Q1) 0xfffef0e0

```
Breakpoint 1, main () at Lab3.c:11
11          int i = 8;
(gdb) disass
Dump of assembler code for function main:
   0x00010408 <+0>:     push    {r11, lr}
   0x0001040c <+4>:     add     r11, sp, #4
   0x00010410 <+8>:     sub     sp, sp, #8
=> 0x00010414 <+12>:    mov     r3, #8
   0x00010418 <+16>:    str     r3, [r11, #-8]
   0x0001041c <+20>:    ldr     r0, [r11, #-8]
   0x00010420 <+24>:    bl      0x103c8 <recurse>
   0x00010424 <+28>:    mov     r3, #0
   0x00010428 <+32>:    mov     r0, r3
   0x0001042c <+36>:    sub     sp, r11, #4
   0x00010430 <+40>:    pop     {r11, pc}
End of assembler dump.
```

```
(gdb) b main
Breakpoint 1 at 0x10414: file Lab3.c, line 11.
(gdb) c
Continuing.
warning: Could not load shared library symbols for 2 libraries, e.g. /lib/libc.s
o.6.
Use the "info sharedlibrary" command to see the complete listing.
Do you need "set solib-search-path" or "set sysroot"?

Breakpoint 1, main () at Lab3.c:11
11          int i = 8;
(gdb) info frame
Stack level 0, frame at 0xfffef0e0:
 pc = 0x10414 in main (Lab3.c:11); saved pc = 0xff6657b4
 source language c.
 Arglist at 0xfffef0dc, args:
 Locals at 0xfffef0dc, Previous frame's sp is 0xfffef0e0
 Saved registers:
  r11 at 0xfffef0d8, lr at 0xfffef0dc
(gdb)
```

Q2)

