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Set Theory

Marathi Phonemes

1. **Universal Set (U):** { अ, आ, इ, ई, उ, ऊ, ऋ, ॠ, ए, ऐ, ओ, औ, अं, अः, क, ख, ग, घ, ङ, च, छ, ज, झ, ञ, ट, ठ, ड, ढ, ण, त, थ, द, ध, न, प, फ, ब, भ, म, य, र, ल, व, श, ष, स, ह, ळ, क्ष, ज्ञ }
2. **Vowel Set (V):** {अ,आ,इ,ई,उ,ऊ,ए,ऐ,ओ,औ}
3. **Consonant Set (C):**
   {क,ख,ग,घ,ङ,च,छ,ज,झ,ञ,ट,ठ,ड,ढ,ण,त,थ,द,ध,न,प,फ,ब,भ,म,य,र,ल,व,श,ष,स,ह}
4. **Nasal Set (N):** {ङ,ञ,ण,न,म, ज्ञ}
5. **Voiced Consonants (G):** {ग,घ,ज,झ,ड,ढ,द,ध,ब,भ,म,न,ञ,ण}

Commutative Property

1. N ∪ G = G ∪ N
2. N ∩ G = G ∩ N

N ∪ G = {ङ, ञ, ण, न, म} ∪ {ग, घ, ज, झ, ड, ढ, द, ध, ब, भ, म, न, ञ, ण} = {ग, घ, ज, झ, ड, ढ, द, ध, ब, भ, म, न, ञ, ण, ङ}

G ∪ N = {ग, घ, ज, झ, ड, ढ, द, ध, ब, भ, म, न, ञ, ण} ∪ {ङ, ञ, ण, न, म} = {ग, घ, ज, झ, ड, ढ, द, ध, ब, भ, म, न, ञ, ण, ङ}

Associative Property

For three sets V, N, and G:

1. $(V \cup N) \cup G = V \cup (N \cup G)$
2. $(V \cap N) \cap G = V \cap (N \cap G)$

$V \cap N = \varnothing$ (since vowels and nasals have no elements in common)

Therefore $(V \cap N) \cap G = \varnothing \cap G = \varnothing$

$V \cap (N \cap G) = V \cap$ {ङ, ञ, ण, न, म} $= \varnothing$ (since vowels and nasals have no elements in common)

Distributive Property

For the sets V, N, and G:

1. $V \cup (N \cap G) = (V \cup N) \cap (V \cup G)$
2. $V \cap (N \cup G) = (V \cap N) \cup (V \cap G)$

Since $V \cap N = \varnothing$ and $V \cap G = \varnothing$ (as vowels don't overlap with consonant subsets), the second equation simplifies to:

$V \cap (N \cup G) = \varnothing \cup \varnothing = \varnothing$

Complement Properties

If we define the complement relative to the universal set U:

1. V' = C (The complement of vowels is the set of consonants)

2. $C' = V$ (The complement of consonants is the set of vowels)
3. $N' = (V \cup (C - N))$

The complement of nasals is all vowels and non-nasal consonants

$G' = (V \cup (C - G))$

The complement of voiced consonants is all vowels and unvoiced consonants)

Identity Property

1. $V \cup \varnothing = V$
2. $C \cap U = C$

Phonetic Features

1. **Place of Articulation Sets**:
   a. Labial (L): {प,फ,ब,भ,म,व}
   b. Dental (D): {त,थ,द,ध,न}
   c. Alveolar (A): {स,ल,र}
   d. Retroflex (R): {ट,ठ,ड,ढ,ण,ळ}
   e. Palatal (P): {च,छ,ज,झ,ञ,य,श}
   f. Velar (K): {क,ख,ग,घ,ङ}
   g. Glottal (H): {ह}

2. **Manner of Articulation Sets**:
   a. Plosives (PL): {प,फ,ब,भ,त,थ,द,ध,ट,ठ,ड,ढ,क,ख,ग,घ}

b. Affricates (AF): {च,छ,ज,झ}

c. Fricatives (F): {स,श,ष,ह}

d. Approximants (AP): {य,र,ल,व,ळ}

e. Nasals (N): {म,न,ण,ञ,ङ}

2. Sentential Logic

2.1. Conditional (—>)

1) dʒər paʊs paɖ-la, tar rasta: ola ho-ɪl.

If rain fall-PFV, then road wet be-FUT.3SG

If it rains, then the road will be wet.

