Problem 5: Heterogeneous Multicore (14 pts)

Suppose you have three different core designs which you can use to build a heterogeneous multicore system.

- An OoO core (OoO-Fixed) that can execute instructions out-of-order.
- An in-order core (IO-Fixed) that can execute instructions in order. The area of IO-Fixed is 1/4th the size of OoO-Fixed.
- Morphy: a hybrid core which can dynamically switch between two modes of execution: out-of-order with a single thread (OoO-Morphy) and in-order with 4 threads (IO-Morphy).

The implementations of out-of-order execution in OoO-Morphy and OoO-Fixed are the same, except OoO-Morphy requires the ability to switch between out-of-order and in-order modes. Likewise, the implementations of in-order execution in IO-Morphy and IO-Fixed are the same except for the ability to switch modes.

Answer the following:

A) [7 pts] The *peak single-threaded performance* of OoO-Morphy mode **could be** less than the *peak single-thread performance* of OoO-Fixed.

CIRCLE ONE: **TRUE** **FALSE**

Why? Explain your reasoning.

True, the OoO-Morphy may have a slower peak frequency due to extra logic for morphing.

B) [7 pts] Imagine a heterogeneous multicore system *Fixed* with 12 IO-Fixed cores and 1 OoO-Fixed core. Imagine a homogeneous multicore system *Morphy* with four Morphy cores.

Suppose we want to accelerate critical sections on both systems using an OoO core.

Could the same critical section that is accelerated run faster on System *Fixed* than on System *Morphy*? Why? Explain.

CIRCLE ONE: **YES** **NO**

True, from above, if OoO-Fixed has a higher peak frequency than OoO-Morphy.

Could the same critical section that is accelerated run faster on System *Morphy* than on System *Fixed*? Why? Explain.

CIRCLE ONE: **YES** **NO**

True, due to preservation of cache contents when IO-Morphy changes to OoO-Morphy.