

Algorithms & Data Structures

Graphs – Part III – Topological sorting, PC scheduling

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Program, Week 15

- Mentimeter: review of curriculum self-evaluation results
- Presentation from all groups of Assignment #4, Airline Network
- Topological order
 - Precedence-constrained scheduling
 - Reverse DFS postorder
 - Topological sorting
 - Exercises
- The plan ahead, towards the final exam
- Begin review of core curriculum

Mentimeter, self-evaluation on curriculum.



Student Presentations – Assignment #4, Airline Networks

All teams are up.

Applications of digraphs

digraph	vertex	directed edge
transportation	street intersection	one-way street
web	web page	hyperlink
food web	species	predator-prey relationship
WordNet	synset	hypernym
scheduling	task	precedence constraint
financial	bank	transaction
cell phone	person	placed call
infectious disease	person	infection
game	board position	legal move
citation	journal article	citation
object graph	object	pointer
inheritance hierarchy	class	inherits from
control flow	code block	jump

Graphs – representations, data structures.

- Array of edges, E ? Nope.
- Adjacency matrix, $V \times V$? Nope.
- Array of adjacency lists? Yep.

representation	space	add edge	edge between v and w?	iterate over vertices adjacent to v?
list of edges	E	1	E	E
adjacency matrix	V^2	1 *	1	V
adjacency lists	$E + V$	1	$degree(v)$	$degree(v)$



Typical digraph theory questions

problem	description
s→t path	<i>Is there a path from s to t ?</i>
shortest s→t path	<i>What is the shortest path from s to t ?</i>
directed cycle	<i>Is there a directed cycle in the graph ?</i>
topological sort	<i>Can the digraph be drawn so that all edges point upwards?</i>
strong connectivity	<i>Is there a directed path between all pairs of vertices ?</i>
transitive closure	<i>For which vertices v and w is there a directed path from v to w ?</i>
PageRank	<i>What is the importance of a web page ?</i>

Topological Sort on DAGs

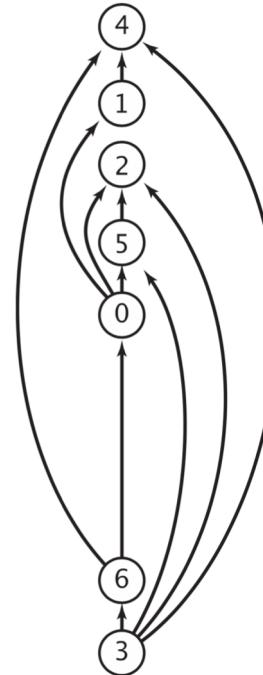
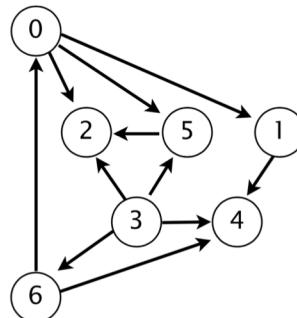
Theorem: a reverse DFS postorder stack of a DAG is a topological order.

PLENUM EXERCISE:

- show by demo'ing.....on the white board.
- discussion does the order of visits matter, actually?

Example of use of topological sorting of DAGs: order of precedence scheduling.

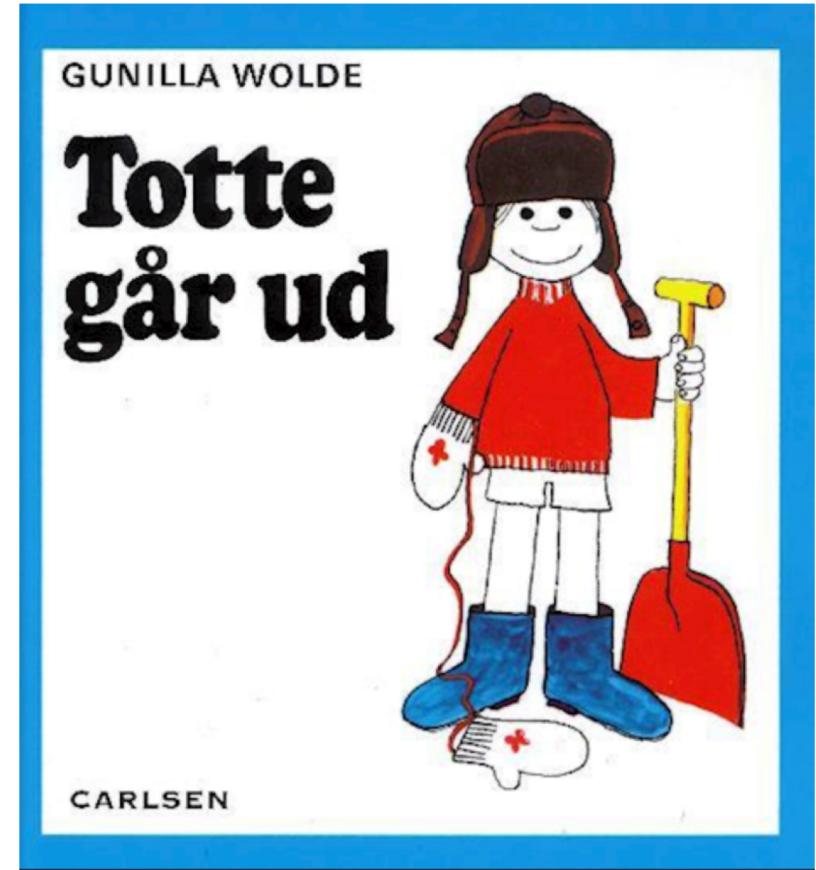
0. Algorithms
1. Complexity Theory
2. Artificial Intelligence
3. Intro to CS
4. Cryptography
5. Scientific Computing
6. Advanced Programming



