

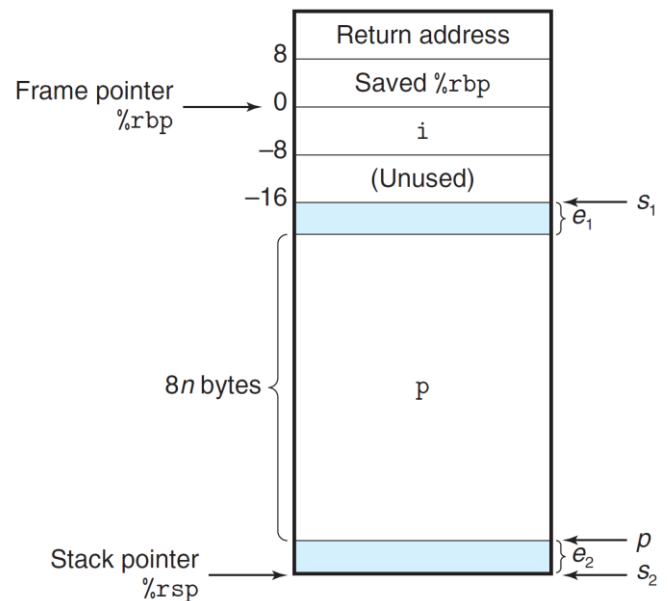
ICS Homework 12 Solution

Stack Frame

Consider the function `vframe` mentioned in class, given the exact `s1`(address of `-16(%rbp)`) and `n`(number of elements in the array), we can calculate the value of `e1`, `e2`, `s2` and `p` accordingly. Now some modifications are done for `vframe`, please read codes and the frame stack given below, and answer the following questions.

```
#define TYPE long
void vframe_new(long n) {
    long i;
    TYPE p[n];
    // do something...
}
```

```
1.vframe_new:
2.    pushq    %rbp
3.    movq     %rsp, %rbp
4.    subq     $16, %rsp
5.    leaq     22(,%rdi,8), %rax
6.    andq     $-16, %rax
7.    subq     %rax, %rsp
8.    // do something...
```



- Why there exists `e1` and `e2` has been discussed in class. For the given `n` and `s1` below, calculate the value of `e1`, `e2`, `s2` and `p`.

n	s1	s2	p	e1	e2
3	2145	2113	2120	1	7
4	2146	2098	2104	10	6
5	2146	2098	2104	2	6
6	2145	2081	2088	9	7

- For the following definition of `TYPE`, how will things become? (HINT: the assembly code may change)

a)

```
#define TYPE int
```

n	s1	s2	p	e1	e2
3	2145	2129	2132	1	3
4	2146	2114	2116	14	2
5	2146	2114	2116	10	2
6	2145	2113	2116	5	3

b)

```
struct f{
    int a;
    union{
        void *b_1;
        char b_2[10];
    }b;
};
#define TYPE struct f
```

n	s1	s2	p	e1	e2
3	2145	2065	2072	1	7
4	2146	2034	2040	10	6
5	2146	2018	2024	2	6
6	2145	1985	1992	9	7

Floating Point

Consider a 16-bit floating point representation based on the IEEE floating-point format, with 1 sign bit, 6 exp bits, 9 frac bits, called **Float16**.

Fill in the table below. Please represent M in the form x or x/y where x is an integer and y is an integral power of 2.

Description	Hex	M	E
-21/2	0xC4A0	21/16	3
5/8	0x3C80	5/4	-1
-85/64	0xBEA8	85/64	0
$-3 \cdot 2^{-34}$	0x8060	3/16	-30
32	0x4800	1	5
-0	0x8000	0	-30
Largest negative normalized value	0x8200	1	-30
$+\infty$	0x7E00	--	--
Largest denormalized value	0x01FF	511/512	-30