



SAPIENZA
UNIVERSITÀ DI ROMA

Artificial Intelligence

Prof: Daniele Nardi

Exercises: Recap Search

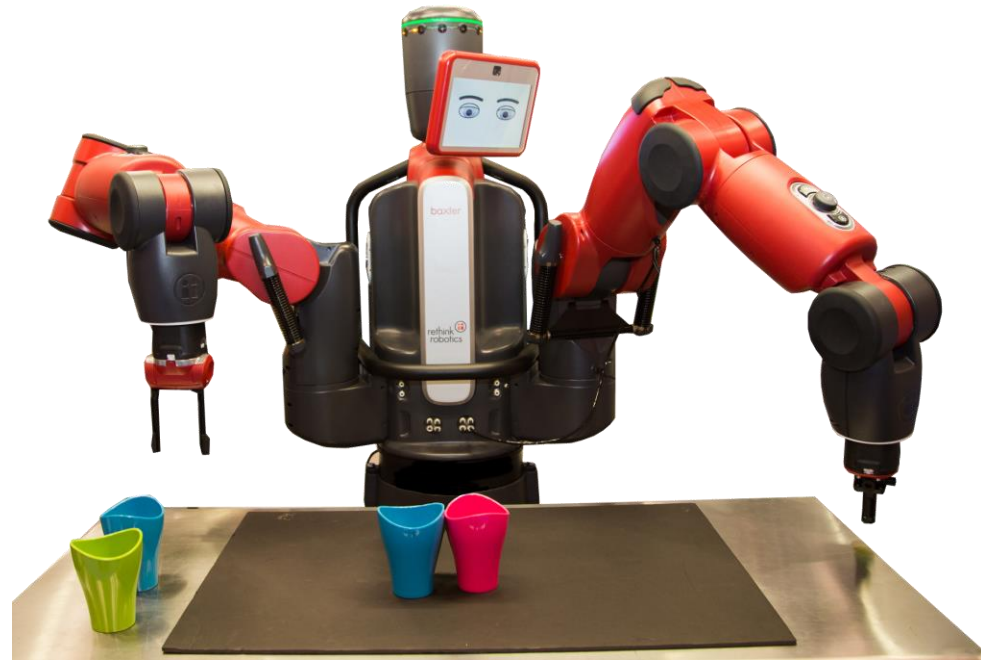
Francesco Riccio
email: riccio@diag.uniroma1.it

Search Ex1: solutions

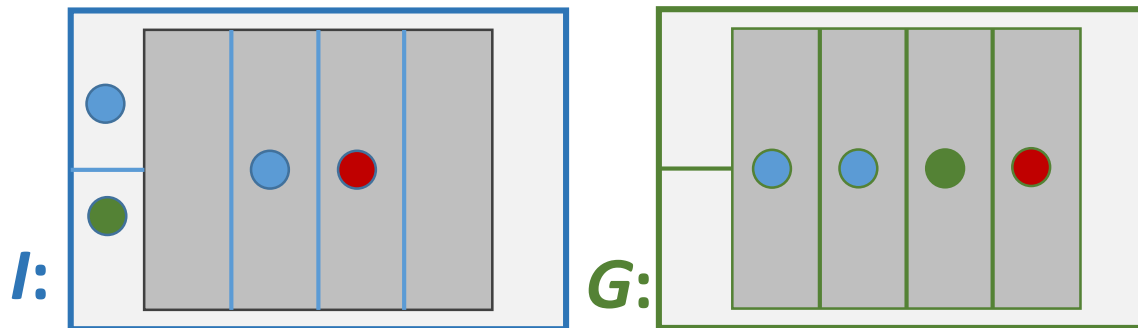
One arm robot

- **State** representation
- **Initial** and **goal** state
- **Operator** specification: move
- **Search** of solution

move(from, to): moves a cup from 'from' and to 'to'. The operator can be applied iff 'to' is empty



