# **CISC204 User Identification | Group 9 - Adam, Amanda, Nick, Vanshita**

# Project Summary

*Short summary of the project setting.*

In summary, our project focuses on the aspect of user identification, a common industry application of logical thinking and strategies. When our program is run, we first survey input responses from the user through a series of questions. When processing the input, we initially start out with a long message, and through the use of predicate logic, we are then able to narrow down which user has sent the message. This is based on the propositions generated from the message given, as well as the constraints we generated for each user as depicted below.

# Propositions

#### Properties:

*Our propositions (properties) are simply characteristics that a user can take on. If the users message includes keywords such as “play soccer”, or “student at Queens”, then we know the characteristic is True, otherwise, we can conclude that the proposition (characteristic) is False.*

* **S**: Plays soccer
* **T**: Plays soccer intramurals
* **B**: Plays music
* **G:** plays guitar
* **D:** Student
* **Q**: Student at Queen’s
* **C**: In a school club
* **F:** Taking a specialization
* **P:** classes in-person
* **A**: 1st year student
* **R**: Living on-residence

#### Users:

*The users we have ‘generated’ are also propositions of a separate class. These Users can take on characteristics from our Properties class.*

* NG: Nicholas
* AM: Amanda
* VU: Vanshita
* AC: Adam
* JR: Jimmy
* MP: Moira
* GG: Gary

# Constraints

*List of constraint types used in the model and their (English) interpretation.*

#### User Constraints:

*These are simply constraints which conclude which properties each user has.*

* NG → S ∧ D ∧ Q ∧ F ∧ P
  + Nick plays soccer, is a student at Queens, is taking a specialization, and has classes in person
* AM → S ∧ T ∧ D ∧ Q, ∧ C ∧ F ∧ P
  + Amanda plays soccer, plays soccer intramurals, is a student, a student at Queens, in a school club, is taking a specialization, and has classes in person
* VU → B ∧ D ∧ Q ∧ C ∧ F ∧ P
  + Vanshita plays music, is a student, a student at Queens, in a school club, taking a specialization and has in person classes
* AC à S ∧ T ∧ D ∧ Q ∧ F ∧ P
  + Adam plays soccer, plays soccer intramurals, is a student, a student at Queens, is taking a specialization, and has classes in person
* JR → S ∧ G ∧ B ∧ D ∧ C ∧ A ∧ R
  + Jimmy plays soccer, plays the guitar, plays music, is a student, in a school club, is a first-year student, and is living on residence
* MP → S ∧ T ∧ B ∧ P ∧ D ∧ C
  + Moira plays soccer, plays soccer intramurals, plays music, takes classes in person, is a student, is in a school club
* GG → G ∧ B ∧ S
  + Gary plays guitar, plays music, and plays soccer

#### Property Constraints:

*These help us simplify more general properties, and help us conclude which properties are also true based on assumptions.*

* T ∨ Q ∨ C ∨ F ∨ P ∨ A ∨ R à D
  + If user plays soccer intramurals, student at Queens, in a school club, taking a specialization, has classes in-person, first-year student, or living on res, then this implies the user is a student
* Q ∧ A à R
  + If user is a student at Queens and they are in first year, then they live on res
* T à (S ∧ D)
  + If the user plays soccer intramurals, then we know the user plays soccer, and is a student
* F à A
  + if the user is taking a specialization, then we know the user is not a first-year
* B à G
  + If the user does not play any instrument, then they must not play guitar
* G à B
  + If the user plays guitar, then this implies they play an instrument
* C à D
  + In a school club implies the user is a student

