1.1) 2, 4, 8, 16, 64

$$s = \frac{1}{(1-\alpha)+\frac{p}{\alpha}}$$

$\alpha_A = 0{,}6$

$\alpha_B = 0{,}8$

$\alpha_C = 0{,}5$

$$S_A = \frac{1}{(1-0{,}6)+\frac{0{,}6}{2}} = 1{,}428$$

$$S_A = \frac{1}{(1-0{,}6)+\frac{0{,}6}{4}} = 1{,}8181$$

$$S_A = \frac{1}{(1-0{,}6)+\frac{0{,}6}{64}} = 2{,}442$$

$$S_A = \frac{1}{(1-0{,}6)+\frac{0{,}6}{8}} = 2{,}105$$

$$S_A = \frac{1}{(1-0{,}6)+\frac{0{,}6}{16}} = 2{,}28571$$

$$S_B = \frac{1}{(1-0{,}8)+\frac{0{,}8}{2}} = 1{,}66$$

$$S_B = \frac{1}{(1-0{,}8)+\frac{0{,}8}{4}} = 2{,}5$$

$$S_B = \frac{1}{(1-0{,}8)+\frac{0{,}8}{64}} = 4{,}705$$

$$S_B = \frac{1}{(1-0{,}8)+\frac{0{,}8}{8}} = 3{,}33$$

$$S_B = \frac{1}{(1-0{,}8)+\frac{0{,}8}{16}} = 4$$

$$S_c = \frac{1}{(1-0{,}5)+\frac{0{,}5}{2}}$$
$$= 1{,}33$$

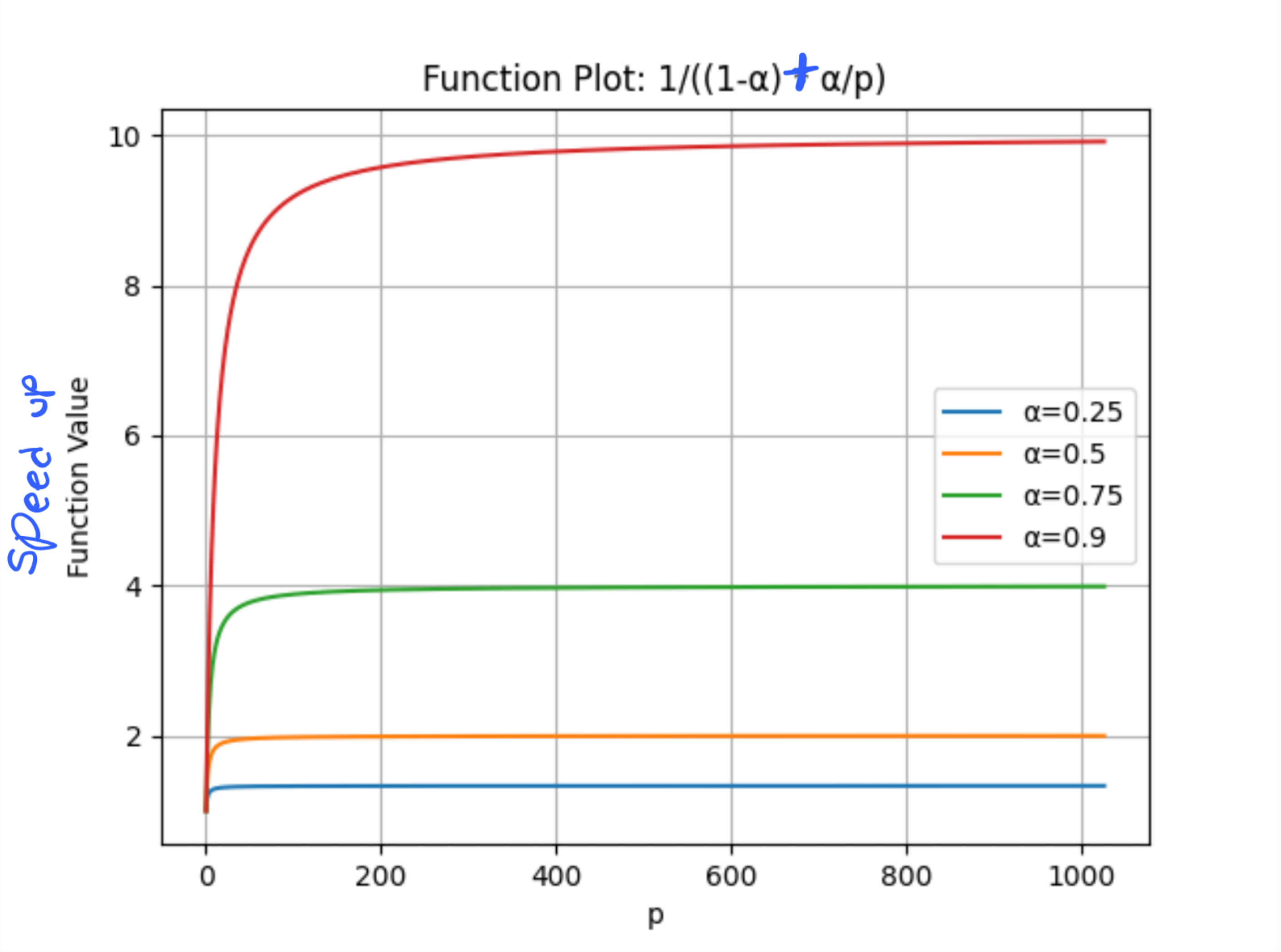
$$S_c = \frac{1}{(1-0{,}5)+\frac{0{,}5}{8}}$$
$$= 1{,}77$$

