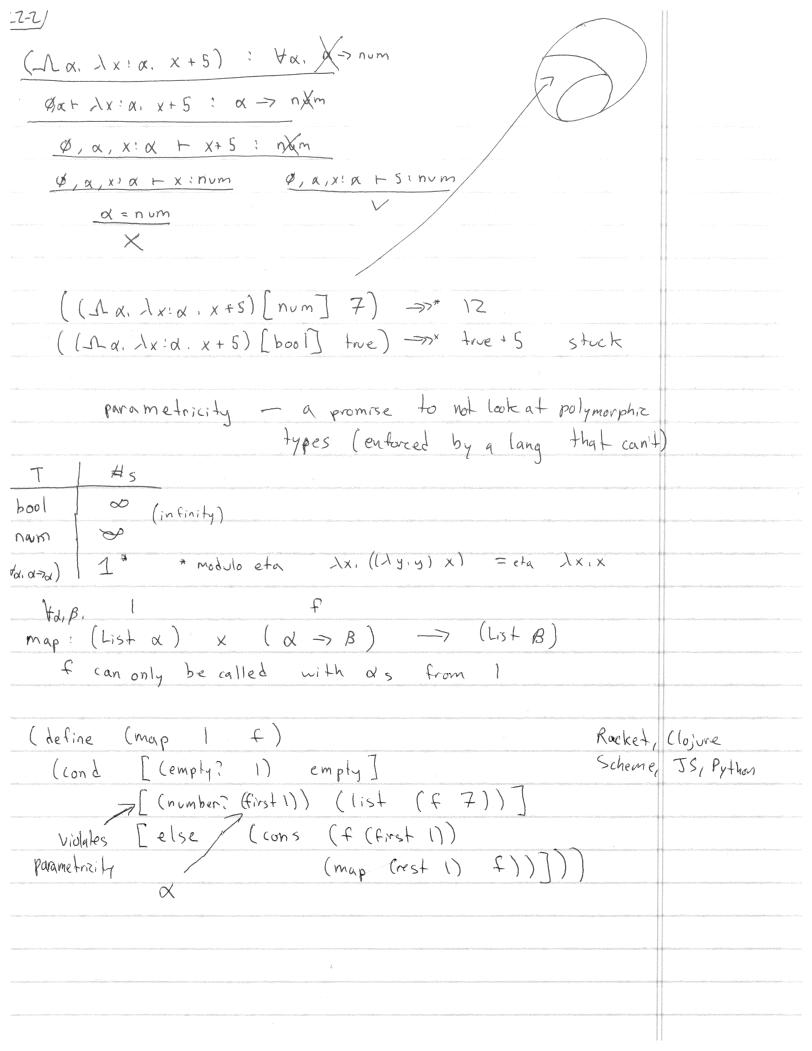
```
21-3/
                                        T = num |bool | TAT
               1 (fix m)
            E = ... | (fix E)
             E [ (fix (1 X:T, m))
              \rightarrow E[m[X \leftarrow (fix (+1x:T, m))]]
             fixed-point of a fun F is avalue to sit. Fxo=xo
             1 + M + (17, -72) -> (7, -772)
            TH (fix m) : (TI > TZ)
           ((fix (If: (num=n/m), In:num, (fn))) 0)
int f (intn) &
          E = ([] 0) ((Eix m)]
 F(n);
                     [Ininum. ((fix m) n)]
            E = [] [(-1 n i n w m, (fix m) n) 0]
             F7 [ (Fix m) o]
            VT. Ø H (Fix (JX:T.X)): T
```

```
21-4/ Data - Pairs
                      V= (pair VV)
                                         T = (T \times T)
    M = 111
      pair M M
                     E = pair E M
      1 fst W
                         pair V E
      1 snd M
                        FST E
                        snd E
  E [ (fst (pair V, Vz)) ] -> E[V.]
  E ( (fot (pair V, Vz)) ] -> E [ Vz]
  M L e : (T1 x T2) M L e : (71 x T2)
                                       Mrte; IT;
 Γ + (fst e1): T1 Γ + (snd e1): T2
                                      Tr ( rair e, e2): TixE
Data-unions (dog or cat) T= 1.1.
