Zürcher Hochschule
für Angewandte Wissenschaften

School of
Engineering
IAMP Institut für Angewandte
Mathematik und Physik

MSE Algorithms

L07: Final Lecture

Samuel Beer

Santa’s Challenge

Results for Santa's Challenge

Solutions for Santa's Challenge 2024

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Team	Team Members	Best Score	Rank
Simon Stuck	Simon Stuck	12'476'761'797	214
Moscatelli, Scherrer	Ramon Moscatelli, Hannes Scherrer	13'257'683'464	783
Zubler	Jeanot Zubler	13'378'578'041	796
SleighRiders	Mathias Weiss, Tenpa Dongtse, Vikas Chaurasia	13'536'023'508	820
Scholfa	Fabian Scholpp	17'591'639'629	985

Best solution in Kaggle Competition: 12'384'507'107
Total 1127 teams in the competition

Solutions for Santa's Challenge 2024

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Team	Description of Algorithm

Simon Stuck	• Simmulated Annealing, 16 separate Regions (Threads) based on Longitude only, 5mio steps/iteration, 100mio-1 degree temp, 0.95 cooling rate
	• 5 weighted heuristics:
	  • Move single parcel to other list,
	  • Swap two parcels (random lists),
	  • Same list: parcel 2-opt,
	  • Same list: move parcel random position,
	  • Two random trips: swap all packets from random positions i,j to end.
	• Optimized implementation in C++, Evaluation and execution (if accepted) in O(k) where k is the number of parcels in a single trip.
	• The largest optimization that is still possible is to not use memory operations for evaluation, but that would take a lot of implementation effort.
	• Another optimization could be to make evaluation possible in O(1) by adding the costs to the data structure. Currently I make a copy of the affected trips and execute the move on this temporary copy. The trip itself is accessible in O(1) due to the use of a vector (not a list).
	• The second thing that still has large optimization potential is the splitting into 16 regions. Currently there are no trips covering more than one single region. Reducing the number of regions (requires to largely increase the number of steps/iteration) could lead to new and better solutions).

Solutions for Santa's Challenge 2024

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Team	Description of Algorithm
Moscatelli, Scherrer	**Construction:** 1. Start with heaviest gift 2. Add N nearest gifts to trip until sledge is full 3. Pick next heaviest remaining gift and repeat **Optimization "Local Route":** 1. For each tript sort the gifts such that the closest gift is the next stop **Optimization "Find Splits":** 1. For each trip split the trip at a random position 2. If it improves the cost: keep, else: discard 3. Iterate until almost no more improvements are found **Optimization "Find Outliers":** 1. Found outliers that add the highest "extra distance" 2. Assign them to a closer trip if possible (check weight) 3. If it improves the cost: keep, else: discard 4. Repeat for N outliers **Optimization "Local Route":** 1. For each tript sort the gifts such that the closest gift is the next stop **Optimization "2-opt":** 1. For each trip randomly swap two positions 2. If it improves the cost: keep, else: discard 3. Iterate N times

Solutions for Santa's Challenge 2024

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Team	Description of Algorithm
Zubler	Just nearest neighbour, with a weight limit for each trip (500).

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Team	Description of Algorithm
SleighRiders	Greedy route build is based on KD Tree- K-nearest neighbours. After getting the routes, Lin-Kernighan heuristic is applied to optimize each route.

Solutions for Santa's Challenge 2024

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Team	Description of Algorithm
Scholfa	Pilot method with simulated annealing.

Solutions for Santa's Challenge: Best so far

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Best solution in this course so far

Greedy construction based on heavy gifts delivered to Antarctica, optimized with SA. Multiple runs of SA were running for 3-4 days, with 8 simultaneous runs on a 12-core VM.

Score: 12'464'701'894
Rank: 188

Best solution in Kaggle Competition: 12'384'507'107
Total 1127 teams in the competition

Solutions for Santa's Challenge 2024

Further readings

A nice description of the methods chosen to solve Santa's Challenge can be found on the internet from the team ranked #3:

https://deepsense.ai/santas-stolen-sleigh-kaggles-optimization-competition/

Lecture Evaluation

Lecture Survey: Module Content

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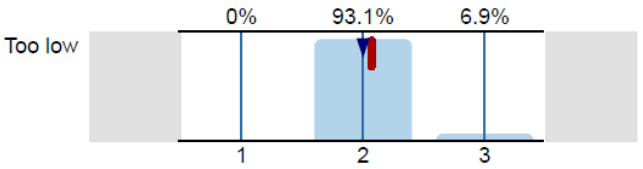
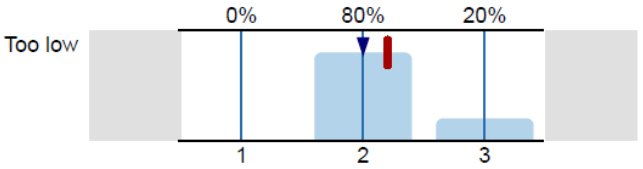
4. Module content

4.1) I consider the level of the learning objectives and the course contents specified in the module description to be just right for a Master's course.