P→Q

P = (paʊs paɖ-la)

Q = (rasta: ola ho-ɪl)

The conditional clauses in Marathi rely on dʒər… tər. The perfective marking -la is used for past events, while future auxiliary hoɪl marks the predicted consequences. The presence of tar shows logical dependency in the context in which it is written.

P	**Q**	**P → Q**
T	T	T
T	F	F
F	T	T
F	F	T

2.2. Conjunction (∧)

2) ram abʰjas kar-to aɳi ʃjam kheɭ-to.

ram study do-PRS.3SG and Shyam play-PRS.3SG

Ram studies and Shyam plays.

Two independent clauses are joined by the conjunction aɳi.

P∧ Q

P = ram abʰjas kar-to

Q = ʃjam kheɭ-to

Each conjunct maintains its independent tense marking. The present tense marker "-to" indicates habitual action in both clauses.

P	**Q**	**P ∧ Q**
T	T	T
T	F	F
F	T	F
F	F	F

2.3. Disjunction (∨, Or)

3) adʒə tu baher dʒa-sil kivha gʰəri rah-sil

today 2SG outside go-FUT.2SG or home stay-FUT.2SG

Today you will go out or stay at home.

P ∨ **Q**

P = adʒə tu baher dʒa-sil

Q = gʰəri rah-sil

P	**Q**	**P ∨ Q**
T	T	T
T	F	T
F	T	T
F	F	F

2.4. Negation (¬, Not)

4) mi adʒ ofis=at dʒanar nahi

1SG today office=LOC go.FUT NEG

I will not go to the office today.

2.5. Biconditional (↔, If and Only If)

5) dʒər aɳi tevhatʃ tu jaməv=ət je-sil tər tjala bʰetu ʃək-sil.

if and only.when 2SG gathering=LOC come-FUT.2SG then him meet can-FUT.2SG

If and only if you come to the gathering, you will be able to meet him.

P	**Q**	**P ↔ Q**
T	T	T
T	F	F
F	T	F
F	F	T

2.6. Modus Ponens

6) dʒər paus pad^{h}la, tər rastjavər paɳi asel.

if rain fall.PST, THEN road.LOC water be.FUT.3SG

If it rained, then there will be water on the road.

paus pad^{h}la

rain fall.PST

It rained.

mʰəɳun   rastja=vər paɳi   asel

therefore, road=LOC water be.FUT.3SG

Therefore, there will be water on the road.

P → Q

P

Therefore, Q

2.7. Modus Tonens

7) dʒər to arogjəvan asel, tər to tʃangla kʰeləl.

if 3MSG healthy be.FUT.3SG then 3MSG well play.FUT.3SG

If he is healthy, then he will play well.

to tʃangle kʰelt nahi

3MSG well play.PRS NEG

He does not play well.

mʰəɳun to arogjəvan nahi

therefore 3MSG healthy NEG

Therefore, he is not healthy.

$P \rightarrow Q$

$\neg Q$

Therefore, $\neg P$

3. Propositional Logics

1. **In a room, there are two types of people, namely type 1 and type 2. Type 1 people always tell the truth and type 2 people always lie. You give a fair coin to a person in that room without knowing which type he is from and tell him to toss it and hide the result from you till you ask for it. Upon asking, the person replies the following. "The result of the toss is heads and only if I am telling the truth." Which of the following options is correct?**
    a. The result is head
    b. The result is tail
    c. If a person of the type 2, then the result is tail.
    d. If the person is of type 1, then the result is tail.

The result of the toss is heads, and only if I am telling the truth.

Let's take P1 and P2 as two possibilities. P1 is the person who is type 1 (Truthful).

1. The person always tells the truth.
2. The statement then simplifies to - The result is head.

P2 is the person who is Type 2 (Liar)

1. The person always lies.
2. The statement “The result is head and only if I am saying the truth” must be false.
3. The phrase is false because he is a liar
4. If the entire statement is false, it means the result is not head, so it must be tail.

