Functional completeness

You need to be alert to (usually minor) changes that may be made to the assignment statement or to the guidelines after the assignment is first put up. Refresh this frame and re-read the assignment carefully before you make your final submission.

Background

In Post's treatment of functional completeness, five classes of Boolean functions are defined

- T-preserving (T)
- F-preserving (F)
- Counting (L)
- Monotonic (M)
- Self-dual (S)

Post's functional completeness theorem is stated below

> A set $\mathbb{F}$ of Boolean connectives is functionally complete if and only if for each of the five defined classes, there is a member of $\mathbb{F}$ which does not belong to that class.

Examples of such functions **not** belonging to various classes are given below.

Not T-preserving

x_2	x_1	x_0	T'_0	T'_1
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
1	0	1	0	0
1	1	0	0	1
1	1	1	0	0

Not F-preserving

x_2	x_1	x_0	F'_0	F'_1	F'_2
0	0	0	1	1	1
0	0	1	1	0	0
0	1	0	0	0	0
0	1	1	0	0	1
1	0	0	0	0	0
1	0	1	0	0	0
1	1	0	0	1	0
1	1	1	1	1	1

Not Counting

x_2	x_1	x_0	L'_0	L'_1	L'_2	L'_3
0	0	0	1	0	1	0
0	0	1	1	1	0	0
0	1	0	0	0	1	1
0	1	1	0	1	0	0
1	0	0	0	1	1	0
1	0	1	0	0	1	0
1	1	0	1	1	0	0
1	1	1	1	0	0	1

Not Monotonic

x_2	x_1	x_0	M'_0	M'_1	M'_2	M'_3	M'_4
0	0	0	0	0	0	0	0
0	0	1	1	1	0	0	0
0	1	0	0	1	0	1	1
0	1	1	1	0	1	1	1
1	0	0	1	1	1	0	1
1	0	1	1	1	1	0	1
1	1	0	1	1	0	0	1
1	1	1	1	1	0	0	0

Not Self-dual

x_2	x_1	x_0	S'_0	S'_1	S'_2	S'_3
0	0	0	1	0	1	1
0	0	1	0	0	0	0
0	1	0	1	0	0	0
0	1	1	1	0	1	1
1	0	0	0	0	0	0
1	0	1	1	1	1	1
1	1	0	1	1	1	0
1	1	1	0	1	1	0

Choice of functions

- Let there be n given functions of a particular class in the table
- Let your group number be m
- You should use the function with index $(n \mod m)$

Realisation of T', F', L', M' and S' functions

- Post's constructions assumes the availability of such functions
- For this experiment, a *cheating* strategy will be used for the realisation of these functions
- The required functions, as defined via these truth tables, should be realised using the available gates and encapsulated as components for use in the Post's construction steps

Define complementation using T', F' and L' functions

- Choose appropropriate function T', F' and L' functions from the given tables of functions
- Construct the complementation function using Post's construction methods (with suitable encapsulations as components)

Define the constant functions T and F

- Choose appropropriate function T', F', L' and S' functions from the given tables of functions
- Construct the complementation function using Post's construction methods (with suitable encapsulations as components)

Define two of the eight $g(p, q)$ functions with odd number of 1s in a row

- Let your group number be m
- You should implement one g_i function with index $i = (n \mod 8)$
- You should implement another g_j function with index $(i + 3 \mod 8)$
- Choose appropropriate function T', F', L', M' and S' functions from the given tables of functions
- Use other supporting functions (complementation, T, F) as constructed in the other parts (with suitable encapsulations as components)

Marking guidelines

Assignment marking is to be done only **after** the deadline expires, as submissions gets blocked after the assignment is marked. Enter the breakup of marks while marking.

Encapsulation of each function not part of a particular class as a component	
Correctly working circuit	**11**
Labels	**5**
Saving and component creation	**5**
Realisation of complement	
Correctly working circuit	**6**
Labels	**2**
Saving and component creation	**2**
Realisation of F and T	
Correctly working circuit	**6**
Labels	**2**
Saving and component creation	**2**
Realisation of g_i and g_j	
Correctly working circuit	**10**
Labels	**2**
Saving and component creation	**2**
Total Marks	***55***

Assignment submission

A PDF report, as appropriate, should be submitted. Submit all your files together.

Use electronic submission via the WBCM link

You should keep submitting your incomplete assignment from time to time after making some progress, as you can submit any number of times before the deadline expires. **You should submit all your files together**.

Warning

Cases of copying will be dealt with seriously and severely, with recommendation to the Dean to de-register the student from the course.