جامعة المنارة

كلية: الهندسة

قسم: الهندسة المعلوماتية

اسم المقرر: الخوارزميات و بنى المعطيات2

رقم الجلسة (العاشرة)

عنوان الجلسة

أشجار AVL

الفصل الدراسي الثاني

العام الدراسي 2023- 2024

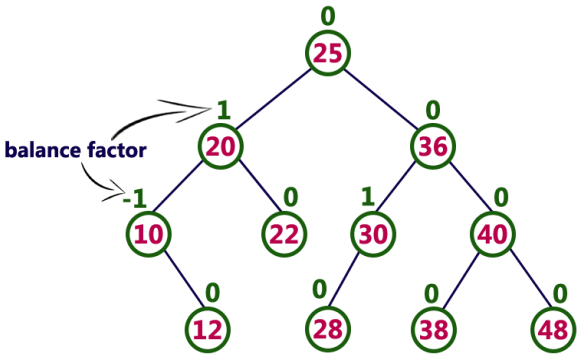
أشجار AVL

أشجار AVL:

أشجار AVL هي أشجار بحث ثنائية متوازنة يكون فيها الفرق بين ارتفاع الشجرة الفرعية اليمنى واليسرى لكل عقدة إما -1 أو 0 أو +1.

مثال عن شجرة AVL :

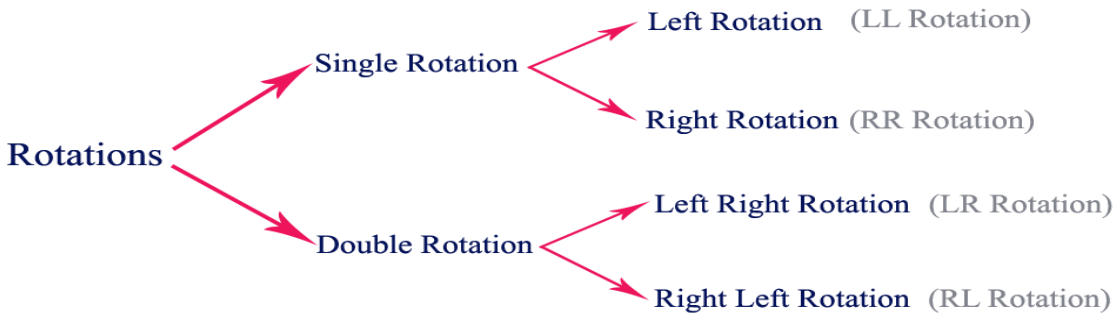
Balance factor = Height(left subtree) - Height(right subtree)



AVL Tree Rotations :

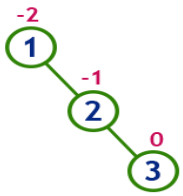
قد يختل التوازن عند إدراج أو حذف عقدة من شجرة AVL، ولتحقيق التوازن في شجرة AVL يتم إجراء عمليات التدوير.

يوجد أربعة أنواع من عمليات التدوير:

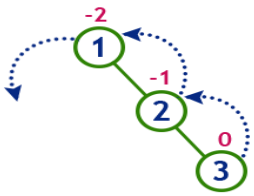


: Single Left Rotation (LL Rotation)

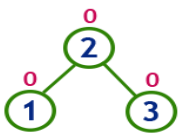
insert 1, 2 and 3



Tree is imbalanced



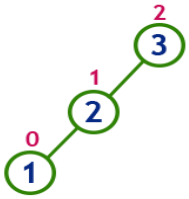
To make balanced we use LL Rotation which moves nodes one position to left



After LL Rotation Tree is Balanced

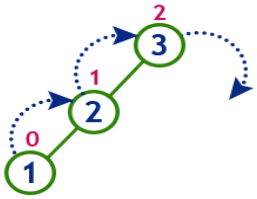
: Single Right Rotation (RR Rotation)

insert 3, 2 and 1

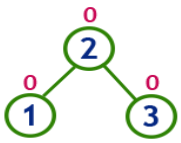


Tree is imbalanced

because node 3 has balance factor 2



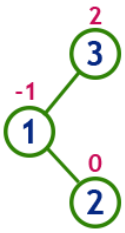
To make balanced we use RR Rotation which moves nodes one position to right