#### Property-to-User Constraints:

*Show us which users apply to each individual characteristic property*

* S à NG ∨ AM ∨ AC ∨ JR ∨ MP
  + If the user plays soccer, then the user can possibly be Nick or Amanda or Adam, or Jimmy, or Moira
* T à AM ∨ AC ∨ JR ∨ MP
  + If the user plays soccer intramurals, then the user can possibly be Amanda, Adam, Jimmy, or Moria
* B à VU ∨ JR ∨ MP ∨ GG
  + If the user plays music, then the user can possibly be Vanshita, Jimmy, Moira, or Gary
* G à JR ∨ GG
  + If the user plays guitar, then the user can possibly be Jimmy or Gery
* D à NG ∨ AM ∨ VU ∨ AC ∨ JR ∨ MP
  + If the user is a student, then the user can possibly be Nick, Amanda, Vanshita, Adam, Jimmy, or Moira
* Q à NG ∨ AM ∨ VU ∨ AC
  + If the user is a student at Queens, then the user can possibly be Nick, Amanda, Vanshita, or Adam
* C à AM ∨ VU ∨ ∨ JR ∨ MP
  + If the user is in a school club, then the user is Amanda, Vanshita, Jimmy or Moira
* F à NG ∨ AM ∨ VU ∨ AC
  + If the user is taking a specialization, then the user is Nicholas, Amanda, Vanshita or Adam
* P à NG ∨ AM ∨ VU ∨ AC ∨ MP
  + If the user has in person classes, then the user is Nicholas, Amanda, Vanshita, Adam or Moira
* A à JR
  + If the user is a first-year student, then the user is Jimmy
* R à JR
  + If the user is living on residence, then the user is Jimmy

# Model Exploration

*List all the ways that you have explored your model – not only the final version, but intermediate versions as well. See (C3) in the project description for ideas.*

# *Current Idea*

* Given a specific message (sent from one of the 7 users), we will conclude which user(s) sent this message based on the given constraints each user has.
  + This might look something like this:
    - “I play soccer intramurals, and I am a student at Queens, and I am taking a specialization.”
    - From this, using python and our jape proofs, we will be able to conclude that this message could have been sent from: Amanda, or Adam

#### Previously Explored Ideas:

* Given a specific message, once again, sent from one of the 7 users, we would generate a response using emojis.
  + Our response would be generated through reactions that included agreement/disagreement, laughter/crying, and celebration.
  + *How does this differ from our current idea?*
    - Instead of generating a response with emojis, we are now simply going to conclude which user sent the message that was given to us.

# First-Order Extension

*Describe how you might extend your model to a predicate logic setting, including how both the propositions and constraints would be updated.* ***There is no need to implement this extension!***

#### Jape Proofs:

1. Our first proof is simply proving a constraint. Our main goal here is to build up propositions in order to match a user to the total propositions at the end of our main premise (which would be the message sent). This is simply one step, which allows us to conclude that when the user plays soccer intramurals, we know the user is also a student and they play soccer.

![Table

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1. Here we have another basic constraint proof which simply allows us to conclude that a student living on residence is also a first-year student and a student at Queen’s.

![A picture containing table

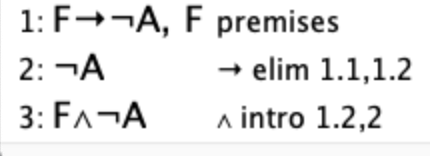
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1. In the following jape proof, we show that if we know the user is a Queen’s student, and they do not live on residence and they are not a first year, then they are a Queen’s student and they are taking a specialization.

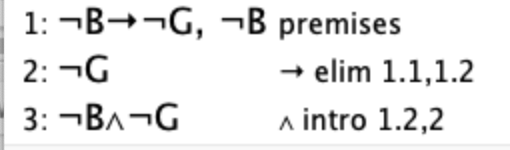
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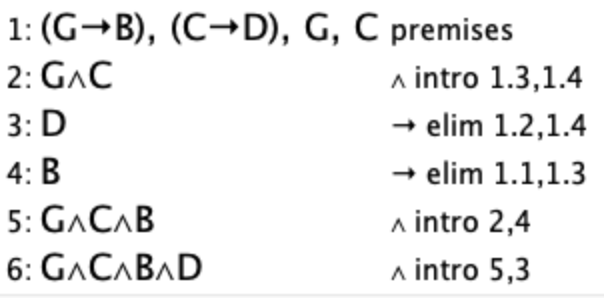
1. In this next proof, it illustrates that given our constraints; F(Taking a specialization) implies that ¬A(1st year student). Then if a given user is taking a specialization, we can conclude that they are taking a specialization(F) and (∧) they are not a first-year student(¬A).



