Tutorial # 1.
Machine, Simulations

Exercise 1. Warming up

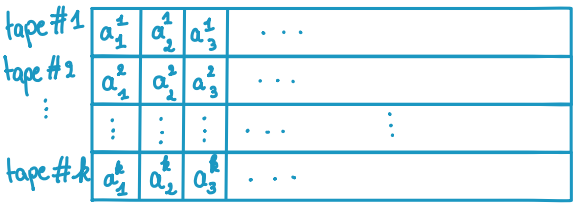
Q1. Write the 0 letters of the word on a 2nd tape.
Write the 1 letters of the word on a 3rd tape.
Compare the length of the words on the 2nd & 3rd tapes

Q2. Replace the # by a 1, remove the last 1.
Given a string w on the tape, write the last part on a 2nd tape.
Then compute addition and compare the results.

Q3. Write a and b on the 2nd & 3rd tape.
Until the start of a is reached, step to the left (2nd tape)
| Write ⟨1st tape⟩ # ⟨3rd tape⟩ on the 1st tape
| and compute addition.

Exercise 2. Universal Turing Machines

Q1.



where we encode each letter in binary

and we have a tape whose size is at most

$$O(\log|\Gamma|) \times 2k \times s(|x|).$$
$$\| \quad O(s(|x|)).$$

Q2. Use a tape for ⟨α, x⟩
and a tape for the state of M_α } C_α
and 2 tapes for the tapes of M_α.

used cells $\leq C_\alpha \times s(|x|)$

Exercise 3. Stimulating Simulation.

Q1.  ⇝

Q2. Write each letter of Γ in binary, the cost is $\lceil \log_2 |\Gamma| \rceil$.

Q3. Store the two tapes on an alphabet $\Gamma^2 \times \{B, \triangleright\}$.
We don't talk about the heads of both tapes.
Reduce the size of the alphabet w/ Q2.

Q4.