

Worksheet solution: Associativity and Commutativity

Recap:

A binary function f is *associative* if $f(f(x,y),z) = f(x,f(y,z))$.

A binary function f is *commutative* if $f(x,y) = f(y,x)$.

Worksheet problems:

1) Claim: a Finish Accumulator (FA) can only be used with operators that are *associative and commutative*.

Why? What can go wrong with accumulators if the operator is non-associative or non-commutative?

You may get different answers in different executions if the operator is non-associative or non-commutative e.g., an accumulator can be implemented using one “partial accumulator” per processor core.

2) For each of the following functions, indicate if it is associative and/or commutative.

a) $f(x,y) = x+y$, for integers x, y , **is associative and commutative**

b) $g(x,y) = (x+y)/2$, for integers x, y , **is commutative but not associative**

c) $h(s_1,s_2) = \text{concat}(s_1, s_2)$ for strings s_1, s_2 , e.g., $h(\text{“ab”}, \text{“cd”}) = \text{“abcd”}$, **is associative but not commutative**

