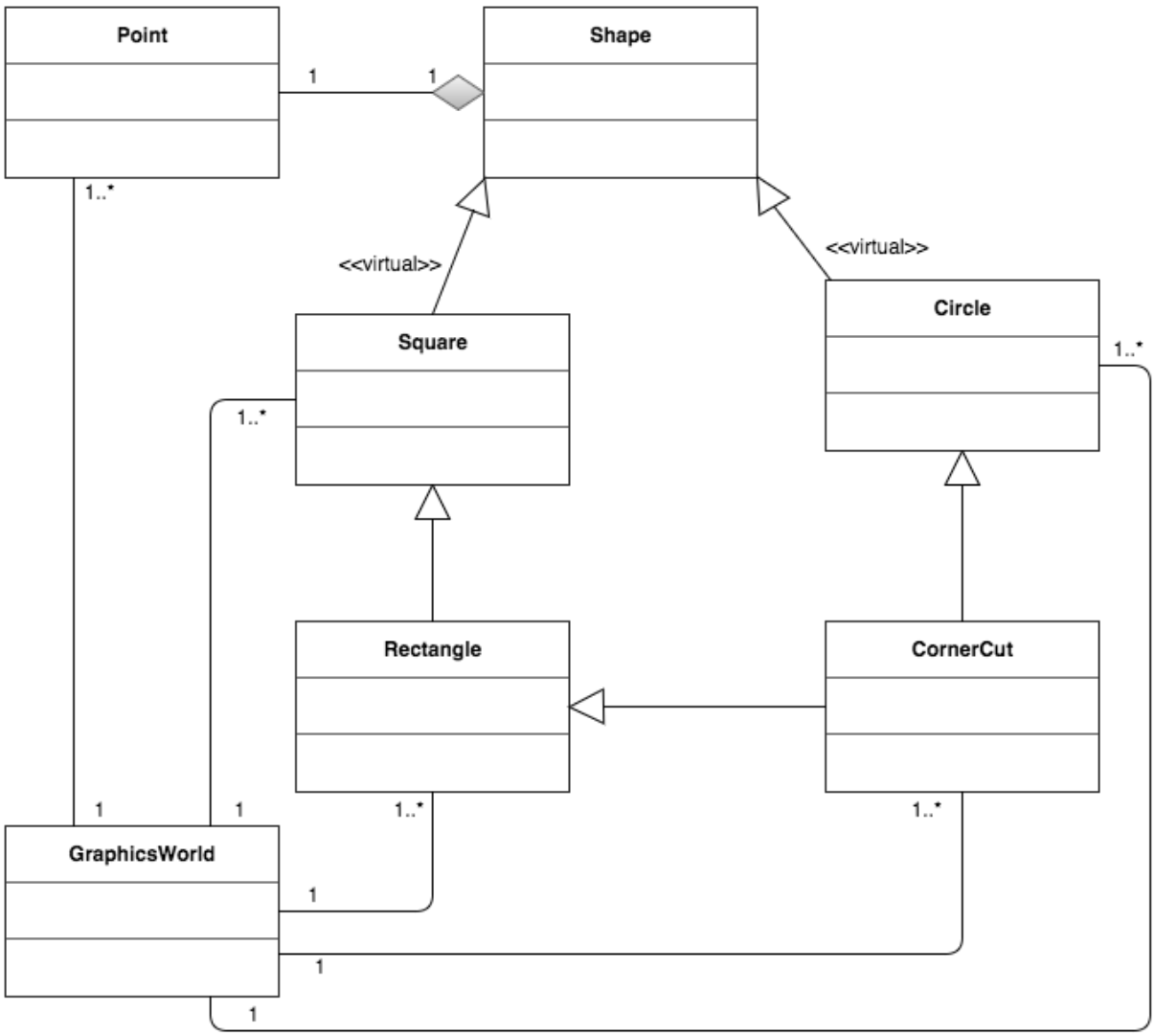
Course: Principals of Software Development – ENSF 409
Lab 9
Instructor: M. Moshirpour
Student Name: Mitchell Sawatzky
Date Submitted: March 28, 2016

