DV2542 Machine Learning

Coursework

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Outline

- Learning objectives
- Examination opportunities (three per year)
- Assignment 1 (A1)
- Assignment 2 (A2)
- Project
- Deliverables
  - Reports
  - Code (+ additional files)
- References

Learning objectives

- **Knowledge and comprehension**

  1. independently and exhaustively define and describe solvable and tractable learning problems (E1, E3, A1, Project)
  2. independently and broadly explain and summarize results from the application and evaluation of learning systems (E1, E2, A2, Project)

- **Skills and abilities**

  3. independently and exhaustively modify or create and apply learning systems to different learning problems (E4, A1, A2, Project)
  4. independently and exhaustively plan and execute experiments to evaluate and compare learning systems (E2, E3, Project)

- **Approach and ability to evaluate**

  5. independently and exhaustively evaluate and compare learning systems for different learning problems given various evaluation criteria (E4, A2, Project)
  6. independently and exhaustively evaluate and compare methods and measures for evaluation of learning systems (Project)

Examination opportunities

- DV2542 Machine Learning is held annually, often between November and January
  - The final coursework submission deadline of the course is in January but it is possible to submit A1 and A2 before their corresponding deadlines before the winter break
- If you are unable to meet the course deadlines or the minimum requirements sfor a pass grade on any of the assignments, you have two more opportunities each year, usually in:
  - June and September (re-examination opportunities)
- Re-examination deadlines and specific information are posted on the course homepage in the preceding calendar month

Assignment 1, 1 ECTS, graded P/F (1)

- The aim of A1 is to implement a concept learner and to verify that it works as expected using the following features and instances:
  - **Prerequisite reading**: chapter 3 in the main literature
  - **Language**: C/C++, Julia, Python, or R (it is not permitted to use any existing code except the standard libraries of the selected language)
  - **Data**: See next slide
  - **Algorithm**: Algorithm 4.1 and either Algorithm 4.2 or Algorithm 4.3 in the main literature
  - Procedure
    - *Compute the size of the hypothesis space and the number of possible conjunctive concepts according to the descriptions in Section 4.1 of the main literature*
    - *Implement the algorithm and verify that it works as expected*
    - *Report the statistics and the generated model (the conjunctive rule)*

Assignment 1, 1 ECTS, graded P/F (1)

- Concept: Students that most likely will pass DV2542
- Features
  - Ambition = high, medium, low
  - Programming Experience = high, medium, low
  - English language skills = high, medium, low
  - Creative = yes, no
  - Meticulous = yes, no
- Instances (positive examples that belong to the concept)
  1. high, medium, medium, yes, yes
  2. medium, high, medium, yes, yes
  3. medium, medium, high, yes, yes

Assignment 2, 1 ECTS, graded P/F

- The aim of A2 is to experimentally compare the computational and predictive performance of three learning algorithms on a spam detection task
  - **Prerequisite reading**: sections 12.1 - 12.3 in the main literature
  - **Language**: C/C++, Julia, Python, or R
  - **Data**: The Spambase dataset (see references)
  - **Algorithms**: three supervised classification learning algorithms of your choice
  - **Comparison**: computational performance (training time), predictive performance (accuracy and F-measure)
  - Procedure (repeat steps 2, 3, and 4 for each evaluation measure above)
    1. *Run stratified ten-fold cross-validation tests*
    2. *Present the results exactly as the table in example 12.4 of the main literature*
    3. *Conduct the Friedman test and report the results exactly as the table in example 12.8 of the main literature*
    4. *Determine whether the average ranks as a whole display significant differences on the 0.05 alpha level and, if so, use the Nemeyi test to calculate critical difference in order to determine which algorithms perform significantly different from each other*

Project, 5.5 ECTS, graded F-A (1)

- The aim of the project is to independently explore and report on the application of machine learning to a real-world challenge
  - The project should be
    - *relevant (with respect to society, science, or industry)*
    - *significant (in that it should take an average computer science Master student more than 100 hours to complete)*
  - The work should be
    - *complete (the report and attached files must cover the complete project, with all intermediary steps from idea to conclusion)*
    - *correct (all design choices must be carefully motivated and all results must be verified)*