$$S_c = \frac{1}{(1-0{,}5)+\frac{0{,}5}{4}}$$
$$= 1{,}6$$

$$S_c = \frac{1}{(1-0{,}5)+\frac{0{,}5}{16}}$$
$$= 1{,}88$$

$$S_c = \frac{1}{(1-0{,}5)+\frac{0{,}5}{64}}$$
$$= 1{,}96$$

1.2) plotted with Python code



↳ The max speed up, we can get is $\frac{1}{(1-\alpha)}$

⇒ This is because the overall speedup of a task is limited by the portion of the task that cannot be improved.

2.1.) geg: $T_1 = 12s$

$\alpha = 0,8$

$p = 64$

$T_p = (1-\alpha) + \alpha$

$T_1 = (1-\alpha) + \alpha \cdot p$

$S(p) = \frac{T_1(p)}{T_p} = \frac{1-\alpha+\alpha \cdot p}{1}$

$E(p) = \frac{S(p)}{p} = \frac{1-\alpha}{p} + \alpha$

ges: $S(p)$, $E(p)$

$T_1(64) = 12 = 0,2 + 0,8 \cdot 64$

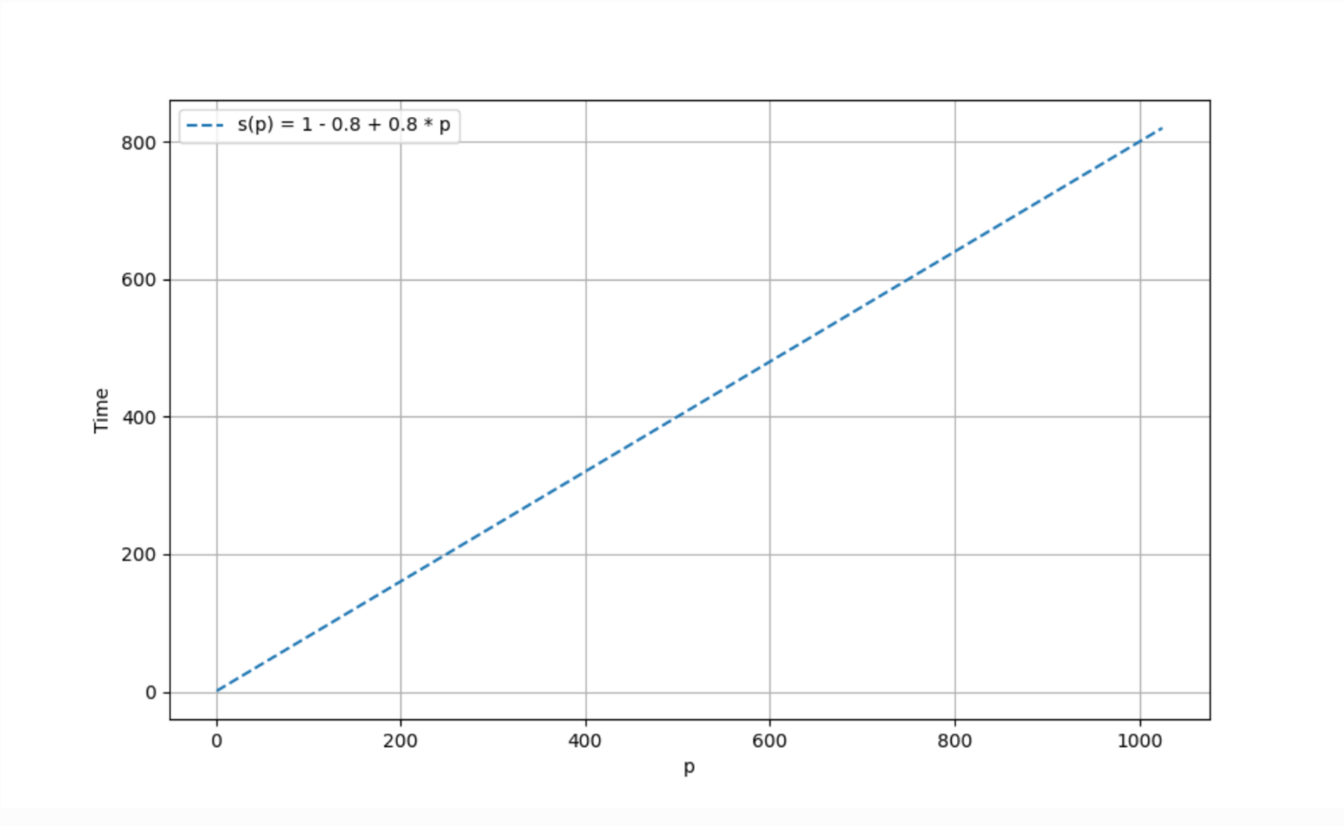
$= 51,4$

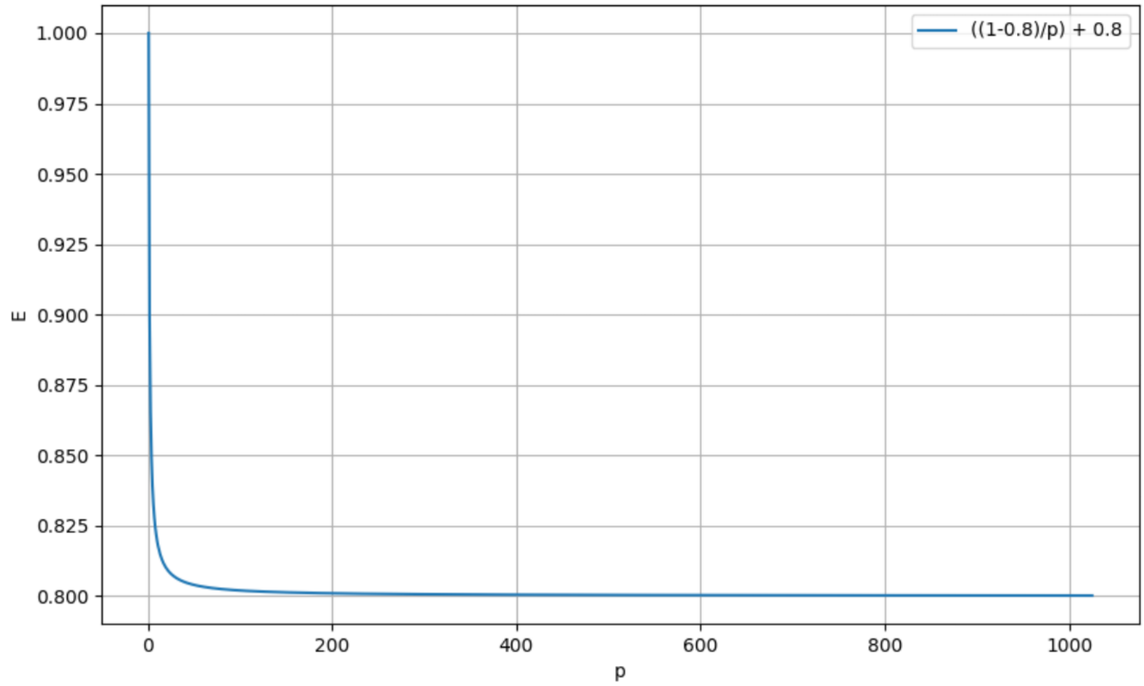
$S(p) = \frac{T_1(p)}{T_p} = 0,2 + 0,8 \cdot 64$

$= 51,4$

2.2) $E(p) = \frac{S(p)}{p} = \frac{51,4}{64} = 0,803$

2.3)





