• **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 is exam is closed book, closed notes, no calculator, and no computer.
  – Turn all mobile devices off and put them away now. You cannot have them on your desk.
  – Write neatly and clearly. What I cannot read, I will assume to be incorrect.
  – Stop writing immediately 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 to do so.
  – Academic misconduct will not be tolerated and will be referred immediately 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 7 questions on 9 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>Total</th>
</tr>
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<tbody>
<tr>
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<td>14</td>
<td>11</td>
<td>14</td>
<td>8</td>
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<td>75</td>
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</tbody>
</table>
1. HISTORY OF COMPUTERS
   Fill in the blank with the correct answer

   (a) (1 point) This technology, invented in 1947 by engineers at Bell labs, propelled the computer industry forward by enabling smaller, more reliable computer chips.

   (a) **transistor**

   (b) (1 point) This was the first successful high-level language, developed at IBM.

   (b) **FORTRAN**

   (c) (1 point) This network, developed by the Department of Defense, was the precursor to today’s Internet.

   (c) **ARPANET**

   (d) (1 point) This was first spreadsheet program and led to computers being considered serious business tools for small business owners.

   (d) **VisiCalc**

   (e) (1 point) Ada Lovelace, widely considered the first “programmer,” developed a program for what computing machine, developed by Charles Babbage?

   (e) **analytical engine**

   (f) (1 point) This machine used punch cards to “program” patterns woven into cloth and is considered to be a precursor of modern computers.

   (f) **Jacquard Loom**

2. TRUE OR FALSE
   Clearly indicate whether each of the following statements is true or false. If the statement is false write a 1 sentence explanation why it is incorrect or correct it to be a true statement.

   (a) (2 points) In a computer, the hard drive is an example of volatile storage.

   **Solution:** False. Volatile storage is erased when the computer is powered off and the HDD isn’t erased every time the computer is shut down. (p 5)
(b) (2 points) The Central Processing Unit (CPU) consists of two main parts: the control unit and the Arithmetic Logic Unit (ALU).

**Solution:** True (p4)

(c) (2 points) All data in a computer is represented in digital form (ie, by bits) except text. Instead, text is represented in a series of decimal numbers called the ASCII standard.

**Solution:** False. Text is also represented as a series of bits and the ASCII standard is just a mapping between a specific pattern of bits and a specific symbol. (p 6-7)

(d) (2 points) Each computer on the Internet has a unique address known as the IP address.

**Solution:** True (p 8)

(e) (2 points) An algorithm is conceptually similar to a packing list: a collection of things which must be completed, but do not have to necessarily be completed in order.

**Solution:** False. An algorithm is similar to a recipe. The steps need to be completed in order to accomplish the task. (p 107)

(f) (2 points) As in a decimal (base 10) numbering system, all fractional quantities can be precisely represented in a binary (base 2) numbering system.

**Solution:** False. Certain quantities cannot be precisely represented (leading to rounding errors), just like the quantity $1/3$ cannot be precisely represented in a decimal numbering system. (p 62)

(g) (2 points) When using functions, you must understand the type and number of pieces of input data the function uses (called “arguments”) as well as the type of result (called the “return value”) the function gives you.

**Solution:** True
Given the spreadsheet below, evaluate each of the following formulas. If the formula will generate an error, you can simply write “error”. You do not need to specify the type of error. Use quotation marks to clearly differentiate text from numbers.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>AB</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>ABC</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>ABCD</td>
<td>1</td>
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<tr>
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<td>ABCDE</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>ABCDEF</td>
<td>3</td>
</tr>
</tbody>
</table>

(a) (1 point) =B3+B5  
(b) (1 point) =A1&B4  
(c) (1 point) =B1&B5  
(d) (1 point) =VALUE(LEFT(B2,1))  
(e) (1 point) =MOD(B3,B6)  
(f) (1 point) =INT(B2/B5)  
(g) (1 point) =LOWER(B5)  
(h) (1 point) =SUMIF(B1:B6, ">12")  
(i) (1 point) =INT(A1)  

(a) 14  
(b) “A1”  
(c) “162”  
(d) 2  
(e) 0  
(f) 12  
(g) error, “2”, or 2  
(h) 41  
(i) Error
(j) (1 point) =RIGHT(A6,2) & "<=" & MID(A6,2,3)

(j) “EF<="BCD”

(k) (1 point) =IF(B1-B3/B6>=B3, B2/5, B6*B5)

(k) 5

4. Base Numbering Systems

(a) (8 points) Find the equivalent decimal numbers for the following numbers. If the number is invalid for the given base, write “invalid”.

i. \(31_4\)

i. \(4+3*16 = 52\)

ii. \(11201_3\)

ii. invalid

iii. \(10101_2\)

iii. \(16+4+1=21\)

iv. \(324_5\)

iv. \(75+10+4=89\)

(b) (6 points) Write the equivalent binary (base 2) number for the following decimal numbers. If the number is invalid in a base 10 numbering system, write “invalid.”

i. \(18_{10}\)

i. 10010

ii. \(39_{10}\)

ii. 100111_2
5. **Short Answer.** Give a brief (2-3 sentence) answer to the following questions.