Project, 5.5 ECTS, graded F-A (2)

- Inspiration
  - See “Applications” on https://en.wikipedia.org/wiki/Machine_learning
  - See “Competitions” on https://www.kaggle.com/competitions
  - See “Challenges” on http://tunedit.org/challenges
  - See https://www.quora.com/What-are-some-interesting-possible-applications-of-machine-learning
  - Or talk to teachers to find out about important challenges in an area that interests you at BTH (e.g. computer science, health, mechanical engineering, software engineering, sustainability, etc.) and then develop a machine learning solution yourself to address the challenge

Project, 5.5 ECTS, graded F-A (3)

- The following must be demonstrated through either logical argumentation, citations of peer-reviewed scientific publications, verifiable results obtained by you in your project, or combinations of those elements:
  - Relevance of the project
  - Significance of the project
  - Completeness of the work (from idea to conclusion)
  - Correctness of the work (correct application of suitable method, correct analysis with suitable method, logical and reasonable conclusions which can be traced to specific results

Project, 5.5 ECTS, graded F-A (4)

- The following concepts must be discussed and motivated for all projects but the balance between them may vary based on the type of project conducted:
  - the machine learning task to solve and the identified learning problem
  - the learning algorithm(s) / parameter configurations / pre-processing used
  - the evaluation procedure and measures (what and how to measure)
  - the experiment (its aim, design, execution, and limitations)
  - analysis (how to interpret the results)

Project, 5.5 ECTS, graded F-A (5)

- For grading, the report and attached files will be investigated by the examiner to find out how well the following questions are addressed:
  - Is the challenge addressed relevant to science, society, or industry?
  - Does the challenge and the proposed solution require a significant effort?
  - Is the learning task and learning problem clearly defined, is the learning problem suitable for the task, and is the learning problem tractable and solvable?
  - Are the choices of algorithm(s), pre-processing, parameter configuration, evaluation measure(s), and data logical and suitable based on the above?
  - Is the experiment design complete, correct, and appropriate for the studied problem and the proposed solution?
  - Is the analysis of the results correct, clear, and lucid?
  - Is the conclusion reasonable and logical, based on the results? Is it profound or trivial?
- Each aspect is scored 0 (FX) - 5 (A). The overall grading is based on a qualitative assessment but should reasonably be close to the average (but may not be, e.g., due to outliers). One or more FX aspects may lead to an overall grading of F

Reports

- Requirements for all reports
  - **Template**: The IEEE conference template and citation style should be followed (see references)
  - **Language**: grammatically correct British or American English without spelling mistakes
  - **Style**: clear, compelling, objective, precise
  - **Argumentation**: correct, lucid, scientifically grounded
  - **Format**: PDF
- Additional requirements for A1 and A2
  - **Page limit**: 1 page excluding references (no abstract should be included)
- Additional requirements for Project
  - **Page limit**: 6 pages excluding references and appendices (pseudocode, proofs, etc.)
  - **Required headers**: introduction, related work, method, results & analysis, conclusions, references

Code (plus additional files)

- Submitted code must compile and run successfully on Mac OS X or Linux with minimal setup effort (less than five minutes)
- Recommended platform/setup
  - Jupyter Notebook, Python 3+, opencv, scipy, pandas, …
  - Jupyter Notebook, R 3+, R-packages from CRAN
- The compilation must require no more than one command
- The execution must require no more than one command
- A README.TXT file must clearly state exactly what should be typed to compile and execute the code and any necessary setups
- Data set files may not exceed 4 MB in total size. The project can report on experiments conducted on larger data sets but you need to select an reasonable excerpt/subset of the data to submit if the original data set is too large. Make sure that the code works on the subset and the original data
- Code + additional files (excluding the report) should be archived using Zip
- The filename of the archive and the report should be DV2542-x-y-z where x = A1/A2/Project, y = Lastname of student, z = birthdate of student (YYMMDD)

References

- Flach, P. (2012). *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*. Cambridge University Press.
- IEEE conference template, https://www.ieee.org/conferences_events/conferences/publishing/templates.html
- Spambase Dataset, https://archive.ics.uci.edu/ml/datasets/Spambase