

Übungen zu Systemnahe Programmierung in C (SPiC) – Sommersemester 2023

Übung 4

Maximilian Ott

Arne Vogel

Lehrstuhl für Informatik 4
Friedrich-Alexander-Universität Erlangen-Nürnberg



Lehrstuhl für Verteilte Systeme
und Betriebssysteme



FRIEDRICH-ALEXANDER
UNIVERSITÄT
ERLANGEN-NÜRNBERG
TECHNISCHE FAKULTÄT

Vorstellung Aufgabe 2

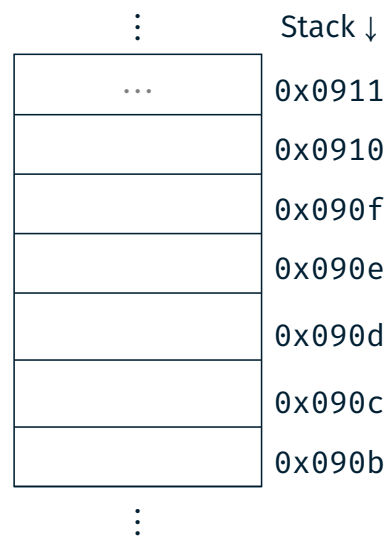
Zeiger & Felder

Vertiefung: Zeiger



- Variable: `uint8_t x`
- Zeiger: `uint8_t *y`
- Adressoperator: `&x`
- Verweisoperator: `*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;
```

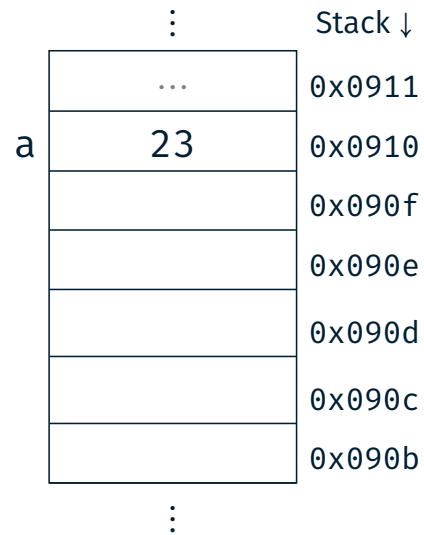




- Variable: `uint8_t x`
- Zeiger: `uint8_t *y`
- Adressoperator: `&x`
- Verweisoperator: `*y`

```

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;
    
```



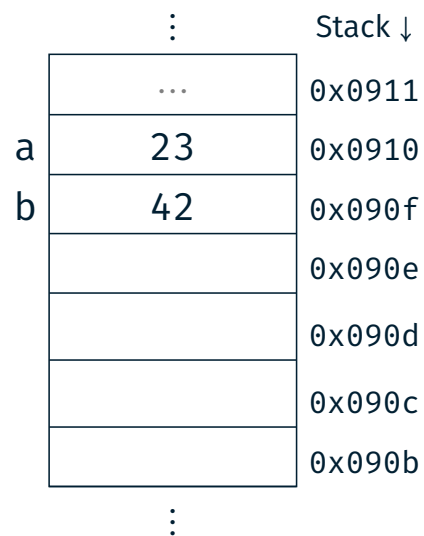
Achtung: Die genaue Anordnung der Variablen auf dem Stack ist abhängig vom Übersetzer und den gewählten Optimierungen!



- Variable: `uint8_t x`
- Zeiger: `uint8_t *y`
- Adressoperator: `&x`
- Verweisoperator: `*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;
    
```



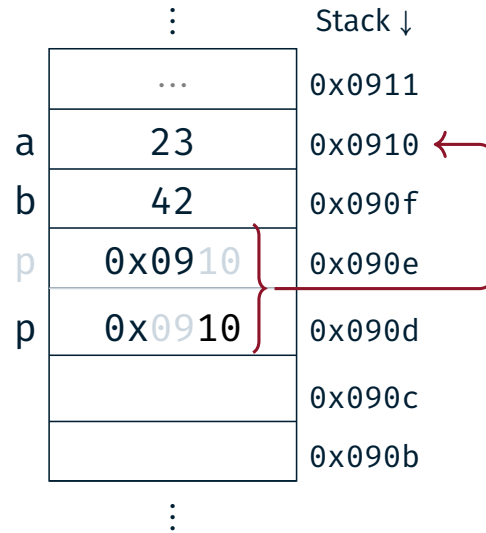
Achtung: Die genaue Anordnung der Variablen auf dem Stack ist abhängig vom Übersetzer und den gewählten Optimierungen!



