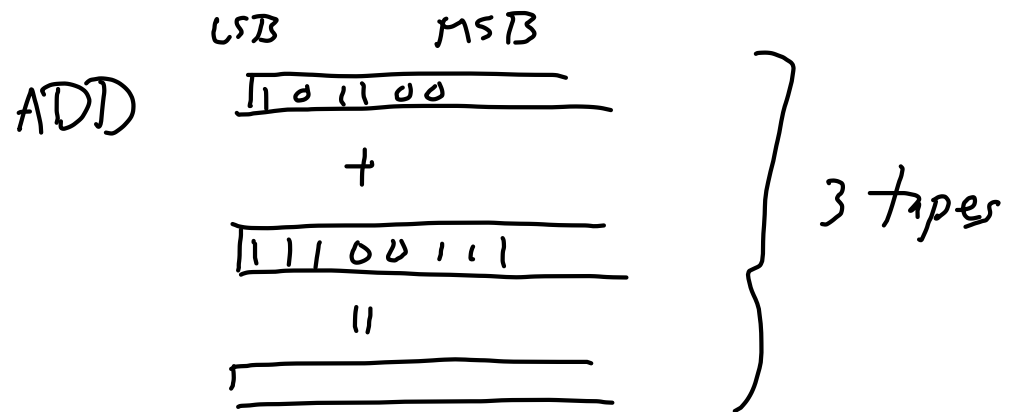


# Real Computer Features

- Numbers
- Jump to labelled state
- Subroutine calls
- Random - access memory

# Numbers

- positive and negative integers
- arithmetic on integers



- floating point

$$a \cdot 2^b$$

- rational  $(a, b)$



\$ bar # 27 \$ fu # 32 \$ ...



