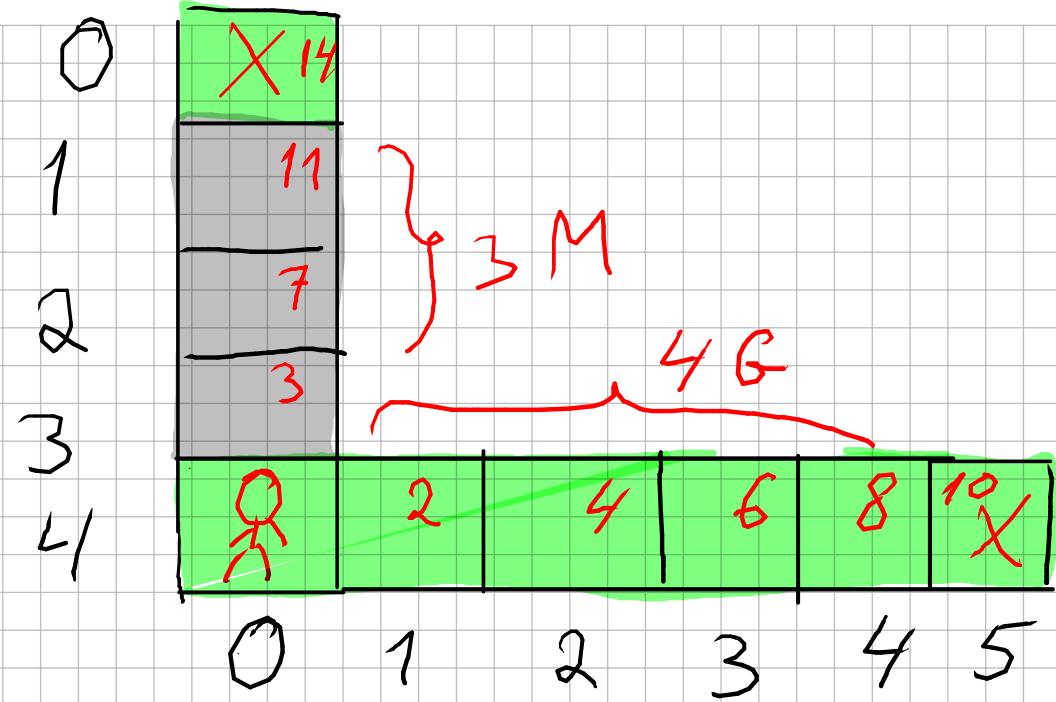


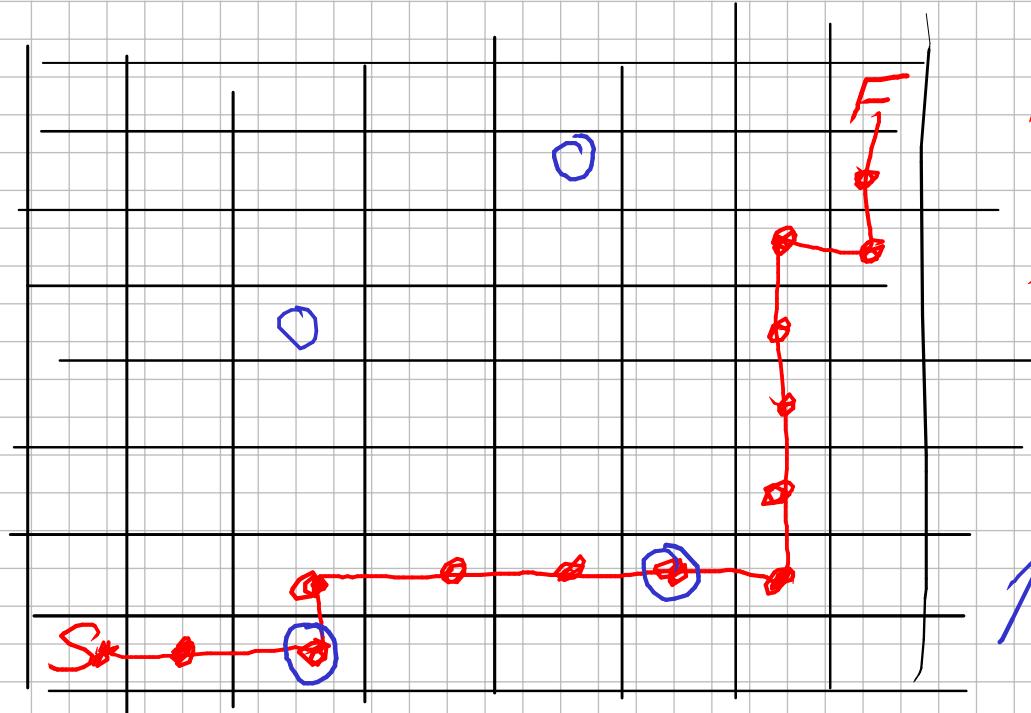
	0	1	2	3	4
6	24	3 ⁶	48	511	6 X 12
1	12	25	37	49	510
2	9	12	4	6	48
3	12	25	3 ⁶	48	510
4	24	36	48	510	612

