ECE 30862 Fall 2018, Test 3

DO NOT START WORKING ON THIS UNTIL TOLD TO DO SO. LEAVE IT ON THE DESK.

THE LAST PAGE IS THE ANSWER SHEET. TEAR IT OFF AND PUT ALL ANSWERS THERE. TURN IN BOTH PARTS OF THE TEST WHEN FINISHED.

You have until 9:00 to take this exam. The total number of points should be 100, including 2 points for putting your name on the answer sheet – SO PUT YOUR NAME ON IT! Most questions are worth two points – those that are not are indicatd on the question and on the answer sheet. After taking the test turn in both the test and the answer sheet *and put your name on both of them!*. You should remove the answer sheet from the rest of the test when taking it.

Your exam should have 13 (ten) pages total (including this cover page, one almost entirely blank page, and the answer sheet). As soon as the test begins, check that your exam is complete and *let a proctor know immediately if it is not.*

This exam is open book, open notes, but absolutely no electronics. If you have a question, please ask for clarification. If the question is not resolved, state on the test whatever assumptions you need to make to answer the question, and answer it under those assumptions. *Check the front board occasionally for corrections.*

Programs may be given without "#include" statements, and without "std::" for brevity, and to allow them to fit on a page. Assume these are present where needed.

For questions that are in comments at the ends of lines, e.g., "foo( ); // Q23", you should:

- Answer what is printed if something is printed;

- if nothing is printed and the statement is legal at both compile time and at runtime answer "Ok";

- and if nothing is printed by the statement gives either a compile time or runtime error, answer "Error", "Err" or something similar. *If the statement is an error, answer questions on following lines in the program as if the statement did not exist in the program.*

I have neither given nor received help during this exam from any other person or electronic source, and I understand that if I have I will be guilty of cheating and will fail the exam and perhaps the course.

Name (signed):

Name (printed):

Last four digits of your ID:

The code on this, and the facing page (page 3), is all one program. It is used for C++ questions 1 - 15, found in the code on the facing page.

```cpp
// A.h
class A {
public:
   A(int);
   virtual ~A( );
   static void f1( );
   virtual void f2( );
   void f3( );
   void f4( );
   int val;
private:
   virtual void f5( );
};

// A.cpp
A::A(int i) {val = i;}

A::~A( ) { }

void A::f1( ) {std::cout << "A::f1" << std::endl;}

void A::f2( ) {std::cout << "A::f2" << std::endl;}

void A::f3( ) {std::cout << "A::f3" << std::endl;}

void A::f4( ) {
   std::cout << "A::f4" << std::endl;
   f5( );
}

int val;

void A::f5( ) {std::cout << "A::f5" << std::endl;}
```

```cpp
// B.h
class B : public A {
public:
   B(int);
   virtual ~B( );
   static void f1( );
   virtual void f2( );
   void f3( );
   void f6( );
   int val;
private:
   virtual void f5( );
};

// B.cpp
B::B(int i) : A(0) {val = i;}

B::~B( ) { }

void B::f1( ) {std::cout << "B::f1" << std::endl;}

void B::f2( ) {std::cout << "B::f2" << std::endl;}

void B::f3( ) {std::cout << "B::f3" << std::endl;}

void B::f6( ) {std::cout << "B::f6" << std::endl;}

void B::f5( ) {std::cout << "B::f5" << std::endl;}
```

```
// C.h
class C : public virtual A {
public:
   C( );
   virtual ~C( );
};

// C.cpp
C::C( ) : A(3) {
   std::cout << "C( )" << std::endl;
}

C::~C( ) { }

// main.cpp
int main (int argc, char *argv[]) {

   A* aP = new B(2);
   B b(2);
   A& aR = *aP;
   A a = b;

   aP->f4( ); // Q1
   aP->f1( ); // Q2
   aP->f2( ); // Q3
   aP->f3( ); // Q4
   aP->f5( ); // Q5
   aP->f6( ); // Q6
   std::cout << aP->val << std::endl; // Q7

   aR.f4( ); // Q8
   aR.f1( ); // Q9
   aR.f2( ); // Q10
   aR.f3( ); // Q11

   a.f4( ); // Q12
   a.f1( ); // Q13
   a.f2( ); // Q14
   a.f3( ); // Q15
}
```

