Exercises in System Level Programming (SLP) – Summer Term 2024

Exercise 4

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Presentation Assignment 2

Pointers & Arrays

In depth: Pointers
- Variable: `uint8_t x`
- Pointer: `uint8_t *y`
- Address-of operator: `&x`
- Indirection operator: `*y`

```
01 uint8_t a = 23;
02 uint8_t b = 42;
03 uint8_t *p = &a;
04 *p = 66;
05 p = &b;
06 *p -= 40;
07 uint8_t c = *p;
```

Stack ↓
⋯
0x0911
0x0910
0x090f
0x090e
0x090d
0x090c
0x090b
⋯
In depth: Pointers

Variable: uint8_t x
Pointer: uint8_t *y
Address-of operator: &x
Indirection operator: *y

01 uint8_t a = 23;
02 uint8_t b = 42;
03 uint8_t *p = &a;
04 *p = 66;
05 p = &b;
06 *p -= 40;
07 uint8_t c = *p;

Caution: The exact placement of the variable on the stack depends on the compiler and the chosen optimization level!
In depth: Pointers

- Variable: uint8_t x
- Pointer: uint8_t *y
- Address-of operator: &x
- Indirection operator: *y

01 uint8_t a = 23;
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05 p = &b;
06 *p -= 40;
07 uint8_t c = *p;

Stack:

Caution: ATmega328PB has 8-bit registers and 16-bit addresses

In depth: Arrays

- Constant pointer: uint8_t a[]
- Variable pointer: uint8_t *b
- Current element: *b
- x-th element: b[x]
- x-th element: *(b+x)

01 uint8_t x[] = {2,4,8,16};
02 uint8_t * y = x;
03 uint8_t z = x[1];
04 z = *y;
05 y = y+2;
06 z = *y;
07 z = x[1];

Stack:

Caution: ATmega328PB has 8-bit registers and 16-bit addresses
In depth: Arrays

- Constant pointer: `uint8_t a[]`
- Variable pointer: `uint8_t *b`
- Current element: `*b`
- x-th element: `b[x]`
- x-th element: `*(b+x)`

```c
uint8_t x[] = {2, 4, 8, 16};
uint8_t y = x;
uint8_t z = x[1];
z = *y;
y = y + 2;
z = *y;
z = x[7];
```

In depth: Arrays

- Constant pointer: `uint8_t a[]`
- Variable pointer: `uint8_t *b`
- Current element: `*b`
- x-th element: `b[x]`
- x-th element: `*(b+x)`

```c
uint8_t x[] = {2, 4, 8, 16};
uint8_t y = x;
uint8_t z = x[1];
z = *y;
y = y + 2;
z = *y;
z = x[7];
```
### In depth: Arrays

- **Constant pointer**: uint8_t a[
- **Variable pointer**: uint8_t *b
- **Current element**: *b
- **x-th element**: b[x]
- **x-th element**: *(b+x)

```c
08 uint8_t x[] = {2,4,8,16};
09 uint8_t *y = x;
10 uint8_t z = x[1];
11 z = *y;
12 y = y+2;
13 z = *y;
14 z = x[7];
```

```c
 Hands-on: Pointers
No Screencast
```
Hands-on: Pointers, Arrays & Structures

- Call-by-value vs. call-by-reference
- Pointer and arrays
- Pointer arithmetic
- struct for GPS coordinates
- Array of GPS coordinates
- Function pointers

Can be compiled for the SPiCboard (serial console), the SPiCsim or Linux

Source code:
https://sys.cs.fau.de/extern/lehre/ss24/slp/uebung/material/pointer.c