$S: \langle c, c, c, c, c, c \rangle, c \in \{r, g, b, e\}$



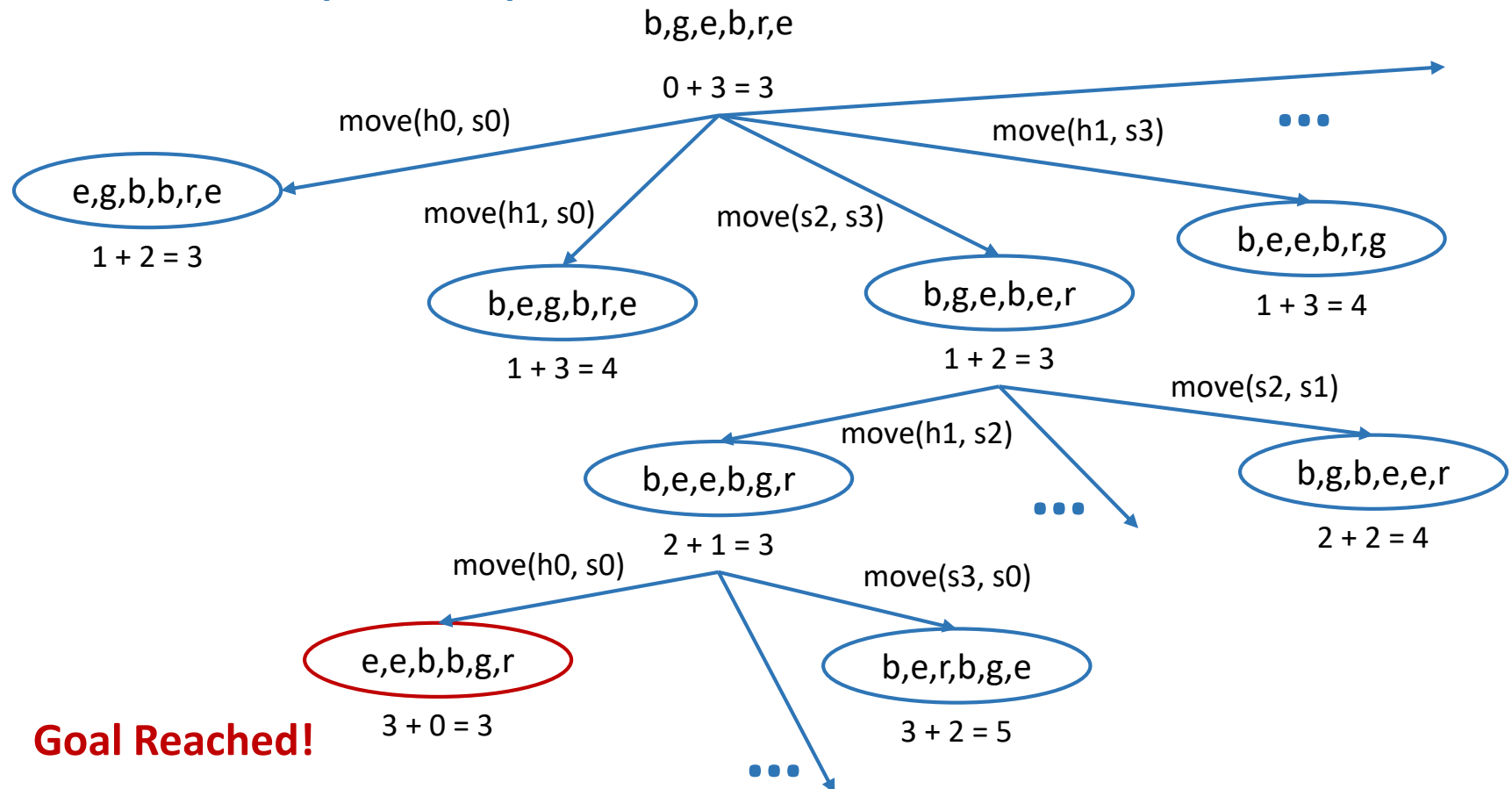
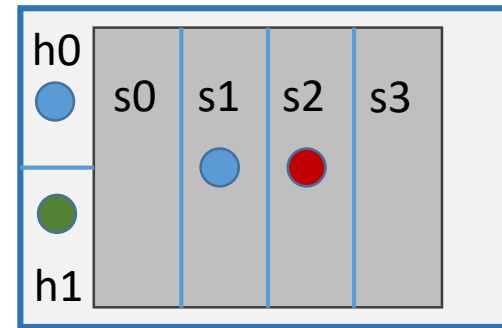
One arm robot

