The language of predicate logic

1. Rx means that x is a rodent. Fx means that x is a feline. Exy means that x eats y. Cx means that x is cute. Let j be a constant referring to Jerry, t be a constant referring to Tom, m be a constant referring to Minnie, and k be a constant referring to Kitty. Translate the following English sentences into sentences of predicate logic.

   > The provided answers are 'standard' answers. There might be other translations that are just as good.

   (a) Jerry is a rodent.

   Rj

   (b) Kitty is a feline.

   Fk

   (c) Felines are cute.

   $\forall x(Fx \supset Cx)$

   (d) Tom is not cute.

   $\neg Ct$

   (e) If Tom is feline, then some felines are not cute.

   $Ft \supset \exists x(Fx \wedge \neg Cx)$

   (f) Tom does not eat Jerry.

   $\neg Etj$

   (g) Minnie is not a feline.

$\neg Fm$

(h) If something is not a feline, it is a rodent.

$\forall x(\neg Fx \supset Rx)$

(i) Some things are rodents.

$\exists x Rx$

(j) There are rodents.

$\exists x Rx$

(k) Rodents are not cute.

$\forall x(Rx \supset \neg Cx)$

(l) No rodent is cute.

$\neg \exists x(Rx \wedge Cx)$

(m) If Minnie is a rodent, Kitty eats Minnie.

$Rm \supset Ekm$

(n) Some rodents eat felines.

$\exists x(Rx \wedge \exists y(Fy \wedge Exy))$

(o) There are rodents that eat felines.

$\exists x(Rx \wedge \exists y(Fy \wedge Exy))$

(p) No rodents eat felines.

$\neg \exists x(Rx \wedge \exists y(Fy \wedge Exy))$

(q) Kitty does not eat rodents.

$\neg\exists x(Rx \wedge Ekx)$

(r) If something is a rodent, Kitty does not eat it.

$\forall x(Rx \supset \neg Ekx)$

(s) Some rodents are cute.

$\exists x(Rx \wedge Cx)$

(t) Some cute things eat cute things.

$\exists x\exists y[Cx \wedge (Cy \wedge Exy)]$

2. Let the domain of discourse be all 5C (Pomona, Pitzer, Scripps, Harvey Mudd, CMC) students. Let Fx mean that x is a Pomona student, Gx mean that x is a Scripps student, Hx mean that x is a Harvey Mudd student, Jx mean that x is a Pitzer student. Let's also say no one attends two 5C colleges at once (I think that's true), every 5C college has some students. Let Px mean that x is currently taking PHIL60, and let's say that PHIL60 has a mix of 5C students except CMC students. Finally, let Sxy mean that x and y are taking the same class.

   Given this interpretation, indicate for each of the following sentences whether or not it is true.

   (a) $\exists x Gx \wedge \exists x Zx$

   ..... (True)/False

   The sentence says that there are Scripps students and there are Pitzer students.

   (b) $\exists x(Fx \wedge Hx)$

   ..... True/(False)

   The sentence says that there is someone who is both a Pomona and a Mudd student.

   (c) $\forall x(Fx \supset Zx)$

   ..... True/(False)

   The sentence says that every Pomona student is a Pitzer student.

   (d) $\forall x(Gx \supset \neg Hx)$

   ..... (True)/False

   The sentence says that anyone who is a Scripps student is not a Mudd student.

   (e) $\exists x(Zx \wedge Hx)$

   ..... True/(False)

The sentences says that there is someone who is both a Pitzer student and a Mudd student.

(f) $\exists x(Px \wedge Fx)$

. . . . . (True)/False

The sentence says that there is someone who is taking PHIL60 and is a Pomona student. Or, more colloquially, there is a Pomona student who is taking PHIL60.

(g) $\exists y(Py \wedge Fy)$

. . . . . (True)/False

This means exactly the same thing as the previous sentence.

(h) $\neg\forall x(Px \supset Hx)$

. . . . . (True)/False

The sentence says that not everyone who is taking PHIL60 is a Mudd student.

(i) $\forall x\forall y[(Px \wedge Py) \supset Sxy]$

. . . . . (True)/False

The sentence says that if any two people are taking PHIL60, then they are taking the same course.

