Name (print): ________________________________

- **INSTRUCTIONS:**
  - Keep your eyes on your own paper and do your best to prevent anyone else from seeing your work.
  - Do NOT communicate with anyone other than the professor/proctor for ANY reason in ANY language in ANY manner.
  - This exam is closed notes, closed books, and no calculator.
  - Turn all mobile devices off and put them away now. You cannot have them on your desk.
  - Write neatly and clearly indicate your answers. What I cannot read, I will assume to be incorrect.
  - Stop writing when told to do so at the end of the exam. I will take 5 points off your exam if I have to tell you multiple times.
  - Academic misconduct will not be tolerated. Suspected academic misconduct will be immediately referred to the Emory Honor Council. Penalties for misconduct will be a zero on this exam, an F grade in the course, and/or other disciplinary action that may be applied by the Emory Honor Council.

- **TIME:** This exam has 8 questions on 10 pages including the title page. Please check to make sure all pages are included. You will have 75 minutes to complete this exam.

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*I commit to uphold the ideals of honor and integrity by refusing to betray the trust bestowed upon me as a member of the Emory community. I have also read and understand the requirements and policies outlined above.*

Signature: ________________________________

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points:</td>
<td>8</td>
<td>13</td>
<td>11</td>
<td>8</td>
<td>11</td>
<td>12</td>
<td>6</td>
<td>6</td>
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<tr>
<td>Score:</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

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1. (8 points) Match the people on the right with their contribution to Robotics and/or Computer Science on the left. Write a letter from the right hand column in a blank next to the person left hand column. You will **not** use all the options in the right hand column.

| J | Ada Lovelace   | A | Inventor who worked on automated machines including the digesting duck and automated looms. |
| G | Charles Babbage| B | Invented complex mechanical toys called ‘Karakuri’ |
| B | Hisashige Tanaka| C | Principle inventor of Unimate |
| I | William Grey Walter| D | American sci-fi author who coined the word ‘robotics’. |
| F | Nicola Tesla   | E | Playwright who coined the term ‘robot’ |
| A | Jacques de Vaucanson| F | Developed ‘teleautomatons’ such as a radio controlled boat |
| K | Norbert Weiner | G | Invented the Difference and Analytical Engines |
| E | Karel Capek    | H | Developed robots such as Televox and Elektro for Westinghouse to do ‘useful’ work |
|    |                  | I | Developed the electronic, autonomous robots called tortoises and named Elmer and Eloise |
|    |                  | J | Wrote the first program to calculate Bernoulli numbers on the analytical engine. |
|    |                  | K | Formalized the notion of feedback via the field of ‘cybernetics’ |
|    |                  | L | Produced the first movie to feature a robot, *Metropolis* |
2. For each question below, briefly answer the question. Your answers should generally be no more than 3 sentences.

(a) (2 points) Explain why a list of GPS coordinates would be insufficient data to navigate a course such as the Mojave Desert course used the DARPA Grand Challenge.

**Solution:** GPS doesn’t give any indication of obstacles, just a (rough) route. Vehicles need to be able to detect obstacles such as poor road conditions, rocks, bushes, other vehicles, etc.

(b) (2 points) List two sensors other than GPS used during the DARPA Grand Challenge and explain why each sensor used on its own would be insufficient for robotic navigation in a high-speed desert course.

**Solution:**
- lidar/laser scanners - mostly useful for short range applications, limits speed
- radar - good for distance, but not very accurate leading to false obstacle detection on occasion.
- cameras - have to have multiple cameras to subtract differences between them; objects in distance appear same to cameras limiting high-speed driving; subject to dust/bad weather obscuring picture.

(c) (3 points) In the context of space exploration, list three tasks that robots would be better suited to than humans and briefly explain why.

**Solution:** answers vary but examples are:
- mining for resources or building things: robots can work longer hours/without rest
- exploring areas which take a long time to reach: don’t have to account for humans biological needs (food, etc) which would require space/resources to produced or transport.
- working in dangerous environments (spacewalks, etc): robots are expendable and we can use them in riskier situations
(d) (3 points) Why is remote control (or “teleoperation”) of robots in space from Earth problematic? What strategy for controlling robots such as Spirit or Opportunity is actually used?

**Solution:** Takes time for commands to reach robots. Humans can’t deal (mentally) with any delay over about .5 seconds. Thus remote control isn’t feasible as it takes well over that for data/commands to reach the moon or Mars. Instead, a series of commands is uploaded/sent all at once. The robot then executes all these commands on its own (autonomously), without human interference.

(e) (1 point) Explain the difference between the `=` operator and the `==` operator in Python.

**Solution:** `=` is the assignment operator which assigns the value on the RHS to the variable on the LHS. `==` tests the equality of the RHS and LHS.

(f) (2 points) Explain why you should include comments in your code. In Python, what symbol is used to indicate a comment?