- Variable: `uint8_t x`
- Zeiger: `uint8_t *y`
- Adressoperator: `&x`
- Verweisoperator: `*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;
    
```



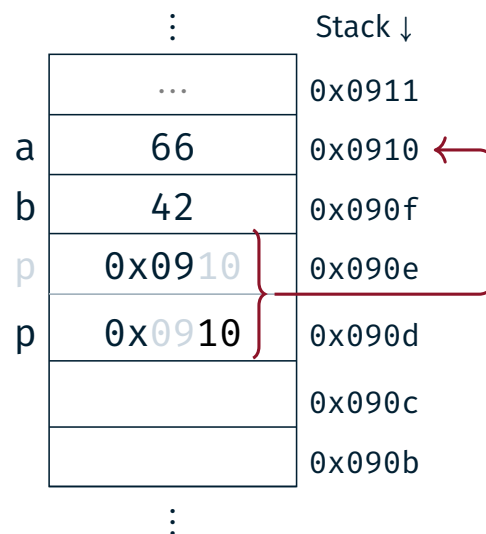
Achtung: ATmega328PB hat 8-bit Register und 16-bit Adressen



- Variable: `uint8_t x`
- Zeiger: `uint8_t *y`
- Adressoperator: `&x`
- Verweisoperator: `*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;
    
```



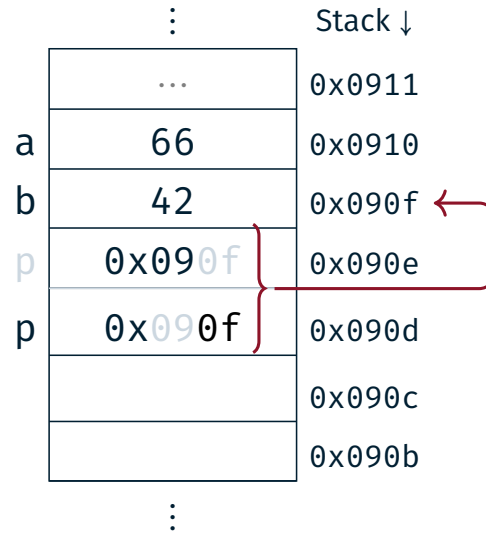
Achtung: ATmega328PB hat 8-bit Register und 16-bit Adressen



- Variable: uint8_t x
- Zeiger: uint8_t *y
- Adressoperator: &x
- Verweisoperator: *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;
    
```



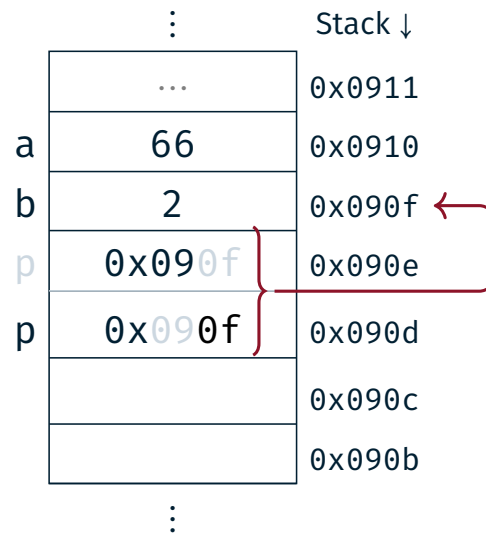
Achtung: ATmega328PB hat 8-bit Register und 16-bit Adressen



- Variable: uint8_t x
- Zeiger: uint8_t *y
- Adressoperator: &x
- Verweisoperator: *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;
    
```



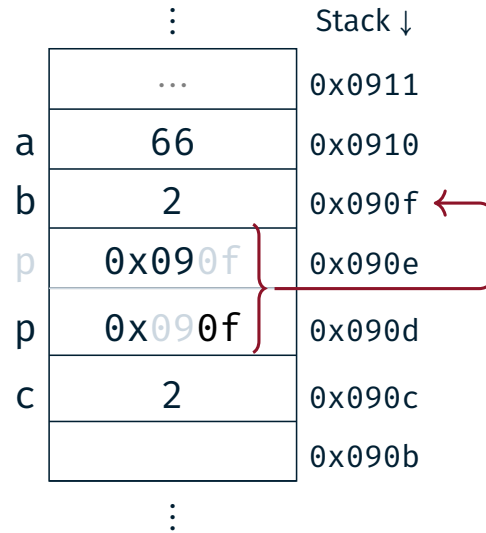
Achtung: ATmega328PB hat 8-bit Register und 16-bit Adressen