G = <e, e, b, b, g, r>

move **cost = 1**

h = **number of misplaced cups**

b = blue
g = green
r = red
e = empty



Towers of Hanoi

State representation

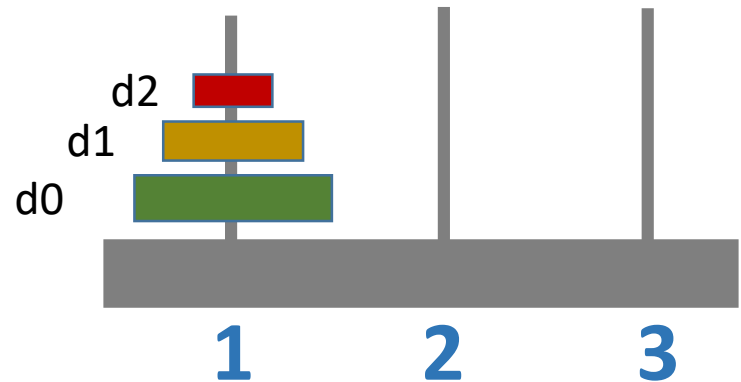
$S = P \times P \times P$, where $P = \{1, 2, 3\}$

$S: \langle d_0, d_1, d_2 \rangle$, where ' d_i ' represents the position of the i -th disc

