

COMP 303

HW #2

1. Fill in the blanks below. Use two's complement representation for negative numbers. Limit binary and hex numbers to 16 bits.

Decimal	Two's Complement Binary	16-bit hexadecimal
a) 8	_____	_____
b) 13	_____	_____
c) -1	_____	_____
d) -2	_____	_____
e) 0	_____	_____
f) -10	_____	_____
g) -13	_____	_____
h) -14	_____	_____

2. For the following arithmetic operations, first convert the decimal to two's complement binary, then to 16-bit hexadecimal (or reuse the conversion from question 1 above), perform the operation, and convert the result back to decimal.

i) $8 + 8 =$

j) $-13 + 14 =$

k) $-13 + 13 =$

l) $13 + -14 =$

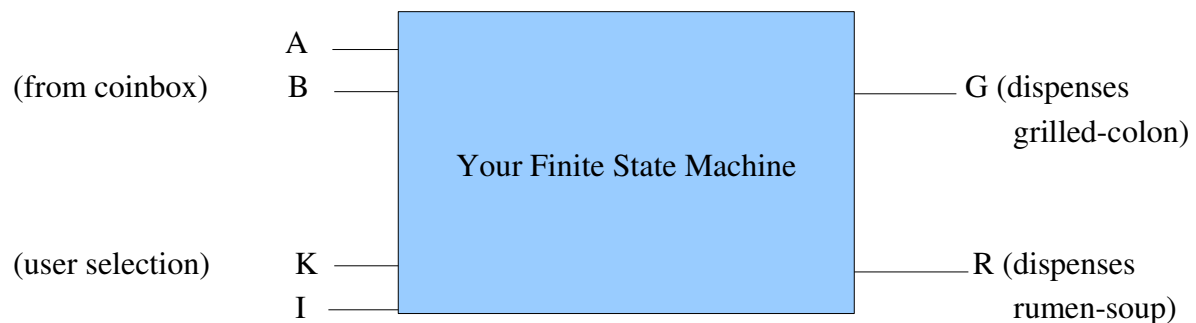
3. Design the circuitry for a rhythmbox. You'll need to produce outputs for drum and cymbals. Assume that we have an induction coil attached to output D; when D transitions from low to high, the induction coil causes an actuator to hit a big drum, creating a loud sound (let's call it "DUM"). Assume that we have a separate induction coil attached to output C; when C transitions from low to high, an actuator hits a cymbal, creating a tinny sound (let's call it "tsss").

Your circuit should play one loud and two tinny sounds in succession, then repeat ad infinitum (as in, DUM-tssss-tssss-DUM-tssss-tssss-DUM-tssss-tssss-DUM-tssss-tssss-DUM-tssss-tssss...)

A clock is the only input to your circuitry. Your circuit will have two outputs, D and C.

We, the course staff, have been unable to go to Bebek or Cadde recently because we cannot compete with other people's sound systems. Give us the circuit diagram for your rhythmbox so we can show them that Koç Engineering rules the world.

4. Recall that you had inherited a grilled-colon company in a previous homework. The minimum wage has gone up and personnel costs are driving you to bankruptcy. Now is the time to expand and fully automate the entire operation. Design a vending machine that dispenses a serving of food for 1.5 YTL. Your circuit will have four inputs. First two inputs come from a coinbox – input A goes high whenever the user inserts a 1 YTL coin, and input B goes high whenever the user inserts a 0.50 YTL coin. The coinbox automatically returns all other types of coins back to the user so you do not have to worry about them. Once the user has paid 1.50 or more, she can select either grilled-colon (kokoreç), or rumen-soup (iškembe çorbasi) by pressing one of two buttons: K for grilled-colon, or button I for rumen-soup. Your circuit can dispense grilled-colon or rumen-soup by making outputs G or R go high. So a simplified schematic for your device looks like this:



Your task is to fill in the circuitry that goes into the rectangle above. Keep in mind that your cart should not dispense anything unless the user has paid in full, and should dispense only the user's selected item after the payment has been made. This version of the cart cannot return change, so if the user pays 2 YTL, it's ok to keep the extra 0.50 YTL. Make and document (no need to justify, just state) all other reasonable assumptions necessary for your working solution.

- 4.a. Show the state-transition diagram for the final finite state machine.
- 4.b. Show the full circuitry for your new and improved food vending machine.
- 4.c. Describe what happens when the user presses buttons K and I at the same time.