPlayer.Create;
```

```
begin
```

```
  inherited;
```

```
  Gun1 := TGun.Create;
```

```

    Gun2 := TGun.Create;
end;

destructor TPlayer.Destroy;
begin
    FreeAndNil(Gun1);
    FreeAndNil(Gun2);
    inherited;
end;

```

```

## ## #####, ##### ##
##### "#####"## TComponent.####, ##### # #####
## #####. ##### # #####
##### # ##### ## ##### (#### ##
##### ## #####, ##### ## #####
##-####). ##### ## #####:

```

```

uses SysUtils, Classes;

```

```

type
    TGun = class(TComponent)
    end;

    TPlayer = class(TComponent)
        Gun1, Gun2: TGun;
        constructor Create(AOwner: TComponent); override;
    end;

constructor TPlayer.Create(AOwner: TComponent);
begin
    inherited;
    Gun1 := TGun.Create(Self);
    Gun2 := TGun.Create(Self);
end;

```

```

##### ## ## #####
TComponent.#### ## #####.
(##### — ##### # reintroduce.## #####
#####, ## ## #####, ##### ## ##
## #####, ## ## #####
# # #####.)

```

```
##### , ## ##### nil. ##
#### "#####" #### ##
#####. #### ## , ## #####
TComponent, ## #####. ## ##
####, ##### ManualGun :=
TGun.Create(nil);.
```

```
##### # #####
OwnsObjects (## true!) ## -#####
TFPGObjectList ## TObjectList.#### ## ##:
```

```
uses SysUtils, Classes, FGL;
```

```
type
```

```
    TGun = class
```

```
    end;
```

```
TGunList = specialize TFPGObjectList<TGun>;
```

```
TPlayer = class
```

```
    Guns: TGunList;
```

```
    Gun1, Gun2: TGun;
```

```
    constructor Create;
```

```
    destructor Destroy; override;
```

```
end;
```

```
constructor TPlayer.Create;
```

```
begin
```

```
    inherited;
```

```
    // Всъщност, стойността true (за OwnsObjects) е зададена по подразбиране
```

```
    Guns := TGunList.Create(true);
```

```
    Gun1 := TGun.Create;
```

```
    Guns.Add(Gun1);
```

```
    Gun2 := TGun.Create;
```

```
    Guns.Add(Gun2);
```

```
end;
```

```
destructor TPlayer.Destroy;
```

```
begin
```

```
    { Трябва да се погрижим за освобождаването на списъка.
```

```
    Той ще освободи елементите си автоматично. }
```

```
    FreeAndNil(Guns);
```

{ Вече няма нужда да освобождаваме ръчно Gun1, Gun2. Хубав навик е да установим на "nil"

техните препратки, тъй като знаем, че са освободени. В този прост клас и с

този прост деструктор, очевидно е, че те няма да бъдат достъпвани повече --

но правейки така ще ни помогне в случая на по-големи и по-сложни деструктори.

Алтернативно, можем да си спестим декларирането на Gun1 и Gun2, и вместо това да използваме Guns[0] и Guns[1] в нашия код.

Или да създадем метод Gun1, който връща Guns[0]. }

```
Gun1 := nil;
Gun2 := nil;
inherited;
end;
```

, ## "#####" # ##### #

, ##

#####. ##### Extract ##

#####

#.

Castle Game Engine: ##### TX3DNode

children

TX3DNode. ##### X3D #####, TX3DRootNode, ## #####

TCastleSceneCore.

- #####

OwnsXxx.

5.4. ##### Destroy

-#####,

деструктор, ##### Destroy.

,

#####. #####

Destroy, ##### Free, ##

FreeAndNil.

Destroy # TObject # ##### ,

override

(### ##### TObjekt). #### #
Free. ##### ##
4.9, „#####“.



```
#####  
#####.  
  
##### # ##### # ## #####.  
##### ## ## Create # #####  
#####, ## # ##### # #####  
#####.  
  
##### ##### Create # TObjekt ## #  
#####, ##### ## ## ## override #  
#####.  
  
#### ##### ##### ##  
#####. ##### ## # #####,  
#### ## ## ##### ## ## ##.  
  
##### #####, ## # ##### # #####  
##### ## TComponent. TComponent  
##### Create(AOwner: TComponent)  
##### ## #####, ## ## #####  
#####. ##### TComponent, #####  
##### ##### (## ## #  
#### override) # ## #####  
##### # #####. #####  
### ## # #####, ## ## ## #  
## "#####". ##### ##  
##### # ##### #  
Create(AOwner: TComponent), # #####  
#### ## ##### ##  
##### ## #####  
##### ## Lazarus.
```

5.5.

#####, #### ## ##
#####, # ##### ## ##
"#####". ## ##


```
# #####, ##### ##### Obj1,
##### ## ##### nil ## ##### Obj2 . #####
##### # #####.
```

- ## #####

#####

```
### #####, ##### ## #####, #####
# #####/##### # ##### ## ##### ## setter. #####
### ## ##### # ##-#####, ## ##### # #####, ##### ##
##### :)
```

```
TControl = class(TComponent)
end;
```

48


```

    read FSomeSpecialControl write SetSomeSpecialControl;
end;

implementation

procedure TContainer.Notification(AComponent: TComponent; Operation:
TOperation);
begin
    inherited;
    if (Operation = opRemove) and (AComponent = FSomeSpecialControl) then
        { set to nil by SetSomeSpecialControl to clean nicely }
        SomeSpecialControl := nil;
end;

procedure TContainer.SetSomeSpecialControl(const Value: TControl);
begin
    if FSomeSpecialControl <> Value then
        begin
            if FSomeSpecialControl <> nil then
                FSomeSpecialControl.RemoveFreeNotification(Self);
            FSomeSpecialControl := Value;
            if FSomeSpecialControl <> nil then
                FSomeSpecialControl.FreeNotification(Self);
        end;
end;

destructor TContainer.Destroy;
begin
    { set to nil by SetSomeSpecialControl, to detach free notification }
    SomeSpecialControl := nil;
    inherited;
end;

```

5.6. ##### (Castle Game Engine)

```

#    Castle    Game    Engine    #####    ##    #####
TFreeNotificationObserver ## ##### CastleClassUtils #####
##### ##### ## FreeNotification, RemoveFreeNotification #
##### ## Notification.

#### ##### ##### TFreeNotificationObserver ##### ##-
##### ## ##### FreeNotification ##### (#####

```

```
## #####, ## # ##### ## #). ## #-#####, ##### # #
##### ## ##### ## ## ##### ##### #####
TFreeNotificationObserver # ##### #-##### ## ##### (#####
##### ## FreeNotification # ##### ##### ## ##### #####,
## ##### ## ##### ## ## ##### ##### #####).
```

```
#### # ##### ##, ##### TFreeNotificationObserver, ##
##### ## ##### ##### ##### # #####:
```

type

```
TControl = class(TComponent)
```

```
end;
```

```
TContainer = class(TComponent)
```

```
private
```

```
FSomeSpecialControlObserver: TFreeNotificationObserver;
```

```
FSomeSpecialControl: TControl;
```

```
procedure SetSomeSpecialControl(const Value: TControl);
```

```
procedure SomeSpecialControlFreeNotification(const Sender:
```

```
TFreeNotificationObserver);
```

```
public
```

```
constructor Create(AOwner: TComponent); override;
```

```
property SomeSpecialControl: TControl
```

```
read FSomeSpecialControl write SetSomeSpecialControl;
```

```
end;
```

implementation

```
uses CastleComponentSerialize;
```

```
constructor TContainer.Create(AOwner: TComponent);
```

```
begin
```

```
inherited;
```

```
FSomeSpecialControlObserver := TFreeNotificationObserver.Create(Self);
```

```
FSomeSpecialControlObserver.OnFreeNotification := {$ifdef FPC}@{$endif}
```

```
SomeSpecialControlFreeNotification;
```

```
end;
```

```
procedure TContainer.SetSomeSpecialControl(const Value: TControl);
```

```
begin
```

```
if FSomeSpecialControl <> Value then
```

```
begin
```

```
FSomeSpecialControl := Value;
```

```
FSomeSpecialControlObserver.Observed := Value;
```

```

end;
end;

procedure TContainer.SomeSpecialControlFreeNotification(const Sender:
  TFreeNotificationObserver);
begin
  // set property to nil when the referenced component is freed
  SomeSpecialControl := nil;
end;

```

https://castle-engine.io/custom_components .

6.

6.1.

#####

- ##### **raise**. ##### **raise ...**, #####

- ##### **try ... except ... end**. ##### **"#####"** #####

#####: #####, #####

LCL ##### (events) #####
 ##### (# LCL #####), #####
 #####.

Castle Game Engine ##### CastleWindow,
 #####
 (# #####).

 #####(##### # LCL ###, # CGE ###...
).

