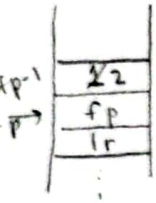
ASM Lab 8 Solutions:

1) c0502.c

```
// c0502.c
#include <stdio.h>

int main()
{
    int x = 1;

    x = x + 1;

    printf("%d\n", x);

    return 0;
}
```

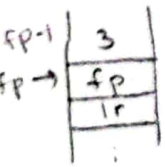



```
startup: jsr main
         halt

main:    push lr
         push fp
         mov fp,sp
         mov r0,1
         push r0
         ldr r0,fp,-1
         add r0,r0,1
         str r0,fp,-1
         ldr r0,fp,-1
         dout
         nl
         mov r0,0
         mov sp,fp
         pop fp
         pop lr
         ret
```

output:
2

2) c0503.c

```
// c0503.c
#include <stdio.h>

global
int y;

int main()
{

    dynamic local
    int x = 3;

    printf("%d\n", y);

    y = x;

    printf("%d\n", y);

    return 0;
}
```




```
startup: jsr main
         halt
y:       .word 0
main:    push lr
         push fp
         mov fp,sp
         mov r0,3
         push r0
         ld r0,y
         dout
         nl
         ldr r0,fp,-1
         st r0,y
         ld r0,y
         dout
         nl
         mov r0,0
         mov sp,fp
         pop fp
         pop lr
         ret
```

output:
0
3

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3) c0505.c

```
// c0505.c
#include <stdio.h>

void f()
{
    static local
    static int x = 3;
    ↳ @s0_x
    printf("%d\n", x);

    x = x+ 1;
}

void g()
{
    static local
    static int x = 5;
    ↳ @s1_x
    printf("%d\n", x);

    x = x+ 1;
}

int main()
{
    f();
    f();
    g();
    g();

    return 0;
}
```

output :

3
4
5
6

```
startup:    jsr main
            halt

f:          push lr
            push fp
            mov fp,sp
            ld r0,@s0_x
            dout
            nl
            ld r0,@s0_x
            add r0,r0,1
            st r0,@s0_x
            mov sp,fp
            pop fp
            pop lr
            ret

@s0_x:      .word 3

g:          push lr
            push fp
            mov fp,sp
            ld r0,@s1_x
            dout
            nl
            ld r0,@s1_x
            add r0,r0,1
            st r0,@s1_x
            mov sp,fp
            pop fp
            pop lr
            ret

@s1_x:      .word 5

main:       push lr
            push fp
            mov fp,sp
            jsr f
            jsr f
            jsr g
            jsr g
            mov r0,0
            mov sp,fp
            pop fp
            pop lr
            ret
```

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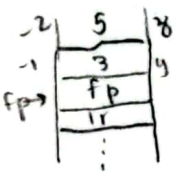
4) c0507.c

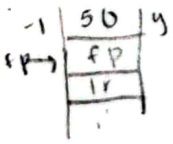
```
// c0507.c
#include <stdio.h>
void f()
{
    static int x = 2;
    int y = 3, z = 5;
    printf("%d %d %d\n", x, y, z);

    x = 1;
    y = 2;
    z = 3;
}
void g()
{
    static int x = 44;
    int y = 50;
    printf("%d %d\n", x, y);

    y = 22;
    x = y;
}
int main()
{
  f();
  f();
  g();
  g();
  return 0;
}
```

static local, @s0_x

dynamic local

@s1_x





output :

```
2  3  5
1  3  5
44 50
22 50
```

```
startup:
    jsr main
    halt

f:
    push lr
    push fp
    mov fp,sp
    mov r0,3
    push r0
    mov r0,5
    push r0
    mov r0,32
    ld r1,@s0_x
    dout r1
    aout
    ldr r1,fp,-1
    dout r1
    aout
    ldr r1,fp,-2
    dout r1
    nl
    mov r0,1
    st r0,@s0_x
    mov r0,2
    str r0,fp,-1
    mov r0,3
    str r0,fp,-2
    mov sp,fp
    pop fp
    pop lr
    ret
@s0_x:
    .word 2

g:
    push lr
    push fp
    mov fp,sp
    mov r0,50
    push r0
    mov r0,32
    ld r1,@s1_x
    dout r1
    aout
    ldr r1,fp,-1
    dout r1
    nl
    mov r0,22
    str r0,fp,-1
    ldr r0,fp,-1
    st r0,@s1_x
    mov sp,fp
    pop fp
    pop lr
    ret
@s1_x:
    .word 44

main:
    push lr
    push fp
    mov fp,sp
    jsr f
    jsr f
    jsr g
    jsr g
    mov r0,0
    mov sp,fp
    pop fp
    pop lr
    ret
```

