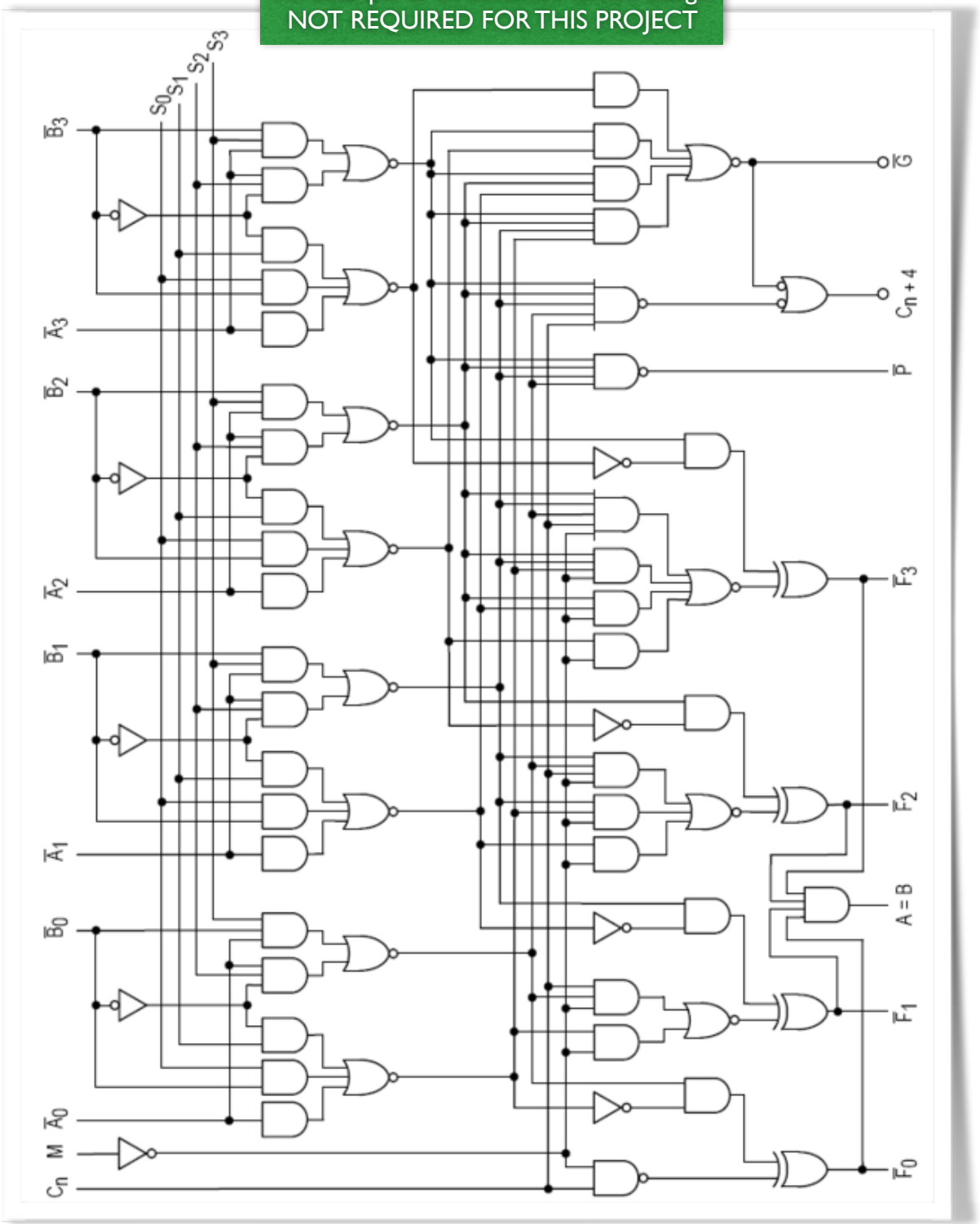
LOGIC PROJECT

Discrete Math
Project 2

An example of an advanced circuit design
NOT REQUIRED FOR THIS PROJECT



Logic Project

Objective

- Explore multiple methods to determine satisfiability and logical equivalence of statements.
- Use Truth Tables and LogiSim to demonstrate whether statements are satisfiable.
- Use Truth Tables and LogiSim to demonstrate whether statements are equivalent.

Instructions

Install LogiSim. http://sourceforge.net/projects/circuit/

Create a new file in MSWord. Save it using the format **LastName_FirstInitial_Proj2**

Include your name, the names of all your teammates, and the date and the title "Discrete Mathematics Project 2"

Truth Tables

1. Let **A**: ¬(P∧¬Q)∧(P∨Q)∧(¬P∨¬Q). Follow the steps below. (Download *Example Circuit 1 for reference*)

1.1. Create a Truth Table for A and include it in your document.
Include columns for the three clauses that comprise A along with A

1.2. Answer the following questions and include your answers in your document:
Is A satisfiable?
How did you determine this?

1.3. Answer the following and include your answers in your document:
If A is satisfiable, then provide truth values that satisfy the statement.
If not, then explain why it is not.

2. Let **B**:P∨(Q∧R) **C**:(P∨Q)∧(P∨R). Follow the steps below.

2.1. **Create a Truth Table for B, C and include it in your document.**
Include columns for the clauses that comprise B and C.

2.2. Answer the following questions and include your answers in your document:
Are B and C equivalent?
If not, then provide the truth values for which they differ.