After RR Rotation Tree is Balanced

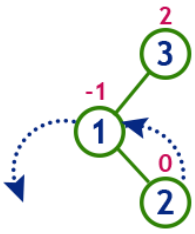
:Left Right Rotation (LR Rotation)

insert 3, 1 and 2

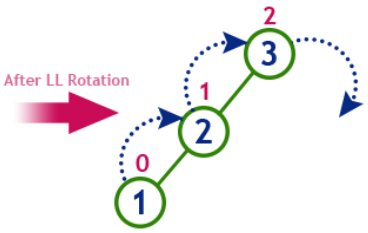


Tree is imbalanced

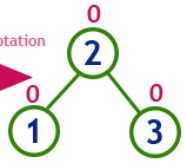
because node 3 has balance factor 2



LL Rotation

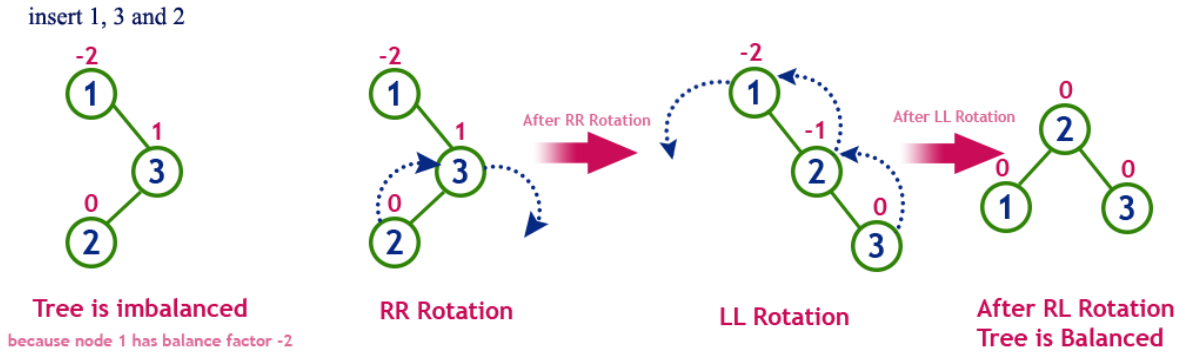


RR Rotation

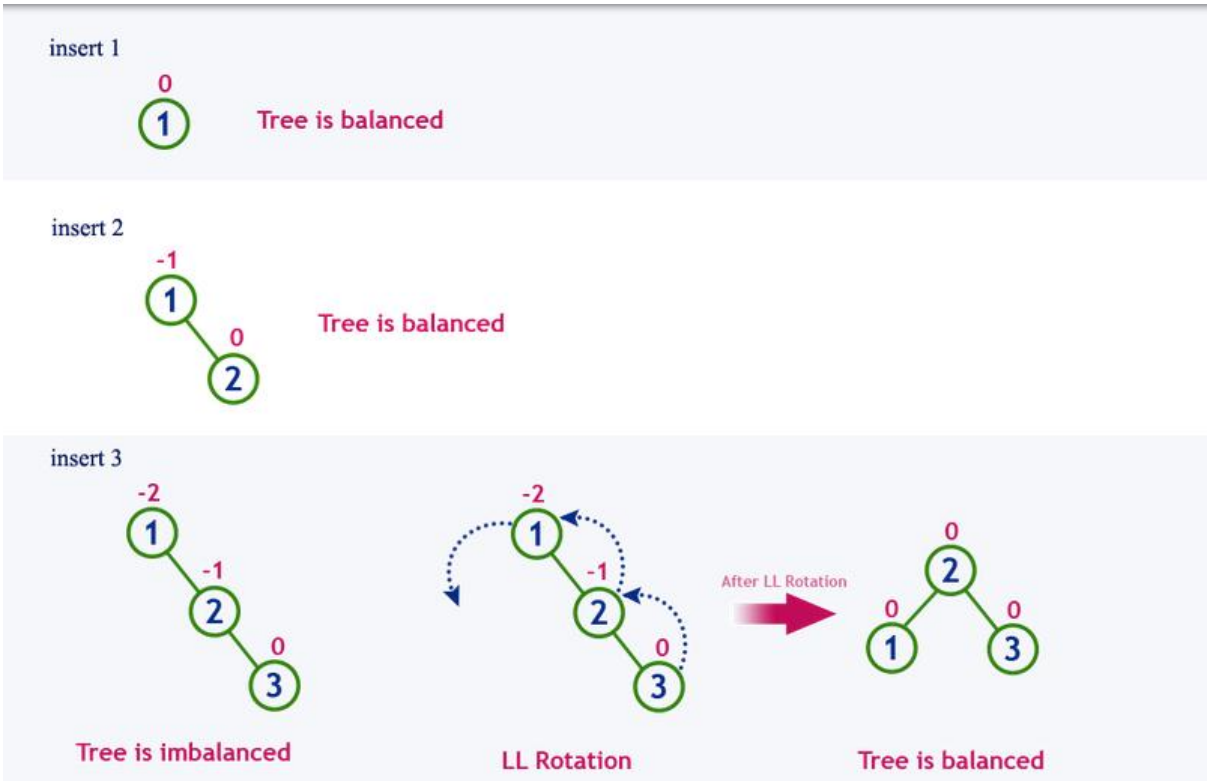


After LR Rotation Tree is Balanced

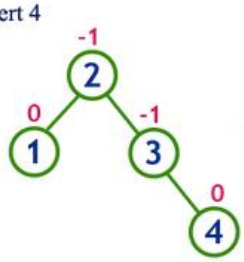
: Right Left Rotation (RL Rotation)



تمرين : قم ببناء شجرة AVL من خلال إضافة الأرقام من 1 و حتى 8 بالتسلسل إلى الشجرة .

