

Instructions

- Before you begin, make certain that you have one exam with 18 pages.
- All solutions must be placed in this exam.
- If you need more space for an answer, you may be writing too much. Regardless, you may use the blank pages at the end of this booklet for overflow answers – clearly indicate if you did this in the question.
- A Processing reference and multiple squares of 100 by 100 graph paper for rough work are provided on a separate sheet.
- Processing defaults: 100 by 100 canvas size, light grey background, white fill, black stroke, 1 pixel strokeWeight, ROUND strokeCap, SQUARE strokeJoin, CORNER rectMode, CENTER ellipseMode.

CS106 W'18 Midterm Exam

University of Waterloo

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Wednesday

February 28, 2018

7:00 p.m. – 8:50 p.m.

(110 minutes)

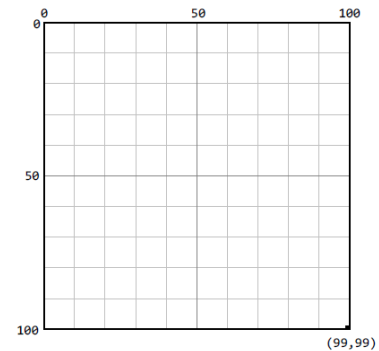
18 pages (including this cover page)

CLOSED BOOK

1) Recap of CS105 [10 marks]

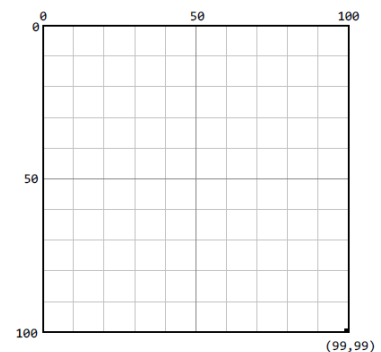
- a) Show what gets drawn in the canvas by the following code. [2 marks]

```
rect(50, 0, 30, 10);  
strokeWeight(4);  
point(20, 80);
```



- b) Show what gets drawn in the canvas by the following code. [2 marks]

```
class Square  
{  
  float x;  
  float y;  
  float wh;  
  
  Square( float xIn, float yIn, float whIn)  
  {  
    x = xIn;  
    y = yIn;  
    wh = whIn;  
  }  
  
  void drawYourself()  
  {  
    rect( x, y, wh, wh);  
  }  
}  
  
void setup() {  
  rectMode(CENTER);  
  Square s1 = new Square(width/2, height/2, 20);  
  s1.drawYourself();  
  Square s2 = new Square(width/2, height/2, 60);  
  s2.drawYourself();  
}
```



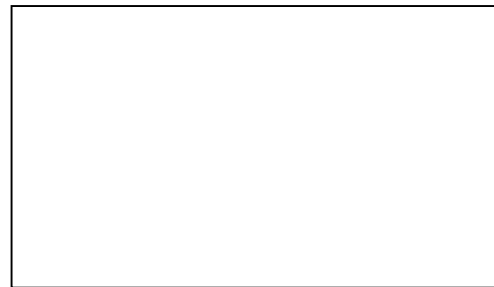
c) What gets printed by the following code? [2 marks]

```
void setup() {  
  int[] a = {60, 30, 10};  
  println(a.length);  
  for (int i=0; i<(a.length - 1); i=i+1) {  
    println(a[i] - a[i+1]);  
  }  
}
```



d) What gets printed by the following code? [2 marks]

```
void setup() {  
  int currentYear = 2018;  
  int birthYear = 1998;  
  int a = 0;  
  a = retire(65, currentYear, birthYear);  
  println(a);  
}  
  
int retire(int r, int cy, int by) {  
  return r - (cy - by);  
}
```



e) What gets printed by the following code? [2 marks]

```
int i = 2;  
  
void setup() {  
  println(i);  
  for (int i=0; i<1; i++) {  
    println(i);  
  }  
  println(i);  
}
```



