L5 functions Exercises

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Acknowledgement: some slides taken from Yifeng Zhu's courseware

Review

PUSH/POP Multiple Registers

They are equivalent.

```
PUSH {r6, r7, r8}   ⟺   PUSH {r8, r7, r6}   ⟺   PUSH {r8}
                                                PUSH {r7}
                                                PUSH {r6}
```

They are equivalent.

```
POP {r6, r7, r8}    ⟺   POP {r8, r7, r6}    ⟺   POP {r6}
                                                POP {r7}
                                                POP {r8}
```

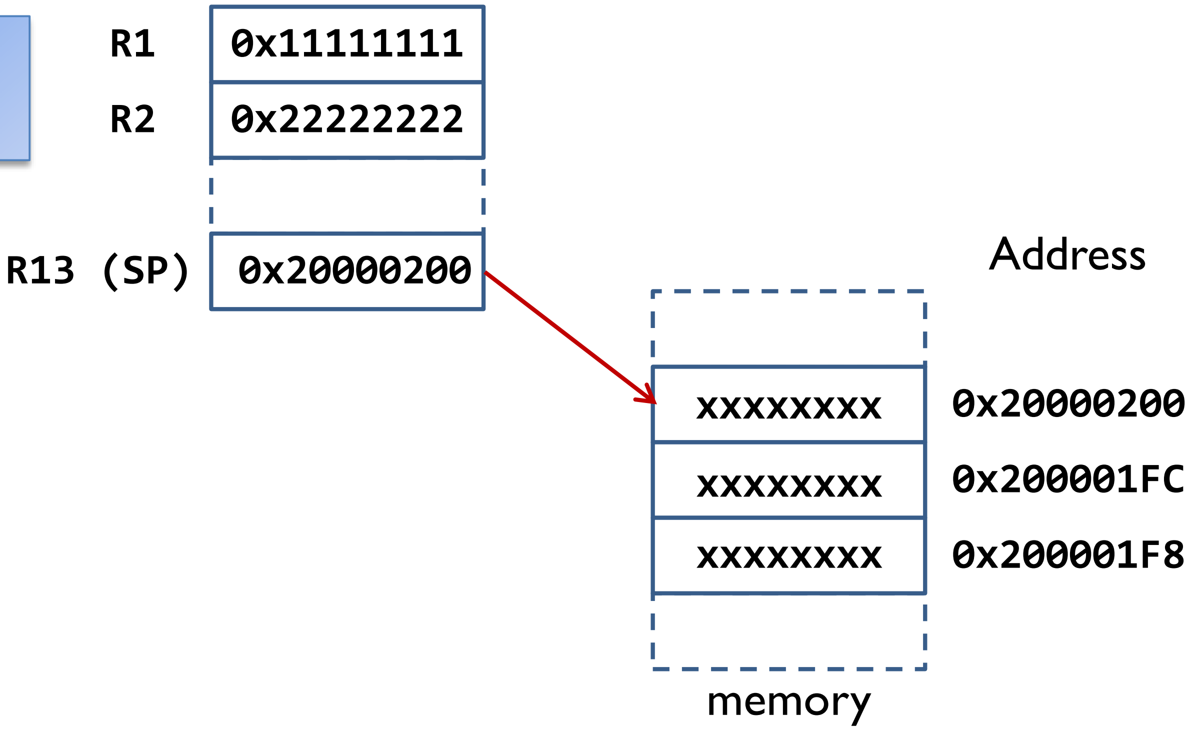
- PUSH/POP multiple registers in a single statement: the order in which registers listed in the {register list} does not matter
- When pushing multiple registers, these registers are automatically sorted by name and the lowest-numbered register is stored to the lowest memory address, *i.e.* is stored last.
- When popping multiple registers, these registers are automatically sorted by name and the lowest-numbered register is loaded from the lowest memory address, *i.e.* is loaded first.

