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Sample Questions From 352 - 355

1. $\exists \langle x,t \rangle [\ STP(f,x,t) \ \&\ VALUE(f,x,t)=0]$

2. Non-trivial: $C_0 \in HZ \quad S \notin HZ$
   where $\forall x\ C_0(x)=0$ & $\forall x\ S(x)=x+1$
   Let f,g be arb. procedures $\Rightarrow \forall x\ \varphi_f(x)=\varphi_g(x)$
   $f \in HZ$ iff $\exists x\ \varphi_f(x)=0$
   iff for some x_0 $\varphi_f(x_0)=0$
   iff $\varphi_g(x_0)=0$
   iff $\exists x\ \varphi_g(x)=0$
   iff $g \in HZ$

3. Let $\langle f,x \rangle$ be an arb. pair of natural numbers
   From f,x define $g_{f,x}(z)=\varphi_f(x)-\varphi_f(x)\ \forall z$
   $\langle f,x \rangle \in HALT$ iff $\varphi_f(x)\downarrow$
   iff $\varphi_f(x)-\varphi_f(x)=0$
   $\Rightarrow g_{f,x} \in HZ$
   $\langle f,x \rangle \notin HALT$ iff $\varphi_f(x)\uparrow$
   $\Rightarrow (\varphi_f(x)-\varphi_f(x))\uparrow$
   $\Rightarrow \forall z\ g_{f,x}(z)\uparrow$
   $\Rightarrow g_{f,x} \notin HZ$

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SAMPLE QUESTIONS FROM 352 - 355

4. P IS NOT AN I/O PROPERTY.
TO SEE THIS CONSIDER THE TWO IMPLEMENTATION OF ZERO ($\forall x$ ZERO$(x)=0$)
$C_0(x)$ HALTS IN ONE STEP, SO
STP$(C_0, 1, 1)$
$Z(x) = \mu y[y==x] - \mu y[y=x]$
Z TAKES $(x+1)\times 2$ SEARCH STEPS + 1 MINUS STEP TO COMPUTE 0.
SO $\forall x\ C_0(x) = Z(x)$ BUT $C_0 \in P$ & $Z \notin P$
THUS, P IS NOT AN I/O PROPERTY.

5. (c) $T = \{\}$ $S = K_0$(HALT) $E = \{\}$
SO E IS REC (YES)
(b) $T = \{0\}$ $S = K_0$(HALT) $E = K_0$
SO E IS RE NON REC (YES)
(a) IF $T = \{\}$ THEN E IS DEF. $\overline{RE}$ $(E = \{\})$
THUS, ASSUME $T \neq \phi$
T REC, NON-EMPTY $\Rightarrow$ T IS RANGE OF SOME ALG f_T
S RE, NON-REC $\Rightarrow$ S IS RANGE OF SOME ALG f_S
DEFINE
$f_E(\langle x, y\rangle) = f_S(x) + f_T(y)$
RANGE$(f_E) = \{z \mid z = f_S(x) + f_T(y)$ FOR SOME $x, y \in \mathbb{N}\}$
$= \{z \mid z = x' + y',$ FOR SOME $x' \in S, y' \in T\}$
$= E$
SO E MUST BE RE (NO)