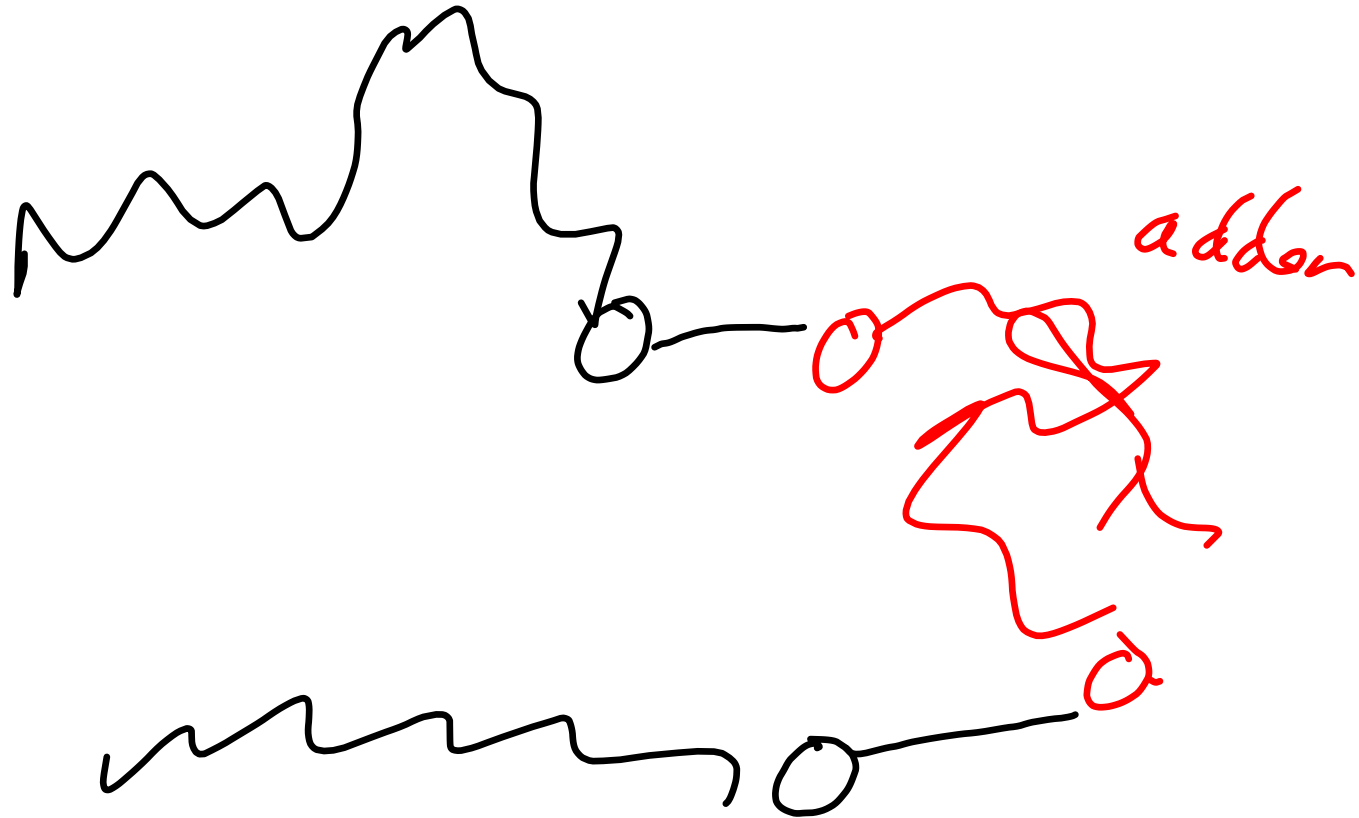
296

end of  
old data

..... ~~\$ fu # 32 \$~~ ..... \$ fu # 296

foo → bar → 27

Multiplicien



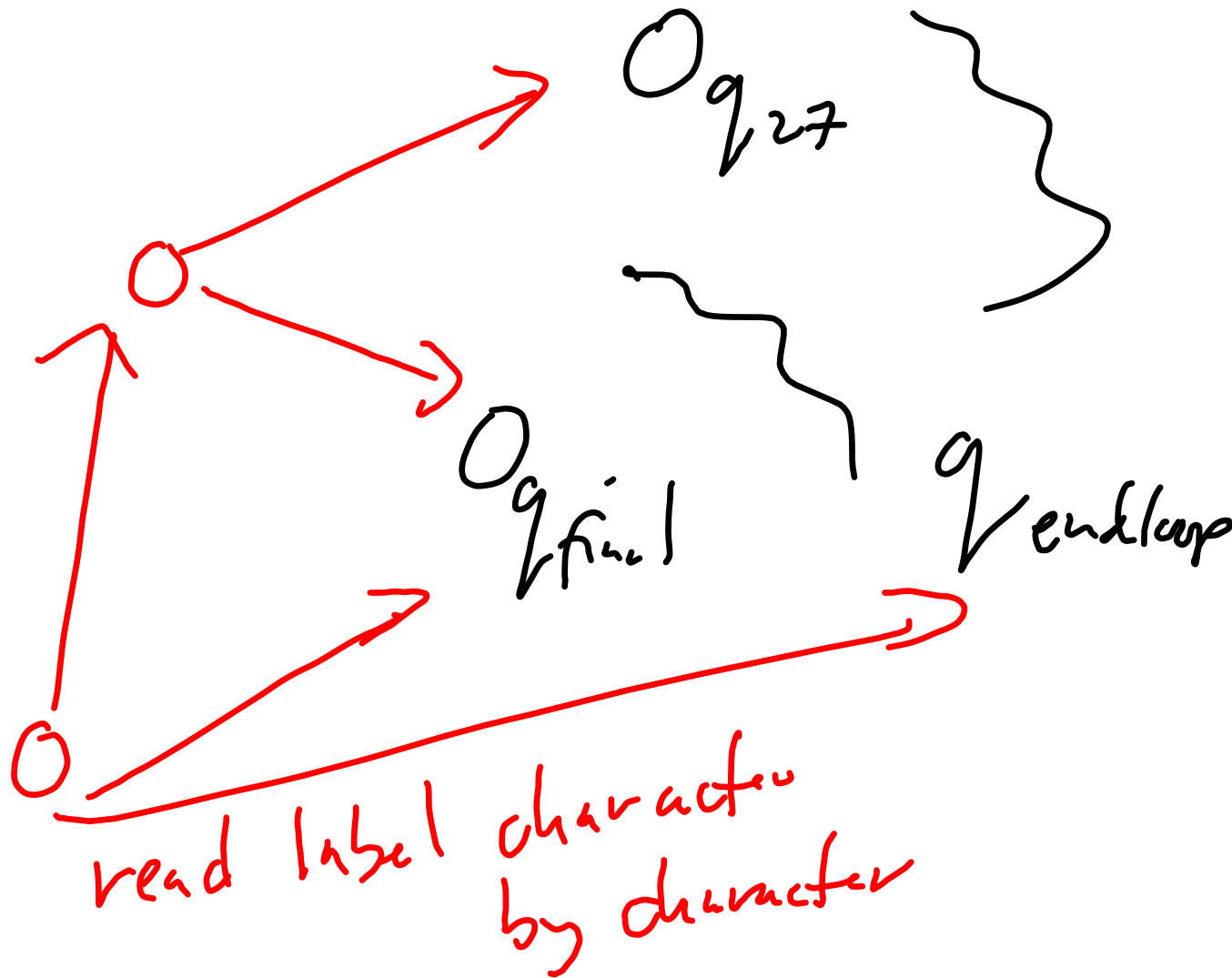
# Jump to labelled state

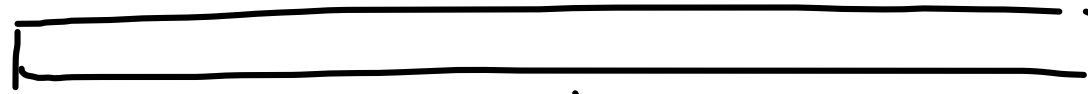
1stage one

label for 1stage one

127

label for 127





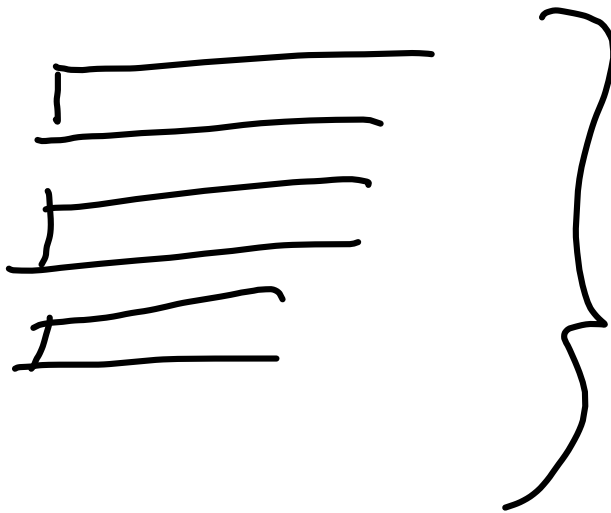
input type



global variables + values



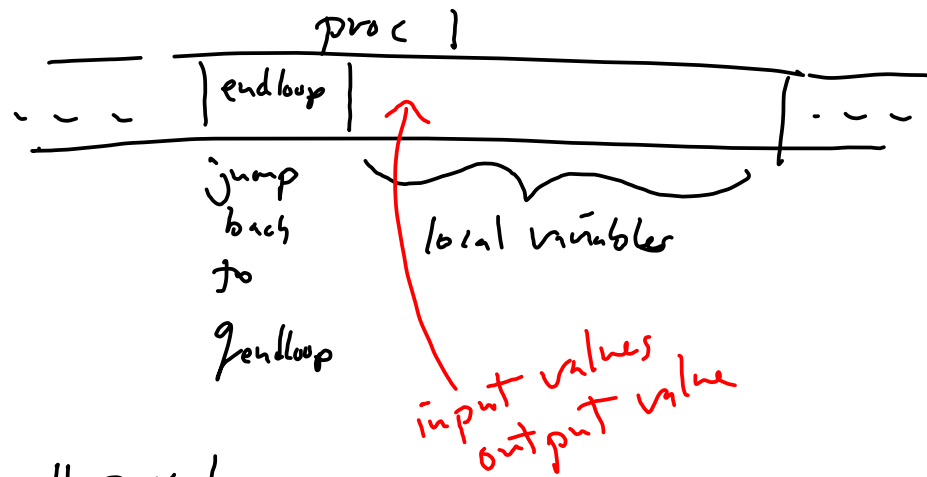
calling stack



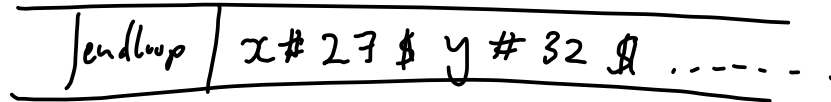
lots of registers



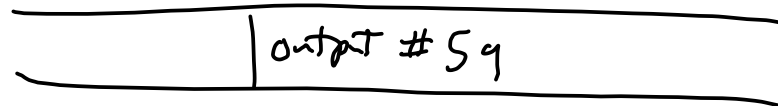
main calls proc 1  
 which calls proc 2



call proc 1



return



# When I call subroutine

① spill registers

② store jump back state  
on local tape

③ store input parameters  
on local tape

If a language  $L$  is  
recognized by a  
NTM then it  
is recognized by  
a normal (deterministic)  
TM

When does an NTM  
"halt on all  
inputs"?