Exercise B



Output for Part I:

```
This program has been written by: Mitchell Sawatzky.
Submitted at: 12:00 am, March 27 , 2016

Testing Functions in class Point:
  X-coordinate: 6
  Y-coordinate: 8
  X-coordinate: 9
  Y-coordinate: 8

The distance between two points m and n is: 3
Testing Functions in class Square:
  Square Name: SQUARE - S
```

```
  X-coordinate: 5
  Y-coordinate: 7
the area of SQUARE - S is: 144
the perimeter of SQUARE - S is: 48

Testing Functions in class Rectangle:
  Rectangle Name: RECTANGLE A
  X-coordinate: 5
  Y-coordinate: 7
  Rectangle Name: RECTANGLE B
  X-coordinate: 16
  Y-coordinate: 7
the area of RECTANGLE A is: 180
the perimeter of RECTANGLE A is: 54

The distance between two rectangles is: 11
Testing copy constructor in class Rectangle:
  Rectangle Name: RECTANGLE A
  X-coordinate: 5
  Y-coordinate: 7

Testing assignment operator in class Rectangle:
  Rectangle Name: RECTANGLE A
  X-coordinate: 5
  Y-coordinate: 7

Testing Functions in class Circle:
  Circle Name: CIRCLE C
  X-coordinate: 3
  Y-coordinate: 5
the area of CIRCLE C is: 254.47
the perimeter of CIRCLE C is: 56.5488

The distance between rectangle a and circle c is: 2.82843
```

Output for Part II:

```
This program has been written by: Mitchell Sawatzky.
Submitted at: 12:00 am, March 27 , 2016

Testing Functions in class Point:
  X-coordinate: 6
  Y-coordinate: 8
  X-coordinate: 9
```

```
  Y-coordinate: 8

The distance between two points m and n is: 3
Testing Functions in class Square:
  Square Name: SQUARE - S
  X-coordinate: 5
  Y-coordinate: 7
the area of SQUARE - S is: 144
the perimeter of SQUARE - S is: 48

Testing Functions in class Rectangle:
  Rectangle Name: RECTANGLE A
  X-coordinate: 5
  Y-coordinate: 7
  Rectangle Name: RECTANGLE B
  X-coordinate: 16
  Y-coordinate: 7
the area of RECTANGLE A is: 180
the perimeter of RECTANGLE A is: 54

The distance between two rectangles is: 11
Testing copy constructor in class Rectangle:
  Rectangle Name: RECTANGLE A
  X-coordinate: 5
  Y-coordinate: 7

Testing assignment operator in class Rectangle:
  Rectangle Name: RECTANGLE A
  X-coordinate: 5
  Y-coordinate: 7

Testing Functions in class Circle:
  Circle Name: CIRCLE C
  X-coordinate: 3
  Y-coordinate: 5
the area of CIRCLE C is: 254.47
the perimeter of CIRCLE C is: 56.5488

The distance between rectangle a and circle c is: 2.82843  CornerCut Name: CornerCut rc
  X-coordinate: 6
  Y-coordinate: 5
  Width: 10
```

```
  Length: 12
  Radius of the cut: 9
the area of CornerCut rc is: 56.3826the perimeter of CornerCut rc is: 40.1372
The distance between rc and c is: 3  Shape Name: SQUARE - S
  X-coordinate: 5
  Y-coordinate: 7

the area of SQUARE - Sis: 144
the perimeter of SQUARE - S is: 48  Shape Name: RECTANGLE A
  X-coordinate: 5
  Y-coordinate: 7

the area of RECTANGLE Ais: 180
the perimeter of SQUARE - S is: 54  Shape Name: CIRCLE C
  X-coordinate: 3
  Y-coordinate: 5

the area of CIRCLE Cis: 254.47
the circumference of CIRCLE C is: 56.5488  Shape Name: CornerCut rc
  X-coordinate: 6
  Y-coordinate: 5

the area of CornerCut rcis: 56.3826
the perimeter of CornerCut rc is: 40.1372
Testing copy constructor in class CornerCut:
  CornerCut Name: CornerCut rc
  X-coordinate: 6
  Y-coordinate: 5
  Width: 10
  Length: 12
  Radius of the cut: 9

Testing assignment operator in class CornerCut:
  CornerCut Name: CornerCut cc2
  X-coordinate: 2
  Y-coordinate: 5
  Width: 12
  Length: 100
  Radius of the cut: 9
  CornerCut Name: CornerCut rc
  X-coordinate: 6
  Y-coordinate: 5
```

```
          Width: 10
          Length: 12
          Radius of the cut: 9
```