$s(p) = 1 - 0{,}8 + 0{,}8 \cdot p$

↳ the time is growing linearly with the number of processes due to the $0{,}8 \cdot p$

- efficiency drops with a higher number of processes due to the $\frac{s(y)}{\partial p}$

2.4) $s(p) = (1-\alpha) + \alpha \cdot p$

↳ The larger is α, the higher the speed up grows

↳ assume: $\alpha = 100\%$ => The maximum speed up we can get is the number of processes

$$E(p) = \frac{s(p)}{p} = \frac{1-\alpha}{\alpha} + \alpha$$

for the efficiency:

- the higher α is, the higher the number of the processes we can use

example.:

example:

$E(10) = \frac{0{,}8}{10} + 0{,}2 = 0{,}28$

$E(3) = \frac{0{,}8}{3} + 0{,}2 = 0{,}2\overline{6} + 0{,}2 = 0{,}4\overline{6}$

Lets make α higher

$\alpha = 0{,}8 \quad p = 10$

$E(10) = \frac{0{,}2}{10} + 0{,}8$

$= 0{,}82$

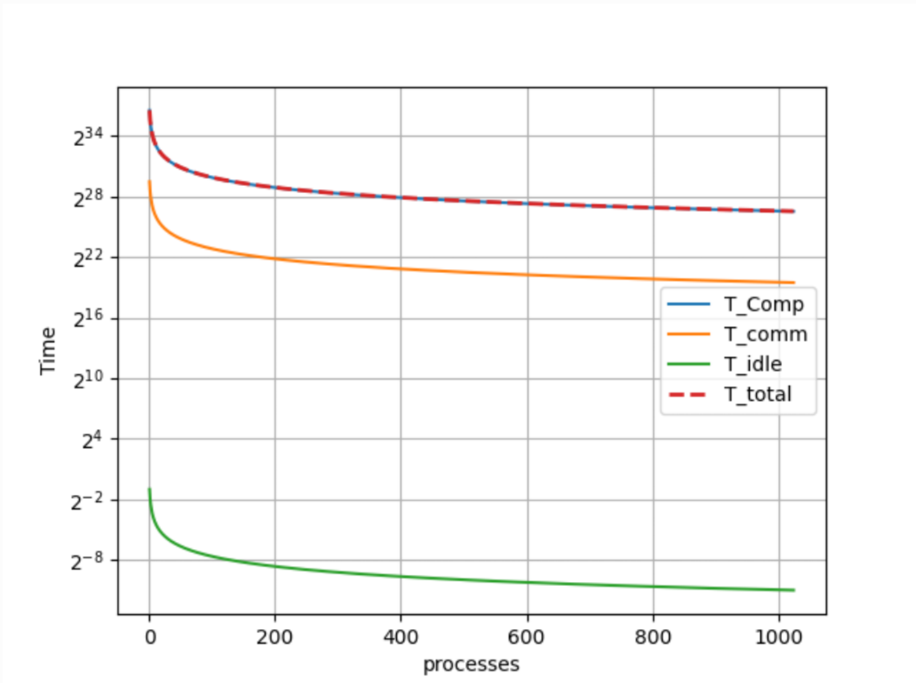
$E(15) = \frac{0{,}2}{15} + 0{,}8 = 0{,}81\overline{3}$

3.1) $T_p = T^p_{comp} + T^p_{comm} + T^p_{idle}$

$T^p_{comp} \to K \cdot \frac{N}{p}$, $T^p_{comm} \to c \cdot \frac{N}{p}$, $T^p_{idle} \to \frac{m}{p}$

geg: $K = 0{,}8 \quad c = 5 \quad m = 0{,}5$

$N_c = 5000^3 \quad N_{comm+idle} = 6 \cdot 5000^2$



3.2) - The execution time has the same graph as T^p_{comp} which implies, T^p_{comp} is the most significant factor

- in The mesh problem T^{p}_{comp} is larger than T^{p}_{comm} due to the $N^3 > N^2 \cdot 6$
- T^{p}_{comp} and T^{p}_{comm} both scale with the problem size
  ↳ $T^{p}_{comp} \in O(N^3)$, $T^{p}_{comp} \in O(N^2)$

Individual contributions

Mohamad Khaled Minawe: all members contributed equally

Daniel Schicker: all members contributed equally

Ward Tammaa: all members contributed equally