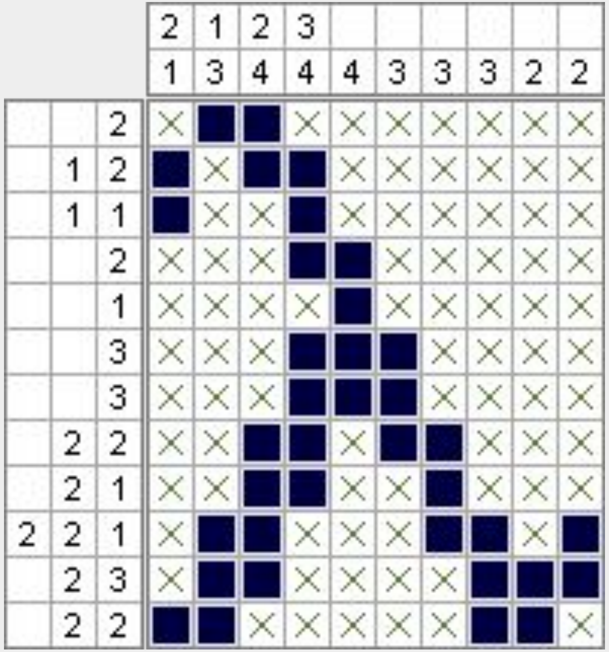
INFO0054
Programmation Fonctionnelle

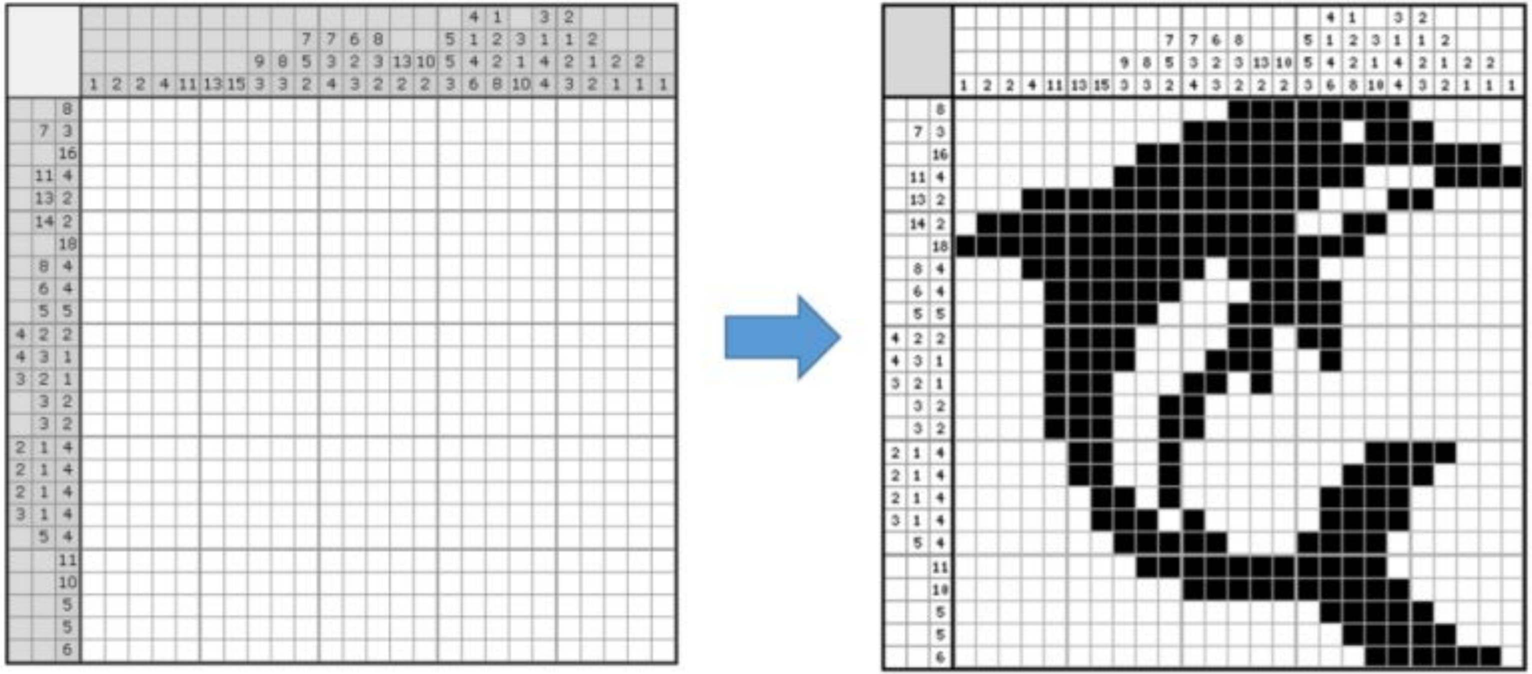
Project 2023-2024

Nonograms



Source: https://www.twanvl.nl/blog/haskell/Nonograms

Nonograms II



Sources: https://chihyulai.com/nonogram-ai/ and https://www.nonograms.org/nonograms/i/32344

Introduction

A nonogram is a popular Japanese puzzle game that combines elements of logic and pixel art.

The goal of a nonogram is to reveal a hidden picture by filling in a grid of squares based on numerical hints provided for each row and column.

The numbers indicate how many consecutive squares should be filled in, separated by at least one empty square.

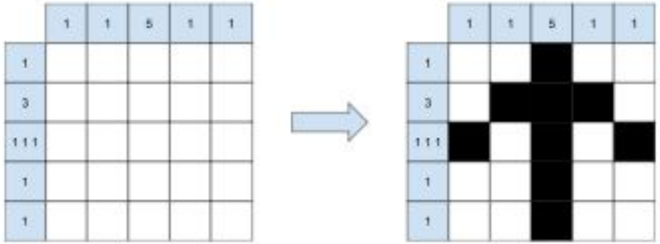


Figure 1: Example of a nonogram revealing an arrow.

Introduction

A (classical) nonogram starts with a rectangular grid. Along the top and left sides of the grid, there are collections of numbers that provide hints. These numbers indicate how many consecutive squares in that row or column should be filled in with the picture, and they are separated by at least one empty square.

For example, if a row has the clue "3 2," then there are three consecutive filled squares followed by at least one empty square and then two more consecutive filled squares in that row.

There are three possibilities to fill a row of length 5 with the hint “3”:

- [X,X,X,_,_]
- [_,X,X,X,_]
- [_,_,X,X,X]

And there is only one possibility to fill a row of length 5 with the hint “1 1 1”:

- [X,_,X_,X]

Introduction

You use the hints to logically **deduce** which squares should be filled in and left empty. By analyzing the clues and cross-referencing them with the adjacent rows and columns, you can gradually reveal the hidden picture.

