I2OS 22 Final Exam Solutions

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1. (a) The result $= \boxed{1}$



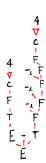
(b) The result $= 2 - 2 - 2 = 0 - 2 = \boxed{-2}$



(c) The result = $(3/3)/3 = 1/3 = \frac{1}{3} \simeq \boxed{0}$



(d) The result = $4 - - - 4 = 4 - - 4 = \boxed{8}$



2. The order of division and multiplication will be reversed resulting in a derivation tree as follows:



The result will be: $3/(3/3) = 3/1 = \boxed{3}$

- 3. (a) 3
 - (b) 3
- 4. (a) Maximum registers needed = $\log(n) + 1$, minimum registers needed = 4
 - (b) Array access takes 2 pebbles.

 $\frac{1}{\text{moveg2s 0 7}} / \text{mode = 0}$

This would set the mode to *system* enabling access to all adresses in the memory, since adress translation (required by user mode) wouldn't be required.

- 6. If we don't do anything special in the kernel (like overwriting gpr(0)) nothing will change, except the fact that users won't be able to access gpr(0) and will have to account for that by possibly redeclaring another gpr as a zero always keeping 0_{32} in that gpr.
- 7. (a) $4 \cdot (32+1) = 128+4 = 132$
 - (b) $2 \cdot 4 \cdot (32 + 8) = 8 * 40 = 320$
 - (c) $320 + 4 \cdot 3 = 332$
- 8. (a) For function calls.
 - (b) To enable the use of local variables.
- 9. The given invariants allow us to save and restore user and kernel state.
- 10. (a) $2^{15} 2$ forwards and $2^{15} 1$ backwards
 - (b) For if-parts in the case of an if-then statement: $2^{15} 2$. In the case of an if-else statement: $2^{15} 3$.
 - For else-parts: $2^{15} 2$
 - For while bodies: $2^{15} 2 |code(n1)|$, where n1 is the while condition.
- 11. (a)