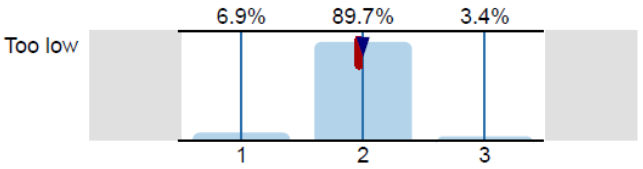
n=29
av.=2.07
md=2
ab.=1

4.2) The amount of material to be studied was appropriate for the 3 ETCS (90 hours of work).



n=30
av.=2.2
md=2

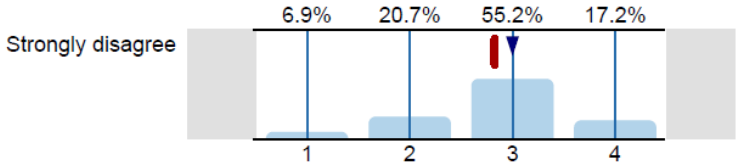
4.3) The prior knowledge expected by the lecturer was appropriate.



n=29
av.=1.97
md=2

5. General impression

5.1) All in all, I am satisfied with this module.



n=29
av.=2.83
md=3
ab.=1

Lecture Survey: Organization

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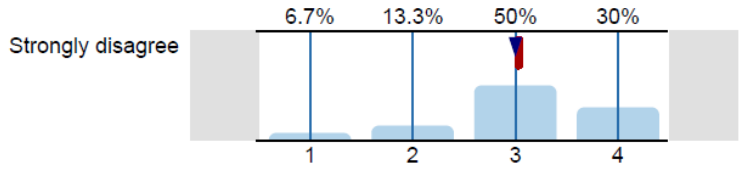
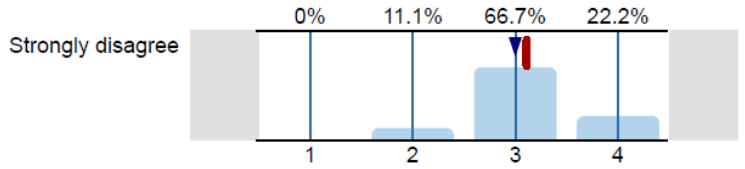
3. Appeal and organization of the module

3.1) The tutorials supplement the lectures in a meaningful manner and support the learning process.



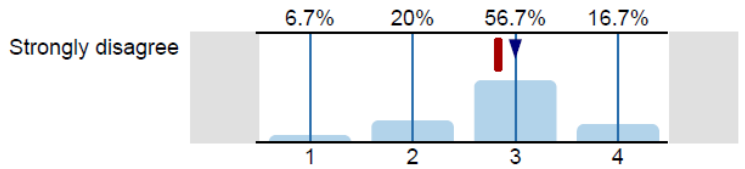
n=30
av.=3.03
md=3

3.2) The support materials (e.g. recommended books, documents handed out) are appropriate.



n=18
av.=3.11
md=3
ab.=12

3.3) The module is sensibly organized, and the coordination between the different lecturers works well.



n=30
av.=2.83
md=3

Lecture Survey: Lecturer J.K. Canci

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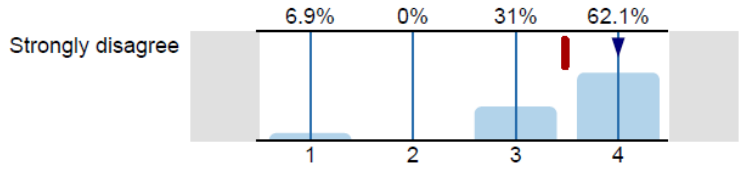
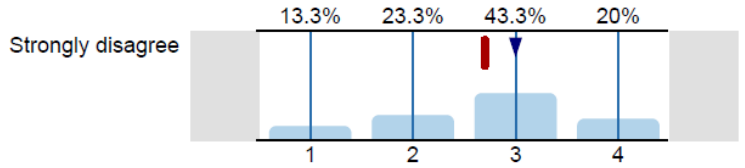
Lecturer 2: Canci Jung Kyu

2.5) I regard the lecturer as being competent in their subject.