2) Arrays and Strings [10 marks]

a) What gets printed by the following code? [1 mark]

```
int[] a = { 1, 2, 3};
int[] b = { 4, 5, 6 };
a = b;
b[2] = 100;
println( a[2] + b[2] );
```

b) What gets printed by the following code? [1 mark]

```
int[] arr = new int[5];

for (int i=0; i<arr.length; i++) {
    arr[i] = i;
}

println(arr[4]);
```

c) What gets printed by the following code? [2 marks]

```
int[] arr = {5, 33, 9, 6};
boolean s = true;

for (int i=arr.length; i>1; i--) {
    if (arr[i-1] < arr[i-2]) {
        s = false;
        println(i);
    }
}

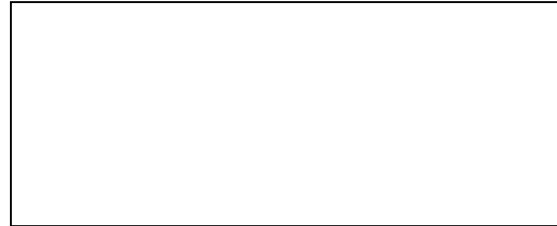
println(s);
```

d) What gets printed by the following code? [1 marks]

```
char[] c1 = {'u', 'w', 'g', 'b', 'd', 'a', '3', '1', '2'};
String s = "";

for (int i=2; i<(c1.length); i++) {
    s = s + c1[i];
}

println(s);
```



e) What gets printed by the following code? [2 marks]

```
void setup() {
    int[] arrKG = {65, 56, 97, 43};
    String[] arrName = {"Addison", "Kerry", "Taylor", "Skye"};
    println(bAthlete(arrKG, arrName));
}

String bAthlete(int[] weights, String[] names) {
    int big = 0;
    for (int i=1; i<names.length; i++) {
        if (weights[i] > weights[big]) {
            big = i;
        }
    }
    println(big);
    return names[big];
}
```



f) What gets printed by the following code? [3 marks]

```
String[] poem = {"I", "love", "coffee", "I", "love", "tea"};

for (int i = 0; i < poem.length-1; i++) {
    for (int j = i+1; j < poem.length; j++) {
        if (poem[i].equals(poem[j])) {
            println(poem[i]);
        }
    }
}
}
```



3) Input and Output [10 marks]

For the following questions assume the file to the right is a text file named "bdays.txt" in the data directory. The file contains a list of people and their birthdays.

```
YEAR, NAME, MONTH, DAY
2000, Joan, April, 15
2001, Peter, January, 2
1999, Ralph, May, 29
2002, Shane, November, 19
2000, Gabi, August, 29
```

a) What gets printed by the following code? [1 mark]

```
void setup() {
  String[] lines = loadStrings( "bdays.txt" );
  String[] row = split(lines[0], ',');
  println(row[0]);
  println(row[1]);
  println(row[2]);
  println(row[3]);
}
```

b) The following code prints out the name of anyone born in 2000. Fill in the blanks. [5 marks]

```
void setup() {
  String[] lines = loadStrings( "bdays.txt" );
  String[] row;

  for (int i=_____ ; _____ ; i++) {
    row = split(_____ )
    if ( _____ ) {
      println( _____ );
    }
  }
}
```

The questions on this page all refer to the code below. Assume "chicken.jpg" is in the data directory and is of size 600x800.

```
PImage img;  
  
void setup() {  
  size( 600, 800 );  
  img = loadImage( "chicken.jpg" );  
}  
  
void draw() {  
}
```

c) What type does the function `loadImage()` return? [1 mark]

d) `loadImage()` has one parameter. What type is that parameter? [1 mark]

e) Add code to the `draw()` above to draw the image to fill the entire sketch window. Show your code here. [1 mark]

f) Add code to the `draw()` function above to draw the image in the middle of the screen at half size. Show your code here. [1 mark]

4) Advanced Shapes [13 marks]

- a) The code below draws the graph below. The data in the array `change` is all positive percentages (i.e. all 12 numbers are between zero and 100). Rewrite the loop so that your loop produces the same graph using the same data but your code must use `beginShape()`, `endShape()`, and `vertex()`. Put your code in the box below. [3 marks]

```
float[] change = {20, 50, 60, 70, 70, 70, 50, 80, 90, 40, 45, 60};  
  
for (int i=1; i<change.length; i++) {  
    line(width/11*(i-1), height-change[i-1], width/11*i, height-change[i]);  
}
```



b) The code below draws something using the three points in the `PVector` array name `pv`. Fill in the blanks so that all three points from the `PVector` are used in the for loop. [2 marks]

```
PVector[] pv = {new PVector(0, 20),
                new PVector(50, 50),
                new PVector(100, 0)};

beginShape();

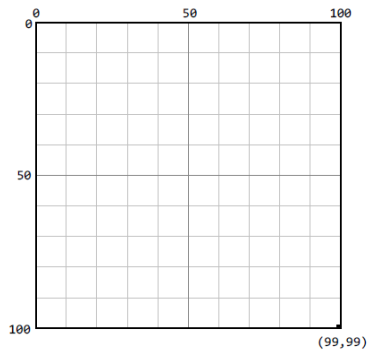
for (int i=0; i<pv.length; i++) {

    vertex(_____);

}

endShape(CLOSE);
```

c) For the above code show what would be drawn. [2 marks]



