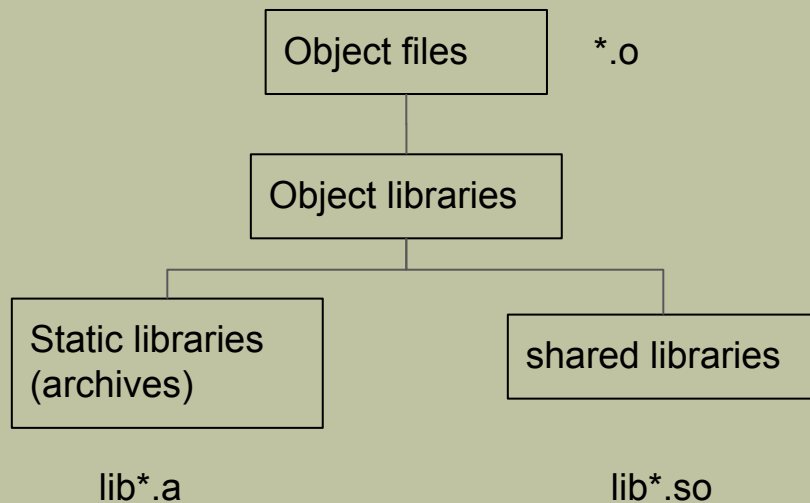# Лекция 5

- Библиотеки объектных модулей (архивы и разделяемые библиотеки).

Статические библиотеки - архивы, и библиотеки динамической компоновки.

```
double fun1(double x, int n){
  return n*x;
}

int fun2(int n){
  int m;
  m=n*n;
  return m;
}

double y=12.4;
```

~/Lab5> cat lab5-2.c

```c
double z=2.87;

double gun1(){
  int a[3]={2,3,4};
  return (double)(a[0]+a[1]+a[2])/3.0;
}
```

~/Lab5> cat lab5.c

```c
#include <stdio.h>
double fun1(double, int);
int fun2(int);
double gun1();
extern double  y;
extern double z;
int main(){
   fprintf(stdout, "%g\t%d\t%g\t%g\t%g\n",
   fun1(0.1,123), fun2(8), y,gun1(),z);
return 0;
}
```

```
~/Lab5> vim lab5-1.c
~/Lab5> vim lab5-2.c
~/Lab5> gcc -c lab5-1.c lab5-2.c
~/Lab5> ar cr liblab5.a *.o
~/Lab5> vim lab5.c
~/Lab5> gcc -c lab5.c
~/Lab5> gcc lab5.o -L. -llab5 -o lab5
~/Lab5> ./lab5
12.3      64        12.4      3         2.87
```

```
~/Lab5> gcc -c -fPIC -Wall lab5-*.c
~/Lab5> gcc -shared lab5-*.o -o liblab5.so
~/Lab5> gcc -c lab5.c
~/Lab5> gcc lab5.o -L. -llab5 -o lab5s
~/Lab5> export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:.
~/Lab5> ./lab5s
12.3     64        12.4     3          2.87
```

```c
#include <stdio.h>
#include <stdlib.h>
#include <dlfcn.h>
typedef double (*fun)(double, int);
typedef double (*gun)();
extern double y,z;

int main(){
  gun g;
```

```c
void* h=dlopen("liblab5.so", RTLD_LAZY);
 fprintf(stdout, "%g\t%g\n", y,z);
 g=(gun)dlsym(h, "gun1");
 fprintf(stdout, "%g\t%d\t%g\n",
   ((fun)dlsym(h, "fun1"))(0.1,123),
   ((int (*)(int))dlsym(h, "fun2"))(8),
   g());

 dlclose(h);
 return 0;
}
```

```
~Lab5> gcc lab5d.c -L. -llab5 -ldl -o lab5d
~/Lab5> export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:.
~/Lab5> ./lab5d
12.4      2.87
12.3      64          3
```

```
~/Lab5> ldd lab5s
        linux-vdso.so.1 (0x00007ffdb8de8000)
        liblab5.so => not found
        libc.so.6 => /lib64/libc.so.6
(0x00007fc5dfc5f000)
        /lib64/ld-linux-x86-64.so.2
(0x00007fc5e001a000)
```

```
/Lab5> ldd lab5d
        linux-vdso.so.1 (0x00007fff037bc000)
        liblab5.so => not found
        libdl.so.2 => /lib64/libdl.so.2
(0x00007f1fb3b05000)
        libc.so.6 => /lib64/libc.so.6
(0x00007f1fb374a000)
        /lib64/ld-linux-x86-64.so.2
(0x00007f1fb3d09000)
```

