Name and UTEID:

- You are allowed 75 mins.
- Open book/notes/web—you cannot message anyone in any form.
- Write your answers on the exam.
- Show your work and give explanations.
- No questions will be entertained—if you feel a question is ambiguous or incomplete, make and state reasonable assumptions.

Question:	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Points:	3	4	6	6	6	6	12	5	6	6	6	4	4	74

3 marks 1. Add left and right parens to `x = 2 + 3 * 5 - 4;` so that `x` is assigned 5 after the assignment.

4 marks 2. What is the difference between `break` and `continue`? Suppose you were trying to find if a negative number is present in an array of integers—would `break` or `continue` be more appropriate?

7 marks 3. Show representative in-memory representation of x and y for the code below:

```
String x = "1234";
int y    = 123;
```

6 marks 4. What is a reference type? Give two differences between reference types and primitive types.

6 marks 5. Explain the output of the code below.

```
// swaps the contents of the two arguments
public static void swap(int x, int y) {
  int tmp = x;
  x = y;
  y = tmp;
}
...
int x = 2;
int y = 4;
swap(x, y);
System.out.println("x, y = " + x + ", " y );
...
```

6 marks 6. Suggest a change to the `Image` class by which both `lat` and `lng` can be set in a single expression, as shown.

```
class Point {
  private double lat;
  private double lng;
  public void setLat(double x) {
    lat = x;
  }
  public void setLong(double y) {
    lng = y;
  }
}
...

Point foo;
foo.setLat(12.3).setLong(45.6); // this code should not be changed
```

12 marks 7. Design a class suitable for images in the context of a social network. The actual image exists in an existing `PNG` class. The class you design should include the actual image as well as the following meta-data: a comment (of type String), GPS coordinates (lat and long, both doubles), and a creation time (a Date object). Give signatures for the constructor and for what you believe to be appropriate getter methods. You do not need to implement any methods.

5 marks 8. What is polymorphism and how does it help recycle code? (Be specific.)

6 marks 9. Give 3 reasons why an $O(N^3)$ algorithm for a given problem might in practise run faster than and $O(N^2)$ algorithm for the same problem.

6 marks 10. Suppose you were required to write a web service to which a city is passed in and a state is returned. For example, the input might be `Austin`, in which case your service should return `Texas`.

What would be an appropriate data structure to back the web service with if fast lookup times are required?

6 marks 11. Suppose you were required to write a web service to which a city is passed in and the city with the closest latitude to it is to be returned.

What would be an appropriate data structure to back the web service with if fast lookup times are required?

4 marks 12. Give two key differences between the `Set` type and the `List` type.

4 marks 13. Describe how the code for the highest affinity pages lab naturally decomposes into three parts.