- d) Write code to draw the screen below. You must use polar coordinates and the function `polar()` is provided to you to convert from polar coordinates to a `PVector`. Starter code is provided. You are to write the entire `draw()` function. The squares have a width and height of 60. The circles have a width and height of 30. The centre of the circles and squares are 200 pixels from the centre of the sketch window. [6 marks]

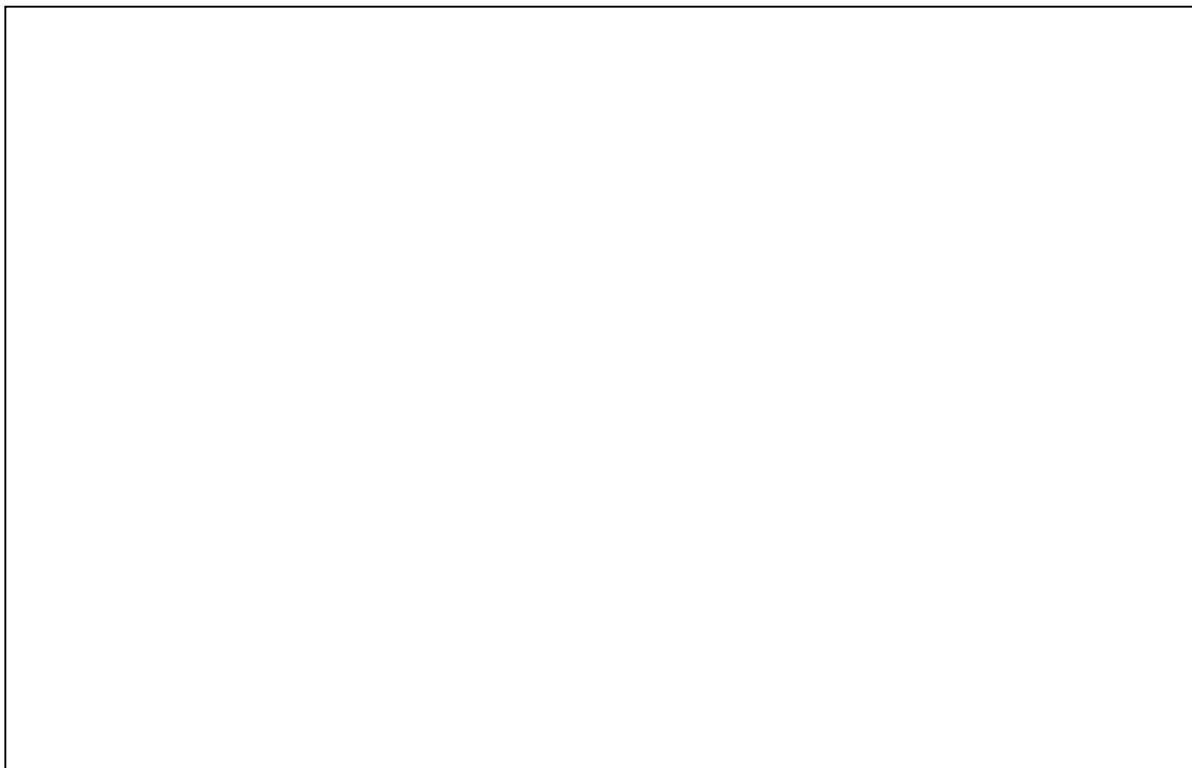
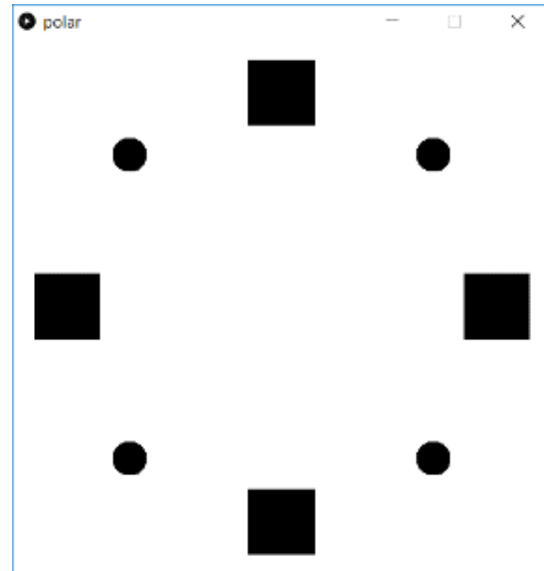
```
float ang = 0;

PVector polar( float r, float theta ){
  float dt = radians( theta );

  float x = r * cos( dt );
  float y = r * sin( dt );

  return new PVector( x, y );
}

void setup(){
  size( 500, 500 );
  background(255);
  fill(0);
  noStroke();
}
```