- Variable: `uint8_t x`
- Zeiger: `uint8_t *y`
- Adressoperator: `&x`
- Verweisoperator: `*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;
    
```



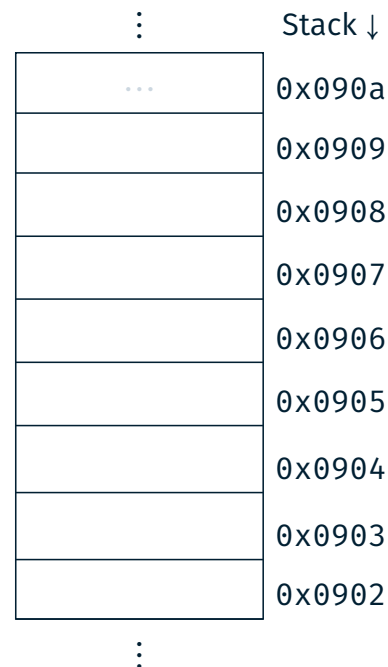
Achtung: ATmega328PB hat 8-bit Register und 16-bit Adressen



- Konstanter Zeiger: `uint8_t a[]`
- Variabler Zeiger: `uint8_t *b`
- Aktuelles Element: `*b`
- x-te Element: `b[x]`
- x-te Element: `*(b+x)`

```

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];
    
```

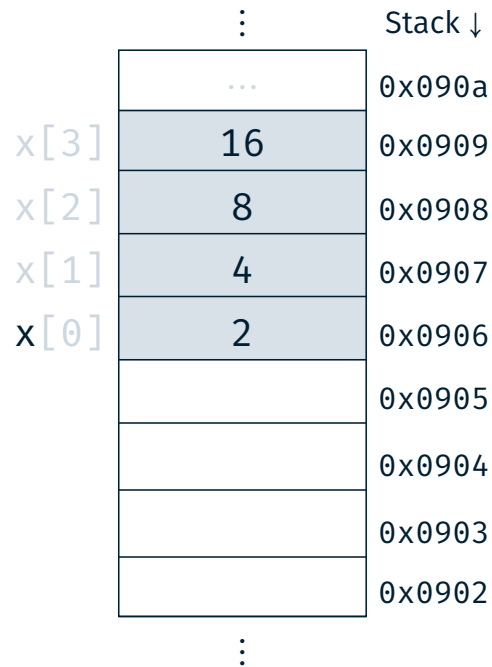




- Konstanter Zeiger: `uint8_t a[]`
- Variabler Zeiger: `uint8_t *b`
- Aktuelles Element: `*b`
- x-te Element: `b[x]`
- x-te Element: `*(b+x)`

```

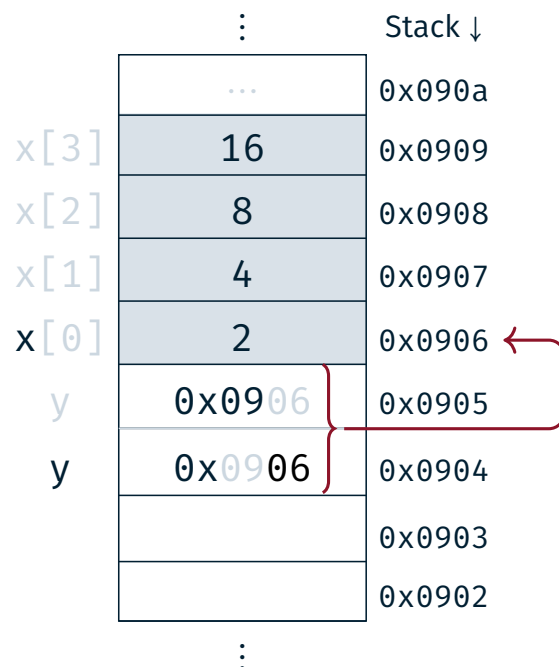
08 uint8_t x[] = {2,4,8,16};
09 uint8_t *y = x;
10 uint8_t z = x[1];
11 z = *y;
12 y = y+2;
13 z = *y;
14 z = x[7];
    