- ```
"#####" ##### ## ##### ##### ## ##### #####.
```

- ```
# #####      #####      ###      #####      #####      #####      ##
#####      #####,      #####      #####      raise,      #####      raise
ESomethingBadHappened.Create('Описание на случилото се лошо
нещо.').
```

```
#### ##### ## ##### ##### #####, ##### ## #
##### raise ...,##### # #####:
```

52

```

    raise EInvalidParameter.Create('Invalid parameter, space is not
allowed');
end;

```

```

##### ,## ##### raise ##### ## #### #####
## ####. ##### ## ##### ## ##### ## #####
#####.

```

```

##### ## ##### CreateFmt, ##### # #####
##### ## Create(Format(MessageFormat, MessageArguments)).
#### # ##### ## ##### # ##### # #####
#####. ##### ## ##### #####:

```

```

type
    EInvalidParameter = class(Exception);

function ReadParameter: String;
begin
    Result := Readln;
    if Pos(' ', Result) <> 0 then
        raise EInvalidParameter.CreateFmt('Невалиден параметър %s, не са
позволени интервали.', [Result]);
end;

```

6.3.

```

##### ## #####:

```

```

var
    Parameter1, Parameter2, Parameter3: String;
begin
    try
        Writeln('Въведете 1-ви параметър:');
        Parameter1 := ReadParameter;
        Writeln('Въведете 2-ри параметър:');
        Parameter2 := ReadParameter;
        Writeln('Въведете 3-ти параметър:');
        Parameter3 := ReadParameter;
    except
        // прихващане на EInvalidParameter предизвикан от някое от
извикванията на ReadParameter
        on EInvalidParameter do
            Writeln('Възникна изключение EInvalidParameter');

```

```
end;
end;
```

```
## ## #####, ##### ## ##### ##
##### (## ##### E # #####). ## ##### ## #####
##### ## #####:
```

```
try
...
except
  on E: EInvalidParameter do
    Writeln('Възникна изключение EInvalidParameter със съобщение: ' +
    E.Message);
  end;
```

```
#### ## ## ##### ## #####:
```

```
try
...
except
  on E: EInvalidParameter do
    Writeln('Възникна изключение EInvalidParameter със съобщение: ' +
    E.Message);
  on E: ESomeOtherException do
    Writeln('Възникна изключение ESomeOtherException със съобщение: ' +
    E.Message);
  end;
```

```
##### ## ## ##### # #####, ##
## ##### on:
```

```
try
...
except
  Writeln('Предупреждение: Възникна изключение');
end;
// ПРЕДУПРЕЖДЕНИЕ: НЕ СЛЕДВАЙТЕ ПРИМЕРА БЕЗ ДА СТЕ ПРОЧЕЛИ ЗАБЕЛЕЖКАТА ПО-
ДОЛУ
// ОТНОСНО "ПРИХВАЩАНЕ НА ВСИЧКИ ИЗКЛЮЧЕНИЯ"
```

```
#### ## ##### ## ##### ##, #####
##### ## #####, # ##### ## ## ## #####. #####
```



```
try
...
except
  on E: EInvalidSoundFile do
  begin
    if E.InvalidUrl = 'http://example.com/blablah.wav' then
      Writeln('Предупреждение: зареждането на http://example.com/
blablah.wav се провали, игнорирайте го')
    else
      raise;
    end;
  end;
end;
```

, ## ##### # ##### # ##### , #####
 ## ##### #####. ##### ## ##### ## ,
 ##### ##### ## ## ## .

6.4. Finally (##### ## ## ##### ## #####)

try .. finally .. end , ## #####
 ## ##### ## , ##### # ##### ##
 ##### ##. ##### ## ##### # #####:

```
procedure MyProcedure;
var
  MyInstance: TMyClass;
begin
  MyInstance := TMyClass.Create;
  try
    MyInstance.DoSomething;
    MyInstance.DoSomethingElse;
  finally
    FreeAndNil(MyInstance);
  end;
end;
```

,
 #### ## MyInstance.DoSomething ## MyInstance.DoSomethingElse
 #####.

MyInstance ##-####, ##### (#### ##
"##### # #####") #####. #####

##:

// НЕКОРЕКТЕН ПРИМЕР:

```
procedure MyProcedure;  
var  
  MyInstance: TMyClass;  
begin  
  try  
    CallSomeOtherProcedure;  
    MyInstance := TMyClass.Create;  
    MyInstance.DoSomething;  
    MyInstance.DoSomethingElse;  
  finally  
    FreeAndNil(MyInstance);  
  end;  
end;
```

#####: ### ##### # TMyClass.Create
(#####) ### #
CallSomeOtherProcedure, ##### MyInstance ##
FreeAndNil(MyInstance) ## ##
MyInstance, ##### ##-##### ## ## Access
Violation (Segmentation Fault). ##### ##

#####.

nil (##### FreeAndNil #
#####). #####
##-##### ##
#####:

```
procedure MyProcedure;  
var  
  MyInstance1: TMyClass1;  
  MyInstance2: TMyClass2;  
  MyInstance3: TMyClass3;  
begin  
  MyInstance1 := TMyClass1.Create;  
  try
```

```

MyInstance1.DoSomething;

MyInstance2 := TMyClass2.Create;
try
    MyInstance2.DoSomethingElse;

    MyInstance3 := TMyClass3.Create;
    try
        MyInstance3.DoYetAnotherThing;
    finally
        FreeAndNil(MyInstance3);
    end;
finally
    FreeAndNil(MyInstance2);
end;
finally
    FreeAndNil(MyInstance1);
end;
end;

```

##-##### ##-#####:

```

procedure MyProcedure;
var
    MyInstance1: TMyClass1;
    MyInstance2: TMyClass2;
    MyInstance3: TMyClass3;
begin
    MyInstance1 := nil;
    MyInstance2 := nil;
    MyInstance3 := nil;
    try
        MyInstance1 := TMyClass1.Create;
        MyInstance1.DoSomething;

        MyInstance2 := TMyClass2.Create;
        MyInstance2.DoSomethingElse;

        MyInstance3 := TMyClass3.Create;
        MyInstance3.DoYetAnotherThing;
    finally
        FreeAndNil(MyInstance3);
        FreeAndNil(MyInstance2);
        FreeAndNil(MyInstance1);
    end;

```

end;



```
# #####
##### 3 #####
#####.
```

6.5.

- # ##### Lazarus LCL, #####
(##### callbacks, #####
OnXxx # LCL #####) #####

#####. #####
"#####"
Application.ProcessMessages, #####
#####. #####
TApplicationProperties.OnException.
- ## #####, # Castle Game Engine # CastleWindow: #####
#####. #####
"#####" ## Application.ProcessMessages. #####

Application.OnException.
- ##### GUI ##### ## #####.
- # ##### #####, ##### ## #####
callback ## OnHaltProgram.

7. Run-time

7.1. #####/##### #

```
##### TStream #
#####/#####. #####
##### TStream, #####: TFileStream, TMemoryStream,
TStringStream.
```

```
{ $mode objfpc } { $H+ } { $J- }
uses
  SysUtils, Classes;
```

```

var
  S: TStream;
  InputInt, OutputInt: Integer;
begin
  InputInt := 666;

  S := TFileStream.Create('my_binary_file.data', fmCreate);
  try
    S.WriteBuffer(InputInt, SizeOf(InputInt));
  finally
    FreeAndNil(S);
  end;

  S := TFileStream.Create('my_binary_file.data', fmOpenRead);
  try
    S.ReadBuffer(OutputInt, SizeOf(OutputInt));
  finally
    FreeAndNil(S);
  end;

  WriteLn('Read from file got integer: ', OutputInt);
end.

```

```

# Castle Game Engine: ##### ## ##### Download ##
##### ## ##, ##### ##### ## ##### URL #####. ## ##
##### ## #####, HTTP # HTTPS #####, Android assets
# #####. ##### ## ## ##### ## ## ## ## ## ## (
##### data), ##### URL ##### castle-data:/
xxx. #####:

```

```

EnableNetwork := true;
S := Download('https://castle-engine.io/latest.zip');

S := Download('file:///home/michalis/my_binary_file.data');

S := Download('castle-data:/gui/my_image.png');

```

```

## ## #####, ##### ##
TStreamReader. ### ##### API # ##### # ## TStream.
##### TStreamReader #### ## URL ##### ## ##
## ##### TStream.

```