The answer is (C)

2. **A detective has interviewed four witnesses to a crime. From the stories of the witnesses, the detective has concluded that if the butler is telling the truth, then so is the cook. The cook and gardener and the handyman are the truth. If the gardener and the handyman are not both lying and if the handyman is telling the truth, then the cook is lying. For each of the four witnesses, can the detective determine whether that person is telling the truth or lying?**

B: Butler is telling truth

C: Cook is telling truth

G: Gardener is telling truth

H: Handyman is telling truth

If B then C ($B \rightarrow C$)

Not both C and G ($\neg(C \wedge G)$)

Not both ¬G and ¬H (¬(¬G ∧ ¬H)), which equals G ∨ H

If H then ¬C (H → ¬C)

C 1: H is true

1. From statement 4, if H is true, then C is false
2. From statement 2, if C is false, G can be either true or false
3. From statement 3, if H is true, G can be either true or false

C2: H is false

1. From statement 3, if H is false, then G must be true
2. From statement 2, if G is true, then C must be false
3. From statement 1, if C is false, then B must be false

If H is true, then C is false

If H is false, then G is true, C is false, and B is false

The only consistent solution is:

1. Butler (B): False (lying)
2. Cook (C): False (lying)
3. Gardener (G): True (telling truth)
4. Handyman (H): True (telling truth)

The statements assume that at least 1 person is lying, influencing how we interpret their truthfulness. The detective assumes the rules of rational conversation.

3. **Are these system specifications consistent?**

a. The system is in a multiuser state if and only if it is operating normally.

b. If the system is operating normally then the kernel is functioning.

c. The kernel is not functioning or the system is in interrupt mode

d. If the system is not in a multiuser state, then it is in interrupt mode.

e. The system is not in interrupt mode .

1. M: The system is in a multiuser state
2. N: The system is operating normally
3. K: The kernel is functioning
4. I: The system is in interrupt mode

Given,

a. $M \leftrightarrow N$ (The system is in a multiuser state if and only if it is operating normally)

e. $\neg I$ (The system is not in interrupt mode)

The problem is underspecified as it's missing several conditions, but based on the given information, we can say that $M \leftrightarrow N$ and $\neg I$ must be true in a consistent system.

This means that either both M and N are true, or both M and N are false, and I must be false.

4. **On an island there are two kinds of inhabitants, knights who always tell the truth, and their opposites, knaves, who always lie. You encounter two people A and B. Determine, if possible, what A and B are if they address you in the ways described.**

We can encounter two people A and B. Their statements will determine whether they are. Knights (truthful) or knaves (liars).

If a person is knight —> True

If a person is knave —> False

If A and B make statements about each other.

If A says B is knave and B says A is a knight, they contradict each other. A knight would never falsely accuse another knight. A knave would always lie about another's nature. A constraint based model can be built using predicate logic.

A is Knight —> B must be knave

A is Knave —> His statement is false, meaning B must be Knight.

4. Tautology, Contradiction and Contingency

1. **A∨B**

Contingency

The statement "A or B" is true when either A is true, B is true, or both are true. It's only false when both A and B are false. Since this depends on the truth values of A and B, it's a contingency.

2. (P&(¬Q∨¬R))⇒(P⇒¬Q)

Tautology

Left side: P&(¬Q∨¬R) means "P is true AND either Q is false OR R is false"

Right side: P⇒¬Q means "if P is true, then Q is false"

We can rewrite P⇒¬Q as ¬P∨¬Q.

Let's construct a partial truth table to check critical cases:

1. If P is false, then P⇒¬Q is true, making the entire implication true.
2. If P is true and Q is true, then:
    a. Left side: P&(¬Q∨¬R) = T&(F∨¬R) = T&¬R = ¬R
    b. Right side: P⇒¬Q = F
    c. So the implication is ¬R⇒F, which is only true when ¬R is false, i.e., R is true.
3. If P is true, Q is false, then:
    a. Right side: P⇒¬Q = T, making the entire implication true

3. A⇒(A&B)

Contingency

The statement "if A then A and B" means that whenever A is true, both A and B must be true. This is only possible when B is also true. If A is true but B is false, the statement is false.

A	**B**	**A & B**	**A ⇒ A & B**
T	T	T	T
T	F	F	F
F	T	F	T
F	F	F	T

4. (A∨B)⇒A

Contingency

This statement is "if A or B, then A." It's false when (A∨B) is true but A is false, which happens when A is false and B is true.

A	**B**	**A∨B**	**(A∨B)⇒A**
T	T	T	T
T	F	T	T
F	T	T	F
F	F	F	T

5. (A⇔B)∨(A&¬B)

Contingency

A⇔B is true when both A and B have the same truth value

A&¬B is true when A is true and B is false

A	**B**	**A⇔B**	**A&¬B**	**(A⇔B)∨(A&¬B)**

T	T	T	F	T
T	F	F	T	T
F	T	F	F	F
F	F	T	F	T

Since, there's at least one case where it's false, it's a contingency.