```



- Konstanter Zeiger: `uint8_t a[]`
- Variabler Zeiger: `uint8_t *b`
- Aktuelles Element: `*b`
- x-te Element: `b[x]`
- x-te Element: `*(b+x)`

```

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];
    
```

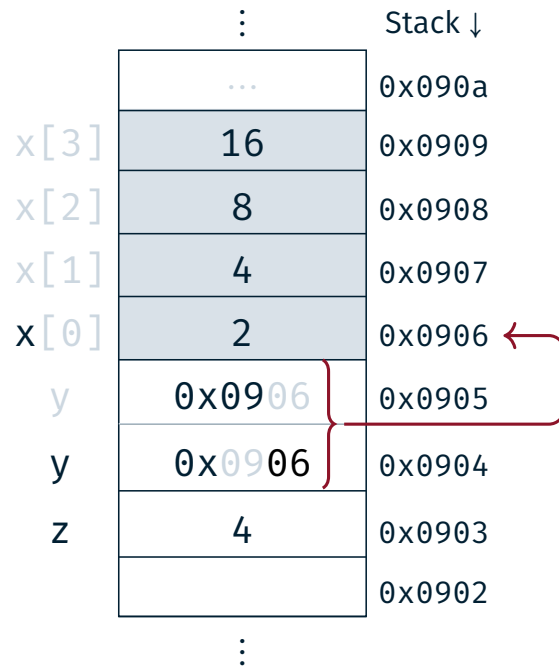




- Konstanter Zeiger: `uint8_t a[]`
- Variabler Zeiger: `uint8_t *b`
- Aktuelles Element: `*b`
- x-te Element: `b[x]`
- x-te Element: `*(b+x)`

```

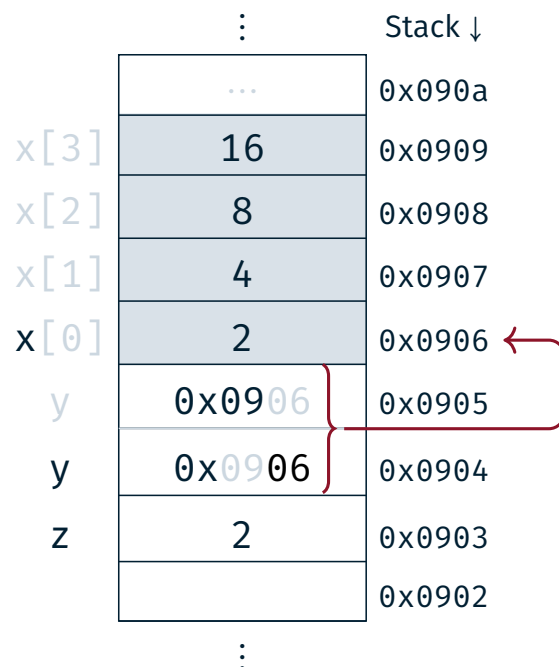
08 uint8_t x[] = {2,4,8,16};
09 uint8_t *y = x;
10 uint8_t z = x[1];
11 z = *y;
12 y = y+2;
13 z = *y;
14 z = x[7];
    
```



- Konstanter Zeiger: `uint8_t a[]`
- Variabler Zeiger: `uint8_t *b`
- Aktuelles Element: `*b`
- x-te Element: `b[x]`
- x-te Element: `*(b+x)`

```

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];
    
```

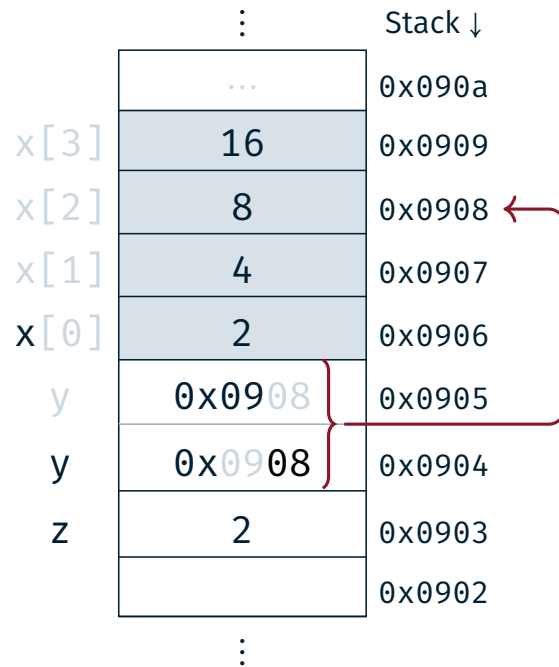




- Konstanter Zeiger: `uint8_t a[]`
- Variabler Zeiger: `uint8_t *b`
- Aktuelles Element: `*b`
- x-te Element: `b[x]`
- x-te Element: `*(b+x)`

