

Closed book. 10 minutes. September 23, 2009. Your name _____

1. Given the operators below, fill in the blanks to make the adjoints.

```

subroutine array(op1,op2, adj,add, m,d1,d2) { # ARRAY
logical, parameter, private :: T = .true., F = .false.
  interface {
    integer function op1(adj,add,m,d){ real::m(:),d(:); logical::adj,add }
    integer function op2(adj,add,m,d){ real::m(:),d(:); logical::adj,add }
  }
  logical, intent(in) :: adj, add
  real, dimension(:) :: m,d1,d2
  integer :: st
  if(adj) {
    ..... You fill in below .....

    st = op1( ) # m = m0 + A' d1

    st = op2( ) # m = m + B' d2

    ..... You fill in above .....
  }
  else { st = op1(F, add, m, d1) # d1 = d1 + A m
        st = op2(F, add, m, d2) # d2 = d2 + B m
  } }

subroutine chain2(op1,op2, adj,add, m,d,t1) { # CHAIN 2
logical, parameter, private :: T = .true., F = .false.
  interface {
    integer function op1(adj,add,m,d){ real::m(:),d(:); logical::adj,add }
    integer function op2(adj,add,m,d){ real::m(:),d(:); logical::adj,add }
  }
  logical, intent(in) :: adj, add
  real, dimension(:) :: m,d, t1
  integer :: st
  ..... You fill in below .....

  if(adj) { st = op1( ) # t = A' d

            st = op2( ) # m = B' t = B' A' d

            ..... You fill in above .....
  }
  else { st = op2( F, F, m, t1) # t = B m
        st = op1( F, add, t1,d ) # d = A t = A B m
  } }

```

2. Theoretically, $y = Ax$. You have x_1 and y_1 filled with random numbers. You have a program **A** to compute $y_2 = Ax_1$ and another program **B** to compute $x_2 = By_1$. You hope that you coded **B** so that it is the adjoint of **A**. What computation do you do to see if actually $B = A'$?