$$G - G = 2$$

$$G - M = 3$$

$$M - M = 4$$





Total cost =
 $= \sum \delta(i, i+1) =$
 $= \sum \text{terr. cost}$

$$14 \cdot 2 = 28$$

$\delta(i, i+1)$ = terrain cost from i
 to $i+1$

terrain_cost + a. z + b.noise

$$a \cdot \gamma = \begin{cases} 0 & \text{if } \text{node} \notin G \\ 1 & \text{if } \text{node} \in G \end{cases}$$

Z
trajectory

→ шум бла

КОМН. а7 на Траектории

$$\sum_{\text{trajectory}} \alpha \cdot \gamma = \alpha \cdot \sum_{\text{traj.}} \gamma = *$$

There are $|G|$ goals on the map in total

Any trajectory w/o loops visits no more than all Goals.

$$0 \leq * \leq \alpha \cdot |G|$$

Even if I can't compute (*) in advance because I don't know what trajectory we end up with, I can still assess lower and upper boundaries for the value.

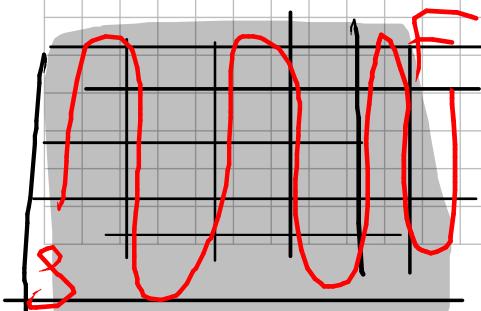
$\text{terrain_cost} + a * r + b * \text{noise}$ ← for each transition

Total Cost + Total Reward + Total Noise

← for the whole trajectory

$$\begin{aligned} 0 &\leq \text{Total Cost} = \sum_{\text{trajectory}} \text{terrain cost} = \\ &= tc(0,1) + tc(1,2) + \dots + tc(n-1, n) \quad \left| \begin{array}{l} n = |\text{traj.}| \\ \text{number of transitions} \end{array} \right. \end{aligned}$$

≤ Max[terrain_cost] · Max [trajectory length] =



$$= 4 \cdot |\text{Map}|$$

even though the formula is **Total Cost** - Total Reward + Total Noise,
we mainly optimize the **Total Cost** component (because we are
looking for the shortest path).

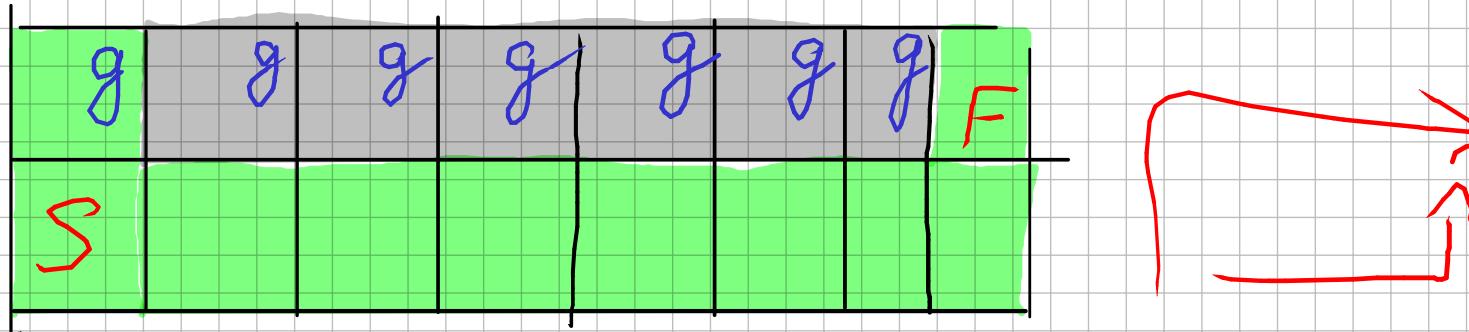
e.g. suppose we have two trajectories A and B.