```
Text := TTextReader.Create('castle-data:/my_data.txt');
try
  while not Text.Eof do
    WriteLnLog('NextLine', Text.ReadLn);
  finally
    FreeAndNil(Text);
  end;
```

7.2. ##### (#####, #####),

run-time #####.
 ### ##### "#####" ##### (#### TList # TObjectList ## #####
 Contnrs), ### # ##### (array of TMyType). ## ## ##
 ###-##### # #####, ##### ## #####
 ## #####.

#####,
 #####, #####, #####, #####... ##### ## ## ## (#
 #####), ## #####.

##, ##### # FPC:

- ##### Generics.Collections (## FPC >= 3.2.0)
- ##### FGL
- ##### GVector (##### # fcl-stl)

Generics.Collections. #####
 ##### ##:

- #####,
- ##### (##### ## ## ⁵ # ##### ##
 #####),
- ##### FPC # Delphi,
- ##### # # #####
 (##### Contnrs).

Castle Game Engine: ### ##### Generics.Collections #
 ##### Generics.Collections # #####!

⁵ ##### = Dictionary, a.k.a. Associative array

###-##### ## Generics.Collections ##:

TList

#####.

TObjectList

#####. ##### "#####"

#####.

TDictionary

#####⁵.

TObjectDictionary

#####

TObjectList:

```
{ $mode objfpc } { $H+ } { $J- }
uses SysUtils, Generics.Collections;

type
  TApple = class
    Name: string;
  end;

  TAppleList = specialize TObjectList<TApple>;

var
  A: TApple;
  Apples: TAppleList;
begin
  Apples := TAppleList.Create(true);
  try
    A := TApple.Create;
    A.Name := 'my apple';
    Apples.Add(A);

    A := TApple.Create;
    A.Name := 'another apple';
    Apples.Add(A);

    Writeln('Count: ', Apples.Count);
    Writeln(Apples[0].Name);
    Writeln(Apples[1].Name);
  finally FreeAndNil(Apples) end;
```

end.

```
##### , ## ##### ##### ##### #####
#### ##### # ##### (####. #### ##### Sort # IndexOf).
##### # Generics.Collections ##### ## #####
##### ## ##### # ##### ## ##### ## ##### (#
##### ##### ##### ##### ## #####, ##### # #####
## ##### ## ##### ## IndexOf ).
```

```
##### #####, ##### ## #####
#### #####. ##### # ####, ##### IComparer.
## ##### ##### ##### callback # #####
TComparer<T>.Construct, ## ## ##### callback # #####
IComparer. ##### ## ##-####:
```

```
{ $mode objfpc } { $H+ } { $J- }
```

```
{ If GENERICS_CONSTREF is defined, then various routines used with
  Generics.Collections
  (like callbacks we pass to TComparer, or OnNotify callback or Notify
  virtual method)
  should have "constref" parameter, not "const".
  This was the case of FPC<= 3.2.0, FPC changed it in
  https://gitlab.com/freepascal.org/fpc/source/-/
  commit/693491048bf2c6f9122a0d8b044ad0e55382354d .
  It is also applied to FPC fixes branch 3.2.3. }
{$ifdef VER3_0} {$define GENERICS_CONSTREF} {$endif}
{$ifdef VER3_2_0} {$define GENERICS_CONSTREF} {$endif}
{$ifdef VER3_2_2} {$define GENERICS_CONSTREF} {$endif}
```

```
uses SysUtils, Generics.Defaults, Generics.Collections;
```

```
type
```

```
  TApple = class
    Name: string;
  end;
```

```
  TAppleList = specialize TObjectList<TApple>;
```

```
function CompareApples(
```

```
  {$ifdef GENERICS_CONSTREF} constref {$else} const {$endif}
  Left, Right: TApple): Integer;
```

```
begin
```

```

    Result := AnsiCompareStr(Left.Name, Right.Name);
end;

type
    TAppleComparer = specialize TComparer<TApple>;
var
    A: TApple;
    L: TAppleList;
begin
    L := TAppleList.Create(true);
    try
        A := TApple.Create;
        A.Name := '11';
        L.Add(A);

        A := TApple.Create;
        A.Name := '33';
        L.Add(A);

        A := TApple.Create;
        A.Name := '22';
        L.Add(A);

        L.Sort(TAppleComparer.Construct(@CompareApples));

        Writeln('Count: ', L.Count);
        Writeln(L[0].Name);
        Writeln(L[1].Name);
        Writeln(L[2].Name);
    finally FreeAndNil(L) end;
end.

```

TDictionaary #####, ##### map (key → value), #####
 ##### associative array. ##### API # ##### TDictionaary # C#.
 #####, ##### →#####.

#####, #####:

```

{$mode objfpc}{$H+}{$J-}
uses SysUtils, Generics.Collections;

type
    TApple = class
        Name: string;
    end;

```



```

TAppleDictionary = specialize TDictionary<string, TApple>;

var
  Apples: TAppleDictionary;
  A, FoundA: TApple;
  ApplePair: TAppleDictionary.TDictionaryPair;
  AppleKey: string;
begin
  Apples := TAppleDictionary.Create;
  try
    A := TApple.Create;
    A.Name := 'моята ябълка';
    Apples.AddOrSetValue('ключ за ябълка 1', A);

    if Apples.TryGetValue('ключ за ябълка 1', FoundA) then
      Writeln('Намерена ябълка с ключ "ключ за ябълка 1" с име: ' +
        FoundA.Name);

    for AppleKey in Apples.Keys do
      Writeln('Намерен ключ за ябълка: ' + AppleKey);
    for A in Apples.Values do
      Writeln('Намерена ябълка с име: ' + A.Name);
    for ApplePair in Apples do
      Writeln('Намерен ключ за ябълка->име на ябълка: ' +
        ApplePair.Key + '->' + ApplePair.Value.Name);

    { Долният ред също работи, но може да се използва само да
      зададе стойност на *съществуващ* ключ в речника.
      Вместо това обикновено се използва AddOrSetValue
      за да се зададе или добави нов ключ ако е необходимо. }
    // Apples['ключ за ябълка 1'] := ... ;

    Apples.Remove('ключ за ябълка 1');

    { Забележете, че TDictionary не притежава елементите си
      и трябва да ги освобожавате ръчно.
      Може да използвате TObjectDictionary за да имате автоматичен
      режим за притежание. }
    A.Free;
  finally FreeAndNil(Apples) end;
end.

```

```

TObjectDictionary ##### #/###, #####
#####. #####

```

#####/#####. ##, ##
 ## Integer (##. ##
 ## Integer, # doOwnsKeys), ##
 #####.

TObjectDictionary # ##-##.
 ##### # *memory leak detection*, ####. #### fpc -gl -gh
 generics_object_dictionary.lpr, ## ##, ##
 #####.

.....
 {\$mode objfpc}{\$H+}{\$J-}

uses SysUtils, Generics.Collections;

type

TApple = class
 Name: string;
end;

TAppleDictionary = specialize TObjectDictionary<string, TApple>;

var

Apples: TAppleDictionary;
 A: TApple;
 ApplePair: TAppleDictionary.TDictionaryPair;

begin

Apples := TAppleDictionary.Create([doOwnsValues]);

try

A := TApple.Create;
 A.Name := 'my apple';
 Apples.AddOrSetValue('apple key 1', A);

for ApplePair in Apples do

Writeln('Found apple key->value: ' +
 ApplePair.Key + '->' + ApplePair.Value.Name);

Apples.Remove('apple key 1');

finally FreeAndNil(Apples) end;

end.

.....
 ##### FGL #####
 Generics.Collections, ##-##### FGL ##:

TFPGList

#####.

TFPGObjectList

#####. ##### "#####"
#####.

TFPGMap

#####⁵.

FGL, TFPGList ##### # #####, #####
(=). ### TFPGMap #####
"##-#####" (>) # "##-#####" (<). ###
#####, #####
(#####), ## #####
8.9, „#####“.

Castle Game Engine ##### CastleGenericLists, #####
TGenericStructList # TGenericStructMap. ##
TFPGList # TFPGMap, ## #####
(##### # #####
#####). ##
6.3 ##### CastleGenericLists # ##### (deprecated) #
Generics.Collections #####.

8.3, „#####“.

7.3. #####: TPersistent.Assign

:=
#####.