5) User Interfaces [12 marks]

a) The Model View Controller (MVC) is a commonly used paradigm for describing the components of an interactive program. In the code below:

- Circle the “model” and write the word “model” beside it. [1 mark]
- Circle the “view” and write the word “view” beside it. [1 mark]
- Circle the “controller” and write the word “controller” beside it. [1 mark]

```
float s = 1.0;
int c[] = {10, 20, 25, 30};

void draw() {
    background(127);
    for (int i=0; i<c.length; i++) {
        ellipse(random(width), random(height), s*c[i], s*c[i]);
    }
    noLoop();
}

void keyPressed() {
    s = random(0.5, 1);
    loop();
}
```

In the code below the `draw()` function bounces a ball (i.e. an ellipse) back-and-forth across the screen from left-to-right. We have seen code similar to this in CS105 and CS106.

In the code below the user gains points by pressing the mouse. With each mouse press the user gains between 0-100 points.

```
float x = 1;
float y = height/2;
float speed = 1.0;
float r = 15;
float points = 0;

void draw() {
    background(255, 0, 0);
    ellipse(x, y, r*2, r*2);
    if (x >= width || x <= 0) {
        speed = -speed;
    }
    x = x + speed;
    println(points);
}

void mousePressed() {
    if (dist(mouseX, mouseY, x, y) < r) {
        points += r - dist(mouseX, mouseY, x, y);
    } else if (mouseX > x-r & mouseX < x+r & mouseY > y-r & mouseY < y+r) {
        points += 100;
    }
}
```

b) The code above contains the following hit test: `if (dist(mouseX, mouseY, x, y) < r)`

Explain what this hit test does. That is, what is it testing? Answer in the box below. [1 mark]

c) Referring to the code on the previous page, if the hit test

```
if (dist(mouseX, mouseY, x, y) < r)
```

evaluates to true then the number of points awarded is calculated as:

```
r - dist(mouseX, mouseY, x, y)
```

Explain how the number of points is calculated. That is, explain what the line of code above does. You must use an example in your explanation. [1 mark]

d) The code on the previous page also contains the following hit test:

```
else if (mouseX > x-r & mouseX < x+r & mouseY > y-r & mouseY < y+r) {  
    points += 100;  
}
```

Explain what this hit test does. That is, how can the user score 100 points? You must use a diagram in your answer. Answer in the box below. [2 mark]

- e) The code below puts a slider and a `rect()` on the screen. As the user controls the slider the rectangle changes in size. Fill in the blanks with the letter A, B, C, D, or E corresponding to the code blocks below. [5 marks]

----- The code starts here -----

```
 // Code is missing here. The code should be
// the first line in this file.
// Is the missing code block A, B, C, D, or E?

 // Code is missing here. The code should be the second
// line in this file.
// Is the missing code block A, B, C, D, or E?
```

```
Slider mySlider;
float t;
```

```
void setup() {
  size(200, 200);
```

```
 // Code is missing here near the beginning of setup().
// Is the missing code block A, B, C, D, or E?
```

```
 // Code is missing here at the end of setup().
// Is the missing code block A, B, C, D, or E?
```

```
}
```

```
void draw() {
  background(127);
  rect(80, 80, t, t);
}
```

```
public void controlEvent(ControlEvent theEvent) {
```

```
 // Code is missing here in controlEvent().
// Is the missing code block A, B, C, D, or E?
```

```
}
```

----- The following are the five blocks of code. -----

```
A) ControlP5 ui;
```

```
C) import controlP5.*;
```

```
D) if (theEvent.isFrom(mySlider)) {
    t = mySlider.getValue();
  }
```