circle.cpp

```
// File: circle.cpp
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#include "circle.h"
#include <iostream>
using namespace std;

Circle::Circle (double x, double y, double radius, const char* name)
: Shape(x, y, name) {
    this->radius = radius;
}

double Circle::area () {
    return M_PI * radius * radius;
}

double Circle::perimeter () {
    return 2 * M_PI * radius;
}

double Circle::getRadius () {
    return radius;
}

void Circle::setRadius (double radius) {
    this->radius = radius;
}

void Circle::display () {
    cout << "  Circle Name: " << getName() << endl;
    getOrigin().display();
}
```

circle.h

```
// File: circle.h
```

```
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#ifndef CIRCLE_H
#define CIRCLE_H
#include "shape.h"

const double M_PI = 3.1416;

class Circle: virtual public Shape {
public:
    Circle (double x, double y, double radius, const char* name);

    // PROMISES: Calculate the area of the shape and return it
    double area ();

    // PROMISES: Calculate the area of the shape and return it
    double perimeter ();

    // PROMISES: Gets the radius and returns it
    double getRadius ();

    // PROMISES: Sets the radius to the new value
    void setRadius (double radius);

    // PROMISES: Outputs shape data to stdout
    void display ();
private:
    double radius;
};

#endif
```

cornerCut.cpp

```
// File: cornerCut.cpp
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#include "cornerCut.h"
#include <iostream>
```

```
using namespace std;

CornerCut::CornerCut (double x, double y, double sideA, double sideB, double radius, const char* name)
: Circle(x, y, radius, name), Rectangle(x, y, sideA, sideB, name), Shape(x, y, name) {
    if (radius > sideA || radius > sideB) {
        cerr << "Error: Cannot create a CornerCut object with radius larger than width" << endl;
        exit(1);
    }
}

double CornerCut::area () {
    return Rectangle::area() - (0.25 * Circle::area());
}

double CornerCut::perimeter () {
    return Rectangle::perimeter() - (2 * getRadius()) + (0.25 * Circle::perimeter());
}

void CornerCut::display () {
    cout << "  CornerCut Name: " << Circle::getName() << endl;
    Circle::getOrigin().display();
    if (getSideA() >= getSideB()) {
        cout << "  Width: " << getSideB() << endl;
        cout << "  Length: " << getSideA() << endl;
    } else {
        cout << "  Width: " << getSideA() << endl;
        cout << "  Length: " << getSideB() << endl;
    }
    cout << "  Radius of the cut: " << getRadius() << endl;
}
```

cornerCut.h

```
// File: cornerCut.h
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#ifndef CORNERCUT_H
#define CORNERCUT_H

#include "circle.h"
#include "rectangle.h"
```

```
class CornerCut : public Circle, public Rectangle {
public:
    CornerCut (double x, double y, double sideA, double sideB, double radius, const char* name);

    // PROMISES: Calculates the area of the shape
    double area ();

    // PROMISES: Calculates the perimeter of the shape
    double perimeter ();

    // PROMISES: Outputs the shape data to stdout
    void display ();
};

#endif
```