Exercise 1

-- getting dressed!

Topological sorting of a DAG

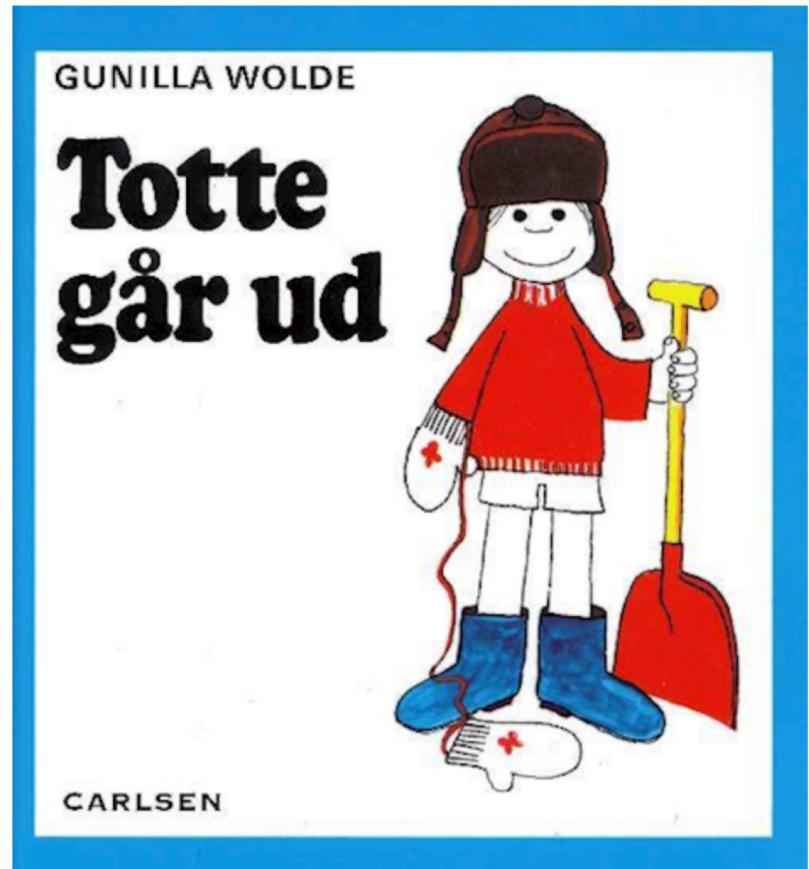


Exercise 1.1

-- getting dressed!

Topological sorting of a DAG

- 1) list all cloting items on the average western civilian – the more, the merrier!

