Transcription from English to Predicate Logic

General Principles of Transcription

- In transcribing an English sentence into Predicate Logic, some general principles apply.
- A transcription guide must be provided.
- It should be determined in advance whether you are using restricted quantifiers or are giving a "complete" transcription.
- You should symbolize as much of the logical structure of the sentence as possible.
- If two sentences of Predicate Logic are equivalent, then neither is more adequate than the other, although one of the two may make the logical form of the English sentence more perspicuous.
- If an English sentence is ambiguous, it may allow for more than one adequate transcription.
- In different contexts, we will "hear" the sentence in different ways.

The Indefinite Article

- The indefinite article 'a' can function as a universal and an existential quantity term.
  - 'A car can go very fast'.
  - 'Any car can go very fast' (universal).
  - 'At least one car can go very fast' (existential).
- Generally, we use the article as a universal quantity term when the subject is taken to be a class of things, e.g. cars.
- We generally use the article as an existential quantity term when the subject is taken to be a specific thing which we do not wish to or cannot identify.
- Sometimes how we understand the predicate of the sentence makes a difference:
  - 'Fast' in comparison to the speed of non-motorized vehicles indicates that the universal might be the best reading.
  - 'Fast' is taken in comparison to the highest speeds of modern motorized vehicles, indicates the existential.

‘Anyone’

- Generally, ‘anyone’ indicates a universal quantifier.
  - Anyone has the right to vote.
  - $(\forall x)_P Vx$.
- When used in the antecedent of a conditional without cross-reference, ‘anyone’ can function as an existential quantifier.
  - If anyone is at home, the lights will be on.
  - $(\exists x)_P Hx \supset J$.
- If there is cross-reference between the antecedent and the consequent, then the universal quantifier is usually called for.
  - If anyone is at home, it is a boy.
  - $(\forall x)_P (Hx \supset Bx)$.

‘Someone’

- Generally, ‘someone’ indicates an existential quantifier.
  - Someone is a registered voter.
  - $(\exists x)_P Rx$.
- If there is cross-reference between the antecedent and the consequent, then ‘someone’ can function as a universal quantifier.
  - If someone is at home, it is a boy.
  - $(\forall x)_P (Hx \supset Bx)$.

Ambiguity with ‘Anyone’ and ‘Someone’

- Some uses of ‘anyone’ in the antecedent of a conditional without cross-reference can be interpreted as universal quantifiers.
- These will be cases of logical truths in which the conditional expresses universal instantiation.
  - If anyone is a boy, then John is a boy.
  - $(\forall x)_P Bx \supset Bj$.
- Some uses of ‘someone’ which seem to apply to classes of things, and thus call for the universal quantifier, apply to a single thing and thus call for an existential quantifier.
  - Someone who is a registered voter has the right to vote.
  - $(\exists x)(Rx \& Vx)$.

Classes and Members of a Class

- Generally, we use the universal quantifier when we want to talk about a class of objects.
- Sometimes in a sentence we have more universal quantity expressions, each being about a class of objects.
  - All the boys kissed all the girls.
- This is perhaps most naturally taken to relate each member of the class of boys to each member of the class of girls.
  - $(\forall x)_{\mathsf{B}}(\forall y)_{\mathsf{G}}Kxy$.
- But it may also taken as stating that the boys, taken as a class, kissed the girls, taken as a class.
- The boys as a class all gave kisses to girls, and the girls as a class all received kisses from boys.
  - $(\forall x)_{\mathsf{B}}(\exists y)_{\mathsf{G}}Kxy \mathbin{\&} (\forall x)_{\mathsf{G}}(\exists y)_{\mathsf{B}}(Kyx)$.

The Scope of Negation Expressions

- Ambiguity can arise because of the variability of the **scope** of natural language operators, including negation, and (in modal logic) words like ‘necessarily’ and ‘possibly’.
  - All the boys are not at home.
- The word ‘not’ might have narrow scope, governing the phrase ‘at home’.
  - $(\forall x)_{\mathsf{P}}(Bx \supset \sim Hx)$.
- Or ‘not’ may have wide scope, governing the whole sentence.
  - $\sim(\forall x)_{\mathsf{P}}(Bx \supset Hx)$.

Scope and Quantifiers

- Scope ambiguities also arise with the use of multiple quantifiers.
  - All the boys kissed a girl.
- We interpret ‘a’ as an existential quantifier.
- Its scope might be the whole sentence.
  - There is at least one girl whom each of the boys kissed.
  - $(\exists x)_{\mathsf{G}}(\forall y)_{\mathsf{B}}Kyx$.

- Or, the scope might be internal to the sentence.
  - Each of the boys is such that there is at least one girl whom he kissed.
  - $(\forall x)_{B}(\exists y)_{G}Kxy$.

Class and Scope Ambiguities Combined

- When we combine ambiguities of class and scope, even more interpretive possibilities arise.
  - All the boys did not kiss all the girls.
- The class/member ambiguity led to two different transcriptions of the sentence without negation.
  - $(\forall x)_{B}(\forall y)_{G}Kxy$.
  - $(\forall x)_{B}(\exists y)_{G}Kxy \;\&\; (\forall x)_{G}(\exists y)_{B}(Kyx)$.
- On the second reading (boys and girls as classes), the negation seems to govern the conjunction:
  - $\sim[(\forall x)_{B}(\exists y)_{G}Kxy \;\&\; (\forall x)_{G}(\exists y)_{B}(Kyx)]$.
- On the first reading (boys and girls as members of classes), there are three positions the negation sign could take.
  - $(\forall x)_{B} \sim(\forall y)_{G}Kxy$.
  - $(\forall x)_{B}(\forall y)_{G} \sim Kxy$.
  - $\sim(\forall x)_{B}(\forall y)_{G}Kxy$.

Transcribing 'Only'

- In sentence logic, 'only' reverses the order of a conditional.
- If Adam is an adult, then he has the right to vote.
  - $Aa \supset Va$
- Only if Adam is an adult does he have the right to vote.
  - $Va \supset Aa$
- This reversal holds when quantifiers are involved.
- If a person is an adult, then he has the right to vote (adults have the right to vote).
  - $(\forall x)_{P}(Ax \supset Vx)$.
- Only if a person is an adult does he have the right to vote (only adults have the right to vote).
  - $(\forall x)_{P}(Vx \supset Ax)$.

Negative Quantifier Expressions

- 'Nothing' makes a negative claim about everything in a whole class of objects, while 'not everything' negates the universality of a statement about a class of objects.
  - Nothing is furry: $(\forall x){\sim}Fx$.
  - Not everything is furry: ${\sim}(\forall x)Fx$.
- 'None' and 'none but' are generally used to indicate a restricted class of things, where 'none but' says the same thing as 'only' and reverses the order of subject and predicate terms in the English sentence.
  - None of the boys are registered voters: $(\forall x)_B\ {\sim}Rx$, or $(\forall x)(Bx \supset {\sim}Rx)$.
  - None but adults are registered voters: $(\forall x)_R Ax$, or $(\forall x)(Rx \supset Ax)$.
- No **P**s are **Q**s is transcribed as $(\forall \mathbf{u})_{\mathbf{P}}\ {\sim}\mathbf{Q}(\mathbf{u})$, or as $(\forall \mathbf{u})(\mathbf{P}(\mathbf{u}) \supset \mathbf{Q}(\mathbf{u}))$.