Logical Arguments

3. Let **D**:(P∧Q)→R **E**:(P→R)∧(Q→R).

3.1. Formulate a logical argument whether D and E are equivalent in your document.

See next page for instructions for the LogiSim Portion of the project

Circuit Design (Logisim)

4. Let **A:** (¬P∨¬Q∨R)∧(¬P∨Q∨¬S)∧(P∨¬Q∨¬S)∧(¬P∨¬R∨¬S)∧(P∨Q∨¬R)∧(P∨¬R∨¬S). Follow the steps below.

   - Rename the "main" circuit "Satisfiability Test".
   - Build the combinational circuit that represents **A**.
   - Use the text tool to add your full name and the date.
   - **Answer the following and PLACE THIS ANSWER IN YOUR DOC**
     Is **A** satisfiable? If so, then provide the truth values that satisfy the statement.
     If not, explain why it is not.

5. Let **B**:(P∧Q∧¬R)∨(P∧¬Q∧R)∨(¬P∧Q∧R), **C**:¬((P∨¬Q∨¬R)∧(¬P∨Q∨¬R)∧(¬P∨¬Q∨R)) Note the negation surrounding C. Follow the steps below.

   - Create a new circuit. Name this circuit "Equivalence Test 1"

   In the "Project" menu select the "New Circuit" option to create a new circuit in this same file

   - Build the combinational circuits that represent each of **B** and **C**.
     (Be sure to present them exactly as they are stated above. ***Do not simplify/ apply DeMorgan's Law beforehand.****)*
   - Use the text tool to add your full name and the date.
   - **Are B and C equivalent? If not, give a set of truth values for which they differ.**
     PLACE THIS ANSWER IN YOUR DOC

6. Let **D**: (P∧Q∧R∧S∧¬T)∨(P∧Q∧R∧¬S∧T)∨(P∧Q∧¬R∧S∧T)∨(P∧¬Q∧R∧S∧T)∨(¬P∧Q∧R∧S∧T),
   E: ¬((P∨¬Q∨¬R∨¬S∨¬T)∧(¬P∨Q∨¬R∨¬S∨¬T)∧(¬P∨¬Q∨R∨¬S∨¬T)∧(¬P∨¬Q∨¬R∨S∨¬T)∧(¬P∨¬Q∨¬R∨¬S∨T))
   Note the outermost negation in E. Follow the steps below.

   - Create a new circuit. Name this circuit "Equivalence Test 2"
   - Build the combinational circuits that represent each of **D** and **E**.
     (Be sure to present them exactly as they are stated above. **Do not simplify/ apply DeMorgan's Law beforehand.**)
   - Use the text tool to add your full name and the date.
   - **Are D and E equivalent? If not, give a set of truth values for which they differ.**
     PLACE THIS ANSWER IN YOUR DOC

Submission Instructions

Collect all the files you've created. You should have 2:

- **LastName_FirstInitial.doc**
- **LastName_FirstInitial.circ**

Compress (zip) the files and save as LastName_FirstInitial_P2.zip. Go to FSO and upload the zip to the assignment Project 2.

	Excellent	Good	Poor	Unacceptable
Truth Tables	Each truth table has the correct number of rows, all statements are represented, the truth values are organized appropriately, and the truth table values are correct. 20 points	Each truth table represents all statements, but either some truth values are incorrect or some rows are not well organized, but not both. 15 points.	Each truth table represents all statements, but some truth values are incorrect and the rows are not well organized. 10 points.	Any missing statements qualify the truth table as being of poor quality A program dependent on these logical statements would either not compile or would exhibit run-time errors. 0 points.
Satisfiability and Truth Values	Correct explanation for 1.2. Argument or truth values are provided. Correct conclusion is reached in 2.2. 20 points.	No more than 1 of the following errors: Explanation for 1.2 is incorrect, truth values were not provided, incorrect conclusion is reached in 2.2. 14 points.	No more than 2 of the following errors: Explanation for 1.2 is incorrect, truth values were not provided, incorrect conclusion is reached in 2.2. 6 points.	All of the following: No more than 2 of the following errors: Explanation for 1.2 is incorrect, truth values were not provided, incorrect conclusion is reached in 2.2 0 points.
Logical Argument	The argument is correct and easy to follow. 10 points.	The necessary statements are contained within the argument, but extraneous statements are also included. 8 points.	Some necessary statements are omitted, but the argument follows an appropriate line of thinking. 6 points.	Argument does not does not follow an appropriate line of thought. An algorithm built like this would not solve the right problem. 0 points.
LogiSim Diagrams	Each statement is represented. Gates are utilized in the standard fashion. Circuit is well organized (using the style represented in the online lecture). Circuit shows no data errors. Circuit evaluates correctly. 30 points.	Each statement is represented. No more than two of the following issues: Gates are not used in the standard fashion but still evaluate correctly. Circuit is a little disorganized. Exhibits a data error. Circuit evaluates incorrectly on a few inputs. 22 points.	Each statement is represented. Three of the previously mentioned issues. 10 points.	Not all statements are represented. (This also means that the student will necessarily have all four of the previously mentioned issues). A program dependent on this information would not run as desired. 0 points.
Group Contribution	Student actively participates in the group by generating files, troubleshooting issues, and anticipating the needs of other group members. Student actively assists in conflict resolution. Student takes on either a leadership or support role. 20 points.	Student provides work to the group. Student causes a group conflict or does not aid in conflict resolution. Student may not have done well with anticipating needs but completes the necessary tasks. 15 points.	Student keeps to him- or herself but takes on a support role by completing the necessary tasks. 10 points.	Student causes and does not resolve a group conflict. In a workplace setting, this coworker would be considered the cause of a hostile work environment. 0 points.