Question: Stack

Before execution

```
R1==0x11111111
R2==0x22222222
```

```
PUSH {R1,R2}
POP  {R1}
POP  {R2}
```



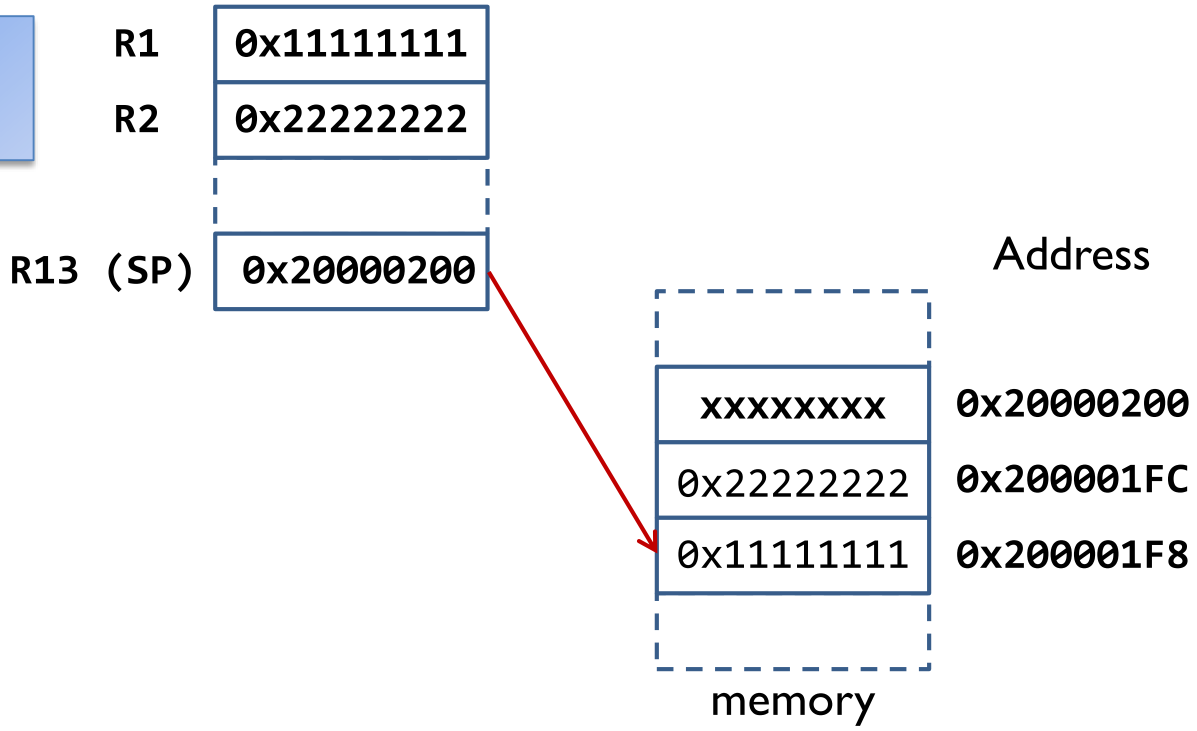
- Question:
  - What is content of stack, and position of SP, after PUSH {R2,R1}?
  - What are the values of R1/R2 after POP {R2}?