6. (X⇒Z)⇒(Y⇒Z)

Contingency

This statement is false when (X⇒Z) is true and (Y⇒Z) is false. (Y⇒Z) is false when Y is true and Z is false. So we need X⇒Z true and Y true and Z false. This happens when X is false or Z is true, Y is true, and Z is false, which is possible when X is false, Y is true, and Z is false.

7. (P&¬(Q&R))∨(Q⇒R)

Tautology

The statement (Q⇒R) can be rewritten as (¬Q∨R). Looking at all cases:

1. If Q is false, then ¬Q is true, making Q⇒R true and the whole statement true.
2. If Q is true and R is true, then Q&R is true, ¬(Q&R) is false, but Q⇒R is true, making the whole statement true.
3. If Q is true and R is false, then Q&R is false, ¬(Q&R) is true, and if P is true, the first part is true. If P is false, then the first part is false, but Q⇒R is false, which means the whole statement might be false.

If Q is true and R is false, then Q⇒R is false, and Q&R is false, making ¬(Q&R) true. So P&¬(Q&R) = P&T = P . Thus (P&¬(Q&R))∨(Q⇒R) = P∨F = P. In every case, the statement is true, making it a tautology.

8. ((P∨Q)⇒R)∨¬((P∨Q)⇒R)

Tautology

This statement has the form A∨¬A, which is always true regardless of what A is (law of excluded middle). So this is always true, making it a tautology.

9. ((P∨Q)⇒R)&¬((P∨Q)⇒R)

Contingency

This statement has the form A&¬A, which is always false regardless of what A is (law of noncontradiction). So this is always false, making it a contradiction.

10. (P ∨ ¬Q) ⇒ (¬P ∧ Q)

Contingency

This statement is false when the left side is true and the right side is false.

Left side (P ∨ ¬Q) is true when either P is true or Q is false (or both).

Right side (¬P ∧ Q) is true only when P is false and Q is true.

P	**Q**	**P∨¬Q**	**¬P∧Q**	**(P∨¬Q)⇒(¬**

				P∧Q)
T	T	T	F	F
T	F	T	F	F
F	T	F	T	T
F	F	T	F	F

Since it’s false in some cases and true in others, it’s a contingency.

11. (P ⇒ Q) ⇔ (¬P ∨ Q)

Tautology

This is a tautology because it expresses the logical equivalence between an implication and its disjunctive form. P⇒Q is logically equivalent to ¬P∨Q by definition.

P	**Q**	**P⇒Q**	**¬P∧Q**	**(P⇒Q)⇔(¬P ∨Q)**
T	T	T	T	T
T	F	F	F	T
F	T	T	T	T
F	F	T	T	T

It’s true in all cases, so it’s a tautology.

12. It is raining

Contingency

This is a simple factual statement about the weather. It can be either true or false depending on the actual weather conditions.

13. Either it is raining, or it is not

Tautology

This statement has the form $P \vee \neg P$, which is always true by the law of excluded middle. No matter what the weather is, either it's raining or it's not raining.

14. It is both raining and not raining

Contradiction

This statement has the form $P \& \neg P$, which is always false by the law of non-contradiction. It cannot simultaneously be both raining and not raining.

15. If it is snowing, then it is cold

Contingency

This is an empirical statement that depends on how we define "snowing" and "cold." While it often holds true in nature, we can imagine situations where it might not (e.g., artificial snow in warm environments). Therefore, it's a contingency.

16: Validity of Deductions

a. A valid deduction whose conclusion is a contradiction

Not possible

In a valid deduction, if all premises are true, then the conclusion must be true. Since a contradiction is always false, it cannot be the conclusion of a valid deduction with true premises. If the premises were true and the deduction valid, the conclusion would have to be true, contradicting the nature of a contradiction.

b. A valid deduction whose conclusion is a tautology

Possible

"A or not A" can be validly deduced from any premise, since a tautology is always true regardless of the premises.

1. It is raining (Premise)
2. Therefore, either it is raining or it is not raining (Conclusion - Tautology)

c. A valid deduction that has a tautology as one of its hypotheses

Possible

A tautology can certainly be used as a premise in a valid deduction.

1. Either it is raining or it is not raining (Premise - Tautology)
2. It is not raining (Premise)
3. Therefore, it is not raining (Conclusion)

d. A valid deduction that has a contradiction as one of its hypotheses

Possible

In classical logic, from a contradiction, anything follows (principle of explosion).

1. It is both raining and not raining (Premise - Contradiction)
2. Therefore, the moon is made of cheese (Conclusion)

This is valid because if we assume a contradiction is true (which it can't be), we can deduce anything.

e. An invalid deduction whose conclusion is a contradiction

Possible

An invalid deduction doesn't preserve truth, so it can lead to false conclusions (like contradictions) from true premises.