Total Cost for A is 82

Total Cost for B is 83

$$\Delta = 1$$

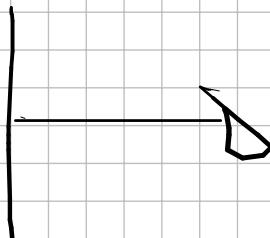
A doesn't visit any goals, but B visits every single goal.
Regardless, we choose A over B because A is shorter.



Total Cost is a discrete value with a step of "1".

So how do we choose formula for Total Reward so that it doesn't mess up priority over Total Cost.

$$V_1 = 82 + 0$$



$$V_2 = 83 - a \cdot |G|$$

$$V_1 < V_2$$

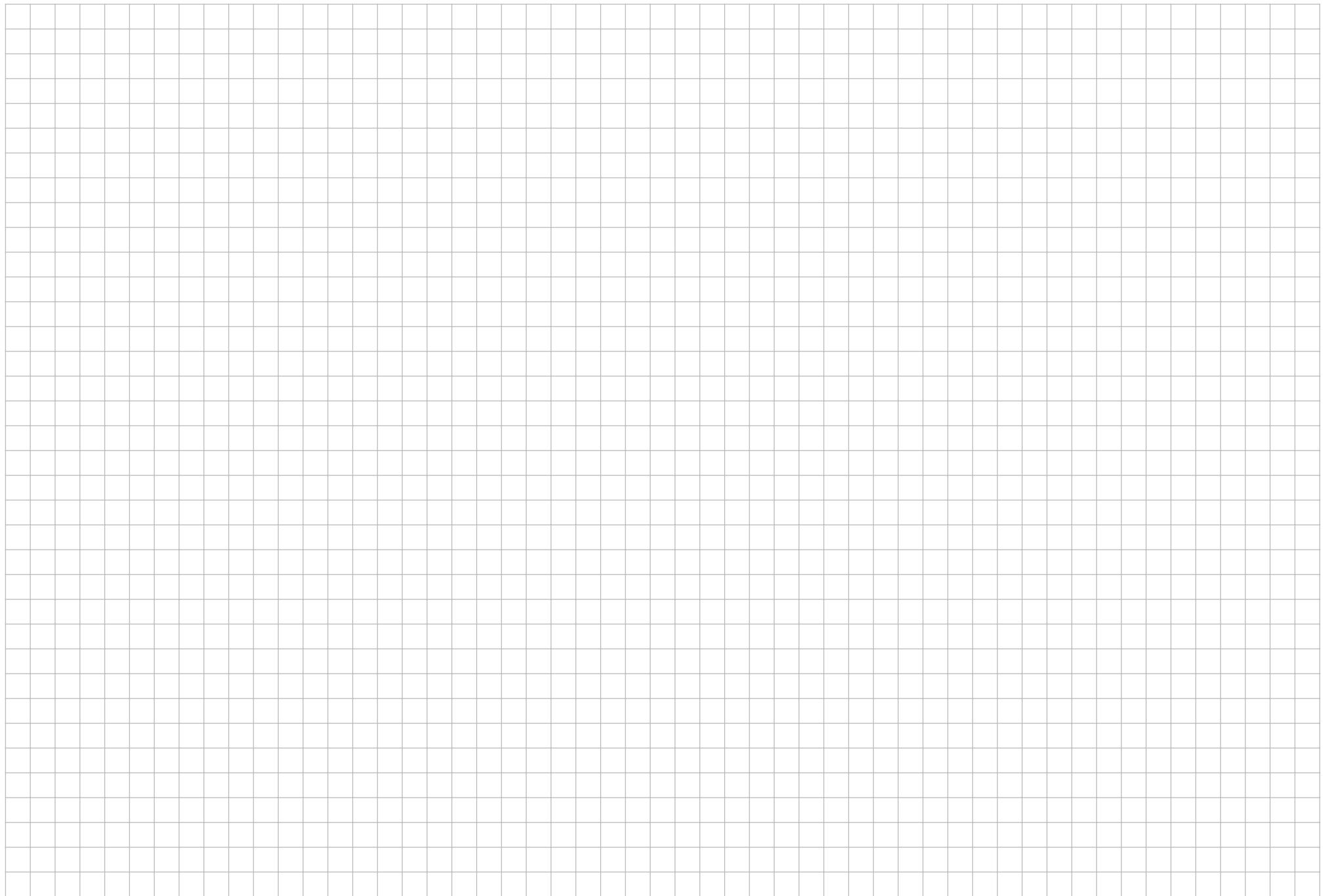
$$82 + 0 < 83 - a \cdot |G|$$

$$a \cdot |G| < 1$$

$$a < \frac{1}{|G|}$$

$$a = \frac{1}{2|G|}$$

$$a = \frac{1}{|G| + 1}$$



random variable that is uniformly distributed

$$\text{Total Noise} = \sum_{\text{traject}} \beta \cdot U[-1; 1] =$$

$$= \underbrace{\beta U[-1; 1] + \beta U[-1; 1] + \dots + \beta U[-1; 1]}_{n = |\text{trajectory}| \text{ terms in total}} =$$

