

## OS 2022 Problem Sheet #6

### Problem 6.1: scheduling strategies

(4+2 = 6 points)

A computer system with a single CPU has to execute  $n = 6$  processes  $A, \dots, F$ . The arrival times and the execution times of the processes are given by the following table.

process	arrival time	execution time
$A$	0	7
$B$	3	5
$C$	5	9
$D$	8	3
$E$	10	1
$F$	12	2

- Draw the schedule for the scheduling strategies first-come first-served (FCFS), shortest processing time first (SPTF), longest processing time first (LPTF), and round robin (RR) with a time slice of 1 time unit. Assume that arrivals happen before a scheduling point and that new processes are added at the end of the run queue.
- For each schedule, calculate the average turnaround time  $\bar{t}$  and the average waiting time  $\bar{w}$ .

### Problem 6.2: linking

(2+1+1 = 4 points)

The following C source files are compiled separately into object files and afterwards linked with other object files into an executable.

```
/* a.c */                               /* b.c */
#include <stdio.h>                         include <stdio.h>
extern int x;                             extern void h();
int y;                                    int x = 1;
static void f()                          static double y = 1;
{                                          static char z = 'A';
    static char z = 'Z';
    puts("a.c: f()");
}
void g()                                  static void g()
{                                          {
    puts("a.c: g()");
    f();
}                                          puts("b.c: g()");
                                          h();
}                                          }
void h()                                  void f()
{                                          {
    puts("a.c: h()");
    g();
}                                          puts("b.c: f()");
                                          g();
}                                          }
```

- Which symbols defined in the files `a.c` and `b.c` are
  - internally defined symbols not accessible outside of the object file,

- references to externally defined symbols that must be resolved by the linker,
- weak linkable symbols defined in the object file, or
- strong linkable symbols defined in the object file?

Mark the corresponding cell in the following table (we ignore the `puts` symbol).

file	symbol	internal unlinkable symbol	reference of external symbol	weak linkable symbol	strong linkable symbol
a.c	x				
a.c	y				
a.c	f				
a.c	g				
a.c	h				
b.c	x				
b.c	y				
b.c	z				
b.c	f				
b.c	g				

- b) What will be printed to the standard output by the following `main()` function? Explain.

```

/* main.c */

extern void f();

int main()
{
    f();
    return 0;
}

```

- c) What is name mangling and why do programming languages like C++ use name mangling? Why do I sometimes need to use `extern "C" {}` in C++ header files?