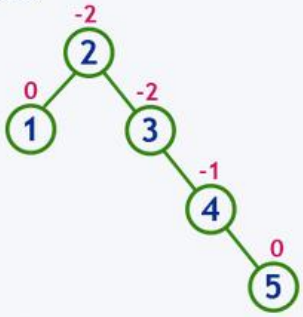


insert 4

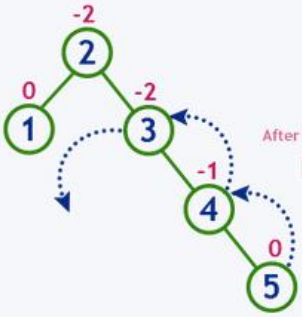


Tree is balanced

insert 5

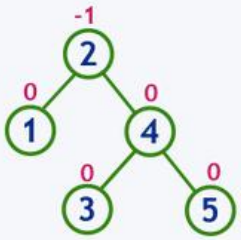


Tree is imbalanced



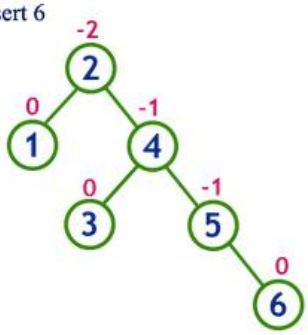
LL Rotation at 3

After LL Rotation at 3

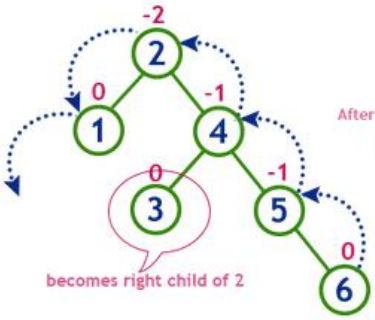


Tree is balanced

insert 6

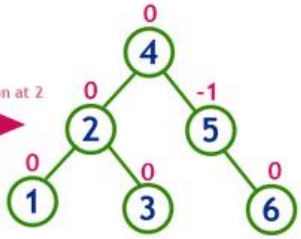


Tree is imbalanced



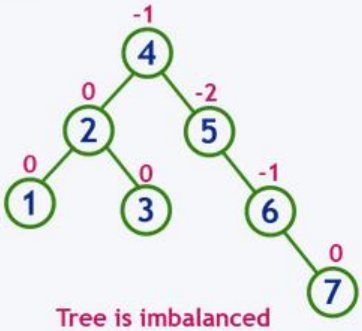
LL Rotation at 2

After LL Rotation at 2

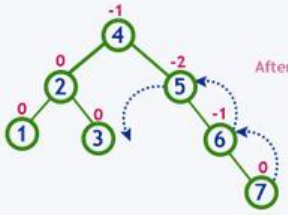


Tree is balanced

insert 7

