- No class on Wednesday, Oct 9 0,1-1 R O > O',R (letto - mgly) is L - S L 7 mit , ц, O' Гејост 0,0' just best to the end of tape, have to now see a l ccorr $O' \rightarrow R \qquad I \rightarrow I', L$ G1-1 I saw the I that I needed to see, how many left T= { Culu | ue |N } Turing Machine to decide $= \left\{ OI, OOII, O^{3}I^{3}, -- \right\}$ [Sip] "High level description (:) " Medium level " (i) Inplementation: [tape alphabet, Q) Kvery simple language Simplifying variant: Multi-tape Turing machine input tape JR L L L L J. J. . - -₹ 1 1 1 - - type 2 type 3 []]] 21 ... Old (-type: f: Qx [~ Gx [x { L, R}]

Multi-tape 5: Qx [K -> Qx [K x { L, R, S } k tupe ! Pstary Infinite Tapes: Cheat Spowerful time strug length n, time ~ n2 1 = [0 m] 000001121111111 n, n+1time could be cs N-1 big as G G _ _ O I I I I _ I n/z n/2Cven 2 tapes 10601010100000000 & step V V V V Mep 2 1000001 11111 , 1 Stert of type stay 100000 ANNO CO 11111

V V 000001 2 tepe mechne decide L= fom in [mEN] in lineer time input size n ワ 000--01 n steps χ (() ())____ 3 or mere types, then can simulate n steps in time O(nlogn) on 2-type machine PALINDROME $S = T_{1}, T_{n}, S^{rev} = T_{n} T_{n-1}, T_{2} T_{1}, T_{1} \in \mathbb{Z}$ To decide PALINDROME on 1-type T.M. takes 3 Cn2 time input 0, 0, is 0, = 10, ? $\frac{1}{2}$ 3n/4 ; Jz= Jn-1; nib T On 2 topes: JOI Fr - ~ On UW

Ŵ [[]] - ~ [on UU O, Phase h steps V On U LI G (F2) ---I.e. and of کے تر ح کو ک tupe? end of Phase 1 €; Q× \mathbb{Q} (\mathcal{P}) (\mathcal{P}) (\mathcal{P}) (\mathcal{P}) work, copying symbol for symbol €(9) until we see a blank C, D, C, C, R, R \bigtriangledown abbca... ر لے 2 90 Ú 6,U abbca --~ 36,6,R,R a,U -sa,a, (Phase 2 م, ر) محرب محرب T a'bb c - vi C L С,U -ic',c',R,Rinit) XFFFFFFFFFFFF CU b, U - b', b', R, R Phase 1 _ _ S,L ~ ~ 5 - is never really needed star on a l-type mechane --Phare 3: compare

Time to decide PALINPROME - 2-type mechine in linear (n) N= STRE IN pot TM (I-tape, multi-tupe) à reasonable Goal: A notices of an elgorithm God Zi Any "polynomial time algorithm can be implemented on a Turing machine and also take poly time. Goal 3: Any K-taperalgorithm can be mylomentro by a l-type Turny machine algorithm elt Γ Super -lepe Fxfxfx ft.h. present, $\Gamma k \times 10, 12$