$I = \langle 1, 1, 1 \rangle$, $G = \langle 3, 3, 3 \rangle$

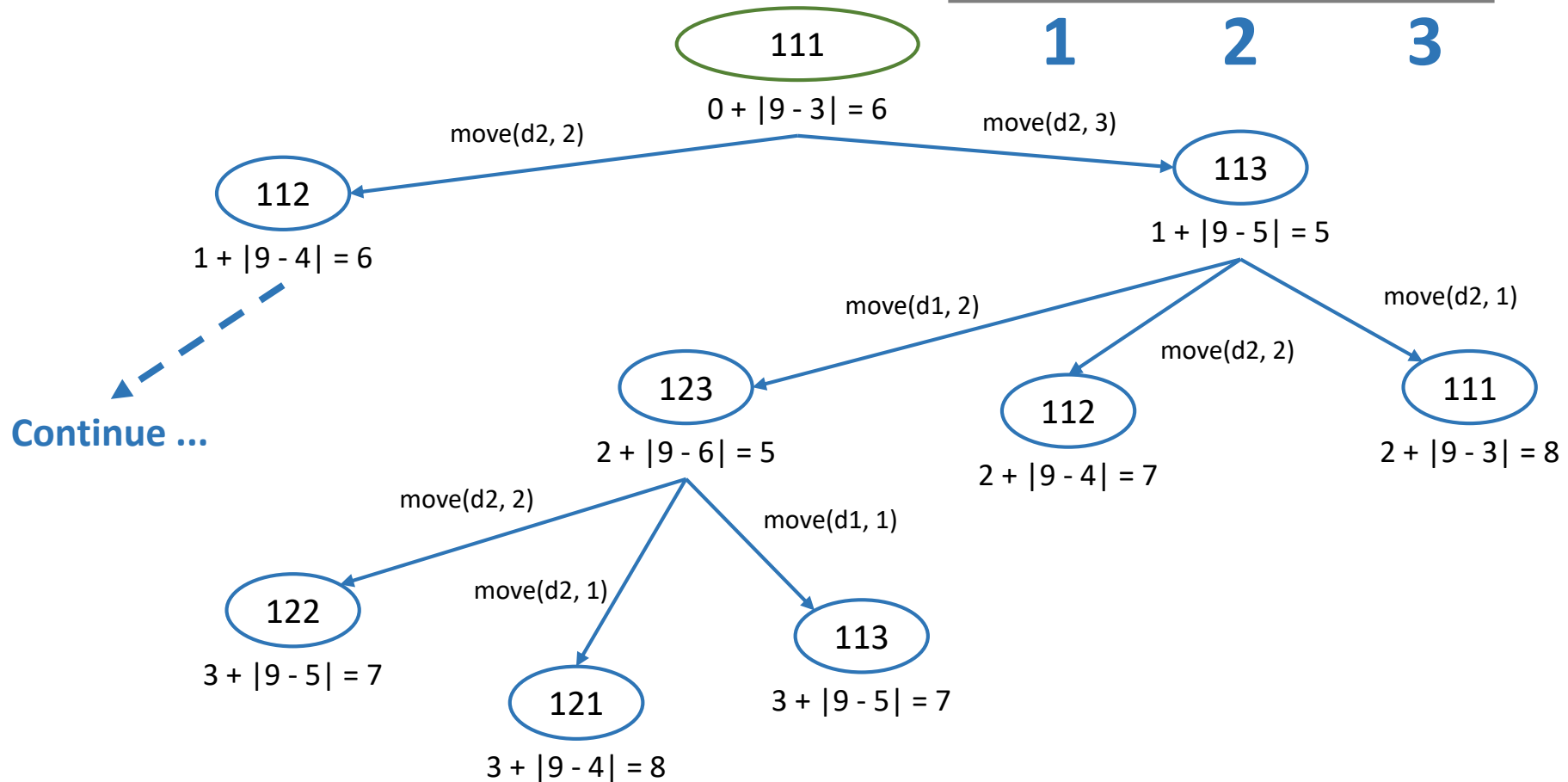
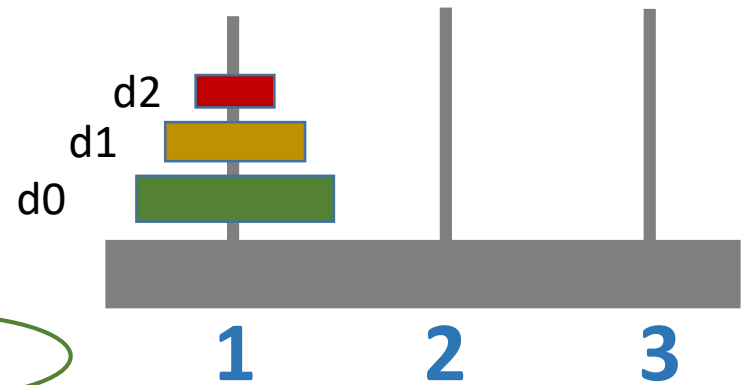
Operators

$\text{move}(\text{disc}, \text{to})$: moves a disc iff nothing is on top of 'disc' and 'to' is either an empty peg or a bigger disc



Towers of Hanoi

$I = \langle 1, 1, 1 \rangle$, $G = \langle 3, 3, 3 \rangle$, $g = G_0 + G_1 + G_2$
 move **cost** = 1, $h = |g - (d_0 + d_1 + d_2)|$

