COMP110 EXERCISE SHEET II: LOGIC GATES

Ed Powley

To complete this exercise sheet:

- **complete** the following problems using **pen and paper**; and
- **hand in** your solutions in the COMP110 workshop session in week 5.

1. Write out the truth tables for the following boolean expressions, for all possible values of boolean variables $A, B, C, \ldots$:
    (a) A AND B AND NOT C
    (b) A AND NOT $(B$ AND NOT $C)$
    (c) $(A$ OR NOT $B)$ AND $(A$ OR $C)$
    (d) A AND NOT $(B$ OR NOT $C)$ AND $($NOT A AND $D)$
2. Draw logic circuits for each of the expressions in Question 1.
3. Use truth tables to show that the following identities hold:
    (a) NOT $(A$ OR $B) = \neg A$ AND $\neg B$
    (b) NOT $(A$ AND $B) = \neg A$ OR $\neg B$
    (c) $(A$ AND $B)$ OR $(A$ AND $C) = A$ AND $(B$ OR $C)$
    (d) $(A$ OR $B)$ AND $(A$ OR $C) = A$ OR $(B$ AND $C)$
4. Explain, using the identities in Question 3 and/or truth tables, why each of the following pairs of programs is equivalent:
    (a)

```
if not(file_exists("a.txt") and file_exists("b.txt")):
    print("A required file is missing")
```

```
if not file_exists("a.txt") or not file_exists("b.txt"):
    print("A required file is missing")
```

    (b)

```
if (type(x) == int and x > 7) or (type(x) == float and x > 7):
    print("Hello")
```

```
if (type(x) == int or type(x) == float) and x > 7:
    print("Hello")
```

    (c)

```
if x == 0 and y == 0:
    do_something()
else:
    print("Do nothing")
```

```
if x != 0 or y != 0:
    print("Do nothing")
else:
    do_something()
```

    (d)

```
if x > 10 or (x > 0 and y > 0):
    do_something()
```

```
if x > 0 and (x > 10 or y > 0):
    do_something()
```