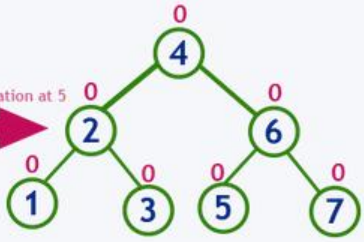


Tree is imbalanced

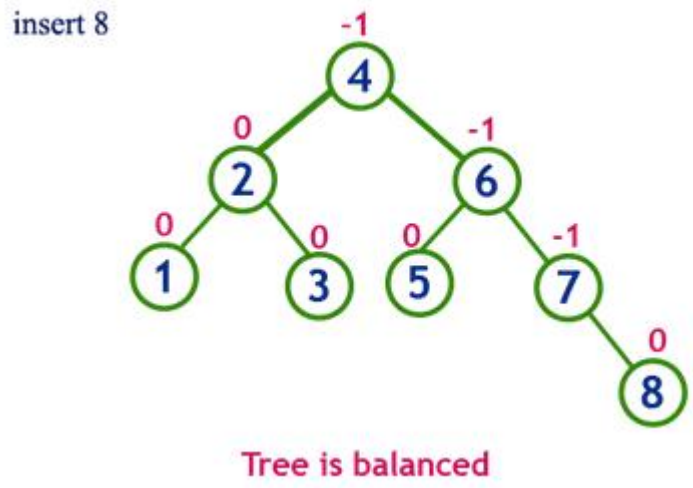


LL Rotation at 5

After LL Rotation at 5

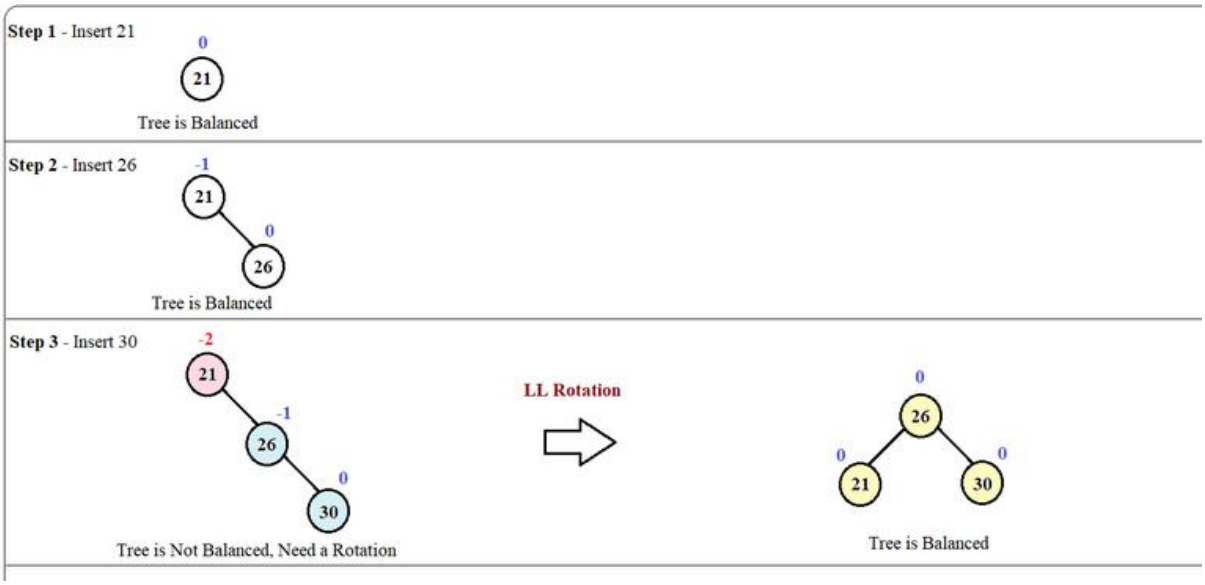


Tree is balanced

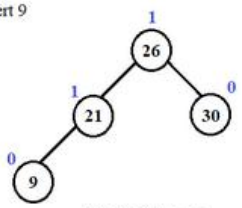


تمرين : قم ببناء شجرة AVL من خلال إضافة الأرقام التالية بالتسلسل إلى الشجرة :

21,26,30,9,4,14,28,18,15

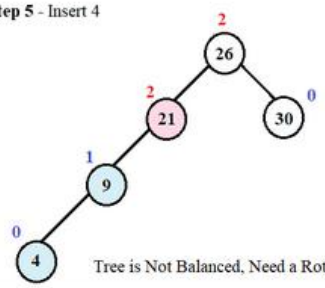


Step 4 - Insert 9



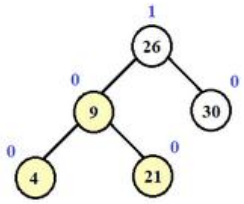
Tree is Balanced

Step 5 - Insert 4



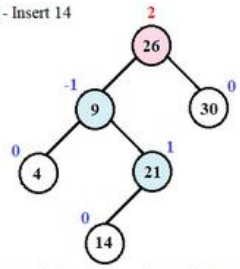
Tree is Not Balanced, Need a Rotation

RR Rotation