Computer scientists are interested in nonograms as conceiving a nonogram solver poses an interesting challenge.

Brute-force solutions are inefficient, as the problem space can grow exponentially large! (but …)

The goal of this project is to create a nonogram solver. You do not have to be (overtly) concerned with the efficiency of your algorithm; a brute-force approach starting from the rows suffices to obtain a good grade for the purpose of this course.

Students who develop a more efficient nonogram solver will be recognized for their efforts, provided they respect the course’s requirements (e.g., developing pure functions). Students will notice that many of the efficient implementations rely on side effects.

Evaluation Grid (see document for more details)

- Algebraic Data Types (ADTs) 10%
- A function **hints** (from solution to hints) 20%
- A function **solve** taking as input two lists of hints and returns a list of solutions (or something representing a success or a failure) 30%
    - *Brute-force approaches are OK, as long as you make your functions as efficient as possible.*
- A more efficient solver 20%
- Implementation and documentation 10%
- A technical report 10%

- Bonus points: a parser for nonograms 10%

Scores

Each “aspect” receives a score between 0 (non-existent) and 5 (excellent), though a 6 (exceeds expectations) can be given <u>on rare occasions</u>. Only on very rare occasions can half points be attributed, which will be motivated.

Scores are not rounded, decimals are taken into account for the course’s overall weighted average.