```

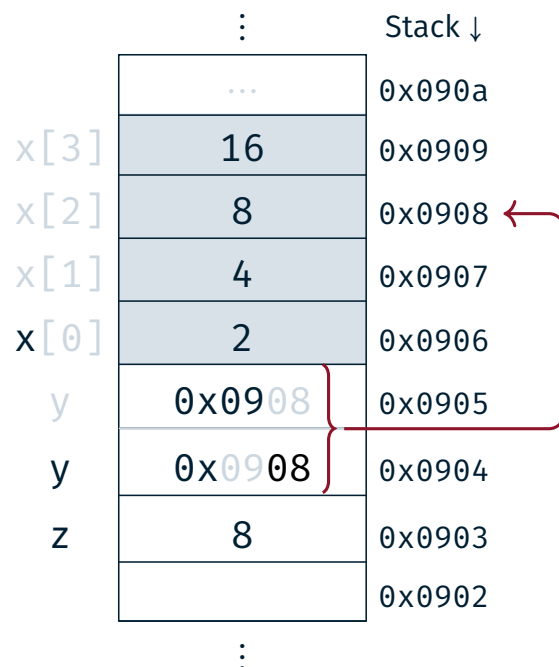
08 uint8_t x[] = {2,4,8,16};
09 uint8_t *y = x;
10 uint8_t z = x[1];
11 z = *y;
12 y = y+2;
13 z = *y;
14 z = x[7];
    
```



- Konstanter Zeiger: `uint8_t a[]`
- Variabler Zeiger: `uint8_t *b`
- Aktuelles Element: `*b`
- x-te Element: `b[x]`
- x-te Element: `*(b+x)`

```

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];
    
```

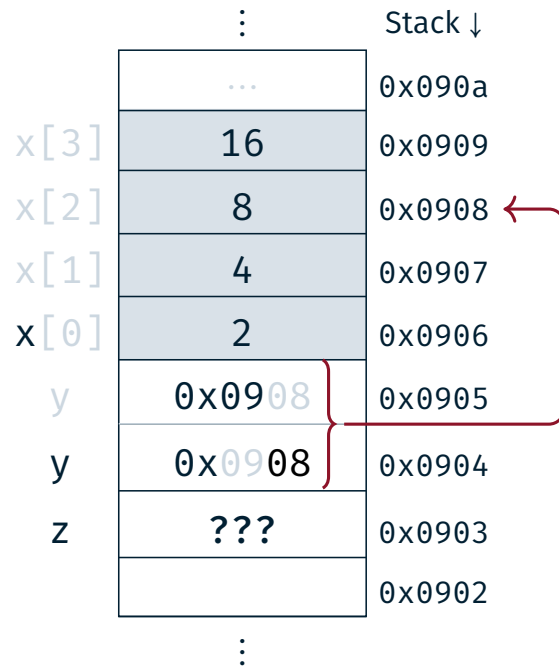




- Konstanter Zeiger: `uint8_t a[]`
- Variabler Zeiger: `uint8_t *b`
- Aktuelles Element: `*b`
- x-te Element: `b[x]`
- x-te Element: `*(b+x)`

```

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]; // ???
    
```



Hands-on: Zeiger

Kein Screencast



- Call-by-Value vs. Call-by-Reference
- Zeiger und Felder
- Zeigerarithmetik
- `struct` für GPS-Koordinaten
- Feld von GPS-Koordinaten
- Funktionszeiger

Kompilierbar für das SPiCboard (serielle Konsole), den SPiCsim oder Linux

Quellcode:

<https://sys.cs.fau.de/lehre/SS23/spic/uebung/material/pointer.c>