Answer: Stack

Before execution

```
R1==0x11111111
R2==0x22222222
```

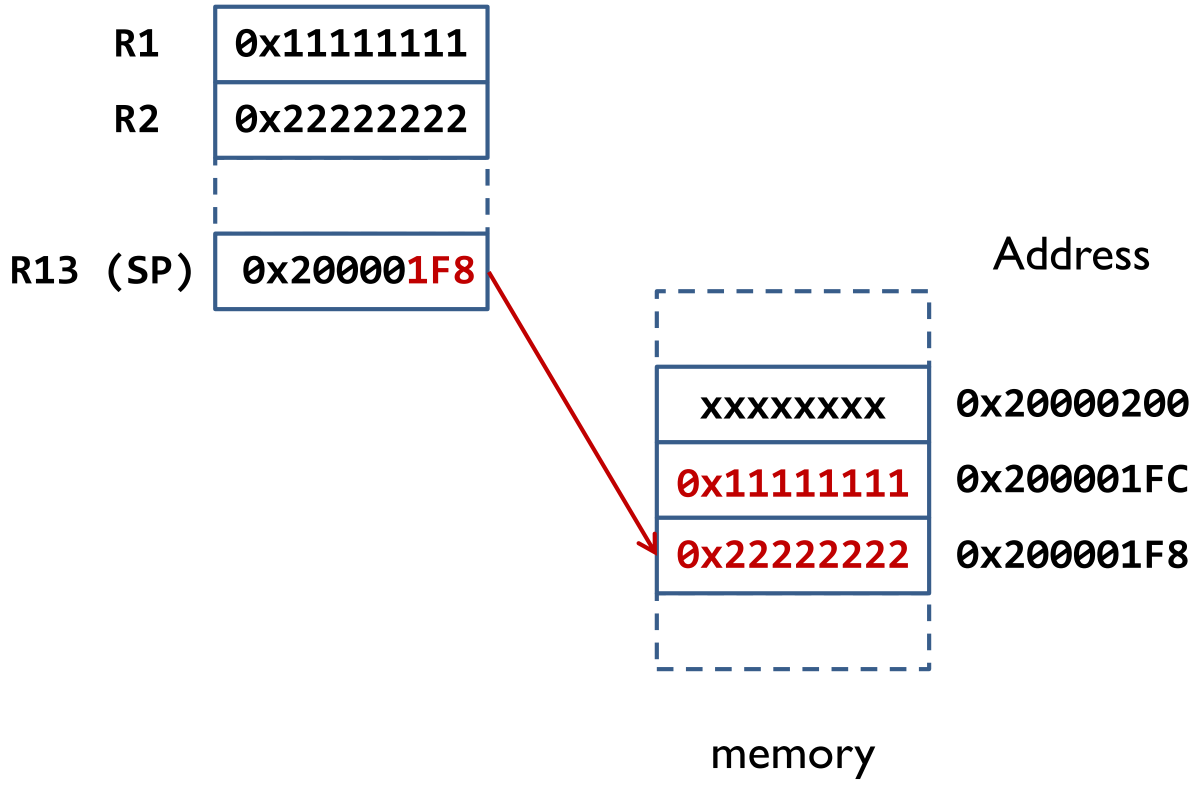
```
PUSH {R1,R2}
POP  {R1}
POP  {R2}
```



- Answer:
  - Shown in figure
  - After POP {R2}, R1==0x11111111, R2==0x22222222

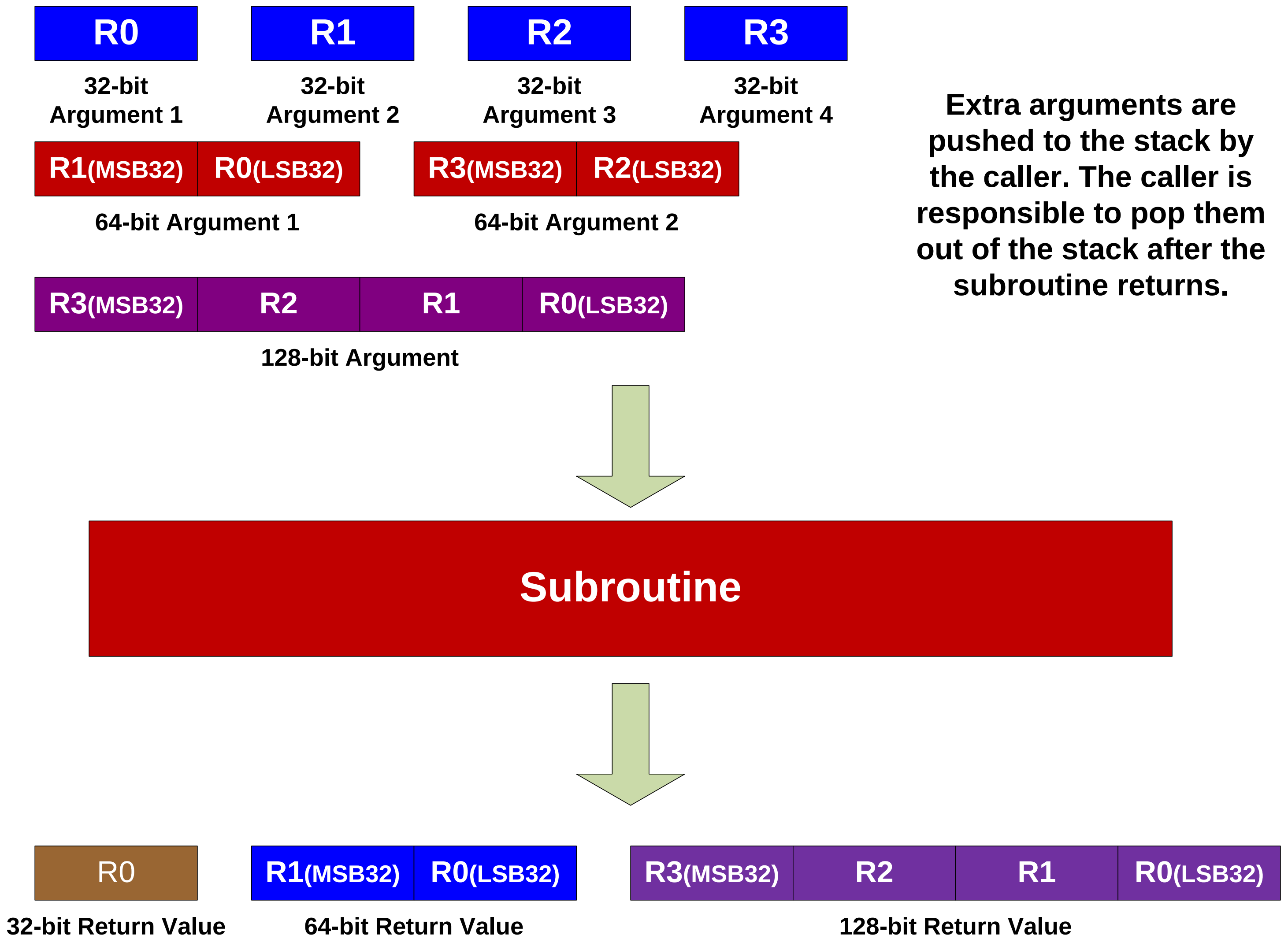
Example: Swap R1 & R2

```
    PUSH {R1}
PC→ PUSH {R2}
    POP  {R1}
    POP  {R2}
```