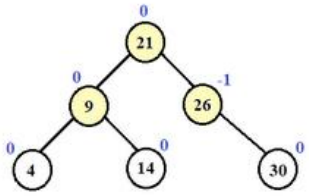
Tree is Balanced

Step 6 - Insert 14



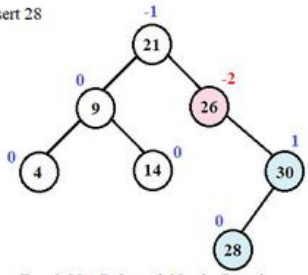
Tree is Not Balanced, Need a Rotation

LR Rotation



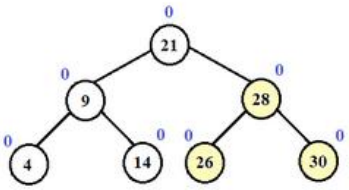
Tree is Balanced

Step 7 - Insert 28



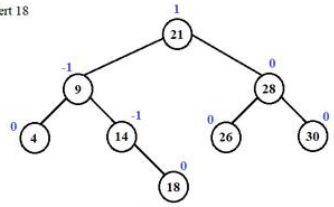
Tree is Not Balanced, Need a Rotation

RL Rotation



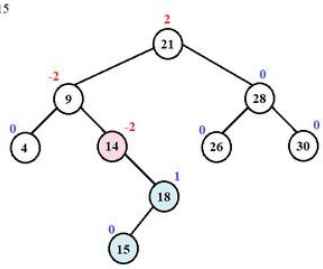
Tree is Balanced

Step 8 - Insert 18



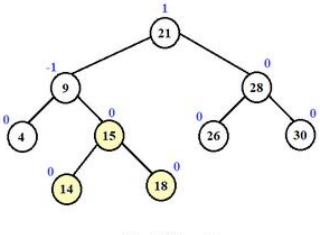
Tree is Balanced

Step 9 - Insert 15



Tree is Not Balanced, Need a Rotation

RL Rotation



Tree is Balanced