```
var
  X, Y: TMyObject;
begin
  X := TMyObject.Create;
  Y := X;
  // X и Y сега са два указателя към една и съща инстанция
  Y.MyField := 123; // ще се промени също и X.MyField
  FreeAndNil(X);
end;
```

```
## ## ##### ##### ## ##### ## ##### ##, #####
##### # ## ##### ##### ## TPersistent, # ## ##### #####
Assign. ##### ## ##### ## TMyObject, ## ## ##
##### ## #####:
```

```
var
  X, Y: TMyObject;
begin
  X := TMyObject.Create;
  Y := TMyObject.Create;
  Y.Assign(X);
  Y.MyField := 123; // това не променя X.MyField
  FreeAndNil(X);
  FreeAndNil(Y);
end;
```

```
## ## #####, ##### # ##### ## ##### Assign ##### ##
##### ##### ## #####. ##### ##
Assign, ## ## #####, ##### ## ## #####
```

```
{$mode objfpc}{$H+}{$J-}
uses
  SysUtils, Classes;

type
  TMyClass = class(TPersistent)
  public
    MyInt: Integer;
    procedure Assign(Source: TPersistent); override;
  end;

  TMyClassDescendant = class(TMyClass)
  public
    MyString: string;
    procedure Assign(Source: TPersistent); override;
  end;

procedure TMyClass.Assign(Source: TPersistent);
var
  SourceMyClass: TMyClass;
begin
  if Source is TMyClass then
```

```

begin
    SourceMyClass := TMyClass(Source);
    MyInt := SourceMyClass.MyInt;
    // Xxx := SourceMyClass.Xxx; // копирайте още полета ако е
необходимо ...
end else
    { Поради това, че TMyClass е директен наследник на TPersistent,
    той извиква inherited САМО когато не знае как да обработи Source.
    Виж коментарите по-долу. }
    inherited Assign(Source);
end;

procedure TMyClassDescendant.Assign(Source: TPersistent);
var
    SourceMyClassDescendant: TMyClassDescendant;
begin
    if Source is TMyClassDescendant then
        begin
            SourceMyClassDescendant := TMyClassDescendant(Source);
            MyString := SourceMyClassDescendant.MyString;
            // Xxx := SourceMyClassDescendant.Xxx; // копирайте още полета ако е
необходимо ...
        end;

        { Поради това, че TMyClassDescendant има предшественик, който вече е
        заменил Assign (in TMyClass.Assign), той извиква inherited ВНАГИ,
        за да позволи TMyClass.Assign да копира останалите полета.
        Виж коментарите по-долу за детайлно обяснение. }
        inherited Assign(Source);
    end;

var
    C1, C2: TMyClass;
    CD1, CD2: TMyClassDescendant;
begin
    // тест TMyClass.Assign
    C1 := TMyClass.Create;
    C2 := TMyClass.Create;
    try
        C1.MyInt := 666;
        C2.Assign(C1);
        WriteLn('C2 state: ', C2.MyInt);
    finally
        FreeAndNil(C1);
        FreeAndNil(C2);
    end;
end;

```

```

end;

// test TMyClassDescendant.Assign
CD1 := TMyClassDescendant.Create;
CD2 := TMyClassDescendant.Create;
try
    CD1.MyInt := 44;
    CD1.MyString := 'blah';
    CD2.Assign(CD1);
    WriteLn('CD2 state: ', CD2.MyInt, ' ', CD2.MyString);
finally
    FreeAndNil(CD1);
    FreeAndNil(CD2);
end;
end.

```

```

##### # ##-##### ## ##### AssignTo # #####, #####
## ##### Assign # #####, ## #####.

##### #####, ##### inherited # ##### Assign. ##
### #####:

##### ##### # ##### TPersistent. (### ## # #####
## TPersistent, ## ##### Assign.)
# ##### inherited
(## TPersistent.Assign) #####
# #####.

##### #####, ##### # ##### Assign.
# ##### inherited (## ##### Assign). #####
inherited # #####.

## ## ##### (##### # ##
##### inherited ## Assign) # ## #
##### AssignTo, ##### TPersistent.Assign #
TPersistent.AssignTo #####:

```

```

procedure TPersistent.Assign(Source: TPersistent);
begin
    if Source <> nil then
        Source.AssignTo(Self)
    else

```

```

    raise EConvertError...
end;

procedure TPersistent.AssignTo(Destination: TPersistent);
begin
    raise EConvertError...
end;

```



```

##### TPersistent.#####
## ##### FPC #####, ## #####, ##
## ## ##### ##### #####
#####.

```

#####, ##### ## ##### ##:

- ##### Assign, ##### AssignTo ## ## ##### ## ##
#####.
- ##### #####, ## ##### TPersistent,
(## #####
#####) ## #####. ## ##### ## ##, ##
Assign ## #####. ##### RTTI
(##### ## ##) ## ##, ## ##
#####.

```

##### TApple, ##### TApple.Assign
##### ## ## #####, ##### ##
## TApple (## ## TApple, ##### TFruit). # ##,
##### TApple.Assign ##### Source is
TApple # #####, ##### TFruit ##
##### inherited, ## TFruit ##
#####.

```

TFruit.Assign # TApple.Assign ##
#####, ##### ##

- ##### TApple ## TApple.Assign, ## ##
#####.
- ##### TOrange ## TApple.Assign, ## ##
TOrange # TApple. # ## - ##
TFruit.

- `##### Twerewolf ## TApple.Assign, ##
(##### TApple.Assign ## #####
TFruit.Assign, ##### ## ##### TPersistent.Assign, ##### ##
#####).`



```
#####, ## ##### TPersistent, ##  
##### published, ## ##  
## ##### TPersistent.  
## ##### # ##### # #####  
published. ## ##### # ## # ##  
## #####, ##### ## public.  
##### 4.5, „#####“.
```

8.

8.1.

```
##### # #-##### (#####, #####, #####) ##### ## ##  
#####, #####.
```

```
##### ##### ## ##### (#### # #####) #####  
##### ## #####, ##### # ##### #####.  
#### # #####, ##### ## ## #####  
##### # ##### #-##### ## # ##### (###  
#### # # ##### # ##### # #####).  
##### ## # ##### — ### ##### (##  
#####) ##### # #####, #####  
## #####.
```

```
##### ## #####:
```

```
function SumOfSquares(const N: Integer): Integer;
```

```
    function Square(const Value: Integer): Integer;  
    begin  
        Result := Value * Value;  
    end;
```

```
var  
    I: Integer;  
begin
```



```
Result := 0;
for I := 0 to N do
  Result := Result + Square(I);
end;
```

, # ##### Square #####
I:

```
function SumOfSquares(const N: Integer): Integer;
var
  I: Integer;

function Square: Integer;
begin
  Result := I * I;
end;

begin
  Result := 0;
  for I := 0 to N do
    Result := Result + Square;
  end;
```

— #####
, ## ##### # ##### # #####
. ##### ## ##### (## ## , ## #####
, ## ##### ## #####:).

8.2. Callbacks (##### , ##### #####)

.
, ## ## ##
#####

Callback-## ## ##:

- ##### , ##### , ## ## ## ##
(## ## # #####).

{ \$mode objfpc } { \$H+ } { \$J- }

```

function Add(const A, B: Integer): Integer;
begin
    Result := A + B;
end;

function Multiply(const A, B: Integer): Integer;
begin
    Result := A * B;
end;

type
    TMyFunction = function (const A, B: Integer): Integer;

function ProcessTheList(const F: TMyFunction): Integer;
var
    I: Integer;
begin
    Result := 1;
    for I := 2 to 10 do
        Result := F(Result, I);
end;

var
    SomeFunction: TMyFunction;
begin
    SomeFunction := @Add;
    WriteLn('1 + 2 + 3 ... + 10 = ', ProcessTheList(SomeFunction));

    SomeFunction := @Multiply;
    WriteLn('1 * 2 * 3 ... * 10 = ', ProcessTheList(SomeFunction));
end.

```

- #####: ##### ## # of object #####.

```

{$mode objfpc}{$H+}{$J-}
uses
    SysUtils;

type
    TMyMethod = procedure (const A: Integer) of object;

    TMyClass = class
        CurrentValue: Integer;
        procedure Add(const A: Integer);
        procedure Multiply(const A: Integer);

```

```

    procedure ProcessTheList(const M: TMyMethod);
end;

procedure TMyClass.Add(const A: Integer);
begin
    CurrentValue := CurrentValue + A;
end;

procedure TMyClass.Multiply(const A: Integer);
begin
    CurrentValue := CurrentValue * A;
end;

procedure TMyClass.ProcessTheList(const M: TMyMethod);
var
    I: Integer;
begin
    CurrentValue := 1;
    for I := 2 to 10 do
        M(I);
    end;

var
    C: TMyClass;
begin
    C := TMyClass.Create;
    try
        C.ProcessTheList(@C.Add);
        WriteLn('1 + 2 + 3 ... + 10 = ', C.CurrentValue);

        C.ProcessTheList(@C.Multiply);
        WriteLn('1 * 2 * 3 ... * 10 = ', C.CurrentValue);
    finally
        FreeAndNil(C);
    end;
end.

```

, ## ## ##### / #####
 #####. ## ## #####. ### ## ##### of object callback, ##
 ## ##### ## ##### ## ##### ## ## ##
 ##### 9.3, „#####“ ## #####.