graphicWorld.cpp

```
// File: graphicsWorld.cpp
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#include "rectangle.h"
#include "square.h"
#include "circle.h"
#include "cornerCut.h"
#include <iostream>
using namespace std;

class GraphicsWorld {
public:
    void run() {
        //================================== PART 1 ==========================================
        cout << "\nThis program has been written by: Mitchell Sawatzky." ;
        cout << "\nSubmitted at: 12:00 am, March 27 , 2016\n";
        cout << "\nTesting Functions in class Point:" <<endl;
        Point m (6, 8);
        Point n (6,8);
        n.setX(9);
        m.display();
        n.display();
```

```
        cout << "\nThe distance between two points m and n is: " << m.distance(n);
        // Testing the second version of the function distance.
        // Put the necessary code in this place
        cout << "\nTesting Functions in class Square:" <<endl;
        Square s(5, 7, 12, "SQUARE - S");
        s.display();
        cout << "the area of " << s.getName() <<" is: "<< s.area() << "\n";
        cout << "the perimeter of " << s.getName() <<" is: " << s.perimeter() << "\n";
        cout << "\nTesting Functions in class Rectangle:" <<endl;
        Rectangle a(5, 7, 12, 15, "RECTANGLE A");
        a.display();
        Rectangle b(16 , 7, 8, 9, "RECTANGLE B");
        b.display();
        cout << "the area of " << a.getName() <<" is: "<< a.area() << "\n";
        cout << "the perimeter of " << a.getName() <<" is: "<< a.perimeter() << "\n";
        double d = a.distance(b);
        cout << "\nThe distance between two rectangles is: " <<d;
        cout << "\nTesting copy constructor in class Rectangle:" <<endl;
        Rectangle rec1 = a;
        rec1.display();
        cout << "\nTesting assignment operator in class Rectangle:" <<endl;
        Rectangle rec2 (3, 4, 11, 7, "RECTANGLE rec2");
        rec2 = a;
        rec2.display();
        cout << "\nTesting Functions in class Circle:" <<endl;
        Circle c (3, 5, 9, "CIRCLE C");
        c.display();
        cout << "the area of " << c.getName() <<" is: "<< c.area() << endl;
        cout << "the perimeter of " << c.getName() << " is: "<< c.perimeter() << endl;
        d = a.distance(c);
        cout << "\nThe distance between rectangle a and circle c is: " <<d;
        // ================================== PART 2 ==========================================
        CornerCut rc (6, 5, 10, 12, 9, "CornerCut rc");
        rc.display();
        cout << "the area of " << rc.getName() <<" is: "<< rc.area();
        cout << "the perimeter of " << rc.getName() << " is: "<< rc.perimeter();
        d = rc.distance(c);
        cout << "\nThe distance between rc and c is: " <<d;
        // Using array of Shape pointers:
        Shape* sh[4];
        sh[0] = &s;
        sh[1] = &a;
```

```
        sh [2] = &c;
        sh [3] = &rc;
        sh[0]->display();
        cout << "\nthe area of " << sh[0]->getName() << "is: " << dynamic_cast<Square*>(sh[0])->area();
        cout << "\nthe perimeter of " << sh[0]->getName() << " is: " << dynamic_cast<Square*>(sh[0])-
>perimeter();
        sh[1]->display();
        cout << "\nthe area of "<< sh[1]->getName() << "is: " << dynamic_cast<Rectangle*>(sh[1])->area();
        cout << "\nthe perimeter of " << sh[0]->getName() << " is: " << dynamic_cast<Rectangle*>(sh[1])-
>perimeter();
        sh[2]->display();
        cout << "\nthe area of " << sh[2]->getName() << "is: " << dynamic_cast<Circle*>(sh[2])->area();
        cout << "\nthe circumference of " << sh[2]->getName() << " is: " << dynamic_cast<Circle*>(sh[2])-
>perimeter();
        sh[3]->display();
        cout << "\nthe area of " << sh[3]->getName() << "is: " << dynamic_cast<CornerCut*>(sh[3])->area();
        cout << "\nthe perimeter of " << sh[3]->getName() << " is: " << dynamic_cast<CornerCut*>(sh[3])-
>perimeter();
        cout << "\nTesting copy constructor in class CornerCut:" <<endl;
        CornerCut cc = rc;
        cc.display();
        cout << "\nTesting assignment operator in class CornerCut:" <<endl;
        CornerCut cc2(2, 5, 100, 12, 9, "CornerCut cc2");
        cc2.display();
        cc2 = cc;
        cc2.display();
    }
};

int main () {
    GraphicsWorld gw;
    gw.run();
    return 0;
}
```