             V = (inL V) | (inR V) | (T + T)
MZII
I (in L M) | (in RM) E = (in L E) | (in R E)
 (match m (1x,N) (1x,Nz)) (match E m m)
 MH e, IT,
                              MHez! Tz
                          MH (in R ez): TI+TZ
Mr (in Lei): TI+TZ
 M+M: T,+ 42 M+N: T, ->T M+N2: T2->T
 M + (match M N, Nz): T
  E[(match (in L V) M N)] +7 E[M V]
  E[(match (inRV) M N)] >> E[N V]
                        MHe,: THT' MHez: TOT"
 M = ...
                       Mr (usel ex ez): T'
  1 (use L M m)
                                   (vxl (inR V) m) is stuck
     E[(usel (inLV) m)] >> E[m v]
```

```
Identify funin ISVIM
            \chi \times \chi \times
         In Typed-ISWIM:
           入x:num, x
                                        ((1xix) 5)
            1x: bool ix
                                          value application
            XX: (num=7bool) , X
         Poly-ISWIM (polymorphic - many shaped)
                                              M = X 1 ...
            normal for - value abstraction
                                                 (MM) | MTXLI
                                              I Daim | M[T]
            type abstract ion (YA, A = A)
                                              T= 1111 / X
         class List < X7 &
C++
                               forester int f(intx) {
Jara
          X elem;
           List (X7 rest,
                                     rehmx + X; 3
                                min strict 1= 1.
                                      (1 x, 1 x B, x)
         Na, 5+6
                                    ( y: Mt. lx: x, y)
           A & , (vector (1x: a, x)
        M = 111 / A.M
                         | m[T]
                                       E[ (AA,m)[T]
        V= ... | AAM
                                          H E[M[A CT]]
        T = ... | A | VA.T
         E = 1 "
        Γ = ε | Γ, x:T | Γ, A records valid type variables
                                   M-M: YAIT! (P-T)
            M, A H M! T
                                   \Gamma + M[T] : \Gamma' [A \leftarrow T]
          Mr (AAim): VA. T
                                    P, X:T + M:T' P+T
              L + A ift L(A) #
                                  TH (Axim): TATI
```



22-3/	E[(AA,m)[T]] => E[M[A <t]]< th=""></t]]<>		
	Tletid = NA, XX:A, Xin		
	(let le (id[num] S)	List < in+>	
5800 and help to the control of the	(id (nom] 7)))		
State State of the Control of the Co	→		
irinatelikka, iligataman kenna menat, ata akan man ara ta ata kalan man ara ta ata ata ata ata ata ara ini ini	(+ ((ILa, /x) [nom] 5) ((ILa, /x; a, x) [nom] 7))		
e de la companya del companya de la companya de la companya del companya de la companya del la companya del la companya de la			
	\mapsto		
	(+ ((\ x : num, x) S)		
etholika alika alikateetti airoonin oonin oonin aasaa oo o			
C++	Templates -		
Java	Generics-		
Standard ML	exactly this -		
	7 165 8065	7 Yh	
	List Kinty, List (Dog7, List (Image)		
momomorphication /c++) Java			
	1 implementation		
	3 implementations	compatible w/ all shapes	
eller folkelige blev blev blev blev blev blev blev ble	Specialized to each shape	+ one binary, faster compiles	
	- many hinaries, slow compiles	+ less i-cache	
	- more reache needed	- all data is beyond a pointer	
	+ compact mem, noderef	865 of men, men deref	
etakkontrinsk limitationen atmosen mittalmiskontrinsk mit innocensieskon altan eusense saas saa stalislassissi	List cint x>		
etten auman keiten maksisaan on aan kahen aan oloonaan tiinniit vaa aan aan allissa kahen keiten sala	List Evoid *>	one imple	
		that is generic	
	Copies code		
		List < X>	
parametric:	No, because of ptrs	add (X ex) {	
atta vivenessa tallitäätää täätää tää ja avasta vasti on talli osa kassa on joja vasta vää ja täätä vasta ja a	List < int> 5	tell what ex is? 3 i in stance of	
	3) 1 11/2/10/2001	

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