```

type
    TMyMethod = function (const A, B: Integer): Integer of object;

```

```
TMyClass = class
  class function Add(const A, B: Integer): Integer;
  class function Multiply(const A, B: Integer): Integer;
end;

var
  M: TMyMethod;
begin
  M := @TMyClass(nil).Add;
  M := @TMyClass(nil).Multiply;
end;
```

@TMyClass(nil).Add
@TMyClass.Add.

- (#####) #####: ##### # is nested # #### # ##
#####, ## ##### { \$modeswitch nestedprocvars } .
8.1, „##### (#####) #####“.

8.3.

#####. ##### # ##
(#####) ##### # #####. ###-#####
#, ##### # ##### (#####, #####, #####,
####...): ##### # ##### # ##### # T, # ##### # ##
#, ##### #
#####, ##### # ##### TMyRecord # #.

Pascal ##### # C++. #####,
"#####" # ##### #, ##### #
(## # # ##-##### # #; ##### # #####
#, # # # #, ##### #
"#####" ##### # #). ##
#, ## # # (##### # #
#) # # # #. #####
(#### #, float), #####
#####, ##### # #.

```
{ $mode objfpc } { $H+ } { $J- }
uses
  SysUtils;
```

```

type
  generic TMyCalculator<T> = class
    Value: T;
    procedure Add(const A: T);
  end;

procedure TMyCalculator.Add(const A: T);
begin
  Value := Value + A;
end;

type
  TMyFloatCalculator = specialize TMyCalculator<Single>;
  TMyStringCalculator = specialize TMyCalculator<string>;

var
  FloatCalc: TMyFloatCalculator;
  StringCalc: TMyStringCalculator;
begin
  FloatCalc := TMyFloatCalculator.Create;
  try
    FloatCalc.Add(3.14);
    FloatCalc.Add(1);
    WriteLn('FloatCalc: ', FloatCalc.Value:1:2);
  finally
    FreeAndNil(FloatCalc);
  end;

  StringCalc := TMyStringCalculator.Create;
  try
    StringCalc.Add('something');
    StringCalc.Add(' more');
    WriteLn('StringCalc: ', StringCalc.Value);
  finally
    FreeAndNil(StringCalc);
  end;
end.

```

```

##### ## ## ##### ## #####, ##### ## ##### #### #####
##### # #####:

```

```

{$mode objfpc}{$H+}{$J-}
uses
  SysUtils;

```

{ Note: this example requires FPC 3.1.1 (will not compile with FPC 3.0.0 or older). }

```
generic function Min<T>(const A, B: T): T;
begin
  if A < B then
    Result := A else
    Result := B;
end;

begin
  WriteLn('Min (1, 0): ', specialize Min<Integer>(1, 0));
  WriteLn('Min (3.14, 5): ', specialize Min<Single>(3.14, 5):1:2);
  WriteLn('Min (''a'', ''b''):', specialize Min<string>('a', 'b'));
end.
```

7.2, „##### (#####, #####), #####“
#####.

8.4. Overloading

(##### # #####) # ##### #
###, ##### # #####. ##### #
#####, ##### #
#####.

overloading-## ##### FPC #####, #####
(##### unit) ##
##-
#####. #####, ### ##### Foo(Integer)
Foo(string) # ##### Foo(Float), #####
Foo(Float)
(## ### --- ##) #####
###-#####). ## #
overload.

8.5.

#:

- ##### (##### # #####) #
#####),

- ##### # ##,
- #####.

##. ##### # ##
.....
##. ##### # ##
##, #####, ## # "#####"
Pascal. ##### # ##, ## # "#####"

```
{ $mode objfpc } { $H+ } { $J- }  
unit PreprocessorStuff;  
interface
```

```
{ $ifdef FPC }  
{ Това е дефинирано само ако се компилира с FPC, не с други компилатори  
(напр. Delphi). }  
procedure Foo;  
{ $endif }
```

{ Дефиниране на константата NewLine. Тук може да видите как нормалния синтаксис на Паскал се "чупи" с препроцесорните директиви. Когато компилирате за Unix (вкл. Linux, Android, Mac OS X), компилатора вижда това:

```
const NewLine = #10;
```

Когато компилирате за Windows, компилатора вижда това:

```
const NewLine = #13#10;
```

За други операционни системи, кодът няма да се компилира, защото компилатора вижда това:

```
const NewLine = ;
```

Хубаво е, че компилирането се проваля в този случай -- така ако трябва да пригледите програмата към ОС, която не е Unix или Windows, компилатора ще ви припомни да изберете конвенция за нов ред (newline) за тази система. }

```
const  
NewLine =  
{ $ifdef UNIX } #10 { $endif }
```


- ##### # # # # ##### unit # # ##### , ##### #
unit ##### . # # # # #
- ##### # # ##### # # # # # # # # unit # #
unit-# , # # # # ##### unit # # ##### .
. ##### # # # # "#####"
unit-## , #### # # # # # # # # # #
#####. ##### , #### # # #-##### # # ##### unit # "#####"
UI #####" ##### # # ##### ## ## unit # # ##### UI
, ## ## ##### # # ##### uses #####
(### ### ##### UI # # ##### # # ##### UI #####). # # #####
UI ##### # ##### myunit.pas # # # # #####
, #### # # # # # # # # # #
#.

```
{ $ifdef UNIX } { $I my_unix_implementation.inc } { $endif }
{ $ifdef MSWINDOWS } { $I my_windows_implementation.inc } { $endif }
```

8.6.

81

- ##### ##### ##### ### #####. ### ##### #####
#####. ### ##### (##### ## #####)

(# #####, ####;
#, ## ## #####,
#####, ## ## #####). #### ##
##-#####. #####. ## ##
#####.

- ##### ## #####, #### ##
#####.
- ##### ## ##### (#####,
#####) # #####: ##### C layout
packed record. #####:

#####, ##### ##
API, #####,

(#####
##, #####
#####).

- ##### case, ##### unions # C-

##, # #####. #####
#####. # #####,
##).

8.7.

Turbo Pascal #####
##, ##### object. #####
"#####" # "#####".

- ##### / #####
/ #####.
- ## ## ## ## ## ## ##
"#####" ##
(#####) ## ## ##. #####
##, #####
#####.
- ##### ## ## ##
—

#####, ## ## ##### ## ##### # #####, ## ##
#####.

##.
#####. ##### #
#####, ##### ## ##
(###. #####). ##### # #-##### ##
#####.

8.8.

#####. ##### ##
TMyRecord ## ##### ^TMyRecord # ## #####
PMyRecord. #-##### # ##### ## #####
#####, #####:

type

```
PMyRecord = ^TMyRecord;
TMyRecord = record
  Value: Integer;
  Next: PMyRecord;
end;
```

(### PMyRecord ##
TMyRecord, ##### TMyRecord #
PMyRecord). ##### # ## ##
##, ##### ## ##
type.

New # Dispose ## (## #-#####
GetMem # FreeMem. ## ##
^ (например `MyInteger :=
MyPointerToInteger^). ## ##

#####-##### @ (##### MyPointerToInteger := @MyInteger).

Pointer, ##### ## void* # C-#####. ##

#####.

```
## #####, ## ##### class ##### # #####, ##### ## ##
##### ^ ### @, ## ## #####. ##### # ## ## #####
##### ##, ##### ##, ### ## ##:
```

type

```
TMyClass = class
  Value: Integer;
  Next: TMyClass;
end;
```

8.9.

```
##### ## ##### ##### ## ##### ## #####, ## ##
##### ##### # ##### ## #####.
#### ##:
```

```
{$mode objfpc}{$H+}{$J-}
```

uses

```
StrUtils;
```

```
operator* (const S: string; const A: Integer): string;
```

begin

```
  Result := DupeString(S, A);
```

end;

begin

```
  WriteLn('bla' * 10);
```

end.

