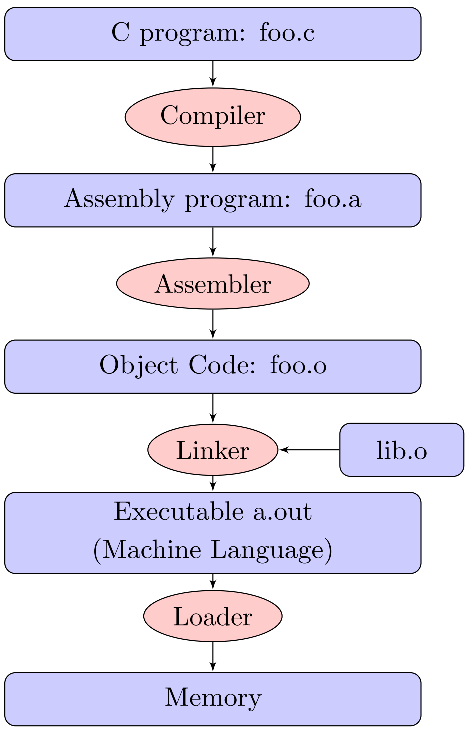
CS 61C — CALL, Logic

Spring 2019 — Discussion 9: February 20, 2019

1 CALL

The following is a diagram of the CALL stack detailing how C programs are built and executed by machines:



1.1 What is the Stored Program concept and what does it enable us to do?

1.2 How many passes through the code does the Assembler have to make? Why?

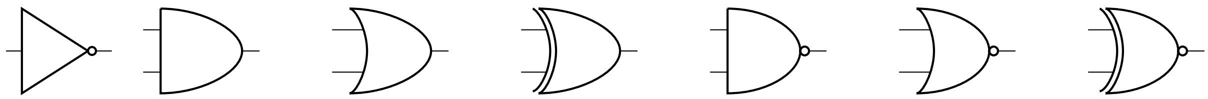
1.3 Describe the six main parts of the object files outputed by the Assembler (Header, Text, Data, Relocation Table, Symbol Table, Debugging Information).

1.4 Which step in CALL resolves relative addressing? Absolute addressing?

1.5 What does RISC stand for? How is this related to pseudoinstructions?

2 Logic Gates

2.1 Label the following logic gates:



2.2 Convert the following to boolean expressions on input signals A and B:

(a) NAND

(b) XOR

(c) XNOR

2.3 Create a NOT gate using only NAND gates.

2.4 Create an AND gate using only NAND gates. (Hint: use 2.3!)

2.5 Create an OR gate using only NAND gates.

2.6 Create a NOR gate using only NAND gates. (Hint: use 2.3 and 2.5!)

2.7 How many different two-input logic gates can there be? How many n-input gates?

3 Boolean Logic

In digital electronics, it is often important to get certain outputs based on your inputs, as laid out by a truth table. Truth tables map directly to Boolean expressions, and Boolean expressions map directly to logic gates. However, in order to minimize the number of logic gates needed to implement a circuit, it is often useful to simplify long Boolean expressions.

We can simplify expressions using the nine key laws of Boolean algebra:

Name	AND Form	OR form
Commutative	AB = BA	A + B = B + A
Associative	AB(C) = A(BC)	A + (B + C) = (A + B) + C
Identity	1A = A	0 + A = A
Null	0A = 0	1 + A = 1
Absorption	A(A + B) = A	A + AB = A
Distributive	(A + B)(A + C) = A + BC	A(B + C) = AB + AC
Idempotent	A(A) = A	A + A = A
Inverse	$\mathrm{A}(\overline{\mathrm{A}}) = 0$	$\mathrm{A} + \overline{\mathrm{A}} = 1$
Demorgan's	$\overline{\mathrm{AB}} = \overline{\mathrm{A}} + \overline{\mathrm{B}}$	$\overline{\mathrm{A} + \mathrm{B}} = \overline{\mathrm{A}}(\overline{\mathrm{B}})$

3.1 Simplify the following Boolean expressions:

(a) $(A+B)(A+\overline{B})C$

(b) $\bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + AB\bar{C} + A\bar{B}\bar{C} + ABC + A\bar{B}C$

(c) $\overline{A(\bar{B}\bar{C} + BC)}$

(d) $\overline{A}(A+B) + (B+AA)(A+\overline{B})$