CSCI 246 – Class 2

PROPOSITIONAL LOGIC, COMPOUND STATEMENTS, ARGUMENTS, DIGITAL CIRCUITS
Quiz Questions

- Lecture 3: Give truth table for propositional variables p, q (include and, or, and not)

- Lecture 4: Give truth table for p implies q ($p \rightarrow q$)
Preferred programming languages?
D2L's Content section now contains copy of Syllabus and link to course website
Office Hours Update
Lesson 3 - Review

- Propositional Logic
- Logical Operations
- Truth Table
- DeMorgan’s Laws
Lesson 3 - Review

- Propositional Logic
- Proposition: Can be either true or false
- Example propositional variables:
Lesson 3 - Review

- Propositional Logic
- Proposition: Can be either true or false

- Example propositional variables:
  - p: it is the starship Enterprise
  - q: Kirk is the Captain
Lesson 3 - Review

Example propositional variables:
- p: it is the starship Enterprise
- q: Kirk is the captain

Logical Operations:
- \( p \land q \): *And, Conjunction* – It is the starship Enterprise and Kirk is captain
- \( p \lor q \): *Or, Disjunction* – it is the starship Enterprise or Kirk is captain
- \( \neg p \): *Not, Negation* – ?
Lesson 3 - Review

- Example propositional variables:
  - p: it is the starship Enterprise
  - q: Kirk is the captain

Truth Table:

<table>
<thead>
<tr>
<th>p</th>
<th>q</th>
<th>p ∧ q</th>
<th>p ∨ q</th>
<th>~p</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>T</td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td>F</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>T</td>
<td>F</td>
<td>F</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>F</td>
</tr>
</tbody>
</table>
Lesson 3 - Review

- Example propositional variables:
  - p: it is the starship Enterprise
  - q: Kirk is the captain

- DeMorgan’s Laws:
  - \( \sim (p \land q) \equiv \sim p \lor \sim q \)
    - “It is not (the starship Enterprise and Kirk is captain)” \( \equiv \) “It is not starship Enterprise OR Kirk is not captain”
  - \( \sim (p \lor q) \equiv \sim p \land \sim q \)
    - “It is not (the starship Enterprise or Kirk is captain)” \( \equiv \) “It is not starship Enterprise AND Kirk is not captain”
Lesson 4

- Logical Implication
- Contrapositive
- Bi-conditional
- Tautology vs Contradiction
- Logical Arguments
Lesson 4

Logical Implication

<table>
<thead>
<tr>
<th>p</th>
<th>q</th>
<th>p → q</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>F</td>
<td>T</td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>T</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
</tbody>
</table>
Lesson 4

Logical Implication

<table>
<thead>
<tr>
<th>p</th>
<th>q</th>
<th>p → q</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>F</td>
<td>T</td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>T</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
</tbody>
</table>

Example propositional variables:

- p: it is the starship Enterprise
- q: Kirk is the captain
Lesson 4

- **Contrapositive:** \( p \rightarrow q \equiv \sim p \rightarrow \sim q \)
  - It is the starship Enterprise implies Kirk is Captain
  - It is not the starship Enterprise implies Kirk is not Captain
- **Biconditional** “If and Only If (iff)”:
  \( p \leftrightarrow q \)
  - It is the starship Enterprise *iff* Kirk is Captain

- **Example propositional variables:**
  - \( p \): it is the starship Enterprise
  - \( q \): Kirk is the captain
Lesson 4

- Tautology: Always True
  - $p \lor \sim p \equiv T$
  - “It is the starship Enterprise OR it is not the starship Enterprise”

- Contradiction: Always False
  - $p \land \sim p \equiv F$
  - “It is the starship Enterprise AND it is not the starship Enterprise”

- Example propositional variables:
  - $p$: it is the starship Enterprise
  - $q$: Kirk is the captain
Lesson 4

Logical Arguments

- A VALID argument is a sequence of statements (which are called PREMISES) followed by a conclusion
- $\text{premises} \rightarrow \text{conclusion}$
- Premises: statement 1 ... statement n
- Conclusion: $\therefore$ therefore conclusion
Logical Arguments

A VALID argument is a sequence of statements (which are called PREMISES) followed by a conclusion

Example propositional variables:

- p: it is the starship Enterprise
- q: Kirk is the captain
- r: Red shirt dies
Lesson 4

Logical Arguments

- A VALID argument is a sequence of statements (which are called PREMISES) followed by a conclusion

- Premises: It is the starship Enterprise and Kirk is the captain
- Conclusion: Red shirt dies

Example propositional variables:

- p: it is the starship Enterprise
- q: Kirk is the captain
- r: Red shirt dies
Lesson 4

- Digital Logic
  - AND
    - A
    - B
    - x
  - OR
    - A
    - B
    - x
  - NOT
    - A
    - x
**Lesson 4**

- **Digital Logic**
  - **AND**
  - **OR**
  - **NOT**

- **Example propositional variables:**
  - **p:** it is the starship Enterprise
  - **q:** Kirk is the captain
  - **r:** Red shirt dies

- **Given Inputs:** p and q
- **Output:** r
Revisiting Set Notation

Sets:
- Starships = \{Enterprise, Voyager\}
- Captains = \{Kirk, Picard, Janeway\}

Set of items when red shirts die
- \( \text{Dead Reds} = \{x, y \mid x \in \text{Starships} \land y \in \text{Captains}\} \)
- In English: “The set of red shirts that die are equal to the ordered pair \(x,y\) where \(x\) is a member of Starships set and \(y\) is a member of Captain set”
1. What is the “English” version of: \( \{ x | x \in \mathbb{R} \land x = x^2 \} \)?
   i.e. how do you read the above?

2. What is the Roster Set notation of the above?

3. Give the truth table for \( (p \lor q) \land \neg r \)
   (Will draw hint on board)

4. Draw Digital Logic Diagram for \( (p \lor q) \land \neg r \)

5. What is the difference between \( \mathbb{N}, \mathbb{R}, \text{and } \mathbb{Z} \)?
Homework (Individual)

- Tell a story using the things we learned in class:
  - 1. Briefly describe the context of your story.
  - 2. Define 3 Premise statements p, b, r for your story
  - 3. Define a conclusion q
  - 4. Give an interesting, valid argument with p, b, r, and q
  - 5. Draw a Digital Logic diagram