```
#### ##### ## ##### ## #####. #####
# #####-##### ## ##### ##
#####, # ##### ## ## #####
## #####.
```

```
{$mode objfpc}{$H+}{$J-}
```

uses

```
SysUtils;
```

type

```
TMyClass = class
```

```
  MyInt: Integer;
```

```

end;

operator* (const C1, C2: TMyClass): TMyClass;
begin
    Result := TMyClass.Create;
    Result.MyInt := C1.MyInt * C2.MyInt;
end;

var
    C1, C2: TMyClass;
begin
    C1 := TMyClass.Create;
    try
        C1.MyInt := 12;
        C2 := C1 * C1;
        try
            WriteLn('12 * 12 = ', C2.MyInt);
        finally
            FreeAndNil(C2);
        end;
    finally
        FreeAndNil(C1);
    end;
end.

```

- #####. ##### # ##-#####
#####, ##### ## ## ##### ##
#####.

```

{$mode objfpc}{$H+}{$J-}
uses
    SysUtils;

type
    TMyRecord = record
        MyInt: Integer;
    end;

operator* (const C1, C2: TMyRecord): TMyRecord;
begin
    Result.MyInt := C1.MyInt * C2.MyInt;
end;

var

```

```

R1, R2: TMyRecord;
begin
  R1.MyInt := 12;
  R2 := R1 * R1;
  WriteLn('12 * 12 = ', R2.MyInt);
end.

```

```

## ##### ### ##### ## ##### ## ##### {$modeswitch
advancedrecords} # ## ##### ##### class operator #####
# #####. ##### ## ## ##### #####, #####
##### ## ##### ## ##### (#### TFPGList, #####
##### ## ##### ## ##### ## #####) # #####. # #####
##### "#####" ##### ## ##### (##### ## # #####) ##### ##
##### (##### ## # ##### # ####, ##### ##### TFPGList) # ##### ##
##### ## ##### ##### ## specialize TFPGList<TMyRecord>.

```

```

{$mode objfpc}{$H+}{$J-}
{$modeswitch advancedrecords}

```

uses

```
SysUtils, FGL;
```

type

```

TMyRecord = record
  MyInt: Integer;
  class operator+ (const C1, C2: TMyRecord): TMyRecord;
  class operator= (const C1, C2: TMyRecord): boolean;
end;

```

```
class operator TMyRecord.+ (const C1, C2: TMyRecord): TMyRecord;
```

begin

```
Result.MyInt := C1.MyInt + C2.MyInt;
```

end;

```
class operator TMyRecord.= (const C1, C2: TMyRecord): boolean;
```

begin

```
Result := C1.MyInt = C2.MyInt;
```

end;

type

```
TMyRecordList = specialize TFPGList<TMyRecord>;
```

var

```
R, ListItem: TMyRecord;
```

```

L: TMyRecordList;
begin
  L := TMyRecordList.Create;
  try
    R.MyInt := 1;    L.Add(R);
    R.MyInt := 10;   L.Add(R);
    R.MyInt := 100;  L.Add(R);

    R.MyInt := 0;
    for ListItem in L do
      R := ListItem + R;

    WriteLn('1 + 10 + 100 = ', R.MyInt);
  finally
    FreeAndNil(L);
  end;
end.

```

9. ##### ##

9.1.

private #####, ## ##### (##) ## # ##### #####
 #####, # ##### # #####. ##### ##### #####: #####
 # ##### ##### ## ##### # ##### # #####. ##### ##
 C++ ## ##### ## ####, ## ##### # ##### ## "#####"⁶. ####
 ##### # ##### # ## ##### ##### # #####
 ##### # # ##### ## #### #####.

#####, ## ##### ##### # #####, ##### ## ##
 ##### # ####, # ##-##### ## ##### **strict**
private. ## ##### ## ##### ## ##### (##) #### #
 ##### ## #####. ## #####.

— ##### **protected** #####, ## ##### ##
 # ##### ## ##### # "#####" # #####, ##### **strict**
protected, ## # ##### ## #####.

⁶ ##### = friends


```

procedure TMyClass.TInternalClass.DoSomething;
begin
end;

```

9.3.

####, ##### (TMyClass),
#####.

```

type
  TEnemy = class
    procedure Kill;
    class procedure KillAll;
  end;

```

```

var
  E: TEnemy;
begin
  E := TEnemy.Create;
  try
    E.Kill;
  finally FreeAndNil(E) end;
  TEnemy.KillAll;
end;

```

- #####
9.4, „#####“.

4.5, „#####
#####“ ##### `private` or `protected` #####.

MyInstance := TMyClass.Create(...);

#####. #####
"#####", ##### (#####
#####) #####
(#####).

#####.

type

```
TMyClass = class(TComponent)
  class procedure DoSomething; virtual; abstract;
end;
```

```
TMyClass1 = class(TMyClass)
  class procedure DoSomething; override;
end;
```

```
TMyClass2 = class(TMyClass)
  class procedure DoSomething; override;
end;
```

```
TMyClassRef = class of TMyClass;
```

var

```
C: TMyClass;
ClassRef: TMyClassRef;
```

begin

```
ClassRef := TMyClass1;
ClassRef.DoSomething;
```

```
ClassRef := TMyClass2;
ClassRef.DoSomething;
```

```
{ Това ще предизвика изключение по време на изпълнение
  защото DoSomething е абстрактен в TMyClass. }
```

```
ClassRef := TMyClass;
ClassRef.DoSomething;
```

end;

```
### ##### # ##### ## ##### ##### (##
##### # ##### # ##### # #####),
##### # ##### ClassType.### ## ClassType # TClass,
##### # ##### class of TObject.##### ## ##
##### ##-##### #, ## # # #, ## # ##### #
##### ##-##### ## TObject.
```

```
##### ## ##### ## ClassType ## #####
##### # ##### # #####.
```

Clone, ##### 7.3, „#####: TPersistent.Assign“
 #####, ##### "#####"

TComponent, TComponent.Create(AOwner: TComponent).

type

```
TMyClass = class(TComponent)
    procedure Assign(Source: TPersistent); override;
    function Clone(AOwner: TComponent): TMyClass;
end;
```

```
TMyClassRef = class of TMyClass;
```

```
function TMyClass.Clone(AOwner: TComponent): TMyClass;
```

```
begin
```

```
    // Това трябва винаги да създаде инстанция точно от клас TMyClass:
    //Result := TMyClass.Create(AOwner);
    // Това може потенциално да създаде инстанция от наследник на TMyClass:
    Result := TMyClassRef(ClassType).Create(AOwner);
    Result.Assign(Self);
```

```
end;
```

9.5.

(#####).
 ##### (#####).
 Self #
 #####: #####
 ##### (#####)

#####

```
{ $mode objfpc } { $H+ } { $J- }
```

type

TMyCallback = **procedure** (A: **Integer**);

TMyClass = **class**

class procedure Foo(A: **Integer**);

end;

class procedure TMyClass.Foo(A: **Integer**);

begin

end;

var

Callback: TMyCallback;

begin

// Грешка: TMyClass.Foo не е съвместим с TMyCallback

Callback := @TMyClass(**nil**).Foo;

end.



```
### ## # ##### Delphi ##### ## ##### ## #####
TMyClass.Foo ##### TMyClass(nil).Foo #####
# # #####. ##### ## ## #####, ## TMyClass.Foo
##### ##-##### # ##### ## ##### ##-
##### ## #####. ##### ## TMyClass(nil).Foo
# ##... ## ##### (#####) # ##### ObjFpc,
##### # ##### # #####.

### #####, ##### ## TMyClass.Foo ##
Callback ##-#### ## ##### Delphi, #####
##### #####.
```

```
##### ## ## #####, ##### ## Callback ## # #####
# ##### ## Foo. ##### ##, ##### ##### Foo ### ##
##### ## implicit ##### ## #####.
```

```
#### ## ##### ## ##### ## ## ##### ##### ##
TMyCallback ## #####: TMyCallback = procedure (A: Integer) of
object; . ## ##### ## ## #####.
```

```
##### ## # ##### ## ## ##### ## static. ## ##### ##
# ##### / #####, # #####, ## ##### ##
##### # #####. ## ##### ##### ## ## (##
##### ## ## ## ##### # ## ## #####).
```


#####. #####:

```

{$mode objfpc}{$H+}{$J-}
type
  TMyCallback = procedure (A: Integer);

  TMyClass = class
    class procedure Foo(A: Integer); static;
  end;

class procedure TMyClass.Foo(A: Integer);
begin
end;

var
  Callback: TMyCallback;
begin
  Callback := @TMyClass.Foo;
end.

```

9.6.

class var #####

#####.

class property ##### property # # ##### getter
/ ### setter, ##### ##### # # #####-#####. ### [9.5](#),
„#####“.

(### [4.3](#), „#####“), #####
#####-#####
#####.

