LE12.2

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LE12.2.1 Compiling a Procedure

3/4 points (ungraded)

You are given the following listing of a C program and its translation to Beta assembly code:

```
int ones(int x) {
  int lowbit = x & 1;    // low bit of x
  int rest = x >> 1;     // shift other bits right
  if (x == 0) return 0;
  else return ones(rest)+lowbit
}
```

```
[01]  ones:  PUSH(LP)
[02]         PUSH(BP)
[03]         MOVE(SP, BP)
[04]         ALLOCATE(2)
[05]         PUSH(R1)
[06]         LD(BP, -12, R0)
[07]         ANDC(R0, 1, R1)
[08]         ST(R1, 0, BP)
[09]         SHRC(R0, 1, R1)
[10]         ST(R1, 4, BP)
[11]         BEQ(R0, labl)
[12]         LD(BP, 4, R1)
[13]         PUSH(R1)
[14]         BR(ones, LP)
[15]         DEALLOCATE(1)
[16]         LD(BP, 0, R1)
[17]         ADD(R0, R1, R0)
[18]  labl:  POP(R1)
[19]         MOVE(BP, SP)
[20]         POP(BP)
[21]         POP(LP)
[22]         JMP(LP)
```

(A) Which line(s) of assembly language form the entry sequence? Include code responsible for allocating local variables and saving the values of registers used in the body of the procedure. Check all the applicable lines.

- [x] `[01] ones:PUSH(LP)`
- [x] `[02] PUSH(BP)`
- [x] `[03] MOVE(SP, BP)`
- [x] `[04] ALLOCATE(2)`
- [x] `[05] PUSH(R1)`
- [ ] `[06] LD(BP, -12, R0)`
- [ ] `[07] ANDC(R0, 1, R1)`
- [ ] `[08] ST(R1, 0, BP)`
- [ ] `[09] SHRC(R0, 1, R1)`
- [ ] `[10] ST(R1, 4, BP)`
- [ ] `[11] BEQ(R0, lab1)`
- [ ] `[12] LD(BP, 4, R1)`
- [ ] `[13] PUSH(R1)`

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- [ ] [14] BR(ones, LP)
- [ ] [15] DEALLOCATE(1)
- [ ] [16] LD(BP, 0, R1)
- [ ] [17] ADD(R0, R1, R0)
- [ ] [18] labl:POP(R1)
- [ ] [19] MOVE(BP, SP)
- [ ] [20] POP(BP)
- [ ] [21] POP(LP)
- [ ] [22] JMP(LP)

✔

(B) Which line(s) of assembly language form the exit sequence? Include code responsible restoring values saved by the entry sequence. Check all the applicable lines.

- [ ] [01] ones:PUSH(LP)
- [ ] [02] PUSH(BP)
- [ ] [03] MOVE(SP, BP)
- [ ] [04] ALLOCATE(2)
- [ ] [05] PUSH(R1)
- [ ] [06] LD(BP, -12, R0)
- [ ] [07] ANDC(R0, 1, R1)
- [ ] [08] ST(R1, 0, BP)
- [ ] [09] SHRC(R0, 1, R1)
- [ ] [10] ST(R1, 4, BP)
- [ ] [11] BEQ(R0, lab1)
- [ ] [12] LD(BP, 4, R1)
- [ ] [13] PUSH(R1)
- [ ] [14] BR(ones, LP)
- [ ] [15] DEALLOCATE(1)
- [ ] [16] LD(BP, 0, R1)
- [ ] [17] ADD(R0, R1, R0)

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- [x] [18] labl:POP(R1)
- [x] [19] MOVE(BP, SP)
- [x] [20] POP(BP)
- [x] [21] POP(LP)
- [x] [22] JMP(LP)

✔

(C) Which line(s) of assembly language were generated when compiling the recursive call `ones(rest)`. Check all the applicable lines.

- [x] [01] ones:PUSH(LP)
- [x] [02] PUSH(BP)
- [x] [03] MOVE(SP, BP)
- [x] [04] ALLOCATE(2)
- [x] [05] PUSH(R1)
- [x] [06] LD(BP, -12, R0)
- [x] [07] ANDC(R0, 1, R1)
- [x] [08] ST(R1, 0, BP)
- [x] [09] SHRC(R0, 1, R1)
- [x] [10] ST(R1, 4, BP)
- [x] [11] BEQ(R0, lab1)
- [x] [12] LD(BP, 4, R1) ✔
- [x] [13] PUSH(R1) ✔
- [x] [14] BR(ones, LP) ✔
- [x] [15] DEALLOCATE(1) ✔
- [x] [16] LD(BP, 0, R1)
- [x] [17] ADD(R0, R1, R0)
- [x] [18] labl:POP(R1)
- [x] [19] MOVE(BP, SP)
- [x] [20] POP(BP)

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- [x] [21] POP(LP)
- [x] [22] JMP(LP)

✖

(D) Which line(s) of assembly language were generated when compiling the statement "lowbit = x & 1;" Check all the applicable lines.

- [ ] [01] ones:PUSH(LP)
- [ ] [02] PUSH(BP)
- [ ] [03] MOVE(SP, BP)
- [ ] [04] ALLOCATE(2)
- [ ] [05] PUSH(R1)
- [x] [06] LD(BP, -12, R0)
- [x] [07] ANDC(R0, 1, R1)
- [x] [08] ST(R1, 0, BP)
- [ ] [09] SHRC(R0, 1, R1)
- [ ] [10] ST(R1, 4, BP)
- [ ] [11] BEQ(R0, lab1)
- [ ] [12] LD(BP, 4, R1)
- [ ] [13] PUSH(R1)
- [ ] [14] BR(ones, LP)
- [ ] [15] DEALLOCATE(1)
- [ ] [16] LD(BP, 0, R1)
- [ ] [17] ADD(R0, R1, R0)
- [ ] [18] labl:POP(R1)
- [ ] [19] MOVE(BP, SP)
- [ ] [20] POP(BP)
- [ ] [21] POP(LP)
- [ ] [22] JMP(LP)

✔

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Answers are displayed within the problem

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- [Staff] Disappearing Answers — 5
  Some time ago I submitted my answers for LE12.2.1 - I'm sure I did this because I did a Print to PDF. I now see that the answers for ...
- LE12.2.1 - wrong lines [08] in questions (A)-(D) — 2
  The lines labeled [08] in questions (A)-(D) should match line [08] in the listing, **ST(R1, 0, BP)**.
- Doubt in beta code — 2
  Will the beta code followed by **[14] BR(ones, LP)** be executed? Since, BR() is unconditional branch, so I think these lines of cod...
- Difference of LP, BP and RI in stack — 2
  What is the difference between LP, BP and RI in stack?
- [STAFF]use of Allocate — 2
  I couldn't understand the use of ALLOCATE(k). It is just adding a constant to Stack pointer. So if we want to pop another variable, w...
- Code optimization — 3
  I see a possible optimization. We don't need to allocate two words for local variables. If you keep "rest" in R1, you can also save the ...
- [STAFF] Strange behaviour of the grader — 1

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