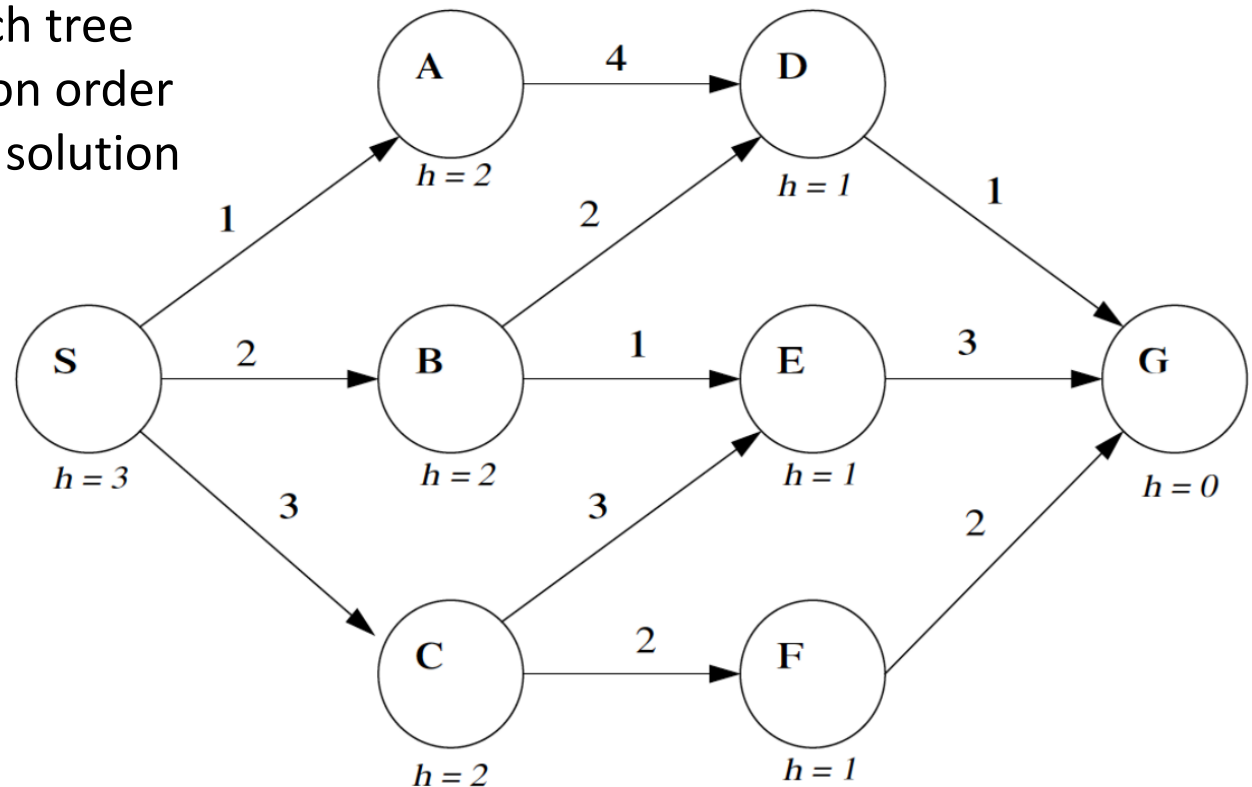


Search Ex2: solutions

Exam 13/2/2015

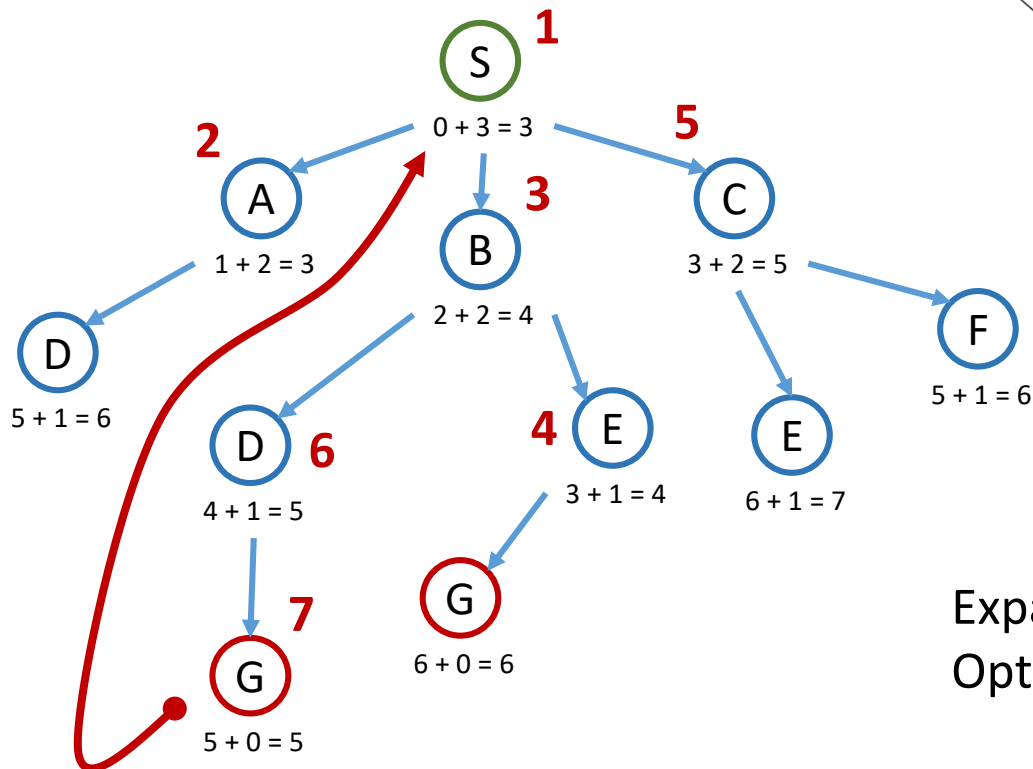
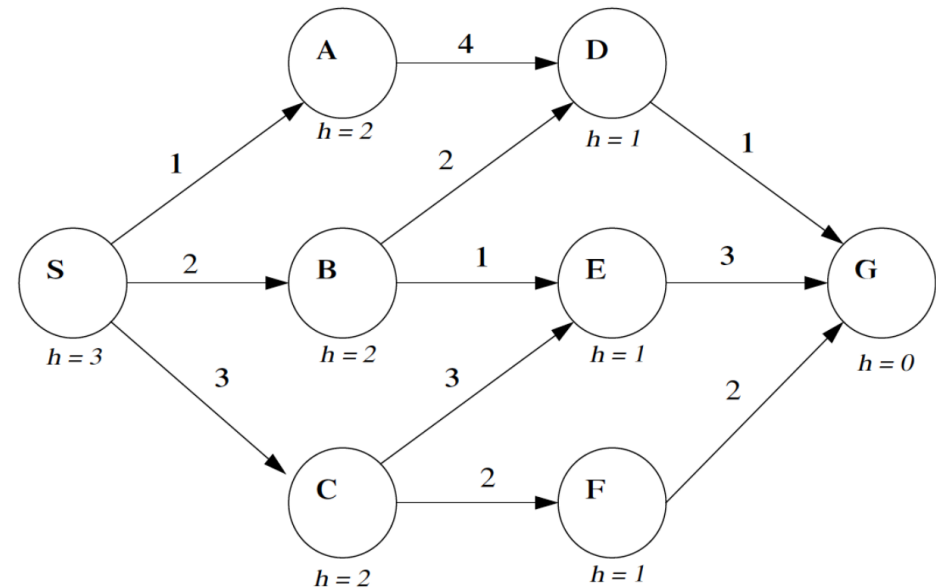
Consider the search problem represented in the following **graph**. It has start state **S** and goal state **G**. Transition **costs** are shown as numbers on the arrows. **Heuristic** values are shown below each state.

1. Draw the A* search tree
2. Mark the expansion order
3. Show the optimal solution path



Exam 13/2/2015

1. Draw the A* search tree
2. Mark the expansion order
3. Show the optimal solution path



Expansion order: **S**, A, B, E, C, D, **G**
 Optimal solution: **S**, B, D, **G**