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# Automata and Logic Engineering 1 (ALE1)
# Feb 2019

# Assignments

**1: parse + tree**
**Due** Feb 21 at 12:45pm

**2: truth table + hash code**
**Due** Feb 28 at 12:45pm

**3: simplify**
**Due** Mar 14 at 12:45pm

**4: normalize**
**Due** Mar 21 at 12:45pm

**5: nandify**
**Due** Mar 31 at 11:59pm

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# ALE1 (so far)

- In ALE1, a sentence will be denoted as letter, e.g.:

  A, B, p, q, etc.

- Logical operators

| Logic notation | Operator | ASCII (prefix) |
|---|---|---|
| ¬ A | Negation | ~(A) |
| A ⇒ B | Implication | >(A,B) |
| A ⇔ B | Biimplication | =(A,B) |
| A ∧ B | Conjunction | &(A,B) |
| A ∨ B | Disjunction | \|(A,B) |

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# ALE1 (so far)

=(>(A,B),C))

Variables: A,B,C

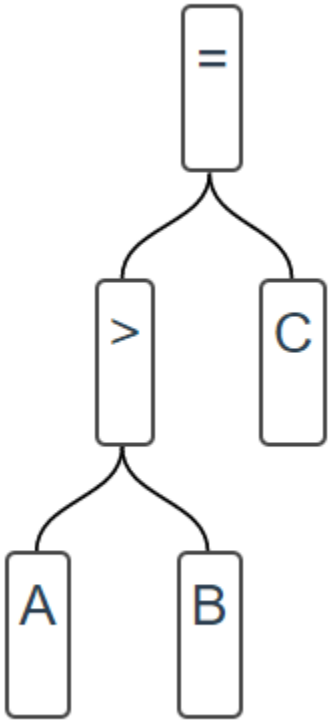


Fig.1: Graphical representation

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# Truth table

=(>(A,B),C))

Variables: A,B,C

| A | B | C | =(>(A,B),C)) |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

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# Truth table

| Logic notation | ASCII (prefix) |
|---|---|
| ¬ A | ~(A) |
| A ⇒ B | >(A,B) |
| A ⇔ B | =(A,B) |
| A ∧ B | &(A,B) |
| A ∨ B | \|(A,B) |

| A | ~(A) |
|---|---|
| 0 | 1 |
| 1 | 1 |

| A | B | >(A,B) |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

| A | B | =(A,B) |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

| A | B | &(A,B) |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

| A | B | \|(A,B) |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

# Truth table

- Filling up the truth table with 0/1s
  - order variables alphabetically

  e.g. =(>(A,Z),B) : A, B, Z
  - $2^{\#\text{variables}}$ rows
  - columns with 0/1 grouped as multiples of power of 2 using the number of variables in descending order

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# Truth table

– columns with 0/1 grouped as multiples of power of 2 using the number of variables in descending order

| A | ~(A) |
|---|---|
| 0 | 1 |
| 1 | 0 |

#variables = 1
#rows = $2^{\#variables}$
#0/1s = $2^{\#variables-1}$

| A | B | >(A,B) |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

#variables = 2
#rows = $2^{\#variables}$ = 4
#0/1s = $2^{\#variables-1}$
for A: $2^{\#variables-1} = 2^{2-1} = 2$
for B: $2^{\#variables-1} = 2^{1-1} = 1$

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# Truth table

| A | B | C | result |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

#variables = 3

#rows = $2^{\#\text{variables}}$ = 8

#0/1s = $2^{\#\text{variables}-1}$

for A: $2^{\#\text{variables}-1} = 2^{3-1} = 4$

for B: $2^{\#\text{variables}-1} = 2^{2-1} = 2$

for C: $2^{\#\text{variables}-1} = 2^{1-1} = 1$

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# Hexadecimal number

=(>(A,B),C))

Variables: A,B,C

| A | B | C | =(>(A,B),C)) |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

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# Hexadecimal number

- Concatenate the digits in the last column and print them as a hexadecimal number

| A | B | C | =(>(A,B),C)) |
|---|---|---|---|
| 0 | 0 | 0 | **0** |
| 0 | 0 | 1 | **1** |
| 0 | 1 | 0 | **0** |
| 0 | 1 | 1 | **1** |
| 1 | 0 | 0 | **1** |
| 1 | 0 | 1 | **0** |
| 1 | 1 | 0 | **0** |
| 1 | 1 | 1 | **1** |

Read from bottom up

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# Hexadecimal

- Group binary data in 4 digits and covert

e.g. 1001 1010 = 9A

| | | | | | | |
|---|---|---|---|---|---|---|
| $0_{hex}$ = $0_{dec}$ = $0_{oct}$ | 0 | 0 | 0 | 0 |
| $1_{hex}$ = $1_{dec}$ = $1_{oct}$ | 0 | 0 | 0 | 1 |
| $2_{hex}$ = $2_{dec}$ = $2_{oct}$ | 0 | 0 | 1 | 0 |
| $3_{hex}$ = $3_{dec}$ = $3_{oct}$ | 0 | 0 | 1 | 1 |
| $4_{hex}$ = $4_{dec}$ = $4_{oct}$ | 0 | 1 | 0 | 0 |
| $5_{hex}$ = $5_{dec}$ = $5_{oct}$ | 0 | 1 | 0 | 1 |
| $6_{hex}$ = $6_{dec}$ = $6_{oct}$ | 0 | 1 | 1 | 0 |
| $7_{hex}$ = $7_{dec}$ = $7_{oct}$ | 0 | 1 | 1 | 1 |
| $8_{hex}$ = $8_{dec}$ = $10_{oct}$ | 1 | 0 | 0 | 0 |
| $9_{hex}$ = $9_{dec}$ = $11_{oct}$ | 1 | 0 | 0 | 1 |
| $A_{hex}$ = $10_{dec}$ = $12_{oct}$ | 1 | 0 | 1 | 0 |
| $B_{hex}$ = $11_{dec}$ = $13_{oct}$ | 1 | 0 | 1 | 1 |
| $C_{hex}$ = $12_{dec}$ = $14_{oct}$ | 1 | 1 | 0 | 0 |
| $D_{hex}$ = $13_{dec}$ = $15_{oct}$ | 1 | 1 | 0 | 1 |
| $E_{hex}$ = $14_{dec}$ = $16_{oct}$ | 1 | 1 | 1 | 0 |
| $F_{hex}$ = $15_{dec}$ = $17_{oct}$ | 1 | 1 | 1 | 1 |

Fig.1: Conversion binary to hexadecimal

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# Assignment 1

- Read course description for more info
- Deadline Assignment 2

28th February 12:45h!

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