```

{$mode objfpc}{$H+}{$J-}
type
  TMyClass = class
    strict private

```

```
// Alternative:
// FMyProperty: Integer; static;
class var
  FMyProperty: Integer;
class procedure SetMyProperty(const Value: Integer); static;
public
  class property MyProperty: Integer
    read FMyProperty write SetMyProperty;
end;

class procedure TMyClass.SetMyProperty(const Value: Integer);
begin
  Writeln('MyProperty changes!');
  FMyProperty := Value;
end;

begin
  TMyClass.MyProperty := 123;
  Writeln('TMyClass.MyProperty is now ', TMyClass.MyProperty);
end.
```

9.7.

a. #####
 ## ##### MyInstance.MyMethod(...). ##
 ##### ##, ## #####
 Action # ##### X, ##### `X.Action(...)`.

#####, ##### #
 ##### TMyClass, ## ##
 ##### # ##, #####
 #####. ##### —
 ## ##### Render ## TMy3DObject #####,
 ##### TMy3DObject #####
 #####? ## ##-#####
 ##### # ##, ##
 #####.

 ##### TMy3DObject #####.

```
procedure Render(const Obj1: TMy3DObject; const Color: TColor);
```



```
var
  I: Integer;
begin
  for I := 0 to Obj1.ShapesCount - 1 do
    RenderMesh(Obj1.Shape[I].Mesh, Color);
  end;
```

```
####, ##, ##
##### X.Action(...), #
##### Render(X, ...).##
##### X.Render(...), ## Render
##### TMy3DObject.
```

```
##. ##
##### /, #####
##### - ##
##### TMy3DObject.
```

```
type
  TMy3DObjectHelper = class helper for TMy3DObject
    procedure Render(const Color: TColor);
  end;

procedure TMy3DObjectHelper.Render(const Color: TColor);
var
  I: Integer;
begin
  { забележете, че тук достъпваме ShapesCount и Shape без да ги
  квалифицираме }
  for I := 0 to ShapesCount - 1 do
    RenderMesh(Shape[I].Mesh, Color);
  end;
```



##-##### # "##### ##". #### ##
 ## #####, ####
 ##### enum. ##### "#####
 #####" ## (#####...) #####. ##### <http://lists.freepascal.org/fpc-announce/2013-February/000587.html> .

9.8. #####,

Destroy, ##### (#####

#####.

Create.

—#####
CreateMy, ##### Create, #####
Create #####
CreateMy.

TObject #####, #####

(#####: ##### overload, #####
#####).

TComponent ##### constructor
Create(AOwner: TComponent);. #####

(##### 9.4, „#####“ ##-#####).

9.9.

#####?

X := TMyClass.Create;

X ##### ...
#####?

Object Pascal #, #####

FreeAndNil.

#####

```
#####, ## # ##### ##### ##### ## nil, ##### ##### ##  
0 # #####.
```

```
#### ## ##### ## ##### ## #####:.
```

```
{ $mode objfpc } { $H+ } { $J- }  
uses  
    SysUtils;  
  
type  
    TGun = class  
    end;  
  
    TPlayer = class  
        Gun1, Gun2: TGun;  
        constructor Create;  
        destructor Destroy; override;  
    end;  
  
constructor TPlayer.Create;  
begin  
    inherited;  
    Gun1 := TGun.Create;  
    raise Exception.Create('Предизвикано изключение от конструктор!');  
    Gun2 := TGun.Create;  
end;  
  
destructor TPlayer.Destroy;  
begin  
    { в случай, че конструктора крашне, бихме могли  
      да имаме ситуация с Gun1 <> nil и Gun2 = nil. Справете се с това.  
      ... Всъщност в случая FreeAndNil ще се справи без  
      допълнителни усилия от наша страна, защото FreeAndNil проверява  
      дали инстанцията е nil преди да извика деструктора. }  
    FreeAndNil(Gun1);  
    FreeAndNil(Gun2);  
    inherited;  
end;  
  
begin  
    try  
        TPlayer.Create;  
    except  
        on E: Exception do  
            WriteLn('Уловено ' + E.ClassName + ': ' + E.Message);
```

end;
end.

10.

10.1. #### (CORBA)

(API⁷), ## ##, ## ##
#####. ##### ## ##
#####, ## ## ## ##.

##, #####
##. ####
##, #####
##, ## ## ## ##. #####
C++.

CORBA ##### # #####
Java (<https://docs.oracle.com/javase/tutorial/java/concepts/interface.html>) ## C# (<https://msdn.microsoft.com/en-us/library/ms173156.aspx>).

```
{ $mode objfpc } { $H+ } { $J- }  
{ $interfaces corba }
```

uses

SysUtils, Classes;

type

```
IMyInterface = interface  
[ '{79352612-668B-4E8C-910A-26975E103CAC}' ]  
    procedure Shoot;  
end;
```

```
TMyClass1 = class(IMyInterface)  
    procedure Shoot;  
end;
```

```
TMyClass2 = class(IMyInterface)  
    procedure Shoot;  
end;
```

⁷ API = Application Program Interface

```
TMyClass3 = class
  procedure Shoot;
end;

procedure TMyClass1.Shoot;
begin
  WriteLn('TMyClass1.Shoot');
end;

procedure TMyClass2.Shoot;
begin
  WriteLn('TMyClass2.Shoot');
end;

procedure TMyClass3.Shoot;
begin
  WriteLn('TMyClass3.Shoot');
end;

procedure UseThroughInterface(I: IMyInterface);
begin
  Write('Shooting... ');
  I.Shoot;
end;

var
  C1: TMyClass1;
  C2: TMyClass2;
  C3: TMyClass3;
begin
  C1 := TMyClass1.Create;
  C2 := TMyClass2.Create;
  C3 := TMyClass3.Create;
  try
    if C1 is IMyInterface then
      UseThroughInterface(C1 as IMyInterface);
    if C2 is IMyInterface then
      UseThroughInterface(C2 as IMyInterface);
    // The "C3 is IMyInterface" below is false,
    // so "UseThroughInterface(C3 as IMyInterface)" will not execute.
    if C3 is IMyInterface then
      UseThroughInterface(C3 as IMyInterface);
  finally
    FreeAndNil(C1);
    FreeAndNil(C2);
```

```
FreeAndNil(C3);
end;
end.
```

10.2. ##### CORBA # COM

-#### ##### "CORBA"?

CORBA # #####. #-##### ## ## ##### #####. #####
"`#####`". ##### ## #####
#####, ## ##### ## ## ##### #
API.

#####, ## ##### ##### ## ## ##### #
CORBA (Common Object Request Broker Architecture) (see https://en.wikipedia.org/wiki/Common_Object_Request_Broker_Architecture), ## ## ##
##.

{\$interfaces corba}?

#, ##### ## ##### COM #####. ##### ##
{\$interfaces com}, ## ##### ## # #####
#####.

COM #####, ##### ## #####
CORBA ##### # #####
C# ## Java. COM #####
#####, ##### ## #####
#####.

#####, ## ##### {\$interfaces xxx} ## #####
(#### # #####
interface # ## interface(ISomeAncestor), #.#. ## ##
#####) ## ##### ## #####, ## ##
##, #####
{\$interfaces xxx}.

COM #####?

COM ##### _#####
IUnknown _. ##### IUnknown:

- ##### _AddRef #
_ReleaseRef. #####

(reference-counting).

- ##### `QueryInterface`.
- ##### `COM` (Component Object Model).

COM #####?

"#####" ###, #####
 ### ## ##### (# "#####"): #####
 # #####. ##### ## #####
 ##### ## #####.

#####: **reference-counting**, #####
 ##### (# ##### # ##), # #####
 #####. ## ##### (#####
 #####) # #####. ##### ##
 #####.

- ##### ## # ##### (#####
 #####) #####.
- ##### ## # #####
 #####.
- ##### ## ##### `COM`.

#####. #####
 ## #####-#####.

- ### ##### `API`, ##
 #####
 ## ##### (#####), ##### `COM`
 ## _____. ##### ##
`_AddRef` # `_ReleaseRef` _____, ##
 ##### ## ##
 #####.
- ### ##### ## `API` ##
 #####, #####
 ##### # ##, #.#. ##
 #####-#####. ##
 (smart pointers) #####
 ##### (## ##).

```
### ##### CORBA ##### # #####  
{ $interfaces corba } ### #####, #####  
#####.
```

```
Delphi ##### COM #####, ##### COM  
#####, ##### # Delphi.
```

CORBA?