**Solution:** Comments give others who work with your code the “big picture” and explain your logic/reasoning which you implemented. In python, the `#` sign indicates a comment.
3. (11 points) Evaluate each expression. Then give the result of the evaluation and the data type of the evaluation. If the expression cannot be evaluated due to an error, you may simply write “error.”

<table>
<thead>
<tr>
<th>Expression</th>
<th>Value</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>4+1</td>
<td>5</td>
<td>int</td>
</tr>
<tr>
<td>4+1*5</td>
<td>9</td>
<td>int</td>
</tr>
<tr>
<td>3*2/4</td>
<td>1</td>
<td>int</td>
</tr>
<tr>
<td>3-4/8.0</td>
<td>2.5</td>
<td>float</td>
</tr>
<tr>
<td>(not True) or (True and False)</td>
<td>False</td>
<td>bool(ean)</td>
</tr>
<tr>
<td>36.0 != 6.0**2</td>
<td>False</td>
<td>bool(ean)</td>
</tr>
<tr>
<td>not 5%6 &gt;0.0</td>
<td>False</td>
<td>bool(ean)</td>
</tr>
<tr>
<td>“Hello” + “ world!”</td>
<td>“Hello world!”</td>
<td>str</td>
</tr>
<tr>
<td>baa * 2</td>
<td>error</td>
<td>note baa isn’t in “”</td>
</tr>
<tr>
<td>“A” + 6</td>
<td>error</td>
<td>trying to concat string and int</td>
</tr>
<tr>
<td>float(1) + int(1.0)</td>
<td>2.0</td>
<td>float</td>
</tr>
<tr>
<td>“Valerie Summet” - “e”</td>
<td>error</td>
<td>- isn’t defined for strings</td>
</tr>
</tbody>
</table>
4. (8 points) The code below contains errors, both syntax errors as well as logic errors. Rewrite the code to remove the errors.

```python
define myLoop(i)
    while i != 0:
        print "The value of i is: " + i
        i = i-2
    for x in Range(i+3):
        print x
myLoop(7)
myLoop(z)
```

**Solution:** syntax errors: (+1 for each)
- case mismatch for range function
- no colon after function definition
- variable z used in function call but not defined/initialized
- no indentation for the for loop body
- define instead of def
- can’t concatenate string and int

logic errors:
- (+2) infinite while loop when myLoop(7) is invoked.

A corrected version (other answers are possible):

```python
def myLoop(i):
    while i > 0:
        print "The value of i is: " + str(i)
        i = i-2
    for x in range(i+3):
        print x
myLoop(7)
z = 4
myLoop(z)
```
5. For the snippets of code below, indicate what each will print out when executed.

(a) (3 points) Code snippet 1:

```python
for i in range(5,0,-2):
    print i
```

**Solution:**
5
3
1
Scoring: +1 for each line

(b) (4 points) Code snippet 2:

```python
def myFunc(x):
    print x
    z = float(x) + 2
    print z
    print str(z)+str(x)
    print x #+z
myFunc(1)
```

**Solution:**
1
3.0
3.01
1
Scoring: +1 for each line

(c) (4 points) Code snippet 3:

```python
x = 4
while x < 10:
    print x + 1
    x = x + 2
print x
```

**Solution:**
5
7
9
10
Scoring: +1 for each line
6. For this question, you will write code using two different methods. However, the code will perform in the same manner and have the same output. The general description and a sample output is below:

Write a function called countUp that accepts two integers as parameters. The function should print out all the integers between the two parameters, excluding both parameters, in ascending order. You may assume that the two parameters are valid integers and that the first parameter will always be smaller than the second parameter.

>>> countUp(1,5)
2
3
4

(a) (6 points) Write this function using a for loop.

Solution:

```python
for i in range(a+1,b,1):
    print i
```

Scoring:
+1 for correct header
+1.5 for starting printout at a+1
+1.5 for stopping before printing b
+2 for using for loop correctly

(b) (6 points) Write this function using a while loop.

Solution:

```python
def countUp(a,b):
    a = a+1
    while a < b:
        print a
        a=a+1
```

Scoring:
+1 for correct header
+1.5 for starting printout at a+1
+1.5 for stopping before printing b
+2 for using while loop correctly
7. (6 points) Write a function called `ageInSecs` which asks for the user’s age in years. Your function should then calculate the user’s age in seconds and print out that information. You may assume the user follows instructions and enters a valid number as input. You may also ignore leap years. An example interaction is below:

```python
>>> ageInSecs()
How old are you in years? 1
You are more than 31536000 seconds old.
```
8. (6 points) Write a function called divCalc which takes 3 integers as parameters. The function should calculate the result when the sum of these numbers is divided by 5 and print out this information as demonstrated below.

```python
>>> divCalc(5, 1, 15)
21 divided by 5 is 4 with a remainder of 1.
```