lr	0xff6657b4	-10070092
lr	0x10424	66596
lr	0x103fc	66556

We are using Stack to store lr values in case of Recursion.

```
Breakpoint 1, main () at Lab3.c:11
11          int i = 8;
(gdb) info frame
Stack level 0, frame at 0xfffef0e0:
 pc = 0x10414 in main (Lab3.c:11); saved pc = 0xff6657b4
 source language c.
 Arglist at 0xfffef0dc, args:
 Locals at 0xfffef0dc, Previous frame's sp is 0xfffef0e0
 Saved registers:
  r11 at 0xfffef0d8, lr at 0xfffef0dc
(gdb) n
12          recurse(i);
(gdb) s
recurse (i=8) at Lab3.c:4
4          if (i == 0)
(gdb) info frame
Stack level 0, frame at 0xfffef0d0:
 pc = 0x103d8 in recurse (Lab3.c:4); saved pc = 0x10424
 called by frame at 0xfffef0e0
 source language c.
 Arglist at 0xfffef0cc, args: i=8
 Locals at 0xfffef0cc, Previous frame's sp is 0xfffef0d0
 Saved registers:
  r11 at 0xfffef0c8, lr at 0xfffef0cc
(gdb) n
8                recurse(i - 1);
(gdb) s
recurse (i=7) at Lab3.c:4
4          if (i == 0)
(gdb) info frame
Stack level 0, frame at 0xfffef0c0:
 pc = 0x103d8 in recurse (Lab3.c:4); saved pc = 0x103fc
 called by frame at 0xfffef0d0
 source language c.
 Arglist at 0xfffef0bc, args: i=7
 Locals at 0xfffef0bc, Previous frame's sp is 0xfffef0c0
 Saved registers:
  r11 at 0xfffef0b8, lr at 0xfffef0bc
(gdb) n
8                recurse(i - 1);
(gdb) s
recurse (i=6) at Lab3.c:4
```

```
recurse (i=6) at Lab3.c:4
4         if (i == 0)
(gdb) info frame
Stack level 0, frame at 0xfffef0b0:
 pc = 0x103d8 in recurse (Lab3.c:4); saved pc = 0x103fc
 called by frame at 0xfffef0c0
 source language c.
 Arglist at 0xfffef0ac, args: i=6
 Locals at 0xfffef0ac, Previous frame's sp is 0xfffef0b0
 Saved registers:
  r11 at 0xfffef0a8, lr at 0xfffef0ac
(gdb) n
8               recurse(i - 1);
(gdb) s
recurse (i=5) at Lab3.c:4
4         if (i == 0)
(gdb) info frame
Stack level 0, frame at 0xfffef0a0:
 pc = 0x103d8 in recurse (Lab3.c:4); saved pc = 0x103fc
 called by frame at 0xfffef0b0
 source language c.
 Arglist at 0xfffef09c, args: i=5
 Locals at 0xfffef09c, Previous frame's sp is 0xfffef0a0
 Saved registers:
  r11 at 0xfffef098, lr at 0xfffef09c
(gdb) n
8               recurse(i - 1);
(gdb) s
recurse (i=4) at Lab3.c:4
4         if (i == 0)
(gdb) info frame
Stack level 0, frame at 0xfffef090:
 pc = 0x103d8 in recurse (Lab3.c:4); saved pc = 0x103fc
 called by frame at 0xfffef0a0
 source language c.
 Arglist at 0xfffef08c, args: i=4
 Locals at 0xfffef08c, Previous frame's sp is 0xfffef090
 Saved registers:
  r11 at 0xfffef088, lr at 0xfffef08c
(gdb) n
8               recurse(i - 1);
```

```
8               recurse(i - 1);
(gdb) s
recurse (i=3) at Lab3.c:4
4         if (i == 0)
(gdb) info frame
Stack level 0, frame at 0xfffef080:
 pc = 0x103d8 in recurse (Lab3.c:4); saved pc = 0x103fc
 called by frame at 0xfffef090
 source language c.
 Arglist at 0xfffef07c, args: i=3
 Locals at 0xfffef07c, Previous frame's sp is 0xfffef080
 Saved registers:
  r11 at 0xfffef078, lr at 0xfffef07c
(gdb) n
8               recurse(i - 1);
(gdb) s
recurse (i=2) at Lab3.c:4
4         if (i == 0)
(gdb) info frame
Stack level 0, frame at 0xfffef070:
 pc = 0x103d8 in recurse (Lab3.c:4); saved pc = 0x103fc
 called by frame at 0xfffef080
 source language c.
 Arglist at 0xfffef06c, args: i=2
 Locals at 0xfffef06c, Previous frame's sp is 0xfffef070
 Saved registers:
  r11 at 0xfffef068, lr at 0xfffef06c
(gdb) n
8               recurse(i - 1);
(gdb) s
recurse (i=1) at Lab3.c:4
4         if (i == 0)
(gdb) info frame
Stack level 0, frame at 0xfffef060:
 pc = 0x103d8 in recurse (Lab3.c:4); saved pc = 0x103fc
 called by frame at 0xfffef070
 source language c.
 Arglist at 0xfffef05c, args: i=1
 Locals at 0xfffef05c, Previous frame's sp is 0xfffef060
 Saved registers:
  r11 at 0xfffef058, lr at 0xfffef05c
```

```
  r11 at 0xfffef058, lr at 0xfffef05c
(gdb) n
8               recurse(i - 1);
(gdb) s
recurse (i=0) at Lab3.c:4
4         if (i == 0)
(gdb) info frame
Stack level 0, frame at 0xfffef050:
 pc = 0x103d8 in recurse (Lab3.c:4); saved pc = 0x103fc
 called by frame at 0xfffef060
 source language c.
 Arglist at 0xfffef04c, args: i=0
 Locals at 0xfffef04c, Previous frame's sp is 0xfffef050
 Saved registers:
  r11 at 0xfffef048, lr at 0xfffef04c
(gdb) n
5               return 0;
(gdb) s
9       }
(gdb) info frame
Stack level 0, frame at 0xfffef050:
 pc = 0x103fc in recurse (Lab3.c:9); saved pc = 0x103fc
 called by frame at 0xfffef060
 source language c.
 Arglist at 0xfffef04c, args: i=0
 Locals at 0xfffef04c, Previous frame's sp is 0xfffef050
 Saved registers:
  r11 at 0xfffef048, lr at 0xfffef04c
(gdb)
```

Q3)

```
#include <stdio.h>

int main() {
        int i = 8;
        for (i; i != 0; i--);
        return 0;
}
```

Implemeting Loops instead of Recursion will make sure that it can run without the use of stack, at the same time the number of function calls are as much as possible.