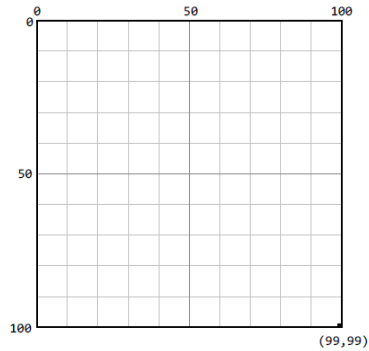
```
B)
mySlider = ui.addSlider( "Slider1" );
mySlider.setPosition(10, 30);
mySlider.setSize(100, 20);
mySlider.setRange(20, 100);
```

```
E) ui = new ControlP5( this );
```

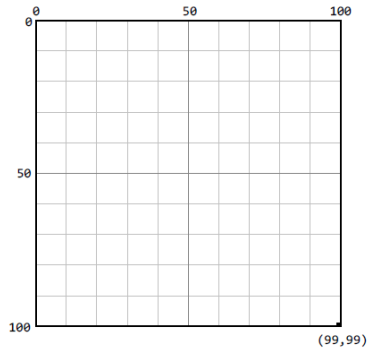
6) Geometric Contest [10 marks]

a) What is drawn by each of the following? [4 marks]

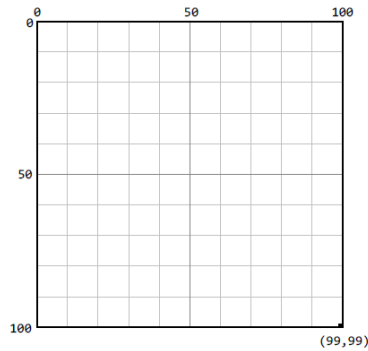
```
void setup() {  
  translate(20, 20);  
  rect(0, 0, 40, 40);  
}
```



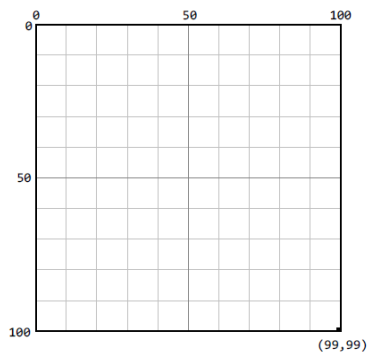
```
void setup() {  
  translate(0, 50);  
  scale(2, 1);  
  rect(0, 0, 20, 20);  
}
```



```
void setup() {  
  translate(50, 50);  
  rotate(radians(90));  
  rect(0, 0, 20, 40);  
}
```

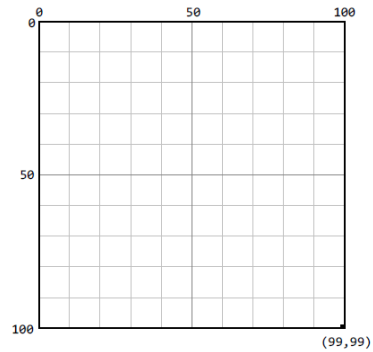


```
void setup() {  
  translate(50, 0);  
  rotate(radians(45));  
  scale(2, 1);  
  rect(0, 0, 20, 20);  
}
```



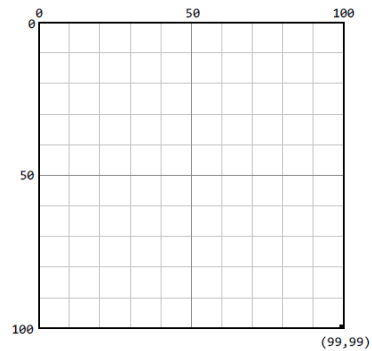
b) What is drawn by the following code? [3 marks]

```
pushMatrix();  
translate(50, 50);  
ellipse(0, 0, 20, 20);  
  
pushMatrix();  
translate(50, 50);  
ellipse(0, 0, 20, 20);  
popMatrix();  
  
popMatrix();  
ellipse(0, 0, 20, 20);
```



c) What is drawn by the following code? [3 marks]

```
pushMatrix();  
translate(50, 50);  
rotate(radians(45));  
rect(0, 0, 20, 20);  
  
translate(0, -25);  
rect(0, 0, 20, 20);  
  
popMatrix();  
rect(0, 0, 20, 20);
```



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