<u>6/5 is very rarely given</u>. Half points are rarely given and will be motivated in the feedback.	0/5) Non-existent 1/5) Insufficient 2/5) Less than adequate 3/5) Adequate 4/5) Good 5/5) Excellent 6/5) Exceeds expectations			C'était un très bon projet, mais une honte est la (mauvaise) utilisation des listes paresseuses et l'utilisation inutile de lazy val. Vous avez également pris trop de liberté (e.g., a semtab pour les formules).	
Part	Aspect	Weight	Score	Feedback (most important pointers)	Mathemagic
Part 1: Sematab	Implementation	20	4	Nous appliquons semtab à une liste de fonctions (ou tableaux dans votre cas), mais pas à une proposition. Pourquoi avoir créé une deuxième fonction semtab qui peut être appliquée à une formule ? Usage de lazy val prop_simplification ne sert à rien, car vous demander immédiatement la longeur de cette liste. Même si l'utilisation de Lazy[illegible]pour les permutations était une bonne idée, l'utilis[illegible]Right force l'évaluation de toutes les expres[illegible]dû utiliser LazyList(h,t) pour vous a[illegible]s n'étaient pas évalu[illegible]iez dû créer la [illegible]ter sur foldRight. [illegible]non stricte pour [illegible]té utilisé/utile. **<u>[illegible] responsable des [illegible]mplémentation de semtab en fait [illegible]ations n'étaient que importantes pour</u>**	80
	Tests	[illegible]	[illegible]	[illegible]ests pour les bases fonctionnent	25
	Documentation	[illegible]	[illegible]	Certaines parties du code étaient difficile à comprendre. Manque de documentation de votre approche de semtab.	15
Part 2: Library	isSatisfiable and isValid	10	5		50
	isTautology and isContradiction	5	5		25
	models and counterexamples	15	4	Utilisation d'un index pour les itérations sur les listes :-(	60
Part 3: Extensions	EQUIV, XOR, NAND, and XNOR	15	5		75

	OR and AND of arity n >= 1	15	3	Les négations ne sont pas implémentés:
				semtab(List(NOT(and(A,B,C,D)), E)).toList
				val res42: List[Tableau.Tableau] =
				List(List(NOT(GAND(List(Variable(a), Variable(b), Variable(c), Variable(d)))), Variable(e)))
				
				semtab(List(NOT(and(A,B,C,D)), E)).toList // INCORRECT
				semtab(List(NOT(or(A,B,C,D)), E)).toList // INCORRECT
					45

Report	Overall appreciation	10	5	Manque de détails sur votre approche "déviée"	50
Part 4: Parser	Overall appreciation	10			0
				Total score on 20:	**17**

Example feedback from 2022-2023

Deducing partial solutions

One way of optimizing the algorithm is by looking for partial solutions (e.g., by deducing the values of a square or by pruning partial solutions that do not satisfy requirements).

You can thus significantly reduce the problem space by such deductions. You are encouraged to tackle this problem. A good approach is to first develop a naïve implementation in one module and then develop an optimized version in another.

The two modules can be used for some benchmarking (in time and space). If you wish to compare the behavior of the two modules (or only one module), then you are allowed to provide the code for the benchmark in a separate file.

Watch this video as a starting point.

Watch out:

If you stick to a brute-force approach, you will notice that your implementation will be slow, and you will soon run out of memory. Limit your examples to grids that are 5x5.

Remember that a nonogram may yield more than one solution.

Nonograms are well-studied in computer science, and you will find many resources in literature and on the Web.

You must cite any resources you used to realize this project in your report. A mere list of references does not suffice; references must be used in the text.

Modalities I

- Deadline: December 1, 2023 @ 11:59 (penalties for late submissions)
- Submit 2 file on eCampus: 1 ZIP file and 1 PDF FILE
- Groups of 3 students!
  - Deadline group formation: October 19, 2023
  - 3 groups of 2 will be transformed into 2 groups of 3
- **The project is a mandatory learning activity. Not partaking in the project (even submitting an empty report and source code) will yield an A(bsence) for the course.**

Modalities II

- All students must fill in a peer assessment form after the deadline. Filling in the form will be a prerequisite to obtaining a grade. Individual grades will be adjusted using these peer assessments, which can deviate at most 2 points from the group's grade (unless a student clearly underperforms or outperforms).
- Peer-assessments will be shared with students.

Do not wait to inform Prof. Debruyne or Mr. Vergain of any problems in your group! Drama 2-3 days before the deadline is… too late for us to meaningfully intervene.

Peer-assessment Form

For each peer, you will assign scores from 0 (did this poorly) to 3 (did this very well) on two dimensions:

- Functioning in the group
- Work on the task

There is an additional question on overall contribution, which acts as a damper.

