Cu	(CS 2203) (Theory Assignment):- 12/04/20
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	(a) one > In computability theory, a primitive Heritability function takes a fixed mumber of arguments, each a natival mumber (man-negative integer) and returns a natival number; if it takes in arguments then it is primitive recovering function. The basic primitive recovering function includes:
	(i) Zoto function:
	A K-ory zoro function is defined as
	$300_{K}(m_{1},m_{2},,m_{K}) = 0; K>0; m_{1},m_{2},,m_{K}\in N$
	$ \begin{array}{c c} \hline (m_1, m_2,, m_K) \end{array} $ $ \begin{array}{c c} \hline 3010_K & N^K \longrightarrow N \end{array} $ $ \begin{array}{c c} \xi g := 3010_2 (4,5) = 0 \end{array} $
	(ii) successor Function:-
	successor function is defined as succ (m)= n+1,
	$ \begin{array}{c} $

(iii) Identity Projection Function: A jth K-ary projection function is defined as, - $\text{proj}_{K,j}$ $(m_1, m_2, \dots, m_K) = m_j + K > j > 0; m_1, m_2, \dots, m_K$ $\left[\left(n_{1},n_{2},\ldots,n_{K}\right)\right]$ $\text{proj}_{K,\delta}: N^K \longrightarrow N$ proj K,j proj 2, 8 (9, 72) = .8. the basic primitive The above three Illustive function. (b) and > The rule of composition states that if g is a k-ary function $(g: N^k \rightarrow N)$ and hi, hz, ..., hk be I-ary functions (in hi is N -> N) K)0, I >0, -Then composition of g with hi, hz, ---, hx will be an I-ary function defined as, $f: N^1 \longrightarrow N,$ $f(m_1, m_2, ---, m_I) = g(h_I(m_1, m_2, ---, m_I), h_2(m_1, m_2, ---, m_I)$ ----, hk (m₁, m₂, ---, m_I)) Let $g: N \rightarrow N, -g(x) = \chi + I(g) = I - ally for.$ $h: N \longrightarrow N, - n(x) = x + 1$ (his 1-ary -fm.)

Then by rule of composition, $f: N \longrightarrow N,$ f(x) = g(h(x)) = h(x) + 1. Both gand h are basic functions (successor),by rule of composition of will also be primitive the wesive function. $\left(\begin{array}{c}
m_{i} \\
\downarrow \\
g \\
\downarrow \\
m_{i}+1
\end{array}\right)$ $\left(\begin{array}{c}
m_{i} \\
\uparrow \\
m_{i}+1
\end{array}\right)$ $\left(\begin{array}{c}
m_{i} \\
\uparrow \\
m_{i}+1
\end{array}\right)$ $\left(\begin{array}{c}
m_{i} \\
\uparrow \\
m_{i}+1
\end{array}\right)$ mx+2. Rule of primitive Mccollion states that if, g is a k-ary function (g: n* -> N) h is a (K+2)-ary function $(h: N^{K+2} \longrightarrow N)$ Thon, function f is a (K+1)-ary function $(f: N^{K+1} \rightarrow N),$ defined thewastely by g and has ;-

 $f(m_1, m_2, ..., m_K, o) = g(m_1, m_2, ..., m_K)$ $f(m_1, n_2, \dots, m_K, m_H) = h(m_1, m_2, \dots, m_K, m_1, f(m_1, m_2, \dots, m_K))$ $fg = \int du (m, 0) = m \left[f(m, 0) = g(m) \right]$ plus (m, n+1) = succ (plus (m, m)) [f(n, m+1) = h(n, m, f(n,m)) (c) Exponent :-Exp (M,N) is defined as, - $Exp: N \rightarrow N, - Exp(M,N) = MN.$ We will prove exponent as primitive recursive function by using rule of primitive recursion. Base Case: 3010 fm. @ Successoft fm. are primitive trecutsive fn. No, - by rule of & composition, -Duce (zero (n)) will also be primitive Hecustive. Ech (M,0) = Duce (3070 (M)) = Succ (0) = 1.

-. Ecp (M, 0) is primitive the wasive AMEN.

Now, - $Exp\left(M,N+1\right)=M^{N+1}$ = MN M = Enp (M, N). M. = Mult (Exp(M, N), M). = id3,3 (M, N, Mult (Exp (M,N),M)). Since, Add (M, N) and Mult (M, N) whe primmitive Elecutsive function, -By, - rule of primitive recordion, -Eap (M, N+1) is primitive Meculsive function. Non- Negative Subtraction: NNbub (M, N) is defined as; $NNSub: N \rightarrow N ; NNSub (M,N) = M-N$ We will prove non-negative subtraction as primitive the cultive function using primitive recursion. Base Case: NN bub (M,0) = M = [broj], M (M)since froj, M is basic function, MN bub (M,0) is prioritive the cuts we function.

Now, het, Pred (0) = 0; Pred: N -> N is a primitive Posed (N+1) = N. ; strussius fm. -. NNSub (M, N+1) = M - (N+1) = NNSub (M, N) -1 = Pred (NN bub (M,N)) = id 3,3 (M, N, Pred (NN bub (M, N))), --. By principle of primitive reculsion, -MN bub (M,N) is primitive Hecutsive function.

(d) Amy > U- Recursive functions consists of all basic functions alongwith functions obtained by buccessive application of composition, Mc wision and minimization of minimizable function. Minimization of a (KH)-wy function g' into a (k)-wy function is defined as i-(6) O otherwise. きりゃ Let, $\vartheta(a,b,p) = 1, \forall a^{\dagger} \geq b$ = 0, othorwise, - @ g is primitive recursive function. &-: Minimization of g, $f(a,b) = \begin{cases} \text{Min. value of } P,-\text{ such that } g(a,b,P) = 1,-\end{cases}$

o, otherwise.

- f being a minimalization of g, - f is primitive recursive function, - implying that f is 4- recursive function.

2) Any > The class diagram for Assignment 04, - Problem No. 2 (collège Program) is: Pollon + String Name + int Age + char gender String Reg. No + Person() + Posson (const string, const int, combt charz, const string) + Person (const Persons) + Void read () + Void display() Staff Academic + double balary + string dept + staff () + staff (coult string, court int + Academic () const char, coult string, + Academic (const string, const double) + Void IreadSalary() comst int, const char, const string, const string + double balazy () + Void nead Department () () triangle depositment () Student Clerk + int year + String WorkLoad Professor + btudent() + string courseload + clonk() + btudent (const string, + Professon () + Clork (const string, const int, const chari, throffssotr (const string complet string, const comet int, const char, boring, comst int) const int, const char, comst string, const combt string, combt + void year () double, comit string) string, const double, + int display fear() compt bleing) + Void work () + void readcourse () + string workloal() + biting course()