$$= \beta \cdot u_1 + \beta \cdot u_2 + \dots + \beta \cdot u_{|\text{traject}|} =$$

$$= \beta \cdot (u_1 + u_2 + \dots + u_{|\text{traject}|}) = (*)$$

$$-1 \leq u_1 \leq 1$$

$$-1 \leq u_1 \leq 1$$

$$-1 \leq u_{|\text{traject}|} \leq 1$$

$$\beta(-1 + (-1) + \dots + (-1)) \leq (*) \leq \beta(1 + 1 + \dots + 1)$$
$$-\beta \cdot |\text{traject}| \leq (*) \leq \beta \cdot |\text{traject}|$$

$$\sum_{i=1}^{30} \iff 1 \leq i \leq 30$$

$$\sum_{i \in \{1..30\}} \iff 1 \leq i \leq 30$$

$$\sum_{\{1..30\}} \iff 1 \leq i \leq 30$$

notation for 'norm'

'norm' is numeric characteristic of some object

Examples:

$$\begin{array}{c} \cancel{x+y}, |x| \\ |x| + |y| \geq |x+y| \end{array}$$

norm for numbers: module, absolute value

$$|-2,8| = 2,8$$

norm for vectors: length, Pythagoras theorem

$$v = (1, 3, -2) ; |v| = \sqrt{1^2 + 3^2 + (-2)^2}$$

norm for sets: number of elements (in case set is finite)