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5) c0602.c

```
// c0602.c
#include <stdio.h>

int x;

int main()
{
   printf("enter\n");

   scanf("%d", &x);

   if (x >= 5)

      printf("hello\n");

   if (x <= -6)

      printf("small\n");

   else
   {

      printf("big\n");

      if (x > 30)

         printf("really big\n");

   }

   return 0;
}
```

```
startup: jsr main
         halt
x:       .word 0
main:    push lr
         push fp
         mov fp,sp
         lea r0,msg1
         sout
         lea r0,x
         din r1
         ldr r1,r0,0
         ld r0,x
         cmp r0,5
         brlt @L0
         lea r0,msg2
         sout
@L0:     ld r0,x
         cmp r0,-6
         brgt @L1
         lea r0,msg3
         sout
         br @L2
@L1:     lea r0,msg4
         sout
         ld r0,x
         cmp r0,30
         brlt @L3
         bre @L3
         lea r0,msg5
         sout
@L3:
@L2:     mov r0,0
         mov sp,fp
         pop fp
         pop lr
         ret

msg1:    .string "enter\n"
msg2:    .string "hello\n"
msg3:    .string "small\n"
msg4:    .string "big\n"
msg5:    .string "really big\n"
```

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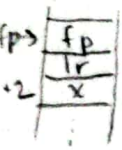
6) c0609.c

```
// c0609.c
#include <stdio.h>

void f(int x)
{
   if (x == 0)
   {
      printf("hello\n");
      return;
   }
   printf("good\n");
   f(x - 1);
   printf("bad\n");
   f (x - 1);
   printf("so so\n");
}

int main()
{
   f(3);

   return 0;
}
```




```
startup:  jsr main
          halt

f:        push lr
          push fp
          mov fp,sp
          ldr r0,fp,2
          cmp r0,0
          brne @L0
          lea r0,msg1
          sout
          mov sp,fp
          pop fp
          pop lr
          ret
@L0:      lea r0,msg2
          sout
          ldr r0,fp,2
          sub r0,r0,1
          push r0
          jsr f
          add sp,sp,1
          lea r0,msg3
          sout
          ldr r0,fp,2
          sub r0,r0,1
          push r0
          jsr f
          add sp,sp,1
          lea r0,msg4
          sout
          mov sp,fp
          pop fp
          pop lr
          ret
main:     push lr
          push fp
          mov fp,sp
          mov r0,3
          push r0
          jsr f
          add sp,sp,1
          mov r0,0
          mov sp,fp
          pop lr
          pop fp
          ret

msg1:     .string  "hello\n"
msg2:     .string  "good\n"
msg3:     .string  "bad\n"
msg4:     .string  "so so\n"
```

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Output :

good

good

hello

bad

hello

so so

bad

good

hello

bad

hello

so so

so so

bad

good

good

hello

bad

hello

so so

bad

good

hello

bad

hello

so so

so so

so so

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7) c0611.c

```
// c0611.c
#include <stdio.h>

int x = 1;

int main()
{
   while (++x + 2 < 20)
      printf("hello\n");
   return 0;
}
```

```
startup:  jsr main
          halt

x:        .word 1

main:     push lr
          push fp
          mov fp,sp

@L0:      ld r0,x
          add r0,r0,1
          st r0,x
          add r0,r0,2
          cmp r0,20
          brgt @L1
          brz  @L1

          lea r0,msg
          sout r0
          br @L0

@L1:      mov r0,0
          mov sp,fp
          pop fp
          pop lr
          ret

msg:      .string "hello\n"
```

output:

hello
hello
⋮
hello

} 16 times

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