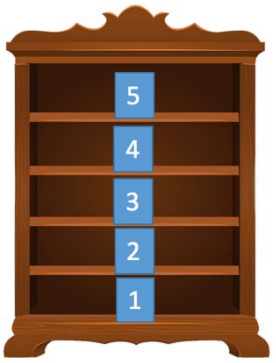
Algorithms – Best Fit
Work Sheet: 08-ALG-07-WS

I. **Storing of books in a bookshelf:** What is the best possible arrangement to store all the given books in a given book shelf?

Consider a bookshelf with 5 shelves. Each shelf has a capacity (or volume) of 14000 cm^2. Books with their dimensions and quantity are given below.

- Small Size Books - (15.2 * 22.9 *2) cm – 20 books
- Mid Size Books - (15.2 * 22.9 *3) cm – 25 books
- Large Size Books – (15.2*22.9*4) cm – 20 books



Answer:

Name: **Class:** **Div:** **Roll. No:**

II. **Berth Allotment in Railway Ticketing Service:** How would the ticketing system make allotments for the following tickets?

- Ticket 1
  - Passenger 1, Age: 23, Male, given preference: lower berth
  - Passenger 2, Age: 65, Male, given preference: lower berth

- Ticket 2
  - Passenger 1, Age: 25, Female, given preference: lower berth
  - Passenger 2, Age: 25, Male, given preference: upper berth
  - Passenger 3, Age: 63, Male, given preference: lower berth
  - Passenger 4, Age: 61, Female, given preference: lower berth

Answer:

Answer Key (For Teachers Only)

I. **Storing of books in a bookshelf:**

- Each shelf has a capacity of 14000 cm^2.
- Compute the total space (volume) each kind (small/medium/large) of book will occupy.
- Compute the space all the books of each kind will occupy.
- If all the books of the same kind fit in a single shelf, store them in the same shelf. Otherwise store the excess in the next shelf.
- Use the remaining space in the shelf to store books of a different kind.
- Repeat the process until all the books have been stored.

Example:

- Space occupied by one book of small size = 15.2 * 22.9 *2 = 696.16 cm^2
- Space occupied by all the books of small size = 696.16*20 = 13923.2 cm^2

- Can all the books of small size fit in a single shelf? Yes, because capacity of each shelf is 14000 cm^2
- Space remaining in the shelf = 14000 – 13923.2 = 76.8 cm^2. Now, check if any other books of medium/big size can fit in this space. To do that let's calculate the space occupied by the medium size book.
- Space occupied by one book of medium size = 15.2 * 22.9 *3 = 1044.24 cm^2
- Hence, none of the medium sized book will not fit in the first shelf. Additionally, none of the large sized book will also not fit in.
- Now, out of the 5 shelves, 1 is already occupied. We try to store rest of the books in 4 shelves.
- Space occupied by all the books of medium size = 1044.24*25 = 26106 cm^2
- A single shelf has a capacity of only 14000 cm^2. Hence, we will need more than one shelf to store the medium sized books.
- But, exactly how many books one can store of medium size in one shelf?
- We know each book occupies a space of 1044.24 cm^2. So, each book occupies a little more than 1000 cm^2. Surely, one cannot fit 14 books of this size in one shelf, but one book less than 14 would surely fit in one shelf. Let's check if that is true?

- Space occupied by 13 books of medium size = 1044.24*13 = 13575.12 cm^2, it is less than 14000 cm^2. Adding one more book would need another 1044.24 cm^2 of space, which is not possible in the same shelf.
- We now move to store in the next shelf. We are left with 12 (25 - 13) medium sized books.
- Can we store all the 12 medium size books in the 3rd shelf? Yes.
- Space occupied by 12 books of medium size = 1044.24*12 = 12530.88 cm^2, it is less than 14000 cm^2.
- Remaining space left in this shelf = 14000 – 12530.88 = 1469.12 cm^2. Can we try in the remaining space to fit any books of big size? Let us check.
- Space occupied by one book of big size = 15.2 * 22.9 *4 = 1392.32 cm^2
- Yes, we can fit one book of big size in the 3rd shelf. We now have filled 3 shelves
- Fill the remaining (20 – 1 = 19) big books in the next 2 shelves using the same methodology.

II. **Berth Allotment in Railway Ticketing Service:**

- **Ticket 1:**
  1. Passenger 1 will be allotted upper or middle berth because passenger 1 is a male of 23 years. He will also be allotted berth very close to passenger 2, either in the same compartment or coach because passenger 2 is a senior citizen.
  2. Passenger 2 will be allotted lower berth as per preference unless all lower berths are already booked.
- **Ticket 2:**
  1. Passenger 1 will be allotted upper or middle berth, even though she is a woman. It is because she is not travelling alone and is with 3 other passengers
  2. Passenger 2 will be allotted upper berth as per preference. It also possible he will be allotted side upper berth in case no upper berths are available.
  3. Passenger 3 is a senior citizen and hence will be given lower berth as per preference unless all lower berth seats are already booked.
  4. Like wise for passenger 4, a lower berth will be allotted. All the passengers will be allotted seats as close as possible, most probably in the same compartment due to presence of 2 senior citizens.