The code below is used for **C++** questions 16 - 21.

```cpp
// A.h
class A {
public:
    A(int);
    A( );
    virtual ~A( );
    int val;
};

// A.cpp
A::A(int i) {
    std::cout << "A(" << i << ")" << std::endl;
    val = i;
}
A::~A( ) { }

// B.h
class B : public virtual A {
public:
    B( );
    virtual ~B( );
};

// B.cpp
B::B( ) : A(2) {
    std::cout << "B( )" << std::endl;
}

B::~B( ) { }

// C.h
class C : public virtual A {
public:
    C( );
    virtual ~C( );
};
```

```cpp
// C.cpp
C::C( ) : A(3) {
    std::cout << "C( )" << std::endl;
}

C::~C( ) { }

// D.h
class D : public C, public B {
public:
    D( );
    virtual ~D( );
};

// D.cpp
D::D( ) : C( ), B( ), A(4)  {
    std::cout << "D( )" << std::endl;
}

D::~D( ) { }

// main.cpp
int main (int argc, char *argv[]) {

    A* aP = new A(1); // Q16 (1pt)
    C* cP = new C( ); // Q17 (1pt)
    D* dP = new D( ); // Q18 (1pt)

    std::cout << aP->val << std::endl; // Q19 (1pt)
    std::cout << cP->val << std::endl; // Q20 (1pt)
    std::cout << dP->val << std::endl; // Q21 (1pt)

}
```

The code below is used for **C++** questions 22 - 24.

```
// Vector.h
template <class T> class Vector {
public:
   Vector(int i) {
      vec = new T*[i];
      size = i;
      next = 0;
   }

   Vector( ) {
      vec = new T*[10]; // allocate array of ptrs.
      size = 10;
      next = 0;
   }

   ~Vector( ) { }

   void put(T* v) {
      if (next < size) vec[next++] = v;
   }

   T* get(int i) {
      if (i < next) return vec[i];
   }

private:
   T** vec;
   int next;
   int size;
};
```

```
// A.h
class A {
public:
   A( );
   virtual ~A( );
};

// A.cpp
A::A() { }
A::~A( ) { }

// B.h
class B {
public:
   B( );
   virtual ~B( );
};

// B.cpp
B::B() { }
B::~B( ) { }

// main.cpp
int main (int argc, char *argv[]) {
   Vector<A>* va = new Vector<A>(10);
   Vector<B>* vb = new Vector<B>(10);

   va->put(new A( )); // Q22
   vb->put(new A( )); // Q23

   va = vb; // Q24
}
```

The code below is used for **C++** questions 25 - 26.

```cpp
// A.h
class A {
public:
    A( );
    A(int);
    virtual ~A( );
};

// A.cpp
A::A() { }
A::A(int i) { }
A::~A( ) { }

// main.cpp
void foo(int i, float f) {
    std::cout << "if" << std::endl; //
}

void foo(A a, A b) {
    std::cout << "ab" << std::endl; //
}

int main (int argc, char *argv[]) {

    int i;
    short s;
    float f;
    A a;
    double d;

    foo(s, d); // Q25
    foo(a, (A) i); // Q26
}
```

The code below is used for **Java** questions 27 - 30.

```java
class A {

    public A( ) {val = 2;}

    public void f(A a, int i) {
        a.val = 0;
        val = -1;
        a = null;
        i = 0;
    }

    public int val;
}
class Main {

    public static void main(String args[]) throws Exception {

        A aR = new A( );
        A aaR = new A( );
        int i = 50;

        aaR.f(aR, i);
        System.out.println(aR.val); // Q27
        System.out.println(aaR.val); // Q28
        if (aR == null) System.out.println("null"); // Q29
        System.out.println(i); // Q30
    }
}
```

```
class E1 extends Exception {

   public E1( ) { }

}
class E2 extends E1 {

   public E2( ) { }

}
class Main {

   static void bar(int i) throws E1, E2 {
      if (i > 0) throw new E1( );
      throw new E2( );
   }

   static void foo(int i) throws E1, E2 {
      try {
         bar(i);
      } catch (E2 e2) {
         System.out.println("foo 2");
         throw new E1( );
      } catch (E1 e1) {
         System.out.println("foo 1");
         throw new E2( );
      } finally {System.out.println("foo f");}
   }


   public static void main(String args[]) throws Exception {

      // Q31 -- everything printed in the try catch.  Worth 4 points
      try {
         foo(1);
      } catch (E2 e2) {
         System.out.println("2");
      } catch (E1 e1) {
         System.out.println("1");
      } finally {System.out.println("f1");}


      // Q32 -- everything printed in the try catch.  Worth 4 points
      try {
         foo(-1);
      } catch (E2 e2) {
         System.out.println("2");
      } catch (E1 e1) {
         System.out.println("1");
      } finally {System.out.println("f2");}
   }
}
```

This page contains Java questions Q31 and Q32.

