PG4200 – Algorithms and Data Structures

- Quick Recap -

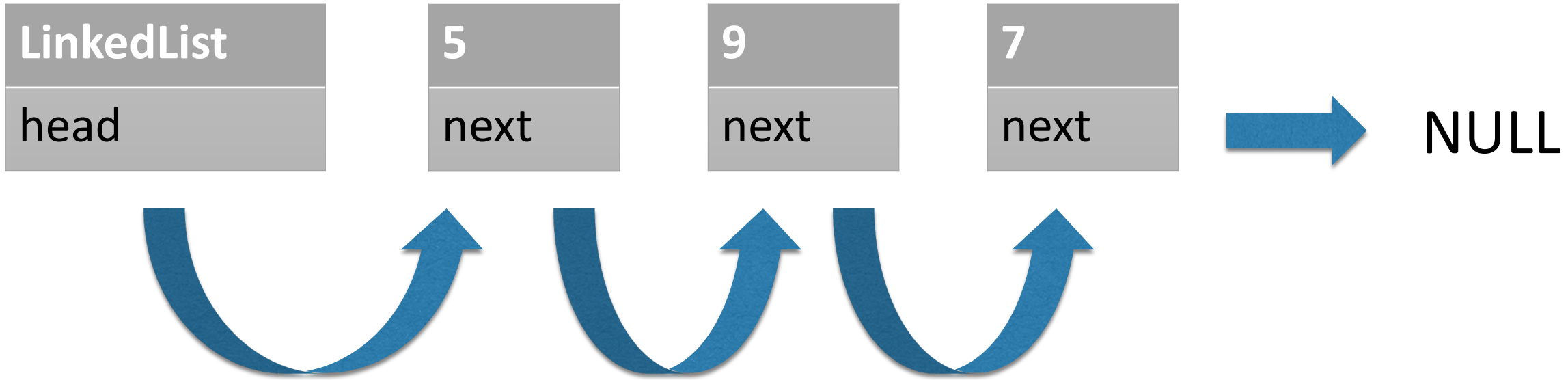
Bogdan Marculescu

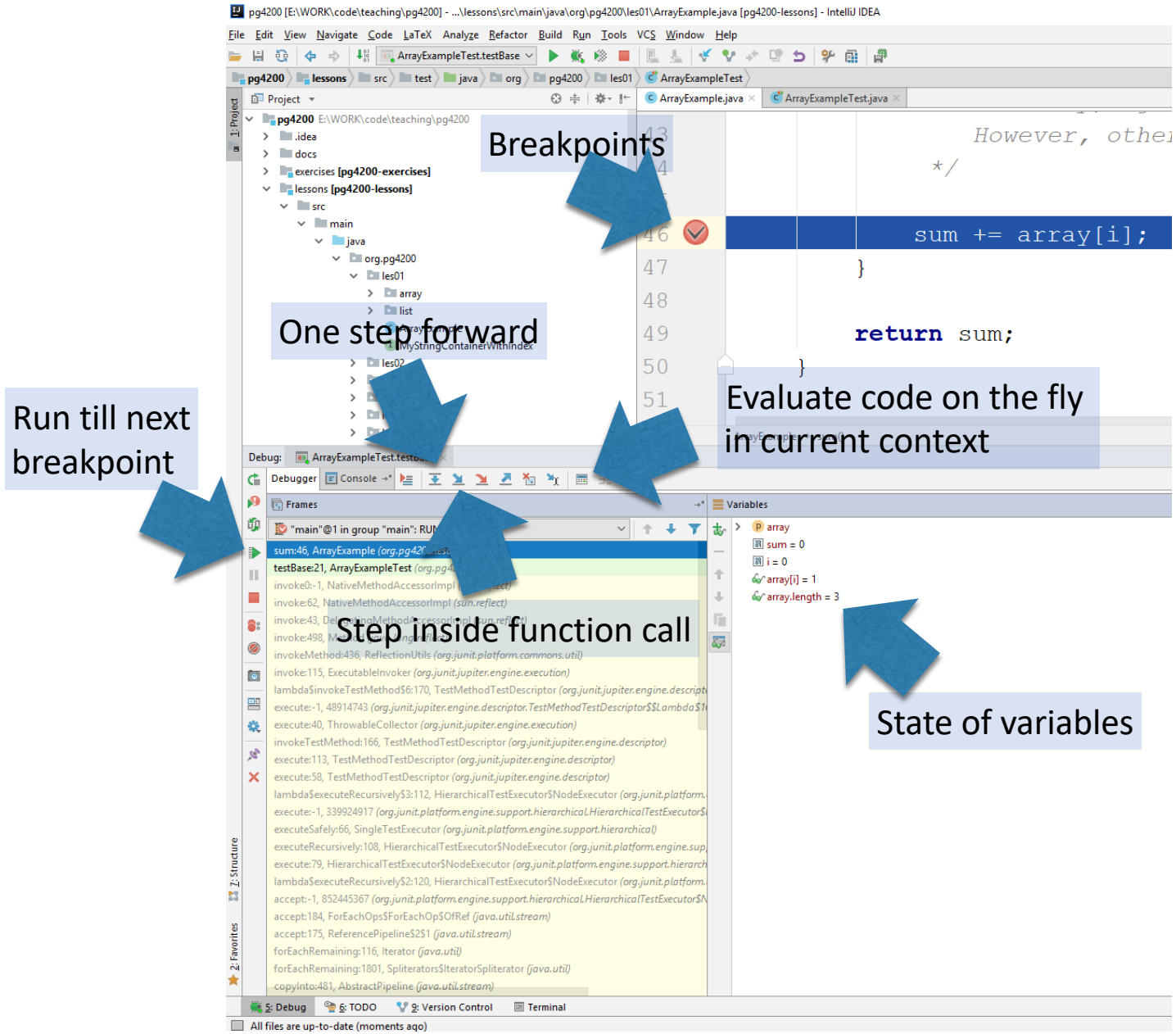
3 Basic areas

- Algorithms
- Analysis tools
- Additional stuff

Arrays and lists

[0]	[1]	[2]	[3]	[4]
5	9	7		




Breakpoints
One step forward
Run till next breakpoint
Step inside function call
Evaluate code on the fly in current context
State of variables