1. It is raining (Premise)
2. Therefore, it is both raining and not raining (Conclusion - Contradiction)

This deduction is invalid because the conclusion doesn't follow from the premise.

f. An invalid deduction whose conclusion is a tautology

Not possible

This is tricky. Even though the deduction may be invalid (not following logical rules), if the conclusion is a tautology, it's true regardless of the premises or the validity of the reasoning. So technically, we might say it's not possible to have an "invalid" deduction to a tautology in terms of truth preservation, since the conclusion is always true anyway.

However, if we define validity in terms of the form of the argument rather than truth preservation, then we can have an invalid deduction with a tautology as the conclusion.

1. It is raining (Premise)
2. Therefore, either the sky is blue or the sky is not blue (Conclusion - Tautology)

The conclusion doesn't properly follow from the premise (invalid form), even though it's always true.

g. An invalid deduction that has a tautology as one of its hypotheses

Possible

Having a tautology as a premise doesn't guarantee the validity of the deduction.

1. Either it is raining or it is not raining (Premise - Tautology)
2. The sun is shining (Premise)
3. Therefore, it is not raining (Conclusion)

This is invalid because the conclusion doesn't necessarily follow from the premises.

h. An invalid deduction that has a contradiction as one of its hypotheses

Not possible (in classical logic)

In classical logic, from a contradiction, anything follows (principle of explosion). So any deduction from a contradiction would technically be valid, not invalid.

1) **There is a woman who has taken a flight on every airline in the world.**

$\exists x[Woman(x) \wedge \forall y[Airline(y) \rightarrow HasFlownOn(x,y)]]$

x is from the set of all people, y is from the set of all airlines

Where Woman(x) means x is a woman

Where Airline(y) means y is an airline

Where HasFlownOn(x,y) means x has taken a flight on airline y

2) **Brothers are siblings, siblinghood is symmetry, everyone likes himself.**

$\forall x \forall y[Brother(x,y) \rightarrow Sibling(x,y)]$

$\forall x \forall y[Sibling(x,y) \rightarrow Sibling(y,x)]$

$\forall x[Likes(x,x)]$

The set of all people

Where Brother(x,y) means "x is a brother of y"

Where Sibling(x,y) means "x is a sibling of y"

Where Likes(x,y) means "x likes y"

If Brother(John,Mary) is true

Then by rule 1, Sibling(John,Mary) is true

Then by rule 2, Sibling(Mary,John) is true

By rule 3, Likes(John,John) and Likes(Mary,Mary) are both true.

5. Travel Agency FAQ

I am creating a FAQ system to see basic sentential logic which can be used to formalize a travel agency's business rules. I'm using propositional logic with simple IF-THEN structures to model travel conditions and answer common customer questions.

Let me take two people for example purpose - their names are Sarah and Michael.

1. Sarah is a family traveler with two children. She is planning a beach vacation to Bali. She wants to travel in July (Summer/ High season). She has done her booking 45 days in advance.
2. Michael is a solo business traveler. He is planning a trip to Paris. He needs to travel in November (off season). He has booked 10 days in advance due to a last minute meeting.

From this, we can define some basic conditions which can be either true or false for each traveler.

Conditions	Sarah	Michael
Traveling during high season	T	F

Traveling with family	T	F
Booking more than 30 days in advance	T	F
Destination is international	T	T
Traveling during summer	T	F

I have used IF-THEN statements to show that the travel agency operates under these logical rules.

Rule 1 - IF a customer travels during high season, THEN they pay a higher price.

HighSeason(x) → PaysHighPrice(x)

Rule 2 - IF a customer travels with family, THEN their package includes child friendly activities. HasFamily(x) → IncludesChildActivities(x)

Rule 3 - IF a customer books more than 30 days in advance, THEN they qualify for an early booking discount. BookingDays(x, n) ∧ (n > 30) → QualifiesForEarlyDiscount(x)

Rule 4 - IF a customer books more than 30 days in advance AND is not traveling during high season, THEN they get a full refund on cancellation.

[BookingDays(x, n) ∧ (n > 30) ∧ ¬HighSeason(x)] → FullRefund(x)

Rule 5 - IF the destination is international, THEN the customer needs to check visa requirements. International(x) → NeedsVisaCheck(x)

Rule 6 - IF a customer travels during summer, THEN they can participate in all beach activities. TravelSummer(x) → CanDoBeachActivities(x)

Rule 7 - IF a customer travels with family OR books more than 30 days in advance, THEN they qualify for a discount.