point.cpp

```
// File: point.cpp
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#include "point.h"
#include <iostream>
```

```
#include <cmath>
using namespace std;

int Point::idIndex = 1001;
int Point::objectCount = 0;

Point::Point (double x, double y) {
    this->x = x;
    this->y = y;
    this->id = Point::idIndex;
    Point::objectCount++;
    Point::idIndex++;
}

Point::~Point () {
    Point::objectCount--;
}

void Point::display () const {
    cout << "  X-coordinate: " << this->x << endl;
    cout << "  Y-coordinate: " << this->y << endl;
}

double Point::getX () const {
    return this->x;
}

double Point::getY () const {
    return this->y;
}

double Point::getID () const {
    return this->id;
}

void Point::setX (double x) {
    this->x = x;
}

void Point::setY (double y) {
    this->y = y;
}
```

```
int Point::counter () {
    return Point::objectCount;
}

double Point::distance (const Point& other) const {
    return sqrt(pow(other.getX() - getX(), 2) + pow(other.getY() - getY(), 2));
}

double Point::distance (const Point& a, const Point& b) {
    return sqrt(pow(b.getX() - a.getX(), 2) + pow(b.getY() - a.getY(), 2));
}
```

point.h

```
// File: point.h
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#ifndef POINT_H
#define POINT_H

class Point {
public:
    Point (double x, double y);
    ~Point ();

    // PROMISES: Outputs point data to stdout
    void display () const;

    // PROMISES: Gets the x coordinate
    double getX () const;

    // PROMISES: Gets the Y coordinate
    double getY () const;

    // PROMISES: Gets the ID of the object
    double getID () const;

    // PROMISES: Sets the x coordinate to the new value
    void setX (double x);
```

```
    // PROMISES: Sets the y coordinate to the new value
    void setY (double y);

    // PROMISES: Calculates the distance between this object and another
    double distance (const Point& other) const;

    // PROMISES: Calculates the distance between two objects
    static double distance (const Point& a, const Point& b);

    // PROMISES: Returns the total number of point objects in memory
    static int counter ();
private:
    double x;
    double y;
    int id;
    static int idIndex;
    static int objectCount;
};

#endif
```

rectangle.cpp

```
// File: rectangle.cpp
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#include "rectangle.h"
#include <iostream>
using namespace std;

Rectangle::Rectangle (double x, double y, double side_a, double side_b, const char* name)
: Square(x, y, side_a, name), Shape(x, y, name) {
    this->side_b = side_b;
}

double Rectangle::area () {
    return side_b * getSideA();
}

double Rectangle::perimeter () {
    return (2 * side_b) + (2 * getSideA());
```

```
}

double Rectangle::getSideB () {
    return side_b;
}

void Rectangle::setSideB (double b) {
    side_b = b;
}

void Rectangle::display () {
    cout << "  Rectangle Name: " << getName() << endl;
    getOrigin().display();
}
```

rectangle.h

```
// File: rectangle.h
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#ifndef RECTANGLE_H
#define RECTANGLE_H
#include "square.h"

class Rectangle: public Square {
public:
    Rectangle (double x, double y, double side_a, double side_b, const char* name);

    // PROMISES: Calculates the area of the shape
    double area ();

    // PROMISES: Calculates the perimeter of the shape
    double perimeter ();

    // PROMISES: Gets the side_b of the shaep
    double getSideB ();

    // PROMISES: Sets side_b to the new value
    void setSideB (double b);

    // PROMISES: Outputs the shape data to stdout
```

```
    void display ();
private:
    double side_b;
};

#endif
```