3 Basic areas

Algorithms

- Arrays and Lists

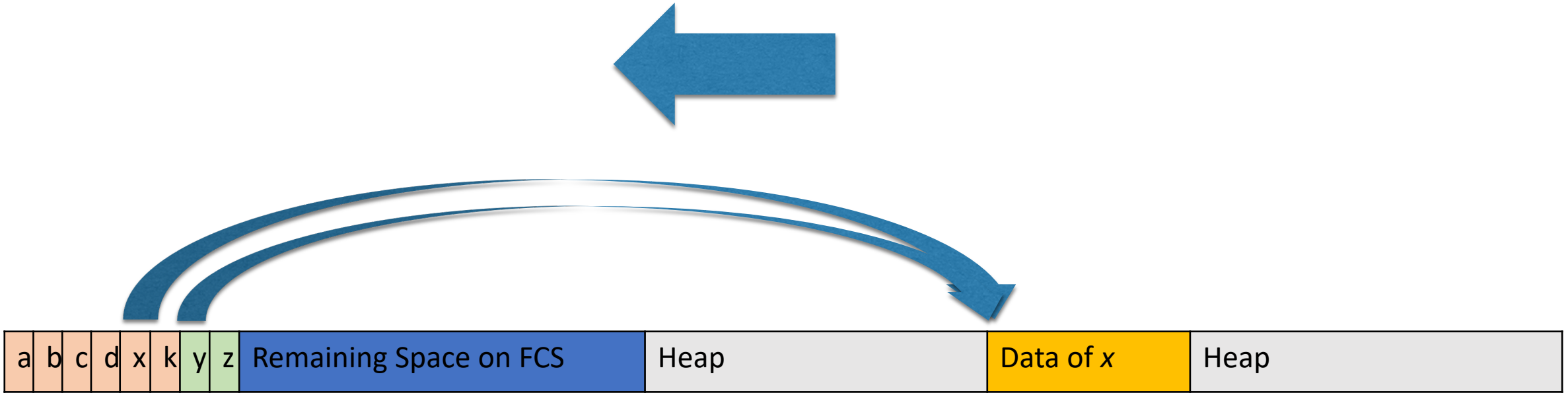
Analysis tools

Additional stuff

- Testing and expected behaviour

Stacks and Queues

Memory model



3 Basic areas

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- Stacks and Queues

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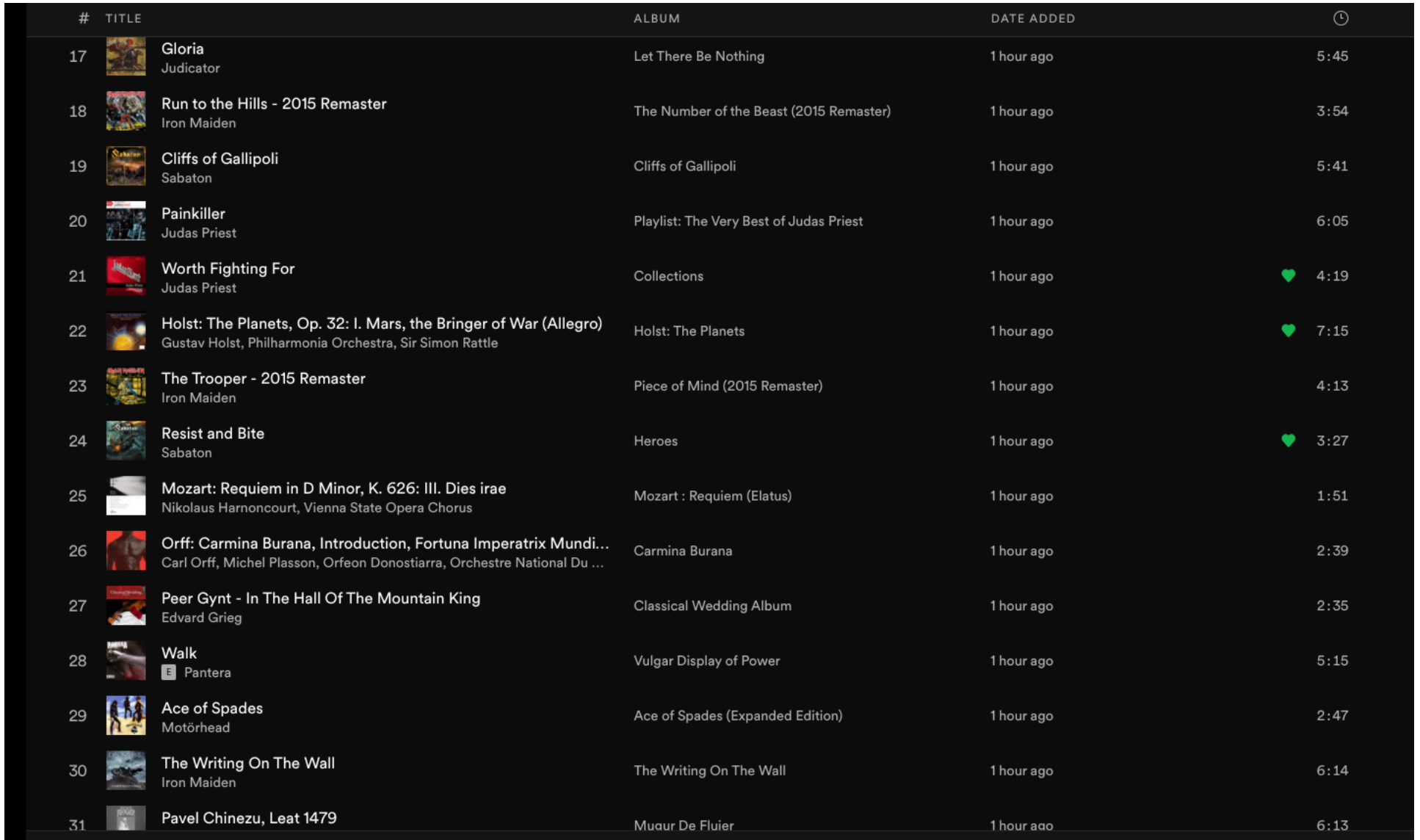
Runtime complexity

