CS 381 Solutions to Homework 4

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32(c) Universe: The set of koalas
$C(x)$: x can climb
Original: $\forall x C(x)$
Negation: $\exists x \neg C(x)$
English: Some koalas can not climb.
(d) Universe: The set of monkeys
$F(x)$: x can speak French
Original: $\forall x \neg F(x)$
Negation: $\exists x F(x)$
English: Some monkeys can speak French.
(e) Universe: The set of pigs
$S(x)$: x can swim
$C(x)$: x can catch fish
Original: $\exists x[S(x) \wedge C(x)]$
Negation: $\forall x[\neg S(x) \vee \neg C(x)]$
English: Every pig can not swim or can not catch fish.

62 (a) $\forall x[P(x) \rightarrow \neg S(x)]$ or
$\neg \exists x[P(x) \wedge S(x)]$
(b) $\neg \exists x[R(x) \wedge \neg S(x)]$, or
$\forall x[R(x) \rightarrow S(x)]$
(c) $\forall x[Q(x) \rightarrow P(x)]$
(d)$\forall x[Q(x) \rightarrow \neg R(x)]$
(e) Yes.

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4 (d) There is a computer science course which every student has taken.
(e) For every computer science course there is a student who has taken it.
(f) Every student has taken every computer science course.

8 (b) $\neg \exists x \exists y Q(x, y)$
(c) $\exists x[Q(x, Jeopardy) \wedge Q(x, Wheelof Fortune)]$

10 (c) $\forall x \exists y F(x, y)$
(d) $\neg \exists x \forall y F(x, y)$
(f) $\neg \exists x [F(x, Fred) \wedge F(x, Jerry)]$
(h) $\exists x \forall y [F(y, x) \wedge \forall z [F(y, z) \rightarrow z = x]$

12 (f) $\exists x \neg I(x)$
(k) $\exists x [I(x) \wedge \forall y [y \neq x \rightarrow \neg C(x, y)]]$
(m) $\exists x \forall y C(x, y)$