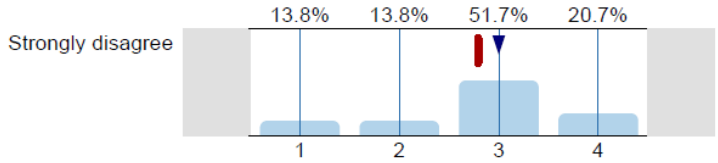
n=29
av.=3.48
md=4
ab.=1

2.6) I regard the lecturer as having good teaching skills.



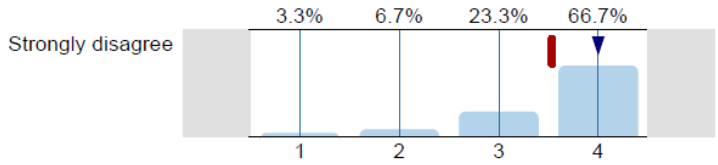
n=30
av.=2.7
md=3

2.7) His/her teaching is clearly structured (a clear thread), and the subject matter was imparted in a comprehensible manner.



n=29
av.=2.79
md=3
ab.=1

2.8) I regard the lecturer as being motivated and committed.



n=30
av.=3.53
md=4

Lecture Survey: Lecturer S. Beer

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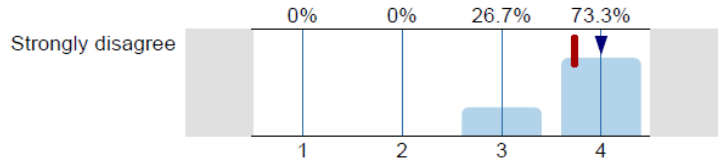
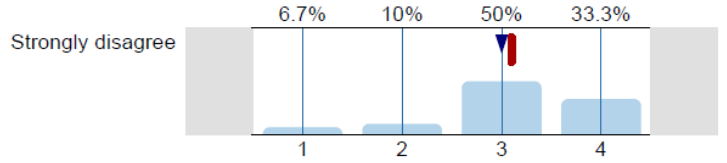
Lecturer 1: Samuel Beer

2.1) I regard the lecturer as being competent in their subject.



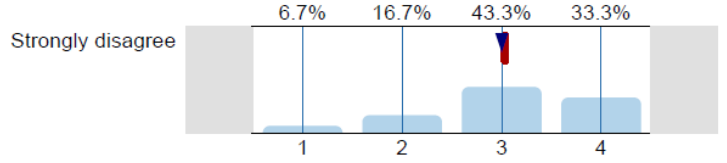
n=30
av.=3.73
md=4

2.2) I regard the lecturer as having good teaching skills.



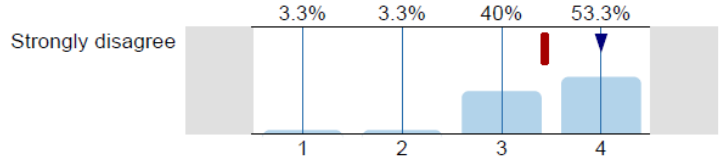
n=30
av.=3.1
md=3

2.3) His/her teaching is clearly structured (a clear thread), and the subject matter was imparted in a comprehensible manner.



n=30
av.=3.03
md=3

2.4) I regard the lecturer as being motivated and committed.



n=30
av.=3.43
md=4

Feedback comments

5.2) What did I like about this module?

- - (2 Counts)
- - Heuristiken sind spannend
- - Overall I was very happy to have chosen this module.
  - I found the lectures interesting and very well structured.
  - Most of the theory was introduced together with lots of examples, which helped me a lot to understand the material.
  - The exercises were also helpful for understanding and not too time-consuming. I liked that it was clearly stated which exercises were relevant/important for the exam.
- Die Dozenten scheinen sehr offen für Feedback zu sein und geben gerne Antworten zu Fragen während dem Unterricht. Dies gibt eine offene und angenehme Atmosphäre im Unterricht.
  Die Santa Challenge klingt sehr interessant. Vor allem ist es angenehm, dass diese fakultativ ist. (Leider bereits in anderen Modulen einige Testate, die es erschweren, Zeit für alles zu finden.)