	1	$\log n$	n	$n \log n$	n^2	n^3	2^n
$O(n)$							
$\Omega(n)$							
$\Omega(n \log(n))$							
$O(n^2)$							
$\Theta(n)$							

Sorting – bubble and insertion



#	TITLE	ALBUM	DATE ADDED	
17	Gloria Judicator	Let There Be Nothing	1 hour ago	5:45
18	Run to the Hills - 2015 Remaster Iron Maiden	The Number of the Beast (2015 Remaster)	1 hour ago	3:54
19	Cliffs of Gallipoli Sabaton	Cliffs of Gallipoli	1 hour ago	5:41
20	Painkiller Judas Priest	Playlist: The Very Best of Judas Priest	1 hour ago	6:05
21	Worth Fighting For Judas Priest	Collections	1 hour ago	4:19
22	Holst: The Planets, Op. 32: I. Mars, the Bringer of War (Allegro) Gustav Holst, Philharmonia Orchestra, Sir Simon Rattle	Holst: The Planets	1 hour ago	7:15
23	The Trooper - 2015 Remaster Iron Maiden	Piece of Mind (2015 Remaster)	1 hour ago	4:13
24	Resist and Bite Sabaton	Heroes	1 hour ago	3:27
25	Mozart: Requiem in D Minor, K. 626: III. Dies irae Nikolaus Harnoncourt, Vienna State Opera Chorus	Mozart : Requiem (Elatus)	1 hour ago	1:51
26	Orff: Carmina Burana, Introduction, Fortuna Imperatrix Mundi... Carl Orff, Michel Plasson, Orfeon Donostiarra, Orchestre National Du ...	Carmina Burana	1 hour ago	2:39
27	Peer Gynt - In The Hall Of The Mountain King Edvard Grieg	Classical Wedding Album	1 hour ago	2:35
28	Walk E Pantera	Vulgar Display of Power	1 hour ago	5:15
29	Ace of Spades Motörhead	Ace of Spades (Expanded Edition)	1 hour ago	2:47
30	The Writing On The Wall Iron Maiden	The Writing On The Wall	1 hour ago	6:14
31	Pavel Chinezu, Leat 1479	Muqur De Fluier	1 hour ago	6:13

3 Basic areas

Algorithms

- Arrays and Lists
- Stacks and Queues
- Sorting
  - Bubble
  - Insertion

Analysis tools

- Runtime complexity analysis:
  - O, Ω, Θ

Additional stuff

- Testing and expected behaviour
- Memory model

Recursion

3 main aspects in recursive functions

Stopping Criterion: otherwise no end, until a stack overflow

Reduced Input: aim at least at halving it

Combine Results: once recursive calls finished, combine their outputs together for the final result

often it is not as trivial as doing a +

3 Basic areas

Algorithms

- Arrays and Lists
- Stacks and Queues
- Sorting
  - Bubble
  - Insertion
  - Merge
  - Quick
- Recursion

Analysis tools

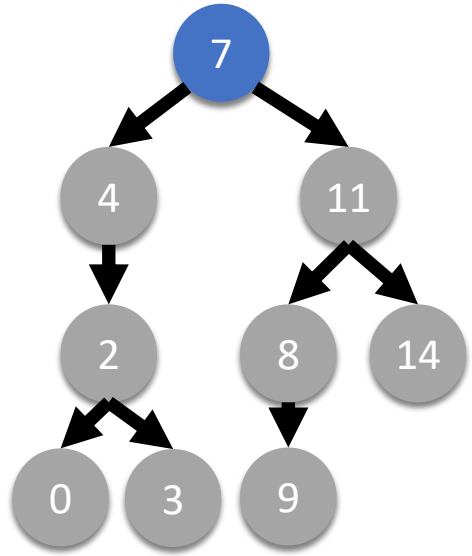
- Runtime complexity analysis:
  - O, Ω, Θ