shape.cpp

```
// File: shape.cpp
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#include "shape.h"
#include "point.h"
#include <iostream>
using namespace std;

Shape::Shape (double x, double y, const char* name) : origin(x, y) {
    shapeName = new char[strlen(name) + 1];
    strcpy(shapeName, name);
}

Shape::Shape (const Shape& src) : origin(src.getOrigin().getX(), src.getOrigin().getY()) {
    shapeName = new char[strlen(src.getName()) + 1];
    strcpy(shapeName, src.getName());
}

Shape::~Shape () {
    delete [] shapeName;
}

Shape& Shape::operator= (const Shape& rhs) {
    if (this != &rhs) {
        if (shapeName) {
            delete [] shapeName;
        }
        origin = Point(rhs.getOrigin().getX(), rhs.getOrigin().getY());
        shapeName = new char[strlen(rhs.getName()) + 1];
        strcpy(shapeName, rhs.getName());
    }
    return *this;
```

```
}

const Point& Shape::getOrigin () const {
    return origin;
}

char* Shape::getName () const {
    return shapeName;
}

void Shape::display () const {
    cout << "  Shape Name: " << shapeName << endl;
    origin.display();
}

double Shape::distance (Shape& other) {
    return Point::distance(origin, other.getOrigin());
}

double Shape::distance (Shape& the_shape, Shape& other) {
    return Point::distance(the_shape.getOrigin(), other.getOrigin());
}

void Shape::move (double dx, double dy) {
    origin.setX(origin.getX() + dx);
    origin.setY(origin.getY() + dy);
}
```

shape.h

```
// File: shape.h
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#ifndef SHAPE_H
#define SHAPE_H
#include "point.h"

class Shape {
public:
    Shape (double x, double y, const char* name);
    Shape (const Shape& src);
```

```
    ~Shape ();
    Shape& operator= (const Shape& rhs);

    // PROMISES: Gets the origin point
    const Point& getOrigin () const;

    // PROMISES: Gets the name of the shape
    char* getName () const;

    // PROMISES: Outputs shape data to stdout
    virtual void display () const;

    // PROMISES: Calculates the distance between the shape and another shape
    double distance (Shape& other);

    // PROMISES: Calculates the distance between the shape and another shape
    static double distance (Shape& the_shape, Shape& other);

    // PROMISES: Moves the shape by dx and dy
    void move (double dx, double dy);
private:
    Point origin;
    char* shapeName;
};

#endif
```

square.cpp

```
// File: square.cpp
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#include "square.h"
#include <iostream>
using namespace std;

Square::Square (double x, double y, double side, const char* name)
: Shape(x, y, name) {
    side_a = side;
}
```

```
double Square::area () {
    return side_a * side_a;
}

double Square::perimeter () {
    return 4 * side_a;
}

double Square::getSideA () {
    return side_a;
}

void Square::setSideA (double side) {
    side_a = side;
}

void Square::display () {
    cout << "  Square Name: " << getName() << endl;
    getOrigin().display();
}
```

square.h

```
// File: square.h
// Author: Mitchell Sawatzky
// Date: March 27, 2016
// Class: ENSF 409

#ifndef SQUARE_H
#define SQUARE_H
#include "shape.h"

class Square: virtual public Shape {
public:
    Square (double x, double y, double side, const char* name);

    // PROMISES: Calculates the area of the shape
    virtual double area ();

    // PROMISES: Calculates the perimeter of the shape
    virtual double perimeter ();

    // PROMISES: Gets the side_a of the shape
```

```
    double getSideA ();

    // PROMISES: Sets the side_a of the shape to the new value
    void setSideA (double side);

    // PROMISES: Outputs the shape data to stdout
    virtual void display ();
private:
    double side_a;
};

#endif
```