/Lab5> readelf -s liblab5.so

Таблица символов «.dynsym» содержит 12 элементов:
```
 Чис:   Знач        Разм Тип    Связ  Vis      Индекс имени
   0: 0000000000000000    0 NOTYPE  LOCAL  DEFAULT  UND
   1: 0000000000000000    0 NOTYPE  WEAK   DEFAULT  UND _ITM_deregisterT[...]
   2: 0000000000000000    0 NOTYPE  WEAK   DEFAULT  UND __gmon_start__
   3: 0000000000000000    0 NOTYPE  WEAK   DEFAULT  UND _ITM_registerTMC[...]
   4: 0000000000000000    0 FUNC    WEAK   DEFAULT  UND [...]@GLIBC_2.2.5 (2)
   5: 000000000000061a   24 FUNC    GLOBAL DEFAULT   12 fun1
   6: 0000000000000648   56 FUNC    GLOBAL DEFAULT   12 gun1
   7: 0000000000000632   22 FUNC    GLOBAL DEFAULT   12 fun2
   8: 0000000000201020    8 OBJECT  GLOBAL DEFAULT   22 y
   9: 0000000000000508    0 FUNC    GLOBAL DEFAULT    9 _init
  10: 0000000000201028    8 OBJECT  GLOBAL DEFAULT   22 z
  11: 0000000000000680    0 FUNC    GLOBAL DEFAULT   13 _fini
```

```
/Lab5> objdump -T liblab5.so

liblab5.so:     формат файла elf64-x86-64


DYNAMIC SYMBOL TABLE:
0000000000000000  w   D  *UND*  0000000000000000
_ITM_deregisterTMCloneTable
0000000000000000  w   D  *UND*  0000000000000000
__gmon_start__
0000000000000000  w   D  *UND*  0000000000000000
_ITM_registerTMCloneTable
0000000000000000  w   DF *UND*  0000000000000000  GLIBC_2.2.5
__cxa_finalize
000000000000061a g    DF .text  0000000000000018  Base      fun1
0000000000000648 g    DF .text  0000000000000038  Base      gun1
0000000000000632 g    DF .text  0000000000000016  Base      fun2
0000000000201020 g    DO .data  0000000000000008  Base      y
0000000000000508 g    DF .init  0000000000000000  Base      _init
0000000000201028 g    DO .data  0000000000000008  Base      z
0000000000000680 g    DF .fini  0000000000000000  Base      _fini
```

```
~/Lab6> gcc -shared -o liblab5.so *.o
 /Lab6> readelf --syms liblab5.so

Таблица символов «.dynsym» содержит 12 элементов:
   Чис:      Знач          Разм  Тип      Связ     Vis      Индекс
имени
     0: 0000000000000000       0 NOTYPE   LOCAL    DEFAULT  UND

.....................................................................................................
     5: 000000000000061a      24 FUNC     GLOBAL   DEFAULT    12 fun1
     6: 0000000000000648      56 FUNC     GLOBAL   DEFAULT    12 gun1
     7: 0000000000000632      22 FUNC     GLOBAL   DEFAULT    12 fun2
     8: 0000000000201020       8 OBJECT   GLOBAL   DEFAULT    22 y
     9: 0000000000000508       0 FUNC     GLOBAL   DEFAULT     9 _init
    10: 0000000000201028       8 OBJECT   GLOBAL   DEFAULT    22 z
    11: 0000000000000680       0 FUNC     GLOBAL   DEFAULT    13 _fini
```

```
VERSION_1 {
    global:
        fun1;
        fun2;
    local:
        *;
};
```

/Lab6> gcc -shared -o liblab5.so *.o \
 -Wl,--version-script,lab5.map

```
~/Lab6> gcc -shared -o liblab5.so *.o \
-Wl,--version-script,lab5.map

/Lab6> readelf --syms liblab5.so
```

Таблица символов «.dynsym» содержит 8 элементов:

```
   Чис:     Знач          Разм Тип       Связ     Vis        Индекс имени
     0: 0000000000000000     0 NOTYPE    LOCAL    DEFAULT    UND
     1: 0000000000000000     0 NOTYPE    WEAK     DEFAULT    UND
_ITM_deregisterT[...]
     2: 0000000000000000     0 NOTYPE    WEAK     DEFAULT    UND __gmon_start__
     3: 0000000000000000     0 NOTYPE    WEAK     DEFAULT    UND
_ITM_registerTMC[...]
     4: 0000000000000000     0 FUNC      WEAK     DEFAULT    UND [...]@GLIBC_2.2.5
(3)
     5: 00000000000005ca    24 FUNC      GLOBAL   DEFAULT    13 fun1@@VERSION_1
     6: 00000000000005e2    22 FUNC      GLOBAL   DEFAULT    13 fun2@@VERSION_1
     7: 0000000000000000     0 OBJECT    GLOBAL   DEFAULT    ABS VERSION_1
```

~/Lab5> cat lab5-11.c

```c
double fun1(double x, int n){
  return n*x;
}

int __attribute__ ((visibility("hidden")))
fun2(int n){
  int m;
  m=n*n;
  return m;
}
double y=12.4;
```