Additional stuff

- Testing and expected behaviour
- Memory model
- Test driven development

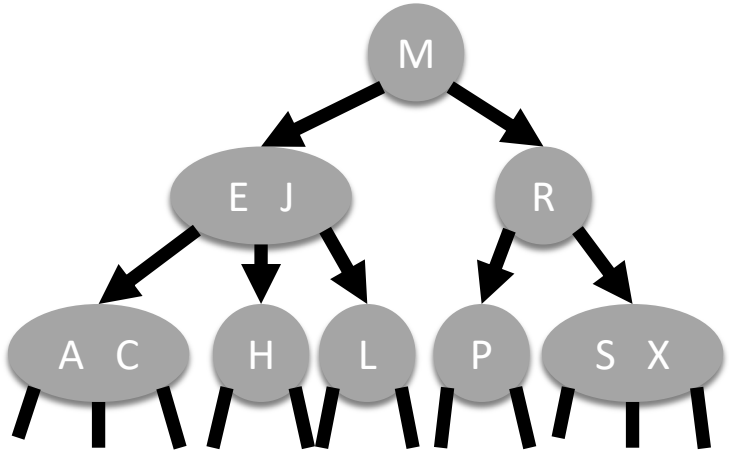
Tree-based Maps

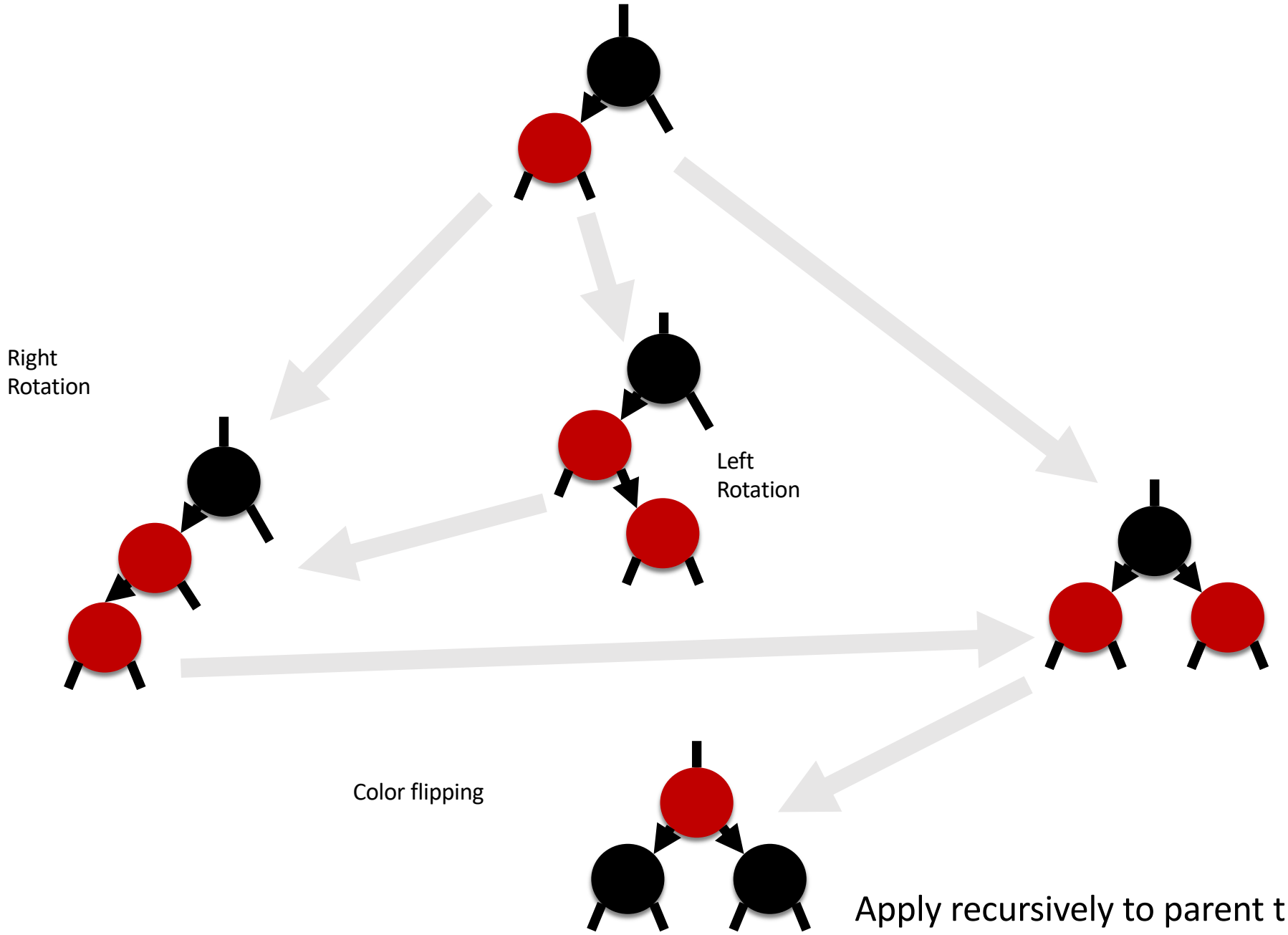
- Data structures resembling a tree
- Nodes contain values, and links to child nodes
- Starting point is the root of the tree
- Two main / most famous versions
  - Binary Trees (“simple”)
  - Red-Black Trees (“very complex”, but high performance)