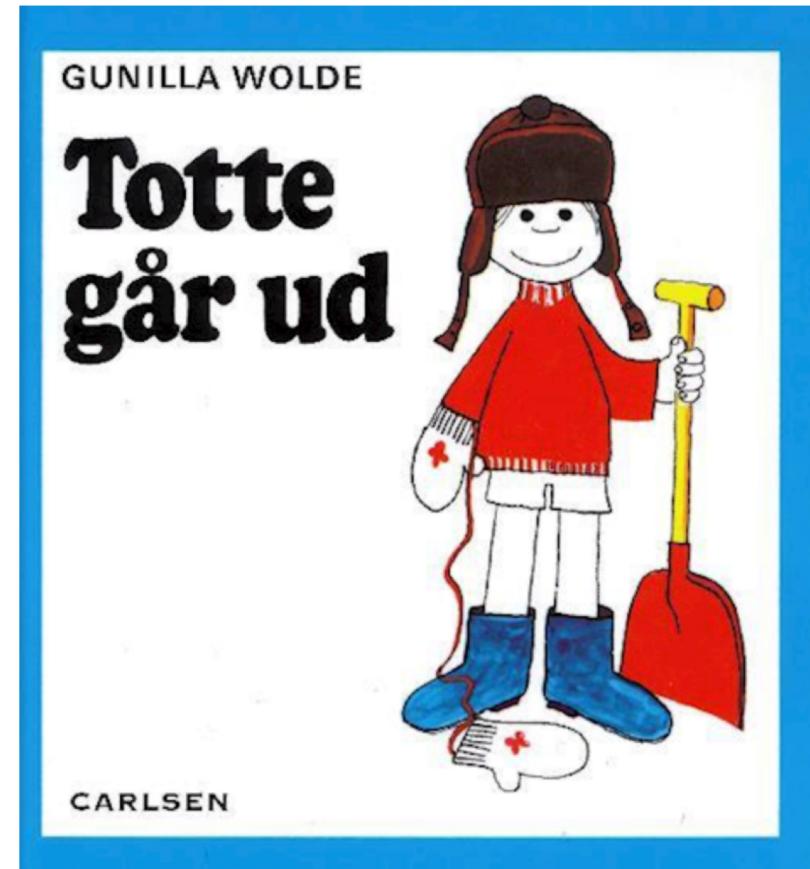


Exercise 1.2

-- getting dressed!

Topological sorting of a DAG

- 1) list all cloting items on the average western civilian – the more, the merrier!
- 2) Produce a simple DAG on how to get dressed properly.

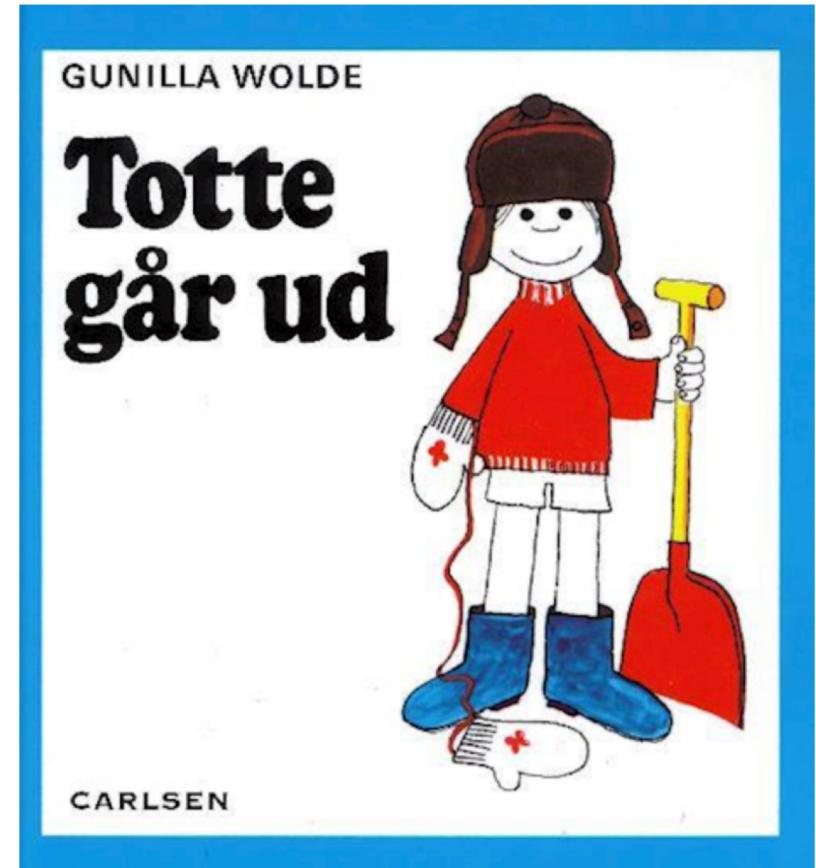


Exercise 1.3

-- getting dressed!

Topological sorting of a DAG

- 1) list all cloting items on the average western civilian – the more, the merrier!
- 2) Produce a simple DAG on how to get dressed properly.
- 3) By *Reverse DFS Postorder*, produce a topological sort of the process.





Acknowledgement

- Some material has been taken from the Princeton course 'Algorithms 4th Edition', by Sedgewick & Wayne.