Review

Passing Arguments via Registers R0-R3



Extra arguments are pushed to the stack by the caller. The caller is responsible to pop them out of the stack after the subroutine returns.

Review

Additional Arguments Passed on Stack

Registers

R0	R1	R2	R3

Stack in Memory

foo (int i0, int i1, int i2, int i3)

Registers

i0	i1	i2	i3

Stack in Memory

foo (int i0, char a1, double D)

Each argument of 8-bit char, or 16-bit short, is passed in a 32-bit register

Registers

i0	a1	D	

Stack in Memory

foo (int i0, int i1, double D, int i2, int i3)

Registers

i0	i1	D	

Stack in Memory

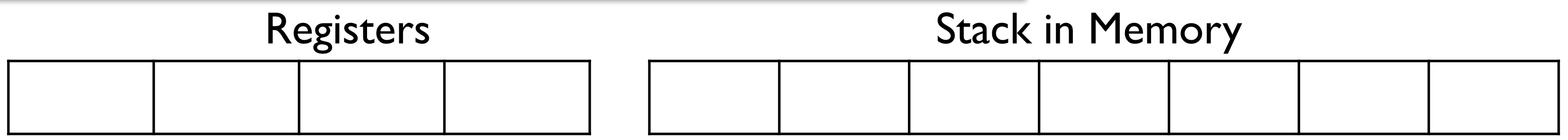
i2	i3					

Caller passes arguments i0, i1, D in registers R0-R3 directly; pushes additional arguments i2 and i3 onto the stack before function call (details not covered in this lecture)

Question: Argument Passing

- Which registers are used to pass the arguments and return the result?

```
long fun (short a1, char a2, double a3, int a4, char a5)
```



Answer: Argument Passing

- Which registers are used to pass the arguments and return the result?

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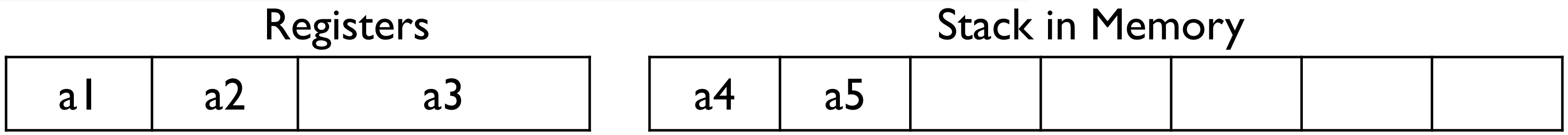
long fun (short a1, char a2, double a3, int a4, char a5)
```



- Each argument of 8-bit char, or 16-bit short, is passed in 1 32-bit register; cannot use 1 register to pass more than 1 arguments