1. Another constraint we have listed is the limitation that a user that does not play music (¬B) implies (à) they also do not play guitar(¬G) and thus, we can conclude that the message must have been sent by a user that does not play music (¬B) and(∧) they do not play guitar (¬G).



1. Finally, the following proof combines two simple constraints; a user that plays guitar(G) implies (à) they play music(B), a user that is in a school club(C) implies (à) they are a student(D). Therefore, given a user that plays guitar(G) and is in a school club(C) we can prove that the user plays guitar(G) and(∧) they play music(B) and(∧) they are in a school club(C) and(∧) they are a student.



#### How our setting can be modeled using predicate logic:

* In our real-world problem, we have people that fit certain properties, for example, someone might play soccer and guitar.
  + In our predicate logic setting, this individual is a user, and these properties are characteristics of the user (ie. A sub-class)
* Each user that is implemented in setting has a sub-class array of their characteristics
* Moving on to our constraints, in a real-world situation, we know if an individual plays guitar, this means they play music. As well, if an individual is in first year, and they have classes in-person, then we can also conclude they live on residence.
  + This can be modelled in a predicate logic setting using implications with conjunctions and disjunctions. All of our constraints have been listed in this document above, and in our run.py file, we have created these constraints and added them to the encoding to help narrow down our options for the user satisfiability.
* Examples:
  + ∃x.(Q(x) ∧ A(x)) →R(x)
    - If there exists some user who is student at Queen’s and is in a club, then they live on residence
  + ∀x.(T(x) ∨ Q(x) ∨C(x)∨P(x)∨A(x)∨R(x)) →∃x.D(x)
    - For all users who play soccer intramurals, are a Queen’s student, in a school club, has classes in person, is in first year, or lives on residence, then there exists some user who is a student
  + ∃x.P(x) →∃x.(NG(x) ∨AM(x)∨VU(x)∨AC(x)∨MP(x))
    - If there exists some user who has classes in person, then there exists some user who is either Nicholas, Amanda, Vanshita, Adam or Moira
  + ∀x.A(x) →∃x.JR(x)
    - If for all users are a first-year student, then there exists a user who is Jimmy

#### Python Implementation:

* For our python implementation we have created 2 classes of propositions which includes our basic propositions (ie. Properties), along with our user propositions
* For our encoding, we went ahead and added all our propositions
* Followed by this, in our example\_theory function, we went ahead and replicated our constraints outlined in this document and added them to our encoding.
* Lastly, we gathered properties from our user using simple input statements which helped us gather which user it could be
  + Using these inputs, we either added the property or its negation to our encoding to finalize all of the property inputs for each user.
* When the file is compiled the inputted properties along with the constraints, the encoding is able to confirm a satisfiability for each user, and return the specific user which is most satisfiable, along with the percentage distribution amongst our set users we created
* Functions that are in our program:

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* getInputs():
  + This function simply consists of a list of all questions that are asked to the user in order for the user to generate their list of properties
  + We have a for-loop which loops through each question, and in this for loop we store each input response and add it to our inputs list
  + Our function returns a list of inputs, which we anticipate to simply be a list of strings that are “T” or “F”
    - The user can enter anything else, therefore, it is possible that strings can be any other ‘jibberish’
      * Therefore, we created our checkInputs() function
* checkInputs()
  + This function takes in a list called inputs as its parameter and checks if the user entered a valid input
  + It loops through the list that consists of the user inputs and checks if the input is a “T” (true) or “F” (false)
  + If the input is not valid, then the function directs the user to enter a valid input and returns False
* InitializingInputs():
  + This function takes in a parameter input, an array of what the user has entered in response to our terminal questions, and loops through the array of inputs checking if the user response is equal to “T” (true) or “F” (false)
  + While looping through the array, if the inputs is equal to “T”, then we add the response to our list of characteristics
  + If the input is equal to “F”, then we add the negated version of their response to the list of characteristics