An NTM is a decider  
= halts on all inputs

if  $\nexists$  infinite legal  
computation paths

input  $\dots \rightarrow$

$C_0 \rightarrow C_1 \rightarrow C_2 \dots \rightarrow C_i \rightarrow \dots$



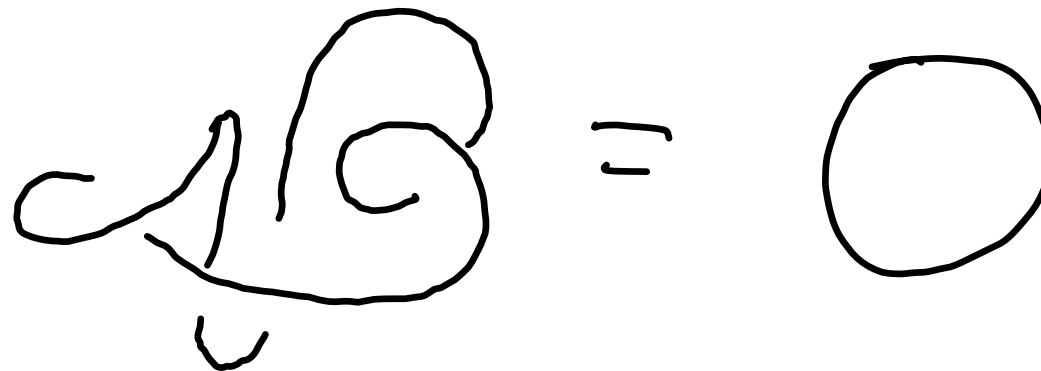
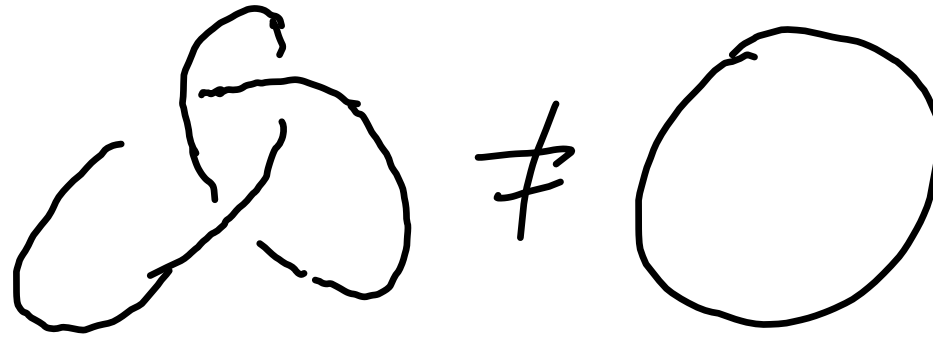
# Reidemeister Moves

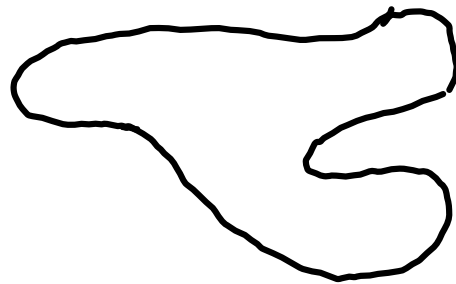
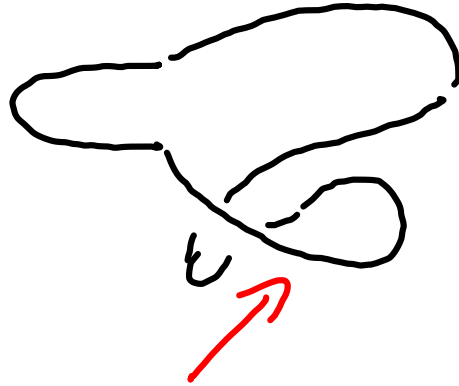
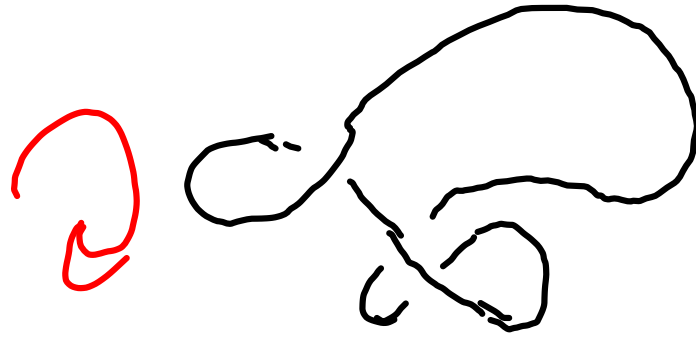
knot w/n crossings

bound on # moves is

$$2^{cn}$$

$$c = 10^{11}$$





||