[HasFamily(x) ∨ (BookingDays(x, n) ∧ (n > 30))] → QualifiesForDiscount(x)

Based on the rules, let me apply them to Sarah and Michael's travel plans.

1. **Will Sarah have to pay a higher price?**

Sarah is travelling during high season (July in Bali). According to Rule 1, if traveling during high season, THEN pay higher price. Yes, Sarah will pay a higher price.

$$\text{Traveler(Sarah)} \wedge \text{HighSeason(Sarah)} \rightarrow \text{PaysHighPrice(Sarah)}$$

2. **Will Michael's package include child friendly activities?**

Michael is not traveling with family. According to Rule 2, IF traveling with family, then the package includes child friendly activities.

Since HasFamily(Michael) is false, the antecedent is not satisfied:

$\neg$HasFamily(Michael)

HasFamily(Michael) $\rightarrow$ IncludesChildActivities(Michael)

$\therefore$ No conclusion about IncludesChildActivities(Michael)

So No, Michael's package will not specifically include child friendly activities.

3. **Does Sarah qualify for any discount?**

Sarah is traveling with family AND booking more than 30 days in advance. According to Rule 7, IF traveling with family OR booking more than 30 days in advance, THEN qualify for a discount.

Since HasFamily(Sarah) is true and (BookingDays(Sarah, 45) $\wedge$ (45 > 30)) is true:

HasFamily(Sarah) $\vee$ (BookingDays(Sarah, 45) $\wedge$ (45 > 30))

[HasFamily(Sarah) $\vee$ (BookingDays(Sarah, 45) $\wedge$ (45 > 30))] $\rightarrow$

QualifiesForDiscount(Sarah)

$\therefore$ QualifiesForDiscount(Sarah)

Yes, Sarah qualifies for a discount and for both the reasons.

4. Does Michael qualify for any discount?

Michael is not traveling with family AND not booking more than 30 days in advance.

According to Rule 7, IF travelling with family OR booking more than 30 days in advance, THEN qualify for a discount.

$[HasFamily(Michael) \lor (BookingDays(Michael, 10) \land (10 > 30))] \rightarrow QualifiesForDiscount(Michael)$

Since HasFamily(Michael) is false and $(BookingDays(Michael, 10) \land (10 > 30))$ is false:

$\neg HasFamily(Michael) \land \neg(BookingDays(Michael, 10) \land (10 > 30))$

$\neg[HasFamily(Michael) \lor (BookingDays(Michael, 10) \land (10 > 30))]$

The condition is not satisfied.

So, No Michael does not qualify for a discount.

5. Does Michael need to check Visa requirements?

Paris is an international destination. According to Rule 5, IF the destination is international, THEN check visa requirements.

$International(Michael) \rightarrow NeedsVisaCheck(Michael)$

Since International(Michael) is true, we can apply modus ponens:

$International(Michael)$

$International(Michael) \rightarrow NeedsVisaCheck(Michael)$

$\therefore NeedsVisaCheck(Michael)$

Yes, Michael needs to check visa requirements.

So based on their scenarios and using logical rules, I can create answers to common customer questions which is my FAQ system.

Q1. Will my trip be more expensive during summer?

Yes, **if** you travel during the high season (summer for most destinations), **then** you will pay higher than our standard rates.

$HighSeason(x) \rightarrow PaysHighPrice(x)$

Q2. Does your package have activities for children?

Yes, **if** you have opted for family bookings **then** automatically the package includes child friendly activities appropriate for your children's ages.

$HasFamily(x) \rightarrow IncludesChildActivities(x)$

Q3. How can I get a discount on my booking?

You can qualify for a discount **either** by traveling with family **or** by booking more than 30 days in advance.

$[HasFamily(x) \lor (BookingDays(x, n) \land (n > 30))] \rightarrow QualifiesForDiscount(x)$

Q4. What is your cancellation policy?

To receive a full refund on cancellation, you must book more than 30 days in advance and be traveling during the off-season. Otherwise, partial **or** no refunds apply depending on timing.

$[\text{BookingDays}(x, n) \wedge (n > 30) \wedge \neg\text{HighSeason}(x)] \rightarrow \text{FullRefund}(x)$

Q5. Do I need a visa for my trip?

If you are traveling for international destinations, **then** you should check visa requirements based on your nationality and destination country.

$\text{International}(x) \rightarrow \text{NeedsVisaCheck}(x)$