Algorithm analysis, Bubble Sort

Instruction	Cost	# Repeat
ArrayList<Game> list = c.getWishList();	c_1	1
for (int i = 0; i < list.size(); i++)	c_2	$n+1$
for (int j = 1; j < list.size() - i; j++)	c_3	$\frac{n(n+1)}{2}+n$
Shelve s1 = searchShelve(list.get(j - 1).getShelveName());	c_4	$\frac{n(n+1)}{2}$
Shelve s2 = searchShelve(list.get(j).getShelveName());	c_5	$\frac{n(n+1)}{2}$
if (s1.getNameShelve().compareTo(s2.getNameShelve()) == 0)	c_6	$\frac{n(n+1)}{2}$
if (s1.getGameShelve().getIndexInTable(list.get(j - 1).getCode()) > s1.getGameShelve() .getIndexInTable(list.get(j).getCode()))	c_7	$\frac{n(n+1)}{2}$
Game temp1 = list.get(j - 1);	c_8	$\frac{n(n+1)}{2}$
list.set(j - 1, list.get(j));	c_9	$\frac{n(n+1)}{2}$
list.set(j, temp1);	c_{10}	$\frac{n(n+1)}{2}$
else if (s1.getNameShelve().compareTo(s2.getNameShelve()) > 0) {	c_{11}	$\frac{n(n+1)}{2}$
Game temp2 = list.get(j - 1);	c_{12}	$\frac{n(n+1)}{2}$
list.set(j - 1, list.get(j));	c_{13}	$\frac{n(n+1)}{2}$
list.set(j, temp2);	c_{14}	$\frac{n(n+1)}{2}$
c.setWishList(list);	c_{15}	1

Note: We assume that $n = list.size$

Analysis of time complexity

$$T(n) = c_1 + c_2(n+1) + c_3\left(\frac{n(n+1)}{2} + n\right) + c_4\left(\frac{n(n+1)}{2}\right) + c_5\left(\frac{n(n+1)}{2}\right) + c_6\left(\frac{n(n+1)}{2}\right) + c_7\left(\frac{n(n+1)}{2}\right) + c_8\left(\frac{n(n+1)}{2}\right) + c_9\left(\frac{n(n+1)}{2}\right) + c_{10}\left(\frac{n(n+1)}{2}\right) + c_{11}\left(\frac{n(n+1)}{2}\right) + c_{12}\left(\frac{n(n+1)}{2}\right) + c_{13}\left(\frac{n(n+1)}{2}\right) + c_{14}\left(\frac{n(n+1)}{2}\right) + c_{15}$$

$$T(n) = c_1 + c_2 + c_2 n + c_3 n + \frac{c_3 n^2 + c_3 n + c_4 n^2 + c_4 n + c_5 n^2 + c_5 n + c_6 n^2 + c_6 n + c_7 n^2 + c_7 n + c_8 n^2 + c_8 n + c_9 n^2 + c_9 n}{2} + \frac{c_{10} n^2 + c_{10} n + c_{11} n^2 + c_{11} n + c_{12} n^2 + c_{12} n + c_{13} n^2 + c_{13} n + c_{14} n^2 + c_{14} n}{2} + c_{15}$$

$$T(n) = n^2\left(\frac{c_3}{2} + \frac{c_4}{2} + \frac{c_5}{2} + \frac{c_6}{2} + \frac{c_7}{2} + \frac{c_8}{2} + \frac{c_9}{2} + \frac{c_{10}}{2} + \frac{c_{11}}{2} + \frac{c_{12}}{2} + \frac{c_{13}}{2} + \frac{c_{14}}{2}\right) + n\left(c_2 + c_3 + \frac{c_3}{2} + \frac{c_4}{2} + \frac{c_5}{2} + \frac{c_6}{2} + \frac{c_7}{2} + \frac{c_8}{2} + \frac{c_9}{2} + \frac{c_{10}}{2} + \frac{c_{11}}{2} + \frac{c_{12}}{2} + \frac{c_{13}}{2} + \frac{c_{14}}{2}\right) + (c_1 + c_2 + c_{15})$$

Assuming that

$$k = \frac{c_3}{2} + \frac{c_4}{2} + \frac{c_5}{2} + \frac{c_6}{2} + \frac{c_7}{2} + \frac{c_8}{2} + \frac{c_9}{2} + \frac{c_{10}}{2} + \frac{c_{11}}{2} + \frac{c_{12}}{2} + \frac{c_{13}}{2} + \frac{c_{14}}{2}$$

$$y = c_2 + c_3 + \frac{c_3}{2} + \frac{c_4}{2} + \frac{c_5}{2} + \frac{c_6}{2} + \frac{c_7}{2} + \frac{c_8}{2} + \frac{c_9}{2} + \frac{c_{10}}{2} + \frac{c_{11}}{2} + \frac{c_{12}}{2} + \frac{c_{13}}{2} + \frac{c_{14}}{2}$$

$$z = c_1 + c_2 + c_{15}$$

We have that:

$$T(n) = n^2(k) + n(y) + z \rightarrow \boldsymbol{\theta}(\boldsymbol{n^2})$$

Spatial complexity analysis

Type	Variable	Size of 1 atomic value	Amount values
Input	List	32 bits	1
Auxiliar	S1	32 bits	1
Auxiliar	S2	32 bits	1

Auxiliar	Temp1	32 bits	1
Auxiliar	Temp2	32 bits	1

- Total Spatial Complexity $= Input + Auxiliary + Output = 5 = \theta(5)$
- Auxiliary Spatial Complexity $= 4 = \theta(4)$
- Auxiliary Spatial Complexity Output $= Auxiliary + Output = 4 = \theta(4)$