I will be using MS Office 365 forms, of course. ;-)

Peer Assessment Form

Student being assessed:______________________________

Student making the assessment:___________________________

For each aspect, rate the student on a scale from A to D using the following guide:
A: did this very well **B**: did this adequately
C: did this less than adequately **D**: did this poorly

General Aspect	Specific Aspect	Comment	Rating
Group Process	Attended a large majority of group meetings		
	Maintained contact with other group members		
	Communicated constructively to discussions		
	Generally was cooperative in group activities		
	Asked useful questions		
	Encouraged and assisted other group members		
The task	Made a genuine attempt to complete all jobs agreed by the group		
	Made an intellectual contribution to the completion of the task		
	Did (at least) their fair share of the work		
	Read and commented in a timely manner on drafts of the report		
	Contributed a significant amount (measured in ideas as well as words) to the report		
Overall	Based on your ratings and comments above, this student's contribution overall on this group task		

Issacs, G. (2002) Assessing Group Tasks. Teaching and Educational Development Institute. Queensland, Australia.

As a reminder, academic misconduct is severely punished.

I also remind students to consult the “Charte d'utilisation des outils d’intelligence artificielle par l’étudiant” (french) or “Charter for the use of artificial intelligence tools by students“ (English)
→ Available on eCampus.

You are encouraged to discuss ideas and approaches with your peers, but you are not allowed to share your code.

“Students having their homework written by a robot with a computer head.”
Christophe × DALL·E
Human & AI

Group self-assessment activity (to be confirmed)

In 2022-2023, I conducted an experiment on group self-assessment in INFO0009.

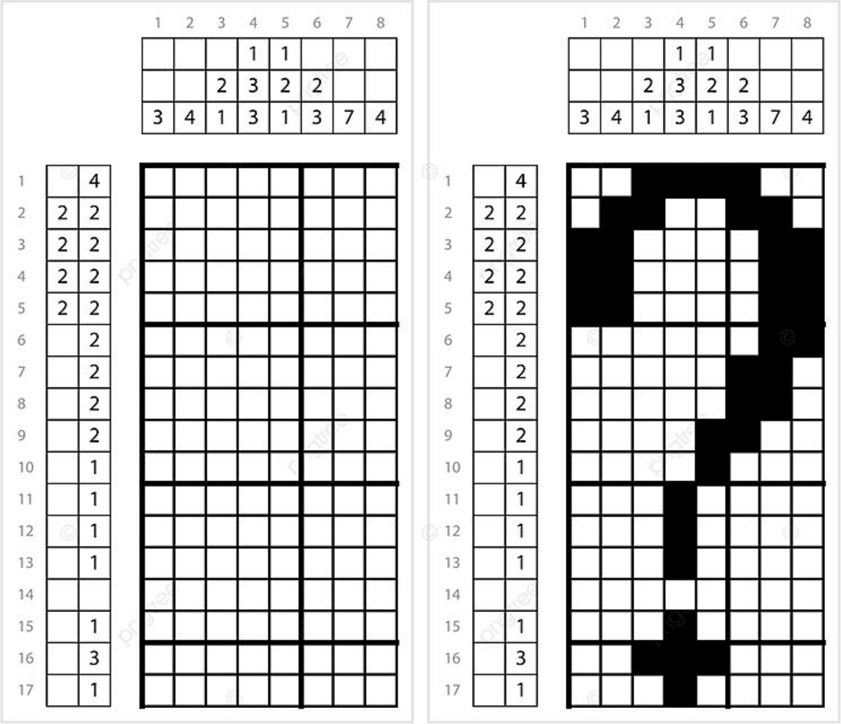
→ Students who took part in that performed better at the exam. *I even observed some self-regulation w.r.t. the material covered in the first part of the project.*

You spend about an hour evaluating you work as a team (filling the evaluation grid). Teams whose assessment falls sufficiently close to their actual grade obtain a bonus point. Only the students who took part in the activity get a bonus point (no free loading).

- E.g., absolute difference <= the mean of absolute differences after removing outliers.

Would this be of interest to you? The majority of the class would need to partake for this exercise to be meaningful.

Questions?



Source: https://pt.pngtree.com/freepng/question-mark-symbol-nonogram-pixel-art_7798372.html