The code below is used for **Java** questions 33 - 35.

```
class A {
    public int val = 0;
    public A( ) { }
}
class D implements Runnable {
    public static A[ ] a;
    public static int cnt = 0;
    public static int s = 0;
    public int i;
    public int tid;

    public D( ) {
        if (a == null) {
            a = new A[2];
            a[0] = new A( );
            a[1] = a[0];
        }
        tid = cnt++;
    }

    public synchronized void run( ) {
        a[tid].val = tid;
        s = tid;            // LINE A, 4 pts
        i = tid;            // LINE B, 4 pts
    }
}
```

```
class Main {

    public static void main(String args[])
    throws Exception {

        D d1 = new D( );
        D d2 = new D( );
        Thread t1 = new Thread(d1);
        Thread t2 = new Thread(d2);
        t1.start( );
        t2.start( );
        t1.join( ); // LINE C
        t2.join( ); // LINE D
    }
}
```

Q33: (4 pts) Is there a race on LINE A in method **run** in class **D**? Answer yes or no.

Q34: (4 pts) Is there a race on LINE B in method **run** in class **D**? Answer yes or no.

Q35: (4 pts) If LINE C and LINE D in method Main in class Main were removed, could the thread running Main terminate before the thread referenced by t2? Answer yes or no.

The code below is used for **Java** questions 36 - 39.

```java
class C1 implements Cloneable {
   C1( ) {
      ary = new int[2];
      ary[0] = 0; ary[1] = 0;
      System.out.println("C1( )");
   }
   public int[ ] ary;
}
class C2 implements Cloneable {
   C2( ) {
      ary = new int[2];
      ary[0] = 0; ary[1] = 0;
      System.out.println("C2( )");
   }

   public Object clone( )
   throws CloneNotSupportedException {
      System.out.println("C2 C");
      C2 rc1 = (C2) super.clone( );
      return rc1;
   }

   public int[ ] ary;
}
```

```java
class C3 implements Cloneable {
   C3( ) {
      ary = new int[2];
      ary[0] = 0; ary[1] = 0;
      System.out.println("C3( )");
   }

   public Object clone( )
   throws CloneNotSupportedException {
      System.out.println("C3 C");
      C3 rc1 = (C3) super.clone( );
      rc1.ary = new int[2];
      ary[0] = 0; ary[1] = 1;
      return rc1;
   }

   public int[ ] ary;
}
class Main {

   public static void main(String args[])
   throws Exception {

      C1 c1 = new C1( );
      C2 c2 = new C2( );
      C3 c3 = new C3( );

      C1 c1New = c1; C2 c2New = c2; C3 c3New = c3;
      c1New = (C1) c1.clone( ); // Q36
      c2New = (C2) c2.clone( ); // Q37
      c3New = (C3) c3.clone( );

      c2.ary[0] = 100; c3.ary[0] = 100;

      System.out.println(c2New.ary[0]); // Q38
      System.out.println(c3New.ary[0]); // Q39
   }
}
```

The code below is used for **Java** questions 40 - 47.

```java
class A {

    public A(int i) {val = i;}

    public static void f1( ) {
        System.out.println("A::f1");
    }

    public void f2( ) {
        System.out.println("A::f2");
    }

    public void f3( ) {
        System.out.println("A::f3");
    }

    public void f4( ) {
        System.out.println("A::f4");
        f5( );
    }


    private void f5( ) {
        System.out.println("A::f5");
    }

    public int val;

}
class B extends A {

    public B(int i) {super(0); val = i;}

    public static void f1( ) {System.out.println("B::f1");}

    public void f2( ) {System.out.println("B::f2");}

    public void f3( ) {System.out.println("B::f3");}

    public void f6( ) {System.out.println("B::f6");}

    private void f5( ) {System.out.println("B::f5");}

}
```

```java
class Main {

    public static void main(String args[])
    throws Exception {

        A a = new B(2);

        a.f4( ); // Q40
        a.f1( ); // Q41
        a.f2( ); // Q42
        a.f3( ); // Q43
        a.f5( ); // Q44
        a.f6( ); // Q45
        System.out.println(a.val); // Q46

        a = new A(1);
        System.out.println(a.val); // Q47
    }
}
```

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Fall 2018 Third Exam Answer Sheet – print your name on this sheet – IT IS WORTH 2 POINTS!

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

15.

16. (1pt)

17. (1pt)

18. (1pt)

19. (1pt)

20. (1pt)

21. (1pt)

22.

23.

24.

25.

26.

27.

28.

29.

30.

31. (4pt)

32. (4pt)

33. (4 pt)

34. (4 pt)

35. (4 pt)

36.

37.

38.

39.

40.

41.

42.

43.

44.

45.

46.

47.