(a) (2 points) What is the difference between operating systems software and applications software?

**Solution:** Operating system software directly interacts with the hardware and is responsible for controlling the hardware’s functions. Application software performs one specific task (such as web browsing or word processing) and must “ask” the operating system for permission to run and interact with the hardware.

(b) (3 points) Explain how computer scientists came to use the term “bug” to mean an error in the functioning of a program.

**Solution:** Computers used to have mechanical (moving) parts and used to generate extreme amounts of heat. Bugs such as moths were drawn to the light/heat but when they got stuck in the moving parts, they would cause the machine to have problems. Thus bugs in the computer were a real problem.

(c) (3 points) Explain the term “killer application” in the context of early computers and productivity software.

**Solution:** In the past, computers and software were produced and manufactured together. So you could not buy software which would run on any computer; you had to buy it from the company that manufactured and sold your computer. “Killer apps” were apps that were so useful that you would buy a new computer just to have access to them.
6. (8 points) **Truth Tables and Logical Functions.**

The formula `$=\text{\texttt{NOT(OR(AND(C1,B1), OR(A1,C1)))}}$` is entered into cell D1. This formula is then copied and pasted into cells D2:D8. Fill in the table below with the appropriate values for cells D1:D8.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FALSE</td>
<td>FALSE</td>
<td>FALSE</td>
<td>TRUE</td>
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<td>2</td>
<td>FALSE</td>
<td>FALSE</td>
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<td>8</td>
<td>TRUE</td>
<td>TRUE</td>
<td>TRUE</td>
<td>FALSE</td>
</tr>
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</table>

Solution:
7. FLOWCHARTS AND PROBLEM SOLVING

In a benefits package, a company contributes 2.5% of an employee’s base salary to each eligible employee’s retirement account and contributes some money towards the employee’s health care insurance. To be eligible for the retirement contribution benefit, an employee must be full time and must have been employed for 3 years or longer. A graphical representation of this might be:

![Flowchart](image)

You are tasked with calculating employees’ retirement contributions and given a spreadsheet like the one below:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Name</td>
<td>Employment Status</td>
<td>Salary</td>
<td>Health Plan</td>
<td>Hire Date</td>
<td>Num Years Employed</td>
<td>Full time?</td>
<td>Eligible</td>
<td>Retirement Contribution</td>
</tr>
<tr>
<td>2</td>
<td>Munoz</td>
<td>part time</td>
<td>45000</td>
<td>family</td>
<td>Jan-11</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Iban</td>
<td>part time</td>
<td>60000</td>
<td>individual</td>
<td>Mar-08</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Cary</td>
<td>full time</td>
<td>37800</td>
<td>family</td>
<td>Oct-10</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Barker</td>
<td>full time</td>
<td>57000</td>
<td>family</td>
<td>Sept-09</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Ap</td>
<td>part time</td>
<td>48000</td>
<td>individual</td>
<td>Feb-07</td>
<td>6</td>
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<td>7</td>
<td>White</td>
<td>full time</td>
<td>42000</td>
<td>other</td>
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<td></td>
</tr>
<tr>
<td>8</td>
<td>Smith</td>
<td>full time</td>
<td>62000</td>
<td>individual</td>
<td>May-10</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(a) (3 points) You decide to break the problem into smaller pieces (smart thinking!) and decide to simply calculate whether or not the employee is a full-time employee or not and store that intermediate result in column G. Write a formula for Munoz which puts the boolean value TRUE in the cell if he is a full time employee. Otherwise, you should store the value FALSE. This formula should be able to be copied into G3:G8 for the other employees.

**Solution:** IF(B2="full time", TRUE, FALSE)

General notes on problem 7: The most common mistakes were confusing text values (ie “TRUE”) with boolean values (ie TRUE). There is a difference. If you had the problem throughout all your answers, I just took off 2 points rather then deduct from every part. Also common: incorrectly written conditions
(e.g. F2>=3" or "B2=full time") and incorrect arguments to functions (e.g. =IF(F2,>=3,G2,"full time","Y", "N"))

(b) (4 points) Your next step is to store another boolean value in column H if the employee meets both criteria outlined above. Write a formula for Munoz which stores TRUE or FALSE depending on whether or not he meets the conditions. This formula should be able to be copied into H3:H8 for the other employees.

**Solution:** Answers vary but two possibilities are:
- =AND(G2, F2>=3) or
- =IF(AND(G2, F2>=3), TRUE, FALSE)

(c) (3 points) You’re finally ready to calculate the retirement contribution for the employees. Write a formula to calculate the company’s contribution Munoz’s retirement account in cell I2. This formula should be able to be copied into I3:I8 for the other employees.

**Solution:** =IF(H2,C2*2.5,0)

(d) (4 points) You are now tasked with calculating the company’s contribution to the employee’s health care insurance costs. The company supplies two options for health care costs. The company provides $10,000 if the employee chooses the “family plan.” The company provides $7,500 in coverage if the employee selects the “individual plan.” The company contributes nothing if the employee is covered by another plan. Draw a flowchart that determines the dollar amount the company contributes for the health care benefit.