  Hoch zu loben ist, dass beide Dozenten während dem Unterricht auf digitale Weise einzelne Folienabschnitte in einzelnen Schritten aufzeigen, durchgehen und erklären. Diese helfen wirklich sehr, das Thema und die Prozesse zu verstehen. Auch wenn man aus Krankheitsgründen z.B. nicht am Unterricht vor Ort teilnehmen kann.
- die Übungen im ersten Teil waren sehr hilfreich um den Stoff anzuwenden
- Hybrid
- I got an overview of different computational problems and their solving approaches, which was definitely valuable.
- Positiv überrascht von Teil 2 des Moduls. Viel neues Wissen, viele spannende, augenöffnende herangehensweisen
- The professors' motivation and style of teaching.
- The programming exercises in the second part of the modul.
- Vor allem der zweite Teil des Moduls ist interessant, aus der Sicht eines Studenten mit Bachelor in Informatik, der erste Teil war zu einem grossen Teil Repetition und Festigung des Wissens
- War absolut zufrieden mit diesem Modul.

Feedback comments

5.3) What should be improved in this module?

- -
- - Der Anfang war sehr viel Wiederholung aus dem Bachelor
  - Herr Kyu verstrickte sich oft in Geschichten, welche für den Unterricht nicht relevant waren
  - Herr Beer hat regelmässig die Lektionszeit um 30-60min überzogen
- Aufzeichnungen als Referenz während Übungs- und Prüfungsvorbereitungsphase, Qualität des Streamings (fehlende Folien, schlechte Kommunikation beim Wechsel der Kanäle)
- Es wäre besser die Lösungen zu den Übungen bereits am gleichen Abend frei zu schalten. Dadurch könnte ein effizienteres Lernen erzielt werden.

  Dozent/in 1: Samuel Beer: Leider ist meistens der Ablauf der Thematik wirklich sehr schwer nach zu vollziehen durch die Anordnung der Folien während dem Unterricht. Erst bei einem weiteren Durchgehen der Folien erschliessen sich die Thematiken.
- Focus should also be on the programming side, the first part was only from a mathematicians point of view. In my opinion it is important to implement an algorithm or at least key parts of it to fully understand it and also to know what the challenges are of implementing an algorithm. In the first part it was also sometimes hard to follow the lecturer (even though I had already taken two algorithm courses in my bachelor). Furthermore the topics in the first part have sometimes been a repetition of the bachelors degree, instead I'd rather have spend more time on topics like Genetic algorithms, Artificial ant systems and the santas challenge.
- im zweiten Teil fehlt mir etwas die Struktur, die Vorlesungen sind sehr monoton und man kann ihnen fast nicht folgen
  zudem war im zweiten Teil die Onlineteilnahme nicht gerade hilfreich, da man Herrn Beer zum Teil einfach nicht versteht durch die leise Sprechlautstärke
- In the first part with Mr. Canci there were several occasions where there were severe problems with the online streaming and he wasn't aware of it. I understand that this is an annoying technical problem for students and lecturers alike. A suggestion would be that to have a student who is physically present in class to monitor the stream chat and point out to the lecturer if online participants report any issues.
- Maybe a little more emphasis on practical implementations.

Feedback comments

- Some contents from the first part appeared in the second part. It was a good repetition, but it's mentionable.
- Strukturierter sowohl die Folien, als auch das ganze Modul. Die Dozenten sollten sich besser abstimmen.
- Teil 1 war im Bachelorstudium Informatik ADS bereits behandelter stoff von einem Semester.
  Demensprechend wird Wissen von Stoff von ungefähr 2 Semester erwartet, was etwas viel Stoff ist für ein Modul. Fokus auf Teil 2 wäre eher erwünscht
- The module needs improvement in several key areas: remote accessibility, screen sharing, and audio quality. Currently, it is impossible to participate remotely, which limits access for students who cannot attend in person.
- we always stay on such a theoretical level that at the end we are learning concepts that I would have absolutely no idea of how to apply in real life examples (except maybe TSP). I find it a shame that we don't have every-day life used algorithms as examples to understand the very theoretical course.

Exam

Exam Infos

- Date: Monday, 03.02.2025
- Time: 09:15 to 11:15
- Room: PHZH LAA-J002A (Building LAA, Lagerstrasse 2, Zürich)

- Mode: open book, on-site, paper exam
  (A document with more detailled preliminary information to the exam is available on Moodle course separately)

- Sample Exams from the past years available on Moodle course: See section “Old Final Exams and Collection of Exercises”

- Exam preparation meetings: Online sessions will be held Monday, 27.01.2025:
  - S. Beer: 13:00 to 14:00
  - J. K. Canci: 14:00 to 15:00

This is the End!

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