2-3 Search Trees

- Before discussing RBT, let's consider 2-3 Trees
- 2-3 Tree: composed of 2-nodes and 3-nodes
- 2-node: 1 value, 2 children (left and right)
- 3-node: 2 values, 3 children (left, middle and right)





Apply recursively to parent till 2-node, or root

3 Basic areas

Algorithms

- Arrays and Lists
- Stacks and Queues
- Sorting
- Recursion
- Tree maps
  - Binary
  - 2-3
  - Red-Black Trees

Analysis tools

- Runtime complexity analysis:
  - O, Ω, Θ

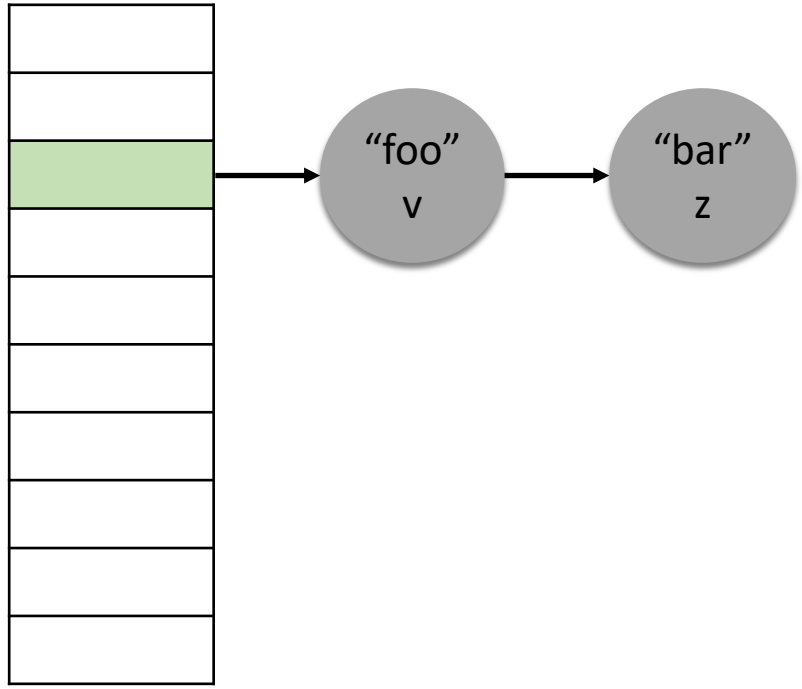
Additional stuff

- Testing and expected behaviour
- Memory model
- Test driven development

Hash Maps and Sets

- *put(“foo”, v)*
- *put(“bar”, z)*
- *h(“foo”)=h(“bar”)*
  - ie, collision due to same hash
- Use list at each position sharing same hash
- Nodes containing keys and values

Internal array buffer of size M=10



3 Basic areas

Algorithms

- Arrays and Lists
- Stacks and Queues
- Sorting
- Recursion
- Tree maps
- Hash Maps
- Sets

Analysis tools

- Runtime complexity analysis:
  - O, Ω, Θ

Additional stuff

- Testing and expected behaviour
- Memory model
- Test driven development
- Deep Copy