$$S = \{"a", "z", "y"\}$$

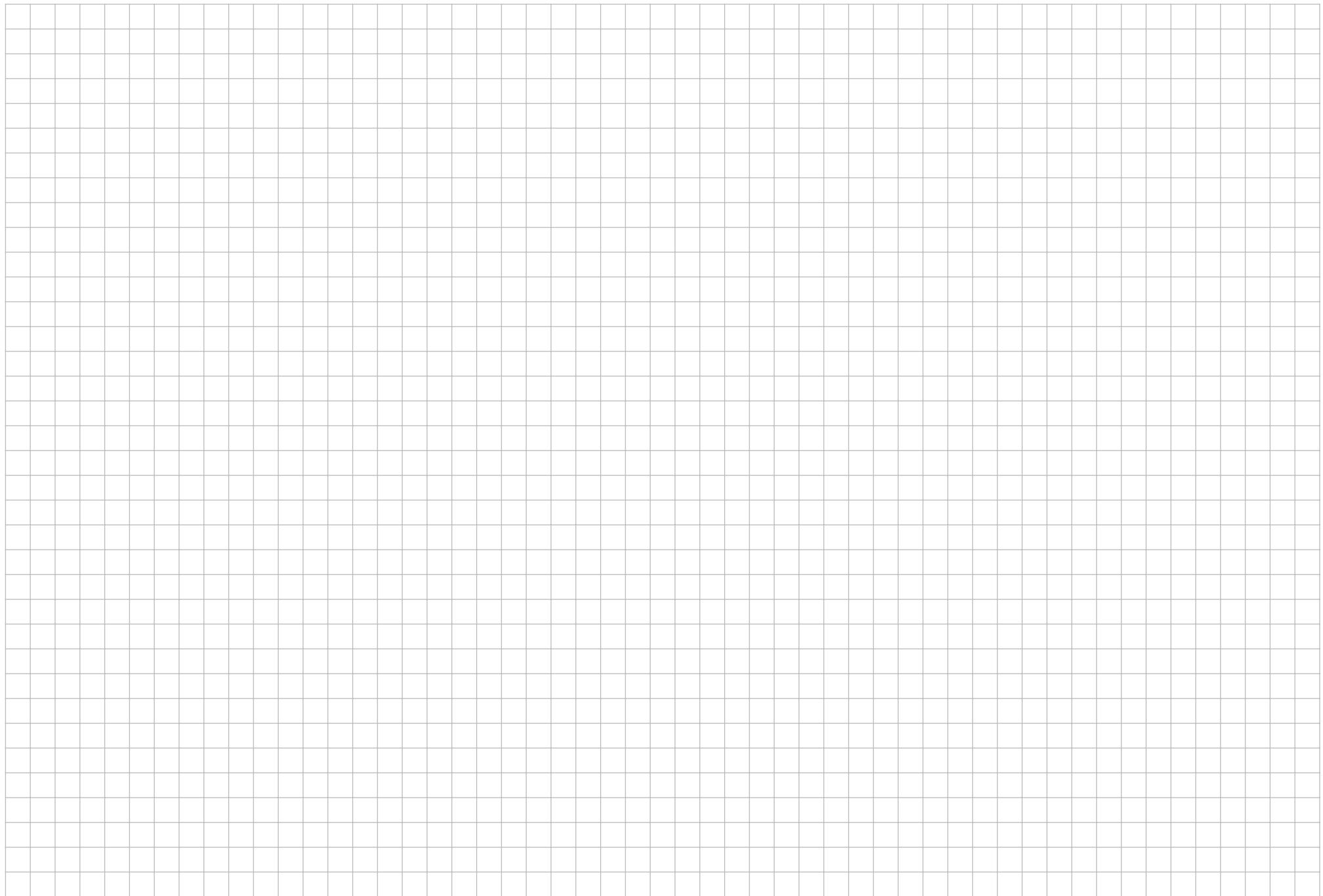
$$|S|=3$$

$$S+P = \{"a", "b", "z", "y"\}$$

$$P = \{"b", "a"\}$$

$$|P|=2$$

$$\underline{|S+P|=4} \leq \underline{|S|+|P|}$$



$$\text{terrain_cost} + a * r + b * \text{noise}$$

1) $82 + 0$ V $83 - a \cdot |G|$

2) $3 + 0$ V $4 - a \cdot |G|$

3) $0 + 0$ V $\Delta TC - a \cdot |G|$
 $\nearrow \searrow$
 ≈ 1

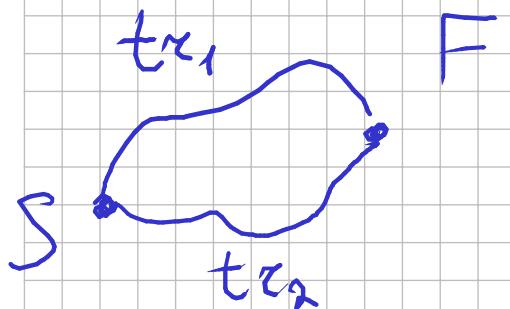
*notation for discretization step of
Total Cost*

$$0 + \beta \cdot |\text{Map}| \quad V \quad \Delta TC - \beta \cdot |\text{Map}|$$

$$\underbrace{\text{terrain_cost}}_{\Delta \text{TC} = 1} + \underbrace{a * r}_{\Delta \text{TR} = 1} + b * \text{noise}$$

$$\Delta \text{TC} = 1$$

$$\Delta \text{TR} = 1$$



tr_1 : 4 goals collected

tr_2 : 5 goals collected

$$\overline{\text{TR}}_1 = \frac{1}{2|G|} - 4 = a \cdot 4$$

$$\overline{\text{TR}}_2 = a \cdot 5$$

$$\Delta \text{TR} = a$$

Suppose Map has
10 Goals in total

$$\boxed{TC + TR + TN}$$

$$\times 82 - 4a - 6 \cdot |\text{Map}|$$

$$\checkmark 82 - 5a + 6 \cdot |\text{Map}|$$

Big ↑

Small ↑

$$b < \frac{a}{2 \cdot |\text{Map}|}$$

$$a = \frac{1}{2|G|}$$

$$b = \frac{1}{8 \cdot |G| \cdot |\text{Map}|}$$