```
##. ##### _AddRef / _ReleaseRef. #####  
##### IUnknown. #####, #####  
##### # #####, ##### COM  
#####.
```

10.3. ##### GUIDs

```
GUID ## ##### [ '{ABCD1234-...}' ], #####  
#####. ##, ## ##  
#####.
```

```
GUID ## ##, ## ##  
#### COM ## CORBA. ## ##  
## ##, #####  
##### GUID.
```

```
### (#####) GUID, #####  
## ##### is. # ##### true, ##  
##### # ## #  
Supports(ObjectInstance, IMyInterface) ## ##-##, ##  
##### GUID. #####  
##### CORBA, ## # COM, ## FPC 3.0.0.
```

```
#### ##, ## ##, ##### GUID ##  
##### Lazarus ##### GUID (##### Ctrl  
+ Shift + G # #####).  
https://www.guidgenerator.com/.
```

```
### #####  
##### CreateGUID # GUIDToString # RTL. #####-##:
```

```
{ $mode objfpc } { $H+ } { $J- }  
uses
```


- #####, #####, #####
#####. #####
(##### reference-counted, ##### _AddRef #####...), #####
#####, #####
"7.7" #
FPC (<http://freepascal.org/docs-html/ref/refse47.html>).

###-##### ## COM ##### #:

- ##, ## reference-counted,
- ## TInterfacedObject,
- # ##, #####

#####.

#####:

.....
{ \$mode objfpc } { \$H+ } { \$J- }
{ \$interfaces com }

uses

SysUtils, Classes;

type

IMyInterface = **interface**
['{3075FFCD-8EFB-4E98-B157-261448B8D92E}']
 procedure Shoot;
end;

TMyClass1 = **class**(TInterfacedObject, IMyInterface)
 procedure Shoot;
end;

TMyClass2 = **class**(TInterfacedObject, IMyInterface)
 procedure Shoot;
end;

TMyClass3 = **class**(TInterfacedObject)
 procedure Shoot;
end;

procedure TMyClass1.Shoot;

```

begin
    WriteLn('TMyClass1.Shoot');
end;

procedure TMyClass2.Shoot;
begin
    WriteLn('TMyClass2.Shoot');
end;

procedure TMyClass3.Shoot;
begin
    WriteLn('TMyClass3.Shoot');
end;

procedure UseThroughInterface(I: IMyInterface);
begin
    Write('Shooting... ');
    I.Shoot;
end;

var
    C1: IMyInterface; // COM се грижи за унищожаването
    C2: IMyInterface; // COM се грижи за унищожаването
    C3: TMyClass3;     // ВМЕ трябва да се погрижите за унищожаването
begin
    C1 := TMyClass1.Create as IMyInterface;
    C2 := TMyClass2.Create as IMyInterface;
    C3 := TMyClass3.Create;
    try
        UseThroughInterface(C1); // няма нужда от оператор "as"
        UseThroughInterface(C2);
        if C3 is IMyInterface then
            UseThroughInterface(C3 as IMyInterface); // това няма да се изпълни
    finally
        { Променливи C1 и C2 излизат от обхват и тук би трябвало да се
          унищожат автоматично.

          За разлика от тях, C3 е инстанция, която не се управлява от
          интерфейс
          и трябва да се унищожи ръчно. }
        FreeAndNil(C3);
    end;
end.

```

```
procedure TMyClass1.Shoot;
begin
  WriteLn('TMyClass1.Shoot');
end;

procedure TMyClass2.Shoot;
begin
  WriteLn('TMyClass2.Shoot');
end;

procedure TMyClass3.Shoot;
begin
  WriteLn('TMyClass3.Shoot');
end;

procedure UseThroughInterface(I: IMyInterface);
begin
  Write('Shooting... ');
  I.Shoot;
end;

var
  C1: TMyClass1;
  C2: TMyClass2;
  C3: TMyClass3;

procedure UseInterfaces;
begin
  if C1 is IMyInterface then
    //if Supports(C1, IMyInterface) then // equivalent to "is" check above
    UseThroughInterface(C1 as IMyInterface);
  if C2 is IMyInterface then
    UseThroughInterface(C2 as IMyInterface);
  if C3 is IMyInterface then
    UseThroughInterface(C3 as IMyInterface);
end;

begin
  C1 := TMyClass1.Create(nil);
  C2 := TMyClass2.Create(nil);
  C3 := TMyClass3.Create(nil);
  try
    UseInterfaces;
  finally
    FreeAndNil(C1);
```

```
FreeAndNil(C2);
FreeAndNil(C3);
end;
end.
```

10.6.

CORBA, ##### COM (#####
CORBA).

1. ##### as #####
#####.

```
UseThroughInterface(Cx as IMyInterface);
```

C1, C2, C3 # #####.

IMyInterface.

as #####, ##### Cx #
(##### TMyClass2) ##### (#####
IMyInterface2).

CORBA #####.

2. #####:

```
UseThroughInterface(Cx);
```


C1 # C2 (#####
IMyInterface). #####
C3.

#a# ##### # ##### #
TMyClass,

TMyClass, ##### TMyClass ##### #
#

3. ##### IMyInterface(Cx):

```
UseThroughInterface(IMyInterface(Cx));
```

```
#####  
#####  
#####  
#####  
#####
```

```
### Cx #  
TMyClass2),  
#####  
#####  
#####
```

```
## ##
```

```
{ $mode objfpc } { $H+ } { $J- }
```

```
// { $interfaces corba } // забележете, че "as" конверсии за CORBA няма да  
се компилират
```

```
uses Classes;
```

```
type
```

```
IMyInterface = interface  
[ '{7FC754BC-9CA7-4399-B947-D37DD30BA90A}' ]  
  procedure One;  
end;
```

```
IMyInterface2 = interface(IMyInterface)  
[ '{A72B7008-3F90-45C1-8F4C-E77C4302AA3E}' ]  
  procedure Two;  
end;
```

```
IMyInterface3 = interface(IMyInterface2)  
[ '{924BFB98-B049-4945-AF17-1DB08DB1C0C5}' ]  
  procedure Three;  
end;
```

```
TMyClass = class(TComponent, IMyInterface)  
  procedure One;  
end;
```

```

TMyClass2 = class(TMyClass, IMyInterface, IMyInterface2)
    procedure One;
    procedure Two;
end;

procedure TMyClass.One;
begin
    Writeln('TMyClass.One');
end;

procedure TMyClass2.One;
begin
    Writeln('TMyClass2.One');
end;

procedure TMyClass2.Two;
begin
    Writeln('TMyClass2.Two');
end;

procedure UseInterface2(const I: IMyInterface2);
begin
    I.One;
    I.Two;
end;

procedure UseInterface3(const I: IMyInterface3);
begin
    I.One;
    I.Two;
    I.Three;
end;

var
    My: IMyInterface;
    MyClass: TMyClass;
begin
    My := TMyClass2.Create(nil);
    MyClass := TMyClass2.Create(nil);

    // Това не може да с компилира, не е известно дали My е IMyInterface2.
    // UseInterface2(My);
    // UseInterface2(MyClass);

    // Това се компилира и работи.

```



```

UseInterface2(IMyInterface2(My));
// Това не може да с компилира. Преобразуването InterfaceType(ClassType)
се проверява при компилация.
// UseInterface2(IMyInterface2(MyClass));

// Това се компилира и работи.
UseInterface2(My as IMyInterface2);
// Това се компилира и работи.
UseInterface2(MyClass as IMyInterface2);

// Това се компилира но не работи при изпълнение, с грозно "Access
violation".
// UseInterface3(IMyInterface3(My));
// Това не може да с компилира. Преобразуването InterfaceType(ClassType)
се проверява при компилация.
// UseInterface3(IMyInterface3(MyClass));

// Това се компилира но не работи при изпълнение, с хубаво
"EInvalidCast: Invalid type cast".
// UseInterface3(My as IMyInterface3);
// Това се компилира но не работи при изпълнение, с хубаво
"EInvalidCast: Invalid type cast".
// UseInterface3(MyClass as IMyInterface3);

writeln('Край');
end.

```

11.

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 #####, ##### # ##### ## ##### ## ##### ## ##) #####
 ## ## ##### # ## ## ## GitHub ## ## ##### ## ## michalis@castle-engine.io⁸. ##### WEB ##### # <https://michalis.xyz/>. ##### # #####
 # ##### Documentation ## Castle Game Engine website <https://castle-engine.io/>.

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Thank you for reading!

#: #####, 2023