Le carré d'*AS*.

On désigne par n un nombre entier strictement supérieur à 1, et on appelle mot une suite de n lettres (ayant un sens ou non).

Une grille carrée de n lignes et n colonnes sera appelée « grille $n \times n$ »)

On se propose alors de remplir les cases d'une grille $n \times n$ de telle sorte que chaque case contienne soit la lettre A, soit la lettre S.
Une fois remplie, cette grille contient :

- *n* mots écrits en ligne, lus de gauche à droite,
- *n* mots écrits en colonne, lus de haut en bas,
- *2* mots écrits en diagonale, lus de gauche à droite.

On dit que la grille est un « **carré d'*AS*** » lorsque les mots qu'elle contient sont tous différents.

Exemple :
Ceci n'est pas un carré d'AS 5×5 car il y existe au moins deux mots identiques.

A	S	A	S	A
S	A	A	S	A
A	A	A	A	A
S	S	A	S	S
S	S	S	S	S

« AAASS »

« AAASS »

1- Montrer qu'il n'existe pas de **carré d'*AS*** dans une grille 2×2.
2- Existe-t-il un **carré d'*AS*** dans une grille 3×3 ?
3- Donner un exemple de **carré d'*AS*** dans une grille 4×4.

Eléments de solution :

1 - Dans une grille 2x2 :
Il ne faut placer que des combinaisons de 2 lettres prises parmi A et S.
Elles sont au nombre de 4 : AA,AS,SA,SS.
Or il existe 2 lignes, 2 colonnes et 2 diagonales. Il faudrait donc 6 combinaisons.
Il n'existe donc pas de carré d'AS 2x2.

2 - Dans une grille 3x3 :
Cette fois, il ne faut placer que des mots parmi : AAA, AAS, ASA, ASS, SAA, SAS, SSA, SSS (il y en a 8, c'est-à-dire autant que de mots à former. Il n'y a donc pas impossibilité flagrante)
Méthode 1 :
La case centrale occupe une position stratégique. On peut lui affecter indifféremment la lettre A ou la lettre S, qui jouent des rôles symétriques. Affectons-lui la lettre A.
Puisqu'il existe exactement 4 mots avec A pour lettre centrale et 4 mots avec S pour lettre centrale, les 4 autres cases qu'occupent les lettres centrales des mots devront contenir la lettre S, conformément au schéma :

	S	
S	A	S
	S	

Le mot SAS apparaît nécessairement deux fois, donc il n'existe pas de carré d'AS 3x3.
Méthode 2 : (vue dans des copies)
Les mots SSS et AAA ne peuvent pas « se croiser ».
Ils occupent donc deux lignes parallèles (ou colonnes). De sorte qu'il ne reste plus qu'une ligne (ou colonne) pour différencier ces mots, soit 3 cases. Comme on ne dispose que de 2 symboles, c'est impossible.

3 - Dans une grille 4x4 :
Il existe 16 mots distincts de 4 lettres formés avec les lettres A et S. On doit former 4+4+2=10 mots.
Y compris les inversions entre A et S, les symétries et les rotations, il existe 652 solutions.
Il n'est possible de placer qu'entre 6 et 10 fois sur 16 la même lettre.
Avec 6 A et 10 S (ou l'inverse), il existe 104 solutions.
Avec 7 A et 9 S (ou l'inverse), il existe 352 solutions.
Avec 8 A et 8 S, il existe 196 solutions.
Les mots AAAA et SSSS apparaissent 480 fois.
Les mots AAAS et SSSA apparaissent 848 fois.
Les mots AASA et SSAS apparaissent 848 fois.
Les mots AASS et SSAA apparaissent 888 fois.
Les mots ASAA et SASS apparaissent 848 fois.
Les mots ASAS et SASA apparaissent 888 fois.
Les mots ASSA et SAAS apparaissent 872 fois.
Les mots ASSS et SAAA apparaissent 848 fois.

Il existe 28 solutions où apparaissent simultanément AAAA et SSSS, et c’est toujours sur les diagonales qu’on les trouvent dans ce cas de figure. Exemples :

A	A	S	S		A	S	S	S		S	A	A	A
S	A	S	S		A	A	S	A		S	S	A	S
S	S	A	S		A	S	A	S		S	A	S	A
S	A	A	A		S	S	S	A		A	A	A	S

Liste exhaustive des solutions. Les 4 premières lettres sont celles de la première ligne, et ainsi de suite.
Exemple avec la première des 652 solutions :

A S A A S A A A S A S A A S A S Est le carré d’AS :

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S	A	A	A
S	A	S	A
A	S	A	S

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