(j) $\forall x\forall y[Sxy \supset (Px \wedge Py)]$

. . . . . True/(False)

The sentence says that if two people are taking the same course, then they are both taking PHIL60.

(k) $\forall x\{Fx \vee [Gx \vee (Hx \vee Zx)]\}$

. . . . . True/(False)

The sentence says that everyone is a Pomona, Scripps, Mudd, or Pitzer student. (That's false since the domain is all the 5C students.)

(l) $\exists x \neg \{Fx \vee [Gx \vee (Hx \vee Zx)]\}$

. . . . . (True)/False

The sentence says that there is someone who is not attending Pomona, Scripps, Mudd, or Pitzer.

(m) $\exists x(\neg Fx \wedge \neg Gx)$

. . . . . (True)/False

The sentence says that some people are neither Pomona nor Scripps students.

(n) $\exists x[(\neg Fx \wedge \neg Gx) \wedge Px]$

. . . . . (True)/False

The sentence says that there are some who are neither Pomona nor Scripps students who are taking PHIL60.

(o) $\forall x \forall y[(Gx \wedge Hy) \supset \neg Sxy]$

. . . . . True/(False)

The sentence says that no Scripps and Mudd students are taking the same class.

(p) $\exists x \exists y[(Fx \wedge Zy) \wedge Sxy]$

. . . . . (True)/False

The sentence says that some Pomona and Pitzer students are taking the same class.

(q) $\forall z\Big(Pz \supset \{Fz \vee [Gz \vee (Hz \vee Zz)]\}\Big)$

. . . . . (True)/False

The sentence says that anyone taking PHIL60 is a Pomona, Scripps, Mudd, or Pitzer student.

(r) $\forall x[Px \supset \exists y(Zy \wedge Sxy)]$

. . . . . (True)/False

The sentence says that anyone who is taking PHIL60 is taking the same class with some Pitzer student.

(s) $\forall x \exists y[Px \supset (Zy \wedge Sxy)]$

. . . . . (True)/False

This says the same as the previous sentence.

(t) $\neg\exists x\Big(Px \wedge \neg\{Fx \vee [Gx \vee (Hx \vee Zx)]\}\Big)$

. . . . . (True)/False

The sentence says that there is no one who is taking PHIL60 but isn't a Pomona, Scripps, Mudd, or Pitzer student.

(u) $\neg\exists x\Big(Px \wedge \{\neg Fx \wedge [\neg Gx \wedge (\neg Hx \wedge \neg Zx)]\}\Big)$

. . . . . (True)/False

This is saying the same as the previous sentence.

3. For each of the following sentences, create an interpretation that makes the sentence true.

> My answers are only examples. They are kept very simple to give you a sense of how to produce models without too much thought.

(a) Gb

- Domain: Just Bernie
- Extension of G: Bernie
- Referent of b: Bernie

(b) $Gc \supset Fc$

- Domain: Just Charlie
- Extension of G: empty
- Extension of F: empty
- Referent of c: Charlie

(c) $(Gc \supset Fc) \wedge \neg Fd$

- Domain: Charlie and Dannie
- Extension of F: Charlie
- Extension of G: Charlie
- Referent c: Charlie
- Referent of d: Dannie

(d) $\exists x Fx$

- Domain: Taylor
- Extension of F: Taylor

(e) $\exists x Gx$

- Domain: Britney
- Extension of G: Britney

(f) $\exists x Fx \wedge \exists x Gx$

- Domain: Taylor and Britney
- Extension of F: Taylor
- Extension of G: Britney

(g) $\exists x Fx \wedge \neg \exists x Gx$

- Domain: Lexi
- Extension of F: Lexi
- Extension of G: Empty

(h) $\forall x(Gx \supset Fx)$

- Domain: Venus
- Extension of G: Venus
- Extension of F: Venus

(i) $\neg \forall x(Gx \supset Fx)$

- Domain: Venus and Pluto
- Extension of G: Venus and Pluto
- Extension of F: Venus

(j) $\neg \exists x(Fx \vee Gx)$

- Domain: Ivy
- Extension of F: empty
- Extension of G: empty